

3. galaxy $d = 10 \text{ Mpc}$

monochromatic luminosity $10^{38} \text{ erg s}^{-1} \text{ \AA}^{-1}$ (optical)

2.3m telescope V filter

$$QE = 0.5$$

observe at $\chi = 2$

* monochromatic luminosity - luminosity per wavelength or frequency unit

→ assuming luminosity isotropic (?)

$$R = (QE \cdot N_{\text{atmos}}) \cdot \underset{\substack{\downarrow \\ 880 \text{ \AA}}}{\Delta \lambda} \cdot \underset{\substack{\downarrow \\ (115 \text{ cm})^2 \pi}}{A} \cdot f_{\lambda}$$

$$N_{\text{atmos}} = (2.5^{2 \cdot 0.2})^{-1} = 0.693$$

$$f_{\lambda} = \frac{10^{38} \text{ erg s}^{-1} \text{ \AA}^{-1}}{4 \pi (10 \text{ Mpc} \cdot 10^6 \text{ pc} \cdot \text{Mpc}^{-1})^2} = 8.842 \times 10^{-15} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ \AA}^{-1}$$

$$E_{\text{ph}} = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-27} \text{ erg} \cdot \text{s} \cdot 3 \times 10^{18} \text{ \AA/s}}{5500 \text{ \AA}} = 3.613 \times 10^{-12} \text{ erg ph}^{-1}$$

$$f_{\lambda} = \frac{8.842 \times 10^{-15} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ \AA}^{-1}}{3.613 \times 10^{-12} \text{ erg ph}^{-1}} = 2.447 \times 10^{-3} \text{ ph s}^{-1} \text{ cm}^{-2} \text{ \AA}^{-1}$$

$$R = (0.5 \cdot 0.693) (880 \text{ \AA}) (115 \text{ cm})^2 \pi (2.447 \times 10^{-3} \text{ ph s}^{-1} \text{ cm}^{-2} \text{ \AA}^{-1})$$

$$= 31009 \text{ ph s}^{-1}$$

$$4. \quad R_S = 0.2 \text{ ph s}^{-1}, \quad R_B = 0.5 \text{ ph s}^{-1} \text{ pix}^{-1}, \quad R_D = 10 \text{ e}^{-} \text{ hr}^{-1} \text{ pix}^{-1}$$

$$N_R^2 = 5 \text{ e}^{-}/\text{pix}$$

$$\text{PSF} \sim 4 \text{ pix} \rightarrow N_{\text{pix}}$$

$$R_D = \frac{10 \text{ e}^{-}}{\text{hr}} \cdot \frac{1 \text{ hr}}{3600 \text{ s}} = \frac{1}{360} \text{ e}^{-} \text{ s}^{-1}$$

$$\frac{S}{N} = \frac{0.2t}{\sqrt{0.2t + 4(0.5t + t/360 + 5)}} \Rightarrow \begin{array}{l} \text{using desmos,} \\ t \approx 552786.825 \text{ s} \\ \text{for } S/N = 100 \end{array}$$

$$552786.825 \text{ s} \cdot \frac{1 \text{ min}}{60 \text{ s}} = 9213 \text{ 1-min exposures}$$