MP 11: Quantum Information

Time: Wednesday 16:30–17:45 Location: H7

MP 11.1 Wed 16:30 H7

Exploring the Limits of Open Quantum Dynamics I: Motivation, Results from Toy Models to Applications — •Thomas Schulte-Herbrüggen[1,2], Frederik vom Ende[1,2], Emanuel Malvetti[1,2], and Gunther Dirr[3] — [1]Dept. Chem., TU-München (TUM) — [2]Munich Centre for Quantum Science and Technology (MCQST) — [3]Institute of Mathematics, Universität Würzburg

Which quantum states can be reached by coherently controlling n-level quantum systems coupled to a thermal bath in a switchable Markovian way? To put this question of quantum engineering on a mathematical footing, we address reachable sets of coherently controllable open quantum systems with switchable coupling to a thermal bath of temperature T.

The core problem reduces to the dynamics of the eigenvalues of the density operator. It translates into a toy model of studying points in the standard simplex allowing for two types of controls: (i) permutations within the simplex, (ii) contractions by a dissipative semigroup. We show how toy-model solutions pertain to the reachable set of the original controlled Markovian quantum system. Beyond the case $T = 0$ (amplitude damping) we present results for $0 < T < \infty$ using more recent methods like extreme points of the d-majorisation polytope.

We put the problem into context and give a number of illustrating examples.

Ref.: arXiv:2003.06018

MP 11.2 Wed 16:55 H7

Exploring the Limits of Open Quantum Dynamics II: Gibbs-Preserving Maps from the Perspective of Majorization — •Frederik vom Ende — TU Munich, 85748 Garching, Germany — Munich Centre for Quantum Science and Technology, 80799 Munich, Germany

Motivated by reachability questions in coherently controlled open quantum systems coupled to a thermal bath, as well as recent progress in the field of thermo-/vector-d-majorization (arXiv:1911.01061) we generalize classical majorization from unital quantum maps to maps with an arbitrary fixed point of full rank. Such maps preserve some Gibbs-state and thus play an important role in the resource theory of quantum thermodynamics, in particular for thermo-majorization.

Based on this we investigate D-majorization on matrices in terms of its topological and order properties, such as existence of unique maximal and minimal elements, etc. In the process we relate the notion of strict positivity to such maps as well as to Markovian processes in general. Moreover we characterize D-majorization in the qubit case via the trace norm and elaborate on why this is a challenging task when going beyond two dimensions.

MP 11.3 Wed 17:20 H7

Reachability and Stabilizability for Markovian Quantum Systems with Fast Hamiltonian Control — •Emanuel Malvetti[1,2], Frederik vom Ende[1,2], Thomas Schulte-Herbrüggen[1,2], and Gunther Dirr[3] — [1]Dept. Chem., TU-München (TUM) — [2]Munich Centre for Quantum Science and Technology (MCQST) — [3]Institute of Mathematics, Universität Würzburg

Markovian quantum systems with fast and full Hamiltonian control can be reduced to an equivalent control system on the eigenvalues of the density matrix describing the state. We explore this eigenvalue control system, whose state space is the standard simplex, by answering questions about reachability and stabilizability in the simplex. This has immediate applications to the cooling of Markovian quantum systems, for instance we give necessary and sufficient conditions for a system to be coolable. Furthermore, we show that for many tasks of interest the control Hamiltonian can be chosen to be independent of time.