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Superconductivity and Magnetism in $LaO_{1-x}F_xFeAs$

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Measuring ^{75}As, ^{139}La, and ^{57}Fe Nuclear Magnetic Resonance (NMR) as well as μSR, transport and thermodynamic properties we have determined the phase diagram of $LaO_{1-x}F_xAsFe$ superconductors [1-6]. In my talk, I will show experimental studies of the magnetic ordering [2, 5], properties of the superconducting state [1, 3, 5] and the normal state properties [1, 4, 6] in the superconducting regions of the phase diagram. While the temperature dependence of the London penetration as determined from μSR points to an isotropic s wave state [3], our early NMR data suggest singlet pairing and nodes of the order parameter [1]. Extending the NMR work to lower temperatures we find evidence for a deviation of the T^3 behaviour of the spin lattice relaxation, which would agree with the extended s-wave symmetry suggested in recent theoretical work. In the paramagnetic normal state, NMR on all three nuclei shows that the local electronic susceptibility rises with increasing temperature. This had led to suggest the presence of a pseudogap, which I will discuss in detail. The scaling of all NMR shifts with respect to the macroscopic susceptibility indicates that there is no apparent multiband effect through preferential hyperfine couplings. Relaxation measurements indicate a similar temperature-dependence for $(T_1T)^{-1}$, and suggest that the dynamical susceptibility changes uniformly in q space with varying temperature. The transport properties show some striking similarities to the findings in cuprates [6] and, finally, susceptibility [4] as well as NMR studies point to the antiferromagnetic fluctuations, whose relevance is also discussed in many theoretical models of the superconducting pairing mechanism. In collaboration with Hans-Joachim Grafe, Christian Hess, Rüdiger Klingeler, Günter Behr, Agnieszka Kondrat, Norman Leps, and Guillaume Lang, IFW Dresden; Hans-Henning Klauss, TU Dresden; and Hubertus Luetkens, PSI Villigen.

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