

GALACTIC ASTRONOMY – HOMEWORK 2 – MAX BECHTHOLD. ELIAS HÜHN

1.a)

a) M100: Spiral, no bar, small arm opening \Rightarrow Sa₀
NGC1300: Spiral, bar, small-medium arm opening \Rightarrow SBa₀ (maybe SBb)
NGC4486: elliptical, $e \approx 0 \Rightarrow$ E0₀
IC5152: irregular \Rightarrow Ir₀

1.b)

b) Blue: Galaxy seems brighter
 \rightarrow Dust, Halo shine and ^{complete} structure ^{size} of the galaxy can be observed

in general:
1. difference in brightness: blue is brightest, then red, IR is faintest
2. Bulge stays "constantly bright" through all senses
3. In the infrared the spirals are fainter (relatively to blue/red) than the elliptical is in IR.

1.c)

a) NGC 4486
- very luminous \rightarrow decreases ~~with light~~ by observing with ~~light~~ light with lower energy
- ~~there~~ there is no disk
M100 & NGC 1300
- there is a high central concentration compared to the spiral arms.
- luminosity lower compared to NGC 4486
- star formation can be observed in the spiral arms

The arms in the spirals are brighter in blue, since those regions are dominated by luminous O and B stars (blue). The Bulges remain bright also in the red, since they also contain ~~old~~ star populations that are usually colder and therefore redder.

The elliptical stays also bright in the red, since ellipticals are usually made up from old star populations. In the IR it stays bright, as ellipticals are usually dust and gas depleted, that absorb in IR

Exercise 2 a)

Exercise 2

$D \sim 15.3 \text{ Mpc}$ $V = 9.79 \text{ mag}$

a) ~~use Radius-Luminosity Relation for spirals:~~

estimate diameter: image is 10×10 arcminutes

$\Rightarrow \theta \approx \frac{1}{2} \text{ image width} = 5 \text{ arcmin} \approx 300 \text{ arcsec} = 0.083^\circ$

for small angles:

$$\theta = \frac{d}{D} \quad \Rightarrow \quad d = D \cdot 0.083 = 1.32 \text{ Mpc}$$

the ~~radius~~ ^{diameter} seems to high

Reasons for the wrong diameter estimate could be various. The Galaxy could not be as face on as it seems (possibly having a small inclination). Most importantly is the image width estimate only by eye measure, giving rise to a high error.

Exercise 2 b and c)

$$b) \quad \left(\begin{aligned} m_2 &= \int I(R, \theta) dA \\ &= 2\pi \int I(R) R dR \end{aligned} \right)$$

$$\begin{aligned} m - M &= 5 \log_{10}(d) - 5 \\ \Rightarrow M_V &= -5 \log(d) + 5 + m \\ &= -5 \log(15.9 \cdot 10^6 \text{ pc}) + 5 + 9.79 \text{ mag} \\ &= -21.22 \text{ mag} \end{aligned}$$

$$c) \quad \begin{aligned} M_{V\odot} &= 4.8 \text{ mag} \\ M_V &= 13.21 \text{ mag} \end{aligned}$$

$$100^{(M_{V\odot} - M_V)/5} = \frac{L}{L_\odot} = \left(\frac{M}{M_\odot} \right)^\alpha$$

$$\Rightarrow \frac{M}{M_\odot} = N \quad \text{mit } \alpha = 1$$

$$\Rightarrow N = 100^{(4.8 \text{ mag} + 21.22 \text{ mag})/5} = 256 \cdot 10^{10}$$