Io-related electron heating in the Io plasma torus: effect of local plasma density around Io

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HISAKI observation of Io plasma torus (IPT) with extreme ultraviolet (EUV) wavelength range is a useful probe to access plasma environment in inner magnetosphere of Jupiter. Emissions from sulfur and oxygen ions in EUV range are caused by electron impact excitation and their intensity is well correlated with the electron temperature distribution in IPT. Previous IPT observation with HISAKI showed that the brightness was enhanced downstream of the satellite Io, indicating that efficient electron heating takes place at Io and/or just downstream of Io. Detailed analysis of the emission intensity shows that the brightness depends on the magnetic longitude at Io and primary and secondary peaks appear in the longitude ranges of 100-130 and 250-340 degrees, respectively [Tsuchiya et al. 2015]. Io's orbit crosses the center of the IPT around these longitudes. The peak position and amplitude are slightly different between dawn and dusk sides. Here, we introduce inhomogeneous IPT density model in order to investigate relation between the emission intensity and local plasma density around Io in detail. An empirical IPT model [Bagenal 1994] is used for radial distribution of ion and electron density in the equatorial plane. The density distribution along magnetic field lines is calculated by solving diffusive equilibrium [Mei et al. 1995], where we do not consider longitude dependence of ion temperatures here. To include longitude and local time asymmetry in IPT, we consider (1)dawnward shift of IPT due to global convection electric field, (2) offset of Jupiter's dipole magnetic field, and (3) tilt of IPT with respect to Io's orbital plane. From the empirical IPT model, electron densities at the position of Io when the satellite is located at dawn and dusk sides are derived. The modeled electron density as a function of magnetic longitude at Io shows similar profile with the ion emission intensity derived from HISAKI. This result suggests that energy extracted around Io and/or efficiency of electron heating is closely related to the plasma density around Io and longitude and local time dependences is explained by the spatial inhomogeneity of plasma density in IPT. A part of the energy extracted around Io could be transferred to the Jovian ionosphere along the magnetic field line and cause bright aurora spots and strong radio emissions. We plan to update the model by including (1) longitude dependence of ion temperatures which also causes longitudinal inhomogeneity of plasma density and (2) spatial density distributions of neutral particles and newly picked up ions which are a primary energy source of local electron heating.