

ASTR 541; Week 1

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1a. Hydrogen density

We can first calculate the density of the disc as

$$\rho = \frac{M}{\pi R_{\text{disc}}^2 H} \quad (1)$$

$$= 1.9 \times 10^{-24} \text{ g cm}^{-3} \quad (2)$$

Now we need to convert the density to a number density as follows

$$\rho = m_{\text{H}} n_{\text{H}} + m_{\text{He}} n_{\text{He}} \quad (3)$$

$$= n_{\text{H}} \left(m_{\text{H}} + m_{\text{He}} \frac{n_{\text{He}}}{n_{\text{H}}} \right) \quad (4)$$

$$= n_{\text{H}} (m_{\text{H}} + 0.1 m_{\text{He}}) \quad (5)$$

$$= 1.4 n_{\text{H}} m_p \quad (6)$$

$$n_{\text{H}} = \frac{\rho}{1.4 m_p} \quad (7)$$

This gives that the average number density of hydrogen is

$$\boxed{n_{\text{H}} = 0.8 \text{ cm}^{-3}} \quad (8)$$