Disorder in iron-based superconductors

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Abstract:

The discovery of iron-based superconductors have provided new insight to multiband superconductivity with unconventional pairing symmetry. At present many open questions remain, including, for example, the physics of the coexistence region, and the importance of so called nematic fluctuations. In this talk I will give an overview of our recent work trying to shed light on these issues from a theoretical “disorder perspective”, which includes the undoped parent spindensity wave (SDW) phase, the superconducting regime, and the normal state. In the SDW phase, simple single-site substitutional impurities generate new meta-stable highly anisotropic and extended emergent impurity sites. These so called nematogens will strongly affect e.g. the in-plane resistivity anisotropy, and also cause electronic dimers in agreement with STM measurments on most of the pnictides materials. In the superconducting phase, depending on the pairing symmetry, subgap bound states may be generated, and electronic interactions can locally cause magnetic impurity induced puddles which seem to explain magnetic short-range phases observed near optimal doping of 122 systems. Finally, in the normal state I will discuss the role of RKKY interactions and the cooperative effects between magnetic impurities in stabilizing a long-range (pi,0) SDW phase well above the putative Neel temperature of the corresponding clean system in agreement with recent neutron scattering data.