A 12: Poster I - Interaction with external fields

Zeit: Dienstag 16:30–18:30 Raum: Poster B

A 12.1 Di 16:30 Poster B

Berry Phases in a Hydrogen Atomic Beam Spin Echo Setup
— Maarten DeKieviet, Sacher Khoudari, •Christian Roux, and Thorsten Schult — Physikalisches Institut, Uni Heidelberg

Berry Phases (BPs) in quantum mechanics, which are purely geometric in origin, have been measured using a wide variety of systems and techniques. In the last few years BPs have received renewed interest due to the possibility of using them as quantum computing gates. This is motivated by the belief that these phases should be naturally fault tolerant in the presence of external noise. In addition, latest theoretical results predict that BPs can be used to measure parity-violating effects in a hydrogen atomic beam spin echo setup. Measurements in light systems like the hydrogen atom are of great interest because theoretical calculations can be done with high accuracy and therefore may help to clarify the spin-puzzle of the nucleon.

The atomic beam spin echo technique gives an opportunity to separate the geometric from the quantum mechanical dynamic phase in appropriate magnetic fields and therefore allows a detailed study of the behavior of the BP. At present we are building an experimental setup capable of measuring BPs between 0 and 2π and, in analogy to the conventional dynamical Spin-Echo, a first "Berry-Echo".

A 12.2 Di 16:30 Poster B

Berry phase in atomic scattering
— •Polina V. Mironova, Maxim A. Efremov, and Wolfgang P. Schleich — Institut für Quantenphysik, Universität Ulm, Ulm, Germany

The Berry phase is determined only by the topology of parameter space and therefore cannot be disturbed by noise. It could be of use for the construction of robust quantum gates. We consider the scattering of a two-level atom by a resonant standing light wave. In our scheme an atom interacts with (i) the standing wave, (ii) the pi-pulse, (iii) the second standing wave which is identical to the first one, and (iv) the second pi-pulse. In the adiabatic approximation of the atomic center-of-mass motion, an adiabatically slow switch-on and -off of the atom-standing wave interaction we shown that we can controll the atomic state population at each moment of the interaction. We suggest a four-step scheme of atom scattering will lead to cancelling of the dynamical phase and the scattering picture will be determined only by the position-dependent geometrical phase.

A 12.3 Di 16:30 Poster B

Negative Energy Resonances of Bosons in a Magnetic Quadrupole Trap
— •Shahpoor Saeidian[1] and Peter Schmelcher[1,2] — [1]Physikalisches Institut, Universität Heidelberg, Philosophenweg 12, 69120 Heidelberg, Germany — [2]Theoretische Chemie, Institut für Physikalische Chemie, Universität Heidelberg, INF 229, 69120 Heidelberg, Germany

We investigate resonances of spin 1 bosons in a three-dimensional magnetic quadrupole field. Complementary to the well-known positive energy resonances it is shown that there exist short-lived, i.e. broad, negative energy resonances. The latter originate from a fundamental symmetry of the corresponding Hamiltonian. They are characterized by an atomic spin that is aligned antiparallel to the local magnetic field direction. In contrast to the positive energy resonances the lifetimes of the negative energy resonances decreases with increasing total magnetic quantum number. We derive a mapping of the two branches of the spectrum.

A 12.4 Di 16:30 Poster B

Photoelectron emission from two Rabi-coupled levels
— •Mircea Girju and Dieter Bauer — Max-Planck-Institut für Kernphysik, Postfach 103980, 69029 Heidelberg

Photoelectron spectra for the strong field ionization from the Rabi-coupled 1s and 2p states in hydrogen are calculated. Comparisons between results obtained with an extended strong field approximation and the solution of the time dependent Schrödinger equation are presented for different numbers of cycles of the ionizing laser pulse, Rabi-field strengths, and for vanishing or partial overlap between the ionizing pulse and the Rabi field. As in some cases the ionization due to the latter may be kept low, agreement between the two methods is shown. For some ionizing- and Rabi-field strengths without overlap the 2p contribution to the ionization rate can be also observed.

A 12.5 Di 16:30 Poster B

Switching in endohedrals through an external static field
— •Paula Rivière[1], Jan-Michael Rost[1], and Mohammed Madjet[2] — [1]Max-Planck-Institut für Physik komplexer Systeme, Dresden — [2]Institut für Chemie, Freie Universität Berlin

Endohedral fullerenes $M@C_{60}$, where an atom M is trapped inside a hollow fullerene cage C_{60}, have arisen significant interest in the last years, due to their unique properties. For example, the C_{60} cage acts as a Faraday cage protecting the quantum state of the inner atom, which can be useful for future applications. The fullerene also acts as a resonance cage, since collective effects lead to resonances in the photoionization cross sections of encapsulated atoms. The equilibrium position, r_e, of different inner atoms inside the cage has also been studied. However, a future use of endohedrals as stable quantum systems requires a control of the quantum state of the inner atom.

Maybe the simplest way of changing the state of the inner atom is changing its position within the cage. In fact, during illumination of an endohedral with (weak) laser light, the polarization of the electronic cage changes. In response, the inner atom alters its position. We have studied this process within the linear response theory, for $M = Li^+$, Na^+, and K^+. The fullerene is described within DFT, using the jellium model. The effect of polarization on r_e is obtained from the minimum of the potential, which has a repulsion-dispersion contribution and a polarization contribution. A switching process in r_e can be observed as a function of the energy of the external field, with special structures centered at the position of the surface and volume resonances of C_{60}.