Modeling of Jovian ionosphere

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The Jovian ionosphere is the source of magnetospheric plasma and affects strongly on the dynamics of plasmasphere. The structure and dynamics of the Jovian upper atomosphere depends on the heating by auroral particles, the magnetospheric electric field as well as the solar EUV. However, we do not understand the detailed structure and dynamics, because the data is limited by only occultation observations of Pioneer, Voyager, and Galileo spacecrafts.

To understand the structure and dynamics of the Jovian upper atmosphere and ionosphere, we made a modeling of the Jovian ionosphere. The model shows densities and velocities of H+, H2+, H3+, He+, CH5+, and C3H7+ along magnetic field line. From computer simulations, we obtained the following results.

(1) The main species of the ionosphere are H3+ up to ~2000 km altitudes, and H+ at higher altitudes.
(2) H3+ is generated in the photochemical process of H2+, which shows clearly day-night density variation.
(3) H+ is generated by photoionization of hydrogen gas, which is distributed over the layer of H3+. A large amount of H+ is distributed in the topside ionosphere, because of small recombination rate of H+ with electron. H+ density, therefore, does not show clear day-night variation.
(4) By the photochemical process of H3+ and CH4, CH5+ is generated in the bottom of H3+ layer. The density of CH5+ is strongly controlled by the density variation of H3+.
(5) H2+ is generated from hydrogen molecule gas by the ionization of auroral particle precipitation. The main ion species in the auroral region are H3+ and CH5+, because of fast chemical reaction of H2+.
(6) The Jovian ionosphere which consists of light ions is unstable.
(7) Centrifugal force is important for the structure and dynamics of the Jovian ionosphere and the Jupiter wind.