ΓΕΝΙΚΟ ΣΕΜΙΝΑΡΙΟ ΤΜΗΜΣΤΟΣ ΦΥΣΙΚΗΣ

PHYSICS COLLOQUIUM

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17:00 -18:00
3rd Floor Seminar Room

"Optical wave propagation in nonlinear periodic structures"

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Abstract

The discrete coupling or tunneling process between periodically arranged potential wells is a fundamental topic that has been extensively investigated in many branches of Physics. In Optics, arrays of weakly coupled waveguides are prime examples of such systems, where the coupling dynamics can be directly experimentally observed. Under nonlinear condition, a self-trapped nonlinear localized entity known as optical discrete soliton, can be supported by the periodic potential of the array.

In the first part of this talk, a theoretical investigation of lattice surface solitons in semi-infinite waveguide arrays will be presented. In particular, these nonlinear Tamm states exist at the interface between a periodic and a bulk medium above a specific power threshold, and are the direct outcome of the nonlinearity with no analogue in the linear regime. Surface solitons were theoretically predicted in various periodic structures of different nonlinear materials, such as AlGaAs (cubic), $LiNbO_3$ (quadratic) and photorefractive crystals. The subsequent experimental observations will also be discussed.

In the second part, the concept of parity-time (PT) symmetry will be introduced in the framework of Optics. This type of symmetry can be realized through a judicious design that involves a combination of optical gain or loss regions. Even though gain and loss are present in this class of non-hermitian potentials, the propagation eigenvalue spectrum is entirely real (bound and radiation modes). These novel PT optical lattices are found to exhibit surprising characteristics that include abrupt phase transitions (spontaneous PT-symmetry breaking), band merging, non-orthogonal Floquet-Bloch modes, non-reciprocal behavior, double refraction, power oscillations, phase dislocations and discrete solitons with real eigenvalues. The recent experimental demonstrations of PT-symmetry in coupled optical waveguides will also be presented.