

Magnetic vortices in a square lattice revealed by local magnetic susceptibilities and neutron diffuse scattering

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Quantum materials (QMs) represent one of the most interesting and innovative areas in today's science due to their promising application potential in quantum computing and information technology. One of the challenges in quantum materials is to find materials with the subtle balance of interactions to display quantum phenomena. Neutron scattering is a key technique in exploring QMs. Recently, by employing polarized neutron scattering and single crystal diffuse neutron scattering, a magnetic vortex liquid state is revealed in a rare-earth bilayer square lattice. It shows no long-range magnetic order upon cooling to 85 mK. Through the machine learning assisted optimization of the spin Hamiltonian, the polarized neutron diffraction and magnetic diffuse scattering together reveal the magnetic interactions of the tilted Ising spins, the role of impurities, and the origin of the short-range order vortex.