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Quantum discontinuity fixed point and renormalization group flow of the SYK model

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We determine the global renormalization group (RG) flow of the Sachdev-Ye-Kitaev (SYK) model. From a controlled truncation of the infinite hierarchy of the exact functional RG flow equations we identify several fixed points: Apart from a stable fixed point, associated with the celebrated non-Fermi liquid state of the model, we find another stable fixed point related to an integer-valence state. These stable fixed points are separated by a discontinuity fixed point with one relevant direction, describing a quantum first-order transition. Most notably, the fermionic spectrum continues to be quantum critical even at the discontinuity fixed point. This rules out a description of the transition in terms of a local effective Ising variable as is established for classical transitions. We propose an entangled quantum state at phase coexistence as a possible physical origin of this critical behavior.

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