META 2023 Paris - France

The 13th International Conference on Metamaterials, Photonic Crystals and Plasmonics

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Paris - France

Program Booklet

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META 2023 Paris - France

The 13th International Conference on Metamaterials, Photonic Crystals and Plasmonics

Edited by

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The Synopsys Optical Solutions Group provides design tools that model all aspects of light propagation. Our innovative software packages include CODE V® imaging design software, LightTools® illumination design software, the LucidShape® products for automotive lighting, and the RSoft™ Photonic Device Tools for passive and active photonic devices. And our optical measurement solutions give customers access to precision light scattering data for materials and media used in optical systems.

At META 2023, Synopsys will demonstrate MetaOptic Designer, an unprecedented inverse design tool that takes user-specified criteria and generates metalenses/metasurfaces for optimal design performance. Metalens design traditionally requires extensive physics knowledge and many hours of development. MetaOptic Designer removes these barriers with exclusive AI that automatically yields the best metalens designs as fast as possible.

PHASICS, founded in 2003, offers state-of-the-art optics metrology and imaging solutions, from standalone SID4 wavefront sensors to fully automated test benches, Kaleo MTF, Kaleo MultiWAVE, and a fully modular metrology solution, Kaleo Kit. This range of wavefront measurement systems and quantitative phase imaging solutions is based on innovative, high-resolution wavefront-sensing technology. PHASICS' unique, patented wavefront sensing technology is called QuadriWave Lateral Shearing Interferometry (QWLSI). This technology was developed to overcome the Shack- Hartmann limitations: it offers ultra-high resolution, high sensitivity (sub-nanometric), and a wide dynamic range (hundreds of microns).

PHASICS has a strong customer focus and cares about satisfying all its customers' needs. Its robust R&D team develops innovative features, explores new applications, and customizes standard configurations to customers' requests. Thanks to these large innovative projects, PHASICS covers a wide range of applications, including laser testing, adaptive optics, lens alignment and quality control, refractive index mapping in materials, quantitative phase imaging for biology, and plasma and gas density measurements.

ENSEMBLE3 is a newly established Centre of Excellence in nanophotonics, advanced materials and technologies based on crystal growth. The Centre was established under the "Teaming for Excellence" program funded by the European Commission and the "International Research Agendas" program funded by the Foundation for Polish Science and works in collaboration with renowned national and international scientific institutions.

The Centre works on the development of new material technologies and advanced materials with exceptional electromagnetic properties that can be applied in areas such as photonics, optoelectronics, telecommunications, solar energy conversion, medicine, aeronautics, security and defense.

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Université Paris-Saclay is a research university based in Paris, France. Université Paris-Saclay offers a comprehensive and varied range of Undergraduate, Master's and PhD degrees, renowned internationally thanks to the University's reputation for research excellence and the commitment of its academic staff. The University's constituent faculties, institutes and component institutions all contribute to the curricula with cutting-edge specialised courses in Science and Engineering, Life Sciences and Health, and Social Sciences and Humanities.
Université Paris-Saclayis ranked 1st in France and 13th in the world according to the Academic Ranking of World Universities (ARWU).

AEM - Advanced Electromagnetics is a peer-reviewed, Gold Open Access journal. It covers recent international research results in the general field of Electromagnetic Waves, Antennas and Propagation. Authors of articles published in Advanced Electromagnetics retain the copyright of their articles and are free to reproduce and disseminate their work (under a Creative Commons Attribution License). AEM is widely indexed and has a Scopus CiteScore of 2.2 (2021).

ACS Photonics is an interdisciplinary forum to communicate on the latest advances in the field of photonics, all the way from basic research to applied research and technology. Embracing the transversality of photonics, it connects scientists and technologists from a broad scientific spectrum, at the interface between physics, chemistry, biology, and engineering. It also aims at bridging the gap between the academic and industrial worlds.

Nanophotonics (De Gruyter) covers recent international research results, specific developments in the field and novel applications. It publishes all article in a Gold Open Access model and belongs to the top journals in the field. Nanophotonics focuses on the interaction of photons with nano-structures, such as carbon nano-tubes, nano metal particles, nano crystals, semiconductor nano dots, photonic crystals, tissue and DNA.

PLENARY SPEAKERS

Andrea Alù

City University of New York, USA

Extreme Control of Light and Sound with Metamaterials

Andrea Alù is a Distinguished Professor at the City University of New York (CUNY), the Founding Director of the Photonics Initiative at the CUNY Advanced Science Research Center, and the Einstein Professor of Physics at the CUNY Graduate Center. He received his Laurea (2001) and PhD (2007) from the University of Roma Tre, Italy, and, after a postdoc at the University of Pennsylvania, he joined the faculty of the University of Texas at Austin in 2009, where he was the Temple Foundation Endowed Professor until Jan. 2018. Dr. Alù is a Fellow of the National Academy of Inventors (NAI), the American Association for the Advancement of Science (AAAS), the Institute of Electrical and Electronic Engineers (IEEE), the Materials Research Society (MRS), Optica, the International Society for Optics and Photonics (SPIE) and the American Physical Society (APS). He is the President of Metamorphose, a Highly Cited Researcher since 2017, a Simons Investigator in Physics, the director of the Simons Collaboration on Extreme Wave Phenomena Based on Symmetries, and the Editor in Chief of Optical Materials Express. He has received several scientific awards, including the NSF Alan T. Waterman award, the Blavatnik National Award for Physical Sciences and Engineering, the IEEE Kiyo Tomiyasu Award, the ICO Prize in Optics, the OSA Adolph Lomb Medal, and the URSI Issac Koga Gold Medal.

Extreme Control of Light and Sound with Metamaterials
In this talk, I discuss recent developments in this field of research, with an emphasis on the role of symmetries in establishing emerging optical responses for metamaterials based on otherwise simple constituents. Geometrical rotations, suitably tailored perturbations, and broken time reversal symmetry can be carefully engaged to tailor waves in robust and efficient ways, control their propagation, break Lorentz reciprocity and enable topological order and phase transitions.

Nader Engheta

University of Pennsylvania, USA

Structuring light with media with higher dimensions: space, time, and more

Nader Engheta is the H. Nedwill Ramsey Professor at the University of Pennsylvaniain Philadelphia with affiliations in the Departments of Electrical and Systems Engineering, Physics and Astronomy, Bioengineering, and Materials Science and Engineering. He received his BS degree from the University of Tehran, and his MS and Ph.D. degrees from Caltech. His current research activities span a broad range of areas including optics, metamaterials, electrodynamics, microwaves, photonics, nano-optics, graphene photonics, imaging and sensing inspired by eyes of animal species, microwave and optical antennas, and physics and engineering of fields and waves. He has received several awards for his research including the 2023 Benjamin Franklin Medal in Electrical Engineering, Election to the American Academy of Arts and Sciences (2023), Caltech Distinguished Alumni Award (2023), the 2020 Isaac Newton Medal and Prize from the Institute of Physics (UK), the 2020 Max Born Award from the OPTICA (formerly Optical Society), the 2019 Ellis Island Medal of Honor, the 2018 IEEE Pioneer Award in Nanotechnology, the 2022 Hermann Anton Haus Lecture at MIT, the 2015 SPIE Gold Medal, the 2014 Balthasar van der Pol Gold Medal from the International Union of Radio Science (URSI), the 2017 William Streifer Scientific Achievement Award, the Canadian Academy of Engineeringas an International Fellow the Fellow of US National Academy of Inventors (NAI), the IEEE Electromagnetics Award, the Vannevar Bush Faculty Fellowship Awardfrom DoD, the Wheatstone Lecture in King's College London, 2006 Scientific American Magazine 50 Leaders in Science and Technology, and the Guggenheim Fellowship. He is a Fellow of nine international scientificand technical organizations, i.e., IEEE, OPTICA, APS, MRS, SPIE, URSI, AAAS, IOP and NAI. He has received the honorary doctoral degrees from the Aalto University in Finland in 2016, the University of Stuttgart, Germany in 2016, and Ukraine's National Technical University Kharkov Polytechnic Institute in 2017.

Structuring light with media with higher dimensions: space, time, and more

In this talk, I will present some of our most recent results on exploring light-matter interaction in material media with high degrees of freedom and dimensions including spatial and/or temporal inhomogeneities, and other degrees of freedom such as anisotropy, ellipticity, and hyperbolicity. We show how light manipulation with such metastructures with high degrees of freedom can lead to exciting novel wave phenomena with potential applications in wave-based reconfigurable analog computing, 4D optics, and other optical devices and components.

Sylvain Gigan

Sorbonne Université, France

Imaging and Computing with disorder

Sylvain Gigan is professor of physics at Sorbonne Université in Paris and group leader in Laboratoire Kastler-Brossel at Ecole Normale Supérieure. His research interests range from fundamental investigations of light propagation in complex media, biomedical imaging, computational imaging, and signal processing, to quantum optics and quantum information in complex media. After graduating from Ecole Polytechnique (Palaiseau France) in 2000 and a Master specialization in optics from University Paris XI (Orsay, France), he obtained a PhD in physics in 2004 from University Pierre and Marie Curie (Paris, France) in quantum and non-linear Optics. From 2004 to 2007, he was a postdoctoral researcher in Vienna University (Austria). from 2007 to 2014, he was at ESPCI ParisTech as Associate Professor, and started working on optical imaging in complex media and wavefront shaping techniques, at the Langevin Institute. Dr. Gigan is also the cofounder of a spin-off called LightOn (www.lighton.ai), aiming at performing optical computing for machine learning and big data. He was awarded the Fabry de Gramont Prize of the French Optical Society in 2016, The Joseph Fourier ATOS prize in 2018, the Jean Jerphagnon Prize in 2019.

Imaging and Computing with disorder

Light propagation in complex media, such as paint, clouds, or biological tissues, is a very challenging phenomenon, encompassing fundamental aspects in mesoscopic and statistical physics. It is also of utmost applied interest, in particular for imaging. Although this scattering process seems to mix and completely destroy all information, thus preventing imaging or communication, a different approach has emerged. I will discuss how this powerful concept has recently triggered a wealth of advances in imaging and computing.

Marin Soljačić

Massachusetts Institute of Technology (MIT), USA

Nanophotonics for tailoring radiation from fast electrons

Marin Soljačić is a Professor of Physics at MIT. He is a founder of WiTricity Corporation (2007), LuxLabs (2017), as well as Lightelligence (2017). His main research interests are in artificial intelligence as well as electromagnetic phenomena, focusing on nanophotonics, non-linear optics, and wireless power transfer. He is a recipient of the Adolph Lomb medal from the Optical Society of America (2005), and the TR35 award of the Technology Review magazine (2006). In 2008, he was awarded a MacArthur fellowship “genius” grant. He is an international member of the Croatian Academy of Engineering since 2009. In 2011 he became a Young Global Leader (YGL) of the World Economic Forum. In 2014, he was awarded Blavatnik National Award, as well as Invented Here! (Boston Patent Law Association). In 2017, he was awarded "The Order of the Croatian Daystar, with the image of Ruđer Bošković", the Croatian President’s top medal for Science. In 2017, the Croatian President also awarded him with "The Order of the Croatian Interlace" medal. He was also Highly Cited Researcher according to WoS for 2019, 2020 and 2021.

Nanophotonics for tailoring radiation from fast electrons

Nanophotonic methods provide intriguing options for manipulating scintillation phenomena. We will outline recent developments in this domain, along with our theoretical framework for modeling these occurrences, supported by our experimental findings. Additionally, Smith-Purcell radiation, characterized by fast electrons interacting with nano-structured materials to produce light, offers a broad spectrum of possibilities for creation of novel light sources. We will discuss our new theoretical framework designed to comprehend and tailor such phenomena, as well as our techniques for boosting Smith-Purcell radiation.

Isabelle Staude

Friedrich Schiller University Jena, Germany

Active photonic metasurfaces empowered by 2D semiconductors

Isabelle Staude is professor at the Institute of Solid State Physics at the Friedrich Schiller University Jena, Germany. She studied physics at the University of Konstanz, Germany, received her Ph.D. degree from the Karlsruhe Institute of Technology, Germany, in 2011, and spent several years as a postdoc at the Australian National University, Canberra, Australia. She received an Emmy-Noether Grant from the German Research Foundation and the Hertha Sponer Prize 2017 from the German Physical Society. She is a member of the German Young Academy (Junge Akademie) and a Fellow of the Max Planck School of Photonics..

Active photonic metasurfaces empowered by 2D semiconductors

This talk reviews our recent and ongoing activities in hybridizing optical metasurfaces composed of resonant metallic or dielectric building blocks with 2D-TMDCs. We demonstrate that the ability of the nanoresonators to concentrate light into nanoscale volumes can be utilized to carefully control the properties, such as pattern and polarization, of light emitted by 2D-TMDCs via photoluminescence or nonlinear optical processes. Furthermore, we investigate the ability of tailored nanostructures to interact selectively with exciton populations located at inequivalent conduction band minima at the corners of the 2D-TMDC's Brillouin zone.

Jelena Vuckovic

Stanford University, USA

Scalable classical and quantum photonics

Jelena Vuckovic (PhD Caltech 2002) is the Jensen Huang Professor in Global Leadership in the School of Engineering, and Professor of Electrical Engineering and by courtesy of Applied Physics at Stanford, where she leads the Nanoscale and Quantum Photonics Lab. She is also the Fortinet Founders Chair of the Electrical Engineering Department at Stanford, and was the inaugural director of Q-FARM, the Stanford-SLAC Quantum Science and Engineering Initiative. Vuckovic has received many awards and honors including recently the Vannevar Bush Faculty Fellowship (2022), the Mildred Dresselhaus Lectureship from MIT (2021), the James Gordon Memorial Speakership from the OSA (2020), the IET A. F. Harvey Engineering Research Prize (2019), Distinguished Scholarship of the Max Planck Institute for Quantum Optics (2019), the Hans Fischer Senior Fellowship from the Institute for Advanced Studies in Munich (2013), and Humboldt Prize (2010). She is a Fellow of the APS, of the Optica (OSA), and of the IEEE, and an associate editor of the ACS Photonics.

Scalable classical and quantum photonics

Novel computational techniques such as photonics inverse design, along with new nanofabrication approaches, play a crucial role in building scalable integrated classical and quantum photonics. Inverse design, a departure from the traditional photonics design approach, can lead to photonics much better than state of the art in many metrics (smaller, more efficient, more robust, a much higher density of integration). This is enabled by development of a computer software which efficiently searches through the space of all possible and fabricable photonic geometries, in any material of interest. On the other hand, future photonic systems also require integration and fabrication of traditional and non-traditional photonic materials, including silicon, silicon-carbide, diamond, sapphire, and strong electro-optic materials such as lithium niobate, strontium and barium titanate.

KEYNOTE SPEAKERS

Harry Atwater

California Institute of Technology, USA

Active Metasurfaces in Space and Time

Harry Atwater is the Otis Booth Leadership Chair of the Division of Engineering and Applied Science, and the Howard Hughes Professor of Applied Physics and Materials Science at the California Institute of Technology. Atwater's scientific effort focuses on nanophotonic light-matter interactions. His work spans fundamental nanophotonic phenomena and applications, including active wavefront shaping of light using metasurfaces, optical propulsion of lightsails, quantum and 2D nanophotonics as well as solar energy conversion.

Atwater was an early pioneer in nanophotonics and plasmonics and gave a name to the field of plasmonics in 2001. He is Chair of the LightSail Committee for the Breakthrough Starshot program. Currently Atwater is also the Director for the Liquid Sunlight Alliance (LiSA), a Department of Energy Hub program for solar fuels, and was also the founding Editor in Chief of the journal ACS Photonics. Atwater is a Member of the US National Academy of Engineering, a Web of Science Highly Cited Researcher, and the recipient of the 2021 von Hippel Award of the Materials Research Society.

Active Metasurfaces in Space and Time
Active dielectric and plasmonic metasurfaces enable new modalities for spatiotemporal beam control for beam steering and wavefront shaping at multiple frequencies. In this talk, I will discuss metasurfaces with high quality factor, local, resonant elements capable of two-dimensional phase gradient generation, in both passive and active metasurface designs. I will also describe active metasurfaces with both spatial and temporal phase gradients, and an active metasurface as a lens-less imaging system, and compare the characteristics to conventional lens-coupled image sensors.

Alexandra Boltasseva

Purdue University, USA

Crossroads of Nanophotonics and Machine Learning

Alexandra Boltasseva is a Professor at the School of Electrical & Computer Engineering at Purdue University. She received her PhD in electrical engineering at Technical University of Denmark, DTU in 2004. Boltasseva specializes in nanophotonics, nanofabrication, optical materials, plasmonics and metamaterials. She is 2018 Blavatnik National Award for Young Scientists Finalist and received the 2013 IEEE Photonics Society Young Investigator Award, 2013 Materials Research Society (MRS) Outstanding Young Investigator Award, the MIT Technology Review Top Young Innovator (TR35), the Young Researcher Award in Advanced Optical Technologies from the University of Erlangen-Nuremberg, Germany, and the Young Elite-Researcher Award from the Danish Council for Independent Research. She is a Fellow of the Optical Society of America (OSA) and Fellow of SPIE. She served on MRS Board of Directors and is Editor-in-Chief for OSA's Optical Materials Express.

Crossroads of Nanophotonics and Machine Learning
We report on advancing machine-learning-assisted optical inverse design optimization for metasurfaces with applications in thermophotovoltaics, reflective optics, and lightsail technology as well as for on-chip quantum photonic components and super-resolution imaging.

Mark Brongersma

Stanford University, USA

Flat Optics for Dynamic Wavefront Manipulation

Mark Brongersma is the Stephen Harris Professor in the Departments of Materials Science and Applied Physics at Stanford University. He leads a research team of ten students and five postdocs. Their research is directed towards the development and physical analysis of new materials and structures that find use in nanoscale electronic and photonic devices. He is on the list of Global Highly Cited Researchers (Clarivate Analytics). He received a National Science Foundation Career Award, the Walter J. Gores Award for Excellence in Teaching, the International Raymond and Beverly Sackler Prize in the Physical Sciences (Physics) for his work on plasmonics, and is a Fellow of the OSA, the SPIE, and the APS. Dr. Brongersma received his PhD from the FOM Institute AMOLF in Amsterdam, The Netherlands, in 1998. From 1998-2001 he was a postdoctoral research fellow at the California Institute of Technology.

Flat Optics for Dynamic Wavefront Manipulation
In this presentation, I will highlight our recent efforts to realize electrically-tunable metasurfaces employing nanomechanics, microfluidics, phase change materials, and atomically-thin semiconductors. Such elements are capable of dynamic wavefront manipulation for optical beam steering and holography. I will also discuss how the nanostructured, planar optical elements can be fabricated by scalable fabrication technologies, opening the door to a wide range of commercial applications.

Demetrios Christodoulides

University of Southern California, USA

Optical thermodynamics of highly multimode nonlinear photonic systems

Demetrios Christodoulides is an Endowed Chair Professor in the Department of Electrical and Computer Engineering at the University of Southern California. He received his Ph.D. from Johns Hopkins University in 1986. After earning his doctorate degree, he joined Bellcore as a postdoctoral research fellow, and was a faculty member in the Department of Electrical Engineering at Lehigh University from 1988 to 2002. Between 2002 and 2022 he was a Pegasus Professor and the Cobb Family Endowed Chair at CREOL–The College of Optics and Photonics at the University of Central Florida. Christodoulides' contributions have been in the general field of optics and photonics. Among them is the first prediction of discrete self-trapped states in optical lattices, Bragg solitons in nonlinear gratings, vector solitons, and the development of the theory describing nonlinear optical interactions in soft matter and biological colloidal systems. His group proposed and demonstrated optical accelerating beams, which today find applications in microscopy and nonlinear optics. In the last ten years or so, his work has focused on the ramifications and applications of some special symmetries in optics, such as those of parity-time symmetry and supersymmetry. Most recently he has been exploring new theoretical avenues in describing the complex dynamics of highly multimode nonlinear photonic systems by means of optical thermodynamics. He has served as an associate editor for the IEEE Journal of Quantum Electronics and JOSA B. He is a Fellow of APS and Optica. He is the recipient of the Optica's 2011 R.W. Wood Prize and 2018 Max Born Award, and of the 2023 Arthur L. Schawlow Prize in Laser Science of APS.

Optical thermodynamics of highly multimode nonlinear photonic systems
In this talk, a thermodynamic theory capable of describing complex, highly multimoded, nonlinear optical systems is presented. It is shown that the mode occupancies in such nonlinear multimode arrangements follow a universal behavior that always tends to maximize the system's entropy at steady-state. This thermodynamic response takes place irrespective of the type of nonlinearities involved and can be utilized to either heat or cool an optical multimode system. Aspects associated with adiabatic compressions and expansions will be discussed along with the possibility for all-optical Carnot cycles.

Javier García de Abajo

ICFO-Institut de Ciencies Fotoniques, Spain

Quantum optical phenomena in two-dimensional materials

Javier García de Abajo received his PhD from the University of the Basque Country in 1993 and then visited Berkeley National Lab for three years. He was a Research Professor at the Spanish CSIC and in 2013 moved to ICFO-Institut de Ciencies Fotoniques (Barcelona) as an ICREA Research Professor and Group Leader. He is Fellow of both the American Physical Society and the Optical Society of America, and he has co-authored 300+ articles on different aspects of nanophotonics, atomic physics, surface science, and electron microscope spectroscopies. See http://www.nanophotonics.es for more details.

Quantum optical phenomena in two-dimensional materials
We discuss new approaches to the synthesis, design, and exploitation of two-dimensional materials for nanophotonics, including plasmonics in ultrathin crystalline metals, a disruptive class of quantum-phase materials, recent advances in the solution to the problem of coupling between free-space light and ultraconfined optical excitations, and the application of these developments to the study of ultrafast nonlinear phenomena and quantum optics at the atomic scale.

Wolfgang Fritzsche

Leibniz Institute for Photonic Technology, Germany

Bioanalytics using plasmonic nanostructures

Wolfgang Fritzsche is heading the Nanobiophotonics Department at the Leibniz Institute for Photonic Technology (IPHT) in Jena, Germany. His scientific interest is in localized surface plasmon resonance, focused on novel effects in the interaction of molecular components with plasmonic nanostructures, with a special emphasis on biosensing. Here, multiplexed assays based on imaging spectrometry readout are targeted, in order to allow for the paralleled monitoring of molecular binding reactions for potential bioanalytical applications.

Bioanalytics using plasmonic nanostructures
The effect of localized surface plasmon resonance (LSPR) on chemically synthesized gold nanoparticles is utilized to setup a biosensing platform with the potential for sensitive and specific detection of biomolecules of interest such as biomarkers. This principle is demonstrated both on a single particle level for DNA detection, then extended also to proteins, and to arrays of particles. In order to readout the arrays, imaging spectrometer were developed.

Sven Höfling

University of Würzburg, Germany

Semiconductor quantum dot based quantum technologies

Sven Höfling received his Ph.D. degree from Würzburg University. He was with the Fraunhofer Institute of Applied Solid-State Physics, Freiburg, Germany from 2001 to 2002 working on blue and white light emitting diodes. From 2006 to 2013, he was head of the Optoelectronic Materials and Devices Group at Technische Physik, Würzburg University. Sven Höfling was a full professor at the University of St Andrews, Scotland from 2013 to 2021. In 2015 he rejoint the University of Würzburg, Germany as a professor of physics and as the Head of the Chair of Applied Physics and the Gottfried-Landwehr-Laboratory for Nanotechnologies. He is running a 550 sqm clean room with a full chain of semiconductor growth, processing and characterization tools. Dr. Höfling is a member of German Physical Society (DPG), a Senior member of IEEE and SPIE, and a fellow of the Institute of Physics (IOP) and Optica.

Semiconductor quantum dot based quantum technologies
We will summarize recent progress made within our group on self-assembled quantum dot device,development for quantum repeater and quantum computer applications. A particular emphasis will be on,semiconductor quantum dots embedded in circular Bragg grating cavities. For scalability, spatially deterministic, placement of quantum dots in bullseye cavities is pursued and tuning by electric and strain fields are,implemented. To apply electric fields, a new device design for electrically contactable circular Bragg grating,cavities in labyrinth geometry is employed.

Jiří Homola

Institute of Photonics and Electronics of the Czech Academy of Sciences, Czech Republic

Plasmonic biosensors for biomedical applications

Jiří Homola is Deputy Director and the Head of Optical Biosensors research group at the Institute of Photonics and Electronics of the Czech Academy of Sciences. He received his PhD (1993) from the Czech Academy of Sciences. From 1993 to 1997 he worked at the Institute of Photonics and Electronics, Prague as a Research Scientist. From 1997 to 2002 he was with the Department of Electrical Engineering, University of Washington, Seattle (USA), since 2001 as a Research Associate Professor. From 2003, he has been with the Institute of Photonics and Electronics in Prague and has been responsible for the optical biosensors research program. In 2009, he received his DSc. degree in technical sciences from the Czech Academy of Sciences and in 2014 he became Professor of physics at Charles University in Prague. From 2009 to 2019, he was Affiliate Professor at the University of Washington, Seattle. He has received the Roche Diagnostics Prize for Sensor Technology, Award for Outstanding Research of the Ministry of Education of the Czech Republic, among other awards. He has been elected Fellow of the Learned Society of the Czech Republic and Fellow of the International Society for Optical Engineering (SPIE). He serves as associate editor of Biosensors and Bioelectronics (Elsevier).

Plasmonic biosensors for biomedical applications
Optical biosensors hold potential for applications in numerous important areas. Herein, we discuss the main challenges in developing plasmonic biosensors for applications in biomedicine and present selected advances in biosensor research that aim to address these challenges. We cover advances in plasmonic nanostructures, sensor instrumentation, transport of target molecules in microfluidic systems, functional coatings, and detection assays. We also highlight applications of plasmonic biosensors related to the investigation of biomolecular interactions related to Alzheimer's disease and diagnosis of Myelodysplastic syndromes.

Mercedeh Khajavikhan

University of Southern California, USA

Micro- and Nano-lasers: From One to Many, Unleashing Endless Possibilities

Mercedeh Khajavikhan is a Professor of Electrical and Computer Engineering at the University of Southern California. She has also a joint appointment at the Department of Physics & Astronomy at USC. She received her Ph.D. in Electrical Engineering from the University of Minnesota in 2009. Subsequently, she joined the University of California in San Diego as a postdoctoral researcher, where she worked on the design and development of nanolasers, plasmonic devices, and silicon photonics components. Prior to joining USC, she was a faculty at the College of Optics and Photonics (CREOL) at the University of Central Florida (UCF), working primarily on unraveling novel phenomena in active photonic platforms. She is the recipient of the NSF Early CAREER Award in 2015, the ONR Young Investigator Award in 2016, the DARPA Young Faculty Award in 2018, the University of Central Florida Reach for the Stars Award in 2017, UCF Luminary Award in 2018, and DARPA Director's Fellowship in 2020. She is a fellow of Optica (formerly known as Optical Society of America OSA).

Micro- and Nano-lasers: From One to Many, Unleashing Endless Possibilities

Micro- and nano-lasers form a crucial category of optical components with significant scientific and technological implications. In this presentation, I will discuss the utilization of non-Hermiticity, supersymmetry, and topology principles to design arrays of these devices, resulting in intriguing and unexpected lasing phenomena. By considering the interaction between cavity modes, array geometry, and both short- and long-range coupling among the array elements, we can achieve novel laser phase locking regimes, high radiance emission, rapid beam steering, photonic spin machines, and unidirectional lasing.

Tobias J. Kippenberg

EPFL, Switzerland

Ultra low loss nonlinear integrated photonic circuits: from soliton microcombs, traveling wave parametric amplifiers, chip based Erbium amplifiers to cryogenic quantum interconnects

Tobias J. Kippenberg is Full Professor in the Institute of Physics and Electrical Engineering at EPFL in Switzerland since 2013 and joined EPFL in 2008 as Tenure Track Assistant Professor. Prior to EPFL, he was Independent Max Planck Junior Research group leader at the Max Planck Institute of Quantum Optics in Garching, Germany. While at the MPQ he demonstrated radiation pressure cooling of optical micro-resonators, and developed techniques with which mechanical oscillators can be cooled, measured and manipulated in the quantum regime that are now part of the research field of Cavity Quantum Optomechanics. Moreover, his group discovered the generation of optical frequency combs using high Q micro-resonators, a principle known now as micro-combs or Kerr combs. For his early contributions in these two research fields, he has been recipient of the EFTF Award for Young Scientists (2011), The Helmholtz Prize in Metrology (2009), the EPS Fresnel Prize (2009), ICO Award (2014), Swiss Latsis Prize (2015), as well as the Wilhelmy Klung Research Prize in Physics (2015), the 2018 ZEISS Research Award and 2020 OSA R. Wood Award. Moreover, he is 1st prize recipient of the "8th European Union Contest for Young Scientists" in 1996 and is listed in the Highly Cited Researchers List of 1% most cited Physicists in 2014-2019. He is founder of the startup LIGENTEC SA, an integrated photonics foundry.

Ultra low loss nonlinear integrated photonic circuits: from soliton microcombs, traveling wave parametric amplifiers, chip based Erbium amplifiers to cryogenic quantum interconnects
Recent advances in attaining ultra low loss highly confining silicon nitride waveguides with loss in the dB-meter range, and their heterogeneous integration with MEMS and Lithium Niobate have opened up novel applications that exhibit both low cost, and scalable manufacturing but also performance that is on par or exceeding that of legacy optical systems. I will describe a range of novel advances, including photonic integrated circuit based frequency agile lasers, wave amplifiers, as well as soliton frequency combs.

Naoto Nagaosa

RIKEN Center for Emergent Matter Science (CEMS), Japan

Chirality and nonreciprocal responses in quantum materials

Naoto Nagaosa was born in Hyogo Prefecture in 1958, and graduated from Department of Applied physics, The University of Tokyo in 1980. From 1983 to 1986, he was a research associate in Institute for Solid State Physics, Univ. Tokyo, and received a D.Sci from Univ. Tokyo in 1986. From 1988 to 1990, he worked as a visiting scientist at Department of Physics, Massachusetts Institute of Technology, before joining the Department of Applied Physics in Univ. Tokyo, where he is now a professor. From 2013 he has joint appointment with the Deputy Director of the RIKEN Center for Emergent Matter Science (CEMS). He is now serving as Senior Advisory Group (SAG) Scientist of APCTP, and also the chairman of c5 commission (Low Temperature Physics) of IUPAP. His research field is theoretical condensed-matter physics, especially involving the strong electron correlation, optical responses of solids, topological aspects of condensed matter, and superconductivity. For his accomplishments, he has received the Yukawa Prize, Japan IBM Prize, Nissan Science Prize, Nishina Memorial Prize, Fujihara Prize, Purple Ribbon, Benjamin Lee Professorship, and is now a Foreign member of National Academy of Science.

Chirality and nonreciprocal responses in quantum materials
We study the chiral dynamics and consequent nonreciprocal responses in quantum materials, where the most fundamental principles in physics manifest themselves, i.e., the symmetries especially the time-reversal and spatial inversion, dissipation, quantum-classical crossover/transition, quantal Berry phase and topology, and many-body correlation effects. They include (1) magnetochiral anisotropy of semiconductors, Weyl semimetals, and superconductors, and (2) the photovoltaic effect, e.g., the shift currents under photo-excitations.

Dragomir Neshev

Australian National University, Australia

Dielectric metasurfaces with fast and ultra-fast tunability

Dragomir Neshev is the Director of the Australian Research Council Centre of Excellence for Transformative Meta-Optical Systems (TMOS) and a Professor in Physics at the Australian National University (ANU). He received a PhD degree from Sofia University, Bulgaria in 1999. Since then, he has worked in the field of optics at several research centres around the world and joined ANU in 2002. He is the recipient of several awards and honours, including a Highly Cited Researcher (Web of Science, 2022 and 2021), a Queen Elizabeth II Fellowship (ARC, 2010), and a Marie-Curie Individual Fellowship (European Commission, 2001). His activities span over several branches of optics, including periodic photonic structures, singular optics, plasmonics, and optical metasurfaces.

Dielectric metasurfaces with fast and ultra-fast tunability
This talk will overview the recent advances and challenges in tunable metasurfaces. I will discuss metasurface tunability through several mechanisms, including electrical and all-optical drives. Such drives allow for fast and ultrafast responses with high modulation strength. We demonstrate how all-optical control can lead to and high ultrafast transmission modulation of 80%. The presented developments hold promise for real-world applications of active meta-optics.

Sir John Pendry

Imperial College London, UK

Extreme time modulation of material properties and Hawking radiation

John Pendry is a condensed matter theorist working at Imperial College London. His early work addressed electronic and structural properties of surfaces developing the theory of low energy diffraction, EXAFS, and of electronic surface states later moving on to studies of transport in disordered systems. In the mid 1990's he turned his attention to metamaterials and proposed several structures which radically influenced the development of the field leading to the experimental discovery of negative refraction by the Smith group and later, also in collaboration with David Smith, the design of a cloak of invisibility. His investigation of negative refraction led to the discovery that it is theoretically possible to design a lens whose resolution is limited only by the perfection of manufacture, not by the well known Abbé law which limits resolution to the order of the wavelength. The technique of transformation optics which he pioneered has led to many applications in the field of plasmonics, particularly building on the perfect lens concept and showing how to concentrate light into sub nanoscale volumes. His most recent work moves the study of metamaterials on to structures that vary in time as well as in space, invoking quantum aspects of metamaterials.

Extreme time modulation of material properties and Hawking radiation
Experiments demonstrating extremely rapid modulation of the permittivity have been performed by exploitingthe enhanced non-linear effects possible in the presence of plasmonic resonances. These experiments measure anextreme rise time by exploiting the analogy between Young's slits which produce diffraction in momentum space,and closely spaced time windows which produce diffraction in frequency space.

Luca Razzari

Centre Energie, Matériaux et Télécommunications (INRS-EMT), Canada

Structured surfaces for enhanced radiation-matter interaction and nonlinear optics

Luca Razzari is a Full Professor at Institut National de la Recherche Scientifique – Centre Energie, Matériaux et Télécommunications (INRS-EMT) in Montreal, Canada, since 2020. He received his Laurea (2001) and PhD (2004) degrees from the University of Pavia, Italy. He completed part of his PhD research at Institut d'Optique in Orsay, France (2004). He then had three postdoctoral experiences: from 2005 to 2006, he worked at the Institute for Complex Systems (CNR-ISC) in Rome, Italy. From 2006 to 2010, he made his first move to Canada as a Marie Curie Fellow at INRS-EMT. From 2010 to 2012, he was with the Italian Institute of Technology (IIT) in Genoa, Italy. In November 2012, he finally joined the INRS-EMT as a junior faculty member. Dr. Razzari's research interests include nanoscale light-matter interactions, metasurfaces, nonlinear optics, as well as terahertz science and technology. He has been recently elected a Fellow of Optica (2023).

Structured surfaces for enhanced radiation-matter interaction and nonlinear optics
In this talk, I will review our main results regarding the exploitation of nanoresonators and,metasurfaces for: (i) enhanced terahertz spectroscopy of low-dimensional materials; (ii) nanoscale phonon strong coupling; and (iii) nonlinear wavelength conversion.

Mikael Rechtsman

Pennsylvania State University, USA

Quantized Fractional Thouless Pumping of Solitons

Mikael Rechtsman is an Associate Professor of Physics at the Pennsylvania State University in the US. His research group studies different aspects of nonlinear optics and photonics, with a focus on topological structures and devices. He is the recipient of the Packard and Sloan Fellowships, the Office of Naval Research Young Investigator Award, and the ICO prize of the International Commission of Optics.

Quantized Fractional Thouless Pumping of Solitons
I will present my group's recent work on the fractional pumping of solitons in photonic Thouless pumps. Specifically, I will show that the displacement (in unit cells) of solitons in Thouless pumps is strictly quantized to the Chern number of the band from which the soliton bifurcates in the low power regime, whereas in the intermediate power regime, nonlinear bifurcations lead to fractional quantization of soliton motion. This fractional quantization can be predicted from multi-band Wannier functions.

Moti Segev

Technion, Israel

Photonic Time-Crystals

Moti Segev is the Robert J. Shillman Distinguished Professor of Physics and Electrical Engineering, at the Technion, Israel. His interests are mainly in photonics, solitons, lasers, and quantum optics. He won numerous international awards, among them the 2007 Quantum Electronics Prize of the EPS, the 2009 Max Born Award of the OSA, and the 2014 Arthur Schawlow Prize of the APS. In 2011, he was elected to the Israel Academy of Sciences, in 2015 to the National Academy of Science of the USA. In 2014 he won the Israel Prize (highest honor in Israel). Above all his achievements, Moti takes pride in the success of his graduate students and postdocs, among them are currently 23 professors in the USA, Germany, Taiwan, Croatia, Italy, India, China and Israel, and many holding senior R&D positions in the industry.

Photonic Time-Crystals
Time-Crystals (PTCs) are materials in which the refractive index varies periodically and abruptly in,time. They conserve momentum but not energy, and display momentum bands separated by gaps. The,fundamentals of PTCs will be presented, with an emphasis on light-matter interactions ranging from light,emission by atoms and free electrons to superluminal k-gap solitons and recent experiments.

Vladimir M. Shalaev

Purdue University, USA

Near-Zero-Index Materials for Nonlinear Optics and Beyond

Vladimir M. Shalaev, Scientific Director for Nanophotonics at Birck Nanotechnology Center and Distinguished Professor of Electrical and Computer Engineering at Purdue University, specializes in nanophotonics, plasmonics, and optical metamaterials. Vladimir M. Shalaev has received several awards for his research in the field of nanophotonics and metamaterials, including the Max Born Award of the Optical Society of America for his pioneering contributions to the field of optical metamaterials, the Willis E. Lamb Award for Laser Science and Quantum Optics, IEEE Photonics Society William Streifer Scientific Achievement Award, Rolf Landauer medal of the ETOPIM (Electrical, Transport and Optical Properties of Inhomogeneous Media) International Association, the UNESCO Medal for the development of nanosciences and nanotechnologies, OSA and SPIE Goodman Book Writing Award. He is a Fellow of the IEEE, APS, SPIE, MRS and OSA. Prof. Shalaev has authored three books, thirty invited book chapters and over 500 research publications.

Near-Zero-Index Materials for Nonlinear Optics and Beyond
We discuss Near-Zero-Index (NZI) materials based on transparent conducting oxides (TCOs) that open new avenues in nonlinear optics including exotic time-varying media phenomena, such as negative refraction, time refraction/reflection, and photonic time crystals.

Kerry Vahala

California Institute of Technology, USA

High-Q photonics

Kerry Vahala is Professor of Applied Physics at Caltech and holds the Jenkins Chair in Information Science and Technology. His research on chip-based high-Q optical resonators and related low-power nonlinear optical devices has advanced miniature frequency and time systems, microwave sources, parametric oscillators, astrocombs and gyroscopes. Vahala also made early contributions to the subject of cavity optomechanics and demonstrations of chip-based devices to cavity QED phenomena. A member of the National Academy of Engineering and Fellow of the IEEE and Optica, he received the IEEE Sarnoff Medal for research on quantum-well laser dynamics, the Alexander von Humboldt award and MPQ Distinguished Scholar Award for work on ultra-high-Q optical microcavities, a NASA achievement award for application of microcombs to exoplanet detection, and the Optica Forman Team Engineering Excellence Award for a 2-photon optical clock. Vahala is the Executive Officer of the Department of Applied Physics and Materials Science at Caltech.

High-Q photonics

After a brief overview of their history, I will review recent applications. These include Sagnac gyroscopes, microwave signal sources, clocks, and high-coherent sources. The current and possible future limits of microresonator performance, and untapped application areas, will also be discussed.

Xiangrong Wang

The Hong Kong University of Science and Technology, Hong Kong

Recent progress in magnetic skyrmion physics

Xiangrong Wang is a full professor in the physics department of The Hong Kong University of Science and Technology (HKUST). He obtained his PhD in 1990 from University of Rochester and joined the Physics Department of HKUST in 1992. Professor Wang is a condensed matter theorist and is interested in revealing the physics principles behind the novel physics phenomena. Currently, he is working on the interplay of charges, spins, and phonons in nano-systems and devices. His current research focus on topological states of matter, magnetization dynamics, and spin/charge transport. The research topics include skyrmion physics, magnonics, magnetic domain wall motion, spin current generation and detection, and magneto-effects.

Recent progress in magnetic skyrmion physics

In this talk, I will discuss several progresses made in our group about fundamental properties of skyrmions in chiral magnetic films. These include 1) skyrmion sizes in isolated, in crystal, or in stripy forms, 2) skyrmion nucleation, formation, and potential barrier energies, 3) the roles of magnetic field in skyrmion crystal formation, 4) the stability and existing conditions of composite skyrmions such as target skyrmions and skyrmion bags/cluster, 5) topological equivalence of stripy phases and skyrmion crystals.

Martin Wegener

KIT, Germany

Roton-like dispersion relations in metamaterials

Martin Wegener is Professor at the Institute of Applied Physics at KIT and one of the Directors of the Institute of Nanotechnology at KIT. He is also spokesperson of the Excellence Cluster "3D Matter Made to Order". He initiated (2006) and co-founded (2007) the company Nanoscribe GmbH. His current research interests are in 3D additive manufacturing driven towards the nanometer scale and applications thereof, for example in 3D metamaterials.

Roton-like dispersion relations in metamaterials
We review our work on mimicking the dispersion relation of rotons in liquid helium in different systems (acoustic, elastic, and electromagnetic waves) and using three different strategies (nonlocal metamaterials, chiral metamaterials, and monomode metamaterials).

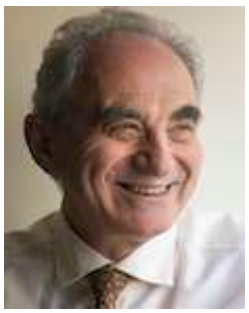
Gary Wiederrecht

Argonne National Laboratory, USA

Ultrafast Optical Studies of Hybrid Nanomaterials of Interest for Optoelectronic and Energy Conversion Applications

Gary Wiederrecht is currently the Deputy Division Director and Senior Scientist in the Nanoscience & Technology (NST) Division at Argonne National Laboratory. He received a B.S. degree in chemistry from UC Berkeley in 1987 and a Ph.D. in physical chemistry from MIT in 1992. He moved to Argonne National Laboratory as a postdoctoral fellow in 1992, working with Michael Wasielewski on molecular photonics, and became a scientific staff member in 1995. His research interests center on the photochemistry and photophysics of hybrid nanostructures, photochemical energy conversion, quantum science, biomimetic materials, and the ultrafast optical responses of nanoparticles and nanoparticle assemblies. He is also working to develop novel approaches to time-resolved optical microscopy and imaging applications. He has received an R&D100 award, the DOE Young Scientist Award, the Presidential Early Career Award for Scientists and Engineers (PECASE), and the Argonne National Laboratory Distinguished Service Award. He has authored or co-authored approximately 165 peer-reviewed research articles and has several patents. He is a Fellow of the American Physical Society.

Ultrafast Optical Studies of Hybrid Nanomaterials of Interest for Optoelectronic and Energy Conversion Applications
Ultrafast optical spectroscopy is used to monitor energy flow in nanostructures of interest for optoelectronic and energy conversion applications. The impact of hybrid nanostructures on aiding in the efficiency of desired energy flow outcomes following the absorption of photons is further described. Using ultrafast spectroscopy to probe hybrid structures designed to increase light-matter interactions, such as through optical cavities, is also discussed.



Eli Yablonovitch

UC Berkeley, USA

The Challenge of Photonic Crystals (and Meta-Materials) is Inverse Electromagnetic Design (Aperiodic)

Eli Yablonovitch is a Professor of Electrical Engineering and Computer Sciences at UC Berkeley, where he holds the James & Katherine Lau Chair in Engineering. He is the Director of the NSF Center for Energy Efficient Electronics Science (E3S), a multi-University Center headquartered at Berkeley.

Prof. Yablonovitch introduced the idea that strained semiconductor lasers could have superior performance due to reduced valence band (hole) effective mass. With almost every human interaction with the internet, optical telecommunication occurs by strained semiconductor lasers. He is regarded as a Father of the Photonic BandGap concept, and he coined the term "Photonic Crystal". The geometrical structure of the first experimentally realized Photonic bandgap, is sometimes called “Yablonovite”. In his photovoltaic research, Yablonovitch introduced the 4(n squared) (“Yablonovitch Limit”) light-trapping factor that is in worldwide use, for almost all commercial solar panels. His mantra that "a great solar cell also needs to be a great LED”, is the basis of the world record solar cells: single-junction 28.8% efficiency; dual-junction 31.5%; quadruple-junction 38.8% efficiency; all at 1 sun. His startup company Ethertronics Inc., has shipped over one billion cellphone antennas.

Prof. Yablonovitch is elected as a Member of the National Academy of Engineering, the National Academy of Sciences, the American Academy of Arts & Sciences, and is a Foreign Member of the Royal Society of London. He has been awarded the Buckley Prize of the American Physical Society, the Isaac Newton Medal of the UK Institute of Physics, the Rank Prize (UK), the Harvey Prize (Israel), the IEEE Photonics Award, the IET Mountbatten Medal (UK), the Julius Springer Prize (Germany), the R.W. Wood Prize, the W. Streifer Scientific Achievement Award, and the Adolf Lomb Medal. He also has an honorary Ph.D. from the Royal Institute of Technology, Stockholm, & the Hong Kong Univ. of Science & Technology, and is honorary Professor at Nanjing University.

The Challenge of Photonic Crystals (and Meta-Materials) is Inverse Electromagnetic Design (Aperiodic)
Inevitably, in electromagnetics, there is a goal, and it may be that the goal is best achieved by an,aperiodic rather than a periodic design. Then there is a universal question: What is the best design to achieve,a specific goal?

Nikolay Zheludev

University of Southampton, UK and NTU, Singapore

Continuous Time Crystals on Opto-Mechanical Platform

Nikolay Zheludev’s research interest are in nanophotonics and metamaterials. He is the Deputy Director of the Optoelectronics Research Centre in Southampton University, UK and co-Director of The Photonics Institute at Nanyang Technological University, Singapore.

Prof. Zheludev is elected as a Fellow of the Royal Society (UK) and Member of the USA National Academy of Engineering. He is a Fellow of the European Physical Society (EPS), the Optical Society (OSA) and the Institute of Physics (London). He has been awarded the Michael Faraday Gold Medal, Thomas Young Medal and President of Singapore Science and Technology Award.

Continuous Time Crystals on Opto-Mechanical Platform
We overview recent developments in the field of photonic time crystals, a state of matter with broken time-translation symmetry.

TUTORIALS

Prof. Philippe Lalanne

Institut d'Optique d'Aquitaine - CNRS, France

Wednesday 19st July
14:00 - 15:00 — Amphi Fournel

Disordered optical metasurfaces

Philippe Lalanne is a CNRS Research scientist. Optician by adoption, he is an expert in nanoscale electrodynamics. His first works with Pierre Chavel at Orsay focused on optoelectronic machines for implementing neural networks operating by simulated annealing at video rate. After a sabbatical year at the Institute of Optics (Rochester), he undertook work in the field of diffractive optics. At the Laboratoire Charles Fabry in Palaiseau, he then designed the first high-efficiency metasurfaces, gave general rules for designing microcavities with high quality factor and explained the role of plasmons in the extraordinary optical transmissions. At the Laboratoire Photonique, Numérique et Nanosciences in Bordeaux, he is currently studying the non-Hermitian dissipative coupling of light with nanoresonators and the properties of disordered optical metasurfaces. From 2018 to 2022, he was director of the GDR Ondes. He received several distinctions, including a 2022 ERC Advanced grant. He is associate editor of the journal Optica and is a fellow of IOP, SPIE and OPTICA.

Disordered optical metasurfaces
Shaping the far-field radiation diagrams of surfaces engraved with high-index subwavelength structures belongs to a longstanding and fundamental ambition of wave science. The problem comes in different forms, but generally consists of angularly and spectrally controlling polychromatic light scattering with nanostructures smartly arrayed on a surface. We discuss important challenges in the emerging field of disordered metasurfaces to address applications such as light focusing, light extraction and detection, color and appearance creation.

Dr. Anja Wecker

Editor in Chief of Advanced Optical Materials (WILEY), Germany

Thursday 20th July
14:00 - 15:00 — Amphi Bezier

Publishing Research with Impact in the Optics and Photonics Field

Anja Wecker studied chemistry at Saarland University in Saarbrücken where she completed her diploma as well as well as her PhD thesis in the field of physical chemistry. She joined Wiley in 2012.

Publishing Research with Impact in the Optics and Photonics Field
For researchers, it's a long road from the idea to the published article. Producing great research results does not necessarily mean they will automatically be appreciated by the community. Choosing the right journal, convincing editors and reviewers, and making work visible to others are essential steps on the way to success. In this tutorial talk, I will give an insight into publishing opportunities in relevant journals and the related peer review process. From an editorial perspective, I will provide some guidance on how to best pass peer review and maximize success in scientific publishing.

INDUSTRIAL WORKSHOPS

SYNOPSYS®

18th & 19th July, 16:40 - 17:40 — Salle des Conseils

Automated Inverse Design Solution for Metalenses

Chenglin Xu, Maryvonne Chalony, Yijun Ding

To help researchers design metalenses easily and quickly, Synopsys has developed MetaOptic Designer, a fully automated design tool for metalenses. Based on a few inputs from designers, such as a pre-built metaatom library and basic lens configuration, MetaOptic Designer generates an optimized design to meet all design targets. Synopsys will introduce and demonstrate MetaOptic Designer in two workshop sessions at META 2023.

On July 18, we will provide a general overview of the MetaOptic Designer optimization algorithm, followed by quick demonstrations of the tool's capability.

On July 19, we will demonstrate advanced metalens applications with tips and tricks; applications will include:

- Achromatic metalens
- Wide-angle metalens
- Chiral hologram
- Reflective metalens
- Hybrid optical system with both metasurfaces and traditional refractive lenses

The workshop is free and open to all META conference attendees.

GUIDELINES FOR PRESENTERS I IN-PERSON

In-person Oral Presentations

Each session room is equipped with a stationary computer connected to a LCD projector. Presenters must load their presentation files in advance onto the session computer. Technician personnel will be available to assist you.

Scheduled time slots for oral presentations are 15 mn for regular, 20 mn for invited presentations, 30 mn for keynote talks and 35 mn for plenary talks, including questions and discussions. Presenters are required to report to their session room and to their session Chair at least 15 minutes prior to the start of their session.

The session chair must be present in the session room at least 15 minutes before the start of the session and must strictly observe the starting time and time limit of each paper.

In-person Poster Presentations

Presenters are requested to stand by their posters during their session. One poster board, A0 size (118.9 x 84.1 cm), in portrait orientation, will be available for each poster. Pins or thumbtacks are provided to mount your posters on the board. All presenters are required to mount their papers 30mn before the session and remove them at the end of their sessions. Posters must prepared using the standard AES poster template (available on the conference website).

GUIDELINES FOR PRESENTERS I **ONLINE**

All Oral presentations will be in person with option for remote viewing via Zoom.

Poster sessions will be hybrid, consisting of both in person and virtual presentations. Instructions for **virtual poster presenters** can be found here: guidelines).

USEFUL INFORMATION

Venue

META 2023 will be held at
Ecole Nationale Supérieure d'Arts et Métiers (ENSAM) - Paris Campus
155 boulevard de l'Hôpital, 75013, Paris

https://artsetmetiers.fr

A leading science & technology Grande École in France with an international reputation in education and research, Arts et Métiers is one of France's oldest and best engineering schools specializing in mechanical, industrial and energy engineering. Arts et Métiers has more than 250 years of tradition in technical innovation and industrial engagement.

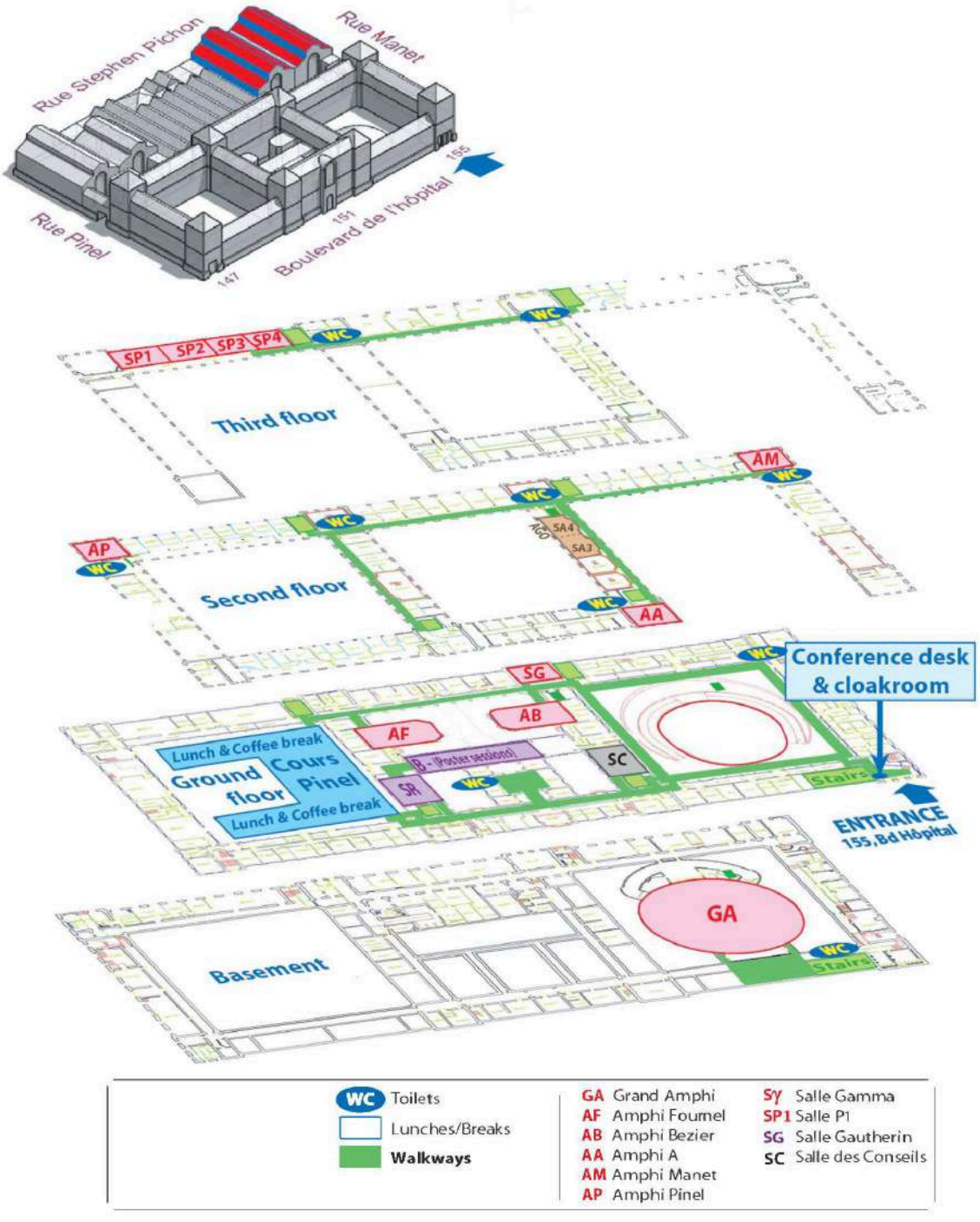
Getting to Venue

Getting to ENSAM

By Metro
Lines 5, 6, 7; Metro station: Place d'Italie
Line 5; Metro station: Campo-Formio

By Bus
Lines 57 & 67; Bus station: Rubens – Ecole des Arts et Métiers

Planing the fastest itinerary between two locations in Paris : https://www.ratp.fr/en


Rue Stephen Pichon
Rue Manet
Rue Pinel
Boulevard de l'hôpital
147
151
155
Third floor
SP1
SP2
SP3
SP4
WC
Second floor
AM
AP
AA
SA4
SA3
SG
AB
AF
SC
SR
Lunch & Coffee break
Ground floor
Cours Pinel
Lunch & Coffee break
Conference desk & cloakroom
Stairs
ENTRANCE
155, Bd Hôpital
Basement
GA
WC Toilets
Lunches/Breaks
Walkways
GA Grand Amphi
AF Amphi Fournel
AB Amphi Bezier
AA Amphi A
AM Amphi Manet
AP Amphi Pinel
Sγ Salle Gamma
SP1 Salle P1
SG Salle Gautherin
SC Salle des Conseils

TECHNICAL PROGRAM

All sessions in the program are scheduled in Central European Time (CET/GMT+2/UTC+2).

Monday 17th July, 2023

Registration

Reception Desk

15:00 - 18:00

Tuesday 18th July, 2023

Registration

Reception Desk

08:00 - 17:30

Opening Address

Grand Amphi

08:45 - 09:00

09:00 - 10:10 — Grand Amphi

Session 1A1

Plenary Session I

Chaired by: Nader Engheta

09:00 : Plenary talk
Active photonic metasurfaces empowered by 2D semiconductors
Isabelle Staude
Friedrich Schiller University Jena (Germany)

This talk reviews our recent and ongoing activities in hybridizing optical metasurfaces composed of resonant metallic or dielectric building blocks with 2D-TMDCs. We demonstrate that the ability of the nanoresonators to concentrate light into nanoscale volumes can be utilized to carefully control the properties, such as pattern and polarization, of light emitted by 2D-TMDCs via photoluminescence or nonlinear optical processes. Furthermore, we investigate the ability of tailored nanostructures to interact selectively with exciton populations located at inequivalent conduction band minima at the corners of the 2D-TMDC's Brillouin zone.

09:35 : Plenary talk
Extreme Control of Light and Sound with Metamaterials
Andrea Alù
City University of New York (USA)

In this talk, I discuss recent developments in this field of research, with an emphasis on the role of symmetries in establishing emerging optical responses for metamaterials based on otherwise simple constituents. Geometrical rotations, suitably tailored perturbations, and broken time reversal symmetry can be carefully engaged to tailor waves in robust and efficient ways, control their propagation, break Lorentz reciprocity and enable topological order and phase transitions.

Coffee Break

Session 1P1
Poster Session I
10:10 - 10:50

P1: Performance Analysis of Patch-HIS Arrays for Visually Impaired Aid System
Alicia Florez Berdasco, Jaime Laviada Martinez, Maria Elena de Cos Gomez, Fernando Las-Heras

Andrés
Universidad de Oviedo (Spain)

A High Impedance Surface (HIS) metasurface has been designed to be combine with patchbased antennas to improve their radiation properties for the Electronic Travel Aid (ETA) application for whichthey are intended. A wearable patch and patch-HIS arrays antennas have been designed ad hoc, in the24.05-24.25GHz frequency band. In order to evaluate the performance of the antennas, electromagneticimages have been obtained and a metric have been applied to compare their quality and evaluate their behaviorfor the application.

P2: Sensitivity Enhancement of THz Meta-Material by Decoupling its Resonance from Substrate's Fabry-Pérot Oscillations

Heena Khand, Rudrarup Sengupta, Gabby Sarusi
Ben-Gurion University of the Negev (Israel)

In this work, we introduce the issue of sensitivity-reduction due to the interaction/coupling of substrate's Fabry-Pérot(FP)-oscillations with the terahertz Meta-Materials(MM) LC-resonance. This coupling is more intense in thicker semiconductor substrates, due to high density of FP-oscillations and thus probability of coupling with the single-MM-resonance increases, resulting in reduced sensitivity of resonant-MM. We show sensitivity-restoration of the MM-resonance red-shift, by decoupling it from the FP-oscillation after thinning down the substrate (using CMOS-only-process), giving 5-fold enhancement in dielectric-sensitivity compared to conventional substrates.

P3: Overcoming color limitation of sub-ambient radiative cooler for full color expression

Suwan Jeon[1], Soomin Son[2], Seokhwan Min[3], Hyeonjin Park[3], Heon Lee[2], Jonghwa Shin[3]
[1] *Department of Nano Mechanics - KIMM (Korea),* [2] *Korea University (Korea),* [3] *KAIST (Korea)*

The lack of color diversity is the fundamental problem inherent in the radiative cooling system, which raises practical issues of eye safety, light pollution, and aesthetics. In this work, we show a breakthrough for colored radiative cooling by experimentally demonstrating that sub-ambient cooling under direct sunlight is possible for all colors, including black. The key principle is thermal non-equilibrium between color and cooling parts, which can potentially serve as a new avenue for radiative cooling applications requiring diverse color expression.

P4: Au@Pd supercrystals as plasmonic photocatalysts for Suzuki C-C coupling

Charlène Brissaud[1], Wajdi Chaâbani[1], Lucas Vazquez Besteiro[2], Miguel Comesana-Hermo[1], Jean-Yves Piquemal[1]
[1] *Université Paris Cité (France),* [2] *Universidade de Vigo (Spain)*

We use Au@Pd core-shell nanorods self-assembled into supercrystals as plasmonic photocatalysts for the Suzuki C-C coupling reaction between bromobenzene and m-tolylboronic acid under simulated sunlight. Such plasmonic device is an interesting model system to understand the relative importance that the electromagnetic field enhancement generated via plasmonic coupling between nanorods, the photogenerated hot charge carriers and the temperature rise may have on this particular reaction.

P5: Metamaterial-Assisted Power Division: An Inverse Design Study in 1D Grating Waveguides

Ahmet Oguz Sakin, Beyza Akcay, Hasan Alper Gunes, Ahmet Canberk Songur, Mehmet Unlu
TOBB University of Economics and Technology (Turkey)

Power dividers are vital components playing a crucial role in facilitating signal merging, routing, and division to ensure the efficient functioning of multi-channel systems in photonic integrated circuits. However, the use of bulky power splitters can occupy a significant amount of space on the chip. Therefore, we propose the utilization of a metamaterial-assisted ultra-low-loss T junction power divider, which integrates an input and two output grating waveguides, with a size of just 2.1 x 2.1 μm2.

P6: MBE substrate deoxidation surveillance via RHEED image analysis with Deep-Learning

Abdourahman Khaireh-Walieh, Alexandre Arnoult, Sébastien Plissard, Peter Wiecha
LAAS-CNRS (France)

In Molecular Beam Epitaxy (MBE), monitoring of the substrate deoxidation and in general, the entire crystal growth is crucial for precise crystal growth. Reflection High-Energy Electron Diffraction (RHEED) is a standard tool in MBE in-situ monitoring, providing complex real time information about the crystal surface. However, the diffraction patterns are often difficult to interpret, requiring experienced human operators[1]. We present an approach to automate the substrate deoxidation detection by analyzing RHEED video sequences by a deep-learning model.

P7: Directional scattering by composite SiO2/Au nanoparticles
Thomas Kotte, A. J. L. Adam, H. P. Urbach
Delft University of Technology (The Netherlands)

We show that composite nanoparticles can be designed to scatter light into a desired direction. By choosing the materials of the nanoparticle carefully, the phase of the scattered light by the different components can be controlled. This leads to constructive interference is certain directions and destructive interference in others, resulting in directional scattering obtainable for a large bandwidth. FEM simulations were used to validate the theory. Furthermore, SiO2/Au nanoparticles were fabricated and measured confirming the directional scattering.

P8: Airborne Transverse Sound: from Spin-Orbit Interactions to Circular Dichroism
Shubo Wang[1], Qing Tong[1], Guancong Ma[2]
[1] *City University of Hong Kong (Hong Kong),* [2] *Hong Kong Baptist University (Hong Kong)*

I will report our study about a new type of sound wave-airborne transverse sound. The transverse sound carries both spin and orbital angular momentum, and the spin-orbit interactions can give rise to novel phenomena that cannot be found in conventional acoustic systems, such as the negative refraction induced by acoustic activity and the spin-dependent vortex generation in sound scattering. We also demonstrate the acoustic circular dichroism associated with the interaction of circularly polarized transverse sound with chiral structures.

P9: Purcell Enhanced Intrinsic Linear and Nonlinear Optical Responses in Colloidal Dielectric Resonators
Jeanne Heintz, Gauthier Roubaud, Samuel Grésillon, Sebastien Bidault
ESPCI Paris (France)

We demonstrate an enhancement of the intrinsic linear and nonlinear spontaneous emission from silicon and gallium phosphide-based resonators by a conjunction of scattering, luminescence lifetime and nonlinear spectroscopies at the single particle level.

P10: Probing the spatial and temporal decay of quasimodes in non-Hermitian Vogel spirals via localization maps
Marcus Prado[1], Fabrizio Sgrignuoli[2], Yuyao Chen[2], Luca Dal Negro[2], Felipe Pinheiro[1]
[1] *Universidade Federal do Rio de Janeiro (Brazil),* [2] *Boston University (USA)*

We investigate the temporal and spatial properties of the quasimodes of non-Hermitian Vogel spiral planar arrays. The analysis of the localization maps reveals that optical quasimodes with three types of spatial decay coexist in these deterministic aperiodic structures: exponential, Gaussian and power-law decay. On average, the Gaussian ones are found to be the most spatially and temporally localized. In addition, our results provide the first direct demonstration of critical quasimodes in Vogel spirals.

P11: Investigation of Field Effect Tuning of Refractive Index in Transparent Conducting Oxide Thin Film Fabry-Perot Cavity Structures
Evan Roy, Nishtha Shelly, Chris Murray, David McCloskey
Trinity College (Ireland)

Electrical tuning of transparent conducting oxides (TCOs) can result in unity order change in refractive index at visible and NIR frequencies by blue shifting the plasma frequency ωp within an interfacial accumulation layer. We used the Transfer Matrix Method (TMM) in MATLAB to simulate TCO heterostructures based on metal-insulator-metal (MIM) Fabry-Perot (FP) cavities. Our results demonstrate that large changes in transmitted and reflected light are achievable in MIM heterostructures in the visible at low voltages in the surface normal geometry.

P12: Time-varying OAM beams generation by a metasurface
Jingxin Zhang[1], Peixing Li[2], Ray C. C. Cheung[2], Alex M. H. Wong[2], Jensen Li[1]
[1] *The Hong Kong University of Science and Technology (Hong Kong),* [2] *City University of Hong Kong (Hong Kong)*

We demonstrate the use of a space-time-coding digital metasurface operating in the microwave regime to experimentally generate various modes of time-varying orbital angular momentum (OAM) beams. By developing a time-domain field mapping technique, we are able to observe the generated time-varying OAM. Moreover, we explore an additional higher-order twist in the wavefront structure of time-varying OAM beams based on

the flexible programmability of the metasurface. These proposed time-varying OAM beams hold potential for applications in communication and particle manipulation.

P13: Lithography-free control of thermal emission.
Mitradeep Sarkar, Maxime Giteau, Michael Enders, Georgia Papadakis
ICFO (Spain)

Blackbody thermal emission is spatially diffuse. Achieving highly directional thermal emission typically requires nanostructuring the surface of the thermally emissive medium. Here, we revisit the simple motif of a planar Salisbury screen and show that hexagonal Boron Nitride thin films can enable grating-like thermal emission lobes in a lithography-free platform.

P14: Reflection of ultrasound by underwater phase-gradient acoustic metasurfaces
Jin-Chen Hsu, H. Alwi, K.-L. Liao, J.-T. Huang
National Yunlin University of Science and Technology (Taiwan)

We numerically and experimentally study anomalous reflection of underwater ultrasound by phase-gradient acoustic metasurfaces. We conduct finite-element calculations to design the metasurfaces for desired phase gradient and simulate the reflected wave fields. The results exhibit anomalous reflection. We fabricate the metasurfaces with sub-mm meta-atoms and conduct pulsed ultrasound experiments to measure the azimuth distributions of the reflected waves. The experimental results agree well with the numerical results, confirming that anomalous reflection of underwater ultrasound can be achieved by the metasurfaces.

P15: Pseudomagnetic suppression of non-Hermitian skin effect
Hau Tian Teo, Subhaskar Mandal, Yang Long, Haoran Xue, Baile Zhang
Nanyang Technological University (Singapore)

Inspired by previous work on magnetic suppression, we demonstrate that a pseudomagnetic field can also suppress non-Hermitian skin effect using a two-dimensional tight-binding lattice. By increasing pseudomagnetic field, the skin modes are pushed into the bulk, accompanied by the reduction of skin topological area and the restoration of Landau levels. Our results provide a new route to localization control and could be useful in classical wave devices that are able to host non-Hermitian skin effect but inert to magnetic fields.

P16: Tailoring coupling conditions between silicon metasurfaces and molecular vibrations
Keisuke Watanabe[1], Hemam Rachna Devi[2], Iwanaga Masanobu[2], Tadaaki Nagao[2]
[1] *National Institute for Materials Science (Japan),* [2] *National Institute for Materials Science (NIMS) (Japan)*

Vibrational coupling to quasi-bound states in the continuum (qBICs) in silicon-based dielectric metasurfaces is experimentally demonstrated. The judicious selection of the asymmetry parameter of qBICs offers tailored coupling between the resonance mode and polymethyl methacrylate (PMMA) molecules from weak to strong coupling regimes. We also show the existence of the asymmetry parameter at which the enhanced molecular signal is maximized. We believe that these findings serve as a bases for highly sensitive surface-enhanced infrared spectroscopy based on all-dielectric materials.

P17: Electrical tunning of metasurfaces via transparent conducting oxide micro heaters
Khosro Zangeneh Kamali[1], Lei Xu[2], Nikita Gagrani[1], Hark Hoe Tan[1], Chennupati Jagadish[1], Andrey E. Miroshnichenko[3], Dragomir N. Neshev[1], Mohsen Rahmani[2]
[1] *The Australian National University (Australia),* [2] *Nottingham Trent University (United Kingdom),* [3] *University of New South Wales (United Kingdom)*

We demonstrate a rapid and programmable amplitude modulator based on the thermo-optical effect by integrating transparent conducting oxide micro-heaters with metasurfaces. The system exhibits sub-millisecond rise-time and 9 folds of amplitude modulation.

P18: Sound insulation performance of ventilated labyrinthine metamaterial described by enriched homogenized continuum
Renan Liupekevicius Carnielli, Hans van Dommelen, Marc Geers, Varvara Kouznetsova
Eindhoven University of Technology (The Netherlands)

Labyrinthine structures that increase the wave-path length can be used as an acoustic liner to attenuate sound in ducts while allowing net airflow. In this study, the performance of ventilated labyrinthine metamaterials is assessed utilizing a homogenized equivalent fluid continuum. The effective domain is a more computationally efficient way to compute the pressure field compared to direct numerical simulation thanks to a coarser mesh.

P19: Angle sensitivity of extraordinary optical transmission and resonant spatial frequency filtering
Sun-Je Kim[1], **Hanbyul Chang**[2]
[1] *Myongji University (Korea),* [2] *Seoul National University (Korea)*

In this paper, we propose a rigorous study on the angle-sensitivity of the extraordinary optical transmission resonances in subwavelength plasmonic silver nanogratings. The mechanism of angle sensitivity of the resonances is revealed in terms of the coupling between the cavity resonance and the propagating surface plasmon excitation. Based on the mechanism, strong and efficient monochromatic spatial filters are engineered by judicious tuning of the geometric parameters. The designed spatial filtering functions are also verified via experiments.

P20: Giant Magnetoimpedance effect at GHz frequencies in amorphous microwires
Valentina Zhukova, Mihail Ipatov, Paula Corte-Leon, Juan Maria Blanco, Arcady Zhukov
University of Basque Country (Spain)

We measured magnetic field dependences of the GMI ratio up to GHz frequency range and observed quite high GMI ratio in studied thin magnetic microwires even at GHz frequencies. We observed different values of the magnetic anisotropy field obtained from the hysteresis loops and the impedance curves. Features of high frequency GMI effect have been analyzed using FMR-like approximation.

P21: Physical limitations on the observability of non-Hermitian effects in passive systems
Henning Schomerus
Lancaster University (United Kingdom)

I contrast fundamental limitations on the physical observability of non-Hermitian effects in passive and active non-Hermitian systems. While active systems suffer from noise, passive systems are limited by causality, which can be reformulated in terms of constraints on the experimentally observed density of states. Applied to paradigmatic effects, it turns out that signatures of exceptional points and the non-Hermitian skin effect become hidden.

P22: Photonic Band Structure Calculations of 3D Finite Nanostructured Supercrystals
Nicolas Large, José Luis Montano-Priede
University of Texas at San Antonio (USA)

Computational modelling of plasmonic periodic structures are challenging due to their multiscale nature. Here, we developed a computational approach, based on the finite-difference time-domain method to accurately calculate the photonic band structures of finite supercrystals, accounting for both nanoscale features an overall habit of the supercrystal. We applied this new approach to 3D periodic microstructures of Au nanoparticles with cubic, spherical, and rhombic dodecahedral habits and discuss how their photonic band structures differ from those of infinite structures.

P23: Fully Beam Scanning Transmissive Mechanical Metasurface with Polarization Conversion
Chhungheng Lor, Sungjoon Lim
Chung-Ang University (Korea)

A circular-polarization (CP) beam scanning metasurface is proposed to achieve fully transmission beam scanning of 28-degree for both positive and negative direction of the radiation pattern. The combination of plannar and non-plannar electromagnetic (EM) elements to enlarge the distance variation of spacing modulation metasurface for larger beam scanning range than the conventional active. The scanning ability is being controlled and optimized by integrated with the DC motor and is being verified through the numerical and measurement result.

P24: Flexible Interdigitated Pd/ZnO-SWCNT/Pd Ultraviolet Photodetectors
M. R. Sabity, Ghusoon M. Ali
Mustansiriyah University (Iraq)

Recently, flexible electronic and optoelectronic devices have gotten excessive attention because of their role in wearable technology. This work successfully fabricates Pd/ZnO-SWCNT/Pd flexible interdigitated photodetector. Hydrothermal growth of ZnO thin films was used. I-V characteristics were evaluated in both dark and UV light environments over a voltage range of -5 to 5 V. The barrier height for the device was 0.765 eV, while the ideality factor was 1.84. The responsivity was found to be 14.8 A/W, the device exhibited gain.

P25: Non-Unity Magnetic Permeability in 2D Hybrid Organic/Inorganic Perovskites

Jon Schuller[1], **Ryan DeCrescent**[1], **Rhiannon Kennard**[2], **Michael Chabinyc**[2]
[1] *UC Santa Barbara (USA),* [2] *Sheffield University (United Kingdom)*

Atomic-scale material optical properties are universally described within the electric dipole approximation-bulk optical frequency light-matter interactions are assumed to arise solely from electric dipoles interacting with electric fields. This inability of matter to interact with optical frequency magnetic fields led to the advent of metamaterials. Atomic-scale optical magnetism represent an unrealized frontier in optical materials. Here, we demonstrate in 2D Hybrid Organic/Inorganic Perovskites the only known example of an atomic scale non-unity optical frequency magnetic permeability.

P26: A Sustainable Power Scavenger Using Zebra-Inspired In-Plane Radiative Cooler/Heater

Se-Yeon Heo, Young Min Song
Gwangju Institute of Science and Technology (Korea)

A typical thermoelectric generators (TEGs) employ complex out-of-plane configurations, which often require additional thermal insulation components to preserve the temperature difference across the TEG. However, this can result in rigid and bulky configuration. In this study, we came up with a new TEG that is environmentally friendly and soft to the touch. It uses a pattern inspired by the stripes of a zebra to create a large temperature difference, making it a good option for future energy systems.

P27: A Terahertz Time-Domain Antenna Array based on a Parametric Study

Ahmet Canberk Songur, Ahmet Oguz Sakin, Beyza Akcay, Hasan Alper Gunes, Mehmet Unlu
TOBB University of Economics and Technology (Turkey)

In this paper, the design parameters are examined in detail for the terahertz photoconductive antenna arrays operating in the terahertz frequency region, which is one of the most important band candidates for future communication systems, and a 1x4 wide-band time-domain bowtie antenna array providing 30° steering is designed for 0.8-2 THz band. This study is entirely realized in the time domain to process the broadband terahertz pulsed signals more efficiently.

P28: Rewritable Optical Fourier Volumes using Photoaddressable Polymers containing Azobenzene and Liquid Crystals

Heeju Son[1], **Kwangjin Kim**[1], **Yongjun Lim**[1], **Seungjae Hong**[1], **Changwon Shin**[2], **Dongjae Baek**[1], **Hyeonho Kim**[1], **Nam Kim**[2], **Joona Bang**[1], **Seungwoo Lee**[1]
[1] *Korea University (Korea),* [2] *Chungbuk National University (Korea)*

Holographic Optical Elements (HOEs) based on the Fourier transform have to consist of the structures with sinusoidally modulated refractive index changes to avoid the mixing of undesired frequencies that can act as noise for the devices. In terms of the structure concepts, the optical Fourier volumes are appropriate for the HOEs due to their high diffraction efficiency, narrow angular selectivity. In this works, we synthesized the photoaddressable polymers and inscribed the optical Fourier volumes to confirm their properties as HOEs.

P29: Characterization of Optical Fourier Volumes made by Holographic Recording on Photo-reactive Polymers

Kwangjin Kim[1], **Yongjun Lim**[1], **Heeju Son**[1], **Seung Jae Hong**[1], **Chang-Won Shin**[2], **Dongjae Baek**[1], **Hyeon Ho Kim**[1], **Joona Bang**[2], **Seungwoo Lee**[1]
[1] *Korea University (Korea),* [2] *Chungbuk National University (Korea)*

Various researches have studied volume grating made of photo-reactive materials for optical elements due to their diffractive characteristics. However, investigation of optical features of volume grating still relies on the conventional Kogelnik's theory. Here, we analyzed the optical behaviors in detail and found out the conditions for noise-free diffraction by using Fourier-optics and computational simulations. Finally, we defined the optical Fourier volume (OFV) which has clear diffraction and experimentally validated our analytical results by using both photopolymer and photoaddressable polymer.

P30: Mesoporous g-C3N4/TiO2 photonic film with a chiral nematic structure: slow photonic effect inducing improved H2 generation

Masa Johar, C. Wang, M. N. Ghazzal
Universite Paris-Saclay (France)

Photocatalysis is one of the ideal approaches to address the energy crisis. Graphitic carbon nitride (g-C3N4) is a promising photocatalyst that attracts attention due to its unique properties. However, its photocatalytic activity remains low due to high photogenerated charges recombination and low absorption factor. Therefore,

massive efforts have been undertaken to solve these problems. This presentation proposes a fabrication of a bioinspired photonic crystal SiO2/g-C3N4/TiO2 film with a chiral-nematic structure to enhance the photocatalytic activity of g-C3N4.

P31: Three-dimensional varifocal device by mechanical tuning of metalens doublet and auxiliary visual alignment guiding hologram
Hyeonhee Kim, Joonkyo Jung, Jonghwa Shin
KAIST (Korea)

In this study, we proposed an optical system including metalens doublet which can generate focus at an arbitrary location in three-dimensional space by simply tuning their distance or orientation angles. For fully exploiting 2-polarization channels of the unitary symmetric metasurfaces, a built-in hologram is embedded in the remaining channel, which visually guides rotational and positional alignment between two metalenses inreal-time, without additional fabrication cost. The suggested hybrid optical system could apply to and widen many other studies.

P32: Stable periodic solutions in fractional dissipative systems with non-Hermitian modulation
Salim Benadouda Ivars, Muriel Botey, Ramon Herrero, Kestutis Staliunas
Universitat Politècnica de Catalunya (Spain)

New stable periodic solutions are uncovered in the fractional complex Ginzburg-Landau equation with the introduction of non-Hermitian potentials. This equation is known to be a general model for extended dissipative systems. A thorough analysis of the dynamics and stability of the system is conducted. The stabilisation is proven to be robust in a wide area in the parameters space, with potential applications to other physical systems. As an example the study provides results on the stabilisation of Class B lasers.

10:50 - 12:20 — Grand Amphi

Session 1A2

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Thomas Wong

10:50 : Keynote talk
Near-Zero-Index Materials for Nonlinear Optics and Beyond
Vladimir M. Shalaev
Purdue University (USA)

We discuss Near-Zero-Index (NZI) materials based on transparent conducting oxides (TCOs) that open new avenues in nonlinear optics including exotic time-varying media phenomena, such as negative refraction, time refraction/reflection, and photonic time crystals.

11:20 : Invited talk
Photo-Induced Sources within Multilayer Optics: from Light Scattering to Micro-cavities and Thermal Radiation
Claude Amra, Paul Rouquette, Myriam Zerrad, Gabriel Soriano, Michel Lequime
Aix Marseille University (France)

We use the same formalism to analyze light scattering, luminescence, and photo-induced thermal radiation in optical interference filters. The 4D spatio-temporal regime is considered. Analytical techniques are presented to design strong inhibition (case of scattering) or huge enhancement (luminescence, thermal radiation) of the pattern emitted from these multi-dielectric coatings.

11:40 : Invited talk
Controllable generation of frequency-encoded qubits and qudits using silicon photonics nano-engineered devices

Massimo Borghi, Noemi Tagliavacche, Federico Andrea Sabattoli, Houssein El Dirani, Laurene Youssef, Camille Petit-Etienne, Erwine Pargon, Corrado Sciancalepore, J. E. Sipe, Marco Liscidini, Matteo Galli, Daniele Bajoni
Università di Pavia (Italy)

We present silicon photonic devices designed for the generation of frequency bin entangled qubits and qudits. We show through quantum tomography experiments that bin spacing, qudit dimension, and bipartite quantum state can be directly controlled using on-chip devices. We discuss further developments and the possible applications in several key quantum technologies.

12:00 : Invited talk
Hybrid-Integrated Quantum Optics on a Silicon Nitride Platform
Khaled Mnaymneh, Edith Yeung, David B. Northeast, Jeongwan Jin, Patrick Laferrière, Sofiane Haffouz, Robin L. Williams, Philip J. Poole, Dan Dalacu
National Research Council (Canada)

We present our progress towards scalable quantum-technology solutions on a silicon nitride platform. Using a pick-and-place technique, we demonstrate hybrid integration of single InAs quantum dots on a Si3N4 optical waveguide and show that the hybrid-integrated process does not ruin the single emitter properties, and may even enhance them.

10:50 - 12:40 — Amphi Bezier

Session 1A3

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Jérôme Plain and Alexander Govorov

10:50 : Invited talk
Active control of the nanoparticle self-assembly for photonic applications
Talha Erdem
Abdullah Gül University (Turkey)

Colloidal nanoparticles enable collective utilization of the inherent properties of the nanoparticles. Furthermore, their collective optical response can be fine-tuned employing DNA-driven self-assembly. Here, we present that the optical transmission of self-assembled DNA-functionalized gold nanoparticle network can be actively manipulated using an external optical excitation. We also show control of optical polarization of emitted light from semiconducting supraparticle networks hybridized with magnetic supraparticles. These results prove the potential of programmed nanoparticle self-assembly in tailoring optical features of colloidal systems.

11:10 : Invited talk
Hyperbolic meta-antennas: magnetic and electric modes
Sema Ebrahimi[1], Alina Muravitskaya[2], Ali Adawi[2], Anne-Laure Baudrion[1], Pierre-Michel Adam[1], Jean-Sébastien Bouillard[2]
[1] *University of Technology of Troyes (France),* [2] *University of Hull (United Kingdom)*

Coupling hyperbolic metaparticles is the next step in metamaterial applications, providing tunable electromagnetic properties on demand. Here we present the magnetic and electric modes in hyperbolic meta-antennas arising from the coupling of metaparticles. We show the existence of two coupling regimes for the magnetic modes, and demonstrate a fine control over the electrical field spatial distribution, opening the route towards a wide range of applications from magnetic nanolight sources and magnetic forces engineering, to single photon sources, and subwavelength lasers.

11:30 : Invited talk
Opto-thermal effects in plasmonic nanocrystals with complex shapes

Oscar Avalos-Ovando[1], **Lucas Besteiro**[2], **Artur Movsesyan**[1], **Alexander Govorov**[1]
[1] *Ohio University (USA),* [2] *Universidade de Vigo (Spain)*

The careful geometrical design of plasmonic nanocrystals (NCs) allows not only to manipulate their optical response, but also to generate heat efficiently. Here we present a opto-thermal study of plasmonics NCs but with complex shapes. We use a two-temperature model to study the ultrafast photothermal responses, and we solve for the lattice and the electronic temperatures. We observe the creation of local modifications of the dielectric function via the temperature, which leads to the thermal imprint of plasmonic hotspots.

11:50 : Keynote talk
Ultrafast Optical Studies of Hybrid Nanomaterials of Interest for Optoelectronic and Energy Conversion Applications
Gary Wiederrecht
Argonne National Laboratory (USA)

Ultrafast optical spectroscopy is used to monitor energy flow in nanostructures of interest for optoelectronic and energy conversion applications. The impact of hybrid nanostructures on aiding in the efficiency of desired energy flow outcomes following the absorption of photons is further described. Using ultrafast spectroscopy to probe hybrid structures designed to increase light-matter interactions, such as through optical cavities, is also discussed.

12:20 : Invited talk
Publishing in Nature journals
Rachel Won
Nature Photonics (UK)

In this talk, I will tell you all you need to know about publishing your work in Nature journals, right from preparing your manuscript and options you have during your submission through to the editorial and review processes.

10:50 - 12:45 — Amphi Fournel

Session 1A4

Recent Advances in Non-Hermitian Photonics: Topological, Disordered and Quantum Systems

Organized by: Konstantinos Makris and Li Ge

Chaired by: Konstantinos Makris

10:50 : Invited talk
Non-orthogonality of Bogoliubov modes and the laser linewidth
Ivan Amelio[1], **Iacopo Carusotto**[2]
[1] *Université libre de Bruxelles (Belgium),* [2] *Università di Trento (Italy)*

The non-orthogonality of Bogoliubov modes accounts for both Henry and Petermann broadening mechanisms of the laser linewidth. Applications to exceptional points, (disordered) topological lasers and polariton condensates are discussed.

11:10 : Invited talk
Emergence of non-Hermitian dynamics in a quantum gas leading to a self-driven topological pump
Alexander Baumgärtner
ETH Zurich (Switzerland)

In our experiment, we study a Bose-Einstein condensate dispersively coupled to a high finesse optical resonator. The cavity is populated by scattering photons from a transverse drive illuminating the atoms. The sum of the drive and the self-consistent intracavity field provides a topological band structure. When the dissipative and coherent timescales are comparable, we find a regime of persistent oscillations where the cavity field does not reach a steady state: The emergence of an exceptional point.

11:30 : Invited talk
Graph parity-time symmetry for bipartite graphs and system stability analysis
Henri Benisty[1], **L.A. Moreno-Rodriguez**[2], **Claudia T. Martinez-Martinez**[3], **Jose Antonio Mendez-Bermudez**[2]
[1] *Universite Paris-Saclay (France),* [2] *Benemérita Universidad Autonoma de Puebla (Mexico),* [3] *Universidad Autonoma de Guerrero (Mexico)*

We investigate the eigenvalues of random matrices depicting a set of gain and loss systems that are coupled to each other, forming a bipartite graph that exhibits parity-time symmetry. It has significance for complex systems e.g. in the sense of May's instability and the consequences of the çircular law.ºf eigenvalues distribution and disordered nanolasers. Regions of real spectra in (connectivity, gain/loss) space are outlined. A new feature is a simple angle dependence of eigenvalue distribution in a parametric plane.

11:50 : Invited talk
Restoration of the non-Hermitian bulk-boundary correspondence via topological amplification
Matteo Brunelli[1], **C. C. Wanjura**[2], **A. Nunnenkamp**[3]
[1] *University of Basel (Switzerland),* [2] *University of Cambridge (United Kingdom),* [3] *University of Vienna (Italy)*

Starting from an open quantum system description of driven-dissipative arrays of cavities, I show how to restore the bulk-boundary correspondence for the most paradigmatic class of non-Hermitian lattice Hamiltonians, namely those involving a single complex band, and how this links to topological amplification.

12:10 : Invited talk
Non-Hermitian dispersive hydrodynamics and Riemann problems
Sathyanarayanan Chandramouli[1], **Nicholas Ossi**[1], **Ziad Musslimani**[1], **Konstantinos Makris**[2]
[1] *Florida State University (USA),* [2] *University of Crete (Greece)*

Dispersive hydrodynamics (DH) is the study of nonlinear dispersive wave dynamics in fluid-like media. A fundamental problem in DH corresponds to studying the dynamics of a Riemann problem: a step-like initial condition connecting two constant amplitude states. Constant-intensity waves can exist in non-Hermitian optical media (while generally absent in Hermitian inhomogeneous environments). Thus, we can define and study the notion of non-Hermitian dispersive hydrodynamics and its associated Riemann problems in both ordered and disordered optical media for the first time.

12:30 : Sensitivity and robustness in non-Hermitian topological lattices
Ioannis Komis[1], **Dimitrios Kaltsas**[1], **Shiqi Xia**[2], **Hrvoje Buljan**[3], **Zhigang Chen**[2], **Konstantinos Makris**[1]
[1] *IESL-FORTH (Greece),* [2] *Nankai University (China),* [3] *University of Zagreb (Croatia)*

Higher order exceptional points (sensitivity) and topological protection (robustness) are two antagonistic effects. We examine their interplay on the prototypical non-Hermitian SSH lattice in terms of pseudospectra theory and its geometric features.

10:50 - 12:30 — Amphi Esquillan

Session 1A5

Symposium V: Phononics and Acoustic Metamaterials

Organized by: Jensen Li, Jean-Philippe Groby, Marco Miniaci, Vicente Romero-García, Vincent Pagneux and Noé Jiménez

Chaired by: Jensen Li

10:50 : Invited talk
Control of wave propagation in networks of gyro-elastic discrete strips
Giorgio Carta[1], **Michael Nieves**[2], **Michele Brun**[1]
[1] *University of Cagliari (Italy),* [2] *Keele University (United Kingdom)*

We present a novel mechanical network, which can guide the elastic waves generated by an external loading towards any of its endpoints, that can be selected a priori. The proposed Mechanical Switching Network (MSN) is made of an arrangement of intersecting strips, possessing a lattice structure where the nodes are

connected to gyroscopic spinners. This innovative system can be useful in engineering applications, where the control of energy propagation plays a crucial role.

11:10 : Invited talk
Topologically invisible defects in chiral mirror lattices
Antonin Coutant[1], Li-Yang Zheng[2], Vassos Achilleos[3], Olivier Richoux[3], Georgios Theocharis[3], Vincent Pagneux[3]
[1] *Aix Marseille Université (France),* [2] *Sun Yat-sen University (China),* [3] *Université du Mans (France)*

The hallmark of topological phases in periodic materials is the existence of localized modes on the edges that are immune to backscattering. However, in the context of classical waves such as in photonics or acoustics, total immunity to backscattering has never been achieved so far. In this work, we show how to obtain perfect transmission and invisibility of topological edge waves over defects or disorder by exploiting a combination of chiral and mirror symmetry.

11:30 : Invited talk
A nonlinear acoustic topological system through active control
Xinxin Guo[1], Lucien Jezequel[2], Mathieu Padlewski[1], Hervé Lissek[1], Pierre Delplace[2], Romain Fleury[1]
[1] *EPFL (Switzerland),* [2] *Université de Lyon (France)*

Here by actively controlling electroacoustic resonators, we implement a one-dimensional nonlinear topological system. We demonstrated theoretically, numerically, and experimentally that by adding nonlinearity, the edge state can be preserved at the same frequency as the linear case, provided that the chiral symmetry is satisfied. A good agreement has been found between theoretical, numerical, and experimental results. Our active control approach shows great potential for exploring different types of systems at the intersection of nonlinear physics and other fields.

11:50 : Invited talk
State of the art on the recovery of mechanical energy in the city. The role of seismic metamaterials
Stephane Brule[1], Sebastien Guenneau[2], Stefan Enoch[3]
[1] *Menard (France),* [2] *Imperial College London (United Kingdom),* [3] *Institut Fresnel (France)*

Studies on structured soils, including seismic metamaterials, have shown the existence of complex wave phenomena within and around the structured zone. Seismic protection or invisibility cloak applications have given rise to another speciality. It is a question of evaluating the zones of energy concentration and deciding on the interest of valuing them by placing piezoelectric energy sensors. The article presents what is already being done and shows the interest of seismic metamaterials in this context.

12:10 : Invited talk
Quasi-Bound States in the Continuum for Acoustic and Elastic Waves
Marc Marti-Sabaté[1], Junfei Li[2], Bahram Djafari-Rouhani[3], Steven Cummer[2], Daniel Torrent Marti[1]
[1] *Universitat Jaume I (Spain),* [2] *Duke University (USA),* [3] *University of Lille (France)*

We study the localization of flexural and acoustic waves in metasurfaces by means of clusters of scatterers. We show that when the scatterers are placed regularly in the perimeter of a circumference these structures form a resonator which quality factor grows up exponentially with the number of scatterers. Numerical experiments are performed for elastic waves in thin elastic plates and acoustic waves trapped atop a metasurface, and an experimental validation of the latter is also presented.

10:50 - 12:25 — Amphi A

Session 1A6

Advanced Computational Electromagnetics for the Analysis and Design of Nanophotonic Devices

Organized by: Maha Ben Rhouma and Kofi Edee

Chaired by: Maha Ben Rhouma

10:50 : Invited talk
An overview of spatial spectral methods with complex-plane deformations for the representation of waves in homogeneous and layered media without absorbing boundary conditions
Roeland J. Dilz, Martijn C. van Beurden
Eindhoven University of Technology (The Netherlands)

The prevention of reflections from the edge of the computational domain is a challenge in computational electromagnetics. Although ways exist to absorb/negate such reflections, we recently proposed an entirely different strategy. Based on a representation in the spectral domain, we analytically represent waves on the entirety of space, but with accuracy focused only on a certain region. Therefore, we can employ formulations without worrying about boundary conditions. We show several examples of this technique, including simulations in layered media.

11:10 : Invited talk
Smart Sensing and Spectroscopy using Thermal Emission
Yuzhe Xiao
University of North Texas (USA)

Thermal emission is a ubiquitous phenomenon where hot objects radiate energy as electromagnetic waves. I will first introduce a new metrology method-depth thermography-that can measure the temperature distributions of an object at different depths, based on the light thermally emitted from that object. Then, I will introduce a new spectroscopic technique-Planck spectroscopy-that measures the spectral emissivity of an object using only a temperature-controlled stage and a detector, without any wavelength-selective components such as prisms, gratings, or interferometers.

11:30 : Invited talk
The Fourier Modal Method simplified for crossed subwavelength gratings
Brahim Guizal
University of Montpellier (France)

We present a simplification of the Fourier Modal Method (FMM) for crossed gratings with subwavelength heights. We show that in this case it is possible to compute the scattering matrix of the structure without solving the eigenvalue problem which is the most expensive computational part of the FMM algorithm. This approach is very efficient and thus suitable for periodic metasurfaces.

11:50 : Nonlinear generation of vortex beams on optical metasurfaces
Laure Coudrat[1], Kimon Moratis[1], Pascal Filloux[1], Rana Tanos[2], Julien Claudon[2], Jean-Michel Gérard[2], Aloyse Degiron[1], Giuseppe Leo[1]
[1] *Université Paris Cité (France),* [2] *Université Grenoble Alpes (France)*

The generation of vortex beams is a field of research with an important impact on both fundamental and applied physics. In this work, we show our recent results on the generation of second-harmonic vortex beams with a dielectric nonlinear optical metasurface.

12:05 : Invited talk
Strategies to Tailor Thermal Properties of Metamaterials: Perforation and Amorphisation
Konstantinos Termentzidis
INSA of Lyon (France)

The rapid development of fabrication techniques enables the elaboration of new class of materials with tailor thermal properties. The thermal metamaterials are intelligently designed artificial structures with which one can engineer heat energy as the thermal conductivity becomes an extrinsic property. Here several theoretical and experimental examples of thermal metamaterials using the strategies of perforation and amorphisation will be presented.

10:50 - 12:45 — Amphi Pinel

Session 1A7

Metasurfaces for Nonlinear and Ultrafast Nanophotonics

Organized by: Giulio Nicola Felice Cerullo and Giuseppe Della Valle

Chaired by: Christoph Lienau

10:50 : Invited talk

From light to heat: electronic dynamics and photothermal effects in engineered metasurfaces

Andrea Schirato[1], Yage Zhao[1], Pratiksha Dongare[1], Joao Cunha[2], Luca Mascaretti[3], Margherita Maiuri[4], Giulio Cerullo[4], Remo Proietti Zaccaria[5], Alberto Naldoni[6], Giuseppe Della Valle[4], Naomi Halas[1], Peter Nordlander[1], Alessandro Alabastri[1]

[1] Rice University (USA), [2] INL (Portugal), [3] Palacky University (Czech Republic), [4] Politecnico di Milano (Italy), [5] Istituto Italiano di Tecnologia (Italy), [6] University of Turin (Italy)

Light can interact with nanostructured materials giving rise to several physical phenomena, including enhanced electric fields, generation of high energy carriers and heat dissipation. These effects can be manipulated by engineering such materials into optical metasurfaces where the shape, material and arrangement of the meta-atoms, the metasurface building blocks, can be modified depending on the application. This talk reports recent results where nanoscale optical metasurfaces are utilized in diverse systems, targeting extreme electromagnetic energy focusing, light rectification or steam generation.

11:10 : Invited talk

All-optical routing of upconverted light by dielectric metasurfaces through coherent control

Agostino Di Francescantonio[1], Attilio Zilli[1], Davide Rocco[2], Fabrizio Conti[1], Vincent Vinel[3], Adrien Borne[3], Martina Morassi[4], Aristide Lemaitre[4], Paolo Biagioni[1], Lamberto Duo[1], Costantino De Angelis[2], Giuseppe Leo[3], Marco Finazzi[1], Michele Celebrano[1]

[1] Politecnico di Milano (Italy), [2] University of Brescia (Italy), [3] Université de Paris (France), [4] Université Paris-Saclay (France)

We achieve all-optical switching of the upconverted light in periodic dielectric metasurfaces through a w+2w pump scheme. Exploiting the pump pulse phase as tuning knob, upconversion is switched between diffraction orders with efficiency $> 60\,\%$. Polarization of the pump beams and of the emitted light can is also employed to route the upconverted light among different sets of diffraction orders. We envision the proposed approach as an effective approach to upconvert and steer telecom photons into visible detection paths.

11:30 : Invited talk

Piezoelectric MEMS-empowered dynamic optical metasurfaces

Fei Ding

University of Southern Denmark (Denmark)

We have demonstrated an electrical-driven micro-electro-mechanical (MEMS) empowered dynamic optical metasurface platform for dynamic polarization control with high modulation efficiencies and fast speed by leveraging the commercially available piezoelectric MEMS technique.

11:50 : Ultrafast modulation of surface plasmon dispersion in metallic bilayers by hot non-equilibrium electrons

Artur Avdizhiyan, Andrzej Stupakiewicz, Ilya Razdolski

University of Bialystok (Poland)

Employing back pump-front probe spectroscopy to Fe/Au bilayers, we investigate an indirect manipulation of the surface plasmon dispersion at the remote Au/air interface. The absorption peak of the surface plasmon resonance experiences a shift at the femtosecond timescale, highlighting the role of hot nonequilibrium electrons for ultrafast plasmonics.

12:05 : Invited talk

K-space engineering in nonlinear metasurfaces

Domenico de Ceglia, Costantino De Angelis

University of Brescia (Italy)

Flat optics has been recently unveiled as a powerful platform to perform data processing in real-time, and

with small footprint. So far, these explorations have been limited to linear optics, while arguably the most impactful operations stem from nonlinear processing of the incoming signals. In this context, here we add a new twist and depth to analog optical computing: we demonstrate that nonlinear phenomena combined with engineered nonlocality in flat-optics devices can be leveraged to synthesize Volterra kernels able to perform complex operations on incoming images in real-time.

12:25 : Invited talk
Ultrafast optical switching in Si-metasurfaces for wireless and space optical communication
Kaloyan Georgiev[1], Anton Trifonov[1], Khosro Kamali[2], Dragomir Neshev[2], Giulia Crotti[3], Giuseppe Della Valle[3], Lyuben Petrov[1], Ivan Buchvarov[1]
[1] *Sofia University (Bulgaria),* [2] *Australian National University (Australia),* [3] *Politecnico di Milano (Italy)*

We demonstrate ultra-fast all-optical switching based on the implementation of a metasurface-based laser-dichroic mirror design. The crystalline silicon metasurfaces with 100 nm thickness on sapphire substrates arefabricated using established processes in Si-semiconductor industry. Under weak-pump excitation, relativetransmittance changes of up to 100 % are possible for characteristic times ranging from 25 to 120 ps. A carrier-drivenabsolute amplitude modulation of over 72 % is observed at 102-120 ps relaxation times. A CW 1030 nm laser's beammodulation for free space communication is verified in a laboratory environment.

10:50 - 12:50 — Amphi Manet

Session 1A8

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

10:50 : Invited talk
Topological textures and CP2 Skyrmion crystals in quantum spin-nematics
Yutaka Akagi
The University of Tokyo (Japan)

Recently, topological spin textures such as Skyrmions have attracted scientific and technological interest. However, in most studies on topological spin textures, magnetic moments are approximated as O(3) vectors. This simplification neglects key features of quantum magnets. Thus, we develop the theoretical methods in models with spin-1 moments for quantum spin-nematics. Using the methods, we have found that CP2 Skyrmion crystals and their relatives are realized in a new type of model for quantum spin-nematics, having a generalized Dzyaloshinskii-Moriya interaction.

11:10 : Invited talk
Flat optical devices for 4D light manipulation through orbital angular momentum
Antonio Ambrosio
Istituto Italiano di Tecnologia (Italy)

By controlling amplitude, phase and polarization of light, optical metasurfaces have recently allowed spin-to-orbital angular momentum transformations with a single device that are not possible with standard optical components. We will present our most recent results in developing flat optical components for orbital angular momentum manipulation.

11:30 : Invited talk
Hyperbolic Anisotropic and Bianisotropic Media
Maxim Durach
Georgia Southern University (USA)

We report on the work of Durach et al. at Georgia Southern University demonstrating that anisotropic and bianisotropic media can be classified as belonging to one of the five classes: non-hyperbolic, hyperbolic,

bi-hyperbolic, tri-hyperbolic, and tetra-hyperbolic according to the high-k plane waves in the media. This determines the topology of the Fresnel iso-frequency surfaces, the reflection and transmission properties, resonances, and surface electromagnetic waves in both anisotropic and bianisotropic media.

11:50 : Invited talk

Chiral photonic cavity based on multiferroic layers

Vakhtang Jandieri[1], Ramaz Khomeriki[2], Koki Watanabe[3], Daniel Erni[4], Douglas H. Werner[5], Jamal Berakdar[1]

[1] *Martin-Luther University (Germany),* [2] *Tbilisi State University (Georgia),* [3] *Fukuoka Institute of Technology (Japan),* [4] *Center for Nanointegration Duisburg-Essen (Germany),* [5] *Pennsylvania State University (USA)*

An electrically controllable multilayer structure for discerning and confining chiral electromagnetic fields is demonstrated. Upon scattering, the chiral nature of the noncollinear spin texture in multiferroic layers is imprinted on the electromagnetic fields resulting in well-defined and electrically controlled chirality density of the standing waves within the resonator. Analytical and full-numerical, material-specific simulations endorse the feasibility and flexibility of the proposed scheme.

12:10 : Invited talk

Strain-gradient-driven and magnetoelectric operation with order parameters in Cr2O3

Oleksandr Pylypovskyi

Helmholtz-Zentrum Dresden-Rossendorf e.V. (Germany)

Progress in computing technologies enforces an active search for novel materials, assuring low-power and high-speed operations. One of prospective materials for such needs is Cr2O3. Here, we discuss access to the order parameters and properties of antiferromagnetic domain walls related to the possibility of electric operations on them, as well as fundamental and technological perspectives of the recently accessed flexomagnetism in thin Cr2O3 films.

12:30 : Invited talk

Spin-Orbit-Coupling Mediated by an Epsilon-Near-Zero Interface

Peter Banzer[1], J. S. Eismann[1], L. Ackermann[2], B. Kantor[1], S. Nechayev[3], M. Z. Alam[4], R. Fickler[5], R. W. Boyd[4]

[1] *University of Graz (Austria),* [2] *University Erlangen-Nuremberg (Germany),* [3] *Max Planck Institute for the Science of Light (Germany),* [4] *Max Planck-University (Canada),* [5] *Tampere University (Finland)*

Taking advantage of a fundamental laws of geometrical optics, i.e., Fresnel equations, allows for coupling polarization and spatial phase degrees of freedom. We show that this conversion of spin to orbital angular momentum can be accomplished by a simple planar, homogeneous, and isotropic layer of an epsilon-near-zero material.

10:50 - 12:30 — Salle des Conseils

Session 1A9

Resonant Optics – Fundamentals and Applications

Organized by: Sven Burger, Philippe Lalanne and Frank Vollmer

Chaired by: Philippe Lalanne and Sven Burger

10:50 : Invited talk

Tailored local fields for nonlinear optics, strong coupling and chiral recoil forces

Bert Hecht, Jessica Meier, Luka Zurak, Rene Kullock, Andrea Locatelli, Daniel Friedrich, Jin Qin, Tommaso Tufarelli, Benedikt Schurr, Thorsten Feichtner

University of Würzburg (Germany)

The precision afforded by He-ion beam milling on monocrystalline gold and silver flakes presents an opportunity to tailor local fields at an unprecedented level of 1nm. This method enables the fabrication of intricate structural details, which can be used to create nanoresonators and antennas with unique properties. We le-

verage these capabilities to create devices that exhibit local symmetry breaking, ultrasmall mode volumes, and precise chiral scattering.

11:10 : Invited talk
Complex chi(3) of polyaniline and silver nanoparticle metafluids
Giuseppe Leo[1], Giorgio Guercio[1], Maeva Laffitte[2], Virginie Ponsinet[2], Olivier Mondain-Monval[2], Alexandre Baron[2]
[1] *Université Paris Cité (France),* [2] *Université de Bordeaux (France)*

Polymers being possible candidates for all-optical devices because of their relatively large chi(3) susceptibility and fast response, a significant effort has been devoted in understanding the properties of polyaniline (PANI), which also exhibits excellent environmental stability.

11:30 : Invited talk
Photon-Pair Generation in Resonant Dielectric Nanostructures
Maximilian Weissflog
Friedrich Schiller University Jena (Germany)

Resonant nonlinear nanostructures are evolving into a versatile platform for the generation of entangled photon-pairs with engineered properties. The talk will discuss recent advances in the theoretical description and experimental control of quantum photon-pair states, particularly the generation of maximally polarization entangled Bell states in single nanoresonators as well as spatial tuning of pair-emission in a nonlocal Lithium Niobate metasurface.

11:50 : Invited talk
Plasmonic nanocavities: From resonant modes to semi-persistent sub-radiant states
Angela Demetriadou
University of Birmingham (United Kingdom)

Plasmonic nanocavities have the ability to significantly confine and enhance light, while at the same time efficiently radiate energy to the far-field. Due to these properties, unprecedented light-matter interactions have been realised at room temperature. In this talk, I will present the complex set of plasmonic modes supported by extreme plasmonic nanocavities, their impact on the excitation and radiative properties of the antenna, and how these properties can lead to generating sub-radiant entangled states between two or more quantum emitters.

12:10 : Invited talk
Nanolasers: Dynamics and Phase Locking
Yeshaiahu Fainman, Sizhu Jiang, Suruj Deka, Athena Pan
University of California San Diego (USA)

We discuss nanoscale metal-dielectric-semiconductor resonant gain geometries to create a new type of light emitters focusing on three key aspects: second order intensity correlation characterizations, direct modulation and coupled nanolasers dynamics.

10:50 - 12:25 — Salle Guy Gautherin

Session 1A10

DNA Nanotechnologies for Photonics and Sensing

Organized by: Guillermo Acuna and Denis Garoli

Chaired by: Guillermo Acuna

10:50 : Invited talk
Interfacing quantum emitters and plasmonic resonators with DNA
Jeanne Heintz[1], Claudia Corti[1], Sylvie Marguet[2], Gaëtan Bellot[2], Sebastien Bidault[1]
[1] *ESPCI Paris (France),* [2] *CEA Saclay (France)*

We discuss how DNA templates can be engineered as smart building materials to associate quantum emitters and plasmonic resonators and to maximize light-matter interactions at room temperature.

11:10 : Invited talk
DNA Precision Placement Allows for Studying and Exploiting Energy Transfer beyond the Classical FRET Limit
Matthew Chiriboga[1], Christopher Green[1], Divita Mathur[2], Youngchan Kim[1], Joseph Melinger[1], Igor Medintz[1], Sebastian Diaz[1]
[1] *U.S. Naval Research Laboratory (USA),* [2] *Case Western Reserve University (USA)*

DNA nanotechnology allows for nm precision positioning of moieties, be these organic dyes, or inorganic nanoparticles. Using this we can study and exploit energy transfer beyond the classic FRET limit in manners that are not available with other methodologies. Using DNA bricks and organic dyes we have demonstrated point-to-plane transfer and its r-4 dependence we also exploited DNA origami for positioning of semiconductor quantum dots and plasmonic gold nanoparticles to investigate nanosurface energy transfer (NSET).

11:30 : Invited talk
DNA-origami-based plasmonic assemblies with tailored stimuli and optical responses
Anton Kuzyk[1], M-K. Nguyen[1], J. Ryssy[1], J. Loo[1], R. Klajn[2], P. Albella[3], Y. Huang[1]
[1] *Aalto University (Finland),* [2] *Weizmann Institute of Science (Israel),* [3] *University of Cantabria (Spain)*

The DNA origami technique has emerged as one of the most versatile bottom-up nanofabrication methods. I will discuss our recent results related to application of DNA origami for fabrication of plasmonic systems with novel stimuli and optical responses. Specifically, we will present fabrication of i) light-responsive dynamic plasmonic assemblies with easily regulated steady out-of-equilibrium states1, ii) chiral plasmonic systems with visually detectable reconfigurable optical activity, iii) metal shells with tailored complex morphologies and optical responses within near-infrared transparency window(s).

11:50 : Invited talk
Neurotransmitter Sensing via Ionic Flux Modulation Through Aptamer Conformational Rearrangement
Annina Stuber[1], Ali Douaki[2], Julian Hengsteler[1], Denis Buckingham[1], Dmitry Momotenko[3], Denis Garoli[2], Nako Nakatsuka[1]
[1] *ETH Zürich (Switzerland),* [2] *Instituto Italiano di Tecnologia (Italy),* [3] *University of Oldenburg (Germany)*

Aptamers are artificially engineered DNA sequences which can change their conformation upon the binding of their specific target. Aptamers immobilized inside of a nanopore regulate ionic flux through target recognition, as the conformation switch rearranges the corona of charge density within the orifice. Gaining mechanistic insight into these dynamic nano-systems would enable the development and tailoring of new methods for small-molecule sensing. We have explored the link between aptamer conformation and signal modulation both experimental and theoretically.

12:10 : Colorimetric sensing with hybrid gold-DNA origami nanostructure
Claudia Corti[1], Elise Gayet[1], Nesrine Aissaoui[2], Sylvie Marguet[3], Gaetan Bellot[2], Sébastien Bidault[1]
[1] *ESPCI - PSL (France),* [2] *CBS-INSERM (France),* [3] *Université Paris-Saclay (France)*

We develop a colorimetric sensing platform compatible with single-molecule detection by assembling gold-nanosphere dimers on a Y-shaped 3D DNA origami that acts as a nanoscale actuator in response to specific stimuli.

10:50 - 12:35 — Salle P1

Session 1A11

Plasmonics and Nano-Optics

Chaired by: Miguel Comesana-Hermo

10:50 : Artificial intelligence-based refractive index sensing achieving atto-mol detection limit

Ning Li, Qizhou Wang, Zhao He, Arturo Burguete-Lopez, Fei Xiang, Andrea Fratalocchi
King Abdullah University of Science and Technology (Saudi Arabia)

This study implements an ultrasensitive platform technology that integrates a wet-chemistry scalable sensor with optical artificial intelligence hardware attached to a conventional monochrome camera. The system extracts sensing features in the optical hardware, enabling accurate quantification of glucose concentration with a detection limit as low as 10-20 mol/L. The results improve the current state-of-the-art by six orders of magnitude. The system does not require an electrochemical workstation and works in real-time.

11:05 : Atomically thin waveguides for photonics with 2D light waves
Myungjae Lee[1], Hanyu Hong[2], Jaehyung Yu[2], Fauzia Mujid[2], Andrew Ye[2], Ce Liang[2], Jiwoong Park[2]
[1] *Seoul National University (Korea),* [2] *University of Chicago (USA)*

Monolayer MoS2 films can be used as a high-index core to support guided modes and create slab waveguides. These waveguides can guide light waves for millimeter-scale propagation lengths across a broad range of wavelengths, including the visible and near-infrared regions. The guided wave exhibits significantly reduced light momentum in the out-of-plane direction compared to its momentum along the waveguiding plane, indicating the guiding of 2D light waves.

11:20 : Ultrasmall and tunable TeraHertz surface plasmon cavities in the deep plasmonic regime
Ian Aupiais[1], Romain Grasset[1], Tingwen Guo[1], Dmitri Daineka[1], Javier Briatico[2], Sarah Houver[3], Luca Perfetti[1], Jean-Paul Hugonin[2], Jean-Jacques Greffet[2], Yannis Laplace[1]
[1] *Ecole Polytechnique (France),* [2] *Université Paris-Saclay (France),* [3] *Université Paris Cité (France)*

I will discuss TeraHertz (THz) cavities exploiting the resonance of THz surface plasmons which achieve extreme plasmonic confinement of the EM-field together with a large tunability as compared to more conventional THz cavity architectures based on noble metals. Deep inside the plasmonic regime, the THz cavities exhibit strong signatures of electromagnetic nonlocality. Our work introduces a new platform for exploring nonlocal aspects in plasmonics at an unprecedentedly large, i.e. micrometer, scale and may open the door to many THz applications.

11:35 : Pd nanoparticles as Visible and near-IR plasmonic catalysts
Yukie Yokota, A. Fujita, M. Abe
Sophia University (Japan)

Pd nanoparticles are used as catalysts for organic chemical reactions and exhibit higher catalytic activity than commercial Pd catalysts. In this study, we have prepared Pd nanoparticles by liquid-phase synthesis and and investigated their optical properties. The optical properties of Pd nanoparticles depending on shape and size, and the reaction kinetics of model reactions were compared.

11:50 : Synergetic hot carrier generation due to coherent couplings of plasmon-carrier excitations and plasmon hybridization in a metallic nano-chain array
Soshun Inoue, Tomohiro Yokoyama, Hajime Ishihara
Osaka university (Japan)

Hot carrier generation is one of the most significant issues in plasmonics and energy conversion of light.In this study, we discuss a novel mechanism of coherent energy transfer between the plasmon and carrier excitations mediated by radiative and cavity fields. In the case of metallic nano array, such coherent effects can be enhanced. We elucidated that plasmon-carrier excitations' coherence and plasmon hybridization in the array cause a synergetic effect and it could enhance the energy conversion efficiency.

12:05 : Visible range active metasurface device fabrication and characterization
Yong-Hae Kim, Kyunghee Choi, Chi-Sun Hwang, Jong-Heon Yang, Jooyeon Kim, Jaehyun Moon, Ji-Hoon Choi
Electronics and Telecommunications Research Institute (Korea)

We fabricated a visible range active metasurface device with Mo/AlO/ITO/AZO/Ag/AZO/AlO/Mo layers and explained its working principle as interacting coupled gap plasmons modes. The metasurface device showed peculiar reflectivity modulation characteristics as a function of incoming electric polarizations, Mo antenna's pitch/space, and applied electric voltage polarity.

12:20 : Symmetry-protected topological exceptional chain
Xiaohan Cui[1], Ruoyang Zhang[1], Guancong Ma[2], C. T. Chan[1]

[1] *The Hong Kong University of Science and Technology (Hong Kong),* [2] *Hong Kong Baptist University (Hong Kong)*

We studied the exceptional chains (ECs) in non-Hermitian systems and the symmetries that secure their stability. By assigning orientations to exceptional lines (ELs), we analyzed the robustness of ECs via establishing a source-free principle for ELs. The principle leads to the discovery of three mechanisms for stabilizing the junction of ELs. The observation of these exotic ECs is demonstrated through numerical simulations in photonic crystals and experimental observations in coupled active oscillators.

10:50 - 12:10 — Salle P2

Session 1A12

Chiroptical Phenomena

Organized by: Alessandro Belardini and Ventsislav K. Valev

Chaired by: Ventsislav K. Valev and Alessandro Belardini

10:50 : Invited talk
Maximum Chirality Achieved with Resonant Dielectric Metastructures
Maxim Gorkunov, Alexander Antonov, Denis Baranov, Yuri Kivshar
Russian Academy of Sciences (Russia)

Resonant dielectric metastructures provide a game-changing platform for chiral optics: maximum-chiral metasurfaces are transparent to waves of a particular circular polarization and strongly interact with waves of the opposite polarization. High-quality chiral resonances enhance selectively diverse nonlinear optical transformations of circularly polarized light. Stacking chiral and achiral metasurfaces and mirrors one can build optical cavities which selectively detect/emit chiral light and open a door to chiral polaritonics and chiral electromagnetic vacuum prospectively facilitating chiral chemistry.

11:10 : Invited talk
Transition Metal Nitride and Oxide Thin Films for Chiral Structures: Spectral and Environmental Applicability
Ryan Bower, Peter Petrov
Royal School of Mines (United Kingdom)

Refractory plasmonic thin film materials are of interest for the development of chiral structures due to their increased thermal stability when compared to gold and silver. Transition metal nitride and oxide thin films have been highlighted as promising alternative materials, offering both strong plasmonic and thermal performance. In this work, we analyse the stability of both the structural and optical response of various plasmonic thin films and individual nanodiscs of various diameters subjected to elevated temperature conditions in the air.

11:30 : Invited talk
Photogalvanics of chiral topological insulator metamaterials
Alexander M. Dubrovkin, Giorgio Adamo, Nikolay I. Zheludev, Cesare Soci
Nanyang Technological University (Singapore)

We report deeply subwavelength nanoimaging of light helicity dependent photocurrents and their local texture in pristine and artificially nanostructured topological insulator crystals. A new, direct probe of the effect of nanostructuring on the local distribution of circular photogalvanic surface currents, helicity dependent photocurrent nanoscopy unlocks the understanding and exploitation of spin-mediated light-matter interactions in in topological insulator metamaterials.

11:50 : Invited talk
Computational implementation of the hyper-Rayleigh scattering optical activity: theory, symmetry considerations and quantum chemistry applications
Andrea Bonvicini, Benoît Champagne
University of Namur (Belgium)

We performed the first computational implementation of the hyper-Rayleigh scattering optical activity (HRS-OA) spectroscopy, a nonlinear chiroptical method theoretically predicted by D. Andrews and T. Thirunamanchandran in 1979. Recent experiments on silver nanohelices and on molecular oligoamide foldamers confirmed this chiroptical phenomenon. Moreover, the measured circular differential scattering ratios make the HRS-OA a promising method for application in chiral discrimination problems due to its high sensitivity compared to other linear chiroptical methods like electronic circular dichroism.

Lunch

12:30 - 14:00

14:00 - 16:00 — Grand Amphi

Session 1A13

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Gary Wiederrecht

14:00 : Keynote talk
Continuous Time Crystals on Opto-Mechanical Platform
Nikolay Zheludev
University of Southampton (UK) and NTU (Singapore)

We overview recent developments in the field of photonic time crystals, a state of matter with broken time-translation symmetry.

14:30 : Keynote talk
Roton-Like Dispersion Relations in Metamaterials
Martin Wegener
Karlsruhe Institute of Technology (KIT) (Germany)

We review our work on mimicking the dispersion relation of rotons in liquid helium in different systems (acoustic, elastic, and electromagnetic waves) and using three different strategies (nonlocal metamaterials, chiral metamaterials, and monomode metamaterials).

15:00 : Invited talk
Strong light matter interaction in plexcitonic crystals
Marzia Ferrera, Jacopo Stefano Pelli Cresi, Vincenzo Aglieri, Elena Ghidorsi, Andrea Toma
Istituto Italiano di Tecnologia (Italy)

Nanohybrid platforms featuring strong light-matter interactions were fabricated and spectroscopically investigated. Both steady-state and ultrafast pump-probe spectroscopies were exploited to investigate the radiative properties of the hybrid systems and to assess the strong-coupling regime achievement.

15:20 : Invited talk
Switch from mono- to multi-mode polariton laser in a GaN ridge waveguide
Christelle Brimont[1], H. Souissi[1], M. Gromovyi[2], T. Gueye[1], L. Doyennette[1], D. D Solnyshkov[3], G. Malpuech[1], E. Cambril[2], S. Bouchoule[2], B. Alloing[4], S. Rennesson[4], F. Semond[4], J. Zuniga-Pérez[4], T. Guillet[1]
[1] Université de Montpellier - L2C (France), [2] Université Paris-Saclay (France), [3] Université Clermont Auvergne (France), [4] CRHEA-CNRS (France)

We report a polariton laser in a GaN ridge waveguide, switching from mono to multi-mode laser operation as temperature is increased. The free spectral range's study between the modes first leads to the unambiguous proof that the polaritons are in strong coupling regime, and above 150K, during the transition to multi-mode

lasing, a flattening of the FSR demonstrates a synchronization of the modes. These results therefore pave the way to the investigation of harmonic mode-locking in polariton waveguide lasers.

15:40 : Invited talk
High performance silicon photonic devices with subwavelength metamaterials
Pavel Cheben[1], Jens H. Schmid[1], Winnie N. Ye[2], Daniel Benedikovic[3], Pablo Ginel-Moreno[4], Shahrzad Khajavi[2], Jose-Manuel Luque-Gonzalez[4], Alejandro F. Hinestrosa[4], Daniel Pereira-Martin[4], Abdel Hadij-ElHouati[4], Radovan Korcek[3], William Fraser[2], Alejandro Sanchez-Postigo[4], Alejandro Ortega-Monux[4], Juan-Gonzalo Wanguemert-Pérez[4], Inigo Molina-Fernandez[4], Robert Halir[4], Daniele Melati[5], Carlos Alonso-Ramos[5], David Gonzalez-Andrade[5], Laurent Vivien[5], Jianhao Zhang[1], Maziyar Milanizadeh[1], Dan-Xia Xu[1], Yuri Grinberg[1], Siegfried Janz[1], Ross Cheriton[1], Shurui Wang[1], Martin Vachon[1], Milan Dado[3], Raquel Fernandez de Cabo[6], Aitor V. Velasco[6]
[1] *National Research Council Canada (Canada),* [2] *Carleton University (Canada),* [3] *University of Zilina (Slovakia),* [4] *University of Malaga (Spain),* [5] *Universite Paris-Saclay (France),* [6] *CSIC (Spain)*

Incorporating subwavelength grating metamaterials in nanophotonic waveguides has opened new degrees of freedom to control light propagation on a photonic chip. In this invited contribution, we will present our recent advances in development of subwavelength-engineered metamaterial devices for silicon photonics.

14:00 - 16:10 — Amphi Bezier

Session 1A14

Recent Advances in Non-Hermitian Photonics: Topological, Disordered and Quantum Systems

Organized by: Konstantinos Makris and Li Ge

Chaired by: Mercedeh Khajavikhan

14:00 : Invited talk
Models and other phenomena in photonic Chern insulator systems
Mark Ablowitz, Justin Cole, Sean Nixon
University of Colorado (USA)

Methods for deriving discrete models of Chern insulators in photonic lattices will be discussed. In particular, honeycomb lattices in Floquet longitudinally driven and magneto-optical systems are found to described by similar asymptotic models, namely the Haldane model. The second half of the talk will focus on some recent results. Spiral wave solutions and how to generate them will be discussed. In addition, a phase-induced switching effect along interface boundaries will be discussed.

14:20 : Invited talk
Observation-dependent enhancement and suppression of two-photon coincidences by tailored losses
Max Ehrhardt, Matthias Heinrich, Alexander Szameit
University of Rostock (Germany)

We investigate the Hong-Ou-Mandel interference of photon pairs in birefringent waveguides with polarization-dependent losses. Depending on the detection basis, we show seamless tunability all the way from enhancement to full suppression of indistinguishable photons.

14:40 : Invited talk
Enhanced avionic sensing based on Wigner's cusp anomalies
Rodion Kononchuk[1], Joshua Feinberg[2], Joseph Knee[1], Tsampikos Kottos[1]
[1] *Wesleyan University (USA),* [2] *The University of Haifa (Israel)*

Sensors typically detect small perturbations by measuring their effects on a physical observable in the linear response regime. Once linear response is abandoned, new opportunities emerge. Here we propose an alternative sublinear optomechanical sensing scheme that is rooted in Wigner's cusp anomalies (WCA): a

frequency-dependent square-root singularity of the differential scattering cross section around the energy threshold of a newly openened channel. Our WCA platforms are compact, do not require judicious arrangement of active elements, and can be cavity free

15:00 : Keynote talk
Photonic Time-Crystals
Moti Segev
Technion (Israel)

Time-Crystals (PTCs) are materials in which the refractive index varies periodically and abruptly in time. They conserve momentum but not energy, and display momentum bands separated by gaps. The fundamentals of PTCs will be presented, with an emphasis on light-matter interactions ranging from light emission by atoms and free electrons to superluminal k-gap solitons and recent experiments.

15:30 : Invited talk
Non-Hermitian microresonators at an Exceptional Point
Riccardo Franchi, Stefano Biasi, Lorenzo Pavesi
University of Trento (Italy)

In this work, we present a new integrated structure operating at an exceptional point consisting of an infinity-shaped microresonator twice coupled to a bus waveguide. Its improved sensing performance is reported as well as its high variability of output spectra. Finally, an experimental method for individually exciting supermodes of resonant Hermitian and non-Hermitian structures is presented.

15:50 : Invited talk
A Hermitian Bypass to the non-Hermitian Quantum Theory
Tanmoy Das
Indian Institute of Science (India)

The non-Hermitian (NH) quantum theory suffers from various ill-defined properties and singularities. Here we construct a unified approach, applicable to all NH operators, by constructing a Hilbert space of a suitably designed Hermitian operator and expanding the NH Hilbert space on this basis. This way, the singularities are transported to the expansion parameters while the basis states remain well-defined. We developed a well-defined time-independent quantum theory of the generic NH Hamiltonians and exhibited several representative examples and applications.

14:00 - 15:30 — Amphi Fournel

Session 1A15

Symposium V: Phononics and Acoustic Metamaterials

Organized by: Jensen Li, Jean-Philippe Groby, Marco Miniaci, Vicente Romero-García, Vincent Pagneux and Noé Jiménez

Chaired by: Jean-Philippe Groby

14:00 : Invited talk
A pathway to lossless non-reciprocal scattering based on synchronization
Nicolas Noiray
ETH Zurich (Switzerland)

Non-reciprocal transmission of information across large periodic networks of resonators is often hindered by their intrinsic dissipation. As a remedy to these irreversible losses, we propose to equip the resonators of these metamaterials with negative resistance elements and with suitable damping nonlinearities, such that they exhibit self-sustained oscillations. Lossless or amplified non-reciprocal scattering at each of these resonators can then be achieved, thanks to the synchronization between the natural radiation of the self-oscillating mode and the incident waves.

14:20 : Invited talk
Meso-scale analysis of non-periodic and periodic discrete flexural waveguides
Michael Nieves[1], **Alexander Movchan**[2]
[1] *Keele University (United Kingdom),* [2] *University of Liverpool (United Kingdom)*

The dynamic behavior of asymmetric flexural systems, involving a master beam attached to a non-periodic collection of flexural resonators, is discussed. The resonators couple longitudinal and flexural responses of the master beam. Its response is described via Green's functions, with intensities determined from an algebraic system embedding interactions of individual resonators. For infinite periodic waveguides, we derive an effective model called the generalized Rayleigh beam that supports flexural-longitudinal wave coupling and is efficient in regimes not typically encountered in homogenisation.

14:40 : Exceptional points and skin modes in non-Hermitian elastic phononic beams
Yabin Jin[1], **Runcheng Cai**[1], **Wenxin Zhong**[1], **Timon Rabczuk**[2], **Xiaoying Zhuang**[1], **Yan Pennec**[3], **Bahram Djafari Rouhani**[3]
[1] *Tongji University (China),* [2] *Bauhaus-Universitat Weimar (Germany),* [3] *Université de Lille (France)*

Exceptional points and skin effect are two hallmarks of non-Hermitian systems combining gain and loss. We demonstrate these phenomena for flexural waves in phononic beams based on applied forces with feedback control. The non-Hermiticity is realized either by means of applying piezoelectric patches on top of the beam or by using a periodic beam made of piezoelectric materials operating as sensor and actuator. We highlight the applications of exceptional points for enhanced sensitivity and of skin modes for energy harvesting.

14:55 : Long-time dynamics of one-dimensional topological lattice models
Bertin Many Manda, Georgios Theocharis
Le Mans Université (France)

We consider a Su-Schrieffer-Heeger chain of oscillators. In the periodic and nonlinear regimes, we show that the dynamics of unstable nonlinear topological edge states leads to the thermalization of the entire lattice due mode interactions and chaos. Furthermore in the linear and disordered limit, the long-time dynamics of localized wave-packets is able to characterize the transition between two different topological phases. The latter feature is lost in the presence of nonlinearity once again due to mode interactions and chaos.

15:10 : Invited talk
Backscattering reduction in a twisted water wave channel
Samantha Kucher[1], **Adrian Kozluk**[2], **Philippe Petitjeans**[1], **Agnes Maurel**[3], **Vincent Pagneux**[4]
[1] *Université Paris Cité (France),* [2] *Warsaw University of Technology (Poland),* [3] *ESPCI-PSL (France),* [4] *L'Université du Maine (France)*

We study experimentally and numerically how to reduce the backscattering of water waves in a channel with multiple turns. We show that it is possible to achieve enhanced transmission in such geometries, in agreement with a recent theoretical prediction. In order to avoid the reflection that naturally arises at each turn of the waveguide, we used an anisotropic metamaterial made of closely-spaced thin vertical plates.

14:00 - 16:15 — Amphi Esquillan

Session 1A16

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Davy Gérard and Pedro Hernandez Martinez

14:00 : Invited talk
In situ and real-time studies of ultrathin silver films grown by physical vapor deposition: The role of nitrogen additive
David Babonneau[1], **Gregory Abadias**[1], **Karan Solanki**[1], **Anny Michel**[1], **Julien Ramade**[1], **Sophie Camelio**[1],

Andrea Resta[2], Alina Vlad[2], Alessandro Coati[2], Yves Garreau[2], Kostas Sarakinos[3], Michal Kaminski[4], Bärbel Krause[4]
[1] *Université de Poitiers (France),* [2] *Synchrotron SOLEIL (France),* [3] *University of Helsinki (Finland),* [4] *Karlsruher Institut für Technologie (Germany)*

In this talk, we discuss growth strategies to produce transparent and conductive silver layers by physical vapor deposition in the presence of nitrogen additive. We use a combination of in situ and real-time diagnostics (substrate curvature measurements, surface differential reflectance spectroscopy, grazing incidence x-ray diffraction, and grazing incidence small-angle x-ray scattering) during deposition, which provides valuable insights into the effects of nitrogen additive on the early-film-formation stages and related optical properties.

14:20 : Invited talk
Characterization and bio-applicability of inexpensive plasmonic nanoparticles and complex-shaped nanocrystals
Veronica Bahamondes Lorca[1], Oscar Avalos-Ovando[1], Christoph Sikeler[2], Liedl Tim[2], Dongling Ma[3], Andrei Kabashin[4], Shiyong Wu[1], Martin Kordesch[1], Alexander Govorov[1]
[1] *Ohio University (USA),* [2] *Ludwig-Maximilians-Universität (Germany),* [3] *Institut National de la Recherche Scientifique (INRS) (Canada),* [4] *Aix-Marseille University (France)*

With the recent developments in biomedical sciences, we have witnessed the impact and application of nanoparticles (NPs) in bio-diagnostics. Since gold-NPs play an important role, our concern about the availability of gold natural resources and prices, made us analyze options to replace gold-NPs usage. Here, we will show the characterization and applicability of novel, affordable, and abundant plasmonic NPs that could be used in this field as an alternative to gold-NPs. Our results concern technologies for preparing NPs and bio-conjugation.

14:40 : Invited talk
Measuring the Ultrafast Dynamic of Nanoparticle Temperature on the fs-to-ps Time Scale
Francesco Bisio[1], Marzia Ferrera[2], Maria Sygletou[2], Michele Magnozzi[2], Daniele Catone[3], Patrick O'Keeffe[3], Alessandra Paladini[3], Francesco Toschi[3], Stefania Benedetti[4], Gian Marco Pierantozzi[5], Riccardo Cucini[5], Alessandro di Bona[4], Piero Torelli[5], Giuseppe Della Valle[6], Giancarlo Panaccione[5], Maurizio Canepa[2]
[1] *CNR-SPIN (Italy),* [2] *Università di Genova (Italy),* [3] *CNR-ISM (Italy),* [4] *CNR-NANO (Italy),* [5] *CNR-IOM (Italy),* [6] *Politecnico di Milano (Italy)*

The impulsive photoexcitation of nanoparticles kicks off the time-dependent re-equilibration of the electron gas, ion lattice, and environment. For better understanding and harnessing these processes, for thermoplasmonics or photocatalysis applications, it is paramount to know the dynamic, time-dependent evolution of the temperature of each system subcomponents. We report two different methods to directly deduce the temporal evolution of the electronic and lattice temperature of plasmonic Au nanoparticles excited by ultrashort laser pulses on the fs-ps time scale.

15:00 : Invited talk
Single photon nanophotonics using hybrid plasmonics
Aurélie Broussier, Régis Deturche, Safi Jradi, Sylvain Blaize, Renaud Bachelot, Christophe Couteau
Université de Technologie de Troyes (France)

The need for photon and electron transport is necessary for quantum information, although very difficult in practice due to the different scales involved. In this work, we propose two different approaches to tackle this problem. The first consists of a hybrid plasmonic nanosystem comprising two types of nanosources placed strategically on a nanowire electromagnetic waveguide. The second is based on the integration of a single photon source, with a photonic structure consisting of optical waveguide used in photonics integrated circuits.

15:20 : Invited talk
Controlling Heat Anisotropy at the nanoscale inside cross arrays
Jean-François Bryche[1], Marlo Vega[1], Julien Moreau[2], Paul-Ludovic Karsenti[1], Mondher Besbes[2], Philippe Gogol[1], Denis Morris[1], Paul G Charette[1], Michael Canva[1]
[1] *Université de Sherbrooke (Canada),* [2] *Université Paris-Saclay (France)*

In this work, we investigate the photothermal heating of asymmetric nano-crosses by ultrashort light pulses. We show experimentally and numerically that non-thermal energy density and temperature inside the two arms of the crosses can be controlled with the polarization of the pump pulse. We also demonstrate the importance of considering non-thermal electron ballistic displacement to reproduce the measured experimental

data.

15:40 : Invited talk
Chiral Generation of Hot Carriers Towards Enantioselective Plasmonic Photocatalysis
Miguel Comesana-Hermo
Université Paris Cité (France)

We present the synthesis of inorganic assemblies composed by the adsorption of Au nanoparticles onto chiral silica nanostructures in order to study the features of non-thermalized charge carriers obtained under circularly polarized radiation. We demonstrate that such materials can be implemented as photocatalytic platforms in polarization-dependent chemical reactions.

16:00 : Photoluminescence from Ultrathin Monocrystalline Gold Flakes
Alan Bowman[1], Fatemeh Kiani[1], Alvaro Rodriguez Echarri[2], Ted Tsoulos[1], Joel Cox[3], Javier Garcia de Abajo[2], Giulia Tagliabue[1]
[1] *EPFL (Switzerland),* [2] *ICFO (Spain),* [3] *University of Southern Denmark (Denmark)*

Photon emission from gold has recently received increased attention, particularly in the context of nanoplasmonics. However, this signal's origin remains unclear. Here we study photoluminescence from ultrathin monocrystalline gold flakes, allowing us to decouple nanoscale from plasmonic effects. We explain our measurements through first-principles theory accounting for electronic and optical properties of the gold films. Our results resolve a fundamental scientific debate and provide insight for the exploitation of photoluminescence as a probe of light-matter interactions in metals.

14:00 - 16:00 — Amphi A

Session 1A17

Advanced Computational Electromagnetics for the Analysis and Design of Nanophotonic Devices

Organized by: Maha Ben Rhouma and Kofi Edee

Chaired by: Brahim Guizal

14:00 : Invited talk
Modeling and Applications of Nonlocal Asymmetric Metasurfaces
Karim Achouri, Sergejs boroviks, Olivier Martin
EPFL (Switzerland)

The concept of nonlocal metasurfaces has recently emerged to overcome the limitations of local metasurfaces in terms of efficiency and diversify their functionalities. To better exploit the potential of nonlocal metasurfaces, we have developed a general modeling framework that includes nonlocal interactions. Based on this model, we show the connection between nonlocality and the metasurface spatial symmetries. Finally, we provide several examples highlighting the advantages and related applications of nonlocal metasurfaces.

14:20 : Invited talk
Effect of top metallic contacts on radiation transfer and conversion efficiency for near-field thermophotovoltaics
Kevin Austry[1], Youssef Jeyar[1], Minggang Luo[1], Brahim Guizal[1], Riccardo Messina[2], Rodolphe Vaillon[1], Mauro Antezza[1]
[1] *Université de Montpellier (France),* [2] *Université Paris-Saclay (France)*

Design of the metallic contact grid at the front side of thermophotovoltaic cells is critical. Our study, based on a rigorous approach, investigates the real influence of the front metal contact grid. By modelling this grid by a metallic grating, we show that it can significantly affect the electrical power generated by the cell. Quantitative and qualitative analyses indicate behaviors which are quite different from those predicted by previous simplistic approaches.

14:40 : Invited talk
Enhanced and Tunable Kerr effect on InSb/graphene hybrid magnetoplasmonic structure at Terahertz waves
Maha Ben Rhouma, K. Edee, B. Guizal
Université Gustave Eiffel (France)

In this work, we propose a novel hybrid magneto plasmonic structure based on graphene and doped InSbto enhance the magneto optical Kerr effect at terahertz frequencies.The structure is composed of a 1D periodic dopedInSb inlayed between a metallic backgate and a dielectric/doped graphene sheet .By computing the optical responseof this structure, w e show an enhanced and large Kerr rotation in a wide range of THz frequencies compared to thatinduced by a single graphene sheet and/or a doped magnetized InSb

15:00 : Invited talk
Green's tensor inverse design of light-matter interactions
Robert Bennett
University of Glasgow (United Kingdom)

Effective designs for photonic elements are usually found through a combination of intuition, symmetry and previous experience. By contrast, inverse design allows (locally) optimal geometries to be algorithmically discovered. In this talk I will outline a very general approach towards inverse design that concerns itself only with the electromagnetic dyadic Green's tensor of a particular scattering geometry. This method allows inverse design techniques to be applied to a whole family of surface-dependent light-matter interactions in a unified and consistent way.

15:20 : Invited talk
Inverse design of dispersive optical nanostructures and tunable metasurfaces
Antonio Cala' Lesina
Leibniz University Hannover (Germany)

Inverse design techniques hold the promise to uncover free-form nanophotonic structures in 3D with shapes beyond human intuition and novel optical functionalities. This talk focuses on our recent work on large-scale topology optimization of dispersive materials, anapole states in plasmonic nanostructures for transparent metasurfaces and metamaterials, and inverse design of tunable metasurfaces while accounting for the tuning mechanism.

15:40 : Invited talk
Deep Learning and Optimization for Efficient and Robust Nanophotonic Design
Sawyer Campbell, Ronald Jenkins, Pingjuan Werner, Douglas Werner
The Pennsylvania State University (USA)

Nanophotonic device design requires efficient full-wave solvers and optimization techniques. To this end, deep learning shows promise for improving both forward- and inverse-design aspects of such problems. Meanwhile, multiobjective and topology optimization approaches have proven successful in realizing highly performant freeform nanophotonic devices with tailored functionalities. Combining deep learning with advanced optimization techniques gives designers beyond state-of-the-art tools for realizing extremely efficient nanophotonic device design cycles.

14:00 - 16:00 — Amphi Pinel

Session 1A18

Metasurfaces for Nonlinear and Ultrafast Nanophotonics

Organized by: Giulio Nicola Felice Cerullo and Giuseppe Della Valle

Chaired by: Mohsen Rahmani

14:00 : Invited talk
Two-Dimensional Electronic Spectroscopy of Strong Exciton-Surface Plasmon Polariton Coupling

Christoph Lienau
Uni Oldenburg (Germany)

Strong exciton-plasmon-couplings are investigated using two-dimensional electronic spectroscopy, revealing Rabi oscillations of polariton cross-peaks and accessing two-quantum excitations. Coherent population oscillations between excitons that are strongly and weakly coupled to the plasmonic field are demonstrated.

14:20 : Invited talk

Generation of quantum entanglement from a nonlinear metasurface and its application in quantum imaging

Jinyong Ma[1], Jihua Zhang[1], Marcus Cai[1], Rocio Camacho Morales[1], Xu Lei[2], Jinliang Ren[1], Yuxin Jiang[1], Tongmiao Fan[1], Matthew Parry[1], Dragomir Neshev[1], Andrey Sukhorukov[1]
[1] *The Australian National University (Australia),* [2] *Nottingham Trent University (United Kingdom)*

We demonstrate experimentally that a strongly enhanced generation of spatially entangled photon pairs can be achieved from metasurfaces supporting nonlocal double resonances at the signal and idler wavelengths, and reveal that multiplexed metagratings featuring different orientations allow the engineering of bi-photon polarization states and optically controllable generation of arbitrary polarization qutrits. Furthermore, leveraging the exceptional capabilities of the metasurface, we present a combined quantum ghost and scanning imaging protocol allowing 2D imaging with a 1D detector array.

14:40 : Invited talk

Combining plasmonic nanostructures and diamond for emission of electrons using visible light.

Patrick O'Keeffe[1], Giuseppe Ammirati[1], Alessandro Bellucci[1], Valerio Campanari[1], Daniele Catone[1], Faustino Martelli[2], Matteo Mastellone[1], Silvia Orlanducci[1], Riccardo Polini[1], Francesco Toschi[1], Daniele Trucchi[1], Stefano Turchini[1], Veronica Valentini[1]
[1] *Istituto di Struttura della Materia-CNR (Italy),* [2] *CNR-IMM (Italy)*

The aim of this work is to exploit the negative electron affinity of the surface of hydrogenated diamond combined with the excitation of conduction band electrons to induce emission of electrons following the interaction with visible light. Diamond is a very wide band gap semiconductor and therefore interacts weakly with visible light. However, we show that by combining plasmonic nanoparticles with diamond it is possible to excite electrons into the conduction band of the diamond through a multistep process involving at least two visible light photons.

15:00 : Invited talk

Broadband control of topological-spectral correlations in space-time beams

Marco Piccardo[1], Michael De Oliveira[2], Veronica Policht[3], Mattia Russo[3], Benedetto Ardini[3], Matteo Corti[3], Gianluca Valentini[3], Jorge Vieira[4], Cristian Manzoni[5], Giulio Cerullo[3], Antonio Ambrosio[2]
[1] *Harvard University (USA),* [2] *Fondazione Istituto Italiano di Tecnologia (Italy),* [3] *Politecnico di Milano (Italy),* [4] *Universidade de Lisboa (Portugal),* [5] *Consiglio Nazionale delle Ricerche (Italy)*

We introduce shaping and characterization methods for femtosecond space-time beams with broadband correlations between their topological charges (up to L=80) and spectral frequencies (covering nearly 50 % of the visible spectrum).

15:20 : Invited talk

Stimulated Emission Tomography of Spontaneous Four Wave Mixing from a Metasurface

John Yang, Paul Dichtl, Jefferson Florez, Nathan Gemmel, Sylvain Gennaro, Xiaofei Xiao, Chris Phillips, Alex Clark, Rupert Oulton
Imperial College London (United Kingdom)

We apply stimulated emission tomography (SET) to assess the ability of individual nanoantennas and their metasurface arrays to generate correlated photon pairs via spontaneous four-wave mixing (SFWM). Following the SET framework, we characterize SFWM by studying four-wave mixing (FWM), producing maps of joint spectral density (JSD) to characterize the bi-photon state. Although a much weaker process than parametric down conversion, SFWM from metasurfaces produces similar photon production rates, and brings the advantage of wider choice of nonlinear materials.

15:40 : Invited talk

Ultrafast nanophotonics of subwavelength semiconductor resonators beyond the perturbative regime

Anton Rudenko[1], Anastasiia Zalogina[2], Jerome Moloney[1], Yuri Kivshar[2], Sergey Kruk[2]

[1] *The University of Arizona (USA),* [2] *Australian National University (Australia)*

Subwavelength resonators can enhance nonlinear optical response of laser-excited semiconductors by several orders of magnitude, provide ideal conditions for accessing and exploring qualitatively new physics beyond the perturbative regime, and serve as nanoscale sources for nonlinear frequency conversion. Nonperturbative generation of higher harmonics can be observed in a single subwavelength resonator supporting bound states in the continuum excited by an ultrashort mid-infrared laser beam. Our experimental observations are supported by numerical simulations based on nonperturbative model for electronic excitation.

14:00 - 16:00 — Amphi Manet

Session 1A19

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

14:00 : Invited talk

Identifying topology directly from Maxwell's equations: Band structures and Bloch eigenstates not required

Alexander Cerjan[1], **Terry Loring**[2]
[1] *Sandia National Laboratories (USA),* [2] *University of New Mexico (USA)*

We develop the mathematical framework for determining a photonic structure's topology directly from its real-space description (i.e., Maxwell's equations), without the need to calculate its band structure or Bloch eigenstates. We illustrate the generality of this approach in three different systems, a standard 2D photonic crystal topological insulator, a novel class of gapless topological photonic crystals, and photonic topological crystalline insulators.

14:20 : Invited talk

Observation of bulk chiral anomaly in photonic crystal systems

Hongwei Jia, Mudi Wang, Che Ting Chan
Hong Kong University of Science and Technology (Hong Kong)

We show that chiral anomaly can be induced in the bulk of 2D photonic crystal systems using the inhomogeneous effective mass or by imposing special boundary conditions. We experimentally characterized the associated transport properties.

14:40 : Invited talk

Creating, Reading, and Switching Skyrmions in a Magnetic Tunnel Junction

Shaohai Chen
*A*STAR (Singapore)*

Magnetic skyrmions - nanometre-scale topological spin textures - are promising active elements for scalable, energy-efficient bio-inspired and unconventional computing electronic devices. A key technological roadblock to unleashing their potential is achieving deterministic electrical readout and manipulation. Here we present wafer-scale realization of a nanoscale skyrmionic magnetic tunnel junction (SK-MTJ) shown to host a single skyrmion in addition to uniform states, and systemically investigate its electrical and magnetic properties.

15:00 : Invited talk

Nonreciprocal charge transport and phase transitions in noncentrosymmetric superconductors

Akito Daido, Youichi Yanase
Kyoto University (Japan)

Nonreciprocal phenomena are attracting attention as the novel functionality and probes of noncentrosymmetric materials. In this talk, we discuss nonreciprocal charge transport and phase transitions in noncentrosymmetric superconductors under magnetic fields. We reveal the close connection of nonreciprocal phenomena

and finite-momentum superconductivity. The obtained results show that nonreciprocal charge transport offers a versatile probe of the finite-momentum superconductivity.

15:20 : Invited talk
Magnetoelectric fields for chirality discrimination
Eugene Kamenetskii
Ben Gurion University of the Negev (Israel)

Chirality is fundamentally related to a magnetoelectric response. But the magnetoelectric response is characterized by the violation of both spatial and temporal symmetry. It is claimed that time-even pseudoscalar optical chirality gives enantioselective fields. Are only time-even pseudoscalars required to describe local properties of chiral light-matter interactions? We argue that near fields with both spatial and temporal symmetry breaking, called magnetoelectric near fields, are true enantioselective fields for describing local properties of chiral light-matter interactions.

15:40 : Invited talk
Dynamic magnetoelectric effects at dielectric/ferromagnetic metal interface: generation of spin currents and modulation of spin wave amplitude
Piotr Graczyk[1], **Maciej Krawczyk**[2]
[1] *Polish Academy of Sciences (Poland),* [2] *Adam Mickiewicz University (Poland)*

We present the operation of the device which non-resonantly modulates the spin-wave amplitude by the ac electric field. The spin accumulation is generated by the charge-mediated magnetoelectric effect at the dielectric/ferromagnetic metal interface and interacts with magnetization through the spin transfer torque. We show the criteria for the effective amplification and dependences of the obtained gain on the applied voltage amplitude and spin-wave frequency.

14:00 - 16:00 — Salle des Conseils

Session 1A20

Resonant Optics – Fundamentals and Applications

Organized by: Sven Burger, Philippe Lalanne and Frank Vollmer

Chaired by: Sven Burger and Frank Vollmer

14:00 : Invited talk
Resonant Photonic Galleries of Dielectric Particles
N. S. Solodovchenko, M. E. Bochkarev, K. B. Samusev, Mikhail Limonov
ITMO University (Russia)

An original picture of photonic resonances in single dielectric particles (cylinder, ring, split ring, cuboid) is presented. The basic result is the separation of low-frequency scattering spectra into short galleries that start with a broad Fabry-Perot band and continue with narrow longitudinal modes. The existence of individual resonant galleries leads to the appearance of entire galleries of bound states in the continuum, in contrast to the repeatedly observed single bound states, and also to the appearance of exceptional points.

14:20 : Invited talk
Resonantly confining light in air: The dielectric Mie voids
Masoud Hamidi[1], **Kirill Koshelev**[2], **Mario Hentschel**[3], **Adrià Canós-Valéro**[1], **Yuri Kivshar**[2], **Harald Giessen**[3], **Thomas Weiss**[1]
[1] *University of Graz (Austria),* [2] *Australian National University (Australia),* [3] *University of Stuttgart (Germany)*

Manipulating light at the nanoscale has become a central challenge in photonic metastructures, resonant metasurfaces, nanoscale optical sensors, and many more, and it is largely based on resonant light confinement in dispersive and lossy metals and dielectrics. We present the theoretical framework for resonantly confining light in air surrounded by high-index dielectrics and compare it with experiments. This confinement works down to the ultraviolet and can be understood to some extent via a generalization of the Babinet's principle to

dielectrics.

14:40 : Invited talk
Quasi-Normal Mode Expansion in Unbounded Photonic structures: Perfectly Matched Layers (PML) vs. Bayliss-Turkel (BT) Absorbing Boundary Condition
Guillaume Demésy, André Nicolet, Frédéric Zolla
Aix Marseille Université (France)

This paper compares truncation methods, i.e. Perfectly Matched Layers (PML) vs. Bayliss-Turkel (BT) Absorbing Boundary Condition (ABC), of unbounded domains for their performance in the quasi-normal mode expansions involving a continuous spectrum.

15:00 : Invited talk
Computing partial derivatives of quasinormal modes
Felix Binkowski[1], Fridtjof Betz[1], Martin Hammerschmidt[2], Philipp-Immanuel Schneider[2], Lin Zschiedrich[2], Sven Burger[1]
[1] *Zuse Institute Berlin (Germany),* [2] *JCMwave GmbH (Germany)*

We present an approach to compute partial derivatives of eigenfrequencies corresponding to quasinormal modes using Riesz projections. The approach is based on contour integration with direct differentiation enabling an efficient numerical realization.

15:20 : Invited talk
Exploiting and Engineering non-Hermiticity in Photonics
Massimo Gurioli, Nicoletta Granchi, Francesca Intonti
University of Florence (Italy)

The non-Hermiticity is an unavoidable feature of any photonics system based on sound models and experiments. It has been used for mapping and optimizing the Q factor of photonic modes. Here we discuss its exploitation for engineering three effects: i) exciton light traps via radiative Lamb shift, ii) Purcell effect beyond the dipole approximation and iii) shaping the Fano LDOS via engineering the cavity losses.

15:40 : Invited talk
Quasi-normal mode expansions of resonant scattering responses
Jörn Zimmerling[1], Rob Remis[2]
[1] *Uppsala University (Sweden),* [2] *Delft University of Technology (The Netherlands)*

Electromagnetic field interactions with photonic resonators can be efficiently modeled using Quasi Normal Mode (QNM) expansions, especially near a resonator, where low-order expansions are often sufficient. However, we are often interested in the electromagnetic field far away from a resonator. Since QNMs diverge with increasing distance from the resonator, a straightforward QNM expansion of the field is not possible. Here, we propose a formulation that allows for field evaluations at arbitrary distances, using only QNM expansions inside a resonator.

14:00 - 15:00 — Salle Guy Gautherin

Session 1A21

DNA Nanotechnologies for Photonics and Sensing

Organized by: Guillermo Acuna and Denis Garoli

Chaired by: Guillermo Acuna

14:00 : Invited talk
DNA origami assembled nanoantennas for manipulating single-molecule spectral emission
Maria Sanz-Paz[1], Fangjia Zhu[1], Nicolas Bruder[1], Karol Kolataj[1], Mauricio Pilo-Pais[1], Antonio Fernandez-Dominguez[2], Guillermo Acuna[1]
[1] *University of Fribourg (Switzerland),* [2] *Universidad Autónoma de Madrid (Spain)*

Optical antennas have been widely used for manipulating single-molecule emission properties, including intensity and decay rates, and thus for affecting lifetime, polarization, spectrum, or directivity. Here, we make use of DNA origami as a breadboard to precisely position a single emitter in the vicinity of a single gold nanorod and study their interaction with high accuracy. We show, that we can affect the spectrum of a single fluorophore depending on its relative position and spectral overlap with the gold nanorod.

14:20 : Invited talk
Colloidal Silicon Nanospheres as Building Blocks for Photonic Applications
Hiroshi Sugimoto
Kobe University (Japan)

Low-loss optical nanoantennas made of high index dielectrics have attracted attention as an alternative to plasmonic antennas that often suffer from losses of noble metals. Here, we develop Mie resonant crystalline Si nanospheres with 100-300 nm in diameter dispersible in solution. Monodisperse colloidal Mie resonators exhibit vivid colors and also act as colloidal metamaterials. In addition, colloidal dispersions of Si nanospheres enable the formation of functional nanoantennas for enhanced light matter interactions using printing and self-assembly technologies.

14:40 : Invited talk
Probing fast dynamics of single DNA molecules in real-time using plasmon-enhanced fluorescence
S. Nooteboom, K. Okholm, V. Lamberti, B. Oomen, S. Dey, D. Sutherland, Peter Zijlstra
Eindhoven University of Technology (The Netherlands)

Plasmon-enhanced fluorescence provides an attractive avenue toward single-molecule studies, providing high sensitivity and superior signal-to-noise ratio. I will describe our recent efforts in this field, focusing on the use of plasmon-enhanced fluorescence to reveal single-molecule DNA dynamics on microsecond timescales and in real-time.

15:00 - 16:00 — Salle Guy Gautherin

Session 1A22

Plasmonics and Nano-Optics

Chaired by: Angela Demetriadou

15:00 : Luminescence of molecular polaritons in a microcavity: non-Markovian Fano resonances, motional narrowing, and nonlinearity associated with vibronic coupling
Boris Fainberg, Vladimir Osipov
Holon Institute of Technology (Israel)

We develop a non-Markovian theory of polariton luminescence taking molecular vibrations into account. In the single-mode microcavity, our theory predicts the Fano resonances in the polariton luminescence, motional narrowing and explains experimental observations of the molecular Stokes shift in polariton fluorescence spectra in systems with strong light-matter coupling. Using the multiconfiguration Hartree approach we also derive nonlinear equations of motion for the polariton wavefunction, where vibration degrees of freedom interact with the polariton quantum field through the mean-field Hartree term.

15:15 : Enhancing Optical Chirality Detection through Collective CD Resonance
Ji-Hyeok Huh[1], Ryeong Myeong Kim[2], SeokJae Yoo[3], Tae Gyun Kim[2], Changwon Kim[2], Hyeohn Kim[2], Jeong Hyun Han[2], Nam Heon Cho[2], Yae-Chan Lim[2], Sang Won Im[2], EunJi Im[1], Jae Ryeol Jeong[4], Min Hyung Lee[4], Tae-Young Yoon[2], Ho-Young Lee[2], Q-Han Park[1], Ki Tae Nam[2], Seungwoo Lee[1]
[1]Korea University (Korea), [2]Seoul National University (Korea), [3]Inha University (Korea), [4]Kyung Hee University (Korea)

Chirality discrimination plays a critical role in various scientific disciplines such as biology, chemistry, and pharmaceuticals. We propose a novel theoretical concept of collective CD resonances (CRs), which exhibit much stronger optical chiral hotspots over a broad region compared to conventional methods. As a result, we have successfully demonstrated the in situ determination of molecular chirality at the picomole level, with

ultra-high sensitivity.

15:30 : Design of Subwavelength Confinement Waveguides at 1 THz Band
Mesut Demircioglu, Muhammed Abdullah Unutmaz, Mehmet Unlu
TOBB University of Economics and Technology (Turkey)

In this paper, we present the design and simulation results of the Terahertz Subwavelength Confinement Waveguides (TSCW) operating at 1 THz. The design of the TSCWs includes CPW-to-TSCW transition circuits and the Spoof Surface Plasmon Polariton (SSPP)-based waveguides. The best-case simulation results exhibit return loss and insertion loss of -13.86 dB and -1.72 dB for the back-to-back (b-to-b) transition circuit and -26.5 dB and -4.66 dB for the TSCW with a total length of 267 μm at 1 THz, respectively.

15:45 : Coherent coupling between the individual and collective excitations by radiative fields in nanoscale materials
Tomohiro Yokoyama[1], Masayuki Iio[2], Takeshi Inaoka[3], Hajime Ishihara[1]
[1] *Osaka University (Japan),* [2] *Osaka Prefecture University (Japan),* [3] *University of the Ryukyus (Japan)*

Plasmon is a collective excitation by the longitudinal electron-electron interaction. The plasmon excitation radiates the transverse field. In this study, we formulate a microscopic self-consistent theory for the nonlocal electronic response and the Maxwell fields. The collective (plasmon) and individual (electron-hole pair) excitations are coupled coherently with each other by the longitudinal and transverse fields in nanostructures. This coherence means a bidirectional energy transfer between their excitations, which would provide an efficient hot carrier generation.

14:00 - 16:00 — Salle P1

Session 1A23

Coherent Control of Absorption in Structured Materials

Organized by: Simone Zanotto and Simon Horsley

Chaired by: Simone Zanotto and Simon Horsley

14:00 : Invited talk
High-Fidelity Reprogrammable Signal Processors Built Off the Anti-Laser
Philipp del Hougne
Université de Rennes (France)

Achieving high-fidelity reflectionless (as opposed to merely low-reflection) excitation of complex scattering structures at specific frequencies is notoriously difficult, in particular if the frequency of operation is supposed to be reconfigured during runtime. We demonstrate that the combination of (i) overmoded systems with (ii) a massive amount of tunable degrees of freedom (provided by a programmable metasurface) enables high-fidelity reprogrammable reflectionless excitation of complex structures. Building on this technique, we demonstrate reprogrammable analog signal differentiation and reflectionless signal routing.

14:20 : Invited talk
Non-Hermitian Wavefront shaping and Optical Limiting
Tsampikos Kottos
Wesleyan University (USA)

The underlying mathematical structures of non-Hermitian wave physics have inspired several recent applications. Among them are wavefront shaping protocols for efficient energy deposition at lossy targets and optical limiters based on lossy non-linear defects. An example of the first category is the coherent perfect absorption while the second is the exceptional-point based photonic limiter. We shall explain the intimate connection between these two seemingly different concepts and present our experimental results that highlight the underlying mechanisms.

14:40 : Invited talk

Quantum and thermal aspects of coherent perfect absorption

Inigo Liberal
Public University of Navarre (Spain)

Coherent perfect absorption (CPA) is an interference phenomena that allows for linear photon-photon interactions, an abstract concept that can be implemented in multiple technological platforms including metasurfaces, photonic integrated circuits and plasmonics. In our talk, we will discuss quantum and thermal aspects of CPA including quantum states transformations, noise-management and the design of optical amplifiers with a reduced noise factor, as well as the practical implementation of those concepts within an integrated photonics setup.

15:00 : Invited talk

A Massively Degenerate Coherent Perfect Absorber

Yevgeny Slobodkin[1], Gil Weinberg[1], Helmut Hoerner[2], Kevin Pichler[2], Stefan Rotter[2], Ori Katz[1]
[1] *The Hebrew University of Jerusalem (Israel),* [2] *TU Wien (Austria)*

In the field of non-Hermitian photonics it is a well-established concept that a time-reversed laser acts as a 'coherent perfect absorber' (CPA). However, CPAs are usually limited to a single, judiciously shaped wavefront ('mode'). Here, we demonstrate how this limitation can be overcome by time-reversing a 'degenerate cavity laser', based on a cavity that self-images any incident light-field onto itself. Placing a weak, critically-coupled absorber into this cavity, ensures that any incoming wavefront is absorbed with close to perfect efficiency.

15:20 : Invited talk

Coherent Retroreflector, Coherent Asymmetric Absorber, and Bianisotropy Emulation using Coherent Illumination

Francisco Cuesta, M. S. Mirmoosa, Sergei Tretyakov
Aalto University (Finland)

In this presentation we will review our recent works on using advanced interference phenomena to realize various effects in extremely thin metasurfaces.

15:40 : Invited talk

Beyond CPA: A General Theory of Reflectionless Scattering

A. Douglas Stone[1], W. R. Sweeney[1], C.-W. Hsu[2], A. Alhulaymi[1], P. Del Hougne[3]
[1] *Yale University (USA),* [2] *University of Southern Califorinia (USA),* [3] *Université de Rennes (France)*

Coherent Perfect Absorption is one form of reflectionless scattering, involving transduction of an adapted input field. We present a general theory of reflectionless scattering, which includes CPA, based on choosing a subset of input channels and requiring no backscattering into them. We show that infinitely many such solutions exist at complex frequency, can be calculated efficiently, and can be made accessible via tuning a single structural parameter. Optimization of a parameterized structure can achieve high quality signal routing.

14:00 - 14:35 — Salle P2

Session 1A24

Chiroptical Phenomena

Organized by: Alessandro Belardini and Ventsislav K. Valev

Chaired by: Alessandro Belardini and Ventsislav K. Valev

14:00 : Invited talk

Signature of the Chiral Tensor Elements of the First Hyperpolarizability in Metallic Nanoparticles in Hyper Rayleigh Scattering Experiments

Zacharie Behel[1], Michalina Slemp[1], Katarzyna Matczyszyn[2], Stephane Parola[1], Pierre-Francois Brevet[1]
[1] *University Claude Bernard Lyon 1 (France),* [2] *Wroclaw University of Science and Technology (Poland)*

We report the use of polarization resolved hyper Rayleigh scattering to identify the chiral elements of the first hyperpolarizability tensor of small metallic nanoparticles. This operation is performed in gold nanoparticles

ensemble measurements directly in liquid suspensions using an elliptically polarized fundamental beam. Several nanoparticle shapes are discussed and directions towards single nanoparticle measurements proposed.

14:20 : Strong broadband circular dichroism in chiral plasmonic woodpiles
B. Abdennadher, R. Iseli, U. Steiner, Matthias Saba
Adolphe Merkle Institute (Switzerland)

Chiral woodpiles are well known to boost chiro-optical effects. We here demonstrate that light scattering at a chiral plasmonic woodpile, structured on the order of the wavelength of the light, can be understood by considering its fundamental evanescent Floquet states. In particular, we report a broadband circular polarization bandgap in the complex band structure between 3 and 4 μm wavelength, yielding a strong and broadband circular dichroism. Our findings could pave the way for an ultra-broadband circularly polarized thermal source.

14:30 - 16:05 — Salle P2

Session 1A25

Superconducting Josephson Classical and Quantum Metamaterials

Organized by: Sergey Saveliev and Kaveh Delfanazari

Chaired by: Sergey Saveliev and Kaveh Delfanazari

14:30 : Invited talk
Slowing down microwave photons in a superconducting quantum metamaterial
Alexey Ustinov
Karlsruhe Institute of Technology (Germany)

Progress in quantum information processing leads to a rising demand for devices to control the propagation of electromagnetic wave pulses and to ultimately realize a universal and efficient quantum memory. While in recent years significant progress has been made to realize slow light and quantum memories with atoms at optical frequencies, superconducting circuits in the microwave domain still lack such devices. We present an overview of our recent experiments with eight frequency-tunable superconducting qubits coupled to a one-dimensional waveguide.

14:50 : Invited talk
Josephson terahertz plasmonics with layered superconductor microcavity arrays
Samane Kalhor, Sergey Savel'ev, Kaveh Delfanazari
University of Glasgow (United Kingdom)

To engineer the ultrastrong light-matter interaction between Josephson plasma waves (JPWs) and terahertz (THz) radiation for manipulation of cavity quantum electrodynamic (cQED), we propose an array of deeply subwavelength micro-cavities composed of high-temperature superconductor BSCCO. We confirm the ultrastrong coupling of the JPWs and THz radiation by observing anti-crossing behaviour in the reflection spectra of the array in the superconducting regime. The proposed metamaterial could be useful in the development of THz cQED, coherent emitters, sensitive detectors and tunable bolometers.

15:10 : Invited talk
Creation and annihilation of Josephson vortex loops in a Junction with nanopillar
G. R. Berdiyorov[1], M. V. Milosevic[2], F. Kusmartsev[3], F. M. Peeters[2], Sergey Savel'ev[3]
[1] *Qatar Foundation (Qatar),* [2] *Universiteit Antwerpen (Belgium),* [3] *Loughborough University (United Kingdom)*

We consider a Josephson Junction with nanoengineered pillars connecting its two banks. Josephson vortices are generated by the applied magnetic field applied and are driven by the applied current flowing through the junction. If pillar is large enough, the vortices cannot pass through it and go around it, forming a loop behind. The evolution of the loops depends on the Josephson coupling and external conditions and usually results in multiple creations and annihilations of the loops.

15:30 : Quantum electrodynamics of non-demolition detection of single microwave photon by super-

conducting qubit array
Patrick Navez
Loughborough University (United Kingdom)

We apply consistently the formalism of quantum electrodynamics and we developed a comprehensive theoretical framework describing the interaction of single microwave photons with an array of superconducting transmon qubits in a waveguide cavity resonator. We analyse the spectral effects (ac Stark shift, peaks, widths) of microwave photons on the array's response to a weak probe signal exciting the resonator. Our results is used for the interpretation of the experiments done within the EU-SUPERGALAX consortium.

15:45 : Invited talk
Ultrastrongly coupled THz metasurfaces: from large arrays to single meta-atom spectroscopy
Giacomo Scalari[1], Elsa Jöchl[1], Shima Rajabali[1], Sergey Markmann[1], Erika Cortese[2], Simone DeLiberato[2], Mattias Beck[1], Jérôme Faist[1]
[1] *ETH Zürich (Switzerland),* [2] *University of Southampton (UNited Kingdom)*

We will present experiments on ultrastrongly coupled, strongly subwavelength resonators in arrays down to single element. We will discuss the limitations of the planar resonators approach when employing extremely subwavelength gaps and we will present the new developments towards single-object, few electrons ultrastrongly coupled systems.

Coffee Break

Session 1P2
Poster Session II
16:00 - 16:40

P1: Breathalyzer-based Prompt Coronavirus Screening Test using Terahertz Spectroscopy of Viruses in LC-Resonant Metamaterial Nano-Antenna Array
Rudrarup Sengupta, Heena Khand, Gabby Sarusi
Ben-Gurion University of the Negev (Israel)

We propose a tested, sensitive and prompt COVID-19 breath-screening method that takes less than one-minute. The non-biological method is based on detection of shift in terahertz resonance-frequency of a nano-engineered LC-resonant metamaterial chip, caused by viruses and related exhaled particles. The chip is enclosed in breathalyzer-like enclosure, which is shown to optically suppress Fabry-Pérot, for the first time. Low-scale clinical trials were conducted with asymptomatic, symptomatic coronavirus-patients and healthy individuals, where coronavirus-positive are effectively-screened with 87 $\%$ accuracy, from healthy individuals.

P2: Near-field seeing the colorful nano-world
Xuezhi Ma[1], Qian Wang[1], Ming Liu[2]
[1] *A*STAR (Singapore),* [2] *University of California (USA)*

We reported the 6 nm spatial resolution for invisible-near IR (415nm-980nm) ultra-broadband near-field scanning optical microscope (NSOM). The NSOM provides two different channels to see the absorption and scattering spectroscopy at the same time. Using this super tool, we revealed a colorful nano-world on the sub-10nm scale. This is the first time that humans can "see"the carbon nanotube, which is well-known as one of the blackest materials, and find them colorful on the nanoscale.

P3: Quantum remote control of vortex beams using a metasurface
Hong Liang[1], Hammad Ahmed[2], Wing Yim Tam[1], Xianzhong Chen[2], Jensen Li[1]
[1] *The Hong Kong University of Science and Technology (Hong Kong),* [2] *Heriot-Watt University (United Kingdom)*

We propose and experimentally demonstrate a scheme to remotely and continuously control the vortex beam structure using polarization-entangled photon pairs together with a metasurface. With a heralding technique adopted, the spin-orbit coupling provided by the metasurface translates to a tailor-made entanglement of the orbital angular momentum and the polarization of the signal photon. Then, the polarization of the heralding photon is used to remotely control the vortex structure of the signal photon, directly manifested as a continuous orbital rotation.

P4: Optical Metasurfaces for Grafted Vortex Beams Generation
Hammad Ahmed, Muhammad Afnan Ansari, Xianzhong Chen
Heriot-Watt University (United Kingdom)

Inspired by plant grafting, the act of placing a portion of one plant on a branch of another, grafted vortex beams (GVBs) can be formed through grafting spiral phase profiles. GVBs have attracted much attention due to their unique properties (e.g., non uniform OAM distributions). Here, we demonstrate the coaxial superposition of GVBs that can generate asymmetric singularity distribution. Our work has provided a compact platform to complete the sophisticated task that is extremely challenging with conventional optics.

P5: Scanning Reflectance Anisotropy Microscopy (SRAM): strain mapping of metasurfaces and beyond
Fabian Haake, Joan Sendra, Henning Galinski, Ralph Spolenak
ETH Zurich (Switzerland)

Elastic deformation of materials leads to breaking of the lattice symmetry. One consequence of the deformation is the emergence of optical anisotropy. However, the capabilities to map local strain fields by optical microscopy are currently limited. Here, we introduce a broadband reflectance anisotropy microscope as a phase-sensitive platform for optical characterization of materials, particularly sensitive to elastic strain. We demonstrate non-destructive mechanical characterization of strained metasurfaces and amorphous dielectric photonic-like crystals.

P6: A Coherent Perfect Absorber for Arbitrary Wavefronts
Yevgeny Slobodkin[1], Gil Weinberg[1], Helmut Hoerner[2], Kevin Pichler[2], Stefan Rotter[2], Ori Katz[1]
[1] *The Hebrew University of Jerusalem (Israel),* [2] *TU Wien (Austria)*

The concept of a 'coherent perfect absorber' (CPA) as a time-reversed laser is well-known in the domain of non-Hermitian photonics. However, conventional CPAs are usually limited to perfectly absorbing only a single, carefully shaped wavefront ("mode"). Apart from the correctly matched input wavefront, all of the possibly many other modes are only weakly absorbed. We have now overcome this limitation by creating a 'massively degenerate coherent perfect absorber' (MAD-CPA) that can absorb any complex input field with near-perfect efficiency.

P7: Acoustic anechoic coatings based on flexible honeycomb corrugated composite sandwich panel
Janghao Wu, Debao Ji, Yu Xie, Junyi Wang, Jiaming Hu, Yun Chen
Fudan University (China)

The absorption of underwater acoustic waves and vibrations is of great importance for underwater applications. In this work, we propose a well-performance acoustic anechoic coating by adopting the perforated honeycomb-corrugation hybrid (PHCH) sandwich panels consisting of aluminum and rubber. The composite structure possesses a high absorption coefficient of the low-frequency acoustic wave under an oblique incidence range. With well pressure resistance ability, the structure has been used in the design and experiment of our underwater detection system.

P8: Atomic-level engineered transition-metal alloy photoanodes with record efficiency for solar water splitting
Fei Xiang, Ning Li, Arturo Burguete-Lopez, Zhao He, Maxim Elizarov, Andrea Fratalocchi
King Abdullah University of Science and Technology (Saudi Arabia)

We report a uniform transition-metal metamaterial alloy with atomic-level control on Si photoanodes for efficient and stable solar-assisted water splitting. This technique extends the lifetime of the photoelectrochemical device beyond 250 hours, achieving a record applied bias photon-to-current efficiency (ABPE) efficiency of 4.25 $\%$.

P9: Quantum exceptional points of metasurfaces
Wai Chun Wong, Hong Liang, Kai Ming Lau, Tsz Kit Yung, Bei Zeng, Jensen Li
Hong Kong University of Science and Technology (China)

We develop an approach to map the quantum optical scattering of linear dissipative metasurfaces to Liouvillian dynamics, based on the effective Hamiltonian of the metasurfaces in a fictitious time. Our approach enables us to specify the generalized eigenspace of the Liouvillian superoperator, allowing us to analytically obtain the input-output relationship of the density matrix and the photon transition probabilities. This work facilitates the straightforward modeling of non-Hermitian metasurfaces in the quantum regime, directly from the specification

of classical scattering matrix.

P10: Plasmon-mediated wavelength-selective photoactuation for multi-directional soft robots
Dong-Jin Lee, Dae Yu Kim
Inha University (Korea)

Light-driven soft actuators have been gaining attention in soft robots, although the challenges of accurately and reversibly modulating in various directions remains. Here we present a strategy for wavelength-selective photoactuation based on Au nanorod/reduced graphene oxide nanocomposites. The plasmonic characteristic of Au nanorods can induce strong photothermal conversion at different wavelengths depending on the aspect ratio of that. The reduced graphene oxides have high thermal conductivity and negative coefficients of thermal expansion, leading to significant bending in bilayer configurations.

P11: Plasmonically-enhanced phase-change integrated photonic memory device
Junchao Song[1], I. Bente[2], W. H. P. Pernice[2], H. Bhaskaran[3], C. D. Wright[1]
[1] *University of Exeter (United Kingdom),* [2] *University of Munster (Germany),* [3] *University of Oxford (United Kingdom)*

We explore the potential for the realization of fast, energy-efficient photonic memory and computing devices arising from the combination of the energy-efficient silicon nitride platform, the sub-wavelength light-squeezing and field-enhancing capability of plasmonic resonant structures, and the intrinsic tuneability brought by chalcogenide phase-change materials. We concentrate on designs that should be readily manufactured, comprising plasmonic dimer-bar nanoantenna deposited on top of a phase-change cell, itself deposited on top of an integrated photonic waveguide.

P12: Study on acoustic metasurface controlling phase of transmitted waves
Jia-Hong Sun, Ching-Yun Chang
Chang Gung University (Taiwan)

This paper studied the acoustic metasurface with microstructures that can control the phase of sound waves passing through it. The microstructures were designed to have a proper phase delay and a high transmission coefficient. After designing the structure properly, acoustic metasurfaces that control refraction angles, focus sounds, and diffuse waves were constructed. The work included design, fabrication of specimens, and experiments. This study is valuable for the development of acoustic metasurface applications.

P13: Realization of true perfect absorber metasurfaces
Yoshiaki Nishijima
Yokohama National University (Japan)

We have realized true perfect absorption with midinfrared metasurfaces by numerical simulation and experimental measurements. To realize this feature, we noticed that the controlling of absorption and scattering in metasurface.

P14: Displacement trajectory of nanoparticles illuminated by pulsed photonic jet and photonic hook
Maya Hen Shor Peled[1], Paolo Maioli[2], Alina Karabchevsky[1]
[1] *Ben Gurion University (Israel),* [2] *Université de Lyon (France)*

We present the displacement trajectory of a gold nanoparticle under photonic nano-jet and photonic hook fields generated with an ultrashort pulsed beam. We compared the optical forces exerted on the nanoparticle under pulsed and CW illumination and calculated its displacement. We observed peculiar nanoparticle trajectories when placed in different initial positions, under pulsed light. To understand the effect, we analyzed the gradient and scattering forces. Our work stimulates the development of experimental methods for opto-mechanical manipulation.

P15: Integrated Polarization Control for Trapped-Ion Quantum Computers
Guochun Du[1], Carl-Frederik Grimpe[1], Anastasiia Sorokina[2], Pascal Gehrmann[2], Elena Jordan[2], Steffen Sauer[2], Stefanie Kroker[1], Tanja Mehlstaubler[1]
[1] *PTB Braunschweig (Germany),* [2] *Laboratory for Emerging Nanometrology (Germany)*

Ion traps are a promising platform for the realization of high-fidelity quantum information processors. Integrated photonic components are important for scaling ion trap systems to large numbers of qubits. Polarization control is essential for state preparation, electron-shelving and quantum logic operations. Here, we present our work on ion traps with integrated grating couplers combined with metasurfaces as a two-layer system for

the conversion of linear polarization to circular polarization.

P16: Level-set optimization of non-reciprocal media
Claire Cisowski, Robert Bennett
University of Glasgow (United Kingdom)

Non-reciprocal photonics holds transformative potential for energy harvesting and optical information processing. While computer assisted design techniques have become widespread approaches for tailoring and enhancing optical devices, devices based on non-reciprocal media constitute a missing entry in the growing catalogue of inverse-designed technology. In this work, we exploit a Green's tensor formalism to introduce a level-set method for the inverse design of a non-reciprocal material for the example of a point-based intensity optimization problem.

P17: Topological corner states in photonic bilayer square lattice with π flux
Natsuko Ishida, Motohiko Ezawa, Guangtai Lu, Wenbo Lin, Yasutomo Ota, Yasuhiko Arakawa, Satoshi Iwamoto
The University of Tokyo (Japan)

We analyzed a bilayer photonic structure consisting of two topologically distinct square lattices with π flux by using a tight-binding model. In the weak interlayer coupling regime, a topological corner state exists at each corner of the finite bilayer lattice, while it disappears when the coupling strength exceeds a critical value, indicating the occurrence of a topological phase transition induced by the interlayer coupling. This phenomenon could be applicable to control light localization in bilayer photonics systems.

P18: Optical Metafluids Composed of Colloidal Mie-Resonant Silicon Nanospheres
Hiroshi Sugimoto, Minoru Fujii
Kobe University (Japan)

Colloidal suspension of resonant nanostructures exhibiting optical magnetism may have very high and low effective index un-achievable in natural liquids, which can be exploited for the applications different from solid-state optical metamaterials. Here, dual nanoparticles with electric and magnetic resonances dispersed in solution dubbed as "dual metafluids"were developed based on Mie-resonant silicon nanospheres. In addition to the strong magnetic response in optical regime, the helicity preserved light scattering from size-purified silicon nanoparticles dispersed in solution were demonstrated.

P19: Integrated Q-switched lasing element in the NIR with transition metal dichalcogenide gain and graphene saturable absorption
Georgios Nousios[1], Thomas Christopoulos[1], Odysseas Tsilipakos[2], Emmanouil Kriezis[1]
[1] *Aristotle University of Thessaloniki (Greece),* [2] *National Hellenic Research Foundation (Greece)*

We propose and analyze an integrated passively Q-switched lasing element in the NIR based on a nanophotonic disk resonator and enhanced with the contemporary MoS2/WSe2 TMD hetero-bilayer and graphene monolayer to provide the optically-pumped gain and saturable absorption, respectively. The configuration is rigorously evaluated utilizing a temporal coupled-mode theory framework. Following a meticulous design process, the pulsed lasing source delivers mW peak power and ps duration pulses, with a repetition rate of tens of GHz for sub-mW pump power.

P20: Nonlinear optical generation of photon pairs using hybrid plasmonic nanostructures
Sandy Mathew, Guillaume Laurent, Nicolas Chauvet, Gilles Nogues, Aurelien Drezet, Guillaume Bachelier
Institut Néel - CNRS (France)

Here, we develop a formalism for the investigation of Spontaneous Parametric Down Conversionin hybrid structures that combine plasmonic resonances and intrinsic nonlinearity. Using quantumand numerical approaches together, we quantitatively evaluate photon pair correlation measurementsfor realistic experimental configurations. Hybrid plasmonic nanostructures embedding a small nanocystal allow fora 1000-fold increase in pair production compared to the same nanocrystal alone and a photon pairproduction efficiency close to the best source to date.

P21: Dynamic plasmonics based on conducting polymers
Shangzhi Chen, M. P. Jonsson
Linkoping University (Sweden)

Plasmonics based on conventional metals are broadly used for biosensing and optoelectronic devices, but suffer from limited optical tunability. We recently demonstrated conducting polymers as a new category of plasmonic materials exhibiting excellent optical tunability. In this talk, I will briefly introduce the emergence, current status, and future prospects of using conducting polymers for dynamic plasmonics.

P22: High efficiency interface between multi-mode and single-mode fibers
Oussama Korichi, Markus Hiekkamaki, Robert Fickler
Tampere University (Finland)

A new method for interfacing MMFs with SMFs is presented using a multi-plane light conversion scheme, achieving coupling efficiencies of 30 % to 70 %, for MMFs with core diameters up to 200.

P23: Strain sensors based on Fano resonance in plasmomechanical system
Najat Ahmidayi[1], W. d'Orsonens[2], Th. Maurer[2], G. Lévêque[1]
[1] *Université de Lille (France),* [2] *Université de Technologie de Troyes (France)*

Due to their unique plasmonic and mechanical properties, plasmomechanical systems have becomethoroughly investigated for strain sensing applications. The realization of strain sensors with high performancerequires plasmonic resonances with high quality Factor (Q) such as Fano resonances (FR). In this respect, wehave carried out an optomechanical study of a plasmomechanical system supporting FR, consisting of two goldnanoparticles (GNs), a disk and a rod, deposited on a polydimethylsiloxane (PDMS) substrate.

P24: Conducting polymers as optical actuators for addressable structural colors
Stefano Rossi, Magnus P. Jonsson
Linköping University (Sweden)

Conducting polymers change their electronic and optical properties when doped with counter-ions. The doping process can be dynamically and reversibly done electrochemically, exposing the polymer to an electrolyte. The permittivity and thickness change upon redox cycling changes the effective refractive index. We demonstrate an application to tune the color of reflective optical nanocavities in all the visible spectrum, using a low-bandgap conducting polymer. The outcome is promising for reflective displays but can be extended to other active nanophotonic systems.

P25: Plasmonic infrared sensor aided with artificial intelligence and immunoassay for structural protein biomarker-based neurodegenerative disease detection
Deepthy Kavungal, Pedro Magalhães, Senthil Kumar, Rajasekhar Kolla, Hilal Lashuel, Hatice Altug
EPFL (Switzerland)

We introduce an infrared metasurface sensor based on plasmonic surface-enhanced infrared absorption spectroscopy combined with immunoassay, which detects alpha-synuclein, an early structural biomarker protein for Parkinson's disease with clinical specificity and identifies its different structural species using their unique spectroscopic signals. Unprecedentedly, we augmented the sensor with Deep Neural Network, enabling quantitative differentiation of aSyn aggregates. Capable of multiplexing and retrieving aggregate absorbance from complex biomatrix, our sensor shows promise for PD diagnosis, disease progression monitoring, and drug efficacy assessment.

P26: Reconfigurable and polarization-dependent grating absorber for large-area emissivity control based on the plasmonic phase-change material In3SbTe2
Lukas Conrads, Natalie Honné, Andreas Ulm, Andreas Heßler, Matthias Wuttig, Robert Schmitt, Thomas Taubner
RWTH Aachen University (Germany)

The plasmonic phase-change material In3SbTe2 can be reversibly switched from an amorphous dielectric to a crystalline metallic state. Infrared emissivity control by patterning a grating absorber metasurface for different polarizations, which can be only seen in the long-wave infrared regime, is demonstrated. Additionally, a 1x1 cm² metasurface is fabricated with enhanced emissivity to display an apparent local temperature pattern.

P27: Shape-multiplexed conformable holographic metasurfaces
Sebastian Schulz[1], Jianling Xiao[1], Robert Hunter[1], Duncan Robertson[1], Graham Smith[1], Simon Horsley[2], Andrea Di Falco[1]
[1] *University of St Andrews (United Kingdom),* [2] *University of Exeter (United Kingdom)*

Conformal metasurfaces hold great potential for retro-fitting optical functionality and decoupling the complexity

of the final shape from the constraints of nanofabrication. Here we demonstrate a reflective conformable metasurface that shows one of two independent holographic images, where we can switch between two independent holographic images, by changing from a concave to a convex shape and vice versa.

P28: Propagating surface plasmons for plasmonic nanocavities
Arsenios Gisdakis, K. Bedingfield, J. J. Baumberg, A. Demetriadou
University of Birmingham (United Kingdom)

Recent advances have led to the realization of plasmonic nanocavities that have gaps of just 1-2 nm and have allowed for light-matter strong coupling at room temperature. Previous studies have focused on theenergy coupled to the far-field, however the energy carried out by propagating surface plasmon polaritons (SPPs)is often neglected in literature. Here we quantify the fraction of energy coupled in to SPPs and that coupled intoplane waves (PWs), which carry the energy into the far-field

P29: Periodically modulated photonic structures for light manipulation
Julianija Nikitina[1], Ceren Babayigit[2], Kestutis Staliunas[3], Lina Grineviciute[1]
[1] *Vilnius University (Lithuania),* [2] *University of California (USA),* [3] *ICREA (Spain)*

In this work the conformal deposition of high refractive index thin films on periodically micro-structured surfaces was investigated. The optical response of fabricated single-layer photonic structures demonstrates sharp sensitivity in both angle and wavelength domains, allowing to perform narrow-band spatial filtering and manipulate light polarization.

P30: Nanophotonics with stratified architecture for bright phosphor-based nano LEDs
Debapriya Pal, Femius Koenderink
AMOLF (The Netherlands)

In pc-LEDs, phosphor blends are illuminated by a blue "pump"LED (GaN die) to achieve the desired spectrum. Nano LEDs are envisioned as pixels for display. This constrains the lateral size and the distance between the phosphor layer and GaN die. We design thin spacers inserted between the phosphor and GaN die, which recover the waveguiding characteristics of the phosphor layer at emission wavelengths and facilitate the use of nanophotonic strategies to increase light absorption and extraction in specific directions.

P31: Applications of Eutectic Materials for 5G Technology
Hamid Reza Darabian[1], Jerzy Krupka[2], Bartłomiej Salski[2], Dorota Anna Pawlak[1]
[1] *ENSEMBLE3 (Poland),* [2] *Warsaw University of Technology (Poland)*

We utilize the micro-pulling down solidification technique with different pulling rates to tailor the dielectric permittivity and tangent loss for combination of TiO2 and MgO for 5G applications. A set of measurements such as XRD and SEM have been conducted to study structural properties. The SEM images exhibit different crystalline sizes with the pulling rates. In addition, the dielectric permittivity measurements in the GHz range have been carried out for the samples revealing a dielectric dependency with pulling rates.

16:40 - 18:20 — Grand Amphi

Session 1A26

Recent Advances in Non-Hermitian Photonics: Topological, Disordered and Quantum Systems

Organized by: Konstantinos Makris and Li Ge

Chaired by: Georgios Siviloglou

16:40 : Invited talk
Continuum of Bound States in a Non-Hermitian Model
Qiang Wang, Changyan Zhu, Xu Zheng, Haoran Xue, Baile Zhang, Y. D. Chong
Nanjing University (China)

In a Hermitian system, bound states have quantized energies while free states form a continuum. We de-

monstrate how this principle can fail in non-Hermitian systems. Certain non-Hermitian systems with imaginary momentum and Landau-type vector potential host eigenstates that we call çontinuum Landau modes"(CLMs), featuring gaussian spatial envelopes and a continuum of complex energies. CLMs could be realized in 1D and 2D photonic or acoustic lattices, and have interesting behaviors such as rainbow trapping and wave funnelling.

17:00 : Invited talk

Topological framework for directional amplification in driven-dissipative cavity arrays

Clara Wanjura[1], **Matteo Brunelli**[2], **Andreas Nunnenkamp**[3]
[1] *Max Planck Institute for the Science of Light (Germany),* [2] *University of Basel (Switzerland),* [3] *University of Vienna (Austria)*

We present a unifying framework based on non-Hermitian topology to understand non-reciprocity and directional amplification in driven-dissipative cavity arrays. Specifically, there is a one-to-one correspondence between non-trivial non-Hermitian topology defined on the spectrum of the dynamic matrix and regimes of directional amplification, in which the end-to-end gain grows exponentially in system size. The distance between complex spectrum and origin (size of the point gap) determines the amount of tolerated disorder which makes topological, directional amplification extremely robust against disorder.

17:20 : Invited talk

Non-Hermitian optical design by coordinate transformations and mapping

Ivor Kresic[1], **Konstantinos Makris**[2], **Andre Brandstötter**[1], **Ulf Leonhardt**[3], **Stefan Rotter**[1]
[1] *TU Wien (Austria),* [2] *University of Crete (Greece),* [3] *Weizmann Institute of Science (Israel)*

Coordinate transformations have been a powerful tool for design of metamaterial optical structures during the last 15 years. In this talk I will discuss our recent research about theoretical methodologies for creating non-Hermitian transparent materials, invisibility cloaks, and light confinement, by coordinate transformations and mapping of electromagnetic field solutions.

17:40 : Invited talk

Time-Refraction Optics at Single Cycle Modulation

Ohad Segal[1], **Eran Lustig**[2], **Soham Saha**[3], **Eliyahu Bordo**[1], **Sarah N. Chowdhury**[3], **Yonatan Sharabi**[1], **Avner Fleischer**[3], **Mustafa Ozlu**[3], **Alexandra Boltasseva**[3], **Oren Cohen**[1], **Vladimir M. Shalaev**[3], **Mordechai Segev**[1]
[1] *Technion (Israel),* [2] *Stanford University (USA),* [3] *Purdue University (USA)*

We present an experimental study of optical time-refraction in single-cycle time-interfaces. Specifically, we study the propagation of a probe pulse through a sample undergoing large refractive index changes induced by an intense ultra-short modulator pulse.

18:00 : Invited talk

Statics and Dynamics of non-Hermitian Many-body Localization

Arijeet Pal
University College London (UK)

Many-body localized phases retain memory of their initial conditions and have been shown to exist in disordered interacting systems with unitary dynamics. The stability of the localized phase due to the breakdown of unitarity is of relevance to experiments when coupling to the environment. Motivated by this, we investigate the impact of non-Hermitian perturbations on many-body localization in the interacting Hatano-Nelson model which breaks unitarity via asymmetric hopping. We study the impact on eigenstates and dynamics due to the non-Hermiticity.

16:40 - 18:30 — Amphi Bezier

Session 1A27

Metasurfaces for Nonlinear and Ultrafast Nanophotonics

Organized by: Giulio Nicola Felice Cerullo and Giuseppe Della Valle

Chaired by: Giuseppe Della Valle

16:40 : Invited talk

Third-order Infrared Upconversion Imaging with Silicon Metasurfaces

Ze Zheng[1], Lei Xu[1], Lujun Huang[2], Daria Smirnova[3], Khosro Zangeneh Kamali[3], Arman Yousefi[1], Fu Deng[4], Rocio Camacho-Morales[3], Cuifeng Ying[1], Andrey E. Miroshnichenko[2], Dragomir N. Neshev[3], Mohsen Rahmani[1]

[1]Nottingham Trent University (United Kingdom), [2]University of New South Wales (United Kingdom), [3]The Australian National University (Australia), [4]Hong Kong University of Science and Technology (China)

We experimentally demonstrated the near-infrared to visible imaging, based on the third-order generation processes, by designing a silicon membrane metasurface supporting symmetry-protected bound states in the continuum.

17:00 : Invited talk

Photon-pair generation in thin-film materials

Frank Setzpfandt

Friedrich Schiller University Jena (Germany)

Thin films of artificially designed materials, e.g. by nanostructuring, are enticing systems for the generation of photon pairs by nonlinear frequency conversion. They can enable control of many properties of the generated photons, as the polarization, spectrum, and propagation direction. The talk will discuss recent results, in particular steps towards the control of the polarization degree of freedom.

17:20 : Keynote talk

Dielectric metasurfaces with fast and ultra-fast tunability

Dragomir Neshev

Australian National University (Australia)

This talk will overview the recent advances and challenges in tunable metasurfaces. I will discuss metasurface tunability through several mechanisms, including electrical and all-optical drives. Such drives allow for fast and ultrafast responses with high modulation strength. We demonstrate how all-optical control can lead to and high ultrafast transmission modulation of 80 %. The presented developments hold promise for real-world applications of active meta-optics.

17:50 : Invited talk

Ultrafast optical control of nonlinear dielectric nanoantennas

Eva A. A. Pogna[1], Michele Celebrano[2], Andrea Mazzanti[2], Lavinia Ghirardini[2], Luca Carletti[3], Giuseppe Marino[4], Andrea Schirato[2], Daniele Viola[2], Paolo Laporta[2], Costantino De Angelis[3], Giuseppe Leo[4], Giulio Nicola Cerullo[2], Marco Finazzi[2], Giuseppe Della Valle[2]

[1]CNR-IFN (Italy), [2]Politecnico di Milano (Italy), [3]Universita di Brescia (Italy), [4]Université de Paris (France)

Efficient ultrafast reconfiguration of the second-harmonic generation of AlGaAs nonlinear nanoantennas operating at 1550 nm telecom wavelength, is achieved by ultrafast interband photoexcitation with femtosecond visible pulses. The combination of broadband transient transmittivity, time-revolved second harmonic generation, and nonlinear optics nanoscale modeling, allows to track the ultrafast modulation of the second harmonic signal, into the nanoscale charge carrier dynamics at the base of a giant permittivity change at the semiconducting band edge.

18:10 : Invited talk

Reconfigurable nonlinear dielectric metasurfaces

Davide Rocco[1], Luca Carletti[1], Marco Gandolfi[1], Attilio Zilli[2], Michele Celebrano[2], Marco Finazzi[2], Unai Arregui Leon[2], Antonio Ferraro[3], Roberto Caputo[3], Giuseppe Leo[4], Giuseppe Della Valle[2], Costantino De Angelis[1]

[1]University of Brescia (Italy), [2]Politecnico di Milano (Italy), [3]University of Calabria (Italy), [4]Université de Paris

(France)

High refractive index metasurfaces represent a promising research area of nanophotonics and light-matter interaction at the nanoscale. In this work, we report our recent progress concerning tunable nonlinear dielectric metasurfaces. We discuss the main physical phenomena enabling the dynamic control of the nonlinear process and compares the temporal dynamics of the different adopted approaches.

16:40 - 17:40 — Amphi Fournel

Session 1A28

Symposium V: Phononics and Acoustic Metamaterials

Organized by: Jensen Li, Jean-Philippe Groby, Marco Miniaci, Vicente Romero-García, Vincent Pagneux and Noé Jiménez

Chaired by: Jensen Li

16:40 : Invited talk

Latent symmetry in acoustic wave systems

Malte Röntgen[1], **Christian V. Morfonios**[2], **Peter Schmelcher**[2], **Vincent Pagneux**[1]
[1] *Laboratoire d'Acoustique de l'Université du Mans (France),* [2] *Universität Hamburg (Germany)*

A central characteristic of a reflection-symmetric wave system is the definite parity of its eigenmodes. In this talk, we will show that such parity of all eigenmodes, however, can also occur in asymmetric systems. To this end, we equip acoustic waveguide networks with so-called latent symmetries, that is, symmetries that become apparent only after a dimensional reduction of the underlying setup. Besides providing a systematic construction principle for such latently symmetric networks, we also explore their scattering properties.

17:00 : Invited talk

Wave reflection, transmission and antireflection layers at a temporal boundary using a Shive wave machine

Motonobu Tomoda, Tetsu Omiya, Hayato Takeda, Osamu Matsuda, Oliver B. Wright
Hokkaido University (Japan)

We demonstrate wave reflections at temporal boundaries, at which physical constants change suddenly, by use of a one-dimensional mechanical metamaterial in the form of a Shive wave machine. We also demonstrate a temporal antireflection layer by temporal impedance matching, that makes use of an appropriate intermediate temporal layer.

17:20 : Invited talk

Deep learning models for acoustic wave scatterings

Waqas Ahmed[1], **Mohamed Farhat**[1], **Pai-Yen Chen**[2], **Xiangliang Zhang**[3], **Ying Wu**[1]
[1] *KAUST (Saudi Arabia),* [2] *University of Illinois at Chicago (USA),* [3] *University of Notre Dame (USA)*

We develop deep learning models based on discriminative and generative networks to solve the forward and inverse acoustic scattering problems and show how these models benefit solving the inverse design process by eliminating the non-unique solution space. We demonstrate examples of using the developed deep learning models for designing broadband acoustic cloaks and arbitrarily-shape acoustic object recognition for underwater applications.

16:40 - 18:20 — Amphi Esquillan

Session 1A29

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Jérôme Plain and Alexander Govorov

16:40 : Invited talk
Tailoring the emission and the photodynamics of quantum emitters with high index dielectric nanostructures
Mélodie Humbert[1], Romain Hernandez[1], Peter Wiecha[1], Nicolas Mallet[1], Frank Fournel[2], Vincent Larrey[2], Aurélie Lecestre[1], Guilhem Larrieu[1], Christian Girard[1], Vincent Paillard[1], Laurence Ressier[1], Aurelien Cuche[1]
[1] *Université de Toulouse (France),* [2] *Université Grenoble Alpes (France)*

We show both experimentally and theoretically that the photodynamics of quantum emitters (NV colored centers in nanodiamonds), accurately positioned by AFM nanoxerography in the near field of silicon dimer nanoantennas, can be controlled by these simple high-index dielectric nanostructures. Then, in order to go a step further and control the directive emission of such quantum sources, we explore numerically and optimize with an evolutionary optimization algorithm, the geometry of silicon nanoantennas, made of a limited number of building blocks.

17:00 : Invited talk
Chiral sensing with semiconductor nanophotonics
Alberto G. Curto
Ghent University (Belgium)

Detecting molecular chirality is crucial in biochemistry. It is, however, limited by low sensitivity at low concentrations. I will discuss our progress to push the limits of chiral sensing by exploiting semiconductor nanophotonics.

17:20 : Invited talk
Oriented Colloidal Quantum Wells: Pushing the Limits, Breaking Records
Hilmi Volkan Demir
Bilkent University (Turkey)

We introduce a powerful, large-area self-assembly technique for orienting colloidal quantum wells in all face-down configuration. We demonstrate three-dimensional constructs of such oriented self-assemblies with monolayer precision. We present the most recent examples of LEDs and lasers using these oriented assemblies for lighting and displays. Here we also show record high efficiency from their LEDs and record thin gain medium from their laser structures. These solution-processed quantum wells hold great promise to challenge their epitaxial thin-film counterparts in semiconductor optoelectronics.

17:40 : Invited talk
Unidirectional ultracompact self-assembled optical antennas
Maria Sanz-Paz, Fangjia Zhu, Mauricio Pilo-Pais, Guillermo Acuna
University of Fribourg (Switzerland)

We report unidirectional emission of a single fluorophore using an ultracompact optical antenna. The design consists of two side-by-side gold nanorods self-assembled via DNA origami, which also controls the positioning of the single-fluorophore. Our results show that when a single fluorescent molecule is positioned at the tip of one nanorod and emits at a frequency capable of driving the antenna in the anti-phase mode, unidirectional emission with a forward to backward ratio of up to 9.9 dB can be achieved.

18:00 : Invited talk
Top-down and bottom-up fabrication of electro-optic flat photonic devices
Rachel Grange
ETH Zurich (Switzerland)

We will demonstrate the fabrication of devices with lithium niobate and barium titanate material for applications

in telecommunication and quantum optics.

16:40 - 18:35 — Amphi A

Session 1A30

Advanced Computational Electromagnetics for the Analysis and Design of Nanophotonic Devices

Organized by: Maha Ben Rhouma and Kofi Edee

Chaired by: Brahim Guizal

16:40 : Invited talk

A multimode quasi-normal mode framework for nonlinear harmonic generation with 2D materials

Thomas Christopoulos[1], **Emmanouil Kriezis**[1], **Odysseas Tsilipakos**[2]
[1] *Aristotle University of Thessaloniki (Greece),* [2] *National Hellenic Research Foundation (Greece)*

In this work, we present a multimode framework for linear and nonlinear modal calculations in non-Hermitian systems comprising 2D materials. The framework is based on the ability to appropriately expand both the linear and nonlinear responses of a resonant cavity in terms of the supported quasi-normal modes. Through numerical simulations, we find that the proposed framework is efficient and extremely accurate, even when complex contemporary photonic systems incorporating 2D materials are involved.

17:00 : Invited talk

Ray Tracing Model for Non-Rotationally Symmetric Geodesic Lens Antennas with Full Beam Scanning Range in the Azimuthal Plane

Sarah Clendinning[1], **Oskar Zetterstrom**[1], **Francisco Mesa**[2], **Oscar Quevedo-Teruel**[1]
[1] *KTH (Sweden),* [2] *Universidad de Sevilla (Spain)*

This presentation discusses a ray tracing model developed to determine the radiation pattern of geodesic lens antennas with non-rotationally symmetric footprints, where the geometry of the lens is defined using spline functions. The shape of this footprint and lens height profile can be modified by changing parameters in the defined functions. The code features a significant modification to work previously published by the authors to account for the non-rotationally symmetric design. The model runs significantly faster than commercially available software.

17:20 : Invited talk

Nanostructures for Photocatalysis - From regular to dendritic Architectures

Christin David
Friedrich-Schiller-University Jena (Germany)

We discuss the opportunity to design switchable nanostructures for enhanced selectivity in photocatalytic reactions. While we can tailor regular nanostructures in active metasurfaces to manipulate light in the desired way, irregular nanostructure platforms as obtained from self-organized growth of dendritic nanoarchitectures offer a high density of hot-spots with a wealth of spectral features. We present numerical calculations assessing optical and thermal properties of such structures as well as estimating light-induced electron transfer mechanisms to nearby molecules.

17:40 : Invited talk

Energy Efficient Back-to-Back Neural Networks to Design Photonic Devices

Ergun Simsek
University of Maryland Baltimore County (USA)

By solving the drift-diffusion equations on nonuniform spatial and temporal grids, where the broadband modulations are defined with window functions, the computation time can be reduced by two orders of magnitude. This significant reduction enables the simulation of thousands of photodetectors within a few hours, allowing for the creation of a large database. This dataset is then used to train energy-efficient back-to-back neural networks that can successfully design photodetectors based on the desired phase noise, quantum efficiency,

and bandwidth.

18:00 : Photonic crystal design targeting room temperature operation of GaN-based ridge polariton laser
Valentin Develay[1], Laetitia Doyenette[1], Christelle Brimont[1], Guillaume Malpuech[2], Jesus Zuniga-Pérez[3], Sophie Bouchoule[4], Thierry Guillet[1]
[1] *Université de Montpellier (France),* [2] *Université Clermont Auvergne (France),* [3] *CRHEA (France),* [4] *Université Paris-Saclay (France)*

We simulate a structured GaN waveguide with EigenMode simulation (EME) and optimize the geometrical parameter of this structure in order to control its emission energy. Those simulations reveal the impact of the decrease of GaN thickness on the Rabi splitting and the photonic gap as well as the optimal filling factor range in order to have large photonic gap. These results contribute to the realization of photonic crystal laser ridge at room temperature.

18:15 : Invited talk
Enhanced photoluminescence of ZnO nanowire coatings and gratings
Emmanuel Centeno[1], Aubry Martin[1], Michel Langlet[2], Audrey Potdevin[1], Francois Réveret[1], Rafik Smaali[1], Elena Kachan[1], Yves Jourlin[3], Geneviève Chadeyron[1]
[1] *Universite Clermont Auvergne (France),* [2] *Université Grenoble Alpes (France),* [3] *Université de Lyon (France)*

We study the light emission of coatings and gratings made of ZnO nanowire (NWs). Our electromagnetic simulations highlight that the NWs ribbons act as coupled microcavities that boost the emission thanks to light localization and diffractive mechanisms. The photoluminescence of the NWs is also simulated with the finite difference time domain (FDTD) algorithm which intergrates Maxwell Bloch equations. Our results shows that the optical properties of these structures result from a competition between the structural disorder and the periodic structuring.

16:40 - 18:20 — Amphi Pinel

Session 1A31

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Giacomo Scalari

16:40 : Invited talk
Chiral Phase Change Nanomaterials: A nanoscale path to microscopic optics
Imad Agha
University of Dayton (USA)

In this talk, we present our most recent results on phase change nanomaterials, based on bottom-up self-assembly fabrication techniques, as well as their use in phase, amplitude, and polarization control.

17:00 : Invited talk
Extremely Localized Optical Modes and Direct Electro-optical Modulation
Xuewen Chen
Huazhong University of Science and Technology (China)

Recent developments of nanoscience and nanofabrication techniques have enabled optical confinement into deep nanoscale or even atomic scale in space, offering exciting new opportunities. Here we discuss the physics to devise extremely localized optical modes that feature quantum-optical mode volumes down to one cubic nanometer. In particular, we present the approaches to overcome Landau damping to make the modes far-field accessible. Moreover, we introduce the concept of nanoscopic electron reservoir for direct electro-optical coupling that potentially allows energy-efficient ultrafast modulation.

17:20 : Invited talk

Plasmon Resonance Mode Evolution in a Semiconductor Nanodimer in the Overlapping Regime
Zi Wang, Thomas Wong
Illinois Institute of Technology (USA)

A semiconductor nanodimer (SND) in the overlapping regime exhibits unique characteristics of geometrical influence on space charge interactions that depend on the amount of overlap. The charge distribution, interior and exterior field, and dipole moment induced on a model SND by a terahertz electric field is studied by a charge transport formulation for carrier dynamics with a quasi-static framework for the electric field. Spectral components observed are interpreted by considering the evolution of charge distribution within the semiconductor material.

17:40 : Invited talk
Proximity Induced Chiral Quantum Light Generation in Strain Engineered WSe2/MPX3 Heterostructures
Han Htoon
Los Alamos National Laboratory (USA)

We report free-space generation of highly chiral single photons from QEs created via nanoindentation of monolayer WSe2 - NiPS3 heterostructures at zero external magnetic field. These QEs emit with a degree of circular polarization and single photon purity as high as 0.89 and 80 % respectively, independent of pump laser polarization. The chiral quantum light emission arises from magnetic proximity interactions between localized excitons in the WSe2 monolayer and the out-of-plane magnetization of defects in antiferromagnetic (AFM) order of NiPS.

18:00 : Invited talk
Advances in multiphysics modeling of phase change materials based metasurfaces
Dmitry Chigrin
RWTH Aachen (Germany)

Phase change materials are substances that can undergo rapid and reversible phase transitions, leading to significant changes in their physical properties. By incorporating these materials into metasurface design, it is possible to create programmable photonics components that can be reconfigured. In this presentation, we report on recent developments of the multiphysics description of complex composite active metasurfaces that incorporate phase change materials as building blocks. We provide a detailed discussion of the method and examples of its application.

16:40 - 18:40 — Amphi Manet

Session 1A32

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

16:40 : Invited talk
Nonlocal response of magnons in photonic structures
Hajime Ishihara, Kenta Kato, Tomohiro Yokoyama
Osaka University (Japan)

We develop a nonlocal response theory of magnons and discuss the spatial correlation between microwaves and magnon waves that leads to unconventional effects of magnon-polaritons (MPs). Based on this framework, we theoretically demonstrate anomalous selective coupling of MPs in layered magnetic thin films in the absence and presence of one-dimensional photonic structures. Further, we show the magnonic antenna effect that transcribes the functionality of the thick-layer MPs to the nanoscale thin-layer MPs.

17:00 : Invited talk

Chiro-optical characterization of self-assembled plasmonic nanostructures

Emilija Petronijevic, Hari Prasat Ram Kumar, Grigore Leahu, Roberto Li Voti, Concita Sibilia, Alessandro Belardini
Sapienza Università di Roma (Italy)

In order to control the circular polarization of light at nanoscale, complex structures can be realized. Among different fabrication techniques, self-assembled approach can produce high reproducible, low cost, large area asymmetric metasurfaces that present different optical functionalities, and in particular can exhibit chiral optical response both in the near field and in the far field. Here we show the optical chiral properties of different self-assembled metasurfaces measured by different characterization techniques, both in linear and nonlinear regime.

17:20 : Invited talk

Chirality of the electromagnetic fields of resonant nanostructures

Mathieu Nicolas[1], Jayeeta Amboli[2], Lingfei Cui[1], Per Magnus Whalmsness[3], Xingyu Yang[1], Catherine Schwob[1], Guillaume Demesy[2], Mathieu Mivelle[1], Morten Kildemo[3], Souhir Boujday[1], Nicolas Bonod[2], Bruno Gallas[1]
[1] *Sorbonne Université (France),* [2] *Institut Fresnel (France),* [3] *NTNU (Norway)*

Metallic nanostructures support localized surface plasmon resonances (LSPR) resulting from the collective motion of the electrons excited by electromagnetic fields. At the LSPR, the intensity of the electromagnetic near-field is also strongly enhanced, which find applications in many domains of Physics, Chemistry, Biology... Lately, there has also been a strong interest in the vectorial properties of the electromagnetic nearfield, in particular for generating strong chiral fields which may be used for biodetection applications.

17:40 : Invited talk

Interfaces of B20 compounds with exotic spin currents

Gina Pantano, Cole Gibson, Samuel Tkacik, Jacob Gayles
University of South Florida (USA)

We use first principal calculations to investigate 2D planar twinning interfaces in B20 compounds. We employ supercell calculations where the area of the interface is restricted to the primitive cell interface. The calculations are carried out for the Weyl semimetal CoGe. Our results show that the spin and anomalous Hall effect can be significantly increased due to the increase in spin-orbit coupling with the change in atomic potential at the interface.

18:00 : Invited talk

Mixed Quantum/Classical Approach to Surface-Enhanced Spectroscopies

Tommaso Giovannini, Chiara Cappelli
Scuola Normale Superiore (Italy)

We present a novel theoretical approach to calculate the optical response of molecular systems interacting with plasmonic substrates, either metallic or graphene-based.

18:20 : Invited talk

Hot-electron generation in chiral plasmonic nanocrystals as a mechanism for chiral photo-growth and photochemistry

Alexander Govorov
Ohio University (USA)

The generation of energetic (hot) electrons and the photoheating are intrinsic properties of any optically excited plasmonic nanocrystal. In addition, high-energy hot electrons and phototemperature contribute to the kinetic processes observed in colloidal nanocrystals, metal-semiconductor hybrids, plasmonic Schottky photodetectors, and metastructures. In this talk, we will focus on the theory of hot electron injection and present related applications for chiral photo-growth, plasmonic photochemistry and plasmonic photocatalysis.

16:40 - 17:40 — Salle des Conseils

Session 1A33

Industrial Workshop by Synopsys Inc.

Organized by: Chenglin Xu, Maryvonne Chalony, Yijun Ding

16:40 : Industrial Workshop
Automated Inverse Design Solution for Metalenses
Chenglin Xu[1], **Maryvonne Chalony**[2], **Yijun Ding**[1]
[1] *Synopsys Inc. (USA),* [2] *Synopsys Inc. (France)*

To help researchers design metalenses easily and quickly, Synopsys has developed MetaOptic Designer, a fully automated design tool for metalenses. Based on a few inputs from designers, such as a pre-built meta-atom library and basic lens configuration, MetaOptic Designer generates an optimized design to meet all design targets. Synopsys will introduce and demonstrate MetaOptic Designer in two workshop sessions at META 2023. On July 18, we will provide a general overview of the MetaOptic Designer optimization algorithm, followed by quick demonstrations of the tool's capability. On July 19, we will demonstrate advanced metalens applications with tips and tricks; applications will include: Achromatic metalens, Wide-angle metalens, Chiral hologram, Reflective metalens, Hybrid optical system with both metasurfaces and traditional refractive lenses. The workshop is free and open to all META conference attendees.

17:40 - 18:20 — Salle des Conseils

Session 1A34

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Sergey Kruk

17:40 : Invited talk
Independent electrical control of phase and magnitude of second harmonic generation using intersubband polaritonic metasurfaces
Jaeyeon Yu[1], **Gerhard Boehm**[2], **Mikhail Belkin**[2], **Jongwon Lee**[1]
[1] *Ulsan National Institute of Science and Technology (Korea),* [2] *Technical University of Munich (Germany)*

We present electrically tunable intersubband nonlinear polaritonic metasurfaces for second harmonic generation. The phase and magnitude of effective nonlinear susceptibility of these metasurfaces can be controlled independently, with a range of 0 to 160 nm/V in magnitude and 0 to 2π in phase.

18:00 : Invited talk
PT-symmetric non-Hermitian plasmonic systems for switchable radiation control
Yuto Moritake
Tokyo Institute of Technology (Japan)

Non-Hermitian photonics is research fields utilizing phenomena induced by non-Hermiticity. Especially, systems with PT symmetry is important due to PT-phase transition across an exceptional point (EP) where the eigenvalues and eigenmodes coalesce. In this presentation, we introduce our recent results on switchable radiation control with PT-symmetric non-Hermitian plasmonic systems. Coupled split ring resonators and coupled plasmonic wires were proposed for switching of unidirectional radiation and polarization states, respectively. The studies provide exotic photonic functionalities based on non-Hermiticity in the systems.

16:40 - 17:40 — Salle Guy Gautherin

Session 1A35

Superconducting Josephson Classical and Quantum Metamaterials

Organized by: Sergey Saveliev and Kaveh Delfanazari

Chaired by: Sergey Saveliev and Kaveh Delfanazari

16:40 : Invited talk
Quantum Analogues of Dissipative Circuit Elements
Alexandre Zagoskin
Loughborough University (United Kingdom)

Quantum analogues of non-dissipative circuit elements, that is, structures which can exist in a coherent superposition of states with different values of inductance or capacitance, are readily realized using superconducting qubits. Here I show the possibility of the existence of quantum analogues of dissipative circuit elements, which demonstrate superpositions of states with different resistances or memristances.

17:00 : Invited talk
Development of high temperature superconducting terahertz emitters
Takanari Kashiwagi
University of Tsukuba (Japan)

To obtain high performance THz-waves emitting devices made by single crystals of high temperature superconductor Bi2Sr2CaCu2O8+δ(Bi2212), an understanding of the device characteristics based on the material characteristics would be an important issue. In principle, electric characteristics of the intrinsic Josephson junctions (IJJs) constructed in Bi2212 crystals strongly depend on the crystal conditions such as carrier concentrations, crystal defects, quality of atomic scale of Josephson junctions. We have studied material and device characteristics of Bi2212 crystals prepared with different conditions.

17:20 : Invited talk
Improved Method for Characterizing Resonance Quality Factor in Superconducting Resonators
Martin Weides
University of Glasgow (United Kingdom)

We present a study on tunable Fano-type resonances in a superconducting coplanar cavity coupled to multiple artificial atoms. We discuss how the background transmission can be accounted for by Jaynes-Cummings type models via modified boundary conditions. Additionally, we investigate the characterization of material losses in superconducting resonators, using a combination of simulation and experiment to determine the reliability of a fitting algorithm for separating internal and coupling quality factors of the resonance quality factor.

17:40 - 18:25 — Salle Guy Gautherin

Session 1A36

Advances in Nanophotonic Systems

Chaired by: Riccardo Franchi

17:40 : Hybrid gold-(CdSe/CdS/CdZnS) nanocrystal supraparticles emission: from FRET inhibition to collective emission of a mesoscopic ensemble of NCs
V. Blondot[1], Domitille Gérard[1], Guillaume Quibeuf[1], Christophe Arnold[1], Aymeric Delteil[1], Alexandra Bogicevic[2], Thomas Pons[2], Nicolas Lequeux[2], Jean-Paul Hugonin[1], Jean-Jacques Greffet[1], Stéphanie Buil[1], Jean-Pierre Hermier[1]
[1] *Université Paris-Saclay (France),* [2] *PSL Research University (France)*

We investigate the optical properties of single self-assembled hybrid gold-CdSe/CdS/CdZnS colloidal nanocrystal supraparticles. First, spectrally time resolved photoluminescence experiments show that they exhi-

bit Förster resonance energy transfer (FRET) that is inhibited by the gold nanoshell, in agreement with the results of numerical simulations. Next, the analysis of the intensity autocorrelation function g(2)(t) reveals that FRET combined to non radiative Auger recombination can result in photon antibunching. Bunching at short time scale related to coherent collective emission is finally reported.

17:55 : Controlling Spontaneous Emission with Nanomaterials at the Single-Emitter Level
R. Margoth Cordova-Castro[1], Clement Cabriel[2], Dirk Jonker[3], Mario Zapata-Herrera[4], Alexey Krasavin[5], Arturo Susarrey-Arce[3], Riccardo Sapienza[6], Yannick De Wilde[2], Valentina Krachmalnicoff[2], Anatoly Zayats[5], Ignacio Izeddin[2], Robert W. Boyd[1]
[1]University of Ottawa (Canada), [2]ESPCI Paris (France), [3]University of Twente (The Netherlands), [4]CSIC-UPV/EHU (Spain), [5]King's College London (United Kingdom), [6]Imperial College London (United Kingdom)

The direct measurement of a single emitter decay rate and the simultaneous knowledge of its position is a powerful tool for the study of light-matter interaction at the nanometer scale. We use single-molecule fluorescence lifetime imaging microscopy (smFLIM) to map at the nanometer scale the decay rate enhancement of single emitters coupled to new nanomaterials platforms that significantly modified the electromagnetic environment.

18:10 : Photonic circuit simulation of topological arrays compared with experimental results in tantalum pentoxide
Bradley Thompson, Ricky Gibson, Stefan Badescu
Air Force Research Lab (USA)

A topological array composed of coupled microring resonators was simulated using passive lumped-element components. The topological bandgap is observable in the simulated spectrum, and no topological bandgap is present for a simulated trivial array which has no synthetic magnetic field phase accumulation. The simulated transmission spectra have similar features to measured experimental arrays. This work demonstrates the capability of using rudimentary photonic circuit elements of waveguides and waveguide couplers to simulate and analyze complex topological array performance.

16:40 - 18:35 — Salle P1

Session 1A37

Coherent Control of Absorption in Structured Materials

Organized by: Simone Zanotto and Simon Horsley

Chaired by: Simone Zanotto and Simon Horsley

16:40 : Invited talk
Many-body Quantum Metasurfaces with Coherent Perfect Absorption with PT Symmetry Breaking
Kyle Ballantine, Janne Ruostekoski
Lancaster University (United Kingdom)

We theoretically show how a quantum metasurface of atoms can undergo coherent perfect absorption with an effective parity-time (PT) symmetry and non-exponential decay. The effective symmetry is achieved in delocalized collective excitation eigenmodes. These modes coalesce at exceptional points (EPs), evidenced by the emergence of coherent perfect absorption (CPA) where coherent incoming light is perfectly absorbed and scattered only incoherently. The system is versatile and can be modified for single-photon absorption and quantum storage.

17:00 : Invited talk
Nontrivial application of coherent quantum absorption
Anton Vetlugin, Ruixiang Guo, Shuyu Dong, Filippo Martinelli, Cesare Soci, Nikolay Zheludev
Nanyang Technological University (Singapore)

The interference of quantum light on a thin absorber (e.g., a metasurface) leads to non-trivial phenomena such as single-photon Zeno and two-photon anti-Hong-Ou-Mandel effects with applications in light detection,

communication, and metrology.

17:20 : Invited talk
Multipolar Coherent Amplification of Chiroptical Scattering and Absorption from a Magnetoelectric Core-shell Nanoparticle
Hsin-Yu Wu, Frank Vollmer
University of Exeter (United Kingdom)

We analytically and numerically demonstrate multipolar coherent amplification of chiroptical responses in the near-infrared wavelength regime via a magnetoelectric core-shell nanoparticle encapsulated in a monolayered optically-active substance. The proposed achiral core-shell nanoparticles can simultaneously support both multipolar electric and magnetic resonances, and thus collaboratively interact with the electric and magnetic components of the incident radiation, which enhances chiroptical signals at specific resonances in the presence of monolayered chiral substances and enables effective molecular chirality sensing at the nanoscale.

17:40 : Invited talk
Quantum Coherent Absorption of Squeezed Light
Umit Hardal, Devashish Pandey, Sanshui Xiao, Martijn Wubs
Technical University of Denmark (Denmark)

Two identical squeezed coherent states at the input ports of a 50 % absorbing beam splitter do not show coherent perfect absorption (CPA). All coherence is lost, though, since at the output ports entangled squeezed vacuum states emerge. Remarkably, this output state is a pure state, although produced by a lossy device. Therefore this CPA gate could become a new tool for continuous-variable quantum state preparation. Moreover, for graphene multilayers engineered for CPA, we discuss the effects of interlayer separation.

18:00 : Invited talk
Optical control of collective states in 1D ordered atomic chains beyond the linear regime
Nikos Fayard, Igor Ferrier-Barbut, Antoine Browaeys, Jean-Jacques Greffet
Université Paris Saclay (France)

Driven by the need to develop new atom-photon platforms, people recently replaced cavities by large arrays of cold atoms that can support superradiant or subradiant collective states. In practice subradiant states are decoupled from radiation with constitutes a hurdle to most applications. In this work, we study a protocol that enables the deterministic coupling to subradiant modes in subwavelength atoms arrays.

18:20 : Controlling wave phases and absorption in curved space for light
Yangjie Liu, Z. K. Xiong, Z. Mao, B. Zhou
Hubei University (China)

In this oral contribution, we present a general methodology to manipulate the amplitude of an electromagnetic wave in a pre-defined way, without introducing any scattering. This leads to a whole class of isotropic spatially varying permittivity and permeability profiles that are invisible to incident waves. Also some new work on manipulating the wave phases and of wave absorption via multipole expansion is included in the hope to develop this methodology further.

16:40 - 18:15 — Salle P2

Session 1A38

An Emergent Frontier of Photonics: Optical Thermodynamics of Nonlinear Systems

Organized by: Konstantinos Makris, Ziad Musslimani and Mercedeh Khajavikhan

Chaired by: Konstantinos Makris

16:40 : Invited talk

Thermalization and condensation of light waves: Wave turbulence theory and experiments in multimode optical fibers

Kilian Baudin[1], **Josselin Garnier**[2], **Nicolas Berti**[1], **Adrien Fusaro**[3], **Katarzyna Krupa**[4], **Lucas Zanaglia**[5], **Claire Michel**[5], **Valérie Doya**[5], **Guy Millot**[1], **Antonio Picozzi**[1]
[1] *Université de Bourgogne (France),* [2] *Ecole Polytechnique (France),* [3] *CEA (France),* [4] *Polish Academy of Sciences (Poland),* [5] *Université Côte d'Azur (France)*

We review recent progress on the experimental observation of light thermalization to the Rayleigh-Jeans equilibrium in multimode optical fibers. We develop a nonequilibrium thermodynamic description of light thermalization on the basis of the wave turbulence theory by taking into account the impact of disorder (weak and strong random mode coupling), which is inherent to light propagation in multimode optical fibers. The analysis reveals that weak disorder increases the rate of thermalization to equilibrium, whereas strong disorder can inhibit light thermalization.

17:00 : Invited talk

Thermalization of weakly non-integrable Josephson junction networks

Gabriel Lando, Sergej Flach
Institute for Basic Science (Korea)

In this talk I will expand on results previously published by our group, namely that there appear to be two main pathways towards integrability, each with markedly distinguishable features. While previous investigations were focused on abstract discrete unitary maps, I will present results obtained for one- and two-dimensional networks of hundred(s) of coupled Josephson junctions. Such a generalization from maps to high-dimensional Hamiltonian systems is quite a formidable computational task, some aspects of which I will also briefly expose in the presentation.

17:20 : Invited talk

Thermodynamics and pressure of composite multimoded optical systems

N. K. Efremidis[1], **D. N. Christodoulides**[2]
[1] *University of Crete (Greece),* [2] *University of Southern California - Los Angeles (USA)*

We investigate the thermodynamic behavior of composite optical systems. Each component is associated with a different color or polarization and the components are coupled via nonlinear interactions. In a manifestation of Le Chatelier's principle, we find that depending on the type of the nonlinearity, such systems thermalize to different final states. In addition, we compute the partial optomechanical pressure of each component, whereas the total pressure is the direct sum of the partial pressures (Dalton's law).

17:40 : Controlling optical thermalization via spectral engineering: A Kinetic Equation Approach

Tsampikos Kottos
Wesleyan University (USA)

We utilize a kinetic equation approach together with a nonlinear scaling theory for the analysis of optical thermalization in multimode nonlinear photonic networks. We show that spectral engineering, either via band-gap design or via disorder, molds the thermalization process and the formation of the thermal states. Further isomorphisms with the theory of spin networks reveals the existence of optical phase transitions of the thermal equilibrium states, which resemble a paramagnetic to ferromagnetic and to a spin-glass phase transition.

17:55 : Invited talk

Diffusion without Spreading of Wavepackets in Nonlinear Lattices with linear Anderson Localization

Serge Aubry
CEA Saclay (France)

We discuss the long time behavior of a finite energy wave packet in nonlinear Hamiltonians on infinite lattices at arbitrary dimension, exhibiting linear Anderson localization. We find that the probabiity that a wave packet spreads to zero amplitude is zero. It may behave as either a stationary quasiperiodic solution (as in the linear case) or as a chaotic wave packet remaining focused around one of few wandering chaotic spots and generating subdiffusion.

18:15 - 19:00 — Salle P2

Session 1A39

Metamaterials and Metasurfaces

Chaired by: Philipp del Hougne

18:15 : Dielectric polarization-insensitive metasurfaces for Bessel beam generation in light sheet microscopy

Anna Archetti[1], **Matteo Bruzzone**[1], **Giulia Tagliabue**[2], **Marco dal Maschio**[1]
[1] *University of Padua (Italy),* [2] *EPFL (Switzerland)*

We present a method based on wave front engineering for rendering a Bessel Beam (BB) lattice with one single, flat, and lightweight optical element. According to this design, we fabricated and characterized a Silicon Nitride (SiNx) element using Meta-Surface (MS) technology encoding all the operations required to generate the designed BB lattice. Finally, we demonstrated its application in microscopy by integrating it along the excitation path of a light-sheet microscope (LSM) and recording neuronal activity from the zebrafish larva brain.

18:30 : Arbitrarily-broadband dispersion compensation with ultrathin multiresonant metasurfaces

Odysseas Tsilipakos[1], **Thomas Koschny**[2]
[1] *National Hellenic Research Foundation (Greece),* [2] *Iowa State University (USA)*

We propose multiresonant metasurfaces exhibiting a broadband and purely quadratic spectral phase to be utilized for dispersion compensation and in general any application requiring temporal pulse shaping of broadband signals. The proposed metasurfaces require implementing a specific combination of Lorentzian resonances in the electric and magnetic surface conductivities. Our approach overcomes the fundamental limitations of both conventional, non-resonant approaches (too bulky) as well as modern, singly-resonant metasurfaces (too narrowband) and aspires to bring broadband dispersion engineering at ultrathin physical scales.

18:45 : Investigating the Bound States in the Continuum Phenomenon in hBN Nano-antenna Arrays

Harsh Gupta[1], **James Edgar**[2], **Francesco De Angelis**[1], **Andrea Toma**[1], **Michele Tamagnone**[1]
[1] *Italian Institute of Technology (Italy),* [2] *Kansas State University (USA)*

In this study, we present the study of phonon-polariton bound states in the continuum (BIC) modes in an array of elliptical hexagonal boron nitride (hBN) nanoantennas. Using both theoretical analysis and experimental verification, we demonstrate the existence of a red-shifted quasi-BIC (Q-BIC) mode with a high-quality factor along the x-polarization. Additionally, we uncover a novel concept of a blue-shifted Q-BIC mode with a high-quality factor along the y-polarization, which we also verify theoretically and experimentally.

Wednesday 19th July, 2023

08:30 - 09:40 — Grand Amphi

Session 2A1

Plenary Session II

Chaired by: Isabelle Staude

08:30 : Plenary talk
Nanophotonics for tailoring radiation from fast electrons
Marin Soljacic
MIT (USA)

Nanophotonic methods provide intriguing options for manipulating scintillation phenomena. We will outline recent developments in this domain, along with our theoretical framework for modeling these occurrences, supported by our experimental findings. Additionally, Smith-Purcell radiation, characterized by fast electrons interacting with nano-structured materials to produce light, offers a broad spectrum of possibilities for creation of novel light sources. We will discuss our new theoretical framework designed to comprehend and tailor such phenomena, as well as our techniques for boosting Smith-Purcell radiation.

09:05 : Plenary talk
Structuring light with media with higher dimensions: space, time, and more
Nader Engheta
University of Pennsylvania (USA)

In this talk, I will present some of our most recent results on exploring light-matter interaction in material media with high degrees of freedom and dimensions including spatial and/or temporal inhomogeneities, and other degrees of freedom such as anisotropy, ellipticity, and hyperbolicity. We show how light manipulation with such metastructures with high degrees of freedom can lead to exciting novel wave phenomena with potential applications in wave-based reconfigurable analog computing, 4D optics, and other optical devices and components.

Coffee Break

Session 2P1
Poster Session III
9:40 - 10:20

P1: Design and Fabrication for Optical Fourier Surfaces Reaching the Theoretical Upper Limit of Diffraction Efficiency
Yongjun Lim, Seung Jae Hong, Heeju Son, Joona Bang, Seungwoo Lee
Korea University (Korea)

Optical Fourier surfaces (OFSs), which are surface gratings having sinusoidally modulated profiles, can be minimized optical loss due to preventing the mixing of waves with undesired frequencies. In this work, we introduce a novel fabricated method for the perfect OFSs. Our method can generate perfect sinusoidal gratings with high throughput because it is based on holographic mass migration. Furthermore, we demonstrate that our OFSs can reach the theoretical upper limit of diffraction efficiency in the whole visible wavelength range.

P2: Self-assembly of magnetoplasmonic nanowires for structural colors and chiral metasurfaces
My-Chi Nguyen, Huu-Quang Nguyen, Jaebeom Lee
Chungnam Nation University (Korea)

A template-free and one-step synthesis of metal core-magnetic shell Au@FexOy nanowires with high as-

pect ratio was introduced. The magnetic field-induced aligned array film presents unique iridescent structural coloration in different observation and polarization modes. Furthermore, a helical metasurface is assembled resembling Bouligand structure which exhibits circular dichroism tunable by adjusting the magnetic field strength, number of layers, and helical pitch angle. These results demonstrate the capability of self-assembly metasurfaces as groundwork for optical and sensing devices.

P3: Multiresonant nano-optical trap of Rayleigh particles with coaxial plasmonic apertures
Hipólito Alan Arredondo Champi, Rina Huamanrayme Bustamante, Daniel Reinaldo Cornejo, Walter Jaimes Salcedo, José Roberto Castilho Piqueira
Universidade de São Paulo (Brazil)

Nano-optical tweezers based on plasmonic nanostructures have been proposed to overcome the diffraction limit imposed by conventional optical tweezers. As a result, it was possible to reduce the confinement volume of the trap and increase the intensity of the gradient force. However, multiresonant isotropic confinement of nanoparticles still remains a major challenge. In this paper, using electromagnetic modeling, we proposed a multiresonant nano-optical tweezer based on coaxial plasmonic apertures with the ability to trap small nanoparticles smaller than 5 nm.

P4: Metasurface-Based Radome for Wearable Antenna at 24GHz
Maria Elena de Cos Gomez, Alicia Florez Berdasco, Fernando Las-Heras Andrés
Universidad de Oviedo (Spain)

A metasurface-based radome (metaradome) is designed to protect a wearable grid array antenna (GAA) for imaging applications in 24.05GHz-24.25GHz. It provides high transmission and low reflection within the GAA operation frequency band in a wide angular range under oblique incidence. The GAA with metaradome. preserves the GAA operation band and radiation parameters. The overall device' size is 40 x 40 x 3.162 mm3. The envisioned application is collision avoidance in aid to visually impaired people at medium-long distance.

P5: Highly Sensitive Flexible Terahertz Metasensor for Thin Film Sensing
Parveen Joon, Sukhvinder Kaur, Ravendra Kumar Varshney
IIT Delhi (India)

We present a flexible terahertz metamaterial sensor that exhibits inductive capacitive (LC)/dipole resonance, and the effects of varying the thickness of a dielectric analyte on Split Ring Resonator/rod structure have been explored. The sensor is highly sensitive to even small (59.9 GHz/μm) environmental changes as the sensor's geometry results in enhanced localized electric fields.

P6: Conductive coupling induced Dark multipole plasmon modes in hybrid cavities
Sukhvinder Kaur[1], Ravendra Kumar Varshney[1], Dibakar Roy Chowdhury[2]
[1] *IIT Delhi (India),* [2] *Mahindra University (India)*

We have demonstrated the excitation of multipole plasmon modes in a hybrid cavity consisting of a split ring resonator (SRR) in the vicinity of the dipole cavity (hole array) via conductive coupling.

P7: Activation of a quantum emitter in a hBN waveguide for integrated quantum photonics
Domitille Gérard[1], Michael Rosticher[2], Stéphanie Buil[1], Jean-Pierre Hermier[1], Julien Barjon[1], Aymeric Delteil[1]
[1] *Université Paris-Saclay (France),* [2] *Université PSL (France)*

We created single-photon sources that are directly integrated into a monolithic hBN (hexagonal Boron Nitride) waveguide. The color centers are locally activated using an electron beam and emit photons at 436 nm that couple to the guided mode and can be collected after having crossed the waveguide. Such structure would be the starting point for designing a nanophotonic circuit.

P8: Controlling High-Q Lattice Resonances in Bipartite Plasmonic Arrays through Nanoparticle Geometry and Orientation
Timo Stolt, Jussi Kelavuori, Ali Panahpour, Mikko J. Huttunen
Tampere University (Finland)

We numerically investigated plasmonic nanoparticle (NP) arrays with bipartite lattice configuration. The lattice periodicities were selected to give rise surface lattice resonances (SLRs) at two separate wavelengths in the near-infrared region. We show that the quality factors of the SLRs can be considerably improved by modifying the NP geometry and mutual orientation. NP modification also impacted the local-field distributions associated

with SLRs, which is expected to have a significant impact on the nonlinear responses of the studied structures.

P9: Near unity Raman beta-factor of surface enhanced Raman scattering in a waveguide
Ming Fu[1], Monica Mota[1], Xiaofei Xiao[1], Andrea Jacassi[1], Nicholas Gusken[1], Huaifeng Xiao[1], Yi Li[2], Ahad Riaz[1], Stefan Maier[1], Rupert Oulton[1]
[1] *Imperial College London (United Kingdom),* [2] *Southern University of Science and Technology (China)*

We show that SERS from monolayer 4-Aminothiophenol (4-ATP) bonded to a plasmonic gap waveguide is directed into a single mode with $> 99\,\%$ efficiency. Although sacrificing a confinement dimension, we find 103x SERS enhancement across a broad spectral range, enabled by the plasmonic waveguide's larger sensing volume and non-resonant waveguide mode. Waveguide-SERS (W-SERS) is bright enough to image Raman transport across the waveguides. This exposes the roles of nanofocusing, the Purcell effect and the spontaneous Raman scattering factor, or Raman β-factor.

P10: Tunable band structures coupled by spin-orbit interaction in self-organized photonic potential inside a liquid crystal optical microcavity
Marcin Muszynski[1], Przemyslaw Oliwa[1], Eva Oton[2], Rafal Mazur[2], Przemyslaw Morawiak[2], Wiktor Piecek[2], Przemyslaw Kula[2], Barbara Pietka[1], Jacek Szczytko[1]
[1] *University of Warsaw (Poland),* [2] *Military University of Technology (Poland)*

To obtain and control remarkable polarization properties of light, we consider a self-organizing, one-dimensional photonic potential inside a liquid crystal optical microcavity. Anisotropic modulation of the refractive index gives rise to two separated band structures for orthogonal, linear polarizations of light that interact with each other through spin-orbit coupling. The soft matter approach allows for efficient tuning of the bands with an external electric field.

P11: Two-photon interference from a position-controlled quantum emitter in hexagonal boron nitride
Clarisse Fournier, Sébastien Roux Roux, Aurélie Pierret, Michael Rosticher, Stéphanie Buil, Julien Barjon, Jean-Pierre Hermier, Aymeric Delteil
Université Paris-Saclay (France)

We investigate two-photon interference of a quantum emitter generated in hexagonal boron nitride (hBN) using an electron beam. We measure the correlations of zero-phonon-line photons in a Hong-Ou-Mandel (HOM) interferometer under non-resonant excitation. We find that the emitted photons exhibit a partial indistinguishability of 0.56 ± 0.11 in a 3 ns time window, after accounting for imperfect emitter purity. With this result, we provide the first demonstration of photon indistinguishability from a 2D material quantum emitter.

P12: Tailoring Nanowire Lasing Modes via Coupling to Metal Gratings
Francesco Vitale, Daniel Repp, Thomas Siefke, Uwe Zeitner, Ulf Peschel, Thomas Pertsch, Carsten Ronning
Friedrich-Schiller-Universität Jena (Germany)

In this study, we proposed a lasing mode selection scheme based on distributed feedback, achieved via the external nano-manipulation of single zinc oxide nanowires onto an aluminum grating. By orienting the nanocavity perpendicular to the ridge direction, we identified an additional peak in the emission spectrum on the low-energy side of the gain envelope. As a consequence of the fulfillment of the Bragg condition, such a peak was attributed to a novel hybrid mode dominating the mode competition.

P13: Dyes emission mediated by plasmonic nanostructures revealed by SNOM
Anna Mercedi, Lucio Litti
University of Padova (Italy)

Looking at an object is the most direct approach to define and describe it. Scanning near field optical microscopy (SNOM) is part of the Scanning Probe Microscopy techniques. Its unique characteristic is to shed light in the nanoscale, overcoming the diffraction limit while simultaneously providing topographical images. These reasons make this technique a powerful tool to directly correlate the complex mechanisms and structure/activity relationships that affect the emission properties of a fluorescent dye located near a plasmonic nanostructure.

P14: Photonic topological phases in pseudochiral metamaterials
Ruey-Lin Chern, Ti-Jung Hsu
National Taiwan University (Taiwan)

We investigate the photonic topological phases in pseudochiral metamaterials characterized by magneto-electric tensors with symmetric off-diagonal chirality components. The underlying medium is considered a photonic analogue of the type-II Weyl semimetal featured with two pairs of tilted Weyl cones in the frequency-wave vector space. Surface modes at the interface between vacuum and the pseudochiral metamaterial exist in their common gap in the wave vector space, which form two pairs of crossing surface sheets that are symmetric about the transverse axes.

P15: A Non-Interleaved Bidirectional Janus Metasurface with Full-Space Scattering Channels
Guanyu Shang, Zihan Zhao, Xumin Ding
Harbin Institute of Technology (China)

Our metasurface with broken mirror symmetry can fully exploit four independent information channels under opposite propagation directions. A series of proof-of-concept is constructed to validity of our methodology, and the simulations and experimental results further show that the proposed non-interleaved bidirectional metasurface can provide an attractive platform for various applications, ranging from structured light conversion, optical imaging, multifunctional optical information processing and others.

P16: Optical matrix computation using programmable metalens array
Randy Stefan Tanuwijaya, Hong Liang, Jiawei Xi, Tsz Kit Yung, Wing Yim Tam, Jensen Li
HKUST (Hong Kong)

We propose and experimentally demonstrate a programmable matrix computation in the optical domain using a spatial light modulator (SLM) and a metalens array. Our scheme encodes the programmable matrix to the metalens array by superimposing multiple phase gradients. Meanwhile, the SLM produces a phase-controlled spatial illuminated light which acts as our input vector. Then, the result can be extracted from the far-field interference pattern constructed by different metalenses using a pattern recognition method.

P17: Fabrication of Mie-resonant nanostructures using laser annealing for highly sensitive fluorescence spectroscopy
Tatsuya Fukuta, Ryo Kato, Takuo Tanaka, Taka-Aki Yano
Tokushima University (Japan)

High refractive index dielectric nanoparticles have gained considerable attention as an alternative to plasmonic nanoparticles. In this study, we developed a new method for producing Mie resonant silicon nanoparticles using laser annealing, and were able to control the Mie resonance wavelength across the entire visible region by adjusting the laser annealing conditions. The Mie resonant Si nanoparticles were then utilized to enhance the fluorescence of analytes in their vicinity.

P18: Laser Anneal for Selective Crystallization of Magnetooptical Film
Hibiki Miyashita, Yuki Yoshihara, Takumi Koguchi, Pang Boey Lim, Mitsuteru Inoue, Kazushi Ishiyama, Taichi Goto
Tohoku University (Japan)

A laser heating technique was used to selectively anneal a magnetic garnet film in a vacuum, which can be useful for integrating devices with other electronic or optical devices. The film was deposited on a synthetic fused silica substrate, and the laser was scanned in-plane to anneal the sample. Two types of periodical Ce:YIG structures were fabricated using the constructed laser annealing system, which could provide additional functionalities.

P19: Hybrid Dielectric-Plasmonic Nanoantenna with Multiresonances for Subwavelength Photon Sources
Emmanuel Lassalle[1], Pavel A. Dmitriev[1], Lu Ding[1], Darren C. J. Neo[1], Vytautas Valuckas[1], Ramon Paniagua-Dominguez[1], Joel K. W. Yang[1], Hilmi V. Demir[2], Arseniy I. Kuznetsov[1]
*[1]A*STAR (Singapore), [2]Nanyang Technological University (Singapore)*

In this talk, we propose and demonstrate single subwavelength hybrid dielectric-plasmonic optical nanoantennas coupled to localized quantum dot emitters that constitute efficient and bright unidirectional photon sources under optical pumping. To achieve this, we devised a silicon nanoring sitting on a gold mirror with a 10 nm gap in-between, where an assembly of colloidal quantum dots is embedded, and obtain experimentally total fluorescence enhancement up to 600-fold, due to high radiative efficiency.

P20: Au/Ag SERS active substrate for broader wavelength excitation

Sebin Augustine, Mahesh Saini, Sooraj KP, Mukesh Ranjan
Institute for Plasma Research (India)

We present a two-stage process for developing dense Au-coated Ag nanoparticle arrays on ion-beampatterned nano-rippled Si substrates for broader range Surface Enhanced Raman Spectroscopy (SERS). Thesesubstrates show LSPR excitation in a broader wavelength range and good enhancement for 532 and 785 nmlasers. Results are qualitatively compared with FDTD simulations where the effect of interparticle gap andAu/Ag layer thickness on their SERS enhancement is explored.

P21: Modifying the integer quantum Hall effect with cavity vacuum fields
Josefine Enkner[1], F. Appugliese[1], G. L. Paravicini-Bagliani[1], M. Beck[1], C. Reichl[1], W. Wegscheider[1], G. Scalari[1], C. Ciuti[2], Jerome Faist[1]
[1] *ETH Zurich (Switzerland),* [2] *Université Paris Cité (France)*

As reported by Appugliese et al. as you immerse a Hall bar into the cavity vacuum fields of a 2-dimensional metamaterial, a split ring resonator (THz), the interaction with vacuum fields not only modifies the finite resistances of the Shubnikov de Haas oscillations in the diffusive transport regime, but it also breaks the topological protection in the integer quantum hall regime. We quantify this loss of quantization as vacuum field induced resistivity that is directly linked to the Rabi frequency.

P22: Imaging of Anti-ferroelectric Dark Modes in an Inverted Plasmonic Lattice
Javier Rodriguez Alvarez[1], Amilcar Labarta[1], Juan Carlos Idrobo[2], Rossana Dell'Anna[3], Alessandro Cian[3], Damiano Giubertoni[3], Xavier Borrisé[4], Albert Guerrero[4], Francesc Perez-Murano[4], Arantxa Fraile Rodriguez[1], Xavier Batlle[1]
[1] *Universitat de Barcelona (Spain),* [2] *University of Washington (USA),* [3] *FBK - Bruno Kessler Foundation (Italy),* [4] *CSIC (Spain)*

In this work an inverted plasmonic honeycomb lattice is studied by using state-of-the-art fabrication techniques, optical and electron spectroscopy, and simulations. The plasmonic lattice exhibits several bright and dark modes in the visible and near-infrared energy regime. Moreover, dark modes with anti-ferroelectric charge distributions that extent out of the unit cell of the honeycomb lattice have been experimentally found.

P23: Electronic beam steering using a reconfigurable metasurface
Nawel Meftah[1], Badreddine Ratni[1], Mohammed Nabil El Korso[2], Shah Nawaz Burokur[1]
[1] *Université Paris Nanterre (France),* [2] *Université Paris-Saclay (France)*

A 2D reconfigurable reflective metasurface with individually addressable unit cells incorporating voltage-controlled varactor diodes is proposed. This metasurface illuminated by a primary source is used as a reconfigurable parabolic reflector antenna, enabling an electronic control of beam steering by assigning the appropriate phase profile along the metasurface through capacitance modulation.

P24: Supersymmetric Reshaping and Higher-Dimensional Rearrangement of Photonic Lattices
Tom Wolterink, Matthias Heinrich, Alexander Szameit
University of Rostock (Germany)

Self-imaging Jx photonic lattices enable perfect imaging and coherent transfer of quantum and classical states, yet their large-scale implementation remains challenging. We harness supersymmetry to engineer compacted two-dimensional systems that exhibit imaging and state transfer characteristics equivalent to one-dimensional Jx lattices and experimentally investigate their dynamics.

P25: Controlling Förster Resonance Energy Transfer in Plasmonic Nanopatch Antennas
Abdullah O. Hamza, Francesco N. Viscomi, Jean-Sebastien G. Bouillard, Ali Adawi
University of Hull (United Kingdom)

Successful control of Förster resonance energy transfer (FRET) through the engineering of the local density of states (LDOS) will allow us to develop novel strategies to fully exploit this phenomenon in key enabling technologies. Here we present an experimental and theoretical study on the effect of LDOS on the FRET rate and efficeny in plasmonic nanopatch antennas. Our results reveal that FRET rate is linearly dependent on LDOS and LDOS plays an important part in controlling FRET efficiency and range.

P26: Photon production in cavity: Quasinormal modes as a tool for quantum dynamics
Maxime Federico, Hans-Rudolf Jauslin
Université de Bourgogne (France)

We discuss the construction of a model using quasinormal modes (QNMs) to describe the production of single-photons inside a leaky cavity. Our approach is based on the fact that photon's dynamics is given by Maxwell's equations. By taking advantage of this property, we construct a hybrid basis made of truncated QNMs inside the cavity and completed with any other basis outside. The completeness allows to write a quantum Hamiltonian interacting with an emitter expressed with creation-annihilation operators directly on QNMs.

P27: Metamaterial Based Miniaturized Broad Band Acoustic Absorber
Santosh Dasila, Venkatachalam Subramanian, C. V. Krishnamurthy
Indian Institute of Technology Madras (India)

A miniaturized, broadband (800 Hz - 5000 Hz) absorber with $> 95\,\%$ absorption is proposed and realized. The absorber is designed using quarter-wavelength resonator tubes coiled as a rectangular "meta-atom."The study describes the basic theoretical aspects of the absorber and compares it with the numerical simulations, fabrication, and experimental validation. The meta-atom, simple in design and made with fabrication-friendly materials, can provide greater spatial coverage through tiling over large surfaces.

P28: Engineering of a THz time-reversal symmetry breaking chiral metamaterial
Lorenzo Graziotto, Johan Andberger, Luca Sacchi, Mattias Beck, Giacomo Scalari, Jerome Faist
ETH Zurich (Switzerland)

A metamaterial of resonators capable of sustaining circularly polarized electromagnetic modes has been developed and it is reported to give rise to chiral light-matter hybrid states when coupled to the cyclotron resonance of a two-dimensional electron gas. The cavity design, which is crucial to ultra-strongly couple to the solid-state system, could potentially be implemented to manipulate topological properties of materials, or to affect their transport behavior, about which one can gain insights via a circuit model that we have developed.

P29: Metal-insulator transition in vanadium dioxide studied by analytical transmission electron microscopy
Michal Horak, Jan Krpensky, Jakub Planer, Peter Kepic, Jiri Kabat, Tomas Sikola, Andrea Konecna, Vlastimil Krapek
Brno University of Technology (Czech Republic)

We present a comprehensive study of vanadium dioxide, a phase-changing material relevant for active plasmonics and optical metasurfaces, using analytical scanning transmission electron microscopy combined with in-situ heating. A combination of imaging, diffraction, and spectroscopy with nanometer spatial resolution allowed us to locally correlate the optical properties with applied temperature and local variations in stoichiometry. We observed a reduction of the oxide for sample thickness below 30 nm and the formation of nanoparticles at elevated temperatures.

P30: Quasi-Dark States: A New Frontier in Light Enhancement and Control based on metasurface structures
Hicham Mangach[1], Abdenbi Bouzid[2], Younes Achaoui[2], Shuwen Zeng[1]
[1] *Université de Technologie de Troyes (France),* [2] *Moulay Ismail University (Morocco)*

Quasi-dark states in optical metasurfaces has a significant impact on the control of electromagnetic fields at subwavelength scales. These exceptional states, resembling bound states, have resulted in unparalleled light enhancement and a dramatic increase in the quality factor under the resonance condition. This phenomenon has been recently employed for refractometric sensing and near-field imaging. In this study, we demonstrate a hybrid metasurface without inversion symmetry, revealing a quasi-bound state in the continuum with a remarkable field enhancement at subwavelength scales.

P31: Invariance of the transmitted field in a periodic waveguide
Elie Salemeh, S. Félix, Vincent Pagneux
LAUM (France)

A characteristic of the localized regime in a disordered medium is the insensitivity of the transmitted speckle pattern to the incident wave. We show that a similar phenomenon is possible in an ordered, periodic medium, when the wave is mainly carried by a dominant Bloch mode. The work presented aims to characterize this phenomenon in the case of propagation in a periodic acoustic waveguide.

10:20 - 12:40 — Grand Amphi

Session 2A2

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Andrea Alù

10:20 : Keynote talk
The Challenge of Photonic Crystals (and Meta-Materials) is Inverse Electromagnetic Design (Aperiodic)
Eli Yablonovitch
UC Berkeley (USA)

Inevitably, in electromagnetics, there is a goal, and it may be that the goal is best achieved by an aperiodic rather than a periodic design. Then there is a universal question: What is the best design to achieve a specific goal?

10:50 : Keynote talk
Crossroads of Nanophotonics and Machine Learning
Alexandra Boltasseva
Purdue University (USA)

We report on advancing machine-learning-assisted optical inverse design optimization for metasurfaces with applications in thermophotovoltaics, reflective optics, and lightsail technology as well as for on-chip quantum photonic components and super-resolution imaging.

11:20 : Invited talk
Symmetry, connectivity, and topology in photonic crystals
Thomas Christensen
Technical University of Denmark (Denmark)

Symmetry imposes strong constraints on the frequency dispersion and topology of photonic crystal bands. I will describe several interesting consequences of these constraints, highlighting implications for the connectivity of photonic bands, the prevalence of photonic topology, and the outlook for having frequency-isolated topological degeneracies at high-symmetry points in the Brillouin zone.

11:40 : Invited talk
3D nanoprinting using light
Maria Farsari
FORTH (Greece)

Multiphoton Lithography is a laser-based additive manufacturing technique which allows fabrication with resolution down to a few tens of nanometres. Based on nonlinear absorption, Multiphoton Lithography has unique capabilities that no-other technique can provide. It has been implemented with a variety of materials and several components and devices have been fabricated such as metamaterials, biomedical devices, photocatalytic systems and mechanical models. I summarize the principles of microfabrication, and present recent research in materials processing and functionalization of 3D structures.

12:00 : Invited talk
Graphene-based 2D Plasmonic Metamaterials for Terahertz Laser Transistors
Taiichi Otsuji, S. Boubanga-Tombet, C. Tang, A. Satou, V. Ryzhii, K. Wojciech, D. Yadav, K. Narahara, M. Ryzhii, V. Mitin, M. S. Shur
Tohoku University (Japan)

This paper reviews recent advances in the research and development of graphene-based 2D plasmonic metamaterials for terahertz (THz) laser transistors.

12:20 : Invited talk
Hybrid bullseye-nanotip antennas for bright directional single photon sources

Hamza Abudayyeh[1], **Annika Mildner**[2], **Julia Fulmes**[2], **Regina Jäger**[2], **Dror Liran**[1], **Boaz Lubotzky**[1], **Lars Luder**[2], **Florian Laible**[2], **Alfred Meixner**[2], **Dieter Kern**[2], **Ronen Rapaport**[1], **Monika Fleischer**[2]
[1] *The Hebrew University of Jerusalem (Israel),* [2] *Eberhard Karls University Tübingen (Germany)*

Single-photon sources that form the basis for various quantum applications have seen fast development. The deterministic generation of single photons can amongst others be realized by semiconductor quantum dots. To achieve efficient sources, parameters such as the brightness, photon rates, directionality, room-temperature stability, etc. need to be optimized. To modify the emission properties of individual quantum dots, they can be coupled to nano-antennas. Here a design that enables bright room-temperature quantum light sources is demonstrated.

10:20 - 12:40 — Amphi Bezier

Session 2A3

Resonant Optics – Fundamentals and Applications

Organized by: Sven Burger, Philippe Lalanne and Frank Vollmer

Chaired by: Frank Vollmer and Philippe Lalanne

10:20 : Invited talk
Photonic resonances in next-level metrology and precision experiments
Stefanie Kroker[1], **Bernd Bodermann**[2], **Johannes Dickmann**[1], **Tim Käseberg**[2], **Mika Gaedtke**[1], **Steffen Sauer**[1], **Thomas Siefke**[3]
[1] *Technische Universität Braunschweig (Germany),* [2] *Physikalisch-Technische Bundesanstal (Germany),* [3] *Friedrich-Schiller-Universität (Germany)*

Photonic resonances are a viable mechanism to shape and switch the properties of light. Besides that, they allow tailoring light mater interaction, opening new pathways in next-level optical metrology and precision experiments. Applications range from non-invasive nanometrology beyond conventional diffraction limits to compact and robust sensors and the world's most stable optical atomic clocks. This contribution provides an overview of selected metrological applications of photonic resonances and the most important physical properties to achieve optimum measurement precision.

10:40 : Invited talk
Towards a highly directional hybrid Mie-Tamm optical cavity for high-performance single-photon sources
José Manuel Llorens Montolio[1], **Anna Nowak**[2], **José Maria Ulloa**[3], **Benito Alén**[1]
[1] *Institute of Micro and Nanotechnology (IMN-CSIC) (Spain),* [2] *g2-Zero S.L. (Spain),* [3] *Universidad Politécnica de Madrid (Spain)*

We propose a Mie-Tamm optical cavity structure (MTOCS) that can enhance the photon flux of a quantum emitter above 3 GHz within a small numerical aperture collection cone. Our design uses a nested cavity system in which the quantum emitter's emission is coupled to an extended Tamm mode through Mie resonances supported by a nanocylinder. This approach enables highly efficient light-matter interactions in nanophotonic systems, making it suitable for single-photon sources.

11:00 : Invited talk
Engineered Solid-State Quantum-Light Sources for Quantum Networking
Tobias Heindel
Technische Universität Berlin (Germany)

In this talk I present our recent progress in the field of solid-state quantum light sources for applications in quantum networking. In this context I present recent advances in the numerical optimization and fabrication of quantum light sources, designed for the direct coupling to single-mode optical fibers, and their application in quantum communication testbeds operating at wavelengths around 800, 1300, and 1550 nm.

11:20 : Quasi normal mode perturbation theory to achieve Q factor optimization of resonances in

disordered photonic systems
Nicoletta Granchi[1], **Francesca Intonti**[1], **Massimo Gurioli**[1], **Guillermo Arregui**[2]
[1] *University of Florence (Italy),* [2] *DTU Electro (Denmark)*

The optimization of the quality factor (Q) of photonic resonators is of great importance for applications exploiting both ordered and disordered systems. Here we propose a gradient-based automated optimization approach to maximize the Q of optical resonances in ordered and disordered dielectric slabs which uses first-order non-hermitian perturbation theory. By applying our method to optimize a selected Anderson mode in a random design exhibiting a Q-factor of 200, a new mode displaying Q = 105 is generated.

11:35 : Invited talk
Optomechanics of Quasi-Bound States in the Continuum of Dielectric Metasurfaces
Simone Zanotto
CNR-Istituto di Nanoscienze (Italy)

Quasi-Bound States in the Continuum (Q-BICs) are here investigated by means of optomechanic spectroscopy. With this technique, the metasurface is driven into motion according to its mechanical eigenstates, and the time-dependent optical transmission is detected and demodulated at the mechanical frequency. Here we show that this method allows to reveal fine features of Q-BICs hardly observable with conventional spectroscopy. In addition, we believe that our work opens interesting technological perspectives for high-quality factor metasurface-based optical modulators.

11:55 : Quasinormal Mode Theory for Nanoscale Electromagnetism informed with the Feibelman's d-Parameter Treatment
Qiang Zhou, Pu Zhang, Xue-Wen Chen
Huazhong University of Science and Technology (China)

We report a self-consistent quasinormal mode theory for nanometer scale electromagnetism where the possible nonlocal and quantum effects are treated through the Feibelman's d-parameters. With the frequency-dependent d-parameters to describe the quantum surface responses, which are reminiscent of the permittivity function, we formulate the source-free Maxwell's equations into a generalized linear eigenvalue problem to define the quasinormal modes. We then construct an orthonormal relation for the modes and consequently unlock the powerful toolbox of modal analysis.

12:10 : Keynote talk
Ultra low loss nonlinear integrated photonic circuits: from soliton microcombs, traveling wave parametric amplifiers, chip based Erbium amplifiers to cryogenic quantum interconnects
Tobias Kippenberg
EPFL (Switzerland)

Recent advances in attaining ultra low loss highly confining silicon nitride waveguides with loss in the dB-meter range, and their heterogeneous integration with MEMS and Lithium Niobate have opened up novel applications that exhibit both low cost, and scalable manufacturing but also performance that is on par or exceeding that of legacy optical systems. I will describe a range of novel advances, including photonic integrated circuit based frequency agile lasers, wave amplifiers, as well as soliton frequency combs.

10:20 - 12:50 — Amphi Fournel

Session 2A4

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Davy Gérard and Pedro Hernandez Martinez

10:20 : Invited talk
Near-Infrared plasmon-induced hot electron extraction in an Indium Tin Oxide/Monolayer Molybde-

num Disulfide Heterostructure

Michele Guizzardi, Michele Ghini, Andrea Villa, Luca Rebecchi, Qiuyang Li, Giorgio Mancini, Xiaoyang Zhu, Ilka Kriegel, Francesco Scotognella
Politecnico di Milano (Italy)

In this work, we observe near-infrared plasmon induced hot electron extraction in a heterostructure between indium tin oxide nanocrystals and monolayer molybdenum disulphide. We excite the sample at 1750 nm, resonant with the indium tin oxide plasmon and we observe the excitonic features of molybdenum disulphide in the visible range, close to the exciton of molybdenum disulphide. Such phenomenon can be ascribed to a charge transfer between indium tin oxide nanocrystals and monolayer molybdenum disulphide upon plasmon excitation.

10:40 : Invited talk

Guided mode resonance enhanced upconversion luminescence of upconversion nanoparticles for immunoassay with ultralow limit of detection

Yu-Chung Chiu[1], Yen-Ta Tseng[1], Van Dai Pham[1], Wen-Hsuan Wu[1], Thanh Thu Le Vu[1], Chao-An Chang[1], Lai-Kwan Chau[1], Shiao-Wei Kuo[2], Michael WY Chan[1], Hung-Chih Kan[1], Jiunn-Yuan Lin[1], Chia Chen Hsu[1]
[1] *National Chung Cheng University (Taiwan),* [2] *National Sun Yat Sen University (Taiwan)*

A low refractive index resonant waveguide grating (RWG) is integrated with up-conversion nanoparticles (UCNPs) to from a sandwich type immunoassay. Guided mode resonance enhanced evanescent field is formed atop of the RWG to enhance upconversion luminescence of UCNPs in aqueous and the detection sensitivity of the bioassay is greatly increased. The limit of detection of the bioassay is 0.42 fg/mL for the detection of cardiac troponin I, which is 6 orders lower than acute myocardial infarction threshold value ($\sim$28 pg/mL).

11:00 : Keynote talk

Bioanalytics using plasmonic nanostructures

S. Kastner, E. Podlesnaia, F. Seier, Y. Luximun, A. Dietel, M. Urban, A. Csaki, Wolfgang Fritzsche
Leibniz Institute of Photonic Technology (Germany)

The effect of localized surface plasmon resonance (LSPR) on chemically synthesized gold nanoparticles is utilized to setup a biosensing platform with the potential for sensitive and specific detection of biomolecules of interest such as biomarkers. This principle is demonstrated both on a single particle level for DNA detection, then extended also to proteins, and to arrays of particles. In order to readout the arrays, imaging spectrometer were developed.

11:30 : Invited talk

Multiresonant and Nonlinear Metasurface-Waveguide Hybrid Structures

Mikko Huttunen, Jussi Kelavuori, Ali Panah Pour, Timo Stolt, Anna Vesala
Tampere University (Finland)

Collective lattice excitations known as surface lattice resonances (SLRs) enable to realize high-Q factor metasurface resonators. Here, we show how multiple high-Q SLRs can be utilized to realize flat resonators with a potential of increasing the nonlinear optical responses of metasurfaces. We will also theoretically demonstrate an approach towards ultra-high-Q SLRs ($Q > 10\ 000$) by studying hybrid metasurface-waveguide structures.

11:50 : Invited talk

Chirality without mirrors

Rahul Kumar[1], Ben Trodden[1], Anastasiia Klimash[1], Affar Karimullah[1], Nikolaj Gadegaard[1], Peter J. Skabara[1], Shun Hashiyada[2], Gordon J. Hedley[1], Malcolm Kadodwala[1]
[1] *University of Glasgow (United Kingdom),* [2] *RIKEN (Japan)*

Chirality is a the concept of asymmetry, physical objects which possess the property lack mirror symmetry and exist in non-superimposible mirror image forms. We demonstrate how a chirality can be instilled into a moelcule without the need to manipulate geometry, using a electromagnetic mechanism invoving strong coupling to a chiral mode of an optical cavity.

12:10 : Invited talk

Vacuum Ultraviolet Light Generation and Circular Polarization Control Using Dielectric Nanomembranes

Kuniaki Konishi
The University of Tokyo (Japan)

We have demonstrated that dielectric free-standing thin film (Nanomembranes) with a thickness of several-hundred nanometers can generate coherent vacuum ultraviolet (VUV) light efficiently and tunably based on third harmonic generation (THG). We have also demonstrated the generation of circularly-polarized VUV THG in a dielectric nanomembrane with a square periodic lattice of circular hole. The presented results show that nanomembranes and their nanostructures are an effective new way to generate and control vacuum ultraviolet coherent light.

12:30 : Invited talk
Foerster-Type Nonradiative Energy Transfer in Media with Complex Permittivity
Pedro Ludwig Hernandez Martinez, Abdulkadir C. Yucel, Hilmi Volkan Demir
Nanyang Technological University (Singapore)

We present the effects of the complex permittivity of a background medium on Foerster-type nonradiative energy transfer (FRET) and the changes in FRET as a function of the relative permittivity of the medium. We discuss examples of enhanced FRET via tuning the complex permittivity of the medium and illustrate that FRET can significantly increase when the denominator of the FRET screening factor approaches zero.

10:20 - 12:20 — Amphi Esquillan

Session 2A5

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

10:20 : Invited talk
Magnetoelectric coupling of topological magnets for spintronic and quantum information applications
Tomoki Hirosawa
Aoyama Gakuin University (Japan)

In multiferroic materials, the magnetic and electric dipole moments are strongly coupled with each other. Here, we propose a novel method to control multiferroic skyrmions via magnetoelectric coupling, which have swirling spin textures characterized by an integer topological charge. Firstly, we consider skyrmions under high-frequency laser irradiation. We find the laser-driven skyrmion motion and laser-controlled magnon band topology. Secondly, we introduce the magnetoelectric magnon-photon coupling by placing skyrmion crystals inside a microwave cavity and discuss potential applications in quantum information.

10:40 : Invited talk
The optical Dirac equation and confined modes at chiral, magnetoelectric, and non-Hermitian interfaces
Simon Horsley
University of Exeter (United Kingdom)

Despite describing particles of different spin, the structure of the classical Maxwell equations and the Dirac equation is almost identical. I will show this is useful for navigating the space materials, where in differing cases we can understand magneto-electric materials as an effective mass, or gauge field for light. I shall show how this analogy enables us to find new interface modes without ever solving Maxwell's equations, in addition to finding one-way propagating optical edge modes, and perfect absorbers.

11:00 : Invited talk
Emergent inductance by dynamical ferromagnetic nanostructures
Jun'ichi Ieda
Japan Atomic Energy Agency (Japan)

Emergent inductance appears universally when magnetization dynamics is coupled with conduction electrons based on a sequential action of spin torque and spinmotive force effects under ac currents. An original version of the emergent inductor using a spiral magnet can be extended to include the spin-orbit coupling effects. A striking common feature among emergent inductors is their size dependence of the effect, the inductance is inversely proportional to the sample cross-sectional area, opening a way for integrating an inductor element.

11:20 : Invited talk
Gain-enhanced chiral sensing with achiral metasurfaces
Sotiris Droulias
University of Piraeus (Greece)

Metasurfaces are ideal platforms for enhancing the inherently weak chiroptical signals of natural optically active molecules. Intuitively, the introduction of gain could provide the desired enhancement, however requires gain media that can couple directly to the chiral medium. In this work, it is shown that metasurfaces can mediate the coupling between the gain and chiral medium, enabling enhanced chiral sensing. The coupling mechanisms are analyzed and, through numerical simulations, the regimes and conditions for enhanced chiral sensing are demonstrated.

11:40 : Invited talk
Photocurrent induced by the momentum-space Berry phase in magnetic materials at a microwave frequency
Hiro Ishizuka, Akira Harada
Tokyo Institute of Technology (Japan)

The low symmetry of chiral materials realizes electromagnetic phenomena prohibited by symmetry inmost materials. For instance, recent studies on Weyl semimetals discovered the photovoltaic effect andmagnetoresistance reflecting the Berry phase. Drawing inspiration from the adiabatic charge pump, we discussthat another kind of Berry phase, the Berry phase arising from the magnetic dynamics, induces a photocurrentthrough a mechanism similar to the adiabatic pump, a topological effect known in driven systems.

12:00 : Invited talk
Chirality sensing employing parity-time symmetric and general gain-loss media
Ioannis Katsantonis, Maria Kafesaki
University of Crete (Greece)

We demonstrate the potential of gain materials and parity-time symmetric systems to enhance the circular dichroism response and the dissymmetry factor of molecular chiral systems, highly facilitating thus the sensing of such systems and the discrimination of the different enantiomers, issue critical in biology and pharmaceutics.

10:20 - 12:35 — Amphi A

Session 2A6

Advanced Computational Electromagnetics for the Analysis and Design of Nanophotonic Devices

Organized by: Maha Ben Rhouma and Kofi Edee

Chaired by: Riccardo Messina

10:20 : Invited talk
Efficient Design of 2D Slanted Gratings using Polynomial Modal Method
Kofi Edee, Gerard Granet, Pierre Bonnet
Universite Clermont Auvergne (France)

We present an efficient approach to design 2D gratings using the polynomial modal method (PMM). The PMM is a rigorous modal method based on orthogonal and modified polynomials, as proposed by. By utilizing the covariant form of Maxwell's equations, we accurately account for boundary conditions. We demonstrate the

effectiveness of our method through several relevant numerical examples.

10:40 : Invited talk
Local-rational models for the adaptive frequency sampling of nanophotonic simulations
Francesco Ferranti, Dries Peumans
Vrije Universiteit Brussel (Belgium)

Adaptive frequency sampling (AFS) algorithms can be used to prevent under/oversampling by automatically selecting a minimal set of frequencies, so that each frequency sample contains as much valuable information as possible about a nanophotonic device's behavior. This work investigates a novel AFS algorithm based on a local rational modeling (LRM) technique. LRM techniques can greatly mitigate issues associated to the model order selection when rational models are used to drive the AFS process. LRM techniques are suitable for parallel computing.

11:00 : Invited talk
Multifunctional metasurface optics for imaging and sensing
Fan Yang, Hung-I Lin, Juejun Hu, Tian Gu
Massachusetts Institute of Technology (USA)

Optical metasurfaces, planar subwavelength nanoantenna arrays with the singular ability to sculpt wavefront in almost arbitrary manners, are poised to become a powerful tool enabling compact and high-performance optics. Multifunctional metasurfaces, whose optical response vary according to the operation conditions, further allow a plurality of new functionalities unattainable with traditional optical approaches. In this talk, we discuss multifunctional meta-optics designs and demonstrations in imaging and sensing applications.

11:20 : Quantum Hydrodynamic Theory for Plasmonics: a Computational Perspective
Cristian Ciraci[1], Michele Castriotta[1], Henrikh Baghramyan[1], Muhammad Khalid[2], Fabio Della Sala[1]
[1] *Istituto Italiano di Tecnologia (Italy),* [2] *CNR-Nanotec (Italy)*

In this talk, we discuss the computational aspects of the quantum hydrodynamic theory (QHT). We review the theoretical basis of the QHT and discuss the numerical methods used to solve the QHT and discuss the challenges associated and applications.

11:35 : Invited talk
Efficient computation of EM scattering from a dielectric cylinder partially covered with a graphene strip
Youssef Jeyar, Brahim Guizal, Mauro Antezza
Université de Montpellier (France)

We present a numerical approach for the solution of EM scattering from a dielectric cylinder partially covered with graphene. It is based on a classical Fourier-Bessel expansion of the fields inside and outside the cylinder to which we apply the ad-hoc boundary conditions in the presence of graphene. Due to the singular nature of the electric field at the ends of the graphene sheet, we introduce auxiliary boundary conditions to better take this reality into account.

11:55 : Invited talk
Time-Varying Photonics
Matias Koivurova, Charles Robson, Marco Ornigotti
Tampere University (Finland)

In this talk, I will discuss the propagation of electromagnetic waves in time-varying media, described by a new wave equation, that also accounts for longitudinal accelaration. In particular, I will discuss how in this new framework fields remain continuous across interfaces, and how this can be connected to the concept of propert time in general relativity. Finally, I will discuss how the propagation of light in time-varying media allows for new insight to the long-standing problem of the Abraham-Minkowski controversy.

12:15 : Invited talk
Chiral nanophotonic waveguides for spin-based quantum optical devices
Hamidreza Siampour[1], Christopher O'Rourke[2], Alistair J. Brash[2], Maxim N. Makhonin[2], René Dost[2], Dominic J. Hallett[2], Edmund Clarke[2], Pallavi K. Patil[2], Maurice S. Skolnick[2], A. Mark Fox[2]
[1] *Queen's University Belfast (United Kingdom),* [2] *University of Sheffield (United Kingdom)*

We present a symmetry-broken nanophotonic waveguide platform with embedded quantum dots (QDs) that

enables both Purcell-enhanced emission and strong chiral coupling.

10:20 - 12:00 — Amphi Pinel

Session 2A7

Metasurfaces for Nonlinear and Ultrafast Nanophotonics

Organized by: Giulio Nicola Felice Cerullo and Giuseppe Della Valle

Chaired by: Costantino De Angelis

10:20 : Invited talk
Quantum optical metasurfaces: new avenues for generating and engineering entangled photons
Tomas Santiago-Cruz
Max Planck Institute for the Science of Light (Germany)

Quantum optical metasurfaces are outperforming their bulk counterparts in terms of multifunctionality. In this talk, I show how quasi bound states in the continuum resonances in semiconductor metasurfaces can be used to engineer entangled photons in several degrees of freedoms, such as frequency and direction of emission.

10:40 : Invited talk
Modelling and Inverse Design of Complex Nanophotonic Systems
Lora Ramunno
University of Ottawa (Canada)

Numerical modelling provides an important tool for understanding light matter interaction in complex nanoscale systems, teasing out most relevant underlying phenomena in very complex scenarios and providing a platform for inverse design. This talk will focus on recent examples of nanophotonics simulations from our group with complex response (e.g., nonlocal and nonlinear plasmonics, and nonlinear ENZ materials for active nanophotonics), as well optimizing the response of time varying materials by inverse designing the incident light.

11:00 : All-Optical Modulation of Birefringence in Nonlinear All-Dielectric Metasurfaces
Mert Akturk[1], Giulia Crotti[1], Andrea Schirato[1], Vincent Vinel[2], Remo Proietti Zaccaria[3], Anton A. Trifonov[4], Ivan C. Buchvarov[4], Dragomir N. Neshev[5], Giuseppe Leo[2], Margherita Maiuri[1], Giuseppe Della Valle[1], Giulio Cerullo[1]
[1] *Politecnico di Milano (Italy),* [2] *Université de Paris (France),* [3] *Istituto Italiano di Tecnologia (Italy),* [4] *John Atanasoff Center for Bio and Nano Photonics (Bulgaria),* [5] *ARC Centre of Excellence for Transformative Meta-Optical Systems (TMOS) (Australia)*

Steering the polarization of light at an ultrafast speed is a crucial functionality for a plethora of applications, including free-space optical links for high-speed information processing and recording. Nonlinear metamaterials have recently been developed for ultrafast manipulation of light polarization by all-optical means (i.e., upon excitation by a femtosecond control pulse). Here, we demonstrate strong birefringence features in a reconfigurable, anisotropic AlGaAs metasurface, achieving more than 90° rotation of the polarization ellipse at a few picosecond timescales.

11:15 : Tensorial artifical optical nonlinearity in dielectric metasurfaces
Fuyong Yue[1], Nicola Montaut[1], Fabrizio Riminucci[2], Giacomo Balistreri[1], Andrea Toma[3], Riccardo Piccoli[1], Stefano Cabrini[2], Roberto Morandotti[1], Luca Razzari[1]
[1] *Institut National de la Recherche Scientifique (Canada),* [2] *Lawrence Berkeley National Laboratory (USA),* [3] *Istituto Italiano di Tecnologia (Italy)*

We report on the development of an analytical expression for the description of the artificial third-order nonlinearity induced in an amorphous-silicon based metasurface, which takes into account the polarization states of the interacting light fields. Based on this model, we retrieve the tensorial values of the nonlinear susceptibility by measuring the third harmonic generation efficiency of a dielectric metasurface composed of rectangularly-shaped amorphous silicon elements.

11:30 : Ultrafast Polarization Control via All-Optical Modulation in Anisotropic Metasurfaces
Giulia Crotti[1], Mert Akturk[1], Andrea Schirato[1], Vincent Vinel[2], Remo Proietti Zaccaria[3], Margherita Maiuri[1], Anton Trifonov[4], Ivan Buchvarov[4], Dragomir Neshev[5], Giuseppe Leo[2], Giulio Cerullo[1], Giuseppe Della Valle[1]
[1] Politecnico di Milano (Italy), [2] Université de Paris (France), [3] Istituto Italiano di Tecnologia (Italy), [4] John Atanasoff Center for Bio and Nano Photonics (JAC BNP) (Bulgaria), [5] Australian National University (Australia)

Sub-picosecond polarization control is a fundamental functionality for several applications, frominformation encoding to probing of chemical systems such as chiral molecules. We present an all-opticallyreconfigurable AlGaAs metasurface, showing giant dichroism modulation upon investigation via ultrafastpump-probe spectroscopy. By combining modelling of carriers excitation and relaxation processes withfull-wave electromagnetic simulations, we can attribute the relevant transient features to pump-inducedband-filling effect, opening a gain region in the spectral range of a sharp resonance of the structure.

11:45 : Disentangling the ultrafast optical response of Titanium Nitride
Silvia Rotta Loria[1], B. R. Bricchi[1], A. Schirato[1], L. Mascaretti[2], C. Mancarella[1], A. Naldoni[2], A. Li Bassi[1], Giuseppe Della Valle[1], M. Zavelani-Rossi[3]
[1] Politecnico di Milano (Italy), [2] University Olomouc (Czech Republic), [3] IFN-CNR (Italy)

In the last decade, Titanium Nitride has emerged as an alternative plasmonic material to noble metals, thanks to its refractory properties and a carrier-lattice thermalization time much faster ($>$ 100 fs), with respect to e.g. gold ($\sim$ 1 ps). In this work, we provide a numerical model to unfold TiN ultrafast nonlinear optical response, on a broad spectral range. The calculations are validated on a 200 nm-thick TiN film on glass.

12:00 - 12:35 — Amphi Pinel

Session 2A8

Bio-Inspired Nanophotonics

Organized by: Debashis Chanda, Hyuck Choo and Radwanul Hasan Siddique

Chaired by: Debashis Chanda

12:00 : Cuttlefish-eye inspired vision systems with high-quality imaging capabilities
Young Min Song
GIST (Korea)

We discuss the development of an artificial vision system inspired by the unique vision system of cuttlefish. The system compensates for uneven vertical light distribution and reduces incident lights from the top of its vertical field of view using a W-shaped pupil. The high-density belt-like pixel region of a cylindrical silicon photodiode array allows for high-acuity imaging in the region of interest. A flexible carbon nanotube polarizing film integrated into the surface of the array enables polarization-sensitive imaging.

12:15 : Invited talk
Bio-inspired surface nanopatterning using Femtosecond Lasers and its Applications
Chunlei Guo
University of Rochester (USA)

In this talk, I will introduce various technologies that have been developed in my lab, including laser-induced structural coloring and wettability alteration.

10:20 - 12:40 — Amphi Manet

Session 2A9

Recent Advances in Non-Hermitian Photonics: Topological, Disordered and Quantum Systems

Organized by: Konstantinos Makris and Li Ge

Chaired by: Mercedeh Khajavikhan

10:20 : Invited talk
Classifying topological solitons using local markers
Stephan Wong[1], **Terry Loring**[2], **Alexander Cerjan**[1]
[1] *Sandia National Laboratories (USA),* [2] *University of New Mexico (USA)*

Due to the local nature of the nonlinearities in nonlinear photonic topological insulators, attempts to describe its topology using traditional band structure approaches are not suitable. Here, we propose to use the so-called spectral localizer, which allows us to define local topological invariants such as a local Chern number. Using the nonlinear Haldane model with on-site Kerr terms, we show that the soliton can creates topological interfaces inside the lattice.

10:40 : Invited talk
Exceptional robustness of anomalous topological scattering network
Zhe Zhang[1], **Pierre Delplace**[2], **Romain Fleury**[1]
[1] *EPFL (Switzerland),* [2] *Ens de Lyon (France)*

Robustness against defects and disorder is one of the most appealing properties of topological insulators. However, such topological resilience typically collapses when the level of disorder is beyond the magnitude of the band gap. Here, we address this problem by exploring the anomalous topological insulator in non-reciprocal scattering networks, whose edge transport survives strong disorder, and even thrives in the absence of periodicity in very amorphous cases. We experimentally confirm such exceptional robustness on microwave scattering networks.

11:00 : Invited talk
The bosonic skin effect: boundary condensation in asymmetric transport
Louis Garbe, Yuri Minoguchi, Julian Huber, Peter Rabl
TU Wien (Austria)

We study the incoherent transport of bosons through a one dimensional lattice with different left and right hopping rates, modelled by the asymmetric simple inclusion process (ASIP). In this unusual transport scenario, the density profile acquires a zigzag pattern near the boundary, with particle distribution alternating between thermal and Bose-condensed distributions. Furthermore, we show that the onset of this phase is closely related to the non-Hermitian skin effect and coincides with an exceptional point in the spectrum of density fluctuations.

11:20 : Invited talk
Non-Hermitian topological disclination defect in a valley-Hall sonic lattice
Julio Iglesias Martinez[1], **René Pernas Salomón**[2], **Penglin Gao**[3], **Muamer Kadic**[1], **Johan Christensen**[4]
[1] *Université Bourgogne Franche-Comté (France),* [2] *Universidad Carlos III de Madrid (Spain),* [3] *Shanghai Jiao Tong University (China),* [4] *IMDEA Materials Institute (Spain)*

In this contribution we focus on topological defects that are local kinks or obstructions in an order parameter field where domain walls, superconductor vortices or dislocations are few of many prominent examples. Topological bound states can form around these defects much in the same way edge and surface states bind to one- and two-dimensional interfaces, respectively. Here, we discuss both numerical and experimental advanced in the context of topological acoustics, where a lattice hosting a topological nontrivial phase is realized.

11:40 : Invited talk
Stability of Non-Hermitian Hamiltonians with Different Periodicities Using Floquet Theory
Avadh Saxena[1], **Julia Cen**[1], **Yogesh N. Joglekar**[2]
[1] *Los Alamos National Lab (USA),* [2] *Indiana University-Purdue University Indianapolis (USA)*

By using Floquet theory Hermitian Hamiltonians with time-periodic coefficients can be readily analyzed. They have been extensively used for engineering Floquet Hamiltonians in standard quantum simulators. When generalized to non-Hermitian Hamiltonians, time-periodicity provides important means to engineer the landscape of Floquet quasi-energies across the complex plane. We study two-level non-Hermitian Hamiltonians with coefficients that have different periodicities. We obtain the regions of stability, defined by real Floquet quasi-energies, contours of exceptional point (EP) degeneracies, and phases accompanying cyclic changes.

12:00 : Invited talk
Non-unitary boson sampling dynamics - distinguishability, complexity, and noise
Ryusuke Hamazaki, Ken Mochizuki
RIKEN (Japan)

We discuss nontrivial physics in boson sampling dynamics generalized to the non-unitary regime. We discover novel dynamical transitions characterized by the distinguishability of photons, which is also relevant for sampling complexity. We especially show that parity-time (PT) symmetry breaking, affects the complexity of sampling the probability distribution. In particular, for a PT-broken phase, a notable dynamical transition that the boson distribution becomes distinguishable in the long time occurs, indicating the easiness of sampling bosons.

12:20 : Invited talk
Non-Hermitian resonant energy transfer
Andrey Novitsky[1], Fyodor Morozko[1], Denis Novitsky[2], Alina Karabchevsky[3]
[1] Belarusian State University (Belarus), [2] NAS of Belarus (Belarus), [3] Ben-Gurion University of the Negev (Israel)

Non-Hermiticity exhibits an excellent platform to achieve new insights in physics and technology. Here we discuss the influence of non-Hermitian environments on the emission properties of a dipole. Using the perturbation theory, we reveal that resonant energy transfer between donor and acceptor molecules strongly enhances at the exceptional point. Our results are essential for nano-optical applications including light energy transport and signal processing on a chip.

10:20 - 12:20 — Salle des Conseils

Session 2A10

Plasmonic Nanomaterials for Bio-Diagnostics, Environmental Monitoring and Food Safety

Organized by: Lucia Petti and Massimo Rippa

Chaired by: Lucia Petti and Massimo Rippa

10:20 : Invited talk
Development of a hybrid plasmonic/photonic nanoscale strategy for multi-level anti-counterfeit labels in the framework of food safety
Vincenzo Caligiuri[1], Aniket Patra[1], Maria Penelope De Santo[1], Agostino Forestiero[2], Giuseppe Papuzzo[2], Dante M. Aceti[3], Giuseppe E. Lio[4], Riccardo C. Barberi[1], Antonio De Luca[1]
[1] Universita della Calabria (Italy), [2] CNR-ICAR (Italy), [3] Bulgarian Academy of Sciences (Bulgaria), [4] CNR-INO (Italy)

Innovative goods authentication strategies are of fundamental importance considering the increasing counterfeiting levels. We propose a hybrid plasmonic/photonic multilayered structure working as a three-level strong Physical Unclonable Function. Our approach combines a functional nanostructured surface, a resonant response and a unique chromatic signature together in one single device. The proposed architectures could also be used as an irreversible and quantitative temperature exposure label in the framework of food safety. They are inexpensive, scalable and can be deposited over different substrates.

10:40 : Invited talk

Nanophotonics for biosensing: development of optical platforms for high sensitivity and specificity

Giovanna Palermo
University of Calabria (Italy)

Plasmonics is a branch of optics that deals with the study of surface plasmons. These plasmons can be used to manipulate light at the nanoscale, allowing for the development of novel devices for applications in sensing, imaging, and information processing. One important application of plasmonics is the development of plasmonic biosensors, which can detect and quantify the presence of molecules as biomarkers with high sensitivity and specificity.

11:00 : Invited talk

Plasmonics on neural implants

Filippo Pisano[1], Liam Collard[1], Di Zheng[1], Antonio Balena[1], Barbara Spagnolo[2], Marco Bianco[2], Linda Piscopo[1], Maria Samuela Andriani[1], Cinzia Montinaro[1], Francesco Tantussi[1], Antonella D'Orazio[3], Francesco De Angelis[1], Manuel Valiente[4], Liset M. de la Prida[5], Marco Grande[3], Massimo De Vittorio[1], Ferruccio Pisanello[1]
[1] *Italian Institute of Technology (Italy),* [2] *Istituto Italiano di Tecnologia (Italy),* [3] *Politecnico di Bari (Italy),* [4] *Spanish National Cancer Research Center (Spain),* [5] *CSIC (Spain)*

The advent of optical neural interfaces in neuroscience research has boosted the scientific community to devise novel methods and systems to interrogate brain cells and neural circuits. A promising approach relies in the use of light-matter, for both sensing and triggering neural activity. In this presentation we will describe our technology to fabricate different types of plasmonic structures on an optical neural implant, for enhanced bio-sensing, beam-manipulation and opto-thermal heat delivery in the brain.

11:20 : Invited talk

Plasmonic sensing for application in food science and eco/nanotoxicology

Duncan Sutherland
Aarhus University (Denmark)

Nanosized sensors based on the local refractive index sensitivity of plasmonic nanostructures can be applied to study interactions occurring at biointerfaces relevant for understanding proteins interactions in eco and nanotoxicology and in food science. Different functionalized plasmonic sensor designs will be described to study bio-interactions. Projects include detection of contaminants in milk via refractive index sensors and SERS, quantification of astringency in wine and the study of protein coronas in nanotoxicology.

11:40 : Invited talk

Nanophotonic biosensors based on bound state in continuum

Vito Mocella, Silvia Romano, Gianluigi Zito, Ivo Rendina
National Research Council (Italy)

In this communication, an overview of the applications of nanophotonic biosensors based on bound state in continuum is reported. Perspective exploitation of this new class of devices is also discussed.

12:00 : Invited talk

Optical pushing of plasmonic nanoparticles for high-sensitivity spectroscopy of molecules and nanoplastics

Maria Grazia Donato[1], S. Bernatova[2], M. Kizovsky[2], A. Foti[1], J. Jezek[2], O. Samek[2], O. M. Marago[1], P. Zemanek[2], P. G. Gucciardi[1]
[1] *CNR-IPCF (Italy),* [2] *Czech Academy of Sciences (Czech Republic)*

Optical forces can be used to trap, manipulate and push micro and nanoparticles. In this work we will discuss the realization of aggregates of plasmonic nanoparticles by optical pushing, aiming at the high-sensitivity sensing of biomolecules and microplastics.

10:20 - 12:40 — Salle Guy Gautherin

Session 2A11

Parity-Time and Quasi-Normal Modes in Photonics, Plasmonics, Acoustics

Organized by: Anatole Lupu and Henri Benisty

Chaired by: Anatole Lupu and Henri Benisty

10:20 : Invited talk

Parity-time symmetric waveguides with tailored dipoles and chiral features

Alice De Corte[1], **Mondher Besbes**[2], **Henri Benisty**[2], **Bjorn Maes**[1]
[1] *University of Mons (Belgium),* [2] *Université Paris Saclay (France)*

We extend the standard coupled waveguide system with balanced gain and loss for PT-symmetry, in order to exploit and tailor the exceptional points. First, we place an electric dipole source between the waveguides, to create a contrast between wave propagation on both sides of the dipole by controlling its polarization. Secondly, we study the influence of chirality on the guided modes, by inserting a chiral material in the waveguide gap. We observe a strong chiral impact at degeneracies.

10:40 : Invited talk

Spectral response at hierarchically-constructed exceptional points

Jan Wiersig
Otto-von-Guericke-Universitat Magdeburg (Germany)

Non-Hermitian degeneracies, so-called exceptional points, have attracted considerable attention in photonics, plasmonics, and acoustics. One way to implement exceptional points of higher order is the scheme of hierarchical construction. We derive explicit formulas for the spectral response at such higher-order exceptional points.

11:00 : Invited talk

Stabilizing topological transport in a non-Hermitian optomechanical system

Justin Lane[1], **Chitres Guria**[1], **Vishnuteja Chavva**[2], **Toni Montalvo**[1], **Hugo Ribeiro**[2], **Jack Harris**[1]
[1] *Yale University (USA),* [2] *University of Massachusetts Lowell (USA)*

When a non-Hermitian system is tuned around a loop in Hamiltonian parameter space, its complex eigenvalues trace out a braid that depends only on how the loop encloses the space of exceptional points (EPs). While in principle adiabatic loops could be used to execute braid operations, long-time dynamics is dominated by gain-loss imbalance and adiabatic evolution breaks down. We discuss experimental progress speeding up adiabatic operations encircling EPs by optomechanically tuning two nearly-degenerate vibrational modes of a SiN membrane.

11:20 : Invited talk

Exceptional-point sensing with a quantum interferometer

Wai Chun Wong, Jensen Li
The Hong Kong University of Science and Technology (Hong Kong)

We demonstrate the existence of exceptional points (EPs) in dual-beam SU(1,1) interferometers and show EPs are linked to both high signal and low noise. For a multistage variant, EPs of the overall input-output matrix form multiple bands of high signal-to-noise ratio (SNR) which separate into two phases by EPs of the transfer matrix of a repeating unit. Our investigations demonstrate the possibility of EP sensing in lossless nonlinear quantum systems and the significance of EPs in quantum interferometers.

11:40 : Invited talk

Shaping the Topological States

Hamidreza Ramezani[1], **Elnaz Hamdarsi**[1], **Cem Yuce**[2], **Prineha Narang**[3]
[1] *University of Texas Rio Grande Valley (USA),* [2] *Eskisehir Technical University (Turkey),* [3] *University of California (USA)*

Topological zero-modes are known to be localized at the interface between two structures with different topology. Here using the degree of non-Hermiticity and using non-unitary and yet similarity transformation we lift this property and design zero-modes that are not necessarily localized. Our proposed approach paves the way for designing topologically protected states that potentially could be used for far field imaging and

sensing.

12:00 : Invited talk
Acoustic nonreciprocity in a linear viscous medium with broken P symmetry
Arkadii Krokhin[1], **Hyeonu Heo**[2], **Arup Neogi**[3], **Yuri Zubov**[1], **Ezekiel Walker**[4]
[1] *University of North Texas (USA),* [2] *Penn State University (USA),* [3] *University of Electronic Science and Technology of China (China),* [4] *Echonovus Unc. (USA)*

Acoustic transmission through arbitrary arrangement of scatterers possesses Rayleigh reciprocal symmetry with respect to switch of emitter and receiver at points A and B, pA(rB) = pA(rB). Velocity field does not possess the same reciprocal symmetry if the system of scatterers does not have reflection symmetry (P symmetry). Here we show that in a viscous fluid lack of reciprocal symmetry for velocity leads to different dissipated energy for forward and backward propagation, thus making acoustic propagation truly nonreciprocal.

12:20 : Invited talk
Maximally transmitted states in non-Hermitian photonics
Konstantinos Makris
University of Crete (Greece)

In the context of non-Hermitian photonics we present recent results regarding structured wavefronts that are maximally transmitted through a complex medium. We investigate dissipative optical lattices with gain and non-Hermitian multimode optical fibers. In both cases we present a unified framework of description that reveals the common features of these optimal states. Connection to Anderson localization, scattering eigenchannels, phase conjugation and imaging will be also discussed.

10:20 - 12:40 — Salle P1

Session 2A12

New Frontiers in Opto-Magnetism and Magneto-Optics

Organized by: Nicolò Maccaferri, Thierry Grosjean and Francesco Pineider

Chaired by: Thierry Grosjean and Nicolò Maccaferri

10:20 : Invited talk
Ultrafast Driving of Orbital Magnetism in Metallic Nanoparticles using Circularly Polarized Light
Paul-Antoine Hervieux[1], **Rajarshi Sinha-Roy**[2], **Jérôme Hurst**[1], **Giovanni Manfredi**[1]
[1] *University de Strasbourg (France),* [2] *Université Claude Bernard (France)*

The angular momentum transfer of circularly polarized light to a metal nanoparticle is studied using the time-dependent density functional theory in the real time formulation. It is found that the induced magnetic moment is maximal at the surface plasmon frequency of the nanoparticle, showing that it is a resonant plasmonic effect.

10:40 : Invited talk
Twisted light affects ultrafast demagnetization
Eva Prinz, Jonas Hoefer, Benjamin Stadtmuller, Martin Aeschlimann
RPTU Kaiserslautern-Landau (Germany)

High-intensity ultrashort laser pulses can destroy the magnetic order of ferromagnetic thin films on the femtosecond timescale. It is still an open question if the angular momentum of light can support this effect. For the material nickel, it has been shown that the spin of light only has a negligible influence. However, in our work, we experimentally demonstrate that photonic orbital angular momentum (OAM) affects the ultrafast demagnetization dynamics of a thin nickel film within the first hundreds of femtoseconds.

11:00 : Invited talk
Magneto-Optical Light-Matter interactions in Weyl Semimetals
Dima Cheskis

Ariel University (Israel)

This work was focused on studying the type I Weyl semimetals. Chiral anomaly, expressed in the term E*B claimed to be a charge imbalance between the Weyl nodes. Then this imbalance can be observed via the magneto-optical Kerr effect. Such studies were made for Cd3As2 crystals under a magnetic field, and magneto-optical methods measured the outcome of the chiral anomaly. We are demonstrating our first results for Co3Sn2S2 crystals and our knowledge, such a study still was not done.

11:20 : Invited talk

Nanoscale and ultrafast magnetophotonics

Alexandre Dmitriev
University of Gothenburg (Sweden)

Nanoscale magnetophotonics unites the concepts from magnetism (switching, storage, steering) with light (energy, information, photochemistry) at the nanoscale. I highlight our recent work, were we employ plasmon nanoantennas to either funnel electromagnetic energy into ferrimagnetic films at the nanoscale assisting the demagnetization, or construct hybrid plasmon-ferrimagnet nanoantennas for that. The produced architectures could also serve as the conceptually new high-resolution light incidence direction sensors or a platform with multistate demagnetization, potentially opening up for nanomagnetic neuromorphic-like ultrafast systems.

11:40 : Invited talk

Magnetoplasmonics beyond metals: the case of plasmonic Transparent Conductive Oxide Nanocrystals

Alessio Gabbani
University of Pisa (Italy)

In this contribution we show the potentiality of Transparent Conductive Oxide (TCOs) nanocrystals (NCs) for magnetoplasmonics, giving a proof-of-concept demonstration of their excellent performance in field-modulated refractometric sensing, challenging state-of-the-art materials for magnetoplasmonics. Moreover, we demonstrate the ability of magneto-optical spectroscopy to accurately extract carrier parameters (density and effective mass) in this novel class of plasmonic materials, widely employed in plasmonics and optoelectronics.

12:00 : Invited talk

Optics and THz for ultrafast magnetization manipulation in ferro and ferrimagnetic systems

Jon Gorchon
Université de Lorraine (France)

Controlling magnetization at ultrafast timescales has always been a major challenge and objective both for applications and fundamental aspects. In recent times, new methods that enable ultrafast magnetization reversal exploiting different stimuli, ranging from optics, to ultrafast on-chip current pulses, have been demonstrated. Moreover, some of these methods enable control of simple archetypal ferromagnetic systems. In this talk I will present some of these methods and will discuss various of the physical mechanisms playing a role.

12:20 : Invited talk

Magnetic Helicoidal Dichroism with XUV Light Carrying Orbital Angular Momentum

Mauro Fanciulli[1], Matteo Pancaldi[2], Emanuele Pedersoli[2], Mekha Vimal[1], David Bresteau[1], Martin Luttmann[1], Dario De Angelis[2], Primoz Rebernic-Ribic[2], Benedikt Rösner[3], Christian David[3], Carlo Spezzani[2], Michele Manfredda[2], Ricardo Sousa[4], Ioan-Lucian Prejbeanu[4], Laurent Vila[4], Bernard Dieny[4], Giovanni De Ninno[2], Flavio Capotondi[2], Maurizio Sacchi[1], Thierry Ruchon[5]
[1] *Université Paris-Saclay (France),* [2] *Elettra-Sincrotrone Trieste (Italy),* [3] *Paul Scherrer Institut (Switzerland),* [4] *Université Grenoble Alpes (France),* [5] *Paris-Saclay University (France)*

We report magnetic helicoidal dichroism (MHD) in the interaction between XUV beams carrying orbital angular momentum (OAM) and magnetic vortices. It appears as a differential intensity profile of beams with OAM, reflected off magnetic structures with opposite curling sense. The results match theoretical predictions and confirm the potential of MHD for studying laser-triggered ultrafast dynamics in complex magnetic materials.

10:20 - 12:10 — Salle P2

Session 2A13

Symposium V: Phononics and Acoustic Metamaterials

Organized by: Jensen Li, Jean-Philippe Groby, Marco Miniaci, Vicente Romero-García, Vincent Pagneux and Noé Jiménez

Chaired by: Vincent Pagneux

10:20 : Invited talk
Tailoring MIMO transfer of sound using reflective reconfigurable intelligent surfaces
Hongkuan Zhang[1], Qiyuan Wang[2], Guancong Ma[1]
[1] *Hong Kong Baptist University (Hong Kong),* [2] *Hong Kong Baptist University (China)*

Acoustic signals emitted by multiple sources in a room are mixed together due to reverberation, resulting in a loss of intelligibility of speech. Here, we demonstrate that the acoustic channel matrix among multiple inputs and outputs can be controlled with reflective reconfigurable intelligent surfaces by the mean of wavefield shaping. We show how 2x2 and 4x2 channels can be customized almost at will. This research has many potential applications, including scenarios such as enhanced indoor speech communications and recognition.

10:40 : Invited talk
A solution to cloaking with Willis materials
Phillip Brucks, Hussein Nassar
University of Missouri (USA)

Willis elasticity is shown to be a particular microcontinuum field theory where the kinematic enrichment has been eliminated in favor of the macroscopic displacement field. The result is somewhat disappointing: it means that Willis elasticity encompasses no wave phenomena that are not already within the reach of generalized elasticity. That said, the gained insight allows to solve the longstanding problem of elastodynamic cloaking with Willis materials. In particular, the Willis materials useful for cloaking are resolved into mechanical lattices.

11:00 : Invited talk
Novel photonic materials enabled by crystal growth
Dorota Pawlak[1], Piotr Paszke[1], Piotr Piotrowski[1], Monika Tomczyk[1], Katarzyna Sadecka[2], Kingshuk Bandopadhyay[2], Krzysztof Markus[2], Barbara Surma[2], Andrzej Materna[2], Johann Toudert[2], Alessandro Belardini[3], Concita Sibilia[3]
[1] *University of Warsaw (Poland),* [2] *ENSEMBLE (Poland),* [3] *University of Rome "La Sapienza"(Italy)*

We will demonstrate how to utilize the crystal growth methods for manufacturing of novel composite materials for various applications, especially photonics (metamaterials, plasmonic materials), topological insulators, energy conversion. We will focus on two novel bottom-up manufacturing methods: (i) method based on directionally-grown self-organized eutectic structures, and (ii) NanoParticles Direct Doping meth-od (NPDD) based on directional solidification of dielectric matrices doped with various nanoparticles.

11:20 : Design, fabrication and performance assessment of an acoustic focusing metamaterial lens
Feng Qin, Jie Zhang, Bruce W. Drinkwater
University of Bristol (United Kingdom)

we describe a procedure to design and assess an acoustic focusing metamaterial lens operating at 40kHz. The design procedure involves using the retrieval method to calculate the unit cell size and layout, and a time delay approach to focus an acoustic wave. The lens was manufactured from ABS using a 3D printer and this paper considers the fabrication limitations. The performance of the lens was assessed experimentally on artificial flaws. This shows the potential application in the non-destructive testing field.

11:35 : Acoustic metagratings: From principle to applications
Jun Mei
South China University of Technology (China)

Wavelength-thick metagratings for airborne and waterborne sound are highly desirable in various application scenarios. In this talk, we present a class of metagratings with which distinct and switchable wave manipulation functionalities, such as extraordinary transmission, total reflection, and abnormal reflection can be

achieved through a single acoustic grating. Simultaneous and high-efficiency control over both reflected and transmitted waves is achieved through a systematic design approach in which wave diffraction theory and intelligent optimization algorithms are concurrently utilized.

11:50 : Invited talk
Subwavelength broadband perfect absorption for unidimensional open-duct problems
Yang Meng[1], Vicente Romero-Garcia[2], Gwénaël Gabard[1], Jean-Philippe Groby[1], Charlie Bricault[3], Sébastien Goudé[3]
[1] *LAUM (France),* [2] *Universitat Politècnica de València (Spain),* [3] *Valeo Thermal System (France)*

This work presents a general design methodology of metamaterial absorbers made of arrays of Helmholtz resonators for open-duct problems, which is encountered in broad practical applications. By using a single point scatterer, it is insufficient to attenuate both the reflected and radiated waves, a frequency-dependent maximum absorption exists and is derived analytically. To go beyond this absorption bound and achieve perfect absorption, at least two point scatterers are necessary. Specific designs are provided and validated both numerically and experimentally.

Lunch

12:30 - 14:00

14:00 - 16:00 — Grand Amphi

Session 2A14

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

14:00 : Keynote talk
Extreme time modulation of material properties and Hawking radiation
John B. Pendry
Imperial College London (United Kingdom)

Experiments demonstrating extremely rapid modulation of the permittivity have been performed by exploiting the enhanced non-linear effects possible in the presence of plasmonic resonances. These experiments measure anextreme rise time by exploiting the analogy between Young's slits which produce diffraction in momentum space and closely spaced time windows which produce diffraction in frequency space.

14:30 : Keynote talk
Recent progress in magnetic skyrmion physics
Xiangrong Wang
The Hong Kong University of Science and Technology (China)

In this talk, I will discuss several progresses made in our group about fundamental properties of skyrmions in chiral magnetic films. These include 1) skyrmion sizes in isolated, in crystal, or in stripy forms, 2) skyrmion nucleation, formation, and potential barrier energies, 3) the roles of magnetic field in skyrmion crystal formation, 4) the stability and existing conditions of composite skyrmions such as target skyrmions and skyrmion bags/cluster, 5) topological equivalence of stripy phases and skyrmion crystals.

15:00 : Invited talk
Wavelength-Independent Bragg-Like Effect
Martin McCall, Stefanos Koufidis
Imperial College London (United Kingdom)

We have recently established that a uniform birefringent medium can exhibit an arbitrarily broadband Bragg-like response, based solely on matching the chirality parameter to the medium's average refractive index rather than on the usual Bragg condition. Here, we demonstrate that such a response can also be achieved in a broader family of optically active media, which relaxes the previously identified hard-to-achieve resonance condition while offering control over the resonance bandwidth via an externally applied static magnetic field.

15:20 : Invited talk
Circular Polarization in absorption and emission of light by molecules and molecular assemblies
Stefan Meskers
Technische Universiteit Eindhoven (The Netherlands)

Chiral molecules and materials preferentially absorb and emit one of the circular polarizations of light. Yet the reverse statement is not necessarily true. Recent developments in circular polarization in topologically chiral molecules, supramolecular assemblies and materials with strong light-matter coupling are discussed.

15:40 : Invited talk
Creation, Manipulation and Switching of Topological Magnetisms in Spin-Charge Coupled Magnets
Masahito Mochizuki
Waseda University (Japan)

We discuss our recent theoretical studies on the dynamical creation, manipulation and switching phenomena of topological magnetisms in a spin-charge coupled magnet described by the Kondo-lattice model.

14:00 - 16:05 — Amphi Bezier

Session 2A15

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Jérôme Plain and Alexander Govorov

14:00 : Invited talk
Metamaterial Thermal Management
Wakana Kubo
Tokyo University of Agriculture and Technology (Japan)

To increase the efficiency of energy harvesting, technologies that can utilize weak thermal energies existing in environments are in demand, however, conventional technologies fail to realize this objective because energy accumulation does not occur in them. Herein we propose a metamaterial thermal engineering technique by which thermal energy can be accumulated from the surrounding environment and can be converted into electricity.

14:20 : Invited talk
Locally controlling quantum yields in 2D semiconductors via electron tunneling
Ricardo Javier Pena Roman[1], Rémi Bretel[2], Delphine Pommier[2], Luis Enrique Parra Lopez[3], Etienne Lorchat[4], Elizabeth Boer-Duchemin[2], Gérald Dujardin[2], Andrei G. Borisov[2], Luiz F. Zagonel[1], Guillaume Schull[3], Stéphane Berciaud[3], Eric Le Moal[5]
[1] *University of Campinas (Brazil),* [2] *Université Paris-Saclay (France),* [3] *Université de Strasbourg (France),* [4] *NTT Research, Inc. (USA),* [5] *CNRS - Institut des Sciences Moléculaires d'Orsay (France)*

Using a scanning tunneling microscope, the radiative recombination yield of excitons in a laser-excited two-dimensional semiconductor is locally and electrically controlled.

14:40 : Dual-Band and High-Speed Plasmonic Metafiber Electrooptic Modulators
Jiyong Wang[1], Lei Zhang[1], Min Qiu[2]
[1] *Hangzhou Dianzi University (China),* [2] *Westlake University (China)*

Conventional electro-optic modulator (EOM) devices are targeting on-chip integrations, suffering from high coupling losses, complex optical alignments and single-band operations. Here, we present an EOM device fully integrated on the optical fiber tips for fast amplitude modulations. Profiting from high quality-factor plasmonic metasurfaces, nanofabrication-friendly EO polymers and coupling-free connections with fiber networks, our EOM is demonstrated to allow dual-band operations (telecom O band and S band) and high-speed modulations ($\sim$ 1 GHz at a bias voltage of $\pm$ 9 V).

14:55 : Keynote talk
Structured surfaces for enhanced radiation-matter interaction and nonlinear optics
Luca Razzari
Institut National de la Recherche Scientifique (Canada)

In this talk, I will review our main results regarding the exploitation of nanoresonators and metasurfaces for: (i) enhanced terahertz spectroscopy of low-dimensional materials; (ii) nanoscale phonon strong coupling; and (iii) nonlinear wavelength conversion.

15:25 : Invited talk
Photodoping of plasmonic doped metal oxide nanocrystals for the direct storage of solar energy
Ilka Kriegel
Italian Institute of Technology (Italy)

We are currently investigating novel processes that work towards the direct storage of solar energy by investigating nanomaterials that act as light-charged (nano-)capacitors. In this talk, I will present our work towards the understanding of the fundamental processes underlying this novel concept. I will present our endeavors in the production of novel nanomaterials, their photophysical and theoretical characterization. Finally, I will give insights into the challenges of device fabrication for this novel system.

15:45 : Invited talk
Enhancing Light-Matter Interaction in MoS2 Monolayer deposited on Metalic Nanostructures
Matheus Fernandes Sousa Lemes[1], Guilherme Migliato Marega[2], Riccardo Chiesa[2], Andras Kis[2], Euclydes Marega Junior[1]
[1] *Universidade de São Paulo (Brazil),* [2] *École Polytechnique Fédérale de Lausanne (EPFL) (Switzerland)*

Monolayer transition metal dichalcogenides (TMDs) with a direct bandgap hold enormous potential for designing novel electronic and optoelectronic devices. However, their atomic-thin thickness leads to inefficient light-matter interactions and hinders more versatile applications. One promising solution to overcome this problem is hybridizing the 2D-TMDs with plasmonic structures to increase the optical absorption of the monolayer materials.

14:00 - 15:00 — Amphi Fournel

Session 2A16

Conference Tutorials I

14:00 : Tutorial
Disordered optical metasurfaces
Philippe Lalanne
Institut d'Optique d'Aquitaine - LP2N (France)

Shaping the far-field radiation diagrams of surfaces engraved with high-index subwavelength structures belongs to a longstanding and fundamental ambition of wave science. The problem comes in different forms, but generally consists of angularly and spectrally controlling polychromatic light scattering with nanostructures smartly arrayed on a surface. We discuss important challenges in the emerging field of disordered metasurfaces to address applications such as light focusing, light extraction and detection, color and appearance creation.

15:00 - 16:00 — Amphi Fournel

Session 2A17

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Maria Farsari

15:00 : Invited talk
Self-powered Flexible Devices: Piezo-sensor and microLED
Keon Jae Lee
KAIST (Korea)

This seminar introduces recent progresses of self-powered flexible devices, piezo-sensors and microLED. The first part, we reported a machine learning-based acoustic sensor by mimicking the basilar membrane of human cochlear. Highly sensitive self-powered flexible piezoelectric acoustic sensor (f-PAS) with a multi-resonant frequency band was employed for voice recognition. The second part will discuss the highly efficient flexible vertical micro LED (f-VLED) for full color displays and biomedical applications. We introduces the flexible vertical GaAs/GaN microLED on plastics using micro-vacuum transfer.

15:20 : Invited talk
Dielectric nanostructures for novel photonics devices: from Solar Cells to NanoLEDs.
Braulio Garcia-Camara, Lorena Escandell, Angela Barreda, Eduardo Lopez-Fraguas, Ricardo Vergaz, José Manuel Sánchez-Pena
Carlos III University of Madrid (Spain)

This work shows a review of our last works in the design of dielectric nanostructures and dielectric metamaterials to improve the performance of photonics devices and/or development new ones.

15:40 : Invited talk
Electromagnetic Signal Propagation Through Lossy Media
Igor Smolyaninov
Saltenna LLC (USA)

It is commonly believed that electromagnetic waves cannot propagate in lossy conductive media and that they quickly decay inside such media over short length scales of the order of skin depth. I will demonstrate that contrary to this belief, surface electromagnetic waves in stratified lossy conductive media may have propagating character, and their propagation length may be considerably larger than the skin depth. This result has important consequences across the electromagnetic spectrum from radio signals propagation underwater to UV nanophotonics.

14:00 - 15:55 — Amphi Esquillan

Session 2A18

Resonant Optics – Fundamentals and Applications

Organized by: Sven Burger, Philippe Lalanne and Frank Vollmer

Chaired by: Philippe Lalanne and Frank Vollmer

14:00 : Invited talk
Light scattering and dipole emission in resonant periodic structures
Lin Zschiedrich[1], Felix Binkowski[2], Phillip Manley[1], Martin Hammerschmidt[1], Philipp-Immanuel Schneider[1], Sven Burger[1]
[1] *JCMwave GmbH (Germany),* [2] *Zuse-Institute-Berlin (Germany)*

We address the numerical computation of the emission and radiation of an isolated dipole within alaterally periodic structure such as a photonic crystal, a light emitting device or a meta lens. We utilize theBloch-Floquet transform and its inverse to represent the solution as an integration of Bloch-periodicsub-solutions over the Brillouin zone. Due to the appearance of trapped modes and Wood anomalies thisintegration is numerically very challenging.

14:20 : Auto-differentiable Computational Photonics and its application to optimization
Benjamin Vial[1], **Yang Hao**[2]
[1] *Imperial College London (United Kingdom),* [2] *Queen Mary University of London (United Kingdom)*

We present the development of numerical methods for the resolution of Maxwell's equationsimplemented using open source libraries. All of them are endowed with automatic differentiation capabilitiesand typical inverse design examples using topology optimization will be presented.

14:35 : Invited talk
Microstar cavities: Ray-wave correspondence in the semiclassical regime
Julius Kullig, Jan Wiersig
Otto-von-Guericke-Universitat Magdeburg (Germany)

Microstar cavities confine light inA*STAR-shaped quasi-two-dimensional microcavity via successiveperfect transmissions through the dielectric interface under Brewster's angle. Therefore, beam splitting effectsare avoided and ray orbits without intensity loss are formed. We investigate the correspondence between the raydynamics and the long-lived modes of the electromagnetic field in the semiclassical regime. A differen-cebetween clockwise and counter-clockwise propagation in traced back to nonlinear resonance chains in phasespace.

14:55 : Invited talk
MAN: A freeware to compute and analysis modes of resonators
Tong Wu, D. Arrivault, W. Yan, Philippe Lalanne
Institut d'Optique Graduate School (France)

In this talk, we introduce MAN (Modal Analysis of Nanoresonators) a software with many open scripts, which computes and normalizes the quasinormal modes (QNMs) of electromagnetic resonators.

15:15 : Invited talk
Calculating resonant states in optical systems: Exact theory and approximations
Egor Muljarov
Cardiff University (United Kingdom)

This talk will focus on recent advances of the resonant-state expansion (RSE) - a rigorous theory of optical resonances in open systems, allowing their accurate calculation and intuitive understanding. New achievements include variations of the RSE aiming to enhance its efficiency and reach, as well as some useful approximations following from the RSE, including single-mode and first-order approximations, for treating homogeneous and inhomogeneous perturbations, both inside and outside the optical systems.

15:35 : Invited talk
Bound-State-in-the-Continuum Resonances in Monolithic Cavities on a Substrate
Cindy Péralle, Sushanth Kini Manjeshwar, Anastasiia Ciers, Witlef Wieczorek, Philippe Tassin
Chalmers University of Technology (Sweden)

We present a strategy to find photonic cavities with bound-state-in-the-continuum resonances that can be fabricated with planar fabrication methods on a substrate.

14:00 - 16:00 — Amphi A

Session 2A19

Advanced Computational Electromagnetics for the Analysis and Design of Nanophotonic Devices

Organized by: Maha Ben Rhouma and Kofi Edee

Chaired by: Maha Ben Rhouma

14:00 : Invited talk
Heat transfer modelling in the crossover regime between conduction and radiation
Mauricio Gomez Viloria, Philippe Ben-Abdallah, Riccardo Messina
Laboratoire Charles Fabry (France)

We analyze the heat transfer between two metals separated by a vacuum gap in the extreme near-field regime, in which tunneling photons, phonons and electrons are expected to play a role. We quantify the relative contribution of these carriers with respect to the separation distance and the applied bias voltage. Our results emphasize some inconsistencies in recent experimental results about heat exchanges in extreme near-field regime and set a roadmap for future experiments.

14:20 : Invited talk
Nanophotonic scintillators for enhanced x-ray detection and imaging
Charles Roques-Carmes
MIT (USA)

Scintillators are materials that emit light in the form of spontaneous emission when pumped by high-energy particles, such as x-rays. We demonstrate that several concepts in nanophotonics, such as out-coupling and Purcell enhancements, can enhance and shape scintillation light. We then discuss possible applications of such "nanophotonic scintillators"(consisting in the integration of scintillator materials into nanophotonic structures) in enhancing the resolution and detection efficiency of x-ray imaging systems.

14:40 : Invited talk
Improving Photonic Crystal Waveguide Simulation Efficiency: A Journey from 3D approaches to Deep Neural Networks
Caspar Schwahn, Sebastian Schulz
University of St Andrews (United Kingdom)

In this paper, we summarize the historical and recent contributions of our group to the development of accurate and efficient simulation and design methods for Photonic crystal waveguides. This will look at the use of ensemble average properties for the calculation of propagation loss, 2-dimensional approximations and finally optimization and machine learning techniques. Here we demonstrate the same accuracy as full 3D simulations with a 7-orders of magnitude reduction in the calculation time, to the sub-ms per design range.

15:00 : Invited talk
Numerical methods for topological polaritonics
Ismaël Septembre, Charly Leblanc, Dmitry Solnyshkov, Guillaume Malpuech
Université Clermont Auvergne (France)

Exciton-polaritons represent an exciting platform for the implementation of topological photonics. In the field of polaritonics, we use the paraxial approximation which allows mapping the Helmholtz equation to the Schrödinger equation. We use this to model microcavities with or without patterning and observe topological effects. We use this in polariton waveguides and demonstrate polariton Bose-Einstein condensation.

15:20 : Invited talk
Modeling the Acousto-Plasmonic Coupling: Raman Energy Density Framework
Nicolas Large[1], José Luis Montano-Priede[1], A. Mlayah[2]
[1] *University of Texas at San Antonio (USA),* [2] *Université de Toulouse (France)*

We present a theoretical study of the interactions between confined acoustic phonons and localized surface plasmons (LSPs) in the framework of acoustic Raman scattering. By using the Fermi golden rule we introduce a new physical quantity, the Raman energy density (RED), which is a local quantity that serves as a tool for the study of resonant Raman scattering mediated by LSPs in nanoparticles. The RED represents the

electromagnetic energy density excited by the Raman probe and modulated by the phonons.

15:40 : Invited talk
Analyzing Invisibility using a Nonlinear Eigenvalue Formulation
Zitao Mai, Ya Yan Lu
City University of Hong Kong (Hong Kong)

For some incident plane waves, the waves reflected by a lossless periodic structure may be identical (in the far field) to the waves reflected by a perfectly electric (or magnetic) conductor. The periodic structure is thus invisible with respect to these incident waves. We propose an efficient method for computing such special incident waves, based on a nonlinear eigenvalue formalation and a contour-integral method.

14:00 - 16:00 — Amphi Pinel

Session 2A20

Bio-Inspired Nanophotonics

Organized by: Debashis Chanda, Hyuck Choo and Radwanul Hasan Siddique

Chaired by: Debashis Chanda

14:00 : Invited talk
Cross-reactive plasmonic arrays as optical tastebuds
Justin R. Sperling, William J. Peveler, Alasdair Clark
University of Glasgow (United Kingdom)

We present a cross-reactive nanoplasmonic sensor capable of identifying and classifying complex liquid mixtures. Analogous to biological tastebuds, our plasmonic sensor shows promise in a variety of industrial applications as a simple, rapid quality control measure.

14:20 : Invited talk
Effective refractive index determination and light propagation mechanisms in natural scattering media
Dominic T. Meiers, Georg von Freymann
RPTU Kaiserslautern-Landau (Germany)

We present a new mixing rule for calculating the effective refractive index beyond the limit of small particles, a restriction found in common effective medium approaches such as the Maxwell-Garnett or Bruggeman theory. Subsequently, these findings are used to distinguish the diffusive and coherent portion of light transport in ultrathin, strongly scattering white beetle scales. It is shown that weakly localized random photonic modes contribute about one third of the overall scattered light, revealing their significance for brilliant whiteness.

14:40 : Invited talk
Bioinspired coating for bird-safe glazing optimised for avian and human vision
Sébastien Mouchet, Rémy Wauters, Emile Haye, Stéphane Lucas, Olivier Deparis
Namur Institute of Structured Matter (NISM) (Belgium)

Bird-window collisions often lead to the death of the bird and damage to the window. However, many animals, including birds, can perceive UV light. Many species have hence developed visual communication in this wavelength range, for instance, thanks to photonic structures. Such structures allowed us to design a new UV-reflecting multilayered coating for bird-safe glazing, through a bioinspiration approach. This coating was optimised for bird and human visual perception.

15:00 : Invited talk
Transparent and Durable Dust-Repellent Coatings for Photonics Application
Pritha Sarkar, Kausik Mukhopadhyay
University of Central Florida (USA)

A case study of an optically transparent, solid- and liquid-repellent ‘omniphobic’ coating (SLRC) developed in our lab with exceptional mechanical durability that can tackle dust mitigation issues for a wide range of solids

(regolith, dust, debris, ice etc.) will be presented. Anti-static, anti-reflective, UV-resistant and dust-repellent features have been designed displaying extreme-low adhesion of solids and liquids. Such SLR coatings are instrumental for a wide range of applications, including photonics.

15:20 : Invited talk
Ultralight, Energy Saving Plasmonic Structural Color Paint
Pablo Cencillo, Debashis Chanda
University of Central Florida (USA)

In recent years, various nanoengineered structures have been suggested as substitutes for chemical colorants. Nevertheless, many suffer from limited color-palette, angle sensitivity, and are incompatible with industrial production requirements. Here, we introduce a technique for structural coloring that overcomes these constraints by exploiting the hybridization of self-assembled nanoparticles with an ultrathin cavity. Our technique provides a flexible foundation for producing an ultralight plasmonic paint that is eco-friendly and large-scale compatible, bridging the gap between proof-of-concept and industrial applications.

15:40 : Invited talk
Transparency in butterflies and moths: structural diversity, impact on adaptive functions
Doris Gomez[1], Marianne Elias[2], Serge Berthier[3], Christine Andraud[4]
[1] CEFE (France), [2] ISYEB (France), [3] Sorbonne University (France), [4] CRC-MNHN (France)

If transparency is abundant in water and well-studied, it is rare on land with largely unknown functions. Scarce existing studies come from physics, although thorough, they focus on isolated species, thereby struggling to encompass structural diversity, its impact on biological functions and potential functional trade-offs, useful for bioinspiration. Here, I will present an interdisciplinary project on clearwing butterflies and moth, showing diversity at various scales, some biological functions and functional trade-offs, and the interest of having an evolutionary/ecological perspective.

14:00 - 16:00 — Amphi Manet

Session 2A21

Recent Advances in Non-Hermitian Photonics: Topological, Disordered and Quantum Systems

Organized by: Konstantinos Makris and Li Ge

Chaired by: Konstantinos Makris

14:00 : Invited talk
Experimental observation of lasing over Anderson-localized modes at exceptional points using quantum echoes
Sushil Mujumdar, Krishna Joshi
Tata Institute for Fundamental Research (India)

We report experimental observation of Anderson-localized lasing modes in quasi-one-dimensional disordered systems over exceptional points. The non-Hermitian system comprised linear arrays of coupled microresonators in which a lasing material provided gain, while free-space scattering in the open system provided loss. Using a probabilistic search over a massive sample space of Anderson-localized modes, we identified exceptional points by tracing the vanishing quantum echo between coupled modes. The spectral lineshape analysis confirmed a second-order exceptional point.

14:20 : Invited talk
Compressibility and fluctuations of an optical quantum gas
Julian Schmitt
University of Bonn (Germany)

Quantum gases provide a test bed to explore phases of matter, for example, by probing susceptibilities. For gases of material particles, studies of the mechanical response are well established, but for optical quantum

gases they have so far remained elusive. In my talk, I will discuss measurements of the compressibility of a two-dimensional quantum gas of photons inside a dye-filled microcavity and report on the observation of a non-Hermitian transition in the fluctuation dynamics of an open photon Bose-Einstein condensate.

14:40 : Invited talk
Non-Hermitian quantum optics in cold atomic ensembles
Georgios Siviloglou, J. F. Chen
Southern University of Science and Technology (China)

In this talk, we will introduce a quantum non-Hermitian interface between photons and atoms. A tunable interaction between photonic and magnonic modes is established, and probing non-Hermitian dynamics at the single quantum level is achieved. We demonstrate experimentally quantum interference between two distinct bosonic excitations, and that their tendency to bunch together can be altered by hermiticity.

15:00 : Invited talk
Experimentally realizable PT phase transitions in reflectionless quantum scattering
Micheline Soley[1], Carl Bender[2], A. Douglas Stone[3]
[1] *University of Wisconsin-Madison (USA),* [2] *Washington University (USA),* [3] *Yale University (USA)*

We demonstrate theoretically that PT-symmetry behaviors could be measured in fundamental Schrödinger quantum mechanics via standard cold-atom experiments. Whereas PT symmetry-breaking has previously only been measured for classical wave equations or open quantum systems with complex potentials and inherent information loss, we identify spontaneous PT-symmetry breaking in a novel family of purely real, experimentally realizable quantum potentials, V(x)=-|x|p for real p. The results encourage the search for quantum PT symmetry behaviors and the development of quantum PT symmetry technologies.

15:20 : Invited talk
Observation of tailored non-Hermiticity induced transparency and photonic constant-intensity waves in optical mesh lattices
Andrea Steinfurth[1], Ivor Kresic[2], Sebastian Weidemann[1], Mark Kremer[1], Konstantinos Makris[3], Matthias Heinrich[1], Stefan Rotter[2], Alexander Szameit[1]
[1] *University of Rostock (Germany),* [2] *Vienna University of Technology (Austria),* [3] *University of Crete (Greece)*

While light waves propagating through inhomogeneous media are typically subject to scattering, non-Hermitian settings allow for these processes to be suppressed by an appropriately tailored complex refracted index. Along these lines, we leverage the additional degrees of freedom presented by gain and loss in optical mesh lattices to observe photonic constant-intensity waves and induced transparency.

15:40 : Invited talk
Level statistics and Anderson localization transitions of non-Hermitian systems with exceptional points
Chen Wang
Tianjin University (China)

In this talk, I will discuss some recent progress in the understanding of level statistics of non-Hermitian Hamiltonians. These include 1) Poisson level statistics of extended states of non-Hermitian metals, 2) A new universal level spacing distribution, which displays linear level repulsion, for exceptional points of disordered non-Hermitian systems.

14:00 - 15:00 — Salle des Conseils

Session 2A22

Plasmonic Nanomaterials for Bio-Diagnostics, Environmental Monitoring and Food Safety

Organized by: Lucia Petti and Massimo Rippa

Chaired by: Lucia Petti and Massimo Rippa

14:00 : Invited talk
Bright-field imaging of nanoscale bioparticles with Gires-Tournois photonic platform
Young Min Song
Gwangju Institute of Science and Technology (Korea)

We propose a novel approach to quantify nano-sized bioparticles by combining nanophotonics and deep learning (DL). We employed Gires-Tournois (GT) resonators as an immunosensor platform functionalized with antigen-specific antibodies without labeling or amplification. Based on the GT resonator, nanoscale bioparticles are dynamically detected and the number of particles is inferred from optical microscope images by a convolutional neural network as a vision-based DL model.

14:20 : Invited talk
Development of plasmonic platforms for sensitive and selective detection of macromolecules for food-quality assessment and environmental monitoring
Giulia Rusciano
University of Naples "Federico II"(Italy)

Surface-Enhanced Raman Spectroscopy is a powerful analytical technique which allows high sensitivity and chemical specificity thanks to the fingerprint character of Raman spectra. Herein, we present the development of novel silver-based SERS substrates endowed with relevant plasmonic performances and their use for the detection of species of environmental interest (Polycyclic Aromatic Hydrocarbons) and relevant for food-quality monitoring (melamine and lipopolysaccharides).

14:40 : Invited talk
Plasmonic metamolecular units for biological analytes investigation
Massimo Rippa[1], Valentina Marchesano[1], Ambra Vestri[1], Domenico Sagnelli[1], Lu Zhou[1], Giovanna Fusco[2], Joseph Zyss[3], Jun Zhou[4], Lucia Petti[1]
[1] *Institute of Applied Sciences and Intelligent Systems of CNR (Italy),* [2] *Istituto Zooprofilattico Sperimentale del Mezzogiorno (Italy),* [3] *Ecole Normale Supérieure Paris-Saclay (France),* [4] *Ningbo University (China)*

The study of novel plasmonic nanopatterns are of great interest for different applications including biological investigation and sensing. In this work we design, fabricate and characterize periodic arrangements of a novel metamolecular cell based on gold nanoelements. We tested their SERS performance analyzing different analytes among which a SARS-CoV-2 (COVID-19) Spike Antibody. Our results suggest that these plasmonic patterns are promising to develop nanodevices for the analysis of biological samples.

15:00 - 16:00 — Salle des Conseils

Session 2A23

Generation and Applications of Textured Photonics Fields

Organized by: Jamal Berakdar

Chaired by: Jamal Berakdar

15:00 : Invited talk
Photonic N00N-sates with spatially structured photons
Markus Hiekkamäki, Rafael F. Barros, Marco Ornigotti, Robert Fickler
Tampere University (Finland)

We study photonic N00N with spatially structured photons, i.e. quantum states where N photons are in a superposition between two orthogonal spatial modes. Using these states, we can show angular super-resolution measurements when implement through modes with a twisted transverse phase front. When realized with radially structured modes, the states allow us to study the Gouy phase anomaly in the quantum domain, its benefits in longitudinal sensing, and its fundamental importance in gaining a deeper understanding multi-photon quantum states.

15:20 : Invited talk

Novel Effects in Propagation and Absorption of Optical Vortices

Andrei Afanasev
George Washington University (USA)

We present new theoretical results on twisted-light propagation and absorption by atomic matter. We demonstrate several effects arising due to the presence of the phase singularity on the propagating wave front: (a) Novel polarization states of optically polarized atoms (b) Enhanced quantum recoil, and (d) Nondivergent polarization features of divergent beams. Possible applications of the above effects will be discussed.

15:40 : Invited talk

Tailoring vortex light sources with planar optical devices

Michael Almeida de Oliveira, Marco Piccardo, Antonio Ambrosio
Istituto Italiano di Tecnologia (Italy)

The generation of vortex light beams, carrying orbital angular momentum (OAM), has seen a shift from using bulky optics to subwavelength structured planar devices. Here, we look at how planar devices are pushing the boundaries in generating complex light fields, from high-purity vortex beams to the dynamic topologies of vortex arrays tailored directly at the source. We will see how multiplexing OAM with other degrees-of-freedom, in particular space-time beams, has the potential to enable exciting insights and applications in optics.

14:00 - 15:30 — Salle Guy Gautherin

Session 2A24

Parity-Time and Quasi-Normal Modes in Photonics, Plasmonics, Acoustics

Organized by: Anatole Lupu and Henri Benisty

Chaired by: Anatole Lupu and Henri Benisty

14:00 : Invited talk

Efficient analysis and design of edge states

Henning Schomerus
Lancaster University (United Kingdom)

I describe an efficient approach that allows to design edge states at arbitrary energies. In this approach, edge states are mapped onto unstable fixed points of a non-linear map, which can be directly determined from microscopic coupled-mode descriptions. The approach can make effective use of topological symmetries, but also applies to non-Hermitian and nonreciprocal systems.

14:20 : Invited talk

Switching between topological edge states in nanophotonic structures using phase-change materials

Georgios Veronis[1], Yin Huang[2], Yuecheng Shen[3]
[1] *Louisiana State University (USA),* [2] *Central South University (China),* [3] *Sun Yat-Sen University (China)*

We introduce non-Hermitian plasmonic waveguide-cavity structures based on the Aubry-Andre-Harper model to realize switching between right and left topological edge states using the phase-change material Ge2Sb2Te5 (GST).

14:40 : Invited talk

Landau-Zener transitions through a pair of higher order exceptional points

Eva-Maria Graefe, S. Malzard, R. Melanathuru
Imperial College London (UK)

We study the Landau-Zener type transition probabilities between the asymptotic states of a PT-symmetric non-Hermitian N-level Landau-Zener with two exceptional points of order N. The system is Hermitian for asymptotically large times, and has purely imaginary eigenvalues between the exceptional points. The transition probabilities show a characteristic binomial behaviour, which, in the adiabatic limit, are given by the ratios of binomial coefficients. This behaviour can be understood via the eigenvector structure, despite the breakdown of adiabaticity typical for non-Hermitian systems.

15:00 : Dispersion curves of guided modes in a PT symmetric waveguide
Nan Zhang, Y. Y. Lu
City University of Hong Kong (China)

In this paper, we analyze dispersion curves of guided modes in a two-layer PT symmetric slab waveguide. It is shown that the total number of cutoff points and dispersion curves is always finite. As the imaginary part of the dielectric constant is increased, the lowest dispersion curve always exists but other dispersion curves degenerate into points on the light line and then disappear. Interestingly, the dispersive curves are not always tangential to the light line.

15:15 : Scanning Quantum Interference across PT-symmetry Breaking
Friederike Klauck, Tom A.W. Wolterink, Matthias Heinrich, Alexander Szameit
Universität Rostock (Germany)

In PT-symmetric systems, losses dramatically alter the quantum correlations of interfering photons. We study lossy directional couplers with increasing loss values beyond the PT-symmetry breaking point and observe the impact of this transition on the two-photon dynamics. Upon entering the PT-broken phase, the visibility of the Hong-Ou-Mandel interference decreases.

15:30 - 16:15 — Salle Guy Gautherin

Session 2A25

Metamaterials and Metasurfaces

Chaired by: Maria Kafesaki

15:30 : Nonlinear Effects of Linear Time-Dependent Metamaterials
Pravinkumar Ghodake
Indian Institute of Technology Bombay (India)

Nonlinear responses of linear time-dependent elastic metamaterials are demonstrated in this study through computational experiments. Manipulation capabilities of the time-varying metamaterials such as harmonic generation, controlling frequency combinations due to monochromatic wave and two-wave mixing by varying parameters time-dependent material property is explored in depth.

15:45 : Ray-based design of hybrid metalens refractive imaging systems
Yijun Ding, Bryan Stone
Synopsys Inc. (USA)

The complexity of the design workflow is one of the main roadblocks for the adoption of metalenses in a hybrid imaging system that include both metalenses and conventional refracting or reflecting optical elements. This complexity is caused by the two significantly different length scales of lenses (macro-optics) and meta-atoms (micro-structures). To bridge the gap between the two scales, we propose a ray-based approach for designing hybrid imaging system and provide design examples.

16:00 : Polarization Dichroic Fabry-Perot Cavities Enabled By Metasurface Structures
Behrooz Semnani, Mohammad Soltani, Sema Kuru, Michal Bajcsy
University of Waterloo (Canada)

Here we report on our experimental progress towards design, fabrication and experimental characterization of a new class of high performance confocal Fabry–Pérot cavities formed by dielectric metasurface structures. The metasurface structures are used to make the cavities stable, optimized their mode volume and also to make them polarization birefringent.

14:00 - 14:55 — Salle P1

Session 2A26

New Frontiers in Opto-Magnetism and Magneto-Optics

Organized by: Nicolò Maccaferri, Thierry Grosjean and Francesco Pineider

Chaired by: Francesco Pineider and Nicolò Maccaferri

14:00 : Invited talk
Amplification of magneto-optical activity via plasmonic modes hybridization
Paolo Vavassori, Terunori Kaihara, Pablo Rodriguez-Suarez
CIC nanoGUNE BRTA (Spain)

We explore magnetoplasmonic-disk/plasmonic-ring nanocavities to achieve free-space light excitation and hybridization of multipolar modes. We show that the enhanced tunability and linewidth sharpening of Fano resonances in metasurfaces made of periodic arrangements of such hybridized magnetoplasmonic nanocavities produce a large amplification of the magneto-optical response together with the control of reflectance (Kerr configuration) and transmittance (Faraday configuration).

14:20 : Invited talk
Ultrafast control of spins using resonant light excitation
Dmytro Afanasiev
Radboud University (The Netherlands)

I will discuss how light can be used to control magnetism: fundamental magnetic interactions, magnetic phase transitions, and highly nonlocal spin dynamics. I will particularly concentrate on nonthermal means to control magnetism when the photon energy of light is tuned precisely in resonance with optical resonance, e.g., lattice, orbitals, or electron excitation, carrying a direct impact on the ordered spins.

14:40 : Structured ultrafast electric and magnetic fields by design
Hrvoje Petek[1], Atreyie Ghosh[1], Sena Yang[1], Yanan Dai[2]
[1] *University of Pittsburgh (USA),* [2] *University of Pittsburgh (China)*

We investigate the electric and magnetic fields in space and time when circularly polarized light interacting with a metal-dielectric interface is structured to generate single, periodic, and quasiperiodic topological vortex arrays. We image the space-time correlations of such fields by ultrafast photoemission electron microscopy. The structured fields interact with matter through electric dipole and magnetic dipole interactions. These interactions can overlap in space and time to drive magnetoelectric responses in topologically trivial and nontrivial matter.

14:55 - 15:40 — Salle P1

Session 2A27

Nano-Optics of Surface Plasmon Polaritons

Chaired by: Alexandre Dmitriev

14:55 : CdZnO nanoparticles for SEIRA sensing in the mid-infrared
Pablo Ibanez Romero[1], Eduardo Martinez Castellano[1], Javier Yeste[2], Vicente Munoz Sanjosé[2], Miguel Montes Bajo[1], Adrian Hierro Cano[1]
[1] *Universidad Politécnica de Madrid (Spain),* [2] *Universitat de València (Spain)*

In this work we report a novel approach to resonant surface enhanced infrared absorption (SEIRA) sensing by employing Cd(Zn)O nanoparticles. We provide experimental demonstration of the coupling between the localized surface plasmons supported by the nanoparticles and the narrowband absorption of PMMA resist. Our system becomes an excellent alternative to the lossy metals commonly used in the mid infrared and prevents the need for complex lithographic processes for SEIRA sensing.

15:10 : Electrical excitation of surface plasmon polaritons with a nanoantenna tunneling junction
Delphine Pommier[1], Cheng Zhang[2], Yunhe Lai[3], Eric Le Moal[2], Christophe Sauvan[2], Jean-Jacques Greffet[2], Jianfang Wang[3], Elizabeth Boer-Duchemin[2]
[1] *Thales Research and Technology (France),* [2] *Université Paris-Saclay (France),* [3] *Chinese University of Hong Kong (China)*

We use the tunneling junction between a nanoantenna and a gold film to electrically excite propagating surface plasmons. The nanoantenna consists of a gold nanocube that is separated from a thin Au film by an insulating molecular layer. A novel method for completing the electrical circuit between the nanoantenna and gold film using an atomic force microscope is developed. Thanks to numerical modeling, the nanoantenna modes exciting the SPPs are identified as gap modes or hybridized gap and antenna modes.

15:25 : Investigation of Terahertz SSPP Waveguides Using TRL Calibration
Yusuf Colak, Mesut Demircioglu, Mehmet Unlu
TOBB University of Economics and Technology (Turkey)

Spoof surface plasmon polaritons waveguides (SSPP WGs) have shown record-breaking performances at the terahertz frequencies to enable CMOS technologies. In this paper, we present the TRL calibration of the SSPP WGs between the 0.22 THz and 0.3 THz. We utilize the TRL calibration to extract the real loss behavior of the SSPP WGs. By designing two different length lines, we prove that the TRL calibration of SSPP WGs is internally consistent.

14:00 - 14:40 — Salle P2

Session 2A28

Symposium V: Phononics and Acoustic Metamaterials

Organized by: Jensen Li, Jean-Philippe Groby, Marco Miniaci, Vicente Romero-García, Vincent Pagneux and Noé Jiménez

Chaired by: Jean-Philippe Groby

14:00 : Invited talk
Tunable topological protection from auxeticity and nonlinearity
Maryam Morvaridi[1], Federico Bosia[1], Michele Brun[2], Vinicius Dal Poggetto[3], Antonio Gliozzi[1], Marco Miniaci[4], Nicola Pugno[3], Giorgio Carta[2]
[1] *Politecnico di Torino (Italy),* [2] *University of Cagliari (Italy),* [3] *University of Trento (Italy),* [4] *Université de Lille (France)*

The dynamic response of an elastic porous material with a periodic distribution of elongated holes is considered. The presence of the cuts makes the effective behavior auxetic and guarantees the presence of multiple Dirac points in the dispersion diagram. By perturbing the microstructure, topologically protected edge modes can be activated. This modes can be tuned by the application of a large deformation.

14:20 : Invited talk
How to steer acoustic waves in a random medium in a programmable way?
Anastasiia Krushynska[1], Martin van Hecke[2]
[1] *University of Groningen (The Netherlands),* [2] *AMOLF (The Netherlands)*

Recently emerged aperiodic textured metamaterials have opened up routes to multi-functional and programmable functionalities. Such possibilities have, however, been explored mainly in quasi-static regimes. Here, we show that the "tuning-by-pruning"strategy enables realizing multi-frequency steering in random elastic networks thus showing a way to the rational design of a new class of programmable acoustic metamaterials.

14:40 - 16:00 — Salle P2

Session 2A29

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Thomas Christensen

14:40 : Invited talk

Microscopic Study of Effective 2+1 Dimensional Gravity in Ferrofluid-Based Hyperbolic Metamaterials

Vera Smolyaninova[1], J. Cartelli[1], N. Christopher[1], B. Kist[1], J. Perry[1], S. Spickard[1], M. S. Devadas[1], I. I. Smolyaninov[2]

[1] *Towson University (USA),* [2] *Saltenna LLC (USA)*

Recent theoretical and experimental work demonstrated that nonlinear optics of ferrofluid-based hyperbolic metamaterials exhibits very unusual 2+2-dimensional spatiotemporal dynamics. Here we report a detailed microscopic study of mutual interactions of individual self-focused optical filaments inside this metamaterial. In agreement with theoretical expectations, the observed mutual interactions of individual filaments exhibit strong similarities with general relativity in 2+1 dimensions.

15:00 : Invited talk

Deep ultraviolet to visible absorbing and sensing applications by stacking film with highly lossy ultra-thin film

Yuusuke Takashima, Shunsuke Furuta, Kentaro Nagamatsu, Masanobu Haraguchi, Yoshiki Naoi

Tokushima University (Japan)

Stacking films with ultra-thin highly lossy material provides unique destructive interference condition in complex phase space far from the real axis. Utilizing the interference, we demonstrated the broadband deep ultraviolet and visible perfect light absorbers with large angle tolerance and the highly sensitive refractive index sensing technique in planer structure.

15:20 : Invited talk

A small spectrometer with extremely high resolution (0.07 nm) realized with an improved reconstruction algorithm

Takasumi Tanabe, Junnosuke Kokubu, Ryo Sugano

Keio University (Japan)

We successfully reconstruct the spectrum of a multi-wavelength input by using the inverse matrix method for data obtained with a random chirped photonic crystal waveguide.

15:40 : Invited talk

Three-dimensional metasurface absorber for gas sensing devices

Takuo Tanaka

RIKEN (Japan)

We discuss about ultra-sensitive infrared spectroscopic techniques enhanced by 3D metasurfaces. To suppress unwanted background and noises in IR spectroscopy, metasurface absorber with three-dimensional vertical-oriented metal-insulator-metal (v-MIM) structure was introduced. Owing to small footprint of v-MIM, the density of hot spots was dramatically increased resulting in strong signal enhancement and efficient suppression of background light. Using this device, 20 ppm concentration of carbon dioxide and butane molecule detection was demonstrated.

Coffee Break

Session 2P2
Poster Session IV
16:00 - 16:40

P1: Plasmonic surface lattice resonances in 2D hexagonal arrays of Au nanoparticles

Rina Huamanrayme Bustamante, Hipólito Alan Arredondo Champi, Daniel Reinaldo Cornejo, Walter Jaimes Salcedo
Universidade de São Paulo (Brazil)

We have fabricated three hexagonal arrays of gold nanoparticles (Au-NPs) using template-assisted electrodeposition. Our transmission measurements show redshifts of the plasmonic resonance as the distance between Au-NPs decreases. Using FDTD simulations it can be shown that the redshifts can be explained by an interference model of localized surface plasmons (or plasmonic surface lattice resonances). Our computational simulations based on the experimentally extracted parameters show an increase in near-field enhancement (27-fold in water) compared to a typical single-NP localized surface plasmon.

P2: Prime comb lasing in a fiber ring at low temperatures

Eyal Buks
Technion (Israel)

We experimentally study a fiber loop laser with an integrated Erbium doped fiber (EDF). The output optical spectrum ismeasured as a function of the EDF temperature. We find that below a critical temperature of about 10K the measured optical spectrum exhibits a sequence of narrow and unequally-spaced peaks. Operation of the device as an optical memory having storage time of about 20 ms is demonstrated.

P3: Optical characterization of polymer-based Fresnel zone plate probe structures combined with hyperbolic metamaterial by means of SNOM

Patrik Micek[1], Alexandr Belosludtsev[2], Dusan Pudis[1], Dorota Pawlak[3], P. Gaso[1], M. Goraus[1]
[1] University of Zilina (Slovakia), [2] Center for Physical Sciences and Technology (Lithuania), [3] Ensemble (Poland)

This paper presents a novel design of a polymer-based 3D FZP near-field probe with implemented hyperbolic metamaterial (HMM) design with sub-wavelength resolution and significant optical field enhancement with the possibility of implementation of such a device onto the optical fiber.

P4: Analog optical differentiation using metal-dielectric layered structures

Artem Kashapov, Leonid Doskolovich, Evgeni Bezus, Nikita Golovastikov, Dmitry Bykov
Russian Academy of Sciences (Russia)

Design and investigation of nanophotonic structures for the optical implementation of different differential operators have attracted considerable attention in recent years. In this work, we present the optical computation of the Laplace operator of the profile of a three-dimensional optical beam incident on a resonant metal-dielectric layered structure composed of two metal-dielectric-metal structures, which, in turn, consist of an upper metal layer, a dielectric layer, and a lower metal layer.

P5: Scattering of acoustic valley Hall modes through different turns

Theo Torres, Antonin Coutant, C. Bellis, R. Cottereau
Aix-Marseille Université (France)

This work studies the propagation of valley Hall modes through turns of different angles in a discrete model. The main goal of our study is the quantitative analysis of the transmission and reflection coefficients through different turns, and to relate our results with the topological argument of valley conservation which predicts high transmission for specific angles. Using the transfer matrix method, we solve the problem semi-analytically and reveal that some angles allow for a rich variety of scattering possibilities.

P6: A Terahertz Lens Antenna Array Design for Beam Steering in Time-Domain

Ahmet Canberk Songur, Ahmet Oguz Sakin, Hasan Alper Gunes, Beyza Akcay, Mehmet Unlu
TOBB University of Economics and Technology (Turkey)

In this paper, a terahertz switched antenna array allowing beam steering between $\pm 30^{\circ}$ in the time-domain for 0.8-2 THz band has been designed. A silicon lens is utilized, which also allows a time-domain steering range between $\pm 30^{\circ}$ and is custom-developed as an extended-hemispherical lens, and the elements of the antenna array consist of broadband bowtie antennas. The far-field terahertz radiation has been successfully obtained in terms of time-domain performance criteria.

P7: Miniaturized Metamaterial Absorber Using Lossy Effective Dielectric-Medium and Resistive Metasurface

Jyoti Yadav, Mondeep Saikia, Kumar Vaibhav Srivastava, J. Ramkumar

Indian Institute of Technology Kanpur (India)

Resistive frequency selective surface (FSS) based microwave absorbers have been widely reported but at lower frequency bands, reducing their unit cell size remains a challenge. In this paper, a resistive ink-based miniaturized passive metamaterial absorber is proposed for S- Band with stable absorption performance up to high oblique incidence angles. The periodicity of the unit cell is approximately λ/26 and the overall thickness is λ/20. The miniaturization of unit cell can be explained using effective medium theory.

P8: Machine Learning Techniques and Practical Advice for the Free-Form Inverse Design of Nanophotonic Devices

Timo Gahlmann, Philippe Tassin
Chalmers University of Technology (Sweden)

The free-form inverse design of nanophotonic metasurfaces can be solved with a modified CGAN machine learning method that balances the accuracy of desired optical properties with experimental feasibility.

P9: Complete linear control based on universal metasurfaces and their applications

Joonkyo Jung, Taeyong Chang, Sang-Hyeon Nam, Hyeonhee Kim, Jong Uk Kim, Nayoung Kim, Suwan Jeon, Minsung Heo, Jonghwa Shin
KAIST (Korea)

By virtue of their high degrees of freedom in manipulating optical properties of an incident light suchas amplitude, phase, and polarization, dielectric metasurfaces have attracted a lot of attraction from academiaand industry. However, they still suffer from the lack of complete controllability of amplitude, phase, andpolarization. Here, we have theoretically, numerically and experimentally proven that the complete linear controlof those properties can be possible by using bi-layer dielectric metasurfaces, which we named universalmetasurfaces.

P10: Some 2D Magnetic Topological Photonic Crystals

Baile Zhang
Nanyang Technological University (Singapore)

Over a decade ago, topological photonics came into existence with the discovery of the first photonic topological insulator, which comprised a two-dimensional (2D) periodic lattice of gyromagnetic rods or a magnetic photonic crystal. Despite the significant progress made in the field of topological photonics in recent years, the potential of 2D magnetic photonic crystals remains largely unexplored. In this talk, we present some of our recent research on 2D magnetic topological photonic crystals.

P11: Fabrication of two-dimensional magnonic crystal using yttrium iron garnets and non-magnetic metals

Kanta Mori[1], Takumi Koguchi[1], Toshiaki Watanabe[2], Mitsuteru Inoue[1], Kazushi Ishiyama[1], Taichi Goto[1]
[1] *Tohoku University (Japan),* [2] *Shin-Etsu Chemical Co. (Japan)*

Two-dimensional magnonic crystals (2D MCs) for forward volume spin waves were demonstrated using yttrium iron garnets (YIG) and copper disks. The 2D MCs with hexagonal lattice were fabricated on a 13 mm thick YIG on a gadolinium gallium garnet substrate by using photolithography and the wet etching and lift-off method. A bandgap was observed in a measured transmission spectrum. The frequency of the bandgap and the propagation band of spin waves were in good agreement with a calculation result.

P12: Efficient broadband mid-infrared linear-to-circular polarization conversion using a nanorod-based metasurface

Huanling Zou, Geoff Nash
University of Exeter (United Kingdom)

In this work a nanorod-based metasurface is experimentally demonstrated to exhibit broadband linear-to-circular polarization conversion in the mid-infrared region of the spectrum. Measurement of the Stokes parameters confirms reflected light is circular polarization with average axial ratio of 0.75 across broadband from 3.5μm to 7.5μm. Such metasurfaces could not only replace conventional quarter wave plates, but also be used for circular dichroism spectroscopy allowing the characterization of important chiral molecules.

P13: Single-shot mapping of the second harmonic 3D radiation pattern by harmonic holography

Serena Goldmann[1], Samuel Grésillon[1], Ignacio Izeddin[1], Gilles Tessier[2], Yannick De Wilde[1]
[1] *ESPCI Paris (France),* [2] *Sorbonne Université (France)*

Digital holography is an imaging technique which measures both the amplitude and phase, from which the 3-dimensional electromagnetic field scattered objects can be reconstructed by digital propagation. Since Second Harmonic Generation (SHG) is a coherent process, SHG light can be used to generate interferences and holograms. We apply SHG holography to nonlinear nanostructured samples made of dielectrics or metals to obtain single-shot measurements of their second harmonic 3D radiation pattern and to map intensity and phase variations near the sample.

P14: Tuning optical properties of individual Sb2S3 nanostructures
Peter Kepic, Petr Liska, Beata Idesova, Filip Ligmajer, Tomas Sikola
Brno University of Technology (Czech Republic)

Phase-change materials represent one of the main directions toward tunable nanophotonic devices. Even though a phase-changing antimony trisulfide (Sb2S3) has recently received tremendous attention due to its low absorption in the visible and near-infrared spectral region, its crystal phase transition is still not fully understood, especially at the nanoscale. Here, by observing the tuning of the optical properties of individual Sb2S3 nanostructures, we want to explain the gradual tunning of the future Sb2S3 metasurfaces.

P15: Silicon Nitride Ring Resonators Operating at 450nm
Samira Jastan[1], S. Iadanza[2], L. O'Faolain[1]
[1] *Tyndall National Institute (Ireland),* [2] *Paul Scherrer Institute (Switzerland)*

This study utilizes Low Pressure Chemical Vapor Deposition (LPCVD) to deposit a 190 nanometer layer of Silicon Nitride (Si3N4) on Silicon Dioxide (SiO2) for the purpose of fabricating Micro Ring Resonators (MMRs). The MMRs are designed to operate in the deep blue wavelength region, specifically at 450 nm. The compact design of the MMRs, characterized by their small radius on the order of a few microns, allows for a reduced device footprint.

P16: Experimental and theoretical study of the plasmonic properties of Cobalt nanoparticles
Wajdi Chaâbani[1], Miguel Comesana-Hermo[1], Jaysen Nelayah[2], Nordin Félidj[1], Jean-Yves Piquemal[2]
[1] *Université Paris-Cité (France),* [2] *Université de Paris (France)*

The control of optical properties at the nanoscale is a current topic of intense research. It has been shown recently in our group that the regular arrays of Co nanoparticles obtained by electron-beam lithography present intense plasmon resonances in the visible range of electromagnetic spectrum. In this work, we purpose to focus our attention on the study of the optical properties of colloidal Co nanoparticles synthesized by the polyol process.

P17: Optical bistability in Su-Schrieffer-Heeger lattice with Kerr nonlinearity
Ghada Alharbi, Sang Soon Oh
Cardiff University (United Kingdom)

We present a nonlinear 1D Su-Schrieffer-Heeger model that models an array of coupled ring resonators-with Kerr nonlinearity. We theoretically demonstrate that spontaneous symmetry breaking can be observed bysymmetrically pumping the array in the clockwise and counterclockwise directions. The optical bistability canbe attributed to the different shift of resonance frequencies between the two counter-propagating modes.

P18: Enabling the inverse design of metasurfaces at the unit cell and the supercell level using neural network approaches for industrial applications
Konstantinos Dovelos, Evangelos Galaris, Vasiliki Vardakastani, Panagiotis Kosmas, Dimitrios Tzarouchis
Meta Materials Europe (Greece)

In this work, we report a general methodology for the inverse design of metasurfaces at the unit cell and supercell level, using a combination of commercial software (FDFD) and a neural network approach, all controlled by a properly designed software wrapper in Python. This automated scheme can be used to develop metasurfaces with on-demand performance and functionalities for industrial applications.

P19: Towards Graphene-comprising Waveguide Resonators for Kerr Comb Generation in the Non-Perturbative Electrodynamic Nonlinearity Regime
Alexandros Pitilakis, Emmanouil Kriezis
Aristotle University of Thessaloniki (AUTH) (Greece)

We present a study of Kerr microcombs generated by CW pumping of graphene-comprising silicon nitride

waveguide ring resonators in the NIR. Our resonator is designed to access the dissipative cavity soliton regime under the combined effect of defocusing nonlinearity from graphene and normal group velocity dispersion (GVD) from a slot waveguide, properly accounting for the wideband dispersion of all waveguide parameters. We then proceed to study the effect of non-perturbative graphene nonlinearity on comb formation and efficiency.

P20: Switching of Phase-Change Optical Metasurfaces via Remote Thermal Sources
George Braid[1], Carlota Ruiz de Galarreta[2], Andrew Comley[3], Jacopo Bertolotti[1], C. David Wright[1]
[1] *University of Exeter (United Kingdom),* [2] *IO-CSIC (Spain),* [3] *Atomic Weapons Establishment (United Kingdom)*

The application space for optical metasurfaces is increased if they are actively controllable. This can be achieved by including a phase-change material, whose optical properties can be changed by thermal stimuli. Such stimuli are often provided by laser excitation of the metasurface, or by embedded micro-heaters within the surface. Some metasurfaces may however not be suited to such approaches. In this work we explore the provision of suitable stimuli using a thermal source that is physically remote from the metasurface.

P21: Coupling of semiconductor nanowire lasers to dielectric cylinders
Daniel Repp, Francesco Vitale, Carsten Ronning, Thomas Pertsch
Friedrich-Schiller-Universität Jena (Germany)

We present active 3D-FDTD calculations of the field distribution and polarization of zinc oxide (ZnO) nanowires in the lasing regime coupled to dielectric cylinders. Significant coupling between nanowire and cylinder can be achieved, showing mode-specific resonance signatures when the cylinder diameter and refractive index are varied. By this modification of the nanowire lasing environment, we numerically demonstrate control of the polarization state of the lasing mode.

P22: Tests for large-scale fabrication of plasmonic metasurfaces with fluorescence enhancement applications
Roxana Tomescu, Veronica Anastasoaie, Catalin Parvulescu, Iuliana Mihalache, Dana Cristea
National Institute for Research and Development in Microtehnologies-IMT-Bucharest (Romania)

This paper presents the initial tests regarding the development of the technology process necessary to obtain large sensitive areas based on plasmonic metasurface for low-cost fluorescent biosensors. The nanostructured surfaces are attained using polystyrene nanospheres lithography and lift-off, processes that do not require high manufacturing time or cost. The test showed that the presence of the metallic nanostructures increases the fluorescence of Rhodamine 6G dispersed in a 170 nm thick PMMA film.

P23: Generalized Lorentz Model and Quasinormal Mode theory for Nonlocal Media
Xuewen Chen
Huazhong University of Science and Technology (China)

Studies of extremely confined optical field down to (sub)nanoscale have been one forefront of optical physics. The related optical phenomena should be understood with the consideration of complex nonlocal effects, which pose a difficult hurdle for constructing a quasinormal mode theory. Here we introduce a generalized Lorentz model to describe the nonlocal effects, then provide a procedure to orthonormalize the quasinormal modes, establishing a general modal theory. Our theory enables drawing the mode evolution path during the quantum tunneling process.

P24: Morphogenetic Design of Self-Organized Correlated Disordered Media
Fadhila Chehami, Cyril Decroze, Thomas Fromenteze
University of Limoges (France)

Recently, a new class of materials referred to as correlated disordered structures has emerged and gained growing attention offering a significant improvement in the control of scattering, transport and localization of light in matter. So far, the different protocols proposed to design such arrangements consist on gradient descent methods requiring high computational efforts. In this paper, we propose a new simple method, inspired by the Turing's morphogenesis theory, for designing self-organized correlated disordered media exhibiting isotropic photonic band gaps.

P25: Graphene-based plasmonic nanostructures for efficient SERS detection of odor molecules
Shinnosuke Ozeki, Ryo Kato, Takuo Tanaka, Taka-Aki Yano

Tokushima University (Japan)

Graphene-based plasmonic nanostructures were investigated for highly sensitive Raman detection of odor molecules. Odor molecules with aromatic benzene rings were preferentially adsorbed on graphene through π-π stacking in the proximity of metallic nanostructures. Raman enhancement factor varied significantly depending on the number of graphene layer, and the highest enhancement was obtained for the monolayer graphene substrate due to the strongest field confinement in the vicinity of metallic nanostructures.

P26: Enhanced Generation of Higher Harmonic from Halide Perovskite Metasurfaces

Pavel Tonkaev[1], Kirill Koshelev[1], Mikhail Masharin[2], Sergey Makarov[3], Sergey Kruk[1], Yuri Kivshar[1]
[1] *Australian National University (Australia),* [2] *Bilkent University (Turkey),* [3] *Harbin Engineering University (China)*

Many outstanding properties of halide perovskites provided their applications in optoelectronics. Perovskite films demonstrate outstanding nonlinear properties with large optical nonlinearities comparable to the nonlinear constants of conventional semiconductor materials. Meanwhile, nonlinear properties can be enhanced by the metaphotonic approach. Here we demonstrate a two-order enhancement of fifth-harmonic generation in halide perovskite nonlocal metasurfaces due to high-quality resonance at the generated harmonic wavelength in the visible frequency range.

P27: Engineering a multifunctional TiO2 BIC metasurface

Haiyang Hu[1], Ludwig Huttenhofer[1], Oliver Bienek[2], Alwin Wester[1], Thomas Weber[1], Ian D. Sharp[2], Stefan A. Maier[1], Emiliano Cortés[1], Andreas Tittl[1]
[1] *Ludwig-Maximilians-Universität Munchen (Germany),* [2] *Technical University Munich (Germany)*

We develop a multifunctional metasurface platform that leverages the combination of loss-engineered substoichiometric titanium oxide (TiO2-x) and the emerging physical concept of optical bound states in the continuum (BICs) to boost photoinduced charge transfer (PICT) and provide broad spectral tunability, making this semiconductor metasurface not only a competitive platform for surface photocatalytic investigations, but also a promising candidate for boosting sensitivities in in semiconductor-based surface-enhanced Raman scattering (SERS) applications.

P28: Quasi-ordered photonic structures colour the bluespotted ribbontail ray

Julien Bouchat[1], Fabio Cortesi[2], Karen Cheney[2], Pete Vukusic[3], N. Justin Marshall[2], Olivier Deparis[1], Sébastien Mouchet[1]
[1] *University of Namur (Belgium),* [2] *The University of Queensland (Australia),* [3] *University of Exeter (United Kingdom)*

Due to the scarcity of blue colour exhibited by natural organisms, highlighting the underlying this colour mechanisms is always very impactful for the understanding of the natural world. In this research, the colour of the blue rounded spots occurring in the skin of Taeniura lymma stingray was unveiled by a combination of experimental and numerical techniques. Our results demonstrated that this blue colour arises from coherent scattering in quasi-ordered photonic structures occurring in the skin of this stingray.

P29: Twist-tunable polaritonic nanoresonators in a van der Waals crystal

Olga Matveeva[1], A. I. F. Tresguerres-Mata[2], R. V. Kirtaev[1], K. V. Voronin[1], J. Taboada-Gutiérrez[2], C. Lanza-Garcia[2], J. Duan[2], J. Martin-Sanchez[2], V. S. Volkov[3], P. Alonso-Gonzalez[2], A. Y. Nikitin[1]
[1] *Donostia International Physics Center (Spain),* [2] *University of Oviedo (Spain),* [3] *Bayan Business Center (United Arab Emirates)*

We introduce a class of nanoresonators that incorporate a new degree of freedom: twist tuning. To achieve this result, we place a pristine slab of the van der Waals α-MoO3 crystal on an array of metallic ribbons. This sample design based on electromagnetic engineering, allows the definition of α-MoO3 nanoresonators with low losses (Q up to 200) and enables a broad spectral tuning of the polaritonic resonances (up to 32 cm-1) by an in-plane rotation (from 0 to 45º)

P30: SERS Detection of Neurotransmitters through Gold Nanoislands-Decorated Tapered Optical Fibers

Di Zheng, Filippo Pisano, Liam Collard, Antonio Balena, Marco Pisanello, Barbara Spagnolo, Linda Piscopo, Cristian Ciraci, Massimo De Vittorio, Ferruccio Pisanello
Istituto Italiano di Tecnologia (Italy)

In this report, we introduce a non-planar repeated dewetting approach to fabricate gold nanoislands (NIs),

uniformly distributed on the wide and highly curved surface of tapered fiber (TF). Through-TF measurements show that the device can achieve a limit of detection in aqueous solution of 10-7 M for rhodamine 6G and 10-5 M for serotonin and dopamine at near-infrared wavelengths. We envision our technology as a first step towards the unexplored frontier of in-vivo label-free plasmonic neural interface.

P31: Focusing of in-plane hyperbolic polaritons in van der Waals crystals with tailored infrared nano-antennas

J. Martin-Sanchez[1], J. Duan[1], J. Taboada-Gutiérrez[1], G. Alvarez-Pérez[1], Kirill Voronin[2], I. Prieto[3], W. Ma[4], Q. Bao[5], V. S. Volkov[6], R. Hillenbrand[7], A. Y. Nikitin[8], Pablo Alonso-Gonzalez[1]

[1] University of Oviedo (Spain), [2] Donostia International Physics Center (Spain), [3] Institute of Science and Technology Austria IST (Austria), [4] Huazhong University of Science and Technology (China), [5] Monash University (Australia), [6] Bayan Business Center (United Arab Emirates), [7] UPV/EHU (Spain), [8] Basque Foundation for Science (Spain)

In this work, we demonstrate for the first time the nanofocusing of in-plane hyperbolic polaritons in the biaxial crystal slab. For this, we perform the experimental and theoretical study of the hyperbolic polariton excitation by the metallic nanoantennas. In particular, we optimize the shape of the antennas and achieve deep subwavelength focusing and the enhancement of the near-field of hyperbolic polaritons in the α-MoO3 slab.

16:40 - 18:30 — Grand Amphi

Session 2A30

Symposium III: Advanced Passive and Active Metasurfaces and Zero-Index Materials

Organized by: Howard Lee and Pin Chieh Wu

Chaired by: Howard Lee and Yang Zhao

16:40 : Keynote talk

Flat Optics for Dynamic Wavefront Manipulation

Mark Brongersma

Stanford University (USA)

In this presentation, I will highlight our recent efforts to realize electrically-tunable metasurfaces employing nanomechanics, microfluidics, phase change materials, and atomically-thin semiconductors. Such elements are capable of dynamic wavefront manipulation for optical beam steering and holography. I will also discuss how the nanostructured, planar optical elements can be fabricated by scalable fabrication technologies, opening the door to a wide range of commercial applications.

17:10 : Invited talk

Metasurface Image Sensors for Optical Spatial Filtering and Quantitative Phase Imaging

Jianing Liu, Yuyu Li, Hao Wang, Lei Tian, Roberto Paiella

Boston University (USA)

We report the development of angle-sensitive photodetectors based on specially designed metasurfaces that can map the phase distribution of the incident light and visualize transparent phase objects without any external spatial-filtering elements. Pixel arrays of these devices can provide quantitative phase reconstruction in a single shot with state-of-the-art sensitivity.

17:30 : Invited talk

Conductive Nitrides for Plasmonics in the Visible Region: Properties and Applications

Yu-Jung Lu

Academia Sinica (Taiwan)

In this presentation, I will discuss emerging plasmonic platforms based on transition metal nitrides. We demonstrated that the refractory hafnium nitride (HfN) plasmonic crystals could generate full-visible color with a high image resolution of $\sim$63,500 dpi while withstanding a high temperature (900 $^{\circ}$C). In addition, I will

present an overview of my research works over the past five years on the plasmon-enhanced light-matter interactions in visible regions and their applications.

17:50 : Invited talk
Harnessing the properties of emerging low-dimensional and phase-change materials for mid-IR photonics
Mitradeep Sarkar, Maxime Giteau, Michael Enders, Aleksandra Deeva, Georgia Theano Papadakis
ICFO (Spain)

Emerging low-dimensional materials are typically exfoliated, rather than grown in large scale. We introduce a method for retrieving the mid-IR dielectric properties of exfoliated flakes, which are too small to be characterized via spectroscopic ellipsometry. Second, I will discuss approaches to leverage the strong anisotropy of several low-dimensional materials for deep-subwavelength control of optical chirality and polarization of a mid-IR beam. Finally, I will present design rules for simple, lithography-free mid-IR absorbers and emitters with active tunability with phase-change materials.

18:10 : Invited talk
Integrated optofluidic devices for medium-switchable metasurfaces and metasurface-based biosensors
Hao Wang, Nanzhong Deng, Yue Xiao, Haogang Cai
New York University (USA)

Active tunable metasurfaces have been demonstrated by various methods including mechanical actuation and phase change materials. Metasurfaces can be easily infiltrated with liquids through microfluidics. The change in refractive index will tune the resonance of meta-atoms and therefore can be used to modulate the optical properties and functions of the given metasurface. Here we demonstrate a series of integrated optofluidic metasurface devices, with wide applications including transparent displays, tunable color filters based on structural color, switchable meta-holograms and biosensors.

16:40 - 18:35 — Amphi Bezier

Session 2A31

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Davy Gérard and Pedro Hernandez Martinez

16:40 : Invited talk
Active photonics using nanocrystal and application for infrared sensing
Emmanuel Lhuillier[1], Yoann Prado[1], Tung Huu Dang[2], Audrey Chu[1], Gregory Vincent[3], Angela Vasanelli[2]
[1] *Sorbonne Université (France),* [2] *Université Paris Cité (France),* [3] *ONERA - The French Aerospace Lab (France)*

This talk discusses how photonic cavities can be coupled to an infrared nanocrystal film not only to reshape the absorption but also to achieve new properties such as bias reconfigurable response.

17:00 : Invited talk
Ultrathin Suspended Chiral Metasurfaces for Enantiodiscrimination and Circularly Polarized Luminescence
Mengjia Cen[1], Huilin He[1], Jiawei Wang[1], Jianxun Liu[1], Tun Cao[2], Yanjun Liu[1]
[1] *Southern University of Science and Technology (China),* [2] *Dalian University of Technology (China)*

We demonstrate a new type of self-aligned suspended chiral bilayer metasurface with only one-step electron beam lithography exposure. Furthermore, we demonstrate that such suspended chiral metasurfaces can be utilized for 1) label-free discrimination of the chiral molecules at zeptomole level , and 2) inducing strong circularly polarized luminescence from achiral nanocrystals including both upconversion nanoparticles (UCNPs)

and quantum dots (QDs).

17:20 : Invited talk
Photoluminescence Engineering with Surface Lattice Resonances
Shunsuke Murai
Kyoto University (Japan)

We combined a luminescent layer or substrate with metallic or dielectric nanoantennae to harness the photoluminescence into a specific direction predefined by the antenna design. A notable ($>$ 10 times) enhancement in in radiation intensity into a designated direction is demonstrated. We describe the mechanism using a simple analytical model. We also fabricated "nanoantenna sticker"where the nanoantenna is embedded in a flexible polymer. The sticker can be stacked on any clean surfaces and act as nanoantenna.

17:40 : Invited talk
Spectrally-Resolved Polarized Cathodoluminescence in STEM
Malo Bézard[1], Yves Auad[1], Davy Gérard[2], Jérémie Béal[2], Jérôme Martin[2], Mathieu Kociak[1]
[1] *Université Paris-Saclay (France),* [2] *Université de Technologique de Troyes (France)*

Compared to pure photon-based spectroscopies, Electron Energy Loss Spectroscopy and Cathodoluminescence (CL) are the best candidates to access the polarisation at deep sub-wavelength scale. We will present our recent theoretical and experimental efforts towards mapping polarisation in a Scanning Transmission Electron Microscope using CL.

18:00 : Invited talk
Local photochemical nanoscopy of plasmonic photocatalysts at work
Alberto Naldoni
University of Turin (Italy)

Recent investigations have demonstrated the strength of investigating the interactions occurring betweenplasmonic materials and molecules at the nanoscale to elucidate the richness of reactivity offered by plasmon-drivenphotocatalysis. In this talk, I will present a photochemical nanoscopy technique that enables the 2D mapping ofplasmonic reaction products, and thus of the hot carriers driving photocatalysis, with subwavelength resolution. Thisapproach opens the way to a deeper understanding of how photonic low-dimensional materials drive chemicaltransformations.

18:20 : Strong coupling in aluminum optical antennas
Thomas Simon, Gabriel Arditi, Xiaoyan Li, Florian Lamaze, Julien Proust, Jérôme Martin, Mathieu Kociak, Odile Stéphan, Davy Gerard
Université de Technologie de Troyes (France)

We analyze the plasmonic response of aluminum nanorods using both optical and electronic spectroscopies. We experimentally evidence a strong coupling phenomenom between the multiple orders of the nanorod's plasmonic resonance and the interband transition of aluminum. The resulting hybrid modes are analyzed using a model for strong coupling to extract the Rabi energies.

16:40 - 18:40 — Amphi Fournel

Session 2A32

Quantum Light Emitters and Photonic Heterogeneous Integration

Organized by: Han Htoon and Galan Moody

Chaired by: Han Htoon and Galan Moody

16:40 : Invited talk
Carbon nanotubes and atomically thin materials integrated with silicon photonic crystal nanocavities
Yuichiro K. Kato
RIKEN (Japan)

Excitons in carbon nanotubes exhibit single photon emission at room temperature, and their telecommunication wavelength emission make them ideal for integration with silicon photonics. We have recently developed a transfer process utilizing anthracene crystals which allows for deterministic coupling of a nanotube emitter to a cavity. The same transfer process can be used to integrate atomically thin materials with the cavities, offering opportunities for manipulation of the photonic structures.

17:00 : Invited talk

Heterogeneous III-V on Diamond Nanophotonics for Quantum Nodes based on Defects in Diamond

Alexander Abulnaga, S. Karg, D. Huang, A. Pakpour-Tabrizi, Z. Zhang, N. P. de Leon
Princeton University (USA)

We describe a heterogeneously integrated, on-chip, III-V on diamond platform designed for color centers in diamond that circumvents the need for etching the diamond substrate. Through evanescent coupling to defects near the surface of diamond, the platform will enable Purcell enhancement and efficient frequency conversion to the telecommunication C-band.

17:20 : Invited talk

Exciton photophysics in MoSe2-WSe2 Moiré hetero-bilayers

Arnab Barman Ray[1], Arunabh Mukherjee[1], Liangyu Qiu[1], Sefaattin Tongay[2], Nick Vamivakas[1]
[1] *University or Rochester (USA),* [2] *Arizona State University (USA)*

The stacking of 2D materials in Moiré heterobilayers provide a novel platform to study intra and interlayer excitons. Of interest for quantum science is the bilayers exhibit a natural and periodic trapping potential that enables a spatially periodic array of programmable quantum emitters. In this talk we discuss the MoSe2-WSe2 system. We demonstrate the existence of valley coherence for trapped trions, excitons, and biexcitons. Our results contribute to an understanding of trapped excitonic species in these systems.

17:40 : Invited talk

Efficient outcoupling of light from single-photon emitters in 2D materials

Rudolf Bratschitsch
University of Munster (Germany)

We demonstrate how single photons originating from 2D materials can be efficiently collected and routed either on a photonic chip or beamed into the far field. For on-chip coupling, we deposit GaSe crystals with embedded single-photon emitters onto silicon nitride rib waveguides. For efficient far-field collection, we 3D-print elliptical polymer microlenses on an array of hBN nanocrystals hosting single-photon emitters.

18:00 : Invited talk

Indistinguishable telecom-band single photons from a coupled cavity-nanotube system at room temperature

L. Husel[1], J. Trapp[1], M. Nutz[1], M. Förg[1], J. Noé[1], T. Hümmer[1], P. Wang[2], J. Wu[2], Y.-H. Wang[2], Alexander D. Hunger[3], Alexander Högele[1]
[1] *LMU München (Germany),* [2] *University of Maryland (USA),* [3] *Karlsruher Institut für Technologie (Germany)*

We report the characteristics of single photons from luminescent quantum defects in carbon nanotubes coupled to a fiber-based microcavity.

18:20 : Invited talk

Hybrid high-Q nanocavities for 2D materials and their heterostructures

C. Qian[1], V. Villafañe[1], P. Soubelet[1], A. Hötger[1], T. Taniguchi[2], K. Watanabe[2], N. P. Wilson[1], A. V. Stier[1], A. W. Holleitner[1], Jonathan Finley[1]
[1] *Technical University of Munich (Germany),* [2] *National Institute for Materials Science (Japan)*

2D semiconductors such as transition metal dichalcogenides (TMDs) and defects in hBN are ideally suited for solid-state cavity quantum electrodynamics (cQED) investigations. The exciton binding energies in TMDs are very strongly bound and emission linewidths close to the homogeneous limit when monolayers, hetero- and homo-bilayers are suitably encapsulated by hexagonal boron nitride (hBN). In addition, 2D-heterostructures can be readily attached to a wide range of substrates, making them ideally suited for solid-state cQED experiments with heterogeneous integration.

16:40 - 17:20 — Amphi Esquillan

Session 2A33

Resonant Optics – Fundamentals and Applications

Organized by: Sven Burger, Philippe Lalanne and Frank Vollmer

Chaired by: Frank Vollmer and Sven Burger

16:40 : Invited talk
Predicting nonlinear optical scattering with physics-driven neural networks
Carlo Gigli, Amirhossein Saba, Ahmed Bassam Ayoub, Demetri Psaltis
EPFL (Switzerland)

We present a physics informed deep neural network trained on Maxwell's equations, hence the name MaxwellNet, which acts as a surrogate of numerical solvers and reduce computational times of three orders of magnitude compared to commercial software packages. Beyond demonstrating the possibility of studying linear and nonlinear scattering in presence of optical kerr effect, we show how this approach facilitates the inverse design of optical components with size comparable with light wavelength for which full wave simulations are normally required.

17:00 : Invited talk
Non-Abelian gauge fields for non-Hermitian systems
Yi Yang
The University of Hong Kong (China)

Non-Abelian gauge fields are versatile tools for synthesizing topological phenomena but have so far been mostly studied in Hermitian systems. We study them in non-Hermitian systems via a generalized Hatano–Nelson model with imbalanced non-Abelian hopping. Despite lacking gauge flux in one dimension, non-Abelian gauge fields create rich non-Hermitian topological consequences. Under only nearest-neighbor coupling, non-Abelian gauge fields enable Hopf-link bulk braiding topology, whose phase transition accompanies the emergence of exceptional points (EPs).

17:20 - 18:35 — Amphi Esquillan

Session 2A34

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Takasumi Tanabe

17:20 : Invited talk
A multi-modal nonlinear optical technique to study in-situ polymer nanostructure formation
Thierry Verbiest, K. Aerts, Y. de Coene
KU Leuven (Belgium)

We describe a new multi-modal optical technique to study the formation of (polymer) nanostructures in solution. The technique is based on linear and nonlinear light scattering combined with multi-photon fluorescence and optical transmission.

17:40 : Retrieving optical parameters of emerging van der Waals microcrystals
Mitradeep Sarkar, Mehrdad Shokooh-Saremi, Michael Enders, Georgia Papadakis
ICFO (Spain)

To achieve high-quality in low-dimensional layered van der Waals materials, microcrystals are typically exfoliated. The small size of exfoliated flakes makes their optical characterization with conventional far-field optics

challenging. Thus, flake-characterization has typically required delicate spatial scanning via a near-field tip. We present a simple method for determining the optical properties of optically small flakes. Our method is based on far-field spectroscopy and requires minimal numerical fitting. We demonstrate the robustness of our method using hexagonal boron nitride and α-MoO3.

17:55 : Invited talk
Chemical interface damping by electrochemical oxidation of gold
Maurice Pfeiffer, Manfred Eich, Alexander Petrov
Hamburg University of Technology (Germany)

Chemical interface damping (CID) is a change of the effective collision frequency of electrons in metal due to chemical change of the metal interface. We show that electrochemical oxidation of gold leads to CID effect. The increase in collision frequency is determined by in-situ ellipsometric measurements during oxidation of flat single crystal and polycrystalline gold films.

18:15 : Invited talk
Epsilon-near-zero materials enhance infrared vibrational spectroscopy
Rafik Smaali, Antoine Moreau, Emmanuel Centeno
Universite Clermont Auvergne (France)

Surface-enhanced infrared absorption (SEIRA) spectroscopy is a powerful technique for a label-free identification of molecular species. The design of actual plasmonics detectors is a trade-off between the detection of very small volumes of molecules and the signal to noise ratio level. We demonstrate that an epsilon-near-zero (ENZ) material combined with nano-slits lifts this constraint and provides both extreme enhancement factor up to 107 and highly contrasted SEIRA signal for an extremely low amount of material of interest.

16:40 - 17:35 — Amphi A

Session 2A35

Advanced Computational Electromagnetics for the Analysis and Design of Nanophotonic Devices

Organized by: Maha Ben Rhouma and Kofi Edee

Chaired by: Maha Ben Rhouma

16:40 : Invited talk
Towards cm-scale full-wave metasurface simulation and design
Owen Miller
Yale University (USA)

Simulating the full wave dynamics of centimeter-scale metasurfaces is beyond the capabilities of finite-difference and finite-element solvers, yet is necessary for reaching the ultimate limits of functionality and performance. In this talk, I describe our fast direct integral-equation solver that can accurately and efficiently simulate cylindrical metasurfaces tens of thousands of wavelengths in diameter. We demonstrate its capabilities with the successful inverse design of a high-efficiency, high-NA, cm-scale metalens.

17:00 : Radiative heat exchange driven by acoustic modes between two solids at the atomic scale
Mauricio Gomez Viloria, Riccardo Messina, Philippe Ben-Abdallah
Université Paris-Saclay (France)

When two solids are separated by a vacuum gap of smaller thickness than the wavelength of acoustic phonons, the latter can tunnel across the gap. We show that the acoustic modes in polar crystals can also significantly contribute, at atomic scale, to the nonlocal optical response of the material. We investigate the radiative heat transfer between two slabs of polar materials separated by vacuum gaps of atomic thickness and highlight the strong contribution of these modes at cryogenic temperatures.

17:15 : Invited talk

Fabrication-Conscious Inverse Design of Single-Material Variable-Index Multilayer Films

Omer Yesilyurt, Samuel Peana, Vahagn Mkhitaryan, Karthik Pagadala, Vladimir Shalaev, Alexandra Boltasseva, Alexander Kildishev
Purdue University (USA)

We developed a neural network-based inverse-design technique for the design of single-material multilayer optical devices. Such devices are made of one material and the growth parameters are varied to achieve different refractive indices at each layer. The inverse design method explored is computationally efficient and capable of designing devices consisting of several hundred layers. If systemic fabrication imperfections are introduced during training the resulting designs account for the non-idealities of the growth process while still yielding sufficiently high performance.

17:35 - 18:20 — Amphi A

Session 2A36

Nano-Optics and Spectroscopy

Chaired by: Kerry Vahala

17:35 : Improved Control over Multipole Excitations in Multi-Shelled Particles Leads to Higher Directivity Scattering

Seokhwan Min, Jonghwa Shin
Korea Advanced Institute of Science and Technology (KAIST) (Korea)

Directional scattering has been studied for decades since the discovery of the Kerker conditions. Numerous studies on superdirective scattering have found that the collective interference of a large number of modes is a crucial factor. In this study, we show that multiple shells are required for the independent control of such an extended number of multipole modes. Furthermore, we use a topology nucleation method tailored to layered systems to design particles with high scattering directivities in the visible wavelengths.

17:50 : Order-Invariant Quantum Correlations in non-Hermitian Interferometers

Tom Wolterink, Matthias Heinrich, Stefan Scheel, Alexander Szameit
University of Rostock (Germany)

We identify types of sequences of concatenated two-mode systems that perform distinct linear optical transformations, whereas their two-photon behavior is invariant under reversal of the order. We experimentally verify this systematic behavior in parity-time-symmetric complex interferometer arrangements of varying composition, and demonstrate that non-Hermitian quantum correlations may be preserved in counterintuitive ways even in small-scale networks.

18:05 : Surface material dependance in tip enhanced Raman spectroscopy

Tim Parker, Felix Schneider, Yang Zhao, Alfred J. Meixner, Dai Zhang
Eberhard-Karls University Tübingen (Germany)

Raman spectra may strongly be enhanced through the use of a gold tip in close proximity to the samples surface. A great difference in the enhancement factor for the Raman spectra can be observed for various substrates and their surface properties.

16:40 - 18:50 — Amphi Pinel

Session 2A37

New Trends in Topological Matematerials

Organized by: Xiao Hu

Chaired by: M. Hafezi and S. Huber

16:40 : Invited talk

Adiabatic topological photonics

Anton Vakulenko[1], Svetlana Kiriushechkina[1], Daria Smirnova[2], Sriram Guddala[1], Filipp Komissarenko[1], Andrea Alù[1], Monica Allen[3], Jeffery Allen[3], Alexander Khanikaev[1]
[1] *City College of New York (USA),* [2] *The Australian National University (Australia),* [3] *Air Force Research Laboratory (USA)*

We introduce the concept of adiabatic topological photonic structures, which allows us to overcome many of the limitations of topological photonic metasurfaces. Adiabatic variation of the mass terms at the domain walls makes topological boundary modes less sensitive to details of the lattice, perceiving the structure as an effectively homogeneous Dirac metasurface. As the result, the modes exhibit longer radiative lifetime and propagation distance, while retaining their topological resilience.

17:00 : Invited talk

Topological photonic integrated circuits for controlling optical vortex signal

Tomohiro Amemiya[1], Hibiki Kagami[1], Sho Okada[1], Itsuki Sakamoto[1], Nobuhiko Nishiyama[1], Xiao Hu[2]
[1] *Tokyo Institute of Technology (Japan),* [2] *National Institute for Materials Science (Japan)*

Topological photonics brings the concept of mathematical topology into the field of optics, which allows us to systematically handle information derived from the topology of light, such as optical spin and orbital angular momentum. In this talk, starting from the concept of topological photonic integrated circuits, we describe analytical methods, fabrication technology, and its application to optical circuits.

17:20 : Invited talk

Harness Light with Spinor Wavefunction

Xiao Hu
National Institute for Materials Science (Japan)

Dirac dispersions are associated with spin degree of freedom. Electromagnetic modes in honeycomb photonic crystals exhibiting Dirac-type frequency dispersions are characterized by synthetic spin and described in terms of spinor wavefunctions. We show that spinor wavefunctions can be exploited for harnessing light and achieving novel features.

17:40 : Keynote talk

Quantized Fractional Thouless Pumping of Solitons

Marius Juergensen, Sebabrata Mukherjee, Christina Joerg, Mikael Rechtsman
The Pennsylvania State University (USA)

I will present my group's recent work on the fractional pumping of solitons in photonic Thouless pumps. Specifically, I will show that the displacement (in unit cells) of solitons in Thouless pumps is strictly quantized to the Chern number of the band from which the soliton bifurcates in the low power regime, whereas in the intermediate power regime, nonlinear bifurcations lead to fractional quantization of soliton motion. This fractional quantization can be predicted from multi-band Wannier functions.

18:10 : Invited talk

Topological Thouless Pumping in Photonic Time Crystals

Xiang Ni, Shixiong Yin, Huanan Li, Andrea Alù
City University of New York (USA)

We study the exotic behaviors and topological phases of photonic time crystals (PTCs) and emulate their Integer Quantum-Hall Effect in parameter space. By exploiting the eigenvalue approach of frequency vs. momentum, we verify their quantized topological invariant and disclose topological edge states at temporal boundary. To experimentally disclose their edge bands, we propose a simple approach of scattering parameters at a dedicated time relating them to the eigenmodes. We also reveal exclusive features of PTCs not

observed in spatial counterpart.

18:30 : Invited talk
3D Magnetic Topological Photonic Crystals
Baile Zhang
Nanyang Technological University (Singapore)

More than a decade ago, topological photonics emerged with the discovery of the first photonic topological insulator, which was a two-dimensional (2D) periodic lattice of gyromagnetic rods or a magnetic photonic crystal. Although electronic topological insulators were successfully generalized from 2D to three-dimensional (3D) in the past decade, the development of 3D photonic topological insulators has been highly challenging. In this talk, we present some of our recent research on 3D magnetic topological photonic crystals.

16:40 - 17:55 — Amphi Manet

Session 2A38

Recent Advances in Non-Hermitian Photonics: Topological, Disordered and Quantum Systems

Organized by: Konstantinos Makris and Li Ge

Chaired by: Georgios Siviloglou

16:40 : Invited talk
Electrically injected first-order gratings broken Parity-Time symmetry DFB lasers: insight on device design rules and experimental results
Yaoyao Liang[1], Quentin Gaimard[1], Jean-Rene Coudevylle[1], Alexandre Garreau[2], Arnaud Wilk[2], Olivier Delorme[2], Henry Benisty[1], Abderrahim Ramdane[1], Anatole Lupu[1]
[1] *Université Paris-Saclay (France),* [2] *III-V Lab (France)*

We address the problem of the optimal design of first-order Parity-Time symmetric Bragg grating for the distributed feedback laser diodes operation. It is shown that the optimal design grating is not the exceptional point where the perfect unidirectional reflectivity condition is met. It is rather the design corresponding to the broken Parity-Time symmetry phase where the reflection asymmetry is still playing in important role. We also present experimental results on the electrically injected DFB lasers based on such design.

17:00 : Invited talk
Extended Nielsen-Ninomiya theorem and non-Hermitian topological phenomena
Masatoshi Sato
Kyoto University (Japan)

The Nielsen-Ninomiya theorem is a fundamental theorem on chiral fermions in lattice systems. In this talk, I report an extension of the theorem in open systems, which includes the original Nielsen-Ninomiya theorem in a particular limit. In contrast to the original theorem, which is a no-go theorem for bulk chiral fermions, the new theorem permits them due to bulk topology intrinsic to open systems. I also report on applications of our theorem and predict new types of topological phenomena.

17:20 : Reflectionless Scattering in Disordered Media: exceptional points and anti-reflection structures
Matthieu Davy[1], Clément Ferise[1], Michael Horodynski[2], Matthias Kühmayer[2], Stefan Rotter[2], Simon Félix[3], Vincent Pagneux[1]
[1] *University of Rennes (France),* [2] *TU Wien (Austria),* [3] *LAUM (France)*

Reflectionless (RL) states that are eigenfunctions of a non-Hermitian operator enable reflectionless coupling of light to a scattering sample. Here, we first observe exceptional points of RL states obtained by tuning the scattering strength in symmetric scattering samples. Then, instead of using wavefront shaping techniques, we will show that we can design anti-reflection structures for perfect transmission through disordered medium for any incident wavefront.

17:35 : Invited talk
Non-Hermitian modulations for stabilization of VCSEL, EEL and EEL arrays
Ramon Herrero, S. B. Ivars, Muriel Botey, K. Staliunas
Universitat Politecnica Catalunya (Spain)

Semiconductor lasers and laser arrays emit temporally unstable and low spatial quality beams associated to intrinsic dynamical spatiotemporal instabilities. We propose the simultaneous modulations of refractive index and gain-loss generating non-Hermitian potentials as a stabilization mechanism. The proposed spatiotemporal modulations are introduced by directly acting on field and carriers. The stabilization is based on the stabilization of specific stationary solutions or on field localization. Stabilization is shown for VCSELs, EELs and EEL arrays.

16:40 - 17:40 — Salle des Conseils

Session 2A39

Industrial Workshop by Synopsys Inc.

Organized by: Chenglin Xu, Maryvonne Chalony, Yijun Ding

16:40 : Industrial Workshop
Automated Inverse Design Solution for Metalenses
Chenglin Xu[1], Maryvonne Chalony[2], Yijun Ding[1]
[1] *Synopsys Inc. (USA),* [2] *Synopsys Inc. (France)*

To help researchers design metalenses easily and quickly, Synopsys has developed MetaOptic Designer, a fully automated design tool for metalenses. Based on a few inputs from designers, such as a pre-built meta-atom library and basic lens configuration, MetaOptic Designer generates an optimized design to meet all design targets. Synopsys will introduce and demonstrate MetaOptic Designer in two workshop sessions at META 2023. On July 18, we will provide a general overview of the MetaOptic Designer optimization algorithm, followed by quick demonstrations of the tool's capability. On July 19, we will demonstrate advanced metalens applications with tips and tricks; applications will include: Achromatic metalens, Wide-angle metalens, Chiral hologram, Reflective metalens, Hybrid optical system with both metasurfaces and traditional refractive lenses. The workshop is free and open to all META conference attendees.

17:40 - 18:20 — Salle des Conseils

Session 2A40

Metamaterials Meeting Industry

Organized by: Tatjana Gric and Edik Rafailov

Chaired by: Tatjana Gric

17:40 : Invited talk
Dynamic plasmonics and optics with organic conducting polymers
Magnus Jonsson
Linköping University (Sweden)

In this presentation, I will present our latest research on using conducting polymers for (1) tunable plasmonics and metasurfaces, (2) tunable structural coloration, and (3) tunable radiative cooling.

18:00 : Invited talk
Modelling hot carrier generation in large metallic nanoparticles
Johannes Lischner

Imperial College London (United Kingdom)

In my talk, I will describe a material-specific theory of hot-carrier generation in metallic nanoparticles which combines a classical description of the electromagnetic radiation with large-scale atomistic quantum-mechanical simulations. I will present results for hot carrier distributions in spherical nanoparticles and also for more complex systems, such as core-shell nanoparticles or reactor"systems in which small catalytic nanoparticles are adsorbed to a larger plasmonic nanoparticles.

16:40 - 18:35 — Salle Guy Gautherin

Session 2A41

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

16:40 : Invited talk

Giant Magnetoimpedance Effect in amorphous magnetic materials

Arcady Zhukov[1], Paula Corte-Leon[1], Mihail Ipatov[1], Juan Maria Blanco[1], Jesus Olivera[2], Valentina Zhukova[1]

[1] *University of Basque Country (Spain),* [2] *Universidad Autonoma de Santo Domingo (Dominican Republic)*

We studied the factors affecting the giant magnetoimpedance, GMI, effect value and magnetic field dependence in magnetic microwires. Specially designed postprocessing allows also to improve substantially the GMI effect in less expensive Fe-rich microwires. A relationship between the optimal frequency for the GMI performance and the wire diameter is observed. A new sensing technique involving free space microwave spectroscopy using inclusions of ferromagnetic microwires with GMI effect at GHz frequencies is proposed for the carbon fiber containing composites monitoring.

17:00 : Invited talk

Non-linear ferrite dynamics for microwave thin film technologies

Feodor Ogrin

University of Exeter (United Kingdom)

Electromagnetic shock waves are normally associated with nuclear explosions. Analogous to a sonic boom, it is an interference effect, resulting in a surge of EM power, propagating with a speed of light. Since early 60s there was an interest to harness the effect tomake it technologically practical. One possible way to do that is by using a magnetically loaded transmission line. Here we demonstrate how the shock wave can be obtained in a thin magnetic film.

17:20 : Invited talk

Pushing the limits of magnetoplasmonics by (meta)material design

Francesco Pineider

University of Pisa (Italy)

The field of magnetoplasmonics has reached a relatively mature state and is currently striving to take the step toward technological application. In this talk, I will show some interesting approaches to increase the magnetoplasmonic modulation, based on rational material design and structuration into metasurfaces. Finally, I will discuss a (failed) attempt to observe magnetochiral behaviour in a nickel-silver metasurface.

17:40 : Invited talk

Optical response of magnetic metals from first principles

Mariia Pogodaeva, Sergey Levchenko, Vladimir Drachev

Skolkovo Institute of Science and Technology (Russia)

We present a first-principle methodology to calculate spin-resolved dielectric function of magnetic metals applying Drude model. Interband and intraband contributions to the dielectric function are calculated using

density functional theory in an all-electron full-potential framework. The results are compared to the experiments. We find a significant difference between the contribution of the spin-up and spin-down electrons. Our results allow to explain the existence of unexpected plasmon resonance in cobalt nanoparticles.

18:00 : Microbundle array of Magnetoplasmonic Nanorods for reconfigurable chiral Metasurface
Juyong Gwak, Hyojin Kang, Jaebeom Lee
Chungnam National University (Korea)

Flexible devices are a fascinating application for wearable electronics, life and healthcare, and stealth technology. In this study, a metasurface film was fabricated by arranging core-shell magnetoplasmonic nanowires in microbundles on a flexible polymer substrate. Its chirality is manipulated by the tilt angle, i.e. the angle between the applied magnetic field vector and the tangent vector of the curved metasurface. These flexible chiral metasurface platform could be useful for fabricating integrated enantiomeric sensing and AR devices.

18:15 : Invited talk
Ultrathin magneto-optical devices based on all-dielectric metasurfaces
Yasutomo Ota[1], Siyuan Gao[2], Satoshi Iwamoto[2]
[1] *Keio University (Japan),* [2] *The University of Tokyo (Japan)*

Magneto-optical (MO) devices play a key role in introducing nonreciprocity in optical systems, but tend to be bulky due to weak MO effects available in the optical regime. In this talk, we discuss our recent efforts to design of all-dielectric MO metasurfaces toward ultrathin MO devices. We found that large Faraday rotations and high light transmittance can be realized in MO metasurfaces that are much thinner than the operating wavelength.

16:40 - 17:20 — Salle P1

Session 2A42

Generation and Applications of Textured Photonics Fields

Organized by: Jamal Berakdar

Chaired by: Jamal Berakdar

16:40 : Invited talk
Generation of Extreme-Ultraviolet structured fields with the seeded Free Electron Laser FERMI, and applications in atomic and molecular physics.
Carlo Callegari
Elettra - Sincrotrone Trieste (Italy)

Free Electron Lasers are the most powerful light source presently available in the EUV and x-ray range, they allow the time-resolved study of atoms, molecules and condensed matter with chemical sensitivity. A seeded, modular design adds the possibility to generate fields with differing properties (wavelength, polarization, phase), and to combine them coherently. Applications range from sub-attosecond resolution in photoionization processes, to the generation and control of attosecond pulse trains, to the excitation or probing of chiral observables.

17:00 : Invited talk
Nanofemto vectorial texturing of electromagnetic fields by spin-orbit interaction of light
Hrvoje Petek[1], Atreyie Ghosh[1], Sena Yang[1], Yanan Dai[2]
[1] *University of Pittsburgh (USA),* [2] *University of Pittsburgh (China)*

The excitation laser polarization and coupling geometry metastructures define the spin-orbit interaction of surface plasmon polaritons at metal-vacuum interfaces. We image the topological plasmonic fields by photoemission electron microscopy with nanometer spatial and femtosecond temporal resolution, to deduce the generated space-time spin textures of plasmonic vortex fields and how they can dress the space-time invariance of matter.

17:20 - 18:35 — Salle P1

Session 2A43

Metasurfaces and Flat Optics

Chaired by: Takuo Tanaka

17:20 : Enabling and perfectioning advanced large Area Metalens Nanofabrication by Electron Beam Lithography (EBL)
Frank Nouvertne, C. Aulbach, G. Piaszenski, J. Münchenberger, V. Boegli
Raith GmbH Dortmund (Germany)

The geometric nature of a large ∼cm2-sized metalense with its many unique and individual design elements can lead to corresponding design data file sizes of several hundreds of GB. This makes it extremely challenging if not impossible to be processed with conventional EBL nanofabrication systems. We present an enabling, innovative, and extremely efficient EBL workflow that circumvents the necessity for generating CAD-design-data for EBL by exploiting the algorithmic (formula-based) description of metalens patterns for on-the-fly EBL exposure pixel stream generation.

17:35 : Large Field-of-View and Multi-Color Imaging with Quadratic Metalenses
Emmanuel Lassalle[1], Anton V. Baranikov[1], Egor Khaidarov[1], Damien Eschimese[1], Joel Yeo[1], N. Duane Loh[2], Ramon Paniagua-Dominguez[1], Arseniy I. Kuznetsov[1]
[1] *A*STAR (Singapore),* [2] *National University of Singapore (Singapore)*

In this talk, we will give a demonstration, based on a recently-developed class of metalenses, of a prototype that alleviates the challenges of chromatic and coma aberrations within a single-layer device, and achieves color imaging over a field-of-view of $\sim 100^{\circ}$. The proposed approach opens venues for translating this emergent technology into commercial products.

17:50 : Polarization holograms assisted with deep-learning
Jiawei Xi, Jian Shen, Man To Chow, Tan Li, Jack Ng, Jensen Li
The Hong Kong University of Science and Technology (Hong Kong)

We demonstrate an integrated deep-learning neural network that generates metasurface designs directly from independent polarization holograms, with a maximum of four different co- and cross- polarization conversion channels. This is achieved by extending the existing DeepCGH network with an inverse design component. Our approach enables a systematic design route for polarization holograms directly from an existing metamaterial library without requiring detailed knowledge of the constraints. Furthermore, it can be adapted for other multiplexing holograms that require automated designs.

18:05 : Metasurface enabled multifunctional microscopy
Muhammad Afnan Ansari[1], Yuttana Intaravanne[1], Hammad Ahmed[1], Narina Bileckaja[2], Huabing Yin[2], Xianzhong Chen[1]
[1] *Heriot-Watt University (United Kingdom),* [2] *University of Glasgow (United Kingdom)*

Edge and polarimetric imaging play an essential role in the enhancement of target detection and recognition performance. However, an imaging system with such multiple functionalities tend to be bulky and expensive because of the substantial footprint of their benchtop-based electronic and optical components. Here, we propose a multifunctional 3-in-1 microscope based on an ultrathin metasurface device which can concurrently perform polarimetric, edge and microscope imaging to visualize the multiple facets of transparent biological samples in real-time.

18:20 : Highly angle-sensitive and efficient optical metasurfaces
Nayoung Kim, Myungjoon Kim, Joonkyo Jung, Taeyong Chang, Suwan Jeon, Jonghwa Shin
KAIST (Korea)

Angle-multiplexed metasurfaces offer new degrees of freedom in multi-functional metasurfaces. However, they can suffer from trade-offs in transmission efficiency and angular sensitivity for paraxial rays. Here, we demonstrate a solution to the limitation by breaking mirror symmetries of single-layer metasurface structures. Using a theoretical model, we intuitively explain which material parameters affect the sensitivity and efficiency. Additionally, through the inverse design method, an angle-multiplexed beam deflector is proposed.

16:40 - 18:20 — Salle P2

Session 2A44

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Keon Jae Lee

16:40 : Invited talk
Reconfiguring electric and magnetic resonances of individual meta-atoms using phase-change materials
Lukas Conrads, Andreas Heßler, Thomas Taubner
RWTH Aachen University (Germany)

We employ Phase-Change Materials (PCMs) for local addressing of individual meta-atoms in both metallic and low-loss dielectric metasurfaces, with special emphasis on tuning electric dipole (ED) and magnetic dipole (MD) resonances simultaneously or individually. Individual control of the electric and magnetic dipole resonances of split-ring resonators (SRRs) is demonstrated by locally changing the refractive index of aluminum SRRs in the corresponding hotspots of the antenna resonances and by direct writing and reconfiguration of SRRs in the new plasmonic PCM In3SbTe2.

17:00 : Invited talk
Topological Tamm states based on flat band symmetry inversion
Soufyane Khattou[1], Amina Rezzouk[1], Madiha Amrani[1], Mohamed El Ghafiani[1], El Houssaine El Boudouti[1], Abdelkrim Talbi[2], Bahram Djafari Rouhani[2]
[1] *Université Mohammed I (Morocco),* [2] *Université de Lille (France)*

We study topological Tamm states at the interface between two comb-like photonic or phononic crystals based on a new mechanism of band inversion symmetry due to the existence of flat bands. Several arguments such as the Zak phase or the phase of the reflection coefficients support the topological nature of the interface states. The analytical results are well reproduced by experiments using coaxial cables.

17:20 : Invited talk
Integrated 2D GaGeTe Electro-Optic Phase Shifter in Silicon Photonics
S. R. Tamalampudi, G. Dushaq, J. E. Villegas, Mahmoud Rasras
New York University Abu Dhabi (United Arab Emirates)

We present a high-speed and compact optical phase-shifter using multi-layered GaGeTe hybrid integrated on silicon micro-ring resonator (Si-MRR) structure. Under static DC bias, a blue-shift of wavelength is observed for both the Transverse Electric (TE) and Transverse Magnetic (TM) polarizations corresponding to -1.78 pm/V and - 6.65 pm/V, respectively. The device showed a remarkable tuning speed of 2.1 MHz with low optical insertion losses $>$ 0.25 dB. The Pockels effect is expected to dominate the observed phase shift.

17:40 : Invited talk
Discovering new high-refractive-index dielectric materials
Soren Raza
Technical University of Denmark (Denmark)

Dielectric materials with a high refractive index are key in the design of optical nanoantennas and metasurfaces. Here, we use a high-throughput screening method combined with optical Mie theory to evaluate the performance of more than 2000 materials and discover a new promising material, boron phosphide, which has so far been elusive. We prepare boron phosphide nanoparticles and experimentally demonstrate that they support Mie resonances across the visible and the near ultraviolet using both optical measurements and electron energy-loss spectroscopy.

18:00 : Invited talk
Color Selective 3D Polarization Profiles
Xianzhong Chen
Heriot-Watt University (United Kingdom)

We propose and experimentally demonstrated a single metasurface device that can realize color selective 3D polarization structures. The device design includes multi-foci design, polarization rotation, and color multiplexing in 3D space. The efficacy of this approach was exemplified through the demonstration of multiple 3D knots with controlled local polarization states. The unprecedented design degree of freedom of optical metasurfaces has provided a compact platform to develop ultrathin optical devices with engineered 3D polarization profiles and color selective functionality.

Thursday 20th July, 2023

08:30 - 09:40 — Grand Amphi

Session 3A1

Plenary Session III

Chaired by: Sir John B. Pendry

08:30 : Plenary talk
Imaging and Computing with disorder
Sylvain Gigan
Sorbonne Université (France)

Light propagation in complex media, such as paint, clouds, or biological tissues, is a very challenging phenomenon, encompassing fundamental aspects in mesoscopic and statistical physics. It is also of utmost applied interest, in particular for imaging. Although this scattering process seems to mix and completely destroy all information, thus preventing imaging or communication, a different approach has emerged. I will discuss how this powerful concept has recently triggered a wealth of advances in imaging and computing.

09:05 : Plenary talk
Scalable classical and quantum photonics
Jelena Vuckovic
Stanford University (USA)

Novel computational techniques such as photonics inverse design, along with new nanofabrication approaches, play a crucial role in building scalable integrated classical and quantum photonics. Inverse design, a departure from the traditional photonics design approach, can lead to photonics much better than state of the art in many metrics (smaller, more efficient, more robust, a much higher density of integration). This is enabled by development of a computer software which efficiently searches through the space of all possible and fabricable photonic geometries, in any material of interest. On the other hand, future photonic systems also require integration and fabrication of traditional and non-traditional photonic materials, including silicon, silicon-carbide, diamond, sapphire, and strong electro-optic materials such as lithium niobate, strontium and barium titanate.

Coffee Break

Session 3P1
Poster Session V
9:40 - 10:20

P1: Metal-insulator-metal metamaterial as optoplasmonic biosensor for refractive index sensing
Z. Ayareh[1], D. Sutherland[2], M. Moradi[1]
[1] *University of Kashan (Iran),* [2] *Aarhus University (Denmark)*

The optoplasmonic biosensor is a label-free sensor which has significant potential to detect biomolecules. We proposed it based on metal–insulator–metal (MIM) metamaterials utilizing the gap between two metals as a space to detect biomolecules. We fabricated Au/SiO2/Au heterostructures using the hole-mask colloidal lithography method. In this work, the localized surface plasmon resonance was demonstrated by modifying the MIM heterostructure by etching back the insulator (SiO2) to provide a sensing cavity. A bulk sensitivity of 285 nm/RIU was measured.

P2: Layer transfer of multispectral plasmonic absorbers onto graphene for enhanced selective photoabsorption

Hyo-Seung Park, Gyu Won Hwang, Jongkil Park, Joon Young Kwak, Doo-Seok Jeong, Kyeong Seok Lee
Korea Institute of Science and Technology (Korea)

In this study, we demonstrate a high-quality transfer method for a multi-periodic array of plasmonic nanodiscs onto a graphene monolayer by carefully adjusting the surface tension of a water-ethanol mixture. Our analysis using optical microscopy, scanning electron microscopy, and optical spectrum measurements revealed little difference compared to those formed by direct patterning. We observed multispectral selective enhancement of photo-absorption at resonant wavelengths corresponding to each period of the plasmonic absorber array.

P3: Explaining an Anomalous Thermally Activated Delayed Fluorescence (TADF) Response for a Phenothiazine Derivative through a TD-DFT Approach

Lucia Cascino[1], Antonio Maggiore[2], Ivan Rivalta[3], Gian Paolo Suranna[4], Roberto Grisorio[4], Daniele Conelli[4], Vincenzo Maiorano[2], Stefania D'Agostino[1]
[1] *Università del Salento (Italy),* [2] *National Research Council (Italy),* [3] *Università di Bologna (Italy),* [4] *Politecnico di Bari (Italy)*

Thermally activated delayed Fluorescence (TADF) mechanism can occur by a complicated and fascinating route involving the triplet manifold. Here, we report a computational approach based on Time Dependent Density Functional Theory (TD-DFT) to shed light on the anomalous response of a phenothiazine derivative exhibiting efficient TADF only upon aggregation. The strong red-shifted peak in the photoluminescence spectrum of the molecule dispersed in a non-polar solvent (i.e. cyclohexane) is explained in terms of aggregation of monomers and dimer formation.

P4: Plasmonic Metasurfaces of Self-assembled Gold Nanoparticle Superlattices with Tunable Sub-nanometer Gaps

Bin Lu[1], Karol Vegso[2], Simon Micky[2], Christian Ritz[1], Michal Bodik[1], Yuriy Fedoryshyn[1], Peter Siffalovic[2], Andreas Stemmer[1]
[1] *ETH Zürich (Switzerland),* [2] *Institute of Physics SAS (Slovakia)*

We developed centimeter scale metasurfaces of self-assembled monolayer gold nanoparticle (GNP) superlattices. Through ligand exchange, the interparticle gap distance was actively tuned from 2.4 to 0 nm. The in-situ reflectance spectra of the GNP metasurfaces showed a monotonously red-shifted bonding dipolar plasmon (BDP) mode of enhanced intensity upon diminishing interparticle gaps until 0.2 nm. The deposited GNP metasurfaces on SiO2/Si wafer showed tunable effective refractive index, where the maximal real part exceeded 5.

P5: LSPR sensors with antiadhesive layer made of DNA: nanostructure pitch study

Remigiusz Trojanowicz[1], A. Vestri[2], M. Rippa[2], J. Zyss[3], K. Matczyszyn[4], Lucia Petti[2]
[1] *Université Paris-Saclay (France),* [2] *.E. Caianiello.of CNR (Italy),* [3] *Institut d'Alembert (France),* [4] *Wroclaw University of Science and Technology (Poland)*

Sensors based on Localized Surface Plasmon Resonance (LSPR) reach impressive detection limits, however their fabrication in most cases is time-consuming and costly. In this work we immobilized LSPR sensor with antiadhesive layer that allows detection of analyte through shift of the resonance and it subsequent recovery to initial LSPR peak position. Immobilization on 4 sensors from the same pattern family (Achiral Octupolar) with different pitch is performed to investigate what role nanostructure dimensions play in sensor's response.

P6: Reconfigurable On-Chip Waveguide-fed cELC-based Metasurface Antenna

Khaled Boubekeur[1], Nicolas Zerounian[1], Badr Eddine Ratni[2]
[1] *Université Paris-Saclay (France),* [2] *Université Paris-Nanterre (France)*

The present paper describes the study and design of a Substrate Integrated Waveguide (SIW) Leaky Wave Antenna (LWA) that has a fixed frequency beam steering and is intended to be fabricated with microelectronic processes using polymers layers and metal deposition. The antenna is designed to operate between 58 GHz and 70 GHz, enabling MIMO communications . The radiation pattern of the antenna is reconfigurable using diodes connected to the capacitive gaps of Complementary Electric LC resonator (cELC) unit cells.

P7: Green-Extraction of Graphene from Natural Mineral Shungite

Anastasia Novikova, A. Karabchevsky
Ben-Gurion University of the Negev (Israel)

With the increasing demand for graphene, the need for a simple, fast, efficient, low-stage, and environmentally

safe method of its production also increases. We utilized physical ultrasound treatment, without the addition of surfactants, to extract graphene films from shungite mineral. Our analysis of the resulting graphene structures revealed film-like shapes with a surface length of 200 nm, a hexagonal center, and a lattice pitch of 0.335 nm.

P8: Analysis of Reliability of Flexible Microwave Absorbing Meta-Surface under Bending Stress
Doo-Sun Choi[1], Ji-Youn Kwak[2], Jun Sae Han[1], Eun-Ji Gwak[1], Eun-Chae Jeon[3]
[1] *Korea Institute of Machinery and Materials (Korea),* [2] *UNIST (Korea),* [3] *University of Ulsan (Korea)*

We developed a simple method to predict the performances of absorbing microwaves under bending stress, and applied the method to a flexible meta-surface for assessing their reliability in this study. Since bending stress made severe damage immediately after bending and some damages were recovered after removing bending stress in flexible meta-surfaces, the reliability of flexible meta-surfaces should be evaluated under bending stress.

P9: Metasurface design by capillarity-assisted nanoparticles assembly in a microfluidic channel and their applications
Juan Xin, Julien Proust, Jérémie Béal, Anne-Laure Baudrion, Abdelhamid Hmima, Jérôme Plain
Universite de Technologie de Troyes (France)

The metasurfaces consist of arrays of sub-wavelength nanostructures, called meta-atoms. The periodic arrangement of these meta-atoms plays a key role in determining the functionality of the metasurface device.1 In this project, Si nanoparticles are synthesized in solution2 and assembled by a capillary force-based technique,3 overcoming some of the drawbacks of the top-down approach. Furthermore, the metasurface structure assembled by Si NPs with high refractive index can realize strong magnetic field response with low loss.

P10: 3D Micro-imprinted Flexible Plasmonic PDMS-based Platform for SPR-SERS Detection of the Formalin Contaminant
Andreea Campu, Monica Potara, Simion Astilean, Monica Focsan
Babes-Bolyai University (Romania)

One of the major concerns of the today's society is related to environmental monitoring and food safety, which have a great impact on the citizens well-being and health. In particular, food contamination is regarded as a severe public health problem due to the constant increase in food-borne diseases. A natural toxin, produced by living organisms and toxic to humans when ingested, is formaldehyde (FA), also known as formalin, which is a colour-less, highly volatile, with an irritating odour gas.

P11: Characterizing Far-Field Plasmonic Resonances of Au and AuAl2 Structures using Dark Field Spectroscopy
Tiernan McCaughery, Achyut Maity, R. Bowman
Queen's University Belfast (United Kingdom)

Plasmonic materials such as Au and AuAl2 have the ability to facilitate nanoscale heat generation and have attracted attention due to their relative availability. In this work, these materials were patterned into various geometries. Dark field spectroscopy (DFS) was used to measure the far-field response of particles, along with 3D-FDTD modelling which calculated the field enhancement present within the structures. The experimental and simulated DF results were compared and showed good agreement.

P12: Cathodoluminescence spectroscopy of Au dendritic structures for photocatalysis applications
Zelio Fusco[1], Asim Riaz[1], Christin David[2], Fiona Beck[1]
[1] *Australian National Universtity (Australia),* [2] *Friedrich Schiller University of Jena (Germany)*

Metallic nanostructures supporting plasmonic resonances offer potential for efficient spectroscopyand photocatalysis. Here, we fabricate hierarchical Au dendrites and map their plasmonic properties usingcathodoluminescence spectroscopy. We demonstrate a controllable hot-spot density and show a correlationbetween the spatial and spectral distribution of resonances and their morphology. Their performance as bothSERS substrates and as photocatalysts is investigated. These findings provide insights for the rationaldesign of plasmonic architectures for various applications.

P13: Bottom-up fabrication of 2D MoS2: from thermochromic sensing to hyperbolic metamaterials.
Jose Luis Ocana Pujol, Ramon Camilo Rodriguez Ordonez, Christof Vockenhuber, Ralph Spolenak, Henning Galinski
ETH Zurich (Switzerland)

MoS2 has been extensively researched ever since the discovery of its thickness-tunable properties. However, its applicability is still limited by fabrication constraints and its integration with other materials. We present a bottom-up fabrication route enabling large-area synthesis of bulk and 2D MoS2. We demonstrate how a thermochromic sensor can be used to track the thickness and the mechanical, electrical and optical properties. To showcase the precise control on the fabrication conditions, we fabricate a large-area hyperbolic metamaterial containing 2D- MoS2.

P14: Quantum dynamics and dissipation-driven formation of entangled dark states in strongly coupled many-qubit systems in solid-state nanocavities

Mikhail Tokman[1], Alexandra Behne[2], Brandon Torres[2], Maria Erukhimova[2], Yongrui Wang[2], Alexey Belyanin[2]

[1] *Ariel University (Israel),* [2] *Texas AM University (USA)*

We study quantum dynamics of many-qubit systems strongly coupled to a quantized electromagnetic field of a nanocavity in the presence of decoherence and dissipation for both fermions and cavity photons, and taking into account the nonuniform nanocavity field and the spread of qubit transition frequencies. We show that the dissipation in a cavity may drive the system into many-qubit entangled dark states that live much longer than the cavity decay time and can be used for quantum information applications.

P15: Resonances in doubly anisotropic, high-index nanoplatelets

Bingying You, Tom Sistermans, Alberto Curto

Gent University (Belgium)

Optical anisotropy plays a crucial role in the manipulation of light. Its strength is, however, limited to low values in conventional materials. Transition metal dichalcogenides possess both high refractive index and high birefringence due to their layered structure. Here we investigate optical resonances in nanoplatelets with both geometrical and refractive index anisotropies. A multipole expansion allows us to analyze their distinct influence on magnetic and electric resonances. Nanoplatelets thus create new opportunities to control light scattering and emission.

P16: Reconfigurable Intelligent Surface as MIMO

Sotiris Droulias, Angeliki Alexiou

University of Piraeus (Greece)

The Reconfigurable Intelligent Surface (RIS) is often treated either as a collection of point scatterers with properties similar to antennas in an equivalent MIMO communication link or as a continuous radiating surface, which is subsequently discretized. In this work we investigate the connection between the two approaches, we analytically find the factor that renders them equivalent and we demonstrate our findings with examples of RIS elements modeled as antennas with commonly used radiation patterns and properties consistent with antenna theory.

P17: Superradiant Scattering from Nonlinear Wave-Mode Coupling

Tiemo Pedergnana, Nicolas Noiray

ETH Zurich (Switzerland)

When waves are scattered at a resonant cavity, due to dissipation, the outgoing waves' energy is decreased compared to the incident waves. This limitation can be overcome if waves are instead scattered at a linearly unstable mode undergoing a limit cycle. Near the mode's eigenfrequency, synchronized self-oscillations feed energy to the outgoing waves, leading to superradiance, or amplification of incident harmonic waves. We derive a multiphysical theory of nonlinear wave-mode coupling and experimentally validate it on a superradiant aeroacoustic scatterer.

P18: Non-radiative cooling materials with high transparency

H. TT. Tam, M. Toma, Kotaro Kajikawa

Tokyo Institute of Technology (Japan)

Transparent non-radiative materials (non-RC) materials were investigated. The temperature reduction was measured for a glass plate covered with ITO, DMD, or Ag nanowire. It was found that the temperature reduction was negligible when exposed to the sky, whereas the samples were transparent in the visible wavelength region. The results show that these materials can be used for non-RC materials.

P19: Active phase control with metasurfaces in the visible by electrochemistry

Junhyung Park, Min Gwan Jo, Jonghwa Shin
KAIST (Korea)

Metasurfaces have been realized large control on properties of light, amplitude, phase, and polarizations with adequate design of meta-atoms. Nevertheless, such control is not yet fully achieved dynamically after fabrication. We show large dynamic change (over 180°) of phase of visible light with a single metasurface, which so far required the use of liquid crystals, based on simple electrochemistry. We believe our approaches will help realize dynamic beam control devices for visible light

P20: Introduction to Functionally Graded Unit Cell of Nonlinear Metamaterial that Controls Harmonic Responses of Elastic Waves

Pravinkumar Ghodake
Indian Institute of Technology Bombay (India)

A unit cell of nonlinear functionally graded metamaterial is exploited in this study through multiple computational experiments. The manipulative capabilities of the nonlinear functionally graded unit cell sandwiched between linear elastic materials of the same impedance are exploited to control harmonic responses. Sensitivities of the parameters that control the spatial distribution of the nonlinear parameters will help to design novel functionally graded nonlinear metamaterials using forward, and inverse design approaches.

P21: Metasurface Design with Robust Resonances for Nonlinear Photonics

Gianni Quimey Moretti[1], Benjamin Tilmann[2], Andreas Tittl[2], Emiliano Cortés[2], Stefan Maier[2], Andrea Veronica Bragas[1], Gustavo Grinblat[1]
[1] *Universidad de Buenos Aires (Argentina),* [2] *Ludwig-Maximilians-Universität (Germany)*

A metasurface of Gallium Phosphide on glass with a robust design enables high-quality factor (Q) modes, arising from the concept of quasi bound states in the continuum (QBICs). The high enhancement of the incident electric field is used to compute the nonlinear second harmonic (SH) fields in a non-perturbative approach, yielding a theoretical maximum conversion efficiency of 0.5 %. Preliminary experimental results will be presented.

P22: Light-matter-coupling effects in pentacene thin films on nanorod antenna arrays

Christoph Theurer, Florian Laible, Jia Tang, Katharina Broch, Frank Schreiber, Monika Fleischer
Eberhard Karls University Tübingen (Germany)

By harnessing light-matter coupling in optical cavities, the chemical and photophysical properties of organic semiconductor films can be tailored without the need for chemical modification. Here, strong coupling is demonstrated in polycrystalline pentacene thin films on top of silver nanorod antenna arrays. Such an open configuration offers advantages in view of device applications. Simultaneous coupling of the two Davydov transitions to surface lattice resonances is observed.

P23: Realization of electromagnetically-induced transparency in the mid-infrared with symmetry-broken metamaterials

The Linh Pham[1], Fei Han[1], Kacper Pilarczyk[1], Joris van de Vondel[1], Niels Verellen[2], Thanh Tung Nguyen[3], Ewald Janssens[1]
[1] *KU Leuven (Belgium),* [2] *IMEC (Belgium),* [3] *Vietnam Academy of Science and Technology (Vietnam)*

A simple metamaterial structure is designed to achieve an analogue of electromagnetically-induced transparency (EIT) in the mid-infrared regime. By breaking the symmetry of the gold resonator, a transmission window occurs around 8.5 μm, instead of a reflectance peak as in the symmetric configuration. Based on the EIT effect, the realization of strong dispersion and high Q-factor resonance metamaterials is the first step to the development of sensing devices or optical modulators that we are focusing.

P24: Fundamental Study of Elastic Wave Damping by Metamaterials with Local Resonant Structures in Electrical Systems

Kyogo Sato, Keisuke Nishida, Toshihiko Sugiura
Keio University (Japan)

Conventional acoustic metamaterials for elastic waves are mainly based on mechanical systems with local resonant structures, but this study aims to reduce vibration by replacing the unit cell with a resonant structure of a coupled electrical-structural system. As a basic study, we confirmed the vibration-damping property of acoustic metamaterials including electrical systems by numerical simulation and further clarified the resonance characteristics of unit cells by experiment.

P25: High-resolution medical ultrasound focusing and temperature rise with acoustic metamaterial
Jiajie He, Xue Jiang, Dean Ta
Fudan University (China)

We experimentally realize the medical ultrasound focusing based on the compact and passive metamaterial. The three-dimensional spot focusing is endowed with high spatial resolution (0.63λ FWHM and 2.75λ FLHM), broad effective bandwidth (0.5-1.4 MHz) and tunable focal length (18.5-71 mm). Ultrasound scalpel, which converge the acoustic energy within a sharp needle area, is demonstrated with an aspect ratio of 12.64. Additionally, we investigate the prominent temperature rise in the focal region and reveal the dependence on the ultrasound frequency.

P26: Ray-Optical Analysis for Optimization of Light Absorption in the Double-Junction III-V Solar Cells with Luminescent Solar Concentrators
Dongjae Baek[1], Shin Hyung Lee[2], Kwangjin Kim[1], Sung-Min Lee[2], Seungwoo Lee[1]
[1] *Korea University (Korea),* [2] *Kookmin University (Korea)*

In order to enhance the light absorption of III-V photovoltaic, the optimal geometry has been the subject of research. For example, solar concentrators have been used to increase the incident photon flux. However, as optic elements are inevitable, there were issues about that the volume of the system increased. In this work, we suggest the strategy to the optimal light-trapping structure for monolithic III-V tandem solar cell with luminescence solar concentrator by systematic analysis, integrating ray-optical analysis with Shockley-queisser limit.

P27: Optoelectronic properties of FeSe nanomaterials with diverse dimension
Hyojin Kang, Jaebeom Lee
Chungnam National University (Korea)

Metal chalcogenides, such as molybdenum sulfide (MoS2), nickel sulfide (Ni3S2), and copper-based chalcogenides, are mainly a two-dimensional structure and have been studied in various fields for the past 10 years. Herein, we report dimension-controlled FeSe nanomaterials (0D, 1D and 2D) to have unprecedented electron structure using absorption coefficient driven by investigating transmittance spectra via Fourier-transform infrared spectroscopy, breaking conventional charge-phase transition. This approach could be applied as a next-generation electronic device due to its specific band gap and photo-reactivity.

P28: Unidirectional mode coupling in graded index fibers
Mohammad Nayeem Akhter, Salim B. Ivars, Ramon Herrero, Muriel Botey, Kestutis Staliunas
Universitat Politecnica de Catalunya (Spain)

We propose a new light management mechanism in parabolic index multimode fibers to control the mode distribution of the propagated beam. The effect is achieved through longitudinal non-Hermitian potential induced by simultaneous modulations of the index and gain/loss profile. The non-Hermitian modulation introduces a unidirectional and controllable coupling between the transverse modes, by adjusting the spatial shift between the real and imaginary components. The unidirectional coupling either to lower or higher order modes yields to mode-cleaning or mode generation, respectively.

P29: Line modes in elastic mechanical metamaterials
Ankur Dwivedi, S. A. R. Horsley
University of Exeter (United Kingdom)

One dimensional analogue of surface modes - line modes - have been found in electromagnetic materials, existing at the interface between surfaces of positive and negative reactance. Here we consider the mechanical analogue of line modes. Analytically we find they exist at interface between two surfaces respectively pinned in vertical and in-plane directions, and examine the conditions for their existence using the finite element method, tuning the line mode eigenfrequencies by varying the density and elastic moduli of the materials.

P30: Higher order exceptional points in photonic lattices
Dimitrios Kaltsas[1], Ioannis Komis[1], Konstantinos Makris[2]
[1] *IESL-FORTH (Greece),* [2] *University of Crete (Greece)*

Higher order exceptional points (HEPs), are unique characteristic degeneracies of non-Hermitian systems. Weprovide a systematic method for constructing infinite optical lattices that exhibit HEPs. The spectral properties-sensitivity ofthese lattices around HEPs is investigated in terms of pseudospectra theory, along with the topological character of thecorresponding bands. Recent results concerning conservation laws in non-Hermitian

systems and their relation to HEPs, willalso be presented.

P31: Highly directional plasmomechanic stretchable strain sensor *online*
Asad Nauman[1], Jae-Won Lee[1], Jun-Chan Choi[2], Hafiz Saad Khaliq[1], Junkai Wang[1], Hak-Rin Kim[1]
[1] *Kyungpook National University (Korea),* [2] *Korea Institute of Science and Technology (Korea)*

We report asymmetric tuning of nanogap resonance between gold nanoparticles (Au NPs), deposited on anisotropically stretchable polydimethylsiloxane (PDMS) for directional strain sensing. The alternate high and low Young's modulus PDMS line patterns induce anisotropic Poisson's effect (0.45 to 0.61), resulting in direction-dependent plasmon resonance between the Au NPs. For the light polarized perpendicular to the stretching direction, the maximum absorbance peak shift of $\sim$90.85 nm and $\sim$39.13 nm is achieved for θ = 0° and θ = 90° direction, respectively.

P32: Dynamic control of emission from quantum emitters embedded in ultra thin ENZ media *online*
Arun Mambra, Joy Mitra
IISER TVM (India)

Controlling light-matter interactions at the nanoscale has been the basis of most of the active plasmonic, photonic and optoelectronic systems. The ability to tailor emission from quantum emitters by tuning the optical parameters of an epsilon near zero (ENZ) material environment around is both of fundamental and applied interest. The understandings provide newer degrees of freedom in controlling and trapping fields within confined regions and in designing opto-mechanical systems, which may be exploited for quantum information processing.

P33: Gap-plasmon Resonance based Energy-efficient Electro-tunable Metasurface for Polarization-independent Optical Intensity Modulation *online*
Tanmay Bhowmik, Jegyasu Gupta, Debabrata Sikdar
Indian Institute of Technology Guwahati (India)

Ultra-thin artificially engineered nanoscale scatterers, known as metasurfaces, have gained immense attention in recent years to realize dynamic nanophotonic components by engineering meta-atoms. In this study, we propose an electrically tunable metasurface for optical intensity modulation by leveraging gap-plasmon resonance effect. The presented metasurface exhibits $\sim$15 dB modulation depth at 1550 nm for both TE- and TM-polarized incident wave with an energy-consumption as low as 213 fJ/bit.

P34: LSPR enhanced In-situ Ellipsometry as a Label-free Optical Sensing Platform *online*
Natasha Mandal[1], Rakesh Singh Moirangthem[2]
[1] *Indian Institute of Technology (India),* [2] *Manipur University (India)*

We present an efficient, highly surface-sensitive, non-invasive, label-free optical sensing platform by integrating Localized Surface Plasmon Resonance (LSPR) and Ellipsometry. We adopted a facile route of solid-state thermal dewetting for preparing a LSPR sensor chip by the formation of highly stable, partially embedded bimetallic alloy nanoparticles with an average size of 27$\pm$8 nm. The experiment was performed in in-situ mode (90°)) using our custom-built 3D printed cell setup. We obtained sensitivity of around 1870$\pm$273 º/RIU for the prepared LSPR chip.

P35: Boosting received magnetic field (B1-) strength using wearable metasurface-based add-ons for 1.5T MRIs *online*
Jegyasu Gupta, Tanmay Bhowmik, Ratnajit Bhattacharjee, Debabrata Sikdar
Indian Institute of Technology Guwahati (India)

Magnetic resonance imaging (MRI) is a popular non-invasive diagnostic technique for examining human body tissues and organs. Metasurfaces have the ability to boost the received magnetic field (B1-) locally inside an MRI scanner. However, the metasurfaces reported in the literature for 1.5T MRI are not flexible enough to conform around different shapes of the subject's body parts undergoing scan. Here, we present a wearable metasurface-based .ªdd-onçomprising copper-based apertures for boosting in the region-of-interest (ROI) for 1.5T MRI.

P36: Spectral Control of Plasmonic response and Spontaneous Emission Reinforcement from Quantum Dot near Nanoplasmonic Structures *online*
Riya Choudhary, Sachin Kumar Srivastava
Indian Institute of Technology Roorkee (India)

We show that the tuning of geometrical parameters of nanoplasmonic structures changes not only theelectric field enhancement and plasmonic response but also the spontaneous emission. Spontaneous emission increases due to interaction between the quantum dot (QD) and the localized electric field in its vicinity. The spontaneous emission rate enhancement of the quantum dot follows plasmonic response of the nanoplasmonicstructures. Thus, modified emission rate leads these nanostructures to have potential applications in sensing, integrated photonics, and solar energy conversion.

P37: All metal 1D plasmonic metasurface broadband absorber for refractive index sensing in Mid-IR regime *online*

Sagar Kumar Verma, Sachin Kumar Srivastava
Indian Institute of Technology Roorkee (India)

A one-dimensional all-metal, plasmonic metasurface absorber was fabricated from a compact disk by transferring a one-dimensionally patterned aluminium (Al) layer on transparent polymer. This plasmonic metasurface absorber was used for refractive index sensing in the mid-infrared region. A sensitivity of 10.708 μm/ RIU was achieved for the operating wavelength range 12-15 μm. This metasurface can be used in various photonics applications such as broadband light absorbers, filters, mode locking for mid-IR lasers, smart windows photodetectors, etc.

P38: Designing tunable, broadband absorber/emitter using epsilon near zero media *online*

Sraboni Dey, Joy Mitra
Indian Institute of Science Education and Research (India)

Customizing the optical response of surfaces, using subwavelength thick coatings is an area of topical interest. The advent of novel materials like ENZ materials along with the capability of nanostructuring has enabled realization of new design strategies to control absorption/emission properties over broad spectral ranges. We present a straightforward design using a multilayer ITO/SiO2/Au coating which shows wide-angle absorption over tunable broadband regimes.

P39: Numerical method for the inverse design of three-component metamaterial multilayers *online*

Takamichi Terao
Gifu university (Japan)

A numerical method for inverse design of three-component metamaterial multilayers was developed. Restart-tempering method was applied to optimize optical properties for three-component metamaterials multilayers. An algorithm suitable for accurately calculating the effective refractive index of these metamaterial multilayers was also demonstrated.

P40: Charge Transfer Process on Plasmonic Cathode Electrode *online*

Hiro Minamimoto, Yuto Tajiri, Minoru Mizuhata
Kobe University (Japan)

The visible-light energy conversion is one of the important challenges for the sustainable society. Recently, various photocatalytic systems, such as molecular catalysts, semiconductors, or plasmonic systems, have been established. In this study, we have focused on the plasmonic photoenergy conversion system and established the new plasmonic cathode electrode system. Through the examination of photoelectrochemical measurements, we have successfully clarified the detail information about charge transfer processes on plasmonic cathode electrodes.

P41: Casimir Force Between Pasteur Materials *online*

Zixuan Dai, Qingdong Jiang
Shanghai Jiao Tong University (China)

Both theoretical and experimental interest in achieving repulsive Casimir force increases in recent years. A well-known paper demonstrated that the Casimir force between two objects is always attractive if the parity symmetry is preserved. In this paper, we calculate the Casimir force between two parallel Pasteur materials and show that the sign of the Casimir force can be modified by breaking parity symmetry.

P42: Atypical light extraction technologies for organic light emitting diodes with spontaneously formed buckling patterns of soft materials *online*

Byung Doo Chin[1], J. Y. Yoo[1], S.-H. Hwang[1], Ohyoung Kim[1], S. M. Cho[2], W. H. Koo[2]
[1] *Dankook University (Korea),* [2] *LG. Display Co (Korea)*

Quasi-periodic, controllable buckling patterns with broad size distribution for outcoupling-enhancing structures of top-emitting OLED are described. The formation of buckling patterns is spontaneously driven by the mismatch of thermal expansion coefficient of the organic and polymeric layers, which are easily deposited by simple deposition process and coating. Luminous efficiency of device with buckling patterns was increased, which was analyzed by the suppression of light loss at the influence of surface plasmonic resonance in the metal/air interface.

P43: Enhanced As(III) detection under near-neutral conditions: Synergistic effect of boosted adsorption by oxygen vacancies and valence cycle over activated Au NPs loaded on FeCoOx nanosheets *online*

Cong-Cong Huang[1], **Xing-Jiu Huang**[1], **Meng Yang**[2]
[1] *University of Science and Technology of China (China),* [2] *Institute of Solid State Physics (China)*

As(III) has always been detected in acidic environments while the unstable modified nanomaterials under this case may lead to unreliable results. Herein, FeCoOx nanosheets with oxygen vacancies were employed to stabilize even activate Au NPs for enhancing As(III) detection under mild conditions. The sensitivity of 1.45 μA ppb-1 with a detection limit of 0.27 ppb were obtained. This study reveals synergistic effect of the defects and valence cycles on catalytic performance, also gives guidelines for constructing electrochemical sensing interface.

P44: Multifunctional Chiral Meta-Platform for Dynamic Spin-Encoded Phase Multiplexing *online*

Hafiz Saad Khaliq[1], **Junhwa Seong**[2], **Asad Nauman**[1], **Jae-Won Lee**[1], **Jung-Yeop Shin**[1], **Junsuk Rho**[2], **Hak Rin Kim**[1]
[1] *Kyungpook National University (Korea),* [2] *Pohang University of Science and Technology (Korea)*

Recently, chiral metasurfaces have been designed for numerous applications in flat optics and photonics, specifically in encrypted displays, imaging, and sensing. Here, we proposed a reflective multifunctional dielectric chiral metasurface integrated with liquid crystal modulator incorporating the ability for spin-encoded phase multiplexing based on the dynamic switching of input and output polarization of visible light. Moreover, the chiral meta-platform reproduces two distinct phase profiles with simultaneous control on its cross and co-polarized component for one-handedness of incident circularly polarized light.

P45: Vertical Injection and Wideband Grating Coupler Based on Asymmetric Grating Trenches for Higher Coupling Efficiency *online*

Md Asaduzzaman
Melbourne Institute of Technology (Australia)

A Silicon-on-insulator (SOI) perfectly vertical fibre-to-chip grating coupler is proposed and designed based on engineered subwavelength structures. High coupling efficiency is achieved with asymmetric diffraction using step gratings and effective index variation using auxiliary ultra-subwavelength gratings. The proposed structure is numerically analysed using two-dimensional Finite Difference Time Domain (2D-FDTD) method and achieves 96 % (-0.2 dB) coupling efficiency and 39 nm 1-dB bandwidth. This highly efficient GC is necessary to applications where coupling efficiency is critical such as photonics quantum computing.

10:20 - 12:40 — Grand Amphi

Session 3A2

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Yurii Gun'ko

10:20 : Keynote talk
High-Q Photonics

Kerry Vahala
California Institute of Technology (USA)

After a brief overview of their history, I will review recent applications. These include Sagnac gyroscopes, microwave signal sources, clocks, and high-coherent sources. The current and possible future limits of micro-resonator performance, and untapped application areas, will also be discussed.

10:50 : Keynote talk
Quantum optical phenomena in two-dimensional materials
Javier Garcia de Abajo
ICFO-Institut de Ciencies Fotoniques (Spain)

We discuss new approaches to the synthesis, design, and exploitation of two-dimensional materials for nanophotonics, including plasmonics in ultrathin crystalline metals, a disruptive class of quantum-phase materials, recent advances in the solution to the problem of coupling between free-space light and ultra-confined optical excitations, and the application of these developments to the study of ultrafast nonlinear phenomena and quantum optics at the atomic scale.

11:20 : Invited talk
PT Symmetric Non-Hermitian Polaritonic System with Single Hexagonal Microcavity on Loss-modulated Substrate
Yong-Hoon Cho
KAIST (Korea)

Photonic systems with complementary gain and loss profiles have recently been studied using non-Hermitian system with parity-time reversal symmetry. Indirect coupling via near-fields between two or more identical photonic components has been used in these systems because photons are non-interactive. In this talk, we present direct coupling via exciton nature of polaritons within a single hexagonal microcavity on a loss-modulated substrate. This polariton-based PT symmetric system provides opportunities for the investigation of non-Hermitian physics and the development of practical applications.

11:40 : Invited talk
Research on Intelligent Photonic Computing Chips
Xiaoyong Hu, Kun Liao
Peking University (China)

One of the most important applications of combining machine learning and integrated photonics is Photonic Hardware for AI. Here, we have done some research from several aspects of potential challenges in the field of photonic neural networks, including expanding the functions of neural networks by taking full advantage of using photons for computing, improving computing efficiency by designing new configurations of neural networks adapted to photonic hardware platforms, increasing complexity of neural networks by realizing reliable all-optical nonlinear activation layers.

12:00 : Invited talk
External Laser Mirror for Oscillation Wavelength Stabilization and Waveguide Input Coupling
Junichi Inoue, Akari Watanabe, Keisuke Ozawa, Kenji Kintaka, Shogo Ura
Kyoto Institute of Technology (Japan)

The potential application of guided-mode resonance devices as an external laser mirror with oscillation wavelength stabilization and waveguide input coupling functions that is a key component for constructing a future ultra-compact multi-wavelength light source is discussed.

12:20 : Invited talk
Two-dimensional photonic crystal: an ideal nanophotonics platform for both fundamentals and applications
Heonsu Jeon
Seoul National University (Korea)

Two-dimensional photonic crystal (PhC) in a planar geometry has enabled many sophisticated photonic functions and devices, such as PhC phosphors, photonic Anderson localizations, random lasers, and topological lasers, all demonstrated by the author's group. It is expected to continue to play pivotal roles in photonics. In this talk, some of the salient features and properties of those devices will be presented.

10:20 - 12:05 — Amphi Bezier

Session 3A3

Symposium III: Advanced Passive and Active Metasurfaces and Zero-Index Materials

Organized by: Howard Lee and Pin Chieh Wu

Chaired by: Howard Lee

10:20 : Invited talk
Optical pulse-shaping with plasmonic metasurfaces
René Geromel[1], Philip Georgi[1], Maximilian Protte[1], Shiwei Lei[2], Tim Bartley[1], Lingling Huang[2], Thomas Zentgraf[1]
[1] *Paderborn University (Germany),* [2] *Beijing Institute of Technology (China)*

We present a miniaturized pulse shaping device that creates an arbitrary dispersion through the interaction of multiple metasurfaces on less than 2 mm3 volume. For this, a metalens and a grating-metasurface between two silver mirrors are fabricated. The grating contains further phase information to achieve the device's pulse shaping functionality.

10:40 : Invited talk
Leveraging Thermo-optical Effects in Nanoantennas and Metasurfaces
Giulia Tagliabue
EPFL (Switzerland)

Thermo-optical effects in dielectric nanoresonators open new opportunities for contactless manipulation of metasurfaces.

11:00 : Tailoring the visual appearance with disordered arrays of resonant metaatoms
A. Agreda[1], T. Wu[1], A. Hereu[2], M. Tréguer-Delapierre[2], G. Drisko[2], K. Vynck[3], Philippe Lalanne[1]
[1] *Bordeaux University (France),* [2] *CNRS (France),* [3] *Université Claude Bernard Lyon 1 (France)*

Metasurfaces have flourished in the last few years thanks to their extraordinary capabilities in the manipulation of light. In this work, we propose a theoretical tool that can effectively and intuitively predict the visual appearance of disordered resonant metasurfaces.

11:15 : Invited talk
Magnetic Nearfield Reshaping Metasurfaces
Hanwei Wang, Xiaodong Ye, Joshua Yu, Yun-Sheng Chen, Yang Zhao
University of Illinois Urbana Champaign (USA)

In this talk, I will discuss a wearable metasurface that can actively reshape the magnetic nearfield to form a desired mode. The active tuning of the metasurface enables an on-demand magnetic field distribution that can be used for efficiently wirelessly charging embedded medical devices. We show that our metasurface can be worn on hands and enhances the delivered power by 10 fold.

11:35 : Keynote talk
Active Metasurfaces in Space and Time
Harry Atwater
California Institute of Technology (USA)

Active dielectric and plasmonic metasurfaces enable new modalities for spatiotemporal beam control for beam steering and wavefront shaping at multiple frequencies. In this talk, I will discuss metasurfaces with high quality factor, local, resonant elements capable of two-dimensional phase gradient generation, in both passive and active metasurface designs. I will also describe active metasurfaces with both spatial and temporal phase gradients, and an active metasurface as a lens-less imaging system, and compare the characteristics to conventional lens-coupled image sensors.

10:20 - 12:45 — Amphi Fournel

Session 3A4

Quantum Light Emitters and Photonic Heterogeneous Integration

Organized by: Han Htoon and Galan Moody

Chaired by: Han Htoon and Galan Moody

10:20 : Invited talk
Spin and level structure of positioned sulfur vacancies in MoS2 acting as quantum emitters
Alex Holleitner
TU Munich (Germany)

We report on the level structure of single vacancies in monolayer MoS2 and WS2 which are generated by the help of a helium ion microscope at a lateral accuracy of $>$ 10nm. The vacancies turn out to be quantum emitters in the near-infrared electromagnetic regime. Moreover, we demonstrate the absorption characteristics of the defect emitters measured by utilizing both a cavity enhanced detection scheme and a highly sensitive photocurrent tunneling spectroscopy.

10:40 : Invited talk
Nanometric axial localization of color centers in hexagonal boron nitride flakes
Pankaj Jha
Syracuse University (USA)

Novel materials are the backbone of next-generation quantum technologies. In this talk, color centers in hexagonal boron nitride, will be discussed as a promising candidate for single photon sources at room temperature. Nanometric axial localization of these color centers with 3D characterization of their dipole orientation will be highlighted.

11:00 : Site Controlled Integration of SiN/SiO2 Single Photon Emitters with a Topologically-Optimized Coupler
Samuel Peana, Omer Yesilyurt, Zachariah Martin, Alexander Senichev, Vahagn Mkhitaryan, Alexei Lagutchev, Alexandra Boltasseva, Alexander Kildishev, Vladimir Shalaev
Purdue University (USA)

We demonstrate the first site-controlled integration of an SiN/SiO2 single photon emitter (SPE) with a topology optimized coupler. Previously our group demonstrated the large scale fabrication of such emitters in nanopillars with high yield (67 %). This work leverages this fabrication process to allow for the large-scale integration of such nanopillar SPEs with complex nanophotonic devices such as topology optimized couplers. This is a major step on the path towards wafer-scale fabrication of quantum-photonic circuitry with precisely integrated SPEs.

11:15 : Invited talk
Plug and play quantum light sources with fiber-integrated quantum emitters
W. B. Jeon, Jehyung Kim
UNIST (Korea)

We presnt a highly efficient fiber-interfacing photonic device that directly launches single photons from quantum dots into a standard FC/PC-connectorized single-mode fiber. An optimally designed hole-based circular Bragg grating produces an ultra-narrow vertical beam whose emission angle matches the small numerical aperture of a single-mode fiber. The heterogeneously integrated fiber-quantum dot system enables the compact plug-and-play operation of single photons from a source to a detector with high coupling efficiency and long-term stability.

11:35 : Invited talk
Low Energy Focused Ion Beam Implantation
Michael Titze[1], Jonathan Poplawsky[2], Barney Doyle[1], Edward Bielejec[1], Alex Belianinov[1]
[1] *Sandia National Laboratories (USA),* [2] *Oak Ridge National Laboratory (USA)*

We performed1-2 keV focused Au implants into Si, in which the depth was validated by atom-probe tomo-

graphy. We show that identical results are achievable by either lowering the column voltage, or decelerating ions using bias -while maintaining nanoscale spatial resolution. Furthermore, our data reveal that standard implant modeling overestimates experimental depth by 4.7x and 3.8x at1 and 2 keV respectively. Finally, we demonstrate how our results pave a way to eV-scale implantation energies, while maintaining high spatial resolution.

11:55 : Keynote talk
Semiconductor quantum dot based quantum technologies
Q. Buchinger, G. Peniakov, J. Michl, I. Gamov, J. Kaupp, P. Gschwandtner, S. Krüger, A. Pfenning, T. Huber-Loyola, Sven Höfling
Julius-Maximilians-Universität Würzburg (Germany)

We will summarize recent progress made within our group on self-assembled quantum dot device development for quantum repeater and quantum computer applications. A particular emphasis will be on semiconductor quantum dots embedded in circular Bragg grating cavities. For scalability, spatially deterministic, placement of quantum dots in bullseye cavities is pursued and tuning by electric and strain fields are implemented. To apply electric fields, a new device design for electrically contactable circular Bragg grating cavities in labyrinth geometry is employed.

12:25 : Invited talk
Room-temperature ultrabright single photon sources based on colloidal quantum dots on directional resonator-antennas: towards high dimensional encoding of photonic qudits
Ronen Rapaport
The Hebrew University of Jerusalem (Israel)

We present a novel approach that overcomes the outstanding challenge of the rate-directionality tradeoff of monolithic single photon sources operating at room temperature, and demonstrate ultrabright, highly directional single photon sources based on colloidal quantum dots positioned on a hybrid nano-resonator - antenna device, that can be used for both free-space and fiber applications. We also demostrate methods for encoding high-dimensional qudits on the different spatial degrees of freedom of the photons emitted from these sources.

10:20 - 12:40 — Amphi Esquillan

Session 3A5

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

10:20 : Invited talk
Rational Design and Fabrication of UV-Resonant Plasmonic Nanoantennas for Enhanced CD Spectroscopy
Bjoern Reinhard
Boston University (USA)

Rational electromagnetic optimization strategies for plasmonic aluminum antennas in the ultraviolet range of the electromagnetic spectrum are presented, evaluated, and discussed. Scalable fabrication strategies for UV resonant plasmonic antennas for applications in CD spectroscopy are experimentally evaluated.

10:40 : Invited talk
Chiral quantum phase shifters
Nir Rotenberg
Queen's University (Canada)

Phase-shifters are a key component of photonic circuits, including those that process quantum information.

This talk introduces such a phase-shifter based on a single, solid-state quantum emitter chirally coupled to a nanophotonic waveguide, covering both the basics of such a device and its performance in the presence of realistic imperfections. Finally, the fidelity of simple quantum photonic circuits based on these phase-shifters is considered.

11:00 : Invited talk
Electric-field Control of Magnetism and Topological Spin Textures
Masahiro Sato[1], **Shunsuke C. Furuya**[2]
[1] *Chiba University (Japan),* [2] *University of Tokyo (Japan)*

Effects of dc electric fields on nano materials have been investigated, especially, in the fields of multiferroics and spintronics. However, their microscopic theories have not been developed enough. We have theoretically tackled this issue, focusing on Mott insulators in Hubbard-like models under a strong electric field. As a result, we predict that a strong enough electric field can generate spin textures (magnetic skyrmion, soliton, hedgehog, etc.) and phase transitions in thin films of chiral magnets and other magnetic systems.

11:20 : Invited talk
Noncollinear chiral orbitronics
Tom G. Saunderson[1], **Fabian R. Lux**[2], **Dongwook Go**[3], **Wanxiang Feng**[4], **Mathias Kläui**[1], **Yuriy Mokrousov**[3]
[1] *Johannes Gutenberg-University (Germany),* [2] *Yeshiva University (USA),* [3] *Peter Grünberg Institut and Institute for Advanced Simulation (Germany),* [4] *Beijing Institute of Technology (China)*

Non-collinear antiferromagnets (NC-AFM) have attracted much attention recently due to the observation of the anomalous Hall effect (AHE) in these materials despite the small magnetic moments present in their unconventional spin structures, in addition to the giant piezomagnetism and a strain-induced anomalous Nernst effect. These fascinating qualities have hints of multiple competing orders that could be harnessed to enable chirality switching and bring these materials ever closer to realistic antiferromagnetic spintronic devices.

11:40 : Invited talk
Angular-Momentum Dynamics in Ferromagnets on Ultrashort Timescales: Electron-Magnon Interactions vs. Spin-Orbit Coupling
Félix Dusabirane, Kai Leckron, Bärbel Rethfeld, Hans Christian Schneider
University of Kaiserslautern-Landau (Germany)

We analyze the contributions of electron-magnon scattering and Elliott-Yafet spin-flip scattering to ultrafast magnetization dynamics in a model metallic ferromagnet. We find that far-from-equilibrium magnon distributions are created after ultrashort-pulse excitation and play an important role in the demagnetization process. We compare these findings to earlier calculations using the Elliott-Yafet mechanism alone.

12:00 : Invited talk
Novel materials with magnetic skyrmions and their three-dimensional dynamics
Shinichiro Seki
University of Tokyo (Japan)

Topological swirling spin textures, such as skyrmions and merons, have attracted much attention as a unique building block for high-density magnetic information devices. In this talk, I overview recent discovery of novel materials and mechanisms to realize a rich variety of nanometric magnetic quasi-particles with nontrivial symmetry and topology.

12:20 : Invited talk
Microwave-to-Optical Quantum Transduction Utilizing the Topological Magnetoelectric Effect
Akihiko Sekine, Mari Ohfuchi, Yoshiyasu Doi
Fujitsu Limited (Japan)

The quantum transduction between microwave and optical photons is essential for realizing scalable quantum computers with superconducting qubits. Due to the large frequency difference between microwave and optical ranges, the transduction needs to be done via intermediate bosonic modes or nonlinear processes. In this study, we focus on the transduction via the magneto-optic Faraday effect (i.e., the magnon-photon interaction) and propose that the transduction efficiency can be greatly improved by utilizing magnetically doped topological insulator thin films.

10:20 - 12:40 — Amphi A

Session 3A6

Metasurfaces for Light Control Emission

Organized by: Braulio García-Cámara and Ángela Barreda Gómez

Chaired by: Braulio García-Cámara and Ángela Barreda Gómez

10:20 : Invited talk
Universal light encoders: artificial intelligent hardware for nanoscale light control
Andrea Fratalocchi
KAUST (Saudi Arabia)

Universal light encoders represent a new generation of metasurface that implements hardware machine learning for controlling light propagation. In this talk, I will review the fundamentals and application of this technology in various areas, ranging from the inverse design of ultra-flat optical components to HyplexTM, an innovative camera for acquiring and processing high-resolution hyperspectral videos in real-time at 30 frames per second.

10:40 : Invited talk
Enhanced light-matter interaction in a hollow nanocuboid metasurface supporting delocalised quasi-BIC modes
Jose Francisco Algorri[1], Pablo Roldan-Varona[1], Luis Rodriguez-Cobo[2], Jose Miguel Lopez-Higuera[1], Dimitris Zografopoulos[3]
[1] *Universidad de Cantabria (Spain),* [2] *Instituto de Salud Carlos III (Spain),* [3] *Consiglio Nazionale delle Ricerche (Italy)*

The two main problems of dielectric metasurfaces for sensing based on enhanced light-matter interaction are that resonances are mainly localised inside the resonator volume and experimental Q-factors are very limited. We investigate a dielectric metasurface supporting delocalised modes based on quasi-bound states in the continuum (qBICs) to address these issues. Thanks to the variation of the unit cell with a cluster of 4 hollow nanocuboids, delocalised modes with ultra-high Q-factor are produced.

11:00 : Invited talk
All-dielectric metasurfaces for enhancing and tuning the emission of quantum emitters
Angela Barreda[1], Chengjun Zou[2], Artem Sinelnik[1], Evgenii Menshikov[3], Ivan Sinev[3], Thomas Pertsch[1], Isabelle Staude[1]
[1] *Friedrich Schiller University Jena (Germany),* [2] *Chinese Academy of Sciences (China),* [3] *ITMO University (Russia)*

All-dielectric metasurfaces have been proposed to enhance the emission of electric and magnetic quantum emitters via engineering of high-quality factor optical modes. The excitation of quasi-bound states in the continuum can offer high Q-factors in symmetry-broken metasurfaces. However, in most designs, the emission wavelengths are fixed by the geometric parameters of the metasurface. Here, we propose to use phase-change materials to tune the emission of light-emitting metasurfaces supporting quasi-bounds states in the continuum in the telecom spectral range.

11:20 : Invited talk
Optical nanostructures for boosting fluorescence from magnetic dipolar transitions
Ayesheh Bashiri[1], Marijn Rikers[1], Aleksandr Vaskin[1], Katsuya Tanaka[1], Angela Barreda[1], Michael Steinert[1], Duk-Yong Choi[2], Thomas Pertsch[1], Isabelle Staude[1]
[1] *Friedrich Schiller University Jena (Germany),* [2] *Australian National University (Australia)*

Trivalent lanthanides naturally offer strong magnetic dipole (MD) transition due to the selection rule forbidden electric dipole (ED) transition. This inspires the investigation of different nanophotonic platforms for efficiently modifying the magnetic nature of light. Here, we introduce high-index all-dielectric nanostructures including Mie-resonant silicon (Si) nanocylinder metasurfaces, broken symmetry titanium dioxide (TiO2) metasurfaces supporting high Q-factor resonances, and an efficient fabrication process for deterministic coupling of the fluorophores to the hotspot of the Si dimers.

11:40 : Invited talk
Exploiting light-matter interactions to realize selective artificial photosynthesis
Zelio Fusco[1], Christin David[2], Fiona Beck[1]
[1] *Australian National University (Australia),* [2] *Friedrich Schiller University of Jena (Germany)*

Artificial photosynthesis of carbon dioxide, using water as the reducing agent and sunlight to drive the reaction, has the potential to provide renewable fuels at scale. Key challenges in the field are realizing product selectivity and enhancing yields. Our work aims to exploit the strong, confined near fields and hot carriers generated at specific energies by suitably designed plasmonic nanostructures to control chemical reaction pathways. We focus on understanding underlying mechanisms and developing scalable plasmonic substrates with suitable resonances.

12:00 : Invited talk
Multifunctional Optical Surfaces with Ultrathin Materials and Nano-structuring
Javier Arres Chillon[1], D. Martinez-Cercos[1], C. Graham[1], A. Mezzadrelli[1], I. Karadzhov[1], W. Senaratne[2], R. Bellman[2], D. Thelen[2], P. Mazumder[2], Valerio Pruneri[1]
[1] *ICFO (Spain),* [2] *Corning Research and Development Corporation (USA)*

A wide range of optical and optoelectronic applications requires surfaces with specific properties, such as optical and electrical tunability, self-cleaning and cooling, antimicrobial properties, etc. In this talk, we will review recent efforts from our group in developing optical surfaces with unique properties based on ultrathin materials and nano-structuring. In particular, we will describe the use of ultrathin metals films (UTMF), dewetted nano-particles (DNPs), scalable nano-patterning for transparent electrodes, transparent antimicrobial glass for display applications, optical windows and infrared sensing.

12:20 : Invited talk
Amplifying nanophotonics lattices
Femius Koenderink
AMOLF (The Netherlands)

Recent theory for scattering lattices with spatially distributed loss and gain point at the potential for topological and pseudochiral bandstructure physics. At the same time, these systems are quite different from true tight-binding systems, owing to long-range dipole dipole coupling, and diffraction channels. We study plasmonic realisations in a femtosecond pump probe set up that provides single-shot imaging, k-space mapping and photonic band structure mapping I will present experiments on diffractive and significantly sub-diffractive amplifying and lasing nanophotonic lattices.

10:20 - 12:40 — Amphi Pinel

Session 3A7

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Jérôme Plain and Alexander Govorov

10:20 : Invited talk
Chiro-optical gradient forces in chiral nanomaterials
Hiromi Okamoto, Junsuke Yamanishi, Hyo-Yong Ahn
Institute for Molecular Science (Japan)

When a chiral nanomaterial is irradiated by circularly polarized light, the material in general exhibits chiro-optical effects. The chiro-optical effects appear as various forms. Here we report chiral optical gradient force observation on chiral nanoparticles and nanoscale imaging of chiro-optical force fields.

10:40 : Invited talk
Perspectives and Challenges for the Fabrication of Plasmonic Nitride Nanostructures

Panos Patsalas[1], Nikolaos Pliatsikas[1], Spyridon Kassavetis[1], David Babonneau[2], Sophie Camelio[2], Gregory Abadias[2]
[1] *Aristotle University of Thessaloniki (Greece),* [2] *Université de Poitiers (France)*

The refractory character of plasmonic transition metal nitrides1 and their growth predominantly by reactive sputtering are simultaneously blessings and curses2, as they limit the fabrication of nitride plasmonic nanostructures to top-down processes, which is time consuming, costly, and of limited scalability. In this work, alternative routes of fabrication of TMN nanostructures are critically reviewed and presented. We focus on the fabrication of nano-islands by nanosphere lithography3, dichroic nanowires by glancing angle deposition4, and colloidal nanoparticles laser ablation in liquids.

11:00 : Invited talk
Chiral plasmonic metasurfaces self-assembled from non-chiral metallic nanowires and nanorods
W. Wu, V. Lemaire, Matthias Pauly
Université de Strasbourg (France)

Large-area chiral multilayer thin films are prepared by combining Grazing Incidence Spraying and Layer-by-Layer assembly from anisotropic plasmonic nanoparticles. The resulting giant chiroptical properties can be finely tuned over a broad wavelength range using simple design principles, reaching ellipticity values higher than 13° and g-factor values up to 1.6 in the visible and near-IR range. The chiroptical properties of helicity-preserving chiral mirrors will also be discussed.

11:20 : Invited talk
Toward the Control of Excitonic flux in 2D materials
Jean-Marie Poumirol[1], Hassan Lamsaadi[1], Dorain Beret[1], Ioannis Paradisanos[1], Ziyang Gan[2], Emad Najafidehaghani[2], Antony George[2], Tibor Lehnert[3], Ute Kaiser[3], Shivangi Shree[4], Ana Estrada-real[4], Delphine Lagarde[1], Xavier Marie[1], Pierre Renucci[1], Vincent Paillard[1], Laurent Lombez[1], Andrey Turchanin[2], Bernhard Urbaszek[4]
[1] *Université de Toulouse (France),* [2] *Friedrich Schiller University Jena (Germany),* [3] *Ulm University (Germany),* [4] *Technische Universität Darmstadt (Germany)*

Being able to control the excitonic flux is a mandatory step for the development of future room- temperature excitonic quantum devices. Transition metal dichalcogenides (ML-TMD) with stable and mobile excitons are highly attractive in this prospect. However, generating an efficient and controlled exciton diffusion over long distances has proven quite complex. Here we demonstrate that ML-TMD based lateral heterostructure (MoSe2/WSe2) acts as an efficient excitonic diode1, with an excitonic flux that can be controlled through near-field engineering.

11:40 : Invited talk
Ultrafast hot-carrier spatial transients in photonic metasurfaces: experiments, modeling, design
Andrea Schirato[1], Giulia Crotti[1], Andrea Toma[2], Remo Proietti Zaccaria[2], Paolo Laporta[1], Costantino De Angelis[3], Alessandro Alabastri[4], Giulio Cerullo[1], Margherita Maiuri[1], Giuseppe Della Valle[1]
[1] *Politecnico di Milano (Italy),* [2] *Istituto Italiano di Tecnologia (Italy),* [3] *Università degli Studi di Brescia (Italy),* [4] *Rice University (USA)*

Hot carriers photoinduced by fs-laser pulses in photonic nanostructures have been widely investigated. In most of the works a spatially homogeneous excitation pattern is assumed. Here we show how ultrafast hot carrier spatial inhomogeneities at the nanoscale can manifest and even dominate the transient transmission of photonic metasurfaces. An inhomogeneous version of the three-temperature model has been validated on pump-probe spectroscopy measurements in plasmonic metasurfaces. Our results pave the way for the design of novel ultrafast nanophotonic devices.

12:00 : Invited talk
Nanophotonic Tools for Lipid Membrane Sensing and Manipulation
Theo Lohmuller
LMU Munich (Germany)

A new approach is presented for monitoring the photoisomerization dynamics of photolipid bilayer membranes on the nanoscale using plasmonic sensing. The azobenzene group in photolipids enables optical control over various membrane parameters, such as lipid mobility and thickness, but measuring the switching dynamics in a bilayer is challenging. We demonstrate that plasmonic sensing with single gold nanorods allows for analyzing membrane photoisomerization and corresponding changes in bilayer thickness with high spatio-

temporal accuracy.

12:20 : Invited talk
DNA Origami as a Versatile Method for Bottom-Up Fabrication of Plasmonic Metamaterials
Christoph Sikeler, Susanne Kempter, Franziska Haslinger, Tim Liedl
Ludwig-Maximilians-Universitat (Germany)

In this work, we exploit the flexibility of DNA origami to create different kinds of metamaterials.DNA origami structures are created in a bottom-up, self-assembly process and plasmonic nanoparticles can beattached at predesigned locations. This can be used to create periodic lattices in solution as well as on a surface.

10:20 - 12:20 — Amphi Manet

Session 3A8

New Trends in Topological Matematerials

Organized by: Xiao Hu

Chaired by: Alexander Khanikaev

10:20 : Invited talk
High-throughput generation of topological metamaterials
Sebastian Huber
ETH Zürich (Switzerland)

There is a wide range of design principles for topological metamaterials. All the indices characterizing of such topological materials also have a correspondence in terms of crystalline symmetries. In this framework, all metamaterials fall under the category of fragile topological insulators. Here we present an algorithm how to find fragile topological bands in two spatial dimensions. We generate all possible fragile bands, up to several ten-thousand structures per unique class and perform a statistical analysis of the so-obtain topological metamaterials.

10:40 : Invited talk
Filling anomalies and chiral winding numbers in higher-order topological metamaterials
Wladimir Benalcazar
Emory University (USA)

I will present the classification of topological bands in one- and two-dimensional crystalline metamaterials based on "filling anomalies.ªnd their accompanying "symmetry indicator invariants". Then, I will present phases outside of that classification, these are chiral-symmetric higher-order topological phases whose invariants, "multiple chiral numbers", indicate the number of degenerate mid-gap states at each corner. Finally, I will show an experimental realization of such a phase in an acoustic metamaterial.

11:00 : Invited talk
Probing bulk topology of one dimensional synthetic frequency lattice
Greta Villa[1], Iacopo Carusotto[2], Tomoki Ozawa[3]
[1] *University of Konstanz (Germany),* [2] *Università di Trento (Italy),* [3] *Tohoku University (Japan)*

Ways to effectively realize lattice models utilizing a frequency degree of freedom of photonic resonators as an effective “synthetic” dimension have been actively studied in photonic community. Since the frequency degrees of freedom is used as a spatial degree of freedom in realizing lattices, its conjugate variable, which is time, plays a role analogous to momentum. We propose how to detect the bulk topological invariant of one-dimensional topological lattices in such a synthetic frequency lattice in the presence of losses.

11:20 : Invited talk
Experimental observation of the bulk-edge correspondence in anomalous-Chern topological insulators in a synthetic photonic lattice
Rabih El Sokhen[1], Albert F. Adiyatullin[1], Alvaro Gómez de Leon[2], Stéphane Randoux[1], Pierre Delplace[3],

Alberto Amo[1]
[1] *Université de Lille (France),* [2] *CSIC (Spain),* [3] *ENS de Lyon (France)*

Coupled fibre rings implement synthetic multiplexed lattices for light pulses with great flexibility to study fundamental topological properties. We measure both the intensity and the phase of the eigenvectors in a two dimensional two bands model and we extract the Berry curvature and the Chern number of the bands across topological phase transitions. The measured topological indices match perfectly the observed number of edge states in each gap at an interface, and the expected value of the Rudner invariant.

11:40 : Invited talk
Topological Transport in a Nanoscale Optomechanical Array
Florian Marquardt
Universität Erlangen-Nürnberg (Germany)

I will present the results of a recent theory-experiment collaboration with the lab of Oskar Painter at Caltech [Nat. Comms, 13, 3476 (2022)]. We were able to design and realize the largest optomechanical array to date, using a new concept that we term a multiscale optomechanical crystal. We engineered it to produce a phononic topological metamaterial at the nanoscale, exploiting the Valley Hall effect. This experiment paves the way towards unlocking optomechanics for the field of nanoscale topological phonon transport.

12:00 : Invited talk
Topological transport of GHz surface acoustic wave
Yoichi Nii, Yoshinori Onose
Tohoku University (Japan)

Implementation of topological concept to phonon could have large impact on sound manipulation since novel features including low-dissipation, localization, and unidirectionality emerge. Intensive studies have realized various topological acoustic waveguides, but most of the demonstrations are limited to kHz to MHz sound-waves. Here, we experimentally show GHz topological surface acoustic waves (SAW) using a nano-scaled phononic device and novel imaging technique. Our realization can be useful for topological SAW device for microwave telecommunication.

10:20 - 12:50 — Salle des Conseils

Session 3A9

Light-Matter Interaction on a Chip

Organized by: Alina Karabchevsky

Chaired by: Alina Karabchevsky

10:20 : Invited talk
Generation of spatial rogue waves in a Q-switched Nd:YAG laser
Roza Navitskaya[1], **Ihar Stashkevich**[1], **Stanislav Derevyanko**[2], **Alina Karabchevsky**[2]
[1] *Ben-Gurion University of the Negev (Israel),* [2] *Belarusian State University (Belarus)*

The generation of spatial rogue waves is demonstrated in a Q-switched Nd:YAG laser operating in a low-power regime under low Kerr nonlinearity. We investigate the dependence of rogue waves' statistics on the laser mode configuration. We show that spatial rogue waves can emerge when the lasing takes place at a large number of high-order transverse modes, while high Kerr or saturable absorption nonlinearity is not a necessary factor for their formation.

10:40 : Invited talk
Anapole metallic nanostructures for metarsurface applications
Emadeldeen Hassan[1], **Andrey Evlyukhin**[2], **Antonio Calà Lesina**[2]
[1] *Umea University (Sweden),* [2] *Leibniz Unversity Hannover (Germany)*

We present recent findings on anapole states in planar plasmonic nanostructures that were optimized for near-field energy enhancement. Because of the low inter-coupling at the anapole state, the nanostructures act as

individual meta-atoms that preserve their optical response even when used in highly packed metasurfaces and metamaterials.

11:00 : Invited talk
Integrated Photonics for Machine Learning Assisted Signal Processing
Imtiaz Alamgir[1], Luigi Di Lauro[1], Celine Mazoukh[1], Stefania Sciara[1], Bennet Fischer[1], Abdul Rahim Aadhi[1], Armaghan Eshaghi[2], Brent E. Little[3], Sai T. Chu[4], David. J Moss[5], Roberto Morandotti[1]
[1] *Institut national de la recherche scientifique (Canada),* [2] *Huawei Technologies (Canada),* [3] *QXP Technology (China),* [4] *City University of Hong Kong (China),* [5] *Swinburne University of Technology (Australia)*

In this work, we propose the use of machine learning-based autonomous optimization techniques for the generation and arbitrary tailoring of the spectral shape, bandwidth, and repetition rate of an integrated micro-ring resonator-based optical frequency comb. This technique has the potential to achieve increased comb efficiency, high repeatability, and reduced generation time. Additionally, this approach is translatable to micro-ring resonators of any geometry and composition, making it promising in telecommunication applications such as frequency synthesis and coherent parallel optical communication.

11:20 : Invited talk
Wafer-scale fabrication of metasurfaces for infrared and energy applications
Otto Muskens, K. Sun, C. Wheeler, J. J. Ou, C. H. de Groot
University of Southampton (United Kingdom)

We present results on the development of up to 200 mm full-wafer fabrication of mid-infrared metasurfaces for a variety of applications in energy, defence and space, including AZO and W:VO2 thermal control meta-surfaces, and silicon meta-lenses fabricated using deep-UV lithography.

11:40 : Invited talk
Efficient grating coupling strategies for silicon photonics
Periklis Petropoulos[1], V. Vitali[1], T. Dominguez Bucio[1], F. Y. Gardes[1], C. Lacava[2]
[1] *University of Southampton (United Kingdom),* [2] *University of Pavia (Italy)*

We discuss techniques for optimizing the coupling efficiency between optical fibers and silicon photonic waveguides through the use of back-end-of-line CMOS-compatible grating couplers.

12:00 : Simulation of Plasmonic Absorption Interplays in Hybridized Semiconductor/Metal Nanostructures
Atefeh Habibpourmoghad, Wenyong Xie, Antonio Calà Lesina
Leibniz University Hannover (Germany)

In low intensity regime, the plasmonic response of hybridized nanostructures can be seen as the linear combination of each constituent's response. However, the surface plasmon resonance (SPR) at the interface, can further modify the absorption cross-section of a hybridized nanostructure. We numerically studied the optical response of hybridized nanostructures made from metal (i.e., gold) and highly doped semiconductor (i.e., copper sulfide) both in the static and transient regimes, and we will present the unconventional response of such a system.

12:15 : Emission enhancement of erbium in a reverse nanofocusing waveguide
Nicholas Gusken[1], Ming Fu[2], Max Zapf[3], Michael Nielsen[2], Paul Dichtl[2], Robert Roder[3], Alex Clark[2], Stefan Maier[2], Carsten Ronning[3], Rupert Oulton[2]
[1] *Stanford University (USA),* [2] *Imperial College London (United Kingdom),* [3] *Friedrich-Schiller-Universität Jena (Germany)*

We report emission enhancement of Er3+-ionsA*STARk-split electric dipole transitions. Simultaneous enhancement of multiple quantum states is of great interest for photonic and quantum networks.

12:30 : Invited talk
Superhydrophobic surfaces and materials: design and biological applications
Pavel Levkin
Karlsruhe Institute of Technology (Germany)

Design, synthesis and applications of functional surfaces and 3D materials with special wettability will be discussed. Fabrication methods as well as biological applications of superhydrophobic surfaces, micropatterns and superhydrophobic 3D structures using 3D printing will be presented.

10:20 - 12:20 — Salle Guy Gautherin

Session 3A10

Bottom-Up Approaches, New Fabrication Routes and ENSEMBLE3

Organized by: Dorota Pawlak and Virginie Ponsinet

Chaired by: Dorota Pawlak and Virginie Ponsinet

10:20 : Invited talk

Fabrication and properties of GaAs Tamm plasmon confined light emitting diodes

Joel Bellessa[1], Vincent Toanen[1], Clémentine Symonds[1], Jean-Michel Benoit[1], Alban Gassenq[1], Aristide Lemaitre[2]

[1] *Université Lyon 1 (France),* [2] *Université Paris-Saclay (France)*

A fabrication process of Ag/GaAs Tamm emitting devices will be described. As the maximum electric field of the Tamm mode is close to the surface, the fabrication requires a special procedure to maintain their emissive properties. For Tamm structures of 5μm diameter, mode confinement appears in the diode emission with energy discretization. The observation of the electrically excited emission of a Tamm structure is an important step towards the exploitation of Tamm structures for novel optical devices.

10:40 : Invited talk

Review of Remote Epitaxy and Blue Spectral Intensity Enhancement Using Surface Plasmon Resonance

Jun Hee Choi, Kiho Kong, Eunsung Lee, Joo Hun Han, Jung Hun Park, Nakhyun Kim, Jinjoo Park, Joosung Kim, Dong Chul Shin, Sunil Kim

Samsung Electronics (Korea)

We review remote epitaxy potentially coupled with pixelated InGaN LEDs via ion implantation for micro displays for augmented reality. Next, we discuss the degree of blue light enhancement in low-efficiency CdS/ZnS core/shell quantum dot (QD) light emitters using Ag/dielectric surface plasmon resonator.

11:00 : Invited talk

Tailoring Anisotropies in NIR-plasmonic Semiconductor Nanocrystals

Jisoo Oh, Yannis Cheref, Capucine Cleret de Langavant, Louise Daugas, Florian Lochon, Alexandre Baron, Thierry Gacoin, Jongwook Kim

Ecole Polytechnique (France)

This presentation illustrates how multiple structural factors can be synergistically tuned to promote novel LSPR properties that are unseen from metal hosts. We demonstrate synthesis, assembly, and film deposition of CsxWO3-y nanocrystals with highly tunable structures and LSPR characteristics.

11:20 : Invited talk

DNA identification using surface-enhanced Raman spectroscopy

A. Kowalczyk[1], A. M. Nowicka[1], J. Krajczewski[1], A. Michalowska[1], E. Pyrak[1], A. Kowalik[2], J. L. Weyher[3], I. Dziecielewski[3], M. Chlopek[2], S. Gozdz[2], Andrzej Kudelski[1]

[1] *University of Warsaw (Poland),* [2] *Holy Cross Cancer Center (Poland),* [3] *Polish Academy of Science (Poland)*

The DNA biosensors are powerful tools in the gene mutation or pathogens detection. That is why there are a lot of DNA detection strategies and methods. Here we present the insight on a slightly overlooked DNA detection technique, surface-enhanced Raman scattering (SERS) spectroscopy. We analyse how to construct more efficient sandwich-type SERS biosensor for DNA identification. A new SERS strategy for the gene mutation identification based on rearrangement of alkanethiols linker and blocking chains is also presented.

11:40 : Invited talk

Nanoimprinted Colloid-based Metasurfaces for Lasing and Chiral Photoluminescence

Agustin Mihi

CSIC-ICMAB (Spain)

Template-assisted self-assembly is a scalable nanofabrication technique in which elastomeric pre-patterned

stamps are used to induce long range order from a colloidal dispersion used as ink. Metal colloids or perovskite nanocrystals are used herein to fabricate (i) high quality and large area 2D photonic crystals supporting narrow lattice resonances and (ii) chiral metasurfaces in which circularly polarized luminescence is observed.

12:00 : Invited talk
Non-resonant enhancement of photoluminescence based on metallic nanocubes
Mohammad Khaywah[1], Audrey Potdevin[1], François Réveret[1], Rachid Mahiou[1], Youcef Ouerdane[2], Anthony Désert[3], Stéphane Parola[3], Genevieve Chadeyron[1], Emmanuel Centeno[1], Rafik Smaali[1], Antoine Moreau[1]
[1] *Université Clermont Auvergne (France),* [2] *Université Jean Monnet (France),* [3] *Université de Lyon 1 (France)*

Metallic nanoparticles are well know for their resonant response, usually associated with Purcell effect and losses. We show here that a very large and broadband enhancement can be reached using metallic nanoparticles far from resonance. The density of nanoparticles is critical and needs to be well controlled to maximize the efficiency.

10:20 - 12:30 — Salle P1

Session 3A11

Resonant Optics – Fundamentals and Applications

Organized by: Sven Burger, Philippe Lalanne and Frank Vollmer

Chaired by: Sven Burger and Philippe Lalanne

10:20 : Invited talk
Quantum confinement effects in atomic-scale polaritons
Javier Garcia de Abajo
ICFO-Institut de Ciencies Fotoniques (Spain)

We discuss the prospects to observe quantum confinement effects in different types of optical excitations supported by systems ranging from single molecules to nanostructures. In contrast to plexitons, where the hybridization of a plasmonic mode and a fermionic excitation leads to a deviation from the uniform energy spacing in the bosonic ladder, we consider optical nonlinearities at the level of a single quantum. Practical implementations and applications are also discussed.

10:40 : Invited talk
Design and Simulation of Large-Scale Metalenses
Jens Niegemann[1], Dan-Nha Huynh[2], Federico Gomez[1], Dylan McGuire[1], James Pond[1]
[1] *Ansys Canada Ltd. (Canada),* [2] *Ansys Germany GmbH (Germany)*

One of the biggest challenges in the characterization of meta-atoms is the large parameter space that needs to be explored. To design realistic metalenses, we usually need to characterize the individual meta-atoms by frequency, angles of incidence, polarization, and often multiple geometric parameters. Here, we present our approach to quickly construct large databases of meta-atoms. In addition, we demonstrate how such a database can then be used to efficiently simulate centimeter-sized meta-lenses.

11:00 : Invited talk
Self-assembled DNA-origami inverse diamond lattice with a photonic band gap in the UV
Gregor Posnjak[1], Xin Yin[1], Paul Butler[2], Oliver Bienek[2], Mihir Dass[1], Ian Sharp[2], Tim Liedl[1]
[1] *Ludwig-Maximilian-Universität (Germany),* [2] *Technical University Munich (Germany)*

Inverse diamond lattice is a potential photonic crystal that was predicted to show one of the widest and most robust photonic band gaps. We designed DNA origami-based self-assembling tetrapod structures which crystalize into an inverse diamond lattice with a periodicity of 170 nm. After chemically depositing silica and titania on the diamond structure we observe tunable reflection bands in the UV which are in good agreement with theoretical predictions of photonic properties of the system.

11:20 : Invited talk
Polarization Singularities in Optical Near Fields: Topology and Chirality
Shubo Wang[1], **Jie Peng**[1], **Shiqi Jia**[1], **Ruo-Yang Zhang**[2]
[1] *City University of Hong Kong (Hong Kong),* [2] *The Hong Kong University of Science and Technology (Hong Kong)*

In this talk, I will discuss polarization singularities emerging in the near fields of optical structures. I will show that simple optical structures can generate rich configurations of polarization singularities with intriguing topological and chiral properties. These properties are subtly related to the topology and symmetry of the structures and provide new degrees of freedom for light manipulations and new mechanisms for chiral light-matter interactions.

11:40 : Anisotropic Light Scattering from Tunable Self-Assembled Submicron Resonators
Maeva Lafitte[1], **Ranjeet Dwivedi**[2], **Rajam Elancheliyan**[1], **Philippe Barois**[1], **Alexandre Baron**[1], **Olivier Mondain-Monval**[1], **Virginie Ponsinet**[1]
[1] *Université de Bordeaux (France),* [2] *ENSEMBLE3 (Poland)*

Metamaterials rely on assembled artificial optical resonators, having strong interactions with light and presenting local field enhancements. This presentation aims at pointing out how colloid-based chemical engineering offers exciting routes to tailor the optical response, including polarizabilities and scattering diagram of nano-resonators.

11:55 : Tailoring resonant interactions in suspensions of disordered particles to achieve near zero reflection
Cédric Blanchard[1], **Timothée Guerra**[1], **Jean-Paul Hugonin**[2], **Olivier Rozenbaum**[1]
[1] *CEMHTI (France),* [2] *Université Paris-Saclay (France)*

We take advantage of the cooperative effects that take place in a suspension of randomly distributed nanoparticles to inhibit the reflection of an electromagnetic radiation incident on it. The strategy consists in coupling resonant and lossless particles. In a counterintuitive manner, the near zero reflection phenomenon relies here on particles which have the ability to strongly scatter light when they are considered individually.

12:10 : Invited talk
Double helical plasmonic antennas for enhanced chiroptical interactions
A. Tsarapkin, S. Jürgensen, Th. Feichtner, K. Mackosz, V. Deinhart, I. Utke, S. Reich, Katja Höflich
Ferdinand-Braun-Institut gGmbH (Germany)

Chiral plasmonic nanostructures can play a crucial role in quantum optics and sensing, as they combine extremely enhanced electromagnetic near field s with a strong sensitivity to the handedness of far field radiation . Here we study the resonant excitation of plasmonic double helices theoretically and experimentally in the visible and near infrared regime.

10:20 - 12:20 — Salle P2

Session 3A12

Metamaterials Meeting Industry

Organized by: Tatjana Gric and Edik Rafailov

Chaired by: Tatjana Gric

10:20 : Invited talk
Time-resolved NIR to Visible Upconversion Luminescence from Single NaYF4:Yb3+, Tm3+ Nanoparticles on Plasmonic Nanowire Composites
K. Y. Chiok[1], **A. Haghizadeh**[1], **A. Ahmed**[1], **A. Baride**[1], **R. B. Anderson**[1], **S. May**[2], **Steve Smith**[1]
[1] *South Dakota School of Mines and Technology (USA),* [2] *University of South Dakota (USA)*

We use single particle imaging to assess the plasmonic enhancement of NIR-to-visible upconversion luminescence (UCL) from single β-NaYF4:Yb3+:Tm3+ upconverting nanoparticles (UCNPs) coupled to random

arrangements of Ag nanowires supported on glass substrates, termed nanowire composites (NWCs). We use wide field and confocal scanning spectroscopic imaging of single UCNPs on and off the plasmonic substrates in combination with energy and time resolved spectroscopy, and compare these results to a coupled rate equation analysis to elucidate the energy transfer upconversion enhancement mechanisms.

10:40 : Invited talk
Topological Trapped-Rainbow and Nonreciprocal Guides Beyond the Time-Bandwidth Limit
Konstantinos Baskourelos, Kosmas Tsakmakidis
National and Kapodistrian University of Athens (Greece)

Topologically protected wave transport has recently emerged as an effective means to address a recurring problem hampering the field of 'slow light' for the past two decades: Its keen sensitivity to disorders and structural imperfections. With it, there has been renewed interest in efforts to overcome the delay-time-bandwidth limitation usually characterizing slow-light devices, on occasion thought to be a 'fundamental limit'. Our talk will overview latest developments and point out important new functionalities that overcoming the limit can enable.

11:00 : Invited talk
The effect of periodically corrugated substrate on SERS anisotropy of organic molecules
Ephraim Thomas Mathew, Jacek Jenczyk, Zygmunt Milosz, Weronika Andrzejewska, Mikolaj Lewandowski, Maciej Wiesner
Adam Mickiewicz University (Poland)

Periodically corrugated Au/α-Al2O3 plasmonic substrates were used for surface enhanced Raman spectroscopy of thiophenol molecules. The results showed a strong dependence of the intensity of the Raman peaks of thiophenol molecules on the value of the period of corrugation and the angle between the polarization of the laser beam and the corrugation vector.

11:20 : Invited talk
From synthesis to assembly: a Silicon based metasurface fabrication
Juan Xin, Wajdi Chaabani, Julien Proust, Jerome Plain
Université de Technologie de Troyes (France)

In this study, we present a simple method to fabricate silicon nanoparticles from wafer chips. This technique allows to obtain nanoparticles of relatively homogeneous size and showing Mie resonances in the visible range. The second result that we will present is an assembly technique based on the use of the capillarity force and allowing the obtaining of metasurfaces from silicon nanoparticles.

11:40 : Invited talk
Chirality nonlinear optics enabled modulator and logic gates
Yi Zhang, Juan Arias Munoz, Zhipei Sun
Aalto University (Finland)

Ultrafast ($>$ 130 fs) chirality all-optical modulators and various chirality logic gates with chirality nonlinear optics in monolayer semiconductors are demonstrated.

12:00 : Invited talk
Surface Susceptibility Synthesis of Spatially Dispersive Metasurfaces
Jordan Dugan[1], Tom Smy[1], Francesco Monticone[2], Shulabh Gupta[1]
[1] *Carleton University (Canada),* [2] *Cornell University (USA)*

We propose a simple method to synthesize and obtain a zero thickness sheet boundary condition of aspatially dispersive (SD) metasurface to achieve desired wave transformations operations specified in the spatialfrequency domain. We demonstrate the proposed method by synthesizing a space-plate as an example, usingzero-thickness sheet description of a Huygens' metasurface in terms of angle-dependent surface susceptibilities.

Lunch

12:40 - 14:00

14:00 - 16:05 — Grand Amphi

Session 3A13

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Euclydes Marega Junior

14:00 : Keynote talk
Micro- and Nano-lasers: From One to Many, Unleashing Endless Possibilities
Mercedeh Khajavikhan
University of Southern California (USA)

Micro- and nano-lasers form a crucial category of optical components with significant scientific and technological implications. In this presentation, I will discuss the utilization of non-Hermiticity, supersymmetry, and topology principles to design arrays of these devices, resulting in intriguing and unexpected lasing phenomena. By considering the interaction between cavity modes, array geometry, and both short- and long-range coupling among the array elements, we can achieve novel laser phase locking regimes, high radiance emission, rapid beam steering, photonic spin machines, and unidirectional lasing.

14:30 : Alternative Plasmonic Metamaterials based on Titanium Nitrides and Oxynitrides with Tunable Properties
Cristina Mancarella[1], Ludovica Tovaglieri[1], Gianluigi Baiardi[1], Alessio Lamperti[2], Vincenzo Caligiuri[3], Antonio De Luca[3], Andrea Li Bassi[1]
[1] *Politecnico di Milano (Italy),* [2] *CNR-IMM (Italy),* [3] *Università della Calabria (Italy)*

The established potentialities of plasmonic effects in boosting light-matter interactions are at the basis for next-generation metamaterials merging multifunctionality, tunability of properties and broader spectral responses. The archetypal plasmonic materials, i.e. noble metals, show limited modulation outside the visible spectrum. Here, original meta-structures (e.g. hyperbolic metamaterials) based on non-metal plasmonic materials (titanium nitrides, oxynitrides) has been experimentally developed to finally pursue tailorable plasmonic features from VIS to IR towards extreme light manipulation in energy or nanophotonic applications.

14:45 : Invited talk
Color centers in ZnO nanowires
Carsten Ronning
Friedrich Schiller University Jena (Germany)

Intrinsic semiconductor nanowires have already extraordinary optical properties, doping them with active impurities significantly expands the potpourri of photonic applications. This talk supplies recent progress on the structural and optical properties of transition-metal and rare-earth element doped ZnO nanowires using ion beam implantation. Analysis of the prepared systems was partly performed by a new experimental setup installed at the synchrotron ESRF in Grenoble, which allows the detection of the carrier dynamics and the luminescence in respect to the local environment.

15:05 : Invited talk
Image processing with metaoptics: phase imaging and asymmetric optical transfer functions
Niken Priscilla, Shaban Sulejman, Wendy Lee, Lukas Wesemann, Timothy Davis, Ann Roberts
University of Melbourne (Australia)

The capacity to modify images in the Fourier domain using all-optical methods in real-time is well-known but there is an emerging interest in manipulating images using metasurfaces in the object or image plane leading to an orders-of-magnitude reduction in size and weight. Many applications, however, require the introduction of a transverse asymmetry in the optical transfer function. Here approaches to introducing the required asymmetry will be discussed and their application to phase contrast imaging of transparent objects will be highlighted.

15:25 : Invited talk
Heavily doped semiconductors: a platform for integrated nonlinear plasmonics

Federico De Luca[1], **Michele Ortolani**[2], **Huatian Hu**[1], **Cristian Ciraci**[1]
[1] *Istituto Italiano di Tecnologia (Italy),* [2] *Sapienza University of Rome (Italy)*

In this talk we numerically investigate heavily doped semiconductors as a platform for integrated nonlinear plasmonics at mid-infrared frequencies. We study free-electron nonlinearities and use surface charge density modulation to control and enhance the nonlinear response.

15:45 : Invited talk
Meta-Optical Fibers
Andrew Palmer, Stuart Love, Leon Zhang, Howard Lee
University of California (USA)

In this talk, I will present our recent development of Meta-optical fiber, an advanced optical fiber integrated with emerging nanophotonic concepts such as optical metasurfaces, plasmonic nanowires, and zero-index photonics. I will present the development of ultrathin optical metalens which is cascaded on the facet of a photonic crystal fiber that enables light focusing.

14:00 - 15:00 — Amphi Bezier

Session 3A14

Conference Tutorials II

14:00 : Tutorial
Publishing Research with Impact in the Optics and Photonics Field
Anja Wecker
Wiley (Germany)

For researchers, it's a long road from the idea to the published article. Producing great research results does not necessarily mean they will automatically be appreciated by the community. Choosing the right journal, convincing editors and reviewers, and making work visible to others are essential steps on the way to success. In this tutorial talk, I will give an insight into publishing opportunities in relevant journals and the related peer review process. From an editorial perspective, I will provide some guidance on how to best pass peer review and maximize success in scientific publishing.

15:00 - 16:00 — Amphi Bezier

Session 3A15

Exotic Meta-media – Time-Dependent, Nonlocal and Other Novel Responses

Organized by: Jonathan Gratus, Rebecca Seviour, Paul Kinsler and Martin McCall

Chaired by: Sergey Siaber and Martin McCall

15:00 : Invited talk
Temporal boundaries in electromagnetic materials
Jonathan Gratus[1], **Rebecca Seviour**[2], **Paul Kinsler**[1], **Dino Jaroszynski**[3], **Shankaranandh Balakrishnan**[2]
[1] *Lancaster University (United Kingdom),* [2] *University of Huddersfield (United Kingdom),* [3] *University of Strathclyde (United Kingdom)*

Temporally modulated optical media have amazing potential to amplify signals. Here we investigate the behaviour of temporal boundaries, and show that traditional approaches that assume constant dielectric properties, with loss incorporated as an imaginary part, necessarily lead to unphysical solutions. Furthermore, although physically reasonable predictions can be recovered with a narrowband approximation, we show that appropriate models should use materials with a temporal response and dispersive behaviour. We indicate recent experiential demonstrating temporal boundaries.

15:20 : Invited talk

Manifestations of thermal hysteresis in theoretical studies of scattering, columnar thin films, and surface-plasmon-polariton wave propagation

Tom Mackay[1], **Tran Son**[2], **Alain Haché**[3], **Waleed Waseer**[4], **Akhlesh Lakhtakia**[5]
[1] *University of Edinburgh (United Kingdom),* [2] *Concordia University (Canada),* [3] *Université de Moncton (Canada),* [4] *Quaid-i-Azam University Islamabad (Pakistan),* [5] *Pennsylvania State University (USA)*

The crystal structure of vanadium dioxide is monoclinic at temperatures below 58 ℃ and tetragonal at temperatures above 72 ℃. Monoclinic vanadium dioxide is a dissipative insulator. Tetragonal vanadium dioxide is a dissipative insulator only at free-space wavelengths less than 1100 nm, at longer free-space wavelengths it is a plasmonic metal. The monoclinic-tetragonal transition is reversible but hysteretic. Manifestations of this thermal hysteresis were found in theoretical studies of (i) scattering, (ii) constitutive parameters of columnar thin films, and (iii) surface-plasmon-polariton waves.

15:40 : Invited talk

Spatial dispersion with Mathieu's equation for EM generation and particle acceleration

Jonathan Gratus[1], **Taylor Boyd**[1], **Sergey Siaber**[1], **Steven Jamison**[1], **Rebecca Seviour**[2]
[1] *Lancaster University (United Kingdom),* [2] *University of Huddersfield (United Kingdom)*

Corrugated waveguides can be modelled as a spatially dispersivemedia. By varying the structure we can make the electric field obeyMathieu's equation. This is utilised to tailor the dispersion relation to match phase and group velocity of the waves to the particle beam. These corrugated structures can be used as slow wave structures to eitherproduce EM fields or accelerate charged particles.

14:00 - 16:10 — Amphi Fournel

Session 3A16

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Xiangrong Wang

14:00 : Invited talk

Bose-Einstein condensation of freely evolving overpopulated magnon gas to the uniform precession state

Oleksandr (Alexander) Serha (Serga)
Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau (Germany)

Bose-Einstein condensate (BEC), which magnons can form even at room temperature, is now a promising object for developing new computational concepts. Most studies employ Brillouin light scattering spectroscopy to observe a short-wavelength BEC in planarly magnetized ferrimagnetic films. However, electrical detection is essential for the implementation of magnon BEC devices. Using parametric electromagnetic pumping of magnons in perpendicularly magnetized films, we achieved a new long-wavelength type of BEC and investigated its behavior by inductive detection.

14:20 : Invited talk

Parity-broken vacuum as a chiral catalyst

Yanzhe Ke[1], **Zhigang Song**[2], **Qingdong Jiang**[1]
[1] *Shanghai Jiao Tong University (China),* [2] *Harvard University (USA)*

A material with symmetry breaking inside can transmit the symmetry breaking to its vicinity by vacuum fluctuations. Here, we show that a parity-symmetry-broken vacuum can induce a chirality-dependent shift of the ground-state energy of a chiral molecule, resulting in a chemical reaction process that favors producing one chirality over the other. We evaluate the chirality production rate for specific chemical reactions, showing the promise of quantum atmospheric selectivity.

14:40 : Invited talk

Magneto-Optical Chirality in a Coherently Coupled Exciton-Plasmon System

Samarth Vadia[1], Johannes Scherzer[1], Kenji Watanabe[2], Takashi Taniguchi[2], Alexander Hoegele[1]
[1] *LMU Munich (Germany),* [2] *National Institute for Materials Science (Japan)*

In this work, we demonstrate that polarization-contrasting optical transitions associated with excitons in monolayer WSe2 can be transferred to proximal plasmonic nanodisks by coherent coupling. The coupled exciton-plasmon system exhibits magneto-induced circular dichroism in a spectrally narrow window of Fano interference, which we model in a master equation framework. Our work motivates exciton-plasmon interfaces as building blocks of chiral metasurfaces for applications in information processing, non-linear optics and sensing.

15:00 : Invited talk

Mimicking TMDs by Plasmonic Topological Metasurface with a broken time-reversal symmetry

E. D. Epstein, D. Cheskis, Yuri Gorodetski
Ariel University (Israel)

In this paper we present a topological plasmonic metasurface exhibiting spin-dependent distribution in the k-space analogical to the behaviour of the K and K' valleys in 2D materials. We intentionally break the lattice inversion-symmetry by local rotation of the lattice features and analyze the helicity dependence in the isofrequency plane. We attribute the characterisic valleytronic behavior to the local geometric Berry phase induced between the structure sublattices.

15:20 : Keynote talk

Chirality and nonreciprocal responses in quantum materials

Naoto Nagaosa
Riken (Japan)

We study the chiral dynamics and consequent nonreciprocal responses in quantum materials, where the most fundamental principles in physics manifest themselves, i.e., the symmetries especially the time-reversal and spatial inversion, dissipation, quantum-classical crossover/transition, quantal Berry phase and topology, and many-body correlation effects. They include (1) magnetochiral anisotropy of semiconductors, Weyl semimetals, and superconductors, and (2) the photovoltaic effect, e.g., the shift currents under photo-excitations.

15:50 : Invited talk

Non-reciprocal spin wave beams in thin magnetic films

Vincent Vlaminck[1], Loic Temdie[1], Vincent Castel[1], Dinesh Wagle[2], M. Benjamin Jungfleisch[2], Carsten Dubs[3], Gyandeep Pradhan[4], Jose Solano[4], Hicham Majjad[4], Romain Bernard[4], Yves Henry[4], Daniel Stoeffler[4], Matthieu Bailleul[4]
[1] *IMT Atlantique (France),* [2] *University of Delaware (USA),* [3] *INNOVENT e.V. Technologieentwicklung (Germany),* [4] *IPCMS (France)*

We present several approaches that allows exciting non-reciprocal spin wave beams in thin magnetic films. Using primarily the spin wave spectroscopy techniques performed in both in- and out-of-plane geometries, we show that the spin wave beamforming can be tailored using concepts inspired from optics. We also developed a near-field diffraction model that benchmarks spin wave diffraction in thin films for any geometry, and is readily applicable for future designs of magnon interferometric devices.

14:00 - 16:00 — Amphi Esquillan

Session 3A17

Symposium III: Advanced Passive and Active Metasurfaces and Zero-Index Materials

Organized by: Howard Lee and Pin Chieh Wu

Chaired by: Zhaowei Liu

14:00 : Invited talk
Plasmonic metasurfaces and waveguide devices based on epsilon-near-zero materials
Pierre Berini
University of Ottawa (Canada)

We report work on tunable plasmonic metasurfaces and on polarization-independent broadband plasmonic modulators ($>$ 200 GHz), exploiting epsilon-near-zero effects in metal-oxide-semiconductor structures fabricated using conductive oxides. The tunable metasurfaces comprise subwavelength pixels that produce no grating diffraction and are used in reflection to control the magnitude and phase of the reflected beam. The broadband modulators share the same material set but are fabricated on embedded Si waveguides and designed to operate with TE or TM light.

14:20 : Invited talk
Building Uncooled Infrared Camera based on One Atom Thick Graphene
Debashis Chanda
University of Central Florida (USA)

The talk will outline a novel strategy for uncooled, tunable, multispectral infrared detection. One atom thick graphene offers an alternative mechanism bypassing material bandgap restriction. Further, the ability of carrier concentration modulation on graphene via external voltage offers dynamic spectral selectivity for çolor"night vision/sensing. The performance of preliminary demonstration compares favorably even with present cryogenically cooled detection schemes paving the path for commercial development of many applications from space exploration to healthcare.

14:40 : Invited talk
Exciton resonances in two-dimensional materials for dynamic wavefront manipulation
Melissa Li, Claudio Hail, Souvik Biswas, Harry Atwater
Caltech (USA)

Exciton resonances in 2D materials have gained widespread attention for active wavefront manipulation due to their large tunability through electrostatic gating. We discuss how excitons in layered materials can be engineered by tuning their radiative and nonradiative rates. By applying spatially-varying amplitude and phase gradients across a monolayer semiconductor, we observe large refractive index modulation at various excitonic frequencies and demonstrate dynamic beam steering. Our results uncover conceptually new metasurface design principles by engineering material resonances for atomically-thin nanophotonic devices.

15:00 : Invited talk
Quasi-Bound State in the Continuum in Intra-Coupled Si Dielectric Metasurface
Wen-Hui (Sophia) Cheng
National Cheng Kung University (Taiwan)

A structure of all-dielectric metasurface with the concept of q-BIC is introduced and studied. Magnetic quadrupole being induced by asymmetry and near field coupling contribute to the high Q resonance. The effect of pitch, size, and scaling factor will be discussed for better understanding of the system.

15:20 : Invited talk
Physics-informed reinforcement learning for nanophotonic device design
Min Seok Jang
KAIST (Korea)

The increasing demand on a high-performance metasurface requires a freeform design method that can handle a huge design space. In this presentation, I discuss design approaches based on deep reinforcement learning. I will introduce how to apply deep reinforcement learning to design a metasurface beam deflector with large degrees of freedom, and discuss how to increase the sample efficiency by informing the agent of the reinforcement learning using physical constraints that govern the electromagnetic system.

15:40 : Invited talk
Active metamaterials and devices: from rapidly-tunable lenses to emergent polaritonic materials
Gennady Shvets
Cornell University (USA)

I will describe how metasurfaces can be combined with liquid crystals to develop a new class of electrically-controlled varifocal metalenses operating at multiple wavelengths. Experimental demonstrations of imaging

using actively controlled varifocal and bifocal metalenses will be presented, and new approaches to making widefield electrically-tunable metalenses will be described. I will also describe how electrically-biased plasmonic metasurfaces - also known as metagates - can be integrated with 2D materials to simultaneously modify the band structure of free carriers and plasmons.

14:00 - 16:00 — Amphi A

Session 3A18

Metasurfaces for Light Control Emission

Organized by: Braulio García-Cámara and Ángela Barreda Gómez

Chaired by: Braulio García-Cámara and Ángela Barreda Gómez

14:00 : Invited talk
Engineering spatial dispersion in metasurfaces through materials dispersion
Sergejs Boroviks, Adrei Kiselev, Christian Santschi, Karim Achouri, Olivier Martin
EPFL (Switzerland)

Although metasurfaces are intrinsically planar objects, geometrical variations in the third - out-of-plane - direction are becoming instrumental to engineer exotic optical responses. Unfortunately, such complex three-dimensional meta-atoms are extremely difficult to fabricate at the nanoscale. Here, we demonstrate that similar optical responses are amenable to simple geometries that include different materials, thus paving the way for a new class of hybrid metasurfaces.

14:20 : Invited talk
Nonlinear dielectric metasurfaces for infrared imaging and light sources
Dragomir Neshev
Australian National University (Australia)

We review the recent achievements of nonlinear frequency conversion in dielectric metasurfaces and show the different strategies for optimization of the nonlinearity enhancement. We further review the important applications of such nonlinear metasurfaces for infrared imaging and novel photon sources.

14:40 : Invited talk
The single Characterization Angle (SCA) approach for objects with cylindrical symmetry
Jorge Olmos-Trigo[1], Jon Lasa-Alonso[1], Iker Viloria-Gcomez[2], Gabriel Molina-Terriza[1], Aitzol Garcia-Etxarri[1]
[1] *Donostia International Physics Center (Spain),* [2] *Centro de Fisica de Materiales (Spain)*

We present an exact multipolar expansion of fCD, which can be used to deduce the integrated near-field CD enhancements of chiral molecules in the presence of scatterers under general illumination conditions. Our analytical findings reveal that the near-field fCD factor is related to magnitudes that can be computed in far-field, such as the scattering cross-section and helicity. We demonstrate that in the case of cylindrically symmetric samples, the near-field fCD factor can be experimentally inferred from only two far-field measurements.

15:00 : Invited talk
Electroluminescent Metasurface Light Emitting Diodes
Jon Schuller
UC Santa Barbara (USA)

Recent demonstrations of metasurface mediated photoluminescence highlight their potential for future device implementation. However, phased array electroluminescent metasurface devices have not previously been realized. Here, we demonstrate GaN-based quantum well LEDs where light is generated within an integrated metasurface architecture. In addition to demonstrating directional and focused electroluminescence, we describe how previous photoluminescent metasurfaces must be modified to incorporate device functionality, and show that metasurface LEDs can add new functionality without negatively impacting device brightness or

efficiency.

15:20 : Invited talk
Topological exciton-polaritons in metasurfaces integrated with transition metal dichalcogenides
Ivan Sinev[1], Mengyao Li[2], Fedor Benimetskiy[3], Tatiana Ivanova[4], Svetlana Kiriushechkina[2], Anton Vakulenko[2], Sriram Guddala[2], Dmitry Krizhanovskii[3], Andrea Alù[2], Anton Samusev[5], Alexander Khanikaev[2]
[1] *EPFL (Switzerland),* [2] *City College of New York (USA),* [3] *University of Sheffield (United Kingdom),* [4] *ITMO University (Russia),* [5] *Technical University of Dortmund (Germany)*

In the last years, polaritonic metasurfaces were established as a viable alternative to vertical cavities forrealization of strong light-matter interaction regimes that in turn enable unique nonlinear and quantum phenomena. Weexplore topological exciton polaritons which are formed in a suitably engineered all-dielectric topological photonicmetasurface coupled to transition metal dichalcogenide monolayers. We experimentally observe the transition of topologicalcharge from photonic to polaritonic bands with the onset of strong coupling regime and demonstrate one-way spin-polarizededge topological polaritons.

15:40 : Invited talk
Nonlinear generation and detection of valleys in atomically thin semiconductors
Paul Herrmann[1], Sebastian Klimmer[1], Thomas Lettau[1], Mohammad Monfared[1], Isabelle Staude[1], Ioannis Paradisanos[2], Ulf Peschel[1], Giancarlo Soavi[1]
[1] *Friedrich Schiller University (Germany),* [2] *Foundation for Research and Technology (Greece)*

We show ultrafastA*STARk shift induced by off-resonance below gap excitation. The read state is enabled by the sensitivity of second harmonic generation to changes in the material symmetry, triggered by the valley imbalance.

14:00 - 16:00 — Amphi Pinel

Session 3A19

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Davy Gérard and Pedro Hernandez Martinez

14:00 : Invited talk
Novel Second Harmonic Rayleigh and Mie scattering chiroptical effects
Ventsislav K. Valev
University of Bath (United Kingdom)

Following our recent discovery of the Hyper Rayleigh Scattering Optical Activity (HRS OA), we report both novel forms of harmonic chiroptical scattering and novel materials in which these effects can be observed. The new effects are enable chiroptical characterization in tiny volumes of illumination. They are also highly sensitive and capable of characterizing the chirality of a single metal nanoparticles, floating freely in an isotropic liquid environment.

14:20 : Invited talk
Theoretical models for chiral photogrowth in plasmonic nanocrystals
Lucas Vazquez Besteiro[1], Miguel Correa-Duarte[1], Zhiming M. Wang[2], Alexander O. Govorov[3]
[1] *University of Vigo (Spain),* [2] *University of Electronic Science and Technology of China (China),* [3] *Ohio University (USA)*

Plasmonic systems can act as photocatalysts, with the energy in their resonant modes driving local chemical reactions. Furthermore, the spatial inhomogeneity of the local plasmonic response can affect its overall properties, most notably through their electromagnetic hot spots. Such locally differentiated response can be exploited by using circularly polarized light to create and amplify local chiral symmetry of the particle-light system. We present computational results suggesting the potential for developing chiral plasmonic nanos-

tructures from achiral templates by exploiting this phenomenon.

14:40 : Invited talk
Ultrafast phenomena at the interface of plasmonic/semiconductor hybrid systems
Margherita Zavelani-Rossi
Politecnico di Milano (Italy)

Hybrid plasmonic/semiconductor junction allow providing and controlling interesting physical functionalities, such hot-electron charge transfer or plasmon induced resonance energy transfer. Ultrafast transient absorption spectroscopy is an effective tool to study the junction behavior. Here, gold plasmon nanostripes coupled to a 2D transition metal dichalcogenide (MoS2) and silver nanoparticles decorating ZnO nanorods are considered. Experimental data together with an analytical model and crossed results, allow disclosing the physics of the systems, providing important information for fundamental knowledge and future applications.

15:00 : Invited talk
Twisted waveguides as arbitrary unitary gates in polarization-encoded quantum information processing circuits
F. Morozko[1], A. Novitsky[2], A. Mikhalychev[3], Alina Karabchevsky[1]
[1]Ben-Gurion University of the Negev (Israel), [2]Belarusian State University (Belarus), [3]NAS of Belarus (Belarus)

Integrated photonics is a remarkable platform for the realization of quantum computations due to its flexibility and scalability. Here we propose a novel paradigm exploiting twisted waveguides as a building block for polarization-encoded quantum photonic computations on a chip. We unveil a transformation (gate) matrix in the closed form and demonstrate that twisted waveguides can implement arbitrary Bloch sphere rotations. The outcomes of this research may open a new direction in the development of quantum computing architectures on a chip.

15:20 : Invited talk
Merging bound states in the continuum and van der Waals materials for enhanced light-matter coupling
Andreas Tittl
LMU Munich (Germany)

Metasurfaces supporting bound states in the continuum (BICs) have emerged as a powerful nanophotonic platform because of their exceptional resonance control and large field enhancements ideal for light-matter coupling. Van der Waals (vdW) materials are particularly interesting for nanophotonics because of their unique optical and electronic properties. This talk will introduce BIC-driven metasurface concepts based on the prominent vdW materials hexagonal boron nitride and the transition metal dichalcogenide WS2, demonstrating broad spectral tunability, ultrasharp resonances, and strong light-matter coupling.

15:40 : Invited talk
Ultra-sensitive Plasmonic Biosensors based on Two-Dimensional NanoMaterials
Shuwen Zeng
Université de Technologie de Troyes (France)

In this talk, I will present the use of hybrid 2D nanomaterials-based metasurface nanostructure as an enhanced sensing substrate. The thickness of the plasmonic sensing substrate is tuned in an atomic scale and optimized to improve the sensing capability. A large phase-related Goos-Hänchen signal shift were achieved due to the strong resonance at the surface of the sensing film. This hybrid 2D nanomaterial-based metasurfaces would provide a good opportunity for developing portable theranostic devices in clinical applications.

14:00 - 16:00 — Amphi Manet

Session 3A20

New Trends in Topological Matematerials

Organized by: Xiao Hu

Chaired by: Tomoki Ozawa

14:00 : Invited talk

Topological singular points and skin modes in asymmetric dielectric structures

Masaya Notomi[1], **Taiki Yoda**[2], **Yuto Moritake**[1]
[1] *Tokyo Institute of Technology (Japan),* [2] *Nippon Telegraph and Telephone Corporation (Japan)*

We investigate how one can control topological and non-Hermitian properties by manipulating the symmetry of dielectric structures. First, we show one can create and annihilate various topological singular points starting from the topological charge of high-symmetry points or exceptional points by breaking the symmetry. Second, we demonstrate that the reciprocal non-Hermitian effect appears in simple uniform media by breaking the symmetry of the dielectric tensor.

14:20 : Invited talk

Non-Hermitian topological light manipulations in integrated waveguide lattices

Wange Song[1], **Luqi Yuan**[2], **Shining Zhu**[1], **Tao Li**[1]
[1] *Nanjing University (China),* [2] *Shanghai Jiao Tong University (China)*

Non-Hermitian photonics has established entirely new ways for flexible control of light, which hassparked considerable interest in connection with topological physics. Here, we propose a new concept ofnon-Hermitian synthetic dimension and reveal its capability in manipulating the topological states, e.g., zero and Floquet π states. Significantly, we unveil new types of high-dimensional Weyl states hidden in thisnon-Hermitian dimension. We anticipate our integrated photonics platform to reveal more complexnon-Hermitian topology in the future.

14:40 : Invited talk

Beam Trajectory Steering by Distorted Photonic Crystals

Kyoko Kitamura, J. Hashizume, Y. Kawamoto, A. Onishi, H. Kitagawa
Kyoto Institute of Technology (Japan)

We show beam trajectory bending, meandering, bifurcating and beam splitting by distorted photonic crystals which possess adiabatic change (lattice distortion) in photonic crystal lattice properties.

15:00 : Invited talk

Hyperbolic topological states with first-order and higher-order Chern numbers

Weixuan Zhang, Xiangdong Zhang
Beijing Institute of Technology (China)

So far, most studies on topological states have focused on Euclidean space. Here, we report on the construction of various topological phases in hyperbolic space, which is non-Euclidean space with constant negative curvature. We firstly reveal the boundary-dominated Chern topological states in hyperbolic spaces. Moreover, based on the unique property of non-Abelian Fuchsian translation group, the 2D hyperbolic topological states with non-zero second-order Chern numbers are constructed. These exotic hyperbolic topological states have been experimentally observed by electric circuit networks.

15:20 : Invited talk

Optical holography and coding based on topological light field in real space

Lingjun Kong, Xiangdong Zhang
Beijing Institute of Technology (China)

Here, we create a type of nested vortex knot, and show that it can be used to fulfill the robust information coding with a high capacity assisted by a large number of intrinsic topological invariants. In experiments, we fabricate metasurface holograms to generate light fields sustaining different kinds of nested vortex links. We introduce optical topological structures into holographic technology and establish a new topological holographic coding. We verify the high-capacity coding scheme based on topological optical knots in experiment.

15:40 : Invited talk
Nanophotonic structures to control propagation, emission and topological behavior of light
Ganapathi Subramania
Sandia National Laboratories (USA)

This work describes controlling light propagation, emission and topological behavior of lightusing semiconductor based nanophotonic structures.

14:00 - 16:00 — Salle des Conseils

Session 3A21

Plasmonic Nanomaterials for Bio-Diagnostics, Environmental Monitoring and Food Safety

Organized by: Lucia Petti and Massimo Rippa

Chaired by: Lucia Petti and Massimo Rippa

14:00 : Invited talk
Numerical optimization of the optical scattering response of plasmonic nanostructures
Sven Burger, Fridtjof Betz, Felix Binkowski, Martin Hammerschmidt, Lilli Kuen, Phillip Manley, Matthias Plock, Philipp-Immanuel Schneider, Ivan Sekulic, Lin Zschiedrich
Zuse Institute Berlin (Germany)

We discuss numerical simulation and optimization methods and their application to models of optical light scattering from plasmonic nanostructures. Agreement between experimental results and corresponding numerical results is discussed for various settings.

14:20 : Invited talk
Plasmon Resonances in Ga Nanoparticles and Plasmonic Antennas for Biosensing
Michal Horak[1], Vojtech Calkovsky[1], Vlastimil Krapek[1], Joseph Riley[2], Victor Pacheco-Pena[2], Jindrich Mach[1], Tomas Sikola[1]
[1] *Brno University of Technology (Czech Republic),* [2] *Newcastle University (United Kingdom)*

We present a study of biocompatible gallium nanoparticles using STEM-EELS on a single particle level showing that they support plasmon resonances in the ultraviolet to visible spectral region. Moreover, we introduce a study of complementary plasmonic antennas designed using Babinet's principle and demonstrate spectral changes in the localized surface plasmons resonances when introducing variations in the parameters of a nearby dielectric analyte.

14:40 : Invited talk
Plasmonic Metasurfaces for Enhanced Spectrochemical Tissue Diagnostics
S. Rosas, K. A. Schoeller, E. Chang, H. Mei, M. A. Kats, K. W. Eliceiri, X. Zhao, Filiz Yesilkoy
University of Wisconsin - Madison (USA)

Label-free and nondestructive mid-infrared (MIR) vibrational hyperspectral imaging is emerging as an important biomedical tissue analysis tool. However, the chemically complex and heterogeneous composition of tissue specimens limit analytical performance of conventional MIR spectral histopathology. We introduce an advanced MIR spectrochemical tissue imaging modality using plasmonic metasurfaces supporting strong surface-localized electromagnetic fields to capture quantitative molecular maps of large-area brain tissue sections. Our surface-enhanced chemical imaging method is well-suited to impact translational biomedical research and diagnostic clinical histopathology.

15:00 : Invited talk
Optical metasurfaces with hybrid TE-TM collective resonances for spectroscopic applications
Radoslaw Kolkowski, Andriy Shevchenko
Aalto University (Finland)

Due to their narrow spectral bands, collective resonances of periodic metasurfaces are of growing interest

in many areas of photonics. Here, we investigate collective resonances that emerge from coupling between TE and TM modes via plasmonic nanoparticles in a metasurface-based slab waveguide. We show that these hybrid resonances can provide high local field enhancement and high quality factors, which makes such plasmonic-photonic metasurfaces especially promising for applications in spectroscopic sensing and detection.

15:20 : Invited talk
Mass customized optical metasurfaces
Anders Kristensen
Technical University of Denmark (Denmark)

Fabrication costs may limit applications of optical metasurfaces. This may be addressed by mass customization where identical metasurfaces or meta-film templates are manufactured by low-cost replication techniques, such as nanoimprint lithography, and differentiated for specific optical functionality by post-processing. High resolution and high throughput structural color prints as well as transparent flat optical elements are demonstrated.

15:40 : Invited talk
Nanoplasmonic sensing of food product and neurochemistry
Jean-Francois Masson
Universite de Montreal (Canada)

This presentation will introduce our research activities in plasmonic nanobiosensing, where we use metallic nanoparticles to develop LSPR and SERS sensors for a series of applications. This paper will highlight our latest developments for sensing off-flavors in maple syrup and neurotransmitters involved in neurochemical processes.

14:00 - 16:00 — Salle Guy Gautherin

Session 3A22

Bottom-Up Approaches, New Fabrication Routes and ENSEMBLE3

Organized by: Dorota Pawlak and Virginie Ponsinet

Chaired by: Dorota Pawlak and Virginie Ponsinet

14:00 : Invited talk
Alignment of quantum rods for single- and multi-layered luminescence-based circular polarization convertors
Yutaka Okazaki, Hayaki Shimizu, Kaito Nakamura, Shusaku Kubota, Kan Hachiya, Takashi Sagawa
Kyoto University (Japan)

Orientation of anisotropic nanoparticles in macroscopic materials have a great potential for the generation and maximization of optical properties such as polarization. Here, we demonstrate an approach for the generation of circularly polarized (CP) light with high purity and high light intensity by luminescence-based CP convertors composed of one-dimensionally aligned quantum rods composite films and retardation film.

14:20 : Invited talk
Escaping the flatland: fabrication and application of volume metamaterials
Thomas Pertsch
Friedrich Schiller University Jena (Germany)

While it appeared that metasurfaces offer almost unlimited functionality, volume metamaterials may provide advantages in specific applications. In this presentation I will give an overview on the limits and perspectives of the research field of volume metamaterials, which governed the meta-research in its beginning, but later was outperformed by the advances in metasurfaces. However, new nanotechnologies bring the dream of a real meta-volume in reach.

14:40 : Invited talk
Self-organization of eutectic two-phase composites: insights from phase-field simulations
Mathis Plapp
Ecole Polytechnique (France)

The crystallization of eutectic alloys yields composites in which the two solid phases are arranged in regular lamellar or rod microstructures. Those are created by a pattern-formation process at the solid-liquid interface which results from the interplay of capillary effects and diffusion. I will review several insights obtained by phase-field modeling on the effect of interphase boundary anisotropy on the emergence of lamellar patterns, the influence of transverse temperature gradients, and the transition from lamellar to rod patterns.

15:00 : Invited talk
Bioinspired Colorimetric Metasurfaces for Next Generation, On-Chip Imaging of Tissue Microstructure
Paula Kirya, Zaid Haddadin, Dev Shah, Loren Phillips, Omonigho Aisagbonhi, Lisa Poulikakos
UC San Diego (USA)

This work introduces a new class of bioinspired 3D-architected metasurfaces which enable the quantitative, colorimetric visualization of tissue microstructure for a variety of fiber-affecting diseases encompassing organ fibrosis, heart disease, neurodegenerative disease or various cancers.

15:20 : Invited talk
Novel surface interactions of 2D TMDs with different bacteria and virus models
Manjo Singh
University of Naples (Italy)

In view of high anisotropy and fascinating chemistry, two dimensional nanomaterials (for example graphene) have attracted increasing interest and attention from the various scientific fields such as catalysis, energy storage, sensors, coatings and biomedicine, due to their unique physicochemical properties. In view of this, we extensively studied the surface interactions of pure water based exfoliated 2D MoS2 (belonging to the family of 2D TMDs) and graphene oxide nanosheets with a gram-negative bacterium, Escherichia coli, and a gram-positive bacterium, Staphylococcus aureus.

15:40 : Invited talk
In situ growth: Bottom-up wet-chemical preparation of plasmonic gold nanostructures on substrates
Gail Vinnacombe-Willson
CIC biomaGUNE (Spain)

We present an unconventional in situ growth approach where bottom-up wet-chemical synthesis is used to synthesize plasmonic gold nanoparticles (AuNPs) directly on substrates, rather than in colloidal suspension. This in situ growth technique was implemented to prepare anisotropic AuNPs on various materials. Furthermore, we show that combining in situ growth and soft lithography opens the doors for the preparation of plasmonic arrays with collective plasmonic responses and tuneable optical properties.

14:00 - 16:00 — Salle P1

Session 3A23

Microwaves and Millimeter Waves Applications of Metamaterials and Metasurfaces for the Real World

Organized by: Shah Nawaz Burokur and Xavier Begaud

Chaired by: Shah Nawaz Burokur and Xavier Begaud

14:00 : Invited talk
Intelligent Surfaces for Wireless Communications: Living at the Interface of Electromagnetic and Communication Theories
Marco Di Renzo
Paris-Saclay University (France)

In wireless, the term intelligent surface refers to a planar metamaterial structure that is capable of generating an arbitrary current density distribution, so as to ensure the highest flexibility in generating a specified electromagnetic field and in shaping the propagation of the electromagnetic waves in large-scale networks. This presentation will report latest research advances on analytical modeling, evaluating the ultimate performance limits, and optimizing intelligent surfaces for application to wireless communications, with focus on synergies between electromagnetic and communication theories.

14:20 : Invited talk

Metagratings for wavefronts manipulation: Theory and design

Zhen Tan[1], Jianjia Yi[1], Badreddine Ratni[2], Shah Nawaz Burokur[2]
[1] *Xi'an Jiaotong University (China),* [2] *Université Paris Nanterre (France)*

Metagratings, structures composed of sparsely arranged load-impedance wires, are exploited to tailor and manipulate diffracted beams. Here, we focus on planar reflective-type metagratings where reflected diffracted orders are controlled.

14:40 : Invited talk

Deep learning-driven all-optical operations utilizing metasurfaces

Zihan Zhao, Yue Wang, Xumin Ding
Harbin Institute of Technology (China)

In this paper, a novel compact trigonometric function operator based on the metasurface is proposed. Such an operator, which consists of a simple P-B (Pancharatnam-Berry) phase metasurface, can implement the four basic trigonometric operations (sine, cosine, tangent, and cotangent functions) at ultra-high speed with low power consumption, providing a feasible way to achieve a universal photonic computing chip.

15:00 : Invited talk

Design and measurement of an oblique wide-angle metamaterial absorber for RF space applications

Anne Claire Lepage[1], Xavier Begaud[1], O. Rance[1], K. Elis[2], N. Capet[2]
[1] *Telecom Paris (France),* [2] *Centre National d'Etudes Spatiales (France)*

The paper deals with the design, realization and measurement of a lightweight electromagnetic metamaterial absorber for space applications operating on the [2 GHz, 2.3 GHz] frequency band, under oblique incidence from 35° to 65°.

15:20 : Invited talk

Modulated metasurface antennas and arrays for millimeter wave and sub-terahertz applications

David Gonzalez Ovejero, Jérôme Taillieu, Christos Bilitos, Ronan Sauleau, Olivier De Sagazan
Université de Rennes (France)

This summary presents the application of modulated metasurfaces in millimeter wave and sub-terahertz antenna systems. We succinctly show that by adopting metasurfaces as array element, one may mitigate some of the challenges found in large phased arrays with a limited field of view and concurrently enhance the gain bandwidth of modulated metasurfaces antennas with a single port.

15:40 : Invited talk

Holographic Metasurfaces for Wireless Communications and Extended Reality

Alexandros Pitilakis[1], Odysseas Tsilipakos[2], Anna Tasolamprou[3], Ageliki Tsioliaridou[3], Traianos Yioultsis[1], Nikolaos Kantartzis[1], Dionysios Manessis[4], George Kenanakis[3], Sotiris Ioannidis[3], Maria Kafesaki[3], Christos Liaskos[3]
[1] *Aristotle University of Thessaloniki (AUTH) (Greece),* [2] *National Hellenic Research Foundation (Greece),* [3] *Foundation for Research and Technology Hellas (Greece),* [4] *Fraunhofer IZM (Germany)*

We present our progress in developing tunable metasurfaces for microwave holographic imagingA*STARts from the analysis of ideal metasurface apertures and moves to tunable static prototypes designed for fabrication with cost-effective techniques, e.g., 3D printing or conductive inks. We envision to translate the proof-of-concept study, and associated devices, to printed circuit board technology, implementing practical reconfigurable metaholograms for wireless communications and VR/AR.

14:00 - 16:00 — Salle P2

Session 3A24

Quantum Light Emitters and Photonic Heterogeneous Integration

Organized by: Han Htoon and Galan Moody

Chaired by: Han Htoon and Galan Moody

14:00 : Invited talk

Localized Dipolar Excitons in 2D Semiconductors for Quantum Sensing of Correlated Electrons

Ajit Srivastava
Emory University (USA)

We report localized dipolar excitons as high-resolution quantum sensors of generalized Wigner crystals in WSe2/MoSe2/WSe2 heterotrilayer.

14:20 : Invited talk

Stimulated Emission from a Three-Level Quantum Ladder System

Eva Schöll[1], Björm Jonas[2], Friedrich Sbresny[2], Lukas Hanschke[1], Dirk Heinze[1], Patricia Kallert[1], Timo Langer[1], William Rauhaus[2], Bianca Scaparra[2], Katarina Boos[2], Eduardo Zubizarreta Casalengua[3], Hubert Riedl[2], Elena del Valle[3], Dirk Reuter[1], Stefan Schumacher[1], Jonathan J. Finley[2], Artur Zrenner[1], Kai Müller[2], Klaus D. Jöns[1]
[1] *Paderborn University (Germany),* [2] *TUM Munich (Germany),* [3] *Universidad Autonoma de Madrid (Spain)*

We investigate 3-level quantum ladder systems in optically active quantum dots and use additional stimulation lasers to tailor the emitted photons properties. We are able to realize highly indistinguishable photons and the on-demand generation of frequency tuned single-photons with polarization control.

14:40 : Invited talk

From flask to devices: Exceptionally functional colloidal quantum emitters and deterministic integration

E. Dolgopolova[1], E. G. Bowes[1], R. Rapaport[2], A. Piryatinski[1], H. Htoon[1], Jennifer Hollingsworth[1]
[1] *Los Alamos National Laboratory (USA),* [2] *The Hebrew University of Jerusalem (Israel)*

Colloidal quantum dots (cQDs) synthesized in simple laboratory flasks are finding real-world applications in demanding technologies from displays and lighting to photovoltaics and photodetectors. In the future, cQDs may be the basis for single-photon devices in quantum networks. Beyond quantum-size control, we pursue an expanded "structural toolbox"to synthetically engineer new quantum emitters with optimal photophysical properties.1-8 Taking advantage of their solution-phase processibility, we demonstrate deterministic, direct-write placement of the quantum emitters into photonic and plasmonic platforms using scanning-probe techniques.

15:00 : Invited talk

Integrated Quantum Dot Optomechanics

M. Weiss, D. Wigger, D. D. Bühler, E. D. S. Nysten, M. Choquer, M. Lienhart, B. Mayer, A. Vogele, A. Crespo-Povedo, K. Müller, J. J. Finley, A. Rastelli, T. Kuhn, P. Machnikowski, M. M. de Lima Jr., P. V. Santos, G. Moody, Hubert Krenner
University of Muenster (Germany)

Elastic waves and phonons are an indispensable resource for radio frequency signal processing. Recently, elastic waves have been recognized as versatile transducers between dissimilar quantum systems for hybrid quantum technologies. Here show recent advances including piezo-optomechanical wave mixing by a single quantum dot, acoustically regulated single photon emission or dynamic routing of on-chip generated single photons. Finally, we highlight how the governing acousto-optic interactions can be deliberately enhanced in heterogeneously integrated devices and nanophononic devices.

15:20 : Invited talk

Modeling exciton dynamics behind single-phonon emission by interacting solid-state defects

Andrei Piryatinski
Los Alamos National Laboratory (USA)

We discuss an open quantum system approach to model exciton dynamics within coupled multi-level states facilitating the spontaneous emission of quantum photons. Our goal is to establish a connection between statistics of emitted photons quantified by the two-photon correlation functions g(2), typically measured via the Hanbury Brown and Twiss (HBT) interferometry, and associated dynamics of the excitons. We apply these techniques to interpret experimental studies of single-photon emission properties of DNA-functionalized single-wall carbon nanotubes and indented MoS2-WSe2 2D layered heterostructures.

15:40 : Invited talk
Generating Quantum Emitters in 2D Semiconductors Using UV Light
Xuedan Ma
Argonne National Laboratory (USA)

In this work, we report an alternative approach for generating quantum photon sources in TMDs utilizingeasily accessible UV light. Combining the optical features of the UV-induced defects with density functional theory calculations, we attribute the quantum defects generated in vacuum to pristine sulfur vacancies, whereas those in air to oxygen-passivated defects.

Coffee Break

Session 3P2
Poster Session VI
16:00 - 16:40

P1: Nanolasing in Self-Assembled Metasurfaces
Tomas Tamulevicius[1], Mindaugas Juodenas[1], Nadzeya Khinevich[1], Domantas Peckus[1], Asta Tamuleviciene[1], Joel Henzie[2], Sigitas Tamulevicius[1]
[1] *Kaunas University of Technology (Lithuania),* [2] *National Institute for Materials Science (Japan)*

Plasmonic surface lattice resonance-based (SLR) nanolasers are attractive because of their small mode volumes and footprint, ultrafast dynamics, and good beam directionality. Underlying plasmonic nanocavities are usually produced by conventional lithography processes. We have developed a deposition method to arrange monodisperse, colloidal nanoparticles onto macroscopic, patterned substrates, otherwise metasurfaces, with a high assembly yield. Furthermore, we have shown that the SLR can drive the lasing modes from the fluorescence spectra of the organic dye when pumped with ultra-short laser pulses.

P2: Demonstration of an ultra-sharp bend in 1D grating waveguides based on inverse design
Ahmet Oguz Sakin, Ahmet Canberk Songur, Hasan Alper Gunes, Beyza Akcay, Mehmet Unlu
TOBB University of Economics and Technology (Turkey)

The design of sharp bends in 1D grating waveguides is a challenging problem as the Bloch mode profiles are being pushed towards the outer sidewall and becoming highly asymmetrical, as a result of the steep and high group velocity dispersion of the 1D grating waveguide. To overcome this problem, we propose a first-of-its-kind ultra-sharp bend design in an extensively corrugated 1D grating waveguide on silicon-on-insulator, based on pixelated metamaterials with an ultra-compact size of 2.1 x 2.2 μm2.

P3: Morphing design of Network of Beams to Maximize Absolute Bandgaps using Spectral Element Method
Theo Bonneval[1], Maxime Lanoy[2], Leonardo Sanches[1], Caroline Lyszyk[3], R. Tanays[3], Adrien Pelat[2], Guilhem Michon[1]
[1] *ISAE-SUPAERO (France),* [2] *Université du Mans (France),* [3] *Institut de Recherche Technologique Saint Exupéry (France)*

We propose a 3D lattice design (assembly of beams) that uses an optimization routine to generate forbidden frequency bands for all types of mechanical waves. The optimization step is performed using the Spectral Element Method (SEM) with a genetic algorithm. A specific example demonstrates the evolution of the unit cell structure over generations, resulting in a complete (relative to all wave polarizations) band gap opening. To verify the bandgap efficiency, wave propagation in an 8-unit cell periodic network is computed.

P4: Size-dependent Localized Surface Plasmon Resonance of Structures Prepared by Nanosphere

Lithography

Milad Karami, Lu He, Teresa Isabel Picoto Pena Madeira, Dietrich R. T. Zahn
Chemnitz University of Technology (Germany)

Nanosphere lithography (NSL), which is used to generate ordered two-dimensional periodic arrays of plasmonic nanostructures, is an inexpensive, versatile, intrinsically parallel, and high-throughput nanofabrication technique. Localized surface plasmon resonances (LSPRs) produced by MNPs offer essential application opportunities in photonics, electronics, and nanotechnology. The LSPR can be tuned by different methods, where changing the geometry of metal nanoparticles (MNP) provides a very diverse approach. We systematically studied the geometry dependence on LSPR produced by polystyrene beads of various sizes.

P5: Large area high-resolution nanostructure fabrication with focused ion beam for surface-enhanced Raman spectroscopy

Liga Bikse, Reinis Ignatans, Juris Prikulis, Annamarija Trausa, Krisjanis Smits
University of Latvia (Latvia)

The development of focused ion beam (FIB) has reached a point where its resolution and time-consumption are suitable for the fabrication of nanostructures. Various 100 nm diameter dumbbell-shaped pits were fabricated with FIB automation controlling the positions, depth, and gap of the dimer systems (Fig.1). Filling well-organized pits with gold nanoparticles (NP), can relieve whether random positioned NP can be a better solution for surface-enhanced Raman spectroscopy (SERS) than periodical positioned, and other related questions.

P6: Metasurface Augmented Camera for General Optical Metrology Applications

Arturo Burguete Lopez, Maksim Makarenko, Qizhou Wang, Fedor Getman, Andrea Fratalocchi
KAUST (Saudi Arabia)

We present a general optical metrology platform that employs an information processing metasurface as the means for the measurement of observables. The approach, consisting of combining an information processing metasurface with an off-the-shelf CMOS sensor, permits rapid characterization of the properties of materials in a cost-effective and mass-producible package. We present initial results on the fabrication of a prototype of this system.

P7: Spin-coating Based Nanosphere Lithography

Alejandro Descalzo Ruiz, Lu He, Teresa Isabel Picoto Pena Madeira, Dietrich R. T. Zahn
Technology University of Chemnitz (Germany)

Nanosphere lithography (NSL) is a straightforward, cost-efficient technique for creating plasmonic nanostructures with high precision. This work reviews the challenge of the NSL mask preparation by spin coating. The process parameters to achieve large, well-ordered monolayer areas covered by polystyrene (PS) nanoparticles with a diameter of 400 nm over a glass substrate are discussed. The results reveal that the surface coverage increases with decreasing spin velocity and acceleration in a certain range.

P8: Supercell Metasurfaces: Hierarchical Designs and Experimental Validation

Tatiana Contino, Michele Tamagnone
Italian Institute of Technology (Italy)

In this work, we demonstrate a new concept of metasurfaces based on a generalization of supercells. In general, these supercells consist of a series of unit cells that combine with each other to achieve a specific function. We present hierarchical supercells (supercells of supercells) and we extend supercells to general 2D Bravais Lattice, providing a simple mathematical framework to describe the resulting metagratings.

P9: Metasurface-enabled molecular spectroscopy and machine learning resolve lipid membrane photoswitching

Martin Barkey[1], Rebecca Buchner[1], Alwin Wester[1], Stefanie Pritzl[2], Maksim Makarenko[3], Qizhou Wang[3], Thomas Weber[1], Stefan A. Maier[4], Andrea Fratalocchi[3], Theobald Lohmuller[1], Andreas Tittl[1]
[1] Ludwig-Maximilians-Universtität Munchen (Germany), [2] Utrecht University (The Netherland), [3] King Abdullah University of Science and Technology (KAUST) (Saudi Arabia), [4] Monash University (Australia)

We present an integrated platform for ultrasensitive in-situ biospectroscopy by combiningall-dielectric pixelated metasurfaces and machine learning. Specifically designed metasurfaces with advancedsampling techniques probe the real-time dynamics of lipid membrane photoswitching in an aqueous environmentin the mid-infrared, overcoming sensitivity limitations and strong water absorption associated with conventionalin-

frared spectroscopy. Our platform combines metasurfaces, optofluidics, and artificial intelligence (AI) toextend the capabilities of dielectric metasurfaces for analyzing complex biological entities.

P10: Rotary metaswimmers powered by linearly polarized light
Mahdi Shanei, Einstom Engay, Vasilii Mylnikov, Mikael Käll
Chalmers University of Technology (Sweden)

Metasurfaces offer great possibilities to manipulate the momentum of light. Changes in linear optical momentum can result in forces and torques acting on a movable metaswimmer. Here, we demonstrate that by spatially distributing the changes in the linear momentum of light across the metasurface, these optomechanical effects can be utilized to generate optical torques able to rotate metaswimmers that are tens of micrometers wide in aqueous environments. We delineate the counterintuitive dynamics resulting from physical and hydrodynamic interactions between metaswimmers.

P11: Surface plasmon polaritons are not polaritons, and not plasmons either
Antoine Moreau
Université Clermont Auvergne (France)

The study of spatial dispersion has brought forward some difficulties in the way the community has named physical objects, sometimes describing guided modes using a vocabulary coming from solid state physics and quantum mechanics. The mode we call a surface plasmon polariton has not always been called so, and its properties do not correspond to those of a polariton or a even a plasmon. Spatial dispersion allows to bring more accurate answers to this problem.

P12: Aiming of water waves in a time-varying metabathymetry
Magdalini Koukouraki[1], A. Maurel[1], P. Petitjeans[1], V. Pagneux[2]
[1] *ESPCI (France),* [2] *Université du Mans (France)*

We investigate both analytically and numerically the two-dimensional propagation of shallow water waves over a time-varying medium, which switches from isotropic to anisotropic at a given time. The anisotropy is established with the abrupt appearance of a plate array at the fluid bottom, which changes the effective water depth in each direction in the long-wavelength limit. Depending on the wavenumber angle incident on the plate array, the angle of the energy flow will change, allowing us to deflect the wave.

P13: Stick-and-play nanoantenna stickers to control photoluminescence
Shunsuke Murai, TienYang Lo, Katsuhisa Tanaka
Kyoto University (Japan)

Nanoantenna stickers, where the periodic array of nanoparticles is embedded in an elastomer film, can be easily attached to and detached from the surface of target materials and work as nanoantenna to control light. The stickers can be fabricated by nanoimprint lithography followed by a transfer process. We make stickers consisting of the nanoantenna made of aluminum, silver, silicon or titania embedded in polydimethylsiloxane, and demonstrate a photoluminescence outcoupling by placing a sticker on luminous layers.

P14: Ion beam doping of phase-change materials: a platform for active metasurfaces
Martin Hafermann, Robin Schock, Annkathrin Köhler, Jacob Grandmontagne, Carsten Ronning
Friedrich Schiller University Jena (Germany)

Phase-change materials (PCMs) have emerged to serve as active media for tunable plasmonic and photonic devices. They provide the ability of reversible, repeatable, and rapid switching between amorphous and crystalline states accompanied with drastic changes in the electronic and photonic properties. Impurity doping by means of ion implantation can be used to tailor the crystallization kinetics of PCMs. Here, we demonstrate that spatially selective ion beam doping of PCMs can serve as a platform in designing active metasurfaces.

P15: Interlayer Exciton Lasing in Atomically Thin Heterostructures
Qiaoling Lin[1], Hanlin Fang[2], Yuanda Liu[3], Yi Zhang[4], Moritz Fischer[1], Juntao Li[5], Nicolas Stenger[1], Zhipei Sun[4], Martijn Wubs[1], Sanshui Xiao[1]
[1] *Technical University of Denmark (Denmark),* [2] *Chalmers University of Technology (Sweden),* [3] *A*STAR (Singapore),* [4] *Aalto University (Finland),* [5] *Sun Yat-Sen University (China)*

We present an interlayer exciton laser composed of a MoS2/WSe2 heterostructure integrated with a silicon photonic topological microcavity with a quality factor of up to 104. We achieve excitonic lasing with ultra-low threshold, high side-mode suppression ratio and the longest emission wavelength to the telecommunication

O-band.

P16: Enhancement of a single molecule triplet depopulation rate by a dielectric nanoantenna
Remigiusz Trojanowicz, Simon Vassant, F. Charra
Université Paris-Saclay (France)

In this work, we investigate the effect of a dielectric nanoantenna on a single Terrylene molecule's photon statistics. Nanoantenna increases the excitation intensity and local density of optical states (LDOS), affecting the rates at play in the fluorescence process. Compared to its plasmonic analog, a dielectric antenna introduces low background and no quenching. Experiments show that the nanoantenna increases the efficiency of pumping the lowest-energy triplet state into higher-level triplets by excitation field concentration.

P17: Engineering localised modes via drive and dissipation in photonic lattices
O. Jamadi[1], B. Real[1], K. Sawicki[2], C. Hainaut[1], A. Gonzalez-Tudela[3], N. Pernet[4], I. Sagnes[4], M. Morassi[4], A. Lemaitre[4], L. Le Gratiet[4], A. Harouri[4], S. Ravets[4], J. Bloch[4], Alberto Amo[1]
[1] *Université de Lille (France),* [2] *University of Warsaw (Poland),* [3] *CSIC (Spain),* [4] *Université Paris-Saclay (France)*

An efficient strategy to design localized modes in photonic structures is to use the interplay of constructive and destructive interference in periodic photonic lattices. Here, we show experimentally that in lattices of lossy resonators, the addition of external optical drives with a controlled phase enlarges the possibilities of manipulating interference effects and allows for the design of novel types of localized modes with footprints down to a single site.

P18: Improvement of photoluminescence quality of MoS2 monolayers by an atomic hydrogen beam
Mahan Bakhshikhah, Jiri Liska, Sayed Hossein Mirdamadi Khouzani, Ondrej Cervinka, Jindrich Mach, Miroslav Kolibal, Tomas Sikola
Brno University of Technology (Czech Republic)

Thin and tiny metasurface-based flat optics based on exciton resonances can be used as the replacement for bulky optical elements to develop tuned nanophotonic structures. We present that the optical response of this type of metasurface can be enhanced by improving the photoluminescence properties of their semiconducting building blocks made of a MoS2 monolayer by their treatment using an atomic hydrogen beam source.

P19: BSW-based transducer for surface mode polarization control
Erika Mogni[1], Giovanni Pellegrini[2], Jorge Gil-Rostra[3], Francisco Yubero[3], Giuseppina Simone[4], Stefan Fossati[5], Jakub Dostalek[5], Rebeca Martinez Vasquez[6], Roberto Osellame[6], Michele Celebrano[1], Marco Finazzi[1], Paolo Biagioni[1]
[1] *Politecnico di Milano (Italy),* [2] *University of Pavia (Italy),* [3] *CSIC-Universidad de Sevilla (Spain),* [4] *Northwestern Polytechnical University (China),* [5] *Austrian Institute of Technology (Austria),* [6] *IFN-CNR (Italy)*

We manufacture and evaluate the optical performance of a novel optical transducer that allows uniform surface-enhanced fields for sensing through the excitation of Bloch Surface Waves (BSWs). The aim is to attain the coherent superposition of TE and TM dispersion relations of BSWs that is essential to provide "superchiral"fields over a wide spectral range (down to the UV). The resulting BSW-based transducer paves the way to the implementation of polarization-resolved surface-enhanced techniques.

P20: Nanophotonic chiral sensing: How does it actually work?
Shaikhah Almousa[1], Harald Giessen[2], Steffen Both[2], Egor Muljarov[1], Diana Shakirova[3], Thomas Weiss[3]
[1] *Cardiff University (United Kingdom),* [2] *University of Stuttgart (Germany),* [3] *University of Graz (Austria)*

We present a general and rigorous theory of chiral light-matter interactions in arbitrary optical resonators. Our theory describes the chiral interaction as a perturbation of the resonant states, also known as quasi-normal modes. We observe two dominant contributions: A chirality-induced resonance shift and changes in the modes' excitation and emission efficiencies. Our theory brings new and deep insights for tailoring and enhancing the chiral light-matter interactions. Furthermore, it allows to predict spectra much more efficiently in comparison to conventional approaches.

P21: Dielectric metalens and polarization beam splitter for UV wavelengths
Beáta Idesová, Katarina Rovenska, Ondrej Cervinka, Martin Hrton, Filip Ligmajer, Tomas Sikola
Brno University of Technology (Czech Republic)

Conventional optical elements used nowadays are usually bulky and heavy, while metasurfaces offer a pro-

mising solution allowing for miniaturization and multifunctionality. In this work, we use hafnium dioxide (HfO2) for its high index of refraction and wide bandgap, both of which allow for fabrication of dielectric metasurfaces even for deep-UV wavelengths. We present a metalens and polarization beam splitter composed of high aspect-ratio nanopillars and analyze their functionality for wavelengths of 325 nm and 266 nm.

P22: Circular dichroism in plasmonic array of elliptical nanoholes with square lattice
Hanan Ali[1], Emilija Petronijevic[2], Giovanni Pellegrini[1], Concita Sibilia[2], Lucio Andreani[1]
[1] *University of Pavia (Italy),* [2] *Sapienza University of Rome (Italy)*

We numerically studied the chiral properties of square 2D elliptic nanohole arrays in three different metallic metasurfaces (Ag, Au, and Al), from the near-infrared to the ultraviolet spectral range. Circular dichroism arises in absorption spectra at the same wavelength region of extraordinary optical transmission. We elucidate the physical origin of absorption CD and we optimize the CD as a function of the geometrical parameters of the structure. The results suggest interesting applications for chiral biomolecule sensing.

P23: Cross-wavelength Metasurface Based on Carbon Nanotubes
Jin Zhang, Peng Liu, Zhipei Sun
Aalto University (Finland)

Multifunctional metasurfaces have garnered significant interest from both academia and industry in the past decade. However, achieving cross-wavelength functionalities remains a challenge due to the strong dispersion of passive materials. In this study, we propose a novel concept of cross-wavelength metasurface that integrates various functionalities with multispectral channels. As proof of concept, we demonstrate optical transparency, Thz diffusion and microwave selectivity simultaneously in a carbon nanotube based metasurface through a laser micromachining technique.

P24: A characterization method for an achiral magnetic photonic antenna with arbitrary excitation
Lingfei Cui, Xingyu Yang, Catherine Schwob, Mathieu Mivelle, Bruno Gallas
Sorbonne Universite (France)

The interaction between chiral materials and light at the nanoscale, can be controlled and optimized by using nano-antenna. However, understanding the properties of the near field of a nano-antenna requires extensive numerical simulations where the polarization and excitation wavelength can be varied. We propose a matrix method based on the Jones decomposition of the polarization to evaluate the vectorial properties of the electromagnetic near field of an antenna.

P25: Band gap tuning based on adjustable stiffness of local resonators
Hossein Alimohammadi[1], K. Vassilyeva[1], H. Hosseinnia[2], E. Petlenkov[1]
[1] *Tallinn University of Technology (Estonia),* [2] *Delft University of Technology (The Netherlands)*

This research explores the feasibility of using a cantilever-type resonator beam to achieve tunable and real-time control of vibration suppression. By varying the center of mass of the attached masses, the bandgap and transmittance response can be significantly impacted. The results suggest potential for improving resonator performance and optimizing metamaterial beams for vibration suppression applications.

P26: Flexible metamaterial microwave absorbers with polymer nanocomposite as substrates
Murugan Anjali, Kumaran Rengaswamy, Abhishek Ukey, Lincy Stephen, Chitti Venkata Krishnamurthy, Venkatachalam Subramanian
Indian Institute of Technology Madras (India)

In this work, we have demonstrated metamaterial absorbers operating at 9.88 GHz using novel epoxy/graphene nanoplatelets composites (E-GnP) as substrates. The substrate is systematically studied for different weight percentages of GnP in epoxy, which could result in variation of dielectric constant as well as loss tangent and hence the enhancement of bandwidth. Owing to the flexibility of the substrate, the metamaterial absorber could cater to conformal applications.

P27: Epsilon near zero metasurfaces (ENZ) at visible wavelengths
Iman Alhamdan, S. A. Schulz
University of Saint Andrews (United Kingdom)

Here we present an Epsilon near zero (ENZ) metasurface in the visible range using a multilayer structure of silicon oxide (SiO2), gold nanoantenna, and Indium tin Oxide (ITO). ITO is an ENZ material with distinguished optical properties and can control antenna resonances. Finite difference time domain (FDTD) simulations

show high efficiencies for the proposed design in transmission and reflection modes. Our metasurface has promising potential for augmented reality and chemical sensing due to the flexibility of ITO's plasma frequency.

P28: Directional emission enhancement measurements in terahertz photonic crystals
Kseniia Lezhennikova[1], Sahand Mahmoodian[2], Boris Kuhlmey[2], Redha Abdeddaim[1], Stefan Enoch[1], Martijn de Sterke[2], Alessandro Tuniz[2]
[1] *Aix Marseille Université (France),* [2] *The University of Sydney (Australia)*

We measure near-field directional emission in a terahertz photonic crystal slab near its quasi-TM band edge. We find that the direction of the emitted field dramatically differs for two neighbouring channels (0.445 THz and 0.465 THz) due to the underlying band structure, in agreement with simulations. We also find that the field is enhanced on the slab surface indicating a concentration of radiation. This platform has potential applications in alignment-free, chip-based 6G technologies.

P29: Active metasurface using Ag/ITO nano antenna for visible wavelength
Chi-Sun Hwang, Yong Hae Kim, Jong-Heon Yang, Joo Yeon Kim, Kyunghee Choi, Jaehyun Moon, Ji Hun Choi
Electronics and Telecommunications Research Institute (Korea)

We propose double line nano antenna structure for the purpose of complex modulation in visible wavelength. RCWA simulation results show that the nano antenna with Ag/ITO outperform the stacked structure in that case the modulated active layers are vertically stacked.

P30: Temporal modulation of Bound States in the Continuum at Mid-IR wavelengths
Saurabh Kishen, Poludasu Sahaan, Jinal Tapar, Naresh Kumar Emani
Indian Institute of Technlology Hyderabad (India)

The physics of time-varying media as a means of wave manipulation has resulted in the demonstration of several novel phenomena such as magnetic-free non-reciprocity, photonic time crystals, etc., to name a few. Here, we numerically demonstrate the excitation of BIC in a silicon metasurface without breaking the symmetry of the structure. By sinusoidally modulating the refractive index in time, using experimentally realizable parameters, we show the excitation, dynamic tuning, and restoration of BIC in mid-IR.

P31: Label-Free Protein Detection based on Surface-Enhanced Infrared Absorption Spectroscopy with vertical Nanogap
Mingyun Kim, Dohyun Kang, Jongwon Lee, Joo-Yun Jung
KIMM (Korea)

The COVID-19 pandemic increased the need for accurate and rapid detection of biomolecules, leading to the development of immunoassay-based biosensors. While label-binding can be time-consuming and costly, Label-free and highly sensitive biosensors using Mid-IR molecular fingerprint have been explored. Surface-Enhanced Infrared Absorption spectroscopy has emerged to enhance and measure vibrational modes in small amounts of analyte, and a metamaterial absorber was developed to increase the sensing area and enhance the SEIRA signal. SEIRA spectroscopy has the potential for biosensing device.

P32: Surface absorbers for thermomechanical bolometers
Benedetta Bertoni[1], Leonardo Vicarelli[2], Simone Zanotto[2], Stefano Roddaro[1], Alessandro Tredicucci[1], Alessandro Pitanti[2]
[1] *Università di Pisa (Italy),* [2] *CNR Istituto Nanoscienze (Italy)*

Thermomechanical bolometers based on high-quality mechanical resonators are a promising technology for broadband light detection. Further functionalities can be added by controlling the absorption spectrum of the devices. To this end, we embedded (almost-) 2D layers, minimally impacting the mechanical quality while, at the same time, offering strong absorbance. Further layer patterning could grant resonant absorption, for hyperspectral imaging or polarization sensitive detection.

P33: Chiral photothermal effect induced by plasmonic metasurface for fluid motion *online*
Peng Yu[1], Alexander Govorov[2], Zhiming Wang[1]
[1] *University of Electronic Science and Technology of China (China),* [2] *Ohio University (USA)*

The plasmonic photothermal effect can be used as an efficient heat source due to enhanced light-matter interaction. This talk will introduce recent advances in plasmonic photothermal effect-driven motion. Also, we will discuss the chiral photothermal effect and chiral optofluidics induced by chiral plasmonics.

P34: Exploring Propagation Characteristics of Ga:ZnO Thin Films in the Epsilon-near-zero Region *online*

Ranjeet Dwivedi, Dorota A. Pawlak
ENSEMBLE3 (Poland)

We examined the propagation characteristics of Ga:ZnO (GZO) thin films in the epsilon-near-zero (ENZ) region, revealing a novel non-radiating TM mode with strong field enhancement. We also explored a multilayer structure of GZO layers in a ZnWO4 matrix, which exhibits strong polarization selectivity and resonant absorption. The spectral location and bandwidth of absorption could be adjusted by carefully selecting the GZO layer thickness and geometrical parameters. Our results offer promising possibilities for developing ENZ-based devices with enhanced functionality and tunability.

P35: Photonic nanojet enhanced Raman scattering: A new platform for Raman nanoscopy *online*

Gour Mohan Das, Piotr Paszke, Katarzyna Sadecka, Dorota A. Pawlak
Ensemble3 (Poland)

This study proposes a novel technique for enhancing Raman scattering signal using a combination of a single dielectric microsphere attached to a stem and confocal Raman microscopy. The technique involves directing laser through the glass microsphere to generate a photonic nanojet, a narrow-focused, non-evanescent, and highly intense electromagnetic beam with subwavelength lateral sizes, and obtaining Raman spectra. The method was tested on Bi2O3-Ag substrate, and an enhancement factor of $\sim$90 was observed for the γ phase of Bi2O3.

P36: Bound states in the continuum in the waveguide structure covered by the 2D-rectangular plasmonic lattice *online*

Sergey Pavlov[1], S. A. Dyakov[2], D. P. Markov[1], S. A. Grudinkin[1], N. A. Feoktistov[1], A. B. Pevtsov[1]
[1] *Ioffe Institute (Russia),* [2] *Skolkovo Institute of Science and Technology (Russia)*

In this work, we study the optical properties of the a-Si0.65C0.35:H-based planar waveguide structure covered by a 2D array of gold nanodisks. The rectangular lattice of nanodisks allows controlling the wavelength of the TE and TM guided modes resonances separately and the single nanodisk size supports localized plasmon resonance. We show that the structure possesses different types of BICs which are the result of the interaction of guided modes and single-particle resonances.

P37: Reciprocity Violation in Time-Modulated Structures for Enhanced Optical Heating *online*

Valeriya Levkovskaya, A. V. Kharitonov, S. S. Kharintsev
Kazan Federal University (Russia)

In recent years, resonant nanostructures have been demonstrated that are capable of absorbing $> 99\,\%$ of incident light in the wide spectral range. However, the photo-heating efficiency observed in these structures is low, which is due to processes of heat diffusion and thermal radiation. These processes can be substantially suppressed by violating the reciprocity. For this purpose, we propose thermophotonic nanostructures, whose optical and thermal properties are simultaneously modulated in time.

P38: Metamaterials with Temporal Inhomogeneity for Analog Optical Computing *online*

Anton Kharitonov, Aidar Minibaev, S. S. Kharintsev
Kazan Federal University (Russia)

In recent years, there has been a growing interest in metamaterials that a capable of performing mathematical operations on the optical signals. However, this concept requires a complicated distribution of spatial inhomogeneities, which hinders its practical applications. Here, we propose an approach for analog optical computing using spatially uniform systems. For this purpose, we leverage novel regimes of light-matter interactions arising in time-varying media. The target operation is achieved by controlling the Fourier amplitudes through the effect of wave amplification/attenuation.

P39: Tuning of Fano resonance in mirrored array of split ring resonators *online*

Dalius Seliuta, Andrius Kamarauskas, Gediminas Slekas, Zilvinas Kancleris
Center for Physical Sciences and Technology (Lithuania)

Fano-type resonances in arrays of mirror-symmetric planar split-ring resonators (SRRs) are investigated using frequency-domain terahertz spectroscopy, numerical simulations, and analytical modeling. Special attention is paid to the guided substrate modes, which are responsible for the excitation of Fano-type peaks in the far-field transmission spectra. We find that the number, frequency, and amplitude of Fano resonances can be

effectively tuned by varying the substrate thickness and array period.

P40: Nonlinear 2D Photonic Crystal Tunable Switch *online*
Amel Bounouioua, Ahlem Benmerkhi, M. Bouchemat
Frères Mentouri Constanine1 University (Algeria)

We explored the effect of different tuning parameters in a 2D photonic crystal structure for all-optical switching based concept. The design based on a defect nonlinear ring resonator in a square lattice of silicon rods in air background is analyzed numerically. The outcomes of this investigation reveal very interesting switching characteristics by fitting the radius and position of the rods surrounding the center of the resonator. Furthermore, the device has multi-wavelength operation regime and fast response time with compact size.

P41: Manipulating the Modes of Radially Symmetric Resonators *online*
James Capers[1], Dean Patient[1], Stephen Boyes[2], Alastair Hibbins[1], Simon Horsley[1]
[1] *University of Exeter (United Kingdom),* [2] *DSTL (United Kingdom)*

The frequency response of a resonator is governed by the locations of its quasi-normal modes (QNMs) in the complex frequency plane. The real part of the QNM determines the resonance frequency and the imaginary part determines the width of the resonance. For applications such as energy harvesting and sensing, the ability to manipulate the frequency, linewidth and multipolar nature of resonances is key. Here, we present a simple analytical tool to control the location and polarity of radially symmetric resonators.

P42: Silicon metalens using Fresnel zone plate with subwavelength gratings *online*
William Fraser, Winnie Ye
Carleton University (Canada)

Beam focusing metalenses have become an enabling technology for flat optic-integrated imaging and free-space communication systems. Traditional metalenses comprised of periodically arranged subwavelength building blocks rely on custom fabrication practices. We present a 500 nm silicon-on-insulator-compatible metalens based on the Fresnel zone plate capable of subwavelength focusing with a peak efficiency of 42.7 % over a 389 nm bandwidth in the C-band.

16:40 - 18:30 — Grand Amphi

Session 3A25

Plasmonic Nanomaterials for Bio-Diagnostics, Environmental Monitoring and Food Safety

Organized by: Lucia Petti and Massimo Rippa

Chaired by: Lucia Petti and Massimo Rippa

16:40 : Keynote talk
Plasmonic biosensors for biomedical applications
T. Springer, M. Bocková, J. Slaby, E. Hemmerová, Jiri Homola
Czech Academy of Sciences (Czech Republic)

Optical biosensors hold potential for applications in numerous important areas. Herein, we discuss the main challenges in developing plasmonic biosensors for applications in biomedicine and present selected advances in biosensor research that aim to address these challenges. We cover advances in plasmonic nanostructures, sensor instrumentation, transport of target molecules in microfluidic systems, functional coatings, and detection assays. We also highlight applications of plasmonic biosensors related to the investigation of biomolecular interactions related to Alzheimer's disease and diagnosis of Myelodysplastic syndromes.

17:10 : Invited talk
Portable Microfluidic Plasmonic Chip for Fast Real-Time Cardiac Troponin I Biomarker Detection
Andreea Campu[1], Ilinca Muresan[1], Monica Potara[1], Diana Lazar[2], Florin Lazar[2], Simona Cainap[2], Dana Maniu[1], Simion Astilean[1], Monica Focsan[1]

[1] *Babes-Bolyai University (Romania),* [2] *University of Medicine and Pharmacology (Romania)*

Acute myocardial infarction is the most serious cardiovascular illness, threatening human lives for decades. Its fast diagnosis can considerably improve the patient's prognosis as well as survival, thus a great amount of effort is directed to the development of biosensing technologies, which are able to efficiently and accurately detect the cardiac troponin biomarkers, the gold standard in detecting myocardial injury. Therefore, we developed a microfluidic plasmonic chip for the fast and accurate real-time detection of the cardiac troponin I biomarker.

17:30 : Invited talk

Optomechanical disk resonators for real-time environmental monitoring and single-nanoparticle detection

Elena Sentre-Arribas[1], Eduardo Gil-Santos[1], Oscar Malvar[1], Jose Jaime Ruz[1], Samantha Sbarra[2], Louis Waquier[2], Aristide Lemaître[3], Maurits van der Heiden[4], Robert Altmann[4], Dimitris Papanastasiou[5], Diamantis Kounadis[5], Ilias Panagiotopoulos[5], Ivan Favero[4], Montserrat Calleja[1], Javier Tamayo[1]

[1] *CSIC (Spain),* [2] *Université Paris-Cité (France),* [3] *Université Paris-Saclay (France),* [4] *Netherlands Organization for Applied Scientific Research (The Netherlands),* [5] *Fasmatech Science and Technology (Greece)*

Optomechanical resonators have been successfully applied on a variety of sensing applications. Here we-propose combining the optical and mechanical signals provided by this kind of devices, in order to increase theirsensitivity and reliability. In particular, we use nano optomechanical disks fabricated out of GaAs. They support highquality optical and mechanical modes that allow for high accuracy measurements. First, we apply the dual sensingtechnique for monitoring environmental changes. Then, we focus on the detection of single nanoparticles.

17:50 : Invited talk

Plasmonic nanomaterials for detection and degradation of pesticedes.

Alexa Guglielmelli[1], R. Mazzei[2], G. Palermo[1], P. Strangi[1], L. Giorno[2], T. Poerio[2]

[1] *University of Calabria (Italy),* [2] *CNR-ITM (Italy)*

Organophosphate pesticides are neurotoxic compounds, widespread in the environment due to agricultural. They are a major cause of cancer and neurological diseases such as Alzheimer's and Parkinson's. Their detection in food and in the environment requires complex and expensive equipment. This has sparked growing interest in developing multifunctional platforms that can both detect and detoxify these hazardous agents. In this work we present a Poly (dimethylsiloxane) - gold nanoparticles composite thin film for detection and degradation of organophosphorus neurotoxins.

18:10 : Invited talk

Plasmonic Metasurface for Enhanced Infrared Spectroscopy: a method to monitor protein denaturation

Valentina Di Meo[1], Gennaro Sanita[1], Massimo Moccia[2], Alessio Crescitelli[1], Annalisa Lamberti[3], Vincenzo Galdi[2], Ivo Rendina[1], Emanuela Esposito[1]

[1] *CNR-ISASI (Italy),* [2] *University of Sannio (Italy),* [3] *University of Naples "Federico II"(Italy)*

Surface-Enhanced InfraRed Absorption (SEIRA) spectroscopy is a powerful tool to overcome the limitation offered by the standard IR spectroscopy in the case of very small amount of analyte to be detected. Our platform relies on a plasmonic metasurface engineered to exhibit different resonances covering the infrared region of the electromagnetic spectrum (EM). We demonstrate the ability of such device to monitor a denaturation biological process over a dehydrated monolayer of protein A, with a detection limit of about 3 fmol.

16:40 - 18:40 — Amphi Bezier

Session 3A26

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Cristian Ciracì

16:40 : Invited talk

Characterization of Nano-grating Profiles using Standard Ellipsometry and Deep Neural Networks

Zijie Jiang, Wen-Di Li
The University of Hong Kong (China)

In-situ measurement of nano-grating profiles is of great importance in the semiconductor industry. We propose a new method based on deep neural networks and gradient descent method to fully reconstruct the profile of nano-gratings using standard ellipsometry data (i.e., ψ and Δ) rather than commonly used Muller matrix ellipsometry. A wide range of samples of fabricated by wafer-scale interference lithography were used to train and test our model with promising performance for fast, non-destructive, and in-situ characterization of nanostructure profiles.

17:00 : Invited talk

Bound States in the Continuum with High Q-factors in Deep Ultraviolet Light Source

Omar A. M. Abdelraouf[1], Aravind P. Anthur[2], Xiao Renshaw Wang[1], Qijie Wang[1], Hong Liu[2]
[1] *Nanyang Technological University (Singapore),* [2] *A*STAR (Singapore)*

Traditional deep ultraviolet (DUV) light sources using nonlinear optical crystals exhibit limitations such as bulky size, inadequate efficiency, and requirement of phase-matching conditions. We proposed a crystalline silicon metasurface with symmetry breaking, which can excite bound states in the continuum (BIC) resonance to enhance third harmonic generation (THG) at the DUV regime. We experimentally realized a high Q-factor of $\sim$ 180 and the measured THG power is around 200 pW at a pump power of 200 mW.

17:20 : Invited talk

Fluid-coupled Lamb waves for self-assembling three-dimensional photonic crystals

Y.-H. Chen[1], Y.-M. Huang[1], P.-K. Tsai[1], M.-H. Li[1], J.-S. Chen[2], Yu-Bin Chen[1]
[1] *National Tsing Hua University (Taiwan),* [2] *National Cheng Kung Universit (Taiwan)*

Fluid-coupled Lamb waves (LWs) were proposed to facilitate the self-assembling of three-dimensional (3D) photonic crystals (PCs). Numerical models were constructed for proof-of-concept, and a fabrication set-up was developed for experimental demonstration. LWs were initially generated by a piezoelectric substrate. A couplant altered the propagating direction of these LWs to form the fluid-coupled LWs at a superstrate. The coffee-ring effect (CRE) of a suspension droplet on the superstrate was thus suppressed. Diversified PCs were fabricated using the developed set-up.

17:40 : Invited talk

Ultrafast nanophotonics: from all-optical control of exciton dynamics towards plasmon-tailored nano-chemistry and information processing based on cavity-electrodynamics

Nicolò Maccaferri
Umea University (Sweden)

Light as information career can revolutionize how we store and process information. At the same time, nanoscale confinement of electromagnetic fields can change the way we approach photo-chemical reactions and electronic energy landscapes. This rich potential can pave the way to develop new hardware enabling faster and more energy-efficient computing schemes, thus contributing to the raise of photonic quantum nanotechnologies.

18:00 : Invited talk

Topological polaritonics with organic materials

Dmitry Solnyshkov[1], J. Ren[2], Y. Li[3], O. Bleu[1], J. Yao[4], C. Leblanc[1], T. Long[1], X. Ma[5], S. Schumacher[5], J. De[2], F. Yin[4], F. Li[3], H. Fu[2], G. Malpuech[1], Q. Liao[1]
[1] *University Clermont Auvergne (France),* [2] *Capital Normal University (China),* [3] *Xi'an Jiaotong University (China),* [4] *Tianjin University (China),* [5] *University of Paderborn (Germany)*

Organic materials exhibit excitonic resonances capable of showing strong light-matter coupling at room temperature. We present a review of our recent results on organic microcavities with 3 different materials (perylene, DPAVBi, and TTPSB polymers). We demonstrate emergent optical activity (equivalent to Rashba-Dresselhaus spin-orbit coupling) leading to the formation of topological valleys capable of helical lasing, and selective strong coupling creating exceptional points. We also demonstrate ultrafast switching between bands, enhancing the polariton interactions by an applied electric field.

18:20 : Invited talk

Importance of Metric Learning and Manifold Learning in Knowledge Discovery and Inverse Design of Nanophotonic Structures

Mohammadreza Zandehshahvar, Muliang Zhu, Mohammad Hadighehjavani, Ali Adibi
Georgia Institute of Technology (USA)

We discuss the importance of manifold-learning algorithms in reducing the dimensionality of the nanophotonic design problems while enabling the better visualization of their input-output relation. This can be helpful in forming least complex structures for a given response while also uncovering subtle details about the physics of light-matter interaction. We also show the importance of metric learning in the efficacy of the manifold-learning algorithms and empowering them to distinguish different classes of responses while preserving important response features.

16:40 - 18:40 — Amphi Fournel

Session 3A27

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Oleksandr Serha

16:40 : Invited talk

Spin-orbit Coupling and Topology of Optical Fields in Metamaterials

Vittorio Aita, Diane Roth, Alexey Krasavin, Anatoly Zayats
King's College London (United Kingdom)

We will discuss spin-orbit coupling manifestations in interaction of complex vector beams with plasmonic metamaterials. Spin-orbit coupling and topology of evanescent waves and vector beams propagating in epsilon near-zero metamaterials will be considered.

17:00 : Invited talk

Quantum theory of magnetic quadrupole moment and its relation to orbital magnetoelectric effect

Nobuhiro Arai, Yang Gao, Di Xiao, Shuichi Murakami
Tokyo Institute of Technology (Japan)

We find that the known formula for the orbital magnetic moment misses a term in its diagonal elements. In this work, by considering a response to the magnetic fields including a monopole, we derive a modified formula for the magnetic quadrupole moment. We show that the trace of the magnetic quadrupole moment now has the Chern-Simons axion term, as expected from the relationship between the orbital magnetic quadrupole moment and the orbital magnetoelectric tensor.

17:20 : Invited talk

Orbital angular momentum of light creates exotic chiral structures

Takashige Omatsu
Chiba University (Japan)

We here in report on the demonstration of chiral engineered optical materials, including chiral crystallization of NaClO3, galaxy-shaped reliefs of azopolymers with spiral arms, and self-written helical fibers, by the illumination of light fields possessing orbital angular momentum.

17:40 : Invited talk

Optical interface for a hybrid magnon-photon resonator

Eyal Buks
Technion (Israel)

We study magneto-optical coupling in a ferrimagnetic sphere resonator made of Yttrium iron garnet. Methods to manipulate quantum entanglement induced by light-matter interaction are explored.

18:00 : Invited talk
Driving and imaging achiral-to-chiral transitions in an all-optical setup
E. Binns, J. Terentjevas, L. Rego, David Ayuso
Imperial College London (United Kingdom)

We show how to imprint chirality into achiral matter using tailored light, and how to monitor such achiral-to-chiral phase transitions in an all-optical setup. Our proof-of-principle simulations reveal that the hydrogen atom undergoes ultrafast and nonlinear chiral electron dynamics when exposed to a locally chiral laser pulse, giving rise to chiral high harmonic generation. Furthermore, the atom remains in a chiral superposition of stationary states after the pulse is gone, emitting chiral free-induction decay radiation which reveals the imprinted handedness.

18:20 : Invited talk
Nonreciprocal Magneto-optical Metasurfaces
Weihao Yang, Shuang Xia, Jun Qin, Longjiang Deng, Lei Bi
University of Electronic Science and Technology of China (China)

Unconstrained by Lorentz reciprocity, nonreciprocal metasurfaces may provide unique functionalities with distinctive characteristics for forward and backward electromagnetic wave propagation. In this work, we report our recent progress on nonreciprocal metasurfaces based on magnetic meta-atoms, demonstrating nonreciprocal phase gradient, magnetic bias free properties and anomalous magneto-optical effects.

16:40 - 18:35 — Amphi Esquillan

Session 3A28

Thermal Plasmonics and Metamaterials for Sustainable Society

Organized by: Junichi Takahara and Kotaro Kajikawa

Chaired by: Junichi Takahara and Kotaro Kajikawa

16:40 : Invited talk
Spectrally selective infrared emitters enabled by 1D metamaterials
Yongkang Gong, Sang Soon Oh
Cardiff University (United Kingdom)

We propose a new type of integrated and electrically controlled infrared emitter that exploits 1D dielectric/metallic multilayers. We design a multilayer system with a large photonic bandgap at the visible wavelengths and negligible reflection at the infrared wavelengths. Here, we experimentally demonstrate significantly enhanced emission at the broad infrared wavelengths of 1.4-14μm as well as strongly suppressed emission in the visible region.

17:00 : Invited talk
Si Plasmonic MEMS device for infrared sensing
Masaaki Oshita, Elyas Ashenafi Abadi, Tetsuo Kan
The University of Electro-Communications (Japan)

When a metallic structure is formed on a semiconductor surface, the hot electrons in the metal excitedby surface plasmon resonance (SPR) are extracted as an electric current. This method makes it possible tomeasure SPR by electric current in spacially limited situations. This sensing method can thus be integrated intoMEMS (Micro Electro Mechanical Systems) to create attractive devices.

17:20 : Invited talk
Fabrication of metasurfaces for heat-shielding windows and 6G communications and investigation of the possibility of near-infrared reflection control by movable thin films
Yoshiaki Kanamori
Tohoku University (Japan)

Metasurfaces for heat-shield windows which transmit visible wavelengths and reflect near-infrared (NIR) wa-

velengths for sun light were designed and fabricated. Transmittance of terahertz waves assumed for 6G communications was measured. Moreover, by combining the metasurfaces with movable thin-films, reflectance switchable filters that could change reflectance at NIR wavelengths whereas there was little change in visible wavelengths were designed. It can be expected to be used as smart glasses that control transmittance of the thermal wavelengths in summer and winter.

17:40 : Perfect Absorbers and Photothermal Control of Light by Single Crystalline Silicon Metasurface
Junichi Takahara
Osaka University (Japan)

Perfect absorbers (PAs) play crucial roles for energy saving towards sustainable society. Recently, all-dielectric PA metasurfaces have been demonstrated by degenerate critical coupling. In this talk, I present recent progress of our studies about single-crystalline silicon metasurface PAs operating from visible to near-infrared region by using electric/magnetic dipoles, quadrupoles excited in silicon Mie resonators. In addition, I demonstrate scattering control of light by photothermal effects in Huygens' metasurface.

17:55 : Invited talk
Optical magnetic field distribution imaging using a single-gap, crescent-shaped metal split-ring resonator
Toshihiro Okamoto, K. Takabatake, K. Yamaguchi, M. Haraguchi
Tokushima University (Japan)

When a previously invisible physical quantity becomes observable, it opens the way to the discovery and elucidation of new physical phenomena. This has advanced science and technology and contributed to the development of society. Since the interaction between the optical magnetic field and matter is small, the optical magnetic field has not been observed. We have enabled optical magnetic field imaging by utilizing the magnetoelectric effect of single-gap split-ring resonator(SRR) that exhibits magnetic resonance at optical wavelengths.

18:15 : Invited talk
Material systems for metamaterial based selective thermal emitters
Eich Manfred[1], G. V. Krishnamurthy[2], M. Störmer[2], A. Yu. Petrov[1]
[1] *Hamburg University of Technology (Germany),* [2] *Helmholtz-Zentrum Hereon (Germany)*

High temperature stable thin film multilayers of metal and dielectric materials are important as selective emitters for thermophotovoltaics (TPV). We will present structured material systems from W, Ir, and HfO2 and discuss degradation mechanisms.

16:40 - 17:40 — Amphi A

Session 3A29

Metasurfaces for Light Control Emission

Organized by: Braulio García-Cámara and Ángela Barreda Gómez

Chaired by: Braulio García-Cámara and Ángela Barreda Gómez

16:40 : Invited talk
Structure dependent photoluminescence of colloidal PbS quantum dots in low refractive index dielectric 3D infrared metamaterials
Angelos Xomalis[1], Lorenzo J. A. Ferraresi[2], Oriol P. de G. Busquests[1], Krzysztof Mackosz[1], Dmitry N. Dirin[2], Ivo Utke[1], Johann Michler[1], Maksym V. Kovalenko[2], Jakob Schwiedrzik[1], Ivan Shorubalko[1]
[1] *Swiss Federal Laboratories for Materials Science and Technology (Switzerland),* [2] *ETH Zürich (Switzerland)*

Colloidal quantum dots (QDs) have been used for their size-dependent optoelectronic properties for broadband detection of light. Photoluminescence (PL) enhancement requires plasmonic structures or high-refractive-index dielectric metamaterials. We instead report on a 1600 % structure-dependent PL enhancement through low-refractive-index ZnO-coated laser-printable 3D infrared metamaterials. The metamaterial structure

is used to enhance interaction between light and PbS QDs. Through conformal QD coating over complex surfaces of 3D structures, this work opens new avenues for colloidal QDs in optoelectronic and nanophotonic applications.

17:00 : Invited talk
Approaching the thin-film absorption limit with monolayer semiconductor superlattices
Sara Elrafey[1], **Lennart M. Heijnen**[1], **Rasmus H. Godiksen**[1], **Alberto G. Curto**[2]
[1] *Technische Universiteit Eindhoven (The Netherlands),* [2] *Ghent University (Belgium)*

Strongly absorbing materials are needed for nanoscale optoelectronics and strong light-matter coupling applications. The absorption limit of ultrathin films is 50 %. The strong excitonic resonance in monolayer WS2 provides 16 % absorptance. Here we demonstrate that monolayer WS2 superlattices provide higher absorption while preserving the exciton emission. We show that an artificial superlattice structure increases absorptance to 37 %. Our results put forward superlattices as a platform for developing novel two-dimensional semiconductor devices.

17:20 : Invited talk
Light source engineering of directive photoluminescent metasurfaces with the local Kirchhoff's law
Elise Bailly, J.-P. Hugonin, B. Vest, J.-J. Greffet
Université Paris Saclay (France)

Light-emitting metasurfaces are nanostructured surfaces covered with emitters. The interaction between emitters and the metasurface enables a precise control of the emission properties. In practice, devices can be designed exploiting a reciprocity picture given by the local Kirchhoff's law. The emission features can be derived from the absorption features. In this presentation, we report on the whole process of quantitative design, fabrication and characterization of devices made on nanoplatelets deposited on a 2D metallic grating, providing highly directional photoluminescence.

17:40 - 18:10 — Amphi A

Session 3A30

Plasmonics and Nano-Optics

Chaired by: Radoslaw Kolkowski

17:40 : Effect of Mirror Quality on the Optical Properties of Nanoparticle-on-Mirror Plasmonic Nanocavities
Zhenxin Wang[1], **Alexey V. Krasavin**[2], **Pan Wang**[1]
[1] *Zhejiang University (China),* [2] *London Centre for Nanotechnology (United Kingdom)*

As an important part of nanoparticle-on-mirror (NPoM) plasmonic nanocavities, metal mirrors play an important role in determining the optical properties of the nanocavities and their application performance. Here, we experimentally study the effect of mirror quality (e.g., surface morphology, crystalline quality) on optical properties of NPoM nanocavities including nanosphere-on-mirror (NSoM) and nanocube-on-mirror (NCoM) designs, which improve the understanding of optical properties of the nanocavity and provide guidelines for the design of nanocavity-based devices with optimized performance for practical applications.

17:55 : Polarization singularities and far-field optical properties in dielectric metasurfaces
Luca Zagaglia[1], **Simone Zanotti**[1], **Momchil Minkov**[2], **Marco Liscidini**[1], **Dario Gerace**[1], **Lucio Andreani**[1]
[1] *University of Pavia (Italy),* [2] *Flexcompute, Inc. (USA)*

We study the relation between the degree of circular polarization of eigenmodes and far-field optical properties in dielectric metasurfaces supporting Bound States in a Continuum or with symmetry breaking leading to Circularly Polarized States. The Stokes parameter S3 is extracted from finite-difference time-domain and rigorous coupled-wave analysis simulations. In addition to the symmetries imposed by the lattice, the S3 parameter has a nontrivial dependence on the wavevector, with different regimes that are manifest in the optical properties.

16:40 - 18:30 — Amphi Pinel

Session 3A31

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Jérôme Plain and Alexander Govorov

16:40 : Invited talk
Laser direct writing of crystallized metal oxide from sol-gel using thermoplasmonic effect
Laurent Noel, Amine Khitous, Celine Molinaro, Olivier Soppera
Université de Haute-Alsace (France)

Near infrared (NIR) laser annealing was successfully used to crystallize TiO2 thin films from a sol-gel solution deposited on gold nanoparticle arrays (AuNPs). The AuNPs were used as nano-heaters allowing a local temperature increase up to 500°C in the film. Direct laser patterning by NIR laser and in combination with Deep-UV photolithography (DUV) has also been demonstrated. This fabrication method opens new perspectives in applications such as photonics, photocatalysis or biosensing.

17:00 : Invited talk
Chiral Nanostructures
Yurii Gun'ko
Trinity College Dublin (Ireland)

Our primary aim is to create novel chiral nanostructured materials that exhibit optical activity and chirality, and to investigate their properties, nature, and potential applications. The chiroptically active nanostructures have unique physical and chemical properties that have attracted significant attention in recent years. Here we present the progress in various approaches for the synthesis of these nanostructures. The study of chiral nanostructures is an exciting and rapidly growing field with promising future prospects for various technological advancements.

17:20 : Invited talk
Metal-Induced Polymerization of Diazonium Salts for Controlled Spatial Deposition of QDs in Hot Spots
Liudmila Trotsiuk[1], Aurélie Broussier[1], Sylvie Marguet[2], Anne-Laure Baudrion[1], Yun Luo[3], Claire Mangeney[3], Nordin Felidj[3], Pierre-Michel Adam[1], Renaud Bachelot[1]
[1] Université de Technologie de Troyes (France), [2] Université Paris Saclay (France), [3] Université Paris Cité (France)

In this work, we demonstrate the possibility of the local functionalization of gold nanoparticle surface using metal-induced diazonium salt polymerization for spatial control of quantum dot deposition. Varying the wavelength of excitation of gold nanoparticles, we can choose the polymerization mechanism, which leads to different polymerization pattern.

17:40 : An approach to fabricating plasmonic Titanium Nitride nanoparticles by pulsed laser ablation for biological applications
Nikolaos Pliatsikas, Spyros Kassavetis, Afroditi Koutsogianni, Stavros Panos, Tamara Odutola, Ilias Fekas, Evi Rampota, Christos Kapnopoulos, Maria Gioti, Panos Patsalas
Aristotle University of Thessaloniki (Greece)

The need to manufacture plasmonic materials with absorption in the Near-Infrared window is imperative even today for biomedical applications due to the efficient absorption and heating when at the same time the use of Traditional plasmonic metal nanoparticles have failed. We could pave the way by the controlled fabrication of refractory transition metal nitrides nanoparticles, such as Titanium Nitride, by pulsed laser ablation process in solvents.

17:55 : Liquid crystal templated chiral films: chiral plasmonics and circularly polarized luminescence
Wiktor Lewandowski

University of Warsaw (Poland)

Nanostructures with chiroptical properties highly desired for photonic technologies. Here, we present endeavors towards achieving nanostructured chiral thin films, which show tunable, highly dissymmetric optical properties. Namely, chiroptical properties of gold or semiconductor nanocrystals are induced by mixing them with (chiral) liquid crystals. Owing to the soft character of liquid crystals, these nanocomposites exhibit durability, tunability and strong dissymmetry (g-factor up to 0.1) attractive for real world applications.

18:10 : Invited talk
Photochemical imaging of near-field and dissymmetry factor of chiral nanostructures
Thinhinane Aoudjit, A. Horrer, S. Koscheev, R. Bachelot, J. Plain, D. Gerard
Université de Technologie de Troyes (France)

We present here a subwavelength imaging approach that is based on the interaction between the highly exalted near-field of chiral nanostructures and an azobenzene molecule (DR1, disperse red 1) grafted to a polymeric chain (i.e., PMMA). The aim of the study is to experimentally demonstrate the visibility factor.

16:40 - 17:45 — Amphi Manet

Session 3A32

New Trends in Topological Matematerials

Organized by: Xiao Hu

Chaired by: Florian Marquardt

16:40 : Invited talk
Optical control of topological and correlated electronic states
M. Hafezi
University of Maryland (USA)

We discuss how quantum optical control techniques could pave a radically new way to prepare, detect and manipulate non-local and correlated electronic states. Specially, we discuss topological interplay between photons and electron and strongly correlated driven-dissipative system.

17:00 : Laser based on Bound States in the Continuum in the Ultraviolet Region
Mu-Hsin Chen[1], Di Xing[1], Vin-Cent Su[2], Yang-Chun Lee[1], Ya-Lun Ho[1], Jean-Jacques Delaunay[1]
[1] *The University of Tokyo (Japan),* [2] *National United University (Taiwan)*

Bound states in the continuum (BICs) in optical systems have been utilized to achieve resonant modes with high quality-factors (Q) as BIC modes provide strong light confinement by suppressing out-of-plane radiative losses. In recent years, BICs have been applied in various fields, including nonlinear optics, sensing, and lasing in the visible or near-infrared region. Here, we report a laser based on symmetry-protected BIC with single-mode ultraviolet (UV) emission and a small full-width at half-maximum (FWHM) of 0.10 nm.

17:15 : Photonic Bimorphic Floquet Topological Insulators
Julius Beck[1], Georgios G. Pyrialakos[2], Matthias Heinrich[1], Lukas J. Maczewsky[1], Mercedeh Khajavikhan[3], Nikolaos V. Kantartzis[4], Alexander Szameit[1], Demetrios N. Christodoulides[2]
[1] *University Rostock (Germany),* [2] *University of Central Florida (USA),* [3] *University of Southern California (USA),* [4] *Aristotle University of Thessaloniki (Greece)*

We introduce a novel class of Floquet topological insulators simultaneously hosting Chern-type and anomalous edge states. The driving mechanism is implemented using laser-written waveguides arranged in a chained honeycomb lattice, allowing us to observe its different chiral edge states.

17:30 : Surface states in double diamond nodal line photonic crystals
Haedong Park, Sang Soon Oh
Cardiff University (United Kingdom)

We theoretically observe photonic surface states related to nodal lines in the momentum space. First, we

demonstrate nodal lines' phase transition by a structural deformation of dielectric photonic crystals. We also calculate the Zak phases using them. Finally, we show the surface states in our photonic crystals.

16:40 - 18:40 — Salle des Conseils

Session 3A33

Symposium III: Advanced Passive and Active Metasurfaces and Zero-Index Materials

Organized by: Howard Lee and Pin Chieh Wu

Chaired by: Howard Lee and Min Seok Jang

16:40 : Invited talk
Dielectric and Transient Optical Properties of Ultrathin TiN and Ti1-xAlxN
I Hung Ho, Hyeyoung Ahn
National Yang Ming Chiao Tung University (Taiwan)

Titanium nitride (TiN) with excellent optical and thermal properties has recently attracted attention in the fields of plasmonics and photothermal applications. We report the dielectric as well as the transient optical responses of ultrathin TiN and Ti1-xAlxN ($0 \leq x \leq 0.67$) films grown by molecular-beam-epitaxy method. With increasing Al compositions, drastic increase of VIS-NIR absorption and the redshift of the epsilon-near-zero wavelength is observed for Ti1-xAlxN. Strong sub-picosecond electron-phonon coupling and nanosecond-long heat-preservation is observed for Ti1-xAlxN in the whole visible spectral range.

17:00 : Invited talk
Metallic quantum well based extreme nonlinear materials and metasurfaces
Zhaowei Liu
University of California (USA)

Optical power dependent nonlinear metasurface has attracted much attention recently due to its great potential in ultrafast meta-optics, optical image and signal processing. Here, we review our recent studies about the development of various metallic quantum well systems with extremely high Kerr nonlinear coefficients and a few examples of applying those materials to nonlinear metasurfaces. We think nonlinear metasurface with exceptionally high nonlinear effect is becoming a promising candidate in real time image processing and parallel analog computing.

17:20 : Invited talk
Generation and Control of Ultrafast Directional Photocurrents at Nanoscale Using Symmetry-Broken Hybrid Graphene Nanoplasmonic Metasurfaces
Jacob Pettine, Hou-Tong Chen
Los Alamos National Laboratory (USA)

The generation of directional photocurrents via a variety of mechanisms is essentially linked to the breaking of spatial inverse and/or time-reversal symmetries. Here we introduce a class of optoelectronic metasurfaces, more specifically hybrid graphene nanoplasmonic metasurfaces with broken inversion symmetry, for the generation of arbitrarily and spatially varying ultrafast directional photocurrents at nanoscales. We further apply this concept for efficient emission of pulsed THz radiation and direct generation of THz vector beams.

17:40 : Invited talk
Piezoelectric Shifter for Wideband Tunability in Chalcogenide Metamaterials
Jesse Frantz[1], Jason Myers[1], Anthony Clabeau[2], Robel Bekele[1], Austin Moore[3], Vinh Nguyen[1], Jasbinder Sanghera[1]
[1] *U.S. Naval Research Laboratory (USA),* [2] *University Research Foundation (USA),* [3] *Jacobs (USA)*

A large-area thin film, with position carefully controlled by a piezoelectric transducer, can be used as a "shifter," a mechanism that provides a large shift in the resonance of a metasurface. Designs for such devices, based on chalcogenide glasses (ChGs) and operating in the midwave infrared (MWIR) are presented, demonstrating

resonance shifts of $>$ 400 nm for a shifter translation of only several hundred nanometers.

18:00 : Invited talk
Merging Nanophotonics with Optical Fibers through 3D Nanoprinting: a novel platform for flexible beam manipulation
Markus Schmidt[1], Henrik Schneidewind[1], Uwe Huebner[1], Matthias Zeisberger[1], Malte Plidschun[1], Jisoo Kim[1], Oleh Yermakov[2], Yuri Kivshar[3], Andrey Bogdanov[4], Haoran Ren[5], Stefan A. Maier[5]
[1]*Leibniz Institute of Photonic Technology (Germany),* [2]*V. N. Karazin Kharkiv National University (Ukraine),* [3]*Australian National University (Australia),* [4]*Harbin Engineering University (China),* [5]*Monash University (Australia)*

Here, we will demonstrate how the fusion of optical fibers with nanostructures creates a new category of fiber-integrated devices – hybrid optical fibers - that unlocks novel applications. We achieve this by leveraging 3D nanoprinting, which is highly compatible with the fiber geometry, to integrate high-NA holographic metalenses, achromatic metasurface-based lenses, and dielectric ring-like gratings onto the end faces of single-mode fibers, allowing to trap biological relevant objects, to focus light across the telecommunication range, and to boost incoupling efficiencies.

18:20 : Invited talk
Nanophotonics-based chiroptical sensing of drug solutions
R. Adhikary, A. Sahoo, M. Aschi, I. Daidone, M. Silvestri, M. Venturi, C. Ferrante, A. Mecozzi, Andrea Marini
University of L'Aquila (Italy)

We theoretically model the bi-anisotropic linear response of reparixin, ladarixin and levodropropizine solutions, discussing the potential of photonic crystal fibers, metasurfaces and photonic nanostructures for chiroptical sensing of drug solutions.

16:40 - 18:20 — Salle Guy Gautherin

Session 3A34

Bottom-Up Approaches, New Fabrication Routes and ENSEMBLE3

Organized by: Dorota Pawlak and Virginie Ponsinet

Chaired by: Dorota Pawlak and Virginie Ponsinet

16:40 : Invited talk
Scalable self-assembled plasmonic metamaterials: fabrication and application
Anastasiia Zaleska, F. Lotti, A. Krasavin, W. Dickson, A. V. Zayats
King's College London (United Kingdom)

The integration of plasmonic effects into metamaterial architectures presents exciting opportunities to design and develop new metamaterials with desired optical properties of metal nanostructures with different geometries, shapes and sizes. This talk will overview the fabrication and optical characterisation of large-area plasmonic metamaterials based on arrays of hybrid nanotubes and nanorods and their applications in nonlinear optics and sensing. The structural and material degrees of freedom allow such metamaterials to find a wide range of applications in nanophotonics.

17:00 : Invited talk
Tailoring Surface Reflectance Using Self-Assembled Block Copolymer Nanopatterns
Gregory Doerk, Charles Black
Brookhaven National Laboratory (USA)

This talk will discuss how thin film block copolymer self-assembly provides an alternative to nanolithography for engineering surface reflectance of visible light. Using existing nanofabrication infrastructure, we demonstrate near-ideal, omnidirectional, broadband antireflection in nanotextured silicon and glass. Furthermore, we use polymer blends that assemble with periodicities exceeding 200 nm to create resonant, reflective structural

color. Using ultraviolet crosslinking-modified thermal reflow to locally tune pattern feature sizes, we fabricate hierarchical patterns for self-assembled metasurfaces with customizable reflectance.

17:20 : Direct Fabrication of Plasmonic Nanoantennas onto Tapered Optical Nanofibers with Electron Beam Induced Deposition for Enhanced Single Photon Emission

Antonio Balena[1], Chengjie Ding[2], Marianna D'Amato[2], Muhammad Fayyaz Kashif[1], Filippo Pisano[1], Marco Pisanello[3], Gaia De Marzo[1], Massimo De Vittorio[1], Alberto Bramati[2], Ferruccio Pisanello[1]
[1] *Istituto Italiano di Tecnologia (Italy),* [2] *Collège de France (France),* [3] *Optogenix s.r.l. (Italy)*

In this work, we introduce a bottom-up fabrication approach based on Electron Beam Induced Deposition to directly fabricate plasmonic nanoantennas onto the surface of tapered optical nanofibers. The structures are optically characterized by measuring the scattering from a propagating Near Infrared laser beam and a supercontinuum beam. The results, along with numerical predictions, suggest that the fabricated structures can enhance the single photon emission properties of room temperature solid-state emitters.

17:35 : 3D Topological Insulators and Eutectics at a crossroad

Kingshuk Bandopadhyay[1], Andrzej Materna[1], Krzysztof Markus[1], Marta Buza[2], Cheng Chen[3], Piotr Piotrowski[4], Alexei Barinov[5], Fumikazu Murakami[6], Masayoshi Tonouchi[6], Yulin Chen[3], Dorota Pawlak[1]
[1] *ENSEMBLE3 (Poland),* [2] *Institute of Microelectronics and Photonics (Poland),* [3] *University of Oxford (United Kingdom),* [4] *University of Warsaw (Poland),* [5] *Elettra-Sincrotrone Trieste (Italy),* [6] *Osaka University (Japan)*

Three-dimensional topological insulators attract a great deal of interest due to their topologically-protected gapless surface states. However, challenges such as the high sensitivity of the surface states to the atmosphere, the low surface-to-volume ratio, and the need for various material heterojunctions limit the application of these materials. Here, we report the successful fabrication of topological insulator heterostructures by an easy, fast, and single-step process, which could meet all those challenges and pave the way for exploring other exotic phenomena shortly.

17:50 : Designing Mode Coupling in Two-Phase Metamaterials made by Sequential Self-Assembly

Jelena Wohlwend[1], Georg Haberfehlner[2], Ralph Spolenak[1], Henning Galinski[1]
[1] *ETH Zurich (Switzerland),* [2] *TU Graz (Austria)*

Design and fabrication of large-area metamaterials is an on-going challenge. Here, we demonstrate how a sequence of self-assembly processes can be used to design and fabricate large-area two-phase metamaterials. These two-phase metamaterials consist of a disordered nanometric network and nanoparticles or nanosheets, which can be readily designed by chemical engineering. Using energy electron loss spectroscopy, we probe the plasmonic environment and coupling between the two phases, confirming energy exchange with the nanoparticle modes and localized "hot spots.ºf the network.

18:05 : Self-assembled hexagonal array or correlated disorder plasmonic metasurfaces: optical properties comparison

Gil Cardoso[1], Frederic Hamouda[2], Vy Yam[2], Béatrice Dagens[2]
[1] *Université Paris Saclay (France),* [2] *C2N (France)*

Plasmonic metasurfaces have been fabricated following two different approaches in order to deliver large area devices for augmented reality systems. Their optical properties are compared at different levels: the contribution of the plasmonic nanostructures arrangement is evaluated thanks to the metasurfaces structure factors, the physical properties are assessed through optical transmission and reflection measurements, and finally the whole metasurfaces are macroscopically tested in a head-up display.

16:40 - 18:15 — Salle P1

Session 3A35

Microwaves and Millimeter Waves Applications of Metamaterials and Metasurfaces for the Real World

Organized by: Shah Nawaz Burokur and Xavier Begaud

Chaired by: Shah Nawaz Burokur and Xavier Begaud

16:40 : Invited talk
Composite based metasurface for surface wave excitation in HF band
Gildas Briand[1], **Andre Barka**[1], **Shah Nawaz Burokur**[2]
[1] *Université de Toulouse (France),* [2] *Université Paris Nanterre (France)*

This paper describes the design of a low profile inductive surface for High Frequency Surface Wave Radars (HFSWR) in HF-band. We discuss about reducing the thickness of the metasurface by designing an adapted dielectric support. The metasurface is then exploited to highly increase the electric field near the ground when illuminated by a quarter-wave monopole in TM polarization. This enhancement of the electric field is necessary in order to excite a surface wave.

17:00 : Invited talk
Emulating Fast-Fading Rician Wireless Environments with Electronically Adjustable K-Factors in a Programmable-Metasurface-Stirred Reverberation Chamber
Ismail Ahmed[1], **Matthieu Davy**[1], **Philippe Besnier**[2], **Philipp Del Hougne**[1]
[1] *Université de Rennes 1 (France),* [2] *INSA Rennes /IETR (France)*

Experimentally emulating the wireless test environments typically considered in signal processing can be challenging, especially for MIMO communications under Rician fast-fading if the K-factor is supposed to be adjustable. We demonstrate experimentally that electronic stirring of a reverberation chamber with a programmable metasurface conveniently enables the implementation of such channel conditions. We carefully characterize the precision with which a desired K-factor can be implemented simultaneously across multiple antenna pairs.

17:20 : Invited talk
A Dual Polarized Metagrating to Manipulate Wavefronts
Wei Zhou, Lina Zhu, Jianjia Yi
Xidian University (China)

Metagratings (MGs), which are sparse arrangements of subwavelength polarizable particles (meta-atoms), have demonstrated efficient realization of various electromagnetic functions in recent years. Here, we proposed a dual polarized metagrating which can independently control dual polarized waves.

17:40 : GRIN Lens Design by Defining Phase Function and Using Optical Path Rescaling
Hossein Eskandari[1], **Mehrdad Shokooh-Saremi**[2], **William Whittow**[1], **Tomas Tyc**[3]
[1] *Loughborough University (United Kingdom),* [2] *Ferdowsi University of Mashhad (Iran),* [3] *Masaryk University (Czech Republic)*

In this paper, the phase function inside a graded index dielectric is directly defined using a closed-form formula to create a rotationally symmetric lens antenna. To maintain the refractive index within realistic limits, the refractive index is modified by the optical path rescaling method. An exemplar lens antenna provides a 2 dB improvement over the Luneburg lens at 10 GHz of the same length. The lens has a maximum refractive index of 2 and a side-lobe level of -25 dB.

17:55 : Invited talk
Perfect Control of Diffraction Patterns with Phase Gradient Metasurfaces
Yuxiang Wang[1], **Kuang Zhang**[1], **Guohui Yang**[1], **Shah Nawaz Burokur**[2], **Qun Wu**[1]
[1] *Harbin Institute of Technology (China),* [2] *Université Paris Nanterre (France)*

Most studies on PGM focus only on single diffraction order. Multiple beams are still in the same order, and energy carried by different beams cannot be controlled. Here we propose a general method to perfectly control diffraction patterns based on a multi-beam phase gradient metasurface. An analytical solution for arbitrarily controlling diffraction beams is derived, the generation and energy distribution in high order diffraction beams

can be achieved.

16:40 - 18:00 — Salle P2

Session 3A36

Exotic Meta-media – Time-Dependent, Nonlocal and Other Novel Responses

Organized by: Jonathan Gratus, Rebecca Seviour, Paul Kinsler and Martin McCall

Chaired by: Jonathan Gratus and Martin McCall

16:40 : Invited talk
Solution generation in electrodynamics
Robert Thompson[1], **Martin McCall**[2]
[1] *Rhea Space Activity (USA),* [2] *Imperial College London (United Kingdom)*

The transformation approach can be understood as a method of solution generation. We discuss solution generation in electrodynamics and seek to develop a systematic approach to identifying mechanisms for generating non-trivial electromagnetic field solutions.

17:00 : Twisting an optomechanical cavity
Daigo Oue, Mamoru Matsuo
Chinese Academy of Sciences (China)

In this presentation, we show introducing birefringence in an optomechanical cavity breaks the rotational symmetry and induces two nondegenerate modes: ordinary and extraordinary rays. Mechanically twisting the cavity mixes the two modes and modulates the electromagnetic energy. Consequently, we find that the two optical modes behave as an effective two-level system which is coupled with torsional mechanical oscillation. We can also find the torsional oscillation can be resonantly driven by optically pumping the cavity.

17:15 : Time-varying fundamental acoustic equations
Rubén Picó, Javier Redondo, Victor José Sánchez-Morcillo
Universitat Politècnica de València (Spain)

The basic equations of acoustics are developed for a purely time-varying medium. The linear non-invariant continuity equation is established by considering the time dependence of the mass density and the adiabatic bulk modulus. A parametric study is carried out to consider the influence of the terms in the equation. Numerical simulations using the Finite-Differences Time-Domain (FDTD) method show the peculiarities of these wave phenomena in different scenarios for time-varying parameters of the medium in specific acoustic systems.

17:30 : Time-varying metasurfaces for parametric amplification of electromagnetic waves
Fedor Kovalev, I. V. Shadrivov
The Australian National University (Australia)

We propose and study a time-varying metasurface for parametric amplification of electromagnetic waves. We found that our subwavelength thin metasurface can provide amplification of up to 10 dB and analysed its stability. The proposed amplification principle can be used for electromagnetic waves in the radio, microwave and subterahertz range and is limited by the properties of modern varactor diodes.

17:45 : The operator theory of dispersive time varying media
Simon Horsley
University of Exeter (United Kingdom)

The theory of dispersive, time varying materials is challenging: the material response is both externally modulated, and depends on the history of the field. I will explain a new approach, where the optical 'constants' (refractive index etc.) become operators. I will show the resulting theory predicts spectrally tailored 'eigenpulses' of modulated materials and matches well with numerical simulations. Finally I will illustrate connections with the ABC problem of non-local media and also discuss some surprising connections with quantum me-

chanics.

Conference Dinner

19:30 - 23:30

Friday 21st July, 2023

8:30 - 10:20 — Amphi Bezier

Session 4A1

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Dai Zhang

08:30 : Keynote talk
Optical thermodynamics of highly multimode nonlinear photonic systems
Demetrios N. Christodoulides
University of Central Florida (USA)

In this talk, a thermodynamic theory capable of describing complex, highly multimoded, nonlinear optical systems is presented. It is shown that the mode occupancies in such nonlinear multimode arrangements follow a universal behavior that always tends to maximize the system's entropy at steady-state. This thermodynamic response takes place irrespective of the type of nonlinearities involved and can be utilized to either heat or cool an optical multimode system. Aspects associated with adiabatic compressions and expansions will be discussed along with the possibility for all-optical Carnot cycles.

09:00 : Invited talk
Plasmon and Graphene-based Nano-tweezers for Raman Imaging
Changjun Min
Shenzhen University (China)

To enhance the optical trapping precision and functions, we propose two new nano-tweezers technologies, including the plasmonic-thermoelectric tweezers and the graphene-based opto-thermoelectric tweezers. The plasmonic-thermoelectric tweezers offer both high trapping stability and high electric-field enhancement, and achieves Raman imaging with resolution of $\sim\lambda/4.5$ by dynamically scanning a single metallic nanoparticle. The graphene-based opto-thermoelectric tweezers significantly reduces the required incident power and extends the working bandwidth, and shows great application potential in intracellular Raman spectroscopic detection.

09:20 : Invited talk
Ellipsometric probing of hot electrons in plasmonic media
Judit Budai[1], **Zsuzsanna Papa**[1], **Péter Petrik**[2], **Peter Dombi**[3]
[1] *ELI-ALPS Research Institute (Hungary),* [2] *Centre for Energy Research (Hungary),* [3] *Wigner Research Centre for Physics (Hungary)*

We show that ellipsometry is an ultrasensitive tool for spatiotemporal probing of surface plasmon-generated hot electrons.

09:40 : Invited talk
Plasmonic high entropy alloy materials for midinfrared metasurfaces towards efficient photo thermal energy conversion
Yoshiaki Nishijima
Yokohama National University (Japan)

We have realized High entropy alloy, (HEA) materials for plasmon applications, especially midinfrared absorption metasurfaces. Optical obtained permittivity realized FDTD simulations that can well reproduce the experimental data. Also FDTD results indicate that HEA metasurface became true perfect absorption condition.

10:00 : Invited talk

Flat Band Induced Metal-Insulator Transitions With Weak Disorder and Many Body Interactions

Sergej Flach
Institute for Basic Science (Korea)

Originally considered as a theoretical convenience useful for obtaining exact analytical solutions of ferromagnetism, flat bands have been observed in a variety of settings, ranging from electronic systems to ultracold atomic gases and photonic devices. I will review the design and implementation of flat bands, classification schemes, discuss recent results on adding many-body interactions and disorder, and chart future directions of this exciting field.

8:30 - 10:30 — Amphi Fournel

Session 4A2

Machine learning for Metamaterials and Metasurfaces

Organized by: Willie Padilla

Chaired by: Willie Padilla

08:30 : Invited talk

Deep-Neural-Network for Meta-Lens Image Reconstruction

Yunxi Dong, Bowen Zheng, Sensong An, Hang Li, Hong Tang, Yi Huang, Mohammad Haerinia, Hualiang Zhang
University of Massachusetts Lowell (USA)

We have proposed a deep learning (DL) approach for reconstructing images taken through meta-lenses. We trained a deep neural network (DNN) that can recover the chromatic aberration of meta-lens imaging. The invented DNN can be used to restore images taken from different focusing distances. The designed DNN model achieved high fidelity computationally and great meta-lens imaging performance.

08:50 : Invited talk

Adaptive physics-driven neural networks for electromagnetic inverse problems and design of ultracompact diffractive devices

Luca Dal Negro, Y. Zhu, R. Riganti
Boston University (USA)

We present a robust computational framework that combines artificial neural network architectures with scattering and wave transport physics for the inverse design of ultracompact diffractive devices and for the inverse solution of high-dimensional integro-differential problems of relevance to optoelectronic and metamaterial technologies. Specifically, we develop and test different adaptive learning strategies that provide enhanced accuracy and scalability for the design and discovery of novel nanophotonic and metamaterial devices.

09:10 : Invited talk

Normalization flows for designing metasurfaces

Kebin Fan[1], Jia-Qi Yang[1], Yu-Cheng Xu[1], Jingbo Wu[1], Caihong Zhang[1], De-Chuan Zhan[1], Biaobing Jin[1], Willie J. Padilla[2]
[1] *Nanjing University (China),* [2] *Duke University (USA)*

Training data are very expensive for metasurface designs using deep-learning based methods. To achieve data efficiency, we introduced normalization flows to inversely design metasurfaces through learning the probabilistic distribution of the data. To explore the distribution efficiently, we proposed a prior shaping method to re-weight the data based on their fitness to the design target. Through implementing the algorithm, we obtained an emitter with in-band emittance efficiency close to 99 %. Our results present a new route for designing metasurfaces inversely.

09:30 : Invited talk

Exploring Multiple Network Architectures to Solve Selected Challenges in Computational Nanophotonics

Yannick Augenstein[1], **Lina Kuhn**[1], **Taavi Repän**[2], **Carsten Rockstuhl**[1]
[1] *Karlsruhe Institute of Technology (Germany),* [2] *University of Tartu (Estonia)*

We present our most recent contributions to explore the use of different architectures for artificial neural networks to simulate the interaction of light with nanostructured materials. Among others, we exploit graph neural networks to substitute a finite-difference time-domain scheme and Fourier neural operators as surrogate solvers for electromagnetic scattering problems. For the latter, we highlight the opportunity to solve tasks in the context of the inverse design of free-form scatterers with an optical response on demand.

09:50 : Invited talk
Informed Deep Learning in Metasurfaces
Omar Khatib, Yang Deng, Jordan Malof, Willie J. Padilla
Duke University (USA)

Deep learning is a powerful machine learning technique that can automatically learn from data. However, the space of possible hypotheses is enormous, which can lead to large required datasets and the data bottleneck problem. In this talk we demonstrate integration of physics and/or domain knowledge into deep neural networks to mitigate this problem. We discuss the types of knowledge that can be incorporated into neural networks and how to incorporate them in the context of metasurfaces. Results show that informed deep learning can significantly improve the performance of deep neural networks on metasurface design tasks with datasets that are four times smaller. We conclude by discussing the outlook of this exciting field.

10:10 : Invited talk
Multipolar Resonance Engineering Using Machine Learning
Wenhao Li[1], **Hooman Barati Sedeh**[1], **Willie J. Padilla**[1], **Jordan Malof**[2], **Natalia Litchinitser**[1]
[1] *Duke University (USA),* [2] *University of Montana (USA)*

We developed machine learning models to predict the multipolar resonances and electric field distributions of all-dielectric meta-atoms. Machine learning method is also used for inverse designing meta-atoms based on the desired multipolar resonances.

8:30 - 09:50 — Amphi Esquillan

Session 4A3

Thermal Plasmonics and Metamaterials for Sustainable Society

Organized by: Junichi Takahara and Kotaro Kajikawa

Chaired by: Junichi Takahara and Kotaro Kajikawa

08:30 : Transition Metal Nitride Metasurface Broadband Absorbers for Plasmon-Enhanced Solar-Driven Hydrogen Evolution
Yu-Jung Lu
Academia Sinica (Taiwan)

We demonstrate the plasmon-enhanced visible-light-driven hydrogen production from water using a polymer photocatalyst integrated with a TiN metasurface absorber. We show that a titanium nitride metasurface absorber exhibits broadband absorption with an average absorption of more than 92 $\%$ over a wavelength range of 400 nm to 750 nm. A 300 $\%$ increase in the hydrogen evolution rate was observed due to the LSPR that enhances the rates of light absorption, carrier separation, and hot-carrier transfer in polymer photocatalysts.

08:45 : Zero-dimensional thermal light emitters in the infrared based on silicon microspheres
Roberto Fenollosa[1], **Fernando Ramiro-Manzano**[1], **Moises Garin**[2], **Francisco Meseguer**[1]
[1] *CSIC (Spain),* [2] *Universitat de Vic (Spain)*

Silicon microspheres with 2-3 micrometers in diameter, heated by means of a blue laser, at temperatures from 500 to 700 ºC emit light in the infrared with pronounced peaks that are associated with their Mie resonances. The emission occurs through the lowest order modes in the mid-infrared where the intensity can surpass the black body limit because the optical absorption cross section is larger than the geometric one.

09:00 : Refractory metamaterials for tuning thermal emission at high temperature
Alima Nzie[1], Syreina Sayegh[2], Olivier Rozenbaum[3], Mikhael Bechelany[2], Quentin Flamant[1]
[1] *Saint-Gobain Research Provence (France),* [2] *Université de Montpellier (France),* [3] *CNRS (France)*

Metamaterials provide an accrued flexibility for tuning thermal emission but their resistance to high temperature is limited. So far, the few attempts to realize refractory metamaterial emitters relied on materials that are prone to oxidation which limits their operating temperature in air. In this work, we show how using innovative fabrication approaches and making the proper choice for associating a conducting and a dielectric material allows elaborating metamaterials with tunable emissivity that can operate in air at temperatures exceeding 1000°C.

09:15 : Dynamic emissivity modulating thermoregulating fabric using metallic particles
Muluneh Geremew Abebe, Gilles Rosolen, Bjorn Maes
University of Mons (Belgium)

Maintaining comfort using photonic thermal management textiles can potentially decrease the energy cost for heating and cooling in residential and office buildings. We propose a thermoregulating fabric comprised of a high emissivity bottom layer and a metal-particle polymer composite on top to modulate emissivity and provide dynamic and passive thermal comfort. With detailed numerical modeling we demonstrate a wide dynamic ambient setpoint temperature window of $\sim$7.25 °C, with the wearer staying comfortable in the range between 18.5 and 25.75 °C.

09:30 : Invited talk
Quasi-resonance of surface plasmons for near-infrared sensitivity improvement of silicon image sensor
Atsushi Ono, Takahito Yoshinaga, Kazuma Hashimoto, Nobukazu Teranishi
Shizuoka University (Japan)

We proposed quasi-resonant mode of surface plasmons with metal grating which diffracts incident photons to a large diffraction angle of nearly 90 degrees with high efficiency. The quasi-resonance of surface plasmons were applied to improve the near-infrared sensitivity of silicon image sensor. Metal grating was fabricated on the top of silicon sensor and the trench was embedded by a metal for the pixel separation. The diffracted light repeats reflection at metal-filled trench. The effective absorption length was extended in silicon.

9:50 - 10:35 — Amphi Esquillan

Session 4A4

Photonic Bandgap Structures

Chaired by: Taka-aki Yano

09:50 : Fabrication of All-Garnet Bragg Mirror using Cerium Substituted Yttrium Iron Garnet
Yuki Yoshihara[1], Pang Boey Lim[2], Mitsuteru Inoue[1], Kazushi Ishiyama[1], Taichi Goto[1]
[1] *Tohoku University (Japan),* [2] *Toyohashi University of Technology (Japan)*

A multilayer sample comprising cerium substituted yttrium iron garnet layer and gadolinium gallium garnet layer, which can act as a magnetooptical Bragg mirror, was fabricated on the yttrium aluminum garnet (YAG) substrate. The sample was fabricated by the ion beam sputtering method. Crystalline, optical, and magnetooptical properties were measured. The three-pair periodic structure was epitaxially grown on the YAG substrate with a lattice relaxation. An optical bandgap at a wavelength of 960 nm was observed, and magnetooptical responses were measured.

10:05 : Integrated polariton condensate in SOI high contrast grating microcavities
Pietro Tassan[1], Darius Urbonas[1], Bartos Chmielak[2], Thorsten Wahlbrink[2], Rainer Mahrt[1], Thilo Stöferle[1]
[1] *IBM Research Europe (Switzerland),* [2] *ETH Zurich (Switzerland)*

A promising approach towards the next generation of computing architectures are all-optical logic gates. Strong light-matter coupling based free space all-optical transistors have recently demonstrated showing ultra-fast switching at room-temperature2. Here, we use silicon-on-insulator high index contrast grating micro-

cavities to demonstrate polariton condensation and strong light-matter interaction on a chip. This opens the door for integrated all-optical transistors with scalability towards more complex optical logic circuits operating at room temperature.

10:20 : Inversely design a phase mask for an extended depth of focus through adjoint optimization
Huade Mao, Jiqiang Kang, Kenneth K. Y. Wong
The University of Hong Kong (Hong Kong)

We present an adjoint optimization method to inversely design a phase mask for an extended depth of focus. It reduces computation burden and has a promising application in optical imaging.

8:30 - 09:10 — Amphi A

Session 4A5

Symposium IV: Chirality, Magnetism, and Magnetoelectricity: Separate Phenomena and Joint Effects in Metamaterial Structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

08:30 : Invited talk
Spin Relaxation, Diffusion and Edelstein Effect in Chiral Metal Surface
Yuta Suzuki, Yusuke Kato
The University of Tokyo (Japan)

Motivated by recent experiments on spin polarization in chiral-crystalline metals, we investigate spin transport at the surface/interface of the chiral metals. Through eigenmode analysis of the Boltzmann equation, we first define spin relaxation time and diffusion length for the spin-splitting surface. We then describe charge-spin interconversion via the Edelstein effect at the interface between the chiral metal and a nonmagnetic metal with finite thickness. We finally show the Onsager's reciprocal relationship at that composite system.

08:50 : Invited talk
Symmetry control of strong chiral light-matter interactions in photonic nanocavities for efficient circularly polarised emission
Rahul Kumar[1], Ben Trodden[1], Anastasiia Klimash[1], Affar Karimullah[1], Nikolaj Gadegaard[1], Peter J. Skabara[1], Shun Hashiyada[2], Gordon J. Hedley[1], Malcolm Kadodwala[1]
[1] *University of Glasgow (United Kingdom),* [2] *RIKEN (Japan)*

We demonstrate a novel concept for creating chiral excited states which does not rely on molecular structure. Instead, it depends on hybridising a non-chiral molecule with a chiral electromagnetic field, producing a hybrid light-matter chiral polariton state. This is achieved by a symmetry-controlled strong chiral-light-matter interaction between an electromagnetic mode of a chiral nanocavity and an achiral molecule. This electromagnetic mechanism simplifies the creation of chiral electronic states since it is far less demanding in terms of materials design.

9:10 - 10:30 — Amphi A

Session 4A6

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Dmitry Solnyshkov

09:10 : Invited talk

Highly conformable terahertz metasurfaces via two-photon polymerization on polymeric ultra-thin films

Andrea Ottomaniello[1], Paolo Vezio[2], Omar Trincici[1], Frank Marco Den Hoed[1], Paul Dean[3], Alessandro Tredicucci[2], Virgilio Mattoli[1]

[1] Istituto Italiano di Tecnologia (Italy), [2] Universita di Pisa (Italy), [3] University of Leeds (United Kingdom)

The interest in flexible and integrated photonics requires new strategies for device manufacturing on arbitrary complex surfaces. THz technology can particularly benefit from this approach to implement compact systems for generation, detection, and manipulation of THz radiation. Here we present a novel fabrication method to realize conformable metasurfaces. The flexible and versatile character of polymeric nanomembranes is combined with direct laser writing and metal deposition to develop freestanding ultra-thin THz devices with an unprecedentedly high level of conformability.

09:30 : Invited talk

Functionalization of gold nanoparticles by localized surface plasmon resonance photopolymerization of molecularly imprinted polymers – An easy route for selective and specific sensors

Amine Khitous, Céline Mollinaro, Simon Gree, Karsten Haupt, Olivier Soppera

Université de Haute-Alsace (France)

Using the localized surface plasmon resonance to enhance the electromagnetic field in optical near field, a new simple, fast and versatile method for the functionalization of gold nanoparticles (AuNPs) by a nanoscale layer of molecularly imprinted polymers (MIPs) was developed1,2. The key step is based on near-field radical photopolymerization of a MIP pre-polymerization mixture. This allows the preparation of hybrid AuNPs@MIPs nanoparticles which are used as substrates for LSPR and surface enhanced Raman spectrometry analyses with excellent sensitivity and specificity.

09:50 : Invited talk

Microscopic theory of cavity-enhanced interactions of dipolaritons

Esben Rohan Christensen[1], A. Camacho-Guardian[2], O. Cotlet[3], A. Imamoglu[3], M. Wouters[4], G. M. Bruun[1], I. Carusotto[5]

[1] Aarhus University (Denmark), [2] Universidad Nacional Autónoma de México (Mexico), [3] ETH Zurich (Switzerland), [4] Universiteit Antwerpen (Belgium), [5] Università di Trento (Italy)

We develop a microscopic theory of interacting dipolar polaritons. Numerical results in a wire geometry together with a Born-Oppenheimer type approach showcase three emerging regimes, including a polariton blockade regime that should be reachable in realistic systems. We extend our theory to higher dimensions and compare dipolar polaritons to non-dipolar ones, highlighting the roles of light-matter coupling and interaction range. Dipolar polaritons in TMDs and/or with multiple quantum wells are promising candidates for realizing strongly correlated fluids of light.

10:10 : Invited talk

Direct and Inverse design forNon-Hermitian light management

Muriel Botey, R. Herrero, K. Staliunas

Universitat Politecnica Catalunya (Spain)

We present direct and inverse-design strategies to achieve .ºn demand"management of light by scattering cancellation in non-Hermitian media. The direct approach is based on our recently proposed generalized Hilbert Transform as a recipe to design complex potentials to tailor the flow of light following any arbitrary direction. Beyond this fundamental approach, we present supervised and unsupervised learning techniques for knowledge acquisition in non-Hermitian systems which accelerate the inverse the .ºn demand"design process.

8:30 - 10:30 — Amphi Pinel

Session 4A7

Metamaterials and Metasurfaces for Medical and Healthcare Applications

Organized by: Panagiotis Kosmas and Marc Dubois

Chaired by: Panagiotis Kosmas and Marc Dubois

08:30 : Invited talk

Comparison between a highly sensitive H-shape Terahertz metasurface absorber and an EIT-like terahertz Metasurface for refractive index biosensing

Tomas Pereira Pires[1], Ruobin Han[1], Shoreh Nourinovin[1], Akram Alomainy[2], Hasan Abbas[1], Muhammad Imran[1], Qammer Abbasi[1]

[1] *University of Glasgow (United Kingdom),* [2] *Queen Mary University of London (United Kingdom)*

Achieving higher sensitivity in THz metasurfaces requires a larger Q-factor to minimize losses. EIT-like and perfect absorber metasurface can reduce losses and gain higher sensitivity. Here, we designed a novel THz absorber metasurface and its EIT-like counterpart and compared their sensing performance. Using EM simulation and varying the sample's refractive index, a theoretical sensitivity of 842GHz/RIU and 560GHz/RIU achieved for absorber and EIT-like metasurface, respectively. These findings validate the effectiveness of both biosensors, with absorbers showing greater potential for biosensing.

08:50 : Invited talk

Segmentation of individual muscles in MR images from patients with neuromuscular diseases

David Ben Dahan

Aix Marseille Université (France)

Segmentation methods developed at CRMBM for the semi or fully automatic delineation of individual muscles in MR Images will be presented and the corresponding performances will be discussed.

09:10 : Invited talk

Metamaterial Antenna for High Field MRI

Anton Nikulin[1], Benoît Larrat[2], Djamel Berrahou[3], Alexandre Vignaud[2], Redha Abdeddaim[4], Abdelwhabed Ourir[1], Julien de Rosny[1]

[1] *PSL University (France),* [2] *Université Paris-Saclay (France),* [3] *Multiwave Imaging (France),* [4] *Aix Marseille University (France)*

A general approach based on cylindrical metasurface is proposed to design antennas for high field magnetic resonance imaging. It is applied to create two volume coils dedicated to brain imaging at 7T with a large aperture on the top. The first prototype is dedicated to preclinical imaging of rodent brain while the second one is committed for clinical application. Both prototypes have been tested in-vivo. Then, this approach combined to phase conjugation processing allows to control the magnetic field distribution.

09:30 : Invited talk

Metamaterials for 7T Ultra High Field MRI

Redha Abdeddaim, Marc Dubois, Stefan Enoch

Aix-Marseille Universite (France)

Different shapes and types of metamaterials will be presented and compared in order to identify the optimal configuration for passive shimming.

09:50 : Invited talk

The benefit of reconfigurable metamaterials in Magnetic Resonance Imaging

Matthias Guenther[1], Endri Stoja[2], Simon Konstandin[3], Thomas Bertuch[2], Johannes Mueller[1], Dennis Philipp[1]

[1] *University of Bremen (Germany),* [2] *Fraunhofer FHR (Germany),* [3] *Fraunhofer MEVIS (Germany)*

Reconfigurable Metamaterials introduce manifold degrees of freedom into MRI to overcome limitations of present technological capabilities. Reconfigurability in this respect does not only include tailored and controllable spatial sensitivity profiles w.r.t. the interaction with incident fields, but also the precise control in the time domain. The state of the art and various use-cases of static, dynamic, reconfigurable, and interactive metamaterials as well as control strategies are shown. Applications range from SNR enhancement to spatial

encoding patterns for reduced gradient fields.

10:10 : Invited talk
Enhancing the performance of antennas for biomedical applications with inverse-designed nonlocal-inspired metamaterials
Dimitrios Tzarouchis[1], Maria Koutsoupidou[1], Dionisios Rompolas[1], Ioannis Sotiriou[1], Efthymios Kallos[2], Panagiotis Kosmas[1]
[1] *Meta Materials Europe (Greece),* [2] *Meta Materials Inc. (United Kingdom)*

In this work, we introduce a nonlocal-inspired metamaterial that enhances the performance metrics of antennae used in biomedical applications, such as glucose sensing and other applications.

8:30 - 09:05 — Amphi Manet

Session 4A8

Microwaves and Millimeter Waves Applications of Metamaterials and Metasurfaces for the Real World

Organized by: Shah Nawaz Burokur and Xavier Begaud

Chaired by: Shah Nawaz Burokur and Xavier Begaud

08:30 : Invited talk
A Compact, Quad-Band, and Wideband Antenna Using Triple-Band AMC
Rafael Gonçalves Licursi de Mello, Anne Claire Lepage, Xavier Begaud
Télécom Paris (France)

We present a compact antenna with stable, unidirectional, high-gain radiation patterns operating in the frequency bands 2.4-2.7, 3.4-3.8, 5.17-7.125, and 8.0-12.0 GHz appropriate to cover the standards 5G/4G/Wi-Fi 2.4/5/6E and X-band communications.

08:50 : Transparent Passive Reflector for Coverage Enhancement in 5G Millimeter Wave
Konstantinos Dovelos[1], Panagiotis Kosmas[1], Efthymios Kallos[2], Ragip Pala[2]
[1] *Meta Materials Europe (Greece),* [2] *Meta Materials Inc. (UNited Kingdom)*

In this work, we propose transparent passive reflectors installed on windows to boost themillimeter wave signal quality in non-line-of-sight scenarios. The transparent passive reflectors arebased on a structured metal mesh called NANOWEB, which exhibits exceptionally highconductivity and optical transmissivity. Ray tracing simulations were conducted for an L-shapedoffice building using commercial software. Numerical results showcase that NANOWEB-madereflectors can effectively eliminate dead spots, hence rendering them an appealing alternative toconventional opaque metallic reflectors.

9:05 - 10:35 — Amphi Manet

Session 4A9

Plasmonics and Nano-Optics

Chaired by: Xiulai Xu

09:05 : Room-temperature waveguide-coupled plasmonic crystal lasers on GaAs substrate
Yue-Ting Tsai, Yu-Hsun Wu, Chu-Chun Wu, Sheng-Di Lin
National Yang Ming Chiao Tung University (Taiwan)

Semiconductor-based 2-D plasmonic crystal lasers (PCLs) has been studied in this work. The waveguide mode coupling with the surface plasmonic mode plays an essential role in these GaAs-based PCLs. The

cooperation of the dielectric layers and the metallic nano-pillar array gives the needed resonant mode of high-quality factor. The polarization-dependent two-wavelength lasing in the PCLs with a rectangular lattice has been demonstrated at room temperature.

09:20 : Stark Effect Control of the Scattering Properties of Plasmonic Nanogaps
Donatello Pagnotto[1], Alina Muravitskaya[2], David M. Benoit[1], Jean-Sebastien G. Bouillard[1], Ali Adawi[1]
[1] *University of Hul (United Kingdom),* [2] *Heriot-Watt University (United Kingdom)*

The development ofA*STARk effect offers practical approach to realise nano-scattering sources with high integration potential and a direct method to probe the excitonic properties of semiconducting materials on the nanoscale.

09:35 : Plasmonic single-nanoantennas enabling fast and nanoscale-controllable insulator-to-metal transition of VO2
Luca Bergamini[1], Bigeng Chen[2], Daniel Traviss[2], Yudong Wang[2], Cornelis H. de Groot[2], Jeffrey M. Gaskell[3], David W. Sheel[3], Nerea Zabala[1], Javier Aizpurua[4], Otto L. Muskens[4]
[1] *UPV/EHU (Spain),* [2] *University of Southampton (United Kingdom),* [3] *University of Salford (United Kingdom),* [4] *CSIC-UPV/EHU (Spain)*

The VO2 attracts wide interest for its insulator-to-metal transition when heated-up above the relatively low critical temperature of 68°. Plasmonic nanoantennas are known to concentrate light at the nanoscale around their surface when resonantly illuminated in the Vis-NIR. Here we show how this nanoantennas plasmonic feature can be used to steer and control a fast and nanoscaled insulator-to-metal transition in a VO2 film. We investigated the effect of a single nanoantenna, which is the smallest unit-block.

09:50 : Reconfigurable Non-Volatile Silicon Photonics Using Ultralow-Loss Phase-Change Chalcogenide Sb2Se3
Sophie Blundell, Daniel Lawson, David Thomson, Ioannis Zeimpekis, Otto Muskens
University of Southampton (United Kingdom)

Antimony Selenide (Sb2Se3) is explored as an alternative to popular phase-change materials (PCMs), such as Ge-Sb-Te (GST), for modulation of light through silicon photonic devices. Previous investigations of Sb2Se3 have been limited by using thin surface films, where only the evanescent field is modulated. By creating waveguide structures where light travels directly through the PCM, greater modulation depths are achieved, resulting in a higher change in effective refractive index. Applications of this work include light routing, photomodulation and photonic computing.

10:05 : Space-time Quantum Metasurfaces
Wilton Kort-Kamp, Abul Azad, Diego Dalvit
Los Alamos National Laboratory (USA)

We introduce the concept of space-time quantum metasurfaces for arbitrary control of the spectral, spatial, and spin properties of nonclassical light using a compact photonic platform. We show that spacetime quantum metasurfaces allow on-demand tailoring of entanglement among all degrees of freedom of a single photon and that spatiotemporal modulation induces asymmetry at the fundamental level of quantum fluctuations, resulting in the generation of steered and vortex photon pairs out of the vacuum.

10:20 : Metasurface-driven surface-enhanced infrared absorption spectroscopy for superior characterization of electrocatalytic reactions
Luca Maria Berger[1], Malo Duportal[2], Leonardo de Souza Menezes[1], Emiliano Cortés[1], Stefan Maier[3], Andreas Tittl[1], Katharina Krischer[2]
[1] *Ludwig-Maximilians-Universität Munchen (Germany),* [2] *Technical University of Munich (Germany),* [3] *Monash University (Australia)*

Understanding electrocatalytic processes is crucial to realize the transition toward a sustainable zero-carbon future. Surface-enhanced infrared absorption spectroscopy (SEIRAS) is a suitable method to monitor the mechanisms of these processes with chemical specificity. However, it remains difficult to detect many relevant aspects of electrochemical reactions such as short-lived intermediates. Here, we demonstrate an integrated nanophotonic-electrochemical SEIRAS platform for the in-situ investigation of molecular signal traces emerging during electrochemical experiments.

8:30 - 09:45 — Salle des Conseils

Session 4A10

Symposium III: Advanced Passive and Active Metasurfaces and Zero-Index Materials

Organized by: Howard Lee and Pin Chieh Wu

Chaired by: Howard Lee

08:30 : Invited talk
Ultrathin Titanium Nitride Epitaxial Structures for Tunable Infrared Plasmonics
Shangjr Gwo
National Tsing-Hua University (Taiwan)

Titanium nitride (TiN) is an excellent material for infrared plasmonics due to unique optical properties (comparable to gold), refractory material nature, mechanical and chemical stabilities, as well as bio- and CMOS compatibilities. In this work, we demonstrate that ultrathin and scalable TiN epitaxial structures can be applied for tunable infrared plasmonics, extending from near- (NIR) to mid-infrared (MIR) spectral region.

08:50 : Invited talk
Full color Imaging with Large-Aperture Meta-Optics
Arka Majumdar
University of Washington (USA)

By exploiting computational backend, coupled with a designer meta-optics we demonstrate high-quality imaging using a single meta-optics with an aperture of 1cm.

09:10 : Active Huygens' metasurface based on in-situ grown conductive polymer
W. Lu[1], L. de S. Menezes[1], A. Tittl[1], H. Ren[2], S. A. Maier[2]
[1] *Ludwig-Maximilians-Universität München (Germany),* [2] *Monash University (Australia)*

Active metasurfaces provide unique advantages for on-demand light manipulation at a subwavelength scale for emerging applications of 3D displays, augmented/virtual reality (AR/VR) and light detection and ranging (LiDAR). Here, we introduce an electrically active Huygens' metasurface based on in-situ grown conductive polymer with holistic switching performance. Our active metasurface design can be readily incorporated into other metasurface concepts to deliver high-reliability electrical control over optical response, paving the way for compact and robust electro-optic metadevices.

09:25 : Invited talk
Modulating and Spinning thermal radiation with incandescent metasurfaces
Anne Nguyen, Léo Wojszvzyk, Jean-Paul Hugonin, Anne-Lise Coutrot, Enrique Garcia-Caurel, Benjamin Vest, Jean-Jacques Greffet
Université Paris-Saclay (France)

Blackbody radiation is intrinsically isotropic, broadband and unpolarized. However, these properties can be strongly modified using appropriate nanostructures. Here we report about the design, fabrication and characterization of incandescent metasurfaces based on subwavelength metallic gratings. When heated by Joule effect, the grating acts as a thermal emitter that can be modulated at frequencies higher than the MHz. The system geometry can also be engineered to provide circularly polarized light with a polarization degree around 35 $\%$.

9:45 - 10:30 — Salle des Conseils

Session 4A11

Metasurfaces and their Applications

Chaired by: Sang Soon Oh

09:45 : Morphogenetic engineering of radiating metasurfaces
Thomas Fromenteze[1], Okan Yurduseven[2], Eric Arnaud[1], David R. Smith[3], Cyril Decroze[1]
[1] *University of Limoges (France),* [2] *Queen's University Belfast (United Kingdom),* [3] *Duke University (USA)*

A morphogenesis-inspired technique for the engineering of electromagnetic components is under development and finds new applications in the procedural generation of radiating metasurfaces. This method simulates the growth of structures capable of spatially self-organizing to respond to electromagnetic constraints. An application is presented with the automated synthesis of a morphogenetic metasurface radiating a field distribution constrained in frequency, in space, and in polarization.

10:00 : ZrO2 Holographic Metasurfaces for Biophotonics Applications
Mohammad Biabanifard, Tomasz Plaskocinski, Jianling Xiao, Andrea Di Falco
University of St Andrews (United Kingdom)

We present zirconium dioxide holographic metasurfaces offering environmental independence operation, ease of fabrication, biocompatibility, and broadband functional nature. Here we show that this class of metasurfaces can be used for integrated optical trapping in the visible range.

10:15 : Broadband Terahertz Emitter with All-Dielectric Metasurface Based on the Quasi-Bound States in the Continuum
Yang Guo, L. Y. Hu, B. Wang, S. Du, C. Z. Gu
Chinese Academy of Sciences (China)

We propose an all-dielectric metasurface supporting quasi-bound states in the continuum, by which terahertz emission is enhanced in a nonlinear lithium niobate (LiNbO3) film under the excitation of femtosecond laser pulses. Our results show that the terahertz emission is enhanced up to 17 times by a silicon dioxide metasurface in the frequency range of 0.1-4.5 THz. This mechanism for the terahertz emission enhancement is attributed to the tight confinement of the pump field in the LiNbO3 film.

8:30 - 10:25 — Salle Guy Gautherin

Session 4A12

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Jae Su Yu

08:30 : Invited talk
Purcell factor for plasmon-enhanced metal photoluminescence
Tigran Shahbazyan
Jackson State University (USA)

We present an analytical model for plasmonic enhancement of metal photoluminescence (MPL) in metal nanostructures. We obtain a universal expression for MPL Purcell factor in terms of metal dielectric function, plasmon frequency, and the system volume. We find that the lineshape of MPL spectrum is affected by the interference between direct carrier recombination processes and those mediated by plasmonic antenna which leads to a blueshift of MPL spectral band relative to scattering spectra observed in the experiment.

08:50 : Invited talk
Active aerosols to control the propagation of light
Jake Fontana, Chuck A. Rohde, Kristin M. Charipar, Paul Johns, Ashlin G. Porter, Nicholas J. Greybush

U.S. Naval Research Laboratory (USA)

This work connects the fields of active plasmonics and aerosols to establish an active aerosol. We report the experimental dynamics and control of ensembles of gold nanorods suspended in air by varying the magnitude and frequency of externally applied electric fields, thereby demonstrating an active aerosol. We further show light filter, valve and gradient-index responses, demonstrating active aerosols as a novel type of optical element we define as component-less optics.

09:10 : Invited talk
Semi-solid Beam Steering System Based on Micro-Meta-Lens Arrays
Rui Chen, Yifan Shao, Yungui Ma
Zhejiang University (China)

In this talk, we present a semi-solid micro-mechanical beam steering system based on micro-meta-lens arrays (MMLAs). It is operated by manipulating the probe beam over two sets of decentered MMLAs potentially driven by high-speed piezo-electric motors. We will also show that this MMLAs could be employed to design a two-dimensional optical ruler with nanometric resolution.

09:30 : Invited talk
Colloidal Metal Nanoparticles under Ultrafast Laser Pulses
Andrés Guerrero Martinez
Universidad Complutense de Madrid (Spain)

The control of the excitation of the localized surface plasmon resonances of colloidal metal nanoparticles with ultrafast laser pulses, from the nanosecond to the femtosecond timescales, can be used to prepare highly monodisperse metal nanoparticles, hollow metal nanoparticle morphologies, alloyed metal nanoparticles, or assembled and welded nanostructures.

09:50 : Invited talk
Lithium niobate metasurfaces-A bright nonlinear light source
Mengxin Ren, Lun Qu, Lu Bai, Wei Wu, Jingjun Xu
Nankai University (China)

Metasurfaces have demonstrated themselves as a promising platform for enhanced second harmonic generation (SHG) to achieve ultracompact nonlinear light sources. Lithium niobate (LN), particularly the crystalline LN thin film on insulators (LNOI) has emerged recently as a promising platform to manufacture metasurfaces. In this talk, we will present our recent work about nonlinear LN metasurfaces with high SHG conversion efficiencies.

10:10 : Towards Predictable 2D/3D Plasmonics via FEBID
Verena Reisecker, David Kuhness, Harald Plank
Graz University of Technology (Austria)

Focused Electron Beam Induced Deposition (FEBID) is a mask-less nano-printing technique that allows for the reliable fabrication of planar and even complex, free-standing 3D nanostructures. Herein, we demonstrate its suitability for creating flexible plasmonic nanostructures, which are not producible with standard lithography techniques. We start with printing simple 2-3D Au nanostructures and evaluate their plasmonic activity via STEM-EELS further corroborated by simulations with the aim to generate an upfront design tool.

8:30 - 10:25 — Salle P1

Session 4A13

Classical and Quantum Phononics

Organized by: Khaled Mnaymneh

Chaired by: Khaled Mnaymneh

08:30 : Invited talk

Generation of entangled electron-photon-phonon states in nanocavity-QED systems

Mikhail Tokman[1], **Maria Erukhimova**[1], **Qianfan Chen**[2], **Alexey Belyanin**[2]
[1] *Ariel University (Israel),* [2] *Texas AM University (USA)*

Many molecular, quantum-dot, and optomechanical nanocavity-QED systems demonstrate strong nonlinear interactions between electrons, photons, and phonon modes. We show that such systems can be described by a universal model in the vicinity of the nonlinear resonance involving all three degrees of freedom. We solve the nonperturbative quantum dynamics in the strong-coupling regime, taking into account quantization, dissipation, and fluctuations of all fields. Strong coupling at the nonlinear resonance leads to tripartite quantum entanglement and distinct emission spectra.

08:50 : Invited talk

Nano-optomechanical systems for ultrasensitive mass measurement

Wayne Hiebert[1], **C. Thrideep**[2], **M. Belov**[1], **J. Westwood-Bachman**[1], **S. K. Roy**[1], **M. P. Maksymowych**[1], **V. T. K. Sauer**[1], **T. S. Lee**[1], **T. Firdous**[1], **A. Venkatasubramanian**[1], **A. Kobryn**[1]
[1] *National Research Council Canada (Canada),* [2] *University of Alberta (Canada)*

Nano-optomechanical systems (NOMS) are developed to explore the ultimate limits of sensitivity in mass sensing. Fabricated using silicon-on-insulator and typical integrated photonics process flows, we use NOMS chips for directly sensing miniscule mass levels in gas chromatography and in mass spectrometry as well as for performing sub-millidegree resolved temperature sensing. We have a vision for achieving single atomic mass unit mass sensitivity resolution in air and room temperature.

09:10 : Invited talk

Single electron spin dynamics in a two-electron double quantum dot under a nonequilibrium phonon environment

Kazuyuki Kuroyama[1], **Sadashige Mastuo**[2], **Shunsuke Yabunaka**[3], **Sascha R. Valentin**[4], **Arne Ludwig**[4], **Andreas D. Wieck**[4], **Yasuhiro Tokura**[5], **Seigo Tarucha**[2]
[1] *The University of Tokyo (Japan),* [2] *RIKEN (Japan),* [3] *Kyushu University (Japan),* [4] *Ruhr-Universität Bochum (Germany),* [5] *University of Tsukuba (Japan)*

We have experimentally studied the charge-spin cooperative dynamics of two-electron states in a GaAs double quantum dot (DQD), which are driven in a nonequilibrium phonon environment created by a nearby QD-based phonon source. The spin-flip rates increase remarkably, which is explained by the simultaneous action of the spin-orbit and electron-phonon interactions. Furthermore, we found the imbalance of the occupation probabilities between antiparallel/parallel spin states, which is explained by the thermal nonequilibrium of the phonon environment in the DQD.

09:30 : Invited talk

Quantum interference of electron-phonon coupled states in semiconductors using phase-locked femtosecond pulses

Kazutaka Nakamura, Itsuki Takagi, Yosuke Kayanuma
Tokyo Institute of Technology (Japan)

Electronic and phononic coherence has been studied in an n-type GaAs crystal using transient reflection measurements with relatively phase-locked femtosecond pulses at 90 K. The interference fringes due to electronic and phononic coherence are observed in the coherent phonon amplitude as a function of pump-pump delays. The collapse and revival feature was observed in electronic coherence and well represented in the theoretical calculations. The electronic decoherence time was estimated to be 23 $\pm$0.3 fs.

09:50 : Invited talk

Engineering optomechanical and nonlinear effects in nanostructured silicon photonics

Paula Nuno Ruano[1], **Jianhao Zhang**[1], **Thi-Thuy-Duong Dinh**[1], **David Gonzalez-Andrade**[1], **Xavier Le Roux**[1], **Miguel Montesinos Ballester**[1], **Christian Lafforgue**[1], **David Medina Quiroz**[1], **Daniel Benedikovic**[2], **Pavel Cheben**[3], **Samson Edmond**[1], **Etienne Herth**[1], **David Bouville**[1], **Norberto Daniel Lanzillotti-Kimura**[1], **Delphine Marris-Morini**[1], **Eric Cassan**[1], **Laurent Vivien**[1], **Carlos Alonso Ramos**[1]
[1] *Université Paris-Saclay (France),* [2] *University of Zilina (Slovakia),* [3] *National Research Council Canada (Canada)*

Periodic subwavelength silicon patterning opens new degrees of freedom to control the propagation of light and sound in silicon photonic circuits. In this invited presentation, we will show our most recent results on leveraging silicon nanostructuration for optomechanical and nonlinear applications.

10:10 : Photonic Implementation of Non-Adiabatic Holonomies for Quantum Computing
Vera Neef, Julien Pinske, Matthias Heinrich, Stefan Scheel, Alexander Szameit
University of Rostock (Germany)

We present the experimental realization of non-adiabatic holonomies in integrated quantum optics. Implementing quantum gates solely by means of non-Abelian geometric phases increases stability and reduces the need for quantum error correction. We use femtosecond laser-written waveguides and to realize topologically protected single-qubit gates as well as gate sequences, and verify their performance by means of heralded single-photon measurements. Our findings pave the way towards a holonomic architecture for quantum computers.

8:30 - 09:10 — Salle P2

Session 4A14

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jérôme Plain, Alexander Govorov, Davy Gérard and Pedro Hernandez Martinez

Chaired by: Davy Gérard and Pedro Hernandez Martinez

08:30 : Invited talk
The kinetics of plasmon-induced chemical reactions studied by surface-enhanced Raman scattering (SERS) and X-ray photoelectron spectroscopy (XPS)
I. Bald[1], S. Kogikoski Jr.[1], A. Dutta[1], R. Schürmann[2]
[1] *University of Potsdam (Germany),* [2] *Physikalisch Technische Bundesanstalt (PTB) (Germany)*

The rate constants of plasmon-induced transformation of brominated adenine and thiophenol derivatives is studied by SERS and XPS. We identified relevant parameters determining the reactivity of molecules on plasmonic nanostructures, among them the material and size of nanoparticles, as well as the local density of states. Furthermore we attempt to exploit these systems for site-selective functionalization of nanoparticles and radical induced polymerization reactions.

08:50 : Invited talk
Non-Thermal Activation of Reactants in Plasmon-Assisted Chemical Reactions: Roles of Molecular Structure and Metal-Molecule Contact
Zee Hwan Kim
Seoul National University (Korea)

In this talk, I will present our recent spectroscopic studies on metal-bound reactants, which proves the non-thermal vibrational molecular excitations caused by plasmons: We find that such a plasmon-induced vibrational excitation causes hyper-thermal vibrational population distribution of a specific molecular vibrational mode, and bring significant population in overtone-excited states. Such excitation is found to be critically dependent on the metal-molecule chemical contact. The inelastic molecule-electron scattering model could fully explain what are observed.

9:10 - 10:25 — Salle P2

Session 4A15

Emerging Applications

Chaired by: Alexander Soibel

09:10 : Theoretical study of optomechanical effects by luminescence-induced optical force on micro-

mechanical membranes
Hideki Arahari[1], **Sota Konishi**[2], **Seiji Akita**[2], **Hajime Ishihara**[1]
[1] *Osaka University (Japan),* [2] *Osaka Metropolitan University (Japan)*

We have assumed a square-type optomechanical resonator formed with the luminescent nanofilm and a metallic mirror substrate, and then theoretically evaluated the luminescence-induced optical force (LiOF) on the emitting film. LiOF is enhanced at a specific cavity length due to the optical confinement effect of the resonator. We have shown theoretically that the enhanced LiOF could induce the mechanical frequency shift of the oscillator. This research provides new insights into the development of optomechanics using luminescence.

09:25 : Inverse design of fabrication-compatible monolithic metasurfaces for optically interfacing deeply embedded solid-state qubits
Amelia Klein, Nader Engheta, Lee Bassett
University of Pennsylvania (USA)

We use adjoint shape optimization to design monolithic metasurfaces tailored exactly to maximize photon collection from a specific solid-state defect into a particular free-space collection angle. Our shape optimization manifestly adheres to fabrication constraints at every iteration. We show that our highly-tailored objective criteria result in performance superior to a structure optimized as a conventional focusing metalens. This flexible design approach will help realize scalable interfaces for developing quantum technologies.

09:40 : Sub-wavelength silicon nano-structuring with direct laser writing
Rana Asgari Sabet, Onur Tokel
Bilkent University (Turkey)

We present a novel laser nano-lithography method inside silicon. We exploit nanosecond laser pulses of 1.55-μm wavelength which are modulated with a spatial light modulator. The created Bessel beams enable highly-controlled subsurface fabrication capability in Si. Using this technique, we demonstrate for the first time, fabrication of sub-wavelength nano-modifications inside Si. We further illustrate nano-patterns of 200-nm width and of sub-micron separation. Such 3D control on sub-wavelength structures inside Si offer exciting possibilities for Si-photonics, meta-material and meta-surface in-chip technologies.

09:55 : Inverse Design of Metalens Systems Including Refractive Lenses
Jan Bos[1], **Evan Heller**[2], **Rob Scarmozzino**[2], **Mayank Bahl**[2], **Li-Ce Hu**[3], **Chenglin Xu**[2]
[1] *Synopsys Inc. (The Netherlands),* [2] *Synopsys Inc. (USA),* [3] *Synopsys Inc. (Taiwan)*

The first fully automated design tool, MetaOptic Designer (MOD) has been extended to design hybrid optical systems that combine metalenses with refractive lenses. In addition to metalenses, MOD can also model refractive lens accurately and efficiently. Hence, it can be used to design metalenses that correct various aberrations in existing optical system or to replace several refractive lenses in the system.

10:10 : Micromagnetic Simulation of Sub-micron Scaled Magnetic Domains in Magnetic Garnet Films
Takumi Koguchi[1], **Yuki Yoshihara**[1], **Pang Boey Lim**[2], **Mitsuteru Inoue**[1], **Kazushi Ishiyama**[1], **Taichi Goto**[1]
[1] *Tohoku University (Japan),* [2] *Toyohashi University of Technology (Japan)*

Magnetic garnet films have been widely used in magnetooptical devices because of their large Faraday rotation angle and low optical loss. For the development of magnetooptical devices such as spatial light modulators and spin-controlled lasers, controlling the magnetic domains is essential. However, predicting the behavior of magnetic domains can be challenging. In this research, we calculated the magnetic domains in the magnetic garnet film using a micromagnetic simulation.

Coffee Break

Session 4P1
Poster Session VII
10:30 - 11:10

P1: Non-linear Optical Properties Investigation on the Colloidal WS2 nanosheets
Yang Zhao, Marcus Fröhlich, Onno Strolka, Tim Parker, Jannika Lauth, Alfred Meixner, Dai Zhang

Eberhard-Karls Universität Tübingen (Germany)

The relationship between the local structure and optical properties of colloidal WS2 nanosheets is studied by nonlinear confocal microscopy. Experimental results show that individual WS2 nanosheets have higher second harmonic signal intensity and shorter fluorescence lifetimes compared to those of clusters, which could be attributed to the different optical properties of monolayers and multilayers.

P2: Large Enhancement in Visible to UV Nonlinear Frequency Conversion by a Plasmonic Gold Nanograting

Shroddha Mukhopadhyay[1], Laura Rodriguez-Suñe[1], Crina Maria Cojocaru[1], Maria Antonietta Vincenti[2], Kent A. Hallman[3], Giuseppe Leo[4], Metodi Belchovski[2], Domenico de Ceglia[2], Michael Scalora[5], Jose Francisco Trull Silvestre[1]

[1] Universitat Politècnica de Catalunya (Spain), [2] University of Brescia (Italy), [3] PeopleTec, Inc. (USA), [4] Université Paris Cité (France), [5] US Army CCDC (USA)

We report a combined experimental/theoretical investigation on second and third harmonic generation from a plasmonic gold nanograting, resonant in the near infrared. The intense field localization leads to significant enhancement in nonlinear optical processes, more than three orders of magnitude herein, compared to flat gold nanolayer. The spectral and angular dependence (qualitative and quantitative) of the harmonics were experimentally recorded and validatedwithin the framework of our microscopic, hydrodynamic model for linear and nonlinear material dispersion mechanisms of metals.

P3: Biocompatible fluorescent carbon dots nanoparticles used for anti-counterfeiting of cultural artefacts

Theo Duarte[1], Aurélie Broussier[1], Sabine Fourrier[2], Alexandre Rabot[3], Anne-Laure Baudrion[1], Jérôme Plain[1], Julien Proust[1]

[1] Université de Technologie de Troyes (France), [2] Histoire et sources des mondes antiques - CNRS (France), [3] Histoire et sources des mondes antiques - CNRS (FR)

In this work, fluorescent biocompatible carbon nanoparticles were synthesized using high-pressure bottom-up synthesis. The influence of the different synthesis parameters was studied to investigate the formation mechanism of this method and their influence on the photophysical properties of the nanoparticles. The carbon dots formed by this method were then integrated into various mediums to produce safe anti-counterfeiting markings used to protect cultural artefacts discovered in archaeological sites with a high risk of looting.

P4: Synergistic Photonic and Morphology Design of Solar Powered Redox Cells

Jiaming Ma, Kiseok Oh, Giulia Tagliabue

EPFL (Switzerland)

Solar powered redox cells offer compelling opportunities for large-scale and long-term storage of solar-energy and have thus attracted increasing attention. Yet, to date, photoelectrodes suffer from poor light absorption and limited charge transport . While efforts have primarily focused on heterostructure engineering, the potential of synergistic morphology and photonic design has not been carefully investigated. We study the wavelength-dependent effects of light-absorption and charge transfer characteristics on the performance of gold decorated TiO2-based SPRC photoanodes operating with RFB-compatible redox couples.

P5: Non-Uniform Array of Polarizable Particles as a Locally Linear Space Invariant (LSI) Metasurface

Jordan Dugan, Tom Smy, Joao G. Nizer Rahmeier, Shulabh Gupta

Carleton University (Canada)

Non-uniform metasurfaces are often analyzed as a locally Linear Space Invariant (LSI) system where the effective parameters of the surface at any given unit cell are equal to the parameters of an equivalent uniform surface composed of only that unit cell. This is often treated as an approximate method for modeling non-uniform surfaces, however, in this work we demonstrate that a non-uniform array of electrically polarizable particles can in fact be modeled as a local LSI system.

P6: Adjoint Optimized Mid-Wave Infrared Metalenses

Joshua Rollag, Raymond Wambold, Ricky Gibson

Air Force Research Laboratory (USA)

Silicon metalenses with numerical apertures of 0.232 are designed for operation in the four to five micron wavelength range using adjoint optimization. The library element optimization allows for each freeform scatterer to be optimized for a given phase with feature size limitations suitable for standard fabrication. It is found

that the silicon metalenses with the adjoint optimized scatterers perform better than traditional cylindrical scatterers in both bandwidth and focusing efficiency over the desired spectral range.

P7: Dynamic phase-modulated metasurface for beam scanning antenna
Zakaria Zouhdi[1], Badr Eddine Ratni[2], Shah Nawaz Burokur[2]
[1] *Univ. Paris Nanterre and Naval Group (France),* [2] *Univ. Paris Nanterre (France)*

A directional high gain reconfigurable planar antenna is designed based on a phase-modulated metasurface. A prototype that operates around 5 GHz is designed, fabricated and tested. The metasurface is dynamically controlled by different bias voltages applied to the incorporated varactor diodes, thus allowing to control its phase characteristics. Different phase profiles have been tested allowing to firstly achieve a highly directive boresight radiation and secondly, to steer the main radiated beam towards an off-normal direction.

P8: Beyond Periodic pillar-wise library for metasurface: a stochastic approach
Loumi Tremas, Mathys Le Grand, Denis Rideau, Louis Henri Fernandez-Mouron, Jeremy Grebot, Bruce Rae, James Downing, Pascal Urard, Valérie Serradeil, Lucie Dilhan, Habib Mohamad, Gonzague De Carpentier, Enrico Giuseppe Carnemolla, Matteo Fissore, Christophe Sauvan
STMicroelectronics (France)

Most of the large scale metasurface are designed using pillar-wise periodic libraries . However, in certain cases, resonances can appear which makes the relation between the desired phase and the corresponding pillar radius ambiguous. In the present abstract, we propose a new stochastic approach beyond pillar-wise periodic libraries.

P9: Optical properties of resonant gratings with spatially varying period
Dmitry Bykov, Evgeni Bezus, Artem Kashapov, Andrey Morozov, Vladimir Podlipnov, Leonid Doskolovich
Samara National Research University (Russia)

We study guided-mode resonant gratings with the period linearly changing along the periodicity direction. At relatively small period change rates, such structures are used as linearly varying filters. However, when designing compact filters, the period change rate increases, which results in the appearance of multiple resonant peaks. We study this effect numerically and experimentally. We also develop a coupled-mode theory describing the optical properties of the investigated structures and providing a very good agreement with the simulation results.

P10: Optical Mie resonances of DNA-assembled three-dimensional gold superlattice crystals
Doxi Misatziou[1], H. J. Singh[1], Angela de Fazio[1], Martinus Werts[2], Alvaro Buendia[3], Vincenzo Giannini[3], Jose Sanchez-Gil[3], Afaf El-Sagheer[4], Tom Brown[4], Antonios Kanaras[1], Otto Muskens[1]
[1] *University of Southampton (United Kingdom),* [2] *Université de Rennes (France),* [3] *CSIC (Spain),* [4] *University of Oxford (United Kingdom)*

We report the DNA-mediated assembly of gold nanoparticles into 3D superlattice crystals and their subsequent stabilization using carbazol-mediated DNA cross-linking. The visible-near infrared optical properties of the gold-DNA superlattice crystals is shown to be mediated by a broad spectrum of higher order Mie resonances.

P11: Development of a novel optical label-free voltage sensing technique
Oscar Barajas Gonzalez, Joseph Sollini, Michael Somekh, Sidahmed Abayzeed
University of Nottingham (United Kingdom)

This work presents an innovative impedance microscopy approach that promises the capability of measuring the bioelectrical properties of single cells. This optical label-free method exploits the sensitivity of metal's dielectric constant to voltage-induced changes in electron density in thin metallic films. This can be monitored by tracking the change in intensity of optical transmission or reflection of metal. This technique is a novel form of performing impedance microscopy, which can allow exploring wide applications in biology.

P12: Investigation of the optical properties and the emission behavior of nanoscale Yagi-Uda antennas using nonlinear optics and back focal plane imaging
Felix Schneider, Felix Nägele, Alfred Meixner, Monika Fleischer, Dai Zhang
Eberhard Karls University Tübingen (Germany)

Downscaling of conventional Yagi-Uda antennas to nanometer size provides a powerful tool to influence

the behavior of visible light for optical applications. For this, the plasmonic properties of gold nanorods are combined with the geometry of the well-established Yagi-Uda antenna. The impact of the linear polarization direction on their excitation and emission behaviors is investigated in optical spectra and the k-space. Here, we demonstrate strong discrepancies between on- and off-resonance excitation.

P13: Non-Hermitian Spin-Hall Effect in Topological Metasurfaces

Svetlana Kiriushechkina[1], Anton Vakulenko[1], Daria Smirnova[2], Sriram Guddala[1], Filipp Komissarenko[1], Monica Allen[3], Jeffery Allen[3], Alexander Khanikaev[4]

[1] *The City University of New York (USA),* [2] *The Australian National University (Australia),* [3] *Air Force Research Laboratory (USA),* [4] *City College of New York (USA)*

We demonstrate that, for suitable trapping one-dimensional Dirac potentials, there exist guided modes exhibiting spin-dependent field distributions, which gives rise to their different coupling efficiency to the radiative continuum or light-matter coupling. For leaky Dirac metasurfaces this manifests in different transport and radiative properties of modes of opposite spin - the non-Hermitian spin-Hall effect. We use silicon nanophotonic metasurfaces that support pseudo-spin degree of freedom as a testing platform to experimentally confirm spin-dependent non-Hermitian properties of spin-full photonic Dirac waveguides.

P14: Epsilon-Near-Zero coupled Surface Lattice Resonances as a Nonlinear Activation Function

Dhruv Fomra[1], Adam Ball[2], Amit Agrawal[1], Henri J. Lezec[1], Nathaniel Kinsey[2]

[1] *National Institute of Standards and Technology (USA),* [2] *Virginia Commonwealth University (USA)*

Photonics is a promising solution to meet the growing demand for data in defense, aerospace, and telecommunication sectors. However, current linear optical systems face limitations in performance and applicability due to the lack of nonlinear elements required for generalized computation. To address this challenge, that combines an ENZ film with a metasurface exhibiting a surface-lattice-resonance (SLR) has been developed. Simulations suggest that on optical excitation, the transmission of the film can be modulated by over 150 % (27 % to 71 %).

P15: High resolution impedance imaging with plasmonic nanostructures

Finlay Nelson, Rafael Fuentes-Dominguez, Fei He, Richard Smith, Matt Clark, George Gordon, Sidahmed Abayzeed

University of Nottingham (United Kingdom)

We present a high resolution impedance microscopy technique for imaging the local electrical properties of cells in an effort to obtain an in-depth understanding of their bioelectrical functions. This information is critical to understanding aspects of cell activity such as metabolism, disease state, and cell stress. Our approach involves the investigation and utilisation of the tuneable local surface plasmon resonances (LSPR) of highly ordered nanoparticle arrays to make impedance imaging possible with spatial resolutions not achievable using pre-existing methods.

P16: Quasi minimum-scattering-superabsorbed nanowires

Jeng Yi Lee

National Dong Hwa University (Taiwan)

With consideration of an energy function involving scattering and power cross sections for a nanowire under a normal incidence for one polarization (either TE or TM), by using variational calculus, we propose a power diagram where can indicate all scattering properties. Without lock of scattering resonant modes with same phases and amplitudes, we design a nanowire with scattering performances having minimum-scattering superabsorption by exciting higher modes.

P17: Fluctuation imaging of nanoscale disorder in monolayer semiconductors

Tom Sistermans[1], Rasmus Godiksen[2], Alberto Curto[1]

[1] *Ghent University (Belgium),* [2] *Eindhoven University of Technology (The Netherlands)*

We show that monolayer semiconductors, a rising material family in photonics and electronics, can exhibit noise-like, localized fluctuations in their fluorescence. Inspired by a superresolution technique, we use imaging to show that the fluctuation strength depends on the monolayer's nanoscopic environment. Fluctuation imaging, a fast and simple method, can thus be used for quality control throughout a manufacturing process flow to quantify and map disorder. Our results are relevant for the integration of monolayer semiconductors into nanophotonic devices and metasurfaces.

P18: Actively Real-time Controllable Metal-Graphene Hybrid Metasurfaces
Fei Han[1], Bart Raes[1], The Linh Pham[1], Nguyen Thanh Tung[2], Xuezhi Zheng[1], Guy A. E. Vandenbosch[1], Joris van de Vondel[1], Niels Verellen[3], Ewald Janssens[1]
[1] *KU Leuven (Belgium),* [2] *Vietnam Academy of Science and Technology (Vietnam),* [3] *IMEC (Belgium)*

We report on actively controllable metasurfaces by in-situ electrostatic doping of graphene. A resonance tuning of 0.40 um is demonstrated around 7.06 um, allowing for more efficient optoelectronic devices operating under ambient conditions.

P19: Metasurfaces for illumination and light concentration
Ivan Moreno, C. P. Castañeda-Almanza, Thaire V. Galvan
Universidad Autonoma de Zacatecas (Mexico)

We show some methods for designing dielectric metalenses that deal with the optimal transfer of light energy, i.e. for light concentration and illumination applications. Owing to its flatness, metasurface-based flat optics may solve some problems that deal with light concentration and illumination. We report our latest advances on this topic. We discuss two algorithms for uniform illumination design with metasurfaces: ray mapping method, and Monge-Ampere equation method. And we discuss the string method for efficient light concentration with flat optics.

P20: Suppression of filamentation in Kerr media by photonic crystals
Edvinas Aleksandravicius, Darius Gailevicius, Audrius Dubietis, Kestutis Staliunas
Vilnius University (Lithuania)

We show the possibility of using photonic crystals to counteract the spatial Kerr effect, thus suppressing filamentation. Fine control of the spatial dispersion can be achieved by tuning the photonic crystal geometry and projecting to the appropriate Bloch mode branch. Chirped photonic crystals can be engineered with such geometry that the designed diffraction compensates for nonlinear focusing, suppressing beam filamentation.

P21: Laser-Induced Nanostructuring of Material Phase and Shape for 3D Light Control
M. S. Elizarov, N. Li, A. Fratalocchi
KAUST (Saudi Arabia)

We introduce a three-dimensional nanostructuring platform that utilizes light-induced control over nanomaterials' phase and geometry. We employ a heterogeneous oxide-polymer nanostructure as the fundamental component of our approach. By applying low-power (up to 15mW) CW lasers of varying intensity and exposure time, we achieve photothermal passivation and reshaping of the initial material. Resulting structures possess modified spectral response, enabling us to develop a technology for large-scale structural color laser printing with widest gamut reported.

P22: Ultracompact Tapers and Splitter for Fishbone-Like Grating Waveguides
Ahmet Oguz Sakin, Hasan Alper Gunes, Beyza Akcay, Ahmet Canberk Songur, Mehmet Unlu
TOBB University of Economics and Technology (Turkey)

The use of fishbone-like grating waveguides (FLGWs) in photonic integrated circuits (PICs) presents a challenge in terms of chip space utilization because it requires incorporating conventional, large components. Therefore, we propose the combination of three key elements - a long adiabatic waveguide taper, a power splitter, and a transition region for FLGWs - using digital metamaterials to allow for the effective utilization of FLGWs that are excited by ultrashort pulses in a compact footprint of only 5 x 14.1 μm2.

P23: A Planar, NEMS-Based Terahertz Phase Shifter Using Subwavelength Confinement Waveguides
Mesut Demircioglu[1], Muhammed Abdullah Unutmaz[2], Mehmet Unlu[1]
[1] *TOBB University of Economics and Technology (Turkey),* [2] *Ankara Yildirim Beyazit University (Turkey)*

In this paper, we present the Nano-Electro-Mechanical Systems (NEMS)-Based phase shifter using the Terahertz Subwavelength Confinement Waveguides (TSCW). The 90° phase difference is obtained from the OFF- and ON-states of the NEMS-based phase shifter at 0.29 THz. The measurement results of the 90° phase shifter show -4.79 dB worst-case insertion loss for the TSCW with 630 μm total length, which indicates the performances of 7.60 dB/mm and 18.8 °/dB.

11:10 - 11:50 — Amphi Bezier

Session 4A16

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Sergej Flach

11:10 : Invited talk
All-optical Control of Nonlinear Light Interaction with Topological Photonic
Yupei Wang, Jitong Wang, Nicolae-Coriolan Panoiu
University College London (United Kingdom)

In this talk I will review some recent results regarding nonlinear interactions and all-optical control of one-way edge-modes of topological photonic crystals (PhCs) and graphene metasurfaces. Thus, I will show that the Kerr effect in graphene can be used to effectively control the valley-Hall topological transport in certain waveguides implemented in graphene metasurfaces. I will also demonstrate that pairs of bound states in the continuum of certain PhC slabs can be employed to achieve a remarkable enhancement of second-harmonic generation.

11:30 : Invited talk
Strong coupling between two-dimensional excitons and plasmonic nanocavities with a low exciton number
Xiulai Xu
Peking University (China)

The interaction between two-dimensional excitons and plasmon nano-cavities has a potential to realize exciton-polaritons in quantum regime. Here, we report on a robust strong exciton-plasmon coupling with MoS2 layers and bowtie nanocavities. With a proper exciton transition dipole moment, we estimated that the exciton number contributing to the coupling is reduced to 40, which is the lowest for this type of work so far. The interacting between 2D excitons and chiral nanocavities will be also discussed.

11:10 - 12:25 — Amphi Fournel

Session 4A17

Machine learning for Metamaterials and Metasurfaces

Organized by: Willie Padilla

Chaired by: Willie Padilla

11:10 : Invited talk
Deep learning based inverse design: Neural adjoint for free-form geometries
Peter Wiecha[1], Abdourahman Khaireh-Walieh[1], Tom Radford[2], Alberto Politi[2], Otto Muskens[2]
[1] *LAAS-CNRS (France),* [2] *University of Southampton (United Kingdom)*

I will give an overview over the most important inverse design techniques techniques, will discuss respective drawbacks and advantages, while discussing also potential dangers and risks, that come with data-driven techniques in a general picture. Particular focus will be spent on the neural adjoint method and its variations.

11:30 : Invited talk
Digital Twins for Generic Radio Environments Parametrized by Reconfigurable Intelligent Surfaces: Physics-Based vs. Physics-Agnostic Surrogate Models
Hugo Prodhomme[1], Philipp del Hougne[2]
[1] *CNRS - IETR (France),* [2] *CNRS-IETR (France)*

Optimizing the configuration of reconfigurable intelligent surfaces (RISs) in generic (potentially complex-scattering) radio environments for a desired communications or sensing functionality is challenging because of the non-linear manner in which the RIS impacts the wireless channel. The availability of a learned surrogate forward model of the mapping from RIS configuration to wireless channel can substantially facilitate the optimization problem. Here, we explore different approaches (physics-based vs. physics-agnostic) to learning such digital twins.

11:50 : Invited talk
Meta-Atom Design for a Highly-Sensitive Liquid Sensor
Kazunori Serita, Luwei Zheng, Kazuki Hara, Masayoshi Tonouchi
Osaka University (Japan)

We propose new type of a highly-sensitive liquid sensor. Terahertz (THz) point source was combined with a few arrays of meta-atoms, and reflection type THz-TDS was developed. The design of the meta-atoms and configuration of the array were studied to enhance the sensitivity.

12:10 : Broadband invisibility cloaking design of concentric multilayered cylindrical metamaterials based on genetic algorithm
Tomoya Momose, Mana Toma, Kotaro Kajikawa
Tokyo Institute of Technology (Japan)

A computational approach to design a cloaking medium is presented on the basis of the genetic algorithm (GA). The cloaking target is a dielectric cylinder with a diameter of 1 μm, and the cloaking medium is multi-layered cylindrical layers with a thickness of 0.5 μm. The cloaking performance designed by the GA is much better than that designed on the basis of the transformation optics and the effective medium approximation.

11:10 - 12:25 — Amphi Esquillan

Session 4A18

Metamaterials and Metasurfaces

Chaired by: Taichi Goto

11:10 : Phase sensing with meta-optical devices for wavefront recovery and biological imaging
Lukas Wesemann, Shaban Barney Sulejman, Timothy J. Davis, Ann Roberts
University of Melbourne (Australia)

Detection of the phase of an electromagnetic field is fundamental to applications including wavefront sensing in ophthalmology and precision telescopes as well as biological cell imaging. In contrast to readily detectable intensity variations, measuring phase usually requires more complex approaches. Conventional methods suffer from drawbacks involving bulky and moving components, long propagation distances, computation time and energy consumption. Here we report on the use of nanophotonic devices used in transmission for phase-sensing and demonstrate their potential for ultra-compact wavefront recovery

11:25 : Metasurface-based optical concentrators monolithically integrated with Barrier infrared detectors
Tobias Wenger, Richard Muller, Cory J. Hill, Anita M. Fisher, David Z. Ting, Dan Wilson, Sarath D. Gunapala, Alexander Soibel
Jet Propulsion Lab (USA)

Recently developed metasurface technology enables optical concentrators that can be integrated with detectors. In this work we developed InAsSb-based infrared photodetectors monolithically integrated with metasurface lenses (metalenses) that act as optical concentrators. The metalenses are fabricated on the backside of a gallium antimonide substrate, and the photodetectors are fabricated on the frontside of the same substrate. The metalenses enhance the detector responsivity up to 10-fold and detectors retain the same detectivity at temperatures up to 40K higher.

11:40 : Design of a beam-modulable vertical cavity using a dielectric metasurface with a full phase

change encircling an exceptional point
Jaewon Jang, Yeonsang Park
Chungnam National University (Korea)

We suggest dielectric metasurfaces that can have a 2p phase with high reflection. Suggested dielectric metasurfaces are designed to have high reflection and simultaneously have a 2p phase with transmitted light by encircling the phase singularity point. We confirmed by simulation that a vertical cavity with high quality factor can be formed by using metasurfaces as a top reflector in the cavity, and the beam shape emitted from this cavity is modulated with ease with the help of metasurfaces.

11:55 : Converged wireless infrastructure with acoustic holography
Chuanxin Zhang, Xue Jiang, Dean Ta
Fudan University (China)

Wireless technologies based on electromagnetic wave are crucial in the modern industry but nonoptimal in biomedical and underwater applications, where ultrasound has been proposed as an alternative approach. Here we construct a unified ultrasonic wireless infrastructure that supports multiple specific and separate functions, dubbed converged wireless infrastructure. The infrastructure based on ultrasound holography serves as the central hub to realize a series of wireless functions which is demonstrated with phased array and holograms.

12:10 : Transmittance analysis of dielectric optical metasurfaces
Ivan Moreno, Carlos Basilio-Ortiz
Universidad Autonoma de Zacatecas (Mexico)

Metasurfaces that consist of a graded array of dielectric nano-posts arranged in a lattice are widely studied in optics and photonics. We analyze the light beam transmittance through such an optical metasurface at oblique incidences for visible wavelengths. We obtain the transmitted intensity through the dielectric metasurface versus the incident angle, for different phase gradients of the metasurface. These results are useful for designing efficient nonimaging metalenses. Finally, some concepts are presented for specifying directional transmittance of a dielectric metasurface.

11:10 - 12:10 — Amphi A

Session 4A19

Symposium II: New Trends in Nanophotonics and Advanced Materials

Organized by: Junsuk Rho, Hakjoo Lee, Namkyoo Park and Seong Ok Han

Chaired by: Sheng-Di Lin

11:10 : Invited talk
Plasmon-enhanced nano-spectroscopies for highly sensitive biomolecular detection
Taka-Aki Yano, Ryo Kato, Takuo Tanaka
Tokushima University (Japan)

Optical biosensing has attracted considerable attention due to its capability of highly sensitive molecular detection and analysis. We have been developing a variety of nanostructure-enhanced biomolecular spectroscopies in combination with plasmonics and metamaterials where optical nanostructures play a crucial role in enhancing various optical signals (visible absorption/reflection, Raman scattering, fluorescence, and infrared absorption) from targeting biomolecules. Here in this talk, we focus on our recent works on high-sensitivity and super-resolution optical sensing and imaging for biomedical analysis.

11:30 : Invited talk
Hierarchical Micro/Nanostructures for Light Harvesting and Photovoltaic Device Applications
Jae Su Yu
Kyung Hee University (Korea)

Hierarchical micro and nanostructures based on inorganic and organic materials for the manipulation of light

behaviors such as reflection, transmission, scattering, etc. are demonstrated. The fabrication of the micro and nanostructures on material surfaces is performed via various manufacturing techniques, together with the design by numerical modelling and simulations. Optical properties of the fabricated micro and nanostructures are theoretically and experimentally evaluated. Eventually, the hierarchical micro and nanostructures are applied to light harvesting and photovoltaic devices to enhance their performances.

11:50 : Invited talk
Enhanced electric field and emission directionality of gap mode
Dai Zhang, Peng Miao, Felix Schneider, Yang Zhao, Tim Parker, Alfred Meixner
Eberhald Karls University of Tübingen (Germany)

The localized plasmoThe localized plasmonic resonance and electric field in small gaps will be discussed. To evaluate the enhanced excitation electric field, the intensities and energies of the photoluminescence, and Raman signals are compared by varying the gap sizes systematically. Further insights into the gap-mode emission properties in the k-space are obtained by combining the back focal plane technique with parabolic mirror assisted optical microscopy.

11:10 - 12:05 — Amphi Pinel

Session 4A20

Metamaterials and Metasurfaces for Medical and Healthcare Applications

Organized by: Panagiotis Kosmas and Marc Dubois

Chaired by: Redha Abdeddaim

11:10 : Invited talk
Super-Resolution Ultrasonic Cellular Imaging by Localization of Meta-Nanodroplets
Chengzhi Shi
Georgia Institute of Technology (USA)

The ability to image cellular structures and morphology in deep tissues in vivo is essential for the fundamental study of developmental cell biology and physiology. Ultrasound imaging has been safely used to observe organ structures deep in the body. However, the resolution of ultrasound imaging is typically limited to the wavelength scale due to the diffraction limit, which can hardly be used to visualize cellular structures. In this work, we used phase-transitioning perfluorocarbon meta-nanodroplets to break the diffraction limit.

11:30 : Invited talk
Metasurface Pads for body imaging at 3T
Marc Dubois, Stefan Enoch, David Bendahan, Abdeddaim Redha
Aix-Marseille Université (France)

Original metasurface pads are presented as an alternative approach to mitigate RF inhomogeneities. Several designs which can be integrated within standard MRI equipment will be presented with a particular attention dedicated to field penetration efficiency and safety in the field of whole-body imaging.

11:50 : On the design, control, and AI-driven optimization of reconfigurable metamaterials for Magnetic Resonance Imaging
Dennis Philipp[1], Endri Stoja[2], Simon Konstandin[3], Thomas Bertuch[2], Johannes Mueller[1], Marina Schmidt[3], Matthias Guenther[3]
[1] *University of Bremen (Germany),* [2] *Fraunhofer FHR (Germany),* [3] *Fraunhofer MEVIS (Germany)*

Reconfigurable metamaterials offer the possibility to drastically improve various metrics in Magnetic Resonance Imaging. Among those are, e.g., speed, efficiency and local signal-to-noise ratio. To extremize a given target function, suitable optimization strategies must be followed. Here we report on the design of first prototypes, including their functionality, wireless control and conventional as well as AI-driven optimization. Simulations, on-bench measurements, deep learning optimization results, and MRI scans are shown to demonstrate a proof-of-principle.

12:05 - 12:35 — Amphi Pinel

Session 4A21

Metamaterials and Metasurfaces for Optics

Chaired by: Zee Hwan Kim

12:05 : Pancake metalens for compact imaging systems
Chen Chen, Shining Zhu, Tao Li
Nanjing University (China)

Metalenses have great potential for miniaturizing imaging systems due to the ultrathin and flat features. However, besides reducing lens thickness, folding/compressing the space between lens and image is also a dominating factor to obtain the utmost compactness. This work proposes a pancake metalens that folds the optical path at will using a metacavity consisting of a bifacial metasurface and a mirror. This pancake metaoptics framework could enable miniaturization of imaging systems and would provide insights for meta-device applications.

12:20 : Hybrid External Cavity Laser based on a novel Si3N4 1D Photonic Crystal cavity for label-free on-chip sensing applications
Taynara De Oliveira[1], Simone Iadanza[2], Jesus Hernan Mendoza-Castro[3], Gautham Paikkath[1], Bernhard Lendl[4], Marco Grande[3], Liam O'Faolain[1]
[1] Munster Technological University (Ireland), [2] Paul Scherrer Institut Forschungsstrass (Switzerland), [3] Politecnico di Bari (Italy), [4] TUW (Austria)

In this work we show the employment of a novel design photonic crystal (PhC) cavity in hybrid external cavity laser (HECL) configuration for refractive index sensing applications, with high sensitivity (145nm/RIU) and low detection limit (∼10-5 RIU). The HECL RI sensor configuration exhibits a 16x improvement in the detection limit compared to the stand-alone photonic crystal cavity. In addition, the sensor is characterized by its compactness, high-power output, simplicity in fabrication, compatibility to integration process, and multi-sensing capability.

11:10 - 12:10 — Amphi Manet

Session 4A22

Plasmonics and Nano-Optics

Chaired by: Jake Fontana

11:10 : A TD-DFT Approach for Polariton Chemistry: Polaritonic and Charge Transfer Excitations in Azobenzene Photoisomerization
Lucia Cascino[1], Stefano Corni[2], Stefano Corni[3], Stefania D'Agostino[3]
[1] University of Salento (Italy), [2] Università di Padova (Italy), [3] Istituto Italiano di Tecnologia (Italy)

The desire to control the interaction between surface plasmons and quantum systems as cells, molecules, polymeric macromolecules has boosted the progress in theoretical and experimental techniques for the effective manipulation of such objects. The work here presented is somehow at the frontier between quantum chemistry and nanophotonics, providing, within the TD-DFT framework, a deeply understanding of the coupling mechanisms between the azobenzene photoswitch and a prototype plasmonic nanocluster, showing the effects of the localized plasmon on strong-coupling and charge-transfer phenomena.

11:25 : Analysis of tip-enhanced photoluminescence image of single molecule based on nonlocal response theory
Yoshitsugu Tomoshige, Mamoru Tamura, Tomohiro Yokoyama, Hajime Ishihara
Osaka University (Japan)

Tip-enhanced photoluminescence (TEPL) can provide the spectroscopic image of photoluminescence with

sub-nm resolution and probe the individual state of a single molecule. To discuss the microscopic optical response in the TEPL, we develop a theoretical framework based on nonlocal response theory and input-output theory. We can successfully obtain the photoluminescence intensity map reflecting the spatial distribution of transition dipole with distinguishing the different modes.

11:40 : Fabrication of GaN Topological Photonic Crystals and Observation of Edge Modes in Visible Region

Yamato Takano[1], Umito Kurabe[1], Koji Yoneta[1], Taiju Kudo[1], Mirai Akimoto[1], Takuto Honda[1], Xiao Hu[2], Kikuchi Akihik[1]

[1] *Sophia University (Japan),* [2] *National Institute for Materials Science (Japan)*

GaN-based visible range topological PhCs consisting of a honeycomb lattice of C6 symmetry triangular nanoholes were successfully fabricated by a combination of hydrogen environment anisotropic thermal etching (HEATE) and wet etching of AlInN sacrificial layer. Experimentally obtained photonic band diagram showed manifestation of topological properties such as, intensity inversion of upper- and lower- band-edge at G-point, and interfacial topological edge states. These topological properties were verified by FDTD simulation with precisely reproduced three-dimensional models.

11:55 : Microscopic Theory of Tip-Enhanced Nonlinear Raman Scattering with Self-Consistent Nonlocal Response

Hiroyuki Ikagawa, Mamoru Tamura, Tomohiro Yokoyama, Hajime Ishihara

Osaka University (Japan)

We constructed a microscopic theory of tip-enhanced coherent anti-Stokes Raman scattering (TECARS) which utilizes a metallic probe tip to enhance the CARS. To describe the optical response in a mesoscopic system including a metal and sample, we self-consistently solved the Maxwell's equations and a nonlocal constitutive equation for the polarization of sample. Based on this theory, we discuss the enhancement effect and spatial resolution in the TE-CARS.

11:10 - 12:25 — Salle des Conseils

Session 4A23

Metamaterials and Metasurfaces

Chaired by: Luca Dal Negro

11:10 : Twisted Polaritonic Crystals in Thin Anisotropic Van der Waals Slabs

Nathaniel Capote-Robayna[1], O. Matveeva[2], V. S. Volkov[2], P. Alonso-Gonzalez[3], A. Y. Nikitin[1]

[1] *DIPC (Spain),* [2] *XPANCEO (United Arab Emirates),* [3] *University of Oviedo (Spain)*

Polaritons -hybrid light-mater excitations- are very appealing for the confinement of light at the nanoscale. Recently, a particular interest has been focused on thin anisotropic slabs of van der Waals (vdW) materials supporting anisotropic polaritons which exhibit ultra-high momenta and strongly directional in-plane. Here we introduce a concept of vdW slabs-based twisted polaritonic crystals (PCs) -lattices with periods comparable to the polariton wavelength rotated with respect to the natural vdW crystal axes- to efficiently excite and control in-plane anisotropic polaritons.

11:25 : Spin-momentum locking breakdown on plasmonic metasurfaces

Fernando Lorén, L. Martin-Moreno

Universidad de Zaragoza (Spain)

We have developed a detailed formalism to analyze the spin-momentum locking (SML) in structured plasmonic metasurfaces. It is valid for any unit cell where holes are placed at certain positions and angles. We can explain the SML emergence just from the unit cell configuration. Besides, there appear several breakdown terms spoiling the polarization landscape. We have studied systems with rotations along the unit cell but also with global symmetry of translation and rotation of the whole lattice, like Kagome lattice.

11:40 : Attribute of attenuation band in smart negative indexed mechanical metamaterials

Ankur Dwivedi, S. A. R. Horsley
University of Exeter (United Kingdom)

Unique tailored geometry and pattern of engineered mechanical metamaterials are essential to accomplish unusual properties which are seldom observed in natural materials. Here we study the characteristic of the attenuation band in smart mechanical metamaterial having negative stiffness and mass properties. We derive critical physical parameters, which are essential in the formation of locally resonant attenuation band. We found the higher attenuation (HA1) region in the attenuation band has different attributes in case of negative stiffness and mass metamaterials.

11:55 : Nonlinear optics of quasistatic origin from a deep-subwavelength metallic meta-atomical system
Avi Niv
Ben-Gurion University of the Negev (Israel)

Surprisingly, the exact macro-world nonlinear mechanisms known for decades are also invoked in nanoscale nonlinear optics. In this talk, we will present a nonlinear optical mechanism that can only be found once the spatial dimension of a system is below the electromagnetic penetration depth. We will describe our experiments with the second harmonic generation (SHG) and optical rectification and discuss future research directions such as third-order effects, high harmonic generation, and chaos.

12:10 : Photonic bound states in the continuum in asymmetric bi-slot metasurfaces
Ti-Jung Hsu, Ruey-Lin Chern
National Taiwan University (Taiwan)

We investigate the photonic bound states in the continuum (BICs) in dielectric metasurfaces composted of two asymmetric slots in the unit cell of a square lattice. Symmetry-protected BICs occur at the polarization vortex center with integer topological charge in the polarization state diagram when the structure is fully symmetric. By introducing the asymmetry between the two slots, accidental BICs or Friedrich-Wintgen BICs can be formed from the merging of two circular polarization points with half-integer topological charge.

11:10 - 12:25 — Salle Guy Gautherin

Session 4A24

Plasmonics and Nano-Optics

Chaired by: Andrés Guerrero Martínez

11:10 : Radiative suppression of exciton-exciton annihilation in a two-dimensional semiconductor
Luca Sortino, Merve Gülmüs, Benjamin Tilmann, Leonardo de S. Menezes, Stefan A. Maier
LMU Munich (Germany)

Exciton-exciton annihilation (EEA) processes are a fundamental limit for the efficiency of two-dimensional (2D) semiconductors. Here, we demonstrate suppressed EEA by enhancing light-matter interaction in hybrid 2D-dielectric nanophotonic platforms, by coupling excitons in a transition metal dichalcogenide (TMDC) WS2 monolayer with optical Mie resonances in gallium phosphide (GaP) dielectric nanoantennas. From their ultrafast dynamics, we show reduced EEA processes, even under high exciton density, demonstrating the potential of all-dielectric nanoantennas for low-power integrated nanophotonic devices based on 2D semiconductors.

11:25 : Layer-Dependent Optical Properties of 2D CrI3 from Monolayer to Mesoscale Mapped by Hyperspectral Imaging
Fernando Ramiro-Manzano[1], Marta Galbiati[2], José Joaquin Pérez Grau[2], Fernando Cantos-Prieto[2], Jaume Meseguer-Sanchez[2], Ivona Kosic[2], Filippo Mione[2], Andrés Cantarero[2], David Soriano[3], Efrén Navarro-Moratalla[2]
[1] *Universitat Politècnica de València (Spain),* [2] *Universitat de València (Spain),* [3] *University of Pisa (Italy)*

Understanding the optical properties of 2D magnetic materials in relation to the number of layers is crucial for their application in photonics research. In this study, we investigate the modulation of the optical properties of CrI3 across different thicknesses ranging from single layer to hundreds of layers. Our findings reveal a

crossover in the modulation of optical properties at the mesoscale, which aligns with the thickness range at which the low-temperature magnetic properties of CrI3 changes from antiferromagnetic to ferromagnetic.

11:40 : Experimental Realization of Quantum Walks near Synthetic Horizons on Photonic Lattices
Chong Sheng, R. Q. He, Y. L. Zhao, J. C Duan, Y. Wei, C. W. Sun, L. L. Lu, Y. X. Gong, S. N. Zhu, H. Zhu
Nanjing University (China)

Recently, integrated photonic chips, particularly those with the aid of transformation optics, have simulated various aspects of curved spacetime. However, thus far, studying the influence of curved space on quantum entanglement on this type of platform has not yet occurred. Here, we propose and experimentally realize quantum walks of entangled photons near an emulated event horizon, resulting in a counterintuitive phenomenon of optical escape. Our study paves a tabletop platform for studying quantum entanglement in curved space.

11:55 : Orbit-Orbit Interaction of Light: Harnessing Vortex-Trajectory Interplay for Light Manipulation
Raghvendra P. Chaudhary, Avraham Reiner, Nir Shitrit
Ben-Gurion University of the Negev (Israel)

The orbit-orbit interaction of light is the interaction between the intrinsic and extrinsic orbital angular momenta associated with optical vortex beams and varying beam trajectories, respectively. We report the orbit-orbit interaction of light in a plasmonic ellipse cavity, whose unique geometry facilitates vortex-trajectory interplay when a vortex is considered in one of the foci of the ellipse. This interaction, manifested by vortex-dependent shifts, opens a new paradigm for light manipulation by leveraging the manifold vortex states.

12:10 : Plasmonic Colors - Valuable Members of the Structured Colors Family
Samuel Peana, Sarah Chowdhury, Ludmila Prokopeva, Alexander Kildishev
Purdue University (USA)

We review the accomplishments and motivations behind the development of plasmonic structural colors, overview the highlights of recent works, and provide a perspective on this field's colorful and bright future going forward. In particular, for perspective, we will review the current application space for plasmonic colors, from displays to sensors. Furthermore, we provide a overview on the different manufacturing processes of various plasmonic color films proposed to produce products at industrial scales.

11:10 - 12:25 — Salle P1

Session 4A25

Classical and Quantum Phononics

Organized by: Khaled Mnaymneh

Chaired by: Khaled Mnaymneh

11:10 : Invited talk
Applications of phonon-electron devices for microwave frequency signal processing
Matt Eichenfield
Sandia National Labs (USA)

Devices that allow controllable interactions between electrons and phonons—acoustoelectric devices—have undergone a resurgence of interest in the last 8 years due to rapid advanced in heterogeneous integration of piezoelectric materials and semiconductors. Here, I will describe some of the novel devices and systems that are emerging from this field. I will discuss my group's work demonstrating devices such as phononic amplifiers, mixers, switches, and others. Finally, I will discuss the prospects of these devices for insertion into wireless technologies both existing and future, as well as novel applications.

11:30 : Quantum explorations and applications of phonon-electron interactions
Matt Eichenfield
Sandia National Labs (USA)

Interactions between electrons and phonons are being vigorously explored for their utility in RF signal processing, sensing, and more. However, these devices are almost entirely unexplored in the quantum regime. Here, I will describe our recent work theoretically and experimentally exploring quantum electron-phonon interactions and how they can be applied to fundamental studies of materials and quantum information science.

11:45 : Invited talk
Diamond X-band Optomechanical Crystals
Elham Zohari, Waleed El-Sayed, Joseph Losby, Gustavo de Oliveira Luiz, Paul Barclay
University of Alberta (Canada)

We demonstrate single-crystal diamond optomechanical crystal cavities that support $\sim$ 200 THz optical modes co-localized with high-frequency 10 GHz acoustic modes. Their measured optomechanical coupling g0/2π $>$ 200 kHz is extracted through optomechanical back action measurements.

12:05 : Invited talk
Automated Inverse Design Solution for Metalenses
David Zoepfl[1], Lukas Eng[1], Olivier-Michel Tardif[2], Étienne Pilon[2], Laurence Mercier-Coderre[2], David Tran[2], Gerhard Kirchmair[1], Mathieu Juan[2]
[1] *University of Innsbruck (Austria),* [2] *Université de Sherbrooke (Canada)*

Departing from traditional optomechanics, the integration of microwave circuits offers substantial nonlinearities that can be effectively harnessed for enhanced coupling between microwave and mechanical systems. In this work, we show that a mechanical system can be strongly coupled to a microwave circuit, enabling cavity cooling with one microwave photon in average. In addition, the strong Kerr non-linearity of the circuit can be leveraged to further increase the cooling efficiency compared to what is achievable with a linear system. Since mechanical systems can also be efficiently coupled to optical fields, mechanical interfaces can be used to realize transduction of quantum information between the microwave and optics domains.

11:10 - 12:10 — Salle P2

Session 4A26

Plasmonic Structures and Cavities

Chaired by: Tigran Shahbazyan

11:10 : Holographic control of plasmonic structures on the distal facet of multimode optical fibers
Liam Collard[1], Filippo Pisano[1], Di Zheng[1], Antonio Balena[1], Linda Piscopo[1], Muahmmad Fayyaz Kashif[1], Marco Pisanello[1], Liset M. de la Prida[2], Cristian Ciraci[1], Marco Grande[3], Massimo De Vittorio[1], Ferruccio Pisanello[1]
[1] *Italian Institute of Technology (Italy),* [2] *CSIC (Spain),* [3] *Politecnico di Bari (Italy)*

Plasmonic fiber tips have attracted considerable research interest from a broad range of perspectives. However, they have been hindered by the turbidity of the fiber combined with the resonant properties of the nanostructures. By applying wavefront shaping, we show that either a sub-region or entire plasmonic structure can be holographically activated. We have applied this method to a wide range of plasmonic structures including periodic nanostructures for EOT and sub-diffraction beam formation and nanoislands for Surface Enhanced Raman Spectroscopy (SERS).

11:25 : Terahertz virtual superlens via evanescent amplification in the radiating near-field
Alessandro Tuniz, Boris Kuhlmey
The University of Sydney (Australia)

We present a universal method for amplifying evanescent waves in the radiating near field, reconstructing subwavelength images akin to a virtual superlens. We quantify the trade-off between noise and measurement distance, and demonstrate complex image reconstruction down to λ/7 with amplitude signal-to-noise ratios below 25 dB between 0.18-1.5 THz. Our procedure applies to any near field probe, greatly relaxes experimental requirements for subwavelength imaging at sub-optical frequencies, and opens the door to non-perturbing near-field scanning.

11:40 : High resolution plasmonic-based impedance microspectroscopy
Sidahmed Abayzeed
University of Nottingham (United Kingdom)

This talk presents a novel optical imaging technique that is capable of mapping electrical impedance with diffraction-limited resolution. The method presented is based on widely used surface plasmon resonance imaging, an optical microscopy technology with an emerging application in label-free and non-scanning imaging of voltage. High resolution probing of electrical impedance is extremely important since it provides a new way of studying electrical properties of living cells as well as a wide range of physiological processes.

11:55 : Plasmonic addressing structure
Marius Crouzier[1], Vy Yam[1], Giovanni Magno[2], Thomas Lopez[3], Béatrice Dagens[1]
[1] *Université Paris-Saclay (France),* [2] *Polytechnic University of Bari (Italy),* [3] *Stellantis (France)*

We present here a new structure allowing for independent addressing of sub-micrometric area. Plasmonic chains are deposited above a waveguide array. The coupling between the chains and the waveguides is numerically analyzed. This structure could have applications in various domains, from holography with reconfigurable metasurfaces to biotechnology with lab-on-chip structure.

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