Phase diagrams of Fe based superconductors

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The magnetic/electronic phase diagrams of several classes of iron pnictide superconductors have been studied using a broad spectrum of experimental techniques, such as NMR, μSR, ARPES, magnetometry, thermodynamics, x-ray diffraction, and transport measurements. For most of the systems the well-known intimate interplay between antiferromagnetism and superconductivity is apparent. There are, however, qualitative differences in the phase diagrams, which could be related to details of the structural/nematic order. For example, measurements of the electrical field gradient by NQR in underdoped $LaO_{1-x}F_xAsFe$ (and other 1111 type materials) yield clear-cut evidence for a nanoscale order of charges and/or orbitals which is absent in other systems. The role of this local order for the unusual electronic/magnetic properties of underdoped 1111 systems will be discussed.

In addition we will present detailed studies of LiFeAs showing superconductivity without doping. From our measurements on the pristine material as well as hole and electron doped compounds we do not find any evidence for strong antiferromagnetic correlations. Instead, measurements of NQR, μSR, magnetisation and neutron diffraction reveal a weak ferromagnetic order in hole doped LiFeAs. Based on our determination of the phase diagram and the results from spectroscopic studies the possible relationship between this unusual ferromagnetic state and superconductivity in stoichiometric LiFeAs is discussed.