Poster-2-2

Broken-Symmetry Ground States of the Heisenberg model on the Pyrochlore Lattice

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The spin-1/2 Heisenberg model on the pyrochlore lattice is an iconic frustrated three-dimensional spin system with a rich phase diagram. Besides hosting several ordered phases, the model is debated to possess a spin-liquid ground state when only nearest-neighbor antiferromagnetic interactions are present. Here, we contest this hypothesis with an extensive numerical investigation using both exact diagonalization and complementary variational techniques. Specifically, we employ a RVB-like many-variable Monte Carlo ansatz and convolutional neural network quantum states for (variational) calculations with up to 44^3 and 43^3 spins, respectively. We demonstrate that these techniques yield consistent results, allowing for reliable extrapolations to the thermodynamic limit. Our main results are (1) the determination of the phase transition between the putative spin-liquid phase and the neighboring magnetically ordered phase and (2) a careful characterization of the ground state in terms of symmetry-breaking tendencies. We find clear indications of spontaneously broken inversion and rotational symmetry, calling the scenario of a featureless quantum spin-liquid into question. Our work showcases how many-variable variational techniques can be used to make progress in answering challenging questions about three-dimensional frustrated quantum magnets.

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