Poster 3

Dissipative mean-field theory of IBM utility experiment

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In spite of remarkable recent advances, quantum computers have not yet found any useful applications. A promising direction for such utility is offered by the simulation of the dynamics of many-body quantum systems, which cannot be efficiently computed classically. Recently, IBM used a superconducting quantum computer to simulate a kicked quantum Ising model for large numbers of qubits and time steps. By employing powerful error mitigation techniques, they were able to obtain an excellent agreement with the exact solution of the model. This result is very surprising, considering that the total error accumulated by the circuit is prohibitively large. In this letter, we address this paradox by introducing a dissipative mean-field approximation based on Kraus operators. Our effective theory reproduces the many-body unitary dynamics and matches quantitatively local and non-local observables. These findings demonstrate that the observed dynamics is equivalent to a single qubit undergoing rotations and dephasing. Our emergent description can explain the success of the quantum computer in solving this specific problem.

[1] Emanuele G. Dalla Torre and Mor M. Roses, arXiv:2308.01339 (2023).