SES19-2019-000178

Abstract for an Invited Paper
for the SES19 Meeting of
the American Physical Society

Understanding Geometrical Frustration in Complex Magnetic Materials[1]

JOSEPH PADDISON, Materials Science and Technology Division, Oak Ridge National Laboratory

Geometrical frustration – the inability of a system to satisfy all its pairwise interactions simultaneously because of geometrical constraints – can generate exotic states in magnetic materials, such as spin ices and quantum spin liquids [1]. The traditional route towards such states typically considers only magnetic interactions between nearest-neighbor and (sometimes) next-nearest-neighbor spins. Surprisingly, however, recent work has revealed that exotic spin-liquid states may be hosted in materials with complex exchange interactions [2,3]. In my talk, I will present neutron-scattering data and modeling results on two such materials, $MgCr_2O_4$ [4] and $LiGaCr_4S_8$ [5], and discuss the origin of the unexpected spin-liquid behavior in each case. In both materials, Cr^{3+} magnetic ions occupy a frustrated lattice of corner-sharing tetrahedra, and the temperature of conventional magnetic ordering or spin freezing is strongly suppressed. I will show how the magnetic diffuse scattering observed in neutron-scattering experiments can be analyzed to determine the further-neighbor exchange interactions in these materials, providing a foundation for understanding both their spin dynamics and their magnetic ground states [4]. Finally, I will present a new open-source computer program for the refinement of spin Hamiltonians to magnetic diffuse-scattering data, to facilitate this type of analysis for a wide range of topical magnetic materials. [1] R. Moessner & A. P. Ramirez, *Physics Today* **15**, 24 (2006); [2] C. Balz *et al.*, *Nature Physics* **12**, 942 (2016); [3] P. Henelius *et al.*, *Phys. Rev. B* **93**, 024402 (2016); [4] X. Bai *et al.*, *Phys. Rev. Lett.* **122**, 097201 (2019); [5] G. Pokharel *et al.*, *Phys. Rev. B* **97**, 134117 (2018).

[1]This work was supported by the U.S. D.O.E., Office of Science, Basic Energy Sciences, Materials Sciences and Engineering Division; Churchill College, University of Cambridge; the Gordon and Betty Moore Foundation EPiQS Initiative (grant GBMF4416); the Kavli Institute for Theoretical Physics (grant NSF-PHY-1748958); and the EPSRC (grant EP/I032487/1).