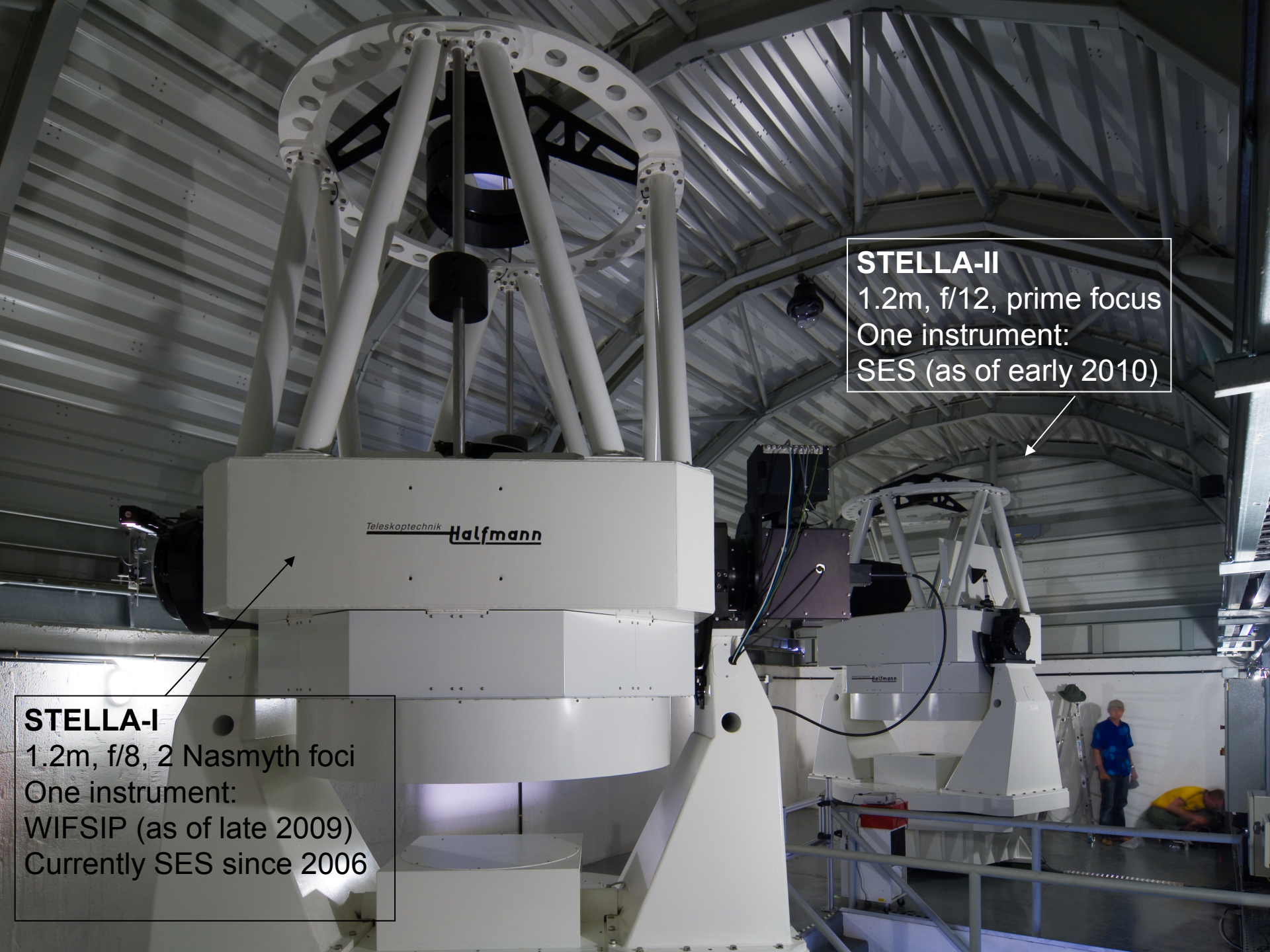
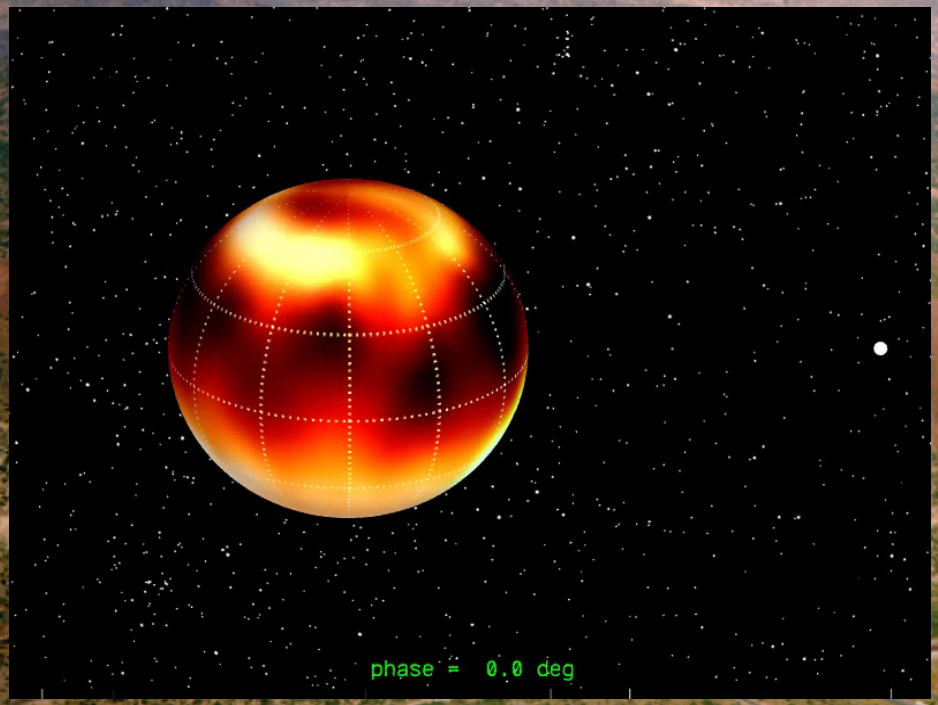

STELLA
AIP
Two robotic 1.2m telescopes
for Stellar Activity
• Robotics & Control
• Telescopes
• SES and WIFSIP
(STELLA Echelle Spectrograph &
Wide-Field STELLA Imaging Photometer)
• First data
Granzer
Weber
Woche
Järvinen
Bartus
Fechner
Dionies
-M. Bauer
Paschke
Popow
Klaus G. Strassmeier & the STELLA team
Astrophysical Institute Potsdam (AIP)


STELLA-II
1.2m, f/12, prime focus
One instrument:
SES (as of early 2010)
Teleskoptechnik Halfmann
STELLA-I
1.2m, f/8, 2 Nasmyth foci
One instrument:
WIFSIP (as of late 2009)
Currently SES since 2006

Core-science

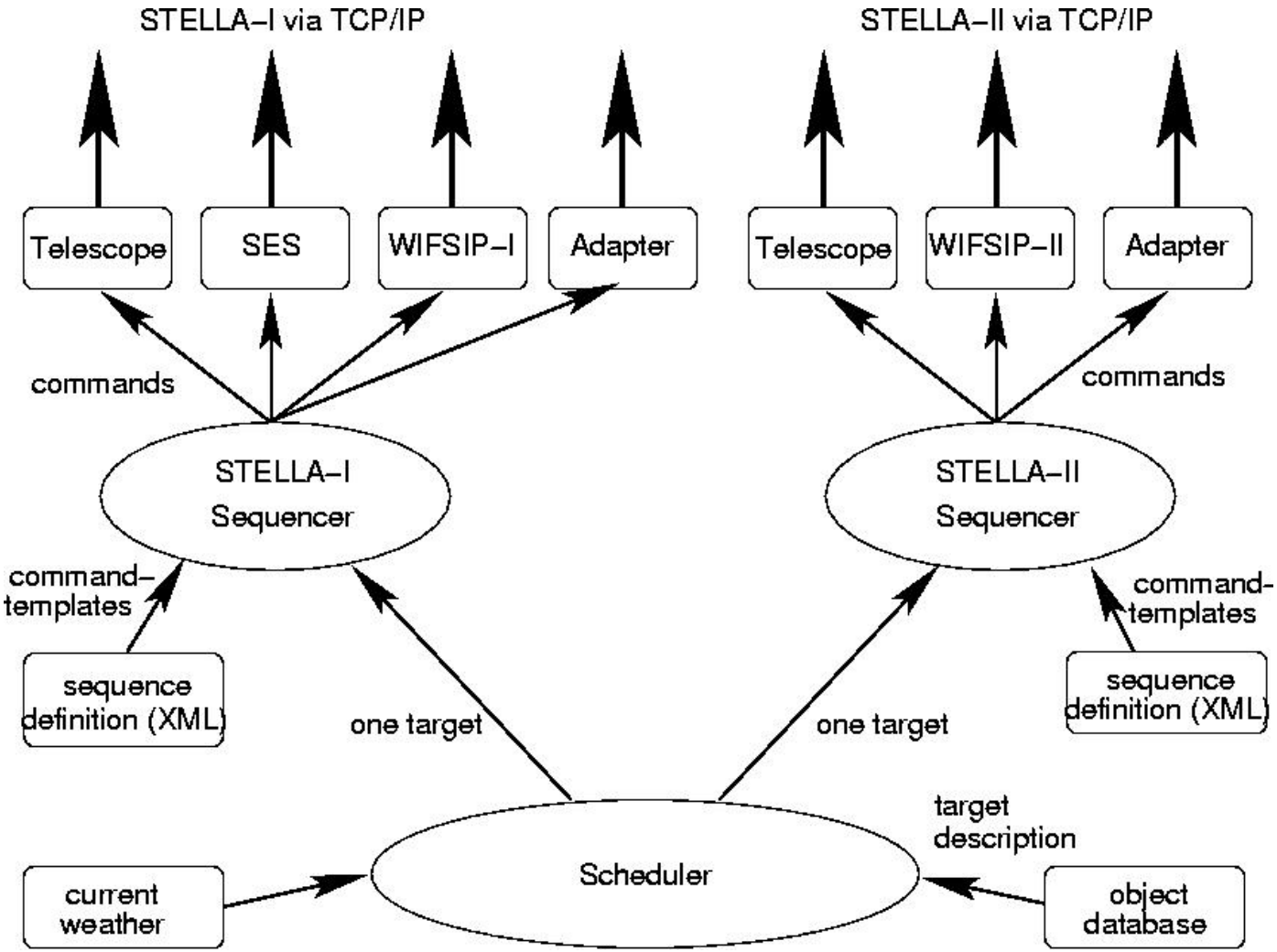
SES key-science project
Time-series Doppler imaging of stellar surface structure



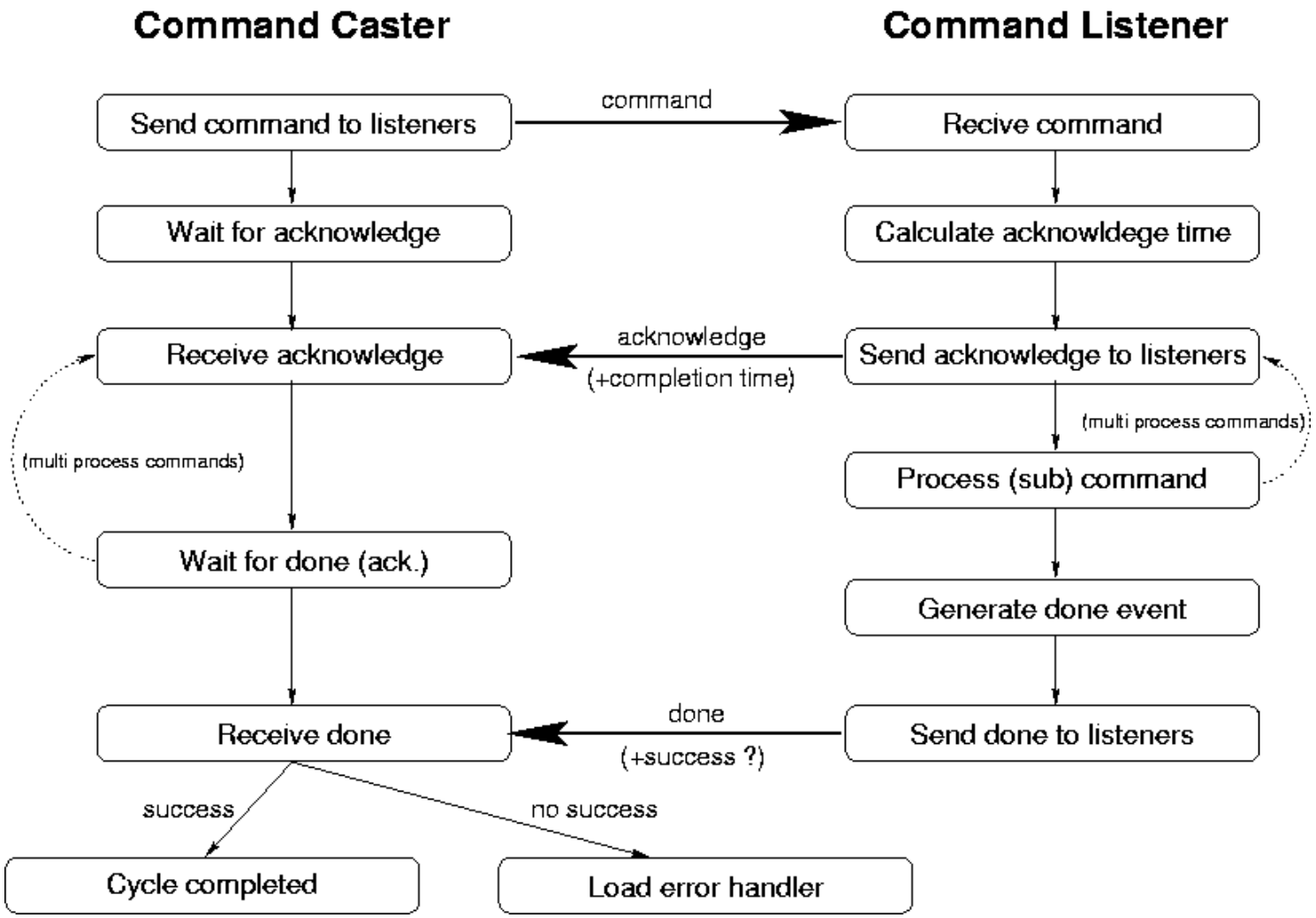
WIFSIP key-science project:
„The STELLA Open Cluster Survey“
The rotation evolution of low-mass stars


STELLA
Robotics & Control

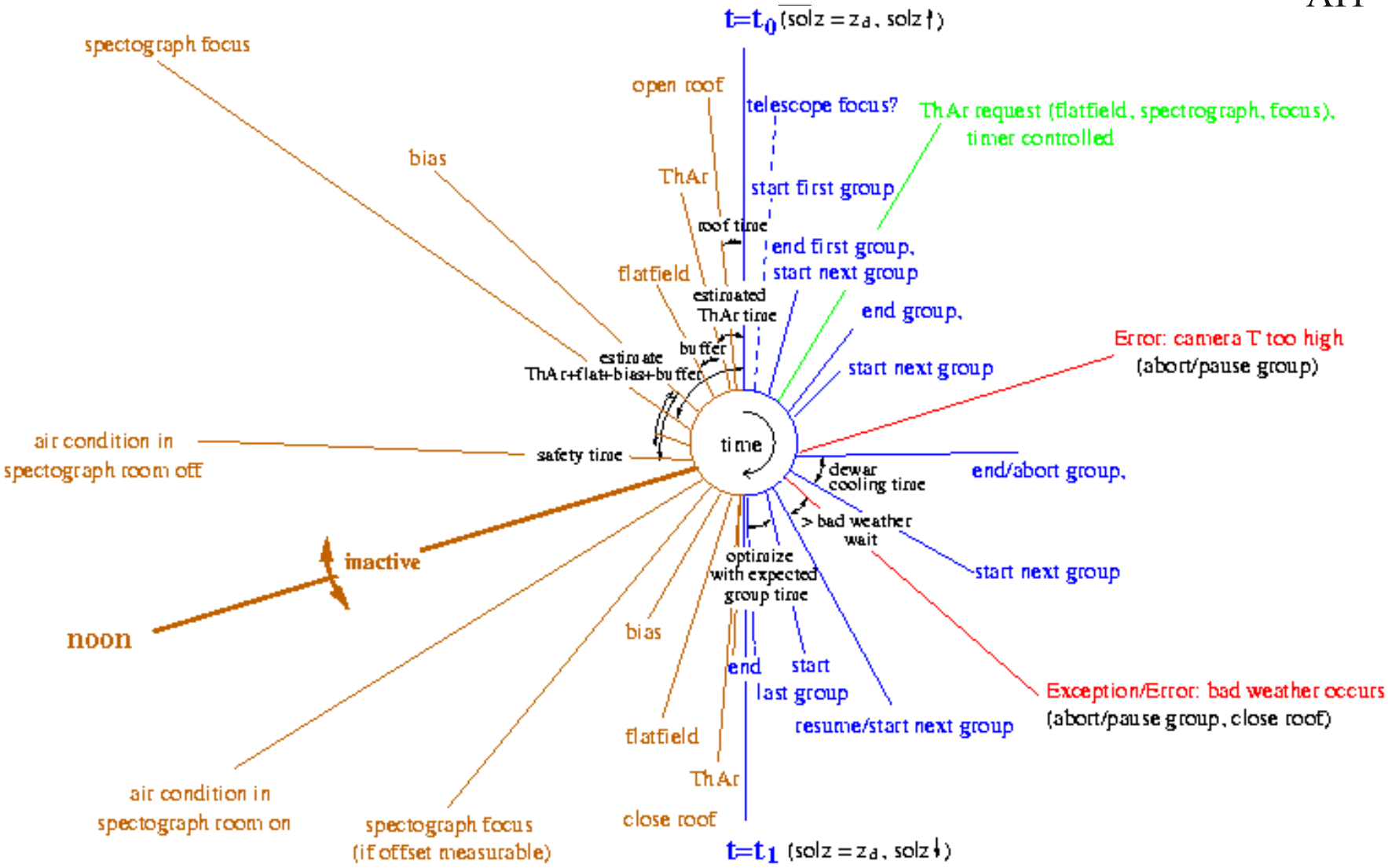
STELLA Control System (SCS)



SCS messaging concept



Timeline


t=t0 (solz = zd, solz↑)
spectograph focus
open roof
telescope focus?
ThAr request (flatfield, spectrograph, focus), timer controlled
bias
ThAr
start first group
roof time
end first group, start next group
flatfield
estimated ThAr time
end group,
buffer
estimate ThAr+flat+bias+buffer
start next group
Error: camera T too high (abort/pause group)
air condition in spectograph room off
safety time
time
dewar cooling time
end/abort group,
> bad weather wait
inactive
optimize with expected group time
start next group
noon
bias
end
start last group
Exception/Error: bad weather occurs (abort/pause group, close roof)
resume/start next group
flatfield
ThAr
air condition in spectograph room on
spectograph focus (if offset measurable)
close roof
t=t1 (solz = zd, solz↓)

Dispatch scheduling

AIP

- Picks target according to actual conditions.
- Runs in real-time.
- Allows easy reaction to weather changes.
- Used on most commercial robotic systems.

STELLA approach: split evaluation of merit

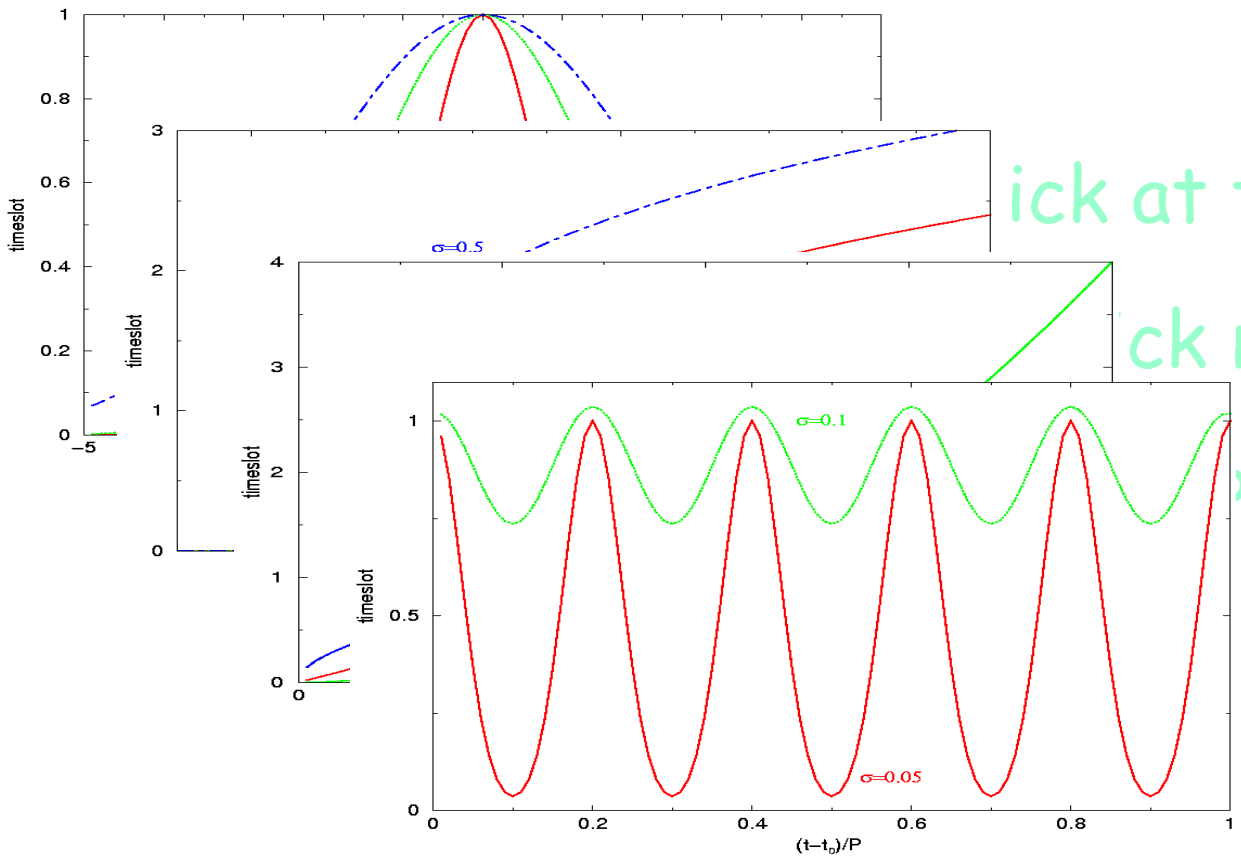
1) Hard constraints:
   must always be fullfilled during the predicted observing time

1) Modified merit function:

$$m(t) = \prod_j ts_j(t) \cdot \sum_i g_i(t)$$

..... ts_j for long-time, g_i for short-time behavior

Timeslots *ts* available



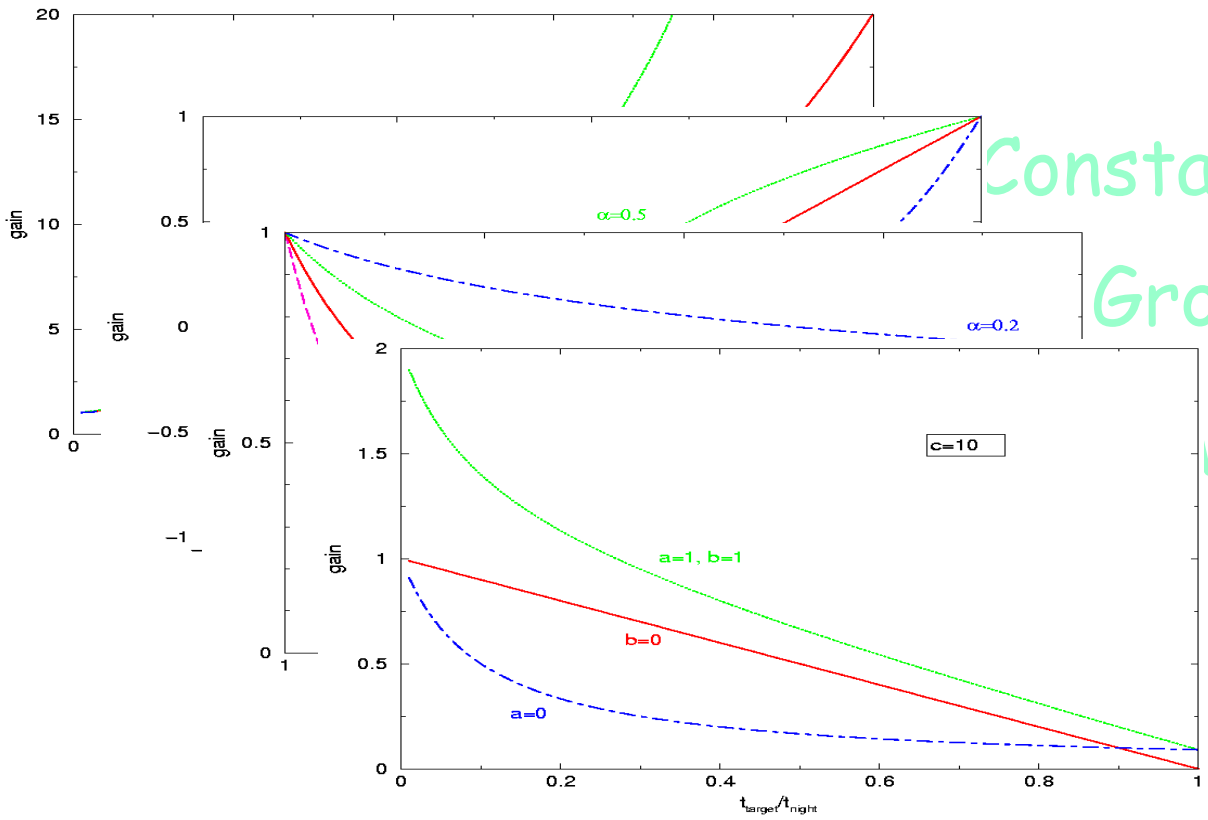
ick at t_{at}

ck not earlier

eriodic pick

Phase coherent

Gains *g* available



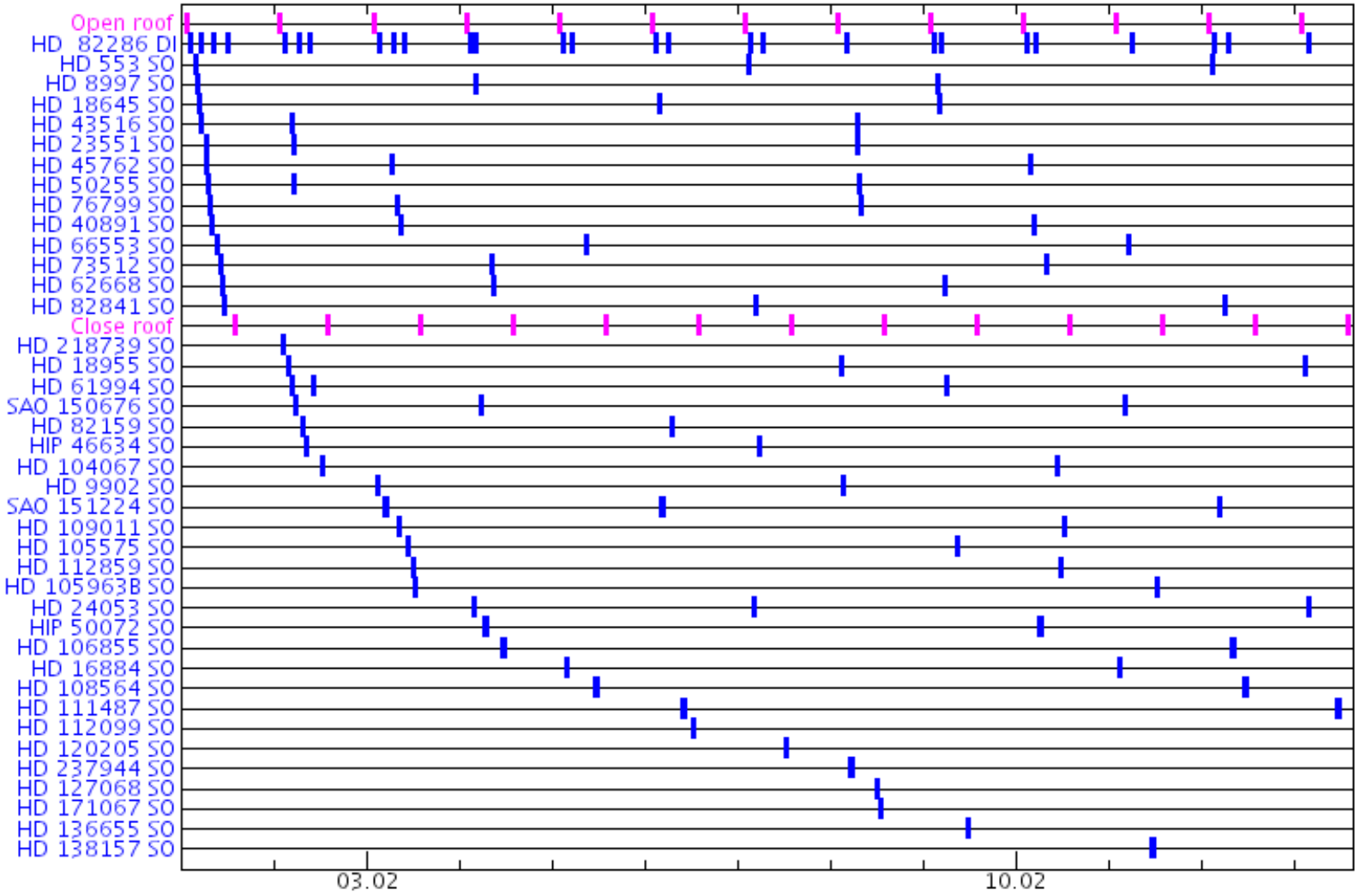
Constant priority

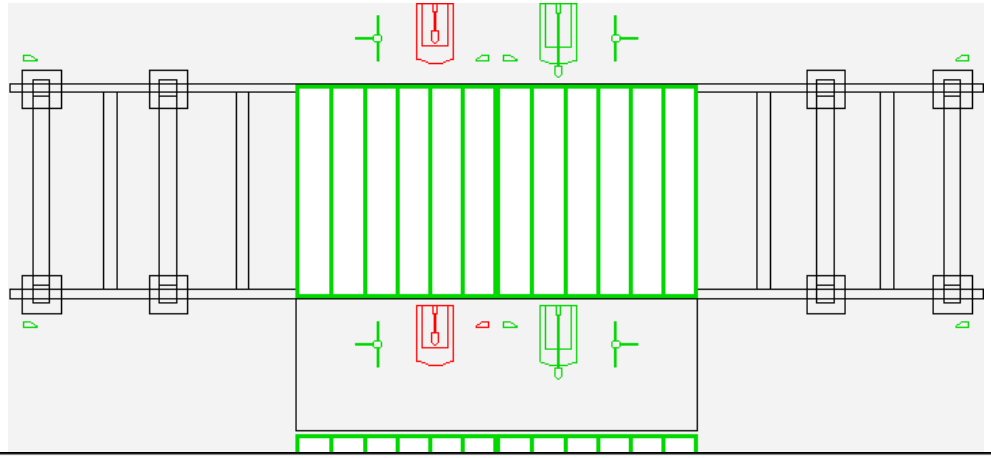
Group tolerance

Airmass

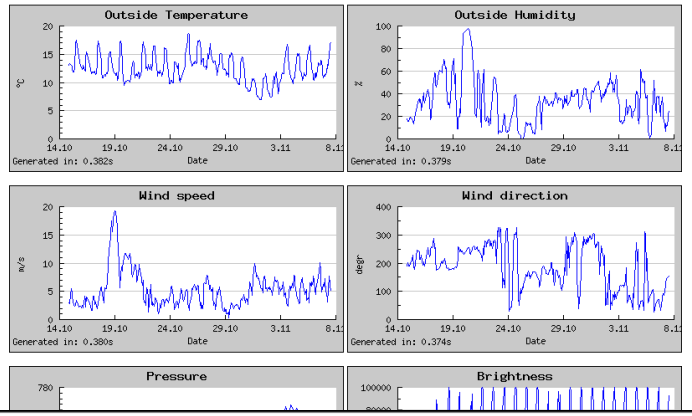
Observing window

Example schedule
(13 continuous nights in Feb. 2009)

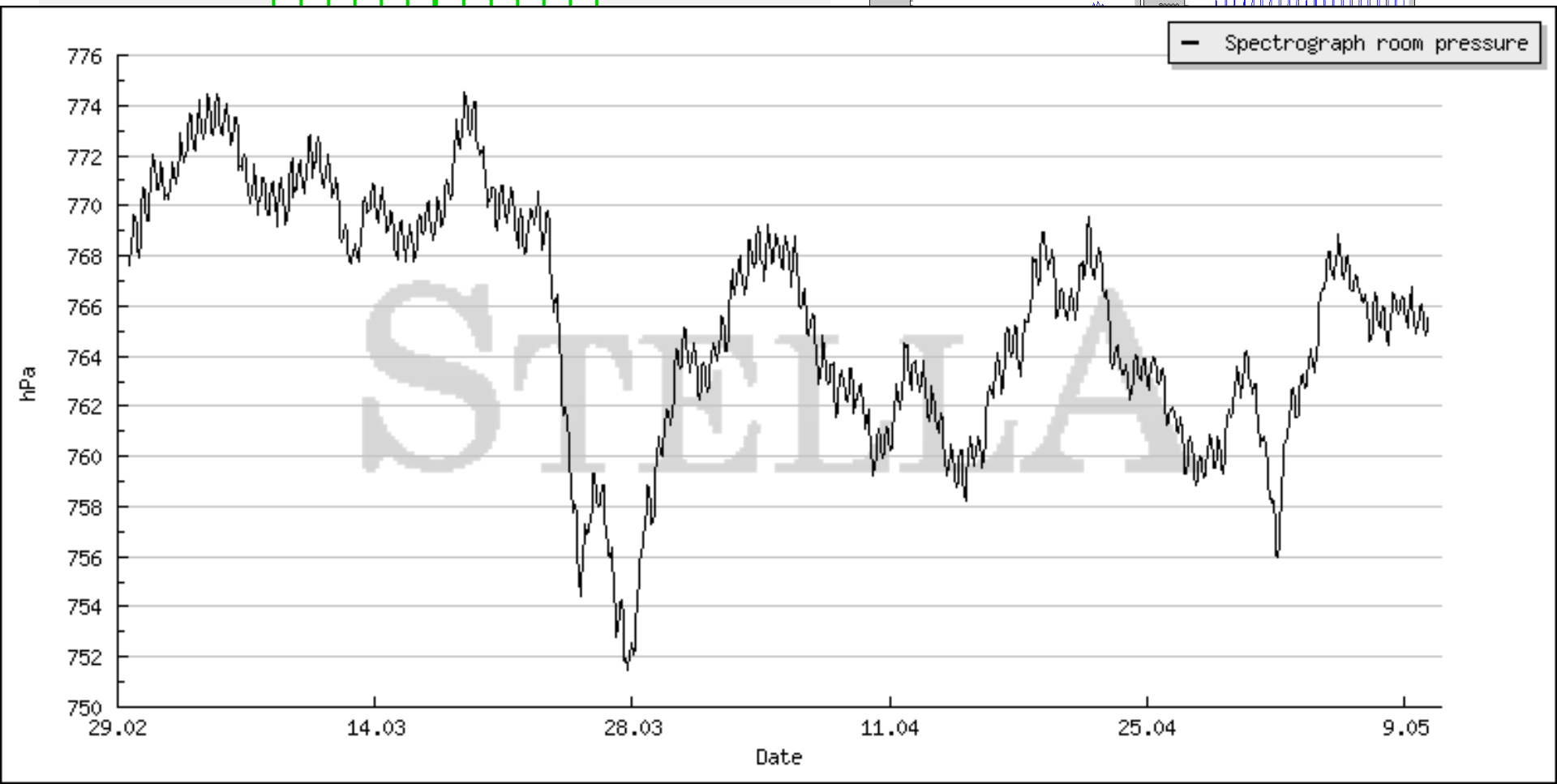




STELLA environmental statistics

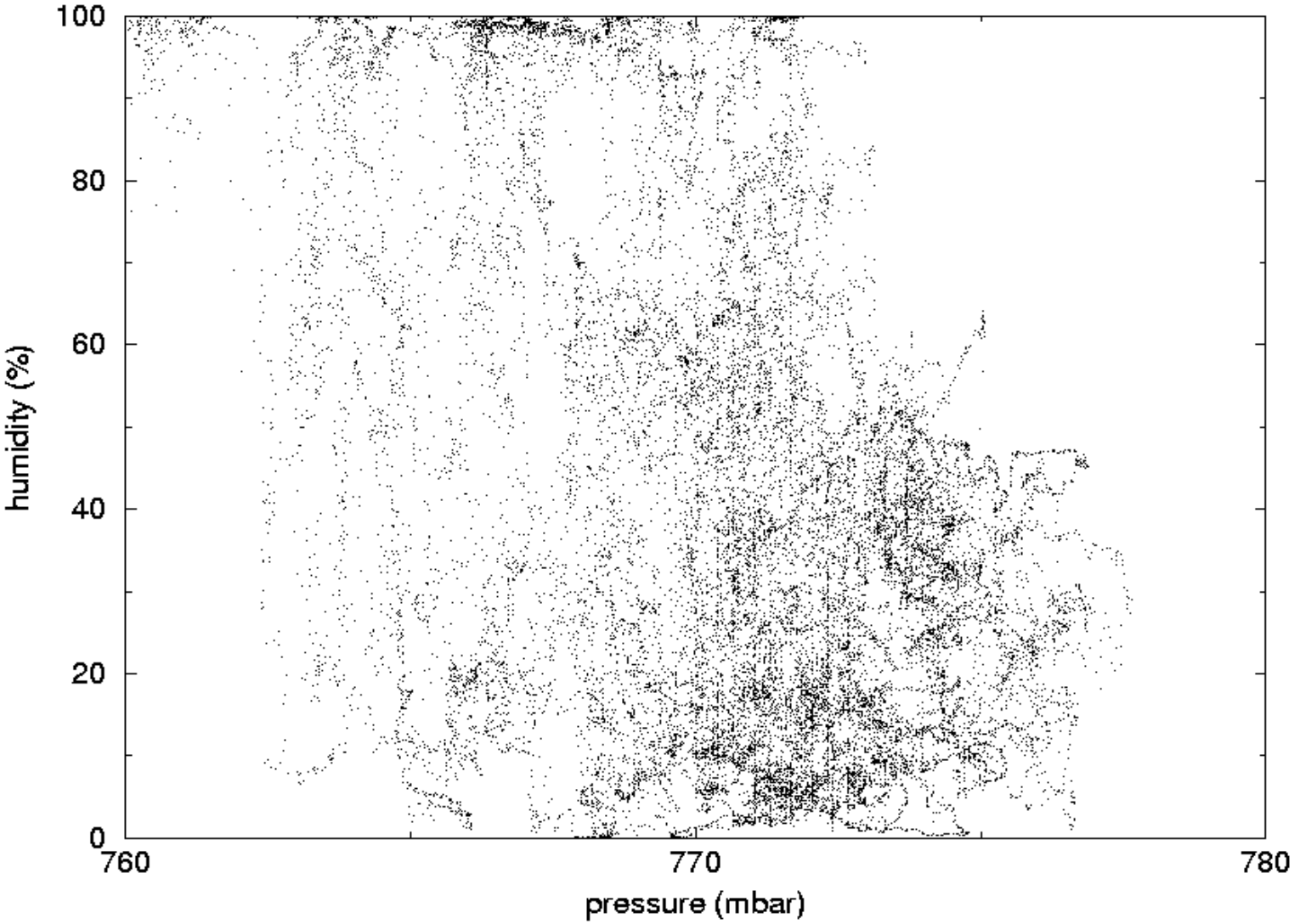


AIP

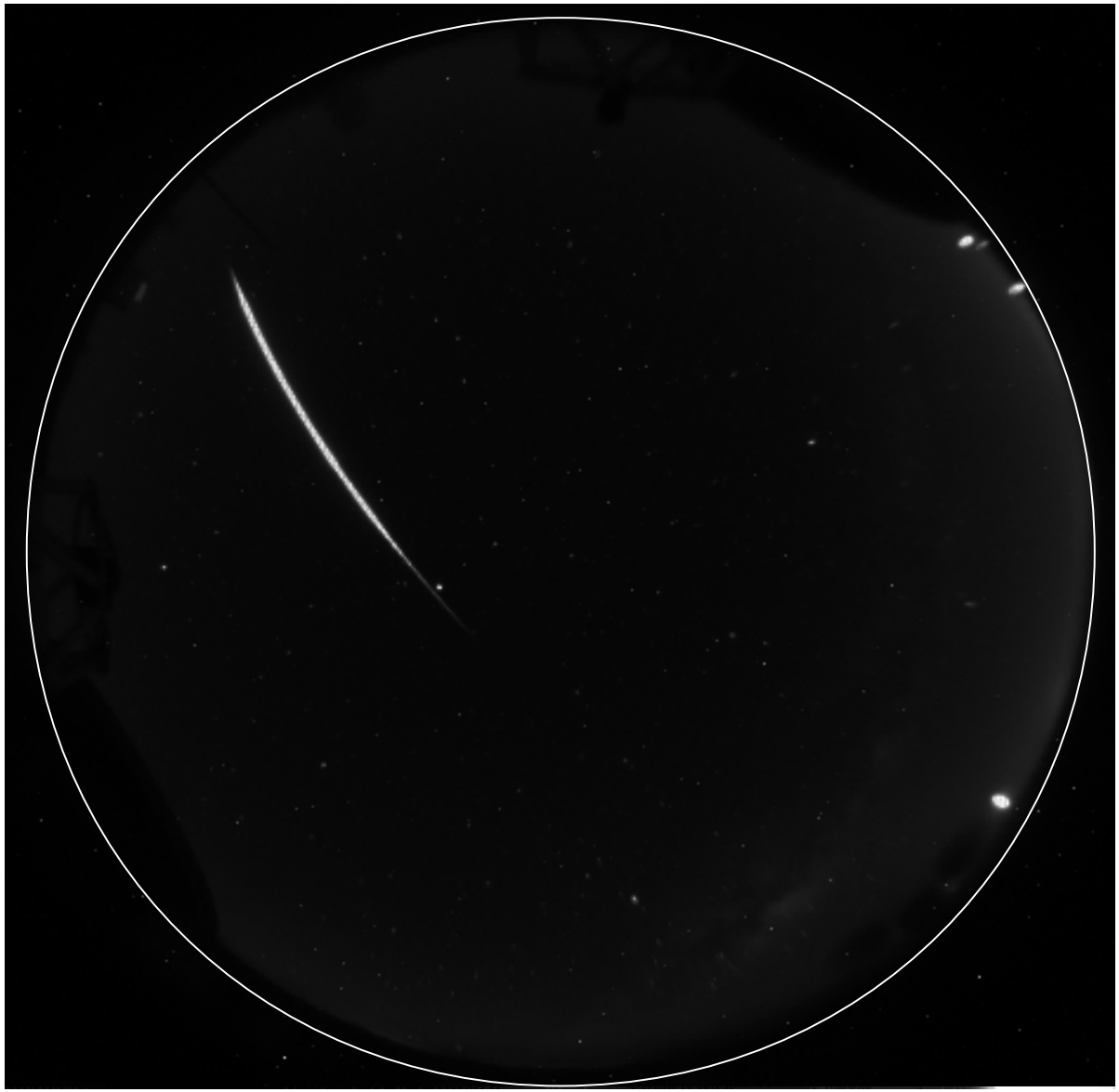


Cloud predictor

Relation between H(%) and p(mbar)



All-sky camera



A „cloudy“ night

and a clear night
with a bolide

Building constructions


Spring 2003


Spring 2006

Electronics room; view from front side (12/2005)

Non-Standard Robotics Problems

AIP


STELLA data & control center
at AIP in Potsdam-Babelsberg

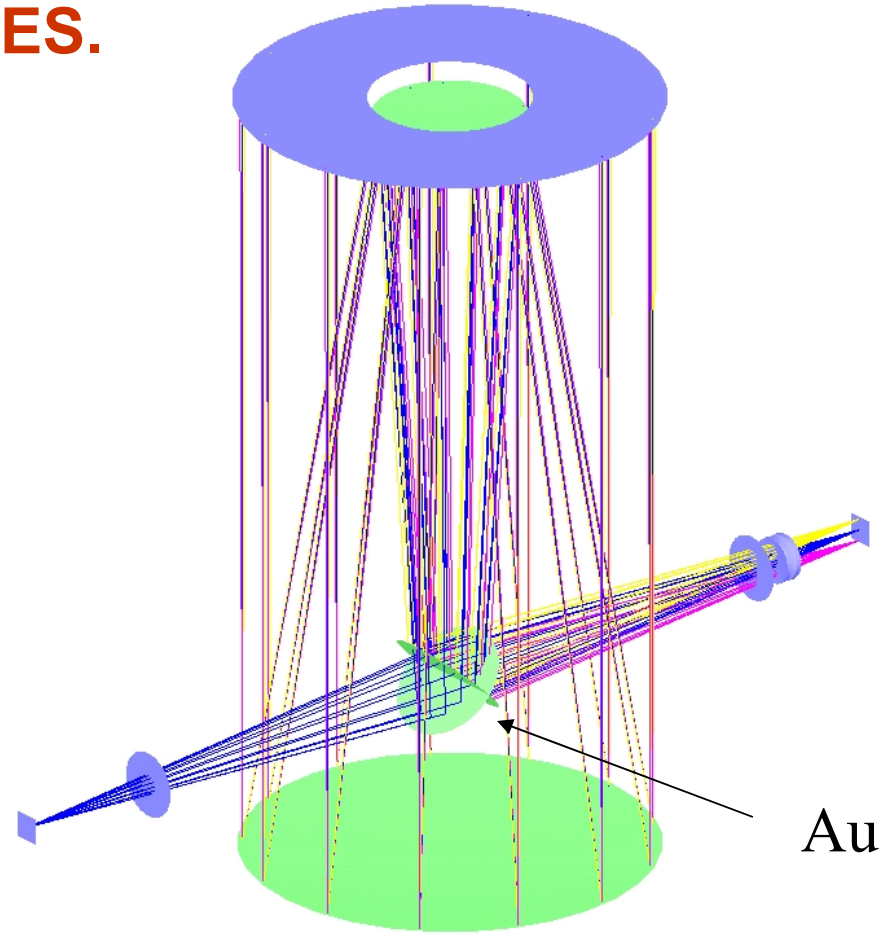
STELLA data & control center at AIP


STELLA
Telescopes

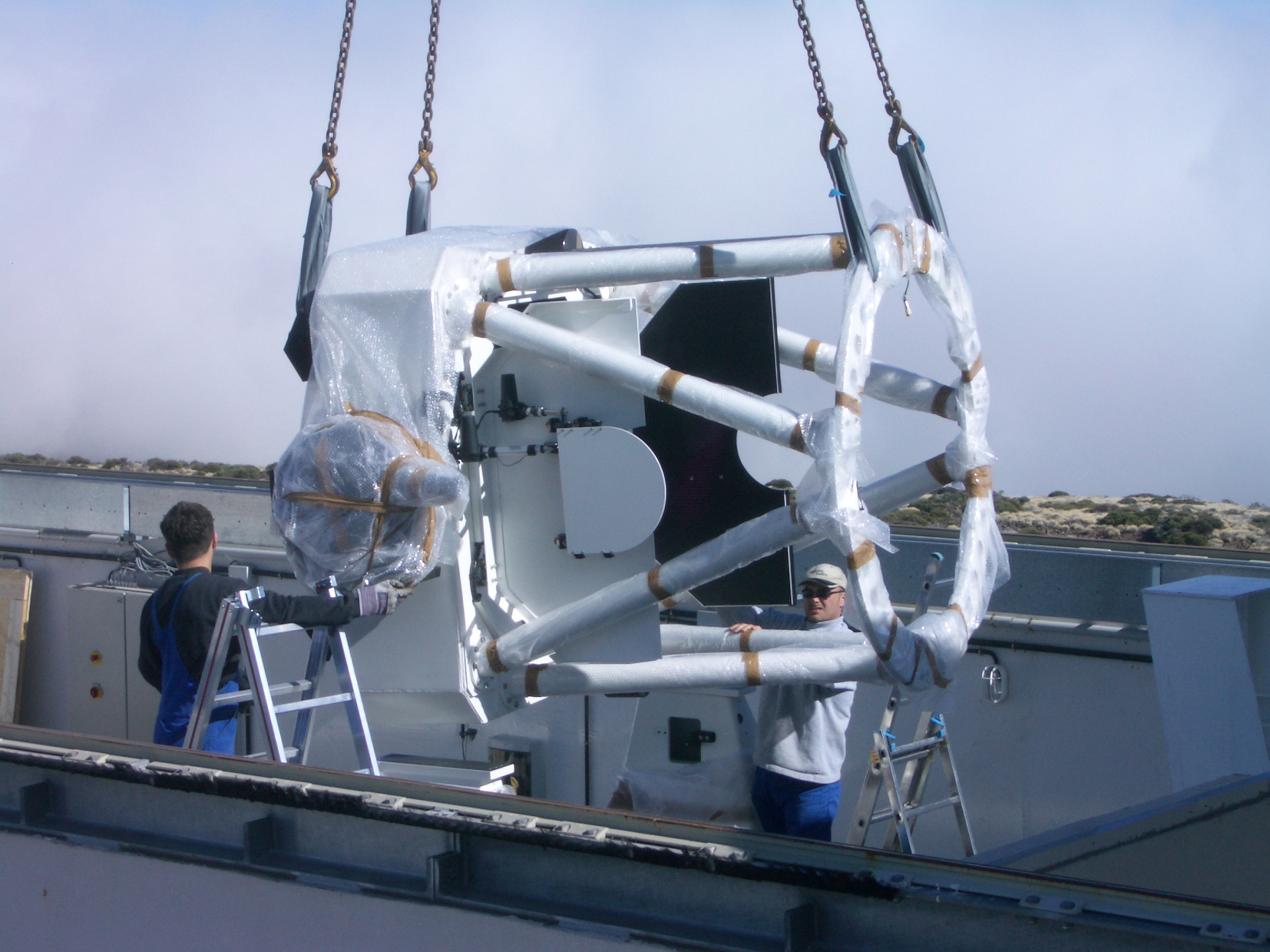
STELLA-I

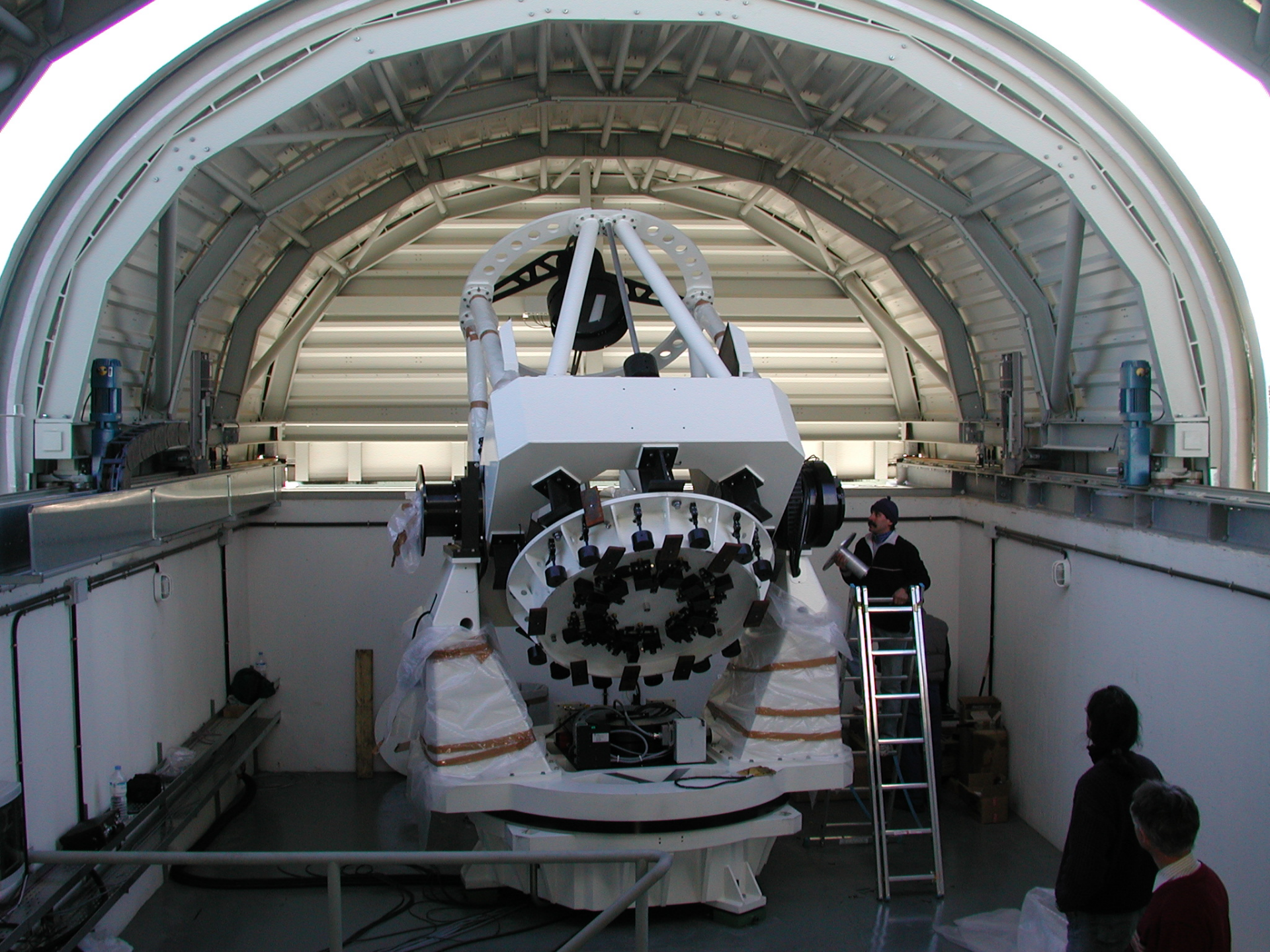
Home of WIFSIP.
First light with SES.

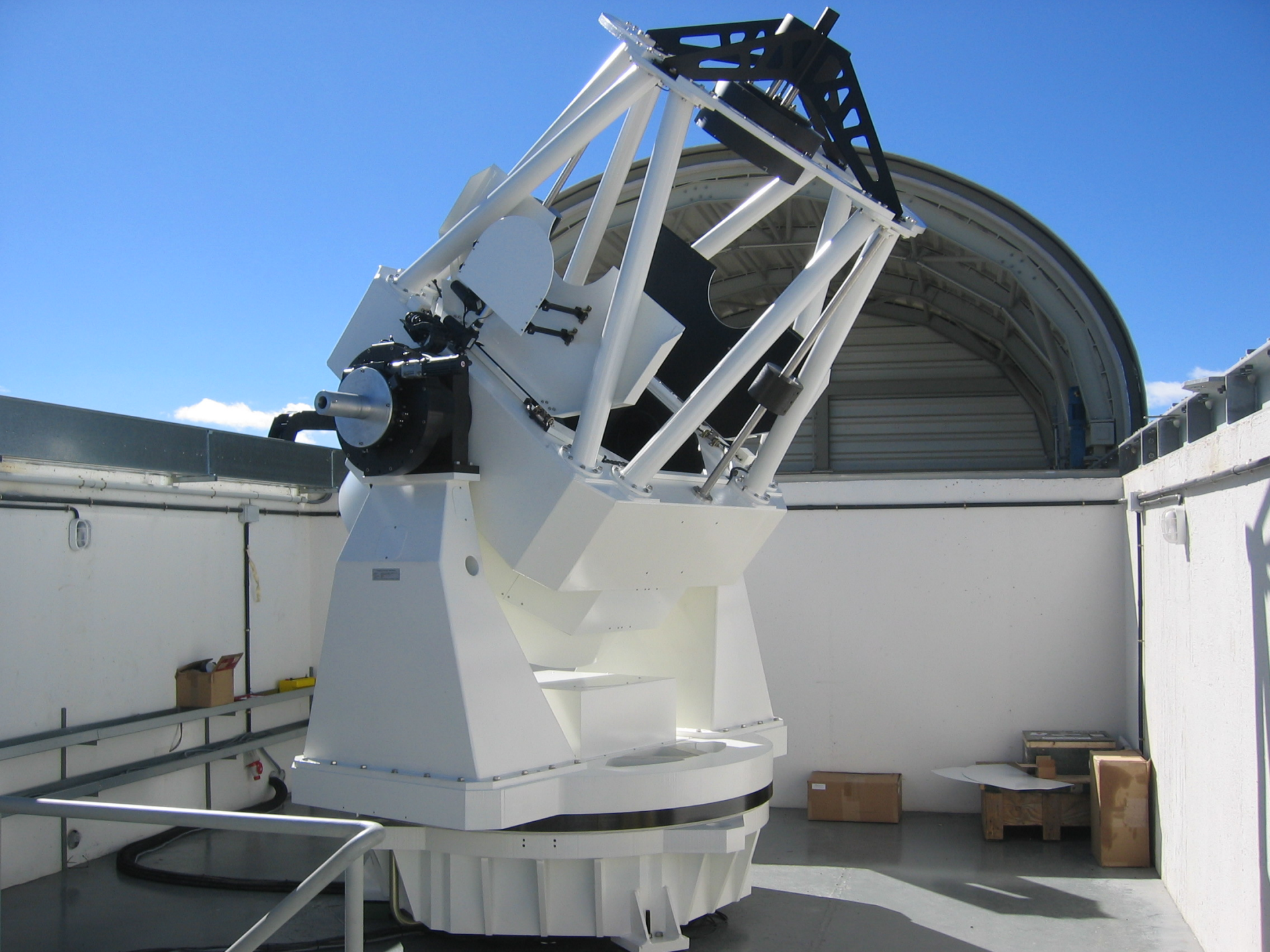
1.2m f/8 Cassegrain
2 Nasmyth foci




Arrival in Tenerife 15.11.2004
Teide Observatory
ARECIO
ARECIO
ARECIO
TRANSPORTES







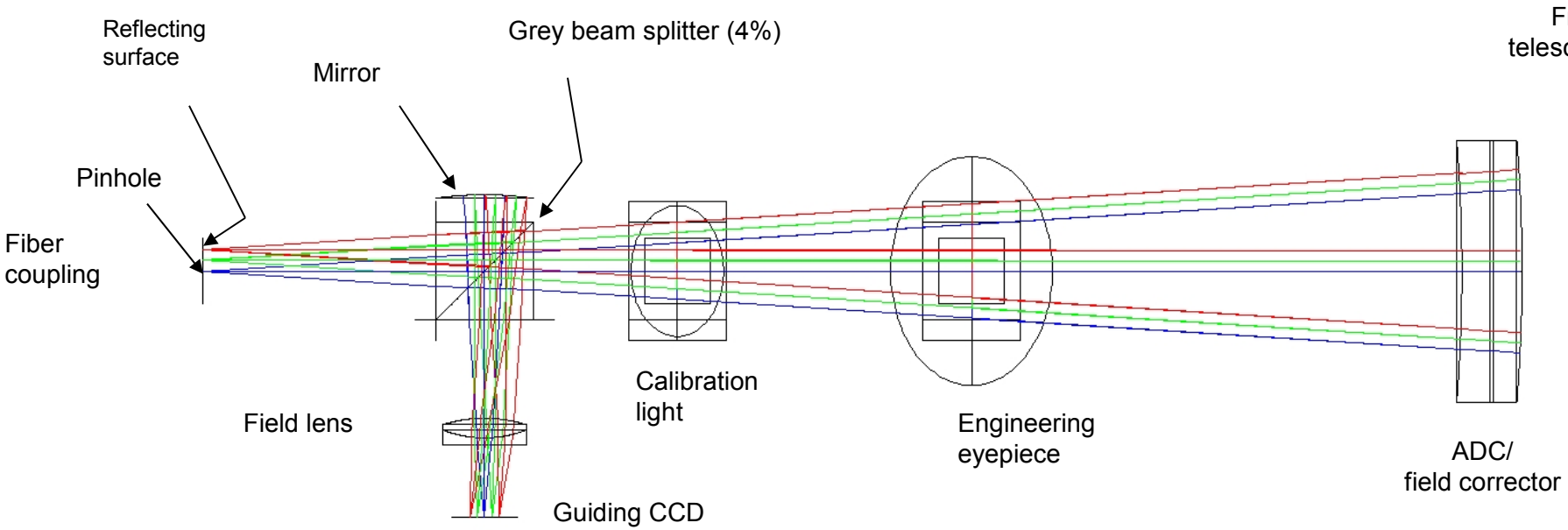
STELLA-II electronics

SES heater and fiber agitator

SES AG unit

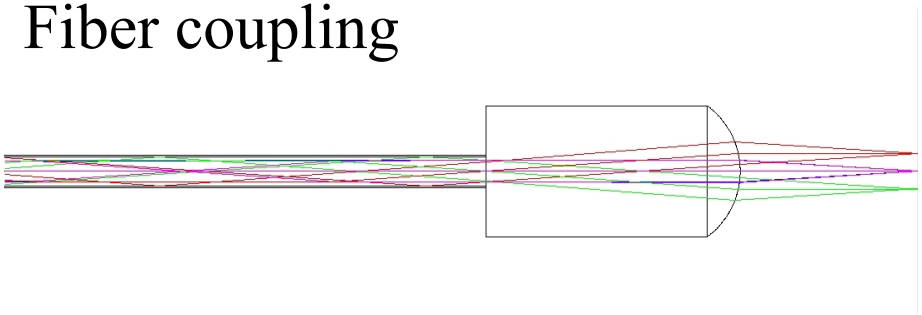
automatic aquisition and focusing, fiber coupling

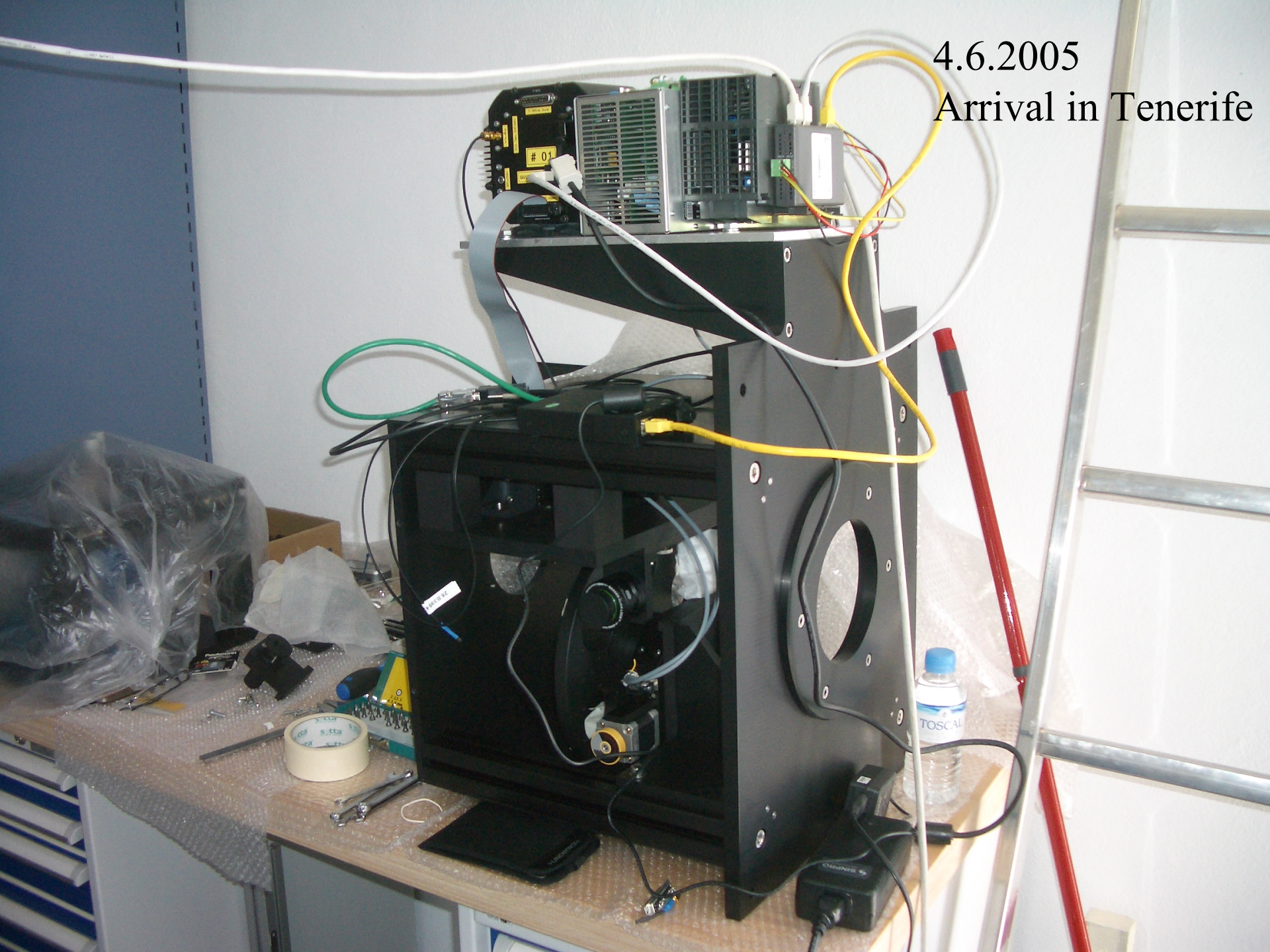
AIP

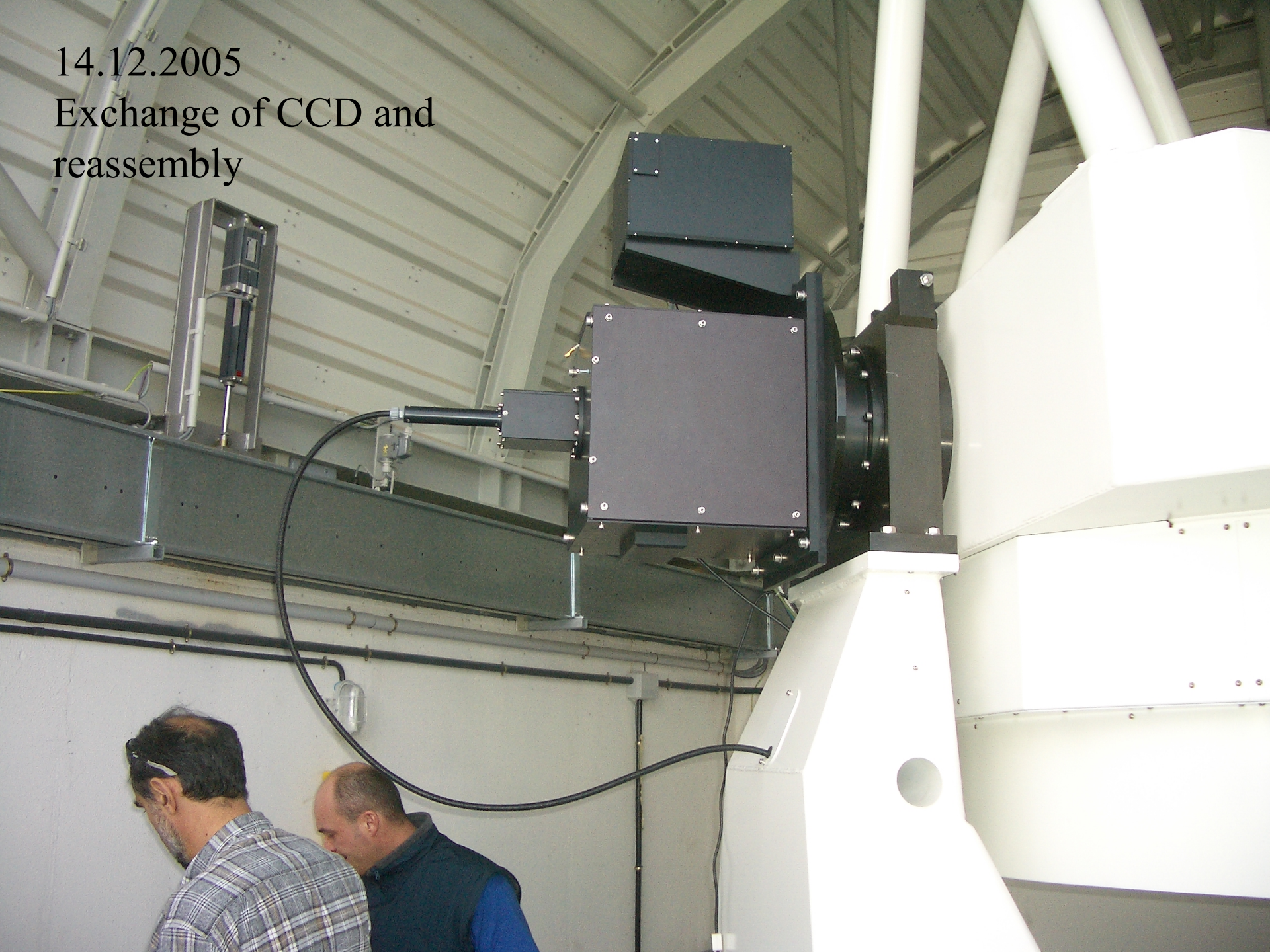


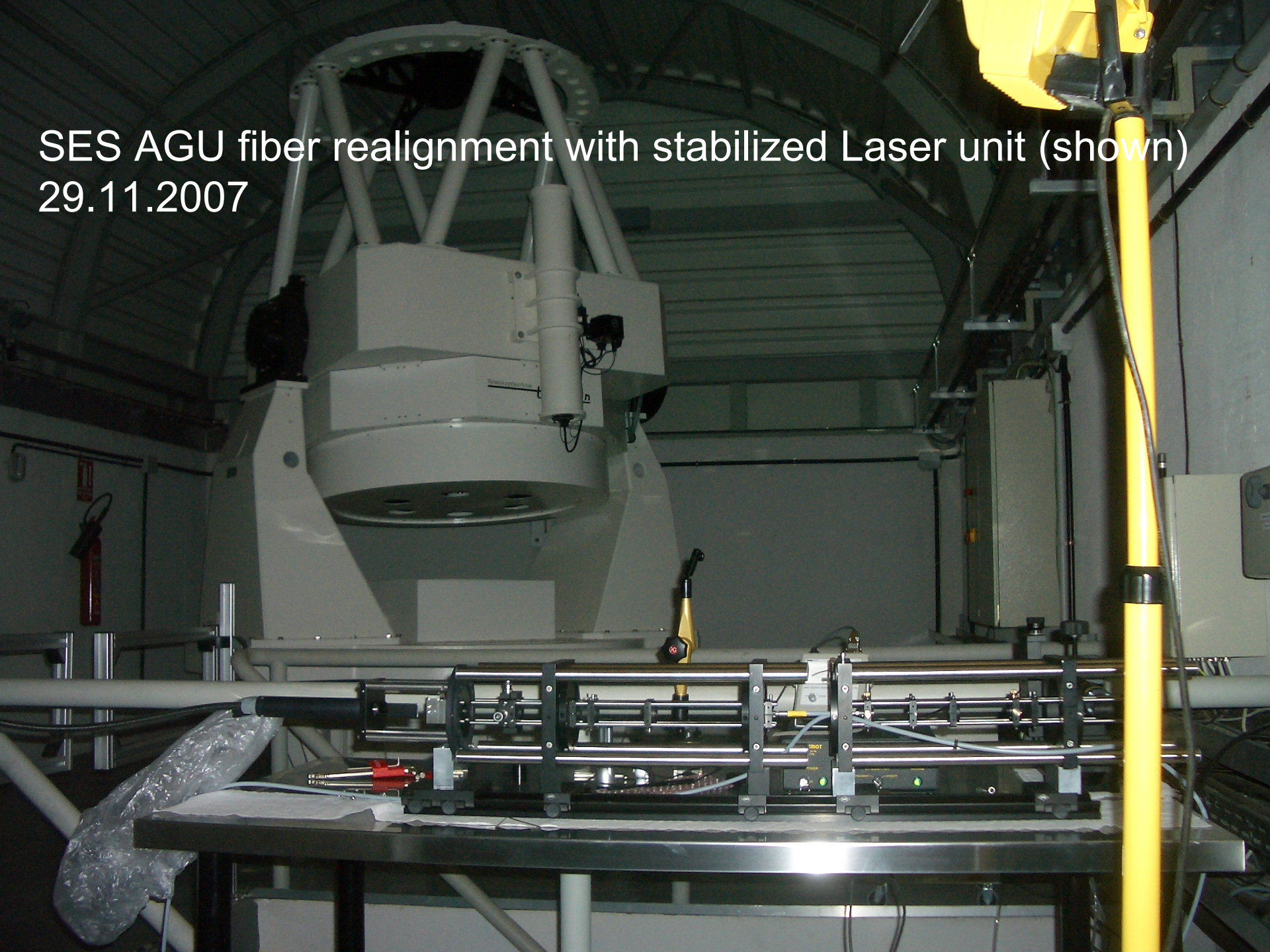
STELLA-I F1 SES AG unit

Optical layout




4.6.2005
Arrival in Tenerife


14.12.2005
Exchange of CCD and
reassembly


SES AGU fiber realignment with stabilized Laser unit (shown)
29.11.2007

STELLA-I SES AG unit

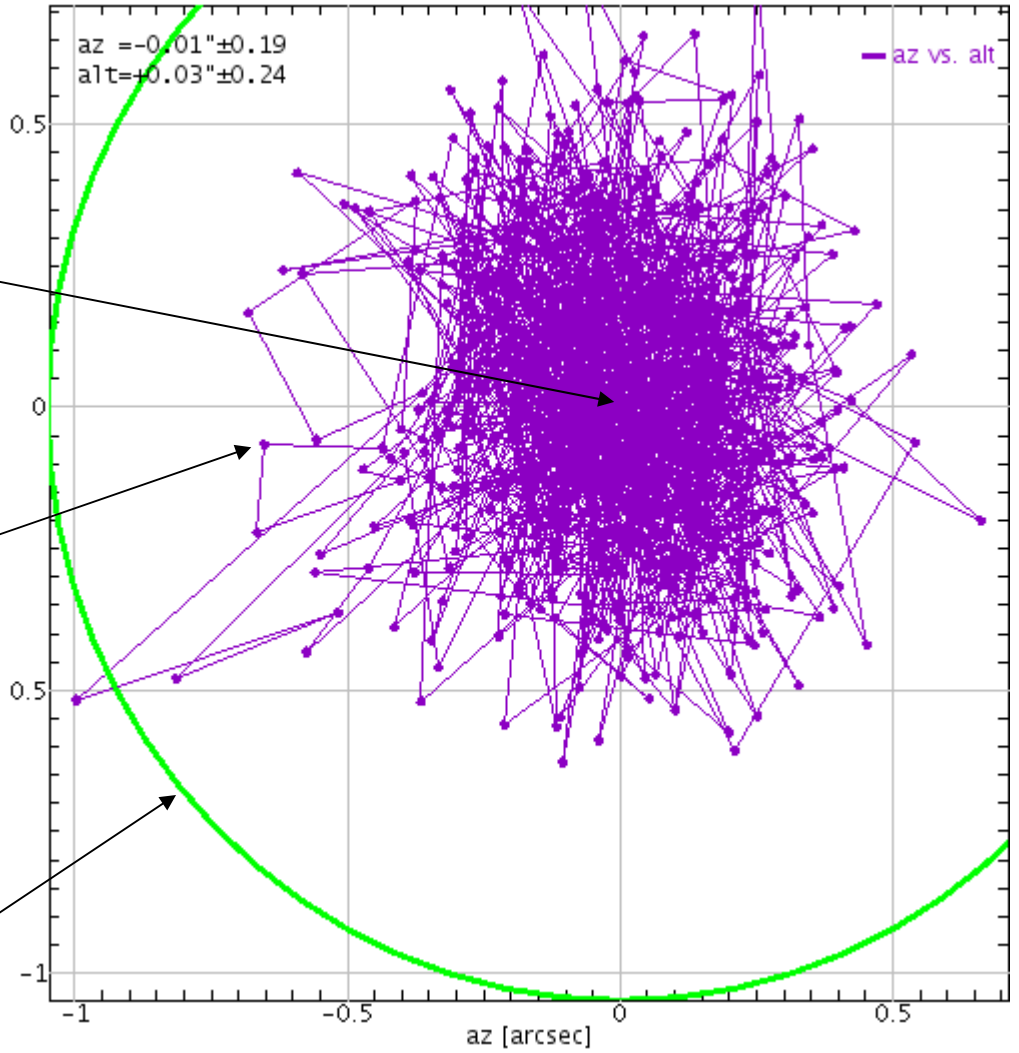
Guiding example from 2009

AIP

Pre-set target position

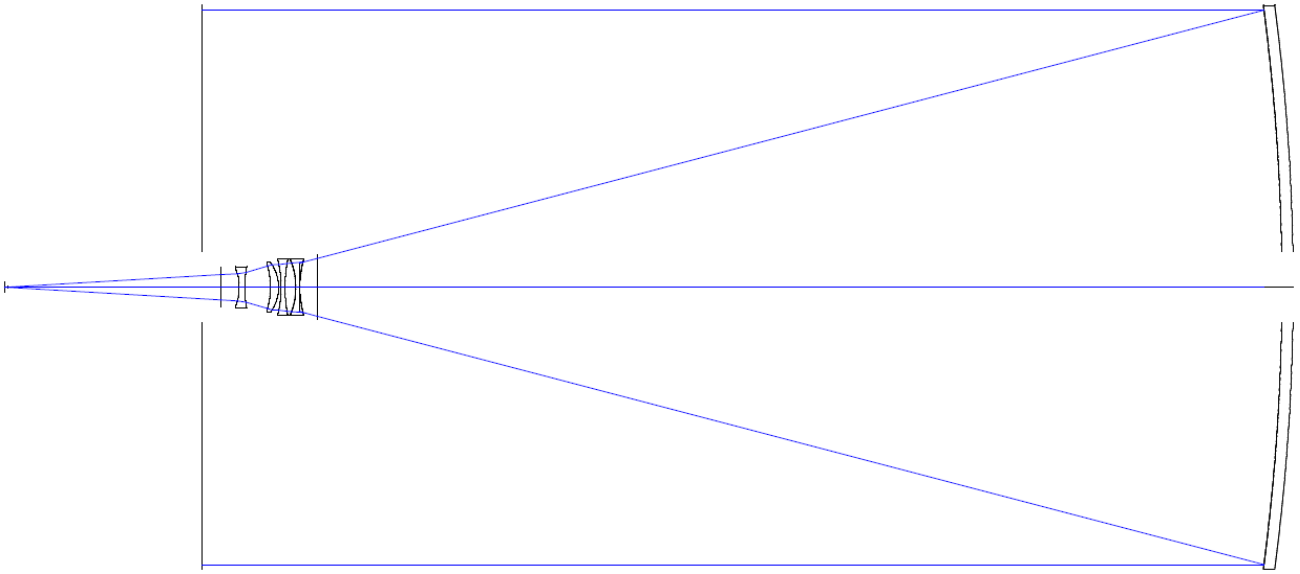
Individual pointing

Projected fiber core



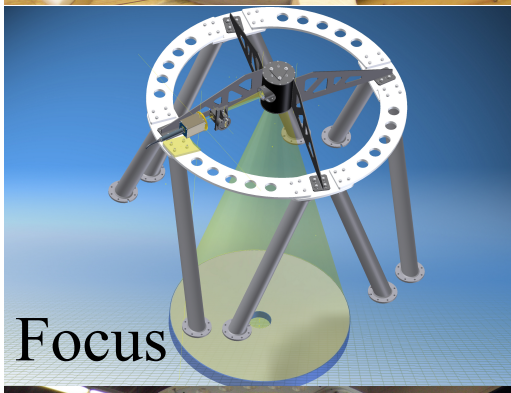
STELLA-II

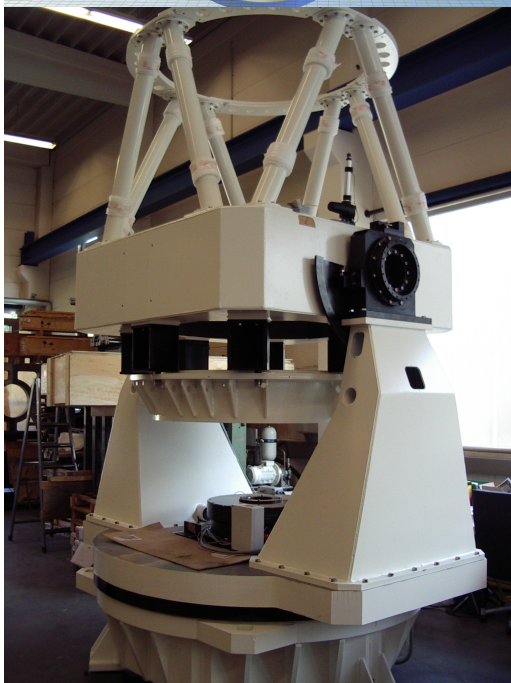
Final home for SES



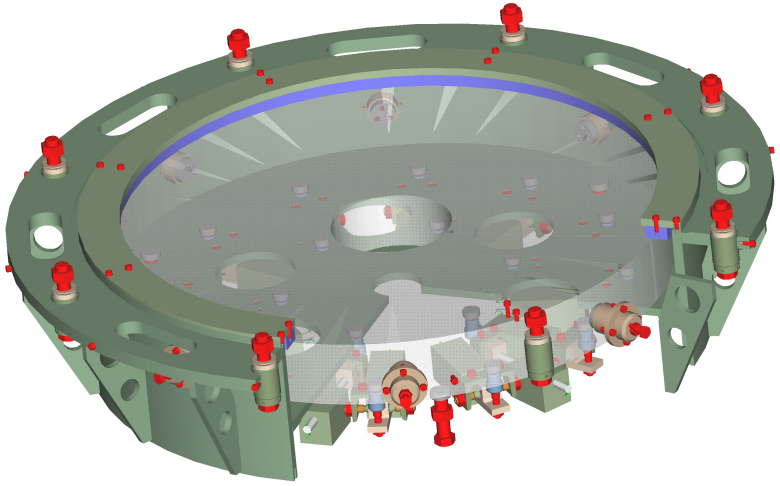
Only one focus = prime focus

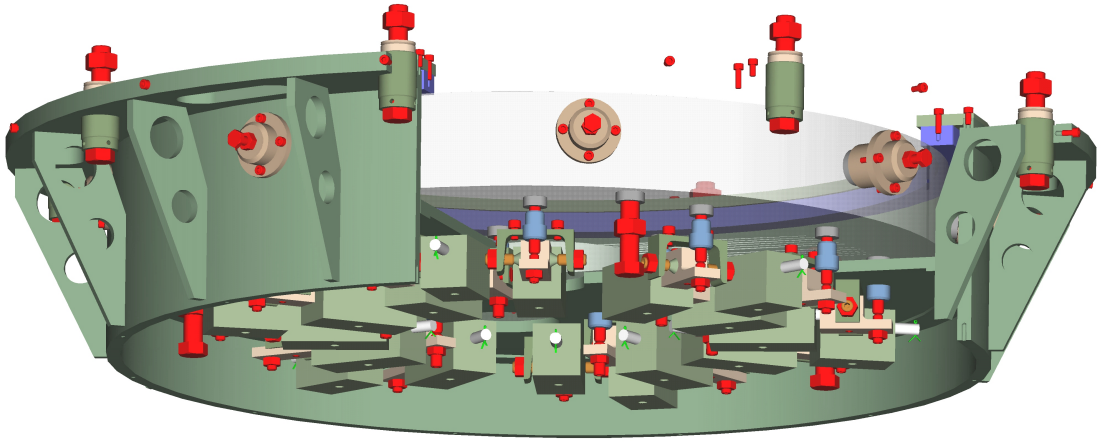
1.2m telescope by Halfmann Teleskoptechnik
Successfull acceptance on 3.11.2005






Teleskoptechnik Halfmann
3.11.2005
HM 180

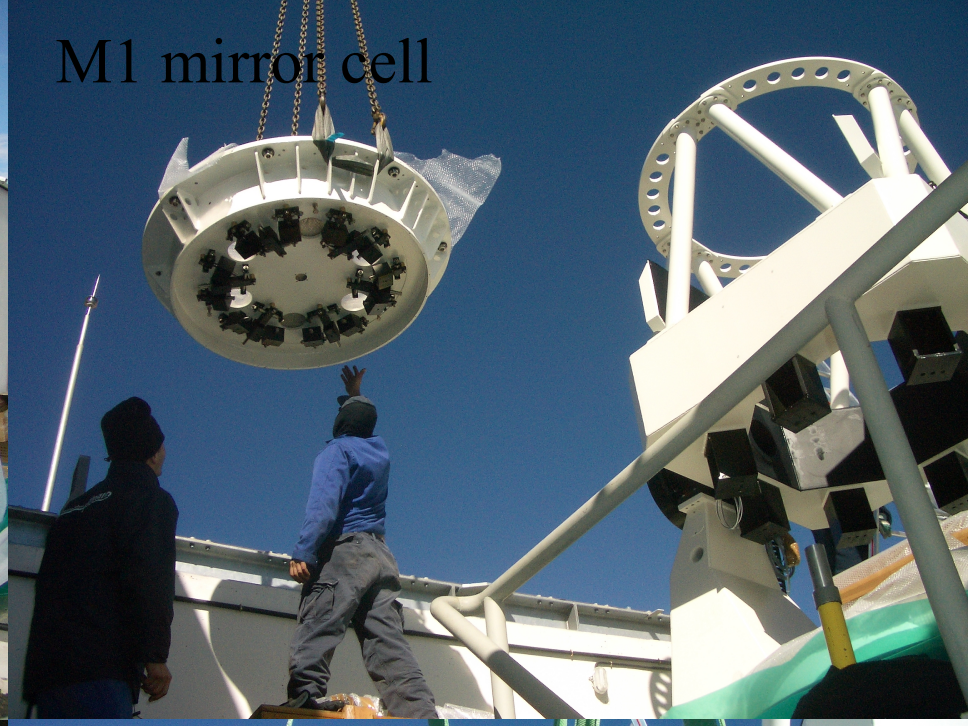




Main mirror cell for 1.2m 1:10 M1 with 20 radial and 18 axial support points designed by AIP & Roschiwal+Partners

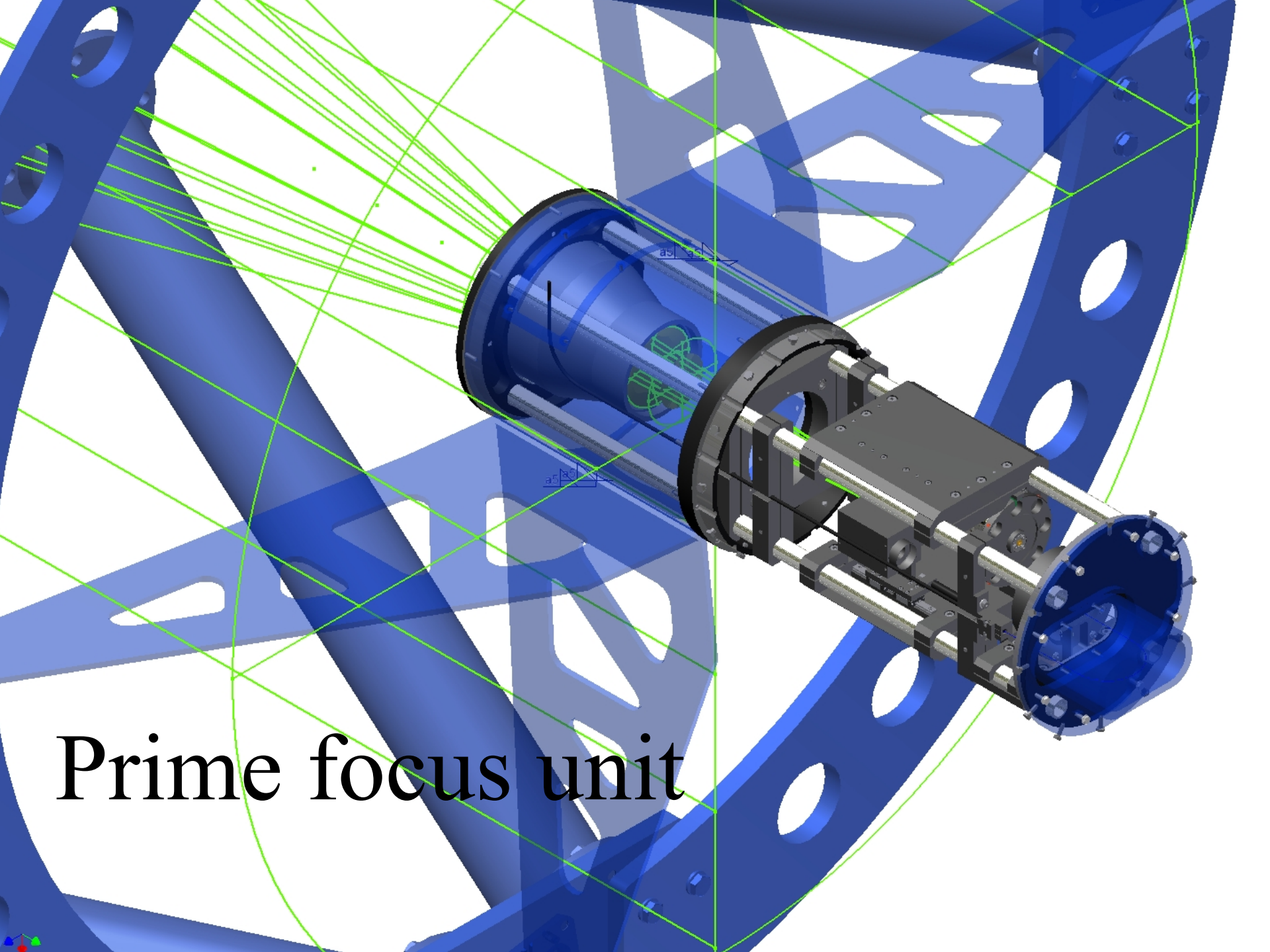

STELLA-II arrival in Tenerife 13.12.2005
Teide Observatory


Oil pump
CASE
MAQUINCA
1840


M1 mirror cell

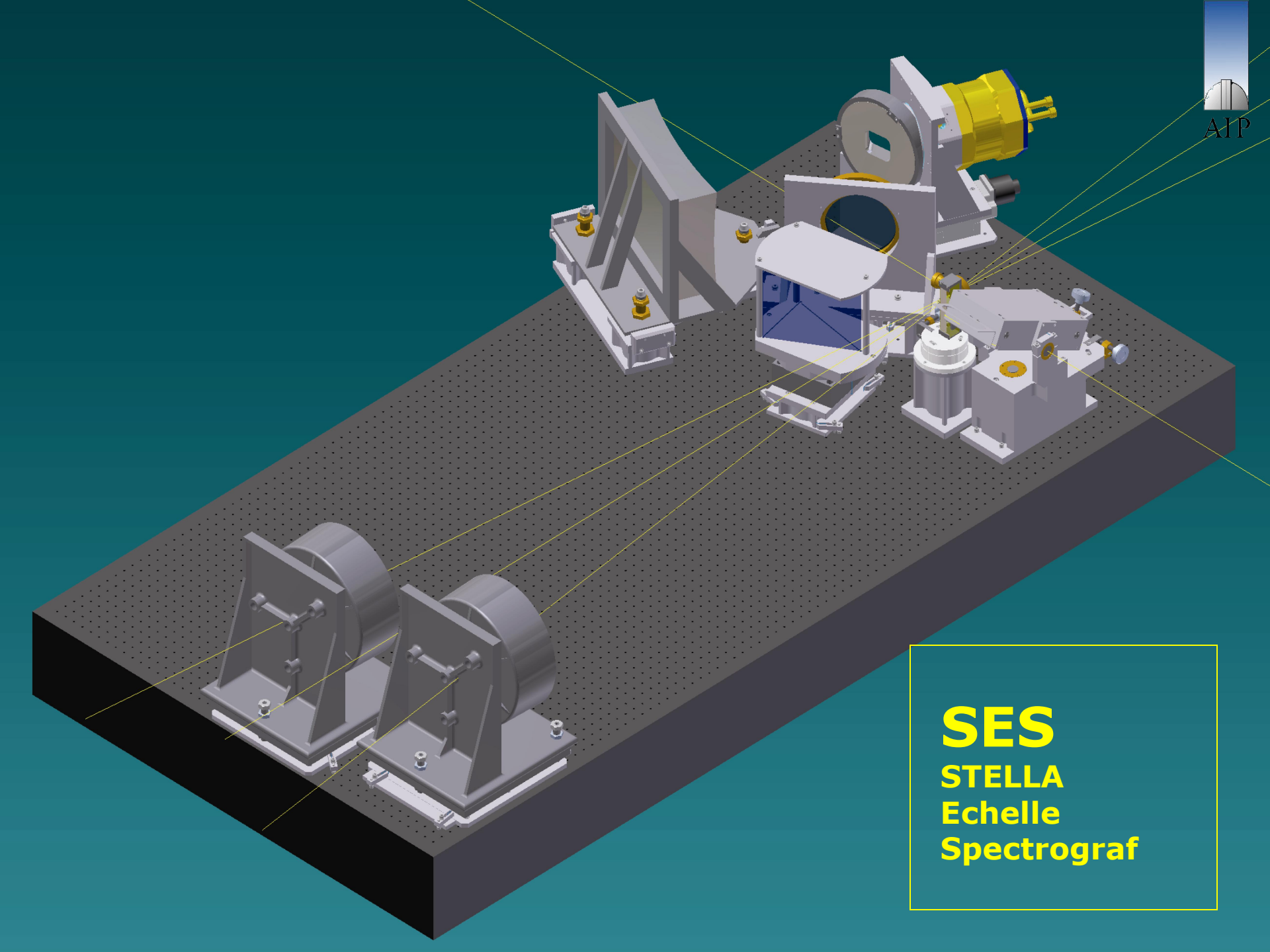

2xSTELLA

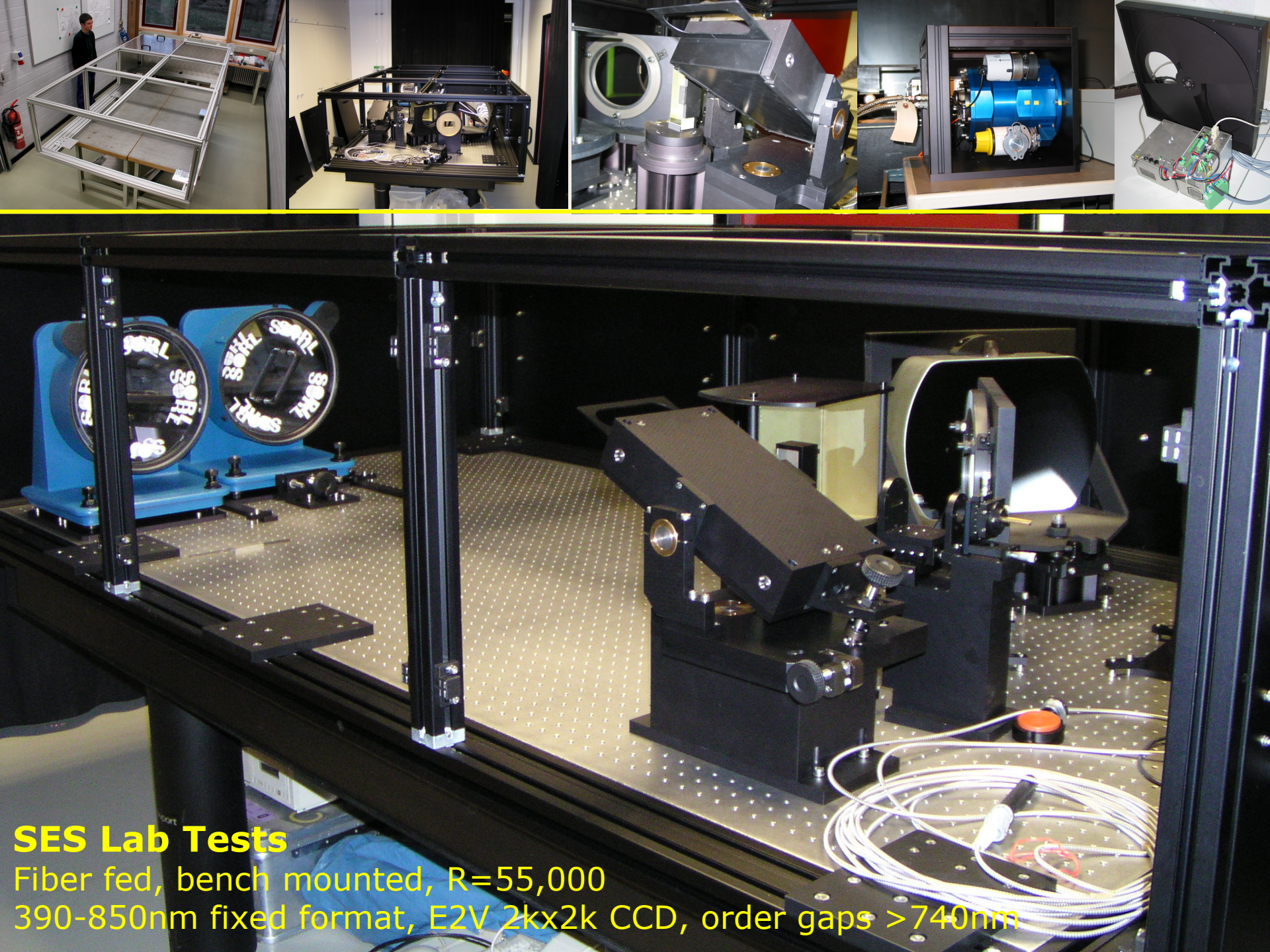

M1 mirror


Prime focus unit


10/2008


STELLA
Instrumentation


AIP
SES
STELLA
Echelle
Spectrograf



SES Lab Tests

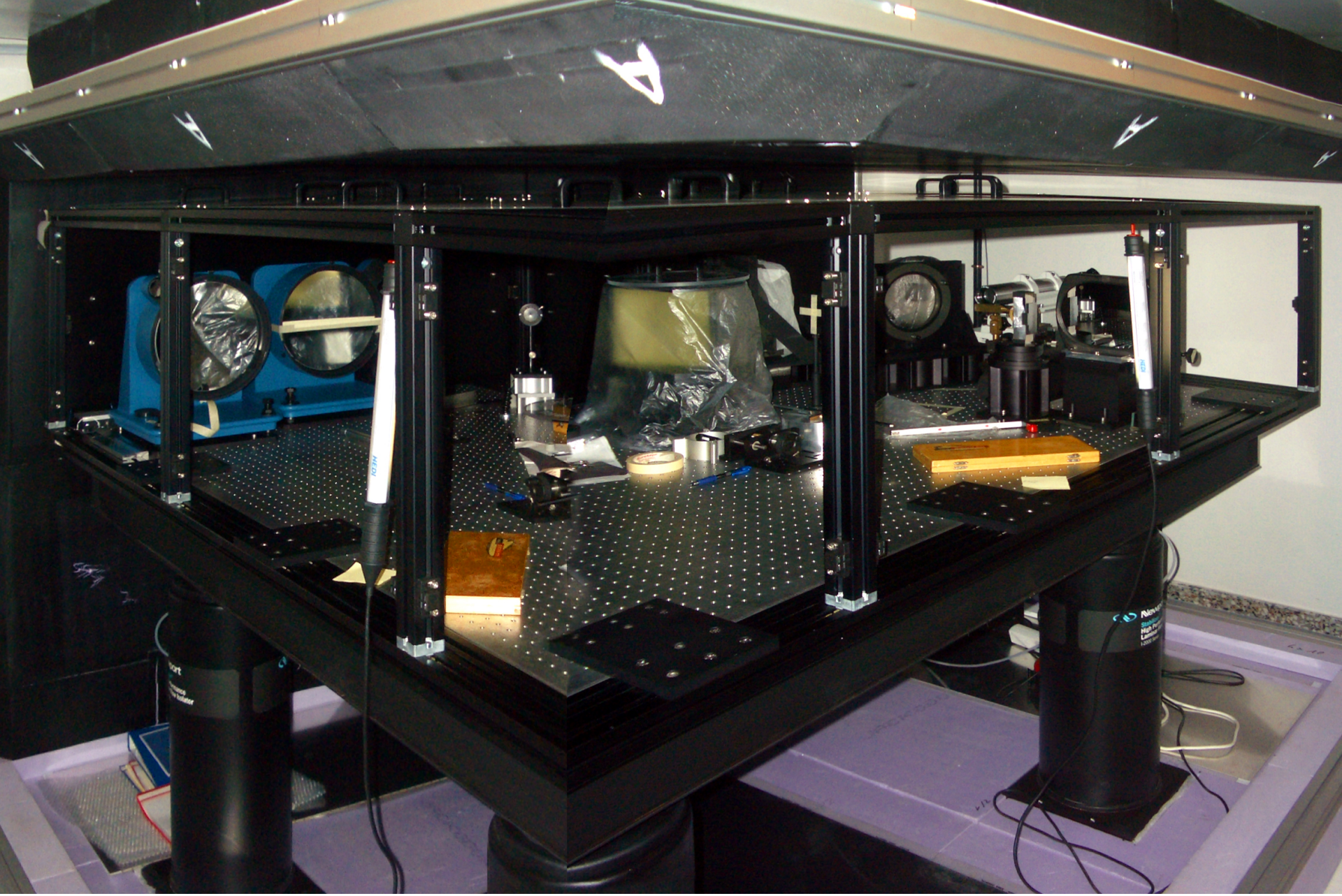
Fiber fed, bench mounted, R=55,000

390-850nm fixed format, E2V 2kx2k CCD, order gaps >740nm

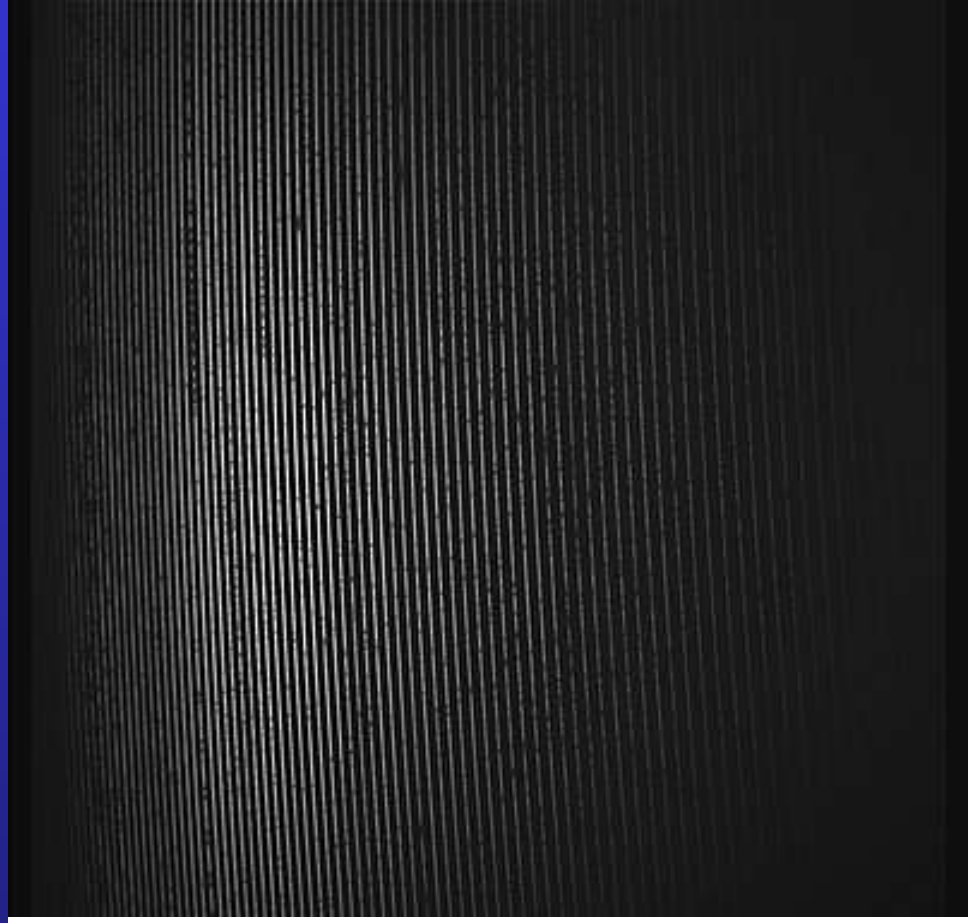

05.2005


Aug 2002

4.6.2005. Assembly in Tenerife



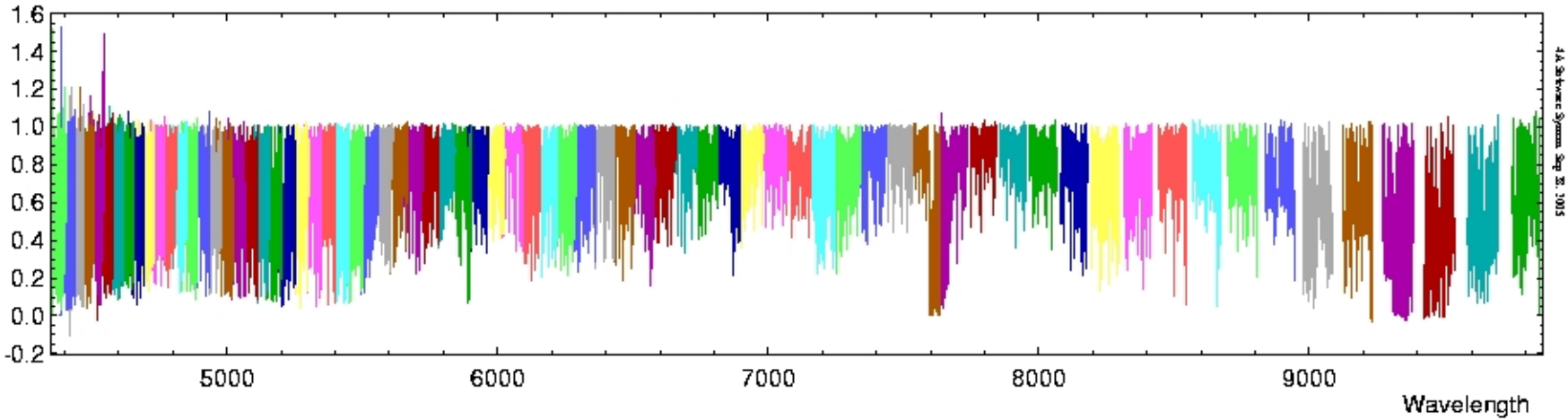
First-light version. R=55,000, 380 - 870 nm, E2V 2kx2k CCD.



First starlight for SES
9. September 2005

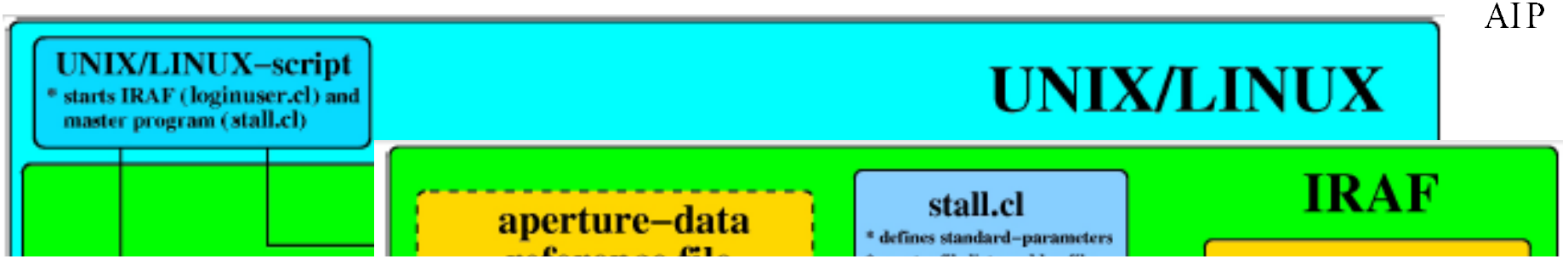
α Tau, K5III, 10-sec,
no ADC, no guiding,
not fine-aligned SES yet,
no agitator, test fiber

λ λ 430-985nm, 72 orders
R=25,000 (w 100μ fiber)
rms vr=440m/s (560nm)

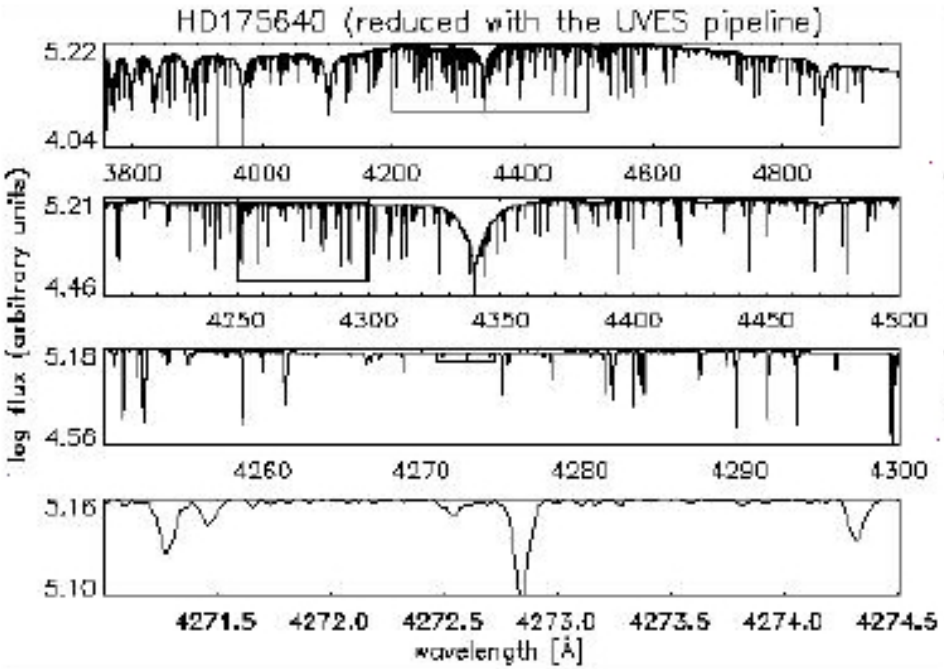


The automated STELLA-SES data reduction pipeline

AIP

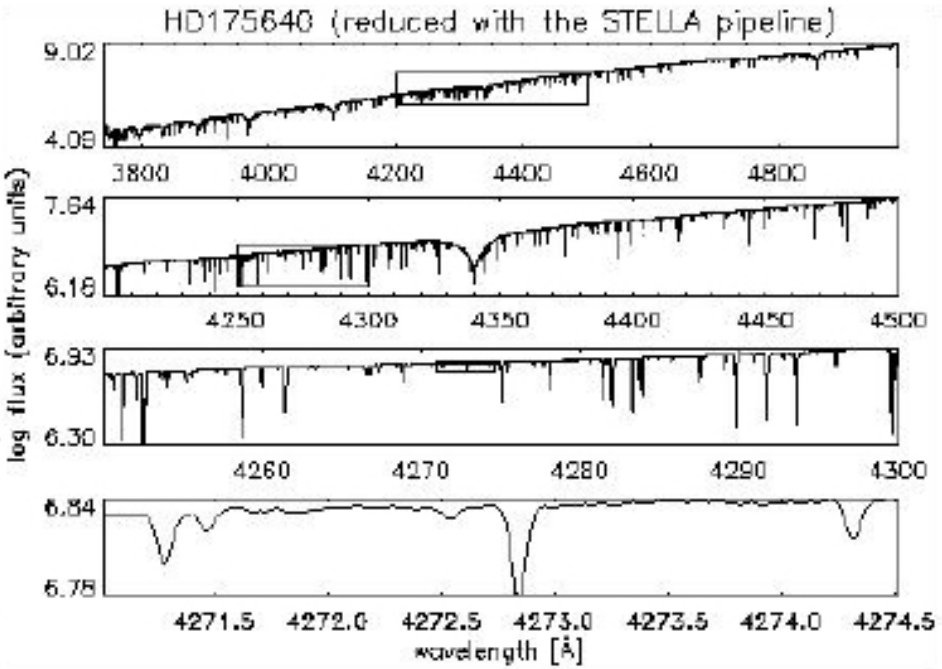


UVES Pipeline



- Produces Jumps.
- Optimized for Low SNR.

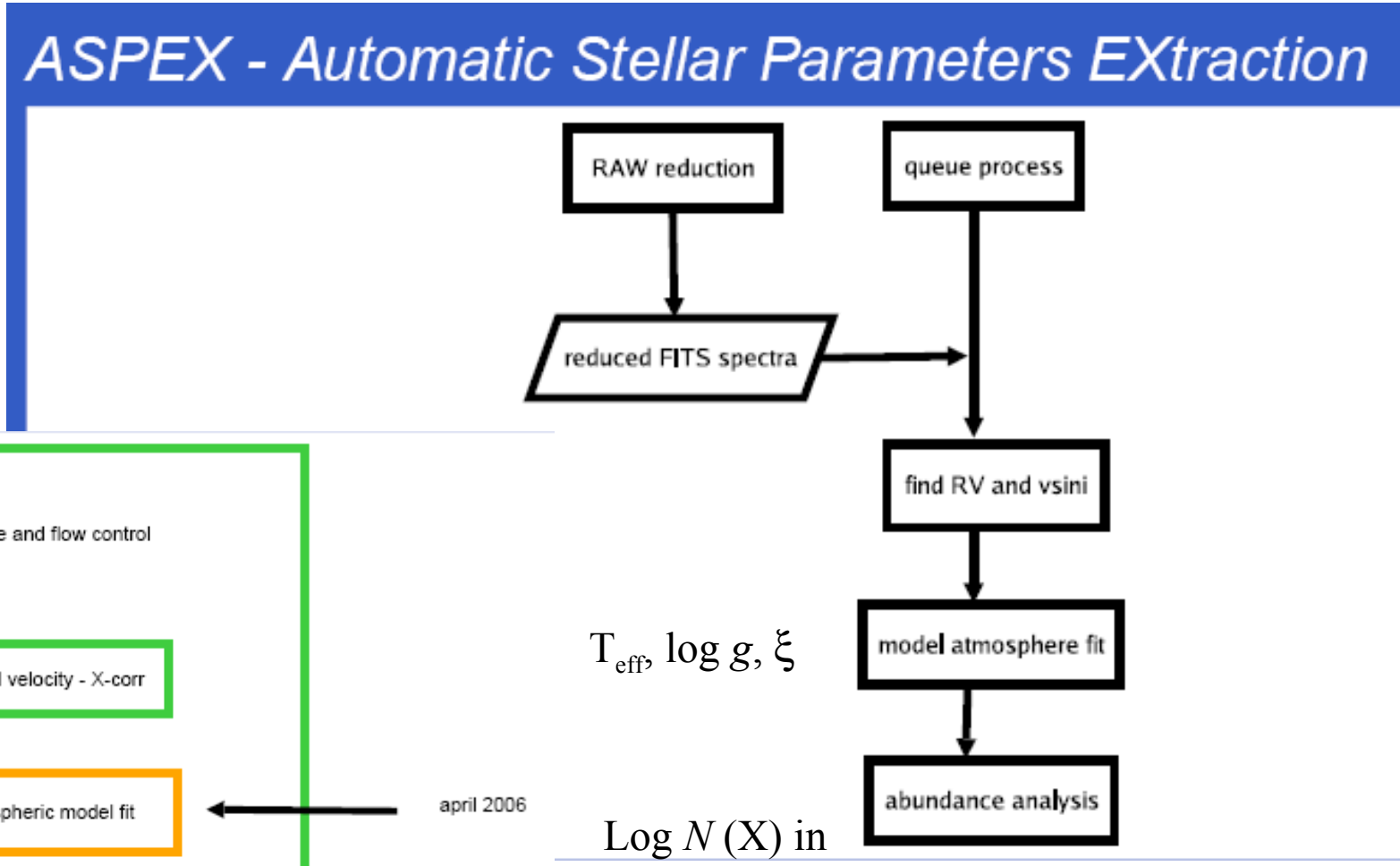
STELLA Pipeline



- No Jumps.
- Can be Optimized Individually.

The automated SES data analysis pipeline ASPEX

AIP



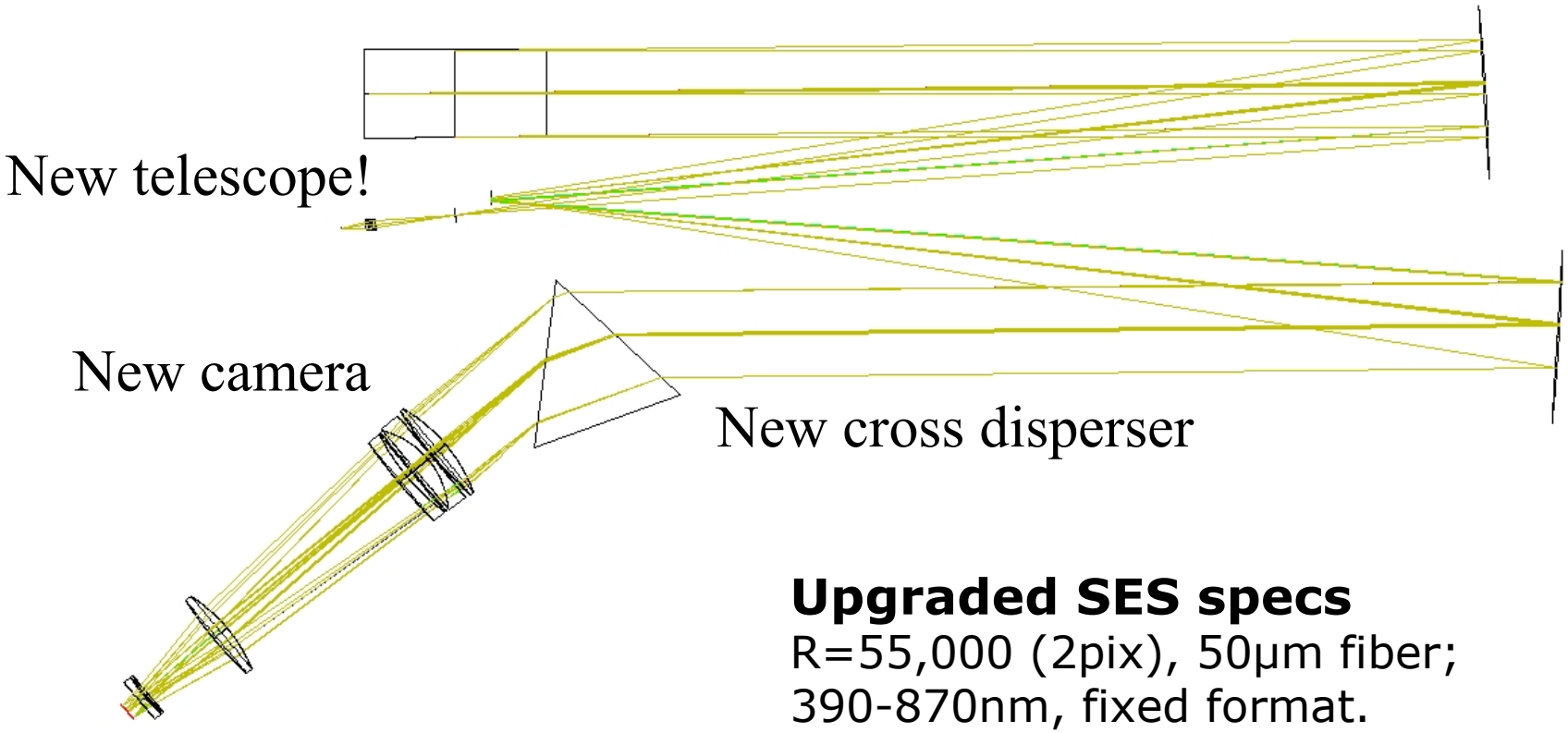
T_{eff}, log g, ξ

Log N (X) in units of H/H(sun)

...with full error propagation analysis

SES upgrade: fall 2009

New silver coating on collimator



Upgraded SES specs

R=55,000 (2pix), 50µm fiber;
390-870nm, fixed format.
With STA 4kx4k CCD no order gaps.
Increase in sensitivity overall factor ≈ 4

3D LAYOUT

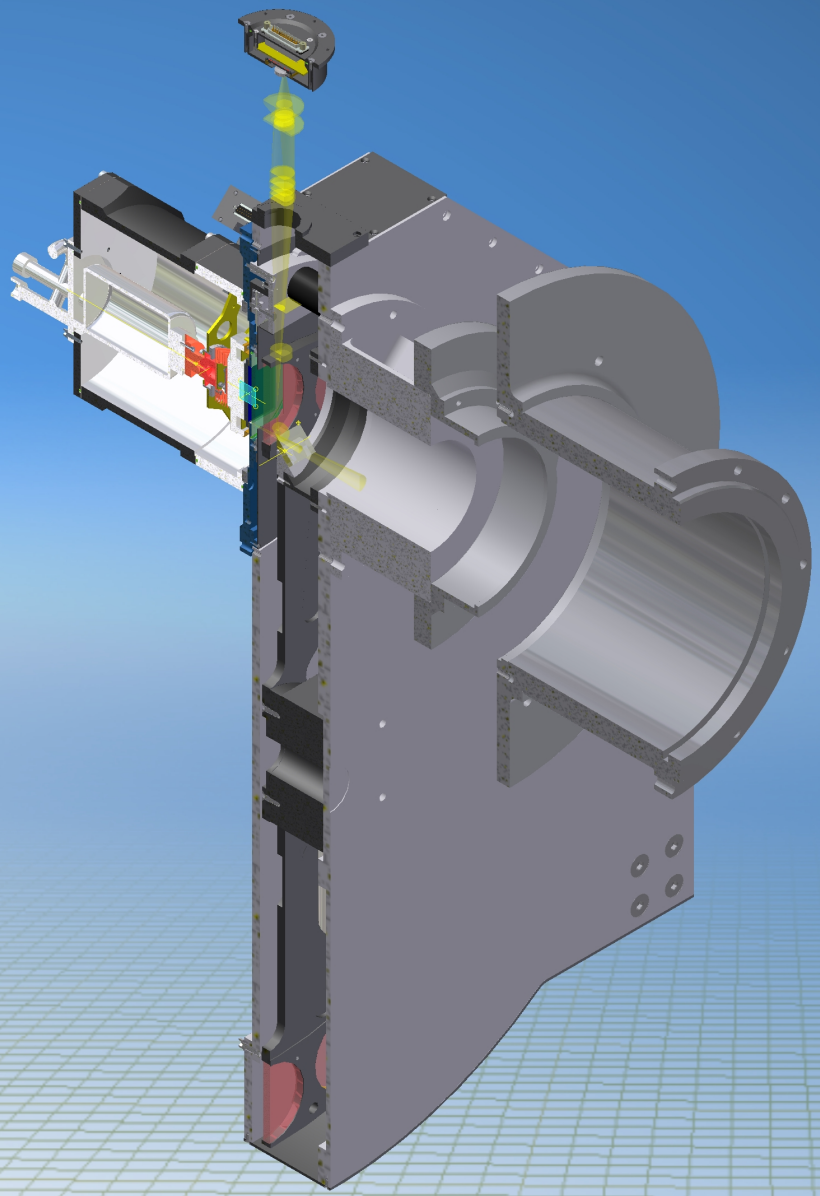
SES-UPGRADE WITH DIOPTRIC CAMERA
MON FEB 9 2004
SCALE: 0.1000

200.00 MILLIMETERS

C:\ZEMAX\LENSES\ECHELLESPECTROGRAPH\STELLA\SPECTROGRAPH\SES-UPGRADE\SES-W-1.ZMX
CONFIGURATION: ALL 4

Wide-field STELLA imaging photometer (WIFSIP)

AIP



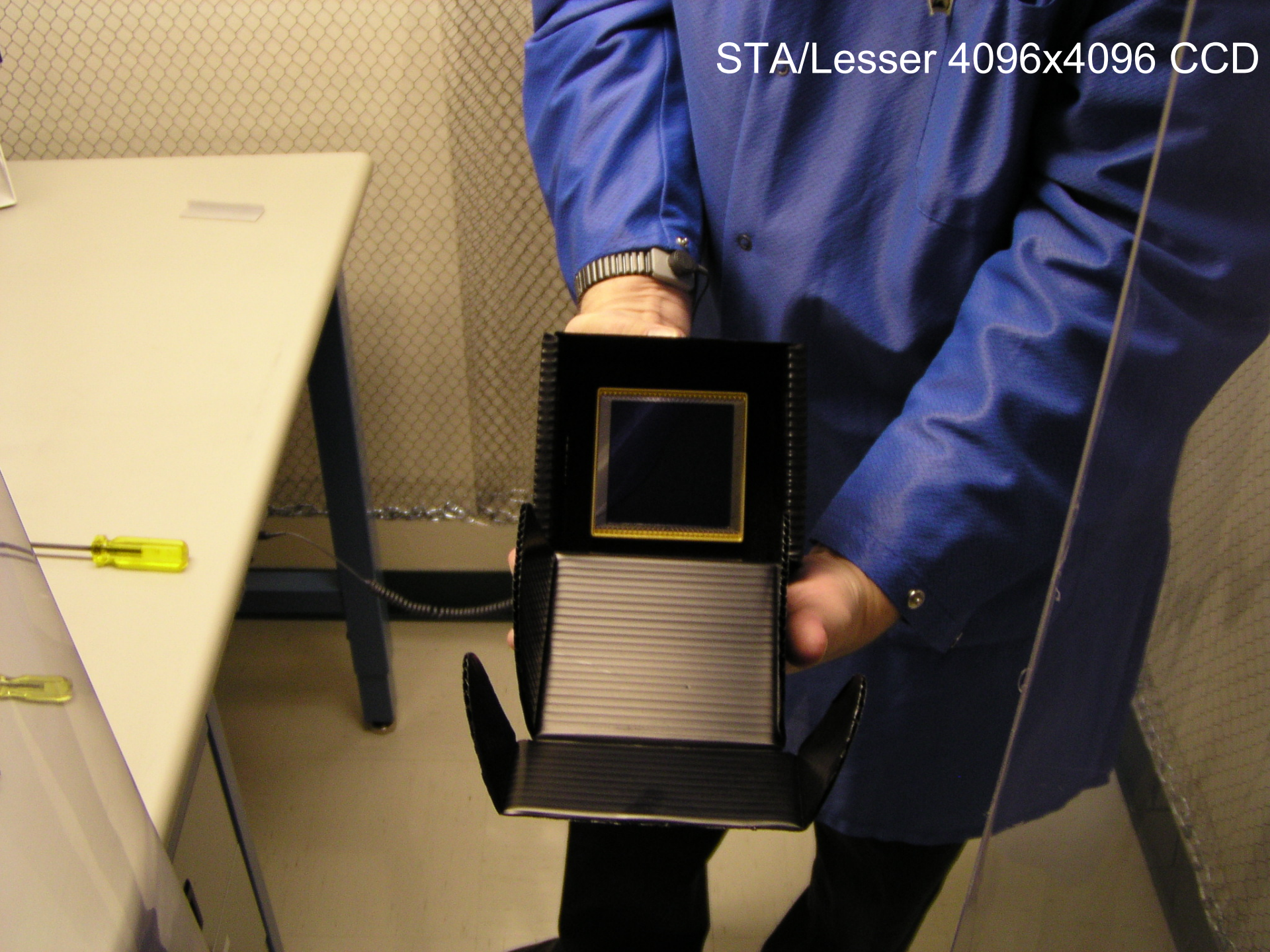
Specs

22′× 22′ FOV, 0.3′′/px;
single 4k × 4k CCD with AIP-Magellan controller;
Peak QE≥ 95%;
17 filters: *uvby*, UBVRI, Hα and Hβ , Sloan *ugriz*;
High-speed Bonn shutter;
Off-axis guiding and automatic focusing.

Filter wheel

AIP

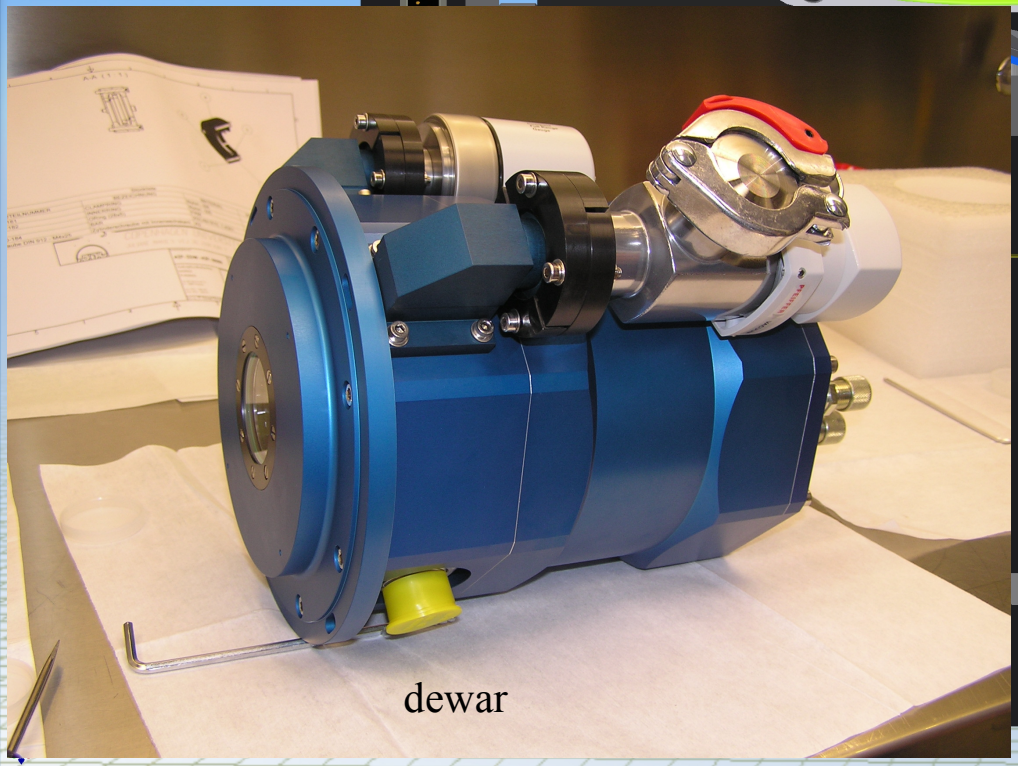

Integrating WIFSIP
at AIP
(12/2007)


STA/Lesser 4096x4096 CCD

4kx4k cameras

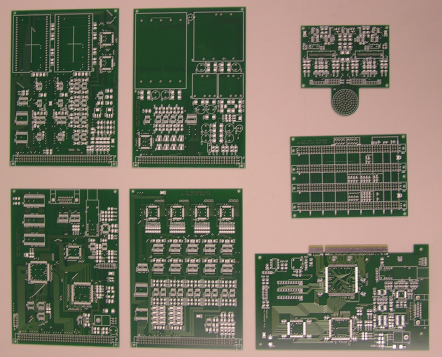
4096² 15µ m CCD

AIP

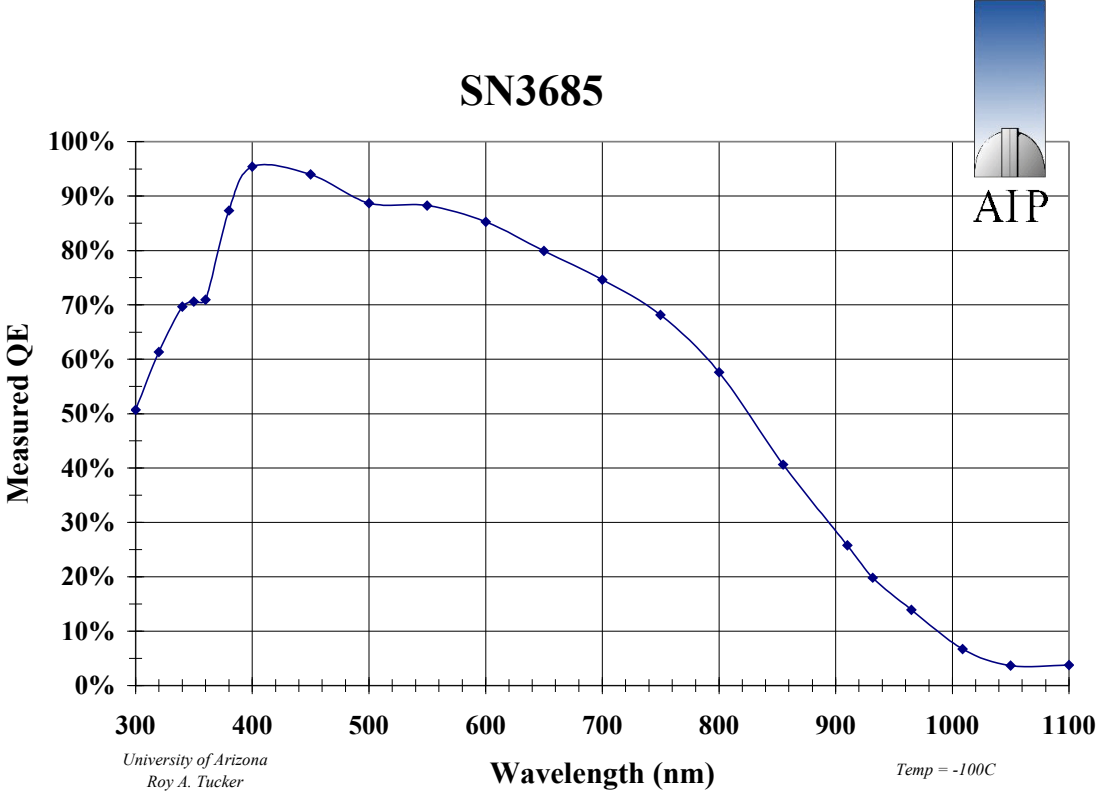


dewar

Controller boards



4kx4k CCD performance



Magellan-AIP controller:

QE peak at 95%@400nm
60%@800nm &
70%@350nm

All four amplifiers work with RON of 2.7-4.2 e.

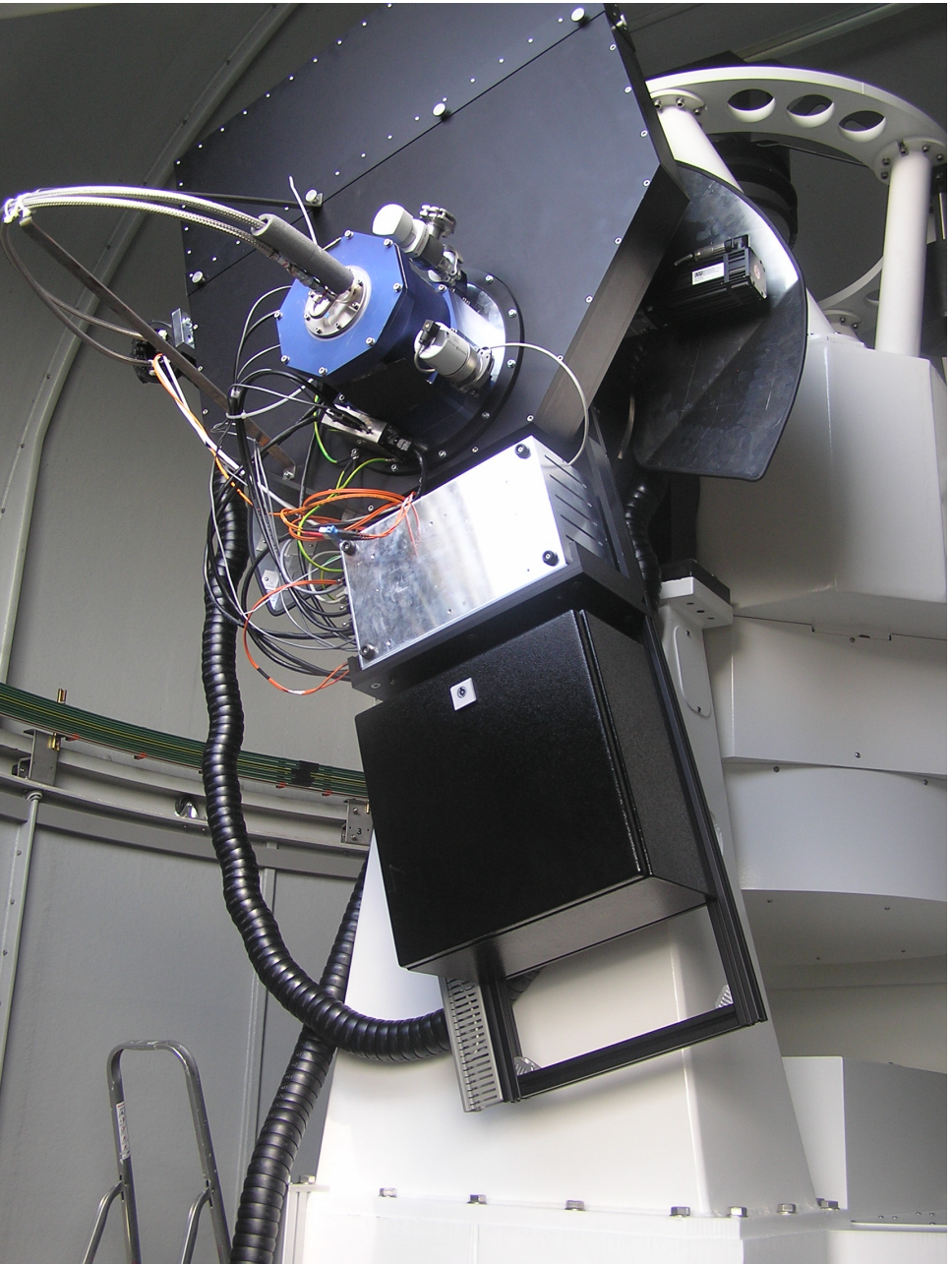
Full-well capacity a bit low: 77 kilo-electrons at 1.4e/ADU

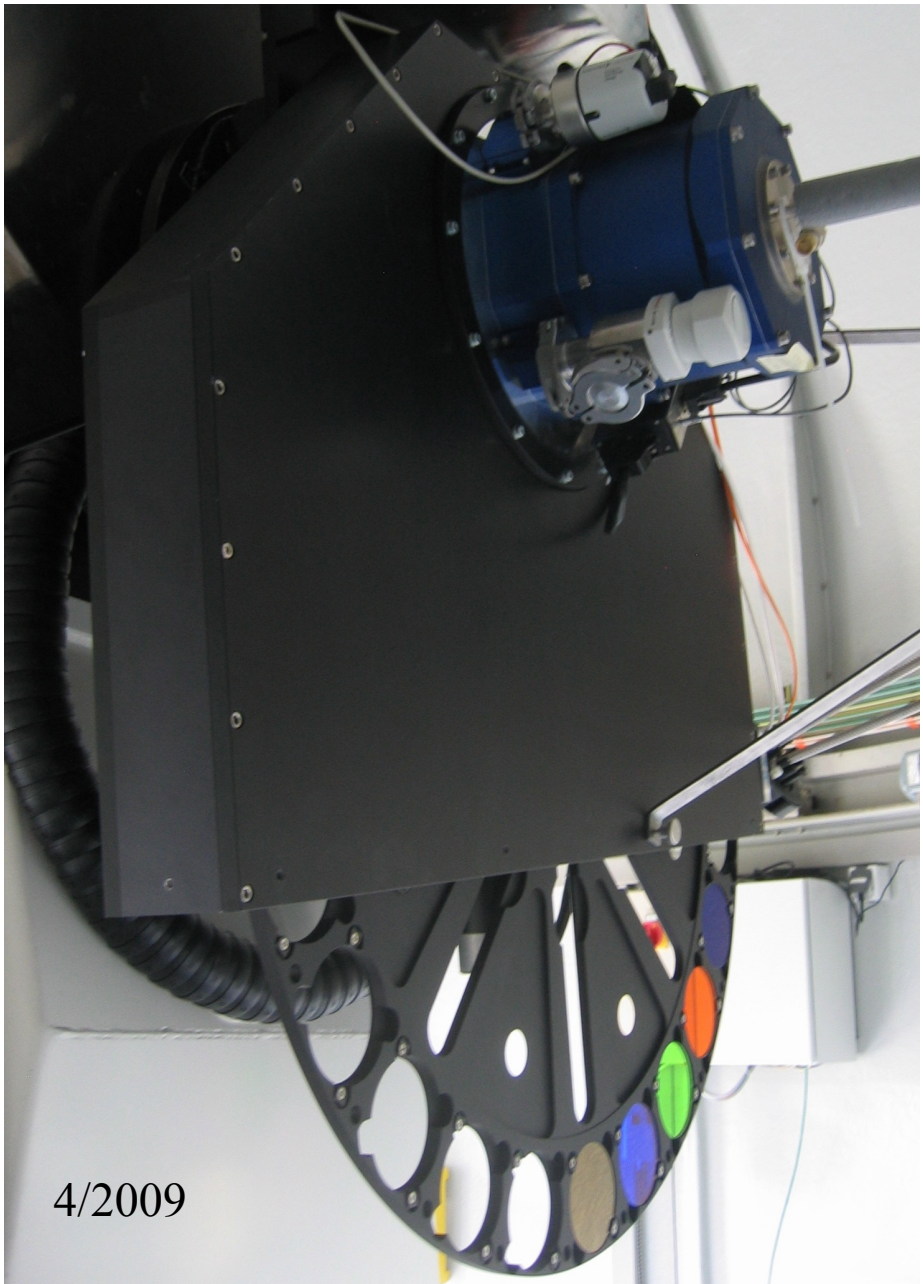
5 bad columns (3 at the edge, 2 in the center)

4-phase readout at max. 1 Mpx/sec/port
⇒ 16 MB read-out-time 13sec!

Performance at -100C	
Amp 0	
Parallel CTE – 1.000003	Serial CTE – 0.999988
Gain – 6.03 μ V/e	Read noise – 4.20 e
Amp 1	
Parallel CTE – 0.999993	Serial CTE – 1.000005
Gain - 5.77 μ V/e	Read noise – 3.48 e
Amp 2	
Parallel CTE – 0.999994	Serial CTE – 1.000008
Gain – 5.63 μ V/e	Read noise – 2.90 e
Amp 3	
Parallel CTE – 1.000003	Serial CTE – 0.999987
Gain - 5.25 μ V/e	Read noise – 2.74 e

WIFSIP tests @ RoboTel



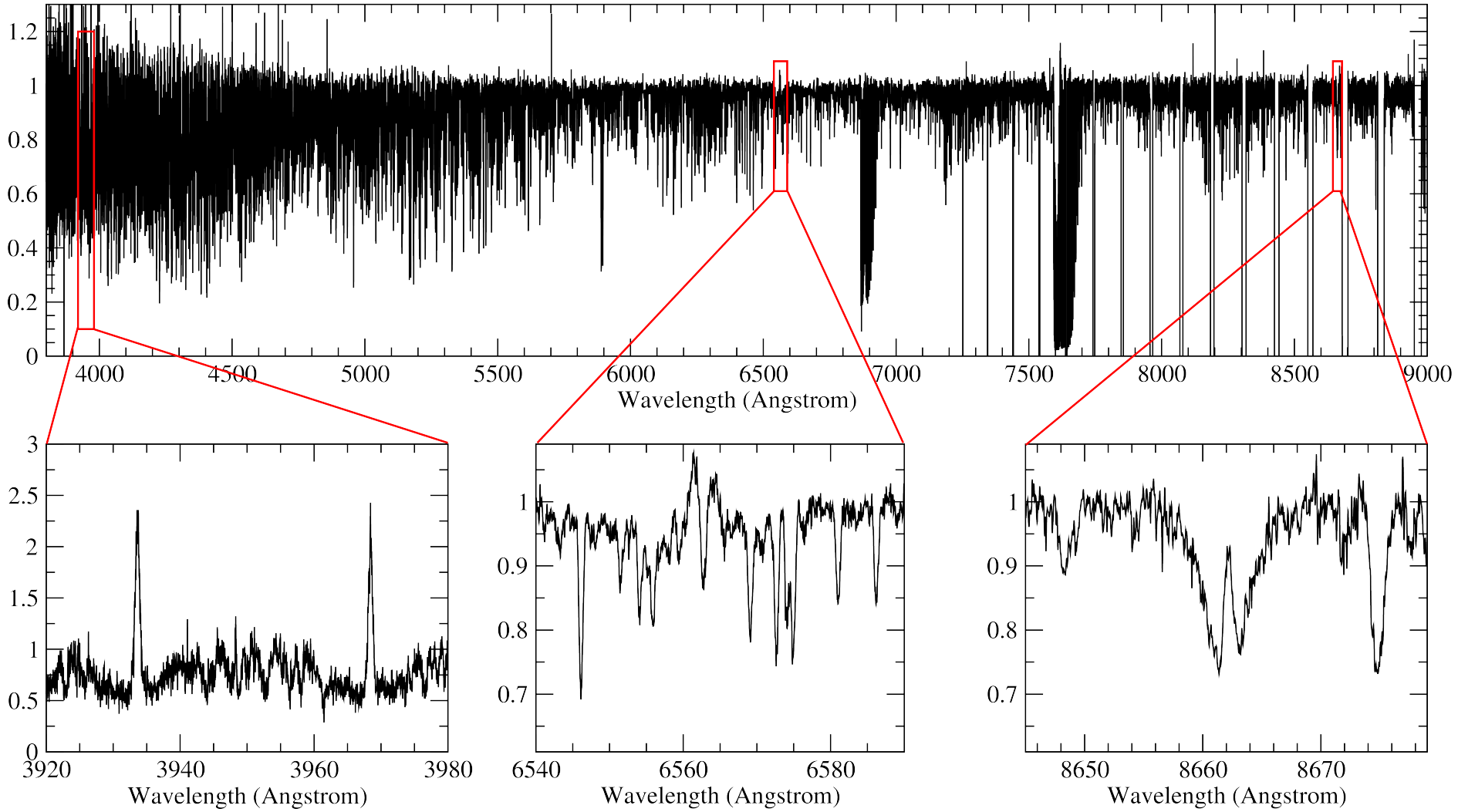


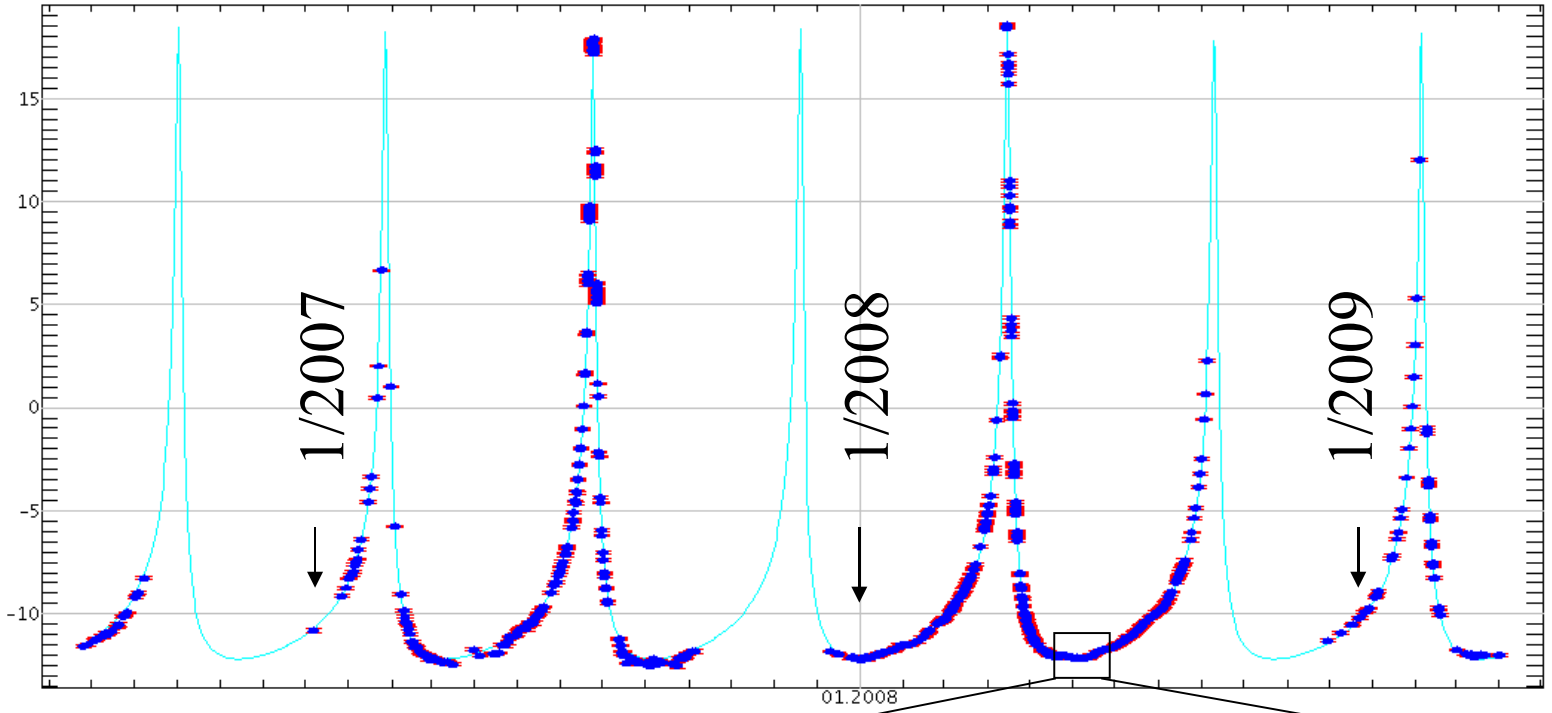
4/2009


STELLA
First data from
SES@STELLA-I

STELLA

XX Tri, V=9.0^{m}, K0III, 1h, S/N=120:1



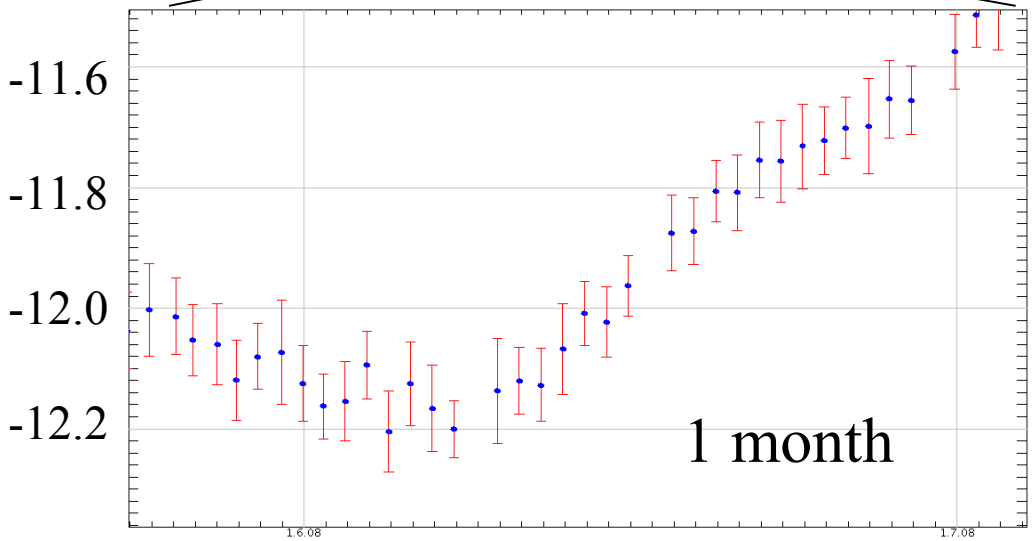


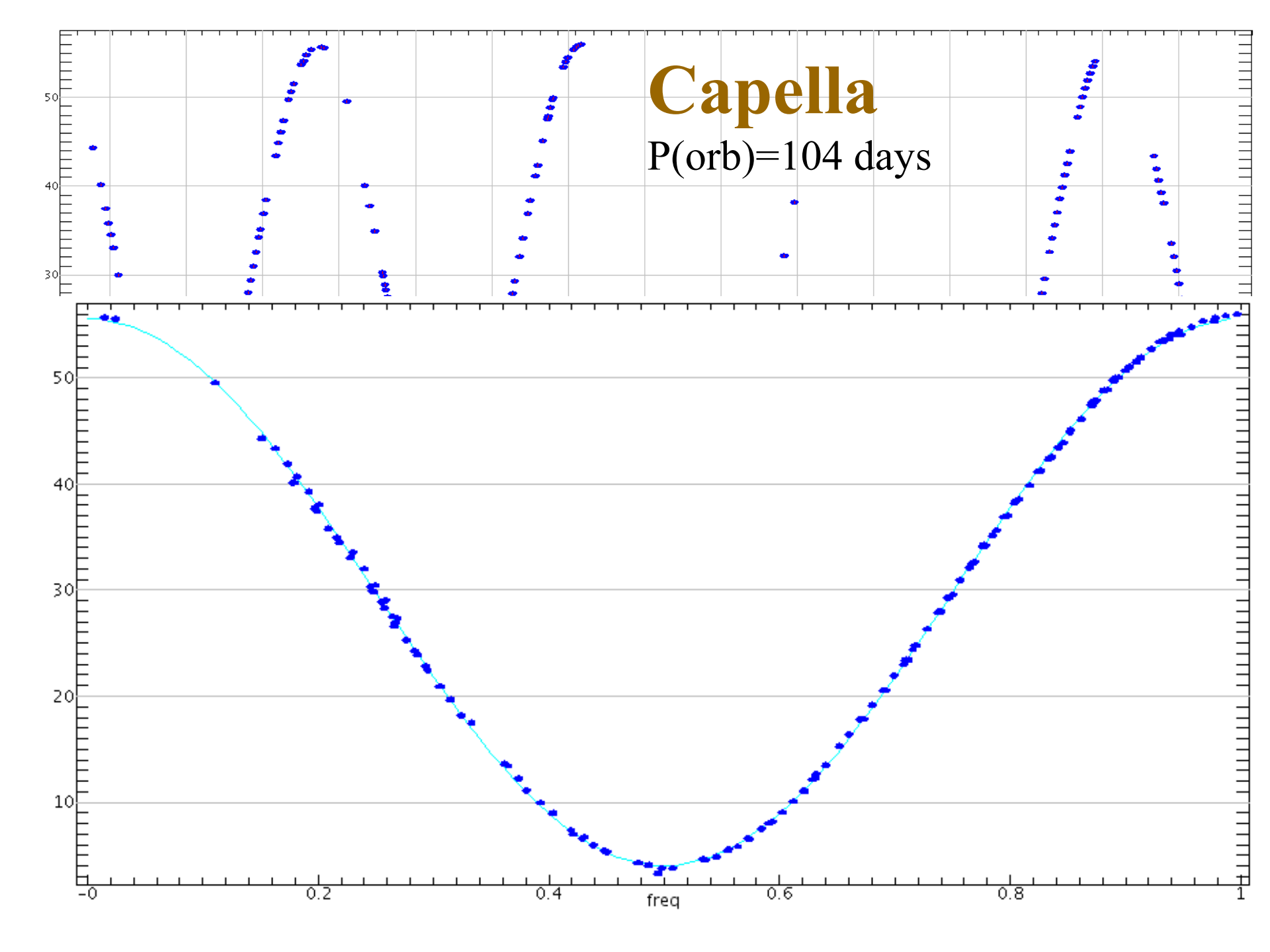
HD123351

P(orb)=147.8 days

e=0.81

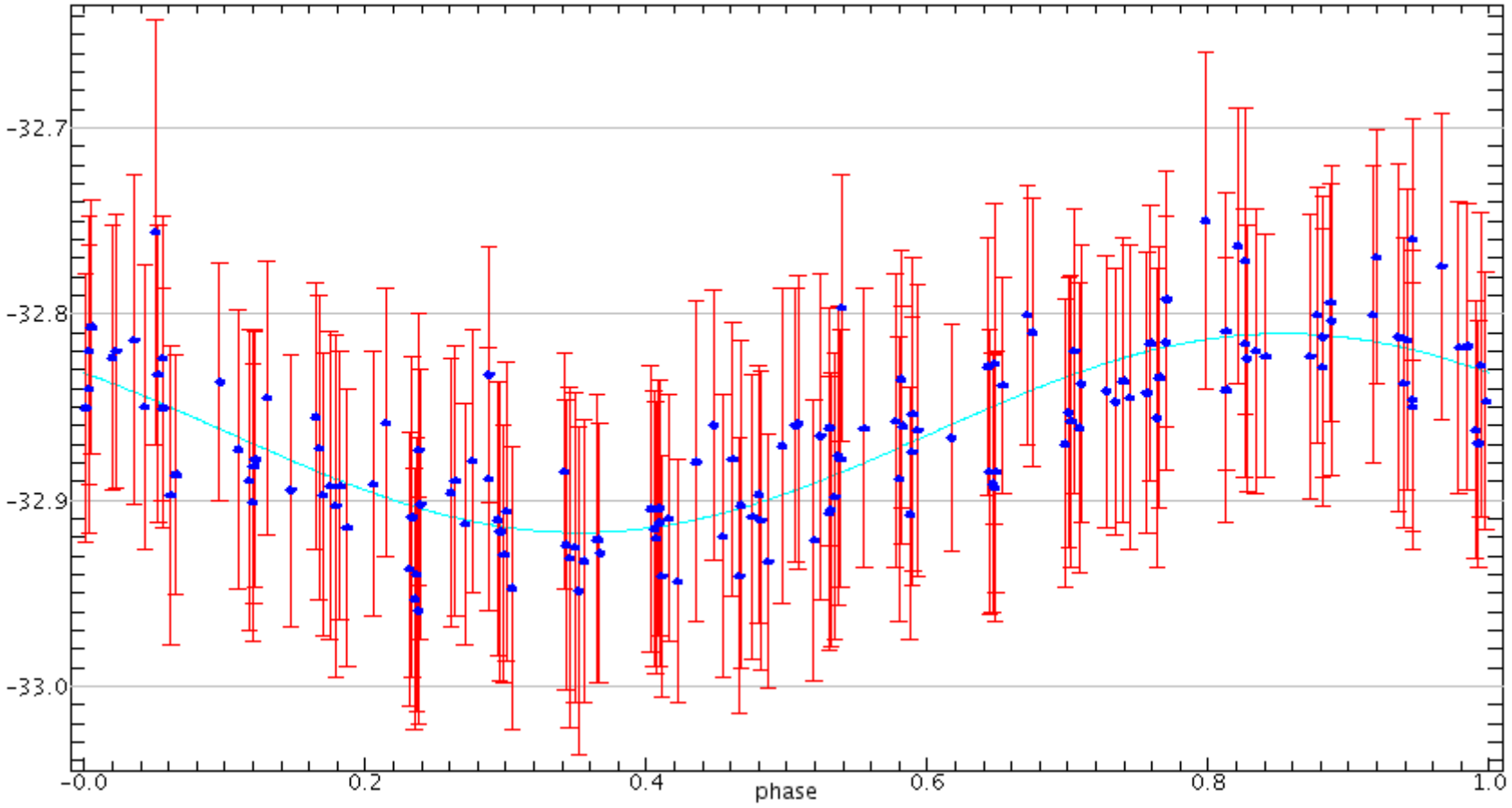
K=15 km/s




Capella
P(orb)=104 days
50
40
30
50
40
30
20
10
-0
0.2
0.4
freq
0.6
0.8
1

STELLA

51 Peg exoplanet



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First measurement of the magnetic field on FK Com and its relation to the contemporaneous star-spot locations★

H. Korhonen,[1]† S. Hubrig,[2] S. V. Berdyugina,[3,4] Th. Granzer,[5] T. Hackman,[6] M. Schöller,[1] K. G. Strassmeier[5] and M. Weber[5]

[1]*European Southern Observatory, Karl-Schwarzschild-Str 2, D-85748 Garching bei München, Germany*
[2]*European Southern Observatory, Casilla 19001, Santiago, Chile*
[3]*Kiepenheuer Institut für Sonnenphysik, D-79104 Freiburg, Germany*
[4]*Institute of Astronomy, ETH Zürich, 8093 Zürich, Switzerland*
[5]*Astrophysikalisches Institut Potsdam, An der Sternwarte 16, D-14882 Potsdam, Germany*
[6]*Observatory, PO Box 14, FI-00014 University of Helsinki, Finland*

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ABSTRACT

In this study, we present simultaneous low-resolution longitudinal magnetic field measurements and high-resolution spectroscopic observations of the cool single giant FK Com. The variation of the magnetic field over the rotational period of 2.4 d is compared with the star-spot location obtained using Doppler imaging techniques, V-band photometry and $V - I$ colours. The chromospheric activity is studied simultaneously with the photospheric activity using high-resolution observations of the Hα, Hβ and Hγ line profiles. Both the maximum (272 ± 24 G) and minimum (60 ± 17 G) in the mean longitudinal magnetic field, $\langle B_z \rangle$, are detected close to the phases where cool spots appear on the stellar surface. A possible explanation for such a behaviour is that the active regions at the two longitudes separated by 0.2 in phase have opposite polarities.

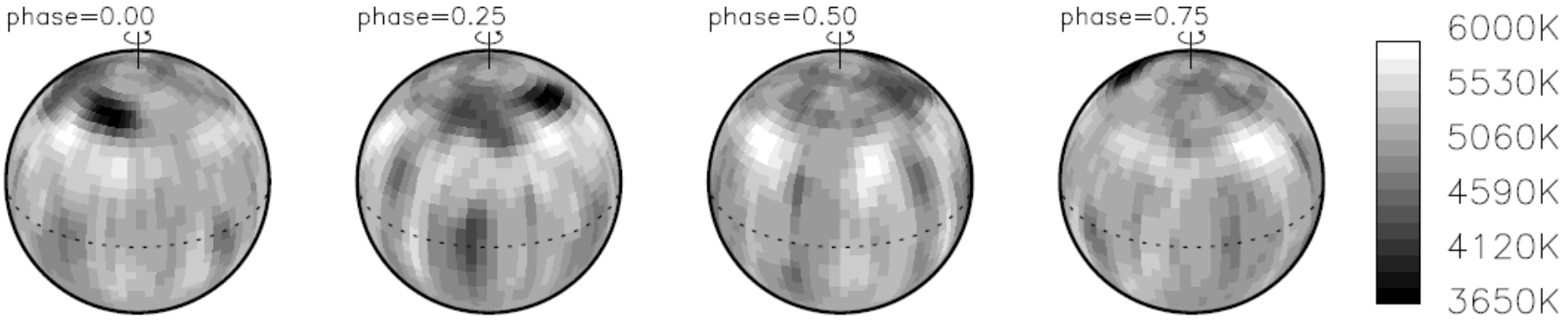
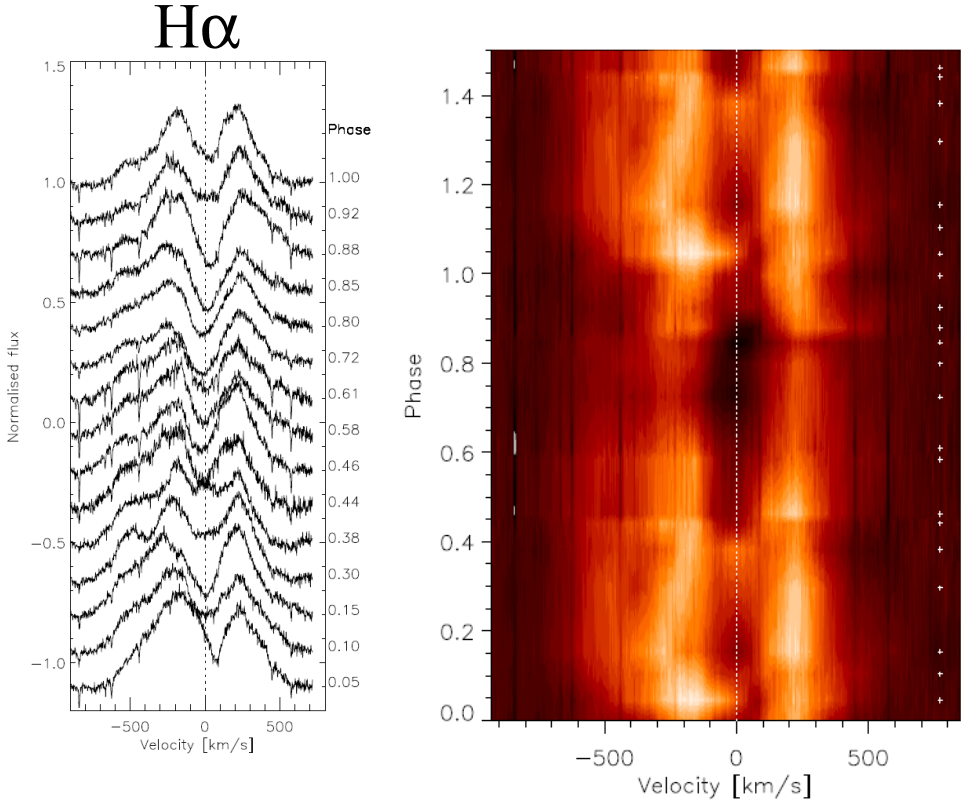


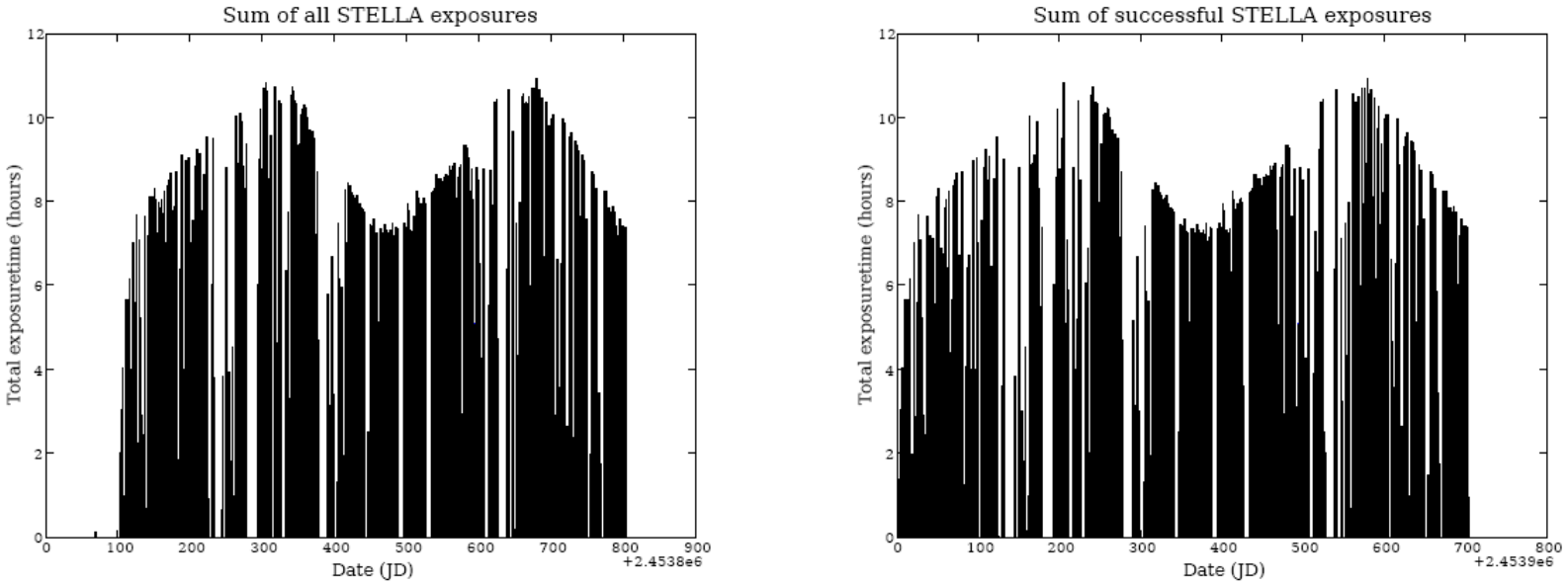
Figure 3. The surface temperature map of FK Com. The surface is shown at four different rotational phases which are 0.25 in phase apart. The gray scale gives the temperature in Kelvin.



* Based on observations collected at the European Southern Observatory, Chile (Prg. 280.D-5075); at the automatic STELLA observatory at Tenerife, Spain; and with the Vienna automatic photometric telescopes Wolfgang and Amadeus, Arizona, USA
† E-mail:hkorhone@eso.org

Peak shutter-open time = 93%

Total exposure time (hours)



700 nights

Figure 7. *Left:* The sum of all SES scientific exposuretimes per day. Nighttime calibration is not included, but targets lost during integration are. *Right:* Same as before, but only targets considert successful. This usually means that the specified integration time has been reached, but could also be a required minimum signal-to-noise ratio. The difference accumulates to approximately 5%.

Weber, Granzer, Strassmeier & Woche 2008, SPIE 7019, 19

Klaus G. Strassmeier *& the STELLA team*
Astrophysical Institute Potsdam (AIP)