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Spin dynamics in the hyperkagome compound $Gd_3Ga_5O_{12}$

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We present the first neutron inelastic scattering results on the magnetic state of the frustrated hyperkagome compound $Gd_3Ga_5O_{12}$ (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 μeV). 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.

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