PT Symmetric Optics

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Interest in complex Hamiltonians was triggered after the pioneering work of Bender and Boettcher in which they showed that a wide class of non-hermitian Hamiltonians can have entirely real spectra [1]. One large class of such systems is the so-called PT-symmetric Hamiltonians which simultaneously respect parity and time reversal operators. In non-relativistic quantum mechanics, governed by Schrödinger equation, a necessary but not sufficient condition for PT symmetry to hold is that the complex potential involves real and imaginary parts which are even and odd functions of position respectively [1]. Unfortunately however, quantum mechanics is by nature a hermitian theory and thus any evidence of PT symmetry in such systems has remained out of reach. On the other hand, due to the presence of gain and loss, optics provides a fertile ground for observation of PT symmetry. Based on this fact, in 2007, it was suggested that notions from PT symmetry can be directly introduced in the optical domain [2,3]. In optics, the refractive index and gain/loss profiles play the role of the real and imaginary parts of the aforementioned complex potential respectively. As it has been indicated in several studies, PT-symmetric optical structures can exhibit peculiar properties that are otherwise unattainable in traditional hermitian structures [4-10]. Among them, is the possibility for breaking this symmetry through an abrupt phase transition, band merging effect and unidirectional invisibility. Here, we review recent developments in the newly emerging field of PT-symmetric optics.

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