Evidence of a field-induced Berezinskii–Kosterlitz–Thouless scenario in a two-dimensional spin–dimer system

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Abstract

Two-dimensional (2D) systems with continuous symmetry lack conventional long-range order because of thermal fluctuations. Instead, as pointed out by Berezinskii, Kosterlitz and Thouless (BKT), 2D systems may exhibit so-called topological order driven by the binding of vortex–antivortex pairs. Signatures of the BKT mechanism have been observed in thin films, specially designed heterostructures, layered magnets and trapped atomic gases. Here we report on an alternative approach for studying BKT physics by using a chemically constructed multilayer magnet. The novelty of this approach is to use molecular-based pairs of spin $S=½$ ions, which, by the application of a magnetic field, provide a gas of magnetic excitations. On the basis of measurements of the magnetic susceptibility and specific heat on a so-designed material, combined with density functional theory and quantum Monte Carlo calculations, we conclude that these excitations have a distinct 2D character, consistent with a BKT scenario, implying the emergence of vortices and antivortices.