Reevaluation of Charge Exchange Cross Sections Related to Energetic Neutral Atom Detection in the Magnetosphere

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Energetic neutral atoms (ENA's) produced in charge-exchange collisions between magnetospheric ions and exospheric neutrals present a means to image remotely the plasma-dynamics of the magnetosphere. ENA detectors play a central role in the Imager for the Magnetopause-to-Aurora Global Exploration (IMAGE) satellite mission. The interpretation and quantification of observed ENA signals depend upon the knowledge of the energy dependence and magnitude of the appropriate charge exchange cross sections. A review of existing experimental cross sections for H^+ and O^+ impacting H, O, O_2 and N_2 is presented. In addition, theoretical studies for the $H^+ + H$, $O^+ + H$, $H^+ + O$ and $O^+ + O$ charge-exchange pairs are reviewed. As a proto-typical case, the non-symmetric $(O + H)^+$ pair, for which significant discrepancies exist in the literature, is examined in detail. Classical and semi-classical differential cross section calculations are compared with existing measurements. New semi-classical calculations of the integral cross sections for this case are presented. The calculations are based on high-level *ab initio* OH^+ interaction potentials and exchange energies[1], and use resonant charge exchange theory[2] including angular momentum conservation constraints. This approach is justified for the non-symmetric system at the energy range of interest given the accidental resonance in the $(O + H)^+$ system.

1. G. Chambaud, J. M. Launay, B. Levy, P. Millie, E. Roueff and F. Tran Minh, J. Phys. **B** 13, 4205 (1980).
2. H. S. W. Massey and H. B. Gilbody, *Electronic and Ionic Impact Phenomena*, 2 ed. (Oxford University Press, London, 1974).