Looking for z>7 star-forming galaxies in lensing fields

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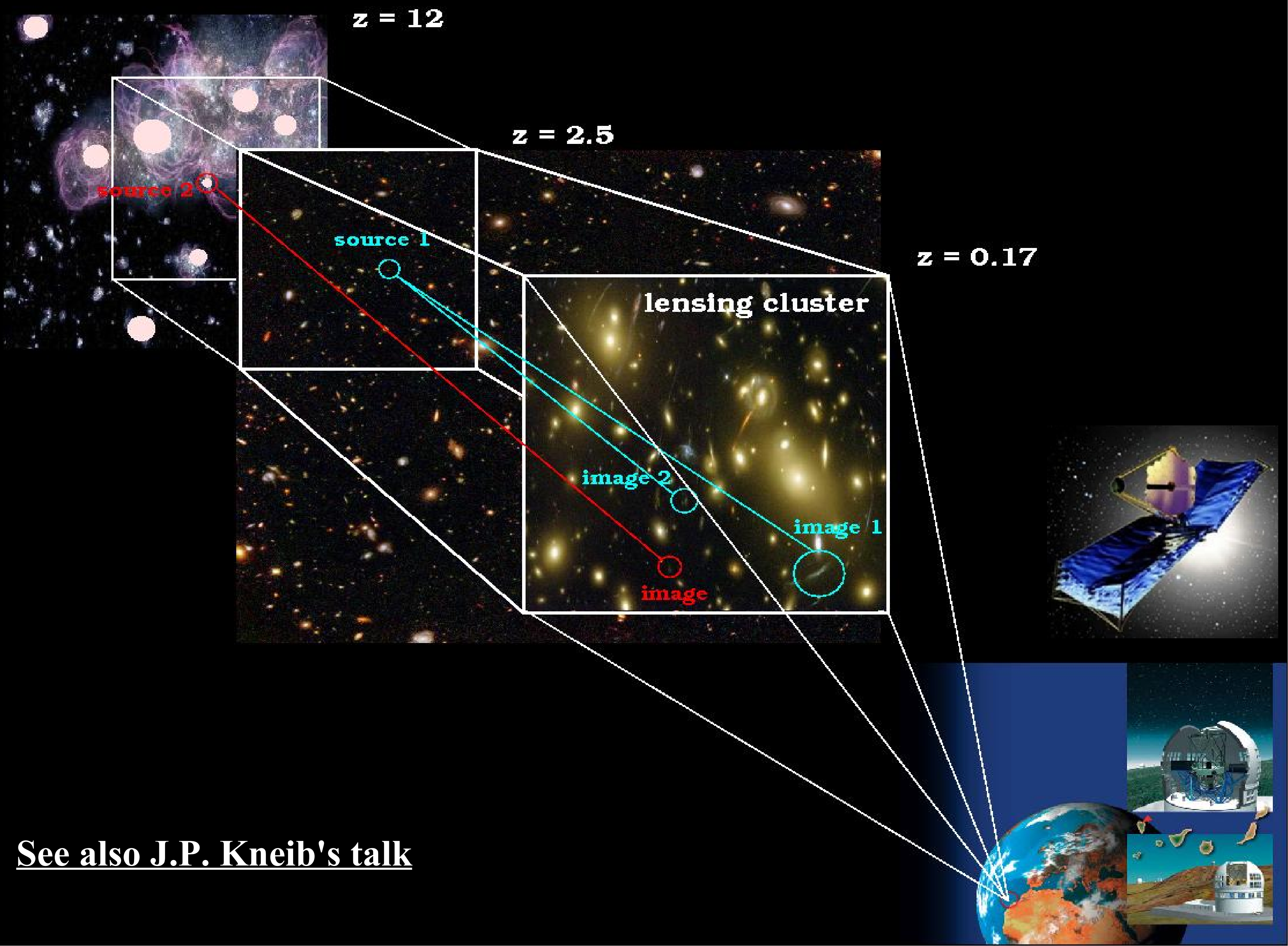


See also J.P. Kneib's talk

Outline:

1. Designing future "massive" spectroscopic surveys targeting z>~7 galaxies: a matter of efficiency.
   - Lensing or blank fields?
   - Towards an « ideal » combination of lensing clusters and blank fields.

See also A. Maizy's poster

2. Back to real life: A multi-wavelength survey of distant galaxies (z>~7) with Gravitational Telescopes.
   - Project design, results and problems.
   - Spectroscopic follow-up and multi-wavelength analysis.

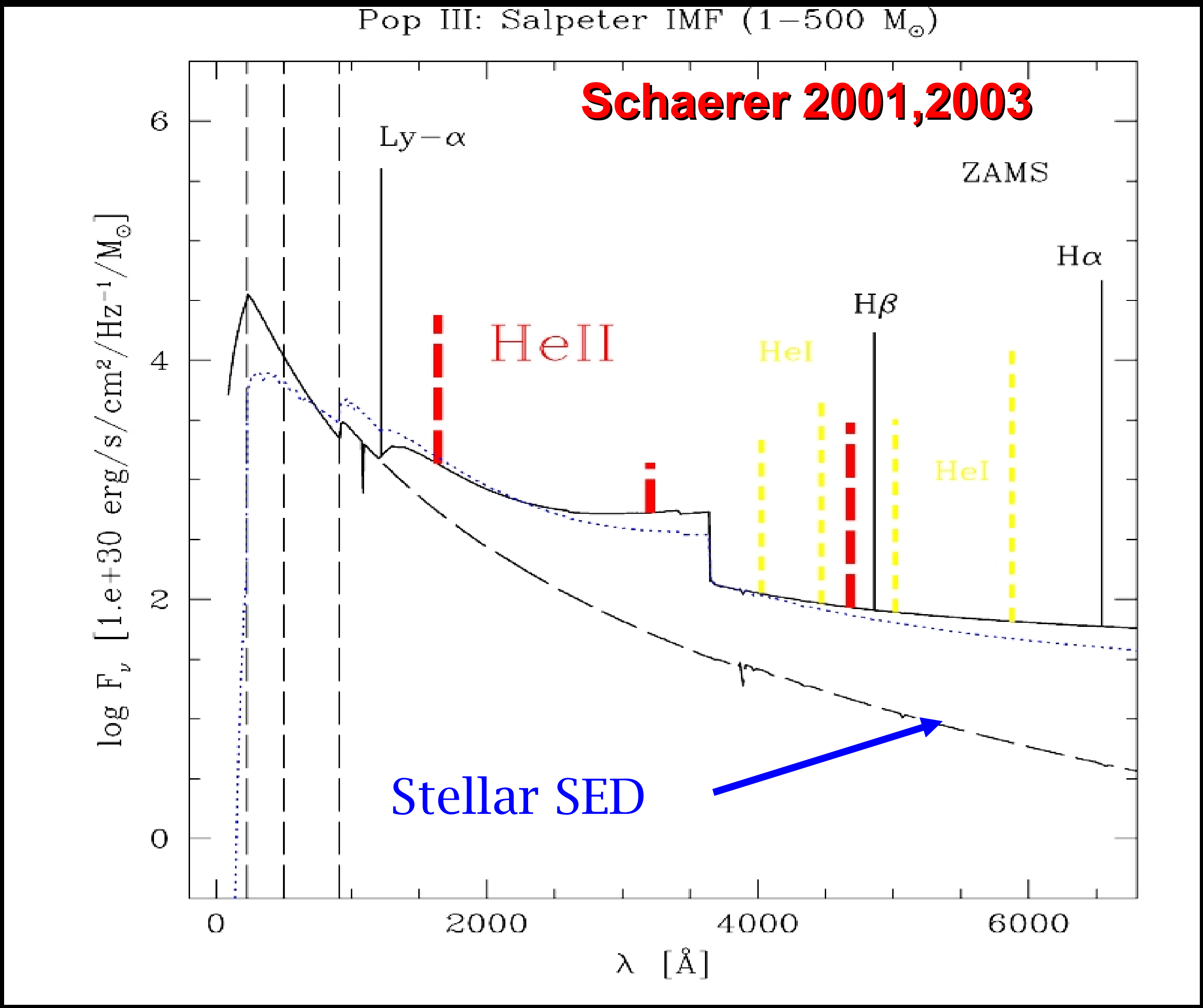
Richard et al., in preparation

Designing future "massive" spectroscopic surveys targeting z>~7 galaxies:

A matter of efficiency

Spectroscopic Observations

- Determination <u>redshift</u> and <u>nature</u> of sources
- Studying the physical properties of the firsts starbursts



- *SFR*
- *LFs ==> reionization*
- *Stellar populations*
- *<u>PopIII starbursts?</u>*

- Top - heavy IMF
- Very massive stars, up to ~500-1000 M_solar

<u>Nebular continuous emission</u> *dominates* the spectrum at λ > 1400 Å

+ Strong HeII lines?: <u>HeII</u> λ1640. HeII λ3203. HeII

<u>See D. Scharer's talk</u>

A new generation of near-IR spectrographs

- Near-IR multi-object capabilities (~20 to 60 targets) in 10m class telescopes
- Large FOV (~4' to 6' wide)
- Optimal spectral resolution: R~3000 to 6000 (large sky-free wavelength coverage)
- “Deep” Spectroscopic follow up from the ground (JWST synergy).

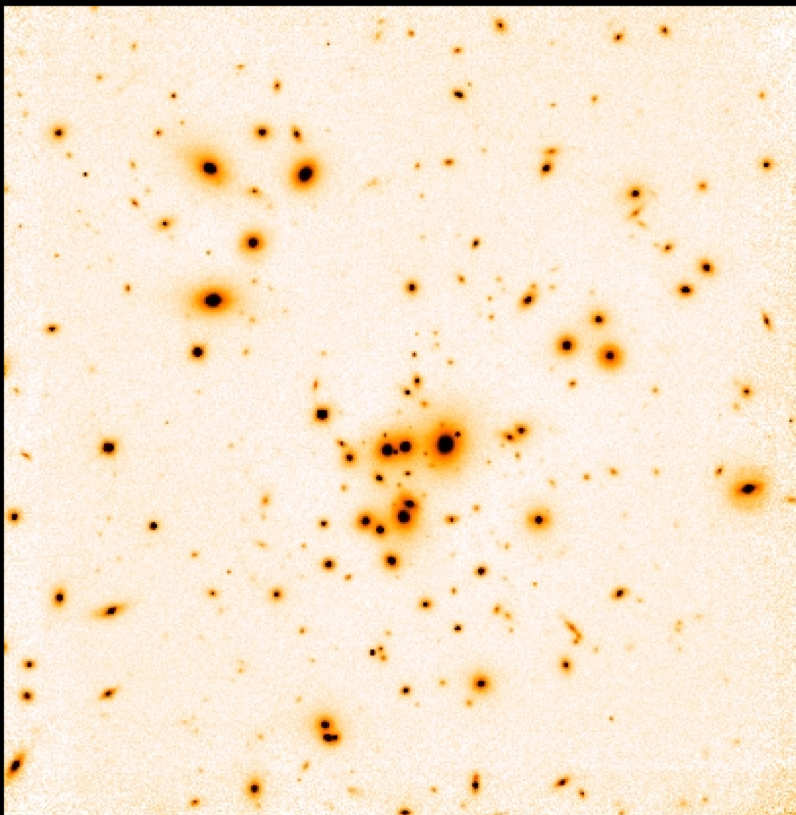
An example: EMIR/ GTC

EMIR/GOYA Survey (~2010):

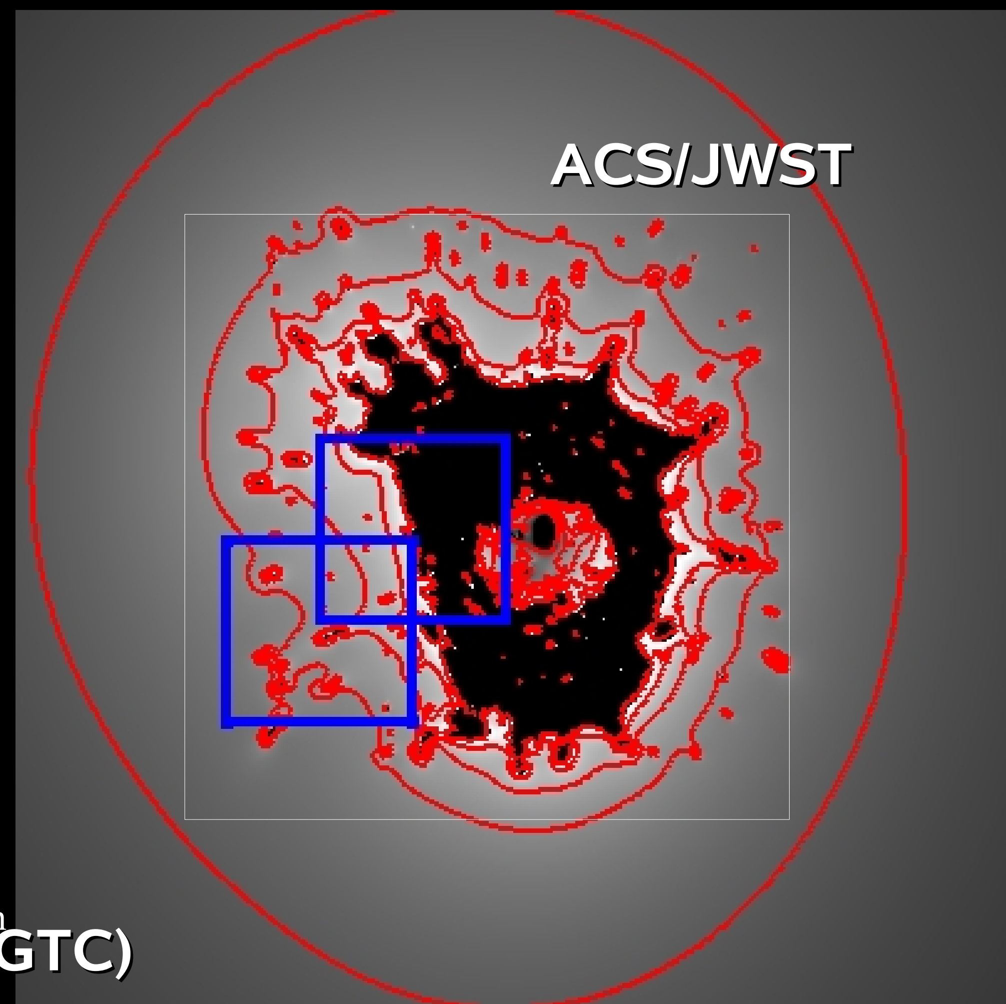
<u>Other examples:</u>
MOIRCS/Subaru (in HR mode) – Flamingos2/Gemini-S – KMOS/VLT 2nd generation

http://www.astro.ufl.edu/GOYA/home.html

Blank Fields versus lensing fields



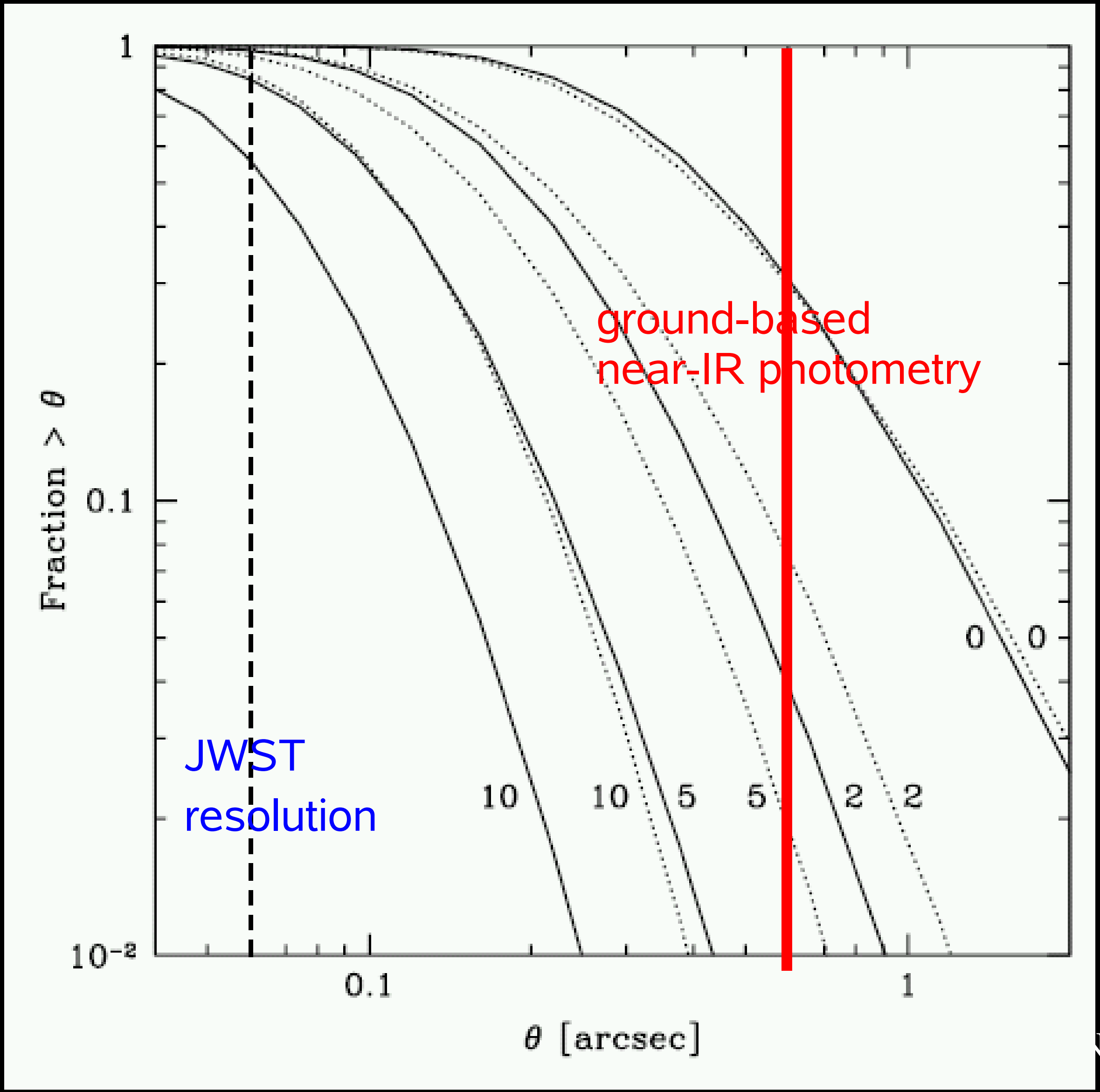
- Example: A1689 (z(cluster)=0.184)
- *Lenstool* modeling of cluster mass distribution
- Magnification (z(source)=6): 2, 5, 10, 25



FOV (1'x1')
NICMOS-NIC3

6' x 6' FOV
(e.g. EMIR/GTC)

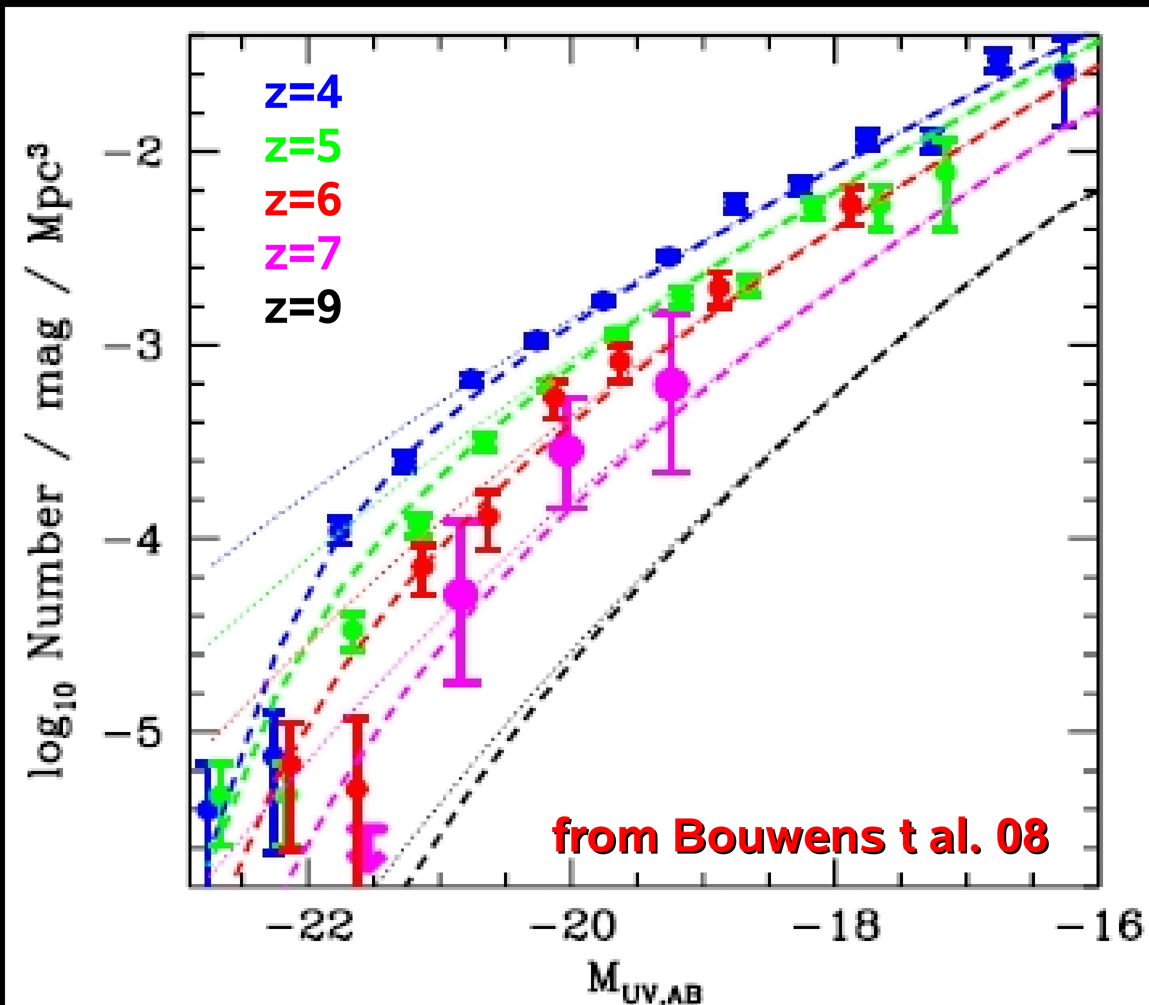
Blank Fields versus lensing fields



- Distribution of disk sizes in ΛCDM model.
- Diameter measured out to one exponential scale length.
- Limiting point-like source flux of 1nJy.
- Most z~10 sources are expected to remain non-resolved, even with a magnification factor μ~10.

From Barkana & Loeb 2000

Deriving Expected Number counts



- Deriving expected number counts from realistic/observed UV LFs at 6 < z < 12.
- Comparison between expected N(z,m) in blank & lensing fields
- Pixel-to-pixel integration of <u>magnification maps</u>, using lensing models and bright-objects masking.

$< z >= 4.0$	$\alpha = 1.6,$	$\phi^* = 1.3\ 10^{-2} \mathrm{Mpc}^{-3},$	$M^* = -21.07$	Steidel et al. (1999)
$< z >= 5.9$	$\alpha = 1.74,$	$\phi^* = 1.1\ 10^{-3}\ \mathrm{Mpc}^{-3},$	$M^* = -20.24$	Bouwens et al. (2006)
$3.8 < z < 7.4$	$\alpha = 1.74,$	$\phi^* = 1.1\ 10^{-3}\ \mathrm{Mpc}^{-3},$	$M^* = -21.02 + 0.36\,(z - 3.8)$	Bouwens et al. (2008)

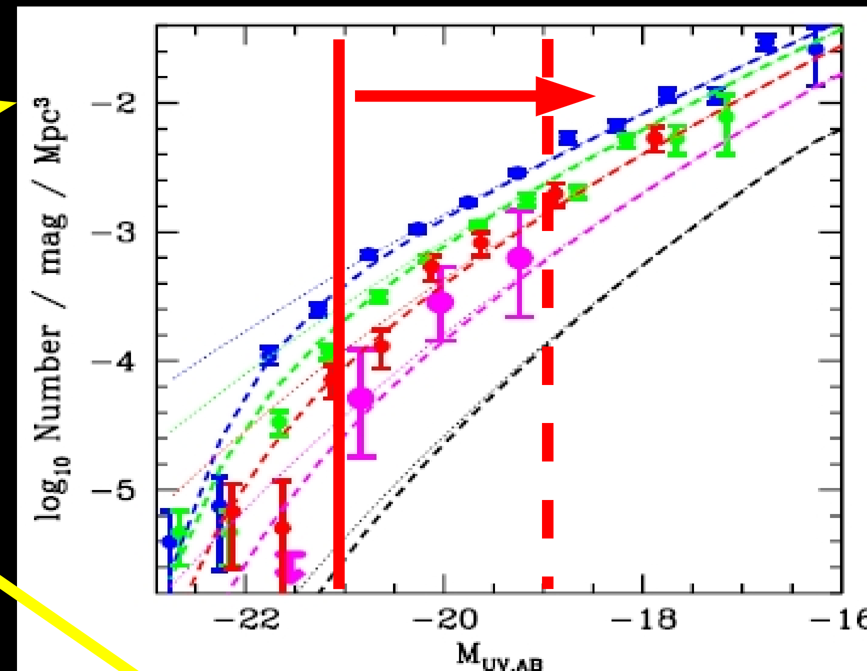
Deriving Expected Number counts

- 2 <u>opposite</u> lensing effects:

  magnification (μ(z))

  and ***dilution*** (1/ μ(z)):

  $N_{lensing}(>L,z) = N(>L/\mu\ ,\ z) \,/\, \mu(z)$



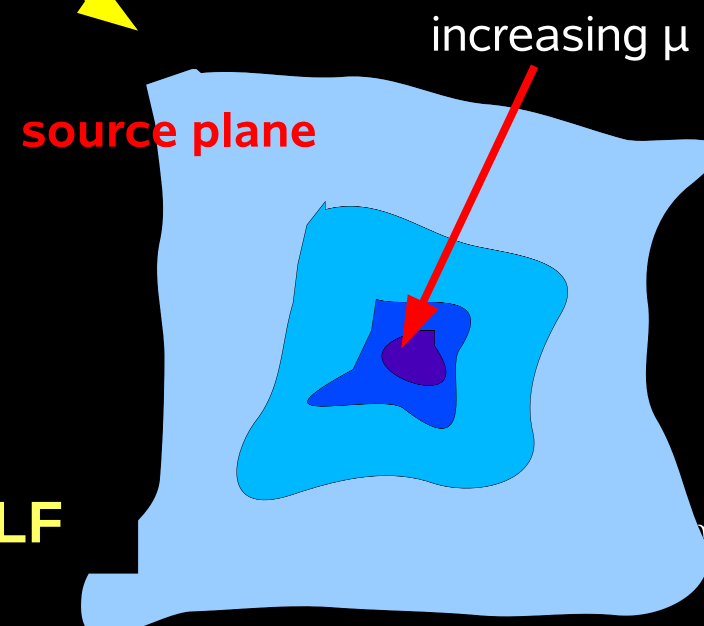
- <u>Positive/negative</u> magnification bias (e.g. Broadhurst et al. 95):

$$N_{lensed}(>\ L)\ =\ N(>\ L)\ \times\ \mu^{\alpha-1}$$

with

$$\alpha = -d(logn)/d(logL)$$

i.e. α > 1 => N(lensing) > N(blank field)



Number counts are highly sensitive to α ===> comparison between N(lensing) and N(blank) helps constraining the faint end of LF

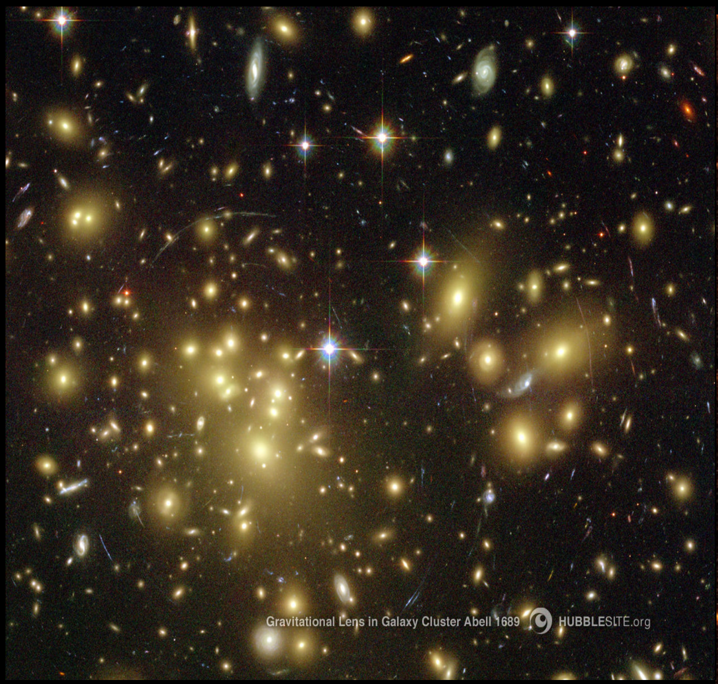
Deriving Expected Number counts

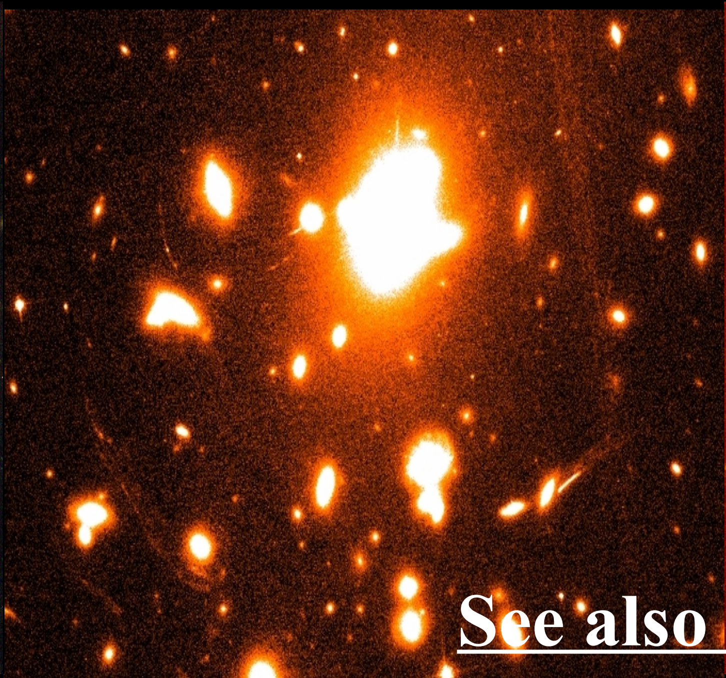
- 3 “reference” lensing clusters: A1689 (z=0.184), A1835 (z=0.25), and AC114 (z=0.310)
- *Lenstool* lensing models

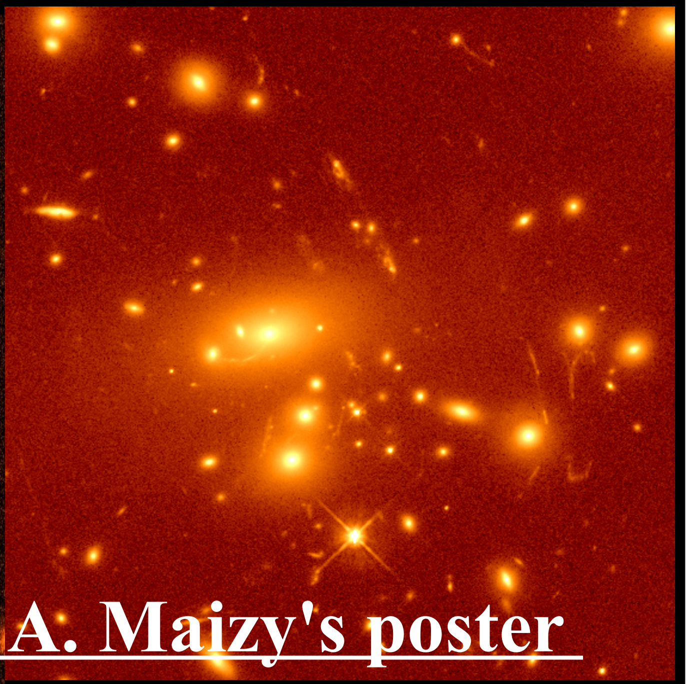
- cluster scale mass component

- galaxy scale mass component

	A1689	A1835	AC114
Large scale components			
r_{core} kpc	90.02	50.00	97.04
r_{cut} kpc	1930.35	1000.00	2226.30
v_{disp} km/s	1334.31	1210.00	1035.98
z_c	0.184	0.253	0.310
Number of substructures	266	90	28



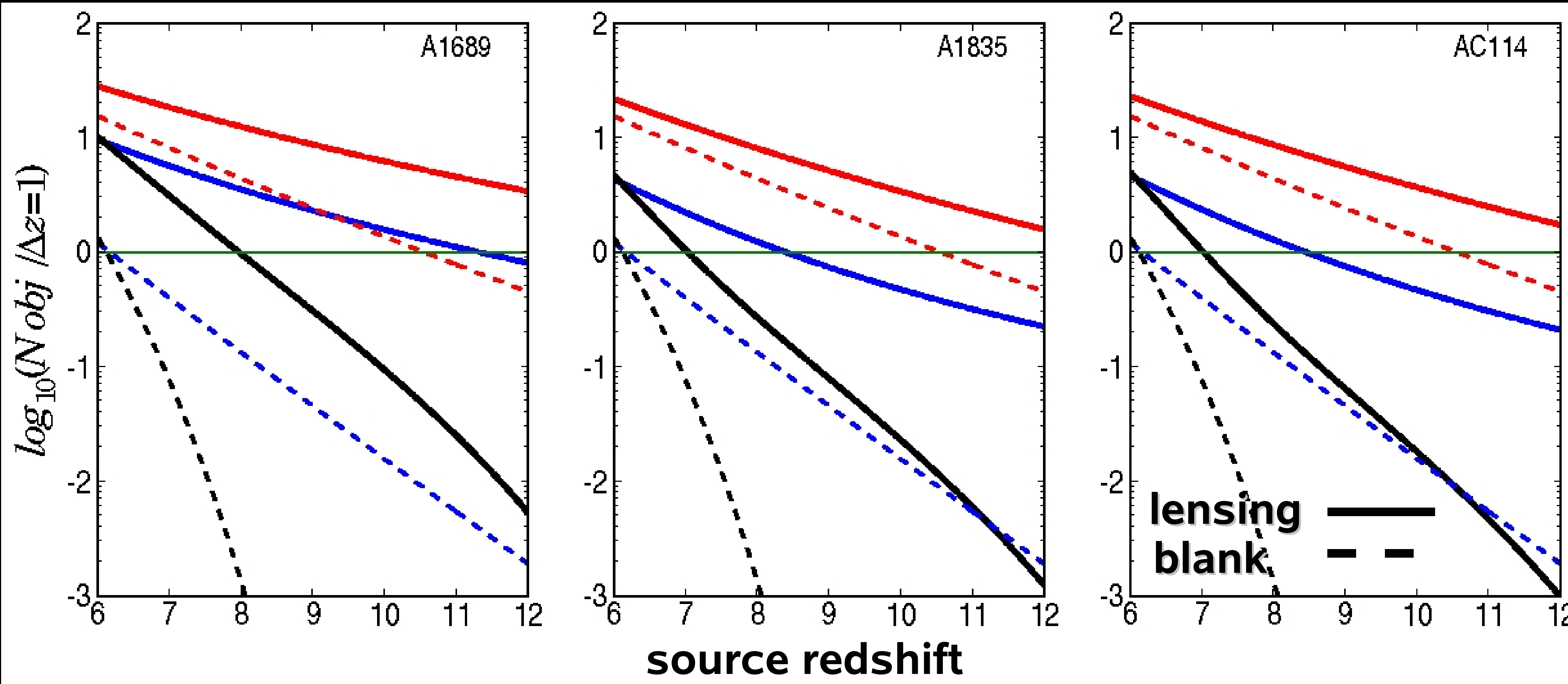




See also A. Maizy's poster

Blank Fields versus lensing fields

« Bright » spectroscopic sample: H(AB)<~ 25.5 in a 6' x 6' FOV, Δz=1



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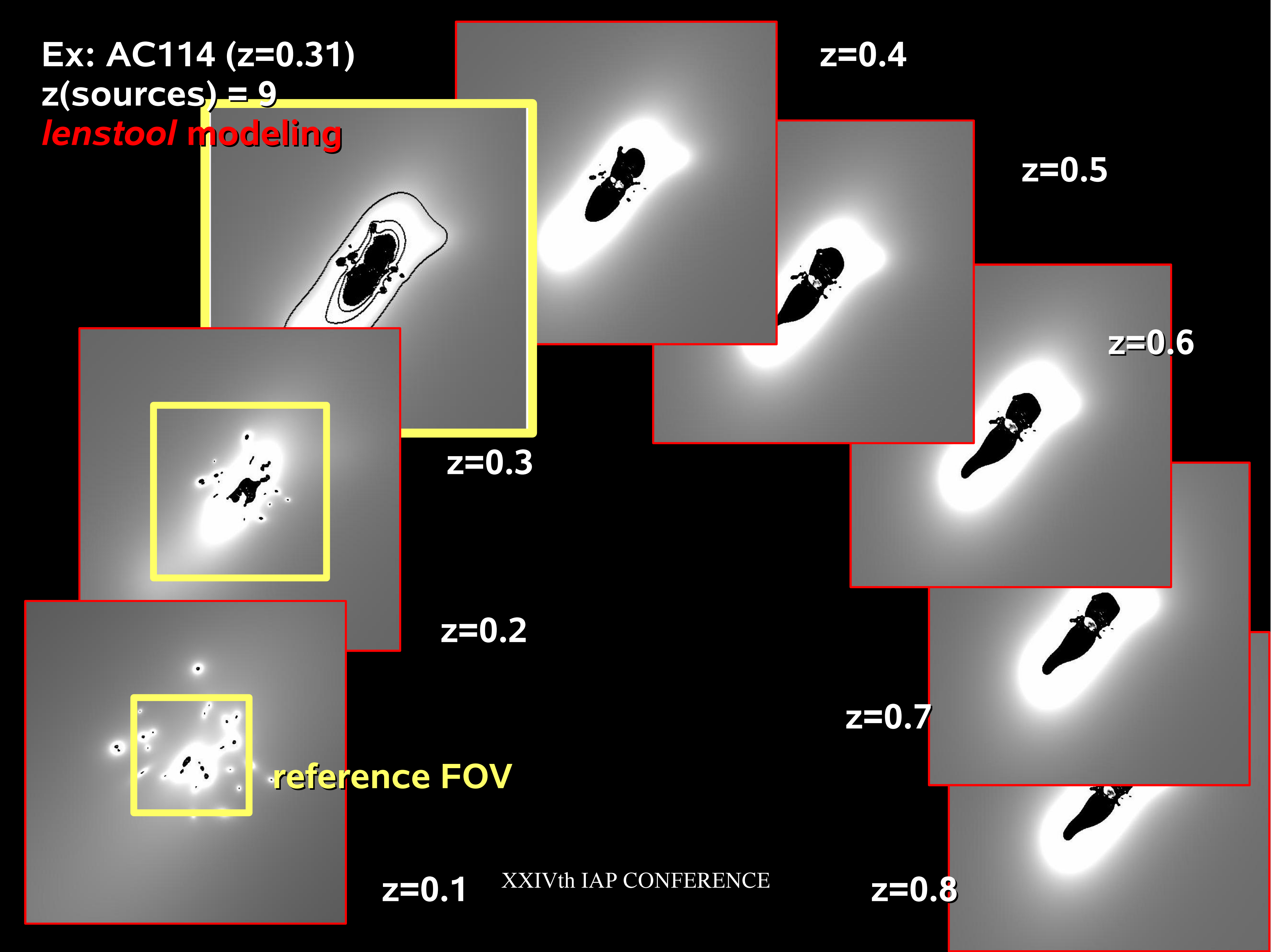
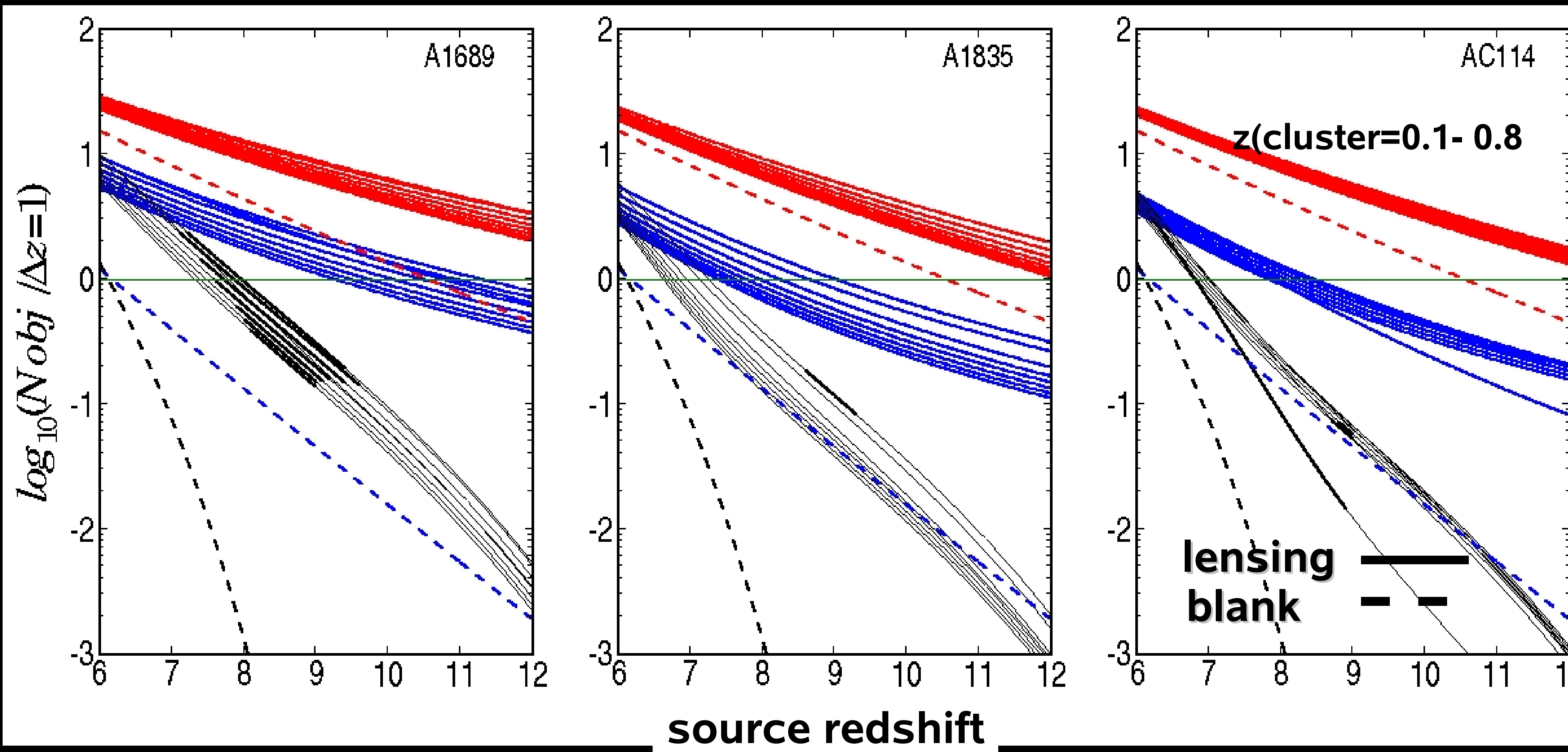

Ex: AC114 (z=0.31)
z(sources) = 9
lenstool modeling
z=0.4
z=0.5
z=0.6
z=0.3
z=0.2
z=0.7
reference FOV
z=0.1
z=0.8

Blank Fields versus lensing fields

« Bright » spectroscopic sample: H(AB)<~ 25.5 in a 6' x 6' FOV, Δz=1



Steidel et al. (1999)
Bouwens et al. (2006)
Bouwens et al. (2008)

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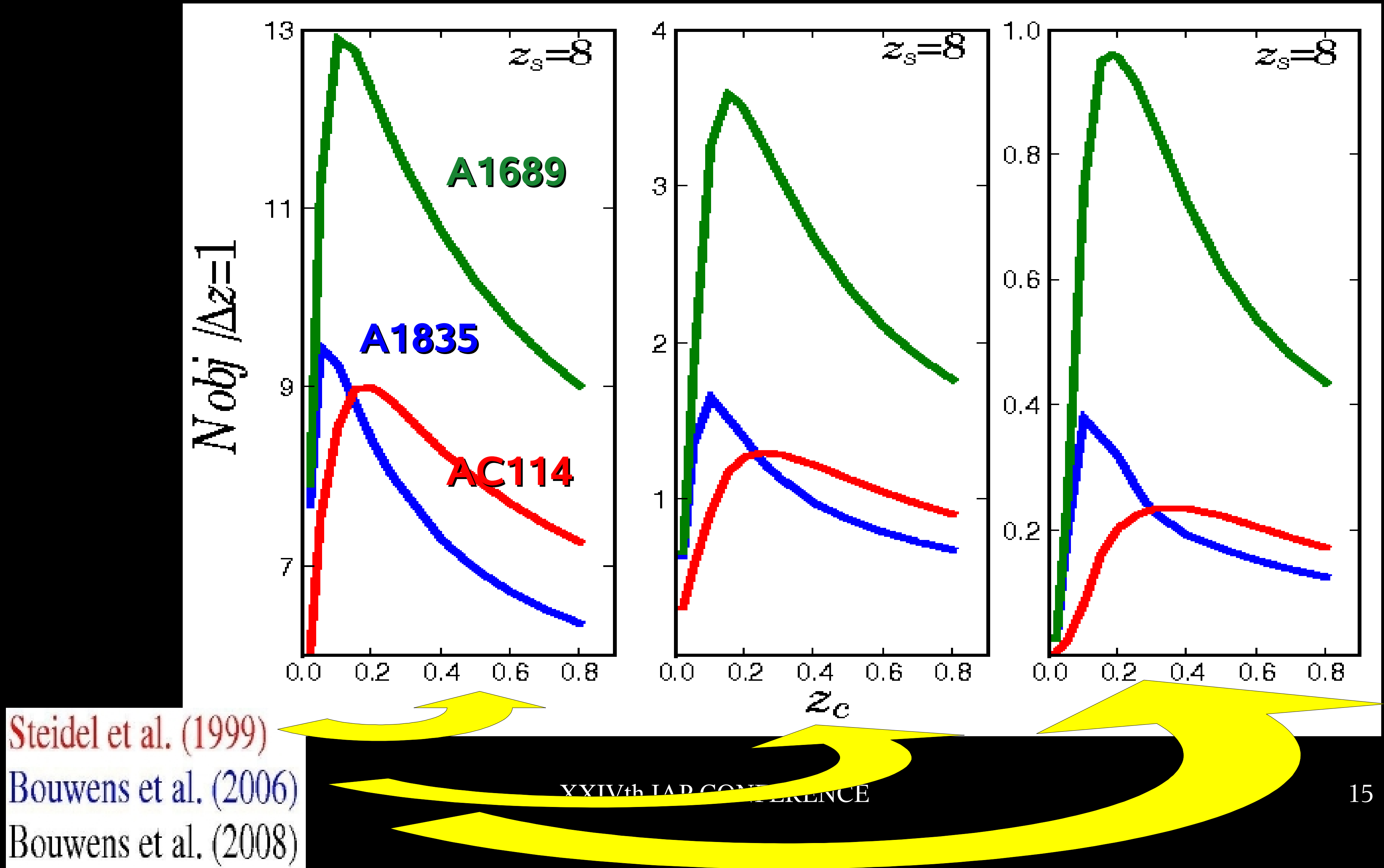
See also A. Maizy's poster

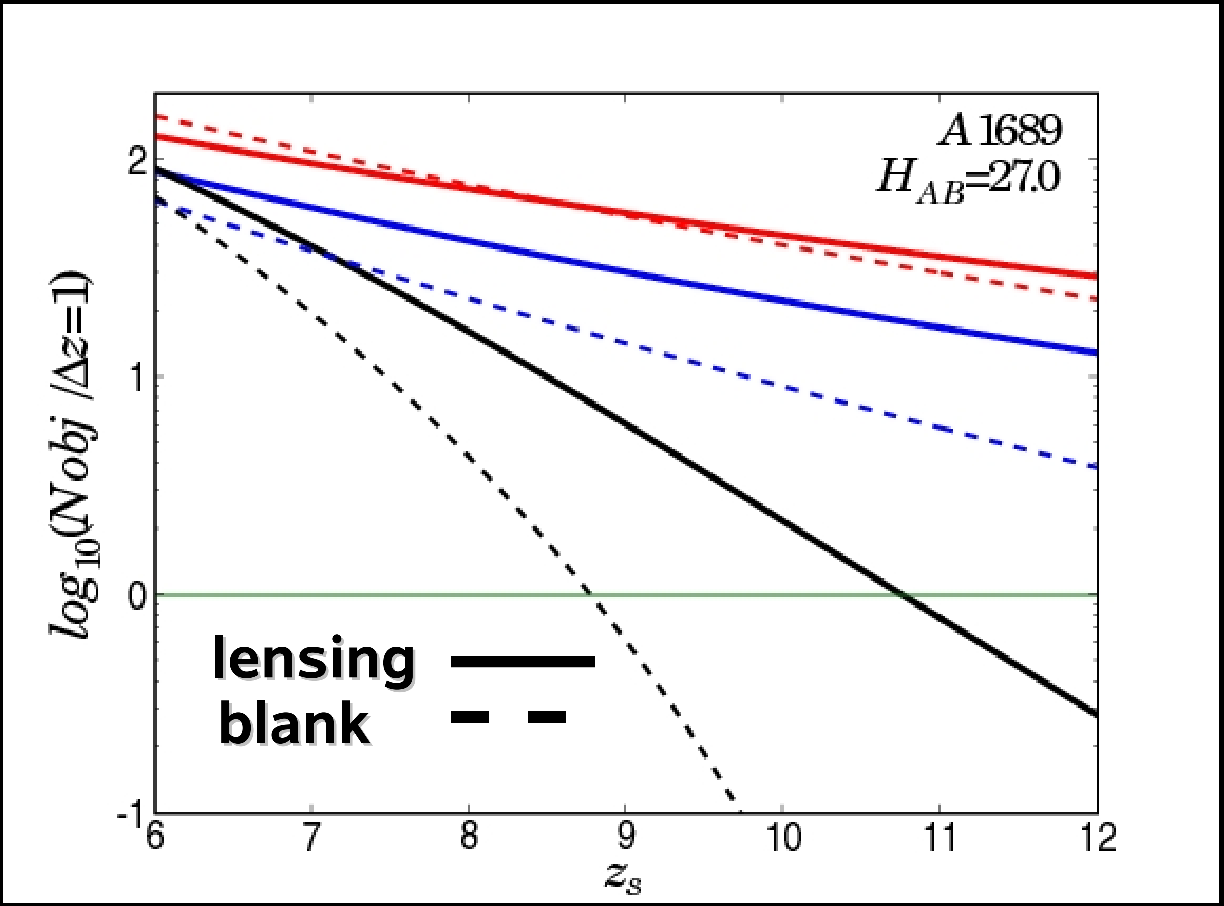
Blank Fields versus lensing fields

« Bright » spectroscopic sample: H(AB)<~ 25.5 in a 6' x 6' FOV, Δz=1



Blank Fields versus lensing fields

« Faint » photometric sample: H(AB)<~ 27.0 in a 6' x 6' FOV, Δz=1



- A lensing cluster along the line of sight has an increasingly positive influence on observation efficiency for:

➔ "shallow" surveys

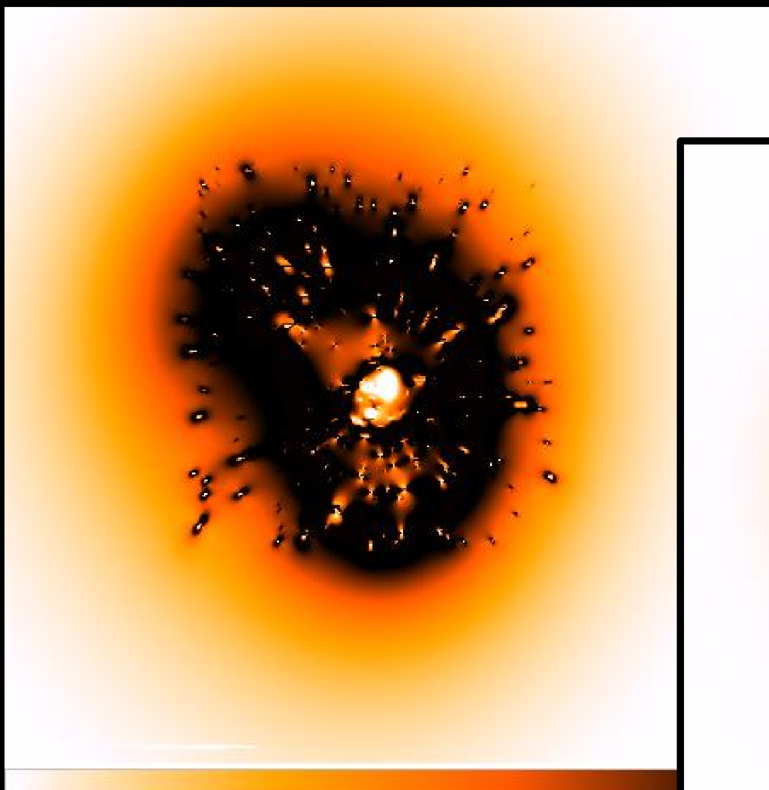
➔ strongly evolving LFs

➔ increasing with z(sources)

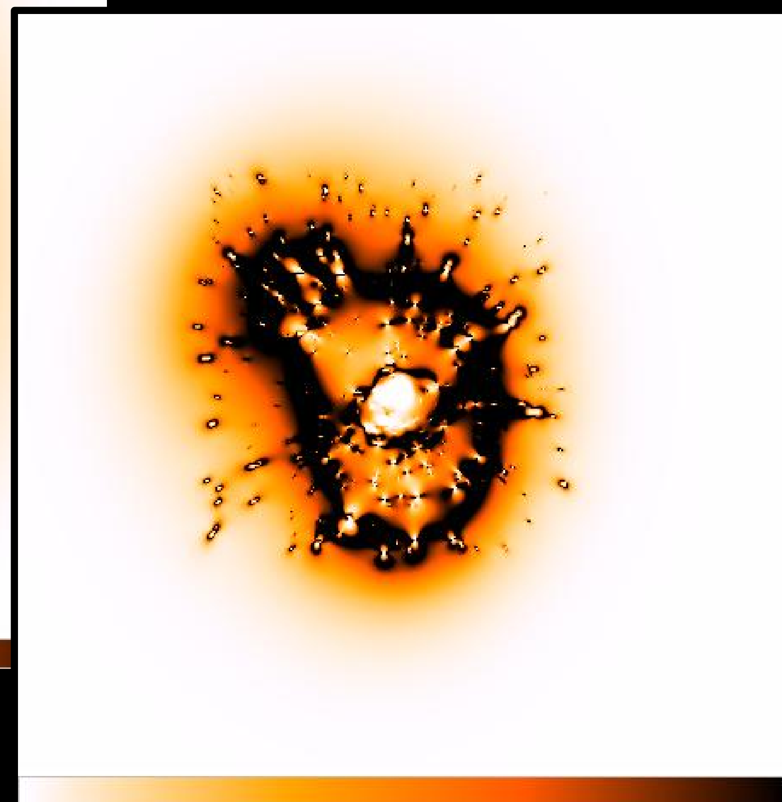
Steidel et al. (1999)
Bouwens et al. (2006)
Bouwens et al. (2008)

Towards an “ideal” survey

Probability density in lensing clusters: ex. A1689, 6' x 6' FOV, magnitude limited sample

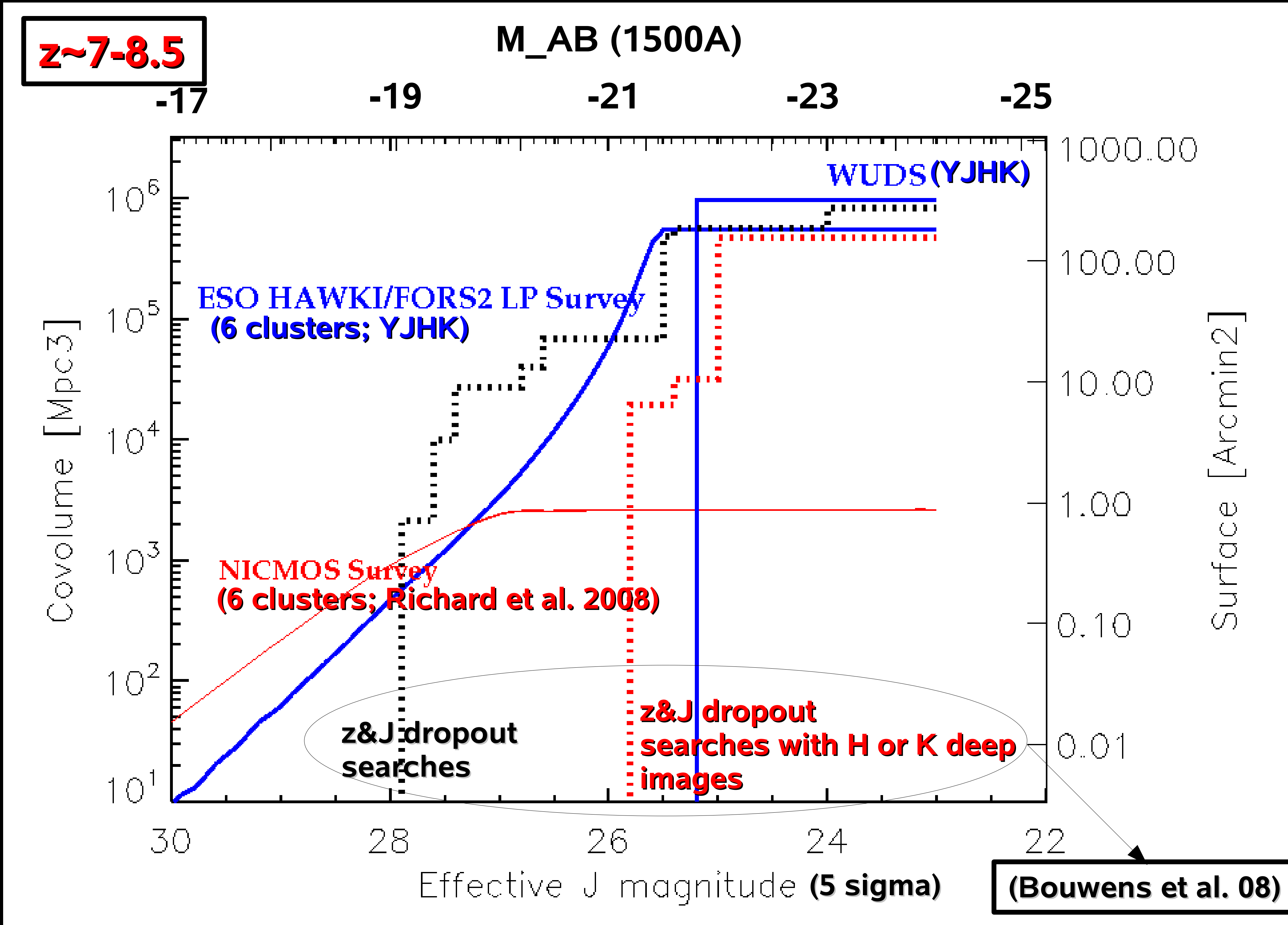


z=6



z=8

z=10



z~7-8.5
M_AB (1500A)
-17
-19
-21
-23
-25
1000.00
100.00
10.00
1.00
0.10
0.01
WUDS (YJHK)
ESO HAWKI/FORS2 LP Survey
(6 clusters; YJHK)
NICMOS Survey
(6 clusters; Richard et al. 2008)
z&J dropout searches
z&J dropout searches with H or K deep images
Covolume [Mpc3]
Surface [Arcmin2]
30
28
26
24
22
Effective J magnitude (5 sigma)
(Bouwens et al. 08)

Back to real life:

A multi-wavelength survey of distant galaxies (z>~7) with Gravitational Telescopes

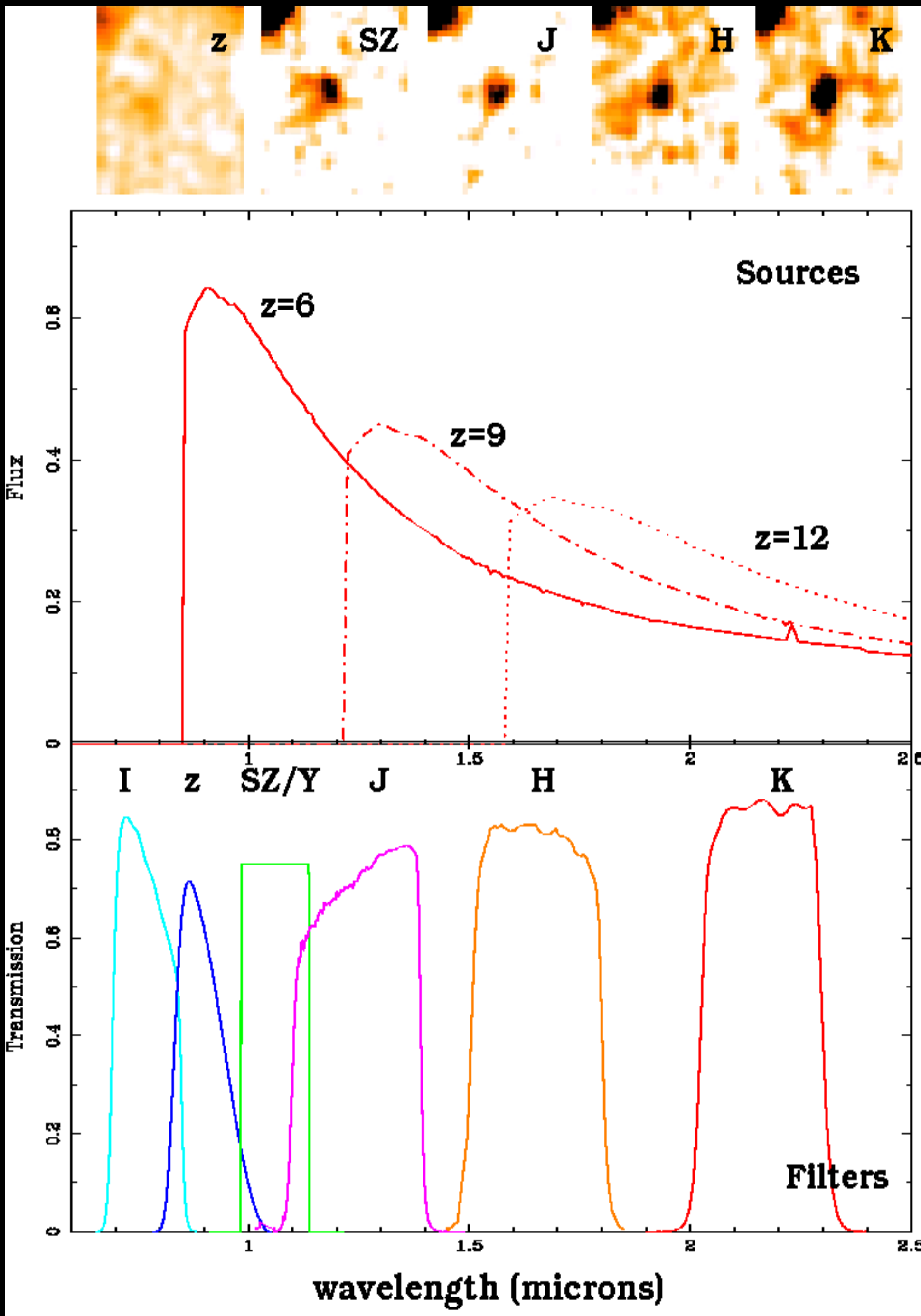
Project Design

- **2001 ---> SpectroPhotometric Simulations:**
  - Broad-band colors for "drop-out" selection at various redshifts (z~6-7, z~7-8, z~8-12).
  - Expected magnitudes for normal, low metallicity, and PopIII starbursts with different IMF, SF histories.
  - Feasibility studies: lensing vs. blank fields; pilot studies for the new generation of near-IR instruments .

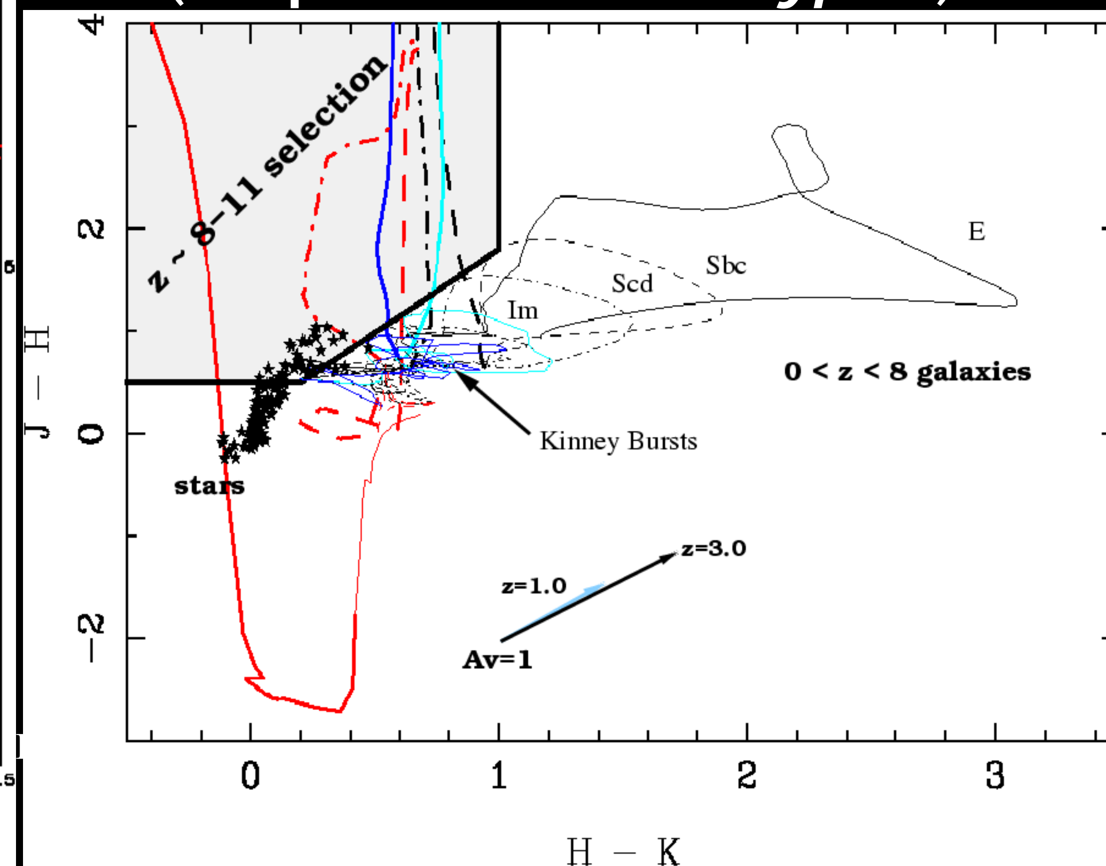
- **2002 ---> Deep near-IR (JHK, SZ) Imaging of well studied lensing clusters with ISAAC/VLT combined with deep optical imaging, including HST imaging.**
- **2003 ---> High-z Candidate Selection. Different detection criteria. Exploitation of final H-band selected sample.**
- **2003/04 ---> Pilot Spectroscopic Follow-up of best candidates ISAAC/VLT.**
- **2005/06 ---> Multi-wavelength follow up (Spitzer-IRAC, Chandra, IRAM, ...)**

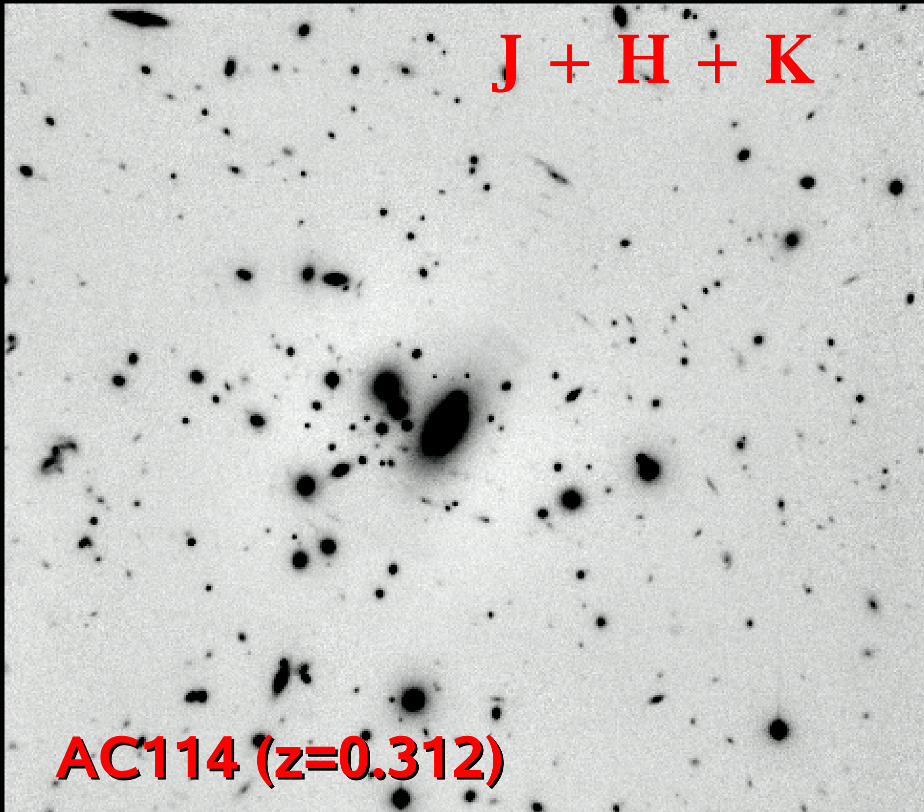
Next generation of multi-object near-IR spectrographs

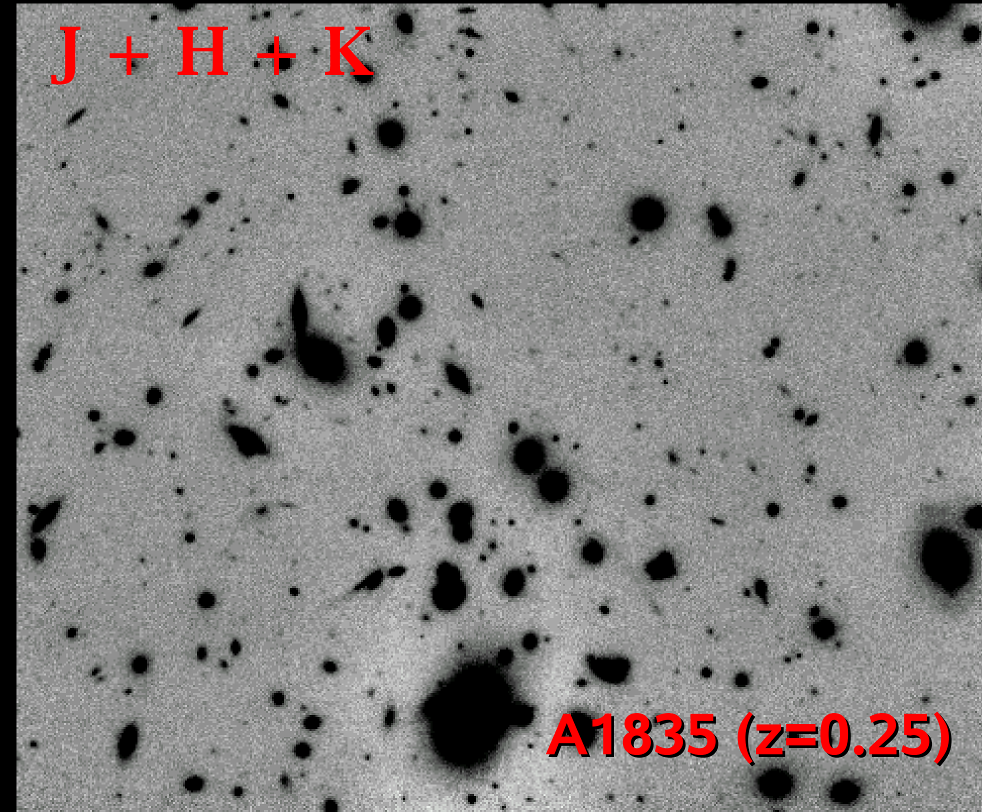
Selection of photometric candidates



- Optical dropouts + near-IR colors
- Filter combinations:
  - z~6-7: zYJ
  - z~7-8: YJH
  - z ~8-12 : JHK
- SED-fitting and photo-zs (adapted version of *Hyperz*)







ISAAC/VLT photometry (Vega system, 3σ):

J : 2h (J = 24.3)

H : 4h (H= 23.5)

K': 5.5 h (K'=23.2 --> K(AB)~25.0)

seeing ~0.4-0.6"

+ UBVRI Optical data + HST R band

ISAAC/VLT photometry (Vega system, 3σ):

J : 2h (J = 24.4)

H : 4h (H= 23.5)

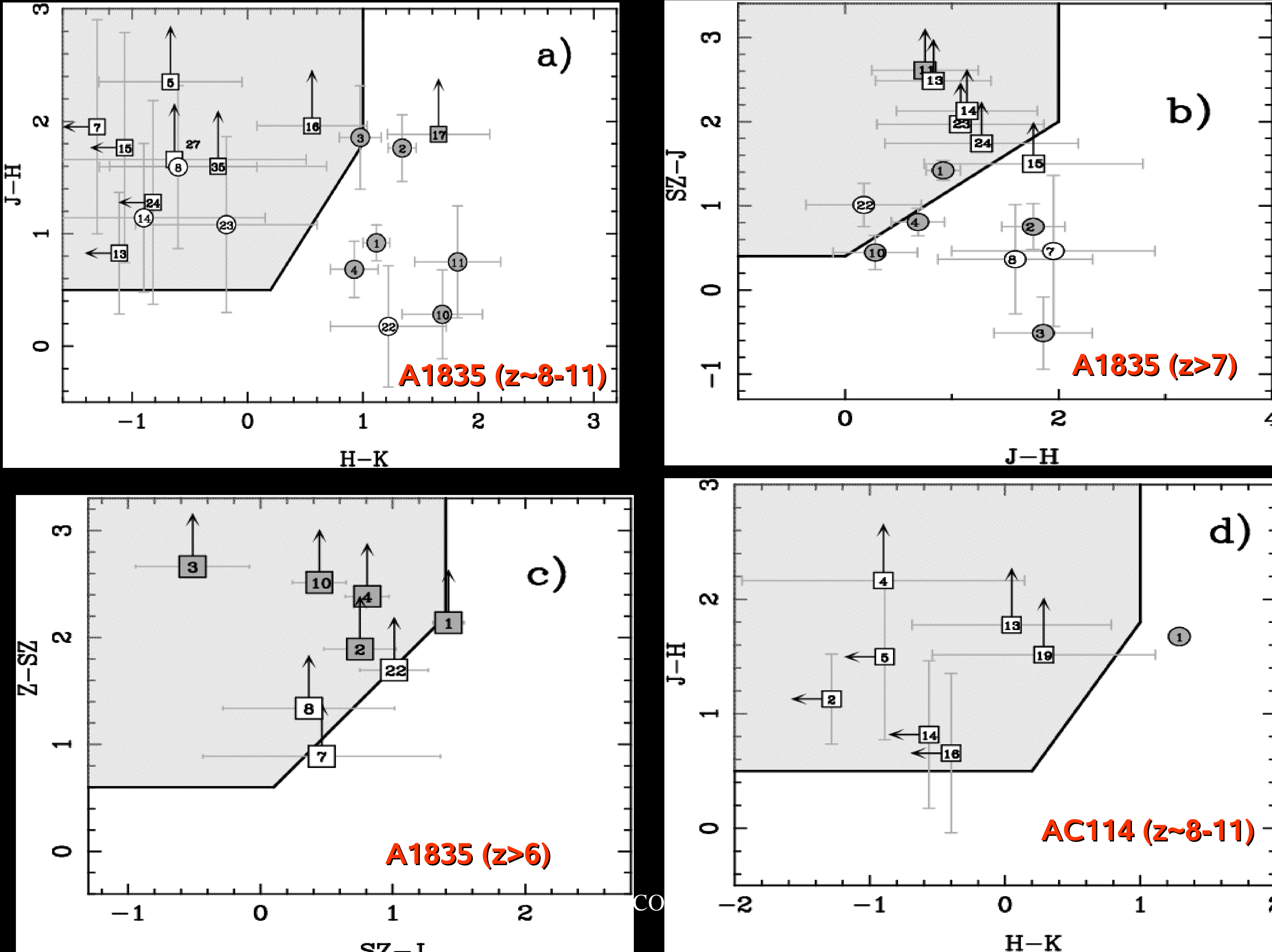
K': 5.5 h (K'=23.6 --> K(AB)=25.4) +

z/FORS (z=25.5) + SZ (Z=25.7)

seeing ~0.4-0.6"

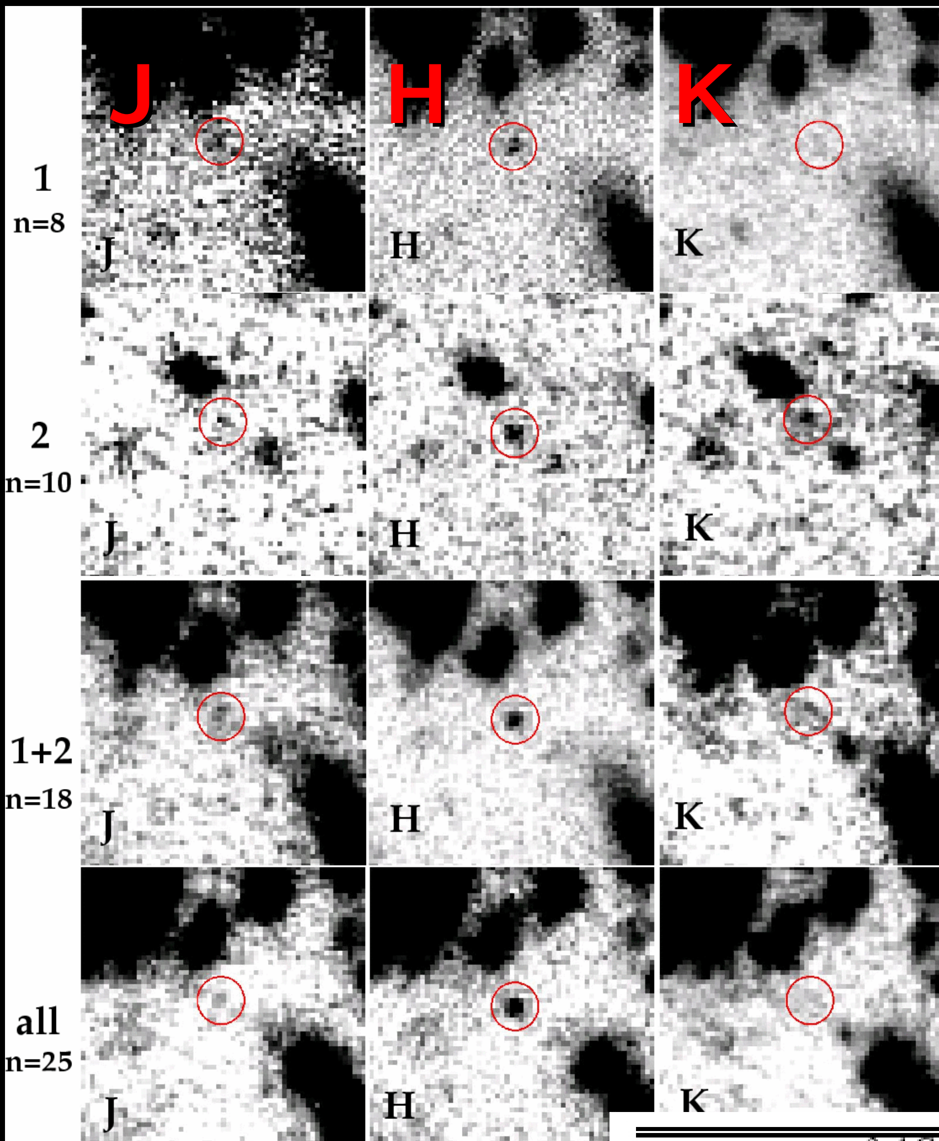
+ VRI Optical data + HST R band

+ ACS/F850W (~28 AB) + FORS (V~28 AB, 3 σ) + NIRI (H~26 AB, 3 σ)
+ HST/NICMOS (1 pointing/cluster) + IRAC/SPITZER new data


a)
A1835 (z~8-11)
J−H
H−K
b)
A1835 (z>7)
SZ−J
J−H
c)
A1835 (z>6)
Z−SZ
SZ−J
d)
AC114 (z~8-11)
J−H
H−K

CO

Stacked images of high-z candidates



- 18(8) first & second-category candidates in A1835(AC114)

CORRECTIONS:

- Lensing:

$$\eta\ (H_e, z) = \frac{N_o(H_e, z)}{N(H_e, z)}$$

= observed number counts up to He/ number counts in a blank field (same depth and FOV)

$$\eta\ (H_e, z) = \frac{\int_{\Delta\Omega} \frac{N(H_e, z)}{M(\Omega, z)} C(H_o) d\Omega}{\int_{\Delta\Omega} N(H_e, z) d\Omega} =$$

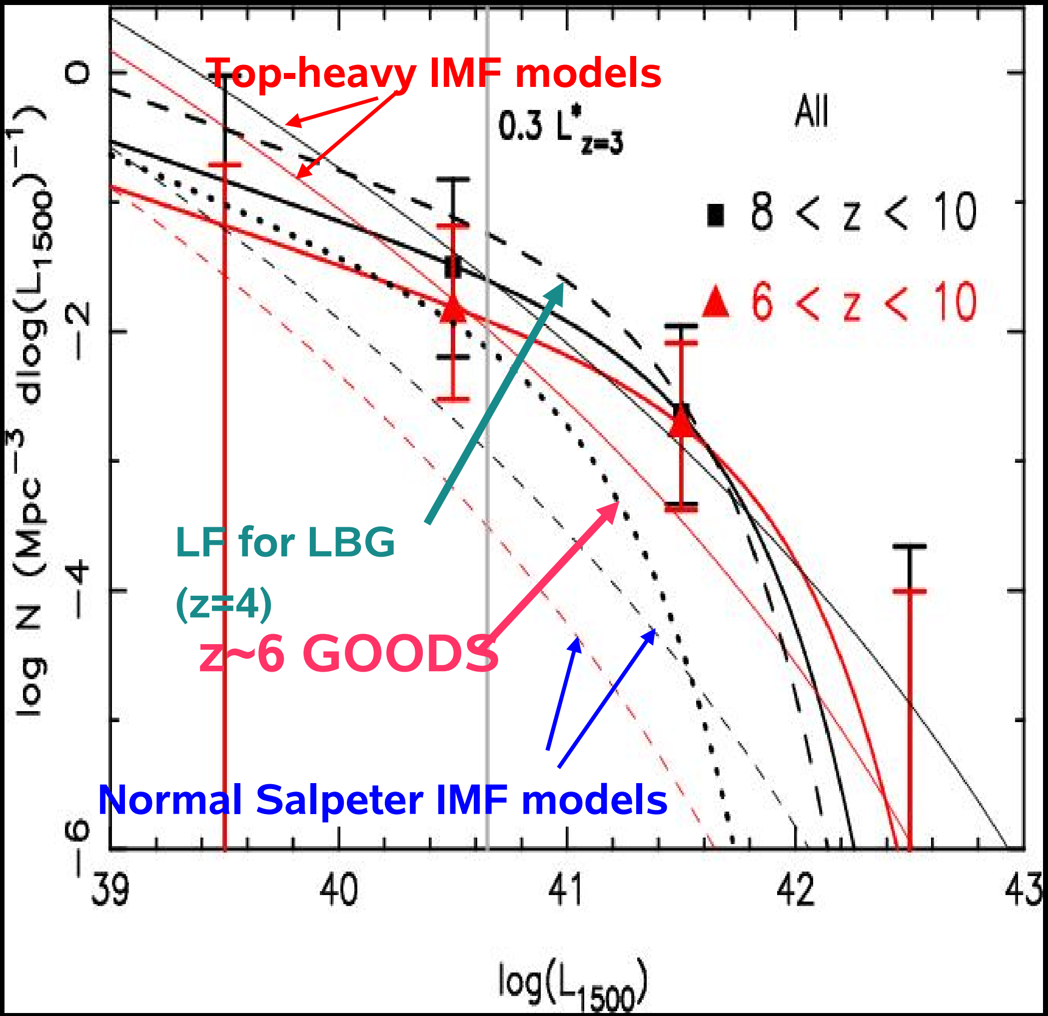
$$= \frac{1}{\Delta\Omega} \int_{\Delta\Omega} \frac{C(H_e - 2.5\ log_{10} M(\Omega, z))}{M(\Omega, z)} d\Omega$$

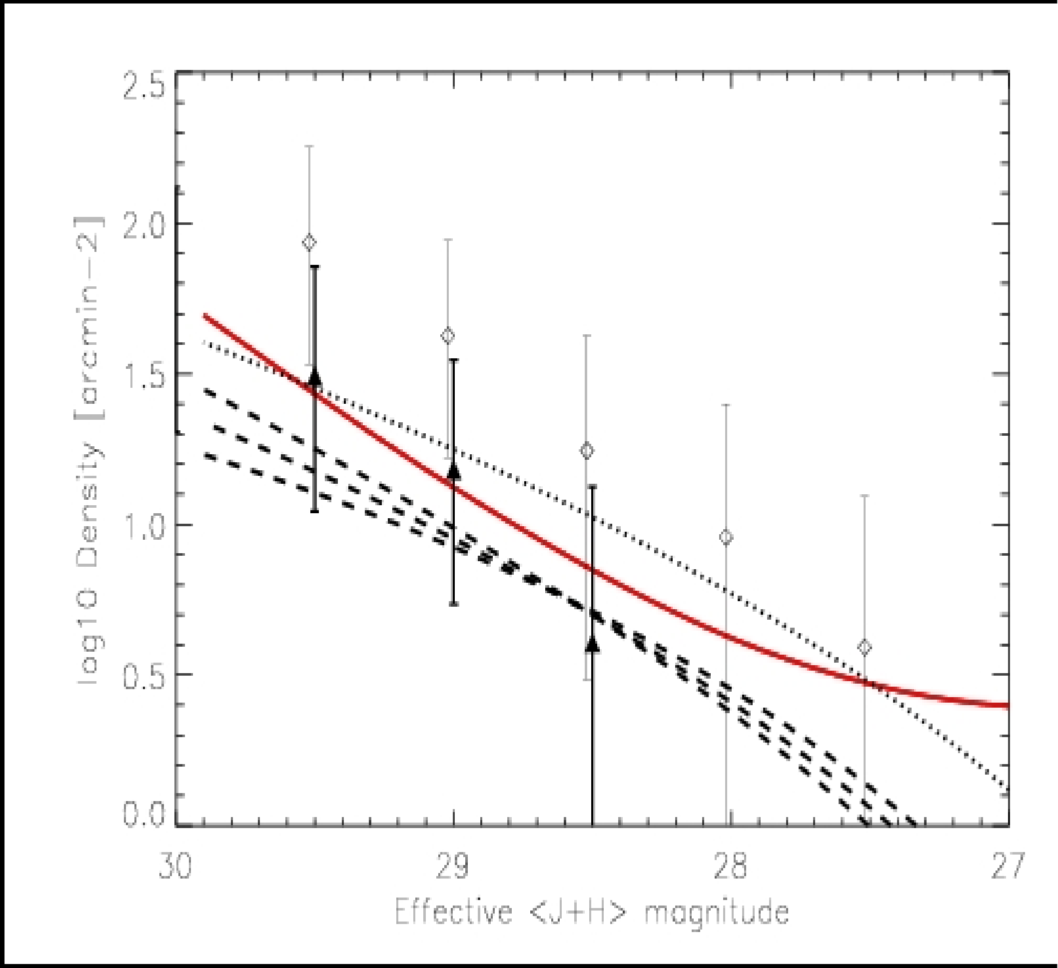
- Photometric incompleteness
- False positive detections (depending on the detection filters)
- 20-25% mid-z contamination expected

H range [mag]	3rd Cat. H	First/second category dropouts $SZ+H$	$J+H$	$H+K$	$SZ+J+H$	$J+H+K$	$SZ+H+K$	$SZ+J+H+K$
	% of spurious detections in Abell 1835 (AC114)							
22.75–23.00	0 (0)	0	0 (0)	0 (0)	0	0 (0)	0	0
23.00–23.30	35 (57)	27	12 (25)	25 (33)	12	12 (33)	12	12
23.30–23.75	98 (100)	66	65 (88)	61 (61)	28	27 (38)	30	12
23.75–24.00	100 (100)	56	96 (100)	73 (100)	27	28 (100)	40	11

Luminosity Functions

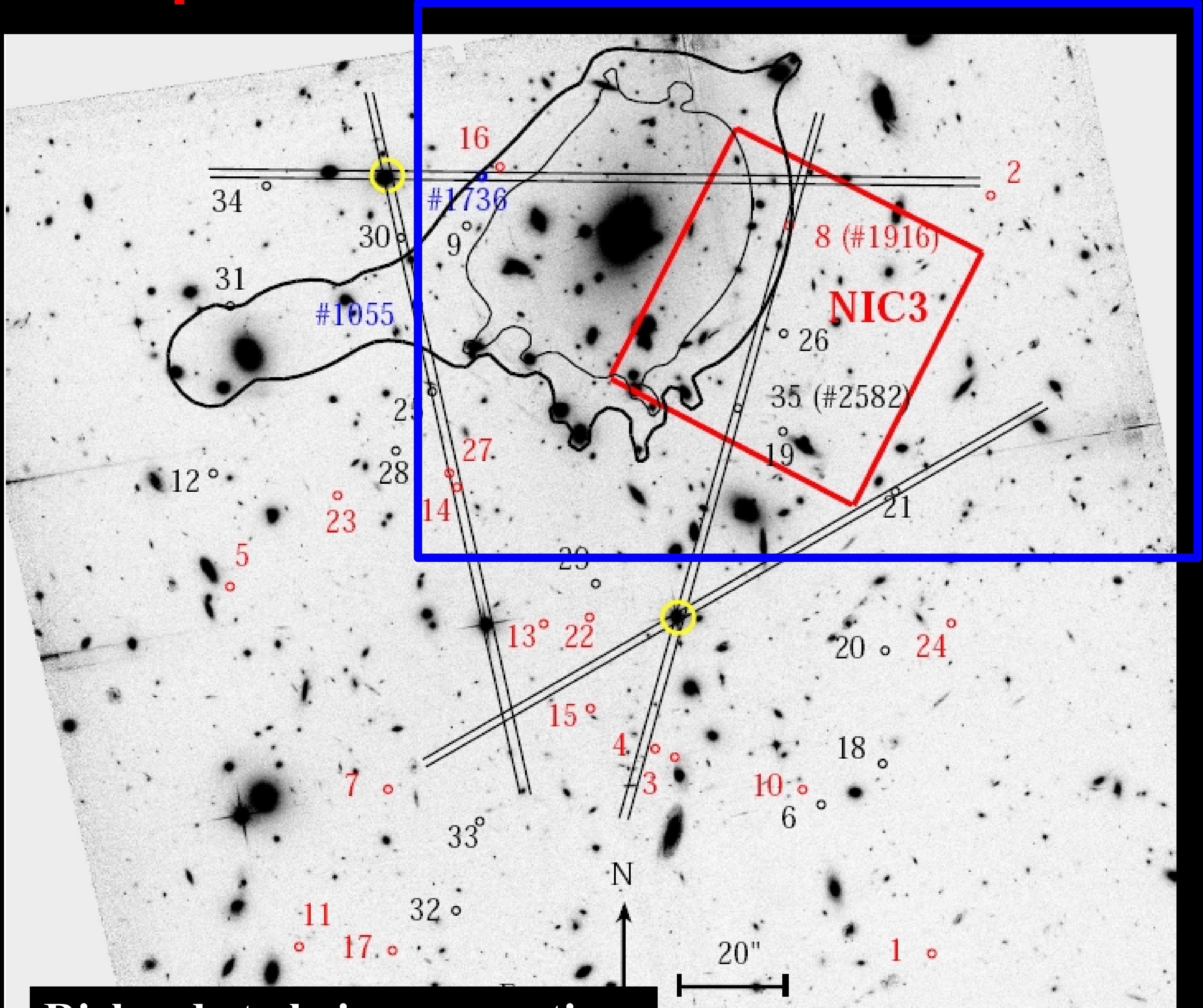
- Correction for lensing effects and incompleteness using the lensing model:





Richard et al. 06 *Richard et al. 08*

Spectroscopic & Photometric follow-up



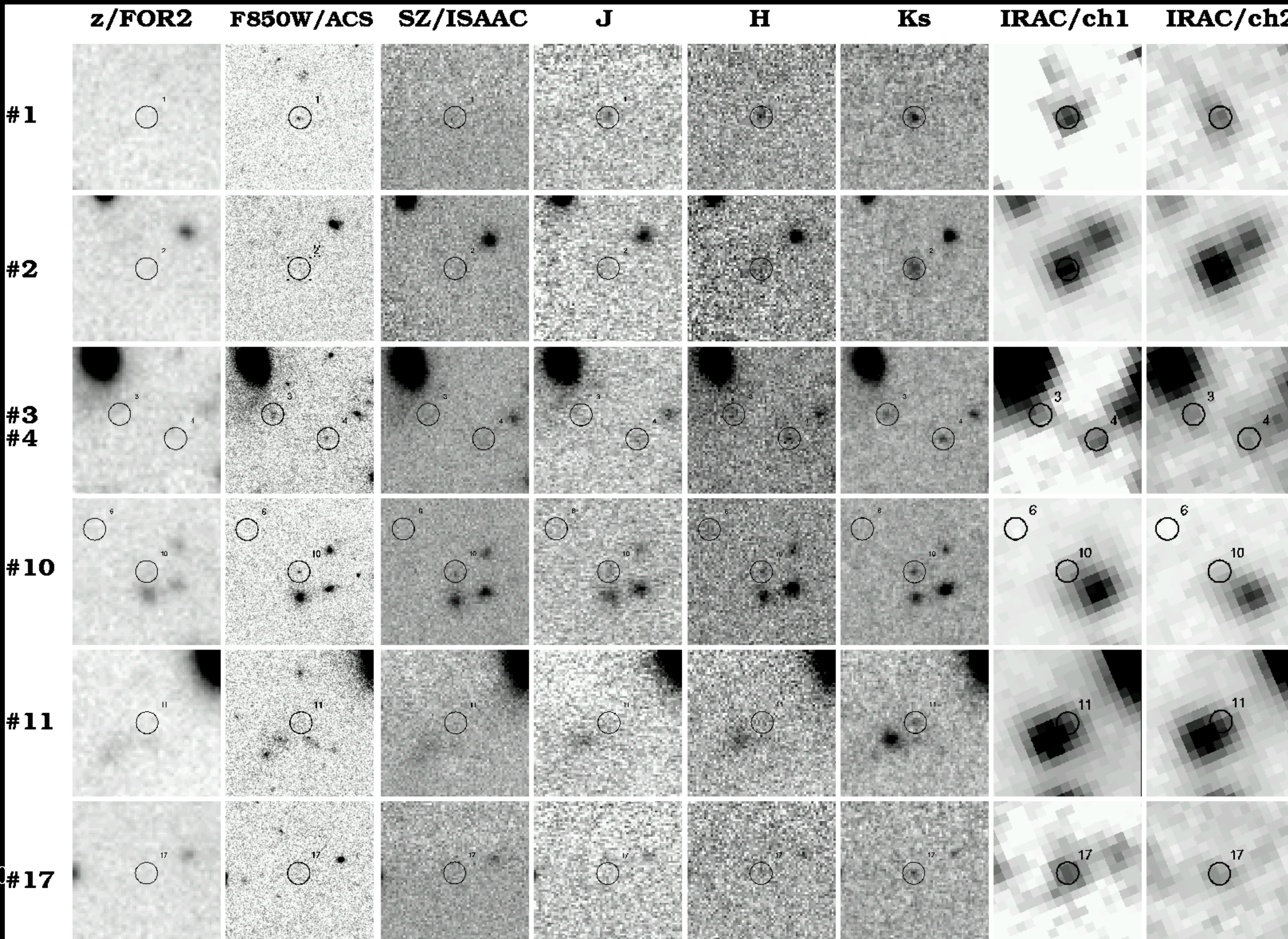
Richard et al., in preparation

ID	RA (14:)	DEC (02:)	*SZ*	*J*	*H*	*K*
First-category dropouts						
#1	0:58.278	50:26.65	24.56 ± 0.18	23.14 ± 0.11	22.22 ± 0.10	21.10 ± 0.04
#2	0:57.538	52:49.35	24.80 ± 0.22	24.05 ± 0.27	22.29 ± 0.11	20.95 ± 0.03
#3	1:01.484	51:03.63	24.03 ± 0.11	24.54 ± 0.42	22.69 ± 0.16	21.71 ± 0.07
#4	1:01.733	51:05.26	24.31 ± 0.14	23.50 ± 0.16	22.82 ± 0.18	21.90 ± 0.08
#5	1:07.034	51:35.71	25.82 ± 0.52	> 25.60	23.24 ± 0.28	23.91 ± 0.55
#7	1:05.067	50:57.52	25.81 ± 0.51	25.34 ± 0.89	23.39 ± 0.32	> 24.70
#8	1:00.058	52:44.08	25.36 ± 0.34	24.99 ± 0.64	23.40 ± 0.32	24.00 ± 0.60
#10	0:59.890	50:57.59	24.18 ± 0.12	23.74 ± 0.20	23.45 ± 0.33	21.77 ± 0.07
#11	1:06.182	50:27.74	> 26.90	24.29 ± 0.33	23.54 ± 0.36	21.72 ± 0.07
#13	1:03.125	51:28.81	> 26.90	24.41 ± 0.38	23.58 ± 0.38	> 24.70
#14	1:04.209	51:54.55	> 26.90	24.77 ± 0.52	23.63 ± 0.39	24.53 ± 0.97
#15	1:02.540	51:12.84	> 26.90	25.40 ± 0.94	23.63 ± 0.40	> 24.70
#16	1:03.657	52:54.83	> 26.90	> 25.60	23.64 ± 0.40	23.08 ± 0.25
#17	1:05.013	50:27.11	> 26.90	> 25.60	23.71 ± 0.43	22.06 ± 0.10
#22	1:02.551	51:30.06	25.00 ± 0.24	23.99 ± 0.25	23.81 ± 0.47	22.59 ± 0.16
#23	1:05.699	51:52.92	> 26.90	24.93 ± 0.61	23.85 ± 0.48	24.03 ± 0.61
#24	0:58.036	51:29.09	> 26.90	25.16 ± 0.75	23.88 ± 0.50	> 24.70
#27	1:04.299	51:57.19	> 26.90	> 25.60	23.93 ± 0.53	24.57 ± 1.01
Second-category dropouts						
#6	0:59.659	50:54.73	> 26.90	> 25.60	23.37 ± 0.31	> 24.70
#18	0:58.890	51:02.47	> 26.90	> 25.60	23.72 ± 0.43	> 24.70
#19	1:00.138	52:05.20	> 26.90	> 25.60	23.72 ± 0.43	> 24.70
#20	0:58.860	51:23.85	> 26.90	> 25.60	23.72 ± 0.43	> 24.70
#21	0:58.732	51:53.86	> 26.90	> 25.60	23.76 ± 0.44	> 24.70
#35	1:00.693	52:09.58	> 26.90	> 25.60	24.00 ± 0.56	24.25 ± 0.75

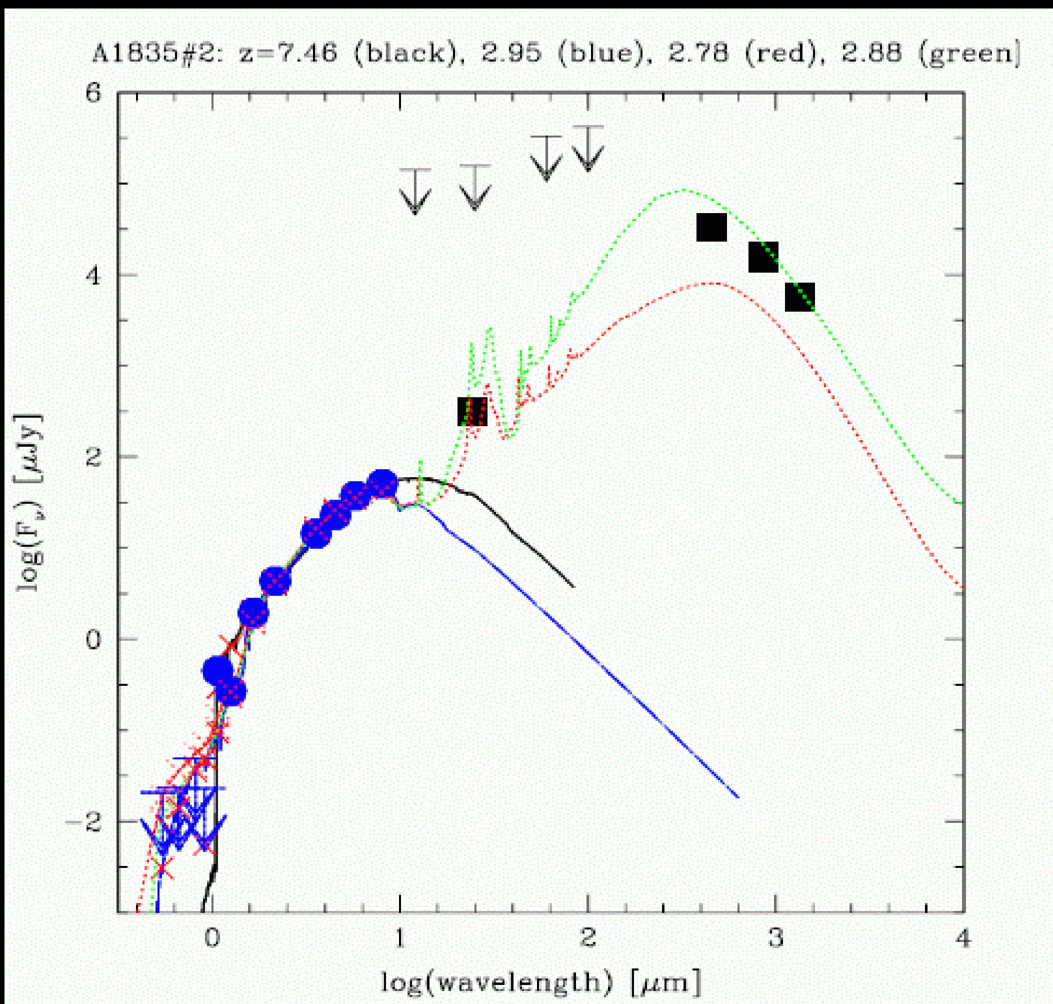
- **Mid-z EROs**
- **Excluded from LF analysis in Richard et al. 06**
- **IRAC sources**
- **Multi-wavelength analysis by Schaerer et al. 07**

Multi-wavelength analysis

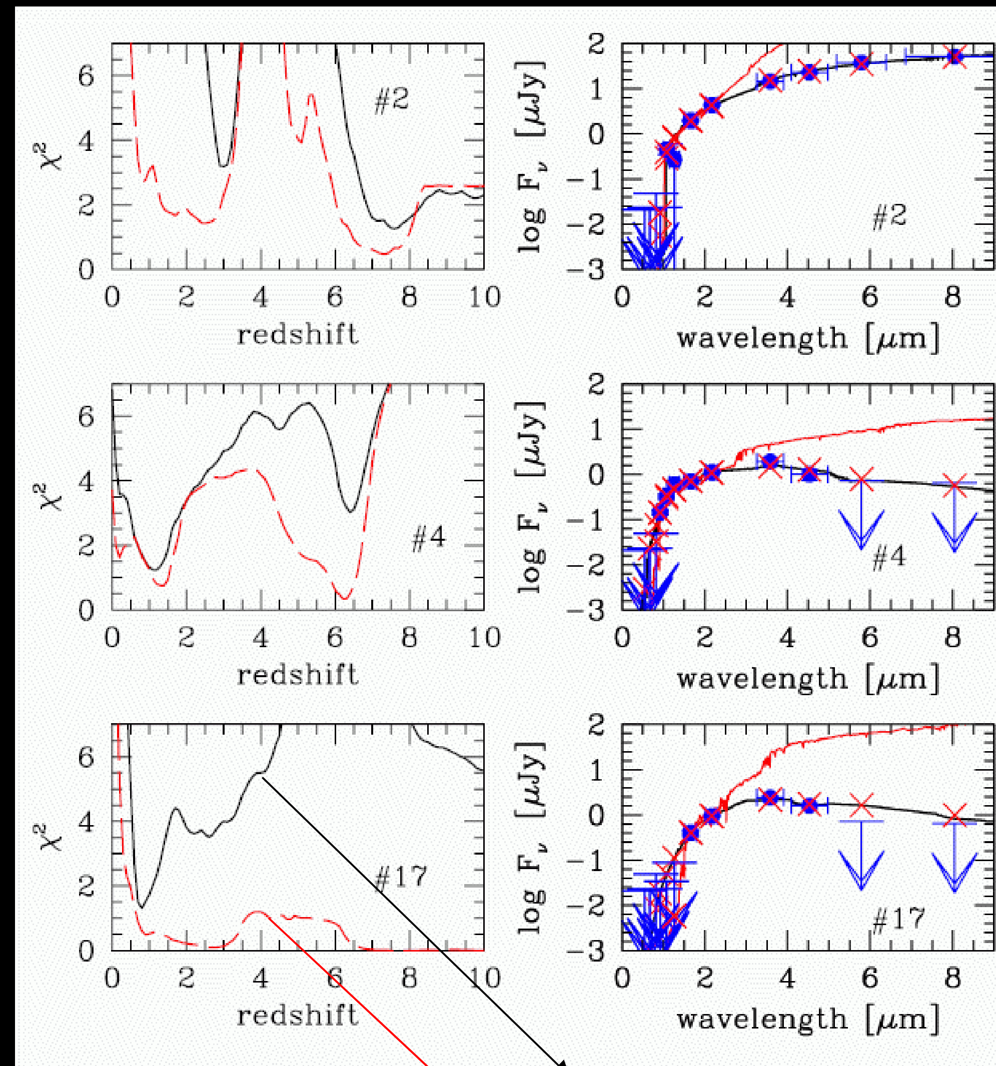
« Bright » optical dropouts in A1835



- **IRAC/Spitzer :**
  - Detection of brightest objects (ERO) between 3.8 and 8 µm --> new constraints on their nature and redshift
  - high-z candidates not detected as expected



ACS/HST z-band observations (non-detection $Z850_{AB} > 28.$ to 28.3) confirm « dropout » nature of z>~7 candidates behind A1835 and AC114.

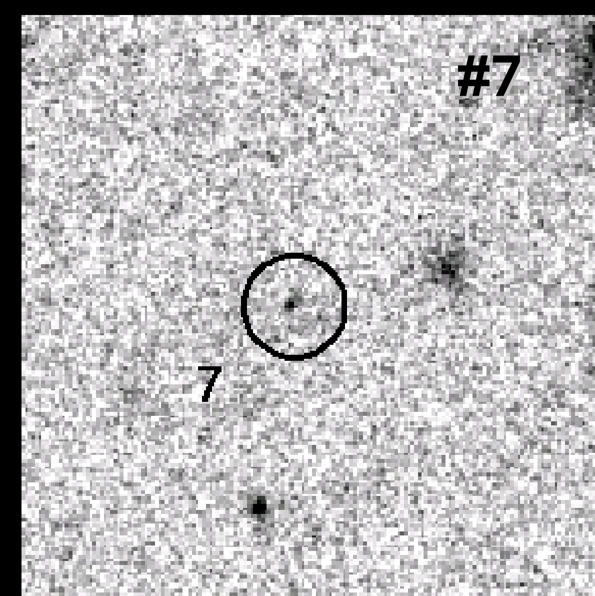


NFERENCE

(Schaerer et al. 07, Hempel et al. 08)

ID	RA (14:)	DEC (02:)	*SZ*	*J*	*H*	*K*	
First-category dropouts							
~~#1~~	~~0:58.278~~	~~50:26.65~~	~~24.56 ± 0.18~~	~~23.14 ± 0.11~~	~~22.22 ± 0.10~~	~~21.10 ± 0.04~~	X
~~#2~~	~~0:57.538~~	~~52:49.35~~	~~24.80 ± 0.22~~	~~24.05 ± 0.27~~	~~22.29 ± 0.11~~	~~20.95 ± 0.03~~	
~~#3~~	~~1:01.484~~	~~51:03.63~~	~~24.03 ± 0.11~~	~~24.54 ± 0.42~~	~~22.69 ± 0.16~~	~~21.71 ± 0.07~~	
~~#4~~	~~1:01.733~~	~~51:05.26~~	~~24.31 ± 0.14~~	~~23.50 ± 0.16~~	~~22.82 ± 0.18~~	~~21.90 ± 0.08~~	X
~~#5~~	~~1:07.034~~	~~51:35.71~~	~~25.82 ± 0.52~~	~~> 25.60~~	~~23.24 ± 0.28~~	~~23.91 ± 0.55~~	
~~#7~~	~~1:05.087~~	~~50:57.52~~	~~25.31 ± 0.51~~	~~25.34 ± 0.89~~	~~23.39 ± 0.32~~	~~> 24.70~~	
#8	1:00.058	52:44.08	25.36 ± 0.34	24.99 ± 0.64	23.40 ± 0.32	24.00 ± 0.60	
~~#10~~	~~0:59.890~~	~~50:57.59~~	~~24.18 ± 0.12~~	~~23.74 ± 0.20~~	~~23.45 ± 0.33~~	~~21.77 ± 0.07~~	X
~~#11~~	~~1:06.182~~	~~50:27.74~~	~~> 26.90~~	~~24.29 ± 0.33~~	~~23.54 ± 0.36~~	~~21.72 ± 0.07~~	?
#13	1:03.125	51:28.81	> 26.90	24.41 ± 0.38	23.58 ± 0.38	> 24.70	
#14	1:04.209	51:54.55	> 26.90	24.77 ± 0.52	23.63 ± 0.39	24.53 ± 0.97	
#15	1:02.540	51:12.84	> 26.90	25.40 ± 0.94	23.63 ± 0.40	> 24.70	
#16	1:03.657	52:54.83	> 26.90	> 25.60	23.64 ± 0.40	23.08 ± 0.25	
~~#17~~	~~1:05.013~~	~~50:27.11~~	~~> 26.90~~	~~> 25.60~~	~~23.71 ± 0.43~~	~~22.06 ± 0.10~~	?
#22	1:02.551	51:30.06	25.00 ± 0.24	23.99 ± 0.25	23.81 ± 0.47	22.59 ± 0.16	
#23	1:05.699	51:52.92	> 26.90	24.93 ± 0.61	23.85 ± 0.48	24.03 ± 0.61	
#24	0:58.036	51:29.09	> 26.90	25.16 ± 0.75	23.88 ± 0.50	> 24.70	
#27	1:04.299	51:57.19	> 26.90	> 25.60	23.93 ± 0.53	24.57 ± 1.01	
Second-category dropouts							
#6	0:59.659	50:54.73	> 26.90	> 25.60	23.37 ± 0.31	> 24.70	
#18	0:58.890	51:02.47	> 26.90	> 25.60	23.72 ± 0.43	> 24.70	
#19	1:00.138	52:05.20	> 26.90	> 25.60	23.72 ± 0.43	> 24.70	
#20	0:58.860	51:23.85	> 26.90	> 25.60	23.72 ± 0.43	> 24.70	
#21	0:58.732	51:53.86	> 26.90	> 25.60	23.76 ± 0.44	> 24.70	
#35	1:00.693	52:09.58	> 26.90	> 25.60	24.00 ± 0.56	24.25 ± 0.75	
#31							X
#32							?

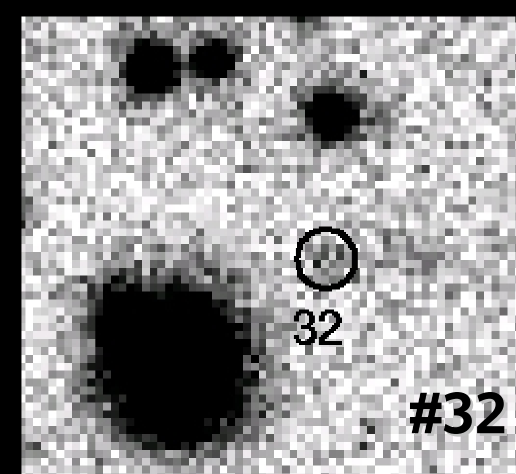
- **Detected on ACS/F850 image**
- **Confirmation of optical dropout**



ID	RA (14:)	DEC (02:)	*SZ*	*J*	*H*	*K*
First-category dropouts						
#1	0:58.278	50:26.65	24.56 ± 0.18	23.14 ± 0.11	22.22 ± 0.10	21.10 ± 0.04
#2	0:57.538	52:49.85	24.80 ± 0.22	24.05 ± 0.27	22.29 ± 0.11	20.95 ± 0.03
#3	1:01.484	51:03.63	24.03 ± 0.11	24.54 ± 0.42	22.69 ± 0.16	21.71 ± 0.07
#4	1:01.733	51:05.26	24.31 ± 0.14	23.50 ± 0.16	22.82 ± 0.18	21.90 ± 0.08
#5	1:07.034	51:35.71	25.82 ± 0.52	> 25.60	23.24 ± 0.28	23.91 ± 0.55
#7	1:05.667	50:57.52	25.81 ± 0.51	25.34 ± 0.89	23.59 ± 0.32	> 24.70
#8	1:00.058	52:44.08	25.36 ± 0.34	24.99 ± 0.64	23.40 ± 0.32	24.00 ± 0.60
#10	0:59.890	50:57.59	24.18 ± 0.12	23.74 ± 0.20	23.45 ± 0.33	21.77 ± 0.07
#11	1:06.182	50:27.74	> 26.90	24.29 ± 0.33	23.54 ± 0.36	21.72 ± 0.07
#13	1:03.125	51:28.81	> 26.90	24.41 ± 0.38	23.58 ± 0.38	> 24.70
#14	1:04.209	51:54.55	> 26.90	24.77 ± 0.52	23.63 ± 0.39	24.53 ± 0.97
#15	1:02.540	51:12.84	> 26.90	25.40 ± 0.94	23.63 ± 0.40	> 24.70
#16	1:03.657	52:54.83	> 26.90	> 25.60	23.64 ± 0.40	23.08 ± 0.25
#17	1:05.013	50:27.11	> 26.90	> 25.60	23.71 ± 0.43	22.06 ± 0.10
#22	1:02.551	51:30.06	25.00 ± 0.24	23.99 ± 0.25	23.81 ± 0.47	22.59 ± 0.16
#23	1:05.699	51:52.92	> 26.90	24.93 ± 0.61	23.85 ± 0.48	24.03 ± 0.61
#24	0:58.656	51:29.69	> 26.90	25.16 ± 0.75	23.88 ± 0.50	> 24.70
#27	1:04.299	51:57.19	> 26.90	> 25.60	23.93 ± 0.53	24.57 ± 1.01
Second-category dropouts						
#6	0:59.659	50:54.73	> 26.90	> 25.60	23.37 ± 0.31	> 24.70
#18	0:58.890	51:02.47	> 26.90	> 25.60	23.72 ± 0.43	> 24.70
#19	1:00.138	52:05.20	> 26.90	> 25.60	23.72 ± 0.43	> 24.70
#20	0:58.860	51:23.85	> 26.90	> 25.60	23.72 ± 0.43	> 24.70
#21	0:58.732	51:53.86	> 26.90	> 25.60	23.76 ± 0.44	> 24.70
#35	1:00.693	52:09.58	> 26.90	> 25.60	24.00 ± 0.56	24.25 ± 0.75

#31 X X
#32 ? X
#26 X

- **Detected on FORS/V image**
- **Mid-z interlopers**



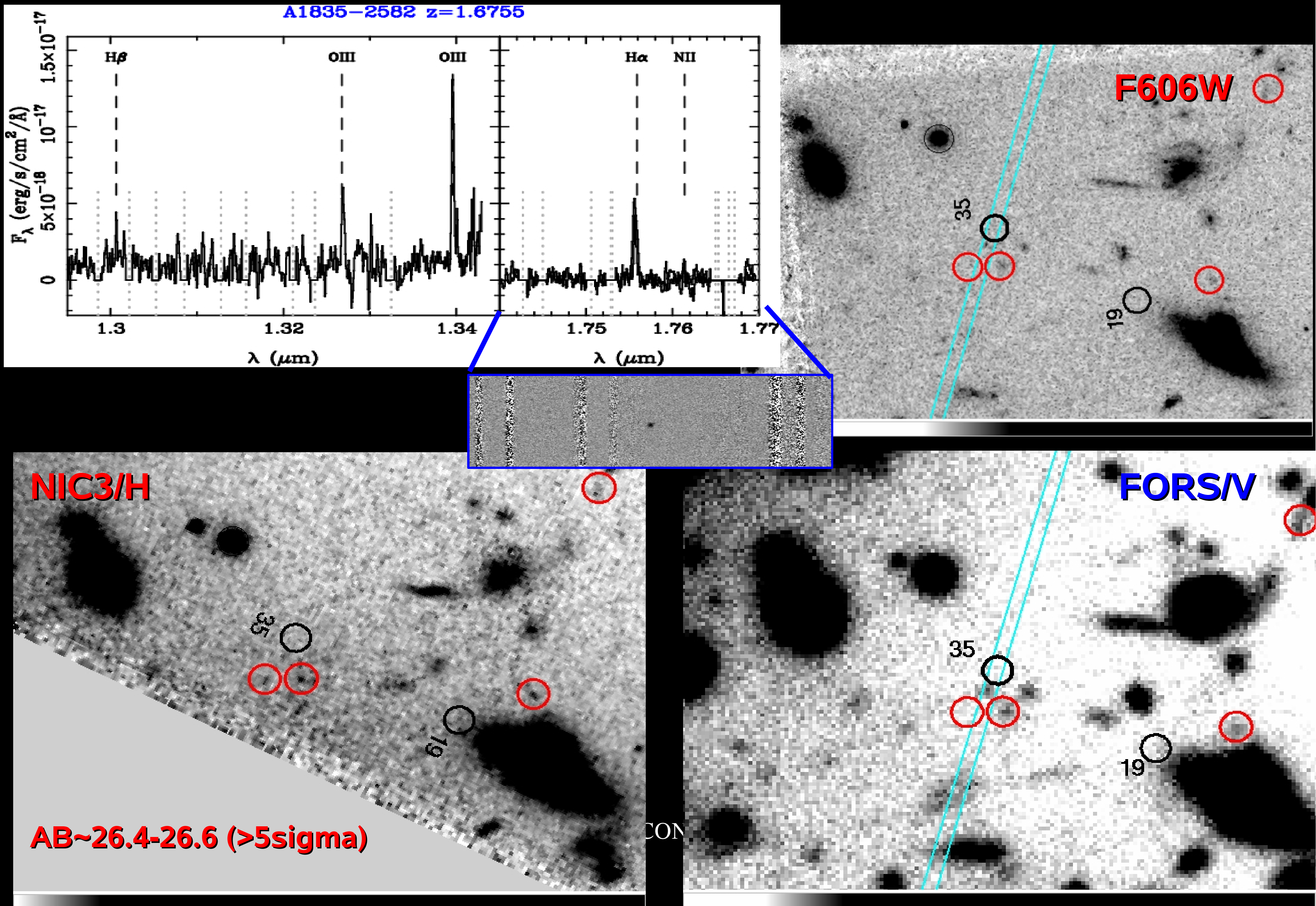
ID	RA (14:)	DEC (02:)	*SZ*	*J*	*H*	*K*	ACS/F850	FORS/V
First-category dropouts								
#1	0:58.278	50:26.65	24.56 ± 0.18	23.14 ± 0.11	22.22 ± 0.10	21.10 ± 0.04	X	
#2	0:57.538	52:49.85	24.80 ± 0.22	24.05 ± 0.27	22.29 ± 0.11	20.95 ± 0.03		
#3	1:01.484	51:03.63	24.03 ± 0.11	24.54 ± 0.42	22.69 ± 0.16	21.71 ± 0.07		X
#4	1:01.733	51:05.26	24.31 ± 0.14	23.50 ± 0.16	22.82 ± 0.18	21.90 ± 0.08	X	?
#5	1:07.034	51:35.71	25.82 ± 0.52	> 25.60	23.24 ± 0.28	23.01 ± 0.55	X	
#7	1:05.067	50:57.52	25.81 ± 0.51	25.34 ± 0.89	23.39 ± 0.32	> 24.70	X	
#8	1:00.058	52:44.08	25.36 ± 0.34	24.99 ± 0.64	23.40 ± 0.32	24.00 ± 0.60		
#10	0:59.890	50:57.59	24.18 ± 0.12	23.74 ± 0.20	23.45 ± 0.33	21.77 ± 0.07	X	X
#11	1:06.182	50:27.74	> 26.90	24.29 ± 0.33	23.54 ± 0.36	21.72 ± 0.07	?	X
#13	1:03.125	51:28.81	> 26.90	24.41 ± 0.38	23.58 ± 0.38	> 24.70		
#14	1:04.209	51:54.55	> 26.90	24.77 ± 0.52	23.63 ± 0.39	24.53 ± 0.97		
#15	1:02.540	51:12.84	> 26.90	25.40 ± 0.94	23.63 ± 0.40	> 24.70		
#16	1:03.657	52:54.83	> 26.90	> 25.60	23.64 ± 0.40	23.08 ± 0.25		
#17	1:05.013	50:27.11	> 26.90	> 25.60	23.71 ± 0.43	22.06 ± 0.10	?	X
#22	1:02.551	51:30.06	25.00 ± 0.24	23.99 ± 0.25	23.81 ± 0.47	22.59 ± 0.16		
#23	1:05.699	51:52.92	> 26.90	24.93 ± 0.61	23.85 ± 0.48	24.03 ± 0.61		
#24	0:58.[illegible]	51:29.[illegible]	> 26.90	25.16 ± 0.75	23.[illegible] ± 0.50	> 24.70		X
#27	1:04.299	51:57.19	> 26.90	> 25.60	23.93 ± 0.53	24.57 ± 1.01		
Second-category dropouts								
#6	0:59.659	50:54.73	> 26.90	> 25.60	23.37 ± 0.31	> 24.70		
#18	0:58.890	51:02.47	> 26.90	> 25.60	23.72 ± 0.43	> 24.70		
#19	1:00.138	52:05.20	> 26.90	> 25.60	23.72 ± 0.43	> 24.70		
#20	0:58.860	51:23.85	> 26.90	> 25.60	23.72 ± 0.43	> 24.70		
#21	0:58.732	51:53.86	> 26.90	> 25.60	23.76 ± 0.44	> 24.70		
#35	1:00.093	52:03.53	> 26.90	> 25.60	24.00 ± 0.50	24.25 ± 0.75		
#31							X	X
#32							?	X
#26								X

#35: spectroscopic confirmation z=1.67

ACS/F850 - FORS/V

- **Robust SZ(Y) re-detections**
- **Among the 1rst rank candidates, #8, #14, #16, #27 are not (re)detected in NIRI or NIC3.**
- **#35 (spectroscopy!) & #26 (low-z) are real, but not (re)detected in NIRI or NIC3!**
- **High contamination by stars & mid-z interlopers: 10/35 dropouts; ~1/4 of faint high-z candidates**

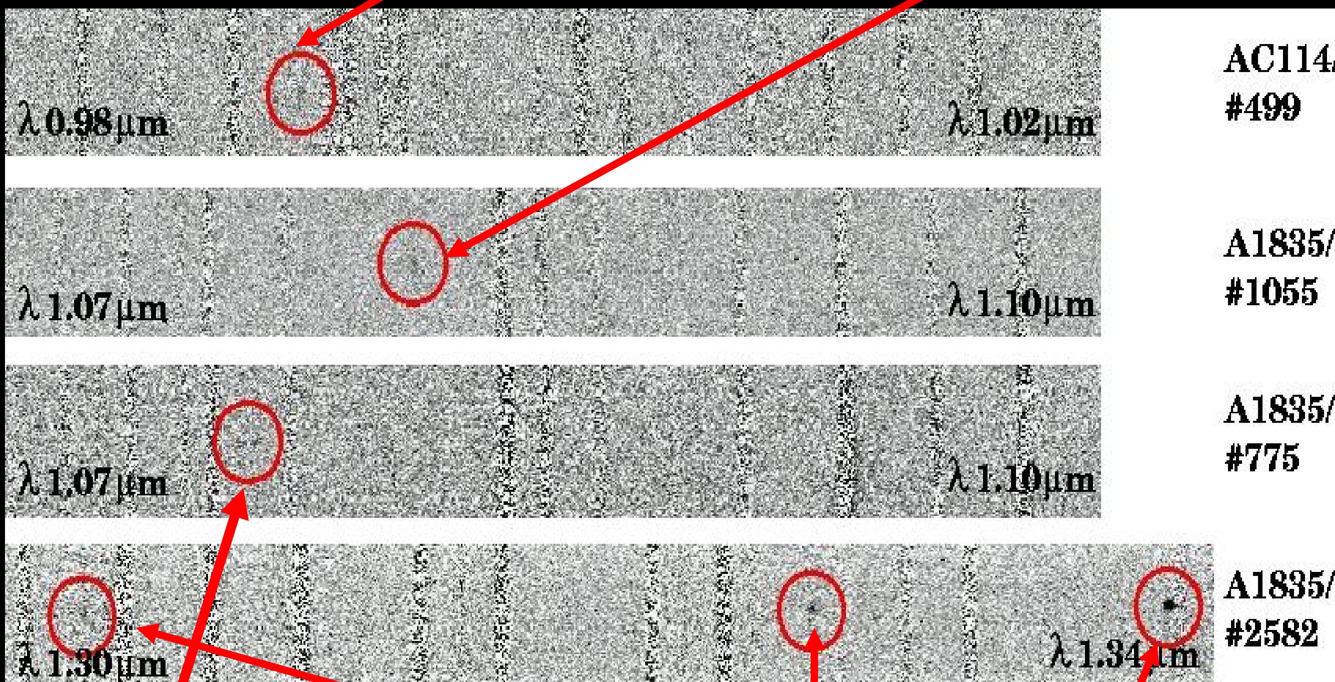
A puzzling source: A1835#135



Spectroscopic follow-up

z=7.17 candidate if Ly α

z=7.89 Candidate if Ly α



z=1.89, doublet of [OII]3727

z=1.67, 3 lines detected (Richard et al. 2003)

A tedious and highly inefficient process with ISAAC/VLT…

- Targets: 2 priority candidates in AC114, and 7 in Abell 1835 (4 ``first priority'' targets and 3 secondary ones). From this sample of 9 targets, 2/3 of the objects observed display emission lines.
- A large majority of our high-z candidates still need to be (re)confirmed, either by a re-detection of a faint emission line, or by the non-detection of other lines expected at low-z.
- FORS/VLT z-band spectra on the "bright" EROs.

See also Pello et al 04, A&A 416, L35; and astro-ph/0410132

Summary/Conclusions

- **Gravitational lensing clusters** are more **efficient** than blank fields to explore the **z~6-7 to 12** domain (same photometric depth and FOV). A significant positive magnification bias expected:
  - for "shallow" surveys/ small FOV
  - increasing for "pessimistic" (or strongly evolving) LFs
  - increasing with z(sources)
- The comparison between N(z,m) in (different) lensing and blank fields helps constraining the faint end of LF.
- Spectroscopic follow up optimized in lensing fields with the new generation of **near-IR multi-object spectrographs** (FOV, multiplexing and spectral resolution).
- Large field-to-field variance in the strong magnification regime and towards the bright end of the LF ==> Wide Field Surveys are also needed.
- First lensing results at 6<z<10 were consistent with a ~constant SFR density up to z~10. The turnover towards the bright end of the LF is not observed. However:

  --> strong field-to-field variance

  --> large corrections have been applied to relatively small samples

  --> low-z contamination (with respect to blank fields) could be higher than expected

==> spectroscopic/photometric confirmation is needed

Thanks!