Nanoscale light emission in PT symmetric nanoantennas

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There is an explosion in demand for bandwidth from mobile devices to data centres and supercomputers. The power consumed by the electrical on-chip interconnects based on CMOS technology has become a significant part of overall chip power consumption, and is fast becoming unsustainable. Integrated photonics aims to address this problem by integrating optoelectronic devices with the CMOS IC. It provides a viable path to improve the data rates in the near term and potentially disrupt computing technology in the next decade.

In this talk, we will review the key challenges in realizing nanoscale light sources. We will then discuss our work at IIT Hyderabad on addressing the miniaturization of optical sources which is one of the key challenges in integrated photonics. We will present the recent developments in the area of lasing from high-index semiconductor nanoantennas and introduce the concept of parity-time symmetry within the context of photonics, wherein the interplay of the system's gain-loss and synergy between them leads to a scattering anomaly called lasing spectral singularity (SS). At SS, the transmission and reflection in the proposed metasurface tend to have large values, marking the onset of lasing with direction-sensitive emission properties. The second half of the talk describes the dynamic tunability in the PT-symmetric phase gradient metasurface. The tunability in intensity and angular response of light is realized through dynamic gain-loss modulation.

Key References

1. Jinal Kiran Tapar, Saurabh Kishen and Naresh Kumar Emani, Dynamically Tunable Asymmetric Transmission in PT-Symmetric Phase Gradient Metasurface. ACS Photonics (2021). [doi]
2. Jinal Kiran Tapar, Saurabh Kishen and Naresh Kumar Emani, Spectral singularities and asymmetric light scattering in PT-symmetric 2D nanoantenna arrays. Opt. Lett. 2020, 45 (18), 5185-5188. [doi]