Session 25aB

Heavy fermion superconductivity in the filled skutterudite $PrOs_4Sb_{12}$ **25aB1**

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The filled skutterudite compound $PrOs_4Sb_{12}$ was recently found to exhibit heavy fermion behavior and superconductivity below a critical temperature $T_c \sim 1.85$ K. The jump in specific heat at T_c, the slope of the upper critical field near T_c, and the normal state specific heat yield an electron effective mass of ~ 50 m_e, where m_e is the free electron mass. Magnetic susceptibility and inelastic neutron scattering measurements are consistent with a Pr^{3+} Γ_3 nonmagnetic doublet ground state which carries an electric quadrupole moment in the cubic crystalline electric field. The heavy fermion state in $PrOs_4Sb_{12}$ may originate from Pr^{3+} electric quadrupole fluctuations, rather than magnetic dipole fluctuations. The unusual normal and superconducting state properties of $PrOs_4Sb_{12}$ are reviewed in this talk.

Possible Type of Heavy-Electron Superconductivity in $PrOs_4Sb_{12}$ **25aB2**

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Unconventional nature of superconducting state of $PrOs_4Sb_{12}$, Pr-based heavy electron compound with the filled Skutterudite structure, is shown to be explained on the basis of a salient structure of the crystalline-electric-field level and of the Fermi surface determined by the band structure calculation. In particular, the anisotropic pairing with a full gap on the Fermi surface, suggested by the measurement of the NMR relaxation rates $1/T_1$, is shown to be possible in the manifold of chiral "p"- or "d"-pairing symmetry, and to be compatible with the absence of the coherence peak and the pseudo-gap behavior of $1/T_1T$ far above the superconducting transition temperature T_c.

25aB3 Magnetism and Superconductivity in UT_2Al_3 (T=Pd, Ni) and UGe_2

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We will present magnetic and superconducting properties of uranium-based heavy fermion compounds. UPd_2Al_3 and UNi_2Al_3 shows coexistence of antiferromagnetism (AF) and superconductivity (SC); the superconducting attractive interaction of the former compound with even parity pairing is likely mediated by magnetic excitons,[1] and Knight shift measurements of the latter strongly suggests an odd parity SC.[2] UGe_2 shows coexistence of SC with ferromagnetism; at low temperatures we have observed a unusual staircaselike hysteresis loop.[3] These experimental results and a possible interpretation will be described.

[1] N. K. Sato *et al.* Nature, 410 (2001) 340.
[2] K. Ishida *et al.* to appear in Phys. Rev. Lett.
[3] T. Nishioka *et al.* Phys. Rev. Lett., 88 (2002) 237203, and in this conference.

25aB4 Spin dynamics and sliding density-wave in $Sr_{14}Cu_{24}O_{41}$ ladder compounds

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The undoped spin 1/2 two-leg ladders have short-range magnetic order and a spin gap. The magnetic excitations out of the ground state have been observed as a sharp Raman resonance around 370 meV. Holes doped into these ladders pair and superconduct at high doping concentrations, while competing with the superconductivity insulator is known to result from low hole concentrations. Here, using transport and Raman scattering data, we identify the insulating state of self-doped two-leg spin ladders of $Sr_{14}Cu_{24}O_{41}$ as a weakly pinned, sliding density wave. This collective density-wave state exhibits a giant dielectric response, non-linear conductivity, and persists to well above room temperature.

25aB5 Spin fluctuation in $Sr_2Ca_{12}Cu_{24}O_{41}$ under high pressure up to 3.5Gpa

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Nuclear magnetic resonance (NMR) were performed under high pressure up to 3.5Gpa on a spin ladder system, $Sr_2Ca_{12}Cu_{24}O_{41}$. The system is nowadays well established as a low dimensional cuprate where superconducting state is realized by applying pressure of 3Gpa. In the present work, we measured relaxation rate $1/T_1$ on ^{63}Cu nuclei at the normal state. $1/T_1$ shows an activated behavior at high temperatures above 50K although the system is metallic. The fact implies breakdown of a scenario that pressure vanishes the spin gap and then superconductivity is induced.

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