M144-P025 Room: Poster Session Hall Time: May 16

Response of the Saturn's Magnetosphere to Variations of the Solar Wind Dynamic Pressure and IMF

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Saturn as well as Earth and Jupiter also shows aurora. Saturn's aurora was discovered by the Pioneer 11 spacecraft in 1979 and observed by the Saturn flybys of the Voyager 1 and 2 spacecrafts in the early 1980s. The first images of the aurora were obtained in 1994 by the Hubble Space Telescope. The interaction of the solar wind with Earth's magnetosphere gives rise to the bright aurora. Jupiter's aurora are dominated by internal processes in the jovian system. While, it is poorly understood what triggers Saturn's aurora.

In order to investigate the structure of the Saturn's magnetosphere, three-dimensional global MHD simulation of interaction between the solar wind and the magnetosphere was performed, and quasi-steady magnetospheric structure was obtained. For inquiring into if the Saturn's magnetosphere and aurora is dependent on solar wind dynamic pressure, dynamic pressure parameters and IMF (interplanetary magnetic field), we show simulation results of Saturn's magnetospheric structures and polar phenomena for no and northward IMFs when the solar wind density increases twice the usual value and the solar wind velocity increases square root of two times the usual value. It is assumed that any interplanetary shock which has twice dynamic pressure as much as the usual value encounters the Saturn's magnetosphere. We see from this simulation results that upward field-aligned currents prominently increase in dawn side than dusk side for northward IMF and increasing the solar wind dynamic pressure. It strongly suggests that Saturn's aurora shines more brightly.

We found that Saturn's aurora activity was dependent on strength and orientation of the interplanetary magnetic field as well as on solar wind dynamic pressure. These simulation results can explain well the observation of Bunce. et al. [Bunce, E. J., et al., Adv. Space Res., 2005].