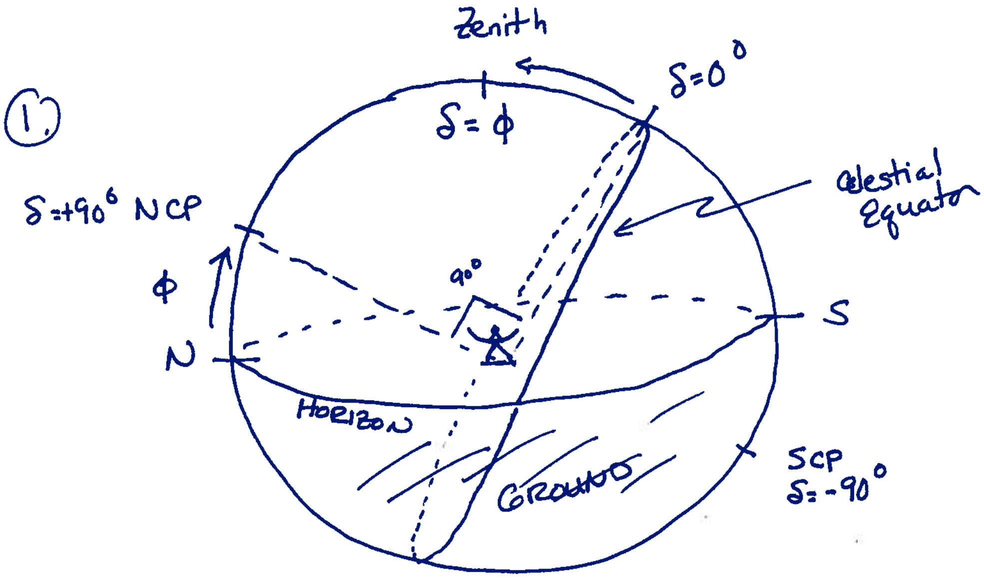
Homework #3 Solutions

ASTR 250

(1.)




At zenith, $\delta_{Zenith} = \phi = +38^\circ 30'$

so declinations affected are $\delta_{zenith} \pm 8^\circ$

$$\Rightarrow \quad 30^\circ 30' \leq \delta \leq 46^\circ 30'$$

If sources are at these $\delta$, then will be unable to effectively track them when they get with $8^\circ$ of zenith.

(2.)

8 inch = D $\quad f/4.5 \quad \Rightarrow \quad f = \text{focal length} = 4.5 \cdot 8\text{in.} = 36 \text{ in.}$

25mm eyepiece $\Rightarrow \quad m = \dfrac{36 \text{ in} \cdot \frac{2.54\text{cm}}{1 \text{ in}}}{2.5 \text{ cm}} = 36.6 \times$

9mm eyepiece $\Rightarrow \quad m = \dfrac{36 \text{ in} \cdot \frac{2.54\text{cm}}{1 \text{ in}}}{0.9 \text{ cm}} = 101.6 \times$

(3.)

$D_{JWST} = 6.5\text{m}$

$D_{HST} = 2.4\text{m}$

$\Rightarrow$ Ratio of Light gathering Power $= \dfrac{D_{JWST}^2}{D_{HST}^2} = \left(\dfrac{6.5}{2.4}\right)^2 = 7.3 \times$ more

(4.) Keck $D = 10\,m$ $\quad f/1.75 \Rightarrow f = 1.75 \cdot 10m = 17.5m$

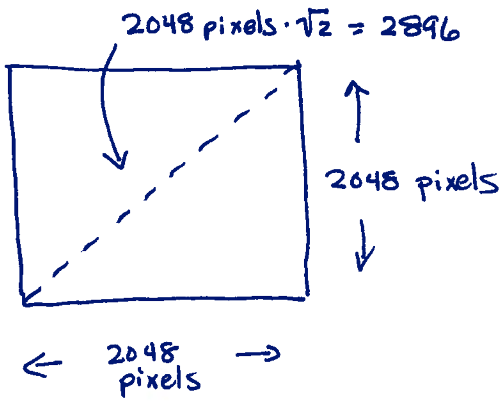
$= 1750\,cm$

Plate scale of 1 pixel $= s = f \cdot \theta = 10\,\mu m$

So $\theta = \dfrac{s}{f} = \dfrac{10\,\mu m}{1750\,cm} = \dfrac{1 \times 10^{-3}\,cm}{1750\,cm} = 5.71 \times 10^{-7}\,rad \cdot \dfrac{206265''}{1\,rad}$

$= 0.12''$

So, the resolution of each pixel is $0.''12$.

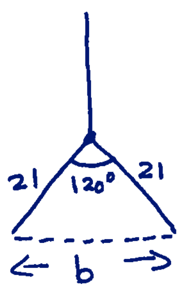



$F.O.V = 2896 \cdot 0.''12 = 341''$

$= 5.7'$

across the CCD

(5.)




Law of Cosines Plane Triangle: $b^2 = 21^2 + 21^2 - 2 \cdot 21 \cdot 21 \cdot \overset{-0.5}{\cancel{\cos}}\,120^\circ$

$= 3 \cdot 21^2 = 1323\,km^2$

$b = 36.4\,km$ is longest baseline

Interferometer Resolution $\theta = \dfrac{\lambda}{b} = \dfrac{21.1\,cm}{36.4\,km \cdot \dfrac{10^5\,cm}{1\,km}} = 5.8 \times 10^{-6}\,rad \cdot \dfrac{206265''}{1\,rad}$

$= 1.2''$

Single VLA dish resolution $\theta \sim 1.2 \dfrac{\lambda}{D} = 1.2 \cdot \dfrac{21.1\,cm}{25m \cdot \dfrac{10^2 cm}{1\,m}} = 8.44 \times 10^{-3}\,rad \cdot \dfrac{206265''}{1\,rad}$

$= 1741''$

$= 29'$

For comparison, the Full Moon is $\sim 30'$!