

ASTR367 - HW2

September 1, 2023, Due September 8, 2023

2 pt for each question part

1. Solar emission

a. Assuming the emission from the Sun peaks at the central wavelength of the V-band filter, and its emission is roughly a blackbody, what is the temperature of the Sun?

b. What is the thermal broadening of the $H\alpha$ line from the Solar photosphere in km/s and nm?

c. What fraction of Hydrogen is ionized in the Solar photosphere? Compute the quantity $n_{\text{HII}}n_e/n_{\text{HI}}$.

d. What fraction of all Hydrogen atoms are in the $n = 1$ ground state in the Solar photosphere? The degeneracy of principle quantum number n is n^2 . (Hint: for this question, you do not need to compute the entire partition function.)

e. Based on the populations in the $n = 1$ and $n = 2$ levels, what absorption line do you think is stronger for the Sun, Lyman α or $H\alpha$?

2. Assume that the density at the Solar photosphere is 2.0×10^{-7} g/cm³ and the opacity in the photosphere is 0.3 cm²/g. Estimate the depth at which light is emitted from the Sun when viewed face-on (assume it is emitted at $\tau = 2/3$).