Highly dynamic magnetism in a novel 3D network of interconnected trillium lattices

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Abstract:

Quantum spin liquids (QSLs) have emerged as promising systems for the observation of entanglement and fractional excitations in magnetic materials. As quantum fluctuations are enhanced in low-dimensional systems, the focus has been predominantly on 1D and 2D systems. Nevertheless, highly frustrated 3D systems have been shown to support a QSL state, as shown in compounds based on the pyrochlore and hyper-kagome lattices. A recent report [1] indicated a novel 3D magnetic lattice in $K_2Ni_2(SO_4)_3$, a member of the langbeinite family, comprising two interconnected trillium lattices. The source of its highly dynamic state can be associated with proximity to a specific spin model, based on a trillium lattice of tetrahedra [2]. Furthermore, this family of compounds exhibits a broad chemical variety, allowing a wide range of magnetic ions and the associated spin states, as well as tuning of their interactions. I will present our efforts in reaching the quantum limit of $S = 1/2$ spin state on this lattice, with an emphasis on the $K_2Ti_2(PO_4)_3$ compound.

[1] I. Zivkovic et al., PRL **127**, 157204 (2021).
[2] M. Gonzales et al., Nature Commun. **15**, 7191 (2024)