MO 18: Experimentelle Techniken

Zeit: Donnerstag 10:30–12:30 Raum: VMP 6 HS-F

Hauptvortrag MO 18.1 Do 10:30 VMP 6 HS-F

Disturbing spectral interferences and their suppression in Femtosecond Stimulated Raman Microscopy (FSRM) — Benjamin Marx, Evelyn Ploetz, and •Peter Gilch — Lehrstuhl für Biomolekulare Optik und CIPSM, Department für Physik, Ludwig-Maximilians-Universität, Oettingenstr. 67, 80538 München, Germany

Femtosecond Stimulated Raman Microscopy (FSRM) is an upcoming technique in non-linear microscopy with the capability to image chemical structures non-invasively [1]. It employs femtosecond white light pulses as probe pulses and intense picosecond pulses as pump pulses. At focus of the scanning microscope stimulated Raman scattering occurs. Chemical entities in the sample are identified via the spectral signature of this process. A disturbing effect is the broadening of the pump pulse due to self phase modulation in the focal region of the microscope leading to spectral interference on the detector. This interference reduces the signal to noise ratio. Slightly modulating the optical path difference between pump and probe by a piezo stage suppresses this effect.

[1] E. Ploetz, S. Laimgruber, S. Berner, W. Zinth, P.Gilch, Appl. Phys. B 87, 389-393 (2007)

MO 18.2 Do 11:00 VMP 6 HS-F

Improving background rejection in femtosecond fluorescence Kerr-gating — •Gerald Ryseck, Björn Heinz, Thomas Schmierer, and Peter Gilch — Ludwig-Maximilians-Universität München, Lehrstuhl für BioMolekulare Optik, 80538 München, Deutschland

Optical gates for ultrafast fluorescence measurements commonly rely on the up-conversion or the Kerr effect. Since Kerr-gating requires no phase matching, broadband detection schemes can be easily realized [1]. This advantage over up-conversion comes at the expense of a poorer performance for long-lived fluorophores. The background rejection as the limiting factor in Kerr-gating setups crucially depends on the extinction ratio of the gate polarizers. Effects that influence this parameter are large angles of incident on the polarizers and depolarization by reflective components.

We investigated the optical effects limiting the accessible time range and introduced methods to overcome this obstruction. With the advanced setup it is possible to trace emissions with lifetimes up to several 100 ps. As a demonstration for the improved performance emission data of a photo-reactive N-oxide are presented. It features decay times ranging from 100 fs to 200 ps.

[1] B. Schmidt et al., Appl. Phys. B 76 (2003) 809-814

MO 18.3 Do 11:15 VMP 6 HS-F

Broadband Multiplex-CARS-Microscopy in forward and backward detection with application in material and biological science — •Christoph Pohling, Alexander Southan, and Marcus Motzkus — Philipps-Universität, Physilkalische Chemie, D-35043 Marburg

We implemented Multiplex coherent anti-Stokes Raman scattering (MCARS) as a labelling free technique in nonlinear microscopy in a commercially available Phase-Contrast microscope acquiring vibrational spectra covering a range of more than 3000 wavenumbers. Since the signal can be detected in forward and backward direction, this technique also matches for non transparent samples. Compared to the previous setup, the lateral and spectral resolution was improved. We carefully studied the influence of collimation of Pump and Stokes as well as beam diameters, microscope objective types and aperture sizes to optimize the spatial resolution in axial direction. The spectral resolution required balancing between narrowband-filtration of the Pump beam and the loss of signal intensity. With the optimised Setup which just uses a traditional Ti:Sa fs-oscillator, we are able to study a film consisting of several layers of different polymers with a thickness of 1-3 *m each by raster scanning the sample in Z-direction. The chemical composition, position and thickness of each layer could be retrieved from the MCARS-data. Concerning biological components cells of moss and porcine brain tissue also led to MCARS-pictures. Finally, the surface of writing paper was scanned in a first approach of three-dimensional imaging.

MO 18.4 Do 11:30 VMP 6 HS-F

Absolute absorption spectroscopy based on molecule interferometry — •Stefan Nimmrichter[1], Klaus Hornberger[2], Hendrik Ulbricht[3], and Markus Arndt[1] — [1]Faculty of Physics, University of Vienna, Boltzmanngasse 5, 1090 Vienna, Austria — [2]Arnold Sommerfeld Center for Theoretical Physics, Ludwig-Maximilians-Universität München, Theresienstraße 37, 80333 Munich, Germany — [3]School of Physics and Astronomy, University of Southampton, Highfield Southampton SO17 1BJ, United Kingdom

We propose a method [1] to measure the absolute photon absorption cross section of neutral molecules in a molecular beam. It is independent of our knowledge of the particle beam density, nor does it rely on photo-induced fragmentation or ionization. The method is based on resolving the recoil resulting from photon absorption by means of near-field matter-wave interference, and it thus applies even to very dilute beams with low optical densities. In case of fluorescing molecules the quantum yield can be measured as well. We account for the influence of realistic experimental uncertainties and show that the precision of our scheme compares favorably with direct extinction and depletion experiments using existing technologies.

[1] S. Nimmrichter, K. Hornberger, H. Ulbricht and M. Arndt, PRA (in press, eprint on arxiv:0811.1141)

MO 18.5 Do 11:45 VMP 6 HS-F

Coherent diffractive imaging of oriented gas-phase molecules using XFELs — •Jochen Küpper[1], Gerard Meijer[1], Henrik Stapelfeldt[2], and Henry N. Chapman[3] — [1]Fritz-Haber-Institut der MPG, Berlin — [2]University of Aarhus, Denmark — [3]Center for Free Electron Laser Science, Hamburg

Upcoming X-ray free electron lasers (XFEL) promise the possibility to obtain coherent diffractive imaging (CDI) patterns from single biological objects. We propose to perform CDI experiments with XFELs using relatively small (bio)molecules, to benchmark the experimental details. Such large molecules have complex potential-energy surfaces with many local minima. They exhibit multiple stereo-isomers, even at very low temperatures.

We have developed methods to manipulate the motion of large, complex molecules and to select quantum states.[1] We have demonstrated the spatial separation of individual conformers and improved spatial alignment and orientation of such molecules. Such clean, well-defined samples would allow novel experiments with complex molecules, such as, for instance, X-ray CDI in the gas-phase using XFELs. They allow to investigate the general feasibility of such gas-phase diffraction experiments using XFELs, and to study radiation damage and the ideas of diffraction-before-destruction for high-intensity X-ray pulses.

[1] Wohlfart et al. *Phys. Rev.* A 77, 031404(R) (2008); Filsinger et al. *Phys. Rev. Lett.* 100, 133003 (2008); Holmegaard et al. *Phys. Rev. Lett.*, accepted, preprint at arXiv:physics.chem-ph 0810:2307 (2008)

MO 18.6 Do 12:00 VMP 6 HS-F

Laser-induced alignment and orientation of quantum-state-selected large molecules — Lotte Holmegaard[1], Jens H. Nielsen[1], Iftach Nevo[1], Henrik Stapelfeldt[1], Frank Filsinger[2], •Jochen Küpper[2], and Gerard Meijer[2] — [1]University of Aarhus, Denmark — [2]Fritz-Haber-Institut der MPG, Berlin

Strong inhomogeneous static electric fields can be used to spatially disperse a supersonic beam of polar molecules, according to their quantum state. We show that the molecules residing in the lowest-lying rotational states can be spatially selected and used as targets for further experiments.

As an illustration, we demonstrate an unprecedented degree of laser-induced alignment and strong mixed-field orientation of state-selected iodobenzene molecules. This method should also enable experiments on pure samples of polar molecules in their rotational ground state, offering new opportunities in molecular science.

MO 18.7 Do 12:15 VMP 6 HS-F

Determination of the absolute photon flux of femtosecond VUV pulses from high harmonic generation with a Gas Monitor Detector — •Torsten Leitner[1], Philippe Wernet[1], Kai Godehusen[1], Olaf Schwarzkopf[1], Tino Noll[1], Jerome Gaudin[3], Andrei Sorokin[2], Henrik Schoeppe[2], Mathias Richter[2], and Wolfgang Eberhardt[1] — [1]Helmholtz-Zentrum Berlin - Elektronen-

speicherring BESSY II — [2]Physikalisch-Technische Bundesanstalt - Berlin — [3]DESY/ European XFEL Project Team - Hamburg

The generation of high-order harmonics of femtosecond lasers in rare gas media has recently emerged as a promising tool to produce bright atto- and femtosecond vacuum-ultraviolet (VUV) and soft x-ray pulses. One of the key parameters of a light source is its photon flux. A suitable tool for counting VUV photons is provided by a Gas Monitor Detector, wherein the number of rare gas ions generated by the passing VUV beam is counted. Knowing the exact gas pressure inside the detector and the wavelength of the light one can translate the absolute number of ions into absolute photon numbers. The detector works within a range of peak irradiances from $10^{-2} W cm^{-2}$ (BESSY II) up to $10^{11} W cm^{-2}$ (FLASH). Such a device, developed and calibrated by the PTB was used to measure the absolute number of photons generated at the BESSY High-order Harmonic Generation source. Additionally, the photon flux was estimated from the photo-current of a calibrated GaAsP diode. A comparison of both measurements proofed, that the diode allows for a good approximation of the number of photons within an error of 20% even for pulses as short as several tens of femtoseconds.