

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

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

2.3m telescope V filter

QE = 0.5

observe at  $\lambda = 2$

$\Rightarrow$  monochromatic luminosity = luminosity per wavelength or frequency unit

$\rightarrow$  assuming luminosity isotropic (?)

$$R = (QE \cdot N_{\text{atoms}}) \cdot \Delta \lambda \cdot A \cdot f_{\lambda}$$

$\downarrow$        $\downarrow$   
 $580 \text{ Å}$        $(1150 \text{ nm})^2 \pi$

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

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

$$E_{\text{ph}} = \frac{h c}{\lambda} = \frac{6.626 \times 10^{-34} \text{ erg s} \cdot 3 \times 10^8 \text{ Å/s}}{5500 \text{ Å}} = 3.613 \times 10^{-12} \text{ erg ph}^{-1}$$

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

$$R = (0.5 \cdot 0.693) (580 \text{ Å}) (1150 \text{ nm})^2 \pi (2.447 \times 10^{-3} \text{ ph s}^{-1} \text{ cm}^{-2} \text{ Å}^{-1})$$

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

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

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

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

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

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

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