Supplementary Informaton

Fits of the low-temperature specific heat data for sample S1

Figure 6 shows various fits of the temperature dependence of the specific heat of sample S1 between 0.1 and 1 K. The fit assuming the full analytical expression for the Schottky anomaly of a two-level system falls well below the data point at 0.1 K.

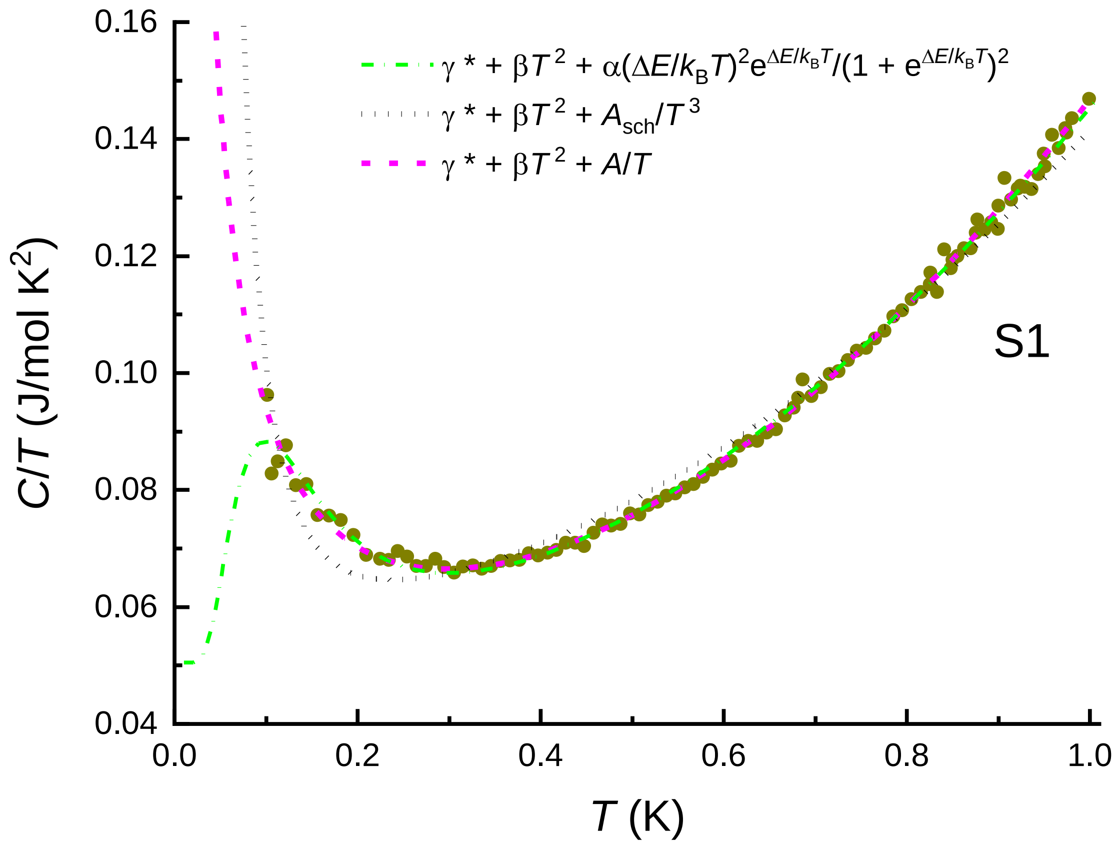

Fig. 6 | Fits of C/T versus T for sample S1 to the sum of $\gamma^* + \beta T^2$ and a third component assuming (i) the full analytical relation for the Schottky anomaly of a two-level system (dash-dotted curve), which yields $\gamma^* = 50.5$ mJ/mol K^2, (ii) the high-temperature tail of a Schottky anomaly for a two-level system (dotted curve), which yields $\gamma^* = 56.6$ mJ/mol K^2, and (iii) the term A/T (dashed curve), which yields $\gamma^* = 39.6$ mJ/mol K^2.

High transverse-field measurements

Transverse-field (TF) μSR asymmetry spectra for the three UTe_2 samples in an applied magnetic field of H =2 T and at a temperature above T_c are presented in Fig. 7a. The solid curves through the data points are fits to

$$A(t) = a_B \exp(-\Delta_B^2 t^2)\cos(2\pi f_B t + \phi) + \sum_{i=1}^{n} a_i \exp(-\Delta_i^2 t^2)\cos(2\pi f_i t + \varphi)\,. \tag{3}$$

The first term is a background component due to muons that missed the sample and stopped in the Ag sample holder. Here a_B is the amplitude of the background signal, ϕ is the angle between the axis of the positron detector and the initial muon-spin polarization $\mathbf{P}(0)$, and f_B is the precession frequency of the muon spin in the magnetic field $\mathbf{B}$. The Gaussian relaxation function $\exp(-\Delta_B^2 t^2)$ is intended to account for the distribution of internal magnetic field, associated with randomly oriented nuclear moments in the sample holder, although the value of Δ_B is influenced somewhat by dipolar fields emanating from the sample associated with the field-induced polarization of the local U electronic moments. The second term, which is a sum of n similar Gaussian damped cosine functions, describes the TF-μSR signal from muons stopping in the sample. The sample component of the signal for UTe_2 samples S1, S2 and S3 is comprised of n = 3, 2, and 2 components, respectively. The fitted parameters are listed in Table 2.

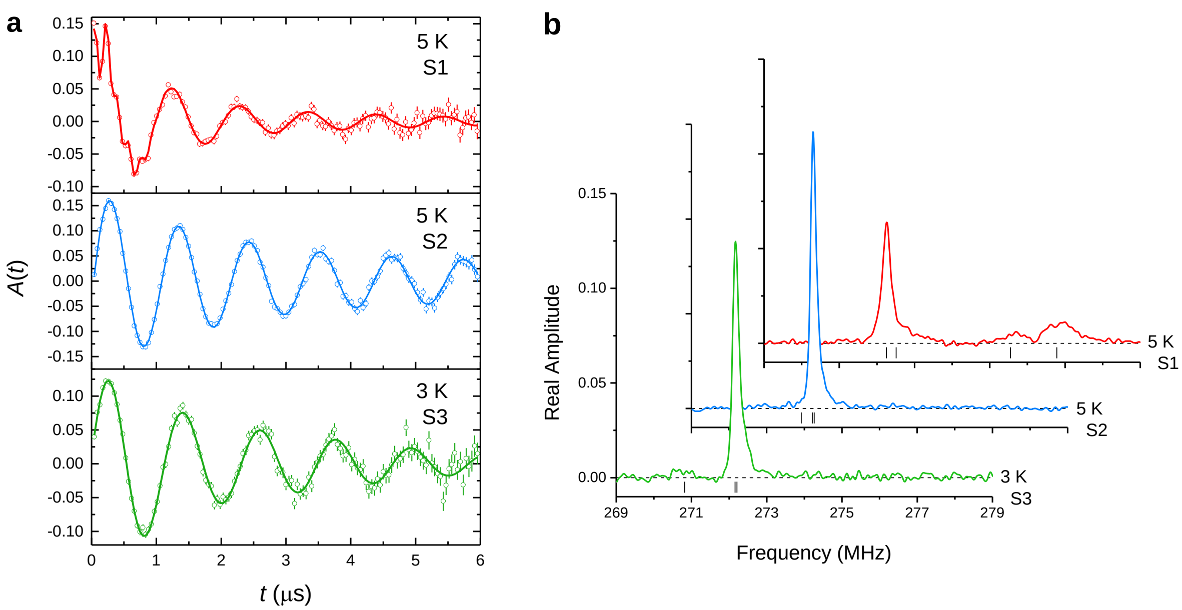

Fig. 7 | a, TF-μSR asymmetry spectra for an applied magnetic field of H = 2 T recorded at temperatures above T_c. The solid curves are fits to the sum of Gaussian damped cosine functions. **b,** Fourier transforms (with Gaussian apodization) of the TF-μSR asymmetry spectra, which provide visual depictions of the internal magnetic field distribution $n(B)$ sensed by the muon ensemble. The frequency (horizontal axis) is related to the local internal magnetic field via the relation $f = (\gamma_\mu/2\pi)B$. The vertical black lines denote the average frequencies of the multiple components that describe the TF-μSR spectra.

Fourier transforms of the TF-μSR signals, which provide an approximate visual representation of the internal magnetic field distribution sensed by the muon ensemble, are shown in Fig. 7b. The additional broad higher-frequency peaks for sample S3 are presumably due to the misalignment of the single crystals in the mosaic, which results in different orientations of the magnetic dipole field from the local U moments in the individual crystals.

Sample	Frequencies (MHz)	Amplitudes (%)	Relaxation Rates (μs^{-1})
S1	f_B = 272.255(2)	a_B = 34(1)	Δ_B = 0.44(1)
	f_1 = 272.51(3)	a_1 = 31(1)	Δ_1 = 2.2(1)
	f_2 = 275.55(4)	a_2 = 13.0(1)	Δ_2 = 1.8(2)
	f_3 = 276.78(2)	a_3 = 22(1)	Δ_3 = 1.57(8)
S2	f_B = 272.221(2)	a_B = 30(1)	Δ_B = 0.05(1)
	f_1 = 271.92(5)	a_1 = 21(1)	Δ_1 = 3.6(2)
	f_2 = 272.261(5)	a_2 = 49(1)	Δ_2 = 0.50(4)
S3	f_B = 272.1558(2)	a_B = 40(2)	Δ_B = 0.20(1)
	f_1 = 270.82(6)	a_1 = 13(2)	Δ_1 = 2.0(3)
	f_2 = 272.21(1)	a_2 = 47(2)	Δ_2 = 0.80(3)

Table 2. Parameters from fits of TF-μSR asymmetry spectra in Fig. 7a to Eq. (3).

Fits of λ_1/T versus T for sample S1

Figure 8a shows the fit of λ_1/T versus T above 0.4 K to the relation $\lambda_1/T \propto T^{-n}$ from our previous ZF-μSR study of UTe_2 (ref. 11). Figure 8b shows a comparison of λ_1/T versus T between the current results for sample S1 and the previous study of a different sample. There is good agreement between the two data sets above 0.75 K. The divergence of the two data sets below 0.75 K signifies a difference in the range of temperature over which the spins (magnetic clusters) freeze. Figure 8c shows a fit of λ_1/T versus T for sample S1 above 0.75 K to the relation $\lambda_1/T \propto T^{-n}$.

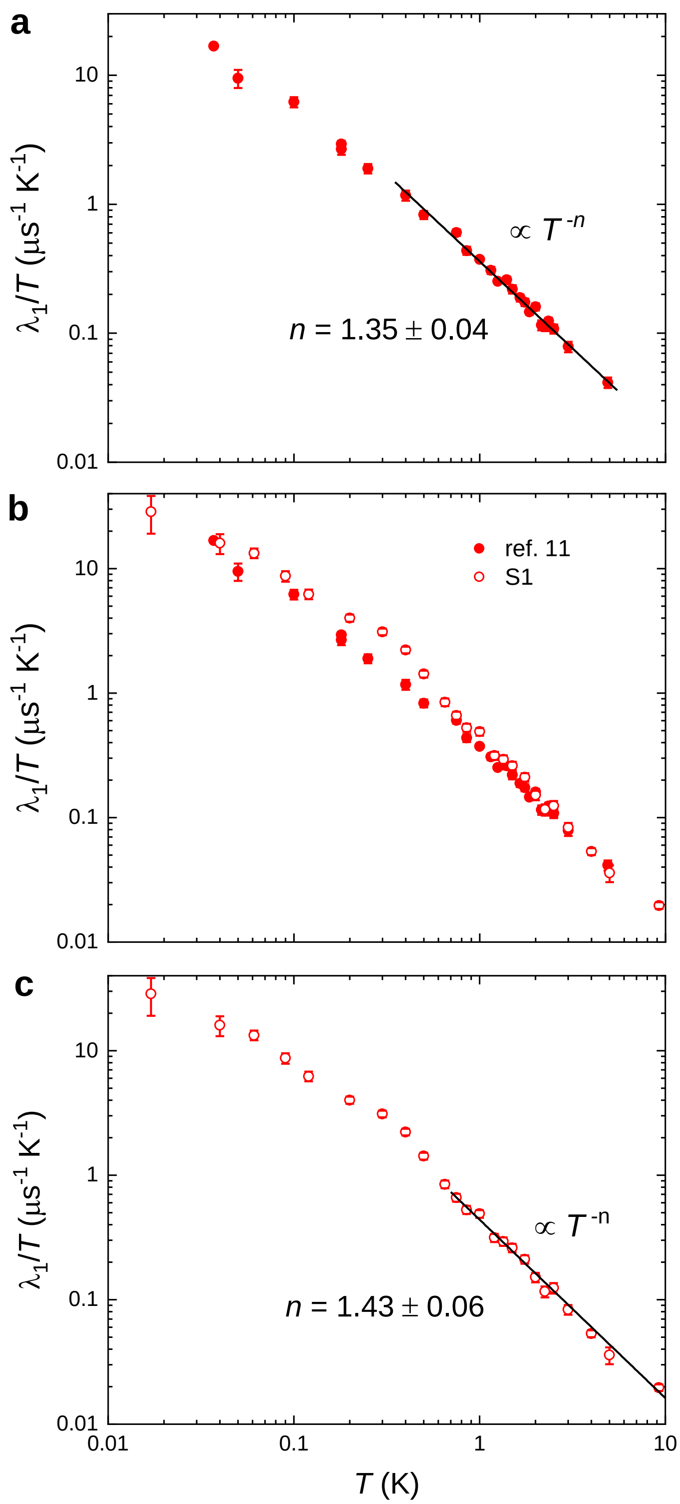

Fig. 8 | a, Fit of λ_1/T versus T above 0.4 K to the relation $\lambda_1/T \propto T^{-n}$ from ref. 11. **b,** Comparison of λ_1/T versus T for sample S1 to data from ref. 11. **c,** Fit of λ_1/T versus T for sample S1 above 0.75 K to the relation $\lambda_1/T \propto T^{-n}$.