EMIR, the NIR MOS and imager for GTC

F. Garzón @ EMIR Team

EMIR PI

ING MOS, La Palma, March 2015

Summary

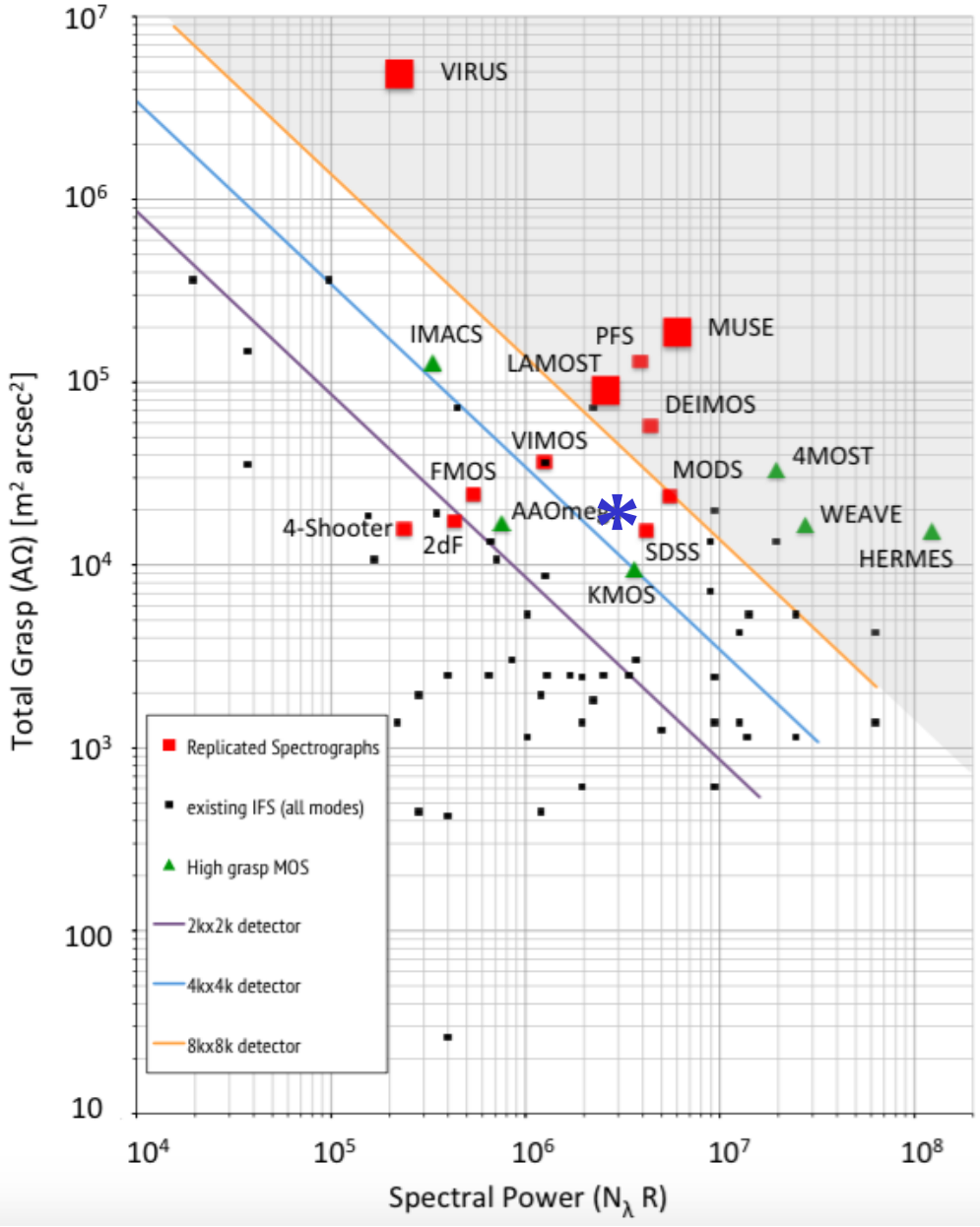
- What is EMIR?
- Science with EMIR
- Instrument integration
- Verification Plan
- Results up to now
- Plan to first light

EMIR

- NIR Imager and Multiobject Spectro-graph, common user instrument at GTC.

Spectral Range	0.9-2.5μm[1.1-2.5μm]	MOS mode	
Top priority	MOS in K band	FOV	6,7x4 arcmin (55 slitlets)
Spectral Resol.	5000,4250,4000 (JHK)	Sensitivity	K~20.1 in 2h @ S/N=5 (continuum)
Spectral coverage	1 single window/exp.		1.4×10^{-18} erg/s/cm^2/Å @ S/N=6 (line)
Detector	HAWAI2 2048^2	Image mode	
Plate Scale	0.2 arcsec/px	FOV	6.7x6.7 arcmin
Image quality	ℓ_{80} < 0.3 arcsec	Sensitivity	K~22.8 in 1h @ S/N=5 in 0.6 arcsec aperture

EMIR metrics



Hill, 2014

EMIR TEAM (now)

- IAC:
  - M. Barreto
  - N. Castro (Cog.)
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  - M. Insausti (Cog.)
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- UCM:
  - N. Cardiel
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- LAM
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  - C. Gry
  - L. Martin
- LATT
  - E. Bourrec
  - R. Pelló
- Sci. Team

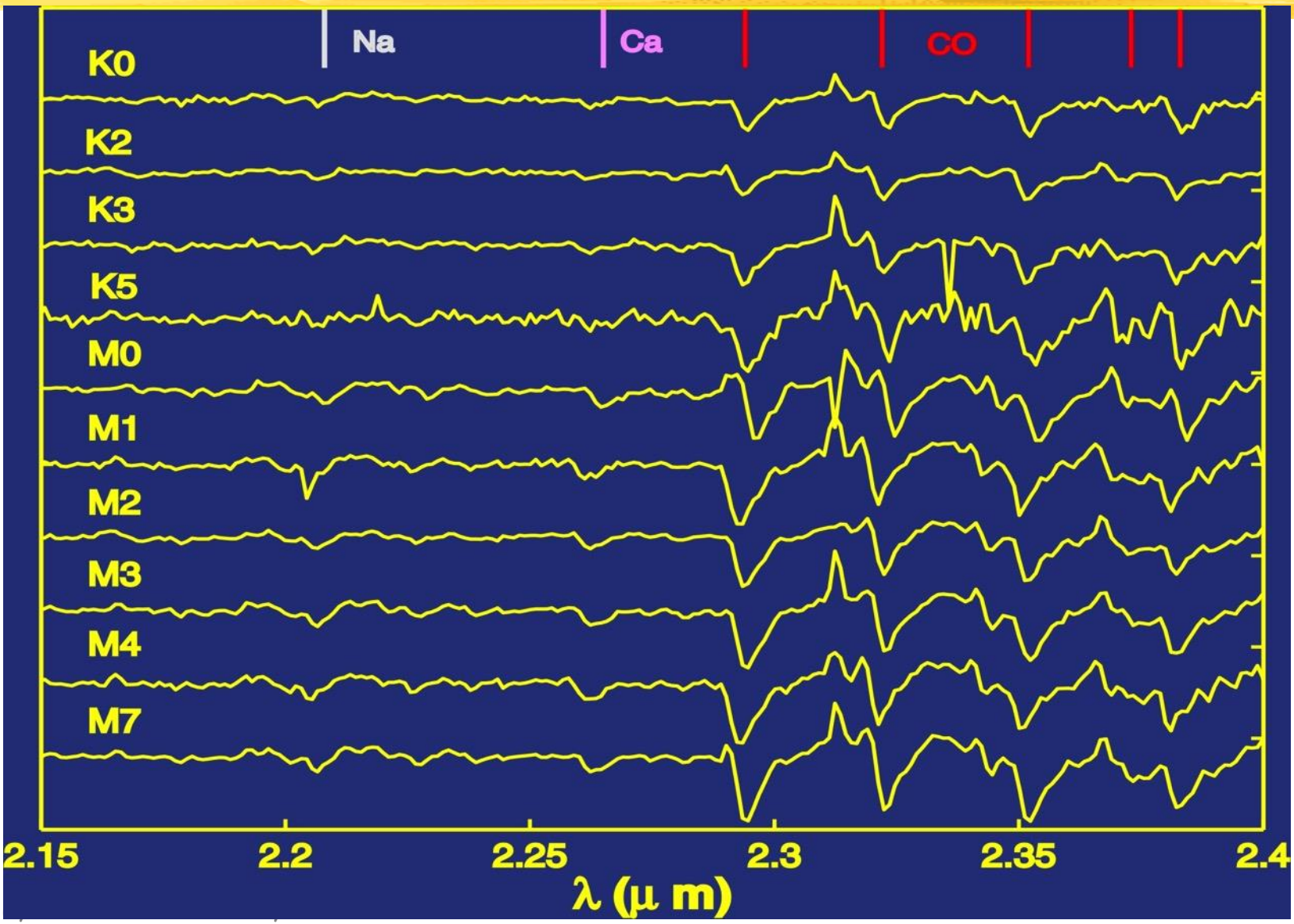
Science with EMIR

- Early sci. mainly coming from GOYA and EAST groups
  - GOYA
  - GALEP
  - MASGOMAS
  - HIGH-Z
  - ....

GOYA

- The Nature of ~L* SF population at 1<z<5.5
  - SFR (Hα, [OII])
  - Metallicity ([OIII+OII]/Hβ, [NII]/Hα)
  - Extinction (Hα/Hβ)
  - Kinematics & Virial Masses (velocity widths)
- Characterize ~L* E/S0 population at 1<z<2
  - Stellar ages/metallicities (4000Å, Hβ, Mg2, Fe)
  - Kinematics & Virial Masses (velocity dispersions)
  - Scaling Laws: structure, kinematics, stellar pops.
- Characterize the AGN population 1<z<4
  - SMBH (Hα and Hβ velocity widths)
- Detect primeval galaxies at z~9: (Lyα)

GALEP

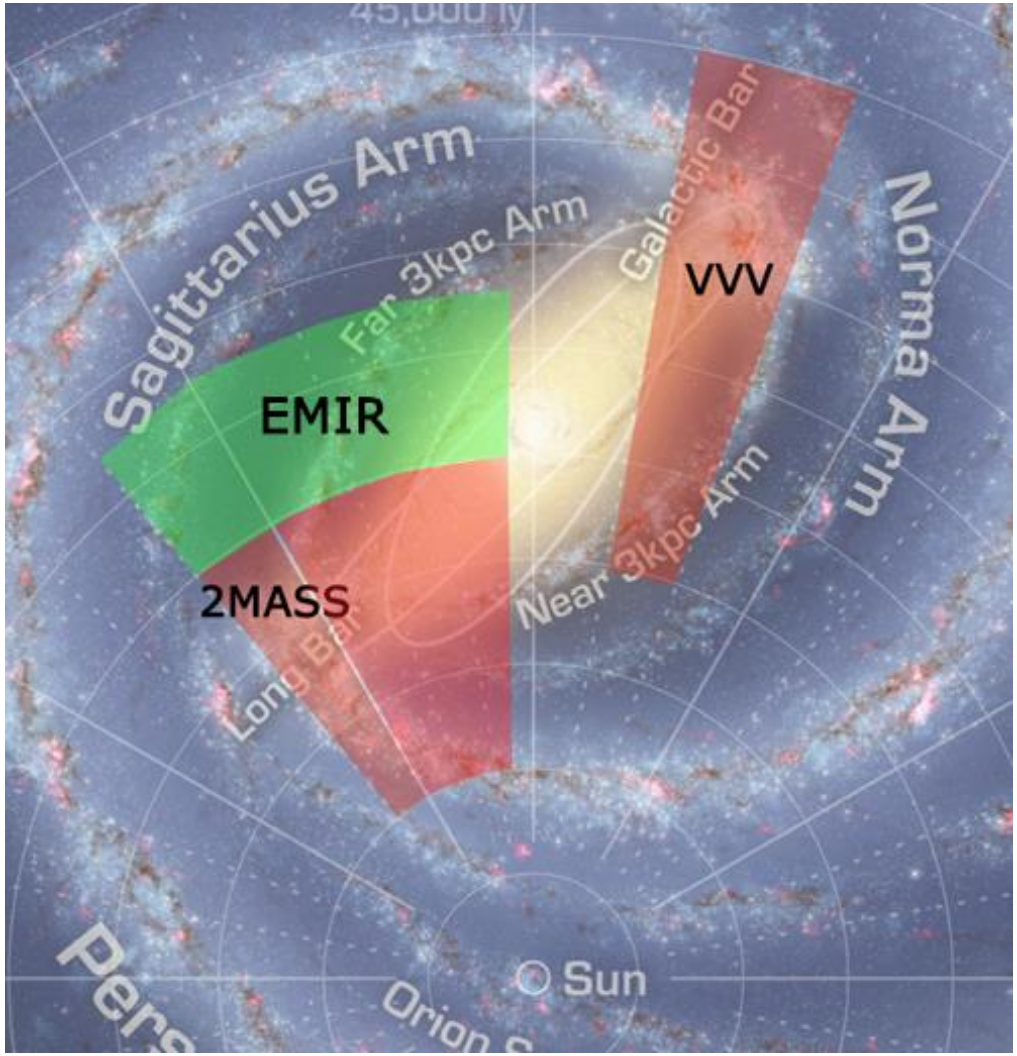


MASGOMAS

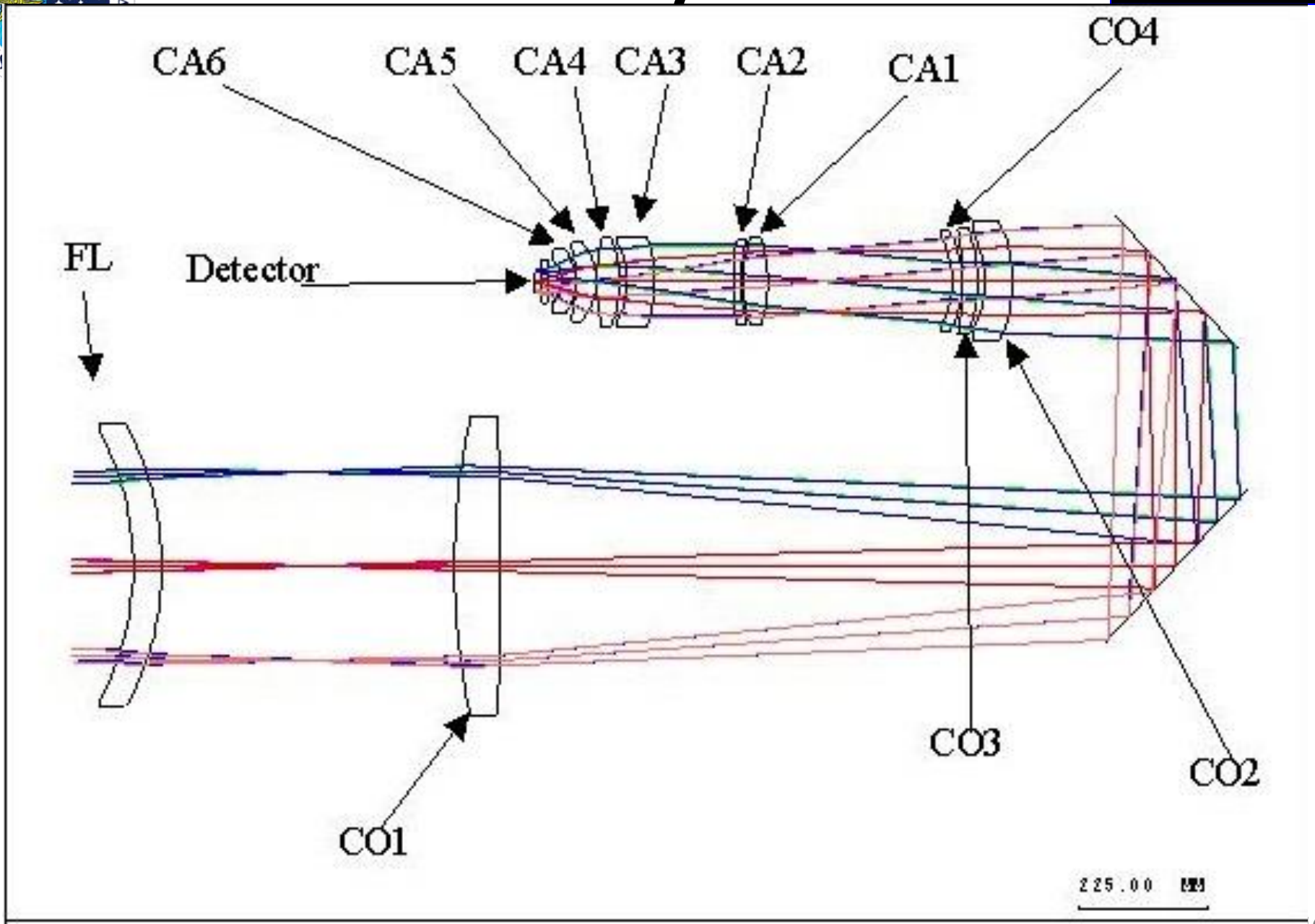
North:
-WHT, Ks < 12.5 (d< 3-4 kpc)

South:
-VLT, Ks < 17 (covers the whole MW)

With EMIR@GTC:
-We will extend the spectroscopic follow-up in the North to similar magnitudes than in the south



EMIR lay-out



Novel elements

Verification Plan

Cycle 0

- Ceramic Detector
- Wheels
- DTU
- Optics –Periscope
- FP – open

- Temperature
- Filter Wheel movement
- Pupil Wheel Movement
- DTU movement

Cycle 1

- Mux
- R band filter
- 1 GRISM + focus mask
- Optics full
- DTU
- FP– Pinhole mask

- Detector cool down
- Detector alignment
- Image quality
- Spectral alignment
- DTU movement calibration
- Filter wheel movement
- Pupil wheel movement

Cycle 2

- Engineering Detector
- IR filters
- Grisms + focus mask
- Optics – Full
- DTU
- FP – Pinhole mask

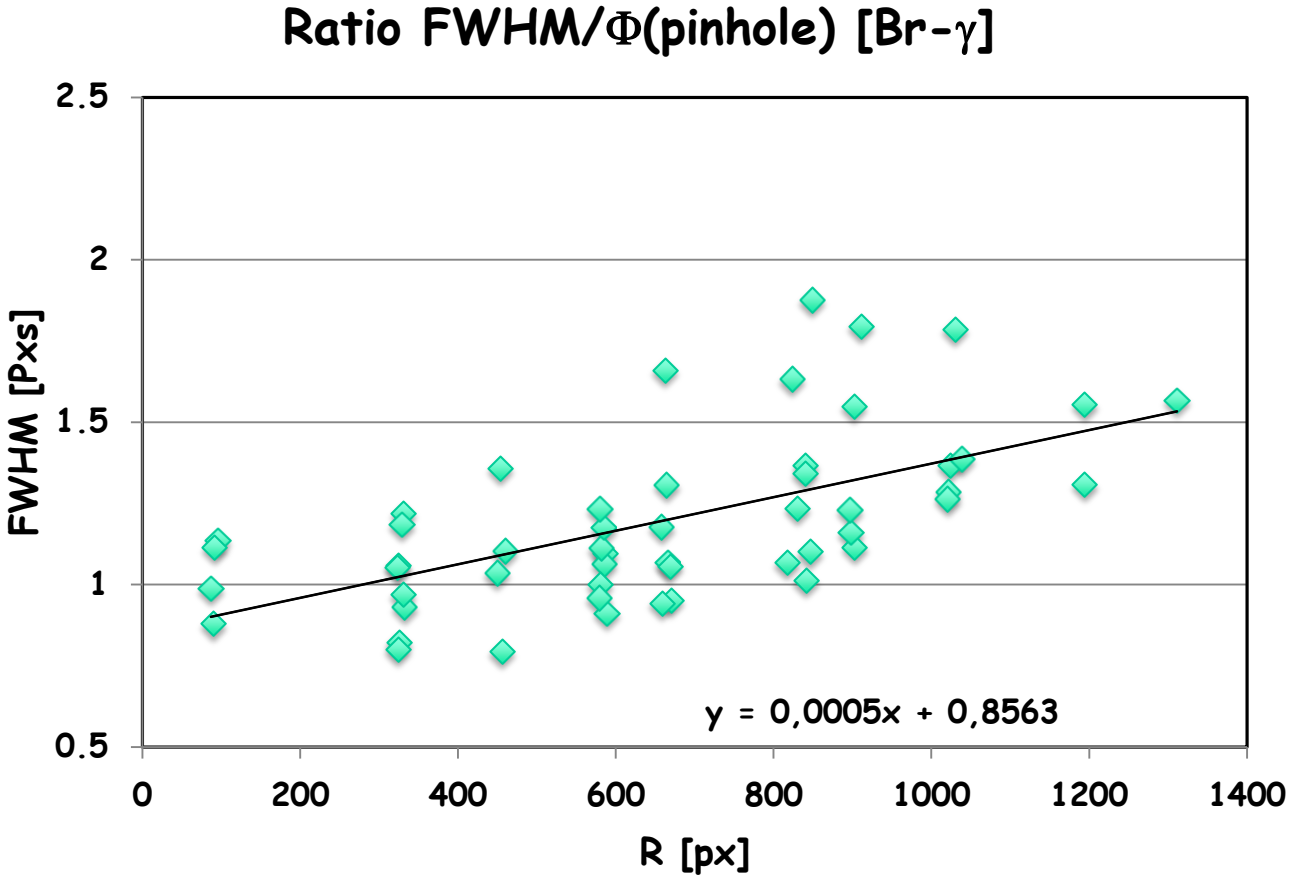
- Characterize Detector
- Detector Aligmnet
- Image quality
- Grism Alignment
- Repeatability test
- DTU movement
- Vingetting tests
- Flexure compensation
- Ghosts

Cycle 3

- Science Array
- IR filters
- Grisms + focus mask
- Optics – Full
- DTU
- FP – CSU

- Characterize Science array
- Alignment of Science array
- Standard Responses
- Stay light
- CSU Characterization

E-II: img. - PSF



1px=166 μm

<ratio> = 1,20

σ = 0,27

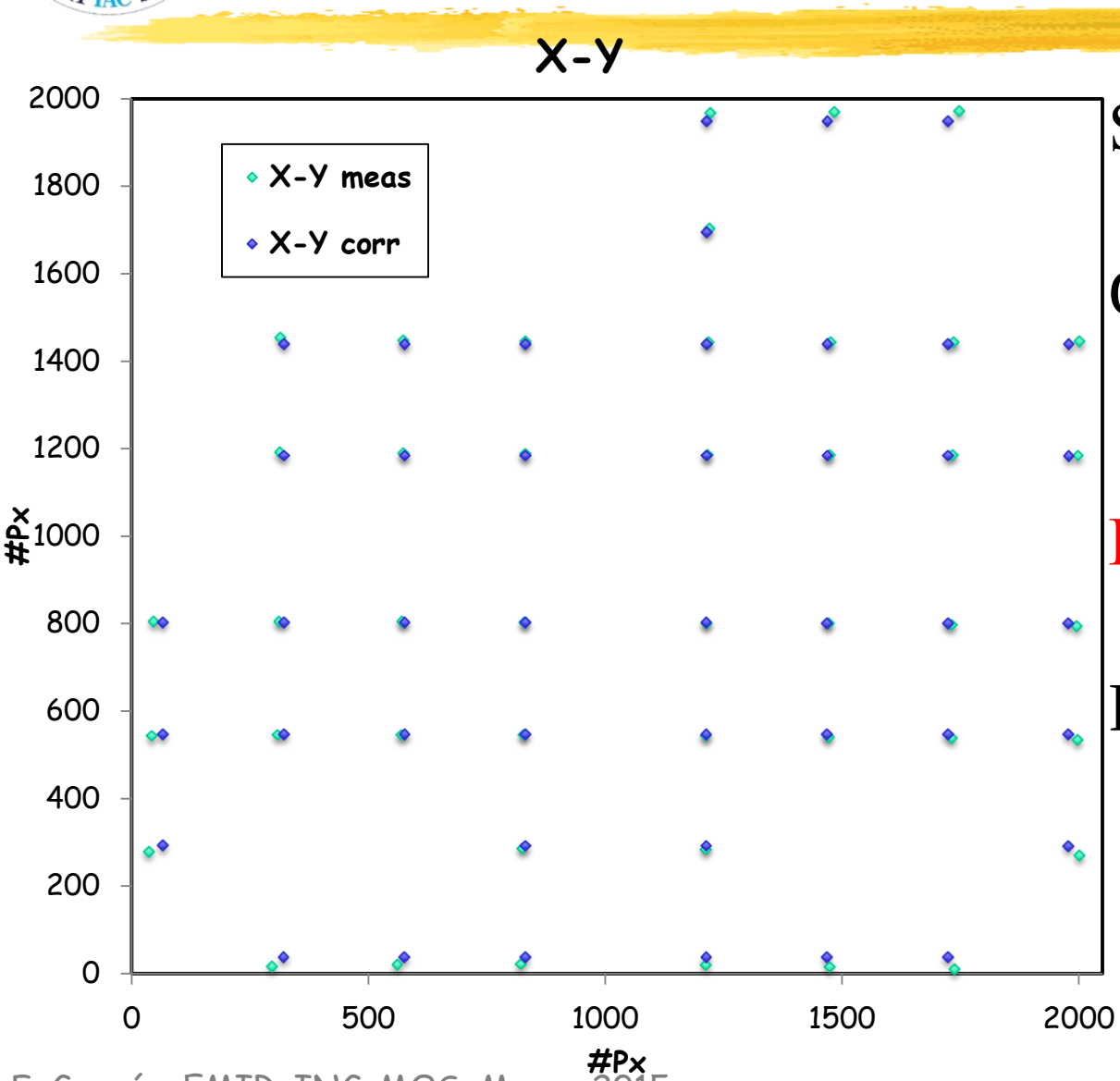
$FWHM_{opt}$=0.75px

req. EED80≤1.5px

si PSF~gauss

➔FWHM~EED80

E-II: img. - distorsion



S_FP: 1,1746”/mm

Geometric distorsion :

1,61% ± 0,59%

(0,23% – 2,76%)

Req. < 2.5%@4.2’

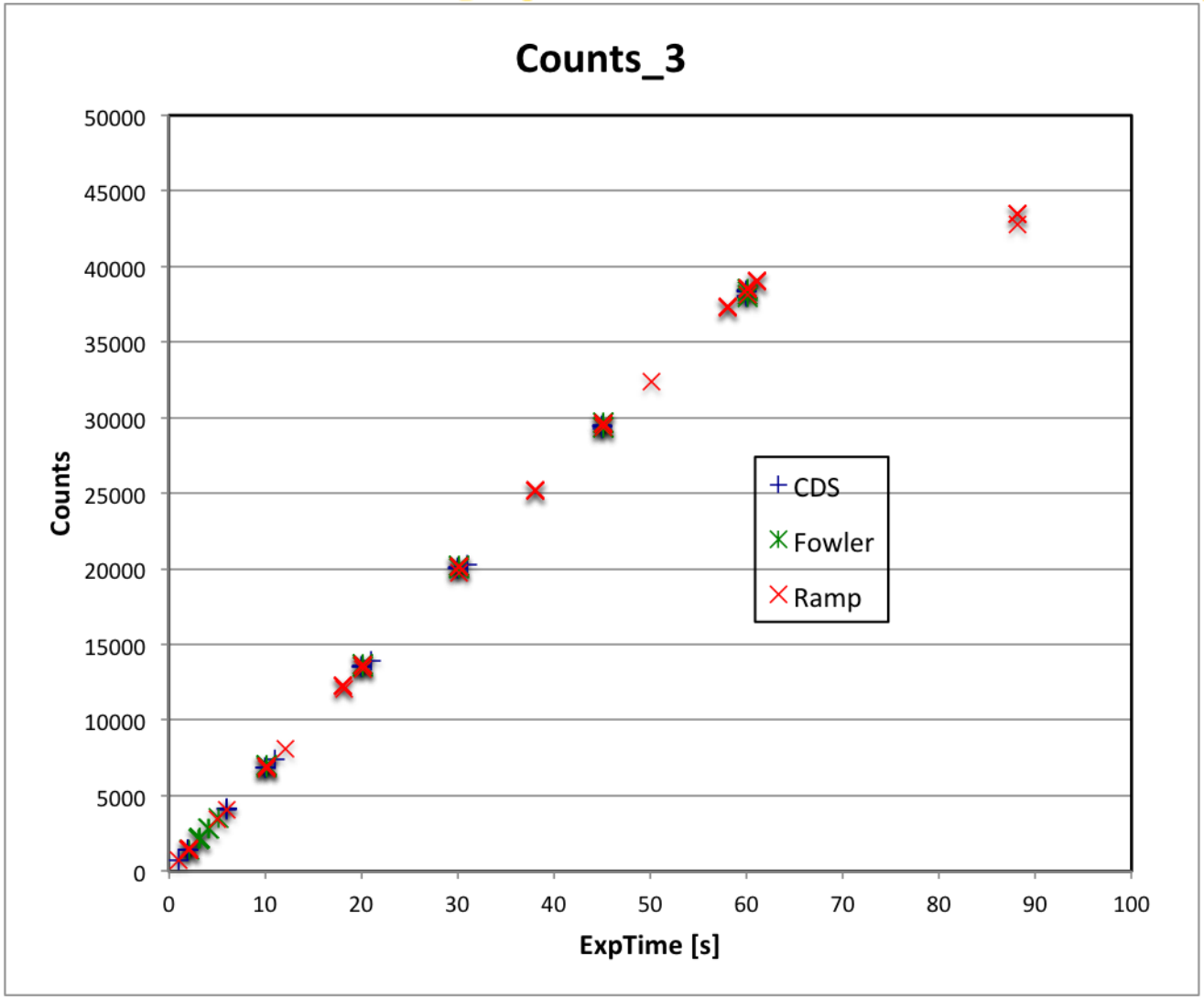
Plate scale

Px_X: 0,1917 arcsec

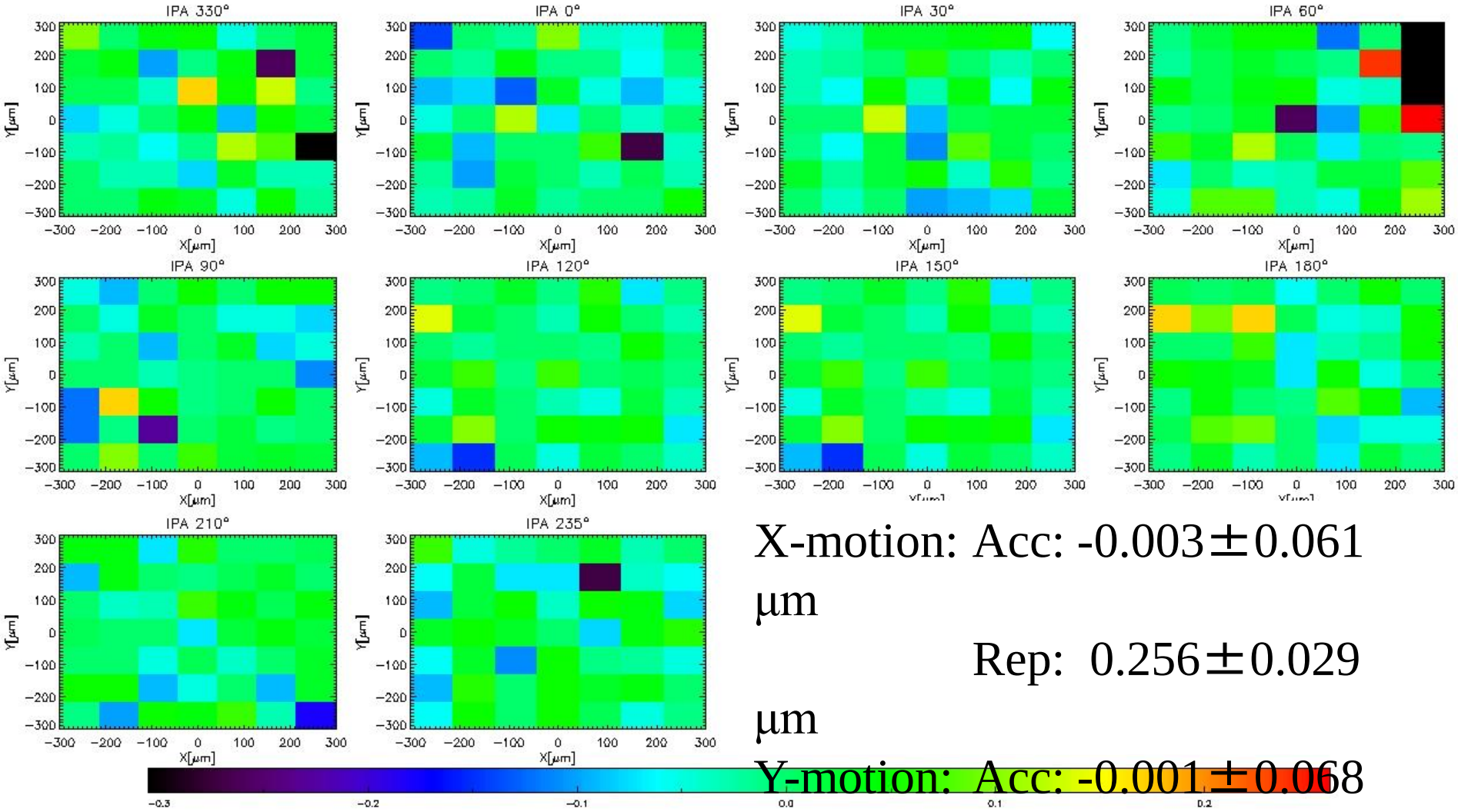
Px_Y: 0.1923 arcsec

Design: 0,1946 arcsec

E-II: readout modes



E-II: DTU



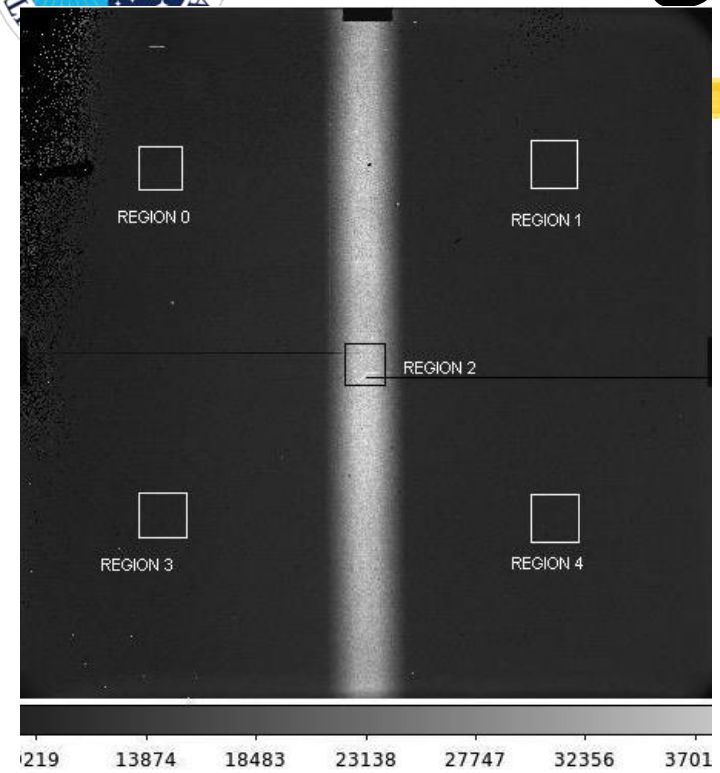
X-motion: Acc: -0.003±0.061 μm

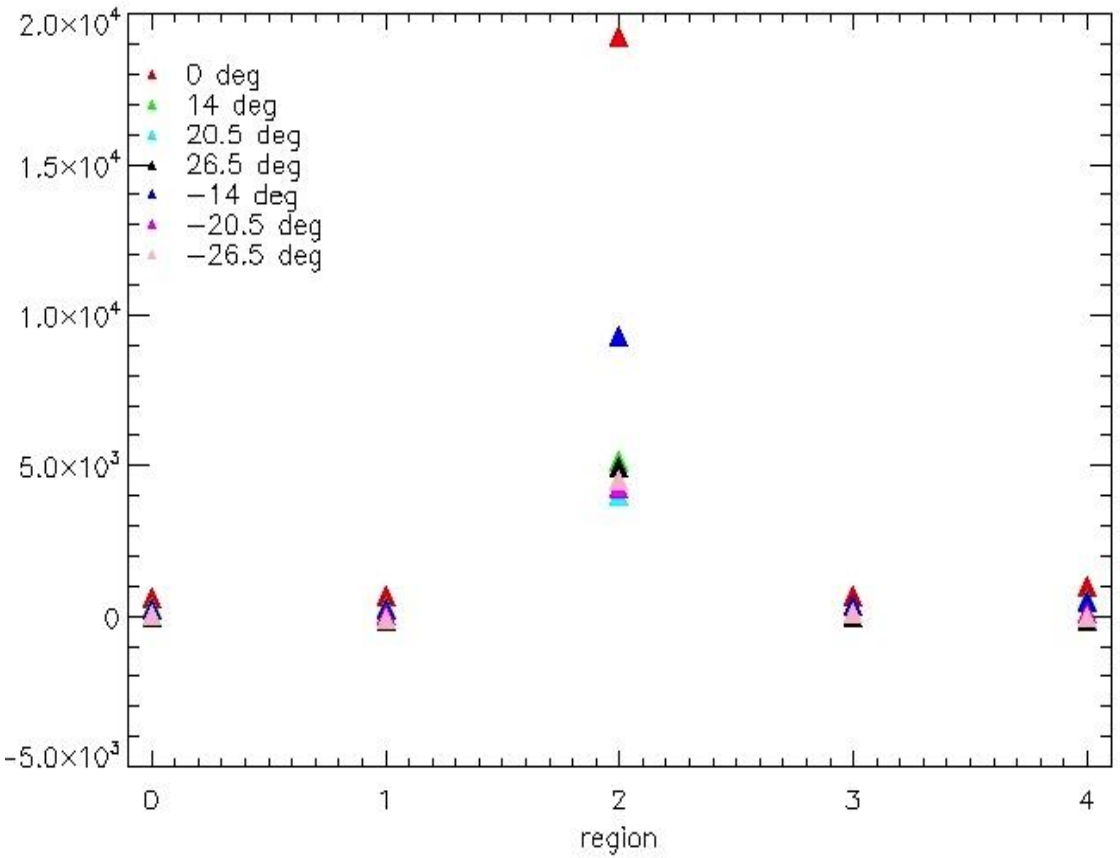
Rep: 0.256±0.029 μm

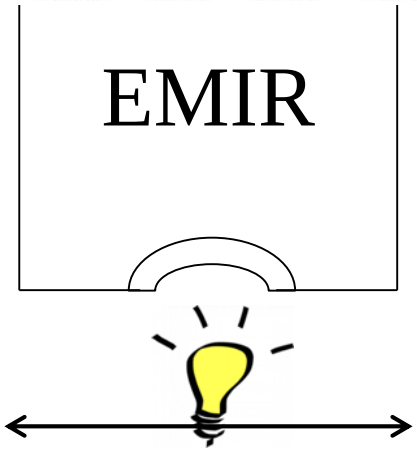
Y-motion: Acc: -0.001±0.068 μm

Rep: 0.241±0.025

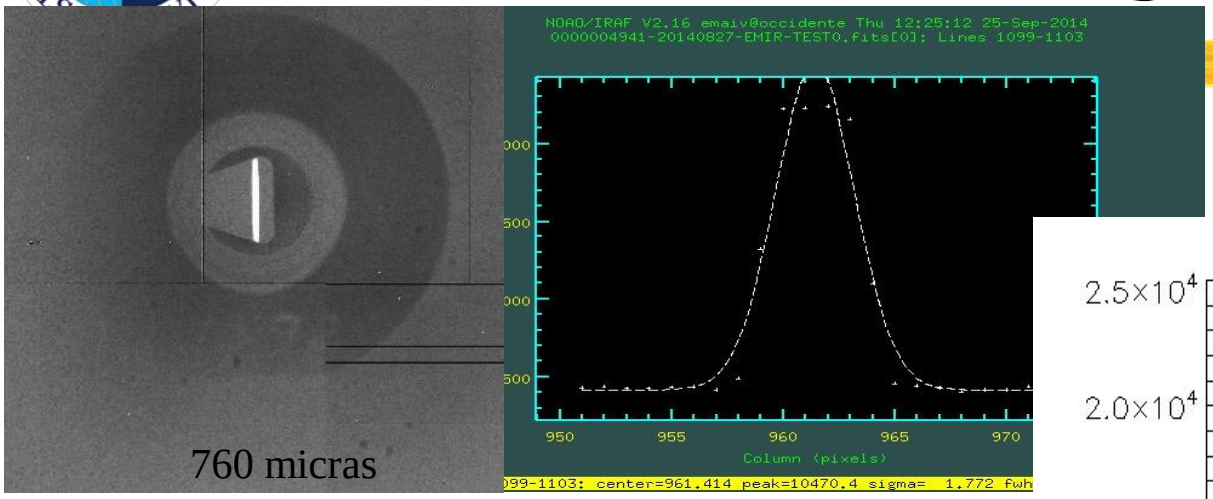
Stray light

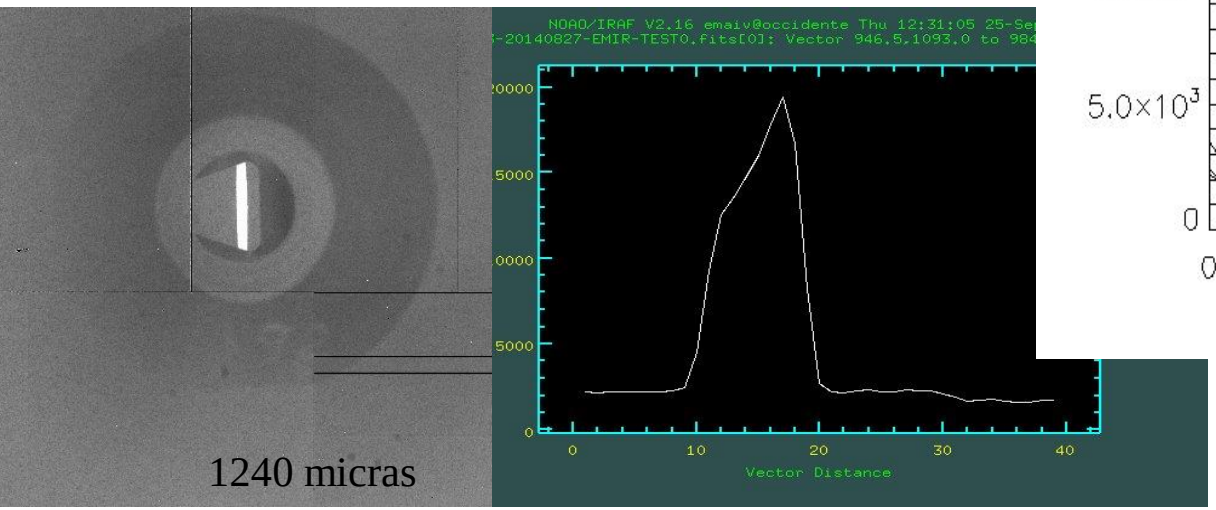

REGION 0
REGION 1
REGION 2
REGION 3
REGION 4
219
13874
18483
23138
27747
32356
3701

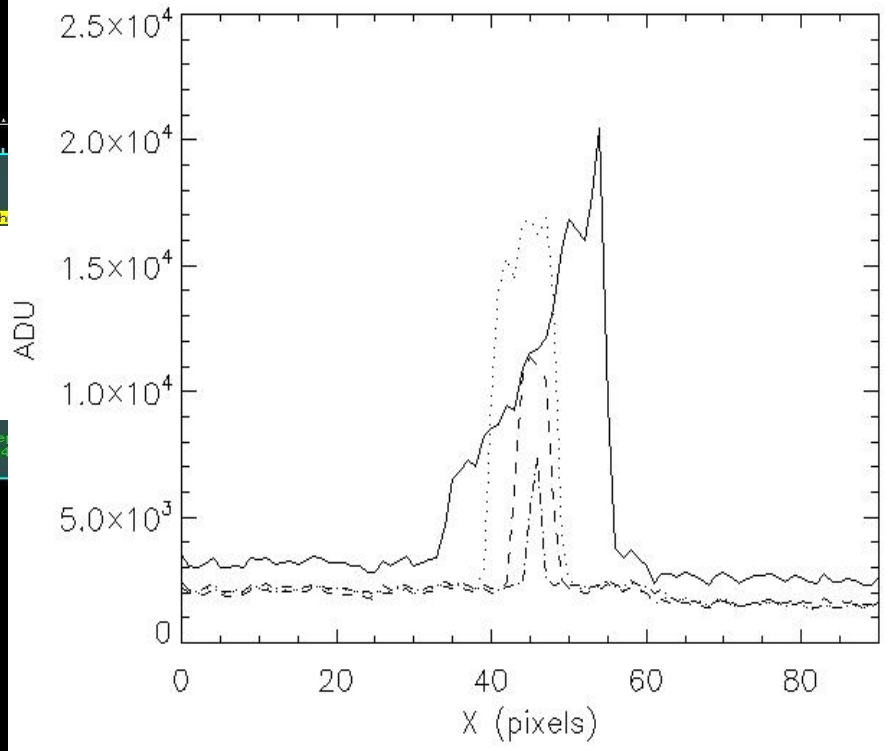

2.0×10^4
1.5×10^4
1.0×10^4
5.0×10^3
0
-5.0×10^3
0 deg
14 deg
20.5 deg
26.5 deg
−14 deg
−20.5 deg
−26.5 deg
0
1
2
3
4
region


EMIR

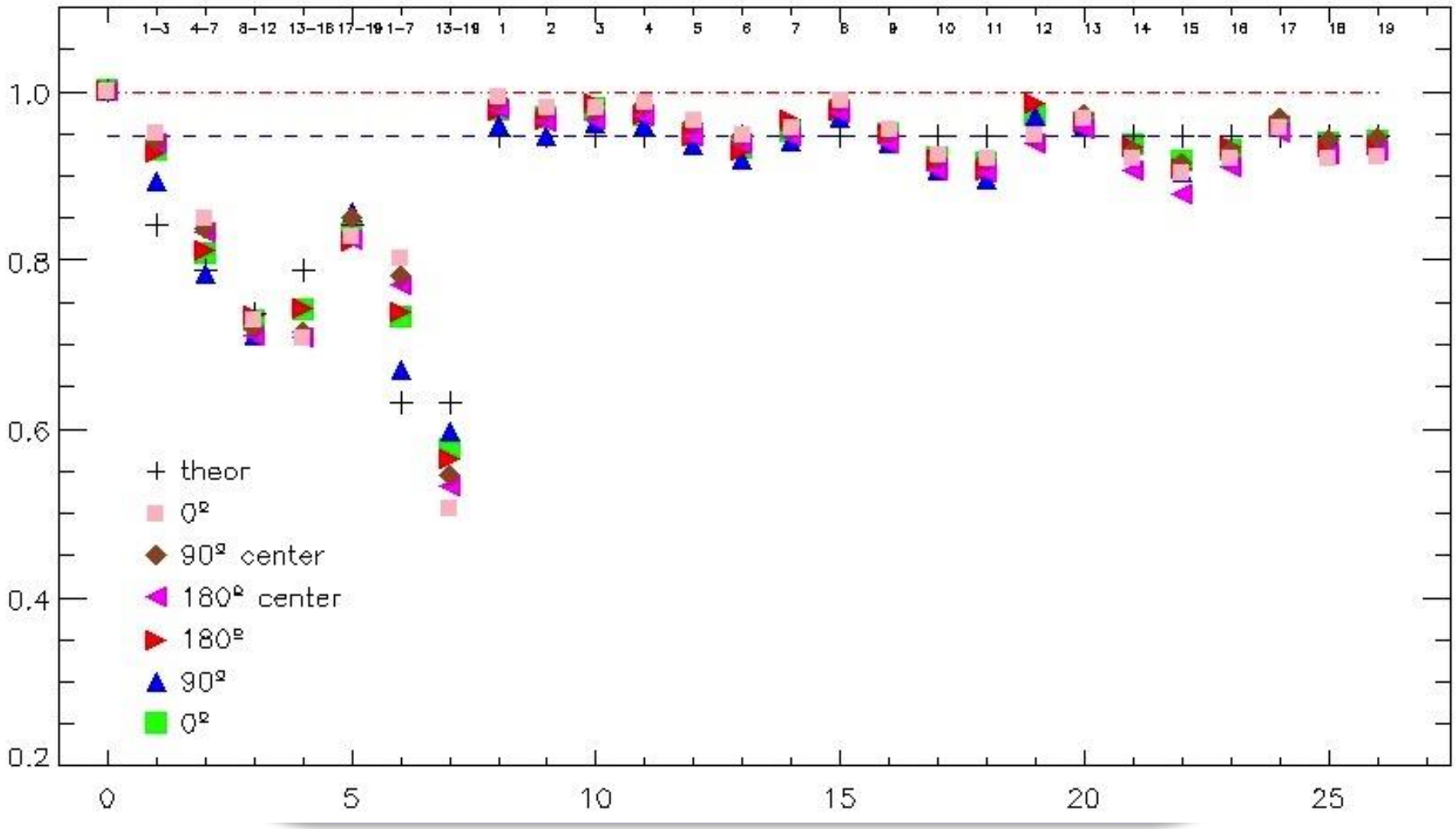
Scattered light



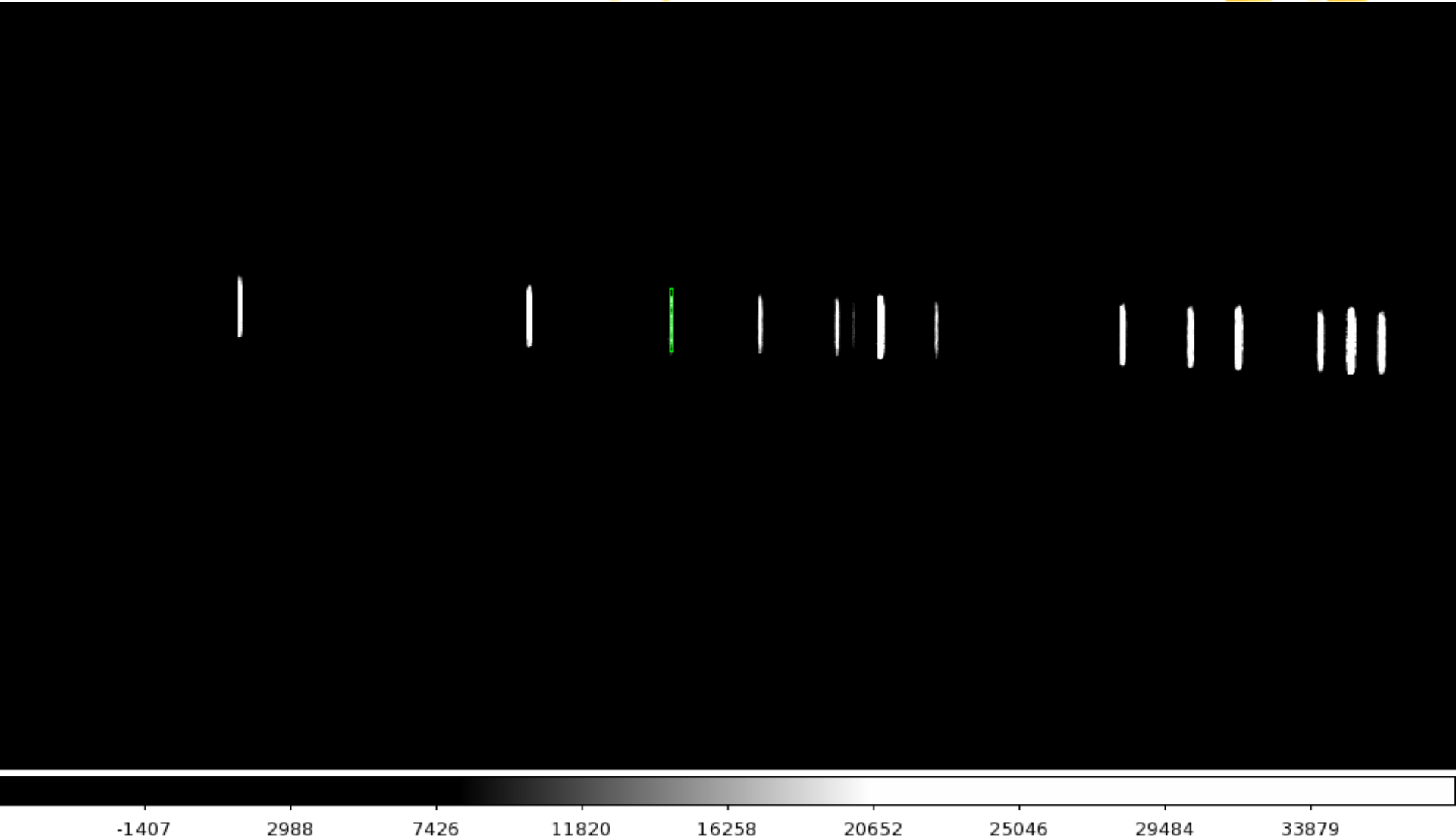




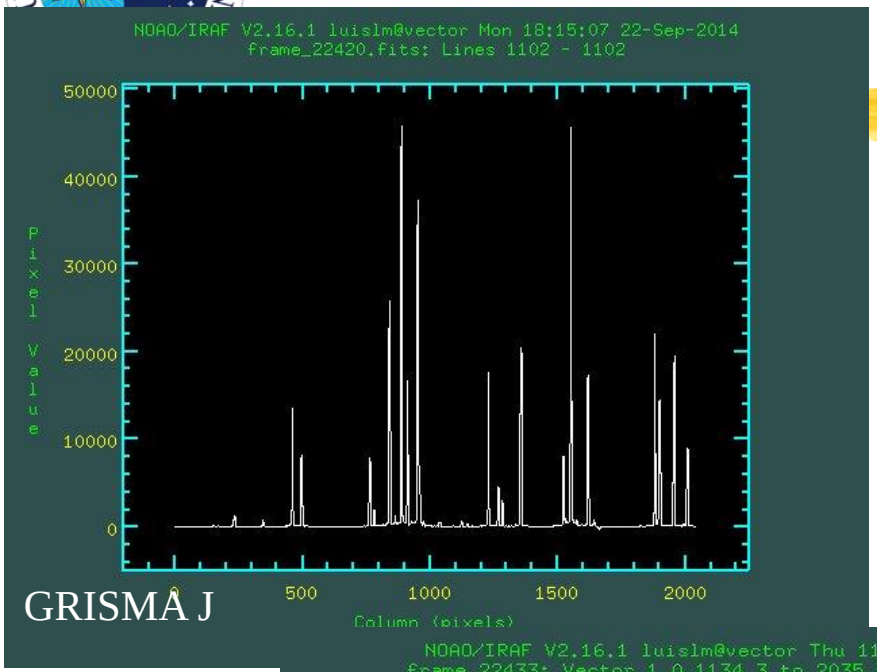
Pupil alignment

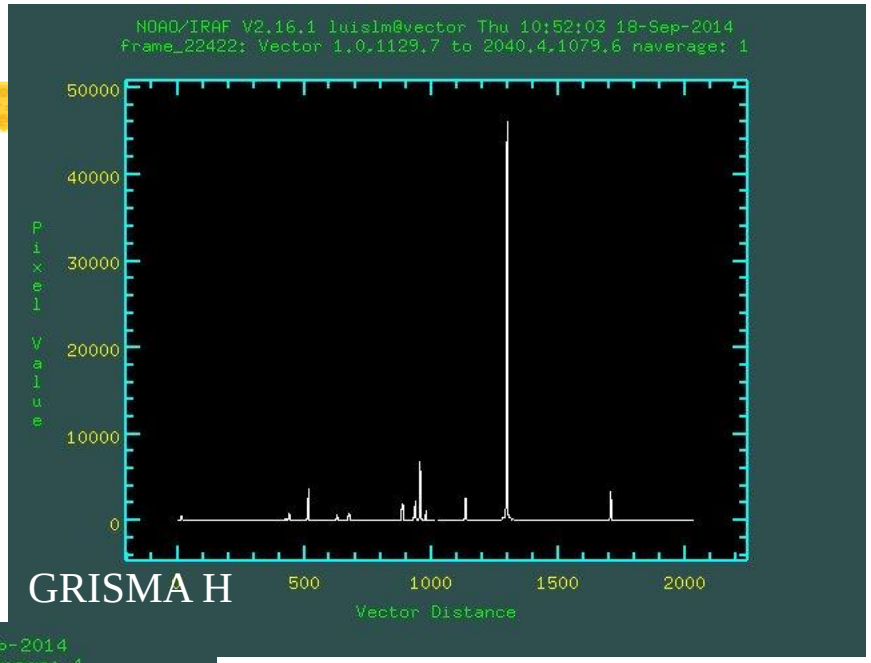


Some spectra

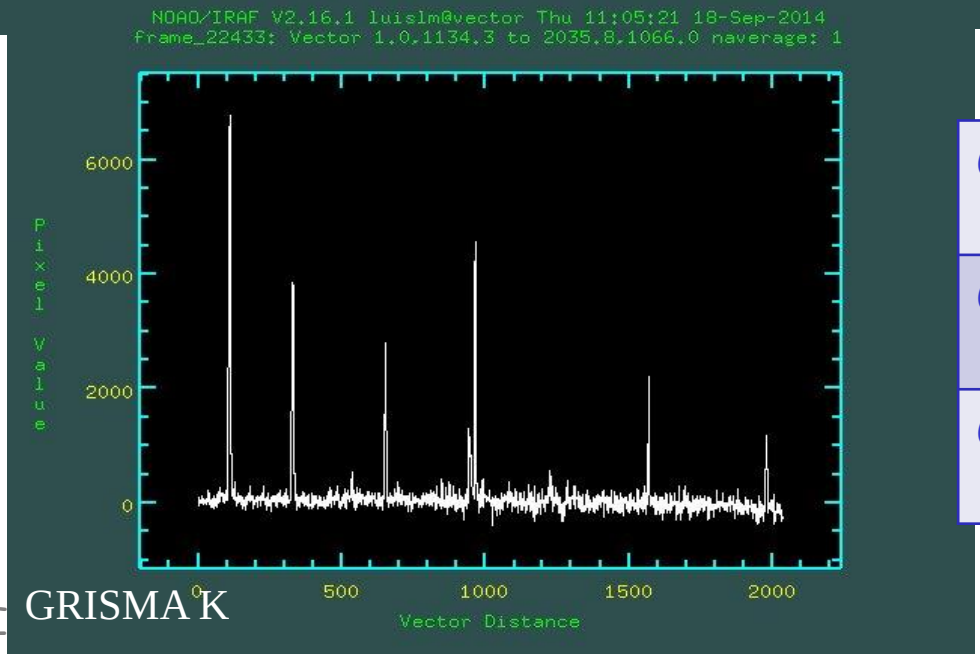


Wavelength calibration



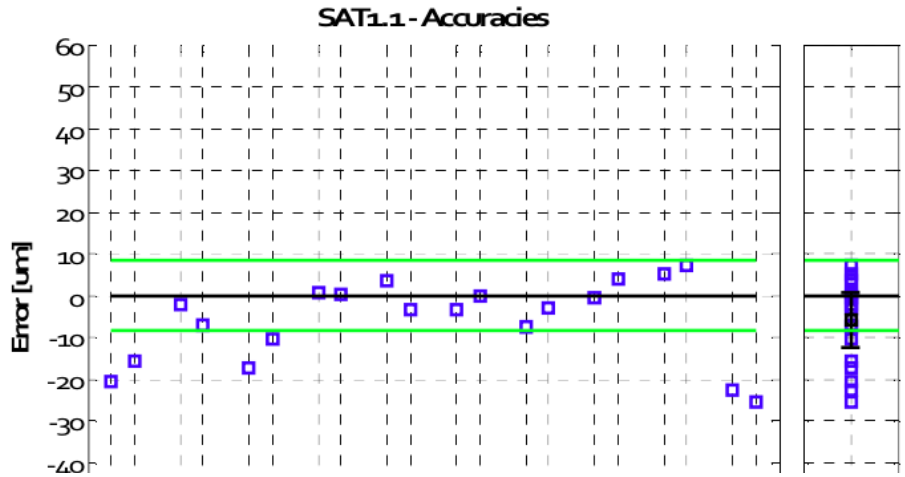


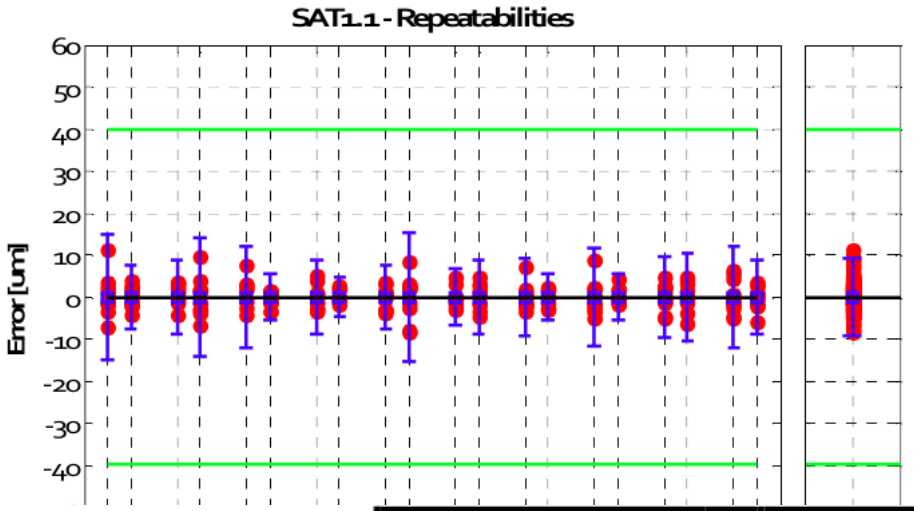
Argon lamp

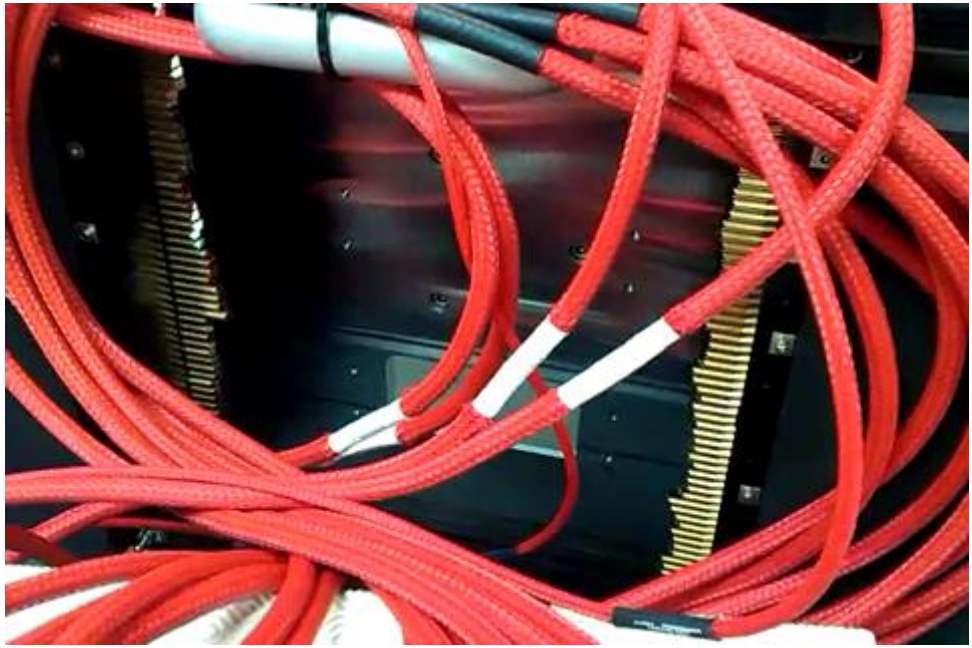


GRISM J	0.771 Å/pix (~5400)
GRISM H	1.216 Å/pix (~4500)
GRISM K	1.710 Å/pix (~4270)

CSU status







	Requirement @ bar level	Measured performance	Background	Unit
|Accuracy|	< 8.5	< 12.5	$\left\|\bar{X} \pm 3\,\sigma/\sqrt{n}\right\| = \left\|-6.0 \pm 6.5\right\|$	[μm]
|Repeatability|	< 39.6	< 9.4	$\pm 3\sigma = \pm 9.4$	[μm]
|Total|	**< 48.1**	**< 35.8**	$\left\|\bar{X} \pm 3\sigma\right\| = \left\|-5.8 \pm 30.0\right\|$	**[μm]**

E-II: ECS + DRP

- System of high complexity
  - Instrument component
  - Data Factory Agent
  - Branch
  - ScienceDB
  - Data Factory Manager
  - Inspector
  - …
- Been configured along the verification stages
- Fine tuning needed before going to telescope

Summary of ver. status

- All mech. fully functional
  - Window covers
  - Wheels
  - DTU
  - CSU (pending of final accept.)
- Img. Quality param. well within specs
- Scattered & Stray light under control
- Det. readout modes ready and phot. comp.
  - HDR & window modes yet untested
- ECS+DRP run stable
  - Further opt. on the way

Plan to first light

- Accept CSU
- Complete AIV stage III
- Agree and execute EMIR AT campaign
- Finalise the commissioning plan
  - 2/3 stages (+ Sci. Val)
- Ship EMIR and execute integration at GTC

Due for somewhen in 2015