PT-Symmetry Breaking in Periodic Potentials

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Over the past decade, there has been an explosion of interest in PT-symmetric structures in quantum systems, when reversed in parity (P) and time (T), remain invariant. The purpose of this work was to investigate PT-symmetry breaking in tridiagonal matrices, based on the tight-binding model where periodic potentials were introduced. Here, I propose and study the characteristics of two new periodic potentials: (i) a complex sine potential, the PT-symmetry extension of a real cosine potential that is based on the Harper or Aubry-André model and (ii) combined real cosine potential and complex sine potential. My hypothesis was that by changing the parameters of the periodic potential, including the type and impurity strength of the periodic potential, one could judiciously control the properties of the PT-symmetric array. Interesting PT-symmetry breaking characteristics have been found. The results show that the type and impurity strength of the periodic potentials have a profound effect on the PT-symmetric array, leading to qualitatively different time evolution as a wavepacket propagates through the system for the complex sine potential lattice. Thus, the addition of periodic potentials provides an important parameter in investigating the properties and altering the characteristics of PT-symmetric structures, which could help advance the fields of quantum optics and photonics, having the promising potential to improve many optical devices, such as lasers, and possible future military applications in preventing radar detection.

Awards Won:

Third Award of $1,000