

Quantitative analysis of hot electron density variation during transient brightening in the Io plasma torus observed by Hisaki/EXCEED

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The Hisaki satellite observed transient increases in the extreme ultraviolet (EUV) emission from Io Plasma Torus (IPT) by ~10% over a period of ~10 hours, a few hours after a transient variation in Jupiter's UV auroral emission. It has been assumed that it is difficult to transport energy in radial direction with the short time scale since plasma co-rotation in the azimuth direction is dominant in the Jupiter magnetosphere. The transient brightening of the IPT and the aurora suggests that the effects of transient energy release in the magnetosphere which causes auroral brightening could extend to the IPT on a time scale of ~10 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 outside the Jupiter magnetosphere.^{[1][2]} On the other hand, the increase of hot electron density in the IPT has not been quantitatively investigated during the IPT brightening. The purpose of this study is to determine the time variation of hot electron density in the IPT quantitatively from EUV spectra during the brightening, and to clarify the contribution of hot electrons to the energy transport process in Jupiter's inner magnetosphere. To derive variations in electron temperature, electron density, and ion mixing ratio in the IPT from the UV spectra observed by Hisaki/EXCEED, we applied plasma diagnosis analysis^{[3][4]} to the EUV spectral data of IPT observed with the 140 arcsec slit. Sulfur and oxygen ions in the IPT emit ultraviolet emission by electron collision excitation. Plasma diagnosis is a method to derive electron temperature, electron density, and ion composition from spectral data containing several sulfur and oxygen ion emission lines. To analyze the strong IPT brightening events occurred on DOY 66 and 87 in 2015, we chose the data from the period DOY 65-90 in 2015. In this presentation, we will derive plasma fluctuations at 3-hour intervals to capture the variations in the IPT during the transient brightening and discuss quantitative results of the increase in hot electrons during the IPT brightening and the contribution of hot electrons to the energy transport process.

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