Contribution ID: **60** Type: **Poster**

Quantum Computing Study of the Speed of Quantum Evolution in the Ising Model in a Longitudinal Magnetic Field

Tuesday, 22 September 2026 17:50 (5 minutes)

The speed of quantum state evolution is a fundamental characteristic of quantum dynamics. As shown in [1], for pure quantum states, it is directly governed by energy fluctuations. In the present work, we examine the speed of quantum evolution in a spin system described by the Ising model and subjected to a longitudinal magnetic field. We perform analytical derivations and quantum computing using AerSimulator. The quantum programming of the speed of quantum evolution employs two distinct approaches: the estimation of the expectation value of the evolution operator for short times and the direct measurement of Pauli correlators [2]. The results of the quantum computations are in agreement with the theoretical results. We also show that the quantum states evolved in spin systems described by the Ising model in a magnetic field can be treated as quantum graph states representing vertex- and edge-weighted graphs. We establish relations between the speed of quantum evolution and the structural properties of the graph.
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Session Classification: Poster Session

Track Classification: MATHEMATICAL PHYSICS