Q 3 Gruppenberichte Quanteneffekte

Zeit: Montag 11:10–12:40 Raum: HI

Gruppenbericht Q 3.1 Mo 11:10 HI

Adiabatischer Ramantransfer optischer Zustände — •Frank Vewinger, Jürgen Appel, Eden Figueroa, Georg Günter, Peter Marzlin und Alexander I. Lvovsky — Department of Physics and Astronomy, University of Calgary, Calgary, AB, T2N 1N4 Canada

Wir präsentieren ein Protokoll zum Transfer von Quantenzuständen zwischen zwei optischen Moden basierend auf elektromagnetisch induzierter Transparenz. Wird ein metastabiler Zustand durch zwei (klassische) Kontrollfelder an zwei angeregte Zustände gekoppelt, welche wiederum mittels zweier (quantisierter) Signalfelder an einen weiteren metastabilen Zustand gekoppelt sind (Multi-Λ Konfiguration), so laesst sich durch die geeignete Wahl der Kontrollelder der Quantenzustand eines Signalfeldes adiabatisch auf die zweite Signalmode übertragen. Wir präsentieren ein theoretisches Modell, welches den Transfer beschreibt, sowie erste Ergebnisse auf dem Weg zur experimentellen Implementierung in Rubidiumdampf.

Gruppenbericht Q 3.2 Mo 11:40 HI

Coherent processes in an ultracold gas of Rydberg atoms — •M. Reetz-Lamour[1], T. Amthor[1], A.L. de Oliveira[2,3], J. Deiglmayr[1], S. Westermann[1], J. Denskat[1], and M. Weidemüller[1] — [1]Physikalisches Institut Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg — [2]Universidade do Estado de Santa Catarina, Departamento de Física, Joinville, SC 89223-100, Brazil — [3]Universidade de São Paulo, Instituto de Física, São Carlos, SP 13560-970, Brazil

Due to the long-range character of the interaction between highly excited atoms, the dynamics of an ultracold gas of Rydberg atoms is determined by van-der-Waals and dipole-dipole interaction. One outstanding property is the tunability of resonant energy transfer processes with a static electric field [1]. The long-range interaction leads to many-body entanglement and has possible applications in quantum computing.

In a recent series of experiments we studied the coherent preparation and the coherent character of interactions in an ultracold gas of Rydberg atoms [3]. Our experiments also reveal the role of interaction-induced mechanical forces.

[1] W.R.Anderson *et al.*, PRL **80** (1998) 249; I.Mourachko *et al.*, PRL **80** (1998) 253
[3] K.Singer *et al.*, PRL **93** (2004) 163001; J.Deiglmayr *et al.*, subm. to Opt.Comm.; S.Westermann *et al.*, subm. to Eur.Phys.J.D

Gruppenbericht Q 3.3 Mo 12:10 HI

Microscopic origin of Casimir-Polder forces — •Stefan Yoshi Buhmann and Dirk-Gunnar Welsch — Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany

Dispersion forces between polarizable objects are a well-known consequence of the vacuum fluctuations of the electromagnetic field. One usually distinguishes between the van der Waals force between two atoms, the Casimir-Polder force between an atom and a macroscopic body, and the Casimir force between two bodies, where the distinction is made between microscopic point-like atoms on the one hand and macroscopic magnetodielectric bodies, which within the frame of macroscopic quantum electrodynamics are characterized by smoothly varying permittivities and permeabilities, on the other hand. Within the frame of macroscopic quantum electrodynamics, the Casimir-Polder force on a ground-state atom placed within an arbitrary arrangement of magnetodielectric bodies can be given in terms of the polarizability of the atom and the scattering Green tensor of the body-assisted electromagnetic field. We present a general proof that the Casimir-Polder force calculated in this way can be rewritten as an infinite series of microscopic many-atom van der Waals forces, for which explicit expressions are derived. The proof, which bridges the gap between the macroscopic and the microscopic description, is based on the Born expansion of the Green tensor together with the Clausius-Mosotti law, which relates the permittivity of the body to the polarizability of its atomic constituents. To illustrate our result, we explicitly show that the leading two-atom contribution is identical to the expression that can be derived from fourth-order perturbation theory.