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Kink dynamics in the ϕ^4 model: asymptotic stability for odd perturbations in the energy space

We consider a classical equation $[\phi_{tt} - \phi_{xx}] = \phi - \phi^3$, $\quad (t,x) \in \mathbb{R} \times \mathbb{R}$ known as the ϕ^4 model in one space dimension.

The kink, defined by $H(x) = \tanh(x/\sqrt{2})$, is an explicit stationary solution of this model. From a result of Henry, Perez and Wreszinski it is known that the kink is orbitally stable with respect to small perturbations of the initial data in the energy space.

In this paper we show asymptotic stability of the kink for odd perturbations in the energy space. The proof is based on Virial-type estimates partly inspired from previous works of Martel and Merle on asymptotic stability of solitons for the generalized Korteweg-de Vries equations.

However, this approach has to be adapted to additional difficulties, pointed out by Soffer and Weinstein in the case of general nonlinear Klein-Gordon equations with potential: the interactions of the so-called internal oscillation mode with the radiation, and the different rates of decay of these two components of the solution in large time.