2.7 (a) mean velocity of galaxy centre

$$= \frac{1090 \longmapsto +690}{20} = 880\ \text{Km/sec}$$

using $v = H_0 R$ $\quad H_0 = 70 \frac{\text{Km}}{\text{s Mpc}}$

$$H_0 = 70\, h_{70} \frac{\text{Km}}{\text{s Mpc}}$$

$$\Rightarrow R = \frac{880}{70} h_{70}^{-1}\ \text{MPc}$$

$$R = 12.5\, h_{70}^{-1}\ \text{MPc}$$

(b)

$$r = \underset{\text{radian}}{\theta} R \rightarrow \text{MPc}$$

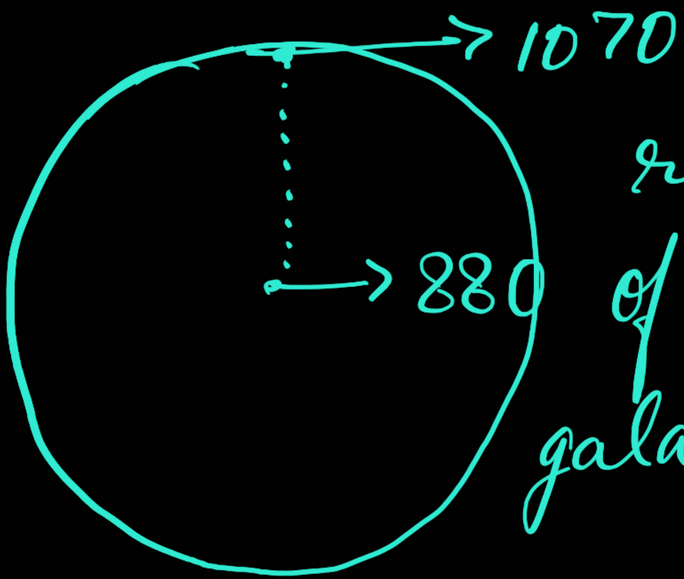
$$= 3\ \text{arcmin} \times 12.5\, h_{70}^{-1}\ \text{MPc}$$

$$= \left(\frac{3}{60}\right)\left(\frac{\pi}{180}\right) \times 12.5\, h_{70}^{-1}\ \text{MPc}$$

$$= 10.9\, h_{70}^{-1}\ \text{MPc}$$

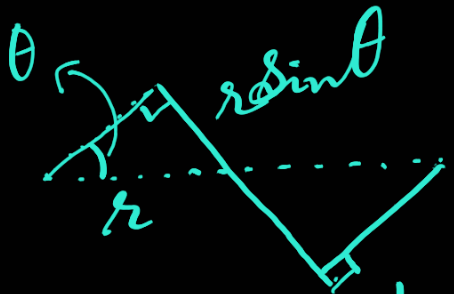
1 deg = 60 min.

(c)



rotating velocity of the tip for galaxy at an inclination

$v' = 1070 - 880 = 190$



$\rightarrow \theta = 65^\circ$ (data from paper)

for an inclined galaxy

$r' = r \sin\theta$

$\Rightarrow v' = v \sin\theta$

↓

linear velocity of end of galaxy in circular motion about centre

hence $v = \dfrac{v'}{\sin\theta} = \dfrac{190}{\sin 65^\circ} \simeq 211$ km/s

Then, from newtonian's gravity

$$\frac{mv^2}{r} = \frac{GMm}{r^2} \Rightarrow v = \sqrt{\frac{GM}{r}}$$

$$\Rightarrow M = \frac{v^2 r}{G} = \frac{(211)^2 \times r}{6.67 \times 10^{-11}}$$

$$r = 10.9\, h_{70}^{-1}\, \mathrm{Mpc}$$

$$\Rightarrow M = \frac{(211)^2 \times 10.9\, \mathrm{Mpc} \times h_{70}^{-1}}{6.67 \times 10^{-11} \times 2 \times 10^{30}}\, M_\odot$$

$$M = \frac{(211)^2 \times 10.9 \times 3.086 \times \cancel{10^{19}} \times 10^6}{6.67 \times 2 \times \cancel{10^{19}}}\, h_{70}^{-1} M_\odot$$

$$= 1.12 \times 10^{11}\, h_{70}^{-1}\, M_\odot$$

in diameter of 6 arcmin, $M = 2.2 \times 10^{11}\, h_{70}^{-1}\, M_\odot$

(e) $m - M = 5 \log\left(\frac{r}{10pc}\right)$

$$M_v = 10.1 - 5 \log\left(\frac{12.5\, h_{70}^{-1}\, \mathrm{MPc}}{10pc}\right)$$

$$M_v = 10.1 - 5 \log\left(\frac{12.5 \times 10^{6}}{10}\, h_{70}^{-1}\right)$$

$$M_v = 10.1 - 5 \log\left(12.5 \times 10^{5}\right) - 5 \log h_{70}^{-1}$$

$$M_v = 10.1 - 25 - 5 \log 12.5 - 5 \log h_{70}^{-1}$$

$$M_v = -14.9 - 5.48 - 5 \log h_{70}^{-1}$$

$$M_v = -20.4 - 5 \log h_{70}^{-1}$$

$$M = -2.5 \log \left(L/L_\odot \right)$$

$$M = -20.4 - 5 \log h^{-1}_{70}$$

$$\frac{L}{L_\odot} = 10^{\frac{M}{-2.5}} = 10^{\left(\frac{20.4 + 5 \log h^{-1}_{70}}{2.5}\right)}$$

$$= 10$$

2.5 Linear plots b/w $\underline{\underline{\log P}}$ and $\underline{\underline{V}}$

$\therefore$ for $\log P = 1$ or $P = 10$ days

for $\underline{LMC}$

$$\underset{\text{apparent magnitude}}{V_1} = -2.765 \log P + 17.044$$

$$\simeq 14.3$$

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for NGC 1365

at $\log P = 1$

$$V_2 \sim 27.5$$

using $V_1 - V_2 = -5 \log\left(\frac{r_2}{r_1}\right)$

$$V_1 - V_2 = 5 \log\left(\frac{r_1}{r_2}\right)$$

$$\Rightarrow \frac{r_1}{r_2} = 10^{\frac{V_1 - V_2}{5}}$$

$$\Rightarrow \frac{r_{LMC}}{r_{NGC1365}} = 10^{\frac{14.3 - 27.5}{5}}$$

$$\text{or } r_{NGC1365} = r_{LMC}\, 10^{\frac{27.5 - 14.3}{5}}$$

$$= (50\, kpc) \times 435$$

$$= 21.75\, MPc$$

now, using $H_0 = \frac{v}{r} = \frac{1441}{21.75}$

$(v = 1441\ km/s)$

$$H_0 = 66.25\ \frac{km}{s\, Mpc}$$