Field dependence of antiferromagnetic spin fluctuations in the heavy fermion superconductor CeCoIn$_5$

S. E. BROWN, UCLA, H. SAKAI, S.-H. BAEK, F. RONNING, E. D. BAUER, J. D. THOMPSON, Los Alamos National Laboratory — Magnetic fields are proposed as a tuning parameter for quantum critical fluctuations in the heavy fermion superconductor CeCoIn$_5$, with a critical point close to the superconducting $B_{c2}$. Here, $^{59}$Co NMR spin lattice relaxation is used to study the effect of magnetic field applied on the amplitude, dimensionality, and anisotropy of antiferromagnetic spin fluctuations for temperatures covering $T=100\text{mK}-100\text{K}$ and $B =5-10\text{T} (\parallel c)$. Spin fluctuations are evident for temperatures below $T \sim 40\text{K}$, below which $[T_1 T]^{-1}$ increases markedly for all fields. At lower temperatures, a significant dependence on magnetic field is observed. For fields $B > B_{c2} =5\text{T}$, $[T_1 T]^{-1} \rightarrow$constant for $T < T_{FL}(B)$ at low temperatures; it is interpreted as a crossover to Fermi liquid behavior in the vicinity of a quantum critical point. The data are analyzed in terms of 2D antiferromagnetic spin fluctuation theory over the entire temperature range. Significant anisotropy in the spin fluctuation energy scale is inferred, and comparisons are made to parameters extracted from other measurements.

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