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Spin order and excitations of a model triangular antiferromagnet[1]
WEI BAO, Los Alamos National Lab., YIMING QIU, NIST, YINGXIA WANG, KUO LI, JIANGHUA LIN, Peking University, ROSS ERWIN, NIST — The triangular antiferromagnet is a model system situating close to the boundary between a three-sublattice order and a quantum-liquid state, due to delicate balance among magnetic interaction, quantum fluctuations and geometrical frustration. The unique topology of the non-collinear three-sublattice order has profound consequences in finite-temperature phase-transitions and spin excitations, which are not yet fully understood. Experimental investigation on such issues has been impeded by imperfect materials which fail to represent the theoretical model at low temperatures. Here we show by neutron scattering that the three-sublattice order in the exceptional new material $La_2Ca_2MnO_7$ remains two-dimensional down to 40 mK. The order parameter and critical spin fluctuations suggest a phase transition at 3.8 K, but the in-plane correlation length becomes resolution-limited only below 1.8 K. While the spin-wave cone at low energy and the softening of high-energy modes in current theories are supported by our observations, measured spectral intensity above the upper energy limit of spin-waves distribution and a pseudogap developing below 1.8 K are not anticipated.

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