

Astronomical Instruments for Robotic Telescopes
Ensenada-México, 03 Sep 2012

Robotic Telescopes to Science and Public Outreach



Dr. Luis Cuesta
Grupo Telescopios Robóticos
Centro de Astrobiología



★ **Telescopes at CAB**

- **Group**
- **Location**
- **Characteristics**

★ **Dedication**

- **Science**
- **Outreach**

★ **Educational programs**

- **Telescope to the classroom**

★ **Participation on shared time projects**

- **PARTNeR**
- **CESAR**
- **GLORIA**

GROUP OF ROBOTIC TELESCOPES AT CAB

★ Head

- Luis Cuesta Crespo

★ Science

- Teresa Eibe García
- Aurora Ullán Nieto

★ Outreach

- Juan Ángel Vaquerizo

★ Technician

- Xavier Miquelez

★ CAB

Campus INTA

Torrejón de Ardoz (Madrid)

3° 28', 40° 30', 639 m

★ CEB

Estación de Espacio

Profundo de ESA

Cebreros (Ávila)

4° 22', 40° 28', 710 m

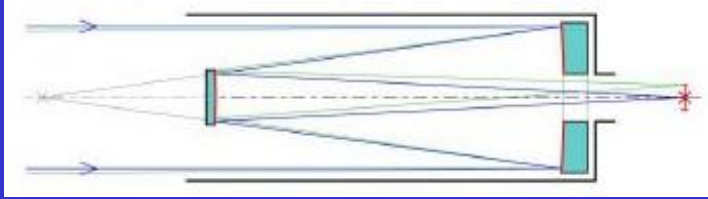
★ CAHA

Observatorio de Calar Alto

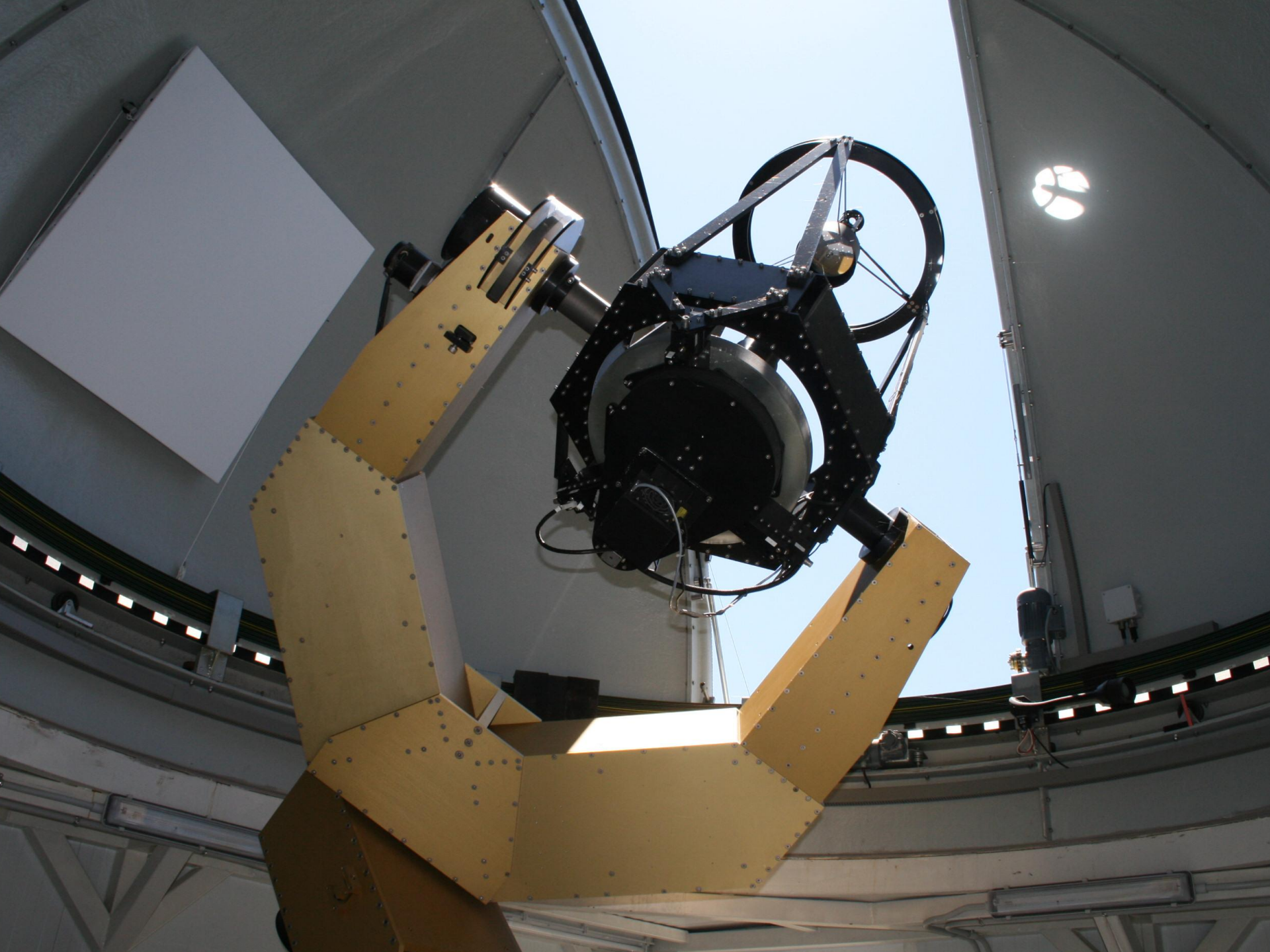
Almería

2° 33', 37° 13', 2.146 m

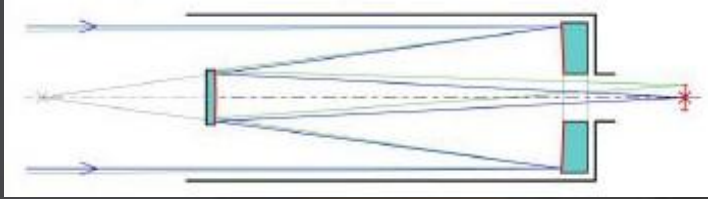




- ★ **Reflector telescopes**
 - 40-50 cm
 - $f/10$ ($\sim 0.5^\circ$)
- ★ **Classic Cassegrain configuration**
 - Parabolic primary
 - Hyperbolic secondary



FEATURES



★ Reflector telescopes

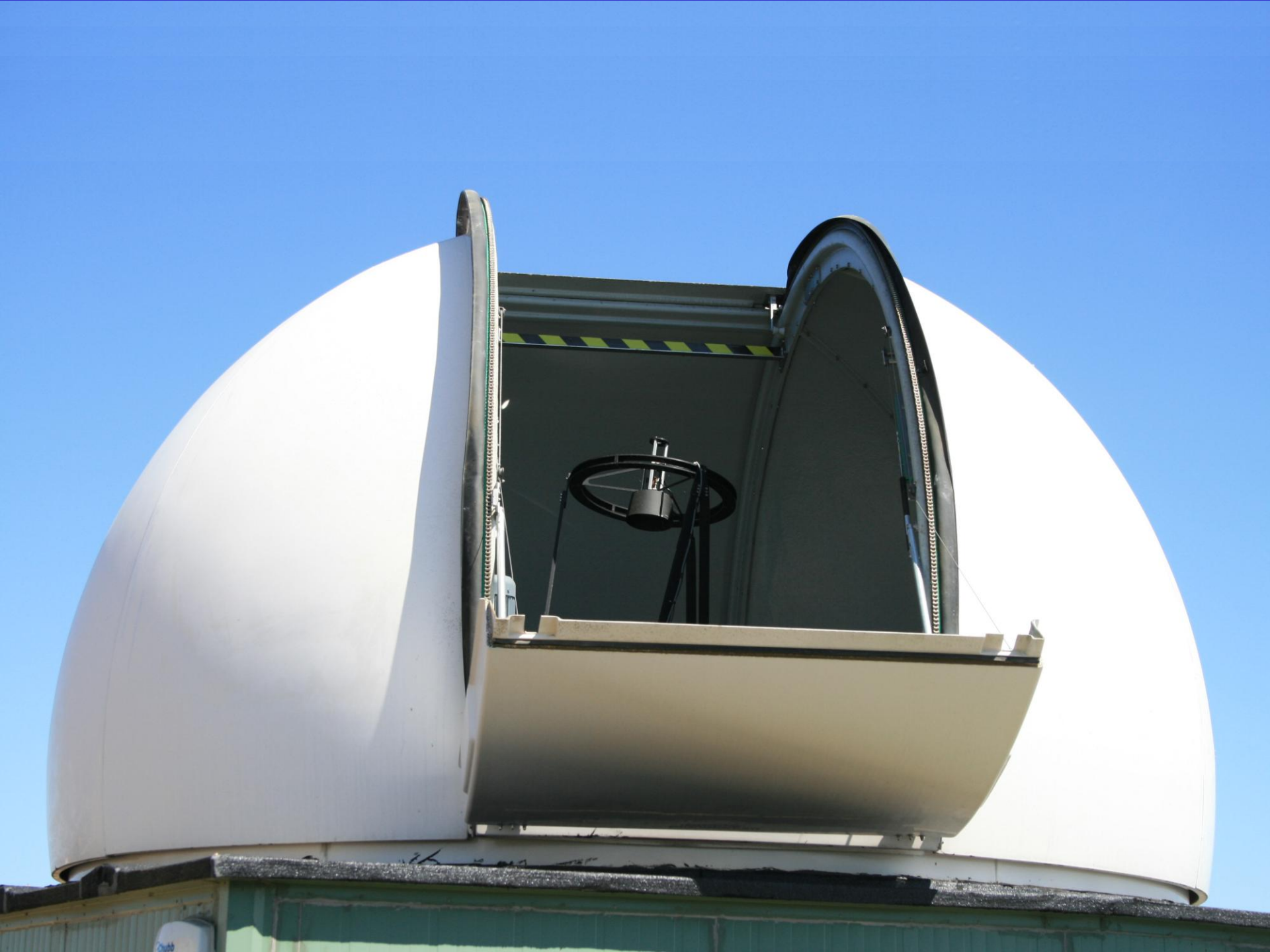
- 40-50 cm
- $f/10$ ($\sim 0.5^\circ$)

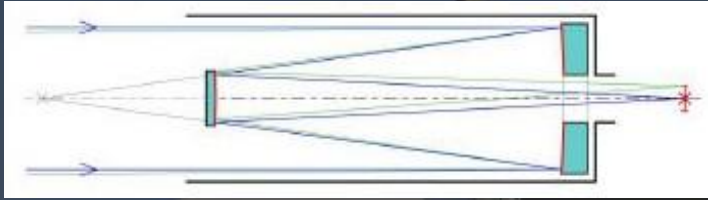
★ Classic Cassegrain configuration

- Parabolic primary
- Hyperbolic secondary

★ Equatorial mount

- Direct transmission
- Friction





★ Reflector telescopes

- 40-50 cm
- $f/10$ ($\sim 0.5^\circ$)

★ Classic Cassegrain configuration

- Parabolic primary
- Hyperbolic secondary

★ Equatorial mount

- Direct transmission
- Friction

★ Dome

- Form 0° to 90°
- Motorized
- Automatic



★ **Two LINUX computers per telescope**

- **Control**
- **Data**

★ **TALON**

★ **Graphical interface**

- **Telescope**
- **Dome**
- **Filters**
- **Focus**
- **Camera**



Positions

	RA(J2000)	Dec(J2000)	HA	Altitude	Azimuth	Dome Az
Current	6:06:57.4	-22:42:29	4:39:22.8	0:00:01	240:00:00	1:00:00
Target						
Difference						



Camera

Filter CFCB

Focus, μ m

Temp, $^{\circ}$ C

Cooler At Targ

Status IDLE

Rotator

Lights 1 2

Control

No Confirm

Batch Mode

Sounds

Status

Batch

Tracking

Slewing

Homing

Limiting

Weather

Confirm

Roof

Auto

Az

Telescope

Source name:

RA HA

Dec Alt

Ep Az

Site Information at Nicolás Copérnico, Torrejón de Ardoz (Madrid)

Local	UT	UT Date	LST	JD	Moon	Sun	Dusk	Dawn
20:36:48	18:36:48	28-May-2012	10:46:38	2454249.276	90% SE +19	WNW +9	20:47 UT	3:36 UT
Wind	Direction	Temp	Pressure	Humidity	Rain	T1	T2	T3
6 KPH	NW	17.0 C	945 mBar	35 %RH	163.8 mm			

Messages

18:34:45 UT: Welcome, telescope user.

Camera 3.39

File Tools Expose Options

obturador001s-07205_01.fts: 5-Feb-2012 12:03:21 0.01S ? Z=1.11

Exposure Setup

Unknown camera

Subimage: X: 0 Y: 0 W: H:

Binning: H: 1 V: 1 Δ ∇ 1:1

Duration: 1 Second(s) Δ ∇ 1

Count: 1 Exposure(s) Δ ∇ 1

Shutter: \blacktriangledown Open \blacktriangledown Closed \blacktriangledown Dbl \blacktriangledown Mult 0 C

Flip: \blacktriangledown Rows \blacktriangledown Columns

Cooler: On Goal: -20 Now: ?????

B...

- \blacktriangledown 1/8 X
- \blacktriangledown 1/4 X
- \blacktriangledown 1/2 X
- \blacktriangledown 1 X
- \blacktriangledown 2 X
- \blacktriangledown 4 X

Flip L/R

Flip T/B

AOI

Crop to

X: 32
Y: 32
W: 960
H: 960

Mean: 12184
Median: 12167
Std D: 89.7
Min: 12118
Max: 51608
at: 755 107
SD>M: 7892.6

Contrast

Auto contrast

- \blacktriangledown Narrow: -SD/3 .. +SD/3
- \blacktriangledown Wide: -SD .. +2*SD
- \blacktriangledown Full: Min .. Max

Contrast based on:

- \blacktriangledown AOI Only
- \blacktriangledown All but AOI
- \blacktriangledown Entire image

Inverse Video

- \blacktriangledown Gray Scale
- \blacktriangledown Heat
- \blacktriangledown Rainbow
- \blacktriangledown Standard

Histogram

Plot just Lo .. Hi

Plot log(N)

Lo: 12094 Hi: 12363

Mean: 12184
Median: 12167
Std D: 89.7
Min: 12118
Max: 51608
at: 755 107
SD>M: 7892.6

OPERATION

★ Two LINUX computers per telescope

- Control
- Data

★ TALON

★ Graphical interface

- Telescope
- Dome
- Filters
- Focus
- Camera

★ Presence

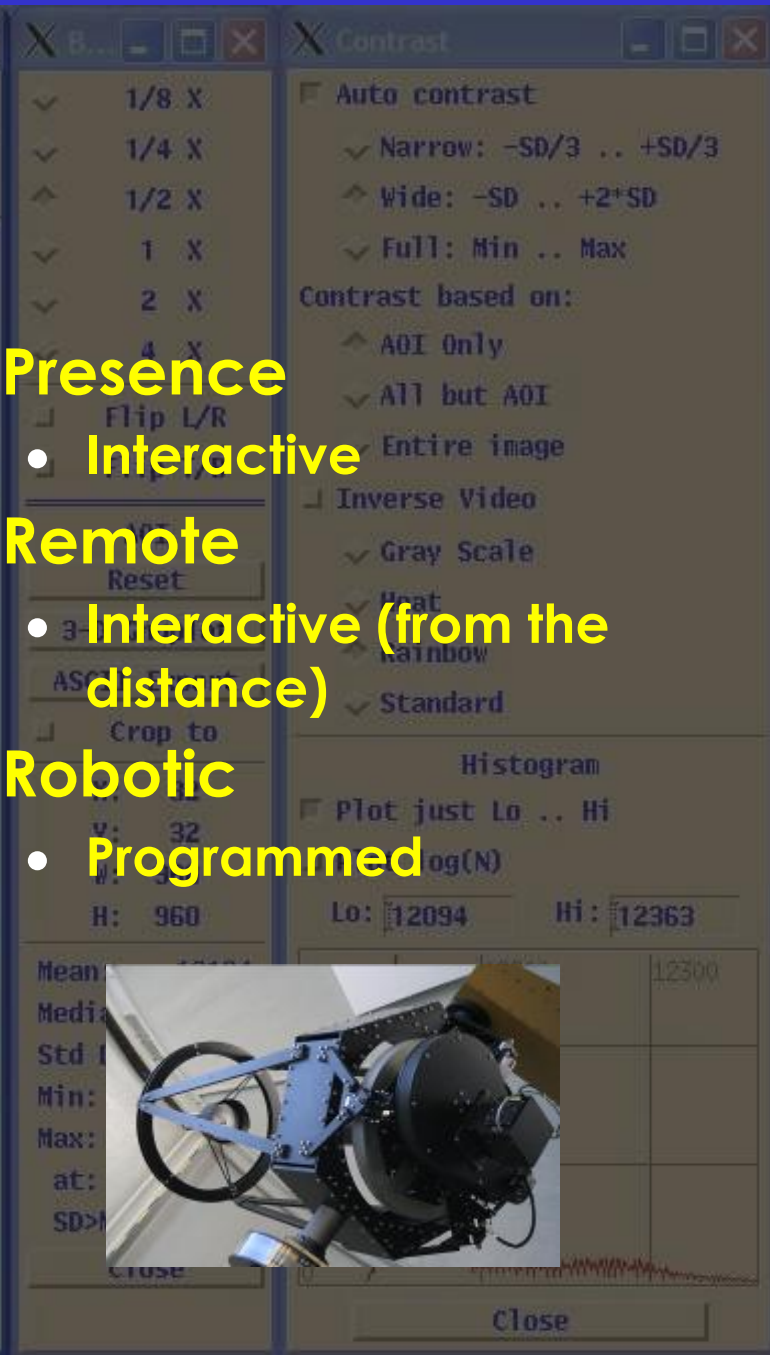
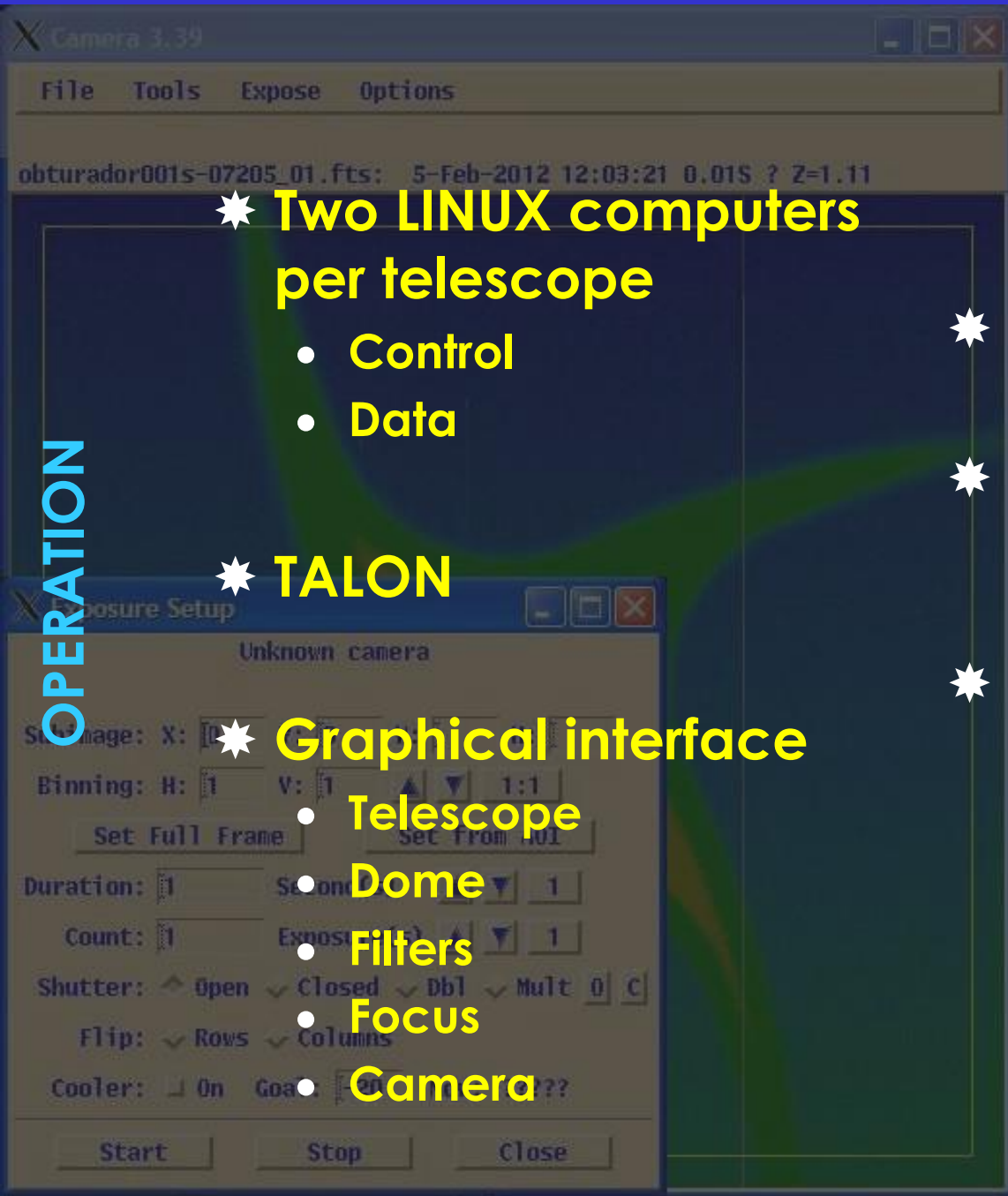
- Interactive

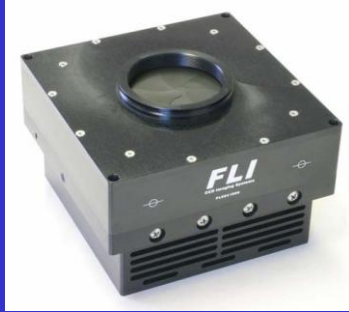
★ Remote

- Interactive (from the distance)

★ Robotic

- Programmed

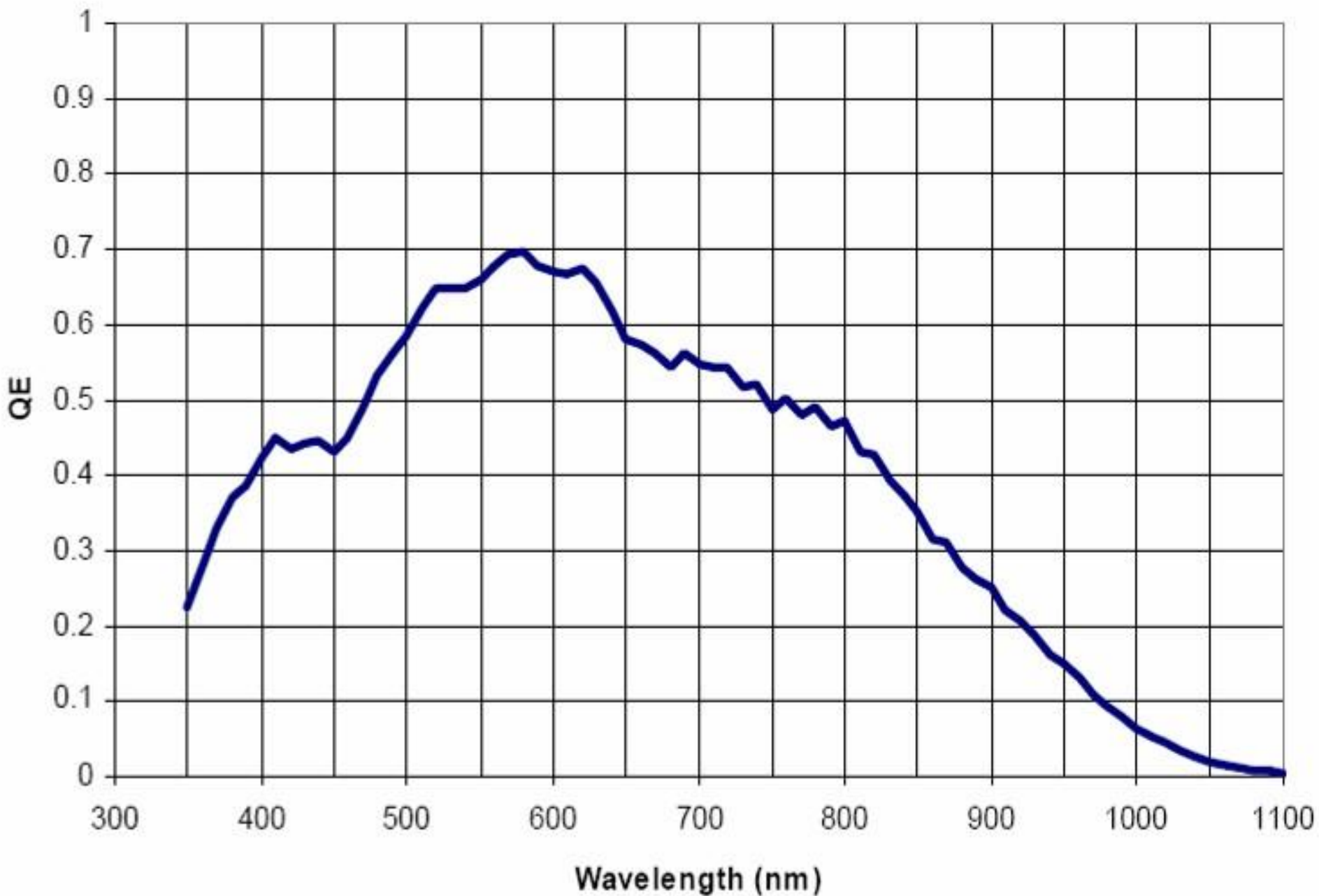




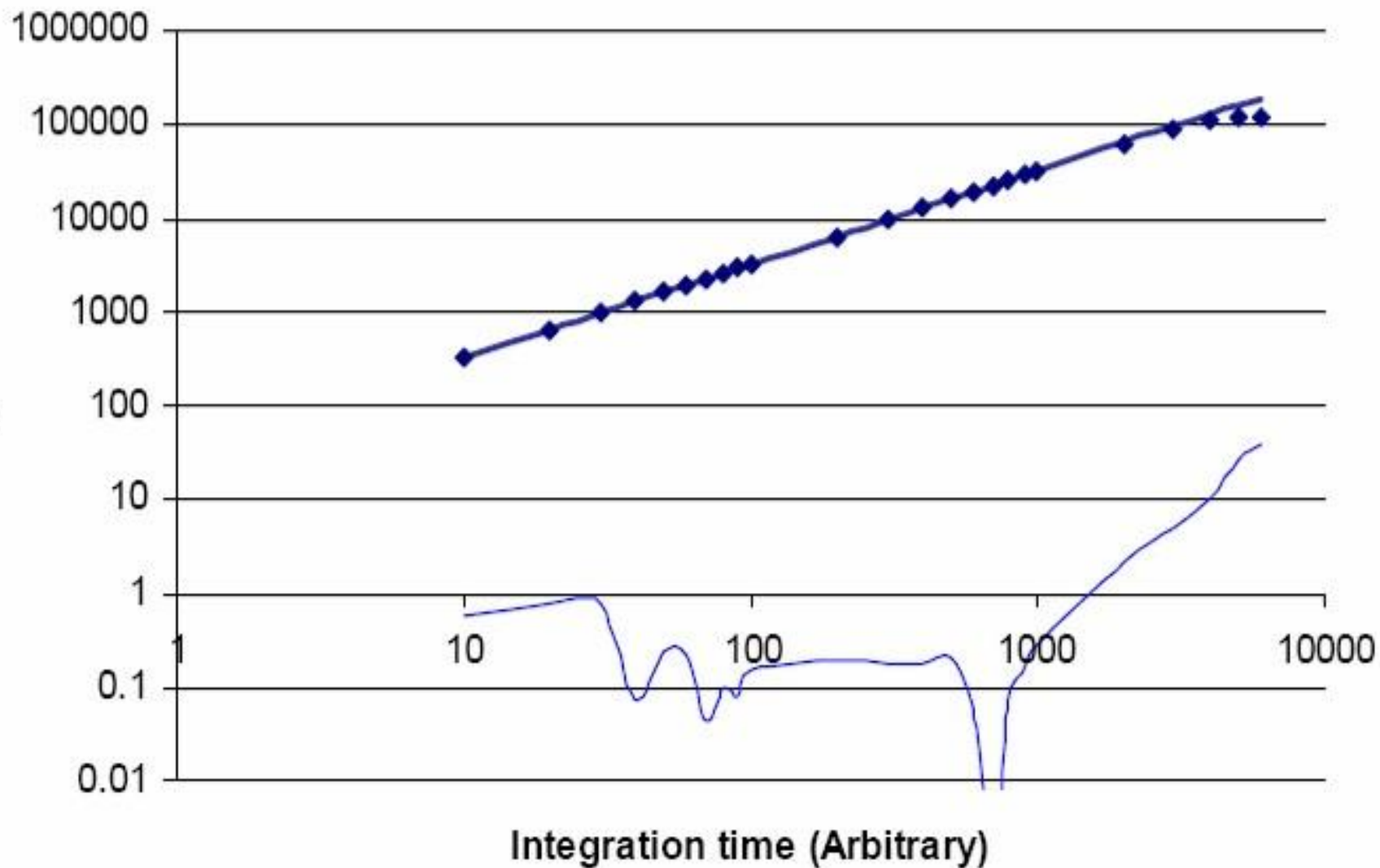
★ CCD Finger Lakes

- **4008 x 2672**
 - 0.37 "/pix
 - 24' x 16'
- **9 μm**
- **Refrigerated**

KAF-09000 Spectral Response



KAF-09000 Linearity



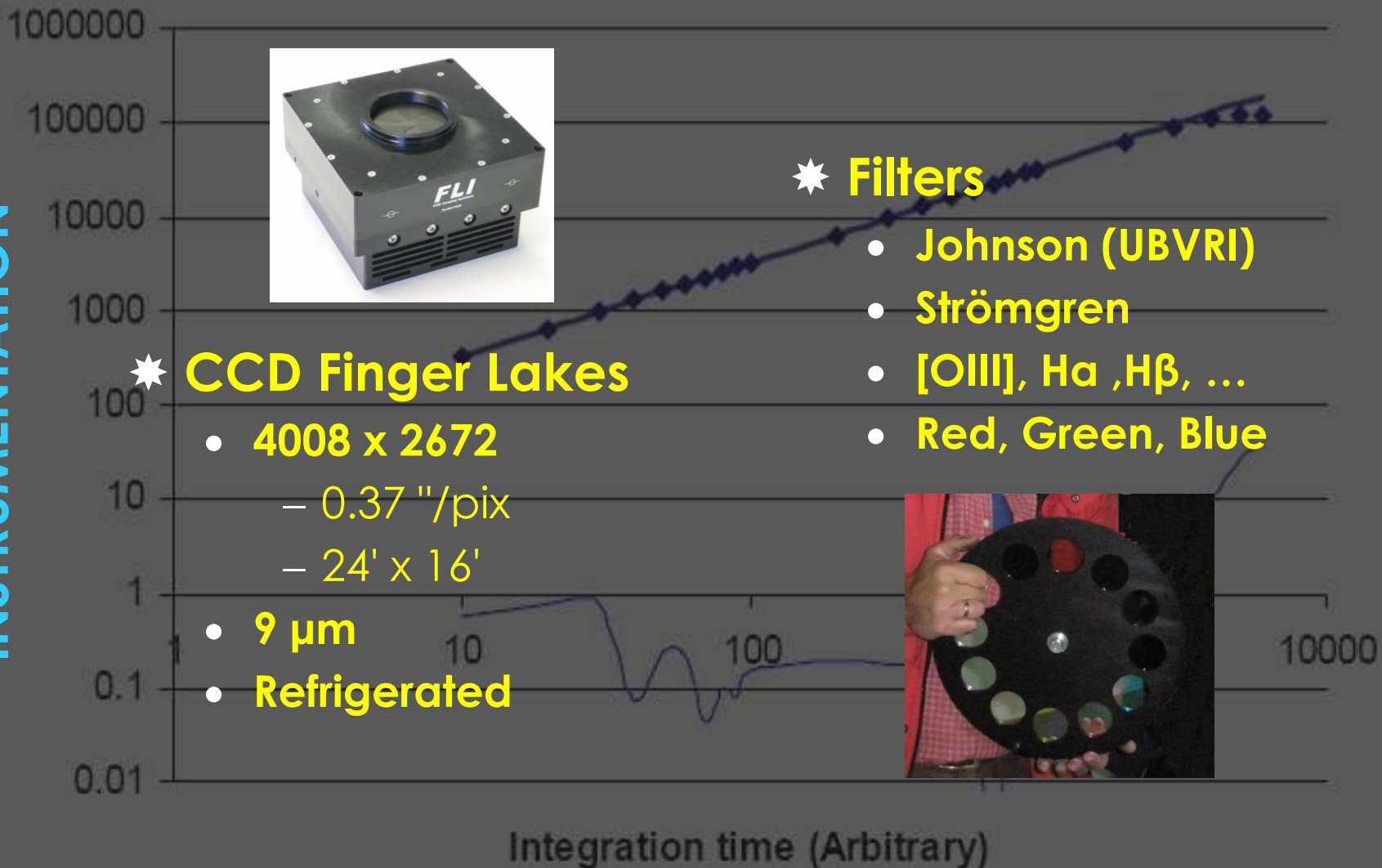
◆ measured

— percent deviation from fit

— fit

KAF-09000 Linearity

INSTRUMENTATION

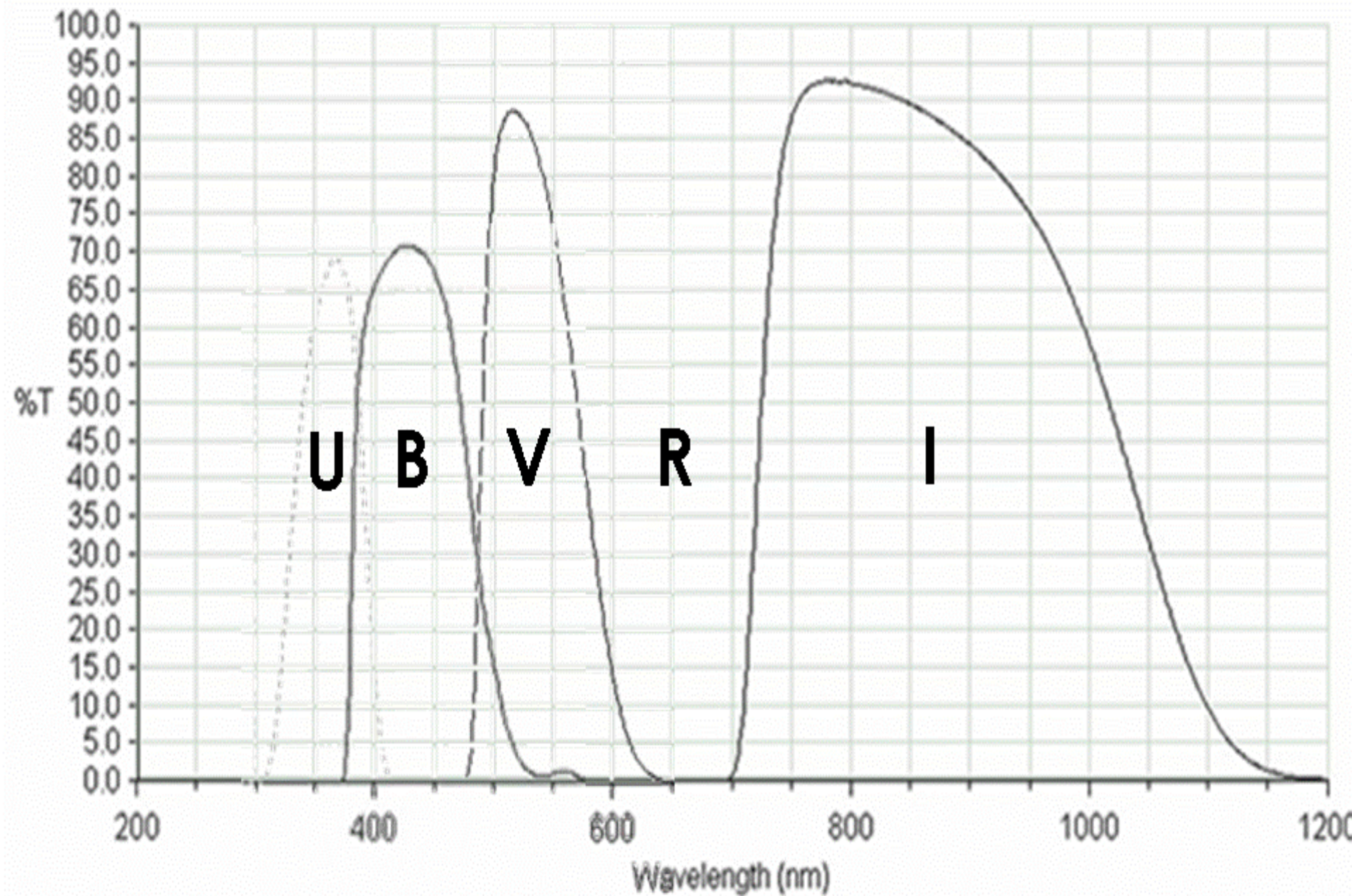


◆ measured

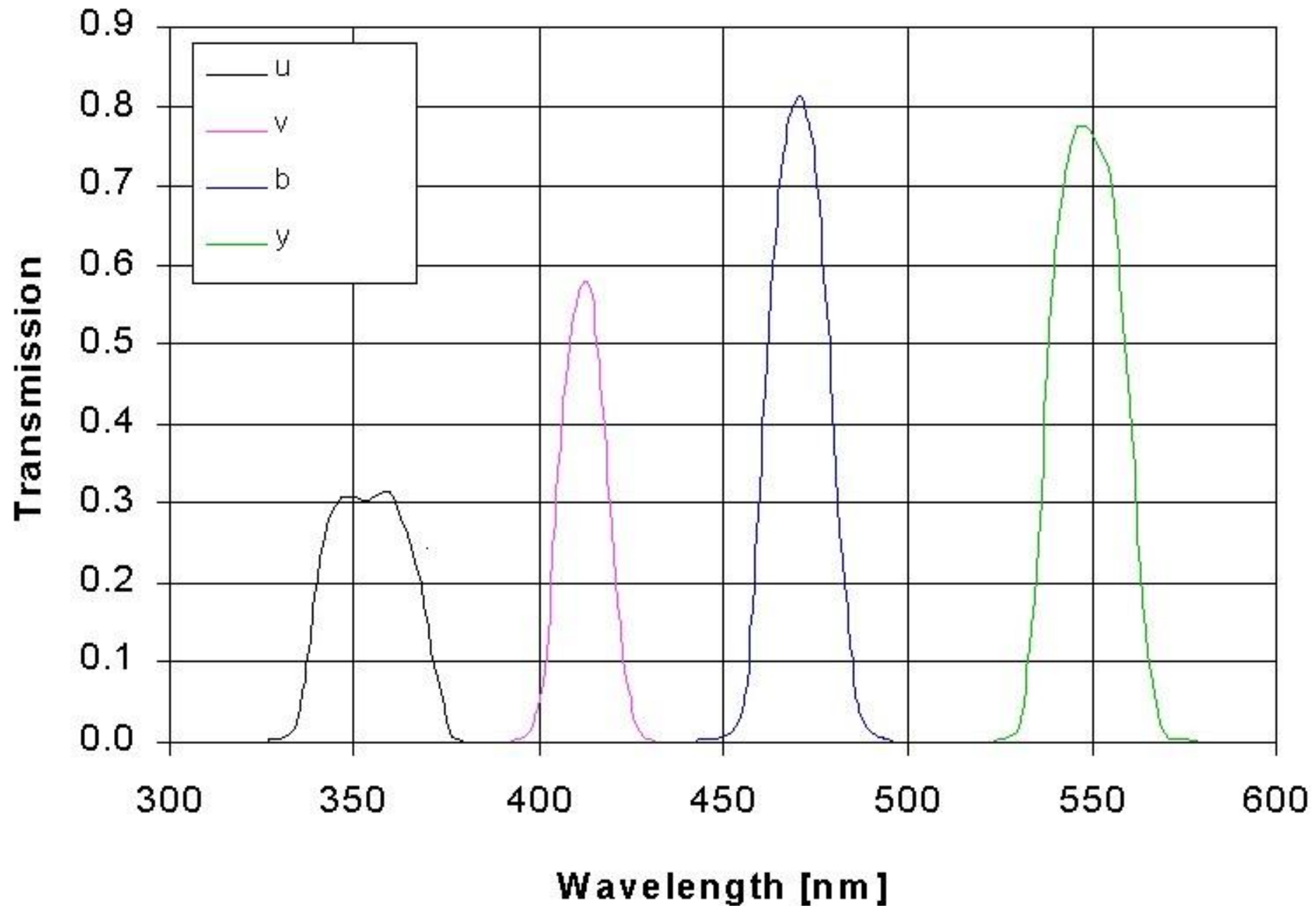
— percent deviation from fit

— fit

Johnson



Strömngren filter set

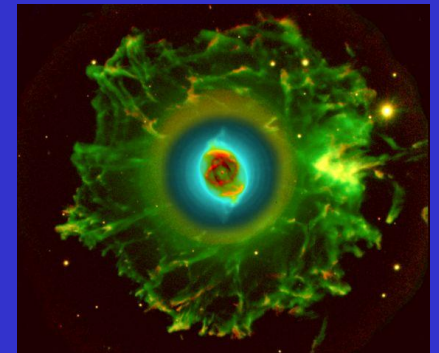
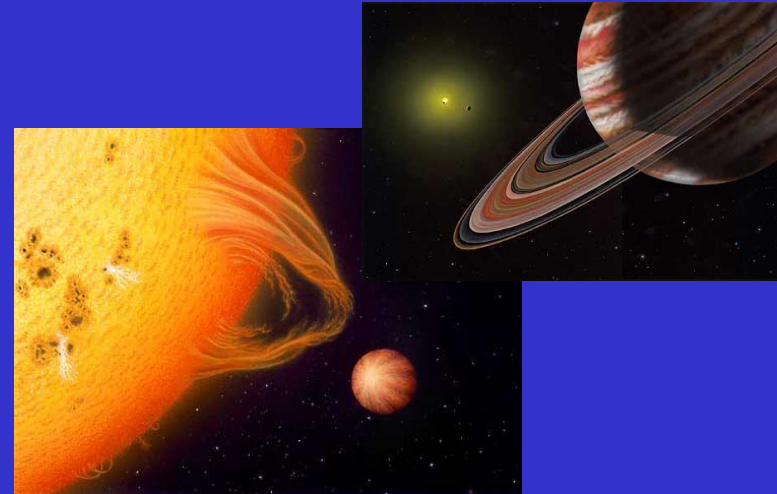


★ **Astrobiology**

- **Exoplanets**
 - Search
 - Characterization
- **Comets and NEOs**

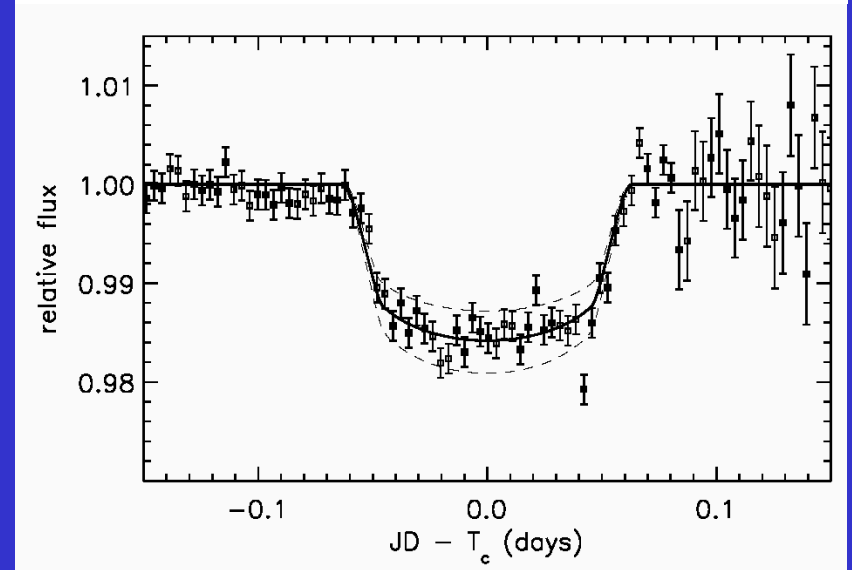
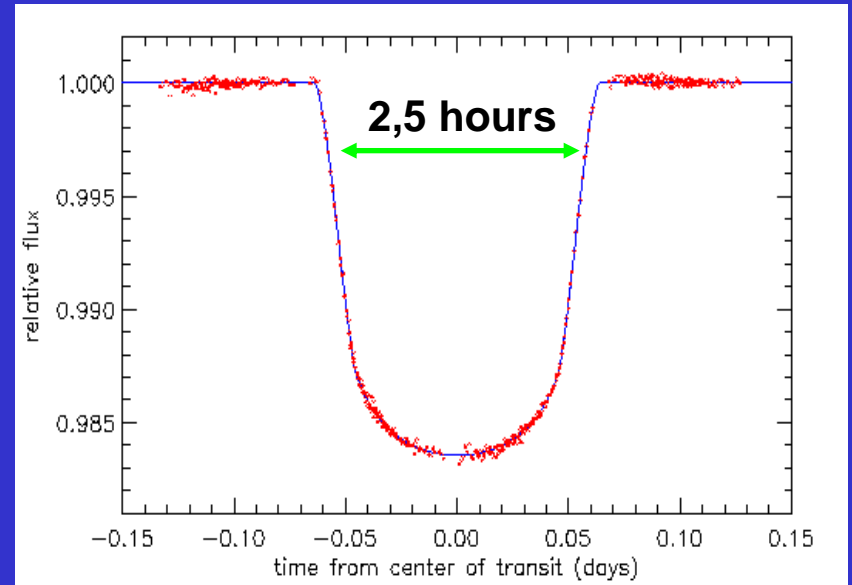
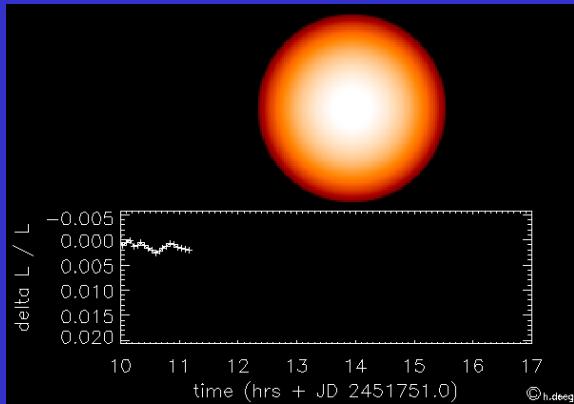
★ **Other lines**

- **Variable stars**
- **Opportunity objects**
- **Galactic surveys (PN, HII, SNR)**



★ Exoplanet detection

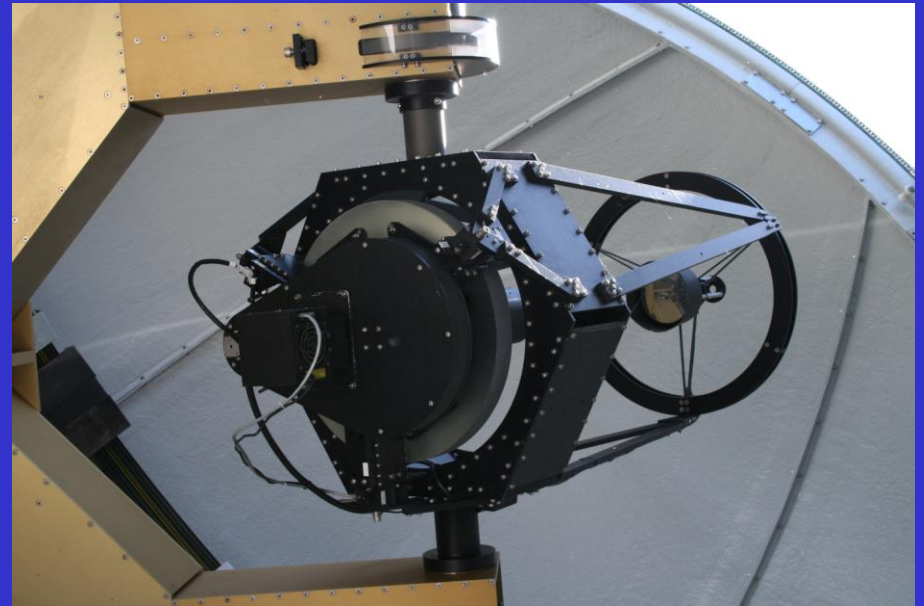
- Transits
 - Photometry
 - (0.01-1%)=>mmag



★ Exoplanet characterization

- **Transits**
 - Repeatability
 - Depth
 - TTV
 - TDV
 - Ellipticity
 - More planets

- ★ **Open telescopes to the public**
- ★ **Educational programs**
- ★ **Collaborations**
 - **International**



★ Sessions of astronomical observation at CAB

- **Dome access**
- **Explanation talk**
- **Remote observation**
 - Auditorium
- **Objects**
 - Moon, planets, comets
 - Nebulae, galaxies

★ Sessions of astronomical observation outside CAB

- **Explanation talk**
- **Remote observation**
 - Internet connection to TR
- **Objects**
 - Moon, planets, comets
 - Nebulae, galaxies
- **Many events**



Whole educational project: Telescopes to the Classroom

★ A new laboratory: The telescope

- Preparation of the observations
- Time application
- Results analysis
- Final report
 - Main astrophysics
 - Exoplanets
- Remote observation
- International collaborations ⇔
 - Observations on local time
- Support to teacher and students



cesar







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CENTRO DE ASTROBIOLOGÍA

CSIC-INTA



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CENTRO DE ASTROBIOLOGÍA

CSIC-INTA

★ **Guided visits to CAB**

- **Laboratories**
- **TR**

★ **Fairs**

- **Science Week**



★ Diffusion of activities

- Press releases
- Astronomía
- PARTNeRama
- Web page
 - Weather station
 - Telescope status
 - Collaborations
 - Time schedules
 - Projects
 - Teachers and students questions

