

TT 45: Superconductivity: Ferropnictides 2

Time: Friday 10:15–12:45

Location: HSZ 03

TT 45.1 Fri 10:15 HSZ 03

Proximity of LaOFeAs to a magnetic instability — ●INGO OPAHLE, HEM KANDPAL, YUZHONG ZHANG, CLAUDIUS GROS, and ROSER VALENTI — Institut für Theoretische Physik, Goethe Universität Frankfurt, Germany

We investigate the effect of external pressure on the Fe magnetic moment in undoped LaOFeAs within the framework of density functional theory and show that this system is close to a magnetic instability: The Fe moment is found to drop by nearly a factor of 3 within a pressure range of ± 5 GPa around the calculated equilibrium volume. While the Fe moments show an unusually strong sensitivity to the spin arrangement (type of anti-ferromagnetic structure), the low temperature structural distortion is found to have only a minor influence on them. Analysis of the Fermi surface topology and nesting features shows that these properties change very little up to pressures of at least 10 GPa. We discuss the magnetic instability in terms of the itineracy of this system.

TT 45.2 Fri 10:30 HSZ 03

Magnetic and Thermodynamic studies on iron based superconductors RFeAsO_{1-x}F_x (R=La, Ce, Pr, Sm, Gd) — ●NORMAN LEPS¹, RÜDIGER KLINGELER¹, CHRISTIAN HESS¹, AGNIESZKA KONDRAT¹, JORGE HAMANN BORRERO¹, LIRAN WANG¹, GÜNTER BEHR¹, HANS-HENNING KLAUSS³, HUBERTUS LUETKENS², and BERND BÜCHNER¹ — ¹IFW Dresden, P.O. Box 270116, 01171 Dresden, Germany — ²Laboratory for Muon-Spin Spectroscopy, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland — ³IFP, TU Dresden, D-01069 Dresden, Germany

We present specific heat and magnetisation data of RFeAsO_{1-x}F_x with R=La, Ce, Pr, Sm, Gd in different applied magnetic fields. For the undoped compounds, i.e. $x = 0$, our data indicate only a weak dependence of both the spin-density-wave formation and the structural transition to the orthorhombic low-temperature phase on type of the R-ion. If R is magnetic, antiferromagnetic ordering of 4f-moments evolves at low temperatures which is also present at higher doping levels x for superconducting materials. The specific heat jump Δc_p at T_C is investigated and we discuss the interplay of magnetism and superconductivity based on our data.

TT 45.3 Fri 10:45 HSZ 03

Magnetic and superconducting properties of REO_{1-x}F_xFeAs (RE=Ce, Sm, Pr, Gd) iron pnictide superconductors studied by muon spin relaxation — ●H. MAETER¹, A. KWADRIN¹, H.-H. KLAUSS¹, H. LUETKENS², R. KHASANOV², A. AMATO², R. KLINGELER³, C. HESS³, J. HAMANN-BORRERO³, N. LEPS³, A. KONDRAT³, G. BEHR³, J. WERNER³, and B. BÜCHNER³ — ¹Institut für Festkörperphysik, TU Dresden — ²Laboratory for Muon-Spin Spectroscopy, Paul Scherrer Institut, CH-5232 Villigen, Switzerland — ³Leibniz-Institut für Festkörper- und Werkstofforschung Dresden

We have investigated the superconducting properties and the interplay of iron and rare earth magnetic order in the iron-pnictide system REO_{1-x}F_xFeAs with RE=Ce, Gd, Pr, Sm and $0 \leq x \leq 0.5$ by means of muon spin relaxation (μ^+ SR) and compare it with LaO_{1-x}F_xFeAs. We find that the undoped compounds show a variety of different magnetic coupling of the rare earth ion to the antiferromagnetic iron layers ranging from independent order to strong polarization of the rare earth moments by the ordered iron. Similar to LaO_{1-x}F_xFeAs the orthorhombic phase transition in REO_{1-x}F_xFeAs is also intimately connected to the suppression of magnetic order and the appearance of superconductivity.

TT 45.4 Fri 11:00 HSZ 03

Thermoelectric properties of undoped iron arsenides REOFeAs (RE = La, Ce, Pr, Sm, Gd) — ●AGNIESZKA KONDRAT¹, JORGE ENRIQUE HAMANN-BORRERO¹, NORMAN LEPS¹, LIRAN WANG¹, MARTIN KOSMALA², OLAF SCHUMANN², JOCHEN WERNER¹, GUENTER BEHR¹, MARKUS BRADEN², RUEDIGER KLINGELER¹, HANS-HENNING KLAUSS³, HUBERTUS LUETKENS⁴, CHRISTIAN HESS¹, and BERND BUECHNER¹ — ¹Leibniz Institute for Solid State and Materials Research Dresden, Germany — ²II. Physikalisches Institut, Universitaet zu Koeln, Germany — ³IFP, TU Dresden, Germany — ⁴Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, Villigen, Switzerland

land

Polycrystalline samples from the REOFeAs system were studied by means of electrical resistivity, thermal conductivity and thermoelectric power in temperature range 5-300K. All investigated compounds undergo a magnetic and a structural phase transition around 150K, which lead to profound anomalies in electrical, thermal and thermoelectric properties. We present the influence of substituting rare earth elements for La ion on the low temperature thermopower data. We discuss also the strong impact of magnetic field ($B = 14$ T) on thermoelectric properties.

15 min. break

TT 45.5 Fri 11:30 HSZ 03

Probing the superconductive energy gap of the iron pnictide superconductor Ba_{1-x}K_xFe₂As₂ by point-contact and scanning tunnelling spectroscopy — ●GERNOT GOLL¹, MICHAEL MARZ¹, SAMUEL BOUVRON¹, TIHOMIR TOMANIC¹, VERONIKA FRITSCH¹, HILBERT V. LÖHNEUSEN^{1,2}, and THOMAS WOLF² — ¹Physikalisches Institut, Universität Karlsruhe, 76128 Karlsruhe, Germany — ²Institut für Festkörperphysik, Forschungszentrum Karlsruhe, 76021 Karlsruhe, Germany

The size of the superconductive energy gap and its directional dependence is one of the central issues of studies on the recently discovered iron pnictide superconductors. The knowledge of both properties is essential for the characterization and a closer understanding of the mechanism of superconductivity. We report on point-contact measurements on (Ba,K)Fe₂As₂/Pt point contacts. (Ba,K)Fe₂As₂ single crystals were prepared by the flux-growth technique with Sn flux. Superconductivity was probed by resistivity and magnetization measurements. A superconducting transition temperature $T_c^{50\%} = 26.5$ K was found resistively for $x = 0.28$. Andreev reflection of charge carriers at the superconductor/normal metal interface of Ba_{0.72}K_{0.28}Fe₂As₂/Pt point contacts was utilized to determine the energy gap for current flow parallel and perpendicular to the FeAs planes. In first measurements, with current flow within the plane, the differential conductance versus voltage curves reveal a multi-gap nature of the superconductive order parameter with a small gap of about 3 meV and a larger one with 7-8 meV.

TT 45.6 Fri 11:45 HSZ 03

Magnetism, superconductivity, and pairing symmetry in Fe-based superconductors. — ●DMITRI EFREMOV¹, ILYA EREMIN², and ANDREY CHUBUKOV³ — ¹TU Dresden — ²MPIPKS Dresden — ³University of Wisconsin

We analyze antiferromagnetism and superconductivity in novel Fe -based superconductors within the itinerant model of small electron and hole pockets near $(0,0)$ and (π,π) . We argue that the effective interactions in both channels logarithmically flow towards the same values at low energies, i.e., antiferromagnetism and superconductivity must be treated on equal footings. The magnetic instability comes first for equal sizes of the two pockets, but loses to superconductivity upon doping. The superconducting gap has no nodes, but changes sign between the two Fermi surfaces (extended s -wave symmetry). We argue that the T dependencies of the spin susceptibility and NMR relaxation rate for such state are exponential only at very low T , and can be well fitted by power-laws over a wide T range below T_c .

TT 45.7 Fri 12:00 HSZ 03

Orbital and spin effects for the upper critical field in strongly disordered iron pnictide superconductors — ●GUENTER FUCHS¹, STEFAN-LUDWIG DRECHSLER¹, NADEZHDA KOZLOVA¹, KONSTANTIN NENKOV¹, GUENTER BEHR¹, ERNEST ARUSHANOV^{1,2}, JENS FREUDENBERGER¹, RUEDIGER KLINGELER¹, ANKE KOEHLER¹, BERND BUECHNER¹, and LUDWIG SCHULTZ¹ — ¹IFW-Dresden, P.O. Box 270116, D-01171 Dresden, Germany — ²Inst. of Appl. Phys., Acad. Sci. Moldova, Chisinau, Moldova

We report upper critical field $B_{c2}(T)$ [1], resistivity, and Hall data for disordered (arsenic deficient) LaO_{0.9}F_{0.1}FeAs_{1- δ} in a wide temperature and field range up to 47 T. Due to the large linear initial slope of $B_{c2} \approx -5.4$ to -6.6 T/K near $T_c \approx 28.5$ K the T -dependence of the in-plane $B_{c2}(T)$ shows a clear flattening already near 23 K above

30 T which is interpreted as the onset of a Pauli-limited behavior with $B_{c2}(0) \approx 63$ to 68 T. Our results are discussed in terms of disorder effects within scenarios for conventional and unconventional superconductivity (SC). Proposed unconventional p - and d -wave scenarios of SC can be discarded for our samples. The enhancement of the upper critical field slope near T_c by strong disorder provides evidence for an important *attractive* intraband contribution to the pairing of Cooper pairs in the Fe pnictides. We compare our results with B_{c2} -data in the literature which show often no Pauli-limiting behavior. A novel disorder related scenario of a complex interplay of SC with two different competing magnetic instabilities is proposed.

[1] G. Fuchs, S.-L. Drechsler, N. Kozlova *et al.*, PRL **101** in press

TT 45.8 Fri 12:15 HSZ 03

Absorption spectroscopy of rare earth oxypnictides — ●FRIEDRICH ROTH¹, THOMAS KROLL¹, ANDREAS KOITZSCH¹, ROBERTO KRAUS¹, GÜNTER BEHR¹, GUOLI SUN², DUNLU SUN², CHENGTIAN LIN², BERND BÜCHNER¹, and MARTIN KNUPFER¹ — ¹Institute for Solid State Research, IFW-Dresden, P.O. Box 270116, D-01171 Dresden, Germany — ²Max-Planck-Institute for Solid State Research, Heisenbergstraße 1, D-70569 Stuttgart, Germany

A large oxypnictides family LnFeAsO (Ln= La, Ce, Pr, Nd, Sm, Gd) has been found to be superconducting with a transition temperature up to 55K and high upper critical fields. The onset of the superconducting critical temperature T_c in these compounds increases with the reduction of the rare-earth ionic size, and the highest T_c obtained so far is 55K in doped SmFeAsO . In this contribution we present results of x-ray absorption (XAS) spectroscopy measurements on the soft

X-ray regime for polycrystalline LaFeAsO , CeFeAsO , SmFeAsO and GdFeAsO at various temperature as well as for $\text{Ba}_{1-x}\text{K}_x\text{Fe}_2\text{As}_2$ single crystals.

TT 45.9 Fri 12:30 HSZ 03

Electronic properties of iron pnictides in the normal state probed by NMR — ●FRANZISKA HAMMERATH¹, GUILLAUME LANG¹, HANS-JOACHIM GRAFE¹, DALIBOR PAAR^{1,2}, KATARINA MANTHEY¹, NICHOLAS CURRO³, GÜNTER BEHR¹, JOCHEN WERNER¹, and BERND BÜCHNER¹ — ¹IFW Dresden, Helmholtzstr. 20, D-01069 Dresden, Germany — ²Dept. of Physics, Faculty of Science, Univ. of Zagreb, P. O. Box 331, HR-10002 Zagreb, Croatia — ³Dept. of Physics, Univ. of California, Davis, CA 95616, USA

We have performed ⁷⁵As, ¹³⁹La, and ⁵⁷Fe Nuclear Magnetic Resonance (NMR) measurements on the new $\text{LaO}_{1-x}\text{F}_x\text{FeAs}$ superconductor. For $x=0.1$, NMR on all three nuclei shows that the local electronic susceptibility increases with increasing temperature in the normal state [1]. The scaling of all NMR shifts with respect to the macroscopic susceptibility indicates a single spin liquid. Relaxation measurements exhibit a similar temperature-dependence for $(T_1T)^{-1}$, and suggest that the dynamical susceptibility changes uniformly in q space with varying temperature. For $x=0.05$, in the underdoped regime, we find a Curie Weiss like increase of $(T_1T)^{-1}$ at low temperatures, indicating the onset of local moment fluctuations.

[1] H.-J. Grafe, G. Lang, F. Hammerath *et al.*, arXiv:0811.4508, submitted to New Journal of Physics (invited paper, special issue on iron pnictides superconductors).