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Nonlinear terahertz emission spectroscopy of topological chiral multifold semimetals[1]

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The absence of mirror symmetry, or chirality, is behind striking natural phenomena found in systems as diverse as DNA and crystalline solids. A remarkable example occurs when chiral semimetals with topologically protected band degeneracies are illuminated with circularly polarized light. Under the right conditions, the part of the generated photocurrent that switches sign upon reversal of the light's polarization, known as the circular photogalvanic effect (CPGE), is predicted to depend only on fundamental constants. The conditions to observe quantization are non-universal, and depend on material parameters and the incident frequency. In my talk, I will discuss nonlinear terahertz emission spectroscopy with tunable photon energy from 0.2 eV - 1.1 eV in the chiral topological semimetals CoSi [1,2] and RhSi[3]. Particularly, we identify a large longitudinal photocurrent peaked at 0.4 eV reaching $\sim$ 550 $\mu A/V^2$ in CoSi, which is much larger than the photocurrent in any chiral crystal reported in the literature. Using first-principles calculations we establish that the peak originates from topological band crossings, reaching 3.3$\pm$0.3 in units of the quantization constant. Our calculations indicate that the quantized CPGE is within reach in CoSi upon doping and increase of the hot-carrier lifetime. References:[1]Ni, et al. arXiv:2006.09612. [2]Xu, et al. PNAS (2020) https://doi.org/10.1073/pnas.2010752117. [3] Ni, et al. arXiv:2005.13473 npj Quantum Materials (2020)

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