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Critical spin models from holographic disorder

Discrete models of holographic dualities, typically modeled by tensor networks on hyperbolic tilings, produce quantum states with a characteristic quasiperiodic disorder not present in continuum holography. In this work, we study the behavior of XXZ spin chains with such symmetries, showing that lessons learned from previous non-interacting (matchgate) tensor networks generalize to more generic Hamiltonians under holographic disorder: While the disorder breaks translation invariance, site-averaged correlations and entanglement of the disorder-free critical phase are preserved at a plateau of nonzero disorder even at large system sizes. In particular, we show numerically that the entanglement entropy curves in this disordered phase follow the expected scaling of a conformal field theory (CFT) in the continuum limit. This property is shown to be non-generic for other types of quasiperiodic disorder, only appearing when our boundary disorder ansatz is described by a "dual" bulk hyperbolic tiling. Our results therefore suggest the existence of a whole class of critical phases whose symmetries are derived from models of discrete holography.

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