WEAVE StePS
Lessons learned

Angela Iovino
INAF-OABrera

WEAVE StePS
A wish list for survey planning

Remember: the success of a survey starts with an intense, detailed and comprehensive planning.

Instrument details : WEAVE

	WEAVE
Telescope Ø	4.2 mt WHT
Location	La Palma
FoV	3.14 sq degs
Multiplexing	1000 fibers
Fiber Ø	1.3 arcsecs
λ @ R~5000	3700-9500
IFU capabilities	Yes

Foreseen operational time span:
5 years at 70% of total available nights guaranteed (=236 nights/year)

Survey Science goals:

WEAVE-StePS PI. A. Iovino & B. Poggianti
- Charting galaxy evolution over the past 7 Gyrs

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

Power of the Archeological approach to galaxy evolution

+

Advantages of the Look-Back approach

Survey Science goals:

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- derive galaxy stellar ages, star-formation timescales, stellar and gas metallicities, and dust attenuation;
- infer the past evolution of galaxies at different masses and redshift, relating their star formation histories to their intrinsic (e.g., stellar mass, galaxy morphology) and environmental properties;
- estimate gas kinematics and stellar velocity dispersions, allowing us to perform a dynamical classification of our galaxies and to make a link between star formation history, mass assembly history and dynamics.

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

- **Can we do it ?**
- **How to optimize the (observational) effort vs results ?**

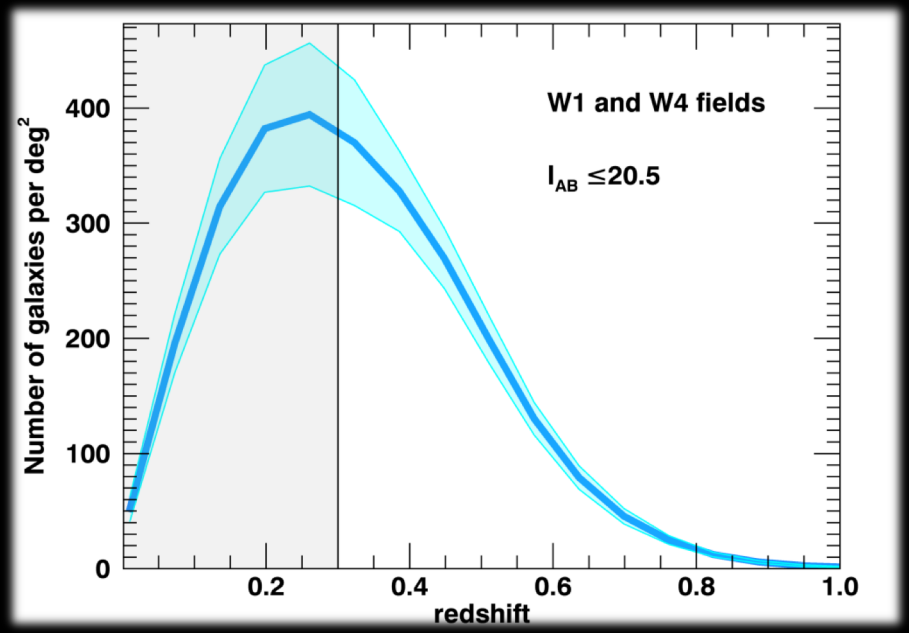
Survey Strategy – Part I

Definition of targets

35K galaxies at magnitude brighter than I_{AB} =20.5
pre-selected from photometric redshifts to be at z > 0.3

Mag Limit	Iab < 20.5
All Galaxies	~ 3000
Zphot > 0.3	~ 2000

StePS redshift distribution



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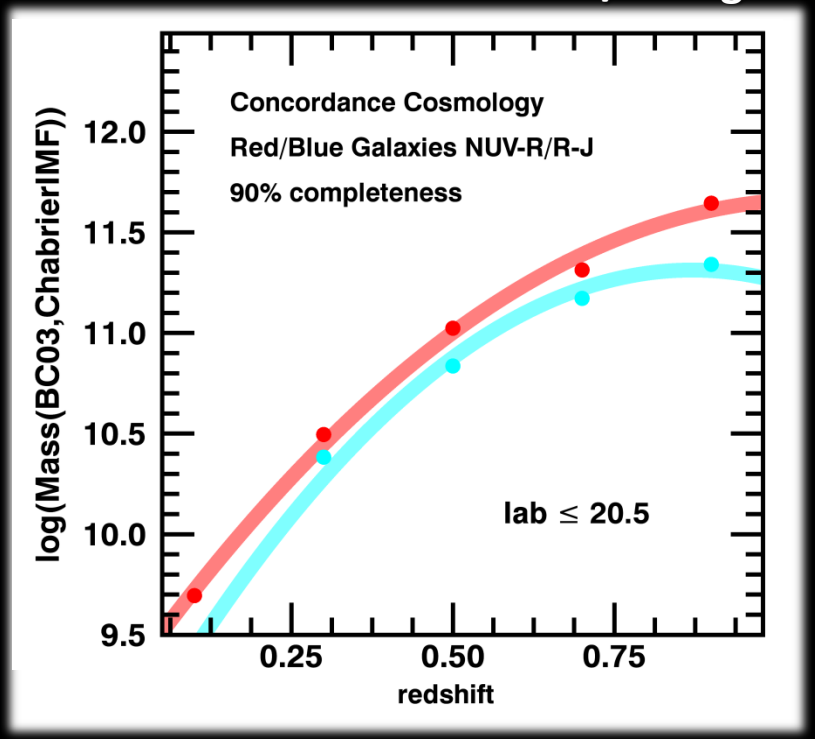
Redshift	Mass limit (log(M/Mo)
z=0.3	10.3
z=0.5	11.0
z=0.8	11.5

StePS Mass limits for red/blue gals

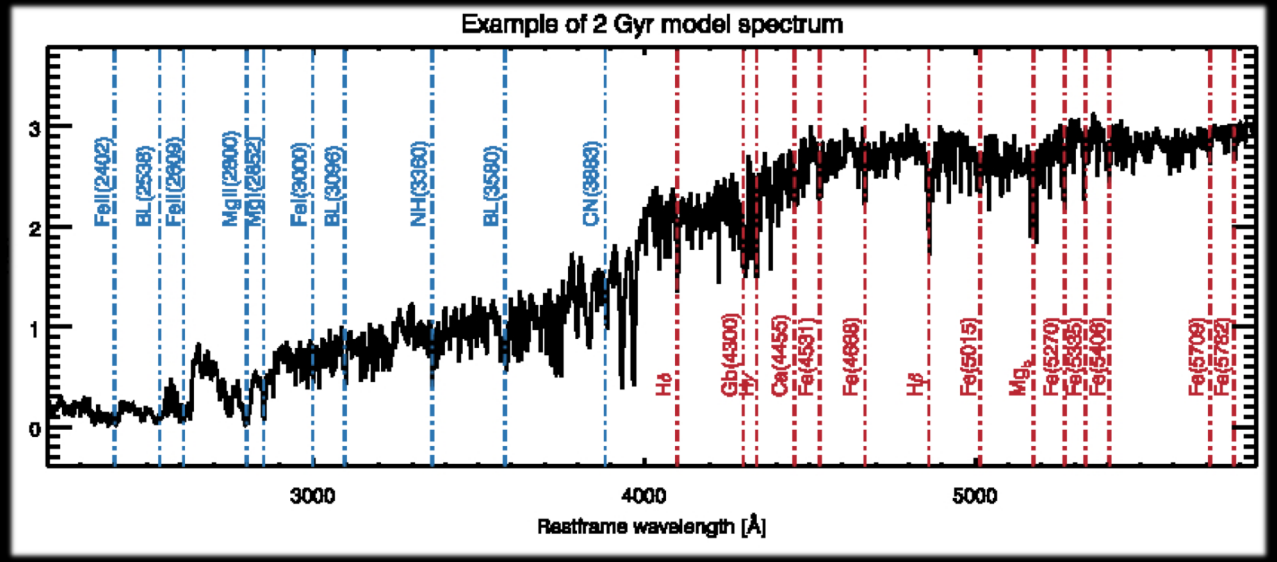


Survey Strategy – Part I

Definition of targets + quality requirements

35K galaxies at I_{AB} =20.5
pre-selected from phot-z to be at **z > 0.3**

High quality spectra: S/N>15
per resolution element (~1Å):
to resolve features in stellar continua



Survey Strategy – Part I

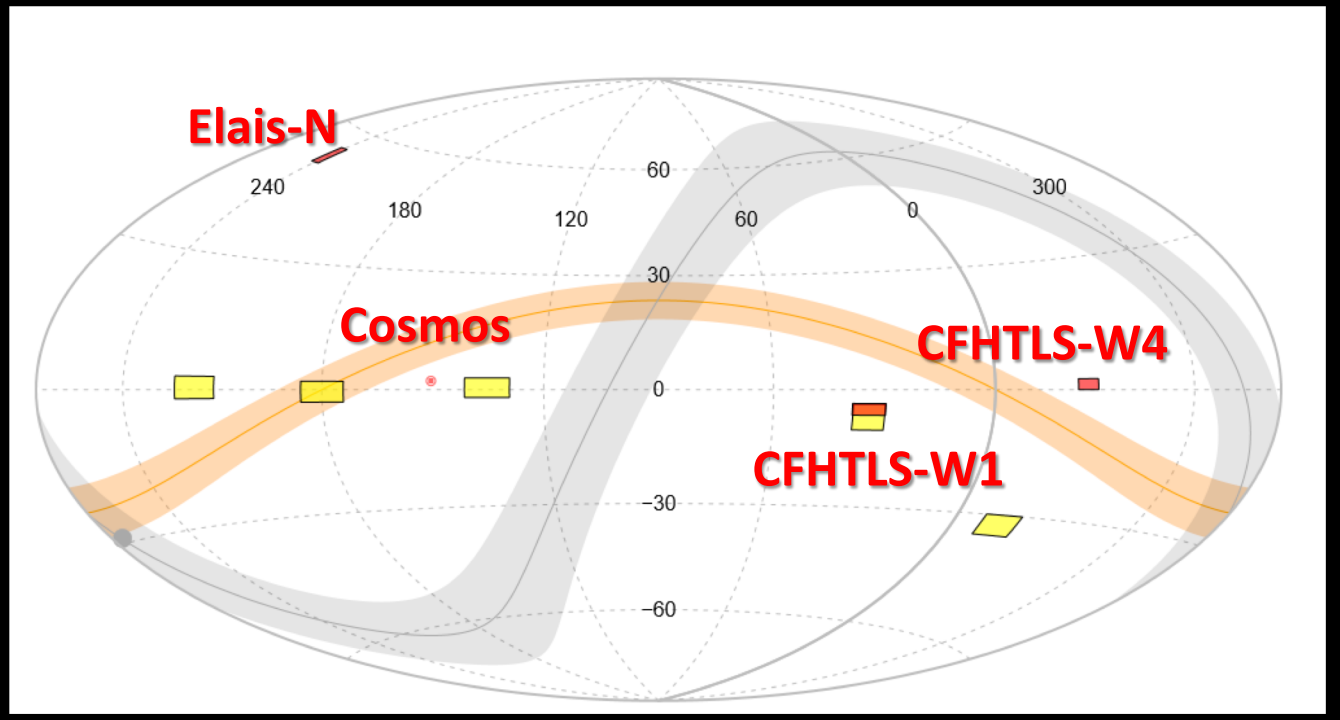
Definition of targets + quality requirements

35K galaxies at I_{AB} =20.5
pre-selected from phot-z to be at **z > 0.3**

High quality spectra: S/N>15

Well known extragalactic Fields:
Cosmos, W1, W4, Elais-N (~20 sq degs)

Plenty of ancillary data !



Survey Strategy – Part II

Moving to reality …

Survey Strategy – Part II

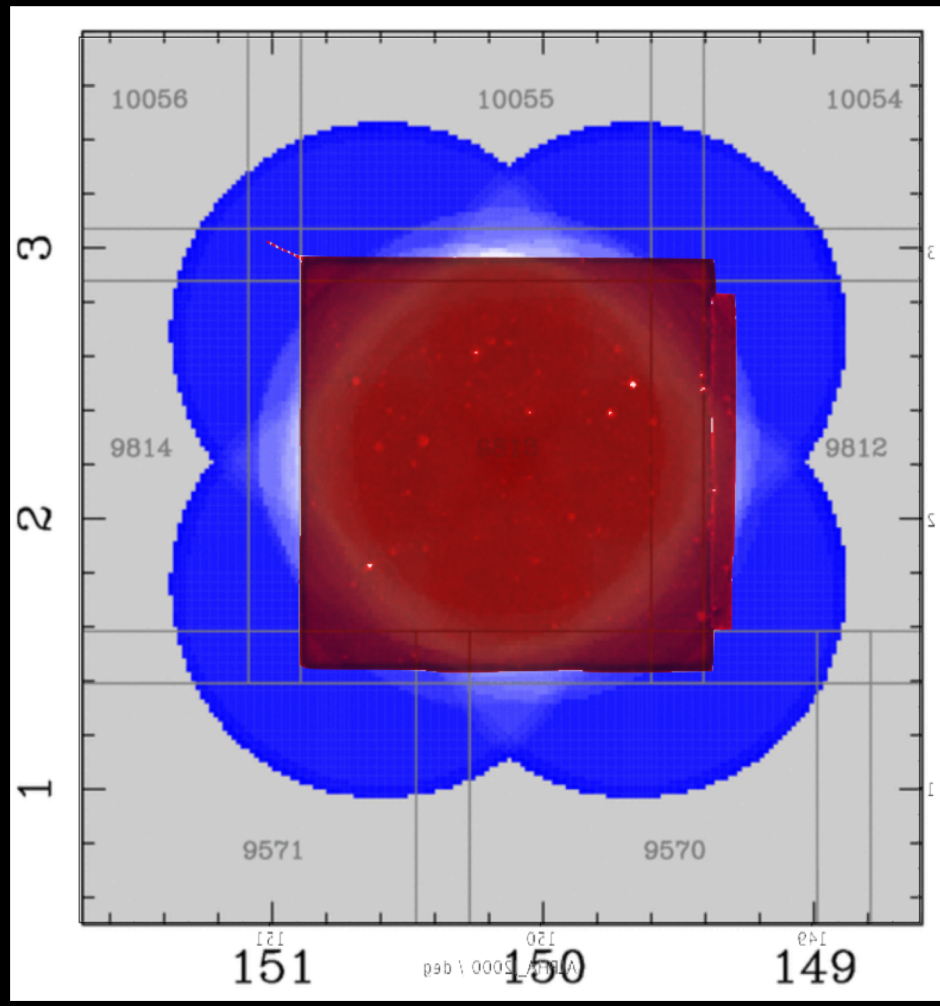
Huge amount of preparatory work:

- **Input Catalogs preparation**
  Delicate work of collating and homogenizing different catalogs

Even when observing well known extragalactic fields the preparatory Work is far from trivial

Catalogs Team: M. Bolzonella, E. Zucca, D. Vergani

Laigle+ 2015
Tanaka+ 2017



Survey Strategy – Part II

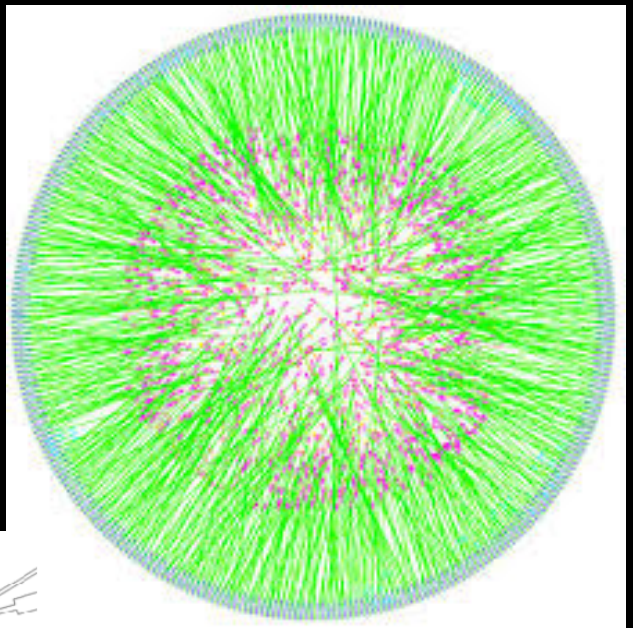
Huge amount of preparatory work:

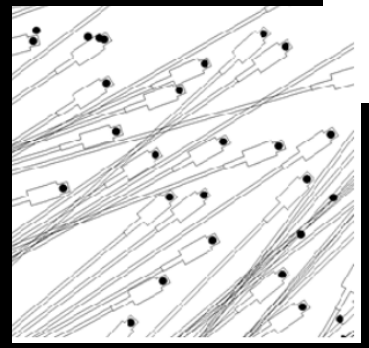
- **Input Catalogs preparation**
- **Tests for best tiling strategy and to optimize fiber allocation**

Need to insert a suitable amount of well distributed sky fibers + white dwarf targets to be used for Calibration purposes.

→ **Efficient tool for fiber positioning**

Survey Working Group: Amata Mercurio, Angela Iovino





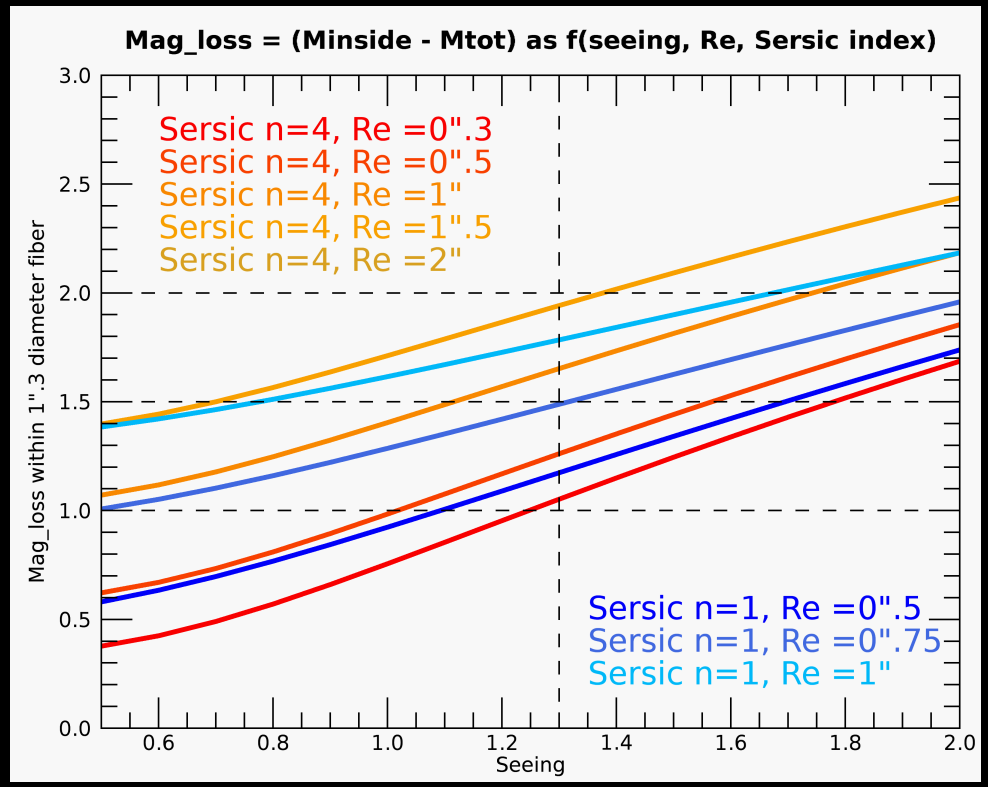
WEAVE Configure Tool
D. Terrett+ 2014

Survey Strategy – Part II

Huge amount of preparatory work:

- **Input Catalogs preparation**
- **Tests for best tiling strategy and to optimize fiber allocation + realistic in-fiber mags**

Need to consider the appropriate magnitude loss due to finite fiber size to check for realistic limiting magnitude – take COSMOS catalog as a baseline (morph parameters available)



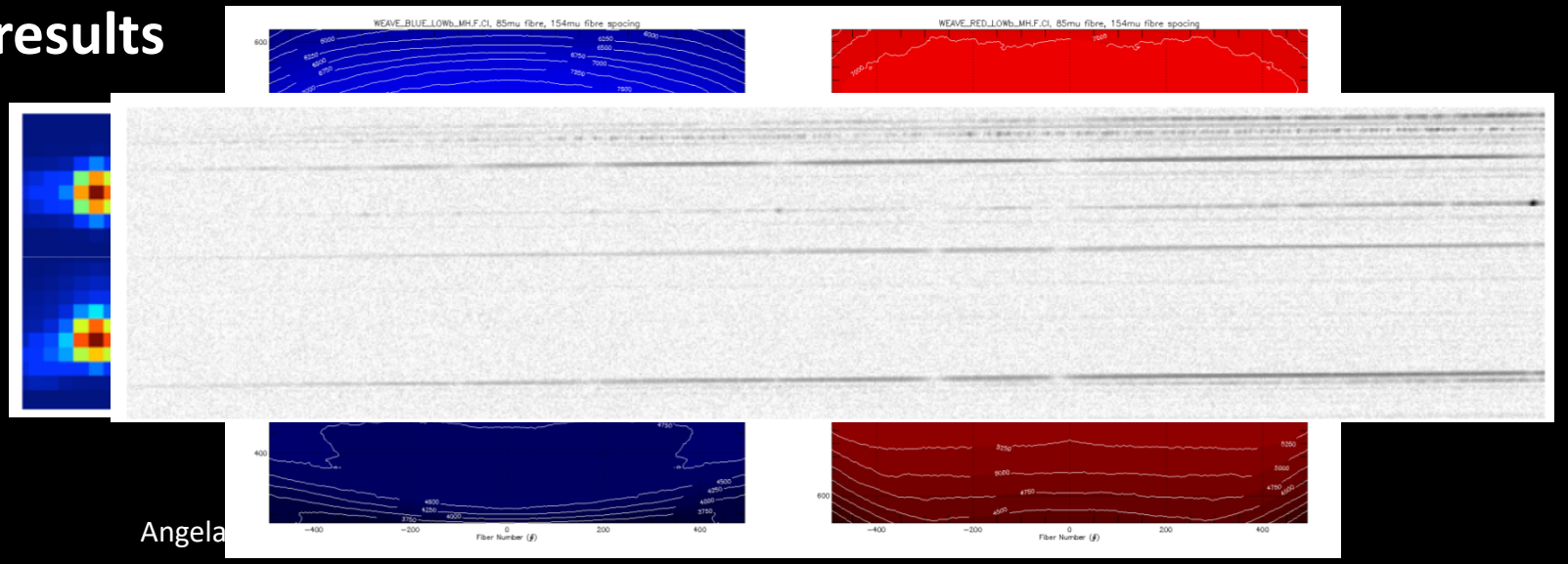
Survey Working Group: Amata Mercurio, Angela Iovino

Survey Strategy – Part II

Huge amount of preparatory work:

- Input Catalogs preparation
- Tests for best tiling strategy and optimal fiber allocation + realistic in-fiber mags
- Realistic Survey simulations (including em lines templates) to check feasibility and pipeline results

Full image simulations for WEAVE
G. Dalton + 2016



Survey Strategy – Part II

Configured fiber allocation

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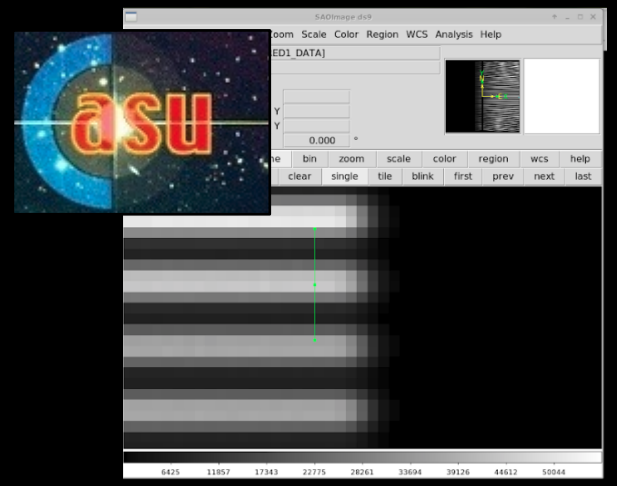
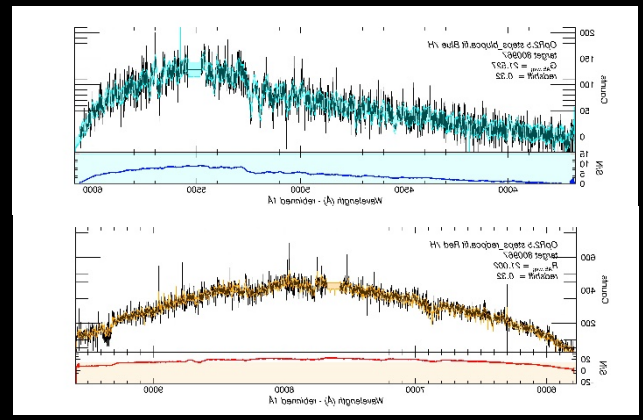
Catalogs + Input Template Spectra (MILES) redshifted and scaled for total mag-loss (fiber finite size + seeing)



Full image simulator



CASU – CPS
Core Pipeline System

N. Walton+ 2014

APS – Advanced Processing System

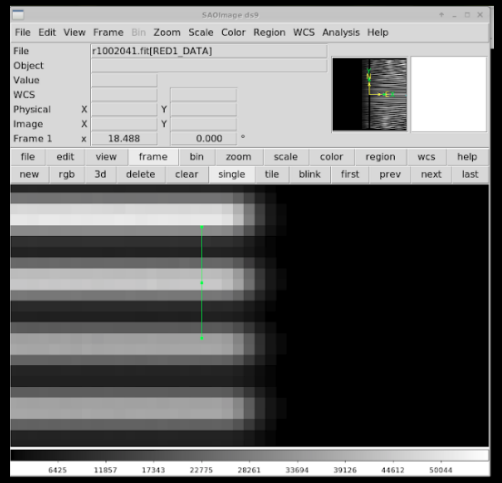
z, σ, D4000, Lick and UV indices…

Survey Strategy – Part II

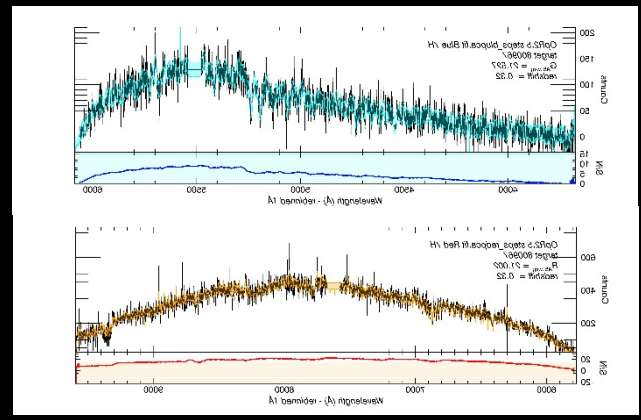
Configured fiber allocation

+

Catalogs + Input Template Spectra (MILES) redshifted and scaled for total mag-loss



Full image simulator



CASU – CPS
Core Pipeline System

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z, σ, D4000, Lick and UV indices…

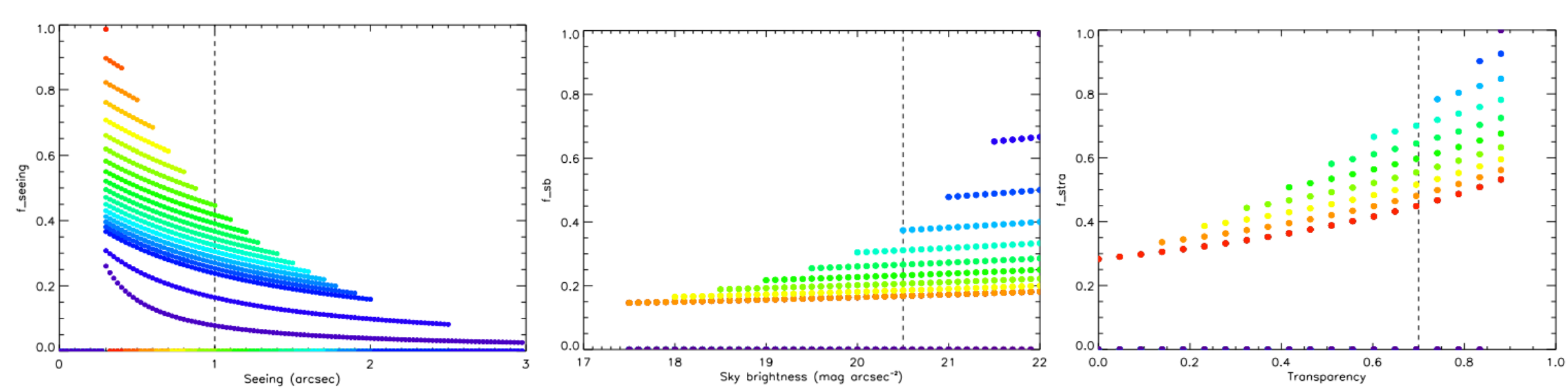
Survey Working Group: A. Mercurio, A. Iovino

Quality Assessment Group: M. Longhetti, S. Zibetti, F. La Barbera

Survey Strategy – Part II

… planning StePS Survey in context of the whole 5 years WEAVE survey

WEAVE Observations Queue Scheduler was used to run full 1.5 years operations reharsal with realistic (years 2016-2017) seeing, sky transparency and surface brightness values



C. Farina + 2018

Survey Strategy – Part II

Moving to reality …

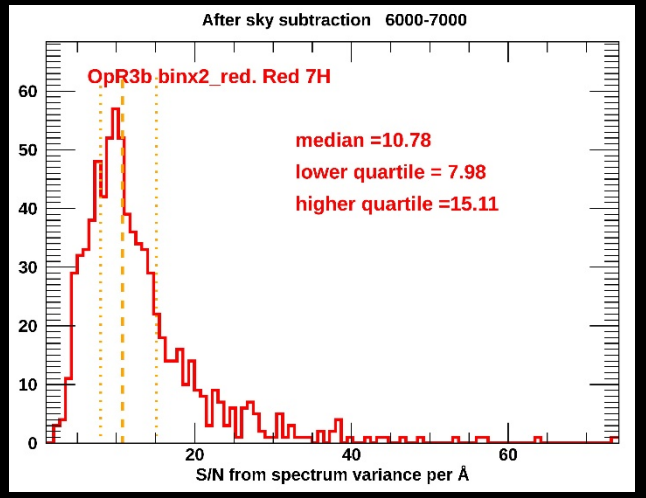
35K galaxies at I_{AB} =20.5
pre-selected from phot-z to be at z > 0.3

High quality spectra: S/N>15

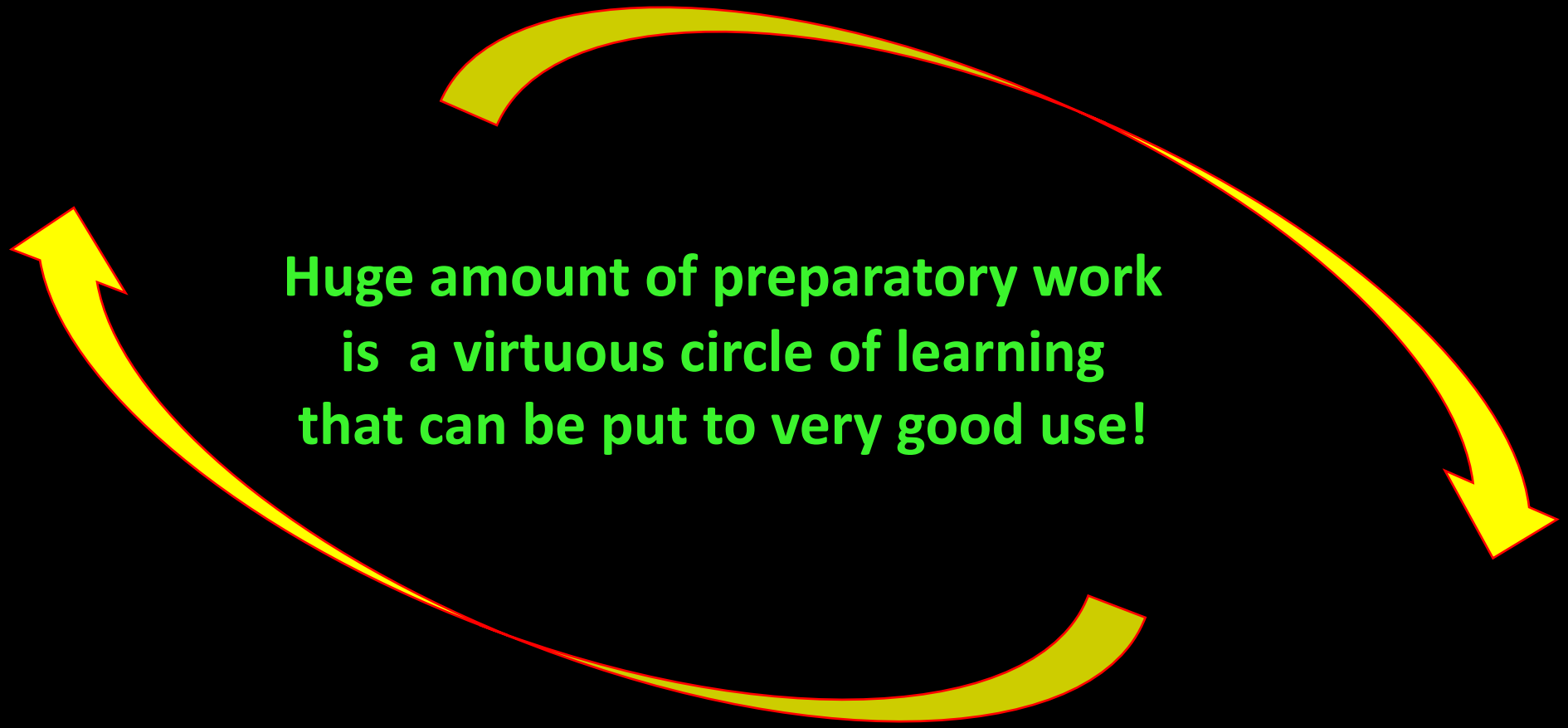
Well known extragalactic Fields:
Cosmos, W1, W4, Elais-N (~20 sq degs)

20K galaxies at I_{AB} =20.5
pre-selected from phot-z to be at z > 0.3

High quality spectra: S/N>10



Survey Strategy – Part II



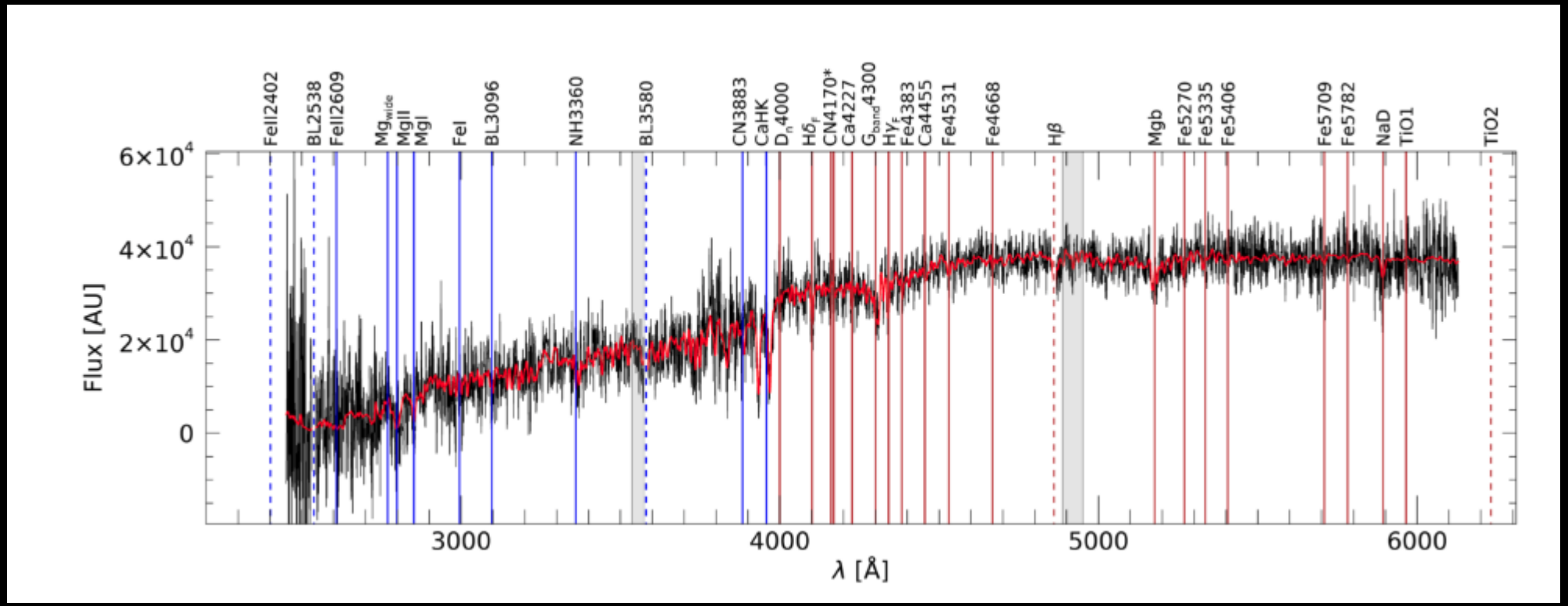
While Preparing for Science Exploitation …

Large library (~ 500.000) of templates library prepared by Zibetti/Gallazzi with a full suite of Star Formation Histories and Metallicities

Extract a random subset templates and produce WEAVE-like observations (CCD Gaps, realistic S/N including Sky, RON etc contributions) in the redshift range: $0.3 < z < 0.7$ and for different S/N: [10, 20, 30] per Å in observed I-band.

Adopt a Bayesian approach (as in Gallazzi et al. 2005, 2014) to explore how reliably input values are retrieved for observed templates.

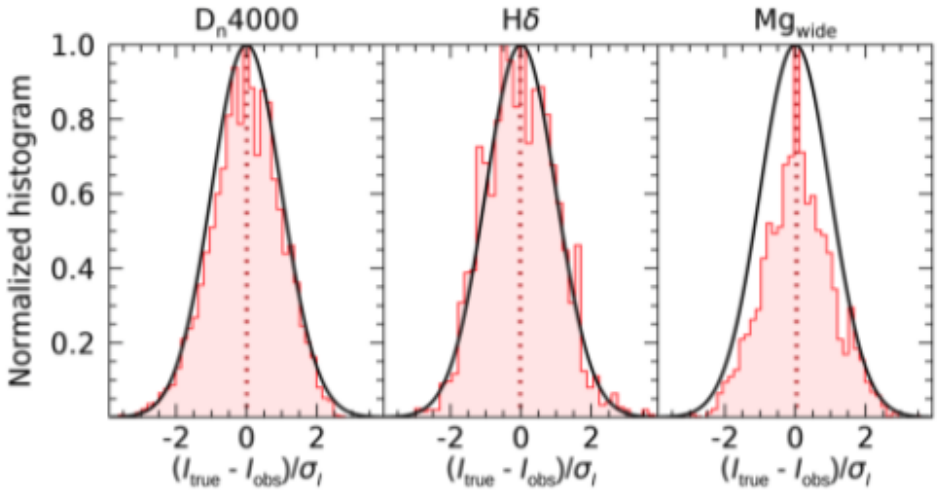
While Preparing for Science Exploitation …



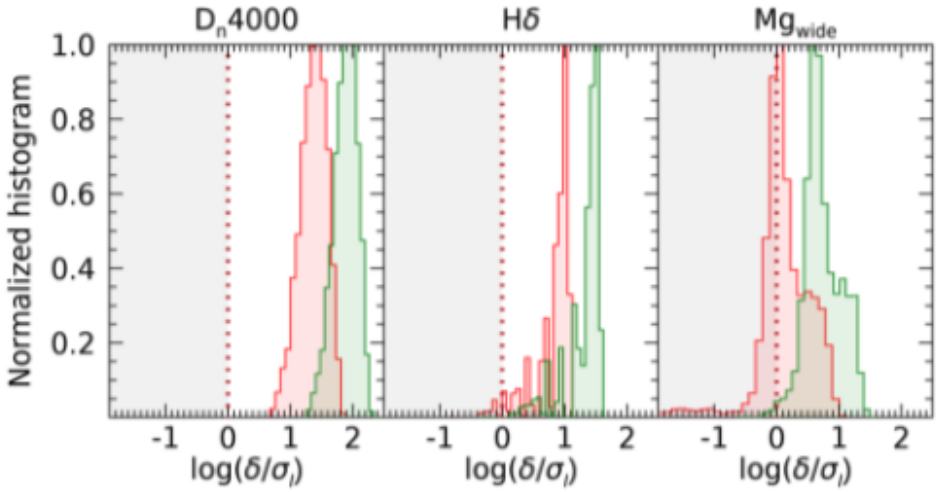
S/N = 10
z= 0.55

L. Costantin+ 2019

While Preparing for Science Exploitation …



No systematics between true and observed values of line indices (S/N=10)

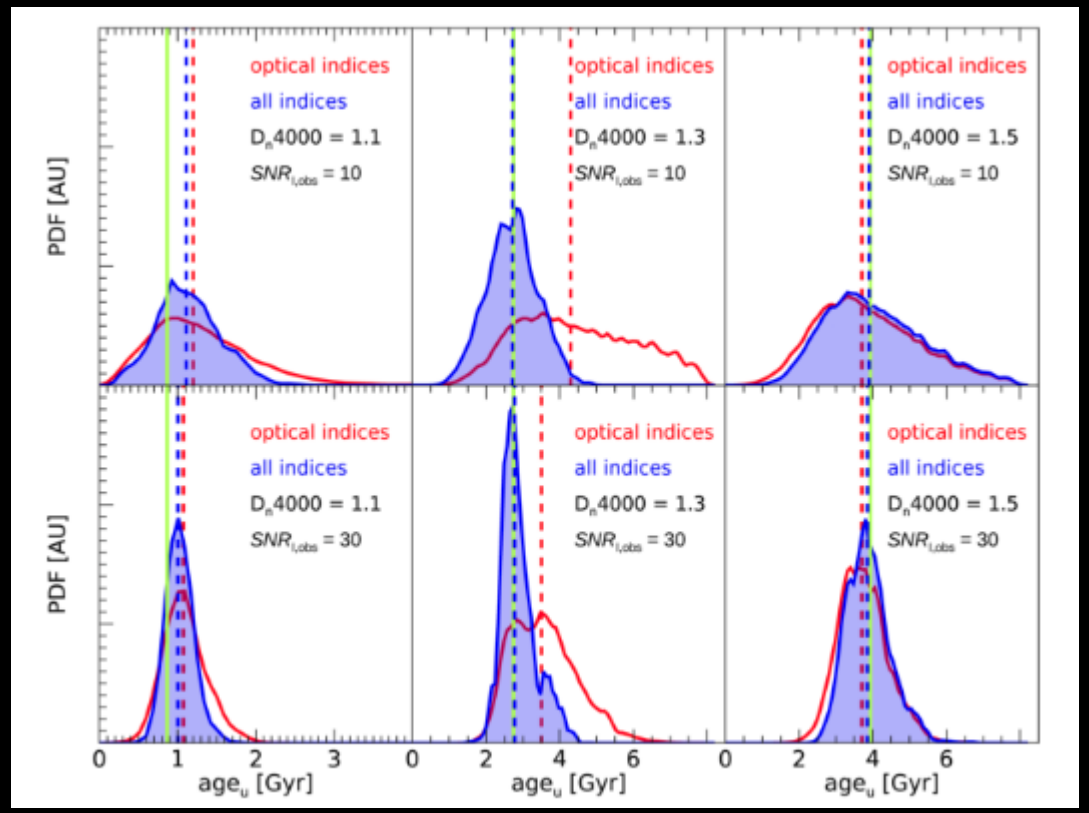


Good Resolving power of line indices (S/N=10/30)

S/N = 10/30
z= 0.55

L. Costantin+ 2019

While preparing for Science Exploitation …



For $D_n4000<1.5$, the ultraviolet indices increase the ability of constraining the age_u parameter, both in terms of true value and uncertainty in the measurement.

L. Costantin+ 2019

Lessons Learned

- Big telescopes and massively multiplexing instruments
- Big datasets
- Large collaborations with different needs
- Long term planning, well before starting observations
- Big challenges

Do-it-at home approach is a relic of the past!
A large coordinated effort is needed to optimize return and move to realistic planning (S/N, number of targets etc.)

The success of a survey starts with an intense, detailed and comprehensive planning.

Such planning has to be realistic and well explored long before survey starts.

Building instruments has to go hand-in-hand with the development of tools that enable thorough planning (simulators, pipelines for data reduction etc.)

Thanks for your attention