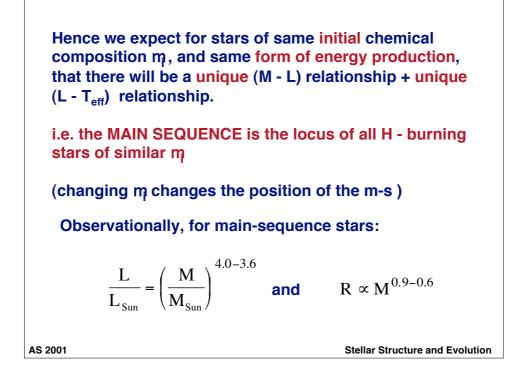


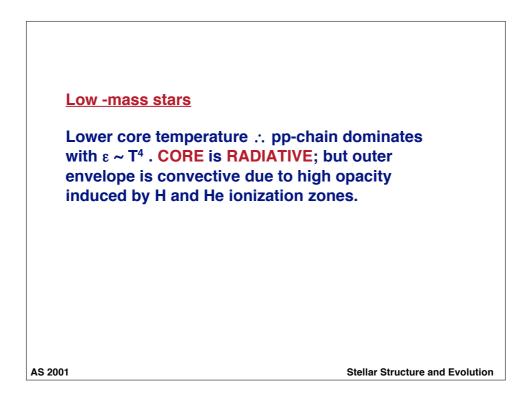
We have seen that, from (7) and (10)

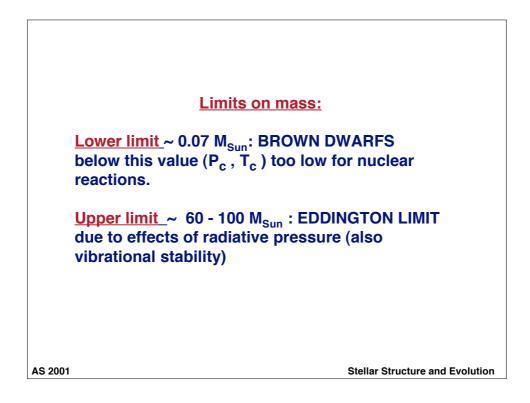
$$T_{c} \propto \frac{\mu M}{R}; \quad P_{c} \propto \frac{\rho M}{R}; \quad \varepsilon = \varepsilon(T, P, \mu)$$
hence

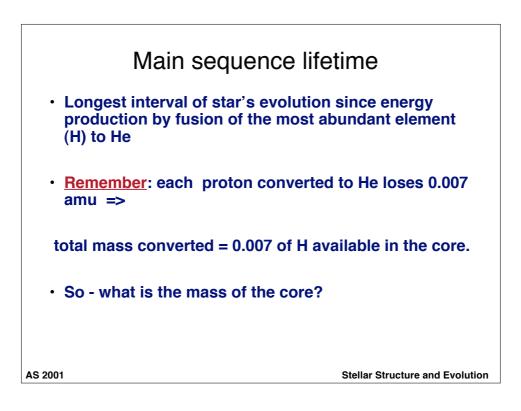
$$\varepsilon = \varepsilon(M, R, \mu)$$
But $R \propto M^{\alpha}$ with $0 < \alpha < 1 \Rightarrow$
 $\varepsilon = \varepsilon(M, \mu)$
and since $L \propto R^{2}T_{eff}^{4}, \Rightarrow$
 $L \propto M^{\beta} \quad \beta > 0$
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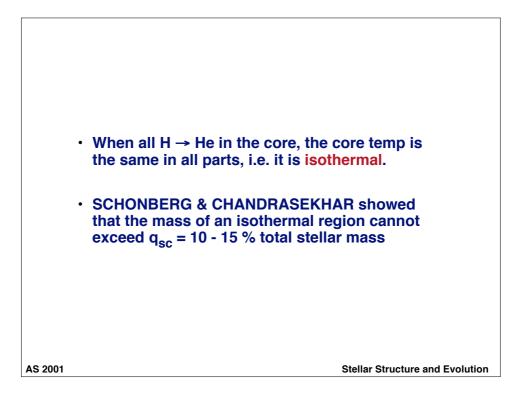


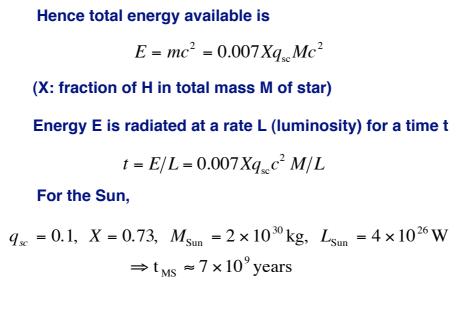
High -mass stars $M \ge 4M_{Sun}$ High core temperature \therefore CNO cycle dominates -
provides highly-concentrated source of energy
since the energy generation rate $\varepsilon \sim T^{15}$ $\frac{d\varepsilon}{\varepsilon} = 15 \frac{dT}{T}$ Hence transport of energy through the CORE
region is by CONVECTION - means that core
material is well-mixed. Outer envelope is radiative.











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Stellar Structure and Evolution

In general, we obtain the approximate result that the main-sequence lifetime is the nuclear time scale

$$t_{MS} \approx 7 \times 10^9 \frac{\left(M/M_{\rm Sun}\right)}{\left(L/L_{\rm Sun}\right)}$$
 years

eg for an O5 star:

 $M = 40M_{\text{Sun}}, L = 4 \times 10^5 L_{\text{Sun}}, t_{\text{MS}} \approx 10^6$ years

eg for an M5 star:

$$M = 0.1M_{\text{Sun}}, L = 5 \times 10^{-4} L_{\text{Sun}}, t_{\text{MS}} \approx 1.4 \times 10^{12}$$
 years

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