Variation on Io plasma torus during 2016 through 2017 measured with Hisaki/EXCEED and gourd-based telescopes

*鍵谷 将人[1]、土屋 史紀[1]、吉岡 和夫[2]、村上 豪[3]、木村 智樹[1]
*Masato Kagitani[1], Fuminori Tsuchiya[1], Kazuo Yoshioka[2], Go Murakami[3], Tomoki Kimura[1]

1. 東北大学大学院理学研究科、2. 東京大学、3. 宇宙科学研究所
1. Graduate School of Science, Tohoku University, 2. Tokyo University, 3. JAXA

Volcanic gases (mainly composed of SO_2, SO and S) originated from jovian satellite Io are ionized by interaction with magnetospheric 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 (e.g. 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; Steffl et al., 2004). On this study, we focus on variability of electron temperature derived from EUV diagnostics measured by HISAKI/EXCEED during 2016 through 2017, as well as ion temperatures parallel and perpendicular to the magnetic field measured from the ground-based spectroscopy.

The ground-based observation of sulfur ion emission, [SII] 671.6nm and 673.1nm from Io plasma torus was made at Haleakala Observatory in Hawaii since 2014 using a high-dispersion spectrograph (R = 67,000) with an integral field unit (IFU) coupled to a 40-cm Schmidt-Cassegrain telescope. The IFU consist of 96 optical fibers (core/crad/jacket diameter are 50/125/250 micro-meters, respectively). The fibers are arranged in 12 by 8 array at the telescope focus which makes high-resolution spectroscopy over field-of-view of 41" by 61" with a spatial resolution of 5.1" on the sky. Two-dimensional Doppler measurements enables to derive spatial distribution of [SII] emissions as well as their temperatures parallel and perpendicular to the magnetic field. We also made observation of neutral sodium cloud extending up to several hundred of jovian radii as a proxy of supply of neutral particles from Io (Yoneda et al., 2015).

In addition, we employee EUV spectroscopy of Io plasma torus with EUV space telescope Hisaki EXCEED since 2014. We have made spectral fitting as the following method. First, we made series of EUV spectra averaged over five days. Next, assuming azimuthal homogeneity of Io plasma torus, Abel inversion is made 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 cloud, Na brightness at 100 RJ had peak intensity of 15 Rayleighs at around DOY = 100 in 2016. Meanwhile, [SII] emission observed from the ground was minimum of 250 Rayleighs at around DOY=70, then increased up to 400 Rayleighs at around DOY = 100. On the presentation, we will show electron temperatures deduced from the EUV diagnosis based on the Hisaki measurements as well as ion temperatures measured from gound-based spectroscopy.