Io-Jupiter interaction during Io’s volcanic event in 2015

Change in on density and ion temperature derived from HISAKI

Change in Alfven transit time from Io to ionosphere

Alfven velocity

$$V_A = \frac{B}{\sqrt{\mu_0 mn}} \propto \frac{1}{\sqrt{n}}$$

- Timing of main arc (decrease)
- Repetition freq. of arcs (decrease)
The brightness scale height $H_b$ is $\sqrt{2}$ smaller than common scale height $H_i$ when the intensity is $\propto n_i n_e$.

[Hill and Michel, 1976]

$$H_i = \sqrt{\frac{2k(T_{i\parallel} + Z_i T_{e\parallel})}{3M_i \Omega^2}}.$$ 

$M_i$: mass of ion
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\Omega$: angular velocity
$Z_i$: average charge state
$T_{i\parallel}, T_{e\parallel}$: Ion and electron temperature parallel to magnetic field line

Thus, ion parallel temperature $T_{i\parallel}$ is proportional to $H_b$.

$$T_{i\parallel} \propto H_i^2 \propto 2H_b^2$$

$\rightarrow$ Ion parallel temperature can be derived from the brightness scale height

- Gaussian fitting to the vertical profile (north-south, integrated along radial direction from 5 – 7 $R_J$).
- The effect of line-of-sight integration has not excluded.
Discussion: Time variations in torus composition

Fig. (Top three panels) Time variations of plasma diagnosis derived from EXCEED data by Kagitani [2016]. (Bottom three panels) Time variations in temperature of sulfur ions (SII, SIII, and SIV) derived from EXCEED data.

Electron density (3000/cc to 4500/cc) and S+ composition increased during Io’s volcanic event. T// slightly increased. Composition of major ion did not show significant change (O+, S2+).

It is expected that Alfven transit time increased at leased one-and-a-half times.

A.I.
- Detail calculation of change in Alfven transit time considering HISAKI data during the volcanic event.
- Comparison with the ExPRES analysis due to the inflow of hot electron into the torus.

Shishido et al. JPGU2017 poster