



SEMINARIO

ACOUSTO-ELECTRIC EFFECT IN PIEZOELECTRIC SEMICONDUCTORS: NON-RECIPROcity AND PT-SYMMETRY

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Applying a DC electric bias on a piezoelectric semiconductor can lead to strong directional dependent mechanical attenuation or gain as induced by the electron-phonon interaction. This phenomenon, known as the acousto-electric effect, has been extensively studied with a particular emphasis on amplifying ultrasonic waves [1].

Here, we theoretically demonstrate a fully dynamical approach towards complete ultrasonic isolation in a piezoelectric semiconductor [2]. Engineering a device able to strongly break the reciprocity of the acoustic wave propagation, that is, to rectify waves along a one-way path only is not only challenging from a physics stand point, but inevitable in countless areas including noise control, energy harvesting, and transducer technology in general.

Using the acousto-electric effect, we also explore the non-Hermitian and parity-time symmetric acoustics in solid media. Parity-Time (PT) symmetric media have been devised in many optical systems with the ground breaking potential to create unconventional scattering properties like one-way cloaks of invisibility. A PT-symmetric media is obtained through the careful balance of loss and gain, which is here obtained in different slabs of piezoelectric media using the DC electric bias as a tuning parameter [2,3].

[1] A. R. Hutson, J. H. McFee and D. L. White, Phys. Rev. Lett. 7, 237 (1961).

[2] A. Merkel, M. Willatzen and J. Christensen, Phys. Rev. applied 9, 034033 (2018).

[3] J. Christensen, M. Willatzen, V. R. Velasco, and M.-H. Lu, Parity-time synthetic phononic media, Phys. Rev. Lett. 116, 207601 (2016).