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Quenching across a quantum critical point: dependence of scaling laws on spatial periodicity SMITHA VISHVESHWARA, University of Illinois at Urbana-Champaign, MANISHA THAKURATHI, Indian Institute of Science, Bangalore, India, WADE DEGOTTARDI, University of Illinois at Urbana-Champaign, DIPTIMAN SEN, Indian Institute of Science, Bangalore, India — We study the quenching dynamics of a quantum many-body system in one dimension described by a Hamiltonian having spatial periodicity. Specifically, we consider a spin-1/2 XX chain subject to a periodically varying magnetic field in the $\hat{z}$ direction or, equivalently, a tight-binding model of spinless fermions having a periodic local chemical potential. If the strength of the magnetic field (or chemical potential) is varied slowly in time at a rate $1/\tau$ so as to take the system across a quantum critical point, we find that the density of excitations thereby produced scales as a power of $1/\tau$.Remarkably, the power depends on the spatial periodicity of the field and deviates from the $1/\sqrt{\tau}$ scaling that is ubiquitous to a range of systems. This behavior is analyzed by mapping the slow quenching problem to a collection of fermionic two-level systems, labeled by the lattice momentum k, for which the effective Hamiltonians vary as a power of the time close to the quantum critical point. For a magnetic field described by multiple periodicities, the power depends on the smallest period for very large values of τ. Finally, we find that if there are interactions between the fermions, the power varies continuously with the interaction strength.

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