

# *“Challenges in modern Astrophysics”*

*OPTICON awareness conference*

*Sofia, 13-14 October 2009*

## *Scientific organisers:*

*Michel Dennefeld*

*Martin Ward*

## *Invited lecturers:*

*A. LeCavelier (France)*

*F. Hammer (France)*

*B. Nordstroem (Denmark)*

*X. Barcons (Spain)*

*M. Ward (UK)*

*St. Wagner (Germany)*

*B. Leibundgut (ESO)*

*Z. Tsvetanov (NASA)*

*E. Gonzalez (UK)*

*E. Semkov (Bulgaria)*

*T. Bonev (Bulgaria)*

## *LOC:*

*K. Panov (Chair)*

*R. Konstantinova-Antova*

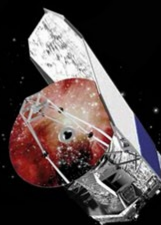
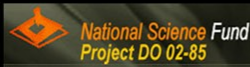
*M. Dechev*

*V. Popov*

# Astronomical infrastructures, observing facilities and recent upgrades in Bulgaria

Tanyu Bonev

Institute of Astronomy  
Bulgarian Academy of  
Sciences



# Outline

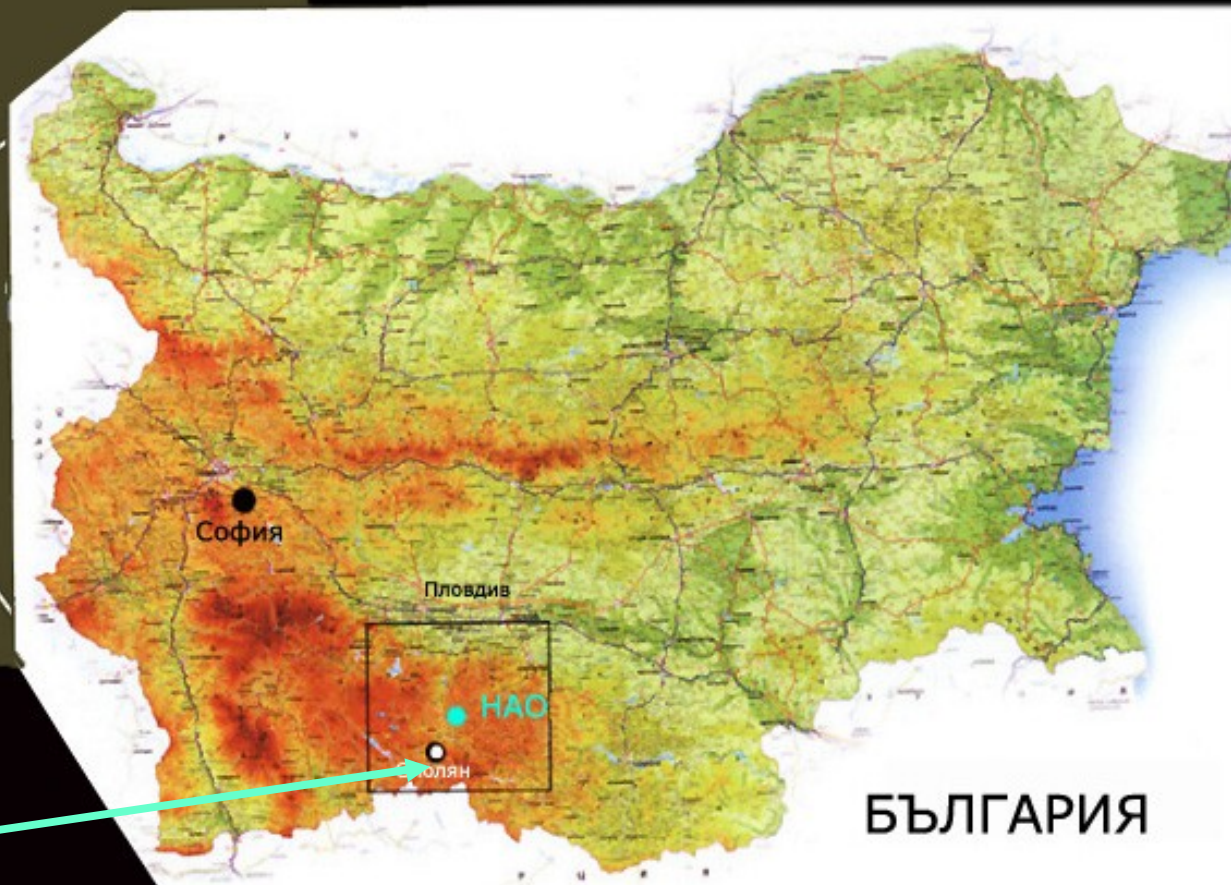
1. National astronomical Observatory, Rozhen
2. Astronomical Observatory Belogradchik
3. Department of Astronomy, Faculty of Physics, University of Sofia
4. Astronomical Center, Shumen University
5. Popular observatories and Planetaria
6. RACIO - Regional Astronomical Center for Research and Education



# National Astronomical Observatory - Rozhen

## Where we are?

NAO is at altitude of 1750 m, 30 km N from *Smolyan* (35 000) and 15 km SE from *Chepelare* (8 000)



$\lambda = 24^{\circ} 45' \text{ E}$ ,  
 $\varphi = +41^{\circ} 41.5'$

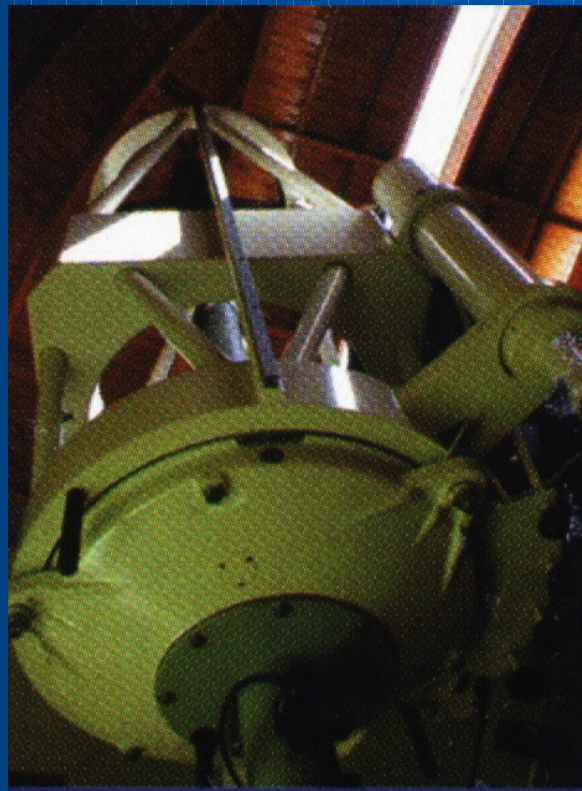


# March 1981 - official opening of The National Astronomical Observatory at Rozhen

2-m Ritchey-Chretien  
Coude telescope



60-cm Cassagrain  
telescope



50/70/172 cm Schmidt  
telescope





# National Astronomical Observatory - Rozhen

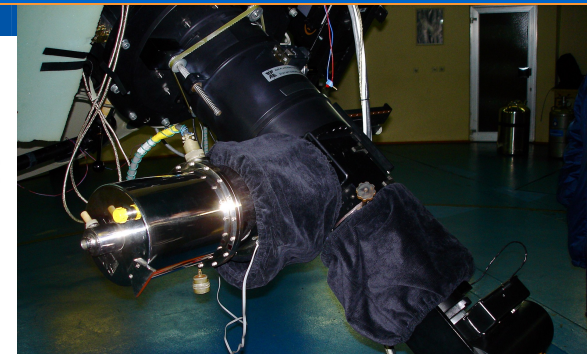
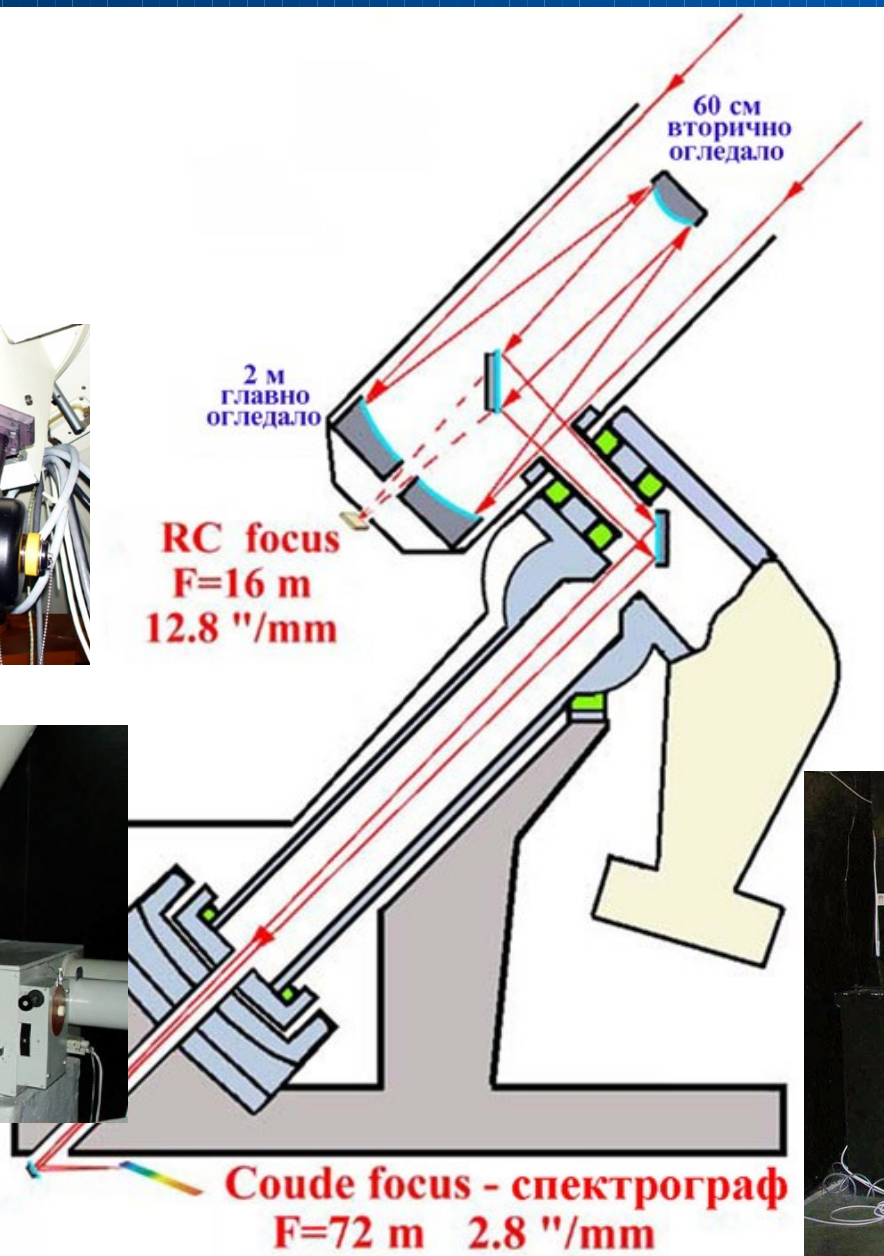
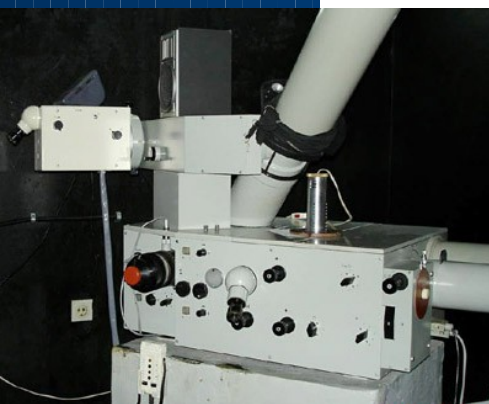
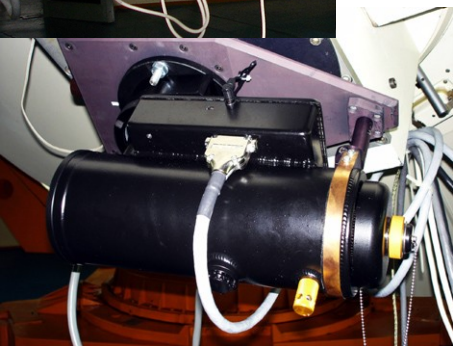
## The dome of the 2-meter telescope





photometer

# 2m telescope – optical scheme and instruments



2-channel focal reducer



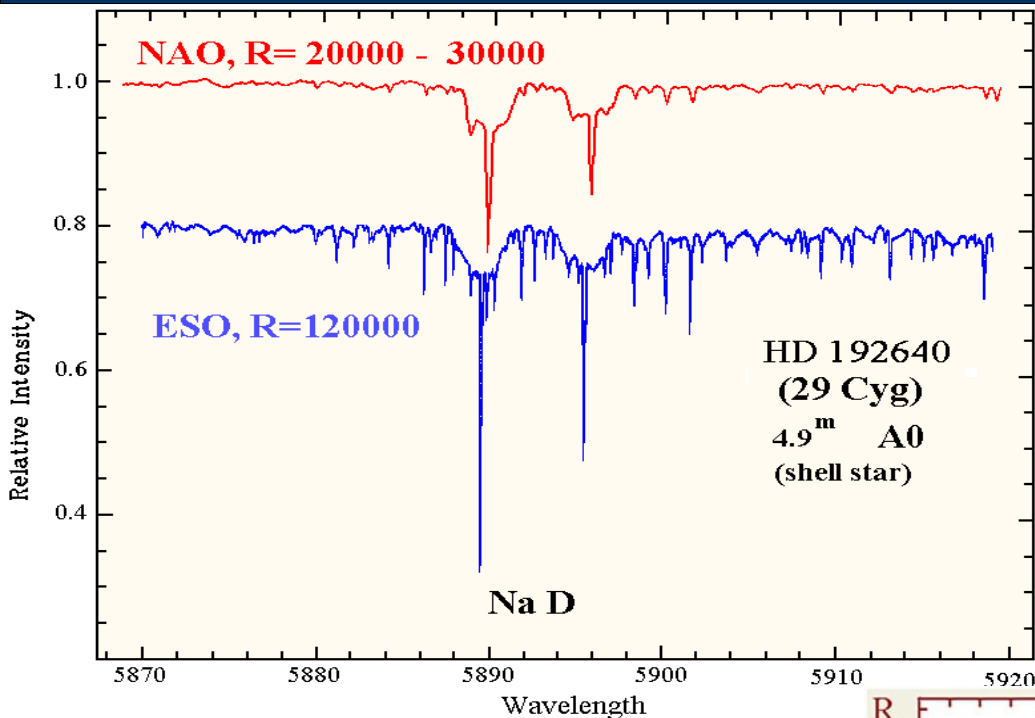
CCD cameras of 1K-class



coude-spectrograph

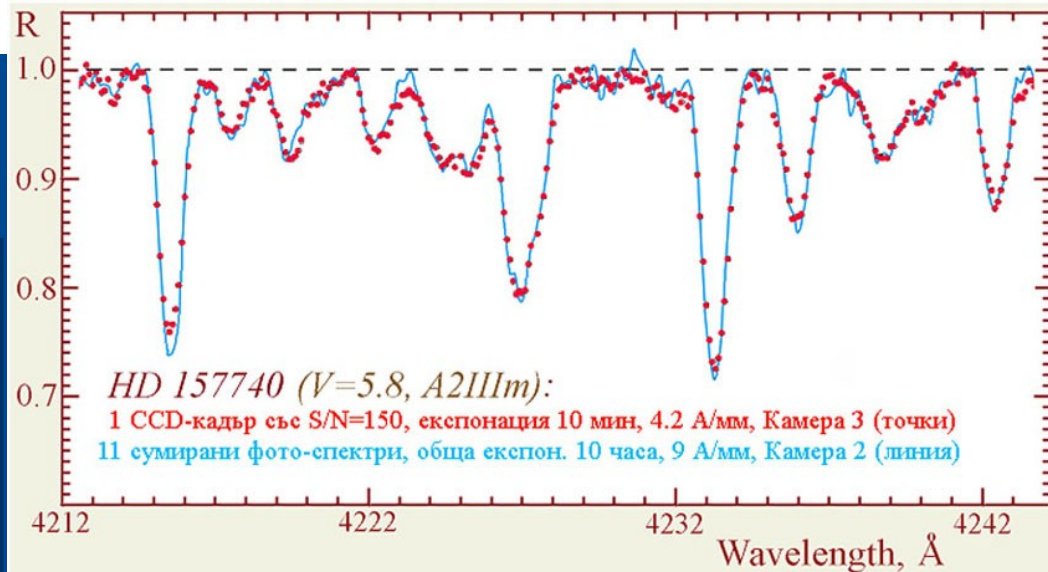


# High-resolution astro-spectroscopy



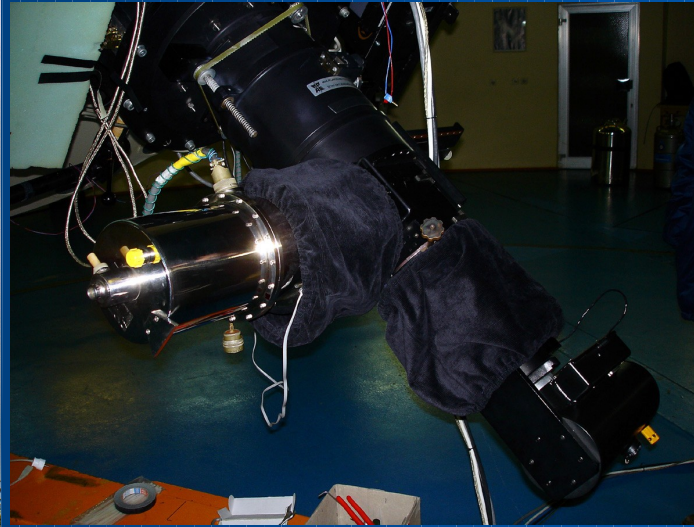
Coude - performance  
Despite the lower spectral resolution (compared to the best examples) spectrograms are valuable for studying the physical conditions in stellar atmospheres.

Radial velocities  
The RV accuracy of a single frame is about 5-10 km/s

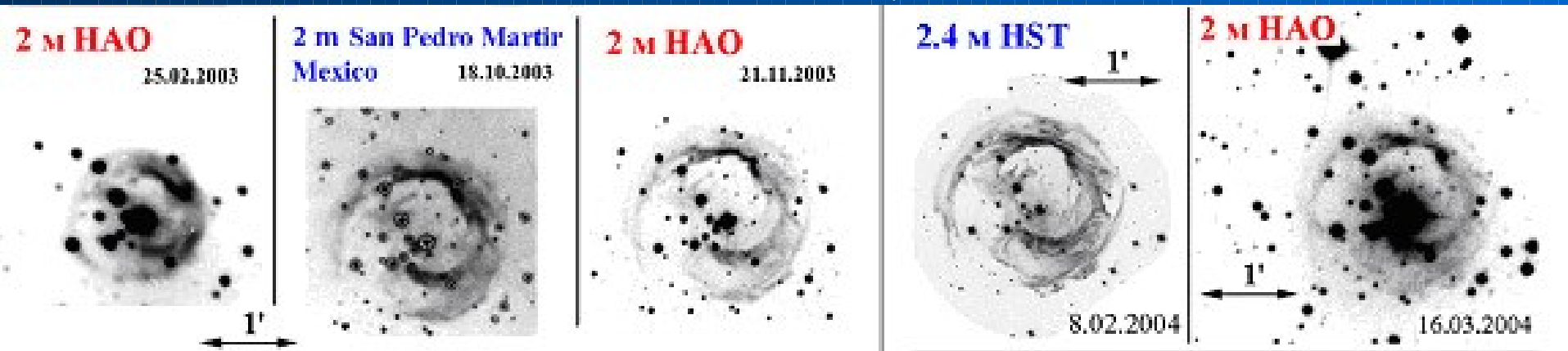


# 2-m Ritchey-Chretien-Coude telescope

FoReRo2



Evolution of the light echo  
after the outburst of  
V838 Mon in January 2002





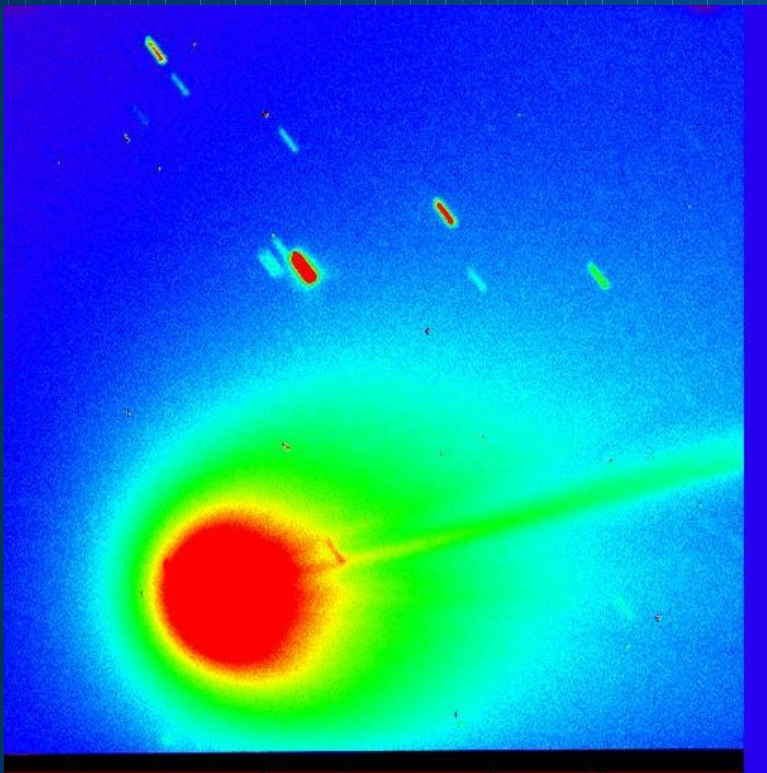
# 2-channel Focal Reducer Rozhen (FoReRo2)

## Modes of Observations

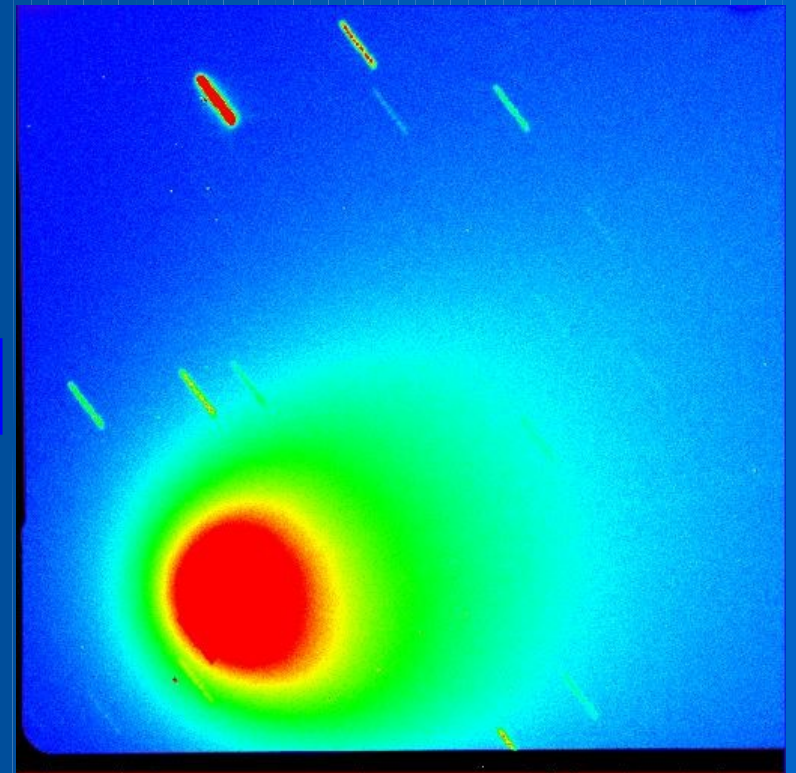
1. Broadband imaging
1. Narrowband imaging
2. Long slit spectroscopy
3. Fabry-Perot imaging
4. Imaging polarimetry

# FoReRo2, an example Narrow band imaging of comet Q4 (NEAT)

On-line, 616 nm,  $\text{H}_2\text{O}^+$



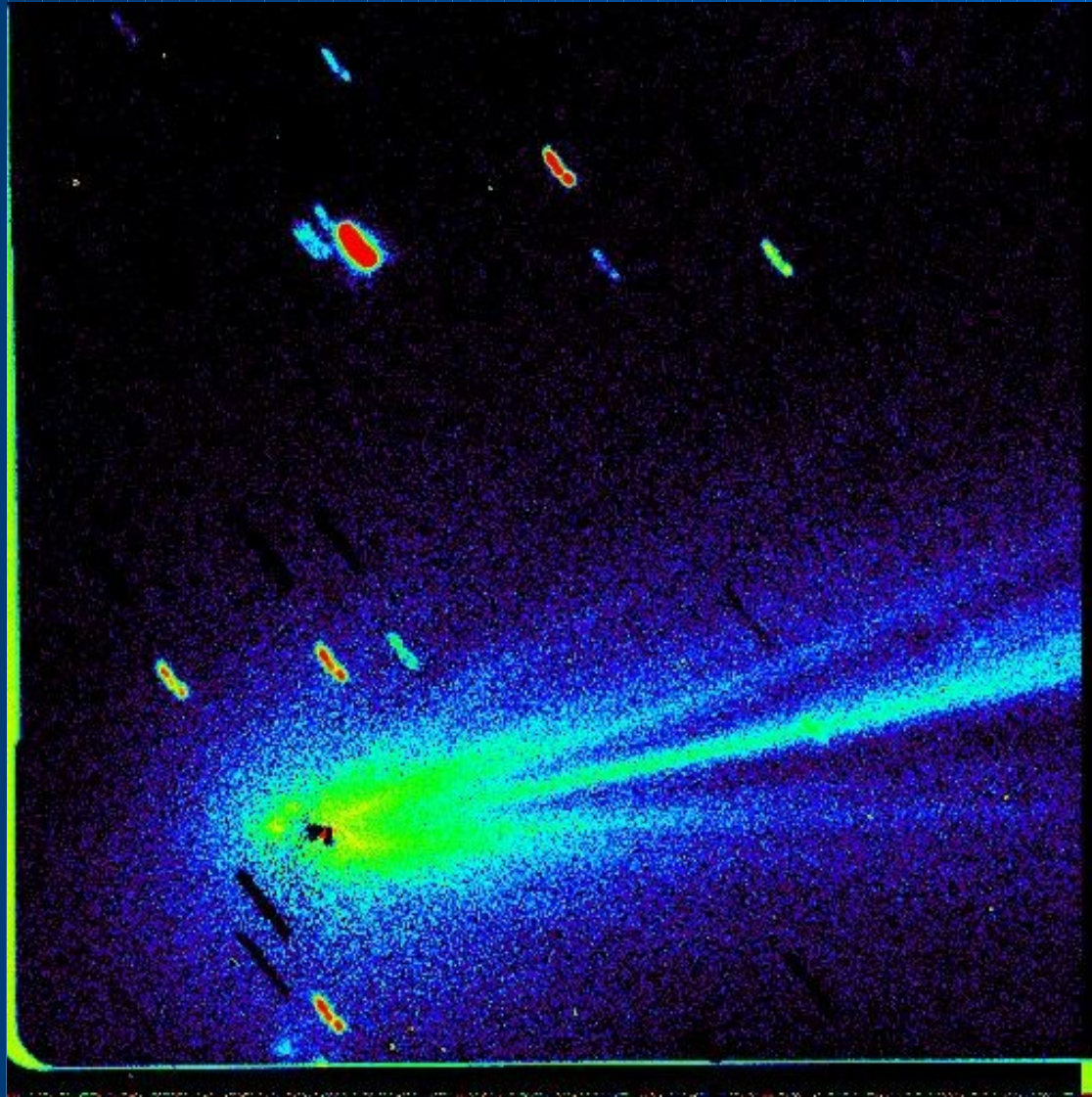
Off-line, 642 nm, Continuum



- k \*



Comet Q4 (NEAT), May 26, 2004  
 $H_2O^+$  ions in the near nucleus region



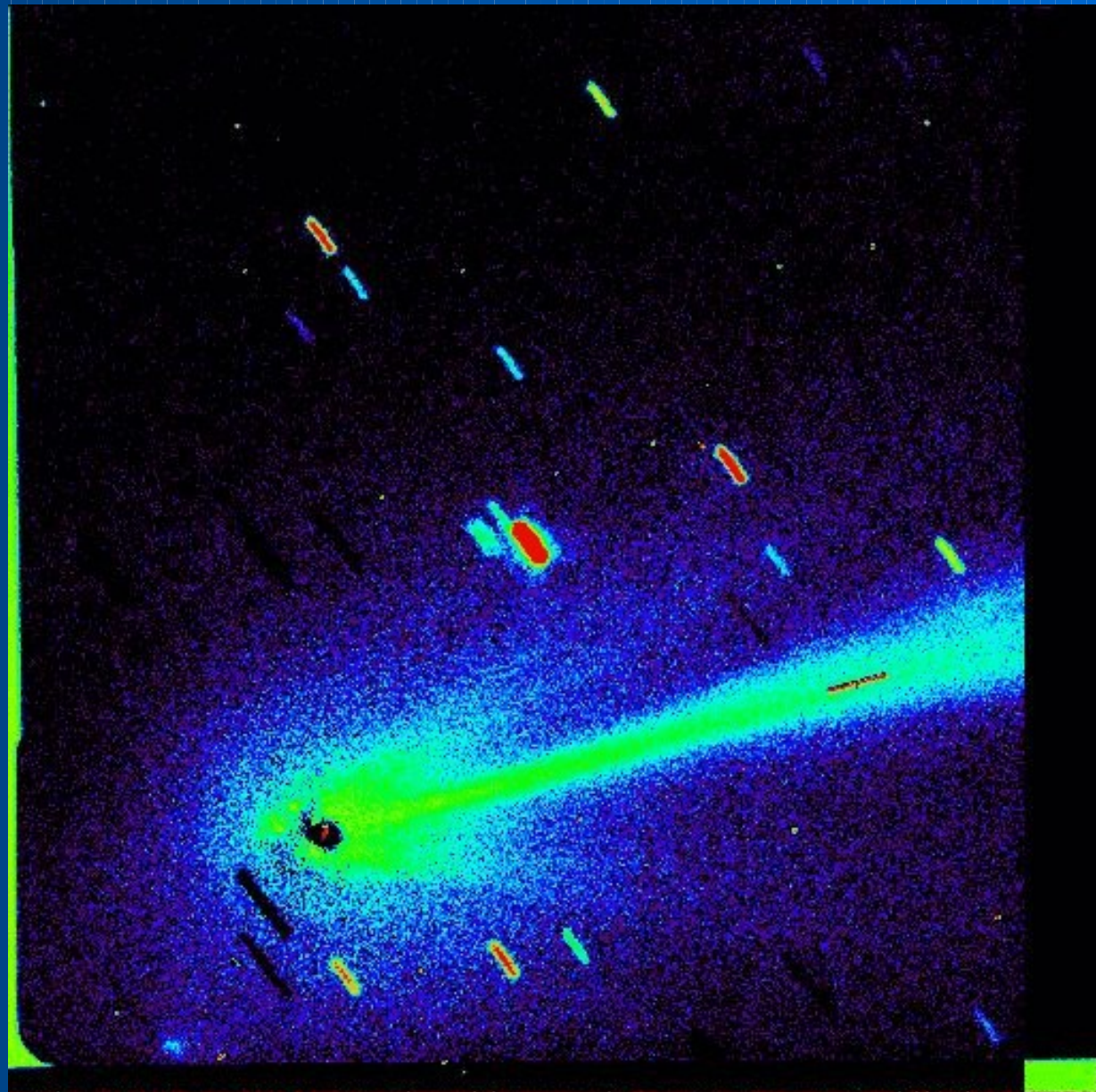
# Comet Q4 (NEAT), May 26, 2004

Dynamics of the  
 $H_2O^+$  ions in the near  
nucleus region

11 frames

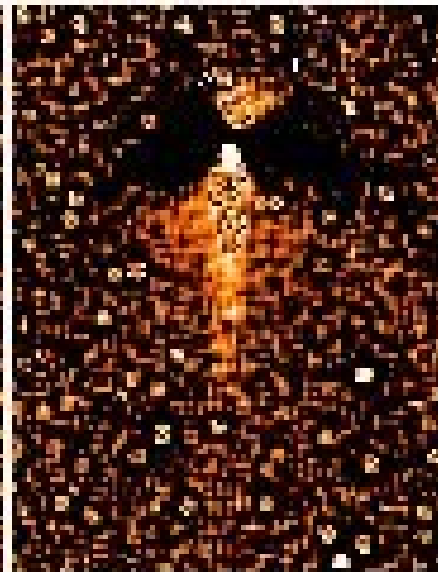
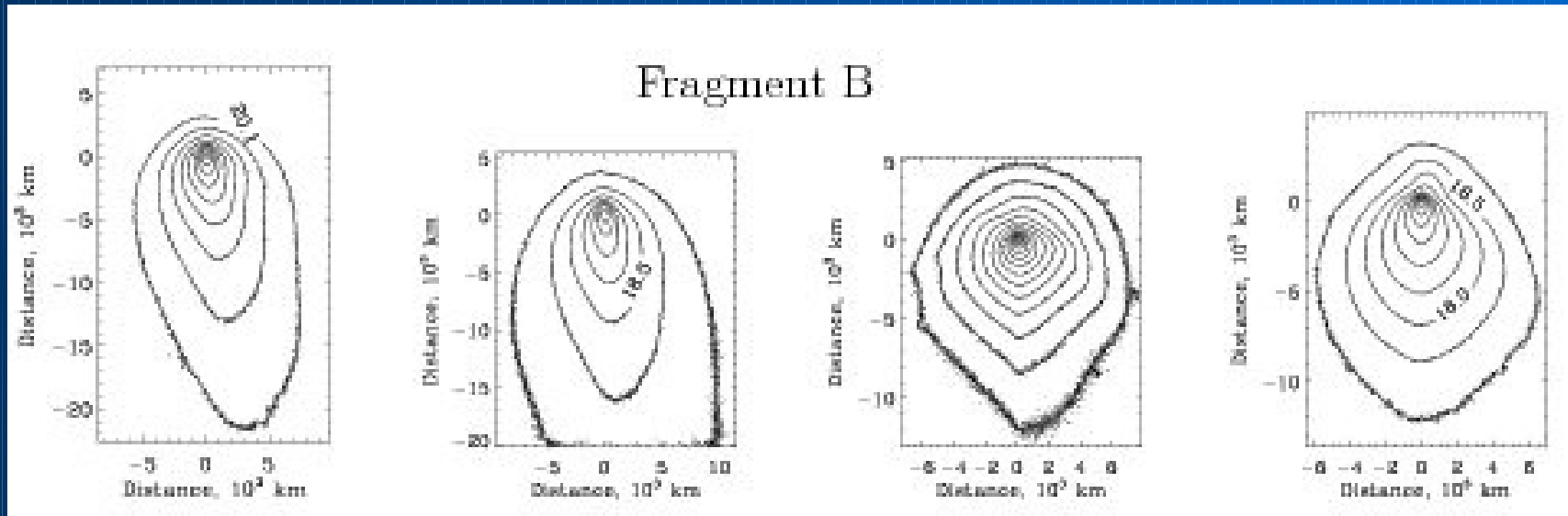
x 300 sec exposure

Total time of the  
sequence < 1 h



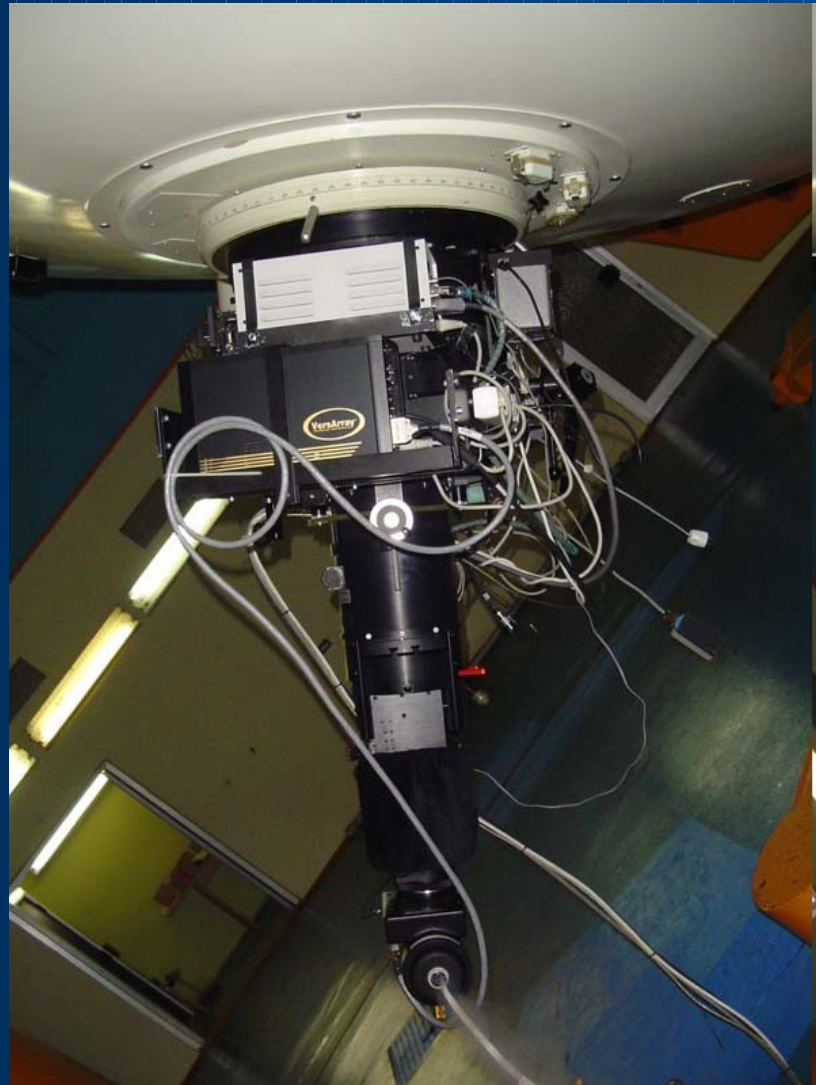


# Schwassmann\_Wachmann 3, observations at Rozhen, 2006, May 3-10

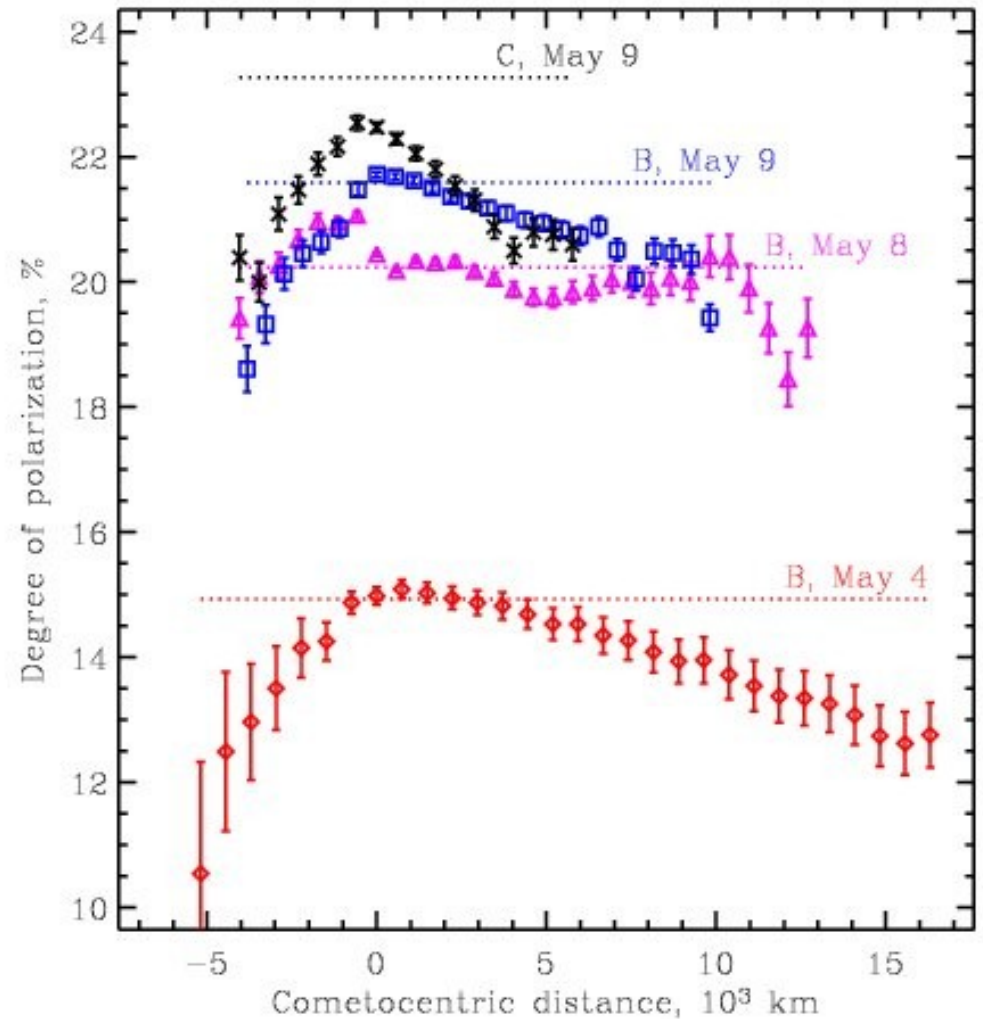


# Schwassmann\_Wachmann 3, observations at Rozhen, 2006, May 3-10

FoReRo2

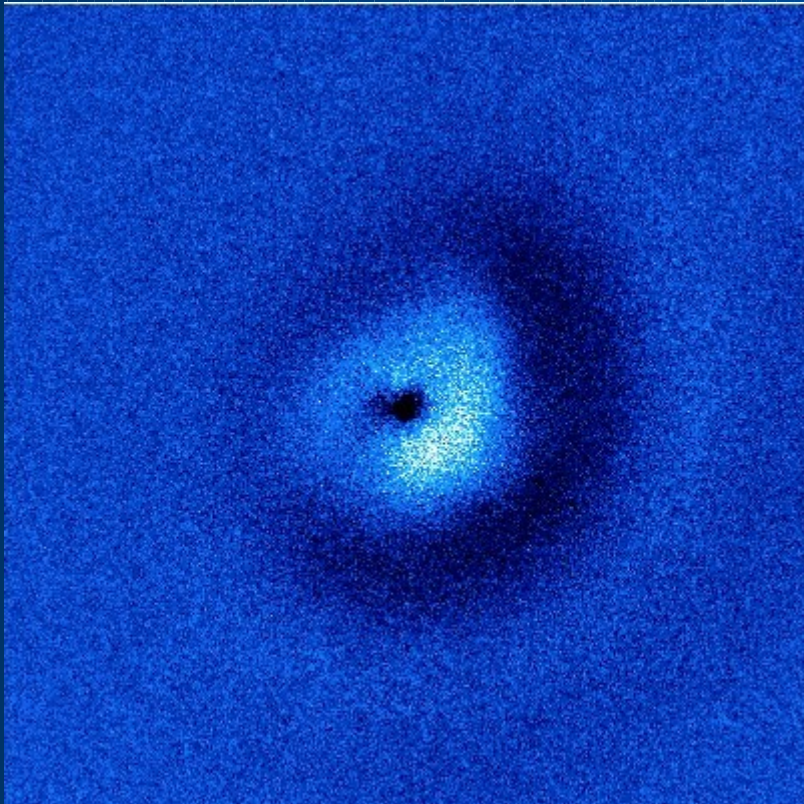


Linear polarization

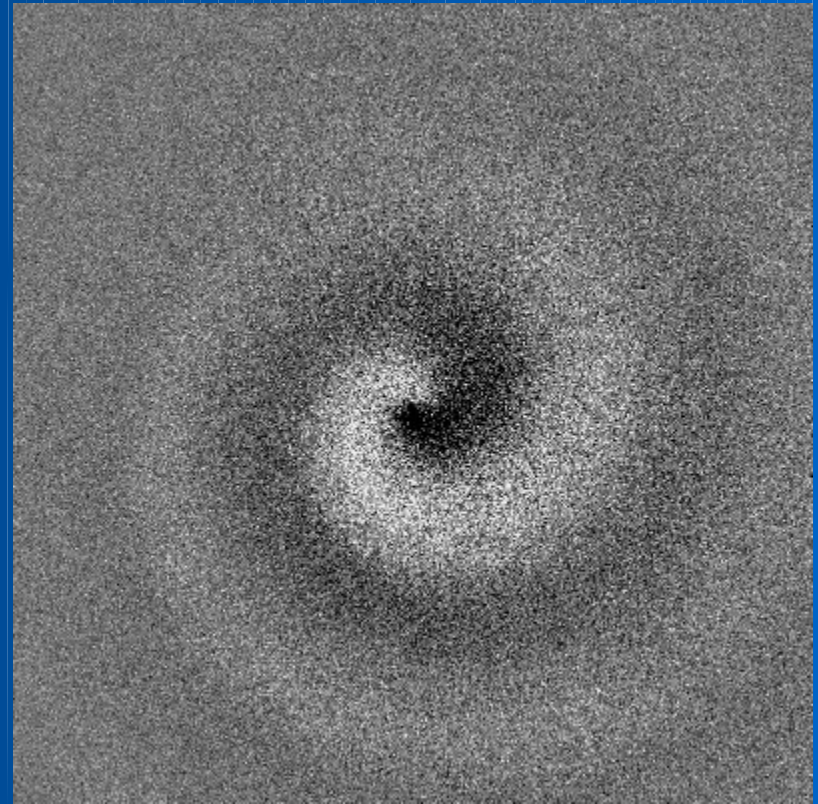




# Spatial distribution of CN in comet 8P/Tuttle (January 2008)



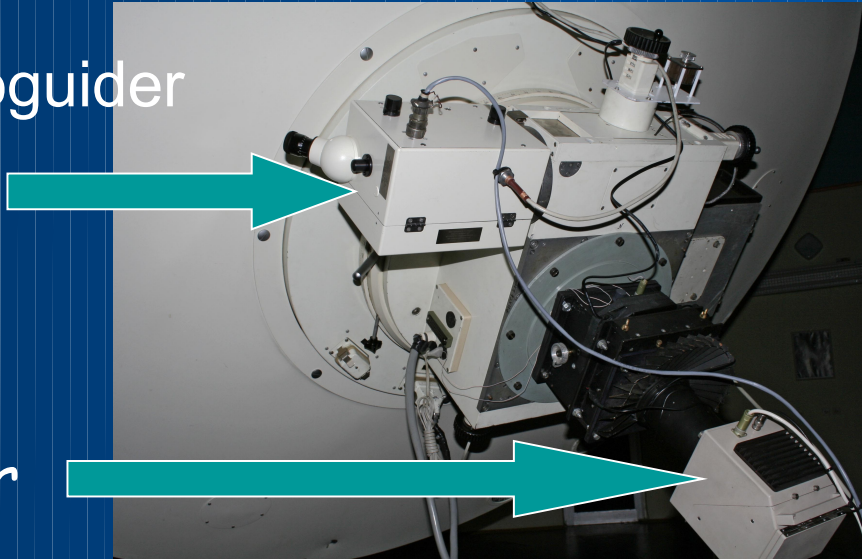
Observation



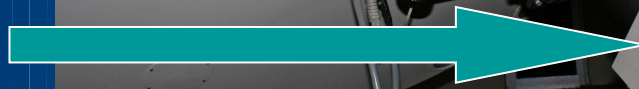
Model

# Recent upgrades: 2005 - automation of the photometer, 2006 - 2007: autoguiding system

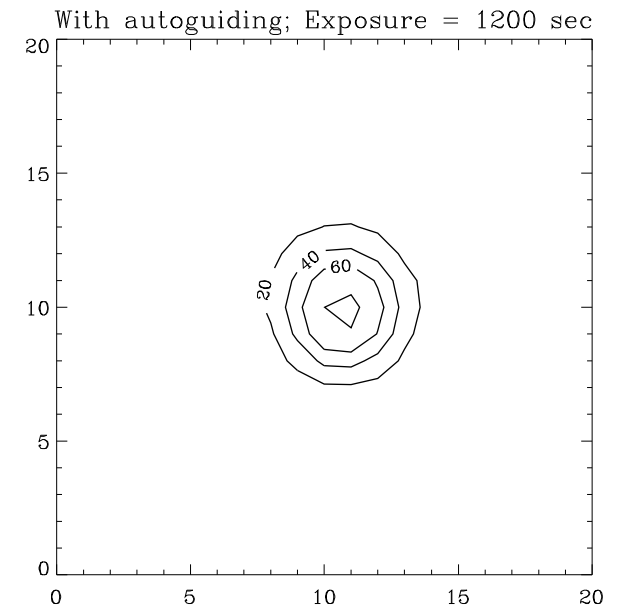
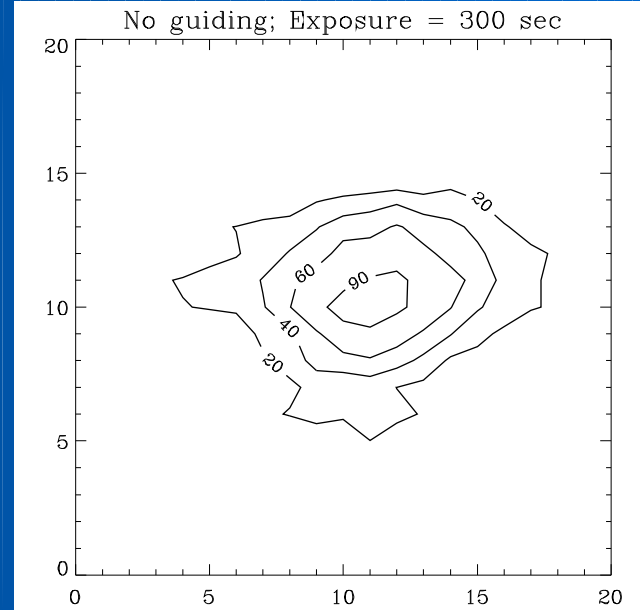
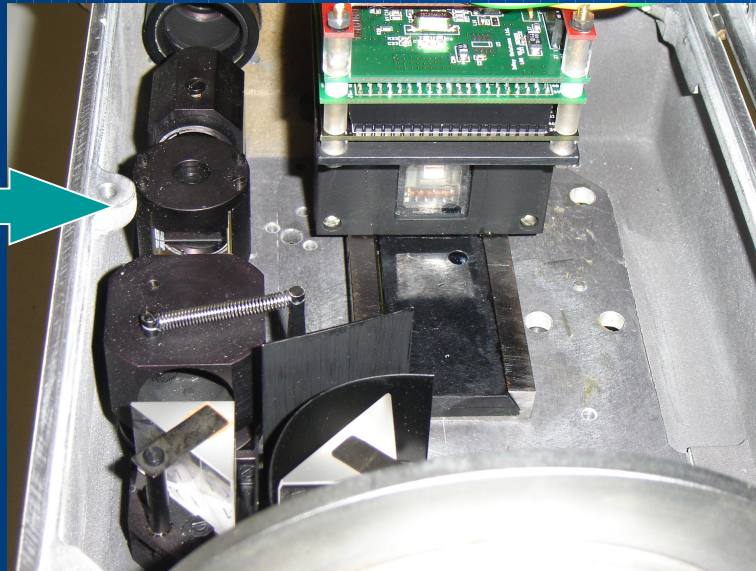
The autoguider  
Box



Photometer



Inside of the  
Autoguider

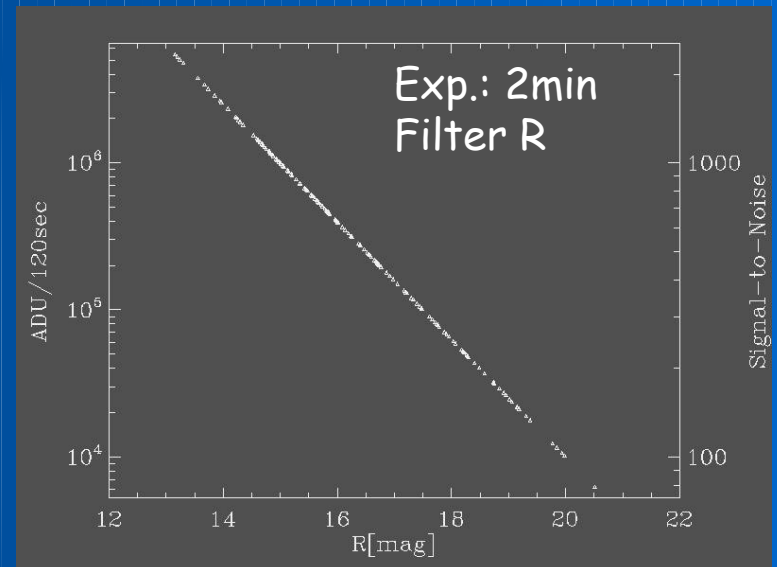
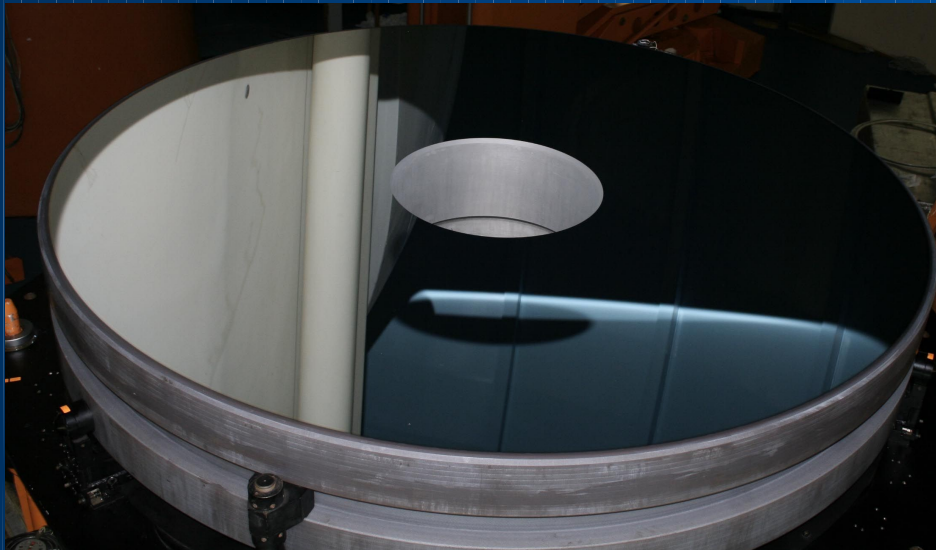




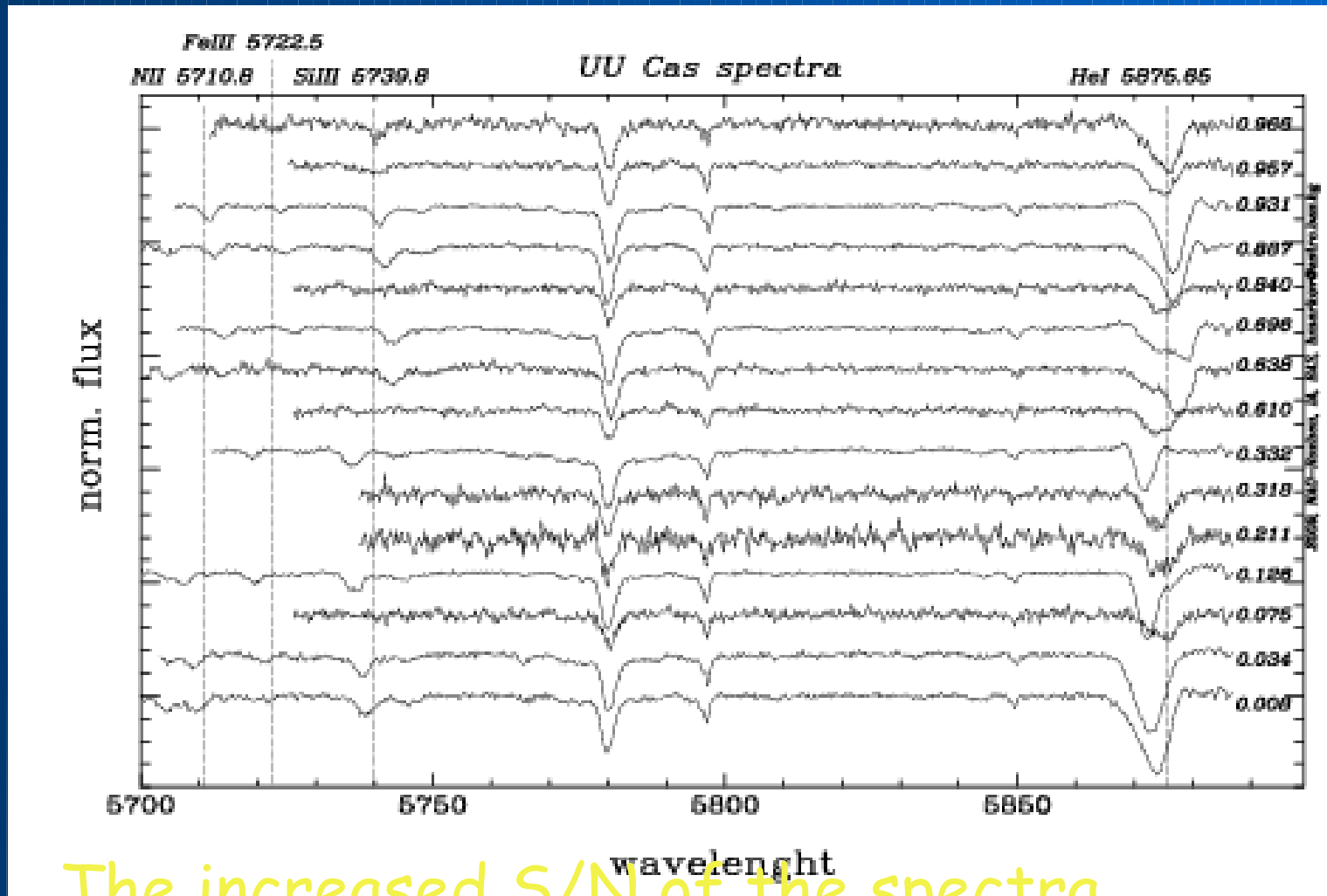
# Recent upgrades – 2008

## new coating of the optics

(funding from the Bulgarian academy of sciences)



# SPECTRA OF THE ECLIPSING BINARY UU CAS



The increased S/N of the spectra (about 50 before coating, 100-120 after), allowed detection of clear line splitting in HeI. In addition to HeI, 3 metal lines have been identified



# Running upgrade – 2009

## new control system for the 2-meter telescope

1. March 26 2009 - Contract signed with the company Projectsoft.
2. In the last 2 years Projectsoft produced CSs for 2 other 2-meter telescopes made by Carl-Zeiss: Ondrejov and Terskol.
3. The design of the new CS is based on Siemens industry controllers.
4. High reliability, improved pointing accuracy, optimized positioning strategy, remote control, ...
5. According to the negotiated schedule the new CS should be commissioned in September 2009.
6. Funding comes from a project with the National science fund (contract No. DO 02-85).

# New control system for the 2-m telescope



21.9.2009 20:59:45

Telescope - main screen

Petrov



NATIONAL ASTRONOMICAL OBSERVATORY  
ROZHEN, BULGARIA



Telescope 1 control panel showing various parameters and status indicators. The interface includes sections for 'Telescope coordinates', 'Observation', 'Status', and 'Control'. It features numerous numerical readouts, green and red status bars, and control buttons.

Telescope 2 control panel showing various parameters and status indicators. The interface includes sections for 'Status', 'Control', and 'Observation'. It features numerous numerical readouts, green and red status bars, and control buttons.

Observatory control panel showing a central diagram of the telescope's field of view with cardinal directions (S, N, E, W) and various status indicators. It includes sections for 'Observation', 'Status', and 'Control'.

Telescope 3 control panel showing a 3D model of the telescope and various parameters and status indicators. It includes sections for 'Status', 'Control', and 'Observation'.

Server - Telescope control panel showing various parameters and status indicators. The interface includes sections for 'Status', 'Control', and 'Observation'.





# New control system for the 2-m telescope


21.9.2009 20:58:41
Telescope I
Petrov





### Telescope coordinates

RA **19h 00m 00,00s**

DEC **41° 41' 41,0"**

Orientation **EAST**

UTC **17h 58m 36,48s**

LST **19h 40m 01,71s**

HA **0h 40m 01,69s**

Azimuth **273.34°**

Elevation **82.53°**

Air mass **1.01**

Coudé rotation **11.58°**

Input (H.axis, D.axis) **Source**

Input (RA, DEC) **Object**

TPoint record **TPC**

### Input coordinates

RA **19h 00m 00,00s**

DEC **41° 41' 41,0"**

Elevation **82.53°**

### User speeds

RA **0.00"/s** DEC **0.00"/s** **On**

● Corrections

RA **0.0"** DEC **0.0"**

### Manual control

DEC+

RA+      RA-

DEC-

T1    **T2**    T3

**5000"/s**    **120.00"/s**    **2.00"/s**

HA guide limit **2.00"/s**

Oil **On** **Off** **On**

### Telescope

Stop slew **On** **Off** **Track**

HA **On**      DEC **On**

Declination centering    Start Stop

Tracking                    On    Off    **On**

Hour axis calibration    Start Stop    **Yes**

Declination axis calibration    Start Stop    **Yes**

### Corrections

	On	Off	Detail
Aberration	On	Off	<b>Off</b>
Precession and nutation	On	Off	<b>Off</b>
Refraction	On	Off	<b>Off</b>
Error model	On	Off	<b>Off</b>
Guide mode	On	Off	<b>Off</b>

### Apertures

	Ope	Clo	Stop	
Coude	Ope	Clo	Stop	<b>Close</b>
Tube	Ope	Clo	Stop	<b>Close</b>
Slit	Ope	Clo	Stop	<b>Unknown</b>

### Focus

Stop **Off**

Actual position    Fast Slow + - **50.00mm**

New position    Rel Start **0.00mm** Abs Start **50.00mm**

Platform **Parked**

### Dome

Azimuth on the dome **99.33°** **ON** **OFF** Aut Stop **Off**

Actual position    + - **181.03°**

New position    Rel Start **0.00°** Abs Start **180.00°**





En Bg
Event

[www.projectsoft.cz](http://www.projectsoft.cz)









# New control system for the 2-m telescope

ProjectSoft 21.9.2009 21:00:36 Observatory Petrov

**Telescope coordinates**

RA	19h 00m 00,00s
DEC	41° 41' 41,0"
HA	0h 41m 56,40s
UTC	18h 00m 31,38s
LST	19h 41m 56,41s

**Input coordinates**

RA	19h 00m 00,00s
DEC	41° 41' 41,0"
Elevation	82.17°

**STOP observe**

**Turning of graphic**  
180.00°

**Actual position**  
181.03°

**Azimuth on the dome**  
100.03°

**Observation parameters:**

Azimuth	273.50°
Elevation	82.17°
Air mass	1.01
Coudé rotation	12.06°

www.projectsoft.cz

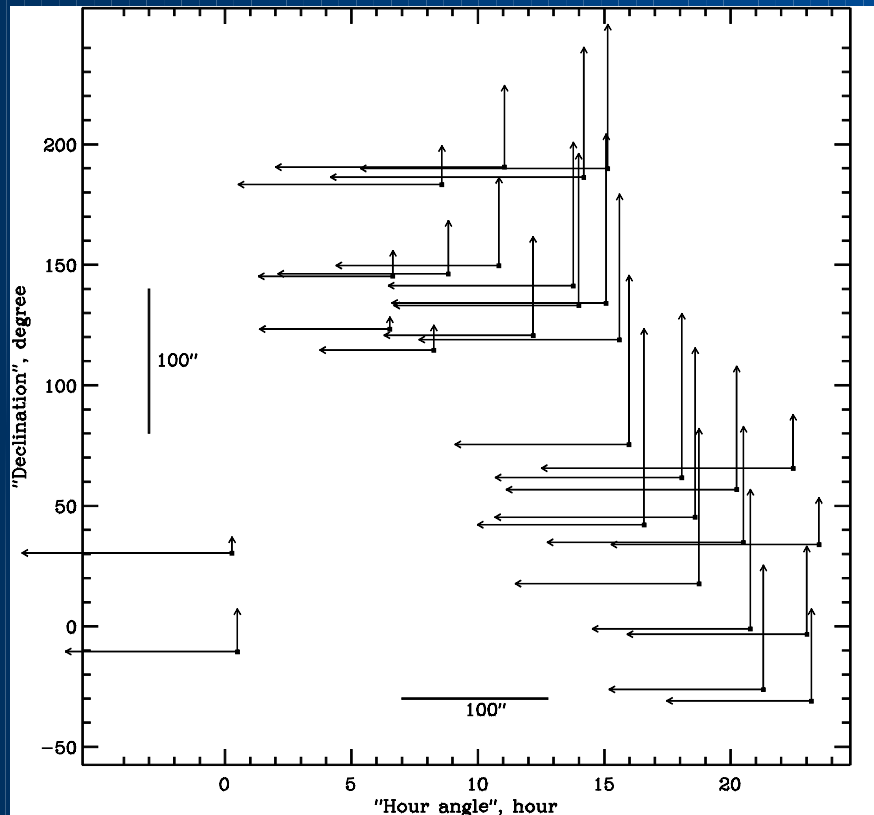


# New control system for the 2-m telescope

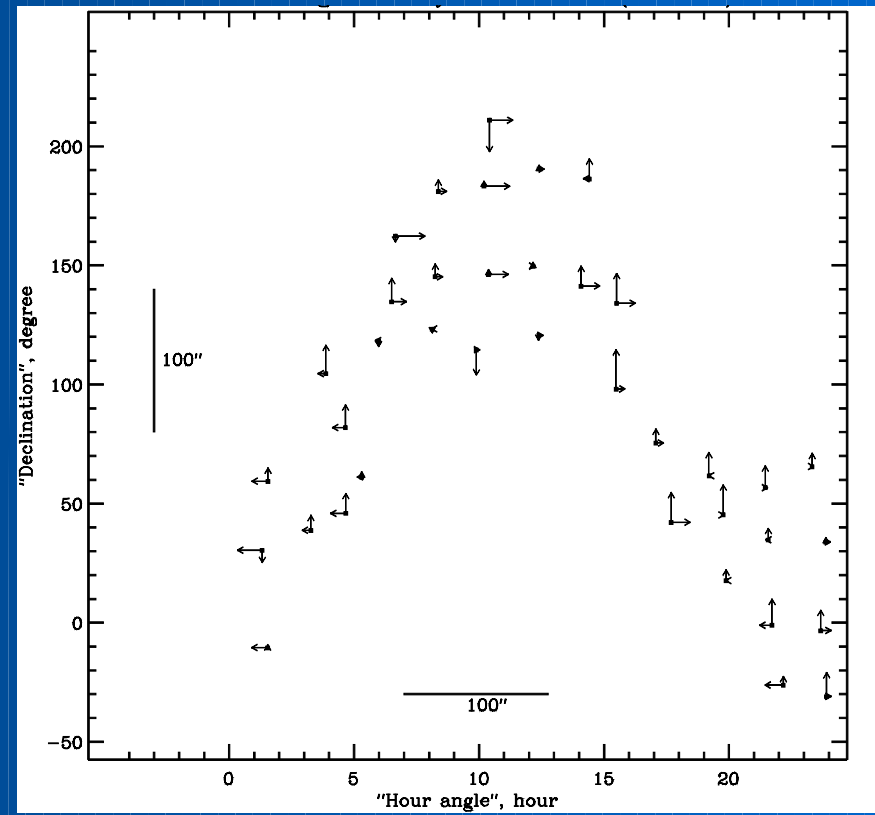
## First results: accuracy of positioning

### Application of Tpoint model

before



after



# Remote control of the 2-meter telescope

- [www.logmein.com](http://www.logmein.com)
- Open VPN



~~Running upgrade - 2009  
Optical fiber connectivity with the external world~~

~~Should be performed during the summer  
and commissioned in September~~

Planned upgrade – 2009 – 2011 (?)  
new echelle spectrograph for the 2-meter telescope

1. FEROS like design
2. Fiber fed, bench mounted, ...
3. Presently, the available funding can cover the purchase of some components only. In order to keep the schedule we will start with the items which require most time between order and delivery.

# Summary - 2-m RCC telescope upgrades in the period 2004 - today

Year	Upgrade (instrument, camera, other) and funding
2004	<ul style="list-style-type: none"><li>• 2-channel focal reducer (co-operation with MPS, Germany)</li><li>• VersArray CCD, 1340 x 1300 (SREAC, UNESCO)</li></ul>
2005	Substantial improvements (automation) of the fast photometer (bilateral co-operation, BG-Ukraine )
2006-2007	Autoguiding system (SREAC, UNESCO grant)
2008	New alluminization of the 2-m mirror (BAS)
2009	<ul style="list-style-type: none"><li>• New control system (contract with NSF, DO 02-85).</li><li>• A set of diaphragms to suppress scattered light (joint efforts of colleagues from the Dept. of Astronomy at the University of Sofia and Inst. of Astronomy at the Bulgarian Academy of Sciences (see poster).</li></ul>



The 60 cm Cassagrain telescope,  
equipped with a CCD camera

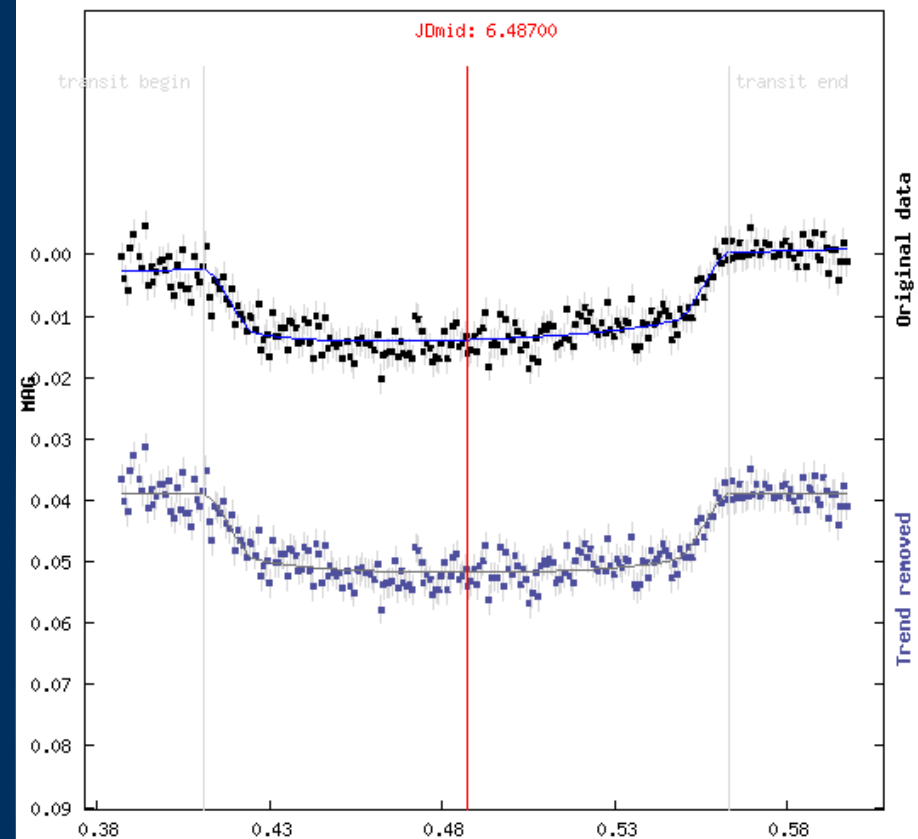


FLI PL 9000,  
3056x3056 active pixels,  
12x12  $\mu\text{m}$  pixel size

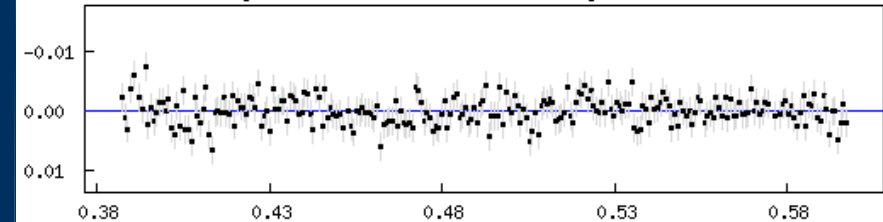
# Observations with the 60 cm Cassagrain telescope

## Example: transiting exoplanets

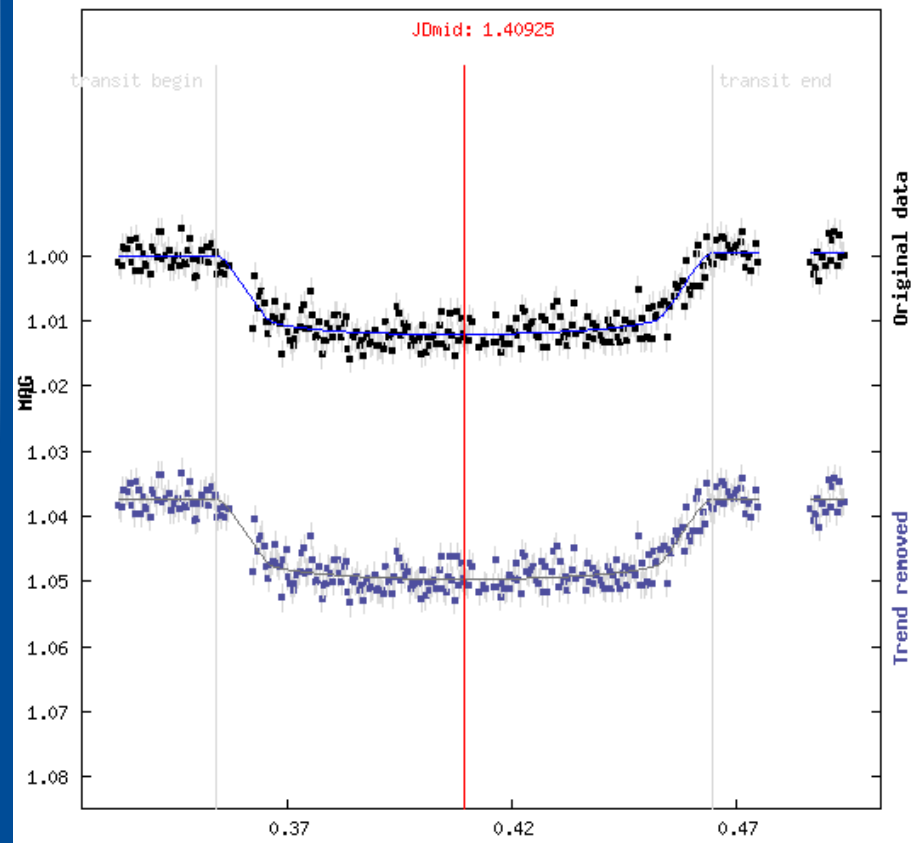
WASP-1 b



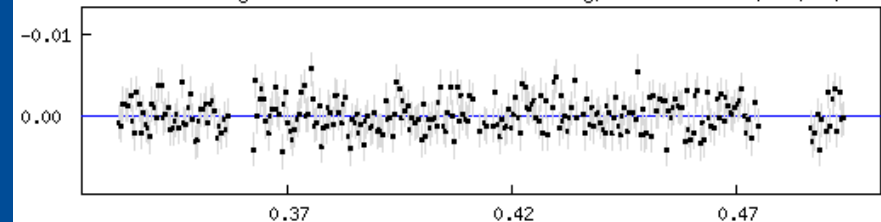
Residuals (mag - fit)  $S = 1.8$  mmag,  $ro = 0.81$  data/min,  $DQ = 2$



WASP-3 b

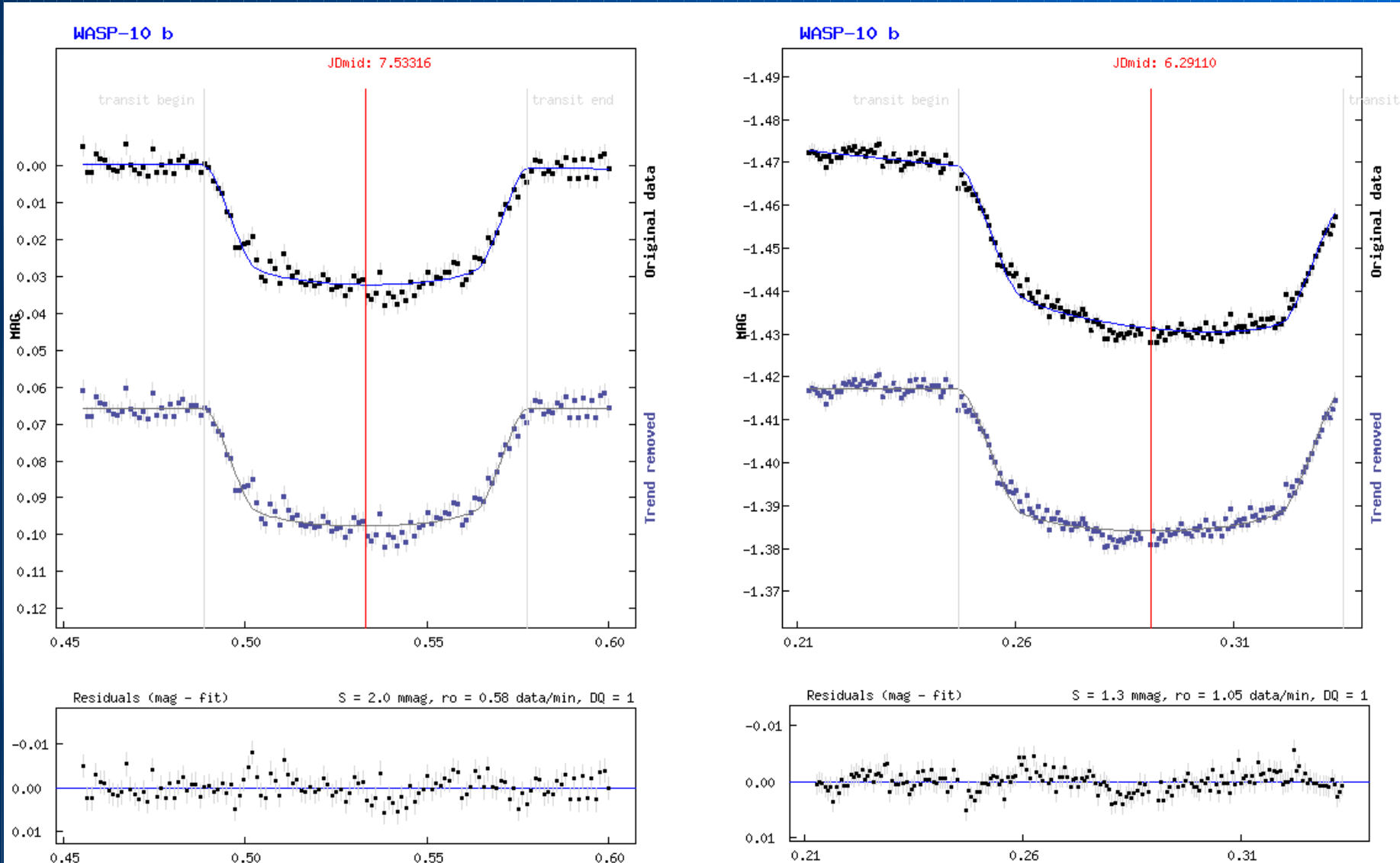


Residuals (mag - fit)  $S = 1.6$  mmag,  $ro = 1.22$  data/min,  $DQ = 2$

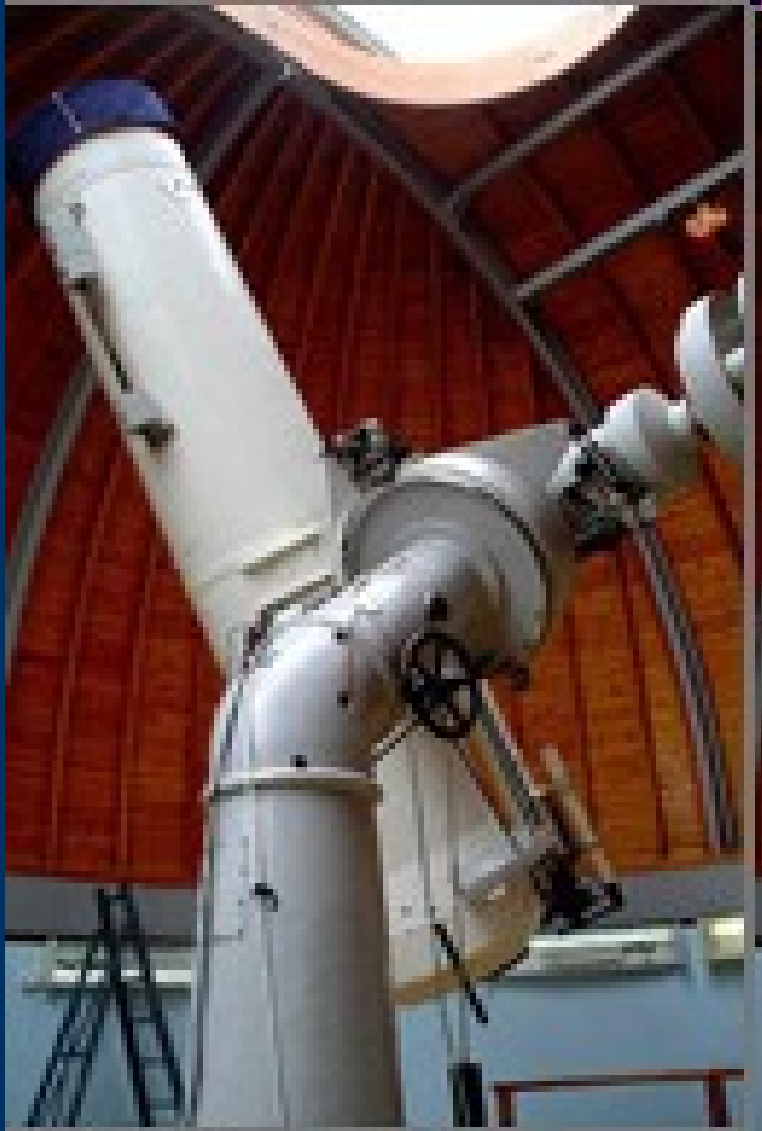




# Observations with the 60 cm Cassagrain telescope, Transiting exoplanets, comparison with the 2-meter telescope

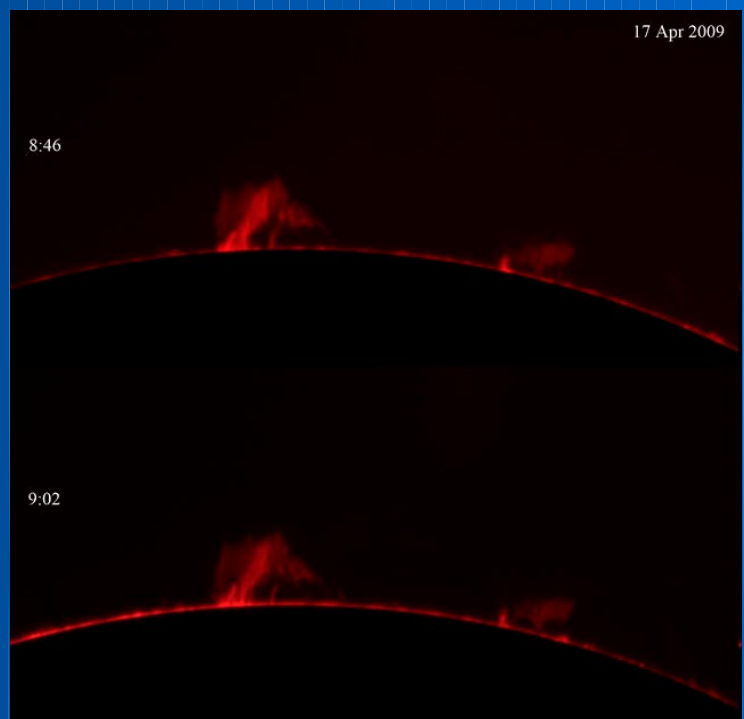
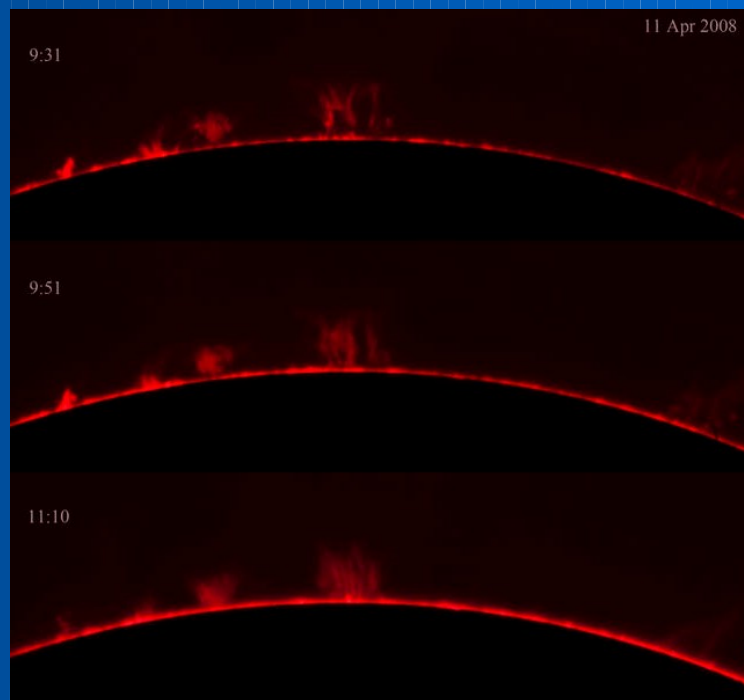
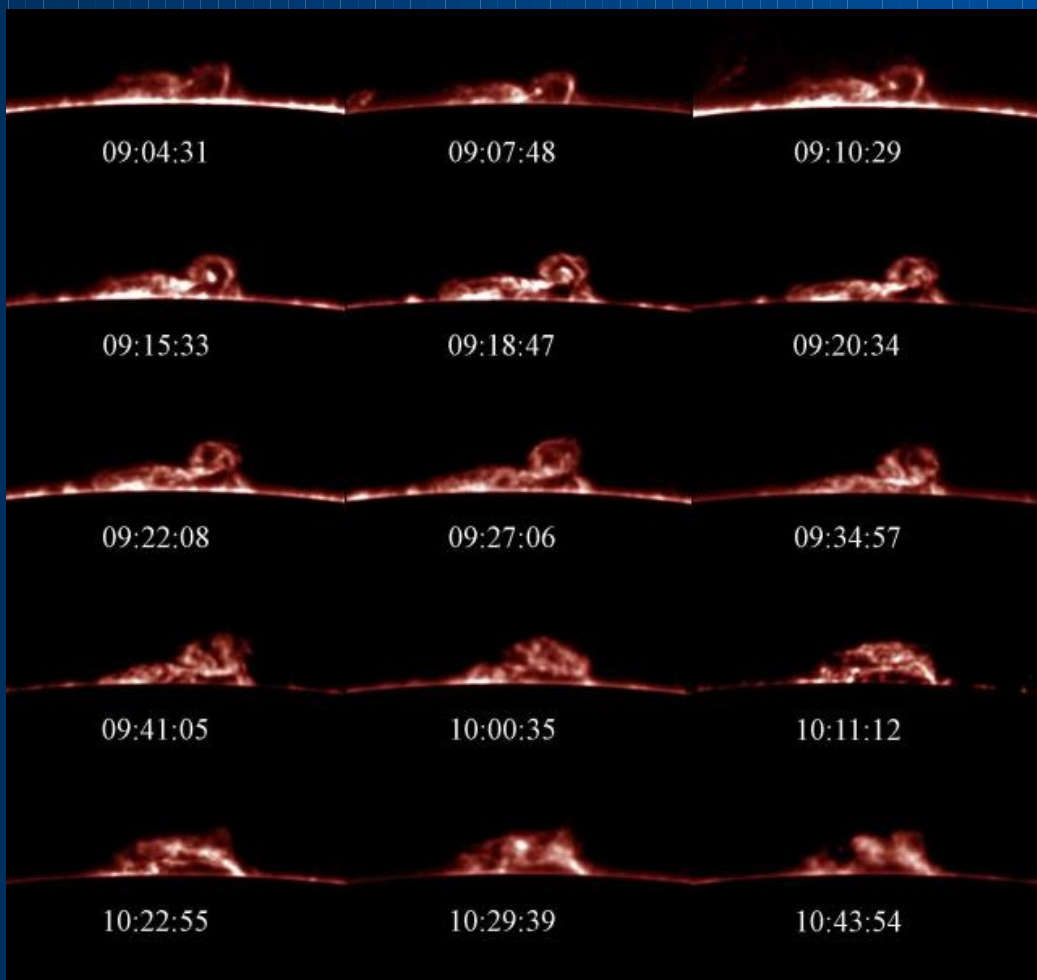


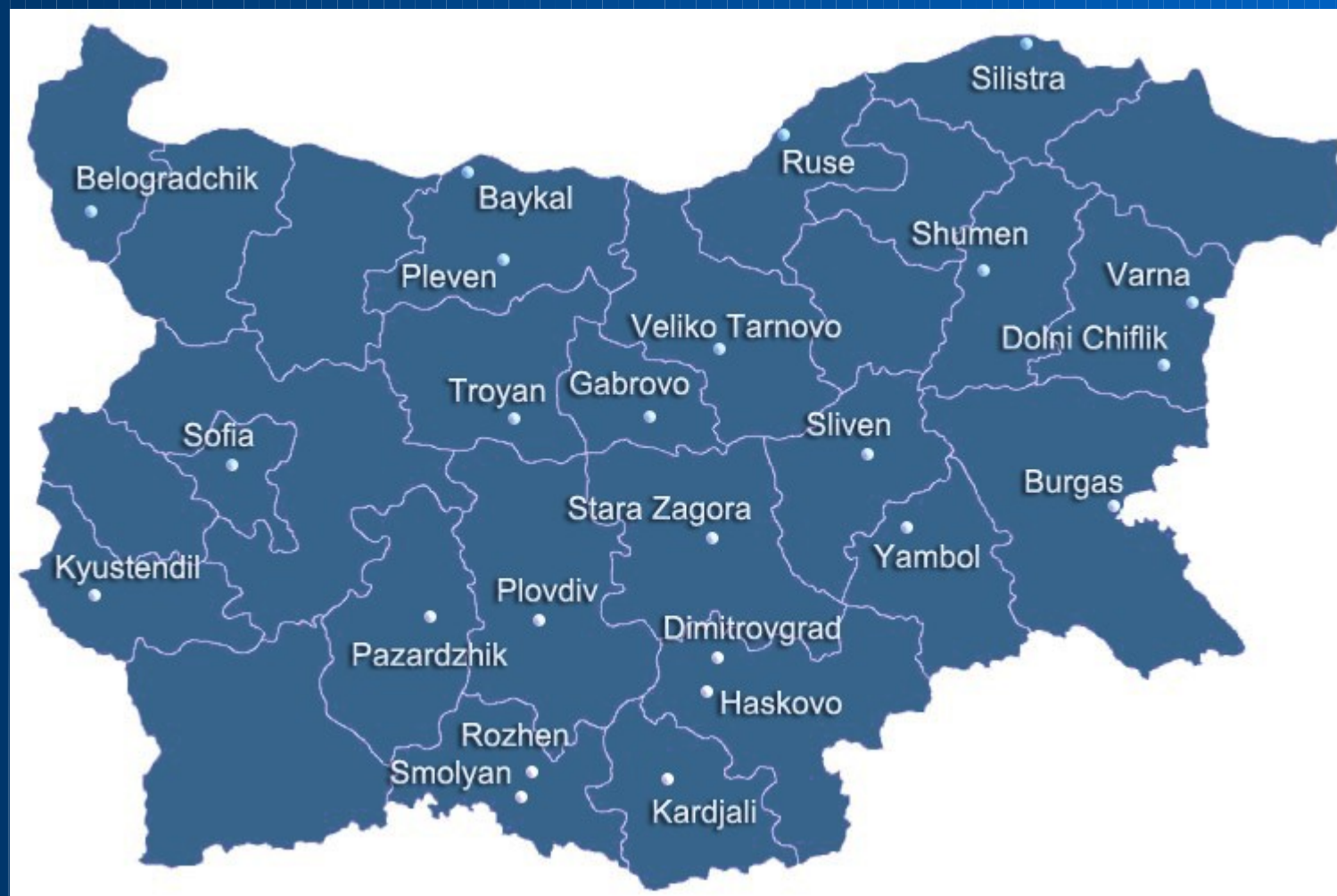
# The 50/70 cm Schmidt telescope





# The 15 cm solar coronagraph







# Astronomical Observatory Belgradchik, site for research, education, development and test of new instruments







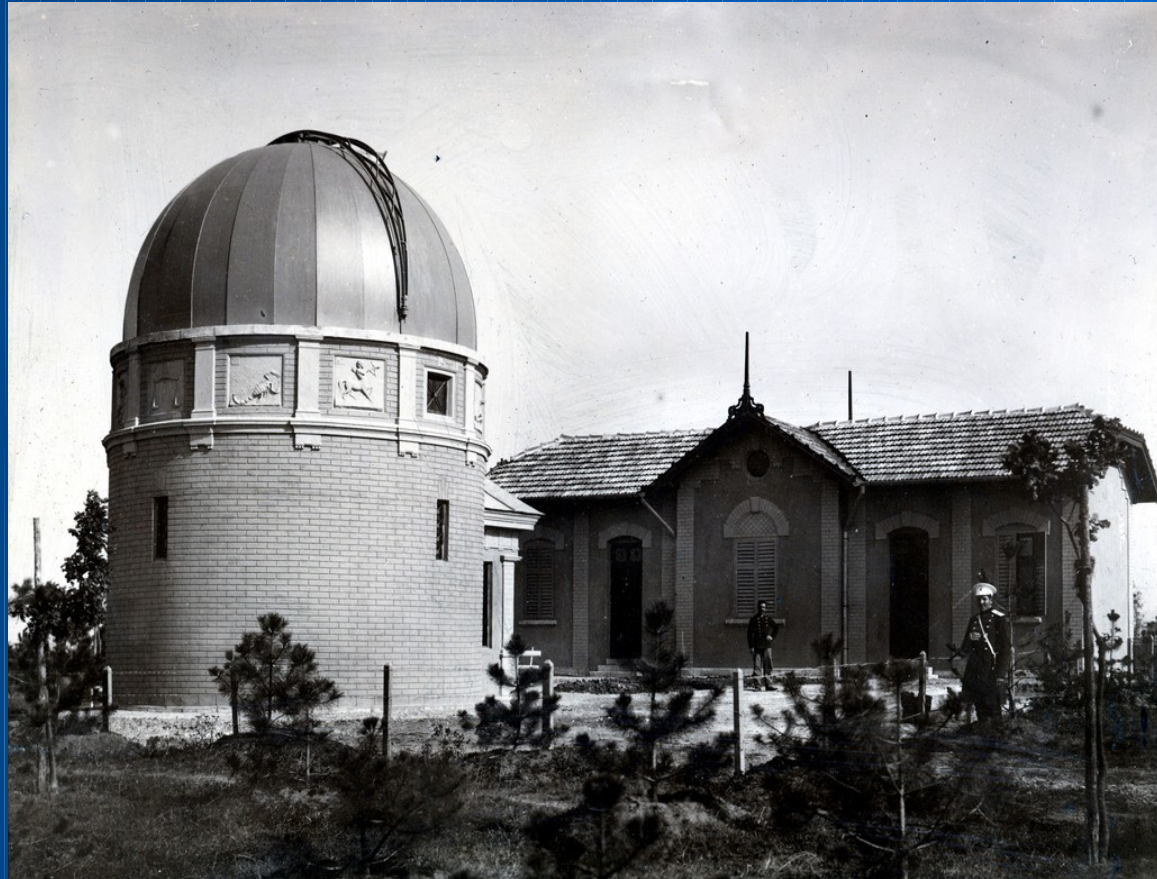








University of  
Sofia,  
Department of  
astronomy at  
the Physics  
Fakulty.

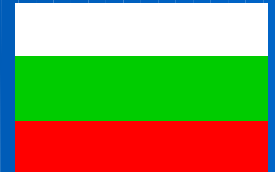


- 1892 - first Bulgarian astronomical observatory
- 1904 - Ciril Popov - first scientific publication in astronomy
- 1952 - Nikola Bonev - first ideas and steps for creating a National Astronomical Observatory

# Astronomical center of Shumen university



ШУМЕНСКИ УНИВЕРСИТЕТ  
Епископ Константин Преславски







SU



BAS

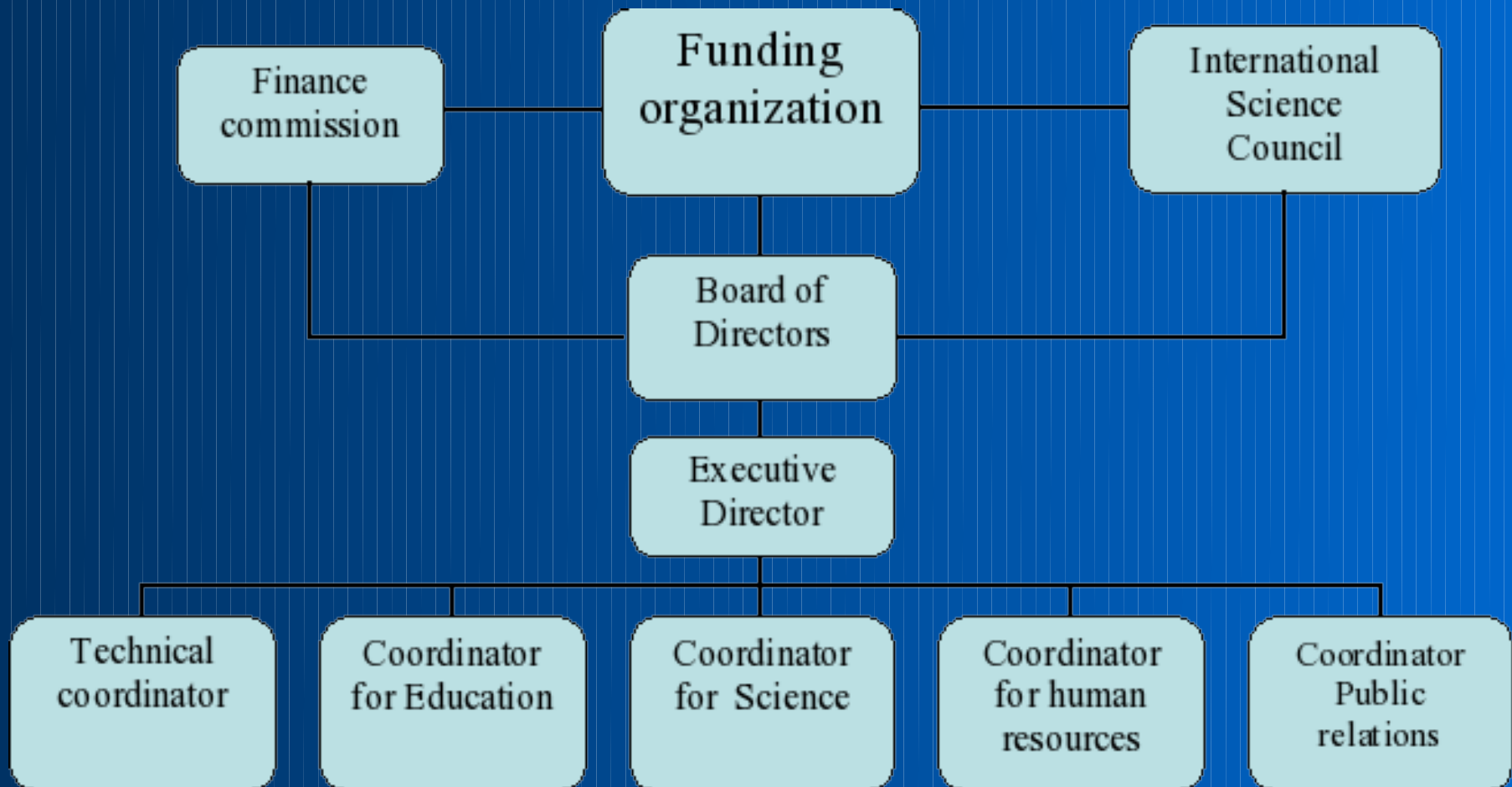


ShU

Регионален Астрономически Център  
за Изследвания и Образование  
( РАЦИО )

Regional Astronomical Center  
for Research and Education  
(RACIO)

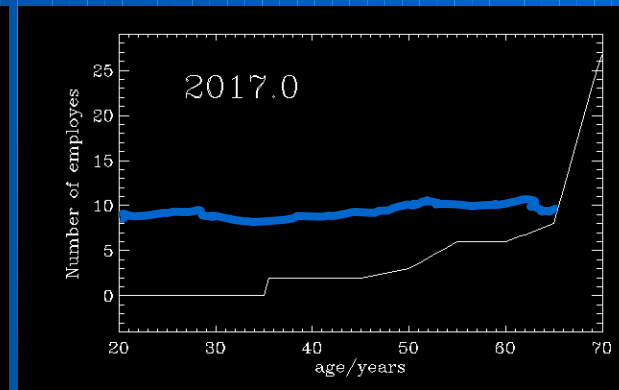
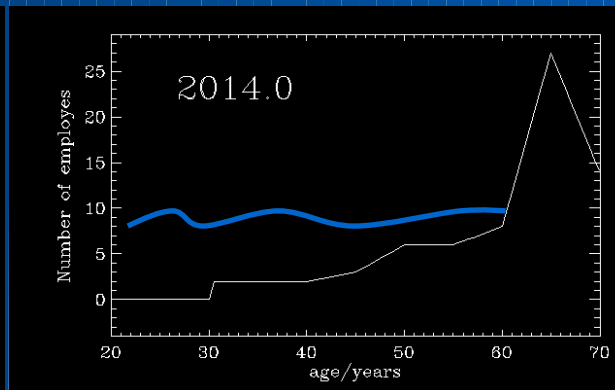
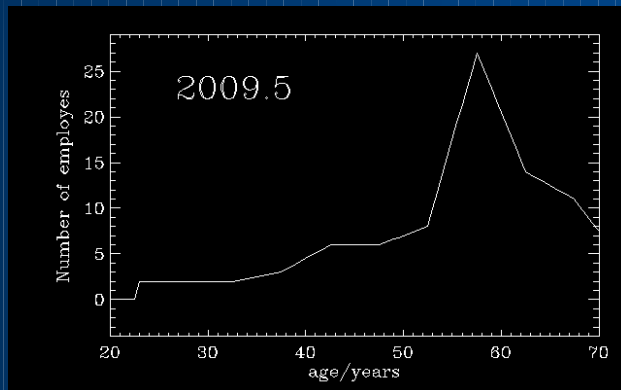
# RACIO - Organizational structure





## The role of RACIO

- Will foster the competitive position of the regional astronomical community in the European research area.
- Will attract young people to astronomy and natural sciences in general





# *“Challenges in modern Astrophysics”*

*OPTICON awareness conference*

*Sofia, 13-14 October 2009*

## *Scientific organisers:*

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*Martin Ward*

## *Invited lecturers:*

*A. LeCavelier (France)*

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*M. Dechev*

*V. Popov*

Astronomical  
infrastructures,  
observing facilities  
and recent upgrades  
in Bulgaria



Questions,  
please!

