

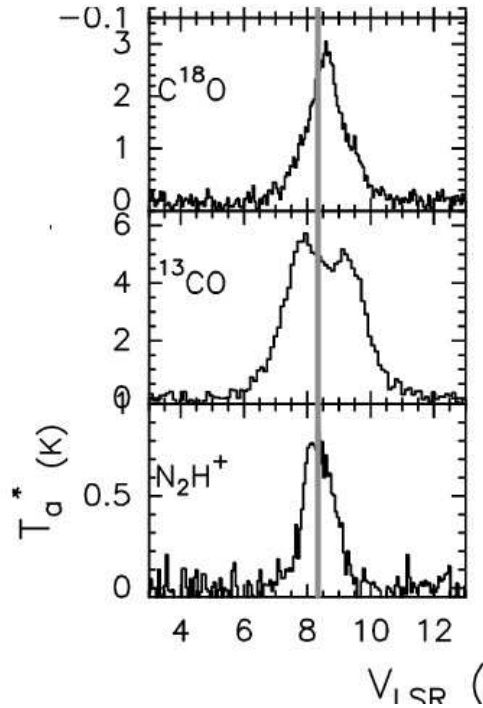
Problem Set 1—Star Formation—Due November 17

- 1) Given a giant molecular cloud with $R = 10pc$, $T = 20K$, $n = 10^4 cm^{-3}$. Calculate the jeans mass and jeans length. Will the cloud collapse? Calculate the gravitational and thermal energies of the cloud. It is stable? Does this agree with the previous answer?

- 2) Calculate the frequency of the J=1-0 line of $^{12}C^{32}S$. The equilibrium C-S bond length is 1.534×10^{-8} cm. By how much is the J=1-0 line of $^{13}C^{32}S$ shifted in frequency? (Use the same bond length).

- 3) You observe a molecular cloud in the ^{12}CO and ^{13}CO $J = 1 - 0$ lines. You assume the ^{12}CO is optically thick and the ^{13}CO thin. The peak T_B is 12.4 K for the ^{12}CO and 4.9 K for ^{13}CO .
 - 1) Calculate the excitation temperature T_{ex} .
 - 2) Show that $\tau(^{13}CO) = -\ln(1 - I(^{13}CO)/I(^{12}CO))$.
 - 3) If the isotope ratio is 70, what is ^{12}CO ?

- 4) The lines below were observed in a molecular cloud.



Say in a few words what you think of each line: optically thin or thick?

What do you think the ^{12}CO would look like?

Calculate the column density of C^{18}O . Use $A_{ij} = 6.5 \times 10^{-8} \text{ sec}^{-1}$ and $T_{ex} = 7\text{K}$.

Calculate the column density of H_2 (look up abundances).

The cloud is $14'$ (minutes of arc) across and 200 pc away. If it is spherical, what is its mass?