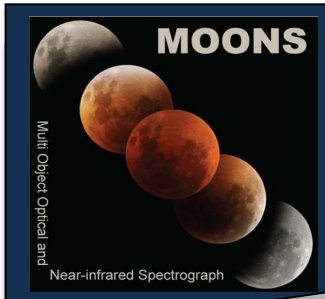


MOONS

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

Hector Flores
on behalf of the MOONS consortium

AIUC CENTRO DE ASTRO-INGENIERIA UC

CAAUL FACULDADE DE CIÊNCIAS UNIVERSIDADE DE LISBOA

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

INAF ISTITUTO NAZIONALE DI ASTROFISICA

UNIVERSITÉ DE GENÈVE FACULTÉ DES SCIENCES Département d'astronomie

l'Observatoire de Paris GEPI Galaxies Étoiles Physique et Instrumentation

ESO

UNIVERSITY OF CAMBRIDGE

Science & Technology Facilities Council
UK Astronomy Technology Centre

MOONS Nutshell

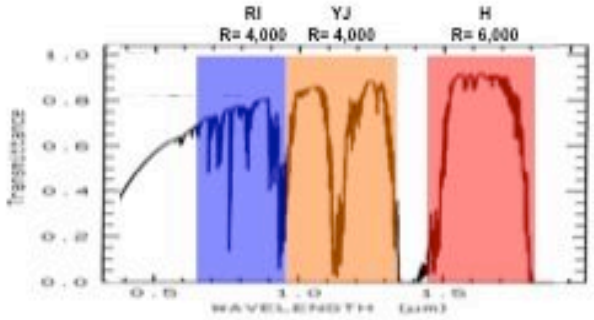
Field of view: 500 sq. arcmin at the 8.2m VLT

Multiplex: 1000 fibers, with the possibility to deploy them in pairs

Fibers: Aperture on sky = 1.1arcsec; Close pair = 10arcsec; Max 7 fibers within 2 arcmin

Medium resolution:

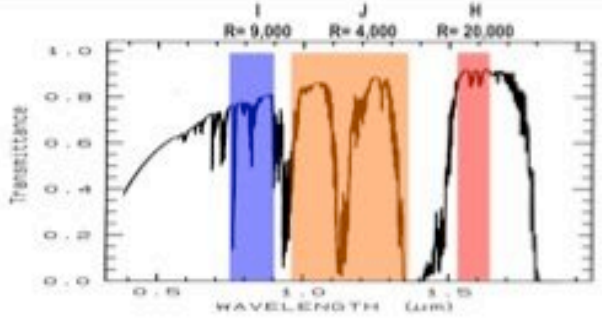
Simultaneously 0.64μm-1.8μm
at
R=4,000 – 6,000

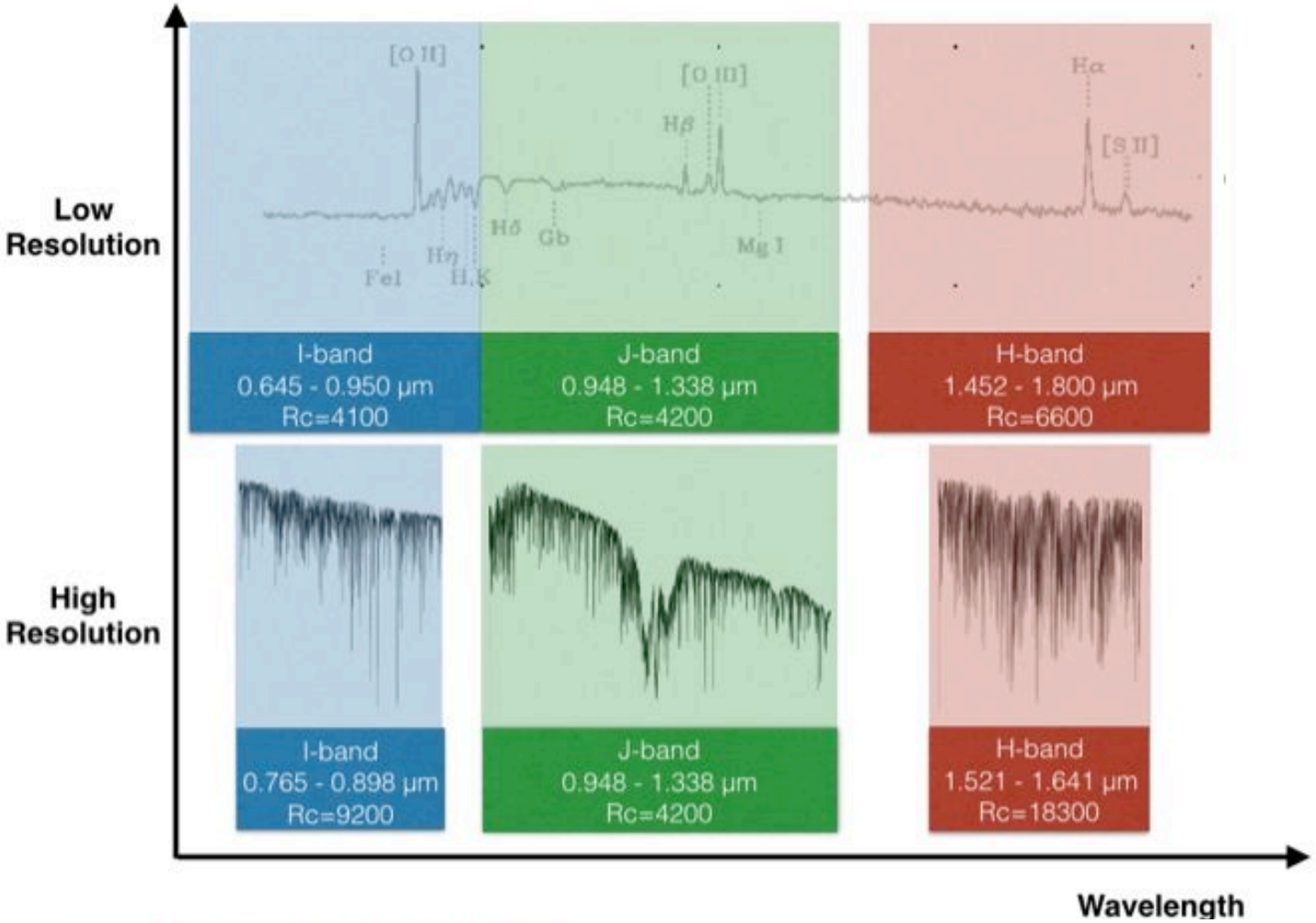


High resolution:

Simultaneously 3 bands:

- 0.76-0.90μm at R = 9,000
- 0.95-1.35μm at R=4,000
- 1.52-1.63μm at R=20,000





Simultaneous coverage in either low or high Res

		RI band	YJ band	H band
Low Res	**Wavelength coverage**	0.647 – 0.955 μm	0.934 – 1.350 μm	1.452 – 1.800 μm
	Central resolution	4100	4300	6600
High Res	**Wavelength coverage**	0.765 – 0.898 μm	0.934 – 1.350 μm	1.521 – 1.641 μm
	Central resolution	9300	4300	18300

MOONS France

Groupe instrumental MOONS-France

Nom	(Fonction)
H. FLORES	(Co-PI)
I. GUINOUARD	(Projet Manager/WP manager Fibres)
F. ROYER	(WP manager DRS)
J.P. AMANS(	WP Manager Shutter)
Y. YANG	(WP DRS)
M. RODRIGUES	(WP DRS)
F. CHEMLA	(WP Fibres)
J. M. HUET	(WP Fibres/WP Shutter)
D. HORVILLE	(WP Fibres)

Science team

Nom	(Laboratoire)
H. FLORES	(GEPI)

Groupe stellaire

E. CAFFAU (GEPI, responsable)

P. BONIFACIO (GEPI)
P. Di MATTEO (GEPI)
N. MARTIN (Obs. Strasbourg)
A. RECIO-BLANCO (OCA)
F. ROYER (GEPI)

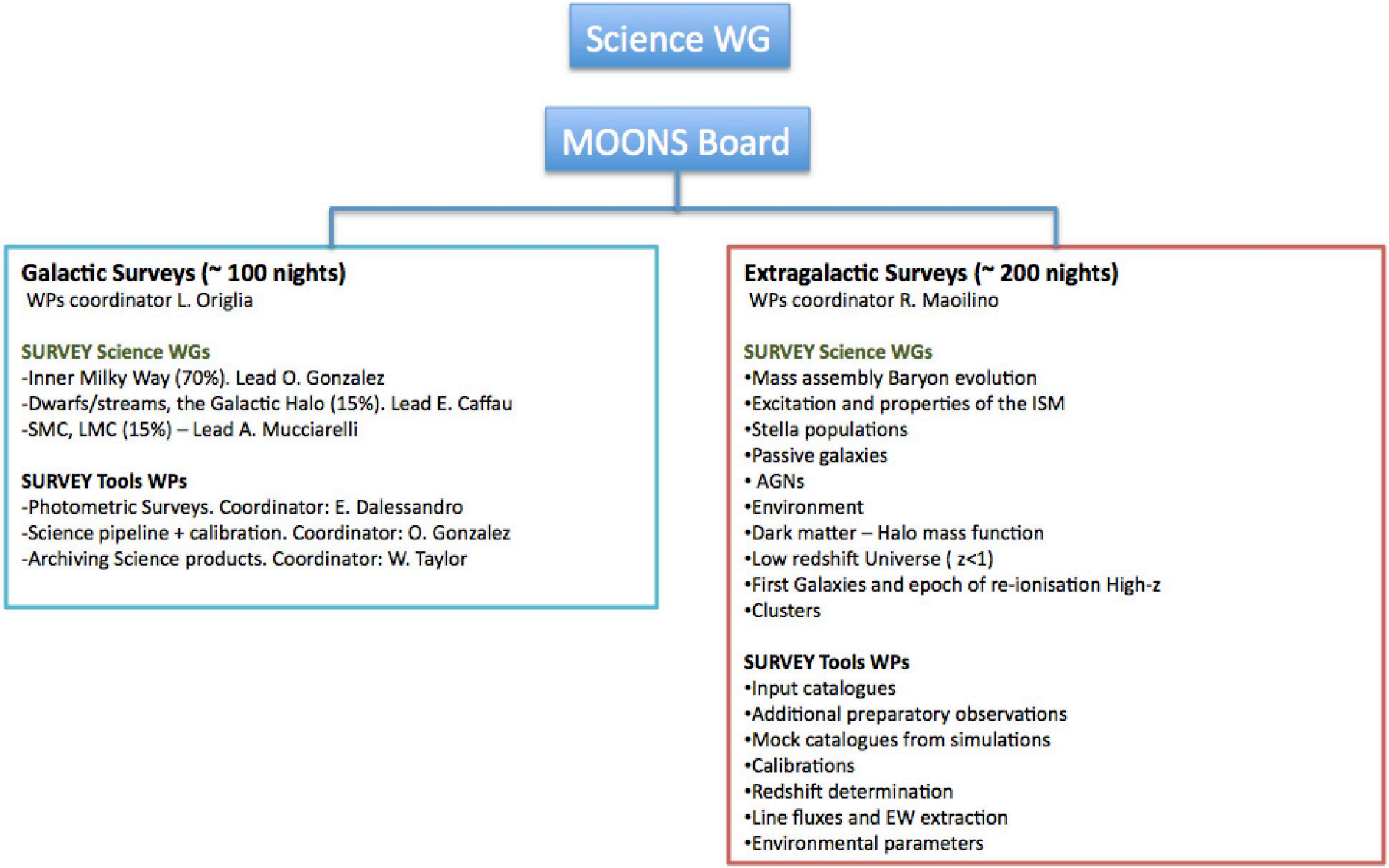
Groupe extragalactique

M. PUECH (GEPI, responsable)

V. BUAT (LAM)
T. CONTINI (IRAP)
E. DADDI (CEA)
H. DOLE (IAS)
F. HAMMER (GEPI)
S. MAUROGADATO (OCA)
R. PELLO (IRAP)
M. RODRIGUES (GEPI)
S. VERGANI (GEPI)

France 15% of the instrument 17% of the science team

Science: Last meeting Sept 2017 Next March-April 2018



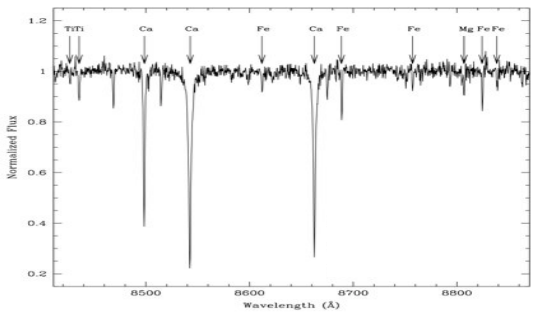
Galactic science cases

On behalf of the Galactic Science Working Group

100n

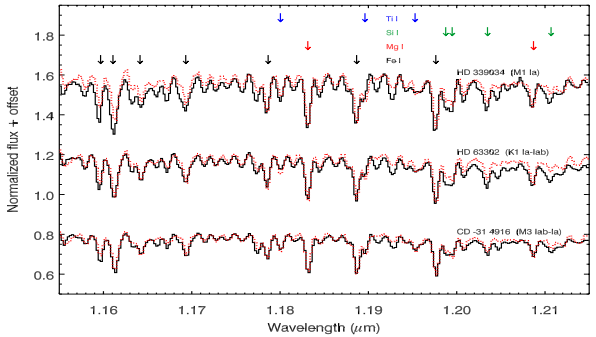
MOONS for Galactic studies

I-band
R=9,000



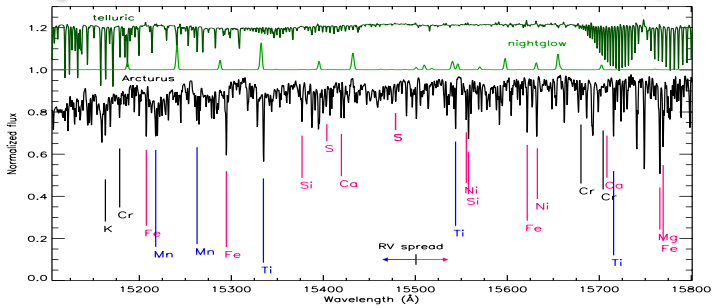
FLAMES
(multiplex = 130)

YJ-band
R=4,500



KMOS
(multiplex = 24)

H-band
R=20,000



APOGEE
(multiplex = 300)

Kinematics – Radial velocities
(<1 km/s)

CaT @R=9,000 for I<21 + [M/H] (via Fe,Si,Ti,Mg) @R=4000-6000 (J+H)

Detailed chemical abundances
(< 0.1dex)

(Si, Ca, Ti, Mg, Fe, Cr, Mn, CNO …) @R=20,000 for H_{Vega}<15.5
+
CaT @R=9,000

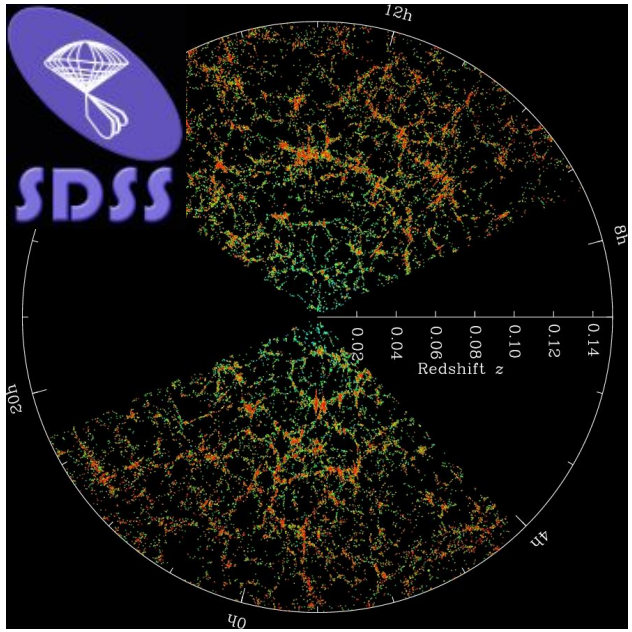
Extragalactic science case

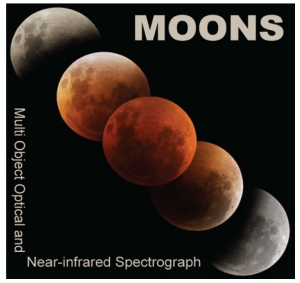
On behalf of the Extragalactic Science Working Group

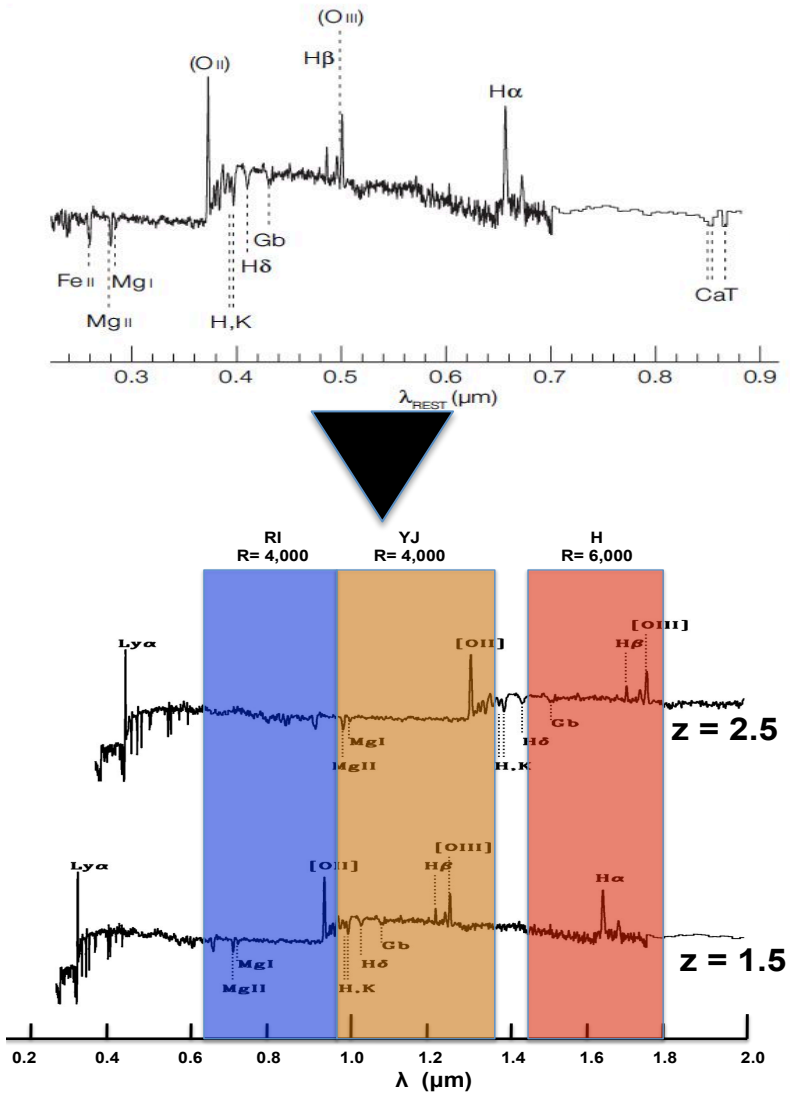
200n

Sloan Digital Sky Survey (SDSS)

In the local Universe the SDSS has been extremely successful due to both size and spectral quality.

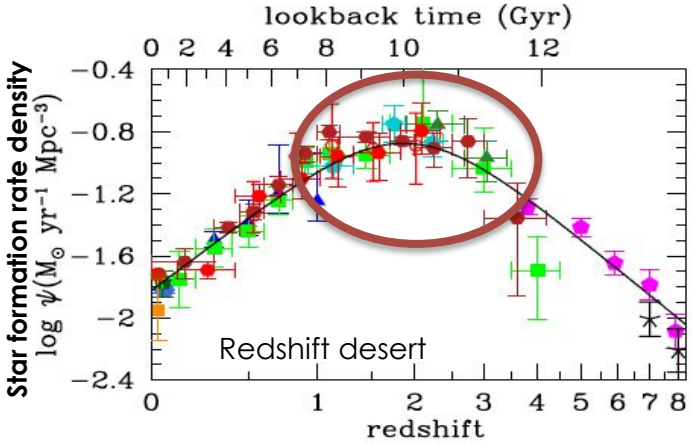






Extra Galactic Science Case

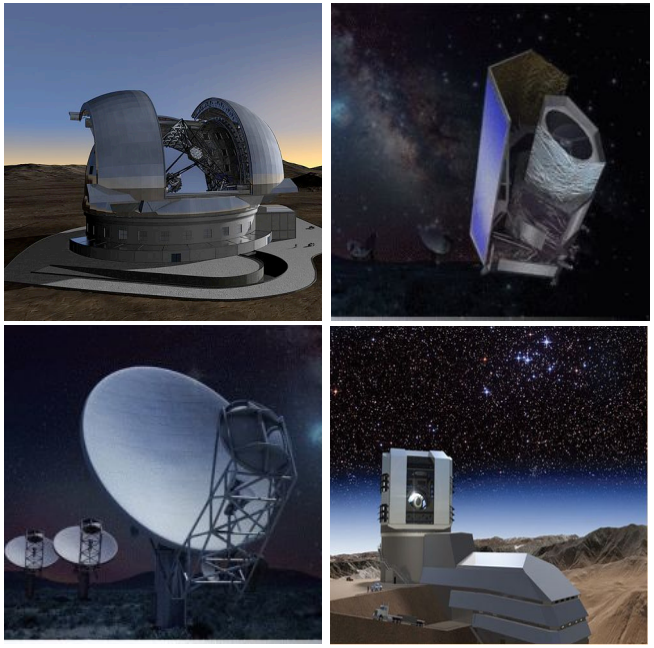
SDSS-like survey
galaxies at z>1 across the peak of star-formation and black hole accretion, up to the very first galaxies at z>7-8



Diagnostics for passive and star-forming galaxies

- ***Metallicity (R_{23},N_2, stellar indices)***
- ***SFR (Hα, Hβ, [OII])***
- ***Stellar populations***
- ***Galaxy transformation (quenching) mechanisms***
- ***AGN power (BPT)***
- ***Dust extinction (Hα/Hβ)***
- ***Galaxy mass (σ_v)***
- ***BH mass (BLR)***
- ***Dependence on environment (large scale structures)***

✓Follow-up of large-area imaging surveys: VISTA, Herschel, DES, UKIDSS, eRosita, etc.



MOONS Extragalactic Surveys

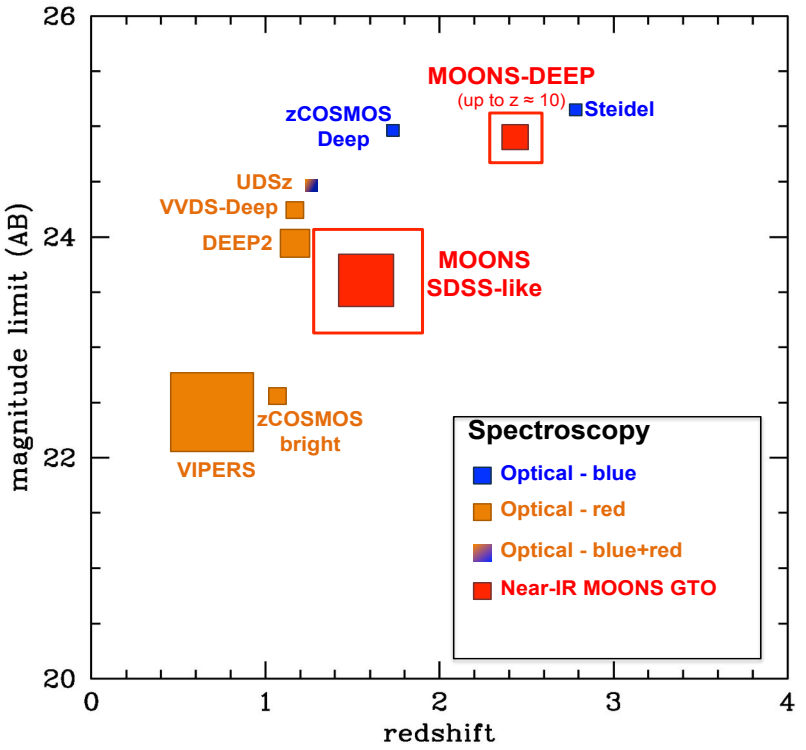
SDSS-like + Deep Surveys

Physical, Chemical and Environmental properties for
Goal ~1M galaxies at 0.8 < z < 10

Optimised observation strategy (Under discussion):

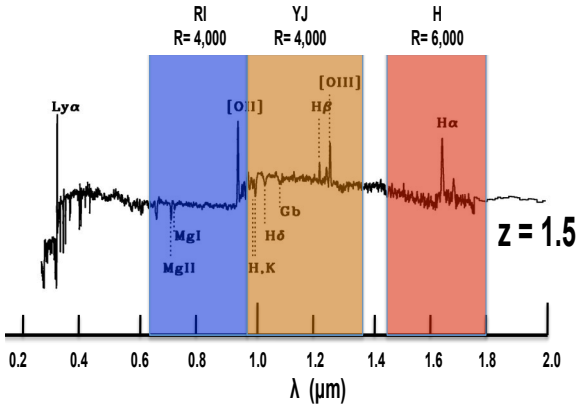
H_{AB} < 23.5 1-8hr over 30sq. deg.

23 < H_{AB} < 25 8-40hr over 5-6sq. deg.



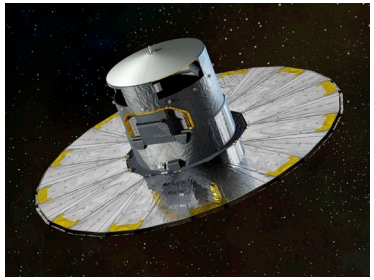
M ~ 10^9 $M_\odot$ and SFR < 1 $M_\odot$/yr at z~1-2
with multiple lines diagnostics to measure:
SFR, Metallicity, Ionisation state, AGN, Dust, Environment, etc …

Considerably deeper if only interested in determining the redshift

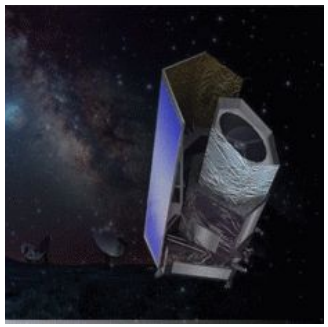


Synergies

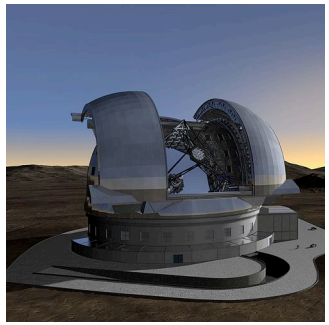
Gaia (ESA): Follow-up



Euclid (ESA): Redshift machine

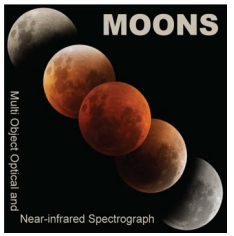


E-ELT (ESO) :**Tech**: DRS & fiber link -- **Sci**: target for the E-ELT



MOONS: VISTA near-IR imaging surveys (**Ultra-VISTA, VIDEO, VIKING, VVV, VMC)** & radio (MeerKat LOFAR)

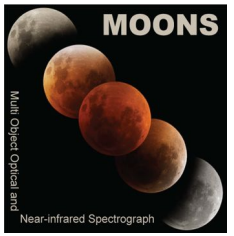
MOONS timeline



- ☑ *October 2015: Preliminary Design Review*
- ☑ *June 2016: started procurement of Teledyne H4RG near-IR detectors*
- ☑ *October 2016: Long lead items (Optics) Final Design Review*
- ☑ *March 2017: Final Design Review → ΔFDR End October*
- ☑ October 2017: MOONS under construction
- End *2019: Preliminary Acceptance Europe*
- Early *2020: Start of science operations*

Summary

MOONS is the long-awaited near-IR MOS for the VLT



Construction phase started in June 2014

Operational by 2020-21

Field of view	500 sq. arcmin
Multiplex	1024 fibres
Low resolution mode	R = 4,000-6000 λ = 0.64µm – 1.8µm simultaneously
High resolution mode	R=9,000 for CaT + R=4,000 in YJ-band + R=20,000 in H band
Throughput	> 30 %

Main science cases:

Galactic Archaeology:

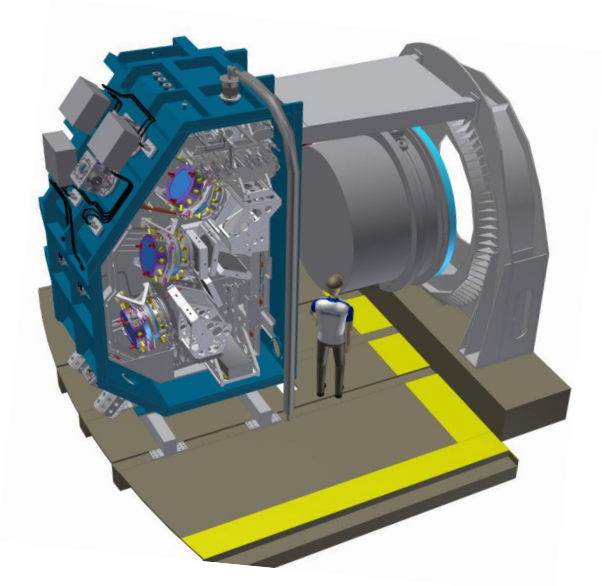
✓ Radial velocities and detailed chemical abundances for **several million stars** in our own Galaxy.

Galaxy evolution:

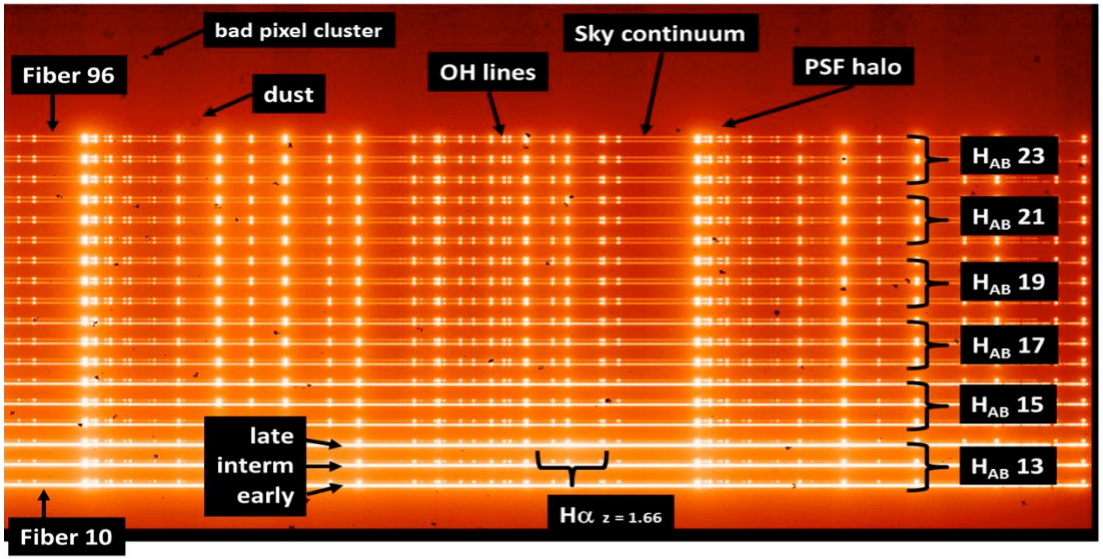
✓ Formidable **SDSS-type survey for >1M galaxies at z>1**. Unique insight into the effect of environment, chemical and physical evolution.

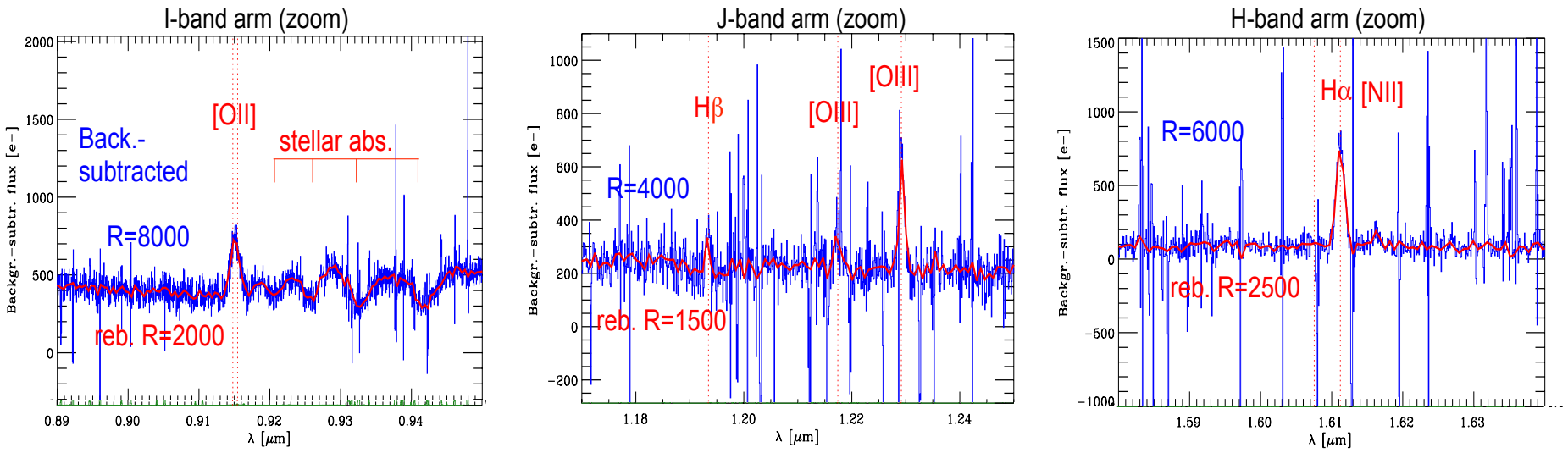
Synergies:

✓ Essential follow-up of large-area imaging surveys: Gaia, VISTA, Herschel, DES, UKIDSS, LOFAR, eRosita, Euclid, LSST, SKA



WP DRS





z=1.45, H_{AB}=22.7, 1hr