

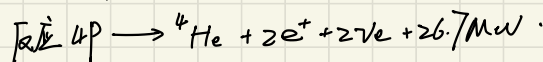
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1. 辐射总功率 $P_{\text{总}} = 4\pi r^2 p$. $r = 1.496 \times 10^{11} \text{ m}$.
 $\approx 3.927 \times 10^{26} \text{ W}$

(2)

$M_{\text{H}} = 1.989 \times 10^{30} \text{ kg}$.

假设太阳全是质子, $N = \frac{M_{\text{H}}}{m_{\text{H}}} N_{\text{A}} \approx 1.199 \times 10^{57}$ 个.



则太阳一共可以放出的能量: $E = \frac{N}{4} \times 26.7 \text{ MeV} \approx 8.003 \times 10^{57} \text{ MeV}$.

可以维持的时间为 $t = \frac{E}{P} \approx 3.252 \times 10^8 \text{ s} \approx 1 \times 10^{11} \text{ a}$.

2. 照射时间取 $T = 8 \text{ h}$. 转换效率 $\alpha \approx 20\%$. 设需要的面积为 S .

$P \cdot T \cdot S \cdot \alpha = 52 \text{ kWh}$.

$\rightarrow S = 23.21 \text{ m}^2$.

3. 电子简并压 $P = \frac{2}{3} \frac{N E}{V}$, $E = \frac{\hbar^2 k^2}{2m}$, $k = \frac{2\pi}{\lambda}$.

$\rightarrow P_1 = \frac{(2\pi)^{3/2} \hbar^2}{5 m_e} \rho^{5/3} = K \cdot \left(\frac{N}{V}\right)^{5/3}$. 假设太阳全由 H 构成, 且有一个电子, 则 $P_1 = K \cdot (\rho \cdot N_{\text{A}} \cdot 10^3)^{5/3}$.

在 r 处的引力场强 Δp , $\Delta p \cdot 4\pi r^2 = \frac{G M \Delta m}{r^2}$, $\Delta m = 4\pi r^2 \Delta r \rho$, $M = \frac{4}{3} \pi r^3 \rho$.

$\rightarrow \Delta p = \frac{4}{3} \pi G \rho^2 r \Delta r$

内部总场强 $P_2 = \int_0^R \Delta p = \frac{2}{3} \pi G \rho^2 R^2$.

氢原子 $T \geq 7 \times 10^6 \text{ K}$.

$P_3 = n k T$, $n = \frac{\rho}{m} = \frac{\rho}{1} \cdot N_{\text{A}} \cdot 10^3$
 $= \rho \cdot N_{\text{A}} k T \cdot 10^3$

$P_2 = P_3$: $\frac{2}{3} \pi G \rho R^2 = N_{\text{A}} k T \cdot 10^3 \rightarrow \frac{G M}{2 R} = N_{\text{A}} k T \cdot 10^3$

$P_1 = P_2$: $\frac{2}{3} \pi G \rho^{1/3} R^2 = K \cdot N_{\text{A}}^{5/3} \cdot 10^5 \rightarrow \frac{2}{3} \pi G \frac{M^{1/3}}{(\frac{4}{3} \pi)^{1/3}} \cdot \frac{G M}{2 N_{\text{A}} k T \cdot 10^3} = K \cdot N_{\text{A}}^{5/3} \cdot 10^5$

$\rightarrow M^{4/3} = 2 K \cdot N_{\text{A}}^{8/3} \cdot k T \cdot \frac{3}{2\pi} \cdot G^{-2} \cdot \left(\frac{4}{3} \pi\right)^{1/3} \cdot 10^8$

$M = (2K)^{3/4} \cdot N_{\text{A}}^{3/4} \cdot (kT)^{3/4} \cdot \left(\frac{3}{2\pi}\right)^{3/4} \cdot G^{-3/4} \cdot \left(\frac{4}{3} \pi\right)^{1/4} \cdot 10^6 \approx 10^{29} \text{ kg}$.

$\approx 0.08 M_{\text{H}} \approx 1.6 \times 10^{29} \text{ kg}$.