Mini-groupwork 3, 2014

Space Physics, EF2240

a) A simple model describes the dayside ionospheric electron density at a certain altitude by the following equation:

$$\frac{\partial n_e}{\partial t} = q - \alpha n_e^2$$

where q is the ionization rate due to solar EUV radiation, and the second term in the right-hand side is the recombination rate. Assuming that the ionosphere is in equilibrium and that $q = 3.8 \times 10^4$ cm^{-3}s^{-1}, use data from Fälthammar to determine the recombination coefficient α at 150 km altitude. (Give α in SI units.)

b) A radio wave pulse with a frequency of 5 MHz is emitted straight upwards from Earth. A receiver registers an echo of this signal at a slightly later time. Estimate the expected time difference between the emission and detection of the pulse, if this experiment would be carried out during daytime, this year.

Please, turn!

c) A satellite has made a number of measurements of the electric field **E** and the magnetic field **B** at 700 km altitude, where you can neglect collisions in the ionospheric plasma. The measurements have been made in the northern hemisphere, and the magnetic field thus points into the plane of the paper in the figure below. This figure is a polar diagram, with the magnetic pole in the centre of the plot. The distance from the centre represents (magnetic) latitude. Instead of longitude, the local time is used, where 12 represents the direction of the sun. For each measurement point the **E**-field is shown by a vector.

Draw the direction of the plasma drift (perpendicular to **B**) for each measurement point. For the point where the values of the fields are given, also calculate the magnitude of the drift velocity. You can assume that **B** is everywhere directed perpendicular to the plane of the paper.