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Ubiquitous Spin Freezing in Spin-Triplet Superconductor UTe_2

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The novel superconductor UTe_2 is a rare material wherein electrons form Cooper pairs in a unique spin-triplet state with potential topological properties. Theoretically, spin-triplet superconductivity in UTe_2 may be explained in terms of pairing mediated by either ferromagnetic or antiferromagnetic fluctuations, but experimentally the magnetic properties of UTe_2 remain enigmatic. Here we report on a μSR study of independently grown UTe_2 single crystals that exhibit either a single or double phase transition in the specific heat near the onset of superconductivity. In the absence of an applied magnetic field, we observe an inhomogeneous distribution of magnetic fields in a sizeable volume fraction of all samples studied. The growth in the volume of the magnetic regions is halted by the onset of superconductivity at the critical temperature T_c. Upon further cooling, slow fluctuations of the local fields persist until a disordered spin frozen state appears below about one tenth of T_c. The μSR results are consistent with the formation of magnetic clusters in UTe_2 due to the influence of disorder on long-range electronic correlations or geometrical magnetic frustration associated with the ladder-like U sublattice structure. Our findings suggest that inhomogeneous magnetic clusters are responsible for the ubiquitous residual linear term and low-temperature upturn in the temperature dependence of the specific heat in UTe_2 below T_c. The omnipresent magnetic inhomogeneity may also have implications for the interpretation of other low-temperature experimental observations in the superconducting state of UTe_2.

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