Observation of ion temperature anisotropy on the Io plasma torus using a high-dispersion spectrograph with an integral field unit

Masato Kagitani[1]; Mizuki Yoneda[2]; Shoichi Okano[3]
[1] PPARC, Tohoku Univ; [2] Planet. Plasma Atmos. Res. Cent., Tohoku Univ.; [3] PPARC, Tohoku Univ.

Atoms and molecules originated from volcanic eruption on Jovian satellite Io are ionized and form a donut-shaped region along Io's orbit which is called Io plasma torus. Although creation of pick-up ion in the plasma torus is expected to make high anisotropy (T_perpendicular >T_parallel) of ion temperature, the value of anisotropy as well as its distribution and variability has not been clear yet. A new high-dispersion spectrograph with an integral field unit (IFU) enables to derive spatial distribution of ion emission as well as its temperatures parallel and perpendicular to the magnetic field.

The observation of sulfur ion emission, [SII] 671.6nm and 673.1nm,from Io plasma torus was made at Haleakala Observatory in Hawaii from March 1st through 20th, 2013 using the high-dispersion spectrograph (R = 67,000) with the 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 a telescope focus, and are lined up at an entrance slit of the spectrograph. This layout enables to make 2-dimentional spectroscopy over field-of-view of 41" by 61" with a spatial resolution of 5.1" on the sky. The IFU was developed in collaboration with the Institute for Astronomy, University of Hawaii.

Based on a preliminary result from the observation that produced 40 spectral datasets, there is a System III variation on the parallel ion temperature which is derived from north-south distribution of torus emission. There is also a System III variation on the torus brightness at the equator showing an anti-correlation with the parallel ion temperature. System III variation of total flux-tube contents (FTCs) was relatively small compared to the variation of ion parallel temperature and torus brightness at the equator. As for an ion anisotropy which is defined by $T_{perpendicular}$ / $T_{parallel}$, it varied from 0.5 through 2.5 at a radial distance of 5.9 Jovian radii (R_J) depending on System III longitude. Average values of anisotropy were 1.2 on dusk ansa and 1.0 on dawn ansa. However, as for the absolute value of ion temperature anisotorpy, we need to consider about line-of-sight (LOS) integration effect at the torus edge which causes an overestimate of $T_{parallel}$. More accurate analysis including correction of LOS effect using a torus emission model called CITEP (Colorado Io torus emission package) is ongoing, the result will be presented at the meeting.