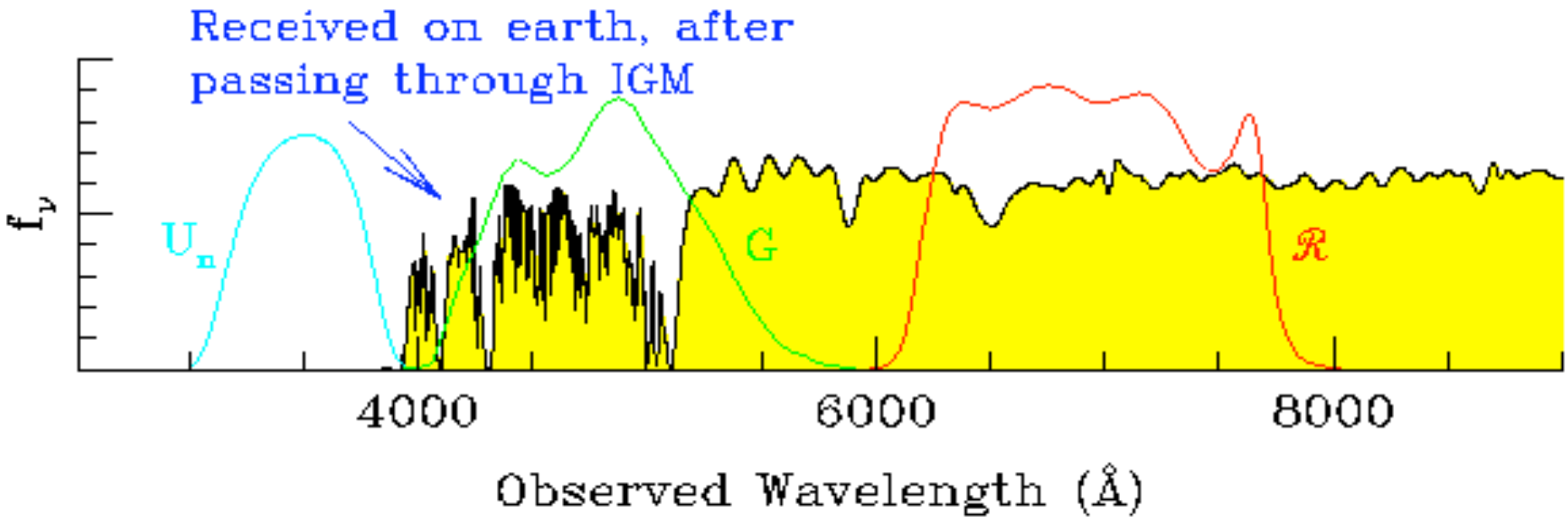
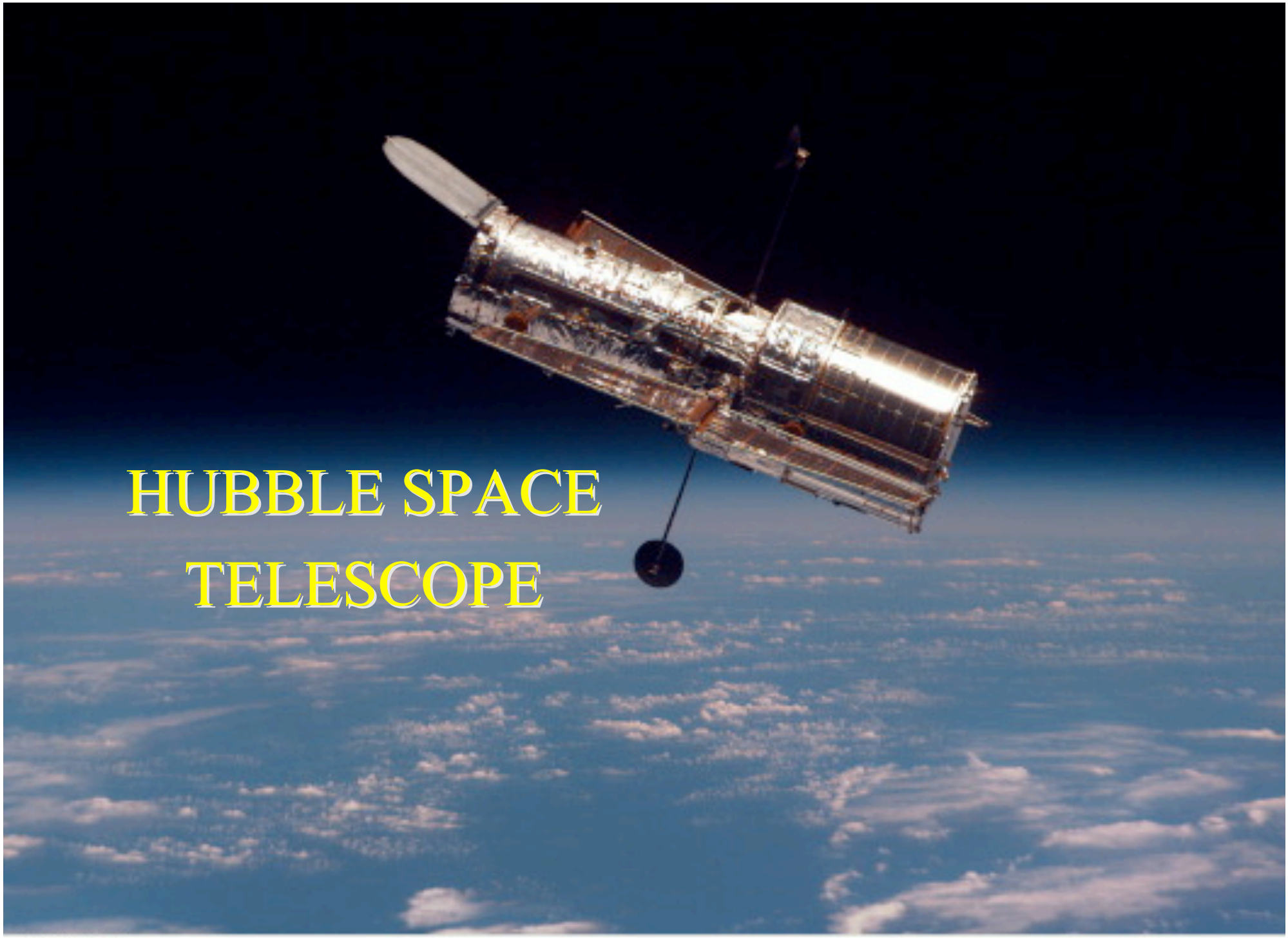
Lyman-alpha at z~6

Andy Bunker (Oxford), Elizabeth Stanway (Bristol), Richard Ellis (Caltech), Laurence Eyles (Exeter) Dan Stark, Richard McMahon (IoA)
Also: [Keck data]: Tommaso Treu, Kevin Bundy, Pat McCarthy
[Gemini data]: Karl Glazebrook, Bob Abraham and the GLARE consortium

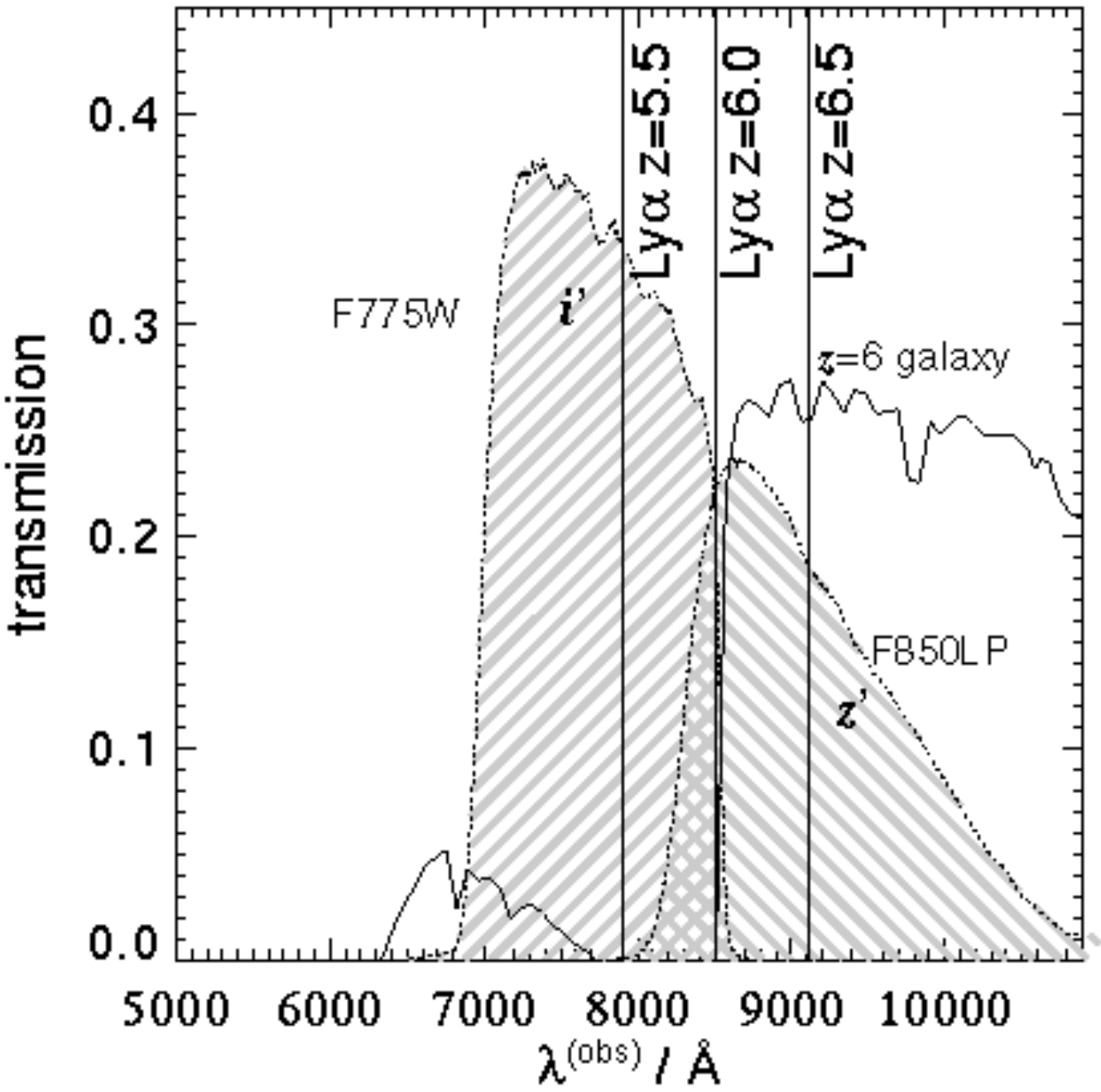


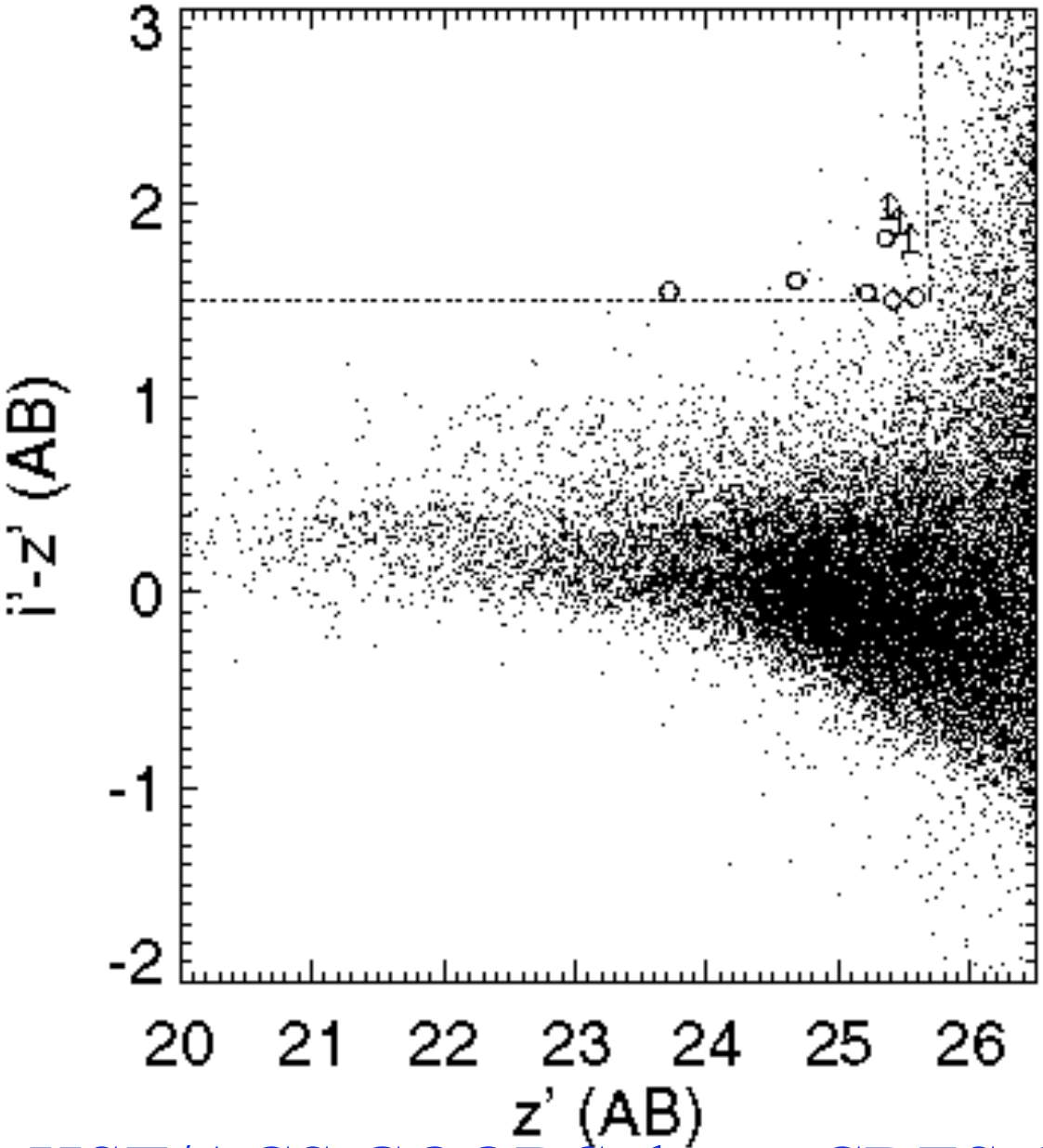
"Lyman break technique" - sharp drop in flux at λ below Ly-α. Steidel et al. have >1000 z~3 objects, "drop" in U-band.

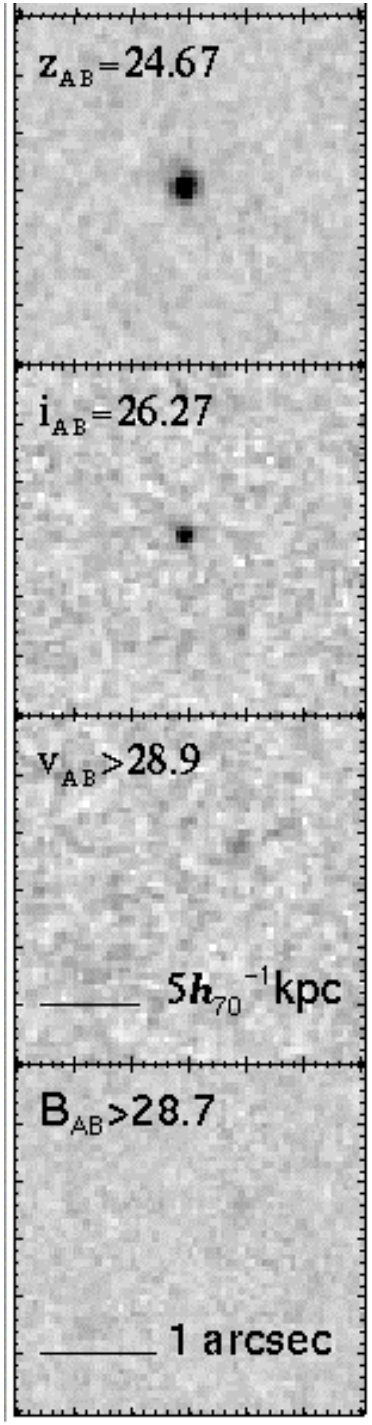

HUBBLE SPACE
TELESCOPE
9 07:06:57

"Lyman break technique" - sharp drop in flux at λ below Ly-α. Steidel et al. have >1000 z~3 objects, "drop" in U-band.

Pushing to higher redshift- Finding Lyman break galaxies at z~6 : using *i*-drops.

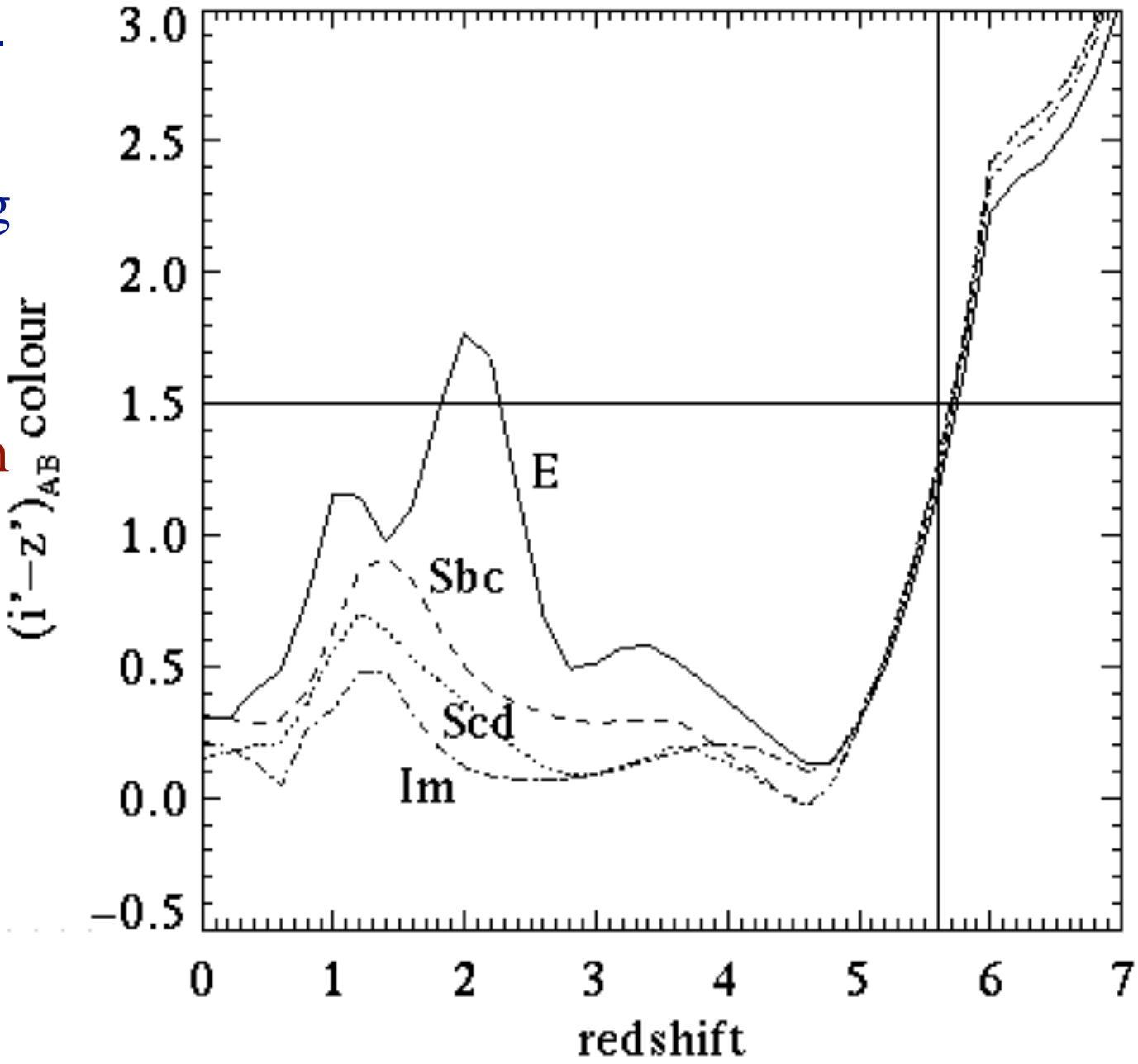






Using HST/ACS GOODS data - CDFS & HDFN, 5 epochs B,v,i',z'

By selecting on rest-frame UV, get inventory of ionizing photons from star formation. Stanway, Bunker & McMahon (2003 MNRAS) selected z-drops 5.6<z<7 - but large luminosity bias to lower z. Contamination by stars and low-z ellipticals.



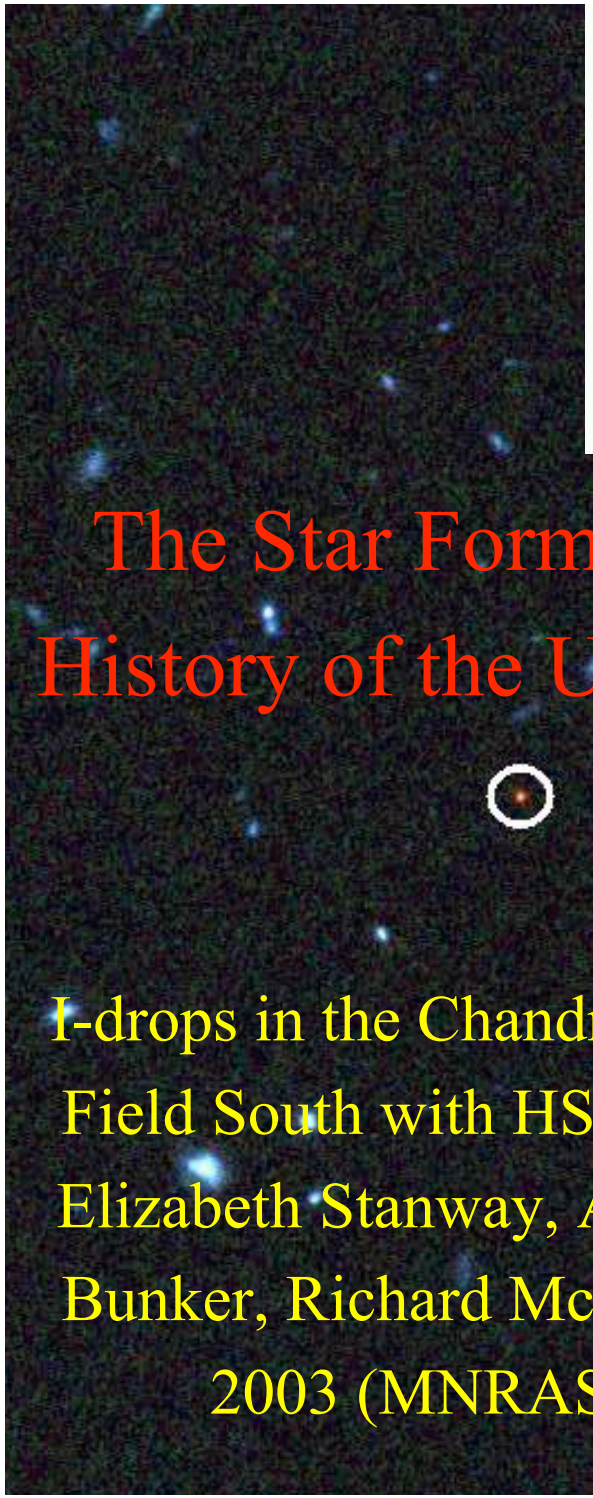

10-m Kecks


ESO VLTs


Photo©Neelon Crawford/Polar Fine Arts


8-m Gemini

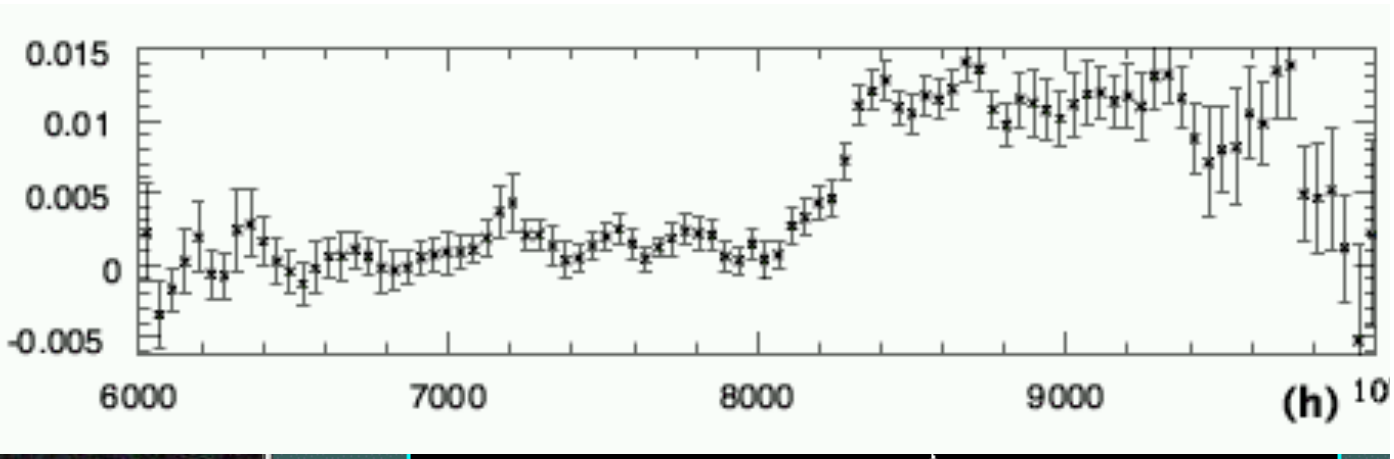
The Star Formation History of the Univese

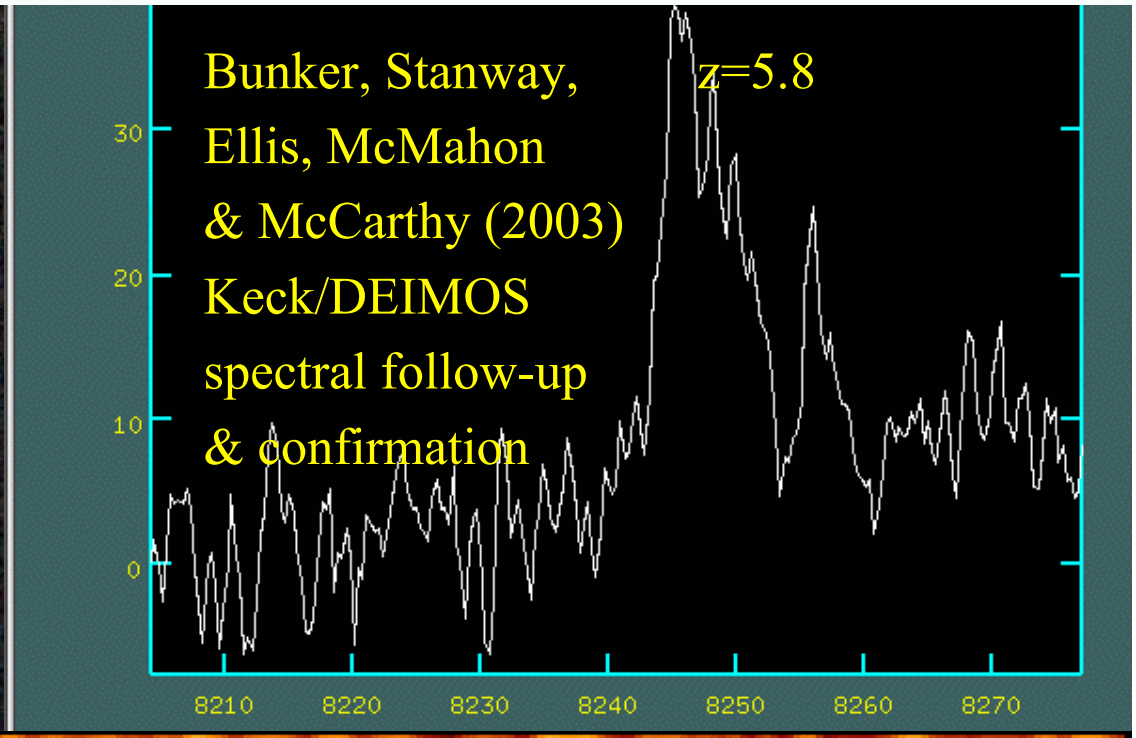


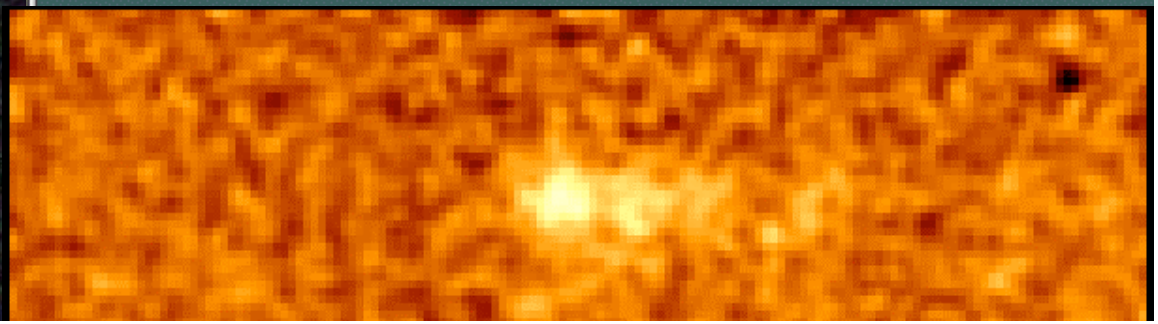
I-drops in the Chandra Deep Field South with HST/ACS

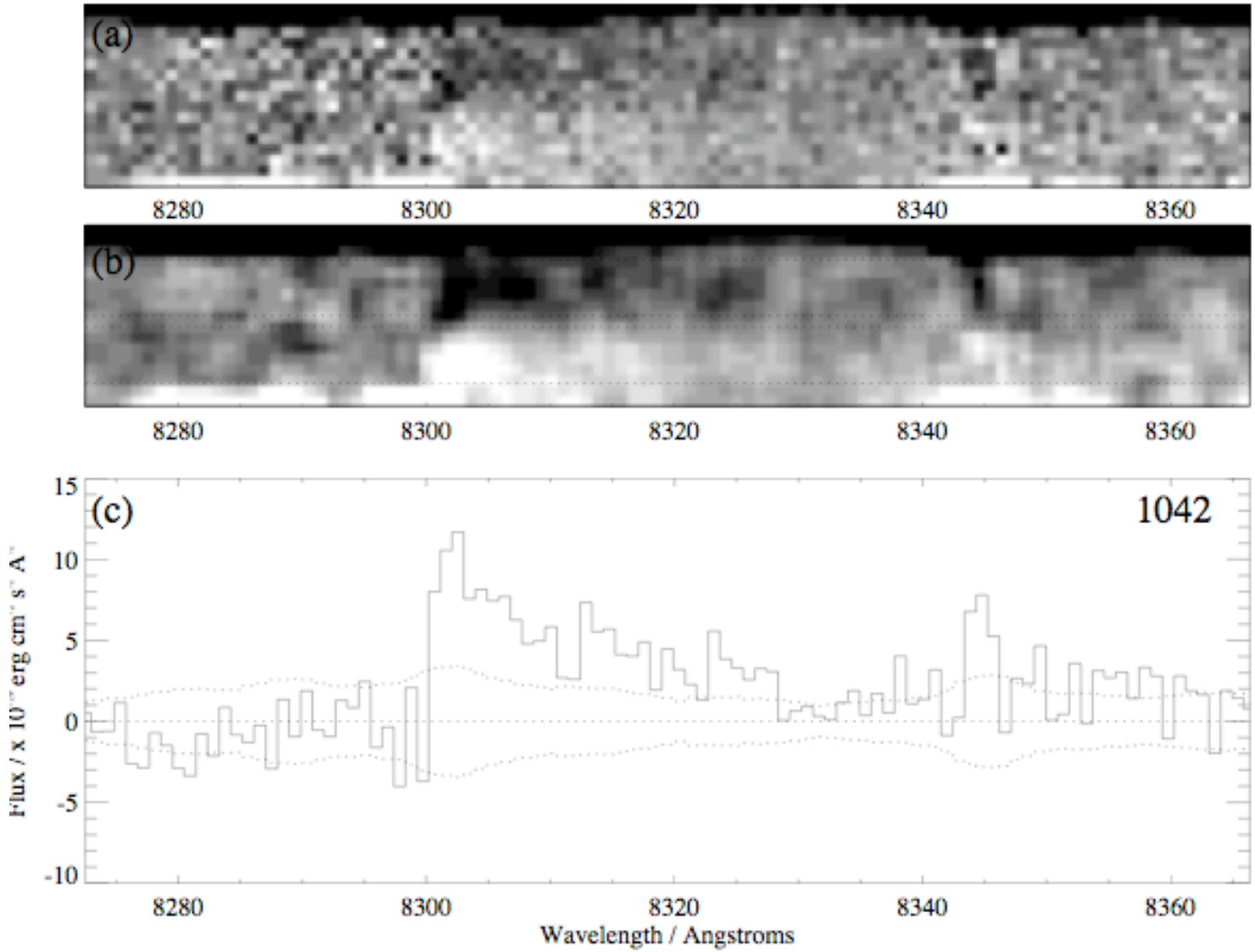
Elizabeth Stanway, Andrew Bunker, Richard McMahon

2003 (MNRAS)

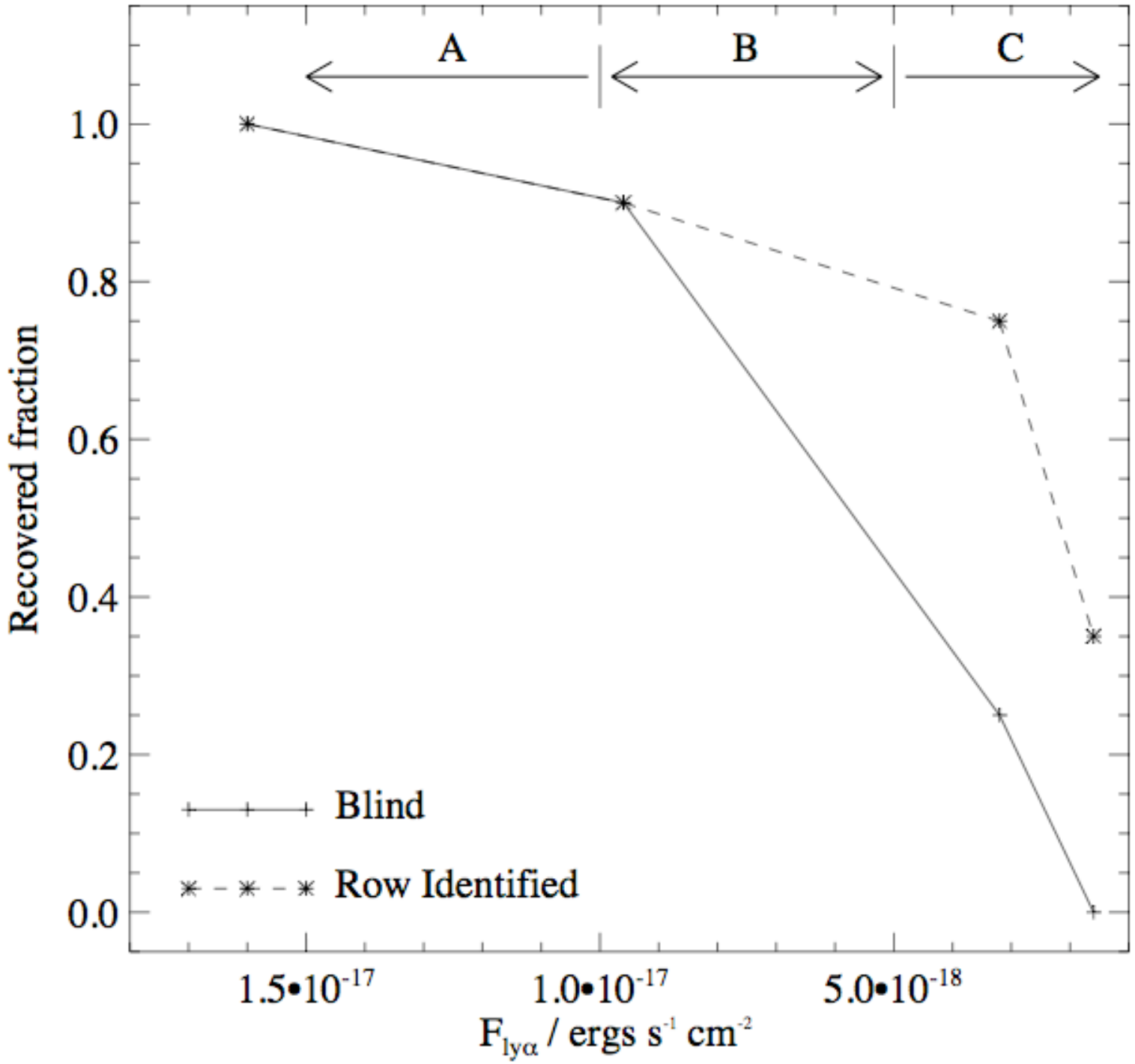


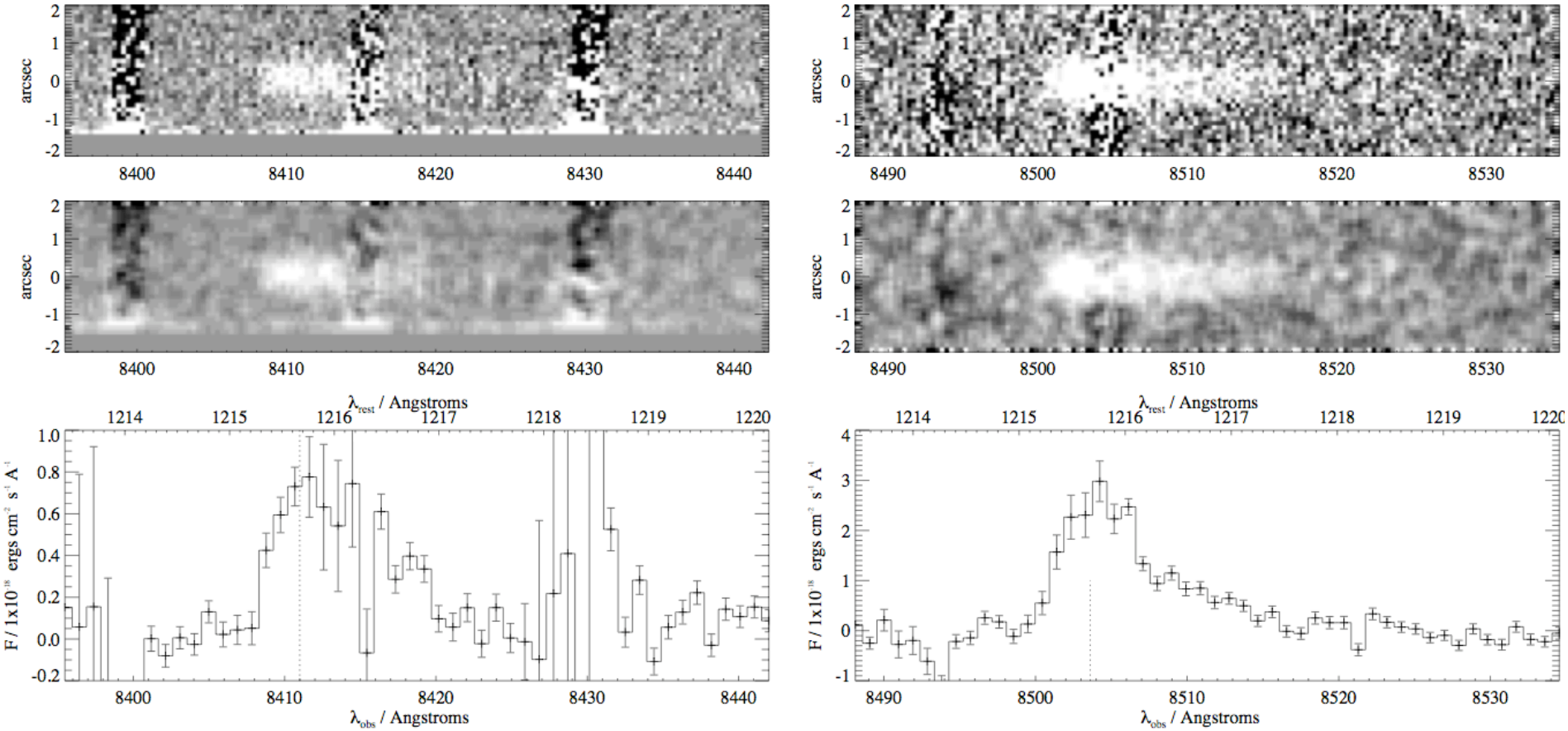


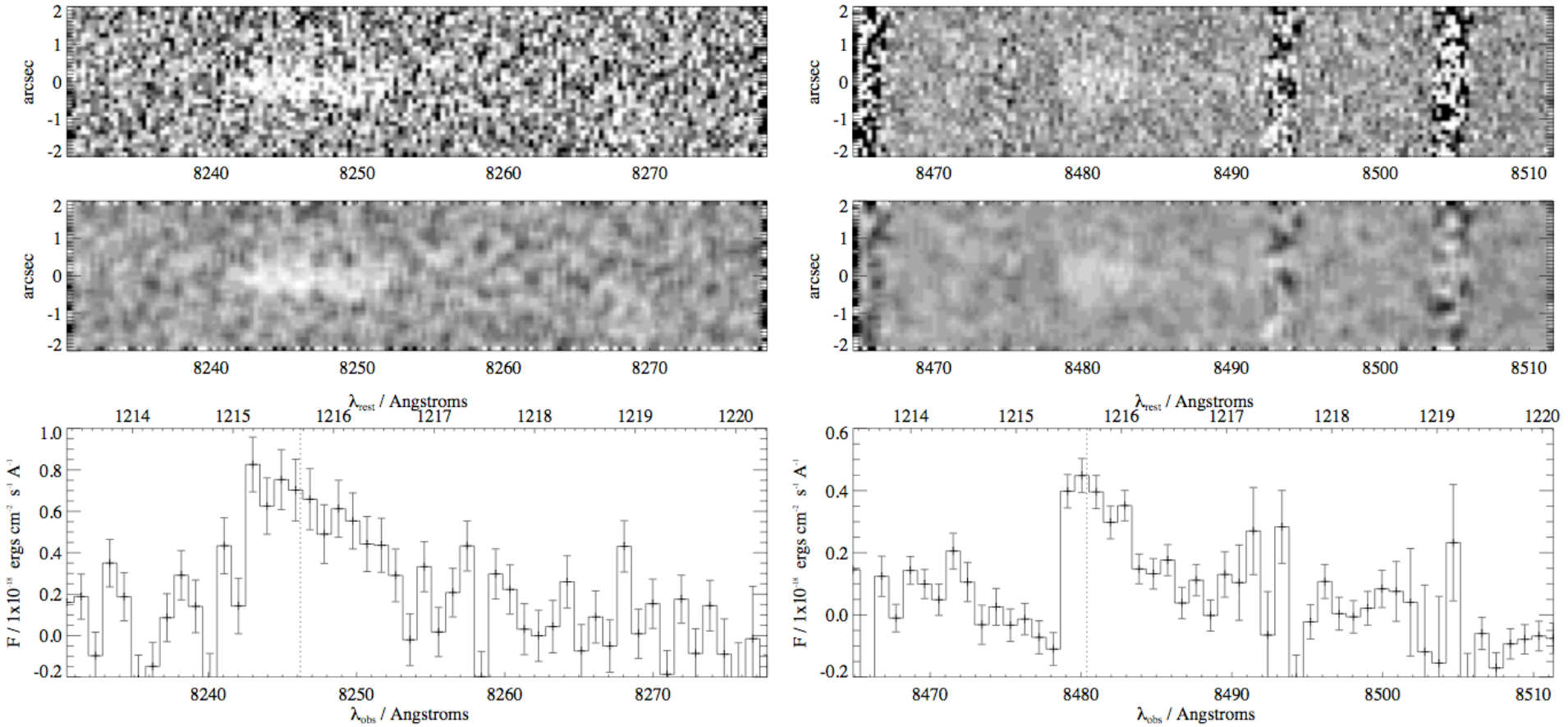


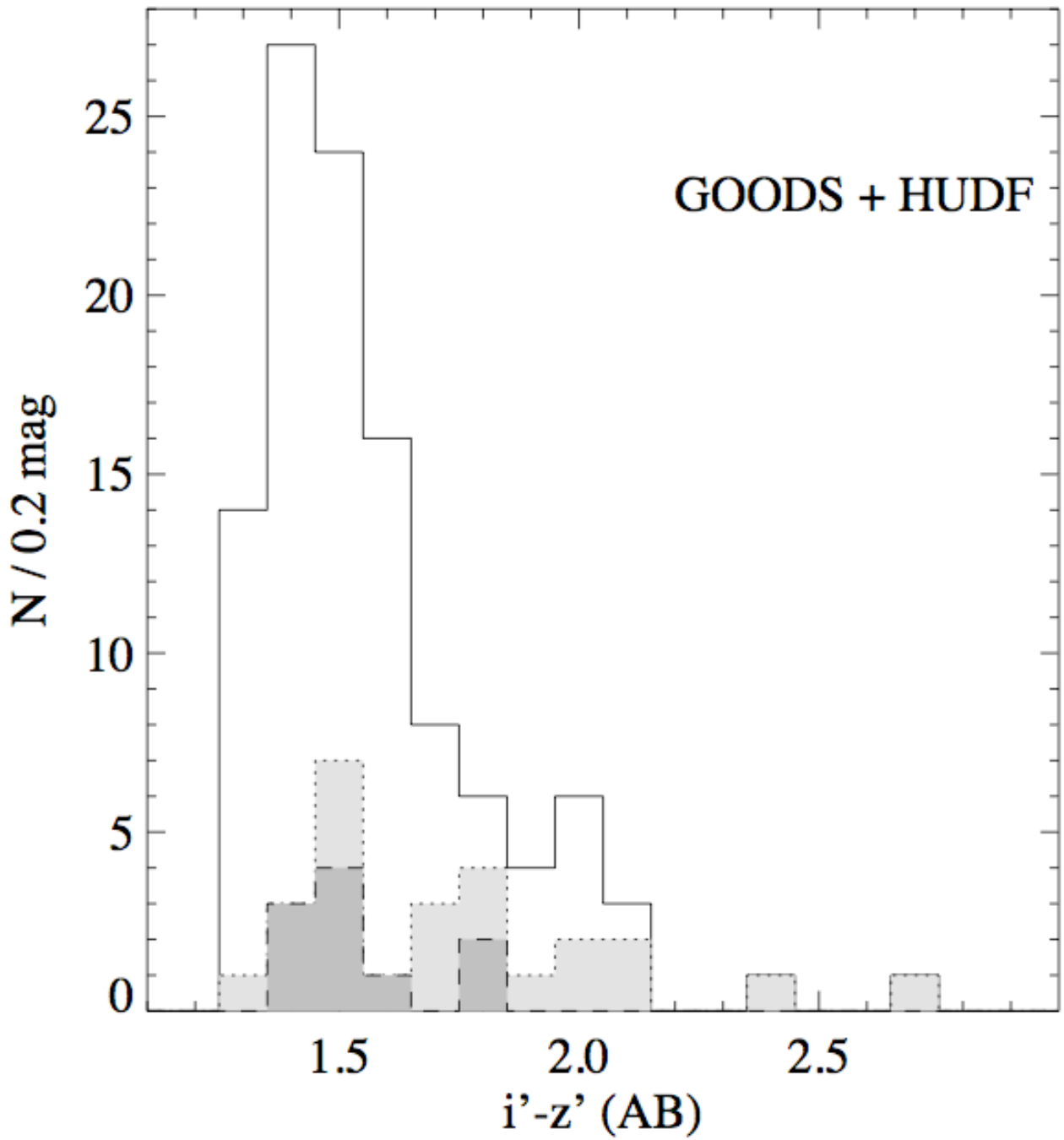


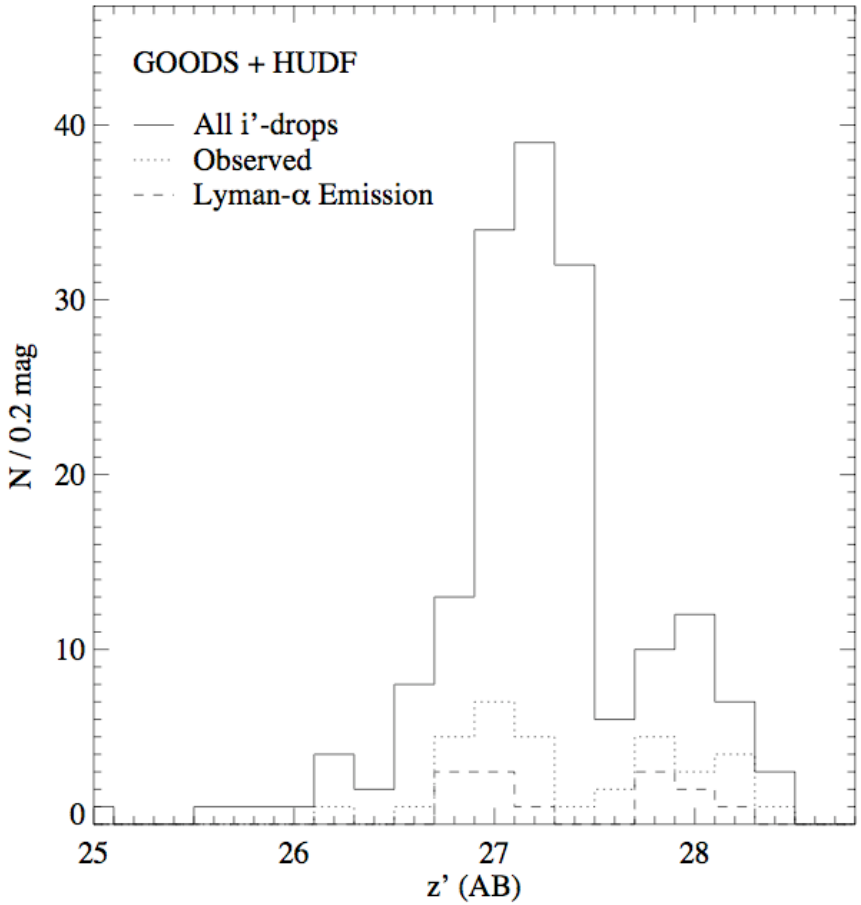
GLARE project - Stanway et al (2004, 2007)

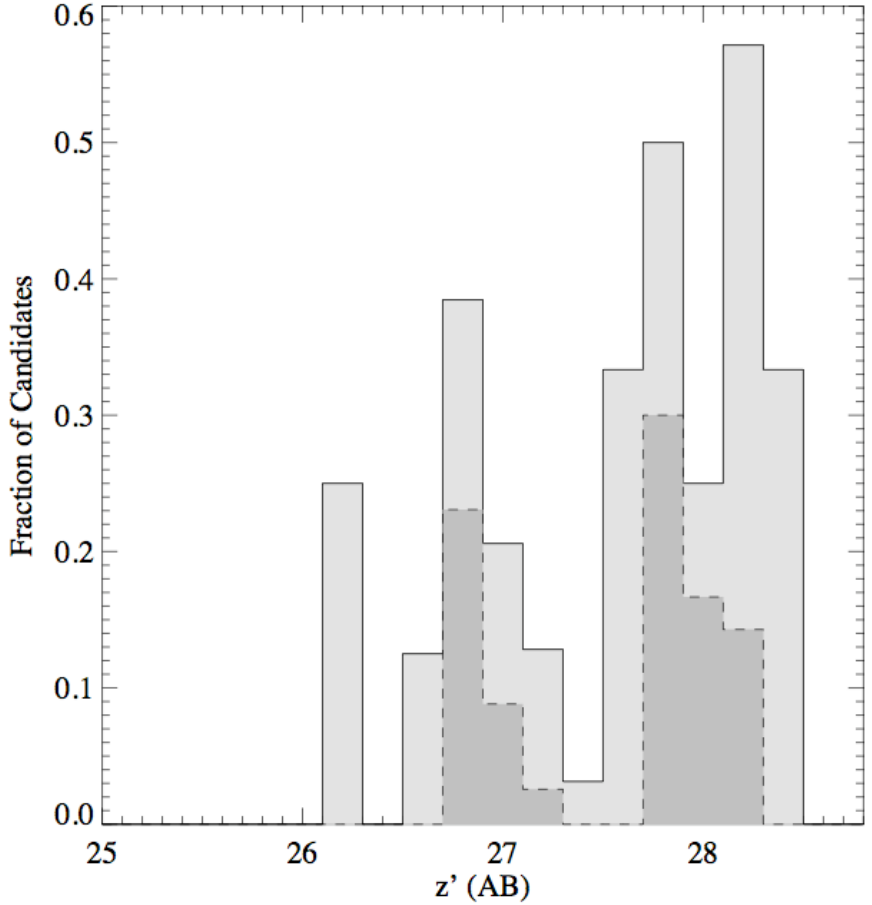

A
B
C
1.0
0.8
0.6
0.4
0.2
0.0
Recovered fraction
Blind
Row Identified
1.5•10-17
1.0•10-17
5.0•10-18
Flyα / ergs s-1 cm-2

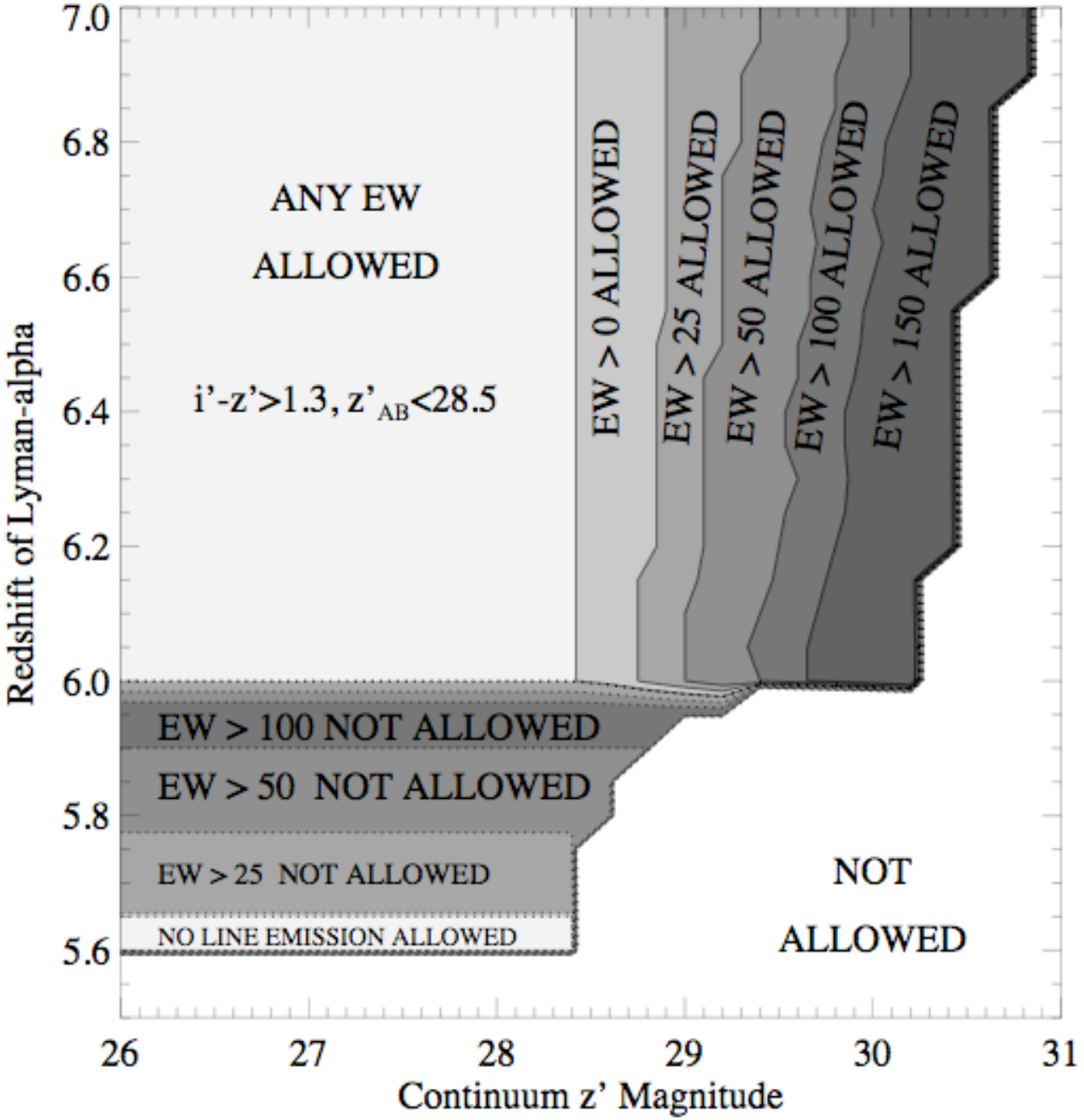

arcsec
2
1
0
-1
-2
8400
8410
8420
8430
8440
8490
8500
8510
8520
8530
λrest / Angstroms
1214
1215
1216
1217
1218
1219
1220
F / 1x10-18 ergs cm-2 s-1 A-1
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
4
3
2
1
0
-1
λobs / Angstroms

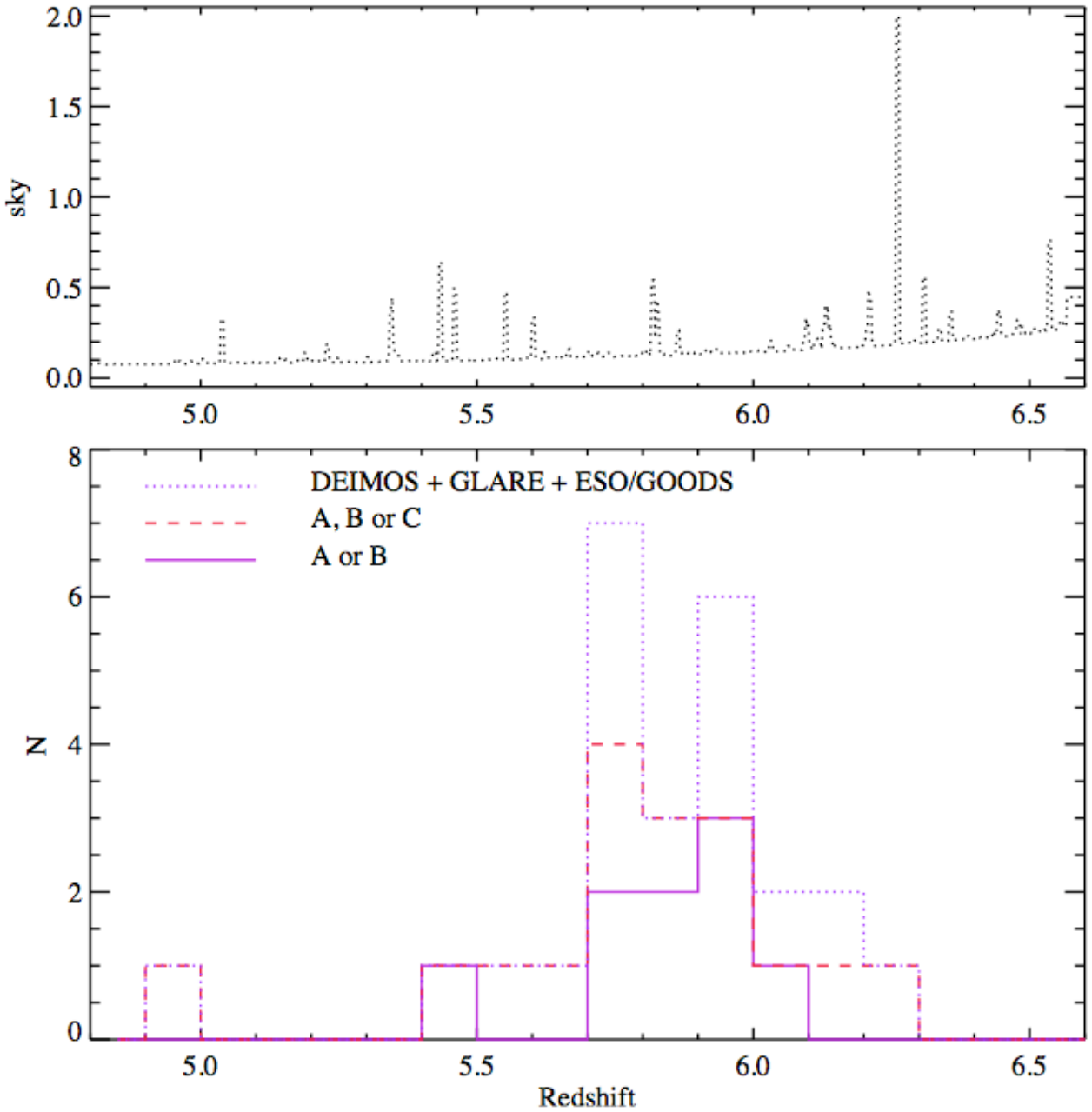

arcsec
2
1
0
-1
-2
8240
8250
8260
8270
8470
8480
8490
8500
8510
λrest / Angstroms
1214
1215
1216
1217
1218
1219
1220
F / 1x10-18 ergs cm-2 s-1 A-1
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
λobs / Angstroms

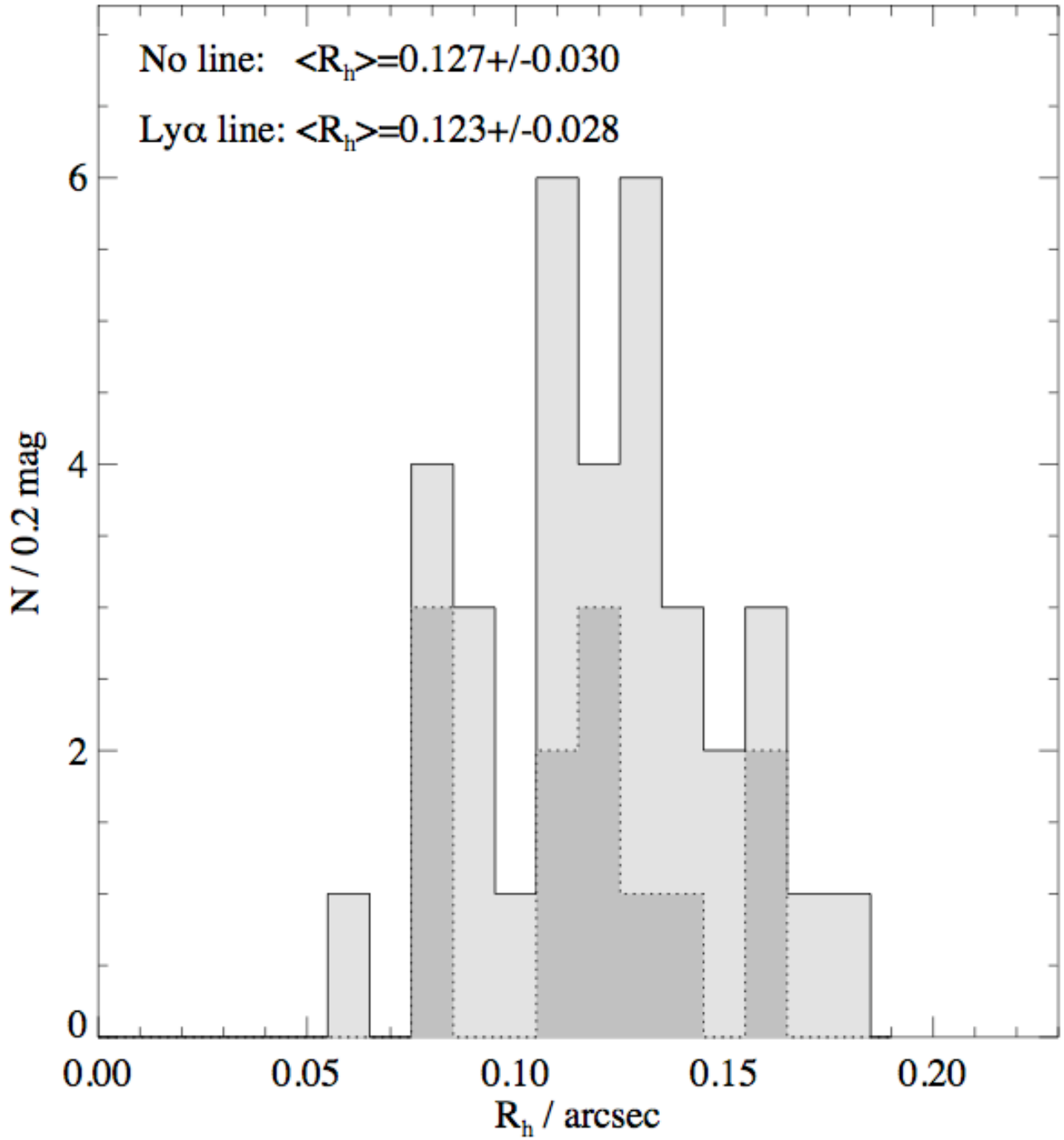

GOODS + HUDF
N / 0.2 mag
0
5
10
15
20
25
1.5
2.0
2.5
i'-z' (AB)


GOODS + HUDF
All i'-drops
Observed
Lyman-α Emission
N / 0.2 mag
z' (AB)
0
10
20
30
40
25
26
27
28


Fraction of Candidates
z' (AB)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
25
26
27
28


7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
Redshift of Lyman-alpha
26
27
28
29
30
31
Continuum z' Magnitude
ANY EW
ALLOWED
i'-z'>1.3, z'AB<28.5
EW > 0 ALLOWED
EW > 25 ALLOWED
EW > 50 ALLOWED
EW > 100 ALLOWED
EW > 150 ALLOWED
EW > 100 NOT ALLOWED
EW > 50 NOT ALLOWED
EW > 25 NOT ALLOWED
NO LINE EMISSION ALLOWED
NOT
ALLOWED


2.0
1.5
1.0
0.5
0.0
sky
5.0
5.5
6.0
6.5
8
6
4
2
0
N
DEIMOS + GLARE + ESO/GOODS
A, B or C
A or B
5.0
5.5
6.0
6.5
Redshift


No line: <R_h>=0.127+/-0.030
Lyα line: <R_h>=0.123+/-0.028
N / 0.2 mag
0
2
4
6
0.00
0.05
0.10
0.15
0.20
R_h / arcsec

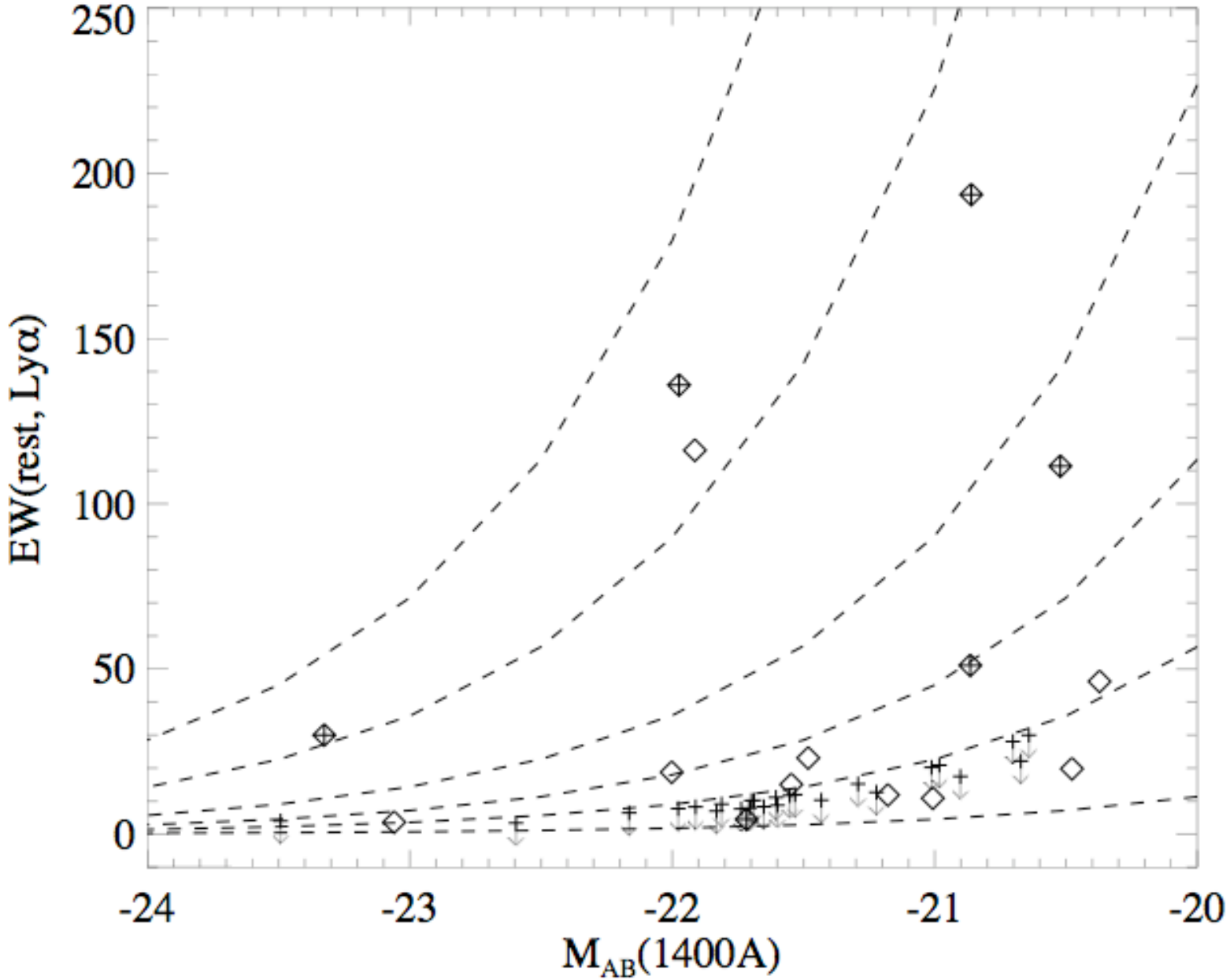
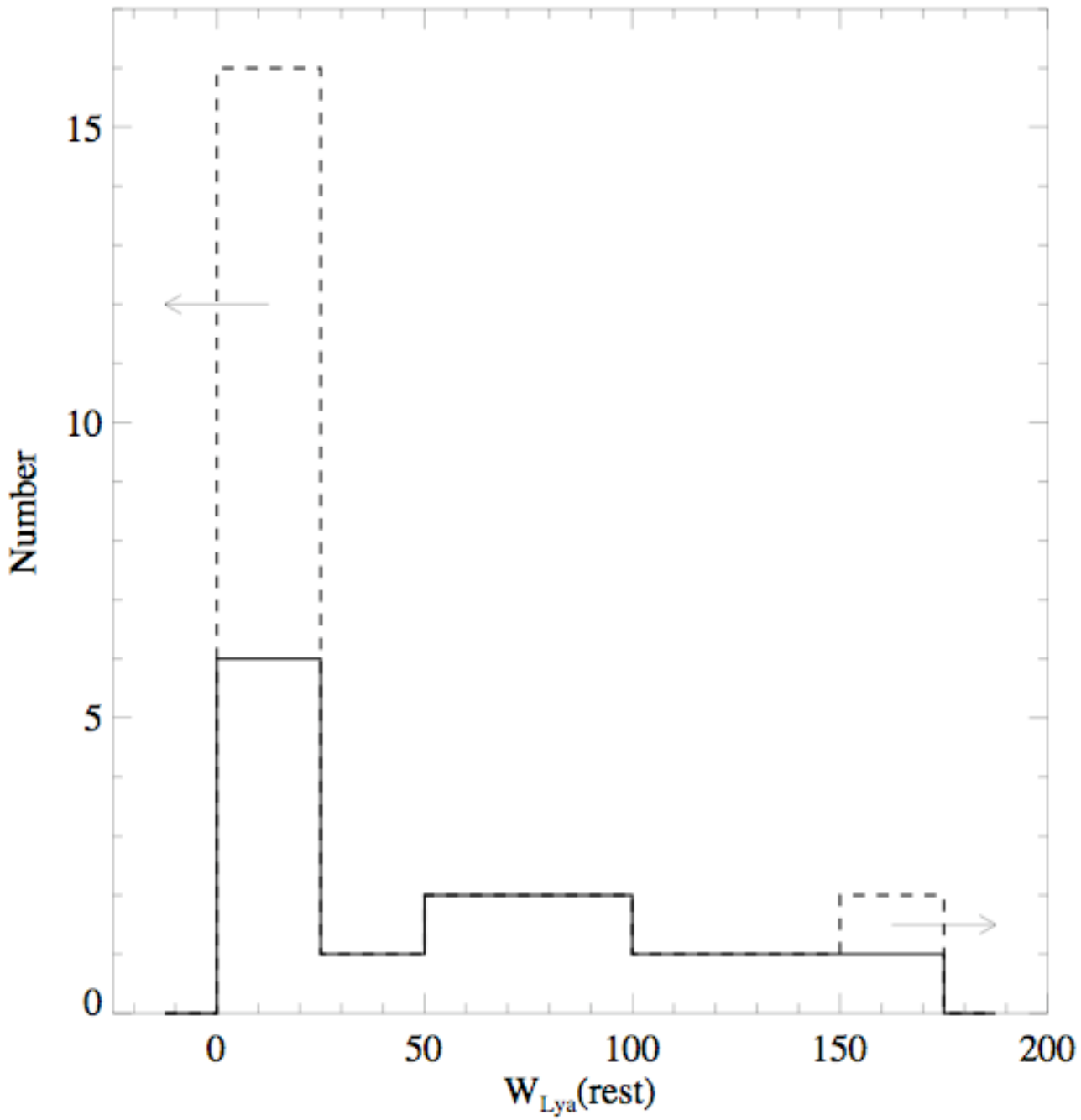


Figure 10.


15
10
5
0
Number
0
50
100
150
200
W_Lya(rest)

Conclusions (with apologies to Michael Jackson)

THRILLER - have obtained spectroscopic redshifts for some of the most distant objects (within reionization epoch), confirming Lyman-break technique selection @ z~6

BAD - selection effects at redshift boundary (effect of line contamination altering colours) and incompleteness

Higher equivalent width Lyman alpha and bluer rest-UV Colours at z~6 hints at lower metallicity, dust and perhaps a different IMF (such conclusions are DANGEROUS)

The future - near-IR spectroscopy (including JWST/NIRSpec could get Lyman-alpha at z>7, but could be compromised by Gunn-Peterson absorption (might be saved by HII ionized BUBBLES)