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Problem Set 1

Problem 1

(a) We can use the formula for angular resolution (with $d = R_E = 6.378 \times 10^6$ m) to calculate this:

$$\theta = \frac{1.22\lambda}{d} = \frac{1.22 \times 0.21 \text{ m}}{6.378 \times 10^6 \text{ m}} = 4.02 \times 10^{-8} \text{ rad}$$

(b) The effective diameter of the telescope would be increased to the distance between the Earth and the Moon. which side of Earth/Moon? does telescope work on far side of the moon?Using the same equation as above, the angular resolution would be

$$\theta = \frac{1.22\lambda}{d} = \frac{1.22 \times 0.21 \text{ m}}{3.844 \times 10^8 \text{ m}} = 6.66 \times 10^{-10} \text{ rad}.$$

Comparing this to the previous result, the angular resolution is increased by a factor of

$$\frac{\theta_1}{\theta_2} = \frac{4.02 \times 10^{-8} \text{ rad}}{6.66 \times 10^{-10} \text{ rad}} = 60.3 \text{ x}.$$

Problem 2

(a) The absolute magnitude of the star can be found using the distance modulus formula

$$m - M = 5\log(d) - 5,$$

where m is the apparent magnitude, M is the absolute magnitude, and d is the distance to the star in parsecs. Then we find that the absolute magnitude is

$$M = m - 5\log(d) + 5 = 21 - 5\log(3000) + 5 = 21 - 17.4 + 5 = 8.6.$$

The stellar type of Delorean would probably be M [1].

(b) We can rearrange the distance modulus equation, accounting for reddening, to isolate absolute magnitude:

$$\begin{aligned} d &= 10^{(m-M+5-A)/5} \\ &= 10^{(m-M+5-kd)/5} \\ \implies \log(d) &= (m - M + 5 - kd)/5 \\ \implies \quad M &= m + 5 - kd - 5\log(d) \end{aligned}$$

do we assume delorean to be MS star?

[1] https://sites.uni.edu/morgans/astro/course/Notes/section2/spectralmasses.html

- For a reddening value of $k = 10^{-3}$ mag/pc, the absolute magnitude is

$$M = 21 + 5 - 10^{-3}\ \text{mag/pc} \times 3000\ \text{pc} - 5\log(3000) = 21 + 5 - 3 - 17.4 = 5.6.$$

  This would probably be a type G star.
- For a reddening value of $k = 2 \times 10^{-3}$ mag/pc, the absolute magnitude is

$$M = 21 + 5 - 2 \times 10^{-3}\ \text{mag/pc} \times 3000\ \text{pc} - 5\log(3000) = 21 + 5 - 6 - 17.4 = 2.6.$$

  This would probably be a type A star.
- For a reddening value of $k = 3 \times 10^{-3}$ mag/pc, the absolute magnitude is

$$M = 21 + 5 - 3 \times 10^{-3}\ \text{mag/pc} \times 3000\ \text{pc} - 5\log(3000) = 21 + 5 - 9 - 17.4 = -0.4.$$

  This would probably be a type B star.

Reddening does make a difference in the estimation of Delorean's stellar type.

(c) sun -3kpc-¿ delorean -5kpc-¿ center

Problem 3

you want to point the telescope away from the galactic center since you cant see through it, and the brightness will interfere with pics We can convert the coordinates of the Hubble Deep Field to galactic coordinates:

$$l = (3 * 3600 + 32 * 60 + 39)/(24 * 3600) * 360 = 53.16^\circ$$
$$b =$$

Problem 4

Problem 5

(a) In this problem, r_0 will be used as the initial distance instead of r. The work required to move a body over a distance dr against the force of gravity is given by

$$W = Fdr = \frac{GMm}{r^2}dr,$$

where M is the mass of the point mass galaxy, m is the mass of the body being moved, and r is the distance between the two. To escape the gravitational force of the galaxy, the object must be moved to an infinite distance. The energy required to do this can be calculated as follows:

$$\begin{aligned}
\int_{r_0}^{\infty} \frac{GMm}{r^2} dr &= GMm \int_{r_0}^{\infty} r^{-2} dr \\
&= GMm \left(-\frac{1}{r}\right) \Big|_{r_0}^{\infty} \\
&= -GMm \left(\frac{1}{\infty} - \frac{1}{r_0}\right) \\
&= -GMm \left(-\frac{1}{r_0}\right) \\
&= \frac{GMm}{r_0}.
\end{aligned}$$

If we consider putting this energy into the body as kinetic energy, it will have a velocity of

$$\begin{aligned}
\frac{1}{2} m v^2 &= \frac{GMm}{r_0} \\
\implies \quad v^2 &= \frac{2GM\cancel{m}}{r_0 \cancel{m}} \\
\implies \quad v^2 &= \frac{2GM}{r_0},
\end{aligned}$$

which is the escape velocity.

Problem 6

Problem 7