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Collision dynamics of elliptically polarized solitons in Coupled Nonlinear Schrödinger Equations

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Abstract

We investigate numerically the collision dynamics of elliptically polarized solitons of the System of Coupled Nonlinear Schrödinger Equations (SCNLSE) for various different initial polarizations and phases. General initial elliptic polarizations (not *sech*-shape) include as particular cases the circular and linear polarizations. The elliptically polarized solitons are computed by a separate numerical algorithm. We find that, depending on the initial phases of the solitons, the polarizations of the system of solitons after the collision change, even for trivial cross-modulation. This sets the limits of practical validity of the celebrated Manakov solution. For general nontrivial cross-modulation, a jump in the polarization angles of the solitons takes place after the collision ('polarization shock'). We study in detail the effect of the initial phases of the solitons and uncover different scenarios of the quasi-particle behavior of the solution. In majority of cases the solitons survive the interaction preserving approximately their phase speeds and the main effect is the change of polarization. However, in some intervals for the initial phase difference, the interaction is ostensibly inelastic: either one of the solitons virtually disappears, or additional solitons are born after the interaction. This outlines the role of the phase, which has not been extensively investigated in the literature until now.
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1. Introduction

The system of Coupled Nonlinear Schrödinger Equations (SCNLSE) is a soliton supporting system. It appeared initially as a model for light propagation in isotropic Kerr materials ([10,8,16,18]). Apart from its splendid performance in modeling the propagation of light pulses in fiber optics, it also offers the opportunity to investigate the quasi-particle behavior soliton. The latter is indispensable for the understanding of the fundamental phenomena associated with propagation of nonlinear waves. There are many different solitons supporting systems whose solution behave as quasi-particles, but NLSE and SCNLSE exhibit the richest behavior and serve as very important testing ground for the quasi-particle approach. For this reason, the SCNLSE attracted the attention of the leading researches, and a

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