Observation of long-term variability of [SII] emission from the Io plasma torus

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The Io plasma torus is a highly dense plasma cloud in the Jovian magnetosphere. Ions in the plasma torus make emissions by collisional excitation with electrons. These emissions can be observed with the ground-based telescope and have significant information on the transportation and dynamics of both gas and plasma in and around the Io plasma torus. Therefore, an optical observation of the plasma torus becomes a useful probe to investigate the Jovian plasma environment from the ground.

We made imaging observations of [SII] 673.1 nm and [SII] 671.6 nm emissions from the Io plasma torus between 1997 and 2000-2001. To come true such observations, we developed the transportable telescope system and observation method.

We extracted variations from imaging data of the [SII] 673.1 nm emission from the Io plasma torus, and obtained following results.

(1). [SII] intensity has little dependence on the System III longitude, although the apparent motion of the entire torus structure is synchronized with the System III Jovian rotation period. This result requires the alternative interpretation on the longitudinal asymmetric distributions of the plasma torus.
(2). From the periodicity search using the Lomb-Scargle periodogram, we found ~10.2 h periodicities in [SII] 673.1 nm emission intensity between the 1998 and 2000 - 2001 observations. There is no System III periodicity in [SII] emission.

(3). There are sporadic enhancements of intensity around the System III longitude of 150 degrees in the 1998 and 1999 observations, indicating that the plasma injection is developed in a peculiar phase of the planetary rotation.

(4). [SII] intensity shows day-to-day variation without the relation to the planetary rotation phase.

As for the long-term variation of the plasma torus;

(5). [SII] average intensities show yearly variation exhibiting the gradual decrease for these 4 years, especially in the 2000 - 2001 observation.

(6). The dawn-dusk asymmetry was confirmed both position of the ribbon and its emission intensity. Positional difference between the dawn and the dusk of ~0.2 RJ (~0.1 RJ displacement toward the dawn) was derived from the 1998 to 2000 - 2001 observations.

(7). The radial profile of [SII] 673.1 nm varied from a single peak structure in the warm plasma torus to twin peak structure in the cold and warm torus during the period from 1998 to 2001.

(8). Using the ratio of averaged radial profile of [SII] 671.6 nm to [SII] 673.1 nm, the statistical electron density profiles were estimated along the centrifugal equator. The electron density showed large decrease in the 2000 - 2001 observation.