Solar wind influences on Jovian magnetosphere: The collaboration of Hisaki EXCEED, Juno and ground-based telescopes

*北 元[1]、木村 智樹[2]、垰 千尋[3]、土屋 史紀[1]、村上 豪[4]、山崎 敦[4]、吉岡 和夫[5]、Ebert Robert[6]、Wilson Robert[7]、Valek Philip[6]、Clark George[8]、韓 秀萬[4]、Santos-Costa Daniel[6]、三澤 浩昭[1]、坂野井 健[1]、笠羽 康正[1]、吉川 一朗[5]、藤本 正樹[4]
*Hajime Kita[1], Tomoki Kimura[2], Chihiro Tao[3], Fuminori Tsuchiya[1], Go Murakami[4], Atsushi Yamazaki[4], Kazuo Yoshioka[5], Robert W Ebert[6], Robert J Wilson[7], Philip W Valek[6], George Clark[8], Sooman Han[4], Daniel Santos-Costa[6], Hiroaki Misawa[1], Takeshi Sakanoi[1], Yasumasa Kasaba[1], Ichiro Yoshikawa[5], Masaki Fujimoto[4]

1. 東北大学、2. 国立研究開発法人化学研究所仁科加速器研究センター、3. 情報通信研究機構、4. 宇宙航空研究開発機構宇宙科学研究所、5. 東京大学、6. Southwest Research Institute、7. Laboratory for Atmospheric and Space Physics, University of Colorado Boulder、8. Johns Hopkins University Applied Physics Laboratory
1. Tohoku University, 2. Nishina-Center for Accelerator Based Science, RIKEN, 3. National Institute of Information and Communications Technology, 4. Institute of Space and Astronautical Science / Japan Aerospace Exploration Agency, 5. The University of Tokyo, 6. Southwest Research Institute, 7. Laboratory for Atmospheric and Space Physics, University of Colorado Boulder, 8. Johns Hopkins University Applied Physics Laboratory

While the Jovian magnetosphere is known to be dominated by the internal source of plasma and energy, it also has an influence from the solar wind. This talk mainly focusses on the solar wind response of Jupiter’s aurora and radiation belt, which is achieved by Hisaki, Juno, and ground-based telescopes. Hisaki is an EUV/UV space telescope launched in 2013. Its spectrometer EXCEED (Extreme Ultraviolet Spectroscope for Exospheric Dynamics) began continuous monitoring of Jupiter from Dec. 2013 with the dumbbell slit which is optimized to the observation of Jovian aurora and Io plasma torus (IPT) simultaneously with wide field of view. In this talk, we treat two issues, the effects on the auroral activities and dawn-dusk electric fields. Juno is a polar-orbiting mission at Jupiter with instruments designed to make in-situ and remote sensing observations of magnetospheric and auroral phenomena.

We made a statistical analysis of the total power variation of Jovian UV aurora obtained from Hisaki. We compared the total UV auroral power in 90-148 nm with the solar wind model. Previous observations such as those by the Hubble Space Telescope showed that the UV aurora and solar wind dynamic pressure had, at times, a positive correlation. We found from the data obtained in 2014-2015 that the auroral total power showed a positive correlation to the duration of a quiescent interval of the solar wind before the enhancements of the dynamic pressure. It is larger than the correlation to the amplitude of dynamic pressure enhancement. A similar trend was identified again in 2016 when Hisaki observed Jupiter with Juno in the upstream solar wind. During this period, the total intensity of IR H_3^+ aurora obtained by IRTF (Infrared Telescope Facility) CSHELL was also enhanced, which indicated the enhancement of heating and H_3^+ production in the thermosphere by the electron precipitations. One possible scenario to explain these results is that the magnetospheric plasma content controls the aurora response to the solar wind variation. Long quiescent interval would mean that the magnetospheric plasma supplied from Io is more accumulated in the magnetosphere. The solar wind compression of the magnetosphere shifts the plasma inward and increases the plasma temperature and density by adiabatic heating, which leads to an enhancement of the auroral field-aligned current density. We examined the solar wind control of Jovian UV aurora based on the global magnetohydrodynamic simulations for the different cases of the dynamic pressure and the quiescent interval of the solar wind. Although the field-aligned current based on the method proposed by Hasegawa and Sato [1979] can increase with a

rise of the dynamic pressure, our model could not find the dependence with the quiescent period.

Continuous Hisaki observations also revealed that the dawn-dusk asymmetry of IPT changes in days to weeks, which suggests that the dawn-dusk electric field also varies within the timescale of days to weeks. If this global electric field affects inside the magnetosphere, the brightness distribution of Jovian Synchrotron Radiation (JSR) can also change. The coordinated observations of Hisaki and Giant Metrewave Radio Telescope showed that the observation in 2014 had little correlation with IPT while the observation in 2016 showed a correlation. The effect of the dawn-dusk electric field on the spatial variation of the radiation belt is still unclear, and further observation would be needed. The variation of the dawn-dusk electric field could also affect to the radial diffusion of the energetic electrons. It is well known that the total flux density of JSR varies by 20-30 % with a time scale of several years, which is well correlated to the solar wind dynamic pressure with a lag time of two years, however, the reason still remains unclear. Our numerical calculation showed that two years lag time can be explained by the radial diffusion driven by the dawn-dusk electric field.

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