Stellar Spectra B. LTE Line Formation

Andreas Ellewsen

1. Stratification of the solar atmosphere

In this exercise we study the radial stratification of the solar atmosphere by using the FALC model by Fontela et al. (1993)

1.1. FALC density stratification

The first thing to do is import the data from the modelfiles and make figures of some key quantities. I start by plotting the total pressure p_{total} against colmn mass m. See figures **??** and **??**. We see that they scale linearly. From this we can conclude that we can write

$$p_{total} = Cm \tag{1}$$

where if one finds C for all pressures and column masses and then find the average C, I get $C = g_{surface} = 27398.2$ cm/s^2.

Fontena et a. (1993) assumed complete mixing, so we check that this condition holds by plotting the ratio of the hydrogen mass density to the total mass density against height. Next we add the Helium as well and calculate the contribution of helium and hydrogen to the total. From the figure it seems that nearly all of the density is contributed form hydrogen and helium. However if one does the calculation one finds that the average fraction of the remaining elements (the "metals") contributes 0.002 (0.02%) of the total .This can be seen in figure **??**

Next we plot the column mass against height. See figure **??**. Note that the curve becomes nearly straight if we make the y-axis logarithmic in figure **??**. This is caused by XXXXXXXXXXXXXXXXXXXXXXXXX.

The next quantity to look at is gas density. Gas density is plottes against height in figure **??**.

We note that the density scale height H_ρ can be found by using that

$$rho \approx \rho(0) exp(-h/H_\rho) \tag{2}$$

Solving for H_ρ gives

$$H_\rho = -\frac{h}{ln(\rho/\rho_0)} \tag{3}$$

2. References

Rutten, R. J.: 1991, The Generation and Transportation of Radiation, Sterrekundig Instuut Utrecht, The Netherlands