Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Fermiology of the low carrier density superconductor Tl-doped PbTe, and its non-superconducting analog, Na-doped PbTe. PAULA GIRALDO-GALLO, Stanford University and National High Magnetic Field Laboratory, PHILIP WALMSLEY, Stanford University, BORIS SANGIORGIO, MICHAEL FECHNER, ETH Zurich, LISA BUCHAUER, BENOIT FAUQUE, ESPCI, Paris, France, SCOTT RIGGS, National High Magnetic Field Laboratory, ROSS MCDONALD, Los Alamos National Laboratory, THEODORE GEBALLE, Stanford University, NICOLA SPALDIN, ETH Zurich, KAMRAN BEHNIA, ESPCI, Paris, France, IAN FISHER, Stanford University — PbTe is a narrow band gap semiconductor, which can be electron- or hole-doped, obtaining typical carrier densities of the order of 1x10^{20}cm^{-3}. The only impurity known to produce superconductivity in this host material is Tl, resulting in a maximum critical temperature of 1.5K - an order of magnitude higher that the T_c observed in similar low carrier density semiconductors. In this work we performed a full Fermi surface characterization of $Pb_{1-x}Tl_xTe$, as well as its non-superconducting analog, $Pb_{1-x}Na_xTe$, via Shubnikov de Haas oscillations in magnetotransport, for magnetic fields up to 35T (DC). Our results show that beyond a critical impurity concentration close to the emergence of superconductivity, there are clear differences in the normal-state carriers. In non-superconducting $Pb_{1-x}Na_xTe$, all carriers reside at four ellipsoidal pockets of the Fermi surface, while in superconducting $Pb_{1-x}Tl_xTe$, there is an additional set of carriers, consistent with incoherent resonant impurity levels. The presence or absence of these states at or near the Fermi energy is intimately connected to the presence or absence of superconductivity in doped PbTe.

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Date submitted: 06 Nov 2015 Electronic form version 1.4