

Coordinated observation of Jupiter thermosphere and radiation belt in January 2014

KITA, Hajime^{1*} ; MISAWA, Hiroaki¹ ; TSUCHIYA, Fuminori¹ ; FUJISAWA, Shota¹ ; SAKANOI, Takeshi¹ ; KASABA, Yasumasa¹

¹Tohoku Univ.

In order to evaluate the solar UV/EUV heating effect on the Jovian radiation belt, we made coordinated observations for both temperature of the Jovian thermosphere using an infrared telescope and synchrotron radiation from the radiation belt (JSR) using a radio interferometer. JSR is the most effective probe for the dynamics of the Jovian radiation belt through remote sensing from the Earth. Recent intensive observations for JSR reveal short term variations of JSR with the time scale of days to weeks, but their causalities are not understood well. It is theoretically expected that the Jovian thermosphere is heated by solar UV/EUV radiation, and planetary atmospheric neutral wind is driven by solar UV/EUV heating. Then, induced dynamo electric field is mapped into the radiation belt and induces radial diffusion. From this scenario, the total flux density of JSR is expected to correlate with the solar UV/EUV flux.

Previous studies confirmed that the total flux density of JSR varied corresponding to the solar UV/EUV variations though it is unclear whether the temperature of the Jovian thermosphere actually varied during this event. The purpose of this study is to confirm whether sufficient solar UV/EUV heating occurs on the Jovian thermosphere and it actually causes variations of JSR total flux density. We made coordinated observations of the NASA Infra-Red Telescope Facility (IRTF) and the Giant Metrewave Radio Telescope (GMRT). From the infrared spectroscopic observations, we measured thermospheric temperature of H_3^+ ion. From the radio interferometer, we measured the total flux density and brightness distribution of JSR.

The IRTF is a 3 m infrared telescope located in Mauna Kea, Hawaii. The IRTF observations were made on Jan 3, 8, and 13 in 2014. We used the high spectral resolution spectrometer, CSHELL, and observed H_3^+ 3.9530 microns emission (Q(1,0)) and 3.4547 microns doublet emission (R(4,3) and R(4,4)). We assumed local thermodynamic equilibrium at the equatorial region and calculated thermospheric temperature from the two emission line ratio. The GMRT is a large radio interferometer located in India. The GMRT observations were made from Dec 31 to Jan 16 with a few days interval. The typical duration of observation time was 2 hours per day, and the observation frequency was 235 and 610 MHz. During this period, the SOHO satellite showed that the solar EUV flux increased from Dec 26, reached at the maximum flux on Jan 8, and then decreased to Jan 16. A preliminary analysis of the IRTF data showed that the temperature increased from Jan 3 to Jan 8, and decreased from Jan 8 to Jan 13. This is the first result that shows the temperature response of Jovian upper atmosphere to the solar UV/EUV heating. We will also introduce analyzed results of the GMRT data and discuss the relationship between Jovian thermosphere and radiation belt.

Keywords: Jupiter, thermosphere, radiation belt, infrared observation, radio interferometer