An Analysis of far Ultraviolet Proton Aurora

Yong Ha Kim[1], S. Chakrabarti[2], G. R. Gladstone[3], S. C. Solomon[4]

We have analyzed far UV spectra from a proton aurora observed near local midnight over the southern hemisphere by the STP78-1 satellite on March 22, 1979. The incident particle beam consists of a mix of electron, proton, and hydrogen atoms. A proton/hydrogen atom transport model is applied to simulate proton precipitation. An electron transport model is utilized to trace secondary electrons from the proton/hydrogen atom transport model and primary and secondary electrons from electron precipitation. We derive the proton and electron energy fluxes as functions of geomagnetic latitude by fitting the observed HI 1216 (Ly-α) and OI 1356 intensities. We find that the peak proton flux occurs about 4° equatorward from the main peak of electron aurora. The peak proton energy flux is computed to be 1.2, 2.0, and 4.5 erg cm^{-2} sec^{-1} for assumed characteristic energies of 4, 8, and 20 keV, respectively. However, regardless of the assumed characteristic energy, the observed OI 1356 and NII 1085 intensities mostly result from an electron aurora with a characteristic energy of 5 keV. We find that direct H^+/H impact excitation of the OI 1356 and NII 1085 lines does not contribute significantly to the observed intensities. Upper limits to the cross section for direct H^+/H impact excitation of O and N, leading to the emission of OI 1356 and NII 1085, are estimated to be 10 % and 15 %, respectively, of the cross section for emission of Ly-α by H^+/H impact on O and N. To the best of our knowledge, these cross sections have not before been measured.

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1) Department of Astronomy and Space Science, Chungnam National University
2) Center for Space Physics, Boston University
3) Southwest Research Institute, San Antonio, Texas
4) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder