RECONSTRUCTION OF THE FERMI SURFACE IN Nd-SUBSTITUTED $CeCoIn_5$

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The interplay of magnetism and superconductivity has been a topic of great interest in recent years due to the fact that magnetic fields usually destroy superconductivity. However, coexistence has been identified in a variety of materials including iron-based superconductors, cuprates, and heavy fermion systems. In $CeCoIn_5$, magnetic order can be fostered by substituting Ce with Nd allowing us to probe the robustness of the superconducting state. Moreover, by adjusting the Nd/Ce ratio in $Ce_{1-x}Nd_xCoIn_5$ we can effectively control the lattice coupling and smoothly tune the system across the superconducting phase boundary [1]. Published specific heat and resistivity measurements indicate a rich phase diagram with a robust superconducting state, persisting for doping levels up to x = 0.2 [1]. Torque magnetometry measurements were performed at the NHMFL and LNCMI for x = 0.02, 0.05, 0.1, and 1 to explore the evolution of the Fermi surface with increased substitution levels. By utilizing high magnetic fields, up to 35 T, and low temperatures, down to 40 mK, numerous de Haas-van Alphen (dHvA) frequencies could be resolved, including up to 23 kT for x = 1. Preliminary band structure calculations for $NdCoIn_5$ reveal a qualitatively similar Fermi surface to the superconducting analogue $CeCoIn_5$, however a slight warping of the cylindrical Fermi surface is evident at even small doping levels, x = 0.05. Current consensus is that the 4f Ce electrons, thought to be responsible for superconductivity, lie on the cylindrical band which is the heaviest. Additional band structure calculations, which are currently underway for various doping levels, are necessary to confirm. Ongoing experiments include neutron scattering which will be crucial to determine the evolution of the magnetic order with increased substitution.

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