Laboratory Studies of the X-ray Emission Generated by the Interaction of Solar Wind Heavy Ions with Comets

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Charge exchange between cometary gases and solar wind heavy ions is likely to be the dominant process of X-ray emission from comets. While charge exchange cross sections have been measured by various facilities, very little is known about the detailed processes that lead to X ray line formation. To fill this void, we are studying the charge exchange process in the laboratory using ions from the LLNL electron beam ion trap. The charge exchange induced X-ray emission is recorded with the spare GSFC ASTRO-E 6x6 microcalorimeter array. The microcalorimeter affords a resolution of better than 10 eV in the range of X-ray energies of interest (≤ 1000 eV) and thus individual emission lines can be resolved.

Our present measurements focus on the most abundant K-shell heavy ions found in the solar wind. In particular, we have measured the K-shell emission of bare C, N, and O and their hydrogen-like counter parts interacting with such gases as CO_2, N_2, and CH_4. Several suprising results are noted that had not been considered in the cometary X-ray models. We find that the emission not only reflects the composition and intensity of the solar wind, but also is a diagnostic of the solar wind velocity.[1] Moreover, the detailed emission depends on the chemical composition of the cometary gases.

References:

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