# Q 15 Quanteninformation II

Zeit: Montag 17:00–18:30 Raum: HI

Q 15.1 Mo 17:00 HI

**Equilibrium entanglement in open, noisy quantum systems** — •Lorenz Hartmann[1], Wolfgang Dür[1,2], and Hans-Jürgen Briegel[1,2] — [1]Institut für Theoretische Physik, Universität Innsbruck, Technikerstr. 25, 6020 Innsbruck, Österreich — [2]Institut für Quantenoptik und Quanteninformation, Österreichische Akademie der Wissenschaften, Innsbruck, Österreich

We show that quantum mechanical entanglement can prevail even in noisy open quantum systems at finite temperatures, and despite the deteriorating effect of decoherence. The system consists of a number N of interacting quantum particles and it can exchange energy and particles with some environment. The effect of decoherence is counteracted by a simple mechanism, where system particles are randomly reset to some standard initial state, e.g. by replacing them with particles form the environment. We present a master equation that describes this process, which we can solve analytically for small N. If we vary the interaction strength and the reset against decoherence rate, we find a threshold below which the equilibrium state is classically correlated, and above which there is a parameter region with genuine entanglement.

Q 15.2 Mo 17:15 HI

**On the connection between Quantum Walks and Quantum Cellular Automata** — •Holger Vogts and Reinhard F. Werner — Institut für Mathematische Physik, TU Braunschweig, www.imaph.tu-bs.de

We review the models of Quantum Walks (QWs) and Quantum Cellular Automata (QCAs) and analyze connections between these two types of quantum lattice systems. In particular, we want to determine particle conserving QCAs, which reduce to a given QW on one-particle states. In general, there are many QCAs with this property, corresponding to different interactions between the walking particles. We discuss the problem of finding an interaction with smallest admissible range, and how to find interactions respecting internal symmetries of the walking particles.

Q 15.3 Mo 17:30 HI

**Scattering of Quantum Walkers** — •Annette Maria Gattner and Reinhard F. Werner — Institut für Mathematische Physik, TU Braunschweig, www.imaph.tu-bs.de

We consider the one-dimensional Quantum Walk with Hadamard coin as the free time evolution for scattering problems. The analogue of a scattering potential is a local modification of the Quantum Walk dynamics. In analogy to the free particle in presence of a potential we determine transmission and reflection coefficients, bound states and estimate their maximal number.

We then consider two particles on the line, specify what happens when they collide and study the scattering of these two colliding particles.

Q 15.4 Mo 17:45 HI

**Quantum Information Processing with Micro-Structures** — •Andre Lengwenus[1], Michael Volk[2,1], Jens Kruse[2,1], Wolfgang Ertmer[1], and Gerhard Birkl[2] — [1]Institut für Quantenoptik, Universität Hannover, Welfengarten 1, 3016 Hannover — [2]Institut für Angewandte Physik, Technische Universität Darmstadt, Schlossgartenstr. 7, 64289 Darmstadt

For the experimental realization of quantum information processing with neutral atoms, it is essential to investigate methods for the coherent manipulation of the internal states of trapped atoms. In order to move towards a scaleable system of qubits for quantum information processing, we apply coherent Raman coupling in parallel to ensembles of atoms in two-dimensional arrays of optical micro-potentials created by micro-fabricated lens arrays. Due to the large lateral separation of neighboring potential wells, each trap is individually addressable. For ultracold Rb85 atoms confined in these optical dipole potentials, we experimentally demonstrate the coherent coupling of the hyperfine ground states by stimulated Raman transitions and investigate the coherence time. The realization of two-qubit gates seems feasible with our system using ultracold collisions. We demonstrate the movement of atoms in our microtraps using steering methods which are based on the variation of the angle of the laser beam illuminating the array of microlenses. With this technique we achieve distances of more than half of the trap-to-trap separation which is enough to move two arrays on top of each other. Trap losses and temperature evolution during movement are determined.

Q 15.5 Mo 18:00 HI

**Heralded single-photon generation using imperfect single-photon sources and a two-photon-absorbing medium** — •Artur Scherer, Thomas Konrad, Michael Nock, and Jürgen Audretsch — Fachbereich Physik der Universität Konstanz, AG-Audretsch, Postfach M 674, D-78457 Konstanz, Germany

We propose a setup for a heralded, i.e. announced generation of a pure single-photon state given two imperfect sources whose outputs are represented by mixtures of the single-photon Fock state $|1\rangle$ with the vacuum $|0\rangle$. Our purification scheme uses beam splitters, photodetection and a two-photon-absorbing medium. The admixture of the vacuum is fully eliminated. We discuss two potential realizations of the scheme.

Q 15.6 Mo 18:15 HI

**Universeller Homodyne-Detektor hoher Bandbreite** — •Frank Vewinger, Jürgen Appel, Sergey Babichev und Alexander I. Lvovsky — Department of Physics and Astronomy, University of Calgary, Calgary, AB, T2N 1N4 Canada

Wir stellen einen Homodyne-Detektor mit einer Bandbreite > 200 MHz vor. Ein Ti:Sa Laser (Coherent Mira, 76 MHz Pulswiederholrate) dient als Lokaloszillator in einem balancierten Detektionsschema. Die Pulse werden mittels zweier vorgespannter Si-PIN Fotodioden detektiert, deren Differenzstrom in einem als Transimpedanzwandler geschalteten Operationsverstärker verstärkt wird. Bei einer Leistung von 10 mW des Lokaloszillators liegt das optische Schrotrauschen bis zu 15 dB über dem elektronischen Rauschen des Detektors. Die hohe Bandbreite des Detektors erlaubt Messungen sowohl im Frequenz- als auch im Zeitraum bei der vollen Pulswiederholrate des Lokaloszillators, z.B. für Quantenkommunikation mit kontinuierlichen Variablen.