

Wednesday 9/13

Speaker: Lucas Sa

Title: Symmetry Classification of Lindbladians and PT-symmetric Hamiltonians

Abstract: We discuss a unified and systematic symmetry classification of non-Hermitian quantum systems, described either by a Lindbladian superoperator or a PT-symmetric Hamiltonian. We start by considering Lindblad superoperators describing general (interacting) open quantum systems coupled to a Markovian environment. Our classification is based on the behavior of the matrix representation of the Lindbladian under antiunitary symmetries and unitary involutions. We find that Hermiticity preservation reduces the number of symmetry classes, while trace preservation and complete positivity do not, and that the set of admissible classes depends on the presence of additional unitary symmetries: in their absence or in symmetry sectors containing steady states, Lindbladians belong to one of ten non-Hermitian symmetry classes; if however, there are additional symmetries and we consider non-steady-state sectors, they belong to a different set of 14 classes. In both cases, it does not include classes with Kramer's degeneracy. We then show that the classification can be extended to PT-symmetric Hamiltonians, by mapping the requirements of Hermiticity preservation and PT symmetry into each other. As a paradigmatic case study, we consider a two-site non-Hermitian Sachdev-Ye-Kitaev model. By varying the parameters of this model, we can realize 14 different classes in our classification. Finally, we show that the examples in each class display unique random-matrix correlations. To fully resolve all symmetries, we employ the combined analysis of bulk complex spacing ratios and the overlap of eigenvector pairs related by symmetry operations.