Ion Scale Height Variability in Hisaki Io Torus Observations

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Ion temperature is a critical variable in Io plasma torus energetics, but is difficult to derive from remote sensing measurements. The relative importance of hot ions vs. hot electrons in powering the torus emissions remains an open question. Torus brightenings, whether caused by episodic changes in the volcanic supply to the torus or periodic System III/IV enhancements, offer the best chance to search for driving variations in hot electrons or ions. Much attention has been paid to hot electron populations, derivable from detailed spectral modeling, but less work has been done on ion temperature. Ground-based studies have successfully derived $T_{\perp}$ from very high resolution spectra, and $T_{||}$ from scale height measurements in images, both over limited datasets. Schneider et al. 1997 found strong longitudinal variations in $T_{||}$ during a week-long dataset, and anti-correlated System III brightness, but more extended followup datasets have not previously been available.

The Hisaki dataset presents the possibility of an unparalleled opportunity to study long-term and short-term variations in ion temperatures. The instrument is not designed to take images of specific emissions, but its large entrance slit accepts the full height and width of the torus. In the ideal case, each spectral emission feature would appear as an image of the torus at its appropriate position in the spectrum, creating an “overlapogram” (as did the Cassini UVIS instrument). In reality, the emissions are blurred due to instrumental resolution and aberrations, and multiple spectral feature overlap. Furthermore, the changing opening angle of the rotating torus adds a spurious apparent scale height variation which must be removed, with special attention to asymmetries introduced by Jupiter's changing tilt. With allowances for all these effects, we will report on our search for ion temperature variations during the first two years of Hisaki observations, and compare our results to a previous independent study by M. Shishido (M.S. thesis, U. Tohoku).

Keywords: Jupiter, Io, plasma torus, magnetosphere , hisaki, ultraviolet

