

3D ST:

A Slitless Spectroscopic Survey of *ten thousand* Distant Galaxies

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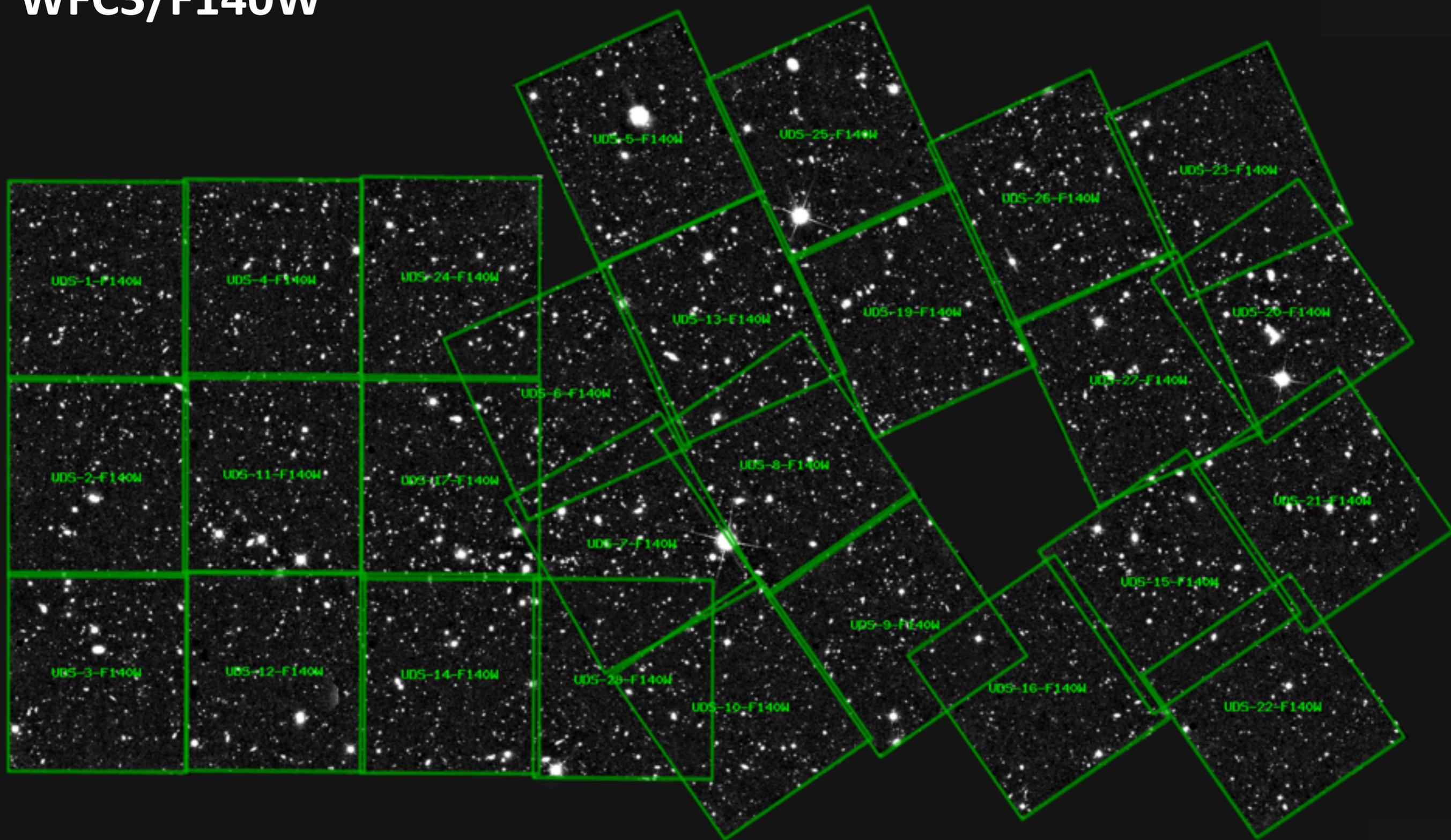
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Adam Muzzin (Leiden)
Pascal Oesch (Yale)
Moire Prescott (DARK)
Rosalind Skelton (SAAO)
Jon Trump (Penn State)
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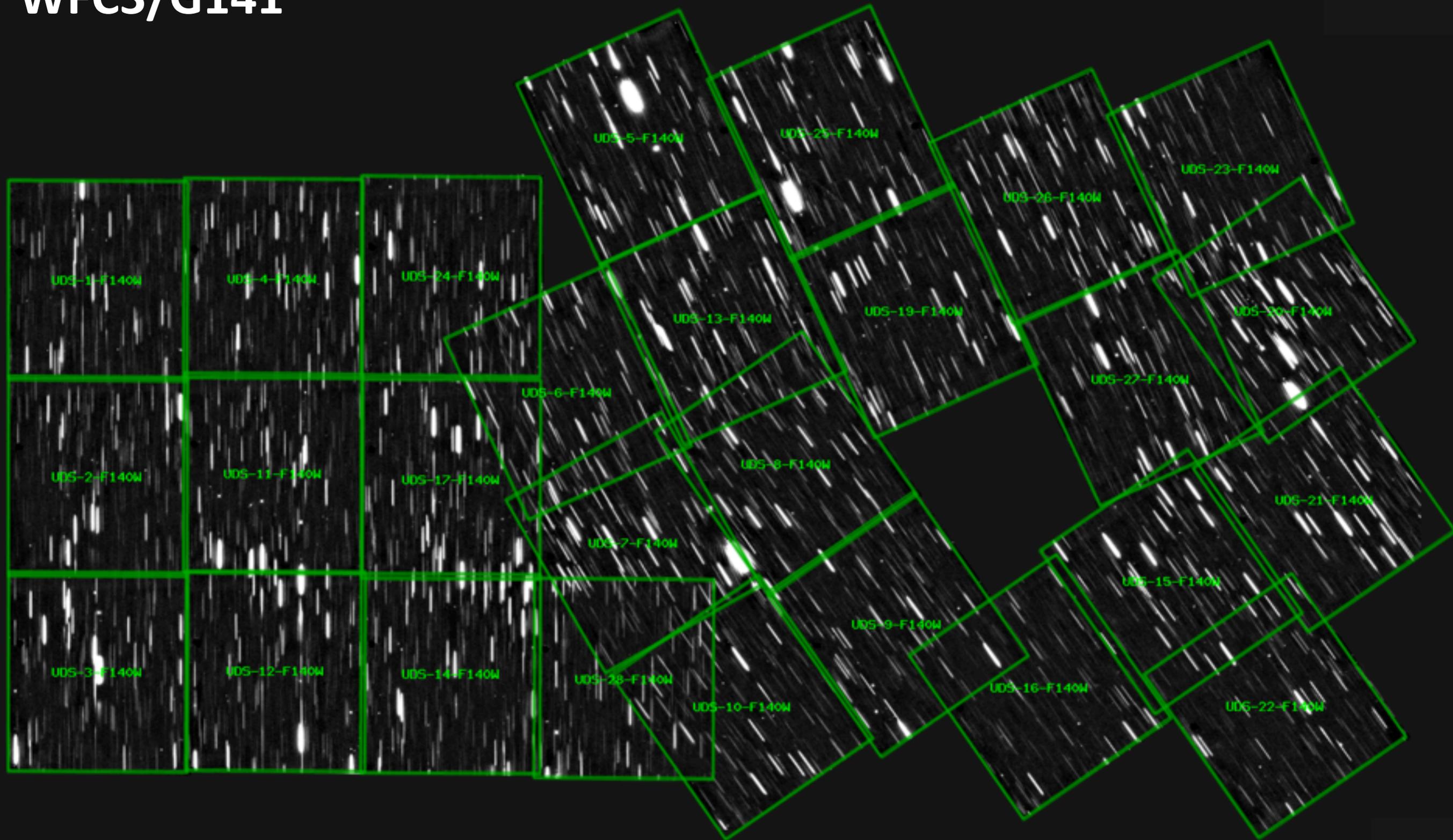
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CANDELS UDS WFC3/F140W



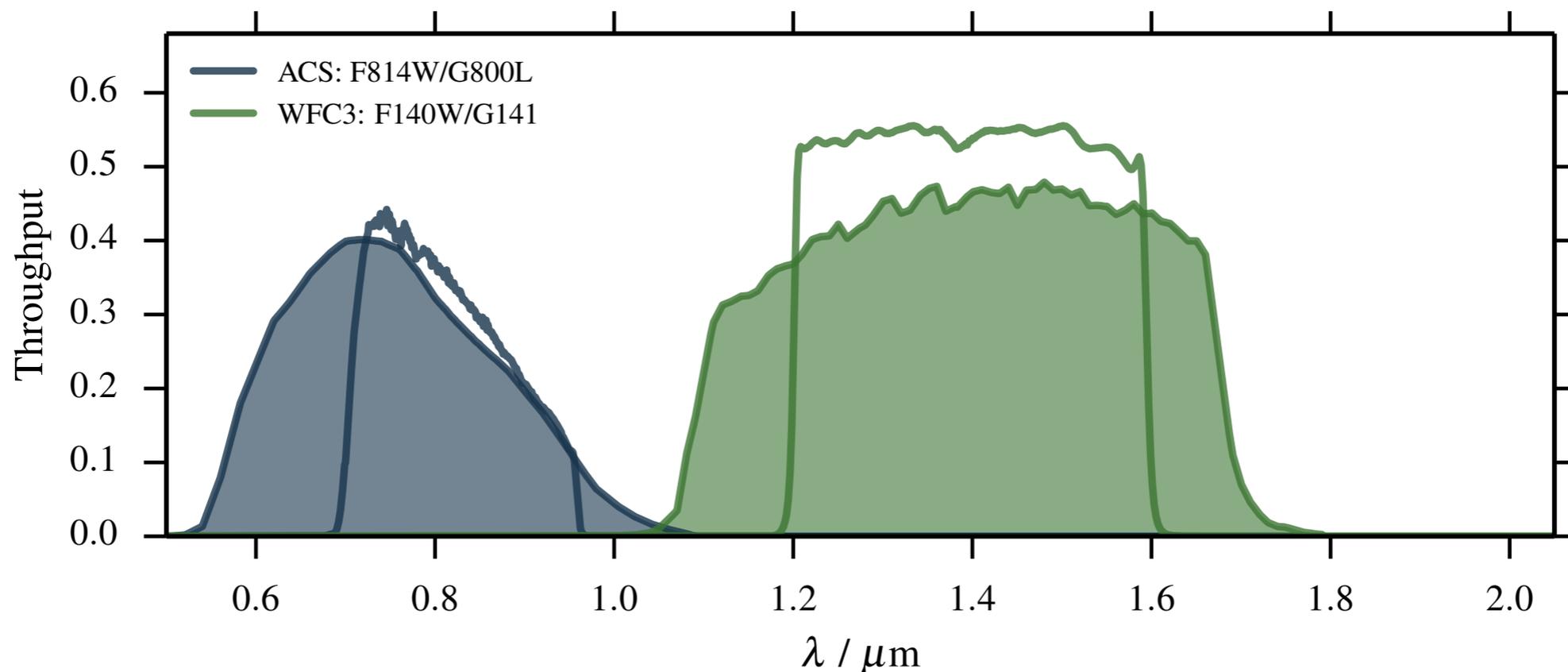
CANDELS UDS WFC3/G141



Survey Overview

(Brammer+2012, Skelton+2014)

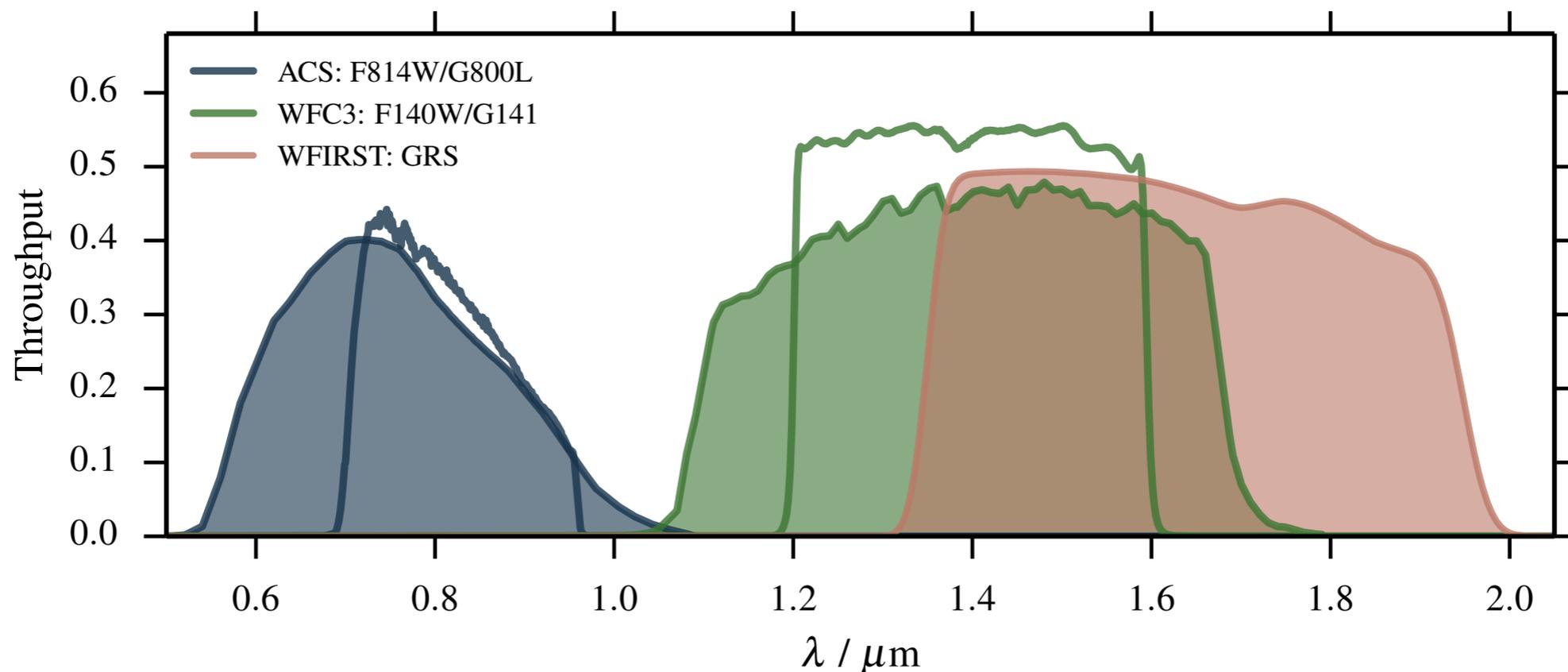
- **Two-orbit visits** 4× [140W (800s) + G141 (4700s)] exposures
- **124 + 28** (GOODS-N, B. Weiner) pointings covering 625 arcmin²
- ACS F814W + G800L parallels



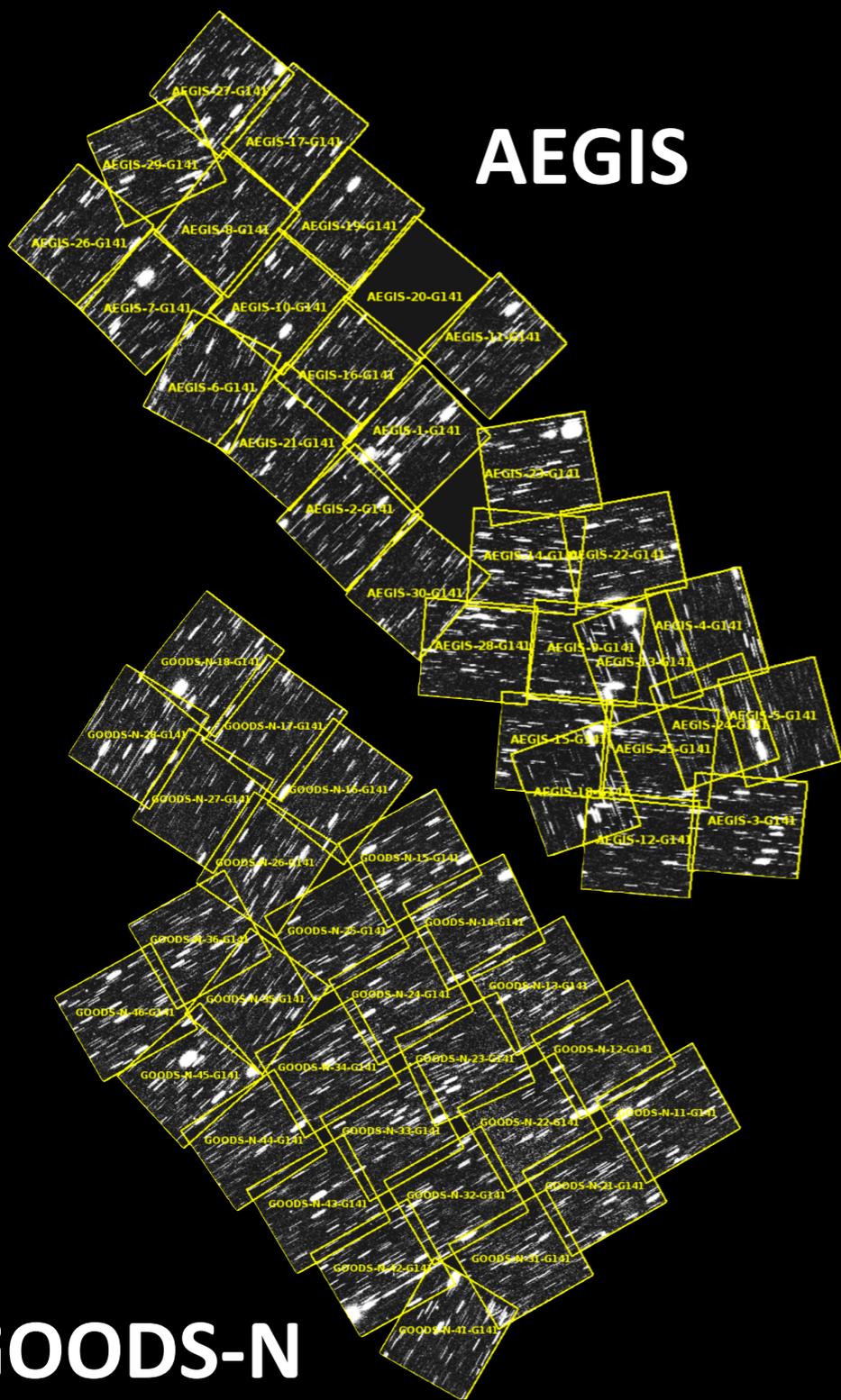
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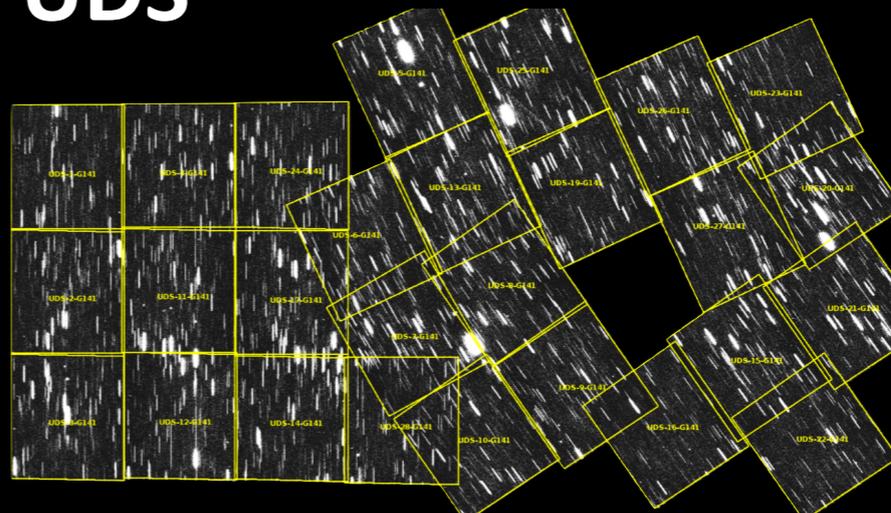


AEGIS

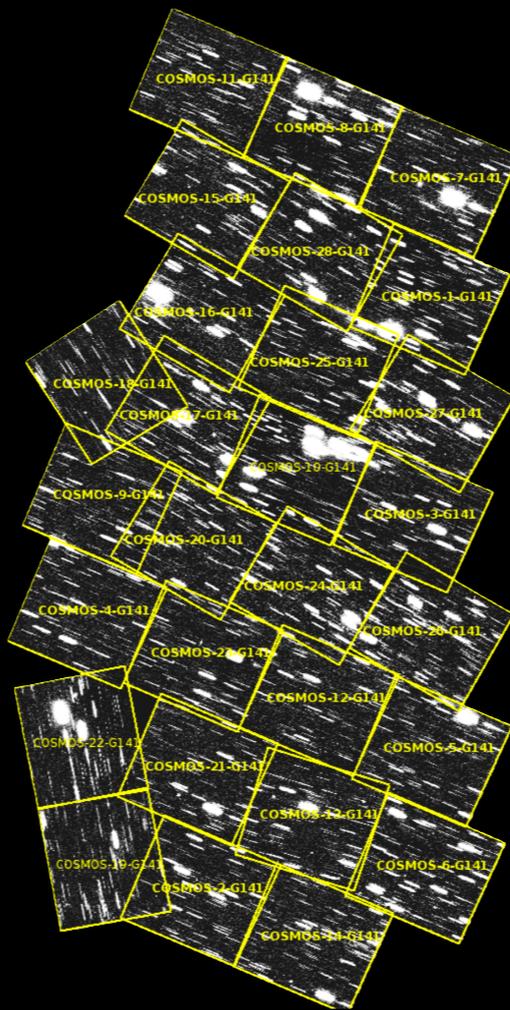


GOODS-N

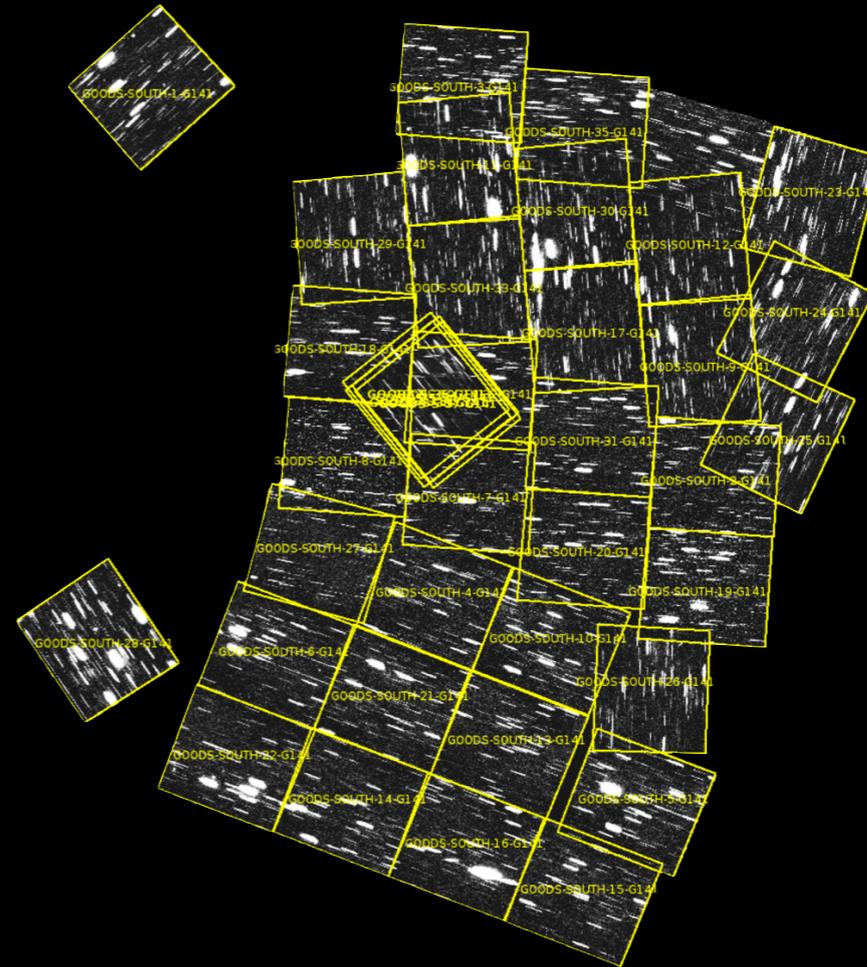
UDS



COSMOS



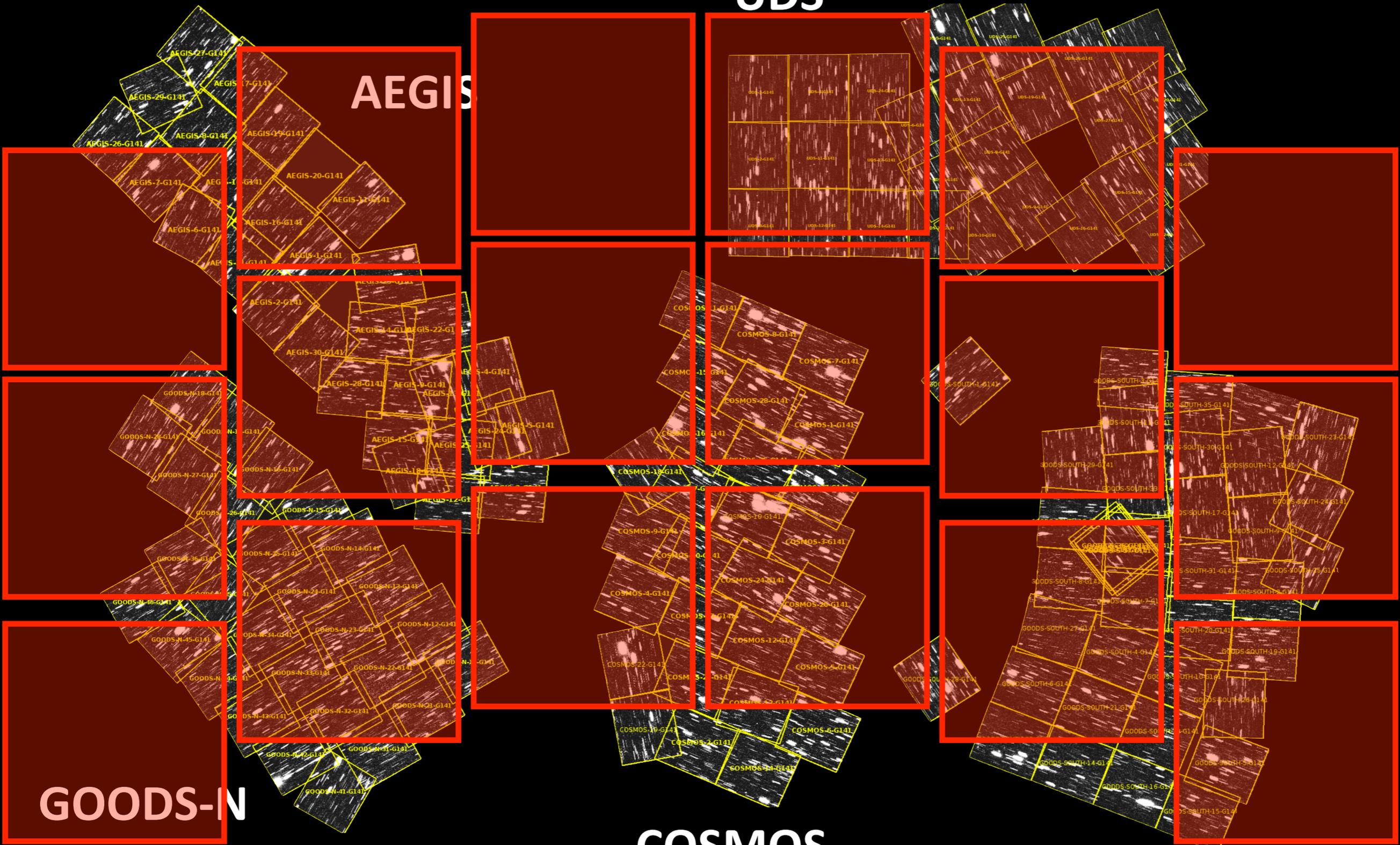
GOODS-S



WFIRST

UDS

AEGIS



GOODS-N

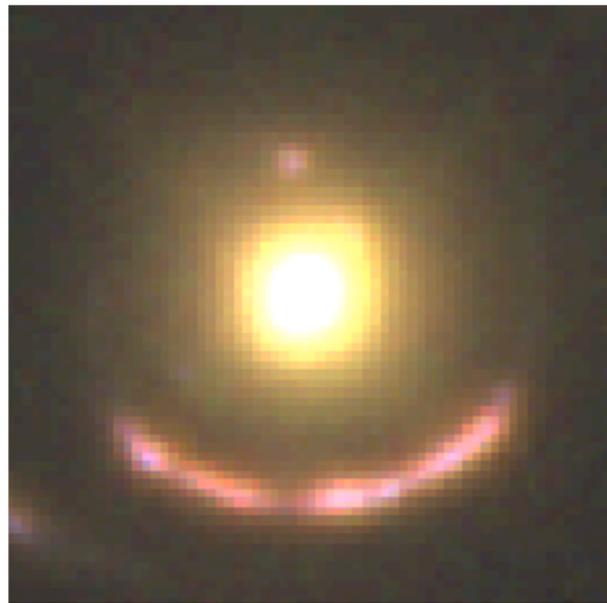
COSMOS

GOODS-S

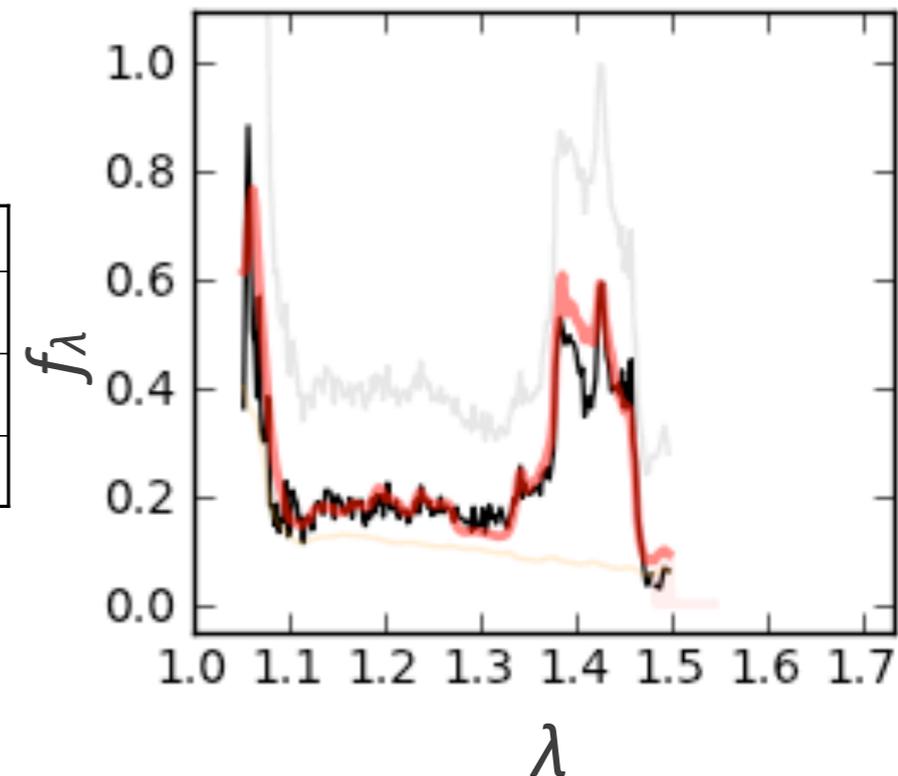
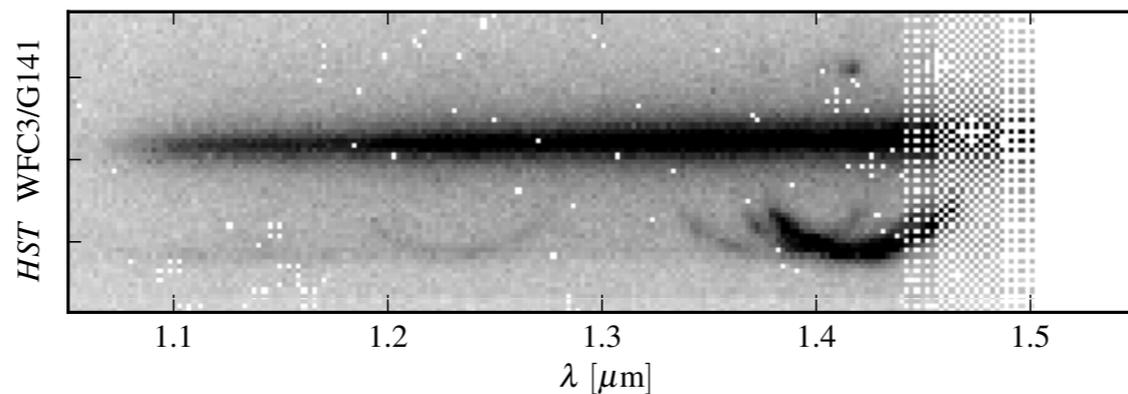
Extracting & Fitting Spectra

- The slitless configuration typically requires modeling galaxy spectra in **2D**, both for the **morphology** of the objects themselves and for **contamination** from nearby objects.

Brammer+2013



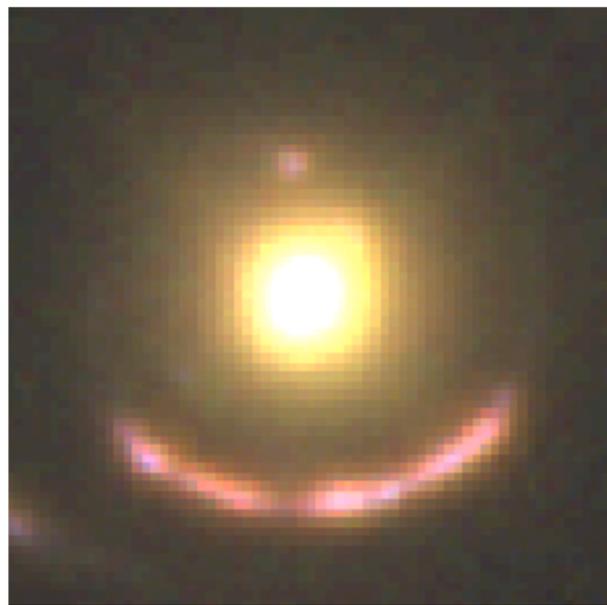
F814W F125W F160W



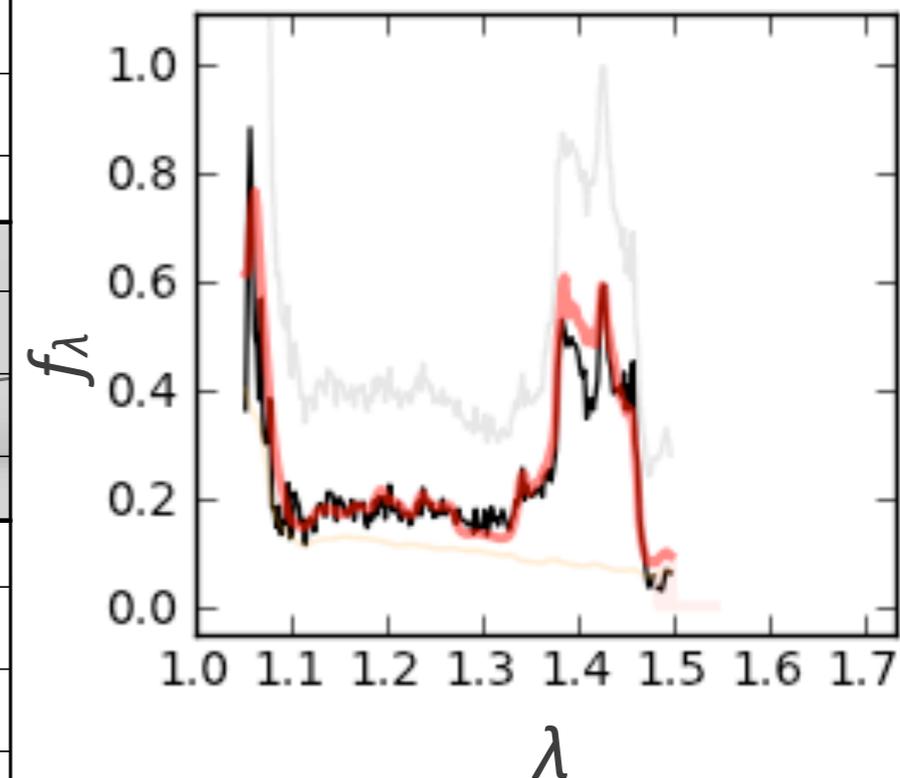
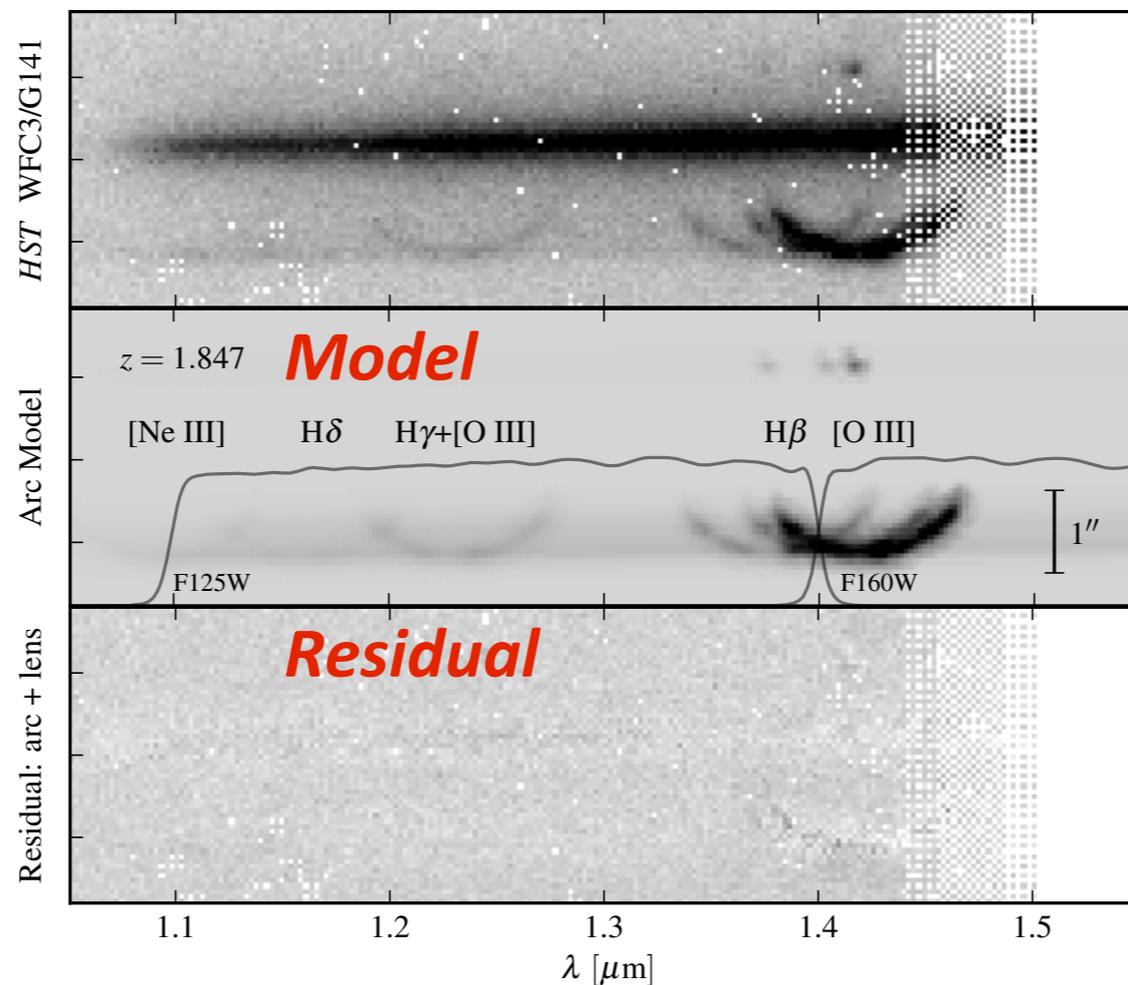
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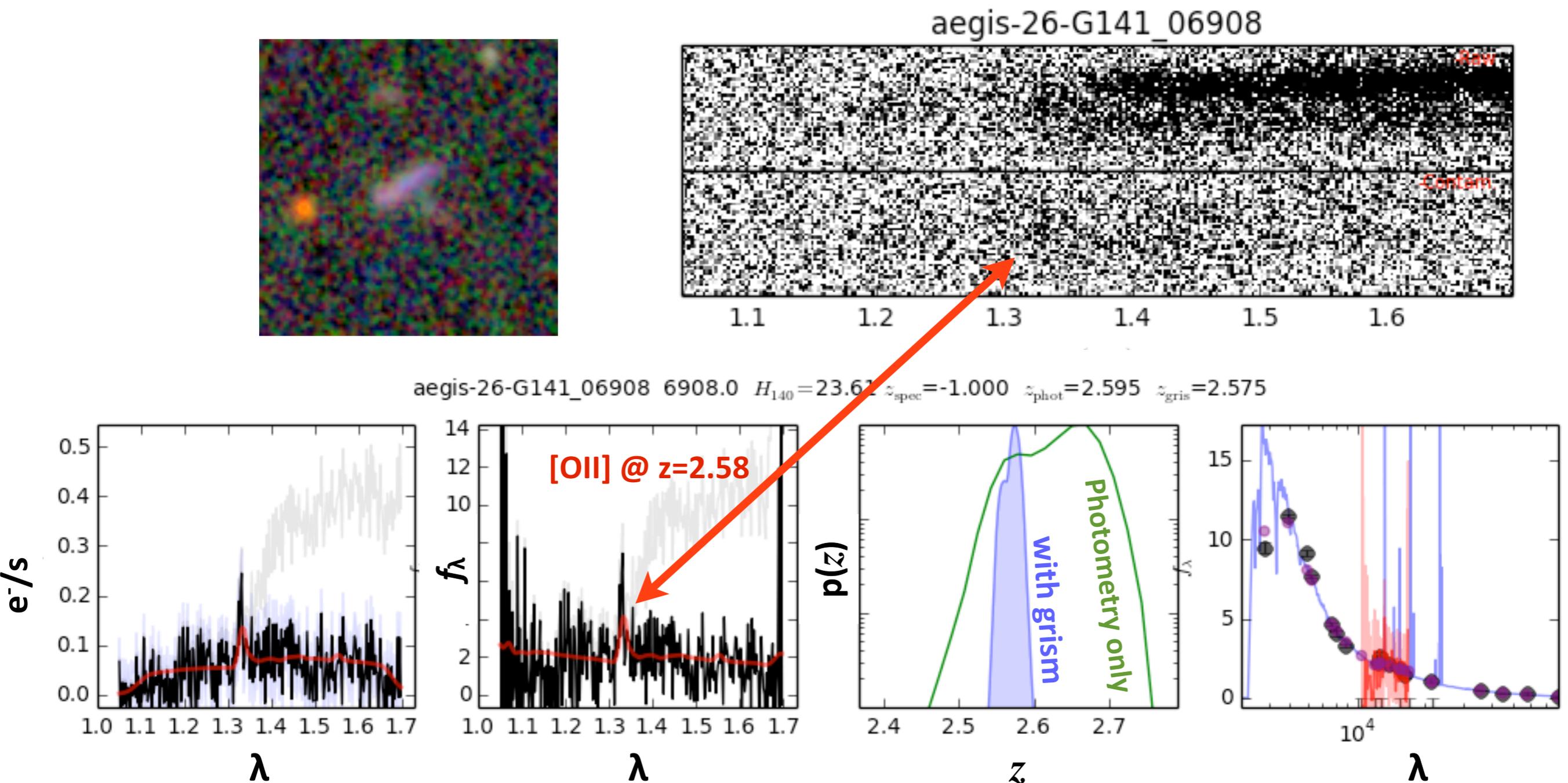


F814W F125W F160W



Extracting & Fitting Spectra

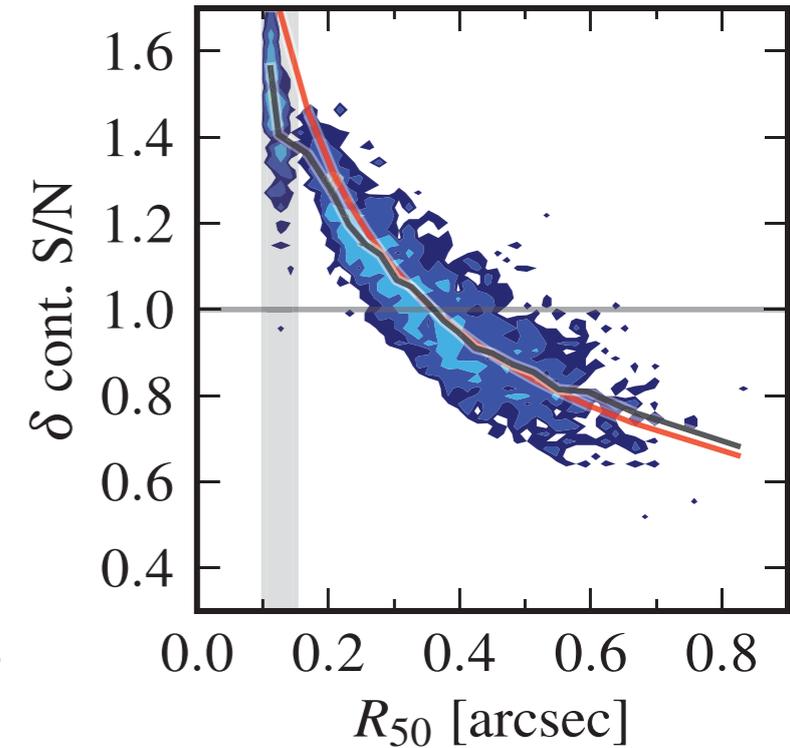
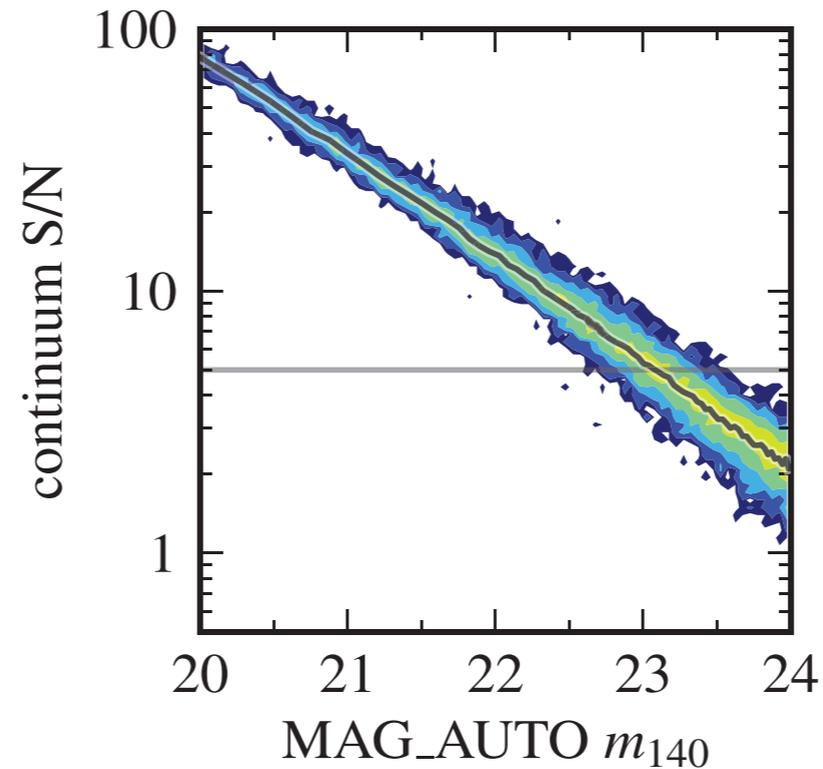
- Finding and identifying faint lines greatly aided by constraints from **ancillary photometry** (e.g., CANDELS, Skelton+2014)



Sensitivity

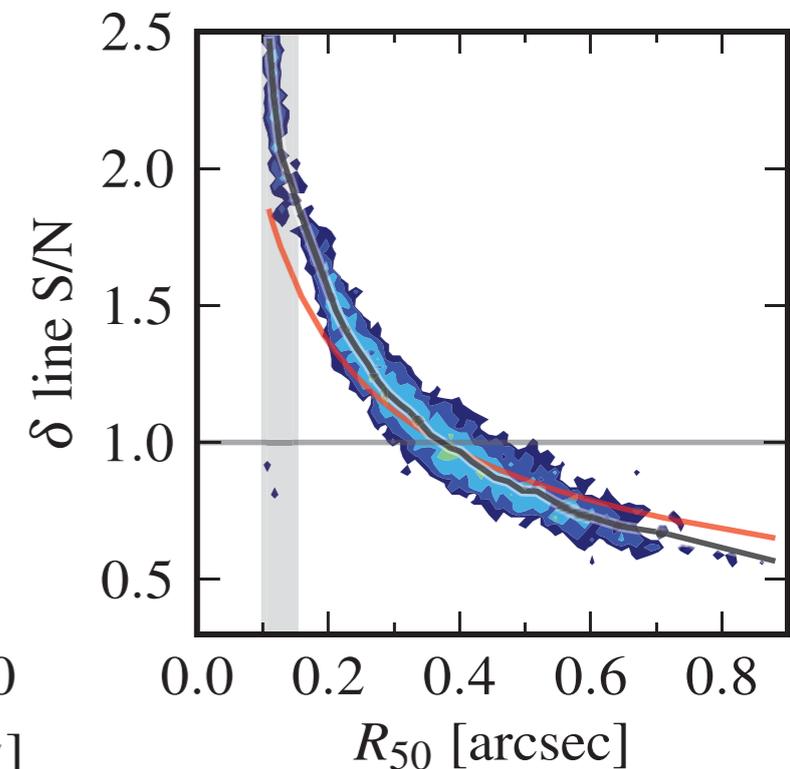
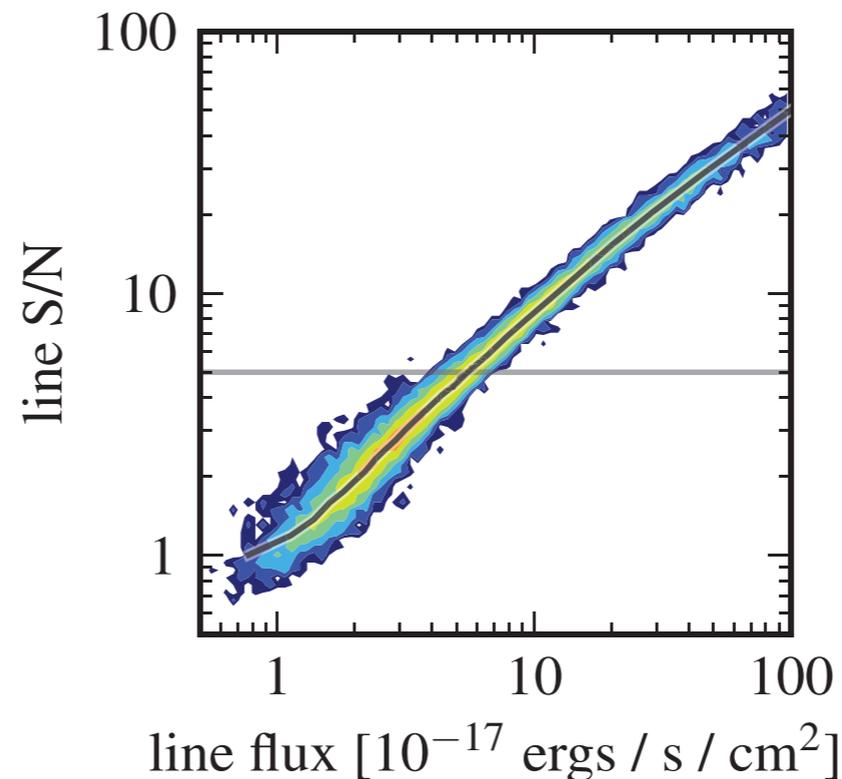
- WFIRST **continuum** sensitivity will be lower due to higher spectral resolution

- 5σ @ $H_{140}=23.2$



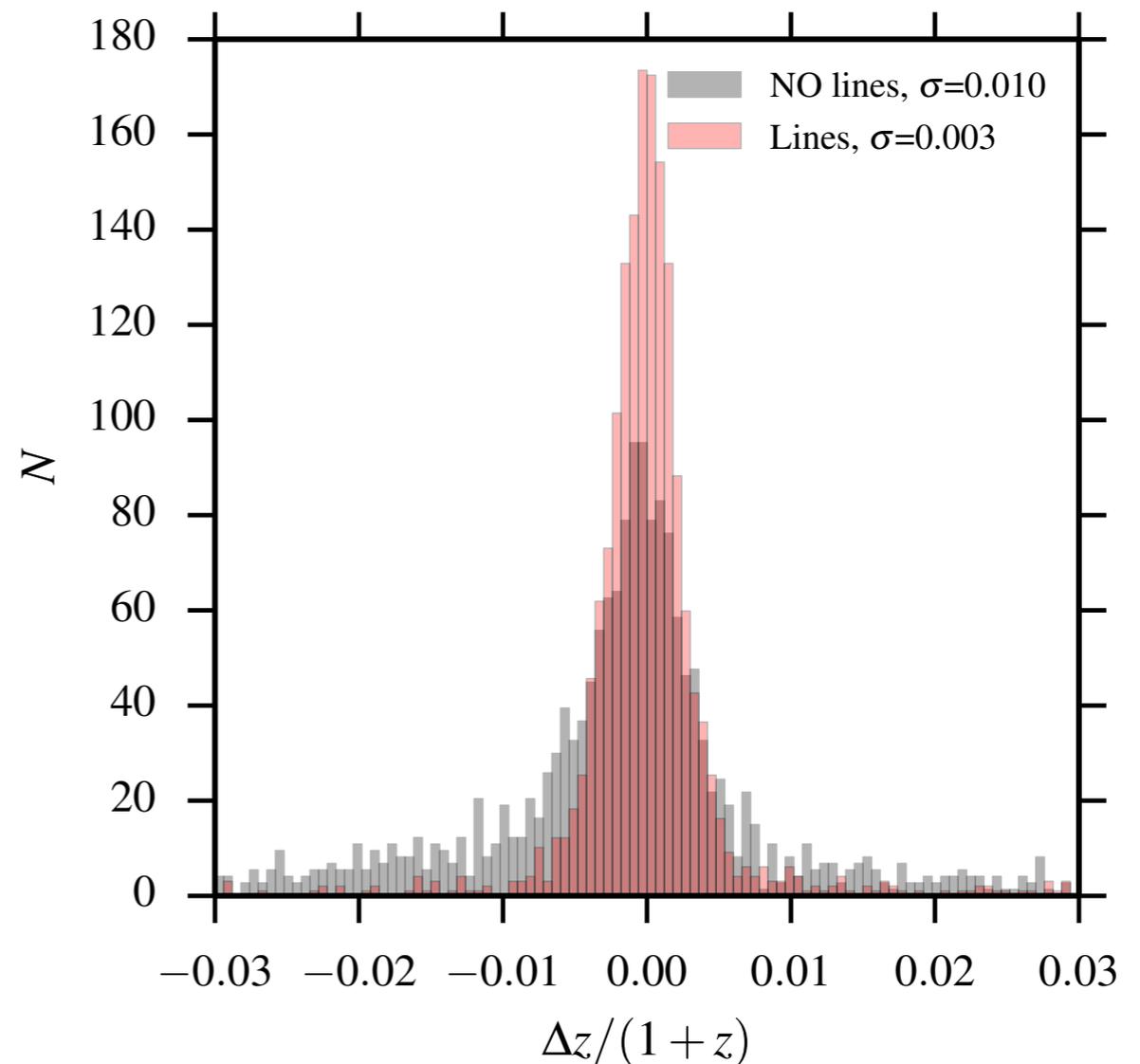
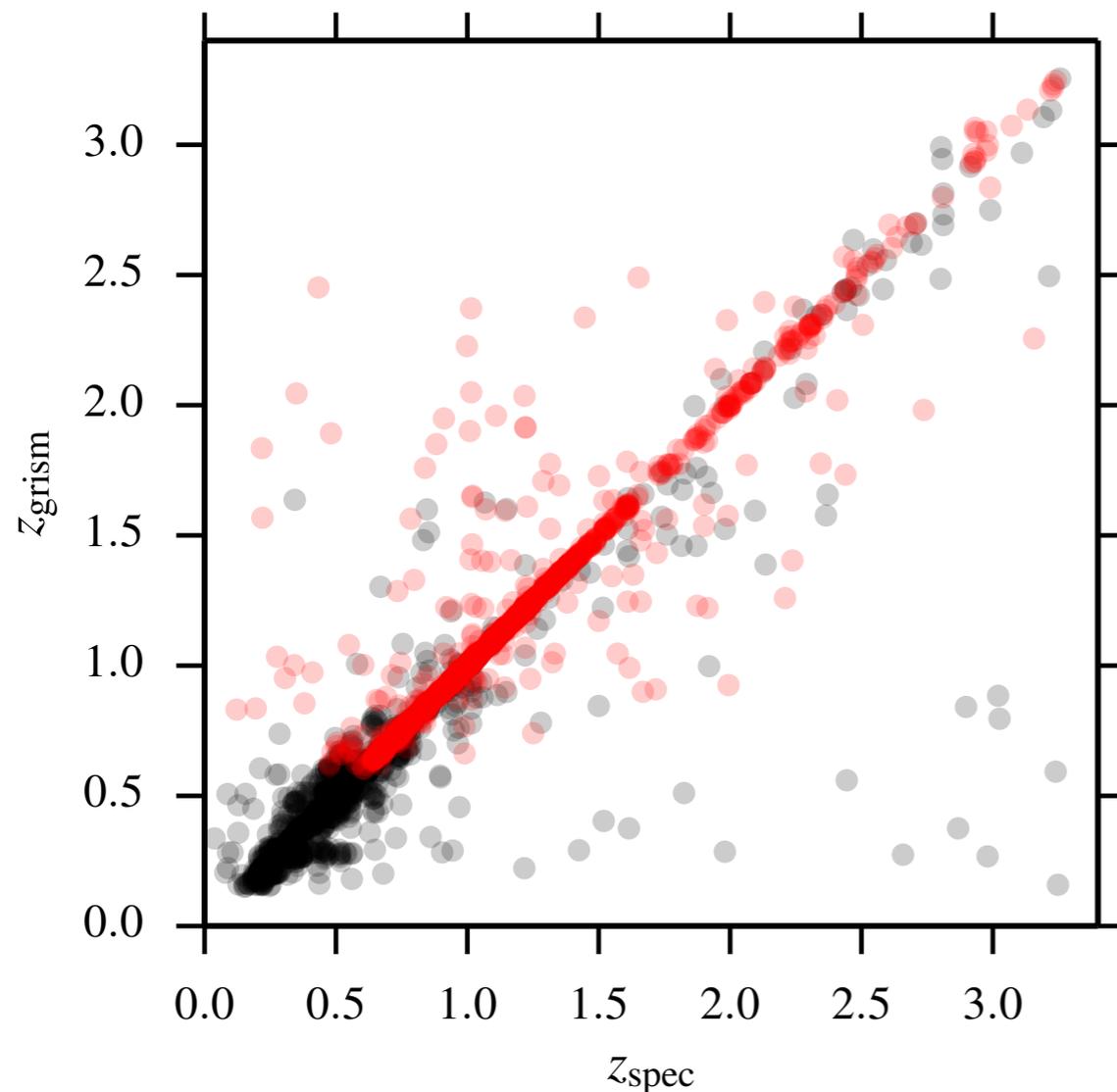
- **Line** sensitivity $\times 1.5$ — 2 deeper than baseline WFIRST HLS

- 5σ @ 5×10^{-17} erg/s/cm²



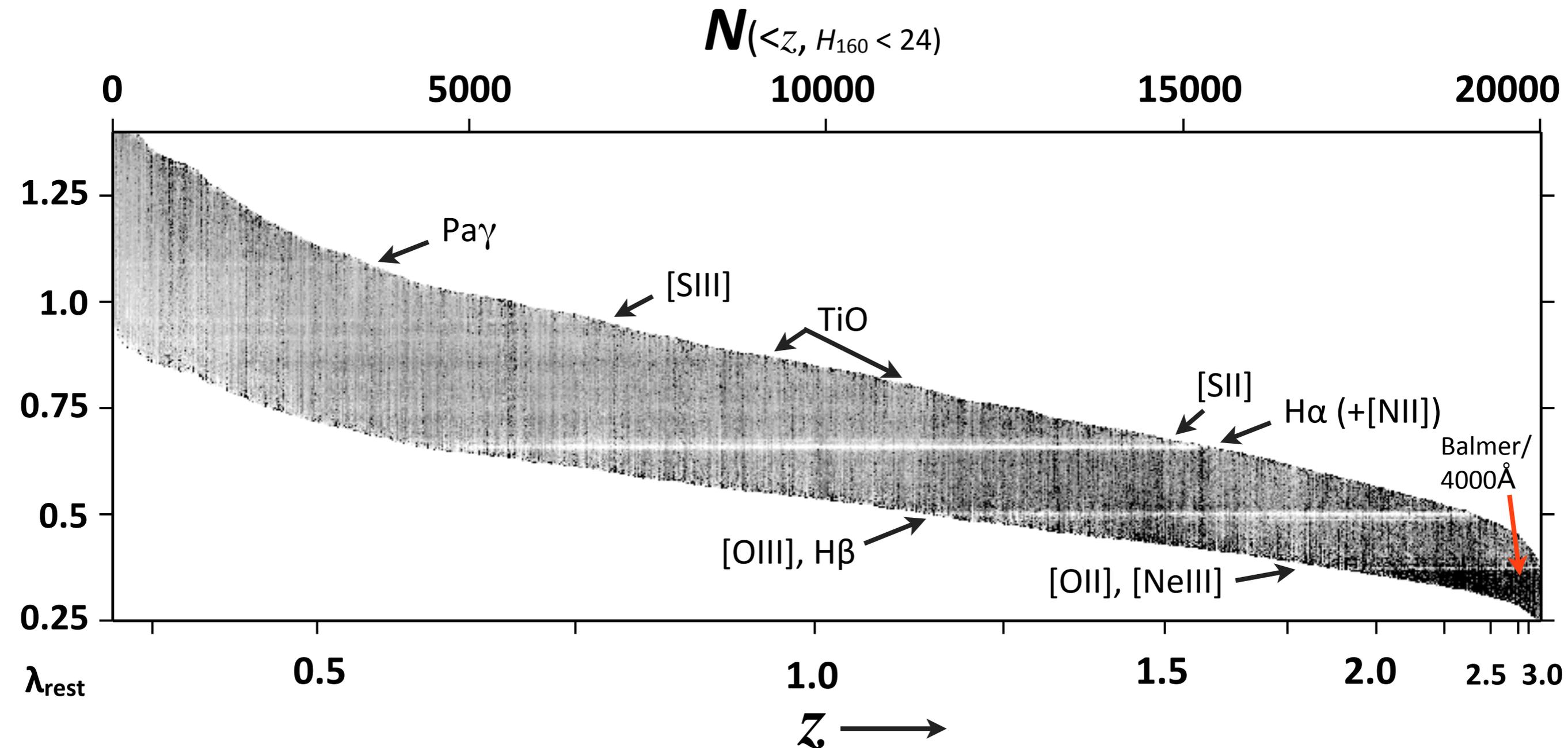
Redshift precision

- For objects with detected lines, $\delta z/(1+z)$, $\sigma=0.3\%$ / 1000 km/s
- 1% for objects without lines, depends on availability of good photometry + photo-zs.



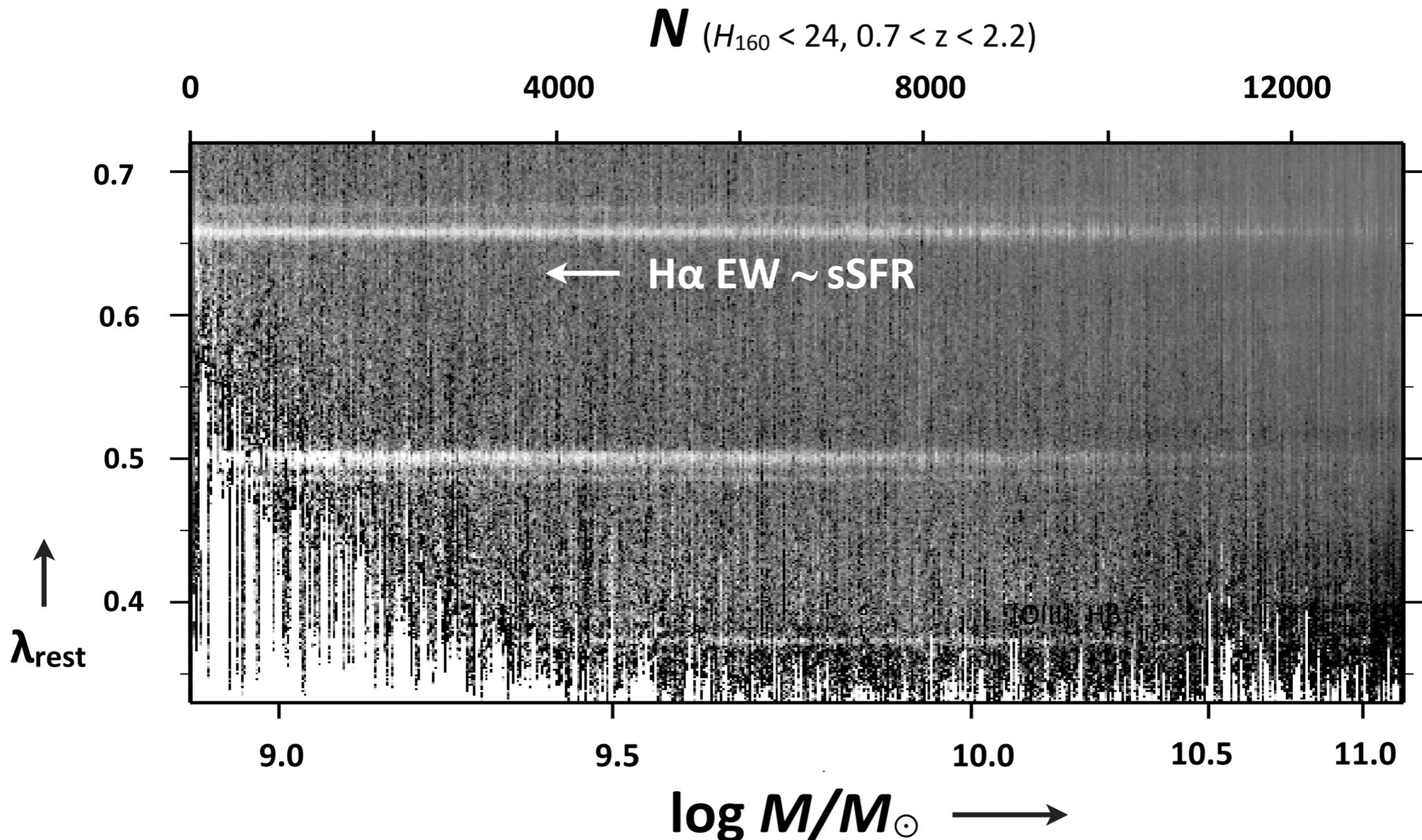
A (mini) “Sloan in Space”

- Slitless spectra provide a **spectrum of everything** in the field. The challenge is *extracting, fitting and cataloging* spectra of everything.



A (mini) “Sloan in Space”

- Highly complete spectroscopic coverage allows detailed study of correlation and evolution of galaxy properties



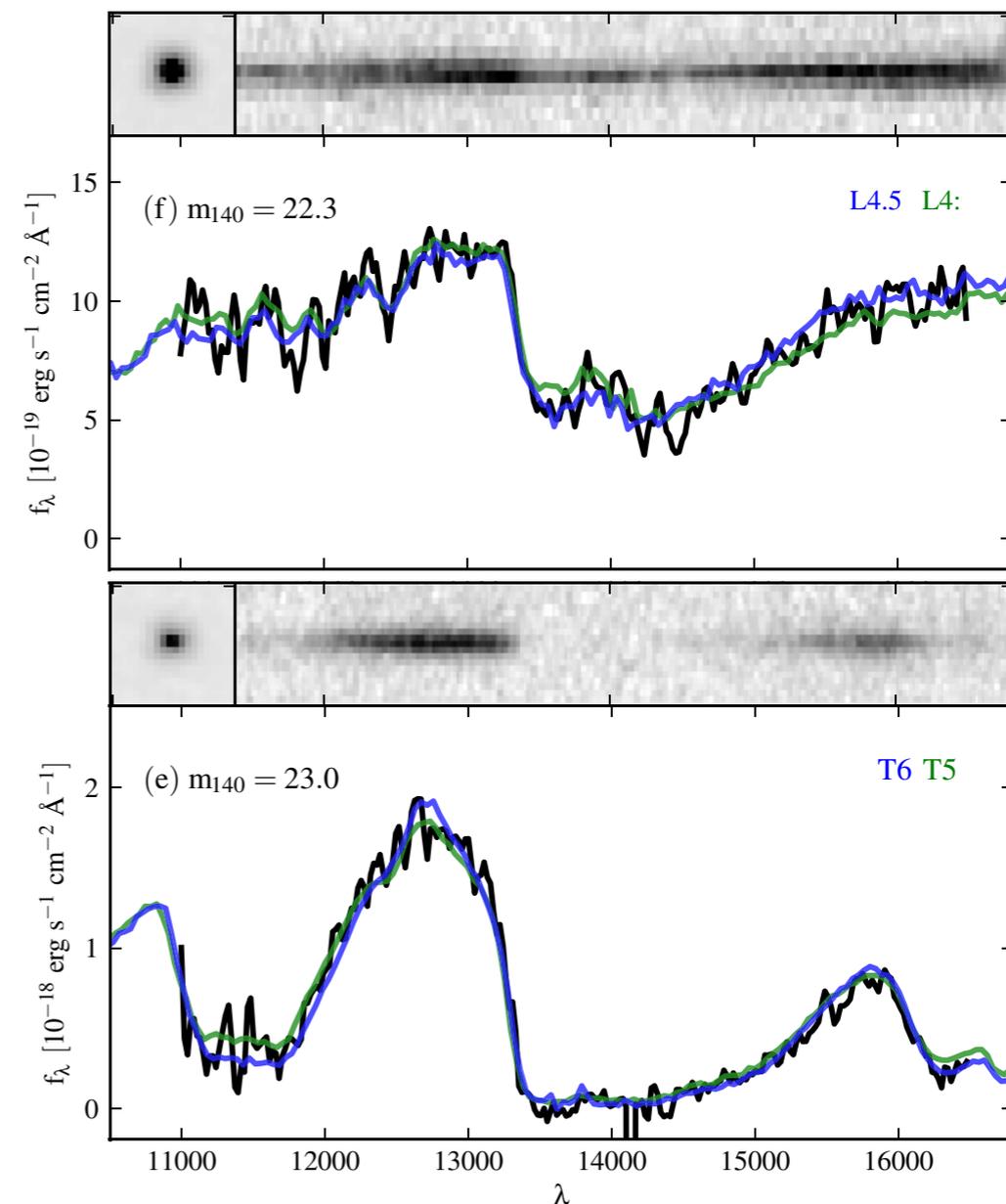
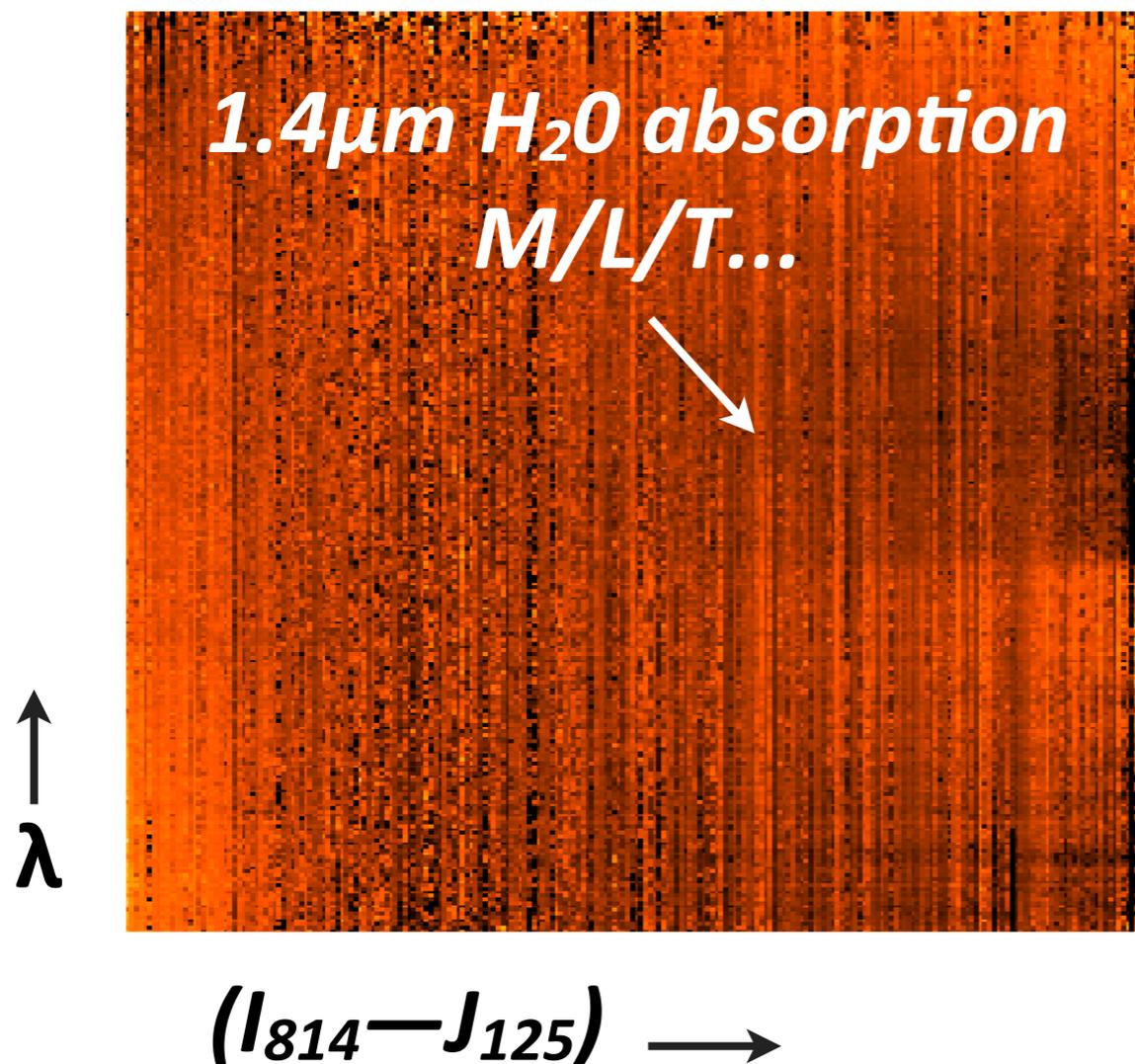
A (mini) "Sloan in Space"

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talk by N. Wright

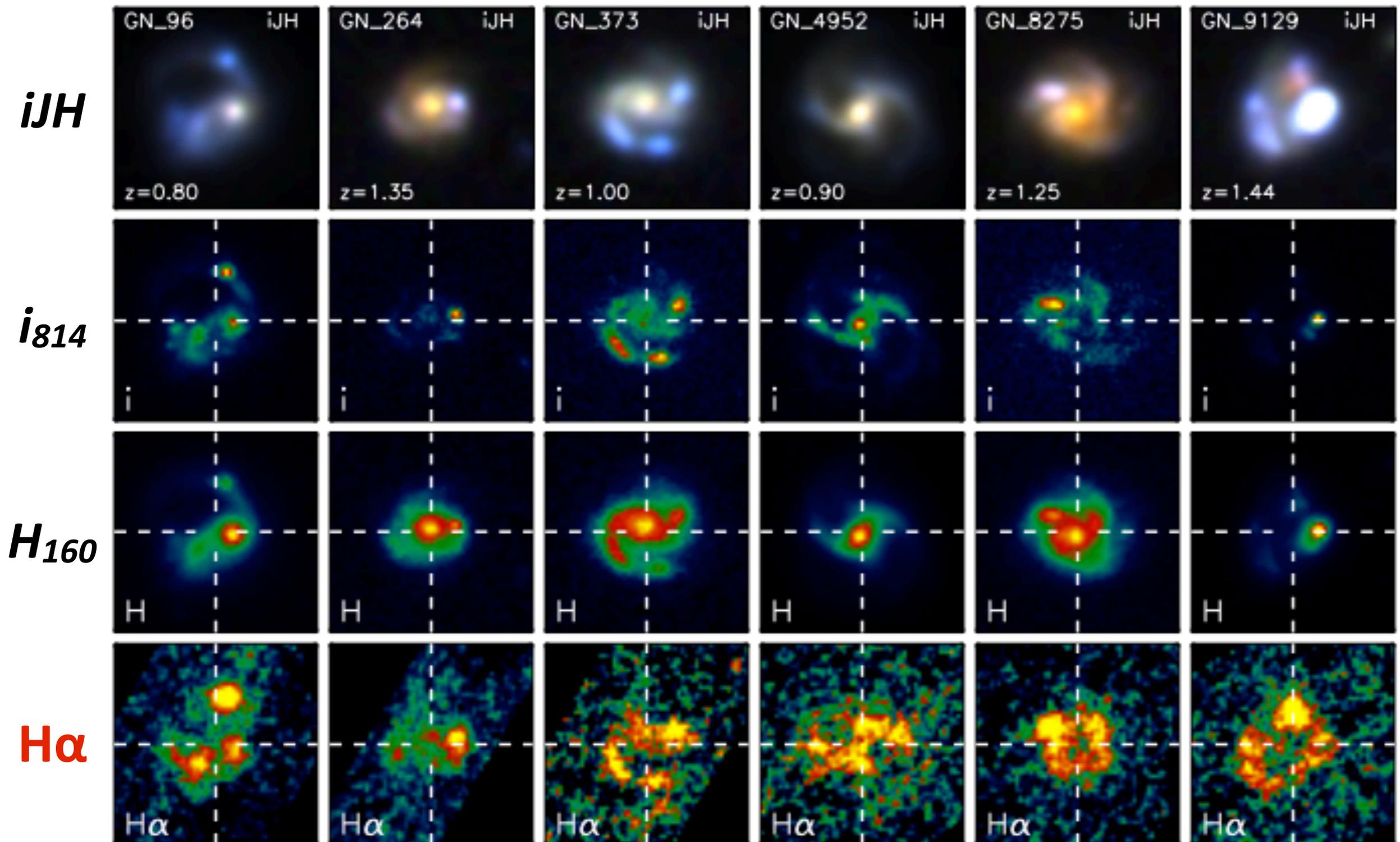
Brammer+2012, Masters+2012

(Stars, too)



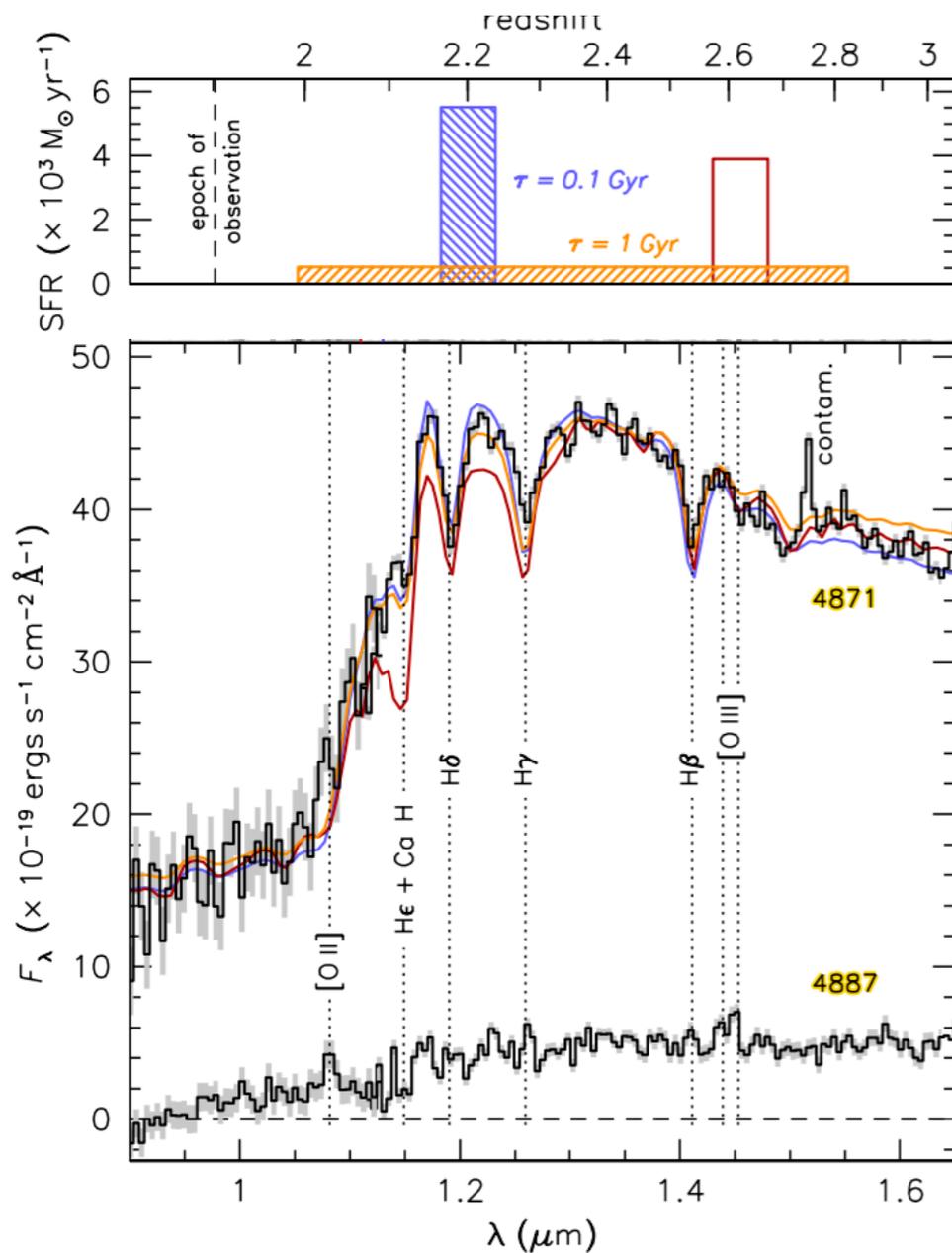
Science: H α maps at *HST* spatial resolution

Wuyts+2013, see also Nelson+2012,2013

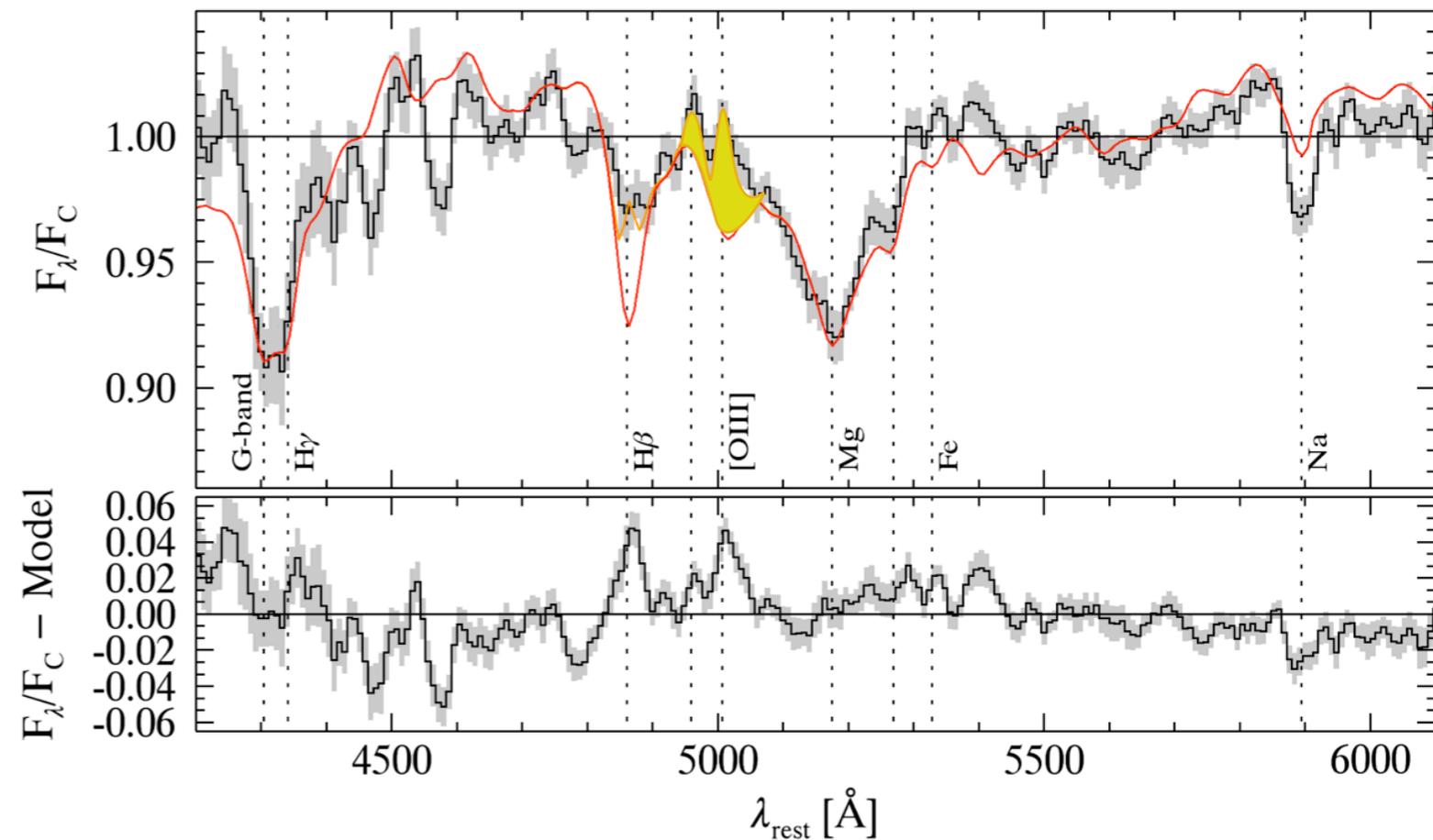


Science: Absorption line spectra

- Near-IR Continuum sensitivity difficult/impossible to achieve from the ground for $N > \text{few samples}$



Stack: Whitaker+2013

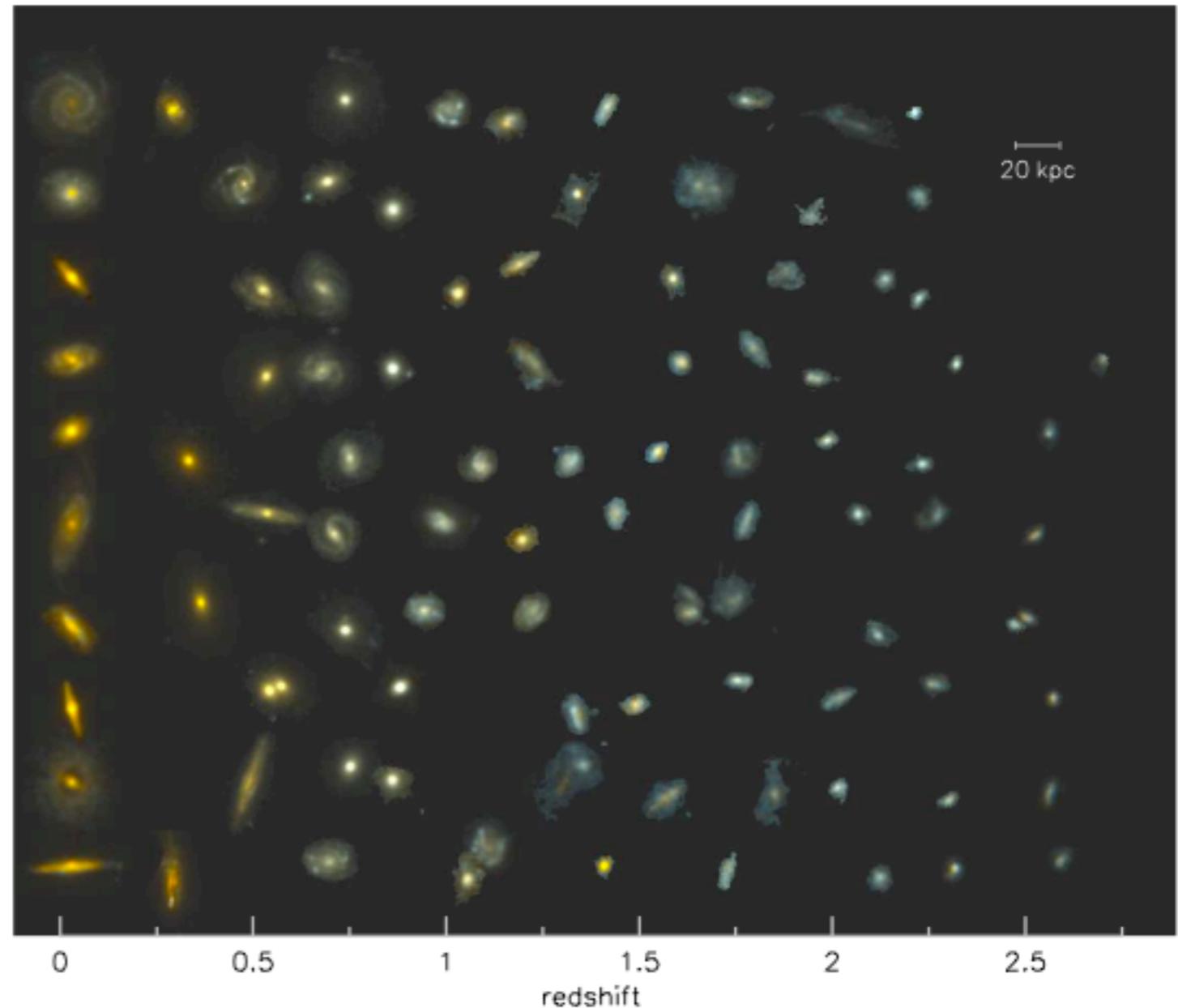
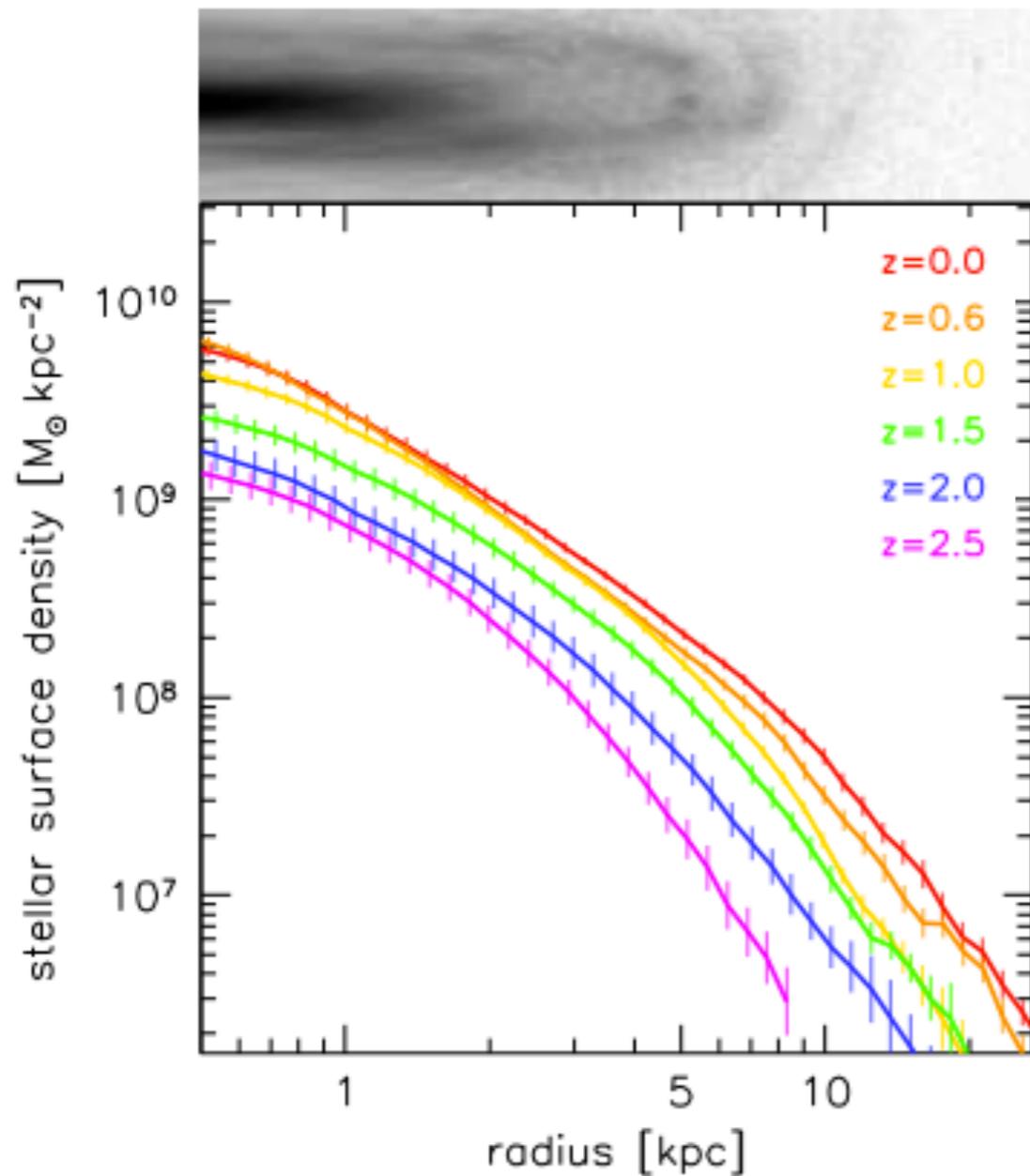


Individual:
van Dokkum & Brammer (2010)

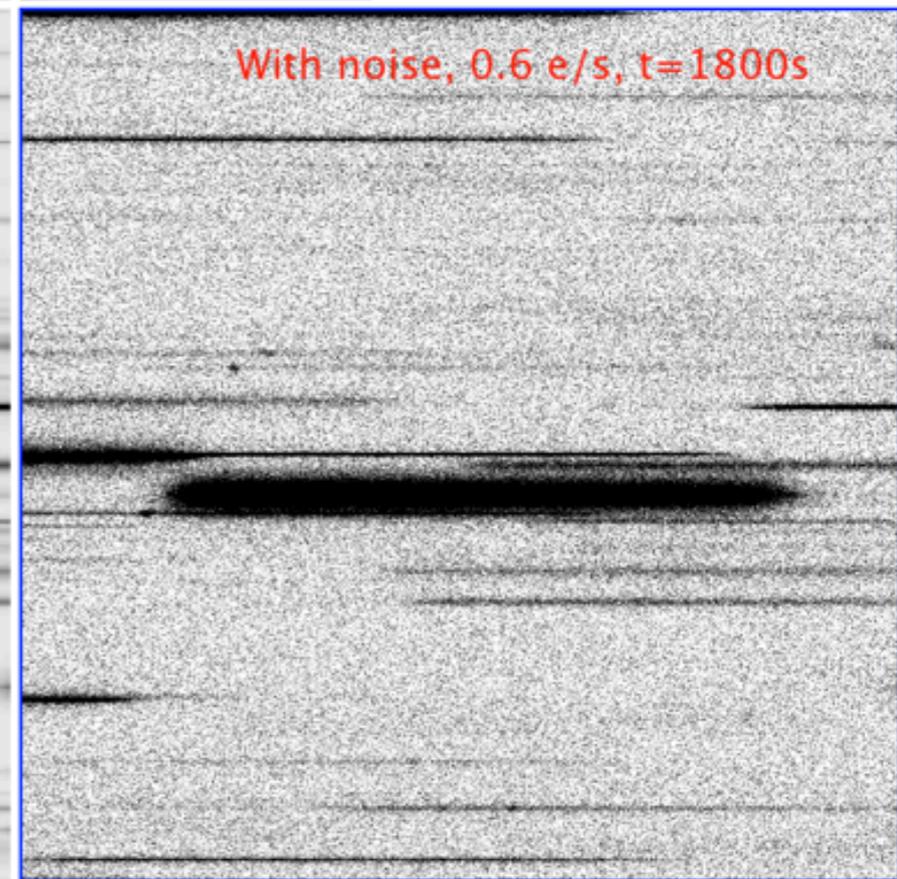
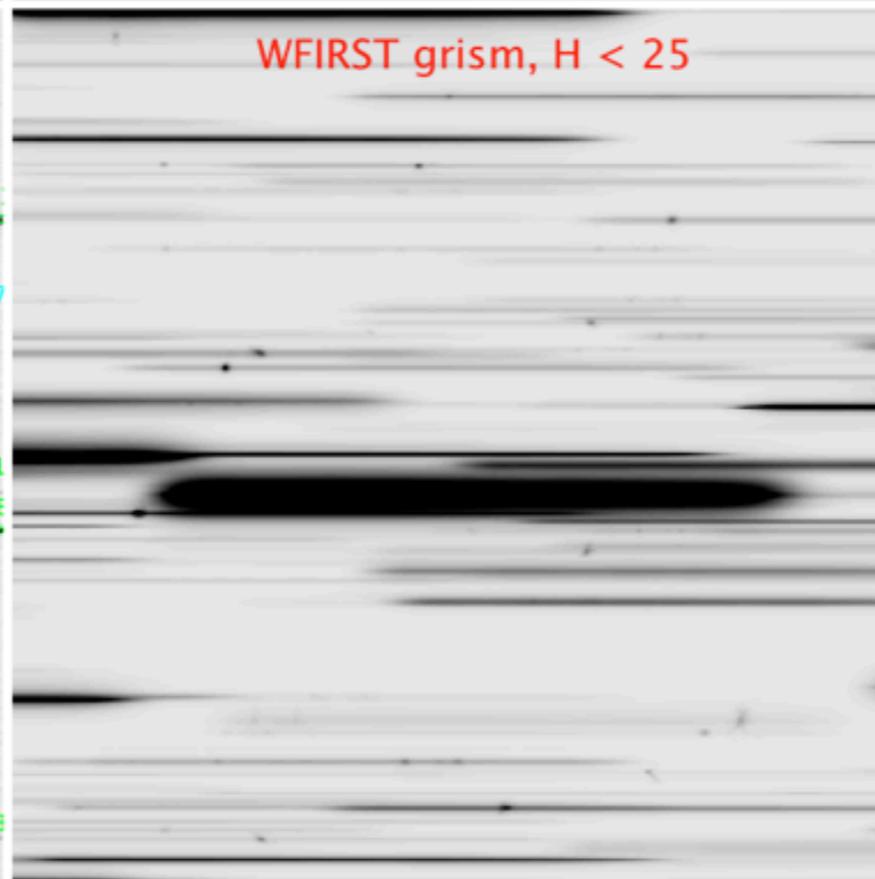
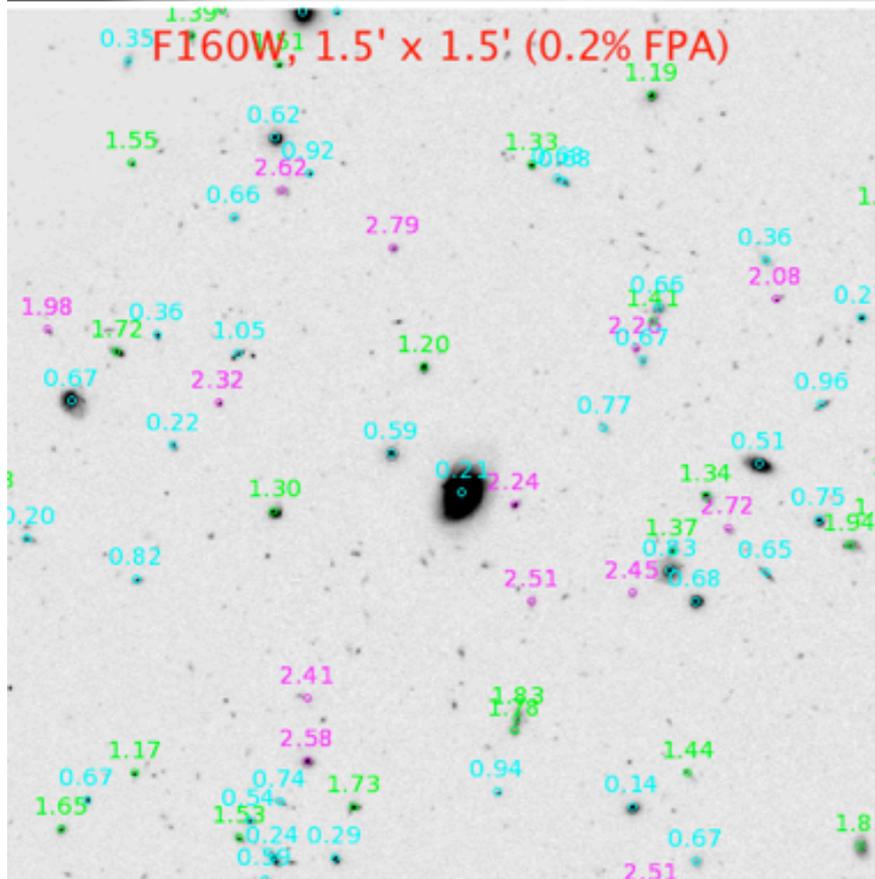
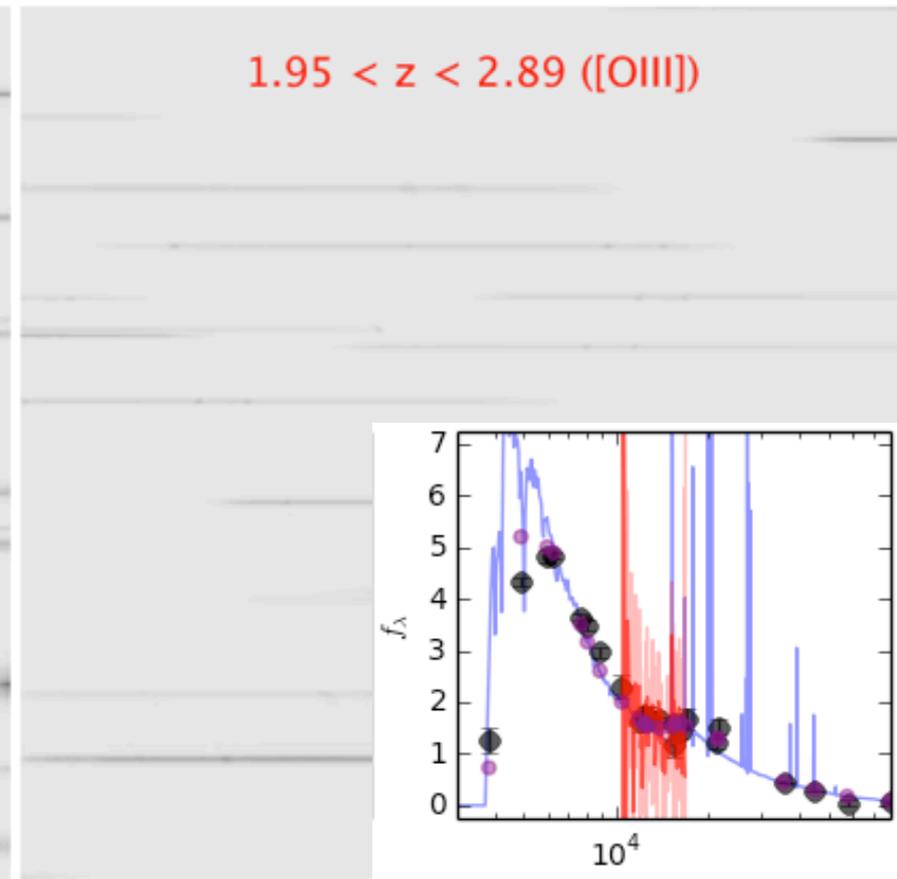
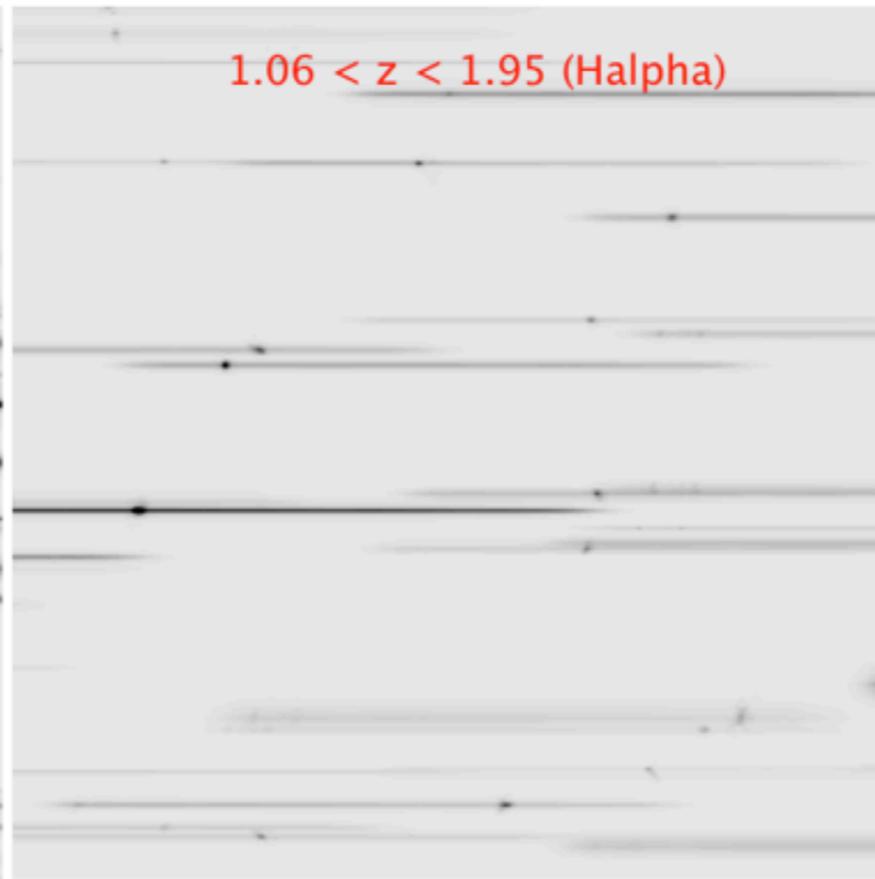
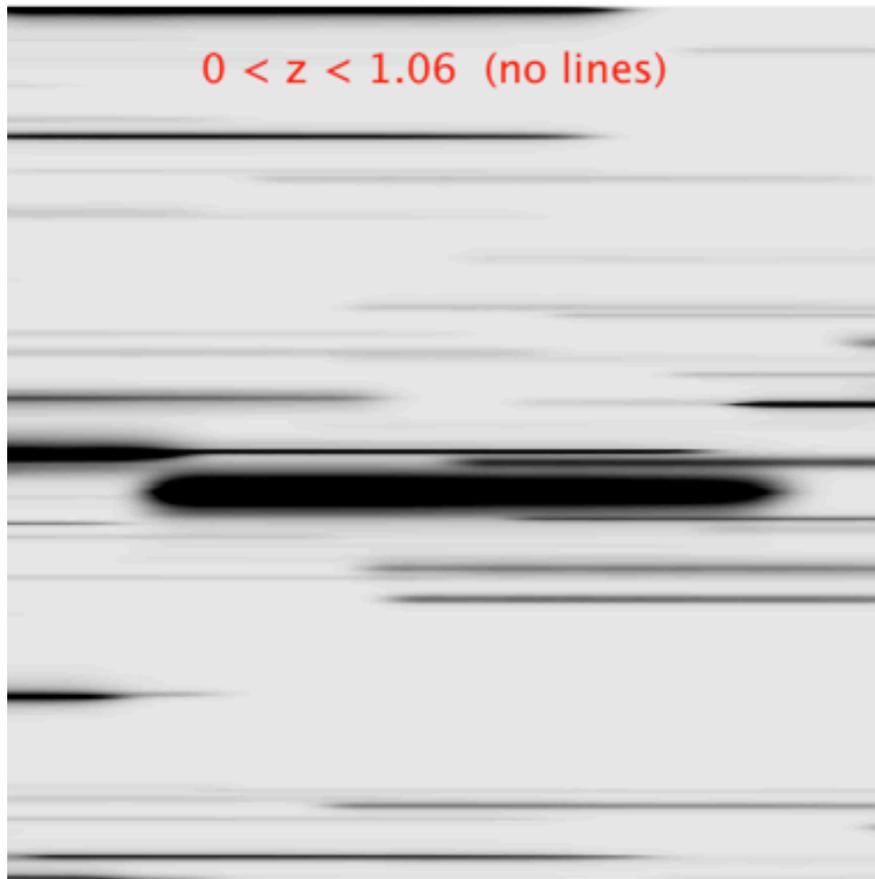
Science: Population studies

- E.g., evolution of Milky Way progenitors (number-density selected)

van Dokkum+2013, Patel+2013



Simulating WFIRST (see also poster by J. Colbert)



Summary

- Grism surveys like 3D-HST offer highly complete spectroscopic resource for galaxy evolution studies
- Existing *HST* grism surveys can tell a lot about what WFIRST will see e.g., $H\alpha$, $[OIII]\lambda\lambda 4959+5007$, $[OII]\lambda 3727$ luminosity functions
- Grism data analysis will be challenging for WFIRST, critical for achieving all of R. Abraham's goals "for free"
- Ongoing development motivated by *HST* surveys
(**wide**:3D-HST,WISPS, **deep**:FIGS/Malhotra, **lensing clusters**:GLASS/Treu)

