Increase of hot ion fraction on Io plasma torus after an outburst in 2015

Masato Kagitani[1]; Fuminori Tsuchiya[2]; Mizuki Yoneda[3]; Tomoki Kimura[4]; Kazuo Yoshioka[5]; Go Murakami[6]; Chihiro Tao[7]; Takeshi Sakanoi[8]; Yamazaki Atsushi Hisaki (SPRINT-A) project team[9]
[1] PPARC, Tohoku Univ; [2] Planet. Plasma Atmos. Res. Cent., Tohoku Univ.; [3] none; [4] RIKEN; [5] The Univ. of Tokyo; [6] ISAS/JAXA; [7] NICT; [8] Grad. School of Science, Tohoku Univ.; [9] -

Volcanic gases (mainly composed of SO_2, SO and S) originated from jovian satellite Io are ionized by interaction with magnetosphere plasma and then form a donut-shaped region called Io plasma torus. Ion pickup is the most significant energy source on the plasma torus thought, additional energy source by hot electron is needed to explain energy balance on the neutral cloud theory (Daleamere and Bagenal 2003). In fact, in-site measurements by Galileo indicates some injections of energetic particles in the middle magnetosphere. Recent EUV spectroscopy from the space shows fraction of hot electron increases as increase of radial distance in the plasma torus (Yoshioka et al. 2014 and Steffl et al. 2004). On this study, we focus on variability of hot electron fraction derived from EUV diagnostics measured by HISAKI/EXCEED after a volcanic outburst in 2015.

We have made spectral fitting as the following method. First, we made series of EUV spectra averaged over 3 days during January through May 2015. Next, assuming azimuthal homogeneity of Io plasma torus, onion-peeling is conducted to reduce line-of-sight integration effect. Then, we made fitting of observed EUV spectra (60 - 140 nm) with CHIANTI model spectra by changing electron density and temperature, mixing ratio of ions (S^+, S^{++}, S^{+++}, O^+ and O^{++}) and fraction of hot electron (Te = 100 eV).

Based on observation of neutral sodium and oxygen (Yoneda et al., 2015), neutral densities started to increase at around DOY = 10, were at maximum at around DOY = 50, and have backed into the initial levels at around DOY = 120. In contrast, plasma diagnostics indicates that hot electron fraction at 7.0 jovian radii was less than 2 % before DOY = 50, started to increase after DOY = 50, and have reached 8(+/-1) % at DOY = 110. EUV emission from aurora was also activated after DOY = 50 as increase of hot electron fraction on the plasma torus. The results suggest that the inward transportation of hot electron was activated after increased of neutral supply on the plasma torus caused by the outburst.