Azeem Bari

HW 1

#1 Alcor: RA = 13:25:13.53783
dec = 54:59:16.6548

Mizar: RA = 13:23:55.54
dec = 54:55:31.2671

To find Angular Distance:

$\Delta\alpha = 13:25:13.5378 - 13:23:55.54$

→ and 25m = 1500s and 23m = 1380s

So, 13h1513.53783s − 13h1435.54s = $\underline{77.998s}$ of RA $= \Delta\alpha$

$\Delta\delta = 54:59:16.655 - 54:55:13.2671$

→ converting arcmin to arcsec

$54°3556.655'' - 54°3331.2671'' = \underline{225.388''}$ of dec $= \Delta\delta$

To find Θ:

$$\Theta^2 = \Delta\delta^2 + (\Delta\alpha \cos \Delta\delta_{avg})^2$$

for the first term: $\Delta\delta = 225.388''$

second term: $\Delta\alpha \cos \Delta\delta_{avg}$

know this, $\Delta\alpha = 77.998s$

So, $\Delta\delta_{avg} = \frac{1}{2}(\delta_B - \delta_A) + \delta_A$

converting to degrees:

$$\delta_B = \left(54° + \frac{59°}{60'} + \frac{16.65°}{3600''}\right)$$

$$\rightarrow 54 + 0.983 + 0.004625 = 54.987°$$

$$\delta_A = \left(54° + \frac{55°}{60'} + \frac{31.262°}{3600''}\right)$$

$$\rightarrow 54 + .9166 + .008685 = 54.9253°$$

$$\Delta\delta_{avg} = \frac{1}{2}(54.987 - 54.9253) + 54.9253 = \underline{54.956°}$$

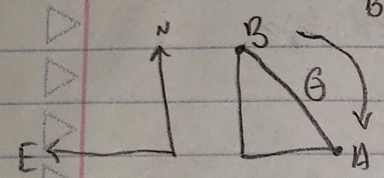
So $\Delta\alpha \cos\Delta\delta_{avg} = 77.9985 \cdot 15^{arcsec/s} \cdot \cos(54.956) = 671.563$ arcsec

then $\Theta = \sqrt{(225.388'')^2 + (671.388'')^2}$

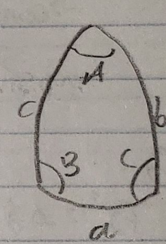
So $\boxed{\Theta = 708.37''}$

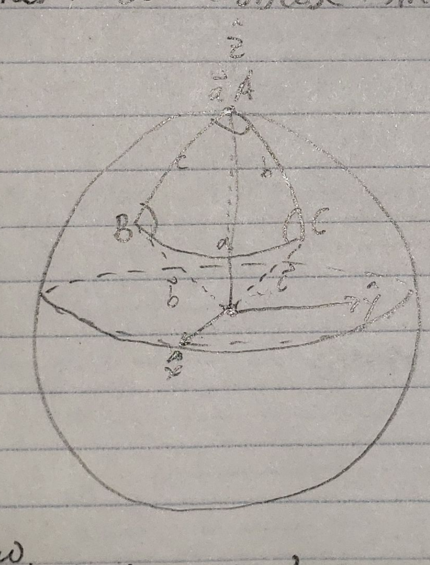
Now for Position angle

$$PA_{BA} = \tan^{-1}\left(\frac{\Delta\alpha}{\Delta\delta}\right) = \tan^{-1}\left(\frac{671.388''}{225.388''}\right) = \boxed{71.44}$$



2.) law of cosines ⇒ $\cos a = \cos b \cos c + \sin b \sin c \cos A$





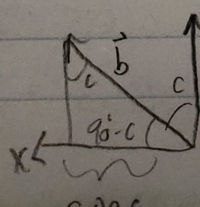
what we know,

$\vec{x}\cdot\vec{y} = |\vec{x}||\vec{y}|\cos\Theta$ → unit sphere $\vec{x}\cdot\vec{y} = \cos\Theta$

So, $\vec{b}\cdot\vec{c} = |\vec{b}||\vec{c}|\cos a = \cos a$

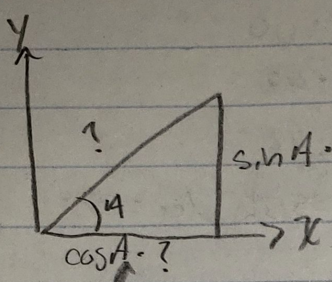
Now, we need to find $\vec{b}$ and $\vec{c}$

So, $\vec{b}$ in cartesian coords, in xz plane, not in y plane



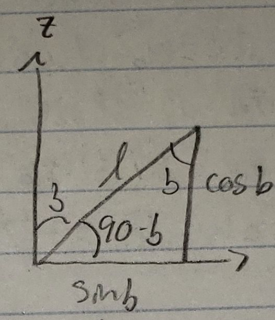
cos C ⇒ $\vec{b} = \sin c\,\hat{x} + \cos c\,\hat{y}$

Now to find $\vec{c} = ?$



in xy plane

and



↳ hypotenuse in xy plane!

So, $? = \sin b$

So, $\vec{c} = \cos A \sin b\,\hat{x} + \sin A \sin b\,\hat{y} + \cos b\,\hat{z}$

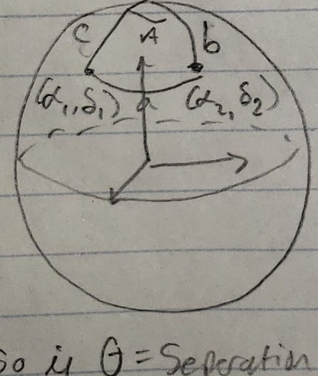
AND,

$\vec{a}\cdot\vec{b} = \cos b$

$\vec{a}\cdot\vec{c} = \cos c$ because $\vec{a} = \hat{z}$

So, $\boxed{\vec{b}\cdot\vec{c} = \sin b \sin c \cos A + \cos b \cos c = \cos a}$

Now to convert to RA and dec,



$\alpha_2 - \alpha_1 = A$, same angle

$90 - \delta_2 = b$

$90 - \delta_1 = c$

So if θ = Seperation angle

$\cos(\theta) = \cos(90-\delta_2)\cos(90-\delta_1) + \sin(90-\delta_2)\sin(90-\delta_1)\cos(\alpha_2 - \alpha_1)$

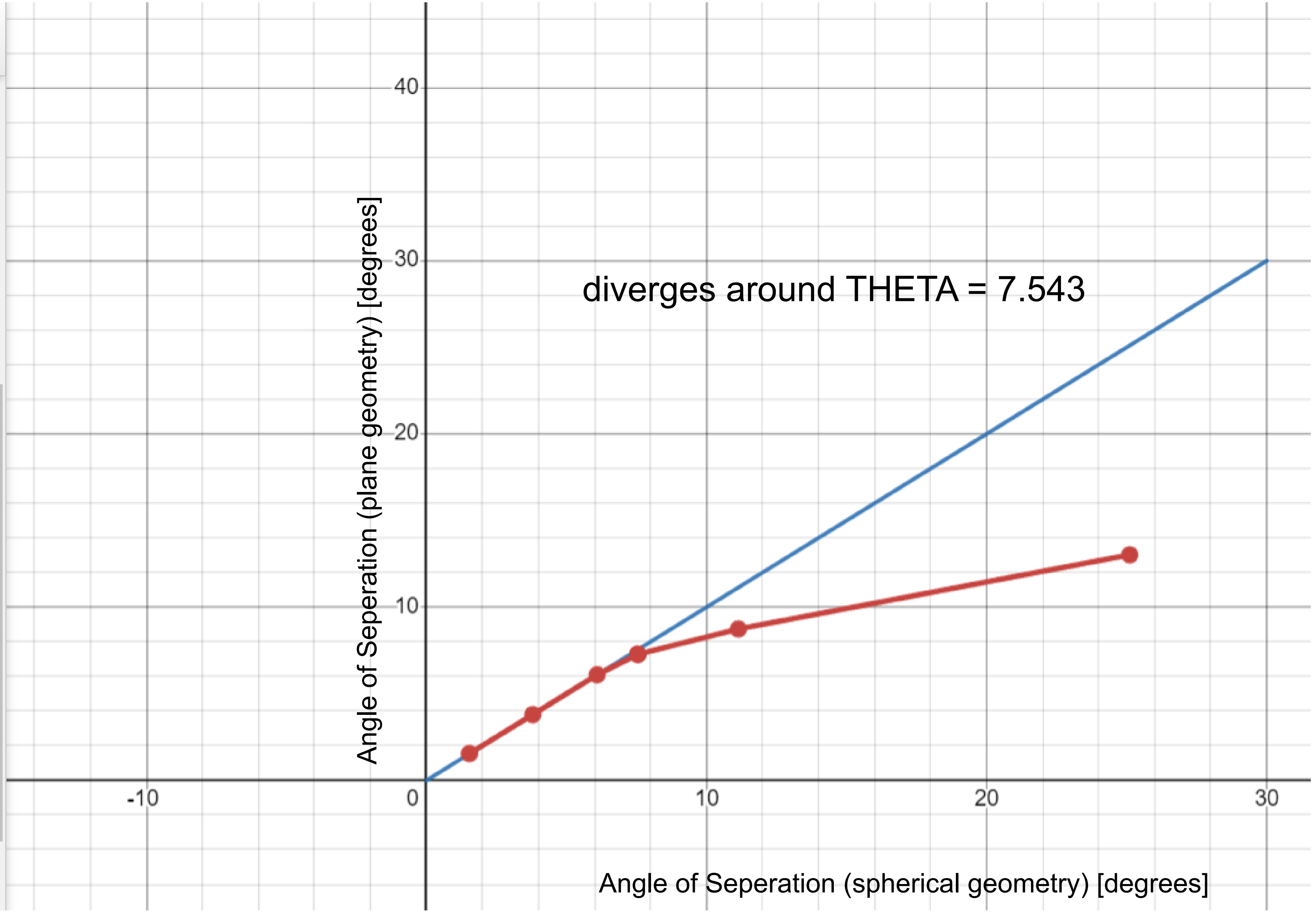
So, $\boxed{\cos(\theta) = \sin\delta_2 \sin\delta_1 + \cos\delta_2 \cos\delta_1 \cos(\alpha_2 - \alpha_1)}$

6

x_1	y_1
0	0
30	30

7

x_2	y_2
1.53249	1.54336
3.79282	3.79413
6.08927	6.09241
7.543	7.275
....	....
7.543	7.275
11.13265	8.73581
25.11073	13.02148



3.) Galactic center : RA = 17:45:40 dec = -28:56:00

Galactic anticenter : RA = 06:17:00 dec = 22:30:00

Galactic northpole RA = 12:51:26 dec = 27:07:42

Galactic southpole : RA = 00:51:26 dec = -27:07:42

Ecliptic : RA = 17.5h dec = -22° AND RA = 5.5h dec = 22°

4.) UM269 : RA = 10.83° dec = 0.8543°

PDS898 : RA = 234.24° dec = 34.58°

PKS 2203-215 : RA = 331.67° dec = -21.327°

To find rise and set times, assume 12h day and 12h night

need RA in hr:min:sec

so,

UM 269 ⇒ RA ≈ 0.722h ≈ 0h 43m 19s ⇒ Zenith around midnight

so, rises around $\boxed{\text{19h, so 7pm}}$

sets around $\boxed{\text{7h, so 7am}}$

PDS 898 ⇒ RA ≈ 15h36m ⇒ Zenith around 3pm

so, rises around $\boxed{\text{9h, so 9AM}}$

sets around $\boxed{\text{21h, so 9pm}}$

PKS 2203-215 ⇒ RA ≈ 22h 6m ⇒ Zenith around 10pm

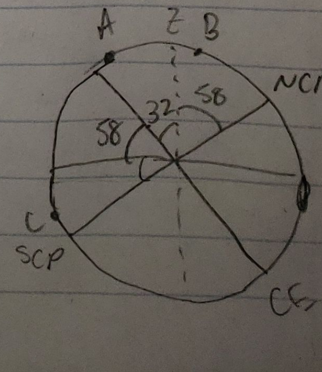
so, rises around $\boxed{\text{16h, so 4pm}}$

sets around $\boxed{\text{4h, so 4am}}$

Now for minimum airmass, X

λ at Kitt Peak ≈ 32°

$$Z_{min} = |\lambda - \delta| \qquad X_{min} = \frac{1}{\cos(Z_{min})}$$



UM269 : $Z_{min} = 32° - 0.8543° = 31.1457°$

$$X_{min} = \frac{1}{\cos(Z_{min})} = \boxed{1.17}$$

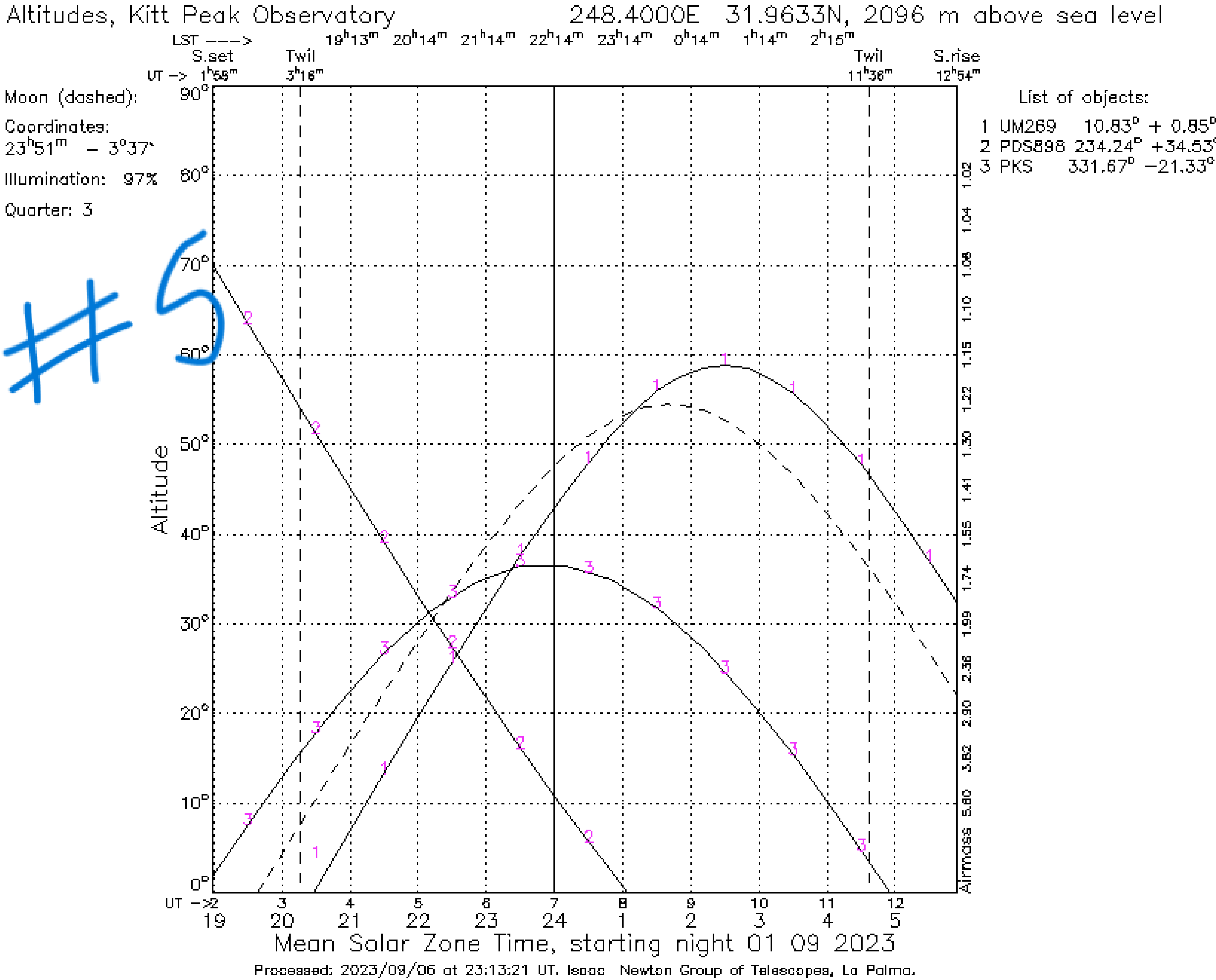
PDS 898: $z_{min} = |32° - 34.53°| = 2.53°$

$$X_{min} = \frac{1}{\cos(z_{min})} = \boxed{1.00009}$$

PNS 2203 - 215: $z_{min} = |32° + 21.327| = 53.327°$

$$X_{min} = \frac{1}{\cos(z_{min})} = \boxed{1.67}$$

#5



Altitudes, Kitt Peak Observatory 248.4000E 31.9633N, 2096 m above sea level
LST ---> 19h13m 20h14m 21h14m 22h14m 23h14m 0h14m 1h14m 2h15m
S.set Twil Twil S.rise
UT -> 1h55m 3h16m 11h36m 12h54m
Moon (dashed):
Coordinates: 23h51m -3°37'
Illumination: 97%
Quarter: 3
List of objects:
1 UM269 10.83° + 0.85°
2 PDS898 234.24° +34.53°
3 PKS 331.67° -21.33°
Altitude
Airmass
Mean Solar Zone Time, starting night 01 09 2023
Processed: 2023/09/06 at 23:13:21 UT. Isaac Newton Group of Telescopes, La Palma.

Telescope	Full Name	Location	Aperture Size	Operational Wavelength Range/Photometric Bands	Website Link	
Spitzer	Spitzer Space Te	Trailing behind E	85cm diameter	Infrared (24-160 microns)	https://www.spitzer.caltech.edu/	
JWST	James Webb Spa	L2	25 sq m	Infrared (0.6-28.5 microns)	https://webb.nasa.gov/index.html	

#6

#7

Direct Imaging Manual for Kitt Peak

- This paper is a manual for the Kitt Peak telescopes that can be used as a source of advice for direct imaging and can also be used as a reference guide. It gives basic parameters for the CCD and telescopes, and overall tips for how to use the instrument.

Photometric Standards: Landolt, 1992, AJ, 104, 340

- This paper presents photometric results of 526 stars on the Johnson-Kron-Cousins broadband UBVRI photometric system. The purpose is for telescopes of intermediate and large sizes to have an "internally consistent homogeneous broadband standard photometric system around the sky".

A User's Guide to Stellar CCD Photometry with IRAF: Massey & Davis, 1992

- This paper acts as a user's guide to obtain instrumental magnitudes and outlines the steps to go from CCD frames to publishable photometry. This paper can be very useful if one is attempting to do either the aperture or PSF method.

A User's Guide to CCD Reductions with IRAF: Massey, 1997

- This paper acts as a guide to help reduce CCD data using IRAF, whether the data be spectroscopic or direct imaging. This paper also discusses why data from CCD images need work.