Bright optical solitons from defocusing nonlinearities

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Abstract:

The talk aims to review recently obtained results which demonstrate that *self-defocusing* cubic [1-3], as well as quintic [4] media, with a spatially *inhomogeneous* nonlinearity, whose strength grows from the center to periphery faster than r^D in the D-dimensional space ($D = 1, 2, 3$), where r is the radial coordinate ($r \equiv |x|$ in 1D), can support a variety of stable *bright* solitons in all the three dimensions, including 1D fundamental and multi-node modes, 2D fundamental and vortex solitons with an arbitrary topological charge, and also 3D fundamental solitons (the latter case is relevant not to optics, but to BEC). Solitons initially shifted from the center maintain their coherence while oscillating in the effective nonlinear (*pseudo*-) potential as robust quasiparticles [1-4]. In addition to numerically found soliton families, many particular solutions are found in an exact analytical form, and accurate approximations for the entire families of fundamental solitons are developed by means of variational and Thomas-Fermi approximations [1-4]. It should be stressed that these stable solitons exist without any support from a linear potential, i.e., they have nothing in common with the *gap solitons*, which may exist in a self-defocusing medium combined with a linear periodic potential (grating). Very recently, it has been demonstrated that a similar mechanism supports, as well, stable fundamental and twisted solitons in a 1D *nonlocal* self-defocusing medium (modeling the thermal nonlinearity in optics), with the local strength of the interaction growing faster than $|x|$. Qualitatively similar numerical and analytical results demonstrate the existence of stable *dissipative* solitons in media with the uniform linear gain and nonlinear loss whose local strength grows toward the periphery faster than r^D [5].

References:

1. O. V. Borovkova, Y. V. Kartashov,B A. Malomed, and L. Torner, Opt. Lett. 36, 3088 (2011).
2. O. V. Borovkova, Y. V. Kartashov, L. Torner, and B A. Malomed, Phys. Rev. E 84, 035602(R) (2011).
3. Y. V. Kartashov, V. A. Vysloukh, L. Torner, and B. A. Malomed, Opt. Lett. 36, 4587 (2011).
4. J. Zeng and B. A. Malomed, Phys. Rev. E 86, 036607 (2012).
5. O. V. Borovkova, Y. V. Kartashov, V. A. Vysloukh, V. E. Lobanov, B. A. Malomed, and L. Torner, Opt. Exp. 20, 2657 (2012).