Effects of interference in the dynamics of spin-1/2 transverse XY Chain driven periodically through quantum critical points

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We study the effects of interference on the quenching dynamics of a one-dimensional spin 1/2 XY model in the presence of a transverse field ($h(t)$) which varies sinusoidally with time as $h = h_0\cos{\omega t}$, with $|t| \leq t_f = \pi/\omega$. We also consider the situation where the magnetic field consists of an oscillatory as well as a linearly varying component, i.e., $h(t) = h_0\cos{\omega t} + t/\tau$. Our purpose is to estimate the defect density and the local entropy density in the final state if the system is initially prepared in its ground state. For a single crossing through the quantum critical point with $h = h_0\cos{\omega t}$, the density of defects in the final state is calculated by mapping the dynamics to an equivalent Landau Zener problem by linearizing near the crossing point, and is found to vary as $\sqrt{\omega}$ in the limit of small ω. On the other hand, the local entropy density is found to attain a maximum as a function of ω near a characteristic scale ω_0. Extending to the situation of multiple crossings, we show that the non-trivial interference effects of certain resonance modes solely contribute to the production of defects. Kink density as well as the diagonal entropy density show oscillatory dependence on the number of full cycles of oscillation. Finally, the inclusion of a linear term in the transverse field on top of the oscillatory component, results to a kink density which decreases continuously with τ and ω. The entropy density shows monotonous growth with both τ and ω, in sharp contrast to the situations studied earlier. We do also propose appropriate scaling relations for the defect density in above situations and compare the results with the numerical results obtained by integrating the Schrodinger equations.

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