AGA5802
Astrofísica Observacional

Astronomical coordinates
& planning observations II

Bibliography: Any book (or chapter) on coordinates.

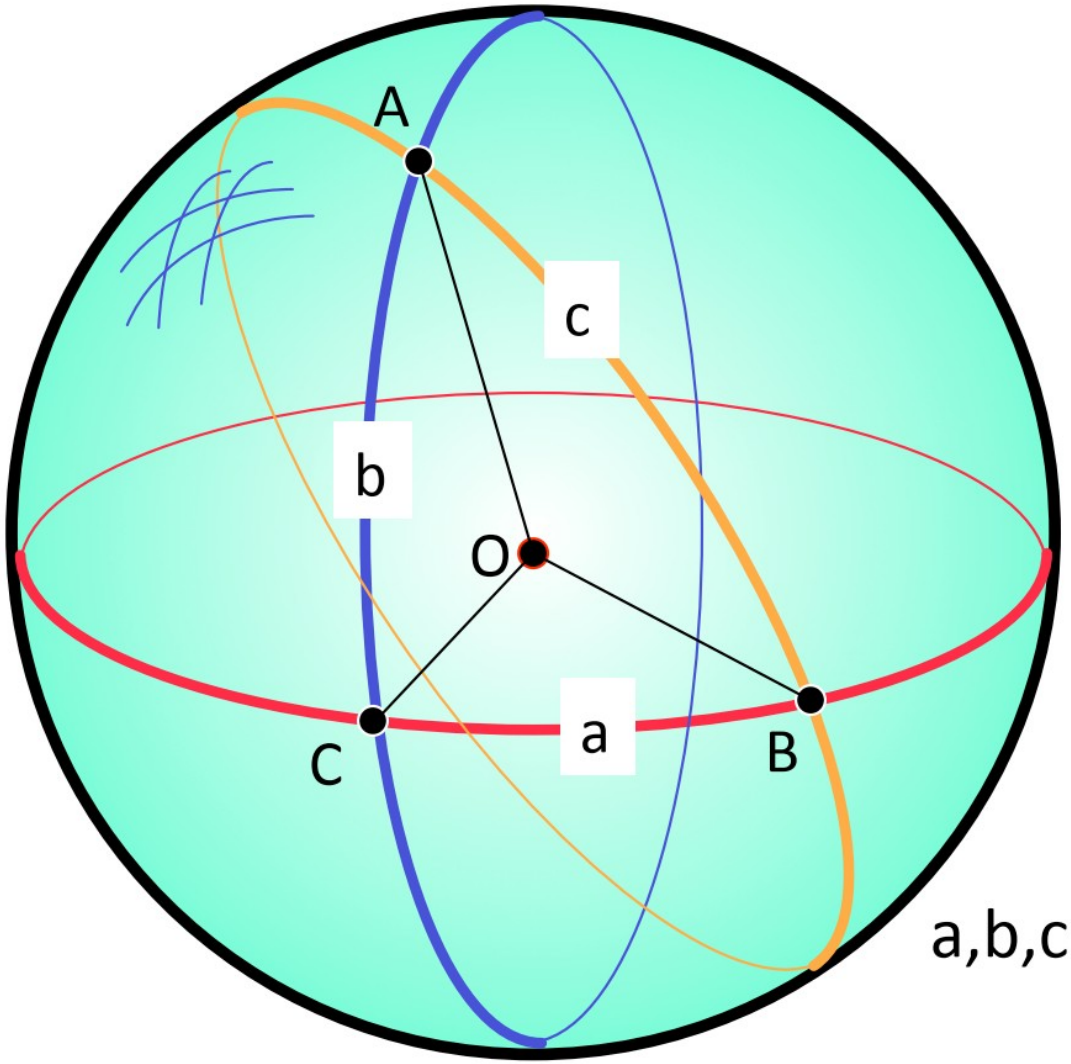
Some basic astrometry in slides from Prof. Roberto Boczko + myself (Elementos de Astronomia):

http://www.astro.iag.usp.br/~jorge/aga205_2011/

Prof. Jorge Meléndez

Spherical triangle

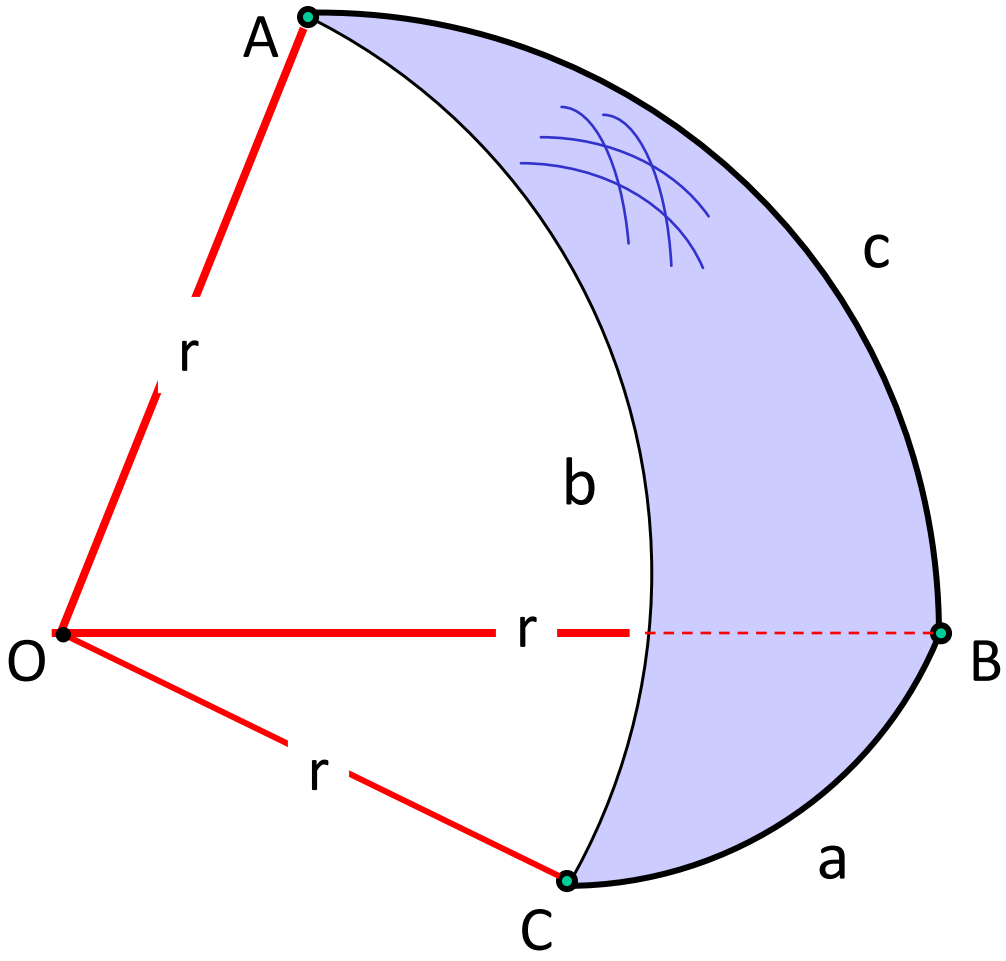
Is the region of the sphere limited by the intersection of 3 planes (A O C, C O B, B O A,) passing by the center of the sphere



A, B, C = vertices

a,b,c = sides

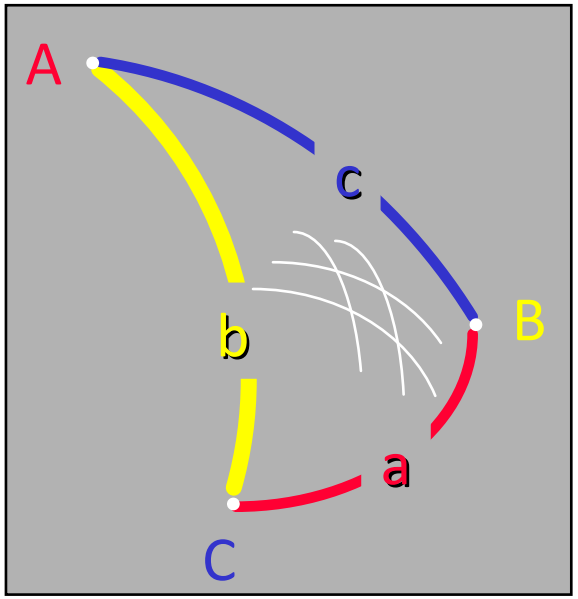
Spherical triangle



a , b , c : sides of the spherical triangle = measurements of the central angles

Sin & cosine formula in a spherical triangle

Important relations for Spherical Trigonometry



Co-seno

$$\cos a = \cos b \cdot \cos c + \operatorname{sen} b \cdot \operatorname{sen} c \cdot \cos A$$

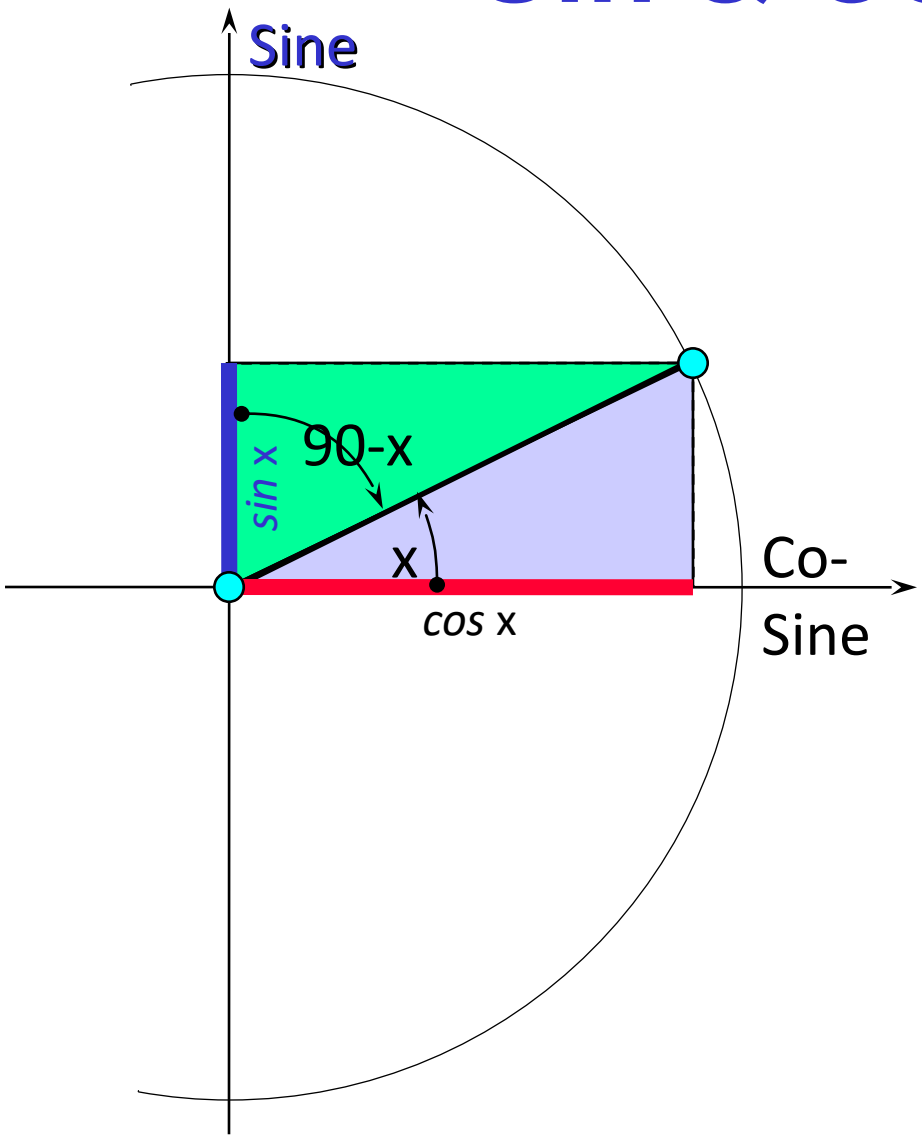
Seno

$$\frac{\operatorname{sen} a}{\operatorname{sen} A} = \frac{\operatorname{sen} b}{\operatorname{sen} B} = \frac{\operatorname{sen} c}{\operatorname{sen} C}$$

Seno & Co-seno

$$\operatorname{sen} a \cdot \cos B = \cos b \cdot \operatorname{sen} c - \operatorname{sen} b \cdot \cos c \cdot \cos A$$

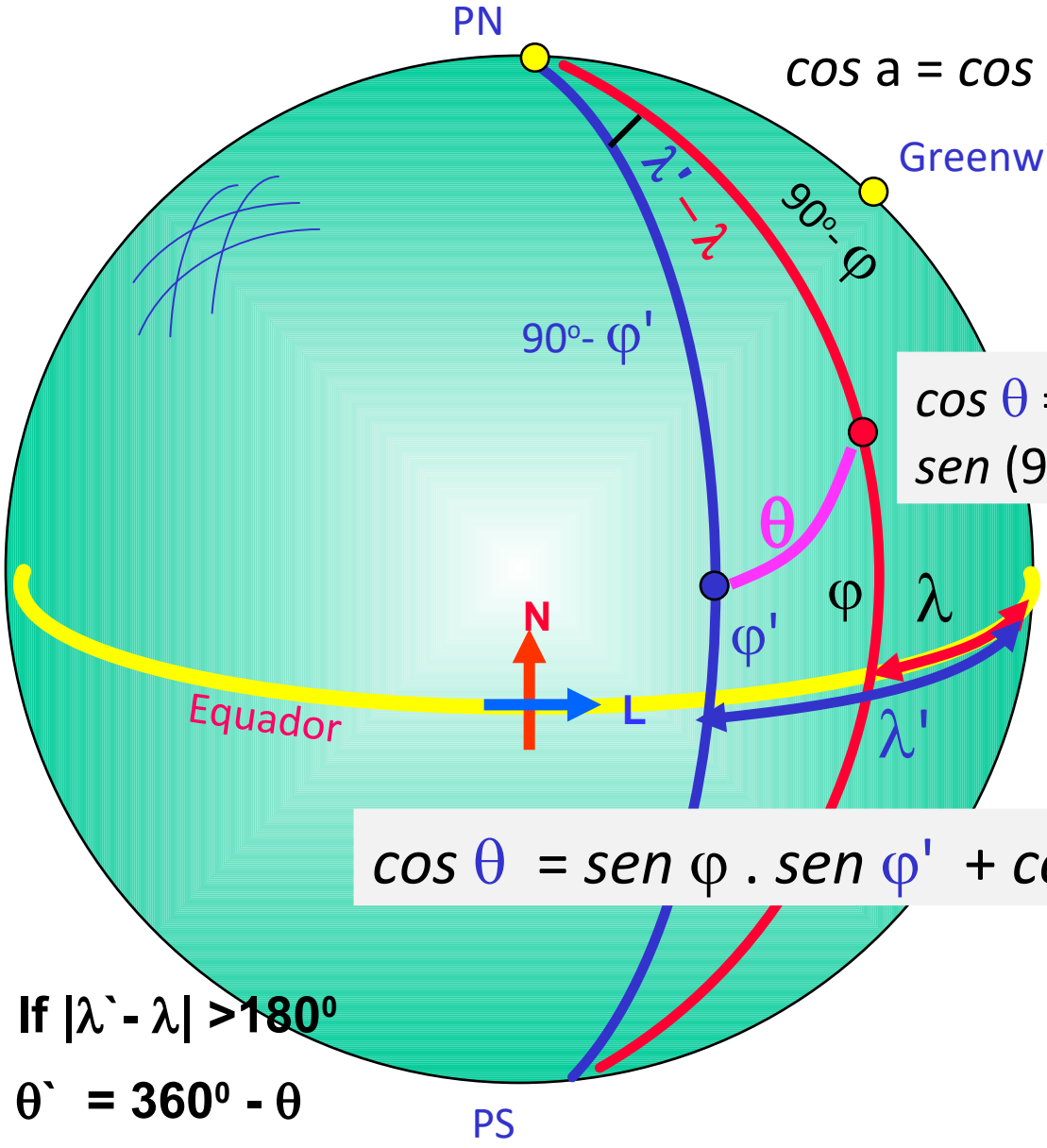
Sin & Cosine of (90^0- x)



$\sin(90^0 - x) = \cos x$

$\cos(90^0 - x) = \sin x$

Angle between 2 cities



$\cos a = \cos b \cdot \cos c + \sin b \cdot \sin c \cdot \cos A$

Co-sine rule

$\cos \theta = \cos (90 - \varphi) \cdot \cos (90 - \varphi') + \sin (90 - \varphi) \cdot \sin (90 - \varphi') \cdot \cos (\lambda' - \lambda)$

$\cos \theta = \sin \varphi \cdot \sin \varphi' + \cos \varphi \cdot \cos \varphi' \cdot \cos (\lambda' - \lambda)$

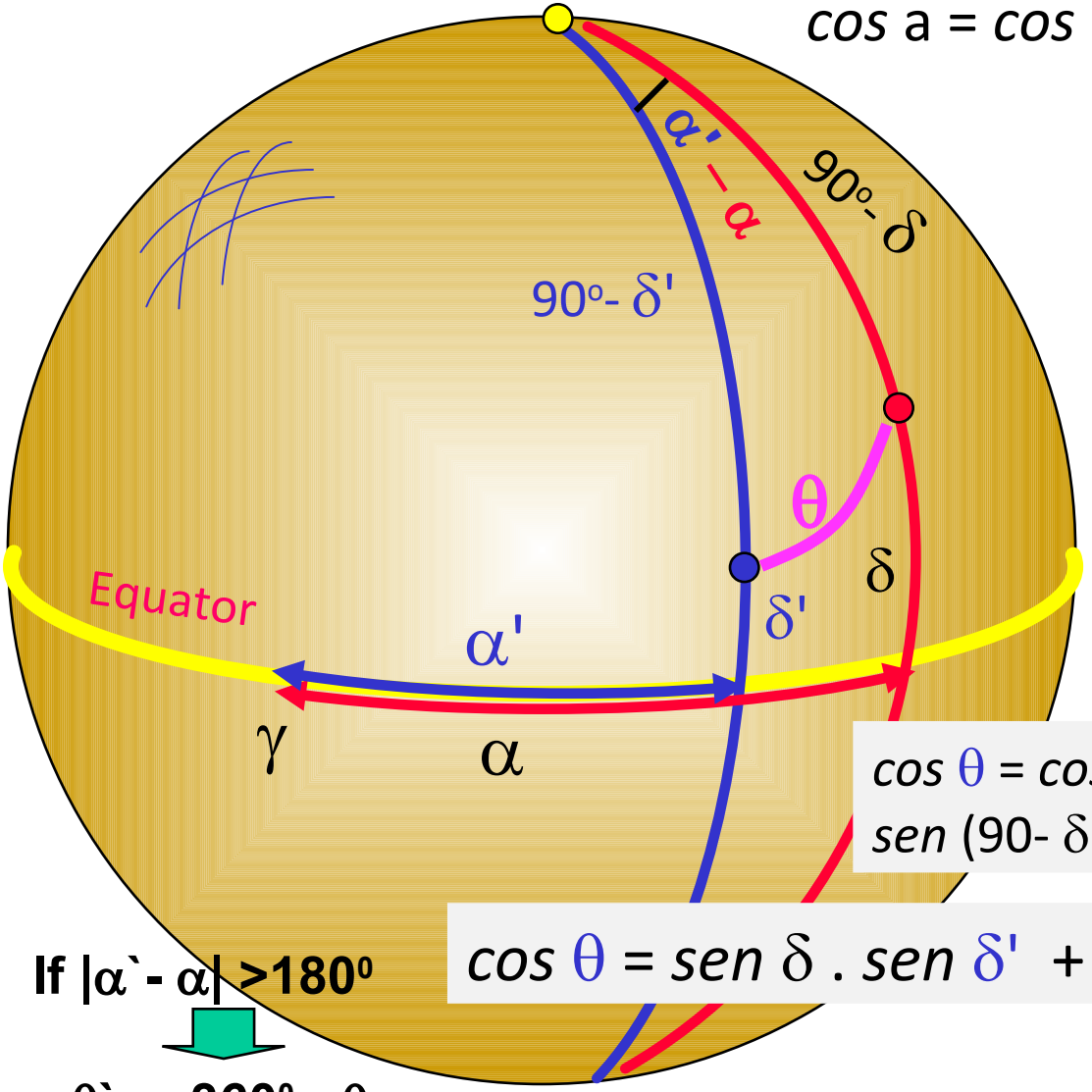
If $|\lambda` - \lambda| > 180^0$

$\theta` = 360^0 - \theta$

Angle between 2 stars

cos a = *cos* b . *cos* c + *sen* b . *sen* c . *cos* A

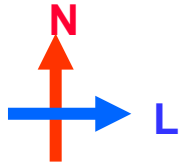
Co-sine rule



Data:

α , δ

α' , δ'



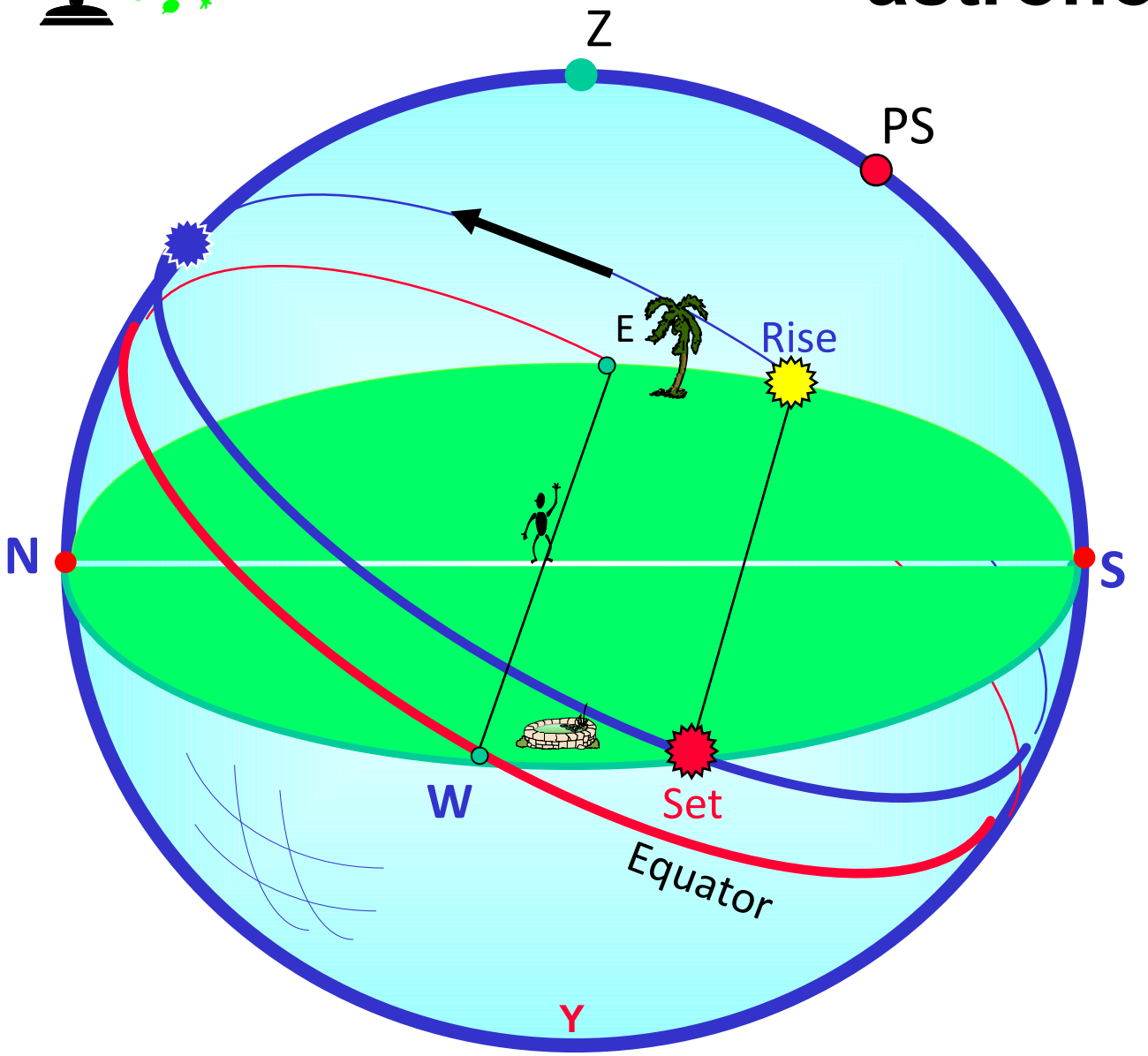
cos θ = *cos* (90- δ) . *cos* (90- δ') +
sen (90- δ) . *sen* (90- δ') . *cos* (α' - α)

cos θ = *sen* δ . *sen* δ' + *cos* δ . *cos* δ' . *cos* (α' - α)

If |α`- α| >180º

θ` = 360º - θ

Condition for the rise or set of an astronomical object

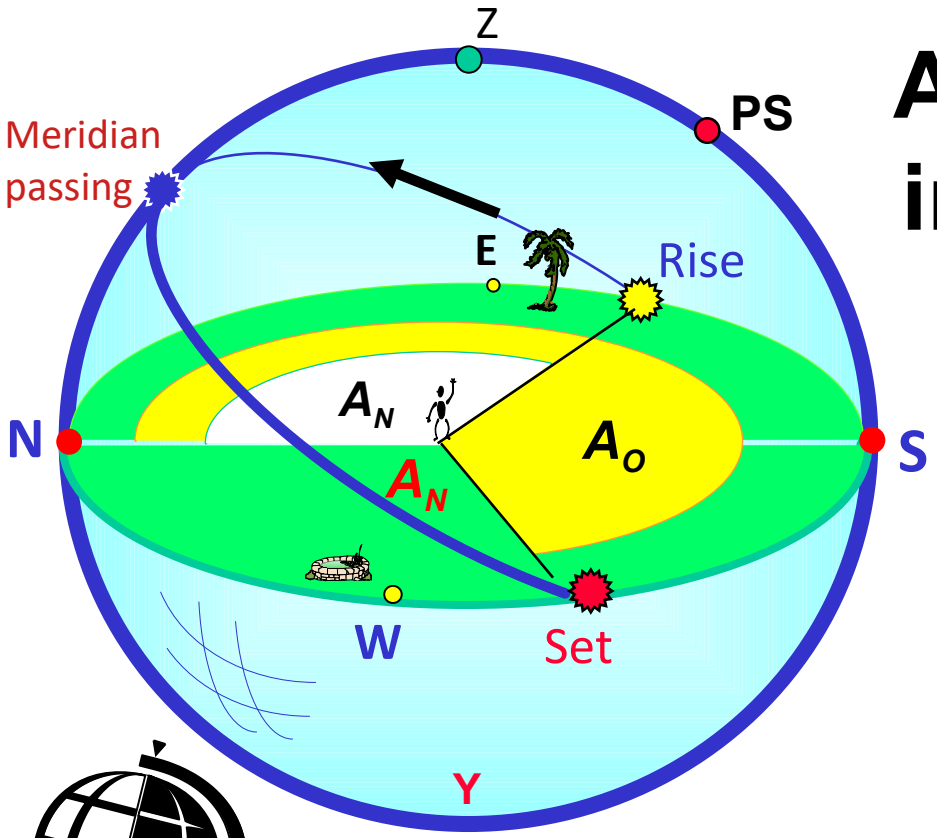


h = 0

or

z = 90°

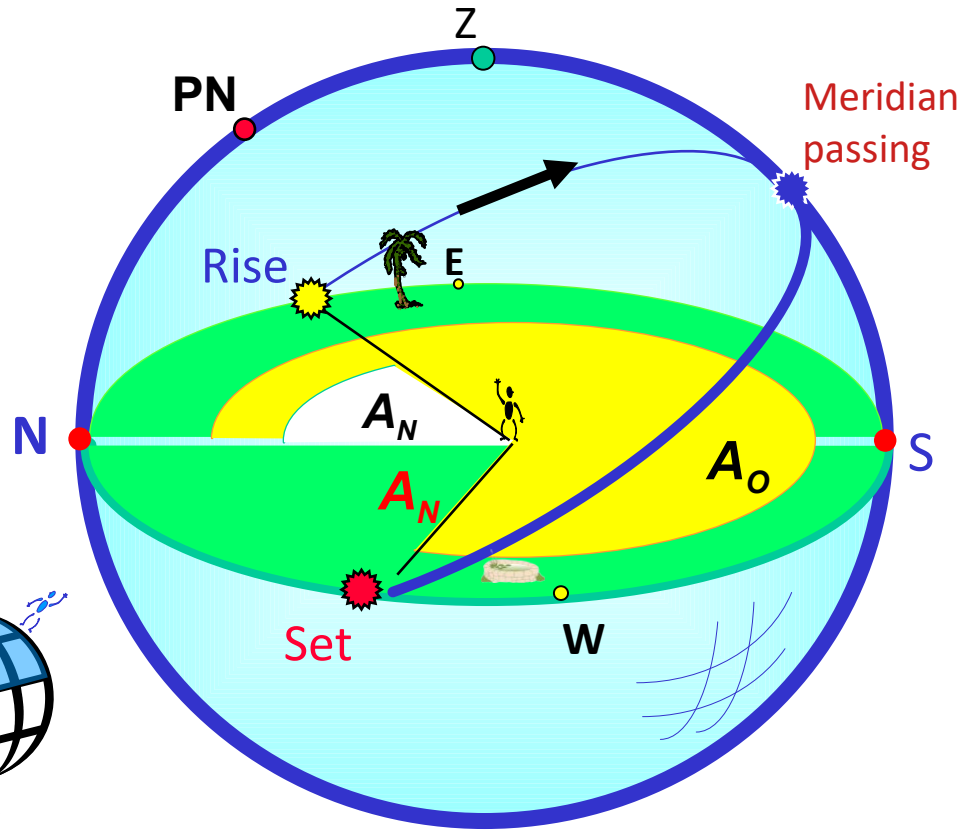
Azimuth at rise & set in the North & South hemispheres



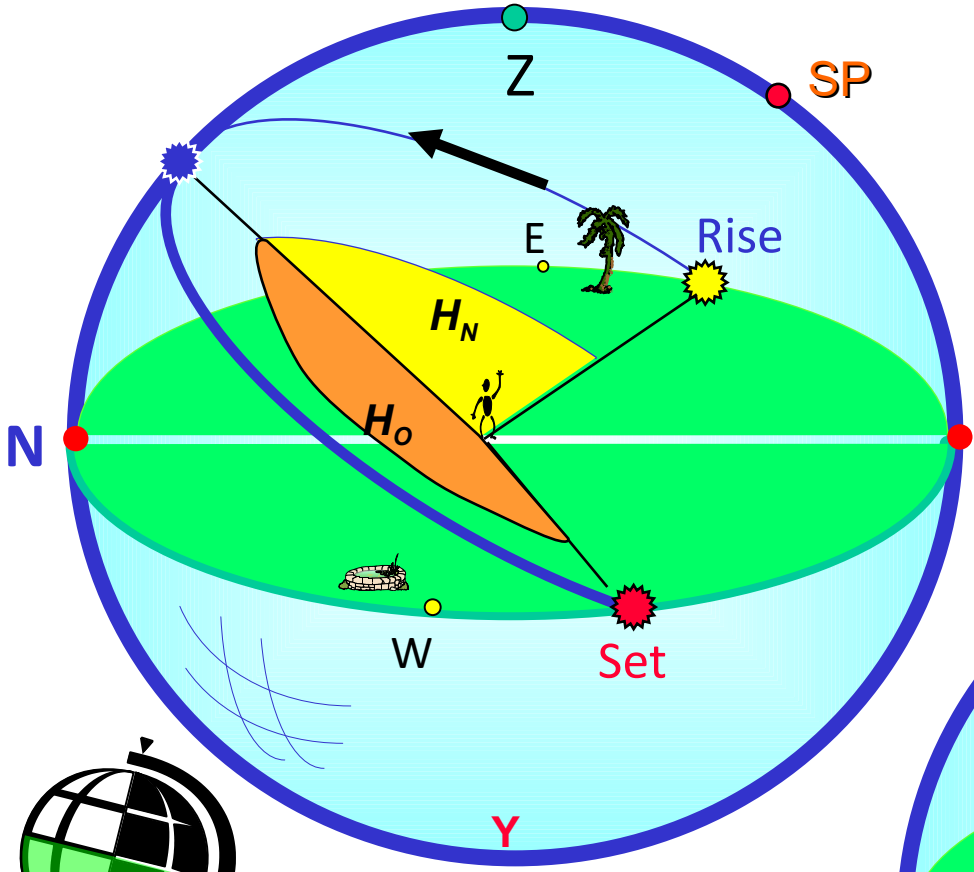
A_N: Azimuth at Rise

A_O : Azimuth at Set

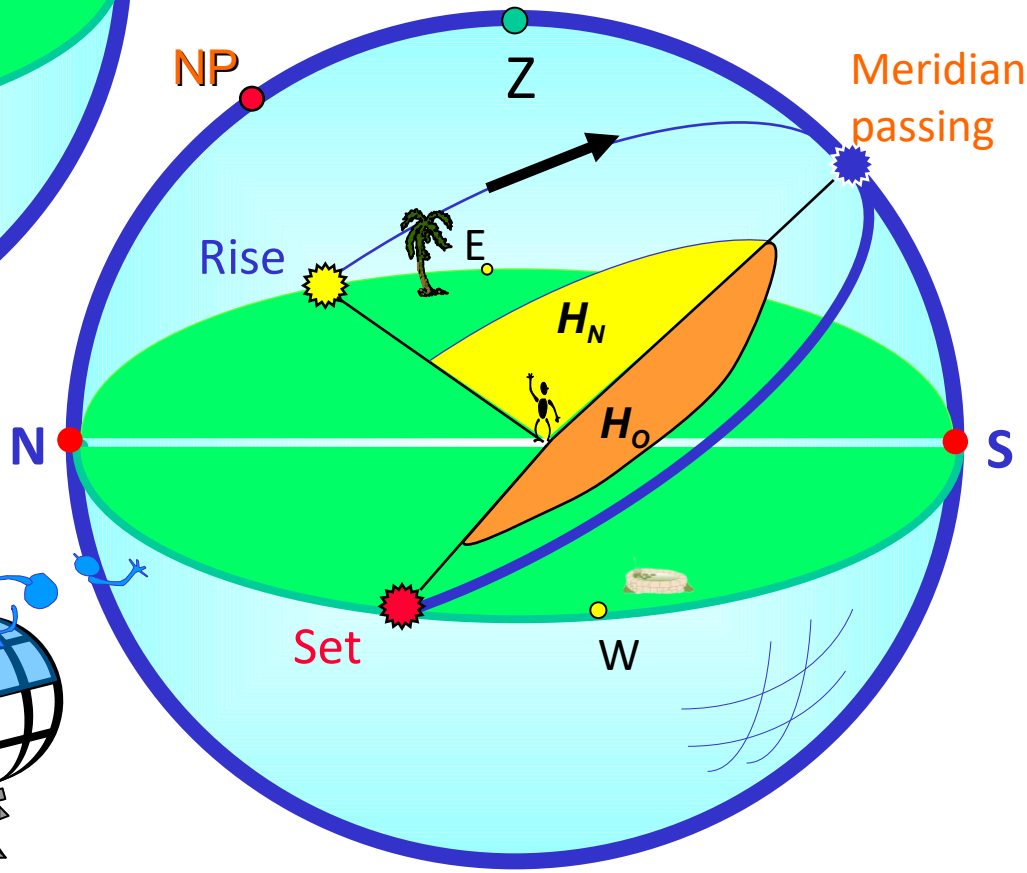
$$A_{Set} = 360^o - A_{Rise}$$



Simmetry of the rise & set in relation to the local meridian

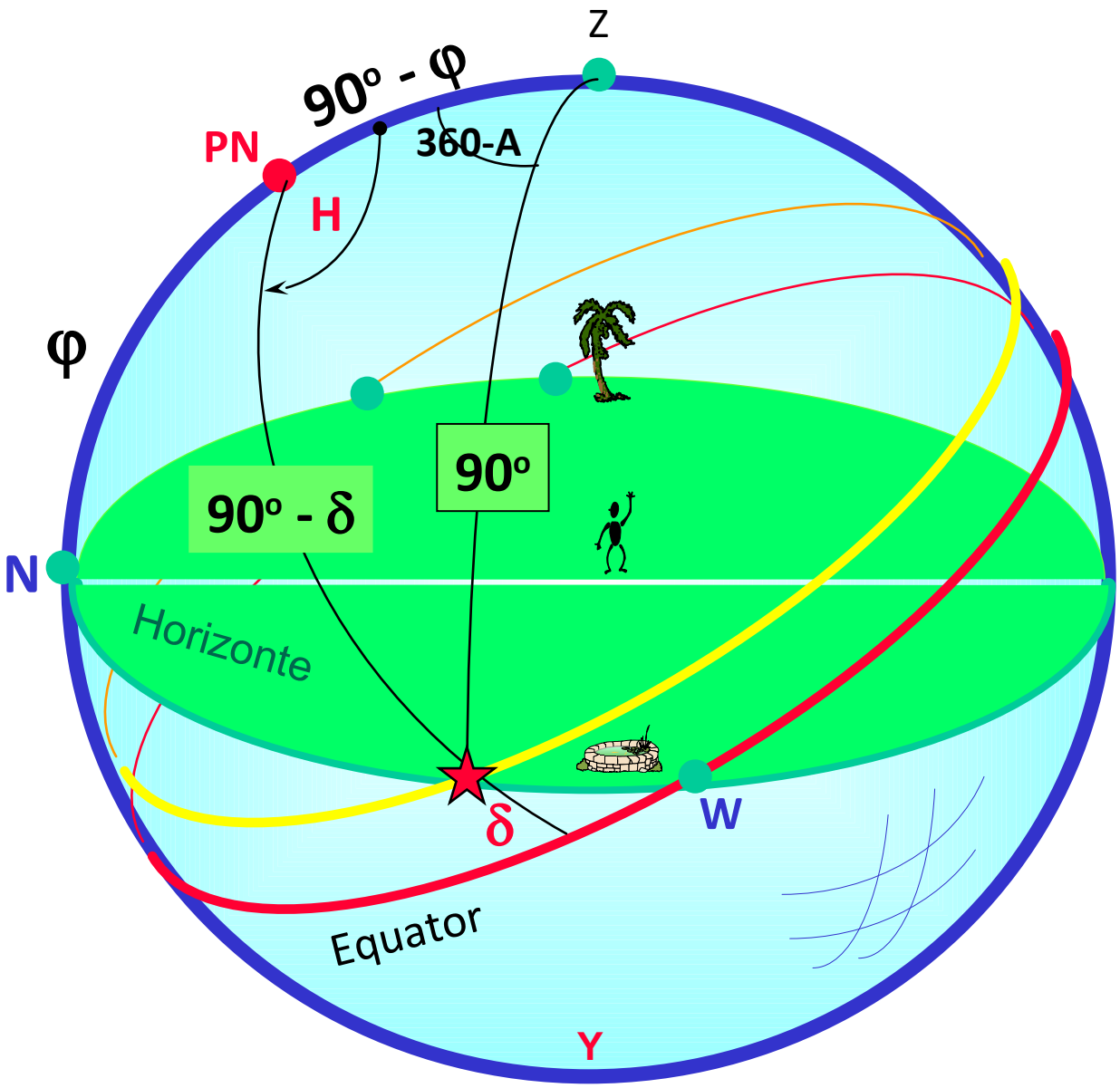


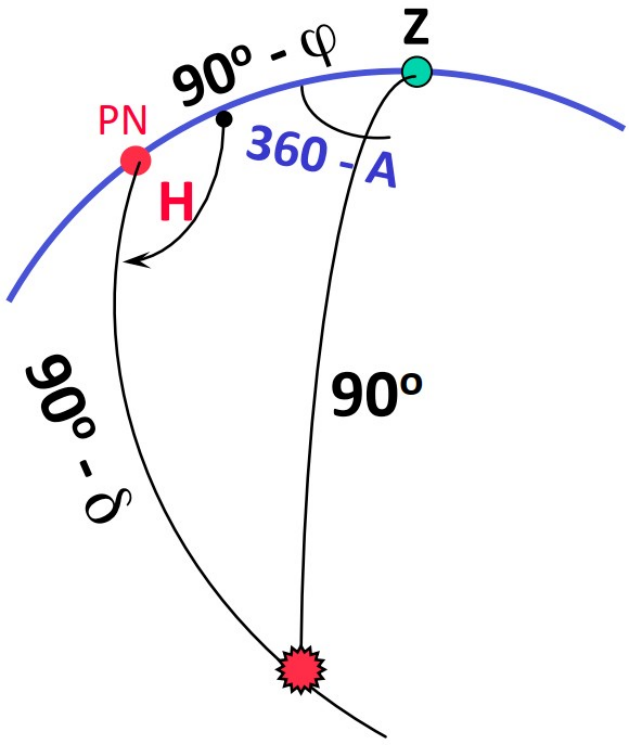
$$H_{Ocaso} = - H_{Nascer}$$



Azimuth & Hour of rise & set of an astronomical object

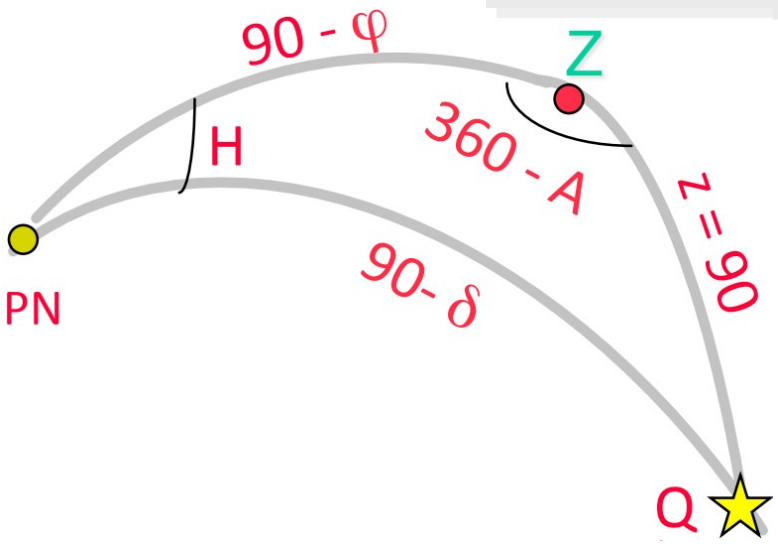
Spherical triangle at set





Azimuth at rise and set

$\cos a = \cos b \cdot \cos c + \operatorname{sen} b \cdot \operatorname{sen} c \cdot \cos A$



a = 90 – δ
b = z = 90 (zenital distance)
c = 90 – φ
A = 360 – A

$\cos(90-\delta) = \cos z \cdot \cos(90-\varphi) + \operatorname{sen}(90-\varphi) \cdot \operatorname{sen} z \cdot \cos(360-A)$ (cos z = 1.0)

$\cos(90-\delta) = \operatorname{sen}(90-\varphi) \cdot \cos(360-A)$

$\operatorname{sen}\delta = \cos\varphi \cdot \cos A$

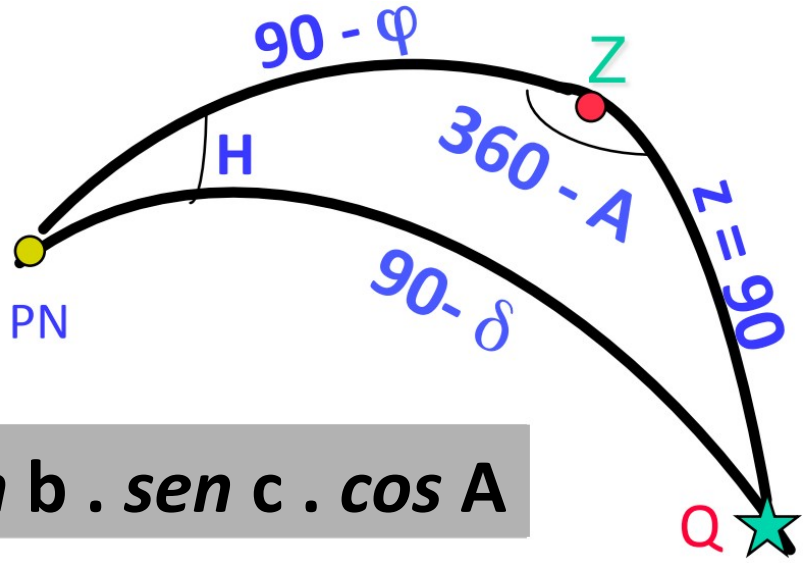
$$\cos A = \operatorname{sen}\delta / \cos\varphi$$

$\Rightarrow 0 \leq \underline{A} \leq 180^o$

At rise: A = $\underline{A}$

At set: A = $360^o - \underline{A}$

Hour angle at rise and set



$$\cos a = \cos b \cdot \cos c + \operatorname{sen} b \cdot \operatorname{sen} c \cdot \cos A$$

$$\cos z = \cos(90-\varphi) \cdot \cos(90-\delta) + \operatorname{sen}(90-\varphi) \cdot \operatorname{sen}(90-\delta) \cdot \cos H$$

$$0 = \operatorname{sen}\varphi \cdot \operatorname{sen}\delta + \cos\varphi \cdot \cos\delta \cdot \cos H$$

$$\cos H = -\operatorname{sen}\varphi \cdot \operatorname{sen}\delta \,/\, \cos\varphi \cdot \cos\delta$$

$$\cos H = -\tan\varphi \cdot \tan\delta$$

$$\Rightarrow 0 \leq \underline{H} \leq 180^0$$

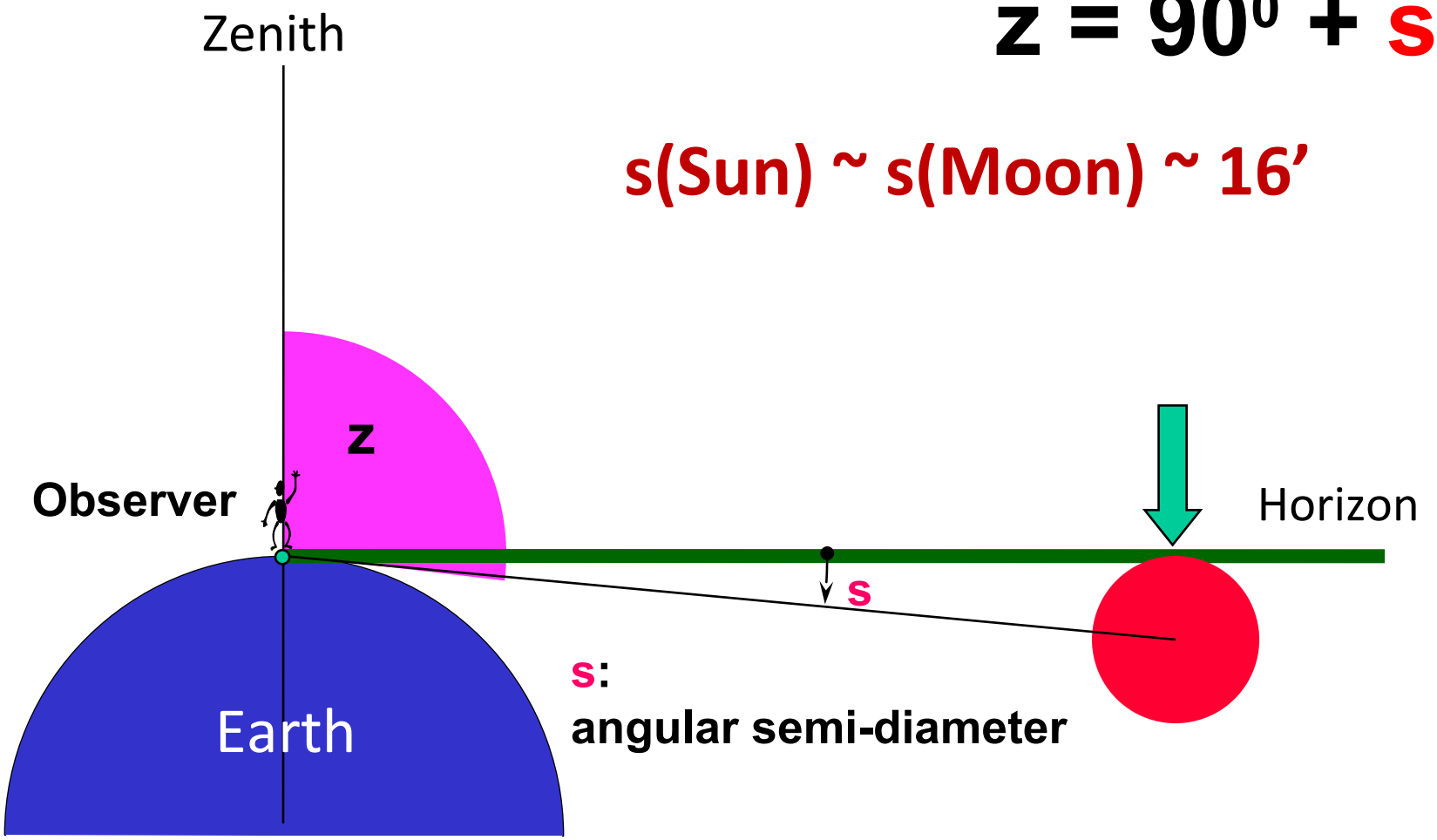
At set: $H_o = \underline{H}$

At rise: $H_n = -\underline{H}$

Zenital distance of an extended object at rise & set

$z = 90^0 + s$

s(Sun) ~ s(Moon) ~ 16’

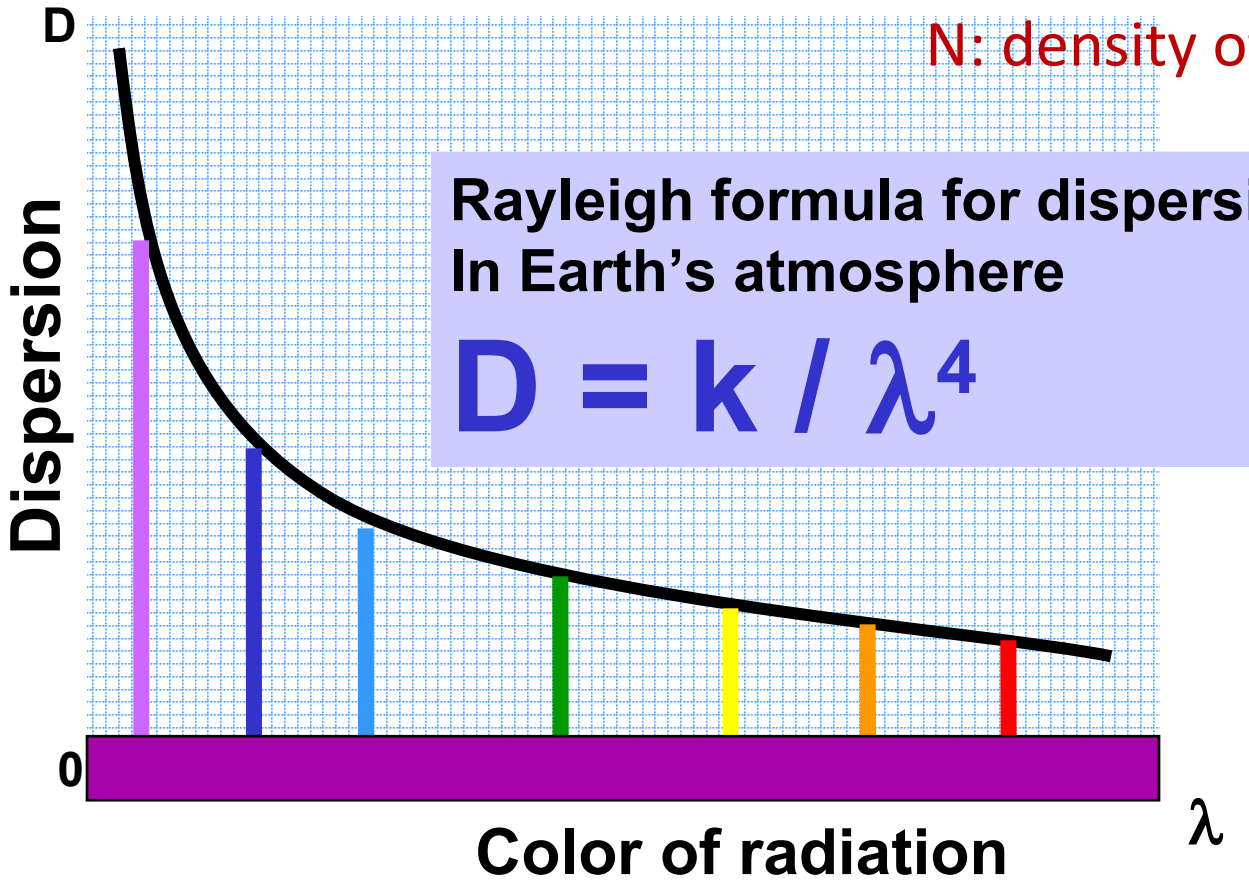


Light dispersion in the atmosphere

$$\sigma_R(\lambda) = \frac{8\pi^3}{3}\frac{(n^2-1)^2}{N^2\lambda^4}$$

n: refraction index

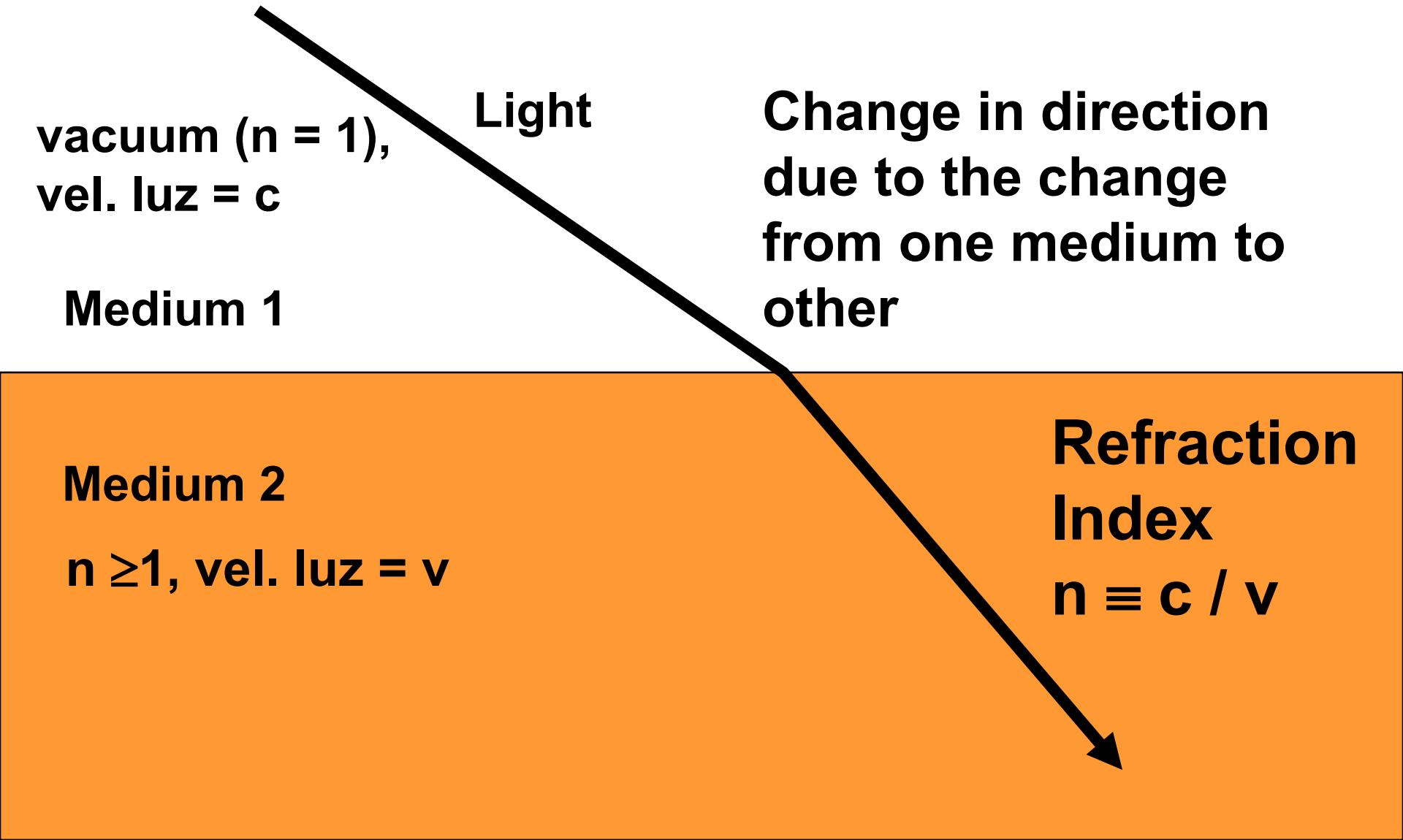
N: density of molecules



Rayleigh formula for dispersion In Earth's atmosphere

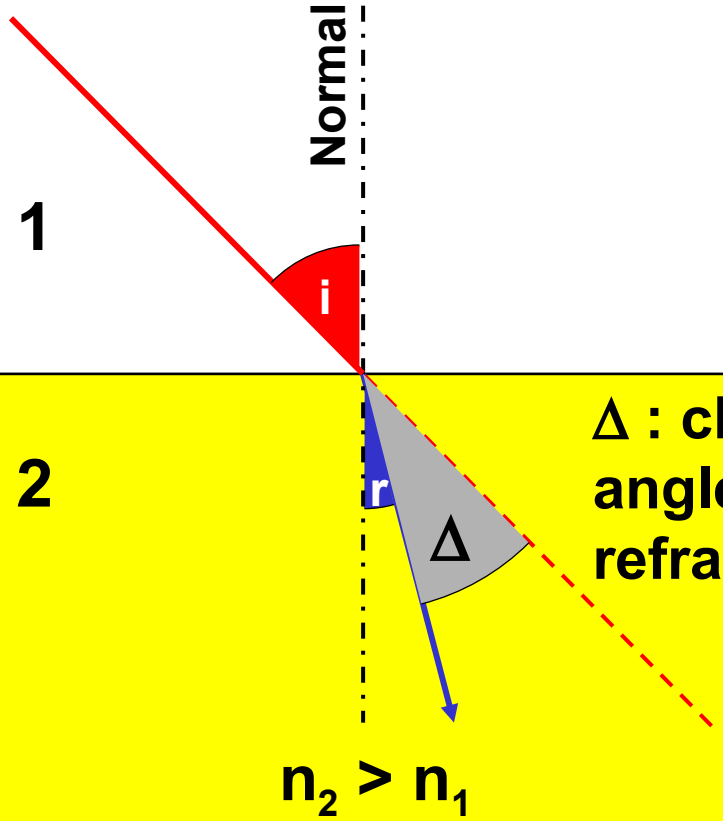
$$D = k / \lambda^4$$

Refraction


vacuum (n = 1),
vel. luz = c
Light
Change in direction due to the change from one medium to other
Medium 1
Medium 2
n ≥1, vel. luz = v
Refraction Index
n ≡ c / v

Snell-Descartes Law

$$n_1 \,.\, sen\ i = n_2 \,.\, sen\ r$$



Medium 1
$n_1 = c/v_1$

$$\Delta = i - r$$

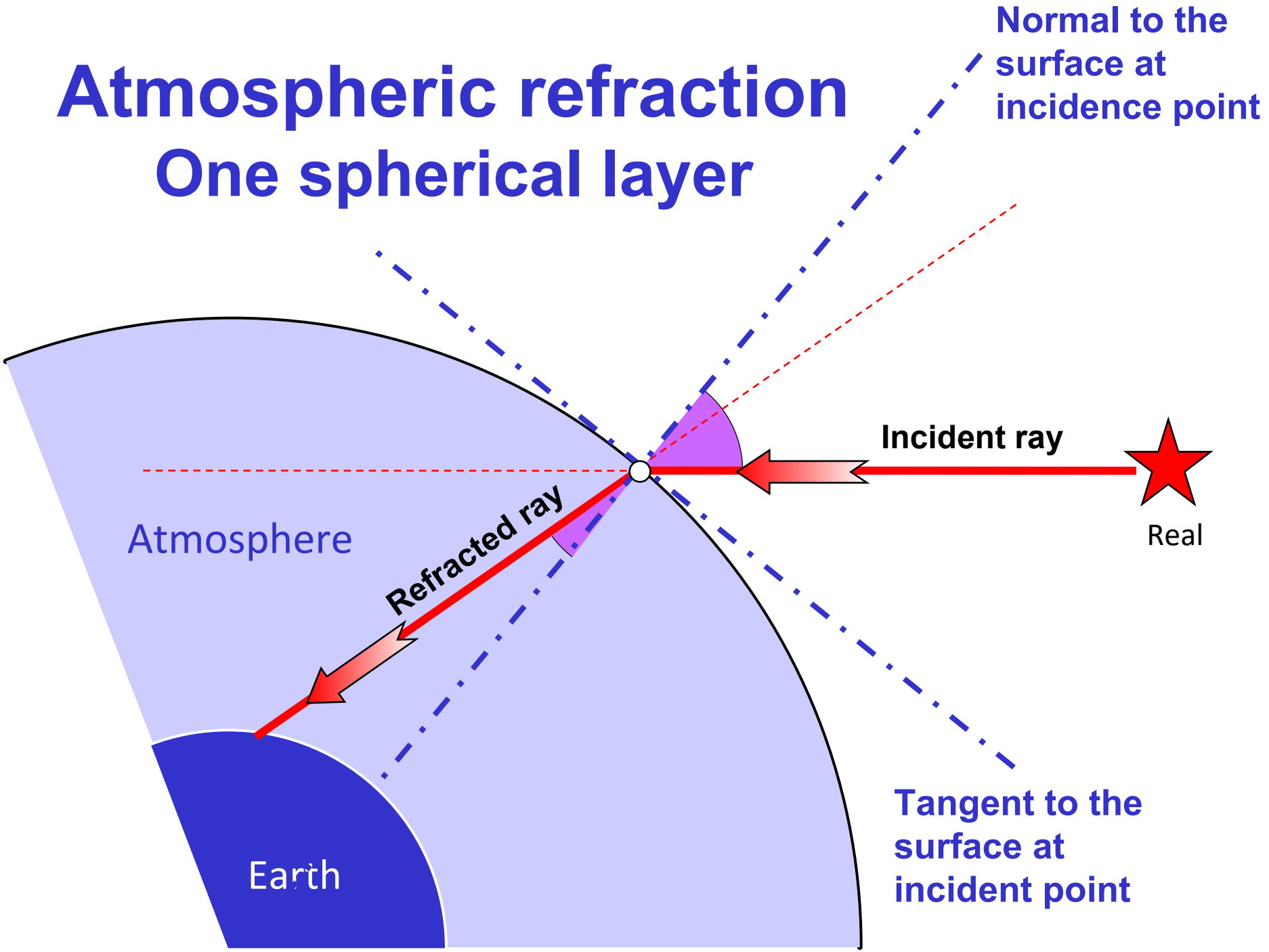
Medium 2
$n_2 = c/v_2$

Δ : change in angle due to refraction

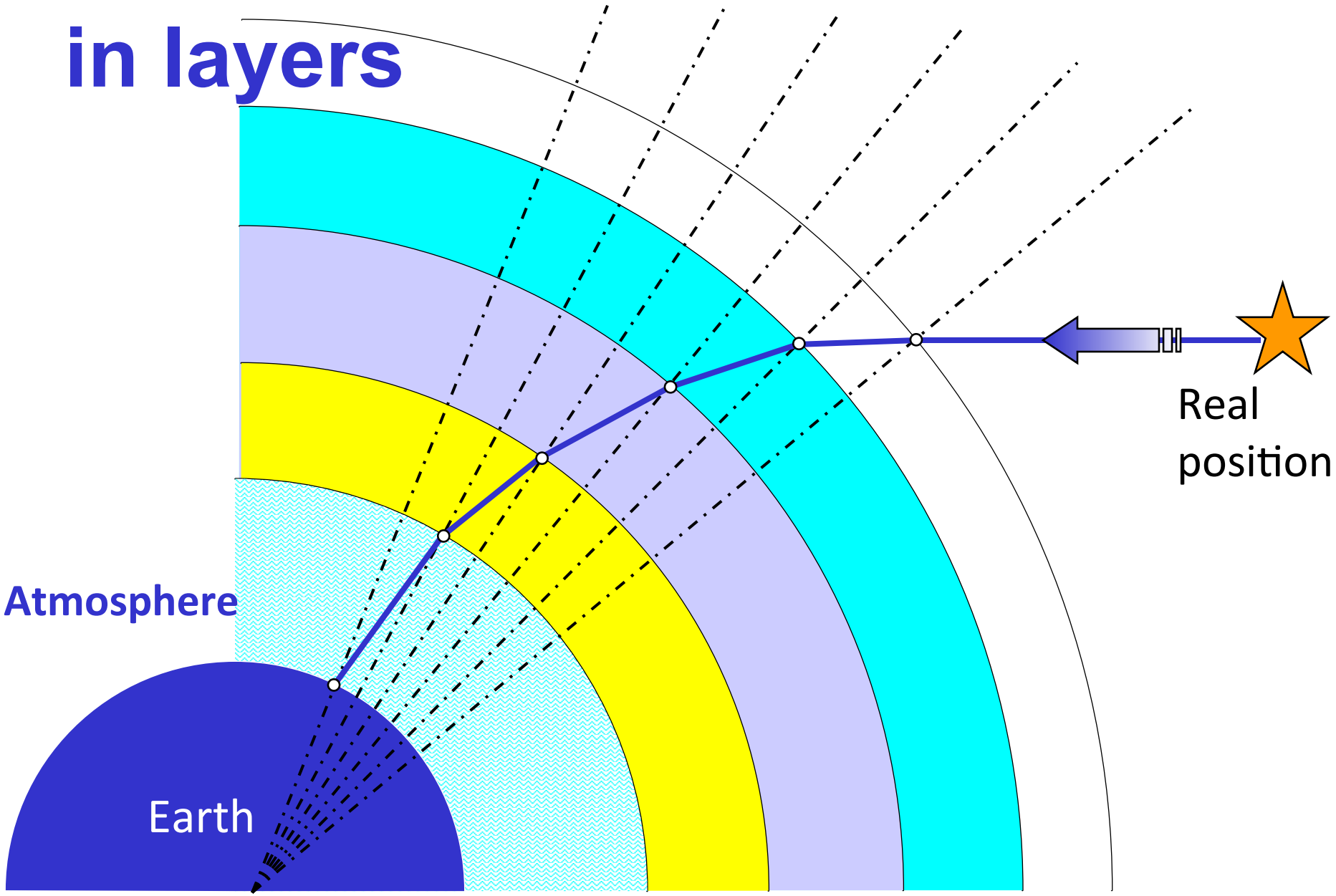
$n_2 > n_1$

Atmospheric refraction

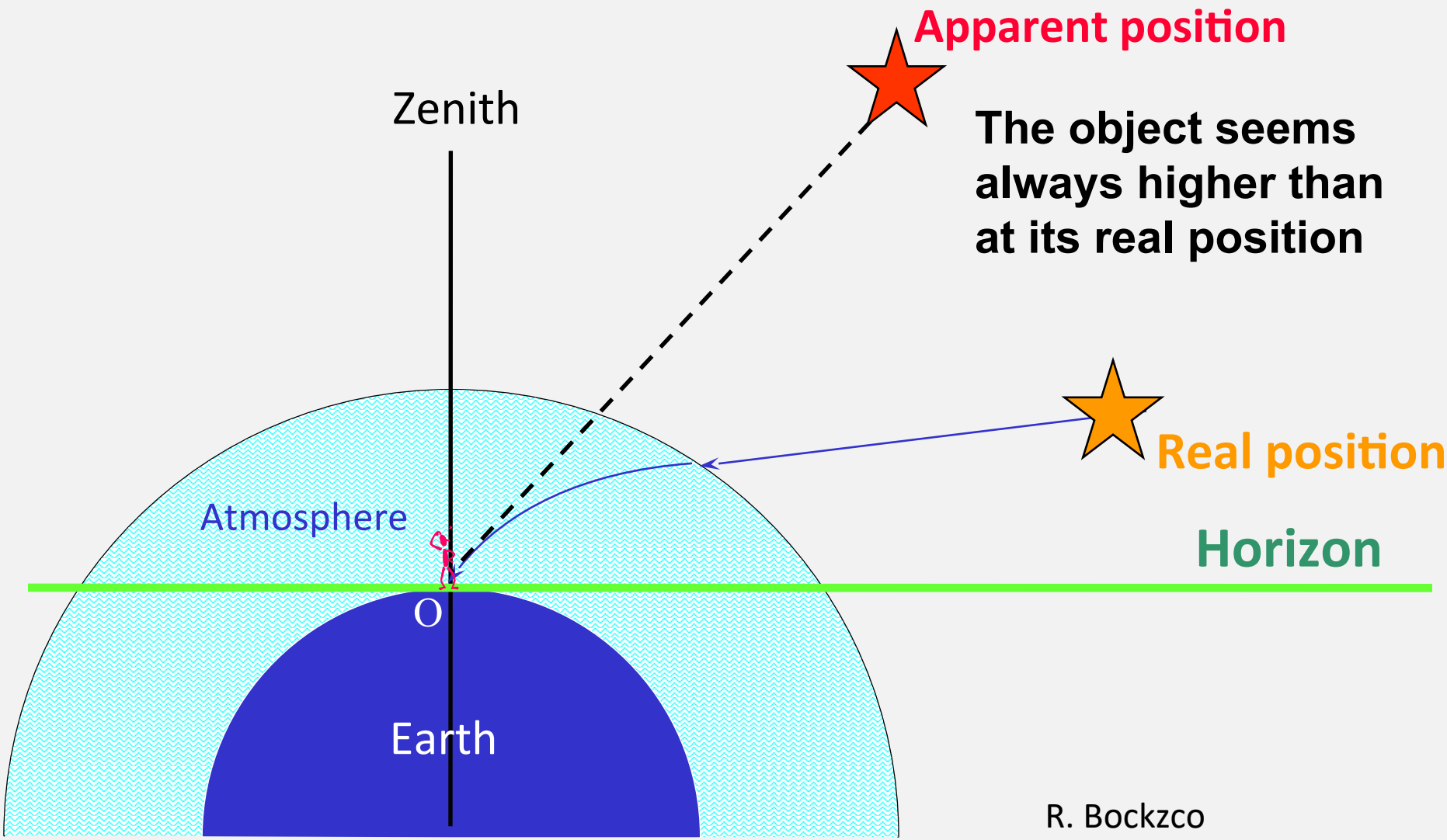
One spherical layer



Refraction in layers

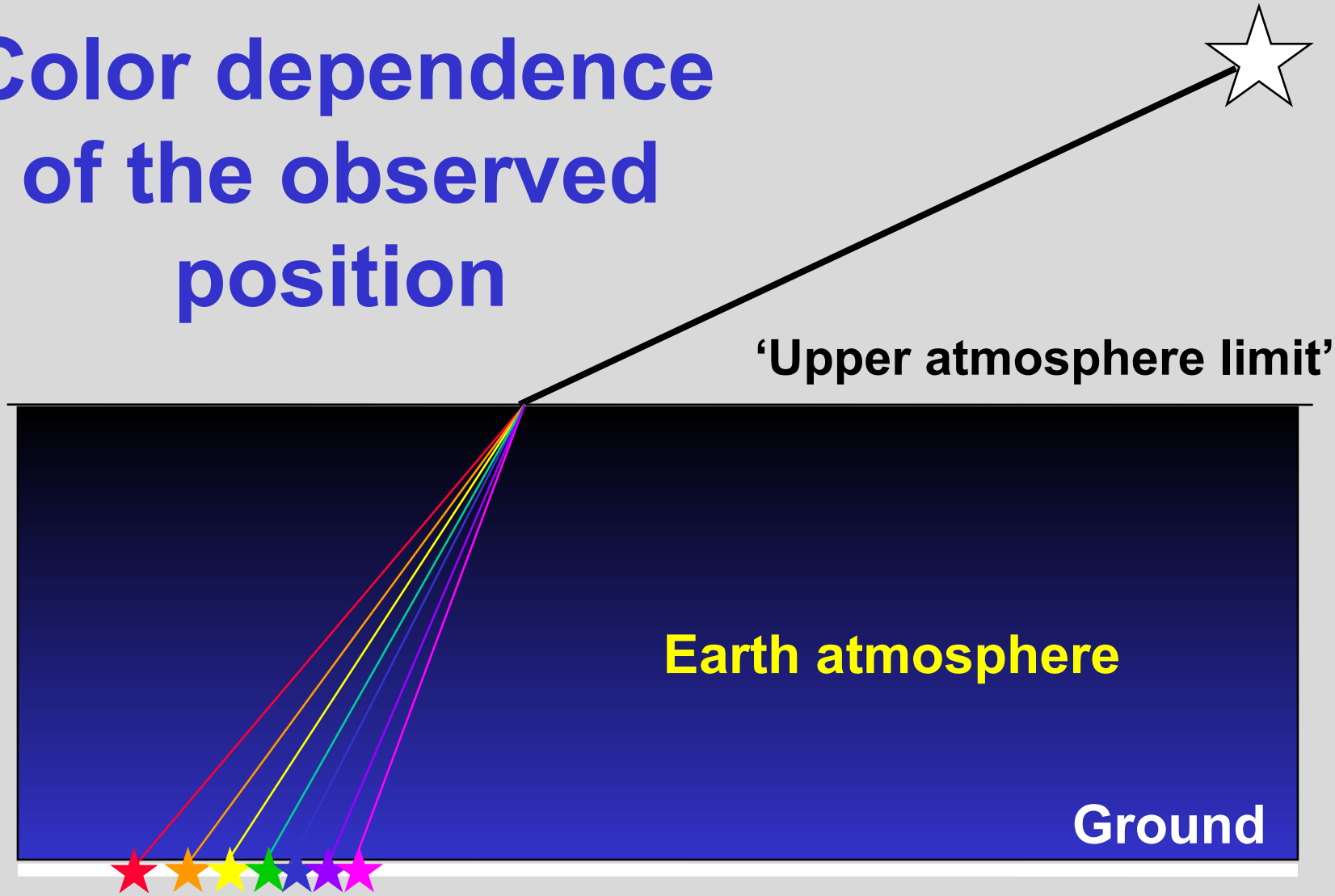


Atmospheric refraction



R. Bockzco

Color dependence of the observed position



Position of the star on the CCD depends on color

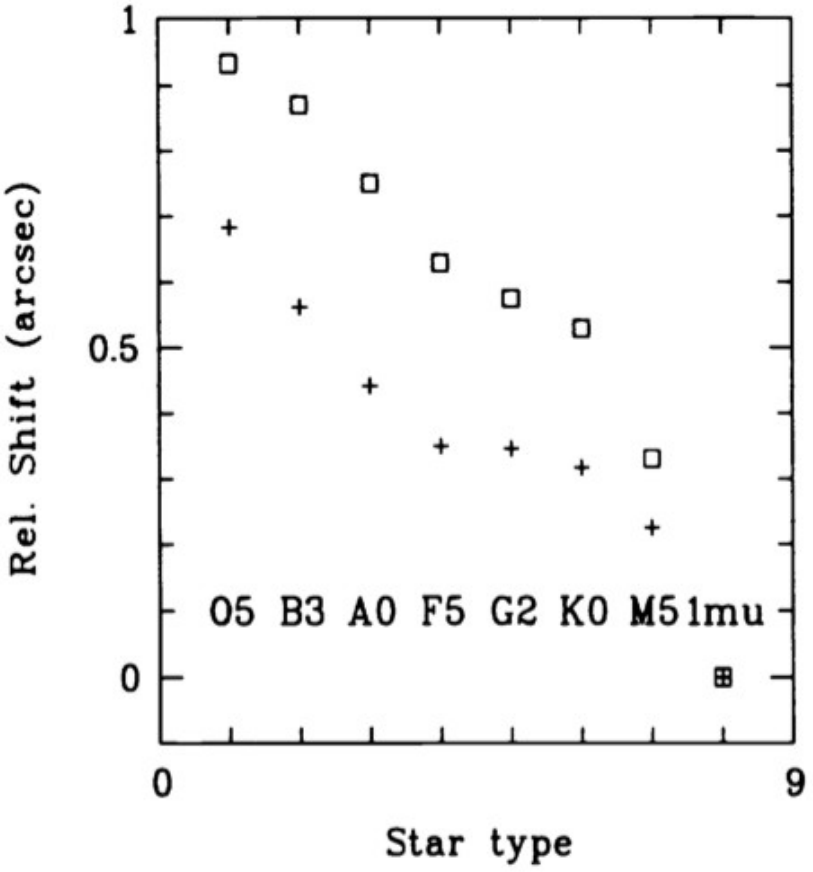
Atmospheric dispersion correction for the FORS Focal Reducers at the ESO VLT

Gerardo Avila ; Gero Rupprecht ; Jacques M. Beckers

[+] Author Affiliations

Differential dispersion within FORS' field

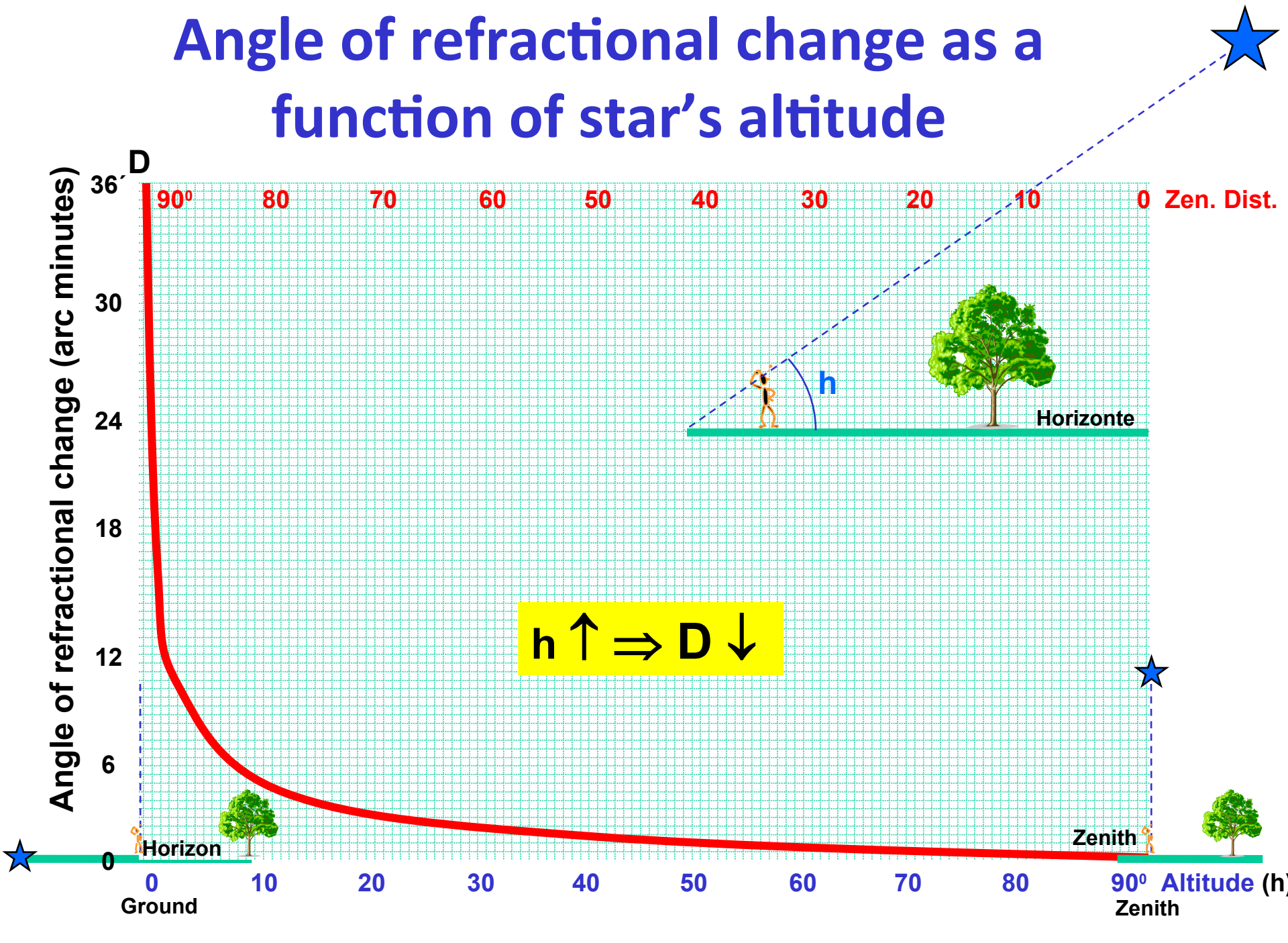
Proc. SPIE 2871, Optical Telescopes of Today and Tomorrow, 1135 (March 21, 1997);
doi:10.1117/12.269000



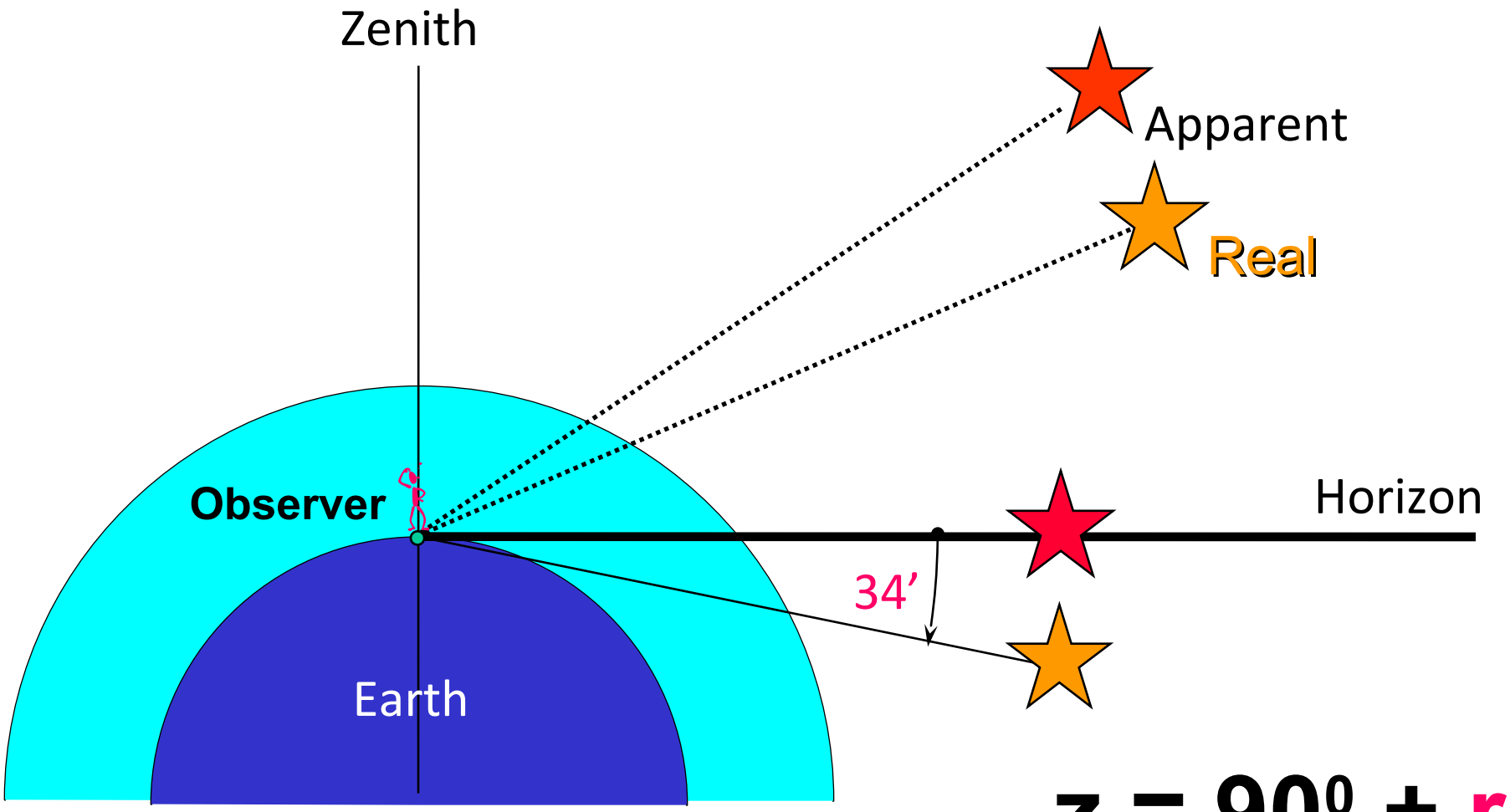
Field	z	ADC	U-Filter	V-Filter
center	0°	no	0.04″	0.06″
center	0°	yes	0.04″	0.05″
center	**50°**	**no**	**0.45″**	**0.38″**
center	**50°**	**yes**	**0.10″**	**0.10″**
edge	0°	no	0.08″	0.06″
edge	0°	yes	0.06″	0.06″
edge	50°	no	0.53″	0.39″
edge	50°	yes	0.17″	0.13″

Figure 3: Relative image shift with the star type

Angle of refractional change as a function of star's altitude



Rise and set including refraction



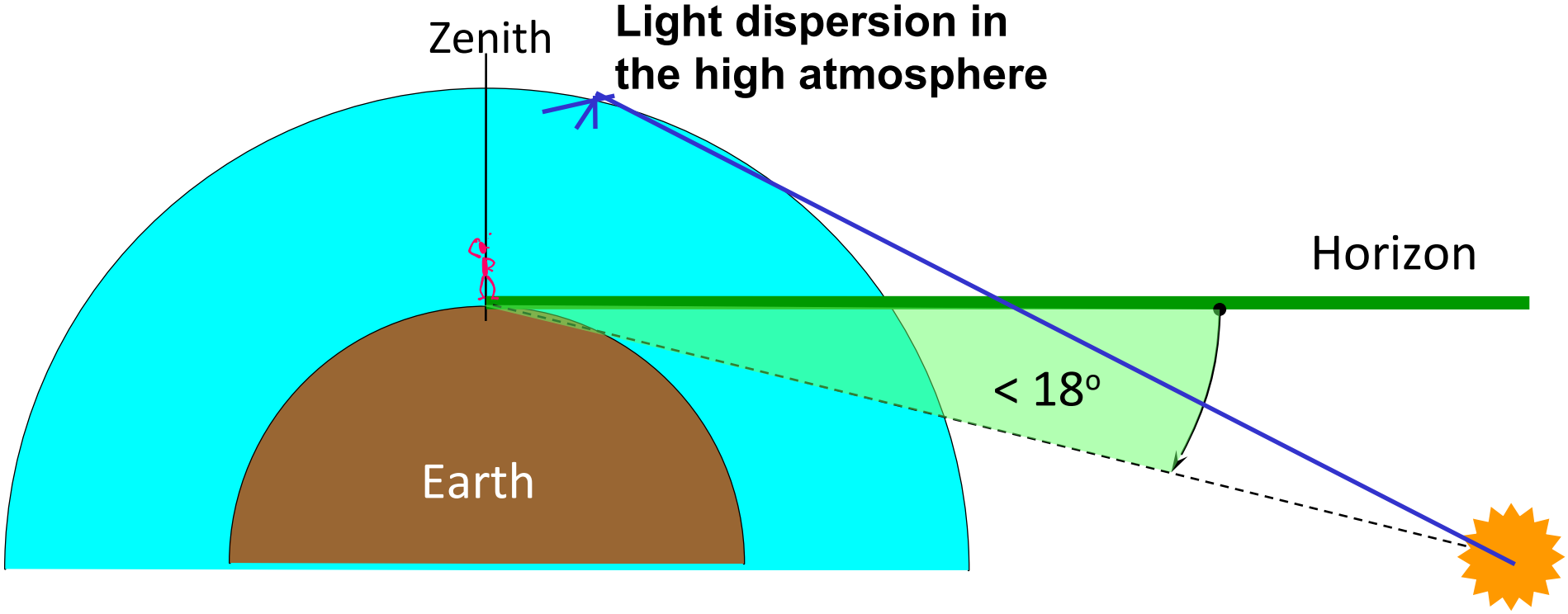
$z = 90^0 + r$

r: angular change due to refraction

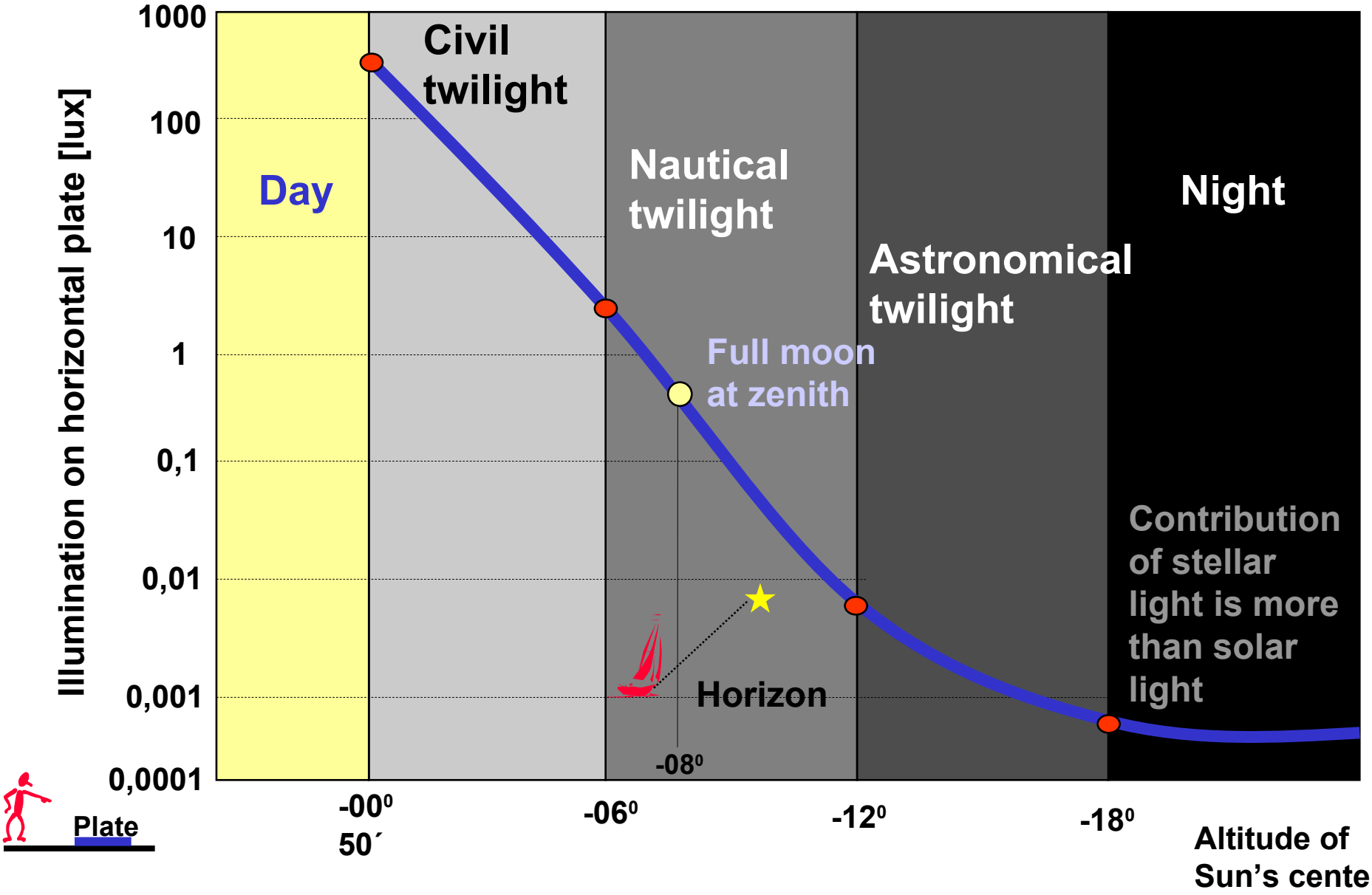

Twilight
solar light before sunrise or after sunset

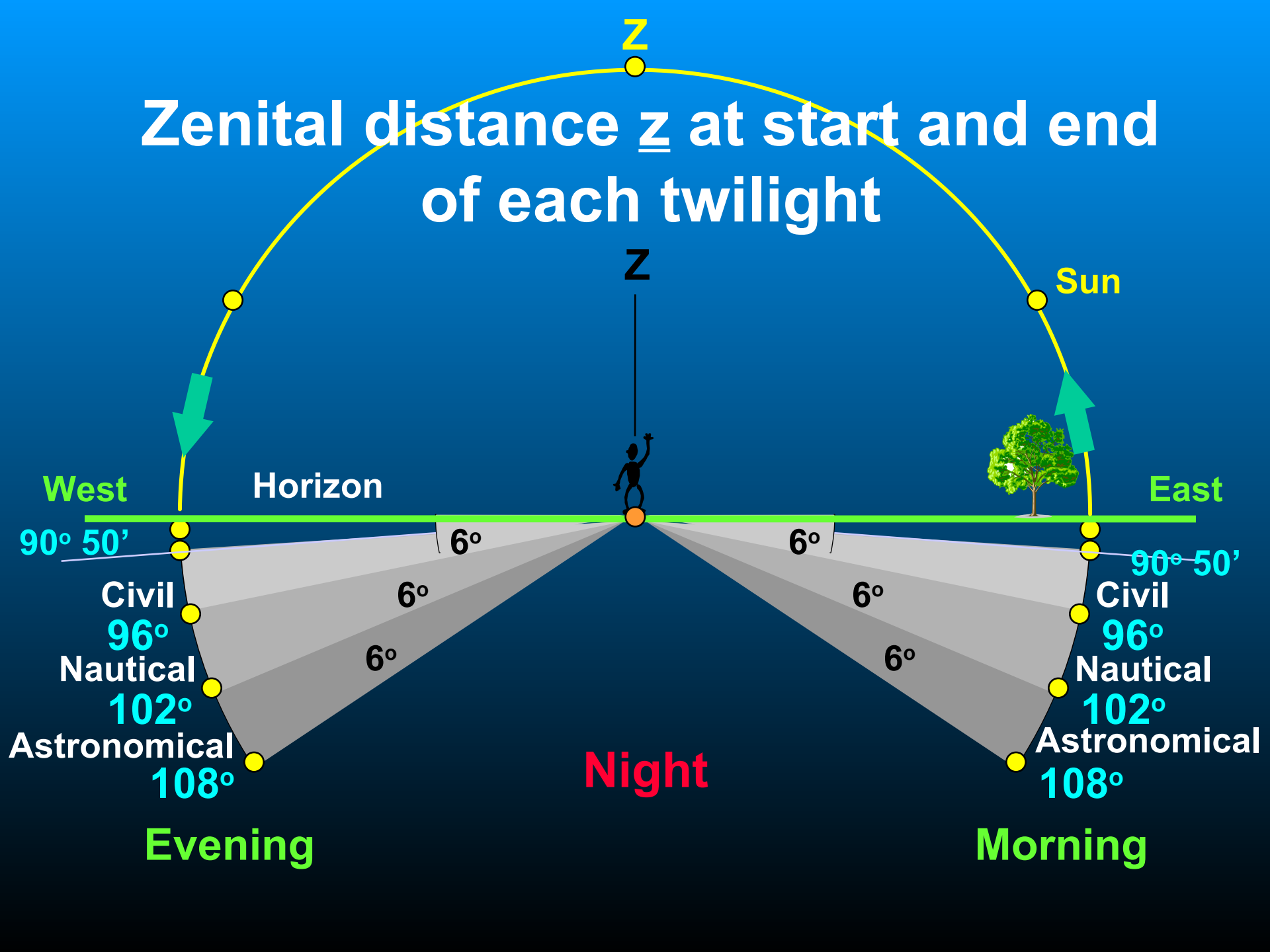
Dispersion & Twilight

Twilight is the result of the dispersion of solar light at high layers of the atmosphere



Ilumination during twilights



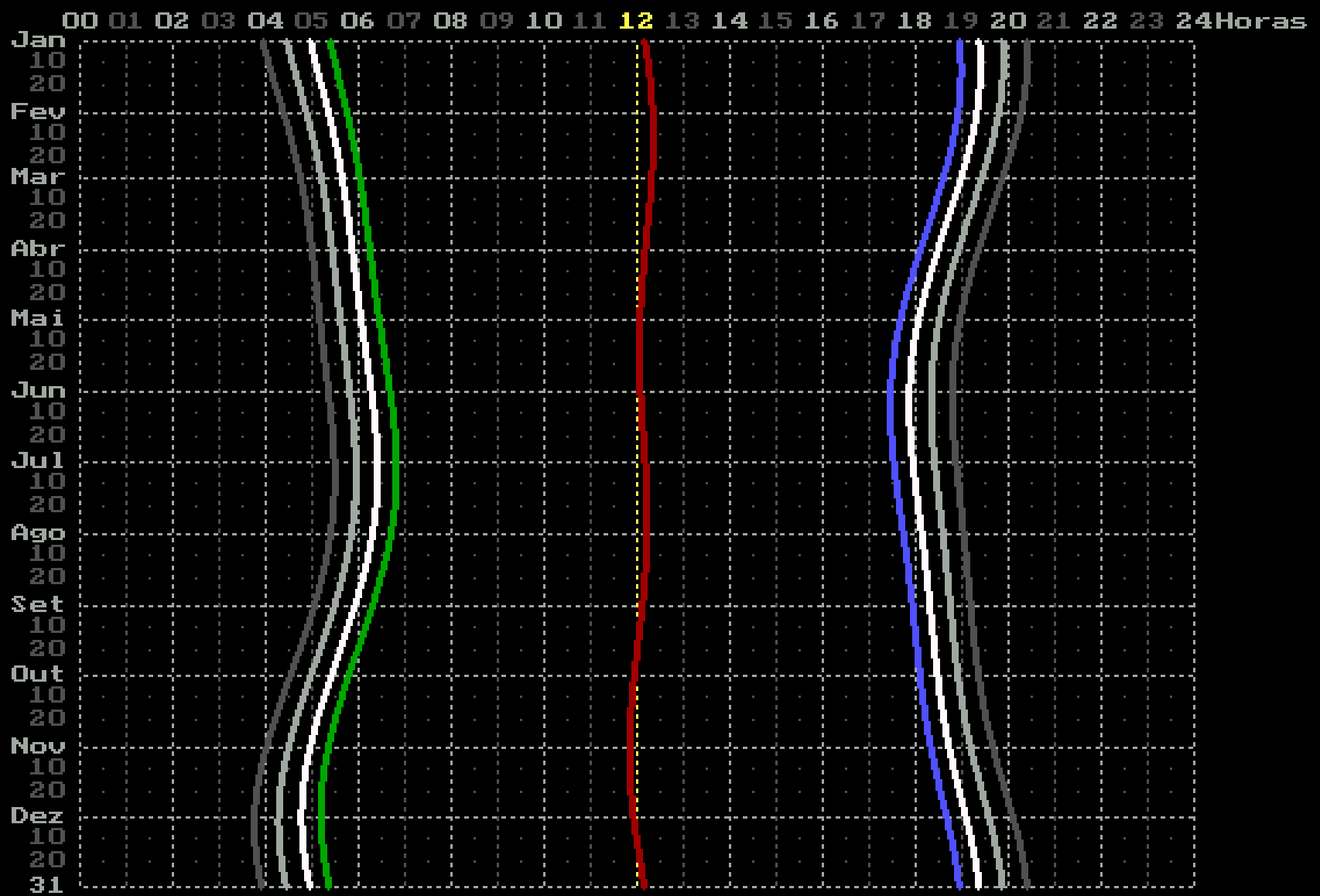

Z
Zenital distance z at start and end of each twilight
Z
Sun
West
Horizon
East
90° 50’
6°
6°
6°
6°
6°
6°
90° 50’
Civil
96°
Nautical
102°
Astronomical
108°
Night
Civil
96°
Nautical
102°
Astronomical
108°
Evening
Morning

Nascer Sunrise, Meridian Crossing and Sunset do Sol

— Nascer
— Passagem Meridiana
— Ocaso

Data: 2007

Sao Paulo
Lat : -23 32 36
Long: 46 37 59



[I] Crep Ast:
[I] Crep Nau:
[I] Crep Civ:

Nascer :
Pas Mer:
Ocaso :

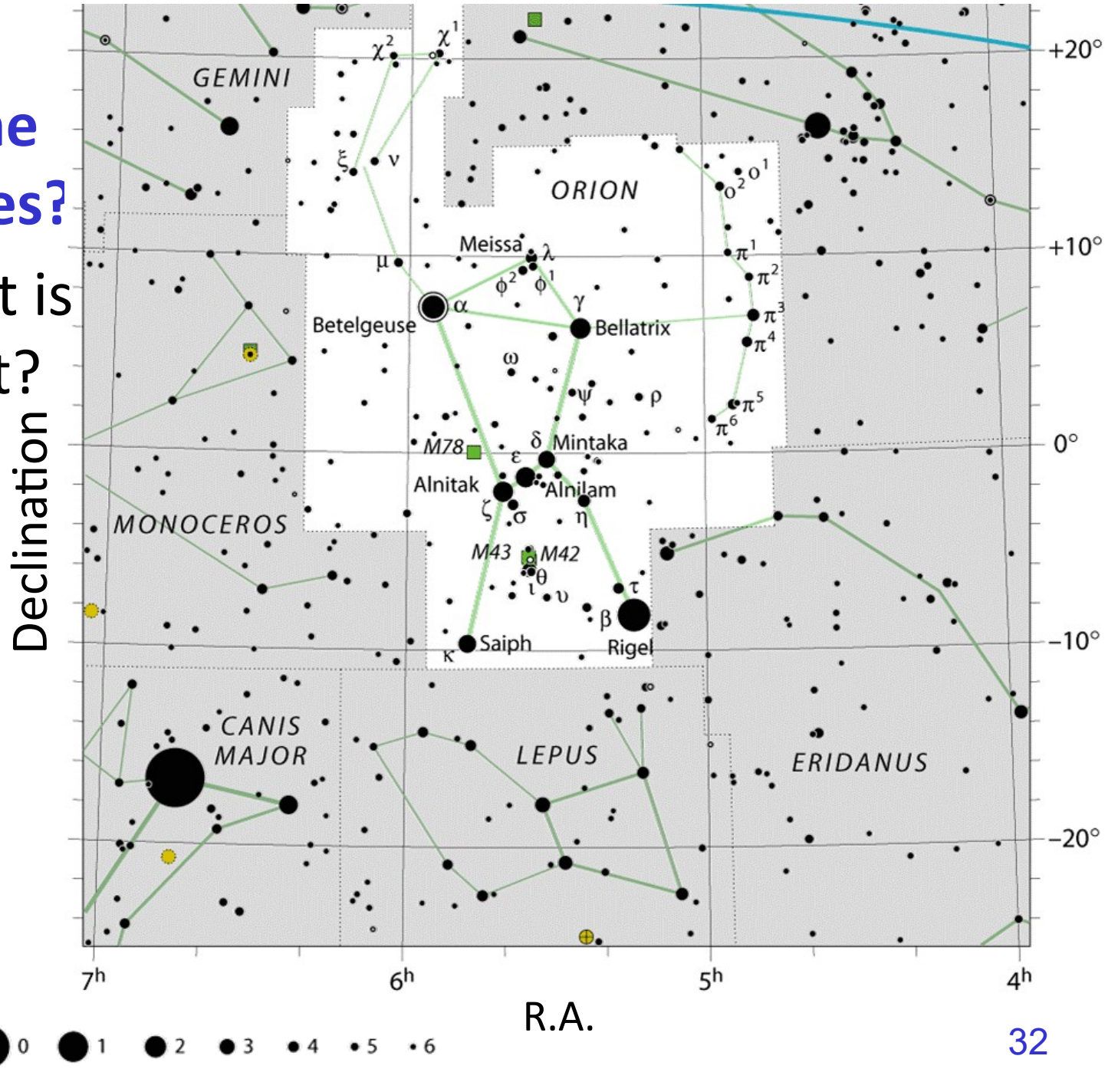
[F] Crep Civ:
[F] Crep Nau:
[F] Crep Ast:

How to obtain the coordinates?

How bright is my target?

A.R. & Dec de Mintaka?

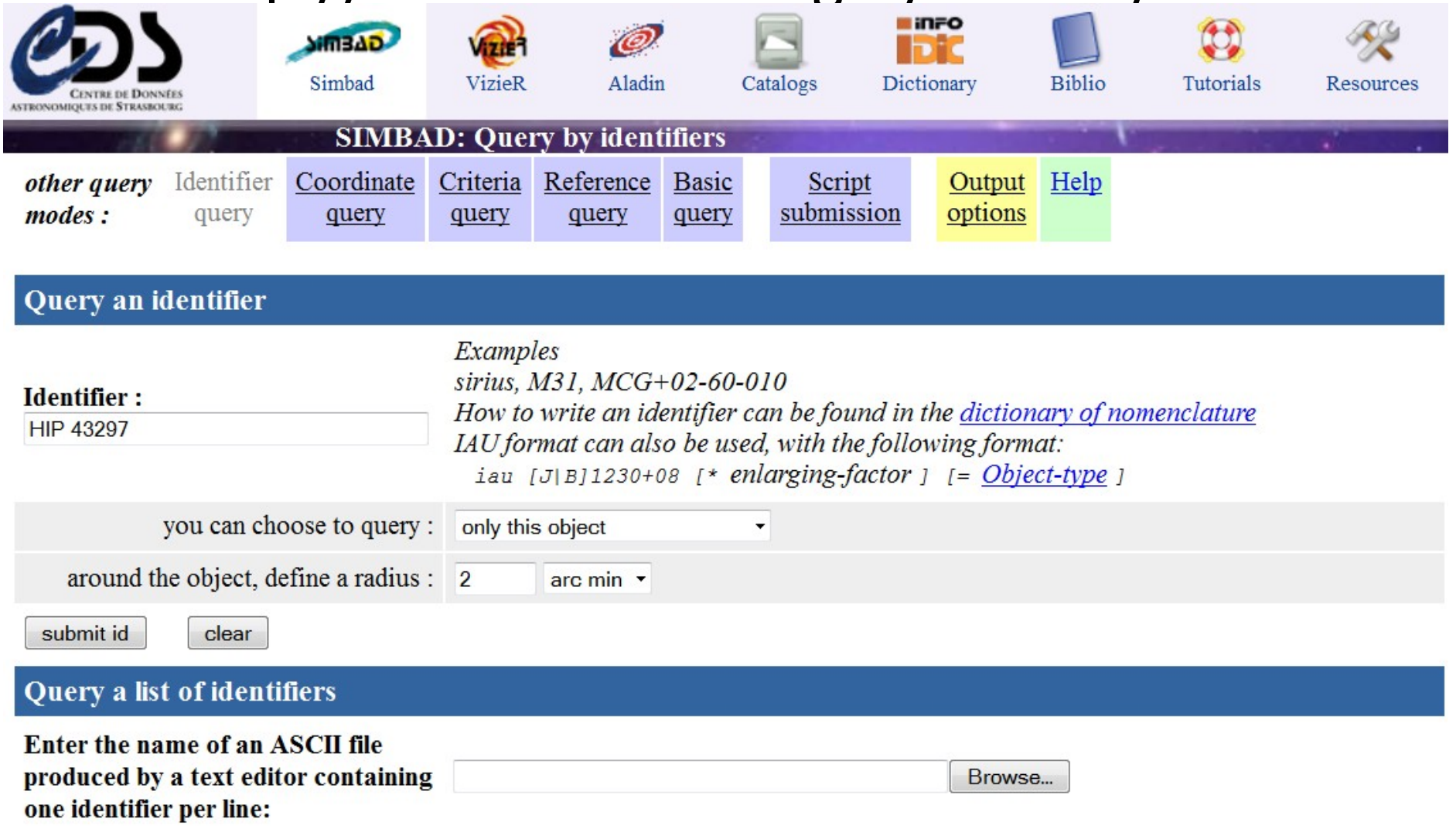
Magnitude?



Planning observations

Coordinates : Simbad

http://simbad.u-strasbg.fr/simbad/sim-fid



Simbad

HD 75302 -- High proper-motion Star

Other object types: * (HD,AG,ASCC,BD,GSC,HIC,HIP,PPM,SAO,SKY#,SPOCS,TYC,USNO,u
IR (2MASS) ,X (1RXS)

ICRS coord. (ep=J2000) : 08 49 12.53044 +03 29 05.1266 (Optical) [7.11 4.22 84]

Epoch 2000

R.A. (α) dec (δ)

HD 75302 -- High proper-motion Star

query around with radius 2 arcı

Other object types: * (HD,AG,ASCC,BD,GSC,HIC,HIP,PPM,SAO,SKY#,SPOCS,TYC,USNO,uvby98,YZ) ,PM* (LSPM) ,
IR (2MASS) ,X (1RXS)

ICRS coord. (ep=J2000) : 08 49 12.53044 +03 29 05.1266 (Optical) [7.11 4.22 84] A 2007A&A...474..653V

FK5 coord. (ep=J2000 eq=2000) : 08 49 12.530 +03 29 05.13 (Optical) [7.11 4.22 84] A 2007A&A...474..653V

FK4 coord. (ep=B1950 eq=1950) : 08 46 36.17 +03 40 12.4 (Optical) [40.72 25.02 0] A 2007A&A...474..653V

Gal coord. (ep=J2000) : 223.9743 +27.6703 (Optical) [7.11 4.22 84] A 2007A&A...474..653V

Proper motions *mas/yr* [error ellipse]: -146.56 60.17 [0.81 0.48 0] A 2007A&A...474..653V

Radial velocity / Redshift / cz : V(km/s) 10.32 [0.45] / z(~) 0.000034 [0.000002] / cz 10.32 [0.45] (~) A 2007AJ....133.2524W

Parallaxes *mas*: 32.26 [0.71] A 2007A&A...474..653V

Spectral type: G5V C 2007AJ....133.2524W

Fluxes (12) :

B 8.128 [0.016] D 2000A&A...355L..27H
V 7.43 [0.01] D 2000A&A...355L..27H
R 7.0 [~] E 2003AJ....125..984M
I 6.7 [~] E 2003AJ....125..984M
J 6.238 [0.021] C 2003yCat.2246....0C
H 5.952 [0.049] C 2003yCat.2246....0C
K 5.840 [0.020] C 2003yCat.2246....0C
u (AB) 12.871 [0.006] C 2009yCat.2294....0A
g (AB) 11.846 [0.005] C 2009yCat.2294....0A
r (AB) 11.318 [0.006] C 2009yCat.2294....0A
i (AB) 10.117 [0.006] C 2009yCat.2294....0A
z (AB) 8.515 [0.001] C 2009yCat.2294....0A

magnitudes

OPD format

Nome	AR	DEC	MAG	Movimento próprio AR	Movimento próprio DEC
HR9077	00 00 19.2	-44 17 26	6.29	0.08	-0.111
HR9078	00 00 23.9	+26 55 06	6.46	0.044	-0.052
HR9079	00 00 30.9	+59 33 35	6.19	-0.077	-0.024
HR9080	00 00 43.Espaço	15 15 12	6.38	0.027	0.005
HR9081	00 01 04.5	-48 48 36	5.71	-0.022	-0.009
HR9083	00 01 19.3	+49 58 54	6.22	0.018	-0.006

Atenção: todos os catálogos carregados deverão possuir coordenadas J2000.

HR 9079 -- Star

Other object types:	* (HR,AG,BD,CSI,FK5,GC,GCRV, (IRAS,IRCO,2MASS)
ICRS coord. (ep=J2000) :	00 00 30.88833 +59 33 34.849 2007A&A...474..653V
FK5 coord. (ep=J2000 eq=2000) :	00 00 30.888 +59 33 34.85 (
FK4 coord. (ep=B1950 eq=1950) :	23 57 58.02 +59 16 54.0 (Op
Gal coord. (ep=J2000) :	116.5145 -02.6761 (Optical
Proper motions *mas/yr* [error ellipse]:	-80.81 -23.64 [0.37 0.28 0]

-0.081 -0.024

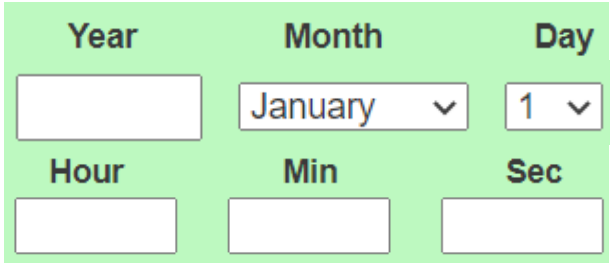
OPD: proper motion in “/year:
Divide SIMBAD’s value by 1000

Julian date (JD)

Continuous count of days (or fraction of a day) since noon on January 1st, 4713 BC

Date 26/4/2022 at noon (GMT): JD = 2459696.00

https://www.aavso.org/jd-calculator

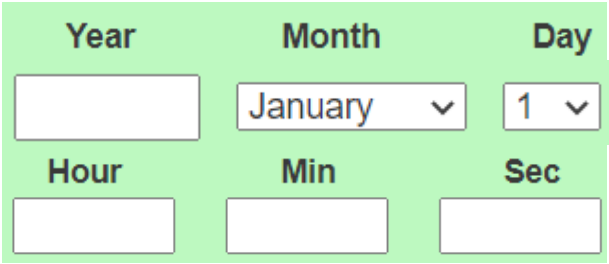


Julian date (JD)

Continuous count of days (or fraction of a day) since noon on January 1st, 4713 BC

Date 26/4/2022 at noon (GMT): JD = 2459696.00

https://www.aavso.org/jd-calculator



Modified Julian date (MJD)

Starts 0:00 on Nov 17, 1858. **MJD = JD - 2400000.5**

Date 26/4/2022 at noon (GMT): MJD = 59695.5

Observing tools

https://www.eso.org/sci/observing/tools/calendar.html

Calendars and Calculators

The tools and information linked from this page will be useful for all the aspects of observations that are related to the position of the target: their visibility, sun- and moon-rise and -set, ephemerides for Solar System minor bodies, etc.

Ephemerides

- Calculation of Site Sky Ephemerides
  This tool produces a nightime calendar of phenomena for a single site.
- Solar System Ephemerides
  The JPL HORIZONS on-line solar system data and ephemeris computation service provides access to key solar system data and flexible production of highly accurate ephemerides for solar system objects.
- Object Observability
  This tool provides object observability tables based on site, object coordinates and observing period.
- Daily Almanac
  This tool produces almanac data for a single site and for a single date. Provided by courtesy of J. Thorstensen and B. Casey.
- JD converter: Converts civil date to julian date and reverse

Position, Airmass, Extinction

- Airmasses Calculator
  This tool provides hourly airmasses based on site, date, and object coordinates information. Additionally, it will compute the parallactic angle as well as heliocentric-barycentric corrections.
  - Plots: draw the airmass curves for a list of objects, for a given night
  - Extinction coefficients for La Silla (old danish 1.54m page)
- Differential athmospheric refraction table for the La Silla and Paranal sites.
  The differential atmospheric refraction is calculated in arcseconds, at an altitude of 2 km, as function of wavelength and airmass. A new calculator is being worked on and will go into the infrared.
- Paralactic angle calculator
  While this tool has specific features for the DFOSC instrument on the 1.54m Danish telescope, it will compute the paralactic angle for any observations.

http://www.briancasey.org/artifacts/astro/skycalendar.cgi

Astronomical Sky Calendar

by Brian Casey , using Skycalendar by John Thorstensen

Get Calendar

Year: 2022 **Start Month:** May **End Month:** May

Observatory: Other

If "Other" enter:

West Longitude(h m s)	03 02 20
North Latitude (d m s)	-22 32 04
Site name	OPD
Standard Time zone, hours West	3
Time zone name	
Hours from Midnight to print Moon rise/set	7.5

☐ Enable daylight time

Brian Casey
bccomment@briancasey.org

O Observatório do Pico dos Dias está localizado entre os municípios sul-mineiros de Brazópolis e Piranguçu, a 1864m de altitude, 900m acima do nível médio da região, nas coordenadas geográficas:

Longitude : -45° 34' 57" = 45.5825° W

Latitude : -22° 32' 04"

Calendar for OPD, west longitude (h.m.s) = 3 02 20, latitude (d.m) = -22 32.1
Note that each line lists events of one night, spanning two calendar dates. Rise/set times are given
in Unknown Zone time (3 hr W), uncorrected for elevation, in standard time all year.
Moon coords. and illum. are for local midnight, even if moon is down. Program: John Thorstensen, Dartmouth College.

JDmid - 2450000

Data

Astron.twilight

Date (eve/morn) (2022 at start)	JDmid (-2450000)	LMSTmidn	Sun: set	Sun: twi.end	Sun: twi.beg	Sun: rise	LST twilight: eve	LST twilight: morn	Moon: rise	Moon: set	Moon: %illum	Moon: RA	Moon: Dec
Sun May 01/Mon May 02	9701.6	14 37 44	17 37	18 53	5 06	6 22	9 30	19 44	7 48	18 14	2	3 33.8	19 39
Mon May 02/Tue May 03	9702.6	14 41 41	17 36	18 53	5 06	6 22	9 34	19 48	.....	18 53	5	4 23.0	23 06
Tue May 03/Wed May 04	9703.6	14 45 37	17 36	18 52	5 06	6 23	9 37	19 53	.....	19 36	10	5 13.8	25 32
Wed May 04/Thu May 05	9704.6	14 49 34	17 35	18 52	5 06	6 23	9 41	19 57	.....	20 23	16	6 05.8	26 51
Thu May 05/Fri May 06	9705.6	14 53 30	17 35	18 51	5 07	6 24	9 44	20 01	.....	21 14	23	6 58.4	26 57
Fri May 06/Sat May 07	9706.6	14 57 27	17 34	18 51	5 07	6 24	9 47	20 05	.....	22 06	32	7 50.7	25 52
Sat May 07/Sun May 08	9707.6	15 01 23	17 34	18 50	5 07	6 24	9 51	20 10	.....	23 01	41	8 42.0	23 36
Sun May 08/Mon May 09	9708.6	15 05 20	17 33	18 50	5 08	6 25	9 54	20 14	.....	23 55	50	9 32.1	20 16
Mon May 09/Tue May 10	9709.6	15 09 16	17 32	18 50	5 08	6 25	9 58	20 18	.....	0 50	60	10 20.9	15 59
Tue May 10/Wed May 11	9710.6	15 13 13	17 32	18 49	5 08	6 26	10 02	20 23	.....	1 45	70	11 08.9	10 54
Wed May 11/Thu May 12	9711.6	15 17 10	17 31	18 49	5 09	6 26	10 05	20 27	.....	2 40	79	11 56.9	5 09
Thu May 12/Fri May 13	9712.6	15 21 06	17 31	18 48	5 09	6 27	10 09	20 31	.....	3 37	87	12 45.7	- 1 01
Fri May 13/Sat May 14	9713.6	15 25 03	17 31	18 48	5 09	6 27	10 12	20 35	.....	4 36	94	13 36.5	- 7 21
Sat May 14/Sun May 15	9714.6	15 28 59	17 30	18 48	5 10	6 28	10 16	20 40	16 27	5 39	98	14 30.4	-13 31
Sun May 15/Mon May 16	9715.6	15 32 56	17 30	18 47	5 10	6 28	10 19	20 44	17 11	6 46	100	15 28.5	-19 02
Mon May 16/Tue May 17	9716.6	15 36 52	17 29	18 47	5 11	6 28	10 23	20 48	18 00	7 56	99	16 30.9	-23 24
Tue May 17/Wed May 18	9717.6	15 40 49	17 29	18 47	5 11	6 29	10 27	20 53	18 56	.....	94	17 37.0	-26 08
Wed May 18/Thu May 19	9718.6	15 44 45	17 29	18 47	5 11	6 29	10 30	20 57	19 59	.....	87	18 44.6	-26 55
Thu May 19/Fri May 20	9719.6	15 48 42	17 28	18 46	5 12	6 30	10 34	21 01	21 05	.....	78	19 50.8	-25 44
Fri May 20/Sat May 21	9720.6	15 52 39	17 28	18 46	5 12	6 30	10 38	21 05	22 12	.....	68	20 53.2	-22 50
Sat May 21/Sun May 22	9721.6	15 56 35	17 28	18 46	5 12	6 31	10 42	21 10	23 17	.....	56	21 50.9	-18 37
Sun May 22/Mon May 23	9722.6	16 00 32	17 27	18 46	5 13	6 31	10 45	21 14	0 17	.....	45	22 43.9	-13 32
Mon May 23/Tue May 24	9723.6	16 04 28	17 27	18 45	5 13	6 32	10 49	21 18	1 15	.....	35	23 33.2	- 7 57
Tue May 24/Wed May 25	9724.6	16 08 25	17 27	18 45	5 13	6 32	10 53	21 23	2 10	.....	25	0 20.0	- 2 10
Wed May 25/Thu May 26	9725.6	16 12 21	17 26	18 45	5 14	6 32	10 57	21 27	3 03	.....	17	1 05.3	3 34
Thu May 26/Fri May 27	9726.6	16 16 18	17 26	18 45	5 14	6 33	11 00	21 31	3 55	.....	10	1 50.2	9 04
Fri May 27/Sat May 28	9727.6	16 20 14	17 26	18 45	5 14	6 33	11 04	21 35	4 48	.....	5	2 35.7	14 07
Sat May 28/Sun May 29	9728.6	16 24 11	17 26	18 45	5 15	6 34	11 08	21 40	5 42	16 13	2	3 22.4	18 33
Sun May 29/Mon May 30	9729.6	16 28 08	17 26	18 45	5 15	6 34	11 12	21 44	6 36	16 51	0	4 10.9	22 12
Mon May 30/Tue May 31	9730.6	16 32 04	17 26	18 45	5 15	6 35	11 16	21 48	7 31	17 33	0	5 01.0	24 54
Tue May 31/Wed Jun 01	9731.6	16 36 01	17 25	18 45	5 16	6 35	11 20	21 53	.....	18 19	2	5 52.6	26 29

SIMBAD: Query by identifiers

Query an identifier

Identifier :

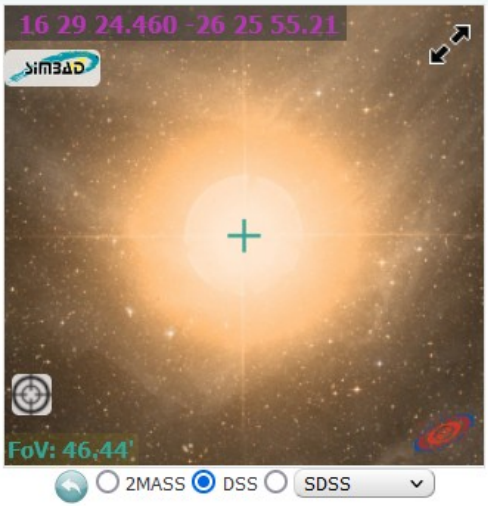
antares

Basic data :

* alf Sco -- Red supergiant star

Other object types:	* (*,CD,...), IR (Elia,IRAS,...
	RNe (DG), HII (LBN), s*r (1989A
ICRS coord. *(ep=J2000) :*	16 29 24.45970 -26 25 55.2094
FK4 coord. *(ep=B1950 eq=1950) :*	16 26 20.23122 -26 19 21.8433
Gal coord. *(ep=J2000) :*	351.94713737 +15.06432170 [10
Proper motions *mas/yr* :	-12.11 -23.30 [1.22 0.76 0] A
Radial velocity / Redshift / cz :	V(km/s) -3.50 [0.8] / z(~) -0. A 2006AstL...32..759G
Parallaxes *(mas)*:	5.89 [1.00] A 2007A&A...474..6
Spectral type:	M0.5Iab+B3V: C 1984ApJS...55..
Fluxes (8) :	U 4.08 [~] C 2002yCat.2237...
	B 2.75 [~] C 2002yCat.2237...
	V 0.91 [~] C 2002yCat.2237...

SIMBAD Query around within 2 arcmin



Object visibility

http://catserver.ing.iac.es/staralt/

Mode Staralt

Night 20 May 2022 or date when the local night starts.

Staralt, Startrack only.

Observatory Pico dos Dias Observatory (Brazil)

Select one above or specify your own site with this format:

`Longitude(°E) Latitude(°N) Altitude(metres) UT-offset(hours)`

Ex: `289.2767 -30.2283 2725 -4`

SIMBAD: Query by identifiers

*** alf Sco** -- Red supergiant star

Other object types: * (*,CD,...), IR (Elia,IRAS,..
RNe (DG), HII (LBN), s*r (1989A

ICRS coord. *(ep=J2000) :* 16 29 24.45970 -26 25 55.2094

Coordinates Formats can be any of t

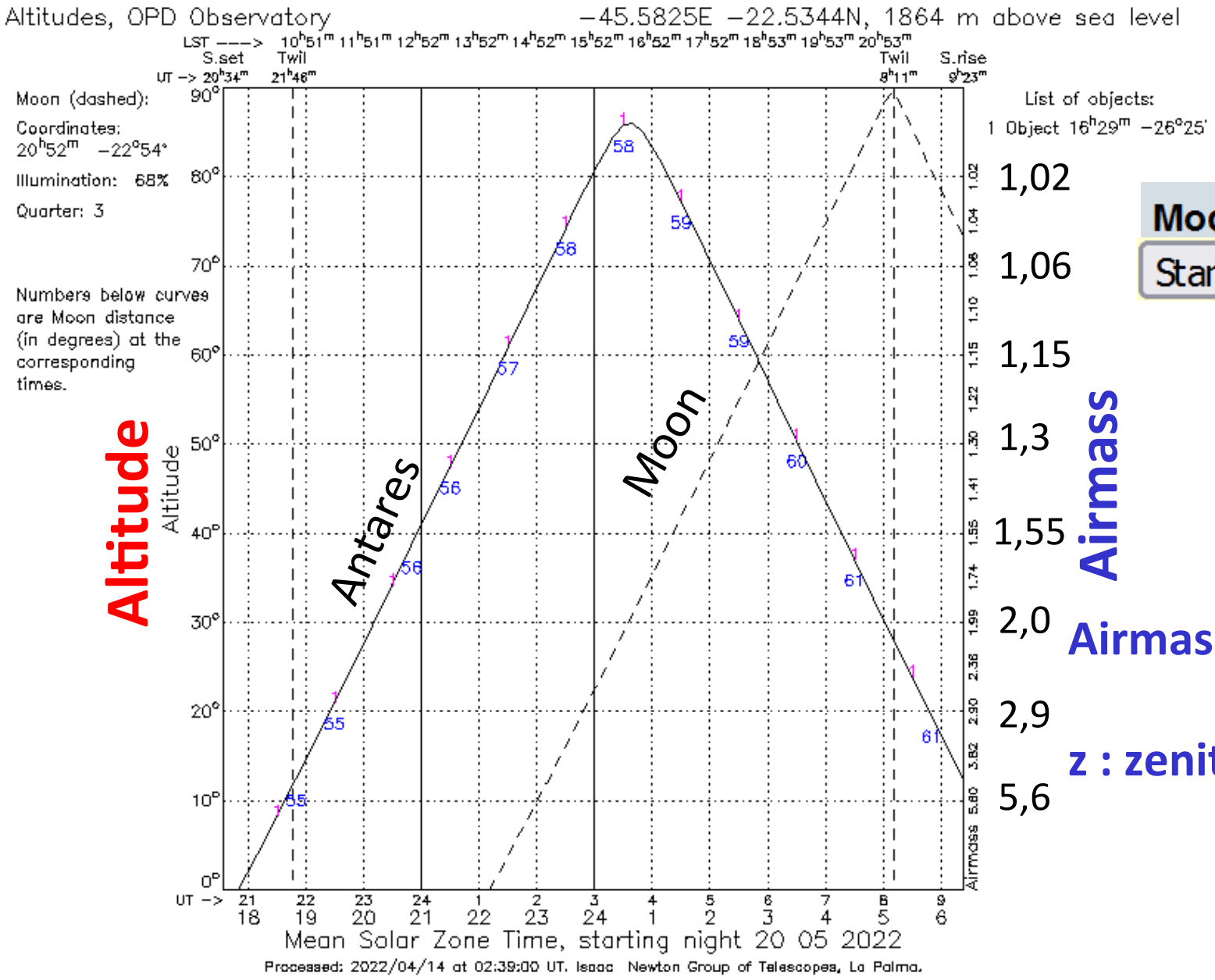
`name hh mm ss ±`

`name hh:mm:ss ±`

`name ddd.ddd dd`

`name` must be a single word with no dots, avoid using single numbers. Every entry must be in the same format, do not use different formats with different entries. We recommend a maximum of 100 targets per submission.

```
16 29 24.45970 -26 25 55.2094
```



Altitude

Airmass

1,02
1,06
1,15
1,3
1,55
2,0
2,9
5,6

Mode

Staralt

Airmass = sec z

= 1/cos z

z : zenital distance

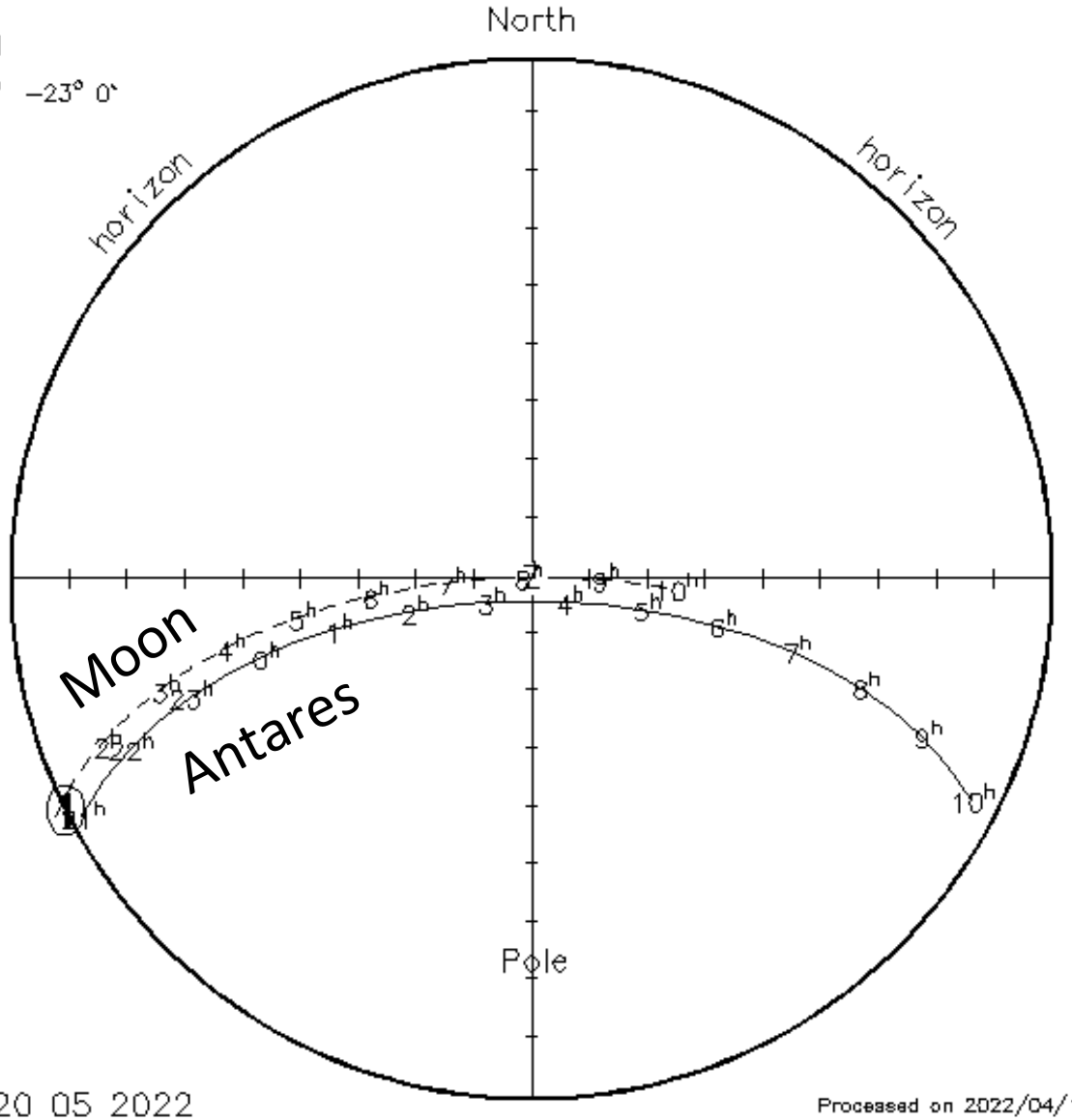
Limits of the 1.6m telescope at OPD

zenital distance ≤ 60
[meaning h > 30]

(the object could be somewhat closer to the horizon, but check the limits and be very careful)

Sky tracks, OPD Observatory −45.5825E −22.5344N, 1864 m above sea level

All times are in UT. Tracks are shown only if above horizon and between Sunset−Sunrise



Moon track dashed

Coordinates: 20^h50^m −23° 0'

Illumination 68%

Quarter 3

List of objects:

1 Object 16^h29^m −26°25'

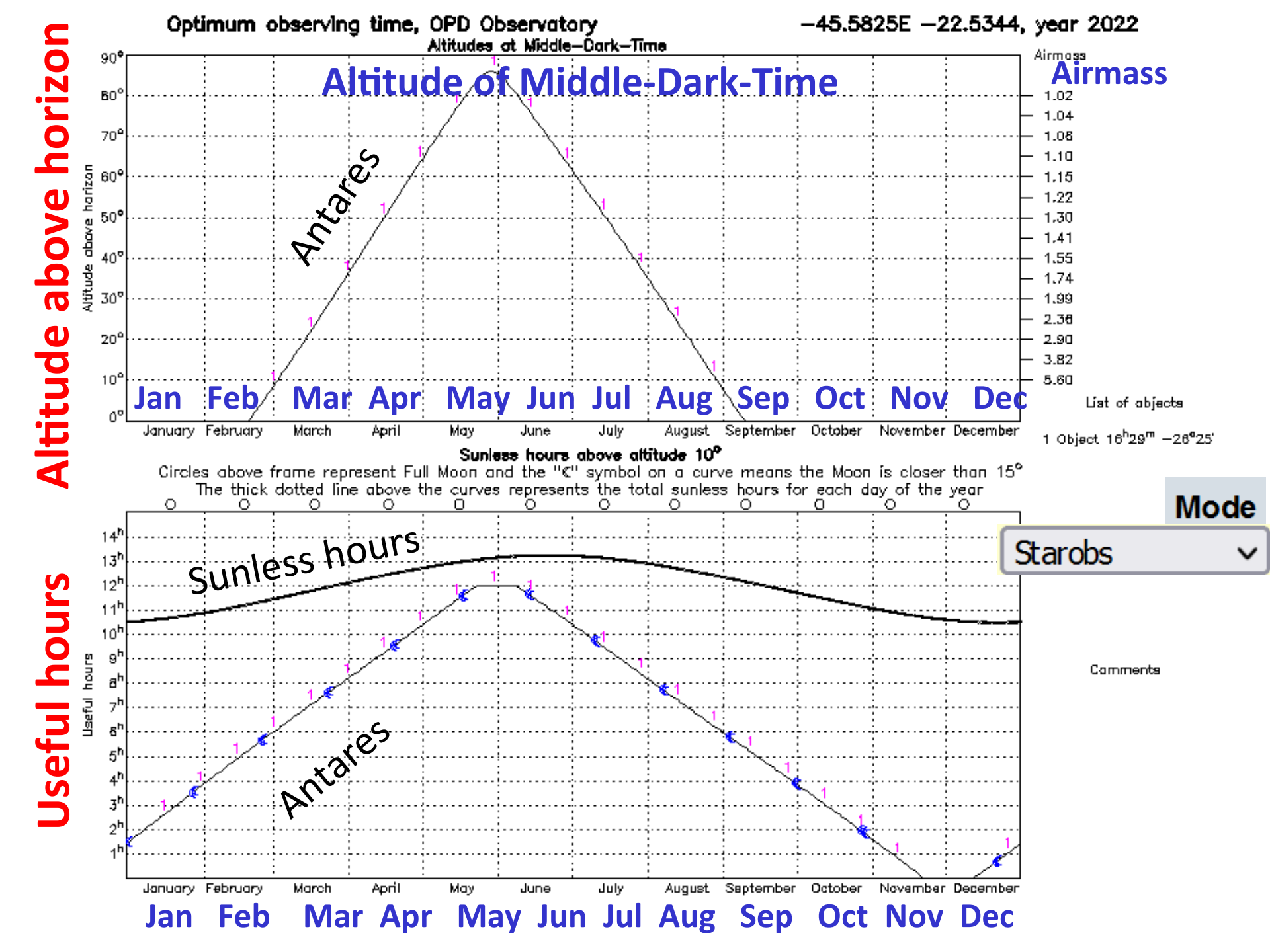
Mode

Startrack

Sunset	20^h34^m
Evening Twi.	21^h46^m
Morning Twi.	8^h11^m
Sunrise	9^h23^m

Starting night 20 05 2022

Processed on 2022/04/14 at 02:50:20 UT


Optimum observing time, OPD Observatory
-45.5825E -22.5344, year 2022
Altitudes at Middle-Dark-Time
Altitude of Middle-Dark-Time
Airmass
Altitude above horizon
Antares
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
January February March April May June July August September October November December
List of objects
1 Object 16h29m -26°25'
Sunless hours above altitude 10°
Circles above frame represent Full Moon and the "€" symbol on a curve means the Moon is closer than 15°
The thick dotted line above the curves represents the total sunless hours for each day of the year
Useful hours
Sunless hours
Antares
Mode
Starobs
Comments

Finding charts: important for weak objects or crowded fields

http://catserver.ing.iac.es/dss1/

DSS1

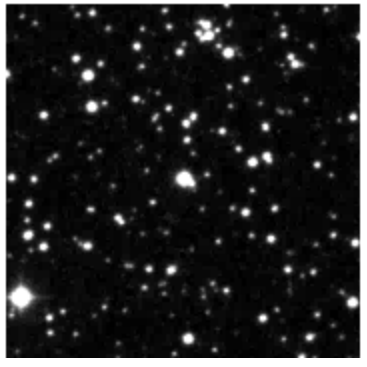
Coordinate Format	Automatic Help **R.A. :** *(hh mm ss)* **Dec. :** *(±dd mm ss)*
Coordinates	Please enter the coordinates of one or more objects. 07 11 54.322 -01 37 25.42 or upload a file containing the coordinates (you can use the same format as in the TCS catalog) Browse... Default Epoch: J2000 B1950
Image Size	5 **X** *(arcminutes)* 5 **Y** *(arcminutes)*
Options	Single Page Output Format (for multi-object queries) PNG format of preview image Invert preview image colour map 100 preview image scale [%] ? FoV acquisition camera
Submit Request	Retrieve Reset input fields

Other (external) finding chart generators:
ESO
IRSA
STScI
CADC
SDSS DR8
Aladin
NED
ESO/ST-ECF
USNO
SkyView.

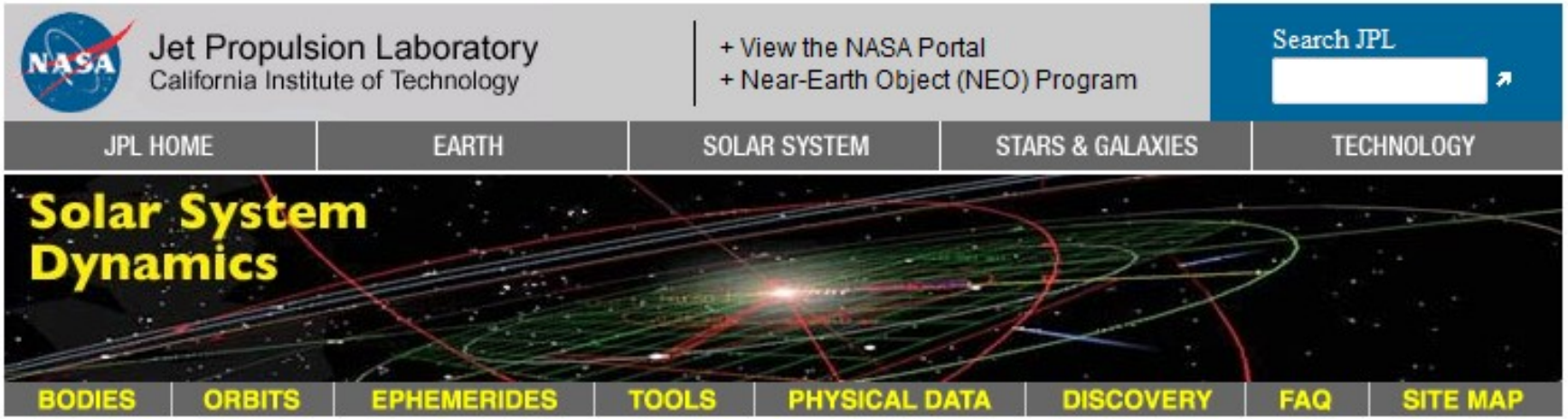
DSS1 Query Result

North to the top, East to the left

Object	RA	Dec	Epoch	Size
	07 11 54.322	-01 37 25.42	J2000	5 x 5 arcmin (?)



What about moving objects?
http://ssd.jpl.nasa.gov/horizons.cgi



HORIZONS Web-Interface

This tool provides a web-based *limited* interface to JPL's HORIZONS system which can be used to generate ephemerides for solar-system bodies. Full access to HORIZONS features is available via the primary telnet interface. HORIZONS system news shows recent changes and improvements. A web-interface tutorial is available to assist new users.

Current Settings

Ephemeris Type [change] : **OBSERVER**
Target Body [change] : **Mars** [499]
Observer Location [change] : **Geocentric** [500]
Time Span [change] : Start=**2014-02-19**, Stop=**2014-03-21**, Step=**1 d**
Table Settings [change] : *defaults*
Display/Output [change] : *default* (formatted HTML)

Generate Ephemeris

Asteroid Ceres
La Silla
1 – 10 august 2014
one per hour

HORIZONS Web-Interface

This tool provides a web-based *limited* interface to JPL's HORIZONS system which can be used to generate ephemerides for solar-system bodies. Full access to HORIZONS features is available via the primary telnet interface. HORIZONS system news shows recent changes and improvements. A web-interface tutorial is available to assist new users.

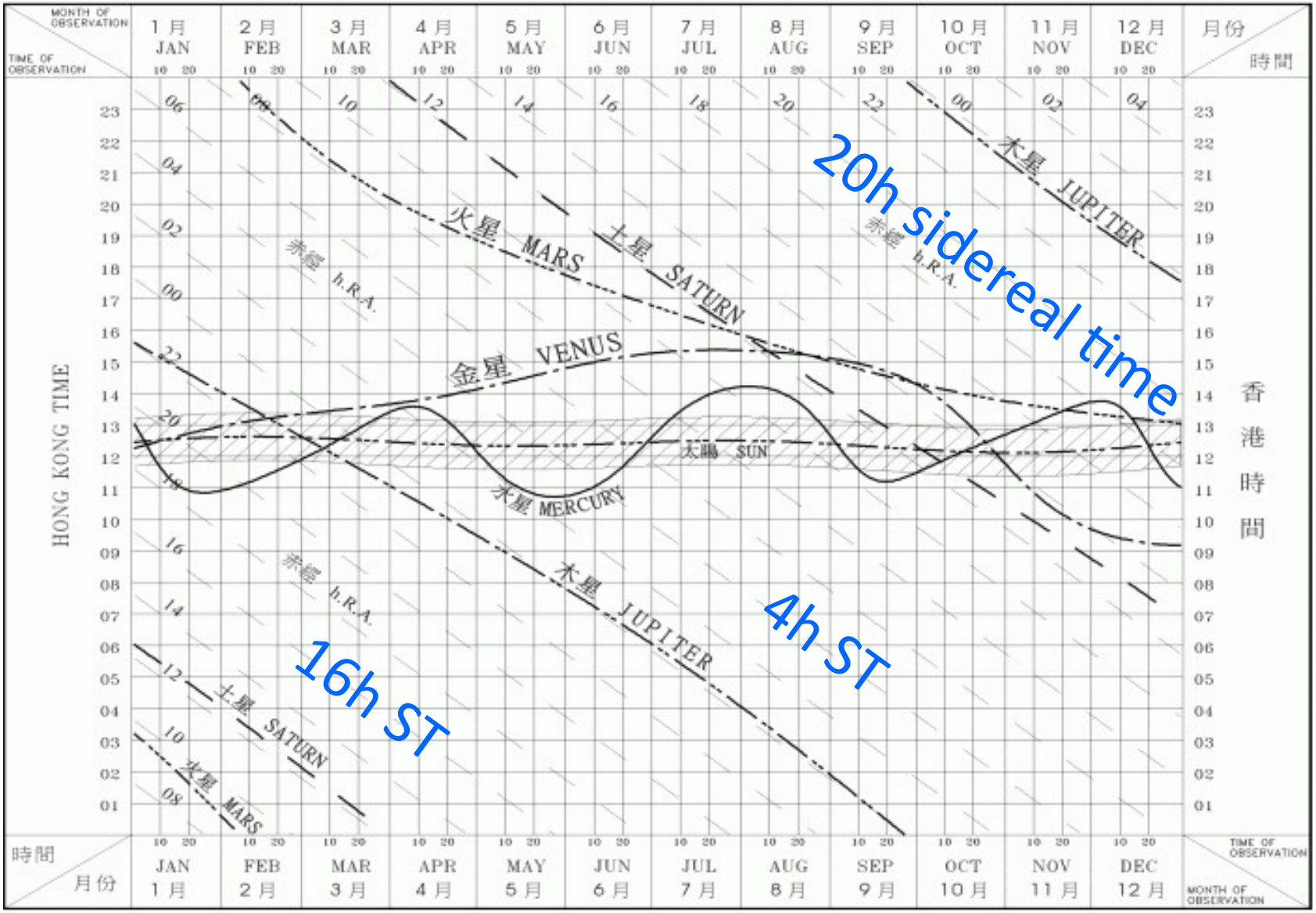
Current Settings

Ephemeris Type [change] : **OBSERVER**
Target Body [change] : **Asteroid 1 Ceres**
Observer Location [change] : **La Silla--TRAPPIST** [I40] (289°15'38.2"E, 29°15'16.6"S, 2317.7 m)
Time Span [change] : Start=**2014-08-01**, Stop=**2014-08-10**, Step=**1 h**
Table Settings [change] : *defaults*
Display/Output [change] : *default* (formatted HTML)

Generate Ephemeris

```
*******************************************************************************************************************
 Date__(UT)__HR:MN     R.A._(ICRF/J2000.0)_DEC  APmag  S-brt            delta      deldot     S-O-T /r    S-T-O
*******************************************************************************************************************
$$SOE
 2014-Aug-01 00:00  m  13 51 51.07 -05 40 24.0   8.75   6.88 2.69659783113561  23.4420144  79.5639 /T  21.6645
 2014-Aug-01 01:00  m  13 51 53.46 -05 40 47.4   8.75   6.86 2.69716297621785  23.5234405  79.5355 /T  21.6623
 2014-Aug-01 02:00  m  13 51 55.86 -05 41 10.8   8.75   6.90 2.69772985300150  23.5850881  79.5070 /T  21.6600
 2014-Aug-01 03:00     13 51 58.27 -05 41 34.2   8.75   6.93 2.69829793034298  23.6226251  79.4784 /T  21.6576
 2014-Aug-01 04:00     13 52 00.69 -05 41 57.6   8.75   6.91 2.69886659220453  23.6333687  79.4499 /T  21.6552
 2014-Aug-01 05:00     13 52 03.13 -05 42 21.0   8.75   6.86 2.69943517980341  23.6164696  79.4213 /T  21.6527
 2014-Aug-01 06:00     13 52 05.59 -05 42 44.4   8.75   6.87 2.70000303668333  23.5729694  79.3928 /T  21.6502
 2014-Aug-01 07:00     13 52 08.05 -05 43 07.8   8.75   6.92 2.70056955362375  23.5057295  79.3645 /T  21.6476
 2014-Aug-01 08:00     13 52 10.53 -05 43 31.2   8.75   6.93 2.70113421031404  23.4192353  79.3362 /T  21.6450
 2014-Aug-01 09:00     13 52 13.01 -05 43 54.7   8.75   6.88 2.70169661094210  23.3192888  79.3081 /T  21.6424
 2014-Aug-01 10:00     13 52 15.50 -05 44 18.1   8.75   6.86 2.70225651126281  23.2126122  79.2802 /T  21.6397
 2014-Aug-01 11:00 N   13 52 17.99 -05 44 41.6   8.75   6.90 2.70281383529554  23.1063873  79.2523 /T  21.6370
 2014-Aug-01 12:00 *   13 52 20.48 -05 45 05.1   8.75   6.93 2.70336868050913  23.0077646  79.2247 /T  21.6343
 2014-Aug-01 13:00 *   13 52 22.96 -05 45 28.7   8.75   6.91 2.70392131113982  22.9233738  79.1971 /T  21.6317
 2014-Aug-01 14:00 *   13 52 25.43 -05 45 52.2   8.75   6.86 2.70447214009964  22.8588704  79.1697 /T  21.6290
 2014-Aug-01 15:00 *m  13 52 27.89 -05 46 15.8   8.75   6.87 2.70502170071254  22.8185488  79.1423 /T  21.6264
 2014-Aug-01 16:00 *m  13 52 30.35 -05 46 39.3   8.75   6.92 2.70557061021228  22.8050482  79.1149 /T  21.6239
 2014-Aug-01 17:00 *m  13 52 32.79 -05 47 02.9   8.75   6.93 2.70611952749793  22.8191721  79.0875 /T  21.6213
 2014-Aug-01 18:00 *m  13 52 35.22 -05 47 26.4   8.75   6.88 2.70666910803849  22.8598336  79.0600 /T  21.6189
 2014-Aug-01 19:00 *m  13 52 37.63 -05 47 50.0   8.75   6.86 2.70721995901124  22.9241293  79.0325 /T  21.6164
 2014-Aug-01 20:00 *m  13 52 40.05 -05 48 13.5   8.75   6.89 2.70777259774426  23.0075382  79.0048 /T  21.6140
 2014-Aug-01 21:00 *m  13 52 42.45 -05 48 37.0   8.76   6.93 2.70832741630737  23.1042310  78.9770 /T  21.6117
 2014-Aug-01 22:00 *m  13 52 44.86 -05 49 00.5   8.76   6.91 2.70888465467489  23.2074692  78.9491 /T  21.6093
 2014-Aug-01 23:00 Nm  13 52 47.26 -05 49 24.0   8.76   6.86 2.70944438429779  23.3100661  78.9210 /T  21.6069
 2014-Aug-02 00:00  m  13 52 49.67 -05 49 47.5   8.76   6.87 2.71000650320908  23.4048787  78.8928 /T  21.6046
 2014-Aug-02 01:00  m  13 52 52.09 -05 50 10.9   8.76   6.92 2.71057074299777  23.4852964  78.8645 /T  21.6022
 2014-Aug-02 02:00  m  13 52 54.52 -05 50 34.4   8.76   6.93 2.71113668717321  23.5456938  78.8361 /T  21.5997
 2014-Aug-02 03:00  m  13 52 56.97 -05 50 57.8   8.76   6.89 2.71170379966245  23.5818151  78.8076 /T  21.5973
 2014-Aug-02 04:00     13 52 59.42 -05 51 21.2   8.76   6.86 2.71227146148920  23.5910657  78.7792 /T  21.5947
 2014-Aug-02 05:00     13 53 01.89 -05 51 44.6   8.76   6.89 2.71283901312374  23.5726892  78.7508 /T  21.5921
 2014-Aug-02 06:00     13 53 04.38 -05 52 08.1   8.76   6.93 2.71340579960484  23.5278195  78.7224 /T  21.5895
 2014-Aug-02 07:00     13 53 06.87 -05 52 31.5   8.76   6.91 2.71397121534616  23.4594026  78.6941 /T  21.5868
 2014-Aug-02 08:00     13 53 09.38 -05 52 55.0   8.76   6.87 2.71453474556133  23.3719953  78.6660 /T  21.5841
 2014-Aug-02 09:00     13 53 11.90 -05 53 18.5   8.76   6.86 2.71509600147407  23.2714532  78.6380 /T  21.5813
 2014-Aug-02 10:00     13 53 14.41 -05 53 42.0   8.76   6.91 2.71565474690504  23.1645300  78.6101 /T  21.5785
 2014-Aug-02 11:00 N   13 53 16.93 -05 54 05.5   8.76   6.93 2.71621091441760  23.0584154  78.5824 /T  21.5757
 2014-Aug-02 12:00 *   13 53 19.45 -05 54 29.0   8.76   6.89 2.71676460991821  22.9602433  78.5549 /T  21.5729
 2014-Aug-02 13:00 *   13 53 21.96 -05 54 52.6   8.76   6.86 2.71731610539757  22.8766036  78.5274 /T  21.5701
 2014-Aug-02 14:00 *   13 53 24.46 -05 55 16.2   8.76   6.88 2.71786582030896  22.8130914  78.5000 /T  21.5673
 2014-Aug-02 15:00 *   13 53 26.96 -05 55 39.8   8.76   6.93 2.71841429285769  22.7739242  78.4727 /T  21.5646
 2014-Aug-02 16:00 *m  13 53 29.44 -05 56 03.4   8.76   6.92 2.71896214316566  22.7616534  78.4455 /T  21.5619
 2014-Aug-02 17:00 *m  13 53 31.91 -05 56 26.9   8.76   6.87 2.71951003083050  22.7769895  78.4182 /T  21.5593
```

Sidereal time



Trip to OPD

Four observing nights: April 28,29,30, May 1

Departure from IAG, April 28, 9:30 **sharp**!
Departure from OPD, May 2, 9:30 **sharp**!

1,6m: spectroscopy
IAG (60 cm): imaging and photometry
Zeiss (60cm): photometry + CCD calibration

Trip to OPD

- RG (or RNE, or passport)
- Warm clothes, flashlight or cell phone
- Good tennis or trekking shoes, as you have to walk many stairs at night, and perhaps you may want to walk around the observatory
- Optional: Linux or mac laptop with IRAF installed. Not strictly needed. You can work later on your data