Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Semiclassical theory of nonlinear magneto-optical responses with applications to topological Dirac/Weyl semimetals TAKAHIRO MORIMOTO, SHUDAN ZHONG, JOSEPH ORENSTEIN, JOEL E. MOORE, UC Berkeley — We study nonlinear magneto-optical responses of metals by a semiclassical Boltzmann equation approach [1]. We derive general formulas for linear and second order nonlinear optical effects in the presence of magnetic fields that include both Berry curvature and orbital magnetic moment. Applied to Weyl fermions, the semiclassical approach (i) captures the directional anisotropy of linear conductivity under magnetic field as a consequence of an anisotropic B^2 contribution, which may explain the low-field regime of recent experiments; (ii) predicts strong second harmonic generation proportional to B that is enhanced as the Fermi energy approaches the Weyl point, leading to large nonlinear Kerr rotation. Moreover, we show that the semiclassical formula for the circular photogalvanic effect arising from the Berry curvature dipole is reproduced by a full quantum calculation in the case of two bands using a Floquet approach. [1] arXiv:1609.05932

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Date submitted: 09 Nov 2016 Electronic form version 1.4