THERMAL TRANSPORT AT THE HIGH MAGNETIC FIELD QUANTUM CRITICAL PHASE REGION OF URu_2Si_2

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The heavy fermion system URu_2Si_2 provides one of the most interesting examples of what happens when matter is driven to a "quantum critical point". When very high fields are applied to this material, the U 5f electrons become progressively more localized and then driven quantum critical whereby zero-point quantum fluctuations acquire diverging length scales. This situation results in unique forms of phase transformations as electrons try to avoid the energetically costly singular quantum critical point, as has been shown by direct thermodynamic measurements [1]. We have chosen to measure the thermal conductivity in order to probe this complicated phase diagram in a different way. The thermal transport can be radically affected by different kinds of ground states in differing amounts so that it is of interest to measure this quantity.

We display our results for URu_2Si_2 below in Figure 1, for which we show the thermal conductivity normalized to its value at 10 K, at various fixed fields. The conductivity was measured by monitoring a temperature gradient with two Cernox thermometers. Heat was applied to one end of the sample with a 10 kOhm chip heater. Interestingly, the thermal conductivity shows a sharp jump at low fields, as the sample transforms into the so–called "Hidden Order" state. At higher fields and at varying temperatures, URu_2Si_2 undergoes transitions into several different phases that appear to be robust against changes in the thermal conductivity. This could be an important clue towards the nature of these phases and thus how itinerant electrons seek to avoid quantum criticality. For example, we have previously shown [2] how the zero field "Hidden Order" phase can be described very well using an itinerant BCS model with a strong coupling of the order to the lattice. The fact that a similar model may not apply at high fields could speak to the degree of itinerancy of the electrons involved in the ordering phenomenon.

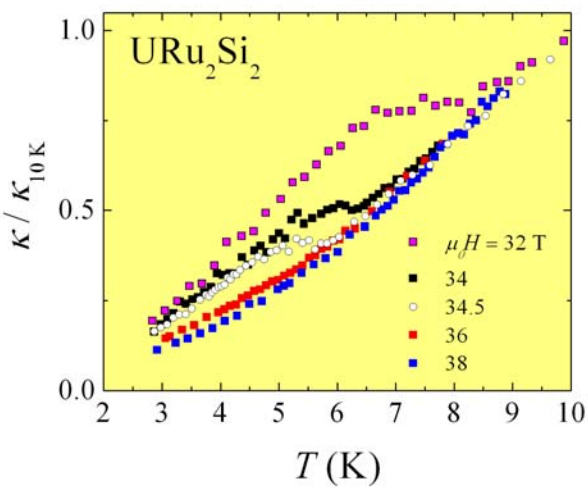

Fig. 1. *Thermal conductivity, normalized with respect to its value at 10 K as a function of temperature at various fixed fields.*

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References

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[2] Sharma, P.A., *et al.*, cond-mat/0507545.