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Dynamics of the Sachdev-Ye-Kitaev model

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We study the dynamics of the SYK model, an important toy model for quantum gravity, on IBM's superconducting qubit quantum computers. Using a graph coloring algorithm for construction with the Jordan-Wigner transformation, we find an implementation for the Trotter evolution with a complexity of $\mathcal{O}(N^5 J^2 t^2 / \epsilon)$, where N represents the number of Majorana fermions, J is the dimensionful coupling parameter, t is the evolution time, and ϵ is the desired precision. With IBM's Eagle r3 processor, we performed simulations of quantum circuits with different error mitigation techniques. In particular, we compute the vacuum return probability and out-of-time-order correlators (OTOC), which are standard observables for quantifying the chaotic nature of quantum systems.

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