A 12 Atomare Systeme in externen Feldern I

Zeit: Mittwoch 14:00–16:00 Raum: H6

Hauptvortrag

A 12.1 Mi 14:00 H6

The geometry of time-dependent transition states — •T. Bartsch, T. Uzer, J. Moix, and R. Hernandez — Center for Nonlinear Science, School of Physics, Georgia Institute of Technology, Atlanta, Georgia, USA

The paradigm of Transition State Theory, though taken from chemical reaction dynamics, is applicable to processes as diverse as the ionization of atoms and the capture of asteroids. We present a construction that makes Transition State Theory available to systems under external driving and promises applications to atoms and molecules in laser fields or atomic recombination in plasmas.

A 12.2 Mi 14:30 H6

Hydrogenic Stochastic Resonance — •Kamal P. Singh and Jan M. Rost — Max Planck Institute for the Physics of Complex Systems, Dresden

Stochastic resonance is a counterintuitive mechanism whereby noise enhances the response of nonlinear systems to a weak coherent signal. Despite its presence in remarkably diverse physical systems, only a few quantum mechanical examples of bistable systems have been discussed [1-3]. Here we shall demonstrate the existence of stochastic resonance effect in the simplest atomic system, namely hydrogen. Both the classical and the quantum mechanical description of associated electron dynamics allows us to further investigate the nature of the classical-quantum correspondence principle for the stochastic resonance. We also discuss the possibility of observing the proposed signature in a real experimental setting.

[1] R. Löfstedt and S. N. Coppersmith, Phys. Rev. Lett 72, 1947 (1994)
[2] L. Gammaitoni, P. Hänggi, P. Jung, and F. Marchesoni, Rev. Mod. Phys 70, 223 (1998)
[3] T. Wellens, V. Shatokhin, and A. Buchleitner, Rep. Prog. Phys. 67, 45 (2004)

A 12.3 Mi 14:45 H6

Molecular response to noise — •Anatole Kenfack[1], Jan Michael Rost[1], and Frank Grossmann[2] — [1]Max-Planck Institute for the Physics of Complex Systems, Dresden, Germany — [2]Institute for Theoretical Physics, Dresden University of Technology, D-01062 Dresden, Germany

Ionization versus fragmentation of the Hydrogen molecular ion under noise will be addressed beyond the Born-Oppenheimer approximation. Furthermore, we will show that this noise source is an efficient way, as compared to intense laser fields, to dissociate diatomic molecules such as HCl, HF, etc. without ionizing them [A. Kenfack and Jan M. Rost, JCP**123**, 204322 (2005)].

A 12.4 Mi 15:00 H6

Microwave-driven Rydberg atoms: From multiphoton ionisation to Einstein's photo effect — •Alexej Schelle[1], Artem Dudarev[1], Dominique Delande [2], and Andreas Buchleitner [1] — [1]Max Planck Institut fuer Physik komplexer Systeme Noethnitzer Str. 38, 01187 Dresden - Germany — [2]Laboratoire Kastler Brossel, Université Pierre et Marie Curie 4, place Jussieu, 75252 Paris 05 - France

We report on numerically exact ab initio quantum calculations on alkali Rydberg atoms under microwave driving. Here, we focus on the competition between different ionisation processes as the driving field frequency is continuously tuned from multiphoton to single-photon transitions from the atomic initial state to the atomic continuum.
Our numerical results, which are obtained by combining the Floquet picture with R-matrix theory and complex rotation of the Hamiltonian, on the most advanced supercomputing facilties, are compared with recent experimental data for different atomic species.

A 12.5 Mi 15:15 H6

Ericson fluctuations in an open, deterministic quantum system: theory meets experiment — •Javier Madronero[1] and Andreas Buchleitner[2] — [1]Physik Department, Technische Universität München — [2]Max-Plank-Institut für Physik komplexer Systeme, Dresden

We report on numerically exact quantum calculations on alkali Rydberg atoms in crossed magnetic and electric fields, above the ionization threshold in a regime of overlapping resonances. The calculated photoexcitation cross sections for rubidium Rydberg states are in quantitative agreement with recent experimental observations [1] and exhibit a clear transition towards the Ericson regime [2].

[1] G. Stania and H. Walther, Phys. Rev. Lett. **95**, 194101 (2005)
[2] J. Madroñero and A. Buchleitner, preprint Phys. Rev. Lett.

A 12.6 Mi 15:30 H6

Resonance-assisted decay of nondispersive wave packets in microwave-driven hydrogen Rydberg atoms — •Sandro Wimberger[1], Peter Schlagheck[2], Christopher Eltschka[2], and Andreas Buchleitner[3] — [1]CNR-INFM and Dipartimento di Fisica E. Fermi, Universita degli Studi di Pisa, Largo Pontecorvo 3, I-56127 Pisa — [2]Institut für Theoretische Physik, Universität Regensburg, D-93040 Regensburg — [3]MPI für Physik komplexer Systeme, Nöthnitzerstr. 38, D-01187 Dresden

We present a quantitative semiclassical theory for the decay of nondispersive electronic wave packets that are formed in resonantly driven hydrogen Rydberg atoms. This decay is induced by a classically forbidden coupling process through the dynamical barriers of the regular island on which the wave packets are localized. The associated coupling rate is determined by the high-order nonlinear resonance that most dominantly manifests within this island. This resonance-assisted tunneling process is combined with quantum transport across a chaotic phase space region, and with the subsequent one-photon decay to the atomic continuum. We thus obtain an analytical semiclassical expression for the average decay rate of the wave packets, which is in excellent agreement with the exact rates obtained by a numerical diagonalization of the Floquet problem.

A 12.7 Mi 15:45 H6

Exceptional points in the spectra of atoms in static external fields — •Holger Cartarius, Jörg Main, and Günter Wunner — 1. Institut für Theoretische Physik, Universität Stuttgart, 70550 Stuttgart

The coalescence of two complex eigenvalues in systems which depend on a parameter is called an exceptional point. Exceptional points can appear in open quantum systems with decaying unbound states which have complex energies and are described by a non-Hermitian Hamiltonian. They have been observed in the laser induced ionization of atoms, acoustical systems, microwave cavities, and atom waves in optical lattices. However, no exceptional points have been discovered in atoms in static external fields yet.

We search for exceptional points in the spectrum of the hydrogen atom in crossed electric and magnetic fields at energies above the ionization threshold. This is a fundamental physical system which fulfills the conditions for a coalescence of two eigenvalues in the complex plane. The calculation of the eigenvalues requires the diagonalization of large complex symmetric matrices.