Integral Field Spectroscopy @ the La Silla Paranal Observatory

Instrument Overview Talk

The 2007 ESO Instrument Calibration Workshop
Garching, January 23-26, 2007

P. Amico

Integral Field Spectroscopy 101

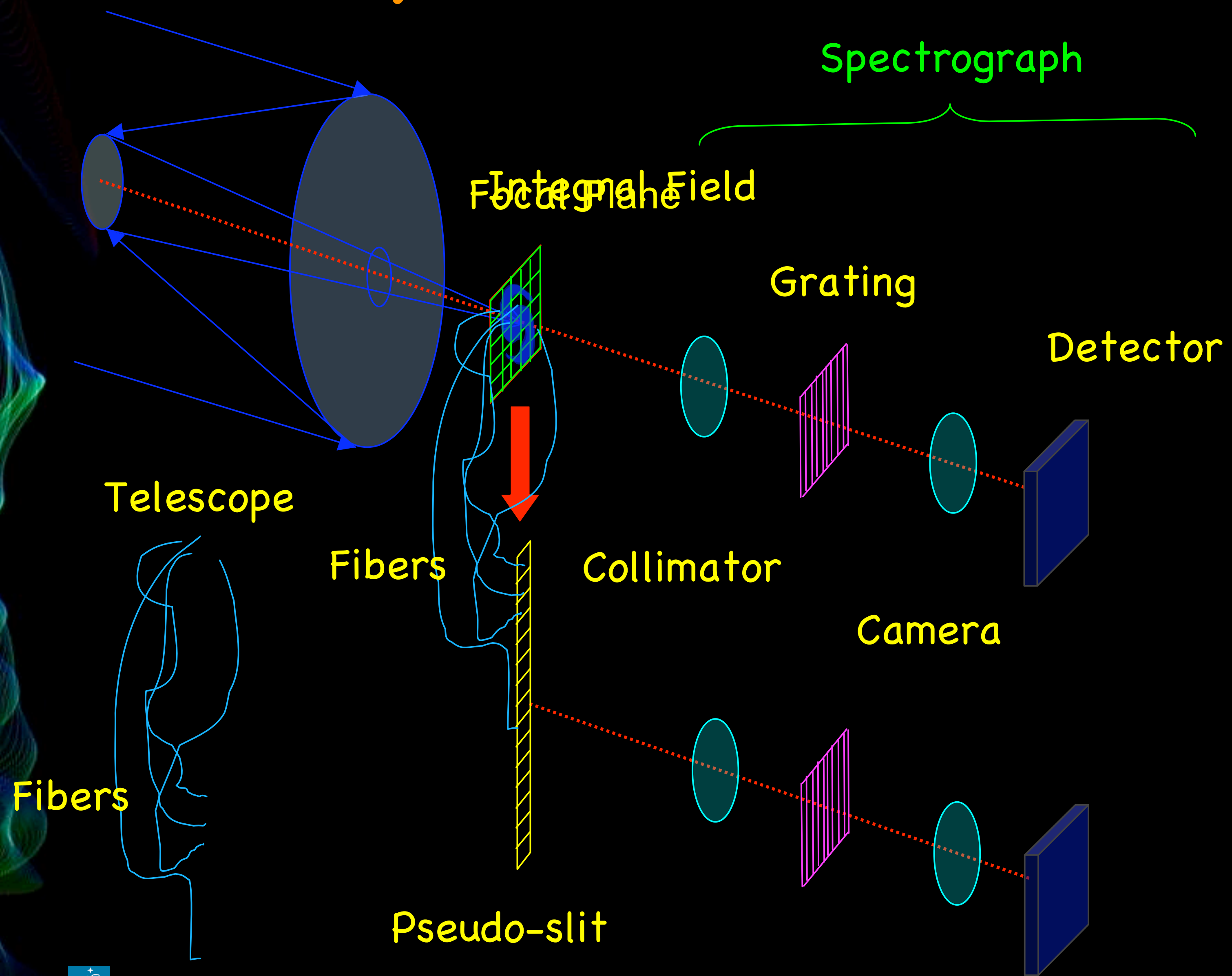
Integral Field Spectroscopy
E. Emsellem

at difference with classical longslit/MOS and FP.

It efficiently maps the full 3D astrophysical information on the object volume (2 spatial, 1 spectral) on the detector in one single exposure.

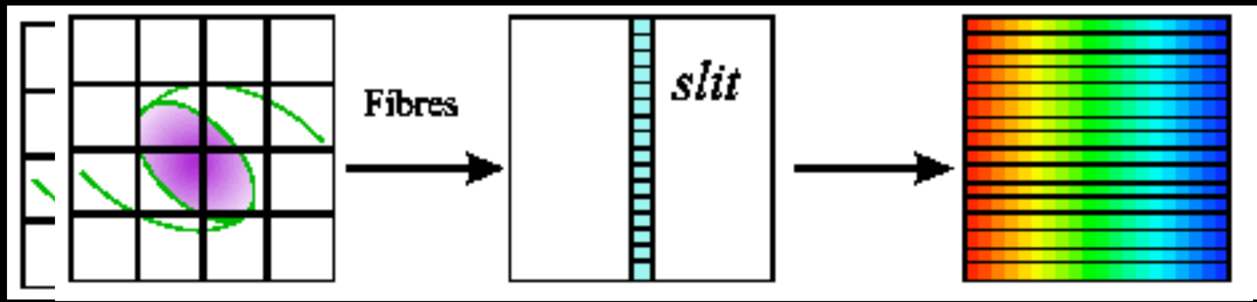
An IFS is based on a classical spectrograph where the 2D focal plane is rearranged in pseudo-slits and then dispersed.

Build your own IFS Kit



IFS Flavors

Focal plane | Spectrograph input | Spectrograph output



Lenslets + Fibers: VIMOS & FLAMES

Lenslet Array

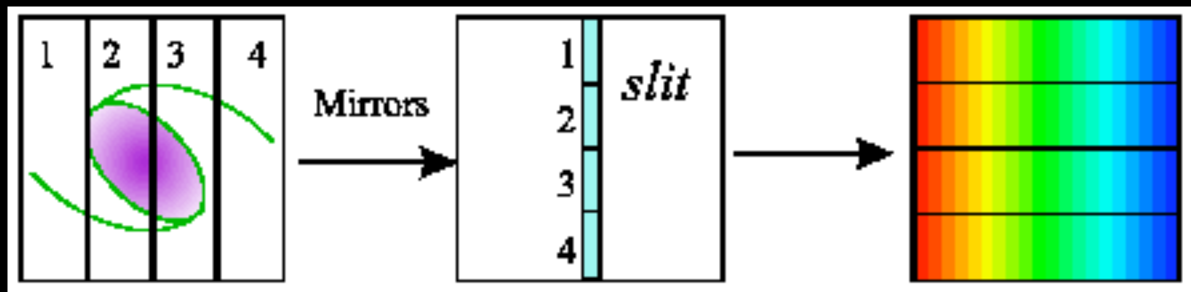
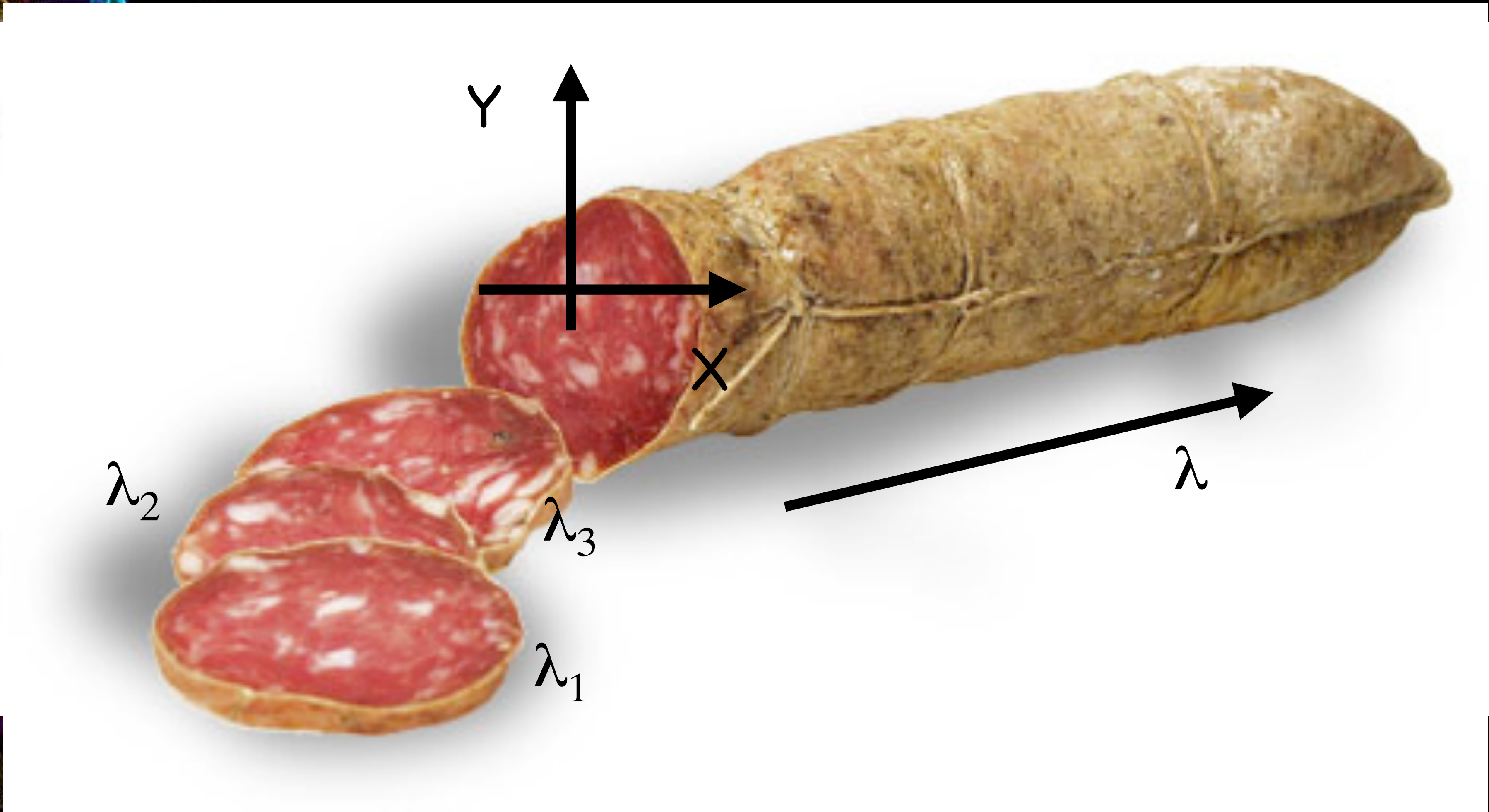
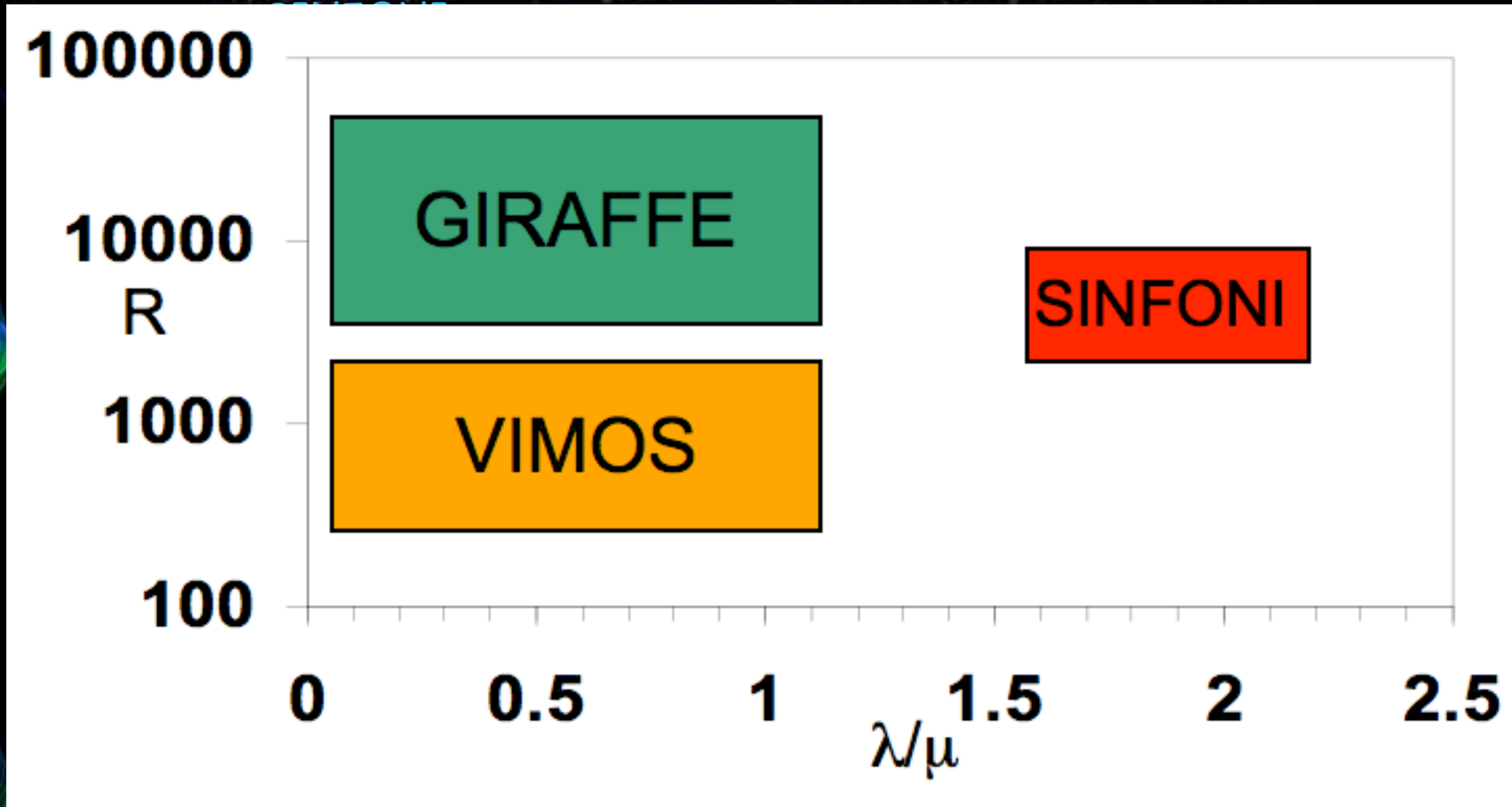


Image Slicer: SINFONI

Image reconstruction



IFSs @ the VLT

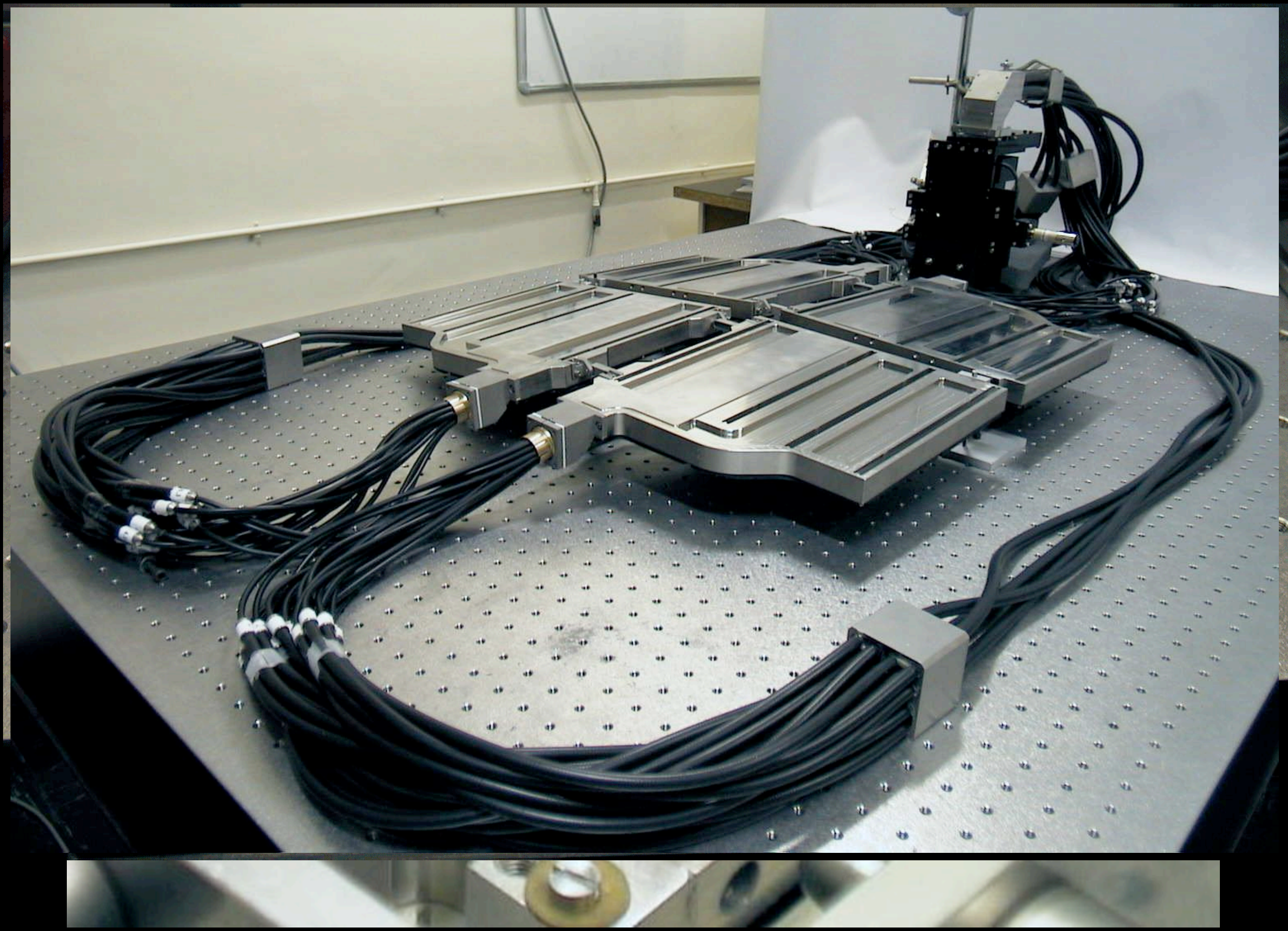


Scale=0.52" & 0.3"
FOV=2"x3" &11.5"x7.3" & 6.6"x4.2"

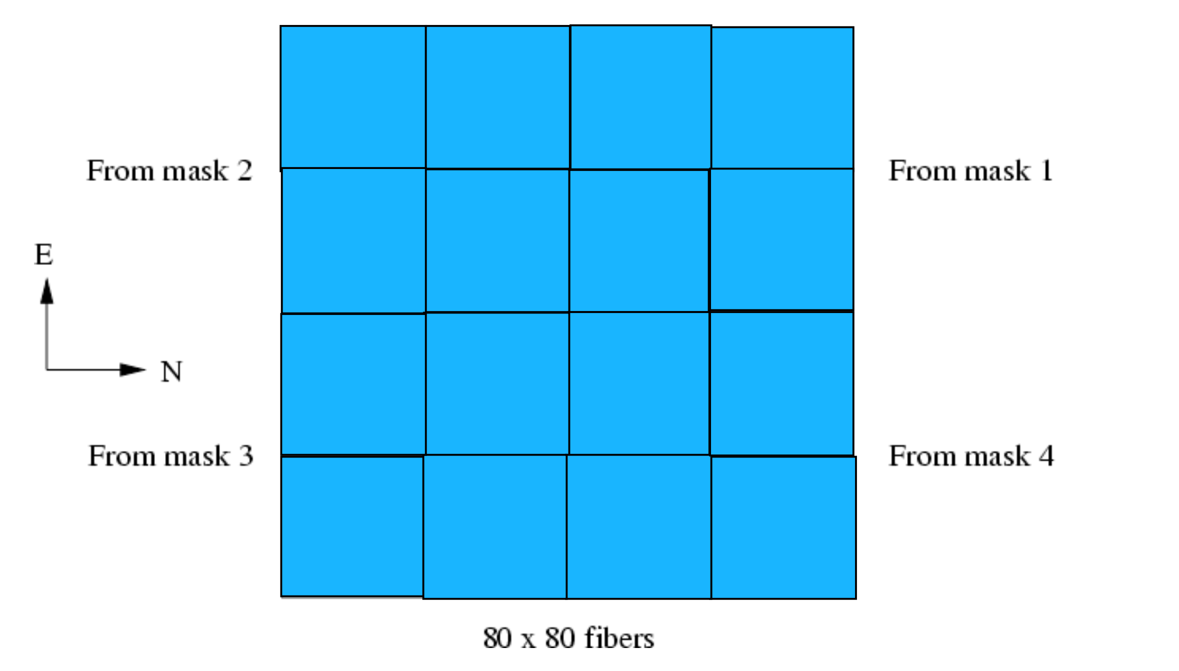
IFUs Hall of Fame & Shame

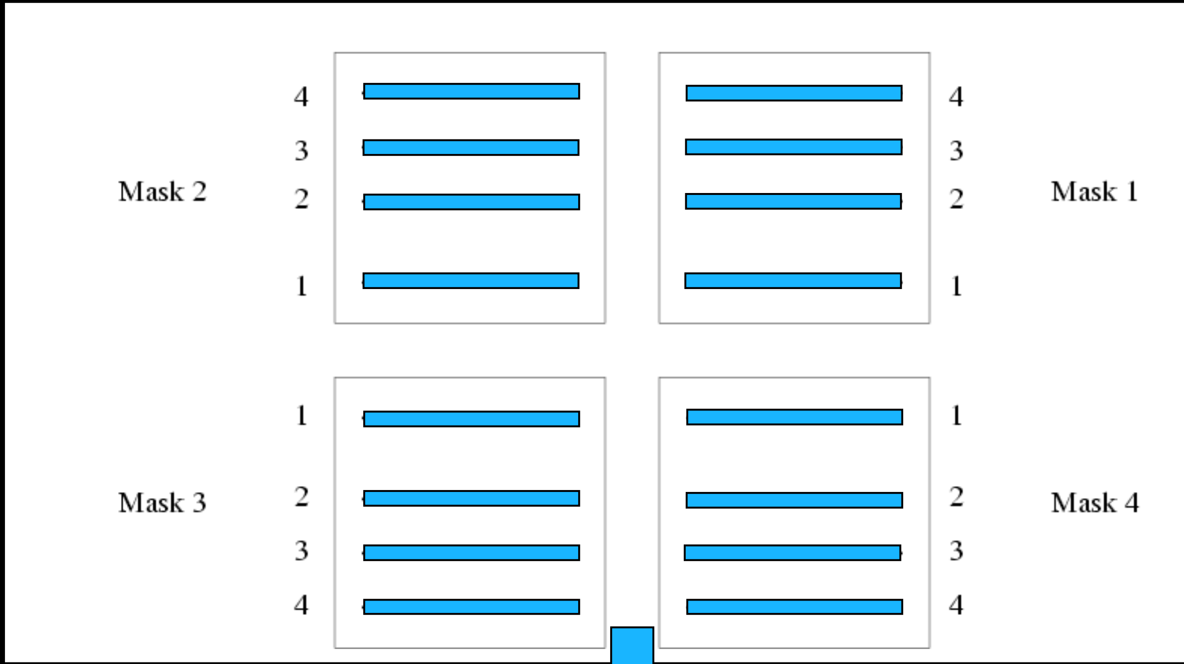
	+	-	Science
VIMOS	FOV Throughput	Flexures Fringing *Overheads*	Planetary nebulae, galaxies, star clusters, etc
GIRAFFE IFU & ARGUS	Resolution Area UVES	FOV Flats	Same as VIMOS
SINFONI	AO/no AO Stability Operability	Persistence	Galaxy cores, AGNs, velocity maps of compact galaxies, GC, star forming regions, physics of extra-solar planets and brown dwarfs, Planetary surfaces, SN1987A, galaxy formation & evolution….

VIMOS Shots

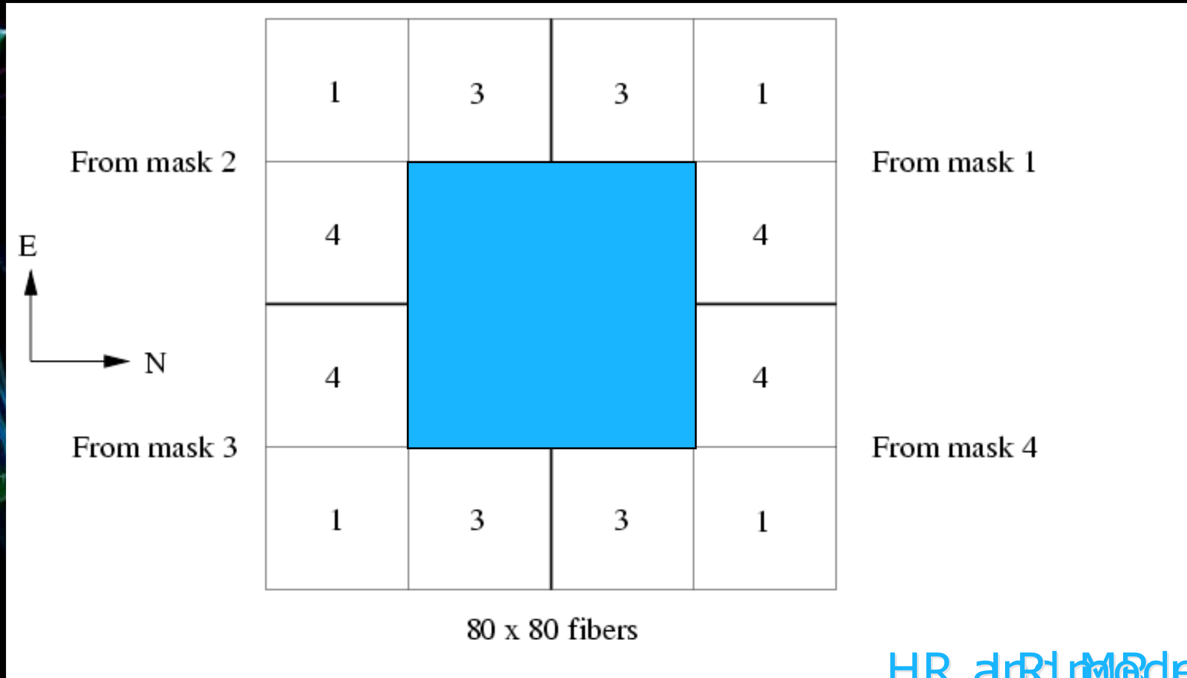


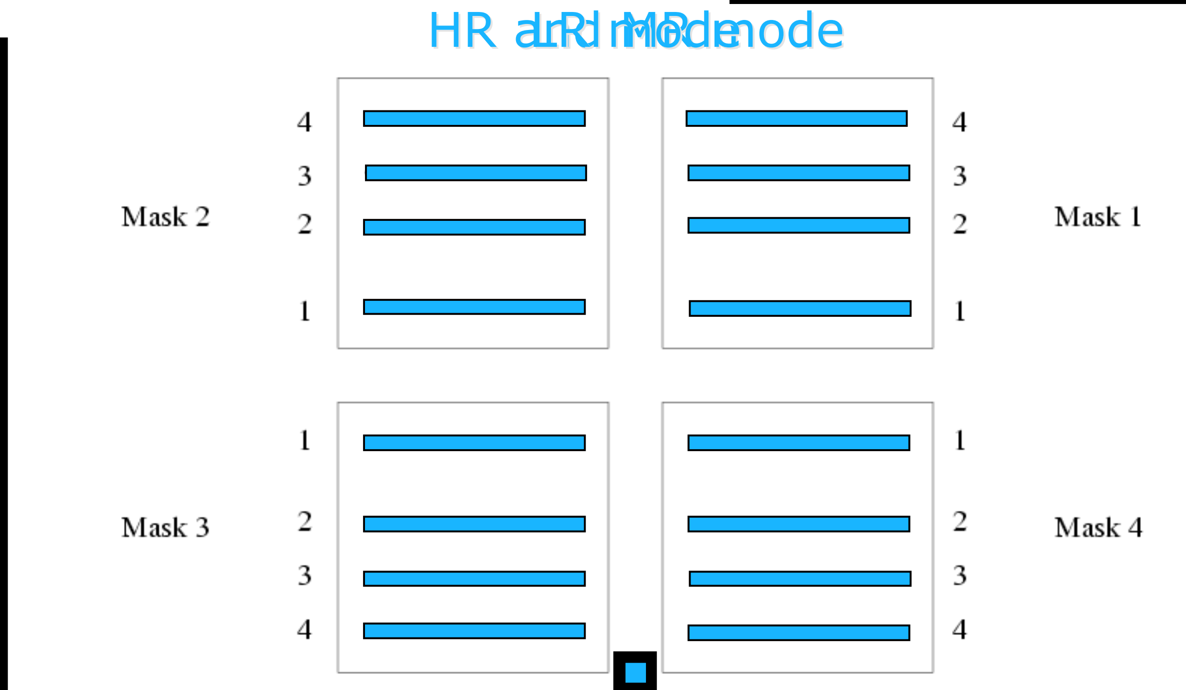
VIMOS Layout



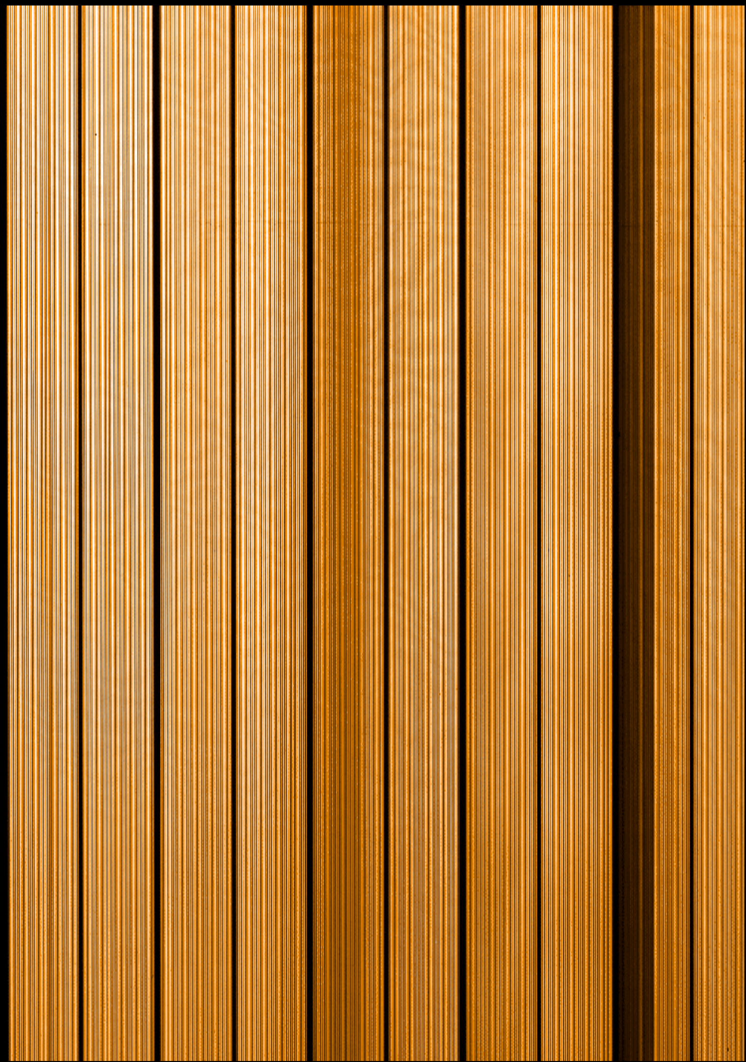


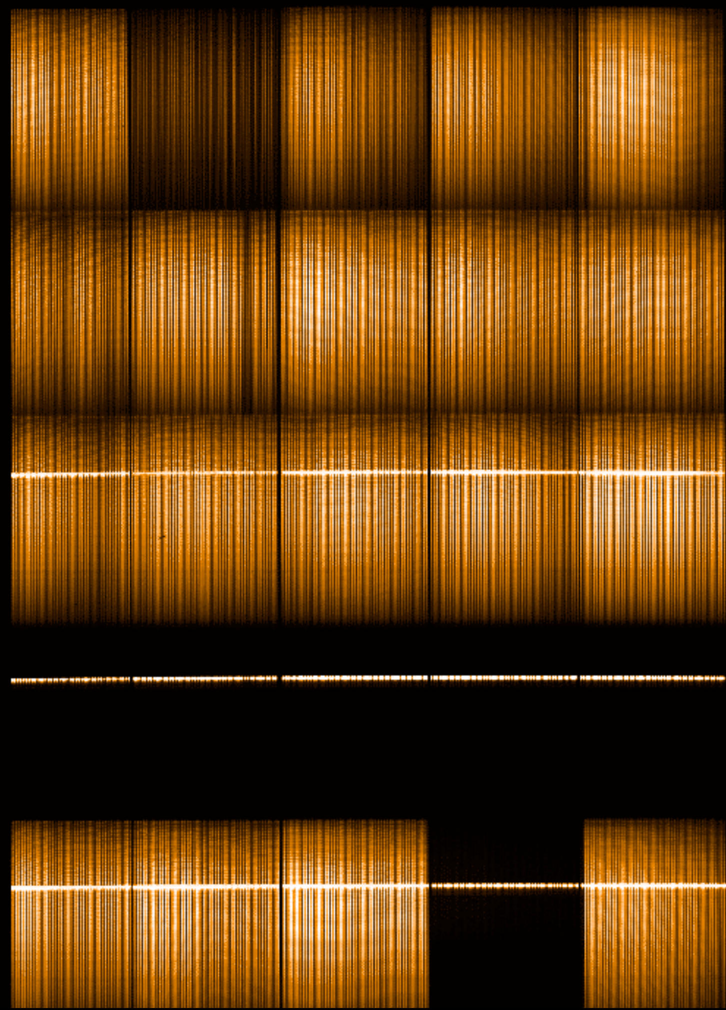
VIMOS Setups





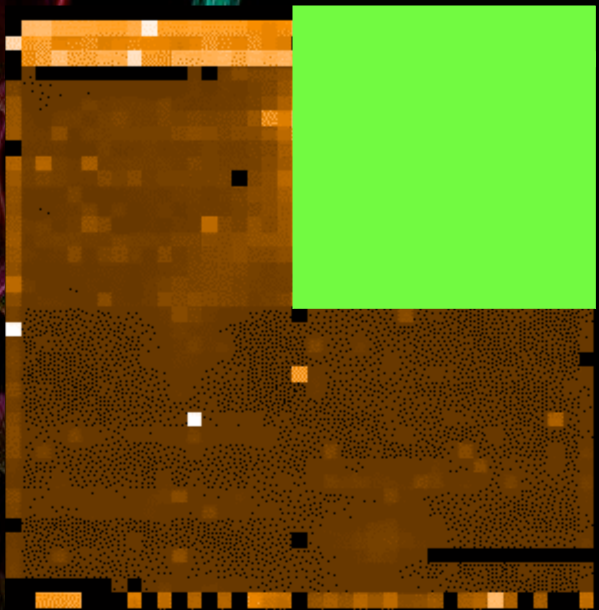
VIMOS HR and LR flats





VIMOS Image reconstruction

Extracted scientific spectra

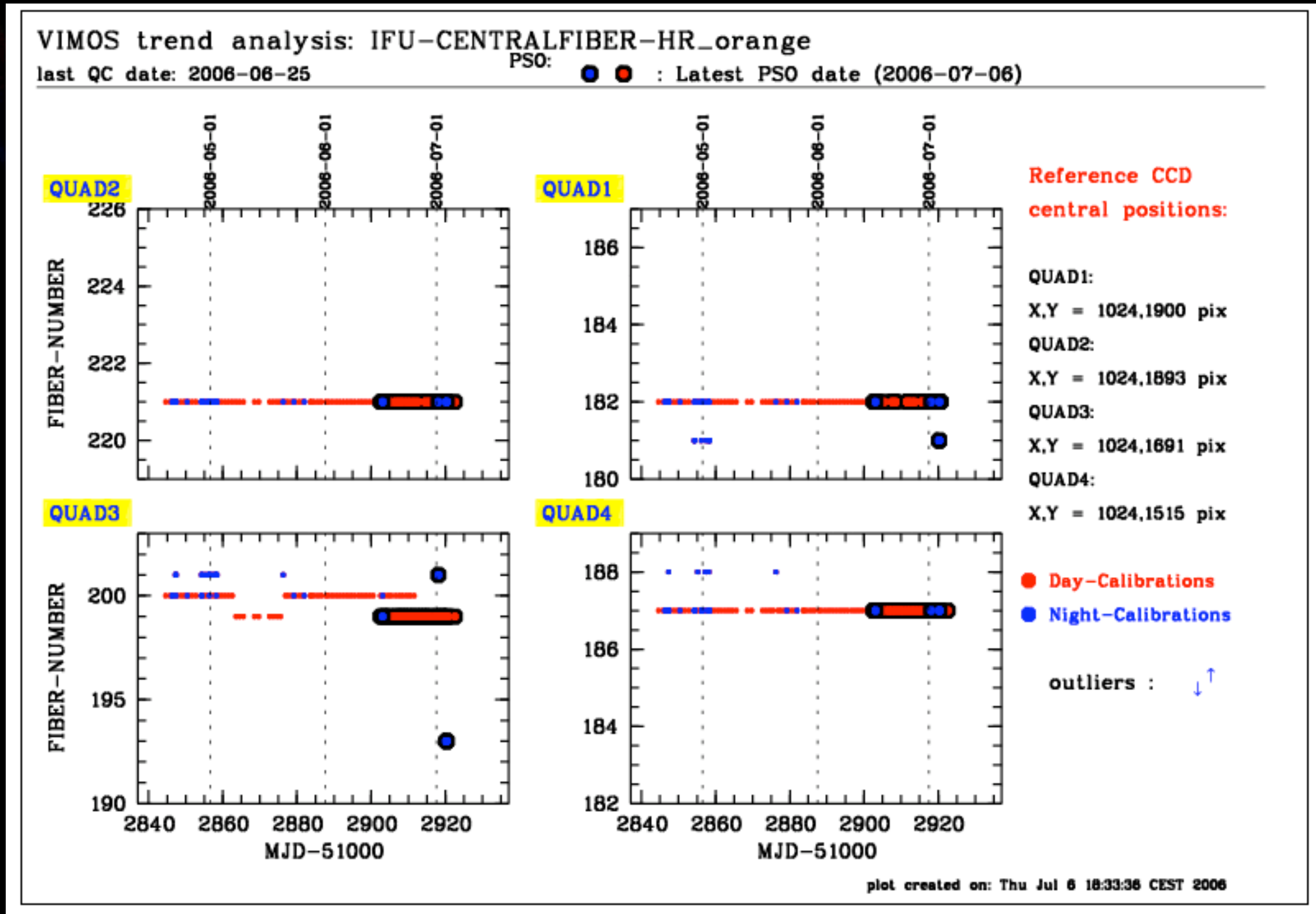


Reconstructed FOV image

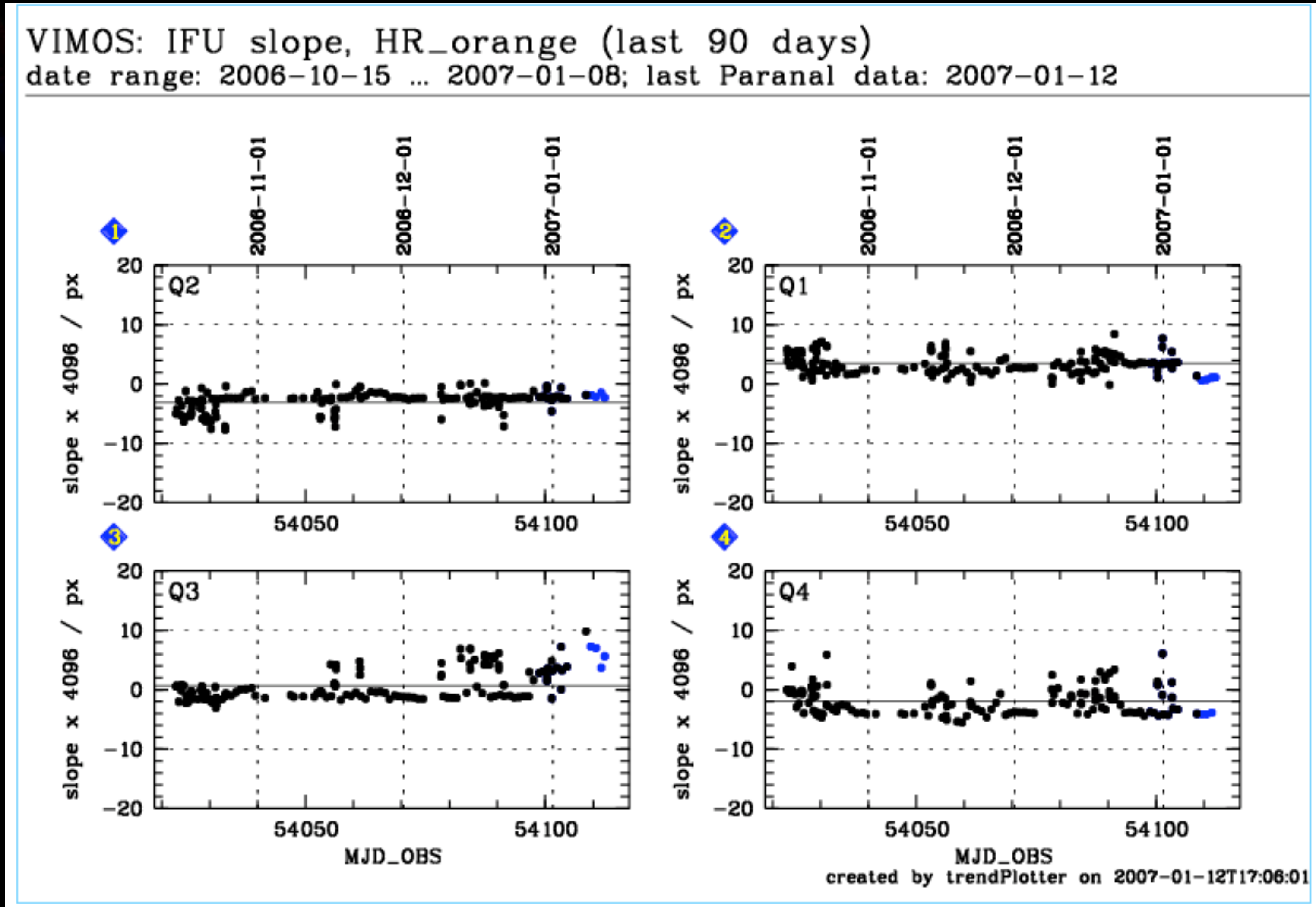
Calibrating VIMOS

- All calibrations are internal, except specphot standard stars
- Daytime calibrations: bias, flat, arcs
  - Bias: level and noise
  - IFU Stability: monitors of the X displacement of the IFU spectra at a reference row . The displacement may be due to IFU mask play, grism alignment variations and instrument flexures.
  - IFU Dispersion: monitors the RMS of dispersion solution as measured by the pipeline
  - IFU flux: monitors the efficiency of lamps and optical components
  - IFU grism alignment

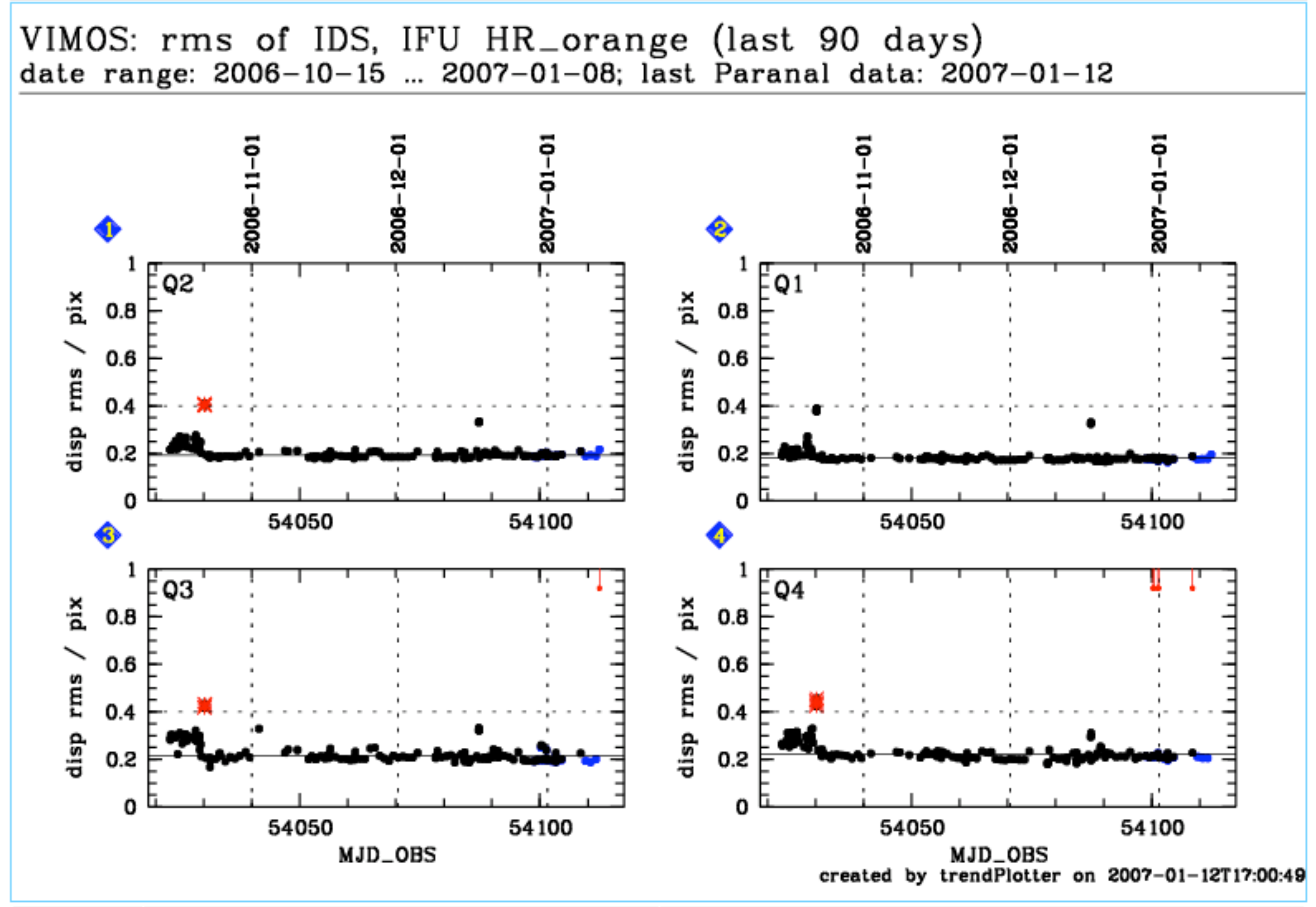
IFU stability



IFU grism alignment



IFU Dispersion

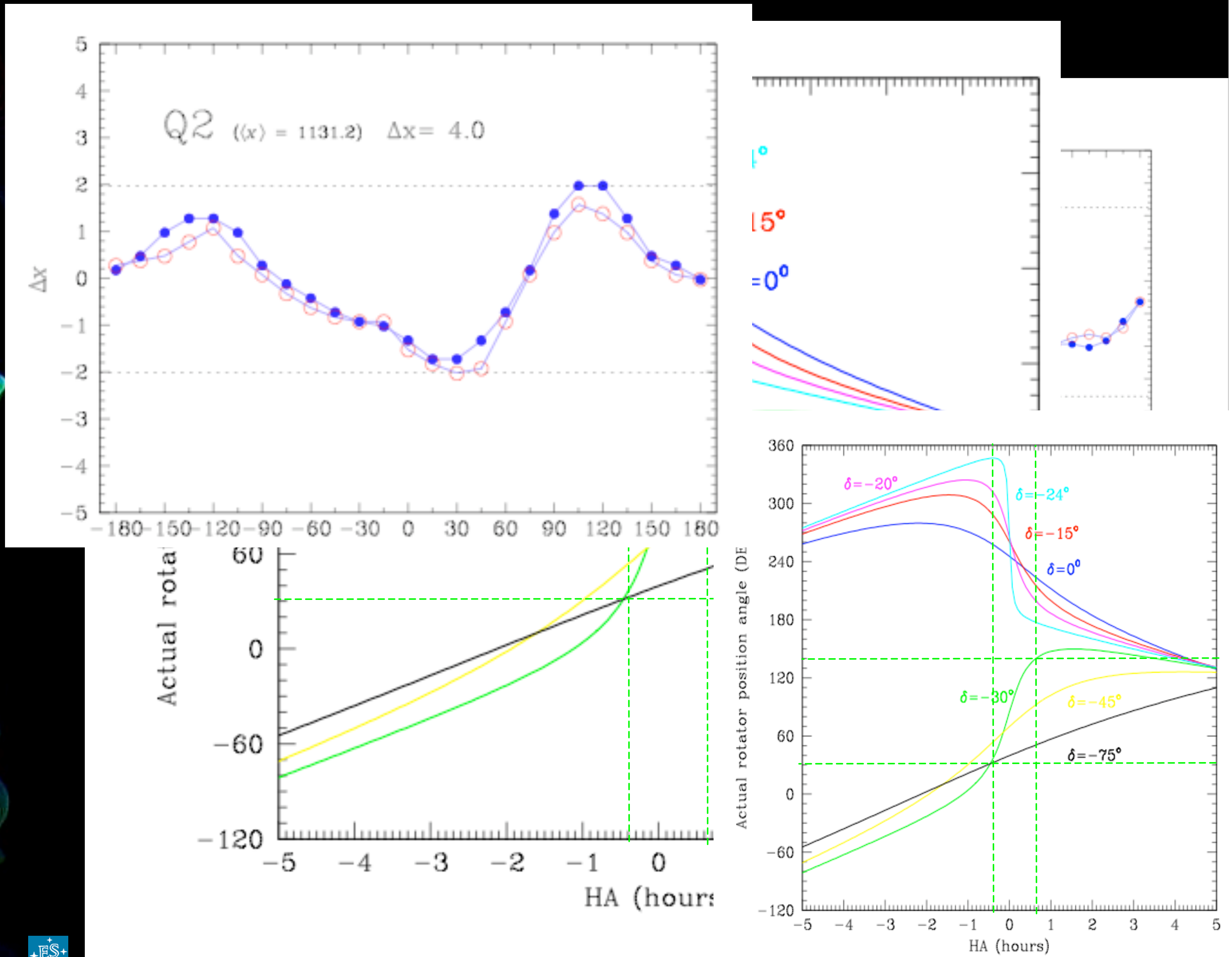


Calibrating VIMOS (cont'd)

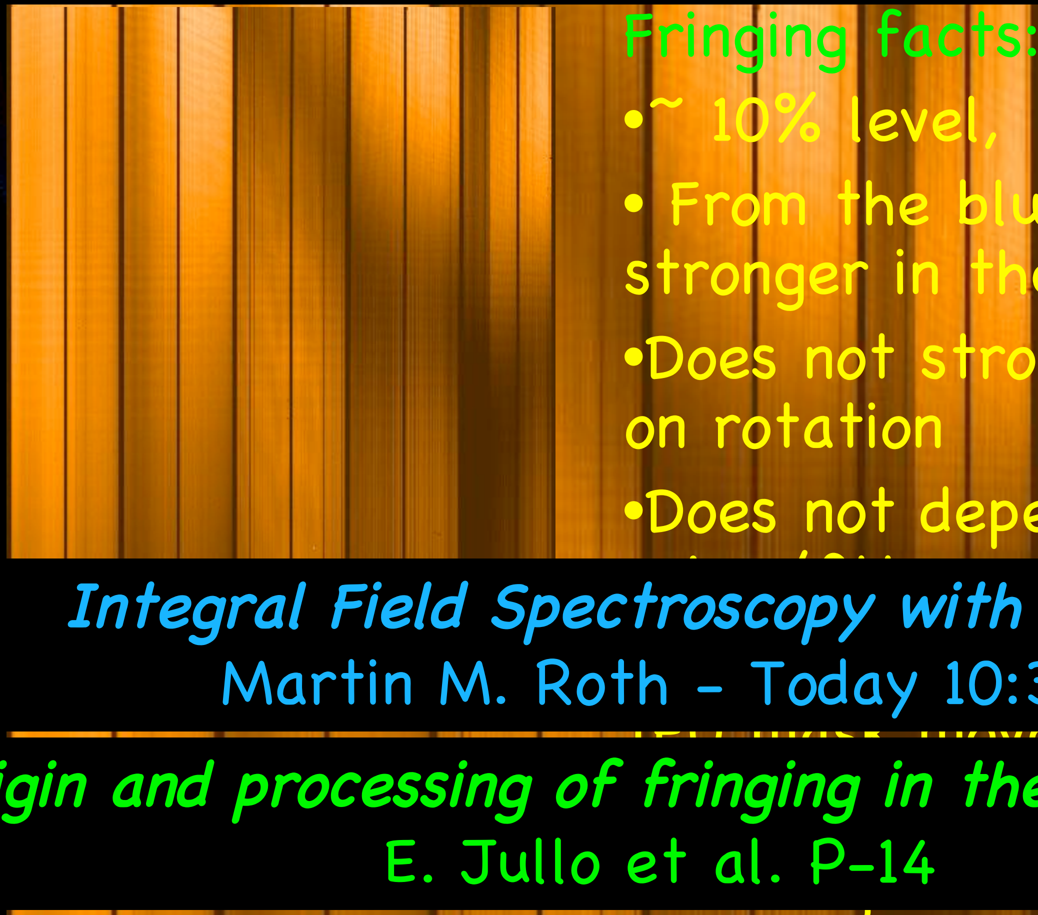
Night time calibrations are executed with the rotator in exactly the same position as at the end of the last science exposure. The telescope is moved at the Zenith to allow to safely close the Nasmyth shutter. This way the instrument flexures are as close as possible to those of the science exposure(s).

- FLATs: identify and trace the fibers and compute their relative transmission
- ARCs: perform wavelength calibration
- Significantly time consuming: takes from 5 to 8 minutes. If one wants to execute consecutively identical OBs, presets must be repeated all the time.

Impact of Flexures



Fringing



Fringing facts:

- ~ 10% level,
- From the blue (4500A), stronger in the red.
- Does not strongly depend on rotation
- Does not depend on

Integral Field Spectroscopy with VIMOS

Martin M. Roth - Today 10:35

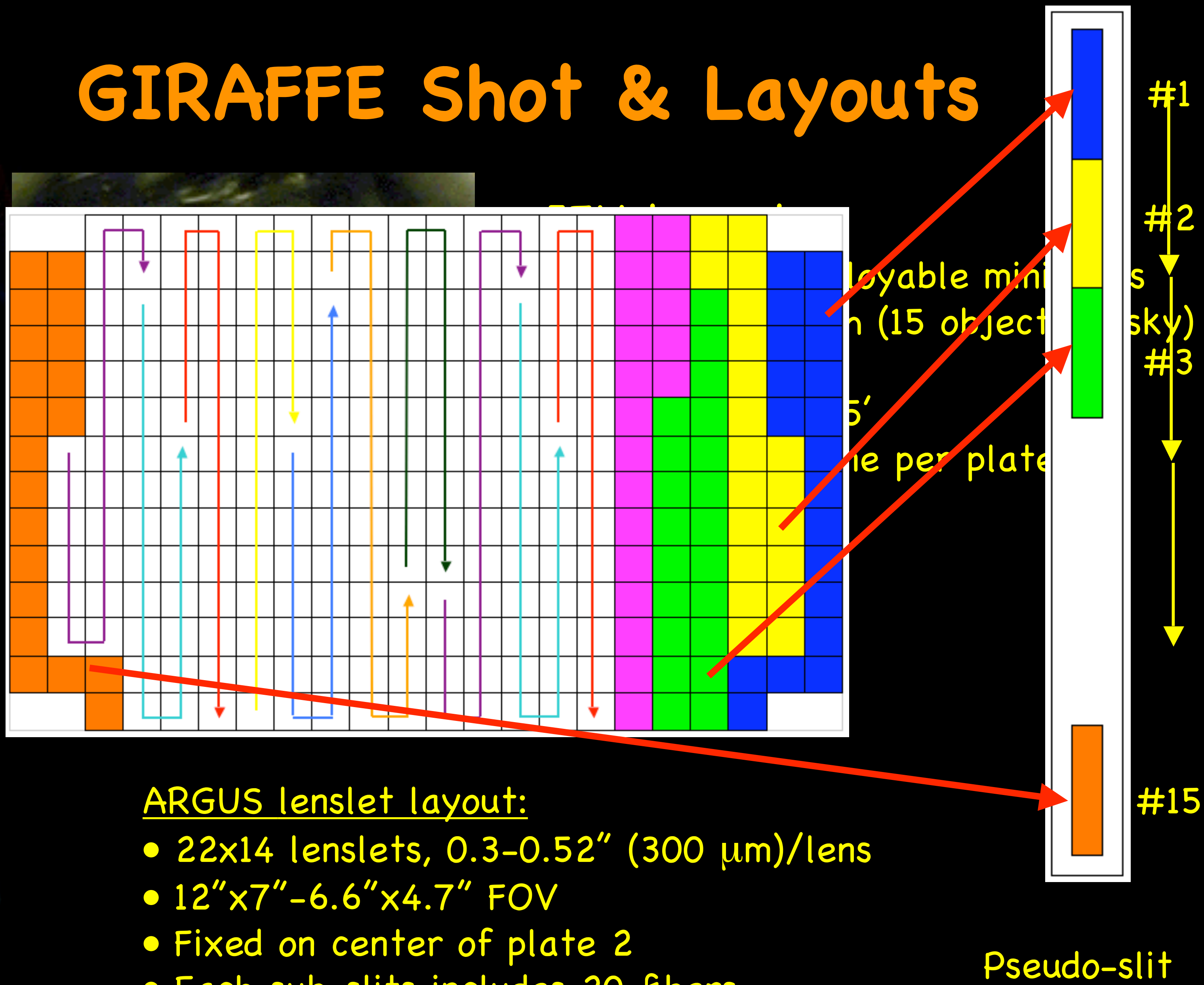
Origin and processing of fringing in the VIMOS IFU

E. Jullo et al. P-14

A User's View of VIMOS-IFU Calibrations

H. Kuntschner P-18

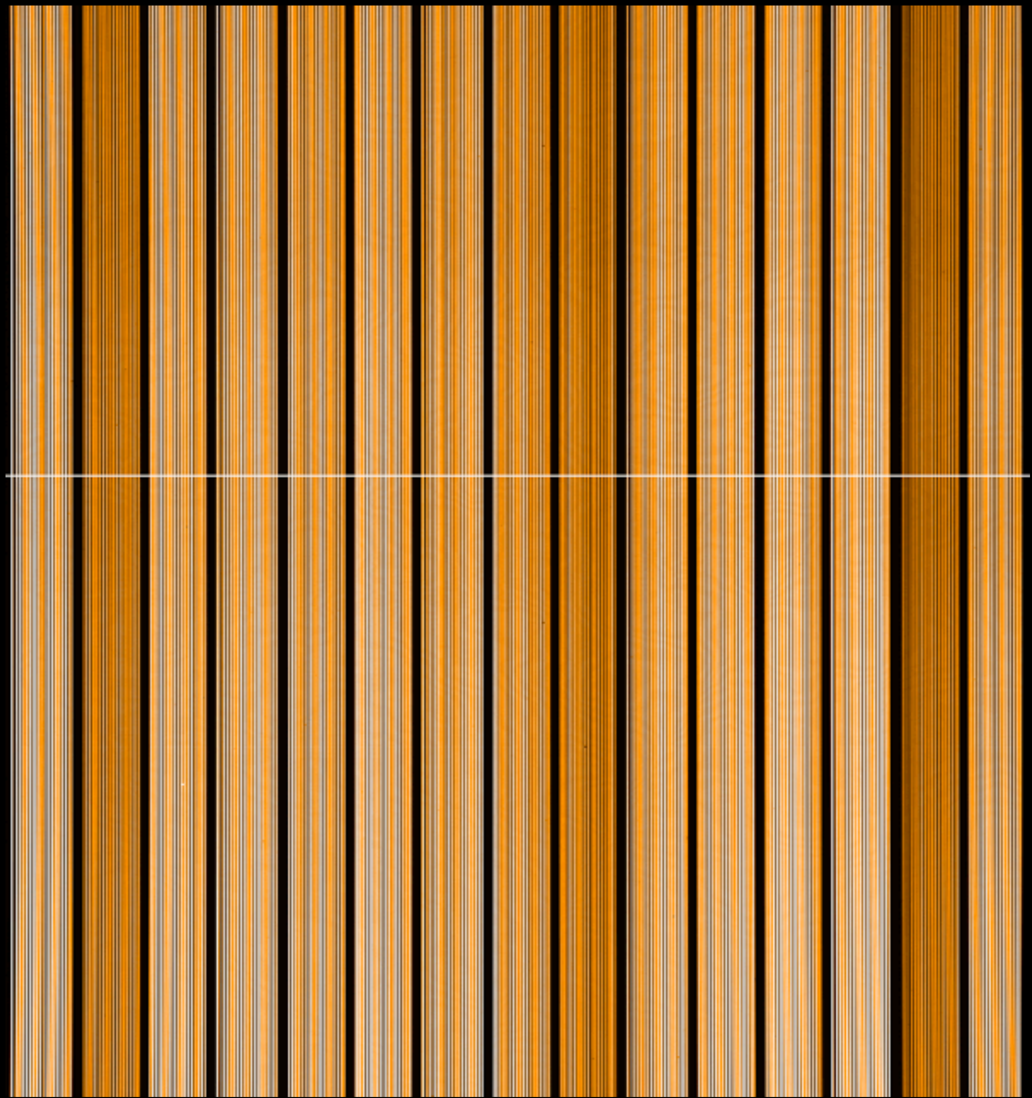
GIRAFFE Shot & Layouts



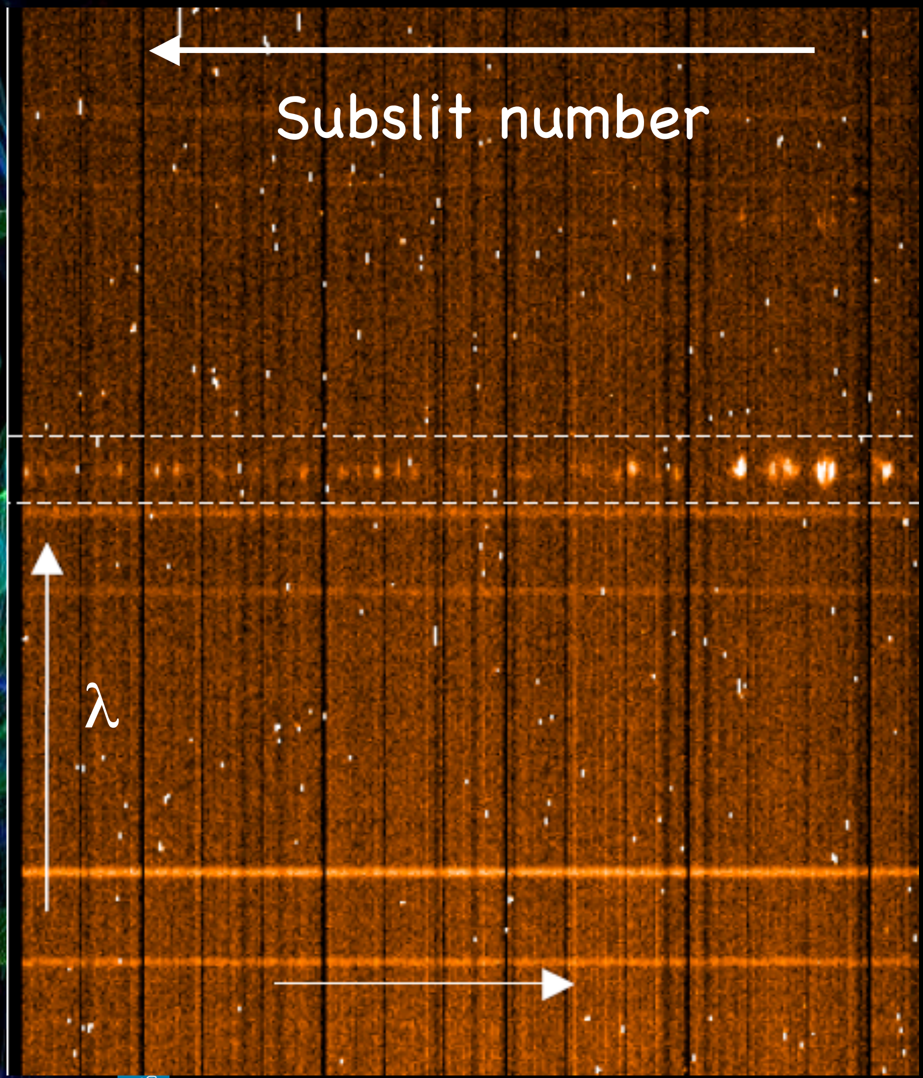
ARGUS lenslet layout:

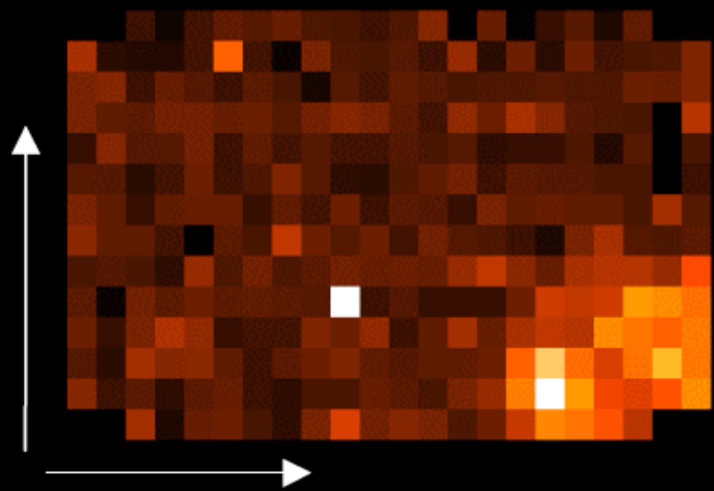
- 22x14 lenslets, 0.3-0.52" (300 μm)/lens
- 12"x7"-6.6"x4.7" FOV
- Fixed on center of plate 2
- Each sub-slits includes 20 fibers

GIRAFFE's IFU Flats



Argus Image reconstruction



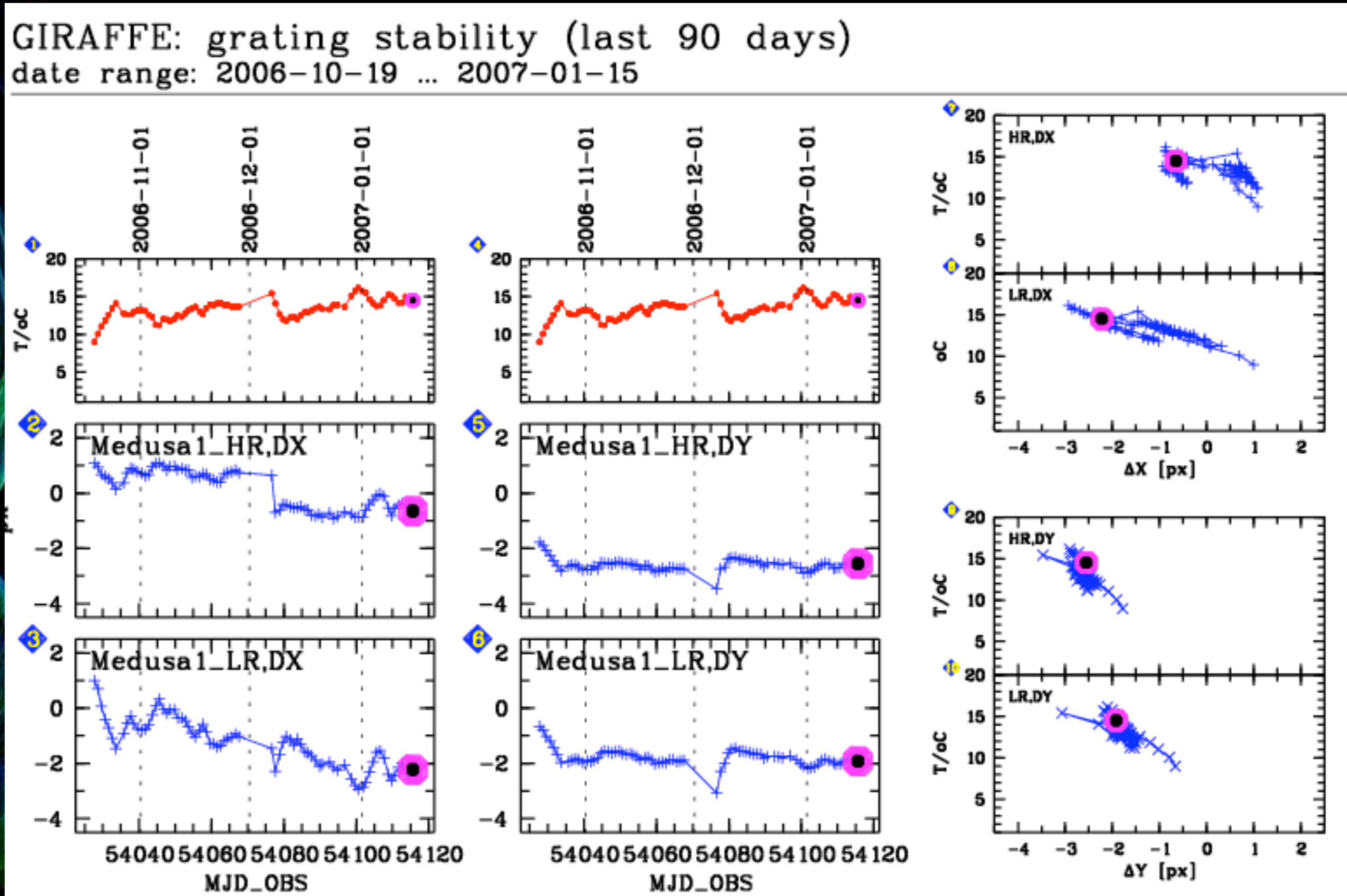


Calibrating GIRAFFE's IFUs

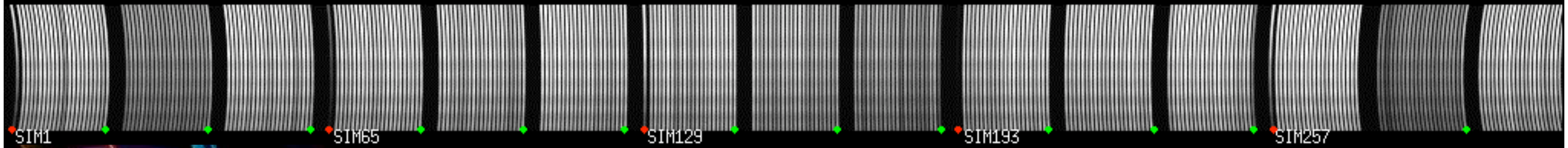
For both the IFU Unit and ARGUS:

- Arcs for wavelength calibration
- Additional monitoring (dark, bias, etc)
- "Robotic" flats
  - Determine fiber location (data reduction)
  - Used to flat field 1-D extracted spectrum
  - Correct for fiber-to-fiber efficiency
- Flux Standard + Screen flats
  - Derive the response curve for flux calibration
  - Take Screen Flats (ARGUS) for fiber location information and flat-fielding

Grating stability



Fiber measurements (ARGUS)

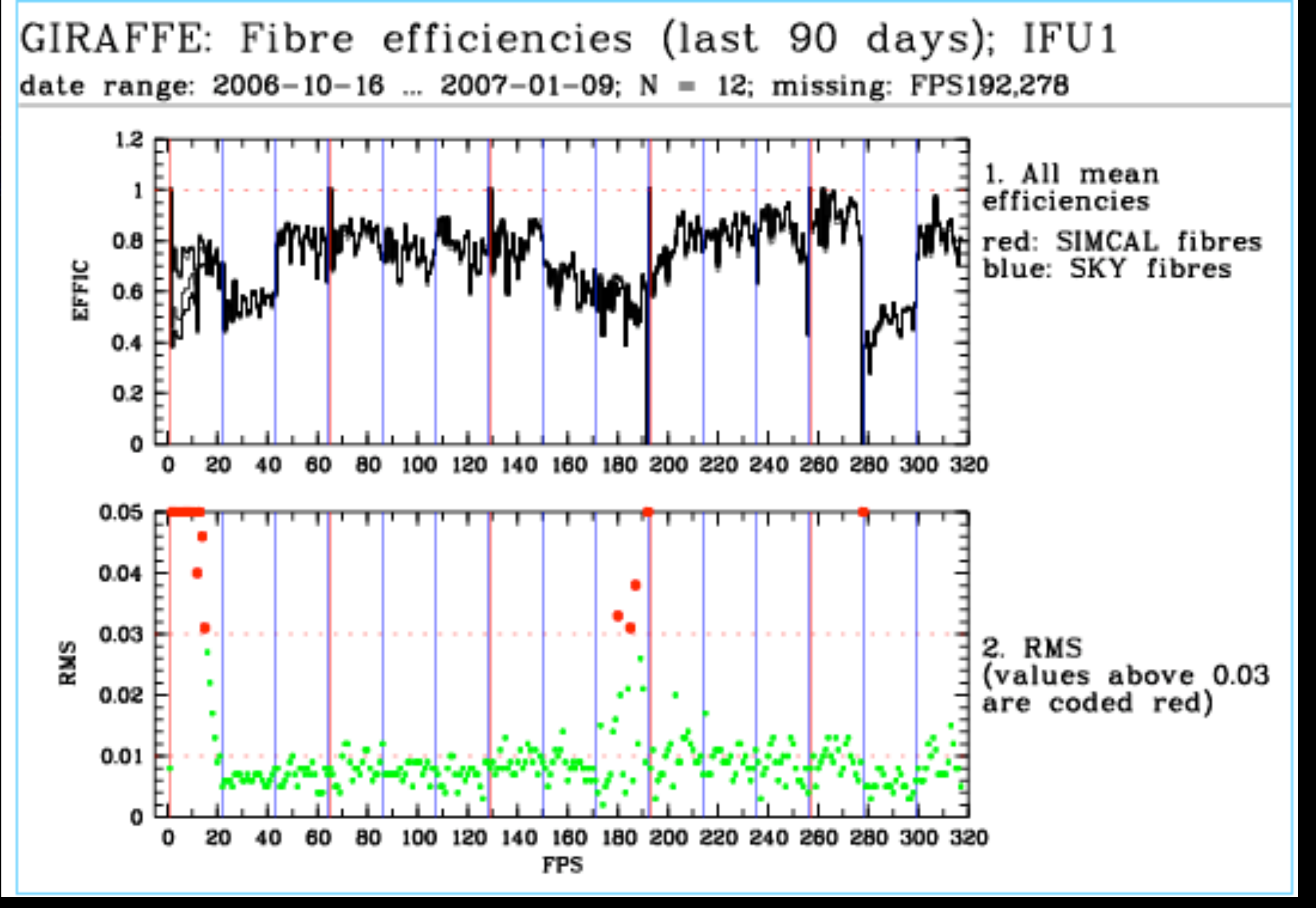


For flux calibration: the std flux is measured for the central fibers only, then extrapolated using the fiber-to-fiber efficiency function

➔ uniform illumination is a must!

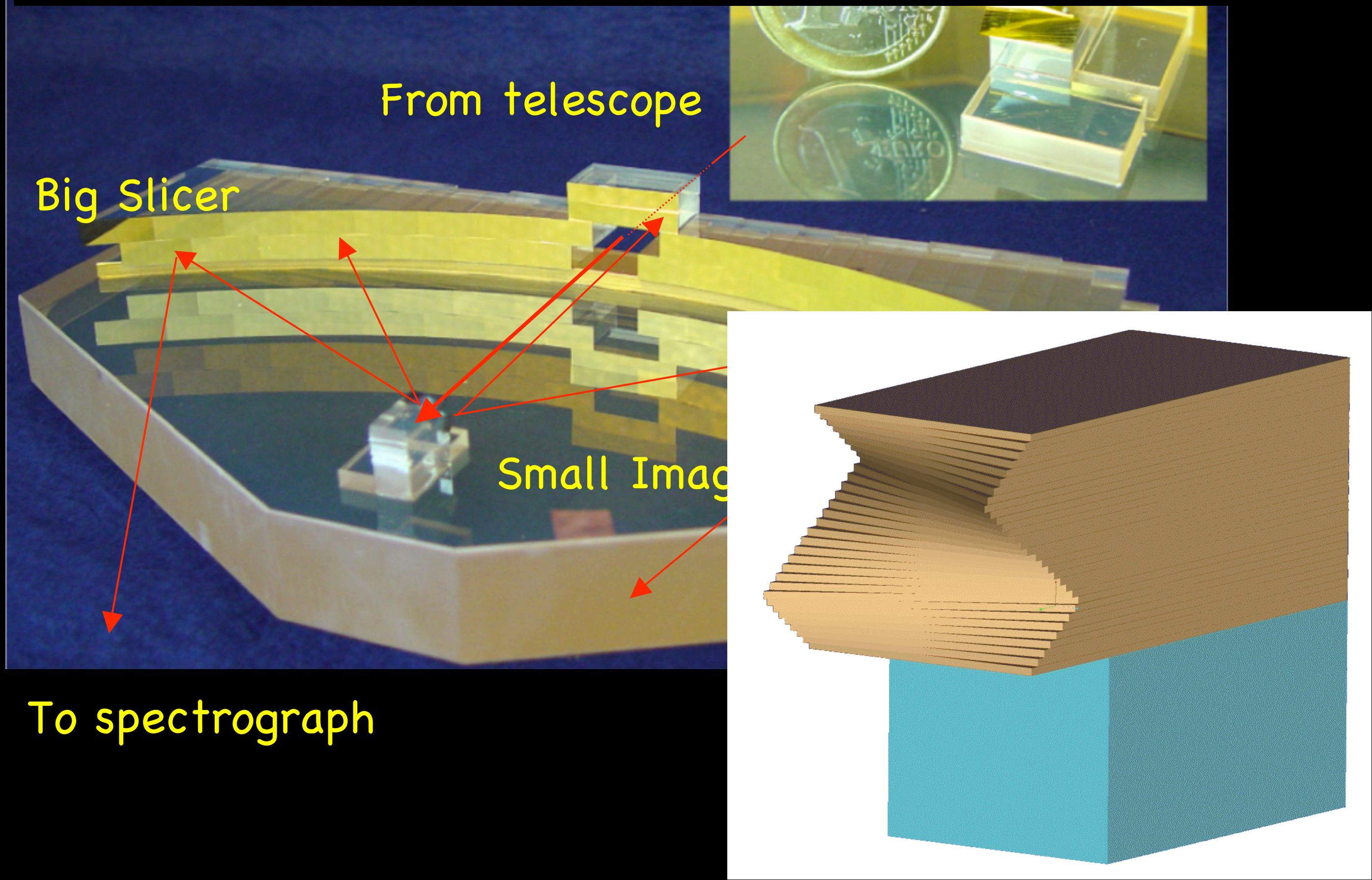
- Robotic flats not good enough
- Screen flat OK, but low flux in the blue.
- Sky flats would be best, but not yet supported.

Fiber-to-fiber efficiency



SINFONI

AO Assisted spectroscopy with SINFONI
R. Davies (yesterday)



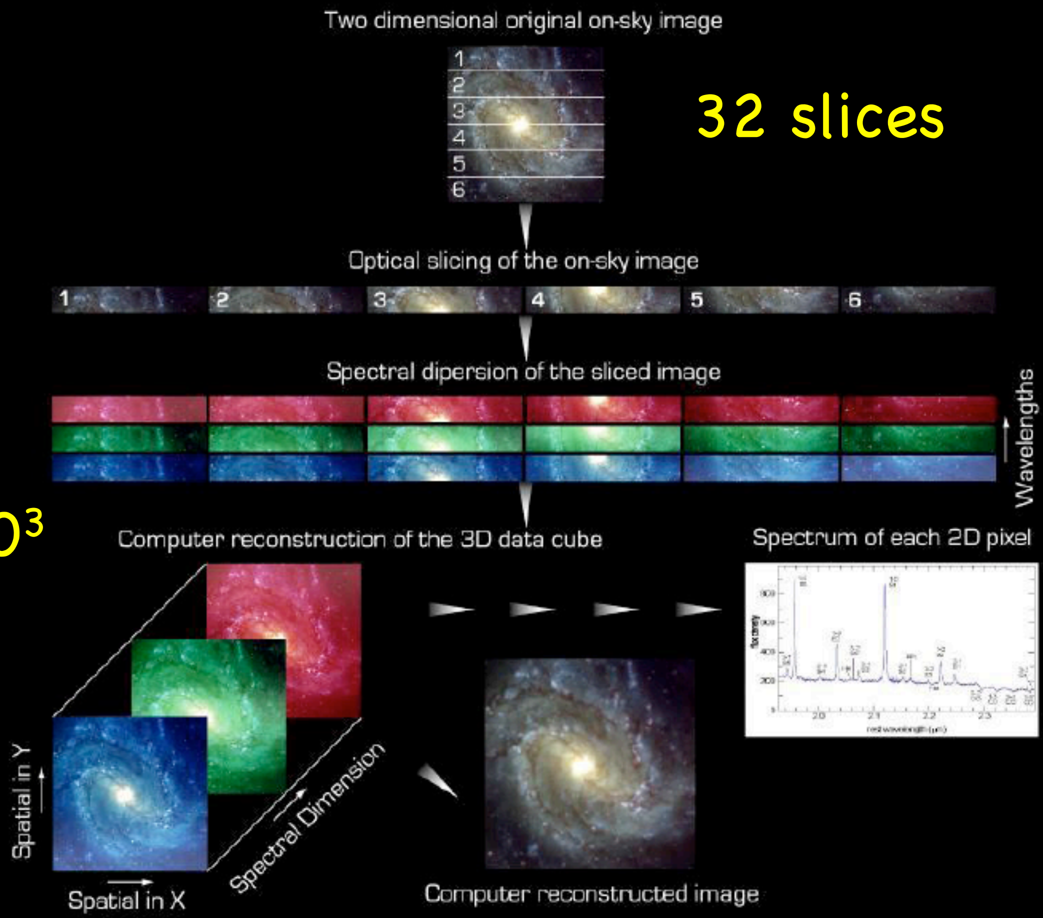
SINFONI Layout

32 slices

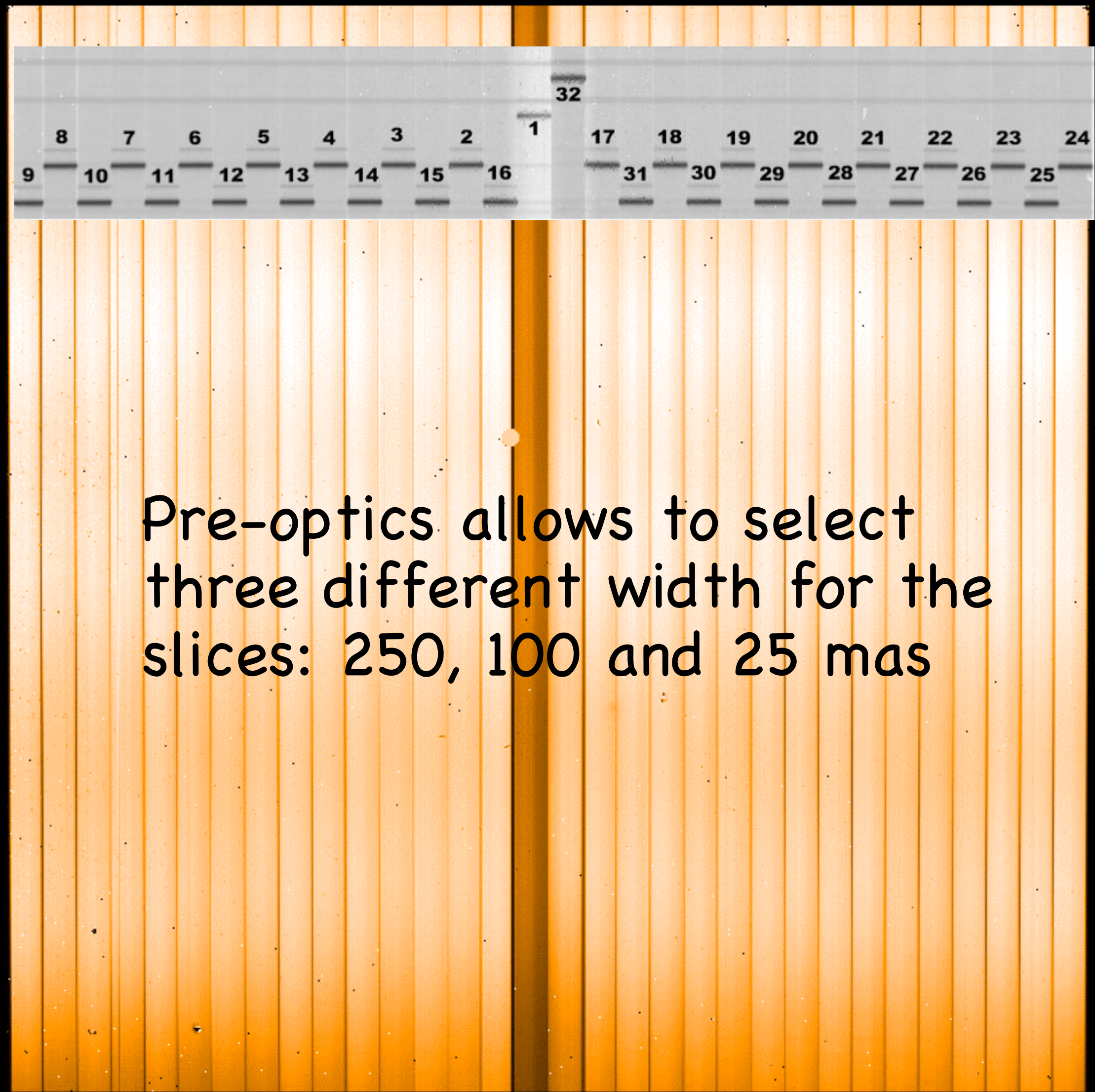
Pseudo-slit

J,H,K, H+K

R=2,3,4,1.5 *10^3

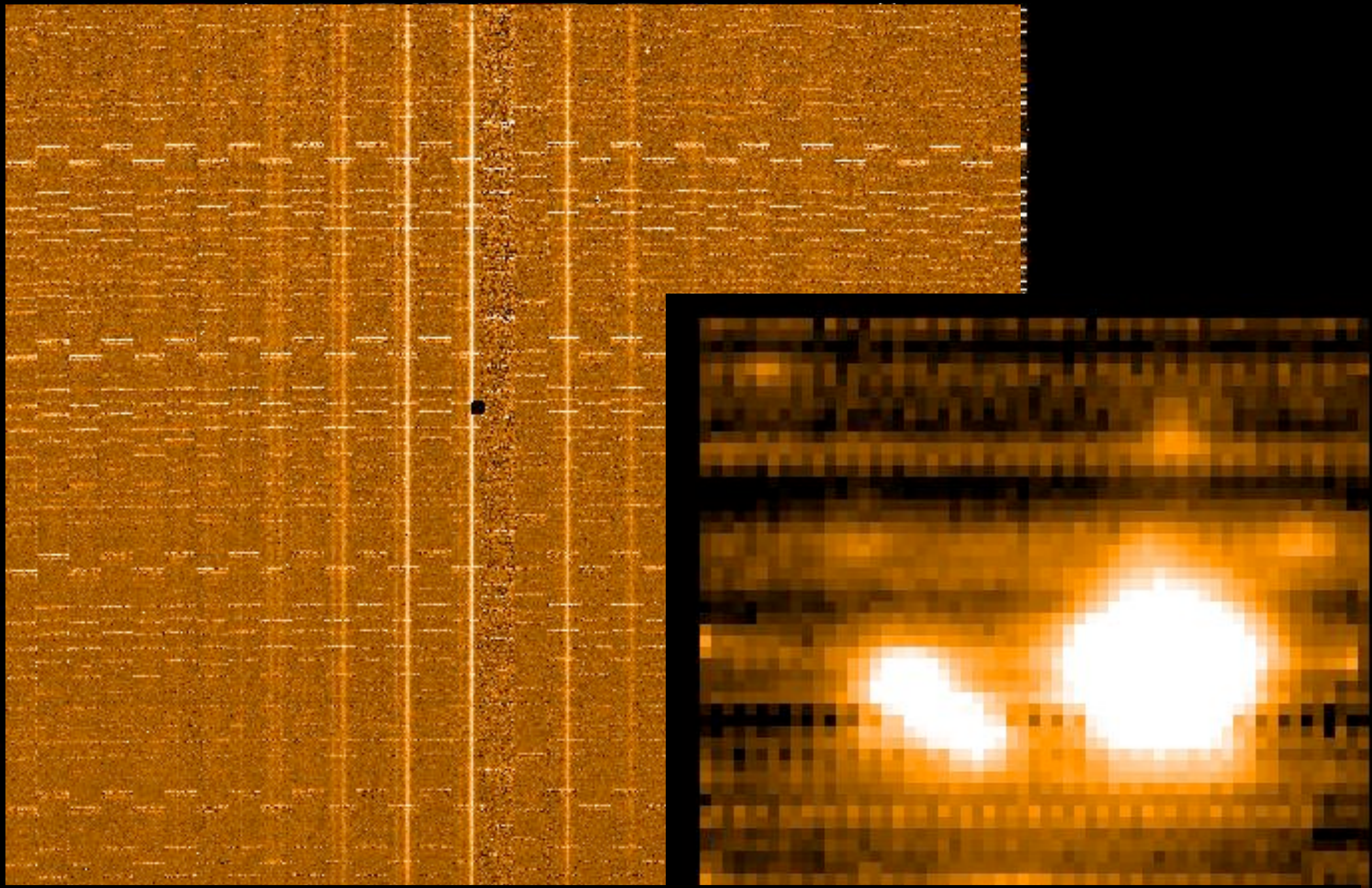


SINFONI flat and arc



Pre-optics allows to select three different width for the slices: 250, 100 and 25 mas

SINFONI Image reconstruction



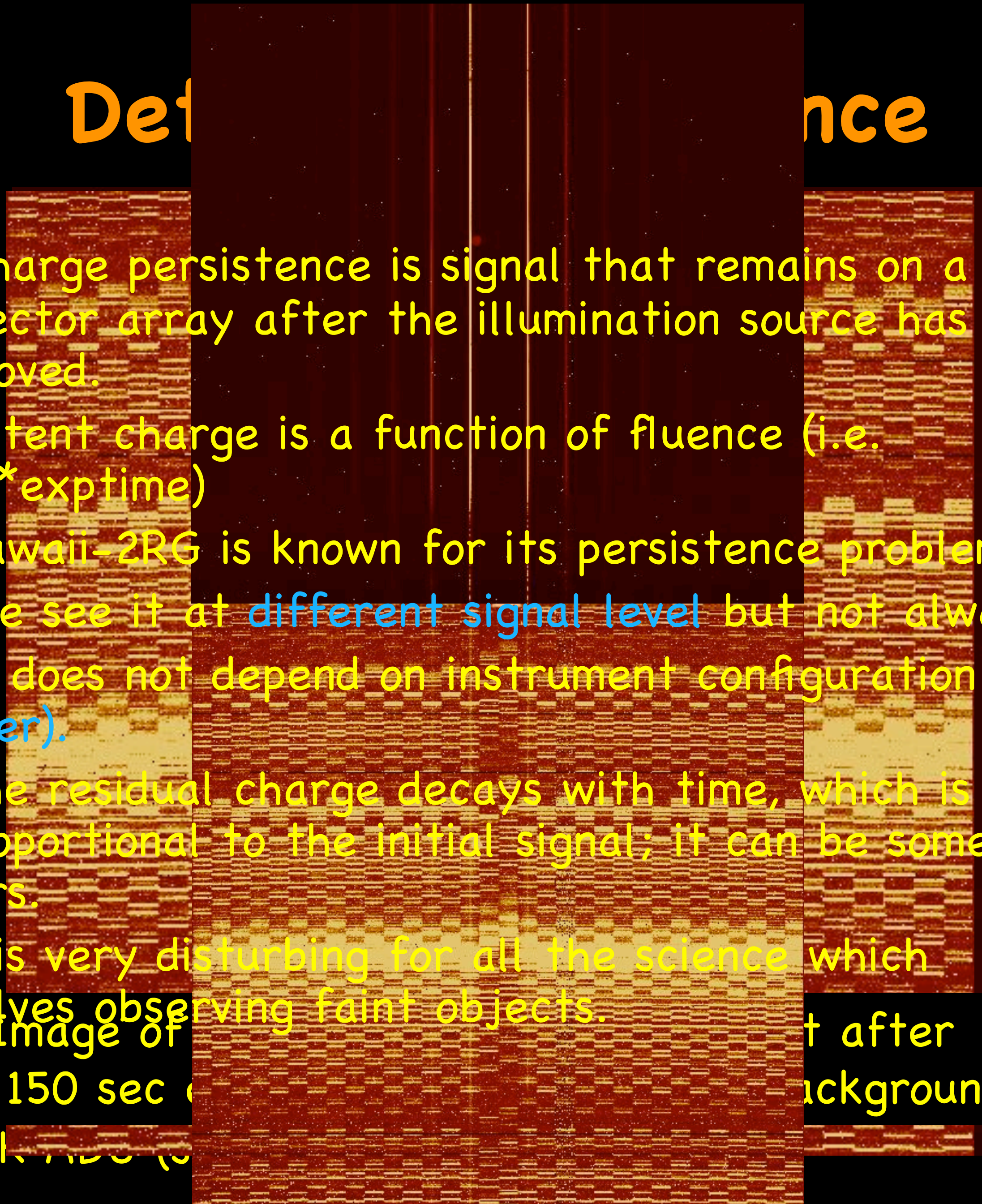
Improvements in the Residual OH emission removal in SINFONI Pipeline spectra

A. Modigliani et al. P-24

Calibrating SINFONI

- Standard calibration plan for monitoring
- Flexures are compensated by means of control loops.
- Filter offset compensation transparent for the user.
- Special NORTH/SOUTH frames (to measure orientation of the slitlets) + arc allow precise mapping in the x,y,λ cube (after interventions).
- Problems with image stacking when observations are taken in different nights:
  - Reference star at beginning and end of the OB
  - GUIDECAM software to be made available soon

Det nce



- Charge persistence is signal that remains on a detector array after the illumination source has been removed.
- Latent charge is a function of fluence (i.e. flux*exptime)
- Hawaii-2RG is known for its persistence problems.
- We see it at different signal level but not always.
- It does not depend on instrument configuration (filter).
- The residual charge decays with time, which is ~proportional to the initial signal; it can be some hours.
- It is very disturbing for all the science which involves observing faint objects.

Image of t after
: 150 sec ackground ,
1k ADU (s

Acknowledgements

	Co-Authors	Good Samaritans
VIMOS	S. Bagnulo, G. Marconi, C. Izzo	M. Rejkuba, M. Roth
SINFONI	C. Dumas	R. Davies
FLAMES	C. Melo	D. Naef, R. Hanuschik

Questions?