MP 1: Quantum Dynamics and Quantum Information

Time: Monday 11:00–12:30 Location: HSZ/0003

Invited Talk MP 1.1 Mon 11:00 HSZ/0003

Insights from random matrices on dissipative quantum dynamics — •Pedro Ribeiro[1], Lucas Sá[1], and Tomaz Prosen[2] — [1]CeFEMA, Instituto Superior Tecnico, Lisbon, Portugal — [2]University of Ljubljana, Ljubljana, Slovenia

Understanding the dissipative dynamics of complex quantum systems is essential to describe quantum matter at large time scales. However, even within a simplified Markovian description, studying the spectral and steady-state properties of Lindblad operators remains a challenging task.

In this talk, we present some novel insights into universal features of generic open quantum systems under Markovian dissipation by using ensemble averaging based on (non-Hermitian) random matrices. We will examine three representative cases: quadratic Liouvilians, dissipative SYK models, and fully random Liouvilian operators. For this last example, we will present a recent systematic classification of many-body Lindblad superoperators based on the properties of the Lindbladian under antiunitary symmetries and unitary involutions.

MP 1.2 Mon 11:30 HSZ/0003

Markovianity in Quantum Thermodynamics — •Frederik vom Ende[1], Emanuel Malvetti[2,3], Gunther Dirr[4], and Thomas Schulte-Herbrüggen[2,3] — [1]Dahlem Center for Complex Quantum Systems, Freie Universität Berlin, 14195 Berlin, Germany — [2]Department of Chemistry, Technische Universität München, Lichtenbergstr. 4, 85737 Garching, Germany — [3]Munich Centre for Quantum Science and Technology & Munich Quantum Valley, Schellingstr. 4, 80799 München, Germany — [4]Department of Mathematics, Julius-Maximilians-Universität Würzburg, 97074 Würzburg, Germany

In the first half of this talk – which is based on arXiv:2211.08351 – we characterize the generators of quantum-dynamical semigroups via Stinespring dilations. More precisely, we prove that the second derivative of Stinespring dilations with a bounded total Hamiltonian yields the dissipative part of some quantum-dynamical semigroup – and vice versa. As a byproduct we obtain that for semigroups which describe an open system, the evolution of the dilated closed system has to be generated by an unbounded Hamiltonian. The second half of this talk will deal with a natural application of these results to Markovianity in quantum thermodynamics, because the central object of the latter – the so-called thermal operations – are defined via their Stinespring form. This will yield a family of generators of Markovian thermal operations, and we conjecture that no further generators exist.

MP 1.3 Mon 11:50 HSZ/0003

The Thermomajorization Polytope and its Degeneracies — Frederik vom Ende[1] and •Emanuel Malvetti[2,3] — [1]Dahlem Center for Complex Quantum Systems, Freie Universität Berlin, 14195 Berlin, Germany — [2]Department of Chemistry, Technische Universität München, Lichtenbergstr. 4, 85737 Garching, Germany — [3]Munich Centre for Quantum Science and Technology & Munich Quantum Valley, Schellingstr. 4, 80799 München, Germany

In quantum thermodynamics thermal operations are considered free. We want to understand which states are reachable from a given initial state using thermal operations. We study the quasi-classical case of diagonal states, where the problem reduces to understanding the thermomajorization polytope. In particular we are interested in degeneracies of this polytope and its connection to the polytope of Gibbs-stochastic matrices.

MP 1.4 Mon 12:10 HSZ/0003

Particle Spin described by Quantum Hamilton equations — •Michael Beyer and Wolfgang Paul — Martin-Luther Universität Halle

The anomalous Zeeman effect made it clear that charged particles like the electron possess a magnetic dipole moment. Classically, this could be understood if the charged particle possesses an eigenrotation, i.e., spin. This classically motivated model of intrinsic rotation described in terms of a continuous stochastic process is revisited within the formalism of stochastic optimal control theory. Quantum Hamilton equations for spinning particles are derived, which reduce to their classical counterpart in the zero quantum noise limit. These equations enable the calculation of the common spin expectation values without the use of the wave function. They also offer information on the orientation dynamics of the magnetic moment of charged particles beyond the behavior of the spin averages.