

# Homework #6

## Due Friday Oct 17

**Homework is due by 5:00 pm on the due date. Late homework will not be accepted.**

1. This homework is optional for undergraduates. If you do it, it is extra credit, if not it won't count against you. It is required for graduate students.

Reproduce the plots on page 16 of Rutten.

For this we will write the total optical depth as:

$$\tau_\nu = \tau_c + \tau_l(\nu)$$

Take the continuum optical depth to be  $\tau_c$  and frequency independent. Set the frequency of the line center to be  $\nu_0 = 1000$ . Take the line optical depth to be

$$\tau_l(\nu) = \Gamma \frac{1}{\sqrt{\pi}} \frac{1}{\Delta\nu_D} \exp -[(\nu - \nu_0)^2 / \Delta\nu_D^2]$$

where  $\nu_D$  is the Doppler width which we shall take  $\Delta\nu_D = 3$ .

$$\Delta\nu_D = \nu_0 \left( \frac{2kT}{m} \right)^{1/2} / c,$$

but for our purposes we can just take it to be a specified number.

You will have to vary  $I_0$  and  $S$  (use values like 1 and 0.1) to reproduce the graphs as shown. You will also have to vary the values of  $\tau_c$  and  $\Gamma$ .