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Magnetic phase transitions of an incommensurate Dzyaloshinskii-Moriya antiferromagnet with effective 2D interactions

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Using neutron diffraction, the magnetic fluctuations are investigated near the phase transition to a long-range ordered incommensurate cycloid spin spiral in the antiferromagnetic insulator Ba2CuGe2O7. We find that these fluctuations possess a two-dimensional character and, as a consequence, cover an extended cylindrical manifold in reciprocal space. Their distribution can be explained with a ratio of in- and out-of-plane stiffness of 0.027, in agreement with previous reports. The temperature dependence of the correlation length is consistent with a crossover from 2D antiferromagnetic Heisenberg fluctuations to incommensurate fluctuations with decreasing temperature, highlighting the plethora of phase transitions associated with spiral magnetic textures.
Recently, a new phase with a vortex-antivortex magnetic structure has been theoretically described. It has been experimentally confirmed in a pocket in the phase diagram at around 2.4K and an external field along the crystalline c-axis of around 2.2T. A lack of evidence for a thermodynamic phase transition towards the paramagnet in high resolution specific heat measurements and a finite linewidth in energy and momentum of the incommensurate peaks in neutron scattering, as opposed to the cycloidal ground state, seem to mark the vortex phase as a slowly fluctuating structure at the verge of ordering.

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