Nonlinear Sciences > Pattern Formation and Solitons

Surface solitons in trilete lattices

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Fundamental solitons pinned to the interface between three semi-infinite one-dimensional nonlinear dynamical chains, coupled at a single site, are investigated. The light propagation in the respective system with the self-attractive on-site cubic nonlinearity, which can be implemented as an array of nonlinear optical waveguides, is modeled by the system of three discrete nonlinear Schr\"{o}dinger equations. The formation, stability and dynamics of symmetric and asymmetric fundamental solitons centered at the interface are investigated analytically by means of the variational approximation (VA) and in a numerical form. The VA predicts that two asymmetric and two antisymmetric branches exist in the entire parameter space, while four asymmetric modes and the symmetric one can be found below some critical value of the inter-lattice coupling parameter -- actually, past the symmetry-breaking bifurcation. At this bifurcation point, the symmetric branch is destabilized and two new asymmetric soliton branches appear, one stable and the other unstable. In this area, the antisymmetric branch changes its character, getting stabilized against oscillatory perturbations. In direct simulations, unstable symmetric modes radiate a part of their power, staying trapped around the interface. Highly unstable asymmetric modes transform into localized breathers traveling from the interface region across the lattice without significant power loss.

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