A 10: Interaction with VUV and X-ray light

Time: Tuesday 16:30–18:30 Location: P

A 10.1 Tue 16:30 P

Towards X-Ray Ramsey Interferometry using Nuclear Resonant Scattering — •Lukas Wolff and Jörg Evers — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Nonlinear spectroscopic techniques such as multidimensional spectroscopy or pump-probe spectroscopy have become indispensable tools for probing ultrafast dynamics of quantum systems in the optical and infrared regime. In contrast, precise control of timing and phase properties of light pulses in the X-ray and XUV-regime still remains challenging due to the properties of available coherent X-ray sources and optics. In the hard X-ray regime, Mößbauer nuclei featuring exceptionally narrow resonances can be employed to split light from modern high-brilliance coherent x-ray sources into double-pulses with characteristic spectral features. High-precision control of the relative phase between these double-pulses was demonstrated recently using fast mechanical motion of nuclear targets.

Here, we explore the possibility of using X-ray double-pulses created with Mößbauer nuclei to implement Ramsey interferometry in the low-excitation regime of nuclear resonant scattering. Our findings may help to pave the way towards multi-pulse control and probe schemes in the hard X-ray regime.

A 10.2 Tue 16:30 P

Fast resonant adaptive x-ray optics via mechanically-induced refractive-index enhancements — •Miriam Gerharz and Jörg Evers — Max-Planck-Institut für Kernphysik, Heidelberg

In this project we introduce a concept for fast resonant adaptive x-ray optics. Using piezo-control methods, we can displace a solid-state target much faster than the lifetime of its resonances. Because in nuclear forward scattering the interference of the sample response with the prompt pulse (fs-ps long) is crucial, the displacement induces a phase shift. This mechanically induced phase shift can be associated with an additional contribution on resonance to the real part of the refractive index while the imaginary part remains unchanged. Hence, we can achieve polarization control by mechanically-induced birefringence without changes in absorption. We demonstrate the approach with two examples: the conversion from linear polarization as often provided by synchrotrons to circular polarization and the rotation of linear polarization, which together with a polarimeter can be used for switching within a single experimental cycle.

A 10.3 Tue 16:30 P

Comprehensive investigation of nondipole effects in photoionization of the He 1*s* and Ne 2*s* shells — •Ticia Buhr[1], Levente Ábrók[2], Alfred Müller[1], Stefan Schippers[1], Ákos Kövér[2], and Sándor Ricz[2] — [1]Justus-Liebig-Universität Gießen, Giessen, Germany — [2]Institute for Nuclear Research, Debrecen, Hungary

Nondipole effects strongly modify the polar- and azimuthal-angle dependence of the double differential cross section of the photoelectron emission [1]. In order to study these effects in detail, angular distributions of He 1*s* and Ne 2*s* photoelectrons were measured over wide ranges of the polar and azimuthal angles covering a solid angle of about 2π at 100 eV and 200 eV photon energies using linearly polarized synchrotron radiation. The photoelectrons were detected with an ESA-22-type electrostatic electron spectrometer [2] in in-plane and in out-of-plane geometry as determined by the photon momentum and polarization vectors. The observed difference between the experimental and theoretical angular distributions might be explained by the neglected terms in the calculation [1].

[1] A. Derevianko *et al.*, At. Data Nucl. Data Tables **73**, 153 (1999).
[2] L. Ábrók *et al.*, Nucl. Instrum. Methods B **369**, 24 (2016).

A 10.4 Tue 16:30 P

Inner-shell-ionization-induced femtosecond structural dynamics of water molecules imaged at an x-ray free-electron laser — •Ludger Inhester[1], Till Jahnke[2], Renaud Guillemin[3], and Maria Novella Piancastelli[3,4] — [1]Center for Free-Electron Laser Science, DESY, Hamburg, Germany — [2]European XFEL GmbH, Schenefeld, Germany — [3]Sorbonne Université, CNRS, LCPMR, Paris, France — [4]Uppsala University, Uppsala, Sweden

Further co-authors are given on the poster

We have exposed isolated water molecules to short x-ray pulses from a free-electron laser and detected momenta of all produced ions in coincidence. By combining experimental results and theoretical modeling, we can image the dissociation dynamics of water after core-shell ionization and subsequent Auger decay in unprecedented detail and uncover fundamental dynamical patterns relevant for the radiation damage in aqueous environments.