Anomalous excitation spectra of conventional magnets

One of the scientific frontier in quantum magnetism is the discovery and understanding of quantum entangled and topologically ordered states in real bulk materials. At the focal point of the experimental investigation of these quantum spin networks is the identification of fractionalized excitations in transport and spectroscopic measurments. Inelastic neutron scattering has proved a powerful technique to reveal such signatures in a variety of systems ranging from quasi-1D magnets to kagome compounds and more. Recent and on-going developments with neutron scattering instrumentation have allowed the characterization of magnetic excitations in entire volumes of momentum-energy space with high resolution.

In this talk, I will discuss such experiments on two long-known materials, FeI2 and MgCr2O4, and show how high-fidelity modeling brings new insights on their spin dynamics. On FeI2 [1], I will describe the mechanism endowing low-energy quadrupolar fluctuations with large spectral weight and how these can be completely understood using a SU(3) representation of spin degrees of freedom. The work on MgCr2O4 [2] will showcase that a continuous magnetic excitation spectrum can emerge in a frustrated magnet in absence of quasiparticle fractionalization. Overall, these experiments uncover highly unusual magnetic responses hidden within conventionally ordered magnets and have implications to the search for quantum spin-liquids using neutron scattering. This work was supported by DOE/BES under award DE-SC-0018660

[1] https://arxiv.org/abs/2004.05623 (2020).
[2] Phys. Rev. Lett. 122, 097201 (2019).