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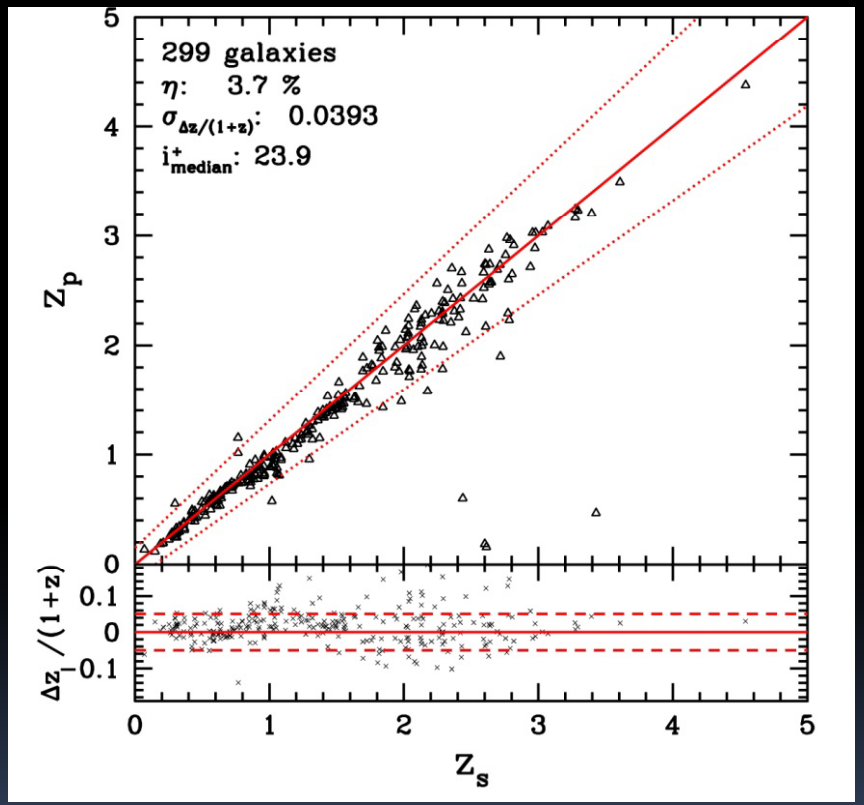
WIDE FIELD IMAGING WITH OPTIMOS (DIORAMAS)

Deep Infrared & Optical imageR And Multi-Aperture Spectrograph (3D scenes)

Why wide field imaging on the EELT ?

- Perform the deepest imaging of large areas of the sky
- Build large samples for statistical studies
  - Input to large MOS spectroscopic surveys
- Identify (rare) targets
  - Very high-z SNe
  - Pointed sourced, for 3D studies followup
  - Narrow band imaging (LAE)
- Imaging is always deeper than spectroscopy
  - Photometric redshifts can be used at extreme depth
- Unique niche: combination wide field / depth

Going beyond the spectroscopy limit: using photoz



VVDS spectro-z I_{AB}=24.75 vs.
CFHTLS+WIRDS (ugrizJHK) photo-z

- Photo-z from exquisite multi-band imaging are stable
- Consistent dataset from same instrument is important
- 1.5 mag deeper than spectroscopy

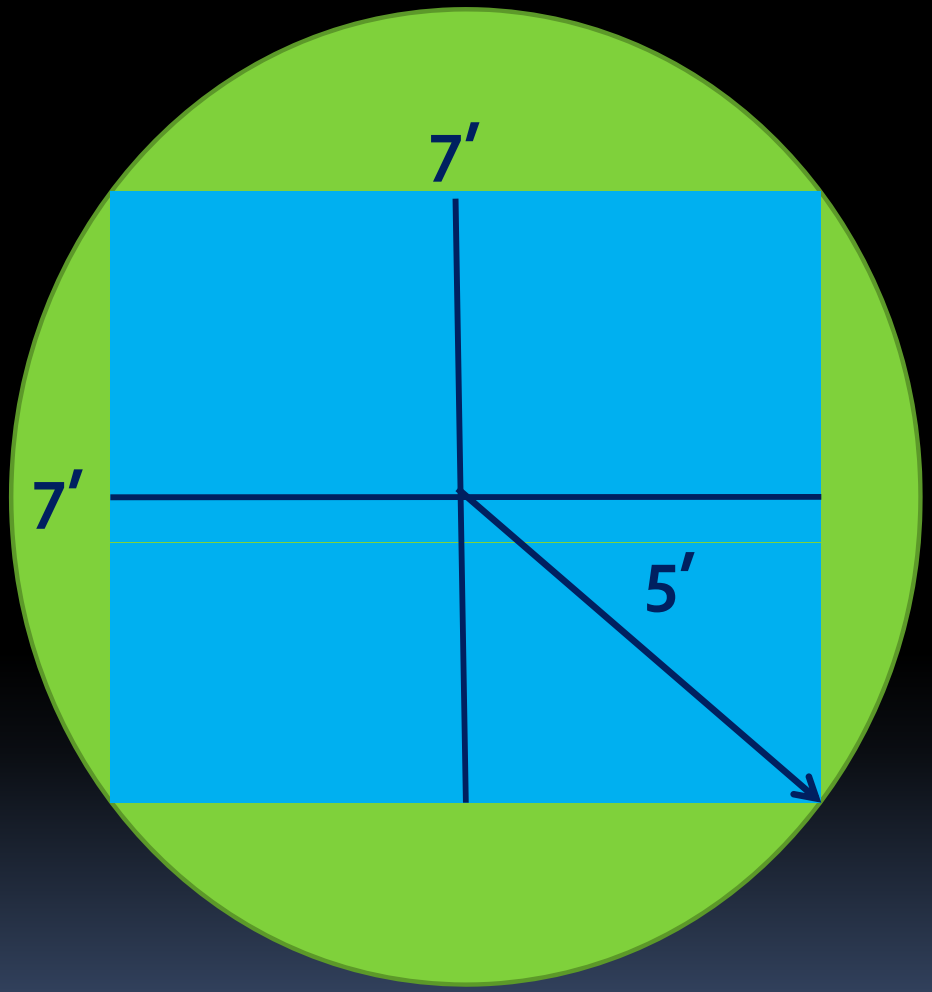
OPTIMOS-DIORAMAS

ESO Phase A study

- Wide field imaging spectrograph for the EELT: 7x7 arcmin^2
- From 0.37 to 1.4 (1.6 tbc) microns
  - Simultaneous 0.37-0.8 and 0.8-1.4(1.6) μm channels
- Large multiplex with multi-slits
  - 500 slits in the visible
  - 170 slits in the NIR
- Operations in natural seeing or under GLAO
  - 0.05 arcsec/pixel

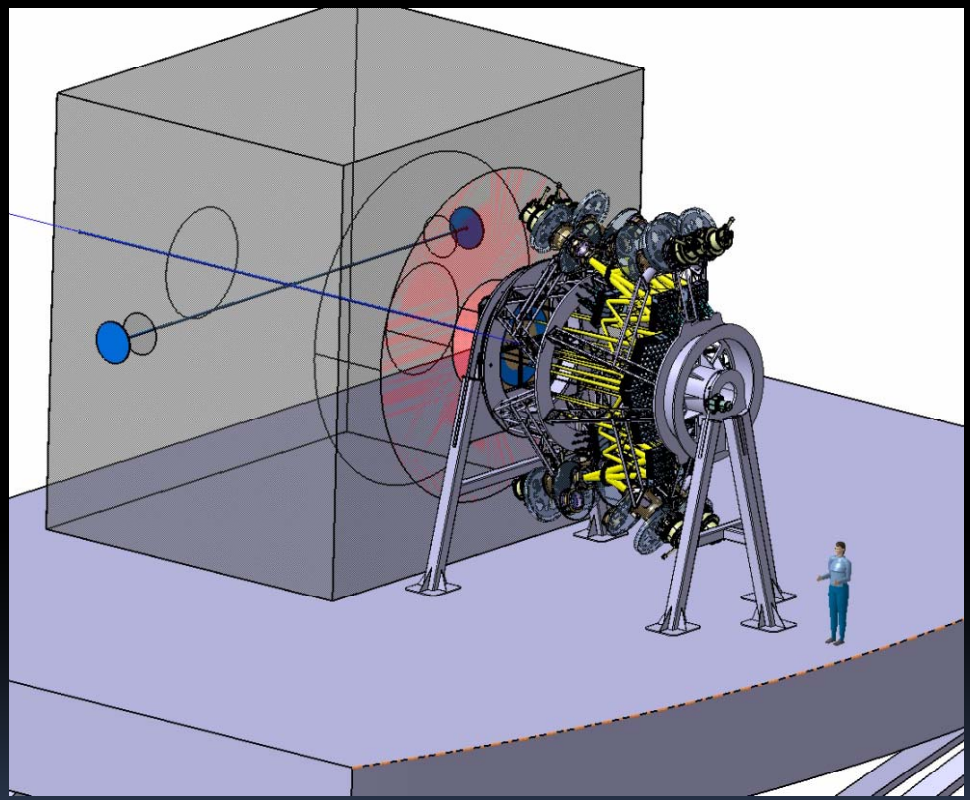
LARGE Field of View

- Available FOV at the EELT is ϕ10 arcmin
- DIORAMAS FOV is the square enscribed in 10′
- The FOV is split in 4 quadrants 3.5×3.5 arcmin² each
- Each quadrant is feeding a VIS and a NIR channel

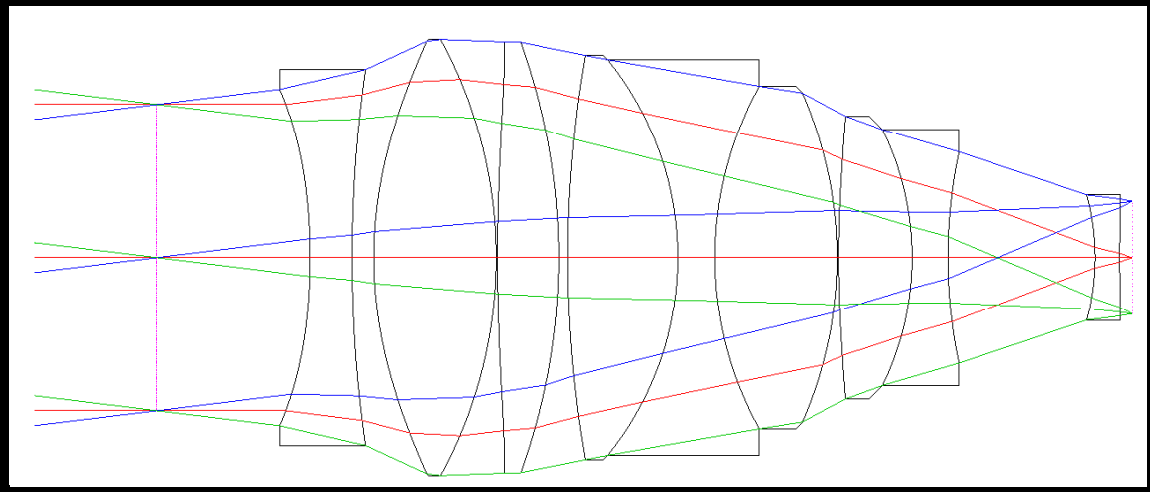


Instrument design (phaseA-MTR)

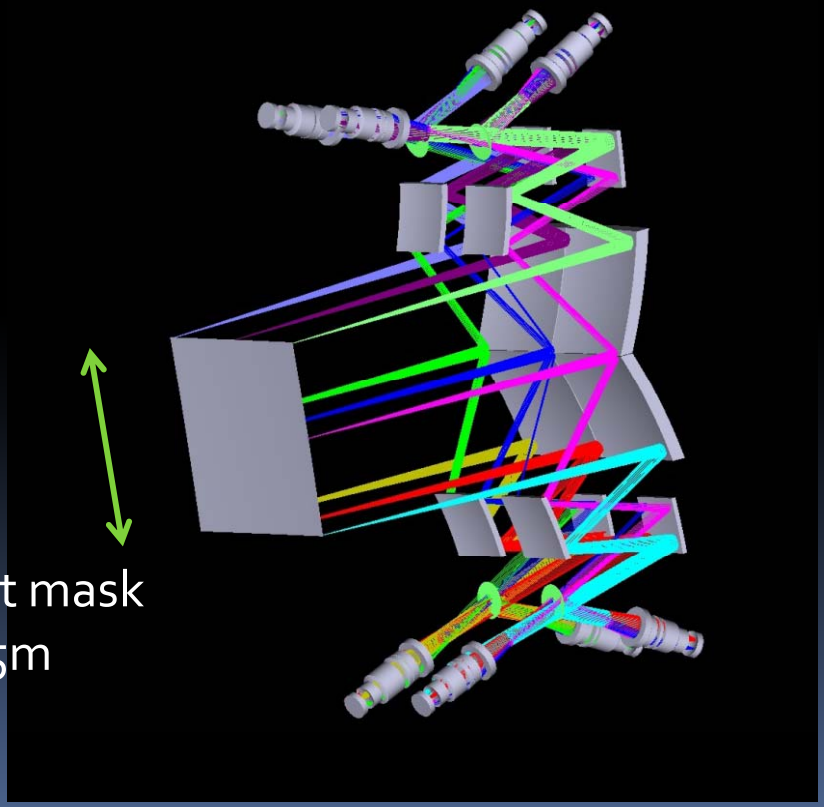
- Imaging and MOS modes
  - Insert filter or grism
- Slit masks at the focal plane
- 4 VIS cameras, and 4 NIR cameras
  - VIS/NIR split by a dichroic
  - Simultaneous VIS/NIR obs.
- Large detector arrays
  - 4K×12K for each camera



Excellent optical design

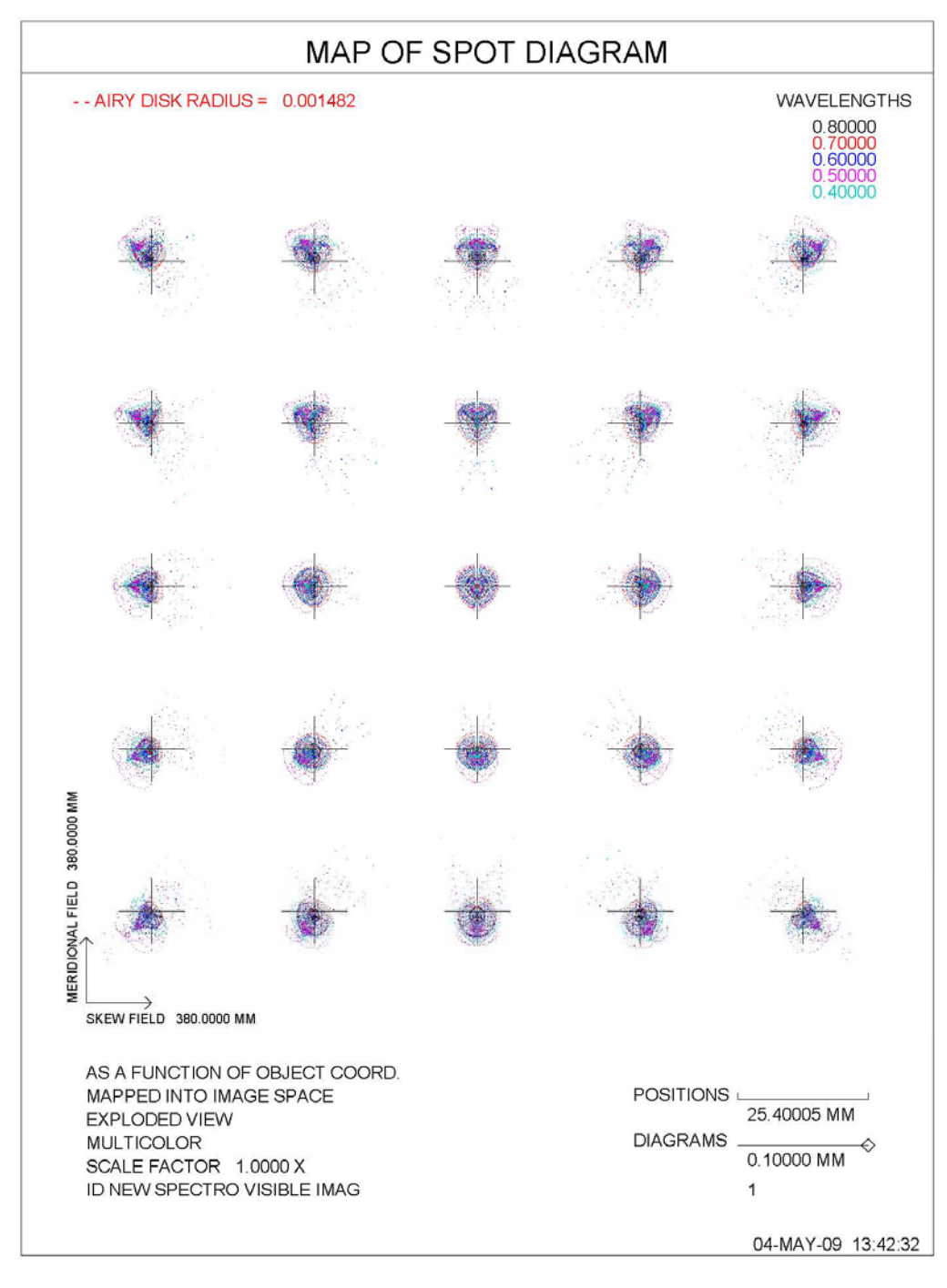


- Optical design by Delabre / Hill
- High throughput
- Fine PSF sampling



Excellent optical design

- Superb image quality in VIS and NIR
  - FWHM<0.05 arcsec



Natural seeing or GLAO operations

- Ground Layer Adaptive Optics module implemented at telescope level
  - will improve the image PSF at entrance focal plane
- Making use of GLAO with DIORAMAS will require no change at instrument level
  - Same optical setup: same field of view and pixel scale
  - Pb of vignetting of NGS/LGS probes: iterative design process to minimize it
- GLAO operations, laser guide stars, field vignetting: TBD

GLAO performance

- Study by Thierry Fusco (ONERA), interaction with T. Le Louarn (ESO)
- Very important item to solve: partial correction can mean huge gains
  - x2 smaller PSF, S/N gain x2 in imaging (point source), 4x faster
  - Further gain in MOS because allows to reduce slit size
- Encourage ESO to commission a dedicated exhaustive study or WG to optimize GLAO towards intermediate image quality 0.2-0.5 arcsec FWHM over 7'x7'

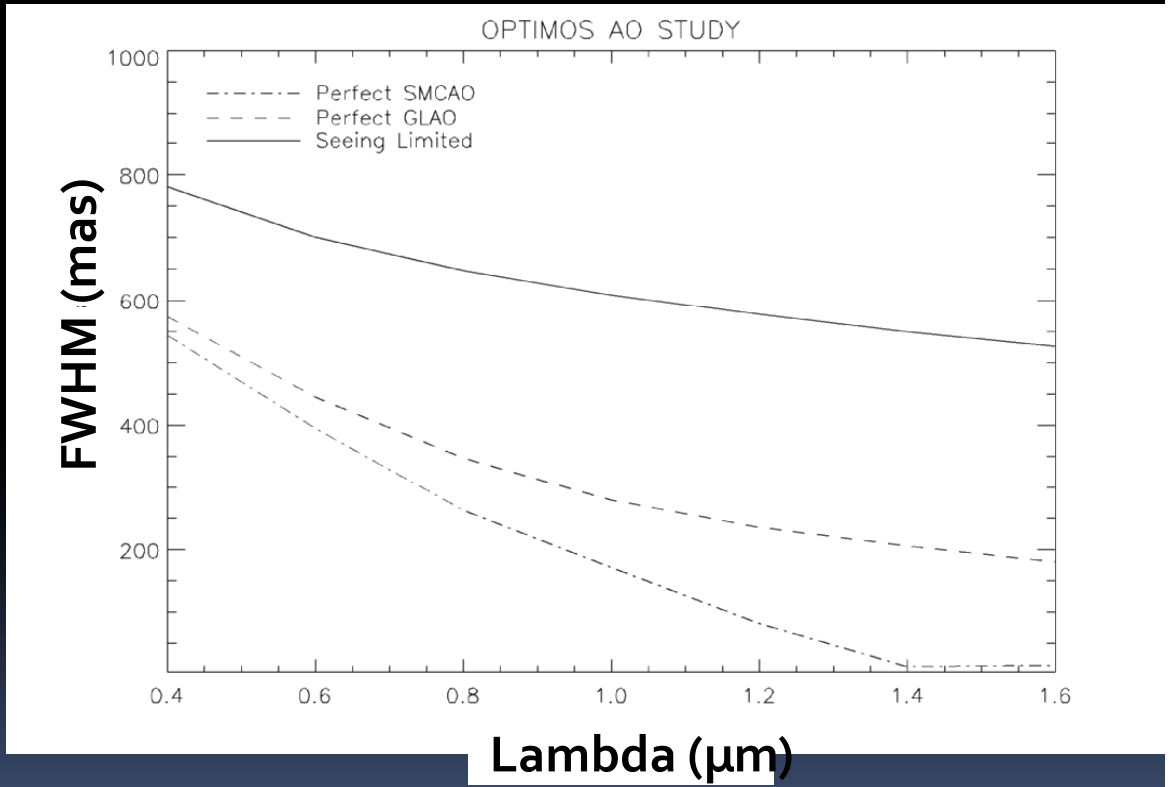
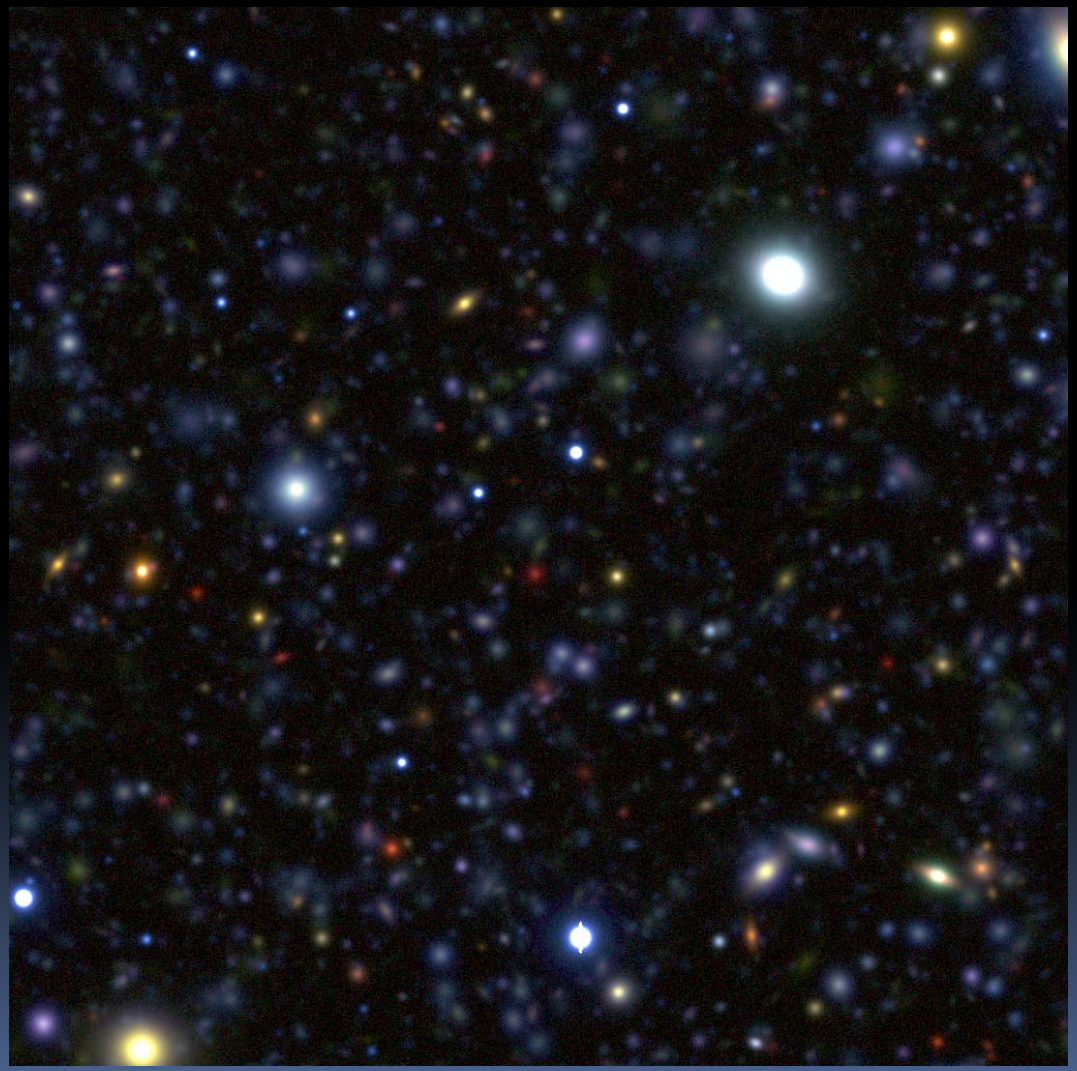


Image Simulations

- Using Skymaker (E. Bertin)
  - Hot from last week
- Realistic luminosity function of galaxies
  - To be refined, work in progress
- Mix of bulges and disks
  - To be refined, work in progress
- Analysis in progress

Simulations: FWHM=0.5 arcsec PSF

1.75x1.75 arcmin² = 1/16th DIORAMAS FOV

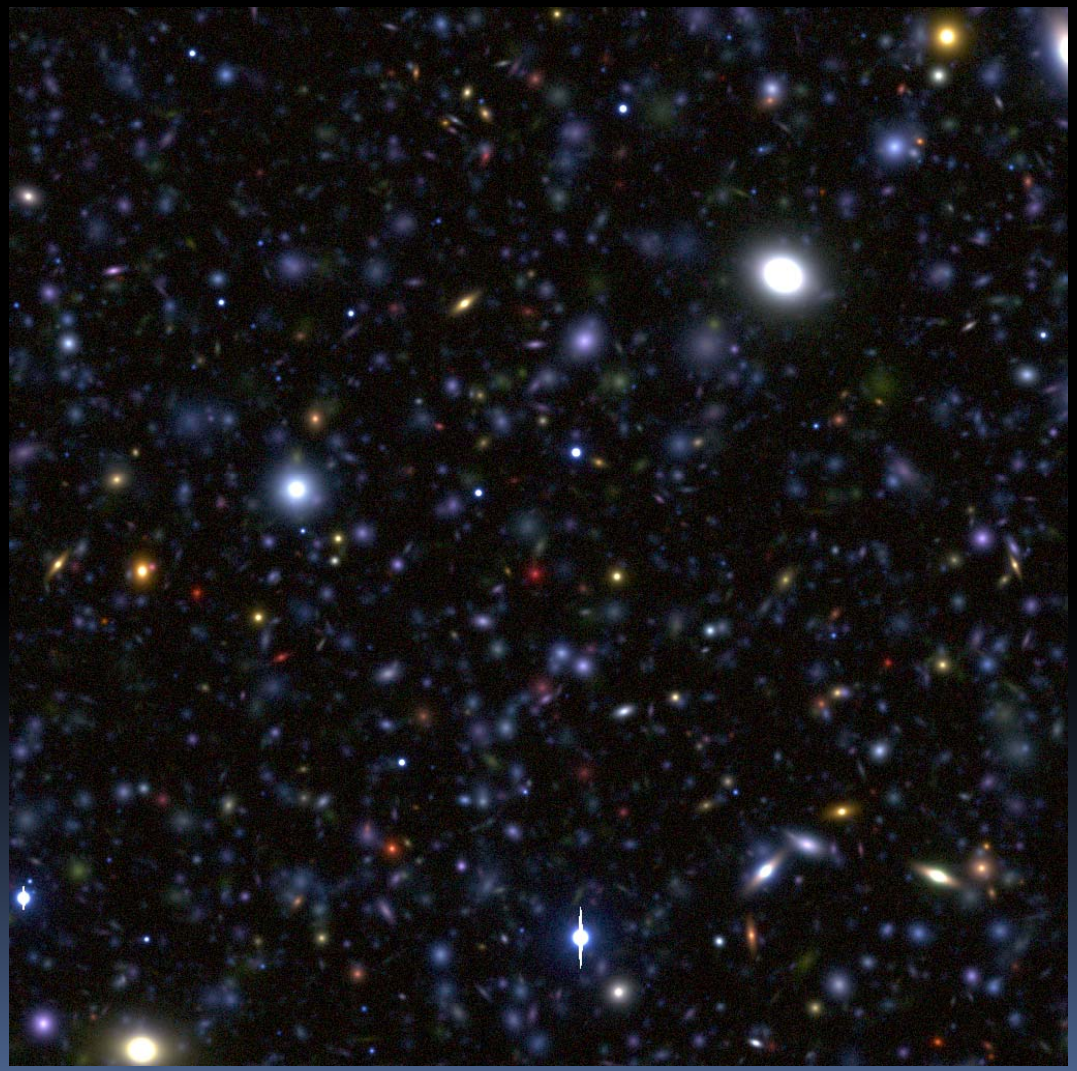


giJ color combination

45000 sources in 7′x7′ to r_{AB}=29.8

Simulations: FWHM=0.25 arcsec PSF

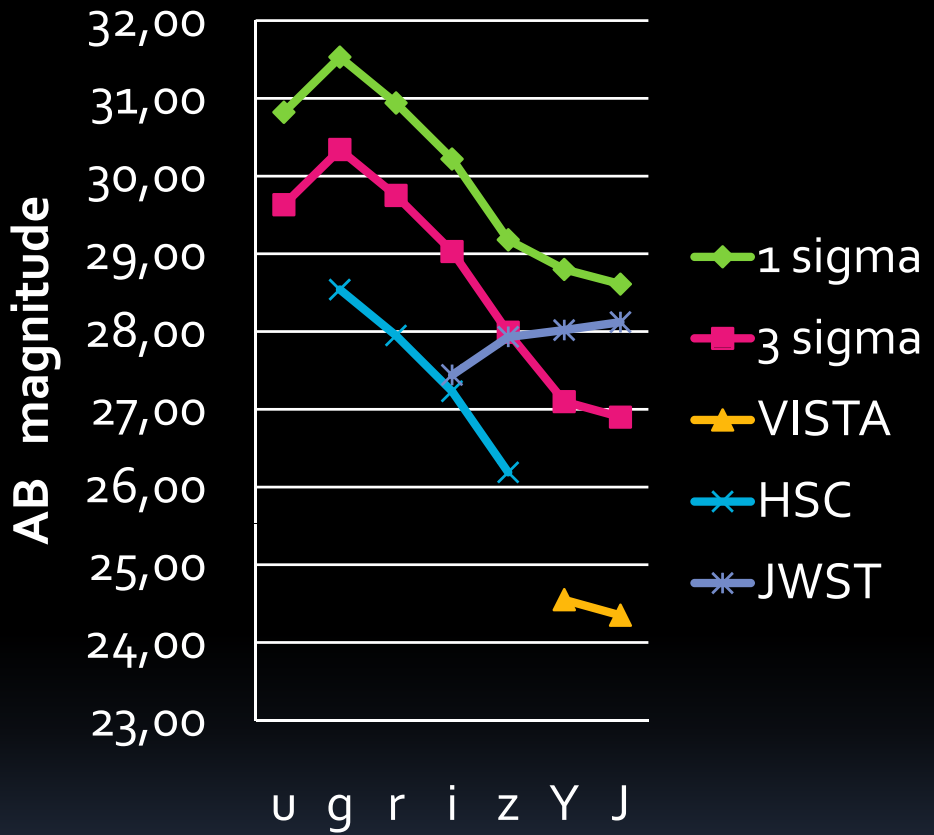
1.75x1.75 arcmin² = 1/16th DIORAMAS FOV

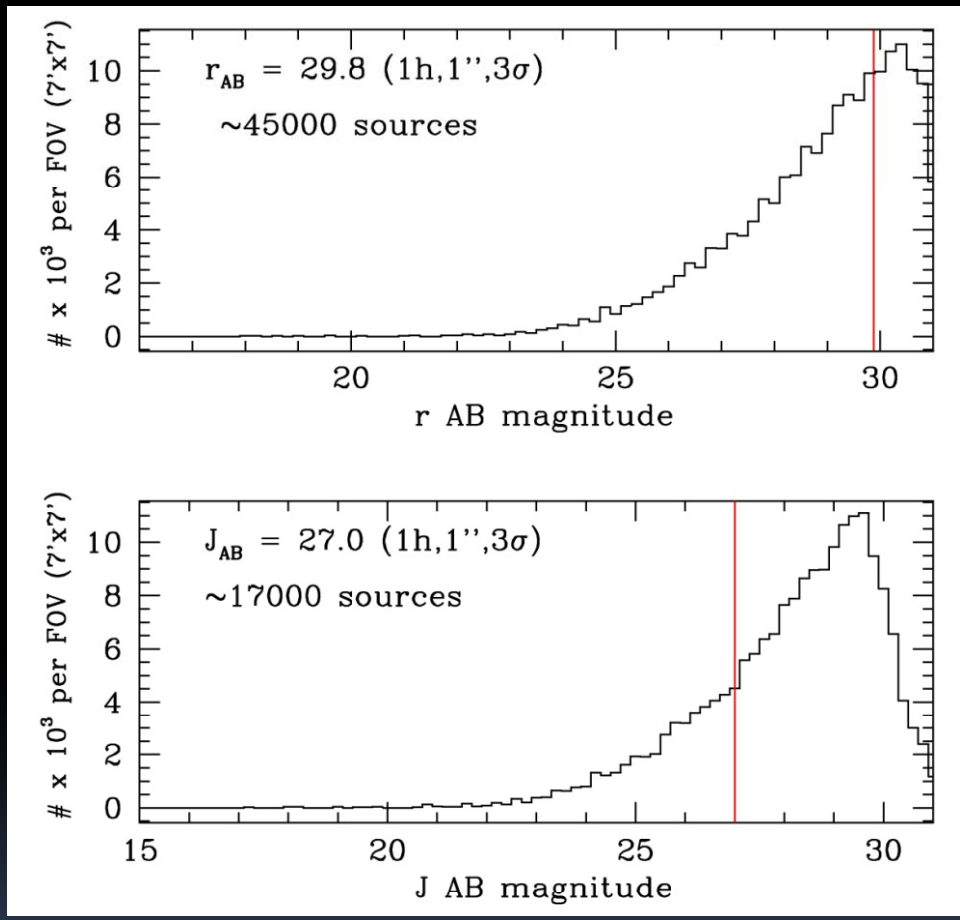


giJ color combination

45000 sources in 7′x7′ to r_{AB}=29.8

Expected performances





Magnitudes in 1 arcsec aperture, 1h, point sources

Comparing DIORAMAS imaging with other facilities

- ~100x/25x faster on pointed observations than 4m/8m telescopes
- Sensitivity comparable to JWST-NIRCAM in 0.6-1.4 microns, but 10x the FOV
- For surveys (>1deg^2), taking into account telescope aperture + FOV ratio,...
  - 3x faster than VISTA
  - 4x slower than Hyper-SuprimeCam-Subaru (which is natural seeing), see also LSST !
  - 10x faster than JWST

Summary

- Deep wide field imaging from u to J (H') with outstanding performances will be possible with EELT-DIORAMAS
  - Limiting magnitude (3σ, point source, AB): **i=29, J=26.9 in 1h**
- 7x7 arcmin² FOV, 0.05 arcsec
  - 30,000 – 45,000 galaxies per field
- Work on GLAO to define best approach to improve from FWHM~0.7 to 0.2-0.5 arcsec
- Competitive with other facilities