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Quantum quench dynamics of a central-spin system ALESSANDRO RICOTTONE, WILLIAM COISH, McGill Univ, STEFANO CHESI, YINAN FANG, Beijing Computational Science Research Center — Quantum effects can significantly influence equilibration dynamics. In quantum annealing, a local tunneling mechanism may accelerate the approach to equilibrium. Similarly, long-range quantum coherence can allow for rapid transitions between macroscopically distinct states of a quantum system. An experimentally relevant example of this is given by a 'central' electron spin coupled to an ensemble of nuclear spins in a quantum dot. This system admits a superradiance-like burst of current through ferromagnetic leads due to long-range nuclear spin coherence [1] with a simultaneous inversion of the nuclear-spin polarization. Here, we study this system coupled to normal leads. In particular, we study quench dynamics of the nuclear spin polarization after passing through a quantum phase transition controlled by an applied magnetic field. As a function of dephasing controlled by a magnetic field gradient, we find a crossover from rapid equilibration via collective states to slow dynamics described by classical (product-state) spin configurations. This understanding may allow us to better control dynamic nuclear spin polarization processes in quantum dots and to control more general quantum states of nuclear-spin ensembles. [1] S. Chesi and W. A. Coish PRB 91, 245306 (2015)

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