University of Texas Rio Grande Valley

Center for Gravitational Wave Astronomy

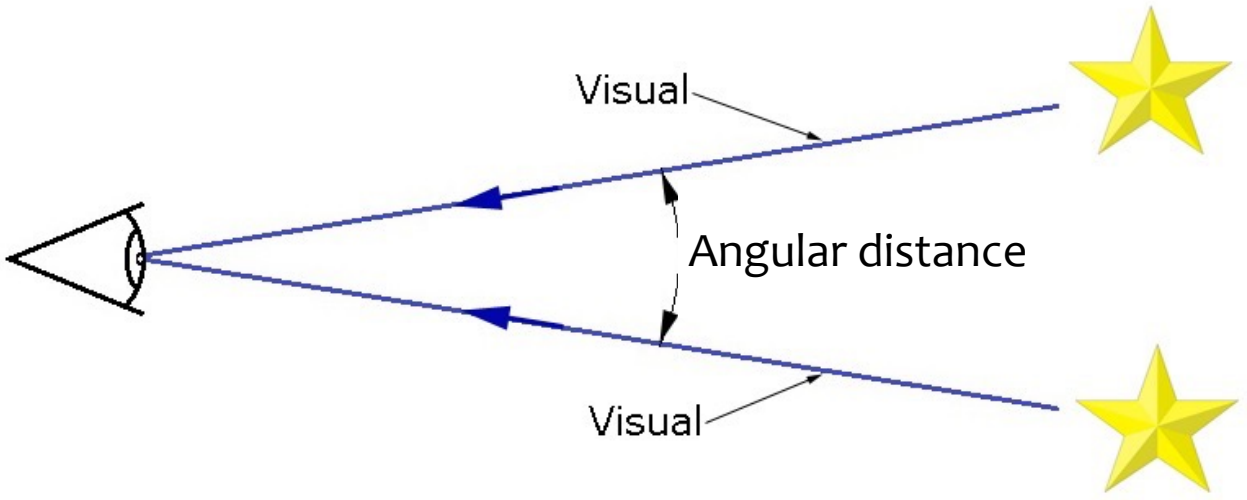
Nompuewenu Observatory

Lesson 5

Brownsville - 2016

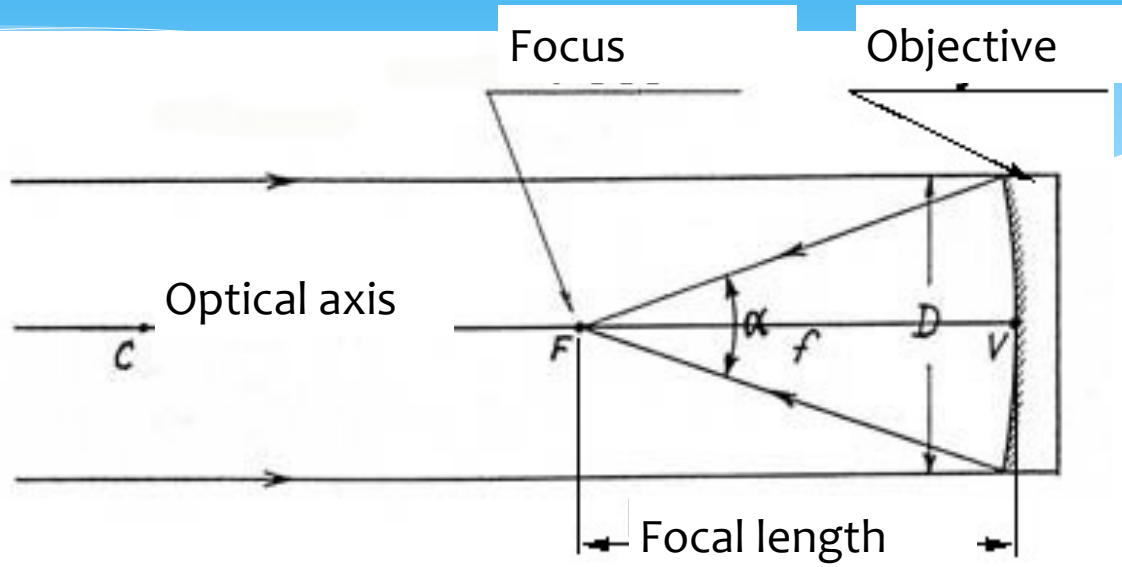
Visual

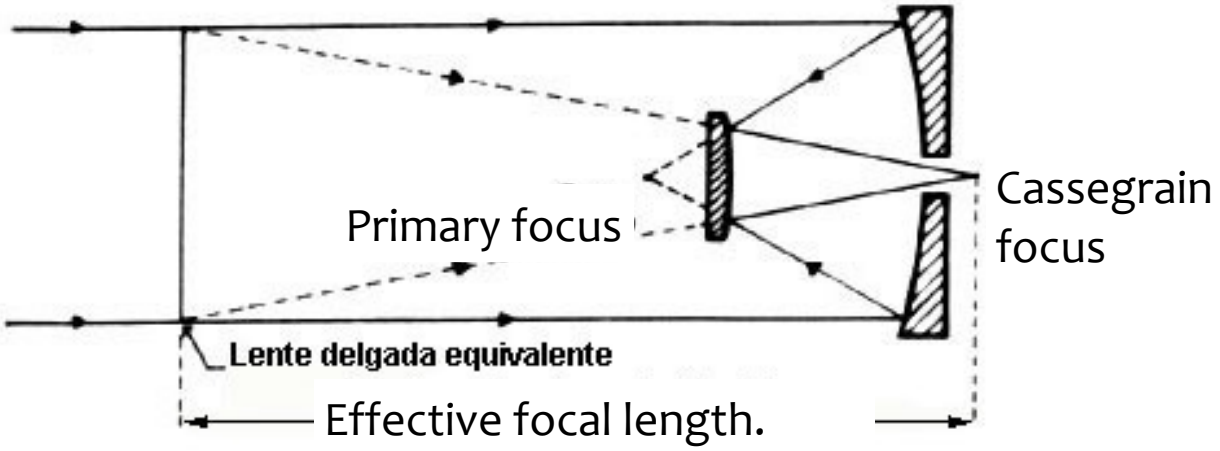
* Visual.
* Angular distance
* Angular diameter
* Examples



Telescope Parameters

* Objective.
* Focus.
* Focal plane.
* Focal length.
* Effective focal length.
* Example:
  - MEADE 16” LX200
  - f = 4064 mm

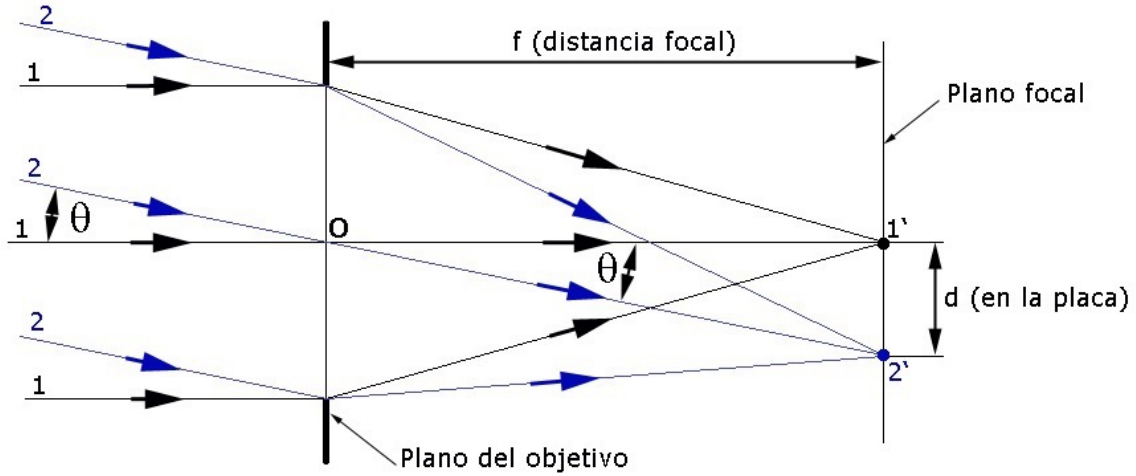




CCD parameters

* Pixel size
* Sensor size
* Example:
  - APOGEE F16M:
  - Pixels: Width = 9 mm y height = 9 mm.
  - Sensor: Width = 4096 píxels Height = 4096 píxels.
  - Sensor dimensions:
  - Width = 36,8 mm Height = 36,8 mm.

Plate field



Field Of View – FOV.

$\theta = d / f$ [radianes]

$\theta = 180/PI * d / f$ [°]

$\theta = 206264{,}8 * d / f$ [arcseg]

Example

* APOGEE F16M in MEADE 16” LX200

$$\theta(\text{width}) = 206264{,}8 * 36{,}86\ \text{mm} / 4064\ \text{mm}$$

$$\theta(\text{width}) = 1870''$$

$$\theta(\text{width}) = (1870/60)' = 31{,}2'$$

$$\theta(\text{height}) = 206264{,}8 * 36{,}86 / 4064\ \text{mm}$$

$$\theta(\text{height}) = 1870''$$

$$\theta(\text{height}) = (1870/60)' = 31{,}2'$$

Plate scale

* Plate scale in chemical photography:

  Plate scale = θ / unit of length. [arseg/mm]

* Plate scale in CCDs:

  θ = 206264,8 d / f , d is the pixel dimensión.

  Pixel scale = 206264,8 * d / f [arcsec/pixel]

* Example: MEADE 16” with APOGEE F16M:

  Plate scale = 206264,8 * 0,009 mm / 4064 mm

  Plate scale = 0,46 ”/pix

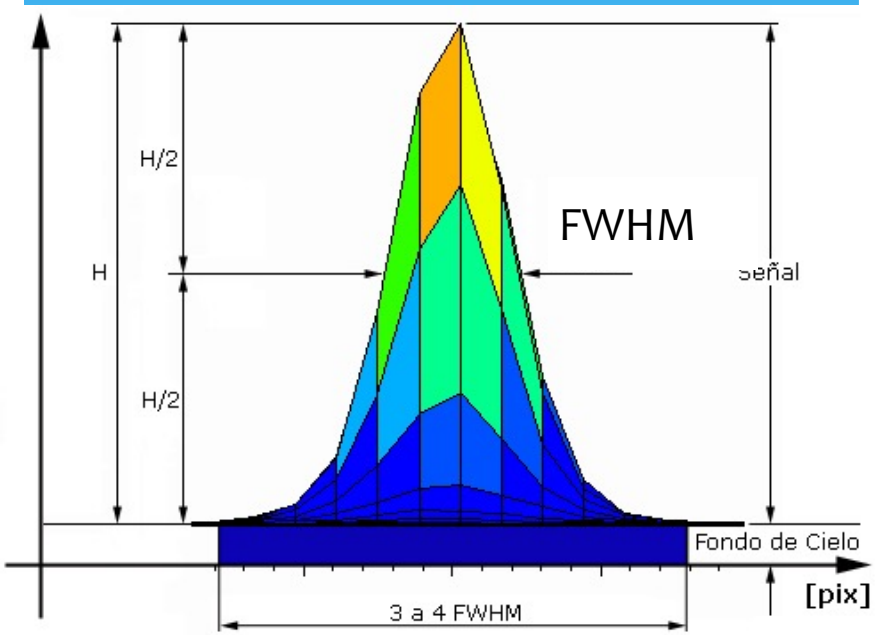
Space resolution

* Space resolution = # Píxels / angular unit
* Space resolution = 1 / Plate scale [pixels/arcsec]
* Example MEADE 16” with APOGEE F16M:

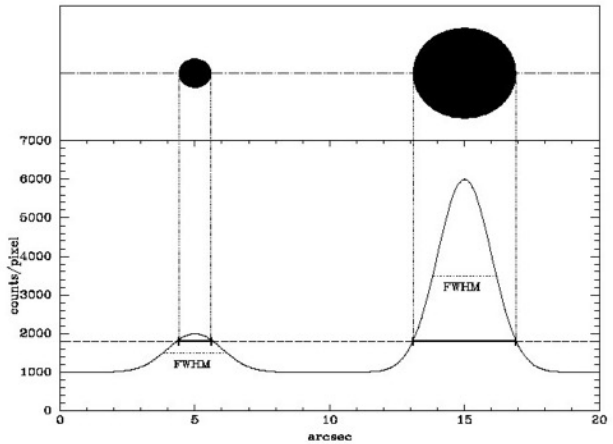
Space resolution = 1 / (0,46 ”/pix)

Space resolution = 2,17 pixeles/arcsec

Seeing



* Atmospheric distortion.
* Other effects: terrain, dome, instrument, etc.
* PSF (Point Spread Function): how a point is spread on the detector
* Seeing measurement: with the FWHM (Full width at Half Maximum).

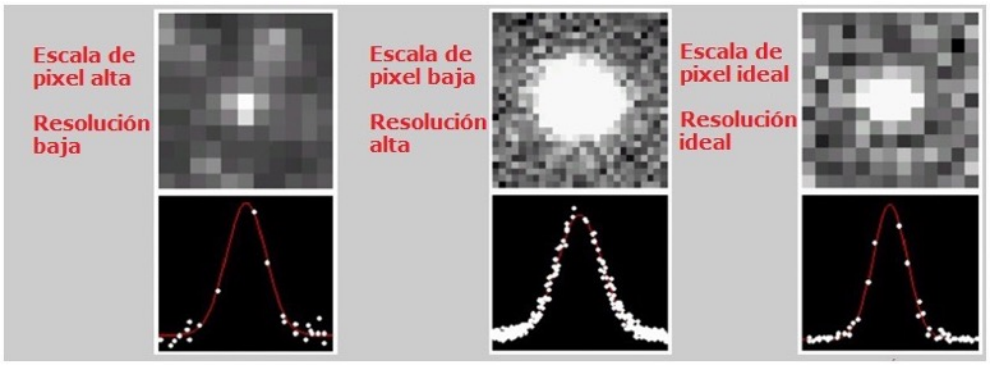


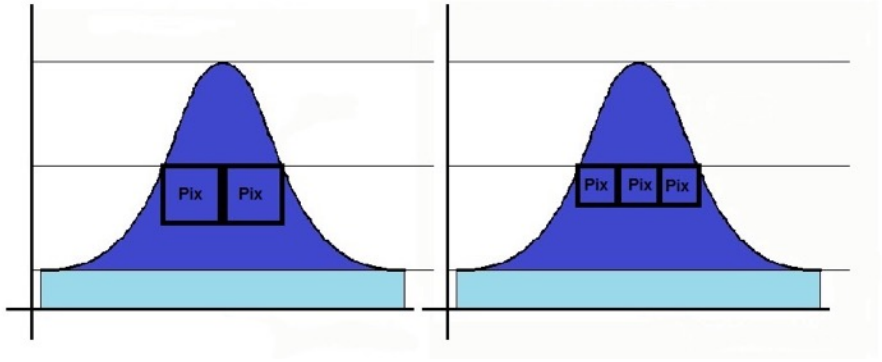
Relationship between seeing and plate scale

* Typical Seeing .
* ideal plate scale .
* Example: If a given seeing es FWHM = 5 arcsec

  Pixel scale max= 5 arcsec /2 = 2,50 arcsec/pix

  Pixel scale mín = 5 arcsec/3 = 1,66 arcseg/pix



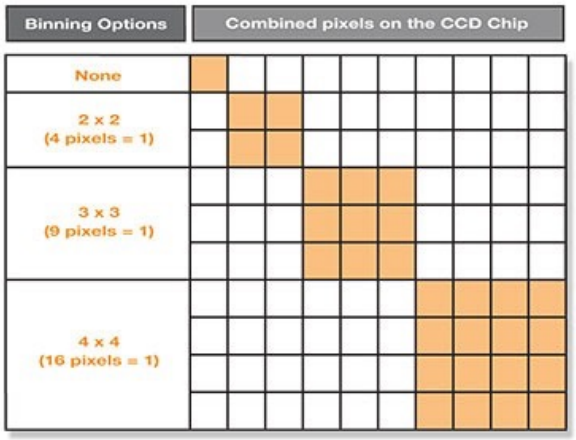


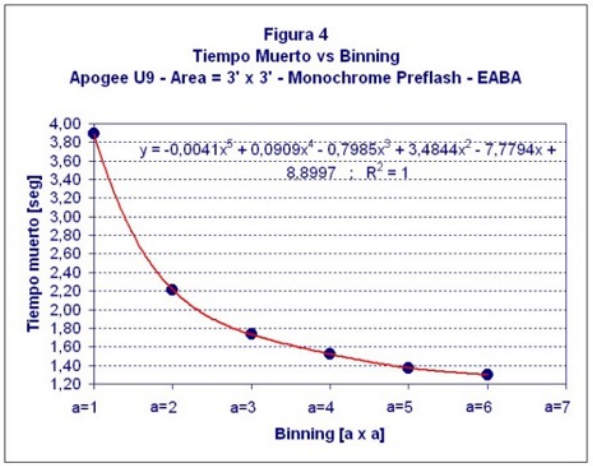
Binning and seeing

* Binning: superpíxel.
* Binning is done to find ideal plate scale
* Example MEADE 16” with APOGEE F16M :

Binning 5x5 : Plate scale = 2,28 arcsec/pix

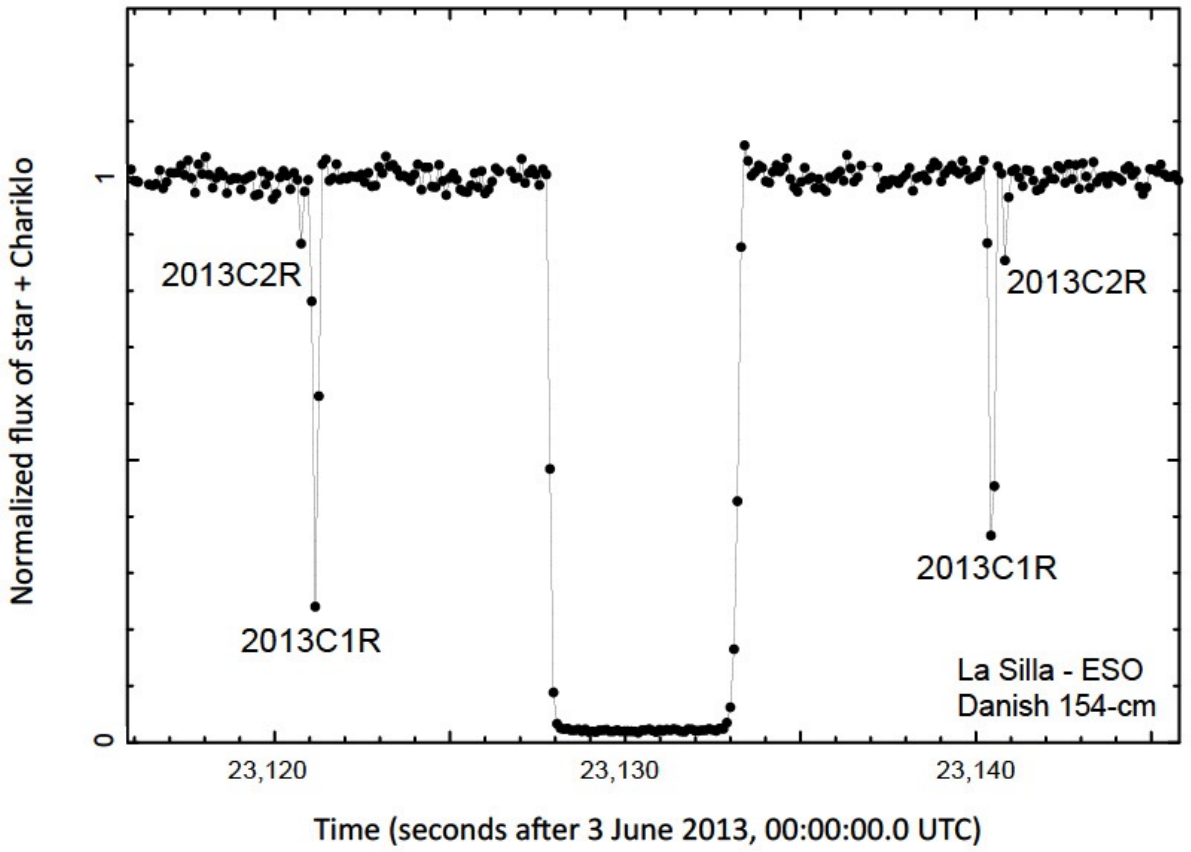
Binning 4x4: Plate scale = 1,83 arcsec/pix





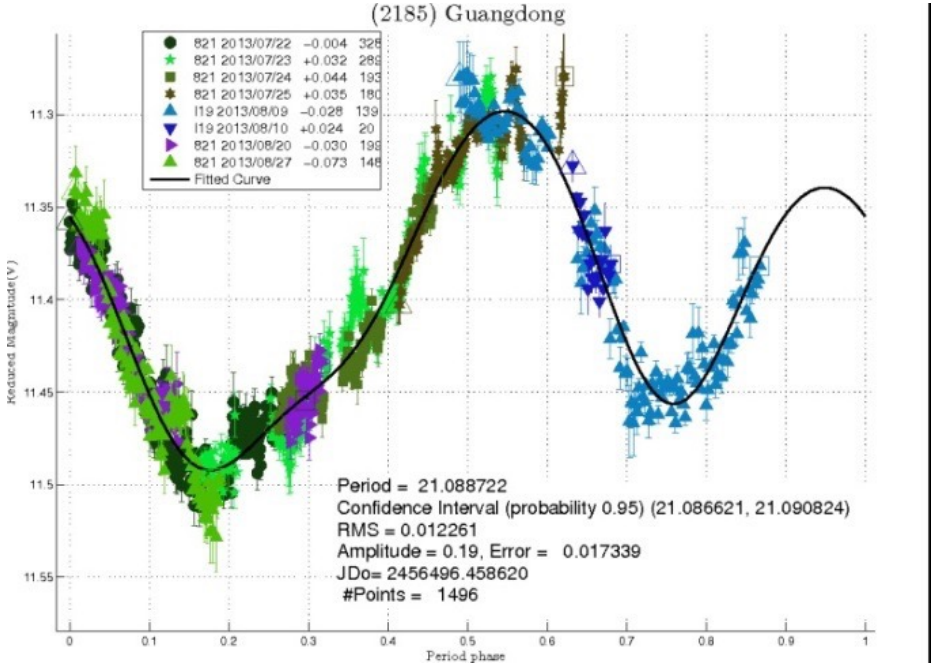
Binning and time resolution

* Time resolution = # images / time



Appropriate time exposure

* Try best SNR (signal to noise ratio).
* DOn't go over linearity. Considere variation of zenit distance during observation.
* Don't loose time resolution , when observing short duration events.

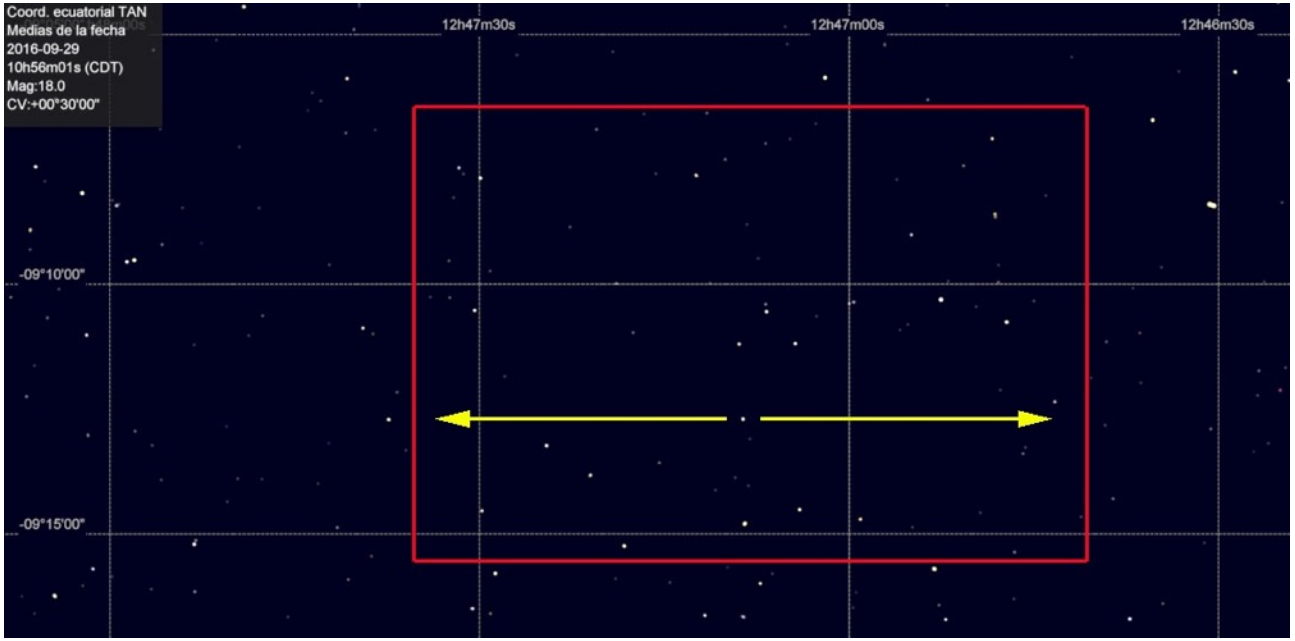


Telescope balancing (German equatorial mount)

1. Polar axis of mount: parallel to world axis.
2. Optical axis parallel to the meridian and braking on both axis.
3. Displacements: weights in the declination axis declinación and tube encasing.
4. Tube balancing: freeing declination brake and moving the tube
5. Polar axis: freeing polar axis brake and moving weights of declination axis.

Camera orientation

* When moving scope in the E-W direction stars' traces must be parallel to the edge of the larger border of the rectangular FOV.



Cardinal points in the visible field

* East of image: when moving scope to the east, East is the side of the image (up or down) where stars first appear.

* North: North is the the side of the image where stars first appear when moving the scope North.

Stationing of equatorial mount

* It is the fine adjustment of the mount polar axis position. The drift method will be applied in the declination.
* Azimut adjustment: Look for a star close to the equator and about to culminate. If the star drifts to the North mount's North is to the West of of the actual North.
* Altitude adjustment: Pick a star with right ascension -6h and declination approx 20°. If the star drifts to the North, the mount's north is higher than the celestial north.