MARE BALTICUM LECTURES
COMPLEX NON-HERMITIAN QUANTUM MECHANICS IN THEORY AND EXPERIMENT

Date: Thursday Feb 6, 10:15-11:45; Thursday Feb 20, 10:15-11:45
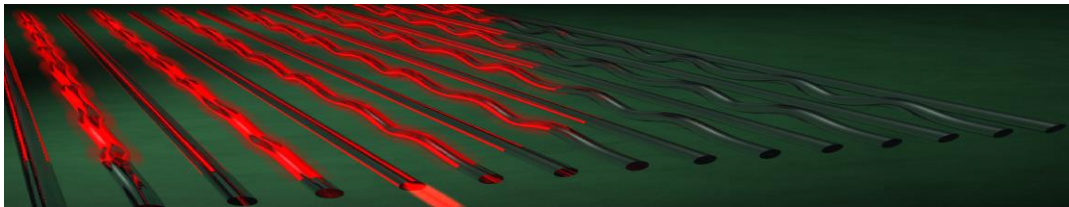
Location: SR 110 (Department LLM)

Lecturer: Prof. Yogesh Joglekar

Number of participants: 20

Language: English

Target audience: Master and PhD students and postdocs in Life Sciences, Chemistry and Physics

Workshop description:

In 1998, Bender et al. challenged the conventional wisdom of quantum mechanics that the Hamiltonian operator of any quantum mechanical system has to be Hermitian. They showed that Hamiltonians that are invariant under combined parity-time (PT-) symmetry transformations likewise can exhibit entirely real eigenvalue spectra. This insight had a particularly profound impact in the field of photonics, where PT-symmetric potential landscapes can be implemented by appropriately distributing gain and loss for electromagnetic waves. Following this approach, it became possible to observe the hallmark features of PT-symmetry – non-orthogonal eigenmodes, exceptional points, and diffusive coherent transport – and to study their implications in settings including nonlinearity and topological phases. Similarly, PT-symmetry has enriched other research fields ranging from PT-symmetric atomic diffusion, superconducting wires, and PT-symmetric electronic circuits.

In this lecture series, the fundamental principles of PT-symmetry will be explained, with their implications on wave mechanics in both the classical and the quantum regime. An important aspect will also be the experimental implementation of the predicted phenomena.

Topics:

- Non-Hermitian and PT symmetric systems; pseudo-Hermicity; conservation laws for PT-symmetric systems; Time-periodic (Floquet) PT symmetric systems.
- Classical realizations in bulk optics, electrical circuits, shallow fluids, and time-delay coupled lasers.
- Quantum realizations in superconducting circuits, ultracold atoms, and quantum photonics.

Information about the lecturer

Prof. Yogesh N. Joglekar is an Associate Professor at the Indiana University Purdue University Indianapolis (IUPUI) in Indianapolis (USA). His main research interest is in quantum simulations of closed and open systems and parity-time (PT) symmetry and its realizations in classical and quantum domains.