

A 7: Interaction with VUV and X-ray light I

Time: Monday 14:00–16:00

Location: B 302

A 7.1 Mon 14:00 B 302

EUV Ionization of Bare and Alkali Doped Helium Nanodroplets — ●D. BUCHTA¹, S.R. KRISHNAN², N. BRAUER³, C. CALLEGARI⁴, M. CORENO⁴, K. PRINCE⁴, P. O'KEEFE⁵, F. STIENKEMEIER¹, R. MOSHAMMER², and M. MUDRICH¹ — ¹Physikalisches Institut, Universität Freiburg, D-79104 Freiburg im Breisgau — ²Max-Planck-Institut für Kernphysik, D-69117 Heidelberg — ³Laboratoire de Chimie Physique Moléculaire, Swiss Federal Institute of Technology Lausanne, CH-1015 Lausanne — ⁴Sincrotrone Trieste, I-34149 Basovizza — ⁵CNR Istituto di Metodologie Inorganiche e dei Plasm, I-00016 Monterotondo Scalo

He nanodroplets are widely used as a cold and weakly interacting matrix for spectroscopy of embedded species. In this work we excite or ionize the He droplets using synchrotron radiation and study the back action onto the impurity atoms. Using photoelectron-photoion coincidence imaging spectroscopy at variable photon energies (20-25eV), we compare charge-transfer to Penning ionization of impurities located inside the droplets (rare gases) and those located at the droplet surface (alkali metals). The surprising finding is that alkali metals are very efficiently Penning ionized upon excitation of the 1s2p-band of He droplets, in contrast to rare gases. This speaks for rapid exciton migration to the surface, followed by relaxation and eventually the energy transfer to the alkali impurity.

A 7.2 Mon 14:15 B 302

Electron emission following collective autoionization of He nanodroplets irradiated by intense XUV pulses — ●YEVHENIY OVCHARENKO¹, VIKTOR LYAMAYEV², RAPHAEL KATZY², MICHELE DEVETTA³, AARON LAForge², OKSANA PLEKAN⁴, PATRICK O'KEEFE⁵, ROBERT RICHTER⁴, TOMMASO MAZZA⁶, MICHELE DI FRAIA⁷, NILS-BENEDICT BRAUER⁸, MARCELLO CORENO⁵, PAOLA FINETTI⁴, PAOLO PISERI³, MARCEL DRABBELS⁸, STEFANO STRANGES⁹, KEVIN PRINCE⁴, CARLO CALLEGARI⁴, FRANK STIENKEMEIER², and THOMAS MÖLLER¹ — ¹Technische Universität Berlin, Germany — ²Universität Freiburg, Germany — ³University of Milan, Italy — ⁴Sincrotrone Trieste, Italy — ⁵CNR-IMIP Rome, Italy — ⁶European XFEL GmbH, Germany — ⁷University of Trieste, Italy — ⁸EPFL Lausanne, Switzerland — ⁹University of Rome "Sapienza", Italy

The narrow bandwidth and tunability of FERMI@Elettra seeded FEL (Free Electron Laser) open new areas in the study of ultrafast radiation-matter interaction. Using this unique source with high-brilliance femtosecond XUV-pulses, photoelectron spectroscopy of He-nanodroplets has been performed by velocity map imaging technique in the photon energy range 20-27 eV. The electron spectra show that ionization occurs not only by a direct process at photon energies above the ionization potential (IP) but also below the threshold. It was found that electron spectra below IP strongly depend on the total energy absorbed by nanodroplets and give evidence for a collective autoionization process with energy transfer between neighboring atoms.

A 7.3 Mon 14:30 B 302

VUV Studies on Doped Helium Nanodroplets — ●RAPHAEL KATZY¹, AARON LAForge¹, MICHELE ALAGIA⁶, LORENZO AVALDI², CARLO CALLEGARI³, MARCELLO CORENO², MICHELE DEVETTA⁴, MARCEL DRABBELS⁵, ANTTI KIVIMAKI¹, VIKTOR LYAMAYEV⁶, TOMMASO MAZZA⁷, THOMAS MÖLLER⁸, MARCEL MUDRICH⁶, YEVHENIY OVCHARENKO⁸, PAOLO PISERI⁴, KEVIN PRINCE³, ROBERT RICHTER³, MICHELE DI FRAIA¹⁰, STEFANO STRANGES⁹, and FRANK STIENKEMEIER¹ — ¹Universität Freiburg, Germany — ²CNR-IMIP Rome, Italy — ³Sincrotrone Trieste, Italy — ⁴University of Milan, Italy — ⁵EPFL Lausanne, Switzerland — ⁶CNR-IOM Trieste, Italy — ⁷European XFEL GmbH, Germany — ⁸Technische Universität Berlin, Germany — ⁹University of Rome "Sapienza", Italy — ¹⁰University of Trieste

We performed measurements on doped helium nanodroplets by the VUV- seeded FEL FERMI@Elettra. Using the FEL's high intensity and broad wavelength tunability, one can resonantly excite a large percentage of either the dopant or the cluster to look for effects of mutual interaction, such as the formation of nanoplasmas or energy transfer between dopant and cluster. In this regard, various dopants and their abundance along with cluster size were varied in order to fully exploit

any possible observables.

A 7.4 Mon 14:45 B 302

Attosecond-resolved electron dynamics around the 1st ionization threshold of helium measured by multidimensional absorption spectroscopy — ●ANDREAS KALDUN, CHRISTIAN OTT, VEIT STOOS, PHILIPP RAITH, KRISTINA MEYER, MARTIN LAUX, ALEXANDER BLAETTERMANN, THOMAS DING, and THOMAS PFEIFER — Max-Planck Institut f. Kernphysik, Heidelberg, Germany

We recently developed a transient-coupling measurement scheme, which we employed to uncover coherent laser-induced coupling of doubly-excited helium states to continuum states [1]. Here, we apply this measurement scheme to study in detail the coherent electron dynamics and general absorption phenomena arising for single-excitation of helium around 24 eV with attosecond-pulsed VUV light fields. Exploiting a multidimensional control by (a) varying the time delay between the attosecond and a coupling laser pulse, (b) tuning the coupling laser intensity and (c) analyzing the propagation direction of the transmitted VUV attosecond pulse we observe the transformation of the original (Lorentzian) resonance shapes into Fano line shapes. To understand the mechanism behind this quantum control we performed numerical simulations to model our experimental results, which include the attosecond-pulsed excitation and laser coupling of multiple excited states [2]. These simulations allowed us to identify the ponderomotive dressing of the states in the laser field as a key component for understanding the control of several line shapes of the observed absorption spectra. [1]C. Ott et al., arXiv:1205.0519v1 [physics.atom-ph] (2012) [2]A. Kaldun et al., in preparation (2013)

A 7.5 Mon 15:00 B 302

XUV induced dissociative photo-ionization of H₂ observed by electron-ion correlation — ●ANDREAS FISCHER¹, ALEXANDER SPERL¹, PHILIPP CÖRLIN¹, MICHAEL SCHÖNWALD¹, ARNE SENFTLEBEN¹, JOACHIM ULLRICH^{1,2}, and ROBERT MOSHAMMER¹ — ¹Max-Planck-Institut für Kernphysik, Heidelberg — ²Physikalisch-Technische Bundesanstalt, Braunschweig

We studied the dissociative photo-ionization of H₂ induced by XUV radiation. The use of a reaction microscope enables us to perform kinematically complete coincidence measurements. In an ion-electron-correlation measurement we observed an asymmetric dissociation in the molecular frame, similar to the asymmetry observed by [1], caused by path interference of two different dissociation channels. The first channel includes the H₂⁺(A²Σ_u) state and the second the H₂⁺(X²Σ_g) state and the doubly excited H₂(Q₁¹Σ_u) states. A semi-classical simulation, using phase integrals, reproduces the observed asymmetry.

[1] F. Martín, J. Fernández, T. Havermeier, L. Foucar, T. Weber, K. Kreidi, M. Schöffler, L. Schmidt, T. Jahnke, O. Jagutzki, et al., Science 315, 629 (2007)

A 7.6 Mon 15:15 B 302

Ly-α coincidence after dissociation of hydrogen molecules in superexcited states into neutral fragments — ●PHILIPP SCHMIDT, PHILIPP REISS, BENJAMIN KAMBS, ANDRÉ KNIE, and ARNO EHRESMANN — Institut für Physik and Center for Interdisciplinary Nanostructure Science and Technology, Universität Kassel, Heinrich-Plett-Straße 40, D-34132 Kassel, Germany

The time dependent fluorescence intensity in the EUV regime of molecular hydrogen after photoexcitation with an energy of 33.66 eV has been measured with a photon-photon coincidence setup at different pressures in the range of 0.1 to 0.4 Pa. At this energy, the resonant excitation of the superexcited Q₂¹Π (1) state leads to neutral dissociation into hydrogen atoms, where both atoms can be excited with principal quantum numbers of $n = 2$ and $n = 3$. The coincidence time spectra as well as individual detector intensity has been analysed with respect to the fluorescence lifetimes for the different pressures, especially the 2p-1s decay by Lyα emission.

A 7.7 Mon 15:30 B 302

Development of an apparatus for the angle-resolved detection of two photons in coincidence — ●PHILIPP REISS, PHILIPP SCHMIDT, BENJAMIN KAMBS, ANDRÉ KNIE, and ARNO EHRESMANN — Institute of Physics, University of Kassel, Heinrich-Plett-Str.40, 34132

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The detection of photons emitted in coincidence by fragments of doubly or multiply excited molecules offers a method to study processes where no ions are formed, i.e. neutral dissociation. In addition to the time-resolved detection, the possibility to perform angular correlations of the emitted photons gives rise to a more thorough investigation of the ongoing processes.

Experimental realizations of a dedicated apparatus are presented and compared in terms of solid angle coverage, optical properties, monitoring of the target pressure and applicability for the use at synchrotron facilities.

A 7.8 Mon 15:45 B 302

Investigation of resonant X-ray absorption structures of different terpenes by total ion yield measurements in the vicinity of C1s-edge — ●BENJAMIN KAMBS¹, KARI JÄNKÄLÄ^{2,3}, PHILIPP SCHMIDT¹, ANDREAS HANS¹, CHRISTIAN OZGA¹, PHILIPP REISS¹, ANDRÉ KNIE¹, and ARNO EHRESMANN¹ — ¹Institut für Physik und Center for Interdisciplinary Nanostructure Science and Technology, Uni-

versität Kassel, D-34132 Kassel, Germany — ²Department of Physics, University of Oulu, P.O. Box 3000, 90014 Oulu, Finland — ³Institute for Experimental Physics, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany

Structures differing from their own mirror images are called chiral. In a variety of biochemical reactions there is a crucial difference in the behaviour of both types of one chiral molecule. For an understanding of those processes, it is of essential importance to know the electronic architecture of such molecules and how it is influenced by the chiral molecular potential.

A small prototypical class of chiral substances often found in nature are terpenes. In the present experiment we investigated Limonene, α -Pinene, Carvone and Fenchone at the beamline UE56/2 at BESSY, Berlin. Those molecules have been excited by monochromatized synchrotron radiation in the regime of the C1s edge. We measured the total ion yield spectra during their subsequent decay and relaxation. The results yield information about the absorption of X-rays and are compared to spectra calculated by means of the time dependent density functional theory method.