TRR 80 Sonderseminar

Am Mittwoch, den 3. Dezember um 15:45 Uhr

spricht

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über das Thema

Strongly correlated electronic phenomena arising from quadrupolar degrees of freedom in non-Kramers $4f^2$ systems PrT_2Zn_{20} (T = Rh and Ir)

There has been considerable interest in praseodymium-based intermetallic compounds with $4f^2$ electronic configurations, because an abundance of unusual phenomena arising from strong hybridization between 4f and conduction electrons has been discovered in Pr-filled skutterudite; heavy-fermion superconductivity in $PrOs_4Sb_{12}$, a metal-insulator transition in $PrRu_4P_{12}$, and scalar-type multipole order in $PrFe_4P_{12}$ [1,2]. We have recently focused on a novel family of Pr-based compounds with a caged structure, PrT_2Zn_{20} (*T: Transition metal*), where large coordination number of the Pr ion leads to weak crystalline electric field (CEF) effect, whereas hybridization of the 4f ^{2} electrons with conduction electrons of cage atoms is strengthened. Such conditions may enable the compounds to show strongly correlated electronic phenomena.
Keeping this in mind, we have synthesized and studied the caged compounds PrT_2Zn_{20} (T = Ru, Rh, and Ir) crystallizing in the cubic $CeCr_2Al_{20}$-type structure, where the Pr ion is encapsulated in a highly symmetric Zn cage [3]. The three compounds show the Van-Vleck paramagnetic behavior in χ(T), indicating the nonmagnetic CEF ground states [4,5]. The magnetic specific heat C_{mag} shows a Schottky-type peak at around 14 K, which can be reproduced by a doublet-triplet model [6,7]. These facts corroborate that the CEF ground states of the Pr ions are the nonmagnetic Γ_3 doublet with quadrupolar degrees of freedom. For *T* = Rh and Ir, the AFQ order of the non-magnetic Γ_3 doublet takes place at T_Q=0.06 and 0.11 K, respectively [6,7]. Furthermore, below T_Q, superconducting transitions occur at T_c=0.05 and 0.06 K. The entropy at T_Q's is only 10 and 20% of Rln2 which is expected for the twofold degeneracy of the Γ_3 doublet, indicating that fluctuations of quadrupole probably remain active below T_Q. The facts suggest that the superconducting Copper pair is possibly mediated by the quadrupole fluctuations. Furthermore, in C_{mag} for *T* = Rh and Ir, broad peaks appear at around 0.3 K, where the electrical ρ shows temperature dependence of $r(T)\mu\sqrt{T}$. The anomalous temperature dependence of C_{mag} and ρ possibly suggests emergence of a quadrupole Kondo lattice formed by the strong hybridization of the 4f ^{2} electrons with the conduction electrons [8].

References
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[7] T. Onimaru et al., Phys. Rev. B 86, 184426 (2012).
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Gäste sind herzlich willkommen.
Der Vortrag findet im Seminarraum S-288 / Institut für Physik, Universität Augsburg statt.

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