



4MOST – StePS

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on behalf of StePS collaboration

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VISTA at night (Credit ESO)

StePS - Stellar Population Survey

- Mapping galaxy evolution over the past 7 Gyrs

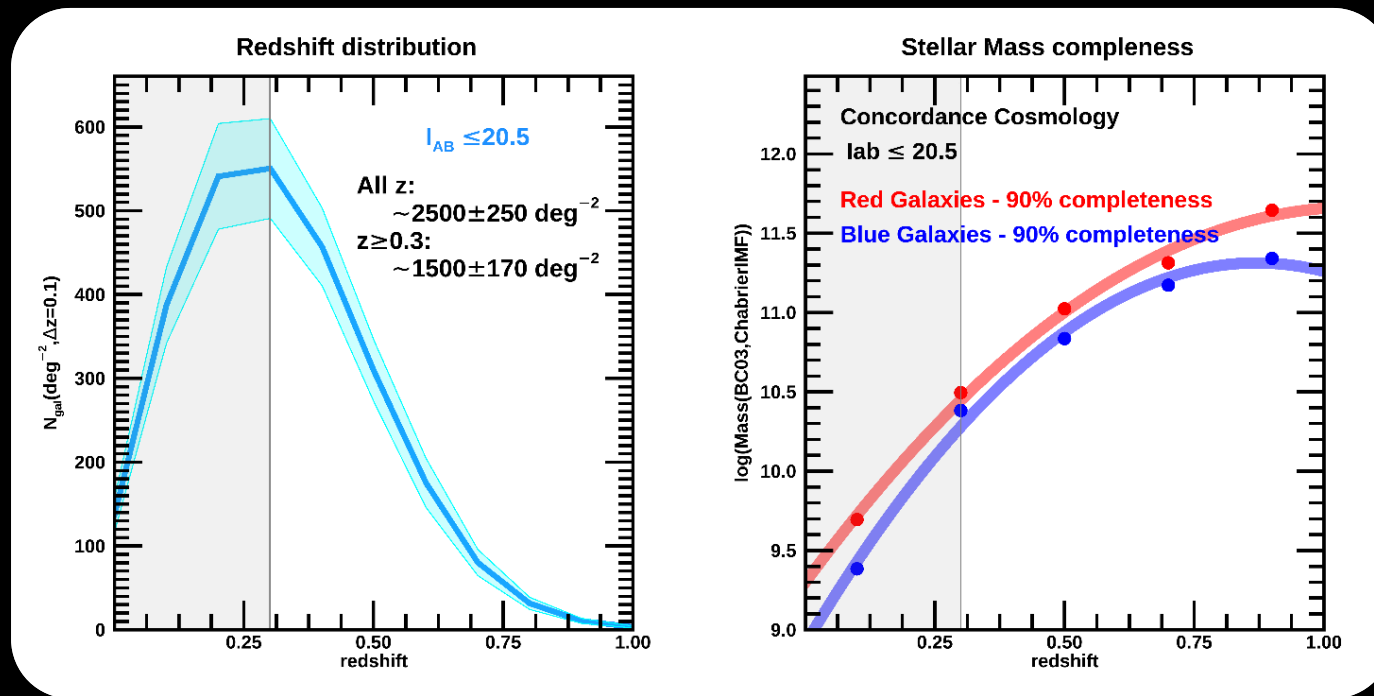
StePS Science Goal in a sentence: detail the processes that shape galaxy evolution in the past ~ 7 Gyrs (half the life-time of Universe) and that produce galaxy properties as observed at $z \sim 0$

StePS Ingredients: high S/N, high resolution spectra with wide wavelength coverage of $I_{AB} < 20.5$ selected galaxies in the range $0.3 < z < 0.7$

StePS Ingredients

$I_{AB} < 20.5$ & $0.3 < z < 0.7$: a redshift range still largely unexplored

StePS fits nicely in the redshift niche between SDSS and LEGA-C



Redshift	$\text{Log}(M/M_{\odot})$
0.3	10.4
0.5	11.0
0.7	11.3

StePS - Stellar Population Survey

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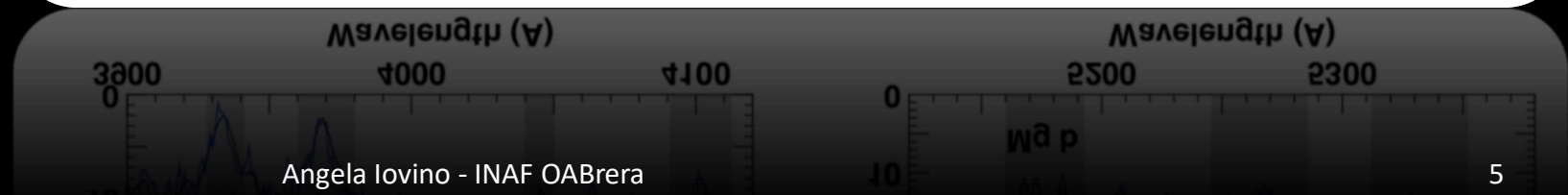
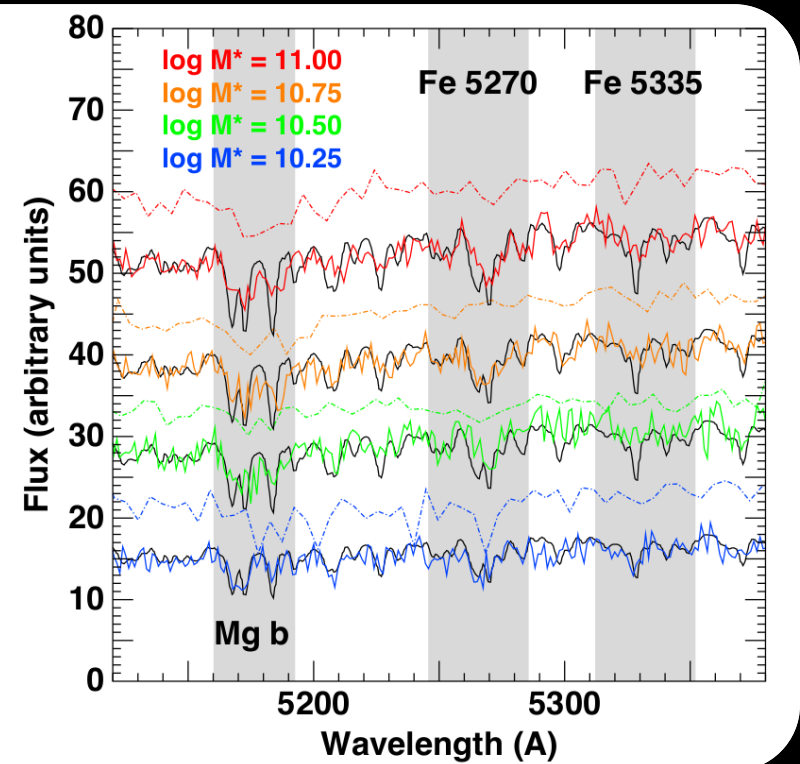
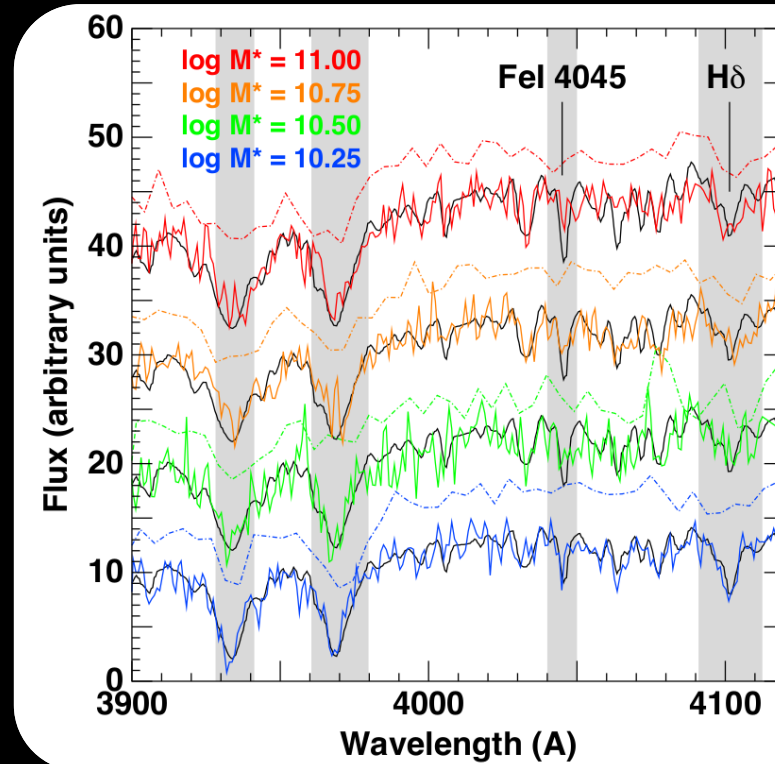
- StePS Products:**
- age of the stellar component
 - star-formation activity time-scale
 - metal abundances in stars and gas
 - presence/absence of AGN activity
 - galaxy stellar and dynamical mass
 - presence of gas inflows and outflows
- & Environment information**

StePS Ingredients

High S/N + High resolution

Together enable good estimates of key spectral indices that are stellar age and metallicity indicators

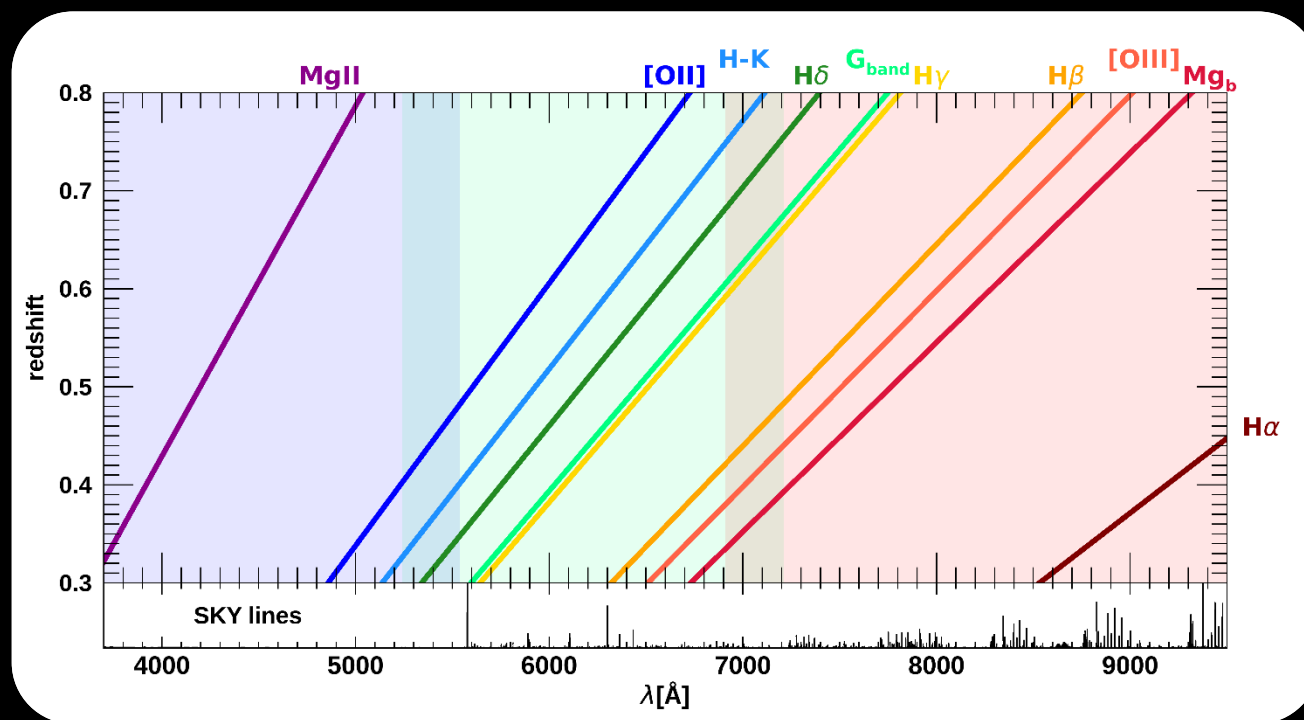
VIPERS (---) vs SDSS (—)
R200 vs R2000



StePS Ingredients

High S/N + High resolution + Wide λ coverage

Coverage of main spectral indices and abs/em lines as a function of redshift in the range of interest



StePS ideal instruments

WEAVE@WHT and/or 4MOST@VISTA

a new window of opportunity for some years to come



@



@



Next big step forward will be MSE: 10 mt telescope, 10 years timescale!



StePS ideal instruments



	WEAVE @ WHT	4MOST @ VISTA
Telescope size	4mt class	4mt class
FoV	3 sq degs	4 sq degs
R @ Low resolution mode	5000	6000
Lambda range	3600 – 9900 AA	3700 – 9500 AA
Multiplexing	1000	1600
Fibers on sky aperture	1".3	1".45



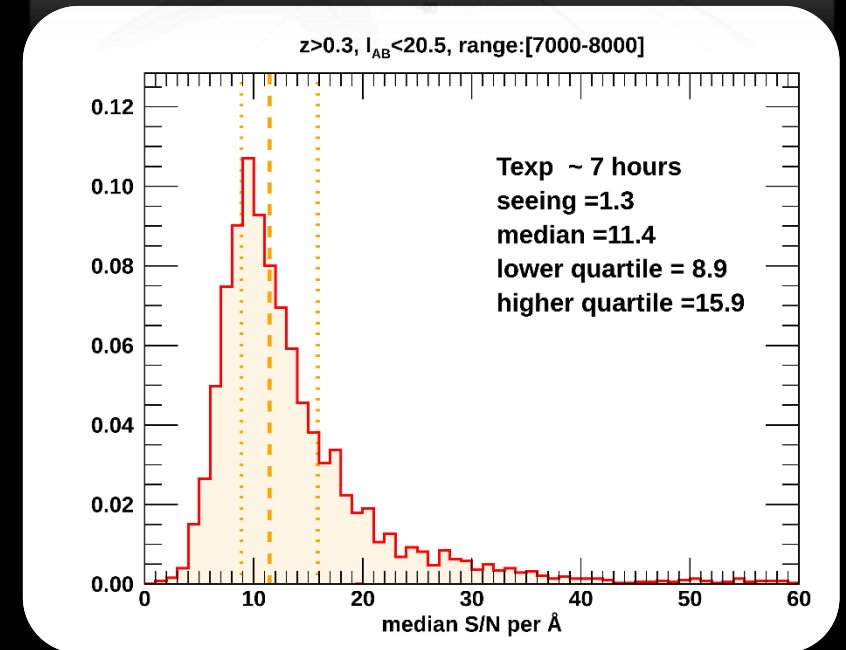
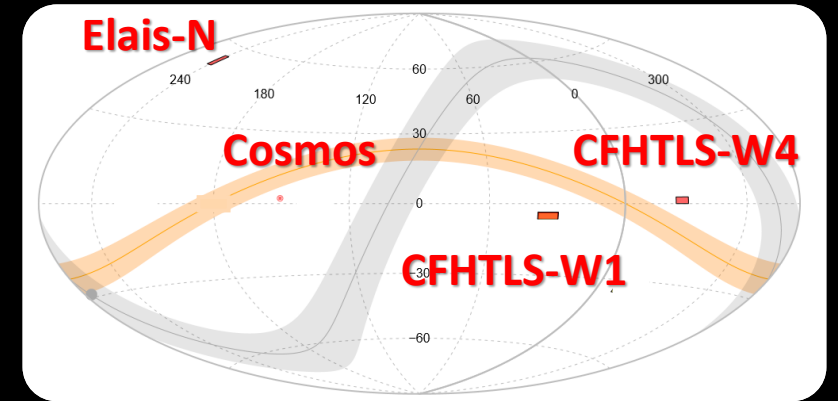
- StePS a WEAVE Consortium survey

High S/N + High resolution + Wide λ coverage

25k spectra @ 7h t_{exp} – $0.3 < z < 0.7$ – $I_{AB} < 20.5$
targetting well known extragalactic fields

Realistic end-to-end simulations
using COSMOS field HST data -
computed in-fiber fluxes and S/N

Assuming 1".3 arcsec seeing

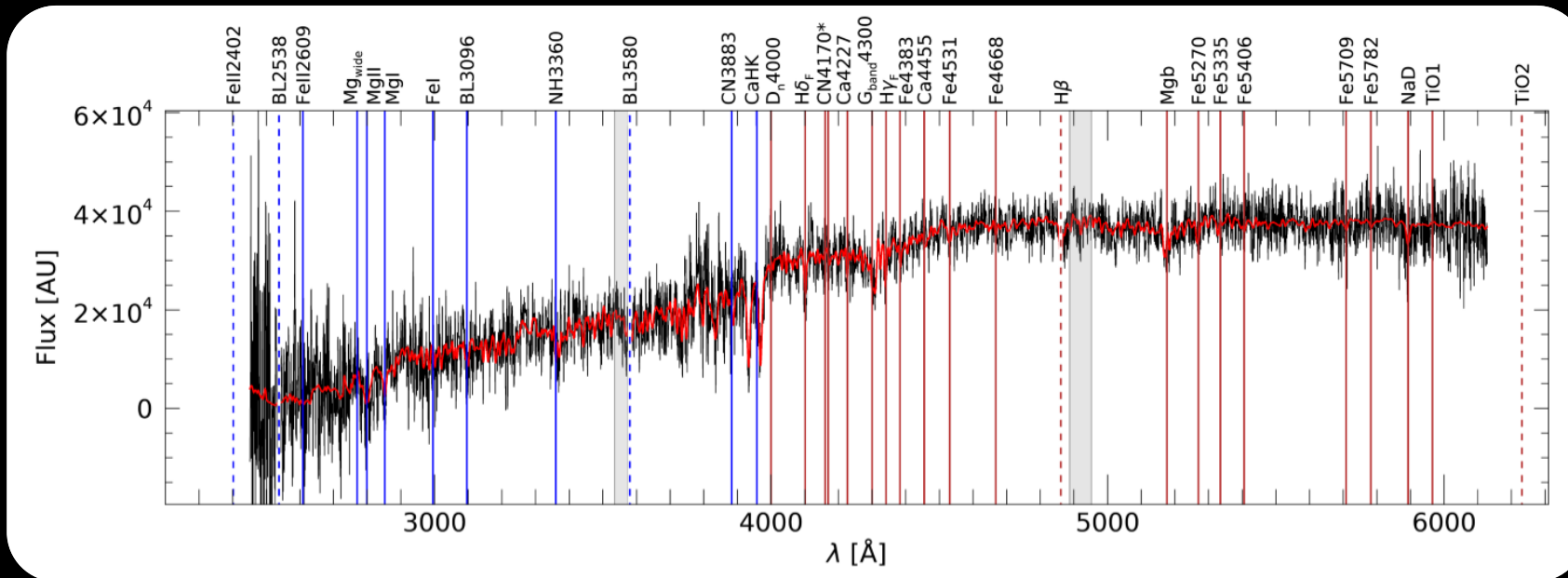




- StePS a WEAVE Consortium survey

High S/N + High resolution + Wide λ coverage

25k spectra @ 7h t_{exp} – $0.3 < z < 0.7$ – $I_{AB} < 20.5$ \rightarrow median (S/N) ~ 10 in I-band



A S/N value of ~ 10 in I-band enables good estimates of major spectral features across the full wavelength range covered

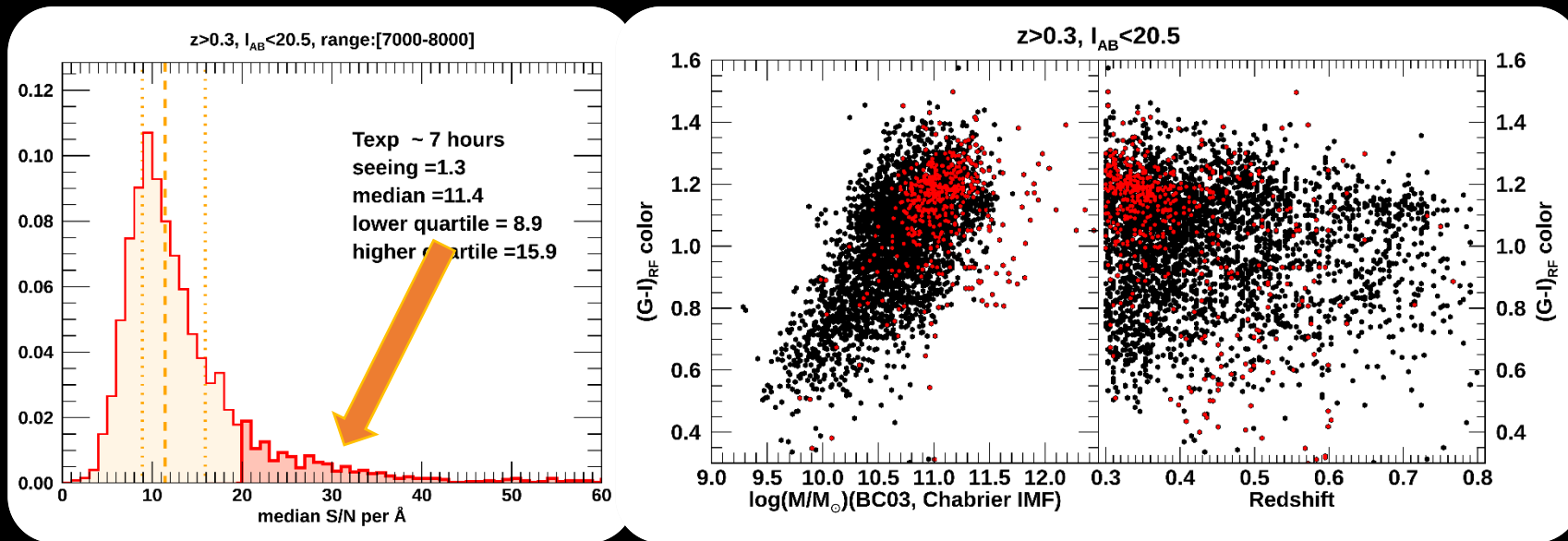
Costantin et al. 2019



- StePS a WEAVE Consortium survey

High S/N + High resolution + Wide λ coverage

At $t_{exp} \sim 7$ hours, only $\sim 10\%$ of targets will have a median (S/N) >20 in I-band



The most massive, redder and lower redshift galaxies: far from being a representative subsample.

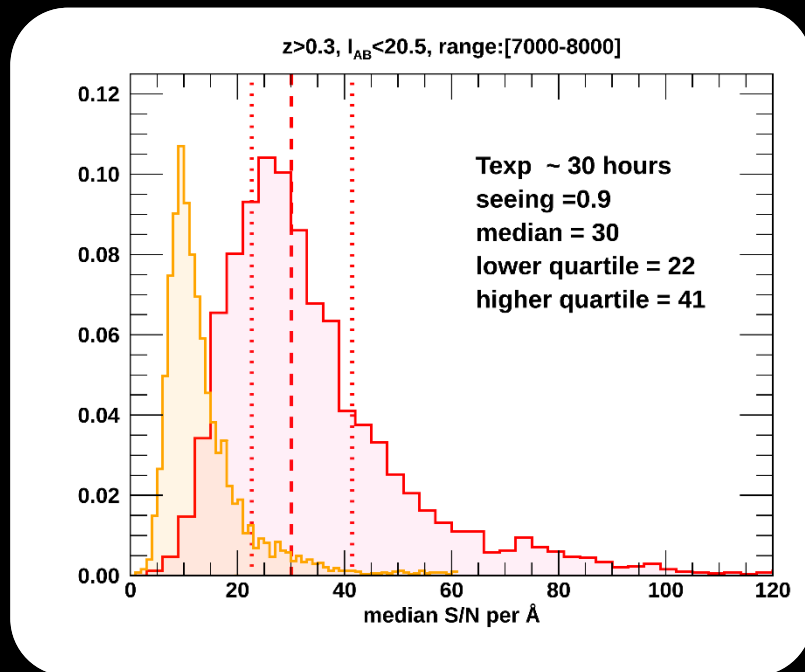
Take a step forward:



- StePS

Higher S/N + High resolution + Wide λ coverage

3.5k spectra @ 30h t_{exp} – $0.3 < z < 0.7$ – $I_{AB} < 20.5$ → median (S/N) ~ 30 in I-band



Trading sample size for much higher S/N
A LEGA-C like survey at $0.3 < z < 0.7$

Take a step forward:

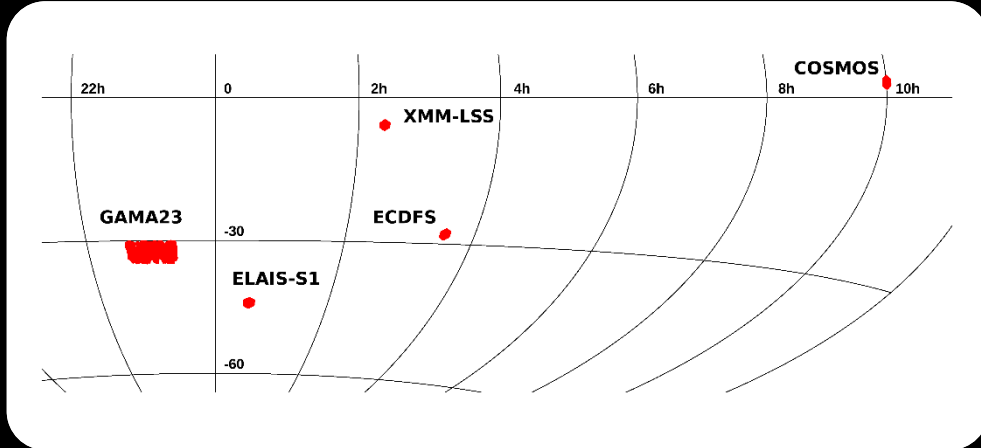


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Piggybacking on WAVES-DEEP footprint –

- Take advantage of planned repeated passes

AND

- Get precise information on galaxy position within the cosmic web



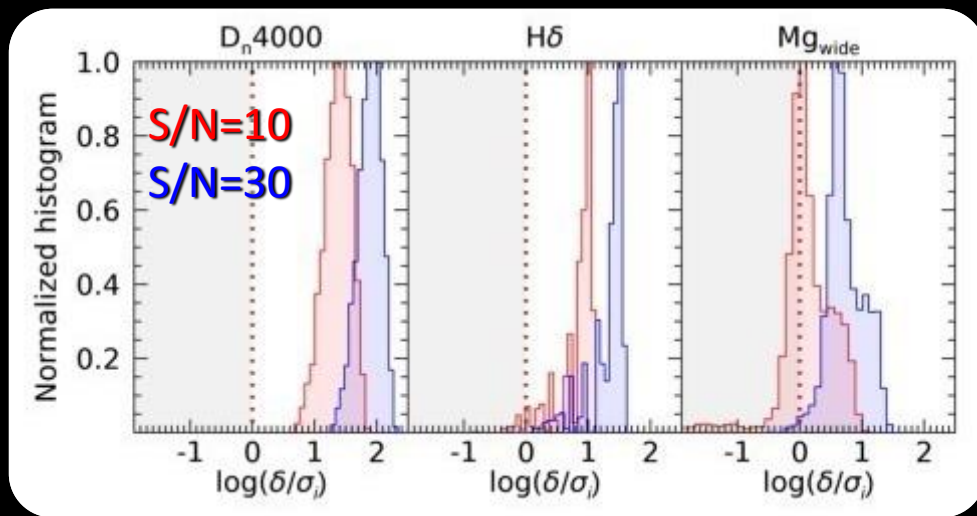
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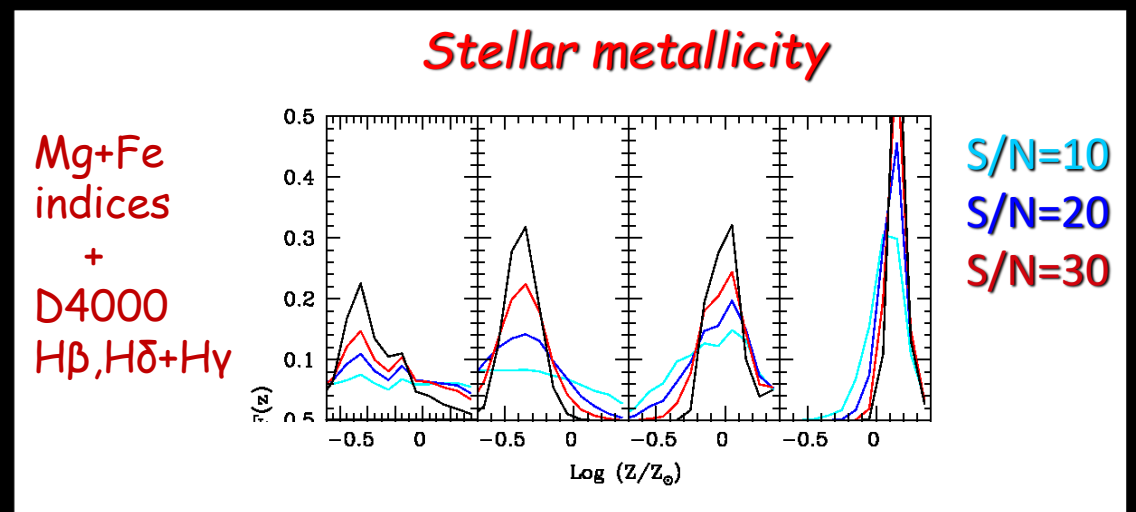
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Costantin et al. 2019



Gallazzi et al. 2005

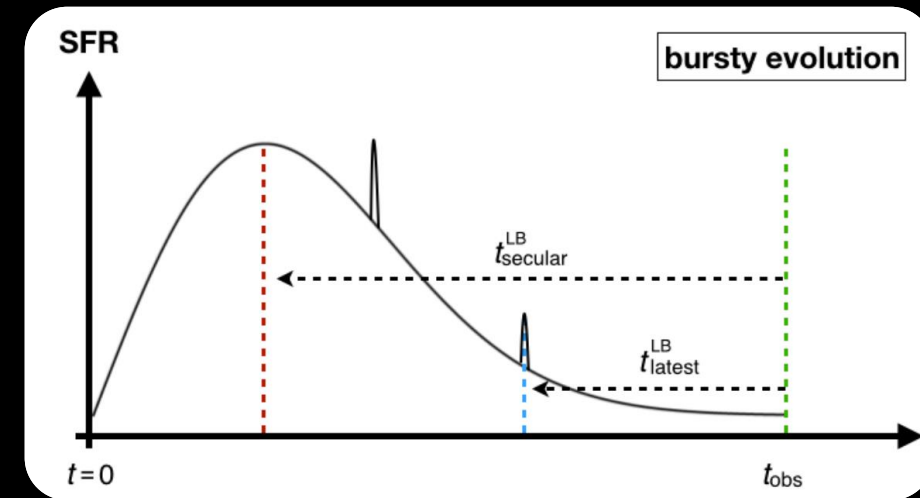
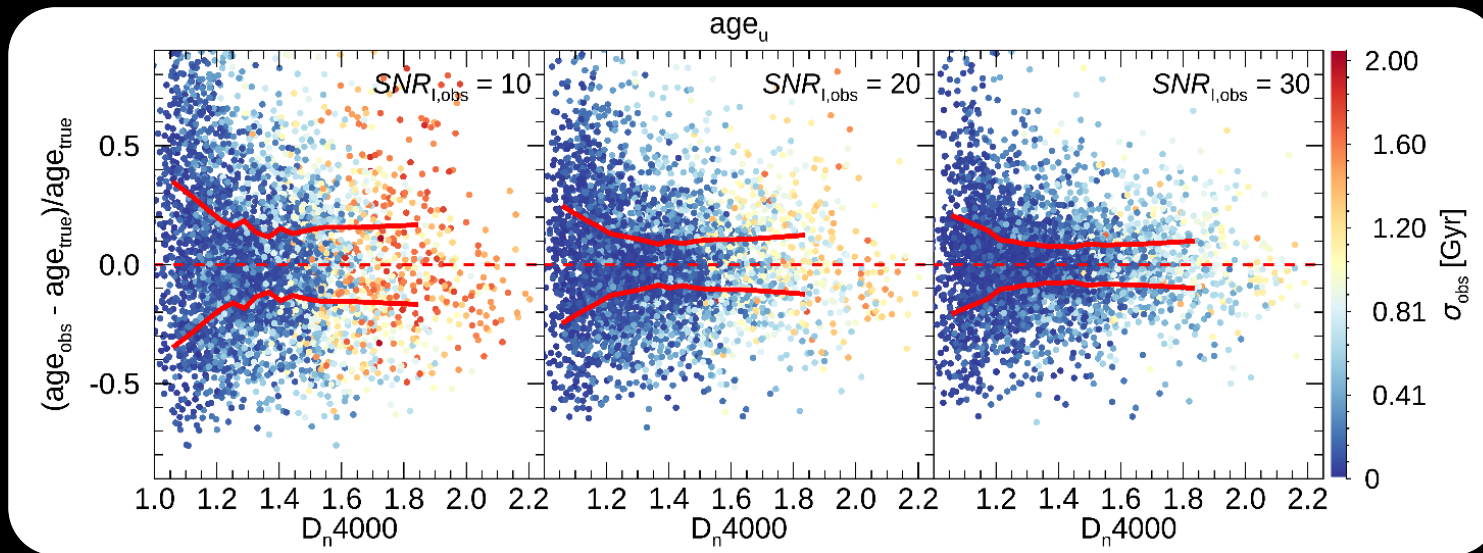
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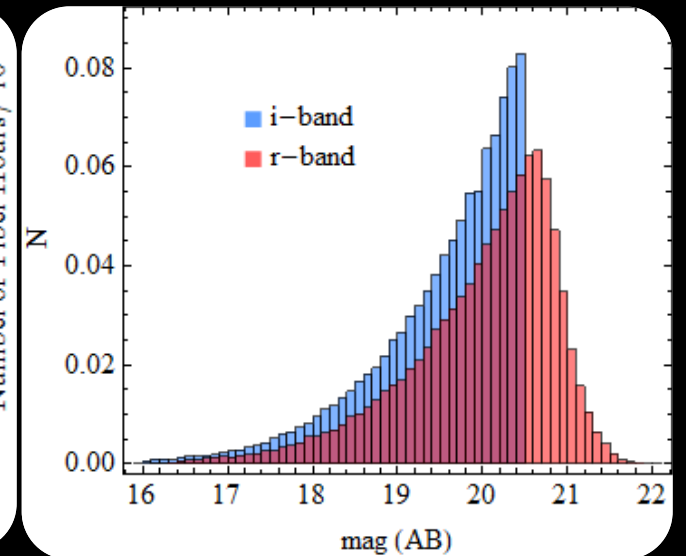
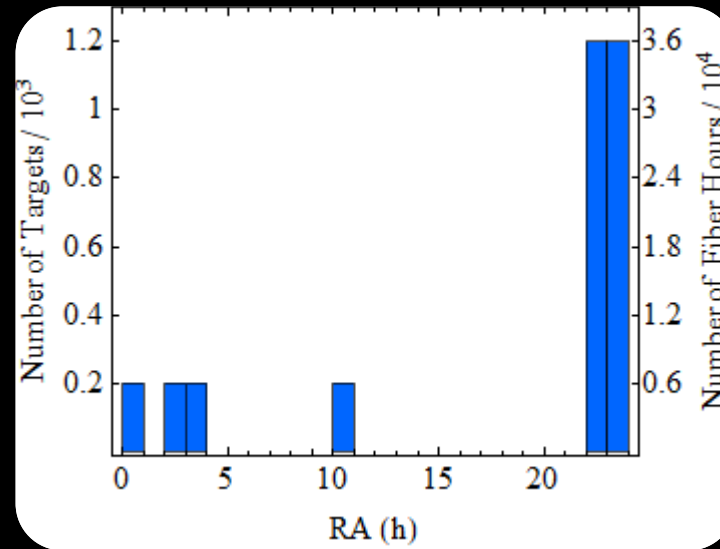
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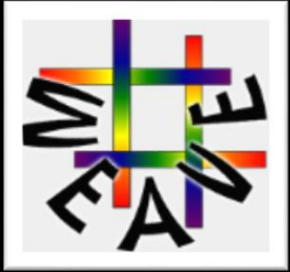
Strategy

- observe repeatedly subset of bright targets (~ 200 per FoV), embedded in the footprint of WAVES-Deep, where high number of passes are expected, totalling ~ 30 h exp for ~ 3.5 K galaxies

Total Fibre hours budget

- 100K fiber hours - only 2.5% of total available for public surveys





-StePS



-StePS



-Deep

A gain for all



- **4MOST-StePS is a powerful enhancement for a full science exploitation of WAVES-Deep – we will explore the connections between observed physical properties (mass, SFR, stellar age, metallicity) and environment - down to galaxy pair scales**
- **4MOST-StePS data will provide robust physical information, given their superior S/N, down to lower stellar masses and higher redshifts, thus complementing WEAVE-StePS results**
- **WEAVE-StePS larger statistic will help characterizing global trends in galaxy evolution mechanisms**



Take home messages

- ❖ **4MOST-StePS is a low-cost survey with a high scientific return**
- ❖ **4MOST-StePS will provide an unbiased empirical description of the evolutionary path of massive galaxies in the still unexplored redshift range $0.3 < z < 0.7$**
- ❖ **The important synergies with the science case of WAVES-DEEP is a win-win opportunity that should be seized**



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