A 27: Poster: Photoionization

Time: Wednesday 16:30–19:00 Location: Poster.V

A 27.1 Wed 16:30 Poster.V

Frequenzstabilisierung eines Systems dreier Diodenlaser zur Laserresonanzionisation an Uranisotopen — •Thomas Fischbach[1], Amin Hakimi[1], Sebastian Raeder[2], Norbert Trautmann[3] und Klaus Wendt[1] — [1]Institut für Physik, Johannes Gutenberg Universität, Mainz — [2]TRIUMF, Vancouver, Canada — [3]Institut für Kernchemie, Johannes Gutenberg Universität, Mainz

Die hochauflösende Resonanzionisations-Massenspektrometrie (HR-RIMS) bietet durch Kombination von mehrstufig resonanter Laserionisation mit schmalbandigen kontinuierlichen Lasern sowie der Quadrupolmassenspektrometrie die Möglichkeit, extremste Isotopenverhältnisse zu erschließen. Die Ionisation erfolgt hierbei isotopenselektiv mittels transversaler Überlagerung der Strahlung dreier Diodenlaser mit einem kollimierten Atomstrahl; diese stellt hohe Ansprüche an die Frequenzstabilität der Laser im Bereich von < 1 MHz. Zur Frequenzstabilisierung mit kontrollierter Verstimmung über die Isotopieverschiebung wurde ein kommerzielles System von festen Quadraturinterferometern mit einer Fringe-Offset-Technik bestehend aus einem Scanning Fabry-Perot-Interferometer und einem Referenzlaser kombiniert. Neben der Kurz- und Langzeitstabilität im Bereich weniger MHz Sollfrequenzabweichung über mehrere Stunden hinweg bietet das System die Möglichkeit für eine schnelle, automatisierte Abstimmung zwischen den Anregungsschritten verschiedener Uran-Isotope, sowie für weiterführende spektroskopische Messungen. Der Aufbau des Systems, Stabilitätsmessungen und der Status aktueller spektroskopischer Untersuchungen an Uran-238 werden vorgestellt.

A 27.2 Wed 16:30 Poster.V

Laser-Assisted Photonuclear Effect in Halo-Nuclei — •Anis Dadi and Carsten Müller — Max-Planck-Institut für Kernphysik Saupfercheckweg 1, D-69117 Heidelberg

The emission of a proton from a halo nucleus by absorption of a high-energy photon in the presence of a strong optical laser beam is studied. It is shown that the assisting laser field modifies the properties of the photonuclear effect in a characteristic way. We investigate the energy distribution of the photoproton in terms of the number of absorbed laser photons, as well as the angular proton distribution as a function of the polar emission angle. The dependencies on the photon energy, the laser polarization, and the field geometry are discussed as well.

A 27.3 Wed 16:30 Poster.V

Quasi free mechanism in single photon double ionization of Helium — •Markus Schöffler[1,2], Till Jahnke[1], Markus Waitz[1], Florian Trinter[1], Ute Lenz[1], Christian Stuck[1,2], Mathew Jones[3], Ali Belkacem[2], Lew Cocke[4], Allen Landers[3], Horst Schmidt-Böcking[1], Thorsten Weber[2], and Reinhard Dörner[1] — [1]Institut für Kernphysik, J. K. Goethe-Universität Frankfurt am Main, 60438 Frankfurt — [2]Lawrence Berkeley National Lab, Berkeley, CA, 94720, USA — [3]Auburn University, Auburn, AL, 36849, USA — [4]Kansas State University, Manhattan, KS, 66506, USA

Double ionization of Helium by a single photon is widely believed to proceed through two mechanisms: knock-off (TS1) or shake-off, with the last one dominating at high photon energies. A new mechanism, termed "Quasi Free Mechanism" (QFM) was predicted 35 years ago by Amusia and coworkers, but escaped experimental observation till today. Here we provide the first proof of this mechanism using 800 eV photons from the Advanced Light Source. Fragments (electrons and ions) were measured in coincidence using momentum spectroscopy (COLTRIMS). He2+ ions with zero momentum were found - the fingerprint for the QFM.

A 27.4 Wed 16:30 Poster.V

Photoelectron-Auger electron coincidence experiments: the next generation — Tiberiu Arion[1], Cosmin Lupulescu[2], Ruslan Ovsyannikov[3], Marko Förstel[4], Gunnar Öhrwall[5], Andreas Lindblad[5], Svante Svensson[6], Alex M. Bradshaw[4,7], Ralph Püttner[8], Wolfgang Eberhardt[1,2], and •Uwe Hergenhahn[4] — [1]CFEL, 22607 Hamburg — [2]TU Berlin, 10623 Berlin — [3]Helmholtz-Zentrum Berlin, 12489 Berlin — [4]Max-Planck-Institut für Plasmaphysik, 85748 Garching — [5]MAX-Lab, SE-22100 Lund, Sweden — [6]Uppsala University, SE-75120 Uppsala, Sweden — [7]Fritz-Haber-Institut, 14195 Berlin — [8]FU Berlin, 14195 Berlin

Inner shell photoionization of atoms and molecules almost always leads to sequential photo double ionization. The primary photoelectron is followed within a few fs by an Auger electron. Detecting these electrons in coincidence can greatly enhance the amount of information that can be spectroscopically retrieved. We present our latest set-up which primarily aims at coincidence electron spectroscopy with very high energy resolution. Our approach is based on a combination of a conventional hemispherical electron analyser with a novel time-of-flight electron spectrometer (ArTOF). Due to its use of an angle resolving electron lens, the ArTOF is superior over conventional, linear time-of-flight spectrometers in both collection angle and energy resolution. With this, we are able to achieve energy resolutions comparable to the vibrational energies of simple molecules in a coincidence experiment, while maintaining acceptable solid angles at the same time. Results of recent experiments on O_2 and $C_2H_2F_2$ will be presented.

A 27.5 Wed 16:30 Poster.V

Long-lived states and decay of Helium in the one and two dimensional configuration — •Klaus Zimmermann[1], Vera Neimanns[1], Felix Jörder[1], Alberto Rodriguez[1], Pierre Lugan[2], and Andreas Buchleitner[1] — [1]Physikalisches Institut, Albert-Ludwigs-Universität, Freiburg — [2]École Polytechnique Fédérale de Lausanne, Lausanne, Schweiz

Helium is a prototypical model for complex decaying systems. While being the simplest system beyond Hydrogen it exhibits intriguing features due to the electron electron interaction that leads to multiple decay channels. We present studies on the driven and undriven one dimensional Zee configuration that provide insight into its (auto-)fragmentation with resolution of distinct channels. Furthermore we show the planar configuration with non-vanishing angular momentum, focusing on surprisingly stable states. This gives rise to a comparative study of the corresponding classical Helium model.

A 27.6 Wed 16:30 Poster.V

Dynamic chirality in the weakly-bound Ar tetramer studied by Coulomb explosion imaging — •Maksim Kunitski, Markus Schöffler, Jian Wu, Martin Pitzer, Till Jahnke, Lothar Ph. H. Schmidt, and Reinhard Dörner — Institut für Kernphysik, Goethe-Universität Frankfurt am Main, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany

Chirality related phenomena such as parity violation, circular dichroism, homochirality [1,2] have attracted much attention in the recent time. Besides "normal" or "static" chirality one distinguishes also instantaneous or "dynamic" chirality, which, for instance, can be induced by zero point vibrations in systems that are in average achiral and symmetric [3].

In this contribution we are going to present our recent results on the investigation of dynamic chirality in the weakly-bound Ar tetramer. Namely, we successfully applied Coulomb explosion imaging by means of the COLd Target Recoil Ion Momentum Spectroscopy (COLTRIMS) [4] for determination of two instantaneous enantiomeric structures of Ar tetramer. Experiments with left- and right-handed circularly polarized femtosecond laser fields reveal no circular dichroism in quadruple ionization of these two enantiomeric forms.

[1] M. Quack, Faraday Discuss. 150, p. 533 (2011)
[2] L. D. Barron, Space Sci. Rev. 135, p.187 (2008)
[3] T. Kitamura et al., J. Chem. Phys. 115, p.5 (2001)
[4] R. Dörner et al., Phys. Rep. 330, p. 95 (2000)

A 27.7 Wed 16:30 Poster.V

The photoabsorption spectrum of O_2 below the O 1s threshold reanalysed — •Ralph Püttner[1], Catalin Miron[2], Kiyoshi Ueda[3], and Uwe Becker[4] — [1]Freie Universität Berlin, Berlin, Germany — [2]Synchrotron SOLEIL, Gif-sur-Yvette Cedex, France — [3]Institut for Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Japan — [4]Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany

The photoabsorption spectrum of O_2 below the O 1s ionization threshold is known to be complex mainly because of two reason. First, O_2 in the ground state has a open-shell structure and second the antibonding O $1s_g^{-1}3\sigma_u^*$ resonance is – contrary to most of the other molecules – below the ionization threshold and interacts strongly with the Rydberg

states. The resulting complexity initiated in the last three decades numerous experimental and theoretical investigations, which led to a general understanding of the photoabsorption spectra. However, some details are still not fully explained.

In this work we present an extended fit analysis of angular resolved total ion yield spectra, which allowed us to observe novel information. First, we observed Fano lineshapes for the lowest Rydberg state, which is due to an interaction with O $1s_g^{-1}3\sigma_u^*$ excitation via the nuclear degree of freedom. Second, two previously unknown and unexpected Rydberg series were identified; these series are probably due to a transition in the coupling scheme of the spins from triplet states of the neutral molecule to doublet and quartet states of the ion.