

## Q 13 Quanteneffekte I

Zeit: Samstag 08:30–10:00

Raum: HU 1072

Q 13.1 Sa 08:30 HU 1072

**Control schemes for collective resonance fluorescence** — ●MIHAI MACOVEI, JÖRG EVERS, and CHRISTOPH H. KEITEL — Max-Planck Institute for Nuclear Physics, Saupfercheckweg 1, D-69117 Heidelberg, Germany.

Multi-atom systems [1] have received considerable attention due to their possible applications in various fields of modern quantum optics. For any applications, however, convenient control parameters to influence the collective atomic dynamics are required [2]. We shall show then various schemes to manipulate the quantum properties of a collection of dipole-interacting few-level atoms. In particular, both the steady-state collective populations and the spectral features of these samples can be controlled by varying the laser parameters, temperature of the environmental bath or especially the atomic-level spacings by, *e.g.*, static magnetic fields.

[1] R. H. Dicke, Phys. Rev. **93**, 99 (1954).

[2] M. Macovei, J. Evers, and C. H. Keitel, Phys. Rev. Lett. **91**, 233601 (2003) and Europhysics Letters **68**(3), 391 (2004).

Q 13.2 Sa 08:45 HU 1072

**Entanglement of Photons with Fractional Orbital Angular Momentum** — ●D. VOIGT<sup>1</sup>, S.S.R. OEMRAWSINGH<sup>1</sup>, X. MA<sup>1</sup>, A. AIELLO<sup>1</sup>, E.R. ELIEL<sup>1</sup>, G.W. 'T HOOFT<sup>1,2</sup>, and J.P. WOERDMAN<sup>1</sup> — <sup>1</sup>Huygens Laboratory, Leiden University, The Netherlands (molphys.leidenuniv.nl/qo) — <sup>2</sup>Philips Research Laboratories, Eindhoven, The Netherlands

High-dimensional entanglement gives access to stronger nonlocality, beyond 2-dim. polarization entanglement of twin photons. Orbital angular momentum (OAM) provides a suitable infinite-dimensional Hilbert space. Fractional OAM, *i.e.* a superposition of Laguerre-Gauss modes, exploits these spatial degrees of freedom. We study twin photons that carry mixed screw-edge phase dislocations with half-integer OAM. These photons are detected with oriented spiral phase plates [1] in a 2-port scheme [2], reminiscent to polarization entanglement. We achieve a Clauser-Horne-Shimony-Holt parameter of  $S=3.06(7)$ , the strongest violation of local realism to date.

[1] S.S.R. Oemrawsingh et al., Appl. Opt. **43**, 688 (2004). [2] S.S.R. Oemrawsingh et al., PRL **91**, 217901 (2004).

Q 13.3 Sa 09:00 HU 1072

**Resonance fluorescence in a photonic crystal** — ●GEESCHE BOEDECKER and CARSTEN HENKEL — Institut für Physik, Universität Potsdam, am Neuen Palais 10, 14469 Potsdam

One of the strong motivations for photonic crystals is the possibility of tuning the spontaneous decay rate of an embedded emitter. The strongly modified density of field modes makes the atom-field dynamics markedly non-Markovian, and this requires new techniques and approximations. In particular, the emission spectrum of a coherently driven two-state system into a photonic band structure has been characterized only in the weak coupling limit so far. We discuss numerically exact simulation schemes for this non-Markovian problem and compare them to approximations developed for the spin-boson model, starting from the Feynman-Vernon influence functional technique.

Q 13.4 Sa 09:15 HU 1072

**Detection of moving atoms by Gaussian shaped lasers** — ●JENS TIMO NEUMANN and GERHARD C. HEGERFELDT — Inst. f. Theor. Physik, Univ. Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Recently, it has been proposed to measure the arrival time distributions of moving spread-out quantum particles by means of laser-induced fluorescence. In these models, the laser intensity has been assumed to be piecewise constant in space. We extend this to lasers with a smooth (Gaussian) intensity distribution, present a method to calculate the probability distribution for the first fluorescence photon and compare our results to axiomatic predictions for arrival time distributions.

Q 13.5 Sa 09:30 HU 1072

**Quantum optical approach to kinetic energy densities** — ●DIRK SEIDEL<sup>1</sup>, GERHARD C. HEGERFELDT<sup>1</sup>, and J. GONZALO MUGA<sup>2</sup> — <sup>1</sup>Institut für Theoretische Physik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen — <sup>2</sup>Departamento de Química-Física, Universidad del País Vasco, Apartado Postal 644, 48080 Bilbao, Spain

We give a measurement based (operational) approach to a positive quantum version of the local kinetic energy density. This is achieved by considering the detection rate of photons which are emitted by a moving three-level atom excited by a localized laser beam. The relation to quantum arrival-time distributions obtained with the same type of experiment is pointed out.

Q 13.6 Sa 09:45 HU 1072

**Multiple Scattering of Cold Atoms in Speckle Potentials** — ●ROBERT KUHN<sup>1,2</sup>, CORD AXEL MÜLLER<sup>1</sup>, and CHRISTIAN MINIATURA<sup>2</sup> — <sup>1</sup>Physikalisches Institut, Universität Bayreuth, D-95440 Bayreuth — <sup>2</sup>Institut Non Linéaire de Nice Sophia Antipolis, F-06560 Valbonne

We study multiple scattering of matter waves by a disordered optical potential in two and in three dimensions. Using a diagrammatic Green's function approach it is possible to calculate the ensemble-averaged propagator and the intensity kernel in the weak scattering regime. From the single-scattering vertex we obtain the scattering mean free path and the transport mean free path as a function of experimentally relevant parameters. We observe strongly anisotropic scattering due to the presence of correlations between potential fluctuations of the optical speckle pattern. Furthermore we will discuss the interplay between the different physical regimes which impose important constraints upon the simultaneous realization of multiple scattering, weak scattering and elastic scattering.