# X-ray emission following charge exchange between fully stripped ions and neutrals

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**Synopsis** X-ray spectrum and line ratio measurements not only provide details about an astrophysical plasma environment, but also test our understanding of the charge exchange mechanism. We have performed a systematic study of X-ray emission and line ratios for charge exchange between fully stripped ions and neutrals.

X-ray emission measurements following charge exchange in $C^{6+}$ -He, $H_2$, Kr and $O^{8+}$-Kr collisions at solar wind velocities have been carried out at the Multicharged Ion Research Facility (MIRF) at Oak Ridge National Laboratory [1, 2, 3]. Lyman series were resolved using a high resolution X-ray quantum microcalorimeter detector with an energy resolution better than 10 eV FWHM at 400 eV [4]. A measured spectrum is shown in Figure 1 for $O^{8+}$ on Kr at 293 km/s. Besides the identified Lyman series lines (red lines), one can also see peaks due to true double capture (A and B).

The measurements show that the dominant n shell capture channels are consistent with the classical trajectory monte carlo calculations using hydrogenic scaling of the ionization potential [5]. For example, the n = 3 capture is dominant in $C^{6+}$ - He single capture, while for $C^{6+}$ - $H_2$ the dominant capture shifts to n = 4. However, the measured line intensity ratios strongly deviate from the theoretical calculations for the single electron capture process, because multielectron processes (e.g., double capture, etc.) come into play. Specifically, our study shows that an autoionizing double capture mechanism leads to the enhancement of Ly-$\alpha$ emission. This results in the significant deviations between theoretical line ratios calculations and experimental results.

Finally, an apparatus is being developed to perform X-ray emission measurements at solar wind velocities for an atomic H target using the merged beam technique. These measurements are expected to test our understanding of the single electron capture process without the interference from double capture.

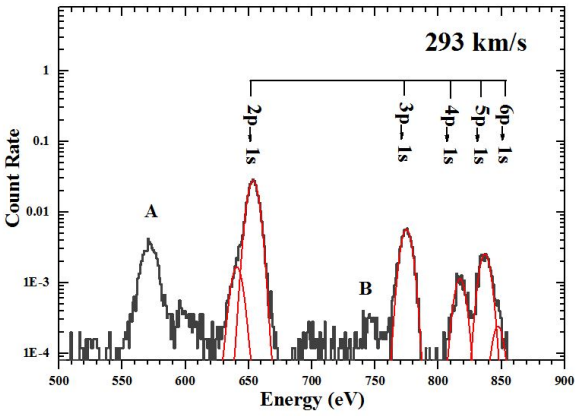


**Figure 1**. X-ray spectra for $O^{8+}$ on Kr at 293 km/s. Gray line and red line represent the experimental data and Gaussian fitting results, respectively.

This research is supported by NASA Astrophysics Research and Analysis Grant No. NNH13ZDA001N and NASA Solar and Heliospheric Grant No. NNX13AF31G.

## References

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