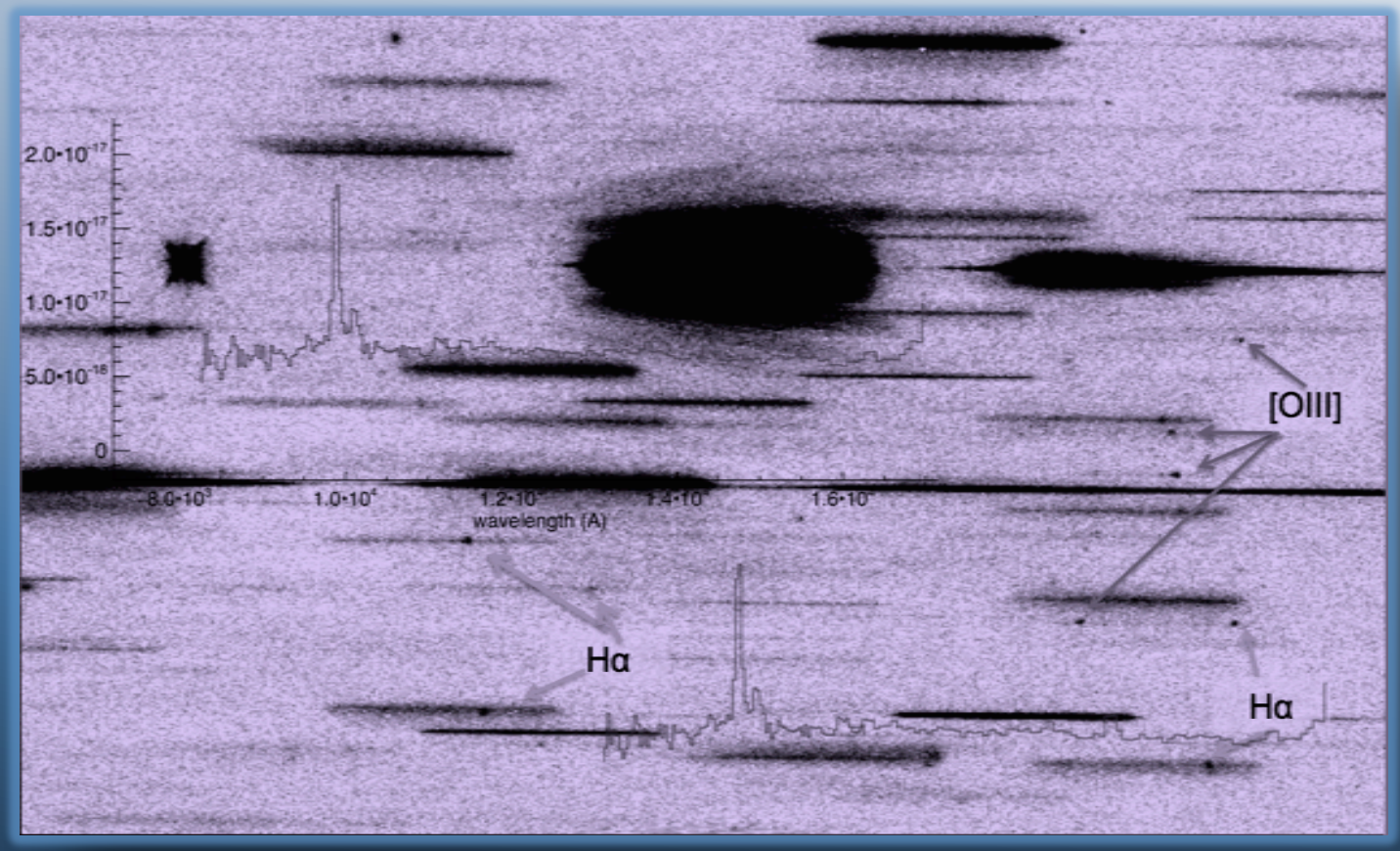
WFC3 Slitless Grism Spectroscopy

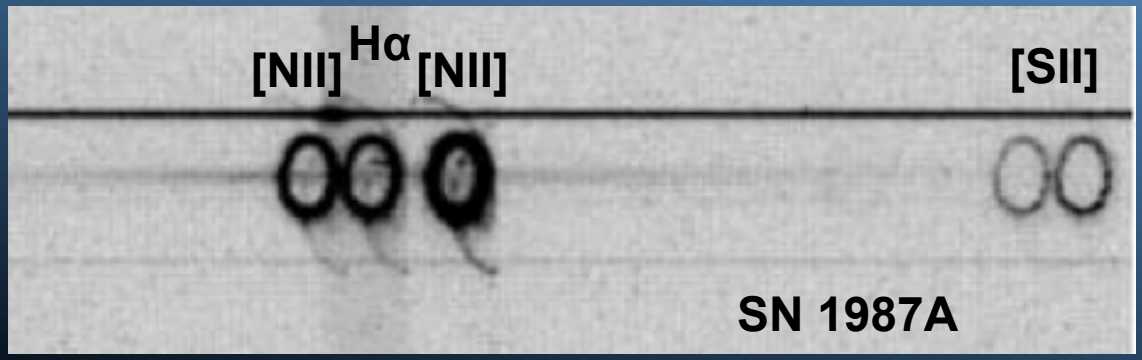


Patrick McCarthy – Carnegie Observatories

Slitless Spectroscopy

No entrance aperture

- Disperser, PSF & Object shape set resolution
- Focal plane image is a stack of monochromatic images of *all* objects
- No unique mapping between x,y and λ
- Good software is essential!



aXe
SPECTRAL EXTRACTION

Slitless Spectroscopy

Backgrounds & Foregrounds –

- All pixels see the full background
- Wider band-pass → more background
- Background is dispersed and reintegrated, so higher dispersion → less contrast
- Low dispersion is preferred

Best Targets:

Compact objects with strong features

Cool stars, Planets, SNe, Distant Galaxies, AGN

Grisms for Slitless Modes on HST

Instrument	Element	R	Lambda (λ)	Notes
STIS	Numerous	-	0.2 – 1.1	Used with slits
	G750L	500	0.5 – 1.05	
ACS	G800L	140	0.6 – 0.9	WFC or HRC
NICMOS	G096	100	0.8 – 1.2	~J
	G141	100	1.1 – 1.9	H
	G206	100	1.4 – 2.5	K
WFC3		50		Not well calibrated
	G102	220	0.8 – 1.1	iz/J
	G141	120	1.1 – 1.7	J/H

R is 2-pixel resolution for point source

NICMOS Thermal Short!

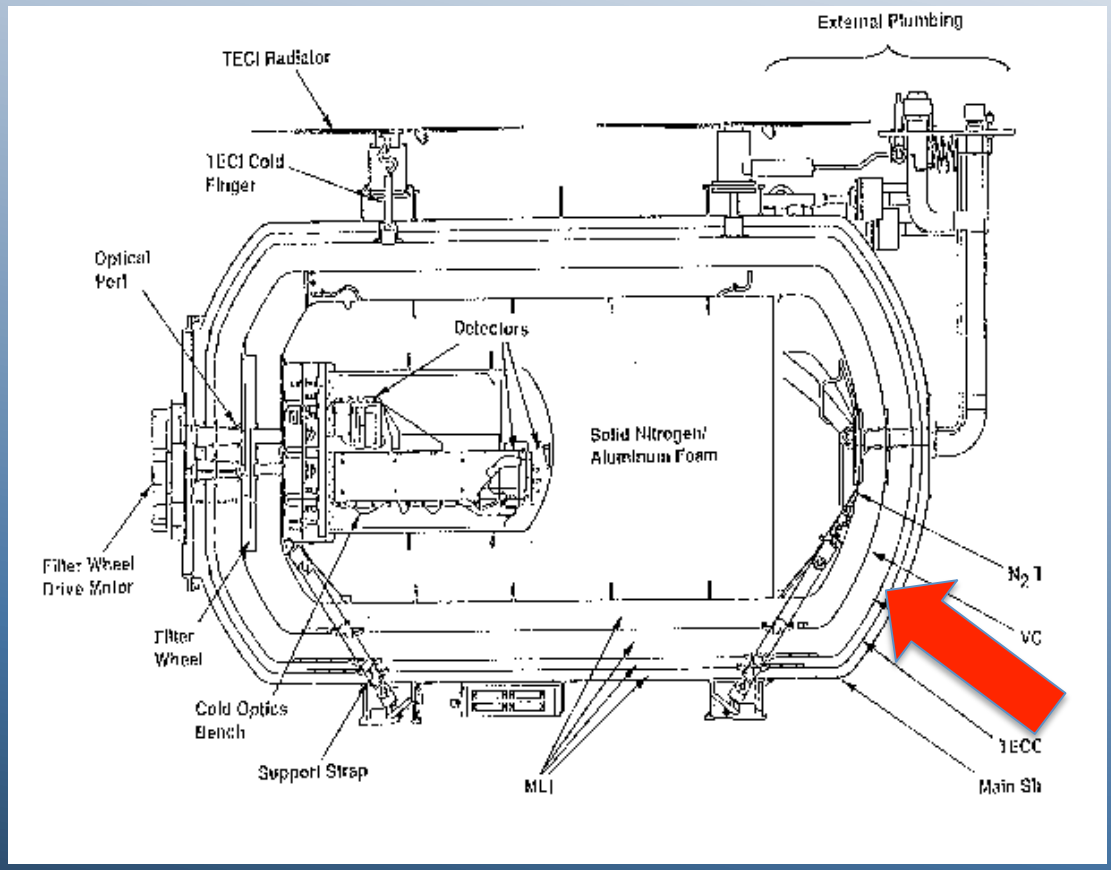
“C’est la Vie”
Bob

Queen’s English:

“Such is Life”

American English:

“Shit Happens”



NICMOS Grism Spectra

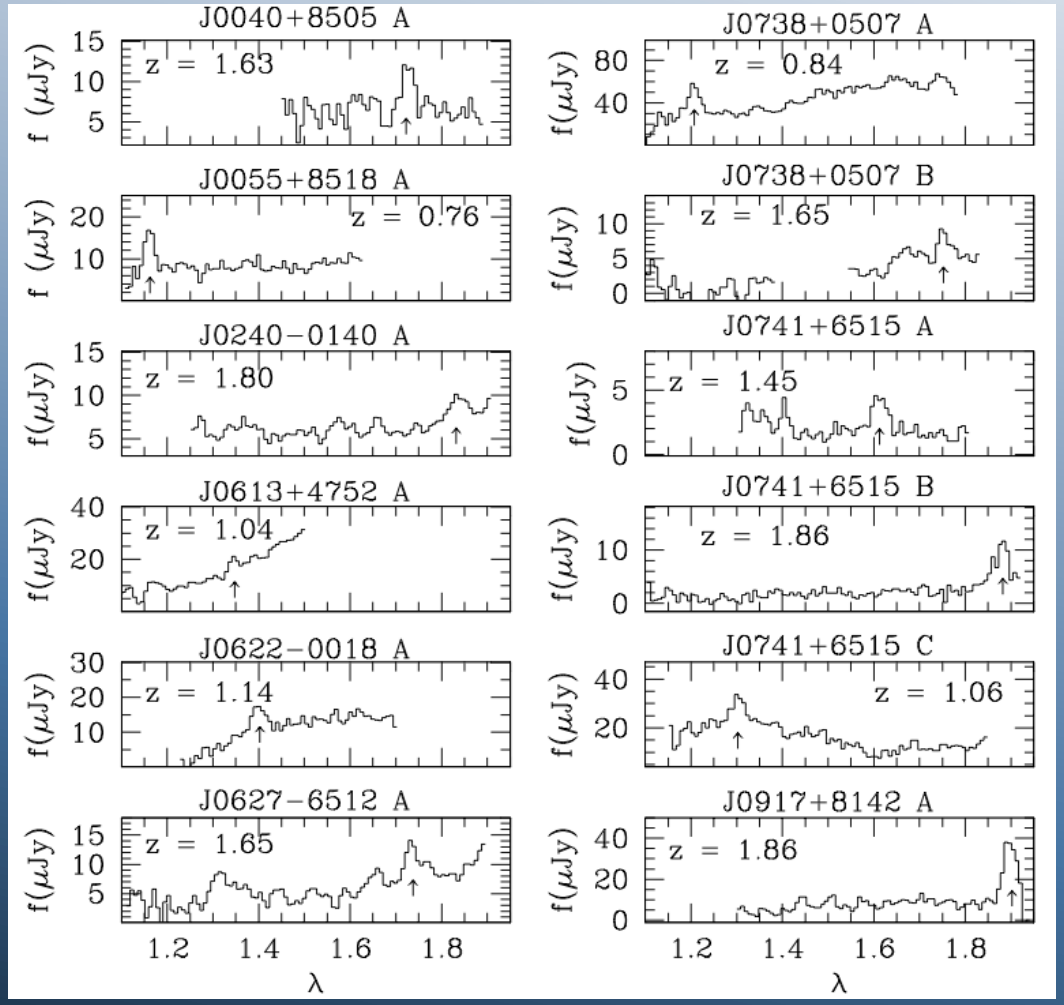
NICMOS G141 spectra of Hα emitters

1 – 3 orbits per frame

1 emission line in every 3rd frame

1 line per object, max!

McCarthy et al. '99



WFC3 Grism Parallel Survey

WISPS - "Wide-Field Infrared Spectroscopic Parallel Survey"

M. Malkan, P. McCarthy, H. Atek, C. Scarlatta,

R. **Fosbury**, A. Henry, B. Siana, A. Bunker, et al.

G102 & G141 Y/J & H grism

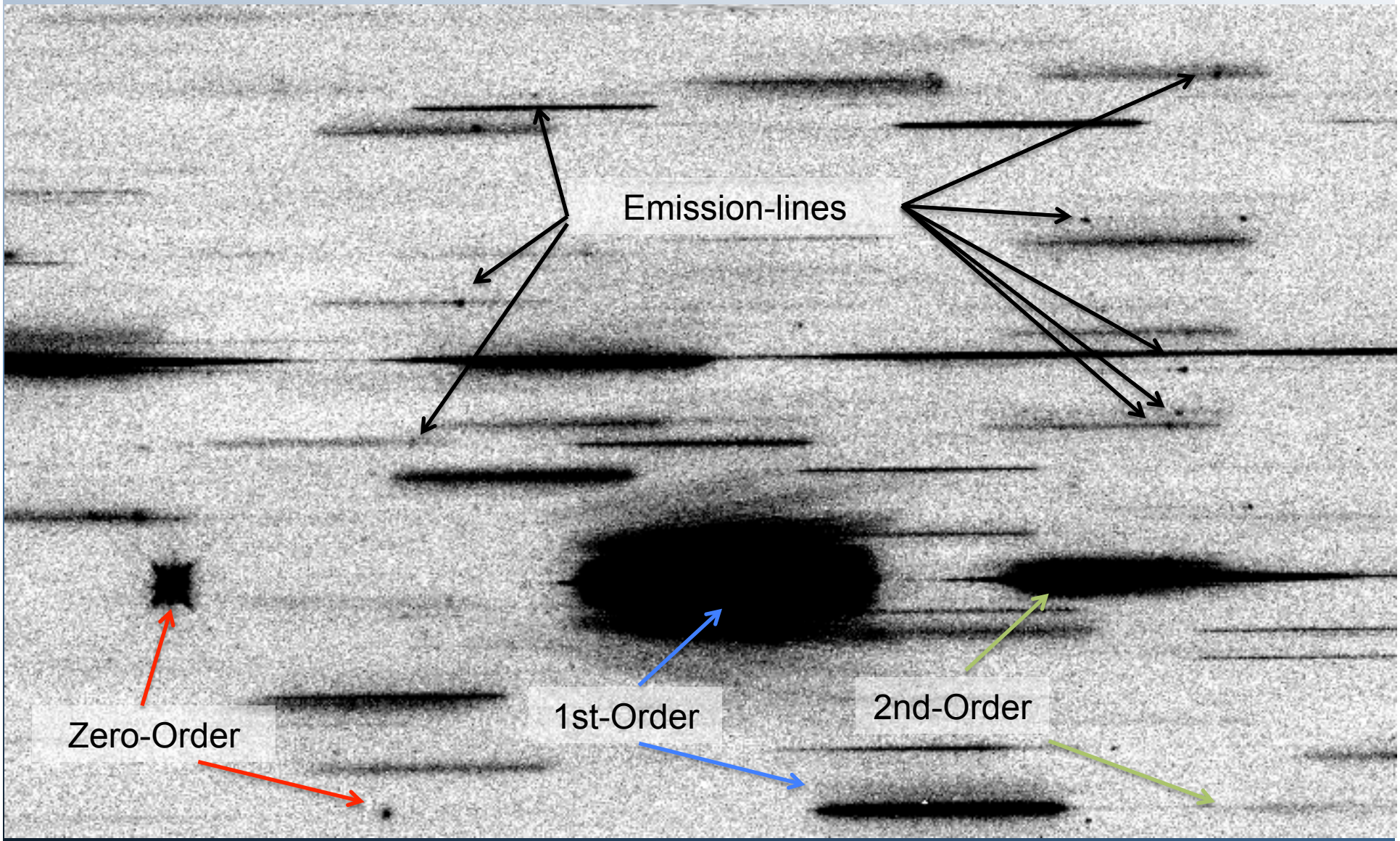
F110W & F160W J & H

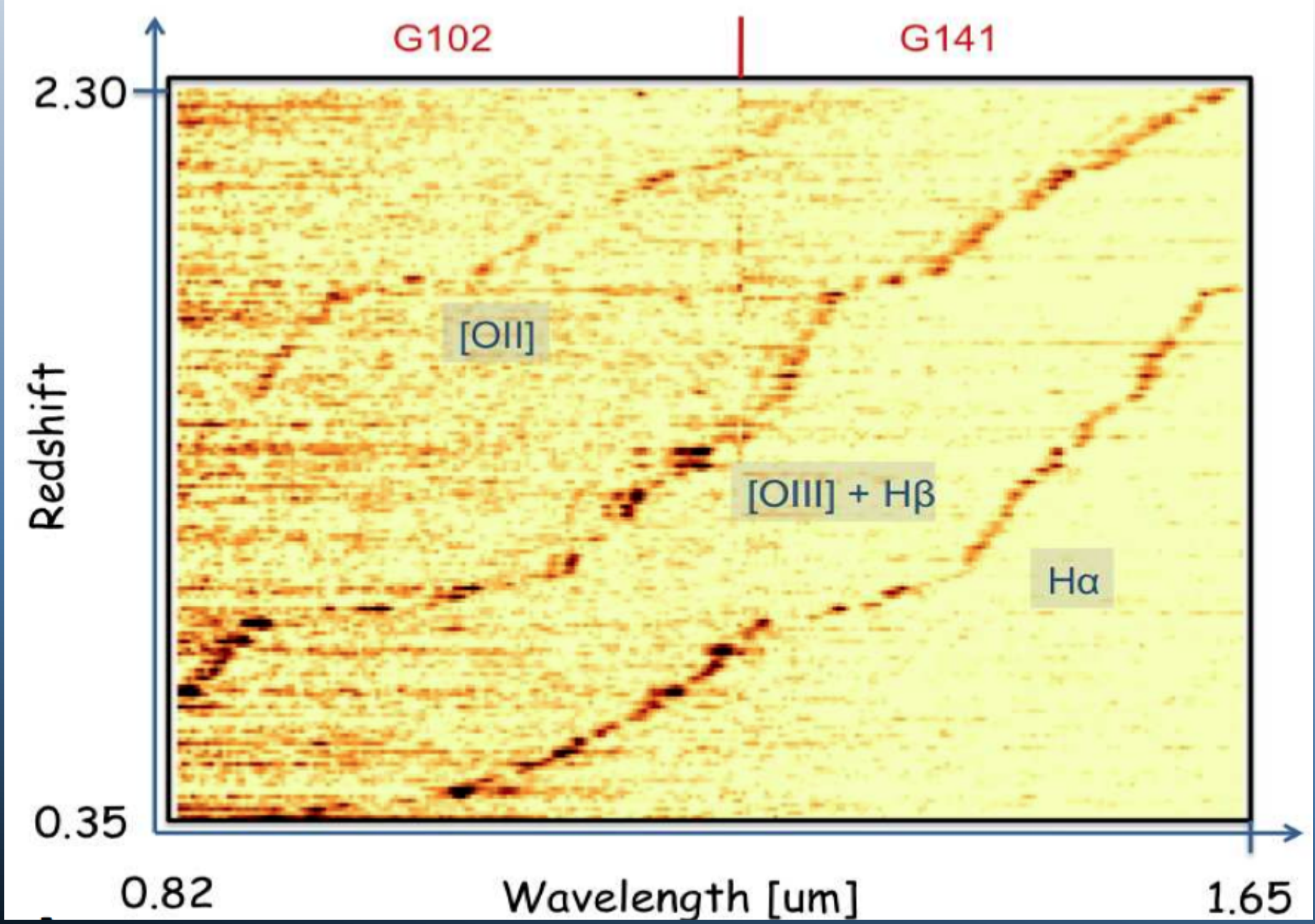
1-5 orbits each grism

On long visits:

V and I images via UVIS channel

WFC3: 30 – 40 emission-line galaxies per field



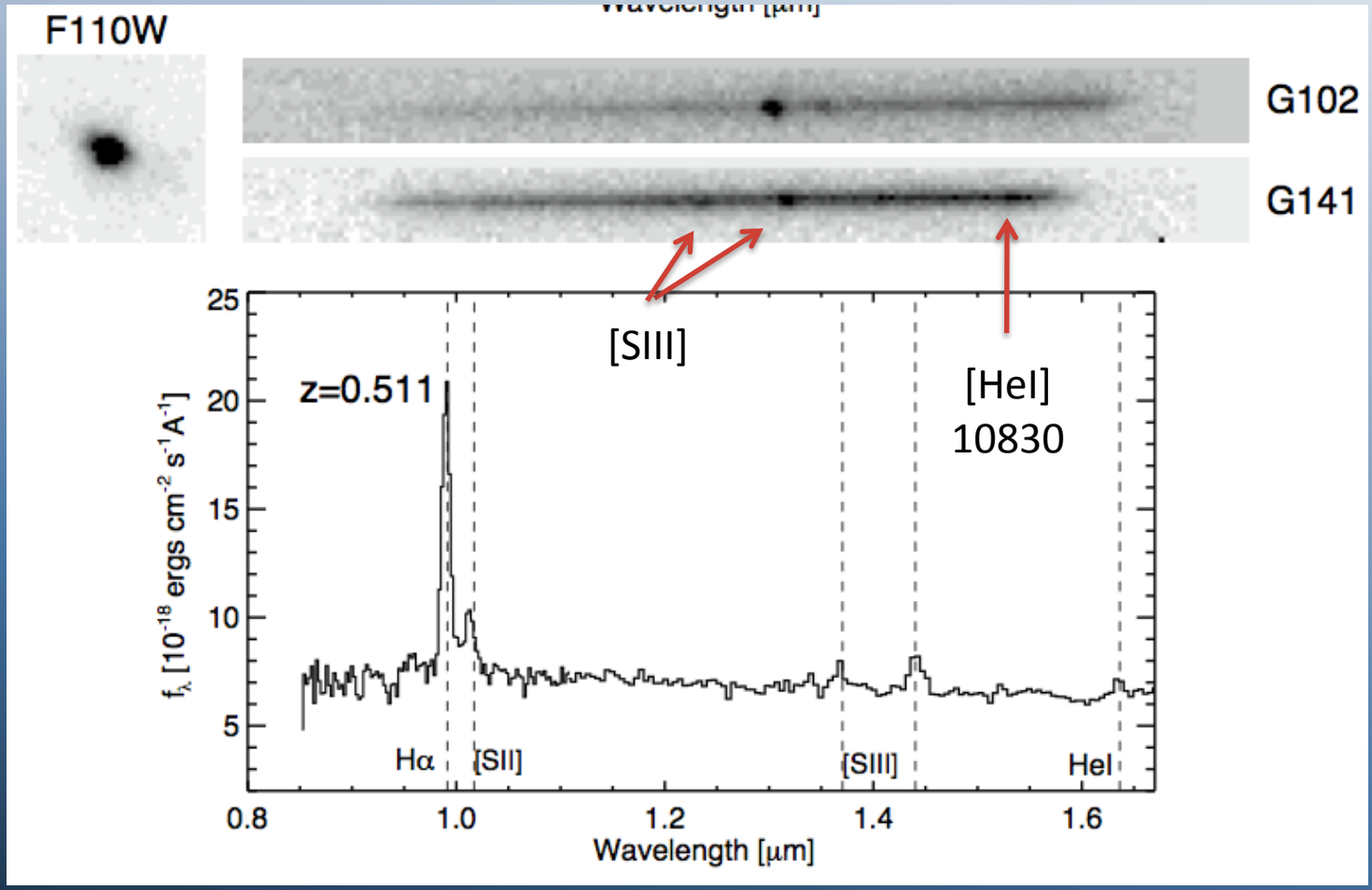

G102
G141
2.30
0.35
Redshift
[OII]
[OIII] + Hβ
Hα
0.82
Wavelength [um]
1.65

Star Forming Galaxies

WFC3 G102 + G141

2 orbits each

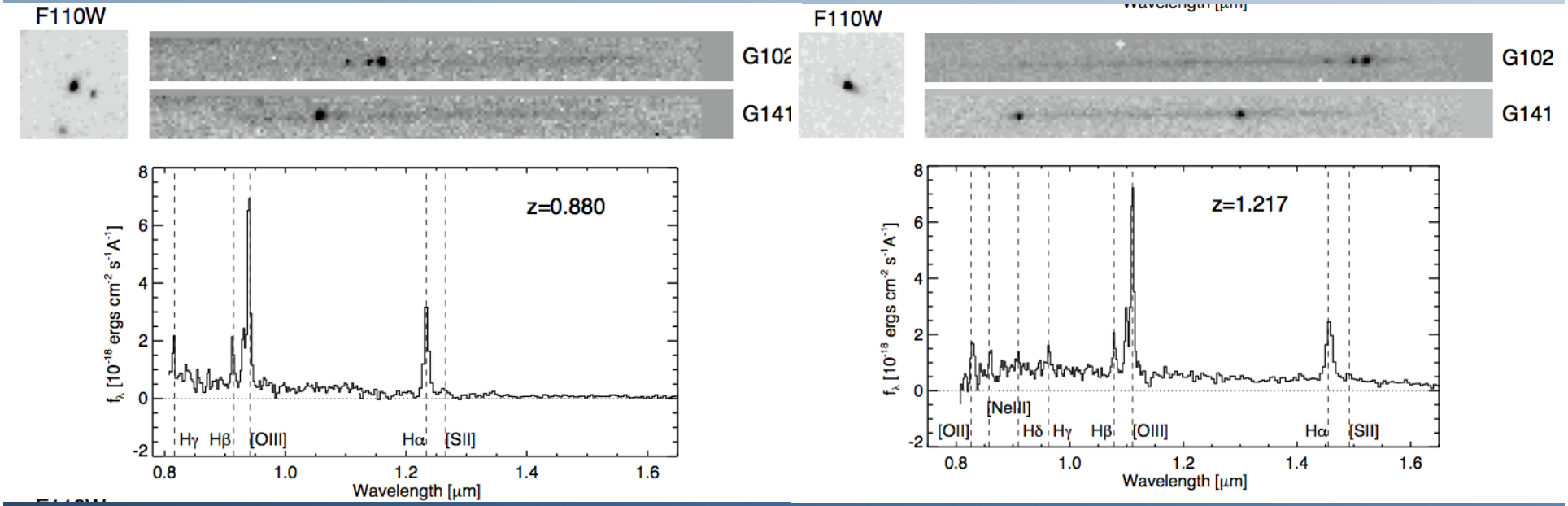
Same telescope, same ruling (G141)!



Atek et al. 2010

Star Forming Galaxies

[OIII]5007 is the strongest line, [OII]3727 is unimpressive

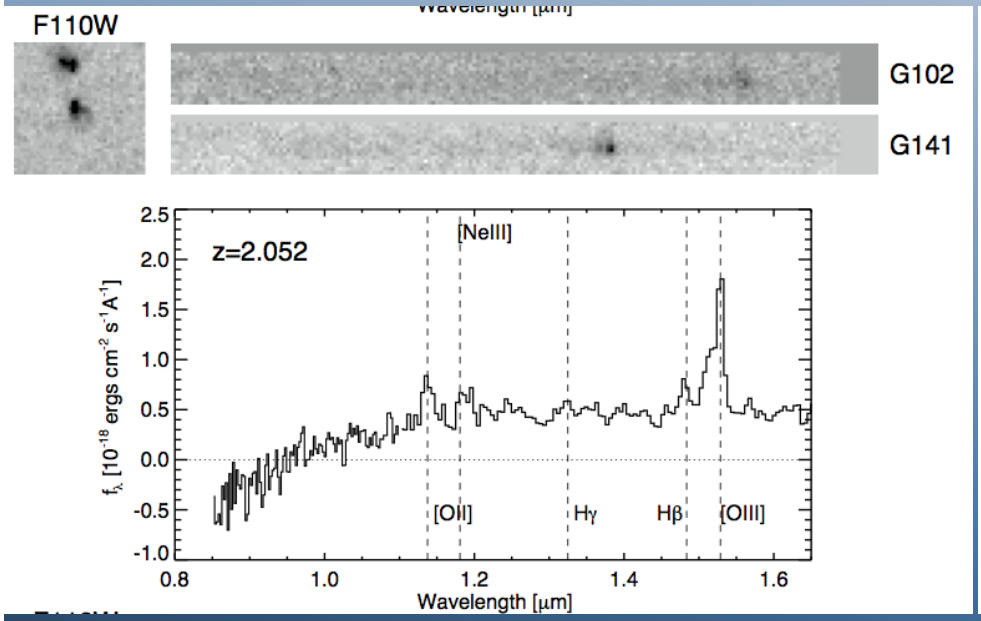


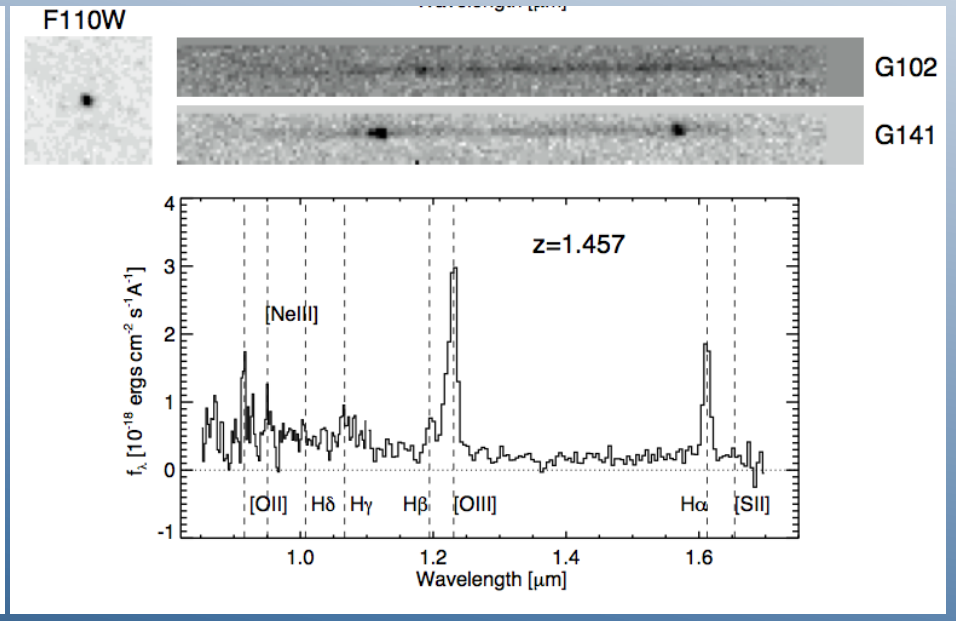
z ~ 1

Atek et al. 2010

Star Forming Galaxies

Note numerous Hβ detections –
essential to E(B-V) and [Fe/H] determinations





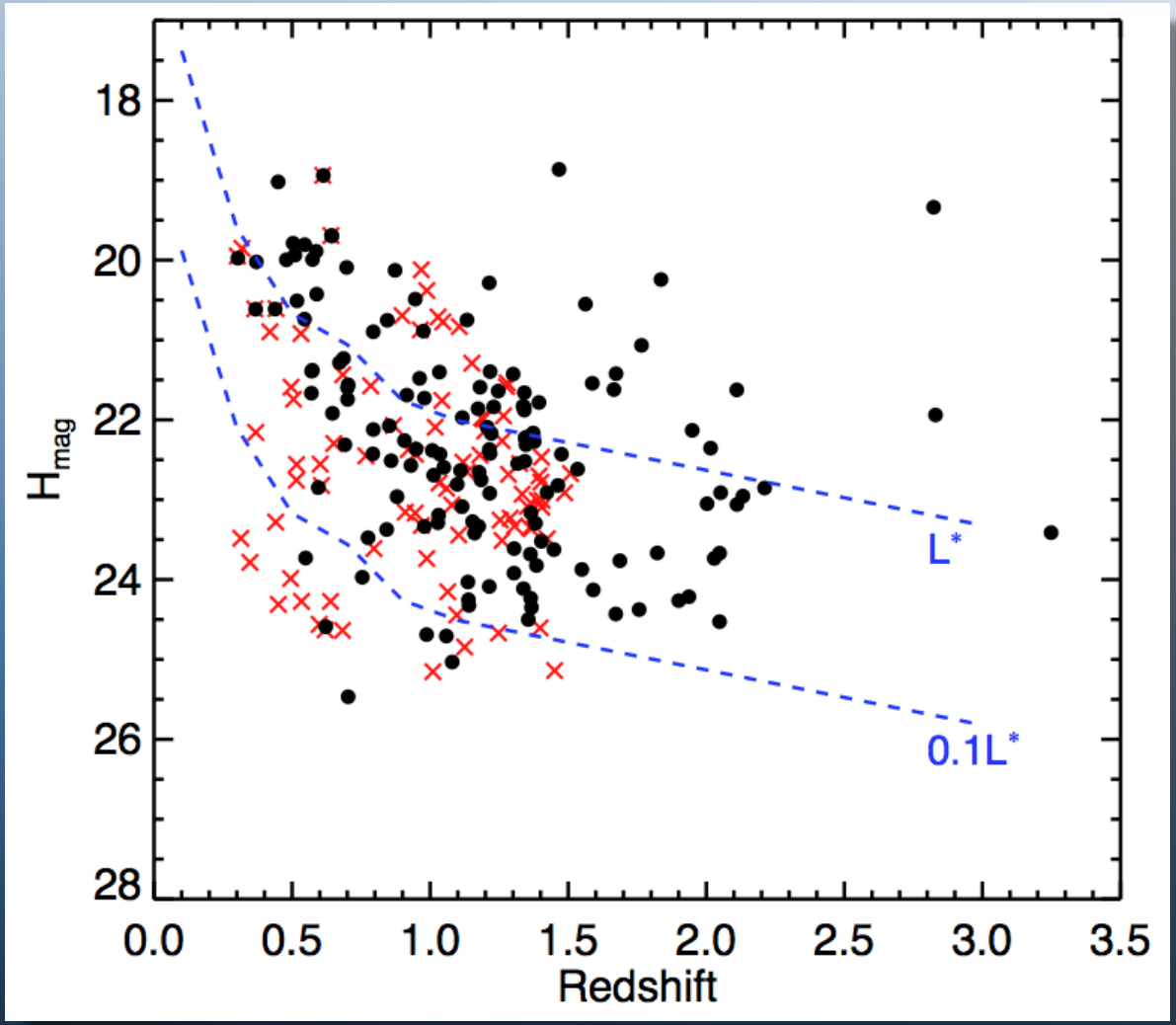
1.5 < z <2

Atek et al. 2010

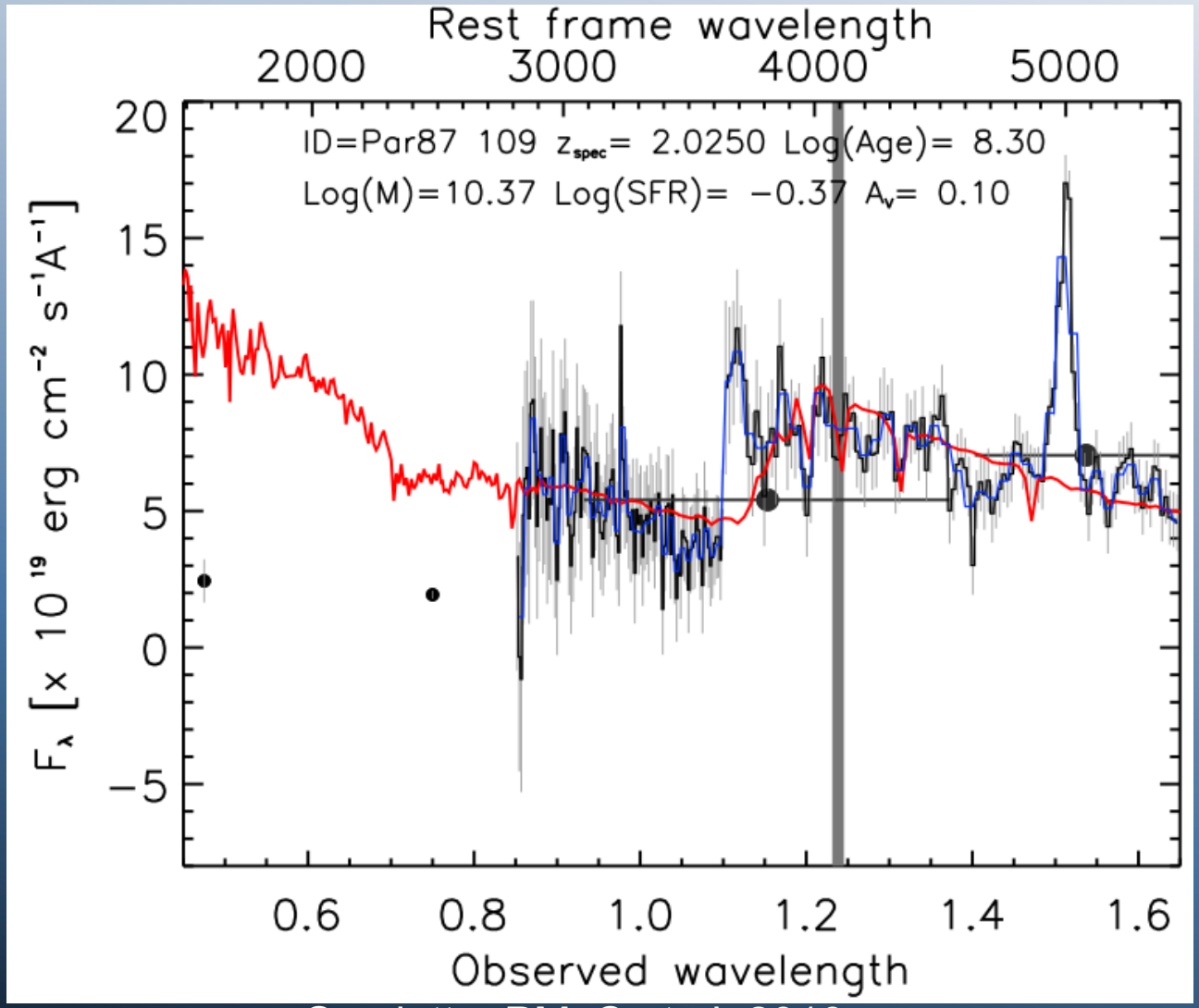
Sampling the Galaxy Mass Function

The WFC3 Grisms have the sensitivity to sample 0.1L* and fainter galaxies to z > 2

Emission-line corrections push continuum 1-2 mag fainter in some cases

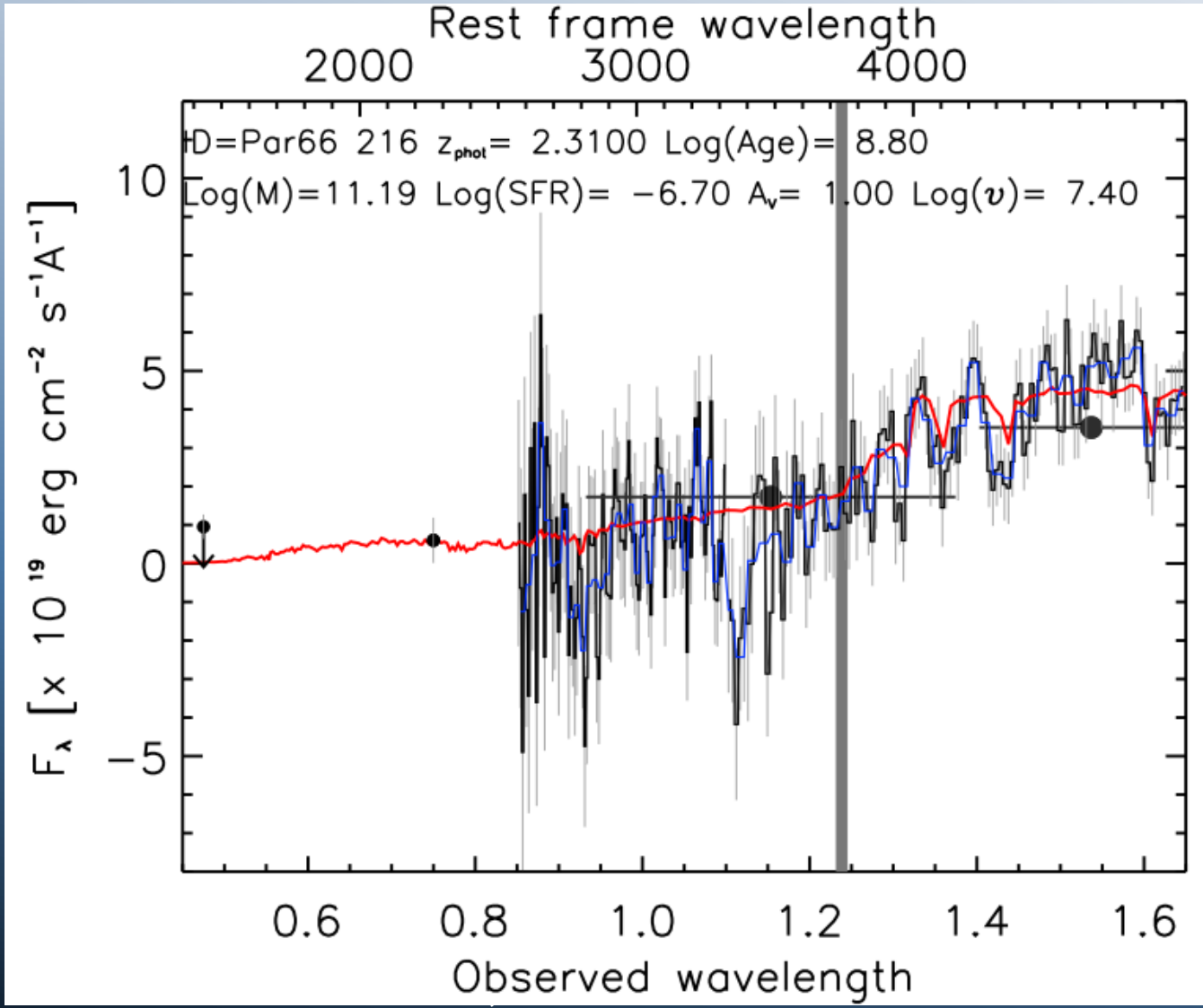


Starburst Galaxies at z = 1 - 3

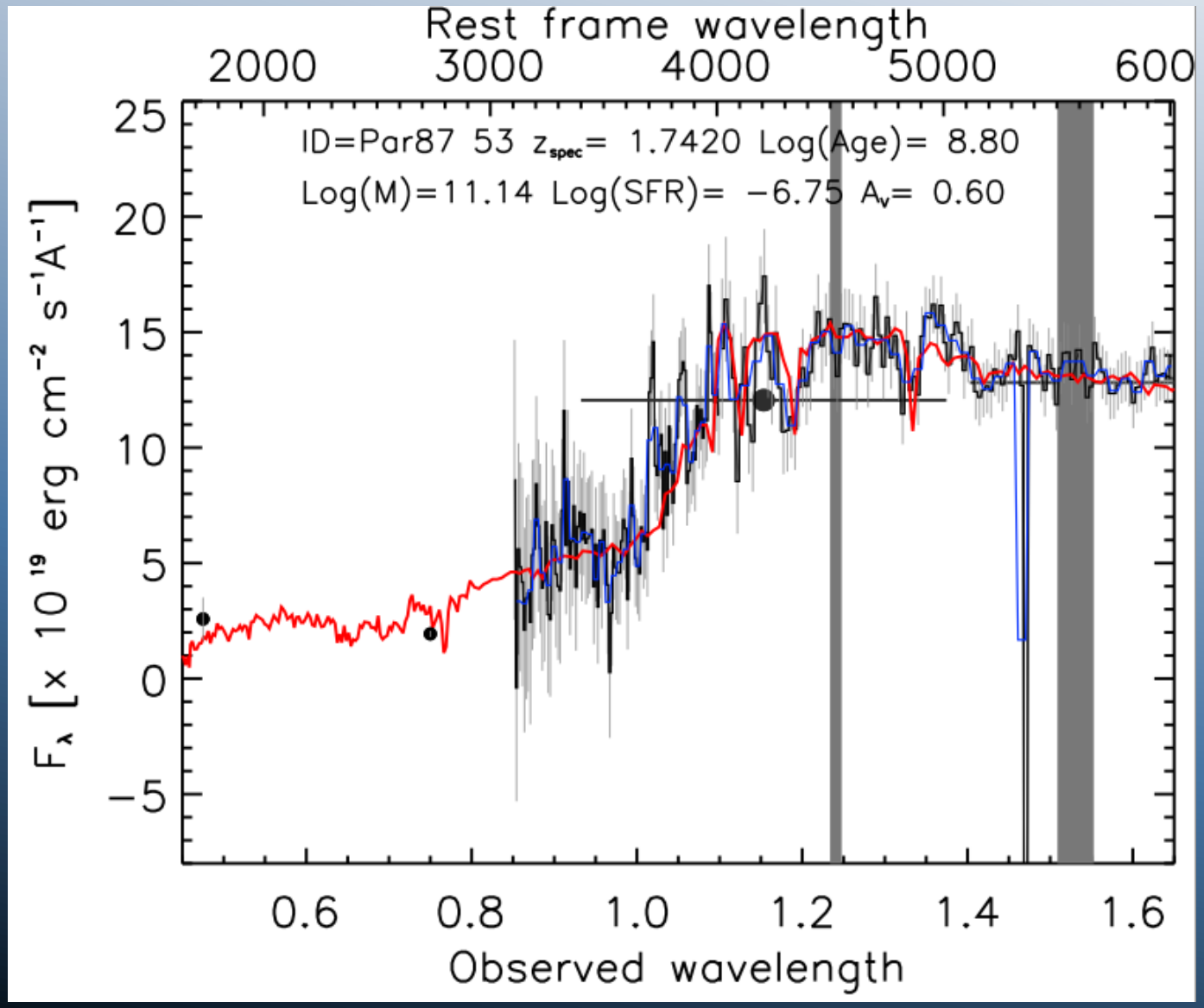


Scarlatta, PMcC et al. 2010

Post-Starburst Galaxies at z = 1 - 3



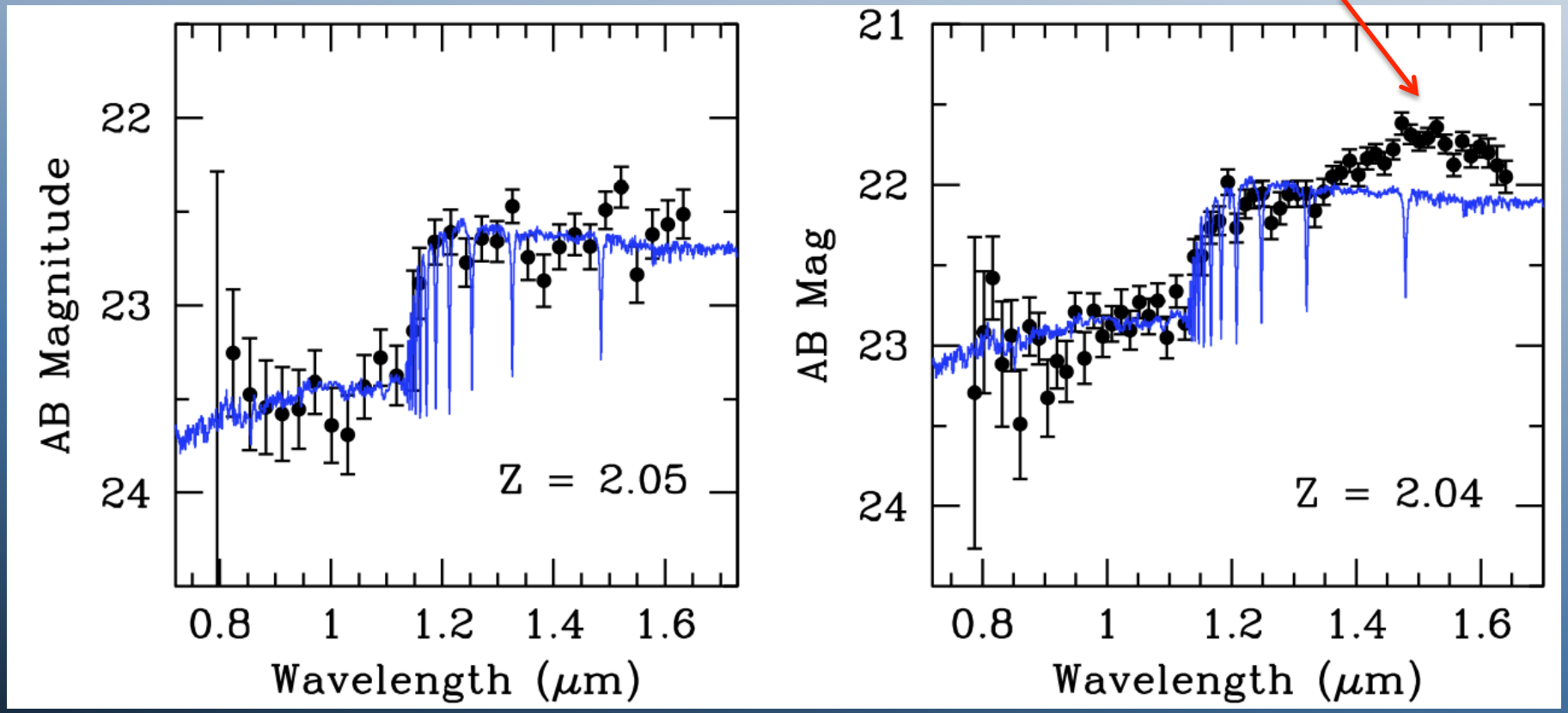
Passive Galaxies at z = 1 - 3



Quenched Galaxies at z > 2

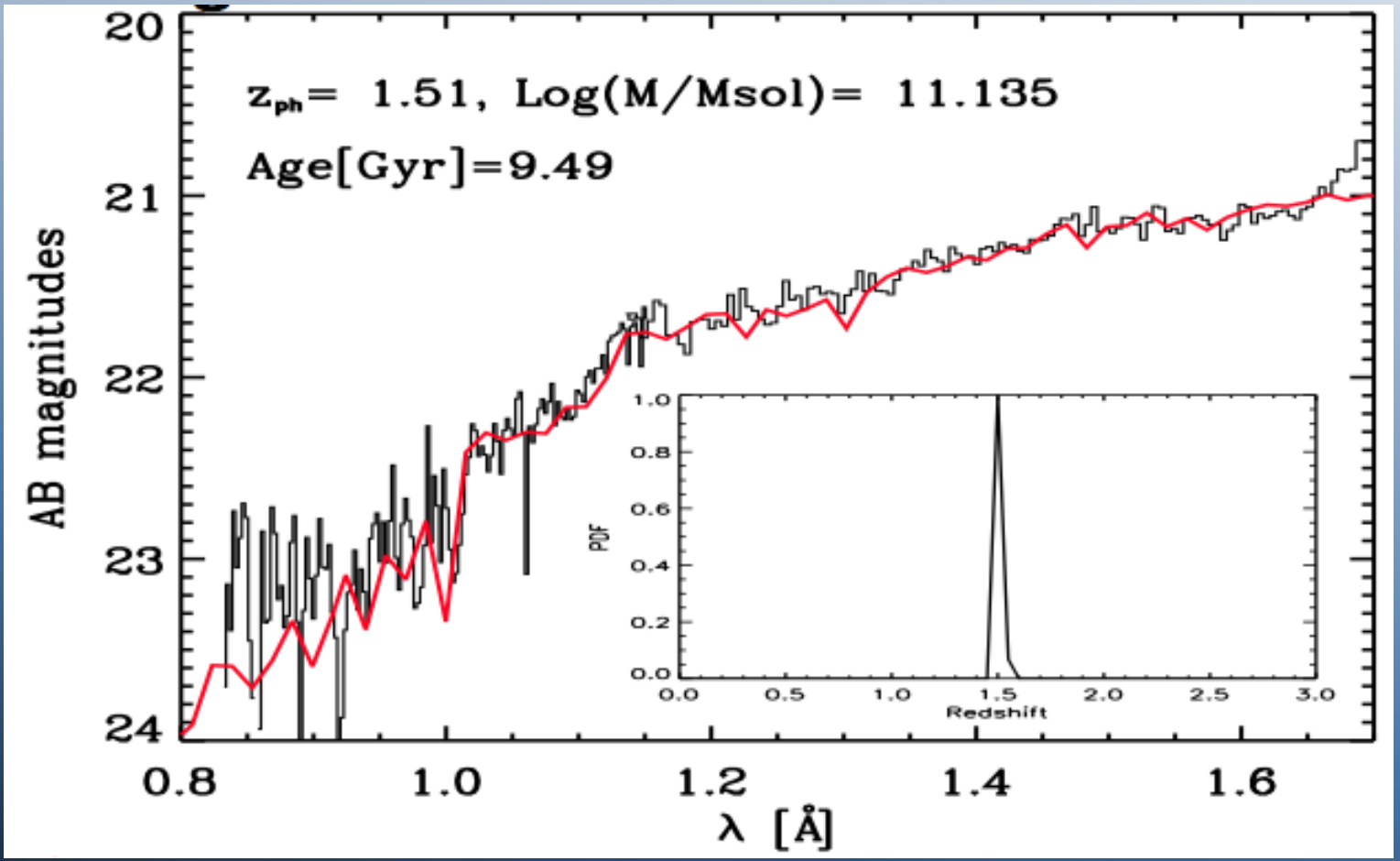
Another magnitude fainter!

Contamination



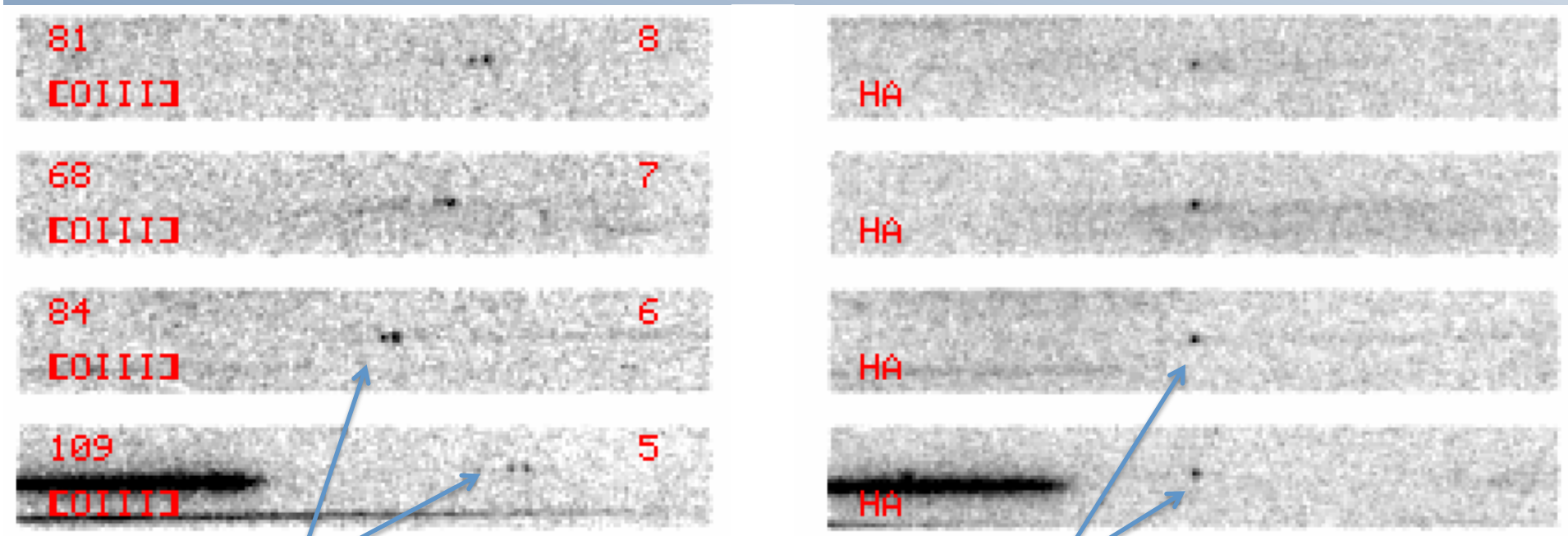
Scarlatta, PMcC et al. 2011

Massive! & Passive Galaxies at z = 1 - 3



Scarlatta, PMcC et al. 2011

High Equivalent Widths



[OIII]

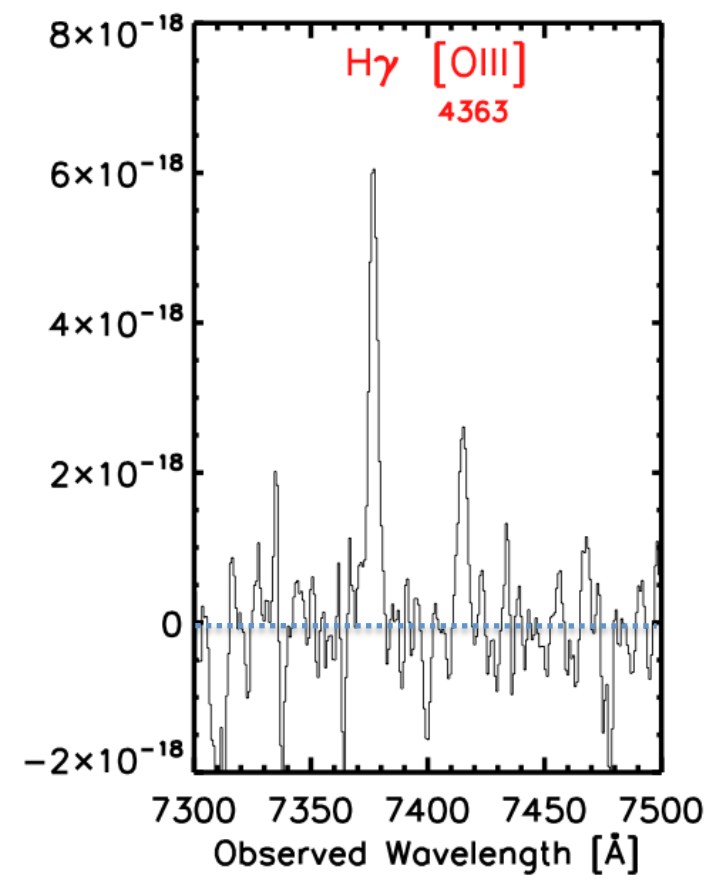
Hα

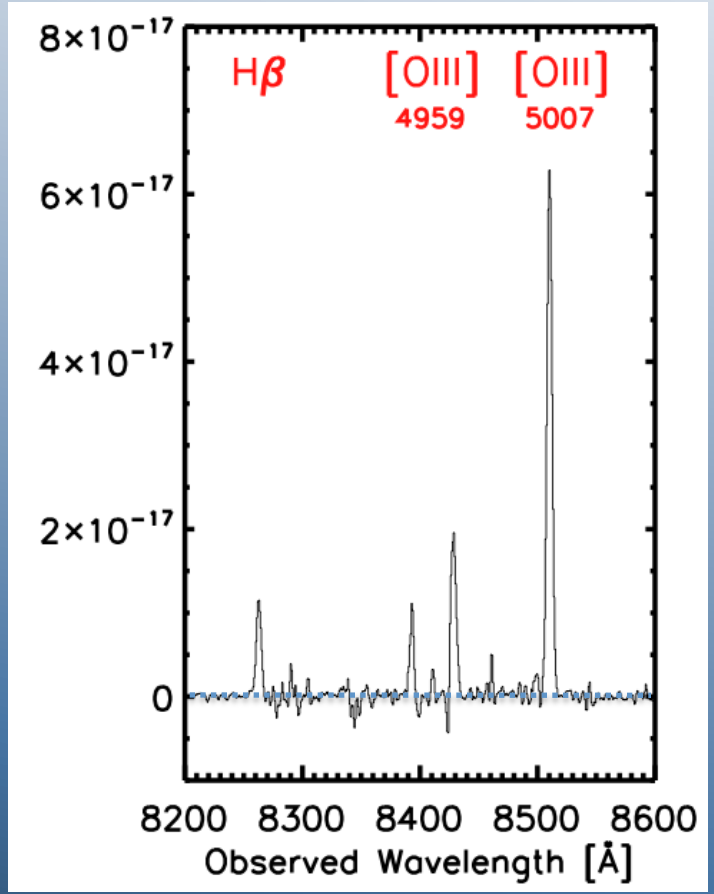
High Equivalent Widths

Keck/Deimos spectra of z = 0.7 High EW [OIII] emitter from G141

Redshifted "Green Peas"

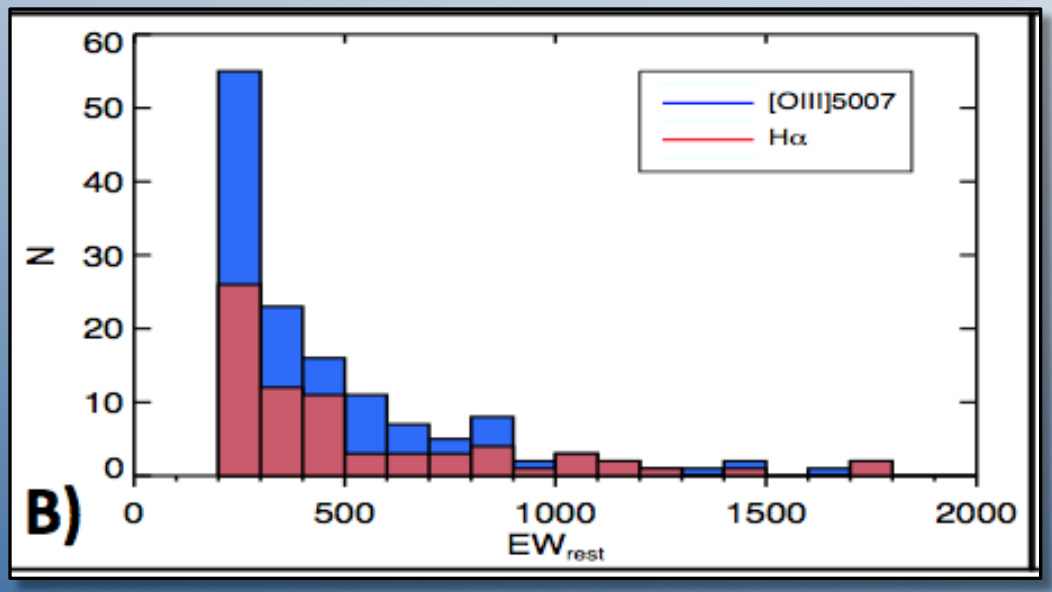
"Red Beans"?





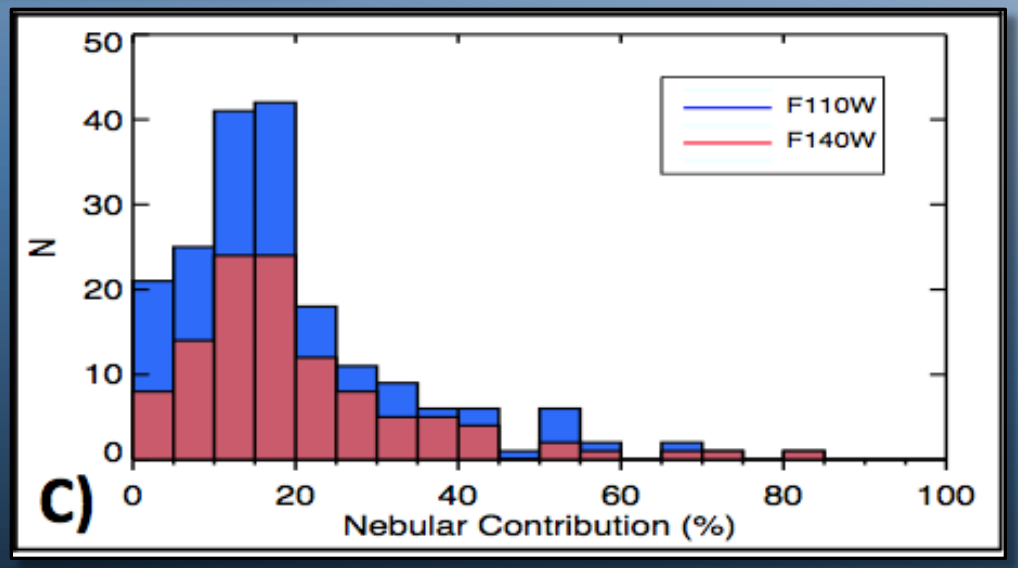
Rest-frame W_λ([OIII]) > 500A!

High Equivalent Widths

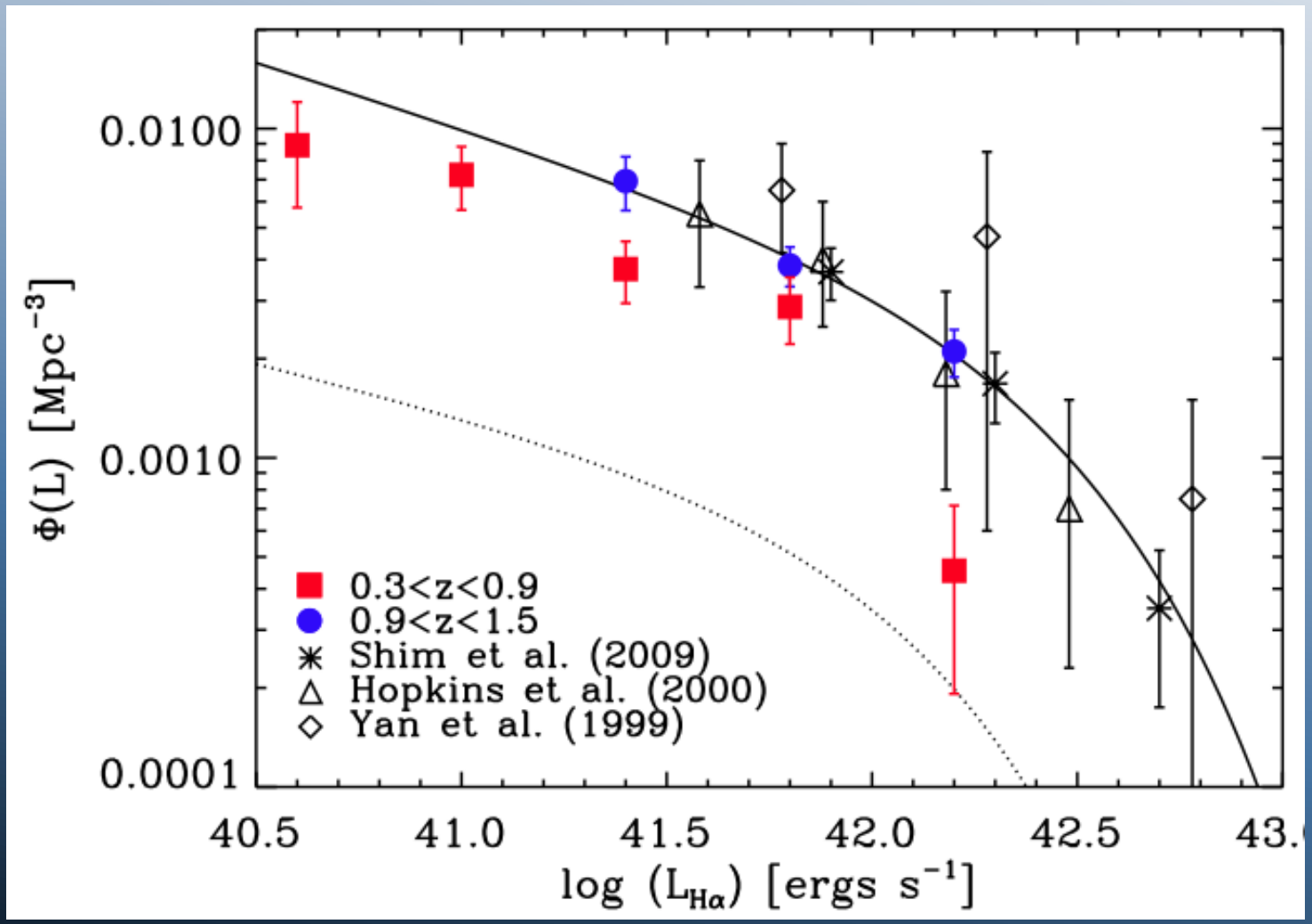


Rest-Frame Equivalent Widths
[OIII]5007,4959
H alpha

Emission-Line contribution to broad-band magnitudes
F110W
F160W



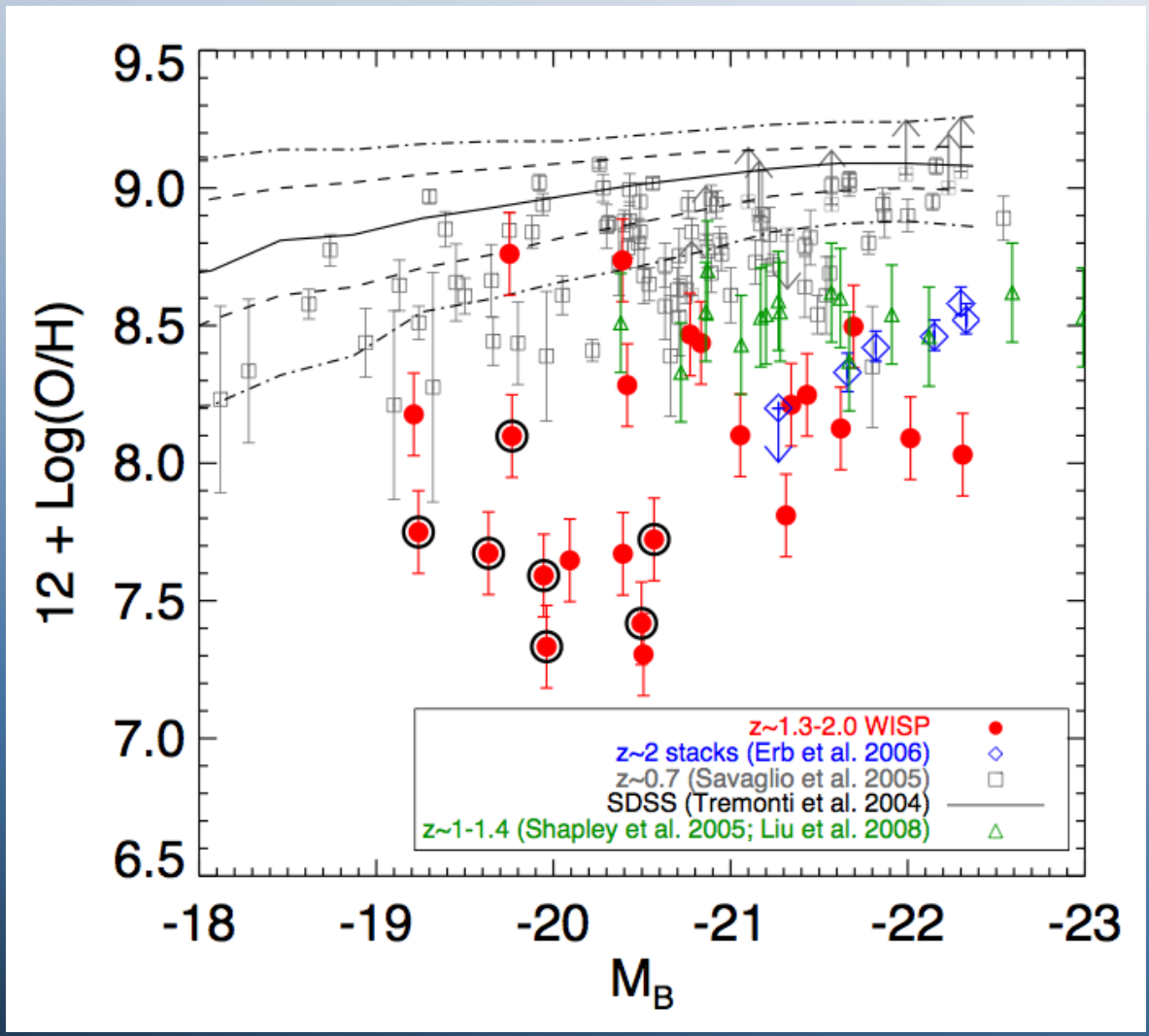
Hα Luminosity Functions



Evolution of the Mass-Metalicity Relation

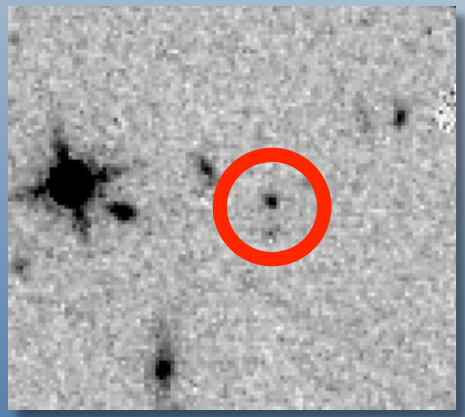
Mass-Luminosity Relations from
z = 0.1 (SDSS)
z = 0.7 (GDDS)
z ~ 1.5 (BMX)
z ~ 1.8 (WISPS)

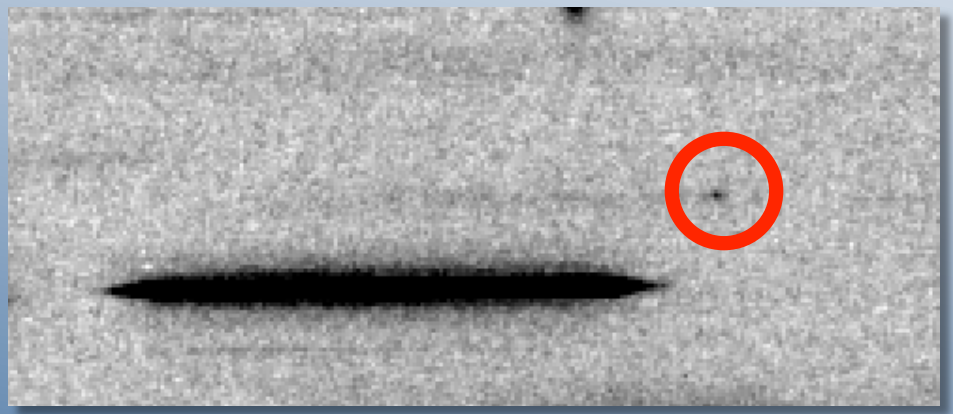
A. Henry et al. 2011

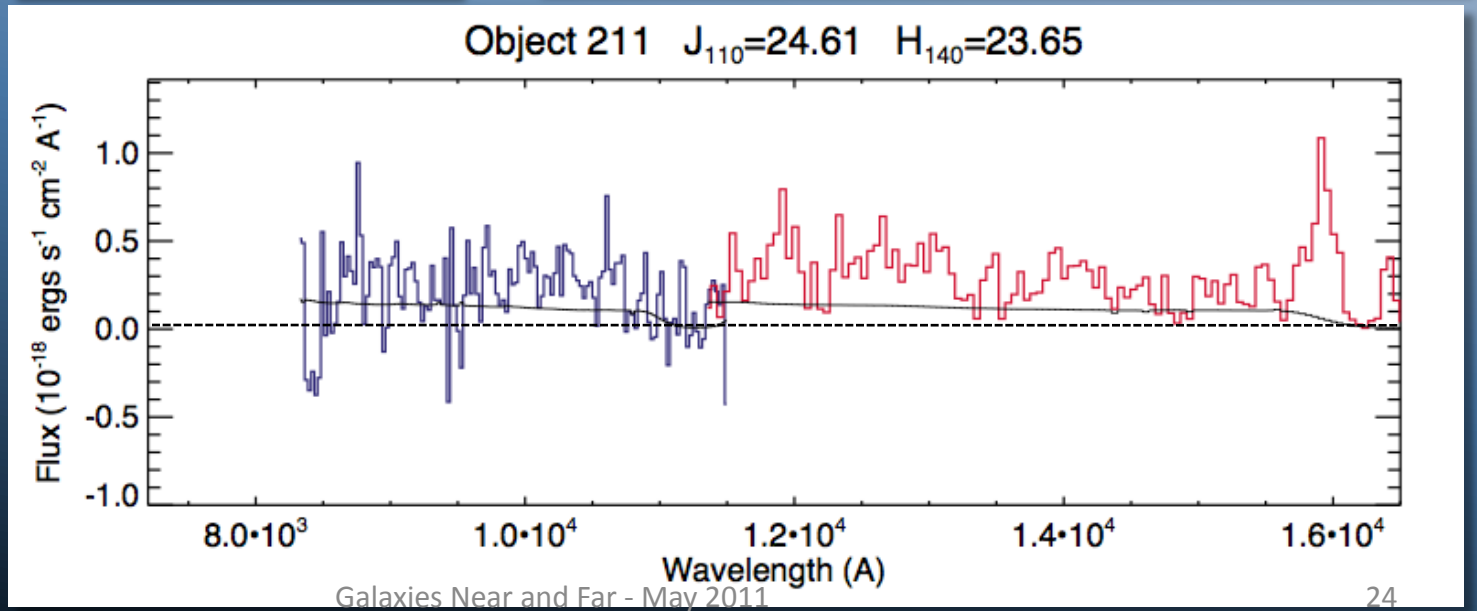


Low Mass Galaxies at z > 2

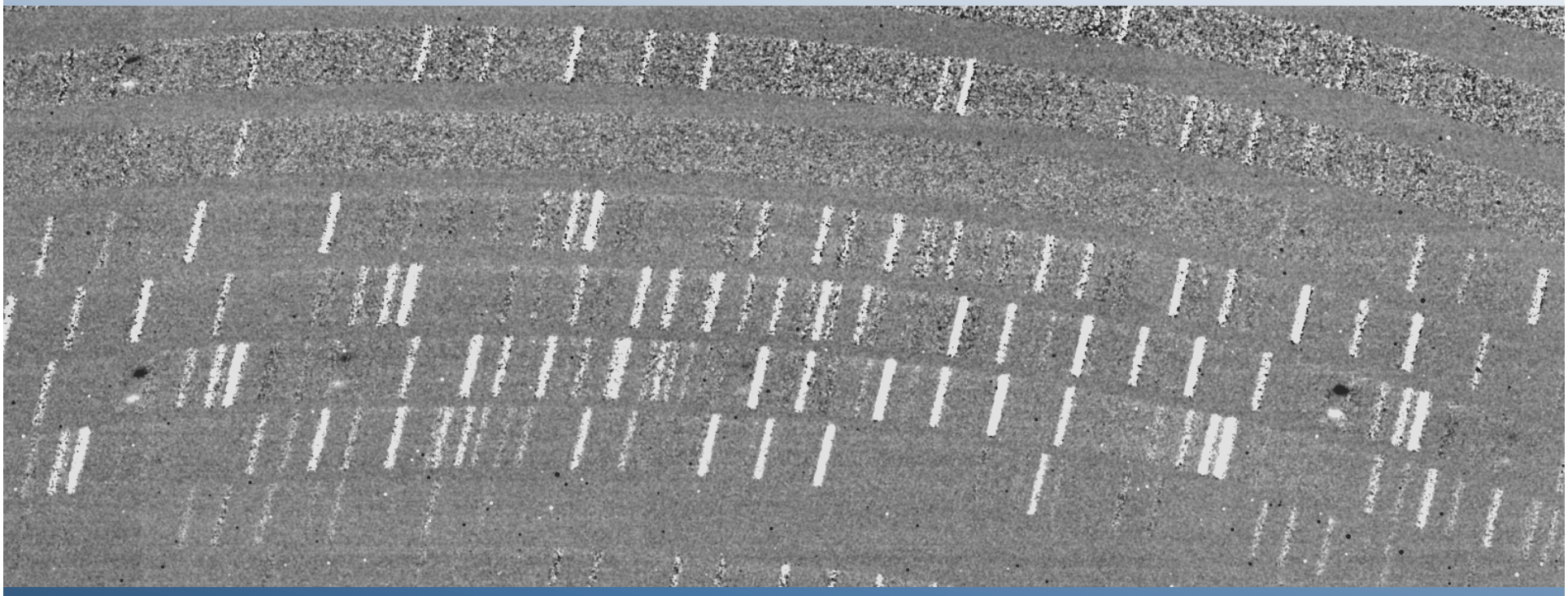
Z = 2.2
[OIII]
Flux =
1.5×10^{-16} cgs

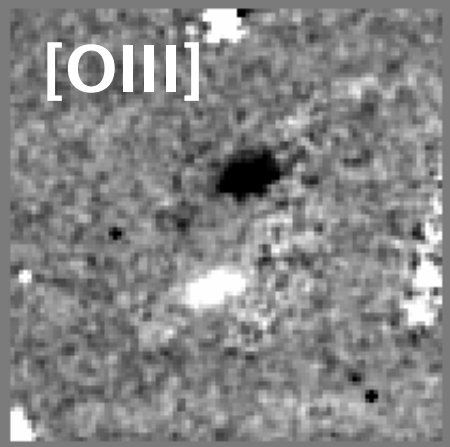


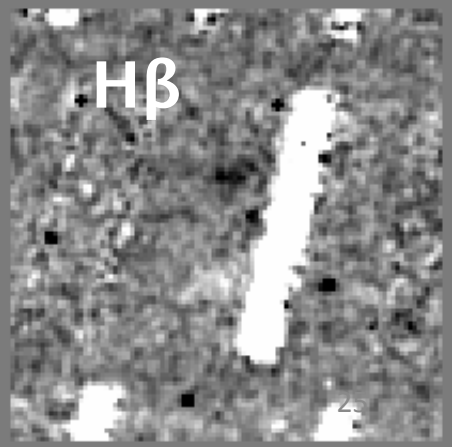




Magellan FIRE Spectrum







So Long, and Thanks for All the Fish

Special Thanks to the ECF team for their dedicated effort to support slitless spectroscopy!

Richard Hook	Jeremy Walsh	Jonas Haase
Harald Kuntschner	Piero Rosati	Martin Kornmesser
Martin Kummel	Marco Lombardi	Kim Nilsson
Brit Sjoberg	Felix Stoehr	Michael Rosa
Colleen Sharkey	Nor Pirzkal*	

And……

The Bob