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Monte Carlo matrix-product-state approach to the false vacuum decay in the monitored quantum Ising chain

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In this work we characterize the metastable dynamics in the ferromagnetic quantum Ising chain with a weak longitudinal field subject to continuous monitoring of the local magnetization. To this end we exploit a numerical approach based on the combination of matrix product states with stochastic quantum trajectories which allows for the simulation of the trajectory-resolved non-equilibrium dynamics of interacting many-body systems in the presence of continuous measurements. We show how the presence of measurements affects the false vacuum decay: at short times the departure from the local minimum is accelerated while at long times the system thermalizes to an infinite-temperature incoherent mixture. For large measurement rates the system enters a quantum Zeno regime. The false vacuum decay and the thermalization physics are characterized in terms of the magnetization, connected correlation function, and the trajectory-resolved entanglement entropy.

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