Poster

Exact Solvability Of Entanglement for Arbitrary Initial State in an Infinite-Range Floquet System

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Sharma and Bhosale [Phys. Rev. B 109, 014412 (2024); Phys. Rev. B 110, 064313 (2024)] recently introduced an N-spin Floquet model with infinite-range Ising interactions. There, we have shown that the model exhibits the signatures of quantum integrability for specific parameter values $J = 1, 1/2$ and $\tau = \pi/4$. We have found analytically the eigensystem and the time evolution of the unitary operator for finite values of N up to 12 qubits. We have calculated the reduced density matrix, its eigensystem, time-evolved linear entropy, and the timeevolved concurrence for the initial states $|0, 0>$ and $|\pi/2, -\pi/2>$. For the general case $N > 12$, we have provided sufficient numerical evidences for the signatures of quantum integrability, such as the degenerate spectrum, the exact periodic nature of entanglement dynamics, and the time-evolved unitary operator. In this paper, we have extended these calculations to arbitrary initial state $|\theta_0, \phi 0>$, such that $\theta_0 \in [0, \pi]$ and $\phi_0 \in [-\pi, \pi]$. Along with that, we have analytically calculated the expression for the average linear entropy for arbitrary initial states. We observed that the average linear entropy exhibits a qualitatively similar structure for $J = 1$, which depends on the parity of N. We numerically find that the average value of time-evolved concurrence for arbitrary initial states decreases with N, implying the multipartite nature of entanglement. We numerically show that the values $\langle S\rangle/S_{max} \to 1$ for Ising strength $(J \neq 1, 1/2)$, while for $J = 1$ and $1/2$, it deviates from 1 for arbitrary initial states even though the thermodynamic limit does not exist in our model. This deviation is shown to be a signature of integrability in earlier studies where the thermodynamic limit exist. Our results could be experimentally verified in various setups like NMR, superconducting qubits, and laser-cooled atoms. However for higher number of qubits, one can use ion trap.