Parity-Time Symmetry with Metamaterials

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Jensen Li

University of Birmingham

An optical system with Parity-time (PT) symmetry is one of the most widely studied platforms in probing the intriguing physics of non-Hermitian Hamiltonians. These include various special phenomena related to exceptional points and phase transitions. In constructing such a system, gain and loss are usually balanced. In the first part of this talk, the speaker will discuss the possibility of constructing a passive system, which respects ideal PT-symmetry by exploring metamaterials with both electric and magnetic resonances using a dipolar model. Instead of balancing gain and loss, the speaker balances scattering and absorption loss to have an analogy to construct an effective PT-symmetric Hamiltonian. Based on the dipolar model, the speaker will discuss the experimental realization of a passive PT-symmetric system with a bright and a dark metamaterial atom using a microwave transmission line platform. The speaker will also show a PT-phase transition of coherent perfect absorption. Such a passive metamaterial with PT-phase transition will be useful for designing optical devices with tunable properties. In the second part of this talk, the speaker will extend the discussion of PT-symmetry within an effective medium model. Instead of a dipolar model, by interpreting the constitutive tensor of a metamaterial as an effective Hamiltonian, the speaker will discuss how magnetic response and electric response can be matched in general to have PT-symmetry by defining an effective parity operator.