A 31: Attosecond physics

Time: Wednesday 16:30–19:00 Location: Empore Lichthof

A 31.1 Wed 16:30 Empore Lichthof

Tunneling time in attosecond experiments, strong field and ultra-fast science — •Ossama Kullie — Theoretical physics, institute for physics, university of Kassel, Germany.

I present a theoretical model of the tunneling time and the tunneling process in attosecond and strong field experiments, leading to a relation which performs an excellent estimation for the tunneling time, where we address the important case of the He-atom [2]. The tunneling time is also featured as the time of passage similar to the Einstein's photon box Gedanken experiment (EPGE), and our model can be seen as a realization of the EPGE. Our work tackles an important case study for the theory of time in quantum mechanics, and is very promising for the search for a (general) time operator in quantum mechanics. The work can be seen as a new fundamental step in dealing with the tunneling time in strong field and ultra-fast science, and is appealing for more elaborate treatments using quantum wave packet dynamics and especially for complex atoms and molecules. [1] O. Kullie, Phys. Rev. A, (2015) accepted. arXiv:1505.03400v2. [2] Eckle et al. Science. 322, 1525 (2008).

A 31.2 Wed 16:30 Empore Lichthof

Time delay in photoionization with light carrying orbital angular momentum — •Jonas Wätzel and Jamal Berakdar — Institut für Physik, Martin-Luther Universität Halle-Wittenberg, Karl-Freiherr-von-Fritsch-Str. 3, 06120 Halle/Saale

The experiment of Schulze et al. on time delay in photoemission triggered large experimental and theoretical activities with the aim to understand and quantitatively reproduce the results of the measurements. Up to date various mechanisms and calculation techniques were put forward but some differences between theory and experiment remain, calling for further investigation to understand this effect.

To add yet a new aspect to this issue we consider using a twisted light beam, also called optical vortex. Such a beam has a phase singularity at its centre and carries orbital angular momentum (OAM), characterized by the topological charge, which can be transferred to the electron. The usage of OAM light leads to a complete new set of selection rules because the magnetic quantum number m is not preserved and they are directly determined by the choice of the topological charge.

We present results of calculations of the atomic time of the photoionization process of the argon 3p subshell initiated by a twisted light XUV pulse. We show that in different directions either the co-rotating electron (relative to the field) or the counter rotating electron dominates photoionization amplitude. Furthermore the corresponding time delays are completely different. Therefore, the time delay represents an interesting measure to identify the origin of the photoelectron with respect to the initial magnetic (sub-)state.

A 31.3 Wed 16:30 Empore Lichthof

A Figure of Merit for Ionization during HHG — •Heiko G. Kurz[1,2], Martin Kretschmar[1,2], Tamas Nagy[1], Detlev Ristau[1,2,3], Manfred Lein[2,4], Uwe Morgner[1,2,3], and Milutin Kovacev[1,2] — [1]Leibniz Universität Hannover, Institut für Quantenoptik, Welfengarten 1, Hannover — [2]QUEST, Centre for Quantum Engineering and Space-Time Research, Welfengarten 1, Hannover — [3]Laser Zentrum Hannover e.V., Hollerithallee 8, Hannover — [4]Leibniz Universität Hannover, Institut für theoretische Physik, Appelstrasse 2, Hannover

We study the impact of an ionized background medium onto HHG in an in-situ pump-probe experiment by using high-density liquid water droplets as a target. By increasing the intensity of the pump pulse, ionization within the target is enhanced. A second, time-delayed probe pulse is used to generate harmonic radiation. A medium consisting of ions which surround the electron-ion couple during HHG therein can critically influence the electronic trajectories along their excursion in the continuum since the ionic Coulomb field may deflect the electron in a way, that the recombination process is inhibited. In combination with numerical simulations, our measurements allow us to develop a figure of merit for ionization within the macroscopic target.