University Astronomy: Homework 12

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Question 17.2

A cepheid star in the Large Magellanic Cloud is observed to have an average apparent magnitude $\bar{m}_V = 11.80$ and a period $P = 95$ days. Compute the distance to the Large Magellanic Cloud, ignoring any effects due to dust.

$$\begin{aligned}
\bar{M}_V &= -2.76 \log\left(\frac{P}{10}\right) - 4.16 \\
&= -6.859 \\
\log\left(\frac{d}{10}\right) &= 0.2(\bar{m}_V - \bar{M}_v) \\
d &= 10 \times 10^{0.2(\bar{m}_V - \bar{M}_V)} \\
&= 10^{0.2(\bar{m}_V - \bar{M}_V)+1} \\
&= 53914.23pc
\end{aligned}$$

Question 19.2

Suppose the Milky Way consisted of 2.7×10^{11} stars, each of solar luminosity $M_B = 4.7$. What would be the absolute magnitude of the whole Galaxy?

$$\begin{aligned}
M_\odot - M_G &= 2.5log\left(\frac{L_G}{L_\odot}\right) \\
M_G &= M_\odot - 2.5 \log\left(\frac{2.7 \times 10^{11} M_B}{L_\odot}\right) \\
&= 41.03
\end{aligned}$$

Question 19.5

Determine the proper motion relative to the LSR for a star in a circular orbit about the Galactic center, at a distance $d = 5$ kpc from the Sun and at galactic longitude $l = 45°$.

$$\begin{aligned}
\Theta(R) &= \omega_{max} R \\
d &= R_0 \cos(l) \pm \sqrt{R^2 - R_0^2 \sin^2(l)} \\
R^2 &= (d - R_0 \cos(l))^2 + R_0^2 \sin^2(l) \\
R &= 5.69\ kpc \\
\Theta(R) &= 306 \frac{km}{s} \\
\omega(R) &= \frac{\Theta(R)}{R} = 38.298 \frac{km}{s \cdot kpc} \\
A &= \frac{v_r}{d \sin(2l)} \\
&= \frac{(\omega(R) - \omega_0) R_0 \sin(l)}{d \sin(2l)} \\
&\approx 12.216 \frac{km}{s \cdot kpc} \\
\mu &= \frac{v_t}{d} = \frac{d(A \cos(2l) + B)}{d} \\
&= A \cos(2l) + (A - \omega_0) \\
&= -15.283 \frac{km}{s \cdot kpc} \approx -0.0032'' yr^{-1}
\end{aligned}$$

Slide Question 1

What would the Schwarzchild radius be for the Sun if it collapsed into a black hole?

$$\begin{aligned}
r_{Sch} &= 3km \left(\frac{M}{1 M_\odot} \right) \\
&= 3km
\end{aligned}$$

Slide Question 2

What is the "rip" radius for a black hole that has a mass of $10M_{Sun}$?

$$\begin{aligned} r_{rip} &= 480km \left(\frac{M}{1M_{\odot}} \right)^{-\frac{1}{3}} \\ &= 222.796km \end{aligned}$$

You can find all my notes at `http://omgimanerd.tech/notes`. If you have any questions, comments, or concerns, please contact me at alvin@omgimanerd.tech