A 7: Attosecond physics

Time: Tuesday 16:30–18:30 Location: P

A 7.1 Tue 16:30 P

Time Delay and Nonadiabatic Calibration of the Attoclock — •Ossama Kullie — University of Kassel

The measurement of the tunneling time in attosecond experiments, termed attoclock, triggered a hot debate about the tunneling time, the role of time in quantum mechanics and the separation of the interaction with the laser pulse into two regimes of a different character, the multiphoton and the tunneling (field-) ionization. In the adiabatic field calibration, we showed in earlier works [1] that our real tunneling time approach fits well to the experimental data of the attoclock. In the present work [2], we show that our model can explain the experimental results in the nonadiabatic field calibration, where we reach a good agreement with the experimental data of Hofmann et al. (J. of Mod. Opt. **66**, 1052, 2019). Moreover, our result is confirmed by the numerical integration of the time-dependent Schrödinger equation of Ivanov et al. (Phys. Rev. A **89**, 021402, 2014). Our model is appealing because it offers a clear picture of the multiphoton and tunneling parts. In the nonadiabatic case, the barrier region itself is mainly driven by multiphoton absorption, where the number of the absorbed photons to be characterized by the barrier height. Surprisingly, at a field strength $F < F_a$ (the atomic field strength) the model always indicates a time delay with respect to the lower quantum limit at $F = F_a$. [1] O. Kullie, PRA **92**, 052118 (2015), J. Phys. B 49 , 095601 (2016). [2] O. Kullie, submitted .... (2021), arXiv:2005.09938.

A 7.2 Tue 16:30 P

Signatures and Scaling of the Strong-Field Ionization Response in Low-Order Harmonic Generation — •Benjamin Liewehr[1], Björn Kruse[1], Christian Peltz[1] und Thomas Fennel[1,2] — [1]Institute for Physics, University of Rostock, Albert-Einstein-Str. 23, D-18059, Rostock, Germany — [2]Max-Born-Institute for Nonlinear Optics and Short Pulse Spectroscopy, Max-Born-Strasse 2A, D-12489 Berlin, Germany

The notion of nonlinear response in dielectric solids has been successfully extended to the strong field ionization regime by linking high-order harmonic generation (HHG) to Bloch oscillations and interband recombination [1,2]. Recently, however, it was shown that these mechanisms cannot explain the emission of low harmonic orders which, instead, are generated by the strong field tunneling excitation that drives Brunel [3] and injection currents. While the tunneling injection current has been identified as the dominant mechanism close to the damage threshold [4], it is so far not known to which extent information about the transient excitation is imprinted on emitted low-order harmonics. Employing an ionization-radiation model, we examine the scaling behavior of ionization induced low-order harmonics and discuss mechanisim specific signatures for different polarization configurations.

[1] T. T. Luu, et al. Nature **521**, 498 (2015)
[2] G. Vampa, et al. Nature **522**, 462 (2015)
[3] F. Brunel, J. Opt. Soc. Am. B **4**, 521 (1990)
[4] P. Jürgens, B. Liewehr, B. Kruse, et al. Nat. Phys. **16**, 1035 (2020)

A 7.3 Tue 16:30 P

Classical model for collisional delays in attosecond streaking at solids — •Elisabeth A. Herzig[1], Lennart Seiffert[1], and Thomas Fennel[1,2] — [1]Universität Rostock — [2]MBI Berlin

Scattering of electrons in solids is at the heart of laser nanomachining, light-driven electronics, and radiation damage. Accurate theoretical predictions of the underlying dynamics require precise knowledge of low-energy electron transport involving elastic and inelastic collisions. Recently, real-time access to electron scattering in dielectric nanoparticles via attosecond streaking has been reported [1,2]. Semiclassical transport simulations [3] enabled to identify that the presence of the field inside of a dielectric nanosphere cancels the influence of elastic scattering, enabling selective characterization of the inelastic scattering time [1]. However, so far a clear picture of the underlying physics was lacking. Here, we present an intuitive classical model for the prediction of collision-induced contributions to the delays in attosecond streaking at solids.

[1] L. Seiffert et al., Nat. Phys. **13**, 766-770 (2017)
[2] Q. Liu et al., J. Opt. **20**, 024002 (2018)
[3] F. Süßmann et al., Nat. Commun. **6**, 7944 (2015)

A 7.4 Tue 16:30 P

Chiral imaging with twisted photoelectrons — Xavier Barcons[1], Andrés Ordonez[1], Maciej Lewenstein[1], and •Andrew Maxwell[1,2] — [1]ICFO - Institut de Ciencies Fotoniques, Av. Carl Friedrich Gauss 3, 08860 Castelldefels (Barcelona), Spain — [2]Department of Physics and Astronomy, Aarhus University, DK-8000 Aarhus C, Denmark

The orbital angular momentum (OAM) of a free particle is a quantized observable leading to a rotating vortex wave. *Twisted* light and electrons have huge potential in imaging of matter in attosecond physics. Much attention has been devoted to the OAM of light fields, but in this work we will focus on the less-studied photoelectron OAM (PEOAM), exploring the great potential to image chiral matter.

In previous work, we developed an adapted version of the well-known strong-field approximation (SFA), to derive strong-field conservation laws for the OAM twisted electrons. This was exploited, in other work, to provide an alternative interpretation on existing experimental work of vortex interferences caused by strong field ionization.

Now we investigate the ability to probe chiral states with PEOAM. Exploiting a construction of chiral states from hydrogenic orbitals, allows an analytical and numerical demonstration of how chirality is encoded in the PEOAM. We will show, that asymmetries maybe observed in the OAM resolved photoelectron momentum distributions for strong-field ionization via a *linearly* polarized field. Thus, paving the way for a new kind of chiral specific imaging technique that, unlike photoelectron circular dichroism, may use linear fields.