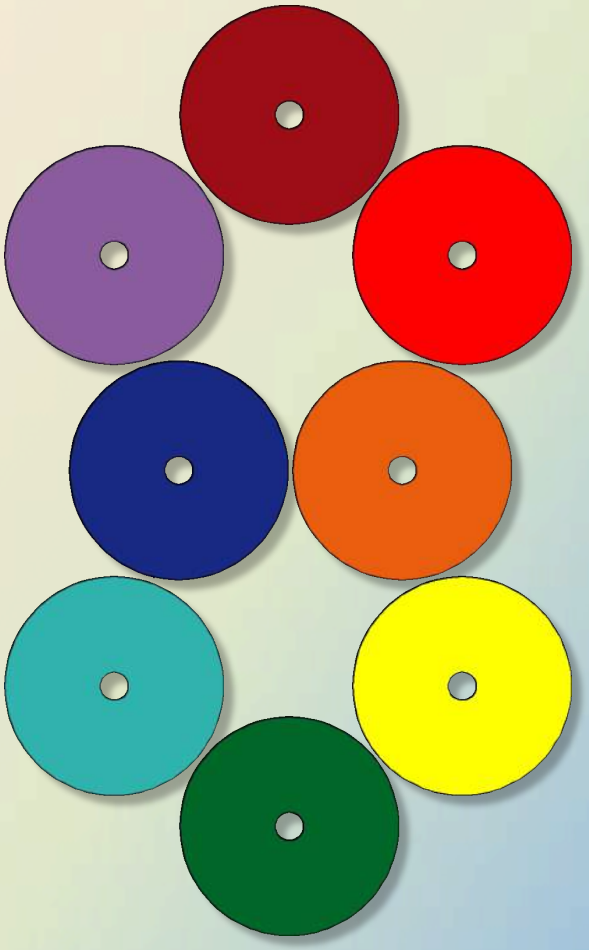
SXA, Granada – 24 October 2017

Synergies between OCTOCAM and ATHENA



Antonio de Ugarte Postigo
(IAA-CSIC)

The OCTOCAM consortium

The OCTOCAM team

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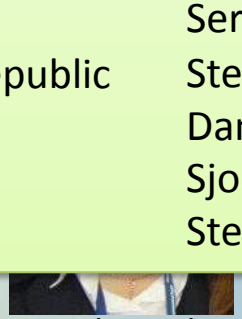
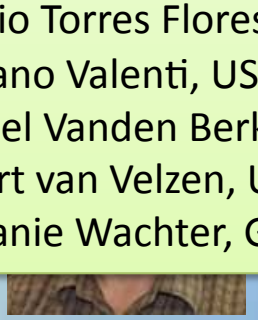
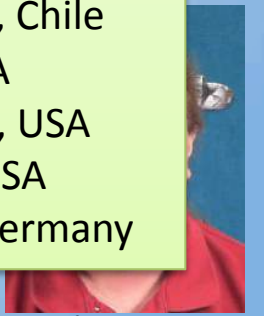

Amanda Bayless


Kelly Smith


Kristian Persson

Covering the scientific needs of the 2020s

- New facilities, new role for Gemini: LSST, ALMA, SKA, ELTs, JWST, ATHENA…
- Workhorse instrument: Many different science topics
- **Simultaneous** VIS/NIR
- Time domain Astrophysics
- Use past experience to create a new instrument concept

Science Drivers

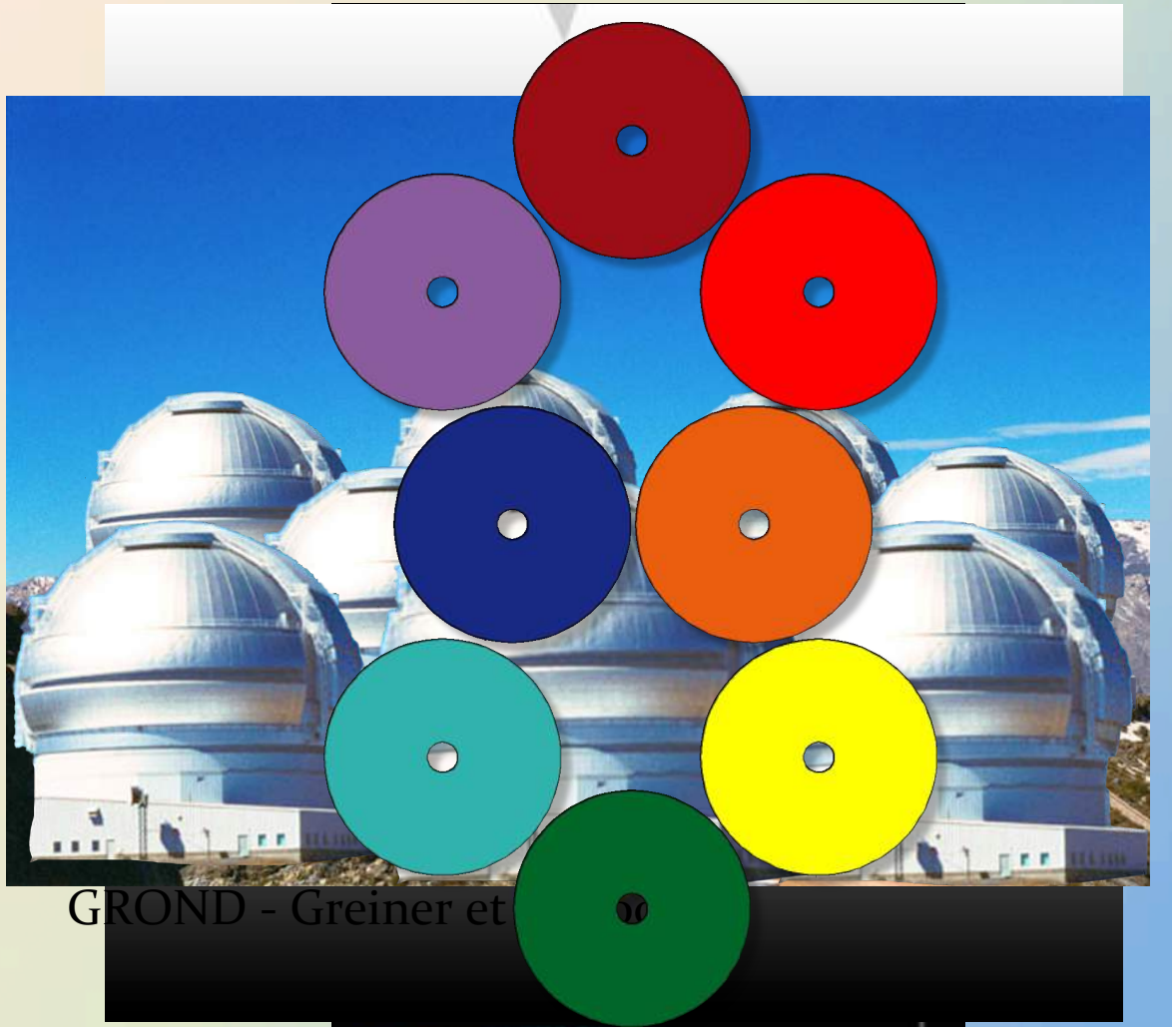
- Rapid characterization of transients (follow-up of LSST)
- Physical understanding of extreme phenomena (gamma-ray bursts, supernovae, magnetars, X-ray binaries)
- The origin of our solar system: comets, asteroids, transneptunian objects
- Asteroseismology
- The first generation of stars and their environments
- The evolution of the Universe since the first galaxies

Science topics

- Transients
- Trans-Neptunian objects
- Extrasolar planets
- Asteroseismology & pulsating stars
- Massive stars
- Brown dwarfs
- Low-mass binaries
- Low metallicity stars
- Isolated neutron stars
- Magnetars
- Interacting binaries
- Millisecond pulsar binaries
- X-ray binaries
- Supernovae
- Supernova remnants
- Gamma-ray bursts
- Active galactic nuclei
- Tidal disruption events
- Galaxy clusters

OCTOCAM concept

- Multi-channel (8!)
- Wide wavelength range (3700-23500 Å)
- Multiband imaging
- Broad band spectroscopy
- High-time resolution
- GROND + X-shooter + ULTRACAM + **MORE!** = OCTOCAM



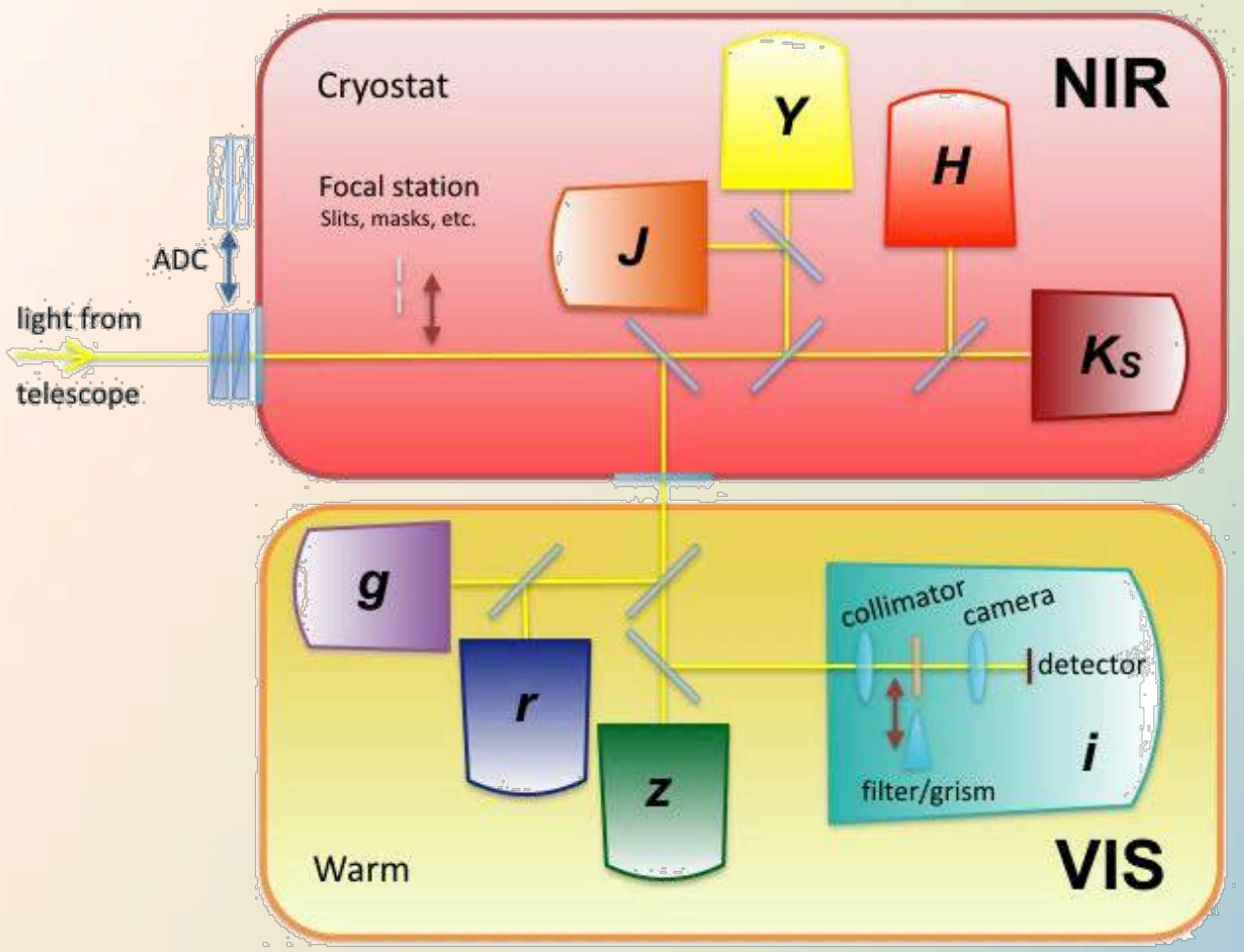
GROND - Greiner et

ULTRACA

X-shooter - D'Odorico et al. 2006

temporal resolution – spectral coverage – spectral resolution

Instrument design



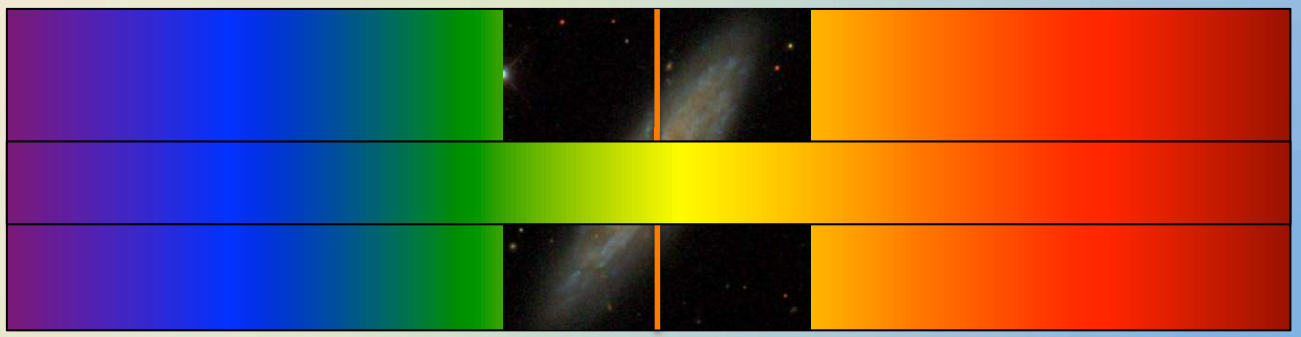
Observing Modes

Imaging:

- Standard: 180”x180”
- Wide: 254” diameter
- Windowed
- Standard binning is 1x1
  2x2 and 1x2 will be available

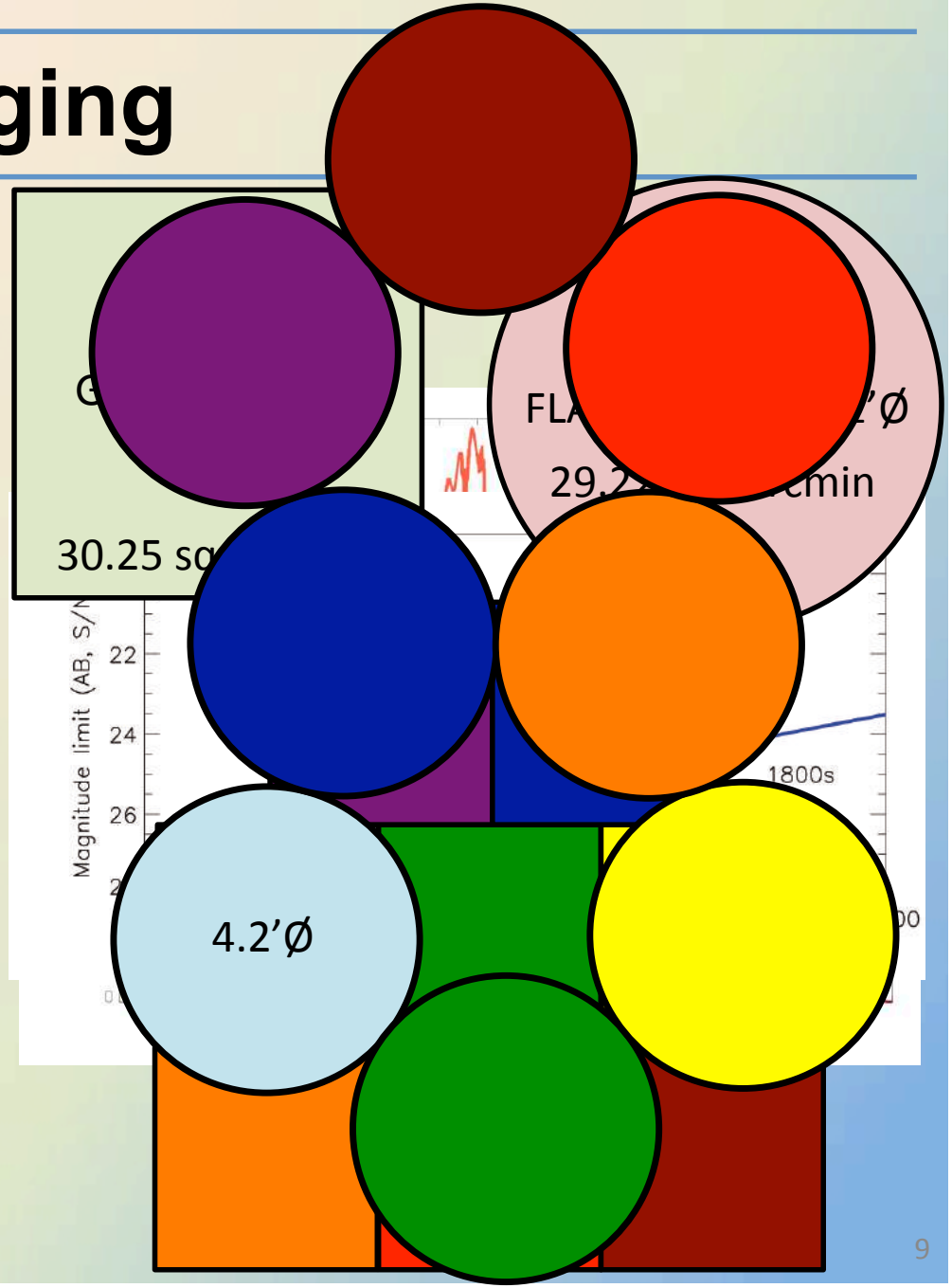
Spectroscopy:

- Full slit (180”)
- Windowed
- Standard binning is 1x1, 2x2 and 1x2 will be available



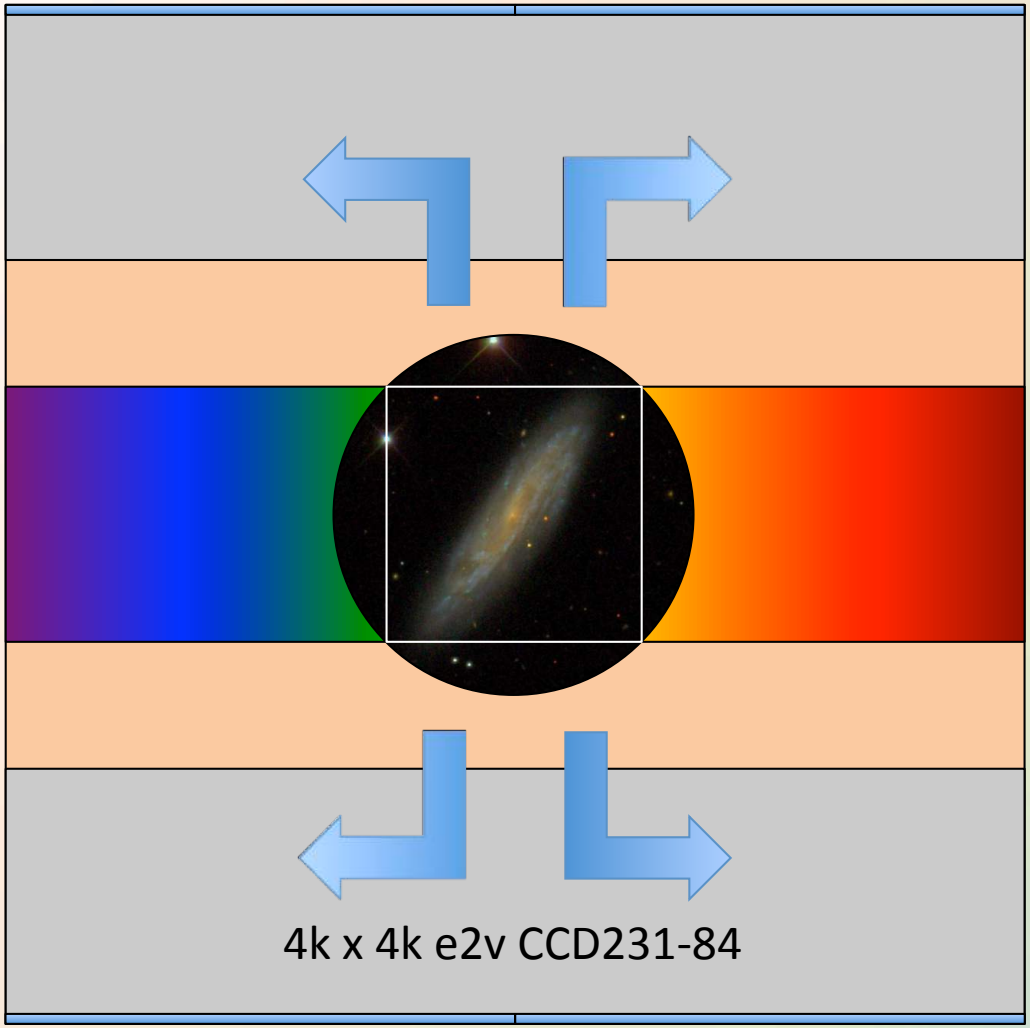
Imaging

- Simultaneous VIS/NIR observations in *g, r, i, z, Y, J, H,* K_S
- Frame transfer detectors + HAWAII-2RG
- Negligible overheads
  - No filter change time loss
  - No readout time loss
- 3’x3’ or 4.2’Ø field of view
  - 3’x3’x8 = 72 sqr. Arcmin
  - 4.2’Øx8 = 112 sqr. Arcmin



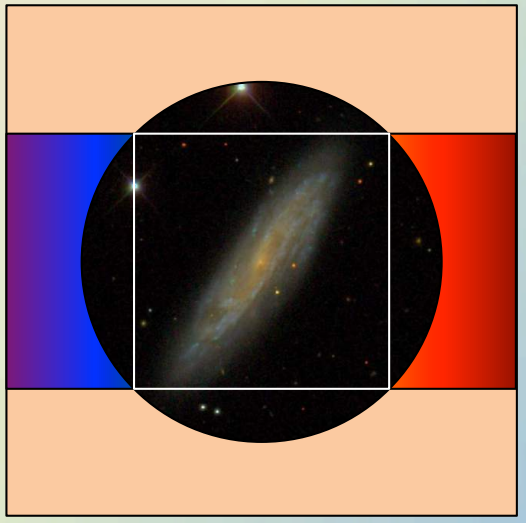
Detector arrangement

VISIBLE (g', r', i', z')



4k x 4k e2v CCD231-84

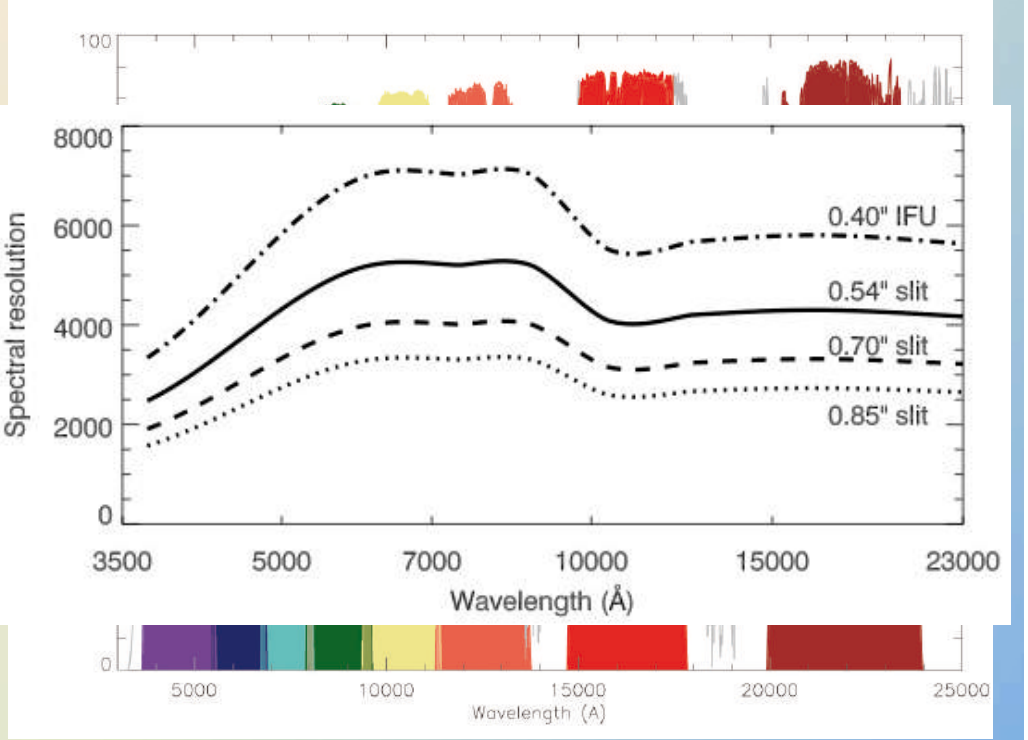
Near-IR (Y, J, H, K_S)



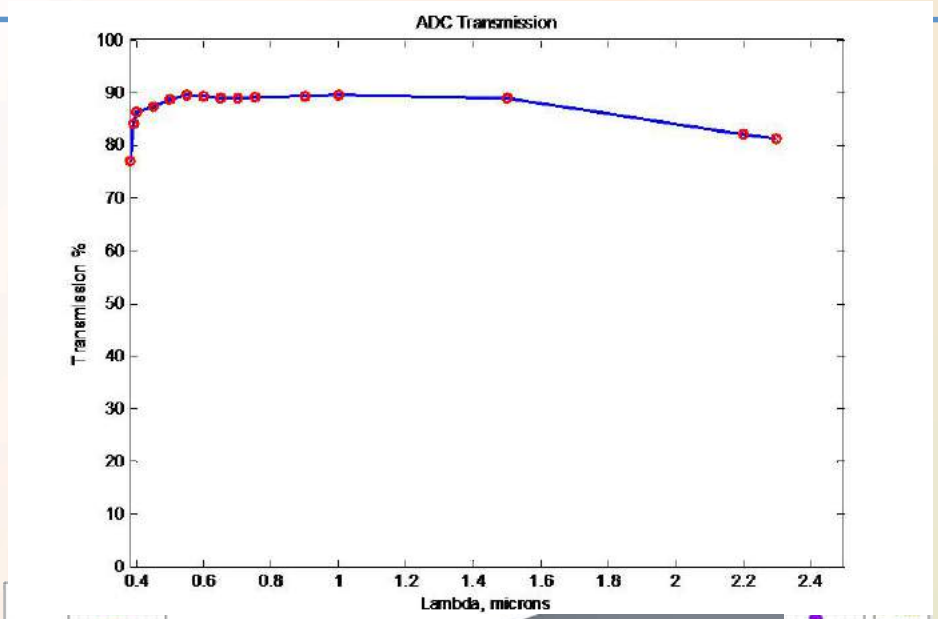
2k x 2k Hawaii-2RG

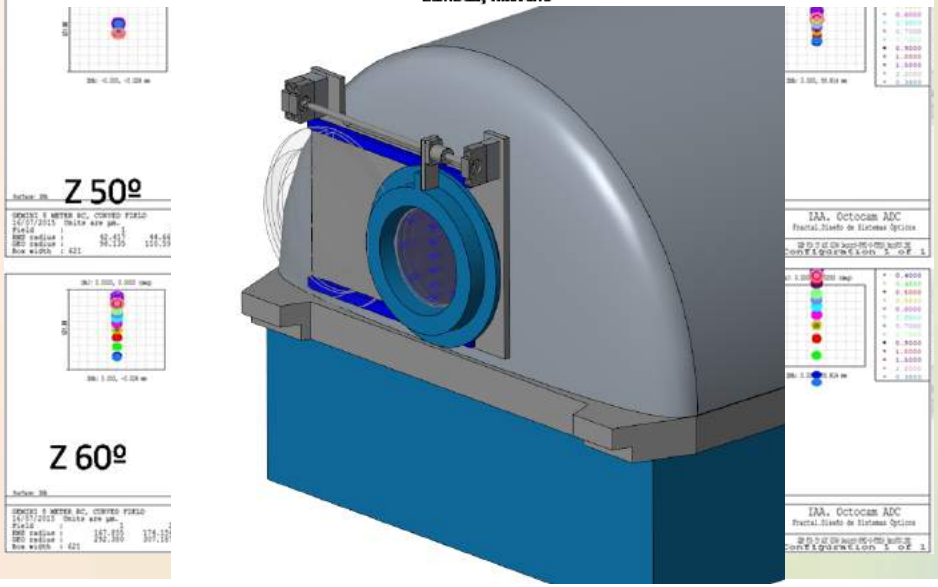
Spectroscopy

- From 3 700 Å to 23 500 Å
  - [OII] 3727/3729 Å at z = 0
  - H-alpha at z = 2.5
  - Extinguished sources
- High efficiency VPH gratings
- Resolution of 3500-4500
  - Look through the NIR sky lines
  - Continuum of faint sources
  - Velocity field in galaxies
- Long slit 3 arcmin
- Atmospheric Dispersion Corrector



Atmospheric dispersion corrector

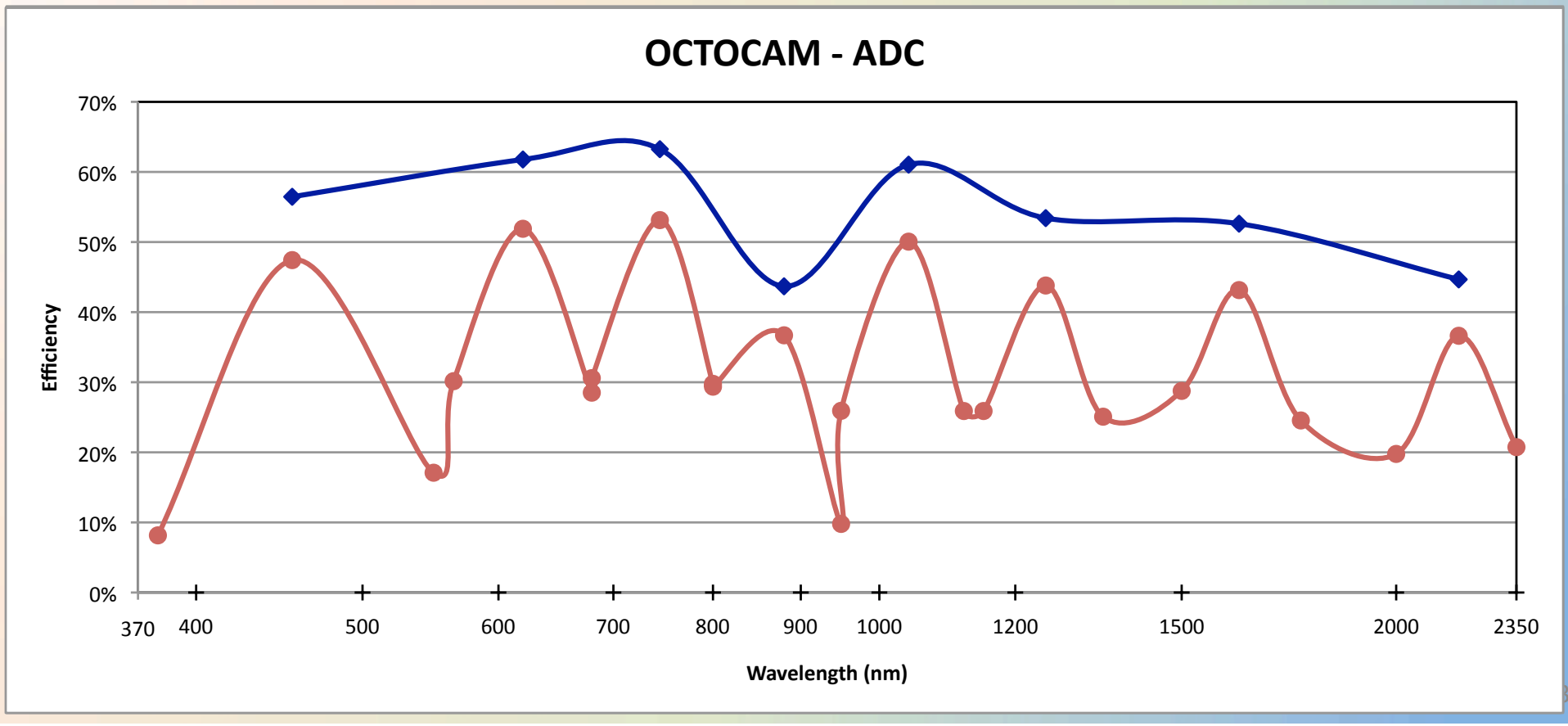




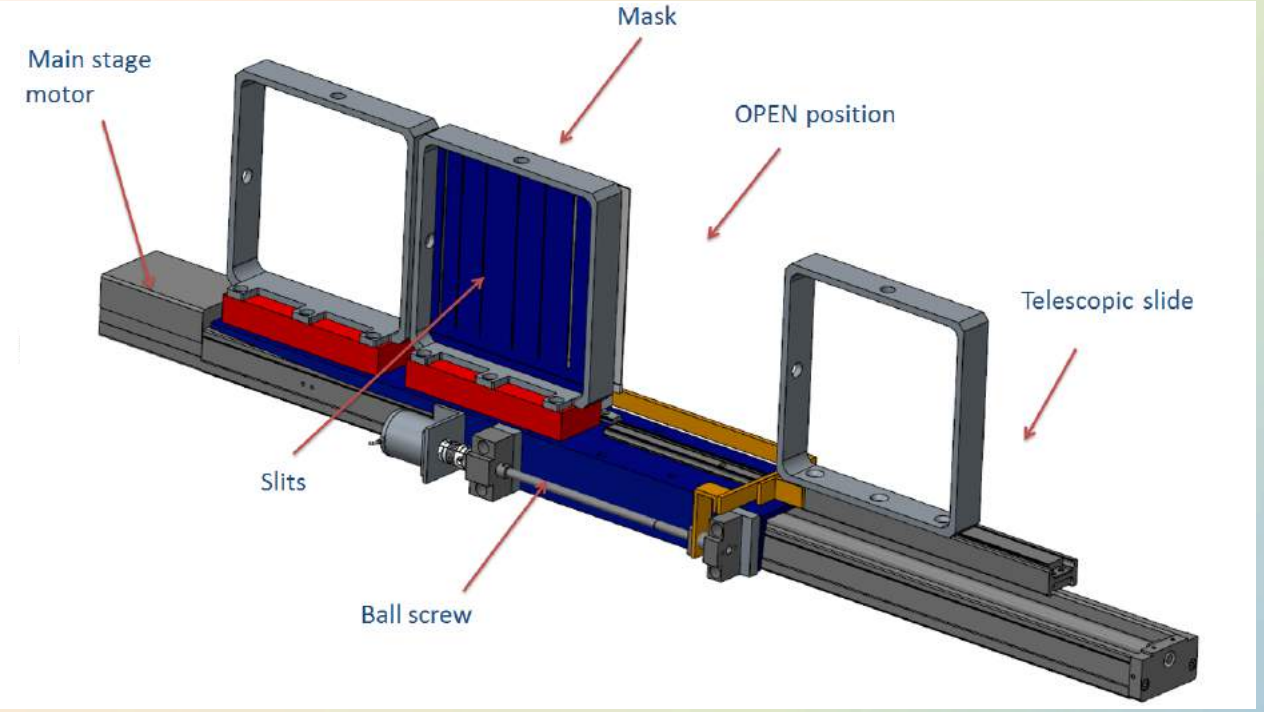
- Correcting all the wavelength range
- Will maintain all wavelengths within 0.54” slit
- Operating down to 40 deg elevation
- Loss of efficiency ~10%, worse at the edges
- Retractable to boost efficiency when not needed (imaging and parallactic slit).

Instrument Eficiency

- Average peak efficiency: 48% imaging, 40% spectroscopy
- Average efficiency: 46% imaging, 30% spectroscopy



Design guidelines

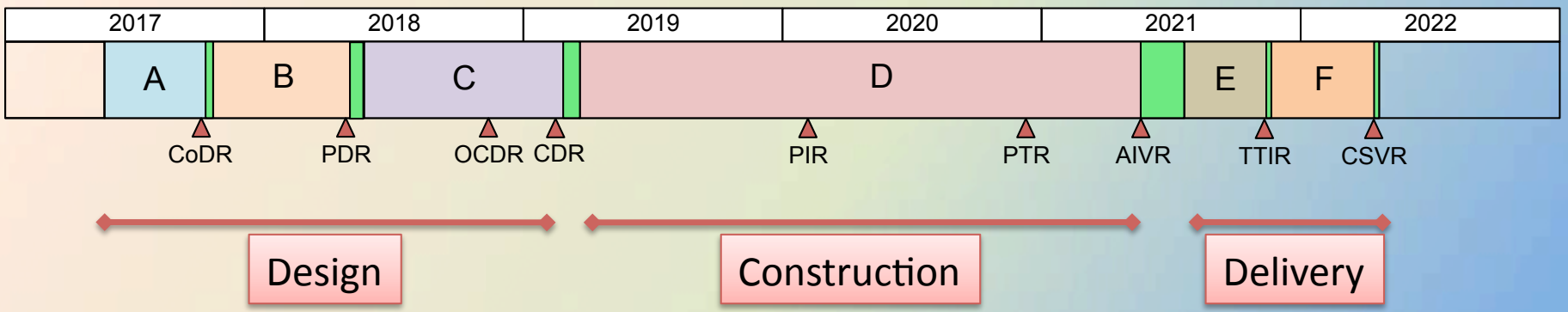


- Efficient
- Simple
- Compact
- Light-weight
- Minimimum number of moving parts

- High efficiency dichroics
- VPH gratings
- Small pupil size (~50 mm)
- Single long slit
- Optics shared by different arms

Five years of project

- Kick-off on 19 April 2017
- 5 years of Project
- 6 phases: Design, Construction, Delivery and Commissioning at the Telescope
- Will be ready for science on the spring of 2022



Possible upgrades

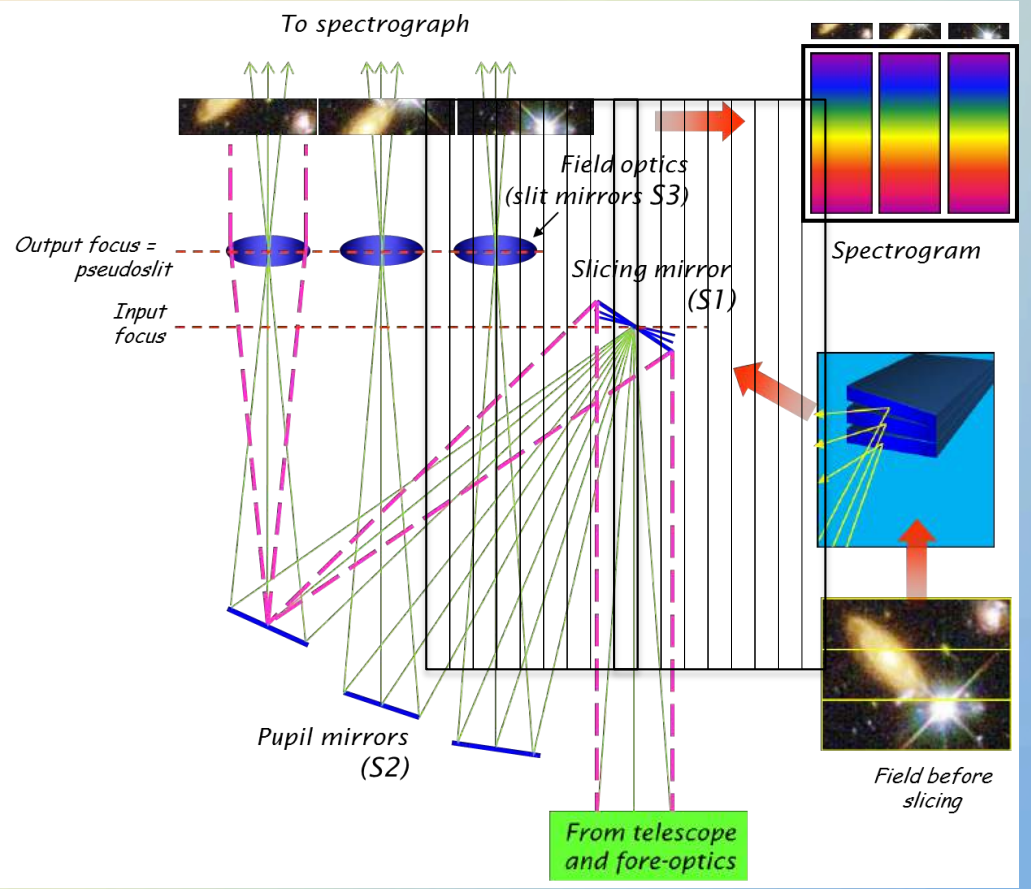
Integral field unit (IFU)

- Image slicer 9.7”x6.8”
- 0.4” resolution elements

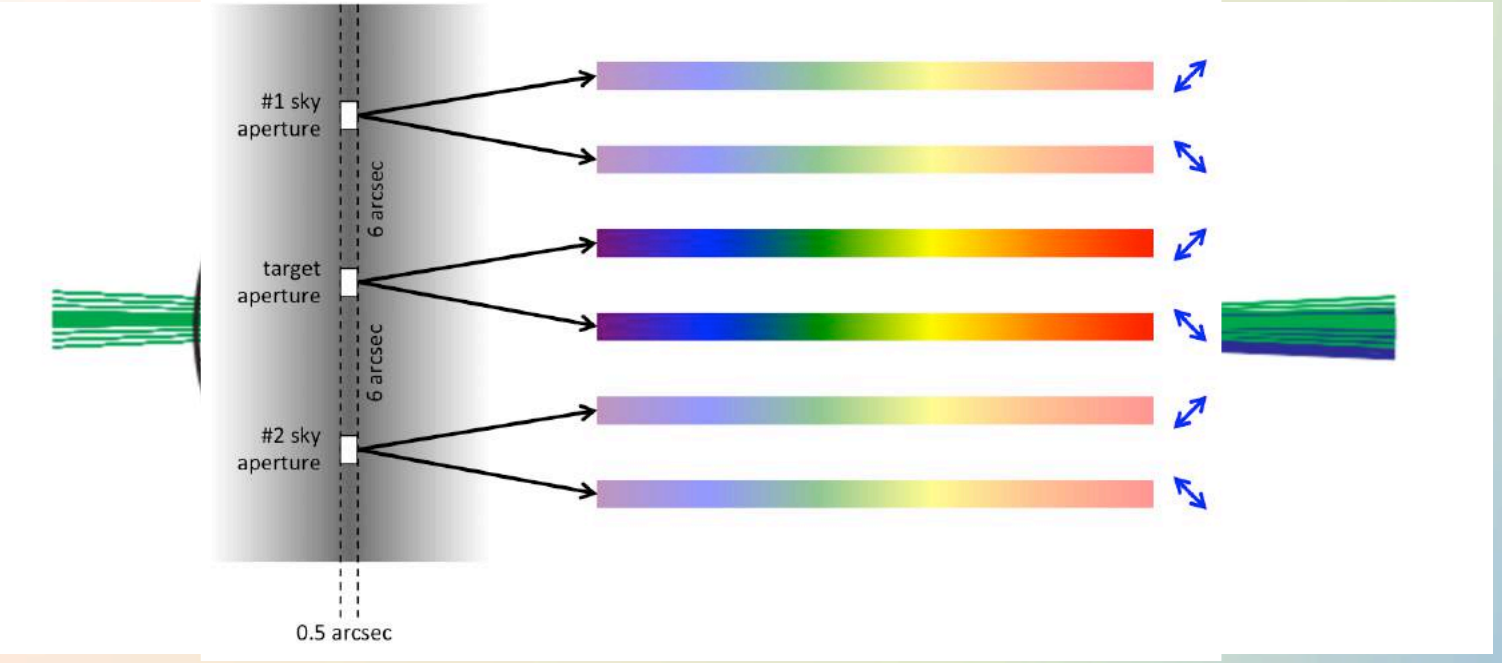
- Wavelength coverage UV+IR!
- Full spectral resolution at any seeing

✓ GRB & SN host galaxies
✓ Massive star environment
✓ TNO & comets

- Adaptive Optics IFU:
  - 2.5”x3.6”, with 0.08” elements
  - 950-2350 nm coverage



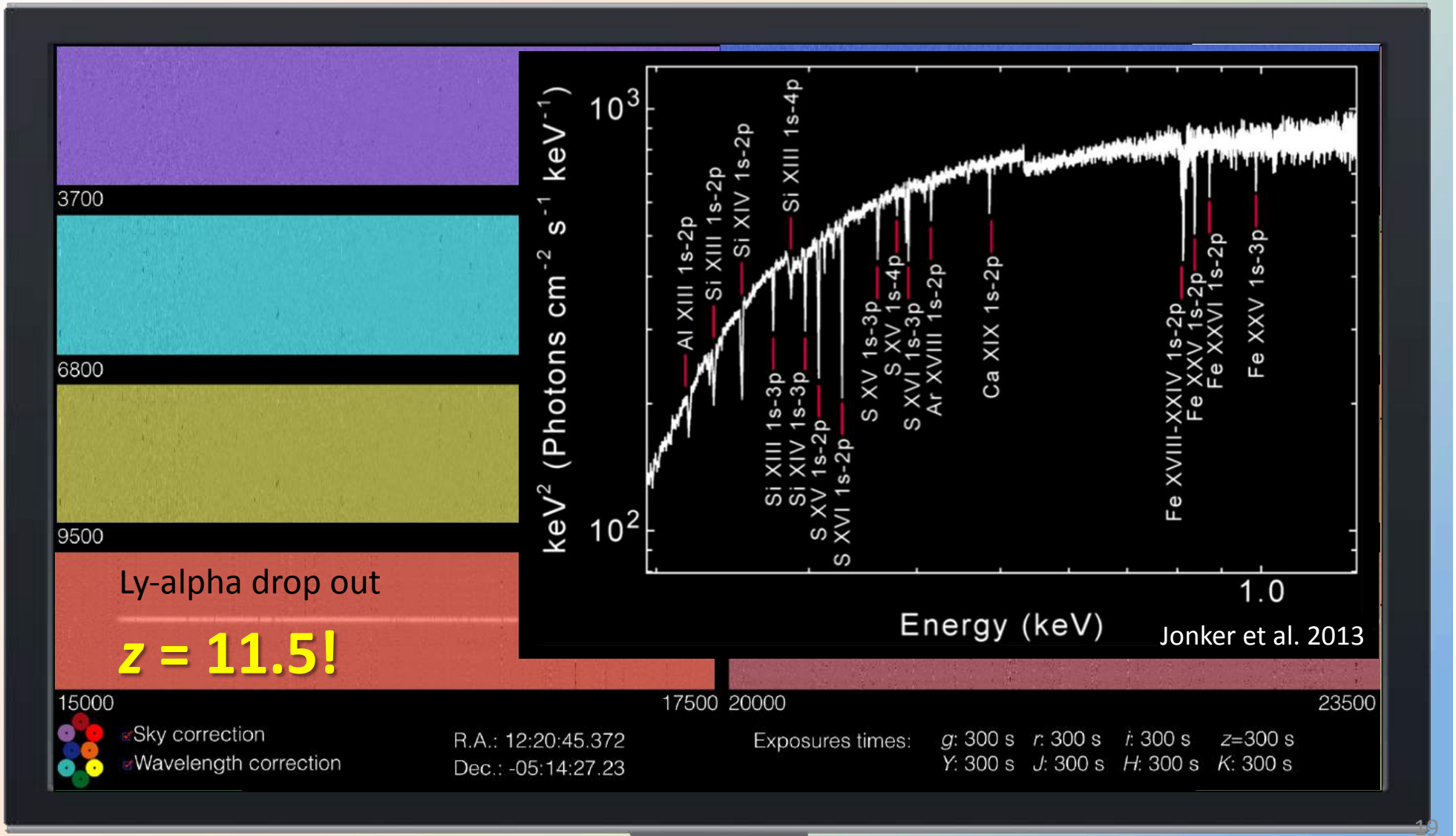
Spectropolarimeter



- Based on the design of Snik et al. (2012) for X-shooter

✓ Structure and magnetism in SNe
✓ Stellar physics
✓ Characterization of transients

Sometime in 2022…



OCTOCAM specifications

Simultaneous spectral range	Photometry: *grizYJHK* Spectroscopy: 3700-23500 Å
Field of view	Imaging: 3’ x 3’ 4.2’ diameter Spectroscopy: 3’ Long slit
Plate scale	0.18”/pixel
Spectral resolution	3 500 – 4 500 standard VPH
Expected average efficiency	Imaging: ~46% Spectroscopy: ~30%
Maximum full-frame rate	~ 4 Hz
Observing modes	Multiband imaging Wide band spectroscopy (long slit) High time-resolution

OCTOCAM

Thank you!