

Physics & Astronomy Colloquium

Presents

Dr. Li Ge

Faculty Candidate

Tuesday, February 12, 2019
4:10 pm, Webster Room 17

“Non-Hermitian photonics based on quantum-inspired symmetries”

In this talk I will discuss several symmetries in quantum physics that have recently led to the observations of intriguing optical phenomena and the realizations of novel photonic functionalities. Different from canonical quantum mechanics, these symmetries implies non-Hermiticity that is difficult to realize in high-energy physics or condensed matter systems in a controlled fashion. However, thanks to absorption and radiation loss as well as light amplification, photonics provides an ideal platform to explore the ramification of these symmetries, including parity-time (PT) symmetry and non-Hermitian particle-hole symmetry. PT symmetric photonics [1] is one of the fastest growing fields in the past five years. It requires a judiciously balanced refractive index satisfying $n(x) = n^*(-x)$, i.e., with a symmetric real index modulation and an antisymmetric imaginary index modulation. I will talk about its spontaneous symmetry breaking [2], the coexistence of laser and anti-laser [3], generalized conservation laws for wave propagation, and anisotropic transmission resonances [4]. Particle-hole symmetry imposes a strong restriction on the underlying system in the Hermitian case, which exists, for example, in superconductors and is related to Majorana zero modes. In photonics however, I will show that particle-hole symmetry is ubiquitous in gain and loss modulated systems with two sublattices [5], such as coupled waveguides and a network of optical cavities. As a consequence, there exist a large set of symmetry-protect zero modes, which can be utilized for building a unique single-mode, fixed-frequency, and spatially tunable laser, potentially useful for spatial encoding of telecommunication signals.

[1] Feng, L., El-Ganainy, R. & Ge, L. Nat. Photon. 11, 752 (2017), [2] Ge, L. & Stone, A. D. Phys. Rev. X 4, (2014), [3] Chong, Y. D., Ge, L., Cao, H. & Stone, A. D. Phys. Rev. Lett. 105, 53901 (2010), [4] Ge, L., Chong, Y. D. & Stone, A. D. Phys. Rev. A 85, 023802 (2012), [5] Qi, B., Zhang, L. & Ge, L. Phys. Rev. Lett. 120, 093901 (2018).

*Please meet our guest speaker and share in refreshments,
3:45-4:10 p.m. in the foyer on floor G above the lecture.*