Q 60: Quantum Information: Photons and Nonclassical Light 2

Time: Friday 10:30–12:15 Location: SCH 251

Q 60.1 Fri 10:30 SCH 251

Two Color Entanglement — •Christina E. Lauköttter[1], Aiko Samblowski[1], Nicolai Grosse[2], Ping Koy Lam[2], and Roman Schnabel[1] — [1]Institut für Gravitationsphysik, QUEST, Leibniz Universität Hannover and Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut), Callinstr. 38, 30167 Hannover, Germany — [2]Department of Quantum Science, Research School of Physics & Engineering, The Australian National University, Australian Capital Territory 0200, Australia

We report on the experimental generation of entangled states of light between the wavelengths 810 and 1550 nm in the continuous variable regime [1]. The fields were produced by a type I optical parametric oscillator operating above threshold. Balanced homodyne detection was used to detect the non-classical noise properties, while filter cavities provided the local oscillators by separating carrier fields from the entangled sidebands. We were able to obtain a conditional variance based measure of I = 0.82, where values below unity demonstrate inseparability.

[1] A. Samblowski, C. E. Lauköttter, N. Grosse, P. K. Lahm, R. Schnabel "Two Color Entanglement" arXiv:1011.5766v1 (2010)

Q 60.2 Fri 10:45 SCH 251

Entangling photons via the quantum Zeno effect — Ralf Schützhold, Andreas Osterloh, and •Nicolai ten Brinke — Fakultät für Physik, Universität Duisburg-Essen, Lotharstraße 1, D-47057 Duisburg, Germany

We present an approach for entangling photons using the quantum Zeno effect and strong two-photon absorption. The quantum Zeno effect describes the suppression of the time evolution of a quantum state by frequent measurements. This effect can be employed for entanglement generation, e.g., to implement a quantum-CNOT gate in a linear optics approach to quantum computing. In contrast to previous proposals, our approach might also work in free space, i.e., without resonators or cavities.

Q 60.3 Fri 11:00 SCH 251

Four-Photon Distinguishability Transition — •Malte C. Tichy[1], Hyang-Tag Lim[2], Young-Sik Ra[2], Florian Mintert[1,3], Yoon-Ho Kim[2], and Andreas Buchleitner[1] — [1]Physikalisches Institut - Universität Freiburg - Hermann-Herder-Str. 3 - D-79104 Freiburg — [2]Department of Physics - Pohang University of Science and Technology (POSTECH) - Pohang, 790-784, Korea — [3]Freiburg Institute for Advanced Studies (FRIAS) - Universität Freiburg - Albertstr. 19 - D-79104 Freiburg

The propagation of photons through a four-port beam-splitter is considered theoretically and experimentally with photon quadruplets created by spontaneous parametric down-conversion [1]. All event probabilities turn out to be sensitively dependent on the mutual indistinguishability of the photons. We find that the rate of individual output events – which may be either enhanced or suppressed with respect to the case of distinguishable particles – depends non-monotonically on the degree of distinguishability, and explain this behavior in terms of an intricate interplay between constructive and destructive many-particle interferences. These effects constitute qualitatively new features with respect to the well-known two-photon Hong-Ou-Mandel effect.

[1] M.C. Tichy et al., arXiv:1009.4998

Q 60.4 Fri 11:15 SCH 251

Einstein-Podolsky-Rosen Correlations from a Vacuum-Class Two-Mode Squeezed State — •Tobias Eberle[1,3], Vitus Händchen[1], Jörg Duhme[2,3], Torsten Franz[2], Reinhard Werner[2], and Roman Schnabel[1] — [1]Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut) and Institut für Gravitationsphysik der Leibniz Universität Hannover, Callinstraße 38, 30167 Hannover, Germany — [2]Institut für Theoretische Physik der Leibniz Universität Hannover, Appelstraße 2, 30167 Hannnover — [3]Centre for Quantum Engineering and Space-Time Research - QUEST, Leibniz Universität Hannover, Welfengarten 1, 30167 Hannover, Germany

In this talk we present the experimental and theoretical analysis of vacuum-class two-mode squeezed states, i.e. of bi-partite continuous variable entangled states generated by mixing a squeezed mode with a vacuum mode at a 50:50 beam splitter. We observed one of the strongest Einstein-Podolsky-Rosen (EPR) correlations in the continuous variable regime. Theoretically we found that arbitrarily strong EPR correlations are possible with this scheme only depending on the optical loss and the input squeezing.

Q 60.5 Fri 11:30 SCH 251

Operator ordering and causality — •Lev Plimak[1], Wolfgang Schleich[1], and Stig Stenholm[1,2,3] — [1]Abteilung Quantenphysik, Universitaet Ulm, D-89069 Ulm, Germany — [2]Physics Department, Royal Institute of Technology, KTH, Stockholm, Sweden — [3]Laboratory of Computational Engineering, HUT, Espoo, Finland

We show that a causality violation emerges if the conventional definition of the time-normal operator ordering [1] is taken outside the rotating wave approximation. It disappears were the amended definition [2] used. Relativistic causality is demonstrated for a time-normal product of two operators under the most general assumptions about quantum dynamics.

[1] P.L.Kelly and W.H.Kleiner, Phys.Rev. 136, A316 (1964).

[2] Lev Plimak and Stig Stenholm, Annals of Physics, 323, 1989 (2008).

Q 60.6 Fri 11:45 SCH 251

Entangled photons in a disordered waveguide — •Frank Schlawin, Nicolas Cherroret, and Andreas Buchleitner — Institute of phyiscs, Albert-Ludwigs University of Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg, Germany

In this talk, we will consider the propagation of non-classical light through a quasi one-dimensional, disordered waveguide. We will investigate the interplay between the classical noise originating from the disorder, and the quantum properties of the radiation. In particular, we will show that strongly non-classical features of the light, such as entanglement, may have a tremendous impact on the statistical distribution of the coincidence rate measured in transmission (the "two-photon speckle").

Q 60.7 Fri 12:00 SCH 251

Probability amplitudes of two-levels atoms beyond the dipole approximation — •Armen Hayrapetyan[1] and Stephan Fritzsche[2,3] — [1]Max-Planck-Institut für Kernphysik, Postfach 103980, D-69029 Heidelberg, Germany — [2]Department of Physics, P.O. Box 3000, Fin-90014 University of Oulu, Finland — [3]GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt, Germany

The interaction of a two-level atom with linearly polarized light is considered beyond the typical dipole approximation. Using an invariant approach for the Schrödinger equation, we derived expressions for the probability amplitudes that depend on both, the space and time coordinates of the varying light field. In this talk, analytical solutions for these amplitudes are presented and discussed in terms of the phase of the radiation field. These solutions are applicable for wavelengths larger or comparable to the size of the atoms. The population inversion is discussed in terms of the phase of the radiation.