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Thermal-transport and electronic structure properties of CePdIn₂

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Abstract content
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The presence of cooperative phenomena and electronic correlations in Ce-based systems leads to the formation of a variety of unusual ground states, such as new quantum states of matter, magnetic ordering, itinerant heavy fermion behaviour and unconventional superconductivity. The ground state properties of these systems are governed mainly by the antiferromagnetic exchange coupling of the Ce 4f magnetic moments with conduction band states. This gives rise to two competing mechanisms, i.e. the Kondo and the RKKY interactions.
CePdIn₂ has been classified by the recent literature as a local moment ferromagnet with T_C = 10 K, a small Kondo temperature of about 5 K and metallic behaviour of the resistivity above T_C [1]. This suggests that the physical properties of the system can be understood in the framework of the RKKY interaction, where Ce 4f electrons are expected to have a localised nature. In this work we report on our recent experimental results on the bulk thermal-transport and electronic structure properties of CePdIn₂, which reveal subtleties not captured by such a classification. In particular, our specific heat results show model mean field ferromagnetic behaviour emerging below 10 K, implying that long-range magnetic correlations are important in establishing magnetic order. Furthermore, the Seebeck coefficient changes sign twice below 100 K, which can be readily explained within the framework of competing (exchange and correlation) energy scales particular to Ce-based intermetallics in which the Kondo interactions become prominent. Moreover, resonant photoemission and x-ray absorption measurements at the Ce M₅₄ edges allow us to determine the valence of the Ce ions and to reveal a large f-d electron hybridization together with a significant intermediate valency.
Combined, these results suggest that CePdIn₂ is a hereto-overlooked member of a small family of strongly correlated ferromagnetic Kondo lattices [2,3], whose properties are determined by a drastic modification in 1) the Ce-ion valence and 2) the 4f hybridization strength which affects the electron hopping between the ions.

[1] L.M. Da Silva et al., Physica B 404, 3018 (2009)
[2] C.D. Batista et al., PRL 88, 187203 (2002)
[3] C.D. Batista et al., PRB 68, 214430 (2003)

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