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土星内部磁気圏における水系中性粒子密度グローバル分布モデル

A numerical simulation of global water group neutral cloud model in Saturn's inner magnetosphere

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Water group neutrals in Saturn's inner magnetosphere are considered to be dominated by water group neutrals (H2O, OH, and O) that have originated in the icy satellites, which are Enceladus (L ~3.94), Tethys (L~4.89), Dione (L~6.26), and Rhea (L~8.74) [e.g., Ip,1997] since an OH cloud was observed by the Hubble Space Telescope (HST) [Shemansky et al., 1993]. Some models before Cassini observations have been developed to explain the OH density distribution [e.g., Ip,1997]. These modeling studies are concluded that an additional source near Enceladus is required to account for the OH density. The prediction of the source was correct: i.e., Cassini observations have revealed that icy moon Enceladus (L~3.94) is highly active with a plume of water molecules from its south polar region (Porco et al., 2006). Contribution to the global distribution of the plume originated neutrals is not unclear. Therefore, we examine the global neutral distribution in a steady state through a Monte Carlo simulation to account for previous observations. The unique points of our simulations are that we treated the followings simultaneously:
1. including the plume ejection, satellite sputtering, and E ring sputtering in the source,
2. using Cassini plasma parameters to calculate some chemical reactions, and,
3. solving OH and O neutral distributions by adding excess energies through dissociation reactions from H2O and OH.
The main results are as follows:
1. Peak densities for H2O, OH, and O around Enceladus' L shell are due to the plume ejection.
2. The H2O distribution shows an asymmetric structure along the Enceladus orbital path.
3. Comparison with the previous observations suggests that some additional sources are required to account for the extended OH and O distributions which are derived by Melin et al., 2009.
In this presentation, we will show these calculated results and discuss the global distributions by comparing with the observations.

キーワード:土星,内部磁気圏,中性粒子,プリューム,エンケラドス,スパッタリング

Keywords: Saturn, inner magnetosphere, neutral, plume, Enceladus, sputtering