FYS 3610

Exercise Week 36 due 10. September 2015

Questions as they might appear in the mid-term and/or oral exam

When talking about magnetic reconnection, people often mention "anomalous resistivity". Why?

Describe the different layers of the Sun.

What are sunspots, how do they form and why are they important?

Exercises

1) On a hot, cloudless day in Oslo during the summer, a black cooking plate of 19 cm diameter placed in the Sun assumes a temperature of about 60°C. The same is achieved by feeding 27W of electric power to the plate.
   a) What proportion α of the total solar irradiance I (about 1400 W/m²) is absorbed by the atmosphere?
   b) Assuming the upper atmosphere is in radiative balance with the Sun, i.e., it acts as a black body of temperature T radiating the absorbed power into space, what temperature does it assume?

2) The Planck Law gives the spectral energy density $u_\lambda(T)d\lambda$ in a wavelength interval $(\lambda, \lambda + d\lambda)$ of a black body with temperature T as

$$u_\lambda(T)d\lambda = \frac{8\pi hc}{\lambda^5}\frac{1}{\exp\left(\frac{hc}{\lambda k_B T}\right) - 1}d\lambda.$$

   a) Derive the expression for the spectral energy density $u_f(T)df$ dependent on frequency f. Further, derive $j_\lambda(T)d\lambda$ and $j_f(T)df$, i.e., the spectral energy densities per emitted photon as a function of wavelength and frequency.

b) Assuming the Sun is a black body at 6000K, derive the wavelength at which $u_\lambda(T)d\lambda$, $u_f(T)df$, $j_\lambda(T)d\lambda$, and $j_f(T)df$ assume their maximum. Discuss your results.

c) Chlorophyll the molecule that facilitates photosynthesis, the process that allows plants to absorb energy from light. For photosynthesis, Chlorophyll absorbs light around 660nm. Why?