

First results from the Double ElectroStatic Ion-Ring ExpERiment, DESIREE

Michael Gatchell¹, Henning T. Schmidt, John D. Alexander, Guillermo Andler, Mikael Björkhage, Mikael Blom, Lars Brännholm, Erik Bäckström, Tao Chen, Wolf Geppert, Per Halldén, Dag Hanstorp*, Fredrik Hellberg, Anders Källberg, Mats Larsson, Sven Leontein, Leif Liljeby, Patrik Löfgren, Sven Mannervik, Andras Paál, Peter Reinhed, Karl-Gunnar Rensfelt, Stefan Rosén, Fabian Seitz, Ansgar Simonsson, Mark H. Stockett, Richard D. Thomas, Henning Zettergren and Henrik Cederquist

Department of Physics, Stockholm University, AlbaNova University Center, SE-106 91 Stockholm, Sweden

*Department of Physics, University of Gothenburg, SE-412 96 Gothenburg, Sweden

Synopsis We have stored the first beams in one of the rings of the double electrostatic ion-storage ring, DESIREE at cryogenic and at room temperature conditions. At cryogenic operations the following parameters are found. Temperature; $T = 13\text{K}$, pressure; $p < 10^{-13}$ mbar, initial number of stored ions; $N > 10^7$ and storage lifetime of a C_2^- beam; $\tau = 450$ s.

Construction of the Double ElectroStatic Ion-Ring Experiment (DESIREE) [1, 2] at Stockholm University has reached completion and the experiment is in the commissioning phase. DESIREE is a novel experiment where two cryogenically cooled electrostatic ion storage rings, each with a 8.6 m circumference, are enclosed in a single cryogenic vacuum chamber and share a common straight interaction section where oppositely charged ions may interact at meV level center-of-mass energies.

The experiment is at operational conditions with an inner chamber temperature of approximately 10 K and pressure below 10^{-13} mbar. The first of the two rings is fully operational and its characteristics have been studied through the storage of 10 keV beams of carbon anions (C^- , C_2^- , C_3^- and C_4^-) and their neutralisation through interactions with background rest gas. We are able store a C_2^- beam containing tens of million ions. After an initial non-exponential decay due to the effects of space charge, the decay approaches a single exponential behaviour with a lifetime of 7.5 minutes (figure 1).

Following the ongoing commissioning of the second ring, this unique experiment will enable the study of mutual neutralisation of pairs of cooled ions and the measurements of reaction

kinetics through the use of a position sensitive multi-hit detector. Thus the study of gas phase ionic chemistry, such as that occurring in the interstellar medium, is possible.

Further commissioning results will be presented at the conference.

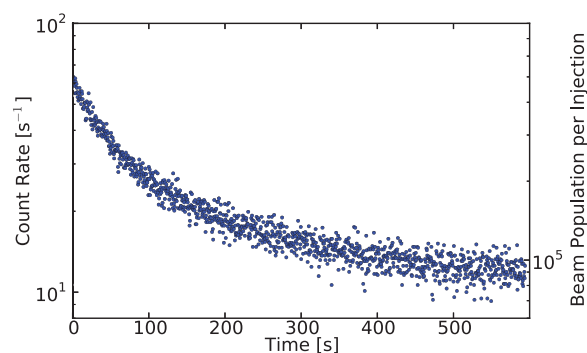


Figure 1. Signal from single ring storage of an initial injection of 5×10^5 10 keV C_2^- ions. The ions are being neutralised in collisions with rest gas with a $1/e$ lifetime of 7.5 minutes.

References

- [1] R. D. Thomas *et al* 2011 *Rev. Sci. Instrum.* **82** 065112
- [2] H. T. Schmidt *et al* 2008 *Int. J. Astrobiol.* **7** 205

¹E-mail: gatchell@fysik.su.se

