ESD2011: Status and outlook: Weizmann electrostatic traps and internal excitation and relaxation of stored molecular ions

D. Schwalm[*§1], O. Aviv[*], O. Heber[*], B. Kafle[*], U. Lev[*], I. Rahinov[*], M. L. Rappaport[*], H. Rubinstein[*], D. Strasser[†], Y. Toker[*#], and D. Zajfman[*]

[*] Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot, 76100, ISRAEL
†Institute of Chemistry, The Hebrew University of Jerusalem, Jerusalem, 91904, ISRAEL
[§]Max-Planck Institute for Nuclear Physics, D-69117 Heidelberg, GERMANY
[#] Institute of Physics and Astronomy, University of Aarhus, DK-8000 Aarhus, DENMARK

Several methods have been developed recently to study the internal excitation and relaxation of stored molecular ions and small charged clusters using the electrostatic ion beam traps (EIBT) available at the Weizmann laboratory.

Based on the bend version of the EIBT [1], which incorporates an electrostatic in trap deflector to allow for a simultaneous measurement of delayed electron detachment and delayed fragmentation of laser excited cluster anions [2], we introduced a new procedure to determine the absolute photo-destruction cross section as well as the branching ratios of these anions into prompt and delayed detachment and fragmentation channels. The absolute destruction cross sections are measured by depletion, i.e. by storing the cluster ions in the linear EIBT configuration and by detecting the clusters surviving the laser pulse as a function of the laser power, using the deflector to guide them to a fast detector. The absolute prompt and delayed fragmentation cross section are determined by deflecting the resulting charged products mass-selectively at various delay times after the laser pulse towards the fast detector. These procedures will be exemplified by discussing first results obtained for Al_n^- clusters, which were produced in a hot sputter ion source and allowed to cool down for at least 90 ms before the laser excitation took place.

Using a linear EIBT coupled to an 'Even-Lavie' supersonic expansion ion source [3] the heating up of cold SF_6 based clusters by the BIRD (Black body Induced Radiative Dissociation) process was investigated. The reduced lifetimes of cold $SF_5^+(SF_6)_{n-1}$ cluster ions in the trap due to their fragmentation caused by the absorption of infrared photons from the 300 K ambient radiation field were measured using an RF based technique. Here the lifetimes are determined by bunching the clusters of a specific mass with a small external RF field, whose frequency corresponds to a multiple of the oscillation frequency, and by using a windowed FT on the signal recorded by a pick-up electrode to follow the remaining number of clusters as a function of storage time. Properties and accuracies of the method and the sensitivity of the BIRD lifetimes to the stability of the cluster will be discussed. In order to control (to avoid) the heating of stored clusters by the absorption of infrared photons an EIBT is presently being build which can be cooled down to temperatures of ~4 K.

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References

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[1] E-mail: schwalm@mpi-hd.mpg.de