Homework 06

Problem 1 (5 points)

Recreate plots depicted at figures 8.8 and 8.9. First, do it for the $P_e = 20$ N/m^2 (as in the book), second do it for the electronic pressure depicting the sun photosphere $n_e = 2 \times 10^{23}$ m^{-3}.

Problem 2 (5 points)

Assuming that the Earth has the albedo (reflection coefficient) of $\alpha = 0.36$, find the equilibrium temperature for the Earth.

Bonus Problem 3 (5 points)

Now, assume that we have a lot of green house gases, which do not let the radiation with wavelength higher than 1 μm escape the Earth. Find how high will be the equilibrium temperature to compensate via the allowed emission with wavelength below 1 μm. Here, we neglect the fact that the Earth atmosphere efficiently screens the short wavelength radiation in UV and below. Why do we neglect this fact?

You will have to do some numerical integrals involving the black body radiation spectrum.

Problem 4 (5 points)

Ratio of probabilities to occupy high energy level with respect to the ground level (n=1) for Hydrogen atom is given by the Boltzmann distribution.

$$\frac{p(n)}{p(1)} = \frac{g(n)}{g(1)} \frac{\exp\left(-E_n/kT\right)}{\exp\left(-E_1/kT\right)} \tag{1}$$

given that degeneracy $g(n) = 2n^2$, it seems that this ratio goes to ∞ for a fixed temperature with growth of n. Yet, in our approximations, the hydrogen is mostly in the ground state. What is wrong with the above equation? Hint: it might be connected to the size of the atom.