

LIRIS

A Long-slit Intermediate Resolution Infrared Spectrograph for the WHT

LIRIS

Project Team

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- Software: Heidy Moreno (IAC)
- Instrument Definition Team :
  - Carlos Eiroa (UAM), Pedro García-Lario (VILSPA), Rafael Rebolo (IAC), Rene Rutten (ING), José M. Vílchez (IAA).

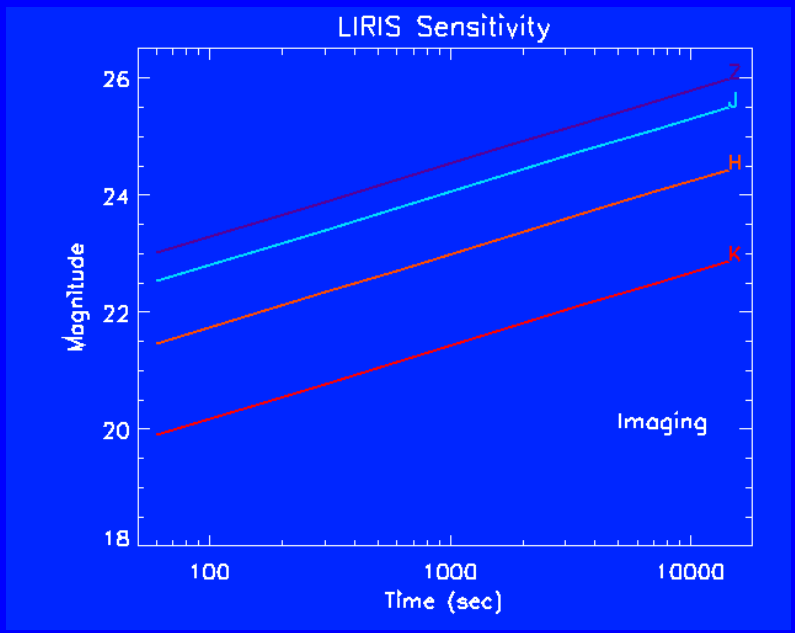
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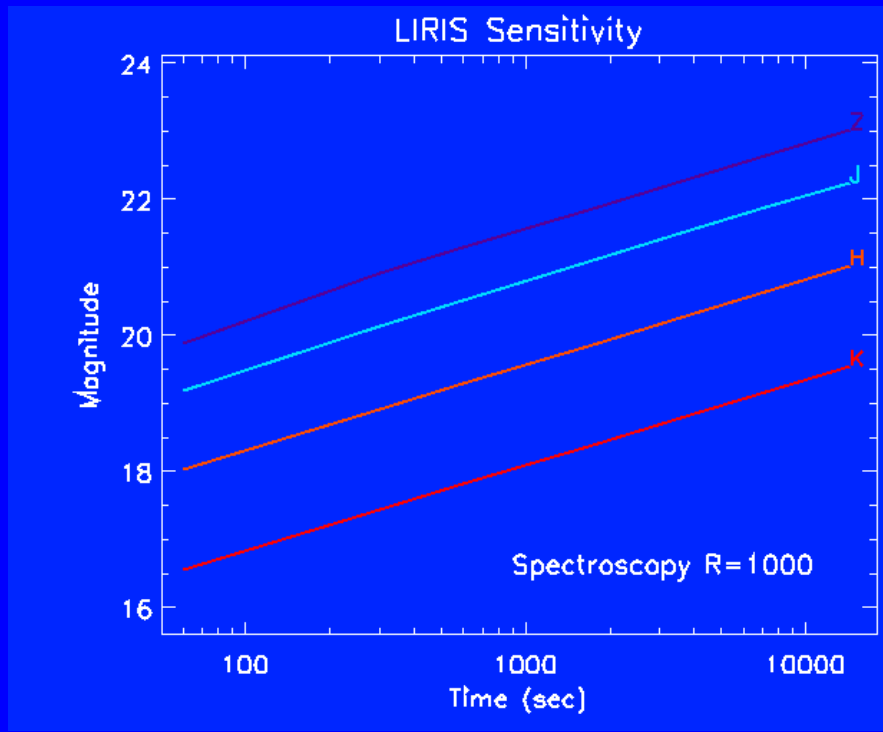
Instrument features

Focal Station	Cassegrain
Spectral Range	0.9 - 2.4 μ m
Array Format	Rockwell Hawaii 1024x1024 HgCdTe
Scale at detector	0.25 arcsec / pixel
Observing modes	Imaging ,long-slit Spectroscopy, Multi-Object Spectroscopy
Imaging	
FOV	4.2 x 4.2 arcmin
Available Filters	Z, J, H & Ks Brg, H_2(v=1-0), H_2(v=2-1), HeI, Kc, Hc, [FeII], CH_4
Sensitivity	K=21.4, H=22.9, J=24.0, Z=24.4 para t=1hr, S/N=3, seeing of 0.5 arcsec.
Spectroscopy	
Available slits	[0.6, 0.75, 1, 2.5, 5] arcsec x 4.2 arcmin + 10 multiobjects (max 24 slitlets) masks
Spectral Coverage	R = 1000 ⇒Z-J, H-K R = 3000 ⇒Z,J, H & K (not yet available)
Sensitivity	R=1000 ⇒ K=18.8, H=20.3, J=21.50, Z=22.3 para t=1hr, S/N=3, seeing of 0.5 arcsec.

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Expected performance





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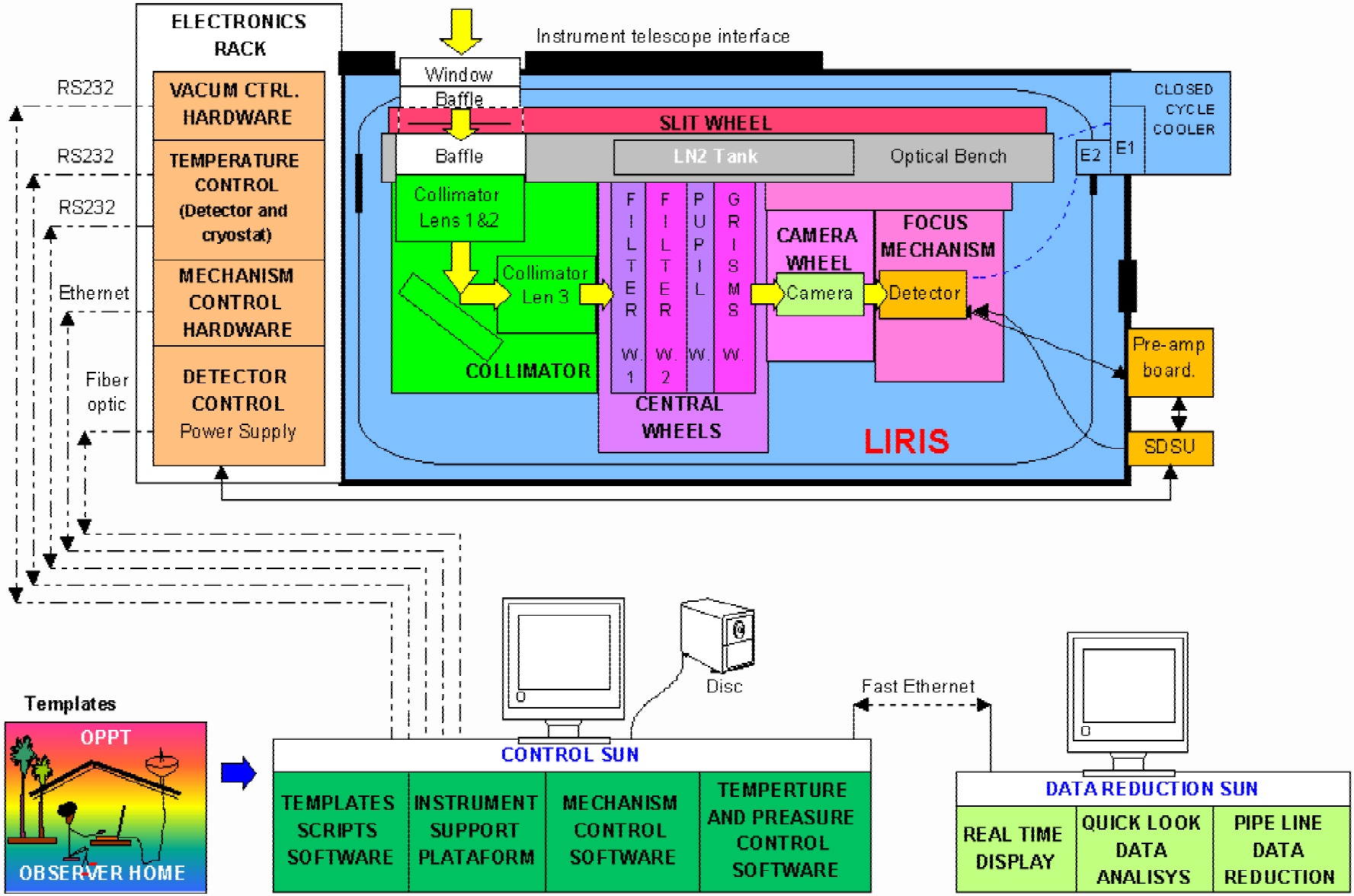
Competitiveness with 8 m class telescopes

- *Example*: **Integration time required to detect (S/N =3) the Ha line (1.25mm , F = 6×10^{-17} erg s^{-1} cm^{-2}) , with spectroscopy (R=3000) within a field of 4.2 x 1" including 5 objects.**

	t_{exp} per object	t_{exp} total (5 obj
LIRIS multi-slit		**10800 s**
ISAAC long-slit	2300 s	**10500 s**

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Functional diagram



Milestones

Nov/Dec-02

- Cooling cycle L4 at IAC (first spectroscopy tests)

Feb-03

- Commissioning at the WHT (Engineering detector).

Sep-03

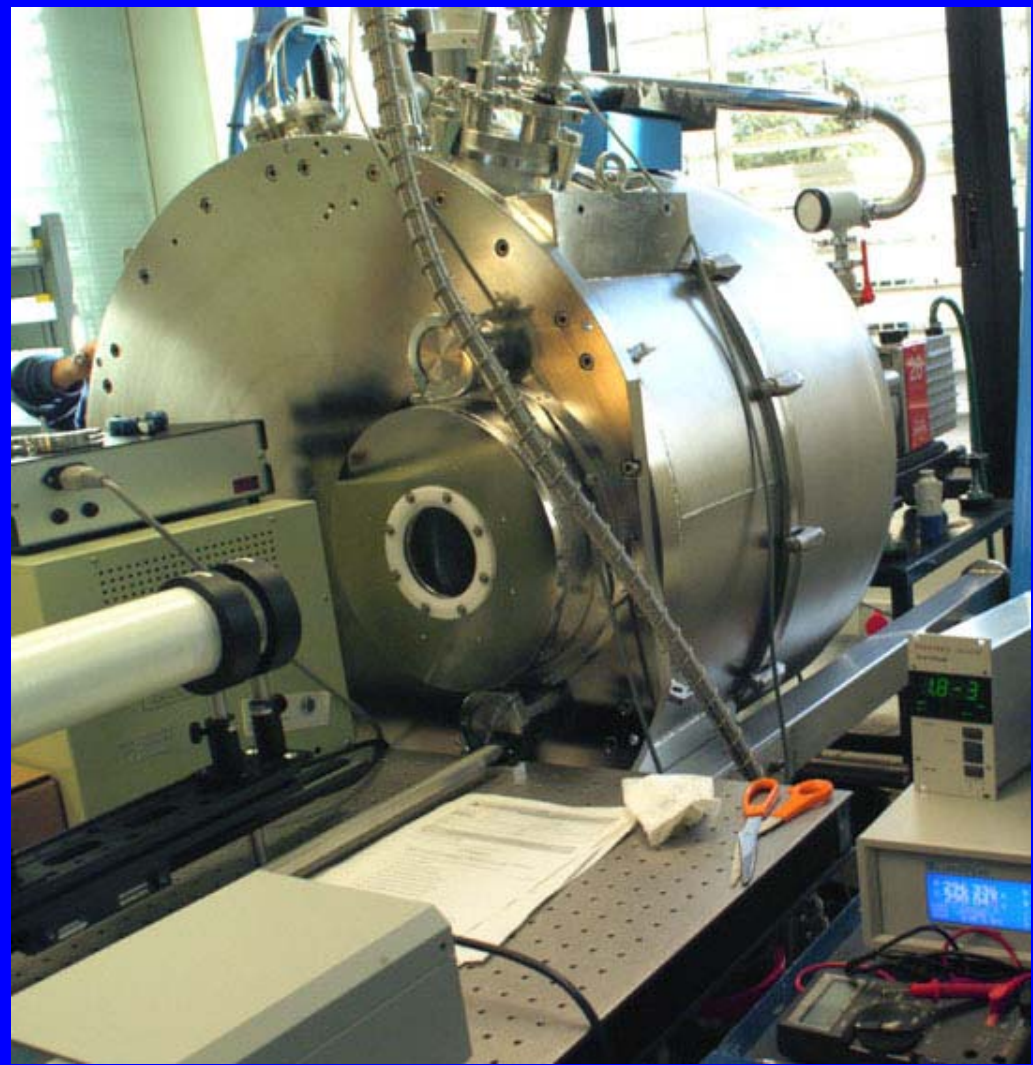
- Commissioning at the WHT (Scientific detector+focus mechanism).

Semester-03B

- Offered as public instrument to the WHT community.

The "Big Boiler"

Vacuum vessel, during first cooling cycle (optical alignment)



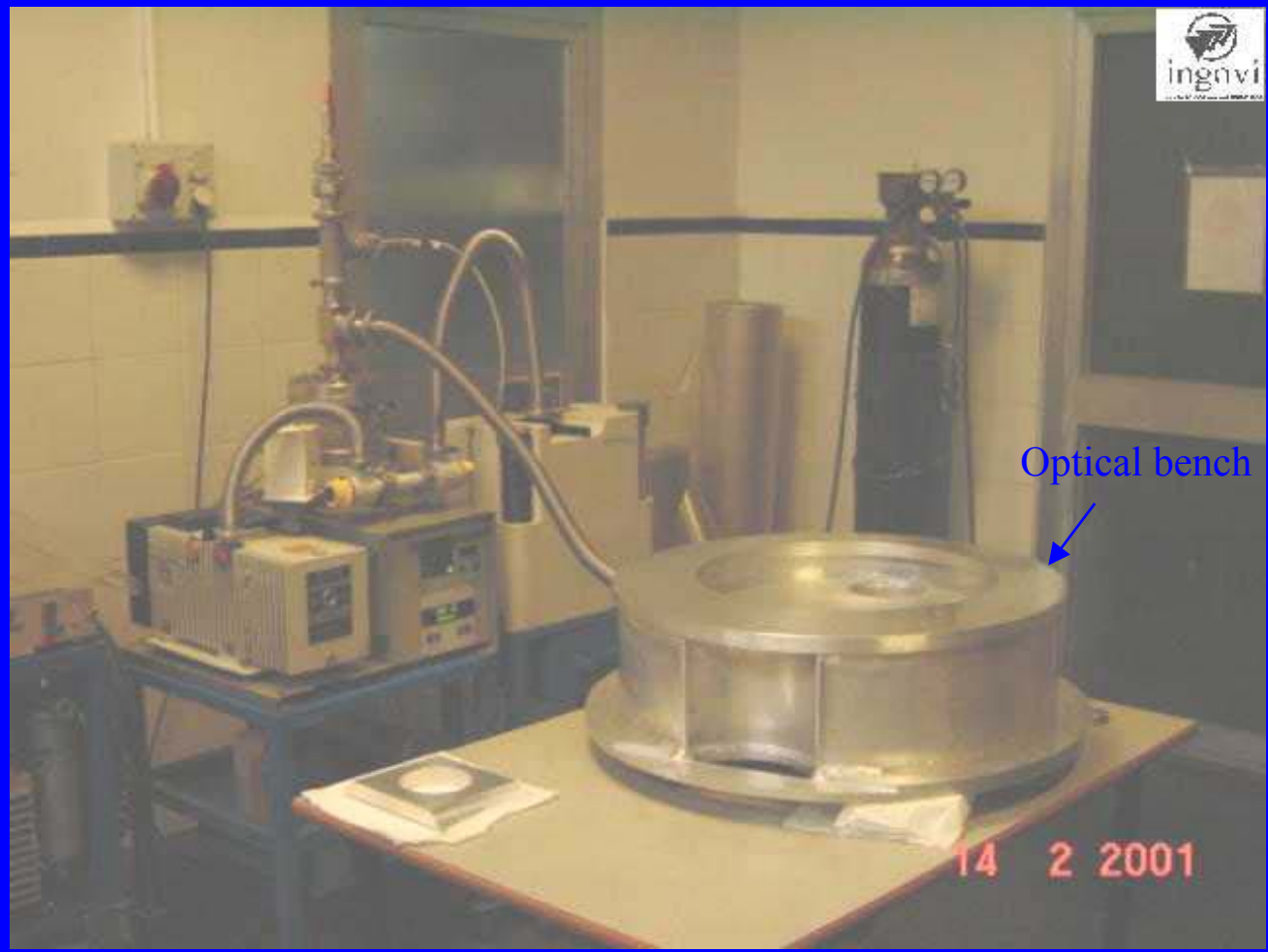
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The "big boiler"



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Optical bench



Aluminium, hold via 3 G10 trusses

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Vacuum tests



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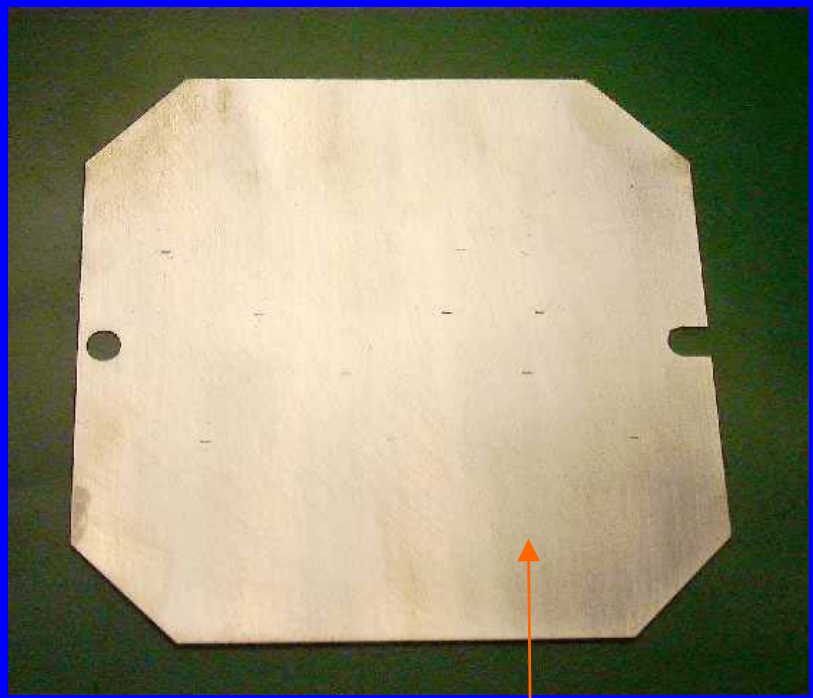
Entrance Wheel



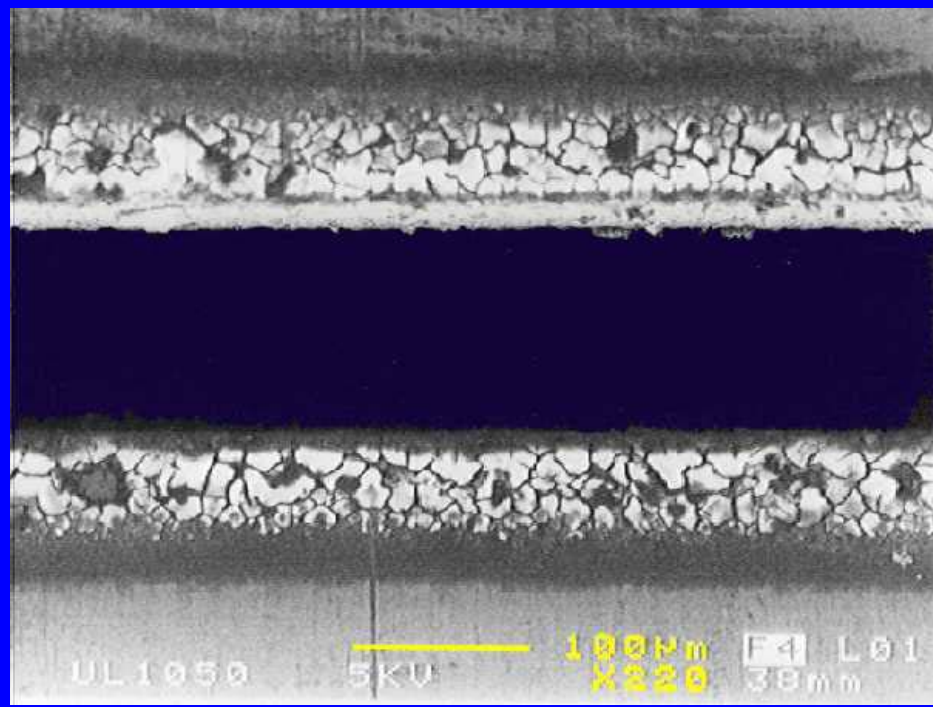


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Multi-slit manufacturing



Multi-slit mask 75 x 75 mm



Cutting the slit-holes made by electro erosion

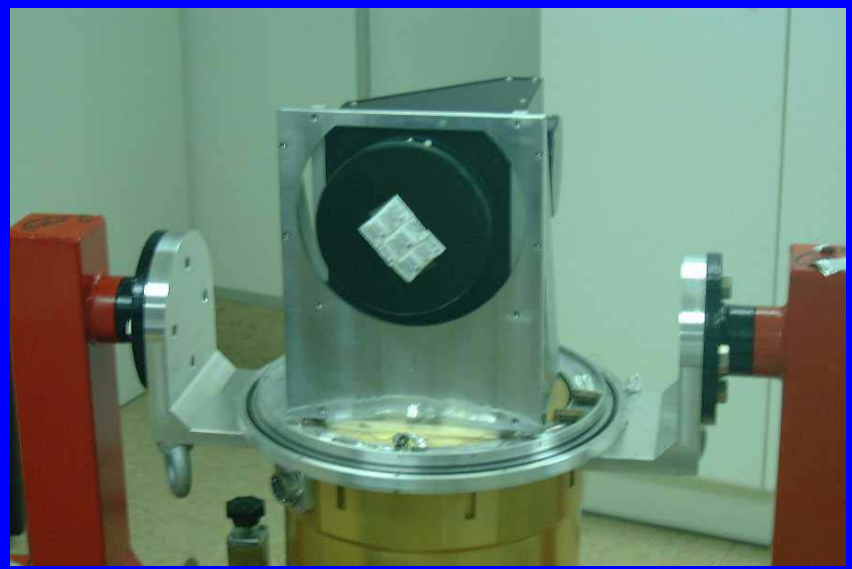
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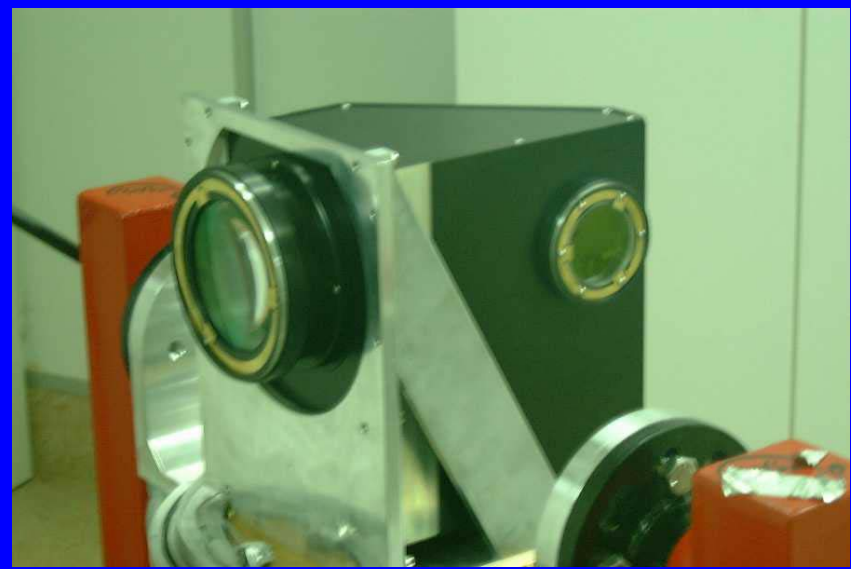
Manufacture of central wheels housing



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Cold verification of the collimator before integration



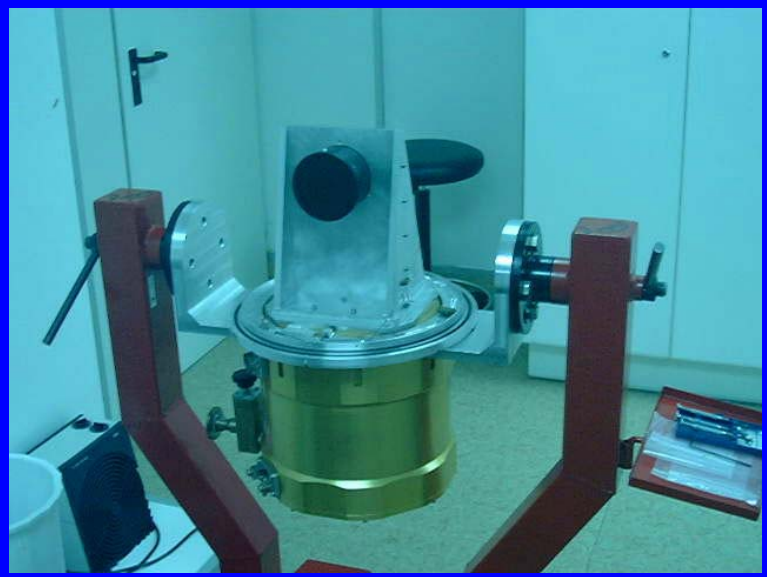


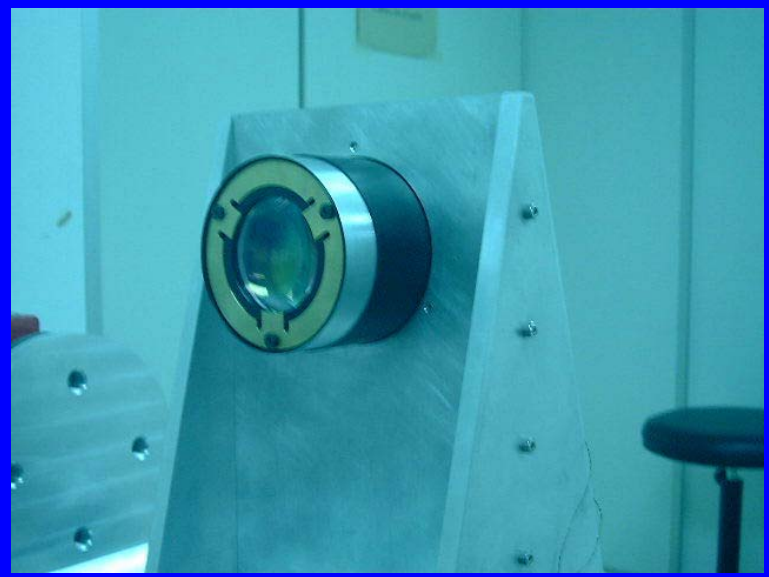


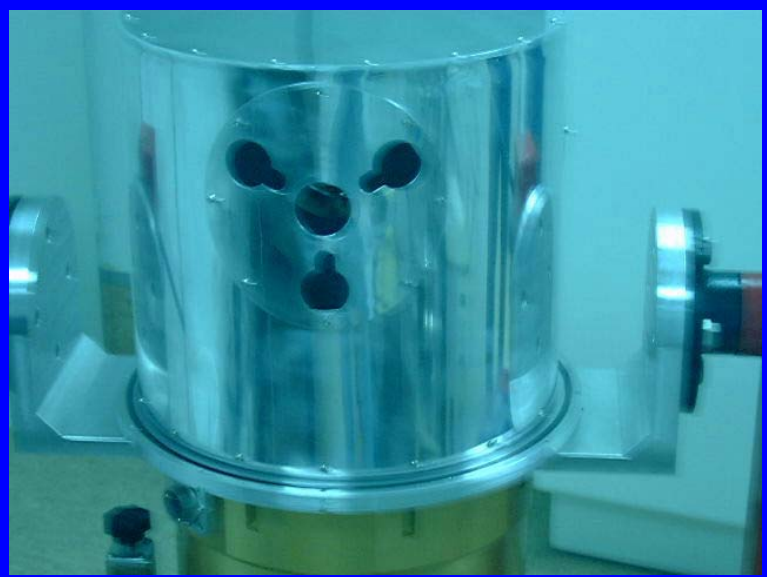


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Cold verification of the camera before integration



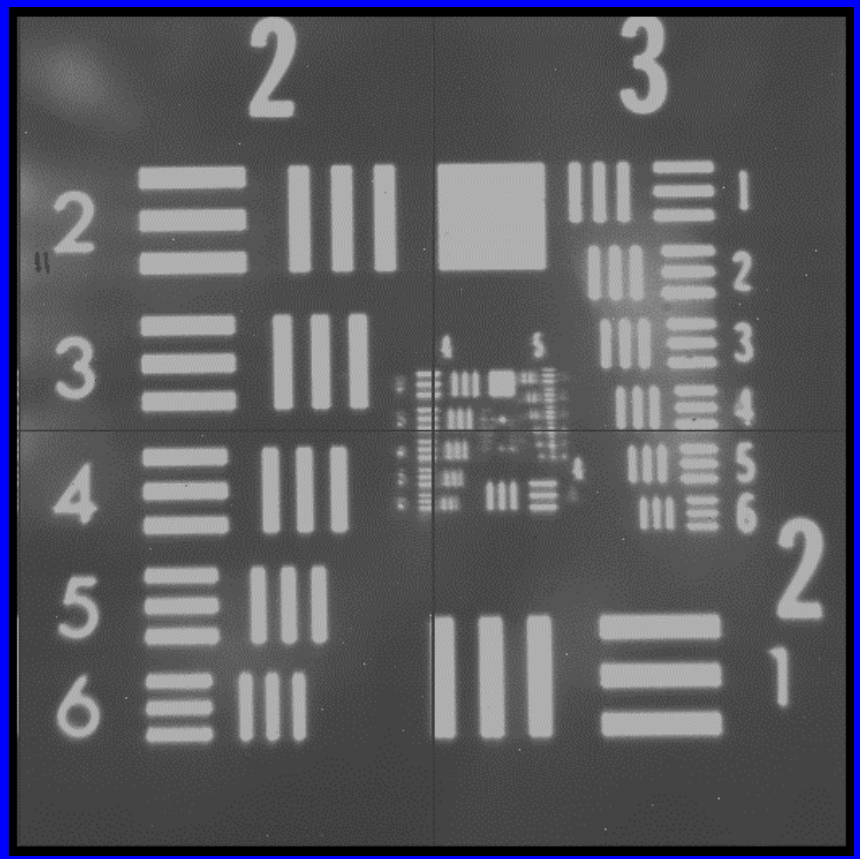






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Science grade detector characterization



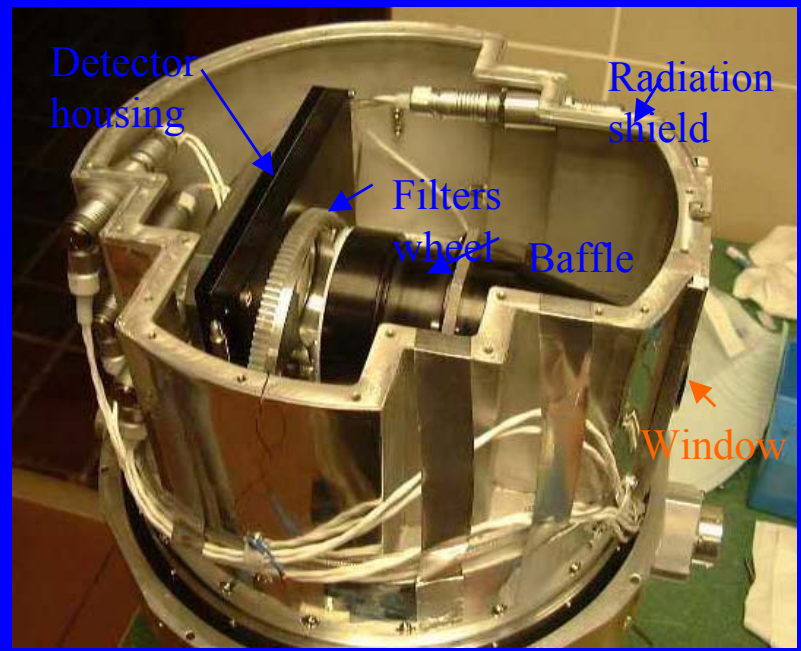
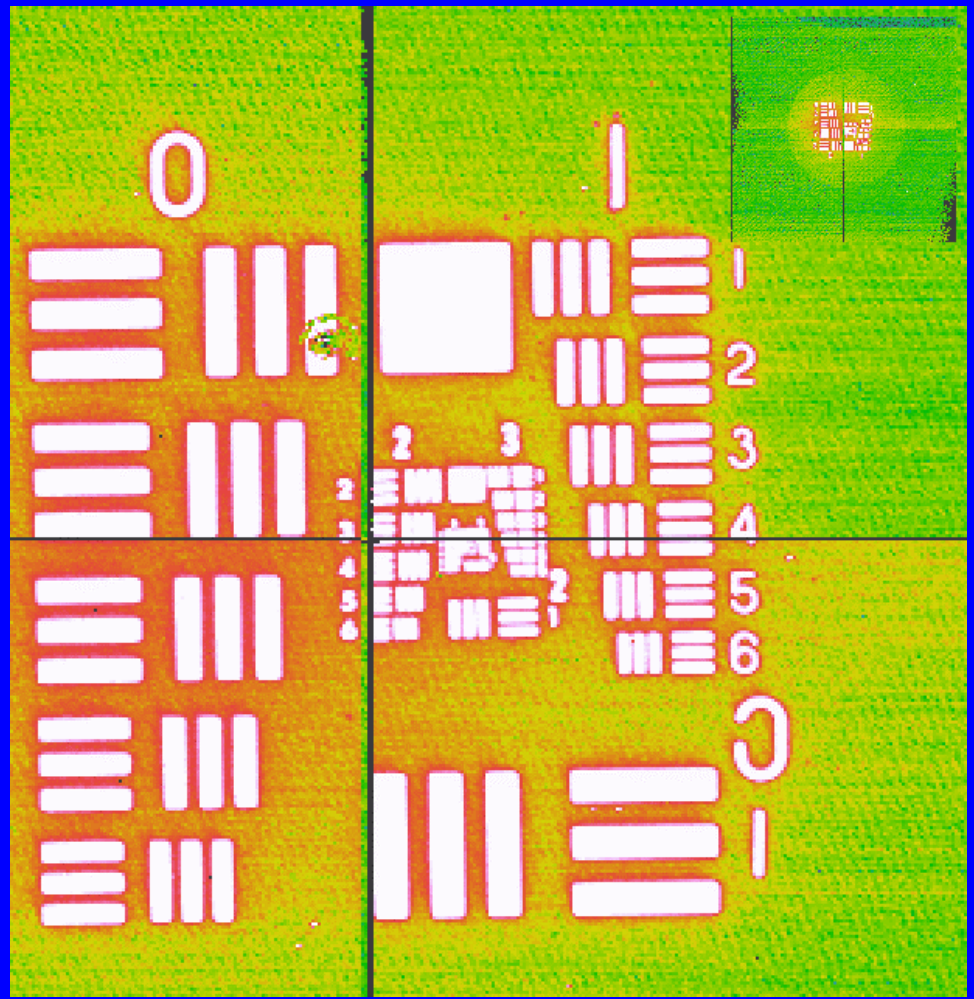


Image of an USAFSR pattern obtained with the science grade detector using a SDSU controller.
Read-out 15 electrons, Dark current < 0.1 e^-/s.
Full depth well ~ 150000~e^- / 65000 e^- (linear > 99%)

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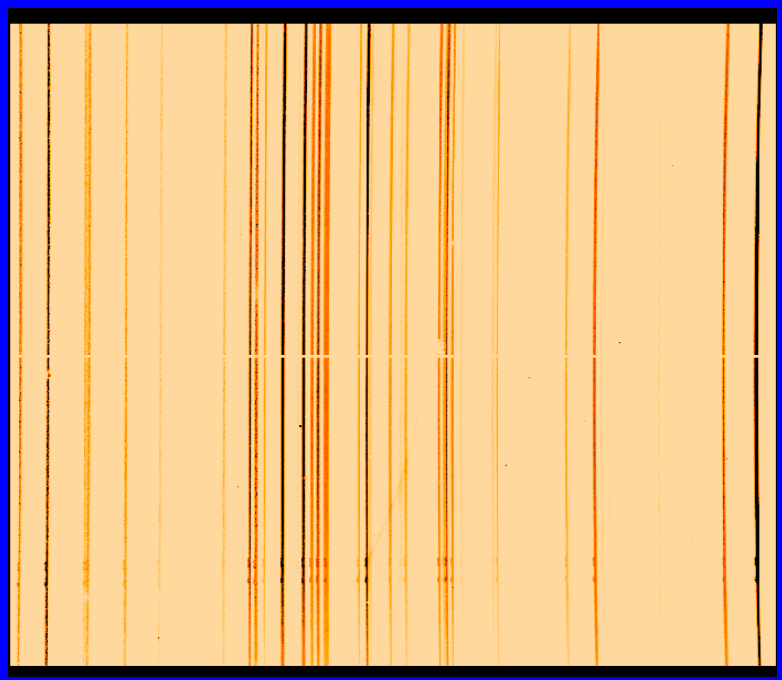
Verification at IAC

USAF test image obtained with LIRIS optics resolution
⇒requirement is fulfilled !!



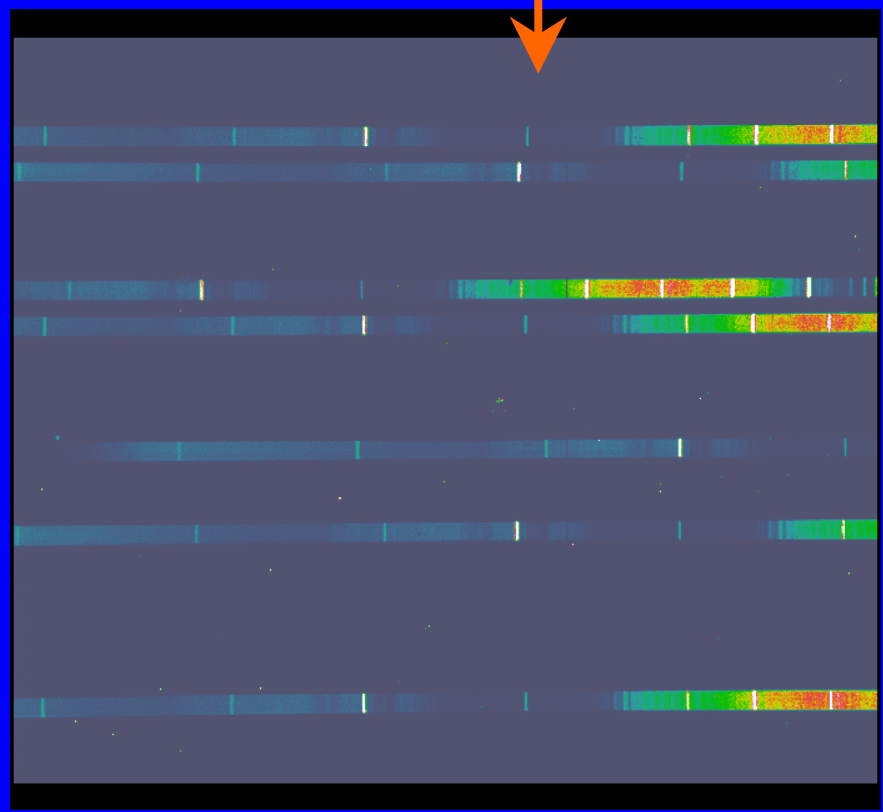
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Verification at IAC (sp.)

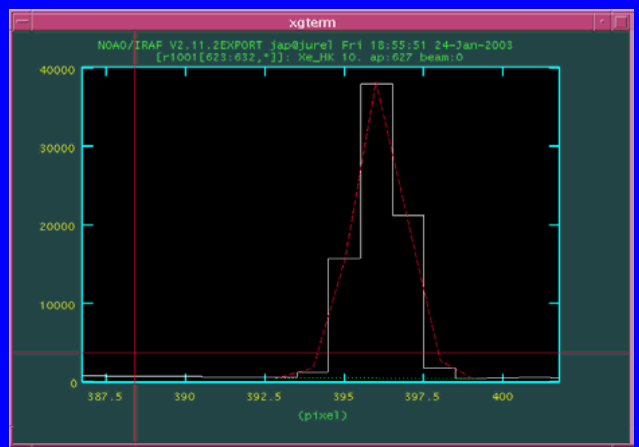


Calibration lamps spectra obtained during L4

Multi-object mask

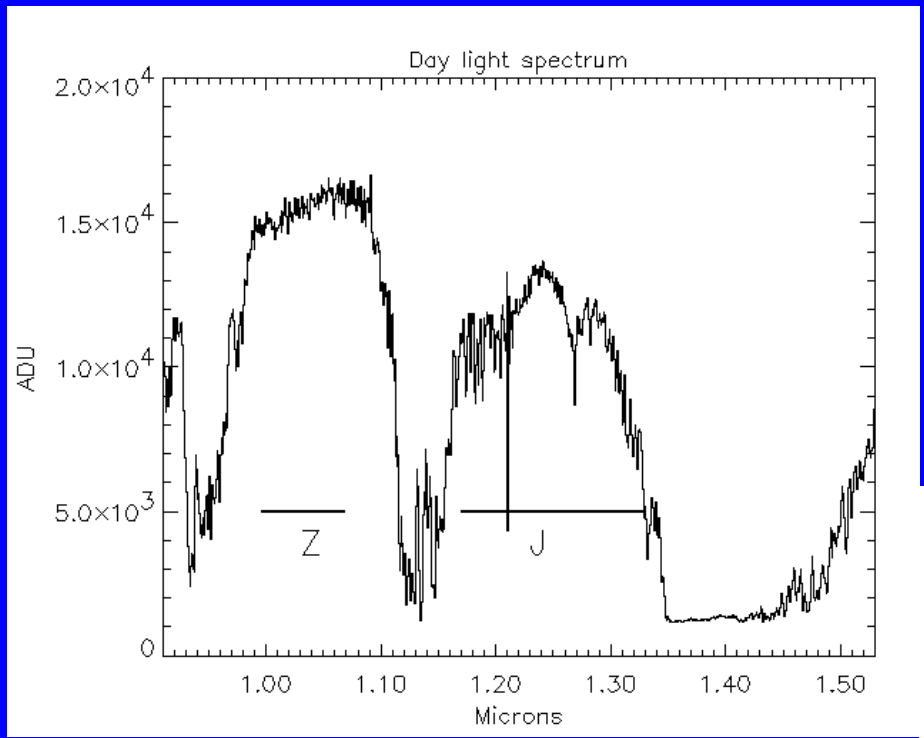


FWHM
~2 pixels

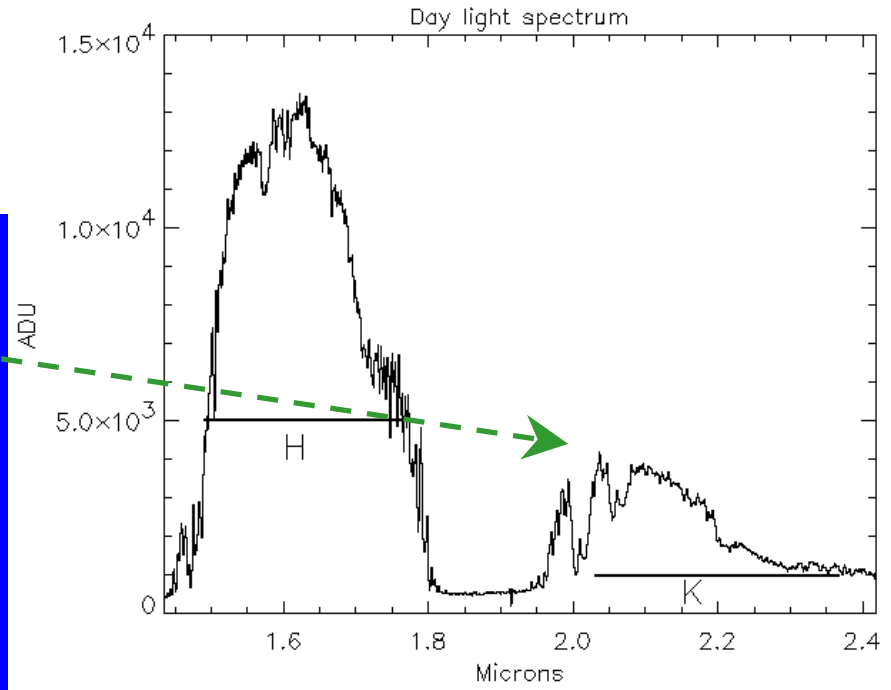


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Verification at IAC



Decreased transmission at K band due to high humidity at La Laguna



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Upgrades

Scientific grade detector

Detector Focus mechanism

Coronography: focal plane masks + apodization mask at pupil plane

Polarimetry: double wedge Wollaston $\Rightarrow$ four polarization vectors at one shot.

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Relevance for Estallidos

Observing at near IR increase penetrating power

Doing IR spectroscopy open to new line diagnostics:

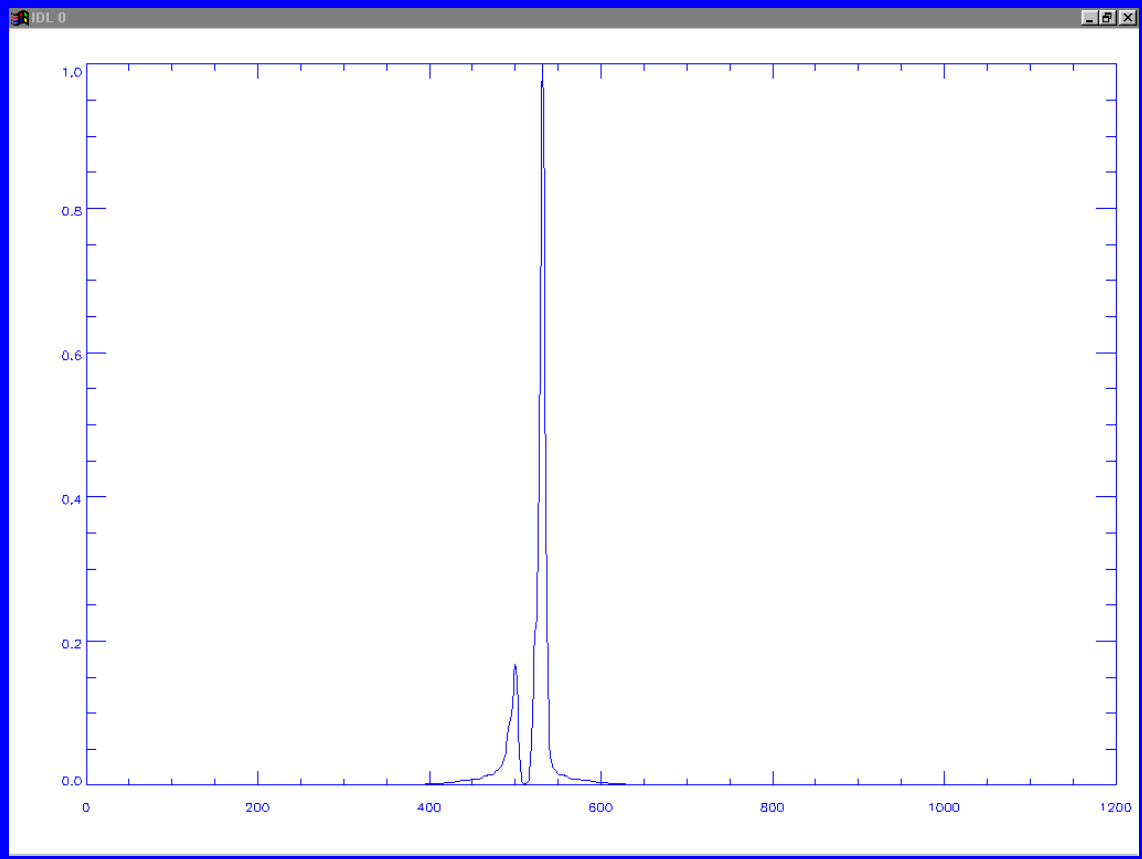
- Brg
- $H_2 \Rightarrow$ shock or photoionizatoin discriminator, density indicator
- [FeII]
- HeI $\Rightarrow$high mass cutoff of IMF?

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Brown dwarfs and planet search

- Methane identification in Brown dwarfs and giant planets via NIR spectroscopy.
- Brown dwarfs and giant planets NIR imaging.

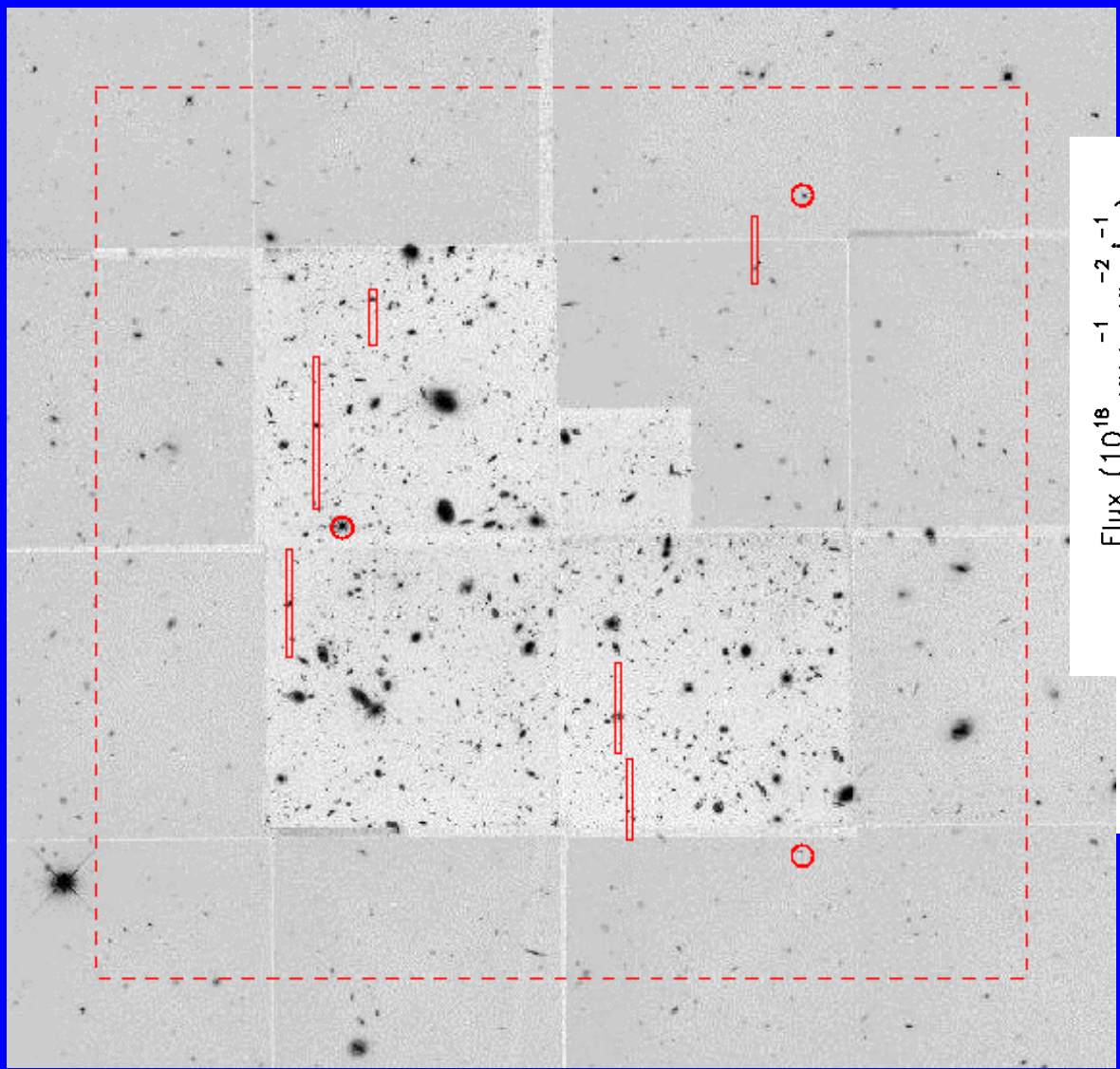
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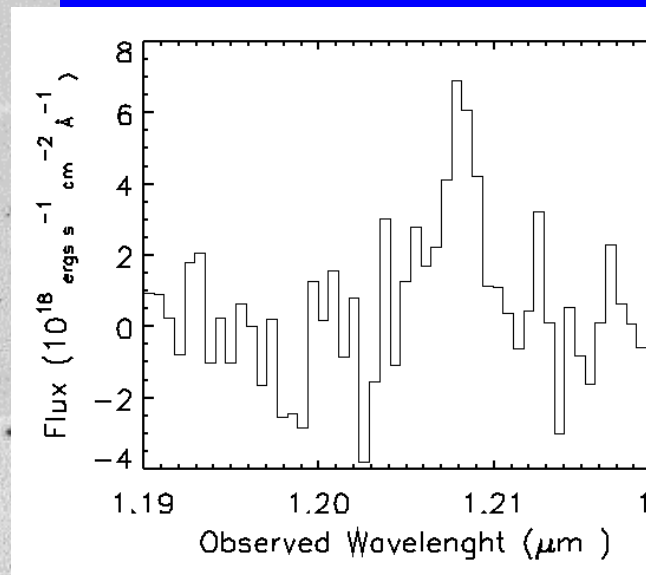


HD 167605B (rho=1.1, Δm_j=4) λ=2.2 μm, seeing 0.4 arcsec, mask 1 arcsec. LIRIS focal plane intensity, scanned through the binary.

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Slit masks for the HDF+FF





Hα in a
galaxy at z = 0.84
NICS t_{exp} = 4000s
15.4 x10^{-17} ergs s^{-1} cm^{-2}
(Dominguez-Tagle et al. 200

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LIRIS *vs* other IR spectrographs

Instrument	Telescope Aperture (m)	Wide field Scale (“/pix)	Wide field Field (arcmin)	Spectral Resolution	Multi-slit	Polarimetry	Coronography
Omega-Cass	3.5	0.3	5 x 5	420,1050	no	imaging	no
SOFI	3.6	0.27	4.7 x 4.7	1000, 2200	no	imaging	no
LIRIS	4.2	0.25	4.2 x 4.2	1000, 3000, 4200	yes (10 masks)	Imaging, spectroscopy	yes
NICS	3.5	0.25	4.3 x 4.3	400, 1200,	no	Imaging, spectroscopy	no
Flamingos	4.0 8.0	0.3 0.08	10x10 2.5x2.5	1000, 2400	yes (11 masks)	no	no

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Filters

Filter	Cut-on (in microns)	Cut-off (in microns)
Z	0.996	1.069
J	1.170	1.330
H	1.490	1.780
K_s	1.990	2.310
Br-gamma	2.150	2.182
K-continuum	2.253	2.287
H-continuum	1.558	1.582
[FeII]	1.632	1.656
H2 v=1-0	2.106	2.138
H2 v=2-1	2.231	2.265
CH4_1	1.640	1.740
He I	2.043	2.073

Current status

Dec- 01

- **First cool down cycle A of LIRIS: Integration of the entrance wheel +collimator (80 K was reached).**

Nov-01

- **Science degree detector characterized.**

Sep-01

- **The entrance wheel assembly with its driving motor tested in cool conditions.**
- **Manufacture of filters, pupil and grisms wheels is finished.**

Aug-01

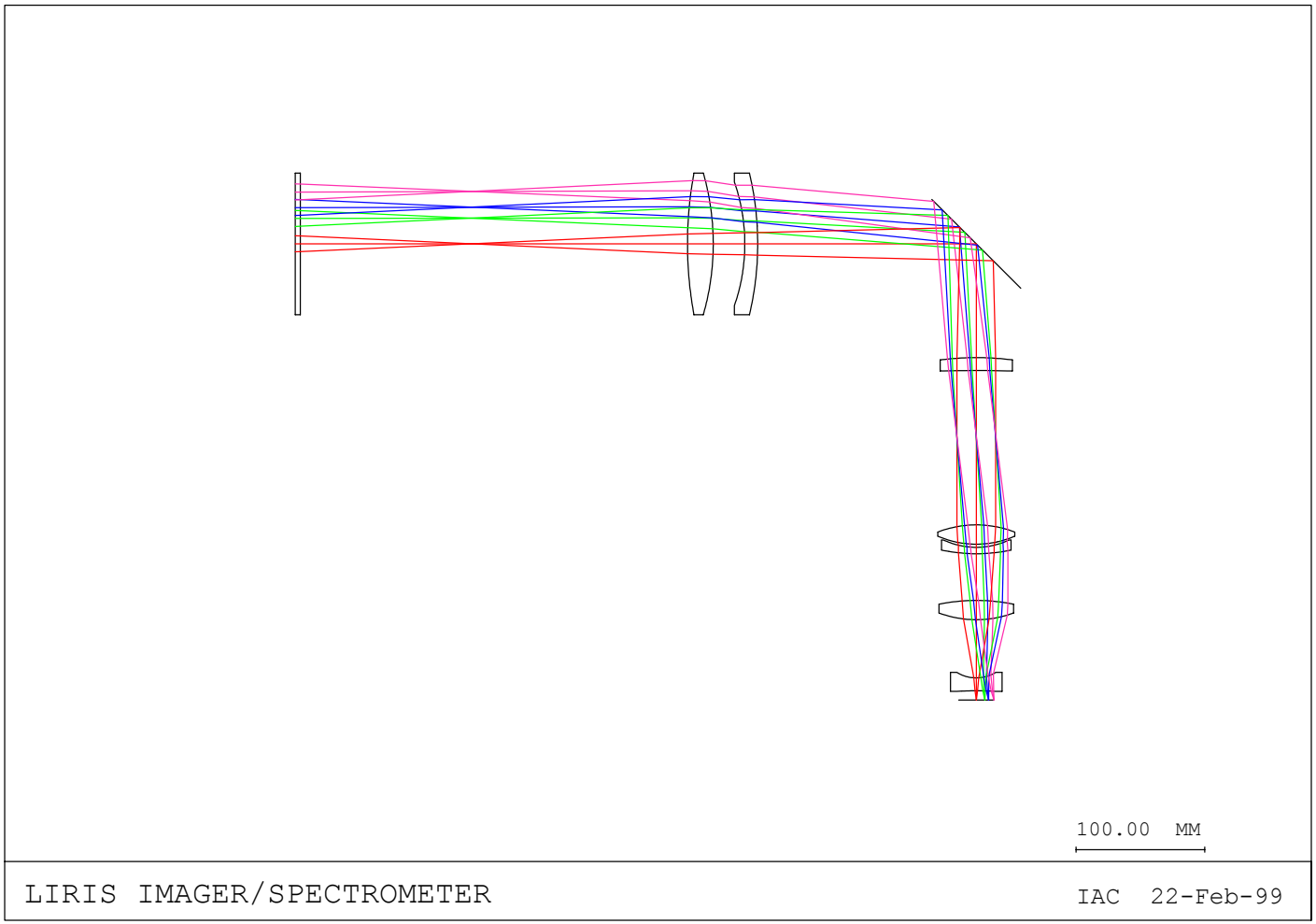
- **Engineering detector characterized.**
- **Cryostat vessel successfully tested in cryogenic conditions.**

Apr-01

- **Cold verification of the camera and collimator.**

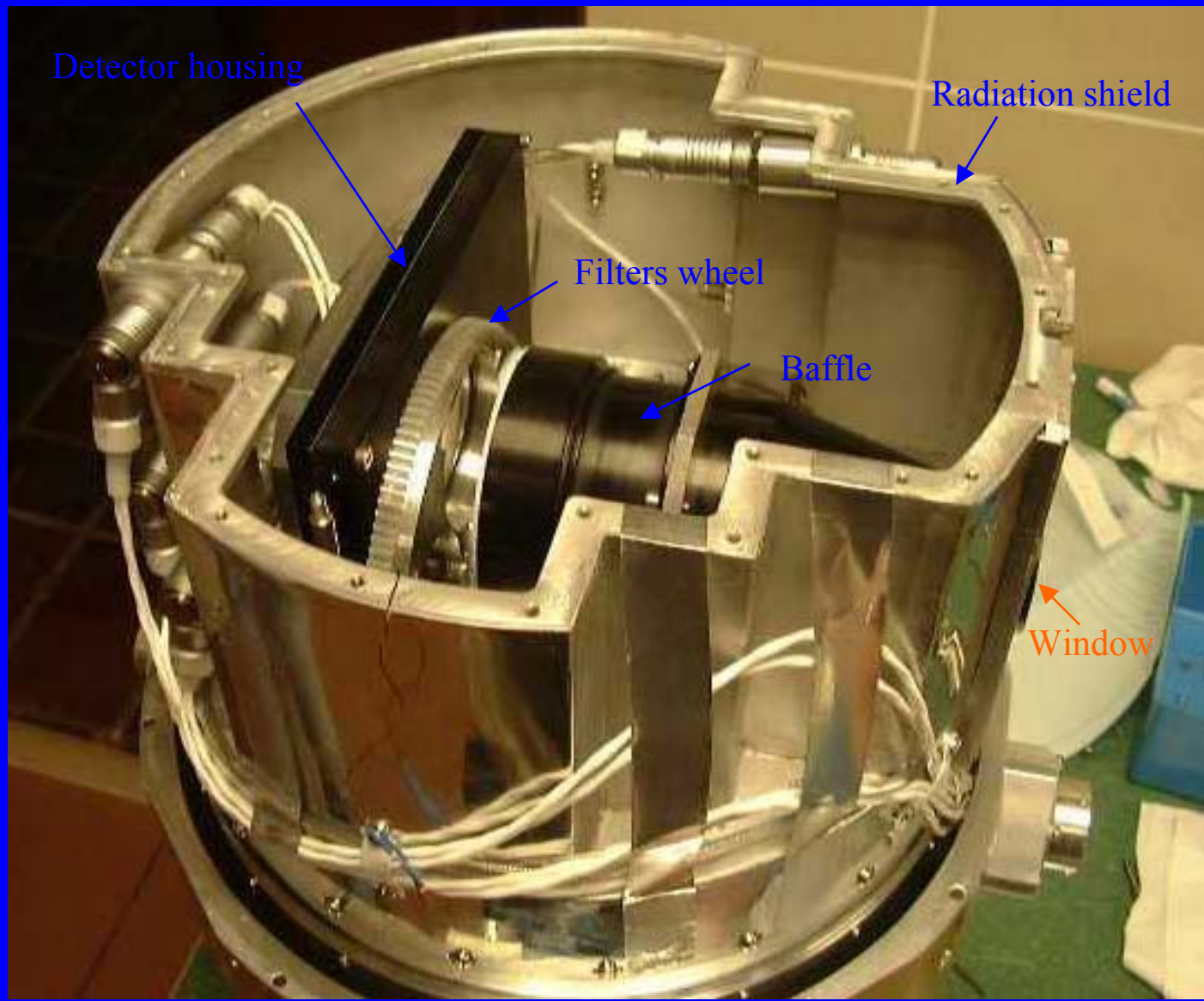
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Optical Concept



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Detector test bench



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Science degree detector

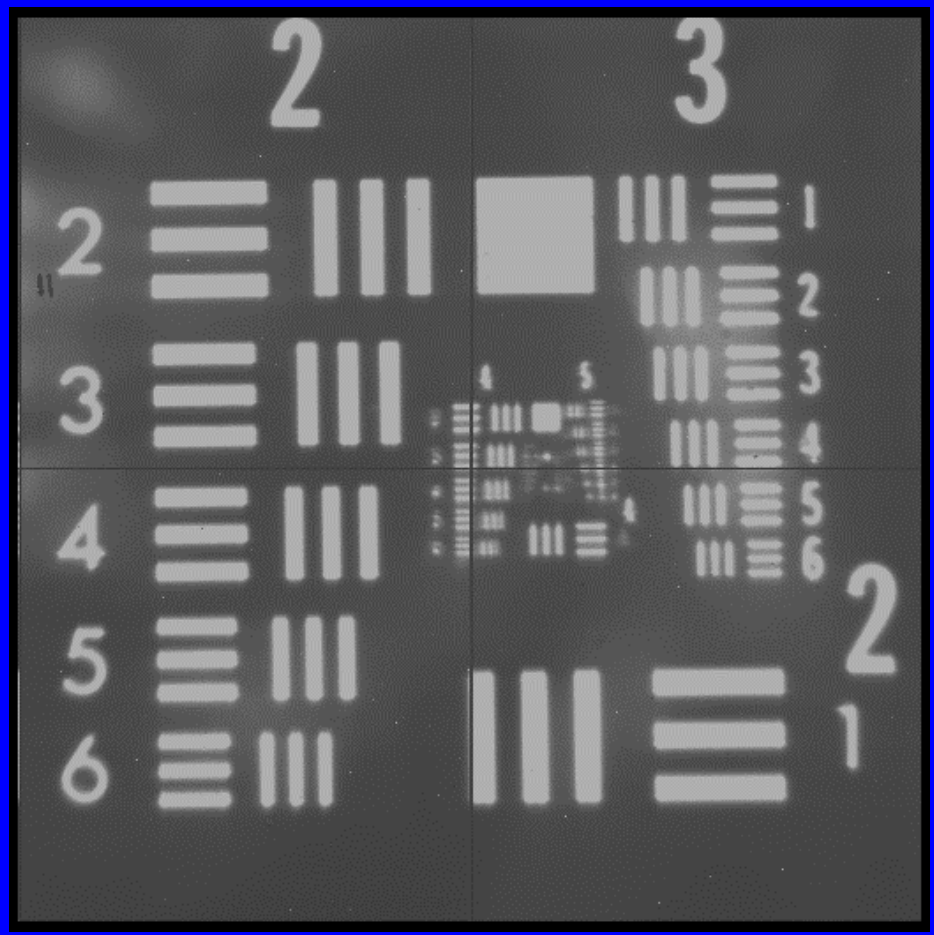


Image of an USAFSR pattern obtained with the science degree detector using a SDSU controller.
Read-out 15 electrons.