MAR09-2008-002190

Abstract for an Invited Paper
for the MAR09 Meeting of
the American Physical Society

Competing orders and spin density wave instabilities in FeAs-based systems

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The discovery of superconductivity with T_c up to 55 K in layered FeAs-based compounds has generated tremendous interest in the scientific community. Except for relatively high T_c, the Fe pnictides display many interesting properties. Among others, the presence of competing orders is one of the most intriguing phenomena. In the early stage of our study on the compounds, we identified a spin-density-wave (SDW) ordered state for the parent compound with a stripe (or collinear) type spin structure based on the transport, specific heat, optical spectroscopy measurements and the first- principle calculations. The proposed spin structure from a nesting of the Fermi surfaces is confirmed by subsequent neutron experiments. However, it could also be explained by a local superexchange picture. In this talk I shall focus on our recent optical data on single crystal samples, trying to address the debating issue about itinerant or localized approaches to the SDW order. We found that the undoped compounds are quite metallic with relatively high plasma frequencies above T_{SDW}. Upon entering the SDW ordered state, a large part of the Drude component is removed by the gapping of Fermi surfaces. Meanwhile, the carrier scattering rate is even more dramatically reduced. Those observations favor an itinerant description for the driving mechanism of SDW instability. Nevertheless, our experiments also indicate that Fe pnictides are not simple metals. A high energy gap-like feature is present even above T_{SDW}, which seems to be linked with the antiferromagnetic spin fluctuations. For the superconducting samples, a superconducting pairing energy gap is clearly observed in the far-infrared reflectance measurement. The Ferrell-Glover- Tinkham sum rule is satisfied at a low energy scale. Work done in collaboration with: G. F. Chen, J. L. Luo, Z. Fang, X. Dai, W. Z. Hu, J. Dong, G. Li, Z. Li, P. Dai, J. Lynn, H. Q. Yuang, J. Singleton.