Kicked-Ising quantum battery

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Abstract

Quantum batteries (QBs) have emerged as promising candidates to store energy, capable of out-performing their classical counterparts via entangled operators. Here, we introduce the kicked-Ising model as a QB [1] and analytically characterize its charging dynamics under the self-dual operator regime where the entanglement growth maximizes. We obtain exact expressions for arbitrary system sizes, boundary conditions and Floquet cycles. The kicked-Ising QB achieves maximal charging while exhibiting remarkable robustness against disorder. We further propose a fixed time window protocol that enables faster and more efficient energy injection, while non-uniform kick schedules enhance experimental flexibility. Spin correlators analysis shows that low-frequency driving boosts energy injection, highlighting an interplay between charging and scrambling. Our results are supported by tensor-network simulations and verified on IBM quantum hardware. Accounting for platform-specific constraints, we demonstrate that the kicked-Ising QB offers a scalable and disorder-resilient protocol.

References

[1] SV Romero, X Chen and Y Ban, Kicked-Ising Quantum Battery, arXiv:2511.17835 (2025).