MAGNETORESISTANCE AND dHvA STUDY OF THE METAMAGNETIC TRANSITION IN $CeIrIn_5$ UP TO 45T

C. Capan, R.G. Goodrich, J.F. DiTusa (LSU, Physics); Y.J. Jo, L. Balicas, T.P. Murphy, E.C. Palm (NHMFL); R. Movshovich, E.D. Bauer, M.F. Hundley, J.D. Thompson, J.L. Sarrao (LANL)

An important issue in heavy fermion physics is to determine possible deviations from Fermi Liquid theory and associated Fermi Surface change at the onset of a magnetic order at T=0. At this so-called quantum critical point, the presence of strong quantum fluctuations is expected to lead to the breakdown of quasiparticle excitations characteristic of the metallic state. Metamagnetism refers to a non-linear change of magnetization induced by an applied magnetic field in a paramagnetic metal. Such a transition has been observed at high fields in the heavy fermion CeIrIn5 in the magnetization [1] and the specific heat [2]. We have previously reported a low temperature study of the transverse magnetoresistance and quantum (dHvA) oscillations of cantilever magnetization up to 33T across the metamagnetic transition in CeIrIn5 in order to address this issue. We have found that resistivity exhibits a deviation from the Fermi Liquid behavior while the quantum oscillations persist above the metamagnetic field for H||[001]. Here, we report the extension of this investigation to higher field and various angles. We have used the portable dilution refrigerator with a rotator in the 45T hybrid magnet at NHMFL, Tallahassee.

Figure 1 shows the magnetic field dependence of the resistivity (ρ) for field applied at an angle ranging from 0 to 36.3^o from [001]. As the field is tilted away from c-axis, the transition shifts to higher fields and the maximum in ρ is suppressed. Morevover, for H||[001] in the high-field state, the power law exponent in the T-dependence of resistivity is found to increase from 1.5 to 2 as the field is increased, indicating a gradual recovery of the Fermi Liquid behavior as one moves away from the metamagnetic transition, consistent with our previous claim of a metamagnetic quantum critical point in this system [3]. Concomitantly, we resolve quantum oscillations in the magnetization over the entire field range and the associated Fast Fourier spectra are shown for selected angles in Figure 2. For field along the c-axis, the FFT amplitude has similar field dependence as the resistivity: it drops at the metamagnetic transition (see Fig.2 inset). This is highly unusual since any known damping mechanism of quantum oscillations (scattering or phase smearing) is expected to lead to an *enhanced* resistivity. Our results suggest instead that the drop in dHvA amplitude across the transition is likely associated with the non-Fermi Liquid behavior seen in resistivity, a connection that has been missed so far in previous studies of metamagnetism in other systems.

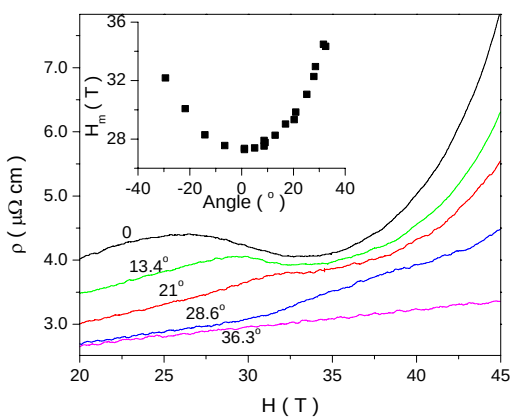

Fig.1: Resistivity vs. Field for various angles
Inset: Angular dependence of the metamagnetic field Hm

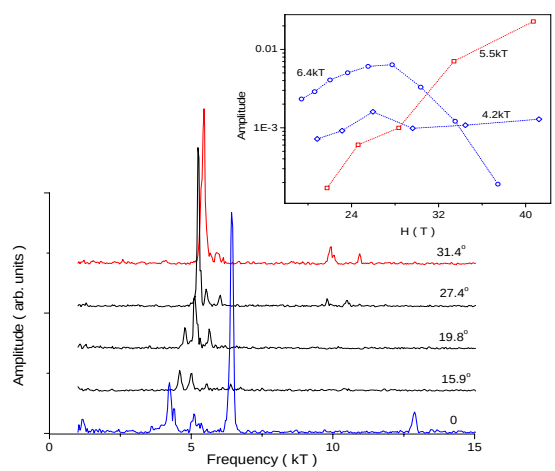

Fig. 2: FFT spectra of dHvA oscillations for various angles.
Inset: Field dependence of the FFT amplitudes at 0 and 31.4^o

References

[1] Takeuchi, T., *et al.*, J. Phys. Soc. Jpn. **70**, 887 (2001).
[2] Kim, J.S., *et al.*, Phys. Rev. B **65**, 174520 (2002).
[3] Capan, C., *et al.*, Phys. Rev. B **70**, 180502 (2004).