University of Crete
Department of Physics

Physics Colloquium

Thursday, 21 May 2026 | 17:00 - 18:00, Seminar Room 3rd Floor

Singular values, focusing and phase conjugation in non-Hermitian Photonics

K. G. Makris

Department of Physics, University of Crete, Heraklion, 71003, Greece
Institute for Electronic structure and Lasers (IESL-FORTH), Heraklion, 71110, Greece
e-mail: makris@physics.uoc.gr

ABSTRACT

The scattering and diffraction of waves through complex media is a paradigmatic phenomenon that has captured the attention of various communities of physics for quite some time now. Recently, there is a lot of interest in composite media that contain spatial distributions of gain and loss materials. Due to the plethora of novel applications, like ultrasensitive sensors and gyroscopes, topological insulator lasers, non-reciprocal ring cavities and single mode nanolasers, such ideas have led to the new area of non-Hermitian photonics.

In this talk, we discuss recent results regarding two main topics of focusing and ultra-sensitivity in open media that contain spatially distributed gain and/or loss. In the first part, we determine the spatial wavefronts that lead to an amplified/dissipated focused spot, in multimode fibers, and lattices of coupled waveguides. The rotational-time symmetry and singular value decomposition of transmission matrices as two alternative strategies for focusing will be discussed. In the second part of the presentation, we examine the role of non-Hermitian singularities (exceptional points) and asymmetric couplings (Hatano-Nelson lattices) to the extreme response of the system in terms of pseudospectra and singular values. Connections to relevant experimental demonstrations will also be discussed.