K 3: Light and Radiation Sources I

Time: Monday 17:00–18:30 Location: HS XI ITW

Invited Talk K 3.1 Mon 17:00 HS XI ITW

Quantenphysik, klassische Physik und Realität — •Alfred Eichhorn — Weil am Rhein

Die klassische Physik hat sich als ein sehr mächtiges und erfolgreiches Instrument zur Beschreibung der Natur erwiesen. Sie entspricht weitgehend unserem menschlichen Vorstellungsvermögen. Es hat sich aber gezeigt, dass die klassische Physik nicht ausreicht, um die Natur vollständig zu beschreiben. Es handelt sich um ein im Gödelschen Sinne abgeschlossenes und somit unvollständiges System. Die Quantentheorie gestattet die Beschreibung von Phänomenen, die sich im Rahmen der klassischen Physik nicht mehr beschreiben lassen. Sie stellt ein übergeordnetes System dar, das aber nicht mehr unserem Vorstellungsvermögen entspricht. Intuitiv gehen wir jedoch weiterhin davon aus, die Realität mit Hilfe der klassischen Größen beschreiben zu können. Wenn wir eine solche Größe messen, setzen wir voraus, dass diese Größe eine Eigenschaft des Systems ist, an dem wir die Messung durchführen. Im Grunde erzeugen wir dabei eine Projektion der Realität auf die Ebene der klassischen Physik, d.h. auf die Ebene unseres Vorstellungsvermögens. Ebenso erzeugen wir, wenn wir aus einer Wellenfunktion den Erwartungswert für eine klassische Größe bestimmen, eine Projektion der Wellenfunktion auf die Ebene der klassischen Physik, wobei die Observable, die die klassische Größe repräsentiert, die Art der Projektion bestimmt. Durch eine solche Projektion werden bestimmte Aspekte hervorgehoben, andere vernachlässigt, was zu einer unvollständigen Beschreibung des Gesamtsystems - einer Unschärfe - führt. In diesem Beitrag soll diese Überlegung näher ausgeführt werden.

K 3.2 Mon 17:30 HS XI ITW

Investigating Photoionization Delays with an Attosecond Source Synchronized with an Infrared OPA — •Muhammad Jahanzeb[1], Marvin Schmoll[1], Narendra Shah Ronak[1], Cristian Manzoni[2], and Giuseppe Sansone[1] — [1]Institute of Physics, University of Freiburg, Freiburg, Germany — [2]Institute for Photonics and Nanotechnology - CNR Piazza Leonardo da Vinci 32, 20133 Milano, Italy

The precise measurement of photoionization delays on attosecond timescales is critical to understanding ultrafast electron dynamics in atoms and molecules. The Reconstruction of Attosecond Beating by Interference of Two-Photon Transitions (RABBIT) technique provides a powerful tool to probe these delays [1-2].

We present an experimental setup in development design to investigate continuum-continuum delays in photoionization using synchronized attosecond extreme ultraviolet (XUV) and infrared (IR) pulses. High-order harmonics are generated by an 800 nm driving laser to produce attosecond XUV pulses, which are then combined with a precisely synchronized 1200 nm pulse from a non-collinear optical parametric amplifier (OPA). This setup enables the generation of two sidebands between photoelectron peaks caused by the absorption of single XUV photons. By analyzing the phase oscillations of adjacent sidebands, we aim to disentangle the contribution of continuum-continuum phases in the photoionization process. [1] Paul et al, Science, 292 (2001) [2] Dahlström et al, Journal of Physics, 45 (2012)

K 3.3 Mon 17:45 HS XI ITW

Coherent control of electron emission direction in helium with ω-2ω SASE FEL pulses — •Muwaffaq Ali Mourtada[1], Harijyoti Mandal[1], Hannes Lindenblatt[1], Florian Trost[1], Gergana D. Borisova[1], Alexander Magunia[1], Weiyu Zhang[1], Yu He[1], Lina Hedewig[1], Cristian Medina[1], Arikta Saha[1], Marc Rebholz[1], Ulrike Frühling[2], Carlo Kleine[1], Steffen Palutke[2], Evgeny Schneidmiller[2], Mikhail Yurkov[2], Stefan Düsterer[2], Rolf Treusch[2], Chris H. Greene[3], Yimeng Wang[3], Robert Moshammer[1], Christian Ott[1], and Thomas Pfeifer[1] — [1]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany — [2]Deutsches Elektronen Synchrotron DESY, 22607 Hamburg, Germany — [3]Purdue University, West Lafayette, IN 47907, USA

We demonstrate the stability of the phase between ω-2ω in an unseeded SASE FEL at FLASH (DESY). Using a two-photon process driven by the fundamental and a one-photon process driven by the 2nd harmonic, we show that the observed asymmetry in photoelectron emission direction confirms this phase stability. Building on [1], we extend a phenomenon previously observed only in seeded FELs [2, 3]. Phase control is achieved by introducing a refractive medium into the beam path. A photon energy scan near the helium 1s2p resonance reveals a sign flip in asymmetry, consistent with prior studies [3-5]. Stronger asymmetries are observed for pulses with higher spectral correlation. [1] Straub et.al.PRL.129. [2] Prince et.al. Nature Photonics,2016 [3] DiFraia et.al. PRL.123 [4] Wang et.al. Phys. Rev.103:053118, 2021 [5] Ishikawa et.al. Appl. Sci. 2013, 3, 189-213

K 3.4 Mon 18:00 HS XI ITW

Towards a High Repetition-Rate, High Power, High Harmonic Generation Setup for Time-resolved Molecular Spectroscopy — •Lorenzo Pratolli[1,3], Katinka Horn[1,2], Vincent Wanie[1], Terry Mullins[1], Luca Poletto[4], Fabio Frassetto[4], and Francesca Calegari[1] — [1]Center for Free-Electron Laser Science, Hamburg, Germany — [2]ETH Zürich, Zürich, Switzerland — [3]HELIOS, Hamburg, Germany — [4]Universita di Padova, Padova, Italy

High-Harmonic Generation (HHG) is a process that allows to generate extreme ultraviolet (XUV) light pulses with attosecond duration through intense optical fields and has been widely employed for ultrafast time-resolved molecular spectroscopy. Scaling the collection statistics is a challenge to which Yb fibre lasers provide a convenient solution thanks to their high repetition-rate operation. Multi-Pass Cells (MPCs) have emerged as an appealing solution to address the primary issue of these systems, their relatively long pulse duration. These cells can compress pulses from several hundred femtoseconds to durations below 20 femtoseconds, while maintaining over 90% efficiency, a compact setup, and excellent beam quality. Here we present the development of a setup for HHG at high repetition-rates driven by compressed pulses from an MPC, which can also be used for ultrafast UV generation. The setup will carry out pump-probe measurements of biomolecules in water clusters, using XUV-near infrared (NIR) interaction. The setup features also a time-compensating monochromator, with possibility to switch between monochromatic and broadband operation dynamically.

K 3.5 Mon 18:15 HS XI ITW

Resonantly Enhanced Frequency Conversion at High Intensities towards the Vacuum Ultraviolet — •Marietta Coelle, Oskar Ernst, and Thomas Halfmann — Technische Universität Darmstadt

Vacuum Ultraviolet (VUV) light is of big interest for a variety of applications like lithography, attosecond physics or spectroscopy. One approach to generate coherent VUV is the nonlinear frequency upconversion of visible light provided by pulsed laser sources in noble gases. Due to low particle densities and higher order nonlinearity, the conversion efficiencies are generally small. This can be counteracted by increasing the laser intensity as well as by increasing the nonlinear susceptibility when using multi-photon resonances. However, high-power laser systems mostly have a fixed wavelength why it is difficult to find suitable resonances. At intensities above TW/cm^2, additionally, AC stark shifts alter the atomic level structure significantly. We present a way to make use of these shifts. Coupling an additional control transition gives rise to large, intensity-dependent Autler-Townes splittings and by adjusting the control laser intensity, the resonance of the atom can then be shifted towards the frequency of an initially off-resonant multi-photon transition. Specifically, we present a coupling scheme in xenon which only uses one single, fixed-frequency laser, paving the way to efficiently generate VUV light of 100 to 130 nm with compact, fixed-frequency, high-power laser systems.