Magnetic-Field Induced Lifshitz Transition in CeBiPt

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Introduction

Unlike in ordinary metals, the inter-metallic compound CeBiPt has a very small Fermi energy of about 20 meV which is comparable to technically available magnetic energy scales and one might expect observable effects of applied magnetic fields on the Fermi-surface topology. At applied fields larger than 25 T, a modification of the band structure together with a change of the charge carrier-concentration was observed as evidenced by Shubnikov-de Haas oscillations and Hall-effect measurements [1]. The most plausible scenario for such a field-driven Lifshitz transition might be that the conduction band which has a strong Ce 5*d* character experiences an enhanced Zeeman splitting due to exchange fields produced by the field-induced polarization of the localized Ce 4*f* moments. Such a spin-polarization scenario would evoke a temperature dependence of the transition field. A clear observation of this temperature dependence with transport measurements was hindered by the thermal broadening of the transition region. In thermo-electric-power measurements, however, a Lifshitz transition would ideally show up as a divergence or more realistically as a maximum due to a non-analytic jump of the DOS at the transition.

Experimental

The magnetic field was applied in the [100] plane. The thermo-electric power (TEP) and the Nernst effect were measured using a lockin technique [2]. Magnetic field sweeps up to 18 T and 45 T were performed at various temperatures using the SCM2 and hybrid magnet respectively both fitted with a Helium-3 insert.

Results and Discussion

We were able to resolve quantum oscillations in the TEP as well as the Nernst measurements which were in agreement with previous SdH measurements. At 30 T both Nernst and TEP show a maximum. This is in agreement with our expectation.

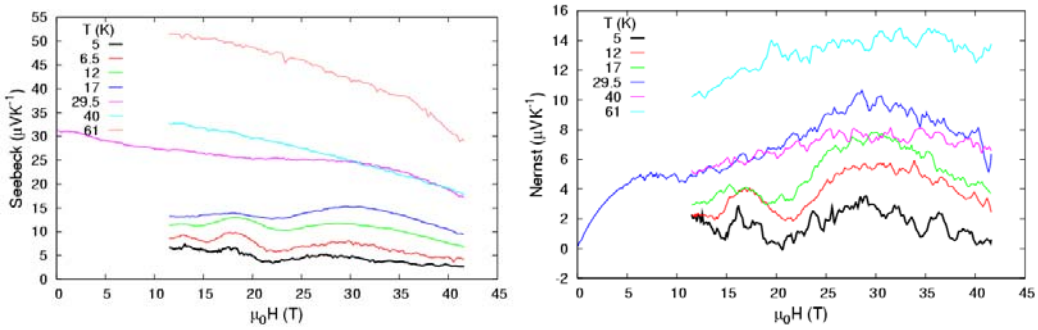

Fig.1: Magnetic field dependence of the TEP (left) and Nernst effect (right) in CeBiPt. Nernst data were obtained by measuring both field directions.

The magnetic-field dependence of the TEP agrees with the expectation for a field-induced Lifshitz transition. The expected temperature dependence of the transition could not unambiguously be identified, but should be rather small according to this experiment.

Acknowledgements

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References

[1] N. Kozlova , *et al.*, Phys. Rev. Lett., **95**, 086403 (2005). [2] E.S. Choi, *et al.*, Rev Sci Inst.,72, 2392 (2001).