Statistical study of solar wind control on Jovian UV auroral activity obtained from long-term Hisaki EXCEED observations

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While the Jovian magnetosphere is known to have the internal source for its activity, it also has the influence from the solar wind. In a theoretical model, the ultraviolet (UV) aurora and solar wind dynamic pressure are anti-correlated. On the other hand, previous observations such as those by the Hubble Space Telescope showed a positive correlation between them. We made a statistical analysis for the total power variation of Jovian UV aurora obtained by the spectrometer EXCEED (Extreme Ultraviolet Spectroscope for Exospheric Dynamics) on board the Hisaki satellite. The data set was obtained from Dec. 2013 to Feb. 2014 and from Dec. 2014 to Feb. 2015. We compared the total UV auroral power in 900-1480 A with solar wind dynamic pressure at Jupiter estimated from the observation at 1 AU with a one-dimensional MHD model.

Superposed epoch analysis supports the positive correlation as the previous observation: Auroral total power increases when solar wind dynamic pressure enhanced around Jupiter. Furthermore, the auroral total power shows a positive correlation to the duration of a quiescent interval of the solar wind before the enhancements of the dynamic pressure with the correlation coefficient of 0.86. It is more than the correlation to the amplitude of dynamic pressure enhancement with the correlation coefficient of 0.44. A similar trend was observed in the auroral field-aligned currents which are inferred from the color ratio between the two bands of the Hisaki spectrum data. These statistical characteristics define the next step to unveil the physical mechanism of the solar wind control on the Jovian magnetospheric dynamics.

One possible scenario to explain the results is that the magnetospheric plasma content controls the aurora response to the solar wind variation. A long quiescent interval would mean that more plasma supplied from Io is accumulated in the magnetosphere. The solar wind compression causes adiabatic acceleration of the plasma and then the aurora increases. However, it is still unclear how the angular velocity distribution of magnetospheric plasma and auroral brightness distribution vary during the solar wind compression. Observationally, the next step for this study is to accompany an imaging observation to inspect morphological changes upon a hit by a solar wind shock. We will also discuss the possible mechanism from the initial result of the ground-based infrared observations in 2016.