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PT symmetry in optics

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Interest in complex Hamiltonians has been rekindled after the realization that a wide class of non-Hermitian Hamiltonians can have entirely real spectra as long as they simultaneously respect parity and time reversal operators. In non-relativistic quantum mechanics, governed by the Schrödinger equation, a necessary but not sufficient condition for PT symmetry to hold is that the complex potential should involve real and imaginary parts which are even and odd functions of position respectively. As recently indicated, optics provides a fertile ground to observe and utilize notions of PT symmetry. In optics, the refractive index and gain/loss profiles play the role of the real and imaginary parts of the aforementioned complex potentials. As it has been demonstrated in several studies, PT-symmetric optical structures can exhibit peculiar properties that are otherwise unattainable in traditional Hermitian (conservative) optical settings. Among them, is the possibility for breaking this symmetry through an abrupt phase transition, band merging effects and unidirectional invisibility. Here we review recent developments in the field of $\mathcal{PT}$-symmetric optics.