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Localized solutions of the nonlinear Schrödinger equation: application to optics, condensed matter and cold atoms

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Spatial soliton is the wavepacket, which can propagate in nonlinear media without losing its shape due to the perfect balance between the dispersion and the nonlinearity. In this poster we consider solitons as special solutions of nonlinear Schrödinger equation. In its turn nonlinear Schrödinger equation describes various physical systems and objects like matter waves in Bose-Einstein condensate, electromagnetic waves in nonlinear Kerr media, and waves on the surface of deep water. In the poster we consider several examples of solitons in such systems.
As first example we show that vector matter–wave soliton in a Bose–Einstein condensate loaded into an optical lattice can escape from a trap formed by a parabolic potential, resembling a Hawking emission [1]. The particle–antiparticle pair is emulated by a low-amplitude bright–bright soliton in a two-component Bose–Einstein condensate with effective masses of opposite signs.
As second example we study nonlinear properties of multilayer metamaterials [2] created by graphene sheets separated by dielectric layers. We demonstrate that such structures are described by the discrete nonlinear Schrödinger equation and that its solutions are associated with stable discrete plasmon solitons.
As third example we demonstrate that in an array of nonlinear waveguides, a giant compression of the input beam can be achieved by exciting a Peregrine soliton [3]. Input field almost homogeneously distributed over hundreds of waveguides concentrates practically all the energy into a single waveguide at the output plane of the structure.

References

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