# ASET-WHCI2012 Colloquia

## Date: Friday, 30th March 2012
## Venue: Lecture Theatre (AG-66)

### Topic: The Double Electrostatic Ion-ring Experiment, Desiree
### Speaker: Prof. Henning T. Schmidt
### Time : 16:00 to 16:30 hours

H.T. Schmidt*, P. Löfgren, L. Liljeby, L. Brännholm, S. Rosén, R.D. Thomas, M. Björkhage, M. Blom, S. Leontein, Páal, G. Andler, P. Reinhed, K.G. Rensfelt, A. Källberg, A. Simonsson, H. Zettergren, J. Alexander, D. Misra, N. Haag, M. Stockett, M. Gatchell, K. Farid, and H. Cederquist

*Stockholm University, Department of Physics, Albanova University Centre, Stockholm, Sweden*

At Stockholm University, we are building the electrostatic double-storage-ring facility, DESIREE [1]. Two 8.8 m circumference race-track shaped electrostatic ion-storage rings are mounted with a common straight section for merged beams on a single large plate of high-thermal-conductivity aluminum. This plate at the same time constitutes the bottom of a vacuum chamber mounted inside another steel vacuum chamber and cooled by the colder second stages of four Sumitomo cryogenerators. The cold inner chamber is surrounded by a thermal copper screen which is cooled by the first stages of the cryogenerators and covered with 30 layers of superinsulation. Estimates of the heat loads to the inner vacuum chamber through wiring, windows and pumping and injection ports indicate that a final temperature inside the inner vacuum chamber below 10 K is possible. Two ion injectors of 100 and 25 kV, maximum acceleration potential are connected to the two storage rings. Ion beams of opposite charges are stored in the two rings and neutral and charged products of interactions between the oppositely charged ions can be observed after the merging section. Further, each ring can be used for experiments with a single stored ion beam interacting with pulsed or cw laser beams. The figure shows some of the ion-optical elements mounted inside the aluminum inner vacuum chamber. The two merged beams will move towards the viewer in the central part of the picture. Neutral atoms or molecules formed in mutual neutralization processes will be collected on an imaging detector system consisting of a triple-stack microchannel-plate detector with a phosphor screen anode that will be mounted directly below the camera position for the photograph in the figure. An updated status of the DESIREE project including an advanced system for biomolecular ion production consisting of an electrospray ion source an ion accumulation rf-trap, a quadrupole mass filter and a cryogenic ring-electrode rf-trap will be presented.

References

[1] R. D. Thomas *et al*, Rev. Sci. Instrum. **82**, 065112 (2011)

### Topic: Ion Micro-beam Irradiation of Living Cells Using Tapered Glass Capillaries
### Speaker: Dr. Volkhard Mäckel
### Time: 16:30 to 17:00 hours

V.Mäckel[1], W. Meissl[1], T.Ikeda[1], M.Clever[2], E.Meissl[1], T.Kobayashi[1], N.Imamoto[2] and Y.Yamazaki[1]

*[1]Atomic Physics Laboratory, RIKEN, 2-1 Hirosawa, Wako, Saitama, 351-0198 Japan*

*[2]Cellular Dynamics Laboratory, RIKEN, 2-1 Hirosawa, Wako, Saitama, 351-0198 Japan*

We present a new facility at the pelletron accelerator laboratory at RIKEN for micro-beam cell irradiation, where protons or Helium ions with a few MeV can be focused down to diameters below 1 µm by means of a tapered glass capillary with a thin window at its outlet [1, 2]. In order to facilitate experiments on biological material while keeping the samples within their optimal biological environment, the ion trajectory is bent by three magnets such that it reaches the sample from above at an angle of 45 degrees. The ions are then guided by the capillary to the desired target area. By choosing an ion energy between 1 and 5 MeV, the penetration depth of the ions in water can be tuned between a few and 150 µm for protons. In contrast to usual micro-irradiation facilities, the position of the Bragg peak thus can be aimed to a specific target inside the cell, whereas the energy loss in the thin plastic exit window [3] is negligible. In this way fully three-dimensionally confined irradiation of a well-selected microscopical volume in a cell can be achieved [4]. This method makes a new class of micro-irradiation experiments possible, as e.g. response studies for targets much smaller than the well-studied nucleus, or cell micro-surgery.

Furthermore, we recently have developed new capillaries that use an additional plastic scintillator window for single proton counting. The protons exiting the capillary are detected via the scintillation photons by means of a photomultiplier, while stray light due to the irradiation of the glass capillary itself is blocked by a metal coating. In future experiments the single proton detection will be used to control an already implemented fast switching ion chopper. Thus we will be able to implant a precise number of protons within selected areas inside living cells, which will be used to study the effects of low dose radiation in detail.

References

[1] T. Ikeda et al., J. Phys. Conf. Ser. **88**, 012031 (2007).

[2] T. Ikeda et al., Surf. Coat. Technol. **206**, 859 (2011)

[3] T. Ikeda, Japanese patent No. 2011-161568

[4] Y. Iwai et al., Appl. Phys. Lett. **92**, 023509 (2008)