Advancements in Metamaterial Design for Terahertz Applications

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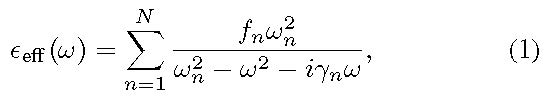
*Keywords*— metamaterials, terahertz, machine learning, photonic crystals.

# INTRODUCTION

Metamaterials have revolutionized electromagnetic wave control. The growing demand for advanced terahertz technologies necessitates innovative material design approaches.

# Methods

Our methodology integrates simulation, optimization algo- rithms, and experimental feedback:



where εeff denotes the effective permittivity, fn the oscillator strength, ωn the resonant frequency, and γn the damping factor.



Fig. 1 Unit cell geometry of the proposed metamaterial.

# Results and Discussion

Experimental results show:

* 92 percent absorption at 0.8 THz
* 40 percent broader operational bandwidth than conventional THz absorbers
* Strong agreement between simulated and measured spectra (Fig. 1)

# Conclusion

We have demonstrated a THz metamaterial with superior wavefront control and broadband absorption. Future work will extend the design to polarization-independent and reconfig- urable THz devices.

# Acknowledgments

This work was supported by the HorizonTech Research Initiative. The authors thank the AMBER Centre for fabrication support.

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