TT 45: Superconductivity: Fe-based Superconductors - 1111,111, FeSe

Time: Tuesday 14:00–16:00 Location: HSZ 201

TT 45.1 Tue 14:00 HSZ 201

In-plane vs. out-of-plane doping and disorder in CeFeAsO — •Oleksii Vakaliuk[1], Giacomo Prando[1], Sabine Wurmehl[1], Christian Hess[1,2], and Bernd Buechner[1,2] — [1]Leibniz Institute for Solid State and Materials Research Dresden, Helmholtzstr. 20, 01069 Dresden Germany — [2]Center for Transport and Devices of Emergent Materials, TU Dresden, 01069 Dresden, Germany

In this contribution we will discuss the effect of the in-plane Fe/Co and the out-of-plane O/F chemical dilutions on the electronic phase diagram of CeFeAsO. Both substitutions lead to a quantitatively identical suppression of the spin density wave (SDW) phase upon doping, regardless of the actual degree of in-plane disorder. We detected two distinct regimes at low-doping levels: a long-range (LRO) followed by a short-range (SRO) ordered magnetic phase, the latter coexisting with superconductivity within a certain range of doping. In contrast, such in-plane disorder dramatically affects superconductivity and, in particular, the optimal-doping value of T_c [1]. Moreover, the magnetic ordering of the Ce ions is preserved throughout the entire phase diagram in $CeFe_{1-x}Co_xAsO$, at variance with what is observed in $CeFeAsO_{1-x}F_x$. Intriguingly, the ordering temperature T_N^{Ce} as a function of doping exhibits a dome-like shape in correspondence with the actual superconduting dome.

[1] G. Prando, *et.al.*, Phys. Rev. **B 87**, 174519 (2013)

TT 45.2 Tue 14:15 HSZ 201

Effects of hydrostatic pressure on the superconducting properties of $LaFeAsO_{1-x}F_x$ — •Giacomo Prando[1], Wolf Schottenhamel[1], Samuele Sanna[2], Rustem Khasanov[3], Zurab Guguchia[4], Anja Wolter-Giraud[1], Sabine Wurmehl[1,5], and Bernd Büchner[1,5] — [1]Leibniz-Institut für Festkörper- und Werkstoffforschung (IFW) Dresden, Germany — [2]Dipartimento di Fisica and Unità CNISM di Pavia, Università di Pavia, Italy — [3]Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland — [4]Physik-Institut der Universität Zürich, Winterthurerstrasse 190, Switzerland — [5]Institut für Festkörperphysik, Technische Universität Dresden, Germany

The most typical way of sweeping the electronic phase diagram of 1111 oxy-pnictides is to induce a gradual charge doping via chemical substitutions such as, e. g., out-of-plane $O_{1-x}F_x$ or in-plane $Fe_{1-x}Co_x$. However, it is well known that external pressure qualitatively mimics the charge doping across the whole phase diagram. In this contribution we will review the effect of pressure in $LaFeAsO_{1-x}F_x$ under different conditions of chemical doping x as examined by means of μ^+ spin spectroscopy. The suppression of the magnetic phase in the undoped compound will be addressed [1] as well as the phase segregation achieved at the crossover between magnetism and superconductivity [2]. Recent studies will be reported dealing with the superconducting side of the phase diagram. The evolution of both the critical temperature and the superfluid density will be discussed in detail.

[1] R. De Renzi et al., Supercond. Sci. Technol. 25 084009 (2012)
[2] R. Khasanov et al., Phys. Rev. B 84 100501 (2011)

TT 45.3 Tue 14:30 HSZ 201

Microscopic insight into the poisoning effect of Mn in $LaFe_{1-x}Mn_xAsO_{0.89}F_{0.11}$ — •Franziska Hammerath[1,2], Pietro Bonfá[3], Samuele Sanna[1], Giacomo Prando[1,2], Roberto De Renzi[3], Pietro Carretta[1], Yoshiaki Kobayashi[4], and Masatoshi Sato[4] — [1]Dipartimento di Fisica and Unitá CNISM di Pavia, I-27100 Pavia, Italy — [2]Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden, Germany — [3]Dipartimento di Fisica and Unitá CNISM di Parma, I-43124 Parma, Italy — [4]Department of Physics, Division of Material Sciences, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8602, Japan

We investigate the extraordinary poisoning effect of Mn on superconductivity (SC) in $LaFe_{1-x}Mn_xAsO_{0.89}F_{0.11}$ [1] by means of muon spin rotation (μSR) and nuclear quadrupole resonance (NQR) on compounds with $x = 0.025\,\%$ up to $x = 0.75\,\%$. We find that the iron plane electronic environment is extremely sensitive to the addition of Mn, even though charge doping effects can be neglected. Already $0.2\,\%$ Mn suppress SC completely, while static magnetism is observed for $x = 0.1\,\%$ and becomes enhanced upon further Mn substitution. This re-entrant magnetism is found to be intrinsic to the FeAs plane. A progressive increase of low energy spin fluctuations, expressed in an enhanced NQR spin-lattice relaxation T_1^{-1}, is observed upon Mn substitution. The analysis of T_1^{-1} for the sample closest to the the crossover between SC and magnetism points towards an antiferromagnetic quantum critical point at this crossover.

[1] M. Sato *et al.*, JPSJ **79**, 014710 (2010).

TT 45.4 Tue 14:45 HSZ 201

Magnetic Vortices in LiFeAs as seen by Scanning Tunneling Spectroscopy — Ronny Schlegel[1], Pranab Kumar Nag[1], Danny Baumann[1], Robert Beck[1], Sabine Wurmehl[1,2], Bernd Büchner[1,3], and •Christian Hess[1,3] — [1]Leibniz-Institute for Solid State and Materials Research, IFW-Dresden, 01171 Dresden, Germany — [2]Institut für Festkörperphysik, TU Dresden, 01069 Dresden — [3]Center for Transport and Devices of Emergent Materials, TU Dresden, 01069 Dresden, Germany

We performed investigations of the Shubnikov phase of LiFeAs in high magnetic fields up to 12 Tesla using scanning tunneling microscopy and spectroscopy. In our measurements the location of individual magnetic vortices can clearly be identified from the spatial variation of the zero bias differential conductance. We determine the Ginzburg-Landau coherence length from our data, as well as the nearest neighbor lattice constant, which we compare with results from complementary methods.

TT 45.5 Tue 15:00 HSZ 201

Incommensurate antiferromagnetic fluctuations in superconducting LiFeAs — •Navid Qureshi[1], Paul Steffens[2], Daniel Lamago[3,4], Yvan Sidis[3], Oleg Sobolev[5], Russell Ewings[6], Luminita Harnagea[7], Sabine Wurmehl[7], Bernd Büchner[7], and Markus Braden[1] — [1]II. Physikalisches Institut, Universität zu Köln — [2]Institut Laue Langevin, Grenoble — [3]Laboratoire Léon Brillouin, C.E.A. Saclay — [4]Institut für Festkörperphysik, Karlsruhe — [5]Technische Universität München, FRM-II — [6]ISIS Facility, Rutherford Appleton Laboratory, Didcot — [7]Institut für Festkörper- und Werkstoffforschung, Dresden

We present an inelastic neutron scattering study on single-crystalline LiFeAs devoted to the characterization of the previously reported incommensurate antiferromagnetic fluctuations [1]. Time-of-flight measurements show their presence up to an energy transfer of 60 meV, while polarized neutrons in combination with longitudinal polarization analysis on a triple-axis spectrometer prove the pure magnetic origin of this signal. The normalization of the scattered intensity to an absolute scale yields that the magnetic fluctuations in LiFeAs are by a factor 8 weaker than in nearly optimally Co-doped $BaFe_2As_2$, although a factor 2 is recovered due to the incommensurability. The longitudinal polarization analysis gives hints for a weak spin-space anisotropy with slightly stronger out-of-plane component between 6 and 14 meV. Furthermore, our data suggest a fine structure of the magnetic signal most likely arising from two nesting vectors.

[1] N. Qureshi et al., Phys. Rev. Lett 108 117001 (2012)

TT 45.6 Tue 15:15 HSZ 201

Phase diagram characterization of $NaFe_{1-x}Rh_xAs$ by electrical transport — •Frank Steckel[1], Robert Beck[1], Dirk Bombor[1], Maria Roslova[1,4], Igor Morozov[1,4], Sabine Wurmehl[1,3], Bernd Büchner[1,2], and Christian Hess[1,2] — [1]Leibniz Institute for Solid State and Materials Research, IFW Dresden, 01069 Dresden — [2]Center for Transport and Devices, TU Dresden, 01069 Dresden — [3]Institut für Festkörperphysik, TU Dresden, 01069 Dresden — [4]Moscow State University, 119991 Moscow

The electronic properties of single crystals from the pure and Rh-doped unconventional high temperature pnictide superconductor NaFeAs are probed by resistivity and Hall effect measurements. Typical transition temperatures for the undoped parent compound are found and their evolution upon $4d$-electron doping up to $x = 6\%$ in $NaFe_{1-x}Rh_xAs$ are investigated. The structural and magnetic transition signatures are strongly suppressed upon Rh-doping. Already at $x = 1.8\%$ no sign of the aforementioned phase transitions are found. Optimal doping is found at $x = 2\%$ doping level with $T_C \sim 19.6$ K. A temperature-composition phase diagram is constructed from the resistivity, Hall coefficient and magnetization data. The comparison to the $3d$-electron doped $NaFe_{1-x}Co_xAs$ phase diagram yields astonishing similarities

as found before in Rh- and Co- doped $BaFe_2As_2$. Thus, we suggest a generic behavior upon Rh- and Co-doping in Fe-based superconductors. Accordingly the structural and antiferromagnetic transition temperatures as well as the superconducting transition may depend only on the doping level and the doped charge.

TT 45.7 Tue 15:30 HSZ 201

Magnetoresistance and Hall effect of $Fe_{1.01}Se$ — •Sahana Roessler, Cevriye Koz, Ulrich Schwarz, and Steffen Wirth — Max Planck Institute for Chemical Physics of Solids, Noethnitzer Str. 40, 01187 Dresden

The simplest member of Fe-based superconductor $Fe_{1.01}Se$ displays a superconducting transition at $T_c \approx 8$ K [1] and a structural transition at $T_s \approx 90$ K [2]. Here we present magnetoresistance, Hall effect, and magnetic susceptibility of $Fe_{1.01}Se$ single crystals. The onset of negative magnetoresistance below T_s indicates a strong change to the Fermi surface topology at the structural phase transition. The Hall resistivity ρ_{xy} is negative below 55 K indicating electron dominated transport, and non-linear in magnetic field down to 12 K. The magnetic susceptibility also displays a minimum close to 30 K suggesting a strong enhancement of antiferromagnetic fluctuations. This behavior is in agreement with the temperature dependence of spin-fluctuation susceptibility in NMR measurements [3]. These results suggest that the pairing correlations in $Fe_{1.01}Se$ are enhanced by antiferromagnetic fluctuations.

[1] F. C. Hsu et al. Proc. Natl. Acad. Sci (USA) 105, 14262 (2008)
[2] T. M. McQueen et. al. Phys. Rev. Lett. 103, 057002 (2009)
[3] T. Imai et. al. Phys. Rev. Lett. 102, 177005 (2009)

TT 45.8 Tue 15:45 HSZ 201

Orbital-selective metal-insulator transition and gap formation above T_c in superconducting Rb_{1-x} $Fe_{2-y}Se_2$ — •Zhe Wang[1], Michael Schmidt[1], Jonas Fischer[1], Vladimir Tsurkan[1], Markus Greger[2], Dieter Vollhardt[2], Alois Loidl[1], and Joachim Deisenhofer[1] — [1]Experimentalphysics 5, Univ. Augsburg, Germany — [2]Theoreticalphysics 3, Univ. Augsburg, Germany

We report on a hierarchy of temperatures $T_c < T_{gap} < T_{met}$ in superconducting Rb_{1-x} $Fe_{2-y}Se_2$ observed by THz spectroscopy. Above $T_{met} = 90$ K the material reveals semiconducting characteristics. Below T_{met} a coherent metallic THz response emerges. This metal-to-insulator-type, orbital selective transition is indicated by an isosbestic point in the temperature dependence of the optical conductivity and dielectric constant at THz-frequencies. At $T_{gap} = 61$ K a gap opens in the THz regime and then the superconducting transition occurs at $T_c = 32$ K. This sequence of temperatures seems to reflect a corresponding hierarchy of the electronic correlations in the different bands.