StePS

Stellar Populations at intermediate redshift Survey

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On behalf of the StePS team*

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1- *Science Goals of StePS*

2- *Survey Planning*

3- *Latest news and future plans*

WEAVE characteristics

Telescope, diameter	WHT, 4.2m
Field of view	2° ⌀
Number of fibers	1000
Fiber size	1.3″
Number of small IFUs, size	20 x 11″x12″ (1.3″ spaxels)
LIFU size	1.3′x1.5′ (2.6″ spaxels)
Low-resolution mode resolution	6000 (4000–7250)
Low-resolution mode wavelength coverage (Å)	3660–9590
High-resolution mode resolution	21000 (15000–25000)
High-resolution mode wavelength coverage (Å)	4040–4650, 4730–5450 5950–6850

Main assets of WEAVE:

- ☆ **Good resolution (R~5000) over a wide wavelenght range (3500-9000Å)**
- ☆ **Large FoV**
- ☆ **Excellent multiplexing**

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2- StePS science goals

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Stellar Populations at intermediate redshift Survey

The processes responsible for galaxy evolution may be studied

- **either scrutinizing todays galaxies to infer their past mass assembly,**

or

- **probing slices of the Universe at different epochs through redshift surveys**

2- *StePS science goals*

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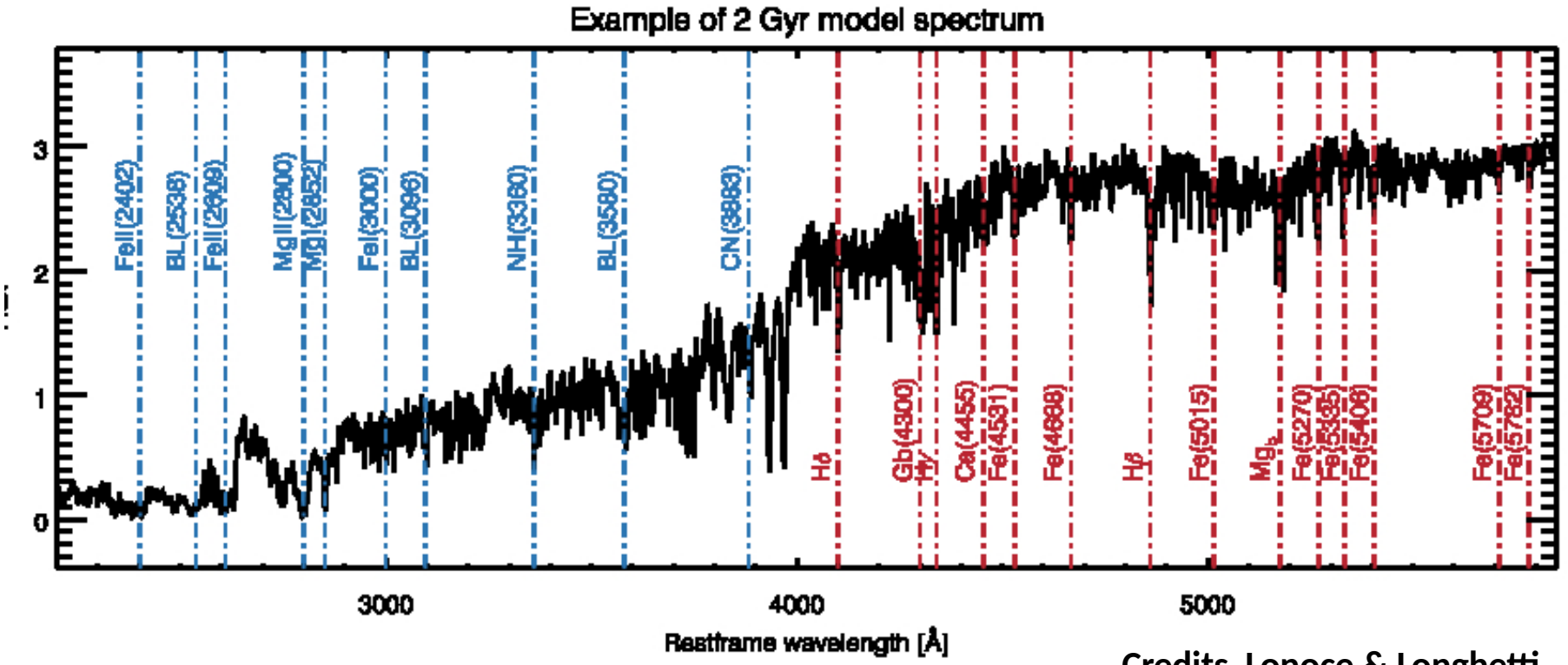
Stellar Populations at intermediate redshift Survey

Each galaxy spectrum contains a wealth of information encoded in its shape and absorption/emission features – information on galaxy physics, mass assembly history and chemical enrichment history.



Credits Lonoce & Longhetti

2- *StePS science goals*

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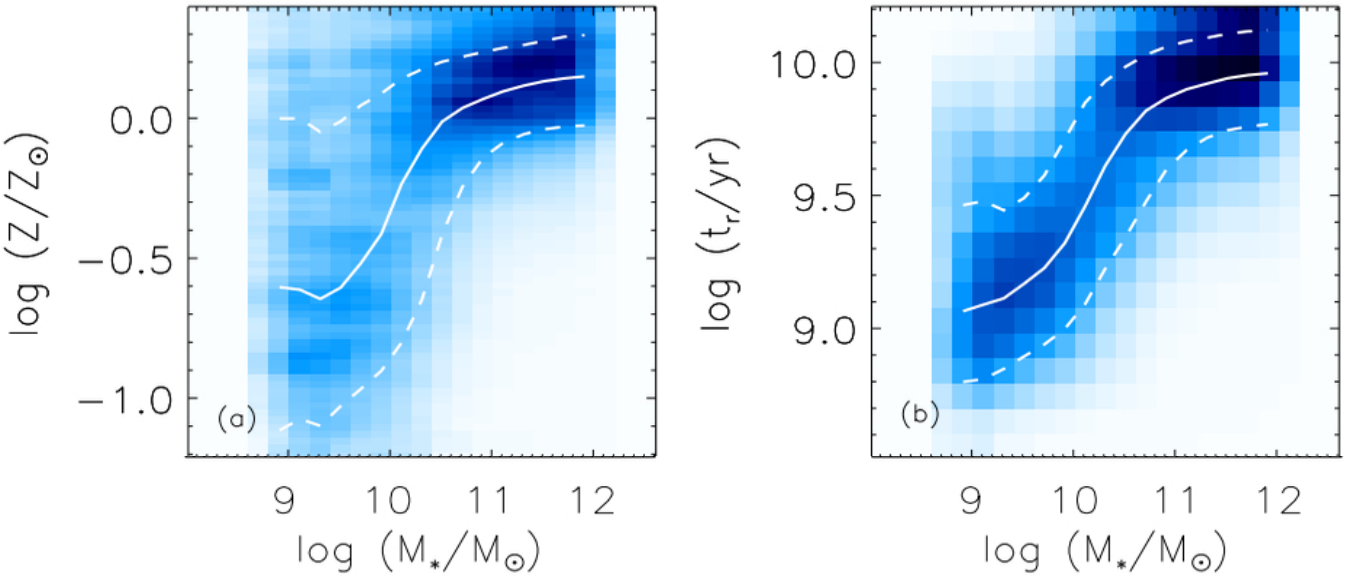
Surveys such as 2dF and SDSS have made ground-breaking progress in the low-redshift Universe …



Gallazzi et al. 2005

2- *StePS science goals*

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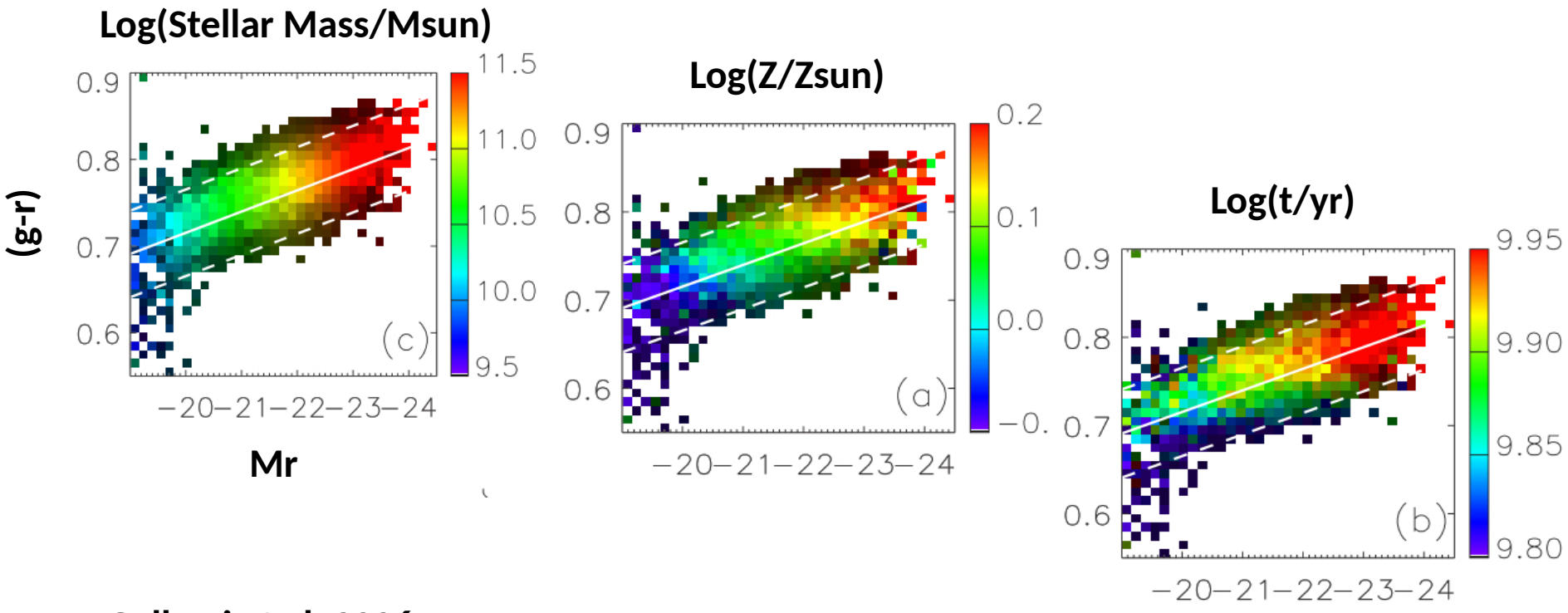

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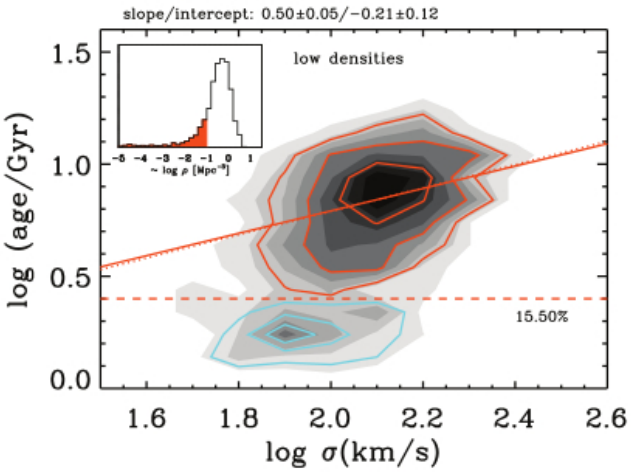
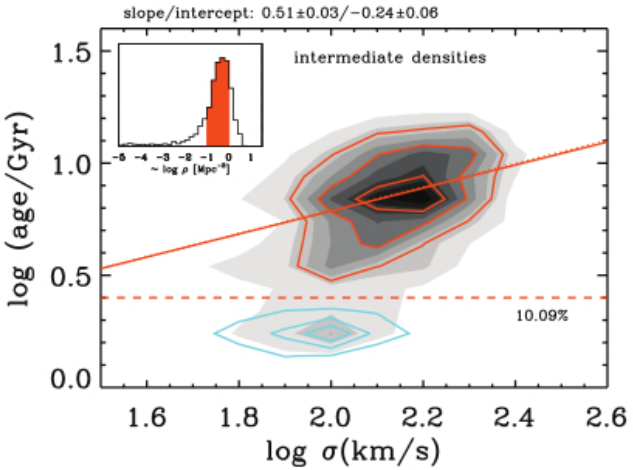
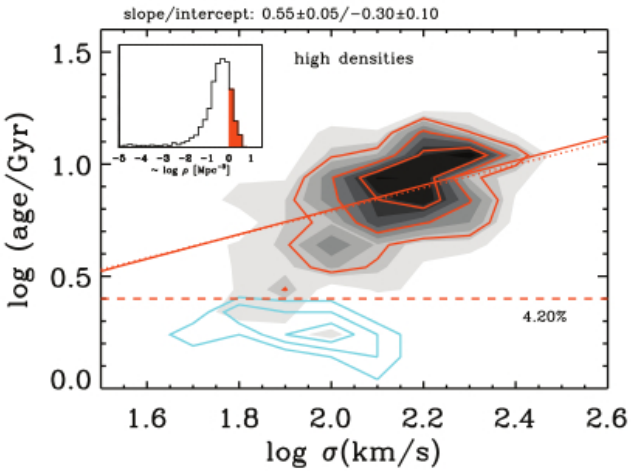






Thomas et al. 2010

2- StePS science goals

Still open questions:

- **what are the physical mechanisms that guide the evolutionary routes of galaxies and produce all the trends that we observe in the local universe ?**
- **what is the link between galaxy evolutionary history and its environment ?**

As of today studies like those of SDSS at intermediate redshift have been limited to relatively small samples of galaxies or to co-added spectra …

StePS ambitious science goal:

Extend to higher redshift and with comparable wealth of data the work done in the local universe.

Tracing back in cosmic time the evolution of galaxy stellar population properties as a function of galaxy stellar mass, star formation activity and environment will provide much needed empirical constraints on the physical mechanisms that regulate galaxy formation and assembly history.

3- StePS survey planning

In a nutshell :

StePS is a spectral survey of ~ 30K galaxies at magnitude brighter than I_{AB} =20.5 and pre-selected from photometric redshifts to be at z > 0.3.

For each galaxy we will obtain using WEAVE high signal-to-noise spectra (S/N>15 per resolution element) in order to:

- **study stellar ages, star formation and star formation histories, stellar and gas metallicities,**
- **stellar velocity dispersions and gas kinematics,**
- **the relations with their intrinsic (galaxy stellar mass, morphology/color/size) and environmental properties**

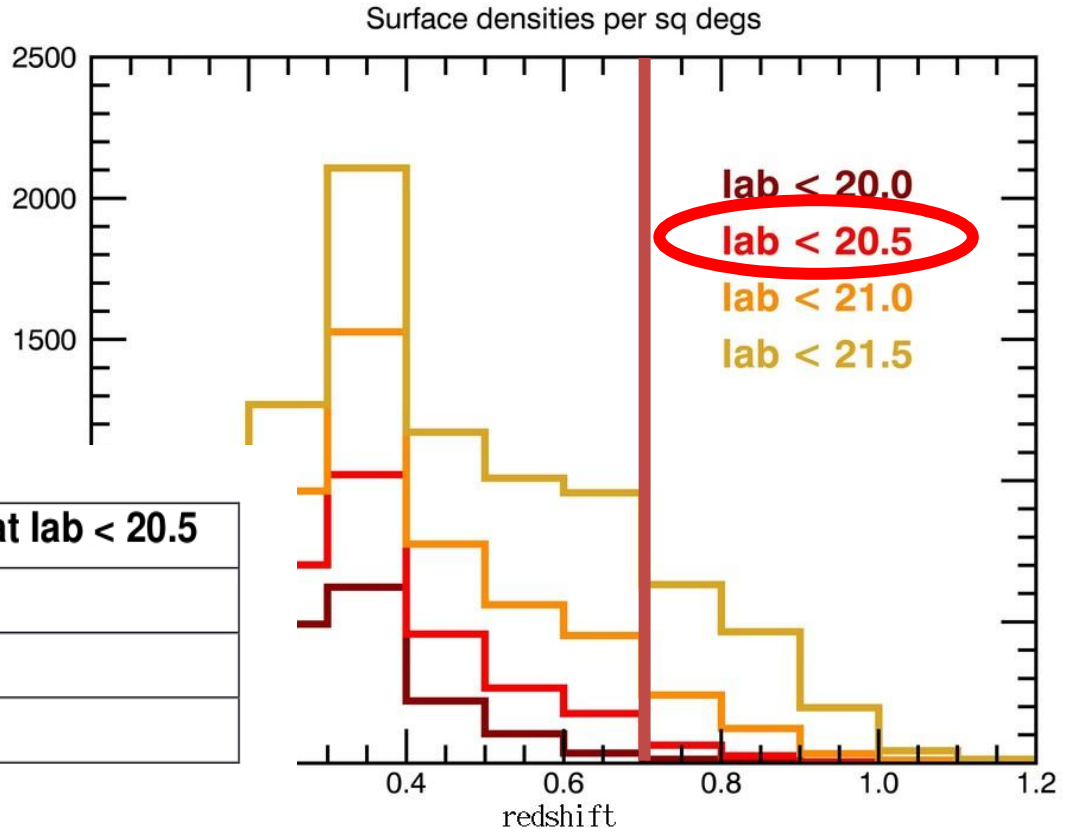
In other words we aim at extending the SDSS results to a 7 Gyr baseline.

Uniqueness: spectral quality (all main galaxy properties) for a large sample of galaxies covering a wide range of cosmic time, galaxy intrinsic properties (eg stellar mass, type, color) and environment.

3- StePS survey planning

Galaxy surface density values (deg^{-2}) from COSMOS catalog

Mag limit	I_{AB} <20.0	I_{AB} <20.5	I_{AB} <21.0	I_{AB} <21.5
All gals	2000	3300	5500	9000
z_{phot} >0.3	1000	2000	3700	6600



Redshift	Mass limit (log(M/M_{sun})) at Iab < 20.5
z=0.3	10.2
z=0.5	11.0
z=0.8	11.5

3- StePS survey planning

A possible prioritization strategy….

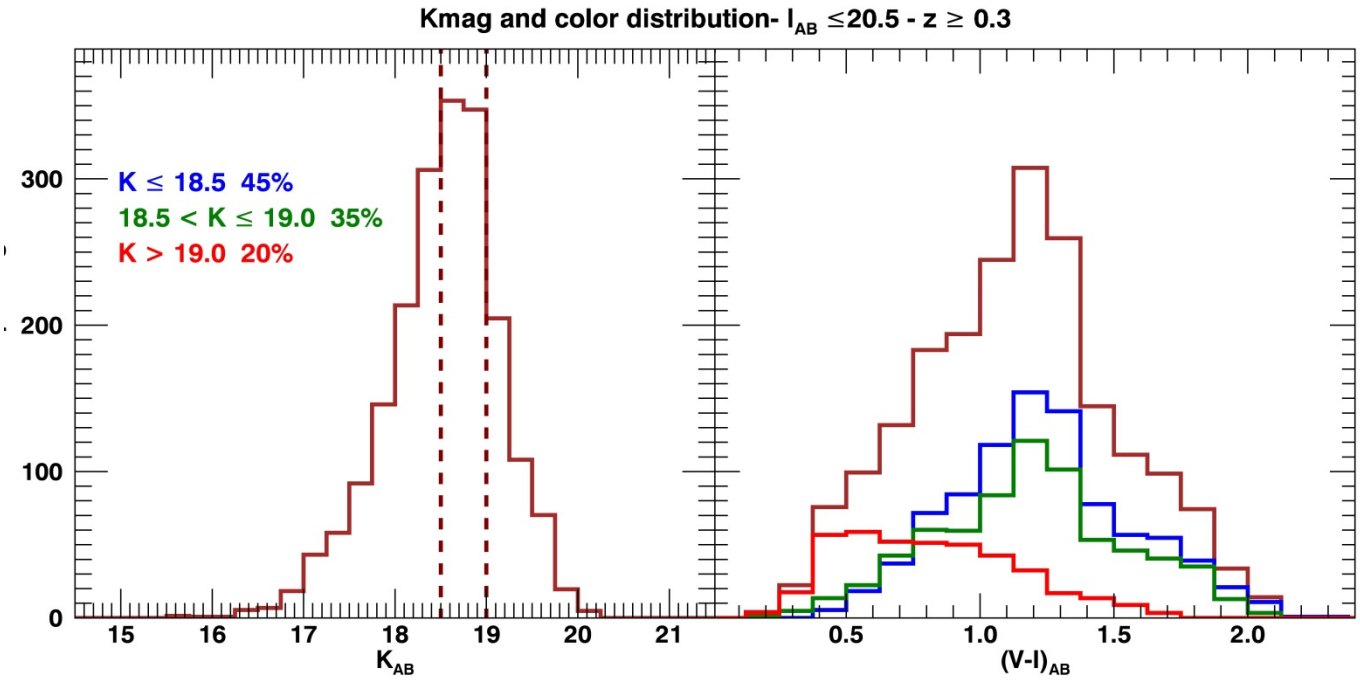
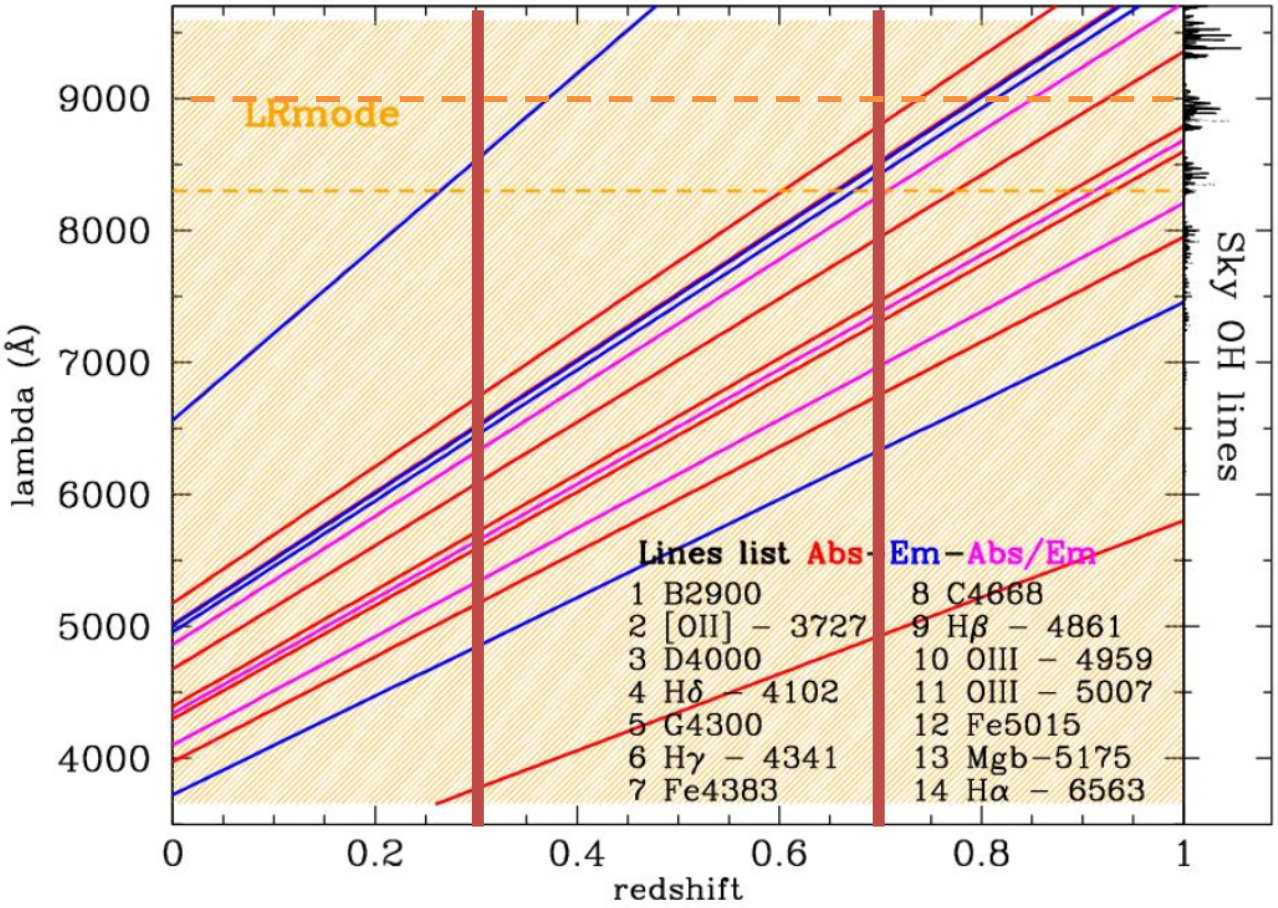


Table 1				
	I_{AB} < 20.5		K_{AB} < 18.5	
Redshift	Red galaxies	Blue galaxies	Red galaxies	Blue galaxies
0.15	9.92	9.67	10.22	10.18
0.35	10.60	10.45	10.85	10.76
0.45	10.88	10.75	11.09	10.98
0.55	11.12	10.99	11.29	11.16
0.65	11.31	11.16	11.44	11.29

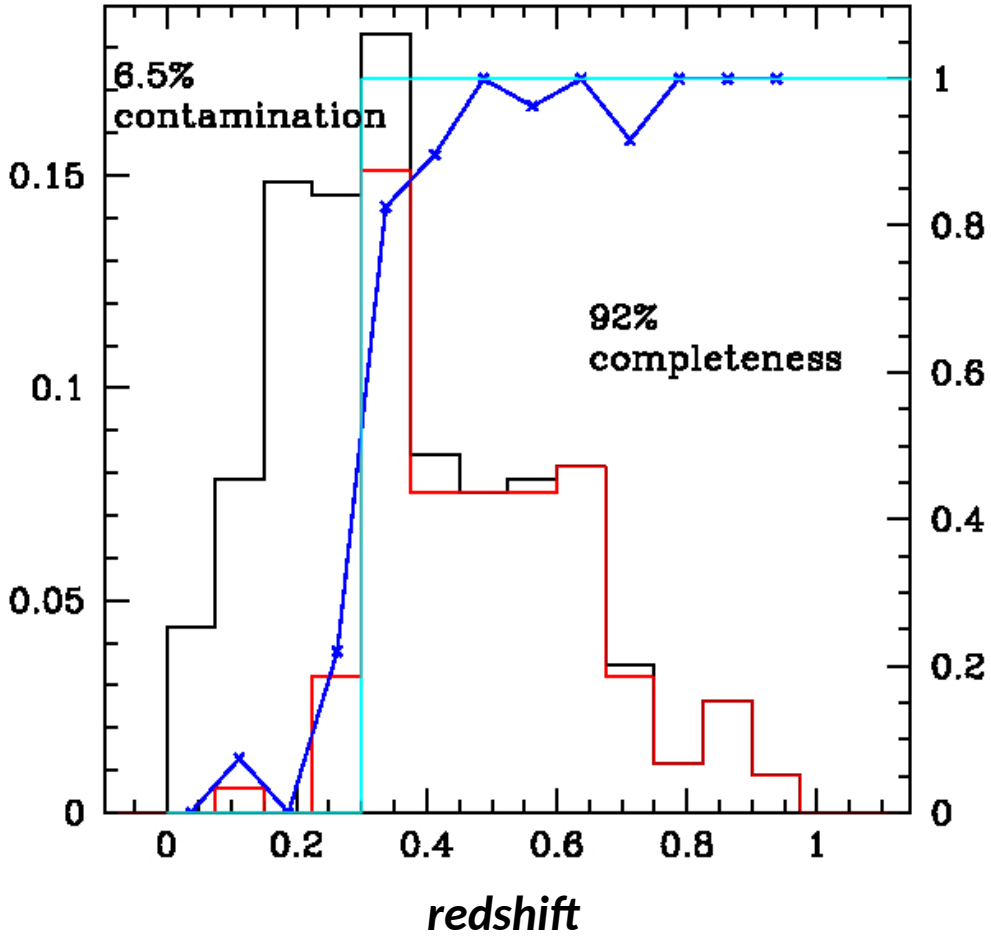
3- StePS survey planning

Main lines visibility:



3- StePS survey planning

Photometric redshift preselection: how accurate ?



3- StePS survey planning

Stellar ages, metallicities, dust extinction and velocity dispersions, are all recovered without significant systematic offsets (accuracy higher than 10%) with a S/N~15.

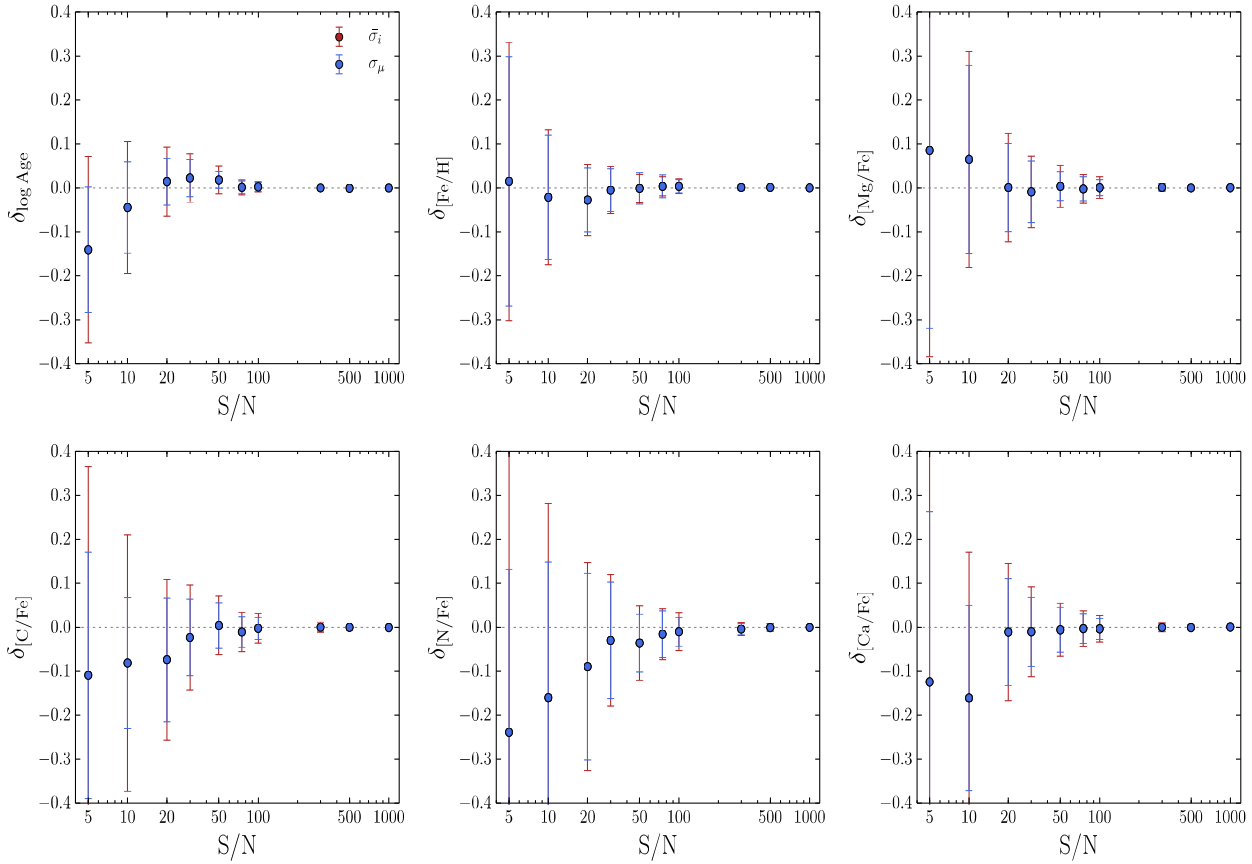


Figure A1. The difference between parameters measured from artificially degraded spectra and the original high-quality SDSS stacked spectrum. We construct 50 realizations at each S/N. The different colored symbols represent two independent error estimates, where the red is the average of the 50 errors measured by the fitting code and the blue corresponds to the 1σ scatter of the 50 measured parameters. Age and [Fe/H] are accurately recovered without significant systematic offsets down to S/N ≈ 10 Å^{-1}. [Mg/Fe] and [Ca/Fe], on the other hand, require S/N ≈ 20 Å^{-1}, and [C/Fe] and [N/Fe] demand S/N ≈ 30 Å^{-1}.

Choi et al. 2014

3- StePS survey planning

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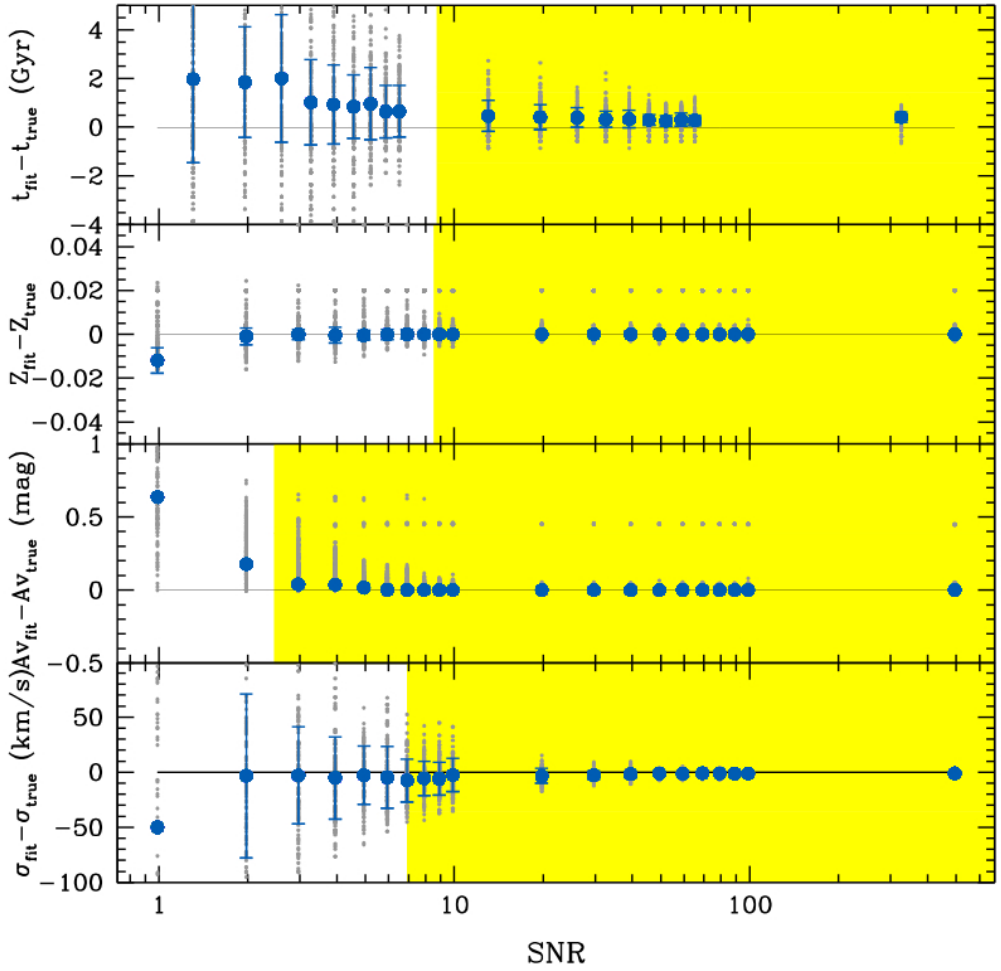
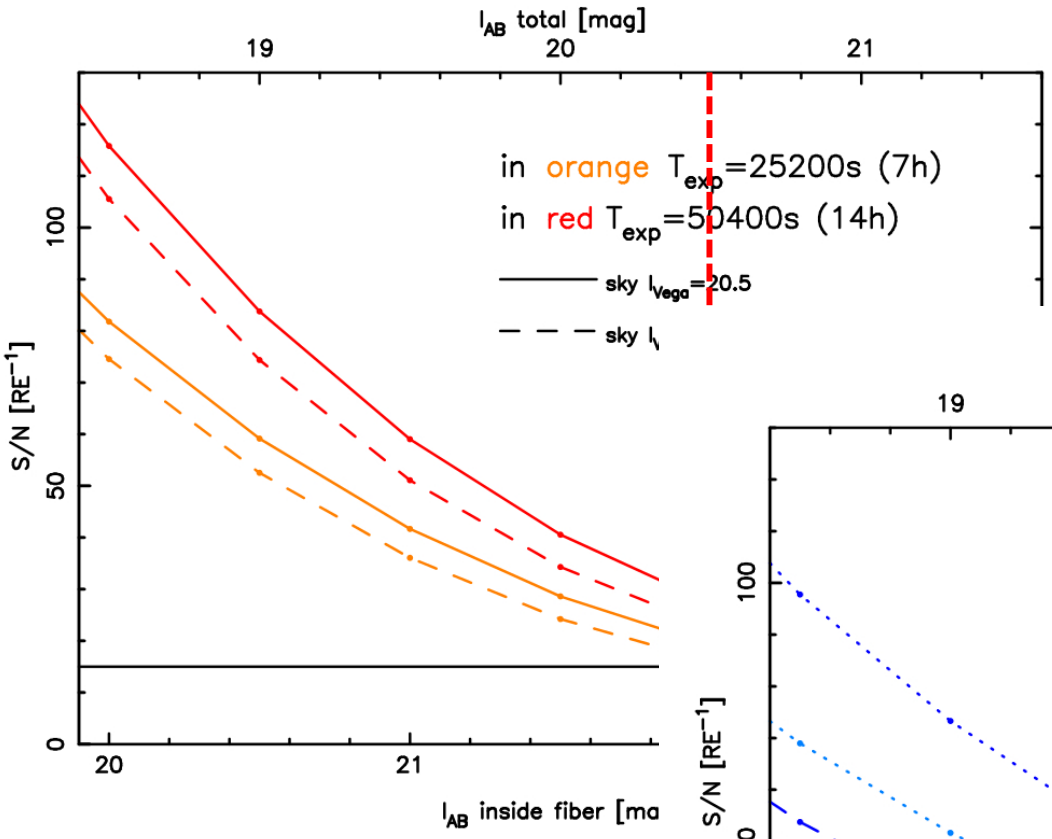
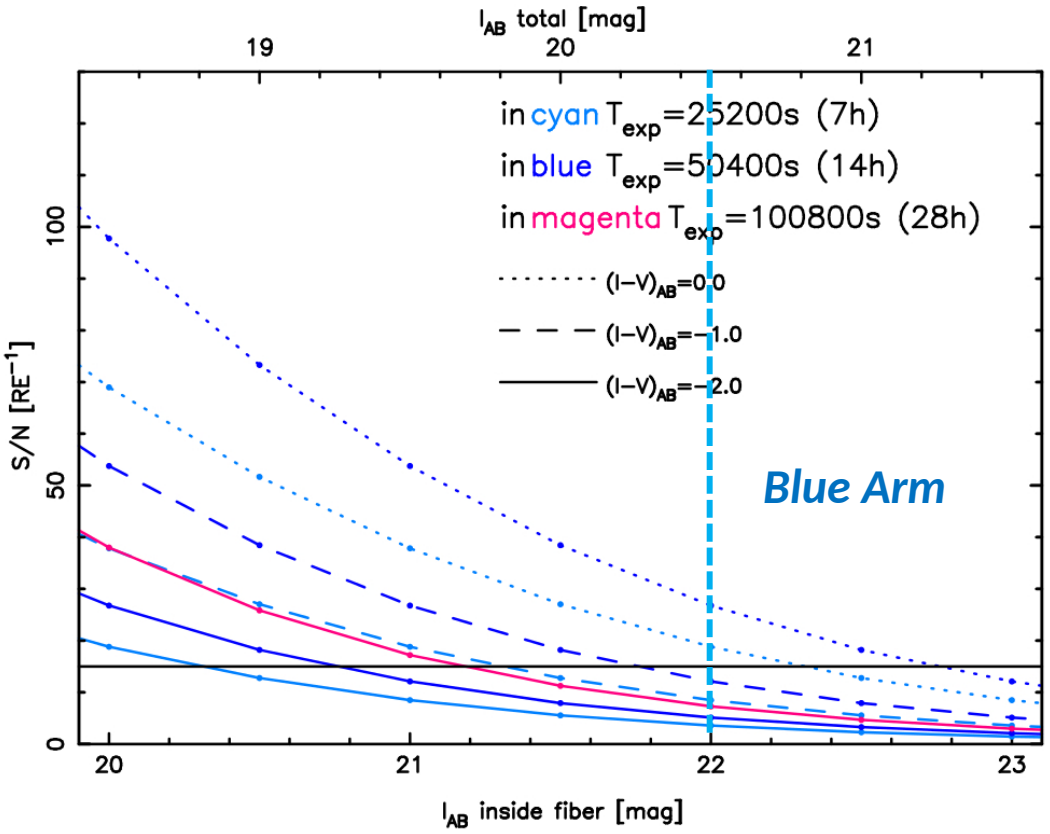


Citro, Pozzetti et al. in prep.

3- StePS survey planning



S/N as a function of exp time



Credits to A. Mercurio

3- StePS survey planning

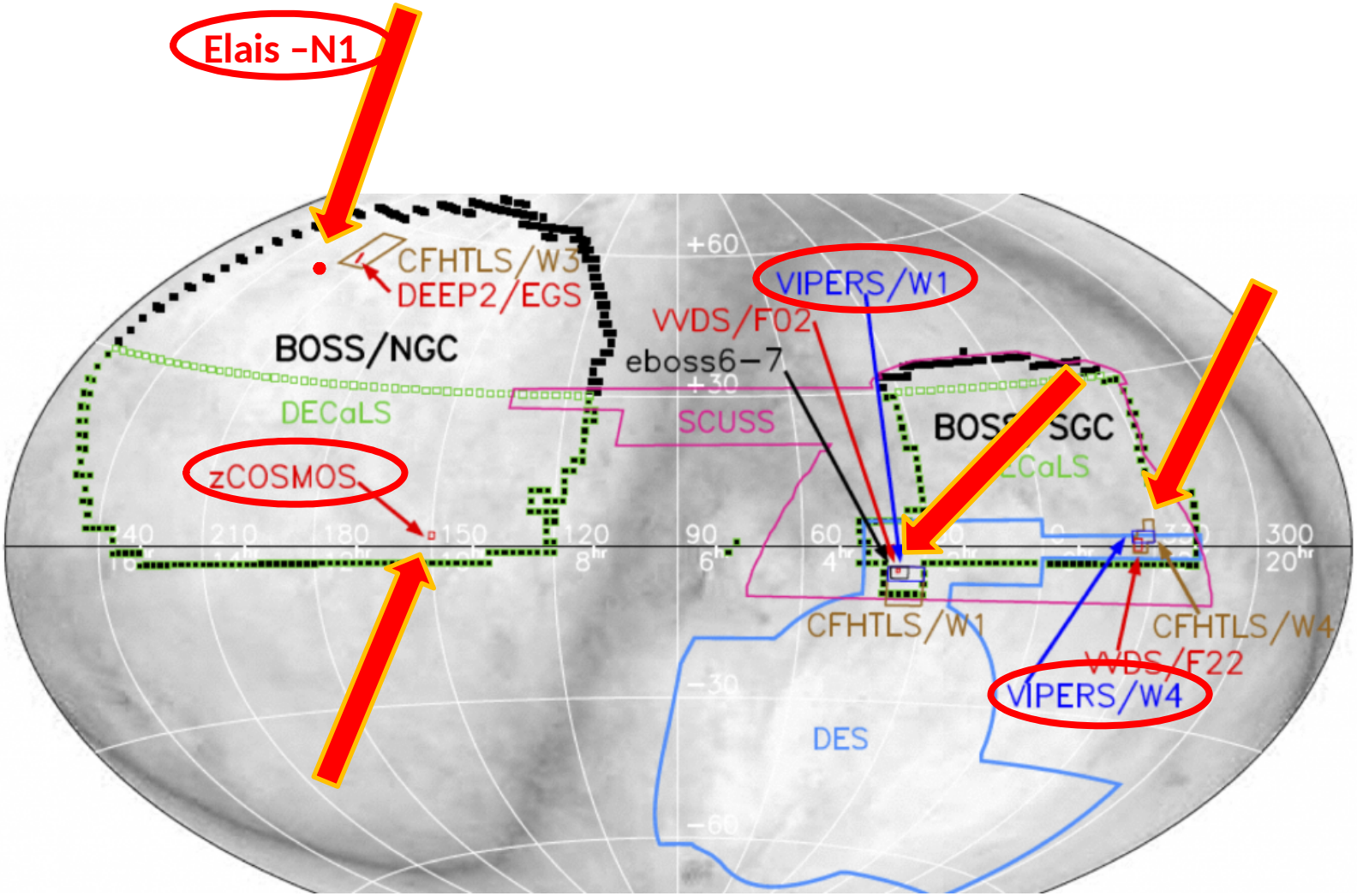
Table 1: StePs fields

Name	Coordinates	Area Covered (deg^2)	Tiles	Ntot
CFHTLS-W1	02:18:00 –07:00:00	14.0	6	28k
CFHTLS-W4	22:13:18 +01:19:00	6.0	4	12k
COSMOS	10:00:28 +02:12:21	2.2	1	5k
ELAIS-N1	16:12:10 +54:30:00	2.8	1	5k

Both CFHTLS-W1 and CFHTLS-W4, as legacy fields of the CFH Telescope, possess excellent optical

Fields pre-requisites:

1. ***Availability of good optical and near IR data, for photo-z's and target selection***
2. ***Well sampled spectroscopic data and/or very high quality photo-z, for environment characterization***
3. ***Any other ancillary data (eg X-ray for environment, HST for getting good morphologies etc.) is welcome!***


Elais –N1
CFHTLS/W3
DEEP2/EGS
BOSS/NGC
DECaLS
zCOSMOS
VIPERS/W1
VVDS/F02
eboss6–7
SCUSS
BOSS/SGC
DECaLS
CFHTLS/W1
CFHTLS/W4
VVDS/F22
VIPERS/W4
DES
+60
+30
–30
–60
240
210
180
150
120
90
60
300
8hr
6hr
4hr
20hr

4- Latest news and future plans

We have received positive feed-back from the Panel

‘ The STePS program in very much worthy of note, and is of high merit … The emphasis on high S/N observations of many individual galaxies […] will set StePS apart for the vast effort to merely measure redshifts. We view STePS to have transformative potential ’

We are in process of finalizing Survey documents and organizing working groups etc.

Thanks !