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【504】Digital Quantum Simulation, Trotter Errors, and Quantum Chaos of the Kicked Top

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Quantum simulation enables studying the dynamics of quantum many-body systems in regimes which are inaccessible to numerical methods. With universal digital quantum simulators, time evolution generated by a large class of Hamiltonians can be simulated by approximating the unitary time-evolution operator by a sequence of quantum gates. However, this "Trotterization" introduces an intrinsic source of errors. Our work connects Trotter errors in digital quantum simulation of collective spin systems to quantum chaos of the kicked top: Trotter errors remain bounded in the regime of small Trotter steps, which corresponds to regular motion of the kicked top. Instead, quantum chaos, which sets in above a sharp threshold value of the Trotter step size, leads to the proliferation of Trotter errors.

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