Lab 3b: Magnetosphere 2: A Magnetosphere in Different Places

Introduction
This lab will use model results to explore how a the magnetosphere of a planet will vary depending on the distance from the Sun.

Goals:
Students will learn:
- which solar wind parameters affect the global structure of the magnetosphere.
- how these factors change with distance from the Sun.
- how the solar wind parameters impact the magnetosphere.

[Prior to this lab you may want to review the definitions of magnetosphere structures that were developed in Lab 3- Magnetosphere 1]

Before you begin, as a group discuss:
- What are the important drivers and parameters that affect the shape of the magnetosphere?
- How do these vary for planets at different distances from the Sun? *[Review your results for Lab 2- Helio Lab]*
- How do you expect the magnetosphere to change at differing distances from the Sun?
- How might a planetary ionosphere change with differing distances from the Sun?

Magnetospheres at Different Distances
This link is to a table of runs for different dipole strengths.
http://ccmc.gsfc.nasa.gov/support/HSS_2013/11deg.php
The table not only gives links to the run outputs, but also gives you the run parameters. The “Keywords” indicate the simulated distance from the Sun, and the solar wind parameters are given.
- Is the variation in solar wind parameters consistent with what you discussed above?
- Why do the other parameters change?

Now let’s look at the specific simulations.
- *Open up all of the simulation links in new tabs and click on “View Magnetosphere” and click “Update Plot”.*
- *Use the “Plot Area” settings to adjust the image size. The plot initially displays density. You may have to choose another variable to see the magnetosphere features in all of the runs.*

- Looking over all of the runs, does the magnetosphere change qualitatively in the way you expect it to?
- What qualitative changes do you see?

Quantitative Changes

- Using the “Line(1D)” plots the way you did in the last lab, identify all of the quantities that we identified previously and tabulate them as a function of distance from the sun. The included:
  - on the day side: position of the bow shock and magnetopause, the width and maximum density of the magnetosheath.
  - on the night side: how far away does the current sheet first develop, and what the maximum value of the current in it. (You may want to go back to the 2D slices for this?)
- What general trends do you see in these features?
- Try plotting the magnetopause stand off position as a function of distance from the Sun. Does it fit the functional form you expect? What solar wind variables do you have to account for?