ELECTRON IMPACT DETACHMENT OF NEGATIVE IONS USING A STORAGE RING

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Negative ions are interesting from a fundamental point of view. In such loosely bound systems the normally dominant coulomb interaction between each electron and the core is suppressed and the inter-electronic interaction becomes of great importance. Under such conditions the independent particle model breaks down. Experimental studies of negative ions can therefore serve as a probe of electron correlation effects and hence be used to test theoretical models in order to better understand atomic and molecular processes.

In this paper we present the first experimental study of negative ions using the heavy ion storage ring CRYRING at the Manne Siegbahn Laboratory in Stockholm. Negative ions were produced in a sputter ion source, injected and accelerated to the full beam energy of 96(q/M) MeV/nucleon, where M is the ion mass and q is the charge on the ion. After acceleration, the beam was transversally cooled by means of an electron cooler, in which the ion beam was merged with an electron beam. The electron impact detachment process was studied by ramping the velocity of the electrons in the cooler. Neutral particles produced by electron impact detachment were detected in the zero-degree direction 3.5 meters downstream the interaction region using a surface barrier detector. The same experimental set-up is used for studies of electron impact on positive ions [1].

As a proof of principle we measured the cross section for electron impact detachment of F^- [2]. The threshold for the detachment process was found to be 7.6 eV. The cross section increased smoothly up to 55 eV collision energy, where it reached a maximum of 1.9×10^{-16} cm^2. At higher energies the cross section decreased according to the Bethe-Born approximation.

Second, we will present results from a study of CN^-. The aim of this study was to search for short lived CN^{2-} ions, and to study the branching between various break up channels. The so-called grid technique was applied to distinguish the pure detachment process from the process of detachment followed by dissociation. In addition, positive fragments were detected with a second surface barrier detector placed on the trajectory for positive ions, i.e. path bending out of the ring. At the maximum collision energy of 70 eV, there are in total eight decay channels that are energetically allowed. However, only the three channels

$CN^- + e^- \rightarrow CN + 2e^-$

$CN^- + e^- \rightarrow C + N + 2e^-$

$CN^- + e^- \rightarrow C^- + N + e^-$

were observed in this experiment. Further, no signs of a resonance caused by a doubly charged negative ion were seen.

In a third experiment we have performed a similarly study on the C_4^- molecule. This experiment has just been completed, and we are in progress of evaluating the data. The result from this experiment will be presented at the conference.

1. C. Strömholm, J. Semaniak, S. Rosén, H. Danared, S. Datz, W. Van der Zande and M. Larsson, Phys. Rev. A, 54, 3086 (1996).

2. K. Andersson, D. Hanstorp, A. Neau, S. Rosén, H. Schmidt, J. Semaniak, R. Thomas, M. Larsson, A. Le Padellec, F. Österdahl, H. Danared, A. Källberg and D. Pegg, Submitted to the *European Physical Journal.*