QUANTUM SIMULATION OF MICRO AND MACRO FRUSTRATED QUANTUM MAGNETISM WITH SUPERCONDUCTING CIRCUITS

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We devise a scalable scheme for simulating a Quantum Phase Transition (QPT) from paramagnetic to a frustrated magnetic phase in a network of superconducting flux qubits, and show how it can be characterized both microscopically as well as macroscopically, a criterion that is often not satisfied in reporting QPTs. We propose a measure for the macroscopic characterization of our QPT based on the Kullback-Leibler divergence between the obtained and expected probability distributions of the total magnetic moment of the network, whereas microscopic characterization is performed via measuring the local entanglement-witness operator. Our result opens up the possibility for performing QPT experiments that can shed light on the long-standing debate if the macroscopic laws of a system are fundamental, or reducible to the laws of its microscopic constituents.

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