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Fast soliton interactions in cubic-quintic nonlinear media with weak dissipation. (English)

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Appl. Math. Modelling 97, 650-665 (2021).

Summary: We derive the expressions for the collision-induced amplitude dynamics of two flat-top solitons in spatial dimensions of 1, 2, and 3 caused by the generic weak nonlinear loss under the framework of coupled cubic-quintic $(n+1)$D nonlinear Schrödinger equations for $n = 1, 2, 3$. We develop a new perturbative technique which is mainly based on the calculations for the fast collision-induced changes in the soliton envelope and the use of the single *perturbed* soliton solution for the calculations. These results quantify the energy dropdown due to a fast collision of two pulses ($n = 1$), or two optical beams ($n = 2$), or two light bullets ($n = 3$) in cubic-quintic nonlinear media with dissipation. The theoretical calculations are then confirmed by numerical simulations with the corresponding coupled nonlinear Schrödinger equations. Our approach can be used for studying the effects of dissipation on colliding solitons described by the coupled nonlinear Schrödinger models, where the *unperturbed* equation is *nonintegrable*.

MSC:

35C08 Soliton solutions
78A60 Lasers, masers, optical bistability, nonlinear optics
81Q80 Special quantum systems, such as solvable systems

Keywords:

soliton interaction; nonlinear dynamics; flat-top soliton; optical beams; light bullets

Software:

AEDU; Gross-Pitaevskii; imagetime1d; GP-SCL

Full Text: DOI

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