Interactions of solitons with a localized impurity in Schrödinger lattices with saturable nonlinearity

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We study the interactions of moving discrete solitons with a localized impurity in periodic systems described by the discrete nonlinear Schrödinger equation. The localized impurity is modeled by the delta function. Numerical simulations of collisions between moving solitons and the impurity show that the soliton can be transmitted, reflected, trapped or scattered by the imputity during the interaction, depending on the velocity of the incoming soliton and the impurity strength. The trapping of soliton is explained by resonance between the soliton and the nonlinear impurity mode. For different values of the soliton frequency ranging from ω= 0.1 (high amplitude) to ω=0.9 (small amplitude), we elucidate in details as a function of impurity strength and soliton initial velocity, the different regimes of soliton-impurity interaction (pure trapping, pure transmission, pure reflection, reflection and transmission, trapping and transmission, trapping and reflection, and trapping with reflection and transmission). We observe that as the soliton frequency increases towards 0.5, the trapping region becomes larger, and becomes narrower when it increases from 0.5 to 0.9. We determine specific values of impurity strength and soliton initial velocity for which the incoming soliton is split equally into a reflected and transmitted parts (for ω=0.7 and ω=0.9), and for which we observe the phenomenon of "double" trapping and "simple" transmission followed by "simple" trapping and "double" transmission (for ω=0.3).