Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Quantum simulation of micro and macro frustrated quantum magnetism with superconducting circuits.[1] JOYDIP GHOSH, BARRY C. SANDERS, Univ of Calgary — We devise a scalable scheme for simulating a quantum phase transition from paramagnetism to frustrated magnetism in a superconducting flux-qubit network, and show how to characterize this system experimentally both macroscopically and microscopically. The proposed macroscopic characterization of the quantum phase transition is based on the transition of the probability distribution for the spin-network net magnetic moment with this transition quantified by the difference between the Kullback-Leibler divergences of the distributions corresponding to the paramagnetic and frustrated magnetic phases with respect to the probability distribution at a given time during the transition. Microscopic characterization of the quantum phase transition is performed using the standard local-entanglement-witness approach. Simultaneous macro and micro characterizations of quantum phase transitions would serve to verify in two ways a quantum phase transition and provide empirical data for revisiting the foundational emergentist-reductionist debate regarding reconciliation of macroscopic thermodynamics with microscopic statistical mechanics especially in the quantum realm for the classically intractable case of frustrated quantum magnetism.

[1]NSERC, AITF and University of Calgarys Eyes High Fellowship Program

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Date submitted: 29 Oct 2015 Electronic form version 1.4