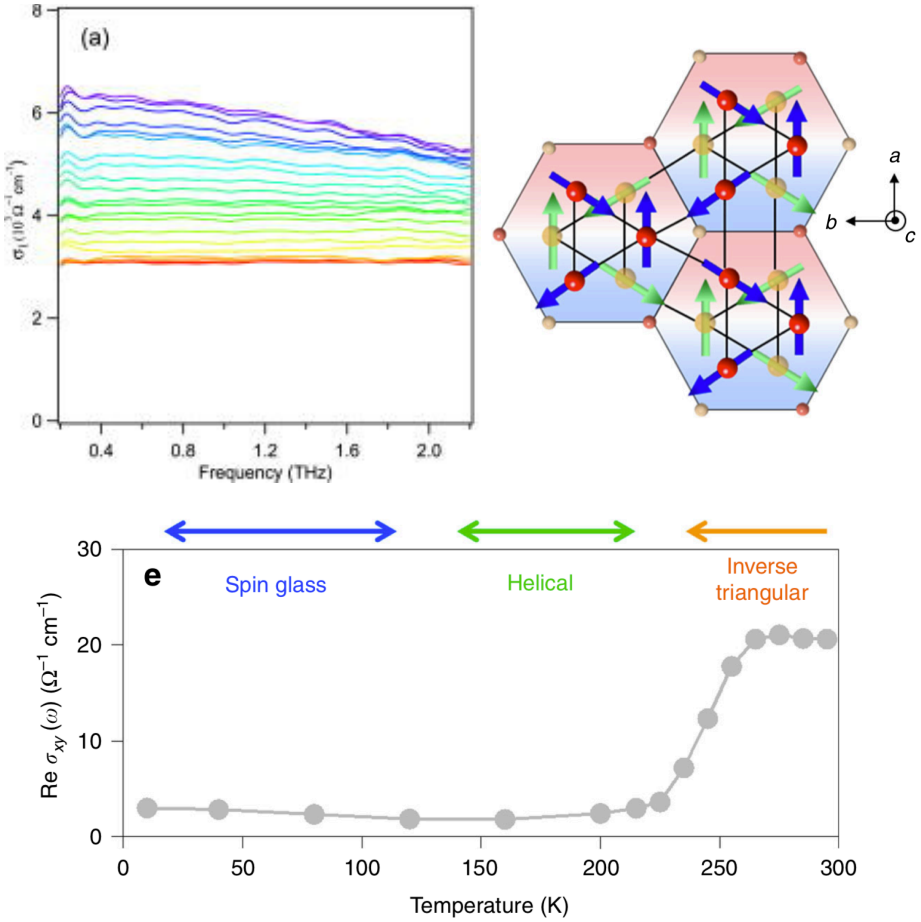
Room-temperature THz anomalous Hall effect in Weyl antiferromagnet Mn_3Sn films

Institute for Quantum Matter EFRC DE-SC0019331



B. Cheng, Y. Wang, D. Barbalas, T. Higo, S. Nakatsuji, and N. P. Armitage, Applied Physics Letters, **115**, 012405 (2019)

T. Matsuda, N. Kanda, T. Higo, N. P. Armitage, S. Nakatsuji, and R. Matsunaga, Nature Communications **11**, 909 (2020).

Scientific Achievement

Using time-domain THz spectroscopy and polarimetry, we have measured the magneto-optical response of the Weyl AF Mn_3Sn. A large anomalous Hall conductivity $|\sigma_{xy}|$~20 Ω^{-1}cm^{-1} at THz frequencies is clearly observed as polarization rotation. Gapping of the Fermi surfaces is apparent due to translation symmetry breaking in the helical phase.

Significance and Impact

Mn_3Sn is one of the most promising candidates for a magnetic Weyl semimetal. Observation of the THz AHE at room temperature demonstrates the possibility of ultrafast readout for antiferromagnetic spintronics using such systems, and will open up new avenues for studying nonequilibrium dynamics in Weyl antiferromagnets.

Research Details

- Films were made by DC magnetron sputtering. Mn_3Sn was deposited at room T and annealed at 500 °C.
- The polarization-resolved THz measurements were performed in zero field after the samples were magnetized under a field of 5 T, where the magnetization vector M is normal to the film.
- At low frequencies, the optical conductivity can be described by a single Drude oscillator.
- The plasma frequency is strongly suppressed in the helical phase for T< 260 K.

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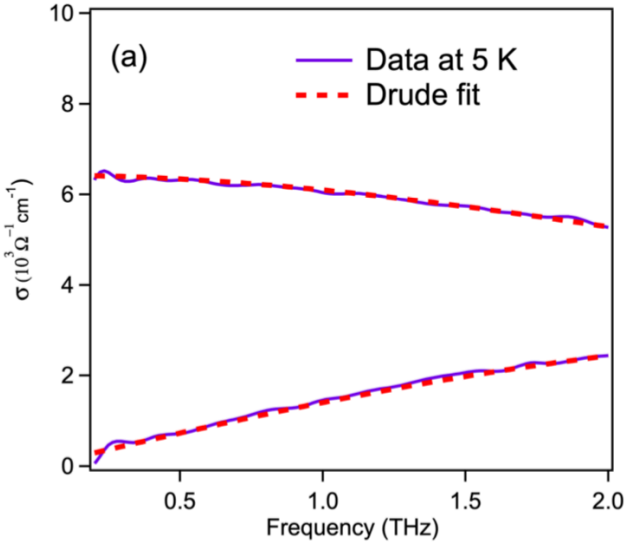

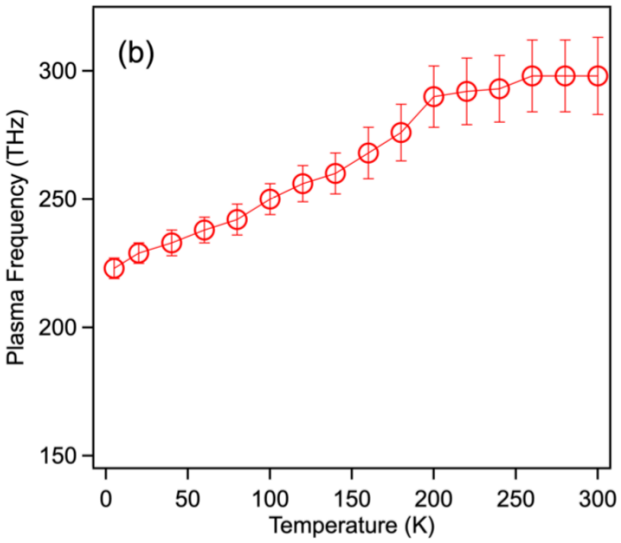

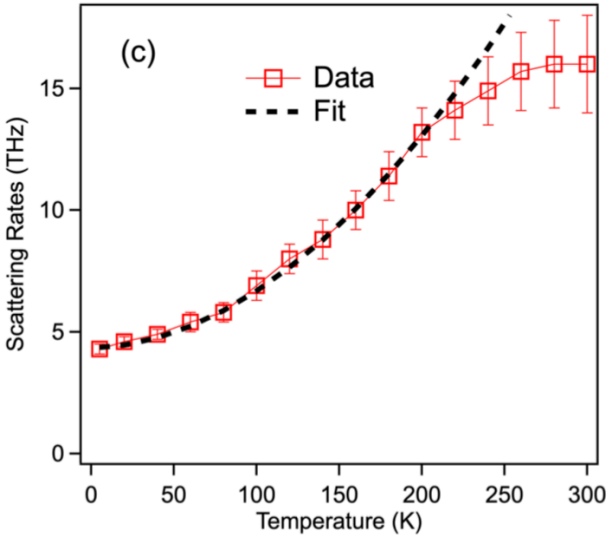

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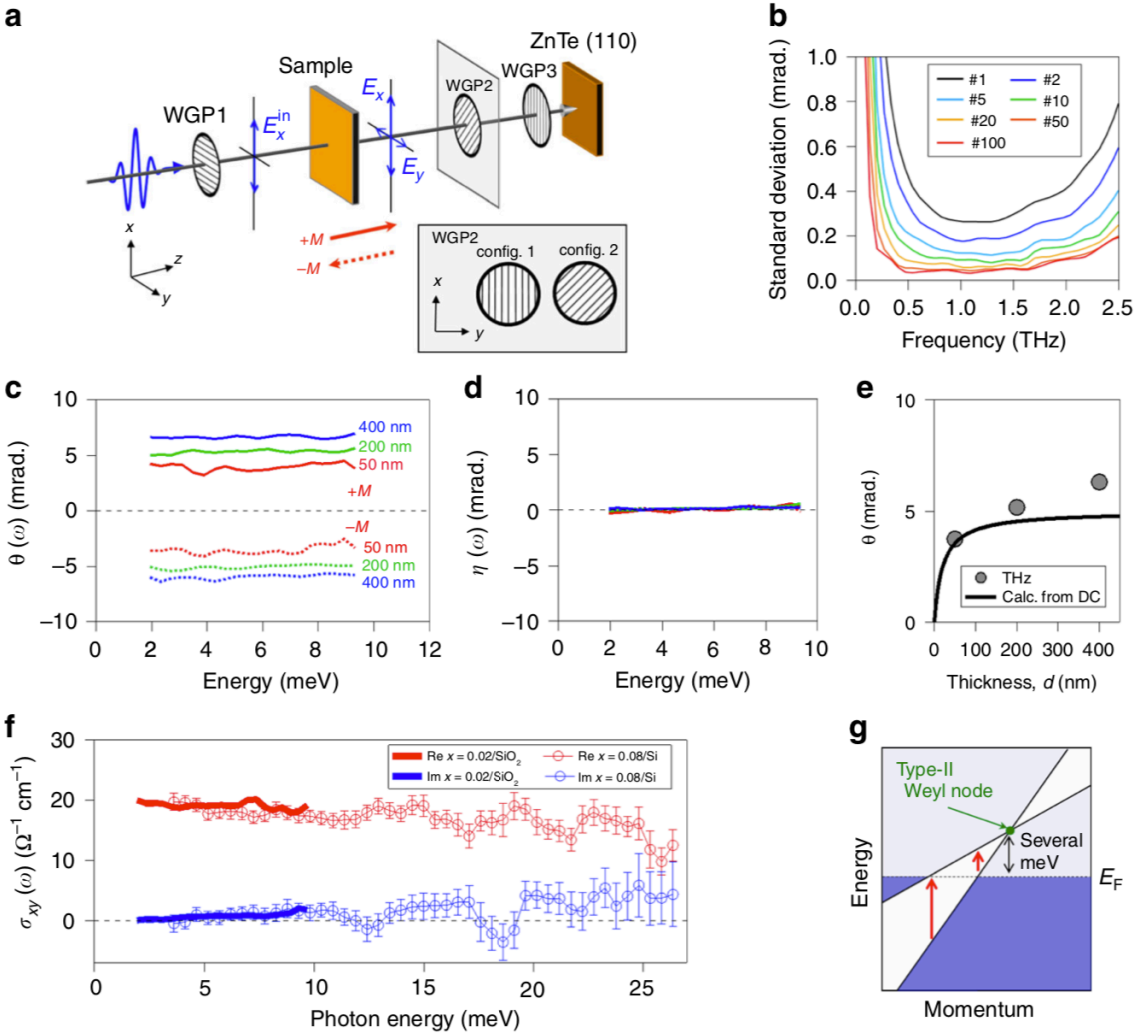

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