Introduction

Quantum phase transitions correspond to a continuous ground state transformation at $T=0$ driven by quantum fluctuations. One of the intensively investigated issues is the possibility of a Fermi Surface volume change at a quantum critical point. In this context, the metamagnetic transition, corresponding to a non-linear increase in magnetization of a paramagnet, have been focus of attention since it might involve such a change, even tough its microscopic mechanism is not fully established. Moreover, strong deviations from Fermi Liquid theory reported in Sr$_3$Ru$_2$O$_7$ have raised the possibility of a metamagnetic quantum critical end-point [1]. CeIrIn$_5$, a heavy fermion compound with a recently discovered metamagnetic transition at high fields [2], offers yet another playground for such investigations. In a preliminary study, we observed a field induced non-Fermi Liquid behavior in both resistivity and specific heat up to 17 T [3]. Here, we report a low temperature study of transverse magnetoresistance and quantum (dHvA) oscillations of cantilever magnetization in a CeIrIn$_5$ single crystal, using the 33 T magnet with the portable dilution refrigerator at NHMFL in Tallahassee.

Results and Discussion

The temperature dependence of the resistivity, shown in Fig. 1, is obtained from field sweeps between 20 T-32.75 T. For fields below metamagnetic transition (28 T), resistivity has an upturn for temperatures below 0.3 K. The upturn becomes more pronounced near the transition. The power law fit with an exponent 1.5 (solid lines in Fig.1) above the transition is indicative of non-Fermi Liquid behavior. Fig. 2 shows the FFT spectrum of the dHvA oscillations resolved in cantilever magnetization at 51 mK in the same field range. The frequencies correspond to the quasi-2D “α” and “β” sheets of the Fermi Surface, in good agreement with a previous report [4]. A more detailed analysis revealed that both the frequency and effective mass of the orbits increase slightly above the transition, pointing to a more itinerant character of f-electrons in the high field state.

![Fig. 1. Resistivity vs. Temperature in CeIrIn$_5$ for $H||[001]$.](image1)

![Fig. 2. FFT spectrum of the magnetization oscillations.](image2)

Taken together with our earlier report of non-Fermi Liquid behavior in the low field phase up to 17 T, this is evidence for a metamagnetic quantum critical point in CeIrIn$_5$. The unusual upturn of resistivity close to the metamagnetic field indicates that disorder effects might be important near this quantum critical point.

References