Localized hot electron inflow on the dusk side during transient brightening in Io plasma torus observed by Hisaki/EXCEED.

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The Hisaki satellite has observed 10% transient increases in the intensity of the Io plasma torus (IPT) emission in the inner magnetosphere (r<8Rj) over a time scale of several to ten hours after a transient brightening of Jupiter's UV auroral emission. Since the plasma convection in the Jupiter 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 auroral brightening, extend to the IPT on a time scale of a few tens of hours. Considering that the relaxation time of hot electrons with energy of several hundred eV in the IPT (electron density of about 2000/cc, electron temperature of about 5 eV) 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. To understand the macroscopic physical phenomena in Jupiter's magnetosphere, it is important to clarify the process of transporting the energy from the outer to inner part of the magnetosphere. In this study, we investigated the start local time (LT) of the IPT brightening from the extreme ultraviolet (EUV) spectra observed by the HISAKI satellite and clarified the inflow position of hot electrons in the IPT. The field-of-view of the EUV spectrograph onboard the HISAKI satellite is 360 arcsec and enables to observe the radial spatial 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 nm to 77 nm in wavelength, and then determined the start LT of the IPT brightening by dividing the spatial distribution of the IPT into 10 parts in each dawn and dusk region (20 regions in total). The integration time was set to 10 minutes. In order to detect the IPT brightening with an amplitude of 10%, the trend of the intrinsic periodic variations in the torus (System III period: 9.93 h, System IV period: 10.14 h, and Io's orbital period: 42.46 h) were fitted by the least-squares method and eliminated from the data. The transient brightening event in the IPT was defined as an event in which 16 among of the 20 regions showed an increase in emission of at least 2 σ from mean in a 10-hour period. 15 brightening events were identified in 2015-2016. Among them, the start LT positions were identified for 13 events. 10 events started in the dusk side, and 8 of them were localized at LT14-16. Assuming that the cause of the brightening is the inflow of hot electrons, this result indicates that inflow of hot electrons in the IPT tend to localize at LT14-16. In the rotation-dominant magnetosphere, the transport of plasma in the radial direction is thought to be caused by interchange instability driven by centrifugal forces. Since the centrifugal force which acts on plasmas is independent of LT, it is expected that both outflow of iogenic plasma and alternate inflow of hot electron would occur in all LT region. The result presented here shows different picture of Jovian inner magnetosphere from that previously thought.

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