Electron Correlations and Superconductivity in Iron Pnictides and Chalcogenides

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The bad metal behavior in the normal state of the iron pnictides suggests the importance of electron correlations, which is further underscored by the observation of a Mott insulator state in the iron chalcogenides. This has motivated a strong-coupling approach based on a proximity to the Mott transition. In this talk, I will discuss three aspects of the theoretical studies within this approach:

- Quantum Criticality: An early theoretical proposal for a quantum critical point in the isoelectronically tuned iron pnictides [1], and the experimental observation in the P-doped iron arsenides
- Superconductivity: The understanding of why the superconducting T_c of the iron chalcogenides is comparably high as in the iron pnictides, despite their seemingly unfavorable Fermi surfaces [2]
- Multi-orbital Aspects of the Electron Correlations: including a proposed orbital-selective Mott phase and its experimental evidence [3].

I will close by briefly discussing the implications of these results for the general phenomenon of unconventional superconductivity at the border of magnetism.

[1] J. Dai, Q. Si, J.-X. Zhu & E. Abrahams, PNAS**106**, 4118 (2009); J.Wu et al., to appear (2014)
[2] R. Yu, P. Goswami, Q. Si, P. Nikolic & J-X Zhu, Nat. Commun. **4**, 2783 (2013)
[3] R. Yu and Q. Si, PRL **110**, 146402 (2013); M. Yi et al., PRL **110**, 067003 (2013)