Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Time-resolved Optical Study of Carrier Dynamics in the Weyl Semimetal TaAs M. MEHDI JADIDI, YIGIT AYTAC, RYAN J. SUESS, ANDREI B. SUSHKOV, GREGORY S. JENKINS, University of Maryland, College Park, JAMES G. ANALYTIS, University of California, Berkeley, H. DENNIS DREW, THOMAS E. MURPHY, University of Maryland, College Park — Since their recent discovery in 2015, Weyl semimetals have attracted attention because they are predicted to exhibit a host of novel physical and topological properties not seen in other materials. While the electronic structure of these new materials has been confirmed using surface probe methods such as angle-resolved photoemission spectroscopy (ARPES), the fundamental carrier dynamics and temporal response of these materials cannot be discerned through DC or surface-probe measurements. Here we present an ultrafast optical study of the carrier dynamics in the broken-inversion-symmetry Weyl semimetal tantalum arsenide (TaAs). We employ reflectance two-color pump-probe measurements at photon energies 0.8 eV and 1.6 eV to measure the relaxation of photoexcited electrons in in TaAs, as a function of the lattice temperature. Our measurements reveal a fast time constant ($\approx$2 ps at 10 K) which we associate with the scattering of hot electrons via optical phonons, followed by a slower relaxation rate ($\approx$200 ps at 10 K) attributed to acoustic phonon emission. The temperature dependence measurements show that both relaxation processes become slower with increasing lattice temperature. We present a thermodynamic model based on thermalized Dirac quasi-particles to explain the observed reflectance pump-probe results.

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Date submitted: 11 Nov 2016

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