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Emergent Defect States as a Source of Resistivity Anisotropy in the Nematic Phase of Iron pnictides

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The pronounced electronic anisotropy observed in several experiments probing the iron-based superconductors is currently a topic of great interest and controversy.[1] I will discuss novel disorder effects in the nematic phase above the transition temperature to the (pi, 0) stripe ordered magnetic state but below the orthorhombic structural transition. The anisotropic spin fluctuations in this region can be frozen by disorder, to create elongated magnetic droplets whose anisotropy grows as the magnetic transition is approached. Such states act as strong anisotropic defect potentials that scatter with much higher probability perpendicular to their length than parallel, although the actual crystal symmetry breaking is tiny. From the calculated scattering potentials, relaxation rates, and conductivity in this region we conclude that such emergent defect states are essential for the transport anisotropy observed in experiments.[2] Thus, a full understanding of the transport anisotropy in iron pnictides requires both intrinsic nematic susceptibility and concomitant emergent impurity response. Below the spin density wave transition the nematogens freeze into dimer states that show many characteristics in agreement with STM measurements.[3] The talk will end with a discussion of theoretical results of other fascinating and highly unusual impurity aspects of iron-based superconductors. This includes, for example, unusual magnetic defect states in the different possibly magnetic structures at low temperatures, the induction of impurity-induced long-range ordered phases due to unconventional RKKY exchange couplings that would not be present without the disorder.[4] [1] R. M. Fernandes, A. V. Chubukov, and J. Schmalian, Nat. Phys. **10**, 97 (2014). [2] M. N. Gastiasoro, I. Paul, Y. Wang, P. J. Hirschfeld, and B. M. Andersen, Phys. Rev. Lett. **113**, 127001 (2014). [3] M. N. Gastiasoro, P. J. Hirschfeld, and B. M. Andersen, Phys. Rev. B **89**, 100502(R) (2014). [4] M. N. Gastiasoro and B. M. Andersen, Phys. Rev. Lett. **113**, 067002 (2014)