SUPPLEMENTARY INFORMATION
for
Exploring the potential of molecular nanomagnets as quantum sensors of radiation

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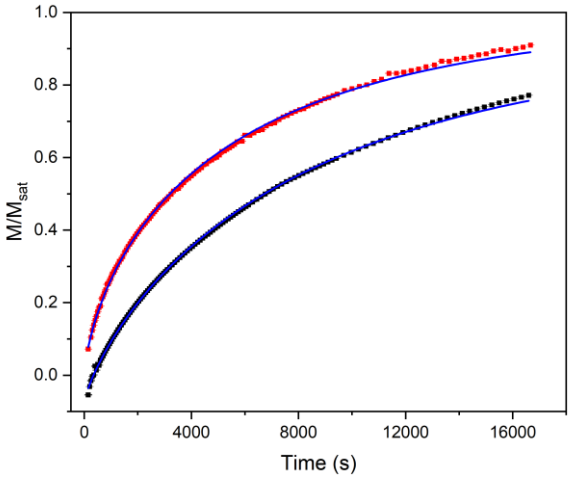
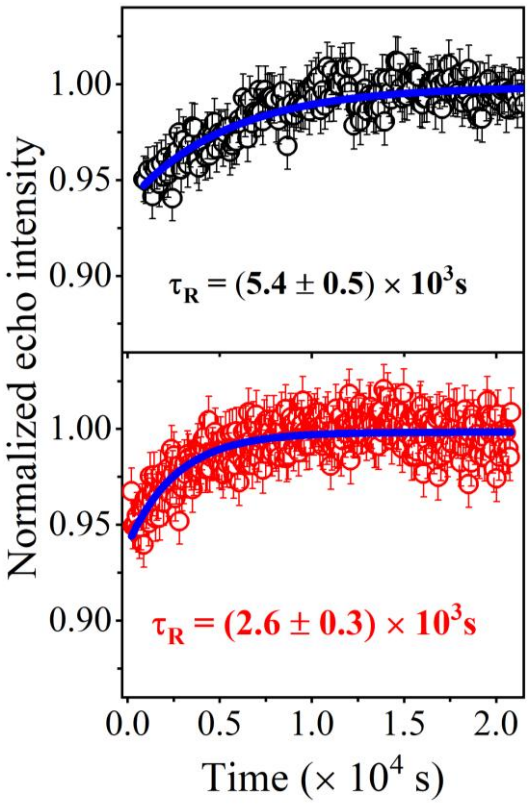
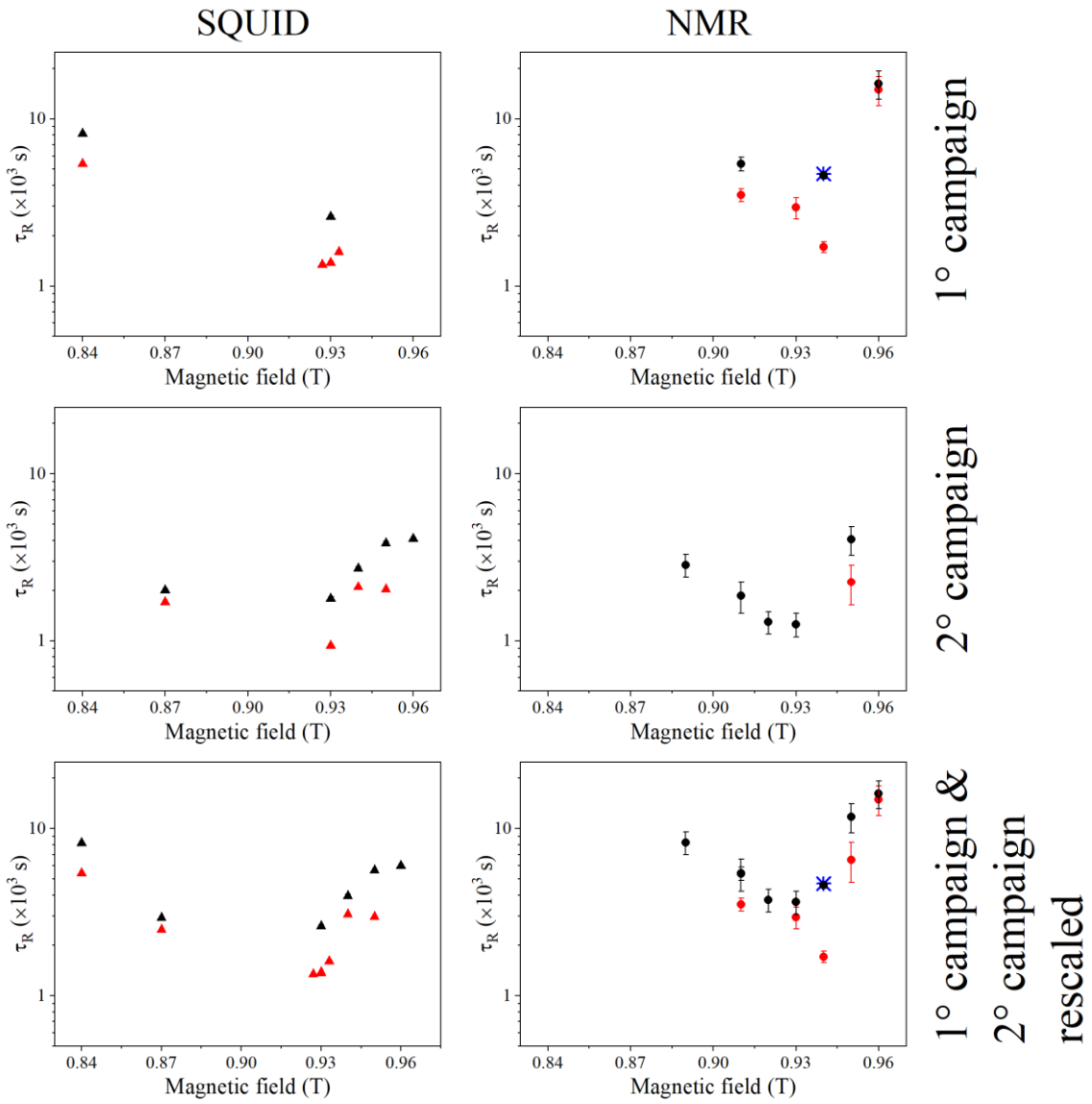
Supplementary Figures



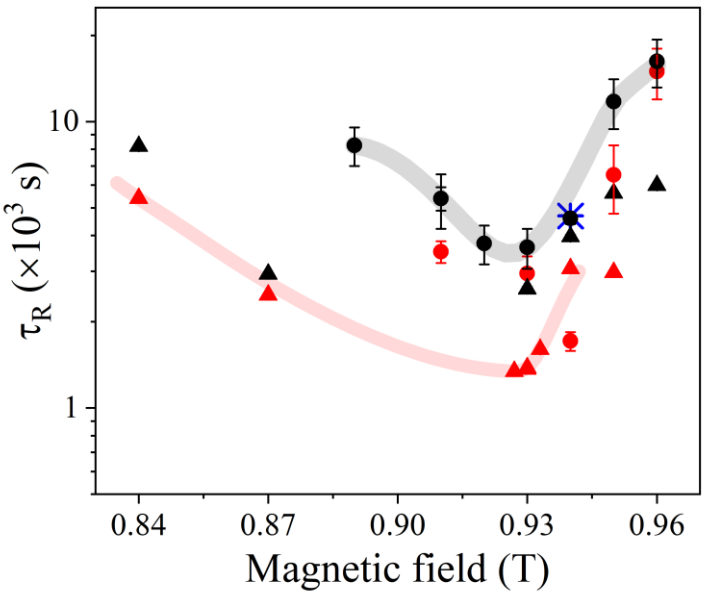
Supplementary Figure 1. Magnetization dynamics at B = 0.84 T with and without irradiation. SQUID recovery curves acquired with B = 0.84 T at T = 2.2 K with the Mn_{12}^{t}BuAc crystal facing the non-emitting (black points) and emitting SC (red points). Blue lines are fits according to Eq. (3B). The curves are normalized to the equilibrium values obtained by the fit procedures.



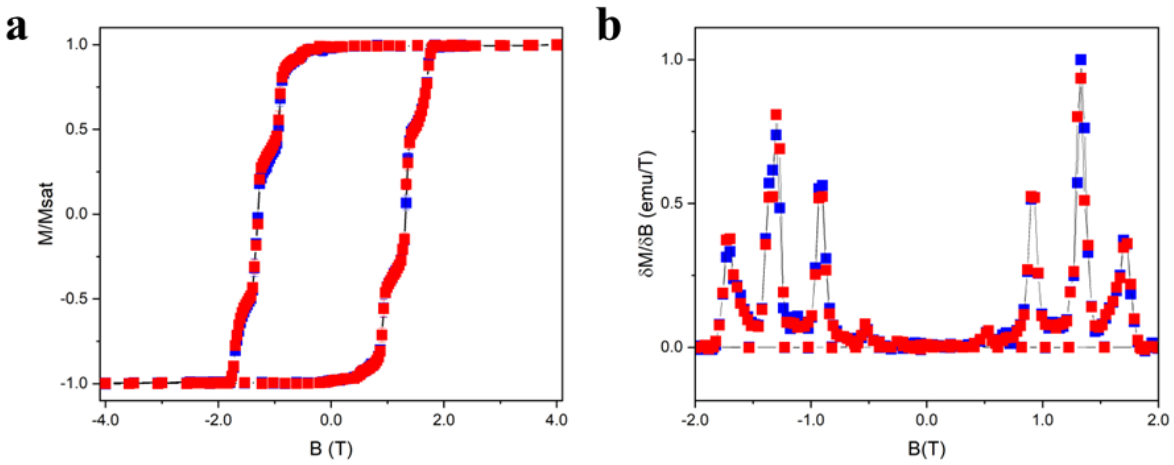
Supplementary Figure 2. Magnetization dynamics at B = 0.91 T with and without irradiation. NMR echo intensity *vs* time, acquired with B = 0.91 T at T = 2.2 K for the crystals facing the non-emitting (top) and emitting (bottom) SC; blue lines are fit with Eq. (3A). The curves are normalized to the equilibrium values obtained by the fit procedures.



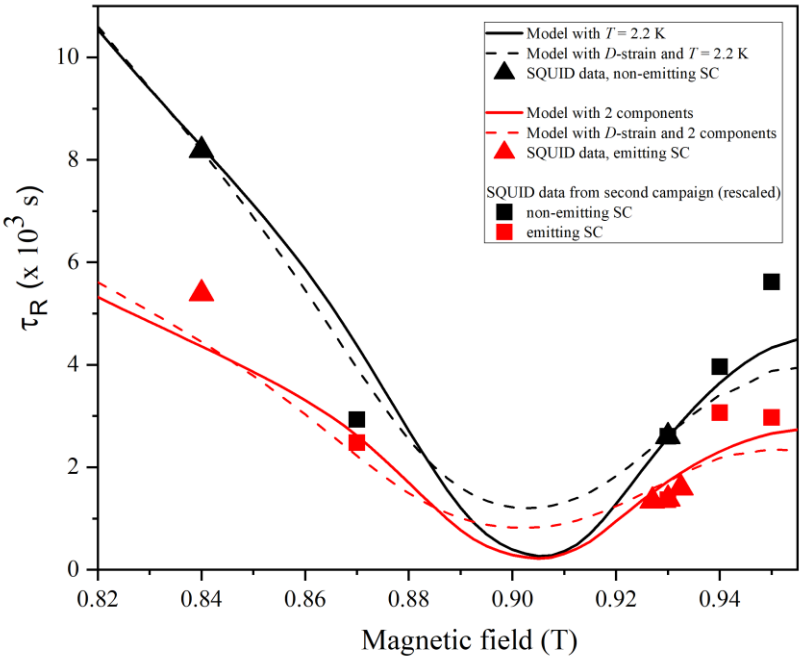
Supplementary Figure 3. Average relaxation time τ_R as a function of B obtained in two different measurement campaigns. The τ_R values are extracted from the fits of the NMR (circles) and SQUID (triangles) data acquired at different B fields around B = 0.93 T and T = 2.2 K, with the crystals facing the non-emitting (black) and emitting (red) SC. The blue asterisk is the NMR measurement repeated after heating up to room temperature. In the first measurement campaign fresh Mn_{12}^{t}BuAc crystals were used, while the second campaign was realized after two months on crystals from the same batch. In the first and second row the τ_R values were directly extracted from the fit. In the third row the data from the second campaign are reported multiplied by a factor 1.46 and 2.9 for the SQUID and NMR data, respectively. This rescaling factor was obtained from the ratio between the τ_R obtained from measurements acquired at the same B value (0.91 T for NMR, 0.93 T for SQUID) in the first and in the second campaign (see text for details).



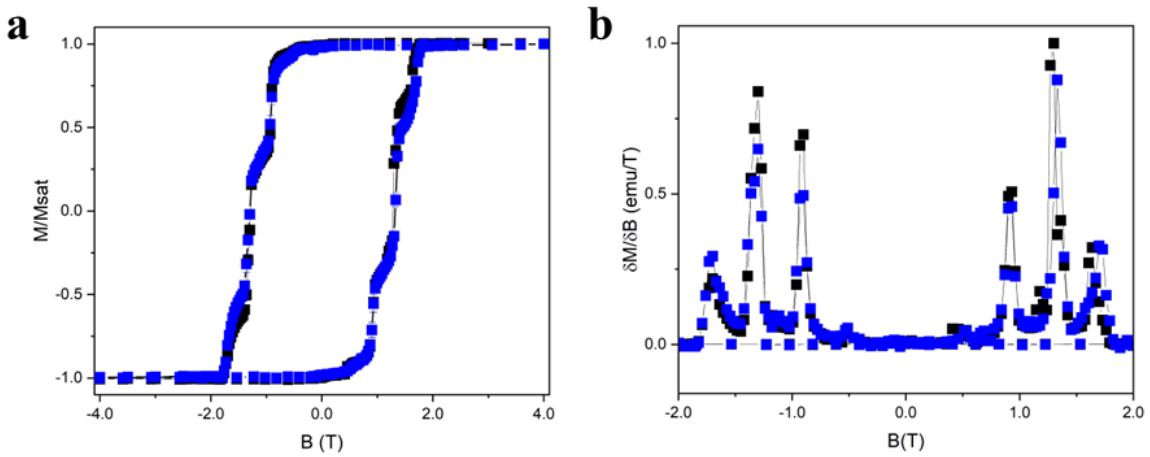
Supplementary Figure 4. Average relaxation time τ_R as a function of B obtained for two different measurement campaigns. The τ_R values are extracted from the fits of the NMR (circles) and SQUID (triangles) data acquired at different B fields around B = 0.93 T and T = 2.2 K, with the crystals facing the non-emitting (black) and emitting (red) SC. The blue asterisk is the NMR measurement repeated after heating up to room temperature. The grey-shaded (pink-shaded) bands are guides for the eye, related to NMR non-emitting (SQUID emitting) data. Data from the second campaign are reported multiplied by a factor 1.46 and 2.9 for the SQUID and NMR data, respectively. This rescaling factor was obtained from the ratio between the τ_R obtained from measurements acquired at the same B value (0.91 T for NMR, 0.93 T for SQUID) in the first and in the second campaign (see text for details).



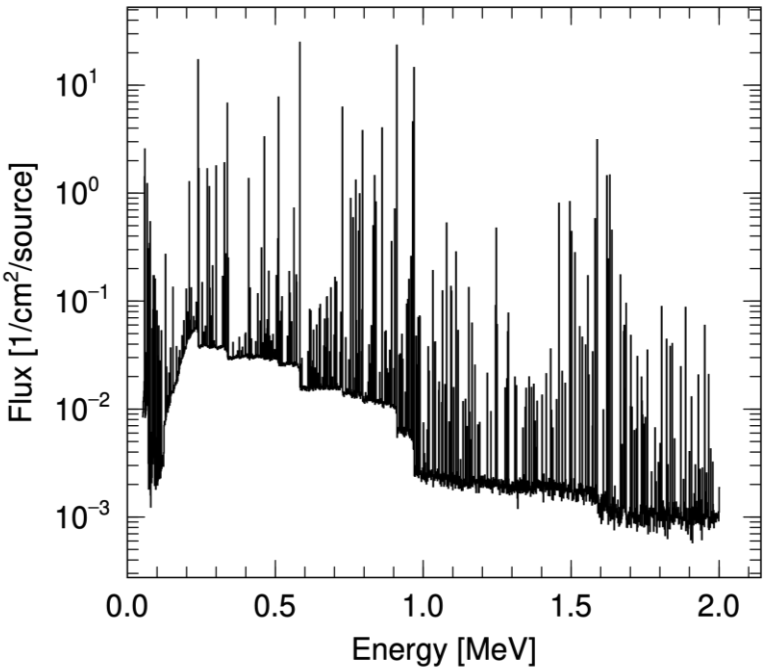
Supplementary Figure 5. Magnetization hysteresis cycle for a Mn_{12}^{t}BuAc crystal under irradiation. **a:** single crystal SQUID measurements acquired at T = 2.2 K with the B field applied along the easy axis: the red curve was measured about 10 hours after the blue one, *i.e.* after 10 hours exposition to the radioactive source. The reported values are normalized to M_{sat}. **b:** plot of dM/dB *vs* B from the same hysteresis, showing the B values at which the anticrossing occurs.



Supplementary Figure 6. Simulated average relaxation time τ_R *vs* applied magnetic field. For simulation details see main text. SQUID data from the first (triangles) and second (squares) campaign are reported. In the first measurement campaign fresh Mn_{12}^{t}BuAc crystals were used, while the second campaign was realized after two months on crystals from the same batch. The data from the second campaign are reported multiplied by a factor 1.46. This rescaling factor was obtained from the ratio between the τ_R obtained from measurements acquired at 0.93 T in first and second campaign (see text for details).



Supplementary Figure 7. Magnetization hysteresis cycle for a single Mn_{12}^{t}BuAc crystal mounted on the non-emitting (black) and emitting (blue) SC. **a:** SQUID measurement acquired at T = 2.2 K with the B field applied along the easy axis. The reported values are normalized to M_{sat}. The two measurements were acquired with different crystals from the same production batch. **b:** plot of dM/dB *vs* B from the same hysteresis, showing the B values at which the anticrossings occur.



Supplementary Figure 8. Photon energy spectrum. Photon energy spectrum of our source from PHITS simulation.

Supplementary Tables

Supplementary Table 1. Average relaxation time τ_R from NMR measurements. Values of the τ_R parameter extracted from the fits - according to Eq. (3A) - of the NMR data acquired in the second measurement campaign, taken at different B fields around B = 0.93 T and T = 2.2 K. The β values are very close to 1. The error on the parameter is reported in parenthesis.

B (T)	Configuration	τ_R (s) × 10^3
0.89	Non-emitting	2.8(4)
0.91	Non-emitting	1.9(4)
0.92	Non-emitting	1.3(2)
0.93	Non-emitting	1.3(2)
0.95	Non-emitting	4.0(8)
	Emitting	2.2(6)

Supplementary Table 2. Average relaxation time τ_R from SQUID measurements. Values of the τ_R and β parameters extracted from the fits - according to Eq. (3B) - of the SQUID data acquired in the second measurement campaign, taken at different fields around B = 0.93 T and T = 2.2 K. The error on the parameters is reported in parenthesis.

B (T)	Configuration	τ_R (s) × 10^3	β
0.87	Non-emitting	2.01(2)	0.82(5)
	Emitting	1.70(1)	0.76(4)
0.93	Non-emitting	1.79(4)	0.639(3)
	Emitting	0.94(1)	0.576(2)
0.94	Non-emitting	2.71(7)	0.671(5)
	Emitting	2.10(4)	0.566(2)
0.95	Non-emitting	3.85(8)	0.736(6)
	Emitting	2.04(1)	0.546(2)
0.96	Non-emitting	4.10(3)	0.747(4)