

Order, entanglement and a new determination of exchange in quasi-two-dimensional molecular magnets

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Though long range magnetic order (LRO) cannot occur at temperatures $T > 0$ in a perfect two-dimensional (2D) Heisenberg magnet, real quasi-2D-materials invariably possess non zero interlayer coupling which will drive the system to LRO. Here we present results from muon-spin relaxation (μ^+ SR) measurements on a class self assembled polymeric systems formed through bridging paramagnetic cations with organic building blocks. These systems' low dimensional structural motifs foster magnetic properties well described by the 2D Heisenberg model. We show for these systems that μ^+ SR is sensitive to LRO, which has proven invisible to conventional measurement techniques. In addition, in materials of this kind that contain fluorine, quantum entanglement, in the form of muon-fluorine dipole-dipole coupling, allows us a sensitive means to determine the muon stopping site [1]. We also demonstrate that the insights gained from μ^+ SR may be combined with high field magnetization measurements and Quantum Monte Carlo calculations [2] in an elegant new method for determining exchange constants in highly anisotropic systems.

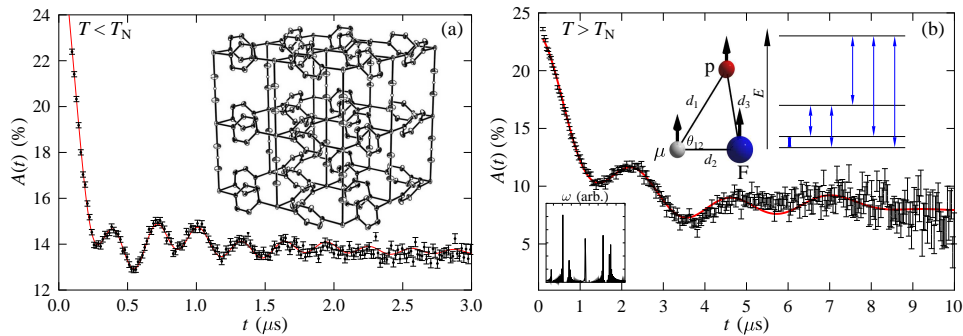


Fig. 1: μ^+ SR spectra demonstrating (a) magnetic order and (b) quantum entanglement in the quasi-2D molecular magnet $[\text{Cu}(\text{HF}_2)(\text{pyz})_2]\text{BF}_4$ [1].

[1] T. Lancaster *et al.*, Phys. Rev. Lett. **99** (2007) 267601.

[2] P. Goddard *et al.* arXiv:0803.4169.