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Finite-temperature dynamics of spin systems on near-term quantum hardware

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Wednesday, February 3, 2021

12:00p.m.

Zoom Link

Meeting URL: https://usc.zoom.us/j/98052669977

Meeting ID: 980 5266 9977

The finite-temperature dynamics of quantum spin systems are challenging to simulate on quantum computers because the operators that can be implemented on the device are unitary. The quantum imaginary time evolution (QITE) algorithm [1] has demonstrated that non-unitary evolution in imaginary time can be carried out without requiring extra qubits. However, existing implementations on hardware have been limited to at most 2 spins and measurements of finite-temperature energy. Here, we report calculations of finite-temperature energies, static and dynamical correlation functions, and excitation spectra of spin Hamiltonians of up to 4 spins on IBMQ's hardware [2]. These calculations are enabled by exploiting symmetries to reduce the quantum resources required by QITE. Our work demonstrates that near-term quantum devices are capable of computing diverse observables of quantum spin systems in real and imaginary time simultaneously without ansatz-based variational schemes.

[1] Motta et al, Nat Phys 16:205 (2020)

[2] Sun et al, arXiv:2009.03542 (2020, PRX Quantum, in press)

The Department of Physics and Astronomy hosts its Colloquium on Wednesday afternoons through the academic semester at 12:00pm.

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