A 25: Attosecond Physics II (joint session A/MO)

Time: Thursday 11:00–12:30 Location: GrHS Mathe

Invited Talk A 25.1 Thu 11:00 GrHS Mathe

Circular Dichroic Attosecond Transient Absorption Spectroscopy — •Lauren Drescher[1,2], Nicola Mayer[2,3], Kylie Gannan[1], Jonah Adelman[1], and Stephen Leone[1] — [1]Department of Chemistry, University of California, Berkeley, California 94720, USA — [2]Max-Born-Institut, Max-Born-Str. 2A, 12489, Berlin, Germany — [3]Attosecond Quantum Physics Laboratory, Department of Physics, King's College London, Strand, London, WC2R 2LS, United Kingdom

The angular momentum of light couples to matter via the total angular momentum. By limiting possible orbital angular momentum states, circular polarized light can be used to enact spin-specificity onto the optical excitation of matter, even within isotropic media. We leverage this effect in our method of circular dichroic attosecond transient absorption spectroscopy to prepare and measure spin-specific coupling with attosecond temporal precision. This principle is demonstrated using co- and counter-rotating two-color excitation of helium Rydberg states, showing the effect of dipole selection and propensity rules in the selective excitation of spin-specific states. Our methods allows to study the dynamic of spin-specific excitations and gives insight into the orbital character of excited states through their interaction with circular polarized two-color fields. Furthermore we demonstrate that, given a known model system, our method allows to measure the polarization state of attosecond extreme ultraviolet (XUV) pulses in-situ and in an all-optical setup.

A 25.2 Thu 11:30 GrHS Mathe

Attosecond Photon Diagnostics at Flash - A Dedicated Angular Streaking Beamline — •Lasse Wülfing[1], Lars Funke[1], Thorsten Otto[2], Sara Savio[1], Niclas Wieland[3], Markus Ilchen[3], and Wolfram Helml[1] — [1]Technische Universität Dortmund, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [3]Universität Hamburg, Germany

The established scheme of angular streaking can characterize the temporal and spectral information of ultrashort X-ray pulses non-invasively. This is done by overlapping the pulses with a circularly polarized IR laser in a gaseous target and measuring the resulting angle dependent photo electron spectra with so called *Cookiebox*-type detectors.

We developed a new detector with optimized electron time of flight spectrometers for increased energy resolution and better overall performance. This experiment will be installed at a new diagnostics beamline at Flash 2 for a dedicated angular streaking setup.

We present an overall rundown of the experimental method and the new setup.

A 25.3 Thu 11:45 GrHS Mathe

In Search of Lost Tunneling Time — •Pablo Maier[1], Serguei Patchkovskii[1], Misha Ivanov[1,2,3], and Olga Smirnova[1,4] — [1]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Max-Born-Straße 2A, 12489 Berlin, Germany — [2]Humboldt-Universität zu Berlin, Unter den Linden 6, 10117 Berlin, Germany — [3]Solid State Institute and Physics Department, Technion, Haifa, 32000, Israel — [4]Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany

The measurement of tunneling times in strong-field ionization has been the topic of much controversy in recent years, with the attoclock and Larmor clock being two of the main contenders for correctly reproducing these times. By expressing the attoclock as the weak value of temporal delay, we extend its meaning beyond the traditional setup. This allows us to calculate the attoclock time for a static one-dimensional tunneling model consisting of a binding delta potential and a constant electric field. We apply the Steinberg weak-value interpretation of the Larmor clock. Using this definition, we obtain the position-resolved time density during tunnel ionization, yielding a non-zero Larmor tunneling time. Our model allows us to derive the analogue of the position-resolved attoclock tunneling time. While non-zero at the tunnel exit, it vanishes at the detector, far away from the atom. Formally, this means that the attoclock does not measure the Larmor time, but instead a time closely related to the phase time.

A 25.4 Thu 12:00 GrHS Mathe

attosecond coherent control using nonlinear processes driven by a seeded FEL — •Sooraj R.S[1], Ioannis Makos[1], Michele Di Fraia[2], Oksana Plekan[2], Praveen Maroju[3], David Busto[3], S Hartweg[1], David Garzella[2], Kevin Prince[2], A Demidovich[2], Johan Mauritsson[3], Marvin Schmoll[1], Aaron Ngai[1], R Moshammer[4], C Medina[4], Muwaffaq Mourtada[4], T Pfeifer[4], Tamas Csizmadia[5], Debobrata Rajak[5], Klemen Bucar[6], Andrej Mihelic[6], Matjaz Zitnik[6], Uwe Thumm[8], Fernando M Garcia[7], Carlo Callegari[2], Elena Gryzlova[1], and Giuseppe Sansone[1] — [1]Albert Ludwigs Universität Freiburg,Germany — [2]Elettra Sincrotrone Trieste,Italy — [3]Lund University, Sweden — [4]MPI für Kernphysik Heidelberg,Germany — [5]ELI ALPS , Hungary — [6]Jožef Stefan Institute,Slovenia — [7]Universidad Autónoma de Madrid,Spain — [8]Kansas State University, USA

In this study, we investigate interference between two coherent pathways in two-photon double ionization (TPDI) of Ar, mediated by the $3s3p^65p$ and $3s3p^66p$[1] states, and in N_2 through the Hopfield resonances $3d\sigma_g$ and $3d\pi_g$[2]. Using phase-controlled XUV radiation from FEL FERMI, we record photoelectron spectra from TPDI to study how intermediate resonances affect the contrast and phase of oscillations from two nonlinear-coherent paths.This study highlights the critical role of intermediate resonances in controlling the interference dynamics of multiphoton ionization processes.[1] Elena V G et al. In: The Eu Phy Jo D 73 (2019)[2] M Reduzzi et al. In: Jo of Phy B:AMO Physics 49.6 (2016)

A 25.5 Thu 12:15 GrHS Mathe

A rigorous and universal approach for highly-oscillatory integrals in attosecond science — •Anne Weber[1], Job Feldbrugge[2], and Emilio Pisanty[1] — [1]Attosecond Quantum Physics Laboratory, King's College London, WC2R2LS London, UK — [2]Higgs Centre for Theoretical Physics, University of Edinburgh, UK

Light-matter interactions within the strong-field regime, such as high-harmonic generation, typically give rise to highly-oscillatory integrals, which are often solved using saddle-point methods. Not only do these methods promise a much faster computation, but they also inform a more intuitive understanding of the process in terms of quantum orbits, as the saddle points correspond to interfering quantum trajectories (think Feynman's path integral formalism). Despite these advantages, a sound understanding of how to apply saddle-point methods to highly-oscillatory integrals in a rigorous way, and with algorithms which work uniformly for arbitrary configurations and laser drivers, remains lacking. This hinders our ability to keep up with state-of-the-art experimental setups which increasingly rely on tightly-controlled laser waveforms. Here, I will introduce the key ideas of Picard-Lefschetz theory – the foundation of all saddle-point methods – and their implementation. Using high-harmonic generation and above-threshold ionisation as examples, I will show how those ideas provide a robust framework for the fast computation of integrals, as well as a widely-applicable algorithm to derive the relevant semiclassical quantum orbits that underlie the physical processes.