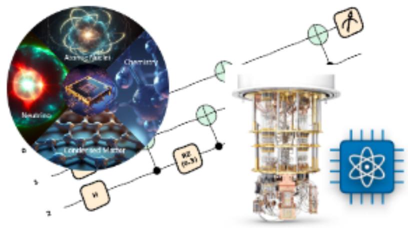

Contribution ID: **30** Type: **Contributed Talk (25 min including questions)**

Off-diagonal Pauli Weight truncation and equilibration temperature dependence for simulating local dynamics in quantum systems

Tuesday, November 18, 2025 3:00 PM (25 minutes)

The complexity of simulating the out-of-equilibrium evolution of local operators in the Heisenberg picture is governed by the operator entanglement, which grows linearly in time for generic nonintegrable systems, leading to an exponential increase in computational resources. A promising approach to simplify this challenge involves discarding parts of the operator and focusing on a subspace formed by "light"Pauli strings—strings with few Pauli matrices—as proposed by Rakovszki et al. [Phys. Rev. B 105, 07513 (2022)] for infinite temperature settings.

In our recent works [Phys. Rev. B 111, 094301(2025), In preparation], we investigated whether this strategy can be applied to quenches starting from homogeneous product states, end extend it to handle arbitrary temperatures, since the evolution of ergodic Hamiltonians combined with these initial states grant access to a wide range of equilibration regimes.

By concentrating on the required matrix elements and retaining only the portion of the operator that contains Pauli strings parallel to the initial state, we uncover a complex scenario. For intermediate simulation times, in some cases the light Pauli strings suffice to describe the dynamics, enabling efficient simulation with current algorithms; however, for other cases heavier strings become necessary, pushing computational demands beyond our current capabilities.

For long simulation times, we detect that complexity is intimately correlated with the equilibration temperature, and that our modified method agrees with the state-of-the art transverse contraction simulations. In the process, we found that the transverse light-cone algorithm also displays a complexity correlated with temperature, which can be explained by a careful reinterpretation of our results in [Phys. Rev. Research 6, 033021(2024)].

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