O 4: New Methods: Experiments

Time: Monday 10:30–12:30 Location: MA 005

O 4.1 Mon 10:30 MA 005

Record breaking resolution in cold antimatter detection using inexpensive hardware. — •Francesco Guatieri and Michael Berghold — Heinz Maier-Leibnitz Zentrum (MLZ), Technical University of Munich, Lichtenbergstr. 1, 85748 Garching, Germany

Modern beam facilities can provide two species of low-energy antiparticle beams: slow positron beams are available in many laboratories that perform surface studies and defect spectroscopy, while slow antiprotons are produced only by the AD/ELENA facility at CERN. Applications of both beams benefit greatly from the availability of realtime detectors of cold antimatter with a resolution in the scale of microns. Last year we demonstrated how modifying an inexpensive commercial camera sensor allows for the detection of positrons with a resolution that was unprecedented for real time applications. This year we broke another record by applying the same technology to cold antiprotons.

O 4.2 Mon 10:45 MA 005

how to stop motion of microparticles by using local light-driven diffusio-osmosis (l-LDDO) under external flow — •Daniela Vasquez, Fabian Rohne, Svetlana Santer, and Marek Bekir — University of Potsdam, Institute for Physic and Astronomy, Karl-Liebneckt str. 25, Haus 28, Potsdam, Germany

Liquid flow can be generated by external pressure (pumping) or by using different types of surface bound phenomena as diffusio-osmosis. For example, the latter requires solute concentration gradients with precise local control in a reversible way and at arbitrary surface. In this study, we use a local light-driven diffusion-osmosis (l-LDDO), where it is possible to manipulate the motion of micro particles reversibly and at any surface. The motor of the mechanism is a photosensitive azobenzene surfactant that present photo-isomerization between more hydrophobic trans and hydrophilic cis isomer. When porous microparticles are immersed in aqueous azobenzene surfactant solution, particle motion can be manipulated during light stimulation of appropriated wavelength.

Under external pumped fluid flow the local-LDDO motion is so strong that it provides a light induced velocity gain of porous particle along a streamline or it can be completely reversed by simply changing the wavelength into full motion stop of such particles against an external pumped fluid flow. Thus, with one stimulus we are able to manipulate the particle motion in both directions. Here we investigate stopping of the microparticles with studying the strength of local-light-driven diffusio-osmosis (l-LDDO) flow.

O 4.3 Mon 11:00 MA 005

Phase-Resolved, Wide-Field Sum-Frequency Generation Microscopy of Molecular Monolayers — •Ben John, Alexander Fellows, Tuhin Khan, Martin Wolf, and Martin Thämer — Fritz Haber Institut der MPG, Berlin, Germany

Inhomogeneous molecular assemblies at interfaces play an outstanding role in nature and industry e.g., in biological membranes, or lab-on-a-chip devices. Gaining experimental access to molecular compositions, arrangements, and packing is therefore of great scientific interest, however this has proven difficult. In particular, the elucidation of molecular conformations and the distribution of molecular orientations typically remains infeasible. Phase-Sensitive Vibrational Sum-Frequency-Generation (vSFG) microscopy can in principle yield such insight into molecular structures owing to its sensitivity to molecular directionality. However, vSFG microscopy still faces substantial technical obstacles, particularly its low signal-to-noise, which highly limits its application to either very thick films or those on metal substrates.

In this contribution, we introduce a novel vSFG microscope design and imaging system that overcomes these limitations. These technical advancements yield highly improved signal-to-noise ratios and a simplified experimental procedure, allowing for the first measurements of molecular monolayers on dielectric substrates. With measurements on phospholipid assemblies, we demonstrate that we can not only detect the molecular species in such monolayers but also characterize molecular compositions and fully determine the spatial distribution of their orientations.

O 4.4 Mon 11:15 MA 005

Energy Distributions of Material Sputtered under Swift Heavy Ion Bombardment — Tobias Heckhoff, •Lars Breuer, Marika Schleberger, and Andreas Wucher — Universität Duisburg-Essen, Fakultät für Physik and CENIDE, Duisburg, Germany

Ion-surface interactions represent a well-established field of research, serving as the foundation for numerous analytical and modification techniques. Despite decades of investigation, certain fundamental questions remain unanswered. These unresolved inquiries include phenomena like the secondary ion formation and the velocity distributions of particles sputtered during swift heavy ion bombardment.

While conventional laboratory-based ion sources can be used to determine the energy distributions of sputtered material by using short ion pulses, this approach is inadequate for prolonged pulses, as delivered by particle accelerators like the UNILAC at GSI.

We have developed a new measurement protocol that has been successfully applied in experiments involving various target materials, including metals, insulators, and organic molecules. We found that the energy distributions show a behavior where in all cases the maximum of the distribution is shifted to smaller energies and follows a different shape compared to the Thompson distribution of material sputtered under nuclear sputtering conditions.

O 4.5 Mon 11:30 MA 005

Quantifying monolayer coverage of endofullerenes by x-ray absorption spectroscopy from equivalent implanted ion doses — •W.C Lee[1], L. Yu[1], J. Oscarsson[2], M. W. Ochapski[3], R. Sagehashi[1], Y. Zhang[4], A. A. Popov[4], Z. M. Gebeyehu[3], L. Martini[3], S. Forti[3], C. Coletti[3], B. Delley[5], M. Muntwiler[5], D. Primetzhofer[2], and T. Greber[1] — [1]Physik-Institut, Universität Zürich, Switzerland — [2]Tandem Laboratory, Uppsala University, Sweden — [3]Istituto Italiano di Technologia, Pisa, Italy — [4]Leibniz-Institute, Dresden, Germany — [5]Paul Scherrer Institute, Switzerland

With x-ray absorption spectroscopy (XAS), the structure of magnetic atoms in molecules may be accessed directly [1]. For $Ho_3N@C_{80}$ endofullerenes on graphene/SiO_2, we calibrated the surface coverage by comparing the molecular XAS signal with implanted Ho ion doses of 3×10^{14} cm^{-2} that are directed to SiO_2 with energies between 2 and 115 keV. The corresponding Ho M_{45} intensity as a function of implantation depth d can be extrapolated to the zero-depth intensity of absorbed molecules. The Ho signal attenuation scales with exp(-d/Λ), with Λ=10.3±0.7 nm. The Si K-edge signal attenuation reveals an influence of the implantation process on the Si density. The XA spectra indicate trivalent Ho for both molecules and implants, while spectral differences and comparison to multiplet theory [2] suggest an isotropic J=8 Ho 4f electron distribution for implants and J_z=±8 ground states in the molecules due to the defined intramolecular ligand field.

[1] R. Westerström, et al., Phys. Rev. Lett., 087201 (2015)[2] A. Uldry, et al., Phys. Rev. B, 85, 125133 (2012)

O 4.6 Mon 11:45 MA 005

Autonomous nanoARPES Experiments — •Steinn Ýmir Ágústsson[1], Alfred J. H. Jones[1], Davide Curcio[1], Søren Ulstrup[1], Jill Miwa[1], Davide Mottin[2], Panagiotis Karras[2], and Philip Hofmann[1] — [1]Dpt. of Physics and Astronomy, Aarhus University — [2]Dpt. of Computer Science, Aarhus University

Angle-resolved photoemission spectroscopy (ARPES) is a technique used to map the occupied electronic structure of solids. Recent progress in X-ray focusing optics has lead to the development of ARPES into a microscopic tool, permitting the electronic structure to be mapped across the surface of a sample. This comes at the expense of a time-consuming scanning process to cover the whole surface.

We implemented a protocol which leverages Gaussian Processes to autonomously search the surface area in order to find positions of particular interest, based exclusively on the observed spectra. The protocol promises significant efficiency gains by avoiding redundant measurements and maximizing information gain from the data already measured. Furthermore, it can easily be expanded to explore a larger parameter space, including temperature or external perturbations.

The autonomous experimental control is implemented on the SGM4 micro-focus beamline of the synchrotron radiation source ASTRID2, where pilot experiments were used to quickly identify regions of inter-

est to study in further detail. The successful implementation of the protocol shows the value of machine learning in the context of controlling complex experiments, and the potential for further development of autonomous experiments.

Topical Talk O 4.7 Mon 12:00 MA 005

Focused and coherent X-rays for the study of thin films and surfaces — •Ivan Zaluzhnyy — Institute of Applied Physics, University of Tübingen, Germany

X-ray diffraction techniques have been extensively used to study the atomic structure of bulk materials and thin films. The rise of new bright synchrotron X-ray sources opens up a possibility to use coherent X-ray diffraction to investigate the structure and morphology of surfaces and thin films. X-ray photon correlation spectroscopy (XPCS) is one of such techniques, which utilizes coherent X-ray beams to study the equilibrium as well as non-equilibrium dynamics of the film surface.

The grazing incidence geometry, which is typically employed to be surface-sensitive, puts certain requirements on the experimental parameters, such as X-ray beam size and sample alignment. This talk will give a few examples of XPCS studies of the thin film surfaces and show recent results on the kinetics and dynamics during in situ growth of organic films [1].

We thank colleagues from University of Tübingen, DESY and ESRF for their contributions.

[1] I. Dax et al., *New J. Phys.* **23** (2023) 103033