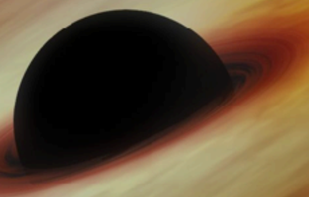
For PFS AGN Town Meeting 2024

Fact Sheets on PFS-SSP-GE and -GO

Based on

Greene et al. (2022): *arXiv:2206.14908 (GE)*

Takada et al., 2014, PASJ, 66, R1 (CO)



Kohei Ichikawa (Waseda U.)

Credit: NASA/JPL Caltech

PFS Parameters

PFS parameters

Taken from https://pfs.ipmu.jp/research/parameters.html

Prime Focus Instrument		
Field of view	~1.38 deg (hexagonal - diameter of circumscribed circle)	
Field of view area	~1.25 deg^2	
Input F number to fiber	2.8	
Fiber core diameter (1)	127 μm (1.12 arcsec at the FoV center, 1.02 arcsec at the edge)	
Positioner pitch	8 mm (90.4 arcsec at the FoV center, 82.4 arcsec at the edge)	
Positioner patrol field	9.5 mm diameter (107.4 arcsec at the FoV center, 97.9 arcsec at the edge)	
Fiber minimum separation (2)	~30 arcsec	
Fiber configuration time	~60-120 sec. [TBC]	
Number of fibers	Science fibers	Fixed fiducial fibers
	2394	96
Fiber density	~2000 deg^{-2} / ~0.6 $arcmin^{-2}$	
Number of A&G camera (3)	6	
Field of view of A&G camera	~5.1 $arcmin^2$ per one camera	
Sensitivity of A&G camera	r'~20.0 AB mag for S/N~30 (100) in 1 (10) sec. exposure	

PFS parameters

Taken from https://pfs.ipmu.jp/research/parameters.html

Spectrograph				
Spectral arms	Blue	Red		NIR
		Low Res.	Mid. Res.	
Spectral coverage	380 - 650 nm	630 - 970 nm	710 - 885 nm	940 - 1260 nm
Dispersion	~0.7 Å/pix	~0.9 Å/pix	~0.4 Å/pix	~0.8 Å/pix
Spectral resolution	~2.1 Å	~2.7 Å	~1.6 Å	~2.4 Å
Resolving power	~2300	~3000	~5000	~4300
Spectrograph throughput (4)	~52% (@500nm)	~52% (@800nm)	~47% (@800nm)	~35% (@1100nm)

λ=0.38-1.26um, R=2300-5000

Mid-Resolution (R~5000) is designed for achieving GA science (observing stars and alpha-elements), while GE+CO would use mainly low-res. mode (Takada+14)

PFS tools

PFS Exposure Time Calculator (ETC)

README

PFS Exposure Time Calculator and Spectrum Simulator

This package is developed by the following people

The original ETC was developed and written by Christopher Hirata (Ohio State University), which is based on the package developed for WFIRST (C. Hirata; arXiv:1204.5151) and altered for use in PFS project.

The code modification, the python wrapping, and the development of the spectral simulator were done by Kiyoto Yabe, Yuki Moritani, Atsushi Shimono (Kavli IPMU) and Robert Lupton (Princeton University)

Release Note

- Version 1.0 Feb. 26, 2016
- Version 1.1 Apr. 27, 2016
- Version 1.2 Feb. 05, 2021

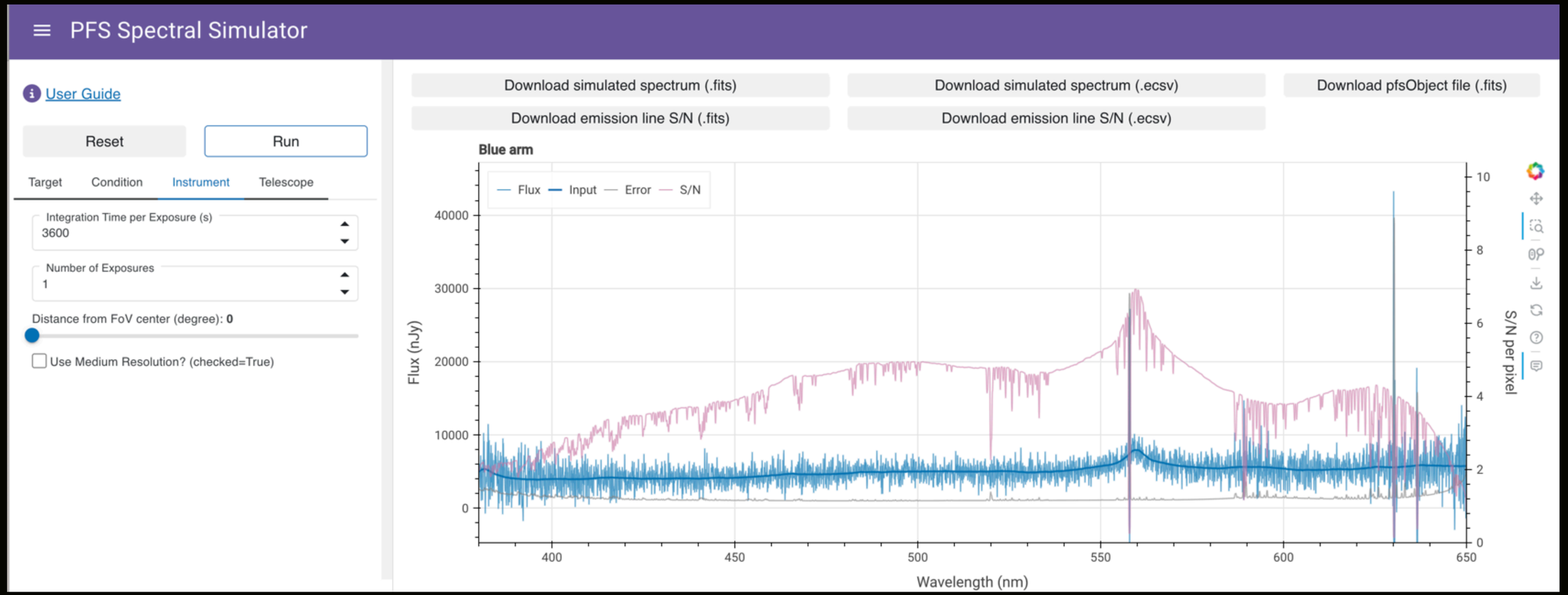
Requirements

https://github.com/Subaru-PFS/spt_ExposureTimeCalculator

PFS Spectral Simulator

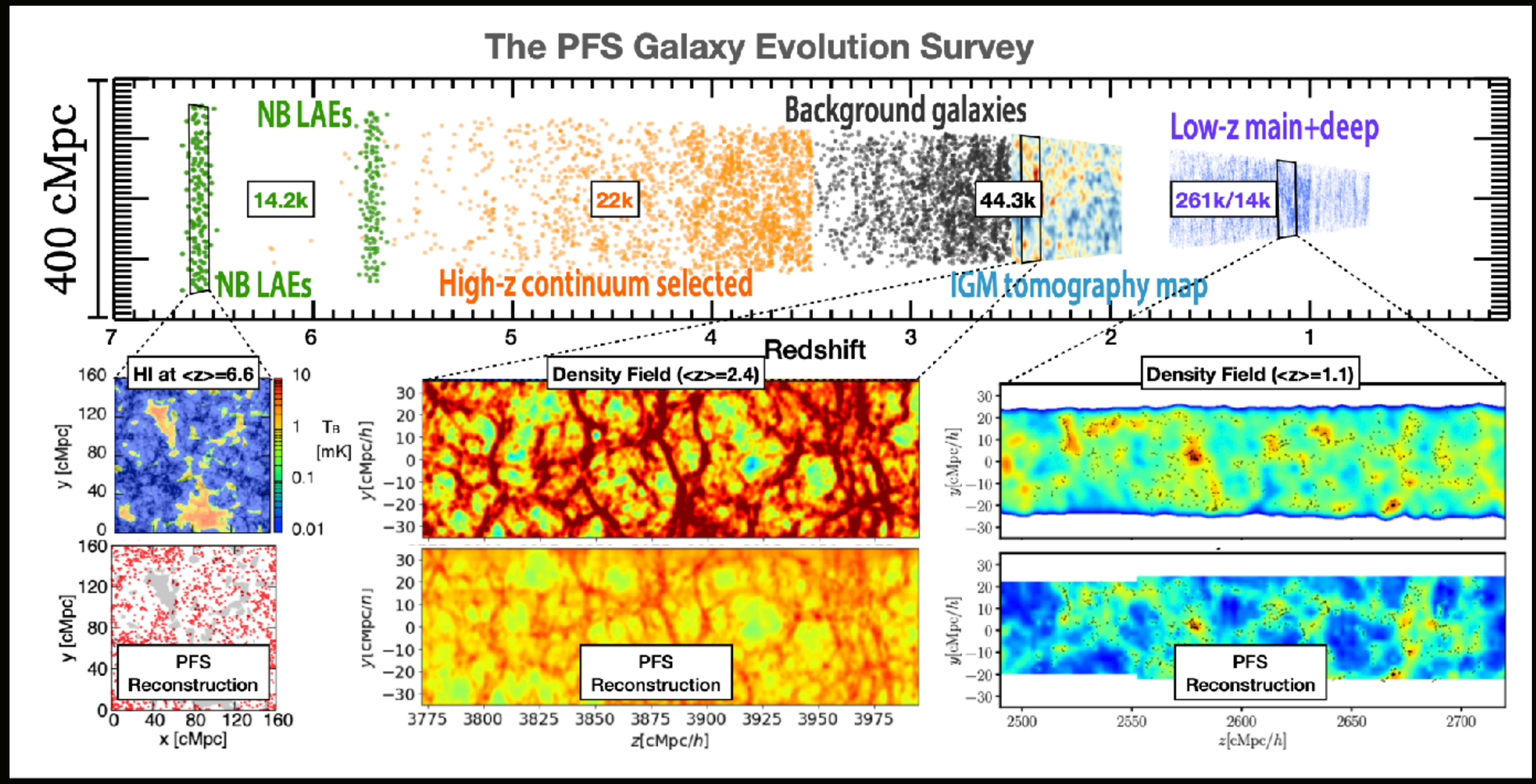
https://pfs-etc.naoj.hawaii.edu/etc/app

Web-based interface



PFS-GE (Greene et al. 2022)

SSP-GE sample in one slide



1. Continuum-selected galaxies at 0.7<z<2 (~270k sources)
2. IGM tomography map with background galaxies at 2.1<z<3.5 (~31k sources)
3. LBGs at z=3.5-7 (22k sources) and LAEs at z=2.2, 5.7, 6.6 (~15k sources)

+ AGN (4.2k sources)

SSP-GE sample and selection cut

Total: ~350k galaxies

Table 1. Galaxy samples and depths

Type	Redshift range	Selection	Exp. Time (hrs)	# of spectra ($\times 10^3$)
Continuum	$0.7-2$	$y, J<22.8$	2, 12	261, 14
IGM	$2.1-3.5$	$y<24.3, g<24.7$	6, 12	30.3, 14
LBG	$3.5-7$	$y<24.5$	6	22
LAE	2.2, 5.7, 6.6	$L_{Ly\alpha}>3\times10^{42}$ erg s^{-1}	3, 6, 12	7.4, 4.5, 2.8
AGN-GE	$0.5-6.0$	various (see text)	$1-5$	4.2

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Galaxy target table

Total: ~350k galaxies

Table 3. Full Target Table

Redshift range	Selection	Exp. Time (hrs)	Targets PFS FOV	Sampling rate (%)	# of spectra (10^3)	Fiber khrs
Continuum-selected						
$\lesssim 1$	i<23	2	6100	40	24	48
$0.7-1$	y<22.5 + $z_{\rm ph}$	2	11900	50	58	116
$1-2$	$y > 22.5 + z_{\rm ph}$ + J<22.8	2	11800	70	81	162
$0.7-2$	y<22.8 + $z_{\rm ph}$	12	1220	...	12	144
Tomography						
$2.1-2.5$	y<24.3 + $z_{\rm ph}$	6	8300	22	18	108
$2.5-3.5$	y<24.3 + $z_{\rm ph}$ + g<24.2	6	770	90	6.8	41
$2.5-3.5$	y<24.3 + $z_{\rm ph}$ +24.2<g<24.7	12	1800	65	11.5	138
LAE						
$3.5-7$	y<24.5 + $z_{\rm ph}$	6	2500	74	18	108
2.2	log $L_{Ly\alpha} > 42.5$	3	770	80	6.0	18
5.7, 6.6	log $L_{Ly\alpha} > 42.7$	6	470	80	3.7	22
5.7, 6.6	log $L_{Ly\alpha}$=42.5-42.7	12	290	80	2.3	28

Why z<2?
to cover 4000A break
=> crucial for
stellar-mass, SFR

Minimum exposure: 2hr (Main-continuum selected)

Maximum exposure: 12 hrs (Deep-continuum selected, faint back ground galaxies for IGM at z=2.5-3.5, faint LAE at z=5.7, 6.6)

AGN Target table

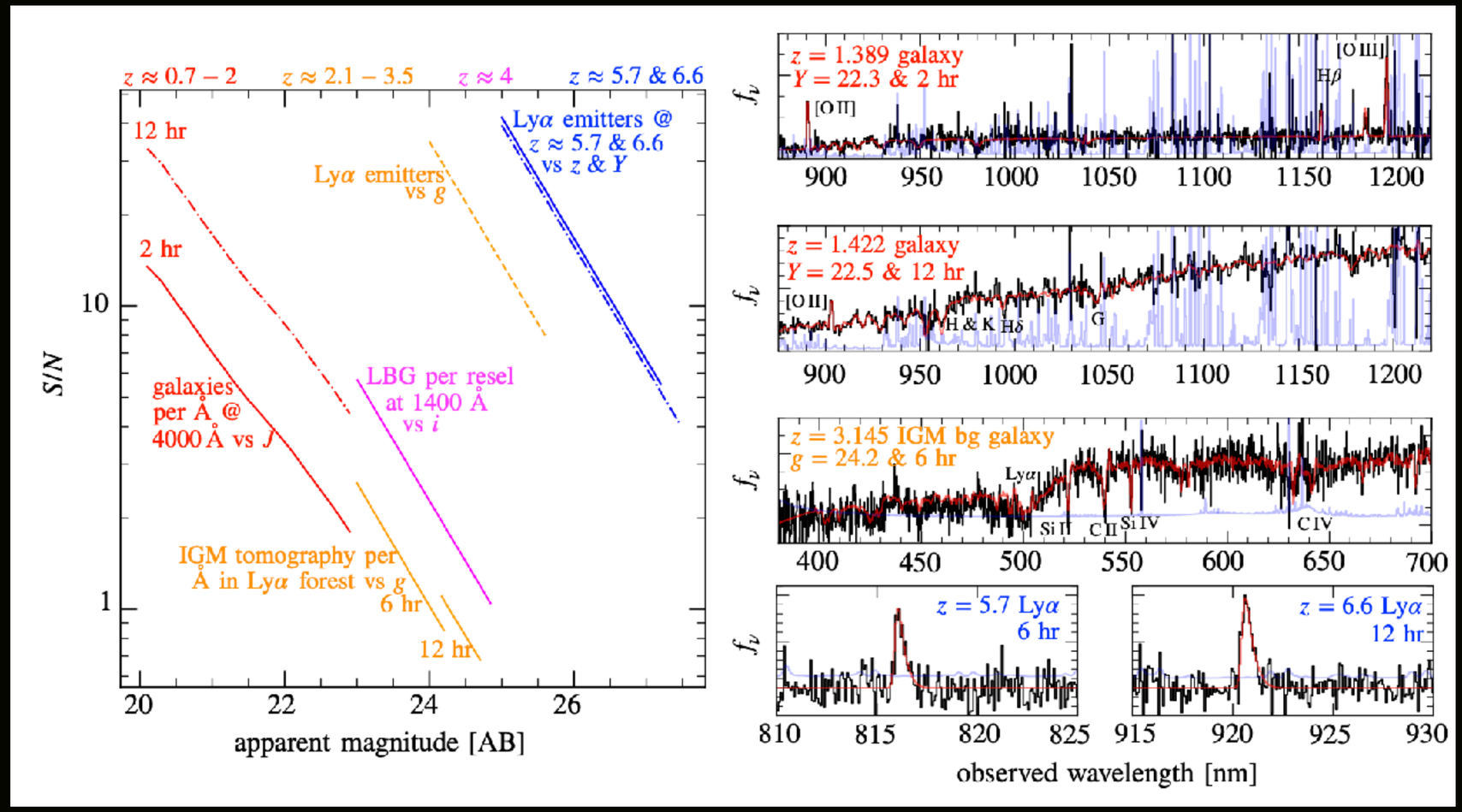
For GE, 6k sources

Targets	Selection	$N_{\rm AGN}^{\rm total}$	$N_{\rm AGN}$	$N_{\rm fiber}$	$T_{\rm exp}$	$N_{\rm fiber}T_{\rm exp}$
Galaxy Evolution						
BL candidates (z<4)	CFHT u – *Spitzer* colors	5,700	3,000	6,000 (0.5)	1 – 4	15,000
BL candidates ($z > 4$)	HSC – *Spitzer* colors	500	500	1,000 (0.5)	4 – 5	4,500
X-ray sources	*Chandra*, *XMM-Newton*	10,000	2,000	2,000 (1.0)	4 – 5	9,000
Sub-mm galaxies	SCUBA-2 w/ ALMA counterparts	300	300	1,000 (0.3)	5	5,000
Radio galaxies	FIRST	200	200	300 (0.7)	3	900
IMBH candidates	HSC flux variability	30	30	300 (0.1)	2	600
Total			6,030	10,600		35,000
Cosmology						
BL candidates ($z > 4$)	HSC colors	15,000	15,000	30,000 (0.5)	0.5	15,000
X-ray sources	*eROSITA*	1,700	1,700	1,700 (1.0)	0.5	850
Mid-IR sources	WISE 22 μm	1,000	1,000	1,500 (0.7)	0.5	750
Radio galaxies	FIRST	20,000	1,500	1,700 (0.9)	0.5	850
Lensed quasar candidates	HSC shapes	100	100	1,100 (0.1)	0.5	550
Total			19,300	36,000		18,000

Several selection criteria, basically with
multi-wavelength cross-matching (IR, X-ray, sub, radio) or variability

SN as a function of mag

With 6 hrs, we can obtain spectra (SN>2/bin) of LBG down to i_{AB} = 24 mag



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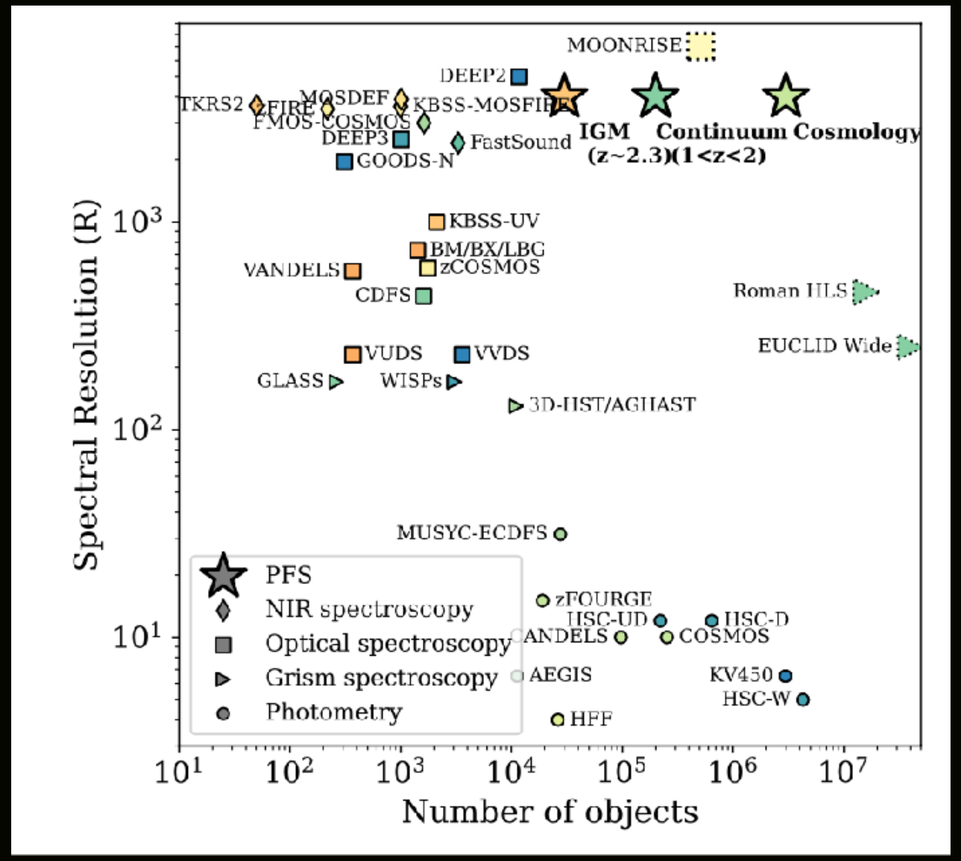
Spectral Resolution and Numbers

No specific resolution in the main text, but figure tells R=3000-5000
Matched with expected resolution by PFS



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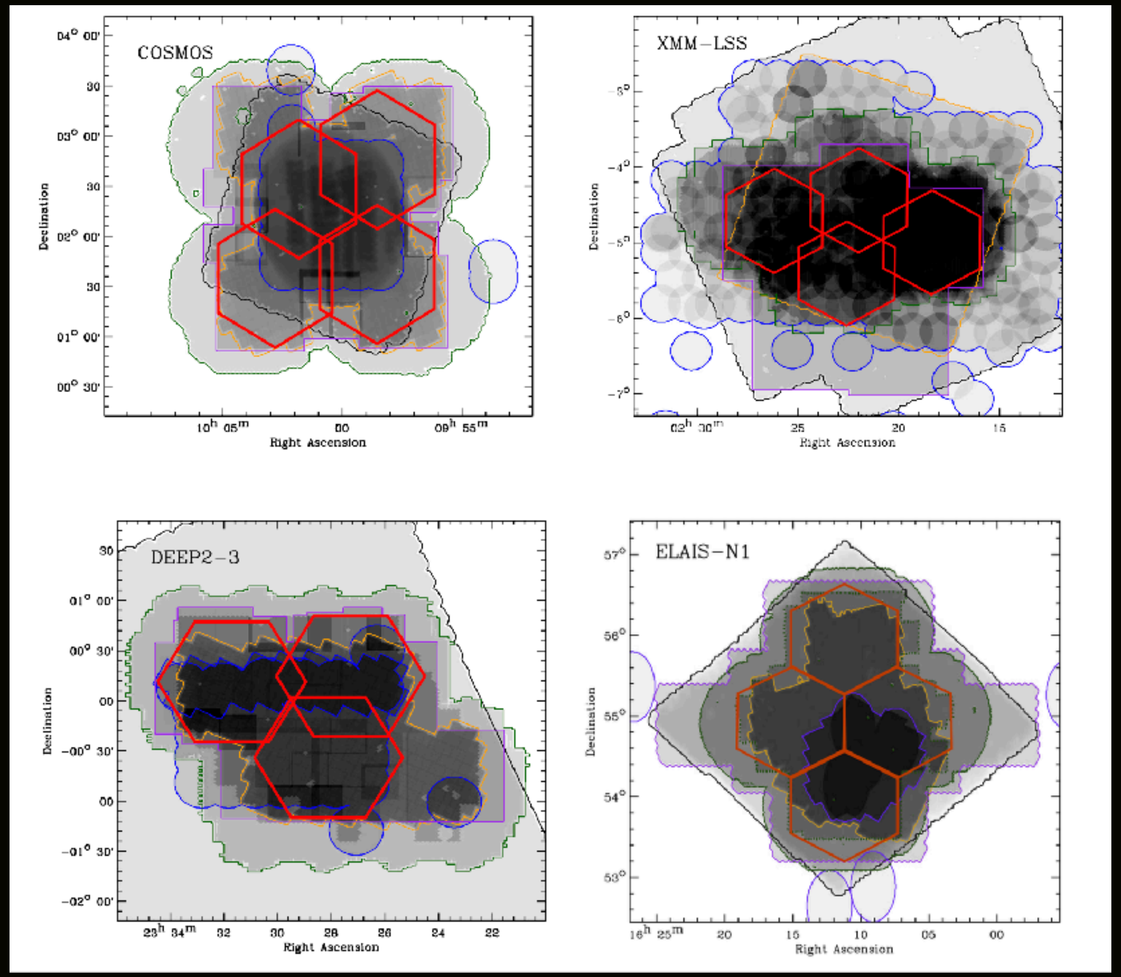
Spectrograph throughput (4)	~52% (@500nm)	~52% (@800nm)	~47% (@800nm)	~35% (@1100nm)

Considering the Mid-Resolution mode is for GA science, primal choice for GE should be R~3000 in Red arm

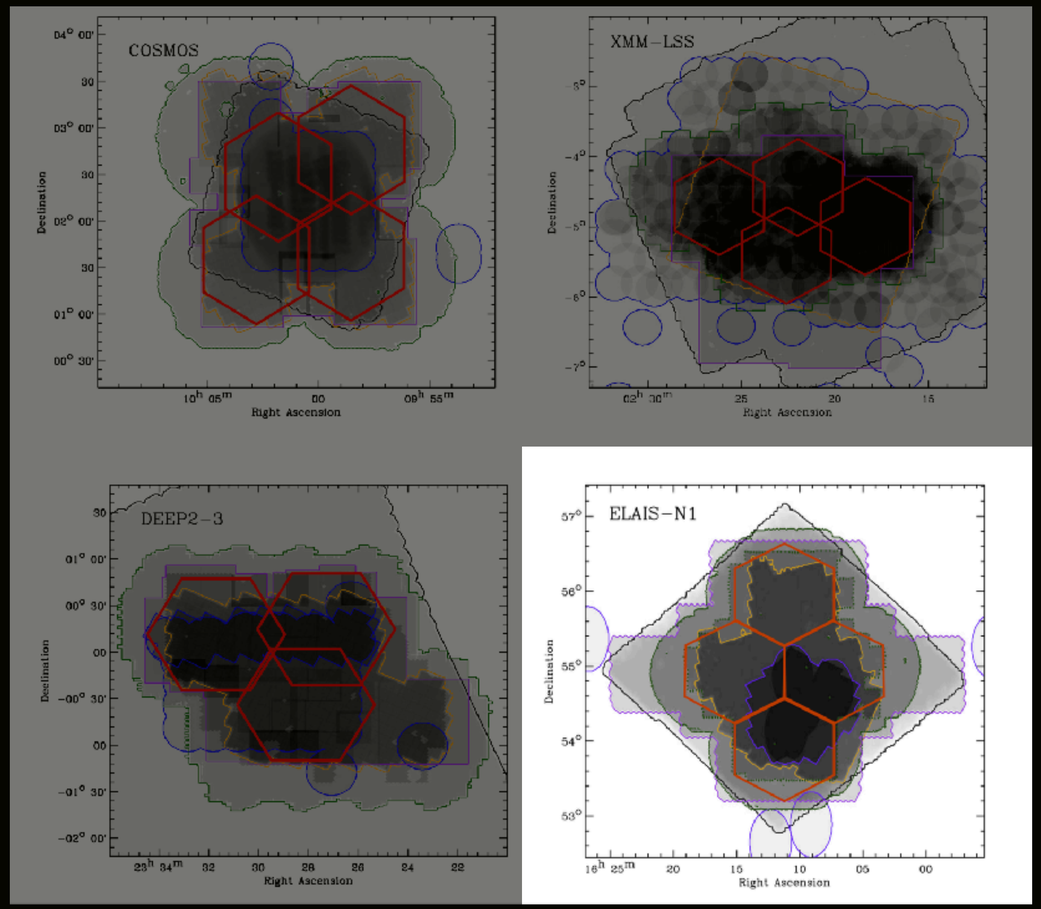
Survey fields: COSMOS, XMM-LSS, DEEP2-3, and ELAIS-N1

Selected from the HSC Deep Field, 12.3 deg² w/ NIR bands



Survey strategy

During SSP year1, ELAIS-N1 will be observed



What are the remaining priority?

Specific survey strategy is not made public yet.

Available photometries

CLAUDS u: u_{AB} ~ 27 mag

HSC grizy: (i_{AB} ~ 28 mag at COSMOS and i_{AB} ~ 26.5 mag at remaining 3 fields)

HSC NBs: NB387, 816, 921 (+additionally NB387/527/718/973 at COSMOS)

UKIRT J+K: J_{AB} ~ 23.5, K_{AB} ~23.2 mag

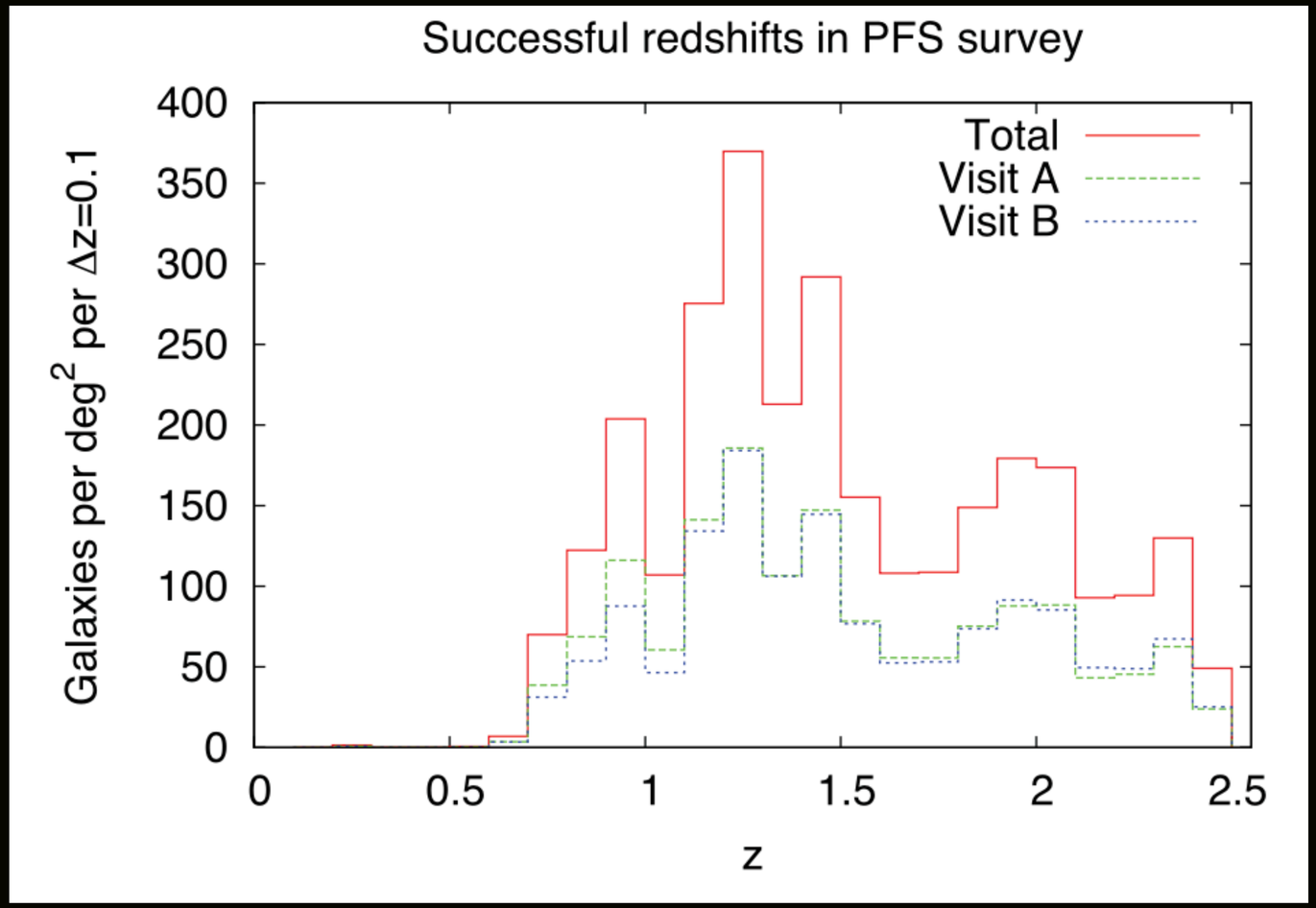
Spitzer IRAC 3.6+4.5um: 23.7 and 23.3 mag each

u2k catalog combining all photometries (except NBs) above is under construction?

See Suzuki-san's talk

PFS-CO (Takada et al. 2014)

SSP-CO sample in one slide



- HSC-Wide 1100 deg^2 , 2 visits/FoV, 15min exp per visit.
- [OII] emitters at red-arm => 0.6<z<2.4
- ~150/z-bin(delta z=0.1)/deg^2 => 150*18*1100~ 3 million sources

SSP-CO sample in one slide

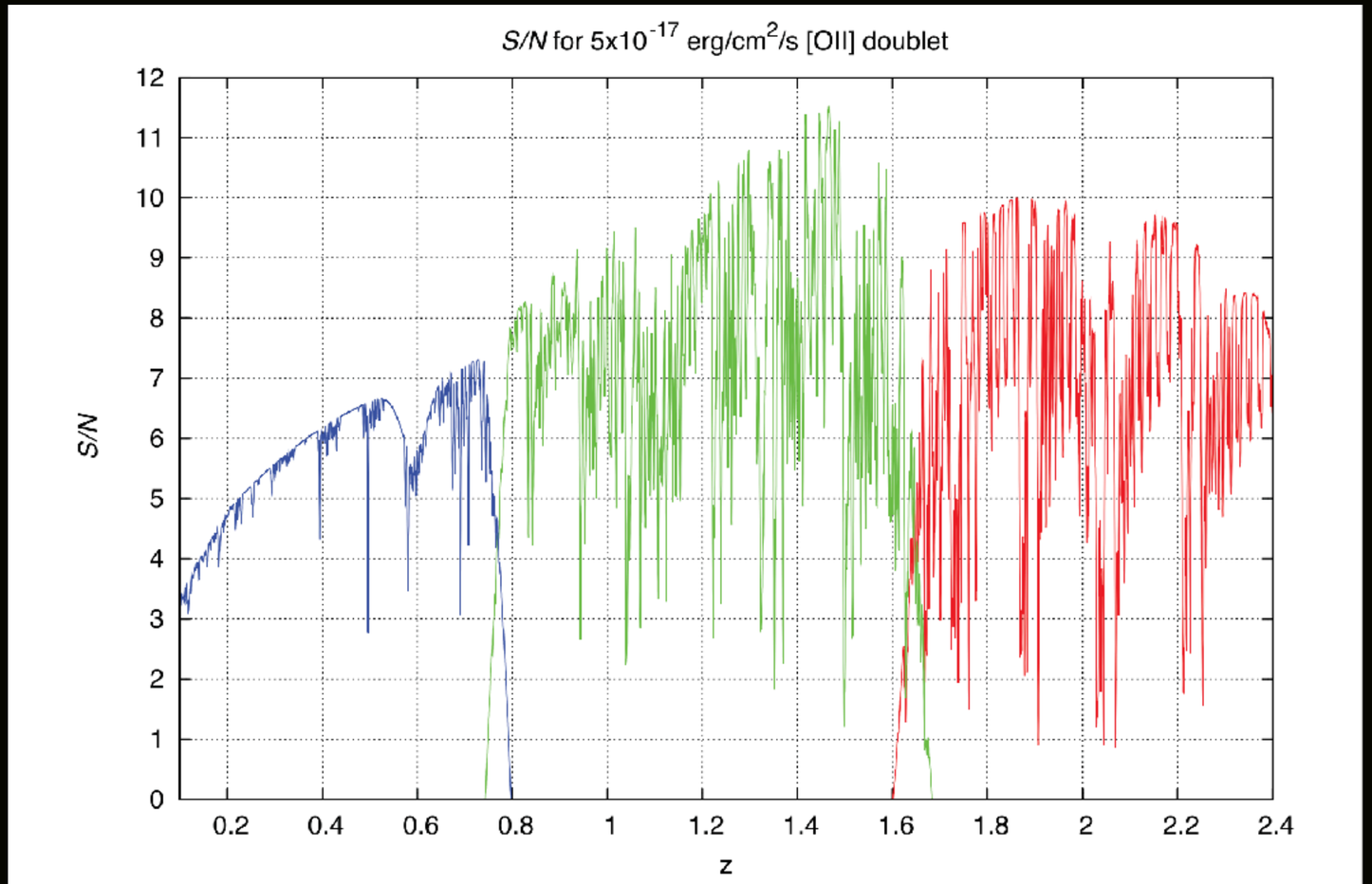
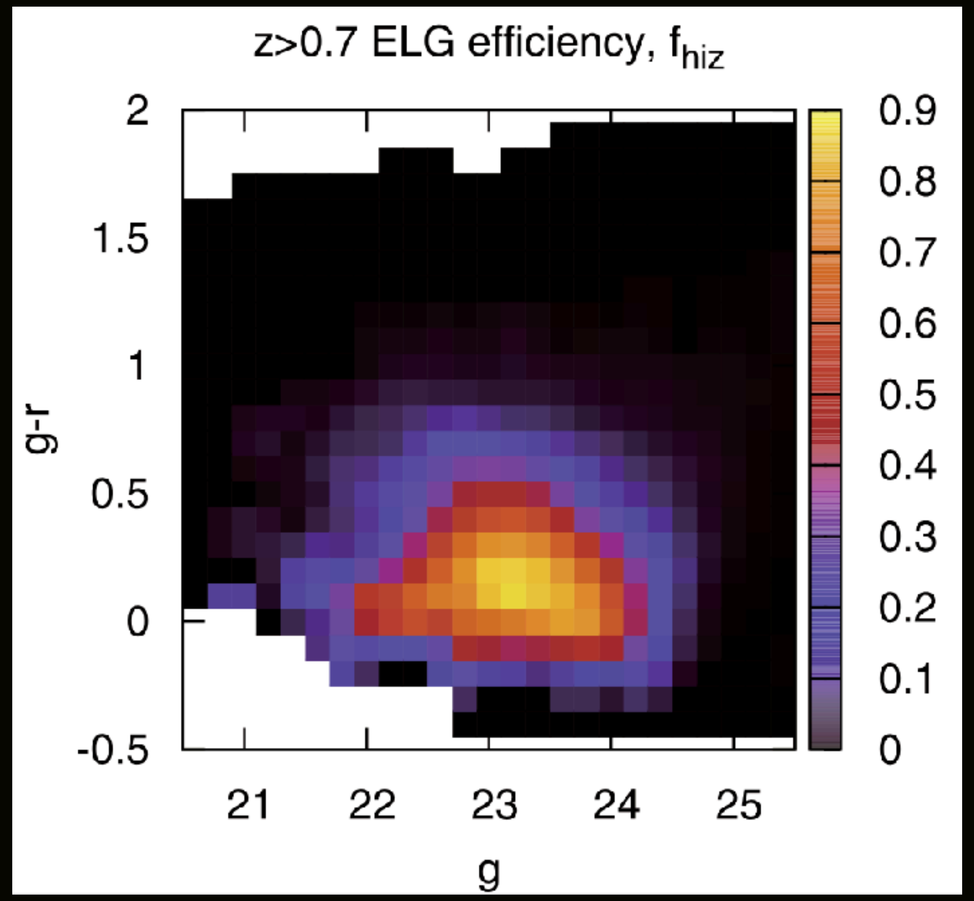


Fig. 2. Expected signal-to-noise (S/N) ratio for measuring the [O II] emission line as a function of redshift; the blue, green, and red curves show the results for the PFS blue, red, and IR arms in table 1, respectively, for a total emission line flux of 5×10^{-17} erg cm^{-2} s^{-1}. To properly account for the

- Depth (15min): $f_{[OII]} = 5 \times 10^{-17}$ erg/s/cm^2 , SN>8 for [OII] (lower SN for continuum)

Sample selection: [OII] emitter at 0.8<z<2.4



$$22.8 \leq g \leq 24.2 \quad \text{AND} \quad -0.1 < g - r < 0.3$$

$$\text{AND NOT } (g > 23.6 \quad \text{AND} \quad r - i > 0.3).$$

- g-r is blue (g-r < 0.3) & no break at g and r (No Balmer/4000AA break)