MASS - RADIUS RELATION

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(eliminate ρ_c, α)

$$\left(\frac{GM}{M_n}\right)^{n-1}\left(\frac{R}{R_n}\right)^{3-n} = \frac{[(n+1)K]^n}{4\pi G}$$

Special CASE

$n = 3 \rightarrow M$ independent of R

$$M = 4\pi M_3 \left(\frac{K}{\pi G}\right)^{3/2}$$

WD: mass accretion $\rightarrow$ more degenerate

EOS non-rel : $n = 1.5$

rel $n = 3$

Recall: $P_{e, rel. deg.} = \underbrace{\frac{hc}{8}\left(\frac{3}{\pi}\right)^{1/3}\frac{1}{(u\mu_e)^{4/3}}}_{K_2}\rho^{4/3}$

$$\rightarrow M = M_{CH} = \frac{M_3}{4\pi}\sqrt{3/2}\left(\frac{hc}{Gu^{4/3}}\right)\mu_e^{-2} \simeq 5.83\,\mu_e^{-2} M_\odot$$

Q: μ_e? OS $\rightarrow M_{CH} = 1.46 M_\odot$

Q: M_{CH} FOR Fe core?

More General

$$M_{CRIT} \simeq M_{CH} \cdot \left[1 + \frac{\pi^2 k_B^2 T^2}{E_F^2}\right]$$

$$E_F = 1.11\,\text{MeV} \cdot \left(\frac{\rho}{10^7\,\text{g cm}^3}\,Y_e\right)^{1/3}$$

Mass Excess

$$\Delta M = c^2\,(m - A \cdot u)$$ unit of E!

for neutral atom!

Binding Energy

$$A = N + Z$$

$$EB = c^2\,(m - (N \cdot m_n + Z \cdot (m_p + m_e)))$$

Q: what is the difference, and why?

Q: what are typical values?