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Breakdown of helical order in the Dzyaloshinskii-Moriya Antiferromagnet Ba₂CuGe₂O₇

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Neutron diffraction on a triple-axis spectrometer and a small-angle neutron scattering instrument is used to study the magnetic phase transition in tetragonal Ba₂CuGe₂O₇ at zero magnetic field. In addition to the incommensurate cycloidal antiferromagnetic (AFM) long-range order, we establish that weak incommensurate ferromagnetism (FM) also arises below the transition temperature T_N identified by sharp Bragg peaks close to the Γ point. The intensities of both the incommensurate AFM and FM Bragg peaks vanish abruptly at T_N , which is indicative of a weak first-order transition. Above T_N , evidence is presented that the magnetic intensity within the tetragonal (a, b) plane is distributed on a ring in momentum space whose radius is determined by the incommensurate wave vector of the cycloidal order. We speculate that the associated soft fluctuations are at the origin of the weak first-order transition in the spirit of a scenario proposed by Brazovskii. [1]

[1]Phys. Rev. B 96, 134409 (2017)

Primary authors: MUEHLBAUER, Sebastian (Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Garching); BRANDL, Georg (Jülich Centre for Neutron Science (JCNS) at Heinz Maier-Leibnitz Zentrum (MLZ), Forschungszentrum Jülich GmbH, Garching, Germany); Dr MÅNSSON, Martin (Materials Physics, KTH Royal Institute of Technology, Stockholm Kista, Sweden); Dr GARST, Markus (Institut für Theoretische Physik, Technische Universität Dresden, Dresden)

Presenter: MUEHLBAUER, Sebastian (Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Garching)

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