X-ray Emission from Charge Exchange of Highly Charged Ions in Atoms and Molecules

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Abstract

Charge exchange is the main process responsible for the neutralization of solar wind ions by cometary (and planetary) atmospheres [1]. Following capture of an electron, the ion is left in an excited state and if it is highly charged (as is the case for C, N, O, Ne, Si, Fe in the solar wind), photons are emitted in the X-ray region. This mechanism is believed to be responsible for the recently discovered phenomenon of X-ray emission from comets [2][3].

Motivated by this discovery we have constructed a new apparatus to measure absolute cross sections for single and multiple charge exchange and X-ray photon emission, in collisions of highly charged ions with atoms and molecules[1]. As the field of X-ray astronomy has recently leapt forward through the recent launch of two new high resolution satellites, Chandra and XMM, these cross sections are essential for the development of current and future models.

The solar wind ions of interest are produced by the JPL highly charged ion facility [4] and passed through a gas target cell. The product charge states are analyzed by a retarding potential technique. Results are made absolute by measuring the gas pressure in the cell using a capacitance manometer, and monitoring the incident and product ion currents in a Faraday cup. X-rays emitted from the product ions are detected at 90° to the beam by a solid state detector of modest resolution. We will be presenting recent data from collisions of various charge states of C, N, O and Ne colliding with H_2, He, H_2O and CO_2.

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