

Heavy-Fermion Superconductivity Mediated by Antiferromagnetic Spin Fluctuations

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The phase diagram of the prototypical heavy-fermion superconductor CeCu_2Si_2 contains a quantum critical point (QCP) of three-dimensional (3D) spin-density-wave (SDW) type^{1, 2}. Recently, inelastic-neutron-scattering measurements have been performed on S-type CeCu_2Si_2 , located on the paramagnetic side close to the QCP³. The magnetic response in the superconducting state is characterized by an inelastic signal resulting from the transfer of spectral weight to energies above a spin-excitation gap. In the normal state, a slowing down of the quasielastic magnetic response is observed that conforms to the scaling expected for a 3D-SDW QCP. According to its momentum dependence this quasielastic (Lorentzian) line can be considered an overdamped dispersive mode (“antiferromagnetic paramagnon”) whose coupling to the heavy charge carriers is strongly retarded. These results highlight Cooper pairing mediated by nearly quantum critical SDW fluctuations.

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²O. Stockert et al., Phys. Rev. Lett. **92**, 136401 (2004).

³O. Stockert et al., Nature Phys. **7**, 119 (2011).