

MO 18: Experimental Techniques and Various Topics

Time: Wednesday 16:30–18:15

Location: MER 02

MO 18.1 Wed 16:30 MER 02

Two-photon absorption as convenient method for the online autocorrelation measurement of sub 20-fs pulses in the deep UV — •NILS KREBS, CHRISTIAN HOMANN, PETER LANG, and EBERHARD RIEDLE — Lehrstuhl für BioMolekulare Optik, LMU München

We show that two-photon absorption (TPA) in thin crystals and glass disks is a convenient and easy to handle method for the characterization of ultrashort pulses in the UV. We create two replicas of the pulse by reflection off an uncoated fused silica cover slip and chirp compensation by a second cover slip and focus them in e.g., a BBO crystal chosen for its high TPA coefficient. At temporal overlap, the probe pulse is depleted by the strong pump pulse through TPA to create the autocorrelation signal. In contrast to the widely used intensity autocorrelation by frequency doubling, TPA is not hampered by the need for phasematching and can therefore be used down to the deep UV. With the proper choice of material we can cover a wavelength range from 200 nm up to the visible. By referencing to the laser fluctuations we achieve an excellent signal to noise ratio that allows for the online measurement of pulses with energies down to a few nJ at 1 kHz repetition rate. The frequency doubled output of a noncollinear optical parametric amplifier is measured down to pulse durations well below 20 fs and crosscorrelations of UV pulses as short as 35 fs are demonstrated. Due to the compact design the autocorrelator can easily be incorporated in existing pump-probe setups and be used for the online optimization of the pulse duration at the sample position.

MO 18.2 Wed 16:45 MER 02

Photoelectron circular dichroism from chiral molecules via multiphoton ionization with femtosecond laser pulses — •QINGQING LIANG, MANUEL GERLACH, CHRISTIAN LUX, JENS KÖHLER, CRISTIAN SARPE-TUDORAN, MATTHIAS WOLLENHAUPT, and THOMAS BAUMERT — University of Kassel, Institute of Physics and Center of Interdisciplinary Nanostructure Science and Technology (CINSaT), D-34132 Kassel, Germany

Using circularly polarized-UV light, a large chiral asymmetry effect in the angular distribution of photoelectron emitted from randomly oriented chiral molecules in gas phase has been obtained experimentally. The technique here relies on a combination of circular dichroism (CD) (which arises from different absorption of left- and right- circularly polarized light by chiral systems) and multiphoton ionization. The asymmetry shows an additional angular distribution in the forward-backward direction (in relation to the propagating direction of the light) compared to the one-photon absorption process induced by synchrotron radiation [1]. The asymmetry reverses while changing the specific handedness of the molecule. The angular distributed asymmetry, defined as $2 \cdot (I_{\text{lp}}(\Theta) - I_{\text{rp}}(\Theta)) / (I_{\text{lp}}(\Theta) + I_{\text{rp}}(\Theta))$, reaches values larger than 0.2. In addition, time of flight mass spectra are measured under the same conditions.

[1] Powis *et al.*, J. Chem. Phys. 119, 17 (2003)

MO 18.3 Wed 17:00 MER 02

High Resolution X-Ray Emission Spectroscopy of Water and Aqueous Ions using the Micro-Jet Technique — •KATHRIN MARIA LANGE¹, RENÉ KÖNNECKE¹, SAMIRA GHADIMI¹, RONNY GOLNAK¹, MIKAIL SOLDATOV², KAI FRIEDRICH HODECK¹, ALEXANDER SOLDATOV², and EMAD FLEAR AZIZ^{1,3} — ¹Helmholtz-Zentrum Berlin für Materialien und Energie, Albert-Einstein-Str. 15, 12489 Berlin — ²Research Center for Nanoscale Structure of Matter, Southern Federal University, Sorge 5, Rostov-na-Donu 344090, Russia — ³Freie Universität Berlin, FB Physik, Arnimallee 14, D-14195 Berlin

Soft X-ray absorption (XA) and emission (XE) spectroscopy is a powerful method for probing the local electronic structure of light elements (e.g. C, O, N, S) and transition metals, which are all of importance for biochemical systems. Here, we report on the XE spectra of a liquid micro-jet sample in a vacuum environment. We developed a high resolution X-ray emission spectrometer and recorded the spectra of pure water in full agreement with those of the literature, as well as of an aqueous solution of NiCl₂. For the latter system, ground state Hartree-Fock calculations using a self-consistent reaction field (SCRF) approach were carried out to specify the nature of the d-occupied orbital. Our results confirm the dark-channel-fluorescence-yield mechanism that we recently proposed for the case of metal ions in aqueous

solutions. The ability to record absorption and emission spectra of an aqueous liquid-jet opens the way for the study of biochemical systems in physiological media.

1 Lange et al., Chemical Physics 377, 1-5 (2010)

MO 18.4 Wed 17:15 MER 02

Characterisation of Position Map Imaging (XMI) — •JOHANNES VON VANGEROW¹, RICO OTTO¹, MARTIN STEI², SEBASTIAN TRIPPEL¹, THORSTEN BEST¹, JONATHAN BROX¹, and ROLAND WESTER² — ¹Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg — ²Institut f. Ionenphysik und Angewandte Physik, Universität Innsbruck, Technikerstr. 25/3, A-6020 Innsbruck

Imaging ionic reaction products using ion optics can be described as mapping the charged products initial state in phase space ($(\vec{x}, m\vec{v})$) onto a 2D detector position and the ion time of flight (x, y, t). To extract different aspects of the phase space information, different imaging modes, i.e. Wiley Mc Laren type mass spectrometry, velocity map imaging and position map imaging can be used. Both mass and velocity imaging mode have been previously analyzed [1][2], whereas the position imaging mode, even though well-known [1], hasn't been characterised in detail so far. Here we report on how the imaging properties depend on the parameters of the system, i.e. geometry, applied voltages and initial phase space distribution of the particles. Measurements characterising the XMI mode will be compared with SIMION simulations. Possible applications of the XMI mode will be discussed.

[1] A. T. Eppink, D. H. Parker, Rev. Sci. Instrum. 68, 3477 (1997).

[2] W. C. Wiley, I. H. Mc Laren, Rev. Sci. Instrum. 26, 1150 (1955).

MO 18.5 Wed 17:30 MER 02

Precision Spectroscopy of the ²⁰⁷Pb¹⁹F molecule: Implications for measurement of P-odd and T-odd effects — •J.-U. GRABOW¹, L. D. ALPHEI¹, R. J. MAWHORTER², B. MURPHY², A. BAUM², T. J. SEARS³, T. ZH. YANG⁴, P. M. RUPASINGHE⁴, C. P. MCRAVEN⁴, and N. E. SHAFER-RAY⁴ — ¹Gottfried-Wilhelm-Leibniz-Universität, Hannover, Germany — ²Pomona College, Claremont CA, USA — ³Brookhaven National Laboratory, Upton NY, USA — ⁴University of Oklahoma, Norman OK, USA

Heavy paramagnetic diatomic molecules enhance interactions that exhibit violation of discrete symmetries. Its extent may help to differentiate between the Standard Model and alternate theories of matter. One reason for enhancing the effect of discrete symmetry violation is that such molecules have closely spaced levels of opposite parity, allowing states of mixed parity to be accessible at laboratory-strength electromagnetic fields. In addition, nuclear interactions grow in strength with mass, enhancing both nuclear effects that are odd upon the inversion of spatial symmetry (P-odd) and/or reversal of time (T-odd). Finally, the electronic orbit of an unpaired electron is highly relativistic providing a linear sensitivity to an e-EDM, despite the fact that (classically) the average electric field must be zero.

The complex hyperfine structure of the ²⁰⁷Pb¹⁹F isotopologue allows for nearly-degenerate states of opposite parity. We present the hyperfine split spin-rotational spectrum of the ground state obtained using the COBRA Fourier transform microwave (FT-MW) spectrometer at the Gottfried-Wilhelm Leibniz-Universität Hannover.

MO 18.6 Wed 17:45 MER 02

Surface based detection schemes for molecular interferometry experiments - implications and possible applications — •ADRIANA MILIC, THOMAS JUFFMANN, MICHAEL MÜLLNERITSCH, and MARKUS ARNDT — University of Vienna, Faculty of Physics

Surface-based detection schemes for molecular interferometry experiments might be crucial for the search of quantum properties of larger becoming objects, since they provide single particle sensitivity. Here we report on molecular interferograms of different biomolecules imaged using fluorescence microscopy. Being able to watch the build-up of an interferogram live and *in situ* reveals the matter-wave behavior of these complex molecules in an unprecedented way. We encounter several problems due to van-der-Waals forces between the molecules and the diffraction grating and discuss possible ways to circumvent these. Especially, the advent of 1-100 atomic layers thin diffraction masks might path the way towards molecular holography. We also discuss

other possible applications such as coherent molecular microscopy.

MO 18.7 Wed 18:00 MER 02

Metal-molecule contacts in liquid environments — •SASCHA BERGER¹, JANNIC WOLF², THOMAS KIRCHNER², THOMAS HUHN², ELKE SCHEER², and ARTHUR ERBE¹ — ¹Helmholtz-Zentrum Dresden-Rossendorf — ²Universitaet Konstanz

The definition of metal-molecule contacts is the first step on the development of molecular electronic components. Using the mechanically controlled break junction (MCBJ) technique single molecules can be contacted reliably under varying conditions. Here we demon-

strate contacts to oligo (phenylene-ethynylene) molecules with two or three phenylene units, which are attached to the metal electrodes via Thiol anchoring groups, in a liquid environment. The junctions are characterized by recording current-voltage (I-V) characteristics. From these curves we extract the position of the molecular energy level, which contributes to the electric current through the junction, and the strength of the coupling to the electrodes. We can show that symmetric coupling to the two metallic electrodes leads to symmetric I-V-curves, while asymmetric coupling is reflected in asymmetric curves. We demonstrate that controlled changes in the design of the molecules lead to changes in the conduction properties of the junctions.