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Point-contact Spectroscopy in Heavy-Fermion Superconductors

MIKAEL FOGELSTROM, Chalmers University of Technology, MATTHIAS J. GRAF, Los Alamos National Laboratory — We present a minimal theoretical model for tunneling into heavy-fermion materials. In particular, we apply this model to point-contact spectroscopy (PCS) on CeCoIn5. The model assumes that electrons from a normal-metal tip tunnel into a heavy-fermion material via two interfereing channels: i) directly into conduction band(s), and ii) indirectly via localized f-electron levels. The model naturally reproduces the asymmetric Fano-shaped normal-state tunneling conductance seen in several PCS experiments. Additionally, in the superconducting state (CeCoIn5 with Tc=2.3K) we compute the PCS conductance. Here, we find that we can reproduce the experimentally obtained dI/dV-spectra accounting for an Andreev signal, i.e. the enhanced sub-gap conductance. Our theory is fully consistent with the typical ∼10% increase with respect to the normal state conductance. Unlike other theories we don't require renormalization of Fermi velocities or scattering potentials at the NS interface to account for the strongly suppressed Andreev reflection in heavy-fermion materials. Finally, in the superconducting state we compare our results with those of the conventional BTK theory and extract information about the pairing symmetry for CeCoIn5.

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