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Universal behavior after a quantum quench in interacting field theories[1]

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The dynamics of an isolated quantum system represented by a field theory with O(N) symmetry, and in d¿2 spatial dimensions, is investigated after a quantum quench from a disordered initial state to the critical point. A perturbative renormalization-group approach involving an expansion around d=4 is employed to study the time-evolution, and is supplemented by an exact solution of the Hartree-Fock equations in the large-N limit. The results show that the dynamics is characterized by a prethermal regime controlled by elastic dephasing where excitations propagate ballistically, and a light cone emerges in correlation functions in real space. The memory of the initial state, together with the absence of time-scales at the critical point, gives rise to universal power-law aging which is characterized by a new non-equilibrium short-time exponent. The dynamics of the entanglement following a quench is also explored, and reveals that while the time evolution of the entanglement entropy itself is not much different between a free bosonic theory and an interacting bosonic theory, the low-energy entanglement spectrum on the other hand shows clear signature of the non-equilibrium short-time exponent related to aging. This work was done in collaboration with Y. Lemonik (NYU), M. Tavora (NYU), A. Chiocchetta (SISSA), A. Maraga (SISSA), and A. Gambassi (SISSA).

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