A 25: Poster Session I

Time: Tuesday 16:15–18:15 Location: Redoutensaal

A 25.1 Tue 16:15 Redoutensaal

The tunneling time, a theoretical model for real tunneling time and the attosecond experimental results. — •Ossama Kullie — University of Kassel, Fachbereich 10, Heinrichplett str. 41, 34132 Kassel

In this work we discuss our theoretical tunnelings model for real tunneling time [1, 2, 3], with a comparison to the results of attosecond experiments for He-atom and H-atom, where good agreements with the experiments are found. However, although the tunneling time is hot debated with a controversial discussions, it offers a fruitful opportunity to understand time measurement and the time in quantum mechanics. In our model a real tunneling time is suggested and is compared with other model including time-dependent Schroedinger equation, and Feynman bath integral or the statistical approach of the tunneling time. In addition, we will see that there are crucial points for higher intensities, in particular where the electric filed strength is higher than the atomic filed strength, this opens some questions on the experimental side.

[1] O. Kullie, Phys. Rev. **92**, 052118 (2015). [2] O. Kullie, J. Phys. B **49**, 095601 (2016). [3] O. Kullie, (2017), Ann. of Phys. (2017), under review. arXiv:1701.05012.

A 25.2 Tue 16:15 Redoutensaal

Near L-edge single and multiple photoionization of singly charged iron ions — •Stefan Schippers[1], Michael Martins[2], Randolf Beerwerth[3], Sadia Bari[4], Kristof Holste[1], Kaja Schubert[4], Jens Viefhaus[4,5], Daniel Wolf Savin[6], Stephan Fritzsche[3], and Alfred Müller[1] — [1]Univ. Gießen — [2]Univ. Hamburg — [3]Univ. Jena and HI Jena — [4]DESY — [5]HZB — [6]Columbia Astrophysics Laboratory, New York, USA

Absolute cross sections for m-fold photoionization ($m = 1, \ldots, 6$) of Fe^+ by a single photon were measured employing the photon-ion merged-beams setup PIPE at the PETRA III synchrotron light source, operated by DESY in Hamburg, Germany. Photon energies were in the range 680–920 eV which covers the photoionization resonances associated with $2p$ and $2s$ excitation to higher atomic shells as well as the thresholds for $2p$ and $2s$ ionization. Supporting semi-relativistic and fully relativistic atomic-structure calculations are in good agreement with each other and with the experimental results. In particular, the complex deexcitation cascades after the creation of inner-shell holes in the Fe^+ ion have been tracked on the atomic fine-structure level. The resulting theoretical product charge-state distributions are in much better agreement with the experimental data than previously published charge-state distributions from a configuration-average approach. The present experimental and theoretical results [1] are valuable for opacity calculations and are expected to pave the way to a more accurate determination of the iron abundance in the interstellar medium.

[1] S. Schippers et al., Astrophys. J. 849 (2017) 5.

A 25.3 Tue 16:15 Redoutensaal

Condensation effects and interatomic processes in noble gases investigated by cathodoluminescence — •Catmarna Küstner-Wetekam, Andreas Hans, Xaver Holzapfel, Philipp Schmidt, Christian Ozga, Gregor Hartmann, Arno Ehresmann, and André Knie — Institut für Physik und CINSaT, Universität Kassel, Heinrich-Plett-Str. 40, 34132 Kassel, Germany

The condensation behaviour and properties of electronic decay processes of noble gases sensitively depend on their atomic number. The grade of condensation strongly impacts the radiative properties of these systems such as line width and spectral shapes. Therefore the luminescence spectra acts as a fingerprint of these systems. Here, we present luminescence spectra from helium, neon, and argon jets produced by supersonic expansion from a cryogenic cluster source after electron impact excitation. As an outlook, we compare them with emission after site-selective photo-excitation and suggest the investigation of various interatomic processes by cathodoluminescence. Finally, we envision our method to be of importance for many schemes, in which electrons are emitted by any means in large clusters, because they can subsequently induce emissions comparable to direct cathodoluminescence.

A 25.4 Tue 16:15 Redoutensaal

A grazing-incidence 4-quadrant split-mirror setup for multi-dimensional spectroscopy experiments in the XUV — •Carina da Costa Castanheira, Marc Rebholz, Thomas Ding, Lennart Aufleger, Patrick Rupprecht, Paul Birk, Christian Ott, and Thomas Pfeifer — Max-Planck Institut für Kernphysik, Heidelberg, Germany

In this work the home-built four-quadrant split-mirror dedicated for grazing-incidence multidimensional spectroscopy experiments in the near infrared (NIR) and extreme ultraviolet (XUV) is characterized by an interferometric measurement. For this purpose the stability was investigated with a HeNe laser and the temporal overlap between the mirrors themselves was determined using a femtosecond Ti:Sa laser system. Beginning with analyzing stability issues and finding temporal overlap between the mirrors, this work continued with first measurements on NIR-NIR-XUV four-wave-mixing in neon in the extreme ultraviolet (XUV) spectral region. Furthermore, first nonlinear XUV-only proof-of-principle experiments were carried out with this setup at the free-electron laser facility FLASH in Hamburg (Germany). These experiments can be seen as a working proof of the four-quadrant split-mirror setup which serves as a basis for future progress in four-wave-mixing experiments with our setup at both mixed NIR/XUV as well as XUV-only spectral regions.

A 25.5 Tue 16:15 Redoutensaal

Attosecond Time Delays in Photoionization of Noble Gas and Halogen Atoms — •Liang-Wen Pi and Alexandra S. Landsman — Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Straße 38, 01187 Dresden, Germany

Ultrafast processes are now accessible on the attosecond time scale due to the availability of ultrashort XUV laser pulses. Noble gas and halogen atoms remain interesting targets due to their giant dipole resonance and Cooper minimum. We have calculated photoionization cross section, asymmetry parameter and Wigner time delay using the time-dependent local-density approximation (TDLDA), which includes electron correlation effects and generates qualitatively good agreement with experimental data and other theoretical calculations. The asymmetry parameter provides additional information on the electron phase in the photoionization process. We find that halogen atoms bear a strong resemblance on cross section, asymmetry parameter and time delay to their noble gas neighbors. Our predicted time delay can be tested in future attosecond experiments on these atoms and related molecules.

A 25.6 Tue 16:15 Redoutensaal

Strong-field assisted VUV amplification in doped helium droplets — •Andreas Rubisch, Ulf Saalmann, and Jan-Michael Rost — Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

High harmonic generation in intense laser pulses is a valuable tool to obtain radiation in the UV and x-ray regime. In order to overcome the typically low conversion efficiency, it was proposed to assist the emission of high harmonics in single atoms or molecules by an intense near-infrared (NIR) driving pulse [1].

Such a mechanism could be powerful in atomic clusters as well. There the NIR pulse generates a nano-plasma, which, however, is highly unstable upon evaporation. Here we study helium droplets doped with a handful of xenon atoms, where by means of dopant-induced ignition a lower-temperature nano-plasma is formed [2,3].

We perform classical molecular-dynamics calculations for the NIR-driven cluster system. The interaction with a weak VUV pulse is treated perturbatively and we investigate the trade-off between absorption and emission of VUV light from the irradiated nano-plasma.

[1] T. Bredtmann et al., PRA 93, 021402(R) (2016)

[2] A. Mikaberidze et al., PRA 77, 041201(R) (2008); PRL 102, 128102 (2009)

[3] S.R. Krishnan et al. PRL 107, 173402 (2011)

A 25.7 Tue 16:15 Redoutensaal

Tracing the molecular potential energy landscape on rovibronic emission maps of molecular hydrogen — •Philipp Schmidt, Andreas Hans, Christian Ozga, Arno Ehresmann, and

André Knie — Institut für Physik und CINSaT, Universität Kassel, Heinrich-Plett-Straße 40, 34132 Kassel, Germany

The band spectra of molecular systems in absorption or emission are an integral part in the history and development of spectroscopic observations. While generally assumed to be well understood and a case for textbooks, there are still transitions between bound and unbound states in even the simplest molecules such as hydrogen that require extensive theoretical treatment to explain or exhibit an intertwined system of lines hard to identify. By examining the photon and ion emissions of such systems in dependance of their internal energy, the full process from excitation to final deexcitation can be monitored. When performed over the complete set of accessible states at once, the resulting map disentangles not only the individual processes from each other, but also gives a unique view on their interaction at the respective boundaries. Here we present such a treatment for molecular hydrogen and its isotopes through comparing experimental results after selective excitation by synchrotron radiation and theoretical models in the entire regime of singly excited states.

A 25.8 Tue 16:15 Redoutensaal

Design of a Thomson Ion Streak Spectrometer for the European-XFEL — Burkhard Langer, Felix Gerke, Egill Antonsson, and •Eckart Rühl — Physikalische Chemie, Freie Universität Berlin, Takustr. 3, 14195 Berlin

When clusters or nanoparticles are exposed to free-electron-laser (FEL) radiation, Coulomb explosion produces ions that can have kinetic energies of several hundred electron volts. In a conventional time-of-flight mass spectrometer the ion spectrum is smeared out since the flight time blends the charge-to-mass ratio with the kinetic energy of the ions. In our novel design of a Thomson type spectrometer the simultaneous application of a magnetic and an electric field is used to disentangle these properties. Ions of the same charge-to-mass ratio are focused on specific parabolas on the detection screen and the positions along these parabolas depend upon their kinetic energy. For experiments at FEL facilities, such as FLASH and the European-XFEL in Hamburg, that offer an X-ray beam with micro-bunches it is possible to use a fast, stepwise varying extraction field to imprint the micro-bunch time structure to the kinetic energy of the ions. This increases the detection efficiency by using several of the micro-bunches, particularly when the novel spectrometer is used in combination with other time resolved devices.

A 25.9 Tue 16:15 Redoutensaal

Electronic bridge for the x-ray Mössbauer transition in ^{57}Fe — •Pavlo Bilous and Adriana Pálffy — Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, D-69117 Heidelberg, Germany

The 14.4 keV transition coupling the first excited state to the ground state in the isotope ^{57}Fe is widely used for Mössbauer absorption spectroscopy. The commissioning of the first x-ray free electron laser (XFEL) sources render possible both direct excitation of this transition [1] but also alternative ways involving two-photon transitions. Here we investigate the excitation of the nuclear 14.4 keV state with two x-ray beams at approximately equal energies at an x-ray laser facility such as SACLA or LCLS. Apart from the process of direct absorption of two photons by the nucleus we investigate excitation of the nuclear state via the electronic bridge process in the atomic shell. Our results show that the direct two-photon excitation of the ^{57}Fe nucleus is highly unlikely whereas the excitation via electronic bridge may reach measurable rates.

[1] A. I. Chumakov *el.*, Nature Phys. in press (2017)

A 25.10 Tue 16:15 Redoutensaal

Angular-resolved photoelectron spectroscopy of xenon doped helium droplets — •Michael Zabel, Josef Tiggesbäumker, and Karl-Heinz Meiwes-Broer — Universität Rostock, Institut für Physik, Albert-Einstein-Strasse 23, 18059 Rostock

Angular resolved photoelectron emission of xenon doped helium droplets ionized with a 810 nm femtosecond laserpuls is studied. The signal of the direct and rescattered electrons was investigated for different laser intensities and doping conditions.

A 25.11 Tue 16:15 Redoutensaal

Direct two-electron ejection from F^- by a single photon — •Alfred Müller[1], Alexander Borovik Jr.[1], Sadia Bari[2], Ticia Buhr[1], Kristof Holste[1], Michael Martins[3], Alexander Perry-Sassmannshausen[1], Ronald Phaneuf[4], Simon Reinwardt[3], Sandor Ricz[5], Kaja Schubert[2], and Stefan Schippers[1] — [1]Justus-Liebig-Universität Gießen — [2]DESY Hamburg — [3]Universität Hamburg — [4]University of Nevada, Reno, USA — [5]ATOMKI Debrecen, Hungary

Double and triple detachment of the $F^-(1s^22s^22p^6)$ negative ion by a single photon have been investigated in the photon energy range 660 to 1000 eV [1]. The experimental data provide unambiguous evidence for the dominant role of direct photo-double-detachment with a subsequent single-Auger process in the reaction channel leading to F^{2+} product ions. Absolute cross sections were determined for the direct removal of a $(1s + 2p)$ pair of electrons from F^- by the absorption of a single photon.

[1] A. Müller *et al.*, (submitted).

A 25.12 Tue 16:15 Redoutensaal

A non-linear mapping from photo-electron spectra to pulse shape — •Sajal Kumar Giri, Ulf Saalmann, and Jan-Michael Rost — Max-Planck-Institute for the Physics of Complex Systems, Dresden, Germany

Strong field quantum dynamics are very sensitive to the shape of the interacting field. Finding a suitable pulse shape to reach a predefined target lies in the heart of quantum control. The forward nonlinear mapping between the interacting pulse and the objective (photoelectron spectra(PES)) can be achieved by solving the time-dependent Schrödinger equation. However, the non-linear inverse mapping i.e. a mapping from the PES to the pulse shape is not straightforward. In this work, we have explored the non-linear inverse mapping using the artificial neural network. As a test system, we have studied quasi-resonant two-photon ionization of a helium atom for the interaction with different pulse shapes of the same energy and same frequency content. For this process, the photo-electron spectra are very different for different pulses and contain all the detailed information of the pulses. The sensitivity of each input to the output is also investigated in this work. This method can be extended for the measurement of free electron laser pulse shape from the knowledge of PES.

A 25.13 Tue 16:15 Redoutensaal

Transitions above (and near) the ionisation threshold — •Anne Harth, Robert Moshammer, and Thomas Pfeifer — Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland

Photoionization is a fundamental and still extensively discussed process, where an electron is removed from e.g. an atom by a high-energy photon. Recently, it was possible to measure a photoionization phase shift between a single electron coming from the 2s or 2p state in a neon atom [1,2]. Such a phase shift can be interpreted as a time delay that is on the order of only a few attoseconds.

However, the kinetic energy of such a released electron depends on the photon energy and the ionisation potential. A slow electron, which is still in the influence of its mother ion, can absorb additional photons. The dipole matrix element, which describes the additional photoabsorption in the continuum, is often either neglected or calculated [4] and was not experimentally studied so far, but plays an important role e.g. in the above mentioned photoionization experiment in Neon [2,3].

We propose and discuss a multi-color electron wave packet interferometer to experimentally study the near ionisation threshold continuum including continuum-continuum dipole transitions matrix elements.

[1] Schultze et al. Science 328, 1658 (2010)
[2] Isinger et al. Science 358 , 893 (2017)
[3] Véniard et al. Phys. Rev. A 54, 721 (1996)
[4] Dahlström et al. Chemical Physics 414, 53 (2013)

A 25.14 Tue 16:15 Redoutensaal

Disentangling the photodissociation pathways of small lead clusters by time-resolved monitoring of their delayed decays: The case of Pb_{31}^+ — •Markus Wolfram, Stephan König, Steffi Bandelow, Paul Fischer, Alexander Jankowski, Gerrit Marx, and Lutz Schweikhard — Ernst-Moritz-Arndt Universität, Greifswald, Deutschland

Lead clusters $Pb_n^{(+/-)}$ in the size range between about $n = 15$ and 40 have recently shown to exhibit complex dissociation spectra due to sequential and competing decays [1]. In order to disentangle the pathways, the exemplary Pb_{31}^+ clusters have been stored and size selected in a Penning trap at the ClusterTrap setup [2] and irradiated by nanosecond laser pulses.

We present time-resolved measurements of the decay behavior at time scales from several tens of microseconds to several hundreds of milliseconds. The study results in strong evidence that Pb_{31}^{+} decays not only by neutral monomer evaporation but also by neutral heptamer breaking off [3].

[1] S. König et al., J. Phys. Chem. C 121 (2017) 10858
[2] F. Martinez et al., Int. J. Mass Spectrom. 365-366 (2014) 266
[3] M. Wolfram et al., J. of Phys. B: Atomic, Molecular and Optical Physics, in print

A 25.15 Tue 16:15 Redoutensaal

Laser-nucleus interactions with nucleon emission — •Sergei Kobzak, Hans Weidenmüller, and Adriana Pálffy — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

Recent experimental developments in laser physics and laser-driven acceleration promise to deliver coherent photon beams with energies ranging up to several MeV. The utilization of a laser beam with photon energies comparable to typical nuclear excitation energies will shed light on a number of questions and will open new unexplored avenues for nuclear physics [1,2].

In this work we investigate theoretically the interaction between coherent gamma-ray laser pulses and medium-weight or heavy nuclei in the case of sudden regime. In this regime the compound nucleus statistical equilibration rate is slower than the average photon absorption rate. Consequently, nucleons are excited independently and are expelled from the common average potential. Multiple photon absorptions may lead to complete evaporation of the nucleus if the duration of the laser pulse of several MeV per photon is long enough. The time evolution of such processes is studied with help of master equations which take into account neutron decay and feeding, dipole absorption and emission and the nucleon-nucleon interaction.

[1] A. Pálffy and H. A. Weidenmüller, Phys. Rev. Lett. 112, 192502 (2014).
[2] A. Pálffy, O. Buss, A. Hoefer and H. A. Weidenmüller, Phys. Rev. C 92, 044619 (2015).

A 25.16 Tue 16:15 Redoutensaal

Attosecond streaking with twisted X waves — •Birger Böning[1], Willi Paufler[1], and Stephan Fritzsche[1,2] — [1]Friedrich-Schiller-Universität, Jena, Germany — [2]Helmholtz-Institut Jena, Germany

Attosecond streaking is an established technique to measure timing information in the interaction of ultrashort laser pulses with atoms or molecules. This technique is based on the photoionization by an attosecond laser pulse in the presence of a strong linearly polarized near infrared (NIR) laser pulse. We investigate the attosecond streaking with an X wave pulse carrying orbital angular momentum and a strong linearly polarized near infrared (NIR) laser pulse. In contrast to plane wave pulses, X waves have a spatially dependent temporal profile, which modifies the ionization process. In this contribution we theoretically explore the influence of this complex pulse structure on the streaking of photoelectrons for both localized and macroscopically extended targets. On the basis of the strong-field approximation (SFA), we find that the streaking spectra of localized targets sensitively depend on the opening angle of the X wave and the position of the atomic target relative to the beam axis. For macroscopically extended targets, we find that the streaking spectra do not depend on the parameters characterizing the twist of the X wave.

[1]: B. Böning et al., Phys. Rev. A 96, 043423 (2017)

A 25.17 Tue 16:15 Redoutensaal

Radical increase of the parametric X-ray intensity under condition of extremely asymmetric diffraction — •Oleg D Skoromnik[1], Vladimir G Baryshevsky[2], Alexander P Ulyanenkov[3], and Ilya D Feranchuk[4,5,6] — [1]Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Institute for Nuclear Problems, Belarusian State University, 4 Nezavisimosty Ave., 220030 Minsk, Belarus — [3]Atomicus GmbH, Schoemperlen Str. 12a, 76185 Karlsruhe, Germany — [4]Atomic Molecular and Optical Physics Research Group, Ton Duc Thang University, 19 Nguyen Huu Tho Str., Tan Phong Ward, District 7, Ho Chi Minh City, Vietnam — [5]Faculty of Applied Sciences, Ton Duc Thang University, 19 Nguyen Huu Tho Str., Tan Phong Ward, District 7, Ho Chi Minh City, Vietnam — [6]Belarusian State University, 4 Nezavisimosty Ave., 220030, Minsk, Belarus

A dynamical theory of diffraction is employed for the description of the parametric X-ray radiation (PXR) from relativistic electrons which move in a crystal along the crystal-vacuum interface. In this geometry the emission of photons is happening in the regime of extremely asymmetric diffraction (EAD). In the EAD case the whole crystal length contributes to the formation of X-ray radiation opposed to Laue and Bragg geometries, where the emission intensity is defined by the X-ray absorption length. We predict a radical increase of two order of magnitude in the PXR intensity in comparison with the conventional experimental geometries of PXR. [1] Nucl. Instr. Meth. B 412 (2017) 86-92.

A 25.18 Tue 16:15 Redoutensaal

Correlation method for velocity map imaging and time of flight techniques for electrons and ions in helium nanodroplets. — •cristian medina[1], dominik schomas[1], nicolas rendler[1], robert moshammer[2], thomas pfeifer[2], and marcel mudrich[3] — [1]Albert Ludwigs University of Freiburg, Freiburg, Germany — [2]Max Planck Institute for Nuclear Physics, Heidelberg, Germany — [3]Aarhus University, Aarhus, Denmark

Velocity map imaging (VMI) and time of flight (TOF) are techniques that have been used separately to study molecules and clusters. Using a combined VMI-TOF setup, doped helium nanodroplets are irradiated by near-infrared femtosecond laser pulses creating a nanoplasma state by strong-field ionization. The occurring electrons couple very efficiently to the laser field and acquire high energy, resulting in an avalanche of impact ionizations. The large number of charged particles allows us to collect complete spectra for both, VMI and TOF, from a single hit. We present a computational method for the data acquisition and correlation in real time for the VMI-TOF experiment by linking the CCD-camera from the VMI to a data acquisition card of the TOF. This allows us to identify a single event in each technique making possible to link each other and study the complete spectra for a single nanoplasma. The program runs on the LabVIEW real-time platform in a rate of 3μs per loop and includes identification of events that analyses and save only single events data discarding non relevant information.

A 25.19 Tue 16:15 Redoutensaal

The role of laser dressed bands in the strong field dynamics of dielectrics — •Lukas Medišauskas, Ulf Saalmann, and Jan-Michael Rost — Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Since the discovery of high harmonic generation (HHG) in solid state materials, the dependence of HHG spectra on the generating medium as well as on the chosen geometry and characteristics of the generating radiation were actively investigated.

However, a strong electromagnetic field applied to a material not only drives the electronic dynamics, but also modifies the electronic states via the AC Stark effect, thus modifying the effective band structure.

We investigate such laser "dressing" of the bands of a solid by solving the time-dependent Schrödinger equation for a model dielectric exposed to a strong and low frequency field. Using an expansion into photon-number states, we identify the dominating multi-photon channels and reveal their connection to the field dressed bands. Finally, we demonstrate that the HHG process in solids can be traced to the field dressed band structure.

A 25.20 Tue 16:15 Redoutensaal

K-shell photoionoization of Silicon ions — •Ticia Buhr[1], Alexander Perry-Sassmannshausen[1], Simon Reinwardt[2], Sandor Ricz[3], Michael Martins[2], Alfred Müller[4], and Stefan Schippers[1] — [1]I. Physikalisches Institut, Justus-Liebig-Universität Gießen, Germany — [2]Institut für Experimentalphysik, Universität Hamburg, Germany — [3]Institute for Nuclear Research, Hungarian Academy of Sciences, Debrecen, Hungary — [4]Institut für Atom- und Molekülphysik, Justus-Liebig-Universität Gießen, Germany

Absolute cross sections for single and multiple photoionization of low charged atomic silicon ions at the silicon K-edge have been experimentally determined. Such data are of immediate interest for x-ray astrophysics [1] and benchmark theoretical calculations. The measurements were carried out at the PIPE setup [2] at the beam line P04 on the synchrotron light source PETRA III (Hamburg, Germany) employing the photon-ion merged-beams technique. Precise K-shell ionization resonance parameters (positions, widths,...) for these ions and branching ratios for the production of the various product-ion charge states are provided.

[1] T. Holczer *et al.*, Astrophys. J. **708**, 981 (2010).
[2] S. Schippers *et al.*, J. Phys. B **47**, 115602 (2014).

A 25.21 Tue 16:15 Redoutensaal

Multiple ionization of Ne^+ ions by photoabsorption near the K edge — Alfred Müller[1], Dietrich Bernhardt[1], Alexander Borovik Jr.[1], •Ticia Buhr[1], Jonas Hellhund[1], Kristof Holste[1], A. L. David Kilcoyne[2], Stephan Klumpp[3,4], Michael Martins[3], Sandor Ricz[5], Jörn Seltmann[4], Jens Viefhaus[4,6], and Stefan Schippers[1] — [1]Justus-Liebig-Universität Gießen — [2]ALS, Berkeley, USA — [3]Universität Hamburg — [4]DESY, Hamburg — [5]Atomki, Debrecen, Hungary — [6]HZB, Berlin

Single, double and triple photoionization of Ne^+ ions by single photons have been investigated at PETRA III in Hamburg [1]. Absolute cross sections were measured using the photon-ion merged-beams technique [2]. Photon energies were between 840 and 930 eV, covering the range from the lowest-energy resonances associated with the excitation of one single K-shell electron up to double excitations involving one K- and one L-shell electron, well beyond the K-shell ionization threshold. Photoionization of neutral Ne was also studied just below the K edge. The photon energy bandwidths were between 32 and 500 meV, facilitating the determination of natural line widths. For comparison with theoretical calculations, astrophysically relevant photoabsorption cross sections were inferred by summing the measured partial ionization channels. The observed resonances in the final ionization channels reveals the presence of complex Auger-decay mechanisms.

[1] A. Müller *et al.*, Astrophys. J. **836**, 166 (2017).
[2] S. Schippers *et al.*, J. Phys. B **47**, 115602 (2014).

A 25.22 Tue 16:15 Redoutensaal

Imaging Charge Distribution in Time with XUV photoelectrons — •Abraham Camacho Garibay, Hyunwook Park, and Louis DiMauro — The Ohio State University, Columbus, OH, USA

Recent experiments with XFELs have shown the usefulness of photoelectron energy measurements in order to understand the electronic properties of the targets. These experiments usually require extreme intensities and very short pulses. Here we show that the same basic idea can be applied in principle with less demanding conditions, by utilizing a table-top IR laser as a pump, and a short delayed XUV probe in order to obtain information about the expansion dynamics of the target.

A 25.23 Tue 16:15 Redoutensaal

Time-resolved X-ray Imaging of Anisotropic Nanoplasma Expansion — •Christian Peltz[1], Christoph Bostedt[2], Mathias Kling[3], Thomas Brabec[4], Eckart Rühl[5], Artem Rudenko[6], Tais Gorkhover[7], and Thomas Fennel[1] — [1]Institute of Physics, University of Rostock, Germany — [2]Argonne National Laboratory, Argonne, USA — [3]Faculty of Physics, LMU Munich, Germany — [4]Department of Physics and Centre for Photonics Research, University of Ottawa, Canada — [5]Physical Chemistry, FU Berlin, Germany — [6]Department of Physics, Kansas-State University, USA — [7]LCLS, SLAC National Accelerator Laboratory, Menlo Park, USA

We investigate the time-dependent evolution of laser-heated solid-density nanoparticles via coherent diffractive x-ray imaging, theoretically and experimentally. Our microscopic particle-in-cell calculations for R = 25 nm hydrogen clusters reveal that infrared laser excitation induces continuous ion ablation on the cluster surface. This process generates an anisotropic nanoplasma expansion that can be accurately described by a simple self-similar radial density profile. It's time evolution can be reconstructed precisely by fitting the time-resolved scattering images using a simplified scattering model in Born approximation [1]. Here we present the first successful high resolution reconstruction of corresponding experimental results, obtained at the LCLS facility with SiO2 nanoparticles (D=120 nm), and compare them to the theoretical predictions.

[1] C. Peltz, C. Varin, T. Brabec and T. Fennel , Phys. Rev. Lett. **113**, 133401 (2014)

A 25.24 Tue 16:15 Redoutensaal

Strong field ionization with Bessel pulses — •Willi Paufler[1], Birger Böning[1], and Stephan Fritzsche[1,2] — [1]Friedrich-Schiller Universität, Jena, Germany — [2]Helmholtz-Institut, Jena, Germany

Since twisted light beams draw interest in many parts of physics, it is also desired to understand their interaction with atoms and molecules. We apply a Quantum Trajectory Monte Carlo model (QTMC) to describe strong field ionization of atoms by twisted beams (Bessel beams) and calculate photoelectron momentum distributions (PEMD). Bessel beams are an infinite superposition of circularly polarized plane waves with the same helicity, whose wave vectors lie on a cone. Thus, we compare the obtained PEMD to those of strong field ionization by cicurlarly polarized pulses. We focus on the momentum distributions in propagation direction of the pulse and show how to these momentum distributions depend on experimental parameters, such as the opening angle of the beam or the impact parameter of the atom with regard to the beam axis.

A 25.25 Tue 16:15 Redoutensaal

Attosecond time-resolved photoelectron holography — Gil Porat[1], Gideon Alon[2], Shaked Rozen[2], Oren Pedatzur[2], •Michael Krüger[2], Adi Natan[3], Barry D. Bruner[2], Marc J. J. Vrakking[4], and Nirit Dudovich[2] — [1]JILA, NIST and University of Boulder, Colorado, USA — [2]Department of Physics of Complex Systems, Weizmann Institute of Science, Rehovot 76100, Israel — [3]Stanford PULSE Institute, SLAC, Menlo Park, California, USA — [4]Max-Born-Institut, 12489 Berlin, Germany

Ultrafast strong-field physics provides insight into quantum phenomena that evolve on an attosecond time scale, the most fundamental of which is quantum tunneling. In this work we apply attosecond photoelectron holography [1] as a new method to resolve the temporal properties of the tunneling process. Adding a weak second harmonic (SH) field to a strong fundamental laser field enables us to reconstruct the ionization times of photoelectrons that play a role in the formation of a photoelectron hologram with attosecond precision. We decouple the contributions of the two arms of the hologram and resolve the subtle differences in their ionization times, separated by only a few tens of attoseconds.

[1] Y. Huismans et al., Science 331, 61 (2011).

A 25.26 Tue 16:15 Redoutensaal

Accurate modeling of Auger cascades and its applications — •Sebastian Stock[1,2], Randolf Beerwerth[1,2], and Stephan Fritzsche[1,2] — [1]Helmholtz-Institut Jena, 07743 Jena, Germany — [2]Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universität Jena, 07743 Jena, Germany

Inner-shell excitation or ionization of atoms and ions usually leads to a cascade of autoionization processes. In the past decade, advances in experimental techniques such as modern UV and X-ray sources as well as ultrafast time-resolved spectroscopy have fueled considerable interest in the study of complex decay cascades. Our approach to an accurate description of these decay cascades is based on extensive multiconfiguration Dirac–Fock calculations on a fine-structure level. In order to achieve good results within the limits of todays computational power, we employ models of varying sophistication, including important electron correlation effects and higher-order effects such as shake processes [1, 2]. Apart from showing our theoretical modeling in general, we here present our recent results on Auger cascades in singly-charged silicon and neutral krypton [3] which have been conducted in collaboration with different experimental groups.

[1] S. Schippers *et al.*, *Phys. Rev. A* **94**, 041401 (2016).
[2] S. Stock, R. Beerwerth, and S. Fritzsche, *Phys. Rev. A* **95**, 053407 (2017).
[3] K. Hütten *et al.*, submitted 2017.

A 25.27 Tue 16:15 Redoutensaal

A source for helium droplets and liquid jets for time-resolved diffractive imaging experiments with high-harmonic pulses — •Katharina Kolatzki[1,2], Nils Monserud[1], Arnaud Rouzée[1], Mario Sauppe[1,2], Bernd Schütte[1], Julian Zimmermann[1,2], Thomas Möller[2], Marc J.J. Vrakking[1], and Daniela Rupp[1,2] — [1]MBI, Germany — [2]IOAP TU Berlin, Germany

Our recent demonstration of single-particle coherent diffractive imaging (CDI) with a femtosecond high-harmonics generation (HHG) source [D. Rupp et al., Nat. Comm. 8, 493 (2017)] opens the door to the investigation of excitation and ionization dynamics in extended matter. These processes take place in the attosecond time domain. In principle, attosecond pulses can be generated by HHG sources, but the achievable intensities are too low for single-shot CDI. For a diffractive imaging approach, it is necessary to average over multiple single shot diffraction images, which requires a constant target. To make this procedure feasible, we intend to build a source for extremely large helium

droplets and liquid jets, which will serve as a reproducible target. Key ideas and design parameters will be discussed.

A 25.28 Tue 16:15 Redoutensaal

Manipulating single photon propagation through alkali vapour cells — •Lea Kopf[1], Hüseyin Vural[2], Simone Luca Portalupi[2], Julian Maisch[2], Simon Kern[2], Jonas Weber[2], Michael Jetter[2], Ilja Gerhardt[3,4], Peter Michler[2], and Robert Löw[1] — [1]5. Physikalisches Institut and IQST, University of Stuttgart, Pfaffenwaldring 57, D-70569 Stuttgart, Germany — [2]Institut für Halbleiteroptik und Funktionelle Grenzflächen, IQST and SCoPE, University of Stuttgart, Allmandring 3, D-70569 Stuttgart, Germany — [3]3. Physikalisches Institut and IQST, University of Stuttgart, Pfaffenwaldring 57, D-70569 Stuttgart, Germany — [4]Max Planck Institute for Solid State Research, Heisenbergstrasse 1, D-70569 Stuttgart, Germany

A crucial component of future quantum network technologies are quantum memories, in which single photons are stored and read-out. Single photons generated in quantum dots provide on-demand emission and a high photon indistinguishability. The broadband capabilities and room temperature operation of quantum memory schemes in alkali vapour cells are a suitable storage medium. By tuning quantum dot photons to a 'transparency window' between the hyperfine lines we have realized a temperature dependent time delay. In a next step we want to employ an EIT/Autler-Townes scheme to achieve optical control on the single photon propagation. An important aspect for storing single photons is excellent control over the read/write pulses, optical pumping and the manufacturing of optimized vapour cells.

A 25.29 Tue 16:15 Redoutensaal

Modular He nanodroplet source for the SQS end station at the European XFEL — •Fabian Seel[1], Anatoli Ulmer[1], Bruno Langbehn[1], Daniela Rupp[1], Yevheniy Ovcharenko[2], and Thomas Möller[1] — [1]IOAP, Technische Universität Berlin, Germany — [2]European XFEL, Hamburg, Germany

Because of their unique properties, ultra-cold superfluid helium nanodroplets are considered to be perfect matrices for high resolution spectroscopy [Angew. Chem. Int. Ed. 2004, 43, 2622 - 2648] and can be doped with virtually any atomic or molecular sample. Diffraction patterns of such single free nanoparticles can be recorded using the ultrashort and bright X-ray pulses generated by X-Ray Free-Electron Lasers (XFEL). From those diffraction patterns, the structure of an embedded sample can be reconstructed quickly and reliably with the novel technique of Droplet Coherent Diffractive Imaging (DCDI) [Struct. Dyn. 2, 051102 (2015)]. To exploit valuable beamtime at the new European XFEL, we set up a new source for helium droplets, matching the XFEL's pulse structure with a pulse train length of 600 μs at a repetition rate of 10 Hz. At operating temperatures as low as 5 K, large droplets with $N \geq 10^8$ atoms can be produced in an expansion through a conical nozzle. To provide a source for different conditions, we have developed a modular source head that is able to operate with either a pulsed Even-Lavie Valve or a commercial Parker Series 99 Pulsed Valve. First characterization measurements taken in the laboratory will be presented and discussed.

A 25.30 Tue 16:15 Redoutensaal

Transient absorption spectroscopy of the ionization continuum of argon — •Paul Birk, Veit Stooss, Maximilian Hartmann, Alexander Blättermann, Christian Ott, and Thomas Pfeifer — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Attosecond transient absorption spectroscopy opens a way to study ultrafast dynamics in excited electronic states of atoms and molecules. The spectral line shapes and their NIR laser-induced changes measured by these experiments carry information about the studied quantum system and originate from the dipole response of bound states. Here, we investigate the response of the ionization continuum. With our all-optical approach, we observed signatures of strong NIR laser-induced coupling between the ionization continuum of argon with its dipole-forbidden excited states. These signatures are compared with the optical response calculated by a numerical multi-level model simulation. This approach enables direct access into the laser-driven strong-field dynamics involving the ionization continuum and spectral dark states.

A 25.31 Tue 16:15 Redoutensaal

Single shot velocity map imaging of electrons from dopand-induced helium nanoplasmas in strong near-infrared laser pulses. — •Nicolas Rendler[1], Dominik Schomas[1], Cristian Medina[1], Robert Moshammer[2], Thomas Pfeifer[2], Andreas Heidenreich[3,4], and Marcel Mudrich[5] — [1]Albert Ludwigs University of Freiburg, Freiburg, Germany — [2]Max Planck Institute for Nuclear Physics, Heidelberg, Germany — [3]Faculty of Chemistry, University of the Basque Country (UPV/EHU) and Donostia International Physics Center (DIPC), Donostia, Spain — [4]IKERBASQUE, Basque Foundation for Science, Bilbao, Spain — [5]Aarhus University, Aarhus, Denmark

A doped helium nanodroplet irradiated by intense near-infrared (NIR) laser pulses forms a highly ionized nanoplasma even at laser intensities where the helium is not directly ionized. The dopant atoms provide first seed electrons which start the electron impact ionization avalanche of the whole droplet. The dynamics of ignition and explosion of the nanoplasma depends not only on the number and the kind of dopants but also on the droplet size and laser intensity. We present single shot velocity map imaging (VMI) measurements of electrons produced by irradiation of xenon doped helium nanodroplets with intense NIR femtosecond laser pulses at various laser intensities for different helium and dopant cluster sizes. The salient structures of the electron spectra are discussed and compared to molecular dynamics simulations. Additionally ion time of flight (TOF) spectra can be recorded in parallel to the electron VMI.

A 25.32 Tue 16:15 Redoutensaal

Electron dynamics in Helium and Neon driven by intense XUV radiation — •Alexander Magunia[1], Lennart Aufleger[1], T. Ding[1], M. Rebholz[1], M. Hartmann[1], V. Stooss[1], P. Rupprecht[1], D. Wachs[1], C. da Costa Castanheira[1], Z. H. Loh[2], A. Attar[3], S. Düsterer[4], G. Brenner[4], R. Treusch[4], Christian Ott[1], and Thomas Pfeifer[1] — [1]Max-Planck Institute for Nuclear Physics, Heidelberg, Germany — [2]Nanyang Technological University Singapore, Singapore — [3]University of California, Berkeley, USA — [4](DESY), Hamburg, Germany

The measurement of laser-induced dynamics in few-electron systems provides a way to investigate the correlated response of multiple electrons in atoms and molecules when driven by strong and short electric fields. Using a lab-based high-harmonic source we have formerly studied such dynamics via their imprint on the XUV absorption line shape in response to strong fields in the near infrared and visible spectral region. [C. Ott et al., Science 340, 716 (2013)].
Here we present an extension of this scheme to the XUV-only spectral region, using intense and partially coherent light of a Free-Electron Laser (FEL, FLASH@DESY) to investigate the line shape modifications across the 2s2p autoionizing resonance in Helium. The XUV-pulse intensity is in the range from 10^{12} Wcm^{-2} to 10^{14} Wcm^{-2}. These first results are supported by a few-level simulation for which the time-dependent Schrödinger equation is solved numerically, addressing also the statistical SASE-FEL pulse-structure. Furthermore a first view into the strong-field behavior of the multi-electron system Neon is given.

A 25.33 Tue 16:15 Redoutensaal

Diffractive imaging of a xenon nanoplasma with pnCCDs — •Timo Dörries[1], Daniela Rupp[2], Thomas Möller[1], Mario Sauppe[1], Maria Müller[1], Anatoli Ulmer[1], Bruno Langbehn[1], Jan Philippe Müller[1], Yevheniy Ovcharenko[1], Benjamin Erk[3], Jonathan Correa[4], and Robert Hartmann[5] — [1]Technische Universität Berlin, Germany — [2]Max-Born-Institut, Berlin, Germany — [3]FLASH at DESY, Hamburg, Germany — [4]XFEL at DESY, Hamburg, Germany — [5]pnSensors, Munich, Germany

We have studied the interplay of intense coherent XUV pulses from the free-electron laser FLASH in Hamburg with single xenon clusters. They serve as ideal model systems for light matter interaction as they are easy to produce, size scalable, free flying particles that often have spherical symmetry. The used photon energies close to 90 eV are resonant to transitions in xenon atoms and ions; consequently a nanoplasma is formed with an altered scattering response and the emission of fluorescence light. Both the elastically scattered and fluorescence photons are detected using a single-photon sensitive large area detector (pnCCDs) with high dynamic range. Different detector coatings allow for identification of the fluorescence signal. Via Mie simulations, optical properties and thus information about the electronic structure of the clusters can be extracted.

A 25.34 Tue 16:15 Redoutensaal

Time resolved coincidence measurements of interatomic Coulombic decays — •Sophie Walther[1], Anastasios

Dimitriou[1], Till Jahnke[2], Markus Pfau[1], Martin Ranke[1], and Ulrike Frühling[1] — [1]Universität Hamburg — [2]Goethe-Universität, Frankfurt

Presentation of the experimental setup for the THz-streaking experiments to measure ICD in Neon-Dimers using a Cold Target Recoil Ion Momentum Spectroscopy (COLTRIMS) detector. In the experiment XUV pulses will be superimposed with THz pulses to perform the time resolved experiments.

A 25.35 Tue 16:15 Redoutensaal

Ionisation dynamics of mixed Xe/Kr clusters in intense laser pulses — •Thomas Menz[1], Bruno Langbehn[1], Patrick Behrens[1], Linos Hecht[1], Anatoli Ulmer[1], Benjamin Erk[2], Laurent Mercadier[3], Daniela Rupp[1,4], and Thomas Möller[1] — [1]IOAP, TU Berlin — [2]DESY Hamburg — [3]European XFEL, Hamburg — [4]MBI Berlin

Atomic clusters can be used for precise light-matter interaction studies. Rare gas clusters for example can serve as ideal model systems with a simple geometric and electronic structure. In particular, mixed clusters can be utilised to disentangle and analyse the dynamics of surface and bulk in a core-shell system. Using a picosecond laser with a wavelength of 263 nm, Xe/Kr clusters were ionised and measured via time-of-flight spectroscopy. Different mixtures of Xe and Kr and varying cluster sizes are compared and implications for the structure and properties of Xe/Kr clusters in intense light pulses are discussed.

A 25.36 Tue 16:15 Redoutensaal

Investigations of Kramers-Henneberger atoms in alkali metals via tailored light fields — •Christoph Jusko[1], Slawomir Skruszewicz[2], Danilo Zille[2], Gerhard G. Paulus[2], and Milutin Kovacev[1] — [1]Institut für Quantenoptik, Leibniz Universität Hannover, Welfengarten 1, 30167 Hannover — [2]Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena

Theoretical studies predict a stabilizing interaction of atoms with high-intense light fields in the over-the-barrier ionization regime. We present an experimental approach to detect these stabilized atoms, called Kramers-Henneberger atoms, with tailored intense light fields in alkali metals via velocity map imaging.

A 25.37 Tue 16:15 Redoutensaal

Coulomb rescattering and the ionization enhancement around the twice pondermotive energy — •P. L. He[1,2], K. Z. Hatsagortsyan[1], and C. H. Keitel[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Shanghai Jiao Tong University, Shanghai 200240, China

In this work, we proposed a method to regularize the Coulomb divergence in the Improved Strong Field Approximation, which takes into account the Coulomb interaction via the Born approximation within the framework of Strong Field Approximation. With this method, the ionization enhancement around twice the ponderomotive energy of the ejected electron is analyzed. By comparing the relevant classical trajectories and the quantum orbits, insights into the enhancement and ionization mechanisms are gained.

A 25.38 Tue 16:15 Redoutensaal

Automated re-establishment of the spatial overlap in XUV/XUV pump-probe experiments in the focus of CAMP at FLASH — •Nils Bernhardt[1], Mario Sauppe[1], Cédric Bomme[2], Stefan Düsterer[2], Benjamin Erk[2], Torsten Feigl[3], Erland Müller[2], Jan P. Müller[1], Christopher Passow[2], Daniel Ramm[2], Daniel Rolles[2,4], Dimitrios Rompotis[2], Rolf Treusch[2], Holger Weigelt[2], Jannis Zimbalski[1], Thomas Möller[1], and Daniela Rupp[1,5] — [1]TU Berlin — [2]DESY — [3]optikX fab — [4]Kansas State University, USA — [5]MBI Berlin

Double pulse experiments with high intensity short-wavelength free-electron lasers enable unprecedented insight into the light induced dynamics of matter on the nanoscale. The recently installed multilayer based split-and-delay unit for the multi-purpose end-station CAMP at FLASH provides sub-femtosecond resolution and long delays up to 650 picoseconds. For time-resolved experiments the two pulses have to be overlapped in the focus, but actuator inaccuracies lead to a slight variation of the beam angle for different delays and subsequently to a misalignment that needs to be corrected. In this work, we develop a routine that tracks the inaccuracies and automatically overlaps the double pulses within the focus plane.

A 25.39 Tue 16:15 Redoutensaal

Characterizing the structure of pulsed rare gas cluster and helium nanodroplet sources — •Patrick Behrens[1], Bruno Langbehn[1], Fabian Seel[1], Anatoli Ulmer[1], Daniela Rupp[1,2], and Thomas Möller[1] — [1]IOAP, Technische Universität Berlin — [2]Max-Born-Institut Berlin

With XUV and X-ray free-electron lasers (FEL) delivering ultrashort intense light pulses, a detailed insight into the structure of nanoparticles such as viruses and macromolecules has become feasible. In this context, atomic clusters and helium nanodroplets enable novel experimental opportunities for fundamental research and imaging of nanospecimen [Tanyag et al., 2015, Struct. Dyn. 2],[Gorkhover et al., 2017, arXiv:1707.09424]. In particular, superfluid helium nanodroplets can serve as an ideal cooling matrix for spectroscopy.

The specific cluster source properties, e.g. stagnation pressure, temperature, valve opening time and distance between source and interaction region, play a crucial role in FEL spectroscopy as they directly determine the size, shape, distribution and density of the cluster beam.

In this presentation, we will discuss available methods to characterize these beam properties for different cluster sources.

A 25.40 Tue 16:15 Redoutensaal

X-ray and XUV Fourier holography of free-flying nanoparticles — •A Ulmer[1], J Bielecki[2], L Flückiger[3], A Al Haddad[4], F Benzi[2], J Correa[5], T Ekeberg[5], B Erk[5], L Hecht[1], A Heilrath[1], M Hantke[2], O Kulyk[6], B Langbehn[1], D Larsson[2], I Lundholm[2], T Osipov[7], C Passow[5], D Rompotis[5], D Rupp[1], J Sellberg[8], G van der Schot[2], P Walter[7], L Young[4], F Zimmermann[1], F Maia[2], J Hajdu[2], T Möller[1], C Bostedt[4], and T Gorkhover[1,7,9] — [1]TU Berlin — [2]Uppsala Univ. — [3]La Trobe Univ. — [4]Argonne Nat. Lab. — [5]Desy — [6]ELI Beamlines — [7]SLAC — [8]KTH Stockholm — [9]Stanford

The advance of XUV/X-ray Free Electron Lasers (FEL) enable unprecedented insights into processes in individual non-crystalline nanoparticles with high spatial and temporal resolution. While in X-ray imaging of solid state targets Fourier transform holography was used for a long time as an elegant solution to the phase problem [Eisebitt et al., *Nature* **432**, 885-888], it was only recently realized for unsupported nanospecimen, using a X-ray FEL facility [Gorkhover et al., 2017, arXiv:1707.09424]. Here atomic gas phase clusters were used as a holographic reference scatterer to image nanometer scale bio specimen – both injected by two different sources. Using a new approach, it becomes possible to overcome problems with alignment and overlap of two particle beams by using only one injector. This simplifies the experimental setup vastly, while increasing the holographic hit rate at the same time. First results of the proof of concept experiment as well as a framework to evaluate gas phase holograms will be presented.

A 25.41 Tue 16:15 Redoutensaal

Laser Infrastructure for Multi-Dimensional Spectroscopy from XUV to Mid-IR — •Patrick Rupprecht, Lennart Aufleger, Thomas Ding, Marc Rebholz, Carina da Costa Castanheira, Stephan Goerttler, Alexander Magunia, Christian Ott, and Thomas Pfeifer — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Two-Dimensional Femtosecond Spectroscopy (2DFS) has developed into an indispensable tool to investigate vibrational and electronic couplings in molecular dynamics [Jonas, Annu. Rev. Phys. Chem. 2003]. The presented setup at MPI for Nuclear Physics, Heidelberg, will extend conventional 2DFS schemes towards multi-dimensional, multi-color transient spectroscopy. Based on a 20 mJ pulse energy, 1 kHz repetition-rate Titanium:Sapphire laser system, the optical setup will provide attosecond pulses in the XUV (with maximum photon energies beyond 150 eV), few-cycle pulses in the visible to near infrared spectral region, as well as multi-mJ, femtosecond tunable-wavelength pulses from 1.1 μm to 2.6 μm from an OPA. In combination with the already existing four-quadrant split mirror, this setup targets electron correlation dynamics in atomic and molecular systems. Of particular interest is also the metrology of absorption line shape changes to quantify the influence of strong laser fields from fundamental to complex systems [Ott et al., Science 2013].

A 25.42 Tue 16:15 Redoutensaal

Grazing-Incidence XUV Split-Delay Unit for the FLASH2 Reaction Microscope — •Florian Trost[1], Kirsten Schnorr[1], Sven Augustin[1], Georg Schmid[1], Severin Meister[1], Hannes

Lindenblatt[1], Yifan Liu[1], Thomas Wodzinski[2], Barbara Keitel[2], Elke Ploenjes-Palm[2], Markus Braune[2], Marion Kuhlmann[2], Stefan Düsterer[2], Rolf Treusch[2], Thomas Pfeifer[1], Claus Dieter Schröter[1], and Robert Moshammer[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]DESY, Hamburg

In order to perform XUV pump-probe experiments on small quantum systems such as atomic targets or small molecules and clusters, a new direct-focussing XUV split-and-delay optics was designed, installed and commissioned as part of the permanent reaction microscope user endstation at FLASH2. A planar mirror, which is divided into two halves geometrically, splits an incoming XUV pulse into two parts and introduces a variable temporal delay between them. An off-axis ellipsoidal mirror then focuses the XUV pulses into the gas target of the reaction microscope.

The focus position and the optical aberrations of the FEL beam were measured using a wavefront sensor. We identified the influence of position and rotation of the mirrors on the different aberrations. A focus size of 3 micrometer in diameter was obtained. The new direct-focussing XUV optics decreases background from scattered light compared to our previous back-reflecting geometry due to single passage through the interaction region and because of the smaller focus size.

A 25.43 Tue 16:15 Redoutensaal

Strong Field Ionization of the H atom in bi-circular fields — •Philipp M. Stammer[1,2], Felipe Morales[1], Olga Smirnova[1,2], and Misha Ivanov[1,3,4] — [1]Max-Born-Institute for Nonlinear Optics and Short Pulse Spectroscopy, Germany — [2]Technical University Berlin, Germany — [3]Imperial College London, United Kingdom — [4]Humboldt-University Berlin, Germany

Interaction of a strong laser field with an atom or a molecule is often described in a simple three-step picture: an electron is ionized, then it is accelerated away from the core, to be finally driven back to the parent ion, driven by the laser field. The recollision or the rescattering with the parent ion is at the heart of strong-field phenomena, i.e. High Harmonic Generation (HHG) and Above Threshold Ionization (ATI).

While a circularly polarized laser field does not allow for recollision, a bi-circular field (consisting of two co-planar, counter-rotating, circularly polarized laser fields) does. Bi-circular HHG has been studied both experimentally and theoretically, whereas research on ATI spectra in these fields has been mostly limited to analytical studies.

In this work we present ATI spectra calculated via direct solution of the Time Depending Schrödinger Equation for the Hydrogen atom, exposed to an intense bi-circular field. These calculations are computationally demanding, and will help to understand the underlying physics, and confirm the analytical predictions.

The emitted photo-electrons exhibit the same three-leaf structure as the electric field, but also deflections and structure due to the interaction with the Coulomb potential will be discussed.

A 25.44 Tue 16:15 Redoutensaal

Reaction Microscope Endstation at FLASH2 — •Hannes Lindenblatt[1], Kirsten Schnorr[1], Sven Augustin[1], Georg Schmid[1], Severin Meister[1], Florian Trost[1], Yifan Liu[1], Markus Braune[2], Rolf Treusch[2], Claus-Dieter Schröter[1], Thomas Pfeifer[1], and Robert Moshammer[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]DESY, Hamburg

Our group has recently installed a Reaction Microscope as permanent endstation at FLASH2. During the last year, first experiments and several upgrades where performed. Most notably, a gracing incidence mirror for focussing and split-and-delay was installed. In the near future, our target delivery system will be upgraded to ease usage of different gas-phase targets. Furthermore, an IR Laser as well as a HHG source will become available for the beamline. These will allow for a multitude of pump-probe schemes. The poster will provide an overview of the setup including beam geometry, target preparation, diagnostics and data acquisition, as well as first results.

A 25.45 Tue 16:15 Redoutensaal

Two photon double ionization in Neon — •Severin Meister[1], Kirsten Schnorr[1], Sven Augustin[1], Georg Schmid[1], Hannes Lindenblatt[1], Florian Trost[1], Markus Braune[2], Robert Moshammer[1], and Thomas Pfeifer2[1] — [1]MPIK Heidelberg — [2]DESY

The presented experiment unveils the angular correlation of emitted electrons in sequential two-photon double ionization of neon (in a time-resolved manner). In sequential ionization electrons are removed via intermediate ionic states. Even though the atom is first singly ionized and in the following, independent step further ionized by absorbing a second photon, measurements and theory find both electrons to be correlated. The angular distribution of the "first" electron is predicted to depend on the detection angle of the "second" one, which stands in contrast to the simple picture of sequential ionization. This can be quantified by the β_4 anisotropy-parameter which is non-zero for the first electron, under the condition that the second electron was emitted.

A 25.46 Tue 16:15 Redoutensaal

Fragmentation Dynamics of Argon Dimers and Multi-Photon Ionization of Atomic Argon Studied by XUV-IR Experiments at FLASH — •Georg Schmid[1], Kirsten Schnorr[1], Sven Augustin[1], Hannes Lindenblatt[1], Severin Meister[1], Thomas Ding[1], Yifan Liu[1], Kamal P. Singh[2], Mathieu Gisselbrecht[3], Harald Redlin[4], Stefan Düsterer[4], Rolf Treusch[4], Claus-Dieter Schröter[1], Thomas Pfeifer[1], and Robert Moshammer[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]IISER, Mohali, India — [3]Lund University, Sweden — [4]DESY, Hamburg

Different XUV multi-photon ionization pathways of Ar_2 dimers such as interatomic coulombic decay (ICD) and charge transfer at a curve crossing (CT-CC) were identified by measuring the kinetic-energy release of the Coulomb-exploded dimer fragments using a reaction microscope. By applying an intense IR probe pulse, we were able to follow the dynamics of these fragmentation pathways in real time. Amongst other things, we have deduced an average lifetime for the charge transfer channel $Ar^{2+}(3p^{-3}nl)-Ar \rightarrow Ar^{+}(3p^{-2}n'l')+Ar^{+}(3p^{-1})$, which agrees with theoretical calculations.

Furthermore, we investigated XUV multi-photon ionization of atomic Ar at FEL intensities of $I \sim 5 \times 10^{13}$ W/cm^2 and measured charge states up to Ar^{5+}. An IR probe pulse enabled to distinguish between sequential and non-sequential ionization routes and revealed intermediate resonances.

A 25.47 Tue 16:15 Redoutensaal

Strong-field induced nuclear dynamics in C_{60} traced via time-resolved X-ray scattering at LCLS — •Sven Augustin[1], Kirsten Schnorr[1], Georg Schmid[1], Hannes Lindenblatt[1], Robert Moshammer[1], Arnaud Rouzée[2], Marc Vrakking[2], Claus-Peter Schulz[2], and Thomas Pfeifer[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]Max-Born-Institut, Berlin

Time-resolved X-ray scattering images and time-of-flight spectra of NIR (800 nm) laser-excited C_{60} molecules have been recorded employing the LAMP instrument at AMO/LCLS. Using a pnCCD detector, in average 100 photons scattered off C_{60} have been detected per 1.8 keV X-ray pulse.

Different dynamics have been observed as the NIR laser intensity was varied: For higher intensities, the scattering signal vanishes within less than 100 femtoseconds indicating complete disintegration (i.e., Coulomb explosion) of the fullerenes. In addition, a fast symmetric shrinking of the circular scattering patterns has been found, from which the time scale of the molecular expansion can be determined to be roughly 100 femtoseconds. For lower intensities, more complex variations of the size of the scattering pattern on longer time scales (up to picoseconds) have been observed.

A 25.48 Tue 16:15 Redoutensaal

The signature of electron correlation in HHG spectra from a He atom — •Julius Rapp and Dieter Bauer — Universität Rostock

We present high-harmonic generation (HHG) spectra from He obtained by numerical simulations which fully treat electron correlation. As expected, the major part of the spectrum is exactly reproduced by single-active-electron modeling. However, beyond the first plateau's cutoff at $3.17\,U_\mathrm{p}+1.3\,I_\mathrm{p}^\mathrm{He}$ we find a second plateau with orders of magnitude less HHG yield. Interestingly, the characteristics of those additional HHG features significantly differ from the singly charged ion's HHG signature. We illustrate the disentanglement of several possible explanations by time-frequency analyses and extended simple-man's modeling based on the strong-field approximation.

A 25.49 Tue 16:15 Redoutensaal

Determination of the mean cluster size and evolution of excitonic valence states by fluorescence from homogenous Ne, Ar and Kr clusters — •Xaver Holzapfel, Andreas Hans, Gre-

gor Hartmann, Christian Ozga, Philipp Schmidt, Philipp Reiss, Arno Ehresmann, and André Knie — Institut für Physik und CINSaT, HeinrichPlett-Str. 40, D-34132 Kassel, Germany

Finite aggregates like clusters are used to study microscopic phenomena, in the range between molecular and condensed matter physics. The average size of clusters is their most important quantity for fundamental investigations. For clusters produced by supersonic expansion, the average cluster size is usually estimated indirectly by an empirical law involving the expansion parameters. Here we present a direct method to measure the mean cluster size by resonant excitation of outer valence electrons and the subsequent emission of fluorescence photons from homogenous Ne, Ar and Kr clusters. This method has been compared to the average cluster size determination by the empirical law. The collected data reveals new excitonic valence states and enables additional and more precise insights into the evolution of cluster states by scaling the mean size from the molecular to condensed matter regions.

A 25.50 Tue 16:15 Redoutensaal

A molecular movie of Interatomic Coulombic Decay in NeKr — •Florian Trinter[1], Tsveta Miteva[2], Miriam Weller[1], Sebastian Albrecht[1], Alexander Hartung[1], Martin Richter[1], Joshua Williams[1], Averell Gatton[3], Bishwanath Gaire[3], Thorsten Weber[3], James Sartor[4], Allen Landers[4], Ben Berry[5], Vasili Stumpf[2], Kirill Gokhberg[2], Reinhard Dörner[1], and Till Jahnke[1] — [1]Institut für Kernphysik, Goethe-Universität, 60438 Frankfurt am Main, Germany — [2]Theoretische Chemie, Physikalisch-Chemisches Institut, Universität Heidelberg, 69120 Heidelberg, Germany — [3]Lawrence Berkeley National Laboratory, Chemical Sciences Division, Berkeley, California 94720, USA — [4]Department of Physics, Auburn University, Auburn, Alabama 36849, USA — [5]J. R. MacDonald Laboratory, Department of Physics, Kansas State University, Manhattan, Kansas 66506, USA

During the last 15 years a novel decay mechanims of excited atoms has been discovered and investigated. This so called "Interatomic Coulombic Decay" (ICD) involves the chemical environment of the electronically excited atom or molecule: the excitation energy is transferred to a neighbor of the initially excited particle usually ionizing that neighbor. It turned out that ICD is a very common decay route in nature as it occurs across van der Waals and hydrogen bonds. The time evolution of ICD is predicted to be highly complex, as its efficiency strongly depends on the distance of the atoms involved and this distance typically changes during the decay. Here we present a direct measurement of the temporal evolution of ICD using a novel experimental approach.