

Q 6: Quanteninformation (Photonen und nichtklassisches Licht II)

Zeit: Montag 14:00–15:00

Raum: 5L

Q 6.1 Mo 14:00 5L

A Single-Photon Server with Just One Atom — •MARKUS HIJLKEMA, BERNHARD WEBER, HOLGER SPECHT, SIMON WEBSTER, and GERHARD REMPE — Max-Planck-Institut für Quantenoptik, Hans Kopfermann-Str. 1, 85748 Garching, Germany

In this contribution we present results on an experiment where just one single atom trapped in the mode of a high-finesse microcavity is used to generate single photons in a deterministic way. In our scheme, a single atom is trapped in a standing wave dipole potential, created by two counterpropagating laser beams. The focus of these laserbeams overlaps with the mode of our cavity. First, the atom is cooled down in the trap by applying a laser beam incident perpendicular to the cavity and under an angle of 45 degrees with respect to the trapping lasers. Second, a sequence of laserpulses is used to stimulate single-photon emission into the cavity, and subsequent recycling of the atom back into the initial state. The atom is cooled during the recycling phase if suitable parameters are chosen. It is thus possible to extend the lifetime of the atom in the trap up to several 10 seconds, while at the same time producing single-photons. The large number of photons generated in this way display a clear antibunching in the photon arrival times as can be determined from just a single run.

Q 6.2 Mo 14:15 5L

Experimental Demonstration of Continuous Variable Cloning with a priori Information — •METIN SABUNCU^{1,2}, ULRIC ANDERSEN², and GERD LEUCHS¹ — ¹Institut für Optik Information und Photonik, Max Planck Forschungsgruppe, Universität Erlangen-Nürnberg — ²Department of Physics, Technical University of Denmark

A state dependent cloning machine has the capability to produce clones, which have a higher average fidelity compared to the universal cloner. We experimentally realize a state dependent cloning machine consisting of only linear optical elements, homodyne detectors and feedforward electronics. Our machine generates clones of coherent states, which are chosen out of an apriori known alphabet, with an average fidelity which exceeds the universal coherent state cloning limit of $2/3$.

Q 6.3 Mo 14:30 5L

A Narrow-Band Single-Photon Source — •FLORIAN WOLFGRAMM, MATTHIAS SCHOLZ, and OLIVER BENSON — Humboldt-Universität zu Berlin, Institut für Physik, AG Nanooptik, Hausvogteiplatz 5-7, 10117 Berlin

Recently, there has been extensive progress on the storage of single photons. Most storage schemes rely on the matching of photons to the

bandwidth of atomic resonances. This feature is not fulfilled by single-photon sources based on quantum dots, parametric down-conversion, molecules, or NV-centers in diamond.

While narrow bandwidths have been achieved using single stored atoms or ions, a more simple approach takes advantage of the narrow-band output of Optical Parametric Oscillators (OPO), where the down-conversion bandwidth is reduced to that of the cavity. Operating the OPO far below threshold, a heralded single-photon source can be realized with the idler photon as the trigger. The feasibility of such a scheme has been proven for a type-I OPO. Type-II down-conversion has the advantage of perpendicular polarization and has been implemented without active stabilization of the cavity. Our approach with type-II phase-matching avoids the problem of stabilizing the cavity for signal and idler. Instead, we are separating the idler by intracavity beamsplitters, stabilizing the cavity only for the signal. With this setup we were able to generate heralded single-photon states with a bandwidth of below 100 MHz at the D1-transition of cesium. Such a narrow-band single-photon source could find wide applications in the field of quantum information processing.

Q 6.4 Mo 14:45 5L

Remote Preparation of an Atomic Quantum Memory — •WENJAMIN ROSENFELD¹, JÜRGEN VOLZ¹, FLORIAN HENKEL¹, STEFAN BERNER¹, MICHAEL KRUG¹, FREDRIK HOCKE¹, MARKUS WEBER¹, and HARALD WEINFURTER^{1,2} — ¹Dept. für Physik der LMU, 80799 München — ²Max-Planck Institut für Quantenoptik, 85748 Garching

Entanglement is a key element of quantum information and communication applications. Of special interest is entanglement between different quantum objects like photons and atoms. It allows to combine the advantages of long atomic coherence times with the ability of photons to transport quantum information over large distances. Therefore atom-photon entanglement forms the basic ingredient for future applications, as e.g. quantum repeater and quantum networks.

In our experiment we generate entanglement between the spin of a single optically trapped Rb87 atom and the polarization of a photon in a spontaneous decay process in a lambda-type transition[1]. Based on this entanglement we performed a first demonstration of a quantum communication protocol between an atomic qubit and a photonic communication channel[2]. In this so-called remote state preparation we utilize the idea of quantum teleportation to transfer an arbitrary quantum state of the single photon to the atomic qubit. Together with a high-fidelity read-out procedure of the atomic state, this is a major building block for the faithful distribution of quantum information.

[1] J. Volz et al., PRL 96, 030404 (2006)

[2] W. Rosenfeld et al., quant-ph/0608229 (2006)