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WIDE-FIELD INFRARED SURVEY TELESCOPE
WFIRST
ASTROPHYSICS • DARK ENERGY • EXOPLANETS

The Power of Infrared Grism Surveys
Insights from the WISP Survey

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see also Talks by J.Colbert, A. Henry
Posters by M. Malkan, C. Scarlata

WFC3 Infrared Spectroscopic Parallel Survey (WISPs) at this meeting

PI: Matt Malkan (UCLA)

Team Members: H. Atek, M. Bagley, I. Baronchelli, A. Bedregal, C. Bridge, A. Bunker, J. Colbert, Y. Dai, A. Dominguez, A. Dressler , N. Hathi, A.L. Henry, C. Martin , D. Masters, V.Mehta , P. McCarthy , M. Noble, M. Rafelski, M. Rutkowski, N. Ross, C. Scarlata, H. Shim, B. Siana, H. Teplitz

WISPS

WFC3 Infrared Spectroscopic Parallel Survey

- WISPs overview

- What can HST-WISPs tell WFIRST?
  - Forecasting emission line galaxy (ELG) number counts
  - Previewing classes of unusual objects
    - EELGs (extreme ELGs)
    - galaxy pairs/triplets
    - Lyα emitters
    - gravitational lenses
  - Showing the scientific insights IR grism surveys can bring to galaxy evolution

WISPs

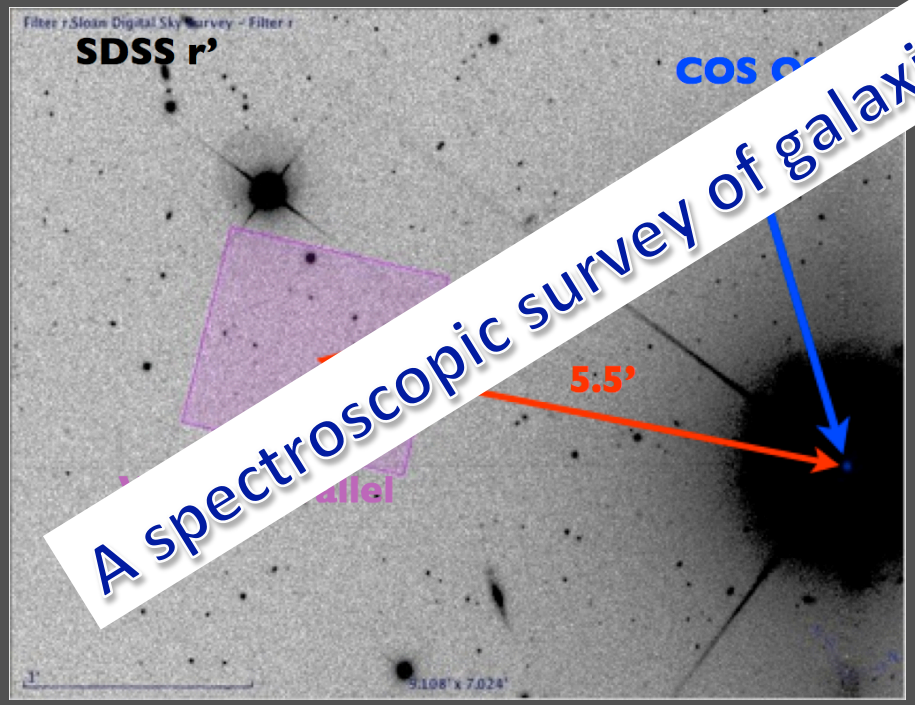
WFC3 Infrared Spectroscpic Parallel Survey

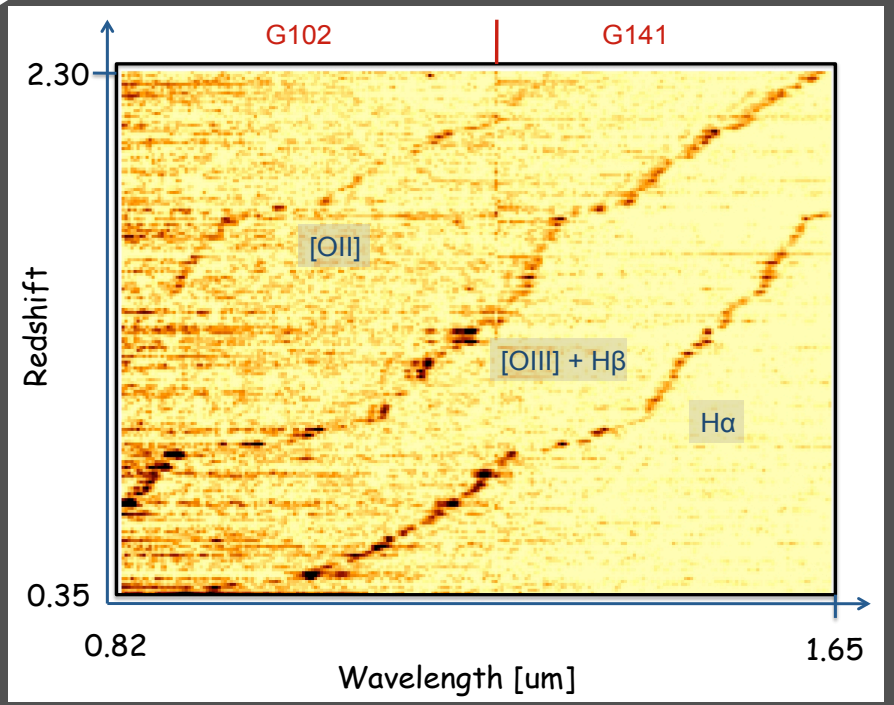
Parallel Separation:

- 5.5’ from COS
- 4.75’ from STIS

- A pure parallel [illegible]ey
- PI: Prof. [illegible]an (UCLA)
- Iden[illegible]n and analysis of [illegible] line galaxies at moderate [illegible] high redshift
- G102 & G141 grisms

A spectroscopic survey of galaxies with no pre-selection!

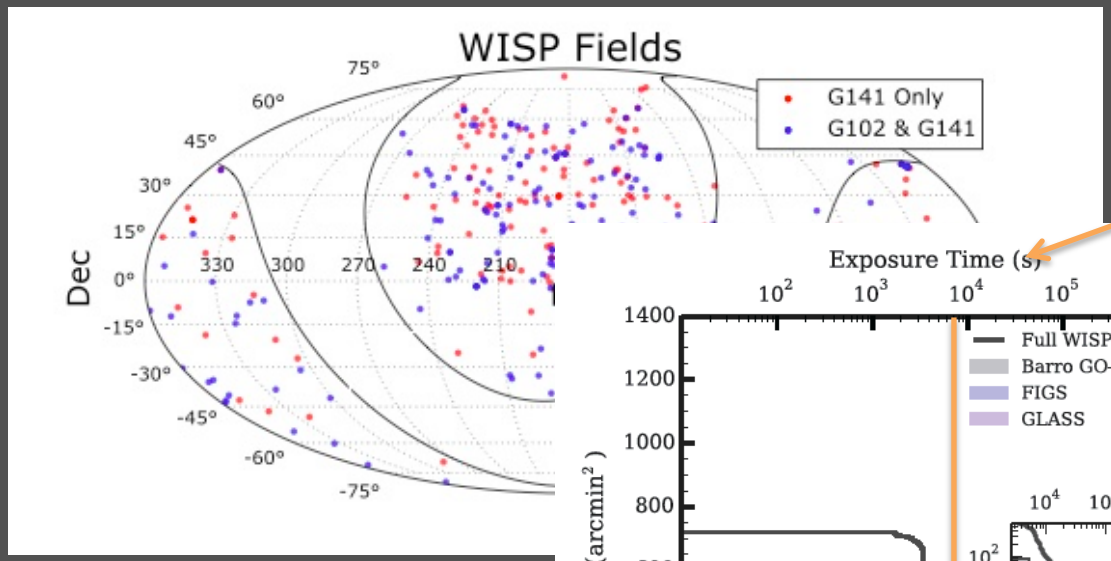




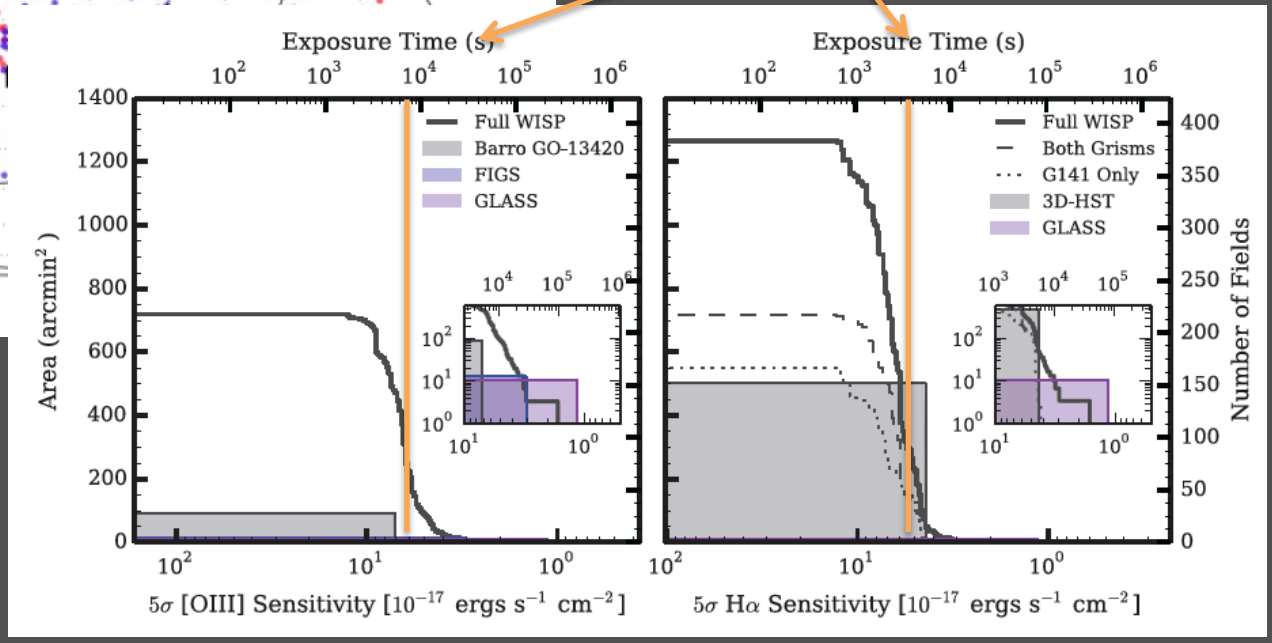
See also: Poster by M. Malkan

Observations (HST + IRAC + Palomar)

- **~ 1,800 parallel orbits of HST ~ 450 fields**
- Direct near-IR imaging (F110W, F140W or F160W)
- Direct UVIS imaging if available (F475X, F600LP)
- The near-IR grisms image (G102, G141)
- **Palomar follow-up of Northern fields**
  - **g + i imaging**
- **Spitzer/IRAC follow-up of deep fields**
  - **IRAC 1 map**
- https://wisps.ipac.caltech.edu

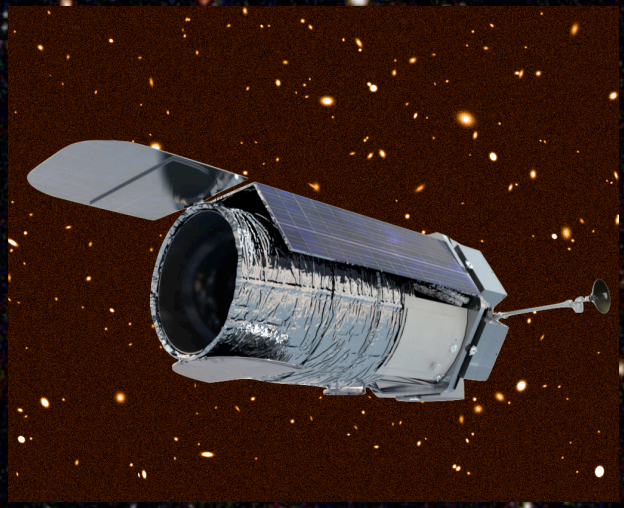


WFIRST/HLS sensitivity



From HST to WFIRST

1. number counts of emission line galaxies



HST / WFC3 vs. WFIRST

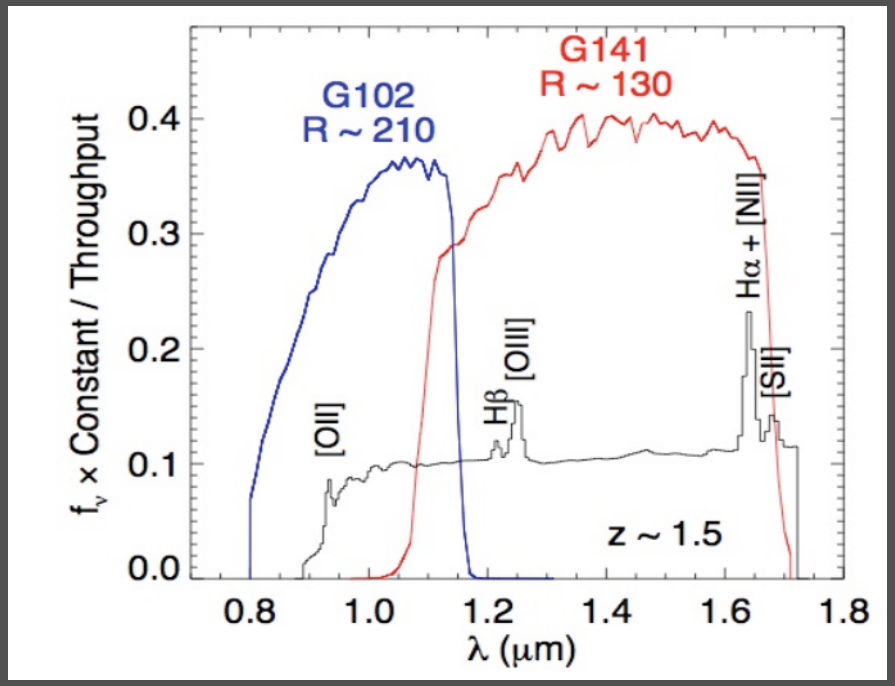
HST/WFC3

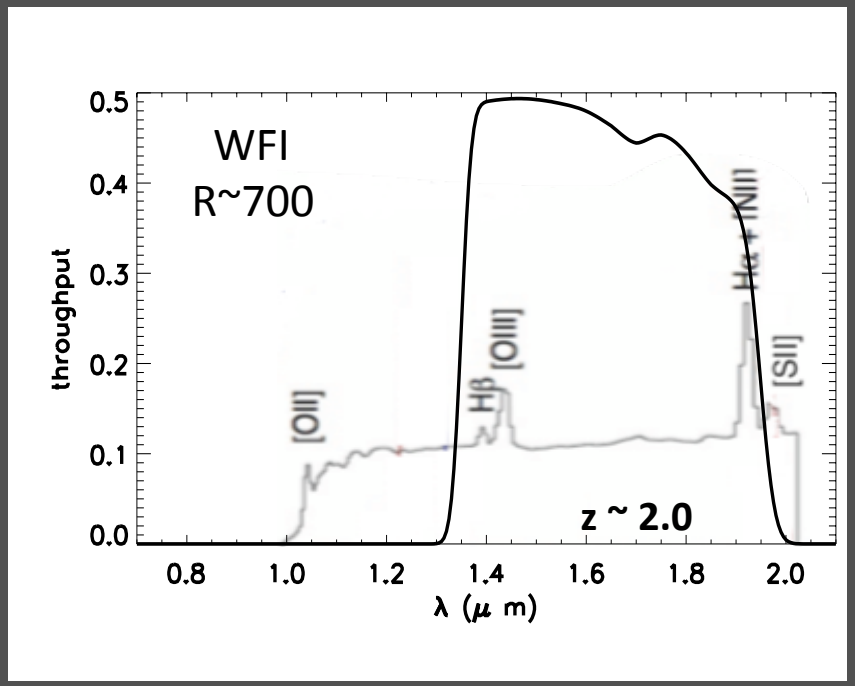
- G102: 0.80—1.15 μm, G141: 1.07-1.70 μm
  - R(Δλ/λ) ~ 130-210
- WFC3: 0.13 ''/pix
- FOV: 0.0013 deg^2

WFIRST/WFI

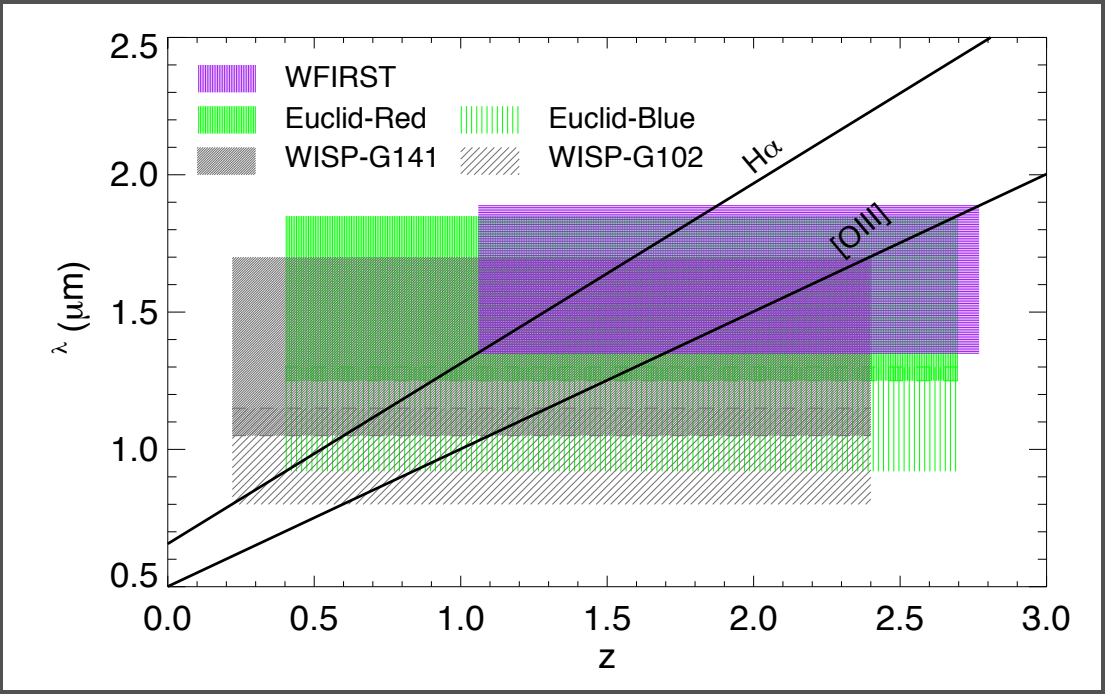
- Grism range: 1.35—1.89 μm
  - R(Δλ/λ) ~ 600
- WFI: 0.11 ''/pix
- FOV: 0.28 deg^2

~100 X bigger FOV!





Wavelength Coverage



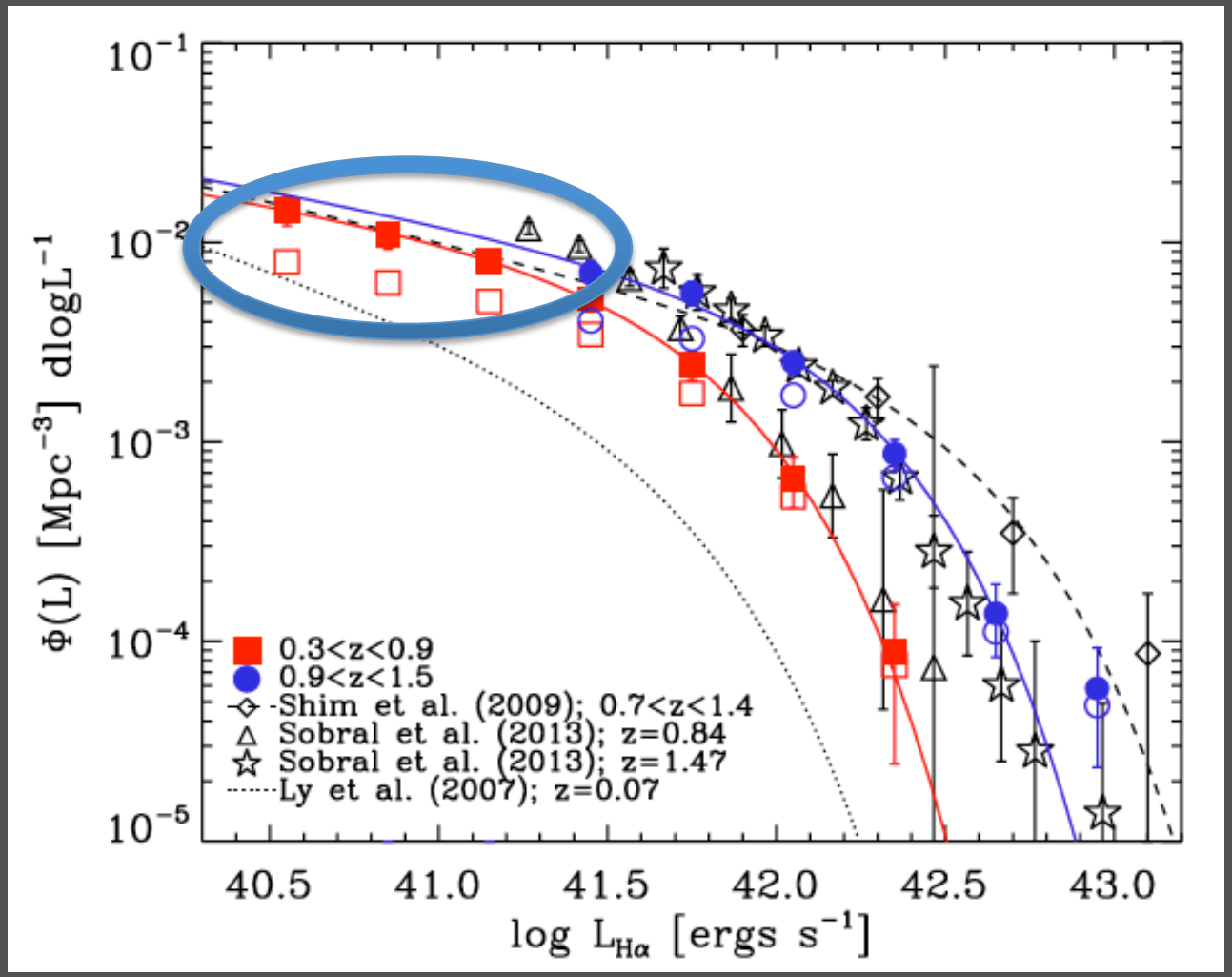
HLS:
4000X WISP area!

Also JWST!

- WISPs spectra continuously cover the 0.85 —1.65 μm range
- WISP targets Hα up to z~1.5, [OIII] up to z~2.3
- Multiple lines in the range 0.9 < z < 1.5
- WFIRST will target Hα in z~ 1.0 - 1.9, [OIII] @ z ~ 1.7 – 2.7

Predicting emission line galaxy (ELG) number counts

Hα luminosity function (LF) down to 10^{40} erg/s

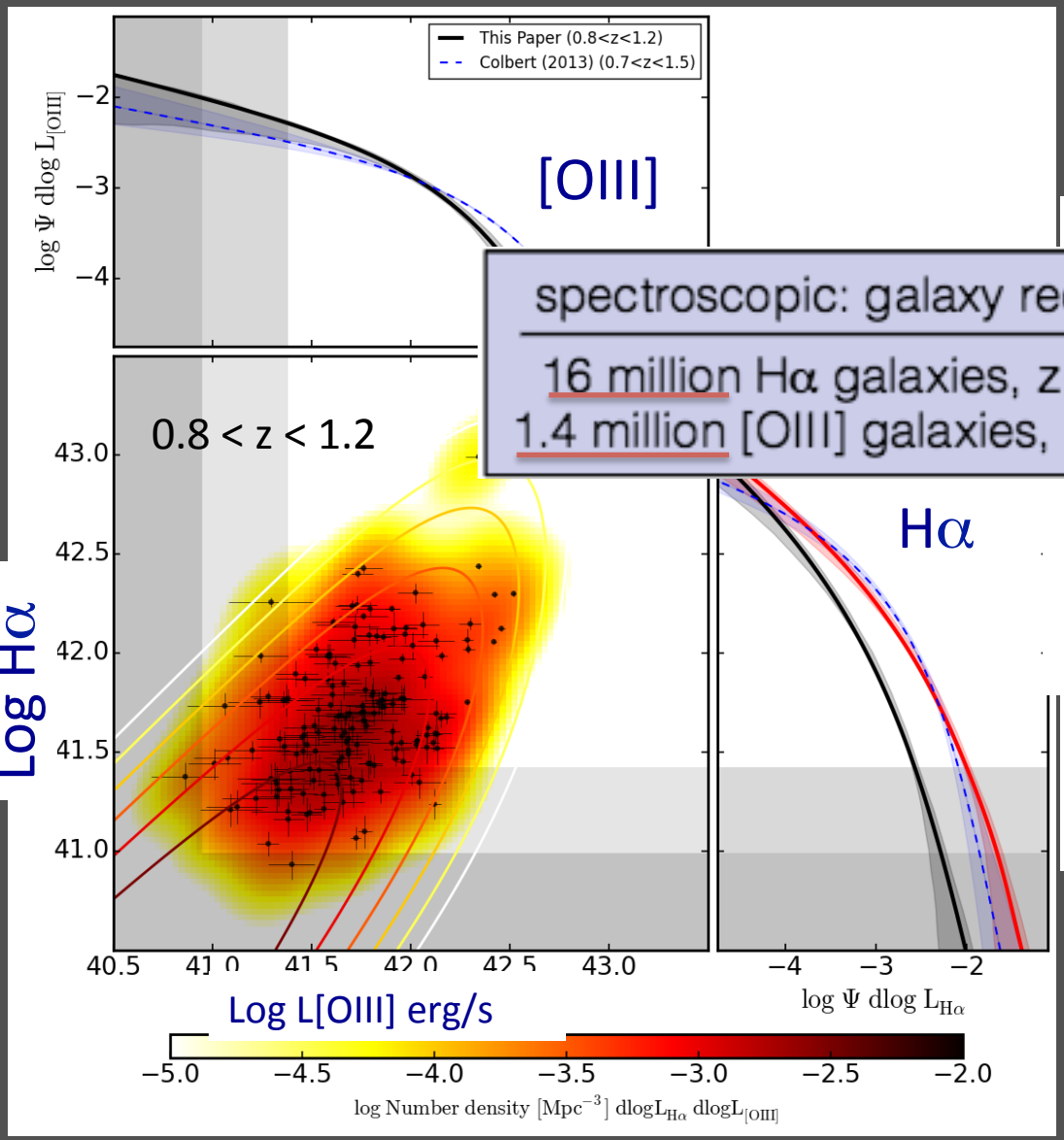


See also: Talk by J. Colbert

Colbert + 2013, ApJ, 779,34

Predicting emission line galaxy (ELG) number counts

The Hα - [OIII] bi-variant LF at z ~ 1

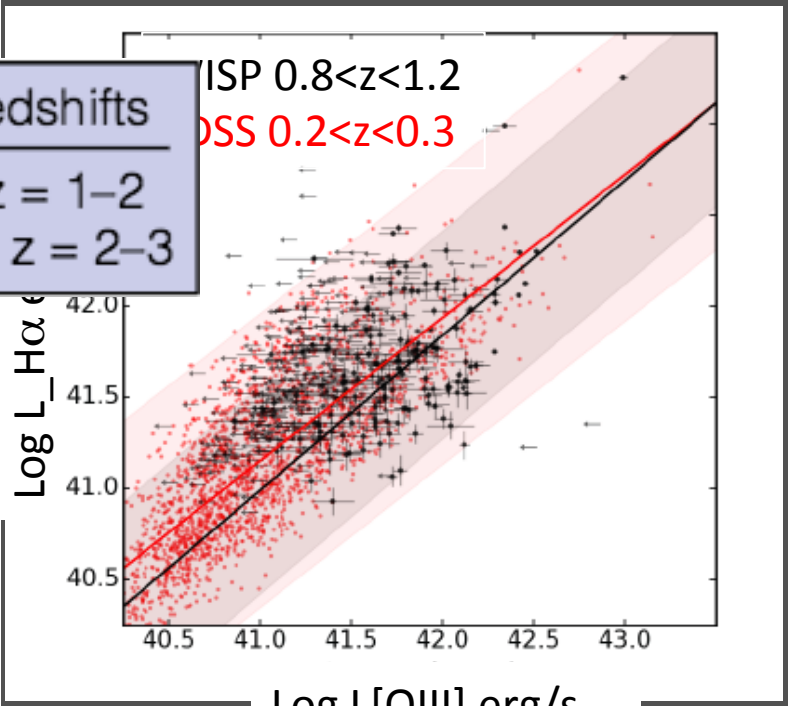


spectroscopic: galaxy redshifts

16 million Hα galaxies, z = 1–2

1.4 million [OIII] galaxies, z = 2–3

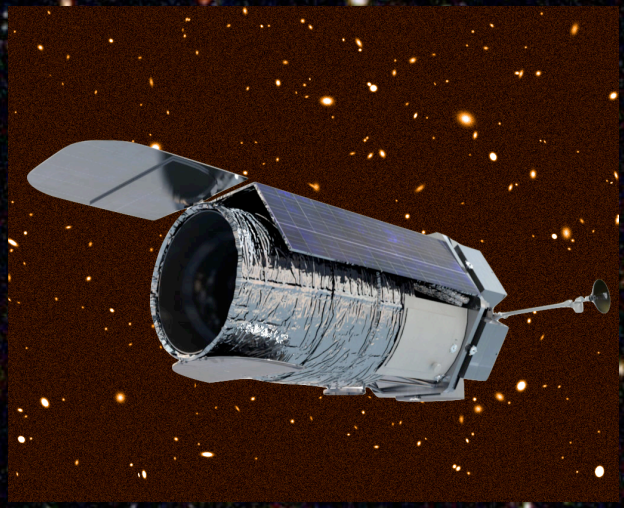
No flux ratio evolution from z=0.2 to z=1



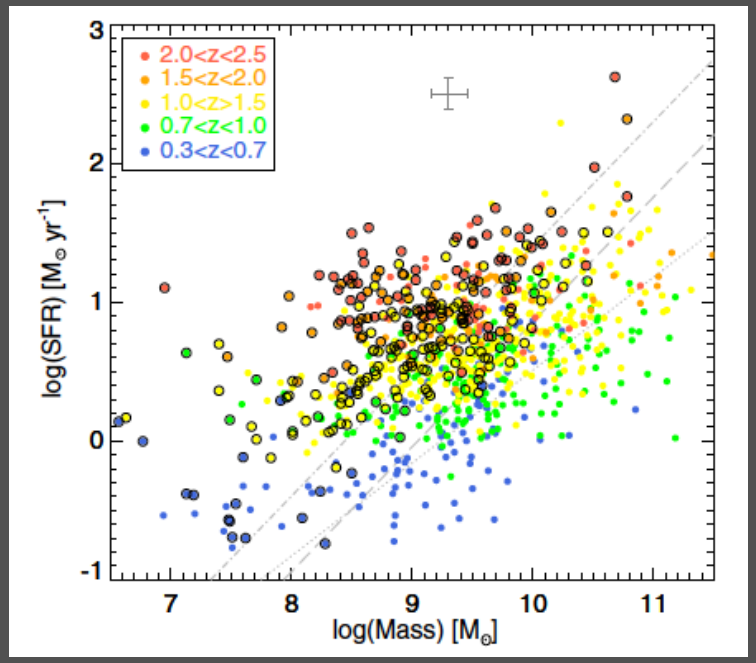
Mehta+2015

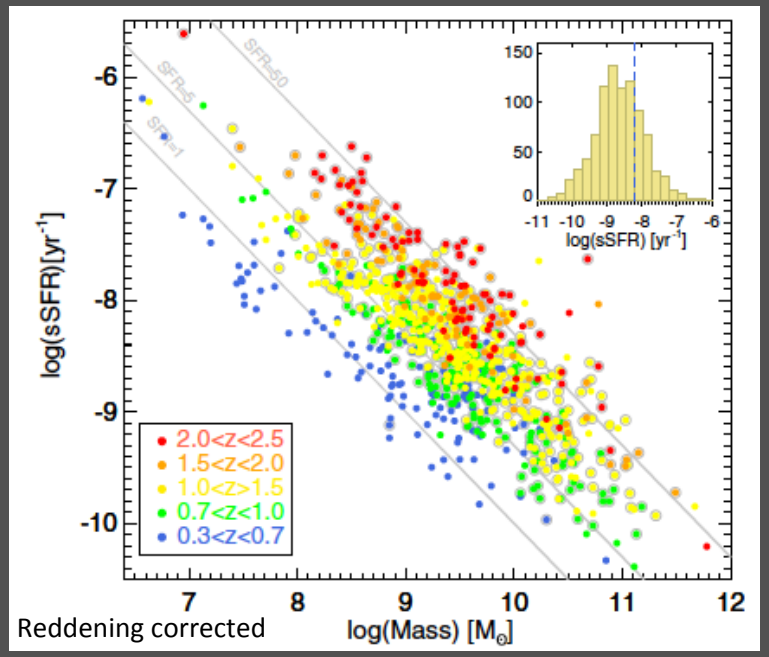
See also: talk by J. Colbert

From HST to WFIRST
2. Unusual classes of targets



Previewing unusual targets for WFIRST: EELG
Extreme Emission Line Galaxies





High EW (Hα) galaxies' contribution to total SFR density @ z = 1~2:

> 300 A : 13%

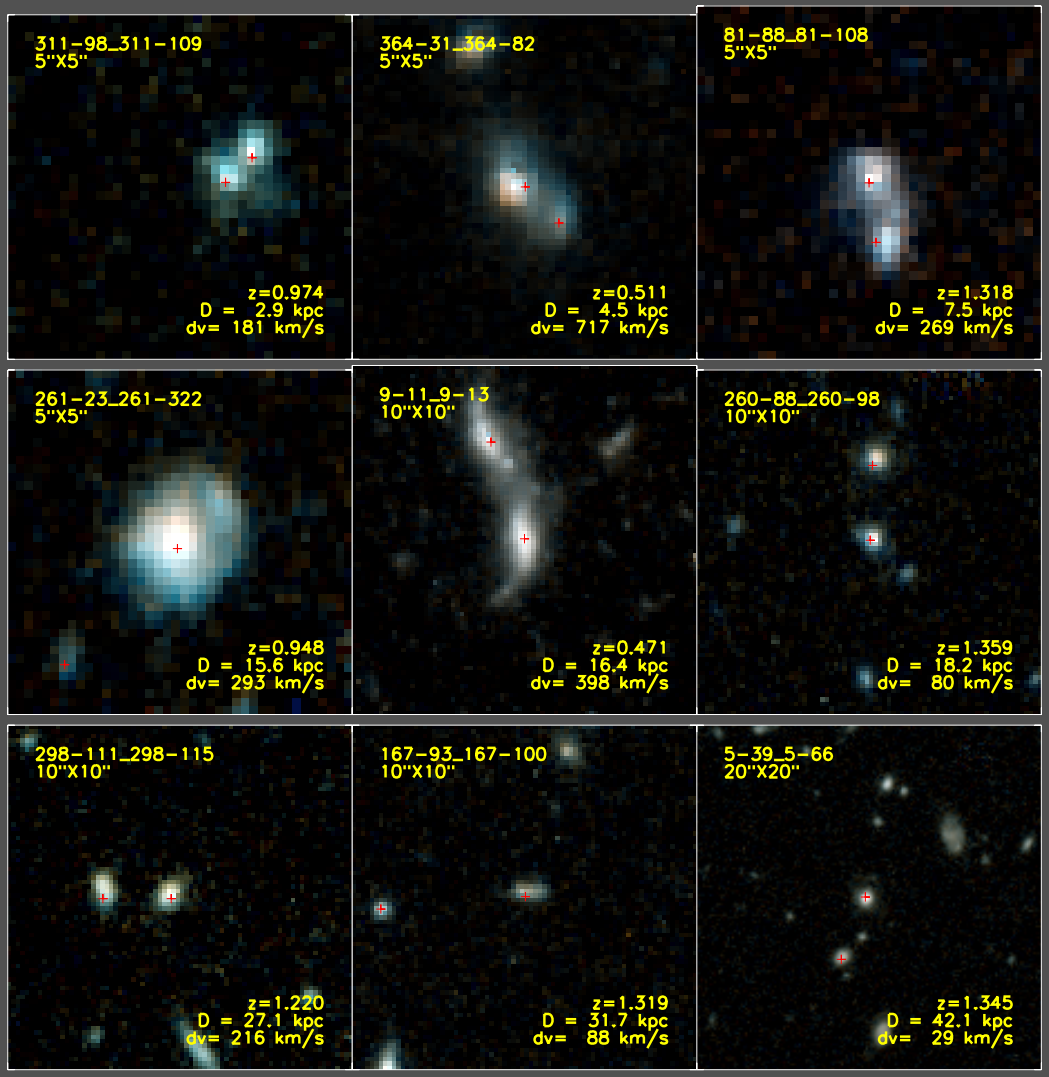
> 200 A : 18%

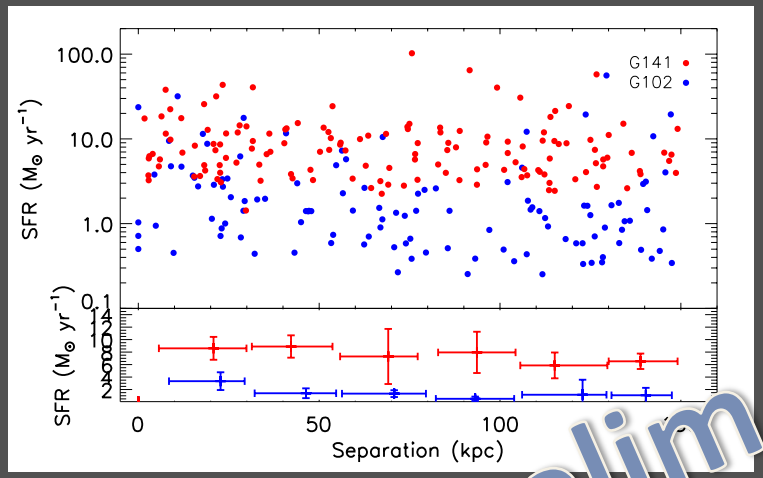
> 100 A : 34%

high sSFR allows doubling M* in <150 Myr

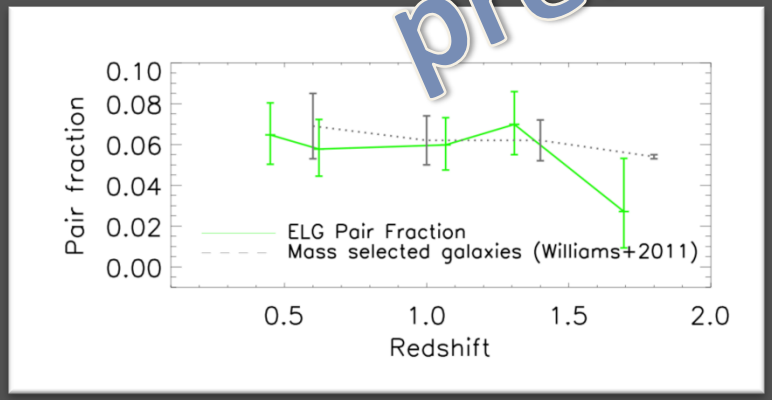
Atek + 2014, ApJ, 789,96

Previewing unusual targets for WFIRST: galaxy pairs
the role of mergers and their impact on SFH





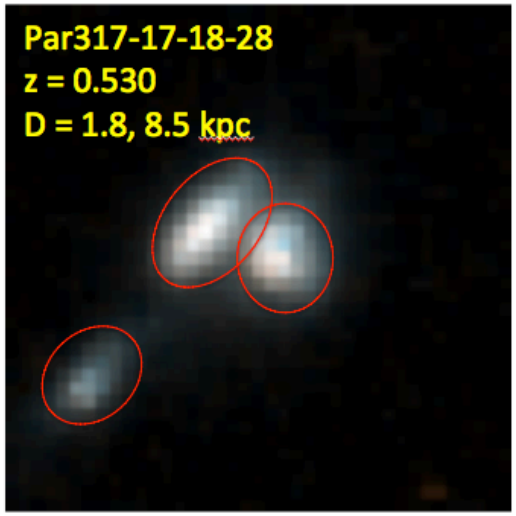
prelim

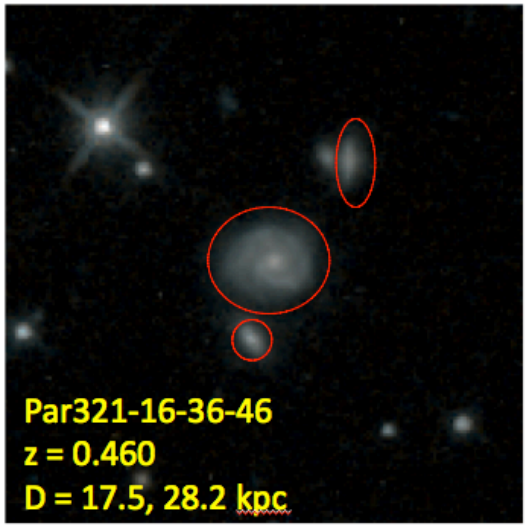


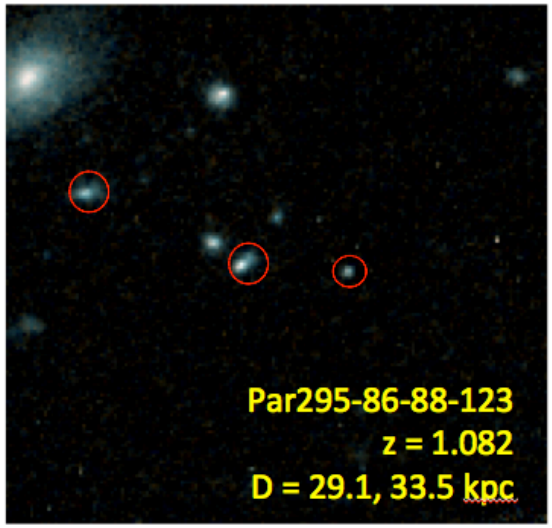
Dai + 2016, in prep

Also JWST

Previewing unusual targets for WFIRST: galaxy triplets and groups
High incidence of triplets and groups in ELGs



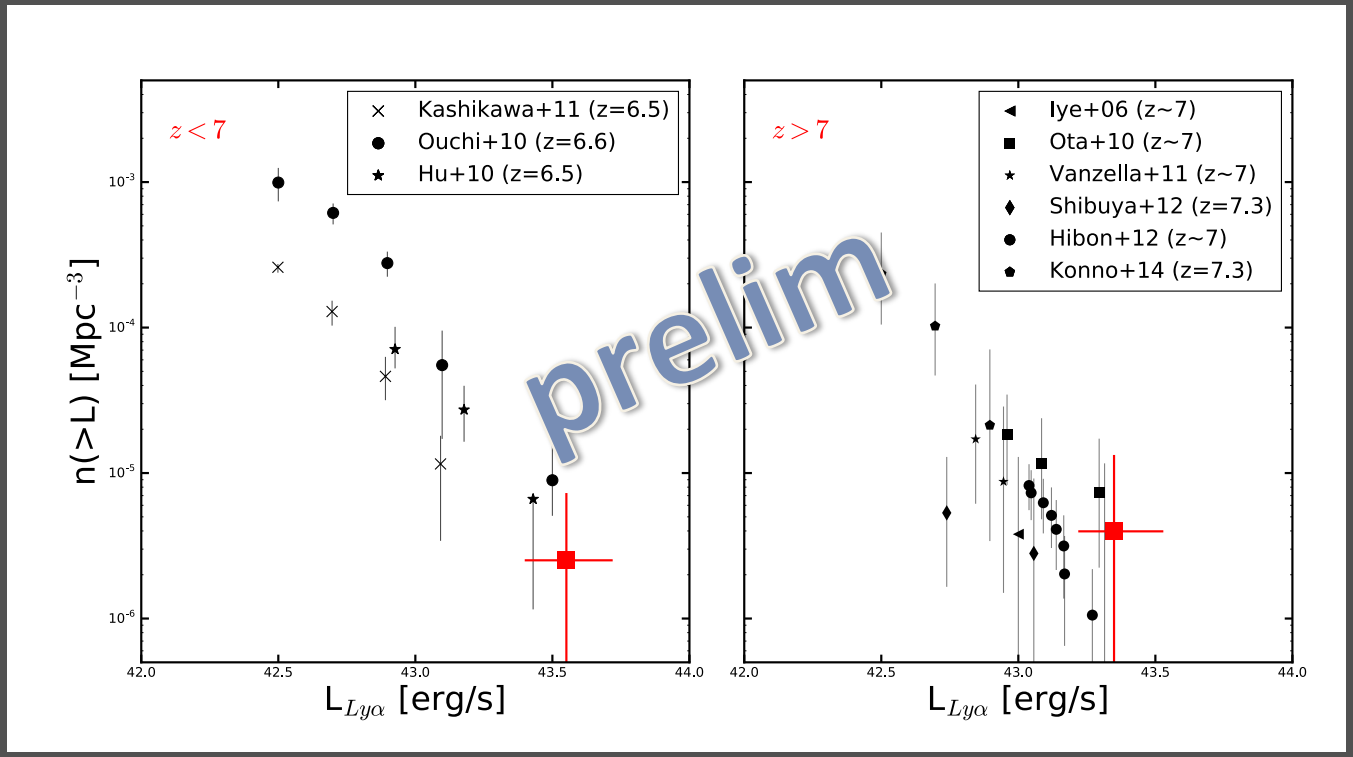




ELGs: 17 +/- 3% (0.2 < z < 2.0)
SDSS: ~ 5% (z < 0.2, Ellison+2008)

Dai + 2016, in prep

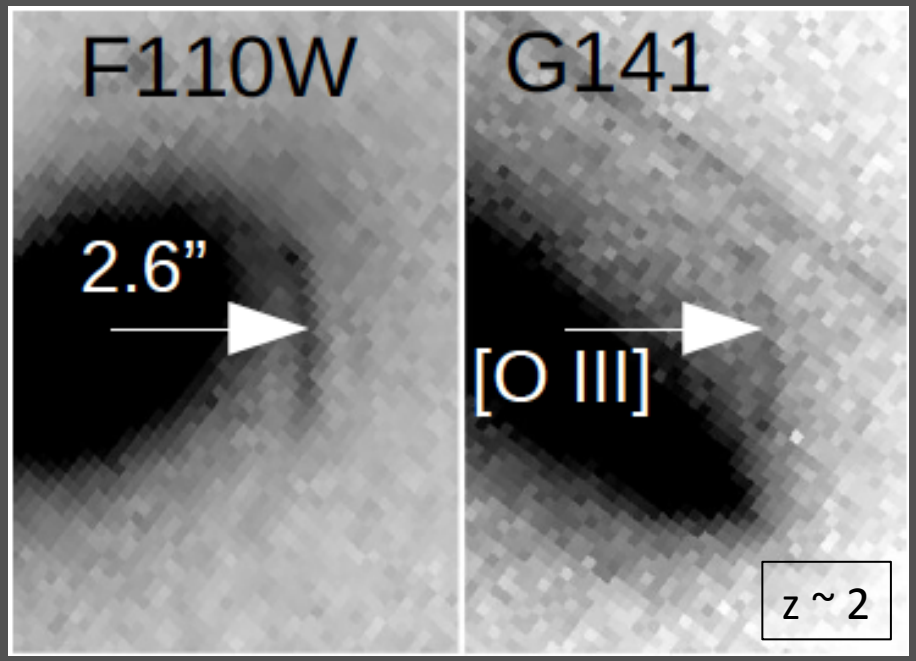
Previewing unusual targets for WFIRST: Lyα emitters
the luminous end of the Lyα LF



Bagley + 2016, in prep

Previewing unusual targets for WFIRST: Lens gravitational lensed galaxies at high z

(1)



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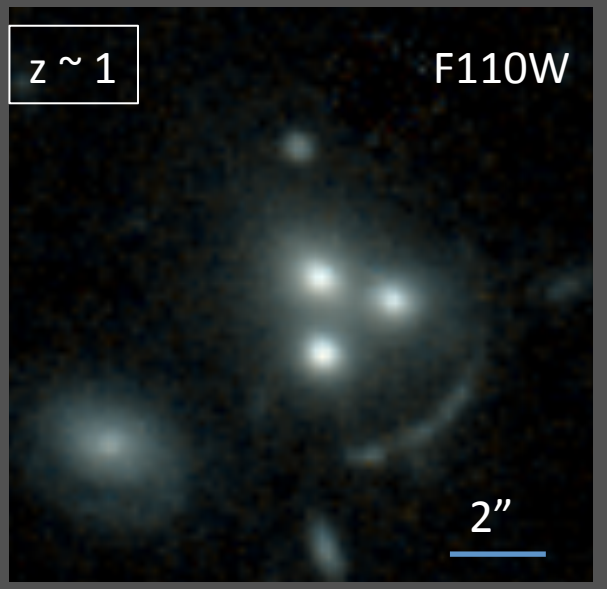
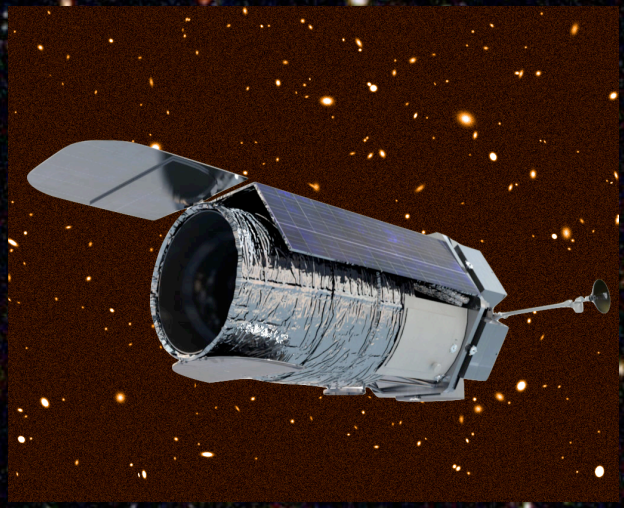
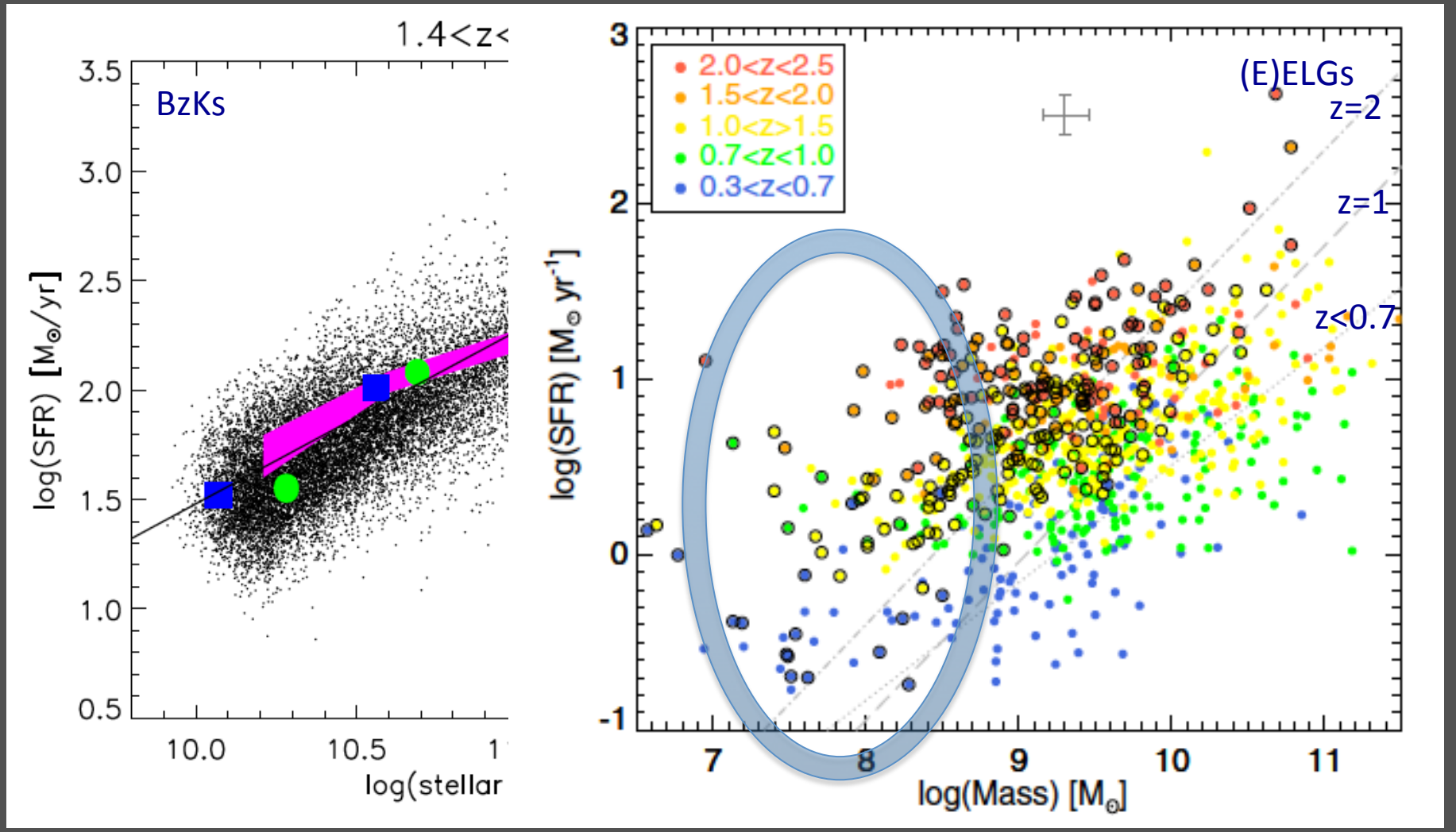


Collaborations welcome.

From HST to WFIRST
3. Insights in galaxy evolution



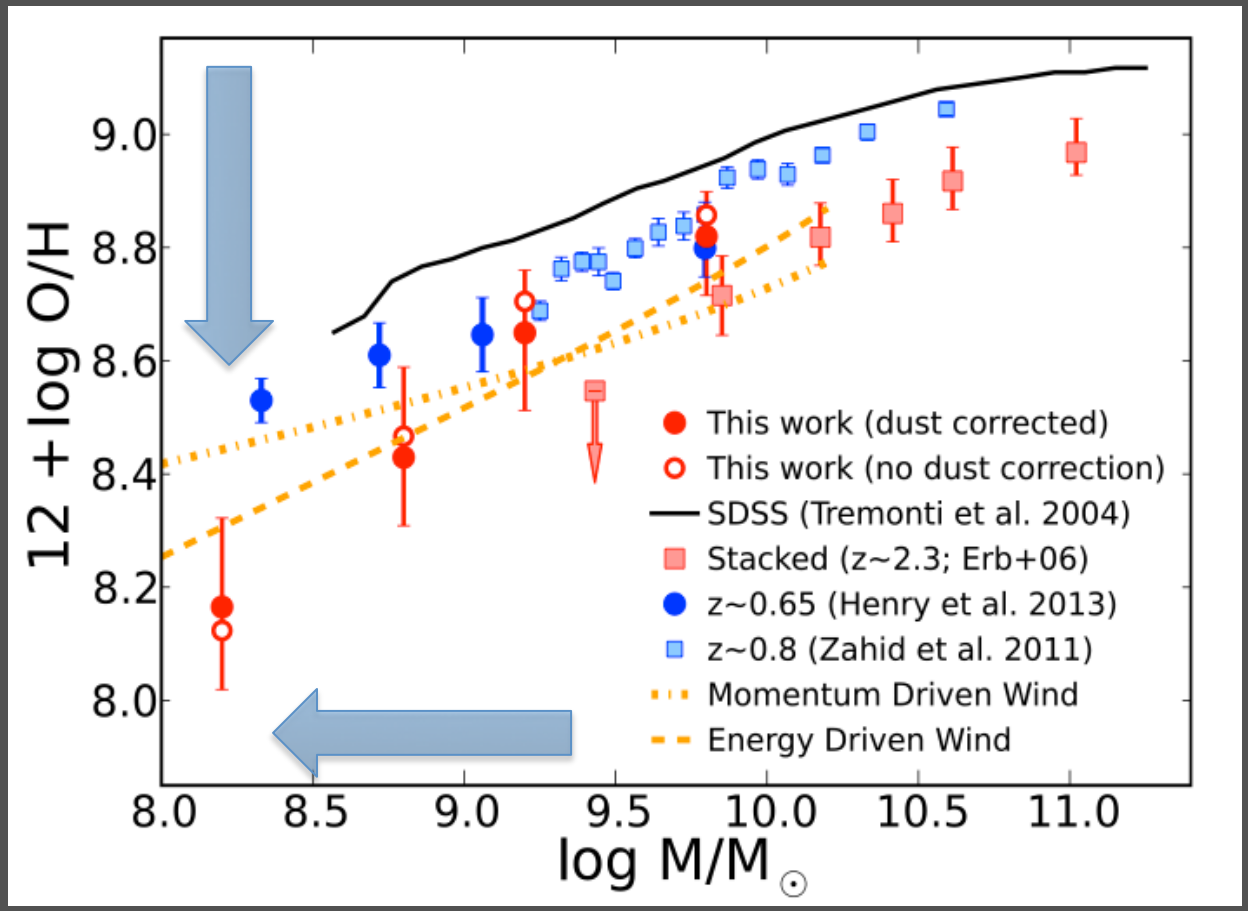
Insights on galaxy evolution from Grism Surveys: Large Dispersion (above MS) in SFR-M⋆ using Hα



e.g. Rodighiero+ 2011, 2014

Atek + 2014, ApJ, 789,96

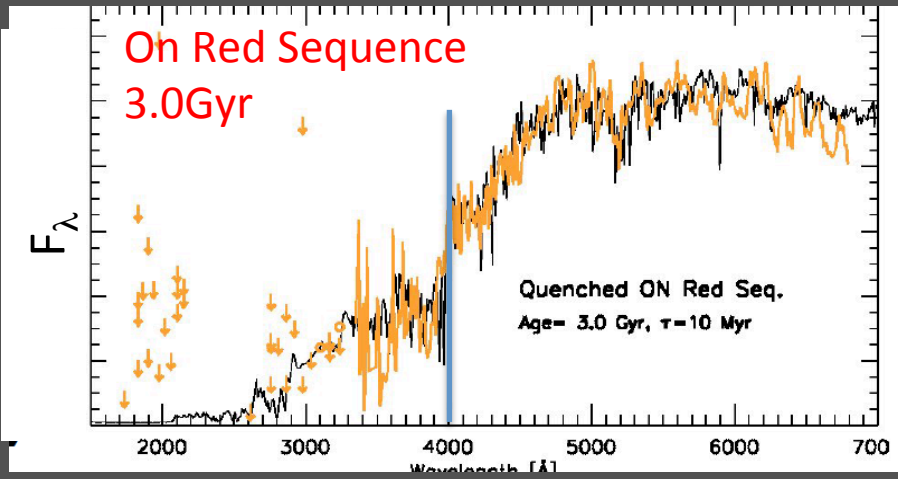
Insights on galaxy evolution from grism surveys: Dust corrected Mass–metallicity (MZ) relation at z=1.76



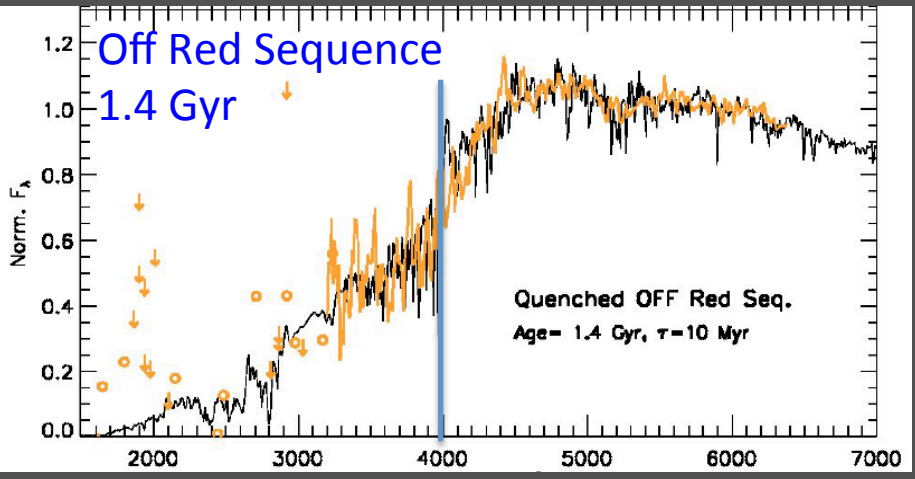
Henry + 2013, ApJ, 776L, 23
Dominguez + 2013, ApJ, 763, 145
Masters + 2014, ApJ, 785, 153

See also: Talk by A. Henry

Insights on galaxy evolution from grism surveys: Stellar age of recently quenched galaxies



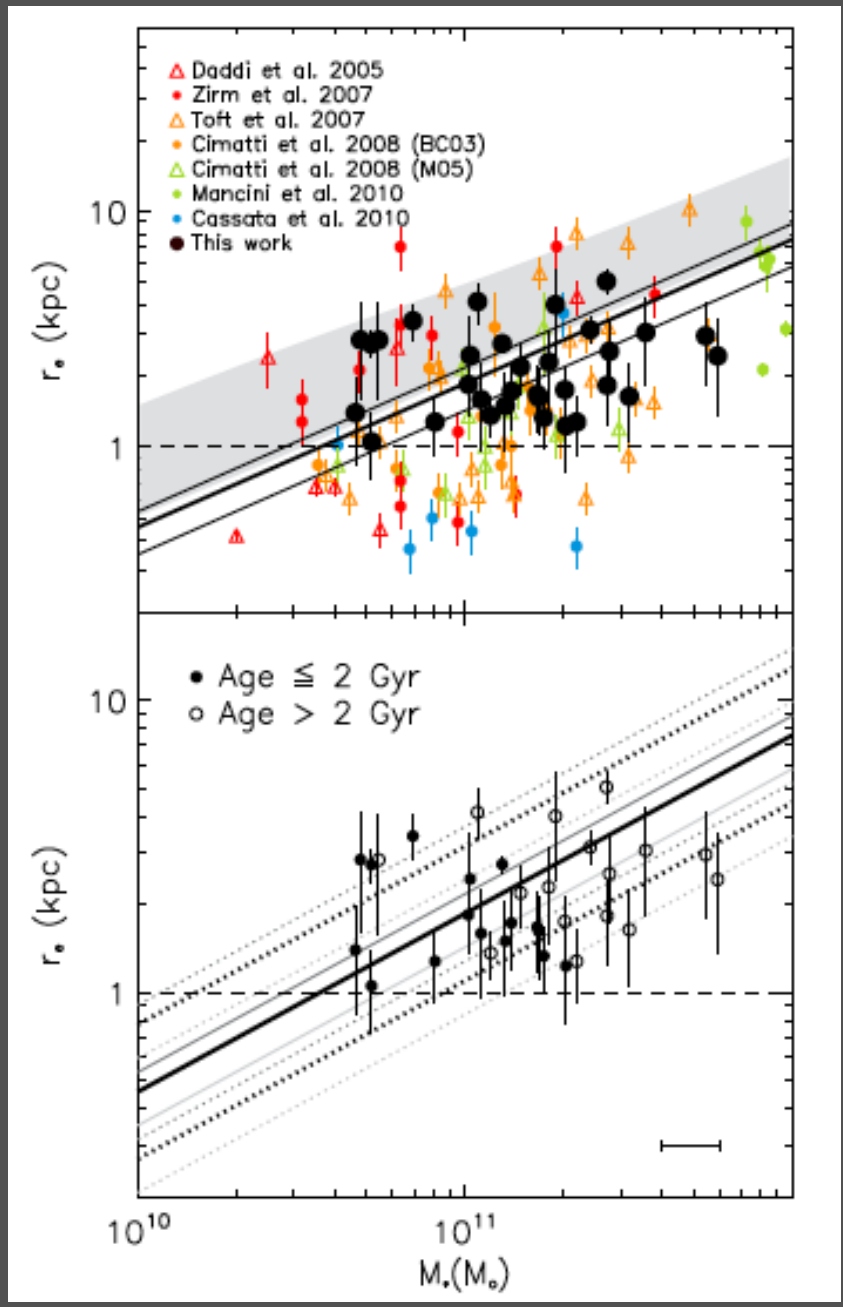
Wavelength [A]



Wavelength [A]

Bedregal + 2013, ApJ, 778, 126

Insights on galaxy evolution from grism surveys: Flat mass-size relation at z~1.6 for passive galaxies



Zanella + 2016, submitted

Poster#25 by C. Scarlata

Data available on MAST

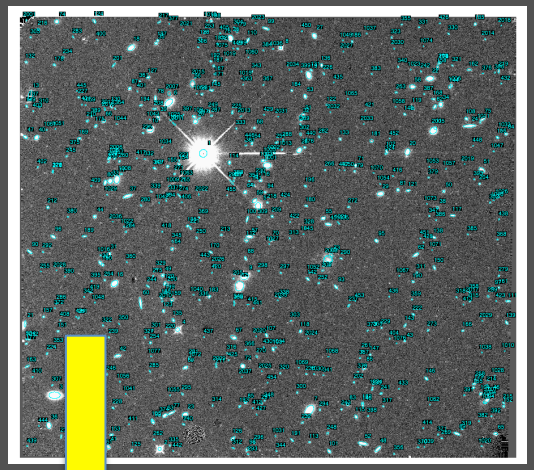
See also: Poster#16 by M. Malkan

https://archive.stsci.edu/prepds/wisp https://wisps.ipac.caltech.edu

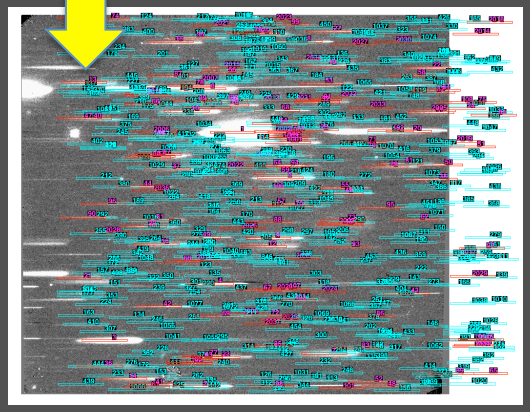
- 1D spectra + WFC3 direct imaging data

DATA PROCESSING FLOW:

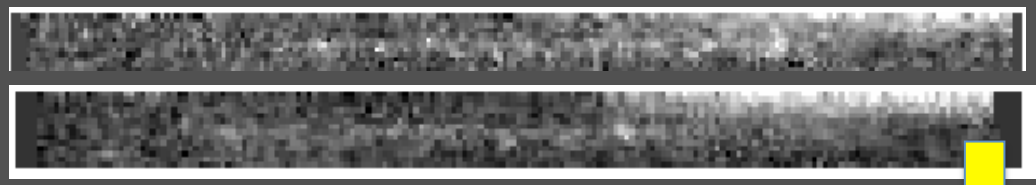
Direct image



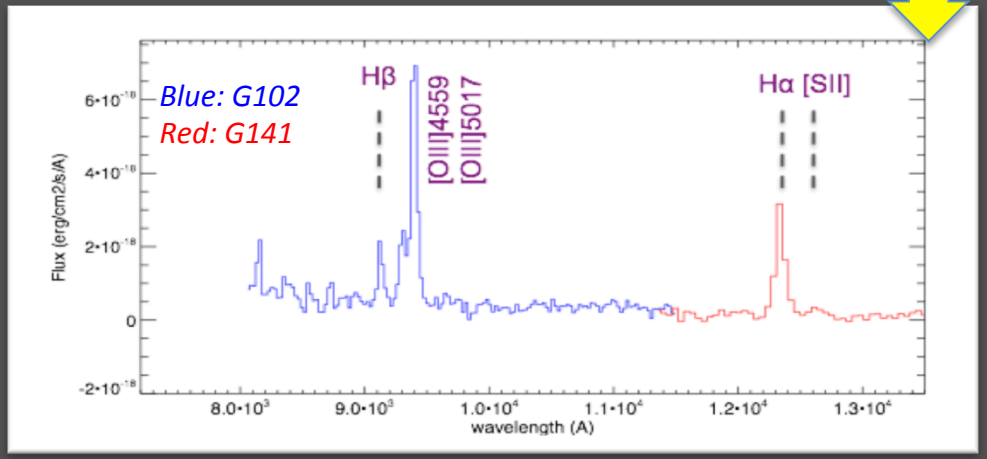
Grism image



G141 stamp



G102 stamp



Atek+2010, ApJ, 723, 104 ; Ross+2016, submitted; Dai+2016, in prep