

Two-Dimensional Optical Solitons in \mathcal{PT} Symmetric Lattice

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Abstract:

In this talk, I will discuss the existence of optical solitons supported by cubic-saturable nonlinearity, in the framework of nonlinear Schrödinger equation with \mathcal{PT} symmetric lattice with defects by using the pseudo-spectral renormalization method. The idea behind the spectral renormalization method is to transform the governing equation into Fourier space and find a nonlinear nonlocal integral equation coupled to an algebraic equation and determine a convergence factor based upon the degree (homogeneity) of a single nonlinear term. The convergence factor can not be found explicitly from the governing equation for the saturable case by the use of the spectral renormalization method. In order to find the convergence factor, the root finding code has to be used such as the Newton method but if we use the pseudo-spectral renormalization method the convergence parameter is found from the governing equation explicitly. The pseudo-spectral renormalization method can efficiently be applied to a large class of problems including higher order nonlinear terms with different homogeneities. In the first part of my talk, I will present the pseudo-spectral renormalization method for cubic-saturable nonlinearity. I report the existence and stability of the optical solitons in parity-time \mathcal{PT} symmetric lattice with defects in focusing/defocusing cubic-saturable media.

The propagation of light beams along the z -axis of the medium composed of alternating domains with cubic and saturable nonlinearities is described by the nonlinear Schrödinger equation (NLSE) with the external potential

$$i \frac{\partial u}{\partial z} + \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \sigma \frac{|u|^2 u}{1 + \alpha |u|^2} + V(x, y)u = 0$$

Saturation parameter $\alpha = 0$ and $\alpha = 1$ correspond to the cubic domain and the saturable domain respectively. I will consider two different configurations. I will investigate the linear and nonlinear stability properties of the lattice solitons in \mathcal{PT} symmetric lattice in two different configurations. It is found that for \mathcal{PT} symmetric lattice the solitons suffer collapse in the cubic domain. I will discuss the stability properties of the optical solitons in the cubic and saturable domain with \mathcal{PT} symmetric lattice.