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Dynamical scalability and control of totally connected spin networks across quantum phase transitions ÓSCAR L. ACEVEDO, LUIS QUIROGA, FERNEY J. RODRÍGUEZ, Univesidad de los Andes, Bogotá, Colombia, NEIL F. JOHNSON, University of Miami, Coral Gables, Miami, FL — Dynamical quantum phase crossings of spin networks have recently received increased attention thanks to their relation to adiabatic quantum computing, and their feasible realizations using ultra-cold atomic and molecular systems with a highly tunable degree of connectivity. Dynamical scaling of spatially distributed systems like Ising models have been widely studied, and successfully related to well-known theories like the Kibble-Zurek mechanism. The case of totally connected networks such as the Dicke Model and Lipkin-Meshkov-Glick Model, however, is known to exhibit a breakdown of these frameworks. Our analysis overcomes the lack of spatial correlation structure by developing a general approach which (i) is valid regardless the connectivity of the system, (ii) goes beyond critical exponents, and (iii) provides a time-resolved picture of dynamical scaling. By treating these models as a method for macroscopic quantum control of their subsystems, we have found microscopic signatures of the dynamical scaling as well as instances of dynamical enhancement of distinctive quantum properties such as entanglement and coherence. Our results yield novel prescriptions for the fields of quantum simulations and quantum control, and deepen our fundamental understanding of phase transitions.

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