Dynamics in Jupiter’s magnetosphere revealed by time variation of plasma densities and temperature in the Io plasma torus coincident with volcanic activations on Io

*Reina Hikida[1], Kazuo Yoshioka[1], Fuminori Tsuchiya[2], Masato Kagitani[2], Tomoki Kimura[2], Fran Bagenal[3], Nick Schneider[3], Go Murakami[4], Atsushi Yamazaki[4], Hajime Kita[4], Edward Nerney[3], Seiya Nishimura[1], Hidetaka Kuniyoshi[1], Ichiro Yoshikawa[1]

1. the University of Tokyo, 2. Tohoku University, 3. University of Colorado, 4. JAXA

The volcanic activity on the Io satellite and the associated outgassing into the Jupiter’s magnetosphere fluctuate dynamically. The fluctuations of plasma densities inside the Io plasma torus (IPT) associated with the volcanic activities on Io were indicated by the spectroscopic observation by the Hisaki satellite. If the supply of plasma from Io increases, the plasma mass-loading enhances, and the magnetospheric dynamics is expected to be affected. The time continuity of the Hisaki observation made it possible to explore the sequence of magnetospheric dynamics from the activation of volcanoes to the recovery for the first time. In this study, we apply the analysis method called plasma diagnosis to the spectroscopic data obtained by Hisaki with the widest slit (140 arc seconds slit). The time variation of plasma densities and temperature has been determined from December 2013 to April 2014, from November 2014 to May 2015, from January 2016 to March 2016, from May 2016 to August 2016, and from November 2016 to December 2016. During the above periods, four significant events of volcanic activation occurred. In each event, there was a common tendency that the density of hot electrons (several hundreds of eV) increased several tens of days after the core electron density increased. The hot electron density can be considered as a tracer for the radial inward transport of magnetic flux tubes. This is because the timescale for thermal relaxation of the hot electrons is at most several days and the outer region is more abundant in the hot electrons. This study revealed the following three facts about the time variation of the hot electron density. Firstly, the radial distribution of mass density showed that the interchange motion of flux tubes inside the IPT subsided before the hot electron density started to increase. This indicates that the cause of the increase in the hot electron density exists in the outside region of the IPT. Secondly, it was found that the timescale from the start of the activation of the volcano to the rise of the hot electron density was 20-30 days at any event. Finally, the hot electron density on the dusk side was higher than that on the dawn side at least with two events of volcanic activation. This suggests that the radial inward transport of flux tubes might reach the dusk side more easily than the dawn side. In this presentation, the dynamics in Jupiter’s magnetosphere will be discussed by using the above findings.

Keywords: Jupiter, Io plasma torus, Magnetospheric dynamics

