



6. In the hydrogen atom, an electron jumping from the second level to the first emits a photon of wavelength 122 nm. In going from the third to the second, a photon of wavelength 656.3 nm is emitted. These can be the strongest emission lines in a nebula. What color are the nebulae to the human eye? What wavelength photon is emitted when an electron drops directly from the third level to the first? (103.4 nm).

(I) was Energy Source

IB Lifetime of Sun!!

Consumption of H

and Lifetime of the Sun

$E = mc^2$. In 1 sec the Sun

radiates $E = 4 \times 10^{26}$ J so the

mass disappearance is

$$m = \frac{E}{c^2} = \frac{4 \times 10^{26} \text{ J}}{9 \times 10^{16} \frac{\text{m}^2}{\text{s}^2}} = 4.4 \times 10^9 \text{ kg}$$

Now how much H is consumed in a second?

$$m = .007 m_H \Rightarrow m_H = \frac{4.4 \times 10^9 \text{ kg}}{.007} = 6.3 \times 10^{11} \text{ kg}$$

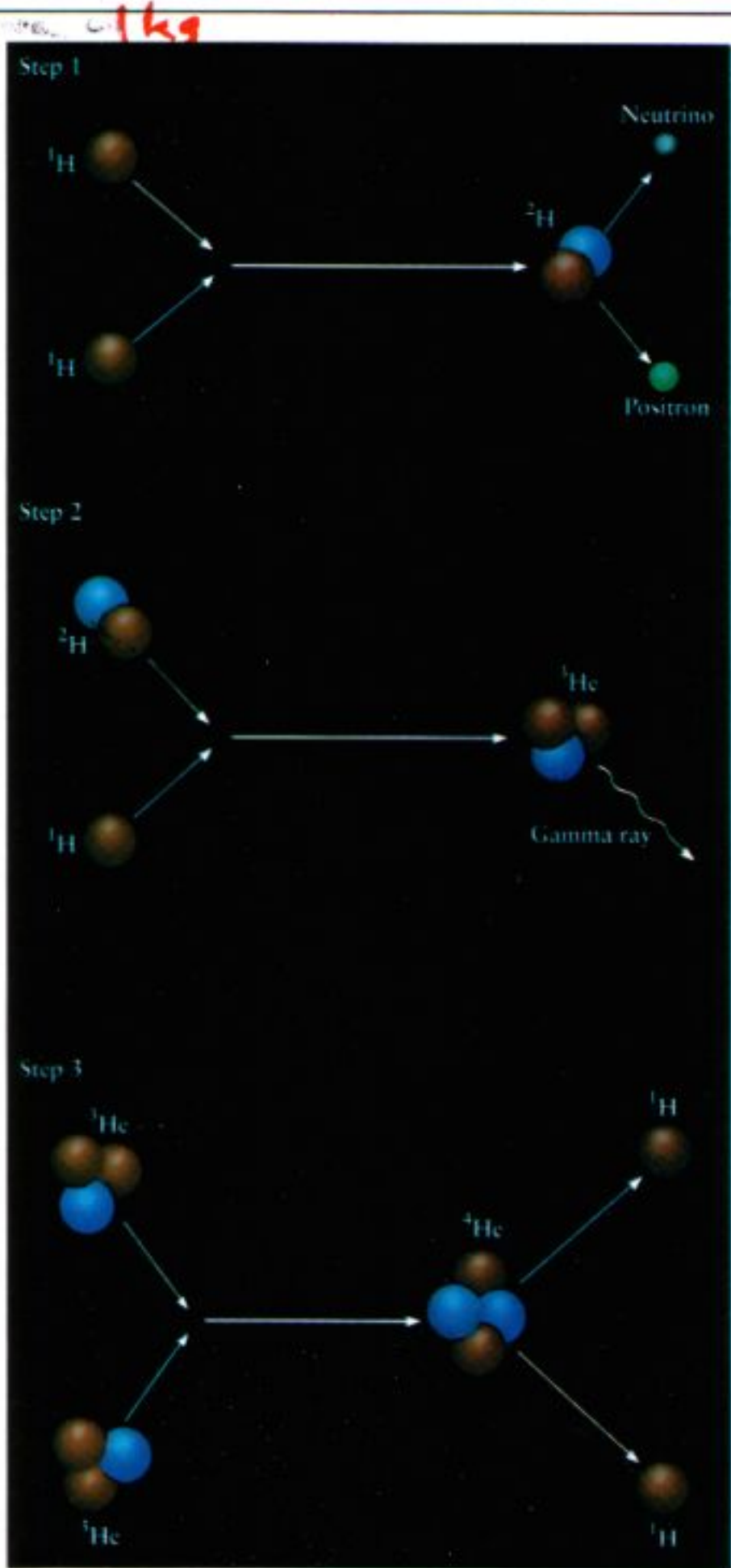
So the Sun's lifetime is $\sim \frac{2 \times 10^{30} \text{ kg}}{6.3 \times 10^{11} \text{ kg/sec}}$

$\sim 3 \times 10^{18} \text{ sec} \approx 1 \times 10^{11} \text{ years}$

But only the inner 10% can burn.

SLOW
Alive or long or core H.

IA Sun's
Energy
Source



deuteron

1 g
= pap

0.993 kg
He

Box 18-2-1

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Sun's Energy Source

Proton-Proton Chain

(most important branch)



total 0.7% energy release

It takes 2 equations
to solve for 2 unknowns.

$$a + b = 3 \quad (1)$$

$$a = 2b \quad (2)$$

By (2), $a = 2b$; inserting $2b$ for a in (1),

$$2b + b = 3 \quad \text{or} \quad 3b = 3 \Rightarrow b = 1$$

Then by (2) $a = 2b = 2$

Solar / Stellar Structure Solved !!!

For stellar interiors there are 7 unknowns and 7 equations, including

Hydrostatic Equilibrium

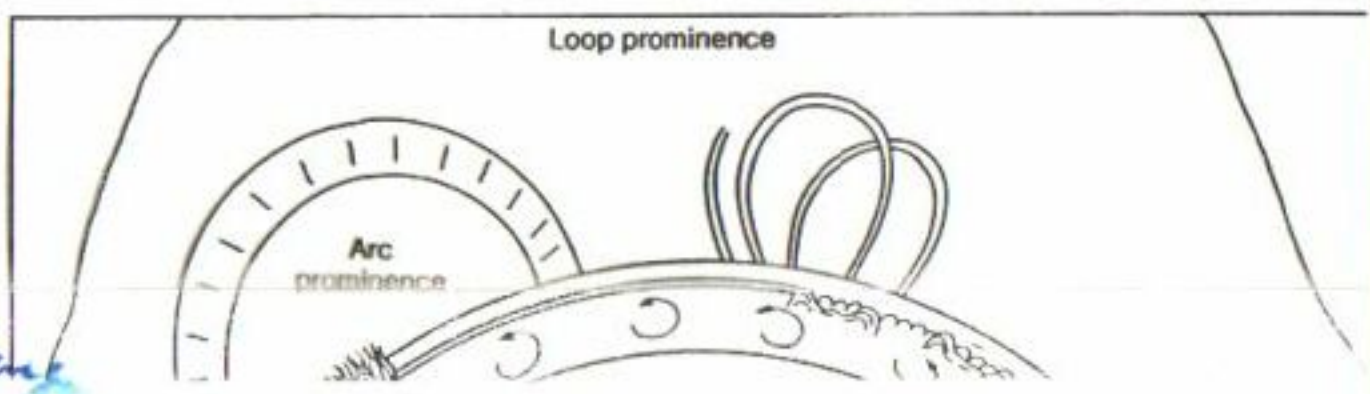
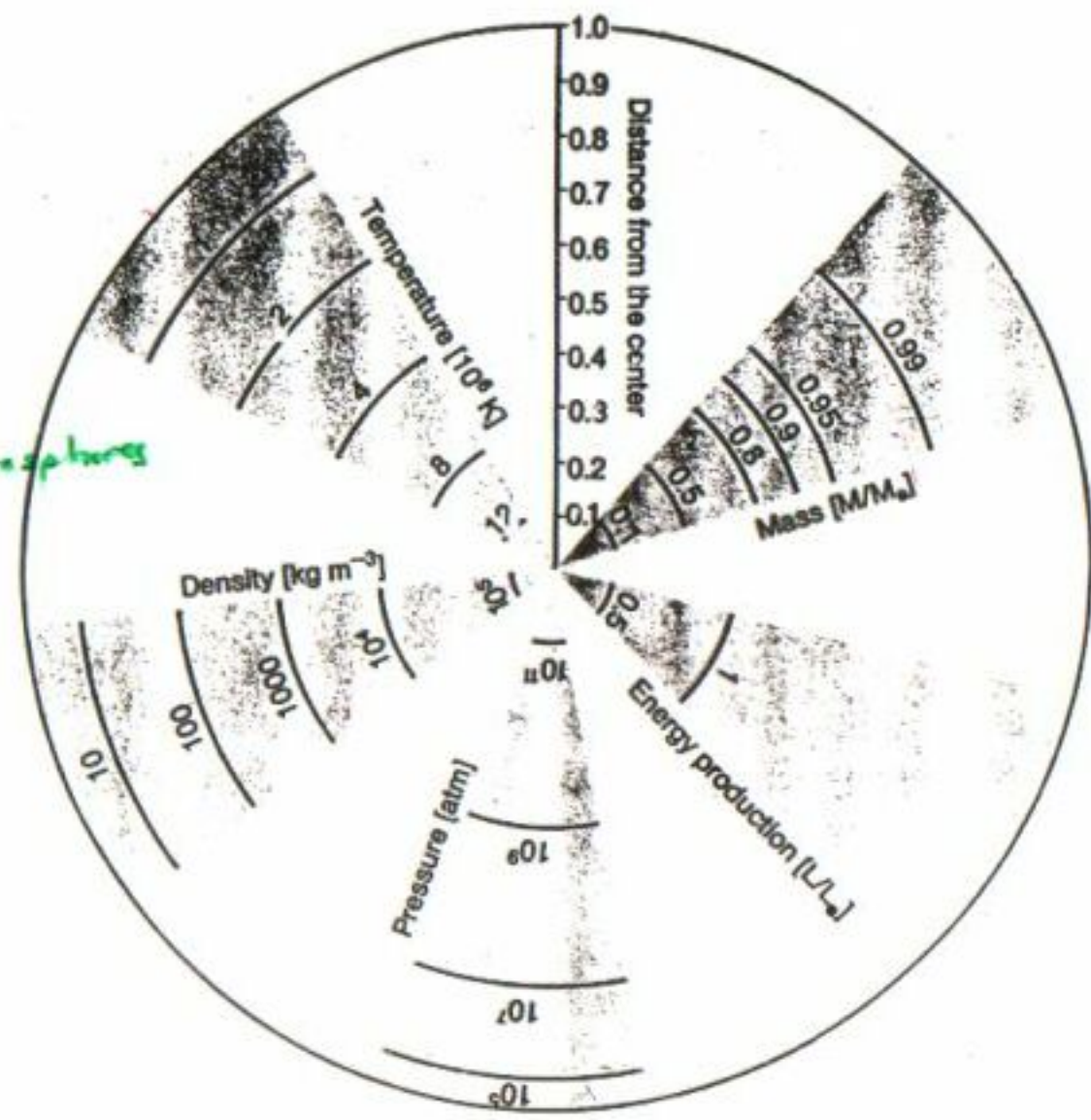
Equation of State $P \propto \rho T$

Energy generation ...

Gravity Formula ...

Fig. 13.1. The distribution of temperature, pressure, energy production and mass as functions of radius in the Sun

Center: $T = 15$ million K
 $P = 250$ billion atmospheres
 $\rho = 150$ g/cm³
 a plasma



5% of H₂ gave

H₂O Oenz

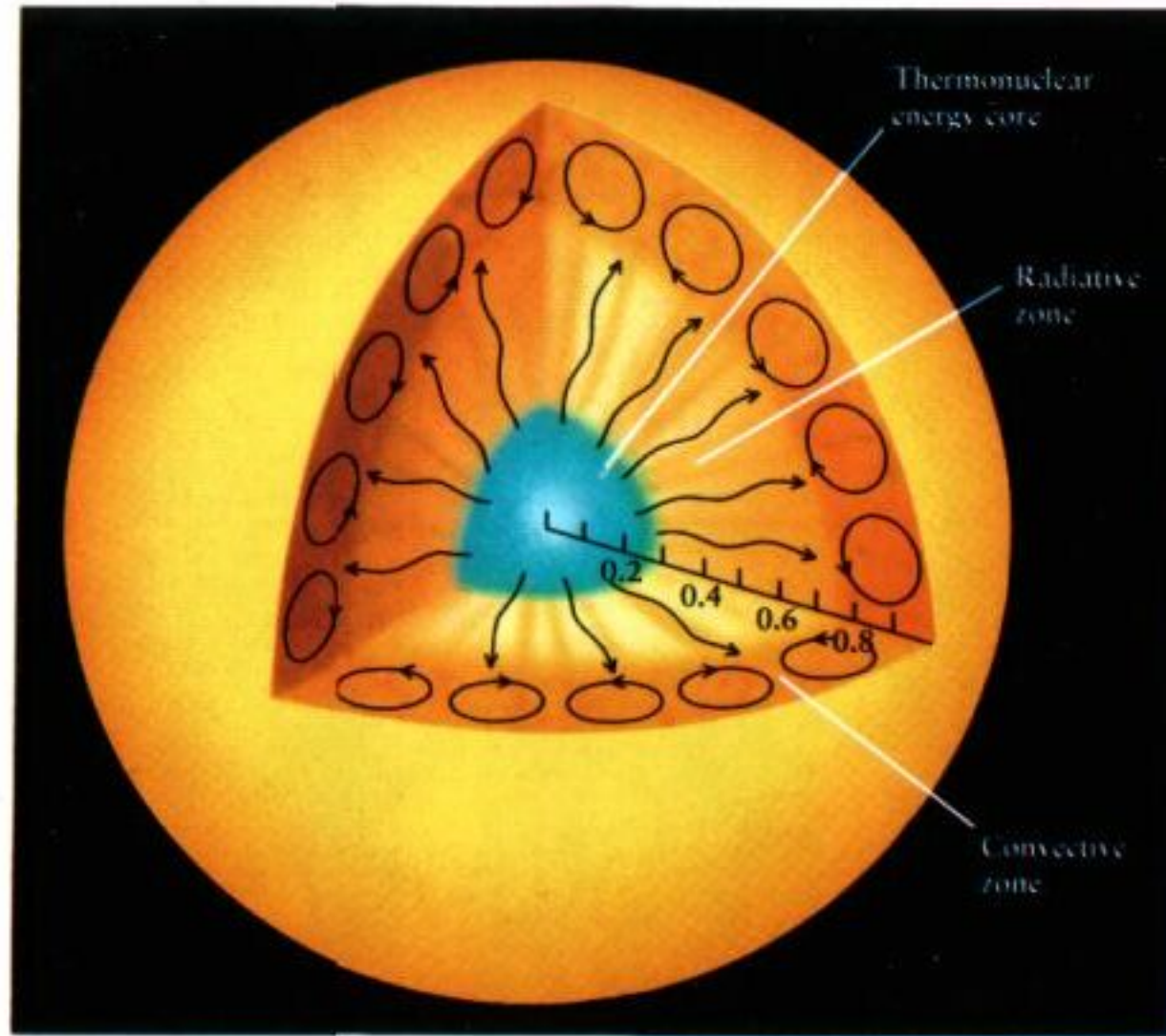


Figure 18-28
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