HALL EFFECT EVOLUTION ACROSS A FIELD-INDUCED PHASE IN $U(Ru_{0.95}Rh_{0.04})_2Si_2$

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The presence of a quantum critical point (QCP) can be often intimately related to the creation of the unexpected low temperature orders [1]. A heavy fermion compound $U(Ru_{0.95}Rh_{0.04})_2Si_2$ has been recently identified as a unique system in which a field-induced QCP is avoid by the creation of a single magnetic phase[2]. To further understand the nature of the QCP, the Hall effect of $U(Ru_{0.95}Rh_{0.04})_2Si_2$ was measured between 0.6 and 30K using a 50T mid-pulse magnet in NHMFL-LANL.

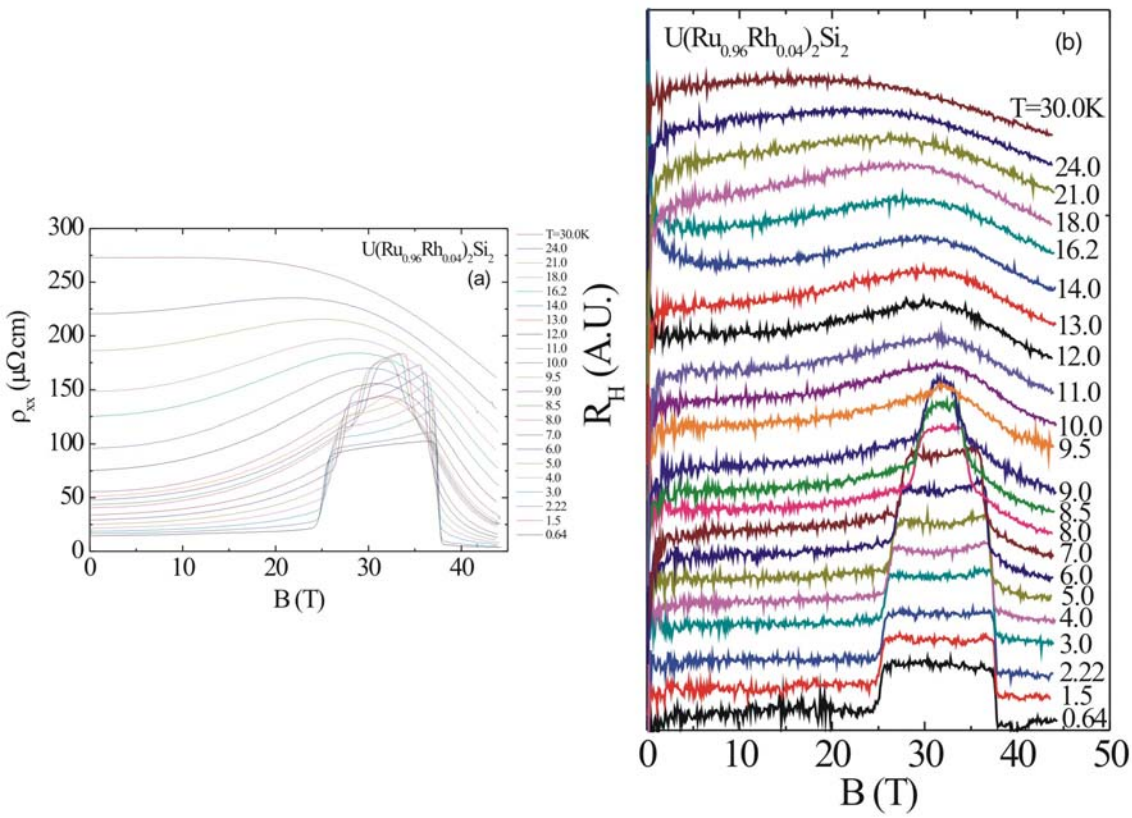

Figure 1. (a) Magnetic field-dependent longitudinal resistivity (b) Hall coefficient R_H at various temperatures as measured by $B//c$ and $I//a$.

Figure 1 (a) and (b) show the B-dependent longitudinal resistivity and Hall coefficient R_H, respectively. Almost constant R_H values at the lowest temperature evidence that the Fermi-liquid ground states are stabilized in each field region, below (heavy Fermi liquid state), above (polarized Fermi liquid state), and inside the phase II. Furthermore, R_H in the polarized Fermi liquid state is clearly smaller than that in the heavy Fermi liquid state. Based on a semi-classical model of electron dynamics, this observation shows that the two Fermi liquid states have different Fermi surface volumes. Therefore, one might expect a quantum phase transition between the two Fermi liquid states at a putative QCP, B_{QCP}. However, instead of showing the signatures of the QCP, resistivity and R_H show a sharp increase inside phase II, evidencing a large decrease in the Fermi surface area. This observation supports the scenario that the divergence of quasi-particle effective mass at the putative QCP was avoided by a partial gap opening in the Fermi surface with the concomitant creation of phase II in $U(Ru_{0.96}Rh_{0.04})_2Si_2$.

References

[1] Laughlin, R.B., *et al*., Adv. Phys., **50**, 361 (2001).
[2] Kim, K.H., *et al*., Phys. Rev. Lett., **93**, 206402 (2004)