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Thermalization with the Inclusion of Conserved Charges

We study the effect of conserved charges on thermalization in quantum chaotic systems. Holographically, in the presence of a chemical potential, a non-monotonicity appears in the thermalization time as a function of chemical potential for small regions. To shed light on this behavior from the quantum side we study the dynamics of out of equilibrium states in finite-dimensional spin chains. Our constructed Hamiltonian embeds a mixed field Ising model of qubits into a larger qutrit Hilbert space, admitting a variable conserved charge Q. We find that a non-monotonicity is present in the entropy saturation times as a function of Q, and find corresponding behavior in the entanglement velocities as well. Additionally, we find that the entropy saturation value grows with the size of the charge superselection sector, maximizing when Q is $1/3$ of its maximal value. We also study the behavior of Pauli matrices acting on the qubit subsystem of each lattice site and show the behavior matches the nearly time-independent behavior of local operators predicted by the Eigenstate Thermalization Hypothesis.

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