Introductory Astronomy

Week 5: Stellar Evolution

Clip 9: White Dwarves

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Discovery

- Bessel 1844: Sirius wobbles: a binary
- Pup hard to find. Clark 1846

$$L_A = 23.5 L_\odot \; L_B = 0.03 L_\odot$$

- Orbits:

$$M_A = 2.3 M_\odot \; M_B = 1.0 M_\odot$$

- Spectrum (Adams 1915):

$$T_A = 9910\,\mathrm{K} \; T_B = 27000\,\mathrm{K}$$

$$R_B = R_\odot \sqrt{\frac{L_B T_\odot^4}{L_\odot T_B^4}} = 0.008 R_\odot < R_\oplus$$

- Surface Gravity

$$g_B = \frac{G M_B}{R_B^2} = 4.5 \times 10^5 g$$

- Spectrum: Very broad Hydrogen absorption lines
- Estimate:

$$\begin{aligned} P_c &= 3.8 \times 10^{22}\,\mathrm{N/m^2} \\ T_c &= 7.6 \times 10^7\,\mathrm{K} \end{aligned}$$

- No Hydrogen else fusion

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Degenerate Matter

- White dwarves are the degenerate cores of stars with $M \lesssim 8M_\odot$
- Composition is Carbon Oxygen
- Masses $0.42M_\odot \leq M \leq 0.70M_\odot$
- Significant mass loss

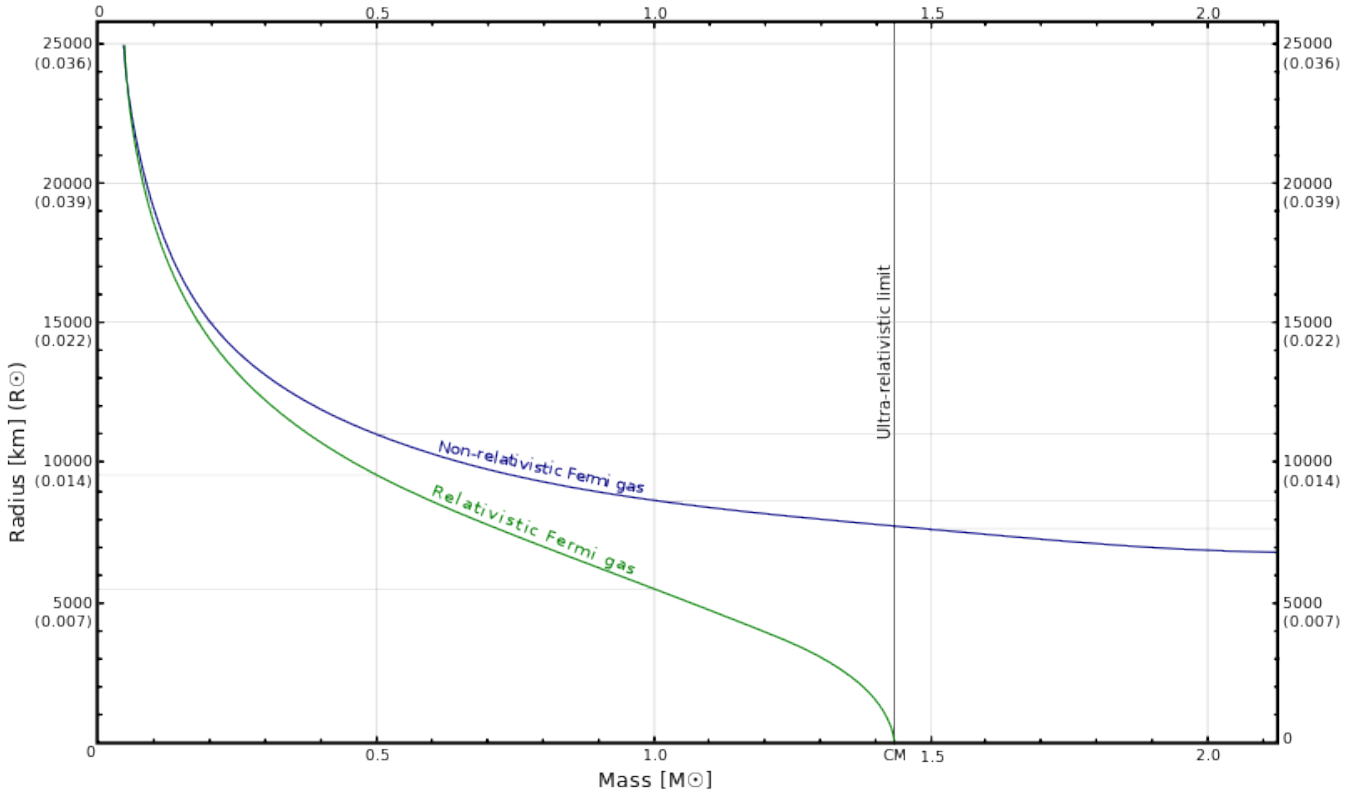
- Chandrasekhar:

$$P_e = K_e \rho^{5/3} = C\left(\frac{M}{R^3}\right)^{5/3}$$
$$P_g = C' \frac{GM^2}{R^4}$$
$$MR^3 = (C/C'G)^3$$

- Relativity:

$$M < M_{Ch} = 1.44M_\odot$$

Mass-Radius



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