UCCS Mathematics Department

Colloquium:

Non-Hermitian Qubits and Photonic Lattices

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Thursday, April 21st

12:15-1:30pm

OCSE B138 or via Zoom

Abstract: Non-Hermitian systems can have real eigenvalues under parity-time reversal (PT) symmetry [1]. We consider two such examples with unusual but useful consequences. (i) A two-level spin system based on PT- and anti-parity-time (anti-PT)-symmetric qubits in which we study its decoherence as well as entanglement entropy properties. We compare our findings with that of the corresponding Hermitian qubit. We find that the decoherence function for the anti-PT-symmetric qubit [2] decays slower than the PT-symmetric and Hermitian qubits [3]. For the von Neumann entropy we find that for the anti-PT-symmetric qubit it grows more slowly compared to the PTsymmetric and Hermitian qubits. Similarly, we find that the corresponding average Fisher information is much higher compared to the PT-symmetric and Hermitian qubits. These results demonstrate that anti-PT-symmetric qubits may be better suited for quantum computing and quantum information processing applications than conventional Hermitian or even PT-symmetric qubits. (ii) We consider a complex photonic lattice by placing PT-symmetric dimers at the Kagome lattice points [4]. This lattice is a two-dimensional network of corner-sharing triangles. Each dimer represents a pair of strongly coupled waveguides. The frustrated coupling between waveguide modes results in a dispersionless flat band comprising spatially localized modes. For a balanced arrangement of gain and loss on each dimer, up to a critical value of the gain/loss parameter the system exhibits a PT-symmetric phase. The beam evolution in the waveguide array leads to an oscillatory rotation of the optical power. We observe local chiral structures with a narrow beam excitation.

[1] C. M. Bender and S. Boettcher, Phys. Rev. Lett. 80, 5243 (1998). [2] J. Cen and A. Saxena, Phys. Rev. A. 105, 022404 (2022). [3] B. Gardas, S. Deffner and A. Saxena, Phys. Rev. A 94, 040101 (2016). [4] G.-W. Chern and A. Saxena, Opt. Lett. 40, 5806 (2015).

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