MP 21: Quantum Information III

Zeit: Donnerstag 14:55–15:55 Raum: 30.45: 201

MP 21.1 Do 14:55 30.45: 201

Quantum Systems Theory and Applications to Quantum Simulation under Collective Controls – an Invitation — •Thomas Schulte-Herbrüggen and Robert Zeier — Dept. Chem., TU-Munich, Germany

We present a unified framework of Lie-algebraic quantum systems theory. It provides a powerful yet straight-forward access to settle problems of controllability, observability, and the design of universal quantum hardware.

A particular focus is on the symmetry principles of quantum simulation. They govern under which conditions and to which extent spin systems, fermionic systems, and bosonic systems can mutually simulate oneanother. Finally, we give an explorative outline of quantum dynamics under collective Hamiltonian controls meant to invite further research.

MP 21.2 Do 15:15 30.45: 201

Geometry of Markovian Quantum Channels Seen as Lie Semigroups — •Corey O'Meara[1], Gunther Dirr[2], and Thomas Schulte-Herbrüggen[1] — [1]Dept. Chem. TU-Munich, Germany — [2]Math. Inst., University of Würzburg, Germany

A plethora of Markovian quantum channels under various degrees of Hamiltonian control are analysed in terms of their differential geometric properties. To this end, the set of all Markovian CP maps described as the solutions of a controlled Kossakowski-Lindblad master equation are characterized as Lie (sub)semigroups. Thus, for depolarising, dephasing, amplitude damping, bit-flip, or phase-flip channels we focus on the specific structure of their Lie wedges being suitable tangent cones encapsulating the control directions as their edge.

Since the geometry of the Lie wedge completely determines the time evolution underlying the controlled quantum channel, this most illustrative insight may subsequently be exploited to approximate the reachable sets of given initial quantum states. Finally, possible applications are outlined.

MP 21.3 Do 15:35 30.45: 201

Limits on non-local correlations from the structure of the local state space — •Peter Janotta[1], Christian Gogolin[2,3], Jonathan Barrett[4,5], and Nicolas Brunner[5] — [1]Fakultät für Physik und Astronomie, Universität Würzburg, Germany — [2]Institute for Physics and Astronomy, Potsdam University, Germany — [3]Department of Mathematics, University of Bristol, U.K. — [4]Department of Mathematics, Royal Holloway, University of London, U.K. — [5]H.H. Wills Physics Laboratory, University of Bristol, U.K.

Nonlocality is arguably one of the most remarkable features of quantum mechanics. On the other hand nature seems to forbid other no-signaling correlations that cannot be generated by quantum systems. Usual approaches to explain this limitation are based on information theoretic properties of the correlations without any reference to physical theories they might emerge from.

In contrast to that we investigate a transition between bipartite classical, no-signaling and quantum correlations by considering generalized probabilistic theories. It turns out that the strength of nonlocality of the maximally entangled state depends crucially on a simple geometric property of the local state space, known as strong self-duality. In particular strong self-duality implies macroscopic locality and therefore Tsirelson's bound for correlations of the maximally entangled state in quantum mechanics. Finally, our results also show that there exist models which are locally almost indistinguishable from quantum mechanics, but can nevertheless generate maximally nonlocal correlations.