Homework Assignment 3

Assignment Date: Oct. 08, 2010
Due Date: Oct. 14, 2010

1. **Force Free Parameter   and Sheared Arcade**
   Consider the coronal magnetic configuration of a sheared arcade. The observations show that (1) the transverse size of the loop arcade (perpendicular to the polarity inversion line) is 10000 km, (2) the shear angle of the arcade is 30°, (3) the strongest line-of-sight magnetic field at the footpoints of the outer loops is 1000 G. You are asked to find:
(1) what is the strength of the strongest transverse magnetic field along the polarity inversion line?
(2) what is the strength of the strongest transverse magnetic field in parallel with the polarity inversion line?
(3) what is the value of the force-free parameter   ?
(4) What is the electric current density at the footpoints of the outer loops?

2. **Magnetic null-point**
   For a magnetic vector potential **A**,
$$\vec{A} = (0,0, Az) = [0,0, \frac{B_0}{2L_0}(y^2 - ax^2)]$$
(1) Calculate the magnetic field **B**, current **J** and Lorentz force **F**.
(2) Draw in the X-Y plane the **B, J** and **F** fields for a=+1 and a=-1, respectively.
(3). Is this a force free field? Briefly discuss the implication of the Lorentz forces on the stability of the structure?

3. **Current sheet**
   Draw the magnetic field lines in the 2-D field (Bx, By) described as follows. In the drawing, indicate the positions of null points, separatrix lines and current sheet.

$$By + iBx = \frac{(z^2 + 1)}{(Z^2 + 4)^{1/2}}$$