A 33: Interaction with VUV and X-Ray Light II

Zeit: Donnerstag 16:30–18:30 Raum: VMP 8 R208

Fachvortrag A 33.1 Do 16:30 VMP 8 R208

Lichtfeldgetriebene Röntgen-Streak-Kamera zur Messung der Zeitstruktur einzelner XUV-Pulse am FLASH — •Ulrike Frühling[1], Marek Wieland[2], Michael Gensch[1], Thomas Gebert[2], Bernd Schütte[2], Maria Krikunova[2], Roland Kalms[2], Filip Budzyn[2], Oliver Grimm[2,3], Jörg Rossbach[2], Elke Plönjes[1] und Markus Drescher[2] — [1]Desy, Hamburg — [2]Uni HH, Hamburg — [3]ETH Zürich, Institut für Teilchenphysik

Der Freie-Elektronen-Laser in Hamburg (FLASH) erzeugt durch selbstverstärkte spontane Emission (SASE) hochintensive kurze XUV-Pulse. Dieses Prinzip führt zu merklichen Schuss-zu-Schuss Fluktuationen von Pulsenergie, Wellenlänge und Zeitstruktur. Ziel unseres Experimentes ist daher eine Einzelschussmessung des XUV Zeitprofils. Dazu werden die XUV-Pulse ($\lambda = 13\,\mathrm{nm}$) mit in einem speziellen THz-Undulator erzeugten THz-Pulsen ($\lambda = 100\,\mu\mathrm{m}$) überlagert. Die verwendete Technik überträgt ein in der Attosekunden-Metrologie verwendetes Konzept auf Zeitmessungen im Femtosekundenbereich. Anders als bei einer konventionellen Streak-Kamera wird die Festkörper-Photokathode durch freie Edelgasatome gebildet, die durch die XUV-Pulse ionisiert werden. Die entstehenden Photoelektronen werden durch das zeitabhängige elektrische Feld der THz-Pulse beschleunigt, wobei die Energieänderung vom elektrischen Feld zum Ionisationszeitpunkt abhängt. Durch Messung der Photoelektronenenergien konnte das THz-Lichtfeld abgetastet werden und es wurden erste Einzelschuss-Spektren gemessen, die Informationen über die Zeitstruktur der einzelnen XUV-Pulse liefern.

Fachvortrag A 33.2 Do 17:00 VMP 8 R208

Time evolution of photon emission from the quark-gluon plasma — •Andreas Ipp, Jörg Evers, and Christoph H. Keitel — Max Planck Institut für Kernphysik, Heidelberg

Photons emitted from the quark gluon plasma (QGP) carry information directly from the interior of the strongly interacting plasma, since they are likely to leave the QGP without further interaction. They can for example provide information about a global quark polarization that can be created in non-central heavy ion collisions. Such a global quark polarization is transferred efficiently to the circular polarization of photons for various emission energies and momentum anisotropies [1].

In this work, we analyze the time evolution of the photon production in the QGP. For this, we fold the photon production with a model of the time evolution of temperature and momentum anisotropy [2]. The evolution is based on Bjorken's one-dimensional expansion model [3]. The photon production rate locally depends on the temperature and the momentum anisotropy. It is boosted from the expanding frame into the laboratory frame to obtain the time-dependent signal in the detector. We find that a strongly varying momentum anisotropy could lead to particular emission envelopes, like a double-peak structure on the zepto-second scale. A detection of the emission shape could lead to experimental insight into the isotropization process within the QGP.

[1] A. Ipp, A. Di Piazza, J. Evers, and C. H. Keitel, Phys. Lett. B 666, 315 (2008).
[2] M. Martinez, M. Strickland, Phys. Rev. C 78, 034917 (2008).
[3] J. D. Bjorken, Phys. Rev., D 27, 140 (1983).

Fachvortrag A 33.3 Do 17:30 VMP 8 R208

A New Endstation for Imaging and Photon-Particle Coincidence Experiments at VUV and X-Ray Free Electron Lasers — Sascha Epp[1], Heinz Graafsma[2], Robert Hartmann[3], Helmut Hirsemann[2], Faton Krasniqi[1], Kai-Uwe Kühnel[4], Robert Moshammer[4], •Daniel Rolles[1], Artem Rudenko[1], Ilme Schlichting[1,5], Lothar Strüder[1,3], Simone Techert[1,6], Joachim Ullrich[1,4], and Christopher Youngman[2] — [1]Max Planck Advanced Study Group at CFEL, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [3]Max Planck Halbleiterlabor, München, Germany — [4]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [5]Max-Planck-Institut für medizinische Forschung, Heidelberg, Germany — [6]Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany

We are building a new endstation to explore the interaction of intense VUV and soft x-ray radiation with various targets of increasing complexity and size, ranging from atoms and (laser-aligned) molecules to nano-particles such as clusters and biological targets, by measuring fluorescent or scattered photons in coincidence with ions and electrons. The endstation is equipped with two large-area, single-photon counting pnCCD detectors and specially-designed ion and electron spectrometers (VMI or reaction microscope), which can detect all charged particles with a large solid angle and measure their kinetic energies and emission directions, while still providing an unrestricted line-of-sight from the interaction region to the photon detectors. Proposed applications of the endstation at FLASH and LCLS are presented.

A 33.4 Do 18:00 VMP 8 R208

Threshold behavior of quantum oscillations in spatially integrated and directionally fixed in space systems — •Sanja Korica[1], Axel Reinköster[1], Markus Braune[1], Daniel Rolles[2], Burkhard Langer[3], and Uwe Becker[1] — [1]Fritz-Haber-Institut der Max-Planck-Gesellschaft Berlin — [2]CFEL Hamburg — [3]Frei Universität Berlin

Oscillatory behavior of particle breakup processes is the result of quantum interference between different emission pathways. Prominent examples are the partial cross section oscillations in the ionization of fullerenes and homonuclear diatomic molecules. This behavior may be described in the simplest way by a 'ripple tank' simulation. Such a simulation predicts a cosine-like threshold behavior of these oscillations. New near threshold measurements of the photoionization of C_{60} and N_2 corroborate these predictions. They are, however, in contrast to corresponding measurements and theoretical calculations of the photoinization probability for fixed in space N_2 molecules along the molecular axis [1]. The threshold behavior of the quantum oscillations of this system points more to a sine-like function. The 'ripple tank' simulation exhibits also a difference between the two kinds of measurements, however much less pronounced. This may be due to the different periodical functions employed in this simulation compared to the real photoionization process.

[1] Zimmermann *et al.* Nature Physics, Vol.**4**, 649, 2008.

A 33.5 Do 18:15 VMP 8 R208

Double Photoionization of Optically Pumped Lithium Atoms at FLASH — •Ganjun Zhu, Jochen Steinmann, Johannes Albrecht, Michael Schuricke, Alexander Dorn, and Joachim Ullrich — Max-Planck-Institut für Kernphysik, Heidelberg

The combination of intense FEL radiation with modern spectroscopy technique of MOTRIMS (Magneto Optical Trap Recoil Ion Momentum Spectroscopy) will pave the way to numbers of unprecedented experiments in atomic, optical and plasma physics as well as on ultra cold ensembles. For instance, the "multi-electron ejection from light atoms via single-photon absorption"process lies in the very focus of atomic physics, which is the most fundamental few-body reaction.

Here we report on a pilot experiment performed at Flash (FEL LASER at Hamburg), investigating double-photoionization (DPI) phenomena. For the first time, initial target preparation by optical pumping (λ= 671nm , linear polarization) was applied to control the DPI dynamics. It is demonstrated that the Li^{2+} recoil ion momentum distribution changes dramatically as the initial $\mathrm{Li}(1s^22s)\ ^2S_{1/2}$ ground state is excited to $\mathrm{Li}(1s^22p)\ ^2P_{3/2}$; and the DPI cross section strongly depends on the spatial alignment of the excited electron wave function. One intuitive interpretation to this new observation could be related with the different overlap of the ionized 1s-electron dipole emission lobes with the aligned 2p-wave function. Thus, the collision probability of both electrons and therefore the DPI cross section differs.