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Searching for Near-IR Fermi Arcs in a Photonic Chiral Woodpile[1]

ALISON WEISS, Amherst College, SACHIN VAIDYA, CHRISTINA JRG, MIKAEL RECHSTMAN, Penn State — Topology in photonic platforms causes light to exhibit unusual transport properties. Weyl points are 3D topological degeneracies in the band structure of a periodic material and have been observed in chiral woodpile photonic crystals. Weyl points give rise to special surface states (Fermi arcs) that exist on the interface between a 3D photonic crystal and a different medium. Previous realizations of Weyl points and Fermi arcs were restricted to large scale structures that operated at microwave wavelengths. However, recent advances in 3D micro fabrication technology have brought the operating wavelength of these photonic crystals to mid and near infrared wavelengths. In this project, we simulate photonic crystal band structures using the MIT Photonic Bands package (MPB) to optimize the parameters of the crystal for observing Fermi arcs, and we compute the transmission spectrum for the optimized crystal using S4. We fabricate our crystals out of photoresist with a nanoscribe, and plan to coat our structures with titanium dioxide using an atomic layer deposition (ALD) machine to increase the effective refractive index contrast of the photonic crystal. We experimentally observe the transmission spectrum for our photonic crystals by using a Fourier Transform Infrared Spectroscopy (FTIR) device. Here we reproduce a previously published experiment observing a charge-2 Weyl point in the infrared using the FTIR and an uncoated photoresist chiral woodpile, an important calibration step for observing Fermi arcs in the coated structure. We also present a design for a fabricable chiral woodpile with potentially observable Fermi arcs in the near-infrared.

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