CSI 769   Fall 2010
Solar and Heliospheric Physics

Homework Assignment 8

Assignment Date: Nov. 24, 2010
Due Date: Dec. 02, 2010

1. Petschek Reconnection Model
Make a sketch of the Petschek reconnection model. In your drawing, indicate the following important parameters: V_e, B_e, L_e, V_i, B_i, **L** and **l** (lower case L) and briefly explain what are these parameters. You also need to denote where are the external region, the diffusion region and the slow mode standing shocks?

2. Magnetic Reconnection Rate
Considering a typical solar active region of the following parameters: dimension 10^5 km, magnetic field 1000 Gauss, electron density is 10^9 /cm^3, magnetic diffusion rate 1 m^2/s
(1) What is the Alfven wave speed?
(2) What is the Magnetic Reynolds number?
(3) What is the dimensionless reconnection rate if the reconnection follows 1-D stagnation flow diffusion? What is the inflow speed?
(4) What is the dimensionless reconnection rate if the reconnection follows Sweet-Parker mechanism? What is the inflow speed?
(5) What is the dimensionless reconnection rate if the reconnection follows Petschek mechanism? What is the inflow speed?

3. Petschek Reconnection Model
Assume that the active region specified above in question 2 is undergoing Petschek reconnection. Further, assume that Petschek assumption of $B_i=B_e/2$ is correct.
 (1) What are the value of V_{Ae}, R_{me}, M_e, V_e, and L_e? (you could copy down from Question 2)
(2) What are the value of B_i, V_i, M_i and **L**?
(3) What is the value of the diffusion region width l?
(4) What is the slow-mode shock speed with respect to the plasma?
(5) In the upstream region of the standing slow-mode MHD shock, what is the angle (in degree) between the inflow magnetic field and the shock front surface? Note that, the total inflow magnetic field is equal to B_e?