ひさき衛星が観測したイオプラズマトーラス突発増光時にDusk側で局在するHot electron流入

Localized hot electron injection on the dusk side during transient brightening in Io plasma torus observed by Hisaki

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The Hisaki satellite has observed ~5% transient increases in the intensity of the Io plasma torus (IPT, r < 8 RJ) emission over a time scale of several to more than ten hours after a transient brightening of Jupiter's UV auroral emission. Since the plasma convection in the Jovian magnetosphere is dominated by the planetary rotation, it has been considered that the fast transport of energy in the radial direction is not significant. However, this transient phenomenon suggests that the effects of transient energy release in the middle or outer magnetospheres, which cause aurora brightening, extend to the IPT on a time scale of around ten hours. Considering that the relaxation time of hot electrons with energy of several hundred eV in the IPT due to Coulomb collisions is comparable to the time scale of the brightening, previous studies interpreted the cause of brightening as the influx of hot electrons into the IPT from outer part of the magnetosphere. In this study, we investigate the start local time (LT) position of the IPT transient brightening from spatially resolved extreme ultraviolet (EUV) spectra observed by the Hisaki satellite to determine the injection position of hot electron into the IPT, and then discuss how the energy is transported inward in the Jovian magnetosphere.
The field-of-view of the EUV spectrograph onboard the Hisaki satellite is 360 arcsec, which enables to observe the radial structure of the IPT emission in both dawn and dusk sides. We obtained the intensity of sulfur ion emission by integrating the EUV spectrum from 65 to 77 nm in wavelength, and then determined the start LT position of the IPT brightening by dividing the IPT into 20 or 8 regions or dawn and dusk.
26 brightening events were identified in 2014 - 2016. Among the 26 events, 18 events (69%) started in the dusk side, and 12 events (46%) were localized at LT 14 - 18. Assuming that the cause of the brightening is the injection of hot electrons, this result indicates that inflow of hot electrons in the IPT tend to localize on the dusk side. The result presented here shows different picture of Jovian magnetosphere from the previous studies.
We analyzed “energetic events” (Louarn et al., 2014) in the Jovian magnetosphere using data from Juno's radio and plasma wave (Waves) instrument to interpret this LT-dependent injection. The results show a correlation between the IPT transient brightening and energetic events. Louarn et al. (2014) showed that energetic events and reconnection events occurred in the Jovian magnetotail are correlated. These two results indirectly suggest that there is a relationship between the IPT transient brightening and reconnection events, and the origin of the hot electrons injected into the IPT during transient brightening

is energy released through the reconnection. The reconnection in the Jovian magnetosphere occurs around 90 RJ in the postmidnight sector (Vogt et al., 2010). We propose the following scenario which explain energy transport into the IPT: (1) Flux tube which contains hot electrons are released from the postmidnight sector at a distance of ~ 90 RJ through reconnection events and transported inward. (2) The flux tube gradually trapped with a co-rotation region, and the hot electrons are transported both inward and azimuthal direction. (3) The flux tube reaches to the IPT before it circulates around Jupiter, and the hot electrons are injected into the IPT at LT 14 –18 (from postnoon to evening sectors).
In this study, by analyzing the start LT position of IPT transient brightening, we found that the hot electron injection into the IPT is localized on the dusk side. Also, we found a correlation between the IPT transient brightening and energetic events, and proposed a scenario in which energy is transported from the reconnection to the IPT.

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