Self-trapping transition for a nonlinear impurity within a linear chain

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In the present work, we revisit the issue of the self-trapping dynamical transition at a nonlinear impurity embedded in an otherwise linear lattice. For our Schrödinger chain example, we present rigorous arguments that establish necessary conditions and corresponding parametric bounds for the transition between linear decay and nonlinear persistence of a defect mode. The proofs combine a contraction mapping approach applied to the fully dynamical problem in the case of a 3D-lattice, together with variational arguments for the derivation of parametric bounds for the creation of stationary states associated with the expected fate of the self-trapping dynamical transition. The results are relevant for both power law nonlinearities and saturable ones. The analytical results are corroborated by numerical computations. The latter are performed for cases of different dimension.