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Modeling of Jupiter's Ionosphere

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Recent IR observations of H_3^+ toward Jupiter, combined with controversial laboratory experiments on H_3^+ recombination, revived interests in modeling of Jupiter's ionosphere. Simultaneous observations of H_3^+ hot and fundamental band lines in 3 micron, and H_3^+ overtone band and H_2 quadrupole lines in 2 micron allowed one to probe populations of H_3^+ and H_2 vibrational levels. I will review critically analyses of non-thermal effects on H_3^+ vibrational levels in the literature, by pointing out some errors in one analysis and clearing out misunderstanding of our H_3^+ vibrational model [1]. I will also discuss the effect of the controversial slow recombination reaction of H_3^+ ion with electron. The slow recombination leads to about 10 times increase in H_3^+ densities during the daytime, which may explain observed intensities of 3.5 micron H_3^+ emission from the mid-latitude Jovian ionosphere without proposing additional ionization source for H_3^+. The slow recombination may also cause electron densities in the F_1-region to be more susceptible to temperature variation and vertical drift due to dynamical process such as gravity wave propagation. About 20 % variation in H_2 vibrational temperature results in reduction of H^+ densities by one third in the F_2 -region via reaction of H^+ with vibrationally excited H_2. Upward and downward ion drifts of 10 m/s move F_2 peak altitudes as high as 1700 km and as low as 800 km, respectively. I find the possibility that some of electron density profiles of the Jovian ionosphere, measured by Voyager and Galileo radio occultation experiments, may be explained with the combination of the H_3^+ slow recombination, temperature variation and vertical drift due to meridional thermal wind.

Keywords: Jupiter; Ionosphere; H_3^+; outer planets.

References

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