Physics Colloquium

Thursday, 18 November 2021 | 17:00 – 18:00, Online with BigBlueButton

Opportunities in Non-Hermitian and Topological Photonics: Optics at an exceptional point

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ABSTRACT

In recent years, non-Hermitian degeneracies, also known as exceptional points (EPs), have emerged as a new paradigm for engineering the response of optical systems. At such points, an N-dimensional system can be represented by a single eigenmode. As a result, these points are associated with abrupt phase transitions in parameter space. Among many different non-conservative photonic configurations, parity-time (PT) symmetric systems are of particular interest since they provide a powerful platform for systematically exploring the physics and consequently utilizing the exceptional points. In this talk, I will review some of our recent works in the area of non-Hermitian active photonics. For example, in a series of papers, we have demonstrated how the generation and judicial incorporation of these points in laser systems can result in unexpected dynamics, unusual linewidth behavior, and improved modal response. On the other hand, biasing a photonic system at an exceptional point can lead to orders of magnitude enhancement in sensitivity- an effect that can enable a new generation of ultrasensitive optical sensors on-chip. Non-Hermiticity can also be used as a means to promote an edge mode in photonic topological insulator lattices. Our most recent result on using non-Hermiticity to engineer interaction dynamics in optical lattices will be presented along with its applications in designing a new class of fully reconfigurable lasers as well as implementing novel topological models.