

ASTR 792
T/R 9:30 - 10:45 AM
Due September 12

Week #4

Draine 1.1 a b d

1.1 The total mass of neutral gas in the Galaxy is $\sim 4 \times 10^9 M_\odot$. Assume that it is uniformly distributed in a disk of radius $R_{\text{disk}} = 15 \text{ kpc}$ and thickness $H = 200 \text{ pc}$, and that it is a mixture of H and He with $\text{He}/\text{H}=0.1$ (by number). Assume ionized hydrogen to be negligible in this problem. [Note: even though the assumptions in this problem are very approximate, please carry out calculations to two significant digits.]

- (a) What is the average number density of hydrogen nuclei within the disk?
- (b) If 0.7% of the interstellar mass is in the form of dust in spherical particles of radius $a = 1000 \text{ \AA} = 0.1 \text{ \mu m}$ and density $\rho = 2 \text{ g cm}^{-3}$, what is the mean number density of dust grains in interstellar space?
- (d) Now assume that 30% of the gas and dust mass is in spherical molecular clouds of radius 15 pc and mean density $n(\text{H}_2) = 100 \text{ cm}^{-3}$. What would be the mass of one such cloud? How many such molecular clouds would there be in the Galaxy?