A Simulation Study of Dynamics in the Distant Jovian Magnetotail

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In late February 2007, the New Horizons spacecraft flew past Jupiter en route to Pluto and repeatedly observed tailward moving plasma structures in Jupiter's distant tail (~2000 R_J). These structures have periods of 3-4 days with velocities ranging from 140 km $^{-s}$ to 760 km $^{-s}$ and they occur from 600 R_J to 1000 R_J down the tail. In fact the Galileo spacecraft also observed the similar plasma burst in the tail (100 R_J) with 48-72 hours period in advance. Although there are some interpretations of these periodic phenomena, the nature of these structures is not yet clear. In our previous simulation results, we obtained the periodic plasmoid ejections in the tail and suggested that a balance between reconnection site and the plasma corotation boundary in the tail is important for those plasmoids.

In this study, we have used a new magnetohydrodynamic model with a 1500 R_J long tail to investigate the propagation of these structures under different solar wind conditions. This simulation produced plasmoid-like structures that may explain the observations from New Horizons. We argue that periodic plasmoid ejection from a neutral line in Jupiter's plasma sheet can be found whenever the interplanetary magnetic field (IMF) has a northward component along the dipole direction and the solar wind dynamic pressure is low. When the IMF has a southward component along the dipole direction high latitude reconnection also can form plasmoid-like structures. As a result plasma structures moving tailward can be found over a large region of the tail as is observed.