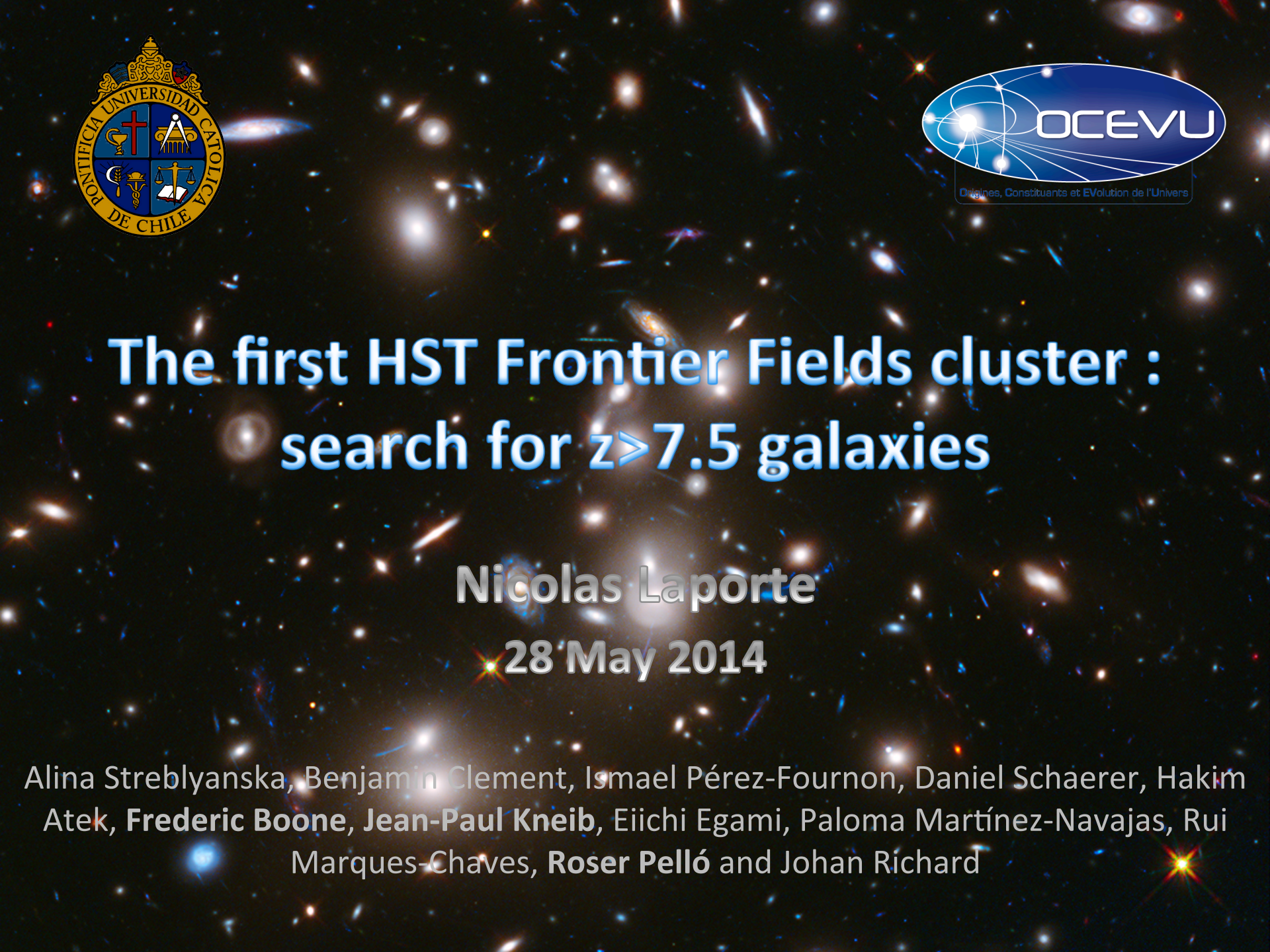

The first HST Frontier Fields cluster : search for z>7.5 galaxies

Nicolas Laporte

28 May 2014

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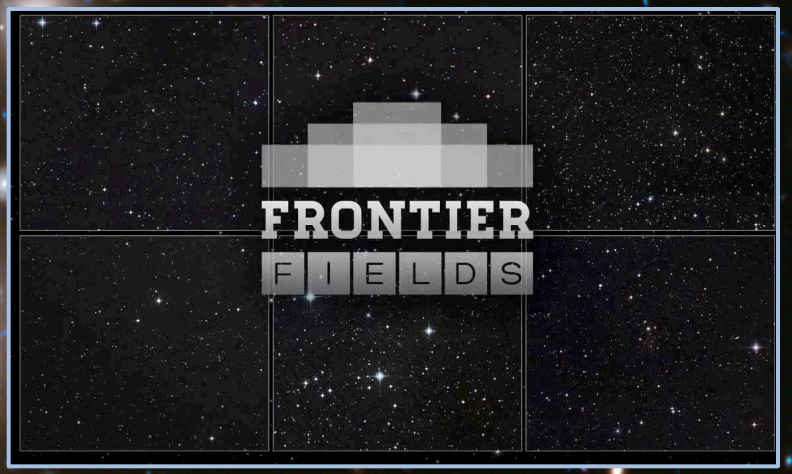
Table of contents

- The Frontier Fields program
- The first data released
- The selection function for z>7.5 objects
- The brightest z=8 candidate
- Next steps

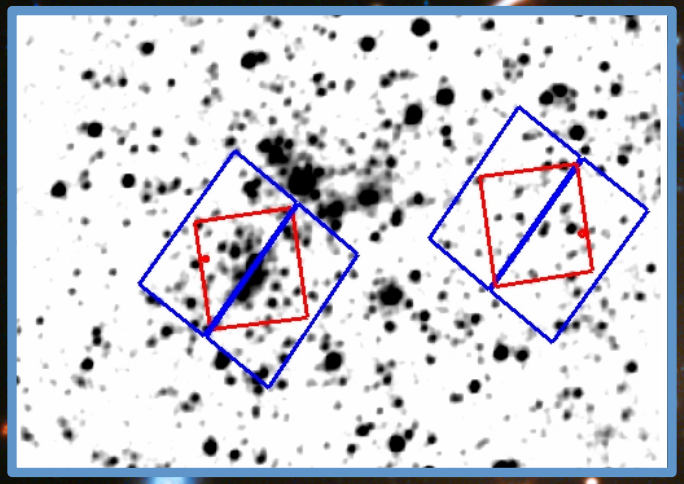


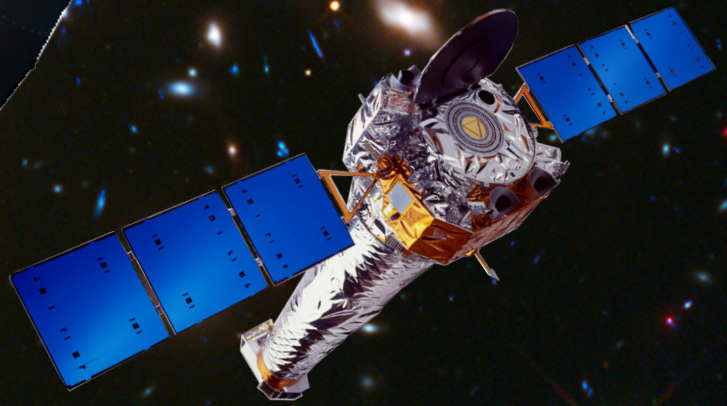
The Frontier Fields program

It is a program involving 3 space telescopes :

- *Hubble Space Telescope*
- *Spitzer Space Telescope*
- *Chandra X-ray observatory*

Six pointing will be made and each pointing combines cluster and blank fields.





The scheduled program

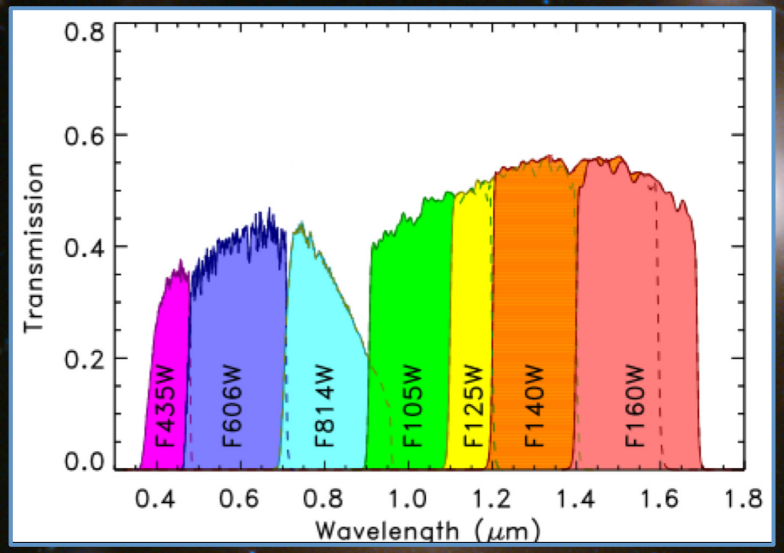
Targets	z	HST Observations	Spitzer observations
Abell 2744	0.308	Oct. 2013 – Jul. 2014	Sep. 2013 – Feb. 2013
MACSJ0416.1-2403	0.396	Jan. 2014 – Sept. 2014	Dec. 2013 – Apr. 2014
MACSJ0717.5+3745	**0.545**	**Oct. 2013 – May. 2015**	**Jan. 2013 – Jun. 2014**
MACSJ1149.5+2223	**0.543**	**Nov. 2013 – Jul. 2015**	**Jul. 2013 – Aug. 2014**
Abell S1063	0.348	2016 (to be confirmed)	If HST confirmed
Abell 370	**0.375**	**2016 (to be confirmed)**	**If HST confirmed**

- HST observations are made using DDT time (PI : J. Lotz) and are reduced and released by the STScI every Friday after observations
- Spitzer observations will be finished during summer 2014 and the raw data are available ≈1 week after.
- 3 clusters are in the Northern Hemisphere and 3 in the South.

The first data released : Abell 2744

The first HST Frontier Fields data has been released on December 17 and included :

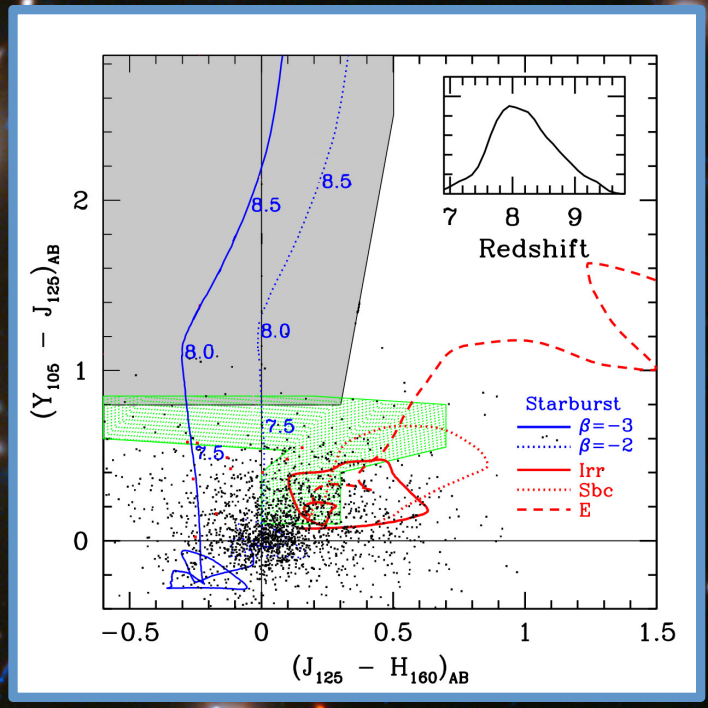
- 100% of WFC3 data (near infra-red)
- 50% of scheduled ACS observations (optical)



Filter	$\lambda_{central}$ [μm]	t_{exp} [ks]	m(5σ) [AB]
B_{435}	0.431	16.16	27.4
V_{606}	0.589	13.25	28.0
z_{814}	0.811	13.25	27.1
Y_{105}	1.050	46.52	28.6
J_{125}	1.250	16.32	28.5
JH_{140}	1.400	22.43	28.7
H_{160}	1.600	46.57	28.2

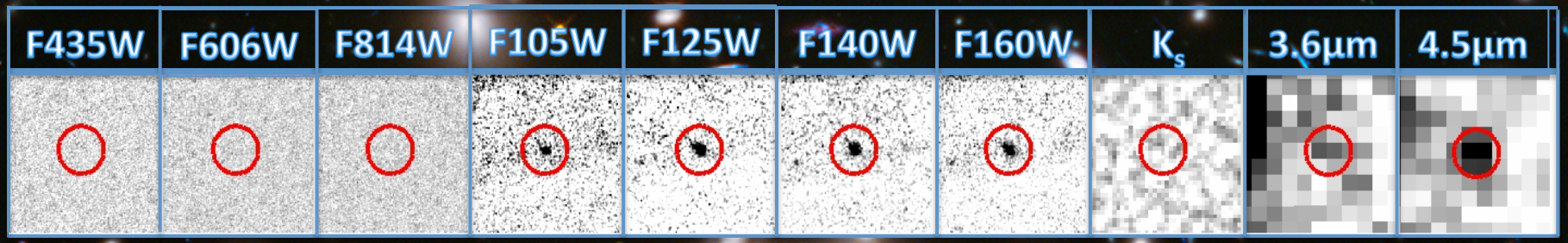
The selection function to select z>7.5 objects

- We applied the Lyman Break technique combining non-detection/detection and colors criteria (Steidel et al. 1996)
- To minimize the selection of mid-z interlopers, we imposed a break of at least 2 magnitudes between optical and NIR data.
- The selection function we applied was :
  - B_{435}, V_{606}, z_{814} > m(2σ)
  - J_{105} < m(10σ)
  - Color-criteria



Bouwens et al. (2010)

The brightest z≈8 galaxy candidate



Laporte et al. (2014)

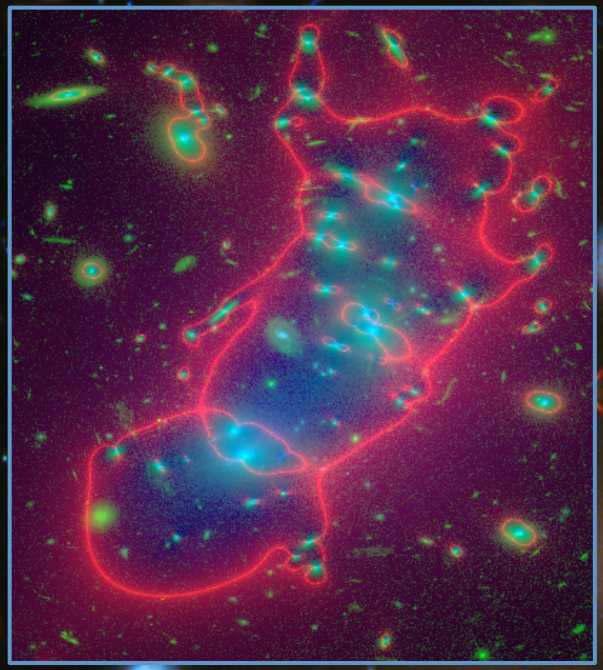
Filter	m(AB)
F435W	>28.4
F606W	>29.0
F814W	>28.1
F105W	27.50 ± 0.08
F125W	26.32 ± 0.04
F140W	26.26 ± 0.03
F160W	26.25 ± 0.04
K_s	>25.9
3.6µm	26.08 ± 0.14
4.5µm	25.16 ± 0.16

We combined the HST images with Spitzer data and noticed that we have another "break" in these data.

The photometry at 4.5µm could be contaminated by [OIII] and Hβ emission lines at z≈8.

Amplification Maps

- Several amplification maps have been provided for each Frontier Fields cluster.
- This object is located on the edges of the WFC3 images, therefore the magnification factor is relatively modest (μ=1.5)



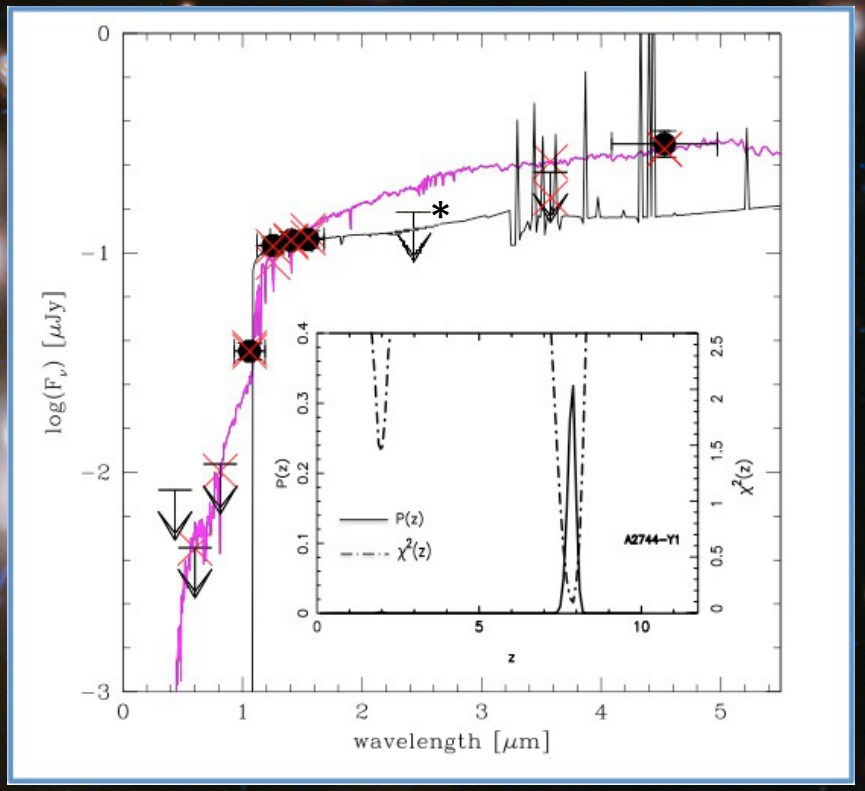
Richard et al. 2014

Photometric properties

We used Hyperz (Bolzonella et al. 2000) and a standard templates library to compute several properties of this object.

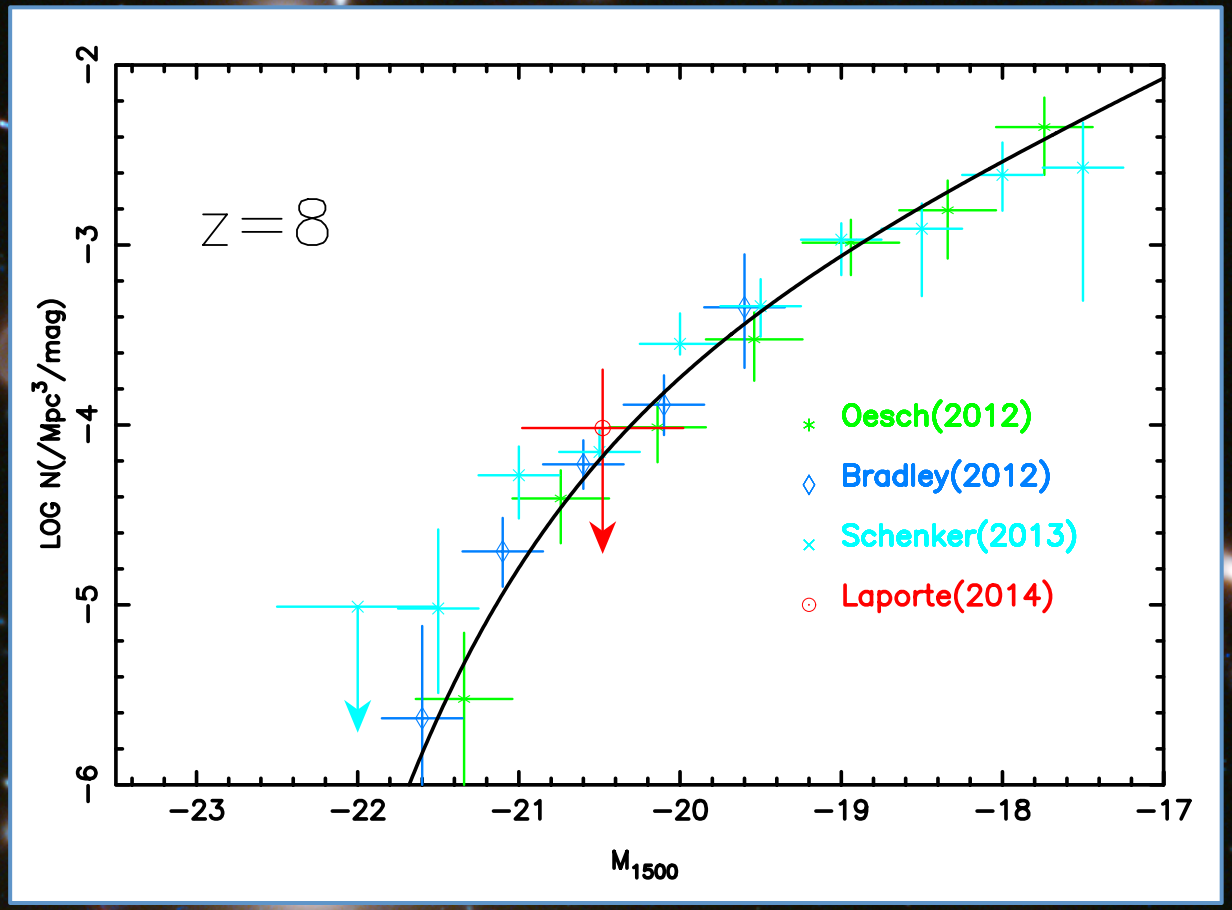
Depending on the metallicity, we estimated the following parameters :

- SFR : 8 – 60 $M_\odot$/yr
- Av : 0.05 – 0.8 mag
- $M_\star$: (2.5-10)x10^9 $M_\odot$
- Log(LIR)=9.7 – 11.4
- EW[OIII]≈600 Å
- EW[Hβ]≈190 Å
- r≈0.35±0.15 kpc (using Galfit)



* Non-detection on FourStar@Magellan K_s image (Thanks to CLASH collaboration)

The UV Luminosity Function



Next steps : at short term

- **On that particular object :**

→ ALMA observations approved
→ Deep FourStar and HAWKI K_s images awaited
→ Spectroscopic confirmation proposed to ESO, Gemini and Magellan

- **On Abell 2744 :**

→ Final HST data awaited during summer
→ Chandra observations will be released at the end of 2014
→ Spectroscopic observations of z<6.5 targets (e.g. MUSE@ESO)
→ Spectroscopic observations of all z>6.5 targets (e.g. KMOS@ESO)

Next steps : at mid/long term

At mid-term :

→ The arrival of EMIR@GTC (expected 2015) will allow us to observe by spectroscopy bright z=7, 8 and 9 (?) objects in the Northern Hemisphere

At long-term :

→ MOONS @VLT, WISH (not before 2019)

→ For the spectroscopic confirmation of the faintest objects : JWST, ELT and SPICA