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木星熱圏・放射線帯の太陽紫外線応答について
Solar UV/EUV response on Jovian thermosphere and radiation belt

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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.

Jupiter's synchrotron radiation (JSR) is the emission from relativistic electrons in the strong magnetic field of the inner magnetosphere, and it is the most effective probe for remote sensing of Jupiter's radiation belt from the Earth. Although JSR has been thought to be stable for a long time, recent intensive observations for JSR reveal short term variations of JSR with the time scale of days to weeks. It is theoretically expected that the short term variations are caused by the solar UV/EUV heating (hereafter the B-M scenario): the solar UV/EUV heating for Jupiter's upper atmosphere drives neutral wind perturbations and then the induced dynamo electric field leads to enhancement of radial diffusion. If such a process occurs at Jupiter, brightness distribution of JSR is also expected to change. Previous studies have confirmed the existence of the short term variations in total flux density and its variation corresponds to the solar UV/EUV variations. However, confirmation of the scenario is limited. The purpose of this study is to examine the B-M scenario based on radio interferometer and infrared observations, and reveal precise physical processes of the inner magnetosphere.

We made simultaneous observations of the Giant Metrewave Radio Telescope (GMRT) and the NASA InfraRed Telescope Facility (IRTF) in January 2014, in order to reveal whether the Jovian thermosphere responses to the solar UV/EUV and whether this actually causes variations of the total radio density and brightness distribution of JSR. The total radio flux density, rotational temperature of H_3^+, and solar EUV flux showed a similar decreasing trend until Jan. 10. These results support the B-M scenario. On the other hand, the total flux density and the temperature increased after Jan. 12 even when the solar EUV flux decreasing almost monotonically. The enhancement of the temperature and the total flux density after Jan. 12 might be caused by the high latitude heating. A numerical simulation study of the Jovian upper atmosphere suggests that the high latitude Joule heating is induced by solar EUV radiation and it affects the mid-low latitude thermosphere. It is shown that the high-latitude heating produces an atmospheric convection cell which propagates from the heat source region at both high and low latitudes. In addition to that, if high latitude heating is caused by some processes other than the solar UV/EUV, it is expected that this also affects the mid-low latitude temperature and the radiation belt: one of such effects might be brought by enhancement of field aligned currents flowing into the high latitude region, which is driven by some global magnetospheric variations.

Thus, we found that the solar UV/EUV enhancement causes the variations in thermospheric temperature and intensity of JSR had correlation from the combined simultaneous observations, which is consistent with the B-M scenario. It is also suggested that one point should be taken into account in addition to the original B-M scenario, i.e., the high latitude heating effect on the mid-low latitude thermosphere.

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