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UNIVERSAL POSTQUENCH COARSENING AND AGING AT A QUANTUM CRITICAL POINT

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Abstract:

The nonequilibrium dynamics of a system that is located in the vicinity of a quantum critical point is affected by the critical slowing down of order-parameter correlations with the potential for novel out-of-equilibrium universality. After a quantum quench, i.e., a sudden change of a parameter in the Hamiltonian, such a system is expected to almost instantly fall out of equilibrium and undergo aging dynamics, i.e., dynamics that depends on the time passed since the quench. Investigating the quantum dynamics of an N-component $\ddot{I}\dagger 4$ model coupled to an external bath, we determine this universal aging and demonstrate that the system undergoes a coarsening, governed by a critical exponent that is unrelated to the equilibrium exponents of the system. We analyze this behavior in the large-N limit, which is complementary to our earlier renormalization-group analysis, allowing in particular the direct investigation of the order-parameter dynamics in the symmetry-broken phase and at the upper critical dimension. By connecting the long-time limit of fluctuations and response, we introduce a distribution function that shows that the system remains nonthermal and exhibits quantum coherence even on long time scales.

References:
[1] Pia Gagel, Peter P. Orth, and Jörg Schmalian, Phys. Rev. Lett. **113**, 220401 (2014).
[2] Pia Gagel, Peter P. Orth, and Jörg Schmalian, Phys. Rev. B **92**, 115121 (2015).