MEASUREMENTS OF ABSOLUTE, SINGLE CHARGE EXCHANGE CROSS SECTIONS OF H', He', AND He2' WITH H2O AND CO2

A. Chutjian1, J. B. Greenwood1,2 and S. J. Smith1

1 Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109 USA
2 Department of Pure and Applied Physics, Queen’s University Belfast, BT7 1NN UK

Absolute measurements have been made of single electron, charge exchange cross sections of H', He', and He2' in H2O and CO2 in the energy range 0.3 - 7.5 keV/amu. The results are relevant to the recent interesting problem of the interaction of the solar wind with comets.

Charge exchange (ce) is an important process in solar and stellar atmospheres, the interstellar medium, planetary ionospheres, and in comets. The present work connects with recent satellite observations of X-rays produced through ce, in collisions of highly-charged solar wind ions with neutral species "boiling off" a comet nucleus as it approaches the Sun.

Described herein are results obtained with a new beam line on the JPL highly-charged ion facility using the Caprice electron-cyclotron resonance (ECR) ion source. Details of the experimental apparatus will be described elsewhere. In the present measurements collimated beams of H', 3He' and 3He2' were produced in the ECR and focused into a collision cell with H2O or CO2 as targets. Single ce cross sections in 3He2' were measured by transmitting only He+ and reflecting the parent He2' using biased apertures. In the case of incident H', He', where the product is uncharged, the attenuation of the singly-charged ion was used to monitor the ce.

Results for the H2O and CO2 targets are shown in Figs. 1 and 2, respectively. Present results for H' agree within experimental errors with measurements of Ref. 5. Data of Koopman for H' and He' are roughly an order of magnitude smaller than present results for H2O, but in better agreement for CO2.

This work was carried out at JPL/Caltech, and was supported by NASA. JBG also acknowledges support by the NASA-NRC.

References


ara.chutjian@jpl.nasa.gov