



UiO : **Department of Physics**
University of Oslo

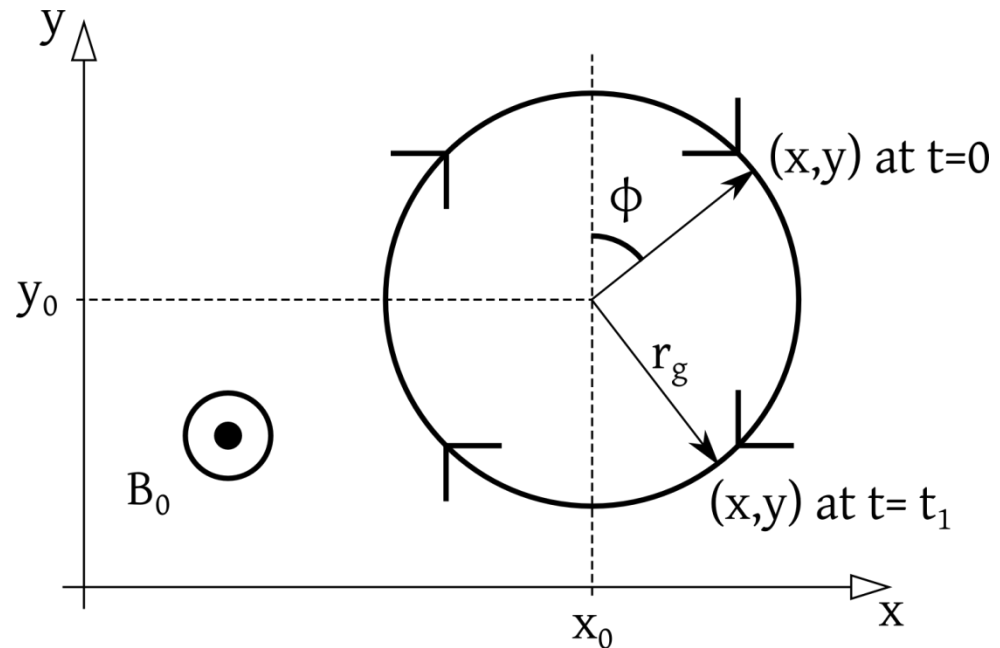
Overview FYS 3610



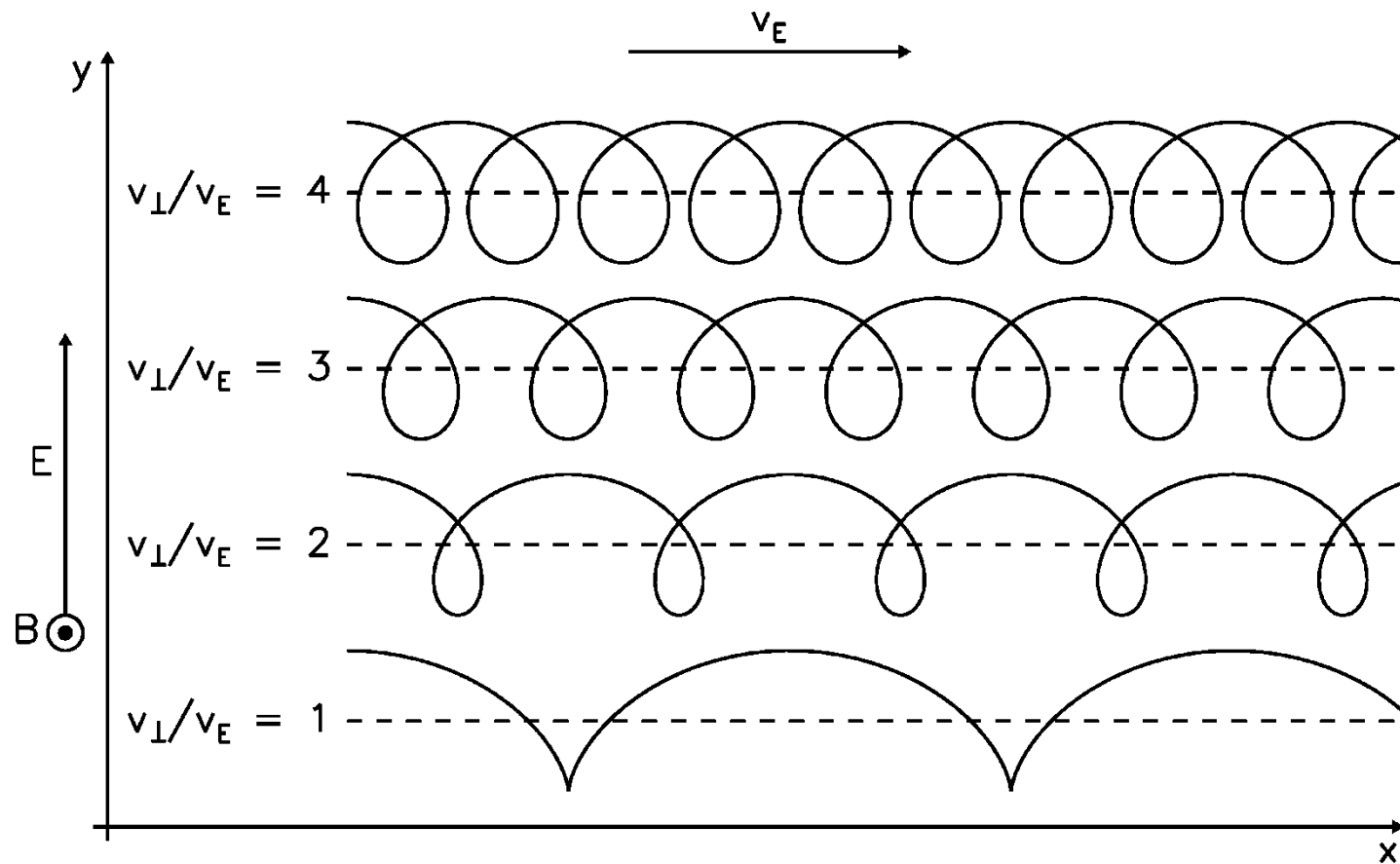
Single particle motion

$$\vec{F} = m_{i,e} \frac{d\vec{v}}{dt} = q_{i,e} \vec{v} \times \vec{B}$$

$$\omega_{i,e} = \frac{q_{i,e} B}{m}$$

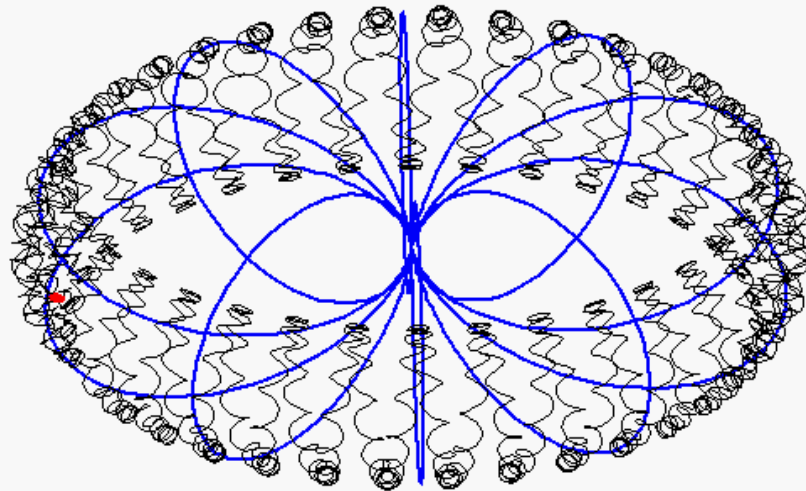


ExB drift



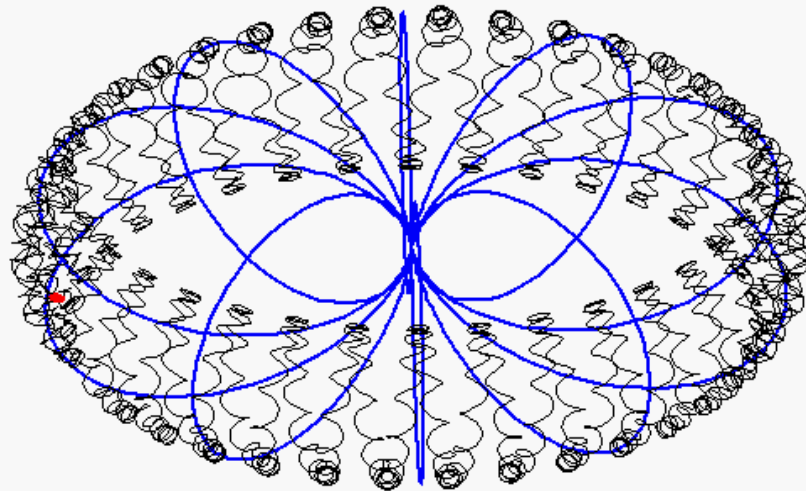
Single particle motion

$$\begin{aligned} m &= 16\text{amu}, q = 1e \\ T_{\parallel} &= 14\text{MeV}, T_{\perp} = 31\text{MeV}, \alpha_0 = 56^\circ \\ t &= 0.00\text{s} \end{aligned}$$



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Diffusion vs. frozen-in

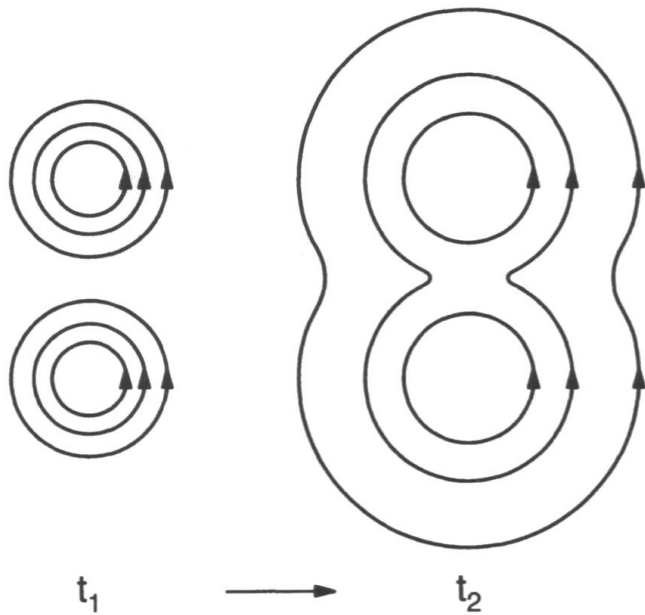


Fig. 5.1. Diffusion of magnetic field lines.

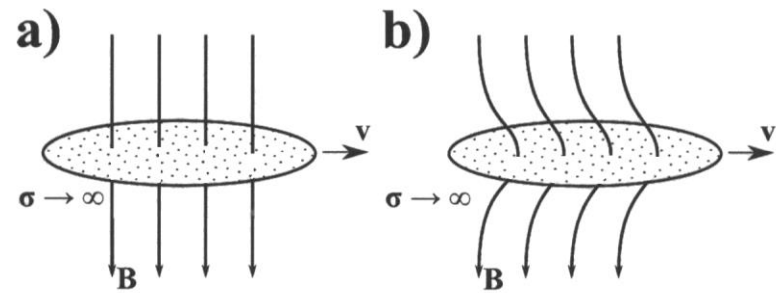


Figure 1.2: Illustration of the "frozen-in" theorem. **a)** A magnetic field penetrates a highly conducting plasma. **b)** As the plasma moves, the magnetic field is "frozen-in" and follows the motion of the plasma.



Magnetic reconnection

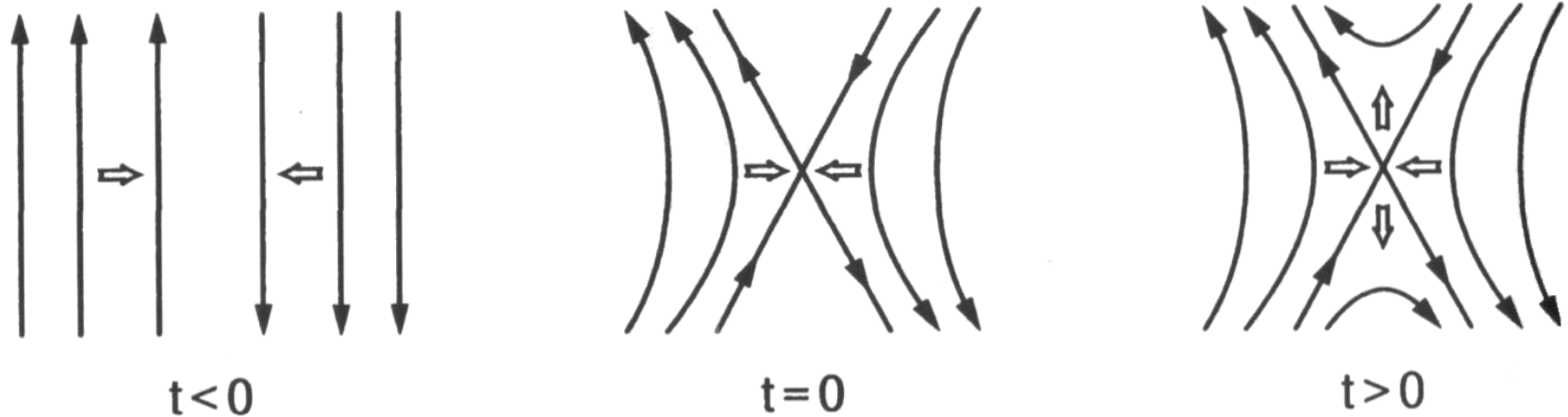
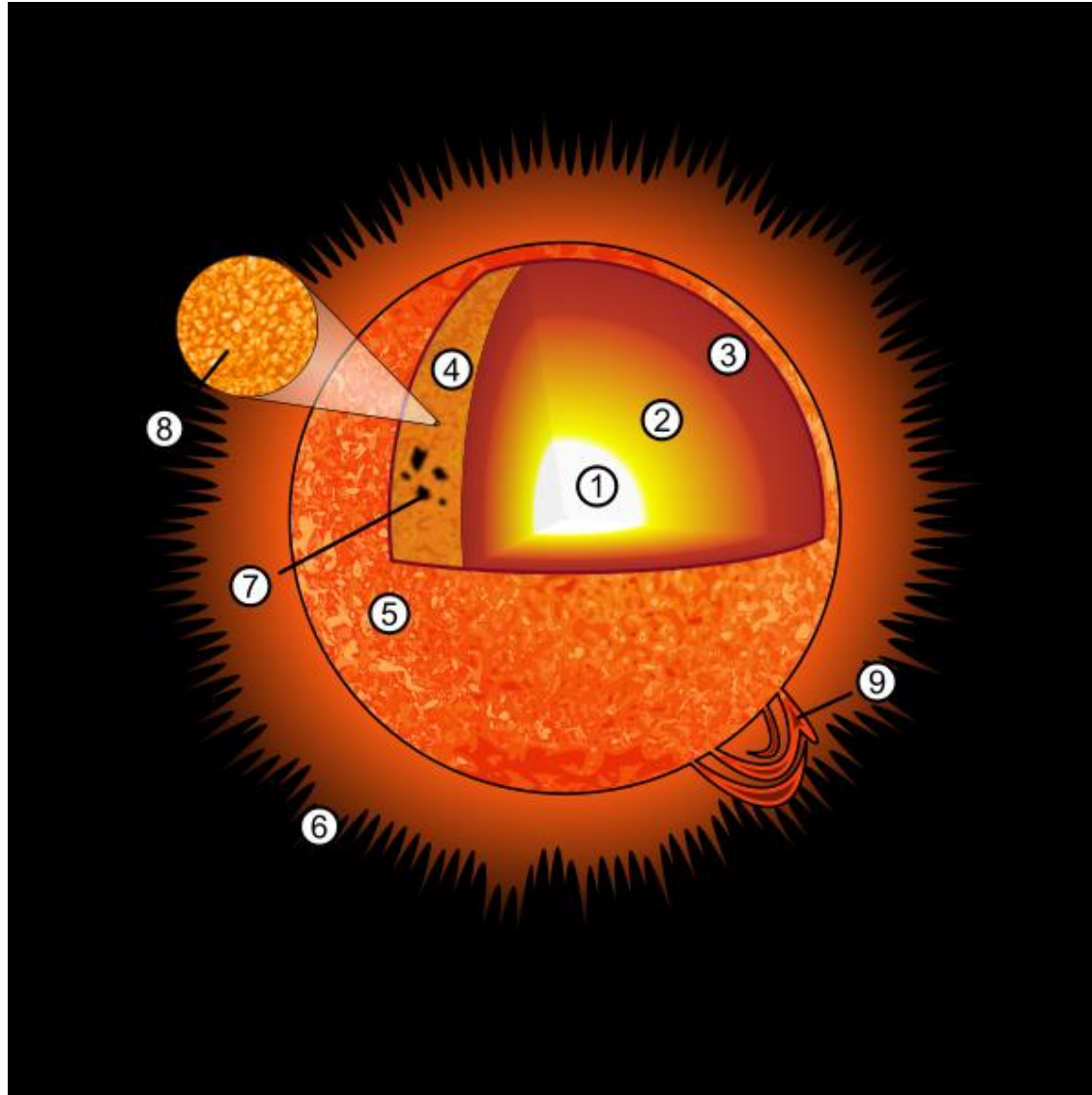


Fig. 5.3. Evolution of field line merging.

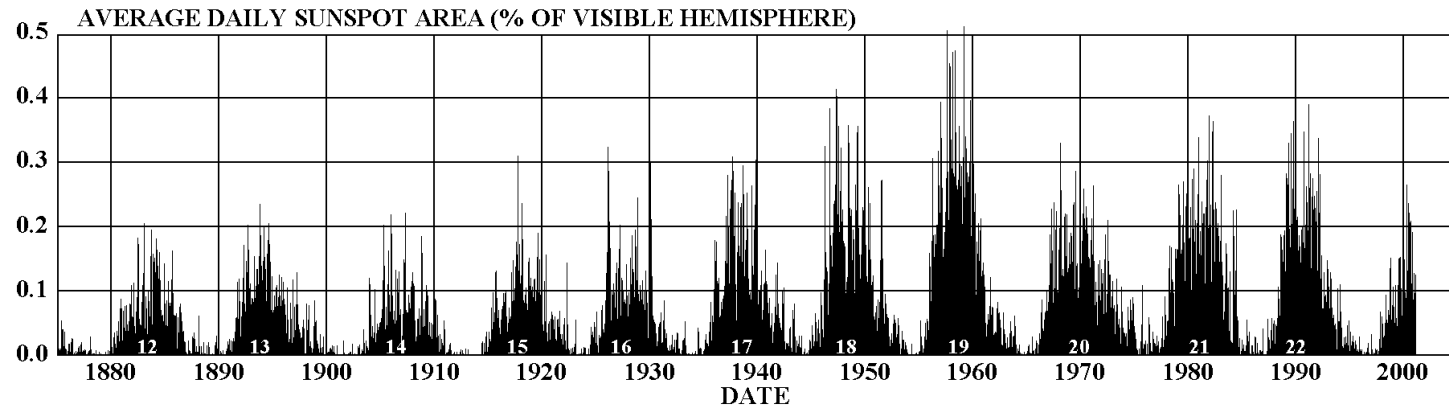
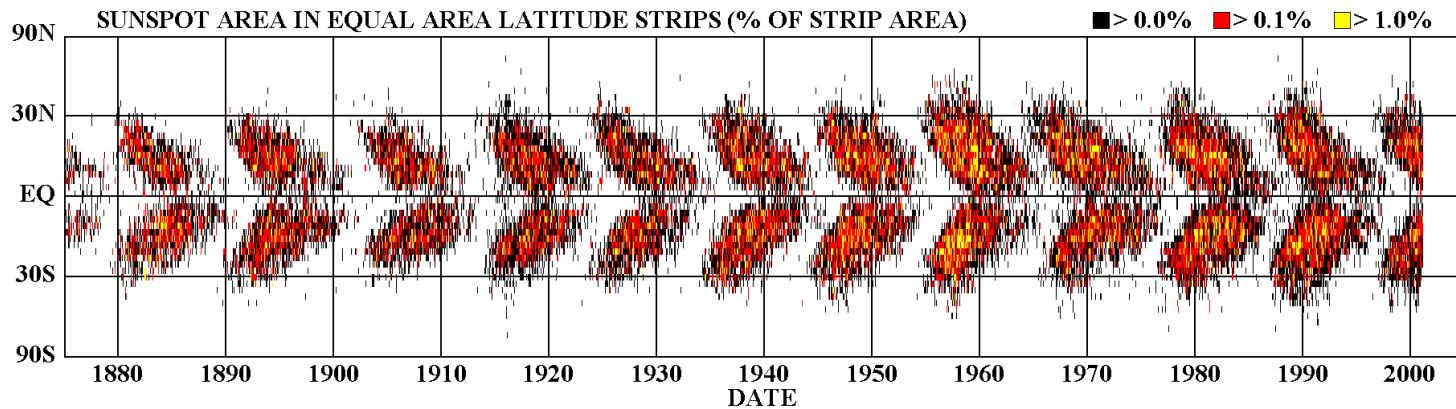


Some solar features



Butterfly diagram

DAILY SUNSPOT AREA AVERAGED OVER INDIVIDUAL SOLAR ROTATIONS

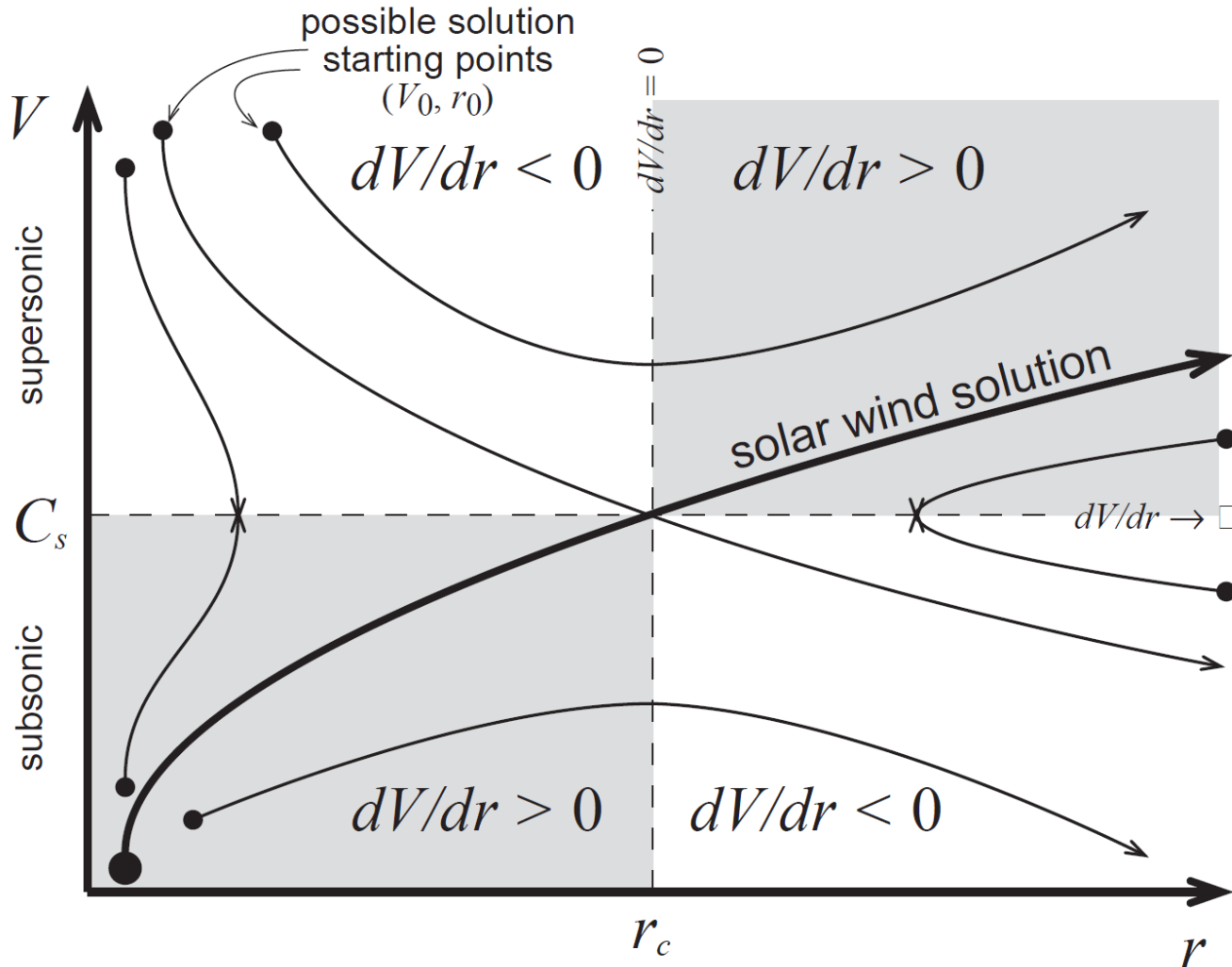


<http://science.msfc.nasa.gov/ssl/pad/solar/images/bfly.gif>

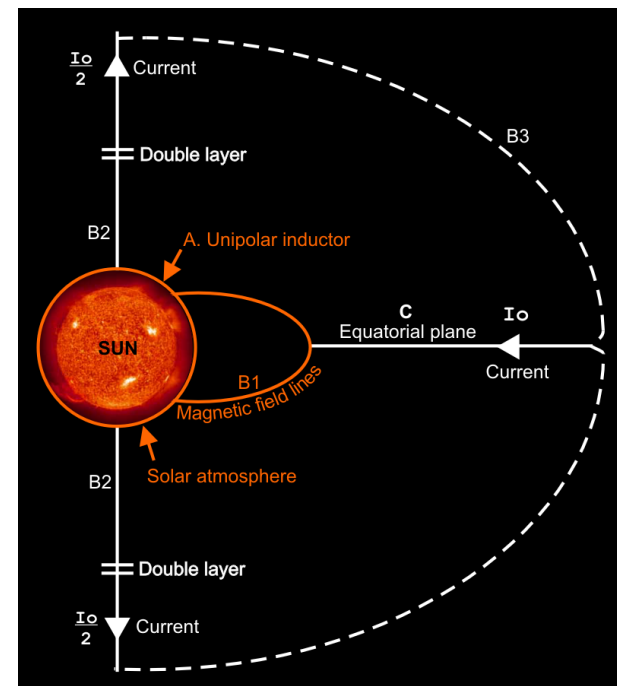
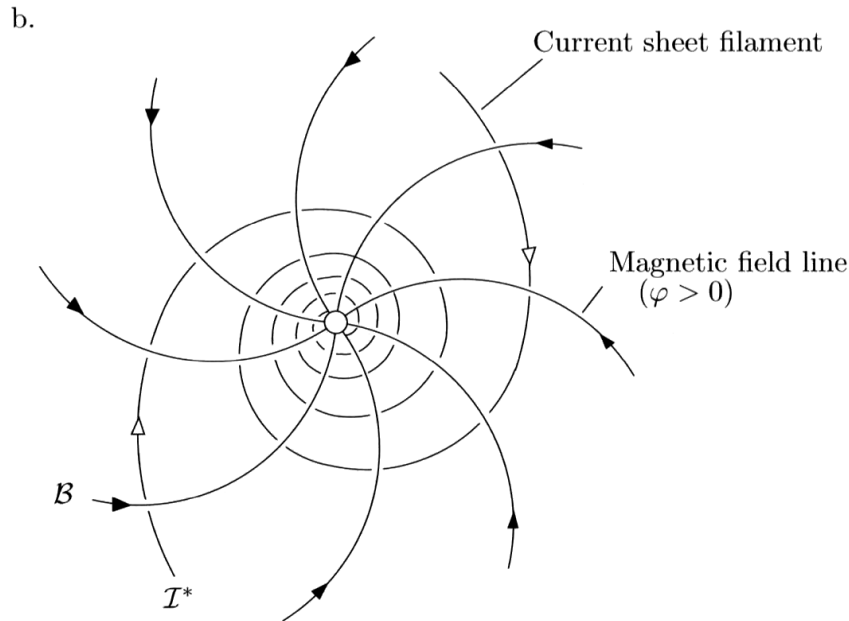
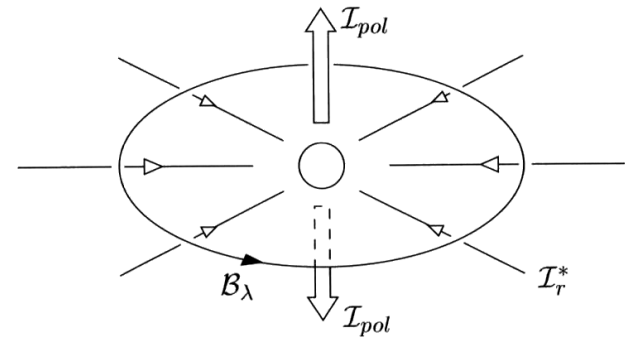
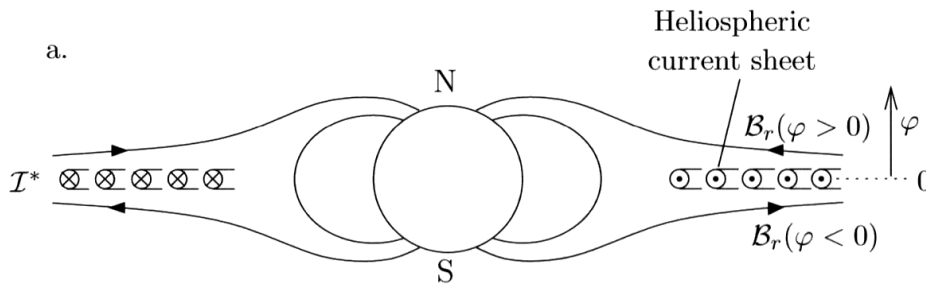
NASA/MSFC/HATHAWAY 02/2001



Gas dynamic model II



Heliospheric current circuit



Dayside magnetosphere

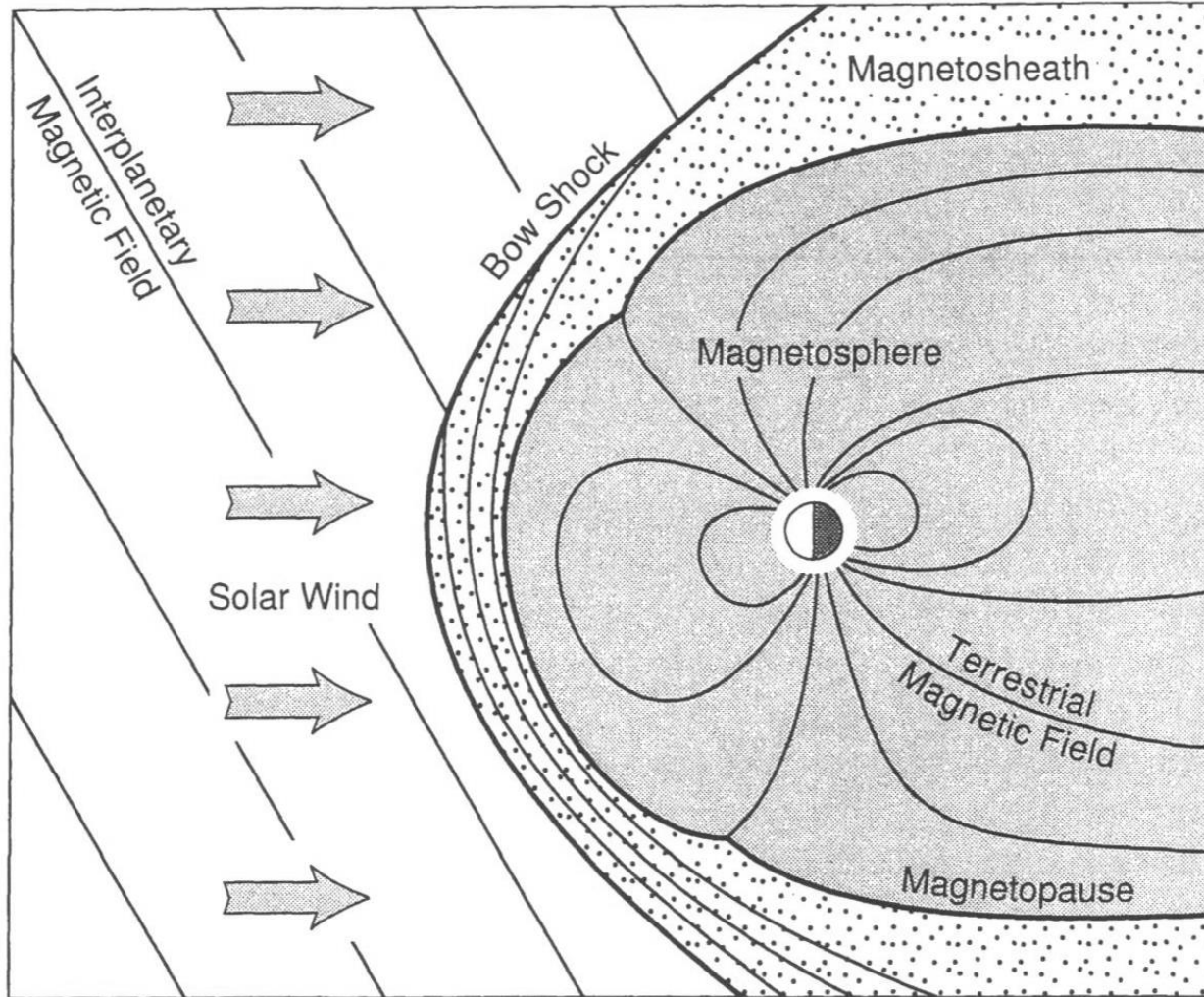
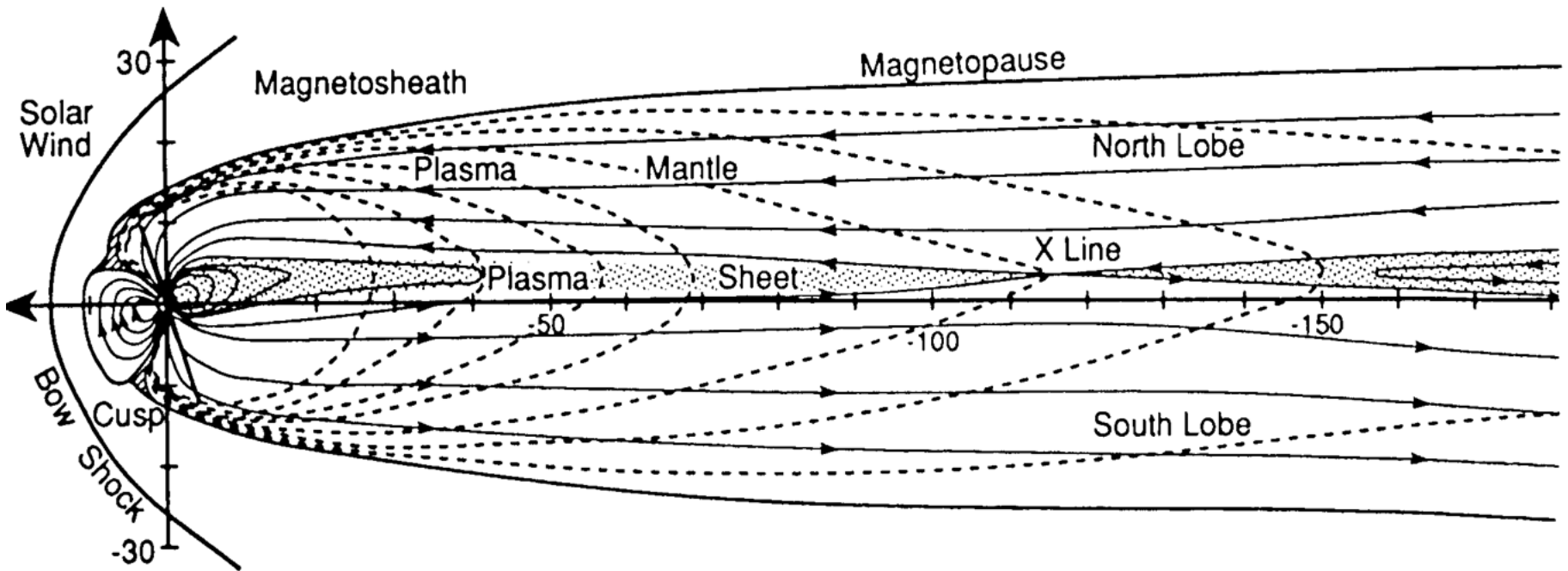


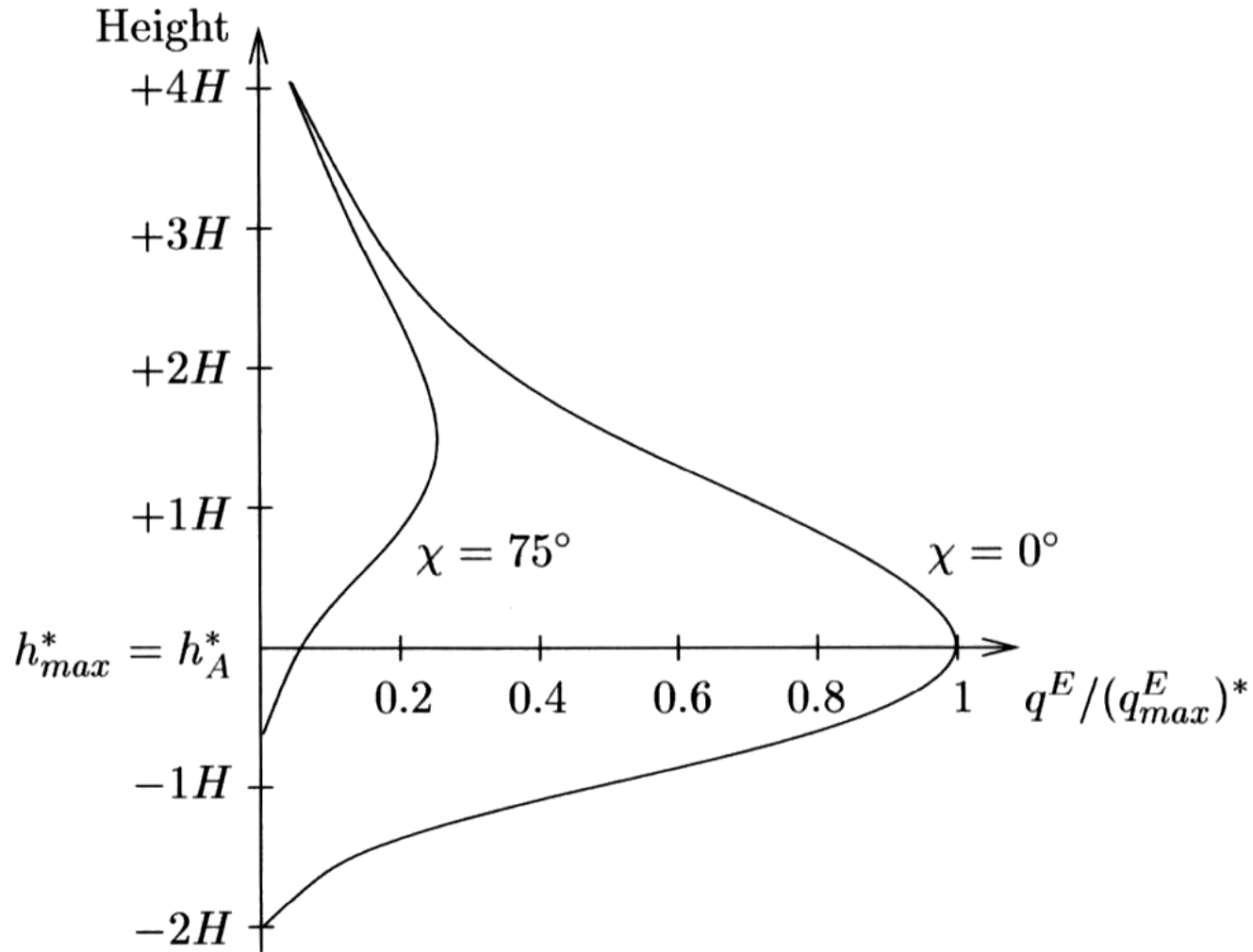
Fig. 1.3. Topography of the solar-terrestrial environment.



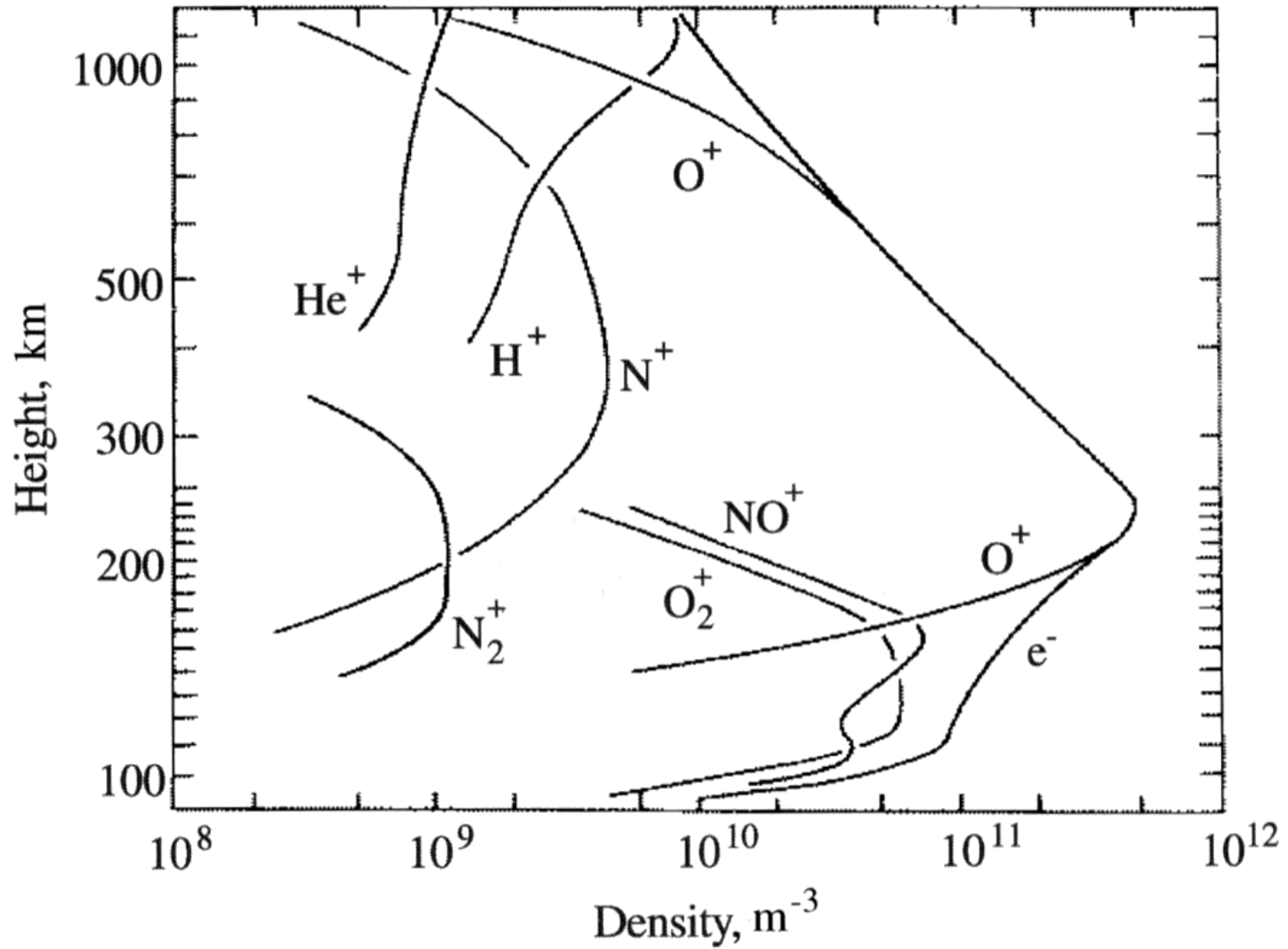
The magnetotail



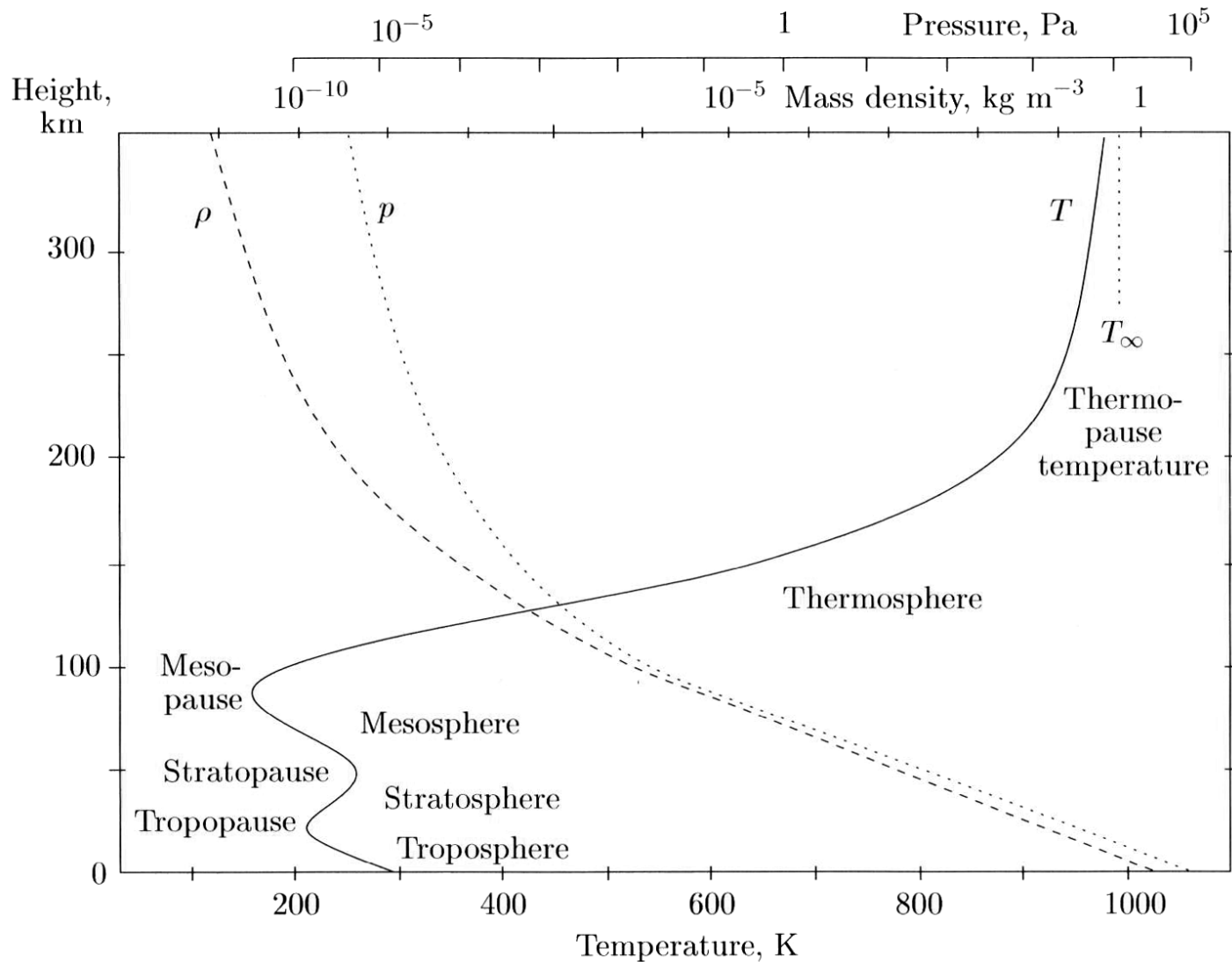
Chapman production function



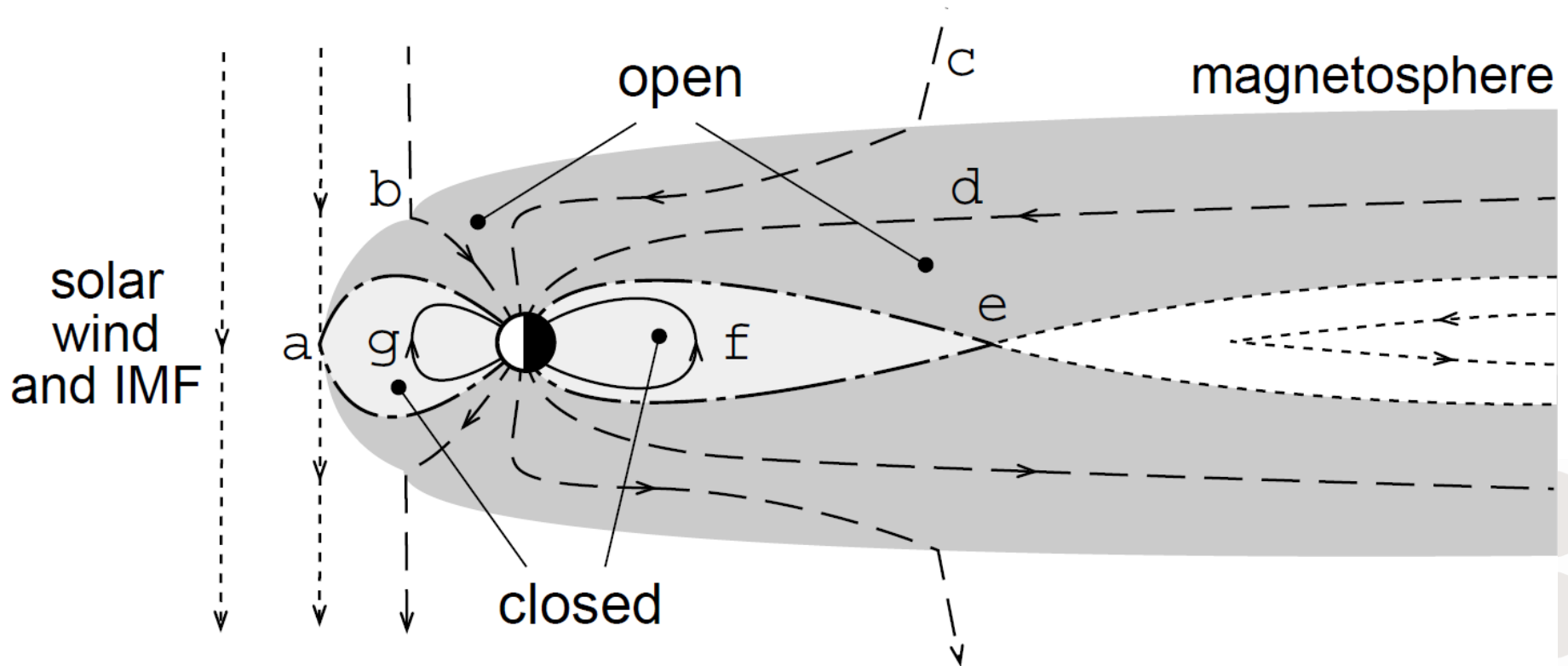
Ionospheric densities and composition



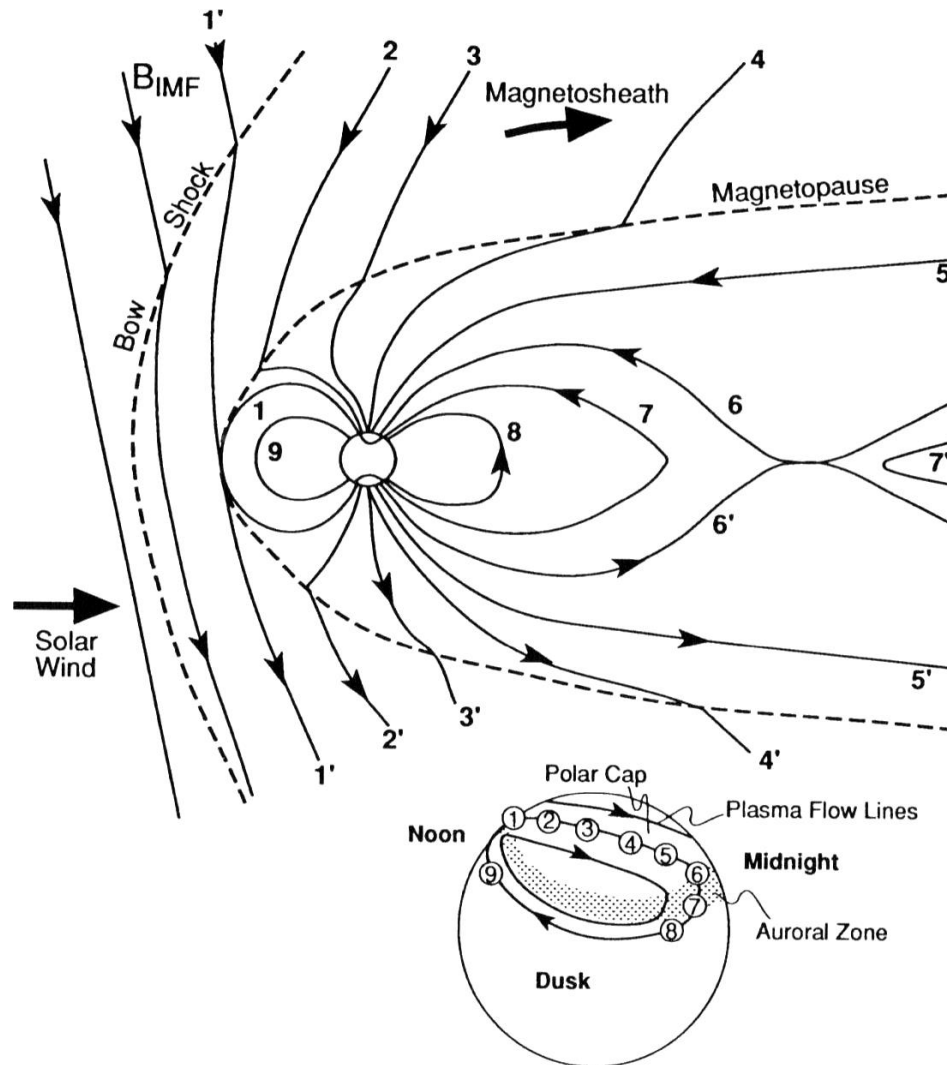
Atmospheric temperature profile



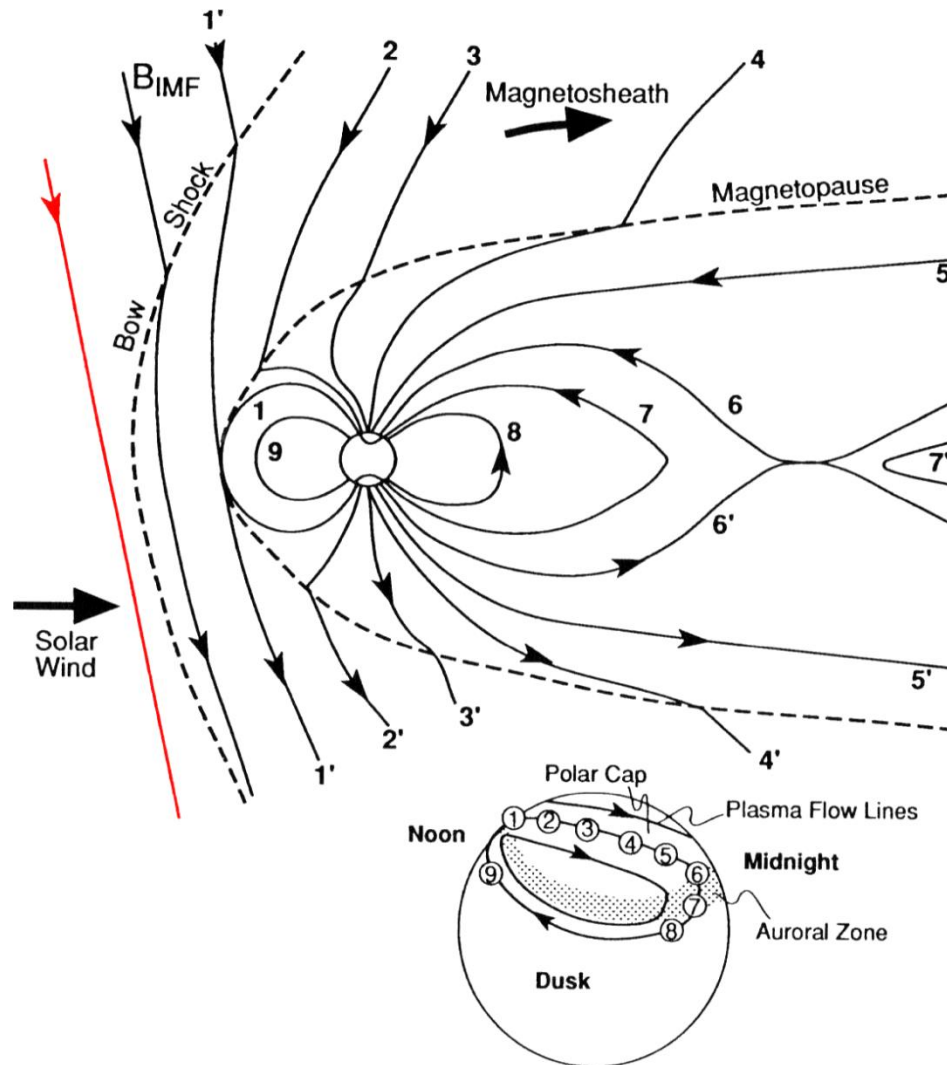
The magnetosphere



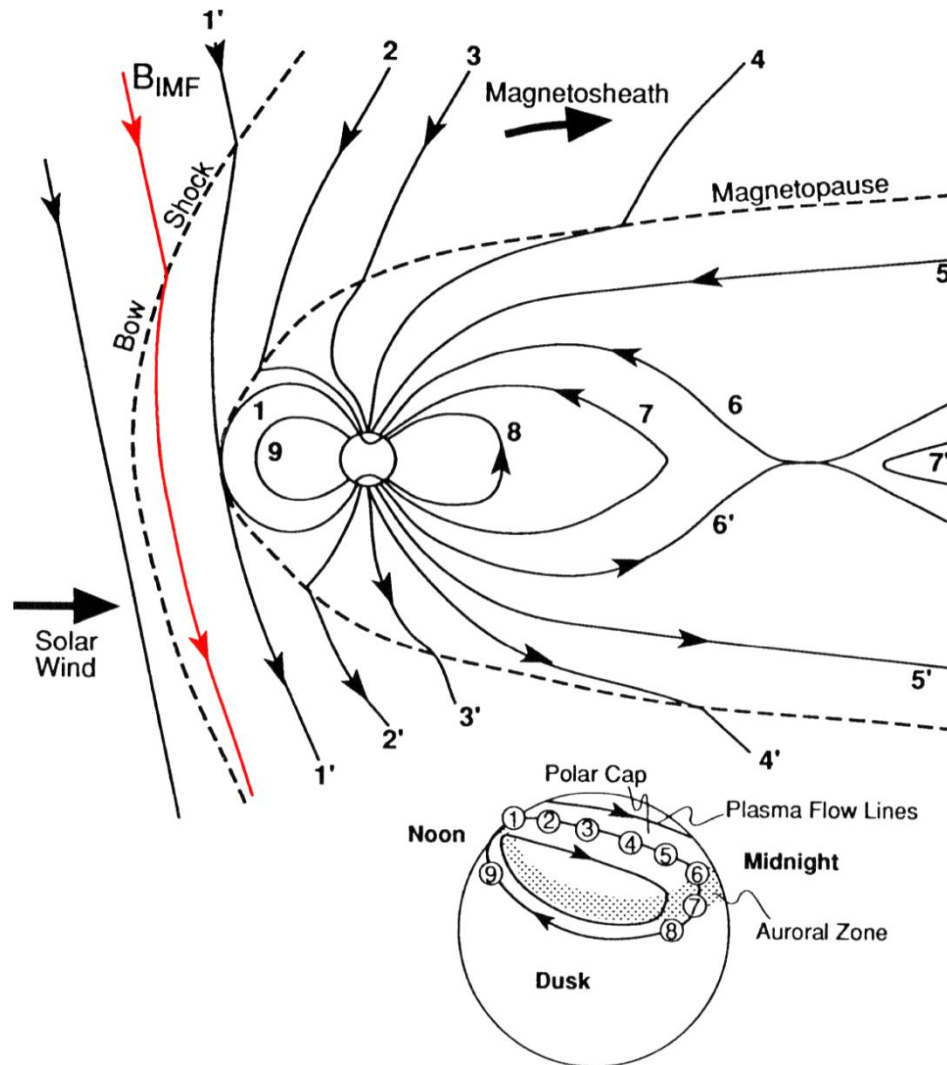
Dungey cycle



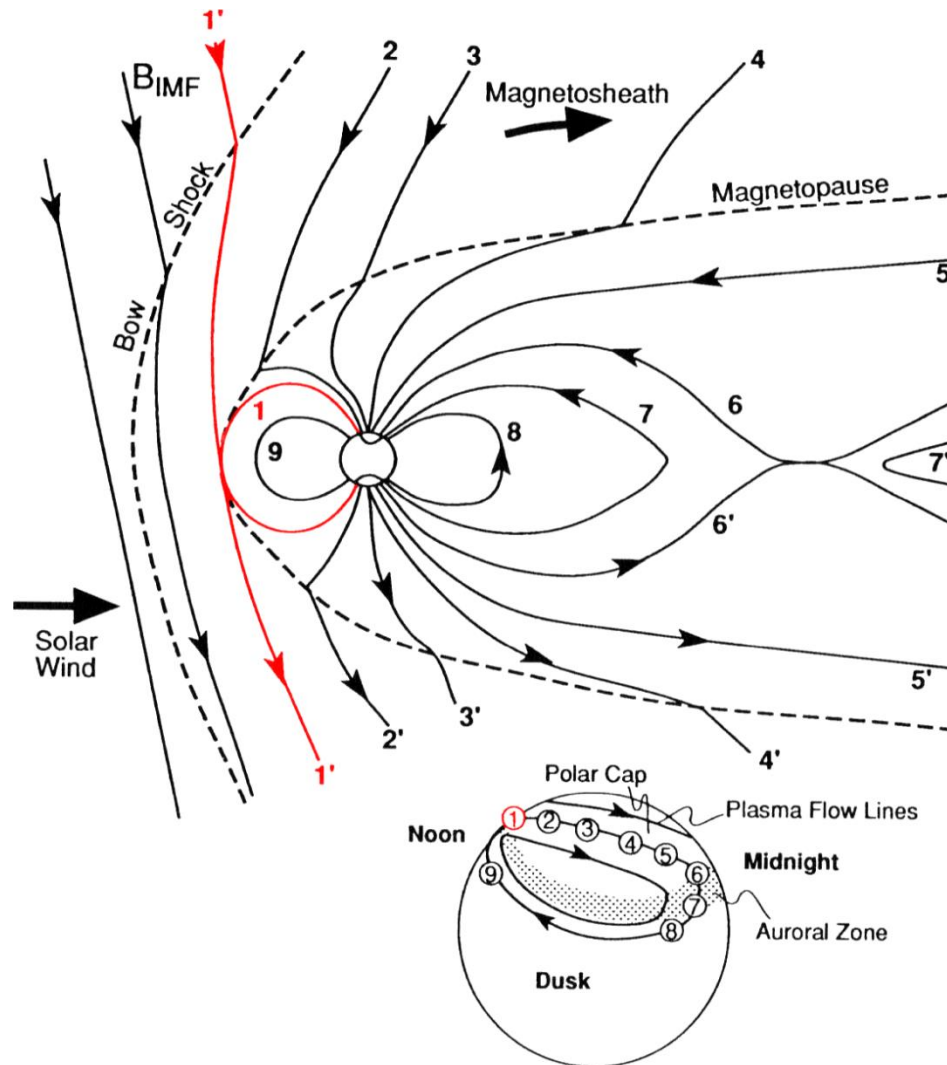
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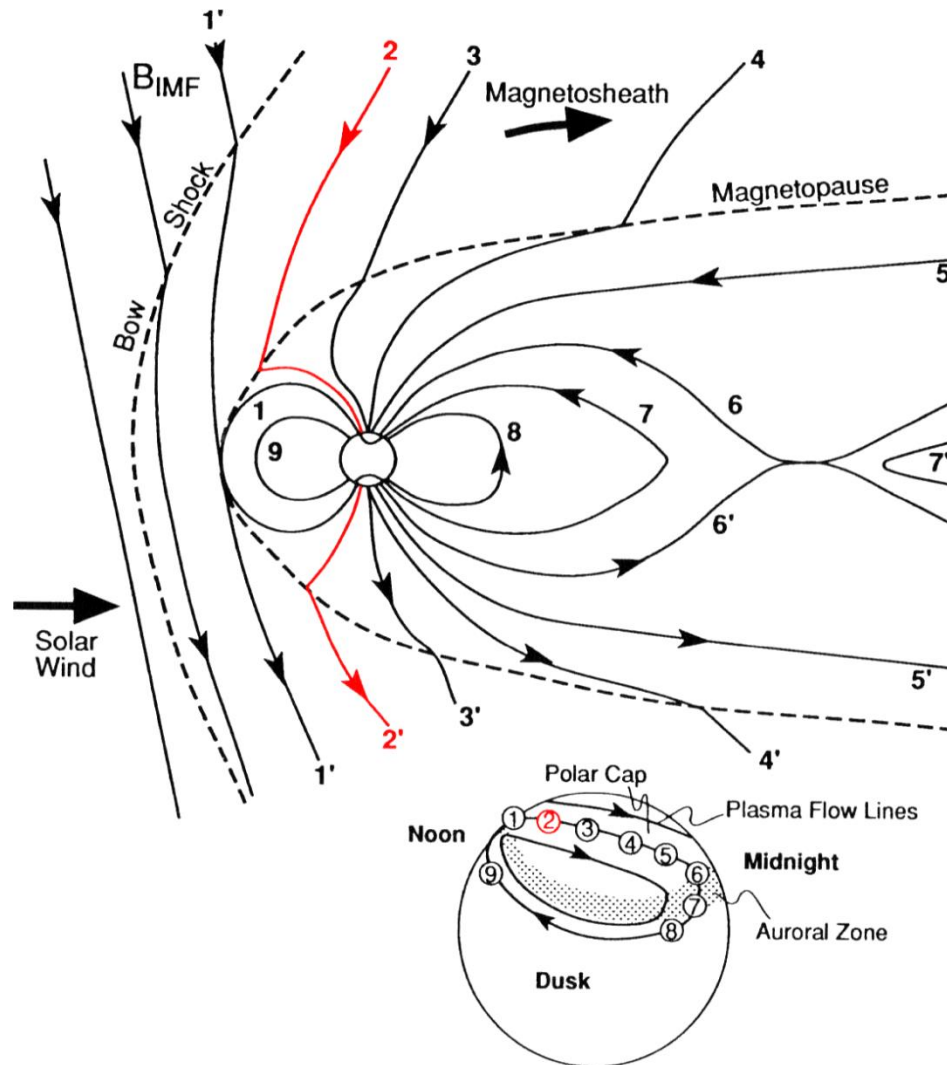
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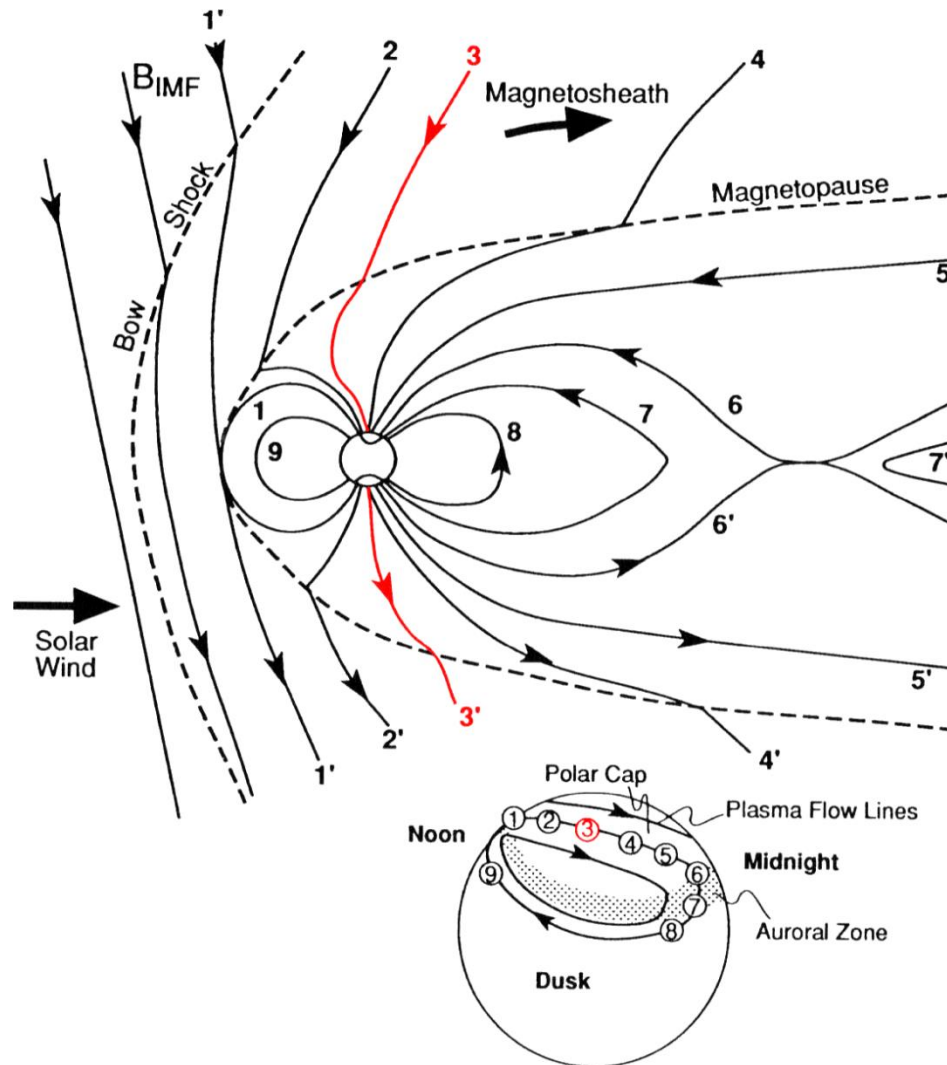
Dungey cycle



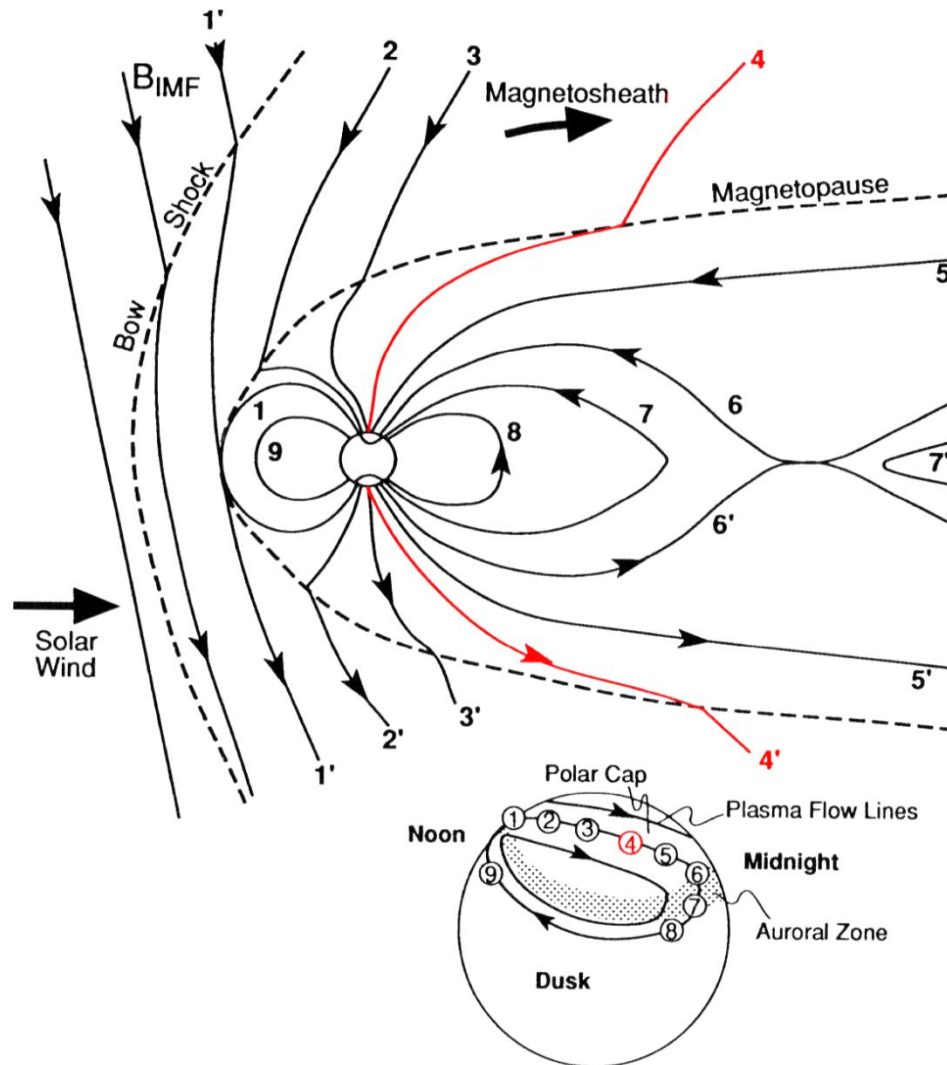
Dungey cycle



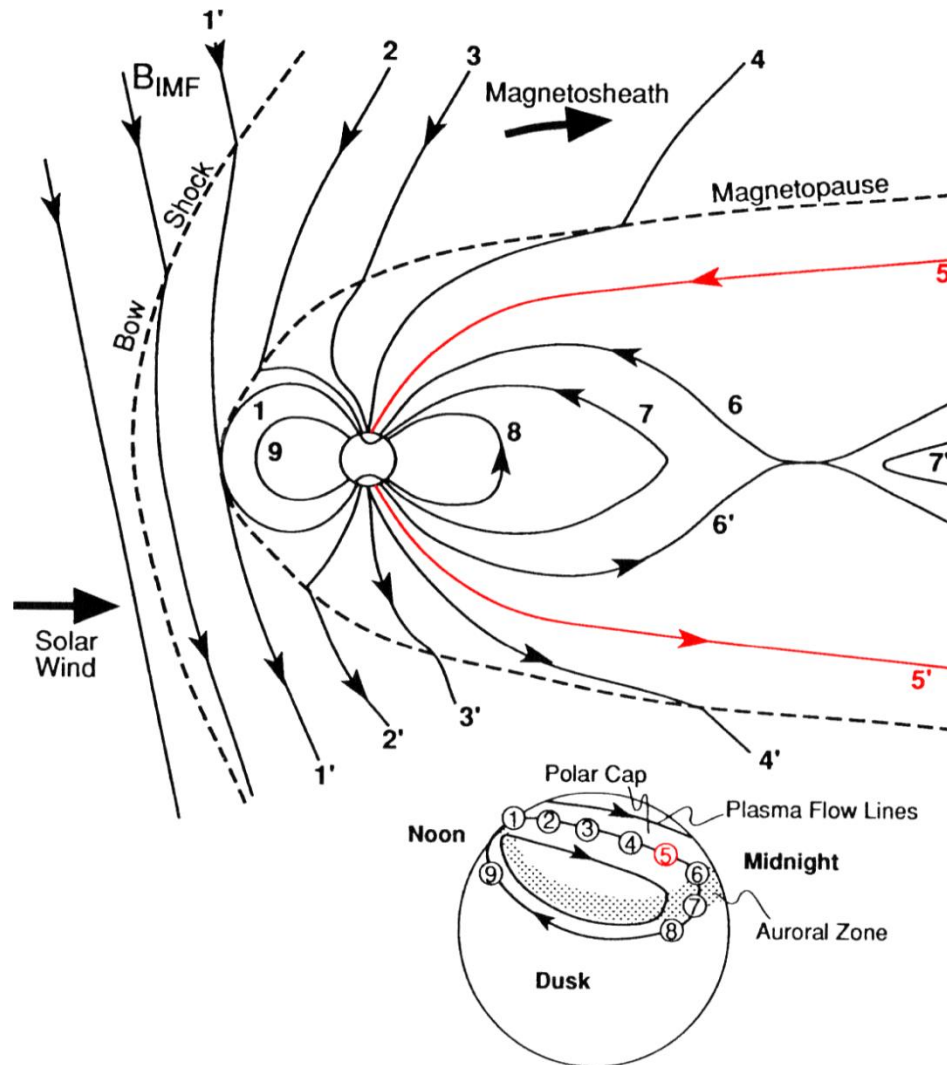
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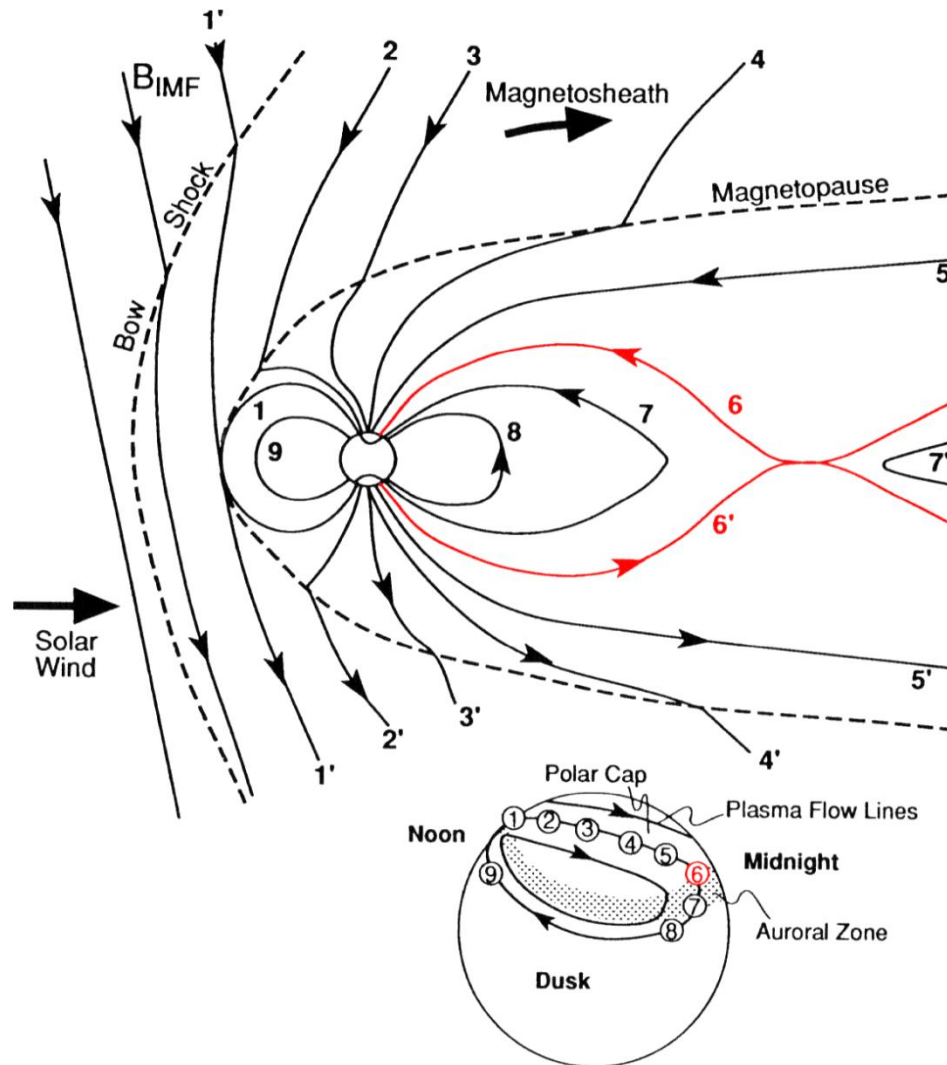
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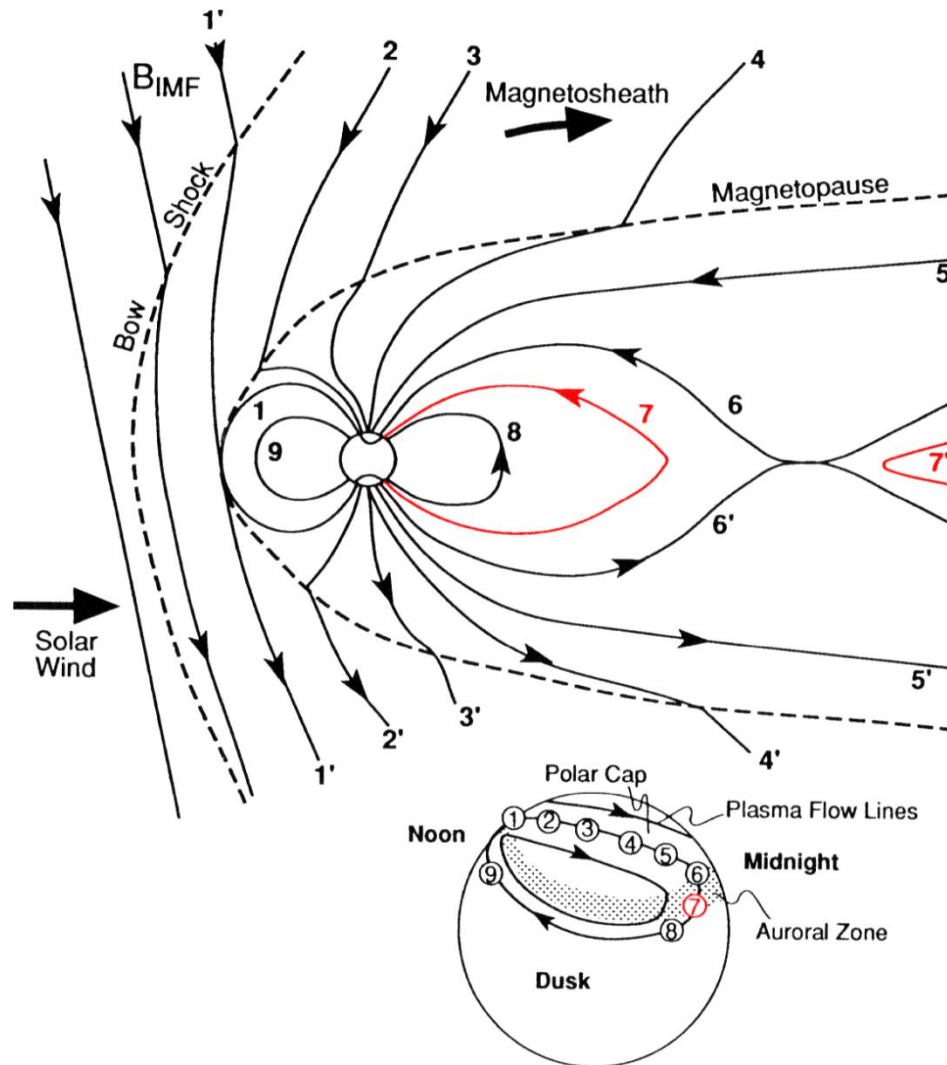
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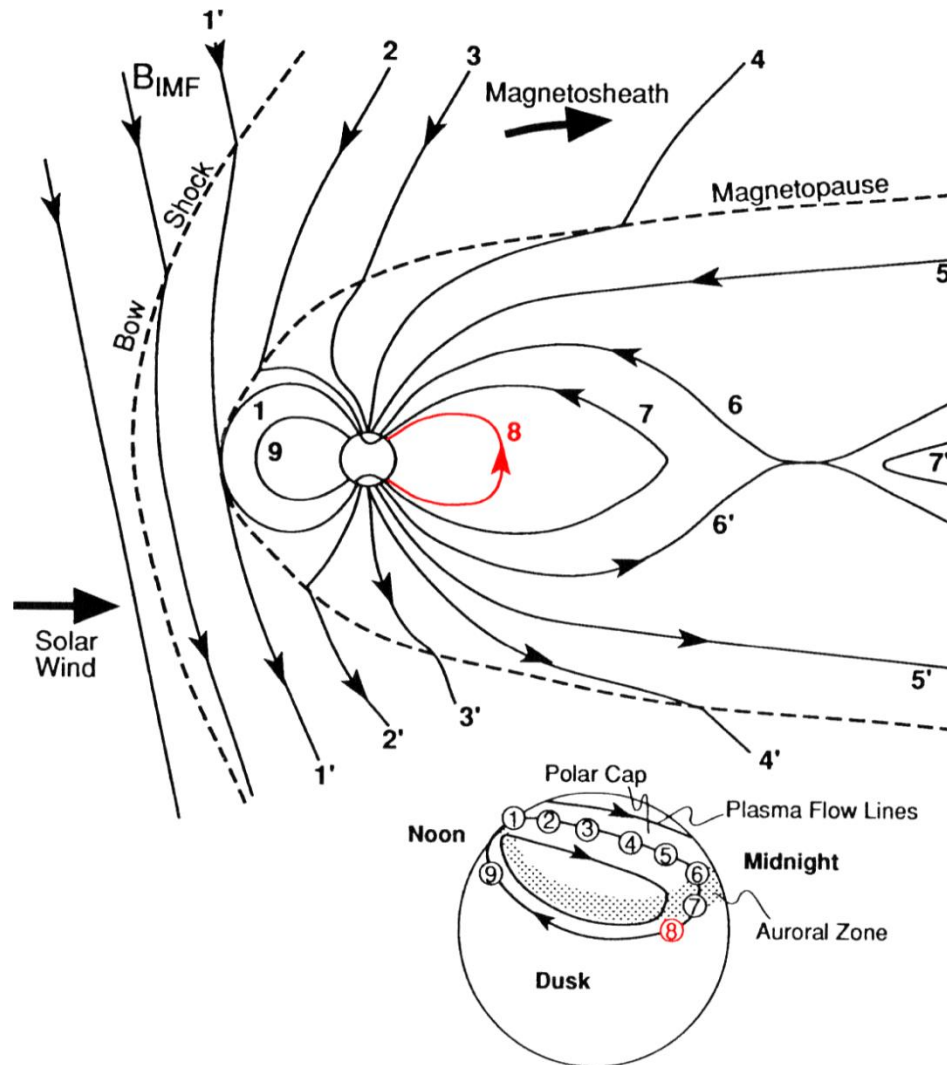
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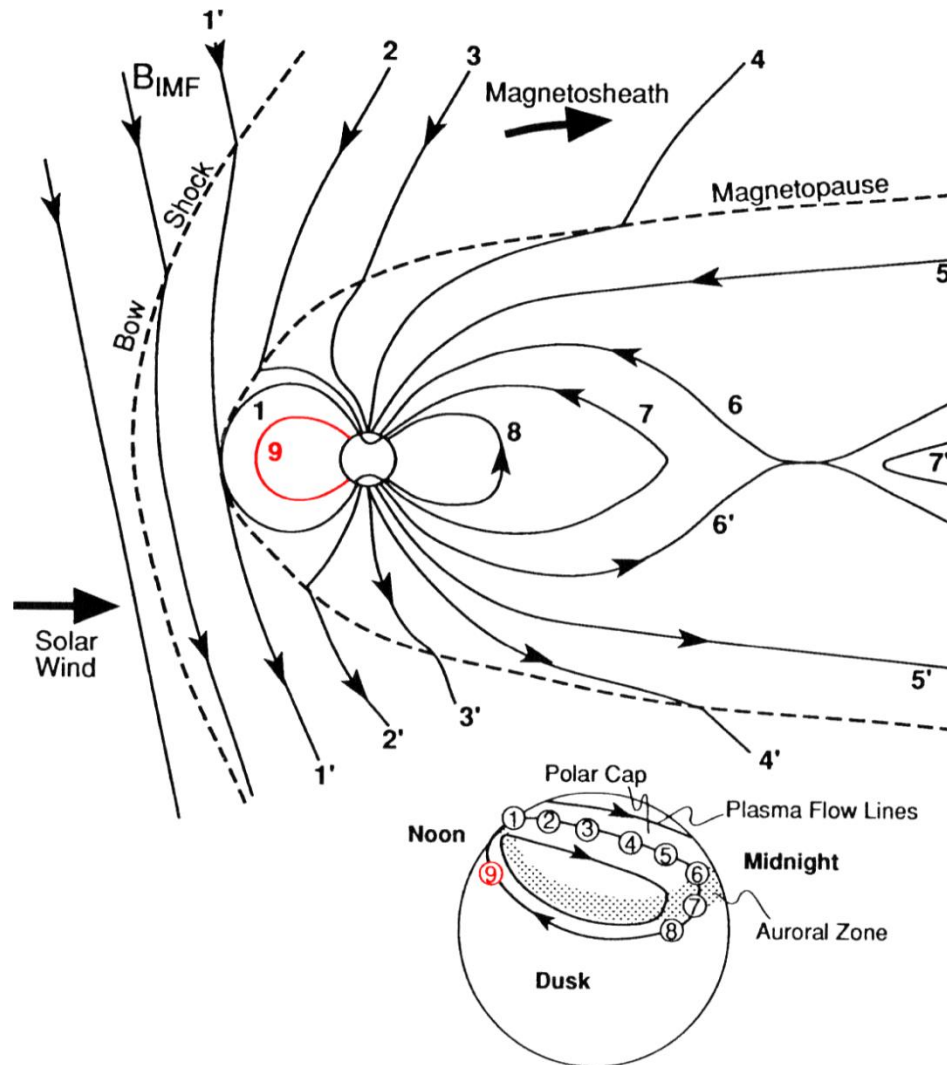
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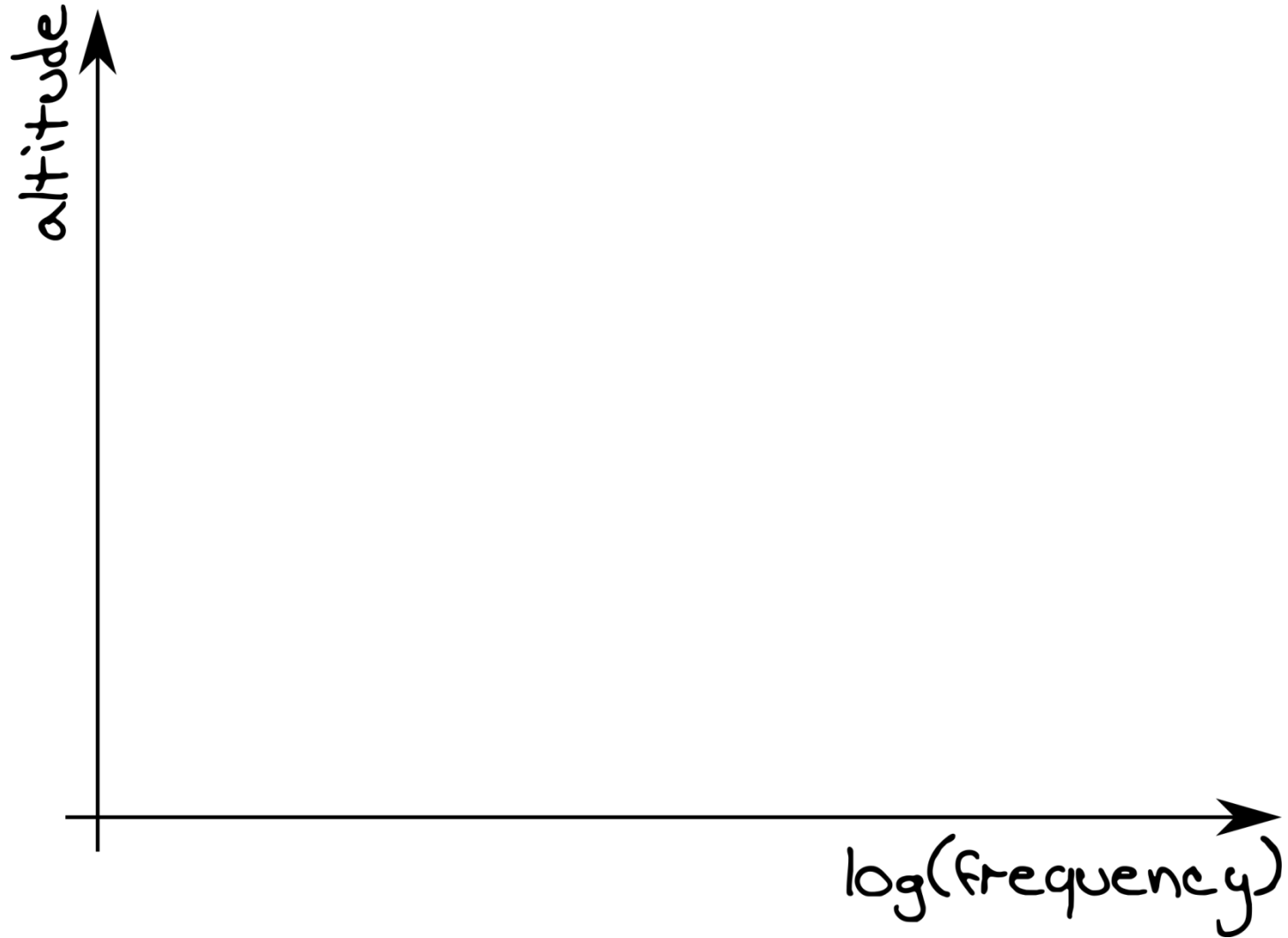
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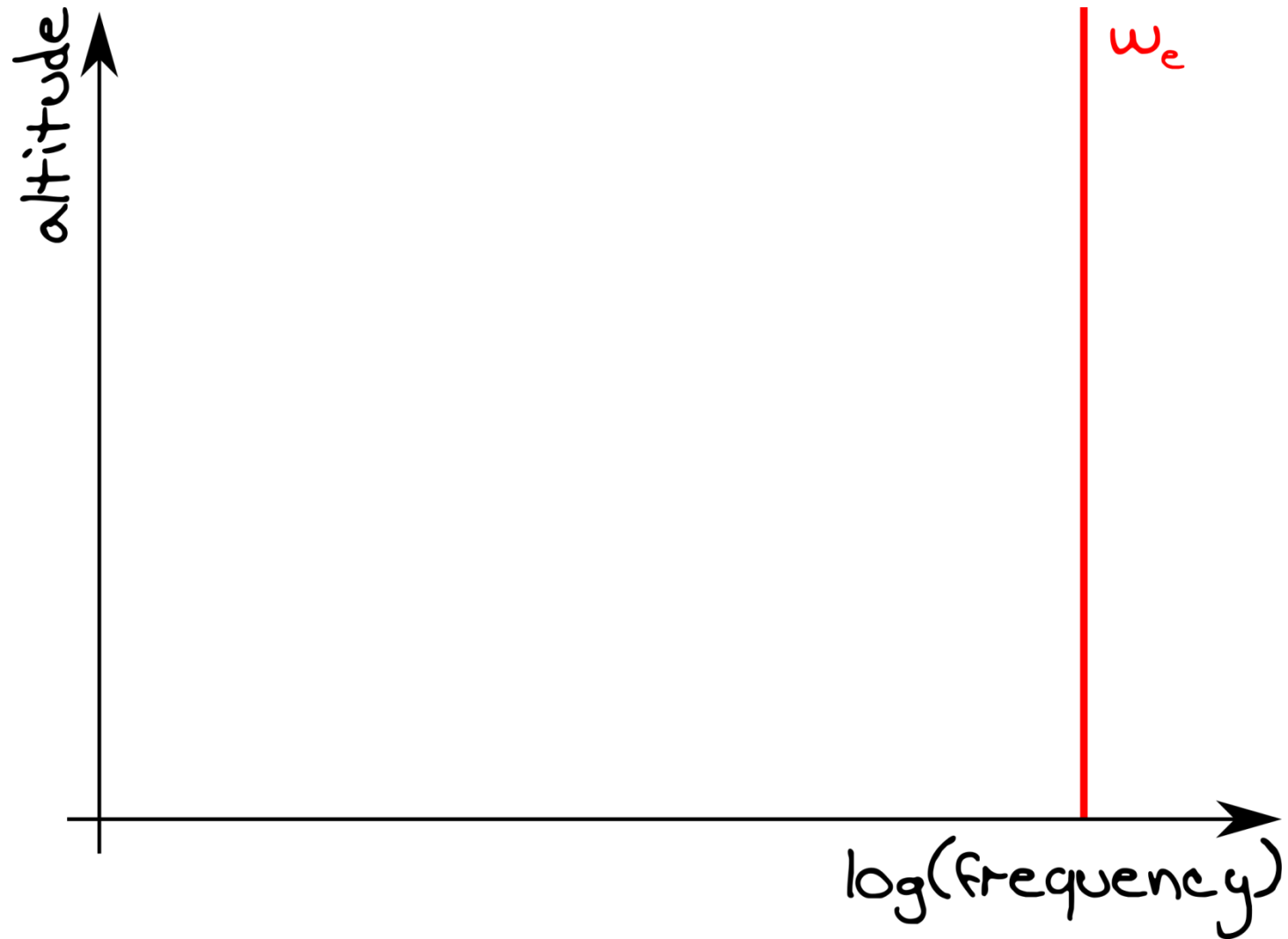
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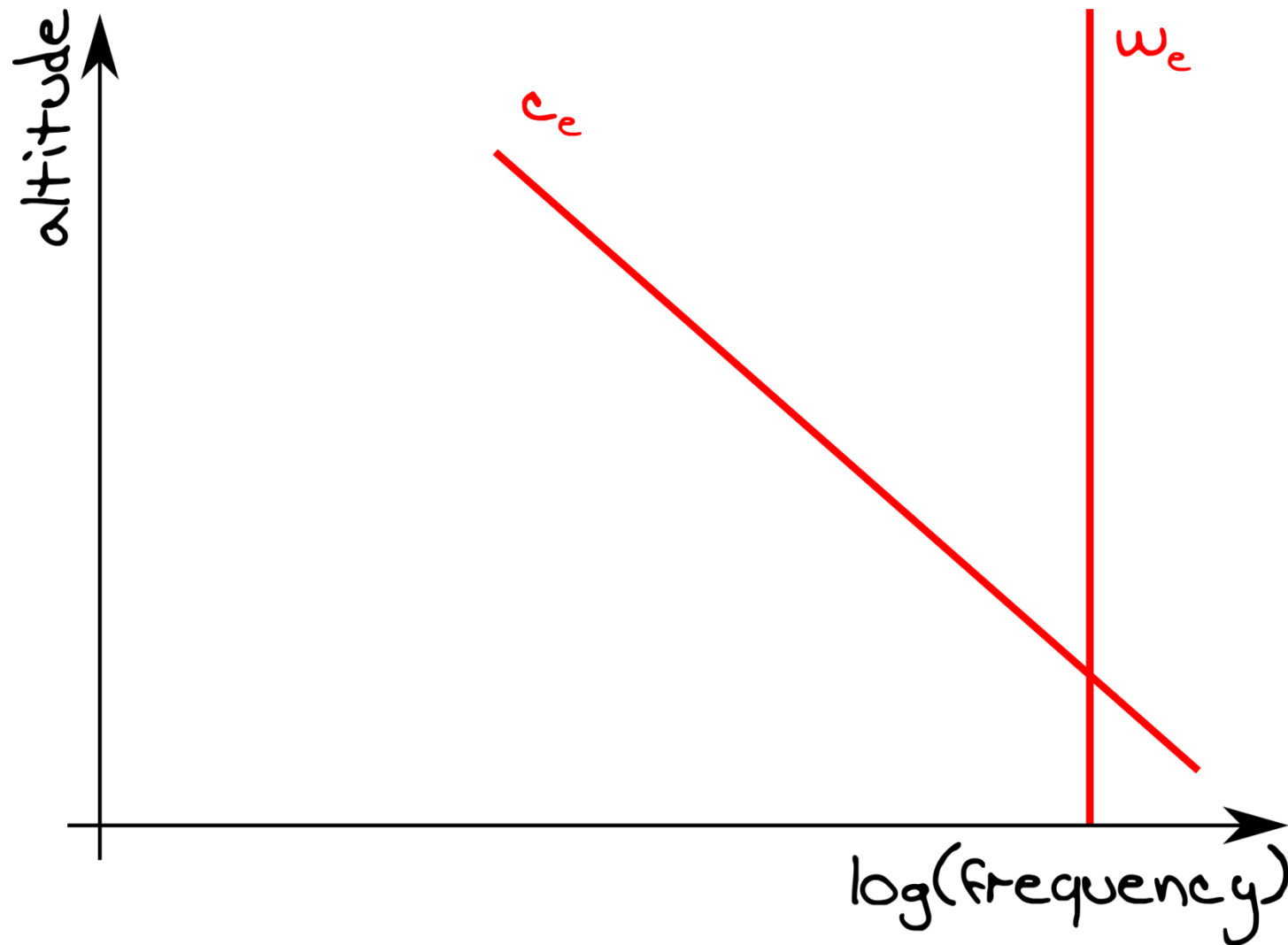
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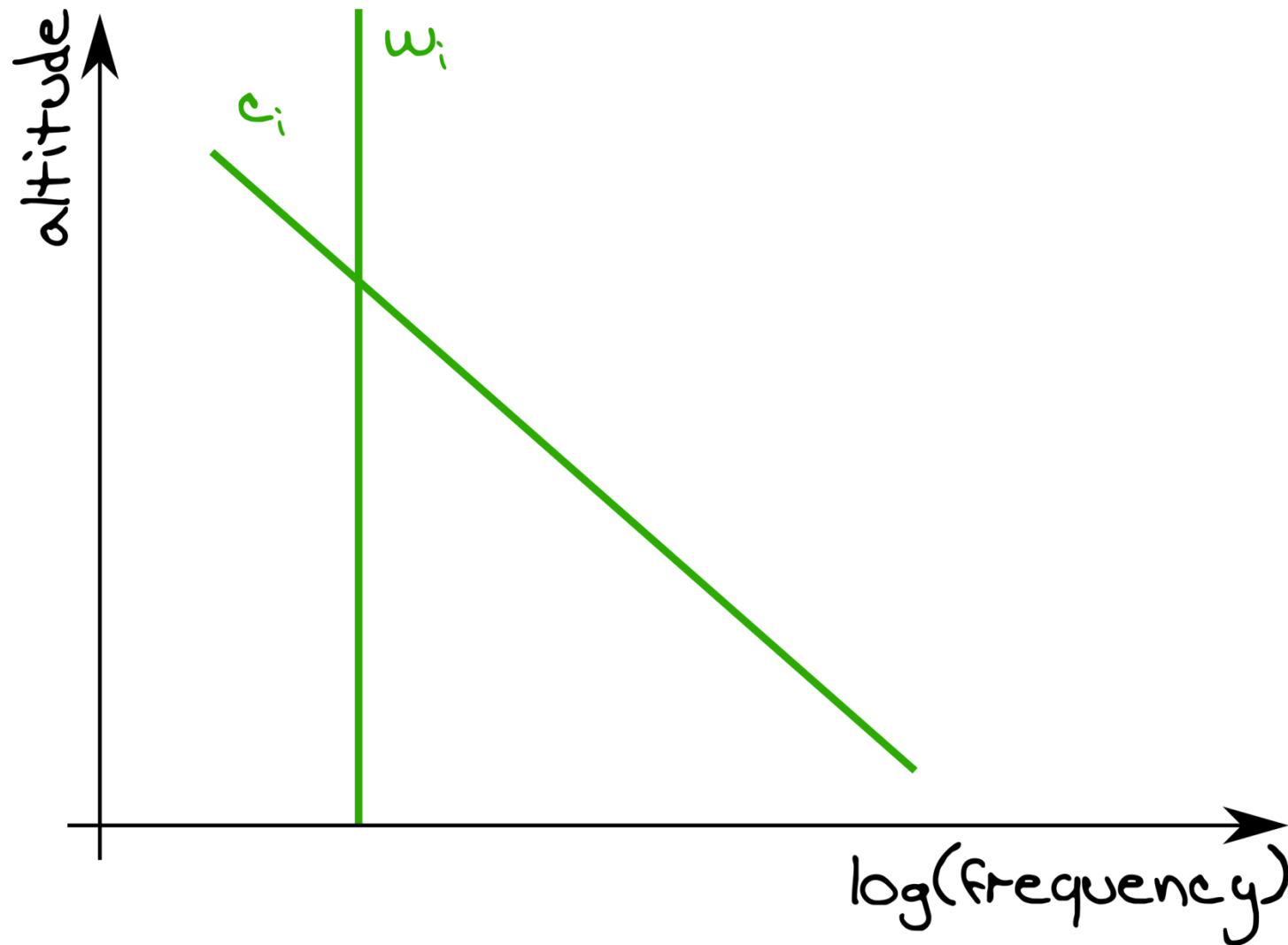
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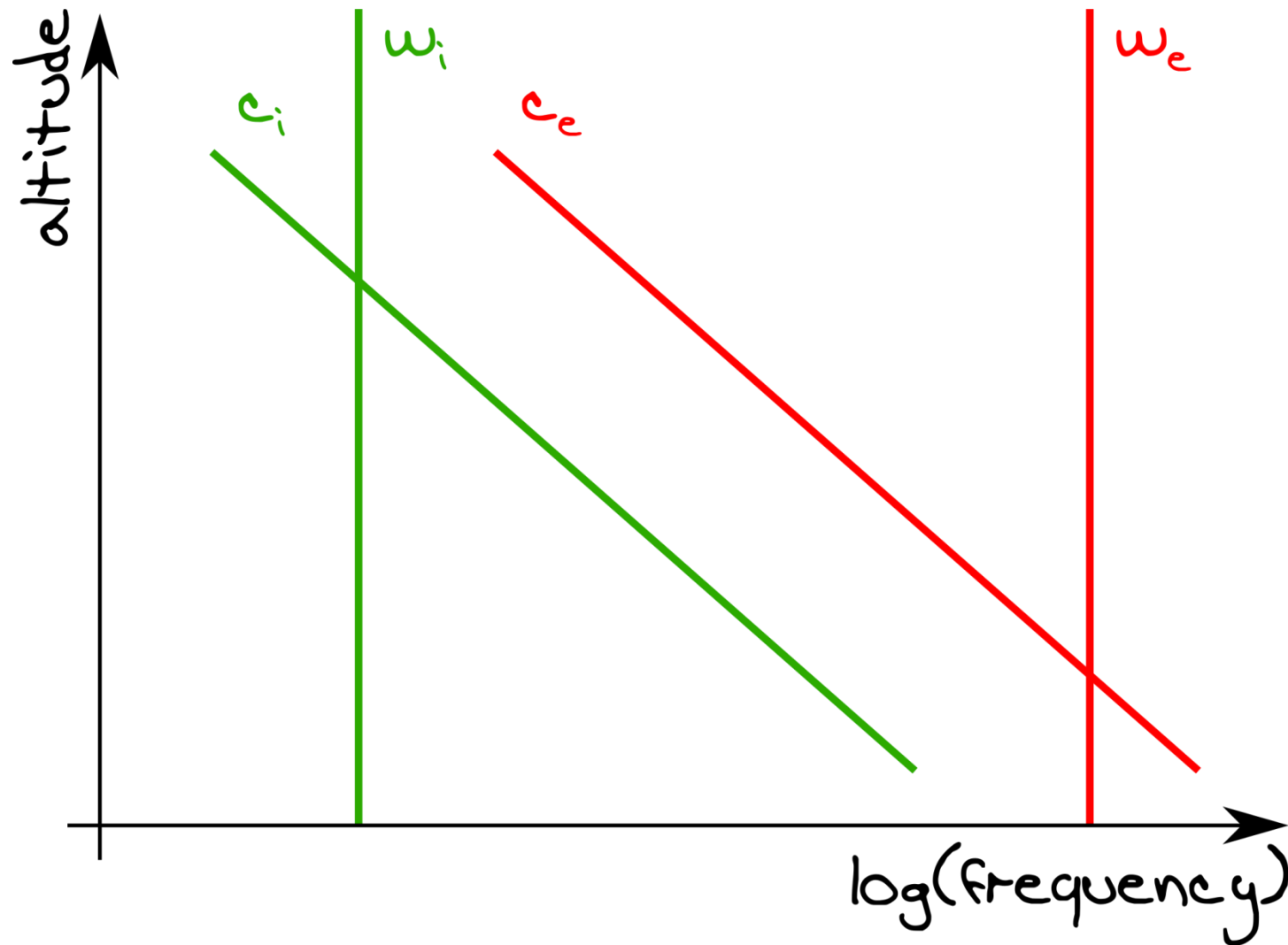
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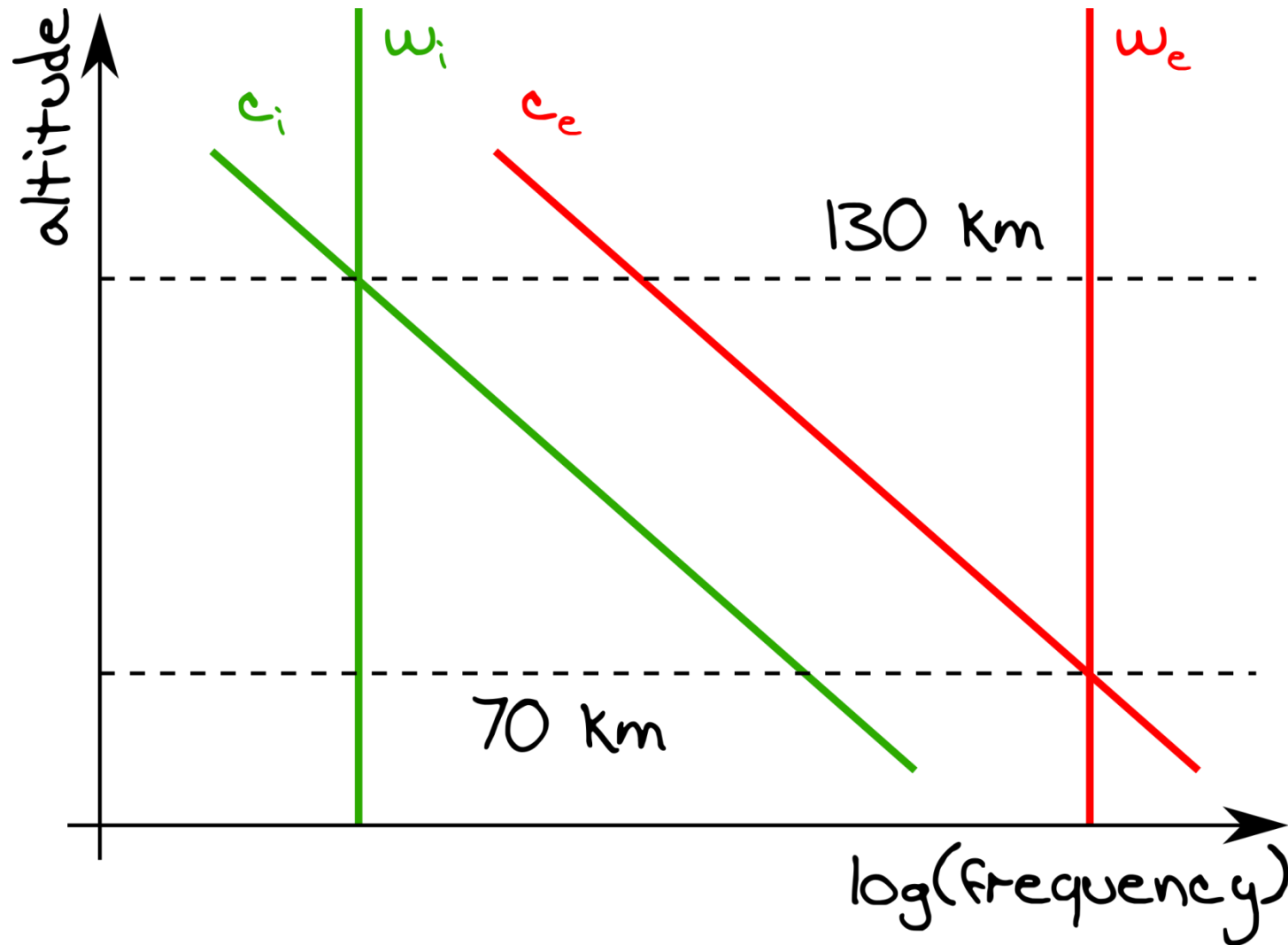
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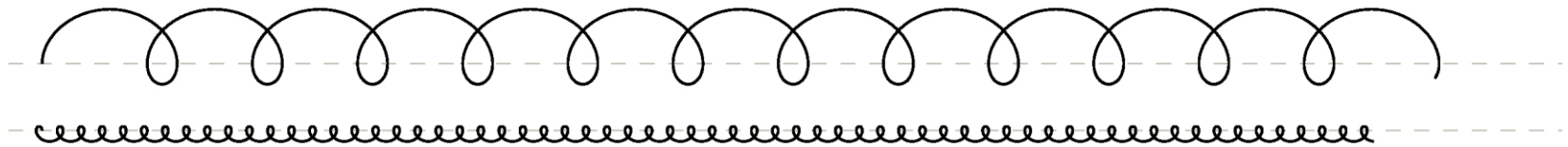
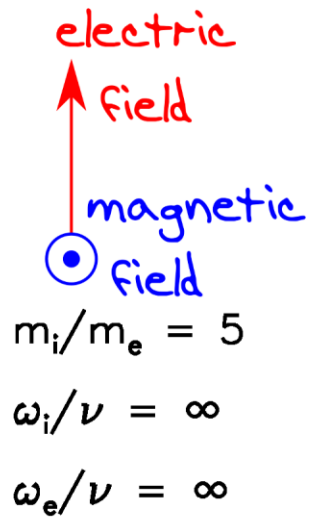
Dynamo layer



Dynamo layer



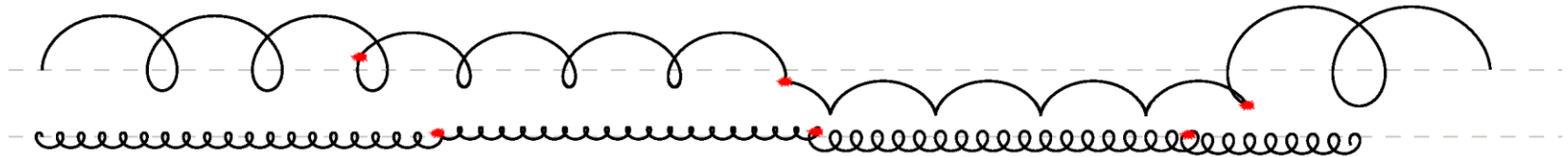
Collision vs gyro frequency



Collision vs gyro frequency

electric
field
↑
magnetic
field
⊙

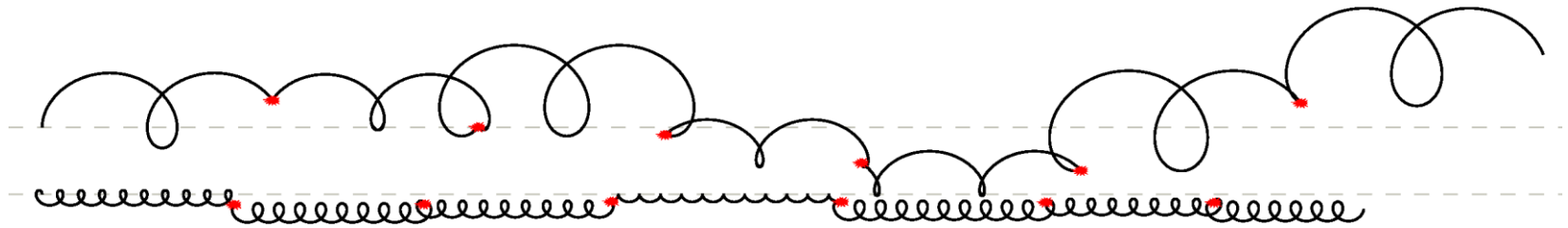
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 $\omega_i/\nu = 3.00$
 $\omega_e/\nu = 15.00$



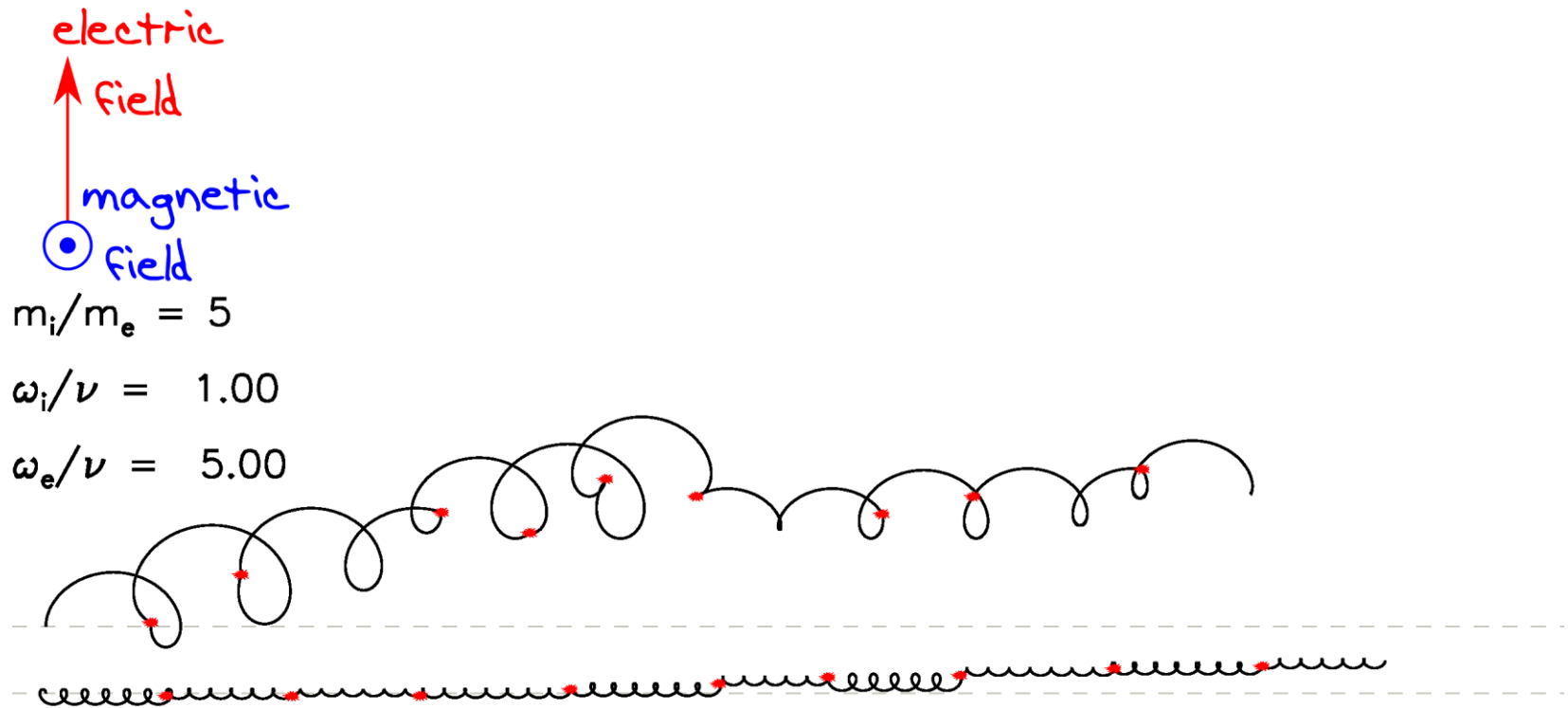
Collision vs gyro frequency

electric
field
↑
magnetic
field
⊙

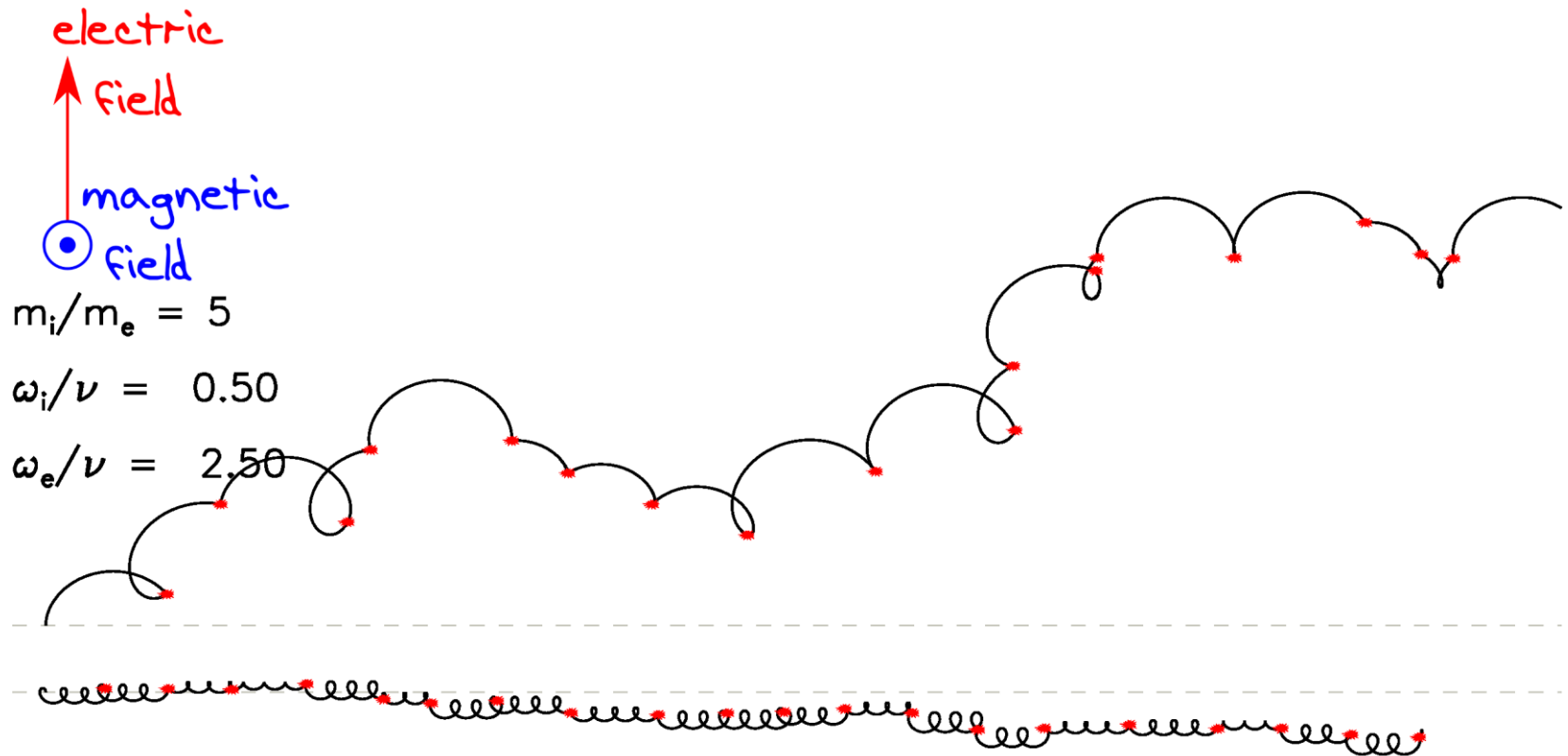
$m_i/m_e = 5$
 $\omega_i/\nu = 1.50$
 $\omega_e/\nu = 7.50$



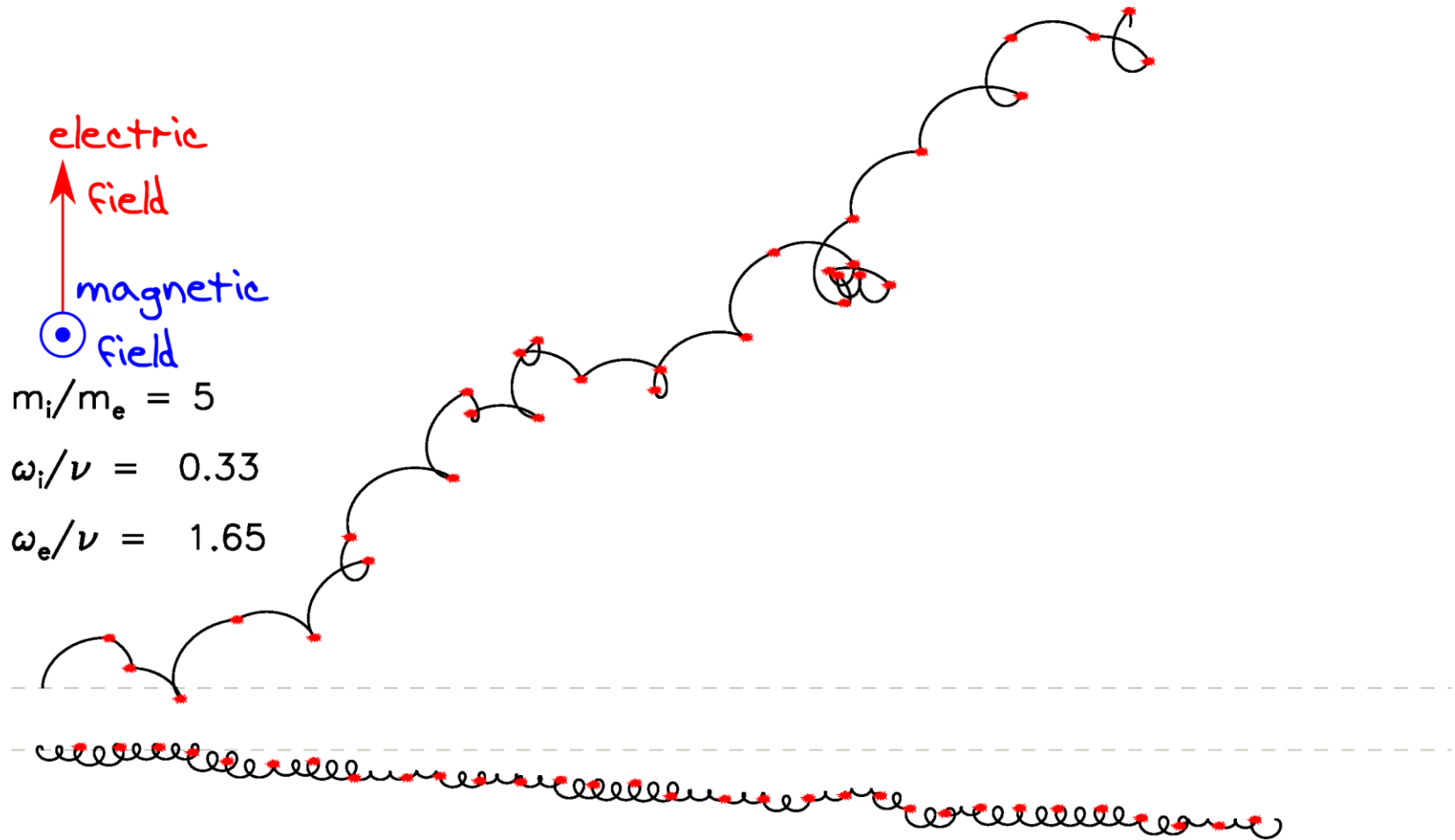
Collision vs gyro frequency



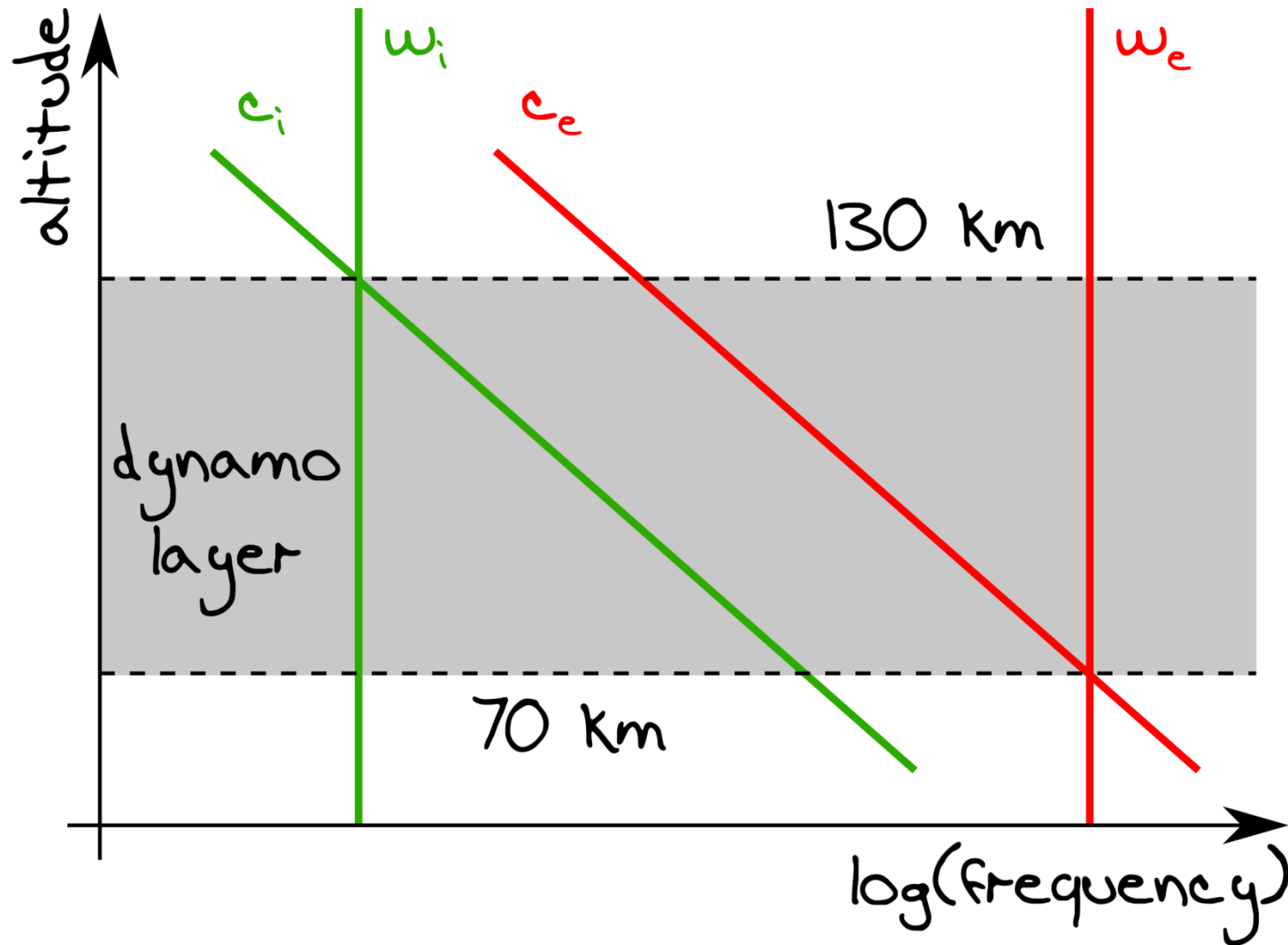
Collision vs gyro frequency



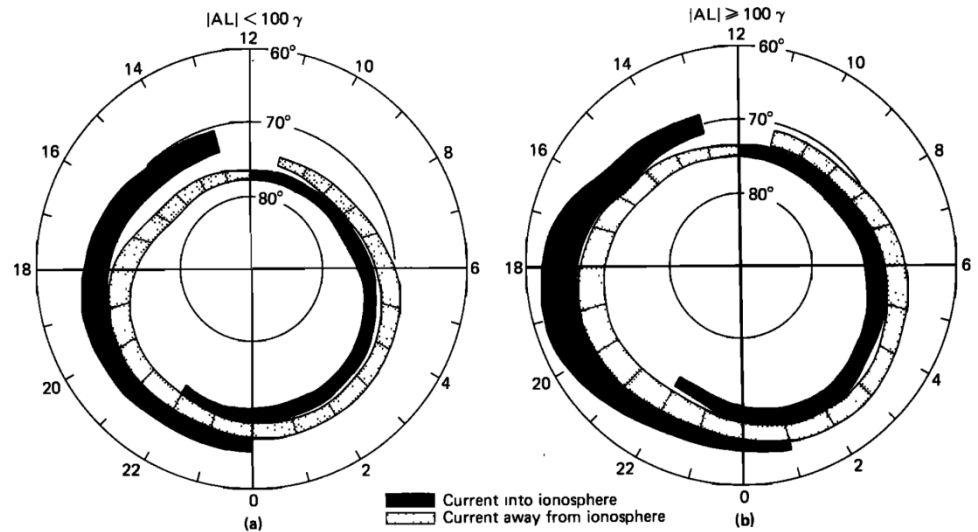
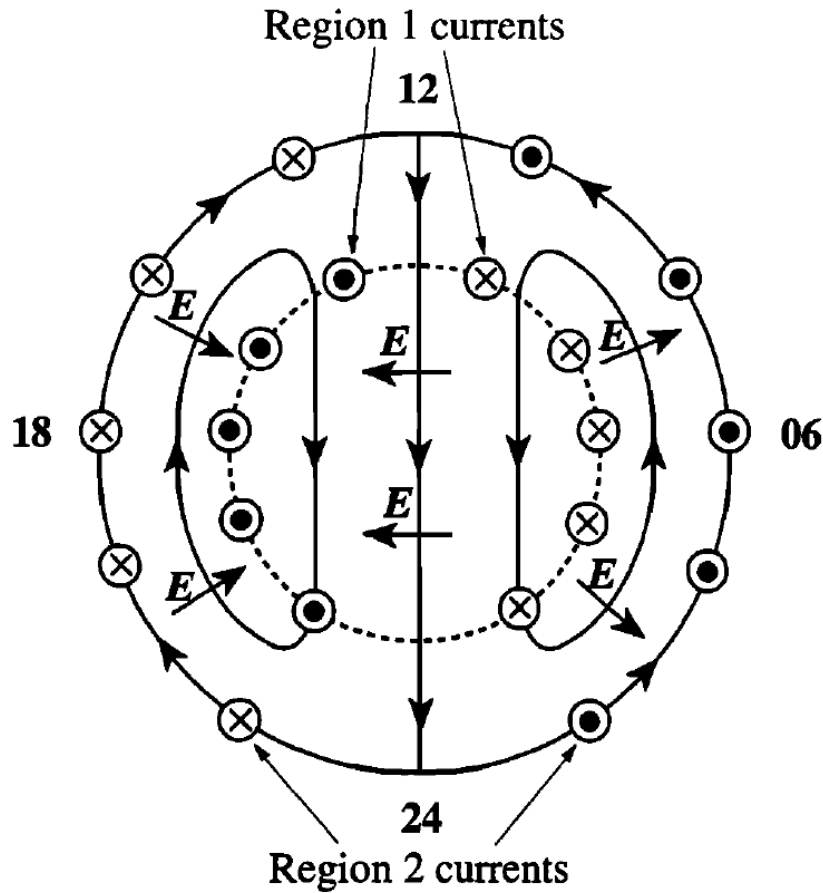
Collision vs gyro frequency



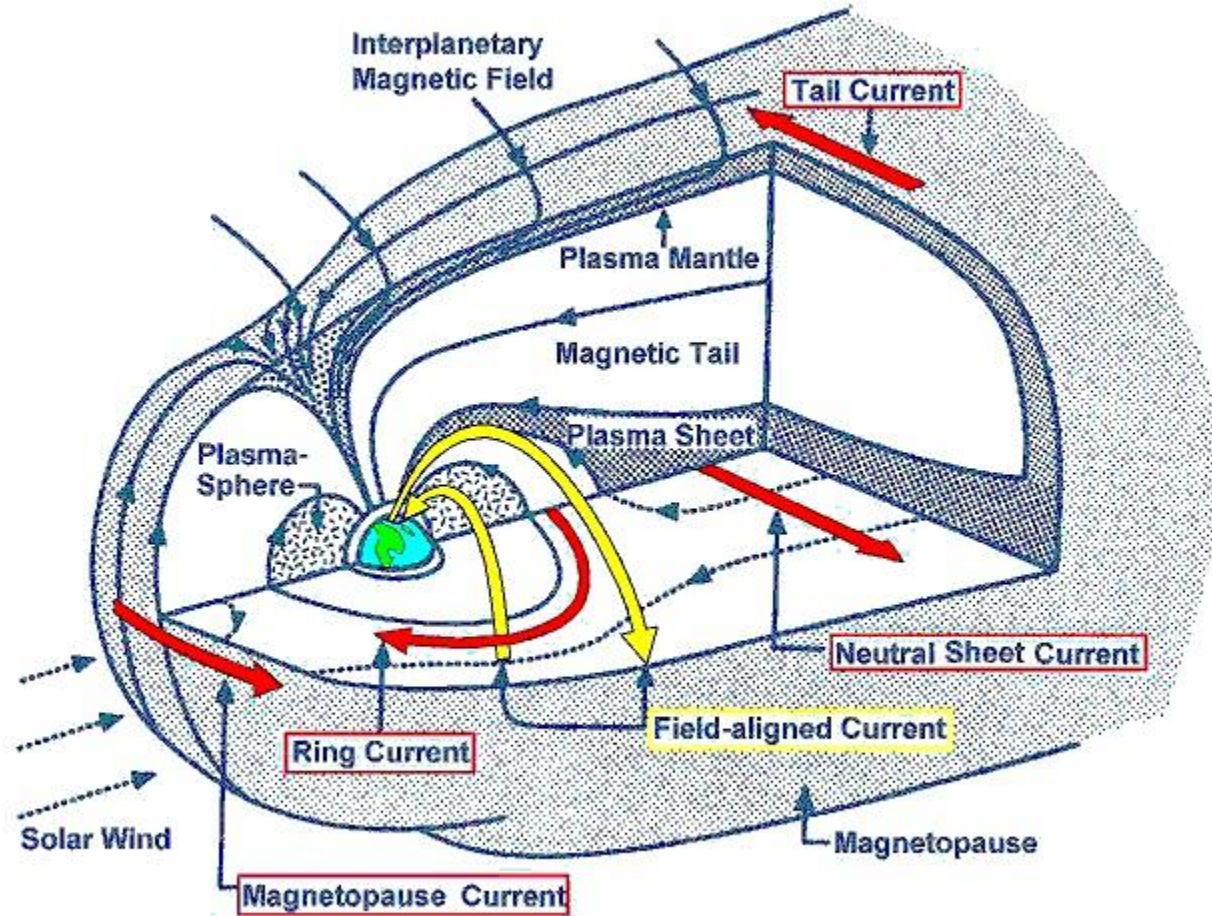
Dynamo layer



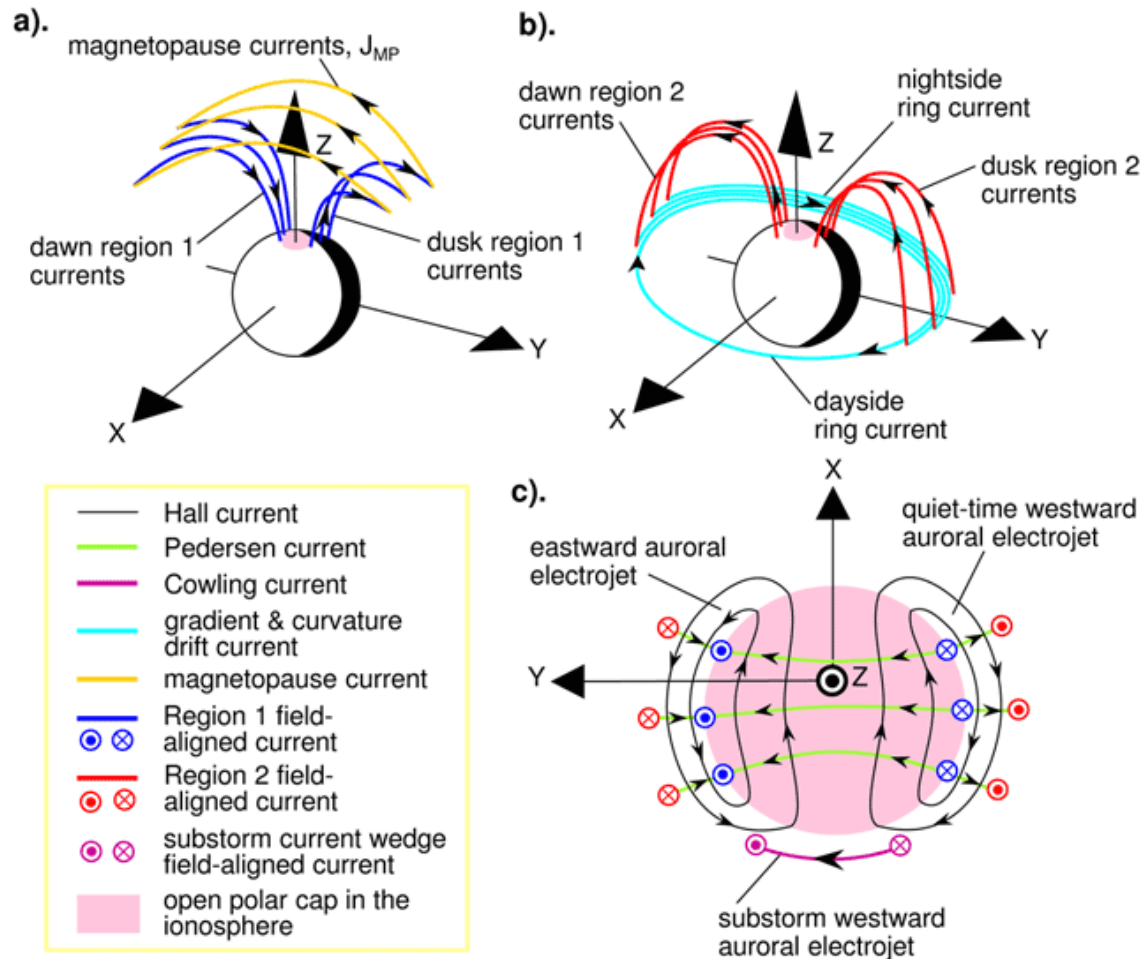
Polar convection & FACs



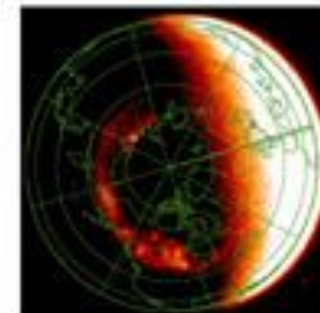
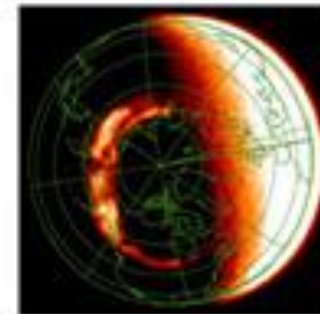
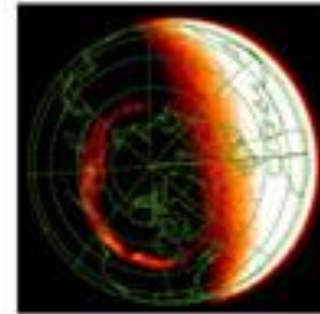
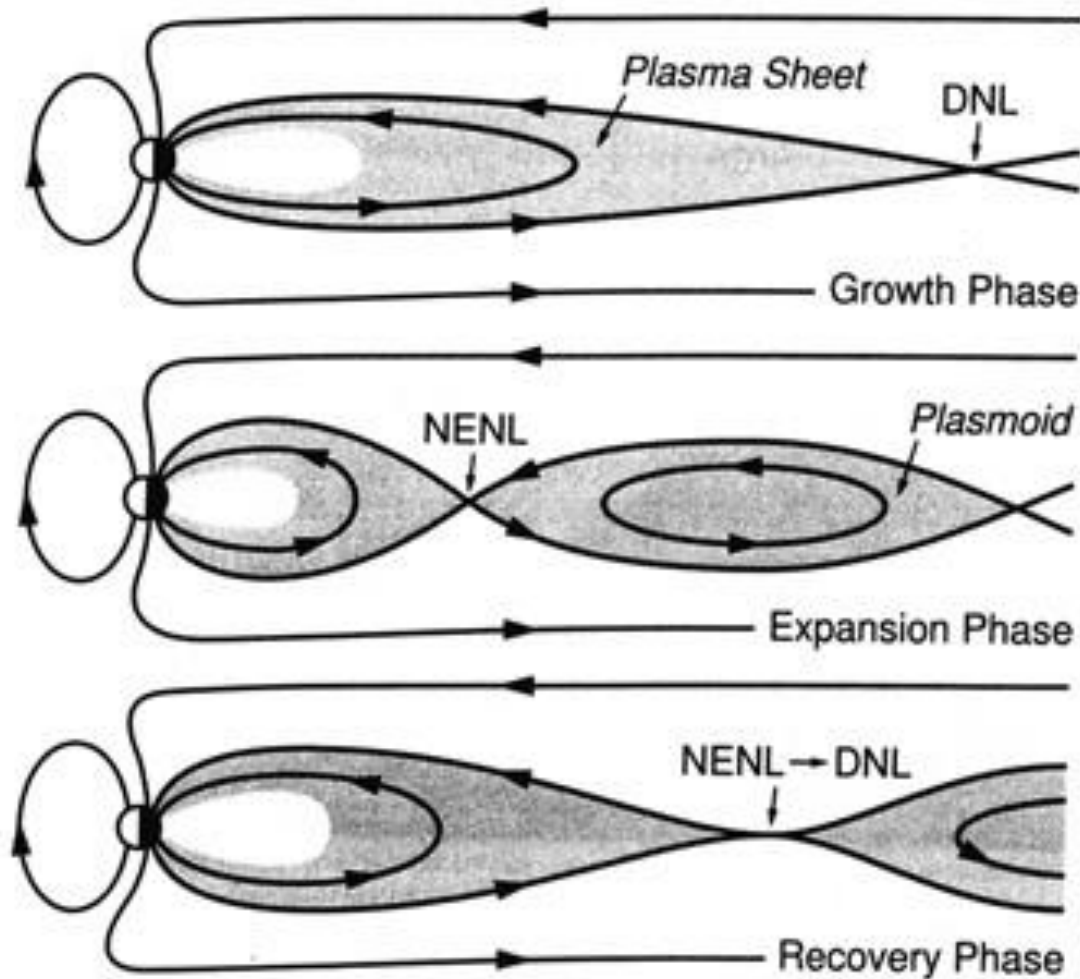
Current closure



Magnetospheric current loops



Substorm



Substorm

