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# Quantum Disorder and Excitations in One-Dimensional Molecule-Based Magnets

The search for states of matter such as quantum spin-liquids involves the characterization of disordered magnetic ground states, and spinons or topological excitations, along with signatures of entanglement [1]. Examples of these features are also found in one-dimensional spin chains. Here we describe our recent $\mu$SR work on such systems built from metal centres linked by molecules.

We discuss examples of linear, staggered and chiral spin-chain materials, and related systems based on dimers. Measurements are supported by electronic-structure calculations that reveal not only muon sites, but also the underlying interactions at play. We review results on linear and staggered $s = 1/2$ chains where the propagation of spinon excitations are probed [2] and on new materials derived from the same structural motifs [3]. Our main topic is new results on the unusual $s = 1/2$ chiral-chain material $[Cu(pym)(H_2O)_4]SiF_6{\cdot}H_2O$, whose spinons appear diffusive, and which undergoes a subtle field-induced transition from quantum disorder to magnetic order in applied fields above 3 T [4,5]. The extension of this work to topologically non-trivial $s = 1$ systems is also discussed [3].

[1] T. Lancaster et al., Contemp. Phys. **64**, 127 (2023).
[2] B.M. Huddart et al., Phys. Rev. B **103** (6), L060405 (2021).
[3] S. Vaidya et al., Phys. Rev. B **111**, 014421 (2025).
[4] J. Liu et al., Phys. Rev. Lett. **122**, 057207 (2019).
[5] R. Scatena et al., in preparation (2025).

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