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Statistical comparison of various dayside magnetopause reconnection X-line prediction models Ramiz A Qudsi¹, Brian Walsh¹, Jeff Broll², Emil Atz¹, Stein Haaland³ ¹Center for Space Physics, Boston University, MA, ²Los Alamos National Lab, NM, ³The University Center in Svalbard, Longyearbyen, Norway

Abstract

Magnetic reconnection is a fundamental plasma process of key importance to several fields. Reconnection at Earth's magnetopause drives magnetospheric convection and provides mass and energy input into the magnetosphere/ionosphere system.

Despite this importance, the factors governing the location of dayside magnetopause reconnection are not well understood. Though a few models can predict Xline locations reasonably well the underlying physics is still unresolved. In this study we present results from analysis of several reconnection regions observed by MMS, to determine what quantities are most strongly associated with the occurrence of dayside magnetopause reconnection. We also attempt to answer under what upstream conditions are global X-line models least reliable.

The eventual goal of the project is to quantify the dependence of each model on different states of plasma, both terrestrial as well as solar wind as well as attempt to answer the question "Under what plasma conditions do each model work best?".

Introduction

As solar wind slams into the earth's magnetic field, the magnetic topology gets rearranged and magnetic energy is converted to kinetic energy, thermal energy, and particle acceleration. This process is called magnetic reconnection.

Though reconnection can occur at any place where two different magnetic fields are present, it is often assumed that the locus of point of reconnection on the dayside magnetopause is a line, which we refer to as X-line.

Though some recent studies assert that reconnection happens in a region, in this study we make the assumption that X-line is a continuous structure. Under this assumption, there are several models in literature (see next section) that predict the location of X-lines on the day-side megnetopause. We compare 4 such models. Each of these models maximizes a specific parameter to find the orientation and location of X-lines.

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Average Distance $(R_{\rm rc})$		
l IMF conditions	$\langle R_{\rm rc,B_z<0} \rangle$	$\langle R_{\rm rc,B_z>0} \rangle$
5.16	4.53	6.34
4.65	3.74	6.88
5.93	5.16	7.69
4.22	3.65	5.27



Figure 5. Plot between the ratio of IMF y-component to its magnitude and corresponding z-component for different models. The Maximum fected even for negative values of B_7 . Other 3 models do not show any significant variation for

As reported in literature, Maximum Shear Model