Field dynamics and kink-antikink production in rapidly expanding systems G. Holzwarth

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Abstract: Field dynamics in a rapidly expanding system is investigated by transforming from space-time to the rapidity-proper-time frame. The proper-time dependence of different contributions to the total energy is established. For systems characterized by a finite momentum cut-off, a freeze-out time can be defined after which the field propagation in rapidity space ends and the system decays into decoupled solitons, antisolitons and local vacuum fluctuations. Numerical simulations of field evolutions on a lattice for the $(1+1)$-dimensional $\Phi^4$ model illustrate the general results and show that the freeze-out time and average multiplicities of kinks (plus antikinks) produced in this 'phase transition' can be obtained from simple averages over the initial ensemble of field configurations. An extension to explicitly include additional dissipation is discussed. The validity of an adiabatic approximation for the case of an overdamped system is investigated. The $(3+1)$-dimensional generalization may serve as model for baryon-antibaryon production after heavy-ion collisions.
\[ \tau_f = (2/\lambda)^{1/2} \]

\[ N \sigma^2/2 \tau_f \tau^{-2} \]

\[ N \sigma^2 \lambda/4 \tau \]

\[ N \sigma^2/2 \tau^{-1} \]
\((77) (78)\)

\((79) (80)\)
$n$ vs $\gamma$

$\tau_0 = 0.1$  
$\tau_0 = 0.01$