

Astrophysics — ASTR-4220
Class 14
Energy Transport

Exercise (20 pts)

- 1. (10 pts)** — Estimate the ratio K_r/K_e for typical physical conditions in a stellar interior: $\rho = 10^5 \text{ kg m}^{-3}$ and $T = 10^7 \text{ K}$. Assume for simplicity that the plasma is pure hydrogen.
- 2. (10 pts)** — What do you conclude about the relative importance, in normal stars, of heat transfer by electrons versus photons?

Solution

- 1.** — You should have found that $Z = 1$, $P_r = 2.52 \times 10^{12} \text{ Pa}$, $P_e = 8.26 \times 10^{15} \text{ Pa}$, and $m_e c^2/kT = 593$. Then

$$\frac{K_r}{K_e} = \sqrt{3} Z \frac{P_r}{P_e} \left[\frac{m_e c^2}{kT} \right]^{5/2} \approx 4500. \quad (1)$$

- 2.** — In normal stars, heat transfer by electrons (thermal conduction) is negligible compared to heat transfer by photons.