ANDES

(aka HIRES) @ ELT

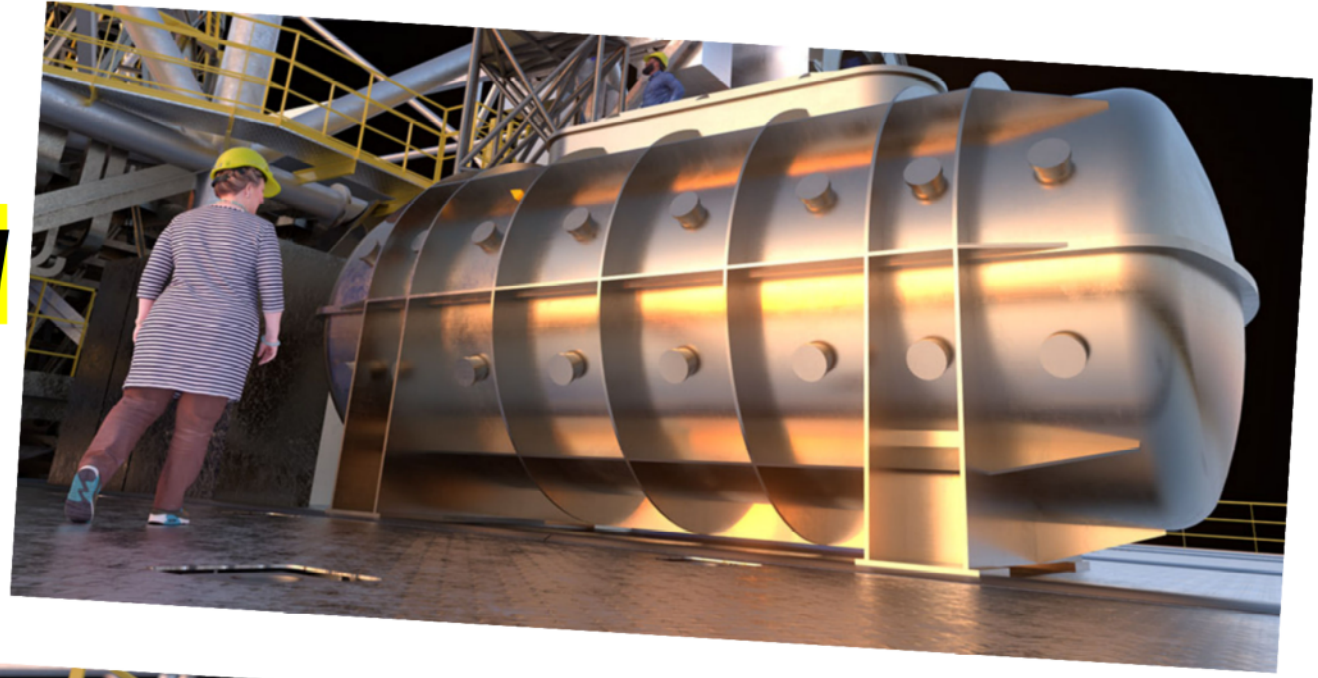
ArmazoNes high Dispersion Echelle Spectrograph

B. Chazelas (ANDES RIZ spectrograph system engineer)
Observatory of Geneva
A. Zanutta (ANDES System Engineer),
INAF – Osservatorio Astronomico di Brera, Italy

ELT Instruments Day - 7 Apr 2022

ANDES in a nutshell

- Second Generation Instrument
- Currently starting the Phase B of its development
- ANDES is a high resolution spectrograph
- R=100’000 (400-1800 nm), (goal 350-2400 nm)
- Built for high stability, precision and accuracy
- Observing one or 2 targets.
- Either seeing limited or having an IFU with a SCAO module



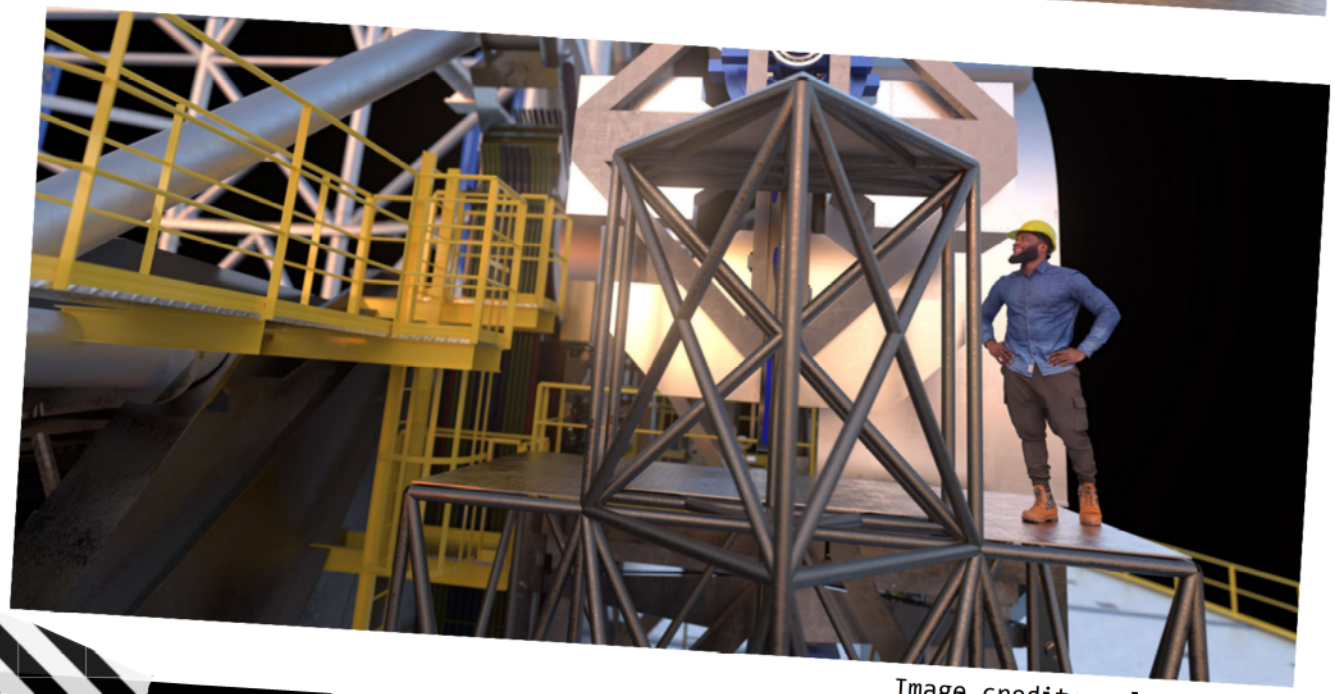


Image credits: elt.eso.org

ANDES - science

Exoplanets: (characterisation of Exoplanets Atmospheres: detection of signatures of life)

Protoplanetary Disks: (dynamics, chemistry and physical conditions of the inner regions)

Stellar Astrophysics: (abundances of solar type and cooler dwarfs in galactic disk bulge, halo and

nearby dwarfs: tracing chemical enrichment of Pop III stars in nearby universe)

Stellar Populations: (metal enrichment and dynamics of extragalactic star clusters and resolved

stellar populations)

Intergalactic Medium: (Signatures of reionization and early enrichment of ISM & IGM observed in

high-z quasar spectra)

Galaxy Evolution : (massive early type galaxies during epochs of formation and assembly)

Supermassive Black Holes: (the low mass end)

Fundamental Physics: (variation of fundamental constants - α, mp /me Sandage Test)

Consortium

The **ANDES project** is managed by an international consortium composed of research institutes from several countries.

Principal Investigator (PI):
A. Marconi

Executive Board & Institutes

Brazil: J. Renan de Medeiros
Federal Univ. of Rio Grande do Norte

Canada: R. Doyon (new partner for Phase B)
Univ. De Montreal, Herzberg Astrophysics Victoria

Denmark: J. Fynbo
Univ. of Copenhagen, Univ. Aarhus, Danish Tech. Univ.

France: I. Boisse
LAM Marseille, LAGRANGE Nice, IPAG Grenoble,
IRAP/OMP Toulouse, LUPM Montpellier

Germany: K. Strassmeier
AIP Potsdam, Univ. Göttingen, Landessternwarte Heidelberg, MPIA Heidelberg, Thüringer Landesternwarte Tautenburg, Univ. Hamburg

Italy: A. Marconi
INAF Istituto Nazionale di AstroFisica (Lead)

Poland: A. Niedzielski
Nicolaus Copernicus Univ. in Toruń

Portugal: N. Santos
Inst. Astrofísica e Ciências do Espaço, CAUP Porto, Lisbon

Spain: R. Rebolo
Inst. Astrofísica de Canarias (IAC), Inst. Astrofísica de Andalucía (IAA - CSIC), Centro de Astrobiología (CSIC-INTA) Madrid

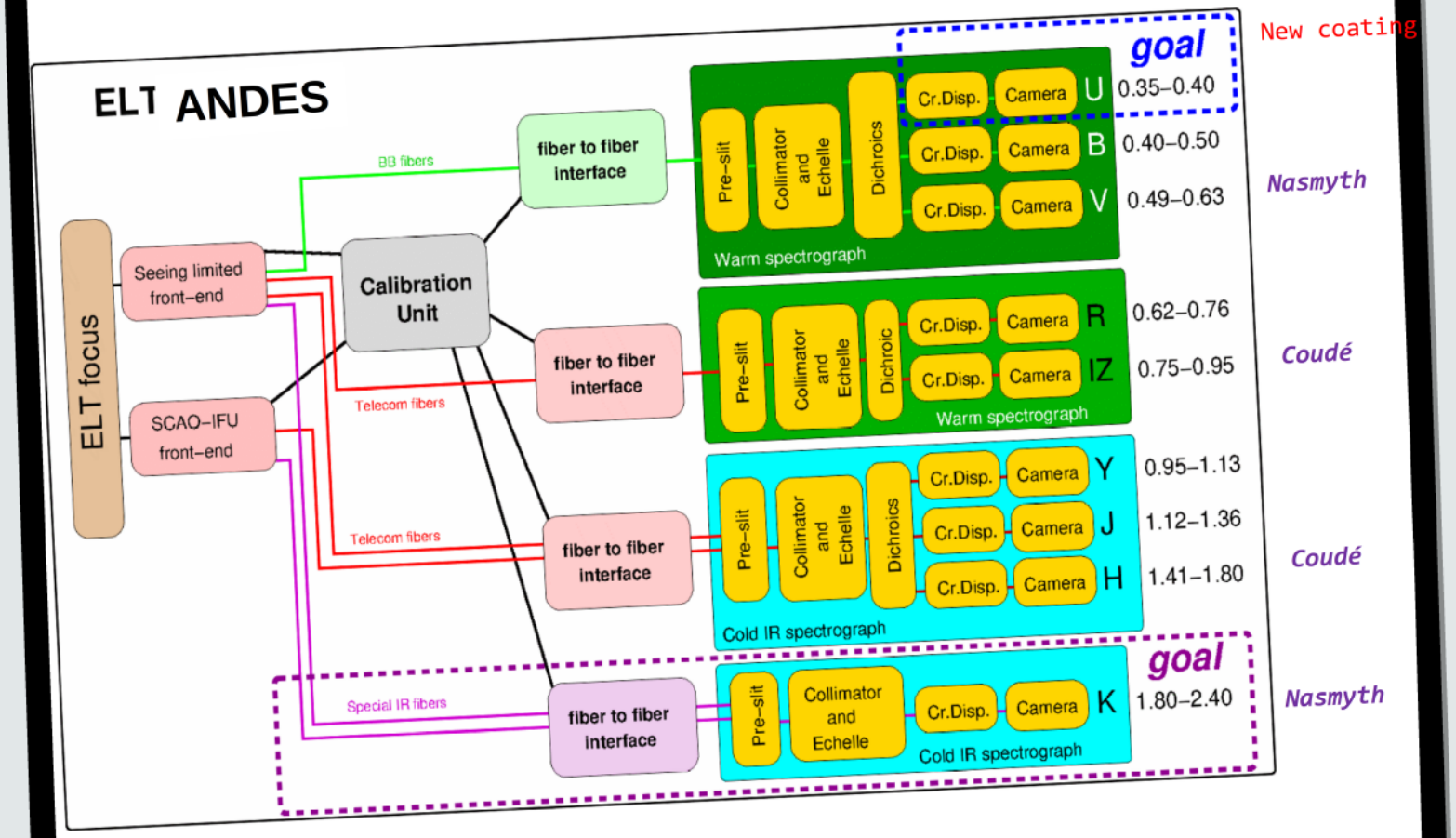
Sweden: N. Piskunov
Uppsala Univ., Lunds Univ., Stockholm Univ.

Switzerland: C. Lovis
Univ. de Genève, Univ. Bern

United Kingdom: M. Haehnelt
Univ. of Cambridge, UK Astronomy Technology Centre, Heriot-Watt Univ.

USA: T. Bergin (new partner for Phase B)
Univ. of Michigan

Architecture

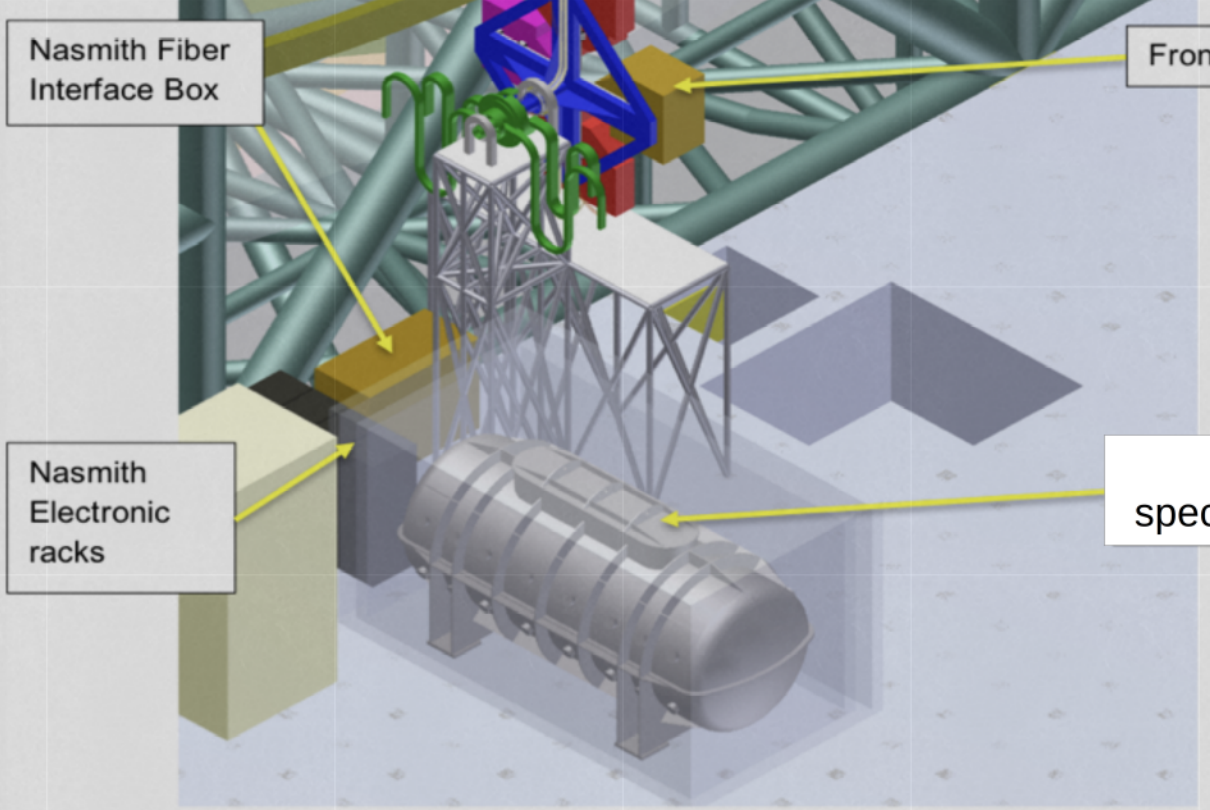


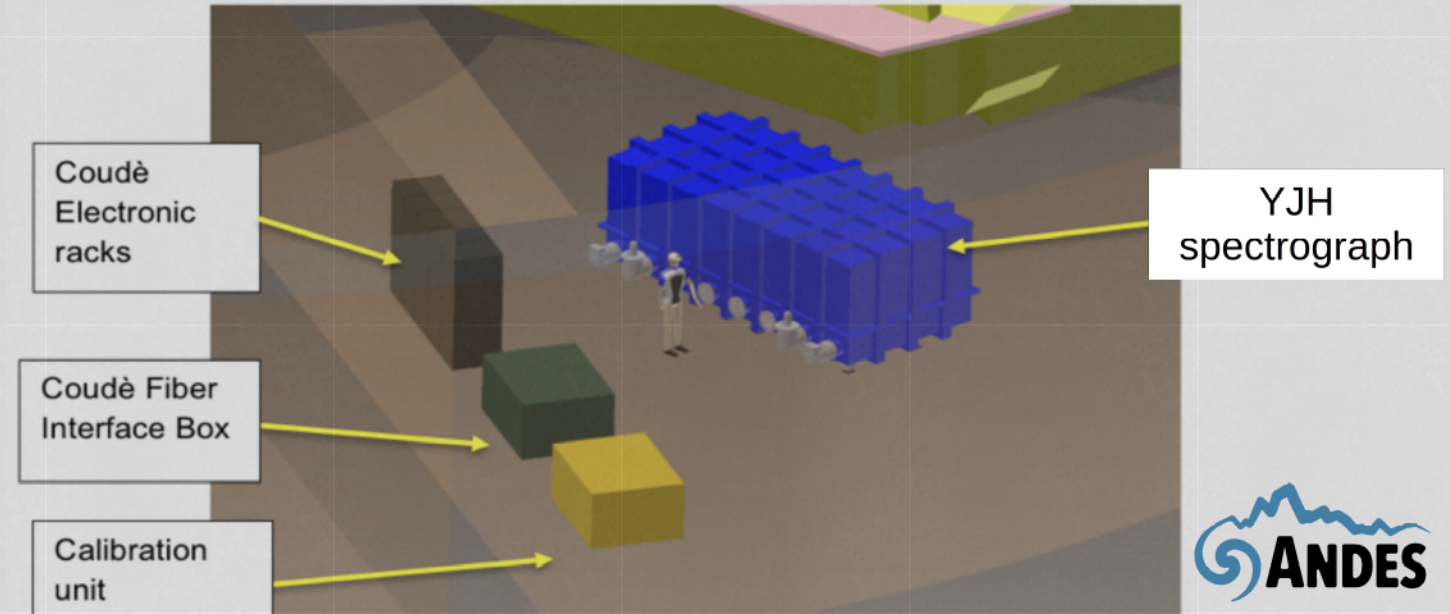
- Stabilized spectrograph :
  - Under vacuum / thermally controlled
  - IR spectrographs at cryogenic temperature
- Stability / Precision / Accuracy better than 1m/s

  Goal 0.1 m/s (or better for some science cases)

ANDES at ELT

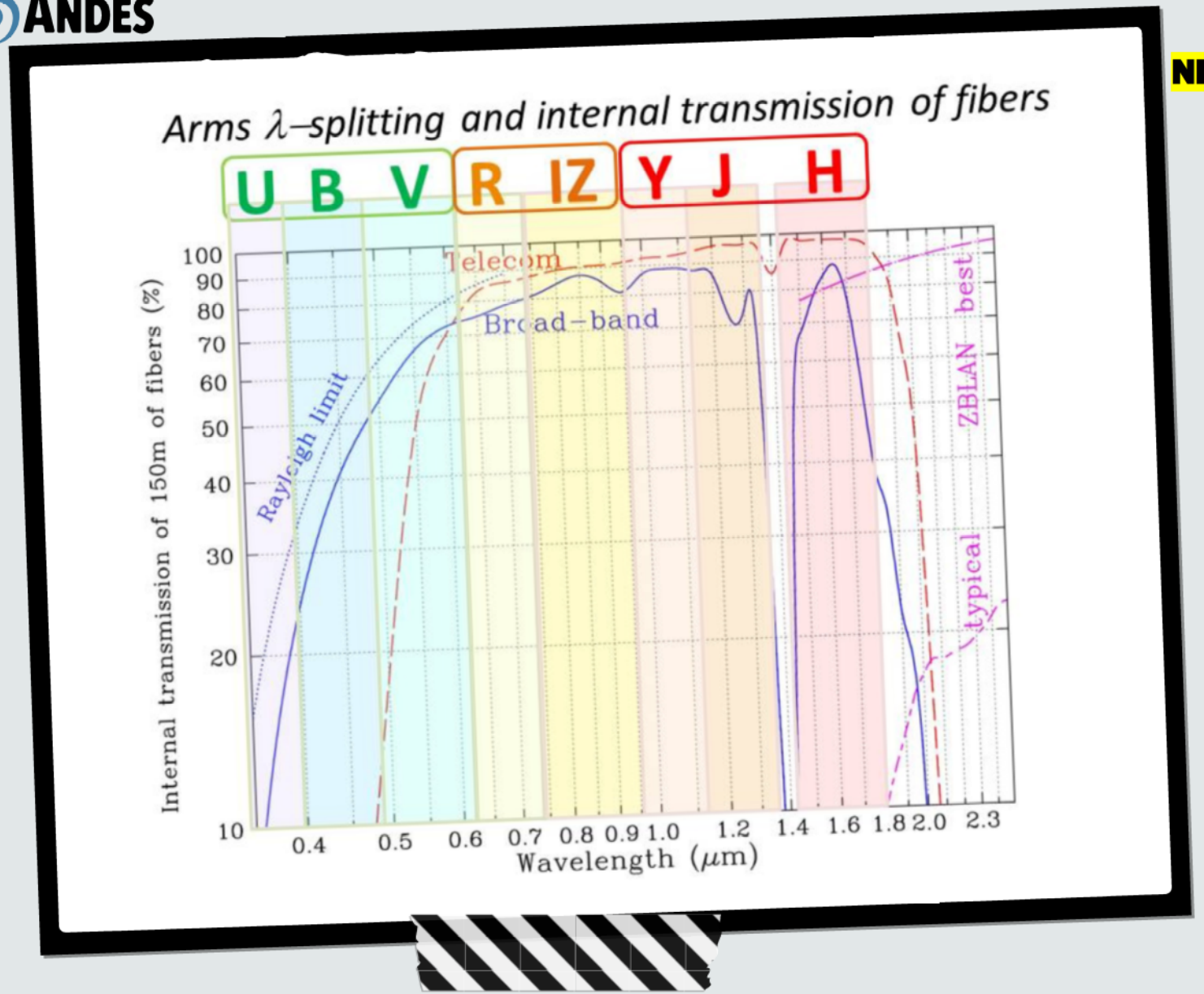

YJH and RIZ
spectrographs


Nasmith Fiber
Interface Box
Front End
Nasmith
Electronic
racks
UBV
spectrograph


Coudè
Electronic
racks
YJH
spectrograph
Coudè Fiber
Interface Box
Calibration
unit

Observing modes

- **Seeing Limited:**
  - One target + sky or 2 targets, within 2 arcminutes
  - 2x0.75” on sky apertures
  - Simultaneous coverage of the whole spectrum (but K band ?)
- **SCAO mode:**
  - An IFU with at least 49 spaxels
  - At least 2 spaxel plate scale (diffraction limit or 100 mas)

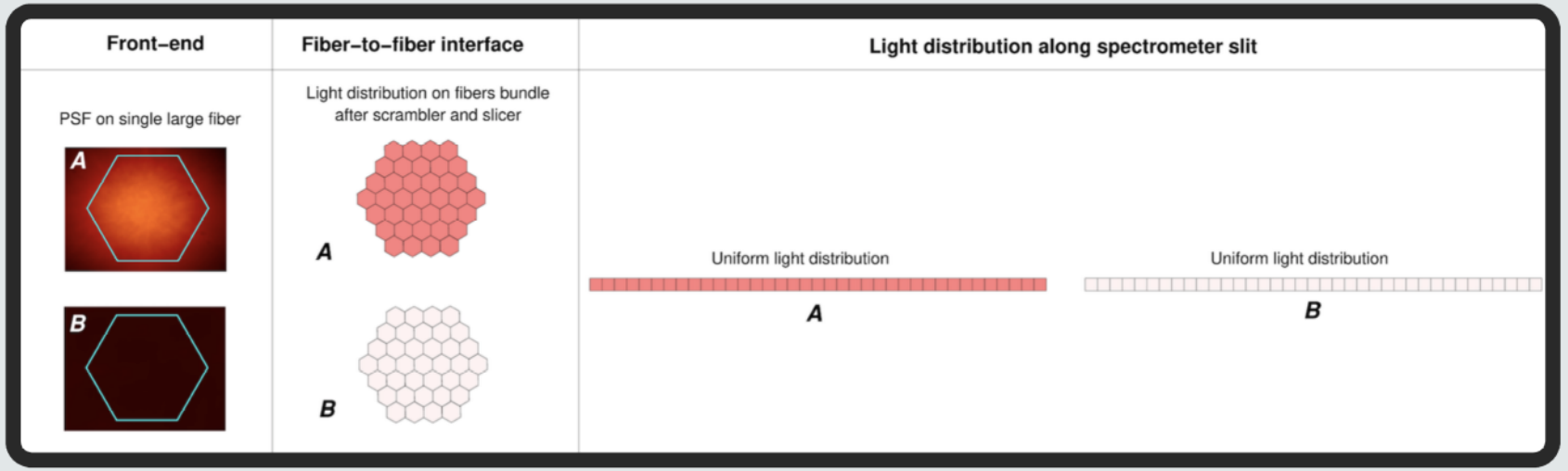


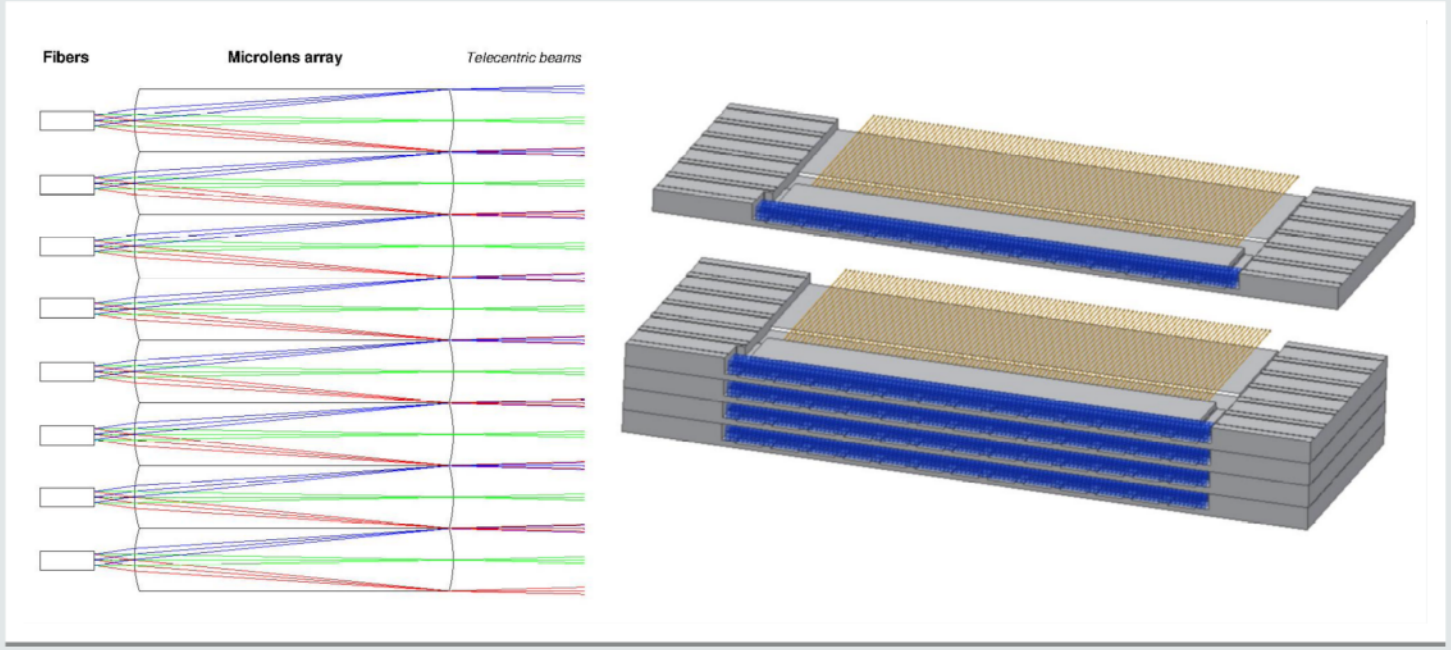
NEEDS:

fibers

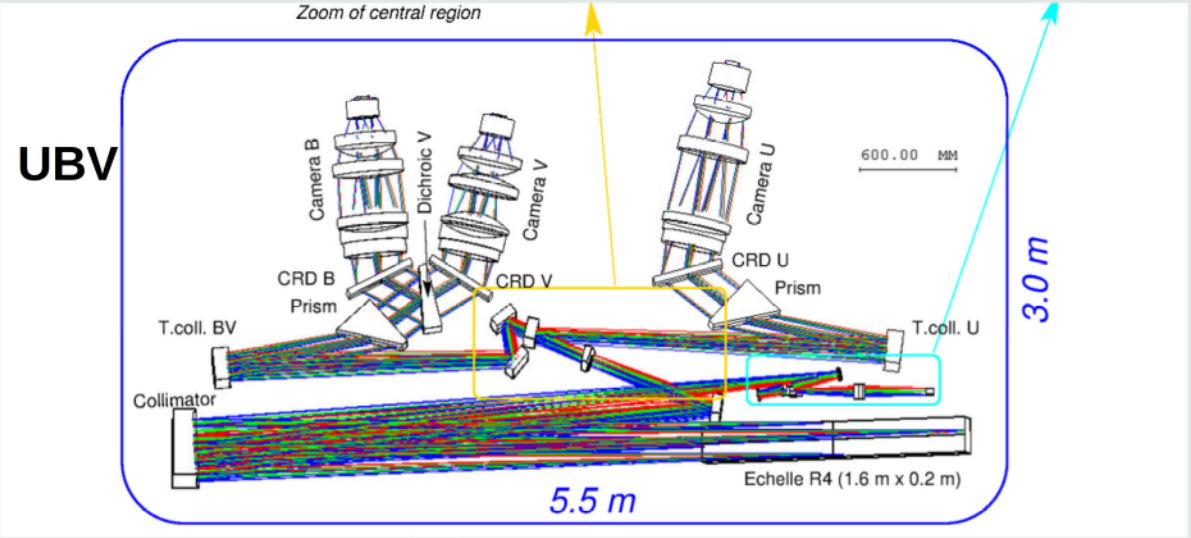
- Standard silica multimode fibers (probably non circular) from U to H
- Decides the position of spectrograph
- For K band an issue under review

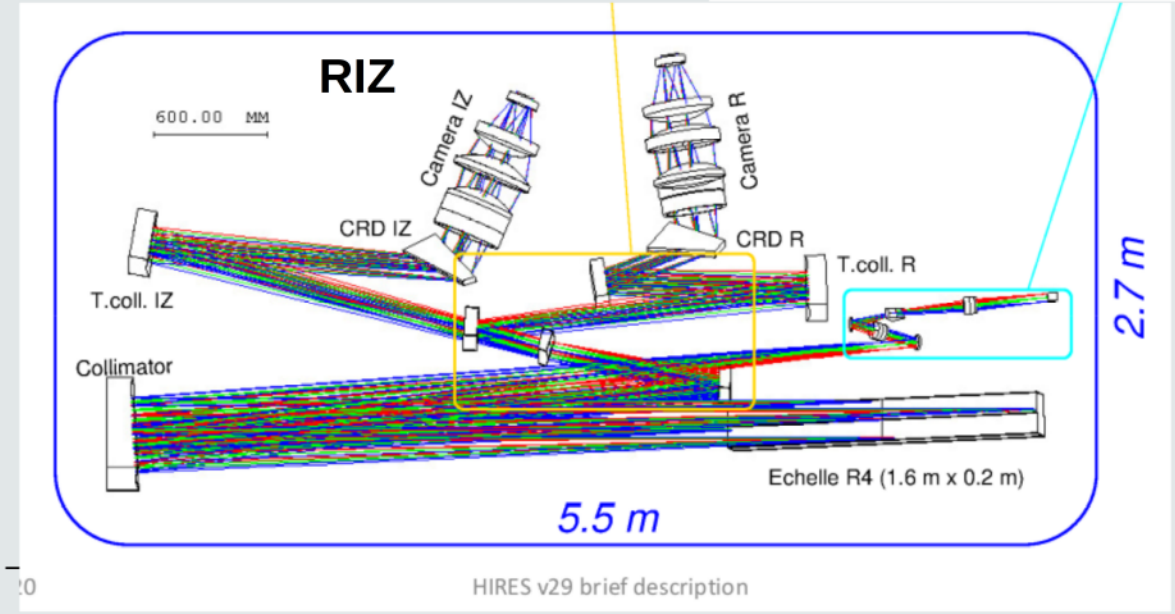
Some challenges with fibers

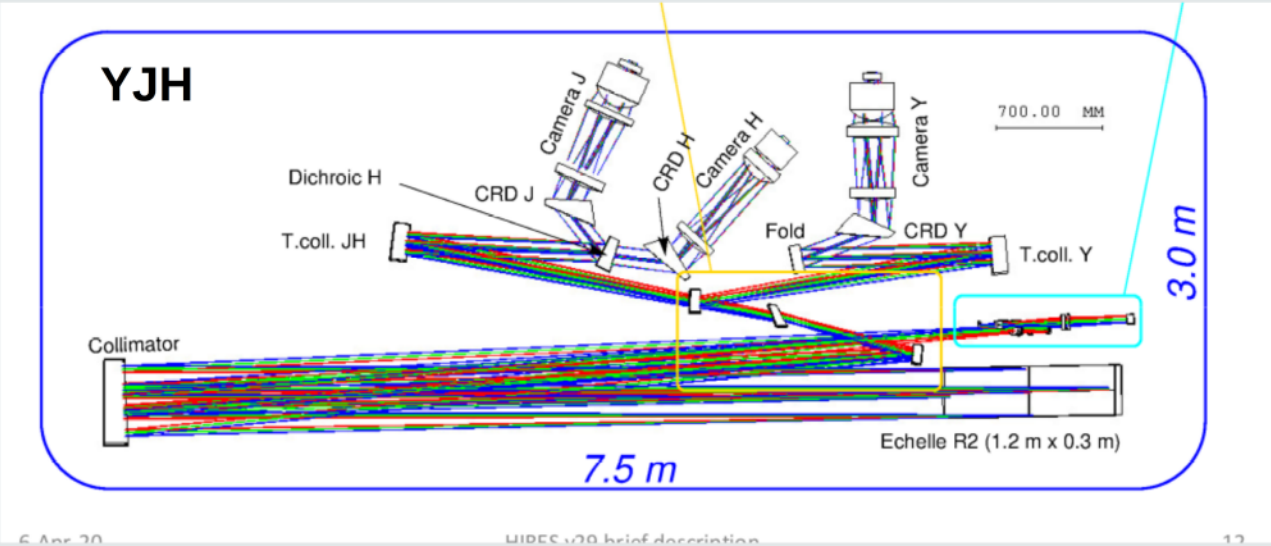




Optical design of the spectrograph



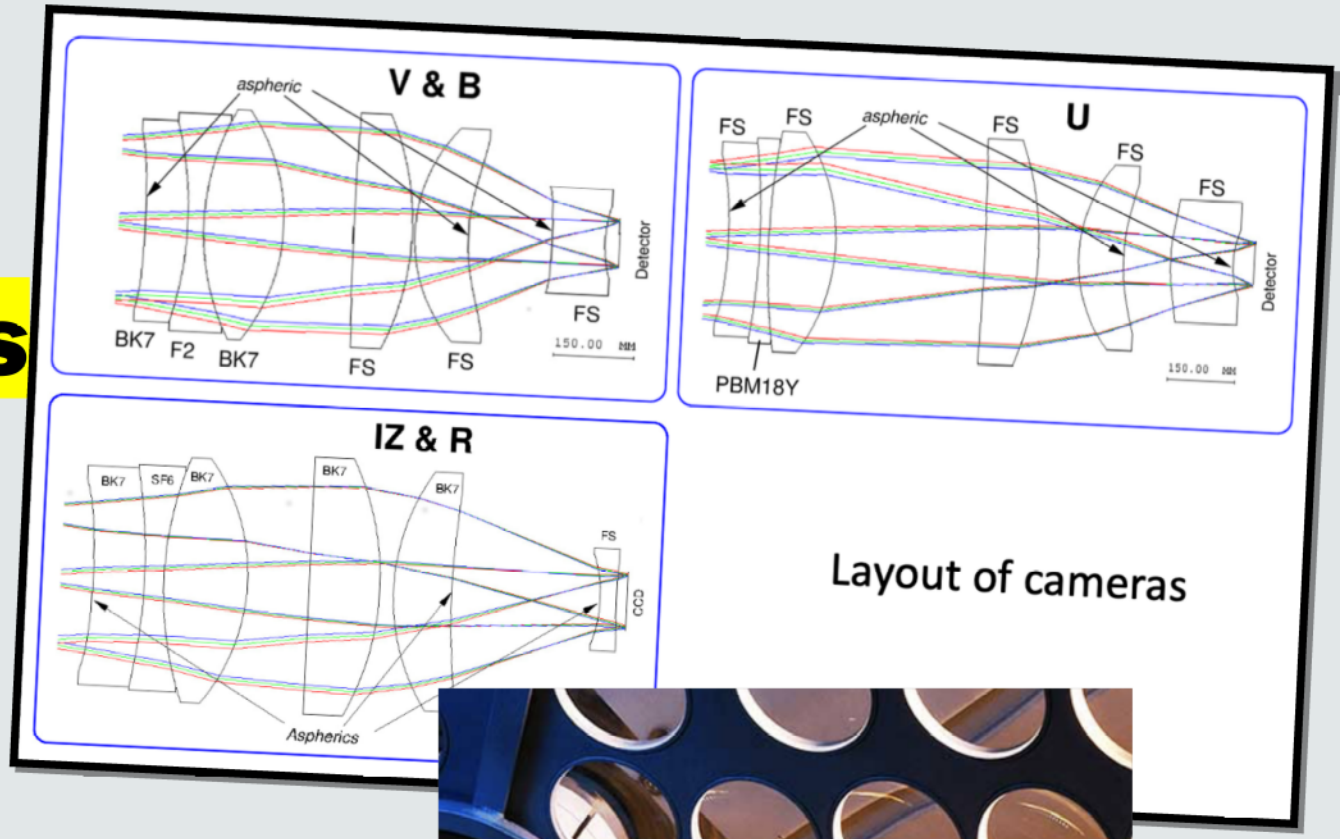




NEEDS:

optics and coatings

- aspheric surfaces with size up to about 80cm;
- high efficiency A/R coatings over wide wl-ranges (1 octave and more), also for very high incidence angles; sizes up to 50cm;
- high efficiency reflection coatings wide wl-ranges (1 octave and more), sizes up to 1m



NEEDS: detectors

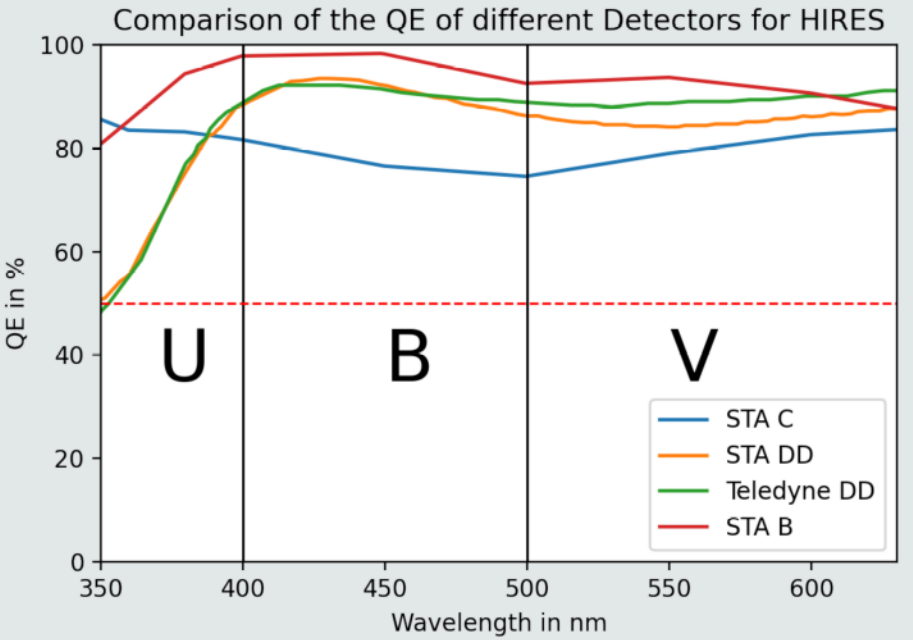
For IR Spectrographs:

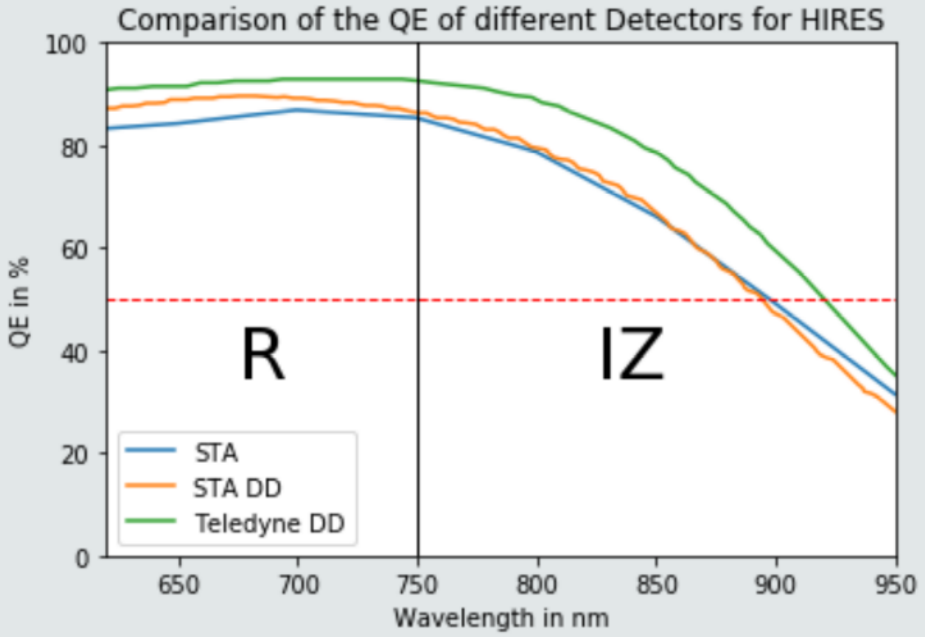
YJH spectrograph:
3 Teledyne HAWAII-4RG-15
- 4096x4096 pixels
- 15 micron pixel size,
- 2.5 micron cut-off

K spectrograph:
1x HAWAII-4RG

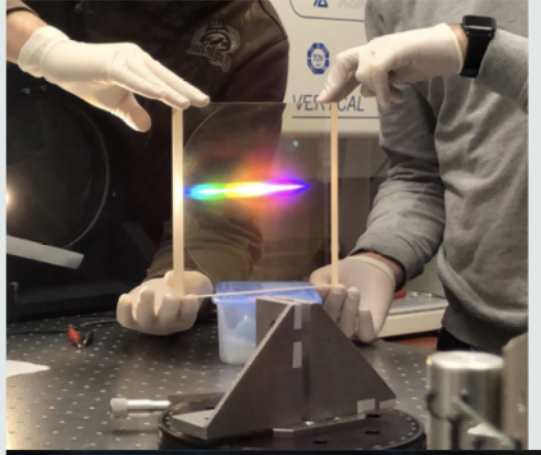
For visible Spectrographs:

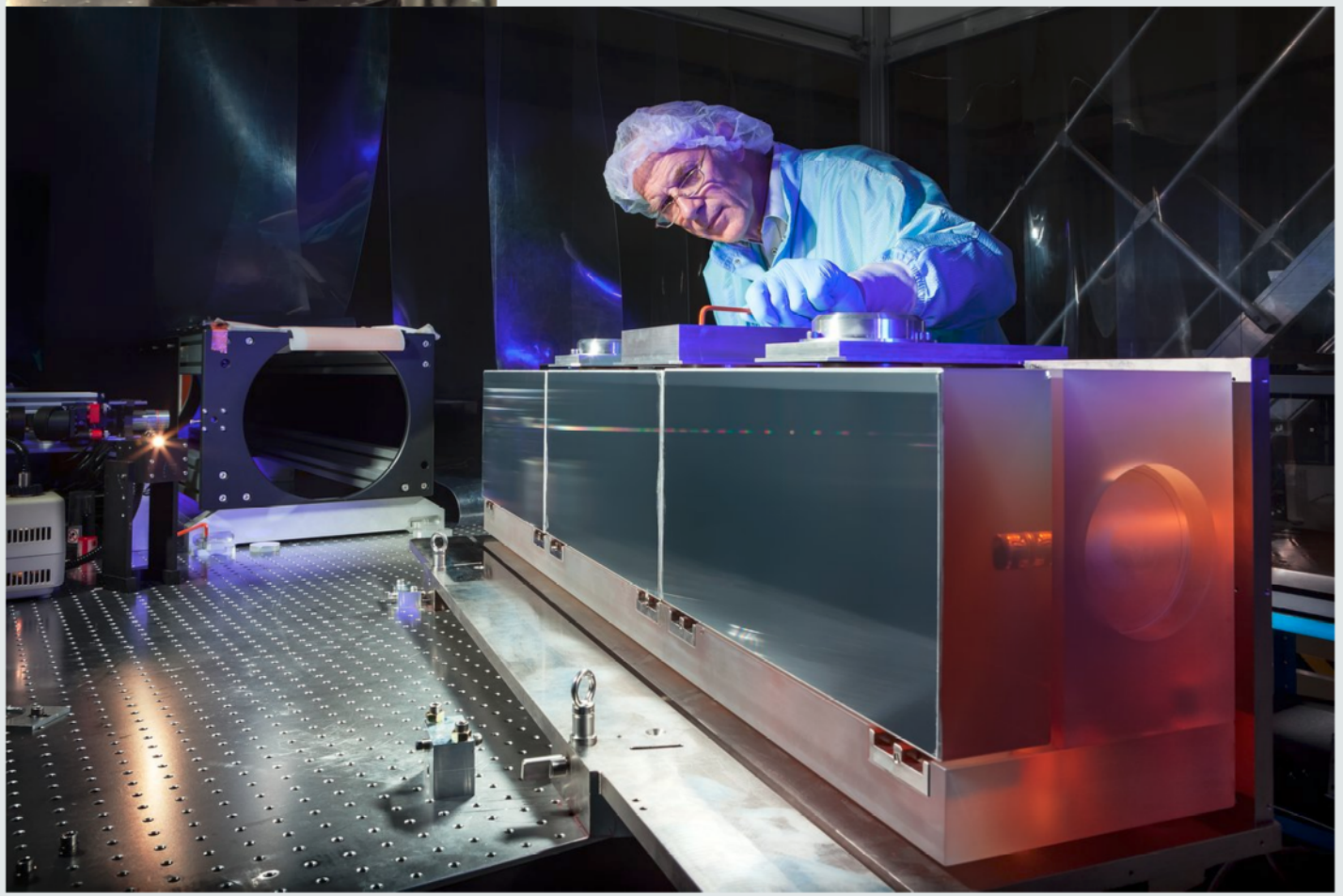
- 5 detectors are needed from 350 nm to 950 nm
- quantum efficiency for the available CCD with a 90mm side (9K or 10K)
- For IZ arms: to improve QE -> Silicon layer of ca. 100um (instead of 30-40um);





NEEDS: *gratings*



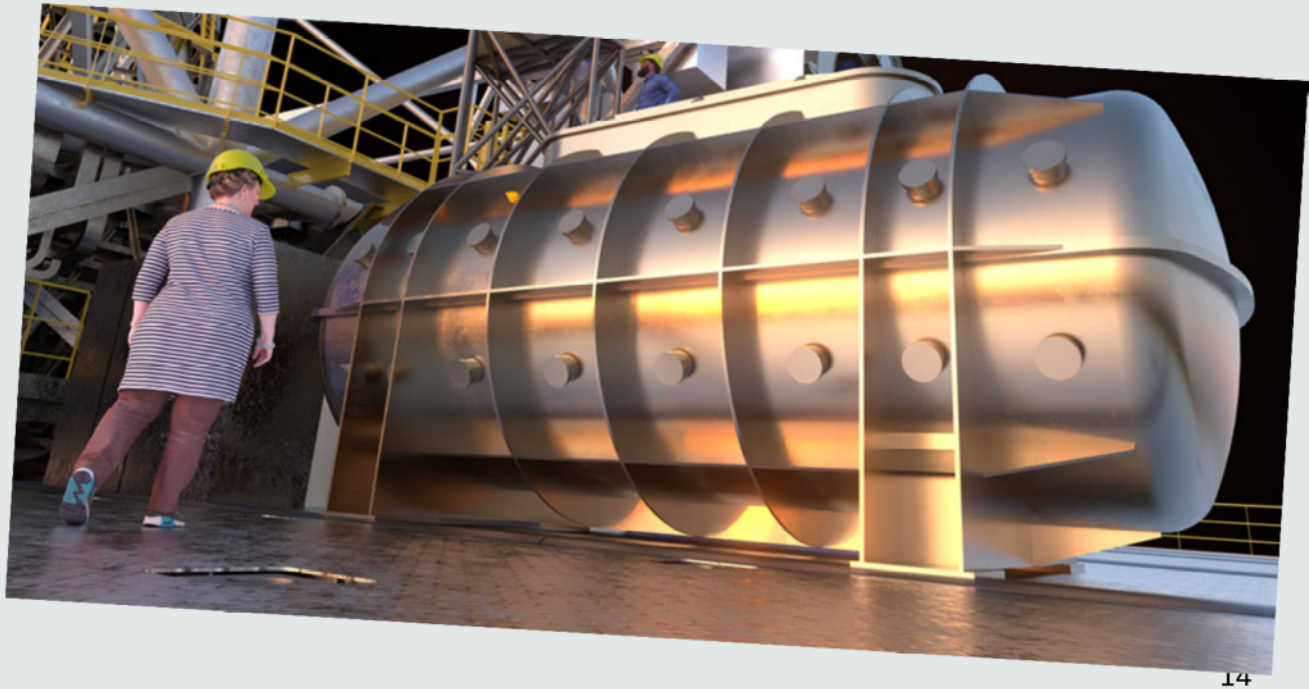


- Very large (up to 1.6m) coarse (10-20 lines/mm) reflection gratings blaze angle >63° and high efficiency (>80% ideally)
- Large (up to about 40cm) transmission gratings working at first order with very high efficiency (>95% ideally)

NEEDS:

Vacuum cryo systems

- Very large vacuum tanks
- Differntial vacuum cryostats for the warm spectrographs
- Warm and cryogenic spectrograph



Timeline

- Now starting Phase B for 2 years before PDR