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Dynamical Quantum Phase Transitions of the Schwinger Model: Real-Time Dynamics on IBM Quantum

Simulating the real-time dynamics of gauge theories represents a paradigmatic use case to test the hardware capabilities of a quantum computer, since it can involve non-trivial input states'preparation, discretized time evolution, long-distance entanglement, and measurement in a noisy environment. We implemented an algorithm to simulate the real-time dynamics of a few-qubit system that approximates the Schwinger model in the framework of lattice gauge theories, with specific attention to the occurrence of a dynamical quantum phase transition. Limitations in the simulation capabilities on IBM Quantum were imposed by noise affecting the application of single-qubit and two-qubit gates, which combine in the decomposition of Trotter evolution. The experimental results collected in quantum algorithm runs on IBM Quantum were compared with noise models to characterize the performance in the absence of error mitigation.

Primary author: POMARICO, Domenico (Istituto Nazionale di Fisica Nucleare)

Co-authors: LUPO, Cosmo (Politecnico di Bari); Dr PEPE, Francesco V. (Istituto Nazionale di Fisica Nucleare); COSMAI, Leonardo (Istituto Nazionale di Fisica Nucleare); FACCHI, Paolo (Istituto Nazionale di Fisica Nucleare); PASCAZIO, Saverio (Istituto Nazionale di Fisica Nucleare)

Presenter: POMARICO, Domenico (Istituto Nazionale di Fisica Nucleare)