A 33: Interaction with strong or short laser pulses III

Time: Thursday 11:00–12:30 Location: B 302

A 33.1 Thu 11:00 B 302

Minicharged particles in a strong laser field — •Villalba-Chavez Selym and Müller Carsten — Institut für Theoretische Physik I, Heinrich-Heine-Universität Düsseldorf, Universitätsstr. 1, 40225 Düsseldorf, Germany

Absorption of photons due to the production of pairs of minicharged particles are investigated in the presence of a high intensity laser. This hypothetical process would induce a tiny rotation of the polarization plane in a linearly polarized probe beam after travelling through the external wave (vacuum dichroism).

The optical theorem is applied to determine the rate and the corresponding rotation angle in terms of the imaginary part of the vacuum polarization tensor. A similar method has been recently applied in the calculation of the photo-production rate of scalar particles in a circularly polarized wave [S. Villalba-Chavez and C. Müller, Phys. Lett. B, in press; arXiv:1208.3595]

High-precision optical experiments would allow to impose bounds on the charge and mass of these hypothetical particles.

A 33.2 Thu 11:15 B 302

Interference Effects in Electron-Positron Pair Creation by the Interaction of a Bichromatic Laser Field and a Nucleus — •Sven Augustin and Carsten Müller — Heinrich-Heine Universität, Düsseldorf

We investigate quantum interferences in electron-positron pair creation in the collision of a relativistic nuclear beam and an intense laser pulse.

In particular, we consider a laser field consisting of two modes with commensurate frequencies. In this situation, quantum path interference may arise which can lead to an increase or a decrease of the total pair production rate. The interference is also visible in angular differential rates which are discussed both in the nuclear rest frame and the laboratory frame.

A 33.3 Thu 11:30 B 302

Decay of autoionizing states in time-dependent density functional and reduced density matrix functional theory — •Varun Kapoor, Martins Brics, and Dieter Bauer — Institut für Physik, Universität Rostock, 18051 Rostock

Autoionizing states are inaccessible to time-dependent density functional theory (TDDFT) using known, adiabatic Kohn-Sham (KS) potentials. We determine the exact KS potential for a numerically exactly solvable model Helium atom interacting with a laser field that is populating an autoionizing state. The exact single-particle density of the population in the autoionizing state corresponds to that of the energetically lowest quasi-stationary state in the exact KS potential. We describe how this exact potential controls the decay by a barrier whose height and width allows for the density to tunnel out and decay with the same rate as in the ab initio time-dependent Schrödinger calculation. However, devising a useful exchange-correlation potential that is capable of governing such a scenario in general and in more complex systems is hopeless. As an improvement over TDDFT, time-dependent reduced density matrix functional theory has been proposed. We are able to obtain for the above described autoionization process the exact time-dependent natural orbitals (i.e., the eigenfunctions of the exact, time-dependent one-body reduced density matrix) and study the potentials that appear in the equations of motion for the natural orbitals and the structure of the two-body density matrix expanded in them.

A 33.4 Thu 11:45 B 302

Near-zero energy electron emission in strong field ionization at long wavelength — •Camus Nicolas[1], Dura Judith[2], Biegert Jens[2], Britz Alexander[2], Thai Alexandre[2], Hemmer Michael[2], Baudish Matthias[2], Ullrich Joachim[1,3], Senftleben Arne[1], and Moshammer Robert[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]ICFO-Institut de Ciences Fotoniques, 08860 Barcelona, Spain — [3]Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

The discovery of surprisingly high yields of low energy electrons in single ionization of atoms and molecules with intense near infra-red laser pulses [1] triggered theoretical [2-4] as well as experimental activities [5,6] in order to complete our understanding of the photo-ionization process. The important role of electron rescattering in the Coulomb potential is a common ingredient of all existing explanations, but a comprehensive description is still missing. Here we report on high-resolution measurements with a Reaction Microscope on ionization of atoms and small molecules using few-cycle long wavelength (3100 nm) laser pulses at high intensity, well in the tunneling regime. Results will be presented and discussed in the framework of already existing measurements and available theoretical models.

[1] Blaga et al, Nature Physics, 2009, 5, 335-338 [2] Liu et al Phys. Rev. Lett., 2010, 105, 113003 [3] Yan et al Phys. Rev. Lett., 2010, 105, 253002 [4] Kastner et al Phys. Rev. Lett., 2012, 108, 033201 [5] Quan, W. et al Phys. Rev. Lett., 2009, 103, 093001 [6] Wu et al Phys. Rev. Lett., 2012, 109, 043001

A 33.5 Thu 12:00 B 302

Emergence of sub-1.5-cycle pulses from a single filament — •Martin Kretschmar[1,2], Daniel S. Steingrube[1,2], Dominik Hoff[3], Emilia Schulz[1,2], Peter Hansinger[3], Thomas Binhammer[4], Gerhard G. Paulus[3], Uwe Morgner[1,2], and Milutin Kovacev[1,2] — [1]Leibniz Universität Hannover, Institut für Quantenoptik, Welfengarten 1, D-30167 Hannover, Germany — [2]QUEST, Centre for Quantum Engineering and Space-Time Research, Welfengarten 1, D-30167 Hannover, Germany — [3]Friedrich-Schiller-Universität Jena, Institut für Optik und Quantenelektronik, Max-Wien-Platz 1, D-07743 Jena, Germany — [4]VENTEON Laser Technologies GmbH, D-30827 Garbsen, Germany

Filamentation has become a versatile tool for pulse shortening, making it applicable in attosecond science. Complex spatio-temporal dynamics taking place during the filamentation process strongly influence the propagating pulse, leading to few-cycle pulse generation as well as high-order harmonic generation directly inside the filament. Temporal dynamics of ultrashort laser pulses undergoing filamentary propagation are determined with a stereographic above-threshold ionization (ATI) phasemeter. The setup is capable of measuring the pulse duration as well as CEO-phase contributions of pulses originating from a fs-filament. We observe the formation of few-cycle pulses as well as temporal pulse splitting dynamics along the propagation direction of the filament. We demonstrate a pulse measurement of 3.8 fs duration, corresponding to sub-1.5 cycles of the electric field, emerging from a single fully propagated filament.

A 33.6 Thu 12:15 B 302

Measurement of the Gouy phase shift in two-color laser pulses — •Robert Irsig, Johannes Passig, Josef Tiggesbäumker, Thomas Fennel, and Karl-Heinz Meiwes-Broer — Insitut für Physik, Universität Rostock, Universitätsplatz 3, 18051 Rostock

The Gouy effect is well known as a phase shift of π of the electric field passing a focus region. In recent years, the Gouy effect was investigated using few cycle laser pulses to ionise rare gas atoms, taking benefit of the strong asymetric field distribution [1,2]. Depending on the phase of the laser pulses, electron spectra show a characteristic behaviour in energy distribution and emission direction. That allows for an absolute phase reconstruction. In contrast to few cycle experiments, we present first phase-depending measurements using intense two-color laser pulses of 150 fs (FWHM). By varying the phase-shift in between first and second harmonic, one can synthesise asymetric light fields which enables to controll electron emission. A home-build stereo-time-of-flight-spectrometer is used to simultaneous detect the electrons emitted in opposite directions with respect to the laser polarisation axis. By applying a focus scan, we can directly map the Gouy phase shift along the propagation direction in the electron spectra.

[1] Lindner et. al., Phys. Rev. Lett 92, 113001 (2004)
[2] Shivaram et. al., Optics Letters 35, 3312 (2010)