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Ion entry into the magnetosphere was studied for different interplanetary magnetic field (IMF) orientations. Field models for the study of ion entry were from the results of global magnetohydrodynamic (MHD) simulations. Ions entering under northward IMF conditions entered on reconnected field lines and entered the flanks of the magnetotail. Some were strongly accelerated during entry at high latitudes. Under southward IMF conditions particles entered through the plasma mantle and only cold ions reached the magnetotail current sheet. In the case of southward IMF with a y component a flux rope was present in the tail. In this case ions reached the flux rope along open field lines and were accelerated there. If the IMF was rotating particles could be accelerated at high latitudes and in the magnetotail

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Summary

The topic of our study is the entry of solar wind ions into the magnetosphere under different IMF conditions. Our approach has been to follow the trajectories of many ions launched in the solar wind in snapshots of the electric and magnetic fields from three-dimensional global MHD simulations of the magnetosphere. Ions enter the magnetosphere in our study in at least three general ways: they are brought into the magnetosphere on a reconnected field line, entry on open field lines and direct entry of hot particles across the magnetopause (a relatively minor process). Within these broad categories the entry and energization for a specific case can be quite varied.

In a southward IMF case we found that the small resistive electric field (compared to the connective electric field) strongly influenced the ability of particles to cross the magnetopause. In an MHD simulation with an IMF component in the GSM y direction, a flux rope formed in the magnetotail. When we launched ions in this configuration, they were able to enter the magnetosphere on the dayside (mainly in the morning sector). Many of these traveled to the distant tail on open field lines where they encountered the flux rope. In the flux rope region of mixed closed, open and solar wind field lines they typically crossed to the dusk side, gained energy, and exited the tail on the dusk side; often being transported back toward the Earth before exiting. Surprisingly most of these particles crossed topological boundaries in the magnetic field three times due to three different types of reconnection: entering the magnetosphere because of dayside reconnection, entering the flux rope because of tail reconnection and leaving the magnetosphere because of reconnection on the flanks in the distant tail.

Recently we have studied PEP's or Polar energetic protons. In these events, Polar observes a large increase in proton flux across a wide range of energies. To model the state of the magnetosphere during this event, we used the results of an MHD simulation with a similar rotating IMF. The magnetosphere during this event was in a state that

seemed surprising to us but may be common; that is, the IMF was predominantly northward yet the magnetotail reflected conditions that resulted from a previous southward IMF: stretched field lines and a dawn to dusk electric field. In our model, Polar was located near a sharp boundary in proton density, the outer edge of the plasma sheet. Here ions are seen up to the 40 keV range. Particles could be accelerated not only in the cusp/reconnection region that was present but also in the magnetotail. Many particles reach the location of Polar on Speiser-type trajectories from the distant tail. The distribution function at Polar shows a combination of low energy particles forming a cool core plus higher energy particles that have been heated by the electric field. We have begun to write up this research. In an effort with implications for the longer term we have also begun to investigate the importance of non-adiabatic particles in forming the global magnetospheric configuration.

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