

Variational preparation of Thermofield Double States

The Thermofield Double State (TFD) is a purification of the Gibbs state that can be used to describe not only thermal physics but also black holes. In particular, as shown by Maldacena and Qi, the TFD state of the Sachdev-Ye-Kitaev (SYK) model can be dual to a wormhole. Probing it in large enough system sizes is a potential strategy to study quantum gravity and close the gap between experiments and holography. However, preparing the TFD is intricate as it requires to double the number of degrees of freedom of the system. We provide a temperature dependent Hamiltonian whose ground state is close to said TFD, which allows to prepare it with a variational approach. We use an ansatz that uses entanglement forging techniques to halve the number of qubits needed for the computation, which allows to reach TFDs of considerable size. As a side product, we also get a quantum circuit that prepares the eigenstates of the system.

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