Measurement-induced topological transition in a free fermion model

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Quantum measurements have been recently exploited as a tool to induce phase transitions between different steady-state phases of many-body systems. Transitions between phases with different entanglement scaling properties have been initially predicted in quantum circuits with unitary and projective gates [1]. Such transitions can be induced by continuous measurement too, for which analytical treatments and large system size numerical implementation are possible in free fermion models. Here we study a free fermion model where two sets of non-commuting continuous measurements induce a transition between area-law entanglement scaling phases of distinct topological order [2].

We find that, in the presence of unitary dynamics, the two topological phases are separated by a region with sub-volume scaling of the entanglement entropy and that the transition universality class of the measurement-only model differs from that in interacting models with stroboscopic dynamics and projective measurements. We further show that the phase diagram is qualitatively captured by an analytically tractable non-Hermitian Hamiltonian model obtained via post-selection. By the introduction of a partial-post-selection continuous mapping, we show that the topological distinct phases of the stochastic measurement-induced dynamics are uniquely associated with the topological indices of the non-Hermitian Hamiltonian. Our results mark a clear distinction between the topological phase transition induced by projective and continuous measurements and open a door to the construction of topological invariants for stochastic quantum dynamics.

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[2] G. Kells, D. Meidan, A. Romito, arXiv:211209787 (2021)