Exploring the formation epoch of massive galaxies

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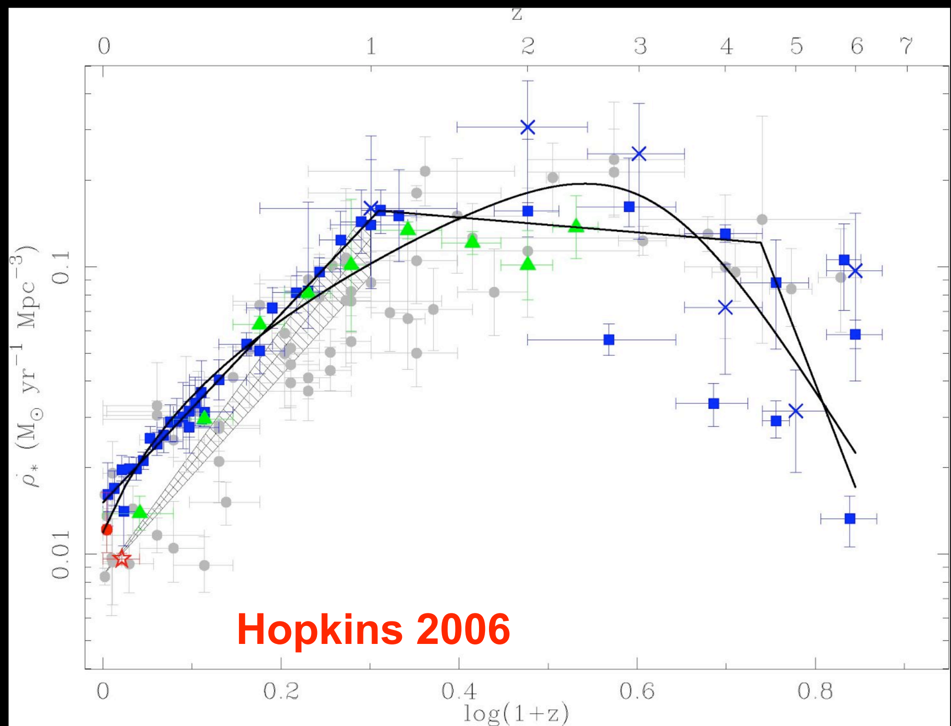
Delineating cosmic star-formation history

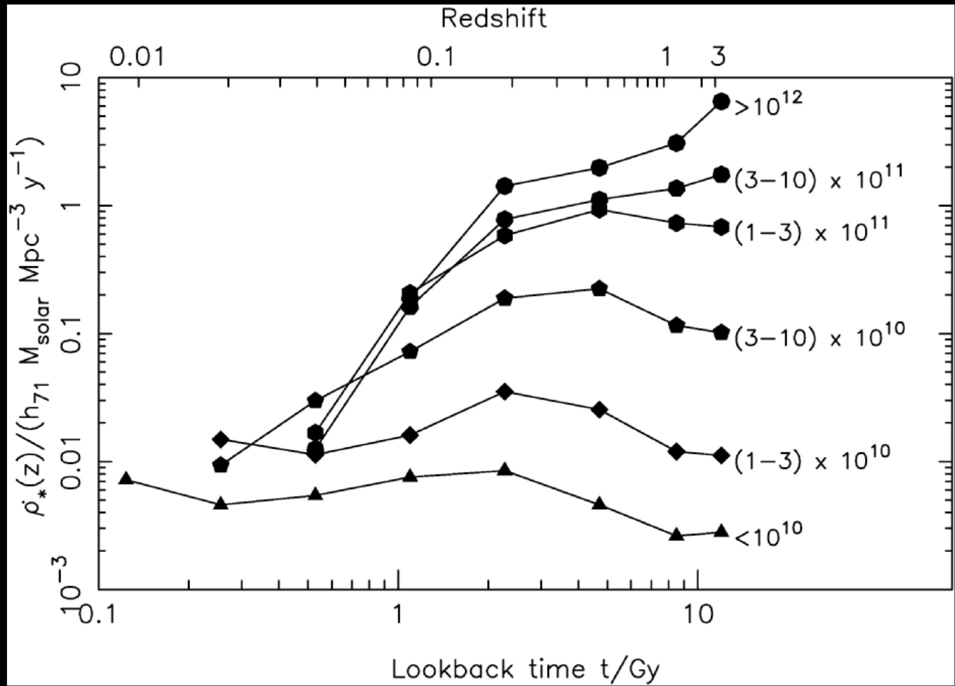
1) Direct observation of star-formation activity with z



Delineating cosmic star-formation history

1) Direct observation of star-formation activity with z

2) From the fossil record (e.g. Heavens et al. 2004)



Delineating cosmic star-formation history

1) Direct observation of star-formation activity with z

2) From the fossil record (e.g. Heavens et al. 2004)

3) By measuring stellar mass in place as a function of z

Needs

- deep near-mid infrared surveys

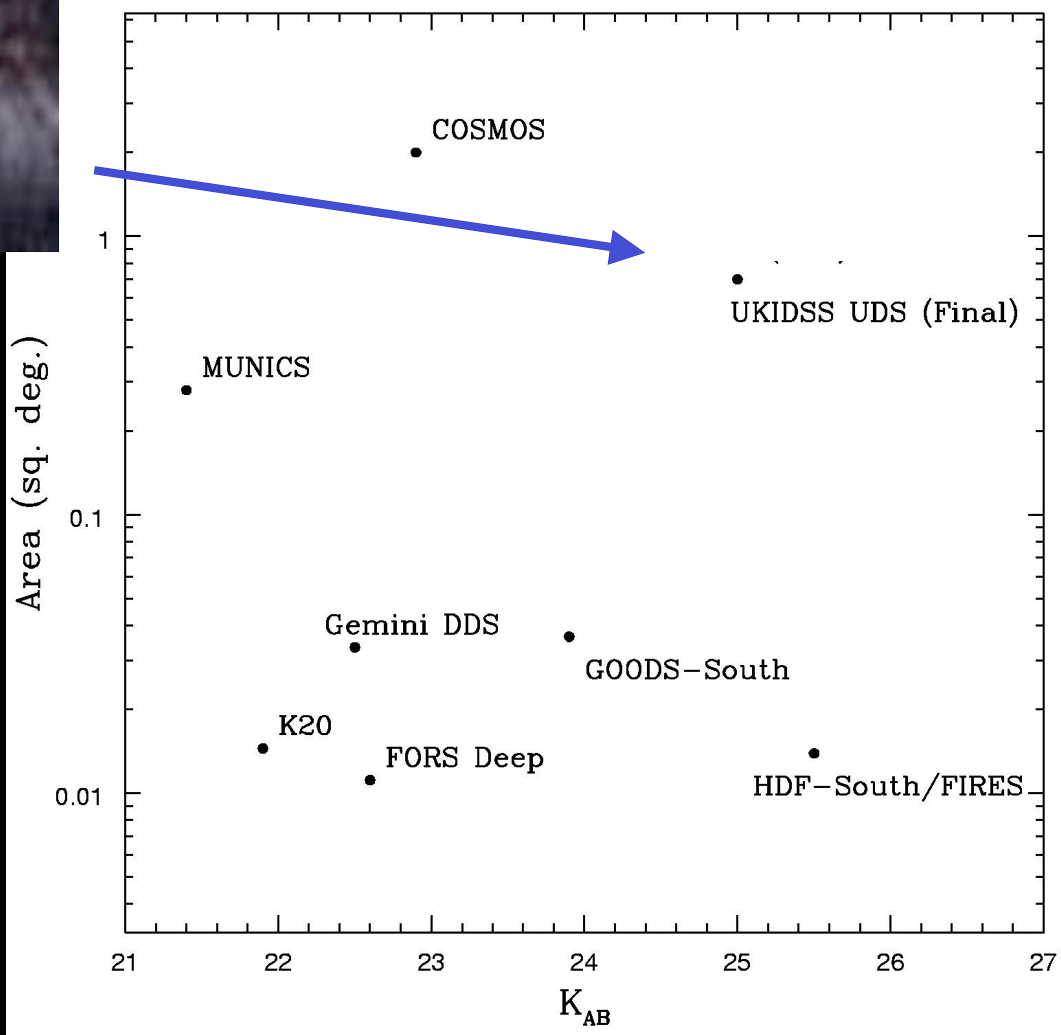
with

- multi-frequency supporting data

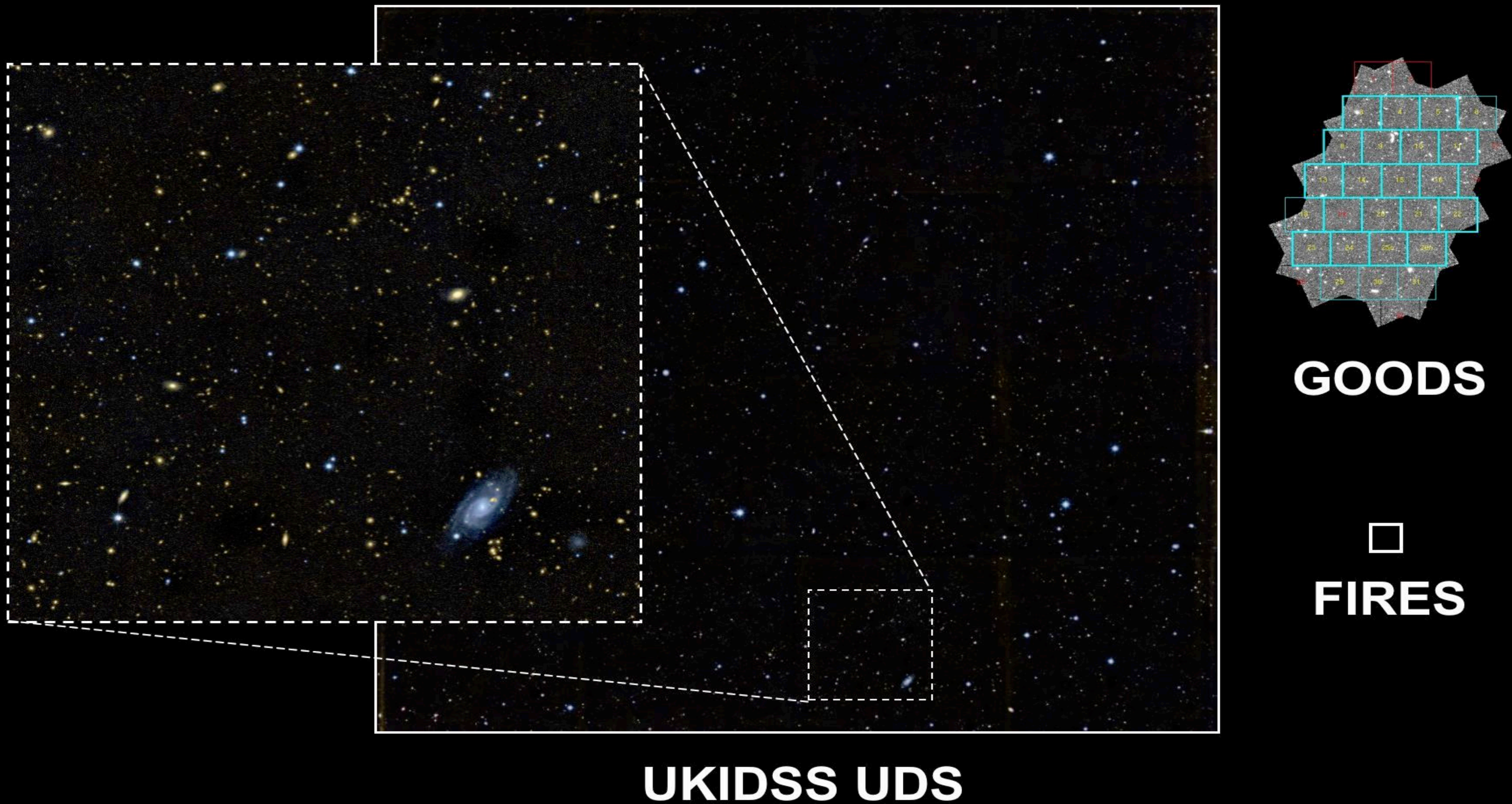
Deep IR surveys

e.g. K20, FIRES, MUNICS, GDDS, K21, GMASS, GOODS...

UKIRT Infra-red Deep Sky Survey

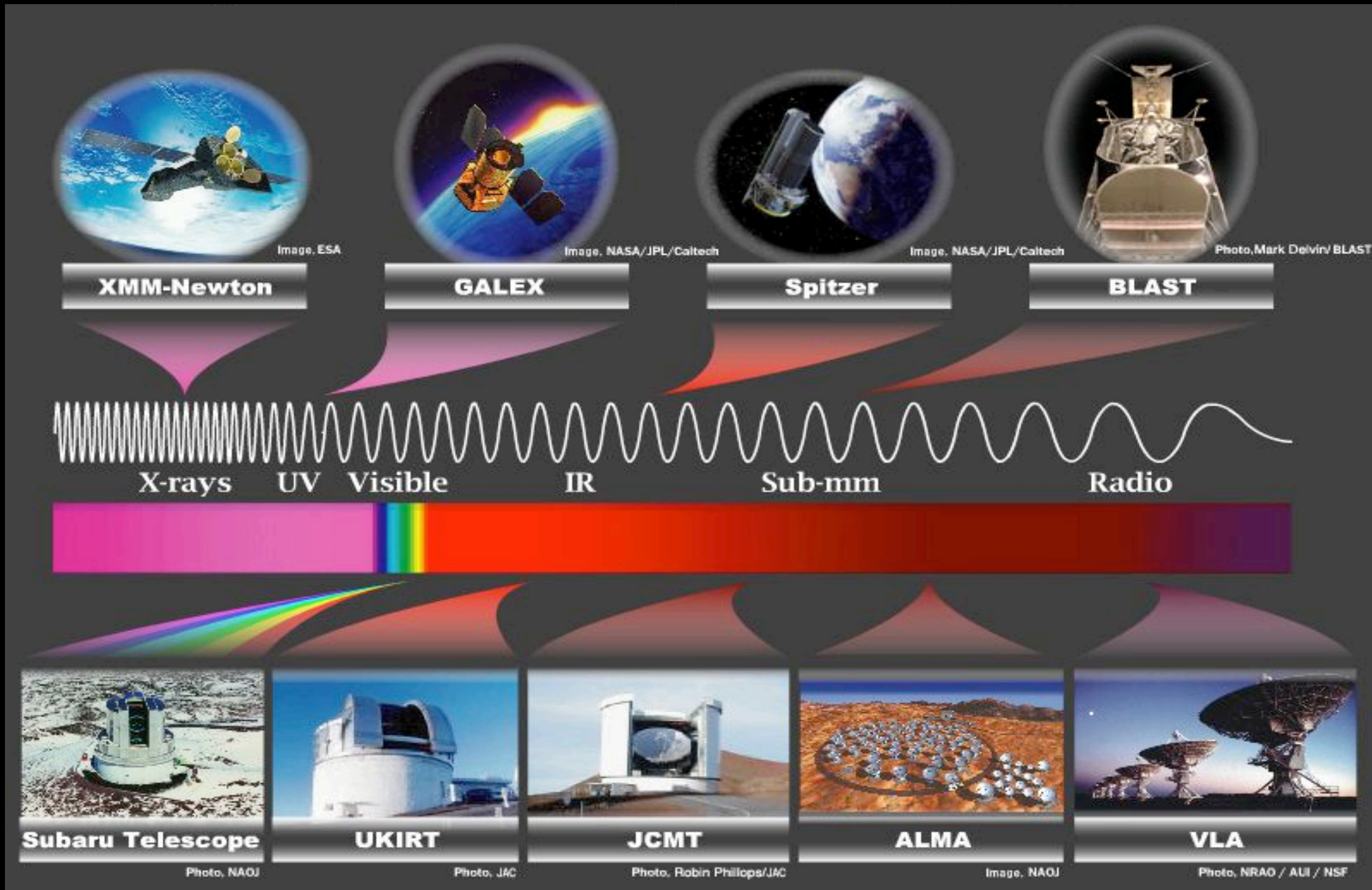


UKIDSS Ultra Deep Survey



Courtesy of Omar Almaini

UKIDSS Ultra Deep Survey



UKIDSS Ultra Deep Survey

Cirasuolo et al. 2006, 2007

K(AB) = K(Vega) +1.9

~50,000 IR-selected galaxies with K(AB) < 23 over an area of 0.7 sq. deg

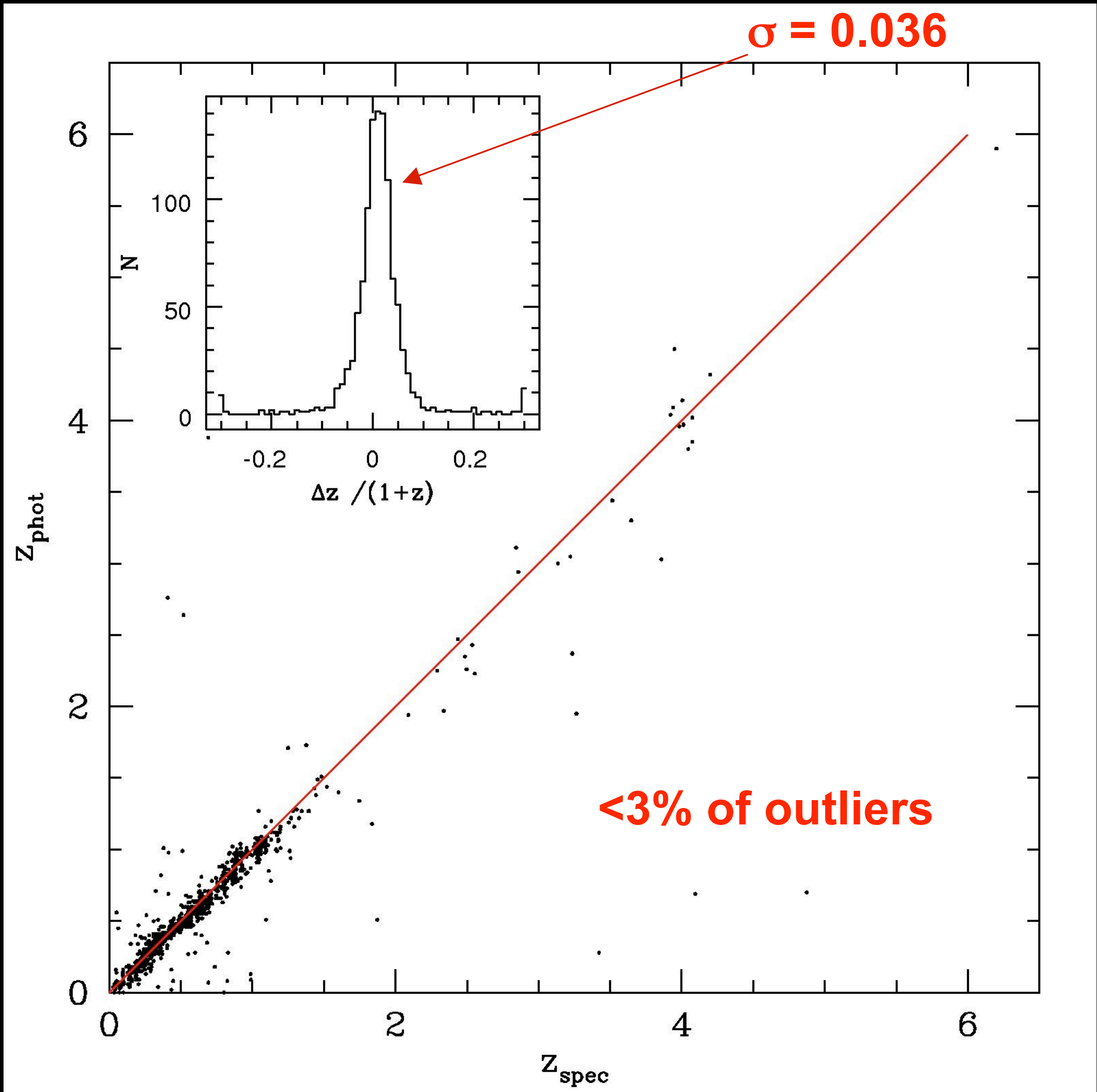
16 wavebands photometry available

GALEX	FUV, NUV
SUBARU	B,V,R,I,z
CFHT	u,g,r,i,z
UKIRT	J, K
Spitzer IRAC	3.6, 4.5 μm

And by the beginning of next year:

- **H band data UKIRT**
- **Deeper u-band from CFHT**
- **300h with Spitzer IRAC and MIPS 24μm**
- **290h VLT time with VIMOS and FORS**

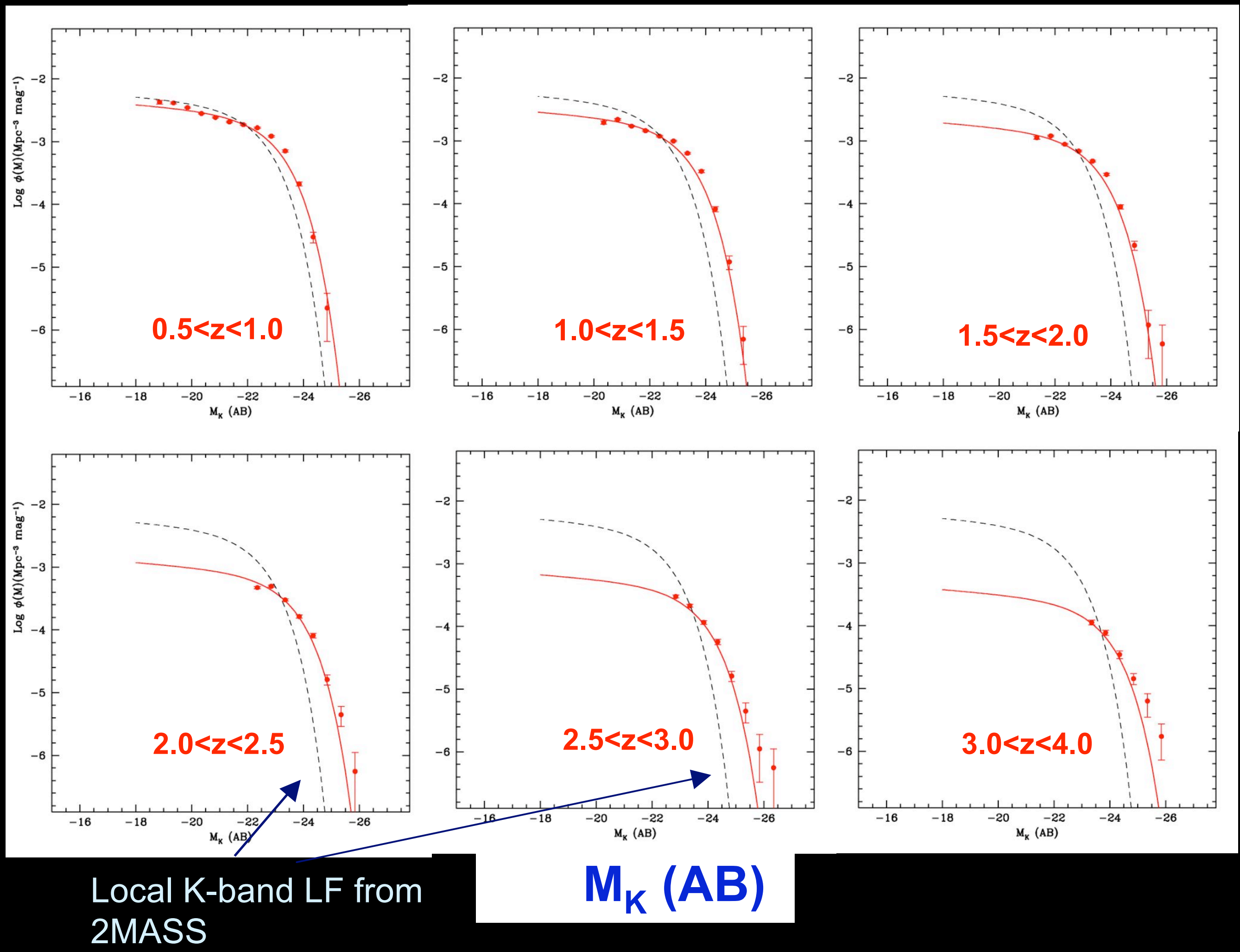
Quality of the dataset



~1200 galaxies with good quality spectra

Evolution of the near-IR galaxy LF

50,000 galaxies with K(AB) ≤ 23.0



M_K (AB)

Schechter function
with

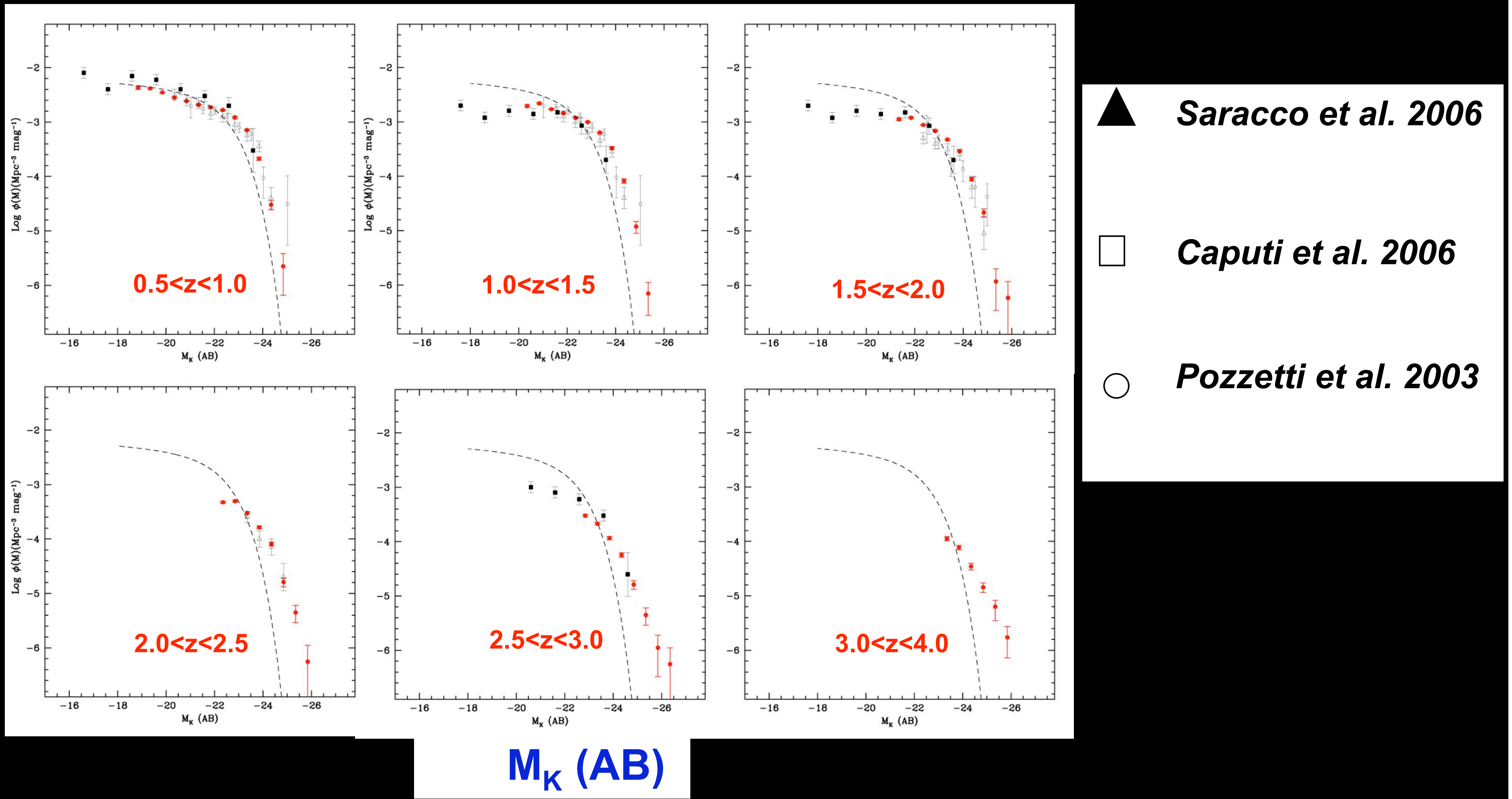
Luminosity evolution

+

Density evolution

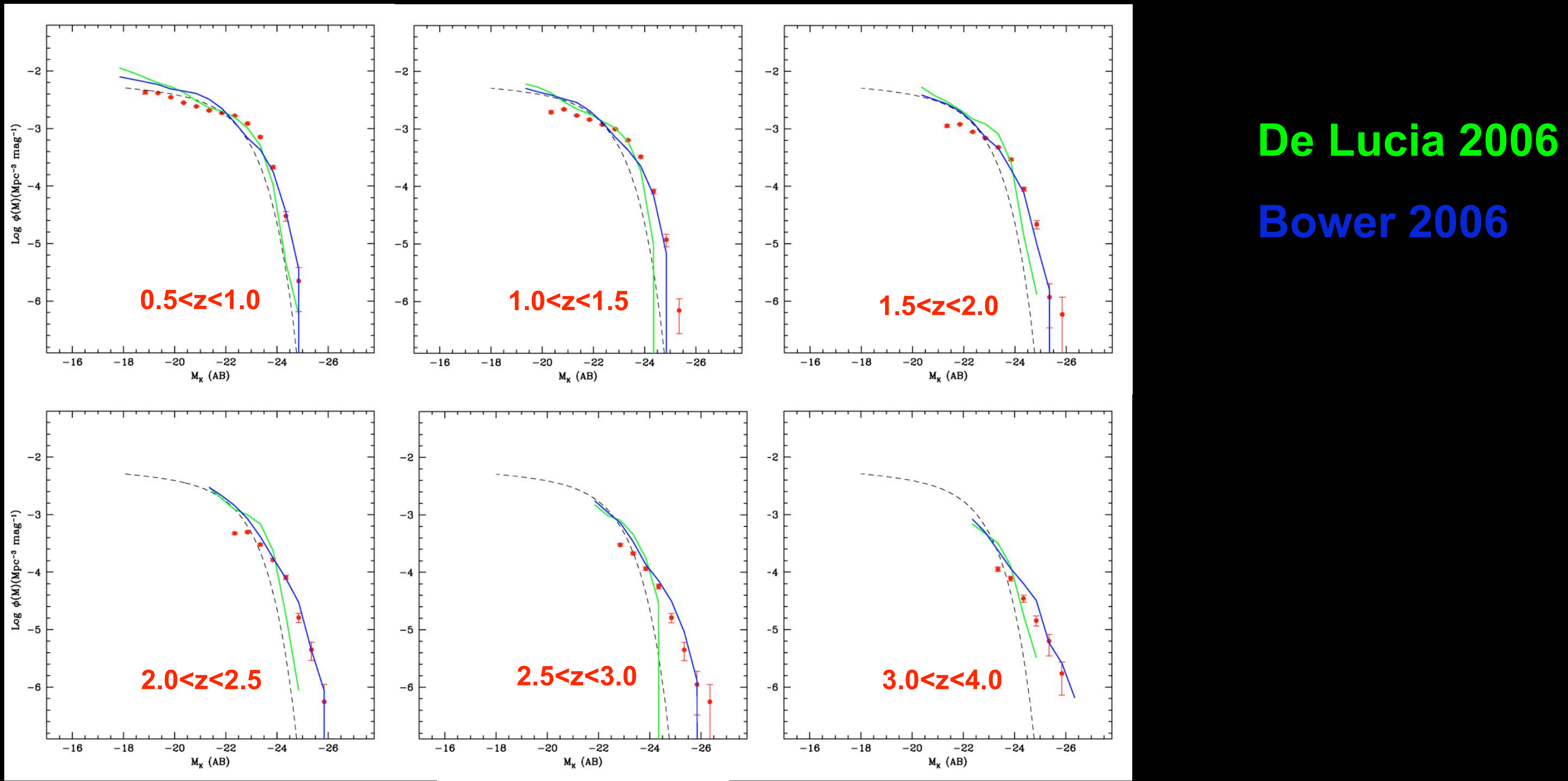
Evolution of the near-IR galaxy LF

Comparison with some results in literature



Evolution of the near-IR galaxy LF

Comparison with semi-analytical models



M_K (AB)

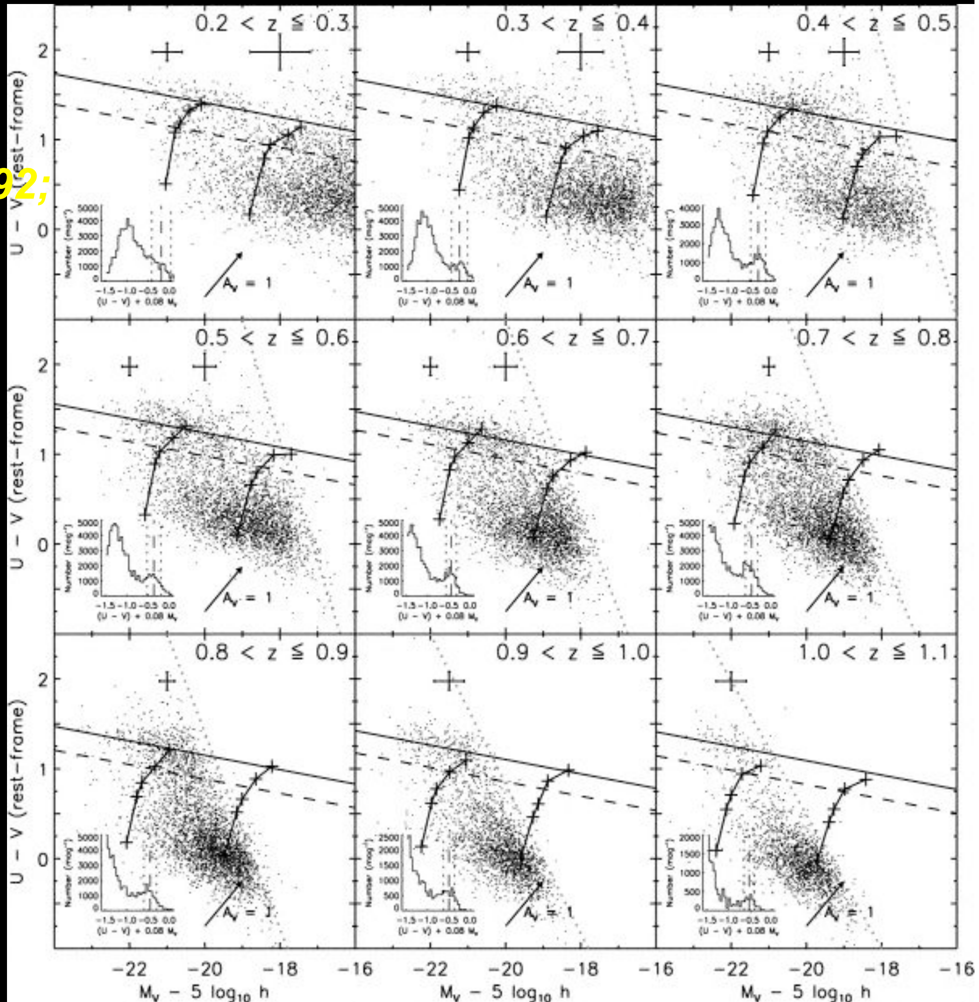
The colour bimodality

Well studied in the local Universe

Visvanathan & Sandage 1977; Bower et al. 1992; Starteva et al. 2001; Baldry et al. 2004

Extended up to z ≈ 1

Bell et al. 2004; Willmer et al. 2005; Franzetti et al. 2006



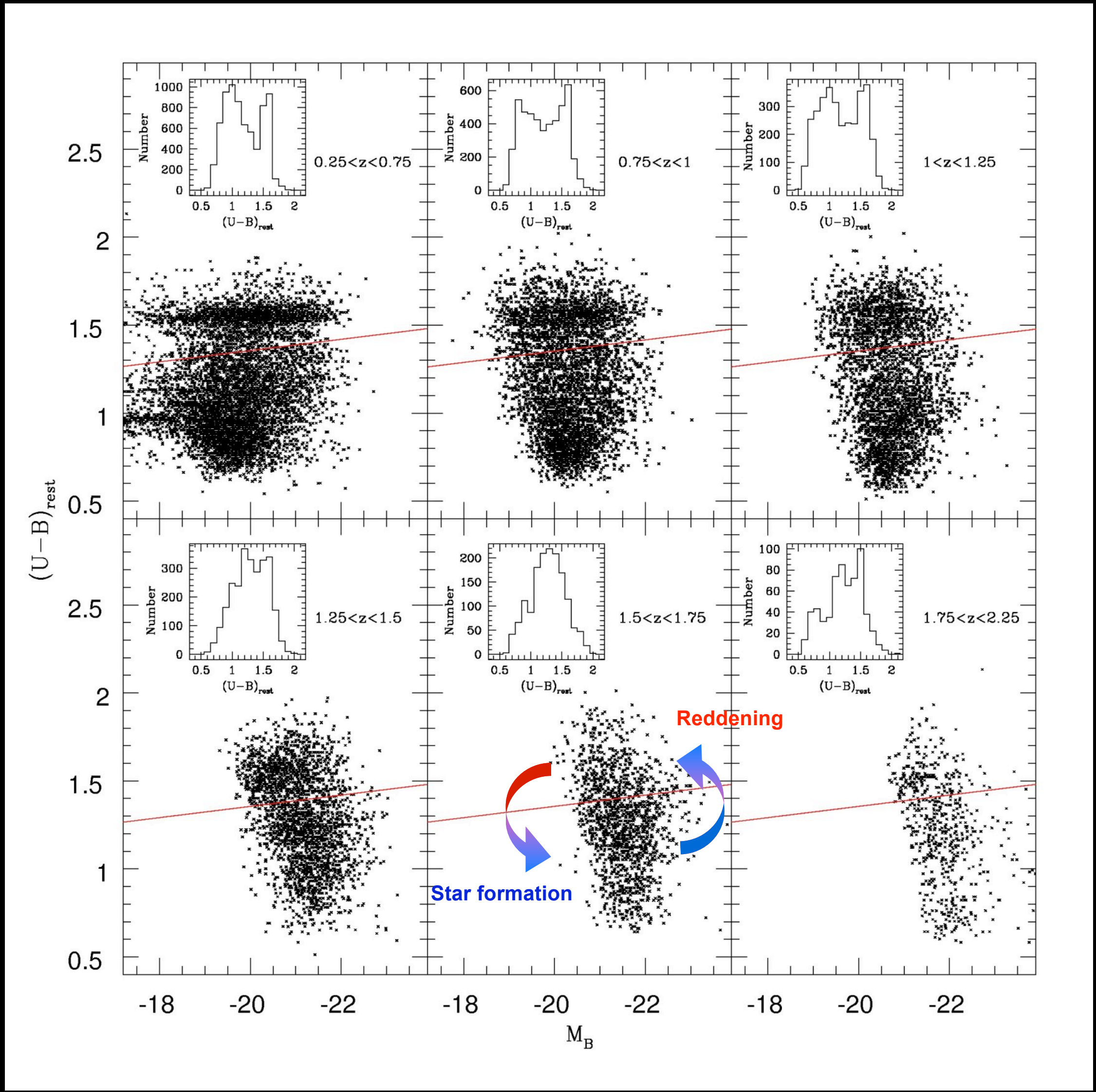
Bell et al. 2004 Combo-17 R < 24

The evolution of colour bimodality

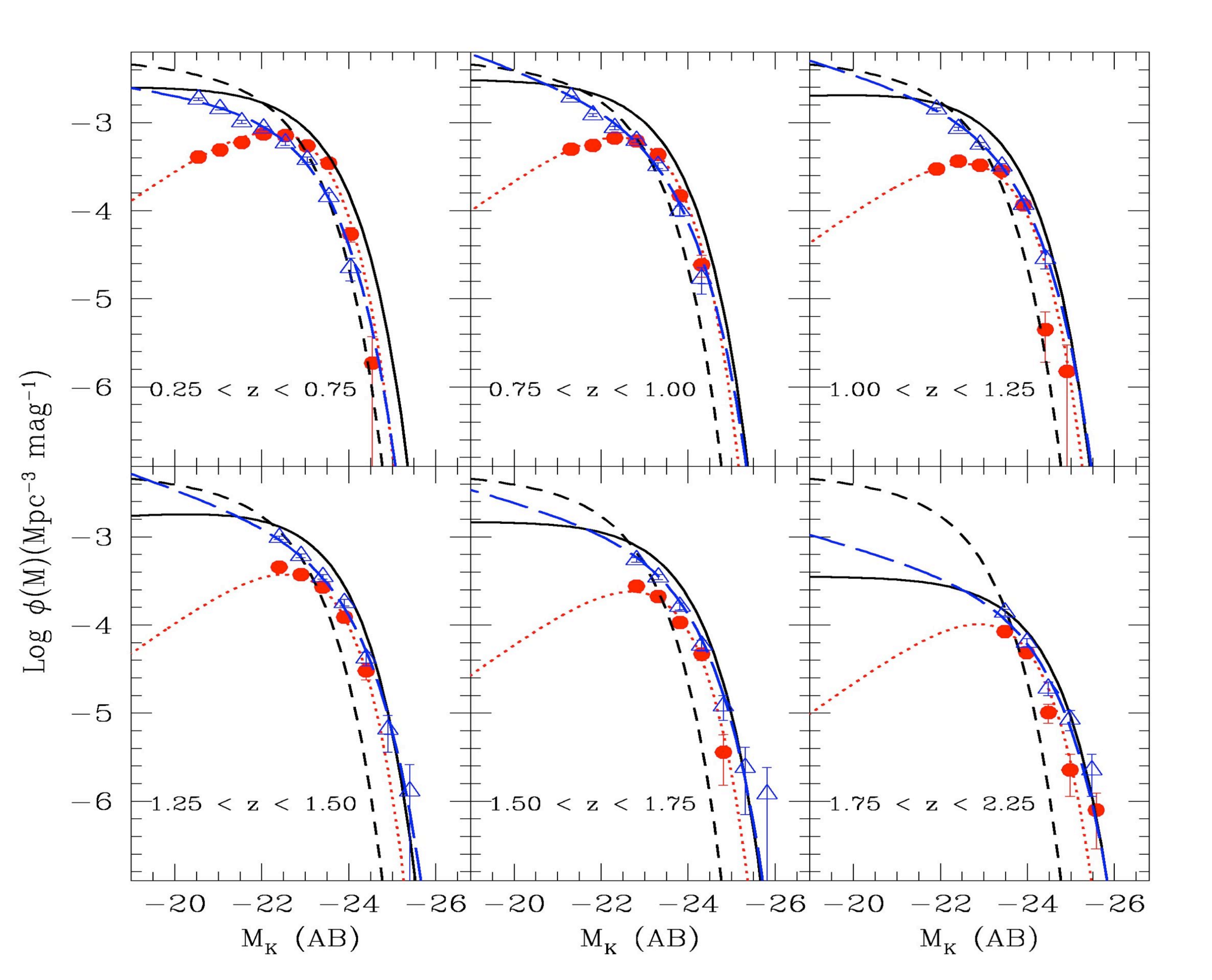
Primary selection in K-band ⇒ No bias against red objects

Confirm the luminosity dependent colour bimodality at z<1

Strength decreases with redshift and seems to disappears by z>1.5



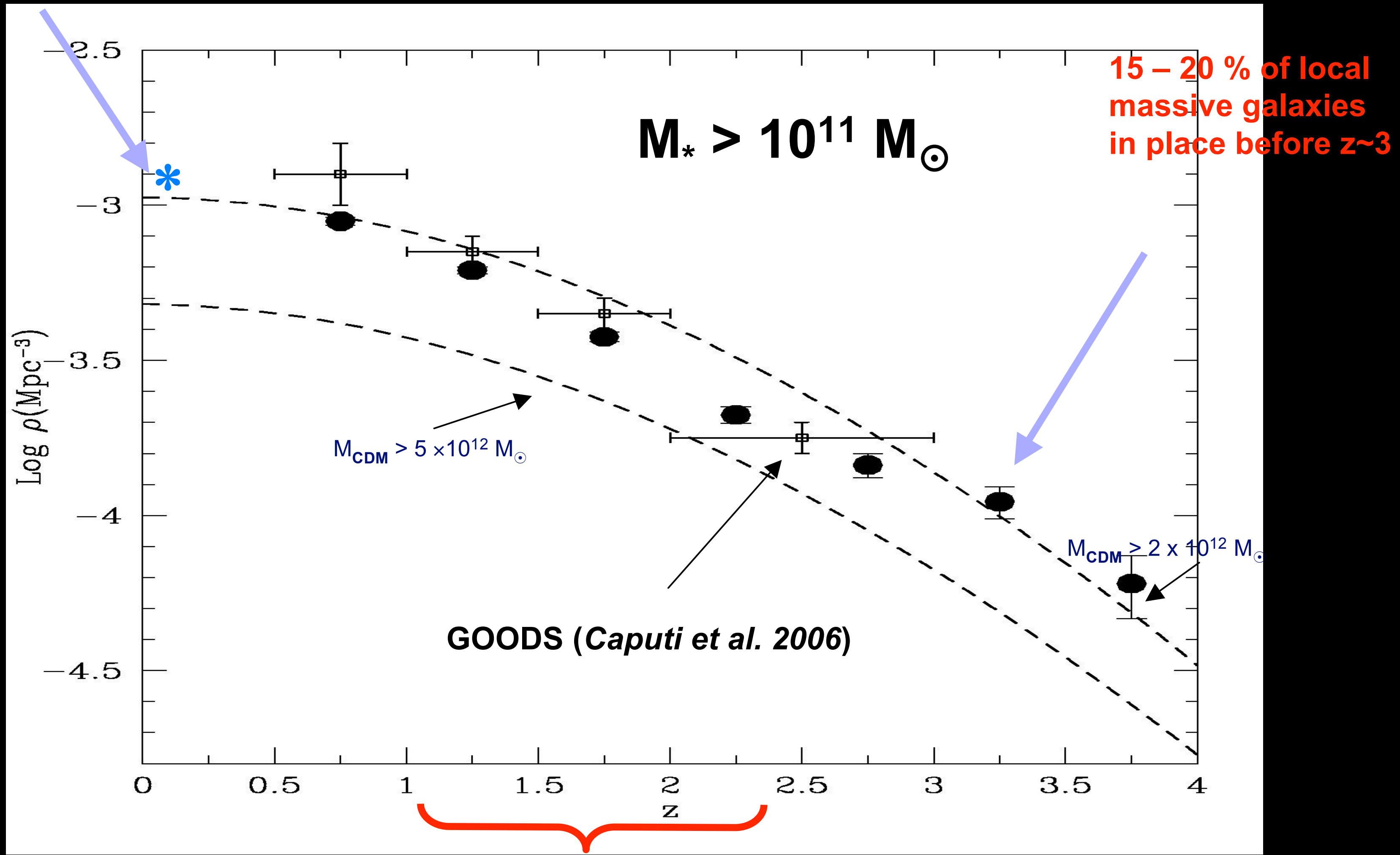
LF by colour type



The most massive galaxies

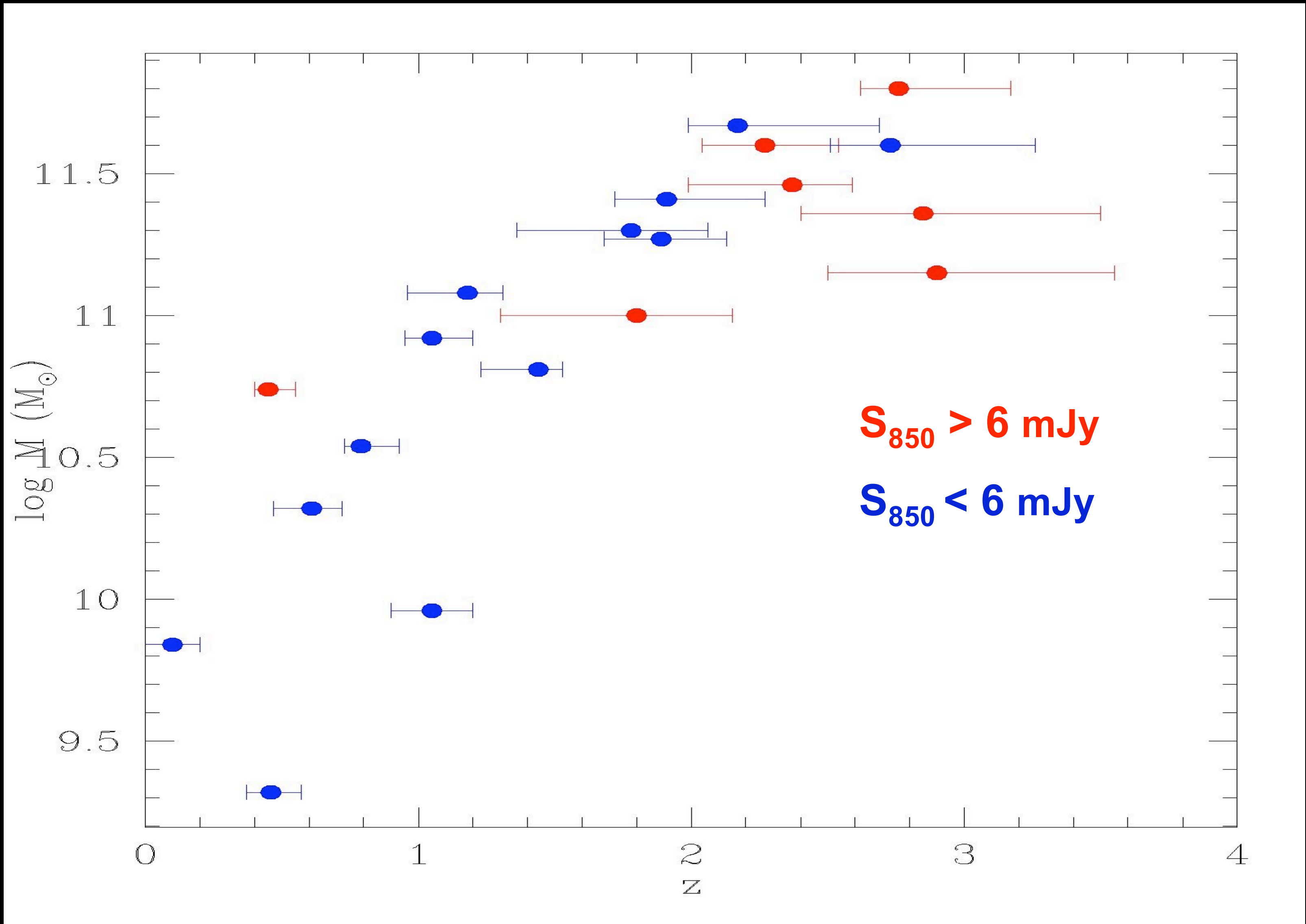
The most massive galaxies

Local space density

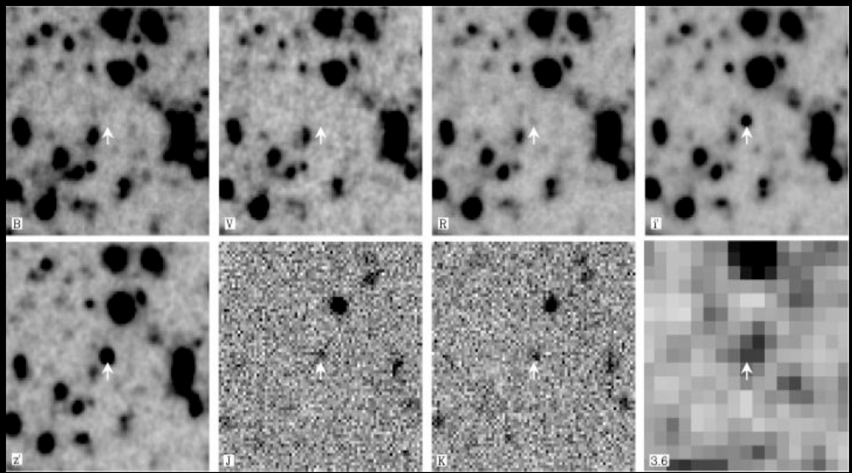


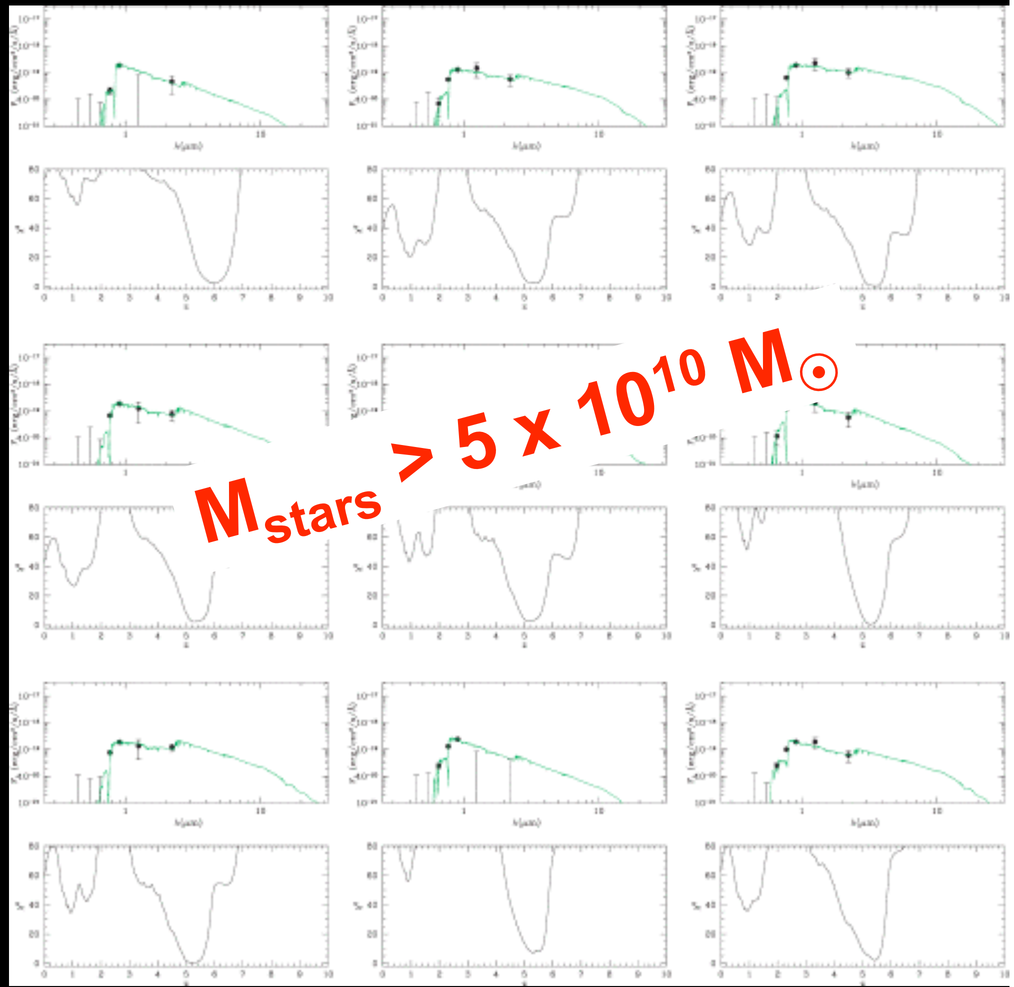
The assembling of 80% of massive galaxies occurs in the range 1 < z < 3

The obscured growth



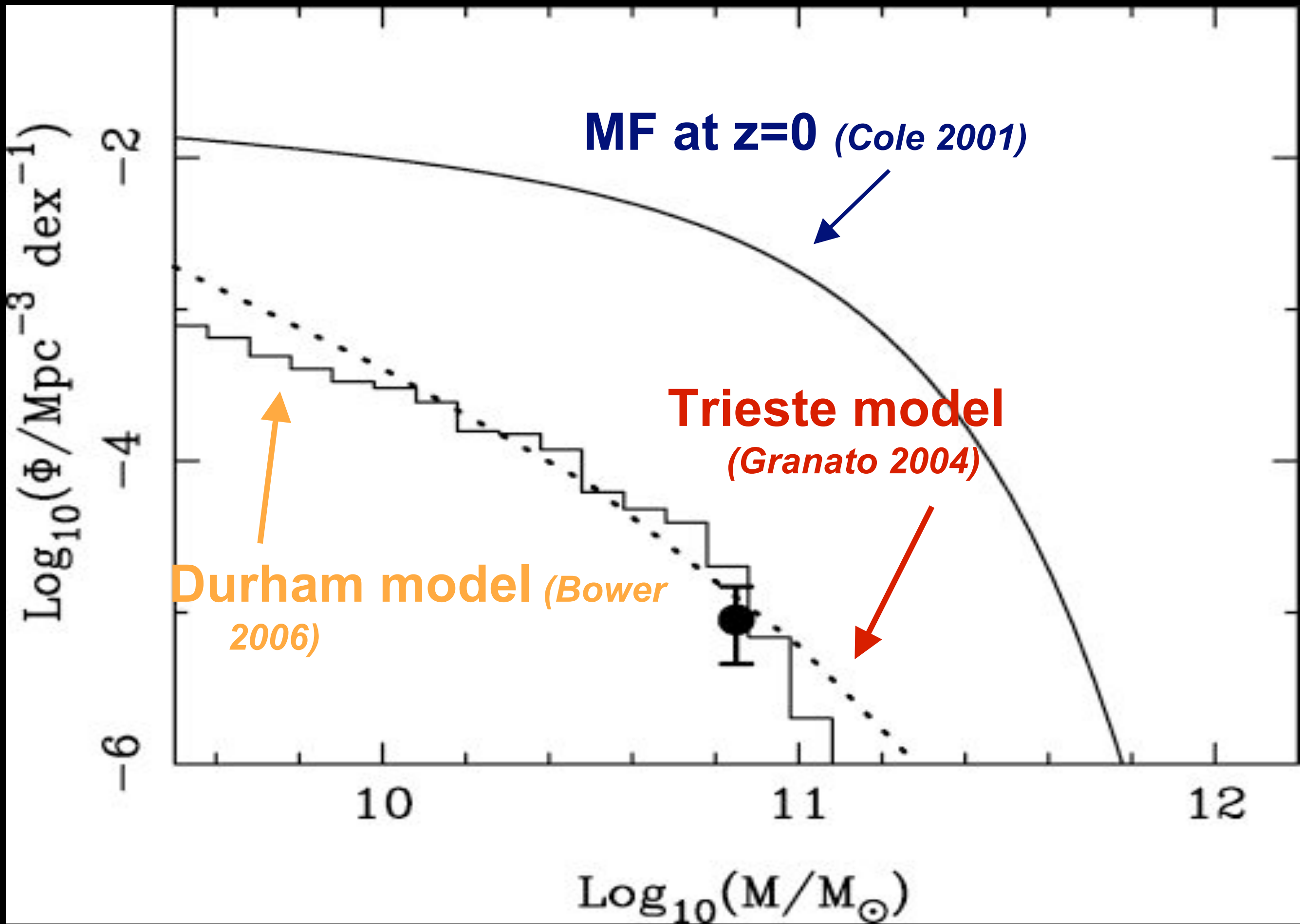
The very high-z Universe





McLure, Cirasuolo, Dunlop et al., 2006, MNRAS

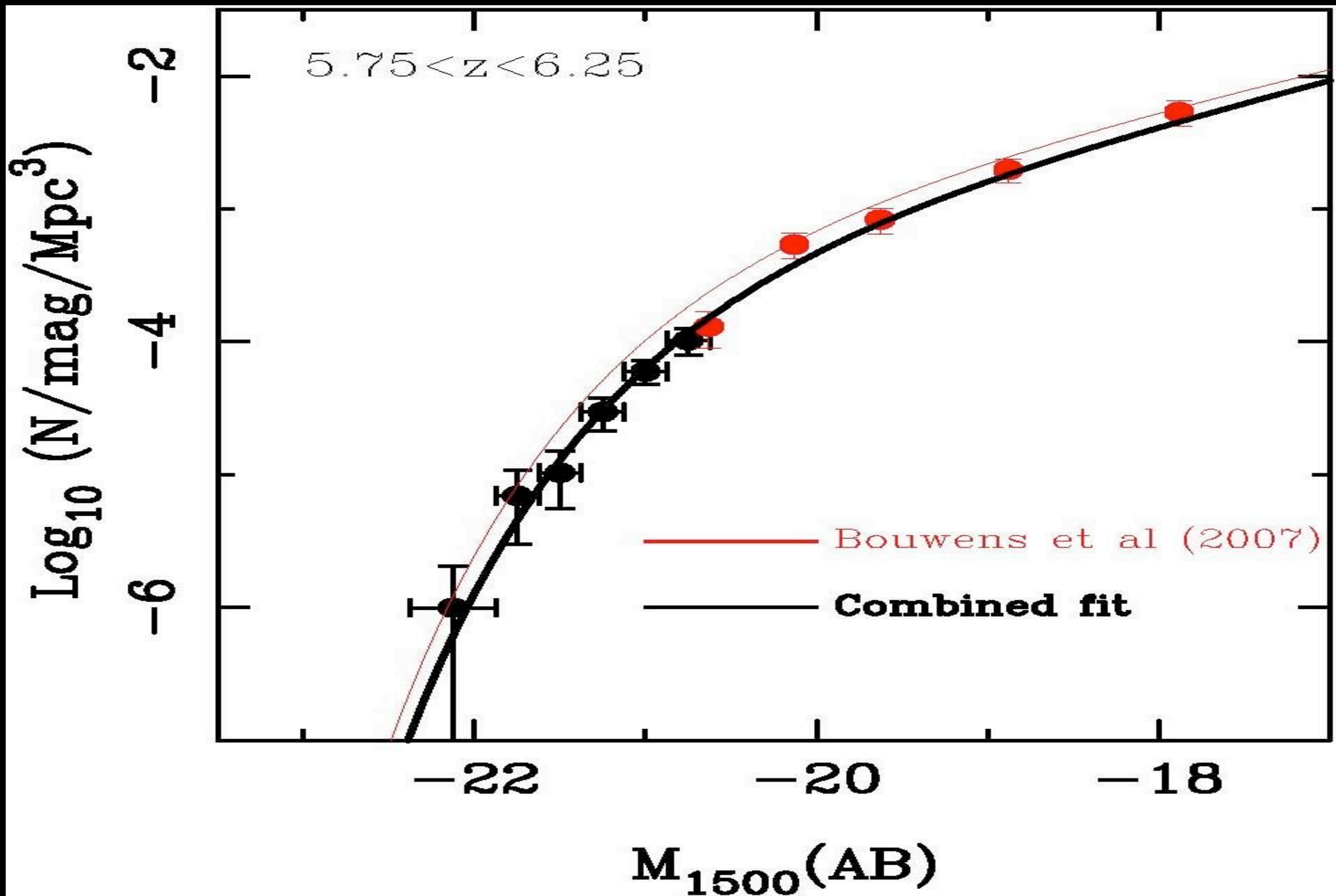
Comparison with models



Uncertainties on IMF, σ_8

McLure, Cirasuolo, Dunlop et al., 2006, MNRAS

Preliminary results at z~6



McLure, Cirasuolo, Dunlop et al., in prep.

Conclusions and future prospects

- ✓ **Strong evolution of the LF with a brightening of ~1 mag between z=0 and z~4**
- ✓ **Nearly 80% of massive galaxies are already in place at z>1**
- ✓ **At low-z the massive systems are red and passive evolving**
- ✓ **At z ≥ 1 star-formation in most of massive galaxies**
- ✓ **Down-sizing mass assembly of sub-mm galaxies**

In the near future:

- ➢ **300h Spitzer MIPS and IRAC**
- ➢ **VLT spectra with both VIMOS & FORS**

→ **Better determination of masses star-formation, environment**

Search for high-z galaxies.

… and a bit later:

- ❖ **SCUBA2, Hershel, VISTA, LOFAR, ALMA etc.**
- ❖ **and hopefully SPACE** (*see M. Robberto's poster*)