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Pairing symmetry in strongly hole-doped iron-based superconductors
FAZEL FALLAH TAFTI, Univ of Sherbrooke

The fabric of superconductivity in the multiband iron-based superconductors is woven out of inter-band and intra-band interactions. By tuning the relative strength of different pairing interactions via external parameters such as pressure we can tune the pairing symmetry of these multiband superconductors. I will present experimental evidence for a pressure induced change of pairing state in the fully hole-doped iron-based superconductor KFe2As2. Our main experimental finding is a sharp reversal in the pressure dependence of $T_c$ at a critical pressure $P_c = 18$ kbar [1]. Compared to previous reports on two separate superconducting domes in fully electron-doped chalcogenides, our discovery points to several novel aspects: (a) $P_c$ is very low, meaning structural changes are negligible; (b) $T_c$ remains finite through the transition, suggesting the phase transition is confined within the superconducting state; (c) No anomalies are observed in the normal state properties, ruling out the possibility of a Lifshitz transition; (d) The two superconducting states manifest a different sensitivity to disorder. These observations lead us to conclude that the sharp reversal of $T_c$ at the critical pressure signals a phase transition between two different pairing symmetries in KFe2As2: a transition which leaves no traces in the normal state properties. Theoretical calculations formulate such a phase transition between different pairing states favored by different inelastic scattering processes [2]. We explore this hypothesis by tracing $T_c$ versus inelastic scattering and demonstrate that below the critical pressure, $T_c$ correlates with inelastic scattering but above the critical pressure, $T_c$ anticorrelates with inelastic scattering. This is consistent with different channels of interactions giving rise to different pairing symmetries and pressure simply tunes the relative strength of these interactions.