MP 5: Quantum Information

Zeit: Dienstag 16:45–18:00 Raum: JUR H

MP 5.1 Di 16:45 JUR H

From quantum computation to quantum simulation: becoming more realistic. — •Dirk-Michael Schlingemann, Michael Keyl, and Zoltan Zimboras — ISI Foundation, Torino, Italy

The purpose of this talk is to introduce the basic tasks and goals of the EU FP7-project "COQUIT (Collective quantum operations for information technology)". Quantum systems are investigated which allow only a partial control by a constrained set of quantum operations. Typical examples are many particle quantum systems like cold atoms in optical lattices or other multi-atom ensembles, which can be manipulated collectively but not individually. Such restrictions are currently one of the biggest obstacles against working quantum computers. Instead of improving the corresponding experimental methods, we aim at a systematic study of the tasks which can be performed with currently available techniques. To this end we want to develop theoretical models which can on the one hand reflect the limitations of current experimental setups, but are on the other hand powerful enough to allow non-trivial practical applications. This point of view is new and complementary to most other research in quantum information science, where complete control over a small number of particles is assumed. One basic pillar of the COQUIT project is based on the concept of quantum simulation. Here a limited set of implementable operations is used to simulate physical properties of another quantum system. In this sense a quantum simulation device is a computational device for special purposes. We present the actual status of the project including new results and future perspectives.

MP 5.2 Di 17:10 JUR H

Entanglement distillation from quasifree Fermions — •Michael Keyl, Zoltan Kadar, and Dirk Schlingemann — ISI Foundation, 10133 Torino, Italy

Since Fermions are based on anti-commutation relations, their entanglement can not be studied in the usual way, such that the available theory has to be modified appropriately. Recent publications consider in particular the structure of separable and of maximally entangled states. In this talk we want to discuss local operations and entanglement distillation from bipartite, Fermionic systems. To this end we apply an algebraic point of view where algebras of local observables, rather than tensor product Hilbert spaces play the central role. We apply our scheme in particular to Fermionic Gaussian states where the whole discussion can be reduced to properties of the covariance matrix. Finally the results are demonstrated with free Fermions on an infinite, one-dimensional lattice.

MP 5.3 Di 17:35 JUR H

Quantum simulation of QFTs with discrete quantum systems — •Zoltan Zimboras, Michael Keyl, and Dirk-Michael Schlingemann — Quantum information group, ISI, Torino

Classical simulation of quantum many-body systems is usually very inefficient with long running times and with high needs for memory (e.g., it is not even possible to store classically the arbitrary state of 50 qubits). One might overcome these difficulities by using other quantum systems, similar to the one we want to study, as quantum simulators. Most of the efforts in this direction has been concentrated on simulating discrete quantum systems (e.g. spin chains) with other discrete quantum systems that are relatively easy to prepare in labs (ion traps, atoms in optical lattices, etc.). In this talk I will treat a different problem: How can we simulate a continuous quantum system (e.g. a QFT) with a discrete one? I will in particular show how (and in which sense) one can use the Holstein-Primakoff transformation to store continuous quantum information in a discrete quantum system, and after the storage how one can model the time-evolution of the continuous quantum system with a Quantum Cellular Automata action on the discrete system.