Stellar Observations Network Group

Frank Grundahl, Jørgen Christensen-Dalsgaard, Uffe Gråe Jørgensen,

Hans Kjeldsen, Søren Frandsen, Per Kjærgaard Rasmussen

+ participation from IAC (Pere Pallé, Orlagh Creevy.....)

GONG 2010 – SoHO 24

What is SONG ?

SONG Goals

Do for stars what GONG does for the Sun

well, almost..... (BiSON, IRIS)

- Asteroseismology (doppler, daytime solar obs.)

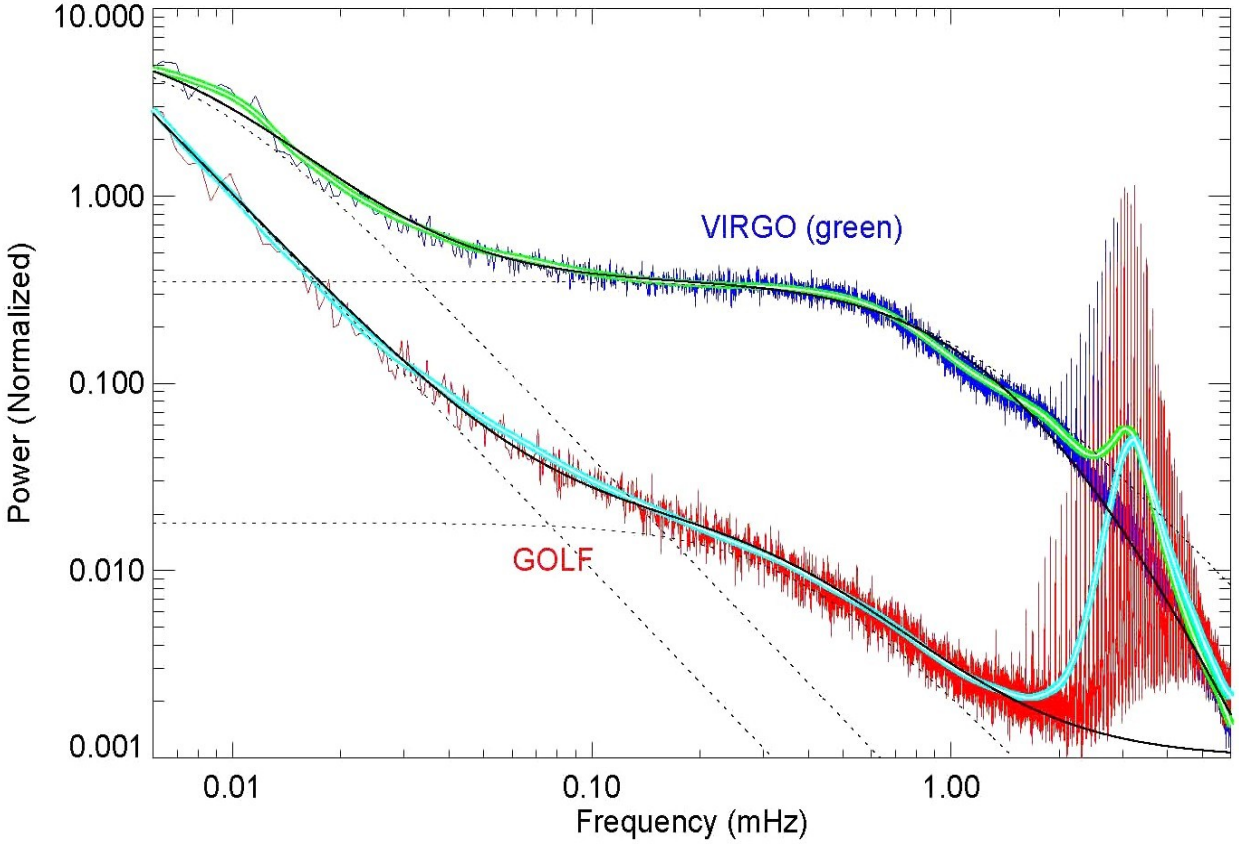
Main focus on solar-like oscillators

- Exoplanets (microlensing, doppler)

Microlensing can potentially detect very small planets
Set limits on occurrence of planets

Use *Lucky-Imaging* (photometry)

Use radial velocities for solar-like oscillations superior to photometry (from the ground)



Seismology targets: V < 6

Long, continuous periods

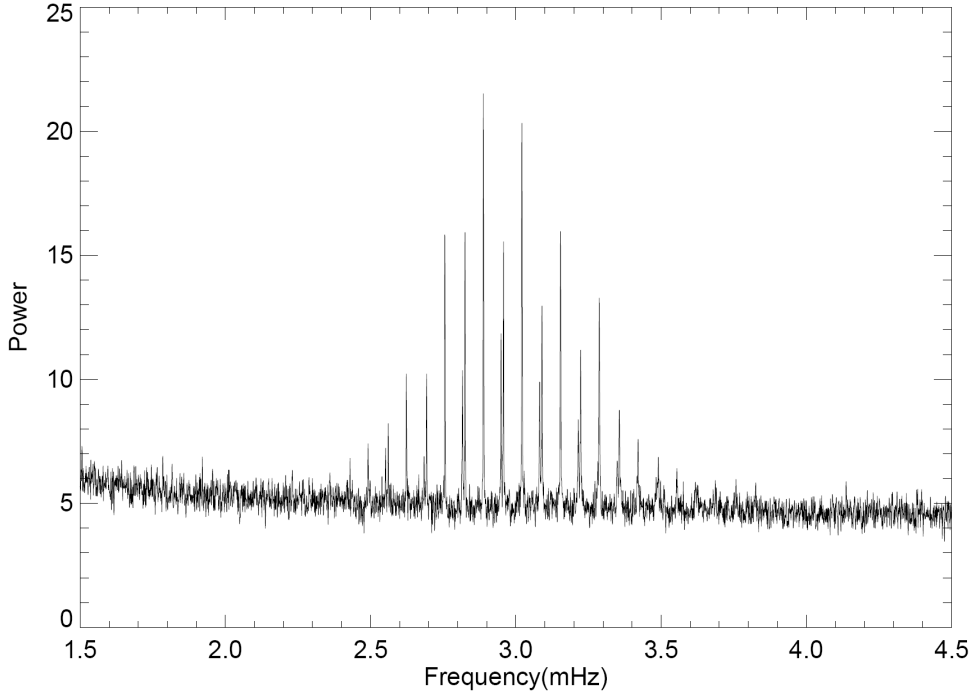
Bright, nearby targets, get *R* from interferometry, *d* from parallaxes, activity levels

Relatively few but well studied targets

Complementary to the space Missions

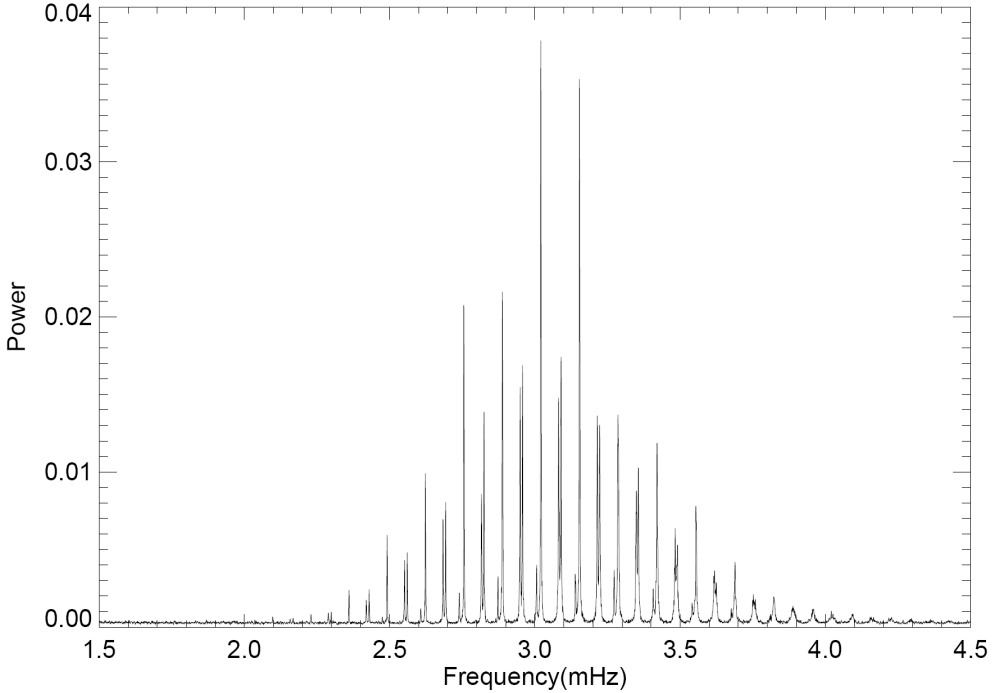
l = 3 + lower frequencies

All basic information will be available for the SONG targets!



Solar type star @ V=10,

4yr with Kepler



Solar type star @ V=2,

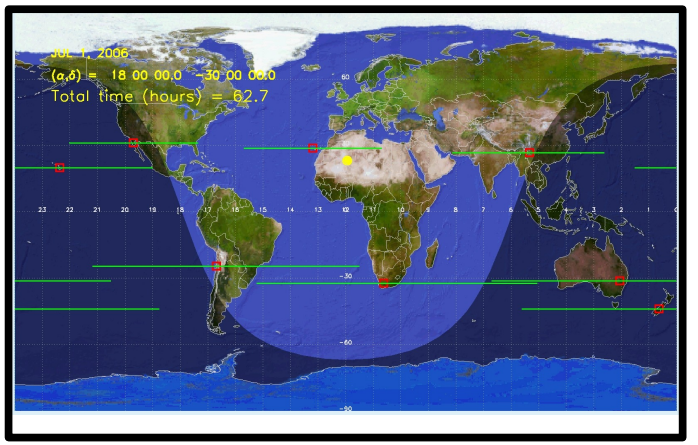
2 × 4 months with SONG

l = 3 can be detected

How will the goals be reached?

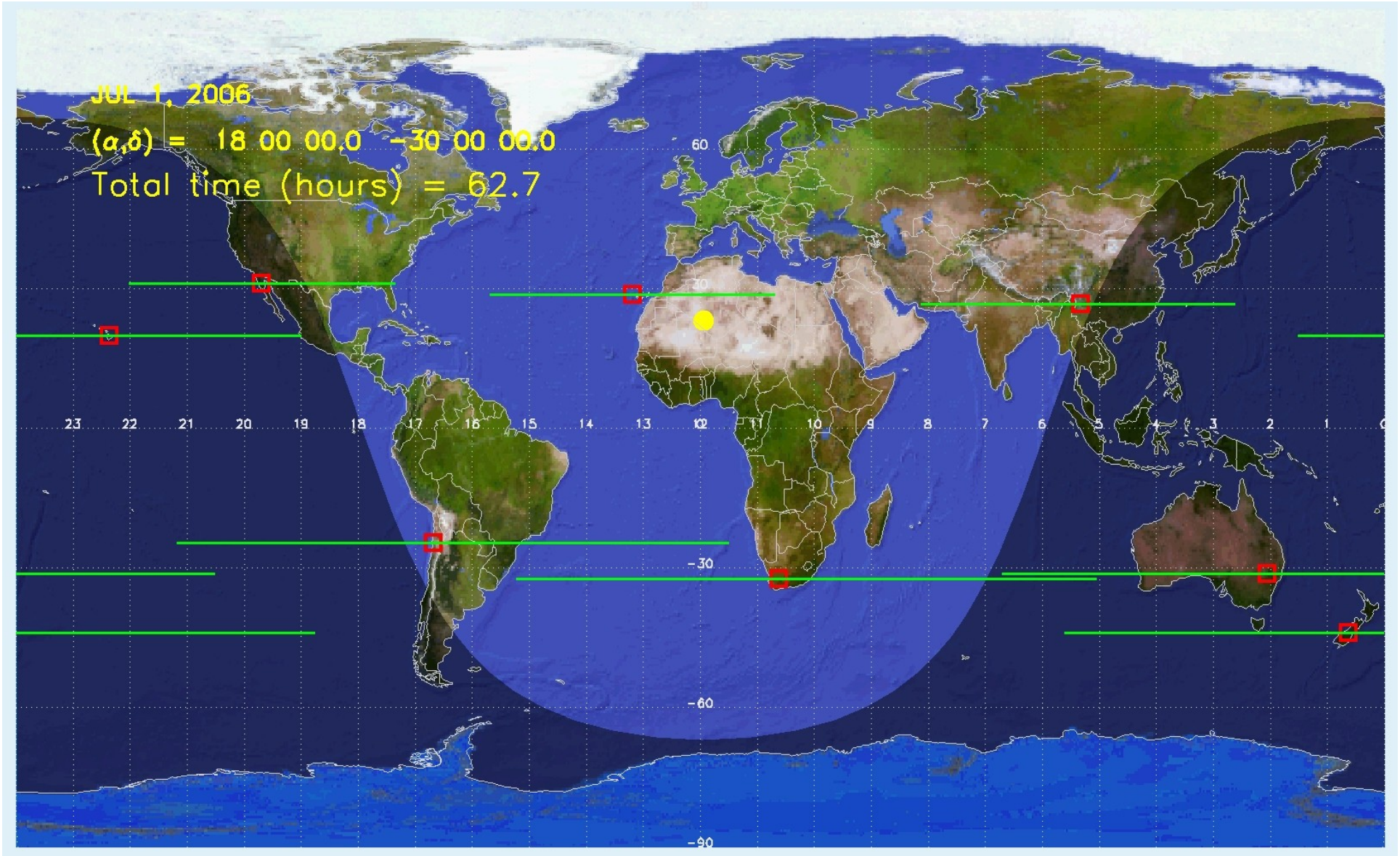
SONG baseline configuration:

- 8 network nodes (4S / 4N) at already existing sites
- 1.0m telescopes at each node
- Instruments: spectrograph + lucky imager
- Optimized for main science goals
- Automatic operations

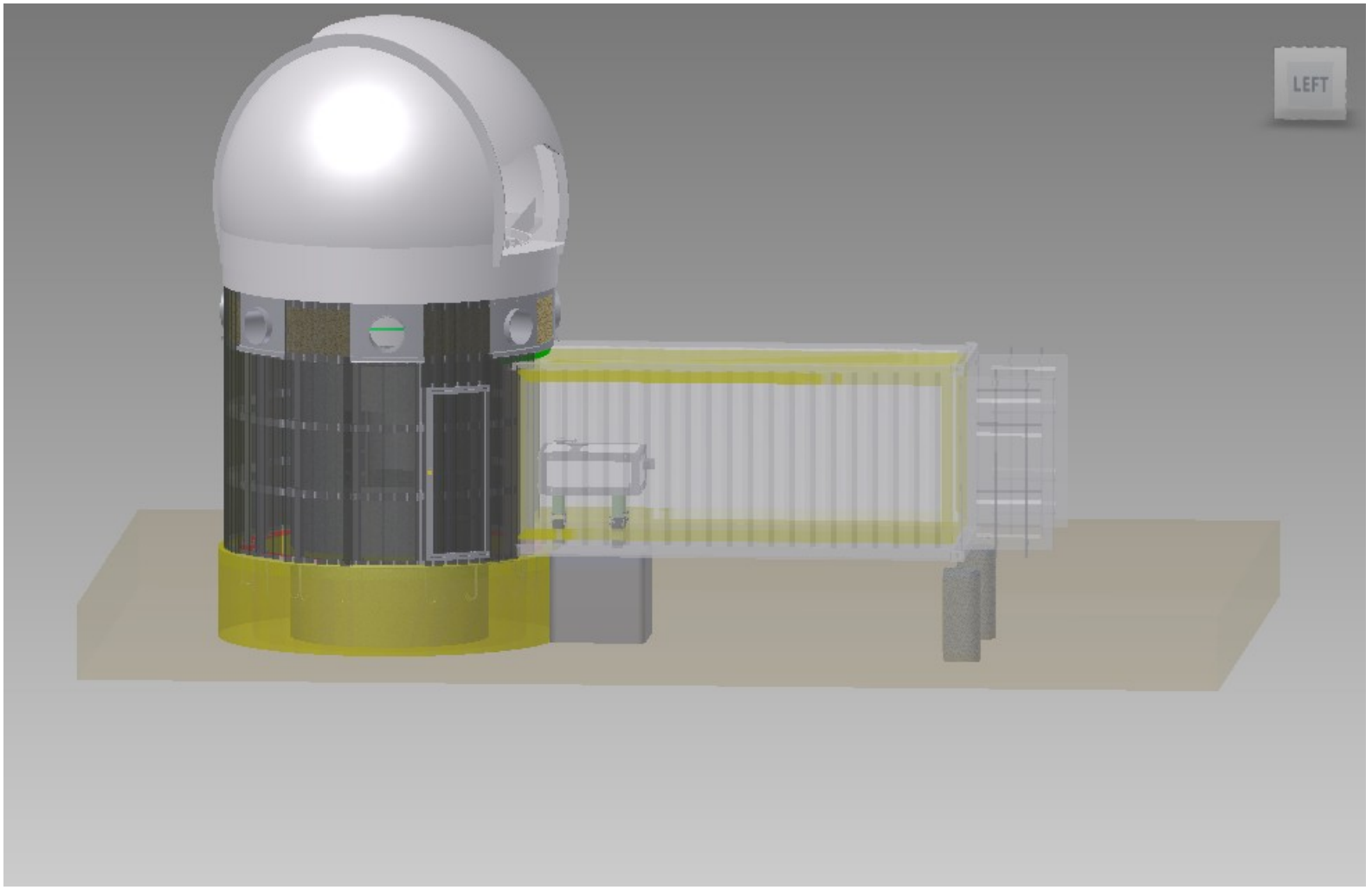


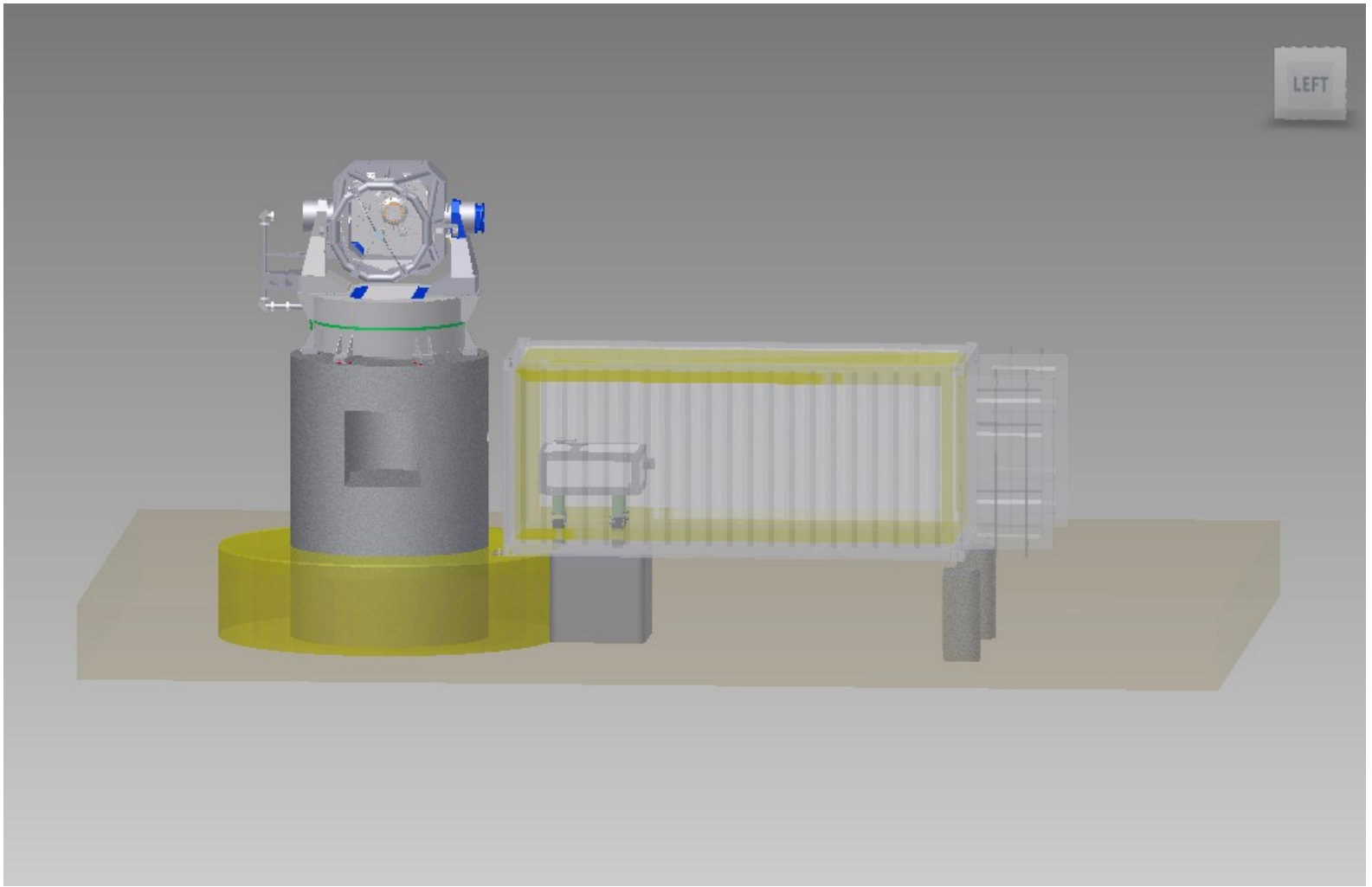
The first step is the construction of a full prototype node

The prototype will be located at Observatorio del Teide

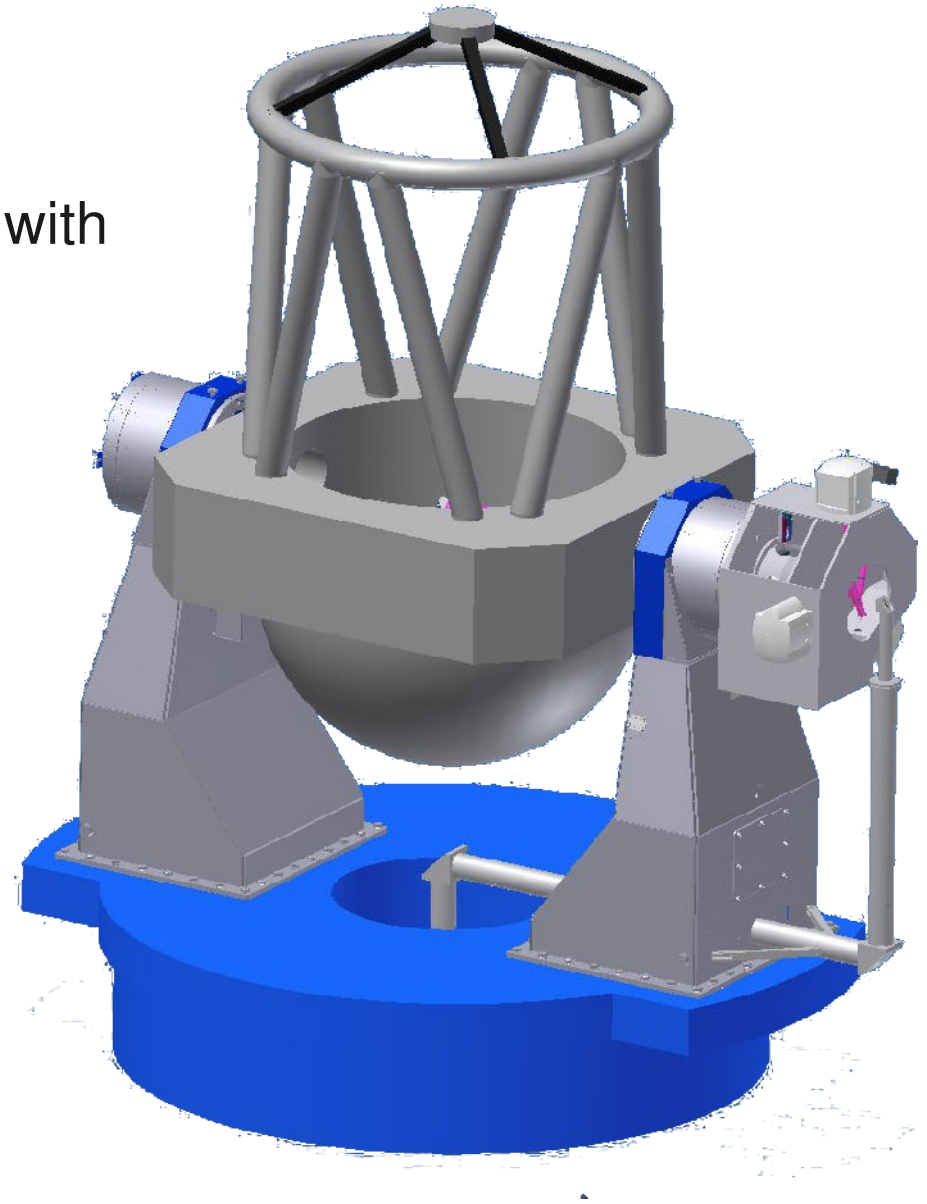


Diameter of the dome: 4.5m



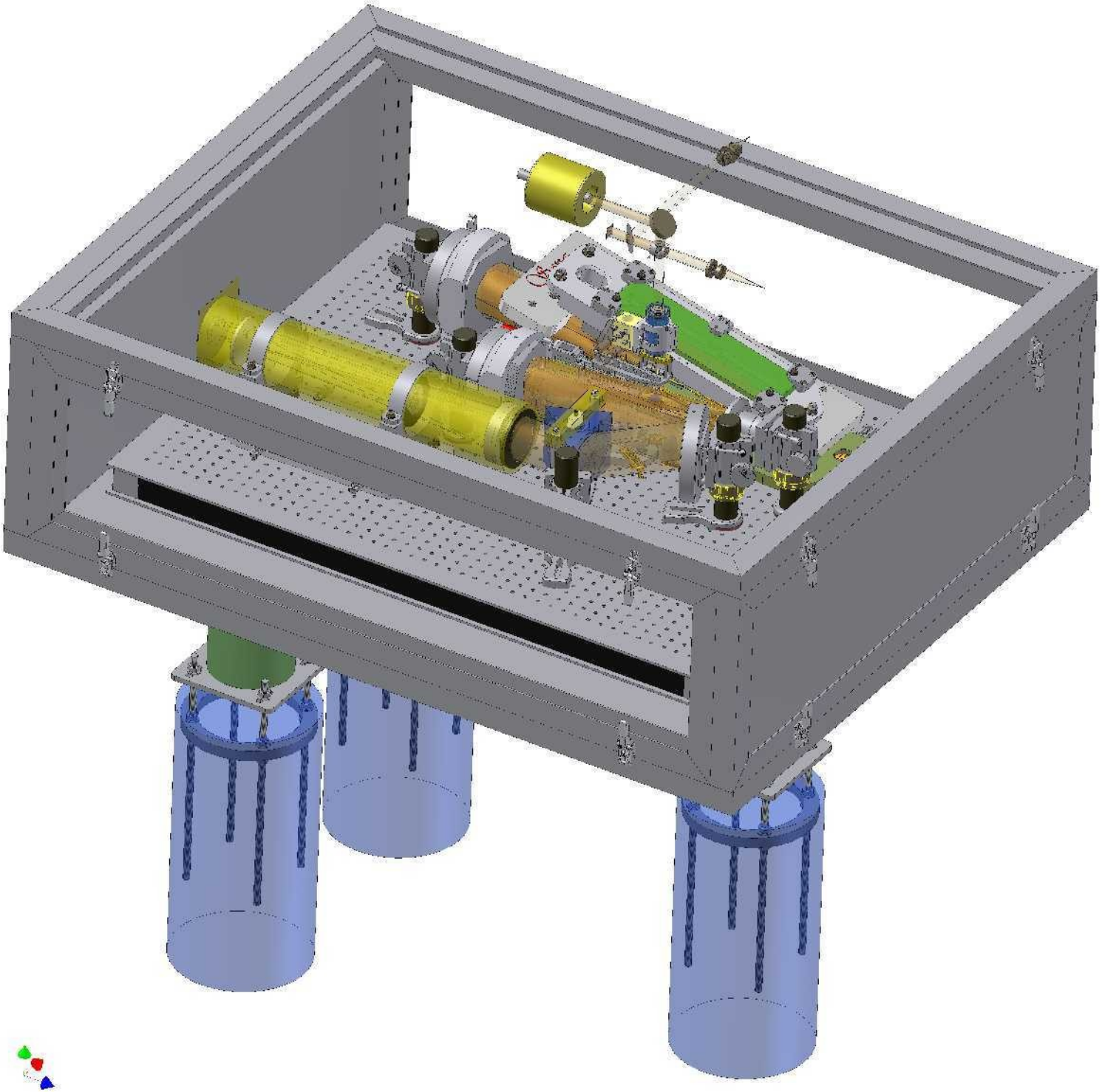

LEFT

- 1m telescope, alt-az mount
- 5” pointing precision and ZD < 80°
- Thin (5cm), controllable primary mirror with Shack-Hartmann WFS (Active Optics)
- M2 on high-precision hexapod
- Rapid re-pointing (20deg/s)
- 2 Nasmyth foci (< 60s switching)
- ADC (lucky imaging)
- Optical de-rotator
- 4.5m diameter dome w. sideports
- Wind-screen for dome
- Window to allow solar obs.

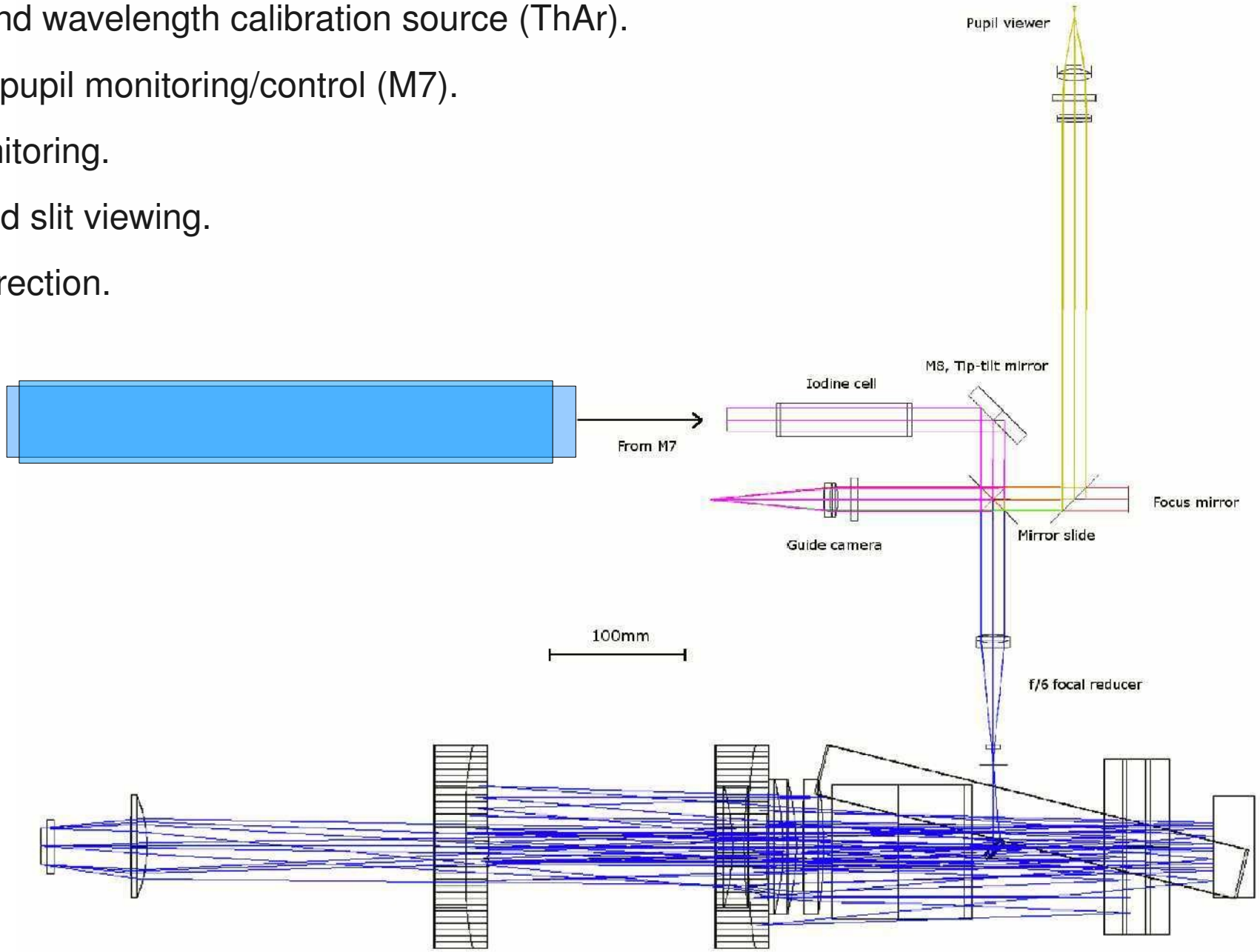


M2 and M3 dimensioned for ø15' field in the 2nd Nasmyth port

Instruments



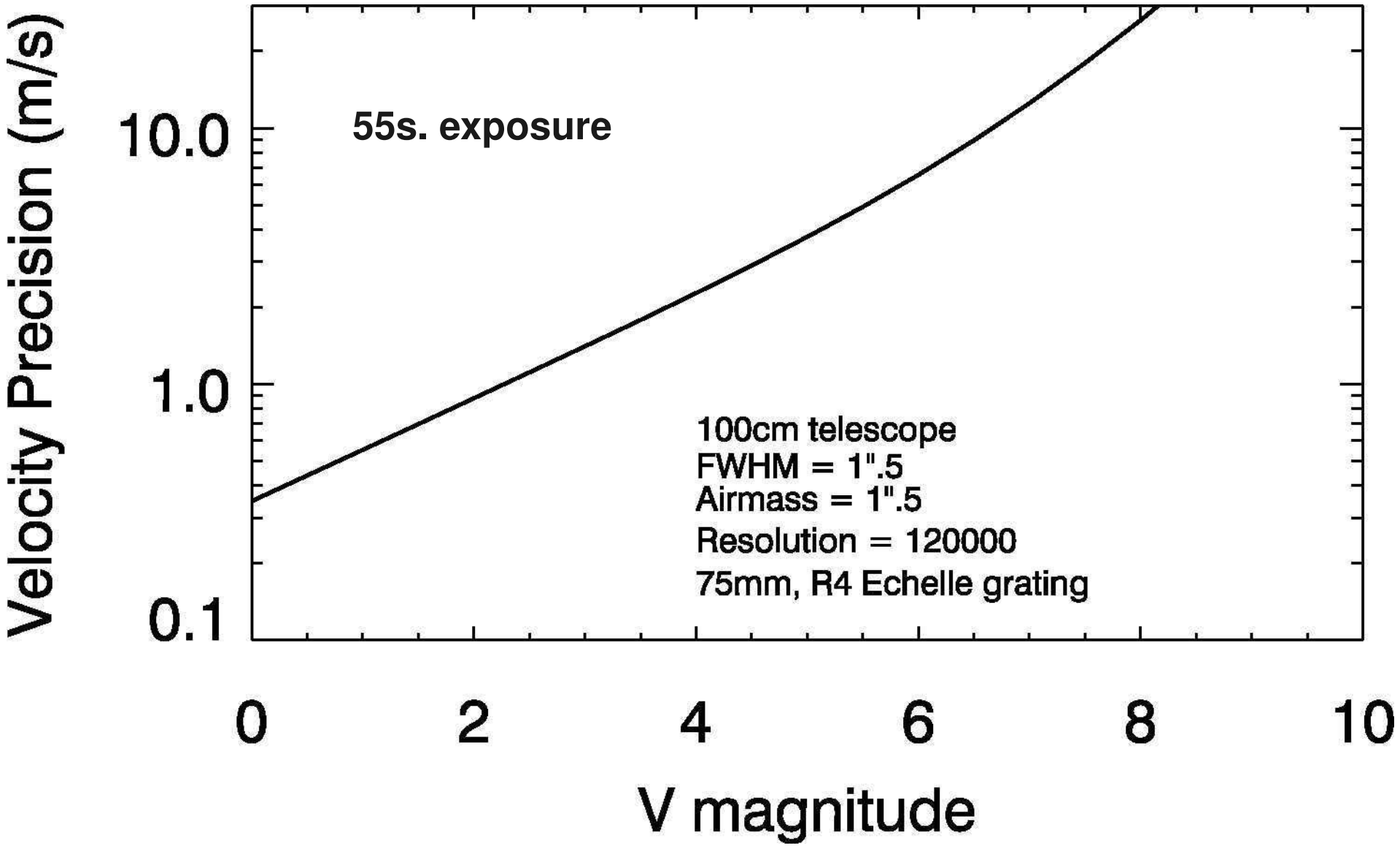
- Iodine Cell
- Flat field and wavelength calibration source (ThAr).
- Telescope pupil monitoring/control (M7).
- Focus monitoring.
- Guiding and slit viewing.
- Tip/Tilt correction.

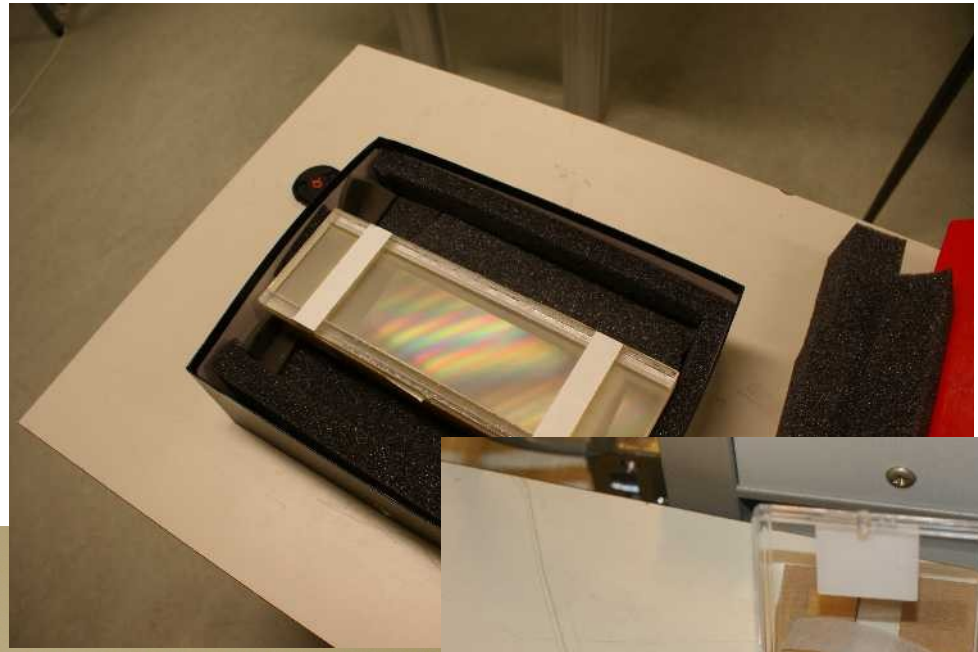


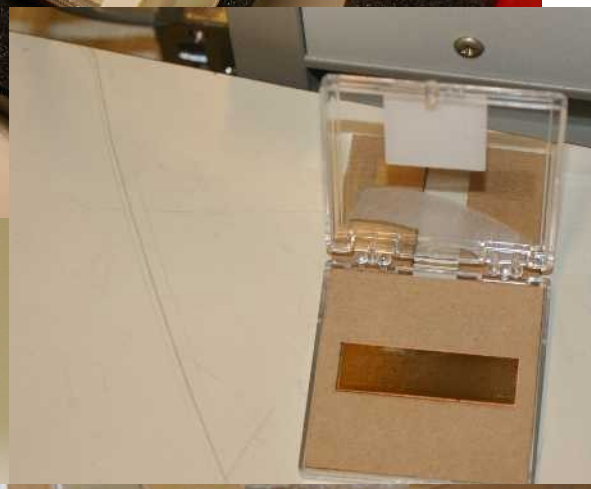
Spectrograph @ Coudè focus

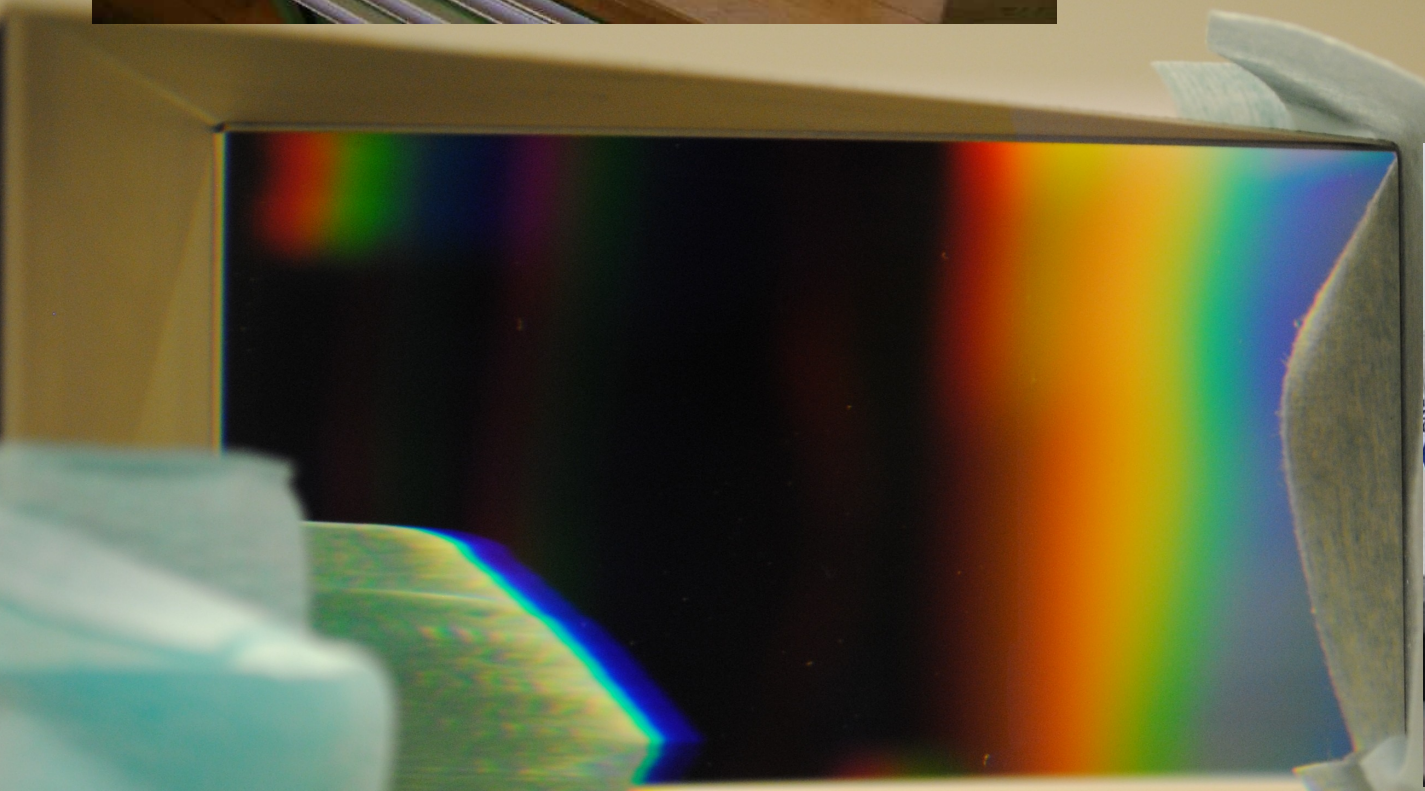
- Ultimate RV. precision of 1m/s expected with iodine cell. Temp. control.
- Wavelength range 4500-6700Å.
- R = 60.000 – 120.000 (higher possible with undersampling).
- Uniform PSF over detector area.
- High throughput (~7% TOTAL expected).
- Tip-tilt correction.
- Pupil correction/control/monitoring.
- Focus control and monitoring.
- Photon-weighted midtime of exposure calculation.
- “Ordinary” operation is possible (no I_2 cell, ThAr calib.)

Velocity precision of the SONG spectrograph

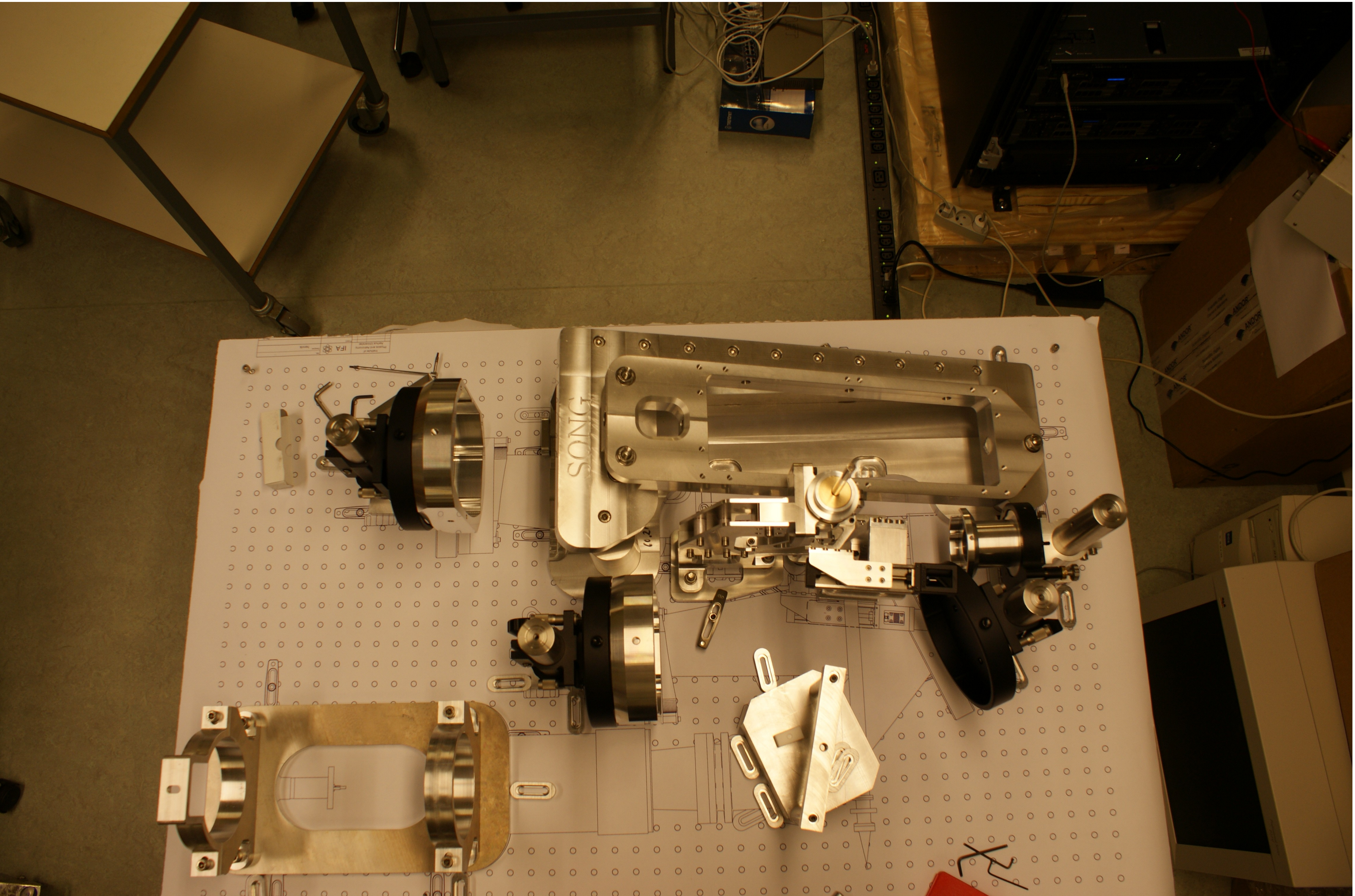


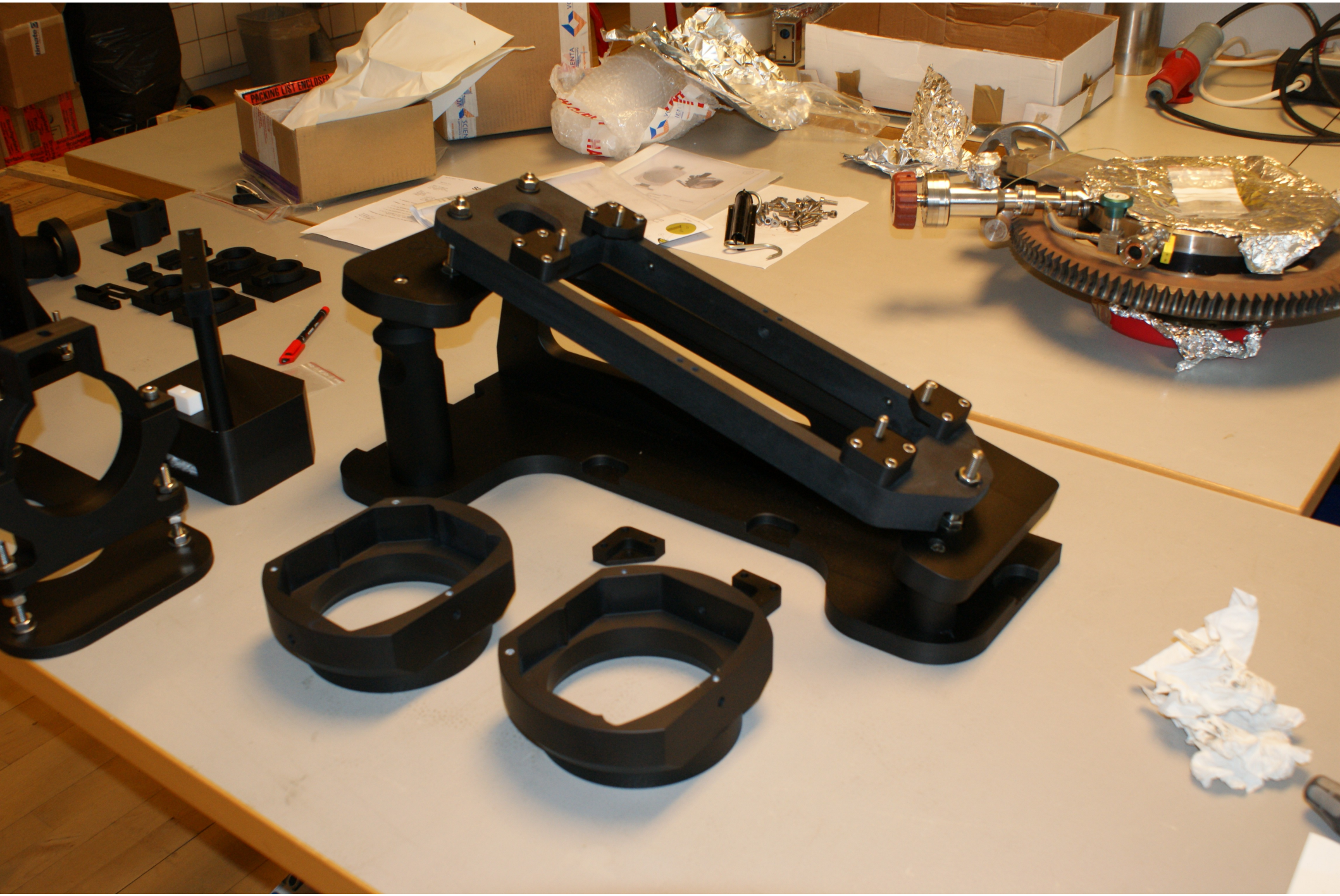







ANDOR


SONG

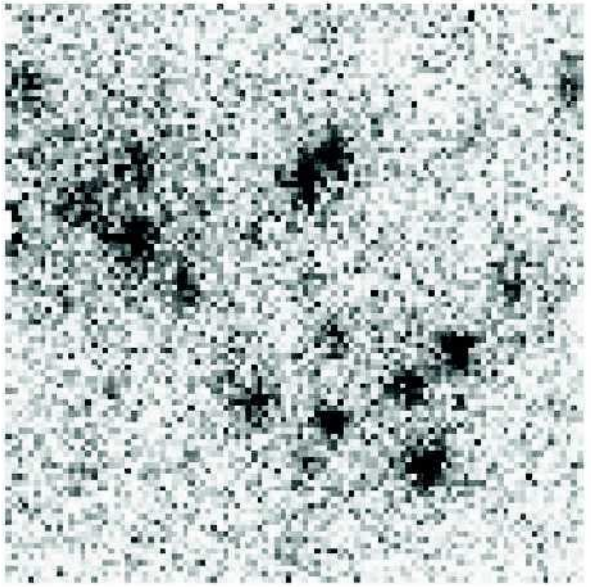

PACKING LIST ENCLOSED

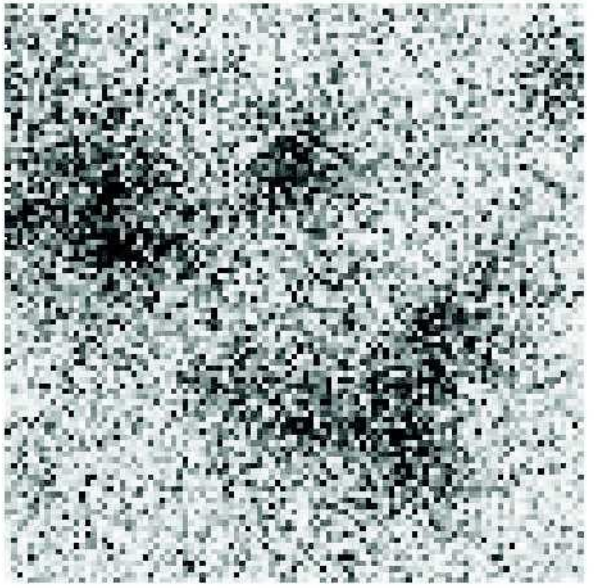
Imaging @ Nasmyth focus

- Dual color lucky imaging – wavelength split at 650nm.
- FOV 46" × 46" with 0.09 pixels to sample diffraction limited imaging.
- Up to 6 filters possible for each channel (4 + dark + grey filter).
- Continuous monitoring of the focus.
- Full frame-rate up to 34Hz.
- Near-diffraction limited performance during best weather conditions.
- Conventional CCD mode possible with low RON and ~1s readout.
- Extra port available to cover up to 75” field in third position.

Good ! **BAD!**

Martin Glitrup, 2010.

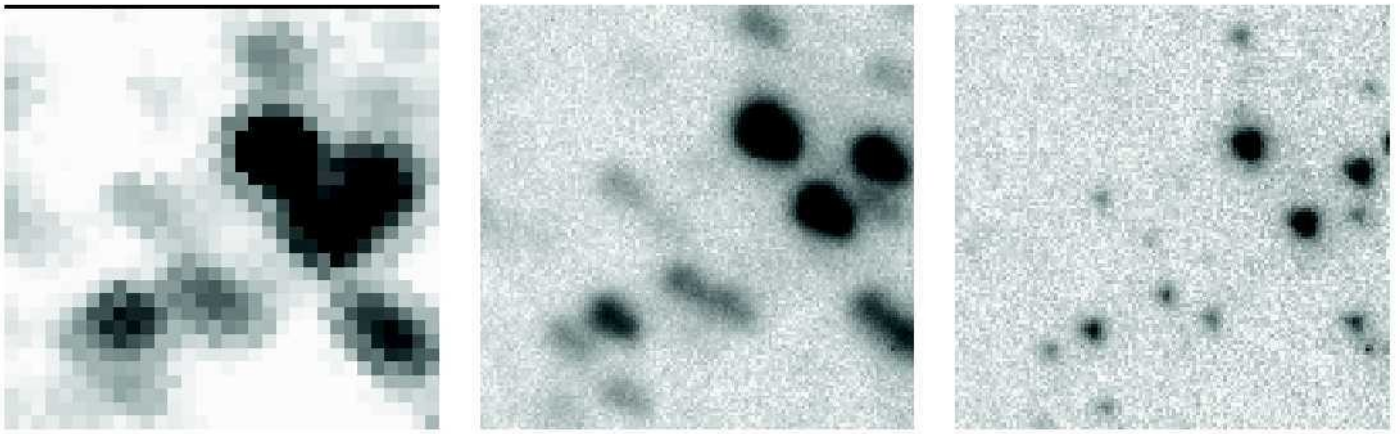




Experiment with Danish 1.54m on La Silla, Summer, 2009, same pixel-size (0".09) as SONG.

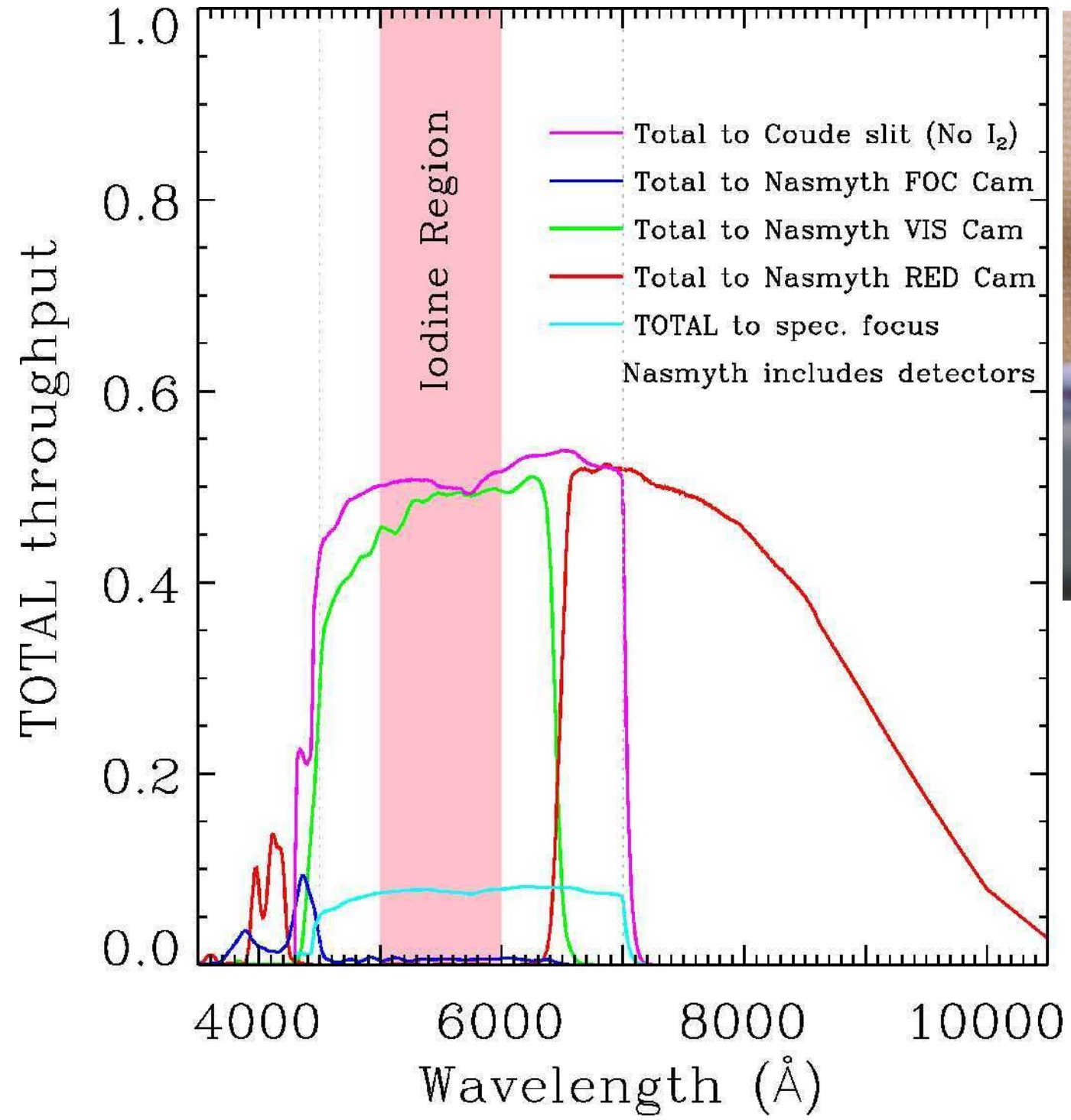
DFOSC

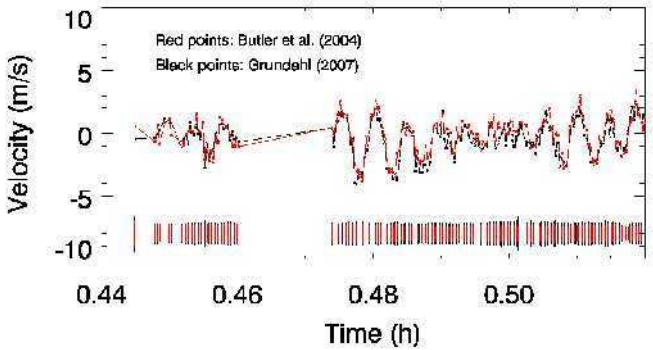
0".4 per pix.



(a) *DFOSC image* (b) *Andor 100%* (c) *Andor 5% selection*

DFOSC 100% 5%


TOTAL throughput
1.0
0.8
0.6
0.4
0.2
0.0
Iodine Region
Total to Coude slit (No I_2)
Total to Nasmyth FOC Cam
Total to Nasmyth VIS Cam
Total to Nasmyth RED Cam
TOTAL to spec. focus
Nasmyth includes detectors
4000
6000
8000
10000
Wavelength (Å)


Red points: Butler et al. (2004)
Black points: Grundahl (2007)
Velocity (m/s)
10
5
0
-5
-10
0.44
0.46
0.48
0.50
Time (h)

Schedule and status:

- Nearly all components are in-house, remaining expected in July.
- Summer, autumn 2010: Assembly, test integration, site preparation @ Observatorio del Teide.
- January 2011: Installation of telescope.
- Feb. + March 2011: Installation and commissioning.
- April – June 2011: Test observations.
- July 2011: Start of science verification observations.

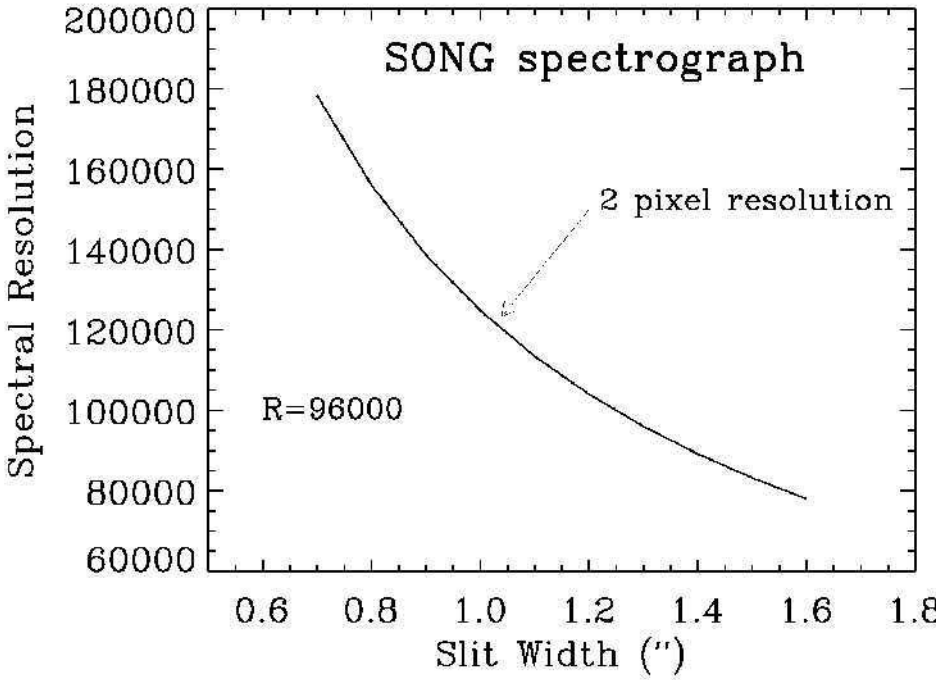
The next steps:

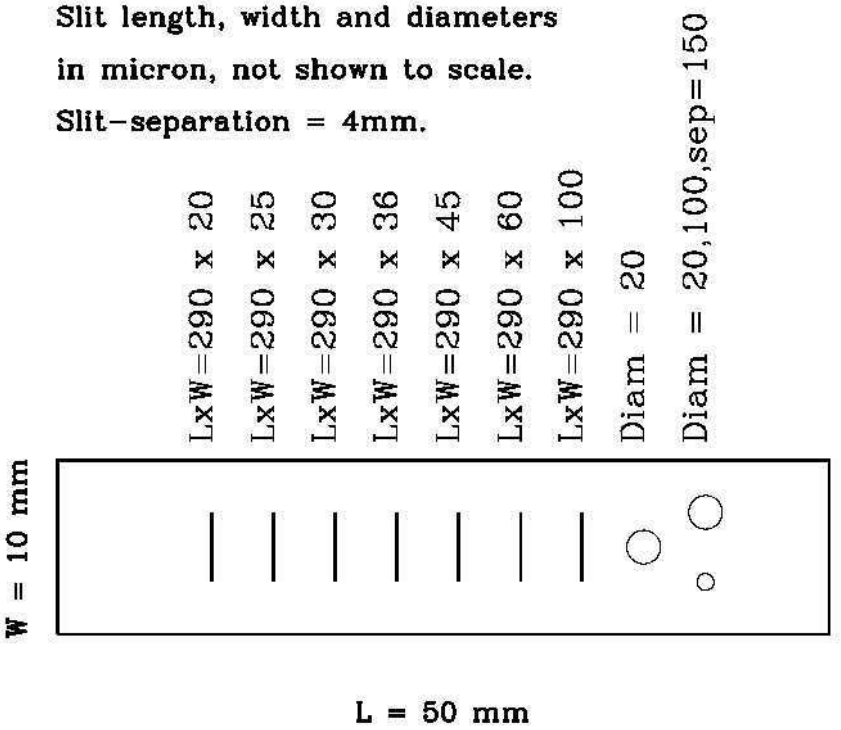
GET MORE NODES !

- A Chinese group (PI: Yan Li, Licai Deng) has passed CDR, PDR in late 2010. Funding for full node in 2011 expected.

- US consortium (PI: Jon Hakkila, College of Charleston) has applied for NSF/MRI funding for one node to be placed on Hawaii.

http://song.phys.au.dk





Slit pos	Resolution (λ/δλ)	Width (")	Width (μm)	Length (μm)	Sampling (pixels)
1	60504	2.06	60.00	290	4.05
2	80672	1.55	45.00	290	3.03
3	100841	1.24	36.00	290	2.43
4	121009	1.03	30.00	290	2.02
5	145211	0.86	25.00	290	1.69
6	181514	0.69	20.00	290	1.35
7	Wide slit	3.44	100	290	6.76
8	Pinhole		ø=20		
9	Alignment		ø=20,100		

Summary of capabilities

Telescope and dome

- 1m telescope, alt-az mount with <5” pointing precision and ZD < 80°
- Thin (5cm), controllable primary mirror with Shack-Hartman WFS
- M2 on high-precision hexapod
- Rapid re-pointing (20deg/s)
- 2 Nasmyth foci (< 60s switching)
- ADC and Optical de-rotator
- 4.5m diameter dome w. sideports
- Wind-screen for dome and window to allow daytime solar obs.
- M2 and M3 dimensioned for ø15' field in the 2nd Nasmyth port