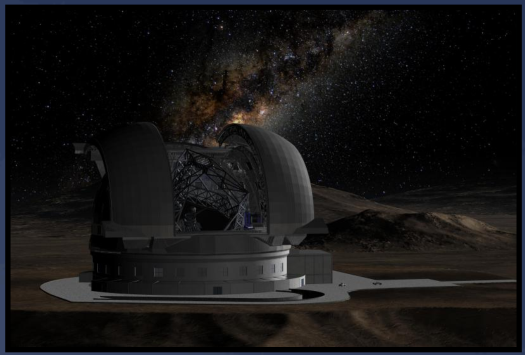
The next generation of near-IR spectrographs KMOS and MOONS

Michele Cirasuolo
Royal Observatory Edinburgh

on behalf of *KMOS* and *MOONS* Consortia

Feeding the giants…



2012

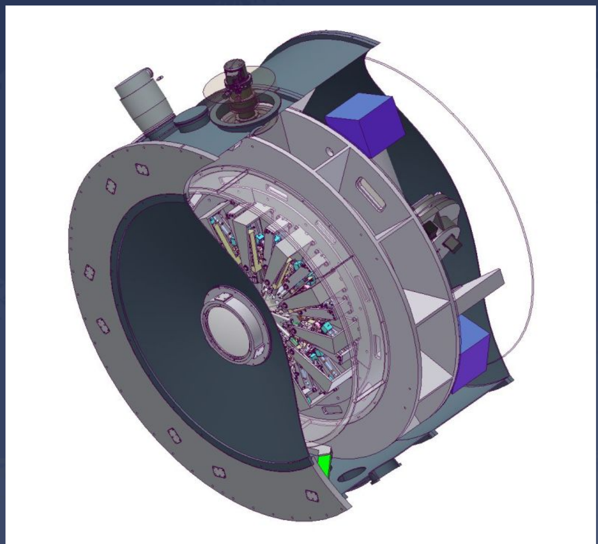
2017-18

KMOS Near-IR multi-object IFU for VLT

To be commissioned in early 2012

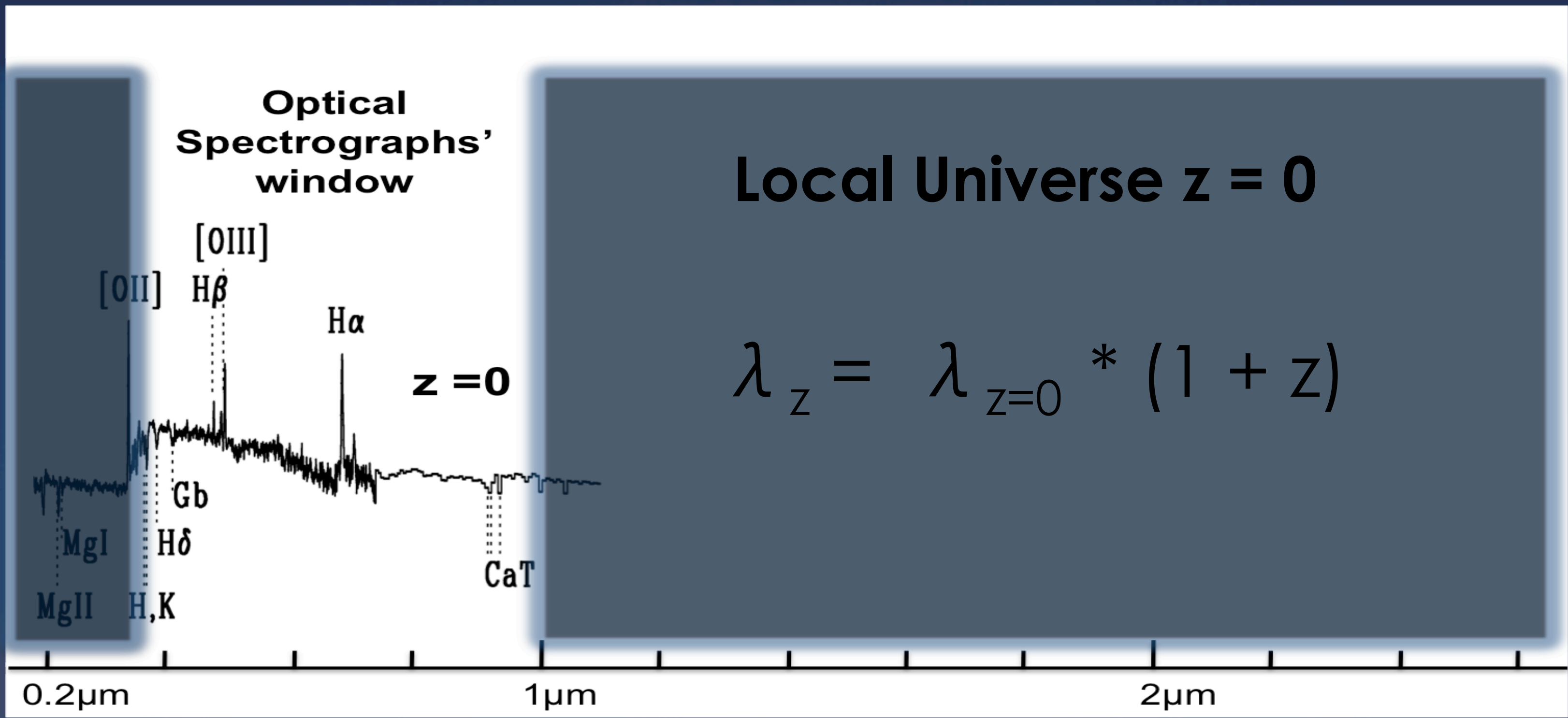
PI: R. Sharples

Consortium: UK, Germany and ESO

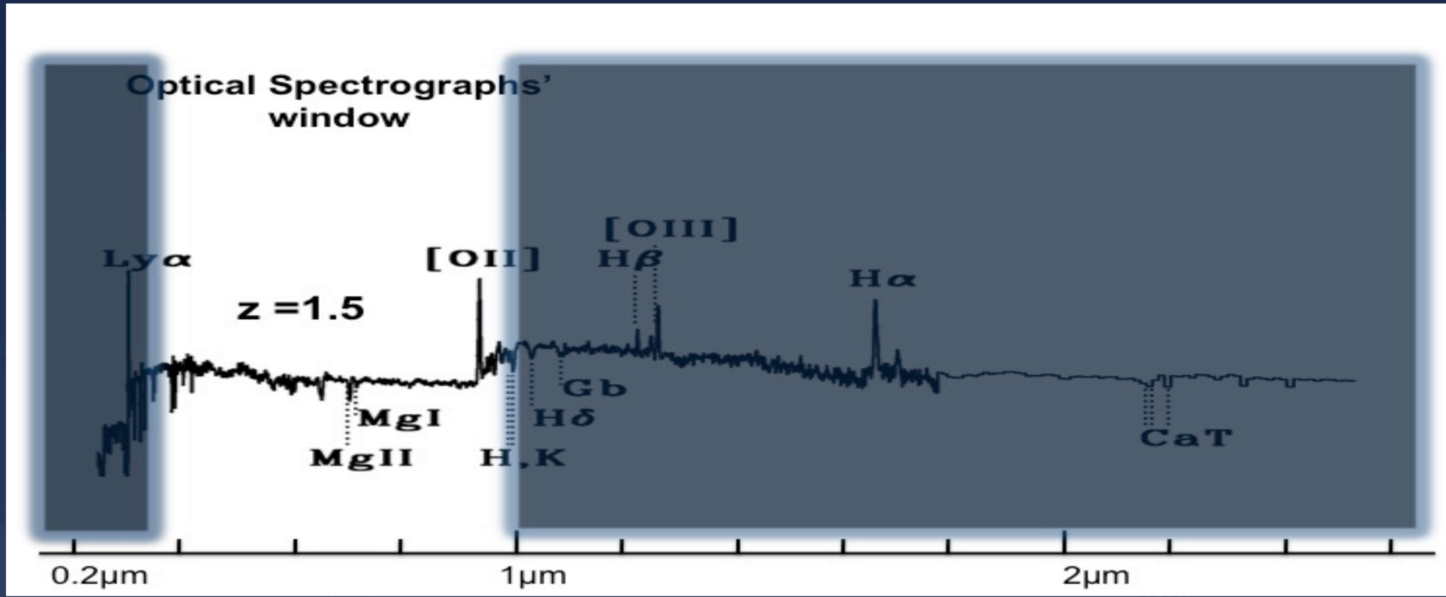


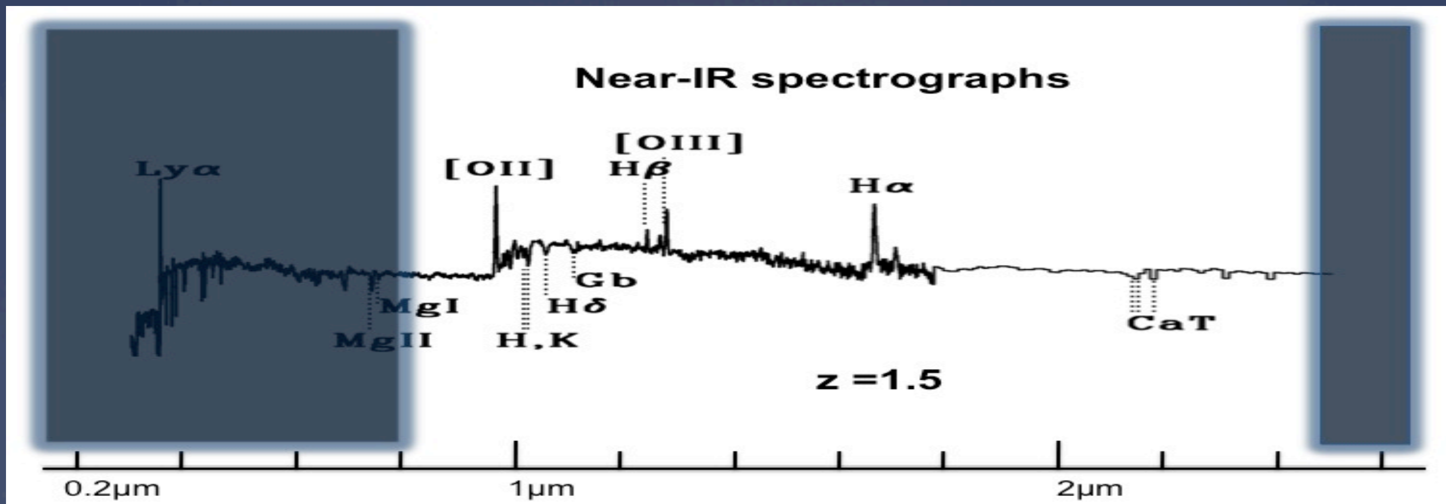
Specifications	
Filters	iz, YJ, H, K, HK
Wavelength coverage	0.8 to 2.5 μm
Spectral Resolution	R~3400,3800,3800 (J,H,K)
Number of IFUs	24
Extent of each IFU	2.8 x 2.8 sq. arc seconds (14 x 14 spatial pixels)
Spatial Sampling	0.2 arc seconds
Patrol field	7.2 arcmin diameter
Close packing of IFUs	3 within 1 sq arcmin
Closest approach of IFUs	2 pairs of IFUs separated by 6 arcsec

Spectral coverage



Observed wavelength λ


Optical Spectrographs' window
Lyα
z =1.5
[OII]
[OIII]
Hβ
Hα
MgI
MgII
H,K
Hδ
Gb
CaT
0.2µm
1µm
2µm


Near-IR spectrographs
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KMOS Near-IR multi-object IFU for VLT

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Credit: A. Glauser

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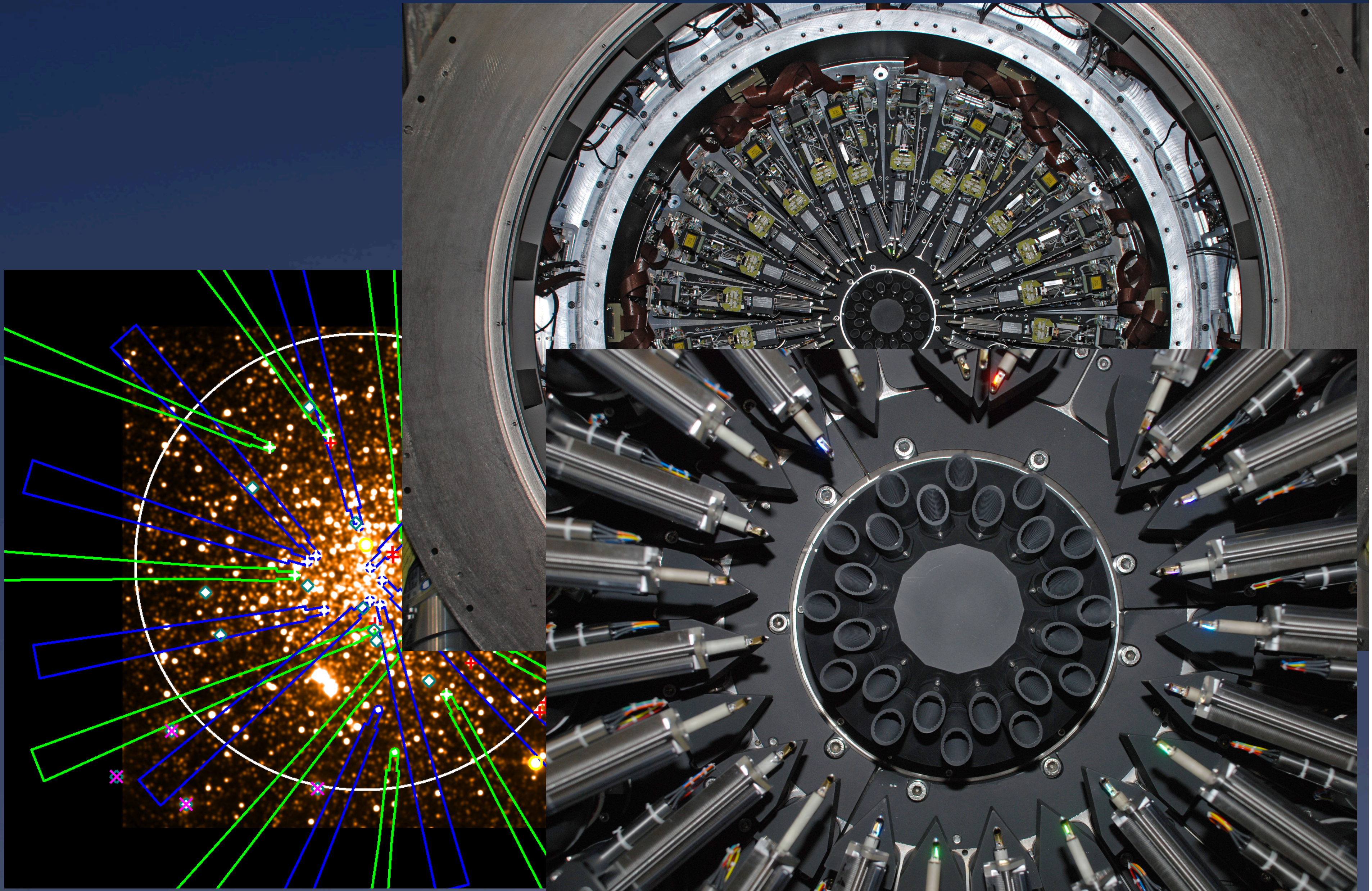
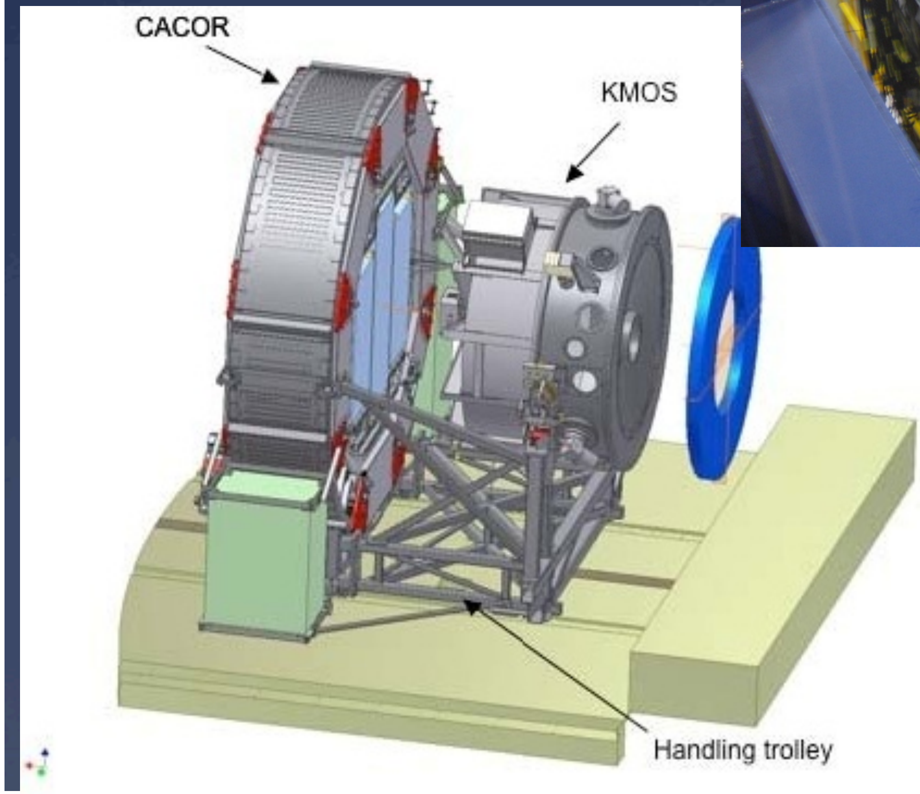
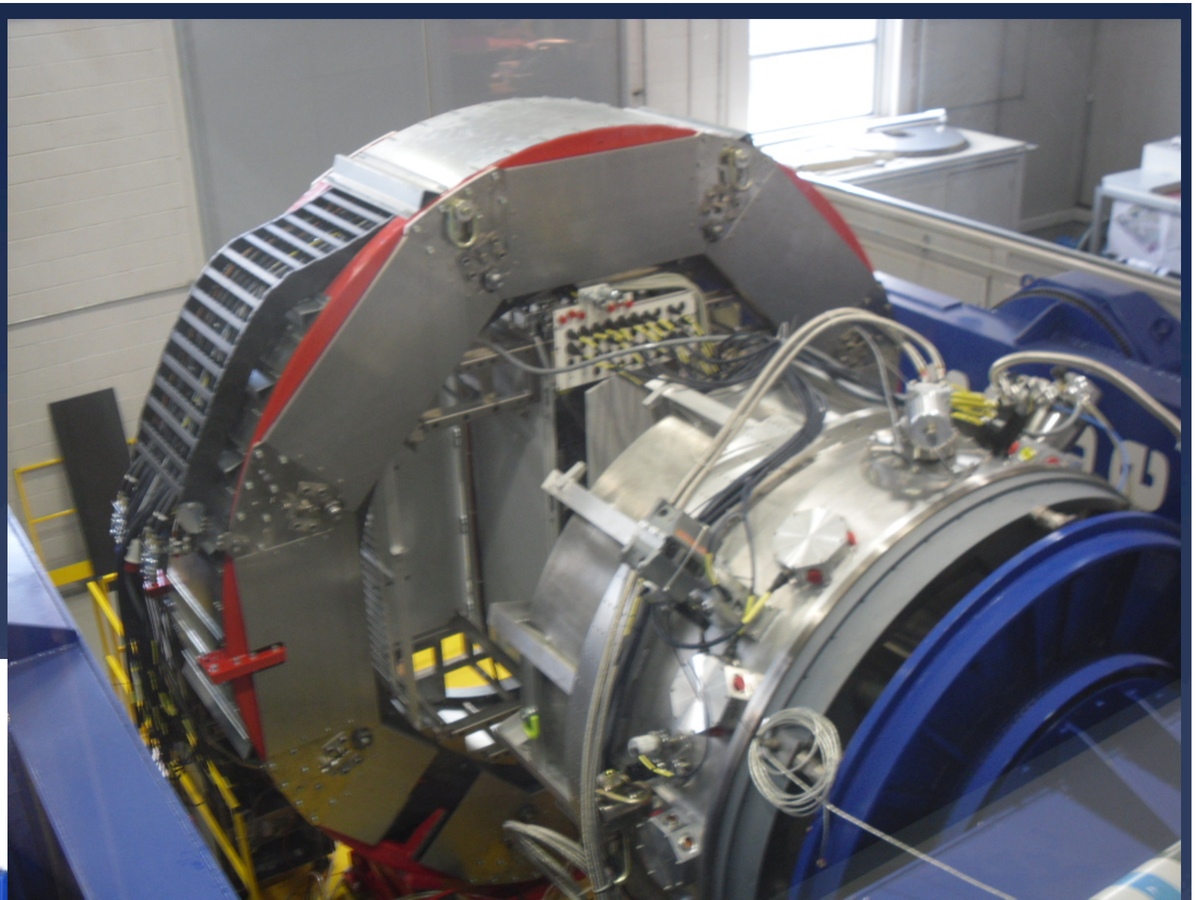
24 pick off arms







June 2011 at UKATC

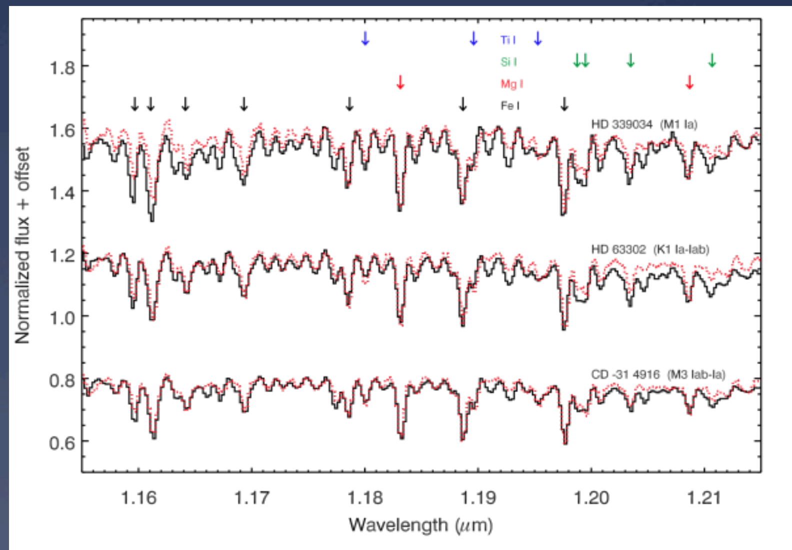
Science with KMOS

Galactic Archaeology and nearby galaxies

Spectroscopic chemical abundances
and kinematics

Calcium triplet at 8500Å

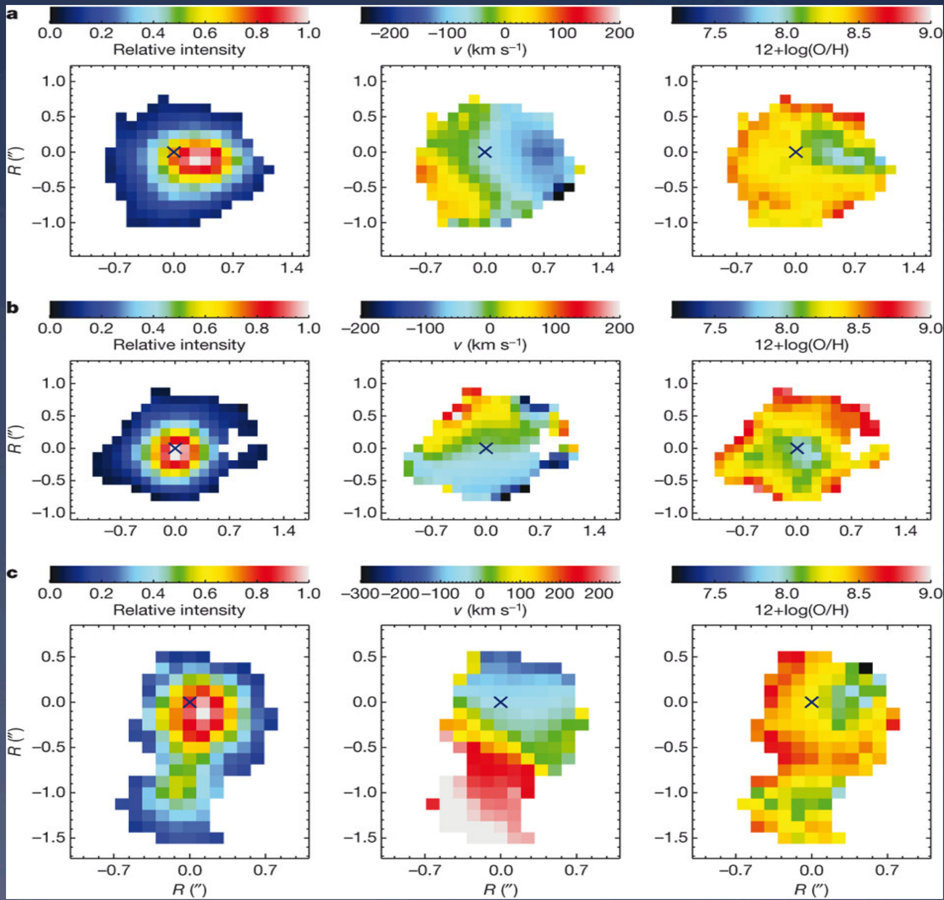
Molecules such as: CO, SiO, OH, ZrO, VO, C2, CH, CN, C3



Physical properties of galaxies

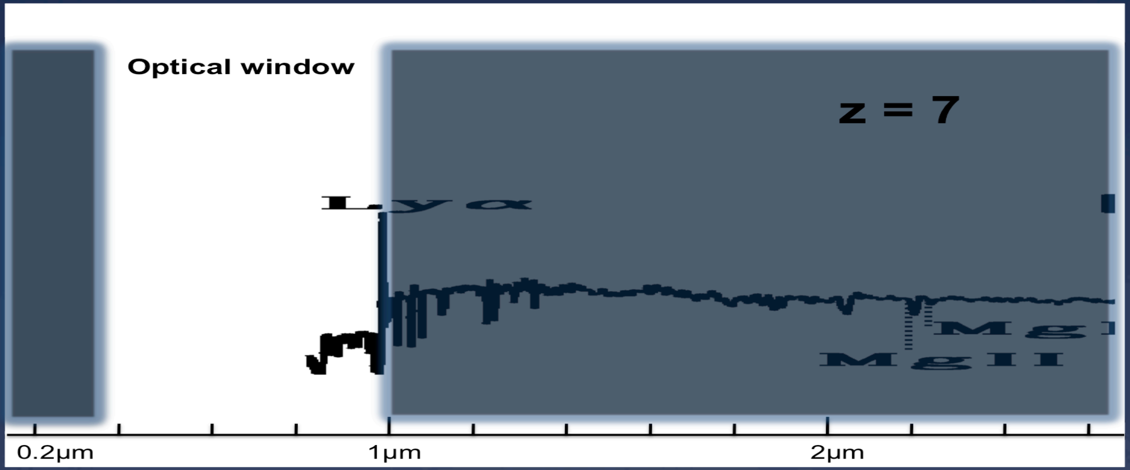
Spatially resolved spectroscopy on kpc scales:

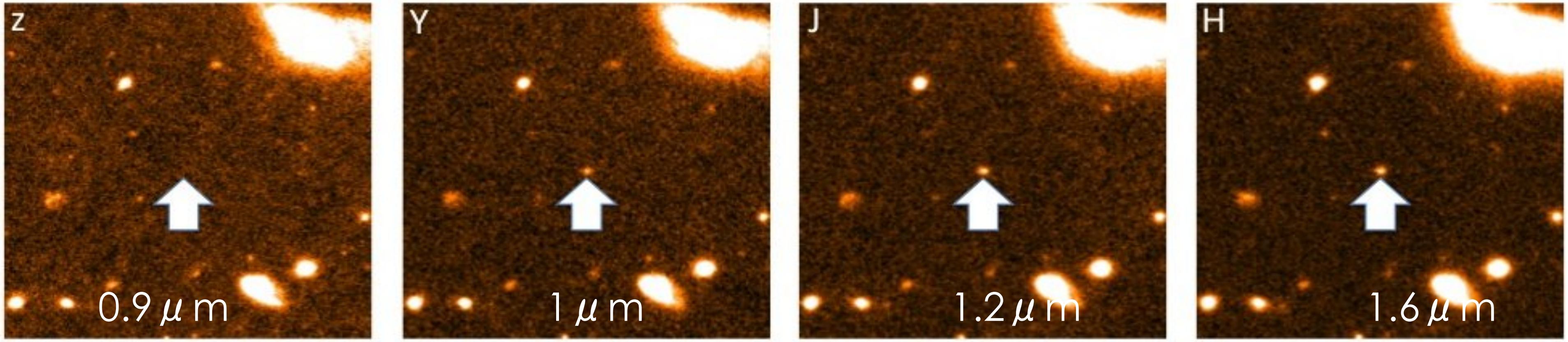
- Star formation history
- Dynamics
- Extinction
- Metallicity
- Mergers



Cresci et al. 2010 Nature

The first galaxies and the epoch of reionization

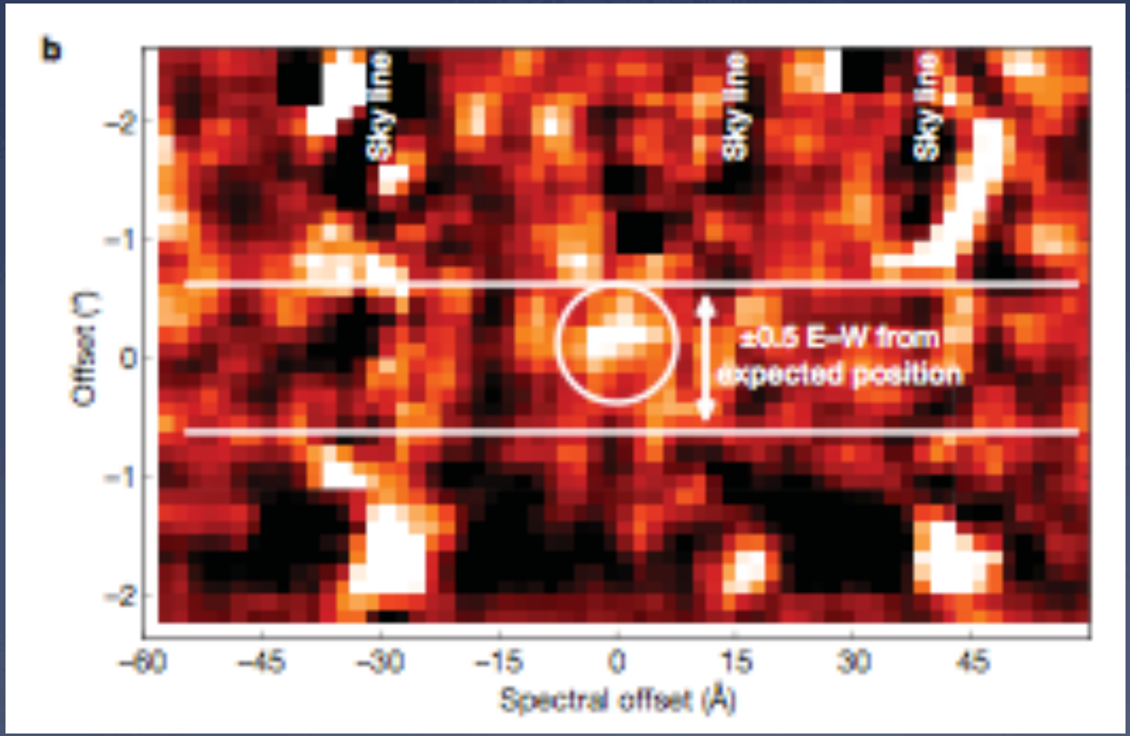




The first galaxies and the epoch of reionization

15 hours on source integration with SINFONI

The most distant galaxy confirmed spectroscopically at z=8.55



Lehnert et al. 2010, Nature

One more step towards the giants…

MOONS

Multi-Object Optical and Near-ir Spectrograph
for the VLT

MOONS

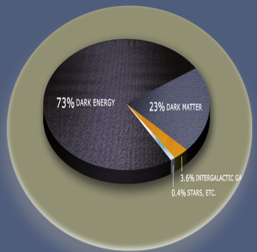
Selected by ESO for a Phase A study as a wide field MOS

- PI: M. Cirasuolo
- Consortium: UK, France, Germany, Italy, Netherlands, Portugal, Chile, Switzerland, Sweden

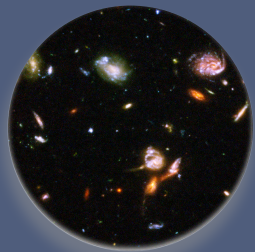
Telescope	VLT 8.2m
Field of view	500 square arcmin
Number of fibers	500 obj + 500 sky
Wavelength simult.	0.5μm -1.8μm
Resolutions	Medium = 3000-5000 High = 10,000 and 20,000
Throughput	> 20%

MOONS

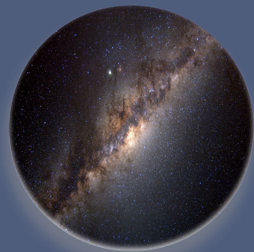
Offers unique features and versatility for a variety of studies



Cosmology



Galaxy Evolution



Galactic Archaeology

Galactic Archaeology

Gaia - ESA cornerstone mission:

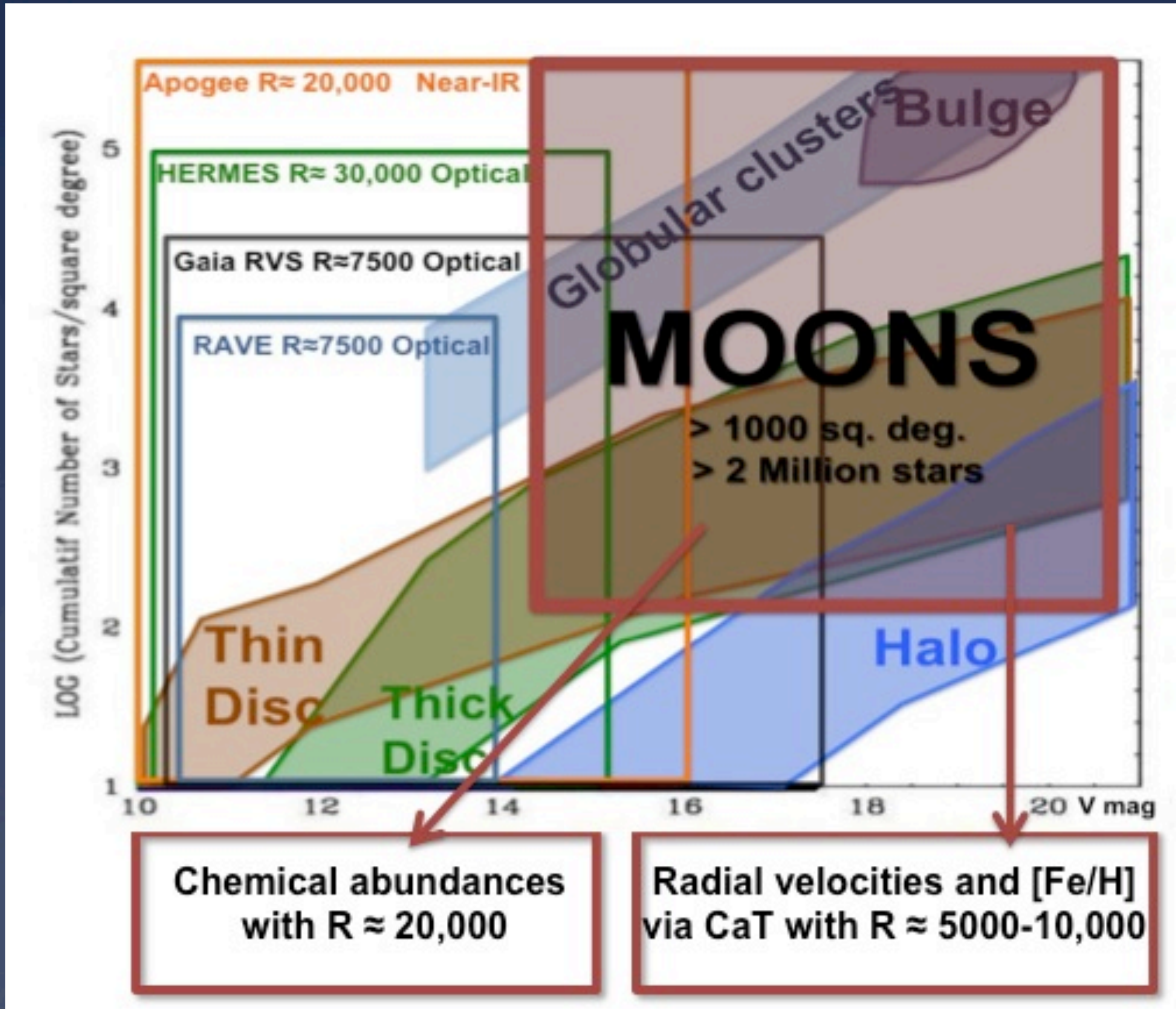
5-year mission (2013- 2018) to map 3D position and velocity of > 1 billion stars

Imaging to measure proper motion on sky over 5yrs

However, on board spectroscopy for radial velocity and chemical abundances limited to bright objects.

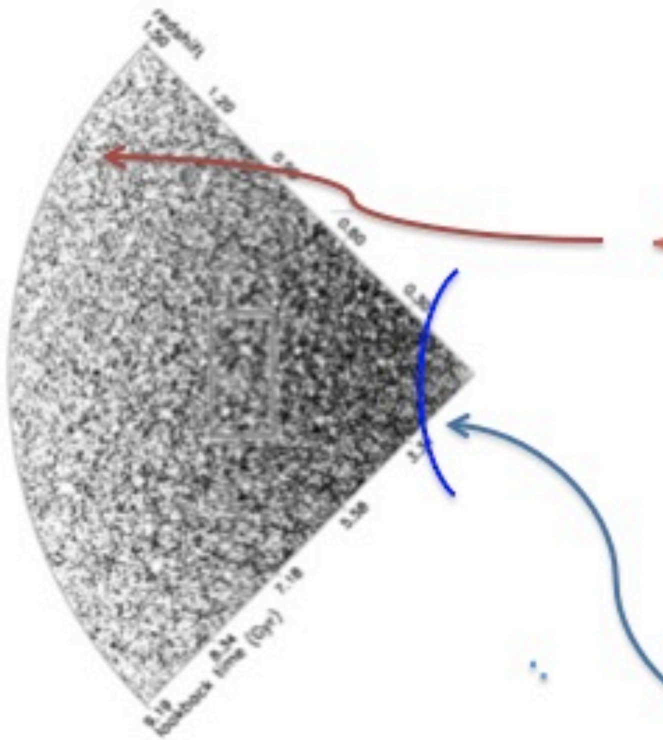
Ground-based spectroscopic follow-up is essential, especially for the Bulge and Disc

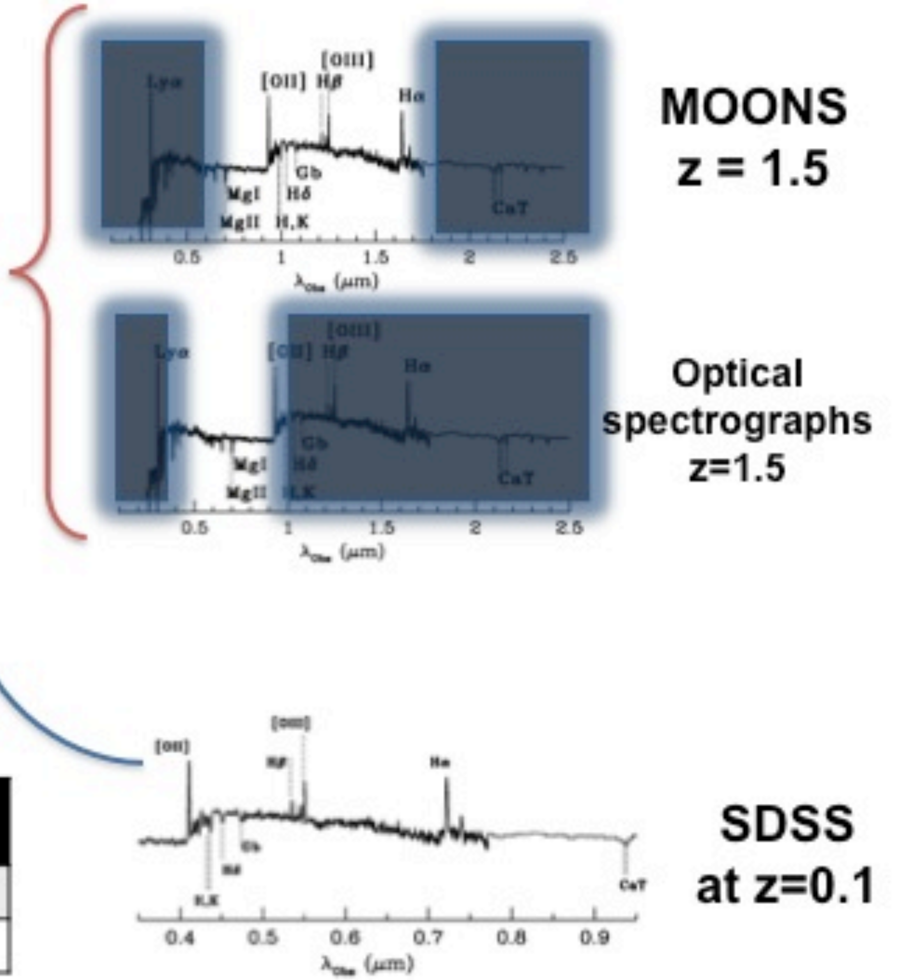
Galactic Archaeology



Adapted from **Recio-Blanco, Hill, Bienaymé 2009**

An SDSS-like survey at z ≈ 1-1.5





Survey	Redshift	Volume (h^{-3} Mpc^3)	# Objects
SDSS	0<z<0.2	1×10^8	10^6
MOONS	0.8<z<1.8	5×10^7	2.5×10^5

Legacy value

Unique, large samples of galaxies at z>1 to achieve robust measurements of inter-dependence of key physical parameters.

- Accurately determine the critical relation between stellar mass, star-formation and metalllicity and the role of feedback.

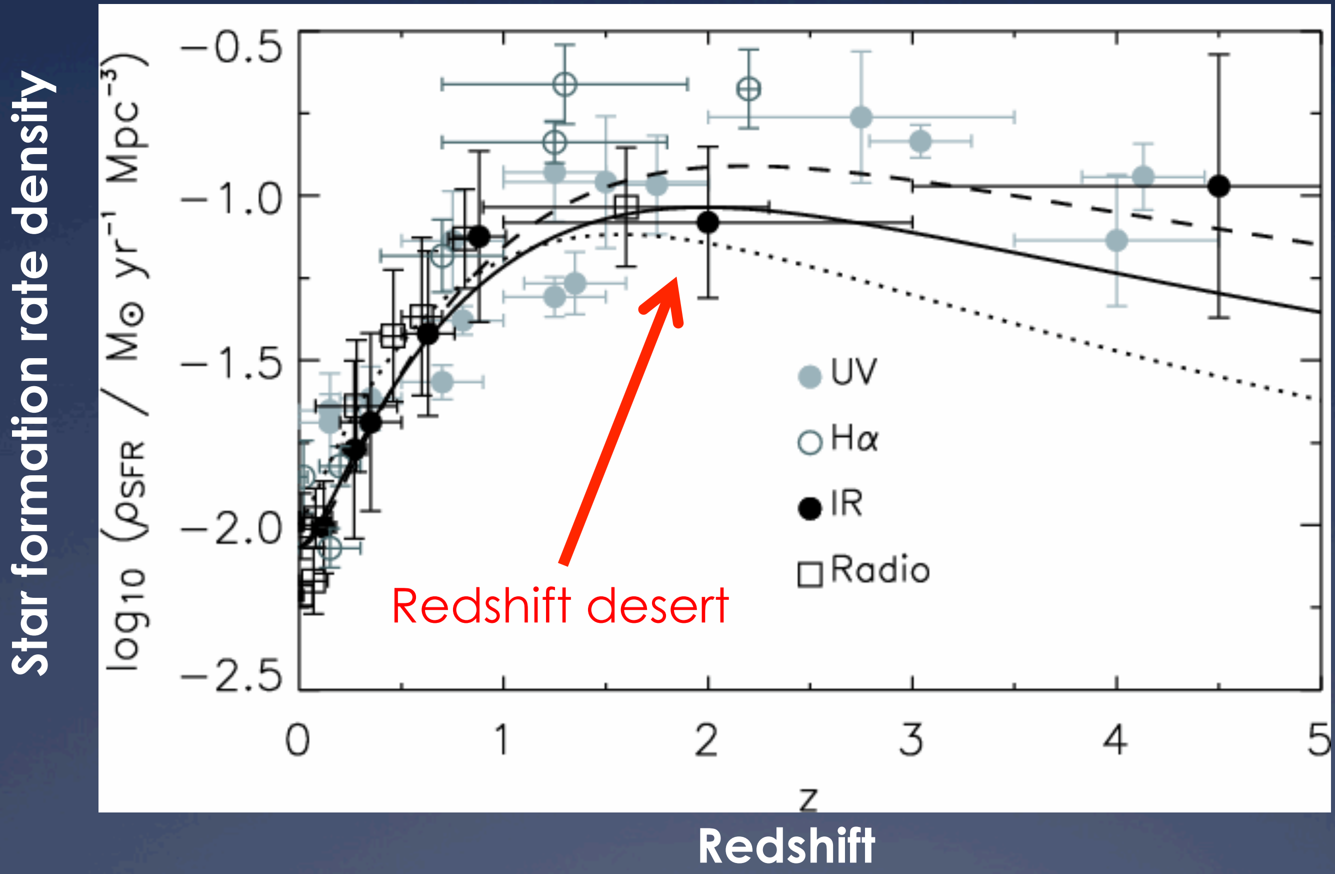
- Study the crucial effect of the environment

- Unveil the link between mass accretion and central black hole growth

- Determine the Dark Matter halo mass function via galaxy groups as a fundamental test of the Cold Dark Matter paradigm.

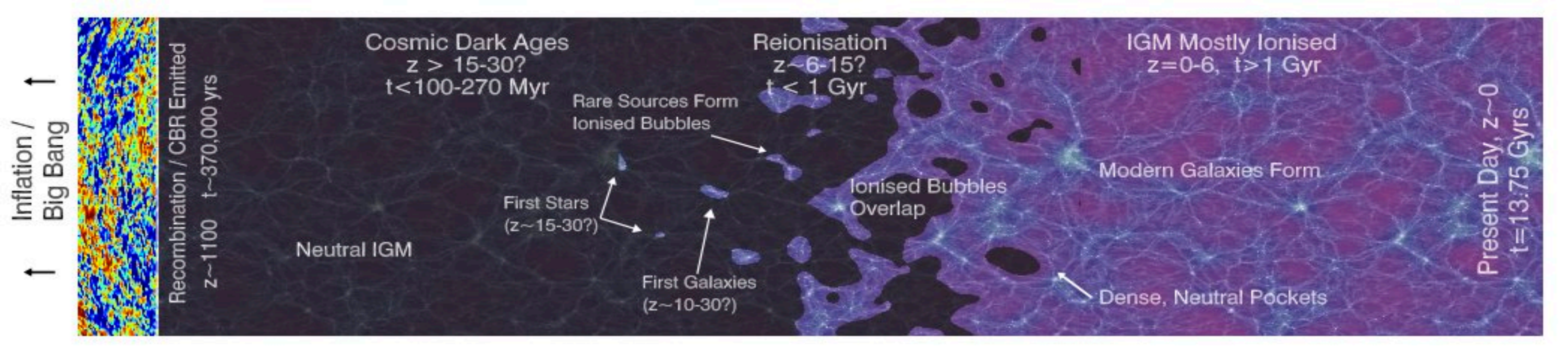
- Allow precise clustering measurements and unprecedented estimation of mass and luminosity function at z>1.

The peak epoch of star-formation and mass assembly



Follow-up of major imaging surveys/facilities: VISTA, UKIDSS, Herschel, LOFAR, ALMA, eRosita etc

The first galaxies and the epoch of reionization



✓ Spectroscopic confirmation of the most distant galaxies.

✓ Establish the Lyman-α escape fraction and unveil the physics of re-ionization.

✓ Measure star-formation and mass assembly of primeval galaxies.

✓ Clustering of high-z galaxies and constrain how re-ionization processes.

Conclusions

Commissioning **early next year**

Unique near-IR IFU multiplex

Large GTO and OT surveys to determine physical and dynamical properties of high-z galaxies

24 IFUs

Aiming to be **on sky in 2017-18**

Large multiplex, field of view and wavelength coverage

Galactic Archaeology and Gaia follow-up

Trace assembly history of galaxies into the epoch of re-ionization

Cosmology via redshift-space distortions

1000 fibers