Physics/Astro 562/ Peterson: Problem Set #1
Due: Tuesday, 1/30
High Energy Astrophysics

Read Chapter 1 and 11

1) **Radiation**: Make a table having a row for each of the electromagnetic wavebands (radio, sub-mm, IR, Optical, UV, X-ray, and Gamma ray). Then add columns describing: 1) whether light from those wavebands can be detected from the ground or space, 2) what technology is used to detect this radiation, and 3) what complications there are in doing astronomy from this waveband.

2) **Relativity**: Cosmic rays that hit the Earth's atmosphere produce muons as secondary particles (rest mass mc^2 of 105 MeV). They are produced typically at a height of 6 km and have a lifetime of 2200 ns before they decay into electrons and neutrinos. How is it possible that they are detected on the ground? Give a lower limit on their energy. (See Appendix for help).

3) **Plasmas**: What is the Debye length for the plasma in the intracluster medium ($kT = 10^8 K$, $n = 10^{-3}\mathrm{cm}^{-3}$)? What is the Debye length for the plasma in the solar coronae ($kT = 10^7 K$, $n = 10^{15}\mathrm{cm}^{-3}$)? How about a molecular cloud ($kT = 10K$, $n = 10^7\mathrm{cm}^{-3}$)?

4) **Observing Photons:** The light from a faint star has an energy flux of 10^{-7} ergs cm^{-2} s^{-1}. Assuming that the light has a wavelength of 5×10^{-5} cm estimate the number of photons from this star that enter a human eye in one second.