IR Magneto Reflection Spectroscopy of Weyl Candidate Semimetal GdPtBi

Moon, S. (NHMFL, FSU); Wei, K. (NHMFL); Siegrist, T., Ozerov, M., Smirnov, D. (NHMFL)

Introduction

GdPtBi is a half-Heusler compound with a non-centrosymmetric cubit structure and strong spin-orbit coupling. Recent calculations have suggested that it has four parabolic bands degenerated at the Γ- point with different spins for conduction and valence bands. Thus, a magnetic field would shift and split these bands forming pairs of crossed linear bands possibly creating a field-induced Weyl semimetal state [1,2]. Indeed, the observed negative magnetoresistance in GdPtBi have been discussed as a signature the chiral anomaly, a key feature specific to Weyl semimetals [1]. However, the IR spectroscopy measurements have indicated the presence of linearly dispersing bands with crossing points near the chemical potential even at zero magnetic field [3]. Our work aims at elucidating the electronic band structure of GdPtBi using the magneto-infrared (magneto-IR) spectroscopy techniques.

Experimental

The magneto-IR reflectance spectra were measured from the (111) plane of GdPtBi crystals at 4.2K and magnetic fields up to 17.5T (SCM3) in both Faraday and Voigt configurations.

Results and Discussion

The 2D map shown in Fig.1 provides an overview of the magneto-IR reflectance spectra plotted versus the square root of the magnetic field. Several field dependent spectral features associated with inter-Landau-level (LL) transitions are observed. The lowest energy transition varies linearly with $B^{1/2}$, which suggests the linear dispersion of relevant electronic bands. However, other higher energy transitions show parabolic dispersion. The mixture of LL transitions originating from both linear and parabolic bands without crossing between them may not be explained by a typical Weyl Hamiltonian or available band structure calculations [2,4].

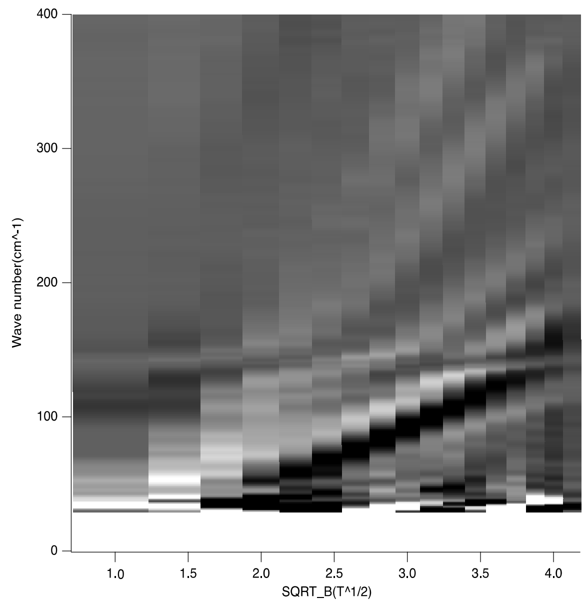

Fig. 1. Map of normalized magneto-IR reflectance R(B)/R(B=0) of GdPtBi as a function of the square root of the magnetic field applied in Voigt geometry.

Conclusions

We have performed IR magneto-reflectance measurements on GdPtBi single crystals and observed several inter-LL transitions indicating contributions from both linear and parabolic electronic bands. More detailed higher fields experiments including measurements with different orientations of the magnetic field in respect to the principal crystallographic directions of GdPtBi single crystals are needed to probe the complex band structure of this material.

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