

# Lattice solitons in cubic-saturable media with external potentials

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## Abstract:

In this talk, I will discuss the existence of lattice solitons supported by cubic-saturable nonlinearity, in the framework of nonlinear Schrödinger equation with external potentials such as periodic, Penrose and PT symmetric lattices 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 non-local 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 such as the Newton method must be used. 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.

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

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

Saturation parameter  $\alpha = 0$  and  $\alpha = 1$  correspond to the cubic domain and the saturable domain respectively. I will consider two different configurations. In the second part of my talk, I will investigate the linear and nonlinear stability properties of the lattice solitons centered on the maximum of the periodic, Penrose and PT symmetric lattices in two different configurations. It is found that for the periodic, Penrose and PT symmetric lattices the solitons suffer collapse in the cubic domain. I will discuss the stability properties of the lattice solitons in the saturable domain with the external potentials such as periodic, Penrose and PT symmetric lattices.

## References:

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