Color distribution of galaxies in the CFHTLS-DEEP T03:

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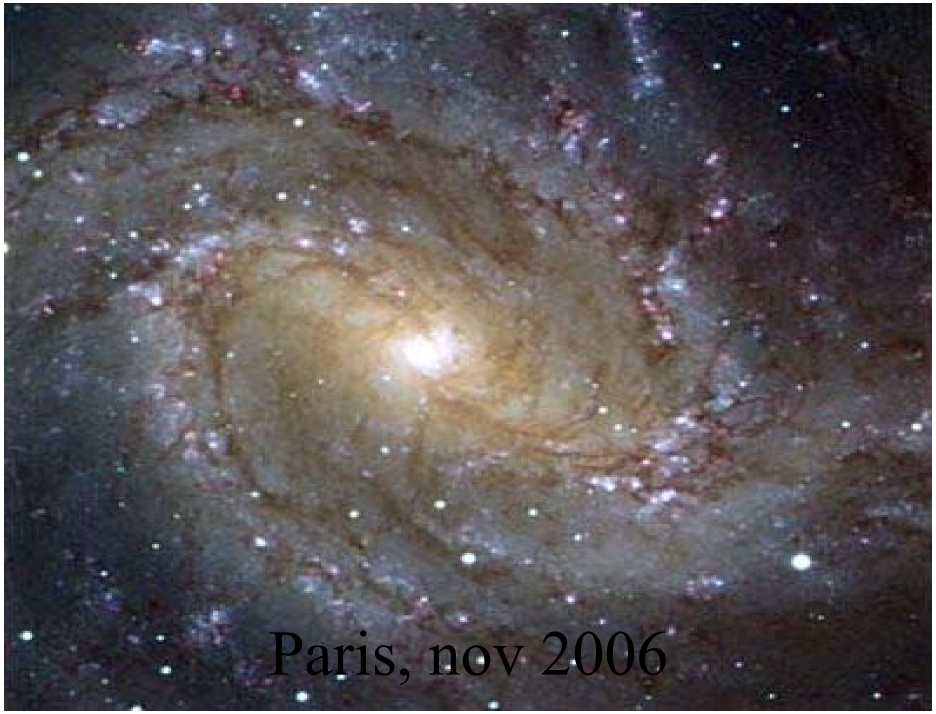


Paris, nov 2006

Context

- **SDSS:** *Balogh et al, Baldry et al, 04*:
bimodal color distribution, high density regions dominated by red galaxies at $z<0.2$.
- **VVDS**: *Ilbert et al, 06*:
SFR increasing with z.
Hierarchical growth of structure
Le Fèvre et al. 03: galaxy distributions were already strongly structured at $z\sim1$.
- **HDFS**: *Saracco et al, 05*:
The local population of bright galaxies was already in place and passively evolving at $z\sim0.8$.
Wiegert et al, 04: All spectral types observed out to $z \sim 1.4$.
- **CFHTLS**: *Nuijten et al, 05*:
Morphological evolution: Bulge dominated galaxies were assembled at earlier times in denser environment. Bimodality in all environment out to $z\sim1$. Large blue peak dominance at $0.8<z<1$.
The buildup proceeds more rapidly in more overdense environments.

Data used

- **CFHTLS-Deep Fields, Release T03**

Canada-France-Hawaii Telescope Legacy Survey

www.cfht.hawaii.edu/Science/CFHTLS/

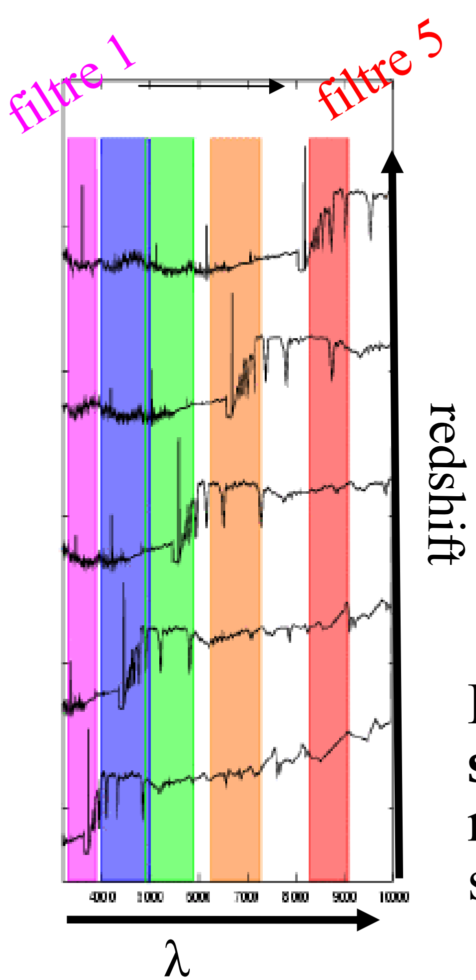
- 4 homogeneous independent fields of 1 square degree: D1/D2/D3/D4
- Release 03: more than 1 600 000 detected objects
- Limit magnitude of about 27 (AB) depending of the filter
- **Terapix Catalog with observed magnitudes in five visible bands: u* g' r' i' z'**

→ **The biggest and deepest photometric sample until now**

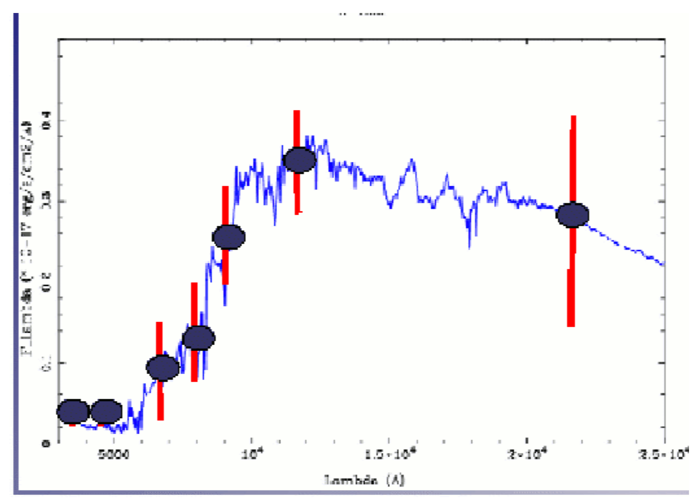
Photometric redshift: New_hyperZ

(Bolzonella et al. 00, http://webast.ast.obs-mip.fr/hyperz **&** http://www.ast.obs-mip.fr/users/roser/CFHTLS_T0003/ **(new version)***)*

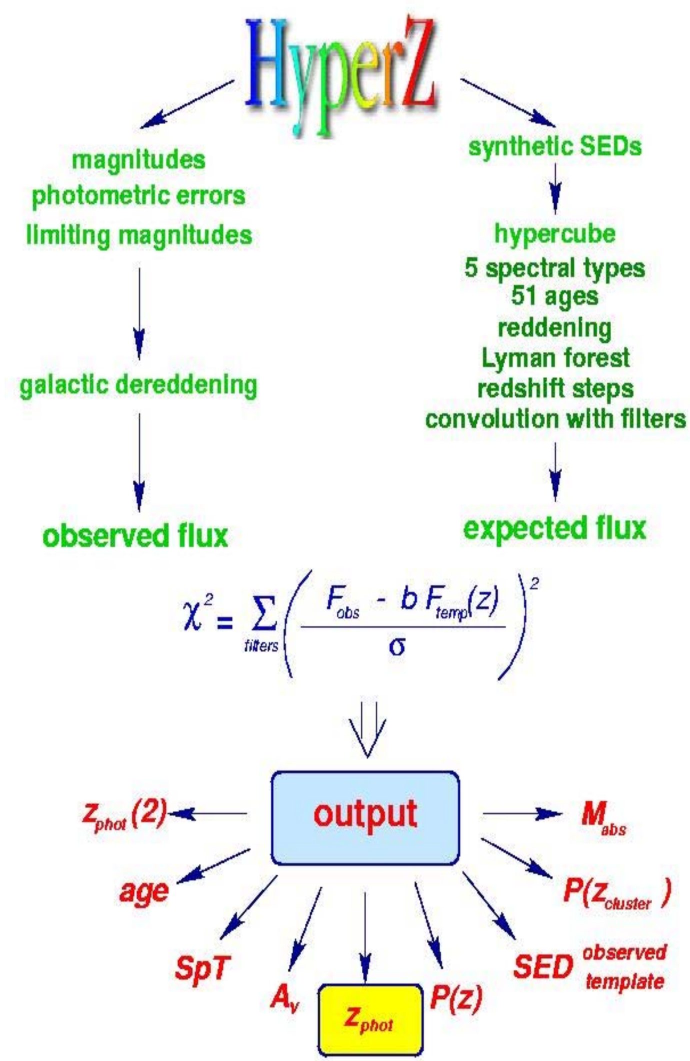
Principle: when redshift increases, the spectra of galaxies go from the UV to the IR wavelenghts.



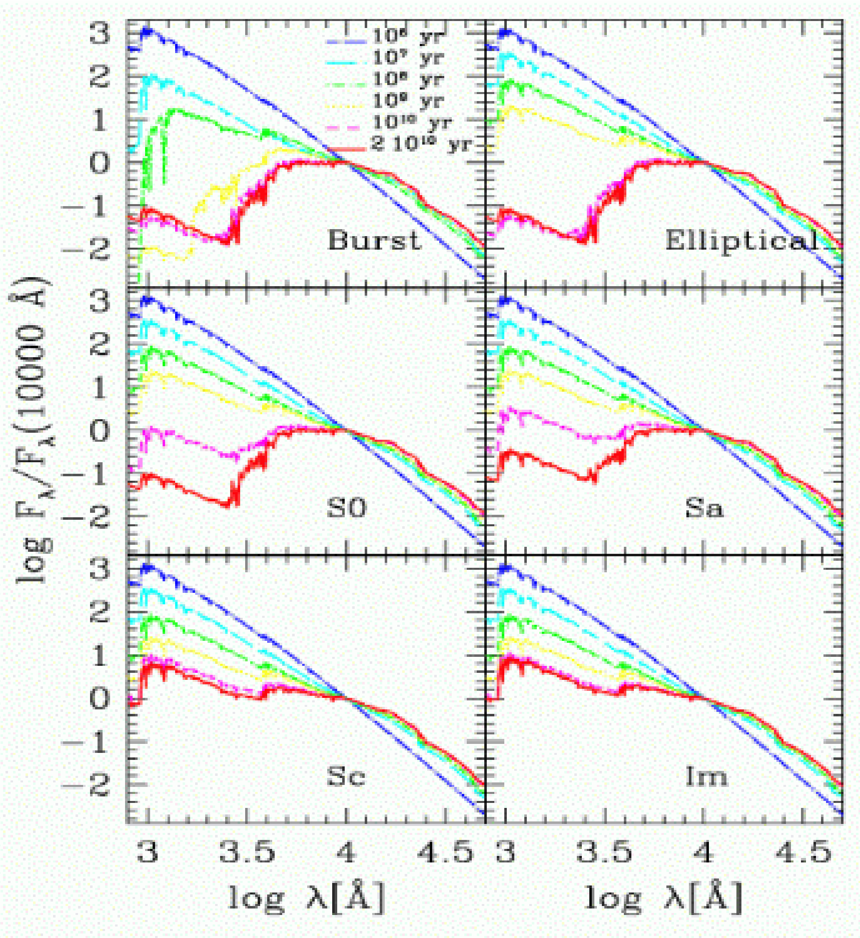
Observation: photometric flux in five filters

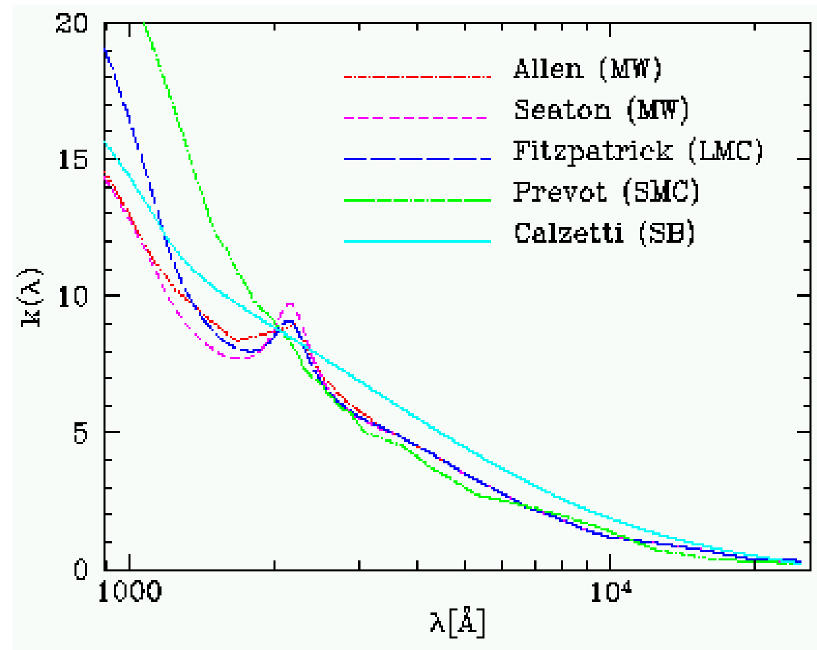


Photometric redshifts based on **standard SED fitting** with a large number of templates & parameter settings.



Photometric redshift





Reddenning law
IMF
SFR type
Metallicity
Lyman forest
Galactic extinction

Photoz Products: z_best + error bars, xi2, P(z), best-fit SED (template, age, Av, ...), **Mag abs** , stellar masses **+ a rough spectral-type classification: E, Sbc, Scd, Im, SB**

New_Hyperz settings

Templates : **14 templates:**

- 8 evolutionary synthetic SEDs computed with Bruzual & Charlot code (1993),
- a set of 4 empirical SEDs by Coleman, Wu and Weedman (1980);
- 2 starburst galaxies (SB1 and SB2) from Kinney et al. (1996) template library.

we have computed new SEDs based on B&C03, with Chabrier 03 IMF. this choice slightly improves the photoz accuracy.

Seeing correction to MAG_AUTO magnitudes :

Original images not seeing-matched before extracting the sources!

--> evaluation of the differential correction needed to account for seeing differences, taking the i-band image as a reference. The corrections applied at first order:

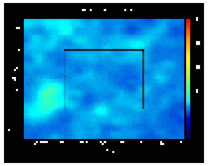
du=-0.23, dg=-0.09, dr=-0.03, di=0.00, dz=0.05 .

Note that rest-frame colors become bluer with the above seeing corrections.

Usual settings :

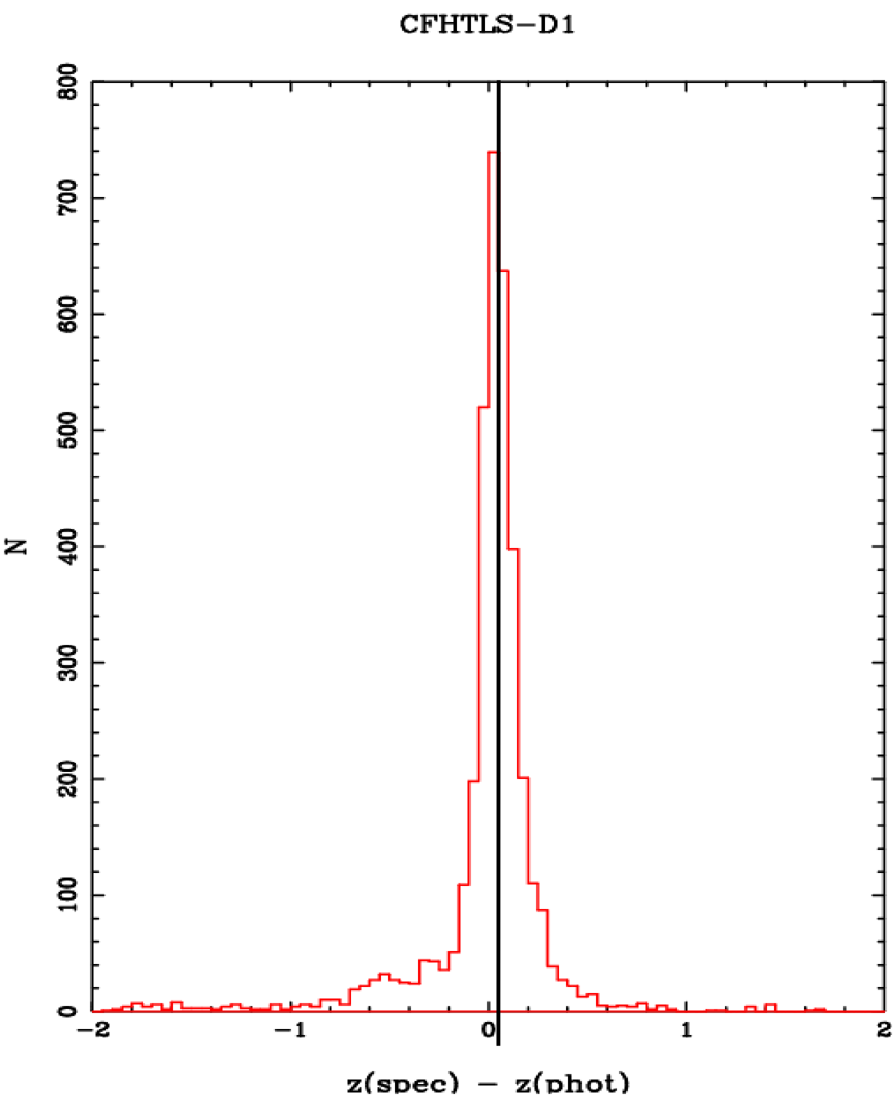
- Photozs computed in the range z=0-6.
- The extinction law from Calzetti (2000), and considered as a free parameter with A_V ranging between [0; 1.5] magnitudes (E(B-V) between 0 and 0.45 mags).
- Galactic E(B-V) corrected according to the Schlegel values at the object position.
- No luminosity prior, but a simple "permitted range" for extragalactic sources, with absolute magnitudes between MB=[-14,-23].

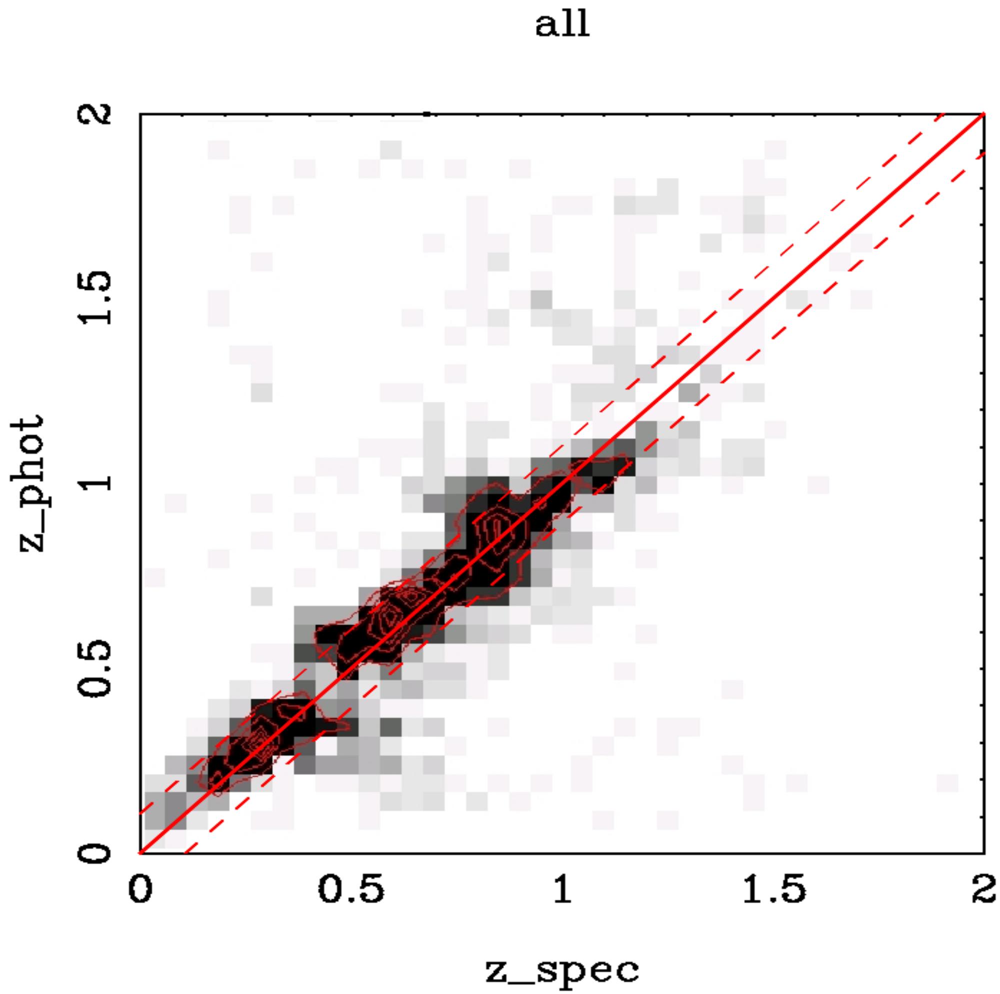
Photometric Redshift Accuracy



D1

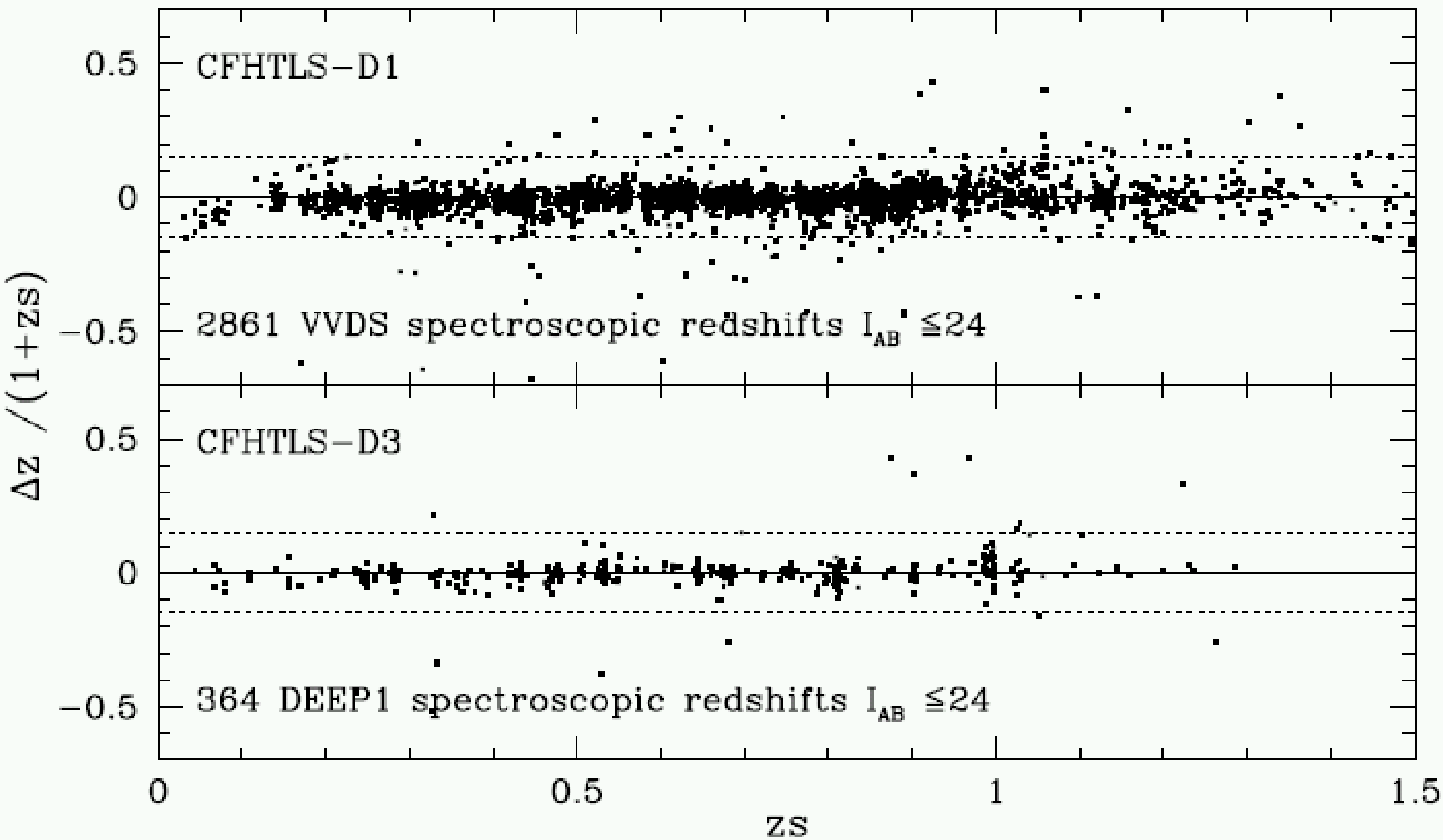
sigma(z)~ 0.05 a 0.1
entre z~0 → 1.5

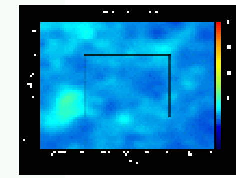




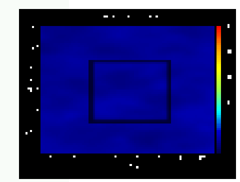
Comparison between the photometric and the spectroscopic redshifts available in D1 (VVDS Survey) + D3 (Groth/Deep Survey) (4155 galaxies).

Photometric Redshift Accuracy





D1



D3

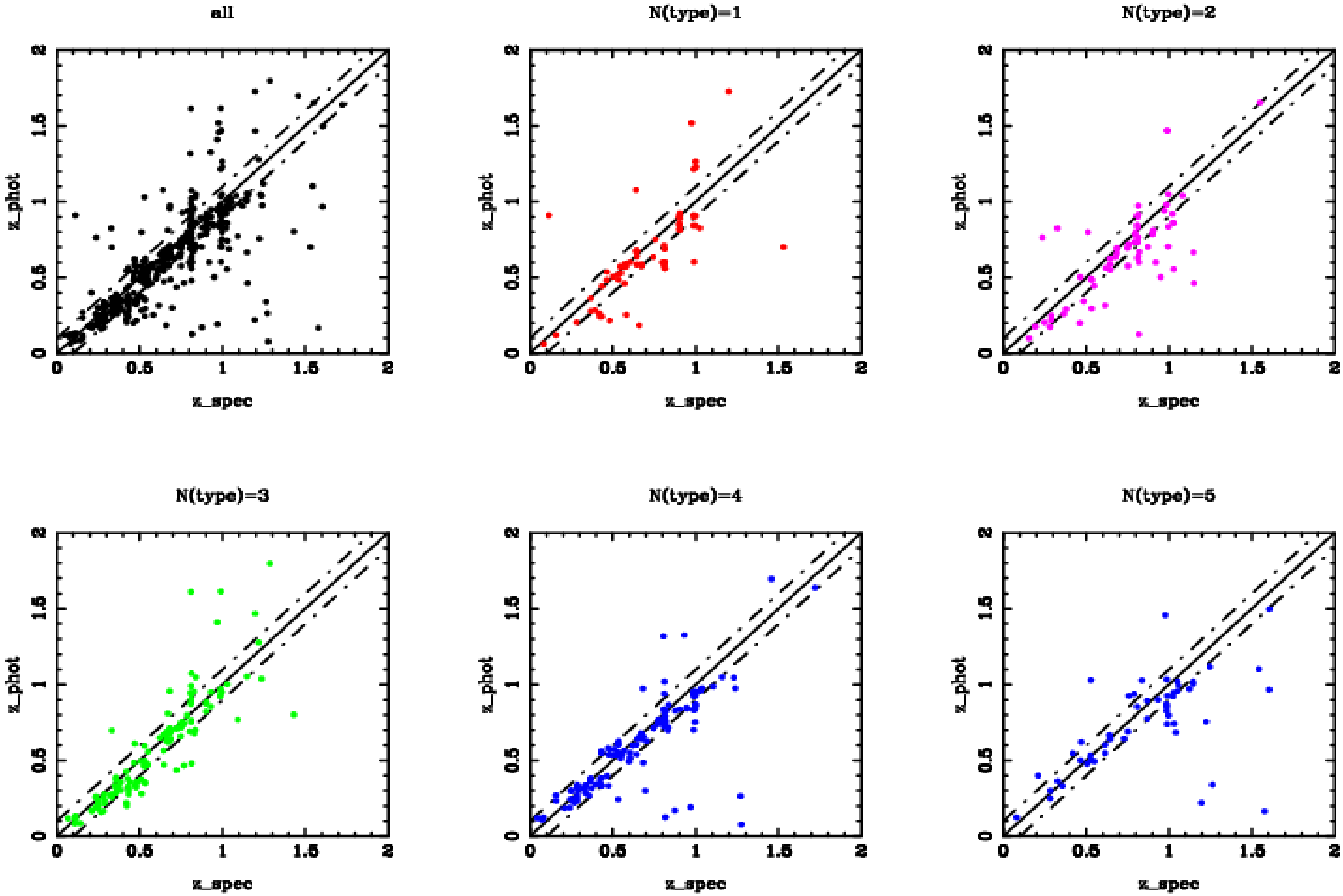
Fig. 14. Δz as a function of redshift. The photometric redshifts are computed using the CFHTLS filter set u^*, g', r', i', z'. The top and bottom panels present the photometric redshifts obtained on the CFHTLS-D1 and CFHTLS-D3 fields respectively.

Ilbert et al. 06

sigma(z)~0.04 a 0.07 entre z~0 et 1

catastrophiques < 10%

Photometric redshits for 471 galaxies in the CFHTLS-D3 field, blindly compared to the spectroscopic redshits publically available from the Groth/Deep Survey. Results are presented for the whole sample, and for different photometric types of galaxies.



Selection of the samples

- Remove stars (1%)
- i mag > 17 (saturated objects)
- Sextractor flag <= 1
 (saturated and masked objetcs) → (14%)
- Detection in at least 2 filters (S/N>3)(4%)
- P_int > 10 (bad fits) (13%)

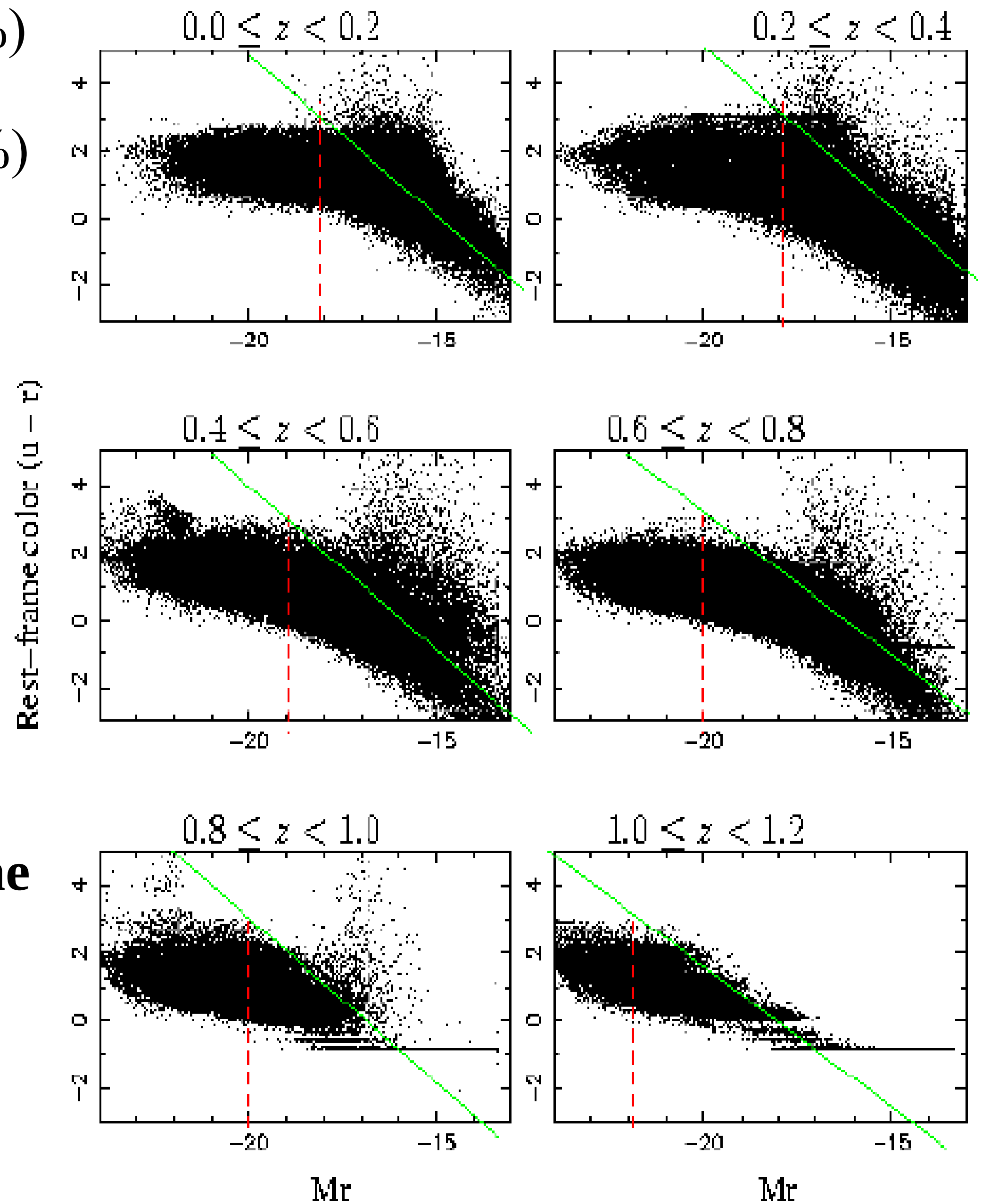
- No IR data → zphot < 1.3

--> more than 1 350 000 objects.

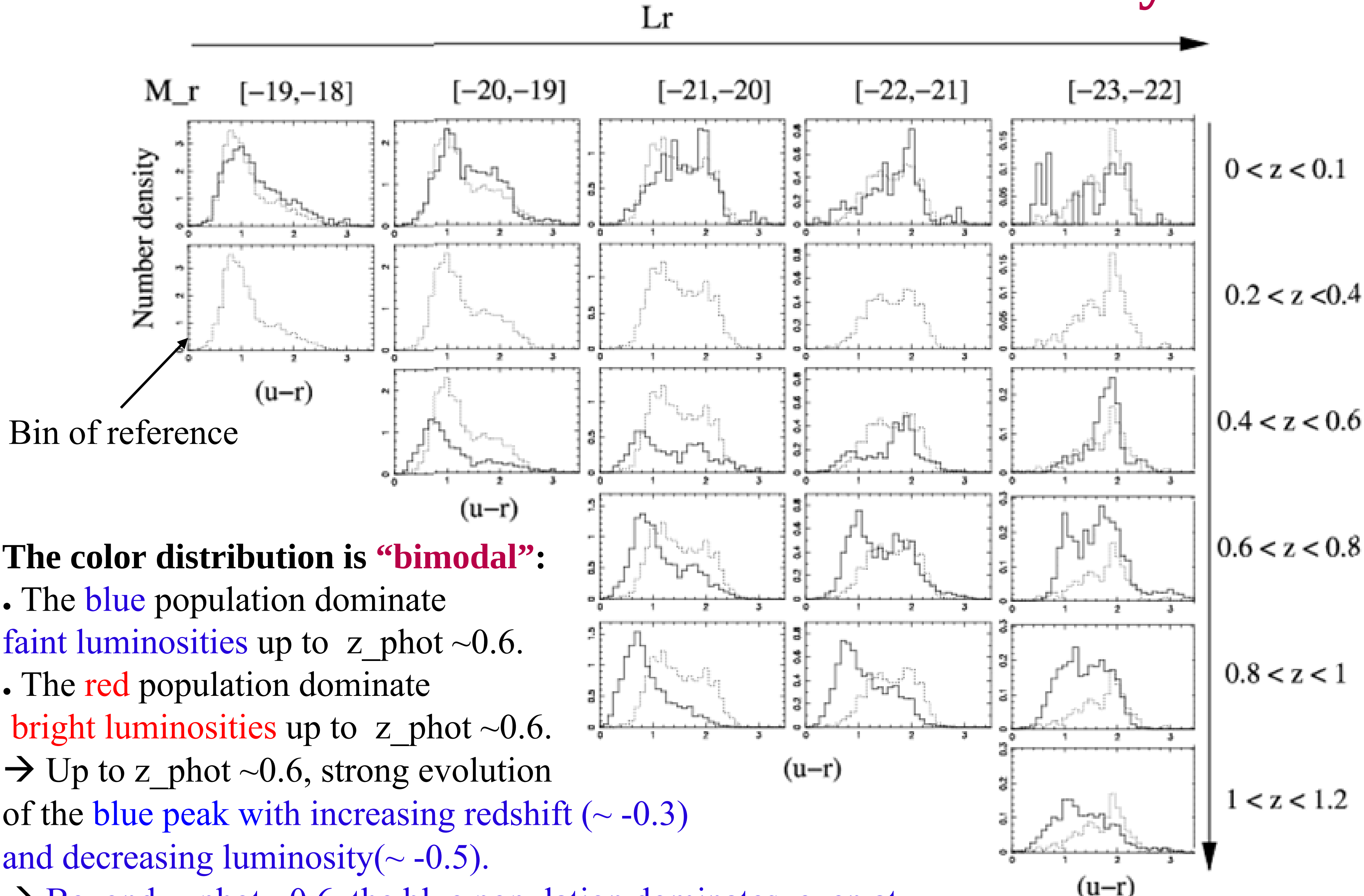
- <u>Four complete r-selected samples</u>
<u>at different redshifts:</u>

Mr < -18.0 --> z_phot < 0.4
Mr < -19.0 --> z_phot < 0.8
Mr < -20.0 --> z_phot < 1.0
Mr < -22.0 --> z_phot < 1.2

We can **follow the evolution of restframe (u-r) color distribution with a complete sample in u and r bands.**



Color Evolution versus Luminosity



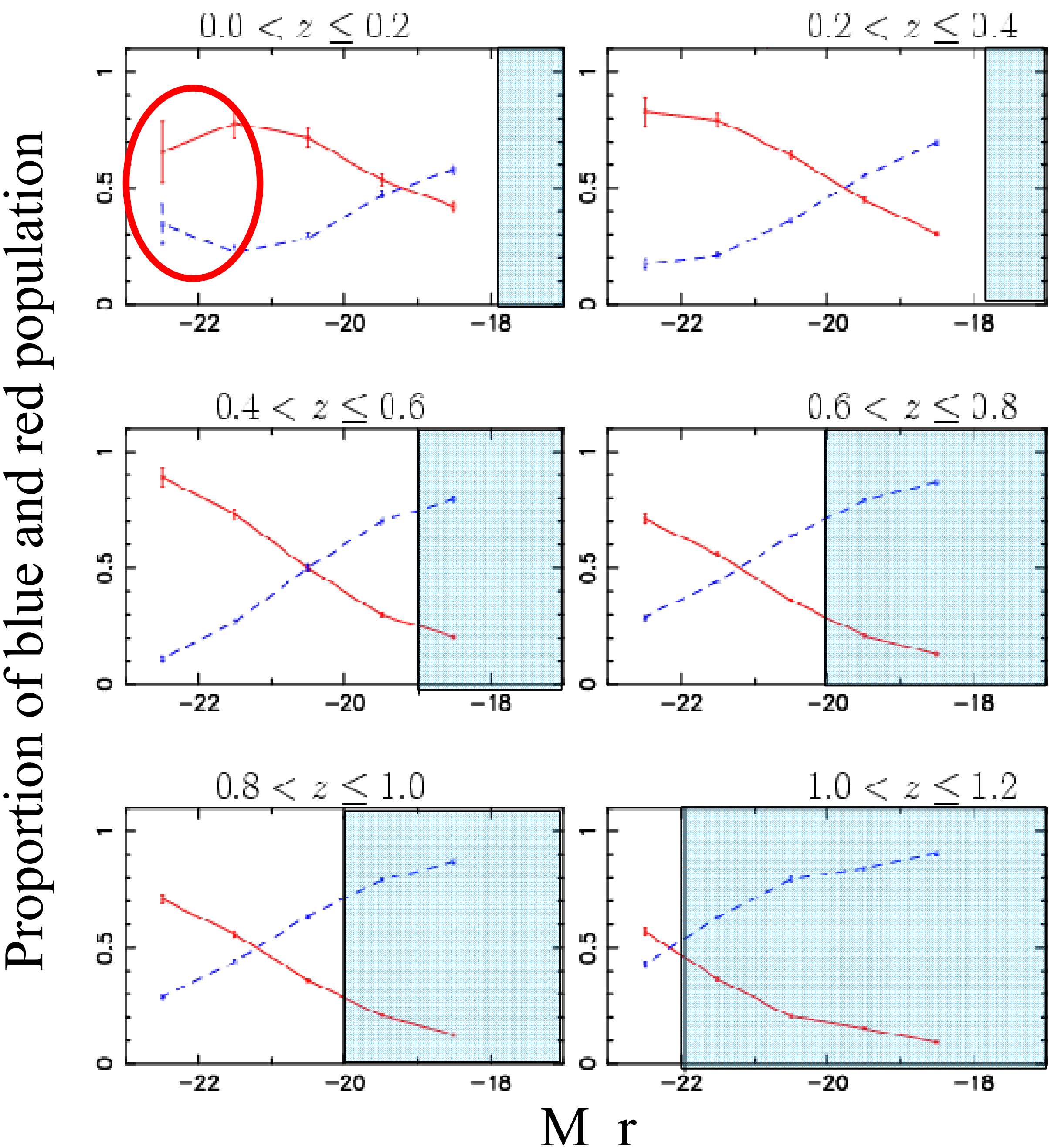
The color distribution is "bimodal":

- The blue population dominate faint luminosities up to z_phot ~0.6.
- The red population dominate bright luminosities up to z_phot ~0.6.

→ Up to z_phot ~0.6, strong evolution of the blue peak with increasing redshift (~ -0.3) and decreasing luminosity(~ -0.5).

→ Beyond z_phot ~0.6, the blue population dominates, even at bright luminosities.

Evolution of the Blue/Red population



Early type: u-r ≥ 1.3

Late type: u-r < 1.3

completeness limit

The reddest “bright” galaxies are present at all redshifts since z~1.2 (50%).

→ **inversion of population at a M_r(zphot).**

Inversion magnitude M_r(zphot) becomes brighter from **-19 to -22** with increasing redshift.

Star-forming systems become fainter with decreasing redshift.

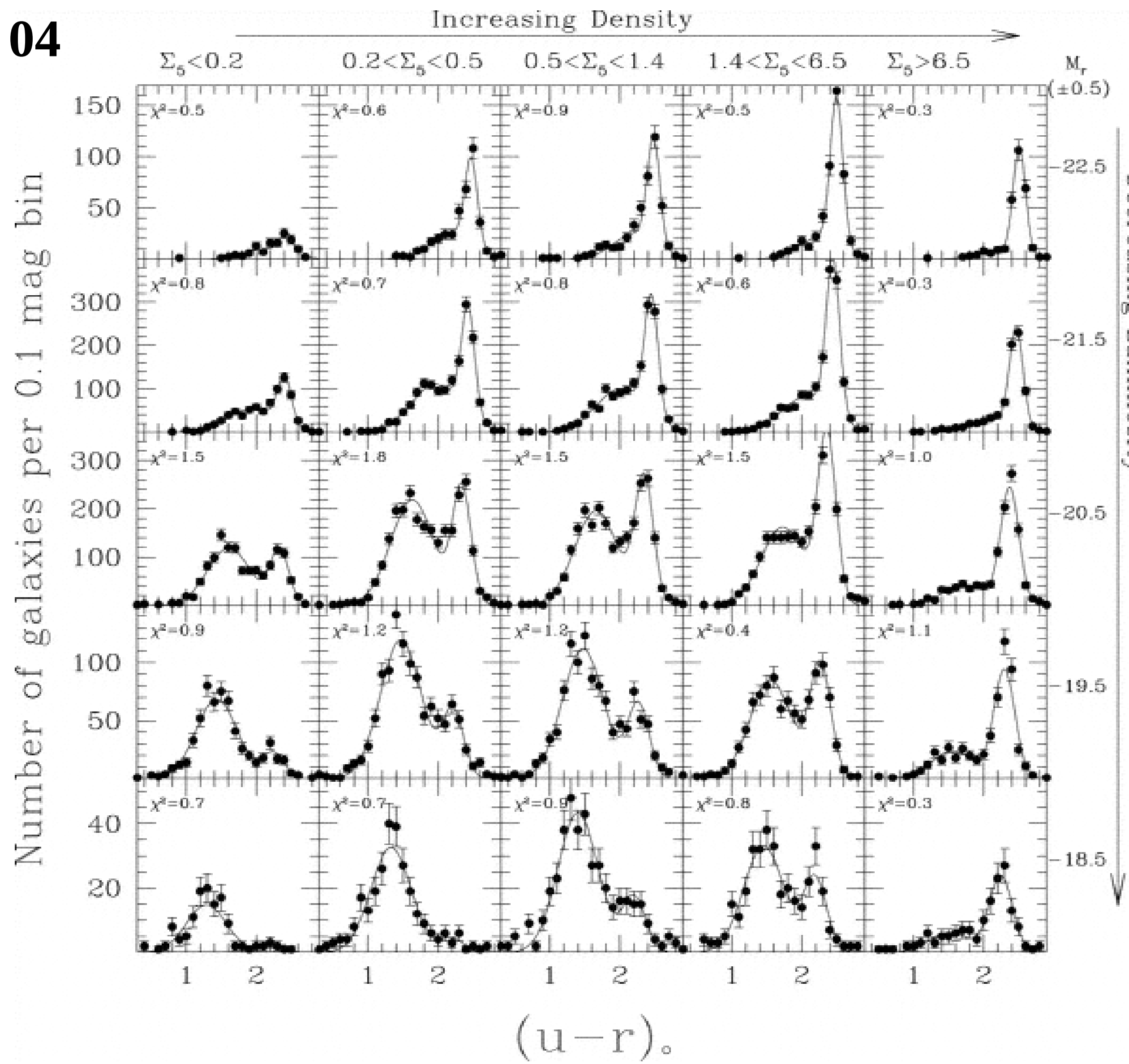
Luminosity and Color Evolution versus Environment

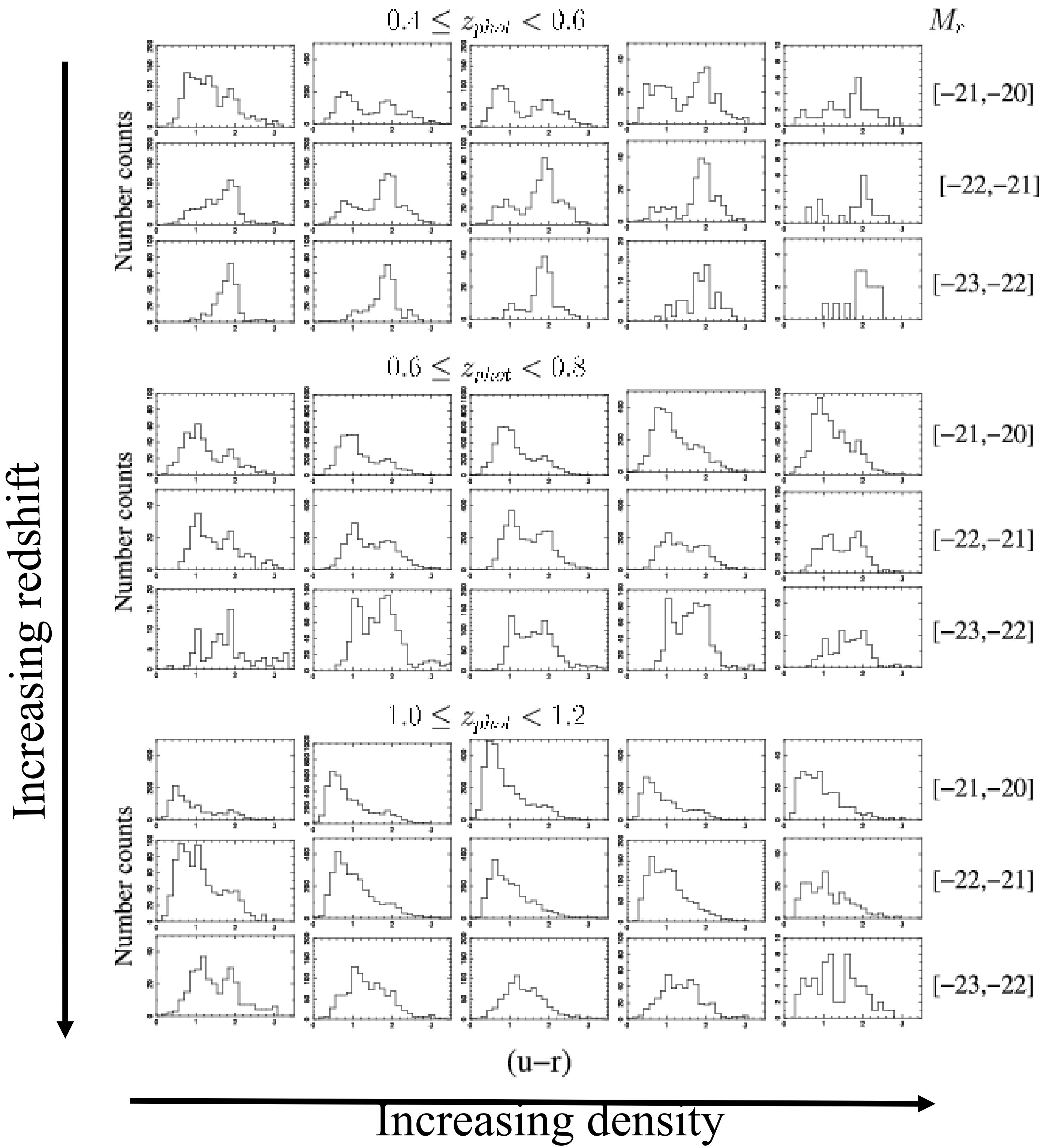
<u>Local density estimator</u>: $\sum_5$

Baldry et al. 04; Balogh et al. 04

- $z < 0.2$
- strong Bimodality
- Early type at high density
- Late type at low density.

Here we use $\color{red}{\sum_{10}}$: projected local density, computed from the distance to the **10th nearest neighbour** within a redshift slice of +/- 0,1 with M_r between [-24;-20].





- Blue population dominate low densities and faint luminosities.
- Red population dominate the high densities and bright luminosities.

→ at z_phot<0.6 we see the same trends as in the SDSS (local universe).

At **z_phot > 0.6** : blue galaxies dominate the bright luminosities and high densities regimes.

At fixed luminosity the shape of the distribution shows a weak dependence on the density regime.

Conclusions

- **The bimodal behaviour is seen up to z~1.2 .**
- The Wide will improve the sampling at redshifts between [0,0.2] (in progress)
- **Up to z~0.6 Blue and Red populations** of galaxies are found to **dominate respectively:**
  - **the faint and *bright* luminosities, and**
  - **the low and high densities.**
- ***--> The characteristics of the color-environment relation observed in the local universe were already built at z ~ 0.6 .***

- **The color of the Blue population show a strong evolution in the magnitude range studied.** Blue galaxies become bluer by Δ(u-r)~ 0.5 with decreasing luminosity at a given redshift bin. They become bluer by Δ(u-r)~0.3 with increasing redshift at a given luminosity bin.

The Red population show less evolution.

- **An important Blue and "bright" population exists at z~ 0.8-1.0, with Mr < -21. We observe a mild evolution as a function of the local density at fixed luminosity.**