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Unidirectional flow of composite bright-bright solitons through asymmetric double potential barriers and wells. (English) Zbl 1477.35241

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Summary: We investigate the dynamics of two component bright-bright (BB) solitons through reflectionless double barrier and double well potentials in the framework of a Manakov system governed by the coupled nonlinear Schrödinger equations. The objective is to achieve unidirectional flow and unidirectional segregation/splitting, which may be used in the design of optical data processing devices. We observe how the propagation of composite BB soliton is affected by the presence of interaction coupling between the two components passing through the asymmetric potentials. We consider Gaussian and Rosen-Morse double potential barriers in order to achieve the unidirectional flow. Moreover, we observe a novel phenomenon which we name "*Polarity Reversal*" in the unidirectional flow. In this situation, the polarity of the diode is reversed. To understand the physics underlying these phenomena, we perform a variational calculation where we also achieve unidirectional segregation/splitting using an asymmetric double square potential well. Our comparative study between analytical and numerical analysis lead to an excellent agreement between the two methods.

MSC:

35Q55	NLS equations (nonlinear Schrödinger equations)
35Q60	PDEs in connection with optics and electromagnetic theory
78A60	Lasers, masers, optical bistability, nonlinear optics
78A45	Diffraction, scattering
35C08	Soliton solutions
37K40	Soliton theory, asymptotic behavior of solutions of infinite-dimensional Hamiltonian systems

Keywords:

optical solitons; Manakov system; unidirectional flow; optical data processing

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