Potential new vortex phase in antiferromagnetic incommensurate magnet $Ba_2CuGe_2O_7$

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$Ba_2CuGe_2O_7$ is a quasi-2D insulator characterised by a tetragonal, noncentrosymmetric space group (P-42_1m) with Dzyaloshinskii–Moriya interactions (DMI). Because of the DMI, at ground state below T_N = 3.05 K, it exhibits an almost AF cycloidal spin structure with a pitch of 220 Å. The magnetic structures of $Ba_2CuGe_2O_7$ for different temperature and magnetic field values have been the topic of numerous experiments [1] indicating a rich phase diagram with a multitude of incommensurate (IC) phases. Following a recent theoretical prediction, the existence of a vortex phase [2] with non-trivial topological properties in $Ba_2CuGe_2O_7$ has been verified, by means of neutron scattering and bulk measurements of specific heat and AC susceptibility. Despite lacking evidence of any signature of a phase transition in the bulk magnetisation and specific heat measurements, hints towards the presence of a vortex phase were found in the neutron scattering data. There significant measured intensity is seen in the region of interest, noticeably higher than in the paramagnetic phase. This intensity is evenly distributed among four IC satellites on a square plane in reciprocal space, even in the presence of a small in-plane magnetic field component. However, it remains unclear whether the observed phase is due to static long range order or is a fluctuating dynamic texture that is on the verge of ordering.

[1] Mühlbauer S, Gvasaliya S, Ressouche E, Pomjakushina E, Zheludev A. Phase diagram of the Dzyaloshinskii-Moriya helimagnet $Ba_2CuGe_2O_7$ in canted magnetic fields. Physical Review B - Condensed Matter and Materials Physics, 86(2), 1–12. https://doi.org/10.1103/PhysRevB.86.024417 (2012)

[2] Wolba B, Aspects of Complex Magnetism: Vortex Phases, Skyrmion Dynamics, and Chaotic Nano-Oscillators. PhD thesis. Karlsruher Instituts für Technologie, unpublished (2021)