Topics for the First Midterm Exam
General Terminology

- Familiarity with terms like
  - Solar wind
  - Heliosphere
  - Magnetosphere
  - Ionosphere
  - Thermosphere
  - Aurora

- SI units
  - 1 AU – Distance from Sun to Earth – 1.5x10^8 km
  - 1 R_E – Radius of the Earth – 6371 km

- Familiarity with scientific notation
Solar Physics

• Energy of a photon $E=hf$
• Black body radiation
  – Wein’s law $\lambda_{\text{peak}} T = 2.898 \times 10^{-3} \, mK$
  – Black body curve $R = \sigma T^4$
• Solar structure
  – Core and the reaction that powers the Sun
  – Einstein equation $E=mc^2$
  – Radiative zone
  – Convection zone
  – Photosphere
  – Chromosphere
  – Corona
  – Solar wind
• If you need to know the value of a parameter I will give it to you.
Solar Physics Continued

• What are conduction, convection and radiation?
• Phenomena we can see
  – Granules
  – Supergranualation
  – Sunspots
  – Prominences
  – Coronal holes
• The solar cycle (11 year and 22 year)
  – Observed changes during the solar cycle (in sunspots, soft x-rays).
  – Changes in the magnetic field
  – Butterfly diagram
• Differential rotation
Solar Physics Continued

• Frozen in flux
  – What is the concept of frozen in flux
    \[ \vec{V} = \frac{\vec{E} \times \vec{B}}{B^2} \]
  – Application of frozen in flux to sunspots

• Magnetic pressure and thermal pressure
  \[ p = nkT \]
  \[ p_B = \frac{B^2}{2\mu_0} \]
Solar Dynamics

- Solar flares
- Coronal mass ejections
Heliosphere

• The solar wind
• Why is there a solar wind?
  – The Parker model - qualitatively only
  – Concept of pressure gradient \( \vec{F} = -\nabla P \)
• Evolution of solar wind with radius
• The interplanetary magnetic field
  – Heuristic model of the IMF
  – Equation for Archmedian spiral – \( r = v_{sw} \frac{\varphi - \varphi_0}{\omega_{Sun}} + r_0 \)
  – Explanation for sector structure
  – Effect of current sheet – Magnetic field from a current carrying wire.
• Latitudinal dependence of solar wind
Heliosphere Continued

- Corotating interaction regions (CIRs)
- Changes in the current sheet between solar maximum and minimum
- Configuration of CMEs (magnetic clouds) in space
- Cosmic rays