PH673 - High Energy Astrophysics

Assignment 16 - Oct. 26, 2007

1. Several astrophysical plasmas are composed primarily of H and He, with a minor component of other 'metals' in lesser abundance.

(a) In the case of a fuly ionized plasma with H and He, the latter with abundance of 10% by number of H atoms, estimate the mean molecular weights μ_i and μ_e.

(b) Start with the definition of the electron scattering opacity given by

$$\kappa_{es} = \frac{n_e}{\rho}\sigma_T$$

where ρ is the plasma density, n_e the electron number density, and σ_T the Thomson cross section. For a plasma with arbitrary metal abundance, show that the opacity can be approximated as

$$\kappa_{es} \simeq \frac{\sigma_T}{2m_H}(1 + X_H)$$

where X_H is the fraction of the total mass contributed by H.