FYS 3610
Exercises week 39

Descriptive questions:

1. Draw a sketch of the undisturbed Earth magnetic field using the Earth's rotational axis as a reference. Indicate direction of the magnetic field. What is the strength of the magnetic field near the equator and near the poles?

2. The Earth magnetic field are normally referred to the local coordinate systems (X,Y,Z) or (H, D, Z). Draw a figure that illustrates the Earth magnetic field vector decomposed in the two coordinate systems. Indicate geographic north in your figure.

3. Describe what happens when the solar wind, consisting of electrons and protons, hits the Earth magnetic field. Expalin the magnetopause currents.

4. What is a typical value for the solar wind stand-off distance? What are the controlling parameters for this distance; i.e. to push it inwards and outwards?

5. Explain the tail current.

EXERCISE 2

Visit NASA's home page for the CGM model of the Earth's magnetic field:
http://omniweb.gsfc.nasa.gov/vitmo/cgm_vitmo.html

i) Where is the north CGM pole located?

ii) Calculate CGMLat, CGMLon, MLT, magnetic conjugate point, L- value, H, D, Z component for the magnetic field, magnetic field strength, Inclination for the following geographic co-ordinates:
University of Oslo: (59.91, 10.73)
University of Tromsø: (69.7, 18.9)
Andøya Rocket Range: (69.28, 16.01)
Longyearbyen: (78.2, 15.7)

EXERCISE 3

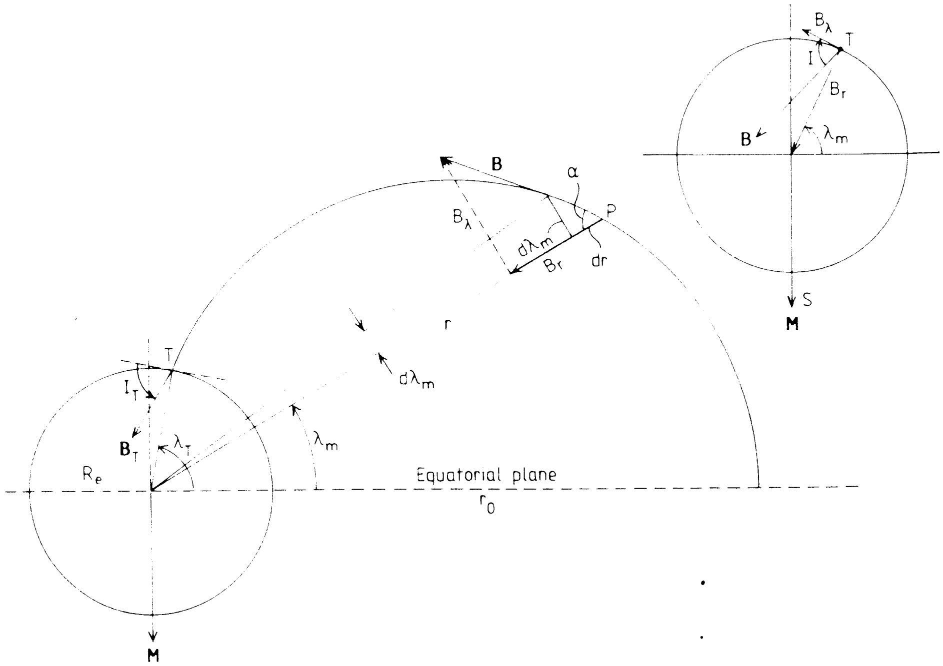

Figure 1: An illustration showing the geometry of the magnetic field line to assist in deriving a geometric formula for B.

Assume a dipole magnetic field. Introducing the magnetic latitude λ_m of which unit vector relates to the co-latitude unit vector defined in the lecture in the following way:

$$\widehat{\lambda}_m = -\widehat{\theta}$$

Then the magnetic field can be written as:

$$\vec{B} = B_r \widehat{r} + B_{\lambda_m} = H_0(-2\sin\lambda_m \widehat{r} + \cos\lambda_m \widehat{\lambda}_m)$$

i) Show that $L = \dfrac{r_0}{R_E} = \dfrac{1}{\cos^2 \lambda_m}$

Hint: $\tan\alpha = \dfrac{r \cdot d\lambda_m}{dr} = \dfrac{B_\lambda}{B_r}$

ii) Estimate B-field strength, inclination and L-value based on the dipole model, and compare with corresponding values calculated in Exercise 2.

EXERCISE 4

Derive the equation for the standoff distance. Estimate the magnetopause standoff distance for average solar wind conditions and extreme conditions.