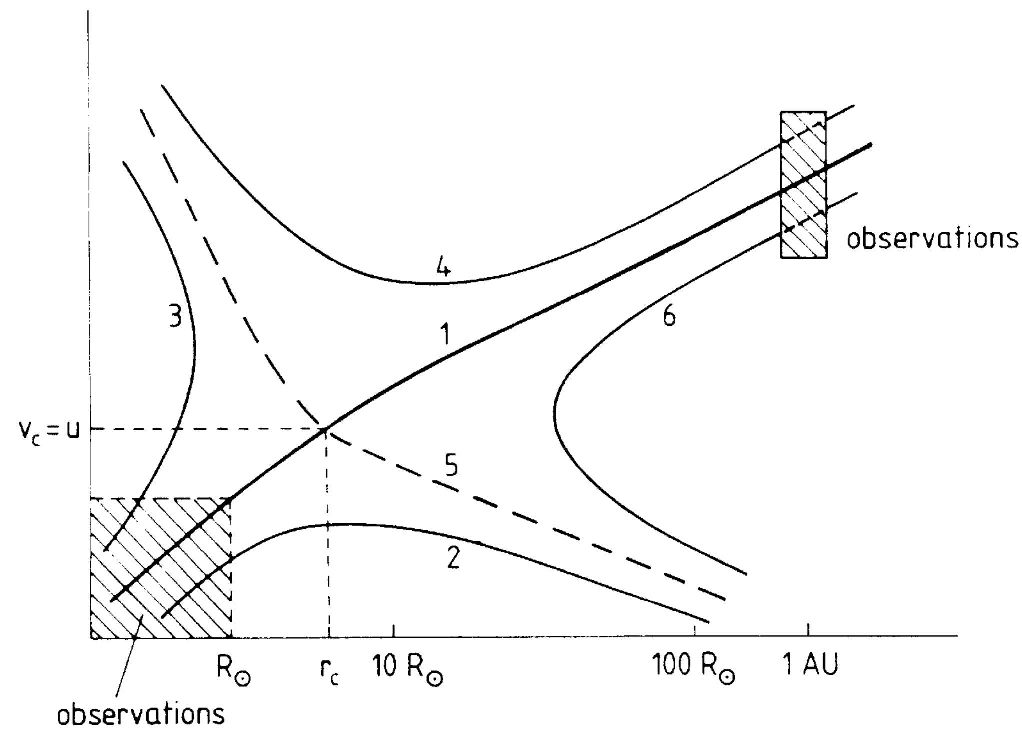
FYS 3610

EXERCISES WEEK 43

EXERCISE 1

Discuss the solutions 1-6 of the solar wind equation

$$\left(2-\frac{GM_S}{c_s^2}\frac{1}{r}\right)\frac{dr}{r}=\left(\frac{v^2}{c_s^2}-1\right)\frac{dv}{v}$$



EXERCISE 2

Assume an Earth-fixed Cartesian coordinate system (*x*,*y*,*z*) where *x* is pointing magnetic northward, *y* magnetic eastward, and *z* downwards towards the Earth's center. In this coordinate system the magnetic field is given by

$$\vec{B} = B(\cos I\ \hat{x} + \sin I\ \hat{z}) \qquad \text{Eq. 2.1}$$

and the electric field is given by

$$\vec{E} = E_x \hat{x} + E_y \hat{y} + \vec{E}_z \hat{z} \qquad \text{Eq. 2.2}$$

For this coordinate system it is assumed that the magnetic dipole axis is antiparallel to the Earth's rotation axis and that the magnetic field is symmetric around this axis. In this coordinate system the height-integrated current can be expressed on tensor form as:

$$\begin{bmatrix} J_x \\ J_y \\ J_z \end{bmatrix} = \begin{bmatrix} \Sigma_P \sin^2 I + \Sigma_\parallel \cos^2 I & -\Sigma_H \sin I & (\Sigma_\parallel - \Sigma_P)\sin I \ \cos I \\ \Sigma_H \sin I & \Sigma_P & -\Sigma_H \cos I \\ (\Sigma_\parallel - \Sigma_P)\sin I \ \cos I & \Sigma_H \cos I & \Sigma_P \cos^2 I + \Sigma_\parallel \sin^2 I \end{bmatrix} \begin{bmatrix} E_x \\ E_y \\ E_z \end{bmatrix} \qquad \text{Eq.2.3}$$

Apply Eq. 2.3 on the equatorial region where the inclination angle is zero and $\vec{B} = B\ \hat{x}$. Assume that the vertical current $J_z = 0$ and show that

$$J_y = \left(\Sigma_P + \frac{\Sigma_H^2}{\Sigma_P} \right) E_y \qquad \text{Eq. 2.4}$$

which is the equatorial electrojet. Comment on the analogy with the auroral electrojet.

From Kievelson&Russell:

Exercise 14.1

Exercise 14.2

Exercise 14.8