OPTIMOS-DIORAMAS for the E-ELT

Science Case

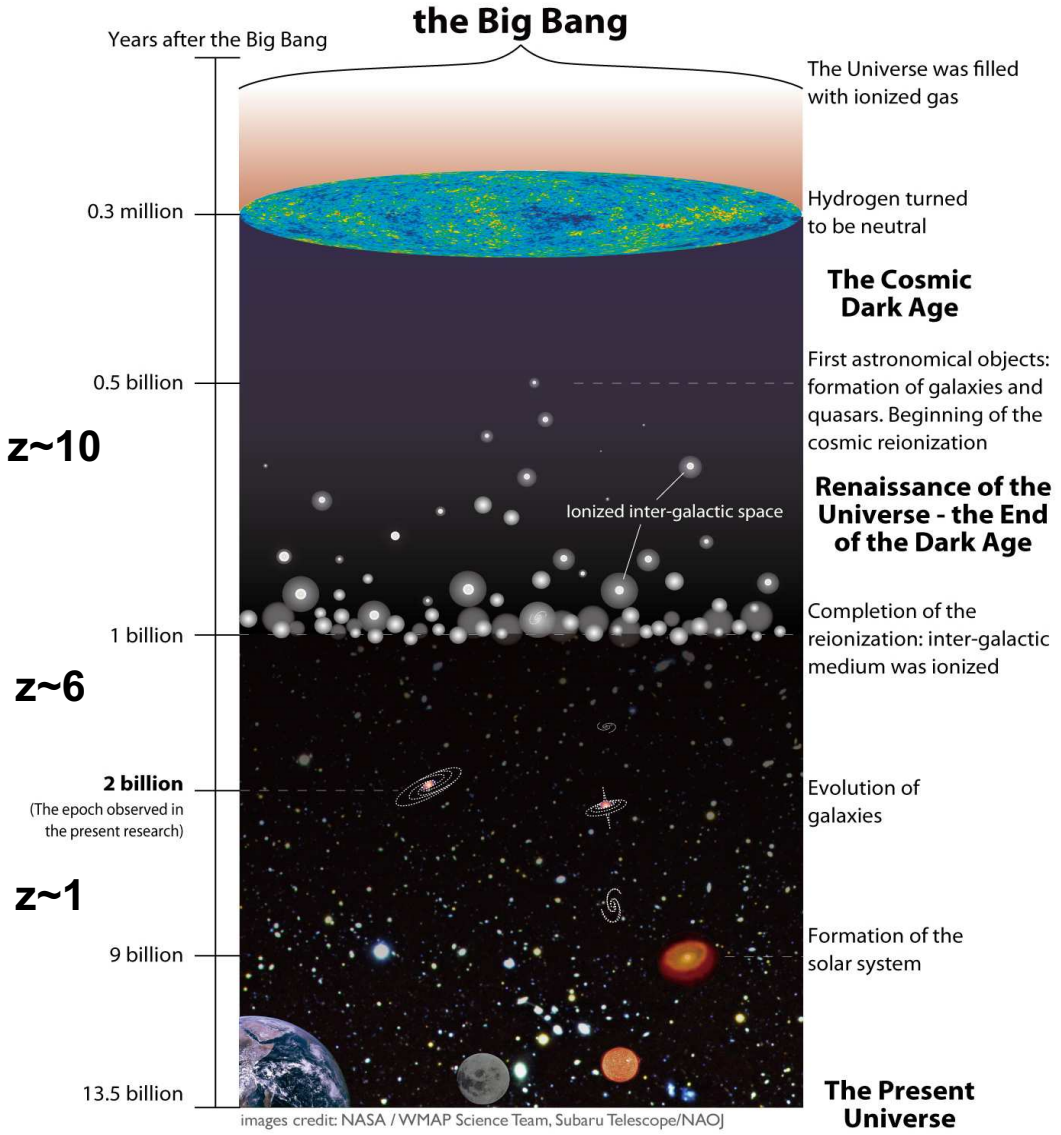
Open Issues

First Light ?

First Galaxies/AGN ?

Mass Assembly ?

Dwarf galaxies ?

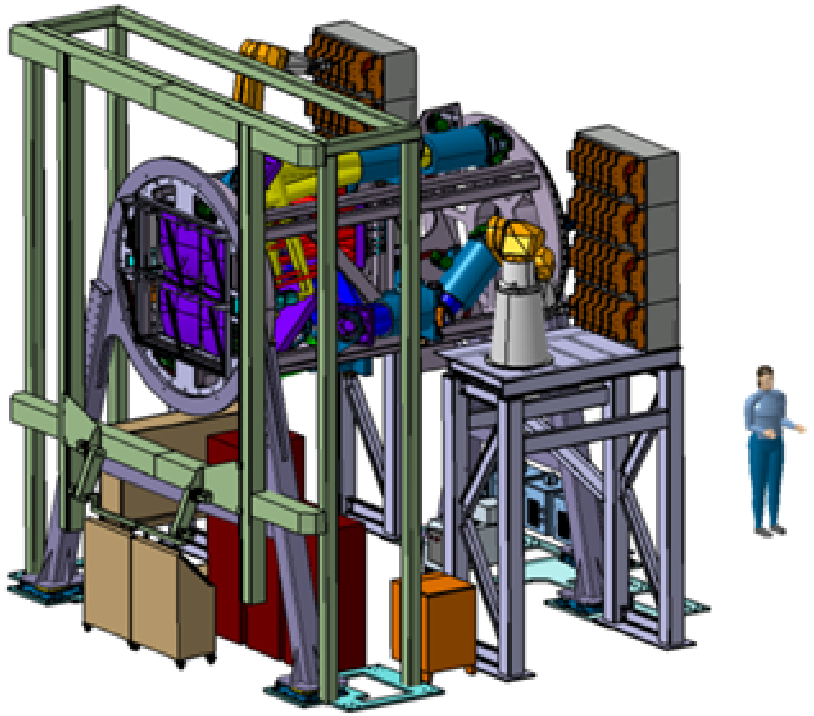


From science issues to instrument

- Find and study first light galaxies: wavelength range extending into NIR
- The history of galaxy assembly: high sensitivity
- Tomography of the high redshift Universe: wavelength range extending to the u band
- The first large structures in the Universe: large FoV
- Issues coming up in the next 5-10 years: multi-purpose instrument

Imaging and Multi-slit Spectroscopy

- Imaging spectrographs are the work-horses of major telescopes
- Goal: combine in one concept the deepest images and the deepest spectra possible with an ELT
- Multi-slit is the most efficient technique for faint objects: sky residual <0.1%
- Capability to work with GLAO-corrected images

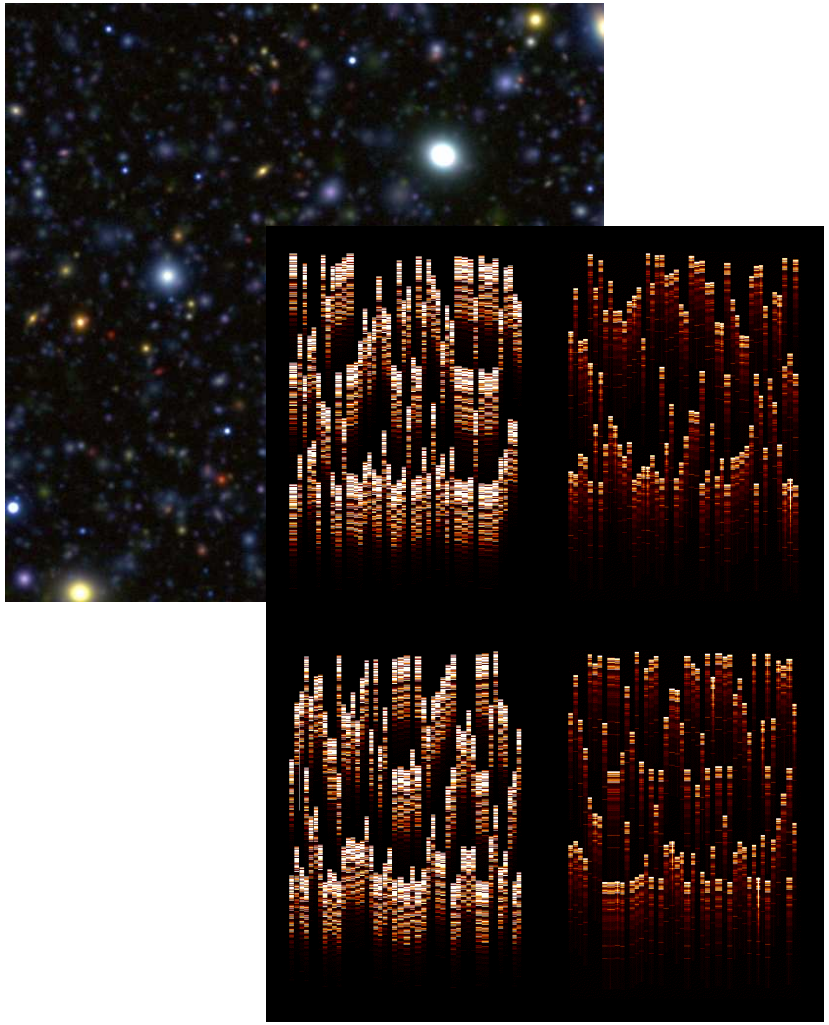


Innovative and robust concept

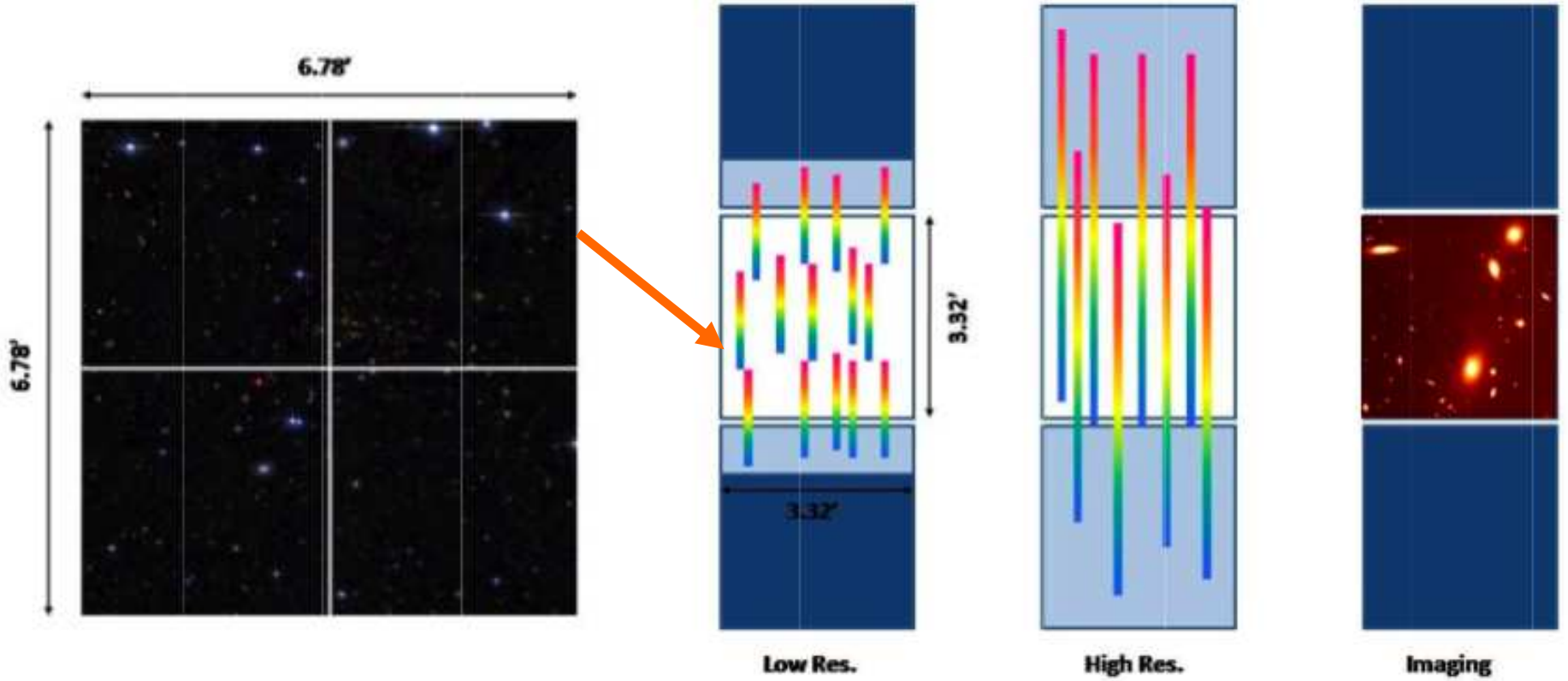
- Wide field up to 44 arcmin², use seeing-limited or GLAO-corrected images, 0.05 arcsec/pix
  - 2 Visible and 2 NIR quadrants, with 0.6-1µm overlap
- Imaging and MOS (slits) from 0.37 to 1.6 µm
  - IFU possible
- Superb optical design and compact mechanical layout
- Opto-mechanical systems using industry standards, no R&D required
- Low risk

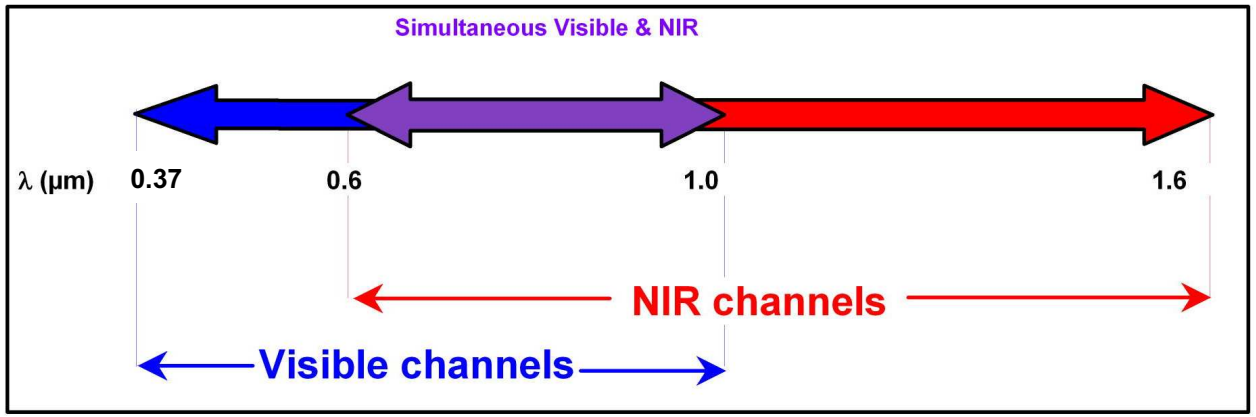
High level of performance

- Excellent image quality and high throughput (~70%)
- Extremely deep imaging from u' to H
- High multiplex: 160 slits in HR, 480 slit in LR
- Limiting magnitude (4h): AB~29 in imaging, AB~26.5 in MOS

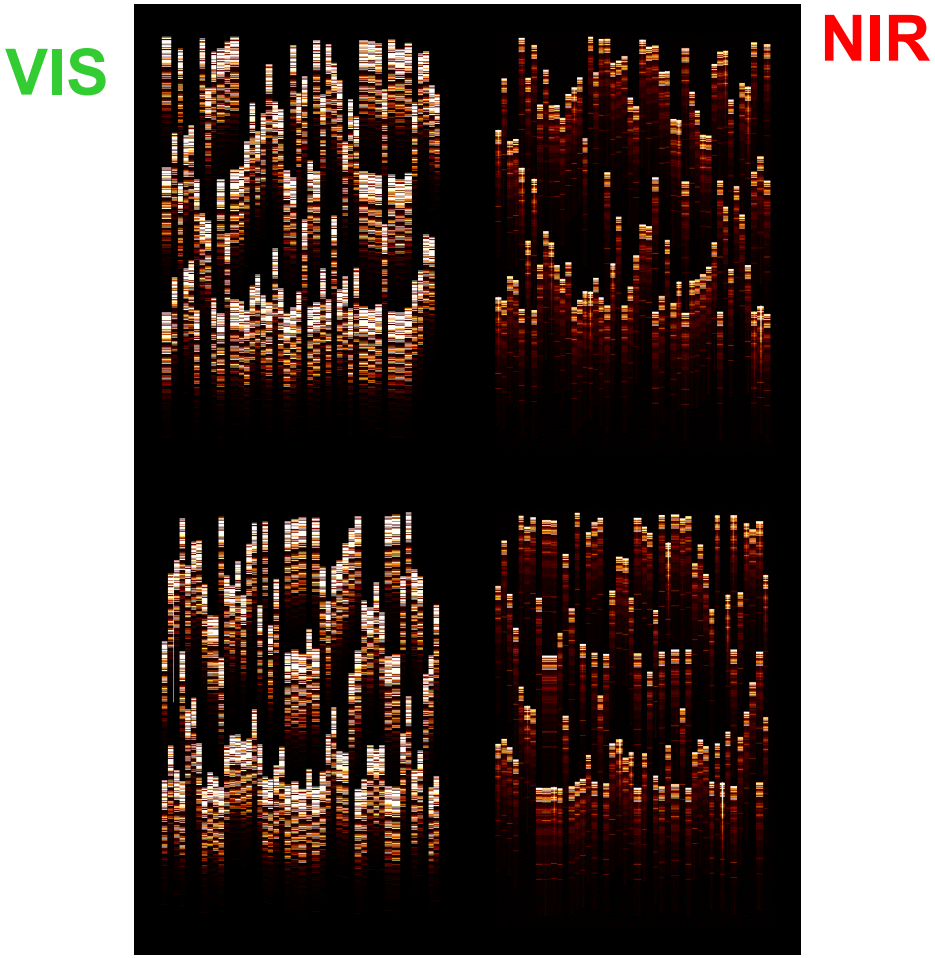


Spatial and Spectral Configurations

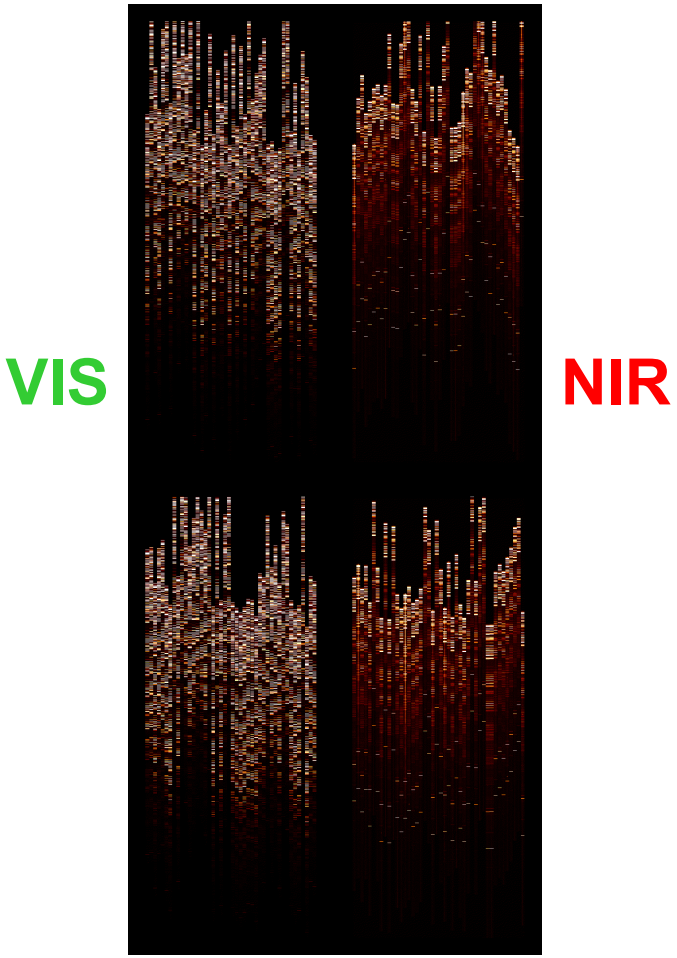




Simulated MOS observations

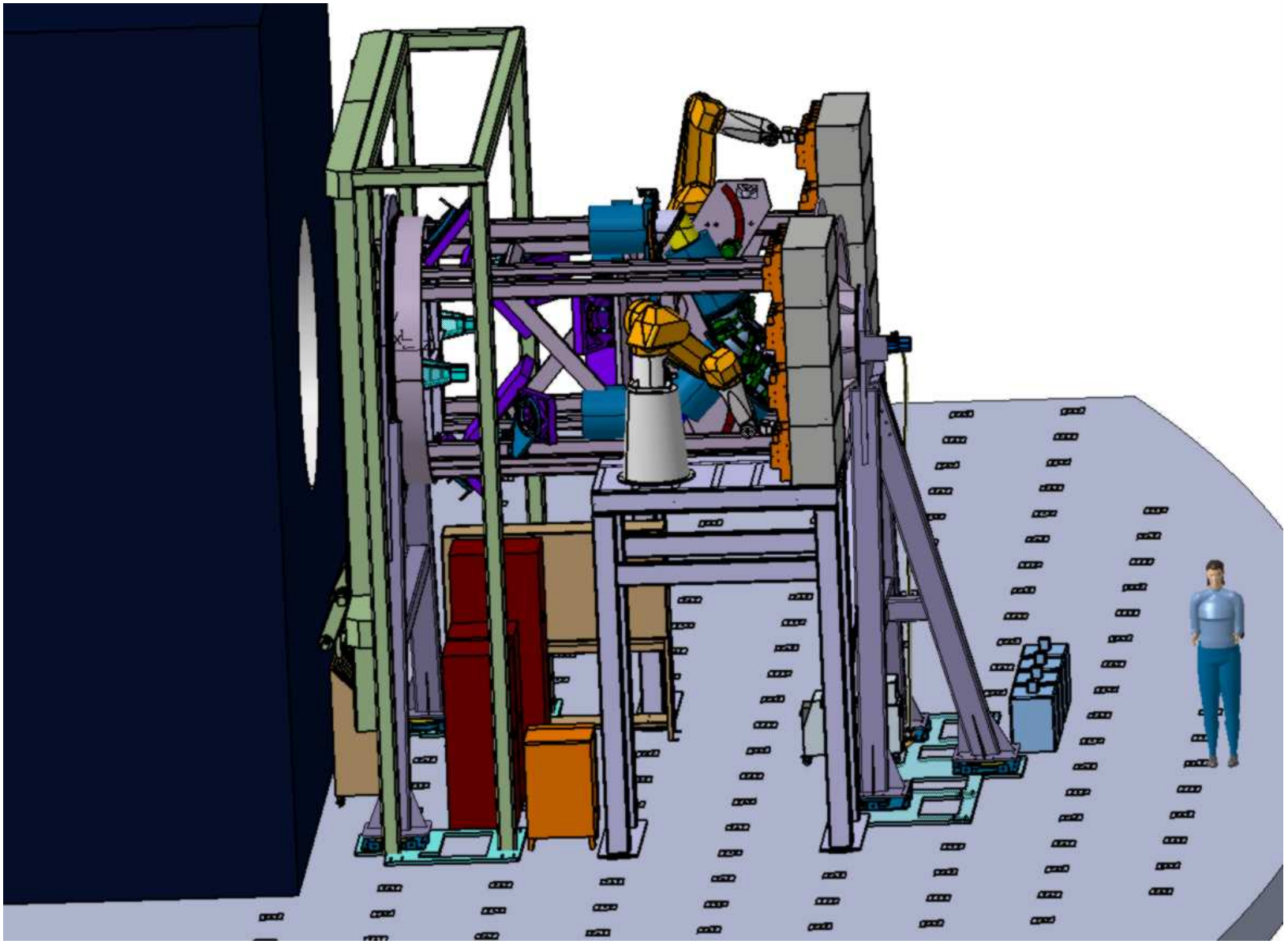


450 spectra R~300



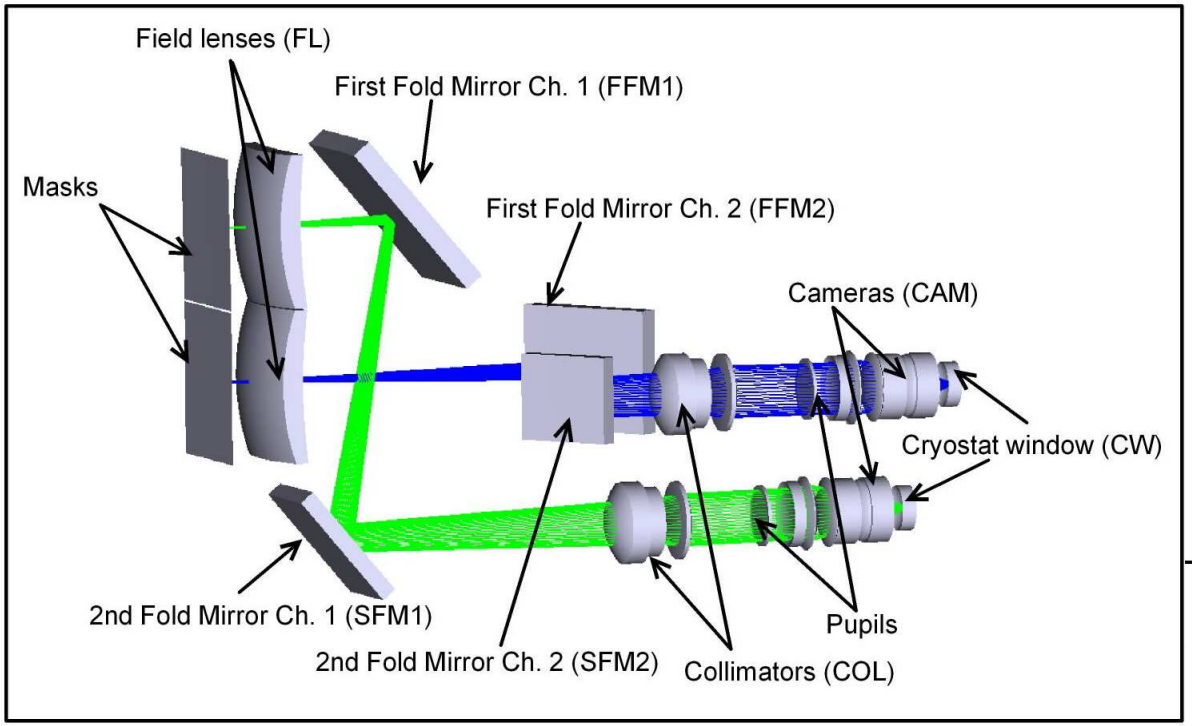
160 spectra R 3000

Instrument concept

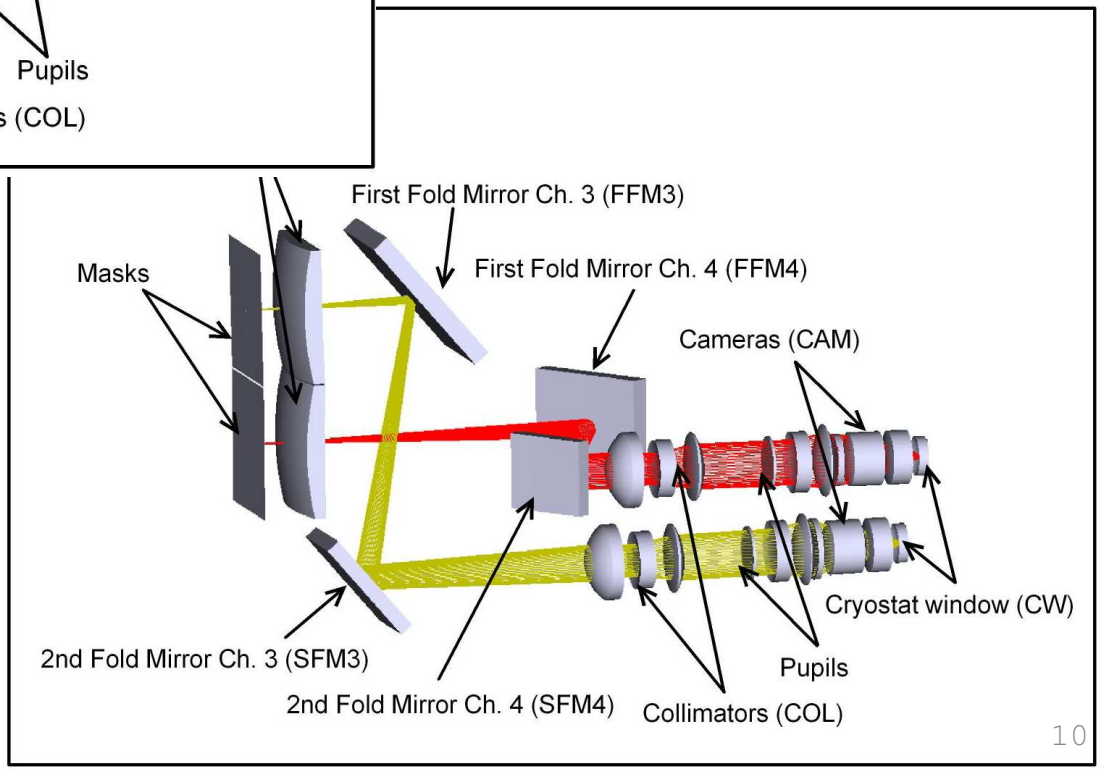


Optical Design

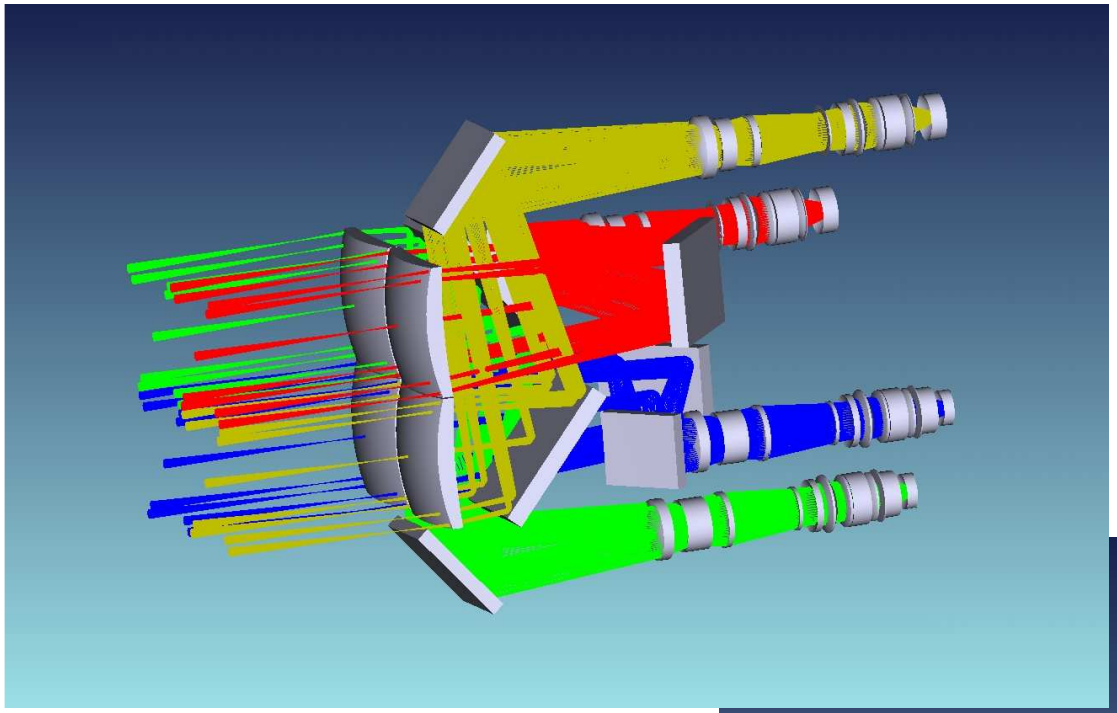
Visible channels



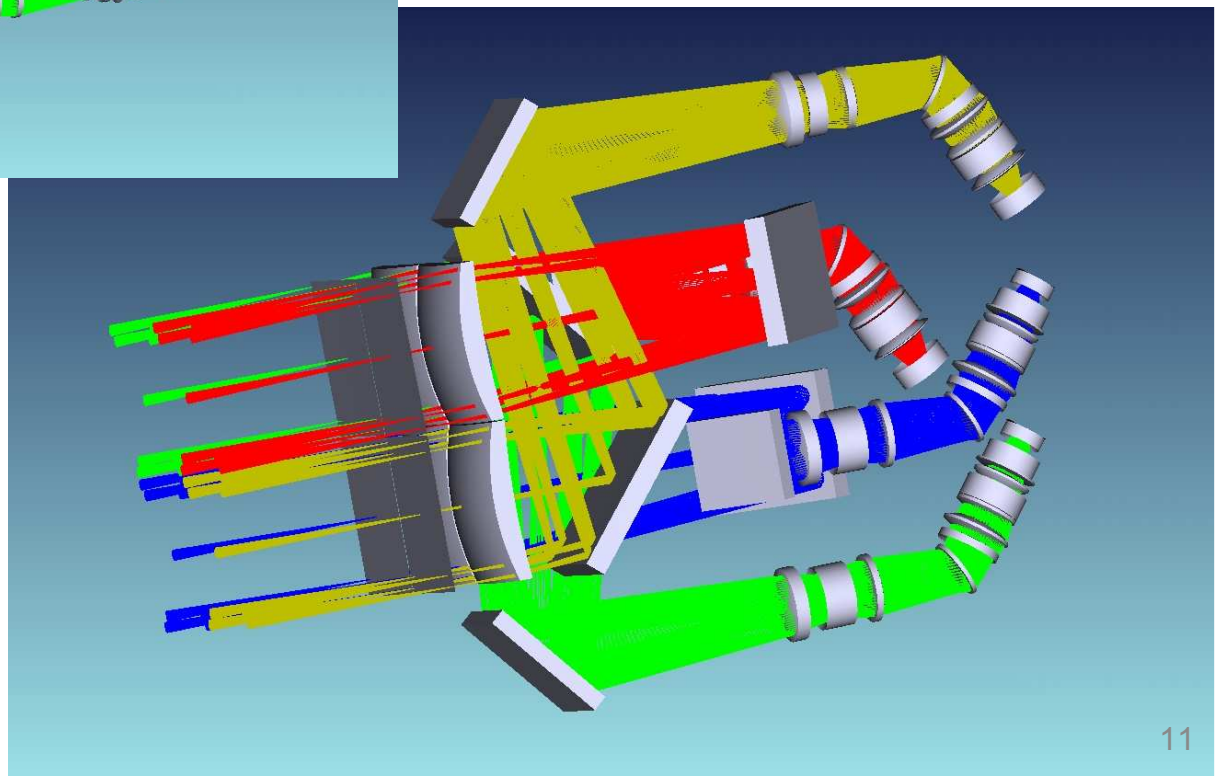
NIR channels



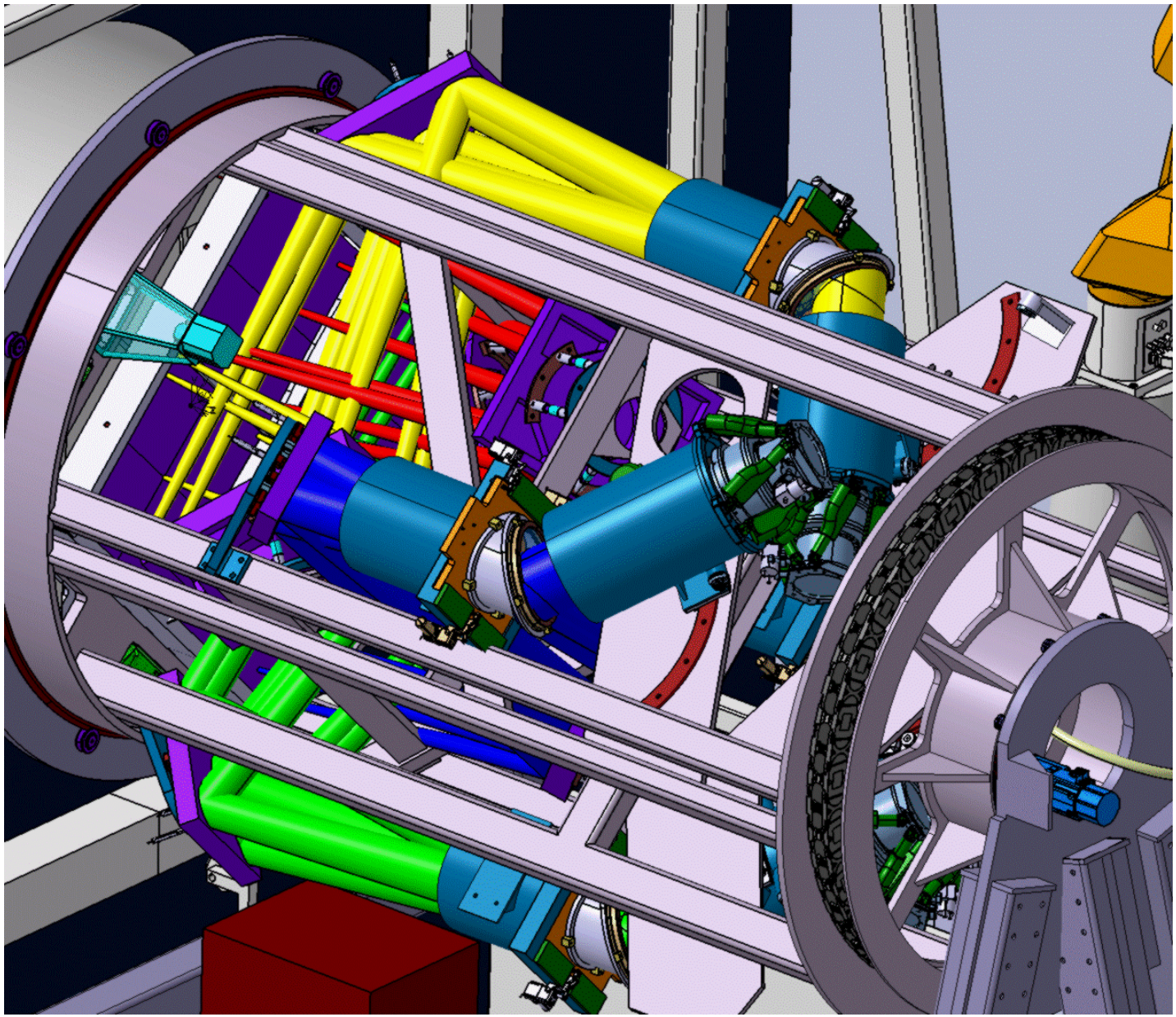
Layout for imaging and spectroscopy



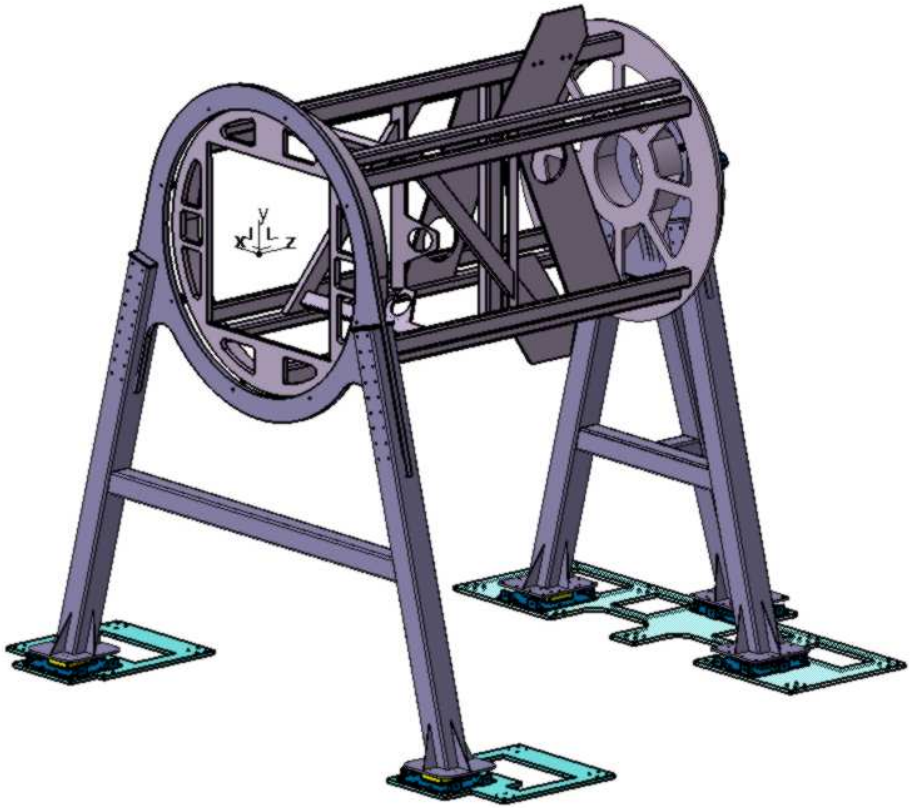
Layout in imaging mode



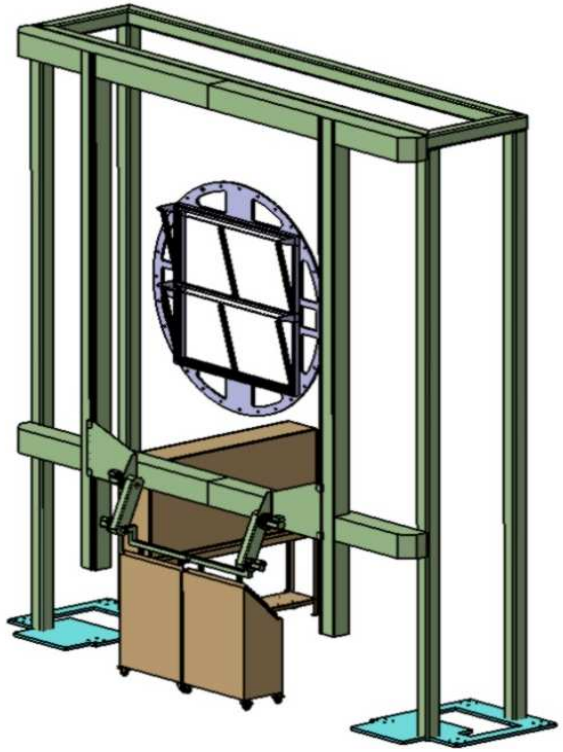
Layout in spectrographic mode



Systems description

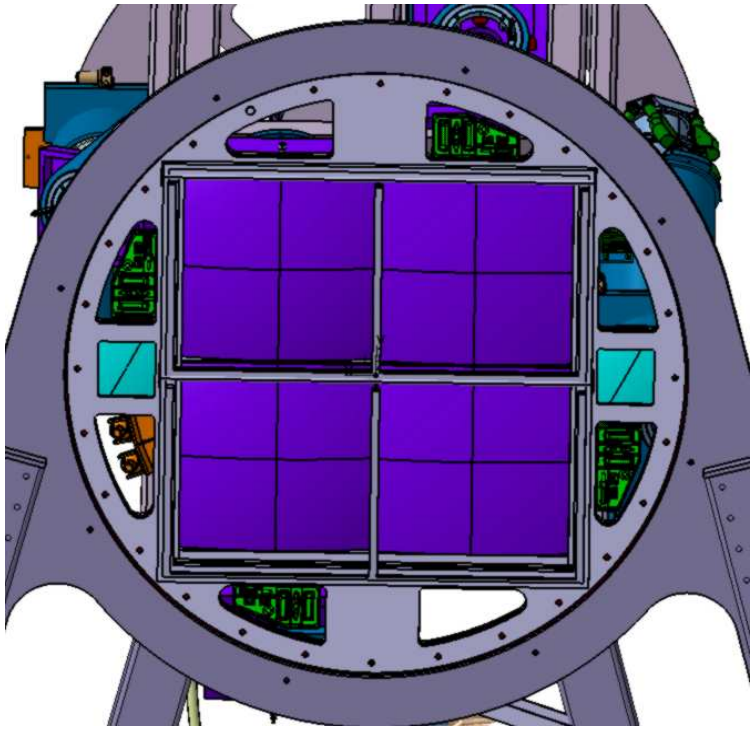


Instrument structure system
- Rotating structure
- Support legs and focal plane frame
- Rotator and cable wrap

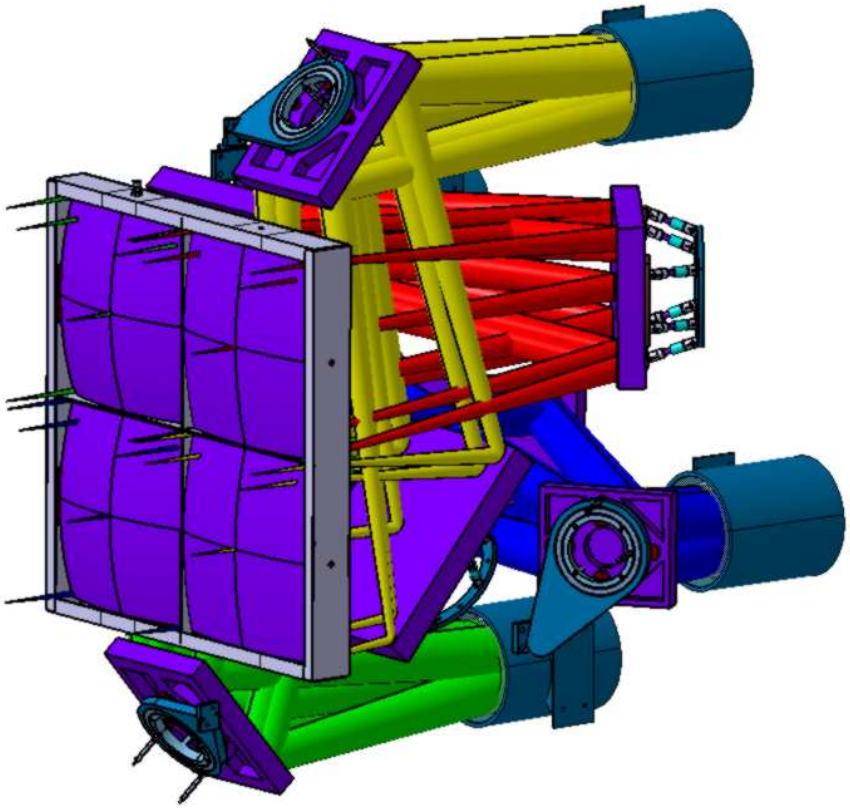


Mask Exchange Unit System
- Mask exchange robots
- Robot structure
- Focal plane backbone support
- Reservoirs

System by System

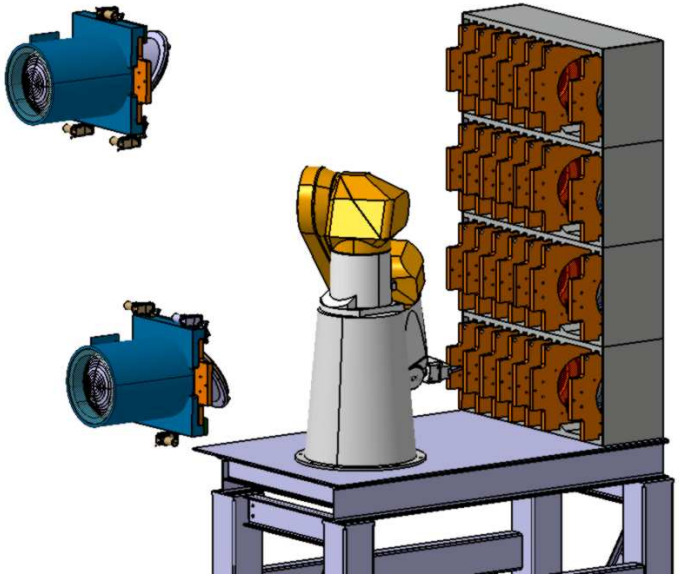


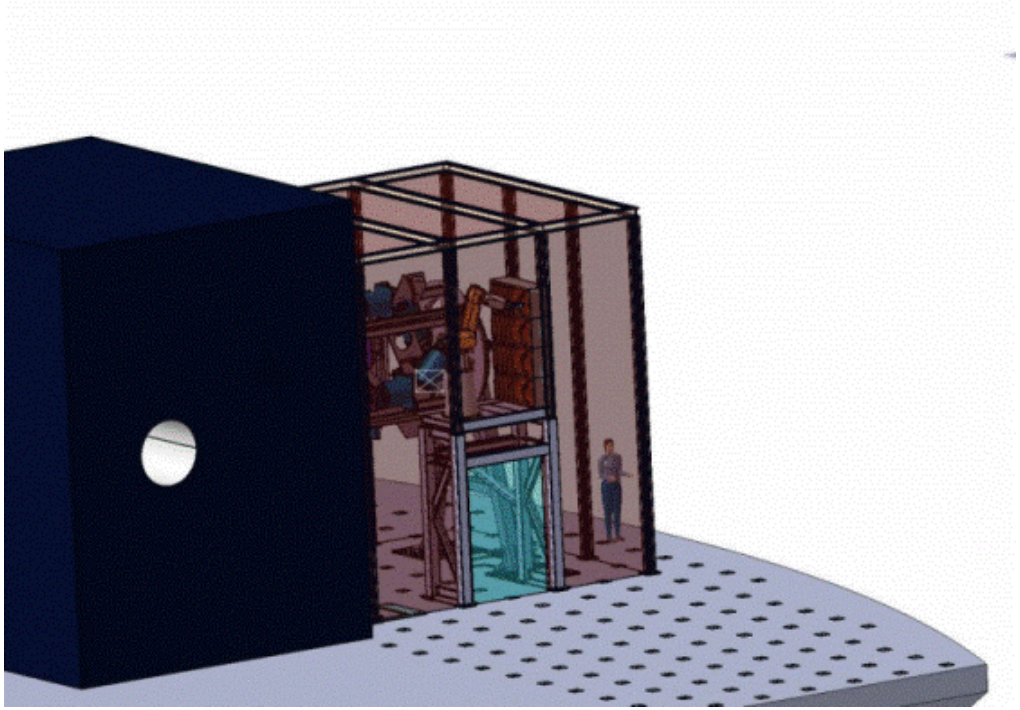
Calibration and Alignment System
- Calibration modules subsystem
- Rotator registration subsystem
- Star tracker subsystem



Instrument Fore-optics System
- Field Lens subsystem
- Collimator subsystem
- Fold mirror subsystems
- Flexure compensation device

System by System

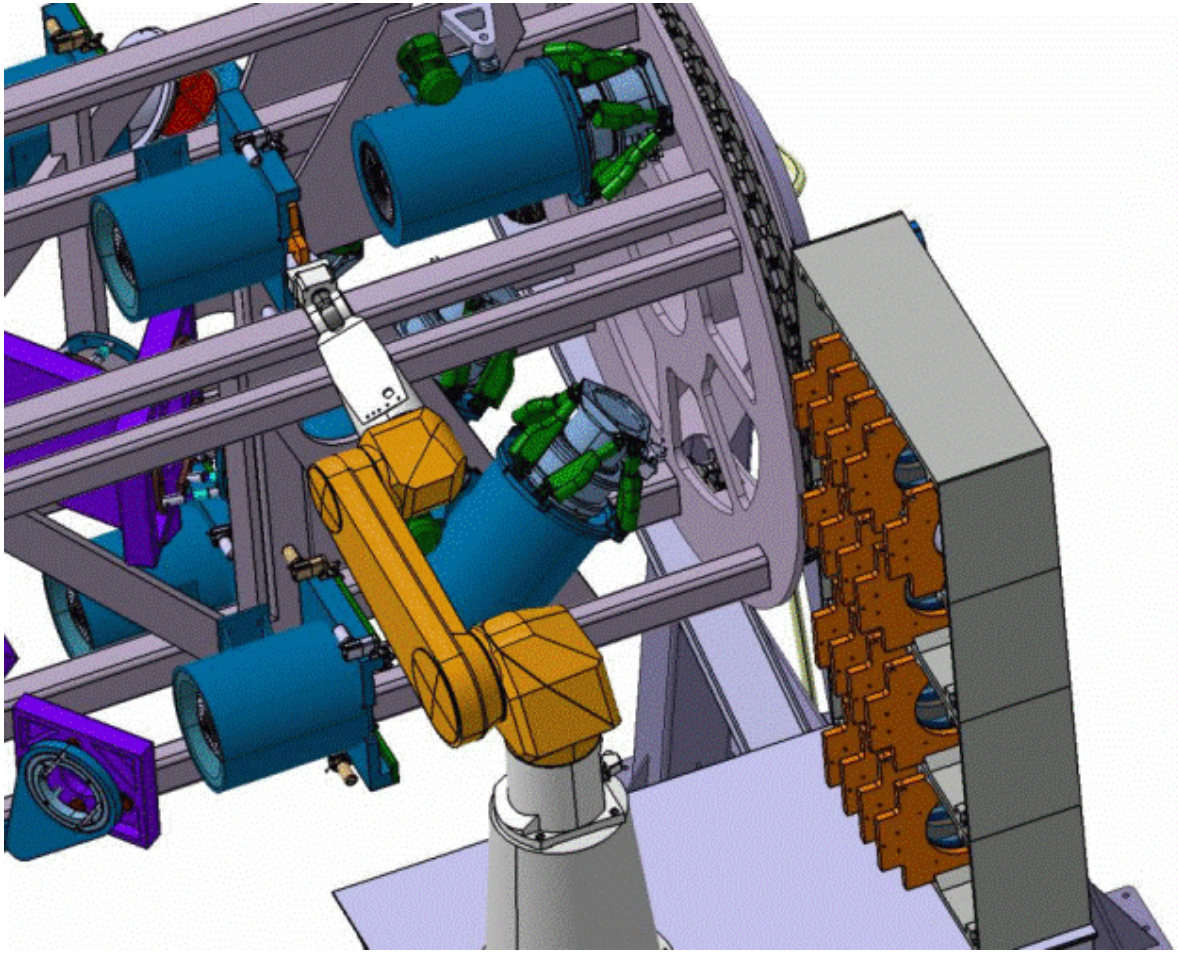




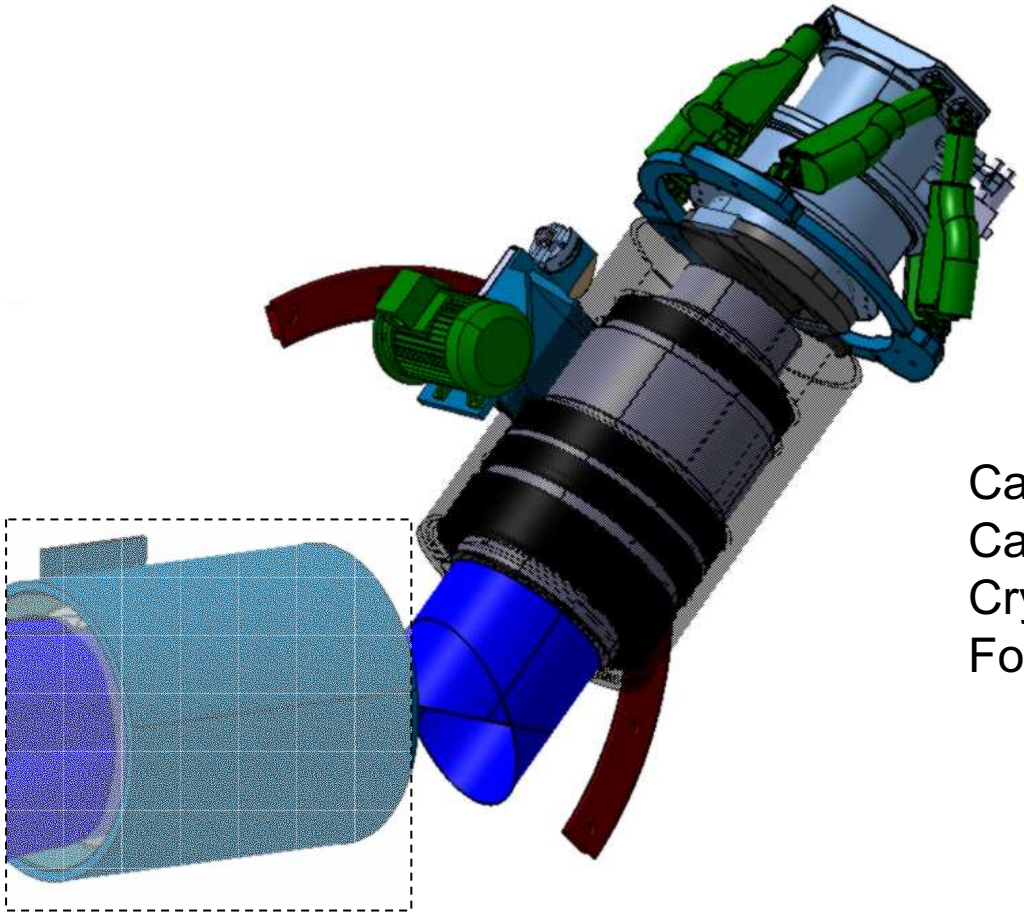
Filter and grating exchange system

- Filters and gratings
- Exchange robots
- Structure subsystem

Changing from filter to grating



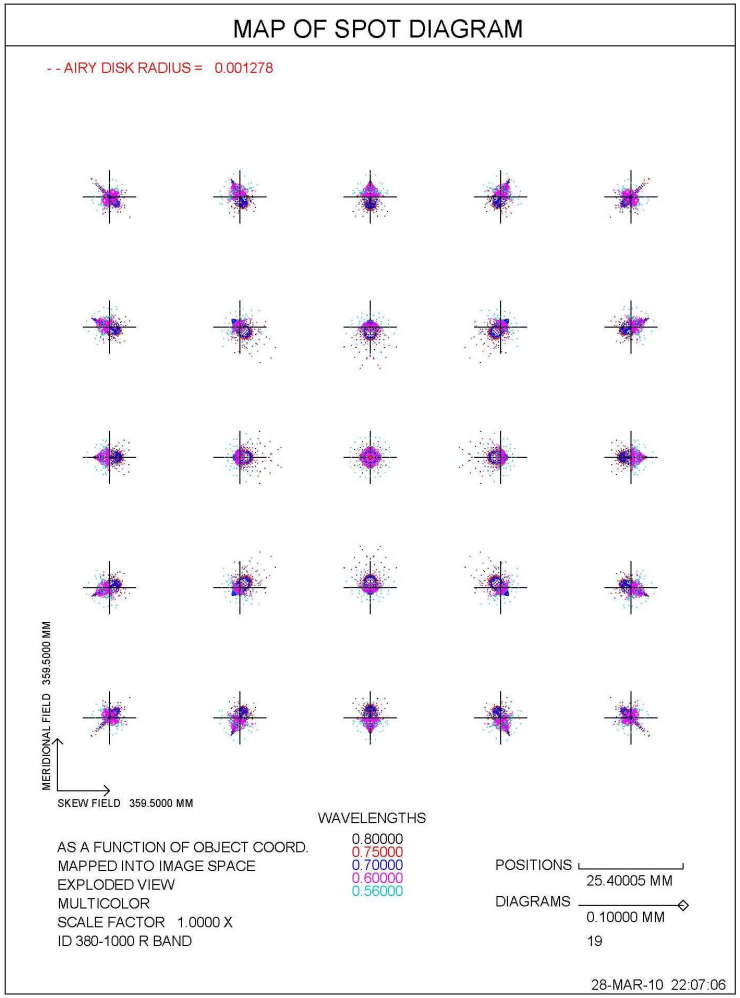
VIS Spectrograph and Imaging System



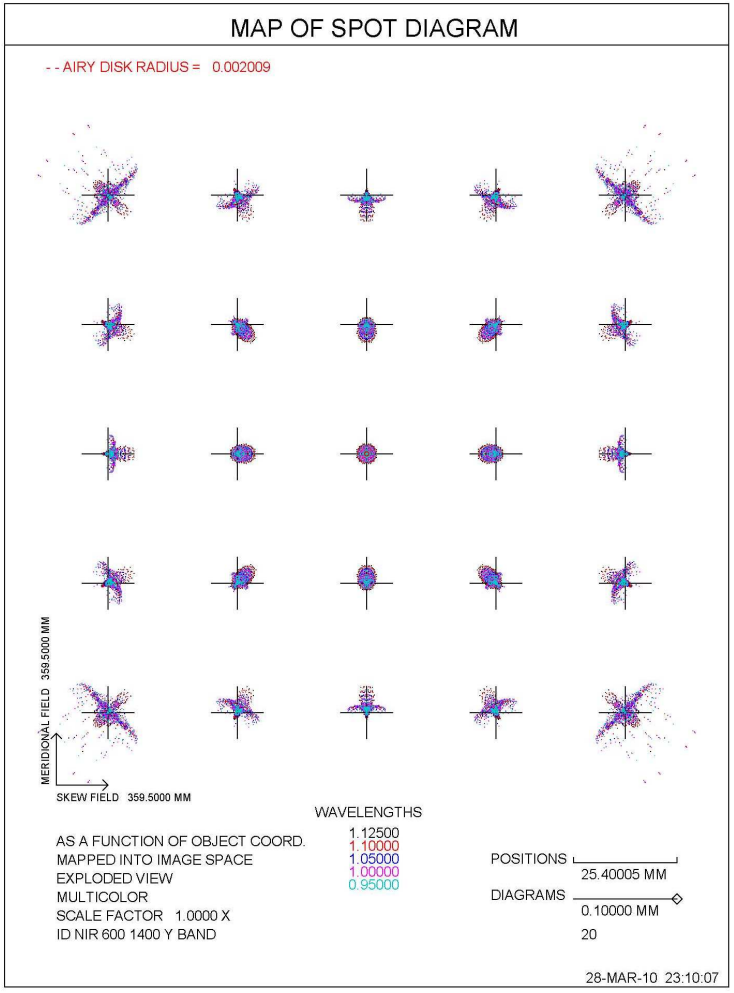
Camera Subsystem
Camera positioning subsystem
Cryostat Subsystem
Focus Compensation Subsystem

Spot Diagrams (imaging)

R band

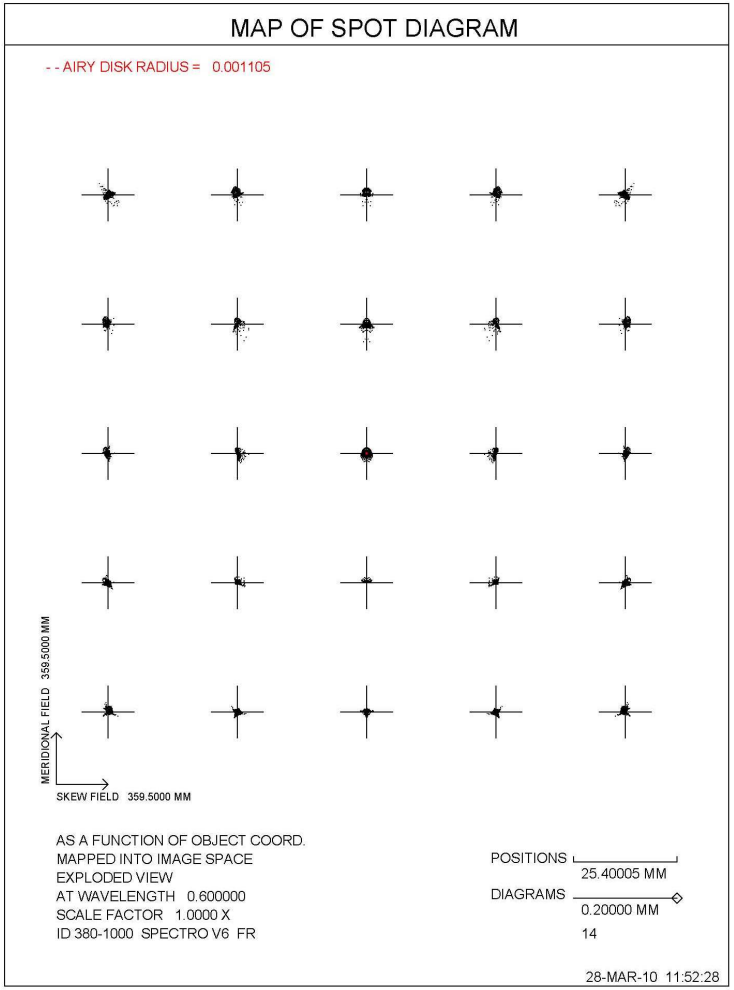


Y band

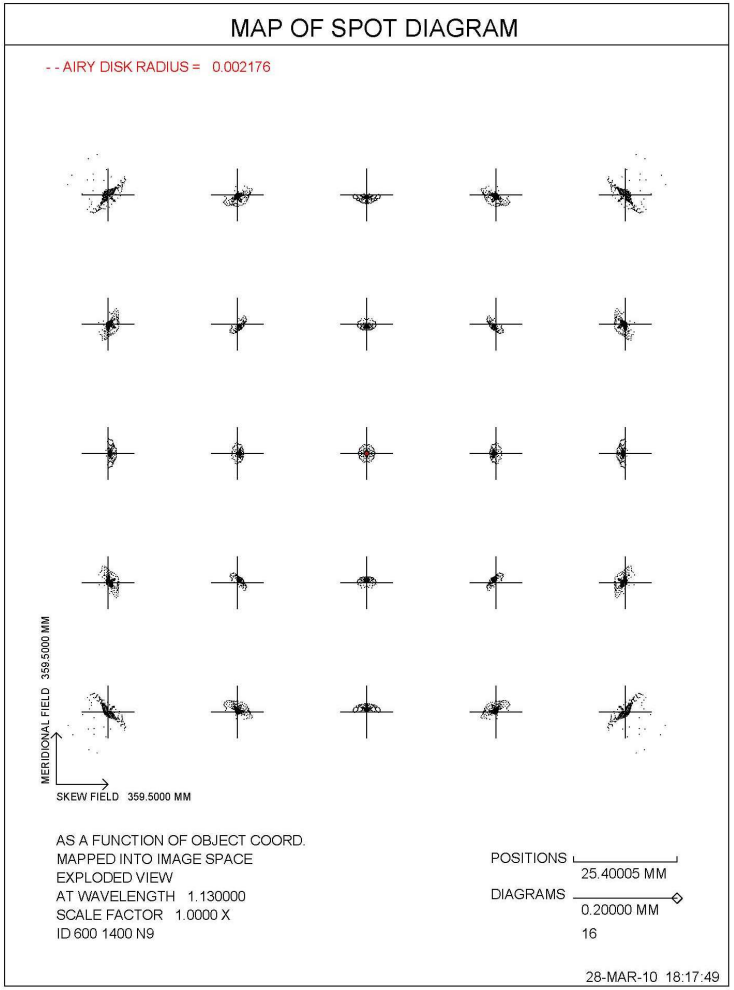


Spot Diagrams (spectroscopy)

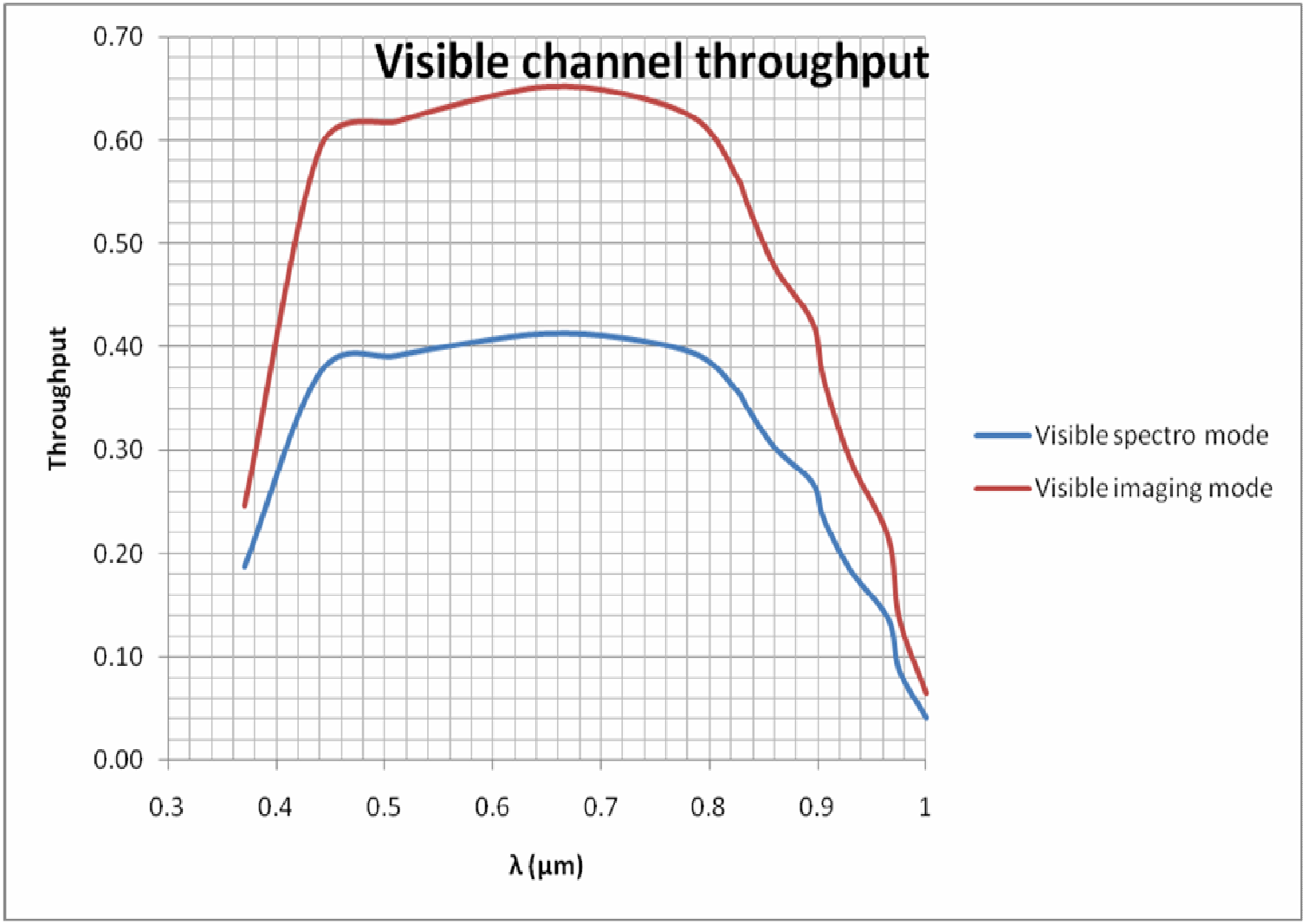
0.6µm



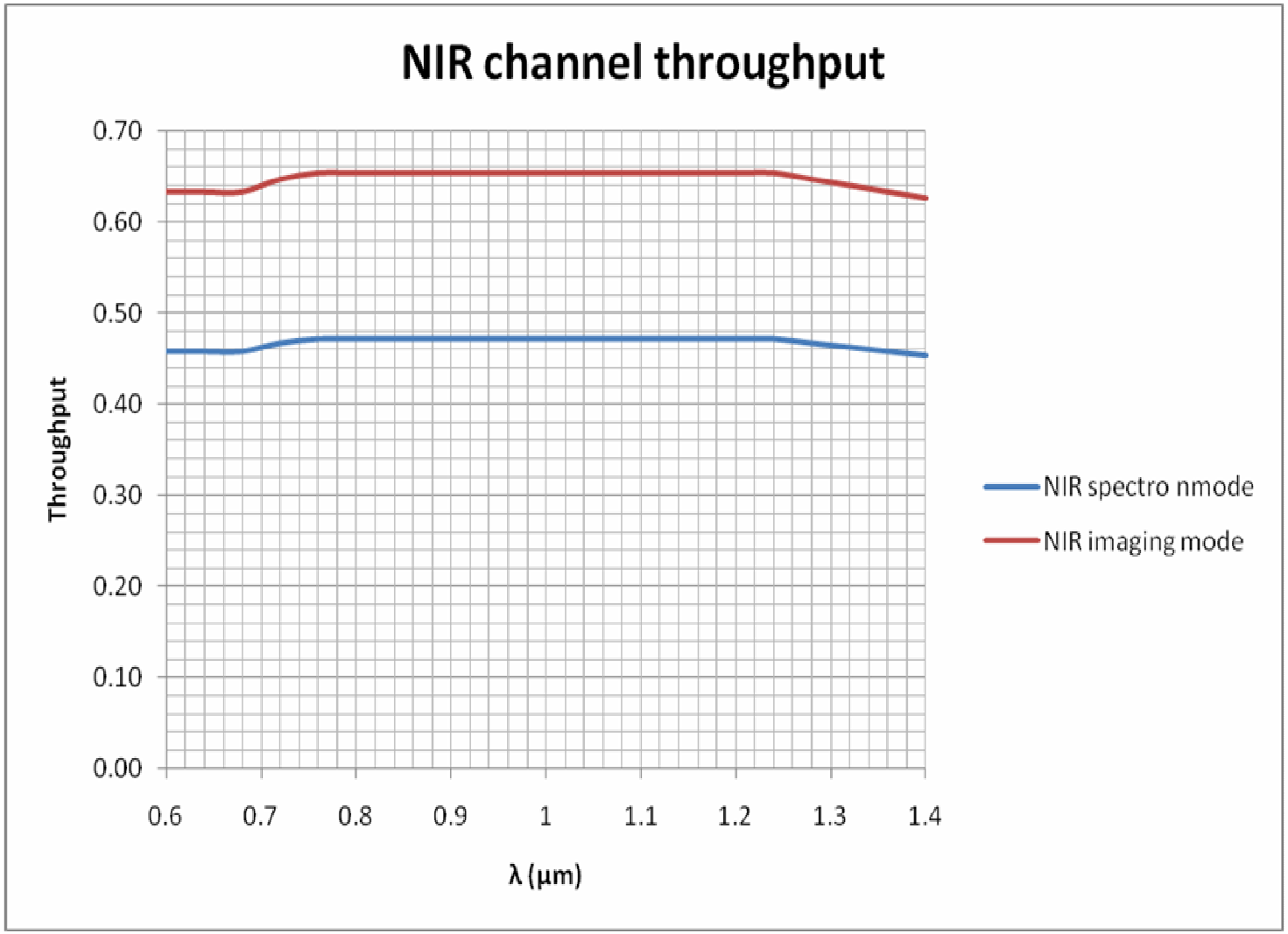
1.130µm



Throughput including CCD



Throughput


NIR channel throughput
Throughput
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
λ (µm)
NIR spectro nmode
NIR imaging mode

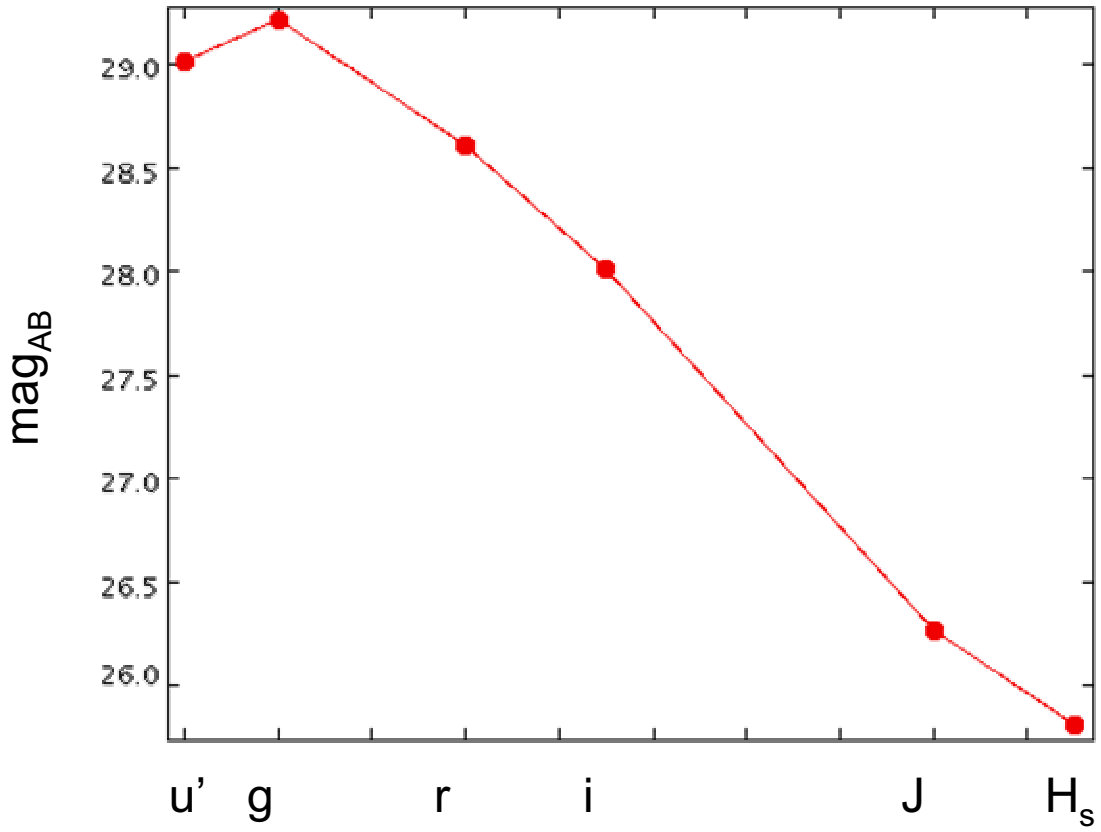
Capabilities

Large FOV:	**0.44 sq arcmin between 0.6 μ and 1 μ** **0.22 sq arcmin between 0.37 μ and 0.6 μ** **0.22 sq arcmin between 1 μ and 1.4**
Image quality:	FWHM 0.25 arcsec
Throughput:	imaging > 60% spectroscopy > 40%
Filters:	**u,g,r,i,z Y,J,Hs + 2 narrow band**
Wavelength range:	**0.37-1 μ** **0.6-1.4 μ**
Resolution:	**R~300: 0.37-0.64; 0.6-1.0 ; 0.6-1.0; 0.86-1.4** **R~1000: 0.37-0.74; 0.5-1.0; 0.86-1.4** **R>2300: 0.37-0.55; 0.86-1.1; 1.1-1.4 ; 1.4-1.6**
Multiplexing:	**480** at low resolution **160** at medium resolution

Performances

Imaging performances, 1 hour integration, 5 σ , 1.2 arcsec aperture

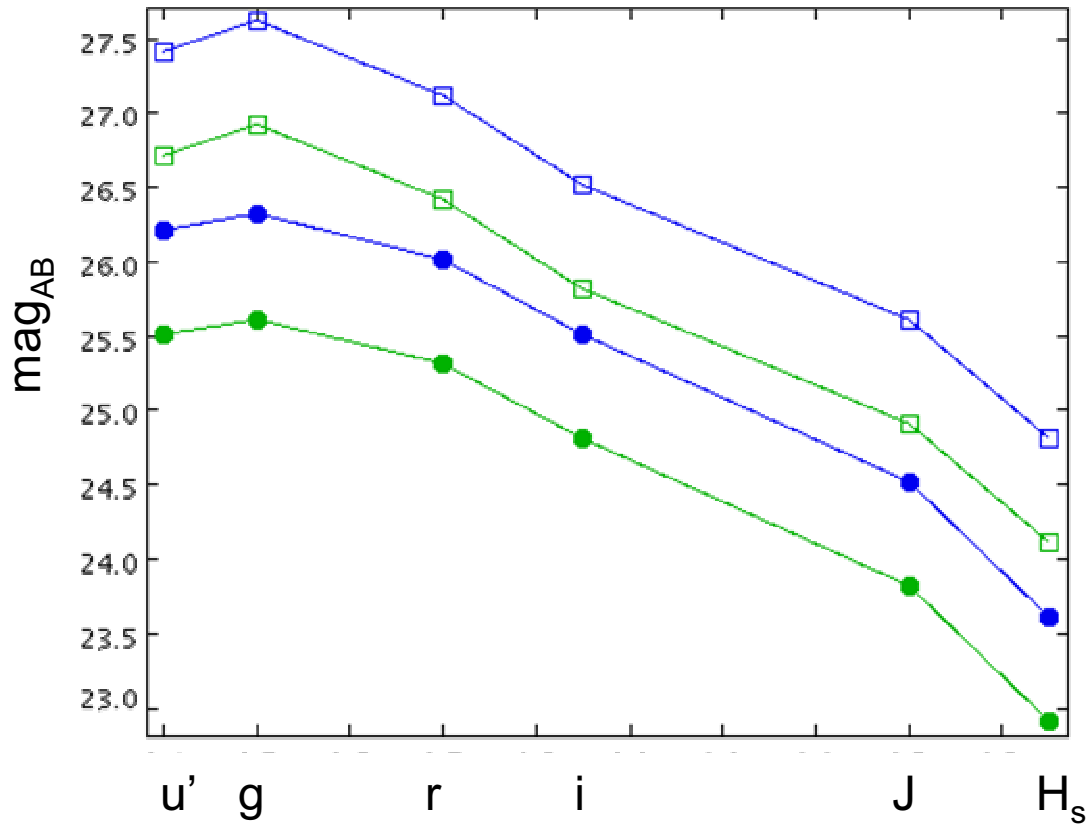
Natural seeing FWHM 0.75” , point source



Performances

Spectroscopic performances, 4hours integration, 3 σ

Natural seeing FWHM 0.75” Slit width 0.5” Extended source 2” Ø



pointlike source R300

extended source R 300

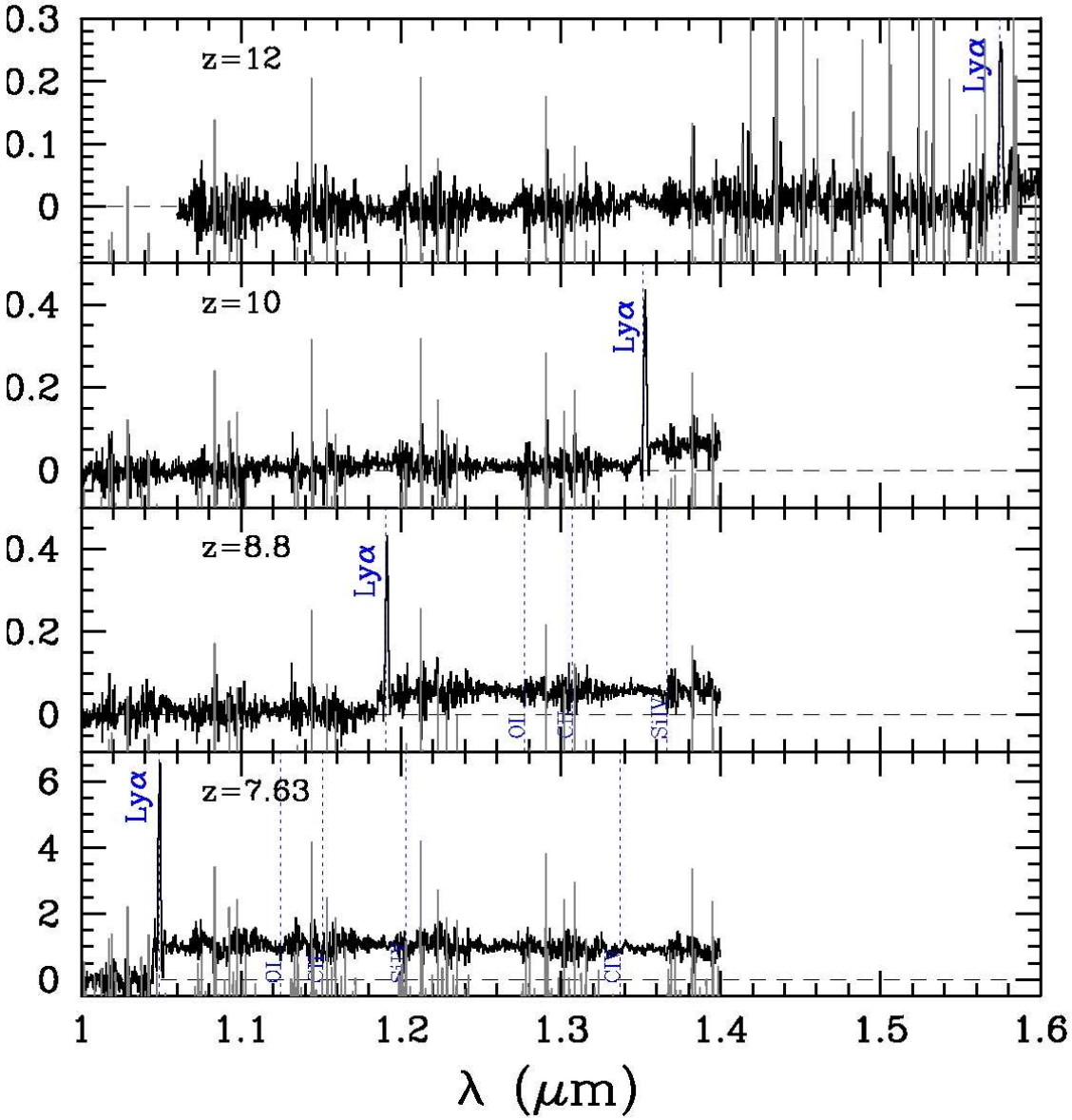
pointlike source R3000

extended source R 3000

Magnitude of the continuum in the reference band

Better performances for line emission

Simulated spectra



Study first light objects:

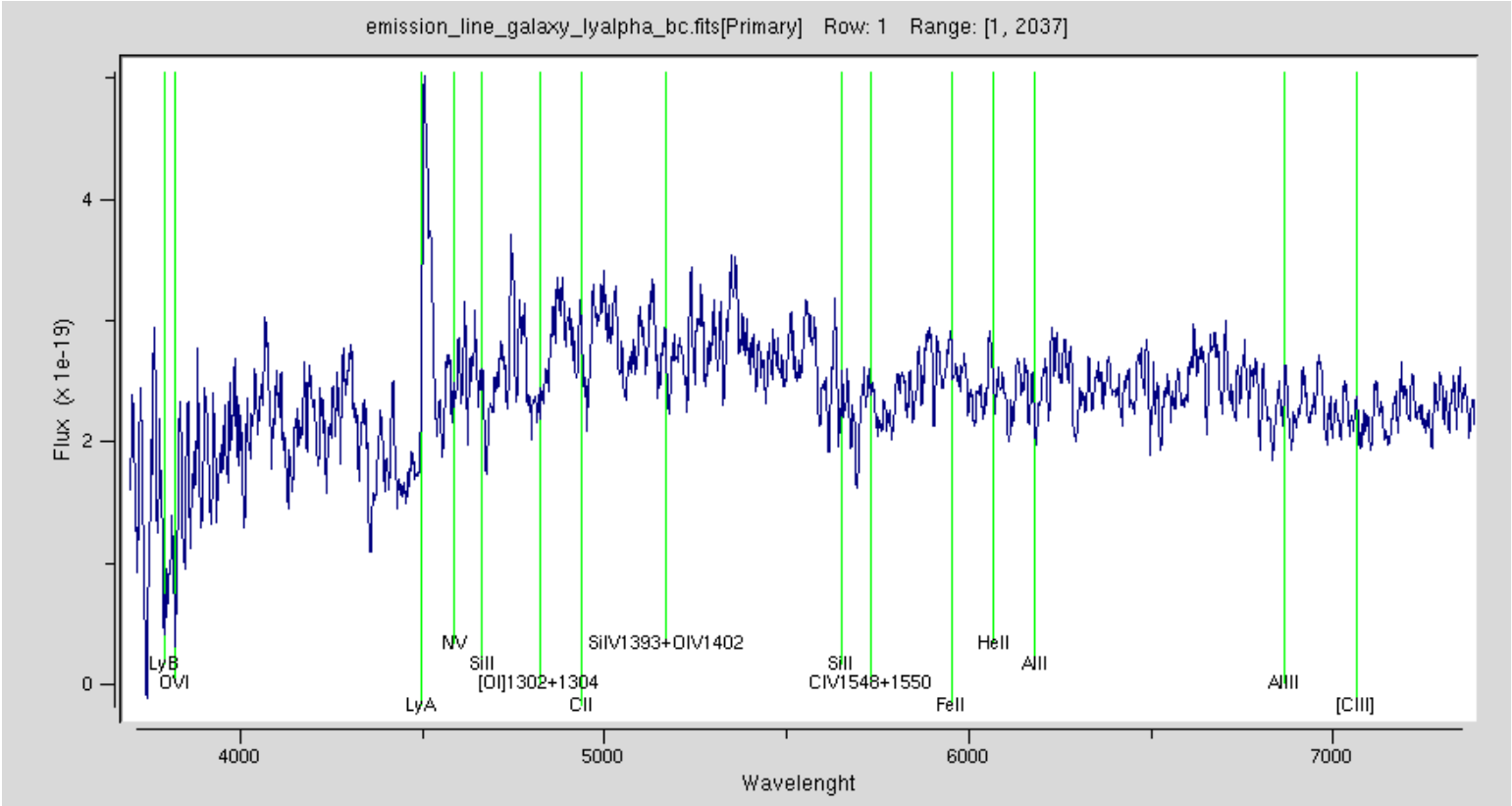
Lyman α flux:
9x10-19 erg/cm2 sec

5 hrs exposure

At z=12 it means detecting a SFR=1 solar mass/yr

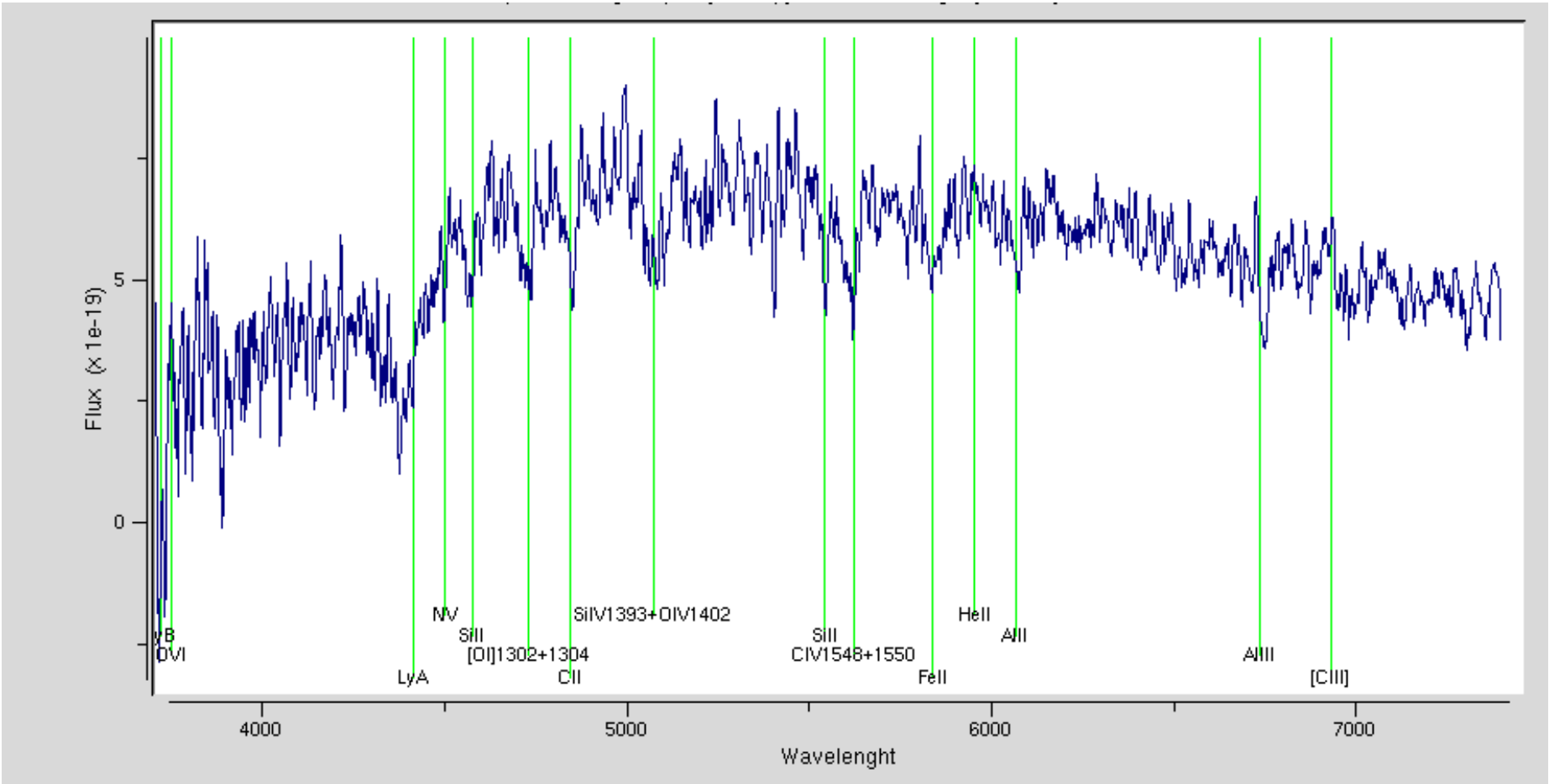
Simulated spectra

LAE: I_{AB}=24.75 z=2.7 t=2 hours R~300
$F_{Ly\alpha}$ =7e-18 erg/cm^2 s



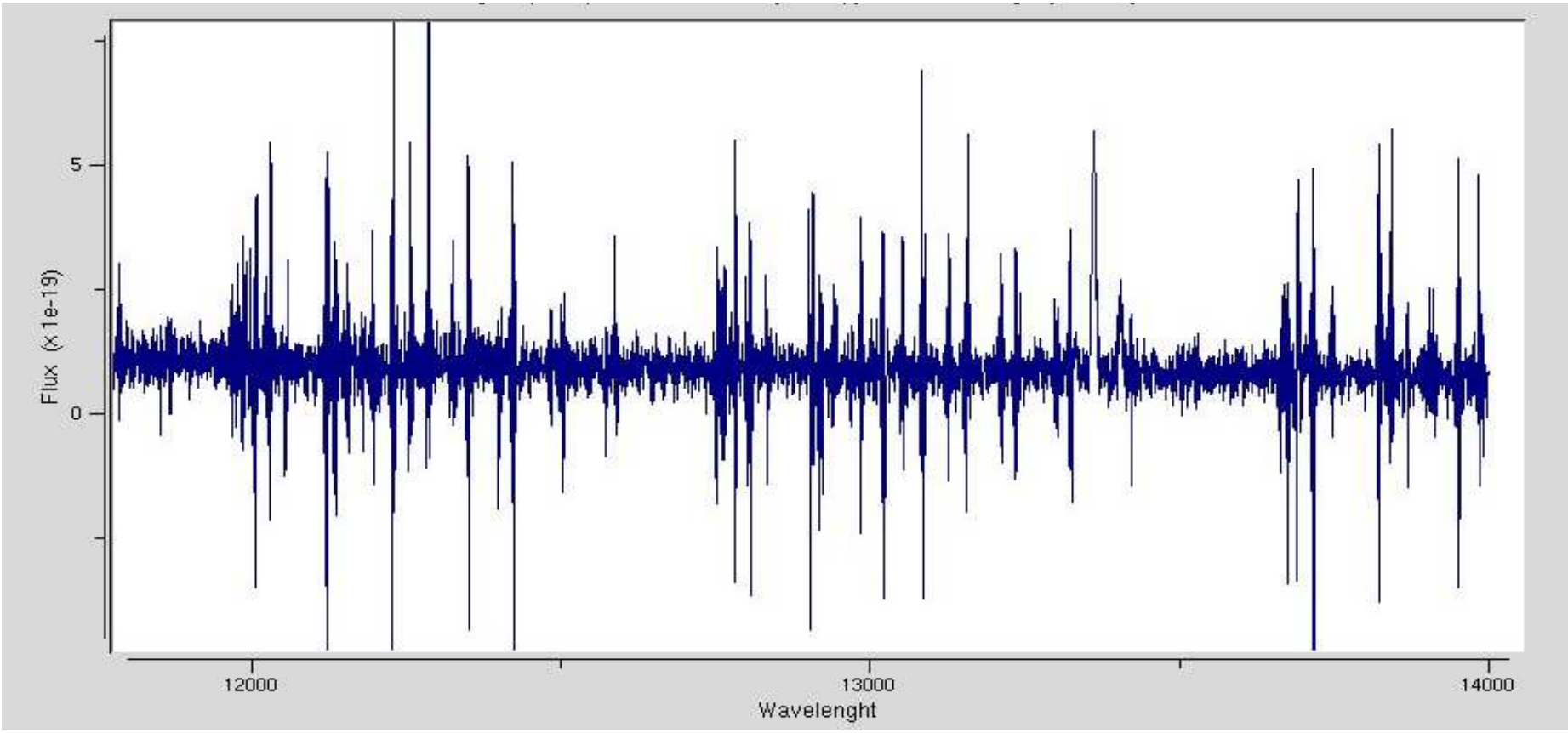
Simulated spectra

LBG: I_{AB}=24.11 z=2.6 t=40 minutes R~300



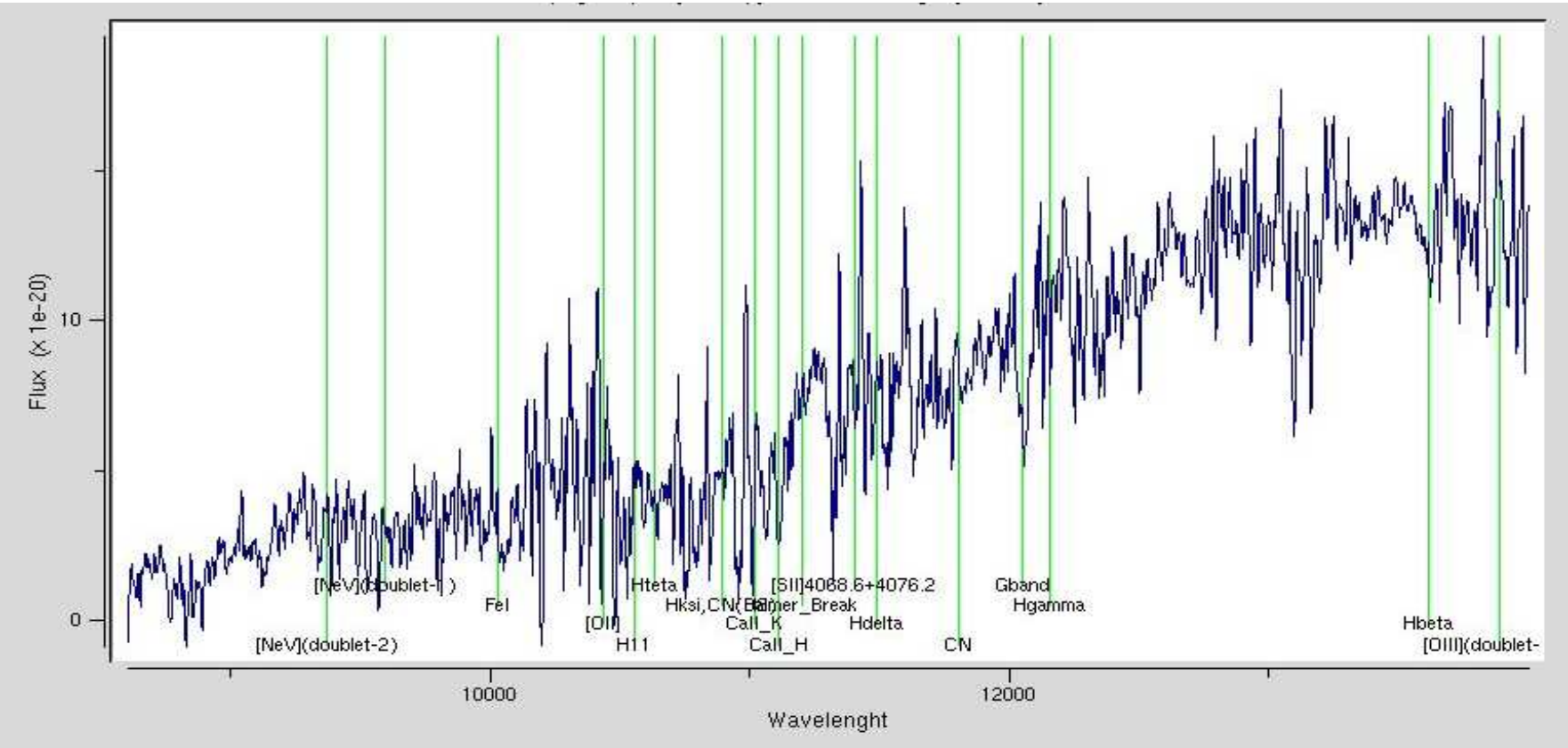
Simulated spectra

SB: I_{AB}=24.5 z=1.036 t=1 hour R~3000
$F_{H\alpha}$=2e-18 erg/cm^2 s



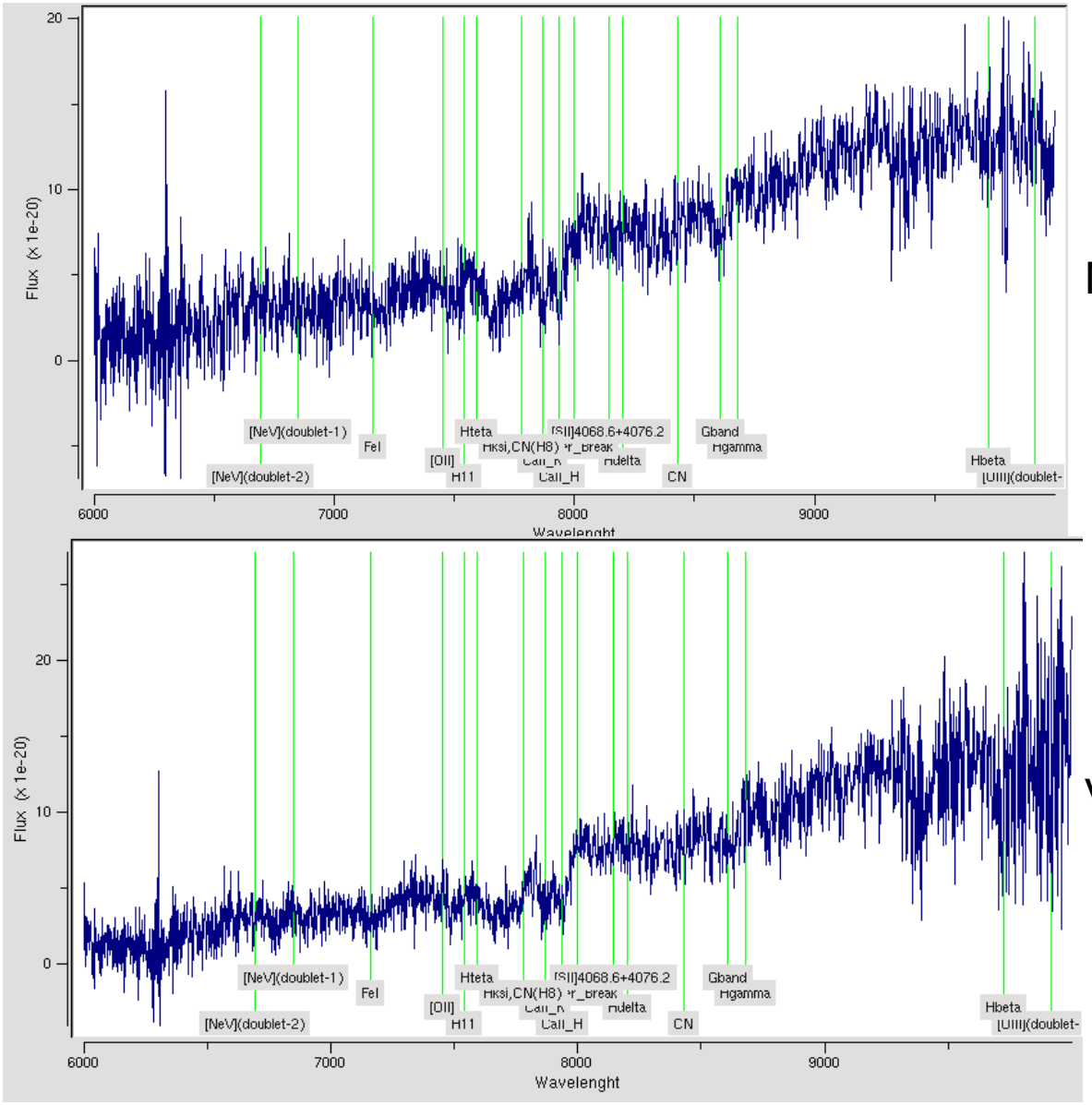
Simulated spectra

E: K_{AB}=22.5 z=1.8 t=1h R~300



Simulated spectra

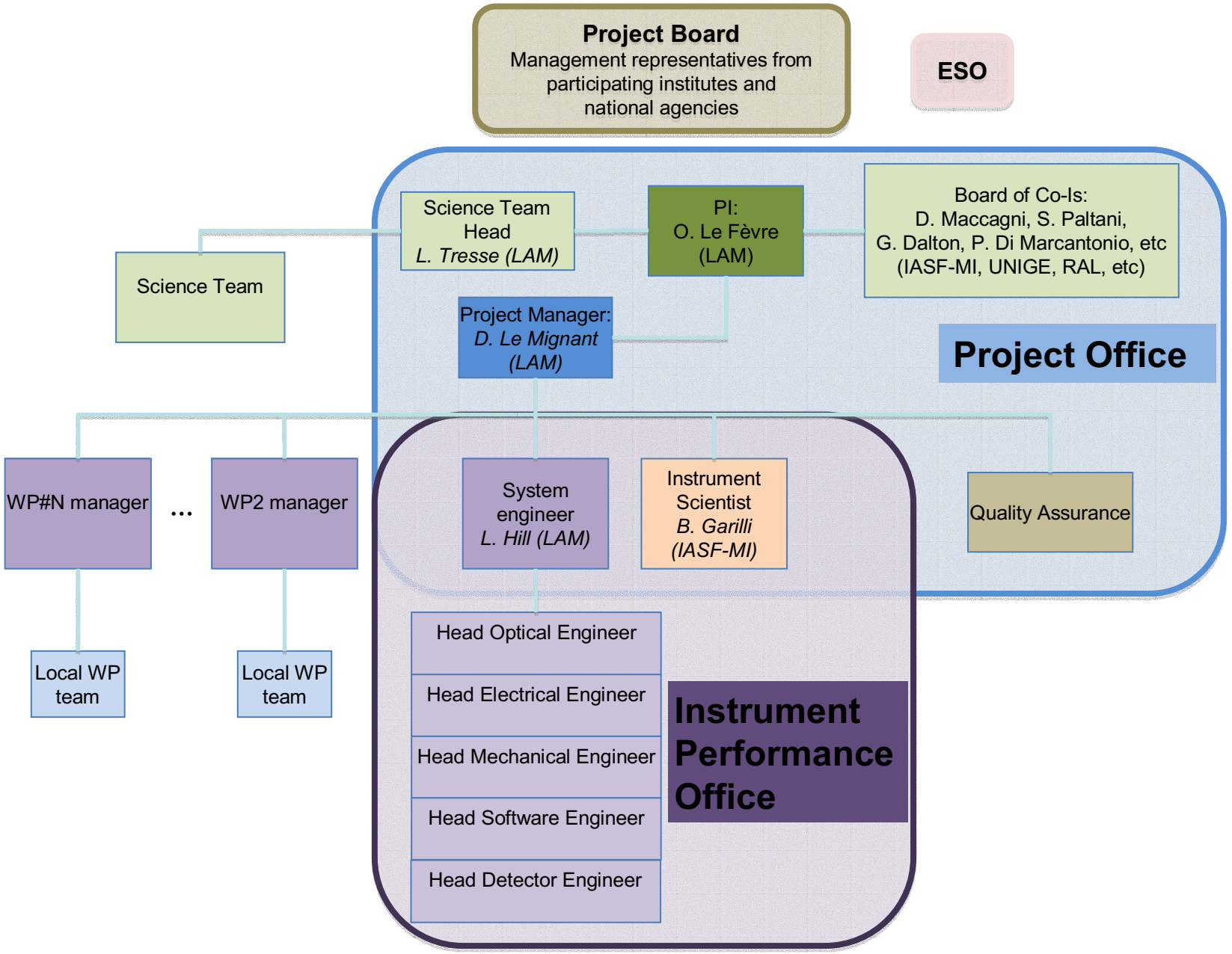
E galaxy
I=25.5
z=1.0
1 hour



NIR channel

VIS channel

Organization



How much?

Time to design, procure, integrate and commission: 6.5 yrs

Weight: ~20 tons

Manpower needed: ~300 FTE

Cost: ~20 M€