Linear and nonlinear guided modes in a parabolic potential

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We describe the families of nonlinear modes of the nonlinear Schrodinger equation with the PT-symmetric harmonic potential. The found modes display a number of interesting features. In particular, even when they bifurcate from the different eigenstates of the underlying linear problem, they can belong to the same family of nonlinear modes. We also show that by proper adjustment of the gain/loss gradient it is possible to enhance stability of small-amplitude and strongly nonlinear modes comparing to the well-studied case of the real harmonic potential. Implications of the above properties for the guidance of optical beams, in particular for giant amplification of the guided modes will also be discussed.
A part of this work is done in collaboration with V. S. Shchesnovich.

Dynamics of Lang-Kobayshi laser equations with large control coefficient

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We study dynamics of single-mode semiconductor laser under strong external optical feedback. The model introduced by Lang and Kobayashi includes terms with delayed argument. In the case of large control coefficient we derive continual sets of quasi-normal forms in local vicinity of the bifurcation parameters. On the base of such parabolic equations we discuss the phenomenon of multistable cycles and tori in the delayed system.

Rogue waves in the Sasa-Satsuma equation

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We investigate solutions of the Sasa-Satsuma equation (SSE), which is an integrable extension of the nonlinear Schrodinger equation (NLSE). In particular we demonstrate the lowest order rogue wave solutions for several parameters. In contrast to the Peregrine solution of the NLSE, these rogue wave solutions are significantly more involved and contain polynomials of fourth order rather than of second order in the corresponding expressions. When the extension parameter of the SSE is reduced to zero we obtain the correct limiting case of Peregrine solution of the NLSE.

Literature: U. Bandelow and N. Akhmediev, “Persistence of rogue waves in extended nonlinear Schrodinger equations: integrable Sasa-Satsuma case”, Phys. Lett. A, 376, 1558-1561 (2012)