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Dynamics of hot random quantum spin chains: from anyons to Heisenberg spins[1] SIDDHARTH PARAMESWARAN, UC Irvine, ANDREW POTTER, ROMAIN VASSEUR, UC Berkeley — We argue that the dynamics of the random-bond Heisenberg spin chain are ergodic at infinite temperature, in contrast to the many-body localized behavior seen in its random-field counterpart. First, we show that excited-state real-space renormalization group (RSRG-X) techniques suffer from a fatal breakdown of perturbation theory due to the proliferation of large effective spins that grow without bound. We repair this problem by deforming the $SU(2)$ symmetry of the Heisenberg chain to its 'anyonic' version, $SU(2)_k$, where the growth of effective spins is truncated at spin $S = k/2$. This enables us to construct a self-consistent RSRG-X scheme that is particularly simple at infinite temperature. Solving the flow equations, we compute the excited-state entanglement and show that it crosses over from volume-law to logarithmic scaling at a length scale $\xi_k \sim e^{\alpha k^3}$. This reveals that (a) anyon chains have random-singlet-like excited states for any finite k; and (b) ergodicity is restored in the Heisenberg limit $k \to \infty$.

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