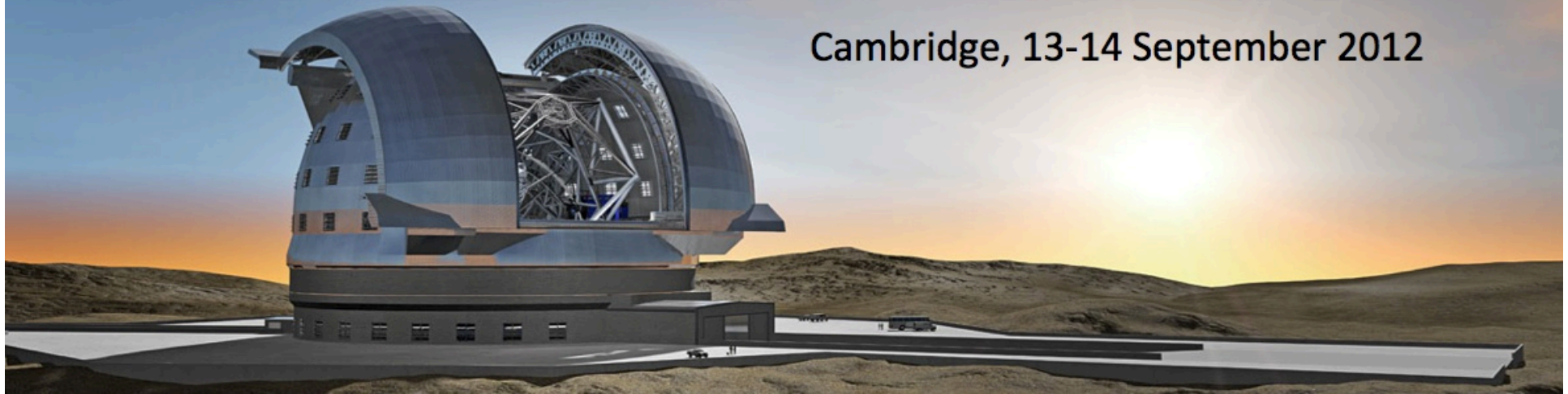


Towards the science case for E-ELT HIRES

Cambridge, 13-14 September 2012



Meeting hosted in Cambridge in September
to discuss the HIRES science cases + preliminary concept

Nearly 100 people attending

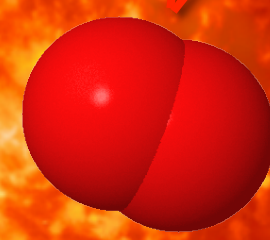
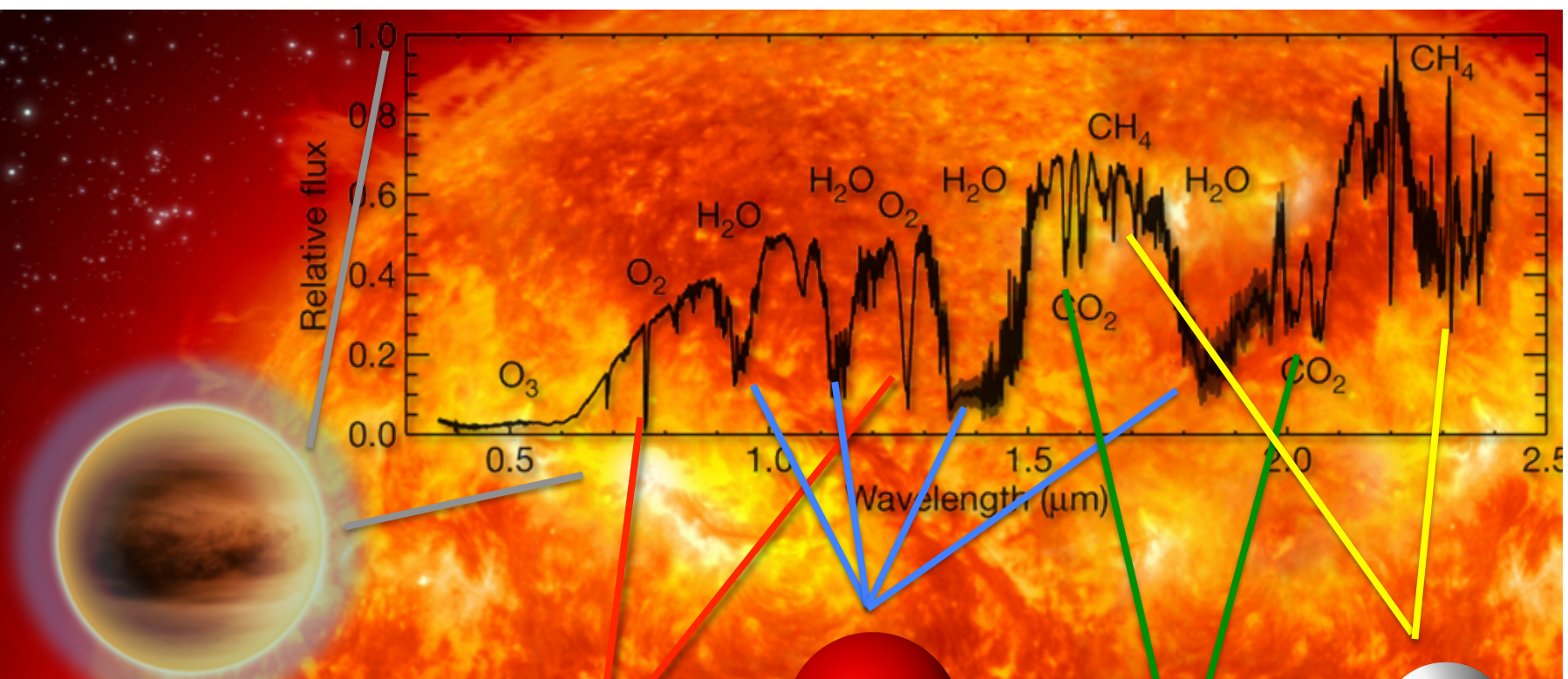
Resulting into a White Paper being written
(also with contributions of people who could not attend)

... on hold to include input from this workshop

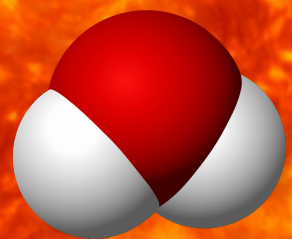
This presentation:

- 1) Quick summary of the main science cases and associated requirements
- 2) Preliminary concept to achieve them

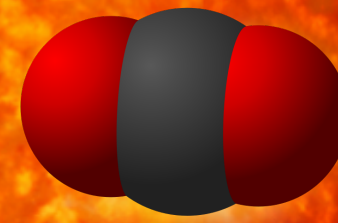
R. Maiolino



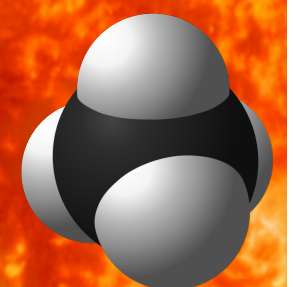
molecular oxygen



water



carbon dioxide

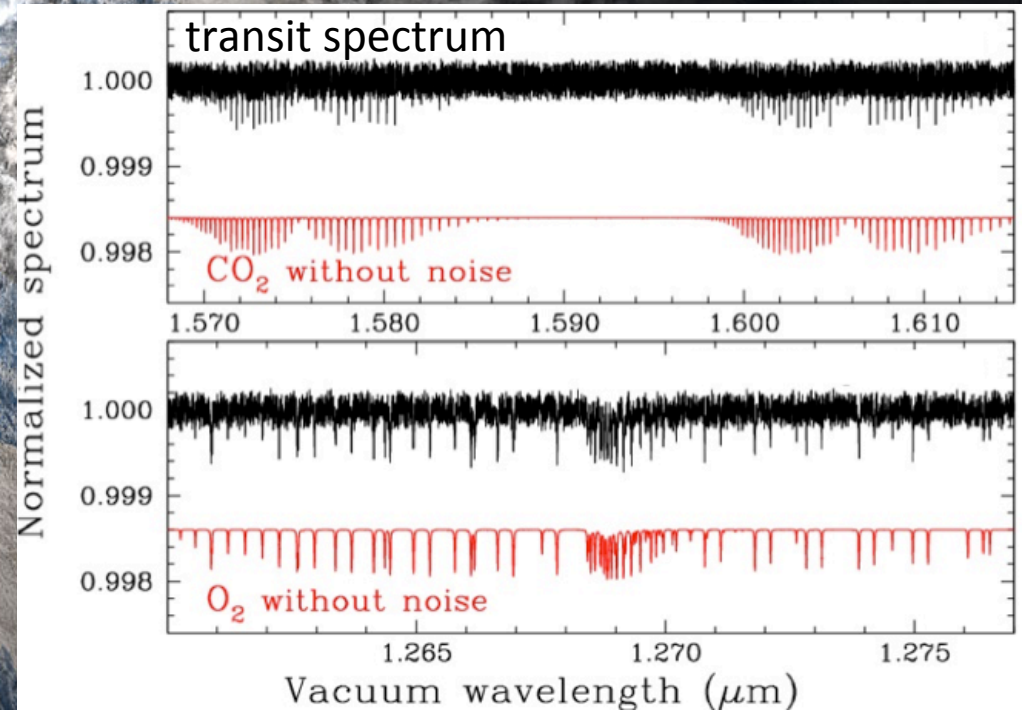


methane

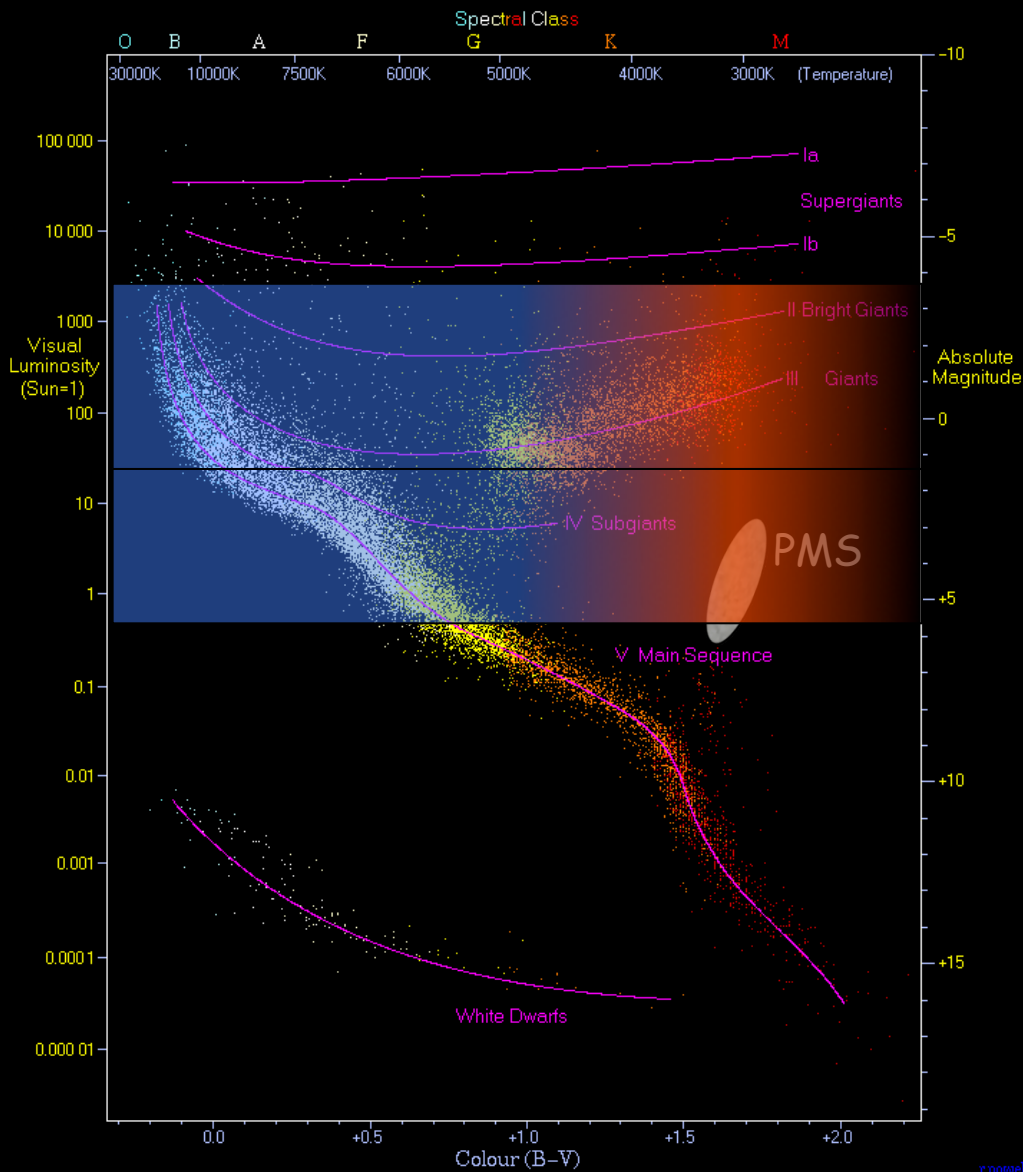
Exo-Earths Atmospheres Detecting signatures of life

Main requirements:

- Stability (flat field & wavelength during transit)
- $R > 100,000$ to disentangle the absorption of our own atmosphere + exoplanet weather + atmosphere structure



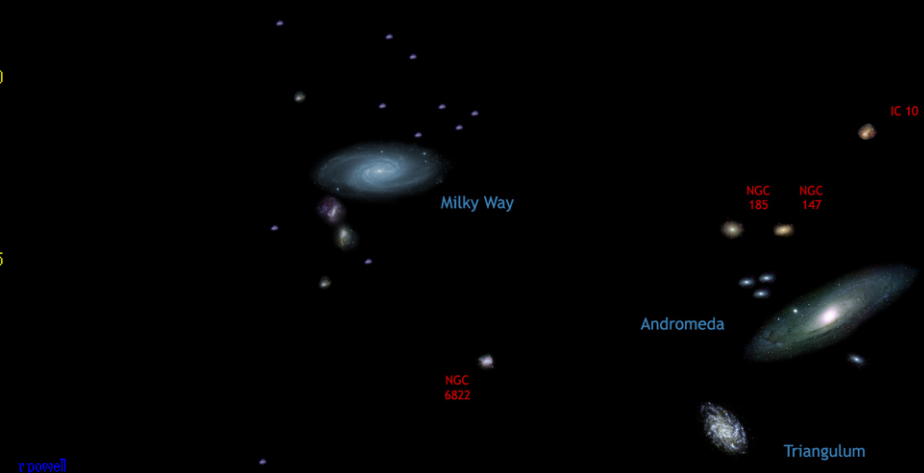
Stellar Evolution and Astro-Archeology



R>50,000-100,000
and full spectral coverage
from 0.38 to 2.4 μm
(all elements and isotopes)

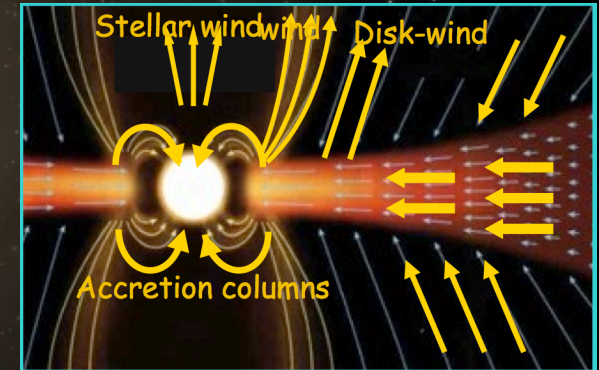
8-10m class telescopes
massive stars, luminous giants/SGs
in the Galaxy

E-ELT
low luminosity stars in the Galaxy
luminous stars in the LG and beyond



Intermediate R~20,000 with some multiplex (~10) for chemistry
from integrated light of star clusters in local galaxies

Protoplanetary disks, jets & winds



Inner disk and wind,
exploring planet formation

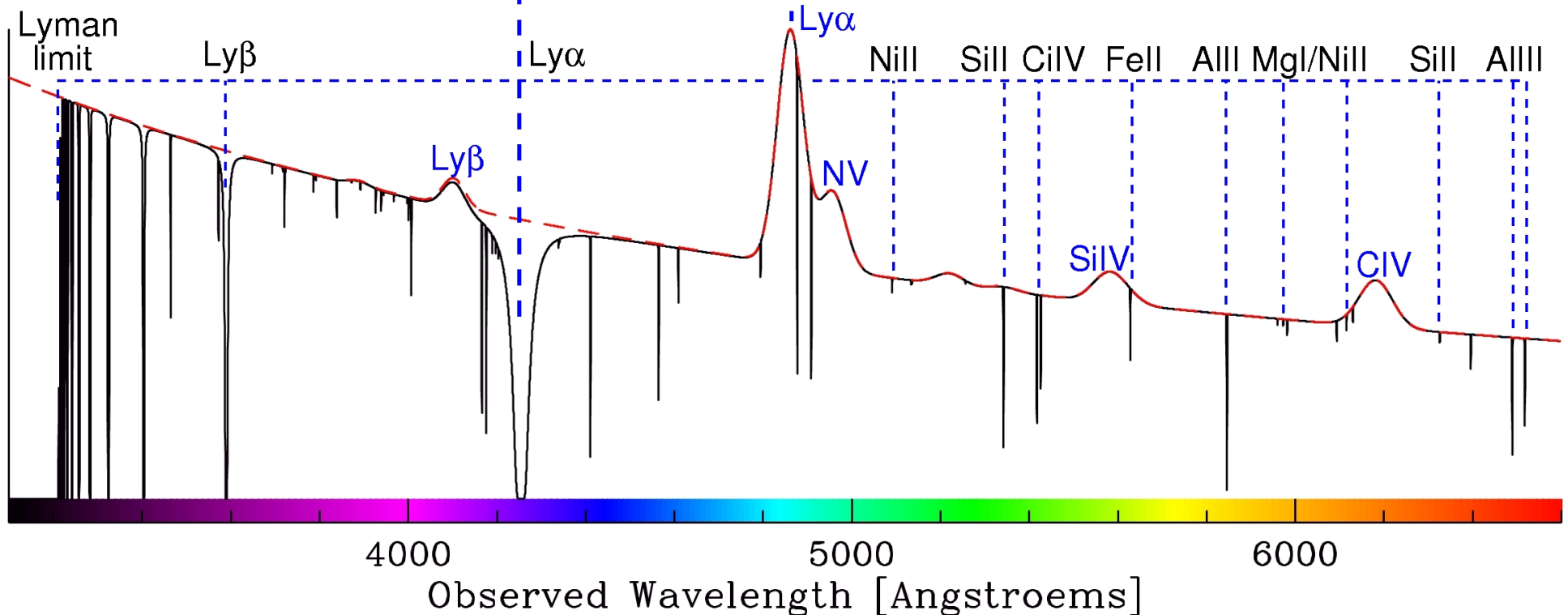
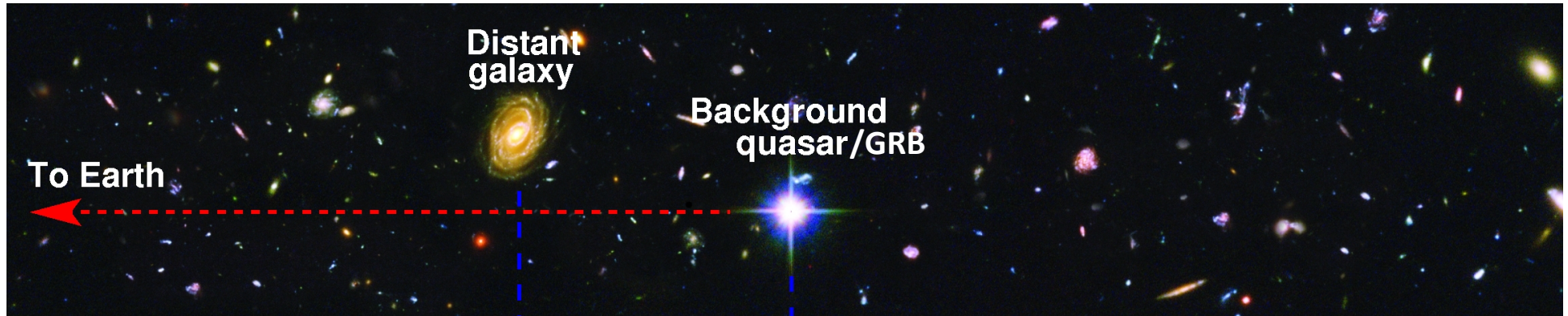


High Spectral resolution
with spatial information
(long slit/IFU)
at the diffraction limit

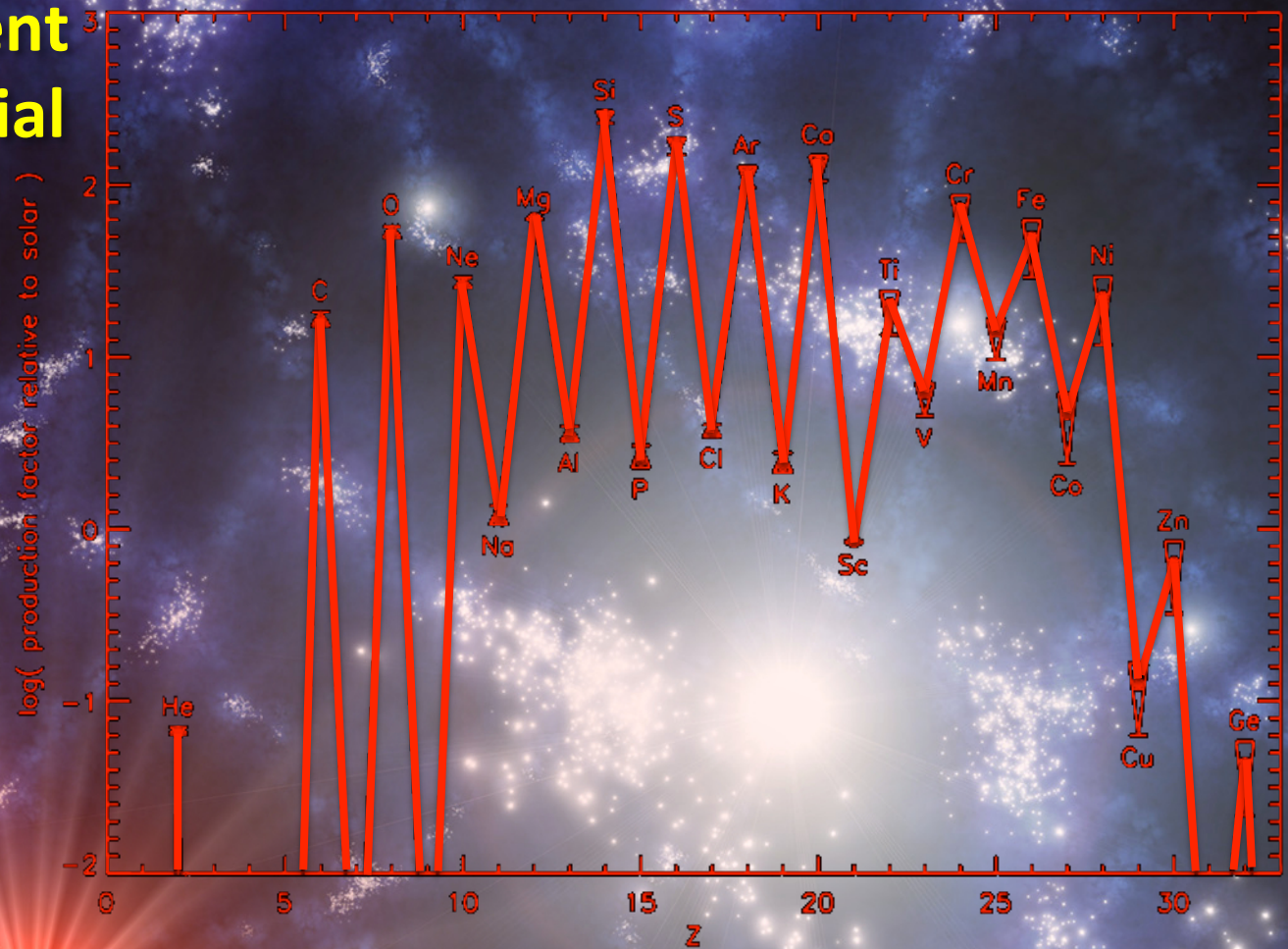
The Inter-Galactic Medium:

tracing the chemical enrichment of the universe

High spectral resolution ($R > 50-100 \times 10^3$) and broad spectral coverage (opt+NIR)

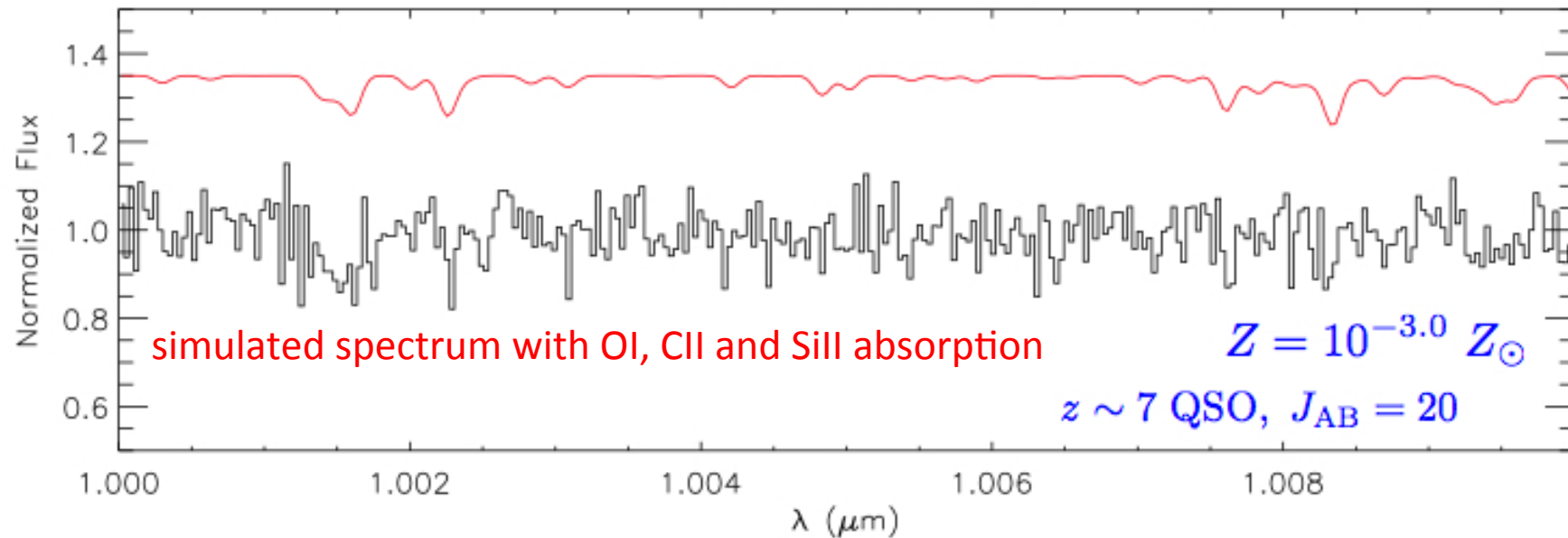


Chemical enrichment imprint of primordial supernovae: PopIII signature

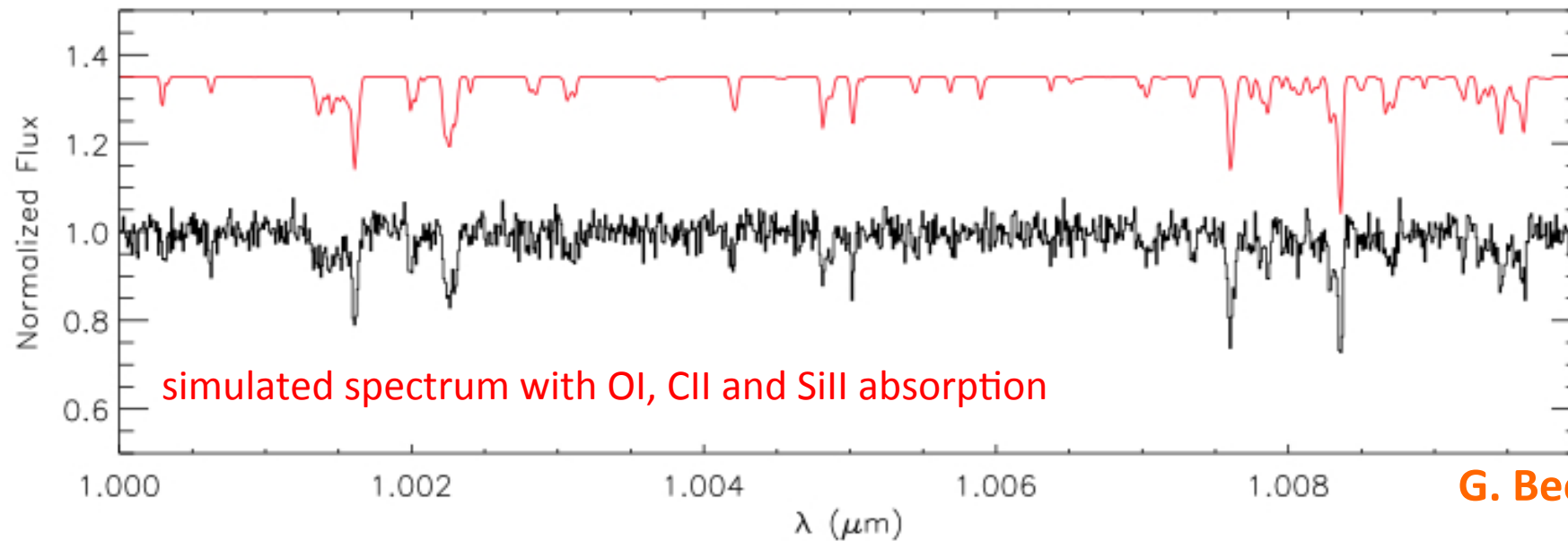


Probing the early chemical enrichment with HIRES

VLT X-shooter 25 hours

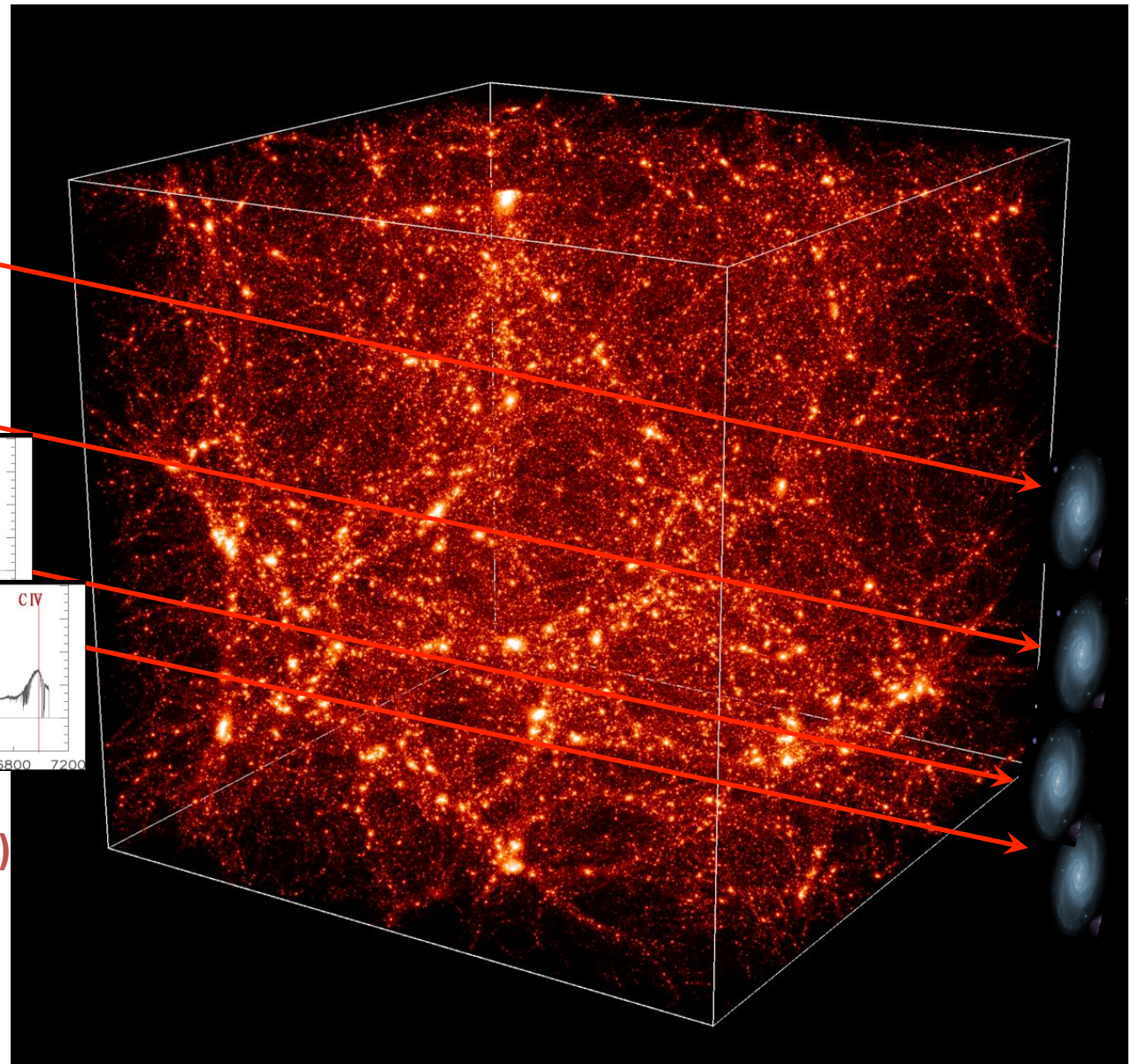
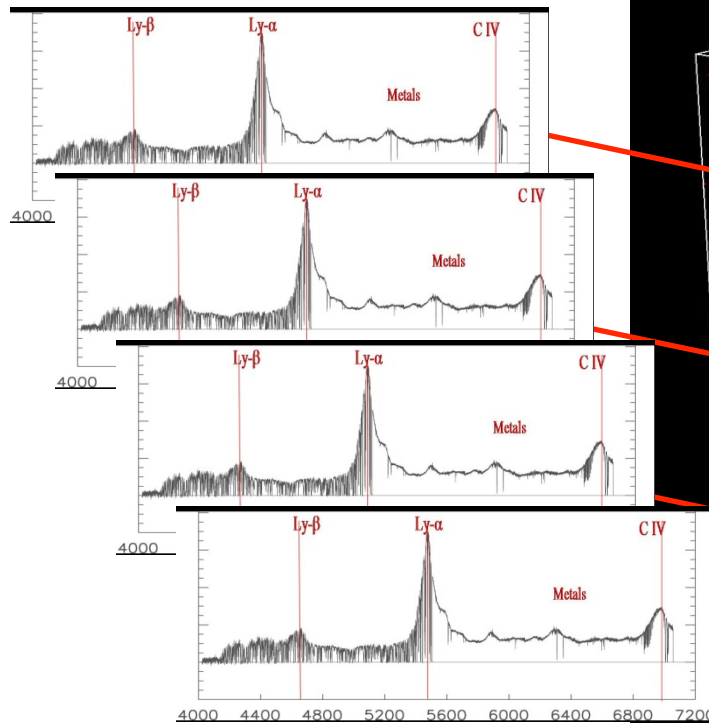


E-ELT HIRES 5 hours



G. Becker

Tomography of the Inter-Galactic Medium and of its Chemical Enrichment: HIRES spectroscopy of multiple lines of sight

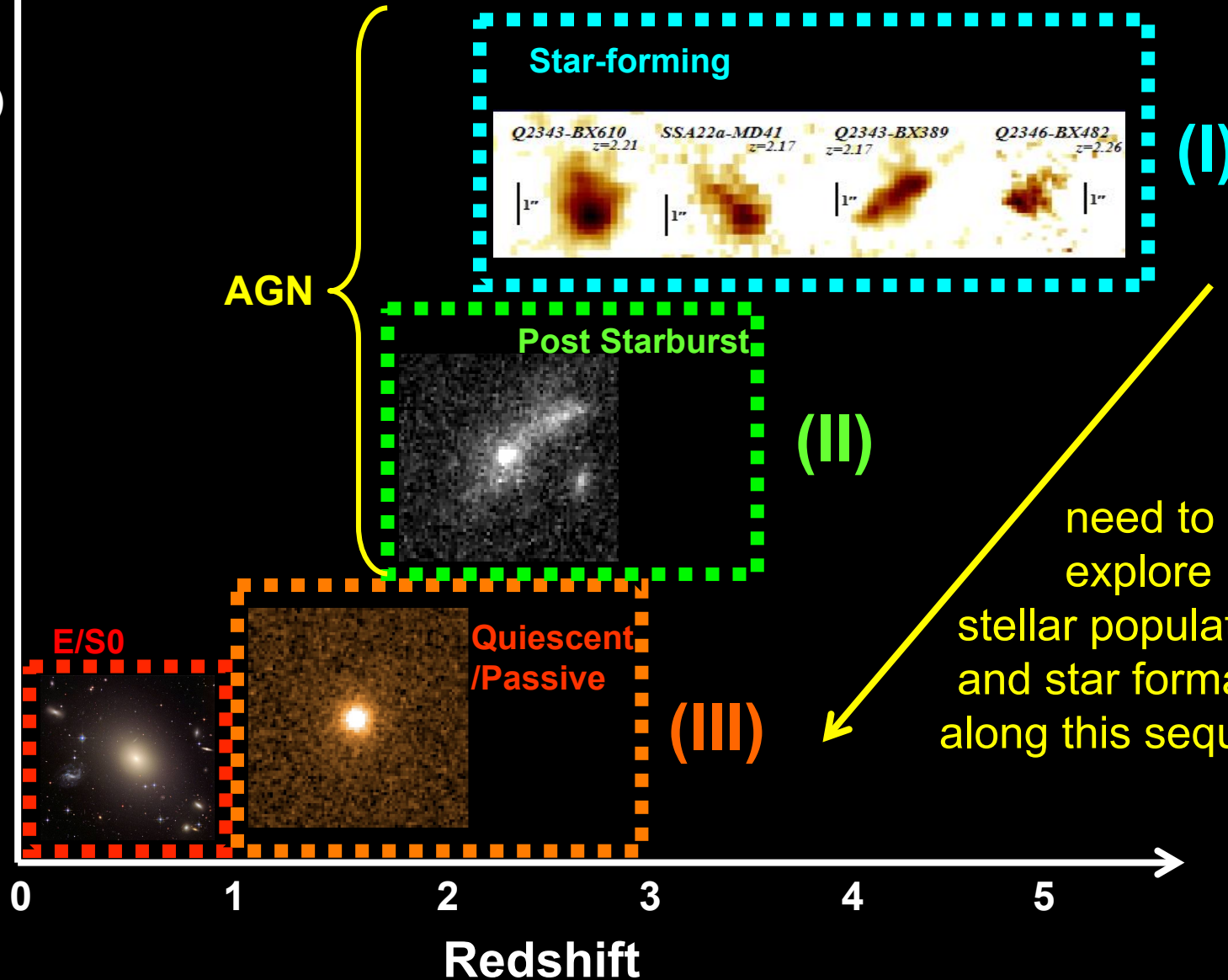


Full spectral coverage (opt.+NIR)
+ moderate multiplexing
(10 objects over 5 arcmin)

Schematic Evolution of Massive Galaxies

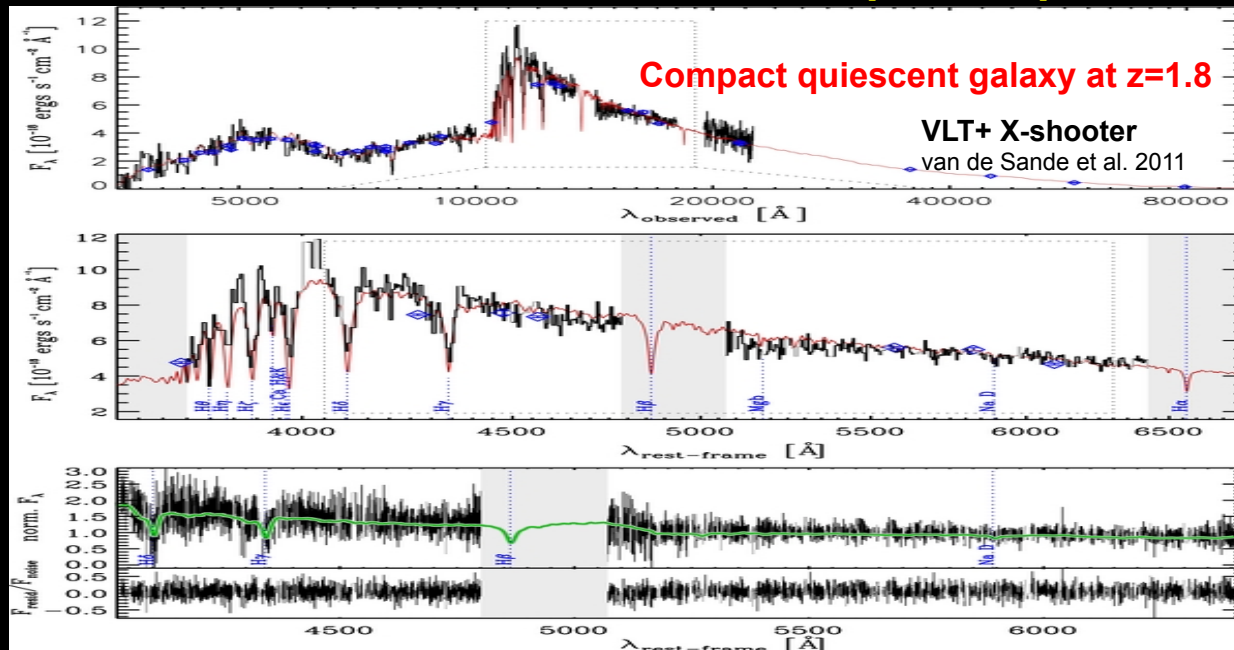
Courtesy A. Cimatti

sSFR
(SFR/M*)

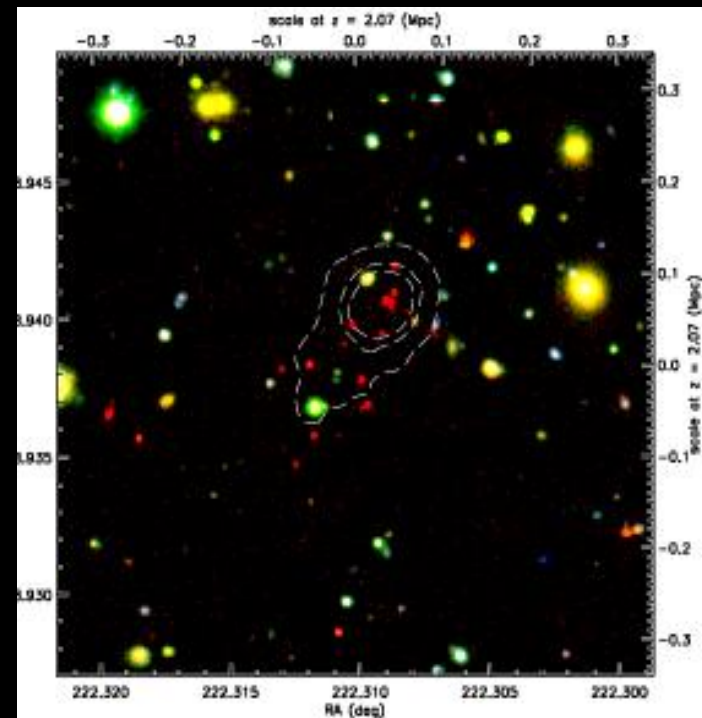


need to explore stellar populations and star formation along this sequence

Example of optical + JHK spectrum



Wide spectral range needed



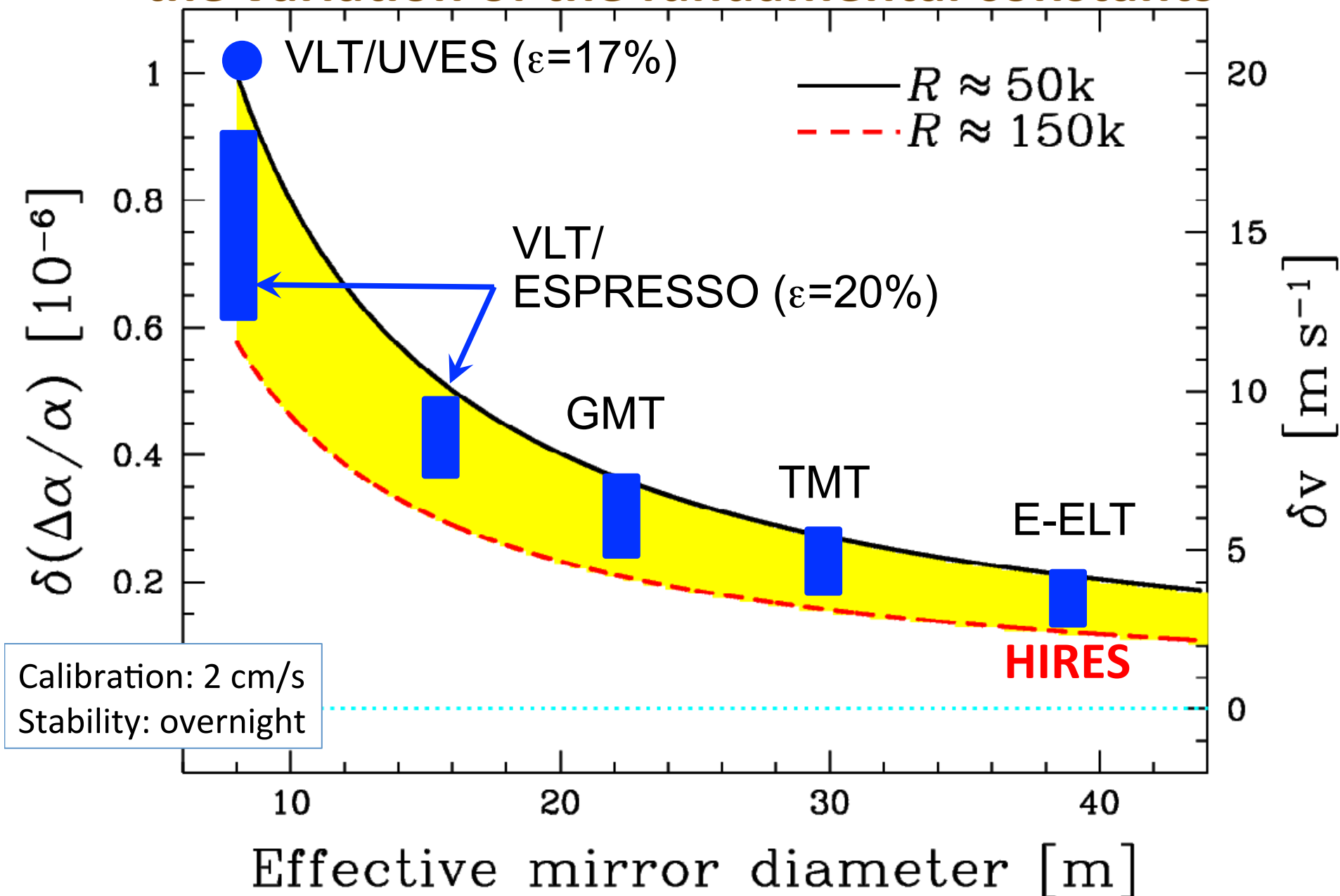
Protocluster at $z = 2.07$
(Gobat et al. 2011)

Some multiplexing highly desired

10 x Super-XShooter

Courtesy A. Cimatti

Fundamental Physics: the variation of the fundamental constants



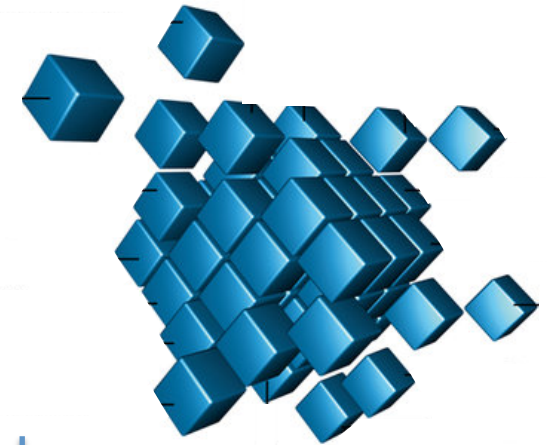
A multipurpose instrument with
a number of key outstanding science cases

How to meet all these requirements
while minimizing instrument complexity
and associated risks?

Highly modular concept

Independent modules

- If needed, it can be de-scoped without affecting the “fundamental” modules/functionalities
- or**
- It can be deployed in sequential stages, starting from essential modules and upgraded with time, depending on budget and resources



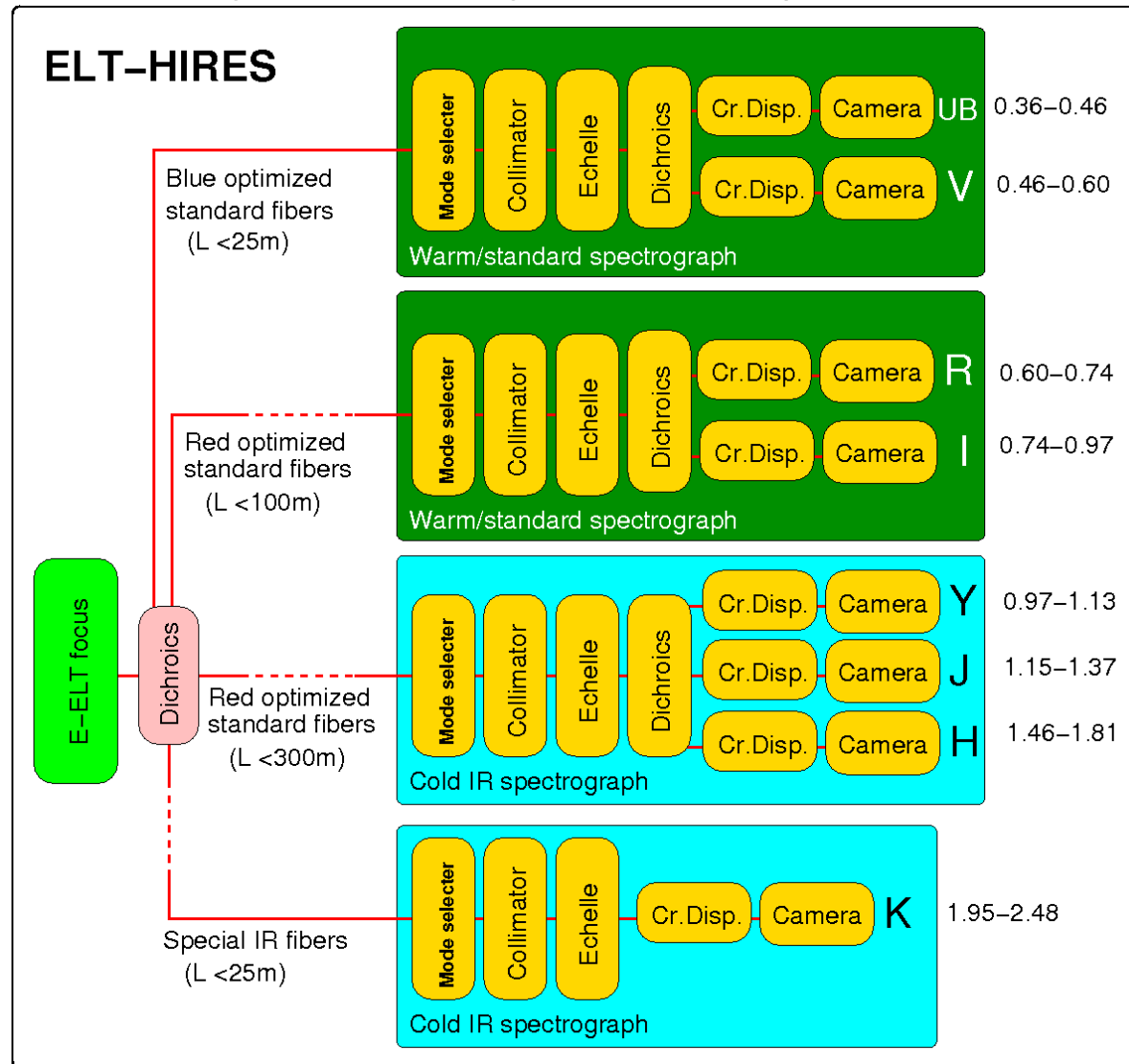
Easy to implement
ESO (PST/STC)
decision flow

Minimizes risks associated with technical issues of individual modules

Minimizes risks associated with cash flow and resources of individual consortium partners

HIRES *modular instrument scheme*

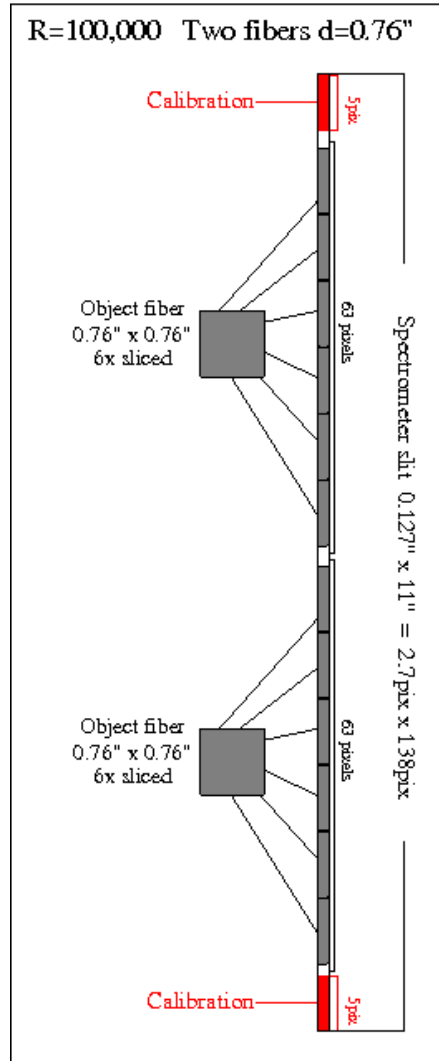
Fiber fed, simple concept, no major technical issues



Courtesy
E. Oliva

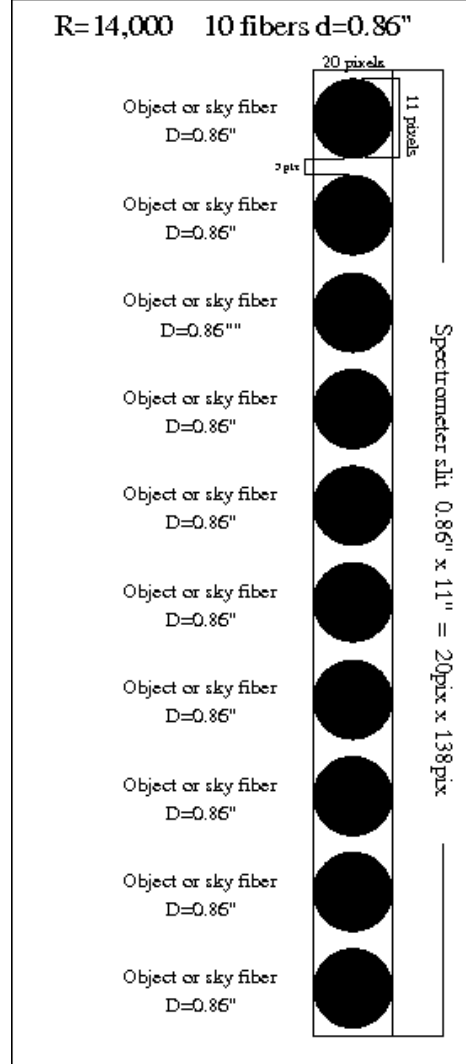
HIRES *observing modes*

HR mode

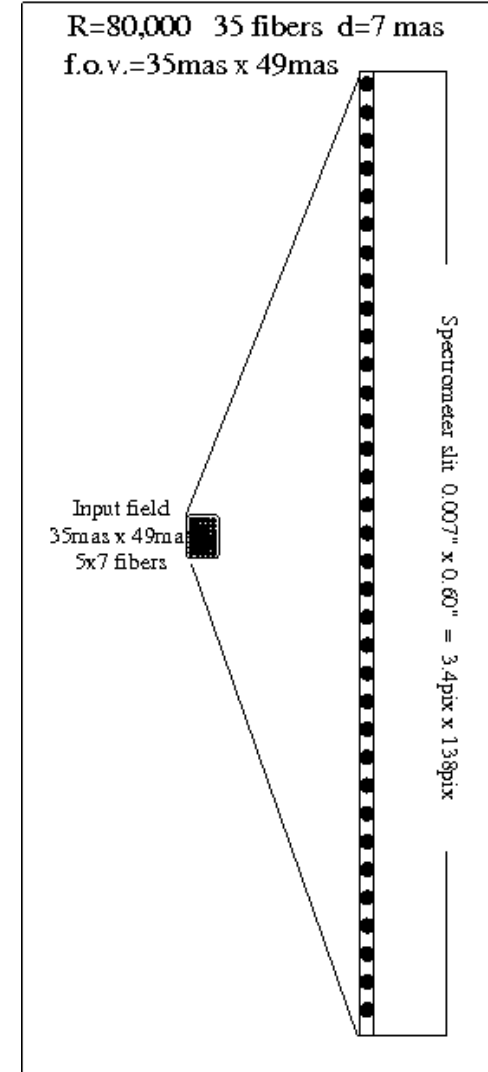


Fiber slicing
(keeps the spectrometer small)

MR MP mode

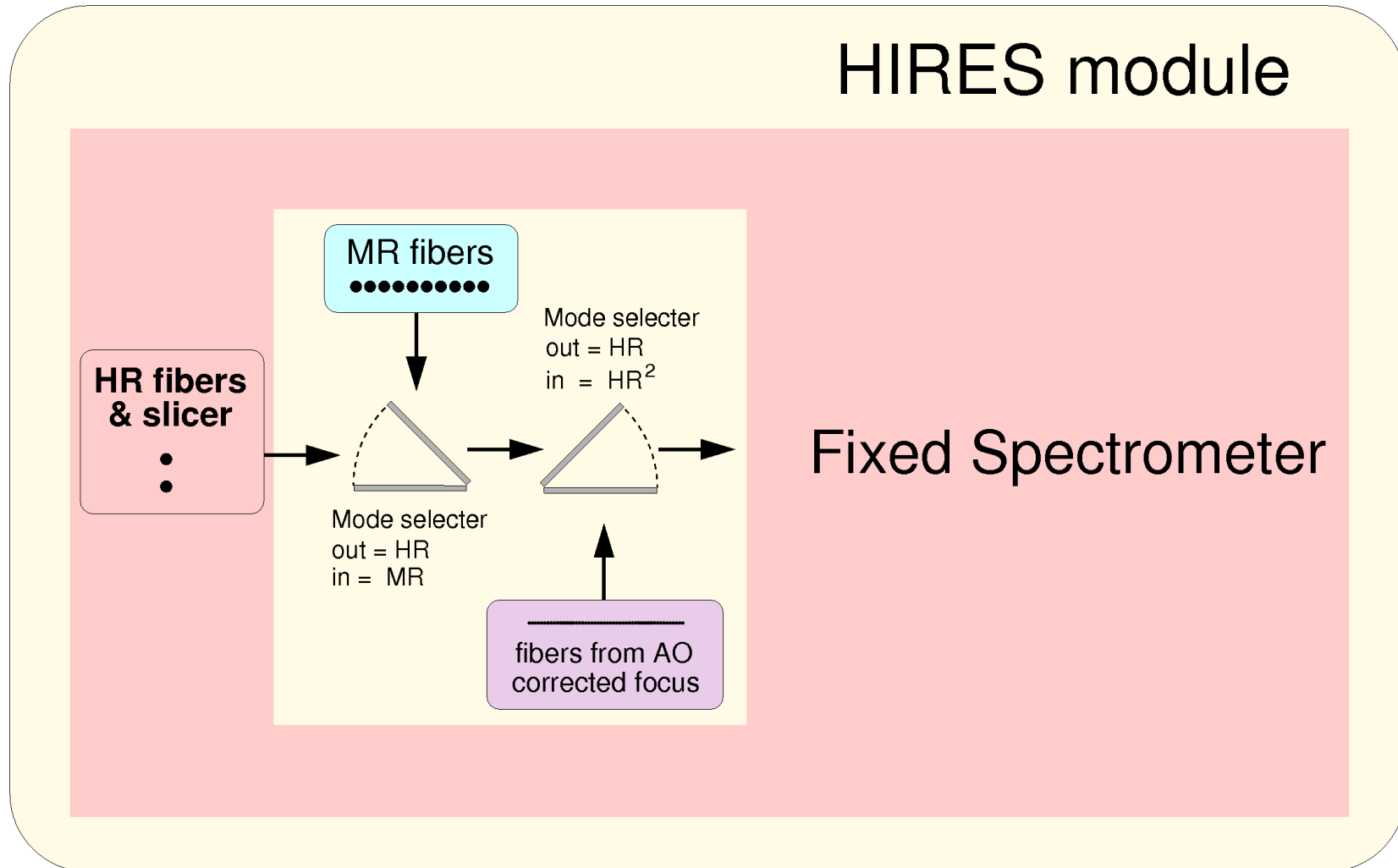


HR² IFU mode



E. Oliva

HIRES *mode exchange in fore-optics*



- Equivalent to a slits exchange mechanism
- HR fore-optics are fixed → HR stability OK

HIRES *observing modes*

Mode	R	D-fib	N.obj	Size of Res. Element		Comment
				sky	pixels	
HR	100,000	0.76''	$2 + \lambda_{\text{cal}}$	0.127'' x 5.0''	2.8 x 63	1x6 slicing
MR MP	14,500	0.86''	10	0.86'' x 0.86''	20 x 11	Multi-Plex on ELT 10' fov
HR ² IFU	80,000	7mas	35	7mas x 7mas	3.5 x 2	SCAO fov 35x49 mas

Summary

HIRES towards a multipurpose instrument enabling a number of key outstanding science cases -> White Paper

HIRES concept simple (low risk) and highly modular, easy to de-scope or to upgrade

Scope and deployment scheme depending on PST/STC recommendations and on budget flow