Comment on "Double and Single Ionization of Helium by High-Velocity N^{7+} Ions"

In a recent Letter,[1] Heber *et al.* have reported on measurements of the ratio R of the double-ionization to single-ionization cross sections for a helium target. The velocity dependence of R was investigated over the range 10–30 MeV/amu using N^{7+} projectiles. From a comparison between their experimental results and a semiempirical analysis from Knudsen *et al.*[2] and theoretical estimates by Ford and Reading,[3] it was concluded that an unknown effect caused the experimental results for N^{7+} ions to be a factor of ~ 2 larger than expected.

Based on our earlier measurements[4,5] of R for antiprotons, protons, and He^{++} ions, we found that R can be given in the form

$$R = R_{\mathrm{I}} + q^2 R_{\mathrm{II}} - 2q R_{\mathrm{int}} .$$

R_{I} represents the fraction of the double-ionization cross section which stems from only one projectile-electron interaction TS-1. R_{II} represents the fraction which stems from two projectile interactions TS-2, and R_{int} represents the interference term between these two mechanisms; q is the projectile charge state. R_{I}, R_{II}, and R_{int} were determined in the velocity range from 1 to 10 MeV/amu, and theoretical estimates of R_{I}, R_{II}, and R_{int} were derived.

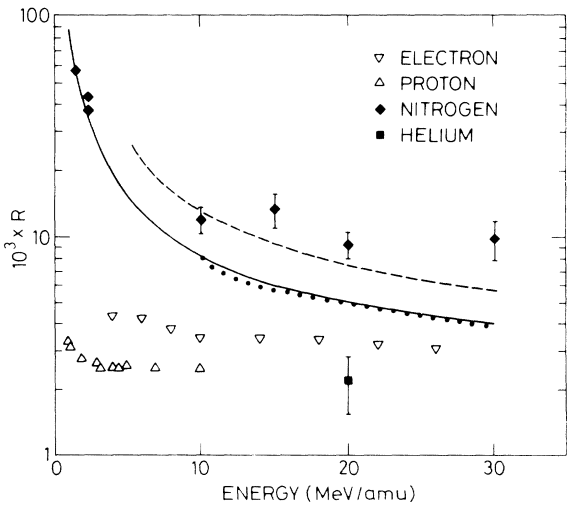

FIG. 1. This figure is identical to Fig. 2 of Ref. 1 except for the dashed line which represents the R ratio estimated from an analysis of antiproton, proton, and He^{++} data (for details, see text).

Since the velocity dependence of R_{I}, R_{II}, and R_{int} is well understood from the theoretical estimates, we have extrapolated the experimental values up to 30 MeV/amu in order to compare with the measurements of Heber *et al.*[1] On this basis, we have constructed the curve shown in Fig. 1, and, except for the point at 30 MeV/amu, good agreement with the new experimental results is obtained.

The calculated ratio R in Fig. 1 is plotted only to a lowest energy of about 5 MeV/amu since this energy corresponds to a value $\kappa = 1$ for N^{7+} projectiles ($\kappa = 2qv_0/v$, where v_0 is the Bohr velocity and v is the projectile velocity). In Ref. 2, it was noted that a perturbative treatment of collision processes is valid in the regime where $\kappa < 1$.

It is interesting to note that simple q scaling rules for the three contributions to double ionization of He apply for high-velocity atoms. This observation may serve as a guide for future theoretical work in the field of two-electron processes.

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