StePS @ WEAVE

Stellar Populations at intermediate redshift Survey

Amata Mercurio – INAF OANapoli
On behalf of the StePS team*

Team Leads: A. Iovino, B. Poggianti
INAF 'active' members: M. Longhetti, F. La Barbera, S. Zibetti, I. Lonoce, L. Pozzetti, M. Bolzonella, S. Bardelli, G. Busarello, A. Gallazzi, C. P. Haines , P. Merluzzi, N. R. Napolitano, D. Vergani, E. Zucca
Project Scientist: S. Trager

***http://www.ing.iac.es/weave/science_team.html**

WEAVE in 2017 VisionINAF Document

Formation and Evolution of Galaxies and Cosmic Structures.

- Key Question: What are the physical processes driving the assembly and the evolution of structures on scales of galaxies up to clusters of galaxies?

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Origin and fate of galaxies.
External and internal mechanisms (environment and relationship with the Cosmic Web) regulating the efficiency of star formation and stellar population properties.

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External and internal mechanisms (environment and relationship with the Cosmic Web) regulating the efficiency of star formation and stellar population properties.

Extend to higher redshift and with comparable wealth of data the analysis 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 empirical constraints on the physical mechanisms responsible for galaxy formation and assembly history.

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Layout:

- ✓ Scientific goals;
- ✓ Sample selection;
- ✓ Observing strategy.

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Layout:

- ✓ Scientific goals;
- ✓ Sample selection;
- ✓ Observing strategy.
- ✓ Operational rehearsal.

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StePS characteristics:

~ 30K galaxies at z=0.3-0.7 with $I_{AB} \leq 20.5$ mag, pre-selected to be at $z > 0.3$.

With

WEAVE @ WHT

WEAVE Characteristics

Telescope, diameter	WHT, 4.2m
Field of view	2° ⌀
Number of fibers	960 (plate A)/940 (plate B)
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	5750 (3000–7500)
Low-resolution mode wavelength coverage (Å)	3660–9590
High-resolution mode resolution	21000 (13000–25000)
High-resolution mode wavelength coverage (Å)	4040–4650, 4730–5450 5950–6850

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StePS will observe with:

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~ 30K galaxies at z=0.3-0.7 with $I_{AB} \leq 20.5$ mag, pre-selected to be at $z > 0.3$.

Unprecedented signal-to-noise ratio
S/N>15 per resolution element (~1Å) 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.**

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Uniqueness:

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

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StePS Fields:

name	coordinates	area covered (sq.deg)	tiles	Ntot
CFHTLS-W1 (XMM-LSS)	02:18:00 -05:00:00	14.0	7	28k
CFHTLS-W4	22:13:18 +01:19:00	6.0	3	12k
COSMOS	10:00:28 +02:12:21	2.2	1	7k
ELAIS-N1	16:12:10 +54:30:00	3.0	1	6k

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. ***Ancillary data (e.g. X-ray for environment, HST for getting good morphologies etc.) increases science impact!***

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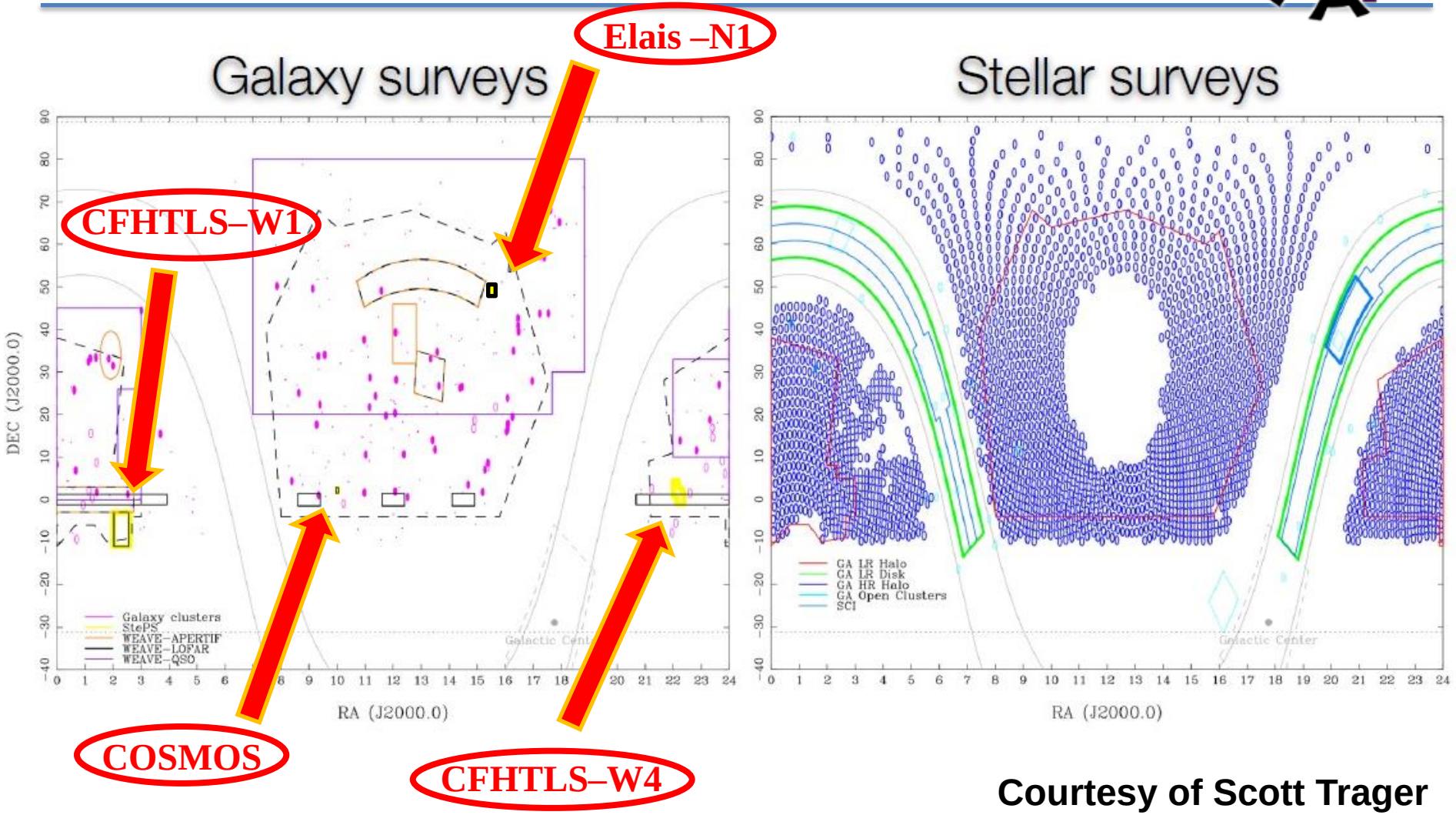
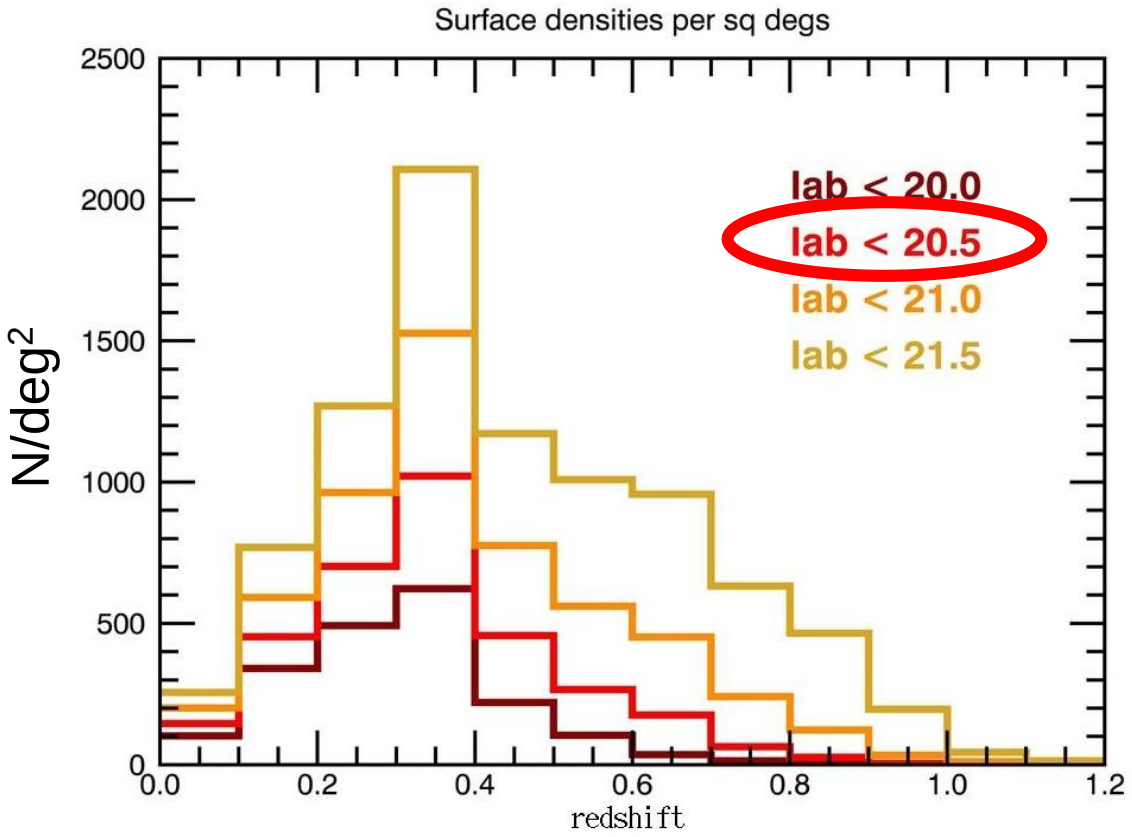


Courtesy of Scott Trager

StePS @ WEAVE


Surface densities per sq degs
N/deg^2
redshift
lab < 20.0
lab < 20.5
lab < 21.0
lab < 21.5
0
500
1000
1500
2000
2500
0.0
0.2
0.4
0.6
0.8
1.0
1.2

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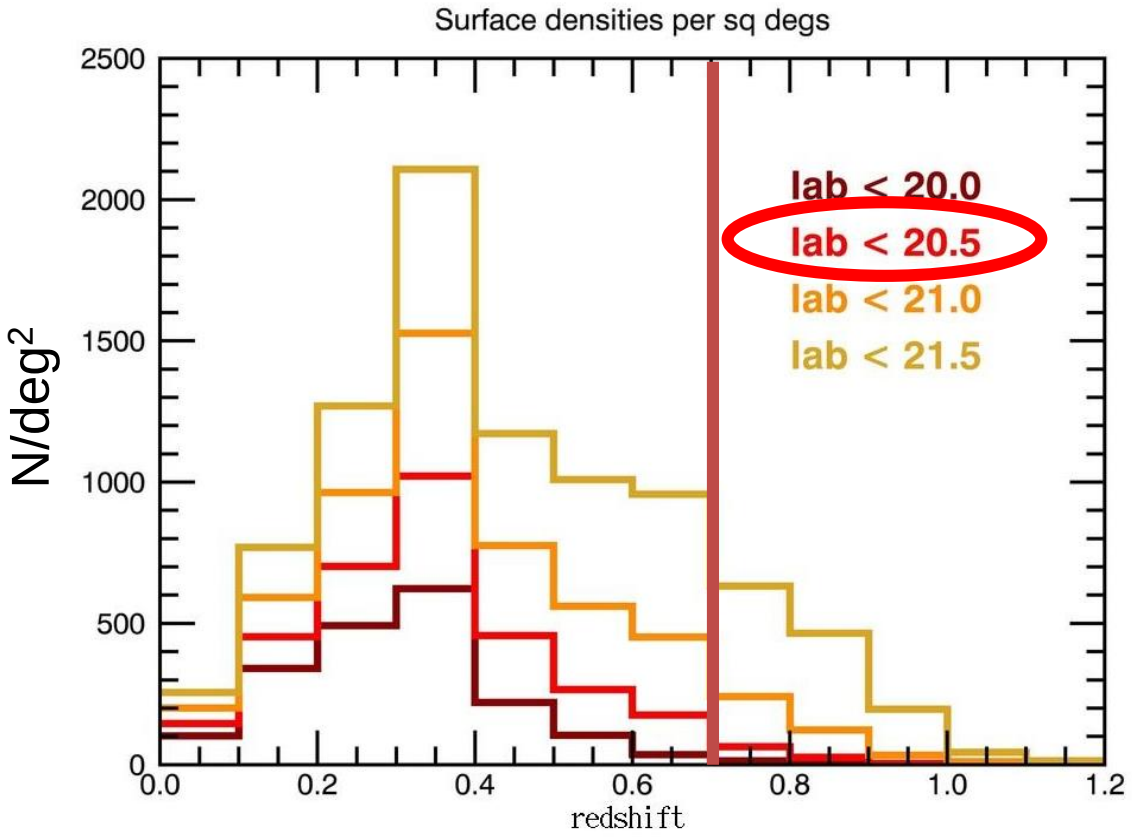
Surface densities per sq degs
2500
2000
1500
1000
500
0
N/deg^2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
redshift
lab < 20.0
lab < 20.5
lab < 21.0
lab < 21.5

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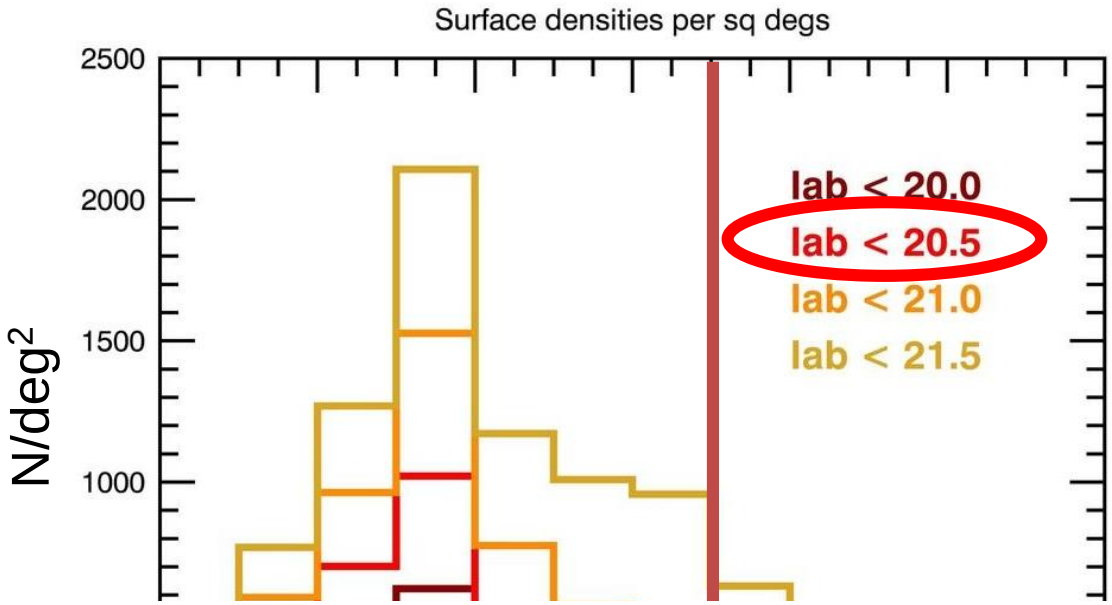

Galaxy surface density values (deg^{-2}) from COSMOS catalog

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

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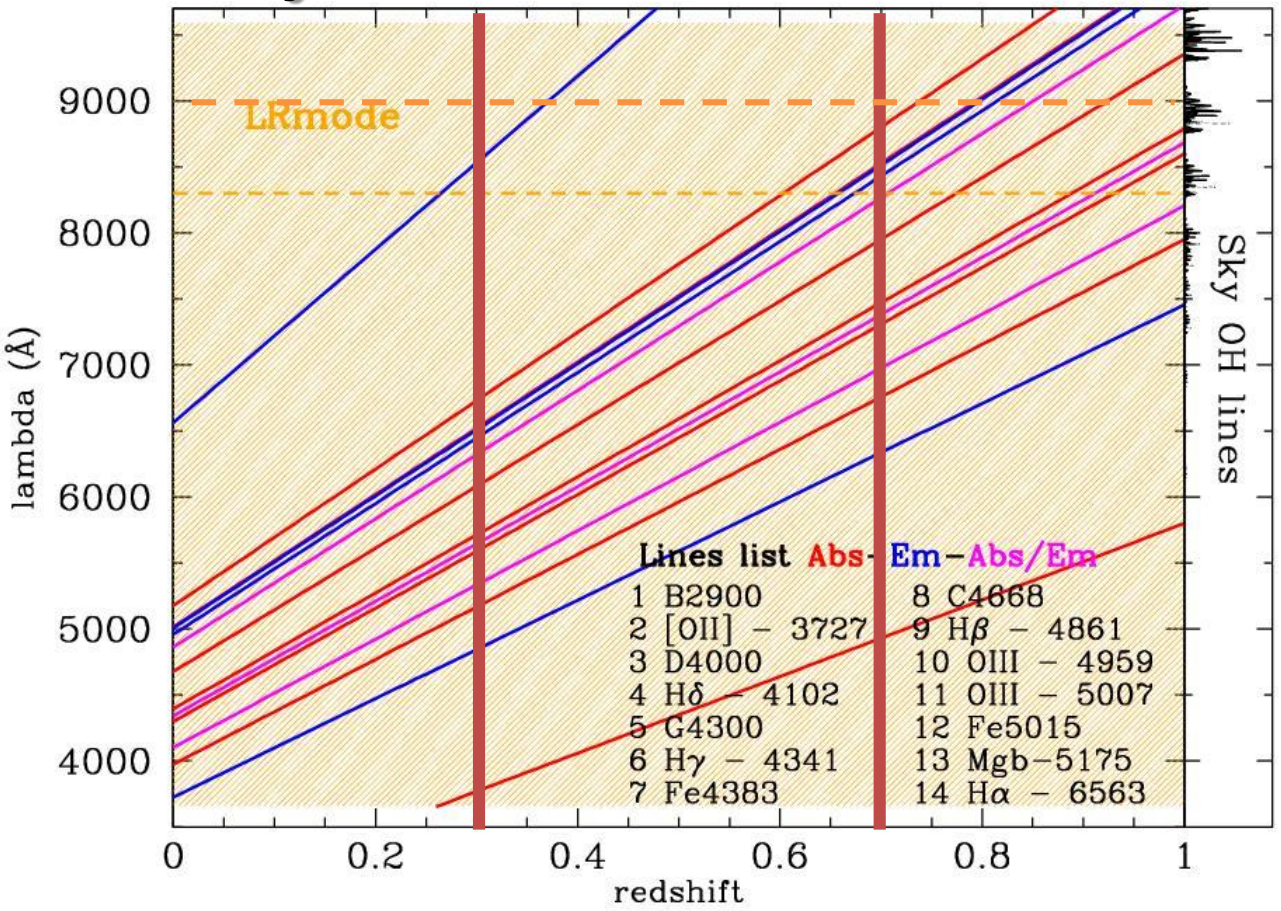
Main lines visibility:



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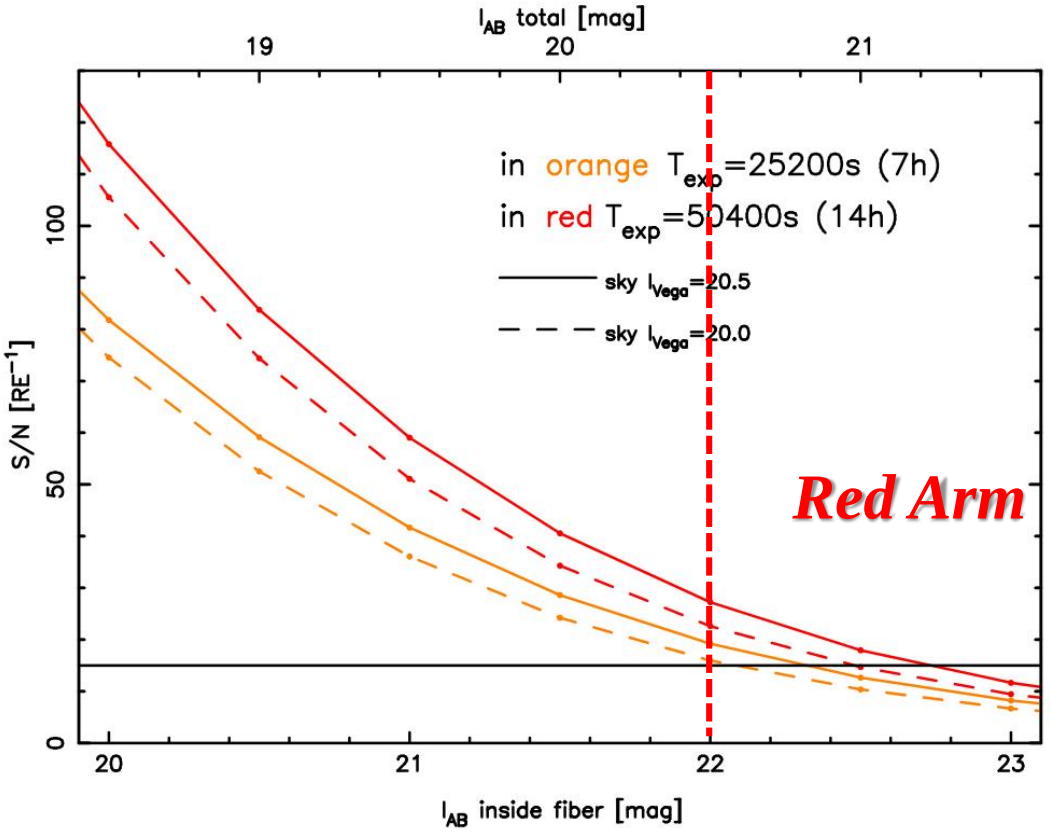
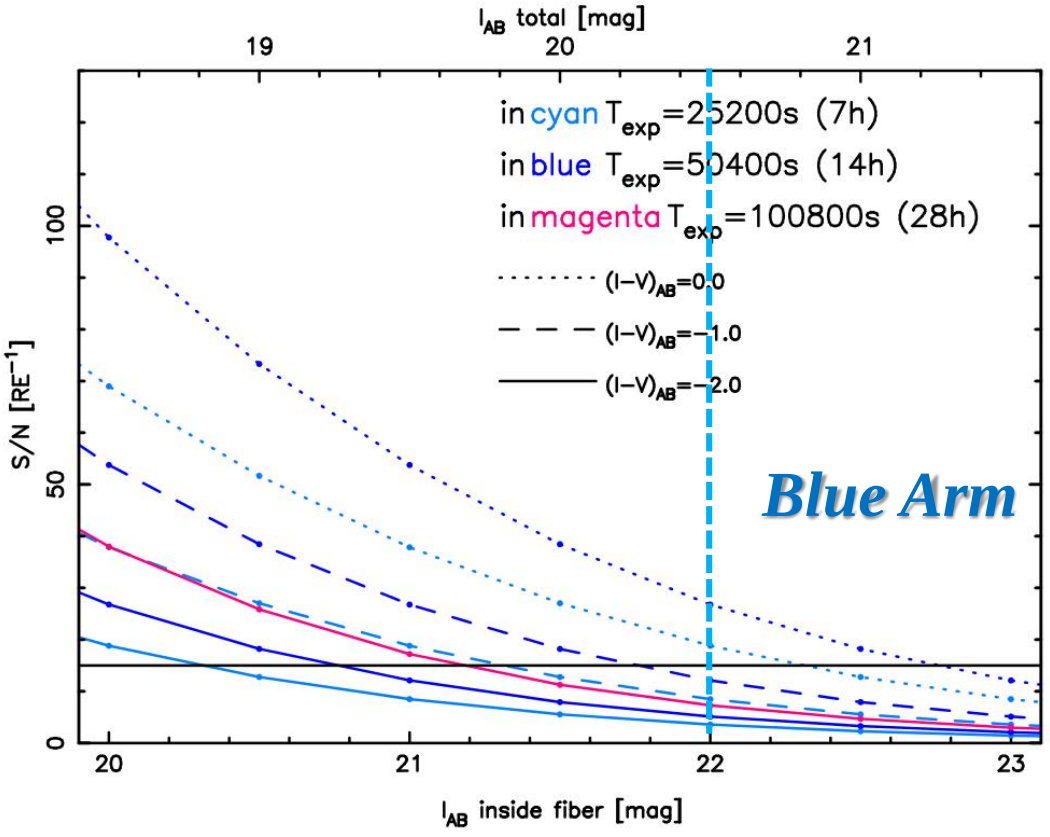
S/N as a function of exp time



StePS @ WEAVE

S/N as a function of exp time



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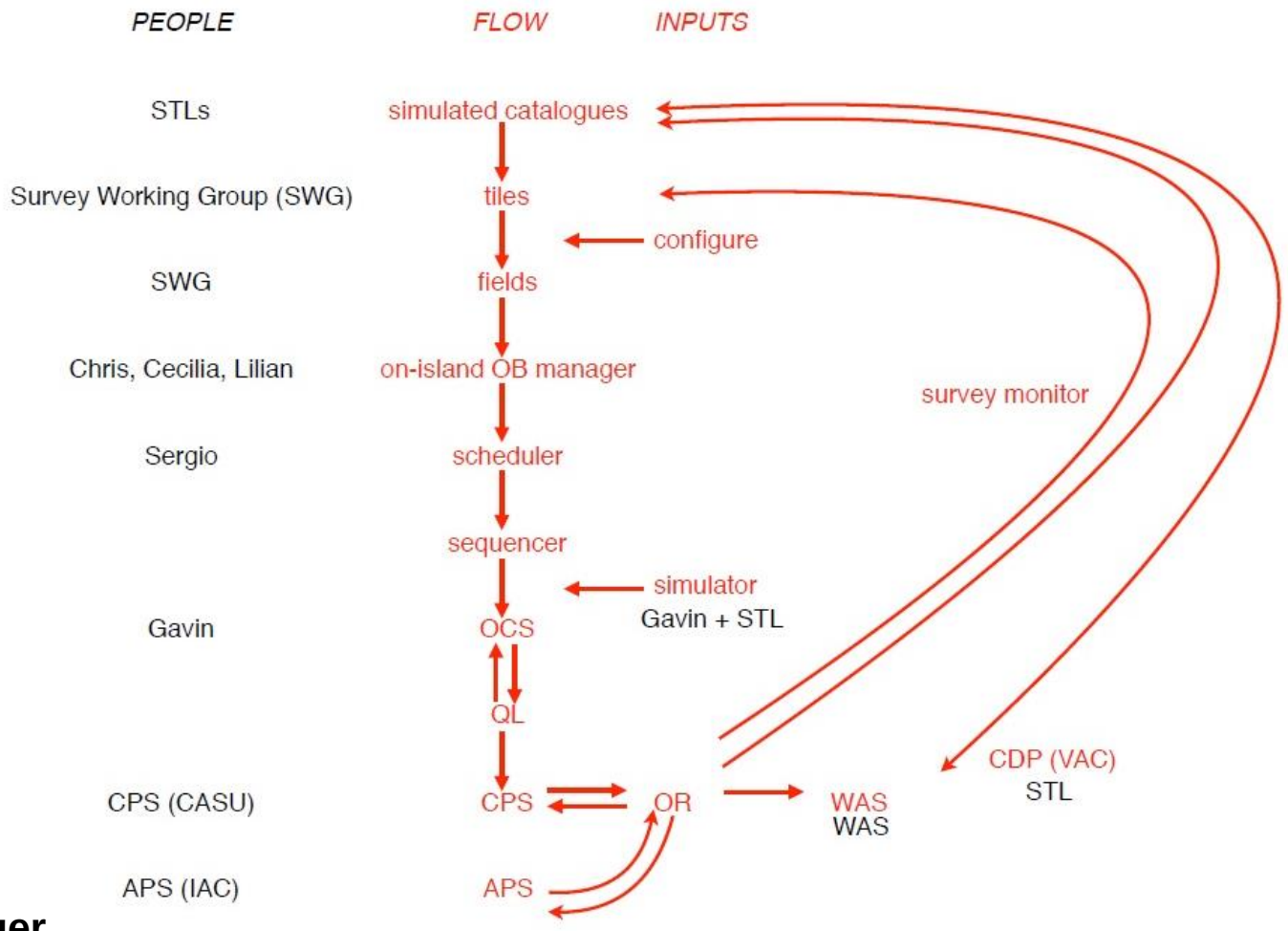
May-Jun 2017

Operational Rehearsal 2

Aug 2017

Operational Rehearsal 2.5



Courtesy of Scott Trager

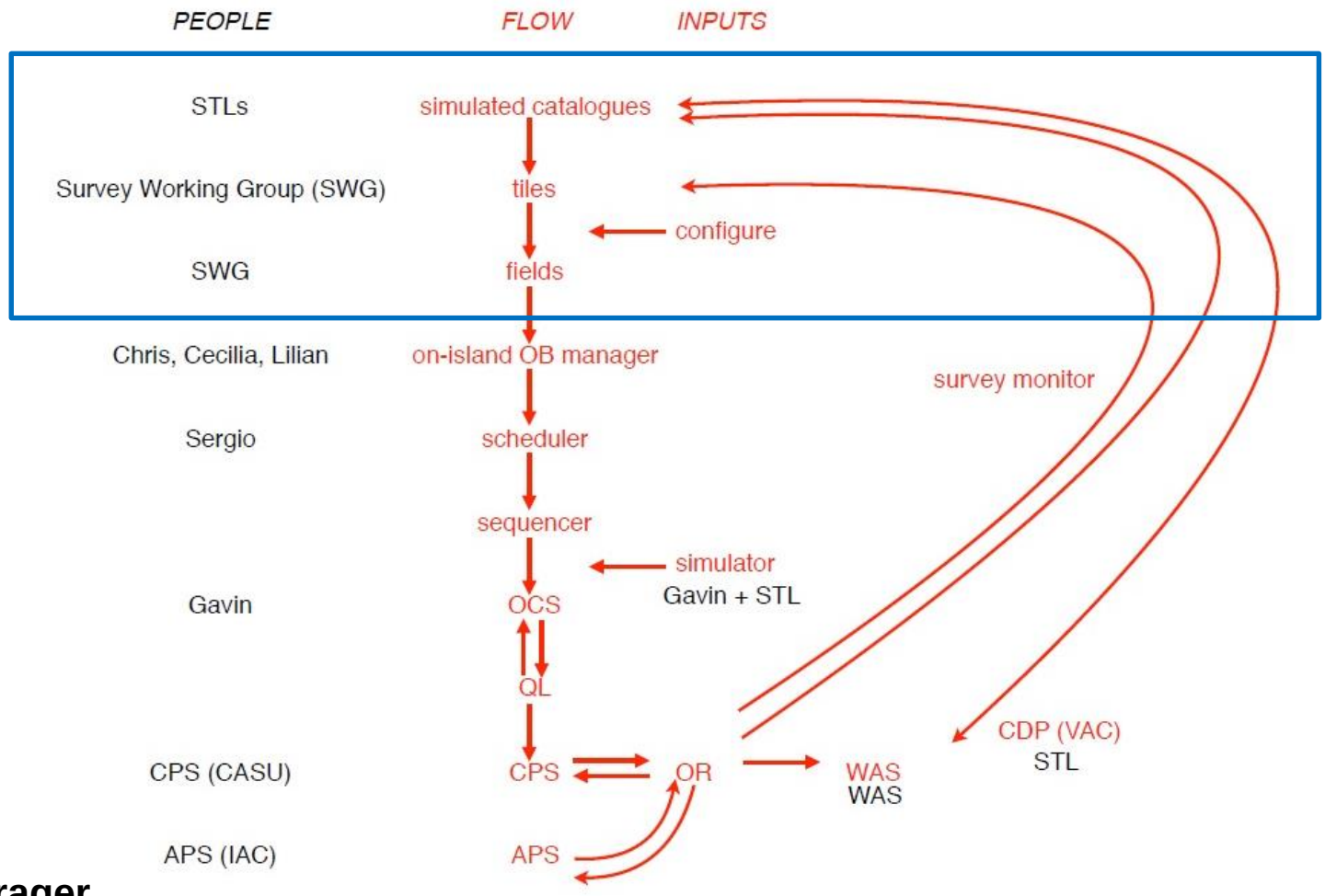
StePS @ WEAVE

May-Jun 2017

Operational Rehearsal 2

Aug 2017

Operational Rehearsal 2.5



Courtesy of Scott Trager

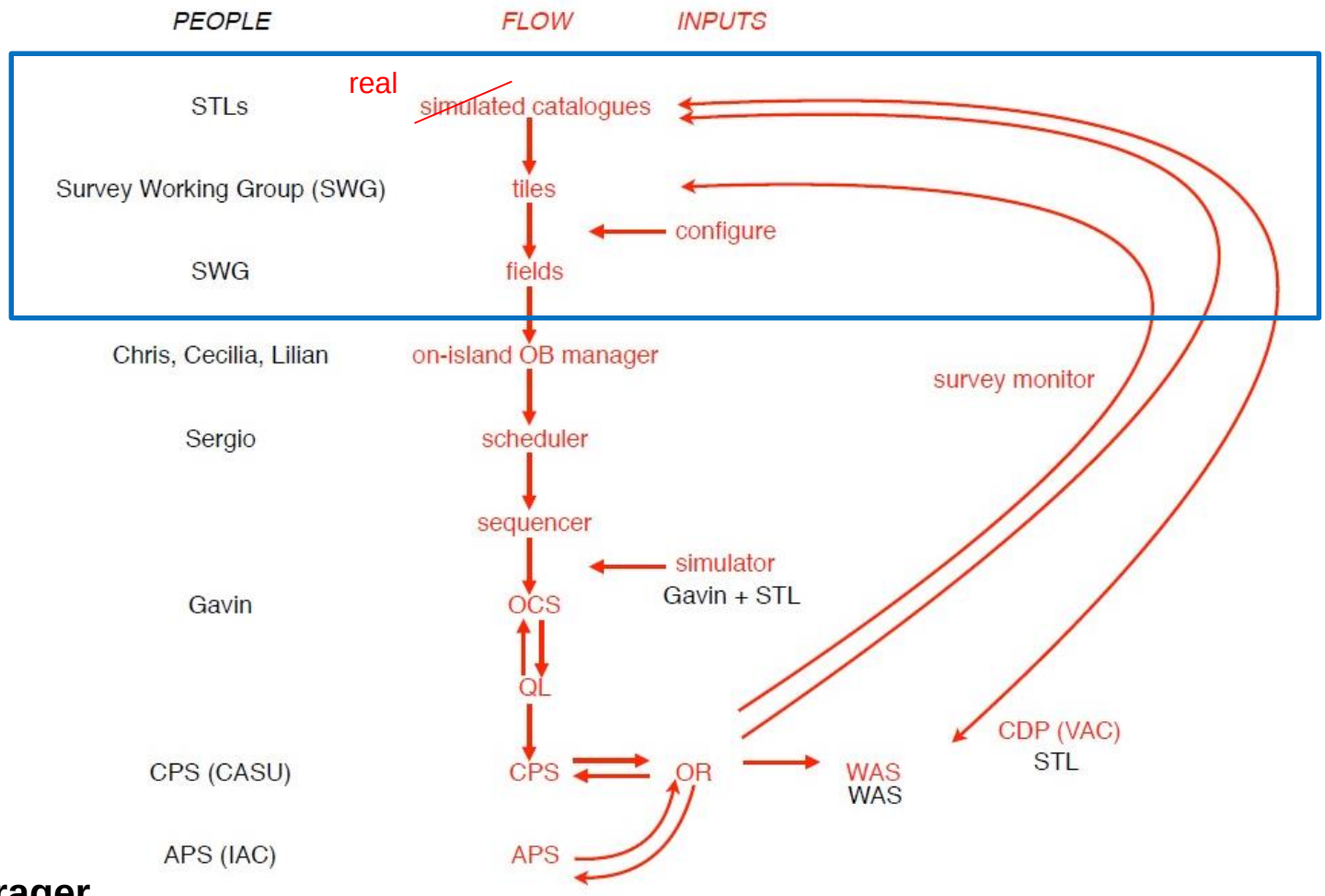
StePS @ WEAVE

May-Jun 2017

Operational Rehearsal 2

Aug 2017

Operational Rehearsal 2.5



Courtesy of Scott Trager

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Catalog of ~ 8000 galaxies in COSMOS field:

$I_{AB} \leq 20.5$ mag,

NO pre-selection.

Synthetic spectra template (actually no emission lines included) .

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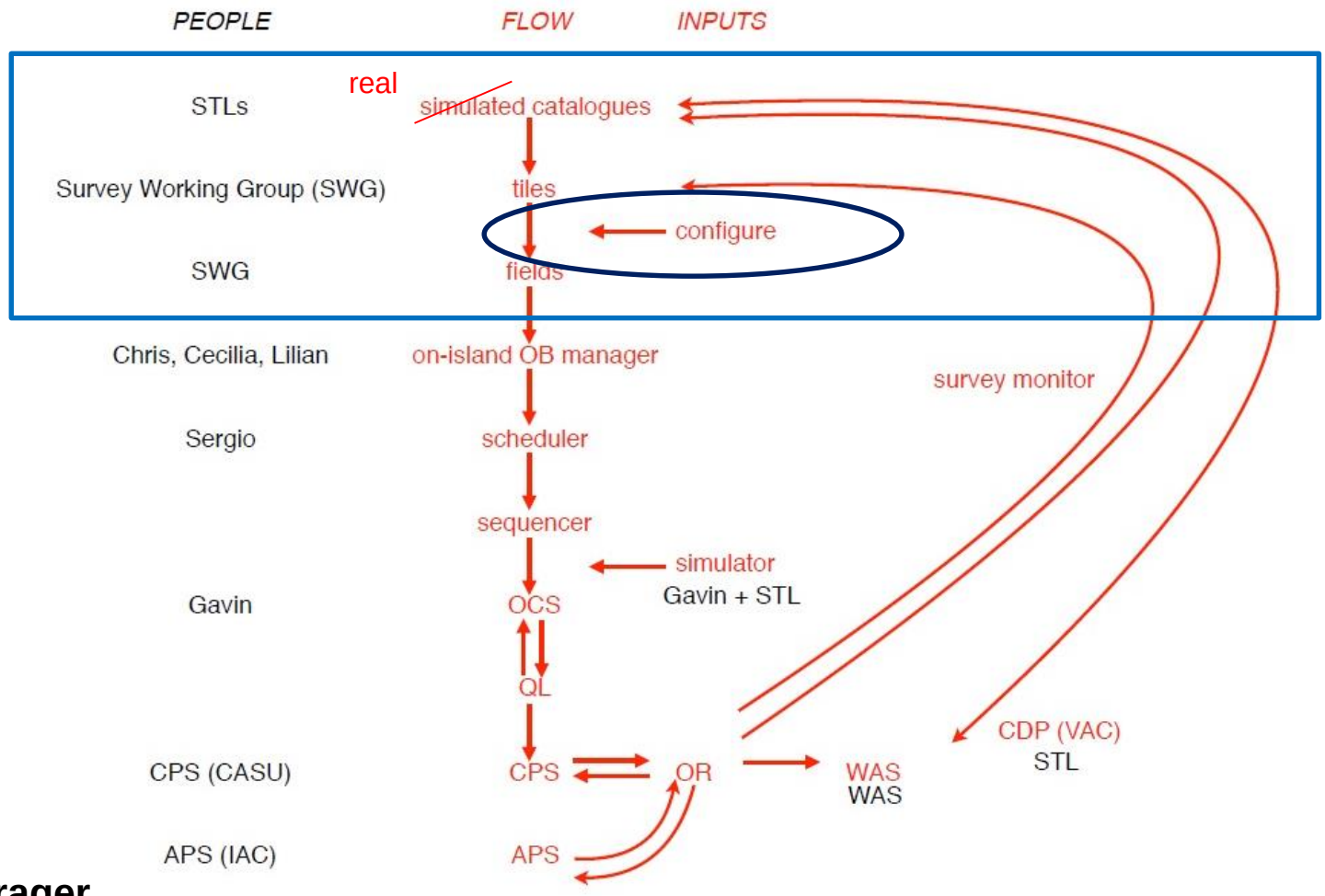
May-Jun 2017

Operational Rehearsal 2

Aug 2017

Operational Rehearsal 2.5



Courtesy of Scott Trager

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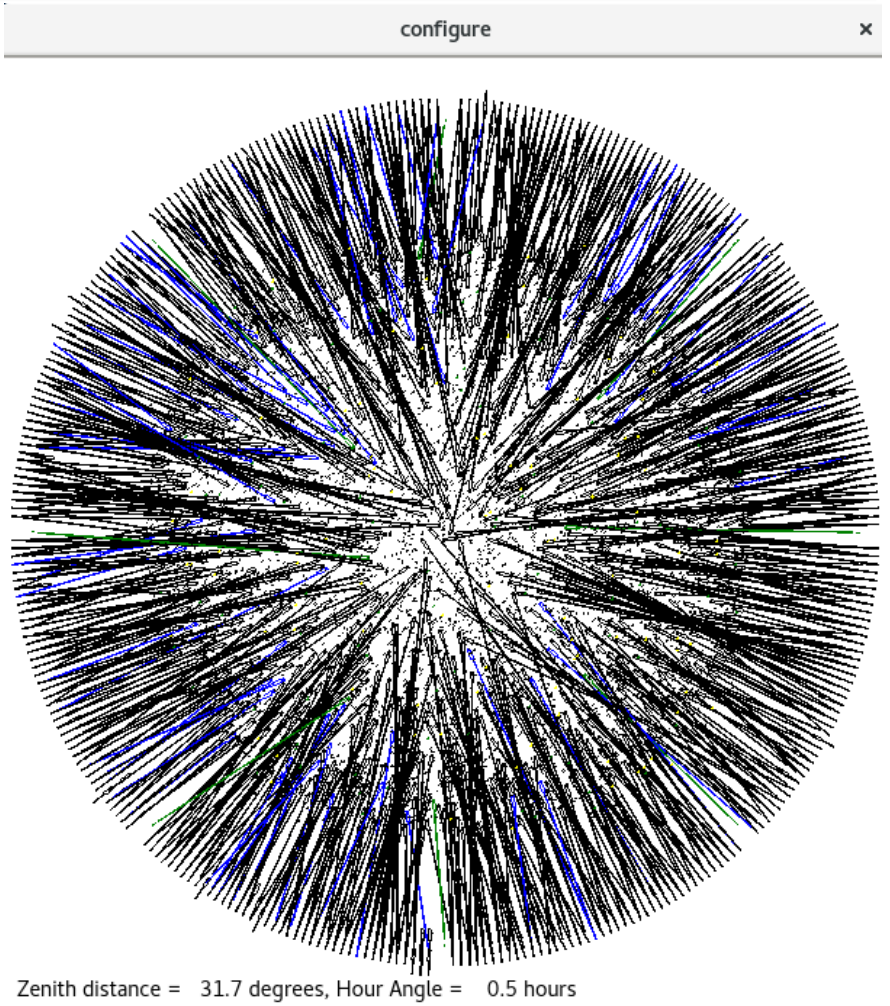
- 8 guide stars
- 20 calibration
- 50/80 sky
- 890/860 science



XML input and output files

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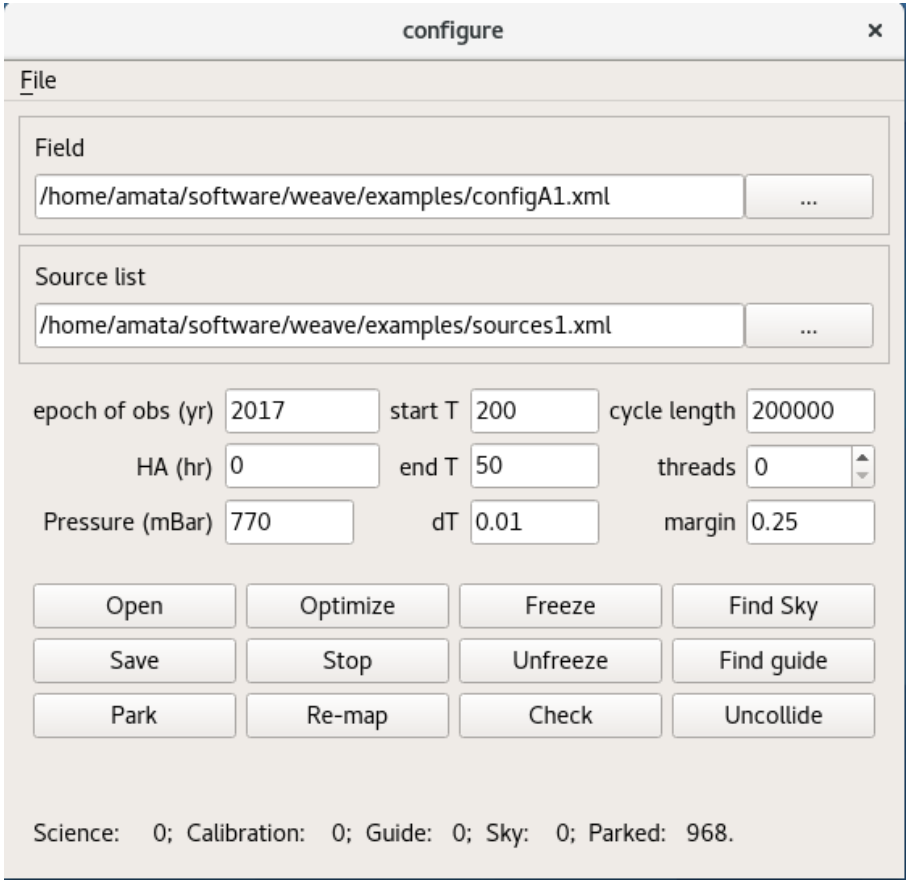
Input files:

- Field file: containing scientific targets (max 2 x num of fibres, calibration stars and guide stars;
- Source file: containing all sources in the field down to I~24 mag.



Observational Constraints

The environmental constraints for the observations are required for being used as an input to the Weave Queue

The following constraints shall be included into the XML field definitions (see WEAVE-ICD-025) under a XML group called **<obsconstraints/>**:

- **seeing_max**: Maximum seeing (arcsecs)
- **skybright_max**: Maximum Sky Brightness (mag/arsec2)
- **elevation_min**: Minimum elevation (degrees)
- **moondist**: Min lunar distance (degrees)
- **transparency_min**: Min transparency, expressed as a fraction n.n to 1.0 e.g. 0.9

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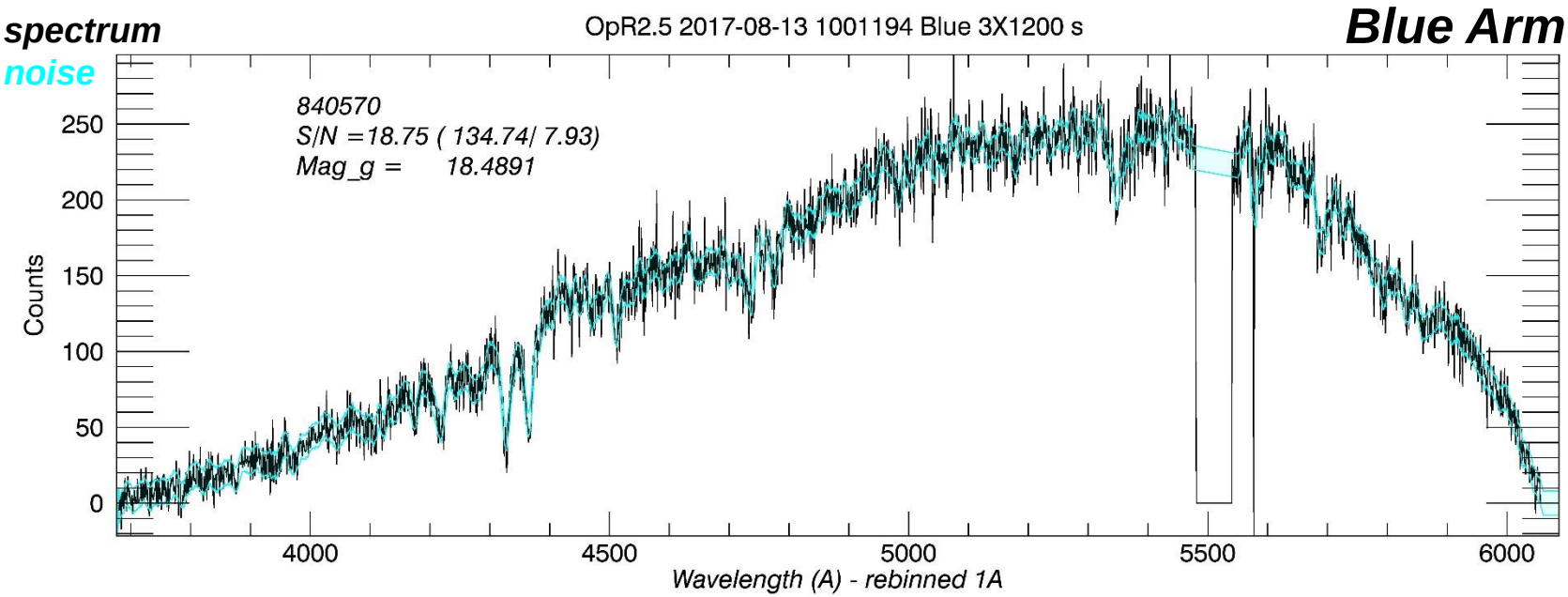
Simulated spectrum

Simulated noise

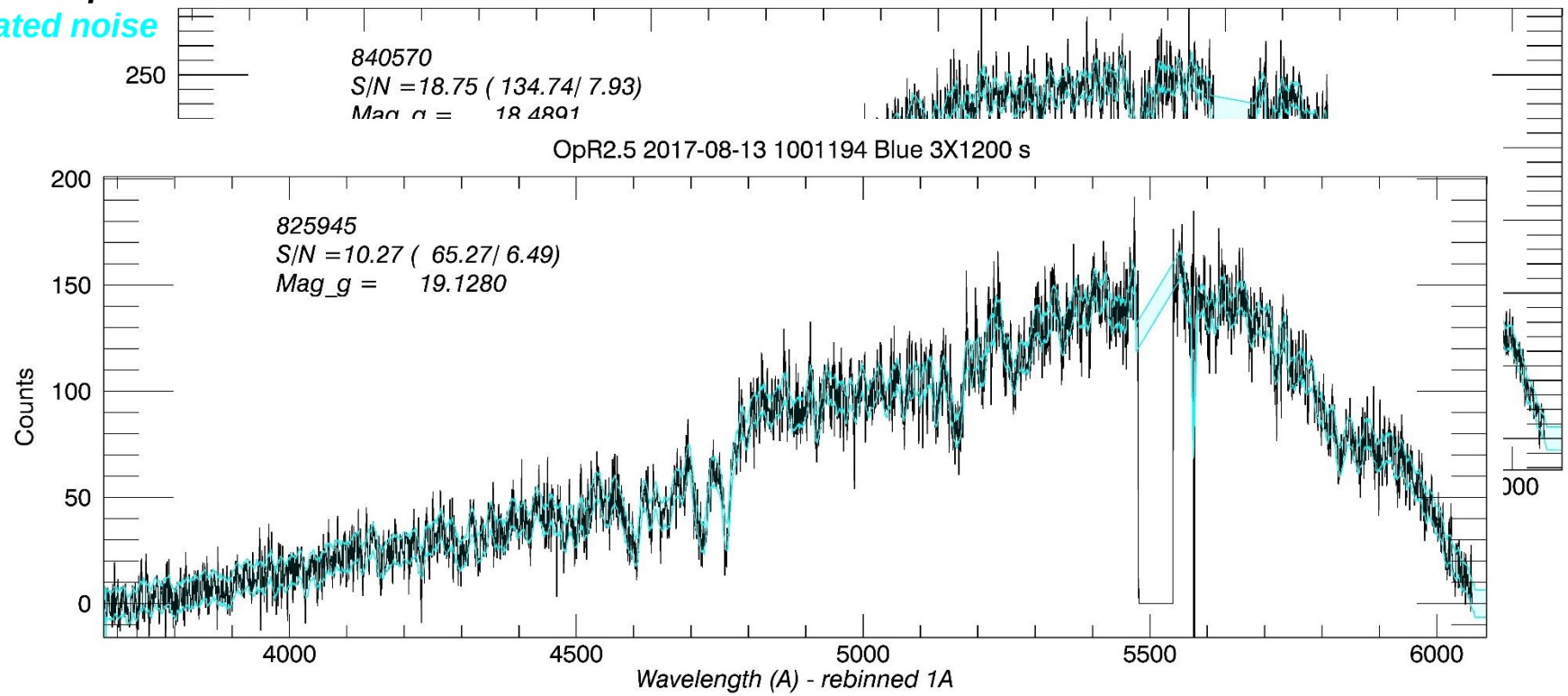


StePS @ WEAVE

Simulated spectrum

Simulated noise

Blue Arm

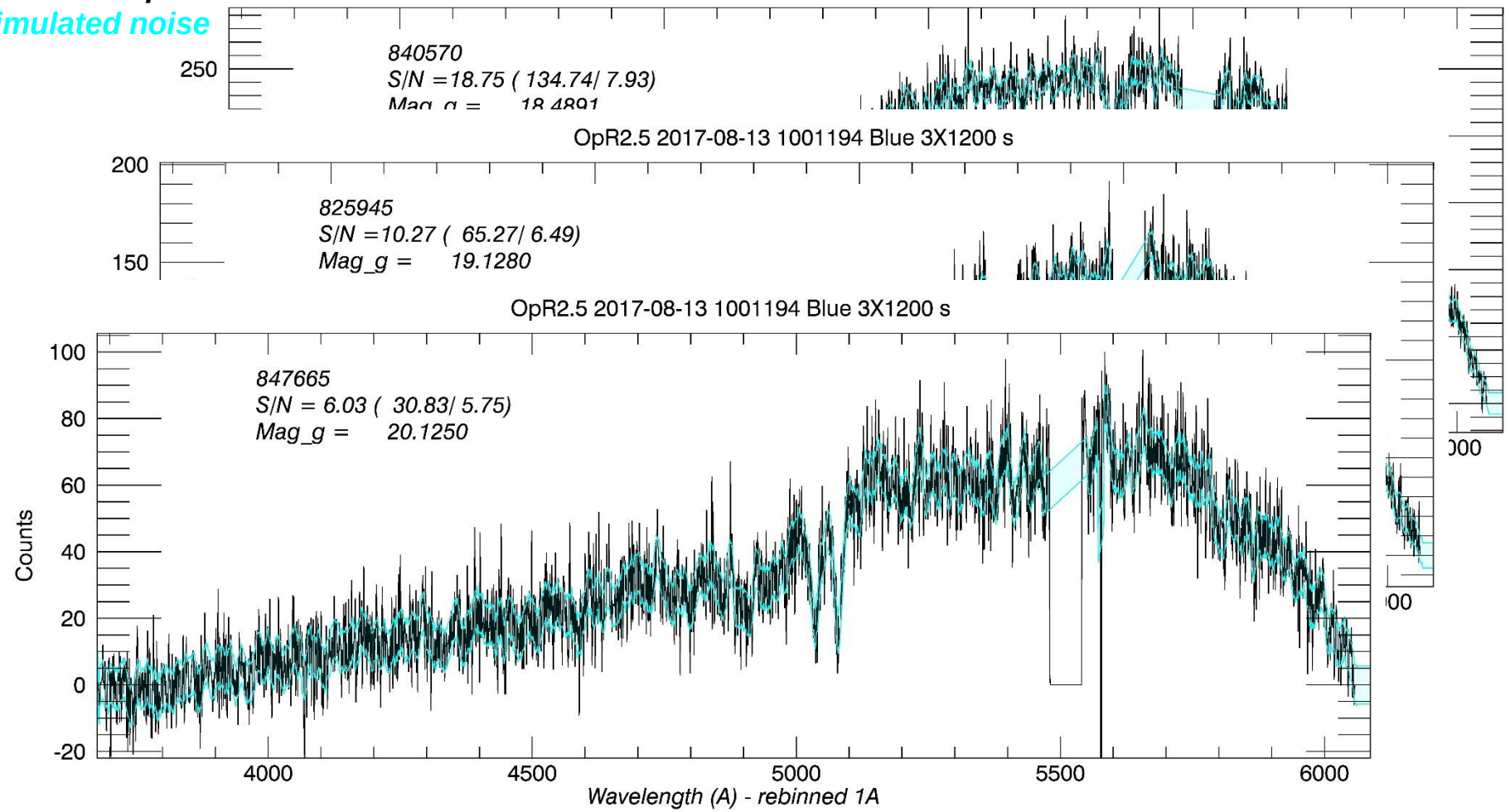


StePS @ WEAVE

Simulated spectrum

Simulated noise

Blue Arm

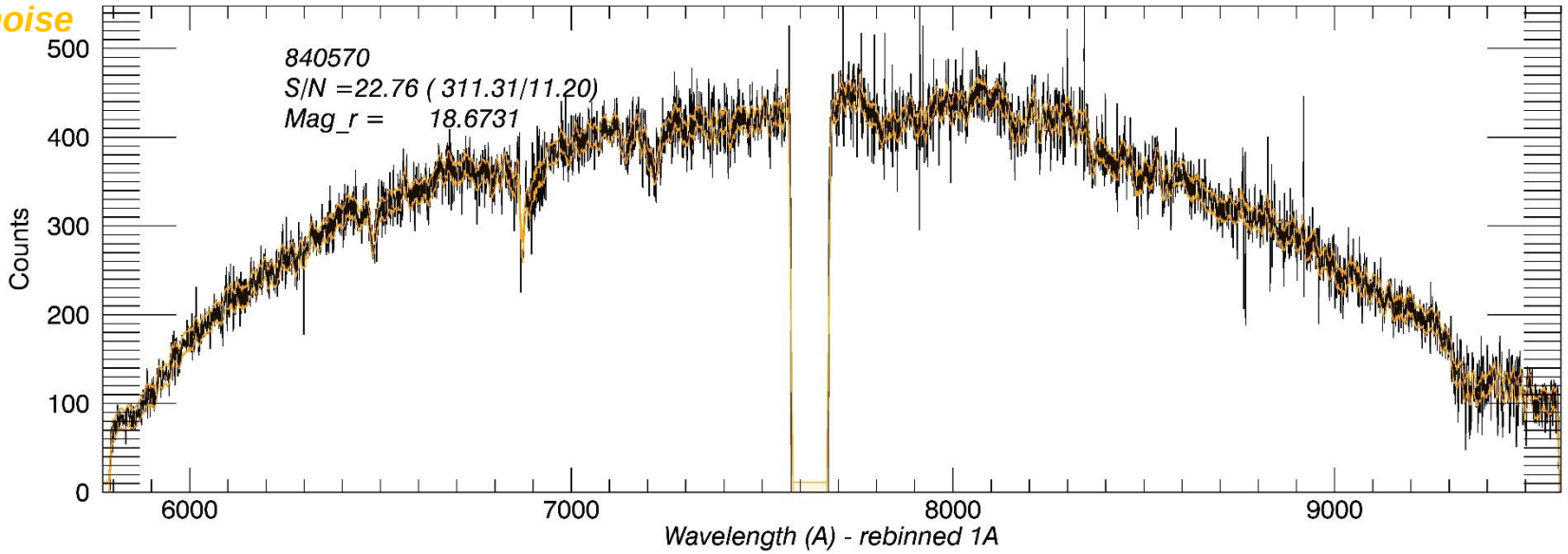


StePS @ WEAVE

Simulated spectrum

Simulated noise

Red Arm

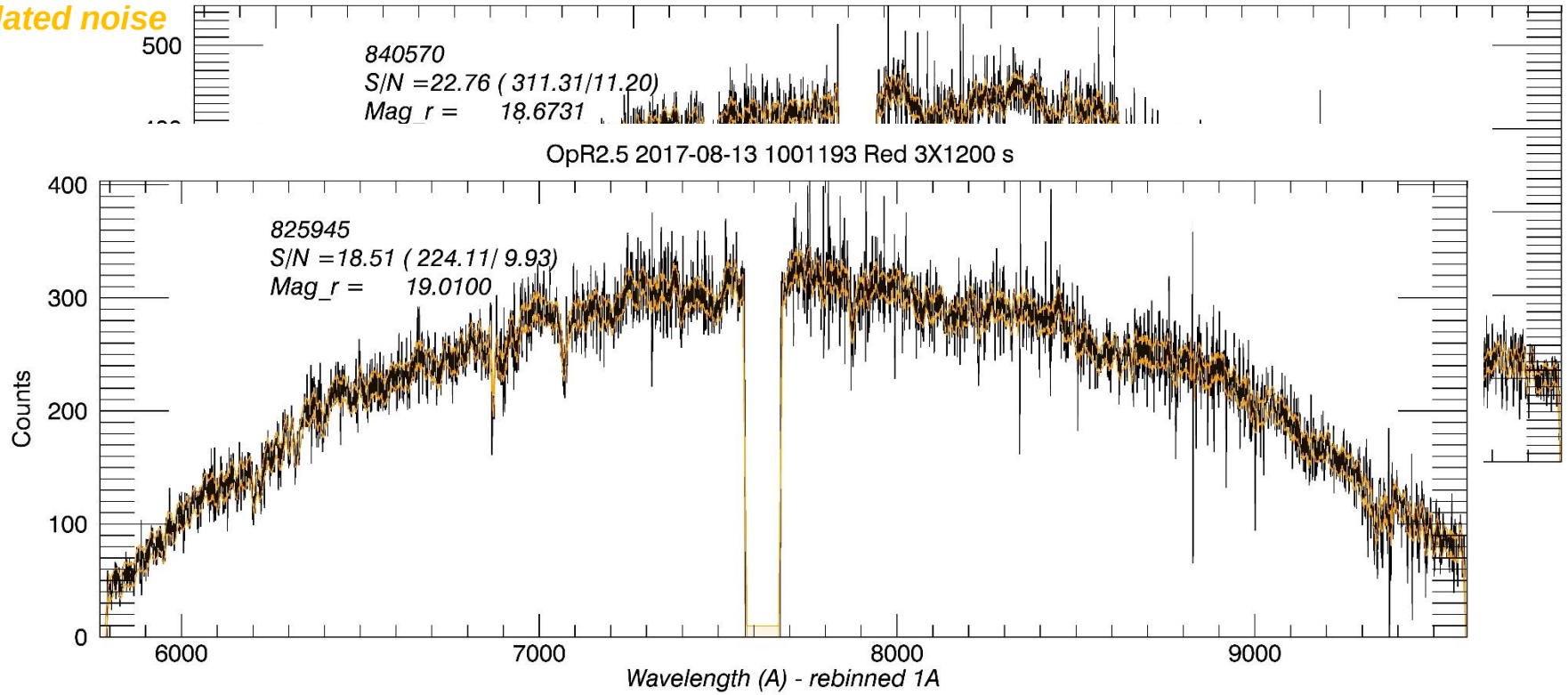


StePS @ WEAVE

Simulated spectrum

Simulated noise

Red Arm



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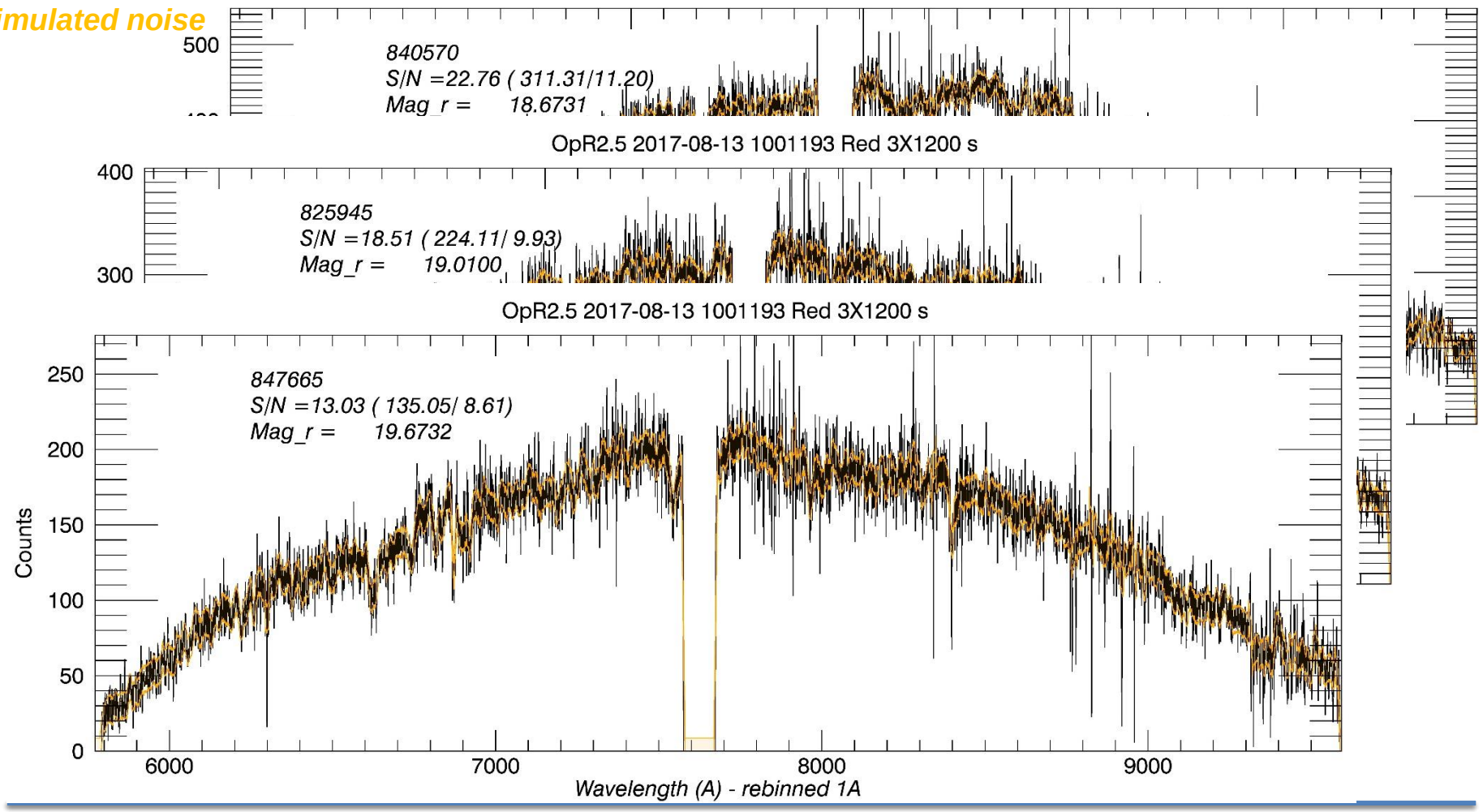

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Thanks!

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Catalogue Format

Mandatory Columns from	Column Name	Definition	Columns in OCS/CPS Data products Fibre info Table
	Naming & Priority		
Mandatory	CNAME	Unique Target identifier provided by SWG - leave empty	CNAME
Mandatory	TARGSRVY	The Survey where the target belongs	TARGSRVY? StePS
Mandatory	TARGPROG	Sub-programme name within the survey	TARGPROG?
Mandatory	TARGCAT	Catalogue name and version (e.g. GA-LRHalo_cat_v1.0.fits)	TARGCAT?
Mandatory	TARGID	The identifier of the target assigned by survey	TARGID?
Mandatory	TARGNAME	The target name (e.g. Draco ET11)	TARGNAME?
Mandatory	TARGPRIO	Target relative priority within a survey	TARGPRIO? Used by Surveys for intra-survey priorities. I
	Coordinates in Gaia Reference Frame		
Mandatory	GAIA_RA	The catalogue RA of object in decimal degrees [Gaia Reference Frame?]	TARGRA (need for CNAME assignment)
Mandatory	GAIA_DEC	The catalogue Dec of object in decimal degrees [Gaia Reference Frame?]	TARGDEC (need for CNAME assignment)
Mandatory	GAIA_EPOCH	The catalogue epoch of the object in decimal years (ICRS 2015 for Gaia DR1	TARGEPOCH (need for CNAME assignment)
Mandatory (if available)	GAIA_PMRA	Target proper motion in mas/yr in RA	TARGPMRA (need for CNAME assignment if available)
	GAIA_EPMRA	Error in target proper motion in mas/yr in RA	
Mandatory (if available)	GAIA_PMDEC	Target proper motion in mas/yr in Dec	TARGPMDEC (need for CNAME assignment if available)
	GAIA_EPMDEC	Error in target proper motion in mas/yr in Dec	
Mandatory (if available)	GAIA_PARAL	Target parallax in arcsec	TARGPARAL
	GAIA_EPARAL	Error in target parallax in arcsec	
			Previously indicated as pro

Catalogue Format

Mandatory Columns in all Catalogues					
CNAME	WEAVE object name from coordinates	A	data format of field: ASCII Character	none	physical unit of field
TARGSRVY	The Survey where the target belongs	A	data format of field: ASCII Character	none	physical unit of field
TARGPROG	Sub-programme name within the survey	A	data format of field: ASCII Character	none	physical unit of field
TARGCAT	Catalogue name and version	A	data format of field: ASCII Character	none	physical unit of field
TARGID	The identifier of the target assigned by survey	A	data format of field: ASCII Character	none	physical unit of field
TARGNAME	The target name	A	data format of field: ASCII Character	none	physical unit of field
TARGPRIO	Target relative priority within a survey (1=lowest, 10=highest)	I	data format of field: 2-byte INTEGER	none	physical unit of field
GAIA_RA	The catalogue RA of object in decimal degrees [Gaia RF]	D	data format of field: 8-byte DOUBLE	Degree decimals	physical unit of field
GAIA_DEC	The catalogue Declination of object in decimal degrees [Gaia RF]	D	data format of field: 8-byte DOUBLE	Degree decimals	physical unit of field
GAIA_EPOCH	The catalogue epoch of the object in decimal years (GDR1 ICRS 2015)	E	data format of field: 4-byte REAL	Decimal years	physical unit of field
GAIA_PMRA	Target proper motion in mas/yr in RA	E	data format of field: 4-byte REAL	mas/yr	physical unit of field
GAIA_EPMRA	Error in target proper motion in mas/yr in RA	E	data format of field: 4-byte REAL	mas/yr	physical unit of field
GAIA_PMDEC	Target proper motion in mas/yr in Dec	E	data format of field: 4-byte REAL	mas/yr	physical unit of field
GAIA_EPMDEC	Error in target proper motion in mas/yr in Dec	E	data format of field: 4-byte REAL	mas/yr	physical unit of field
GAIA_PARAL	Target parallax in arcsec	E	data format of field: 4-byte REAL	arcsec	physical unit of field
GAIA_EPARAL	Error in target parallax in arcsec	E	data format of field: 4-byte REAL	arcsec	physical unit of field

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Catalogue Format

Mandatory Columns in all Catalogues

SDSS_ID	SDSS ID	A	data format of field: ASCII Character	none	physical unit of field
SDSS_MAG_G	Magnitude estimate for the target in the SDSS g band	E	data format of field: 4-byte REAL	mag	physical unit of field
SDSS_EMAG_G	The error in the magnitude estimate for the target in the SDSS g band	E	data format of field: 4-byte REAL	mag	physical unit of field
SDSS_MAG_R	Magnitude estimate for the target in the SDSS r band	E	data format of field: 4-byte REAL	mag	physical unit of field
SDSS_EMAG_R	The error in the magnitude estimate for the target in the SDSS r band.	E	data format of field: 4-byte REAL	mag	physical unit of field
SDSS_MAG_I	Magnitude estimate for the target in the SDSS i band	E	data format of field: 4-byte REAL	mag	physical unit of field
SDSS_EMAG_I	The error in the magnitude estimate for the target in the SDSS i band.	E	data format of field: 4-byte REAL	mag	physical unit of field
GAIA_ID	Gaia ID	A	data format of field: ASCII Character	none	physical unit of field
GAIA_MAG_GG	Magnitude estimate for the target in the Gaia G band (AB mag system)	E	data format of field: 4-byte REAL	mag	physical unit of field
GAIA_EMAG_GG	Error in the magnitude estimate for the target in the Gaia G band	E	data format of field: 4-byte REAL	mag	physical unit of field
GAIA_MAG_BP	Magnitude estimate for the target in the Gaia BP band (AB mag system)	E	data format of field: 4-byte REAL	mag	physical unit of field
GAIA_EMAG_BP	Error in the magnitude estimate for the target in the Gaia BP band	E	data format of field: 4-byte REAL	mag	physical unit of field
GAIA_MAG_RP	Magnitude estimate for the target in the Gaia RP band (AB mag system)	E	data format of field: 4-byte REAL	mag	physical unit of field
GAIA_EMAG_RP	Error in the magnitude estimate for the target in the Gaia RP band	E	data format of field: 4-byte REAL	mag	physical unit of field

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Catalogue Format

Survey Specific columns present in individual survey catalogues only

StePS	provided non-GaiaRF coords. need to convert these				
EXTCAT_ID	Catalogue name and target ID of non-Gaia source of coords				
EXTCAT_RA	RA of target in non-Gaia catalogue in decimal degrees	D	data format of field: 8-byte DOUBLE	Degree decimals	physical unit of field
EXTCAT_DEC	Dec of target in non-Gaia catalogue in decimal degrees.	D	data format of field: 8-byte DOUBLE	Degree decimals	physical unit of field
EXTCAT_EPOCH	RA of target in non-Gaia catalogue in decimal degrees	E	data format of field: 4-byte REAL	Decimal years	physical unit of field
PMCAT_ID	Catalogue and target id from which alternative PM is taken	A	data format of field: ASCII Character	none	physical unit of field
PMCAT_PMRA	Alternative PMRA from non-Gaia catalogue if available	E	data format of field: 4-byte REAL	mas/yr	physical unit of field
PMCAT_PMDEC	Alternative PMDEC from non-Gaia catalogue if available	E	data format of field: 4-byte REAL	mas/yr	physical unit of field
lab_mag_selection	lab_mag_selection	Catalogue file already provided with the following fields			
Kab_mag_selection	Kab_mag_selection				
z_selection	z_selection (zphot/zspec)				
stargal_flag	Star/Galaxy separation from photometry, magnitude, SED fitting etc				
photometry_flag	Masked areas, bright stars etc				
U_mag	Variety of magnitudes from a variety of sources				
u_mag					
g_mag					
r_mag					
i_mag					
z_mag					
JPAS, PAU mags +200 cols					

StePS GAMA Catalogues

				Previously indicated as providing
	Photometry - Ideal set for CPS			StePS
Desirable	SDSS_ID	SDSS ID		
Desirable	SDSS_MAG_G	Magnitude estimate for the target in the SDSS g band	MAG_G	
Desirable	SDSS_EMAG_G	The error in the magnitude estimate for the target in the SDSS g band	EMAG_G	
Desirable	SDSS_MAG_R	Magnitude estimate for the target in the SDSS r band	MAG_R	y
Desirable	SDSS_EMAG_R	The error in the magnitude estimate for the target in the SDSS r band.	EMAG_R	y
Desirable	SDSS_MAG_I	Magnitude estimate for the target in the SDSS i band	MAG_I	
Desirable	SDSS_EMAG_I	The error in the magnitude estimate for the target in the SDSS i band.	EMAG_I	
Desirable	GAIA_ID	Gaia ID		
Desirable	GAIA_MAG_GG	Magnitude estimate for the target in the Gaia G band (AB magnitude system)	MAG_GG	
Desirable	GAIA_EMAG_GG	Error in the magnitude estimate for the target in the Gaia G band (including m	EMAG_GG	
Desirable	GAIA_MAG_BP	Magnitude estimate for the target in the Gaia BP band (AB magnitude systen	MAG_BP	
Desirable	GAIA_EMAG_BP	Error in the magnitude estimate for the target in the Gaia BP band (inlcuidng	EMAG_BP	
Desirable	GAIA_MAG_RP	Magnitude estimate for the target in the Gaia RP band (AB magnitude systen	MAG_RP	
Desirable	GAIA_EMAG_RP	Error in the magnitude estimate for the target in the Gaia RP band (including	EMAG_RP	

StePS @ WEAVE

HA=0

input sources: 1601 science - 100 Guide stars - 100 Calibration stars

3 surveys – 948 fibers

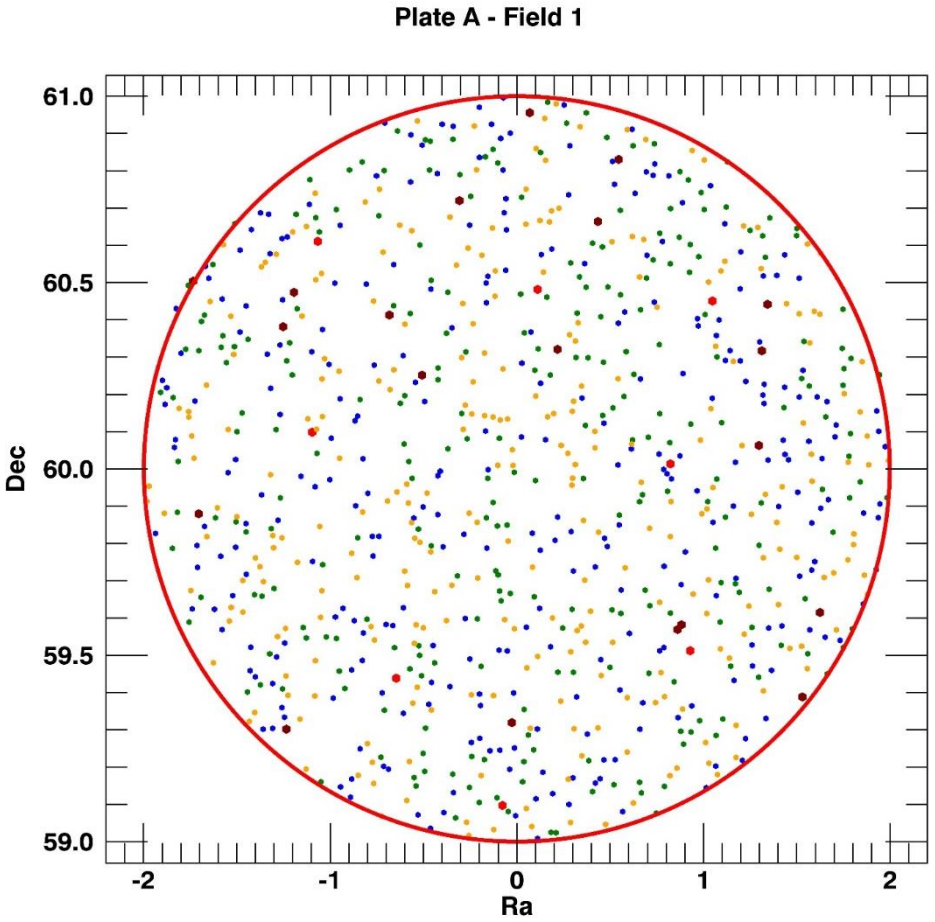
Survey_1: 531 Input
298 Fibres (green Points)
Input max number of fb: 600

Survey_2: 538 Input
265 Fibers (blue Points)
Input max number of fb: 400

Survey_3: 532 Input
281 Fibers (orange Points)
Input max number of fb:

8 giude star (red points)
20 calibration (brown points)

76 Sky fibres



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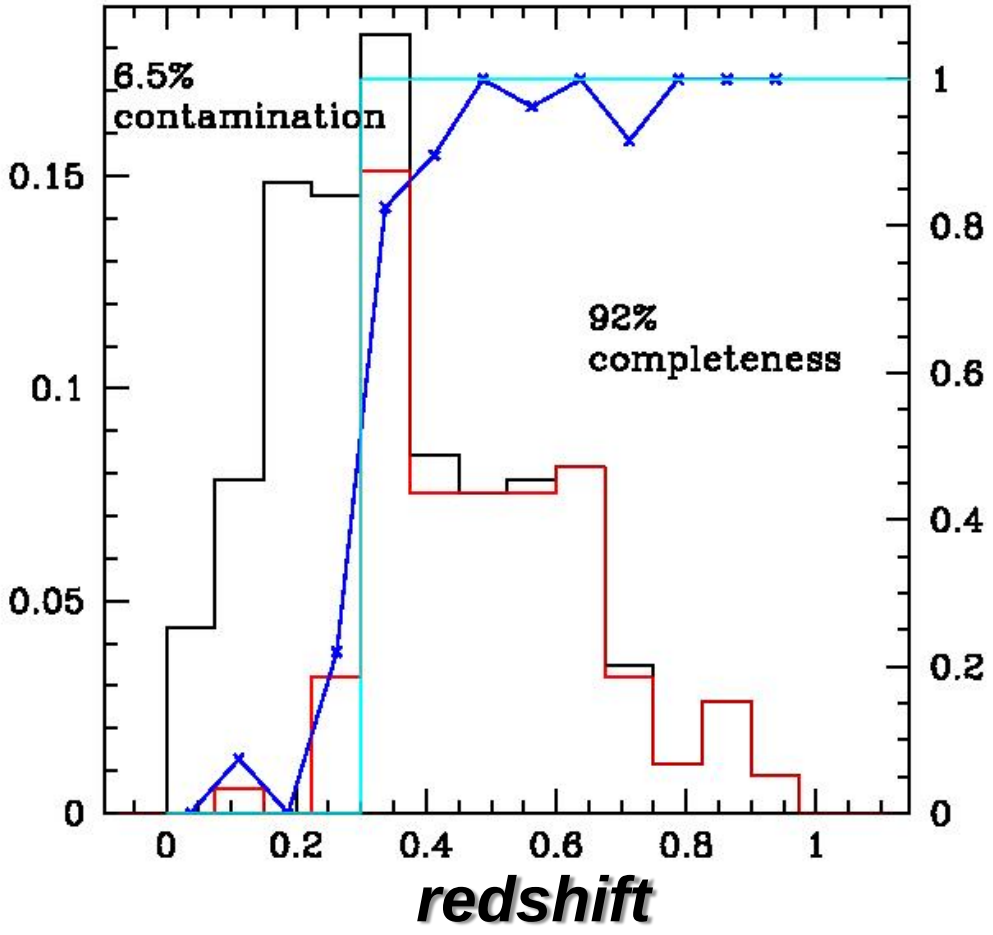
Photometric redshift preselection: how accurate ?



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

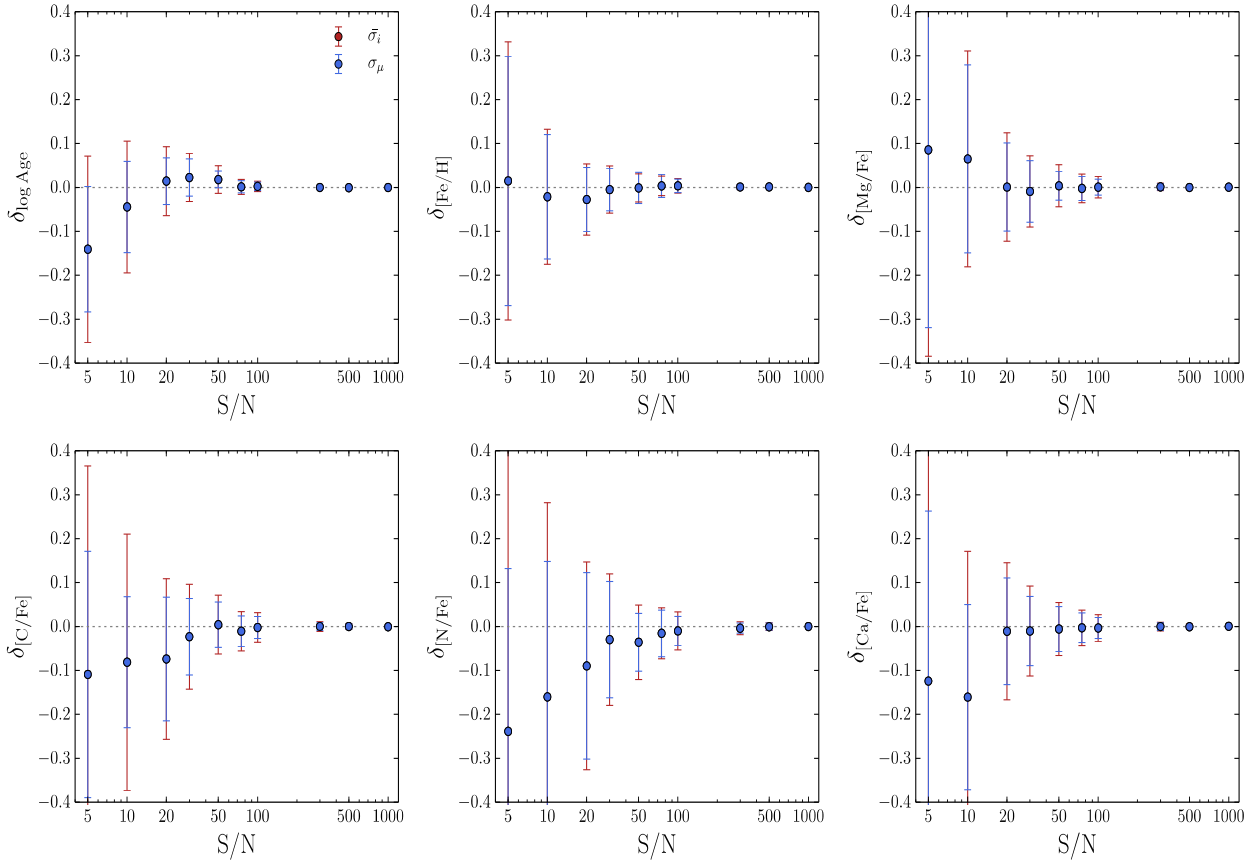

Figure A1. The difference between parameters measured from artificially degraded spectra and the original high-quality SDSS stacked spectrum. We construct 50 realizations at each S/N. The different colored symbols represent two independent error estimates, where the red is the average of the 50 errors 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

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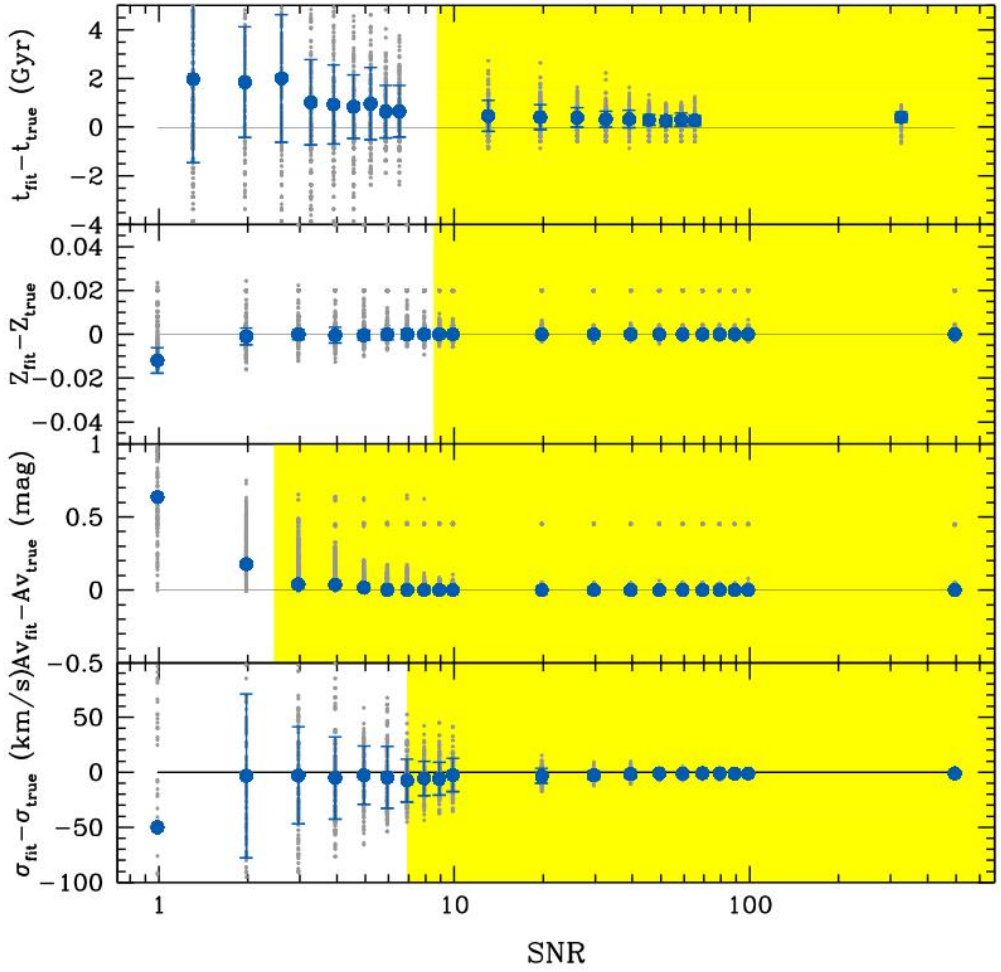
Stellar ages, metallicities, dust extinction and velocity dispersions, are all recovered without significant systematic offsets (accuracy higher than 10%) with a S/N~15.



Citro, Pozzetti et al. 2016

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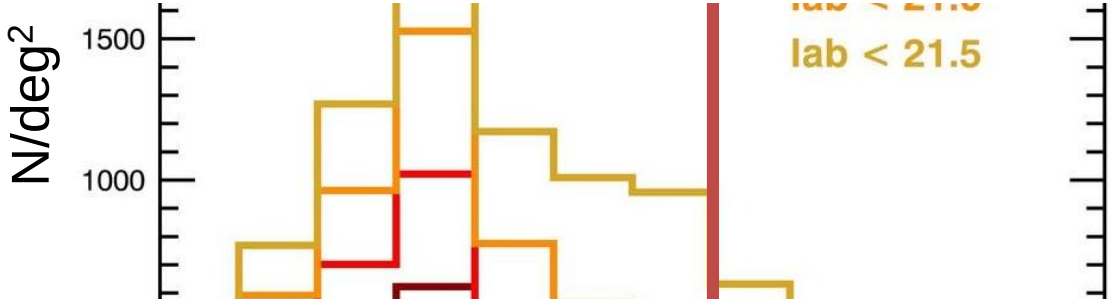
Redshift	Mass limit (log(M/M_{sun})) at Iab < 20.5
z=0.3	10.2
z=0.5	11.0
z=0.8	11.5



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

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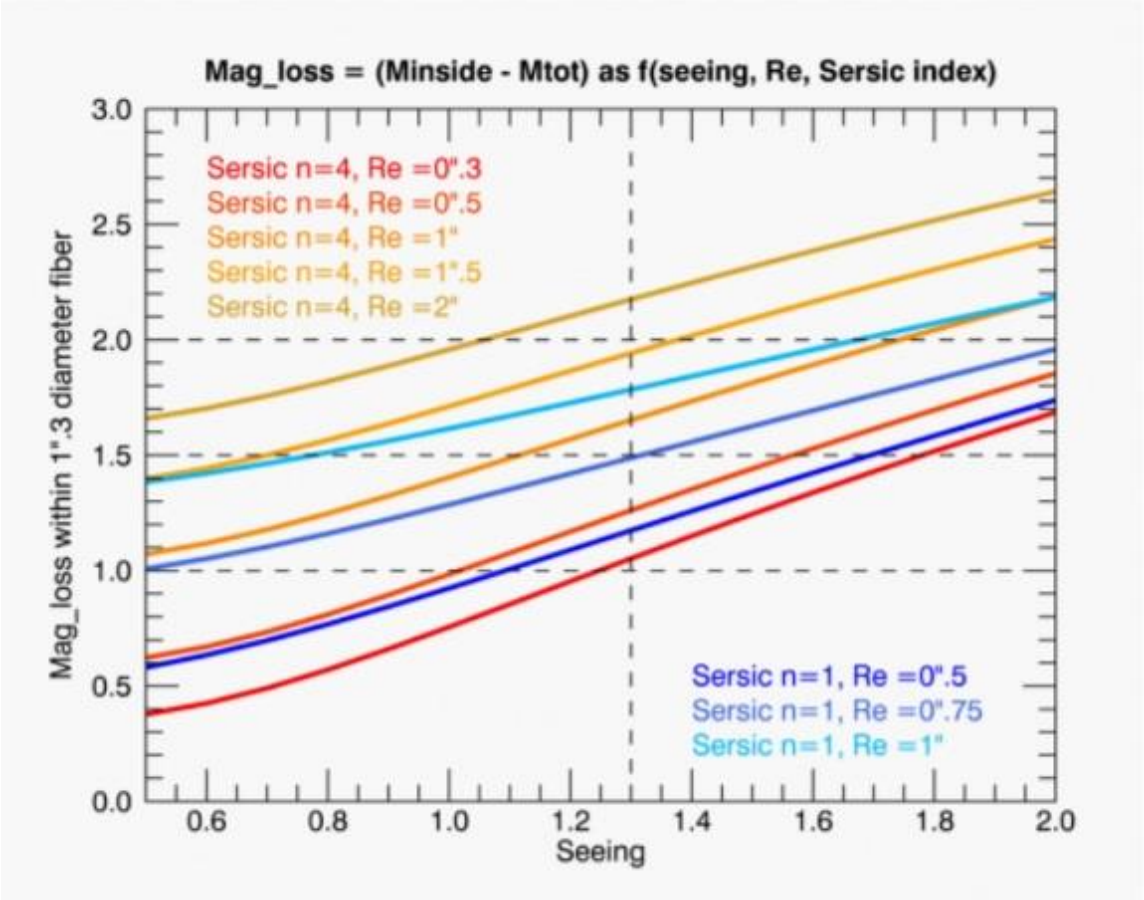
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Sersic n=4, Re =1"
Sersic n=4, Re =1".5
Sersic n=4, Re =2"
Sersic n=1, Re =0".5
Sersic n=1, Re =0".75
Sersic n=1, Re =1"
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2.5
2.0
1.5
1.0
0.5
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1.8
2.0

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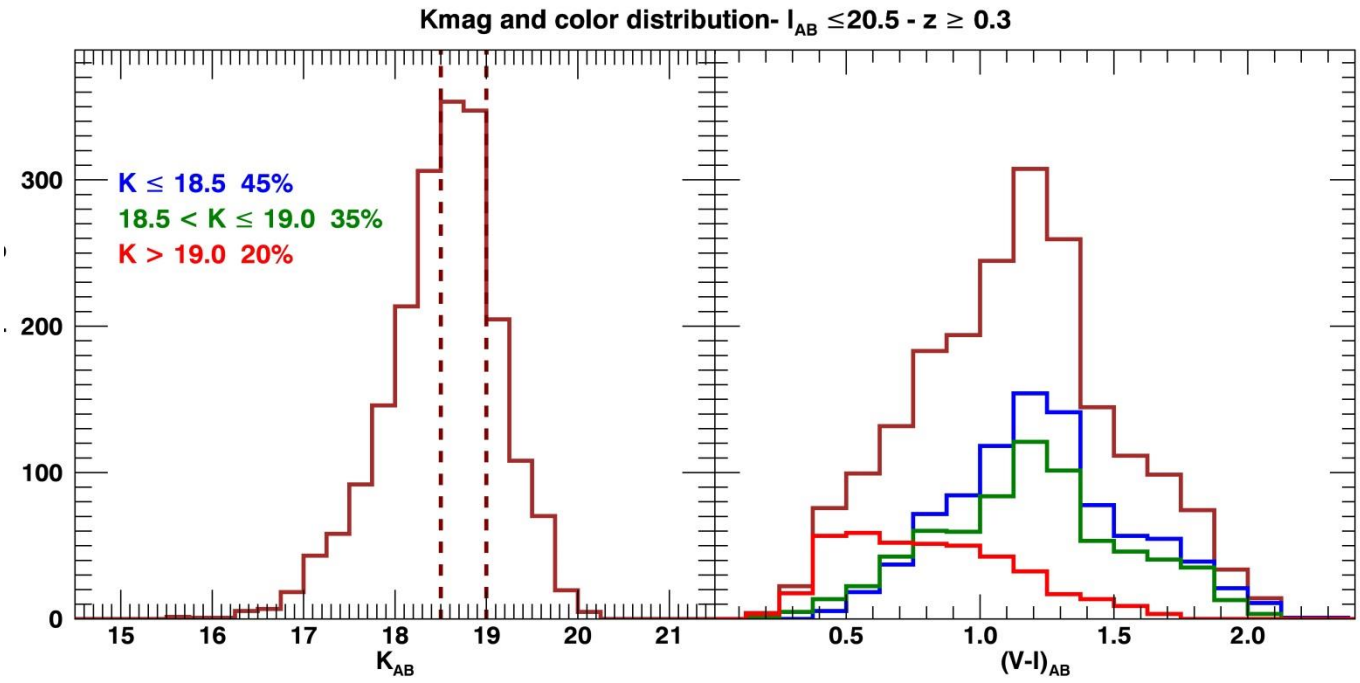
A possible prioritization strategy….



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A possible prioritization strategy….

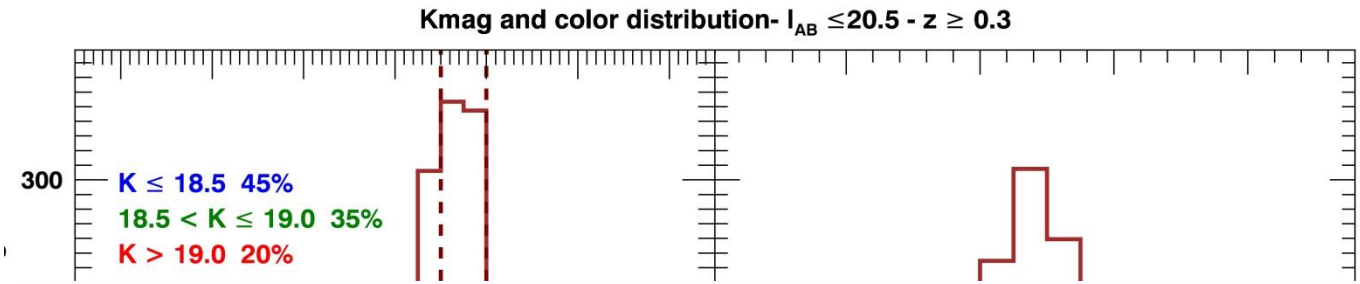

Table 1

	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

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StePS @ WEAVE


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StePS @ WEAVE


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Thanks to Angela we can read xml files producing ascii catalogs and plot results.

StePS @ WEAVE

Formation and Evolution of Galaxies and Cosmic Structures.

- A detailed picture of the stellar and (multi-phase) gas kinematics, gas inflows and outflows in both high-z and mid-z star-forming galaxies and its connection with the circum-galactic and inter-galactic medium is becoming accessible thanks to spatially resolved (optical/IR/radio) spectroscopy