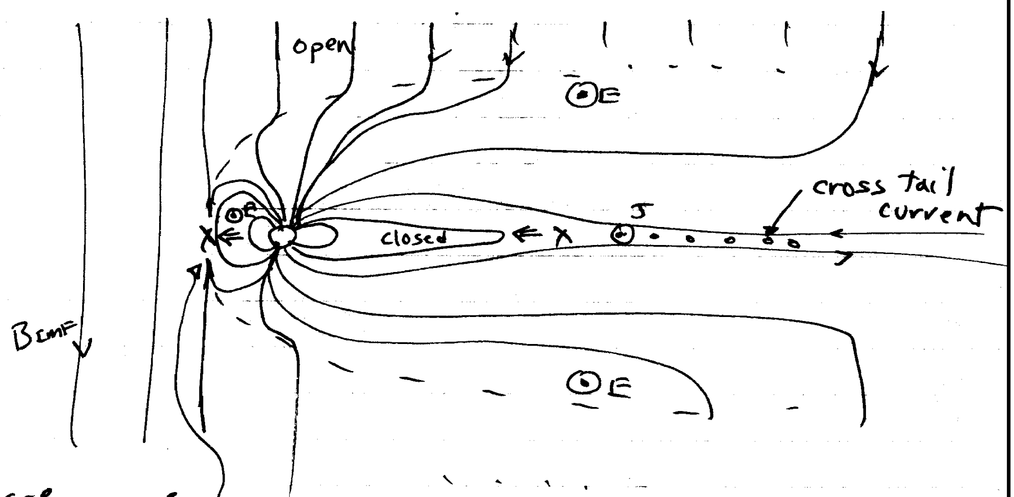
505day22.pdf
GPHYS 505 lecture 22
Review of magnetospheric Convection and discussion of current systems

Lecture 22

Review Reconnection
and discuss properties of Magnetosphere



see Next figure for details

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Solar wind momentum
directly transfered to
ionosphere in polarcaps

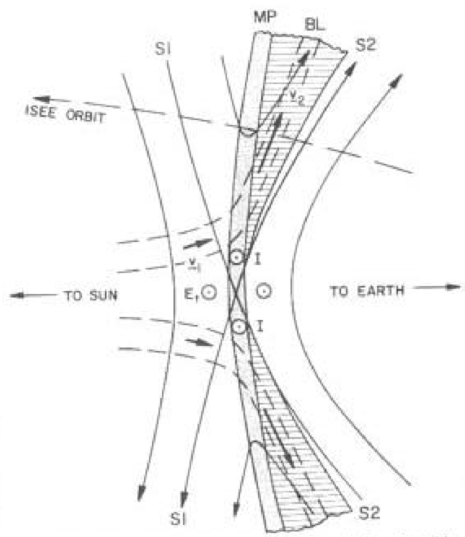


Fig. 4. Meridional view of the reconnection configuration for antiparallel external and internal magnetic fields. The magnetic field lines are shown as solid lines. The magnetopause (MP) is shown as a current layer of finite thickness, with an adjoining boundary layer (BL) of comparable thickness. Those magnetosheath and magnetospheric field lines connected to the separator (or X line) form the outer (S_1) and inner (S_2) separatrices. Dashed lines are stream lines and the heavy arrows indicate plasma flow speed outside and inside the magnetopause. The reconnection electric field, E_t is aligned with the magnetopause current, I. (From Sonnerup et al., 1981).

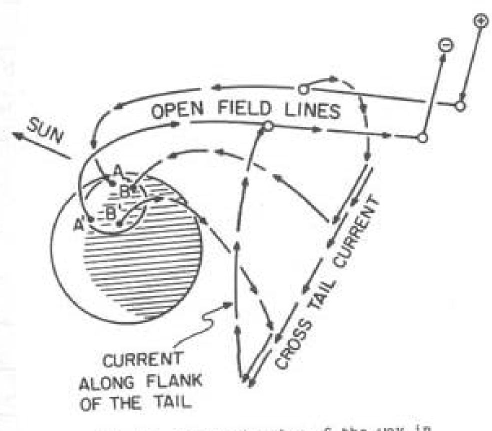
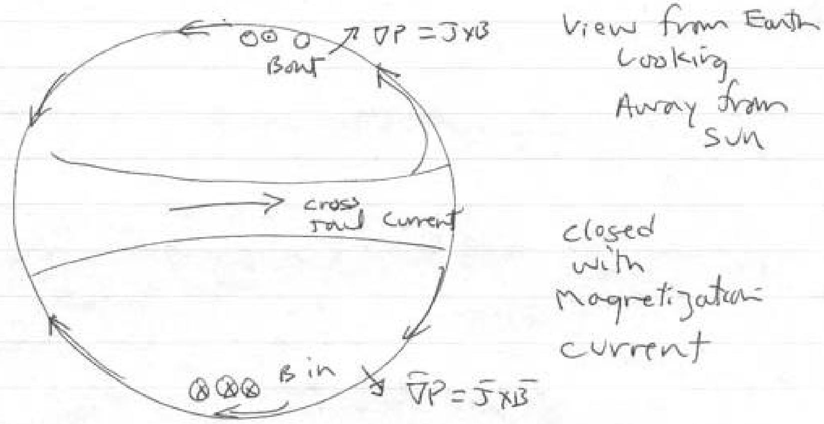


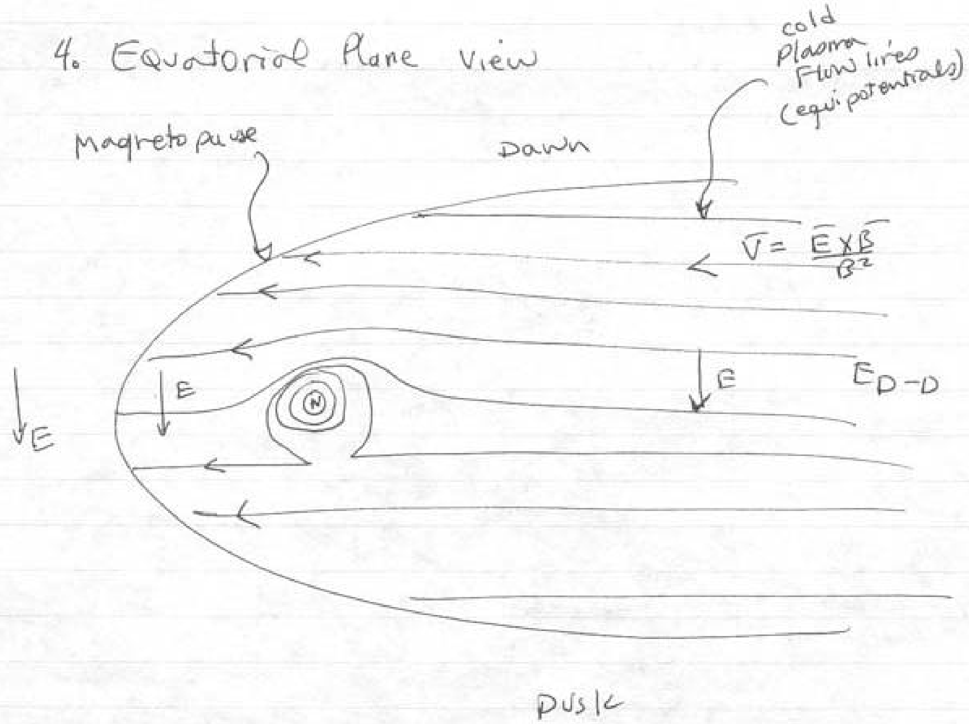
Fig. 7. Schematic view of the way in which region 1 currents may form a shunt of the cross-tail circuit.

Review contd

3. Tail Cross section



4. Equatorial Plane view



Review cont'd

5. Magnetopause as pressure balance surface

$$\nabla\left(P + \frac{B^2}{2\mu_0}\right) = \frac{(\bar{B}\cdot\bar{\nabla})\bar{B}}{\mu_0} \equiv \frac{1}{\mu_0}\frac{\partial \vec{B}}{\partial l} = 0 \text{ at subsolar point}$$

for $\frac{\partial \bar{B}}{\partial l}$ small

$$P_{sw} = \frac{B_m^2}{2\mu_0}$$

directed kinetic "pressure"

P_{sw} = Solar wind pressure $\propto |\rho \bar{V} \bar{V}|$

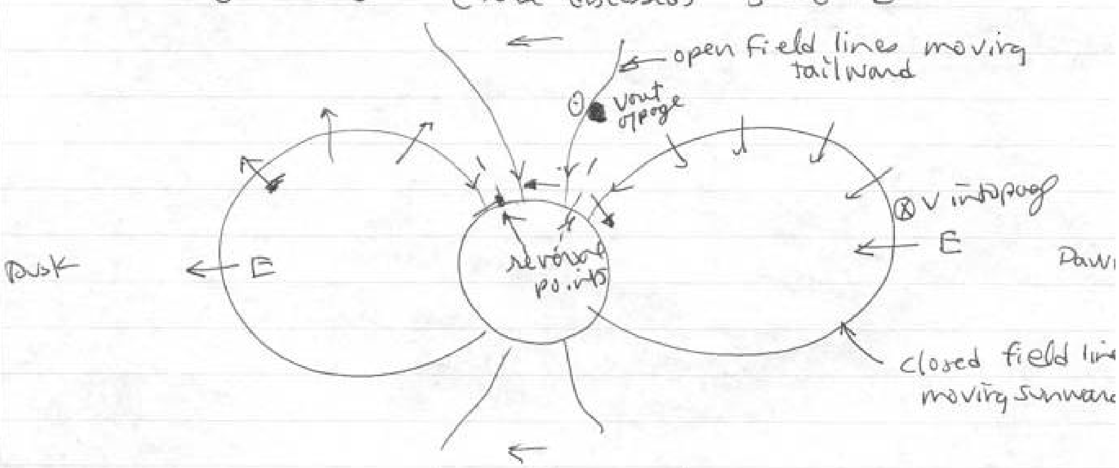
B_m = Magnetospheric B field

Same phenomenon – most Planets / solar flares / pulsars

Implications for ionosphere

Density profile (see view graph)

$\sigma \rightarrow \overleftrightarrow{\sigma}$ (to be discussed) $\bar{J} = \overleftrightarrow{\sigma} \cdot \bar{E}$



View From tail towards Earth and Sun

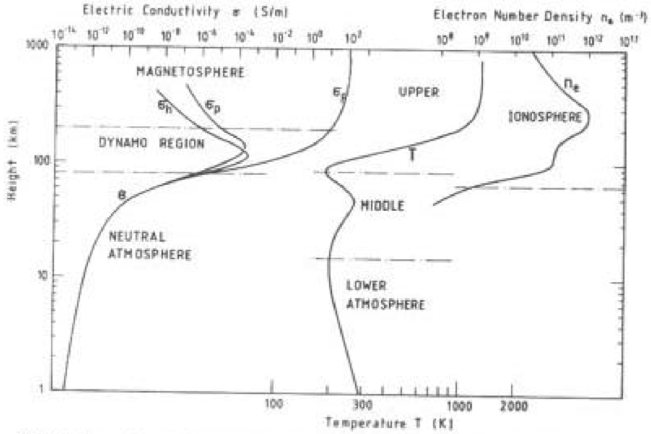


Fig. 1.1. Nomenclature of atmospheric regions based on profiles of electric conductivity, neutral temperature, and electron number density

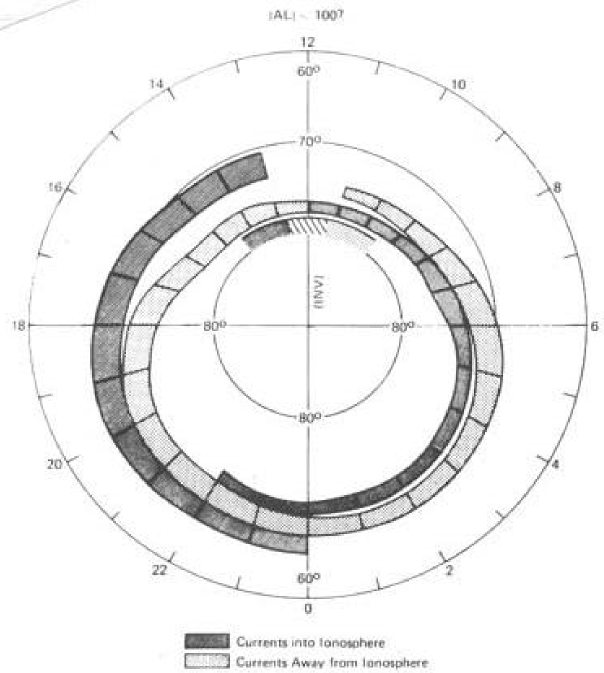


Fig. 9. The distribution of upward and downward field-aligned currents in invariant latitude-MLT coordinates (Iijima and Potemra, 1978).

Since field lines are Nearly equipotentials

E from Magnetosphere is carried right down to Ionosphere

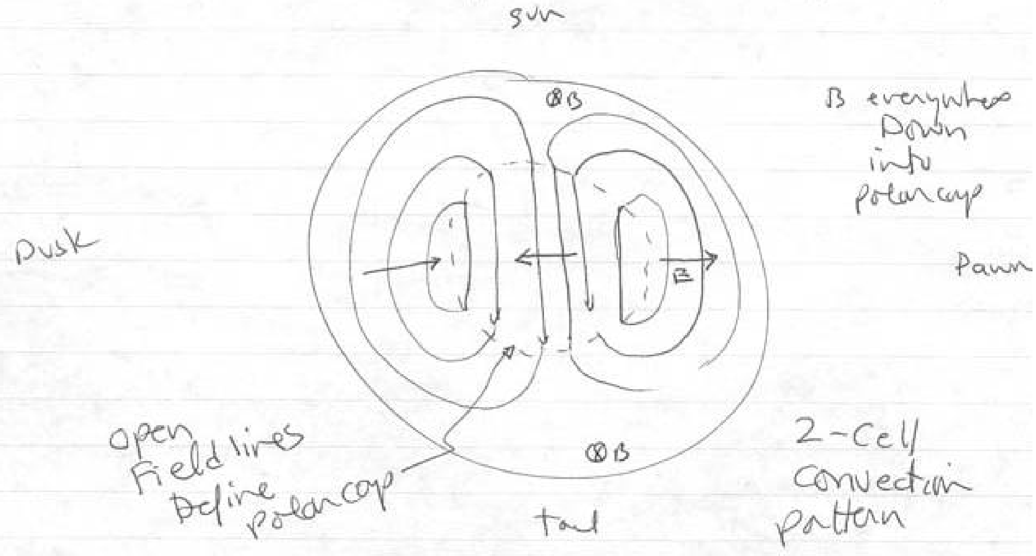
This Puts ENTIRE Polar Cap(s) in Motion

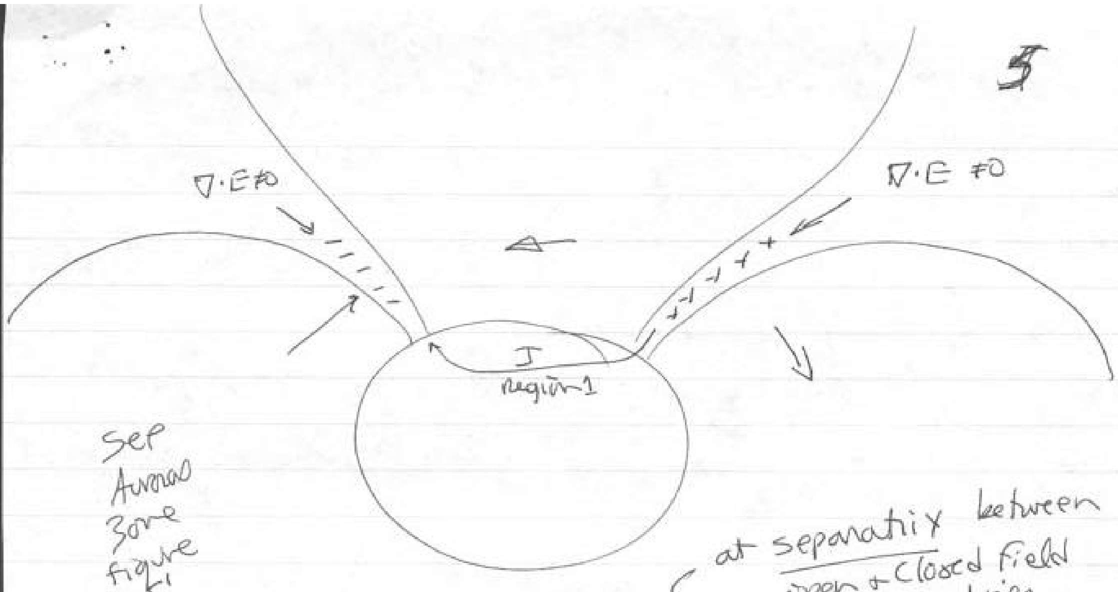
$$\vec{V} = \frac{\vec{E} \times \vec{B}}{B^2}$$

Note: $E_{magnetosphere}$ * Amplification = $E_{ionosphere}$

(due to Convergence of B field lines)

Directions of ionospheric convection pattern





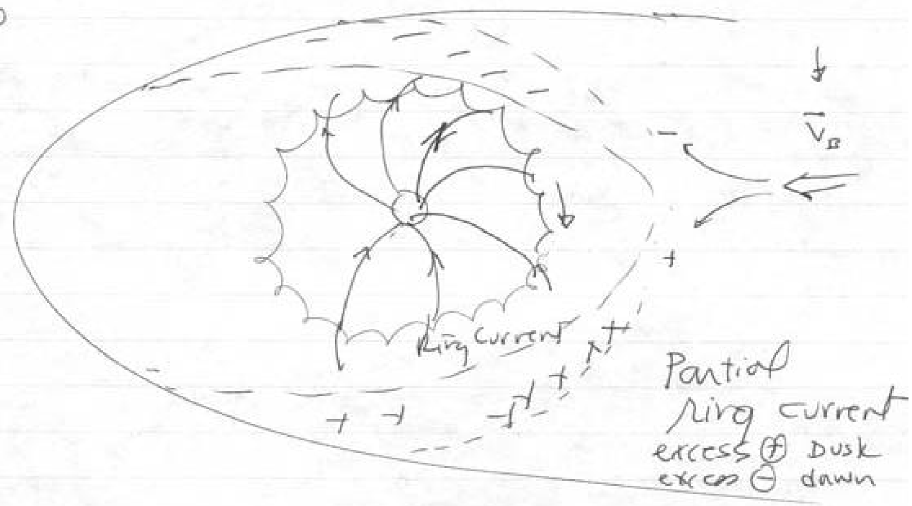
See Auroral zone figure on 5'

at E field reversals (at separatrix between open + closed field lines) there is charge distribution which can drive currents through ionosphere

Also, Region 2 currents associated with Ring Current

equatorial plane

sun



Partial ring current
excess ⊕ Dusk
excess ⊖ dawn

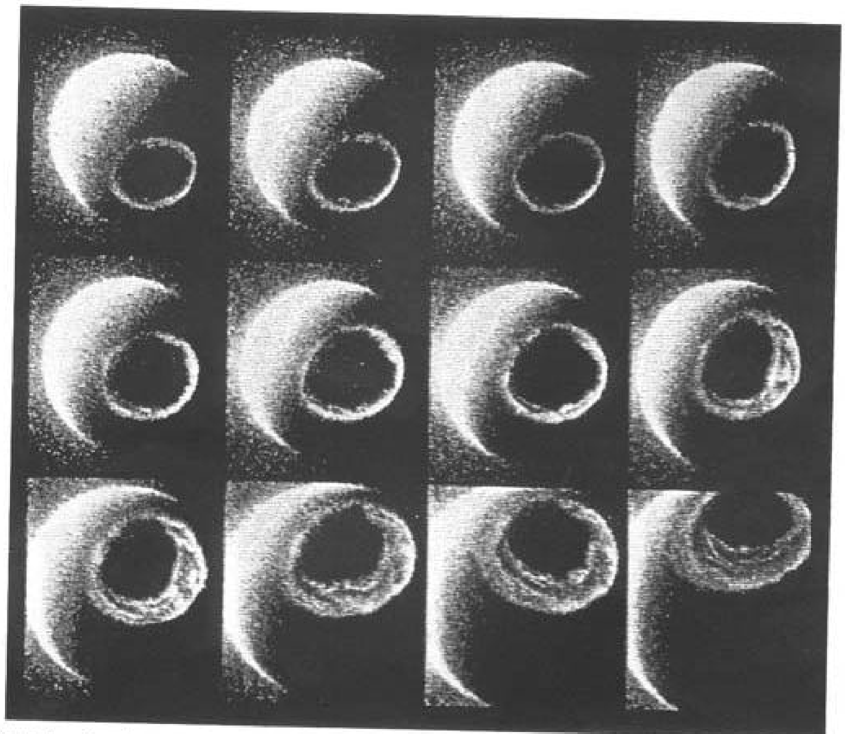
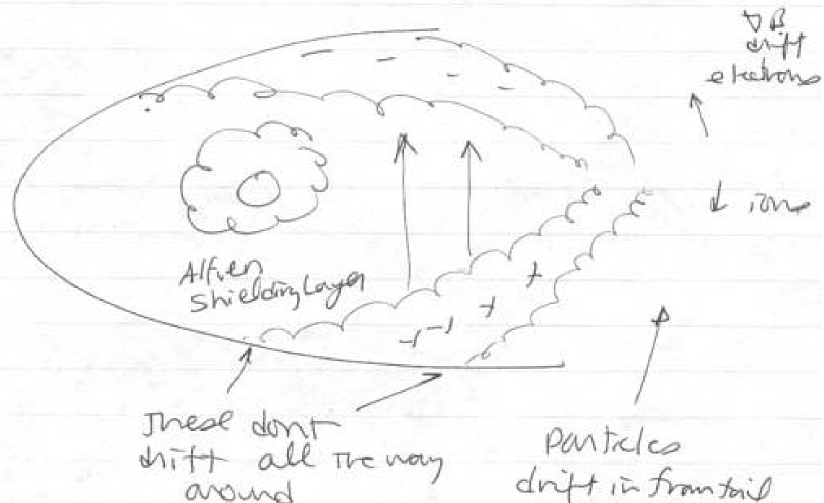


Plate 1. Imaging sequence of 12 consecutive frames displaying global auroral activity at ultraviolet wavelengths in the interval 0719 - 0945 UT on 8 November 1981. Onset of a sub-storm occurs at ~ 0719 UT (first frame), with maximum epoch at ~ 0850 UT (eighth frame). The geocorona is visible in the scattererd light of solar Lyman-α radiation sunward of the dayside limb, at upper left in each frame. Antisunward of the terminator the entire auroral region is detected in the light of OI at 130.4 and 135.6 nm.

Iijima + Potemra View Graph

Another affect of Partial Ring Current

→ Alfven Shielding



Alfven shielding is due to Partial ring current which gives excess ⊕ on dusk and ⊖ on dawn. This is like a "polarization" field which eventually Cancels the $E_{dawn \to dusk}$ Magnetospheric Electric Field below some Latitude Self Consistent with Co-rotation of Low Latitudes.