

Zeeman Limited Superconductivity and Incoherent Cooper Pairing

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I will present low temperature tunneling density of states measurements on thin superconducting Al films that are in high parallel magnetic fields. The films undergo a first-order transition to the normal state at a parallel field that is near the predicted Clogston-Chandrasekhar critical field. I will present evidence for the existence of a disordered FFLO phase that emerges as one approaches the critical field from below transition. Although this phase has no long-range order, it produces local order parameter oscillations that are manifest as an anomalous large subgap density of states ¹.

On the normal-state side of the transition a resonance feature appears in the tunneling spectra that is associated with incoherent Cooper pairing ². I will show how this resonance can be used to determine the microscopic parameters of the superconductor, including the gap, spin-orbit scattering rate, and the antisymmetric Fermi-liquid parameter. In addition, we have exploited the resonance to probe the exchange field in Al-FM bilayers and to determine the high-field spin polarization in magnetic films ³.

¹Y.L. Loh, N. Trivedi, Y.M. Xiong, P.W. Adams, and G. Catelani, arXiv:1102.3889 (2011)

²G. Catelani, Y.M. Xiong, X.S. Wu, and P.W. Adams, Phys. Rev. B **80**, 054512 (2009)

³Y.M. Xiong, P.W. Adams, and G. Catelani, Phys. Rev. Lett. **103**, 067009 (2009).