A 8: Attosecond Science II

Time: Monday 14:00–15:45 Location: K 1.011

Invited Talk A 8.1 Mon 14:00 K 1.011

Attosecond timing with spectral resolution near resonances, and new opportunities with high-repetition rate attosecond sources — •Anne Harth — Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland

To directly observe the ultrafast motion of electrons in atomic or molecular systems is an aspect of fundamental physics and is achievable thanks to the generation of attosecond pulses in the XUV spectral range, whereby attosecond pulse trains play by no means a less important role than single isolated attosecond pulses. A key advantage of using pulse trains is the high spectral resolution, while high temporal resolution is still retained [1]. In this talk we will provide an overview of attosecond measurements using attosecond pulse trains near resonances; the role of continuum-continuum transition in attosecond time delay measurement will be discussed within a perturbative approach.

Furthermore, we will discuss the present achievements and future steps towards high-repetition rate attosecond experiments based on optical parametric amplifier systems driving high-order harmonic generation [2]. Experiments involving e.g. double photoionisation dynamics of atoms or complex molecules, which require so-called kinematically complete measurements of all charged fragments [3], greatly benefit from high-repetition rate attosecond sources.

[1] Isinger et al. Science 358, 893 (2017)
[2] Harth et al. Journal of Optics 20, 014007 (2018)
[3] Ullrich et al. Reports on Progress in Physics 66, 1463 (2003)

Invited Talk A 8.2 Mon 14:30 K 1.011

Towards attosecond pump-probe experiments at high repetition rates — •Tobias Witting[1], Federico Furch[1], Felix Schell[1], Peter Susnjar[1], Carmen Menoni[2], Chih-Hsuan Lu[3], Andy Kung[3], Claus-Peter Schulz[1], and Marc J.J. Vrakking[1] — [1]Max-Born-Institut, Max-Born-Strasse 2A, D-12489 Berlin — [2]Department of Electrical and Computer Engineering, Colorado State University, Fort Collins, CO 80523, USA — [3]Institute of Photonics Technologies, National Tsing Hua University, Hsincho 30013, Taiwan

Our aim is to perform attosecond pump probe experiments with coincidence detection of photoelectrons and -ions in a reaction microscope. To increase the data-rates we have recently developed a NOPA based OPCPA laser system providing 190 uJ laser pulses at 100 kHz repetition rate [1]. Here we discuss the laser system, pulse compression to near single-cycle duration, and spatio-temporal pulse characterization. We show high harmonic generation up to 50 eV driven by sub-3-cycle CEP stable laser pulses at 100 kHz. We discuss our recent progress towards a complete attosecond pump-probe beamline coupled to a reaction microsocpe (COLTRIMS).

[1] F.J. Furch, T. Witting, A. Giree, C. Luan, F. Schell, G. Arisholm, C.P. Schulz, and M.J.J. Vrakking. Optics Letters 42, no. 13 (2017)

A 8.3 Mon 15:00 K 1.011

Ultrafast CEP detection and control in real-time on an every single shot basis — •Dominik Hoff[1], Federico Furch[2], Daniel Adolph[1], Tobias Witting[2], Klaus Rühle[1], A. Max Sayler[1], Claus P. Schulz[2], Gerhard G. Paulus[1], and Marc J. J. Vrakking[2] — [1]Helmholtz-Institut Jena and Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, D-07743 Jena, Germany. — [2]Max-Born-Institute, Max-Born-Straße 2a, 12489 Berlin, Germany

With the emergence of high repetition rate few-cycle laser pulse amplifiers, e.g. for high-harmonic generation and the investigation of rare events in atomic and molecular science, the need for fast carrier-envelope phase (CEP) detection and control has arisen [1]. Here, we demonstrate an ultrafast detection and feedback scheme based on a stereo above-threshold ionization time-of-flight spectrometer (stereo ATI) capable of detecting the CEP and pulse duration at a repetition rate of up to 400 kHz [2]. It is applied to a 100 kHz, 200 μJ pulse energy NOPA laser system that is seeded by a Ti:Sa oscillator [3].

[1] Hädrich, S. et al, Opt. Lett. 41, 18, 4332 (2016)
[2] Sayler A.M. et al, Opt. Lett. Vol. 36, No. 1, 2011
[3] Furch F. et al, Opt. Lett. Vol. 42, No. 13, 2017

A 8.4 Mon 15:15 K 1.011

Tunneling exit characteristics from classical backpropagation of an ionized electron wave packet — •Hongcheng Ni, Ulf Saalmann, and Jan-Michael Rost — Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden, Germany

We investigate tunneling ionization of a single active electron with a strong and short laser pulse, circularly polarized. With the recently proposed backpropagation method, we can compare different criteria for the tunnel exit as well as popular approximations in strong-field physics on the same footing. Thereby, we trace back discrepancies in the literature regarding the tunneling time to inconsistent tunneling exit criteria. The main source of error is the use of a static ionization potential, which is, however, time dependent for a short laser pulse. A vanishing velocity in the instantaneous field direction as tunneling exit criterion offers a consistent alternative, since it does not require the knowledge of the instantaneous binding energy. Finally, we propose a mapping technique that links observables from attoclock experiments to the intrinsic tunneling exit time.

A 8.5 Mon 15:30 K 1.011

Tunneling time in attosecond experiment, a theoretical model with a comparison for H-atom — •Ossama Kullie — University of Kassel, Fachbereich 10, Heinrichplett str. 41, 34132 Kasel

Tunneling and tunneling time are hot debated and very interesting due to their fundamental role in the quantum mechanics. The measurement of the tunneling time in today's attosecond and strong field (low-frequency) experiments, despite its controversial discussion, it offers a fruitful opportunity to understand time measurement and the time in quantum mechanics. In [1, 2] we suggested a model and derived a simple relation to calculate the real tunneling time, to calculate the real tunneling time. In this work [3] we discuss and analyze the model against an experimental result for H-atom obtained recently by Sainadh et al [4]. For H-atom the model shows a good agreement with the experimental result as previously for He-atom [1]. However there are crucial points for higher intensities, in particular where the electric field strength is higher than the atomic filed strength, we will discuss this for the case of H-atom. [1] O. Kullie, Phys. Rev. 92, 052118 (2015). [2] O. Kullie, J. Phys. B49, 095601 (2016). [3] O. Kullie, Phys. Rev. A, under review (2017). [4] U. Satya Sainadh et al arxiv:1707.05445, 2017.