A 4: Photoionization I (exchanged with A1)

Time: Monday 16:30–18:30 Location: F 303

Invited Talk A 4.1 Mo 16:30 F 303

A hitherto unrecognized source of low-energy electrons in water — •Melanie Mucke[1], Markus Braune[2], Silko Barth[1], Marko Förstel[1,3], Toralf Lischke[1], Volker Ulrich[1], Tiberiu Arion[1], Uwe Becker[2], Alex M. Bradshaw[1,2], and Uwe Hergenhahn[1] — [1]Max-Planck-Institut für Plasmaphysik, EURATOM association, Boltzmannstr. 2, 85748 Garching — [2]Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin — [3]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

Our experiments focus on the investigation of water clusters by electron-electron coincidence spectroscopy. The clusters were generated by supersonic molecular expansion of water vapour. After photoionisation of an inner valence electron by synchrotron radiation (BESSY, Berlin) an ultrafast non-local autoionisation process can occur. This so-called Intermolecular Coulombic Decay (ICD) leads to the ejection of two electrons, a photoelectron from molecule A and an electron of very low kinetic energy emerging from molecule B within the same cluster. This process is faster than a possible proton transfer and will thus efficiently generate these slow electrons. ICD can be triggered by any radiation of sufficient energy, but may as well take place as a secondary process following e.g. Auger decay. Therefore it is easy to imagine that there will be a wealth of low energy electrons generated wherever a watery environment is given, e.g. in biological tissue, and thus radiation damage might occur.

A 4.2 Mo 17:00 F 303

Signatures of the complex classical dynamics in the spectrum of highly doubly excited states of two-electron atoms — •J. Eiglsperger, M. Schönwetter, and J. Madroñero — Physik Department, Technische Universität München, Germany

Close to the break-up threshold of two-electron atoms the spectrum is strongly influenced by the underlying classical mixed regular-chaotic dynamics and typical signatures of quantum chaos, e.g., Ericson fluctuations or scaling laws [1] for the fluctuations of the photoionization cross section (PCS), are expected to become observable.

Computations for the PCS of He and Li^+ have been performed to test the charge dependent exponent of the scaling law in [1]. A comparison of experimental data with the planar model reveals a quantitative agreement for the PCS of helium. PCS calculated up to the 25th single ionization threshold exhibit fluctuations. These are mainly due to a dominant series of resonances which can be associated with an approximate quantum number $F = N - K$ in accordance with 3D full calculations and experimental observations [2]. As the energy increases, the dominant role of a single series as sole contributor is apparently lost as new series start to contribute significantly to the cross sections. This would result in an earlier onset of Ericson fluctuations [3] than in the picture of a single dominant series, where the onset is expected around I_{34}.

[1] C. W. Byun *et al.*, Phys. Rev. Lett. **98**, 113001 (2007).
[2] Y. H. Jiang *et al.*, Phys. Rev A **78**, 021401 (2008).
[3] J. Eiglsperger and J. Madroñero, Phys. Rev A **80**, 022512 (2008).

A 4.3 Mo 17:15 F 303

Photoionization of highly charged ions in the x-ray regime — •Zoltán Harman[1,2], Martin C. Simon[1], Maria Schwarz[1], Sascha W. Epp[1], José R. Crespo López-Urrutia[1,3], Christoph H. Keitel[1], and Joachim Ullrich[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]ExtreMe Matter Institute EMMI, Planckstrasse 1, 64291 Darmstadt, Germany — [3]Max Planck Advanced Study Group, Center for Free-Electron Laser Science, Luruper Chaussee 149, 22761 Hamburg, Germany

Photoionization (PI) of multiply and highly charged ions is studied theoretically by means of the multiconfiguration Dirac-Fock (MCDF) method and experimentally using an electron beam ion trap and synchrotron radiation at the BESSY II electron storage ring. The method introduced here extends the range of ions accessible for PI investigations. Experimental data on near-threshold and resonant PI of N^{3+}, Ar^{8+} and Fe^{14+} ions, species of astrophysical and fundamental interest, show high resolution and accuracy, and agree with the present and other advanced theoretical approaches at the level of 0.1 eV at 800 eV.

A 4.4 Mo 17:30 F 303

Dissociation of protonated water clusters after x-ray ionization — •Christian Domesle[1], Lutz Lammich[2], Henrik B. Pedersen[2], Brandon Jordon-Thaden[1], Marko Förstel[3], Tiberiu Arion[3], Toralf Lischke[3], Uwe Hergenhahn[3], Stefan Klumpp[4], Michael Martins[4], Oded Heber[5], and Andreas Wolf[1] — [1]Max-Planck Institut für Kernphysik, Heidelberg, Germany — [2]University of Aarhus, Denmark — [3]Max-Planck Institut fuer Plasmaphysik, Garching, Germany — [4]Universität Hamburg, Germany — [5]Weizmann Institute of Science, Rehovot, Israel

Protonated water clusters are important systems in interstellar and planetary atmospheric environments. Moreover, studies of their properties in the gas phase elucidate the elementary mechanisms behind the mobility of free charges in aqueous surroundings. Soft x-rays give access to the excited electronic orbitals of these systems and their role in the fragmentation dynamics. With the FEL light source (FLASH) at DESY and the ion beam infrastructure TIFF, the observation and imaging of individual fragmentations triggered by soft x-ray absorption on dilute gas-phase targets of these ionic species has become possible. We investigated the photoionization and subsequent fragmentation of $H^+(H_2O)_2$. At TIFF the serial arrangement of two MCP detectors with delay-line readout allowed for time, position and coincidence investigations of the fragments. By means of time of flight analysis the fragments could be clearly indentified. Coincident events on both detectors give first information on the expected final decay channels.

A 4.5 Mo 17:45 F 303

Precise Determination of Valence Photoionisation Properties - From Precision Electron Spectroscopy to Molecular Two-Centre Interferences — •Markus Ilchen[1], Markus Braune[2], Sascha Deinert[1], Leif Glaser[1], Frank Scholz[1], Peter Walter[1], and Jens Viefhaus[1] — [1]Deutsches Elektronen Synchrotron, 22067 Hamburg — [2]Fritz-Haber-Institut, 14195 Berlin

Angle resolved photoelectron spectroscopy was performed with an online analysis tool which has been set up for determining several beamline parameters of the P04 beamline at PETRA III, DESY. The device is capable of giving users an online feedback of e.g. the degree of polarization within seconds without affecting the beam. Building a precise database of anisotropy parameters β for many gases in a wide energy range is the basis for this task. An intrinsic benefit of this method is that actual literature is evaluated and complex phenomena can be analysed in detail. Highly precise angle resolving measurements for the valence photoionization of N_2 and O_2 are presented in a low energy range from 19 - 50 eV in comparison to other authors [1,2]. Concerning the data calibration, modified data for the β-literature of Neon [3] is presented. In a collaboration with the Fritz-Haber-Institut, additional measurements of N_2 and O_2 in a wider energy range show Cohen-Fano oscillations due to interference of two-centre electron emission [4].

[1] S.H. Southworth et al, Phys. Rev. A **33** (1986) 1020.
[2] I. Iga et al, J. Phys. B **22** (1989) 2991.
[3] F. Wuilleumier and M.O. Krause, JESRP **15** (1976) 15.
[4] H.D. Cohen and U. Fano, Phys. Rev. **150** (1966) 30.

Invited Talk A 4.6 Mo 18:00 F 303

Two-Center Interference in Valence Photoionization of N_2 and O_2 — •Markus Braune[1], Markus Ilchen[2], Sanja Korica[1], Andre Meissner[1], Lokesh Tribedi[1], Sascha Deinert[2], Leif Glaser[2], Frank Scholz[2], Peter Walter[2], Jens Viefhaus[2], and Uwe Becker[1] — [1]Fritz-Haber-Institut, 14195 Berlin — [2]DESY, 22607 Hamburg

Cohen and Fano derived their famous formula for the oscillation of the partial cross sections of homonuclear diatomic molecules in 1966 [1]. The oscillatory behavior in the valence photoionization of N_2 and O_2 which they presented as experimental evidence turned out to be basically an intensity variation due to a shape resonance rather than a signature of coherent emission from two emitter sites. The oscillation period of a real Cohen-Fano type oscillation depends on the internuclear distance and extends over a broad energy range as has been proven many years later for the 1s core photoionization of H_2 [2] and N_2 [3]. Most recently, we analyzed the valence photoionization of N_2 and O_2 used as an example by Cohen and Fano by means of angular resolved photoelectron spectroscopy in a collaboration with DESY. We

present first data of Cohen-Fano oscillations concerning outer valence partial cross sections and angular distribution asymmetry parameters. The results are compared with recent theoretical calculations [4].

[1] Cohen H D and Fano U, Phys. Rev. 150, 30 (1966)
[2] N. Stolterfoht et al., Phys. Rev. Lett. 87, 23201 (2001).
[3] B. Zimmermann et al., NPhys. 4, 649 (2008)
[4] D. Toffoli, P. Decleva, J. Phys. B 39, 2681 (2006)