DARK ENERGY
SURVEY

Limitations of Spectroscopy

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With

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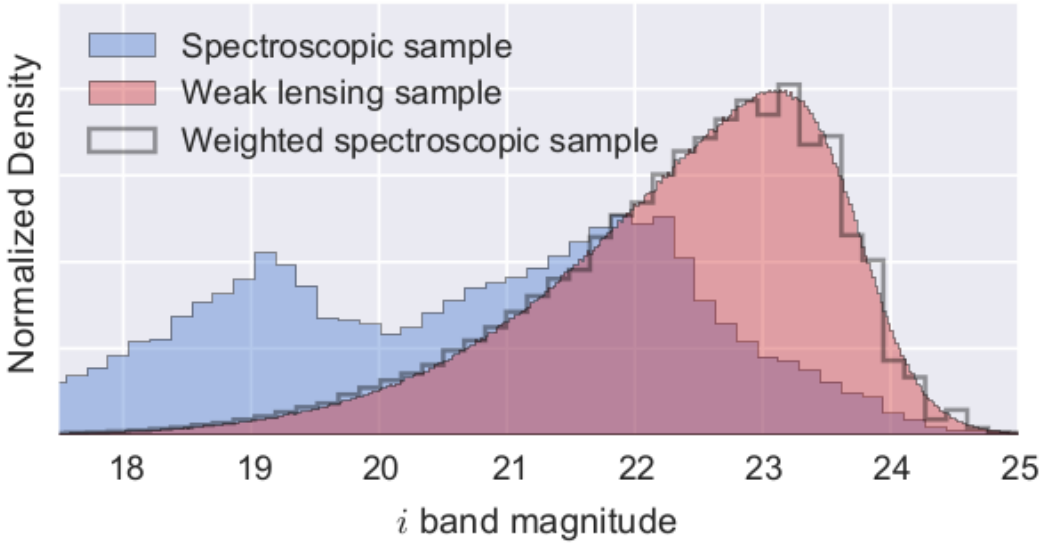
Julia Gschwend
Jacobo Asorey
Sam Hinton

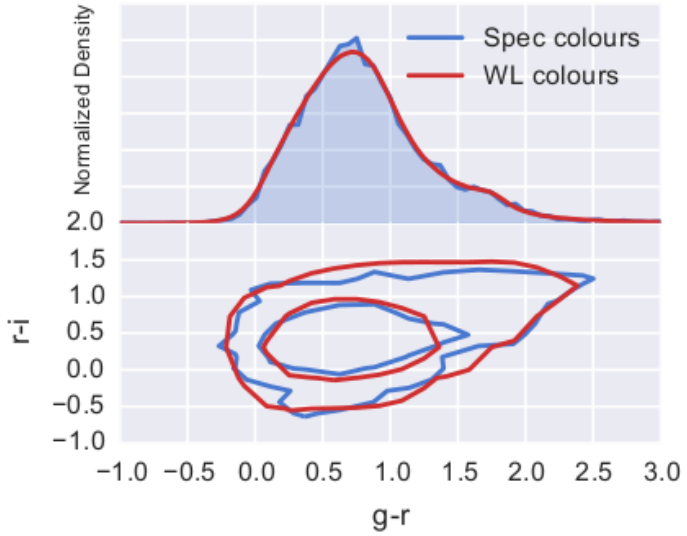
The 2015 concensus approach to uneven sampling

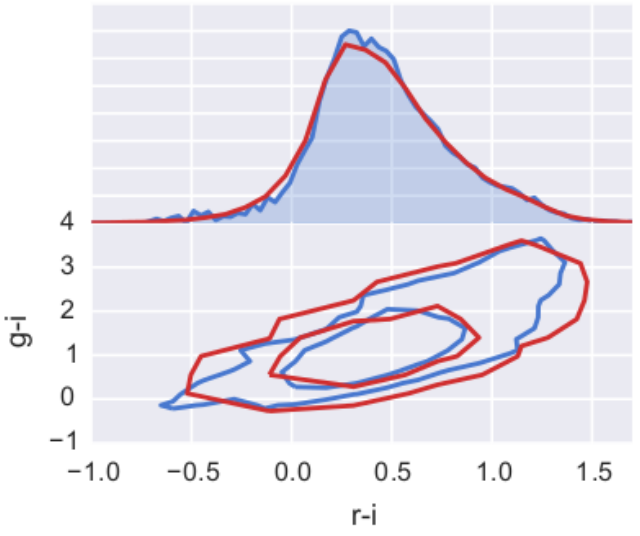
DARK ENERGY SURVEY

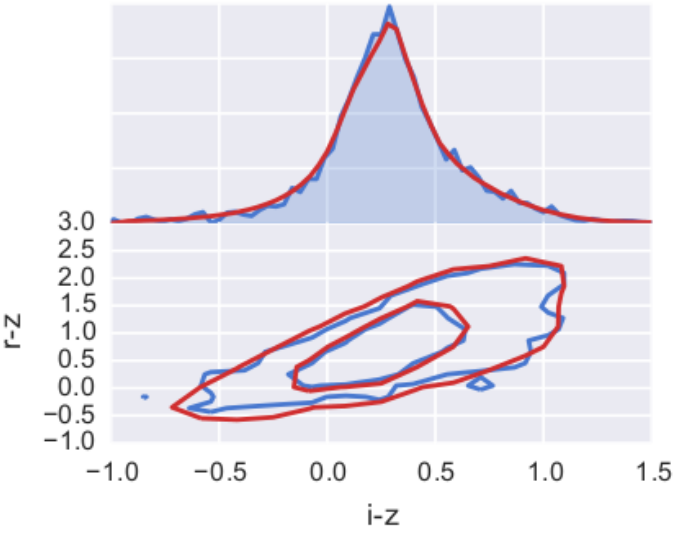
Validating photo-z with spectroscopy:

→ re-weight in col-mag (Lima+ 08)









The 2015 concensus approach to uneven sampling

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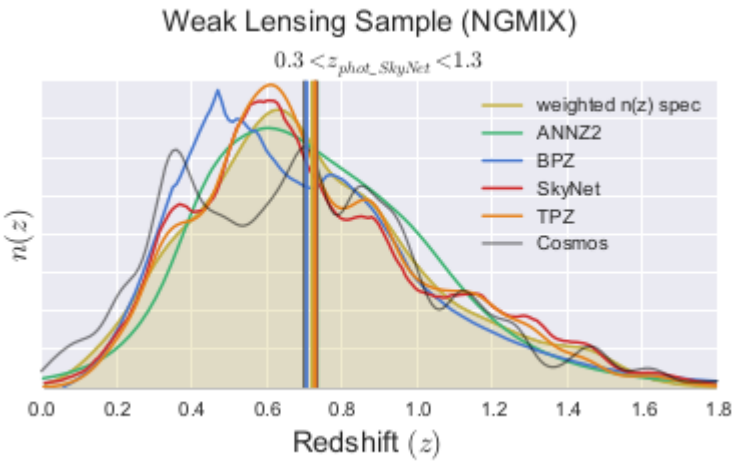

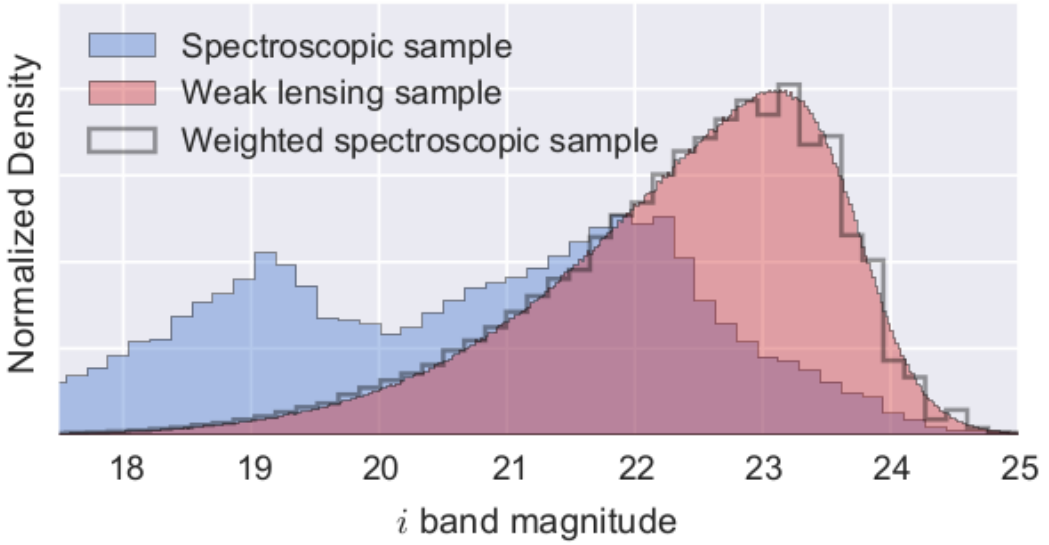

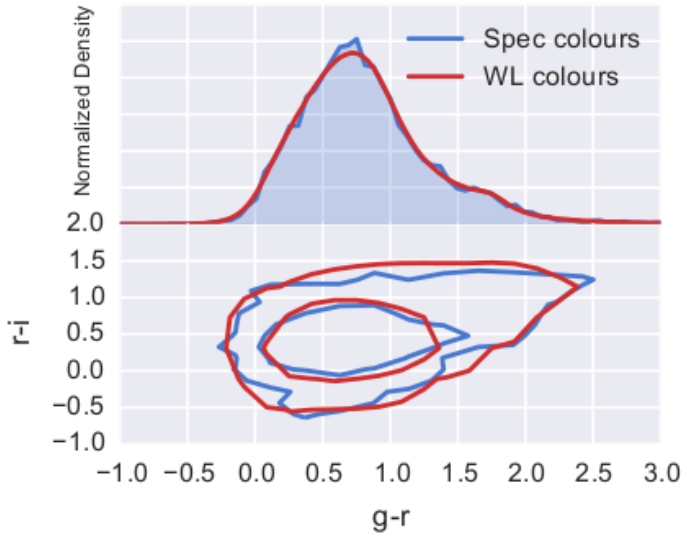

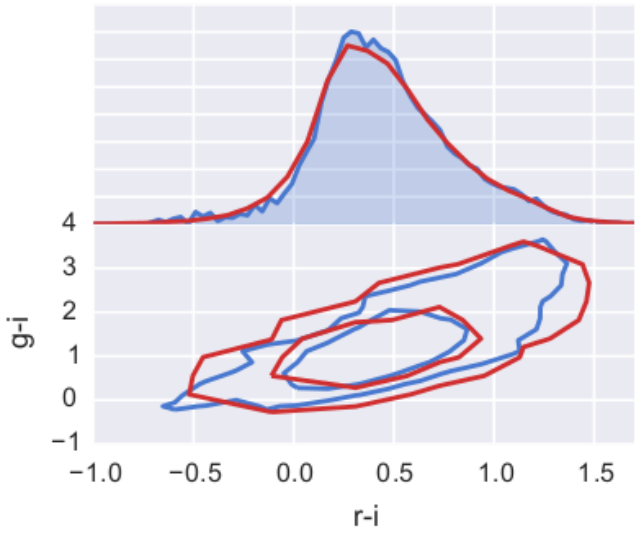

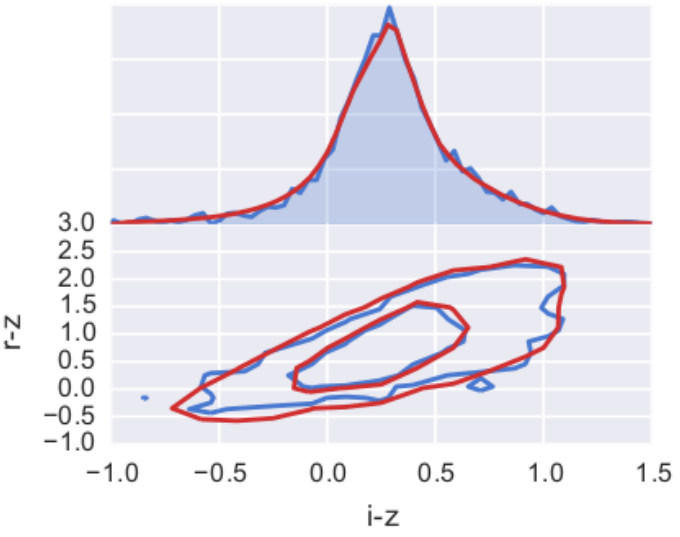

Selection effects in spectoscopic samples matter...

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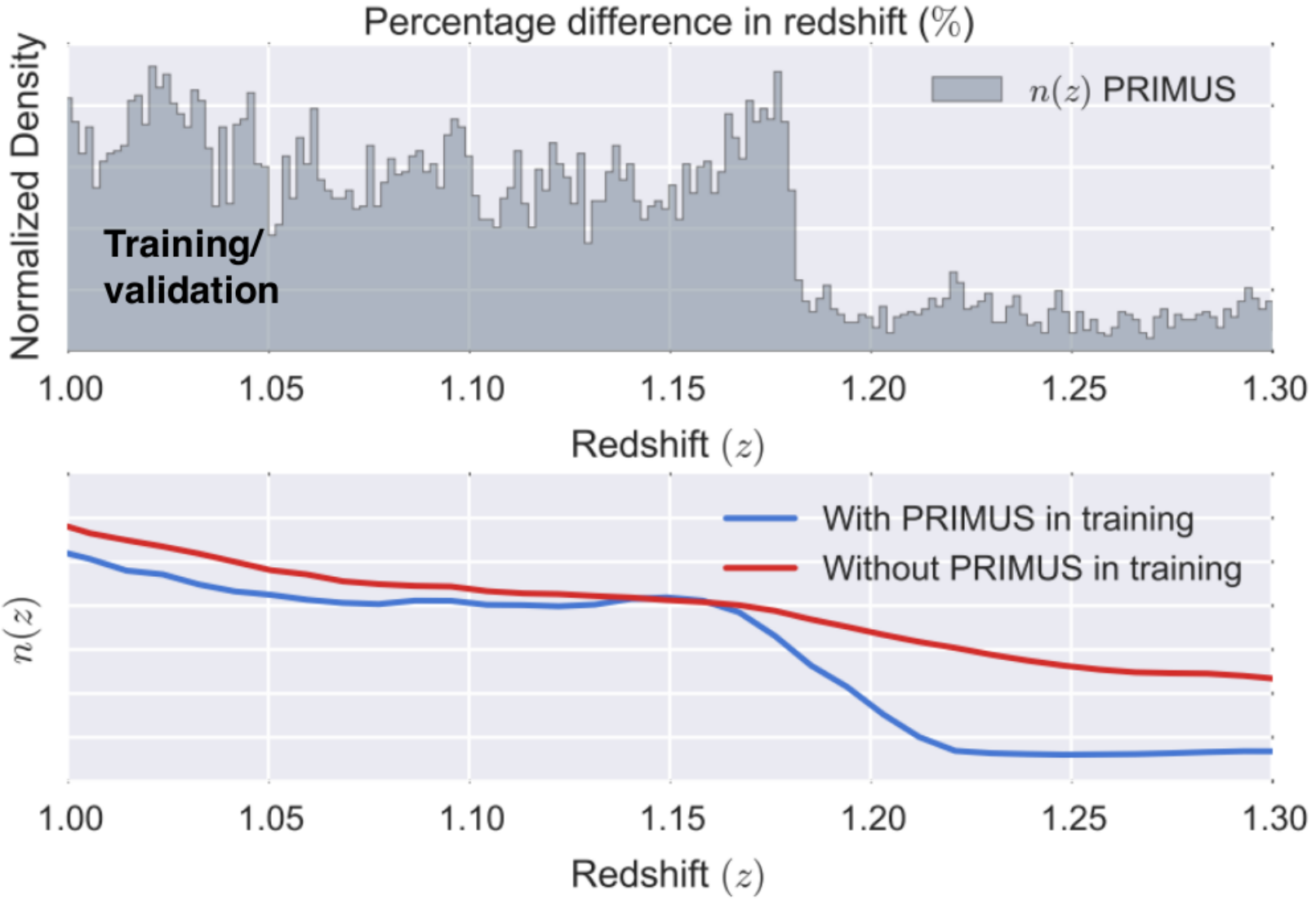

Bonnett, Troxel, Hartley, Amara & DES (2016)

Selection effects in spectoscopic samples matter...

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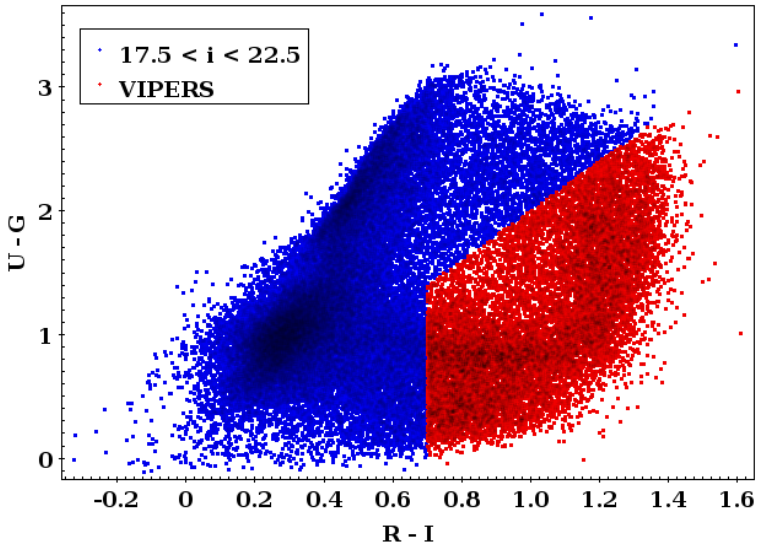

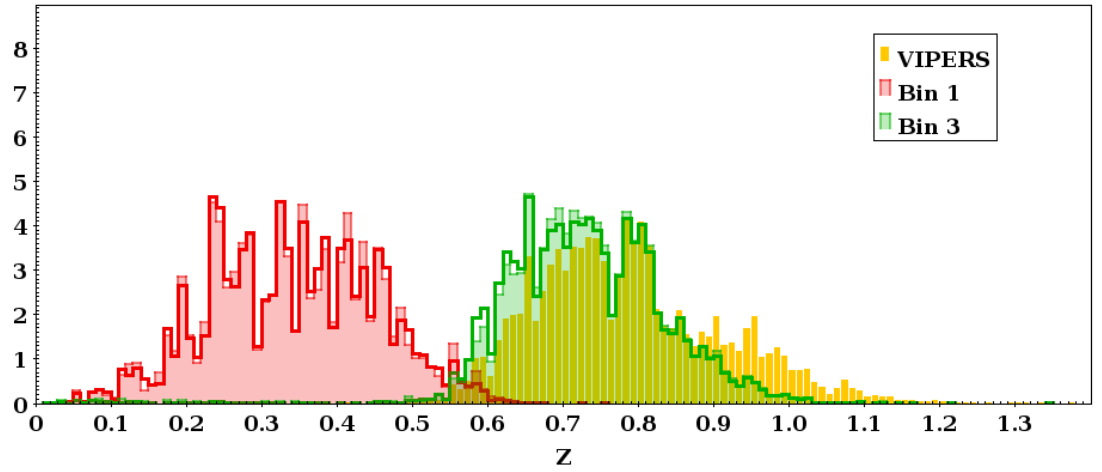

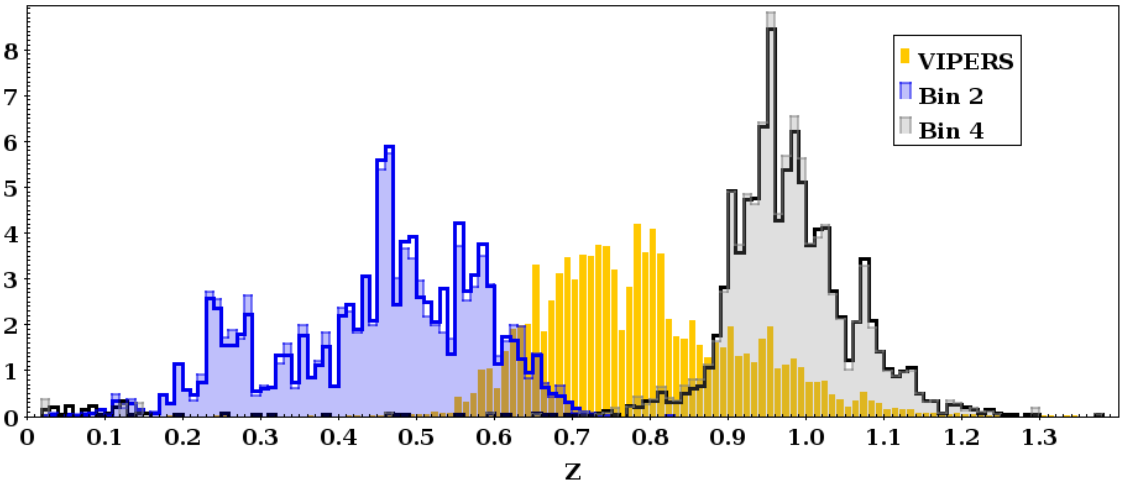

Bin	bias <z>
0.2 – 0.43	0.000
0.43 – 0.63	-0.001
0.63 – 0.9	0.004
0.9 – 1.3	-0.008

→ Filling out with other spec samples may help, but we need to do the work to understand the biases.

Photometric precision also matters...

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- *Redshift distribution (Lima et al. 2008)*

$$< z_{sci} >= \sum_{i=1}^{N} w_i z_{i(val)}$$

- *Mean bias (C. Sanchez et al. 2014)*

$$< \Delta z_{sci} >= \sum_{i=1}^{N} w_i \Delta z_{i(val)}$$

- *Mean bias require another term in deep surveys*

$$< \Delta z_{sci} >= \sum_{i=1}^{N} w_i \Delta z_{i(val)} + \sum_{i=1}^{N} z_{i(val)} \Delta w_i$$

How do we estimate Δw_i? → Bootstrap samples

Lead: Juan de Vicente

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Spectroscopic incompleteness

Recap:

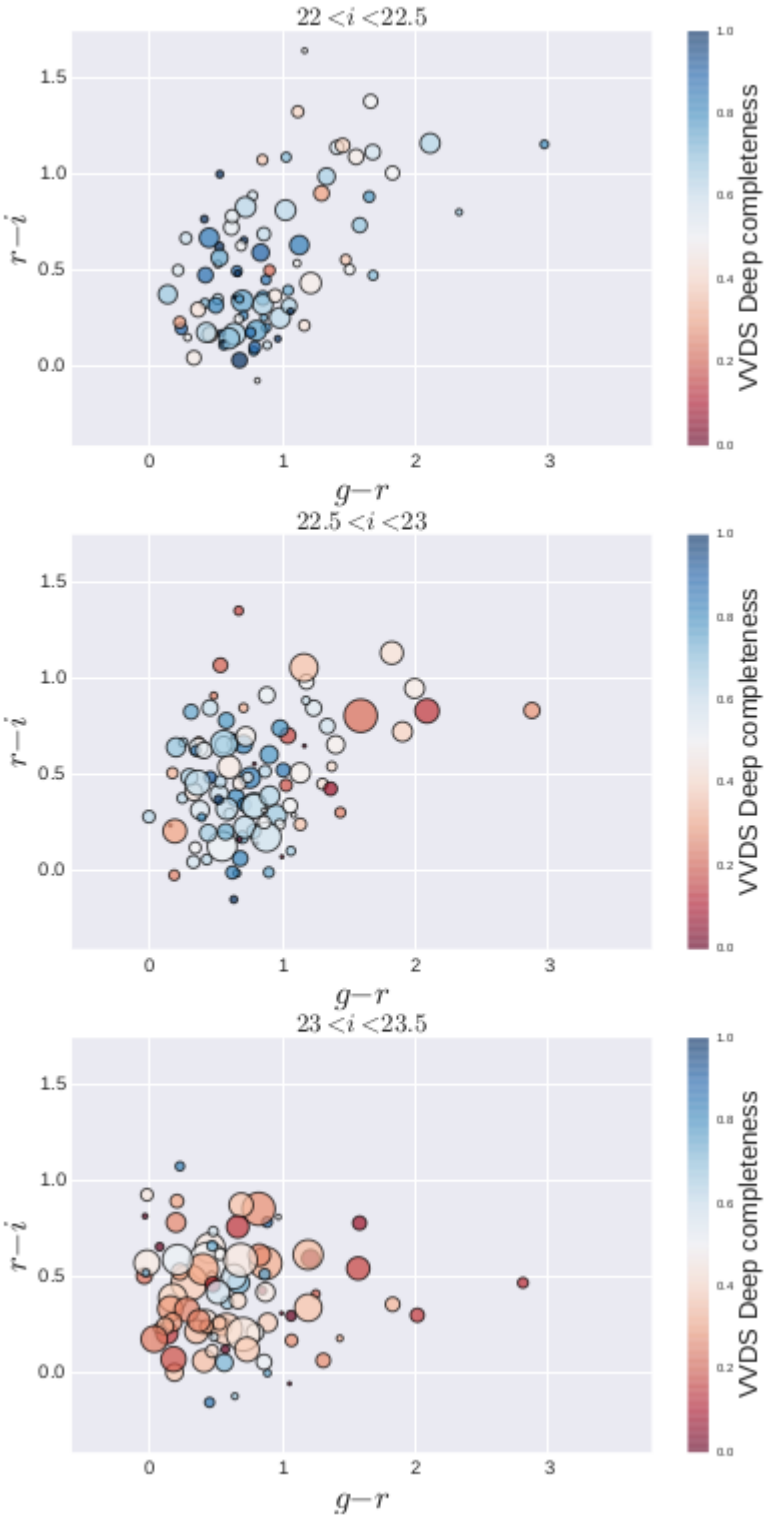
Good cells: ~ 1% offset (VVDS Deep – cosmos)
Bad cells: ~3 % offset
(across all z)

→ **Systematic** bias in redshift due to nature of galaxies and spectroscopy

SV: 5% error on Δz (per tomo) → Y1: 2%

→ Need to understand the impact in tomo bins
→ In a way that is not cos. var. limited

Bonnett, Troxel, Hartley, Amara & DES (2016)



Spectroscopic incompleteness via simulation

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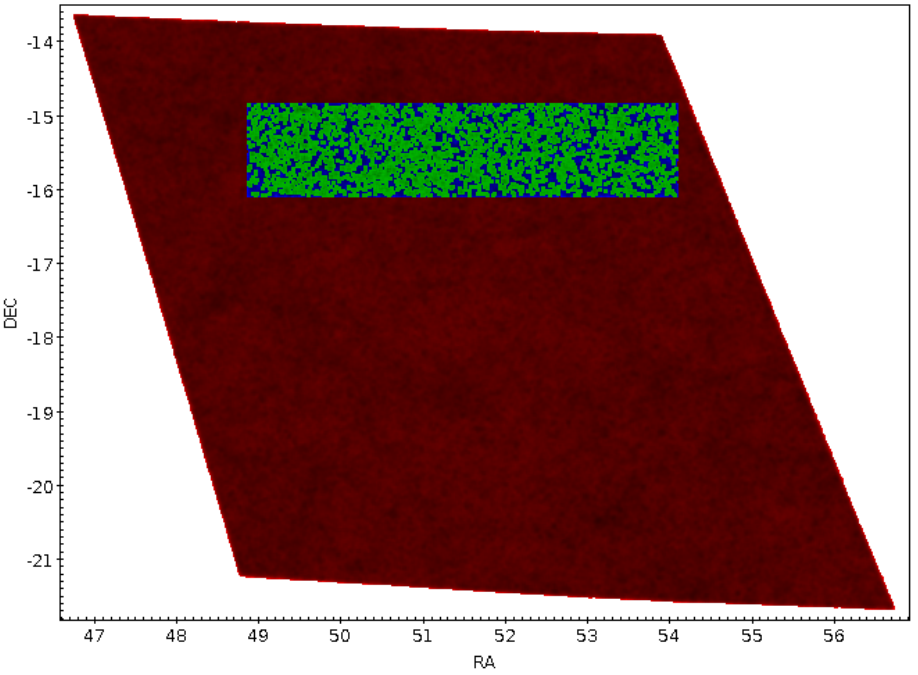
To understand the potential impact of spectroscopic incompleteness we need a ‘truth’.

- BCC – R. Wechsler

- ADDGALS

- SED from linear comb. of k-correct templates

  → simulate spectra
  → observer-determined quality flags
  → in practice, only a sub-set are viewed



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Spectroscopic incompleteness via simulation

Survey	N_spec	z_mean	contribution*
'VVDS'	11121	0.60117582052	0.14879671
'VIPERS'	9455	0.679955346378	0.13222064
'DEEP2'	7161	0.96211750011	0.12722054
'ZCOSMOS'	11751	0.538961313931	0.12504472
'WIGGLEZ'	13496	0.574014198281	0.10376833
'3DHST'	7011	0.885519388104	0.10305213
'ACES'	4244	0.589617512818	0.08127892
'DES_AAOMEGA'	12436	0.612238700547	0.05858695
'EBOSS_DES_ELG'	4432	0.956351457529	0.0274456

* sum of sampling weights to match Y1 GOLD

* base template resolution is lower than DEEP2

→ Start with the key surveys that use VIMOS.

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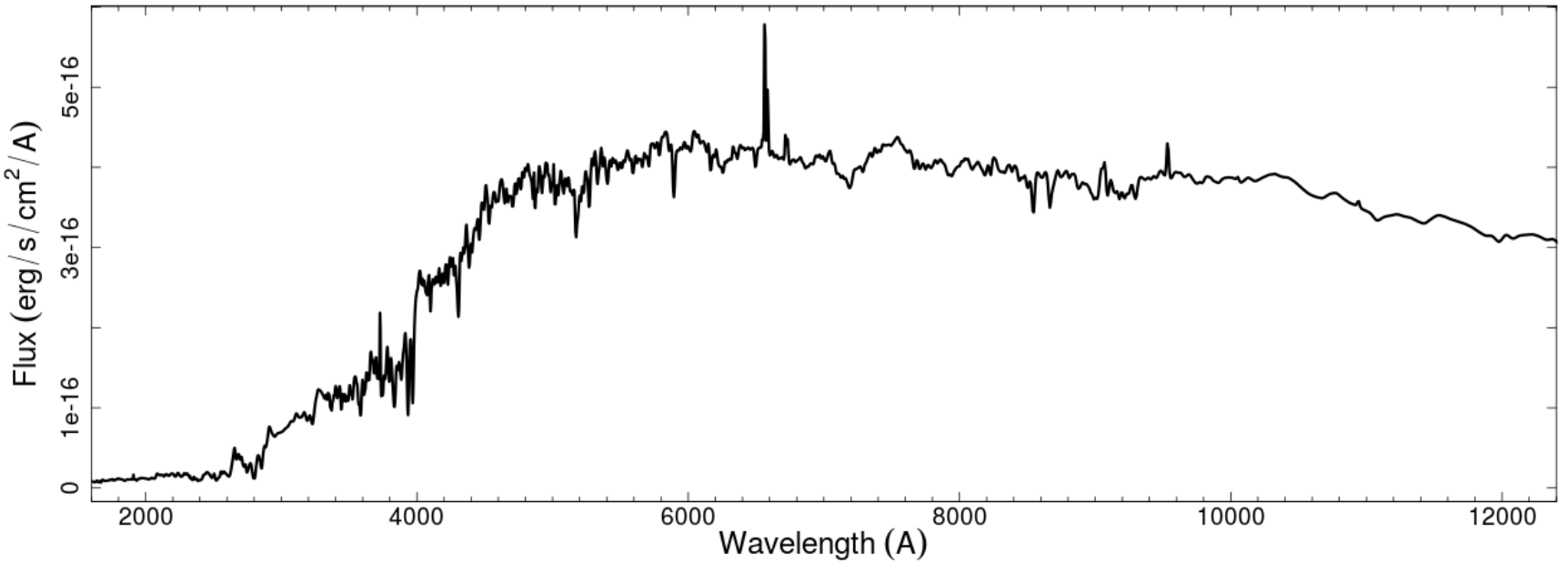
Original spectrum...



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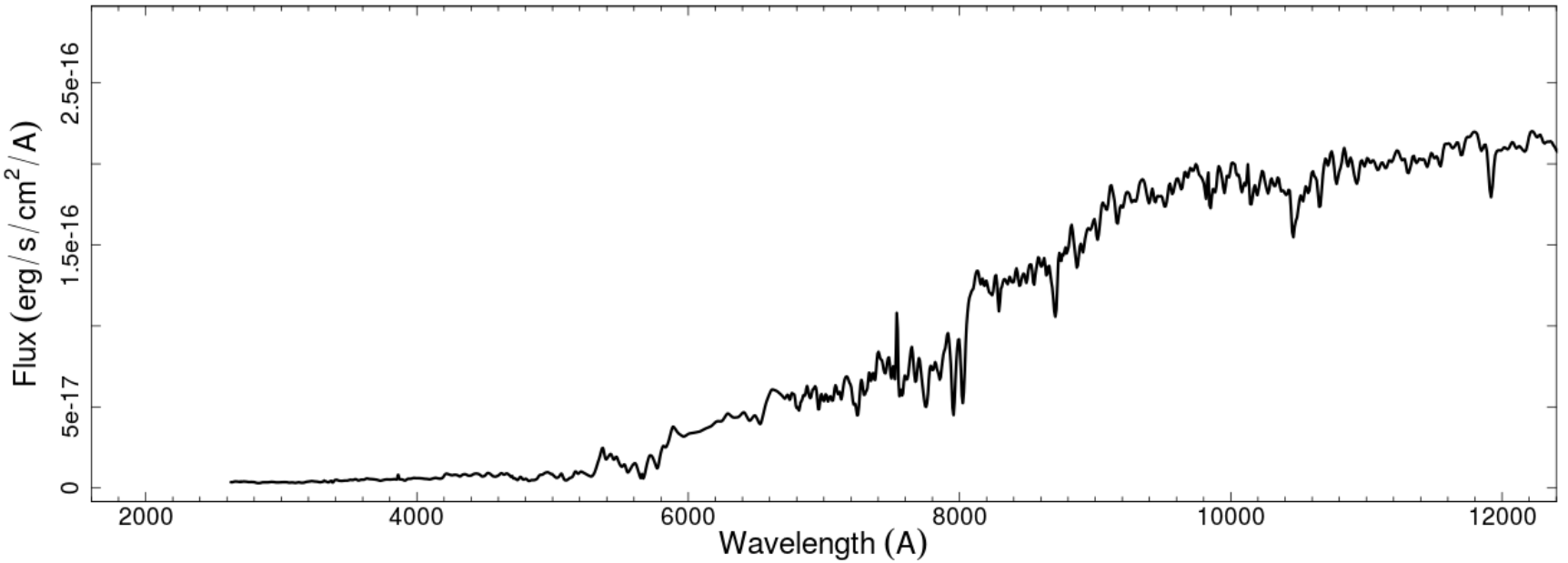
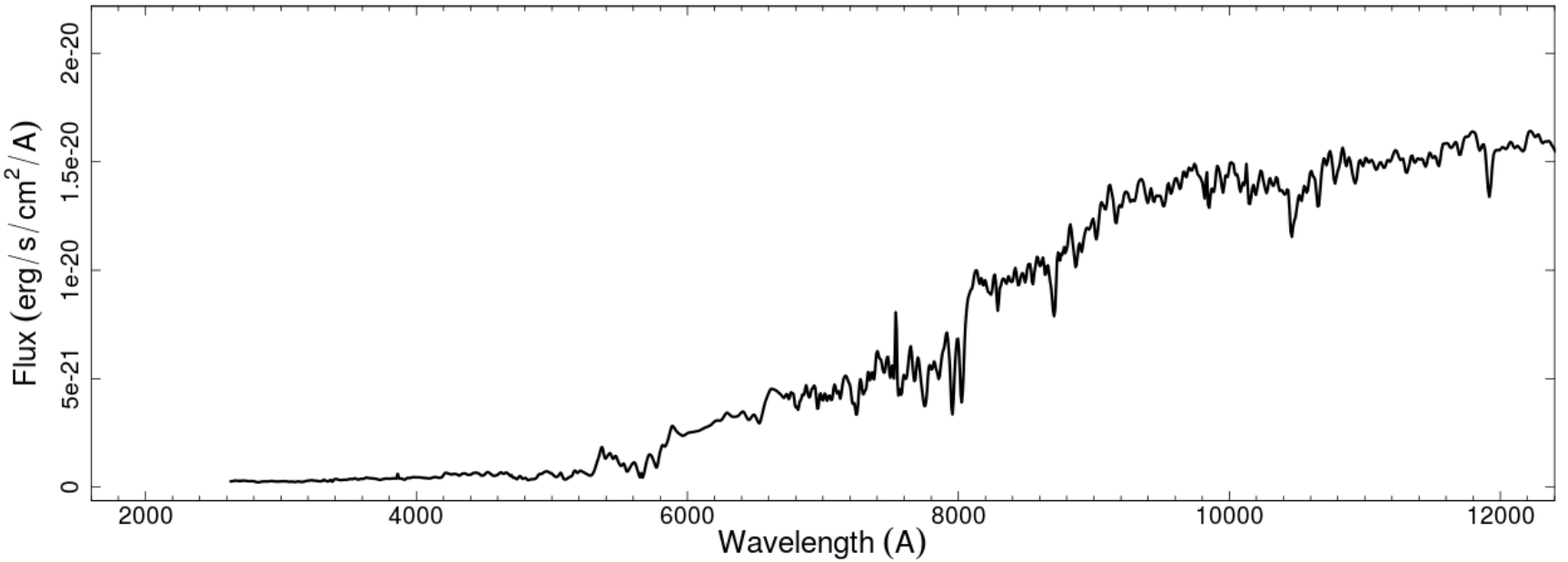
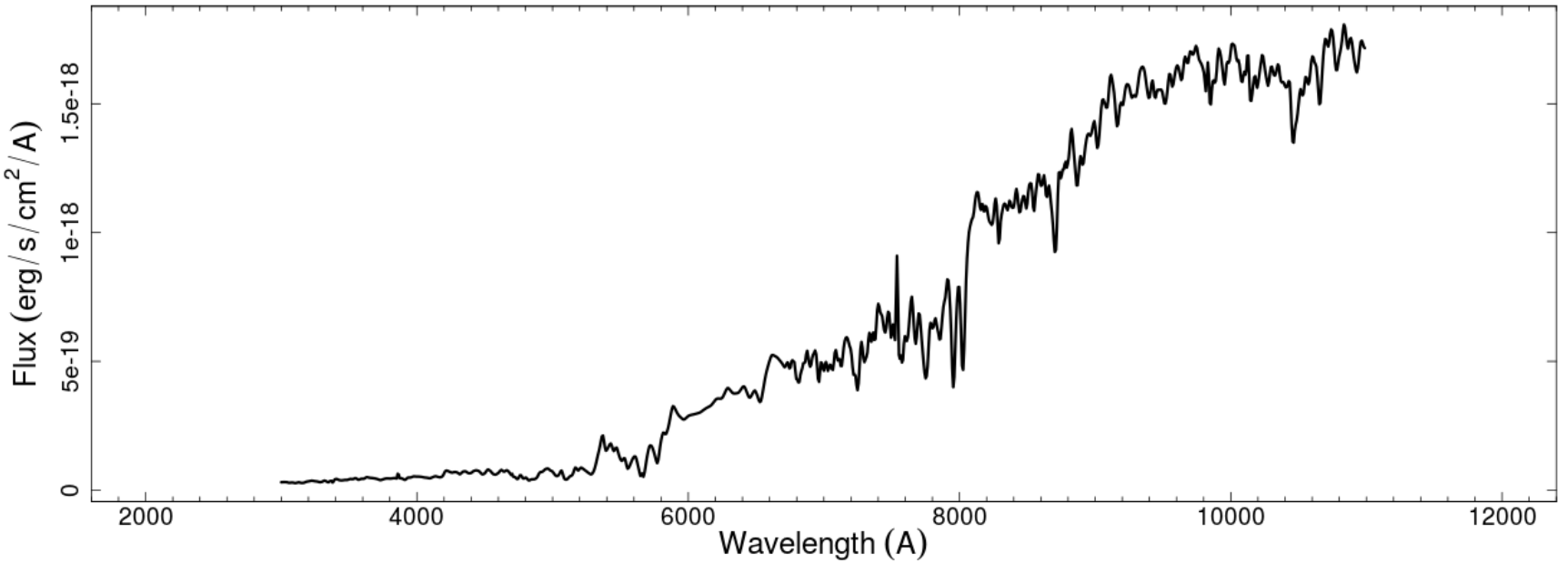
Redshifted...



Scaled to observed magnitude...



Rebinned to VIMOS LR-red resolution...



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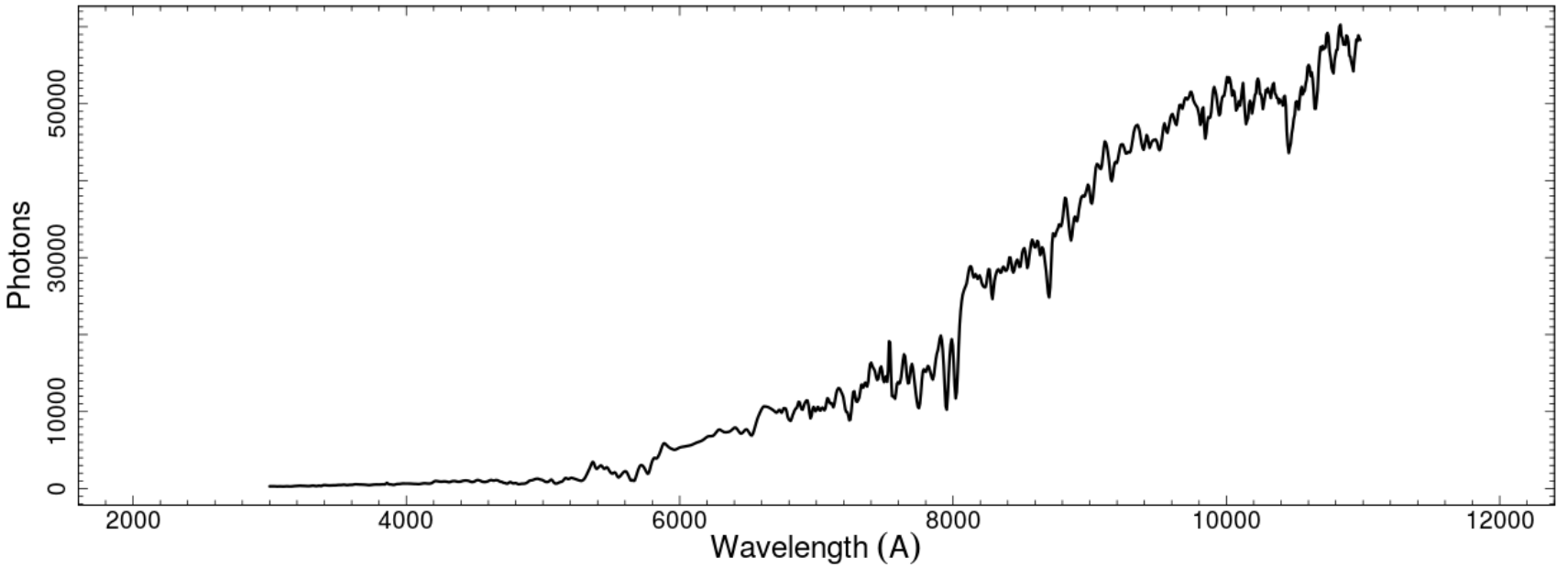
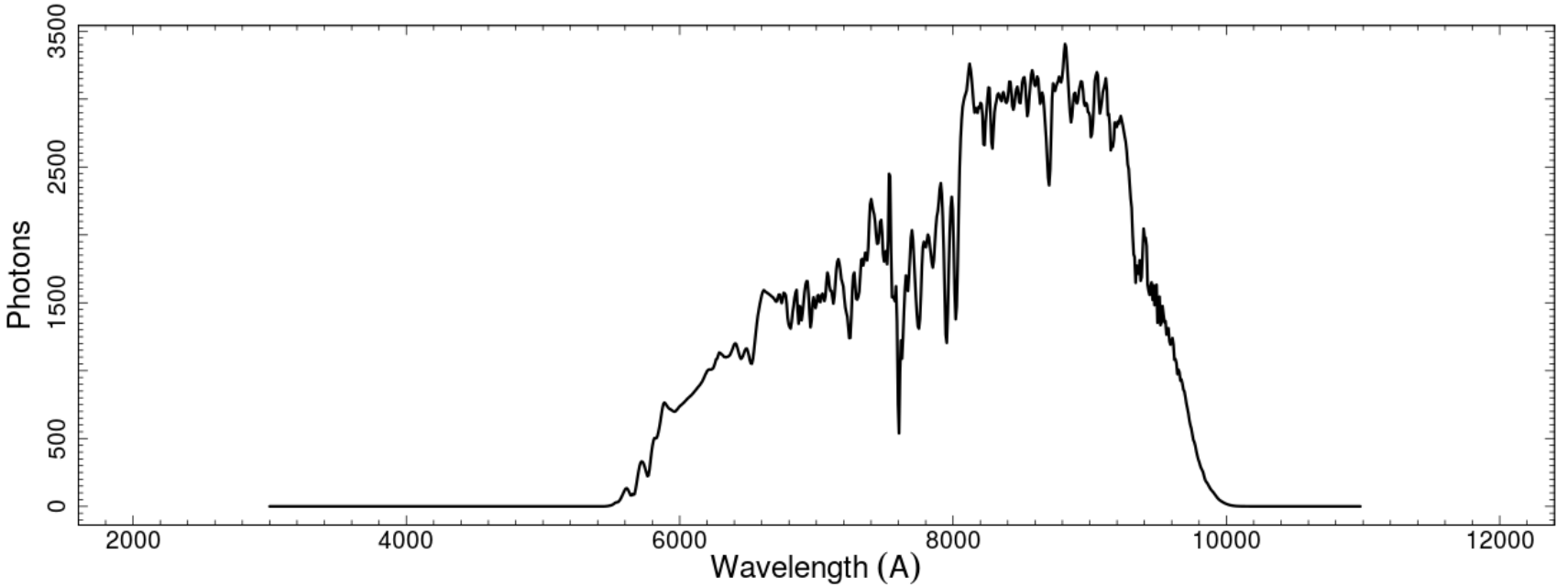
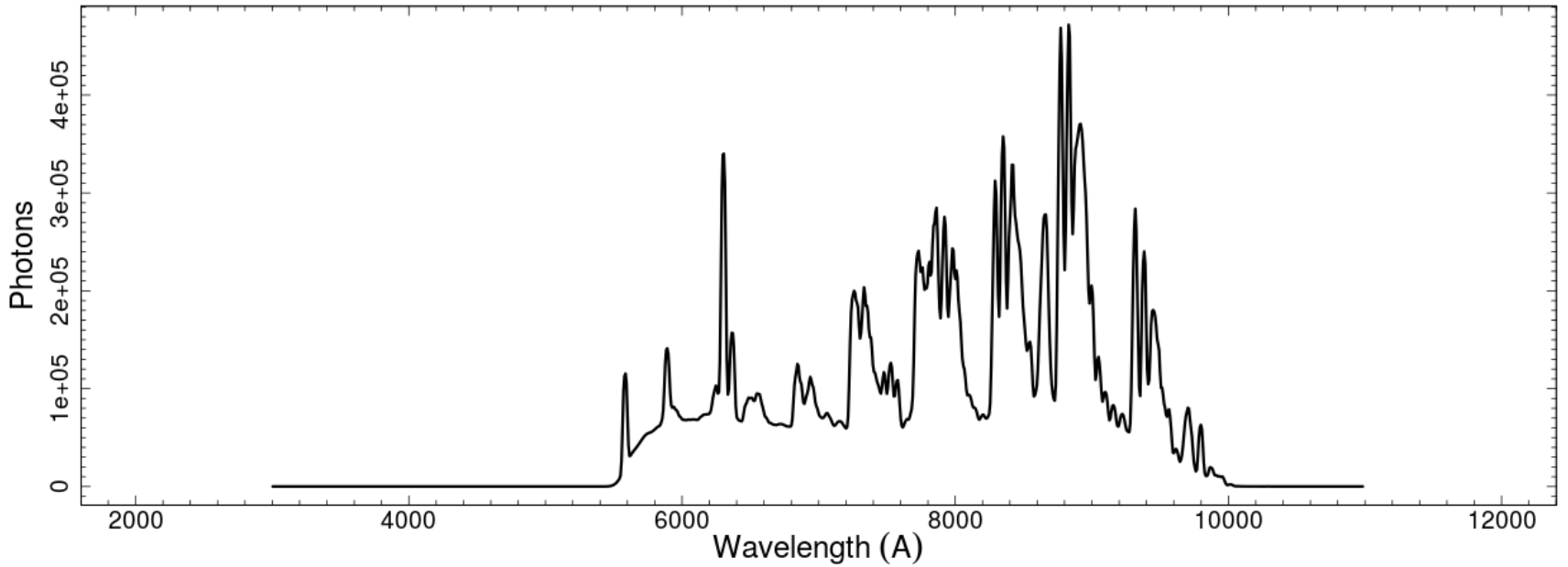
Converted to photons...



Transmission function and slit losses applied...



Sky added...


Photons
0
1e+05
2e+05
3e+05
4e+05
2000
4000
6000
8000
10000
12000
Wavelength (A)

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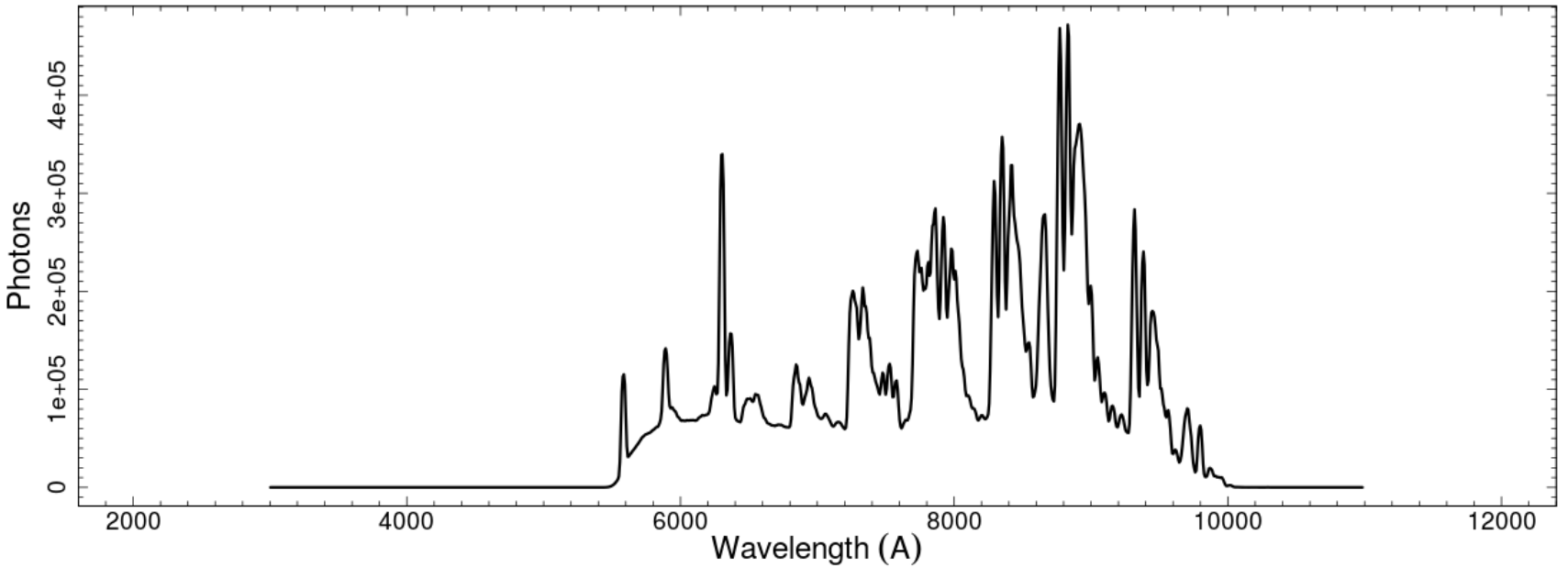
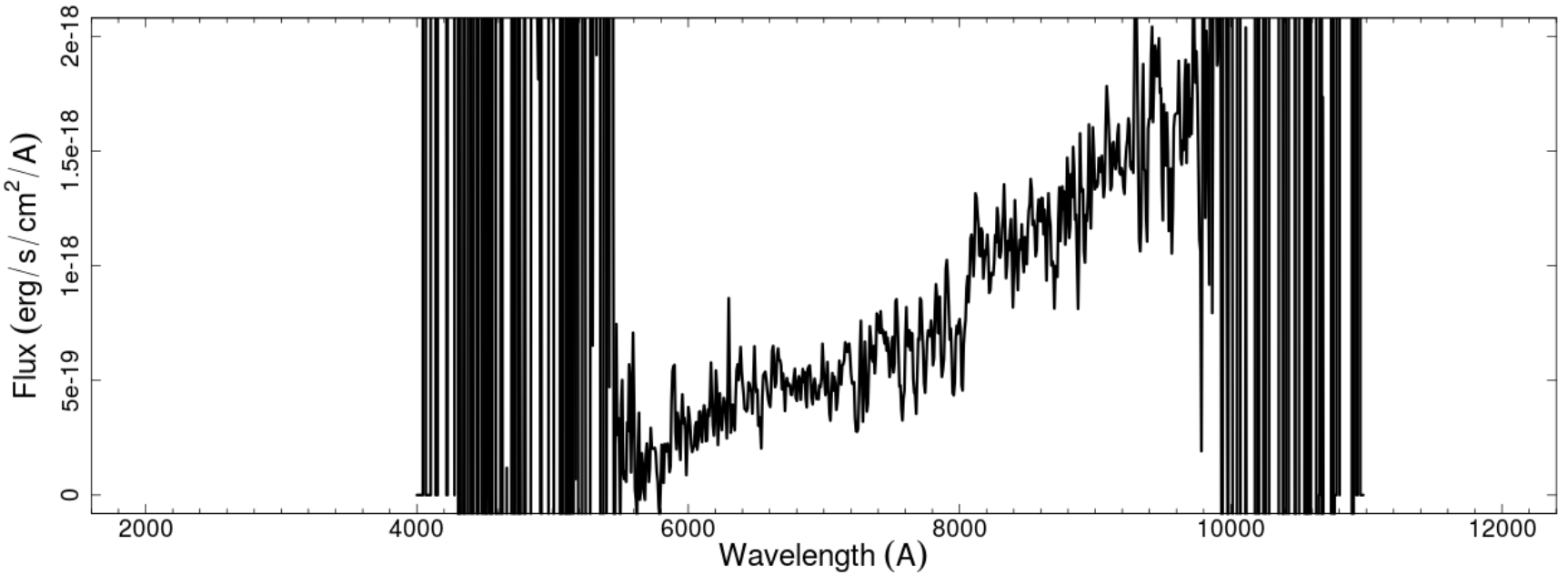
Poisson sampled...



Converted back to flux, sky subtracted and corrected for transmission and slit losses...



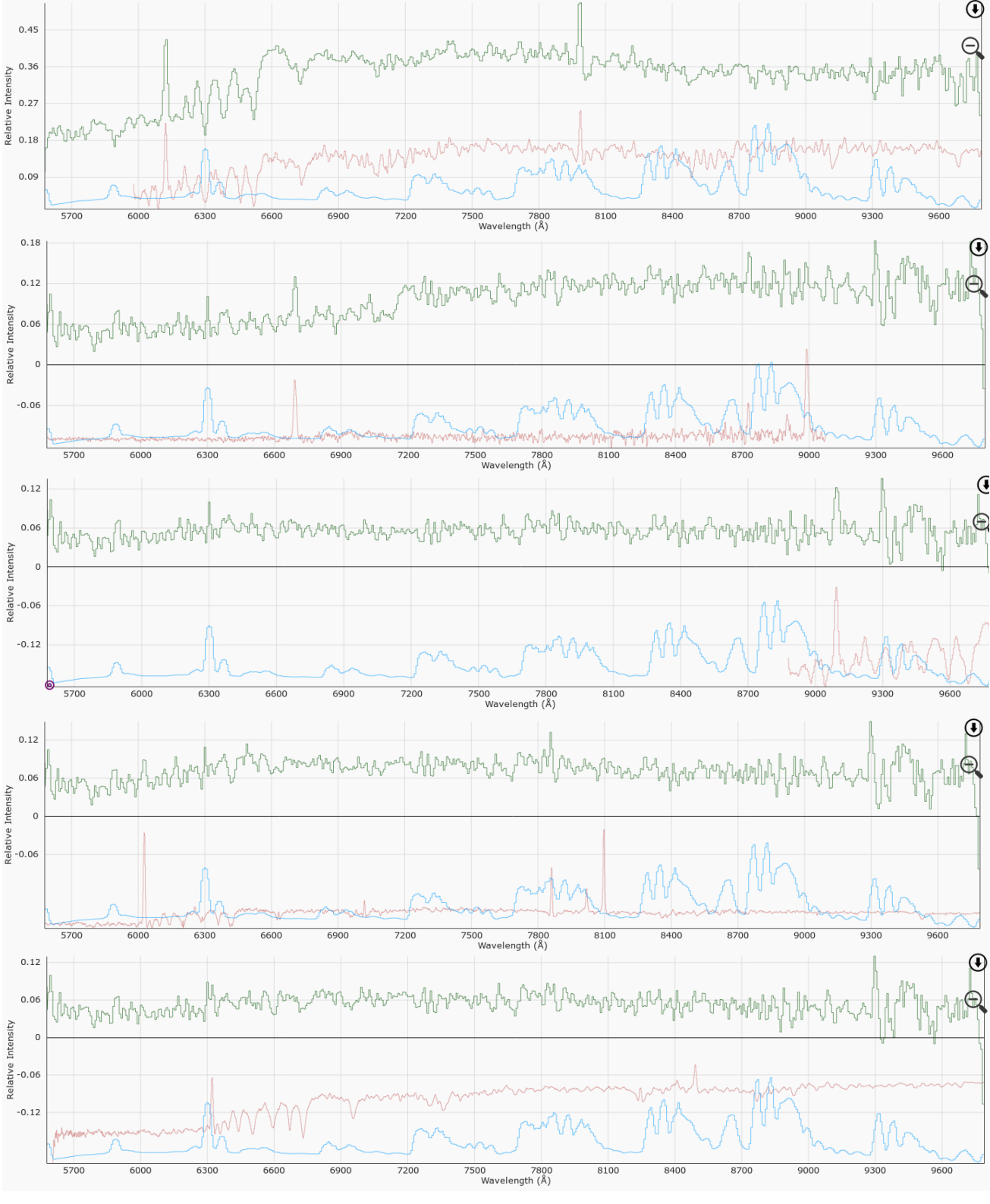
Flag = 4

Flag = 3

Flag = 6 → 2.5

Flag = 2

Flag = 1



Spectroscopic incompleteness – already a problem

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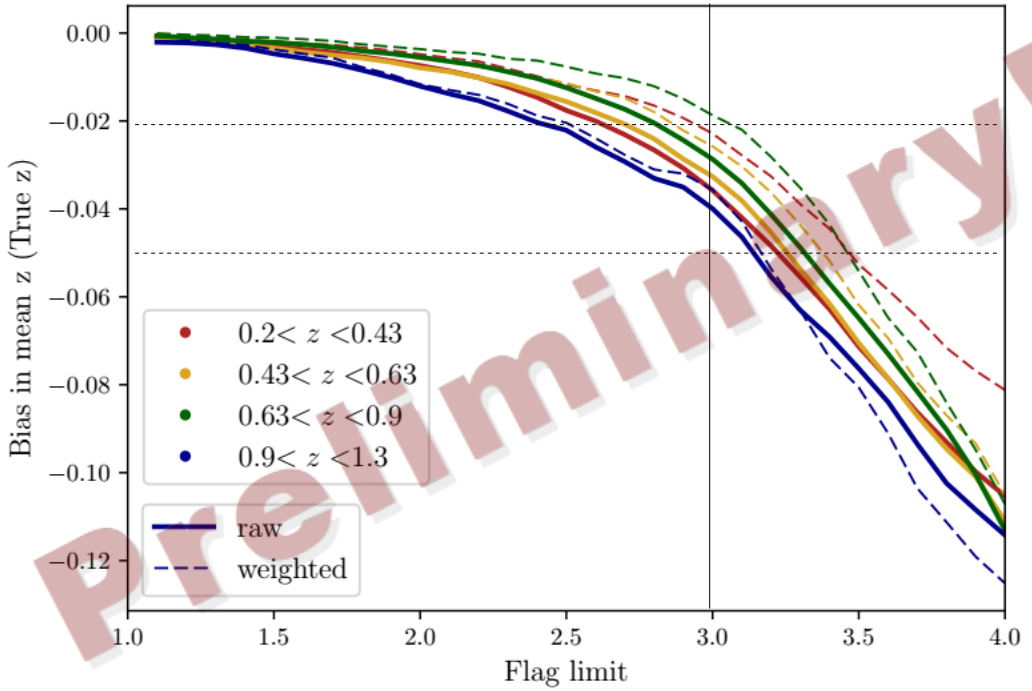
Bias in mean redshift due to incompleteness

→ within SV budget

→ ~ to **total** budget for Y1 in 3 bins

→ greater than allowed in highest tomo bin

Leads: Will Hartley, Chihway Chang



Y1

SV

Solutions I: Remove bad regions of col mag space

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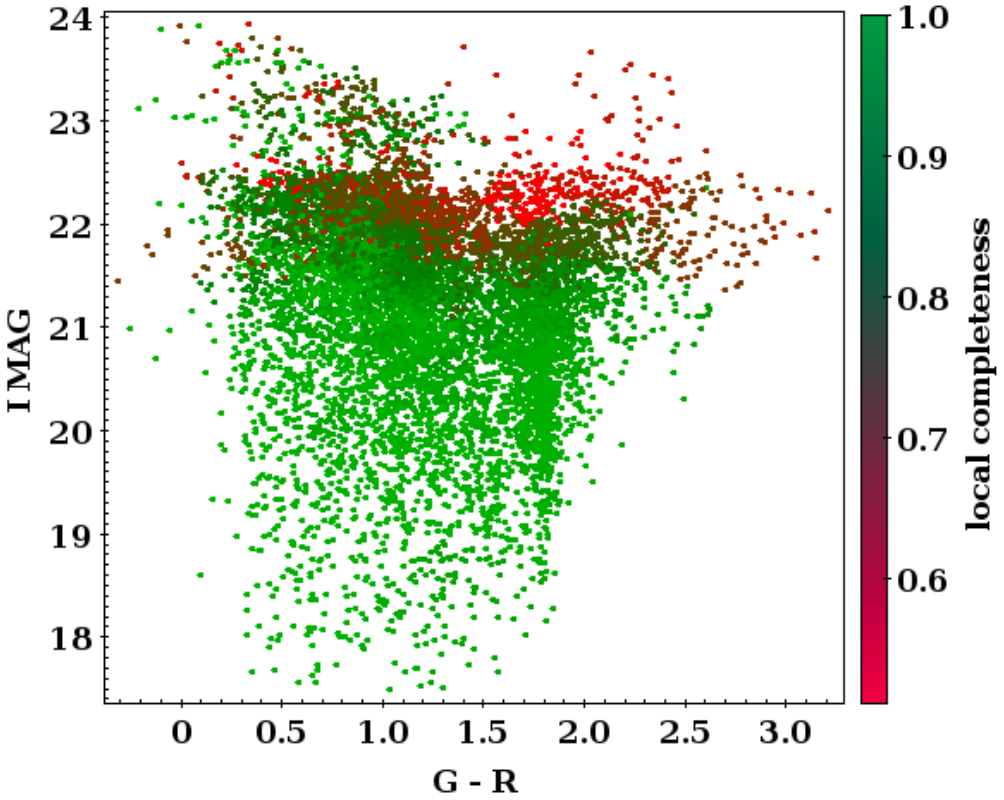
Remove ~20% (spec) objects in regions of worst incompleteness.

<z> bias:

0.2 – 0.43	-0.001
0.43 – 0.63	0.000
0.63 – 0.9	-0.001
0.9 – 1.3	0.007



→ **But this does not account at all for photometric errors**

Solutions II: Filling in the gaps

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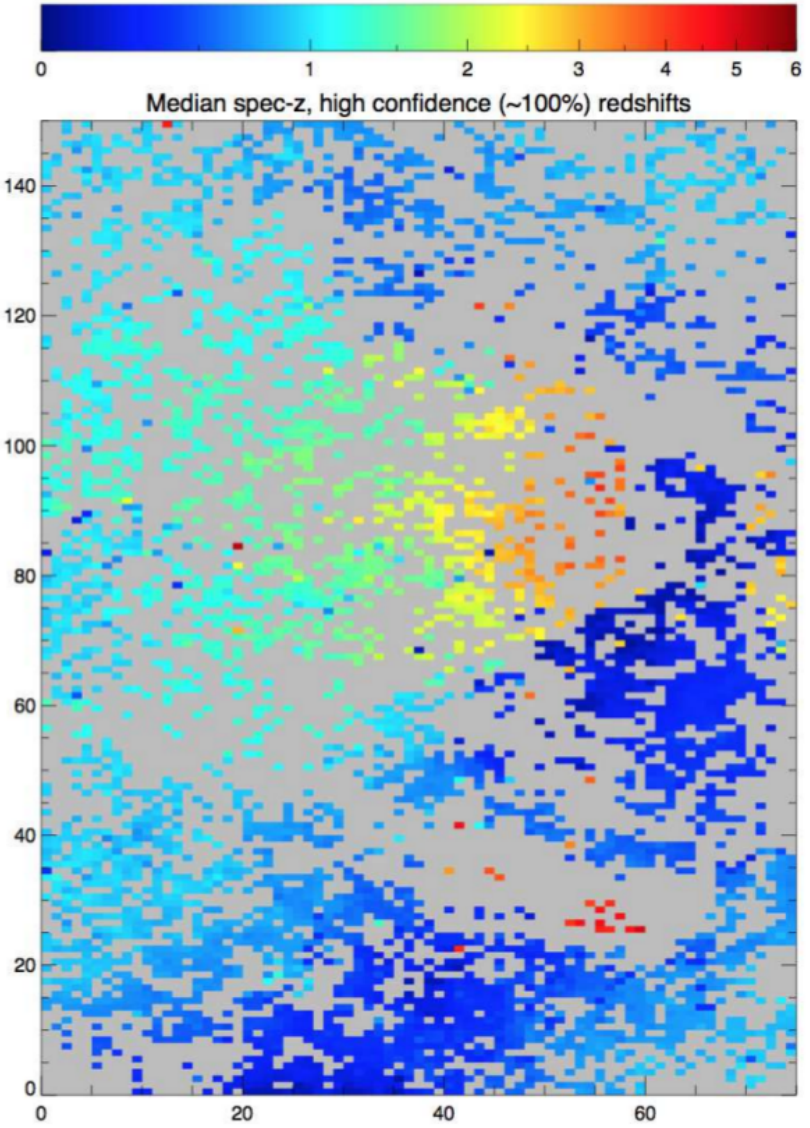

Masters et al. (2015)

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Requirements for absolute precision:

→ Unique feature → redshift mapping (within features accessible to whole survey)
→ Infinite S/N data

Or:

→ Complete spectroscopic sample (e.g. I < 24. for DES)
→ Culled to match science sample

→ How far can we wander from these criteria and still be safe?