Graph theory measures capture weak ergodicity breaking on large quantum systems

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We study the onset of weak ergodicity violations in closed quantum many-body systems and focus on cases in which they occur through a transition that is controlled by a model parameter.

Our analysis is based on representing quantum systems in Fock space and utilizes graph-theoretical measures.

As a main result, we show that the recently introduced graph energy centrality captures known weak ergodicity breaking transitions via characteristic changes in its distribution.

While most numerical tools are limited to small system sizes, our measure can be calculated analytically for large systems and in some cases even in the thermodynamic limit.

We conclude by demonstrating the applicability of our Fock-space based measure to a spin-glass transition in a kinetically constrained quantum model.