Band geometry and nonlinear optical studies on polar Weyl semimetals

Liang Wu[1,2]
[1]*University of Pennsylvania, 209 S 33rd St, Philadelphia, PA, 19104, USA*
[2]*University of California, Berkeley, CA, 94720, USA*

Email: liangwu@sas.upenn.edu

The second-order optical nonlinearity $\sigma^{(2)}(\omega)$ has been a focus of basic research and technological development for decades as it is both a probe of inversion symmetry breaking in media and the basis for generating coherent light from far-infrared to ultraviolet wavelengths. Here, we focus on the relation between band geometry and nonlinear optics. We measured second harmonic generation (SHG) with incident photon energy from 0.4 eV - 1.6 eV on a polar semimetal TaAs with a sharp resonant peak detected, that is larger than previously measured in any crystal. Our discovery of a giant anisotropic $\sigma^{(2)}(\omega)$ in TaAs raises the following questions: what is special about TaAs and/or polar metals that accounts for large resonant optical nonlinearity, and, is there a fundamental upper bound on $\sigma^{(2)}(\omega)$ in such inversion breaking crystals? I will describe a coupled Rice-Mele model based on the band-geometric theory of nonlinear optical response that addresses these questions.

References

[1] Liang Wu et al 2017 *Nature Physics*, 13, 350-355.