

MO 29: Poster: Experimental Techniques

Time: Thursday 16:00–18:30

Location: Lichthof

MO 29.1 Th 16:00 Lichthof

A versatile setup for single particle tracking — ●DOMINIQUE ERNST and JÜRGEN KÖHLER — Experimental Physics IV, University of Bayreuth, 95440 Bayreuth, Germany

We present a novel technique to perform automated single particle tracking in 3 dimensions with high spatial and temporal resolution. In order to do so, we create a light orbit with a focussed laser beam and project that light orbit with a homebuilt fluorescence microscope into the plane of the sample. For tracking the movement of a fluorescing nanoparticle (microsphere, molecule), the particle is initially located in the centre of the orbit. Subsequently, we detect the fluorescence intensity of the nanoparticle as a function of its position, recalculate the direction of the movement from the change of the emission intensity, and compensate the movement of the nanoparticle with the aid of a piezostage. The trajectory of the nanoparticle is reconstructed from the feedback-loop of the piezo. To access the 3rd dimension we employ two light orbits that are slightly displaced along the axis of the orbits perpendicular to the plane of the rings enclosing the nanoparticle in the geometrical centre.

MO 29.2 Th 16:00 Lichthof

Peculiar Concentration Dependent Surface Enhanced Raman Scattering (SERS) of Glycine — ●ANIMESH OJHA, PATRICE DONFACK, and ARNULF MATERNY — Jacobs University Bremen, Germany

Critical SERS behaviors, strongly influenced by the molecular density at the metal surface, are predicted for multipolar charged molecules. We present the case of glycine, a biological molecule coexisting in solution with its zwitterionic form having two oppositely charged chemical groups. SERS spectra of glycine have been recorded at different concentrations, from 1M, through 6.25x10.2M down to 1.95x10.3M (twice diluted each time) using silver nanoparticle colloids (AgNPs). The UV-visible spectra of pure AgNPs and of the mixtures with glycine at different concentrations, have been measured to explore the interaction behavior of glycine with AgNPs, and revealed an interesting observation indicated by the appearance, shifting, and strength of an additional absorption band as a function of the concentration. Moreover, the intensity of some SERS bands increases consistently with decreasing glycine concentrations and reaches an optimal value at a critical point of $\approx 6.25 \times 10.2M$. A further decrease in glycine concentration below the critical point causes the intensity of all SERS bands to drastically drop as expected. Besides the permanent chemisorption at all concentrations, the observed concentration dependent variation of SERS of glycine may be attributed to the specific nature of its interaction with AgNPs, such as molecular tails reorganization at the AgNPs surface as a function of density, which is further indicated by the changes in the UV-visible features of AgNPs with glycine.

MO 29.3 Th 16:00 Lichthof

Alternating gradient focusing of large neutral molecules — FRANK FILSINGER, ●STEPHAN PUTZKE, HENRIK HAAK, GERARD MEIJER, and JOCHEN KÜPPER — Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany

Polar molecules can be manipulated using strong electric fields. Many techniques have been developed for the manipulation of small molecules in low-field-seeking quantum states. However, application of these techniques to large molecules is not straightforward, because, for larger molecules, all states are high-field seeking at the relevant electric field strengths.

In order to spatially focus molecules in high-field seeking states alternating gradient (dynamic) focusing has to be applied [1]. This method has been successfully used, for instance, for the alternating gradient deceleration of benzonitrile [2] and for the conformer selection of 3-aminophenol in an m/μ -selector [3].

Here we discuss how the resolution of such a selector can be optimized by changing the duty cycle of the AC switching sequence and present corresponding experimental results. Furthermore, simulations for a second generation m/μ -selector employing an improved mechanical setup and higher electric fields will be presented.

[1] D. Auerbach et al., *J. Chem. Phys.* **45** (1966), 2160;

H.L. Bethlem et al., *J. Phys. B* **39** (2006), R263

[2] K. Wohlfart et al., *Phys. Rev. A* **77**(3), (2008), 031404(R)

[3] F. Filsinger et al., *Phys. Rev. Lett.* **100**, (2008), 133003

MO 29.4 Th 16:00 Lichthof

Towards synchronization of a highly repetitive multi-frequency laser system with PETRA III for pump-probe experiments — ●MORITZ SCHLIE, ARMIN AZIMA, MARIA KRIKUNOVA, MAREK WIELAND, and MARKUS DRESCHER — Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany

For enabling laser/X-ray pump-probe experiments on molecules at the new PETRA III synchrotron radiation facility at DESY, a synchronized laser system is being set up. Wavelengths ranging from 210 nm to 2600 nm are delivered at a high repetition rate of 130 kHz, thus allowing highly efficient experiments with flexible excitation schemes. The system is based on a commercial diode-pumped Yb:KGW laser with 6 W output power followed by an Optical Parametric Amplifier and Harmonic Generation modules. The laser repetition rate will be synchronized with one electron bunch within the 40-bunch operation mode of the storage ring. To this end, two phase locked loops (PLL) will lock the lasers's oscillator frequency (83 MHz) and its 6th harmonic to the PETRA III master oscillator (500 MHz) and its 6th sub-harmonic. Test results of the synchronization loop will be presented.

MO 29.5 Th 16:00 Lichthof

Electric field quenching of long-lived states in H₃ — ●PEER FECHNER, HANNES HÖFFLER, FRANK BAUMGARTNER, and HANSPETER HELM — DMOP, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

Due to its simple structure, neutral H₃ qualifies as a model-system for observations of dynamics inside molecules. Our focus lies on the three-body-decay into three single H-atoms H(1s)+H(1s)+H(1s) which provides direct insight into the effects of non-adiabatic coupling. Using triple-coincidence techniques, the momentum-correlations of the fragment atoms are determined and visualized in so-called Dalitz-plots. In the experiment we control the predissociation of H₃ in the metastable 2p state by applying an electric field. In this fashion an adjustable amplitude of the short-lived 2s state can be mixed into the 2p state. The experiment shows, that with increasing field strength the decay behaviour of the 2p acquires that of the 2s state. In addition we present measurements, which demonstrate the existence of highly excited, long-lived states close to the ionization limit. In order to characterize them, we once again use an electric field. At well defined spatial location, the admixture of short-lived states leads to a quenching of their lifetimes. In this way we achieve an improved energy-resolution and higher dissociation-rate which may help identify these currently unknown states.

MO 29.6 Th 16:00 Lichthof

An apparatus for the experimental observation of the angular correlation of two photons detected in coincidence — ●IRINA HAAR¹, RAINER HENTGES¹, KARI JÄNKÄLÄ², and ARNO EHRESMANN¹ — ¹Institute of Physics University of Kassel, Heinrich-Plett-Straße 40, 34134 Kassel, Germany — ²University of Oulu Department of Physics, 90041 Finland

An apparatus is devised that allows to investigate the angular correlation of two Lyman- α photons emitted coincidentally by dissociation fragments of doubly excited hydrogen molecules. This coincidence technique is advantageous for the investigation of neutral dissociation processes of molecular doubly or multiplies excited states when no ions are formed.

The experimental set up contains a home-built target cell with two position sensitive detectors for the measurement of fluorescence with k -vectors of $90^\circ/-90^\circ$ or $0^\circ/90^\circ$ relative to the \vec{E} -vector of the linearly polarized synchrotron light. In order to obtain a large solid angle of the fluorescence radiation two parabolic off-axis mirrors are used, one for each detector branch. The interaction volume, which is defined by the crossing of the synchrotron radiation and the effusive gas jet, is placed in the focal point of both mirrors. The metal needle for the gas jet is adjustable in three dimensions. The mirrors image the emitted photons on the position sensitive detectors. The high spatial and time resolutions of the used detectors based on delay lines provide an angularly detection of the coincident photons. The general layout and the first recorded experimental data will be presented.

MO 29.7 Th 16:00 Lichthof

Time-resolved photoelectron spectroscopy of a liquid jet —

•FRANZISKA BUCHNER¹, NADJA HEINE¹, ANDREA LÜBCKE¹, THOMAS SCHULTZ¹, and INGOLF V. HERTEL^{1,2} — ¹Max-Born-Institut, Max-Born-Strasse 2a, 12489 Berlin — ²Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin

A magnetic-bottle-type electron spectrometer is combined with a fs-laser system to perform time-resolved photoelectron spectroscopy of a liquid jet. The spectrometer is optimized for electrons with low kinetic energies. Currently, the collection efficiency is about 10%, the resolving power at 2 eV is about 15. The experimental technique is described in detail, and the results of first experiments with aqueous solutions of sodium iodide of different concentrations are discussed. This experimental approach opens up exciting new perspectives to study photochemical and photophysical reactions of biologically and chemically relevant substances in liquid environments.

MO 29.8 Th 16:00 Lichthof

Advances in UHV tip-enhanced Raman spectroscopy —

•PHILIP SCHAMBACH, NICOLA SCOTT, and BRUNO PETTINGER — Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany

Tip-enhanced Raman spectroscopy (TERS) is a technique used to obtain vibrational spectra of molecules on surfaces with a very high sensitivity and spatial resolution well below the diffraction limit of the light used. This allows it to be applied for chemical analysis on the nanometer scale.

The characterisation of molecular surface species is of fundamental importance in many applications including, e.g. heterogeneous catalysis. In order to address many interesting questions in such areas it is highly desirable to couple the advantages of TERS with the well-established benefits of ultra high vacuum (UHV) studies.

Here we discuss our approach and results towards single molecule TERS under UHV conditions.