Wednesday, 02.09.2015, Room EI 2

Time	ID	Medical Physics *Chair: Georg Pabst, Uni Graz*
13:30	701	**Non-clinical Research at MedAustron** *Thomas Schreiner, PEG MedAustron, AT-2700 Wiener Neustadt* MedAustron is a synchrotron-based light-ion beam therapy centre for cancer treatment as well as for clinical and non-clinical research, currently in the commissioning phase in Wiener Neustadt, Austria. Whilst the choice of basic machine parameters was driven by medical requirements, i.e. 60 MeV to 250 MeV protons and 120 MeV/A to 400 MeV/A carbon ions, the accelerator complex design was also optimised to offer flexibility for research operation. The potential of the synchrotron is being exploited to increase the maximum proton energy far beyond the medical needs to up to 800 MeV, for mainly experimental physics applications. To decouple research and medical operation, one dedicated irradiation room for non-clinical research – besides three medical irradiation rooms with different beam lines – was included providing the installation of different experiments. For performing translational research activities, this non-clinical irradiation room has been equipped with the same beam delivery system, robotic positioning system and imaging system as the medical irradiation rooms. In addition, several laboratories have been equipped with appropriate devices for carrying out research activities. This includes radio-biological laboratories for cell cultivation, histology, immunohistochemistry, various analyzing modalities, storage capacities, and a kilovoltage X-ray source, as well as a dedicated software laboratory for simulations and a dosimetry laboratory with a comprehensive dosimeter and phantom equipment. Recently three professorships on Radiation Physics, Medical Radiation Physics and Radiation Biology have been established, one at the Vienna University of Technology and two at the Medical University of Vienna. The presentation gives a status overview over the whole project and highlights the non-clinical research opportunities at MedAustron.
14:00	702	**DEA to bare and hydrated biomolecular clusters** *Jusuf Khreis, Michael Neustetter, Julia Aysina, Stephan Denifl* *Ion Physics and Applied Physics, University of Innsbruck, Technikerstrasse 25/3, AT-6020 Innsbruck* Radiation damage of biological tissue is characterized by formation of secondary particles like low energy electrons (LEE) with kinetic energies < 20 eV which are also responsible for chemical transformation of this tissue. Previous studies focused on LEE interaction with single building blocks of DNA. Living cells consist of up to 70% water. For more realistic conditions we studied inelastic electron attachment to hydrated clusters of pyrimidine ($C_4H_4N_2$) which is often used as model system for collision studies related to radiation damage. It turns out that the dissociative electron attachment process is substantially altered compared to the isolated molecule. Acknowledgment: This work is partially supported by FWF, Vienna (P22665,I1015,M1445-N20) and DFG (FOR1789)
14:15	703	**SAFIR: Towards a high-rate capable PET insert for multimodal dynamic imaging** *Jannis Fischer [1], Robert Becker [1], Jean-Pierre Cachemiche [2], Chiara Casella [1], Günther Dissertori [1], Alexander Howard [1], Kevin Kramer [1], Werner Lustermann [1], Christian Morel [2], Josep F. Oliver [3], Ulf Röser [1], Qiulin Wang [1], Bruno Weber [4]* *[1] Institut für Teilchenphysik, ETH Zürich, Otto-Stern-Weg 5, CH-8093 Zürich* *[2] CNRS/IN2P3, Aix Marseille Université, CPPM UMR 7346, FR-13288 Marseille* *[3] Instituto de Fisica Corpuscular, Apartado de Correos 22085, ES-46071 Valencia* *[4] Institut für Pharmakologie und Toxikologie, Universität Zürich, Winterthurerstr. 190, CH-8057 Zürich* The Small Animal Fast Insert for mRi (SAFIR) project aims at developing a preclinical PET insert for the Bruker 70/30 MR system. To observe fast biological processes such as oxygen perfusion in the rodent brain, unprecedented temporal resolution (~seconds) is essential. Using electronics originally developed for time-of-flight PET applications, short coincidence windows (~500 ps) are possible leading to low random coincidence event rate at activities up to 500 MBq permitting the acquisition of sufficient count statistics in a few seconds. The results of Monte-Carlo simulations of the system as well as performance studies of individual components will be presented.

14:30	**704**	**Ultramicroscopy in neuroscience** *Nina Jährling [1], Saiedeh Saghafi [1], Klaus Becker [1], Inna Sabdyusheva [2], Martina Wanis [1], Hans-Ulrich Dodt [1]* *[1] Dept. Bioelectronics/FKE, TU Vienna, Floragasse 7, AT-1040 Vienna* *[2] Section Bioelectronics, Center for Brain Research, MUW Vienna, Spitalgasse 4, AT-1090 Vienna* Ultramicroscopy (UM) is a light sheet based imaging technique allowing three dimensional reconstruction of up to cm-sized organs of animal models with μm resolution. We present technical aspects of standard laser light sheet fluorescence microscopy and its application to neuroscience. In the field of Alzheimer Disease (AD) we demonstrate that UM is an easy, fast and direct method for counting beta-amyloid deposits in entire mouse brains. Furthermore, we present a new way of signal preserving using a particular resin, latest improvements in light sheet generator optical unit, and final developments of imaging optics corrected for refractive index mismatch.
14:45	**705**	**Magnesium from bio-resorbable implants: distribution and impact on the bone nano- and mineral structure** *Helga Lichtenegger [1], Tilman Grünewald [1], Harald Rennhofer [1], Bernhard Hesse [2], Manfred Burghammer [3], Stefanie Stanzl-Tschegg [1], Marine Cotte [2], Annelie-Martina Weinberg [4]* *[1] Institut für Physik und Materialwissenschaft, Universität für Bodenkultur Wien, Peter-Jordan-Str. 82, AT-1190 Wien* *[2] X-ray and FTIR Microspectroscopy Beamline ID21, ESRF - The European Synchrotron, FR-38043 Grenoble* *[3] Microfocus Beamline ID13, ESRF - The European Synchrotron, FR-38043 Grenoble* *[4] Universitätsklinik für Orthopädie und orthopädische Chirurgie, MedUni Graz, Auenbruggerplatz 34, AT-8036 Graz* Biocompatibility is a key factor for novel implant materials, such as the promising class of biodegradable Mg implants. In this study Mg accumulation and distribution in bone was shown to depend on the speed of implant degradation by synchrotron microbeam x-ray fluorescence (micro-XRF), small angle x-ray scattering (micro-SAXS) and x-ray diffraction (micro-XRD). Mg was found preferentially around blood vessels and only at highest Mg concentrations also at the implant interface. Mg levels decreased after completed implant degradation. SAXS and XRD showed that in zones of high Mg concentration the bone mineral (hydroxy apatite, HAP) crystallite size decreased and HAP lattice distortions compatible with partial replacement of Ca by Mg occurred.
15:00	**706**	**The influence of the topology of reversible cross-links on the mechanics of polymeric chain bundles** *Soran Nabavi, Markus A. Hartmann* *Institute of Physics, Montanuniversität Leoben, Franz-Josef Straße 18, AT-8700 Leoben* An effective strategy to provide enormous diversity of mechanical properties for biological materials is using reversible cross-links (RCL). We use Monte Caro simulations to examine the influence of grafting density and RCL density on mechanical properties of the chain bundle [1,2]. Surprisingly, only two RCLs are sufficient to break the backbone of the system, although the RCLs are weaker than the covalent bond by factor of four. This backbone failure caused by the topology of the interchain RCLs, weakens the strength of the material, but increases the amount of work to elongate and apparent stiffness of the bundles. [1] S. Soran Nabavi, Mathew J. Harrington, Oskar Paris, Peter Fratzl, Markus A. Hartmann, New J. Phys. 16, 013003 (2014). [2] S. Soran Nabavi, Peter Fratzl and Markus A. Hartmann Phys. Rev. E, 91, 032603 (2015).

15:15	**707**	**Structure - mechanics relationship of cellulose II aerogels** *Harald Rennhofer [1], Leticia Carbajal [2], Nicole Pircher [3], Christian Schimper [3], Jean-Marie Nedelec [2], Helga Lichtenegger [1], Thomas Rosenau [3], Falk Liebner [3]* *[1] Insitute of Physics, University of Natural Resources and Life Sciences Vienna, Peter Jordan Straße 82, AT-1190 Vienna* *[2] Institute of Chemistry of Clermont-Ferrand, Clermont Université, BP 10448, FR-63000 Clermont-Ferrand* *[3] Division of Chemistry of Renewables, University of Natural Resources and Life Sci, Konrad-Lorenz-Straße 24, AT-3403 Tulln* Lightweight cellulose II aerogels were produced from cotton linters using four different cellulose solvent systems. The respective materials were compared with regard to bulk properties, cellulose network morphology and pore features to derive relations between structure and mechanical performance. Small Angle and Wide Angle X-ray Scattering were used to estimate the dimensions of the basic fibrils forming the scaffolds after coagulation of cellulose, and the crystallinity of the different types of cellulose aerogels. The obtained results revealed that by variation of the solvent considerable differences in the cellulose network properties are obtained affording materials of different mechanical performance.
15:30	**708**	*cancelled*
15:45		
16:00		***Coffee Break***
		Biophysics *Chair: Giovanni Dietler, EPFL*
16:30	**711**	**Molecular chaperones: about pulling, folding, unfolding and energy consumption** *Paolo De Los Rios, Laboratory of Statistical Biophysics, Ecole Polytechnique Fédérale de Lausanne* Molecular chaperones are a class of proteins which oversees the protein homeostasis, i.e. good balance, of other proteins and RNA in the cell. They are ubiquitous, present in each and every organism on Earth, and highly abundant in the cell. Moreover, most of them need the energy from ATP molecules to work. Here we will review the main roles of chaperones in the cell, what is the present understanding of their mechanism of action and why energy consumption is needed.
17:00	**712**	**Techniques for direct imaging of nanoplatforms in the live cell plasma membrane** *Mario Brameshuber, Gerhard Schütz* *Institute of Applied Physics - Biophysics, TU Wien, Wiedner Haupstr. 8-10, AT-1040 Vienna* Based on single molecule fluorescence microscopy we developed techniques, which enable the detection of mobile nanometer sized platforms or molecular aggregates diffusing in the plasma membrane. By utilizing a single molecule FRAP-approach termed TOCCSL ('Thinning Out Clusters while Conserving the Stoichiometry of Labeling') combined with quantitative brightness analysis, nanoplatforms are detected by their property to confine fluorescent labels on a timescale of seconds. TOCCSL was further enhanced by implementing a dual-color based co-localization approach allowing for detection of very rare events and better size estimations. A combination with photo-activatable molecules provides information about immobile proteins diffusing in the cell membrane.
17:15	**713**	**GPI-anchored proteins do not reside in ordered domains in the live cell plasma membrane** *Eva Sevcsik, Mario Brameshuber, Martin Fölser, Gerhard Schütz* *TU Wien, Getreidemarkt 9, AT-1060 Wien* It is still unclear how proteins sense and influence their lipid environment in the live cell plasma membrane. Sterol-rich nanoscopic lipid "raft" phases were proposed to mediate protein interactions but have not yet been directly observed. Here, we used protein micropatterning combined with single-molecule tracking to measure the local membrane environment of immobilized "raft" proteins. We found no indication for the existence of nanoscopic ordered domains associated with these proteins. Essentially, the immobilized "raft" proteins behaved as inert obstacles to the diffusion of other membrane constituents indicating that phase partitioning is not a fundamental element of protein organization in the live cell plasma membrane.

17:30	**714**	**Nano-Confined Polymer Structures for Protein Binding** *Jaroslaw Jacak [1], Richard Wollhofen [1], Andrea Sonnleitner [2], Clemens Wolfesberger [2], Moritz Wiesbauer [2], Thomas A. Klar [1]* *[1] Applied Physics, Johannes Kepler University Linz, Altenberger Str. 69, AT-4040 Linz* *[2] Medical Engineering, Upper Austria University of Applied Sciences, Garnisonstr. 21, AT-4020 Linz* Stimulated emission depletion (STED) lithography belongs to the most promising methods for 2D and 3D structuring of polymer scaffolds with structure sizes in the nanometer range. We use STED lithography for the assembly of nano-confined protein adhesive structures. The structures show good biocompatibility and allow an easy biofunctionalization with proteins down to a single protein level. For characterization of the protein binding properties to the polymer nano-structures we use direct stochastic optical reconstruction microscopy (dSTORM), which enables determination of protein cluster properties at a nanoscale level. Combining STED lithography with dSTORM fluorescent microscopy allows us to produce well characterized, biocompatible structures, applicable to many biological assays.
17:45	**715**	**Asymmetric Lipid Vesicles at Subnanometer Resolution** *Barbara Geier [1], Drew Marquardt [1], Milka Doktorova [2], Frederick A. Heberle [3], Robert Standaert [4], Erwin London [5], Gerald Feigenson [2], John Katsaras [3], Georg Pabst [1]* *[1] Inst. of Molecular Biosciences, Biophysics Division, Univ. of Graz, Humboldtstr. 50/III, AT-8010 Graz* *[2] Tri-Institutional Training Program in Computational Biology and Medicine, Corne, 1300 York Ave, 10065 NY, USA* *[3] Neutron Sciences Directorate, Oak Ridge National Laboratory, Oak Ridge, 37831 Tennessee, USA* *[4] Energy and Environmental Sciences Directorate, Oak Ridge National Laboratory, Oak Ridge, 37831 Tennessee, USA* *[5] Biochemistry and Cell Biology, Stony Brook University, 5215 NY, USA* Mammalian plasma membranes consist of an asymmetric lipid distribution along the two leaflets. However, due to difficulties of preparing artificial asymmetric lipid bilayers membrane biophysical studies have been mostly performed using symmetric lipid-only mimics of plasma membranes. Of recent we developed new protocols for asymmetric vesicles with a well-defined inner and outer leaflet composition. This enables us to study their inner structural parameters, such as, the thicknesses and lipid packing densities in each leaflet through a joint analysis of small angle X-ray and neutron scattering (SAXS and SANS) data exploiting D/H contrast variation. We report first results yielding detailed insight into transbilayer coupling mechanisms.
18:00	**716**	**Ion-mediated membrane interactions under constrained and unconstrained conditions** *Santosh Prasad Gupta [1], Michal Belicka [1], Bing Sui-Lu [2], Heinz Amenitsch [3], Rudolf Podgornik [2], Georg Pabst [1]* *[1] Inst. of Molecular Biosciences, Biophysics Division, Univ. of Graz, Humboldtstr. 50/III, AT-8010 Graz* *[2] Faculty of Mathematical and Physics, University of Ljubljana, Jadranska ul. 19, SI-1000 Ljubljana* *[3] Institute of Inorganic Chemistry, Graz University of Technology, Stremayrgasse 9/IV, AT-8010 Graz* Interaction potentials between biological aggregates such as lipid bilayers can be manipulated by solute ion condition (ionic strength, ionic type and valency) (unconstrained case) and by external osmotic stress (constrained case) i.e. using a large, neutral (bio) polymers such as polyethylene glycol (PEG). Using synchrotron SAXS on anionic phosphatidylglycerol lipids mixed with Hexaammincobalt(III)-chloride, we have generated this way equal bilayer separations for either constrained or unconstrained bilayers. Our result shows that interaction potentials differ significantly, in particular in terms of fluctuations around their equilibrium separations which can be understood in the framework of a modified Poisson-Boltzmann theory.

18:15	**717**	**The separation of racemic mixtures via functionalized, two-dimensional membranes: A new concept beyond molecular sieving** *Andreas Hauser, Institute of Experimental Physics, TU Graz, Petersgasse 16, AT-8010 Graz* *Martin Head-Gordon, Department of Chemistry, UC Berkeley, 94720 Berkeley, USA* *Alexis Bell, Dep. of Chemical and Biomolecular Engineering, UC Berkeley, 94720 Berkeley, USA* *Peter Schwerdtfeger, Centre for Theoretical Chemistry and Physics, Massey University, Private Bag 102904, NZ-0745 Auckland* The chirality of a drug molecule affects its potency, toxicity and effect on biological systems. Therefore, drug research demands to have enantiomers of bioactive molecules separated and tested. A new method for the efficient separation is demonstrated given the example of a chirally functionalized nanoporous graphene sheet. Computational simulations based on density functional theory show that the attachment of a suitable chiral 'bouncer' molecule to the pore rim prevents the passage of the undesired enantiomer. In contrast to common methods such as gas chromatography, this allows an identification of a left- or right-handed drug molecule in a single molecular event.
18:30	**718**	**Intermediate-scattering function of a single self-propelled particle** *Christina Kurzthaler, Sebastian Leitmann, Thomas Franosch* *Institut für Theoretische Physik, Universität Innsbruck, Technikerstraße 21A, AT-6020 Innsbruck* The dynamics of a single self-propelled particle in two dimensions is analyzed in terms of the intermediate-scattering function (ISF), i.e. the characteristic function of the random displacements. Its analytical solution is derived by solving the Fourier transform of the Fokker-Planck equation which has the form of a complex Mathieu equation. Exact expressions for the mean-square displacement and non-Gaussian parameter are obtained as derivatives of the ISF. For large wave numbers, oscillations in the ISF reflect the straight swimming motion, whereas at small wave numbers diffusive behavior emerges with an effective diffusion coefficient depending on the velocity and rotational diffusion of the swimmer.
18:45	**719**	**Coherent deflectometry in a matter-wave interferometer for biomolecules** *Lukas Mairhofer, Christian Brand, Ugur Sezer, Philipp Geyer* *Institut für Quantenphysik, Universität Wien, Boltzmanng. 5, AT-1090 Wien* Matter-wave interference has been demonstrated for molecules with up to 10.000 amu (Eibenberger, PCCP 15, 2013). If a deflecting field maintains the spatial coherence of the molecule´s center-of-mass wave-function, interference enhances the spatial resolution of deflection measurements by four orders of magnitude. Such experiments were conducted with static electric fields (Eibenberger, NJP 13, 2011). Also the absorption of a single photon suffices to shift the interference pattern (Eibenberger, PRL 112, 2014). We introduce a source for beams of internally cold and neutral biomolecules. Furthermore we present a magnet array suitable for spatially coherent deflection of diamagnetic molecules. This will allow us to study photo-induced conformational changes in molecules like beta-Carotene and Retinal and even photochemistry in the gas phase in molecules like Resveratrol or Dehydrocholestorol.
19:00		***END***
19:15		***Transfer to Dinner***
20:00		***Conference Dinner***

731 A biosensor device based on microwave split ring resonators

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Biosensors based on microwave split ring resonators (SRRs) have become very attractive in the field of chemical analytics and medical diagnostics, especially for the detection of biomolecules and biomarkers. For sensor applications, small parts of the SRR surface will be biofunctionalized where only specific molecules can bind. Proportional to the load of biomolecules the electric permittivity of the SRR gets changed and the resonant frequency is shifted. In our study a theoretical SRR biosensor device was developed, by means of extensive finite element method (FEM) simulations. Our preliminary simulation results indicate a high sensor functionality of the SRR device.

732 Ultra-fast laser microprocessing of medical polymers for cell engineering applications

Jose L. Toca-Herrera [1], Rocio Ortiz [2], Iban Quintana [2], Susana Moreno-Flores [1], Maria Vivanco [3], Jose Ramon Sarasua [4]
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Picosecond laser micromachining technology (PLM) has been used to fabricate 3D structured substrates consisting of polystyrene and poly-L-lactide. The results showed that altered substrate roughness changed very little the adhesion and proliferation of the breast cancer cells. However, pattern direction directly affected cell proliferation (cell clusters were growing along the pattern direction). When cultured in square-like compartments, cells remained confined inside these for eleven incubation days. PLM technology seems to be a suitable method to modify the cell microenvironment to induce a predefined cellular behavior.

733 DNA origami platform for protein interaction analysis

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[4] Inst. of Structural and Molecular Biology, University College London, 20 Gordon St., London WC1H 0AJ, UK

Quantitative analysis of the interaction of single proteins in live cells can capture mechanistic details that are lost in bulk measurements. Here, we use electron beam induced deposition (EBID) to generate carbon nanoislands of 50 nm diameter on a polyethylene glycol (PEG)-coated coverslip. These nanoarrays are then decorated with DNA origami structures of matching size featuring a single engineered capture site for a target protein. Using this experimental approach we are able to immobilize individual to a few protein molecules per nanoisland. Finally, we will use this new platform to single out individual protein complexes in their native membrane environment.

734 Sound Speed Dispersion and Compressibility of Aqueous Lysozyme Solutions

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Compared to pure liquid water, aqueous protein solutions show a larger sound speed and a smaller isentropic compressibility, which is interpreted to be due to protein-solvent interaction and the corresponding formation of a hydration shell. We have investigated aqueous lysozyme solutions at ambient pressure over the temperature range $275 < T/K < 335$ by Brillouin spectroscopy and have also measured density, refractive index (at $\lambda = 514.5$ nm) and ultrasonic speed (at 3 MHz).
A significant dispersion of the sound speed in the lysozyme solutions was observed corresponding to a smaller compressibility at higher frequencies indicating relaxation processes which have not be seen in pure bulk water.