Insights from the analytical solution of a periodically driven transverse-field Ising chain

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Abstract

We present exact analytical solutions for the non-equilibrium dynamics of a periodically driven transverse field Ising chain after an arbitrary number (n) of drive cycles. Going beyond the conventional Floquet theory approach that is restricted to the asymptotic limit ($n \to \infty$), we obtain closed-form expressions for the time-evolved wavefunction and various observables including excitation probability, defect density, magnetization, and correlation functions. Our analysis reveals a universal decomposition of observables into transient oscillatory components and steady-state saturation values. The analytical framework, developed using properties of SU(2) matrices, enables us to: (i) identify specific driving frequencies that prevent dynamic freezing in the delta-kicked model, (ii) derive exact conditions for dynamical transitions in correlation functions, and (iii) compute the entanglement entropy numerically from correlation matrices. These results provide new insights into finite-time dynamics of driven integrable systems and establish a theoretical foundation for exploring more complex scenarios involving non-Hermitian or long-range interactions.

Reference: Pritam Das and Anirban Dutta, "Insights from the analytical solution of a periodically driven transverse-field Ising chain," *Phys. Rev. B* **111**, 045159 (2025).