Stars & Galaxies, Galaxies example class 1

Question 1.

1. What are the two main galaxy types? Describe three characteristics for each.

2. Describe the three main stellar components of a spiral galaxy.

3. What is an HII region? How do you recognise them in a picture of a galaxy? Why do they tend to follow spiral arms?

4. Why can you not see the MWs bulge in the night sky?

5. Compute the value of a parsec in meters. Use $1\text{AU} = 149.60 \times 10^6$ km.

6. Derive the equation $m - M = 5\log(r) - 5$ that relates the apparent magnitude, m, the absolute magnitude, M, and the distance to a star, r, when obscuration is neglected.

Question 2.

The absolute magnitude of the sun in the B-band is $M_\text{B} = +5.58$, and its luminosity $L_\text{B} = 3.86 \times 10^{26}$ W.

1. Compute the flux from a solar type star in the Andromeda galaxy at distance $r = 710$ kpc. Compute its apparent magnitude in the B-band.

2. Assume that the density of stars in Andromeda falls exponentially with height above the disk, $n(z) = n_0 \exp(-|z|/z_0)$, with $n_0 = 1$ pc^{-3} and the scale-height $z_0 = 0.1$ kpc. Compute the surface density (σ) of stars (the number of stars seen per unit area), when the disk is seen face on.

3. Consider the flux, F, received from Andromeda from a square with side-length $\theta = 1$ arc seconds. Converts this to magnitudes. Show that the surface brightness μ is independent of distance. Assume Andromeda's disk is seen face-on.

4. Assume Andromeda has an exponential disk, where the number density of stars in cylindrical coordinates (R, z) follows $n(R, z) = n_0 \exp(-R/R_0) \exp(-|z|/z_0)$, with the disk scale-length $R_0 = 3$ kpc. Compute and plot the surface brightness $\mu(R)$. Use the same values for n_0 and z_0 as above, and assume the disk to be face-on.

[1 pc=3.09×10^{16} m.]