Spin dynamics in the hyperkagome compound Gd$_3$Ga$_5$O$_{12}$

OLEG PETRENKO, University of Warwick, UK

We present the first neutron inelastic scattering results on the magnetic state of the frustrated hyperkagome compound Gd$_3$Ga$_5$O$_{12}$ (GGG) at low temperatures and in applied magnetic field. Our neutron scattering studies reveal a remarkable range of timescales. Short-range spatial correlations appear static within the instrumental resolution (50 $\mu$eV). Three distinct inelastic modes are found at 0.04(1), 0.12(2) an 0.58(3) meV at 0.06 K. The application of a magnetic field up to 2.5 tesla reveals disparate behavior of the magnetic excitations. In zero applied field, the lowest and highest energy excitations show spatial dependencies indicative of dimerized short-range antiferromagnetic correlations that survive to high temperatures, comparable to the nearest neighbor exchange interactions. Our results suggest that the ground state of a three dimensional hyperkagome compound differs distinctly from its frustrated counterparts on a pyrochlore lattice and reveal a juxtaposition of cooperative paramagnetism and strong dimerized coupling. These results are surprising since GGG is often classified as a strongly frustrated system with a manifold of connected states for which one would expect a continuum of gapless excitations.

In collaboration with: Pascale Deen, Institut Laue Langevin; G. Balakrishnan, Department of Physics, University of Warwick; B.D. Rainford, Department of Physics and Astronomy, Southampton University; C. Ritter, Institut Laue-Langevin; L. Capogna, Istituto Officina dei Materiali, IOM-CNR; H. Mutka and T. Fennell, Institut Laue-Langevin.