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Charge-Transfer and Impact-Ionization Cross Sections for Highly Stripped Carbon and Niobium Ions Incident on Argon and Hydrogen

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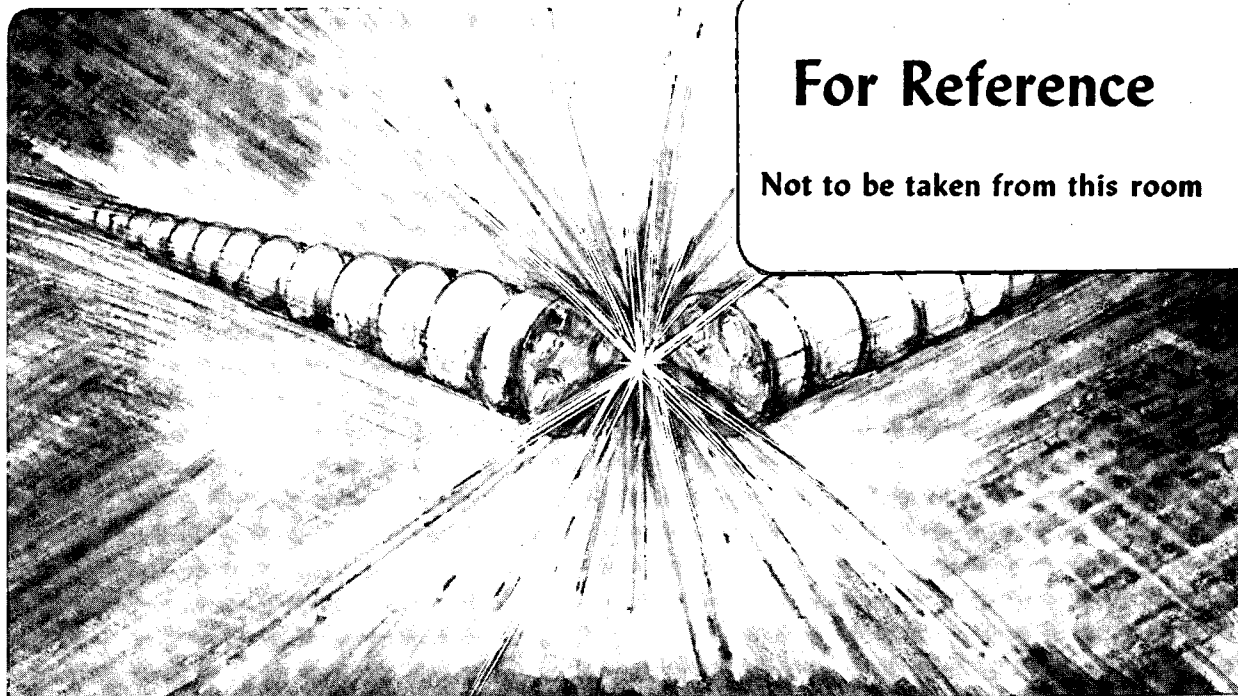
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CHARGE-TRANSFER AND IMPACT-IONIZATION CROSS SECTIONS
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and J. W. Stearns

May 1979



For Reference

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May 7, 1979

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CHARGE-TRANSFER AND IMPACT-IONIZATION CROSS SECTIONS FOR HIGHLY STRIPPED CARBON AND NIOBIUM IONS INCIDENT ON ARGON AND HYDROGEN*

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We have measured the cross sections for net impact ionization of H₂ and Ar targets by 290 keV/amu and 1.1 MeV/amu C^{+q} ions for q = 4-6, and by 3.4 MeV/amu Nb^{+q} ions for q = 23-36. We have also measured charge-transfer cross sections for these projectiles in H₂ and Ar.

The net impact-ionization cross section, σ_1 , is the weighted sum, $\sum n\sigma(n)$, where σ_n is of the cross section for removal of n target electrons. This cross section can be very large, especially for an Ar target, where multiple ionization is an important process. Typical values for the net ionization cross section are $3.3 \times 10^{-15} \text{ cm}^2$ for C⁺⁶ in Ar at 1.1 MeV/amu, $1.0 \times 10^{-14} \text{ cm}^2$ for Nb⁺³⁴ in H₂ at 3.4 MeV/amu, and $3.4 \times 10^{-14} \text{ cm}^2$ for Nb⁺³⁴ in Ar at 3.4 MeV/amu. Our results for the net ionization cross section are in reasonably good agreement with the weighted sum of recently measured $\sigma(n)$.¹

The sum of the charge-transfer and impact-ionization cross sections for a projectile X^{+q} in H is the cross section for electron loss from the hydrogen atom. We use the above results (divided by a factor of 2 for comparison with calculations for H atoms) to extend to large q values and to different ion species the experimental confirmation of our previously determined theoretical/experimental scaling rule² for electron loss from a hydrogen atom in collision with a heavy, highly stripped ion.

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¹C. L. Cocke, submitted to Physical Review.

²R. E. Olson, K. H. Berkner, W. G. Graham, R. V. Pyle, A. S. Schlachter, and J. W. Stearns, Physical Review Letters 41, 163 (1978); and K. W. Berkner, W. G. Graham, R. V. Pyle, A. S. Schlachter, and J. W. Stearns, submitted to XI ICPEAC (Kyoto, 1979).

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