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# Resonant energy exchange in kink-antikink collisions in $\phi^8$, $\phi^{10}$ and $\phi^{12}$ field theories

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We investigate resonance phenomena in kink-antikink collisions in (1+1)-dimensional scalar field theories with higher-order polynomial potentials. Particular attention is paid to the mechanism of energy exchange between the translational motion of the kinks and vibrational modes of the kink-antikink system.

Numerical simulations reveal a nontrivial dependence of the collision outcome on the initial velocity of the kink and antikink. In addition to kink–antikink capture and one-bounce escape, narrow multi-bounce resonance windows are observed. Within these windows, part of the kinetic energy of the kinks is transferred during the first collision into vibrational excitations of the kink-antikink system and can subsequently be transferred back into translational motion. This allows the kink and antikink to escape after two or more collisions for initial velocities below the critical velocity.

The structure of the resonance windows, the critical velocities, and the spectral properties of kink-antikink configurations are analyzed. The numerical results support the resonant energy exchange mechanism as an explanation for the formation of the observed resonance windows. In particular, the resonance structure can be interpreted in terms of energy exchange between the translational motion of the kinks and collective vibrational modes of the kink-antikink pair.

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