Magnetism and Superconductivity: Pnictides versus Cuprates

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Two years ago, the discovery of high-temperature superconductivity in iron-pnictides reshaped the landscape of condensed matter physics. Until that time, for more than two decades, the copper-oxide materials were the only game in town and their mysterious properties loomed large as perhaps the greatest intellectual challenge in our field. Cuprates are strongly interacting systems, near to the so-called Mott insulating limit, in which electrons are made motionless by strong correlations, and it is currently believed that much of their unusual behavior stems from such correlations.

In contrast, the newly discovered iron-based high-temperature superconductors exhibit a more moderate degree of correlations and do not appear to be near the Mott limit. Consequently, some of their properties are easier to understand. In this presentation, the basic ideas in theory of iron-pnictides will be introduced and illustrated with experimentally-relevant examples. Particular attention will be paid to the interband pairing mechanism of multiband superconductivity and the renormalization group description of the underlying physics. This will be contrasted with strongly correlated cuprates, where a thousand fancy theoretical ideas bloom, from quantum fluctuations to Berry phases, from gauge field theory to AdS/CMT duality. But we will never lose touch with reality and promise to keep a watchful eye on recent and sometimes conflicting experiments.