Q 45 Quanteneffekte III

Zeit: Dienstag 14:30–16:00 Raum: HU 1072

Q 45.1 Di 14:30 HU 1072

Nonlinear coherent backscattering of light by a dilute gas of two-level atoms — •Thomas Wellens[1,2], Benoît Grémaud[1], Dominique Delande[1], and Christian Miniatura[2] — [1]Laboratoire Kastler Brossel, 4 Place Jussieu, 75005 Paris, France — [2]Institut Non Linéaire de Nice, 1361 route des Lucioles, 06560 Valbonne, France

We study coherent backscattering of a quasi-monochromatic laser pulse by a dilute gas of two-level atoms. Due to interference between different multiple scattering paths, the average intensity scattered by the disordered sample exhibits a narrow cone in exact backscattering direction, on top of the diffused background. We consider the perturbative regime of weak intensities, where nonlinear effects arise from two-photon scattering processes. In contrast to the case of linear scattering, we find that the nonlinear coherent backscattering cone is formed by the interferenc of *three* different amplitudes. We derive microscopically founded equations for the coherent and incoherent component of the backscattering signal, and present numerical results showing that the enhancement factor exceeds the linear barrier two in certain frequency windows.

Q 45.2 Di 14:45 HU 1072

Repulsive Casimir forces on the nanoscale: limits and feasibility — •Carsten Henkel[1] and Karl Joulain[2] — [1]Potsdam University, Germany — [2]ENSMA Poitiers, France

Casimir forces are becoming increasingly important, as mechanical devices are downscaled into the nanometer range. In particular, serious dysfunction may arise when mobile parts of nano-mechanical systems attract each other and stick together. To cure this problem, it has been suggested that suitable materials (simultaneously dielectric and permeable) may turn the Casimir interaction into repulsion [1]. We establish here fundamental and realistic limits to this approach, taking into account material dispersion with simple models [2]. The theory is generalized to planar, multilayer mirrors at finite temperature. We show that repulsion in the nanometer range is extremely difficult to achieve because typical permeable materials do not have a sufficiently large magnetic response. Even recently proposed metamaterials are not suitable because of the breakdown of the effective medium approximation.

[1] O. Kenneth, I. Klich, A. Mann, and M. Revzen, Phys. Rev. Lett. 89 (2002) 033001.
[2] C. Henkel and K. Joulain, quant-ph/0407153; C. Raabe and D. G. Welsch, quant-ph/0408075; M. S. Tomaš, quant-ph/041057.

Q 45.3 Di 15:00 HU 1072

Nonlinear Properties of Resonantly Driven Atomic Gases — •Sarah Schröder[1], Giovanna Morigi[2], and Sonja Franke-Arnold[3] — [1]Abteilung für Quantenphysik, Universität Ulm, Germany — [2]Departament de Fisica, Universitat Autonoma de Barcelona, Spain — [3]Department of Physics, University of Strathclyde, Glasgow, United Kingdom

In atomic configurations with a closed cycle of radiation-induced transitions, the dynamics and the steady-state of the atom depends critically on the relative phase between the driving lasers [1]. In this work we consider light propagation in a medium of atoms with diamond configuration of levels and investigate how the initial phase between the fields entering the medium affects the dynamics of light propagation. We present an analytical and numerical study of the propagation dynamics in its dependence on the initial laser parameters for this kind of medium, and compare our results with the dynamics of light propagation in a medium of double-Λ atoms [2].

[1] G. Morigi, S. Franke-Arnold and G.-L. Oppo, Phys. Rev. A **66**, 053409
[2] E. A. Korsunsky and D. V. Kosachiov, Phys. Rev. A **60**, 4996 (1999)

Q 45.4 Di 15:15 HU 1072

Quantum correlations in the radiation emitted by a cold trapped ion — Jürgen Eschner[1], Stefano Mancini[2], •Giovanna Morigi[3], and David Vitali[2] — [1]ICFO-Institut de Ciencies Fotoniques, 08034 Barcelona, Spain — [2]INFM and Dipartimento di Fisica, Universitá di Camerino, 62032 Camerino, Italy — [3]Departament de Fisica, Universitat Autonoma de Barcelona, 08193 Bellaterra, Spain

We study theoretically the motion-induced properties of the radiation emitted by a single trapped ion. We show that the motion creates quantum correlations between pairs of emitted photons. We characterize these correlations and discuss how these dynamics could be exploited for quantum non linear optical applications.

Q 45.5 Di 15:30 HU 1072

Bloch oscillations of Fermi and Bose atoms in optical lattices — •Alexey Ponomarev[1], Andrey Kolovsky[1,2] und Andreas Buchleitner[1] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, D-01187 Dresden — [2]Kirensky Institute of Physics, Ru-660036 Krasnoyarsk

Using the formalism of the Bose-Hubbard model, we compare the Bloch dynamics of bosonic and fermionic atoms. For a weak static force, Bloch oscillations (BO) of bosonic atoms are shown to decay within approx. one Bloch period. This effect finds its explanation in the properties of the Floquet-Bloch operator (i.e., the system evolution operator over one Bloch period), the matrix representation of which is found to be a random matrix of the circular *orthogonal* ensemble. In contrast to the bosonic dynamics, BO of spin-polarized fermionic atoms do not decay for arbitrarily weak static forcing. However, in a non-polarized Fermi gas (with two different spin projections), the BO decay once again, and the Floquet-Bloch operator pertains to the circular *unitary* ensemble. The case of strong static forcing, inducing quasiperiodic BO, will also be discussed.

Q 45.6 Di 15:45 HU 1072

Macroscopic Effects of Quantum Entanglement — •Caslav Brukner[1], Vlatko Vedral[2], and Anton Zeilinger[1] — [1]Institute of Experimental Physics, University of Vienna, Boltzmanngasse 5, 1090 Vienna, Austria — [2]The School of Physics and Astronomy, University of Leeds, Leeds, LS2 9JT, United Kingdom

It is commonly believed that for the understanding of the behaviour of large, macroscopic, objects there is no need to invoke any genuine quantum entanglement - Einstein's "spooky action at a distance". We show that this belief is fundamentally mistaken and that entanglement is crucial to correctly describe some macroscopic properties of solids. We demonstrate that macroscopic thermodynamical properties - such as internal energy, heat capacity of magnetic susceptibility - can detect quantum entanglement in solids in the thermodynamical limit even at nonzero temperatures. We identify the parameter regions (critical values of magnetic field and temperature) within which entanglement is witnessed by these thermodynamical quantities. Finally, we demonstrate that two different experiments performed in 1963 and in 2000 clearly and conclusively indicate that entanglement exits in macroscopic samples of Cooper Nitrate at temperatures below 5 Kelvin.