“STELLAR TRAIL SEEING MONITOR”

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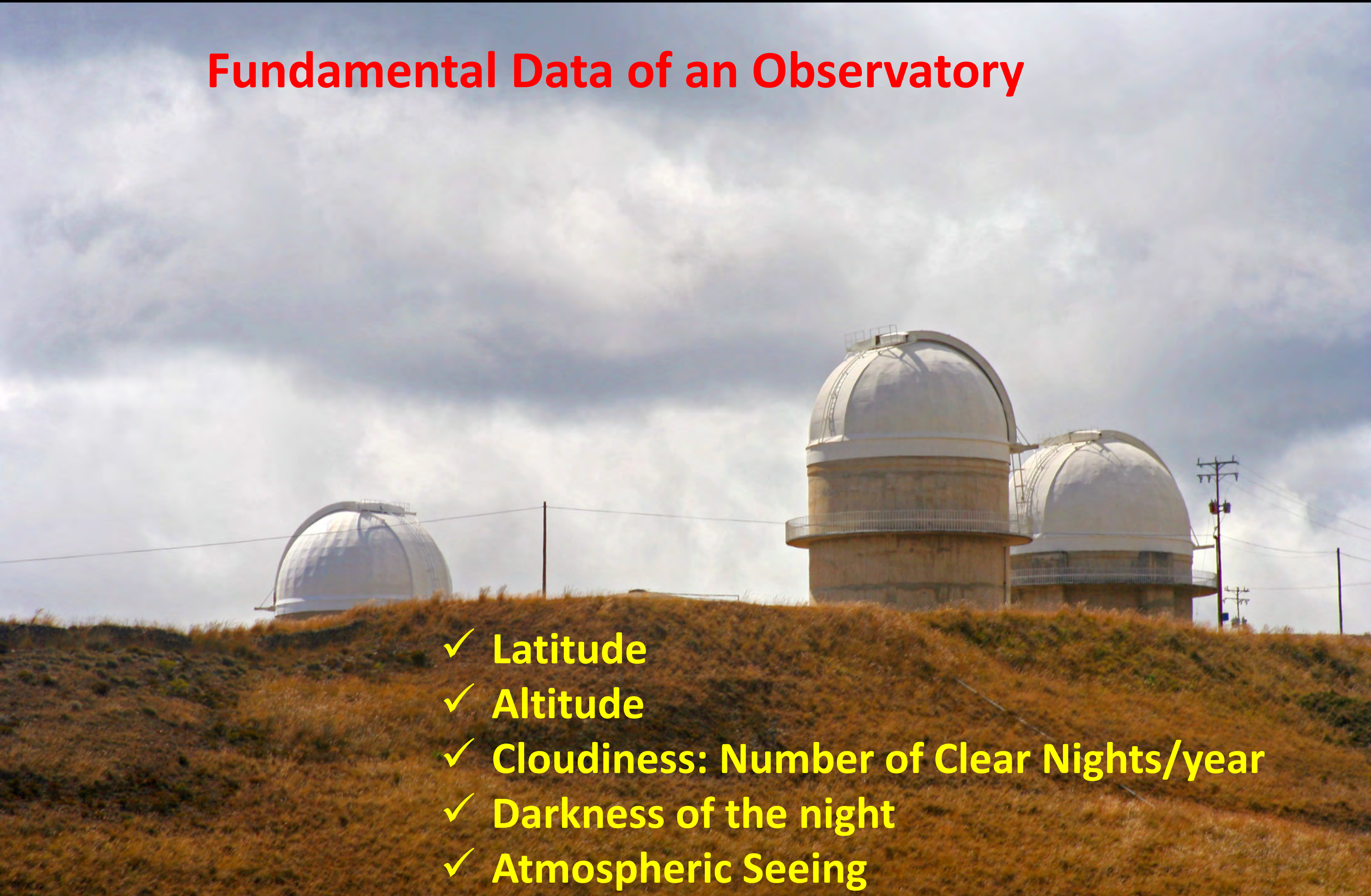
FACom

Solar, EArth & Planetary Physics SEAP Institute of Physics / University of Antioquia

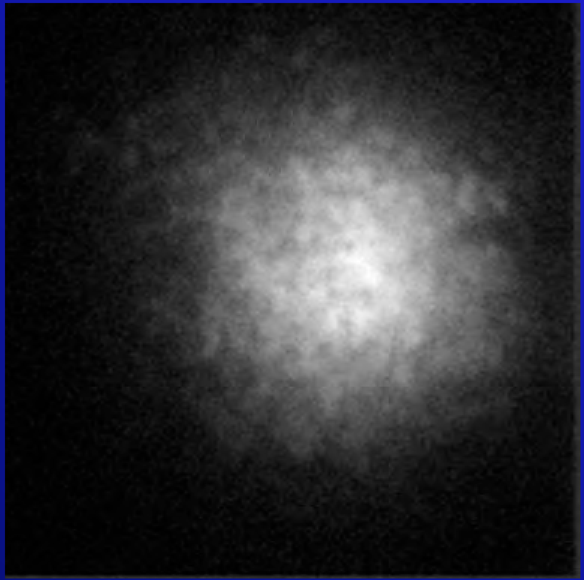
UNIVERSIDAD DE ANTIOQUIA

Fundamental Data of an Observatory

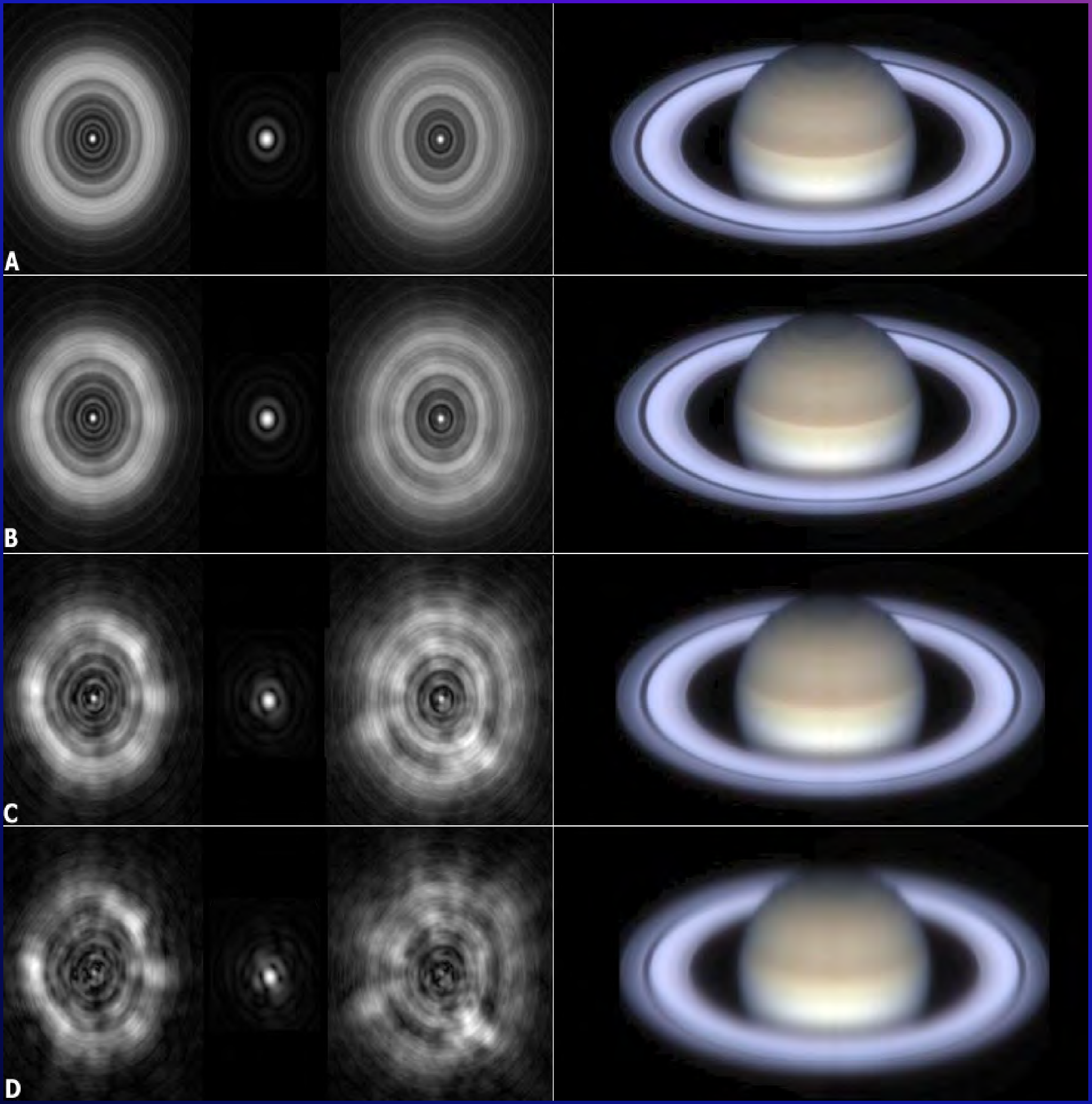


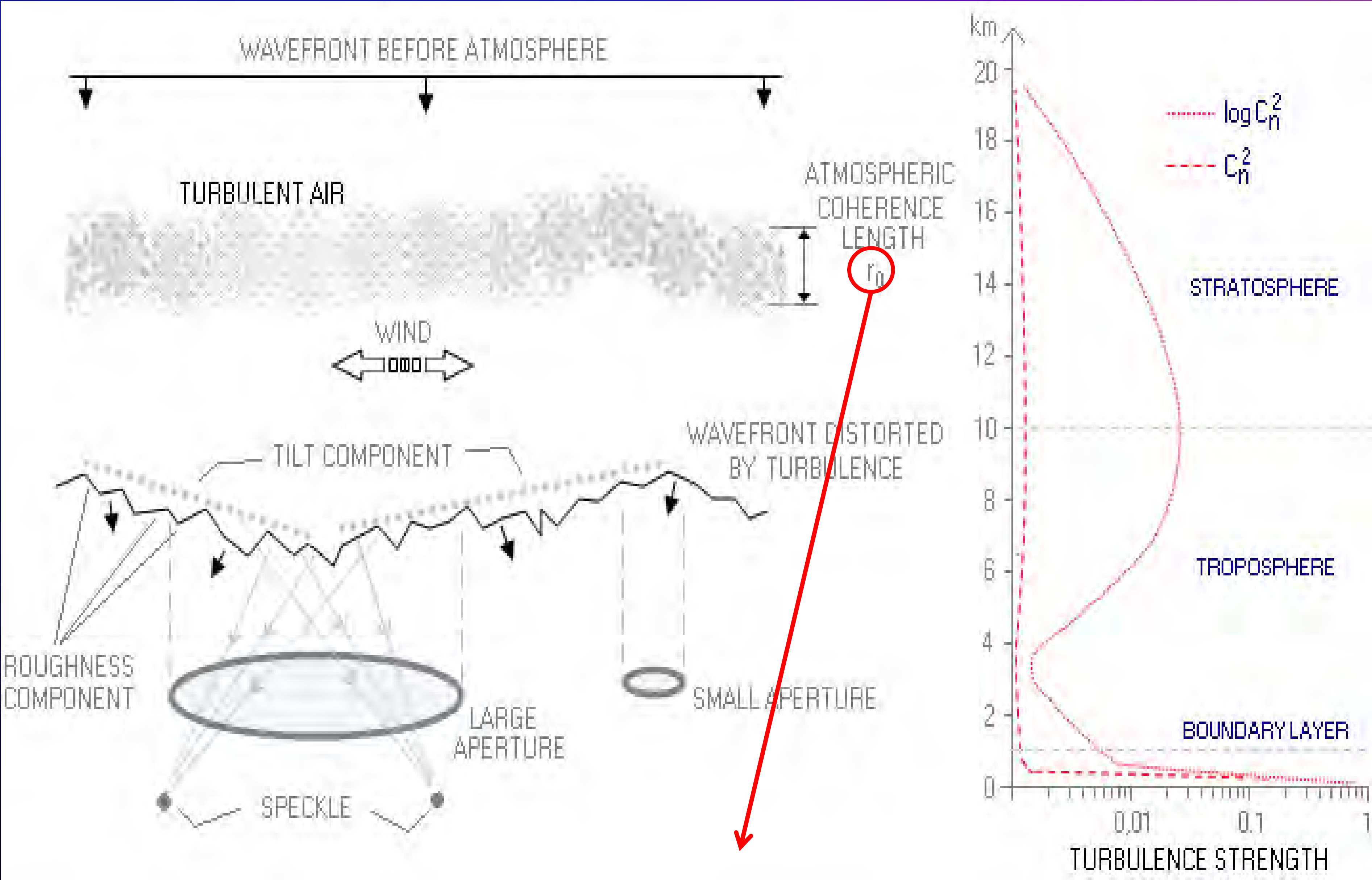
- ✓ Latitude
- ✓ Altitude
- ✓ Cloudiness: Number of Clear Nights/year
- ✓ Darkness of the night
- ✓ Atmospheric Seeing


Effect of "Seeing"
Mars on Different Nights

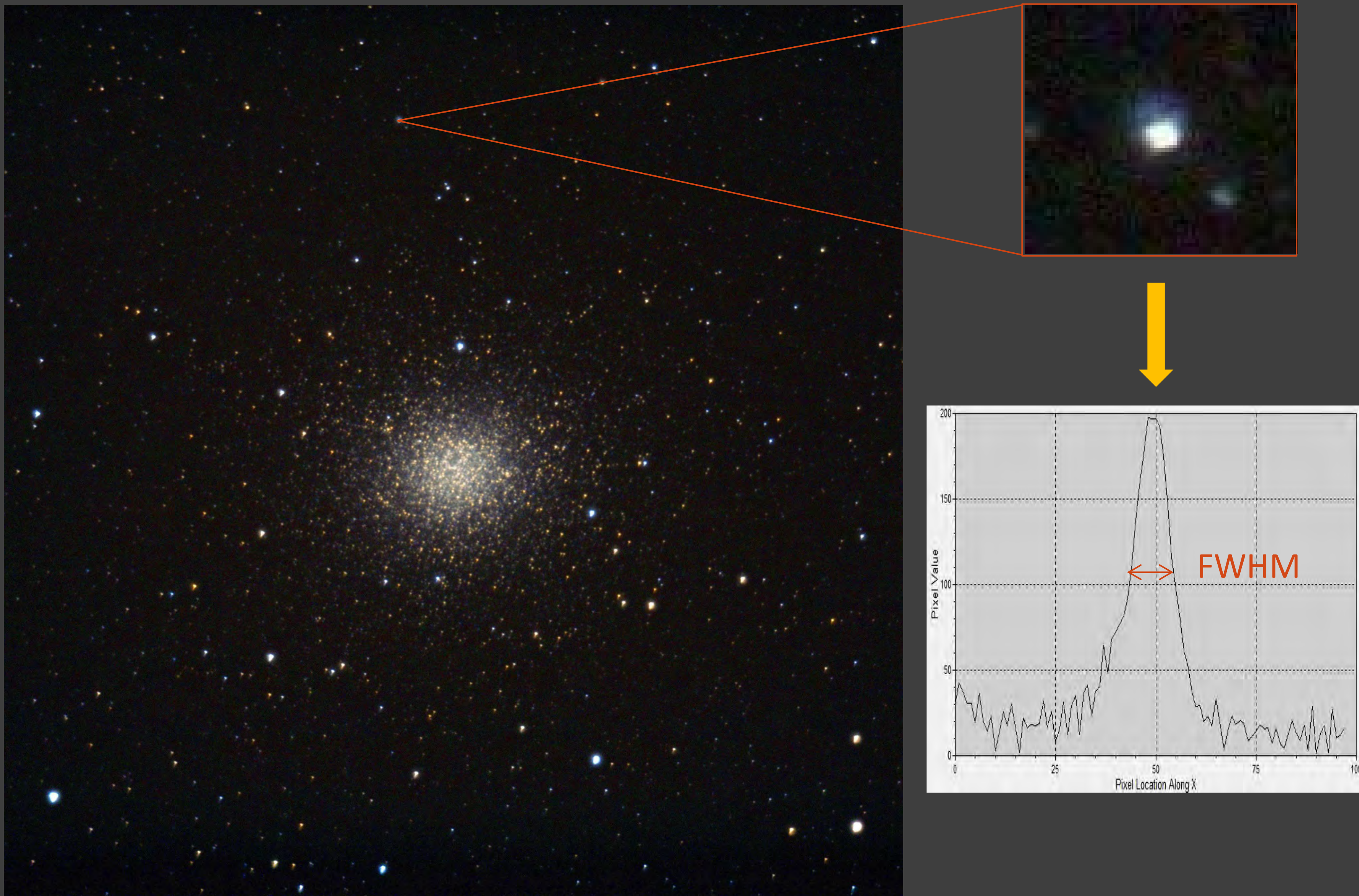


Efect of Seeing





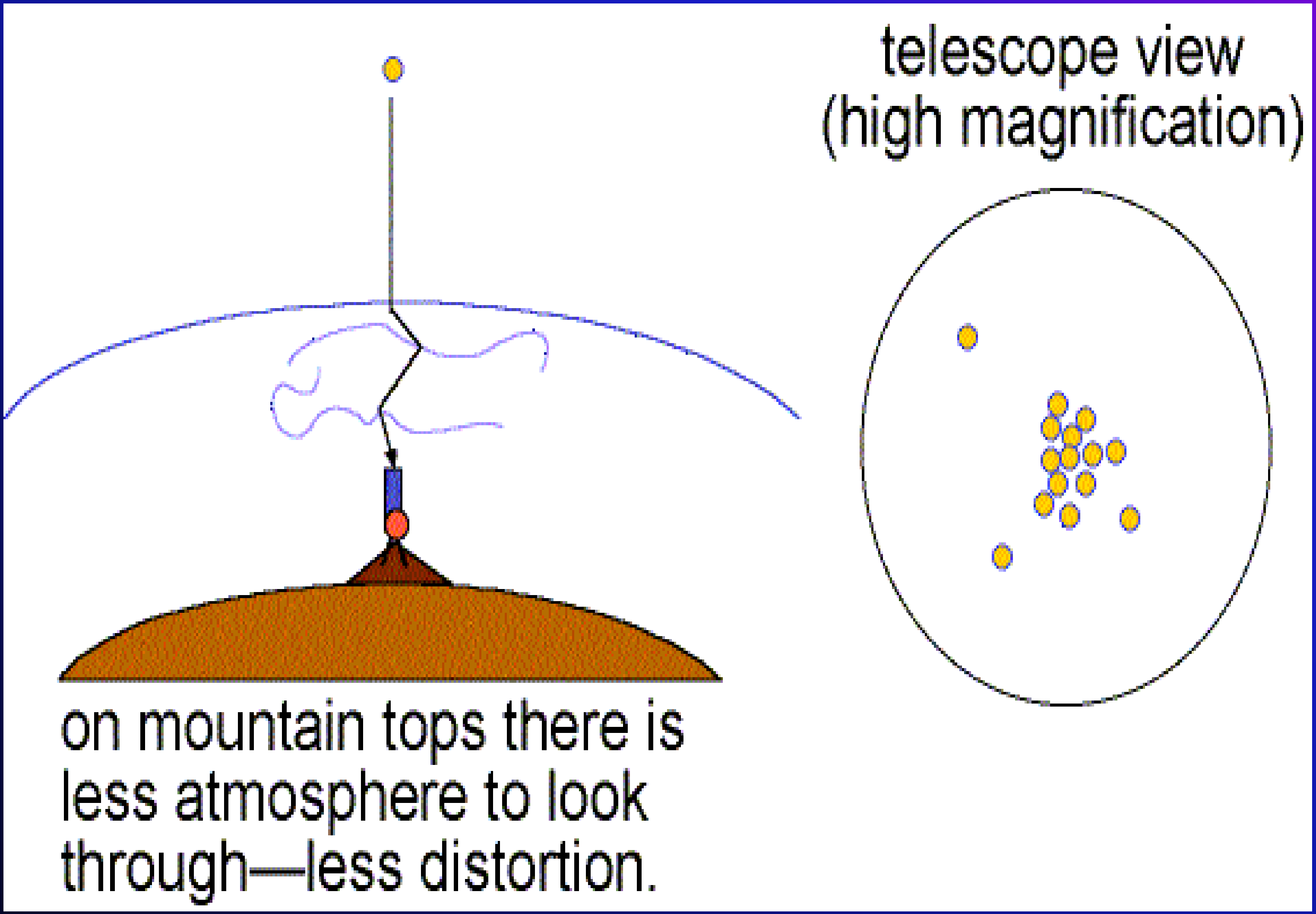
Fried r_0 (cm) Parameter



FWHMs typical 1 ~ 3 seconds of arc

¿Why a Stellar Trail Seeing Monitor?: STSM

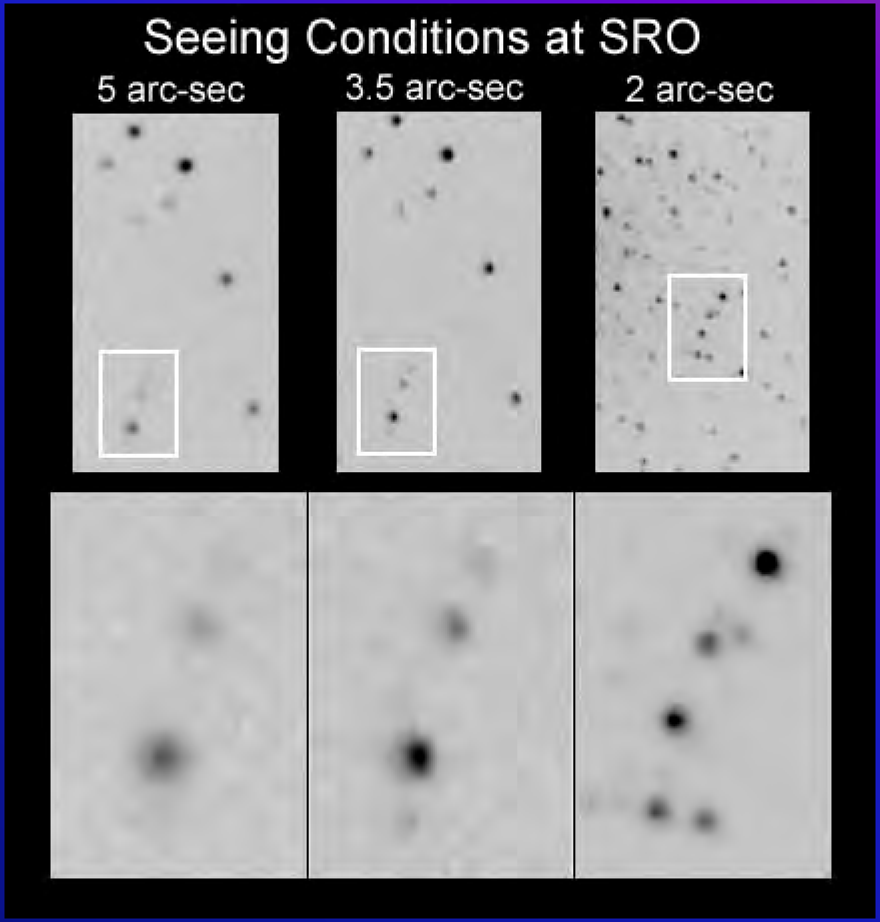
- ✓ To monitor the imagen quality (FWHM)
- ✓ Obtain the Fried parameter
- ✓ Determine the Greenwood's frequency
- ✓ Determine the resonant frequency of a telescope


telescope view
(high magnification)
on mountain tops there is
less atmosphere to look
through—less distortion.

The **detectability** of a faint source goes as the inverse squared of the seeing:

$1/S^2$

=> Laminar Flow



3 *

18 *

Harlan, 1965

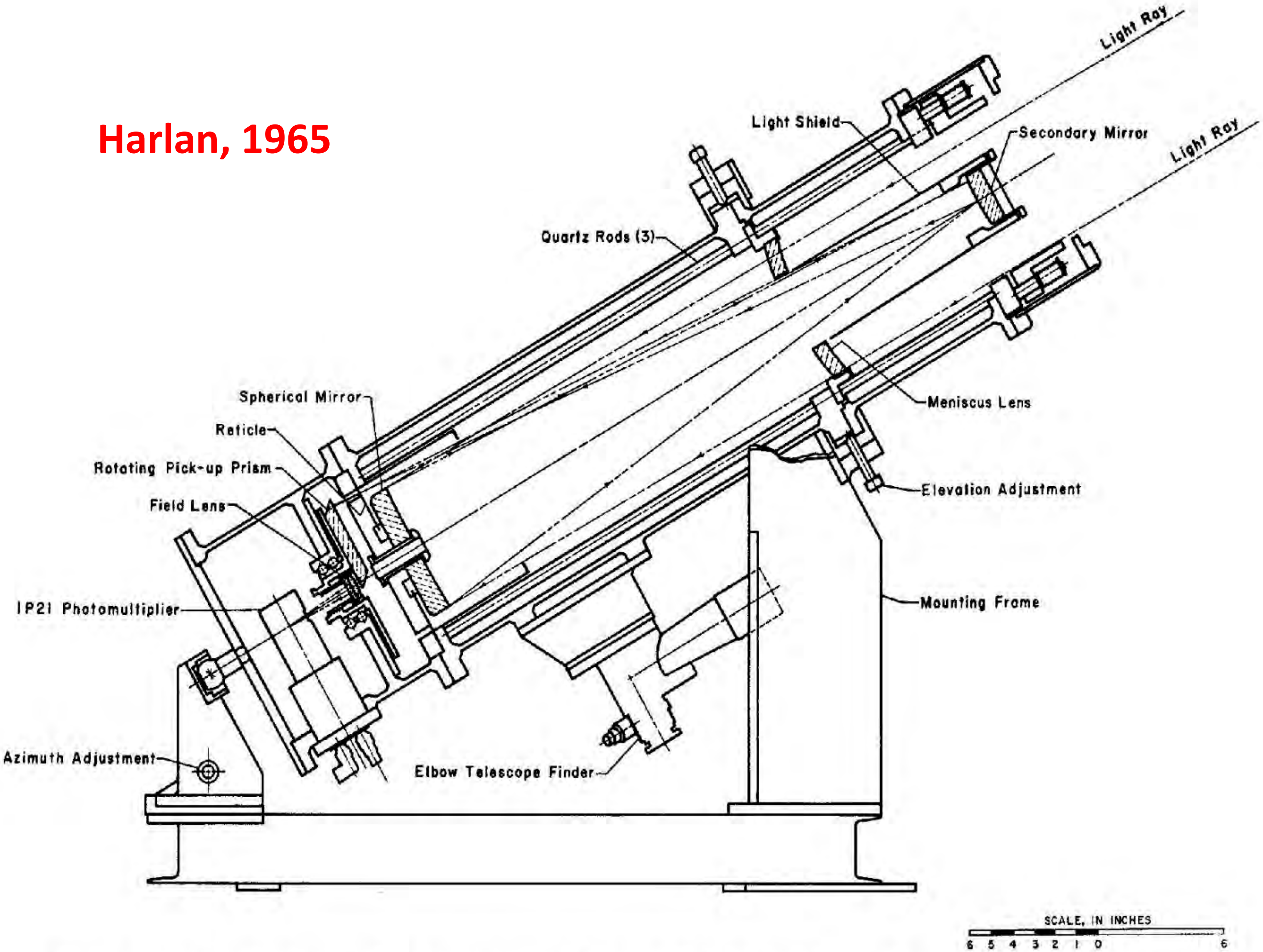
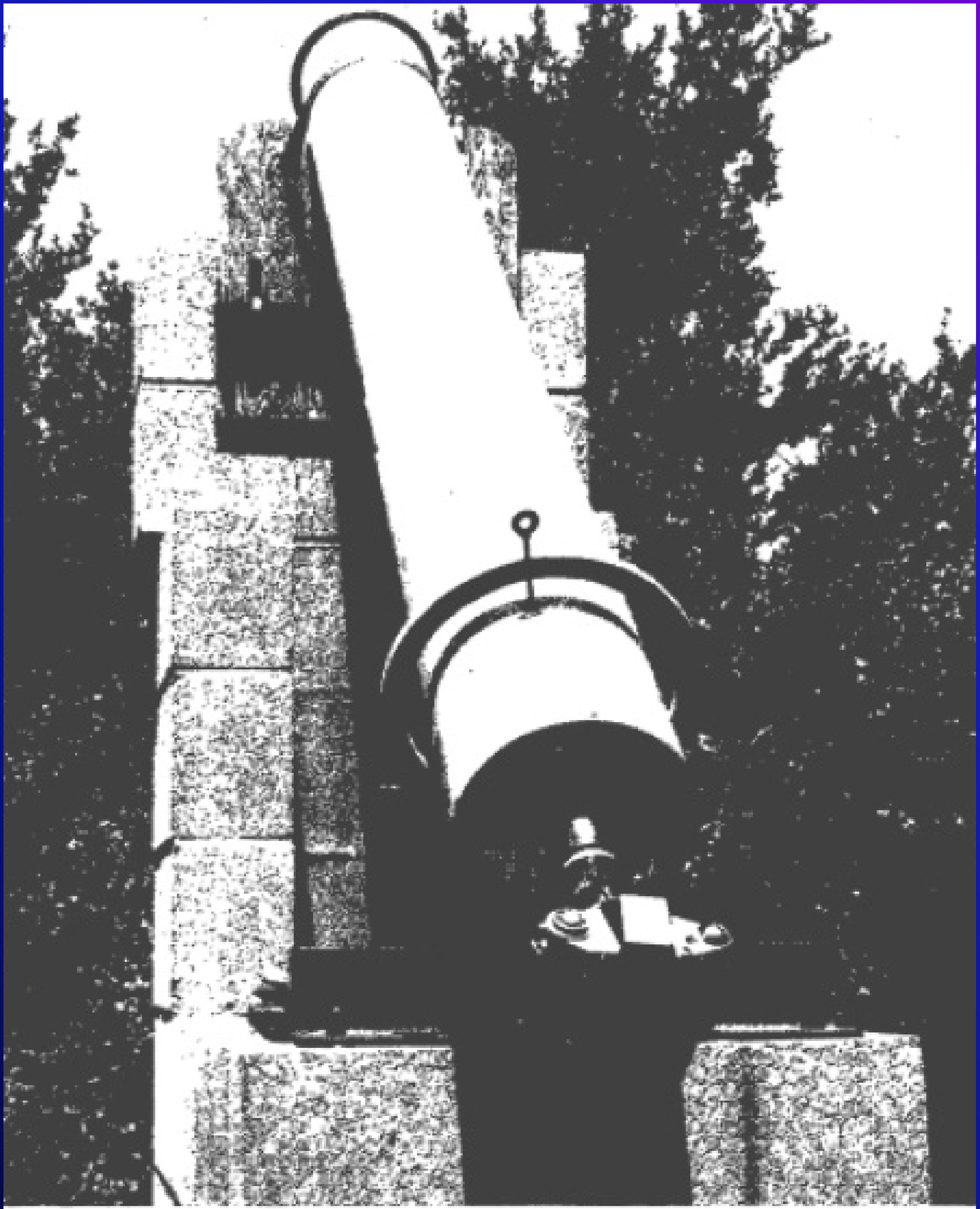


FIG. 4.—Cross-section drawing of the Polaris seeing monitor. The image of Polaris is formed outside the periphery of the primary mirror

Harlan, 1965



Six and one-half inch site-testing telescope on a fixed mounting for observation of star trails of Polaris, situated about 400 feet west of the 120-inch reflector.

Figura 1: Izquierda.- Imagen del DIMM y tapa con dos aperturas para la obtención de dos imágenes de la misma estrella. Derecha.- Torre de 5m diseñada por el Grupo italiano Galileo sobre la que se instala el DIMM, protegido por una cúpula de protección realizada en los talleres del IAC.

DIMM vs STSM

DIMM-ADVANTAGES

1- Focus is not critical

DIMM-DISADVANTAGES

1- Mount has to follow the sky => needs electricity
2- Needs a video => heavy files
non-trivial processing, more than 200 images needed
3- Bright stars

STSM-ADVANTAGES

1- Fix telescope pointing to the zenit
2- No need of electricity
3- Trivial processing of one single image
4- Fourier techniques allow the determinations of atmospheric frequencies
5- Faint stars easy to find can be used
6- FWHM in real time

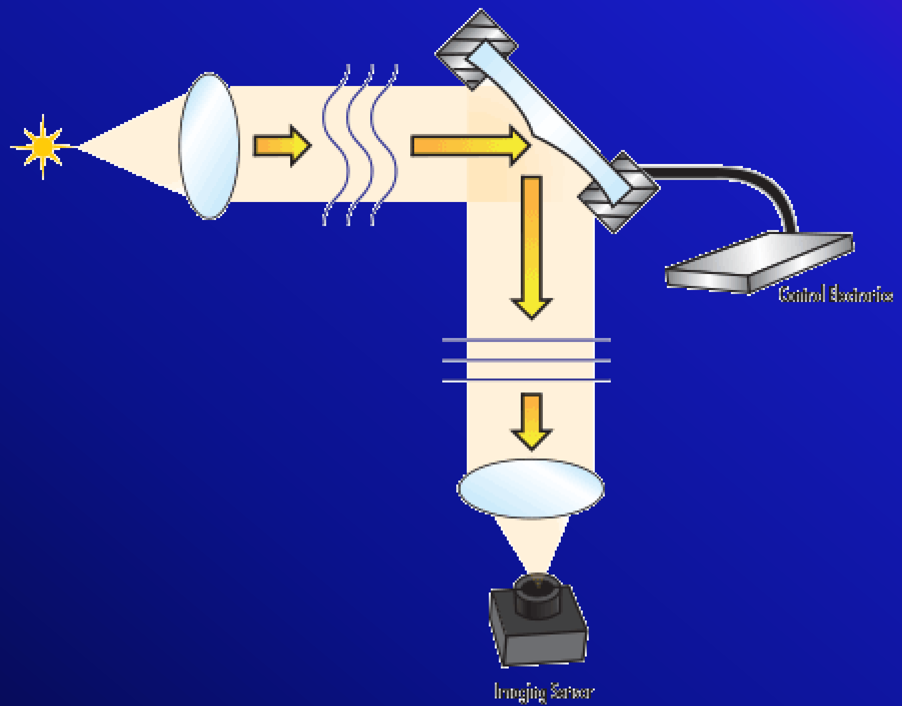
STSM-DISADVANTAGES

1- Focus is critical
2- Sensitive to local vibrations and wind

Fried parameter (r_0)

It is a measure of the quality of the optical Transmission of the atmosphere due to Index of refraction
Es una medida de la calidad de la transmision Óptica a traves de la atmosfera debido a Inhomogeneidades del indice de refracción.
Tiene unidades de longitude y se mide en cm.

4. OPTICA ADAPTATIVA requiere Greenwood frecuency



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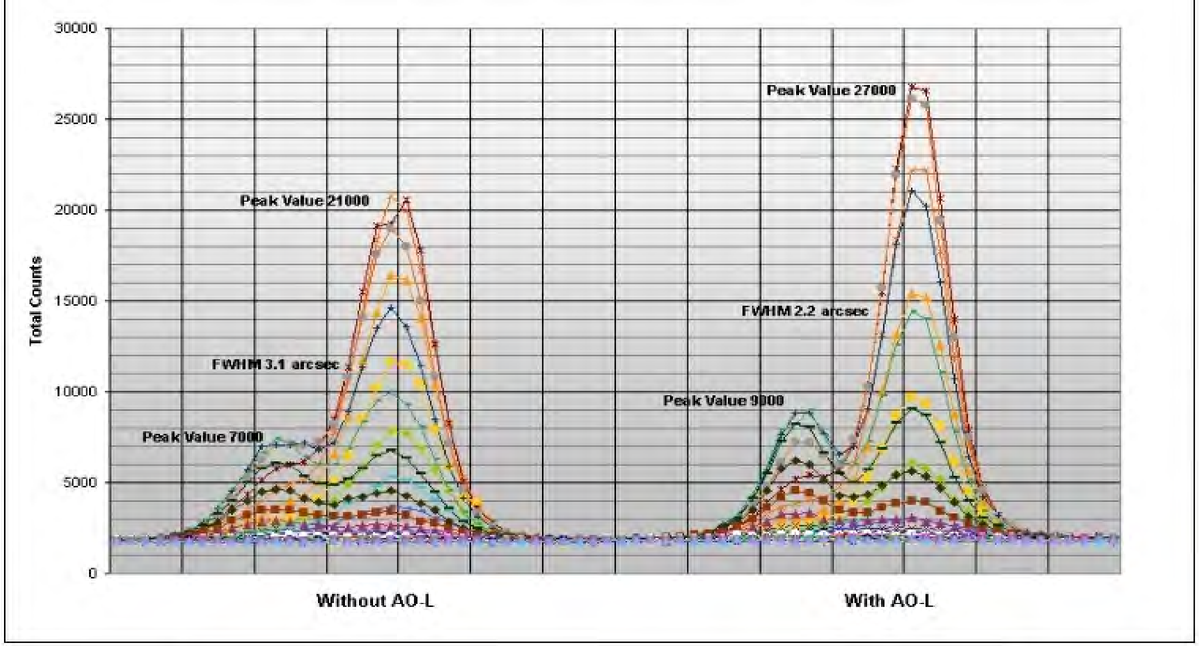

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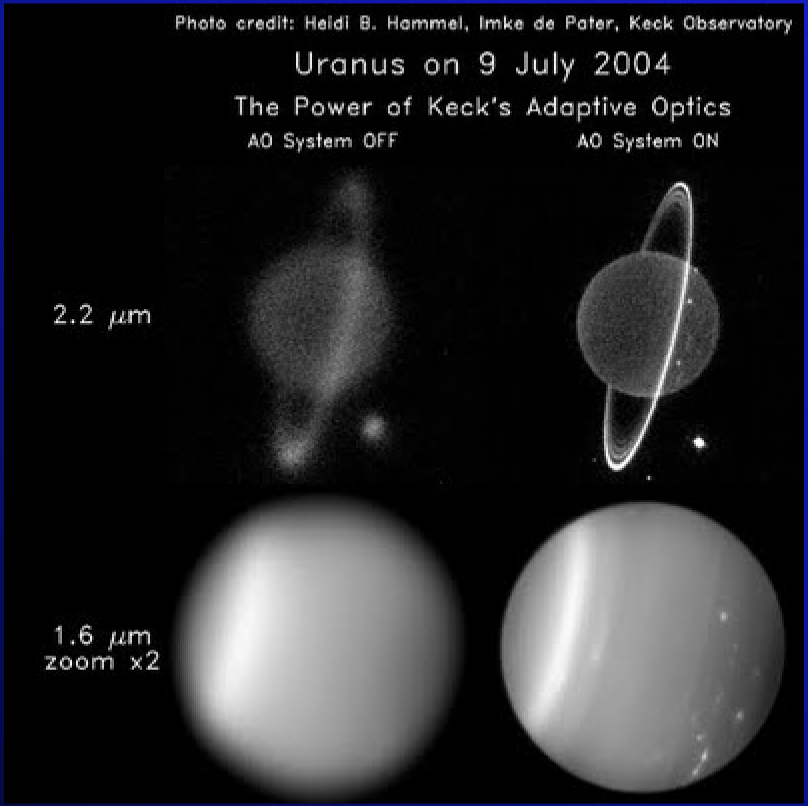
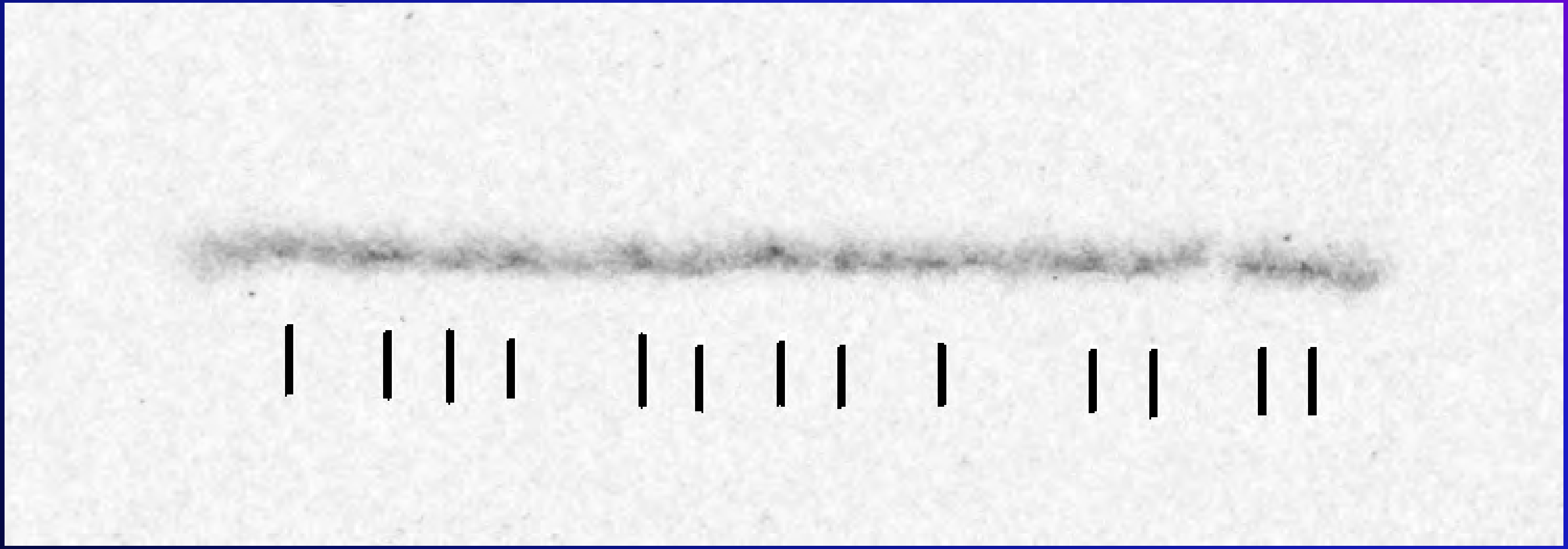


4. OPTICA ADAPTATIVA requiere Greenwood frecuency



Frecuencia de Greenwood y Longitud de Escala de Titilación

Es la frecuencia o ancho de banda para la correción óptima de un Sistema de optica adaptativa. Va desde decaHz a KiloHz.

Determinamos GF = 0.59 Hz
Definimos Scintillation Scale Length = v / GF
donde v = velocidad del viento = 2.5 km/h
SSL = 1.2 m = Fried Parameter

MOSA

Telescopio **Maksutov-Cassegrain**

Apertura **180mm**

Focal **2751mm (medida)**

Razón Focal **f/15.3**

Resolución

0.7 segundos de arco @ 550nm

Cámara

Canon EOS 500D

Sensor **CMOS 4752 × 3168 (22.3 × 14.9mm^2)**

Pixel **4.69 × 4.69μm^2**

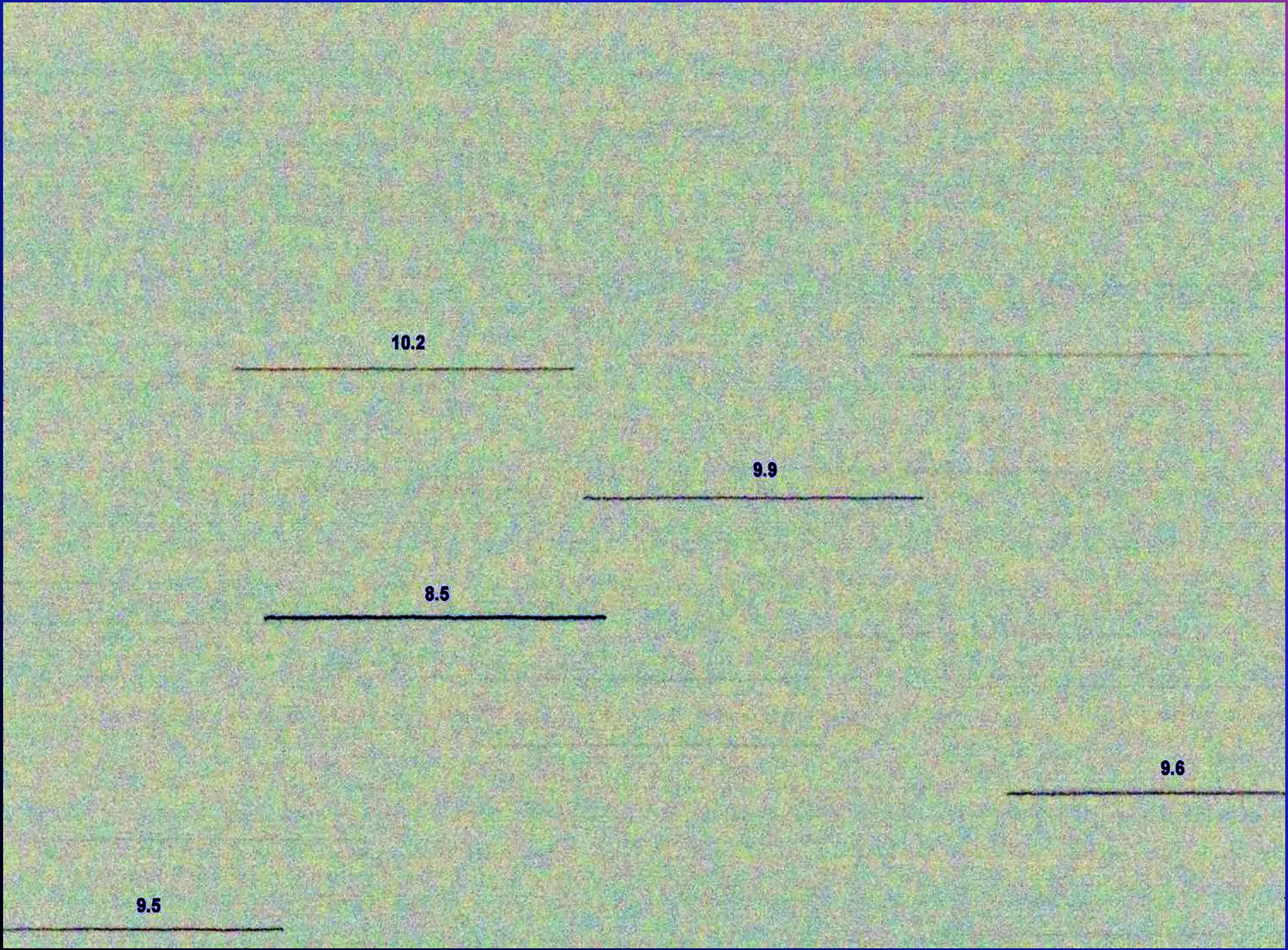
Escala

0.35seg.arco/pixel

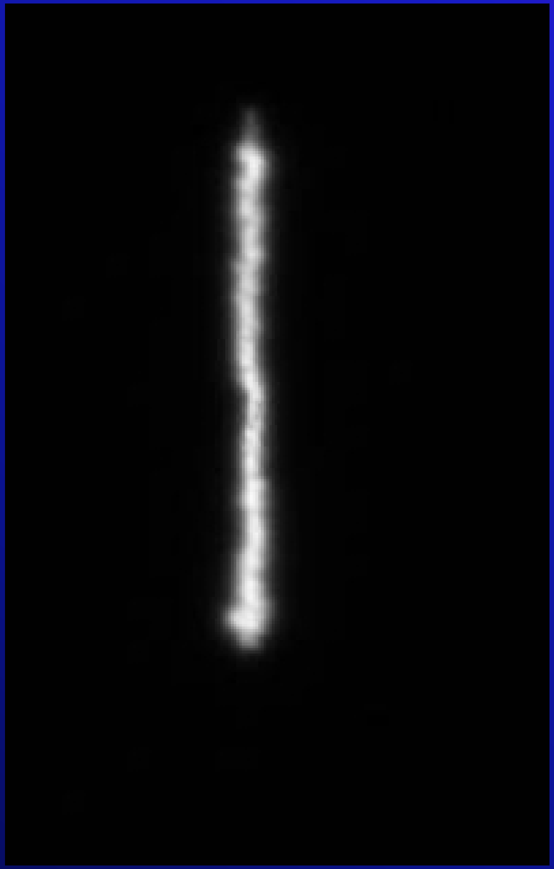
Campo **27.8 × 18.6 minutos de arco^2**

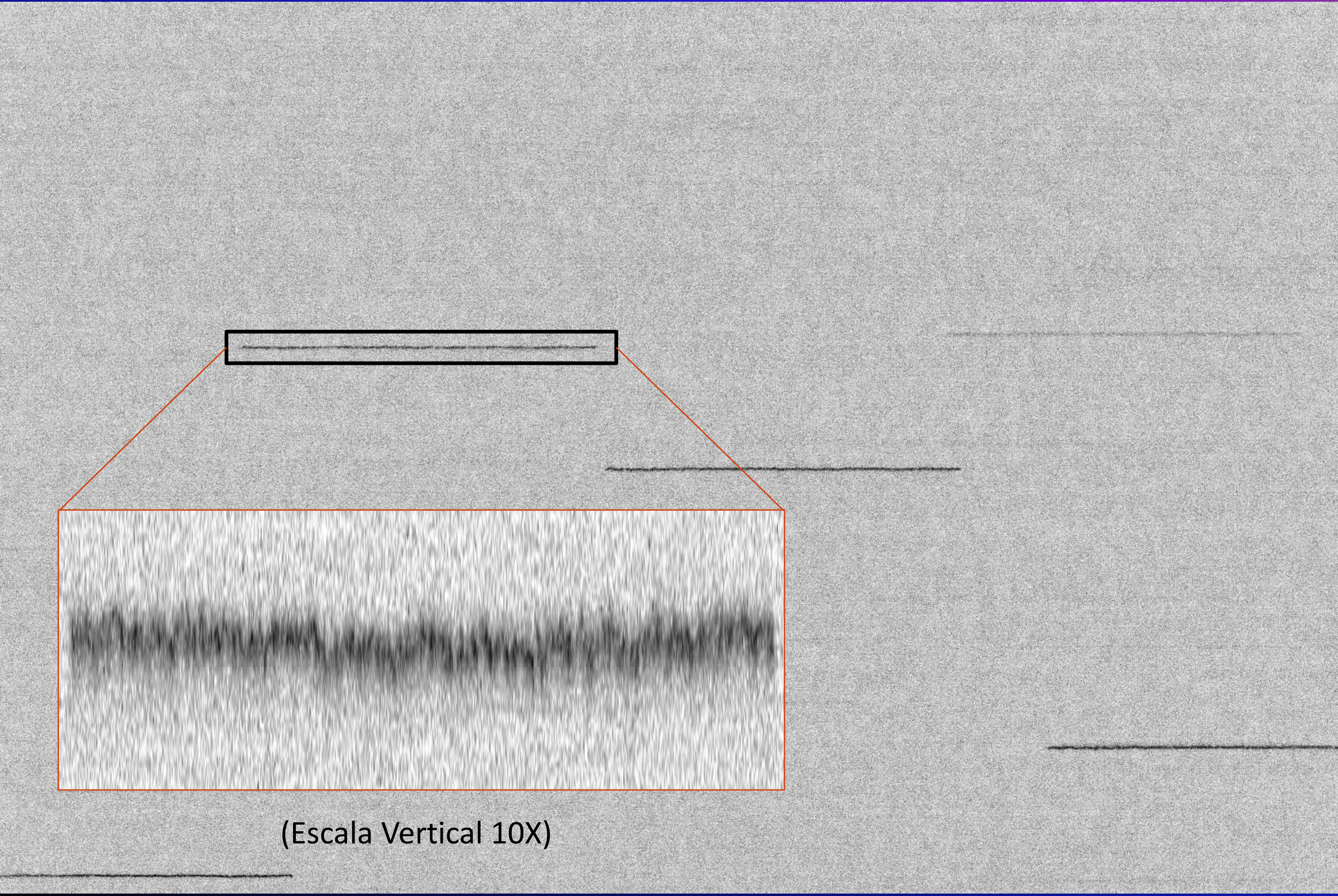
Pruebas Nocturnas de MOSA

16/17, 17/18 y 19/20 de marzo del 2013


10.2
9.9
8.5
9.6
9.5

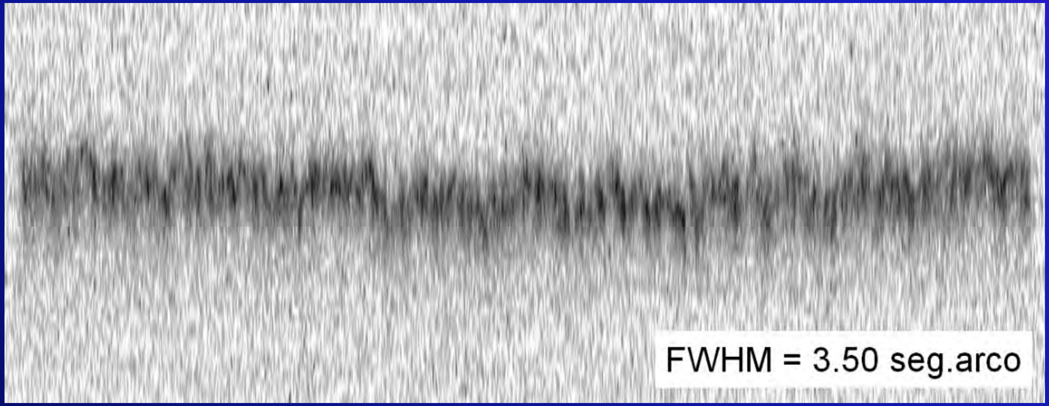
Ejemplo de vibración y viento



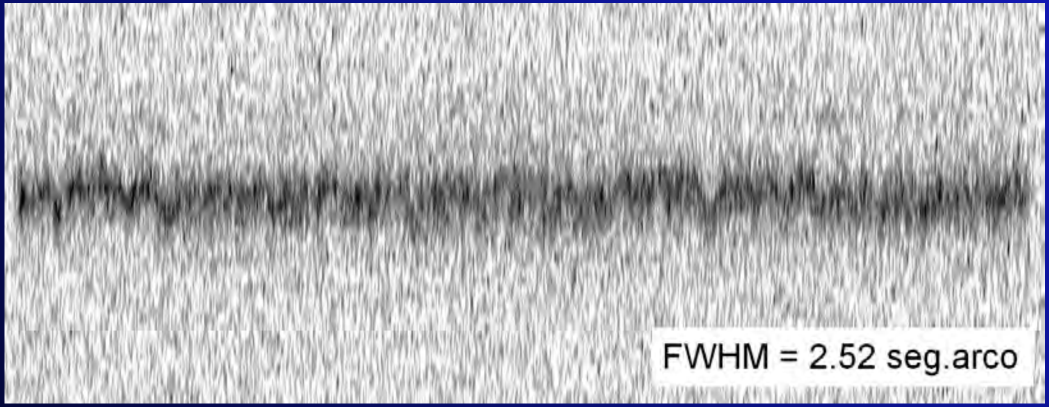


(Escala Vertical 10X)

Un par de ejemplos…



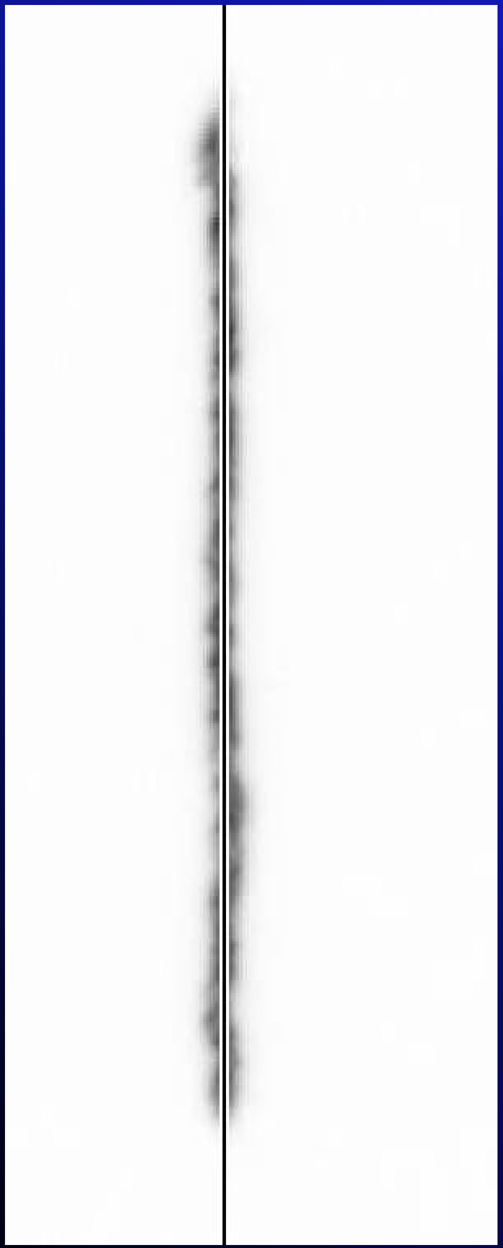
HLV 04:38:39

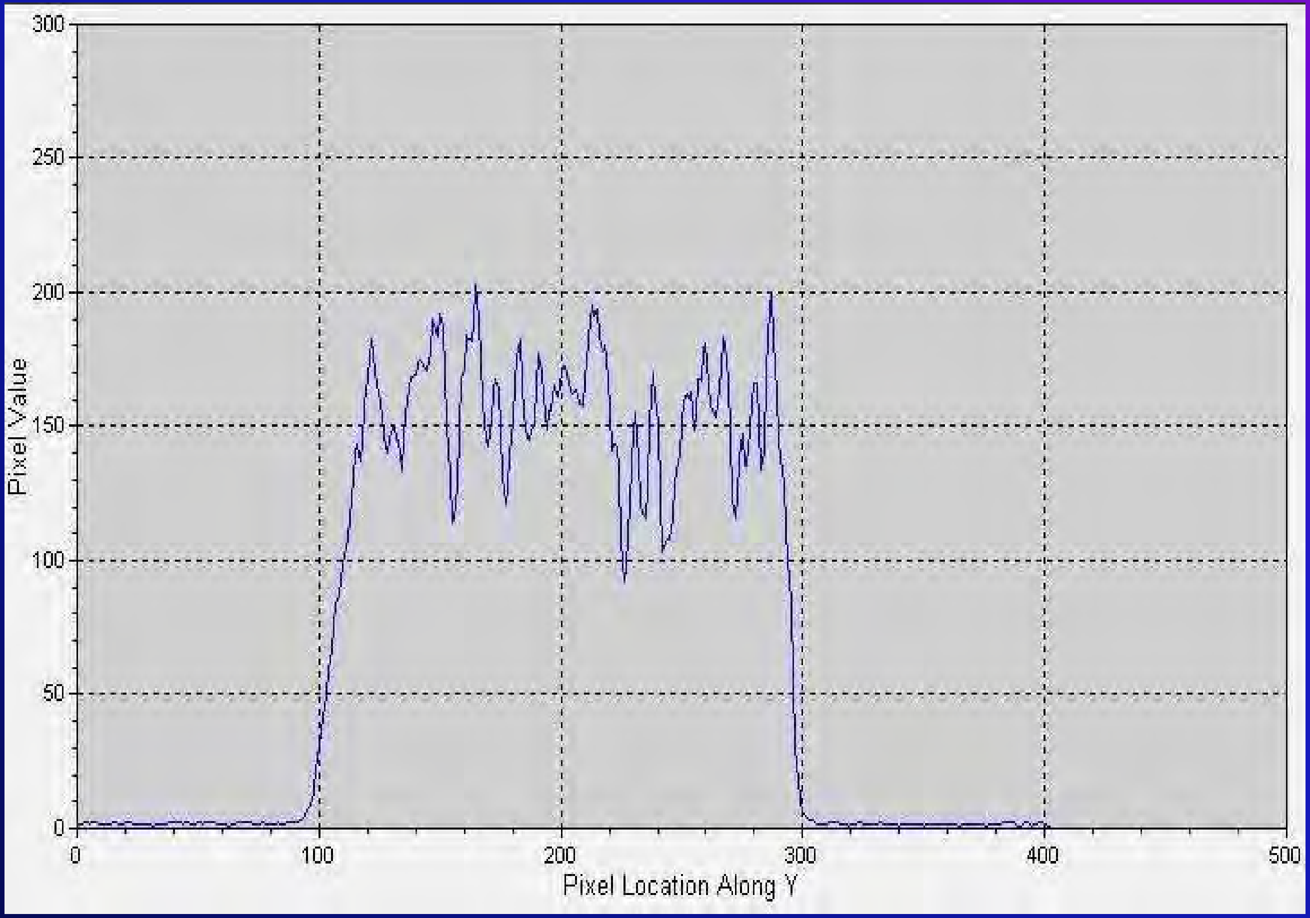


HLV 05:09:46

20/03/2013

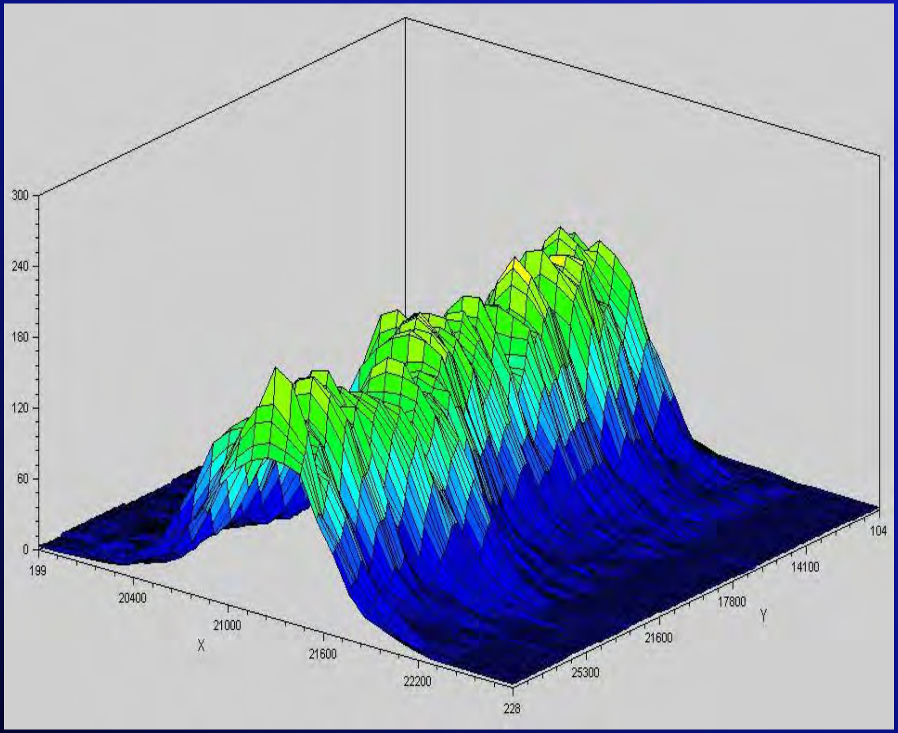
Instituto Tecnológico de Medellín

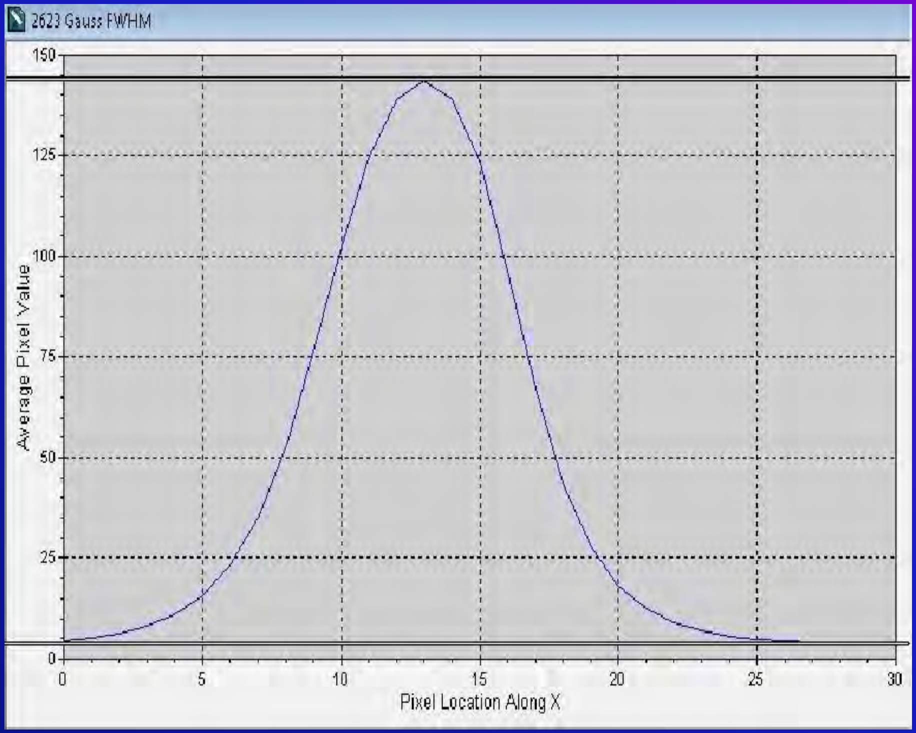




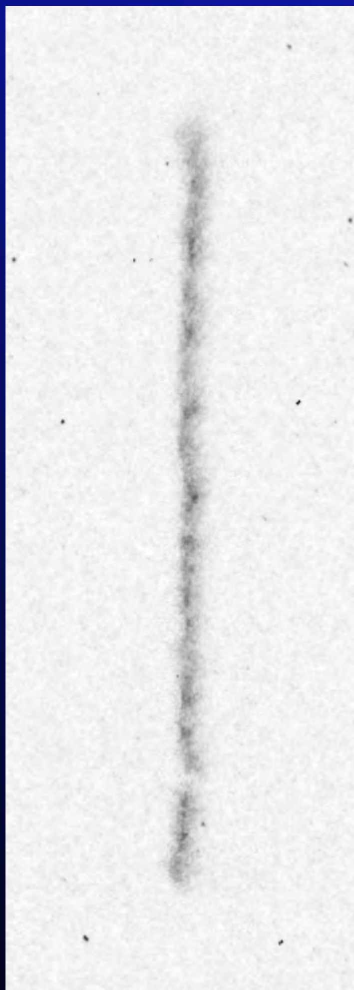
Pixel Value
300
250
200
150
100
50
0
0
100
200
300
400
500
Pixel Location Along Y

Conversión de 3 a 2 dimensiones



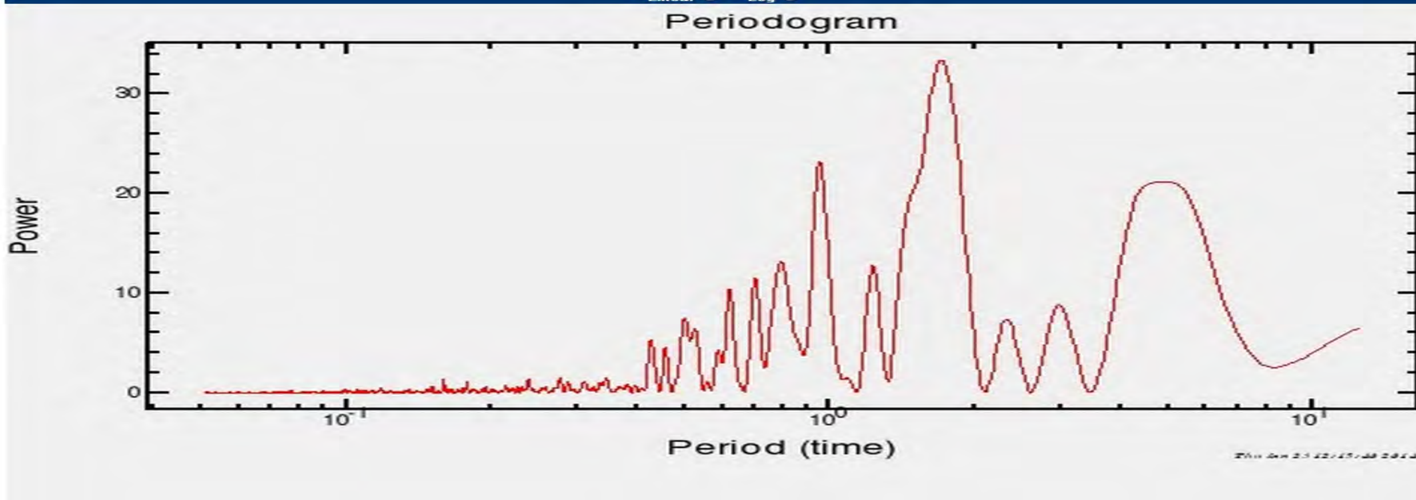


Análisis de Fourier de un trazo



Periodogram Download

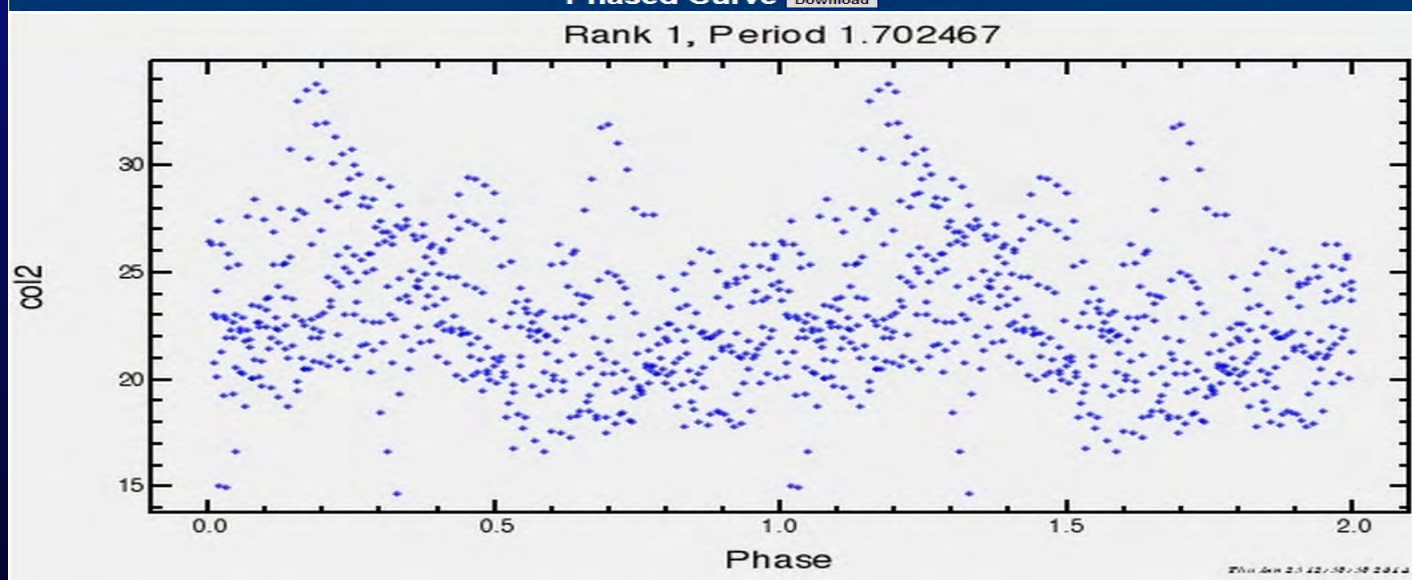
Linear ● Log ●



Most Significant Periods Download

Rank	Period	Power	P-value	Link
1	1.702467	33.395083	1.50768e-11	Phased curve
2	0.955544	23.146046	4.30072e-07	Phased curve
3	4.997324	21.185451	3.05504e-06	Phased curve

Phased Curve Download



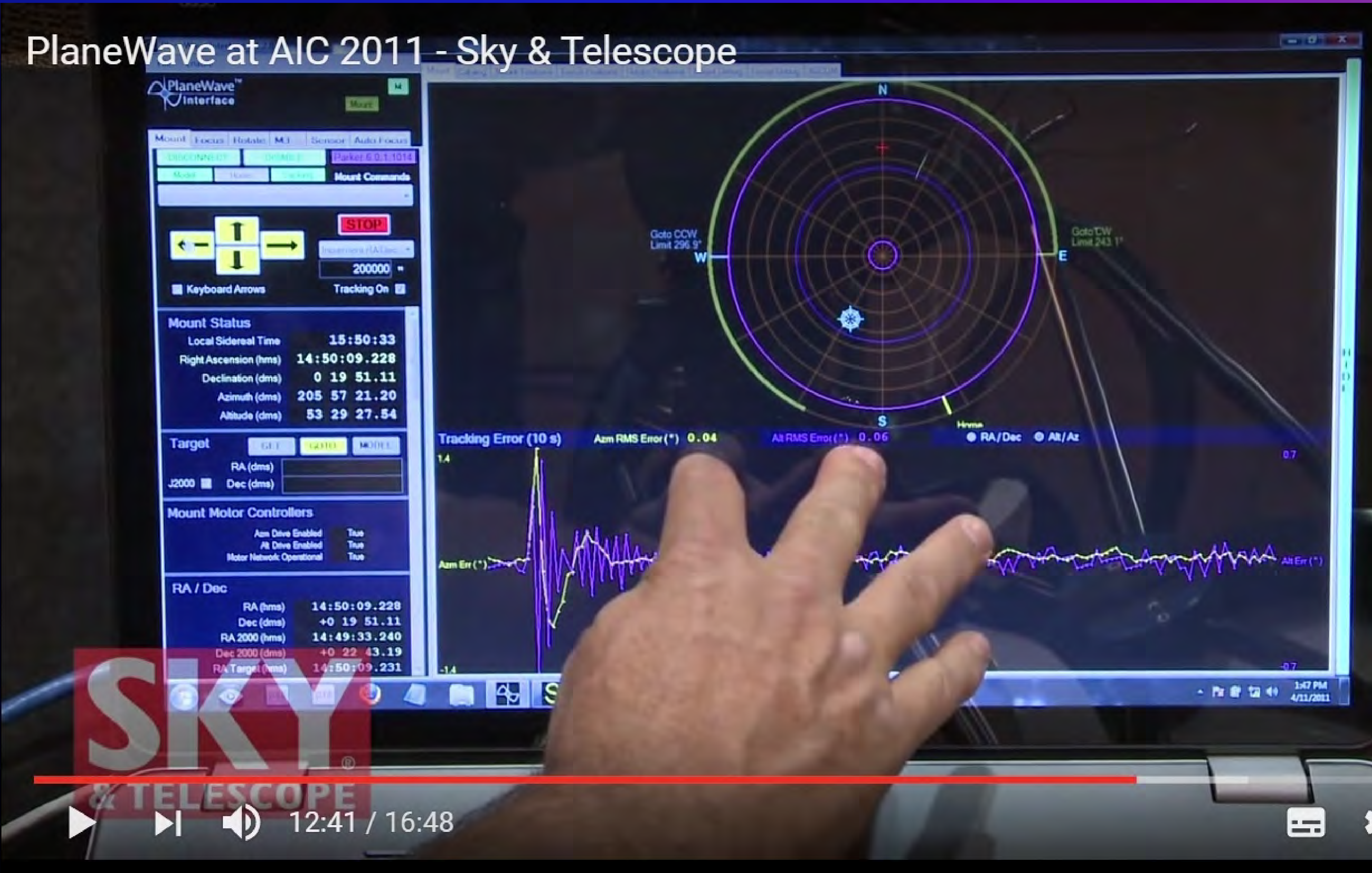
Frecuencia de Resonancia de Un Telescopio

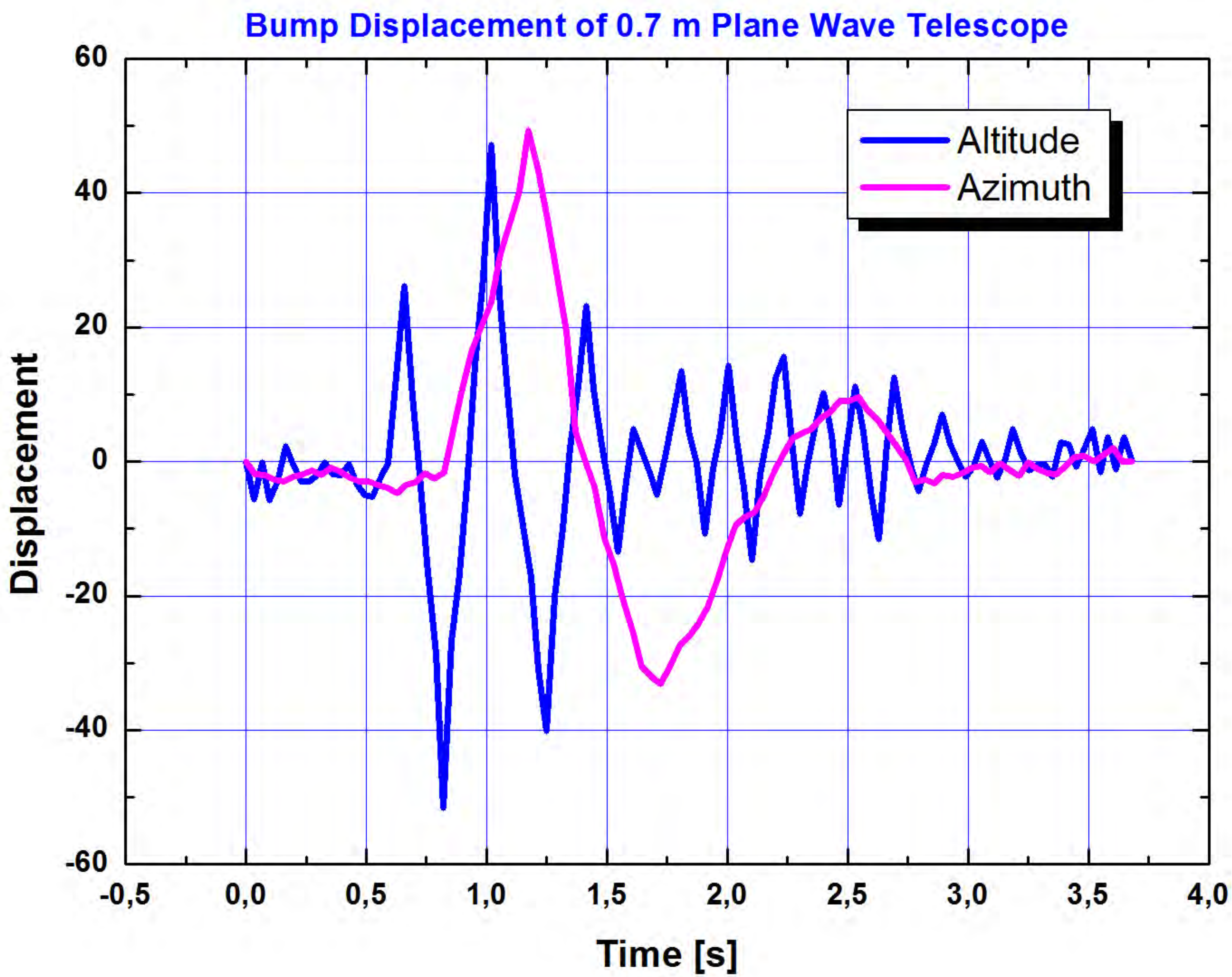
Frecuencia de Resonancia

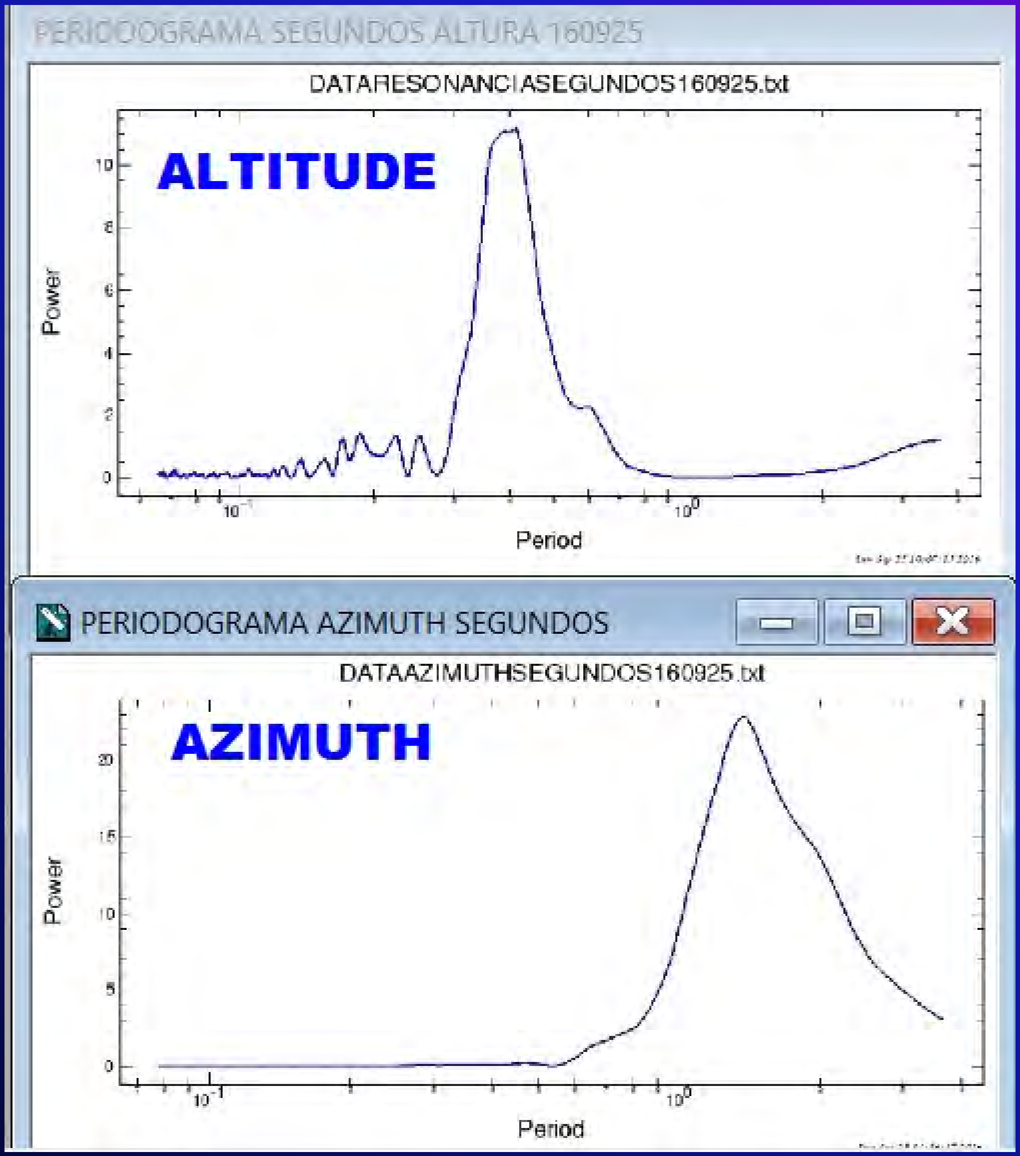
Es la frecuencia a la cual un telescopio vibra debido a fuerzas externas como el viento o golpes.

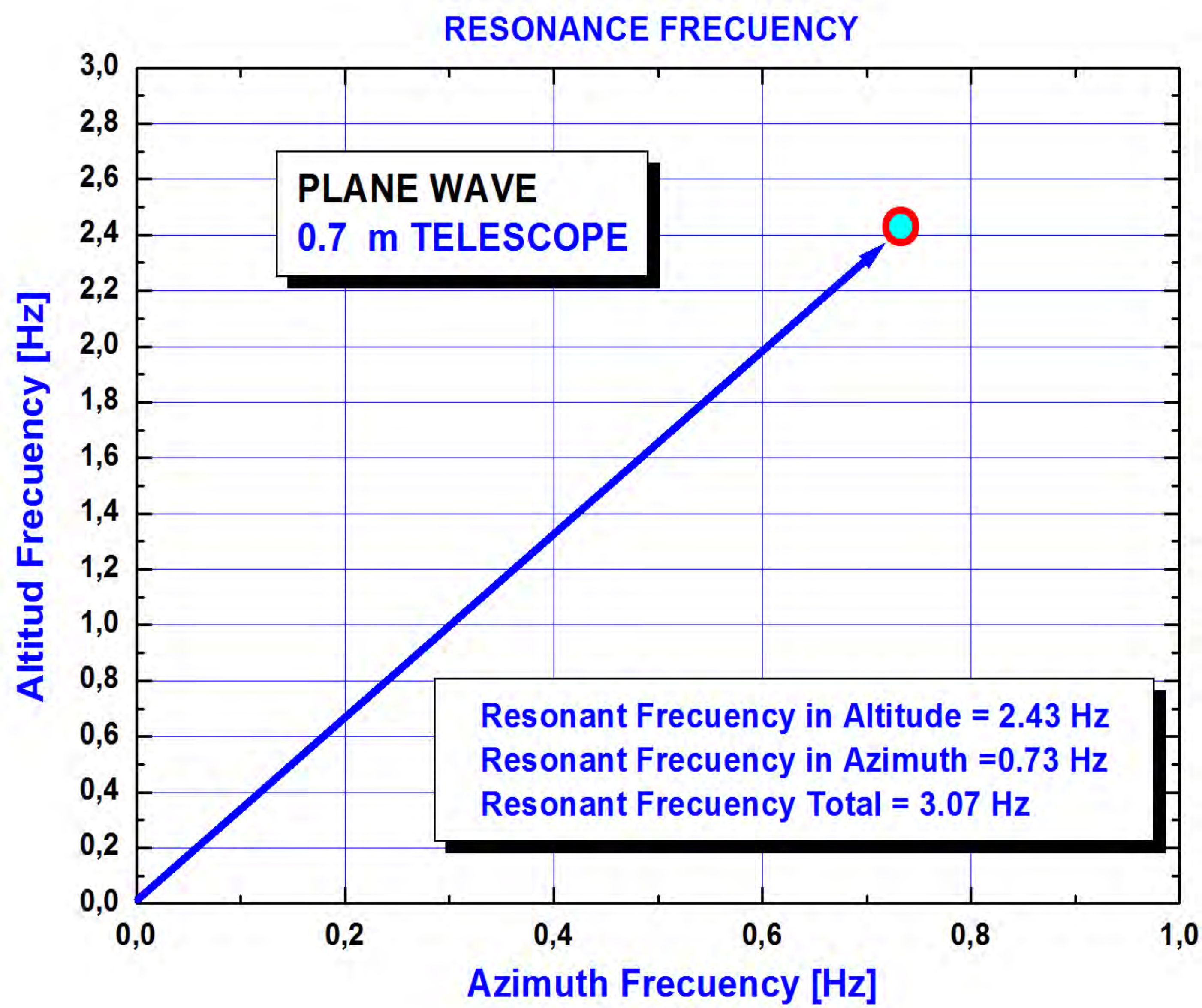
Dennis DiCicco y Rick Hendrick

El telescopio de 0.7 m de Plane Wave


PlaneWave at AIC 2011 - Sky & Telescope
PlaneWave Interface
STOP
200000
Keyboard Arrows
Tracking On
Mount Commands
Mount Status
Local Sidereal Time 15:50:33
Right Ascension (hms) 14:50:09.228
Declination (dms) 0 19 51.11
Azimuth (dms) 205 57 21.20
Altitude (dms) 53 29 27.54
Target
RA (dms)
J2000
Dec (dms)
Mount Motor Controllers
RA / Dec
RA (hms) 14:50:09.228
Dec (dms) +0 19 51.11
RA 2000 (hms) 14:49:33.240
N
S
W
E
Tracking Error (10 s)
Azm RMS Error (°) 0.04
RA/Dec
Alt/Az
SKY & TELESCOPE
12:41 / 16:48


Bump Displacement of 0.7 m Plane Wave Telescope
Altitude
Azimuth
Displacement
Time [s]
60
40
20
0
-20
-40
-60
-0,5
0,0
0,5
1,0
1,5
2,0
2,5
3,0
3,5
4,0


PERIODOGRAMA SEGUNDOS ALTURA 160925
DATARESONANCIASEGUNDOS160925.txt
ALTITUDE
Power
Period
PERIODOGRAMA AZIMUTH SEGUNDOS
DATAAZIMUTHSEGUNDOS160925.txt
AZIMUTH
Power
Period


RESONANCE FRECUENCY
PLANE WAVE
0.7 m TELESCOPE
Resonant Frecuency in Altitude = 2.43 Hz
Resonant Frecuency in Azimuth =0.73 Hz
Resonant Frecuency Total = 3.07 Hz
Altitud Frecuency [Hz]
Azimuth Frecuency [Hz]
3,0
2,8
2,6
2,4
2,2
2,0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,0
0,0
0,2
0,4
0,6
0,8
1,0

Este método se está implementando en 3 Lugares: Mérida, Medellín y Tatacoa

Instalación en el OAN

Este método se está implementando en 3 Lugares: Mérida, Medellín y Tatacoa

FIN