UNIVERSITÄT BIELEFELD

Faculty of Physics
Faculty of Mathematics

THE UNIVERSITY OF MELBOURNE

Seminar

Bielefeld - Melbourne Random Matrices

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University of Ljubljana

Symmetry Classification of Lindbladians

We discuss systematic symmetry classification of Lindblad superoperators describing general (interacting) open quantum systems coupled to a Markovian environment.

Our classification is based on the behavior 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 19 classes. In both cases, it does not include classes with Kramer's degeneracy.

While the abstract classification is completely general, we then apply it to spin-1/2 chains. We explicitly build examples in all ten classes of Lindbladians in steady-state sectors, describing standard physical processes such as dephasing, spin injection and absorption, and incoherent hopping, thus illustrating the relevance of our classification for practical physics applications.

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.

Reference: L. Sa, P. Ribeiro, T. Prosen, arxiv:2212.00474

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Zoom Conference call— Please contact Lucas Hackl (lucas.hackl@unimelb.edu.au) for details regarding access