Wave scattering in chiral parity-time symmetric metamaterials

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Abstract

Chiral electromagnetic metamaterials, i.e. structures with building units lacking any mirror-symmetry plane, are a class of metamaterials associated with unique electromagnetic wave polarization effects and polarization control capabilities. Despite the fact that such metamaterials are inherently mirror asymmetric, we have recently shown that they can exhibit full parity-time (PT) symmetry [1], a symmetry associated with peculiar wave propagation and scattering characteristics (e.g. asymmetric reflection, loss-induced transparency, unidirectional invisibility, etc.). We will show in this talk that combining chirality and PT-symmetry in a single metamaterial structure one can achieve unique propagation and scattering characteristics [2-3]. These characteristics include multiple exceptional points, asymmetric circular dichroism, asymmetric optical activity (see Fig. 1), and others. All these novel effects can be highly and easily controlled in a scattering system by adjusting the impinging wave direction and polarization, giving thus to chiral PT-symmetric systems a great potential in a large variety of applications related with dynamic electromagnetic wave polarization control**.**

REFERENCES

[1] S. Droulias et. al., Phys. Rev. Lett. 122 (2019) 213201.
[2] I. Katsantonis et. al., Phys. Rev. B 101 (2020) 214109.
[3] I. Katsantonis et. al., Photonics 7 (2020) 43.

FIGURES

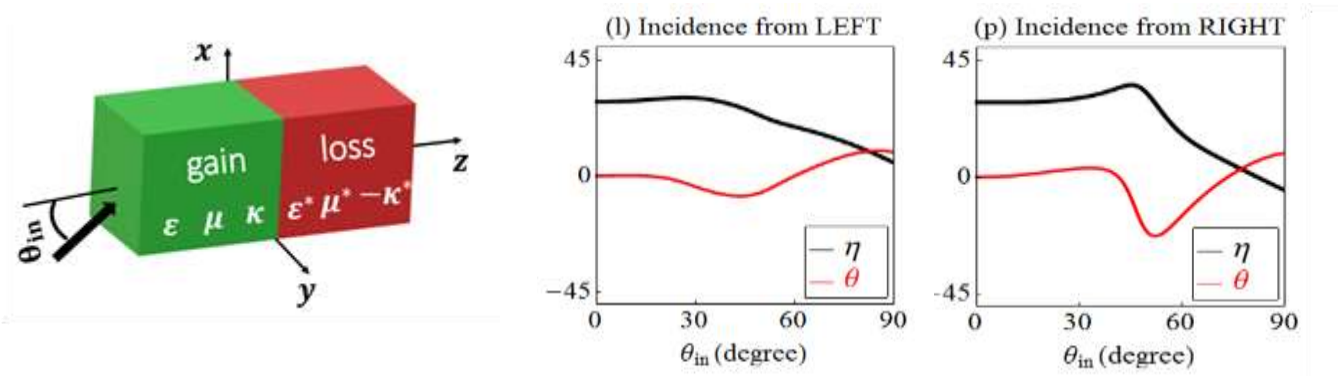

Figure 1: *Left:* The model system discussed in the present study: A simple chiral PT-symmetric bilayer (infinite along the *x* and *y* directions) of constant material parameters, permittivity (ε), permeability (μ) and chirality (κ). (the * in the parameters denotes the complex conjugate). *Right:* Optical activity (θ) and transmitted wave ellipticity (η) as a function of incidence angle for a monochromatic wave incident from the left and from the right side of the bilayer shown in the left panel.