

SINFONI: The AO-assisted NIR Field Spectrograph for the VLT

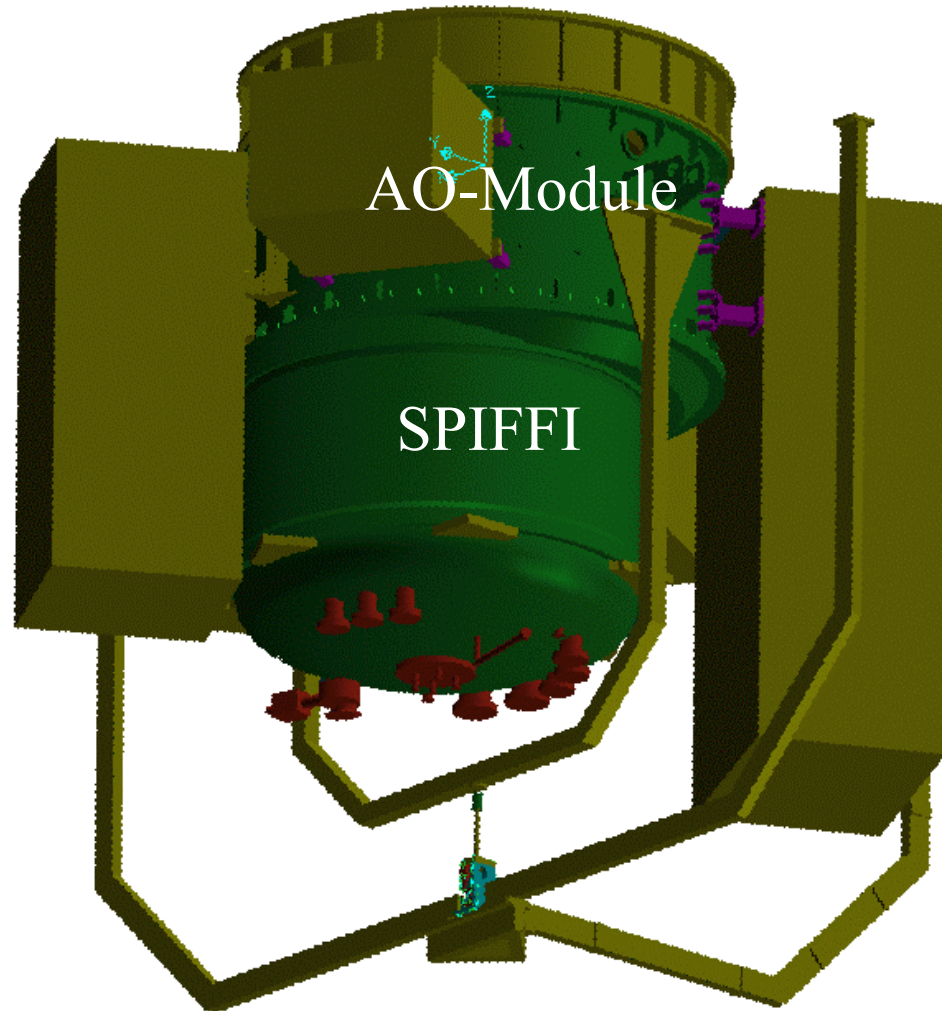
SINFONI =
SPIFFI (MPE) + SINFONI-AO (ESO)

SINFONI – an adaptive optics assisted integral field spectrometer for the ESO VLT

- Scale changer in the pre-optics allows pixel scales to be adapted to the performance of the adaptive optics system
 - 3 pixel scales of 0.25", 0.1" and 0.025" per pixel, corresponding to 8" × 8", 3.2" × 3.2" and 0.8" × 0.8" FoV
- Spectral resolution of ~1500 for H and K bands combined, or ~3200 in a single band (J, H or K)
- ~35% instrument throughput, total system efficiency exceeding 15%
- 1024 simultaneous spectra to fully utilize detector area
- OH avoidance capability
- Simultaneous spectra of blank sky using one corner of the field
 - 15", 30" and 45" distance from the field center
 - Sky can cover 0 to 50% of the field



SPIFFI and SINFONI Schematic



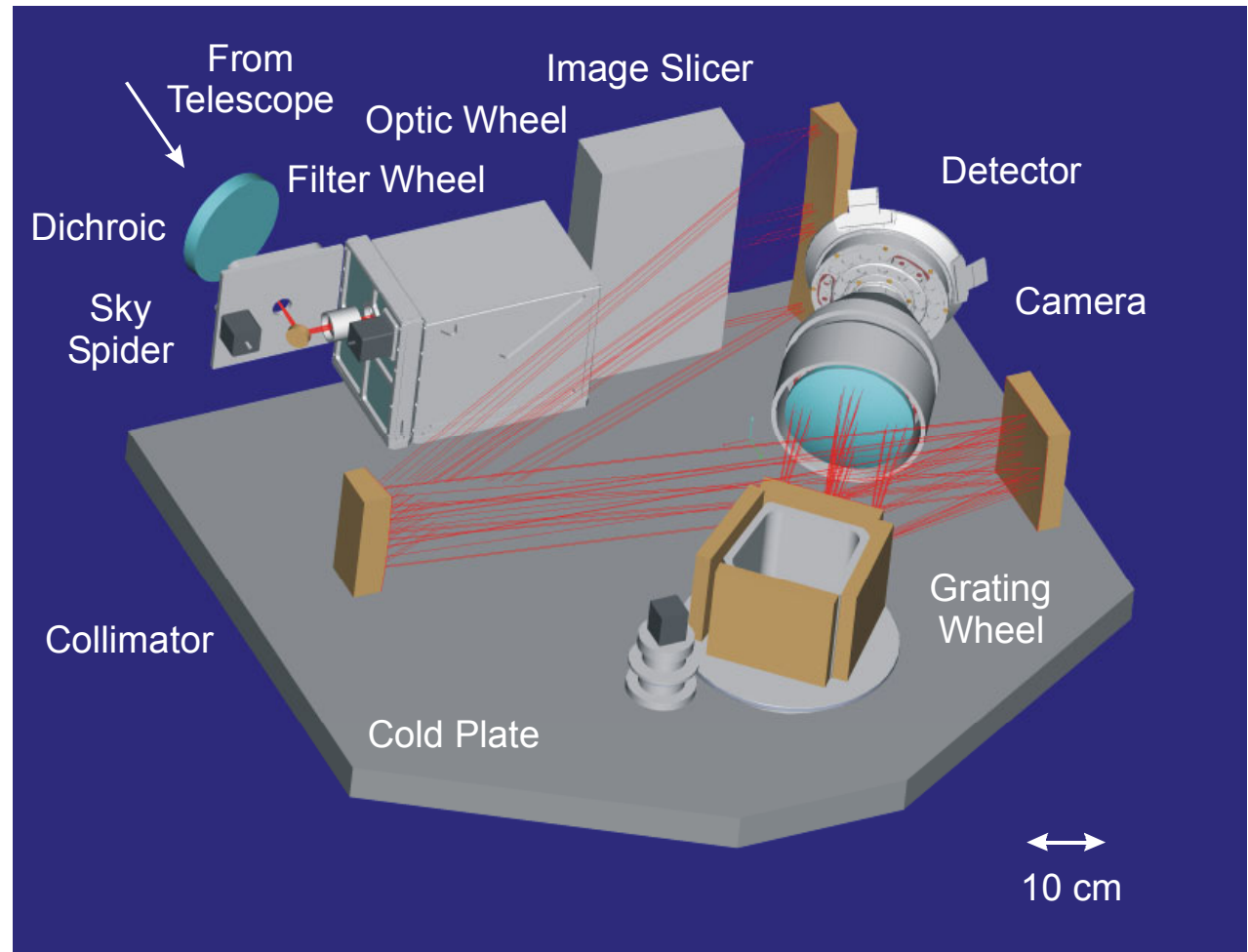
SPIFFI: SPectrometer for Infrared Faint Field Imaging

- Fully cryogenic instrument

Mass: ~500kg

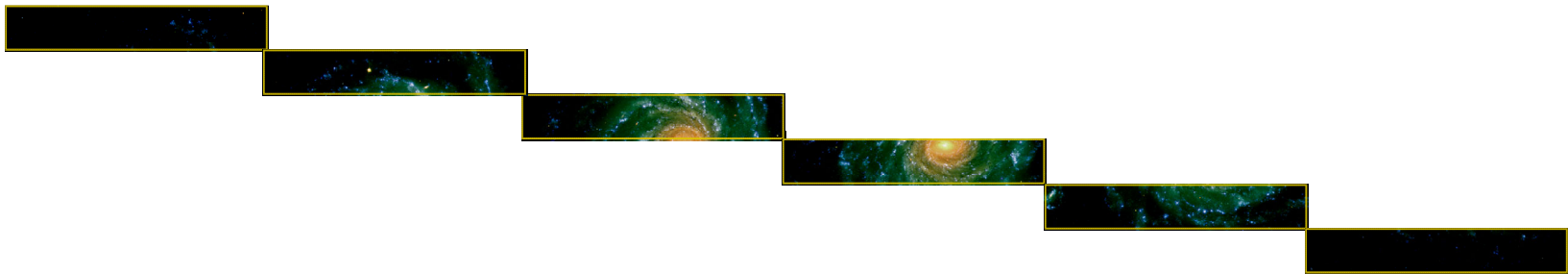
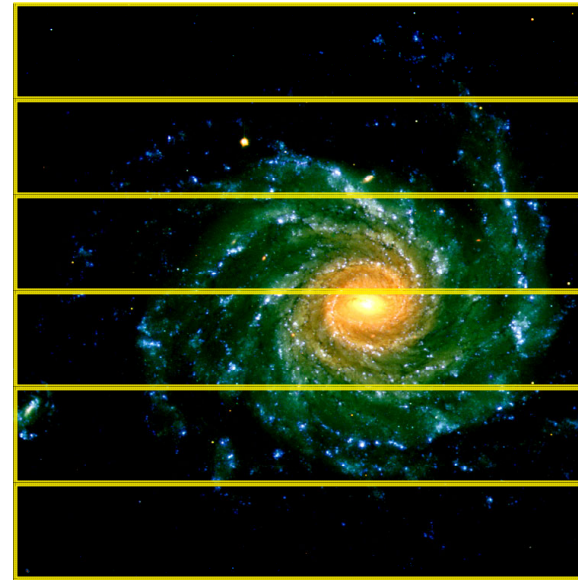
Diameter: ~1.3m

Height: ~1m

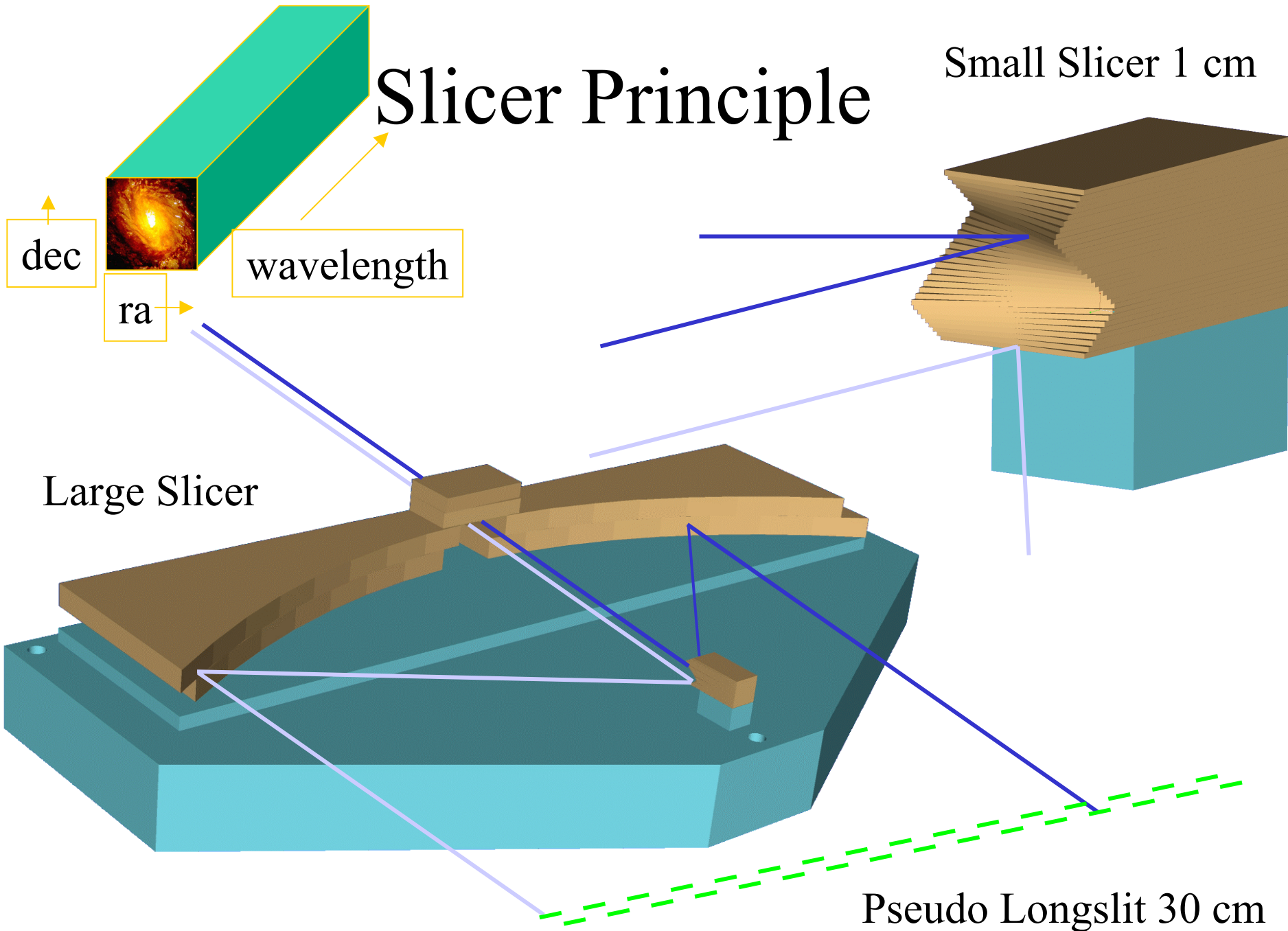


Slicing the Image

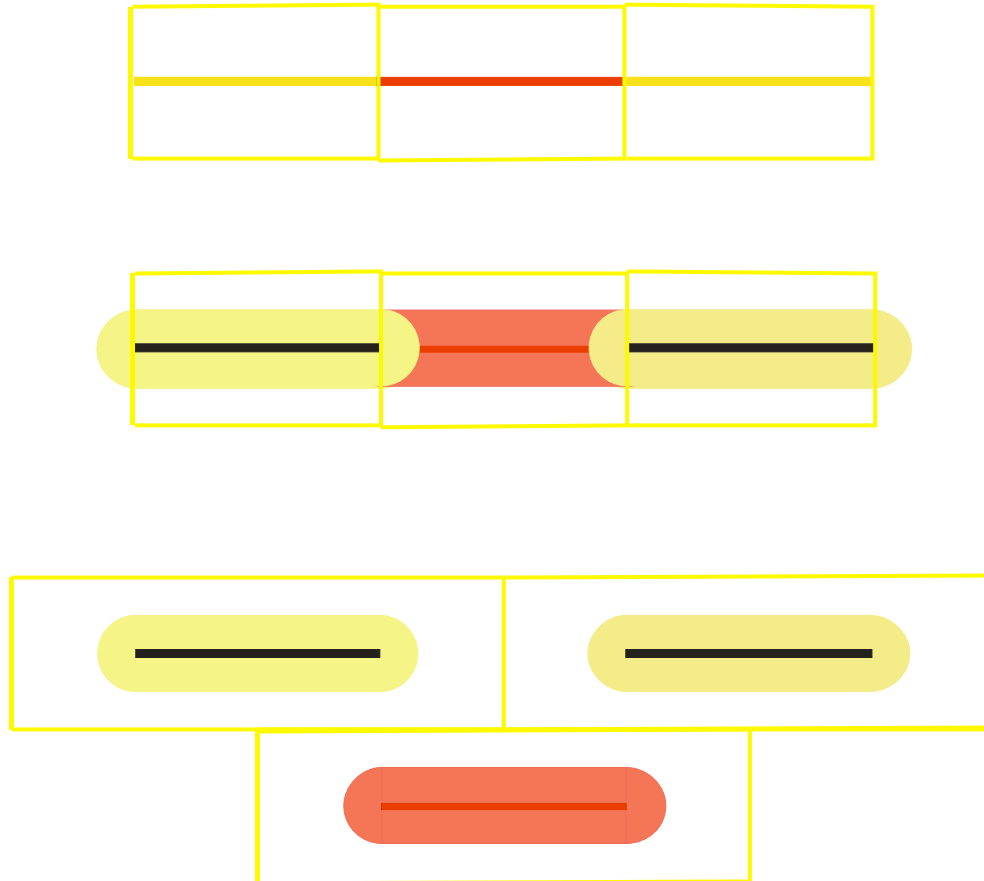
Spatial information is retained inside the slitlets



Slicer Principle



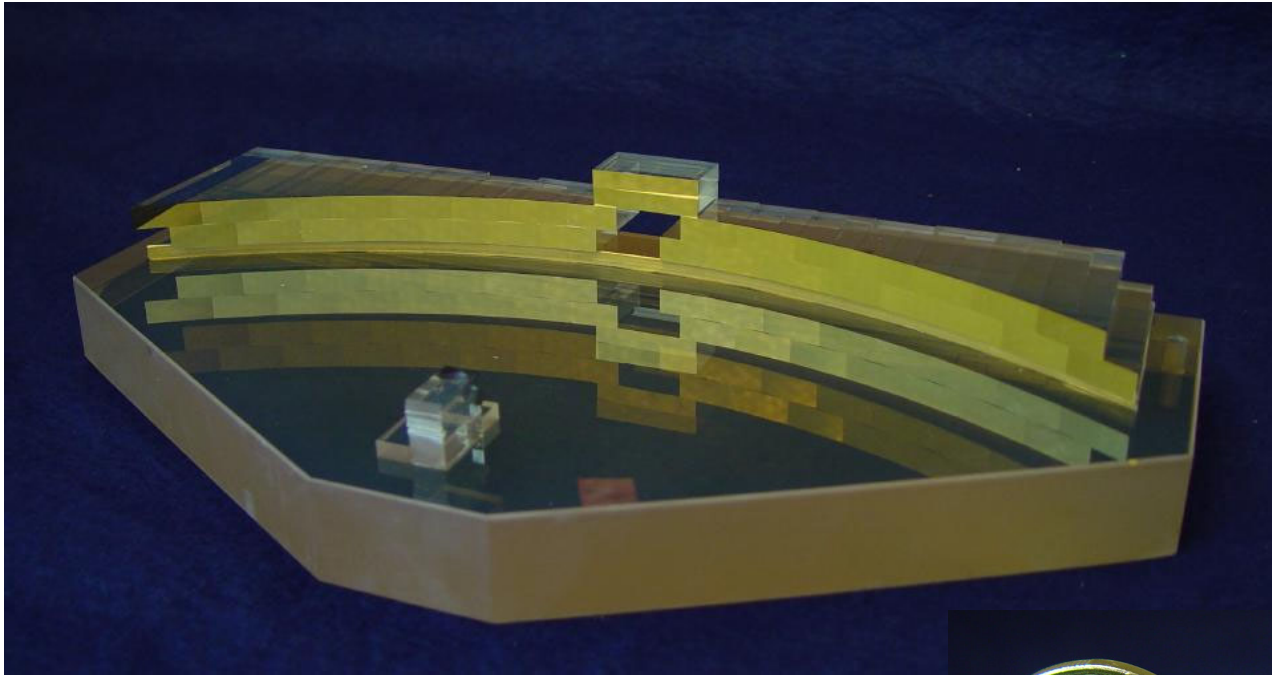
Brick-wall pattern on the slicer



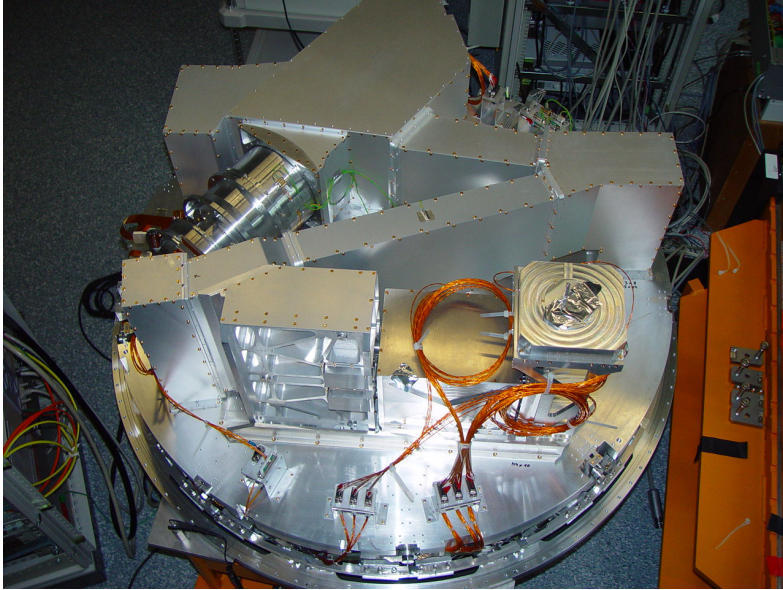
SPIFFI Image Slicer

- Fully cryogenic monolithic Zerodur design
- 32 slit-lets, each 32 pixels long, 0.3mm slit-width
- >97% transmission

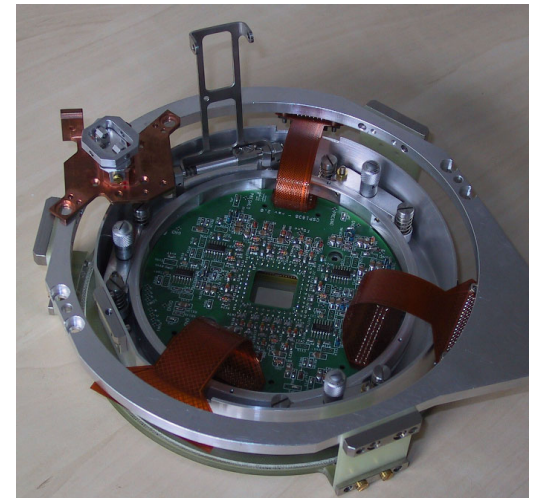
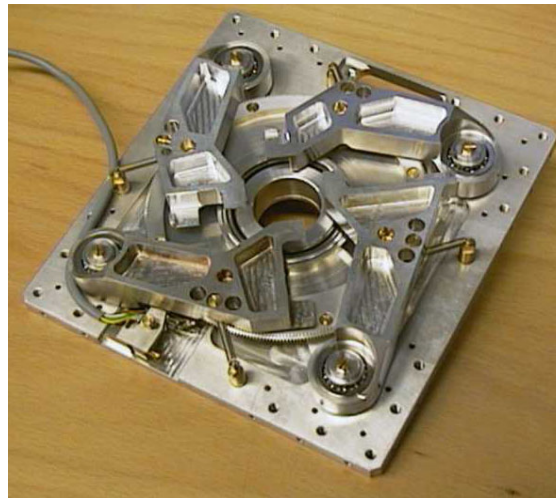
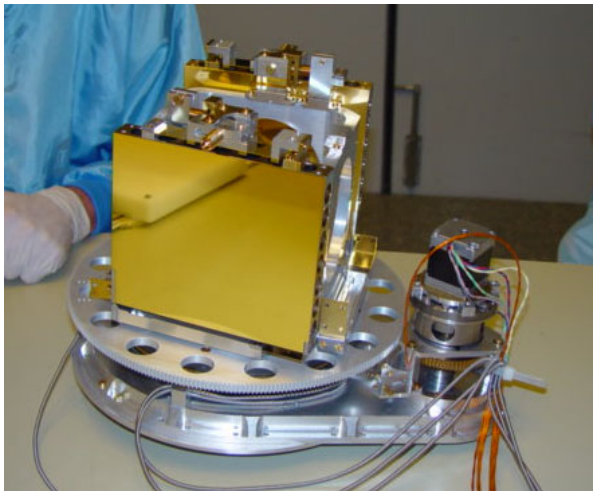
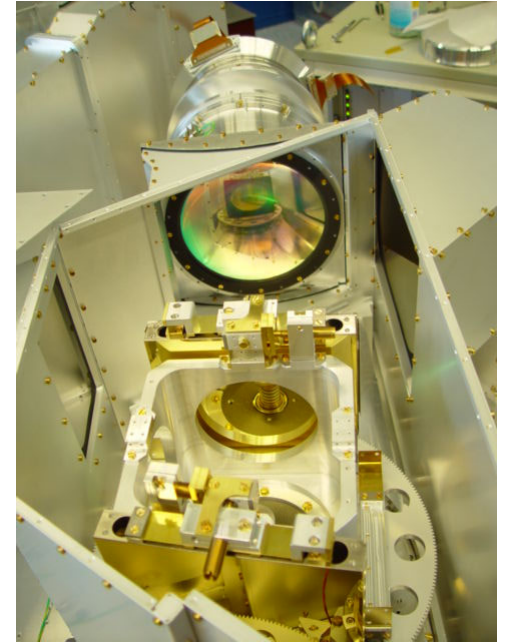
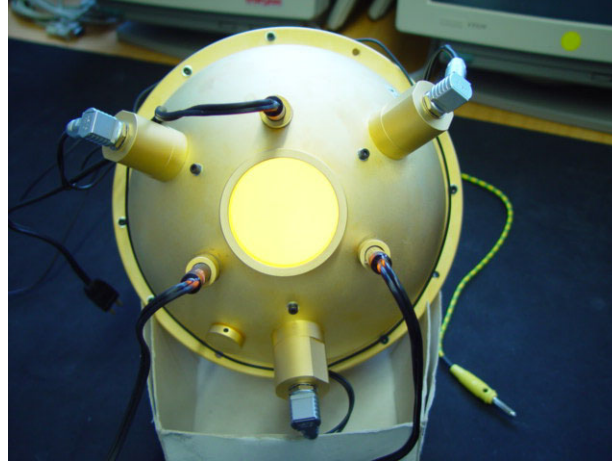
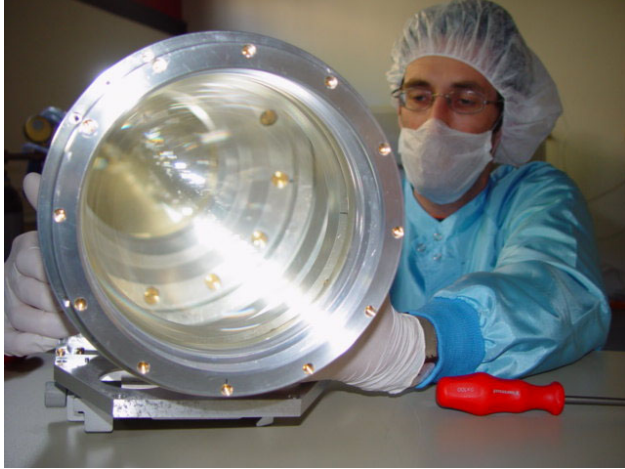
Photographs of the SPIFFI Image Slicer



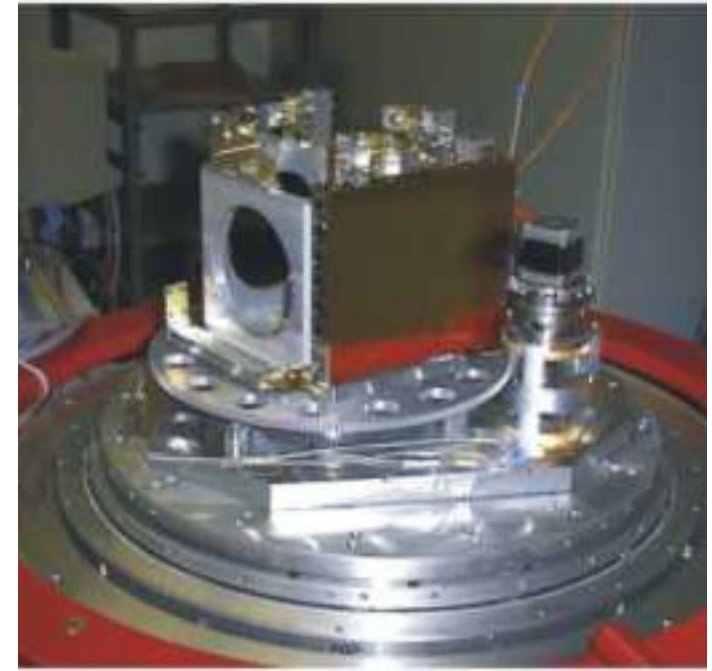
Optomechanics Pictures



Optomechanics Pictures 2

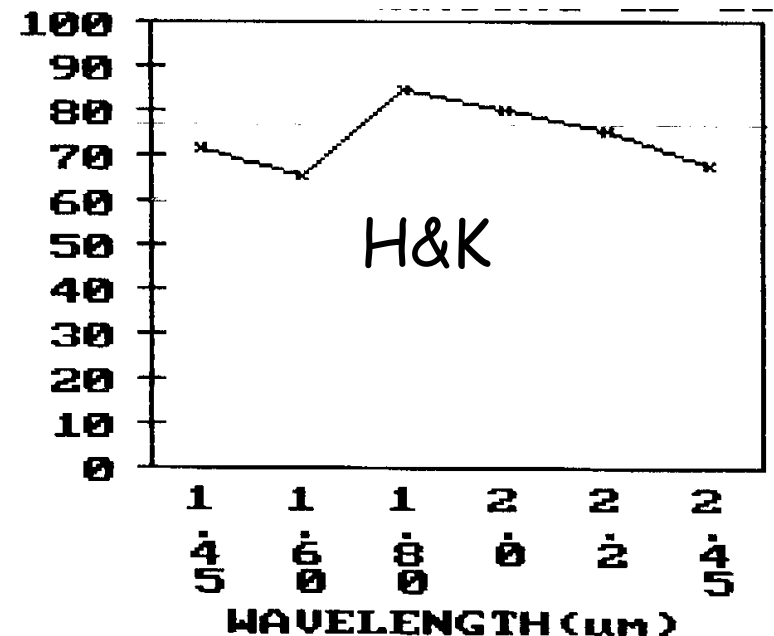


SPIFFI Grating Wheel

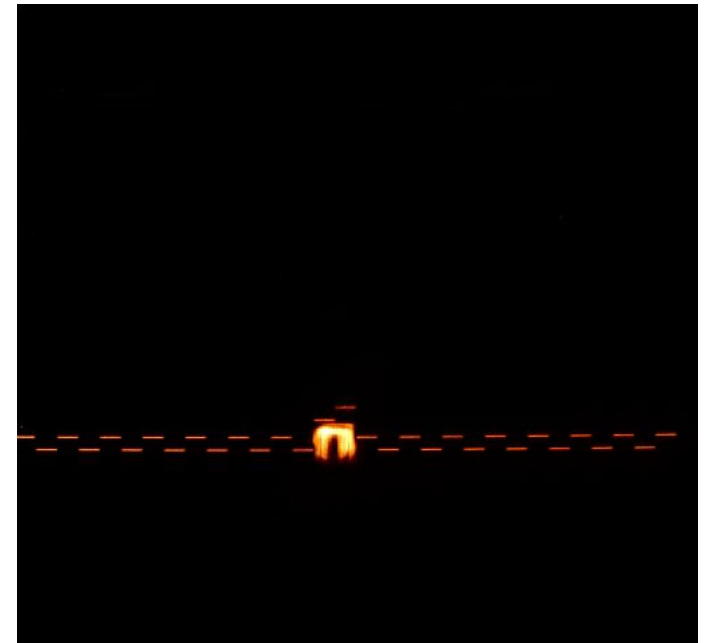
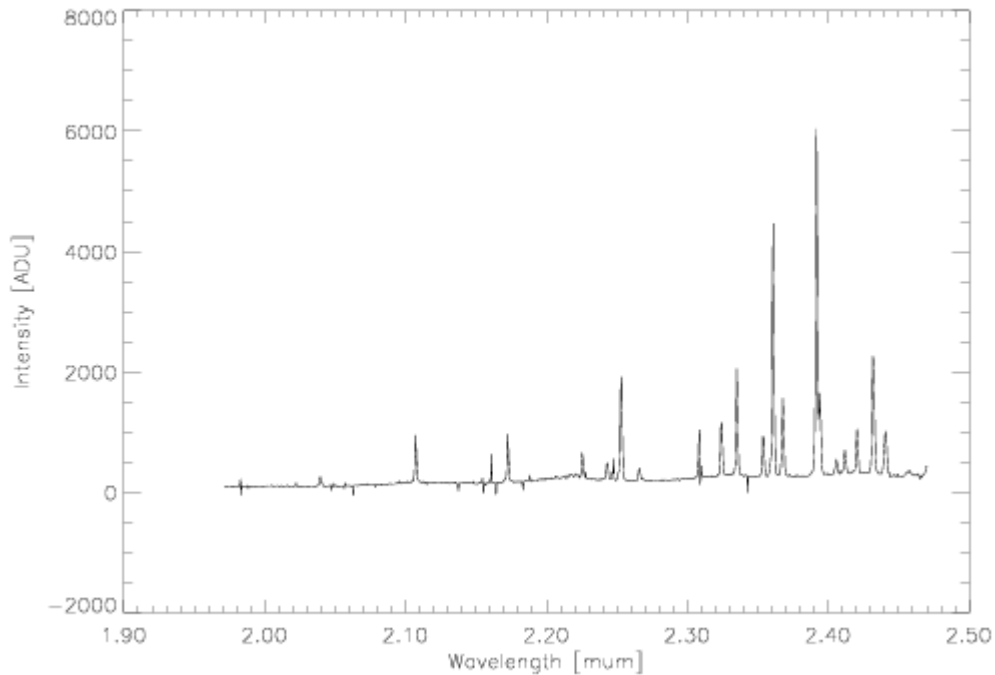


Band	$R=\lambda/\Delta\lambda$	Δv [km/s]
J, H, K	~ 3200	~ 85
H&K	~ 1500	~ 185

- Spectral Dithering:
Full spectral resolution
requires 2 exposures



First Light in the lab at 5/6/2002



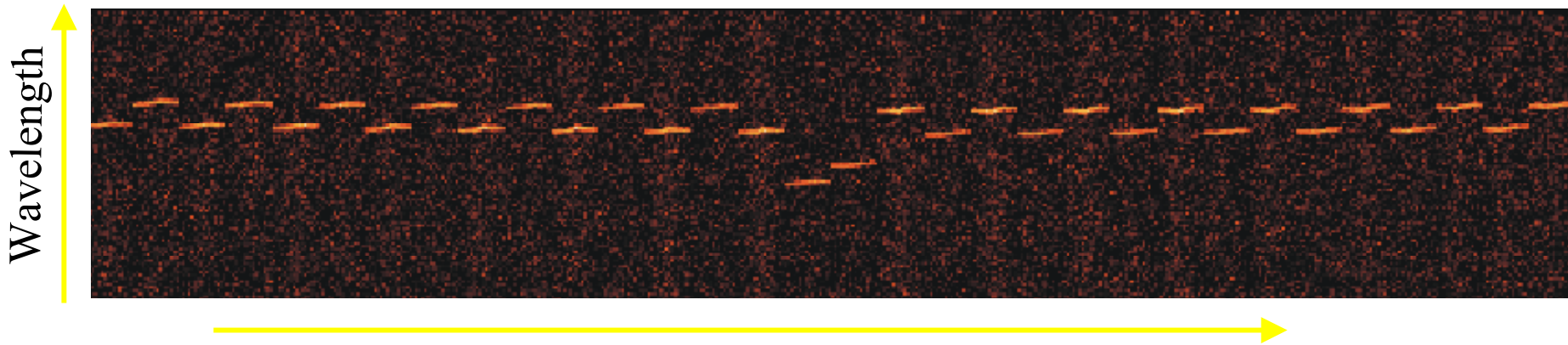
Performance:

- ✖ R~3200 allows for OH-Avoidance (not H&K):
 - ⊙ e.g. 98% of H-band sky background is emitted by ~70 OH-lines
- ✖ Point-Source limiting magnitudes (S/N = 5, 6×10min)

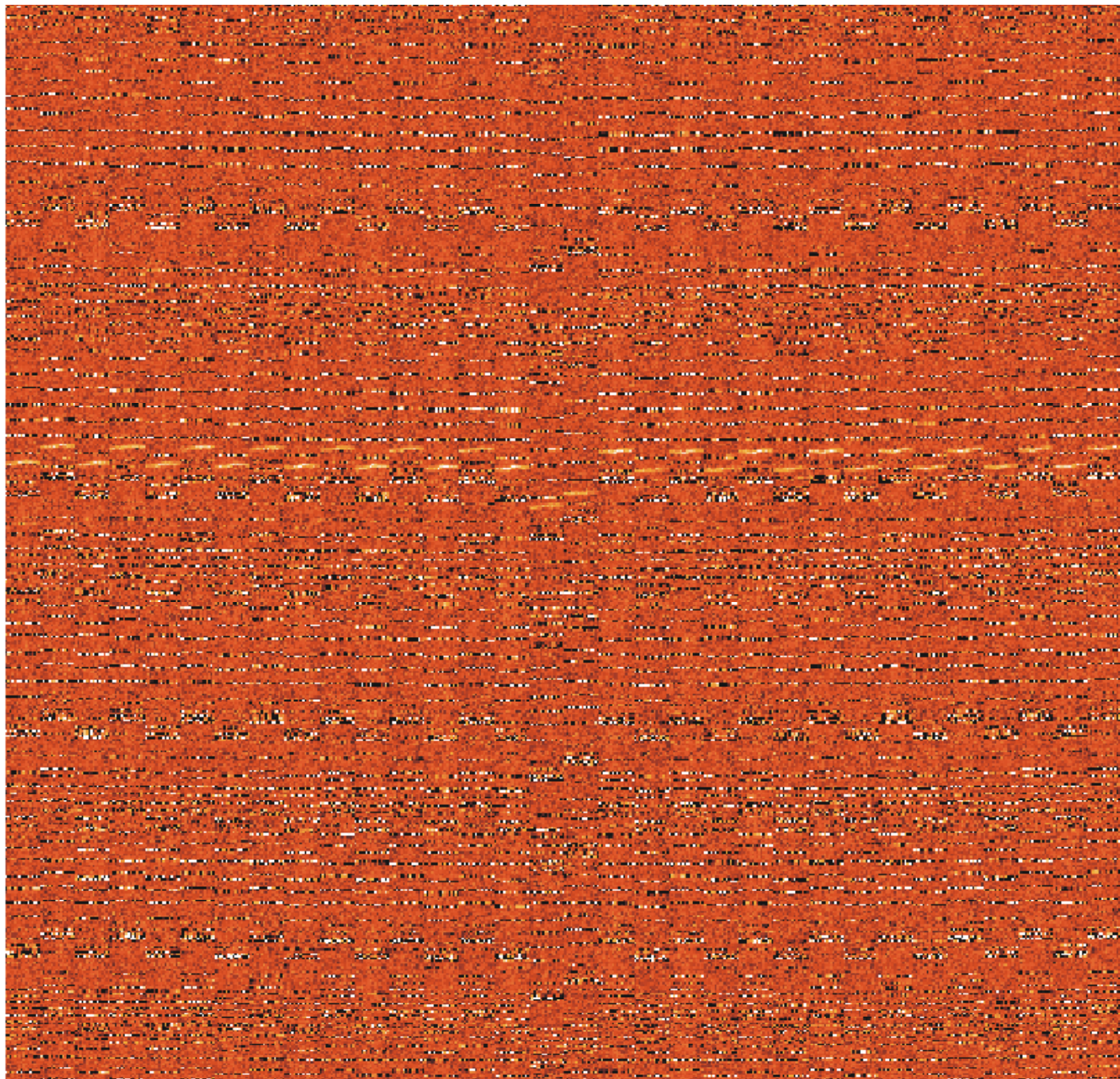
Band	Without AO	With AO
J	20.4	19.2
H	20.1	18.6
K	18.0	18.0
H + K	19.1	19.0

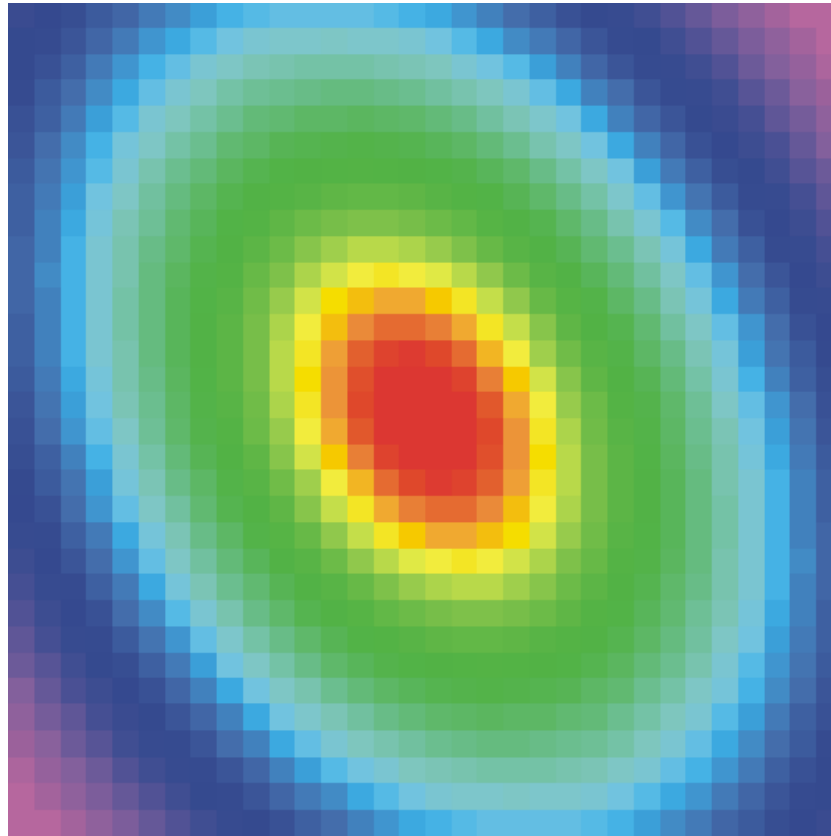
- Less sensitive at the AO pixel scale because of detector noise limitations (only 20% of flux in the central peak)

Reconstructing the image

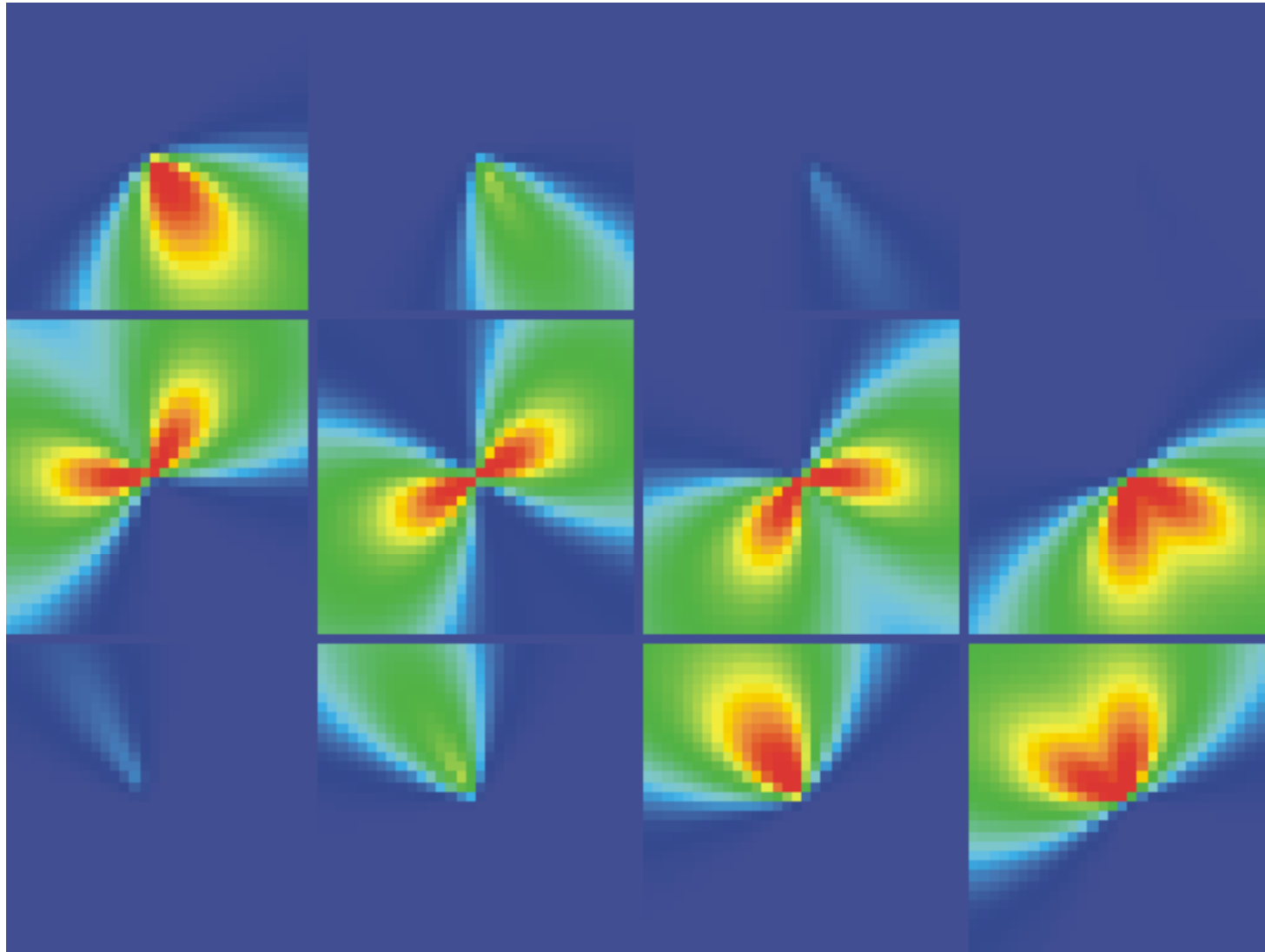


Spatial information (both x and y reformatted by the slicer)





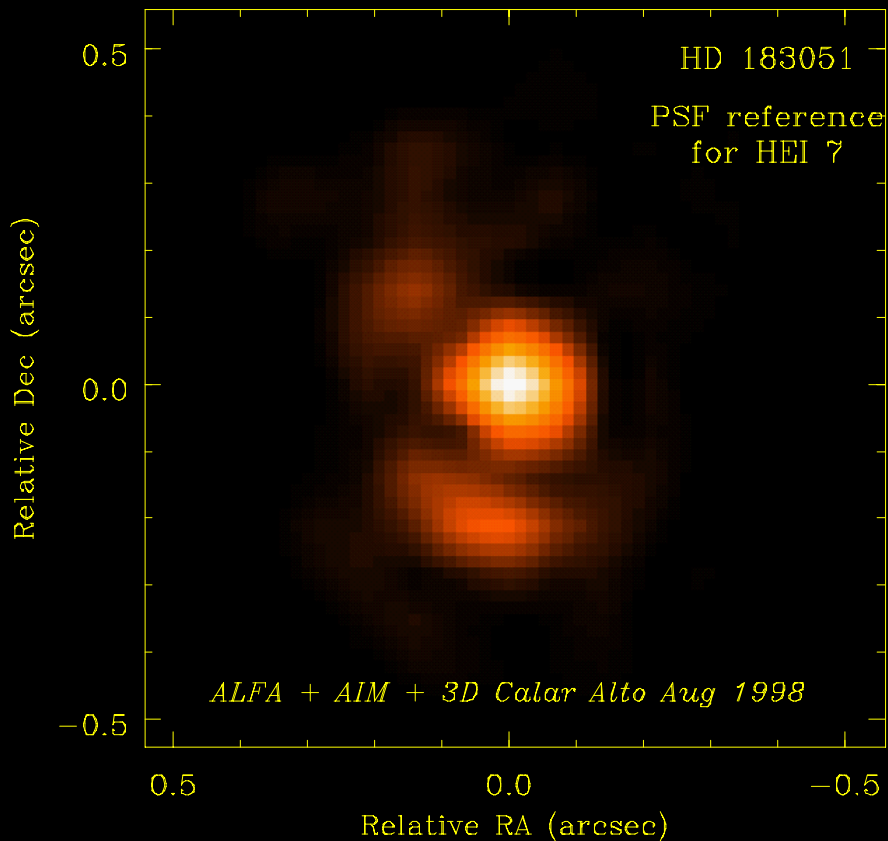
Reconstructed image of the galaxy made by collapsing the data cube along the wavelength axis.



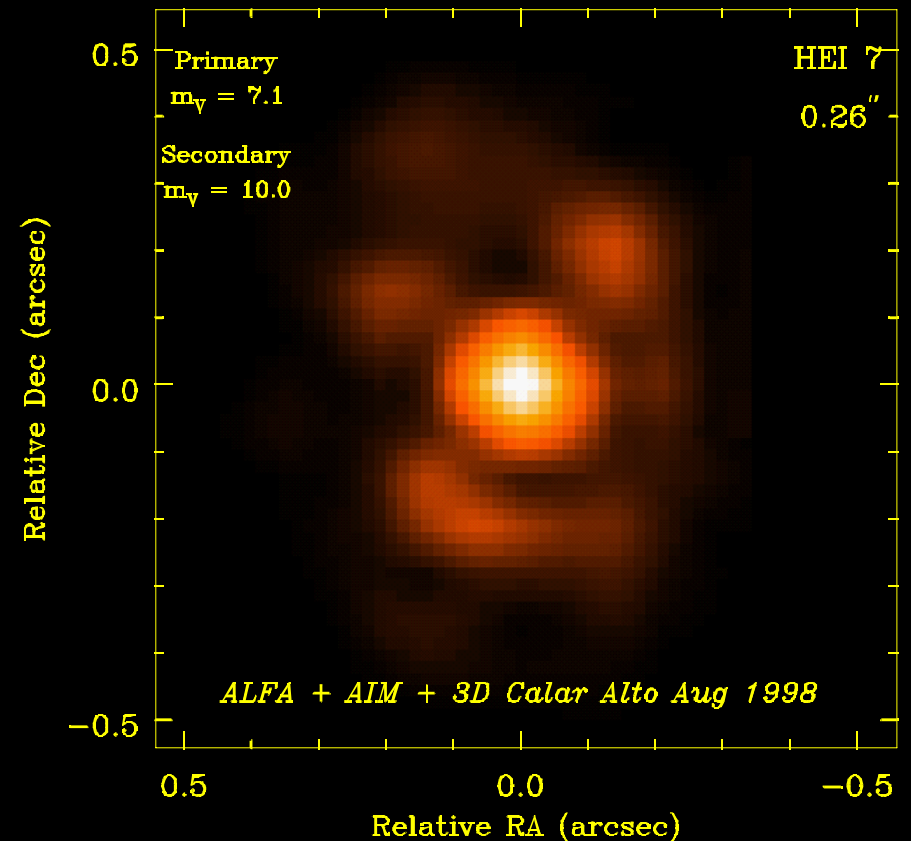
Channel maps (wavelength sections of the data cube) showing the velocity field of the galaxy

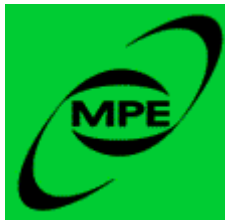
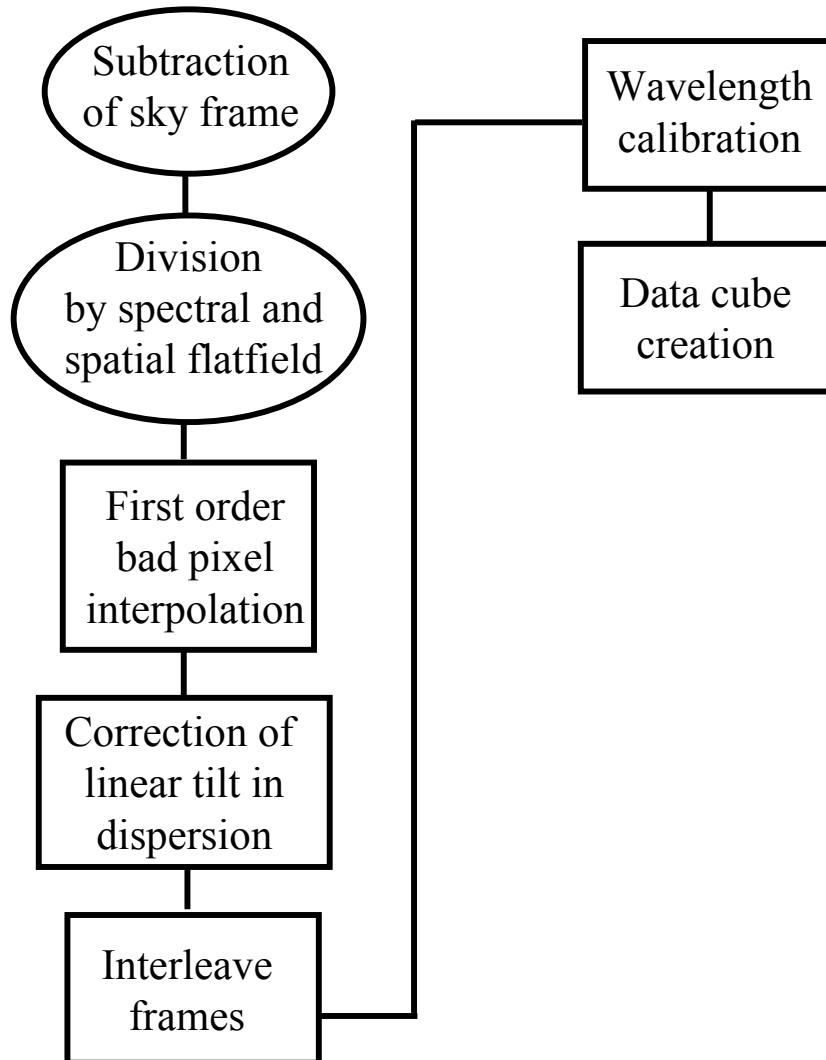
Integral field spectroscopy with adaptive optics

Reconstructed K band image of PSF ref for HEI 7

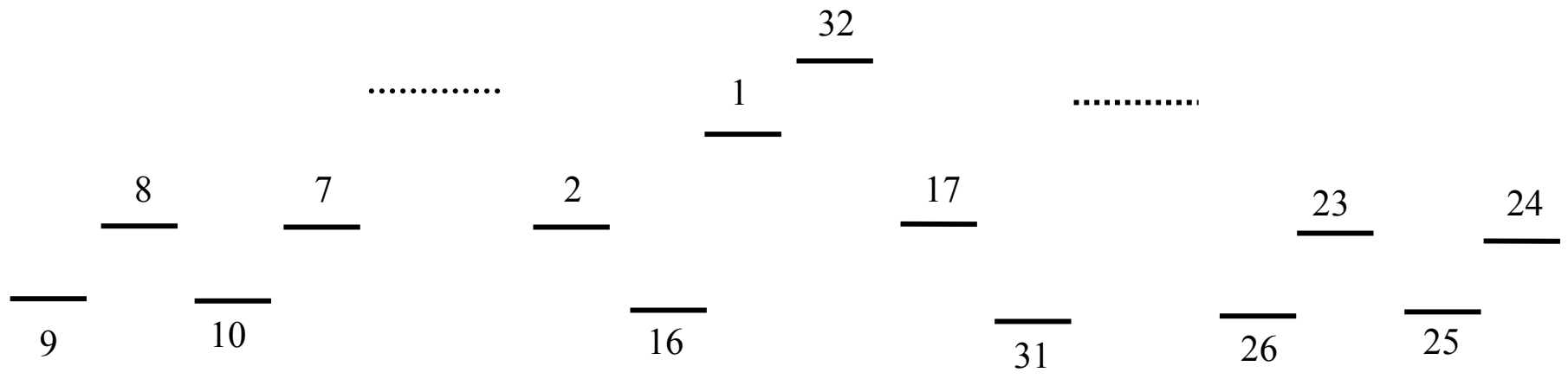


Reconstructed K band image of HEI 7

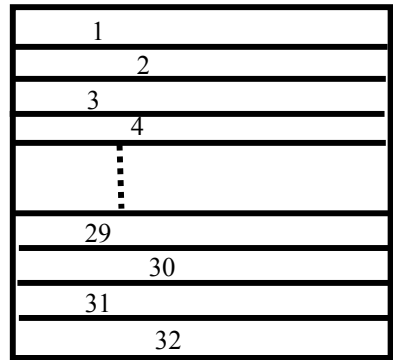




Detector raw image



Reconstructed image



3 reduction packages needed:

•Online pipeline reduction

quality control of observations

automatically launched

available calibration frames used

•Quicklook reduction for the RTD

“simple” and fast image reconstruction

first look on observed field

can be used to adjust the telescope pointing

•Offline reduction

results usable for scientific analysis

interactively

best calibration frames can be used



Guest Instrument Phase

- Basic routines are written in ANSI C
- These routines can be connected by using the script language PYTHON
- Interface between C and PYTHON: SWIG
- FITS I/O and basic stuff from ECLIPSE

Advantages of this approach:

- Fast running software (PYTHON and SWIG are written in C++)
- ANSI C, PYTHON and SWIG Software is freely available and easy to install
- run on all UNIX species
- reduction pipeline is changeable without compiling

Facility phase: only ANSI C



SINFONI Project History

- ✗ Mid 1996: Conception of ESO-MPE project
- ✗ Oct 1997: Approval by ESO STC
- ✗ Jun 1999: ESO Council approves MoU draft
- ✗ Sep 1999: NOVA plans to join in Phase II
- ✗ Nov 1999: SPIFFI (spectrometer only) PDR
- ✗ Feb 2000: MoU signed (ESO-MPE)
- ✗ Nov 2000: A.O. Module PDR, Interface defined
- ✗ June 2001: SPIFFI FDR
- ✗ Nov 2001: A.O. Module FDR
- ✗ Apr 2003: PAE A.O. Module
- ✗ Aug 2003: PAE SPIFFI
- ✗ Jan 2004: Commissioning at UT4
- ✗ Oct 2004: Release to the ESO community(?)

SPIFFI Upgrade

- Detector:
 - 2k² HAWAII
 - New Spectrograph camera
- Grating:
 - R=10000? ($\Delta v=30\text{km/s}$)
- ESO Facility Instrument
- More information on the web:
www.mpe.mpg.de/SPIFFI