Third-order rectification in centrosymmetric metals

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Rectification, the conversion of AC fields into DC currents, is crucial for optoelectronic applications such as energy harvesting and wireless communication [1, 2]. However, it is conventionally absent in centrosymmetric systems due to vanishing second-order optical responses. In our paper [3], we demonstrate significant rectification and photogalvanic currents in centrosymmetric metals via third-order nonlinear optical responses, driven by finite Fermi surface and disorder-induced contributions. We unveil distinct band geometric mechanisms---including Berry curvature quadrupole, Fermi surface injection, and shift effects---and classify all symmetry-allowed rectification responses. Using graphene as an example, we illustrate rectification tunability via light polarization and helicity, enabling rectification engineering in centrosymmetric materials for energy-efficient photodetection and terahertz applications.

References

[1] D. Kumar, C.-H. Hsu, R. Sharma, T.-R. Chang, P. Yu, J. Wang, G. Eda, G. Liang, and H. Yang, Nature Nanotechnology **16**, 421 (2021).
[2] X. F. Lu, C.-P. Zhang, N. Wang, D. Zhao, X. Zhou, W. Gao, X. H. Chen, K. T. Law, and K. P. Loh, Nature Communications **15**, 245 (2024).
[3] Sanjay Sarkar, Amit Agarwal, arXiv preprint arXiv:2501.17460.

Figures

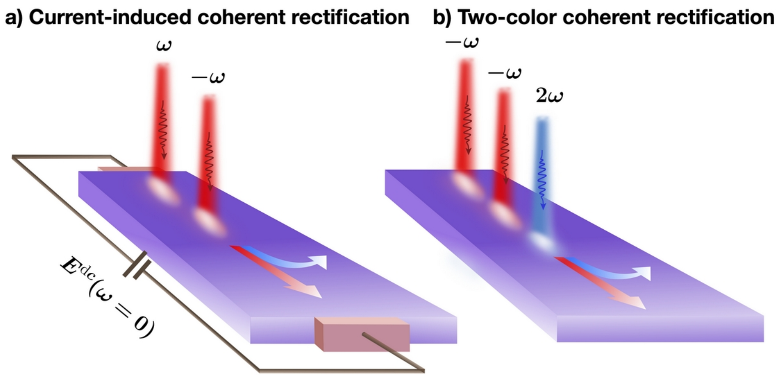

Figure 1: Schematic of third-order rectification in centrosymmetric systems

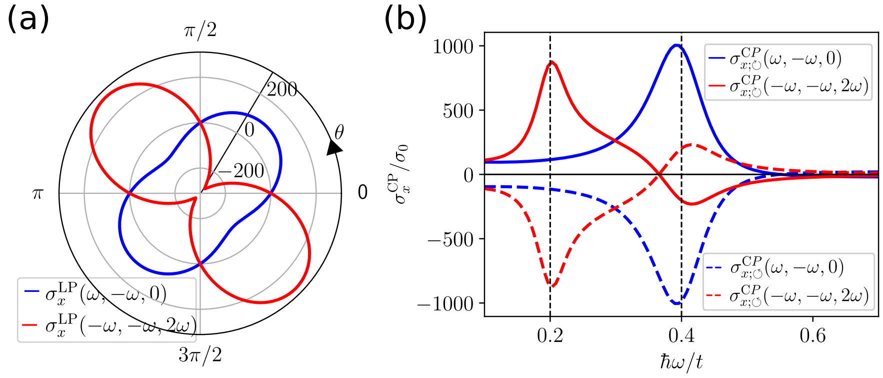

Figure 2: Polarization angle and helicity dependent third-order rectification current in graphene