

ASTR 531 - Stellar Interiors and Evolution

Problem Set 4

TOM WAGG

May 11, 2022

20.2 - White Dwarf Luminosity

Part a

The luminosity of a white dwarf in the slow cooling phase is given by Eq. 20.10 in the textbook

$$\frac{L}{L_{\odot}} \approx 5.2 \times 10^{10} \frac{M}{M_{\odot}} \mu_{\text{ion}}^{-7/5} \left(\frac{t}{\text{yr}} \right)^{-7.5} \quad (1)$$

Since we are comparing white dwarfs with the same cooling age, the only relevant factors are the mass and μ_{ion} when comparing a H-rich WD to He-rich and C-rich.

The values of μ_{ion} for these WDs are 1, 4, 12 respectively. This means that the relative luminosity of the WDs is

$$\frac{L}{L_{\text{H-rich}}} = 1 : 0.14 : 0.03 \quad (2)$$

respectively. This shows that H-rich WDs are the brightest for a given cooling age, following by He-rich and then C-rich WDs.

TODO: Can we assume that the mass is constant?

Part b

TODO: Unsure, maybe larger ions make cooling happen faster? Why?

23.2 - Central Temperature-Density Gradient
