R009-09
Zoom meeting D ：11/1 AM2 (10:45-12:30)
11:30〜11:45

Variability of Io plasma torus based on ground-based observation during 2015 through 2021

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Volcanic gases (mainly composed of SO2, 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 though, distribution of pick-up region and its variability is still unclear. Density profiles of ions along the magnetic field line are determined under condition of diffusive equilibrium. Based on the equilibrium, plasma equator is close to the centrifugal equator though, higher ion anisotropy moves the plasma equator toward the magnetic equator. Measuring ion distribution with enough special resolution enables us to derive ion anisotropy which is tightly related to the amount of fresh pickup ion. On this study, we focus on variability of latitudinal structure of Io plasma torus as well as its radial structure using ground-based observation starting from 2018 through 2020.

The ground-based observation of sulfur ion emission, [SII] 671.6 nm and 673.1 nm was made at Haleakala Observatory in Hawaii during December 2014 through July 2021 using Tohoku 60-cm telescope. A monochromatic imager with coronagraph attached onto the telescope enables to measure distribution of singly charged sulfur ion with spatial resolution of 0.03 jovian radii. A digital micro-mirror device DMD was employed to block light from Jupiter disk and Galilean moons. Typical integration time of each frame was 20 minutes and total number of reduced images is about 1500. We also made observation of neutral sodium cloud extending up to several hundred of RJ as a proxy of supply of neutral particles from Io (Yoneda et al., 2015).

From the monitoring observation in 2020, [SII] brightness increases from DOY 120 through 160, then gradually decreases though DOY 230, whereas the brightness scaleheight indicating ion temperatures increased gradually from 0.9 RJ to 1.2 RJ during DOY 150 through 220. Given that the primary source of S+ in the Io plasma torus is the electron impact ionization of S, SO and SO2, the [SII] brightening suggests increase in the neutral densities, presumably associated with volcanic active events.

Over the past six years, we identified three prominent peaks of [SII] brightness in February 2015, August 2019 and June 2020. In the three cases, [SII] ribbon scaleheight started to increase just after [SII] brightness peaks suggesting increase of ion temperature due to volcanic outbursts.