

## Q 34 Quanteninformation I

Zeit: Dienstag 12:00–13:15

Raum: HU Audimax

Q 34.1 Di 12:00 HU Audimax

**Ultracold Rydberg atoms for quantum information processing** — •THOMAS AMTHOR, MARKUS REETZ-LAMOUR, JOHANNES DEIGLMAYR, KILIAN SINGER, and MATTHIAS WEIDEMÜLLER — Phys. Inst., Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg

Neutral atoms are interesting candidates for quantum information storage because of their weak interaction with the environment, which leads to long coherence and storage times. However, fast quantum gates require strong interactions. One possible implementation uses Rydberg states for this purpose [1]. We present our experimental results on the "dipole blockade" [2], being the central concept to implement qubits in a mesoscopic system. Further perspectives of the experiment will be discussed.

[1] Lukin et al., Phys.Rev.Lett. **87** 037901 (2001)

[2] Singer et al., Phys.Rev.Lett. **93** 163001 (2004)

Q 34.2 Di 12:15 HU Audimax

**Gaussian Quantum Cellular Automata** — •OLE KRÜGER and REINHARD F. WERNER — Institut für Mathematische Physik, TU Braunschweig, www.imaph.tu-bs.de/qi

Quantum cellular automata are a promising candidate for quantum information processing tasks. One physical implementation might be by means of vibrational degrees of freedom in an optical lattice. We consider such continuous variable quantum cellular automata focusing on Gaussian states and quasi-free evolution. The translation invariant, pure Gaussian states on the lattice are characterized in terms of a Fourier transform of the correlation function. We investigate their evolution under the dynamics of the automaton, their properties in the limit of large time, the generation of entanglement and the ability to simulate ground states of other systems.

Q 34.3 Di 12:30 HU Audimax

**Optimal unambiguous state discrimination of two density matrices and its link with the fidelity** — •PHILIPPE RAYNAL and NORBERT LÜTKENHAUS — Institut für theoretische Physik I, Max-Planck-Forschungsgruppe, Universität Erlangen-Nürnberg, Staudtstr. 7/B1, 91058 Erlangen, Germany

Quantum state discrimination is a fundamental task in quantum information theory. One strategy is Unambiguous State Discrimination (USD). In that strategy the discrimination succeeds only with some probability. Whenever it succeeds, however, the discrimination is without error. The problem to find optimal USD strategies, which optimize the success probability, has been solved for many pure state scenarios, including any two pure states. However, no optimal USD has been described in the case of mixed states, unless that problem can be reduced to some pure state cases [1]. Bounds exist for the optimal success probability and they are given in terms of the fidelity [2,3]. In this contribution we study the case of two density matrices and present a wide class of mixed states for which exact solutions can be given. For this class, the bound is saturated.

[1] Ph. Raynal, N. Lütkenhaus, S. J. van Enk, Phys. Rev. A **68**, 022308 (2003)

[2] T. Rudolph *et al.*, Phys. Rev. A **68**, 010301 (2003)

[3] Y. Feng *et al.*, Phys. Rev. A **70**, 012308 (2004)

Q 34.4 Di 12:45 HU Audimax

**No Disturbance without Measurement** — •DENNIS KRETSCHMANN, DIRK SCHLINGEMANN, and REINHARD F. WERNER — Institut für Mathematische Physik, Technische Universität Braunschweig, www.imaph.tu-bs.de/qi

In this contribution we focus on the trade-off between the amount of information that can be sent through a quantum channel and the degree of disturbance caused by interaction with the environment. This trade-off lies at the heart of quantum mechanics, and has given rise to the well-known slogan 'no measurement without disturbance'. Here we will chiefly be concerned with the converse problem: given a quantum channel that releases (almost) no information to the environment, we show that (almost) all the information can be retrieved from the channel, and give explicit bounds. We present several different formulations of this trade-off, which are adapted to different physical setups. In particular, we relate these concepts to the coherentification protocol which Igor Devetak recently applied in his proof of the quantum channel coding theorem.

Q 34.5 Di 13:00 HU Audimax

**Information transfer via molecular bridges** — •ULRIKE TROPPEMANN<sup>1</sup> and REGINA DE VIVIE-RIEDLE<sup>1,2</sup> — <sup>1</sup>LMU München, Department Chemie, Butenandtstr. 11, 81377 München — <sup>2</sup>MPI für Quantenoptik, Hans-Kopfermann-Str. 1, 85741 Garching

We have launched a new approach to quantum computing using vibrational qubits of polyatomic molecules and shaped fs laser pulses for logic operations [1]. A set of essential global quantum gates has been calculated, using Optimal Control Theory (OCT), and applied successfully in a fundamental quantum algorithm [2]. In the context of quantum information processing a further issue is how information can be transported between spatially separated quantum registers. An imaginable solution for a molecular quantum channel is to connect sub units of vibrational qubits with carbon chains. Different test systems were investigated where we select CC stretches as transport modes. The molecular properties, as vibrational energies and coupling elements, are derived from ab initio calculations. A first goal is to optimize population transfer through a carbon chain with specially modulated laser pulses acquired by OCT. Further issues will be coherence as well as entanglement transfer.

[1] C. M. Tesch and R. de Vivie-Riedle, PRL **89**(2002) 157901.

[2] C. M. Tesch and R. de Vivie-Riedle, JCP, in press (2004).