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# Wigner function thermalization —- a quantum simulation of QGP based on the Schwinger Model

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Thermalization of the quark gluon plasma (QGP) created in relativistic heavy-ion collisions is a crucial theoretical question in understanding the onset of hydrodynamics, and in a broad sense, a key step to the exploration of thermalization in quantum systems.
Addressing this problem theoretically, in a first principle manner, requires a real-time, non-perturbative method. To this end, we carry out a fully quantum simulation on a classical hardware, of a massive Schwinger model, which well mimics QCD as it shares the important properties such as confinement and chiral symmetry breaking. We focus on the real-time evolution of the Wigner function, namely, the two-point correlation function, which approximates quark momentum distribution, etc. Starting from a non-equilibrium initial state, the real time evolution of the Wigner functions, as well as the entanglement entropy, both demonstrate that thermalization of the quantum system is approachable. In particular, relaxation to the thermalized state depends on coupling strength, in the presence of quantum fluctuations. We also study the connection of the Wigner function thermalization to the well-known Eigenstate Thermalization (ETH).

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