Energy and angular distributions of electrons transmitted through Al_2O_3 nanocapillaries

Aleksandar R. Milosavljević[1*], J. Jureta[1], Gy. Víkor[1], Z. D. Pešić[1], D. Šević[1], S. Mátéfi-Tempfli[2], M. Mátéfi-Tempfli[2] and B. P. Marinković[1]

[1]Laboratory for atomic collision processes, Instiutute of Physics, Pregrevica 118, Belgrade, 11080, Serbia
[2]Unité de Physico-Chimie et de Physique des Matériaux, Université Catholique de Louvain, Place Croix du Sud, 1, B-1348 Louvain-la-Neuve, Belgium

* Present address: Synchrotron SOLEIL, 91192 Gif-sur-Yvette, France

Girona, 2009

Summary

- Transmission of low-energy electrons (≈ 2 eV – 350 eV) through insulating Al_2O_3 nanocapillaries (40, 140, 270 nm diameter; 15 μm length) have been investigated. Measurements include energy spectra from elastic down to a few eV's and relative transmission dependence on incident electron energy, tilt angle, observation angle, incident current and time.

- The results suggest a more complex nature of low-energy electron transport through insulating nanocapillaries than proposed for positive ions.

- Further measurements with different types of capillaries are of interest!

2nd Symposium on Ion-Insulator-Interactions

Time	Subject	Speaker / Chair Person
Wednesday 20th May 2009		
	SESSION 1: ION GUIDING	**B.A. HUBER**
14H00 - 14H30	Opening - Introduction	*Y. Yamazaki, Riken, JP*
14h30 - 15h00	Dynamics of insulator nano-capillary charge up	*R. Schuch, Stockholm Univ., SE*
15h00 - 15h30	Dynamic properties of ion guiding through nanocapillaries in an insulating polymer	*E. Bodewits, KVI Groningen, NL*
15h30 - 16h00	***Coffee Break***	
	SESSION 2: ION GUIDING	**J. TANIS**
16h00 - 16h30	Guiding of slow HCI beams through glass-made optics	*T. Ikeda, Riken, JP*
16h30 - 17h00	Imaging the auto-organised charging dynamics of glass capillaries by ion beams	*A. Cassimi, CEA-CIMAP, Caen, FR*
17h00 - 17h30	The guiding in flat capillaries	*G. Pokhil, Moscow State Univ., RU*
17h30 - 18h00	Simulations of charged-particle transport through capillary targets	*C. Lemell, ITP, TUW, Vienna, AT*
19h30	***Dinner***	
Thursday 21st May 2009		
	SESSION 3: ION-SURFACE INTERACTIONS	**F. AUMAYR**
9H00 - 9H30	Swift heavy ion collisions with surfaces under grazing incidence	*H. Lebius, CEA-CIMAP, Caen, FR*
9h30 - 10h00	Nanostructures induced by highly charged ions on insulating surfaces	*René Heller, FZD Dresden, DE*
10h00 - 10h30	***Coffee Break***	
	SESSION 4: ION-SURFACE INTERACTIONS	**R. SCHUCH**
10h30 - 11h00	Sputtering and surface modification of insulators: charge effect	*B. Ban d'Etat CEA-CIMAP, Caen, FR*
11h00 - 11h30	Potential energy - induced nanostructuring of insulator surfaces by impact of slow, very highly charged ions	*F. Aumayr, IAP, TUW, Vienna, AT*
11h30 - 12h00	Diffraction of fast atoms from surfaces	*H. Khemliche, CNRS-LCAM, Orsay, FR*
12h00 -14h00	***Lunch***	
	SESSION 5: CHARGED PARTICLE GUIDING	**Y. YAMAZAKI**
14H00 - 14H30	Fast electron and ion transmission and guiding in nano- and micro-capillaries	*J. Tanis, MSU, Michigan, USA*
14H30 - 15H00	Energy and angular distributions of electrons transmitted through Al2O3 nanocapillaries	*A. Milosavljevic, Belgrade University, RS*
15h00 - 15h30	Charged particle guiding through macroscopic capillaries	*G. Kowarik, IAP, TUW, Vienna, AT*
15h30 -16h00	***Coffee Break***	
	SESSION 6: CHARGED PARTICLE GUIDING	**N. STOLTERFOHT**
16h00 - 16h30	Investigation of MeV ion transport in tapered glass capilleries and its application to micro-PIXE analysis	*J. Hasegawa, Tokyo Inst. of Tech., JP*
16h30 - 17h00	Systematic study of the ion guiding power for Al2O3 capillary samples and ideas for studying ion insulator interactions above the surface	*B. Sulik, ATOMKI, Debrecen, HU*
17h00 - 17h30	Grazing incidence scattering from insulator surface vs. guiding through capillaries: what do we learn?	*N. Bundaleski, CNRS-LCAM, Orsay, FR*
17h30 - 18h00	Conclusion	*N. Stolterfoht, Helmholtz Zentrum, Berlin, DE*
19h30	***Dinner***	
Friday 22nd May 2009 - 10h00 am: End of the symposium - Departure		

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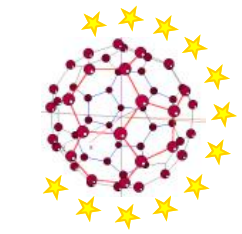
ITSLEIF NEWSLETTER

Ion Technology and Spectroscopy at Low Energy Ion Beam Facilities

a European Integrated Infrastructure Initiative (I3)



News—Events—Meetings—Scientific Highlights—Personnel—Infrastructures

The 4th Annual Meeting – a Great Success!

From 15th to 22nd of May 2009 the 4th Annual Meeting was organised in Platja d'Aro in Spain counting about 100 participants. For the first time the meeting lasted for one week, including the 2nd International Symposium on Ion Insulator Interactions (S3I, see further below). During the first day, the different ITS LEIF Committees assessed the activities in their respective fields. In particular, the deliverables and the financial situation have been discussed and reviewed in view of the 6-months extension of the contract. During the following days, the users presented their projects in the framework of the Transnational Access Activity and the Proposal Selection Panel discussed the beam time attribution which was ratified by the Executive Committee. The contributions, presented during the foresight studies from nearby fields, have been appreciated very much. They covered a large spectrum of science, ranging from Cosmo-climatology (H. Svensmark, DNSC, DK), the Irradiation of small organic molecules and clusters (E. Suraud, IRSAMC, FR), Charge instabilities of micro-droplets (E. Giglio, CIMAP, FR) to Power dissipation in cold microplasma jets (T. Gans, QUB, UK) and Graphene and Boron Nitride single layer templates (T. Greber, U. Zürich, CH). At half-time of the meeting, a half-day excursion to the old town of Girona and the Museum of Dali allowed to discuss physics from another point of view and in a different surrounding. Although no specific summer school was integrated in the programme, the participation of young researchers with about 40% was again very encouraging. A fifth Annual Meeting is planned to be held in June 2010.

Bernd A. Huber, ITS LEIF Coordinator

XVIIth Symposium on Atomic, Cluster & Surface Physics 2010

Jan. 24 - 29, 2010
Universitätszentrum
Obergurgl, Austria

This international symposium is one in a continuing biennial series of conferences (the last one was held in 2008 in Les Diablerets, Switzerland) which seeks to promote the growth of scientific knowledge and effective exchange of information among scientists in the field of atomic, molecular, and surface physics and with a major focus on nano particles and biomolecules. The symposium deals in particular with collisional interactions involving different types of collision partners, i.e. electrons, photons, molecules, nano particles, and surfaces. A special emphasis of this conference will be to provide room for discussion between academics and industry by a proper choice of lecturers.
http://www.uibk.ac.at/ionen-angewandte-physik/tagungen/sasp10/

Clustertreffen 2009

4-9 Oct. 2009,
Herzogenhorn, Schwarzwald, Germany

The "Clustertreffen" is an informal workshop about cluster physics and related fields. This year, the meeting will take place from the 4th to the 9th of October, 2009 in the federal centre for competitive sports at Herzogenhorm in the Black Forest.

Contact: clustertreffen@physik.uni-freiburg.de

Highest German Award for Prof. Dr. H. Schmidt-Böcking

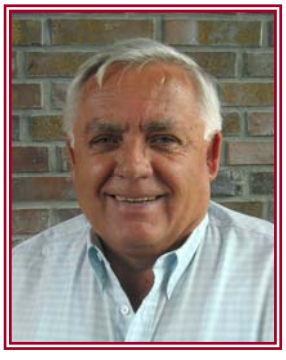
In recognition of his outstanding scientific achievements as an experimental physicist – including the development of the COLTRIMS and his contributions to Reaction Microscope technology – Prof. Dr. H. Schmidt-Böcking has received the most prominent German award, the "Verdienstkreuz 1. Klasse des Verdienstordens der Bundesrepublik Deutschland". Ceremoniously presented by the President of the Federal Republic of Germany, Horst Köhler, Horst Schmidt-Böcking was honoured not only for his far-reaching contributions to the science of ultra-fast correlated electronic motion in atoms and molecules, but also for his accomplishments as a Professor, teacher and leader of a research group at the University of Frankfurt. Internationally recognized on the highest level, e.g. as the first non-American recipient of the prestigious Davisson-Germer Award of the American Physical Society, many of his students have developed to take on leading positions in the field worldwide.

Scientifically, the aforementioned instruments have revolutionized our understanding of many-body quantum dynamics in atomic and molecular physics by enabling few-particle coincidences through projection technologies. They are well-known and operated in many laboratories worldwide, for the investigation of atomic and molecular collisions, at synchrotrons, free electron lasers and are considered to be a key technology in the emerging field of "atto science", the exploration of ultra-fast electronic and nuclear motion on time-scales below 10^{-15} s.

We all know Horst as an enthusiastic scientist and enlightening teacher usually with many more visions and ingenious ideas than his group or likely the whole Institute could ever realize! Those who had the pleasure to work with him appreciate his always optimistic attitude, his charming and warm personality, his never ending energy attacking new obstacles, his fresh and unconventional view on the enigma of correlated and entangled electron motion, "flying fishes" and much more.

Thanks, Horst and congratulations!

Joachim Ullrich, MPIK Heidelberg



H. Schmidt-Böcking, Head of the ITS LEIF Scientific Council.

The 2nd Symposium on Ion Insulator Interactions S3I

Charged particle beam - insulator interactions were avoided so far, as they mostly showed un-reproducable results and macroscopic charge-up effects. Recently, through the ability to produce and analyze nano-structured materials, such as nano-capillaries, in-situ atomic force micro-scopes, and improved beam handling, a new access to ion-insulator interac-tion was opened.

Because of this being an intense research and development activity in ITS LEIF an International Symposium entitled "Ion Insulator Interactions (S3I)" was held on the 20th and 21st of May, after the 4th Annual ITS LEIF Meeting. It was the second meeting of this kind with the first one held in Japan, Sept. 2008. The field is rapidly developing into different branches and showing ex-citing spring-offs. The issues of strongest concerns, that were discussed at the meeting, are the guiding (enhanced transport by electrical charge up) of charged particles in capillaries, with various geometrical properties, cylindrical, tapered, romboedric capillaries from a few nanometers to mm diameter, and parallel glass plates, as well as different insolating materials. Particle beams of charged ions, electrons, myons are transmitted and partly focused to mi-crometer spots. Bio-medical applications are started. Very closely connected to that, particularly to the parallel glass plates – is charging of insulator sur-faces - with instabilities, discharges, showing oscillations in transmission and strong non linear effects. These were observed and theoretically postulated. Another highlight was the dynamics of charge up, seen in oscillations of the centroid of transmitted intensity by several groups which has now been proven by theory as well. A bit more contradictory was the transmission of electrons through nano-structures. Is it really guiding or scattering?

In ion-beam induced modifications of insulating surfaces, reports on blisters and craters were given, with a control of size and positioning within reach.

The presentations given will become available on the ITS LEIF website soon. The discussion was very lively and culminated in a quest to establish criteria and definitions of “guiding”, “guiding power”, “charge-up properties”, “fresh or treated surfaces”, “memory effects”, … A next meeting has already been en-visaged.

Reinhold Schuch, Stockholm University

Instrumentation & Experimental Techniques

High-Resolution Mass Spectrometry of Femtosecond Laser Produced Ions

Short pulse, intense IR lasers have a number of features which are desirable in mass spectrometry. Ionisation by a femtosec-ond (10^{-15} s) laser pulse is efficient and sensitive, producing an ion bunch that is well defined in space and time.
At Queen’s University Belfast, we use a novel linear electrostatic trap (Fig. 1) to analyse the masses of the ions produced via femtosecond laser induced ionisation. Once trapped, these ions oscillate on stable trajectories with frequencies inversely pro-portional to the square root of their mass and are detected non-destructively by a pick-up ring. A Fourier transform of the time dependent signal yields mass spectra which can be of high resolution (Fig. 2).

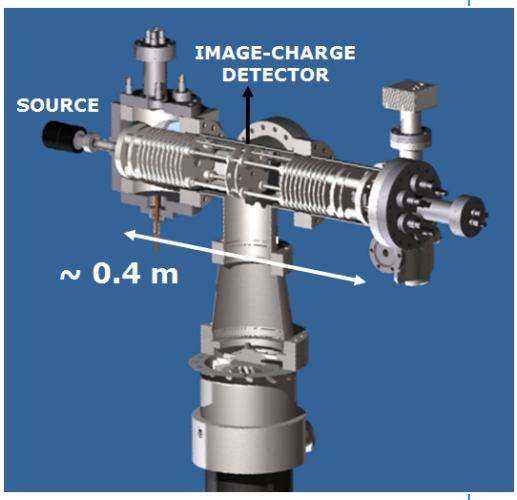


Fig 1: KEIRA (Kilovolt Electrostatic Ion Reflection Analyser)

Our results demonstrate that the laser produced ions have a very small energy spread and spatial extent which means that the ions remain bunched for long periods in the trap. At present the mass resolution is limited by the background gas pressure of a few 10^{-7} mbar. The trapping conditions in our apparatus are mass-independent and thus this technique promises useful application to larger biomolecu-lar systems in future studies.

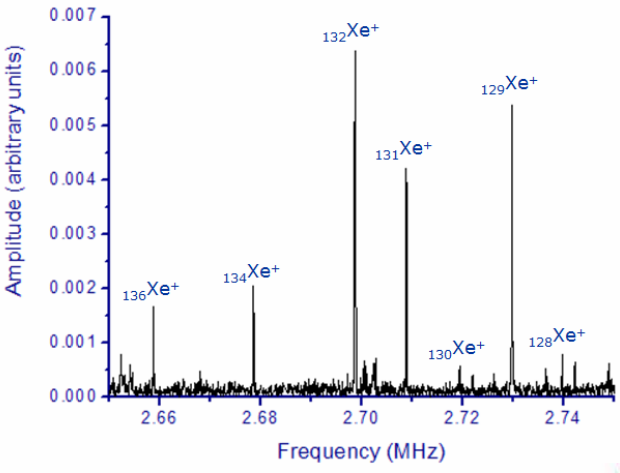


Fig 2: Separation of xenon isotopes in frequency space, achieving a resolution of $m/\Delta m = 10^4$.

Contact: Jason Greenwood (j.greenwood@qub.ac.uk), Orla Kelly (okelly04@qub.ac.uk), Queen’s University Belfast, Northern Ireland.