Materials Science and Technology Division

"Tests of Order Parameter Symmetry in the Superconducting Iron Arsenides"

David Parker
Naval Research Laboratory

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10:30 a.m.
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Abstract:

The iron arsenide superconductors have been extensively investigated since the original discovery by Kamihara early in 2008, with maximum Tc's exceeding 50 K. Despite this, the most basic questions such as pairing symmetry and mechanism remain highly controversial.

In this talk, I propose two methods of ascertaining this order parameter symmetry. The first is based upon the phase-sensitive Josephson interferometry, which was applied to the cuprates with great success, ultimately identifying the d-wave nature of these materials. The pnictides present great challenges to such experiments because many pairing states proposed for the pnictides are equivalent in the a and b directions, so that unlike in the cuprates, ab-plane corner junctions will not be useful. Yet one can find ways to use appropriate barrier materials to filter out the transmitted electrons so that different directions 'see' different electrons, or design junctions for this purpose. I will describe in detail three such possible experiments.

The second method is based upon the general discovery of a phase-diagram region of spin density wave / superconductivity coexistence, and upon some experiments suggesting fully gapped superconductivity. We show that such a coexistence state necessarily leads to Fermi surface nodal behavior, where the material is effectively 'normal' if the original pairing state is 's++' or fully symmetric s-wave. However, in the case of the sign-changing 's+/-', no nodes would be formed in the coexistence state so that thermodynamic and transport probes would see exponentially activated behavior.

Host: David Singh (241-1944, singhdj@ornl.gov)