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Cross Sections and Spectral Models for Charge Exchange Between Bare Ne and Atomic H and He at Solar Wind Velocities

S. J. Bromley[1], **M. Pindzola**[1], **D. Bodewits**[1], **M. Fogle**[1]

[1]*(Presenting author underlined) Department of Physics, Auburn University, Leach Science Center, Auburn, AL 36849, USA*

Charge exchange between highly charged ions and neutrals introduces a problematic background for every x-ray observation [1], including comets [2], supernovae remnants [3], and a plethora of other environments [4]. For H-like ions produced by charge exchange with bare ions, the ℓ states within each n shell are degenerate. The majority of charge exchange spectral models rely on calculated n-resolved cross sections, and the unknown distribution of ℓ states is assumed to follow one of several analytical expressions. With few laboratory measurements available for benchmarking at the relevant solar wind velocities (300 - 1000 km/s, $\sim$0.5 – 5 keV/amu), comparison to $n\ell$-resolved cross sections can be used to mitigate inaccuracies introduced by the use of analytical ℓ-distributions. We report explicit calculations of $n\ell$-resolved CX cross sections using the time dependent close coupling method [5] for Ne^{10+} incident on atomic H and He at 1 - 5 keV/amu. We incorporated the cross sections into a radiative cascade model and investigated the influence of n- and $n\ell$-resolved cross sections on important line ratios. Comparison of the ℓ-distribution extracted from the new cross sections to the 4 available analytical distributions shows similarities to the statistical ℓ-distribution for the majority of the possible ion-neutral-energy combinations considered. Similar agreements are observed in Lyman and Balmer line ratios for collisions involving atomic H, and disagreements for the Ne^{10+}-He collision system are discussed. Possible line ratio diagnostics are explored, and data needs related to molecular targets are identified.

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