AST 2705

HW #4

1) b) Measure FWHM.

$\text{FWHM} = 21.47 \; T_4^{1/2}$ km/s

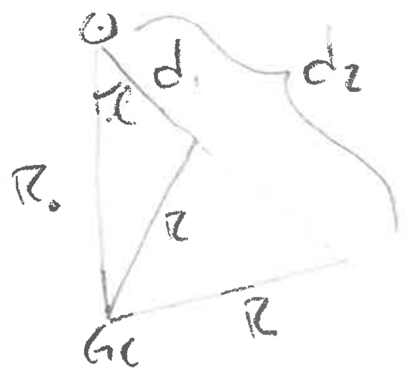
$\Rightarrow T_4 = \left(\frac{\text{FWHM}}{21.47 \text{ km/s}} \right)^2$ this is T_{max}!

$$V_{lsr} = R_0 \sin l \left(\frac{\Theta(R)}{R} - \frac{\Theta_0}{R_0} \right)$$

Assume $\Theta = \Theta_0 = 235$ km/s

$R_0 = 8.35$ kpc

$$R = R_0 \left(\frac{V_{lsr}}{\Theta_0 \sin l} + 1 \right)^{-1}$$



$R^2 = R_0^2 + d^2 - 2R_0 d \cos l$

$\Rightarrow$ gives 2 soln for d for given R, l

Use $N(HI) = \frac{1.813 \times 10^{18}}{K \cdot km/s} \int \Delta T_B(v)\, dv$

Can estimate integral from peak, FWHM of line.

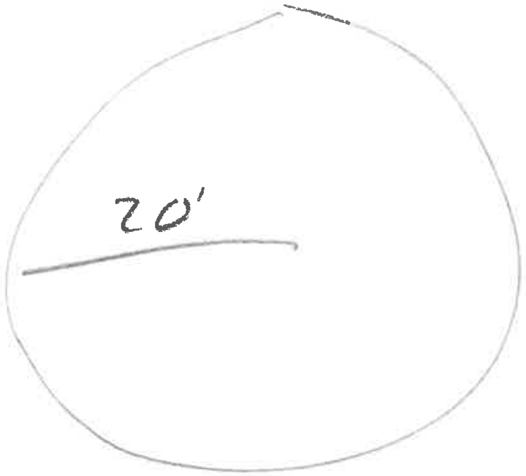
$$T_s = \frac{T_A^{off}\, T_{RS} - T_A^{on}\, T_{sky}}{(T_{A_{RS}} - T_{sky}) - (T_A^{on} - T_A^{off})}$$

Look up T_{RS} in continuum data

Assume same value for T_{sky}

Since data are actually ΔT, have to work to get T_{on}, T_{off}.

3)



Radius in pc

$R = d\theta = 5000\,\text{pc} \cdot \frac{20' \cdot 60}{206265}$

$= 29\,\text{pc}$

$$\frac{M_{vir}}{M_\odot} = 378 \cdot 29 \cdot 3^2 = 9.8 \times 10^4\ M_\odot$$

$$M_{LTE} = 0.96\,M_\odot \left[\frac{N_{T,13CO}}{8.75 \times 10^{14}\ \text{cm}^{-2}}\right] \left(\frac{\theta_x}{60''}\right)\left(\frac{\theta_y}{60'}\right)\left(\frac{D}{\text{kpc}}\right)^2$$

$$N_{T,13CO} = 8.75 \cdot 10^{14}\ T_B\,\Delta V\ \text{cm}^{-2}$$

Brightness temp is a surface brightness so if one pointing has $T_B = 20\,\text{K}$ and all pointings are the same, the term above for entire cloud is $20\text{K} \cdot 3\,\text{km/s} = 60\,\text{K km/s}$

$$M_{LTE} = 0.96\,M_\odot \cdot 60 \cdot 20 \cdot 20 \cdot 5^2 = 5.76 \times 10^5\ M_\odot$$

This is telling us that the derived cloud mass is greater than the Virial mass. The cloud is bound and possibly collapsing.

$$\frac{M_{vir}}{M_{LTE}} \simeq \frac{1}{6}$$

Sometimes we define the parameter

$$\alpha_{vir} = \frac{5\sigma^2 R}{GM} = 88 \text{ for our cloud}$$