AST 2367

HW #6

1) δ Cephei

For sinusoidal variations,

$$R(t) = R_0 + A\sin\left(\frac{2\pi t}{\Pi}\right)$$

so $v(t) = \dfrac{dR(t)}{dt} = \dfrac{2\pi A}{\Pi}\cos\left(\dfrac{2\pi t}{\Pi}\right)$

the book says $\Pi = 5^d 8^h 48^m = 4.64 \times 10^5 s$

and $v_{max} = 19$ km/s (@ $t=0$)

so $\dfrac{2\pi A}{\Pi} = 19 \times 10^3$ m/s $\Rightarrow A = 1.4 \times 10^9 m \hat{=} 2 R_\odot$

2) $m_v = 23 \qquad \Pi = 200^d$

$M_v = -2.81 \log 200 - 1.54 = -8.00$

$m - M = 5 \log d - 5$

$\Rightarrow \quad 10^{\frac{m-M+5}{5}} = d$

$d = 10^{\frac{23+8+5}{5}} = 1.58 \times 10^7 \text{ pc}$

Accepted distance is 2.32×10^7 pc. Must be Type II

3) $\gamma = 5/3$ $\quad \bar{\rho} = \dfrac{M_\odot}{4/3 \pi R_\odot^3} = 1390 \text{ kg m}^{-3}$

$$\Pi \approx \left(\frac{3\pi}{2\gamma G \rho} \right)^{1/2} = 5.52 \times 10^3 \text{ s}$$

4) $P = nkT = \frac{\rho kT}{\mu m_H}$ Assume $\rho = \bar{\rho} = \frac{M_\odot}{4/3 \pi R_\odot^3}$

$= 1.84 \times 10^9 \text{ kg m}^{-3}$

for pure ionized C, $\mu \hat{=} \frac{12}{13} \sim 1$

$T = 3 \times 10^7 K$, so

$$P = \frac{1.84 \times 10^9 \text{ kg m}^{-3} \cdot 1.38 \times 10^{-23} \text{ J/K} \cdot 3 \times 10^7 K}{1.67 \times 10^{-27} \text{kg}}$$

$= 4.56 \times 10^{20} \text{ N m}^{-2}$

$P = 1/3 a T^4 = 2.04 \times 10^{14} \text{ N m}^{-2}$

Both way smaller than P_c

5) # stars in MW ~ 2×10^{11}

avg stellar lifetime ~ 10^{10} yr (for the Sun)

Assume MW lifetime ~ 10^{10} yr

So any star with $M < M_\odot$ hasn't had time. And stars with $M \lesssim 10 M_\odot$ don't form WDs.

If half of all stars have $M > M_\odot$, we can use 1×10^{11} as the extreme upper limit.