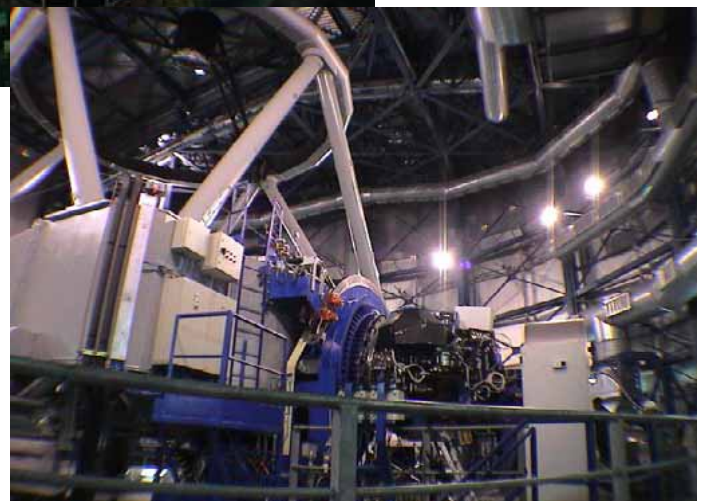
VVDS FIRST EPOCH RESULTS

GALAXY LUMINOSITY FUNCTIONS UP TO Z=1.5



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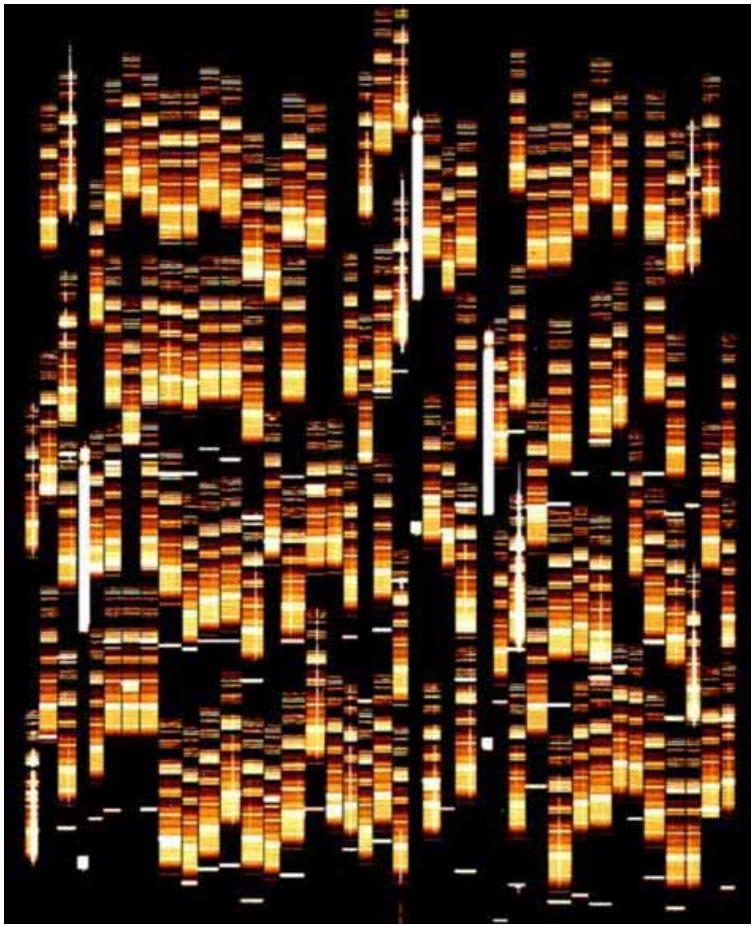
L. Tresse
O. Ilbert
S. Arnouts

E. Zucca
S. Bardelli
G. Zamorani

O. Le Fèvre, G. Vettolani and the VVDS team

THE VVDS DEEP SAMPLE



- **The deep VVDS 0226-04 field : 1.2 deg^2**
- **Purely magnitude selected sample**

  $17.5 \leq I_{AB} \leq 24$
- **3 observing runs, 2002**

  20 VIMOS pointing , 4h exposure, R=200

  → **10,500 spectra**

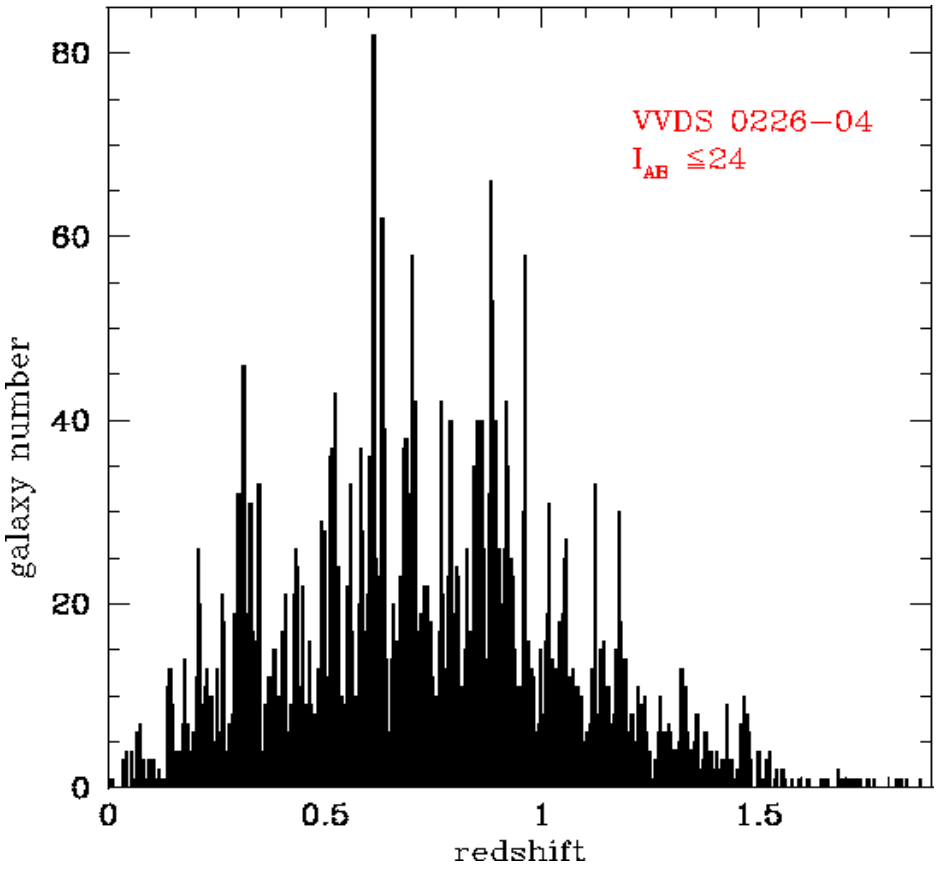
  The largest spectroscopic sample at $I_{AB} \leq 24$ up to now !
- **Spectroscopic data combined with (U)BVRI(JK) multi-color catalogue**

  (H. J. McCracken et al. 2003, A&A, 410,17)

DEEP SPECTROSCOPIC SAMPLE

VVDS 0226-04

- **Data reduction is on-going**
- **Preliminary deep spectroscopic sample :**
  - **Area already covered 0.5 deg^2**
  - **4,500 redshifts of galaxies @z < 1.5**
    <z> = 0.73
  - **485 stars + 45 QSOs**
- **Full sample being assembled (up to z=5)**
  (O. Le Fèvre et al. 2004)



LUMINOSITY FUNCTION TOOL

- **Absolute magnitude**
  - → Fit the best template on multi-color data : SED, k-correction
  - → Procedure to limit the model dependency using multi-color data

  Le Phare , www.oamp.fr/arnouts/LE_PHARE.html , S. Arnouts & O. Ilbert

- **The VVDS LF tool**
  - → Can be applied on any multi-color data
  - → Three non-parametric estimators , **1/Vmax , C+ , SWML**

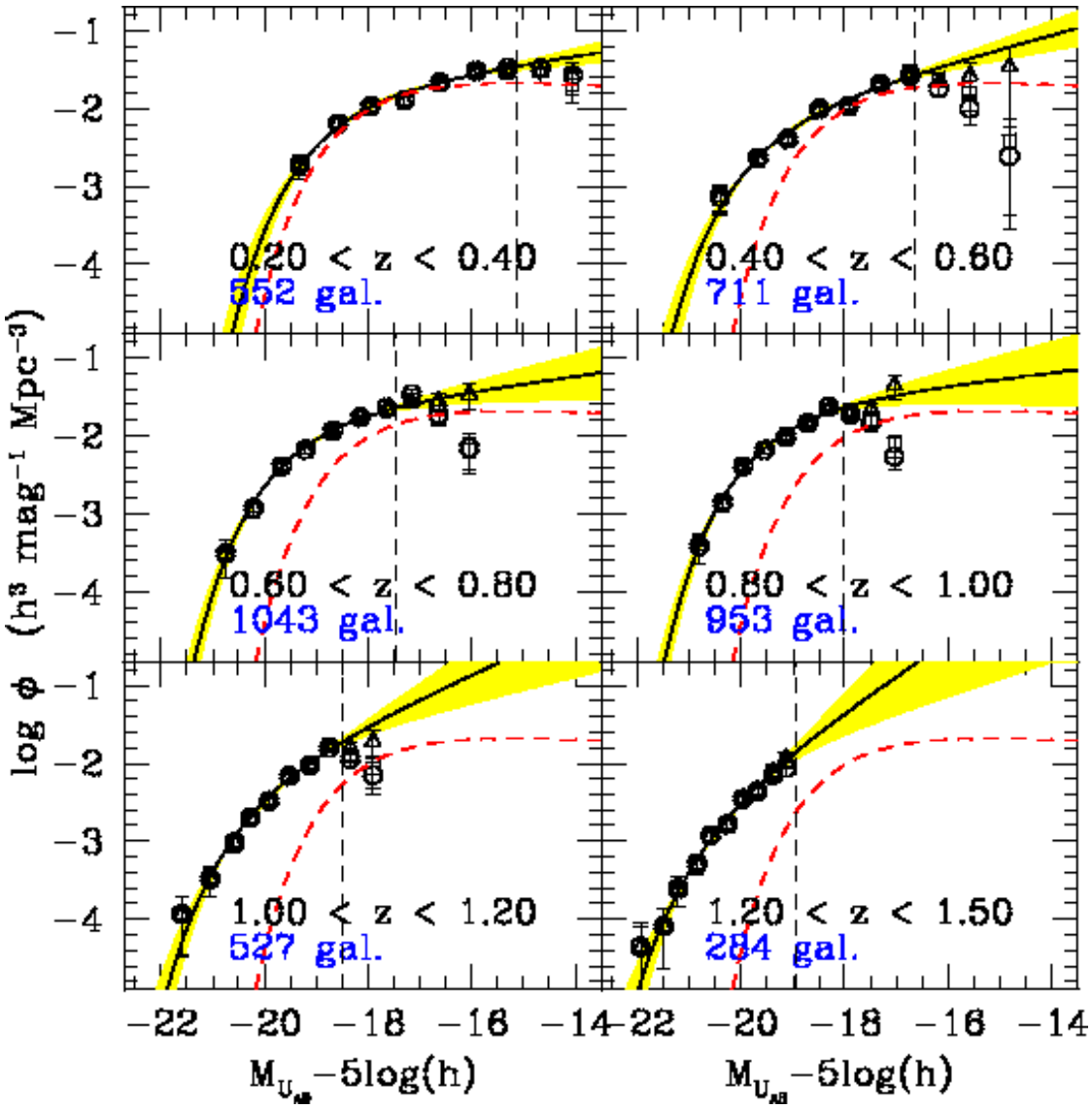
    One parametric estimator, **STY** , using Schechter function

$$\Phi(L)dL = \Phi^* exp(-L/L^*) \frac{L}{L^*}^{-\alpha} d\frac{L}{L^*}$$

  - → Quality control of the LF tool on simulated data

    (Ilbert et al. , 2004, MNRAS, in press, astro-ph/0402202)

GLOBAL LF UP TO Z=1.5



- **~1,000 galaxies at $0.8 \leq z < 1$!**
- **Strong constrain on the slope up to z=1.5**
- **Study the LF evolution up to z=1.5 with a same sample**

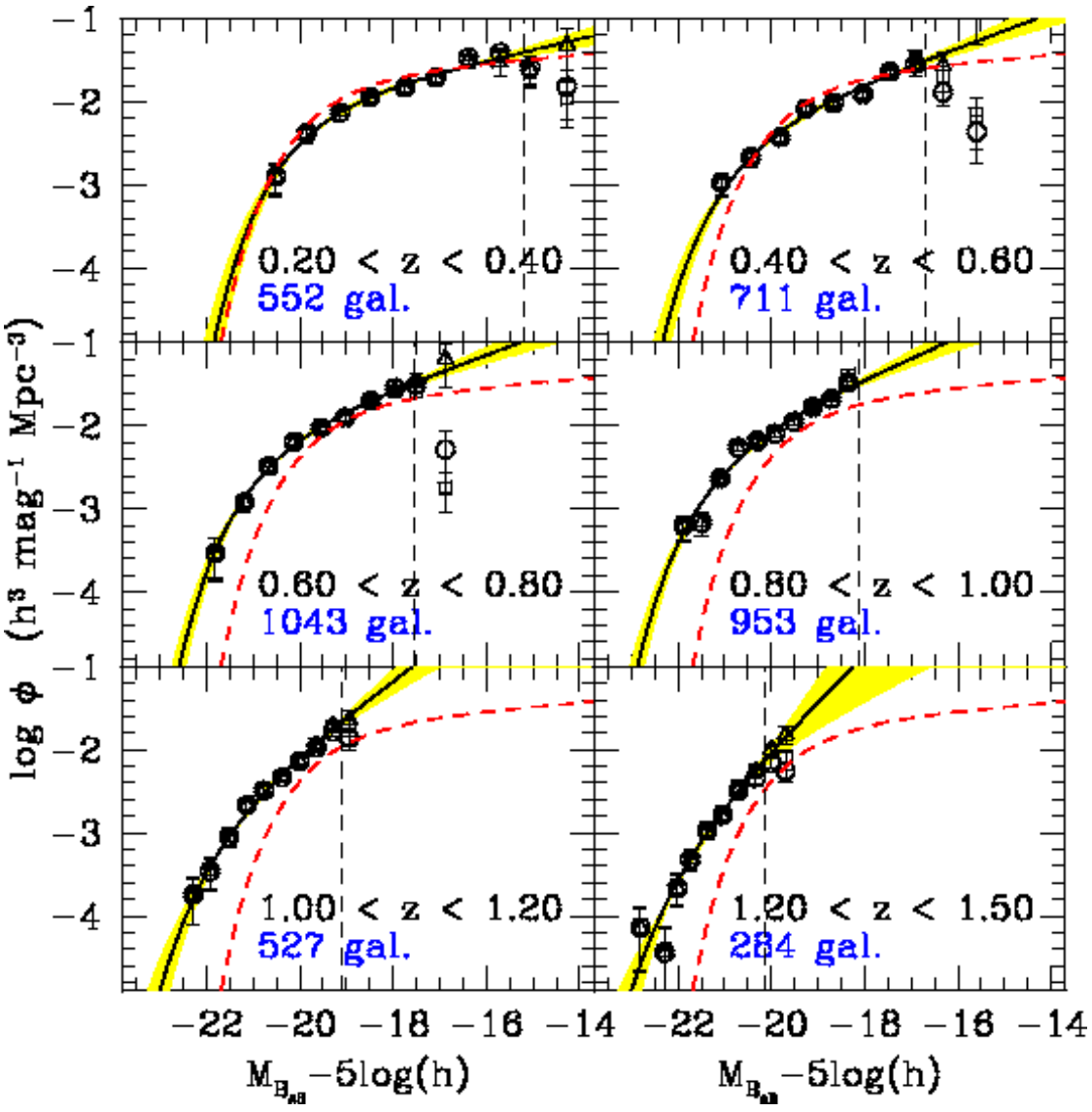
$(h = 0.7, \Omega_m = 0.3, \Omega_\Lambda = 0.7)$

○ $1/V_{max}$ ▫ C^+

△ SWML —— STY

——— Local LF (SDSS)

GLOBAL LF UP TO Z=1.5



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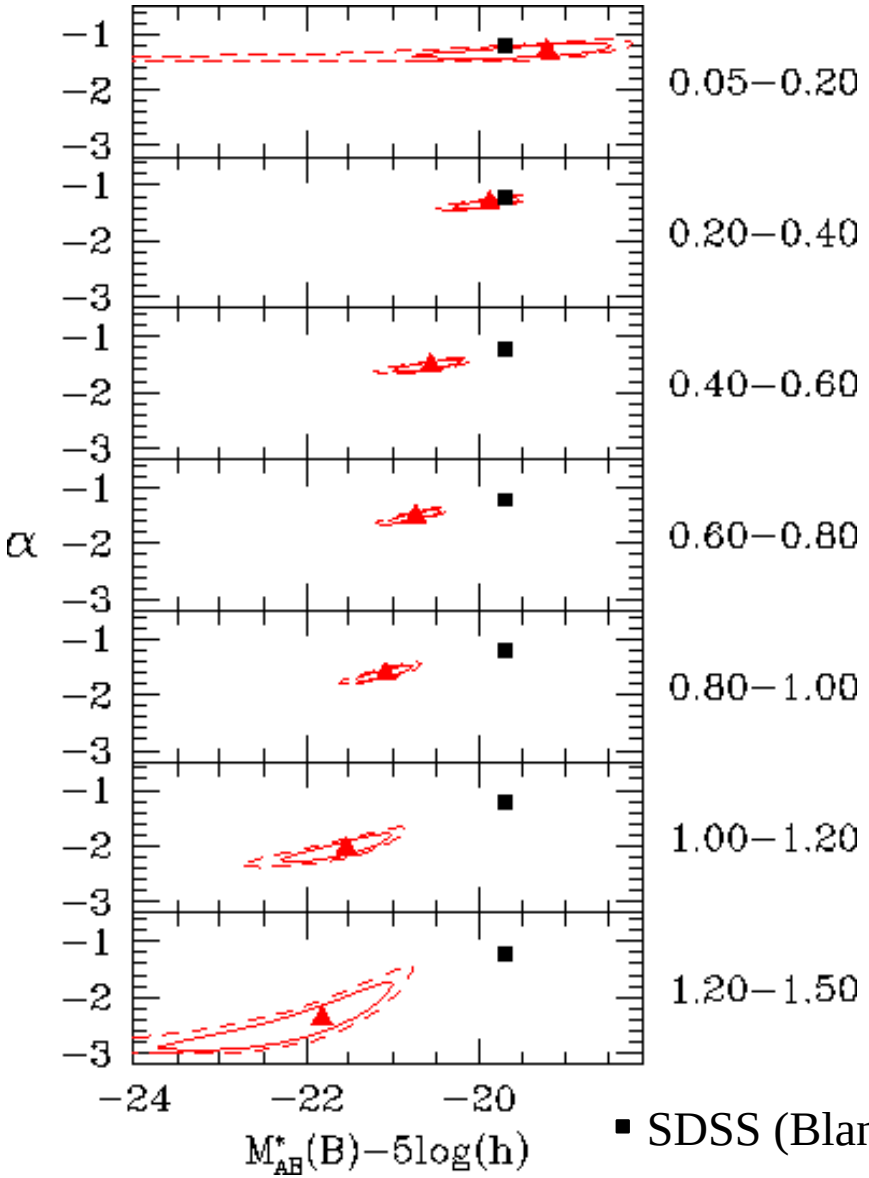
△ SWML —— STY

– – – Local LF (SDSS)

EVOLUTION OF THE GLOBAL LF SHAPE



68% error contour

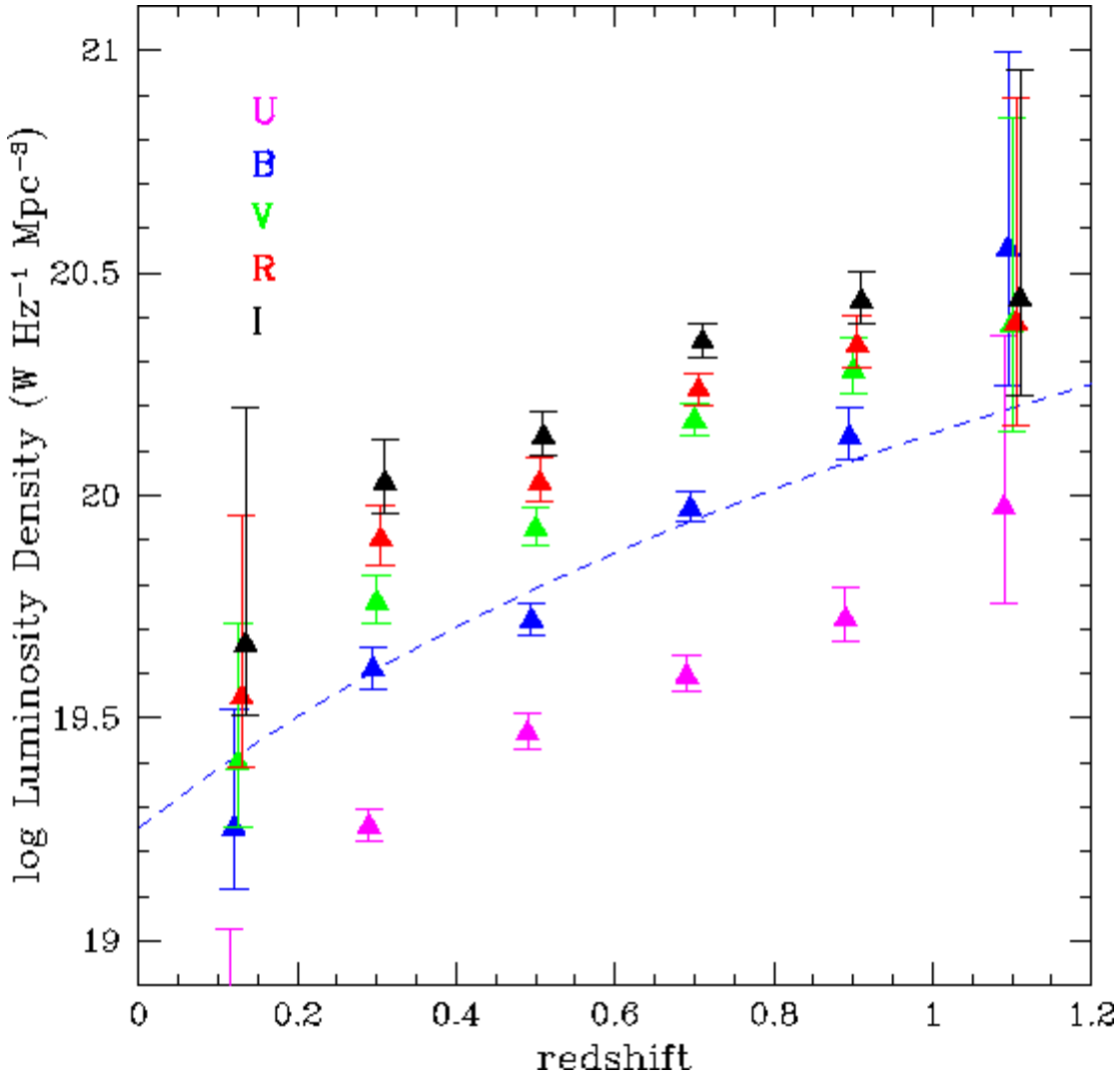
90% error contour

evolution of the global LF shape
from z=0.05 up to z=1.5

- Brightening of 2 mag in M*
- Steepening of the slope

▪ SDSS (Blanton et al., 2001, ApJ, 121, 2358)

EVOLUTION OF THE LUMINOSITY DENSITY



Good constraint on the LD up to z=1.2

Dashed lines :

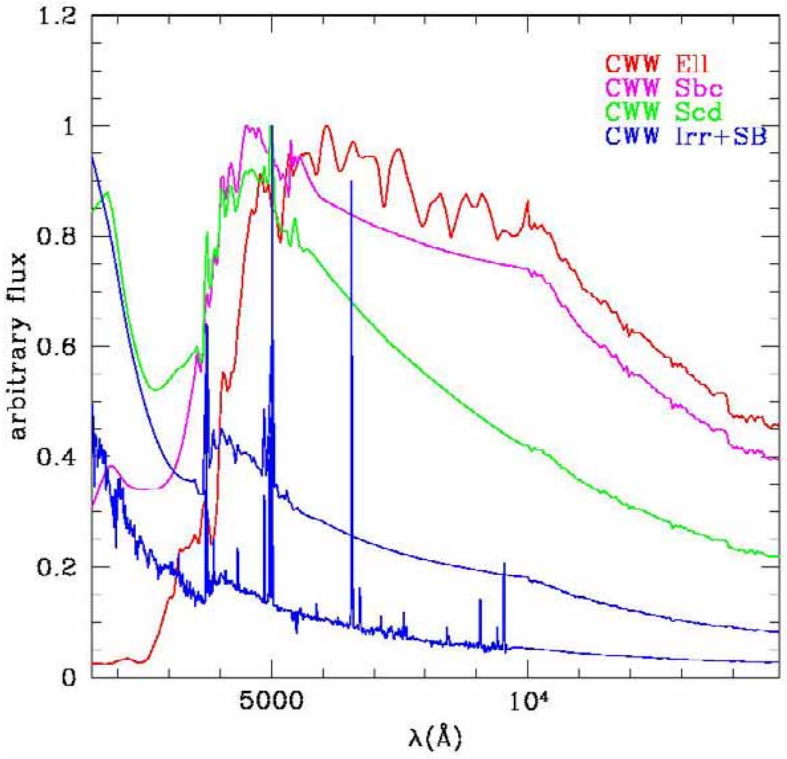
$$LD(z) \; \alpha \; (1+z)^{2.3}$$

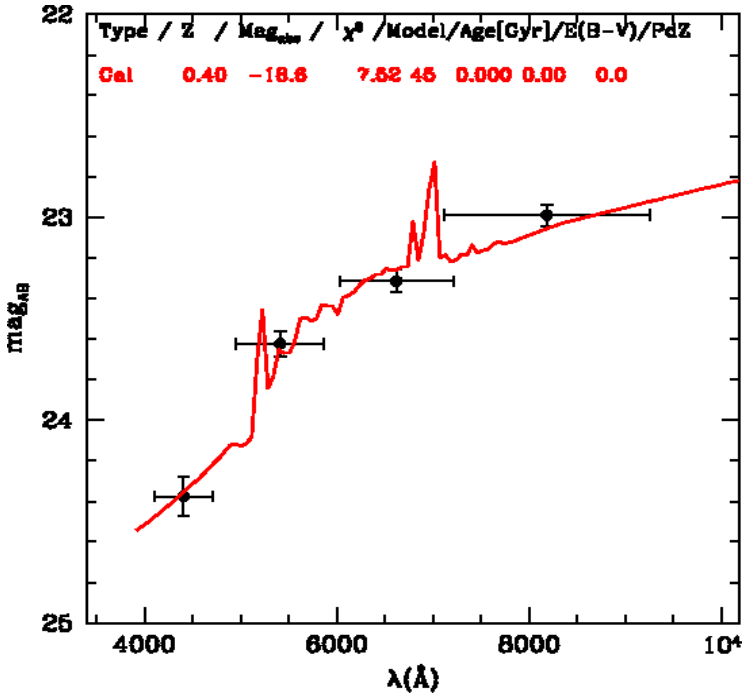
LF PER TYPE : CLASSIFICATION

- Fit the best template on multi-color data

  → **Photometric type**

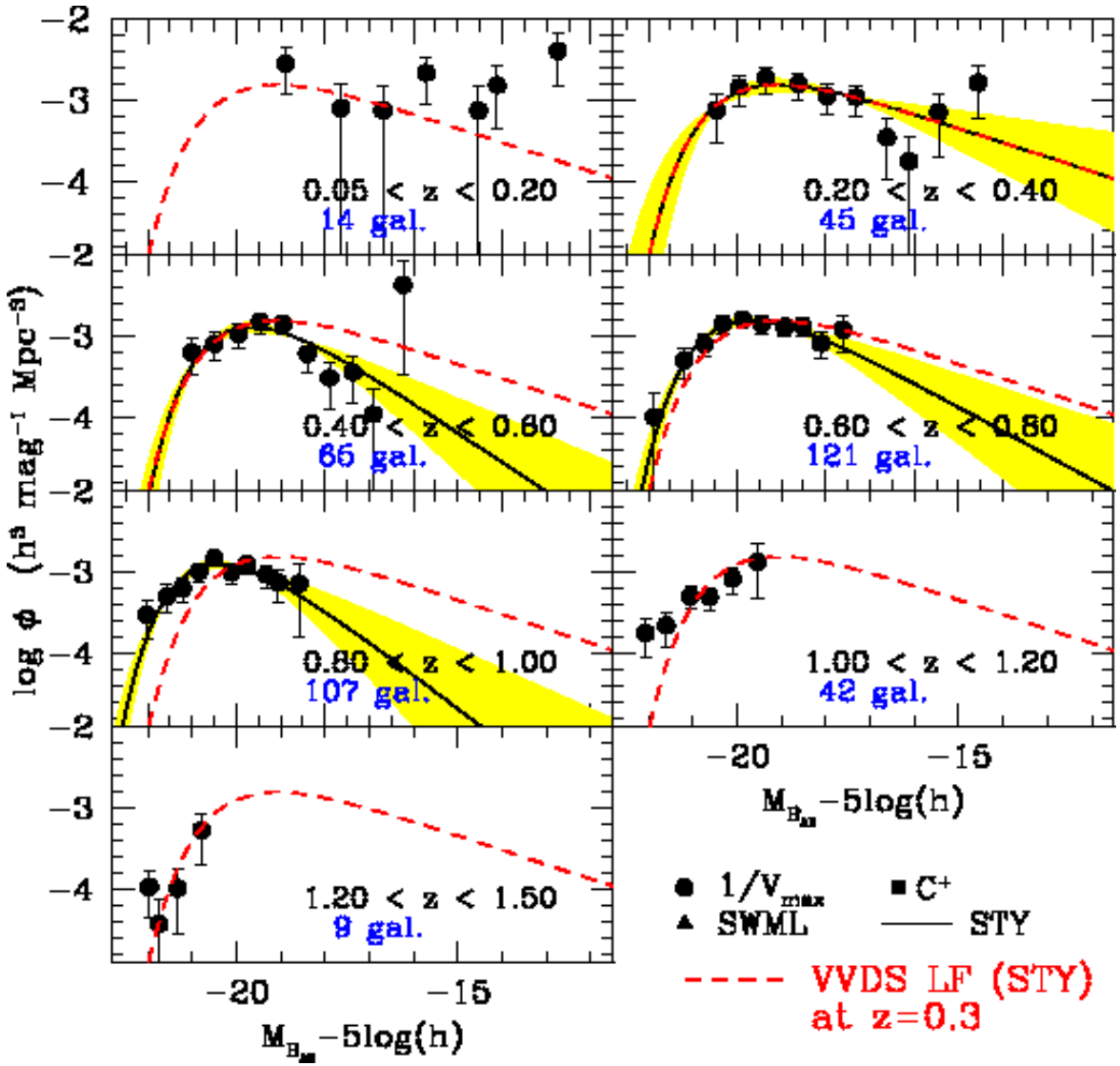
- Split our sample in four photometric types from the CWW set of template





TYPE	CWW	$M_B - M_I$ (AB)
1	Ell	1.3 - $+\infty$
2	Sbc	0.95 - 1.3
3	Scd	0.68 - 0.95
4	Im+SB	$-\infty$ - 0.68

THE EVOLUTION OF TYPE 1 LF



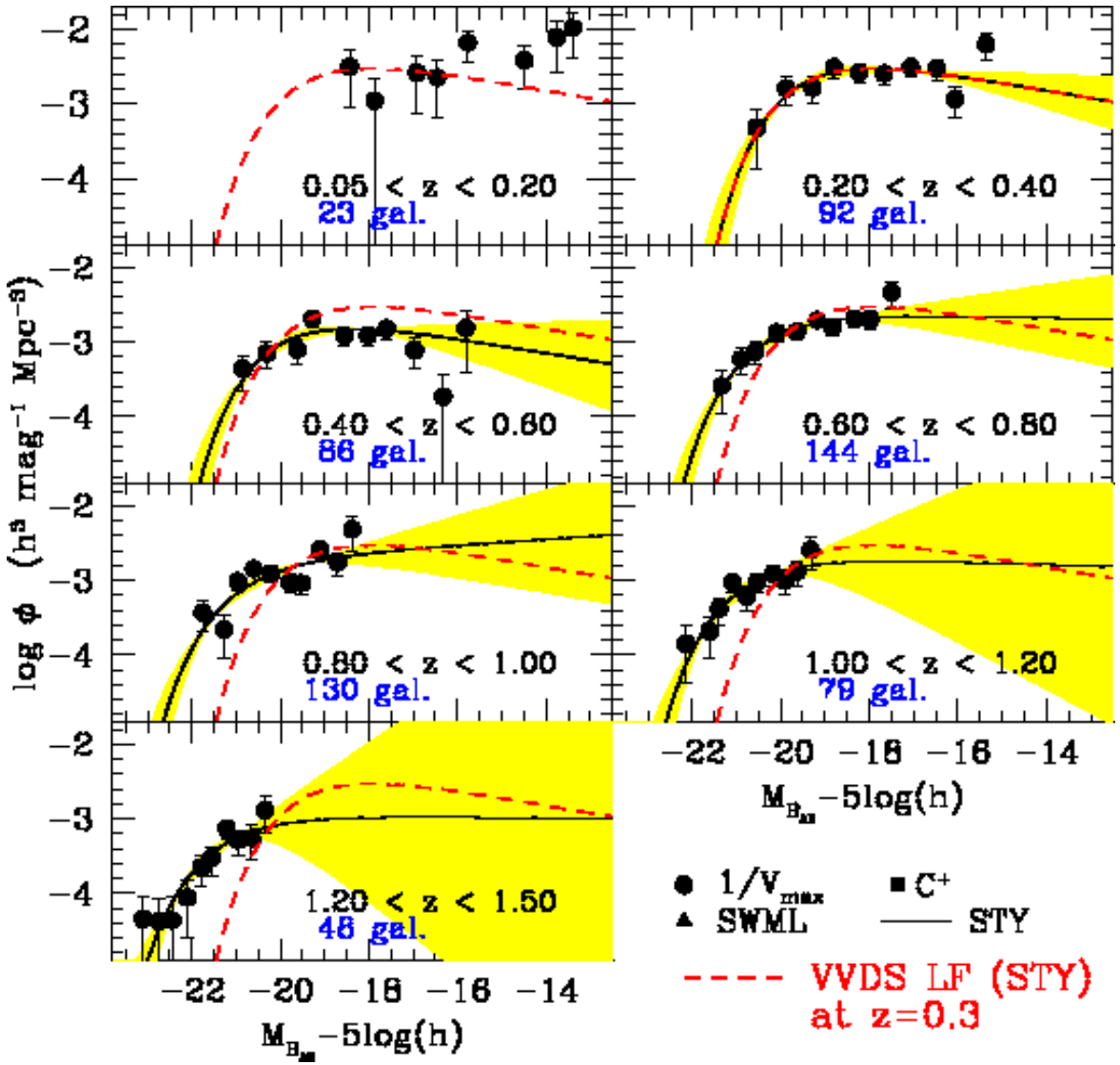
WEAK EVOLUTION
FOR REDDEST TYPES

TO

STRONG EVOLUTION
FOR BLUEST TYPES

TYPE	CWW	$M_B - M_I$ (AB)
1	Ell	1.3 - $+\infty$
2	Sbc	0.95 - 1.3
3	Scd	0.68 - 0.95
4	Im+SB	$-\infty$ - 0.68

THE EVOLUTION OF TYPE 2 LF



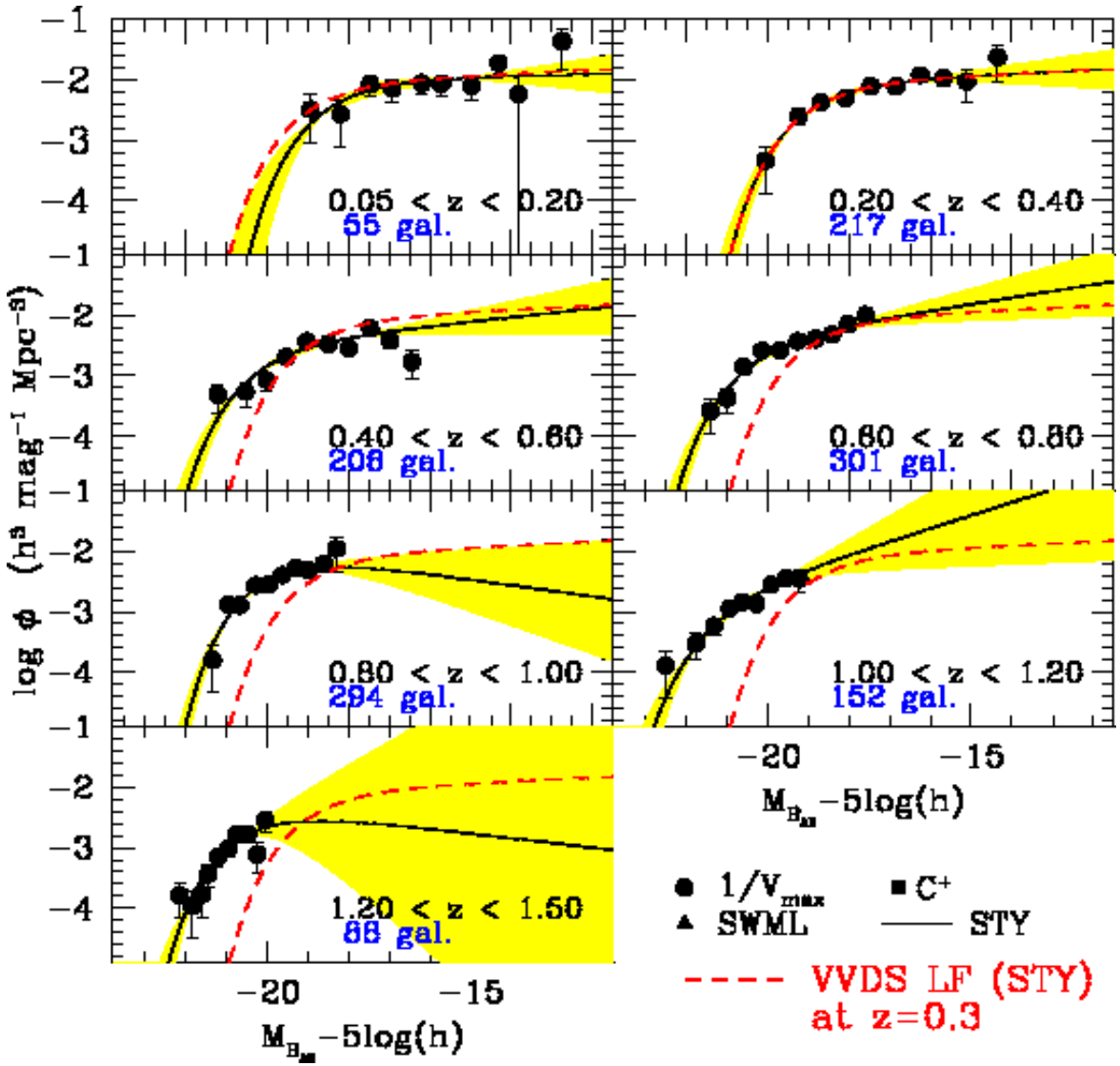
WEAK EVOLUTION
FOR REDDEST TYPES

TO

STRONG EVOLUTION
FOR BLUEST TYPES

TYPE	CWW	$M_B - M_I$ (AB)
1	Ell	1.3 - $+\infty$
2	Sbc	0.95 - 1.3
3	Scd	0.68 - 0.95
4	Im+SB	$-\infty$ - 0.68

THE EVOLUTION OF TYPE 3 LF



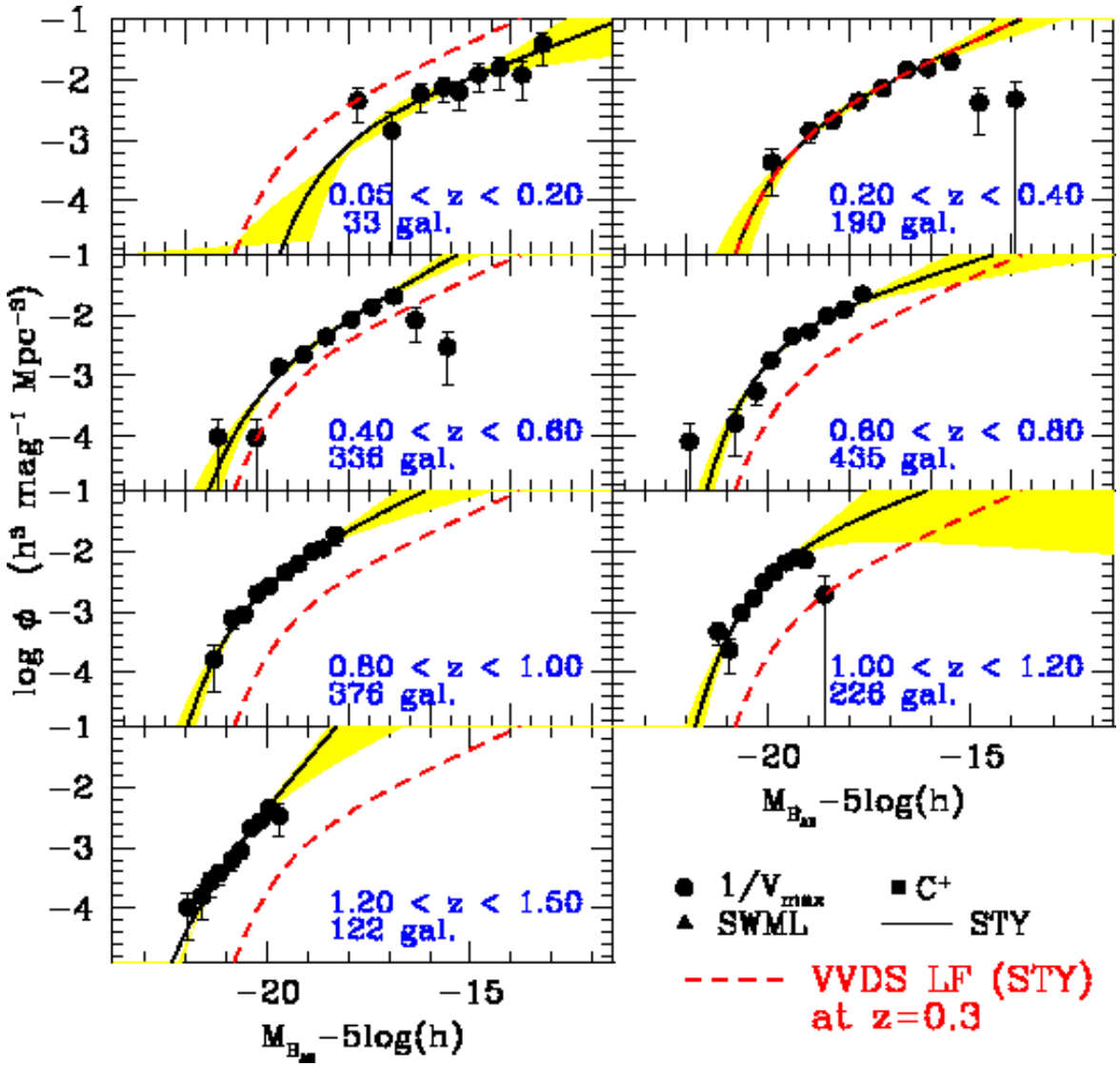
WEAK EVOLUTION
FOR REDDEST TYPES

TO

STRONG EVOLUTION
FOR BLUEST TYPES

TYPE	CWW	$M_B - M_I$ (AB)
1	Ell	1.3 - $+\infty$
2	Sbc	0.95 - 1.3
3	Scd	0.68 - 0.95
4	Im+SB	$-\infty$ - 0.68

THE EVOLUTION OF TYPE 4 LF



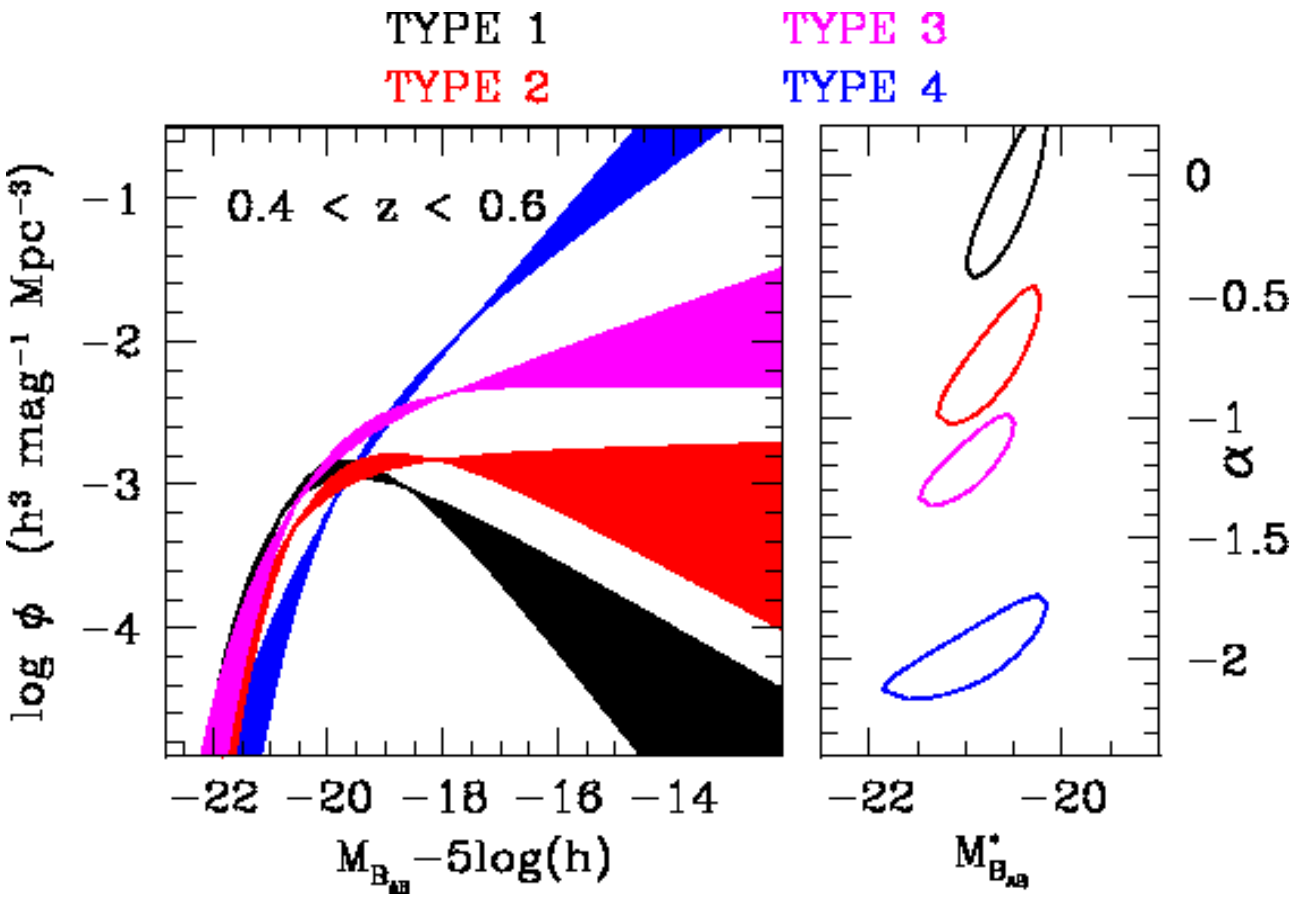
WEAK EVOLUTION
FOR REDDEST TYPES

TO

STRONG EVOLUTION
FOR BLUEST TYPES

TYPE	CWW	$M_B - M_I$ (AB)
1	Ell	1.3 - $+\infty$
2	Sbc	0.95 - 1.3
3	Scd	0.68 - 0.95
4	Im+SB	$-\infty$ - 0.68

SHAPE OF THE LF PER TYPE



Steepening of the slope from

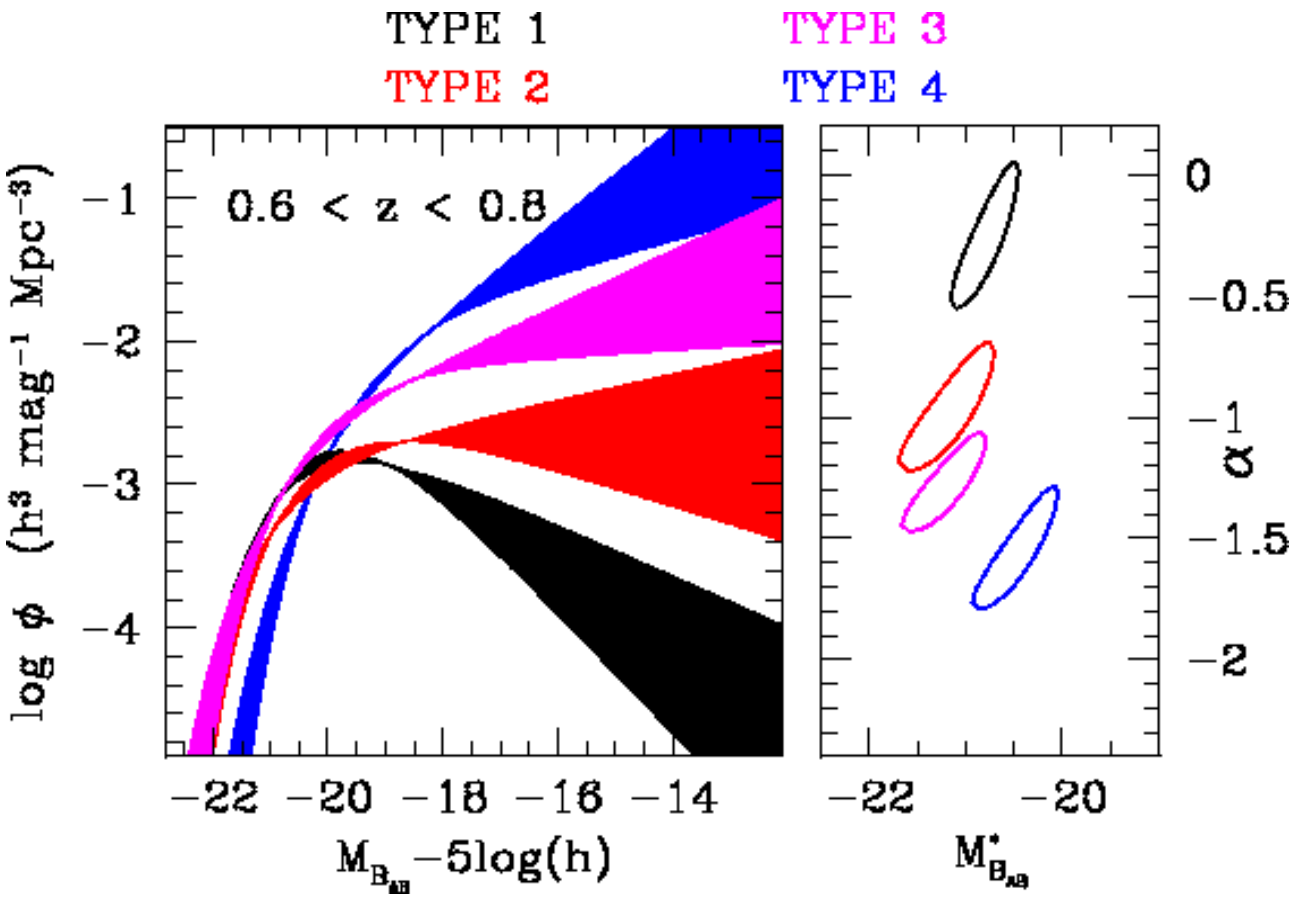
reddest

to

bluest

photometric types

SHAPE OF THE LF PER TYPE



Steepening of the slope from

reddest

to

bluest

photometric types

LF PER ENVIRONMENT

- **Environment classification on large scale (C. Marinoni) :**

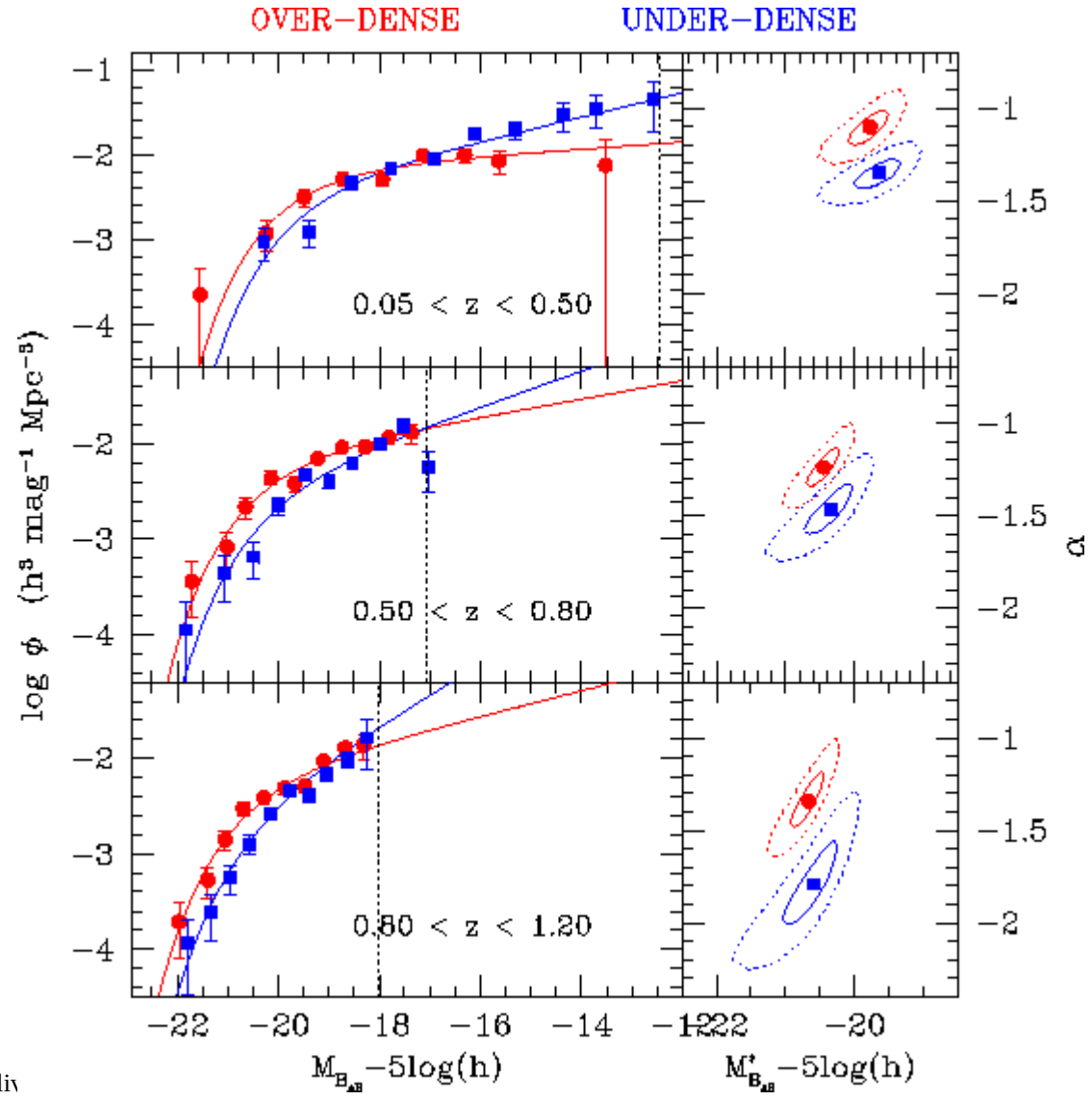
  - **Smoothing with a Gaussian of caracteristic length 5 Mpc**

  - **Definition of a local density contrast :**

$$\delta = \frac{\rho - <\rho>}{<\rho>}$$

$\delta < 0$ => under-dense region
$\delta \geq 0$ => over-dense region

GLOBAL LF PER ENVIRONMENT



Significant dependency of the global LF shape with large-scale environment

90% confidence level

One sigma confidence level

CONCLUSIONS

- Global LF up to z=1.5 with 4,500 spectroscopic redshifts
  - → Brightening of the M* parameter of 2 magnitudes
  - → Steepening of the slope with redshift
- Evolution of the LF for four photometric types
  - → Strong evolution of bluest type, weak evolution of reddest type
  - → Steep slope of bluest type , deacreasing slope of reddest type
- Dependency of the global LF shape with large-scale environment

PERSPECTIVES

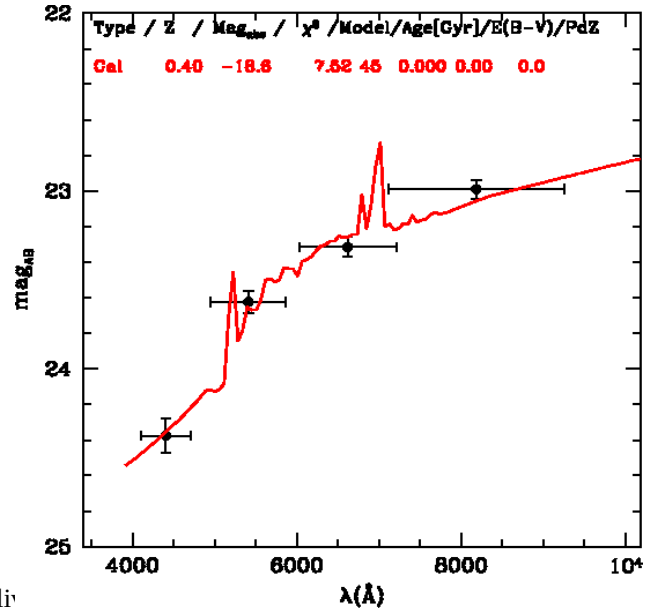
- On-going acquisition of 100,000 spectra with VIMOS
  - → LF, LD and SFR by type and environment simultaneously
- New expertise of the VVDS team in the redshift desert (1.5-3)
  - → LD evolution with a same sample from z=0.05 to z=4
- Extend the measurement of the LF and LD to a larger λ range
  - → FUV, NUV with GALEX
  - → NIR with J and K bands from VVDS
  - → Radio with VLA data
- Use photometric redshifts trained on spectroscopic data to
  - → Improve the statistic
  - → Go deeper

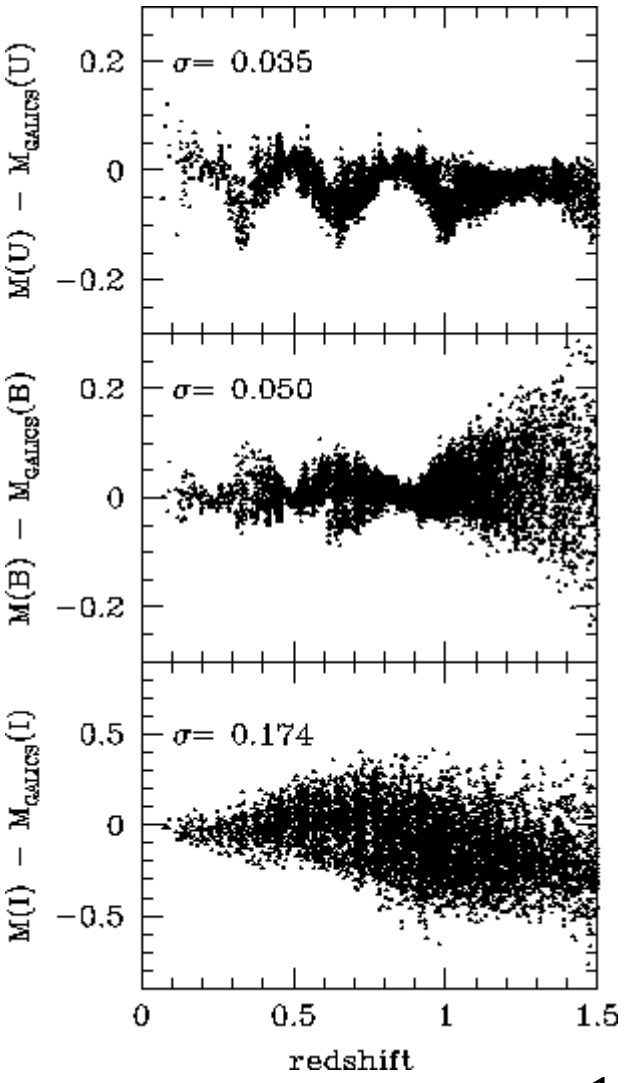

VIRMOS

LF TOOL : ABSOLUTE MAGNITUDE

- Fit the best template on BVRI multi-color data
- Derived the k-correction with the template SED
- We used the flux in the observer frame

➡ Limits the template dependency



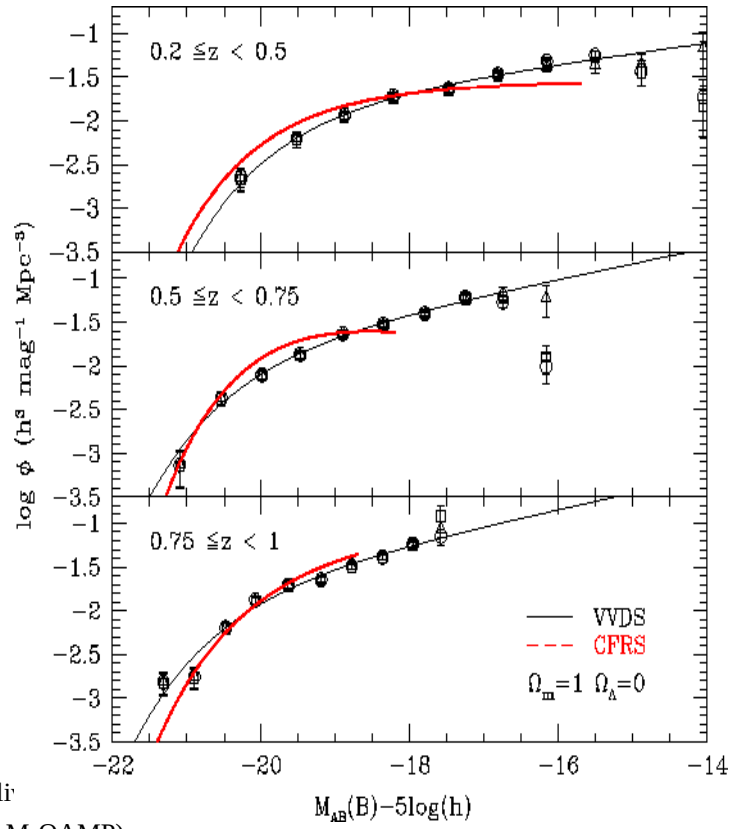


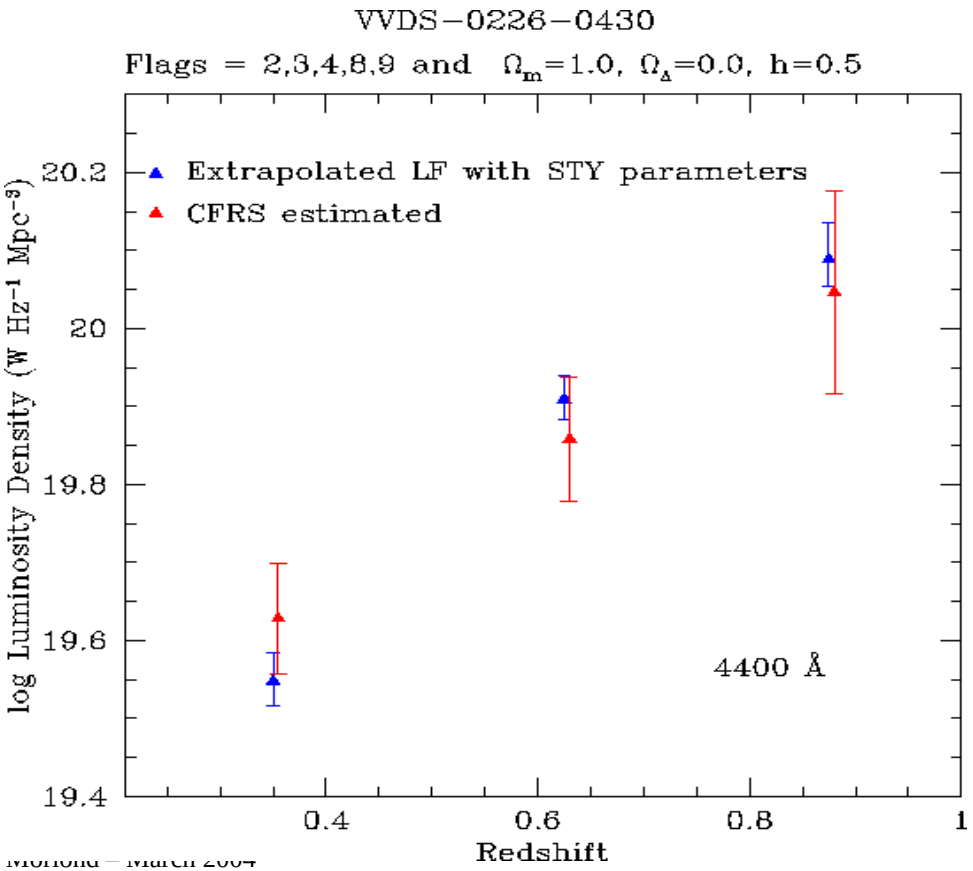
Oli
(LAM-OAMP)

COMPARISON WITH THE CFRS

- Canada-France Redshift Survey (CFRS) : 591 secured redshift Iab<22.5
- Luminosity function and luminosity density from Lilly et al. 1995

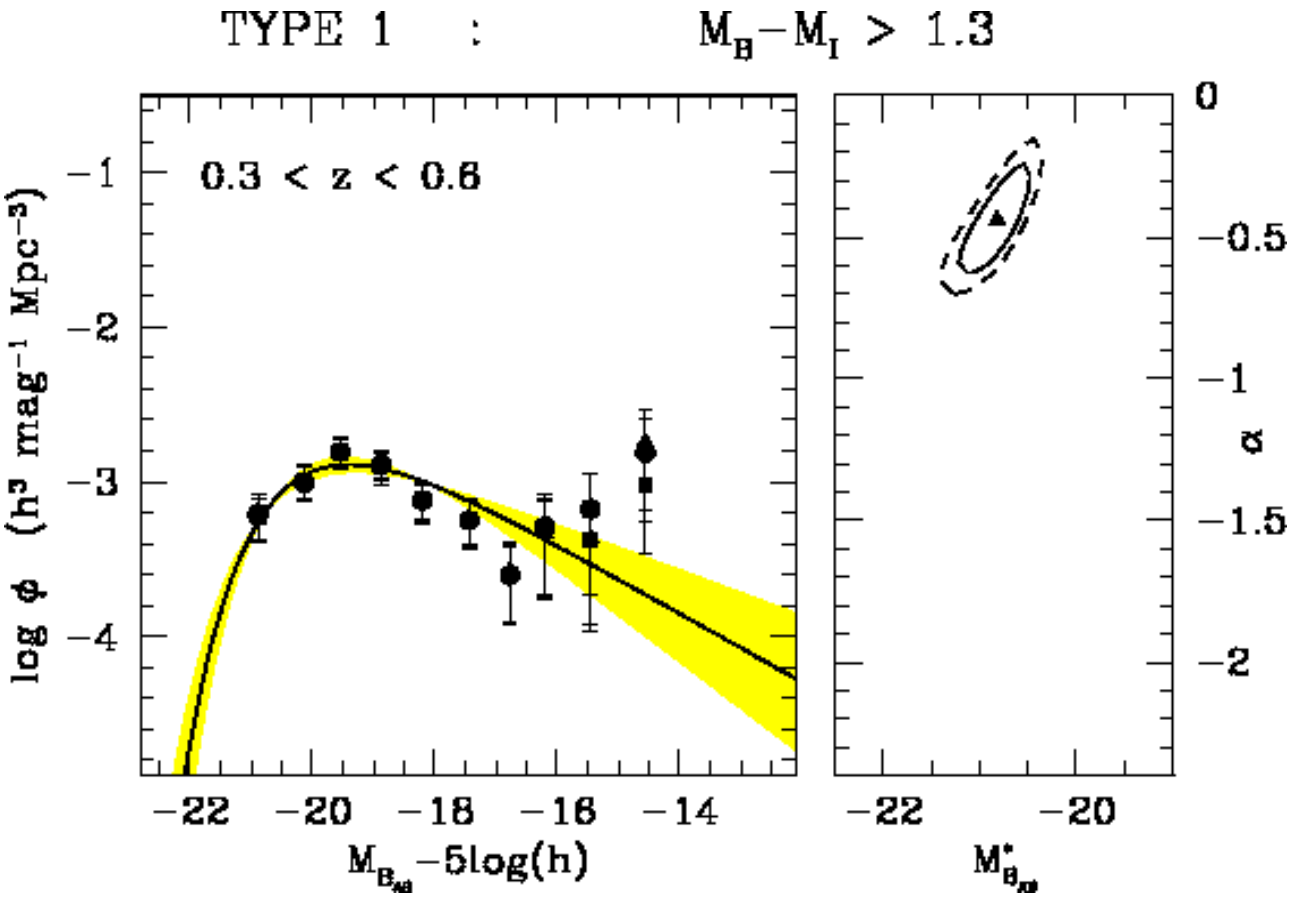
▶ **Agreement**





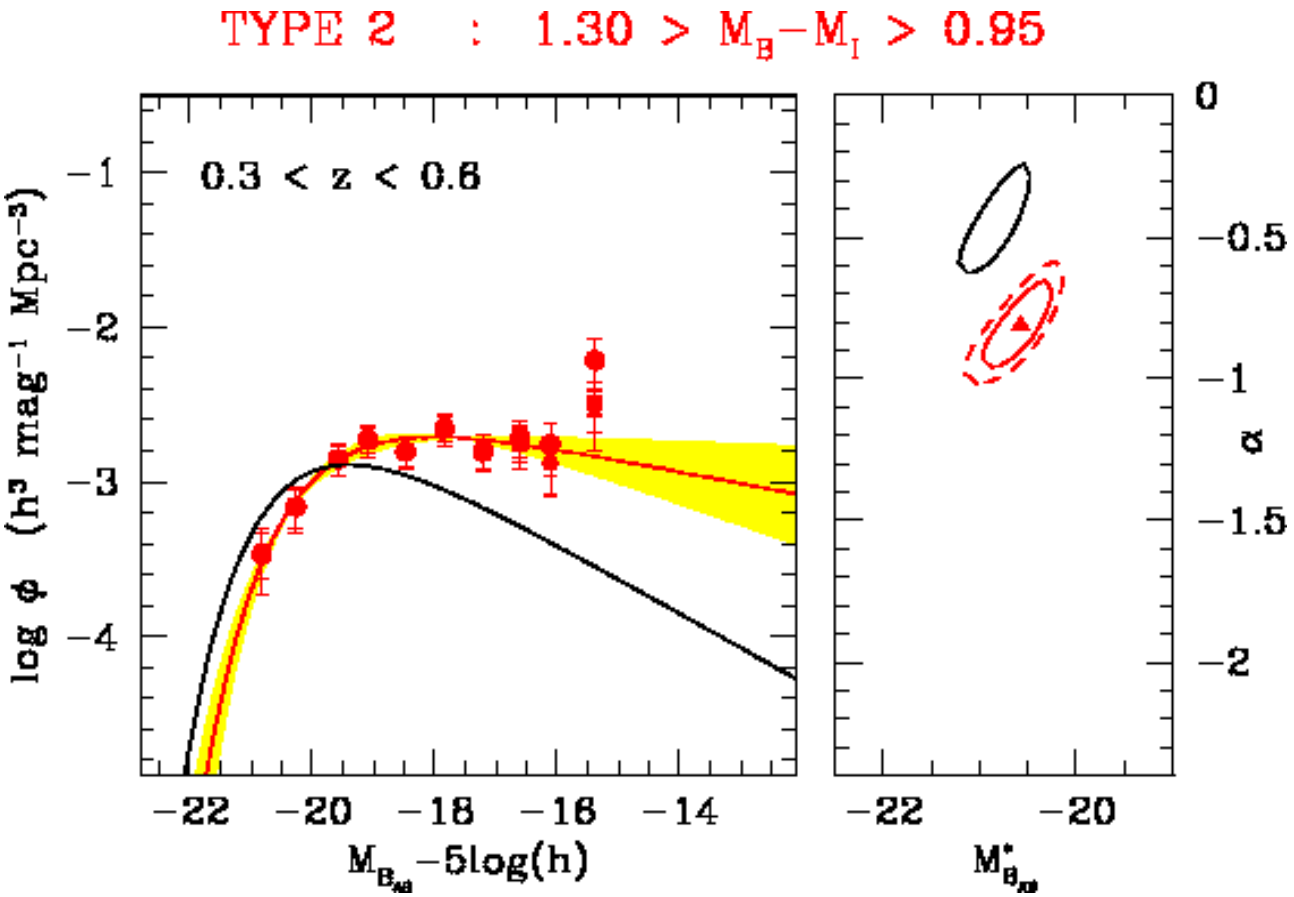
SHAPE OF THE LF PER TYPE

Fit the best template on BVRI multi-color data => photometric type



SHAPE OF THE LF PER TYPE

Fit the best template on BVRI multi-color data => photometric type



Steepening of the slope from

reddest

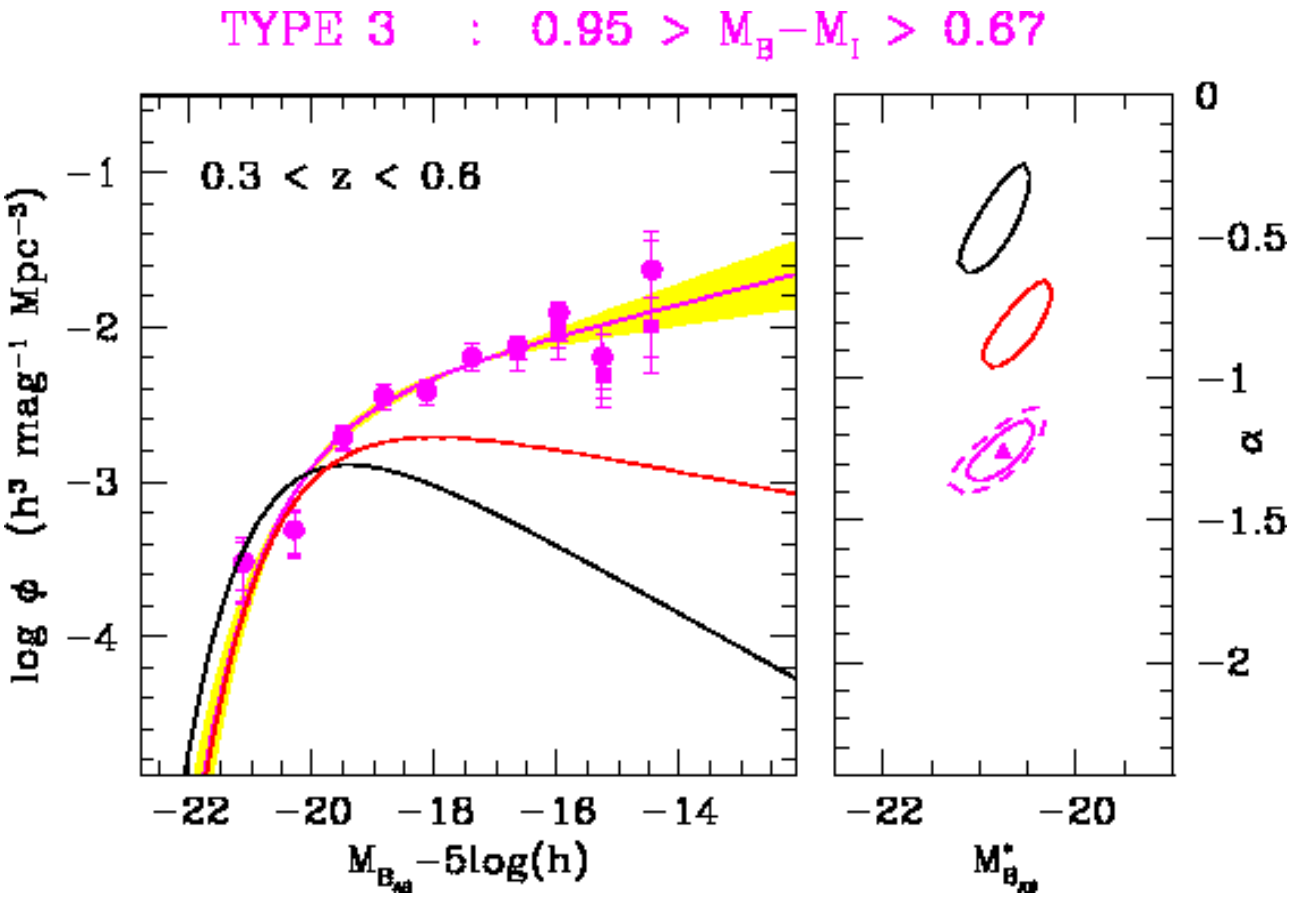
to

bluest

photometric types

SHAPE OF THE LF PER TYPE

Fit the best template on BVRI multi-color data => photometric type



Steepening of the slope from

reddest

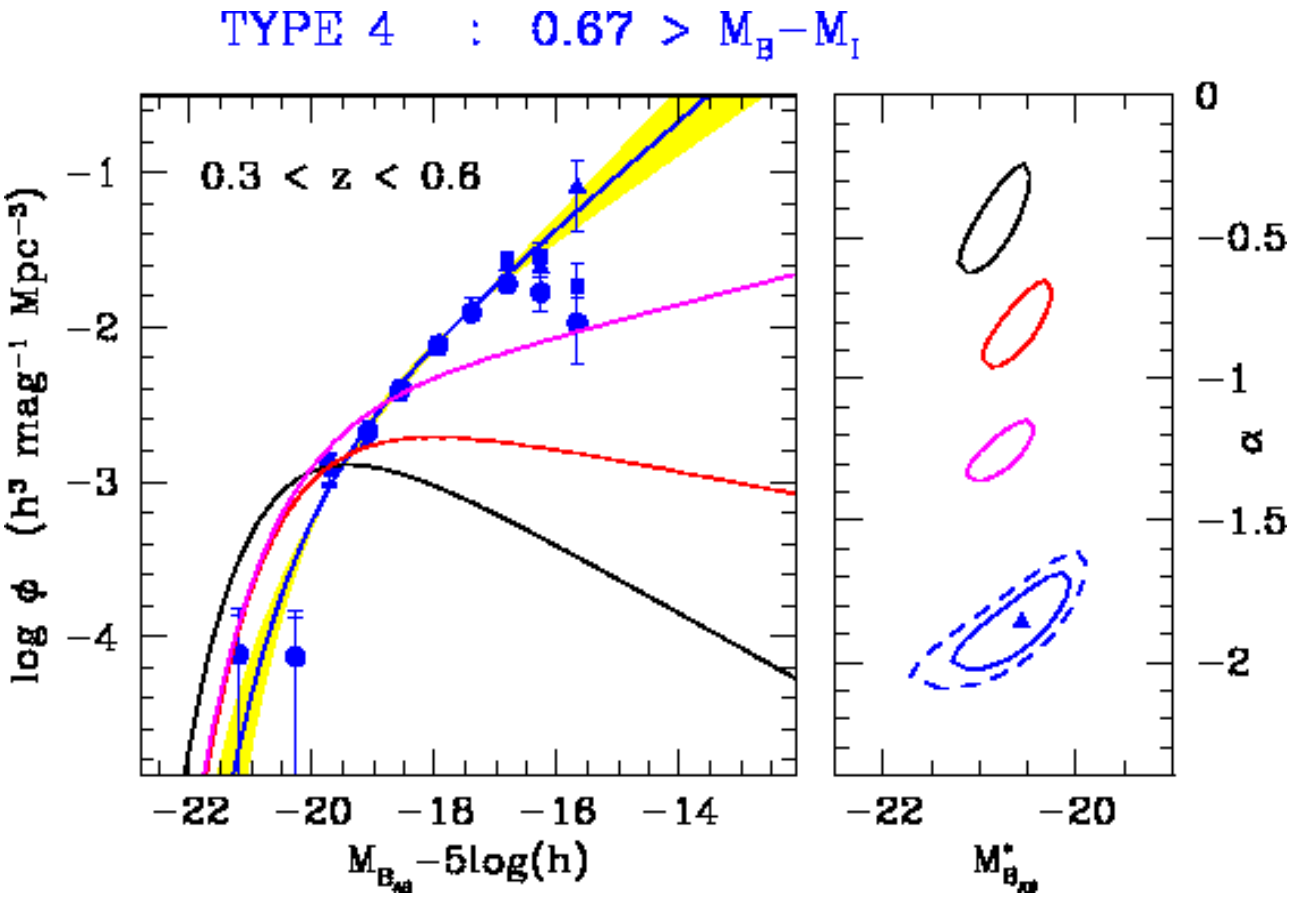
to

bluest

photometric types

SHAPE OF THE LF PER TYPE

Fit the best template on BVRI multi-color data => photometric type



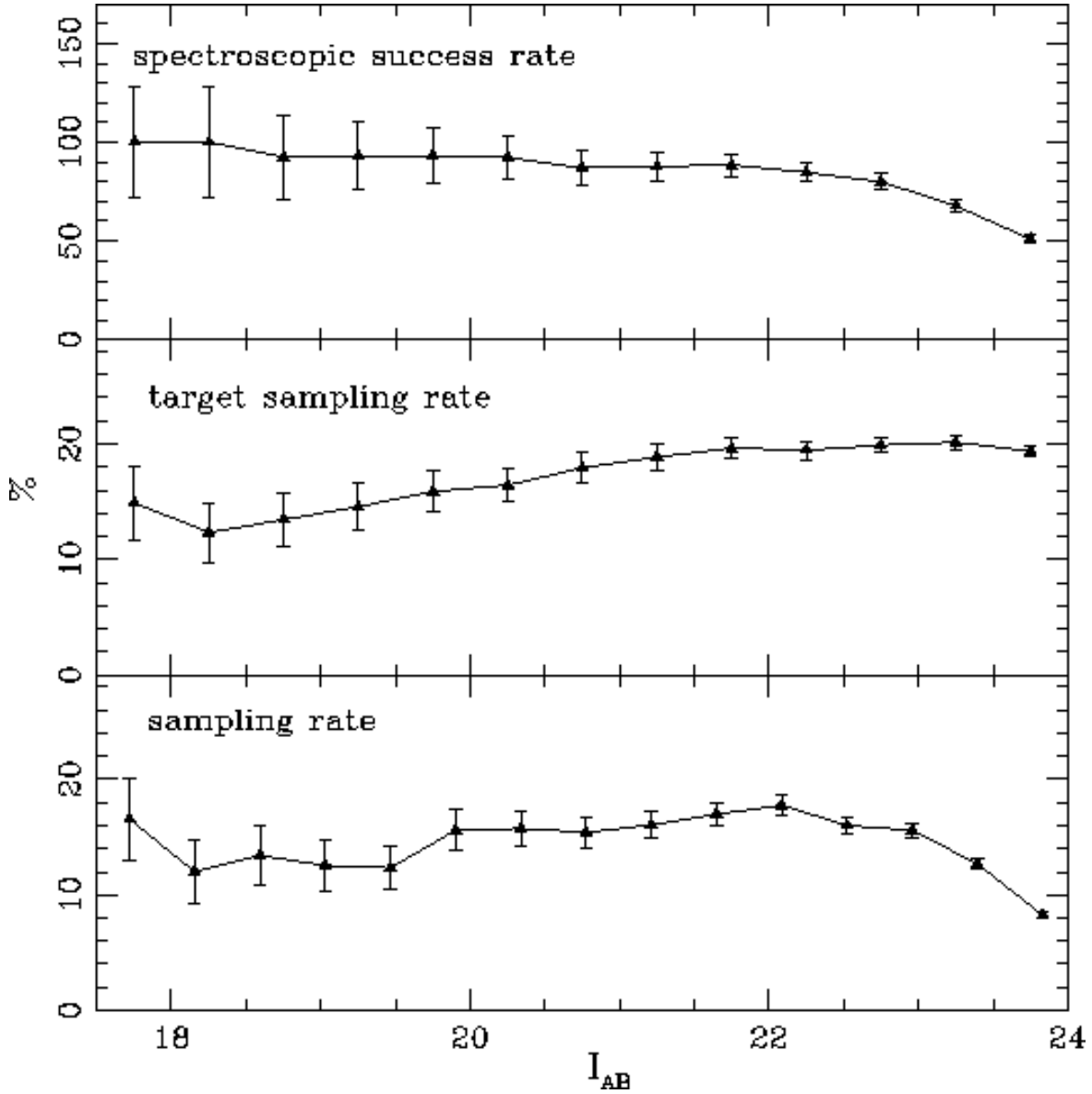
Steepening of the slope from

reddest

to

bluest

photometric types



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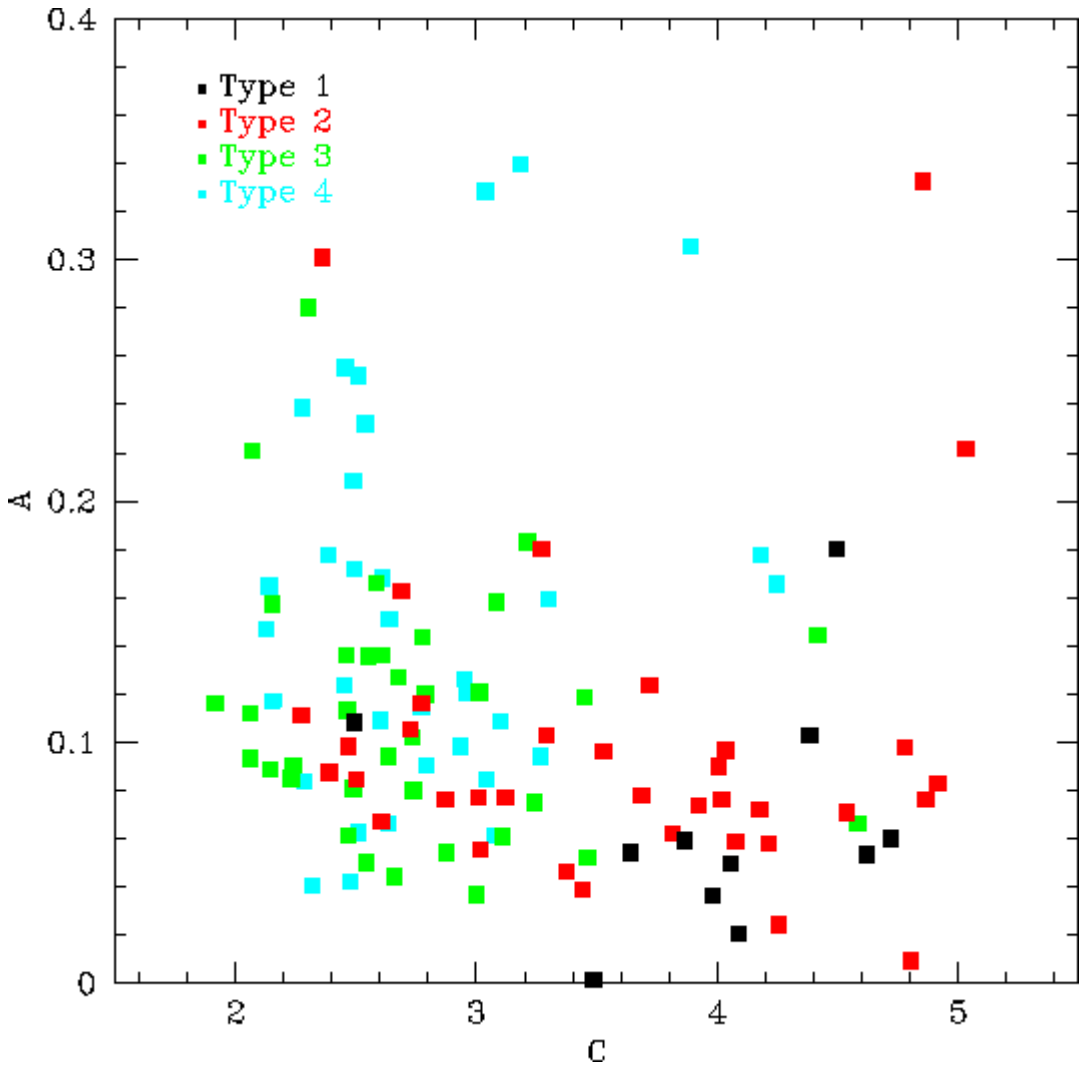
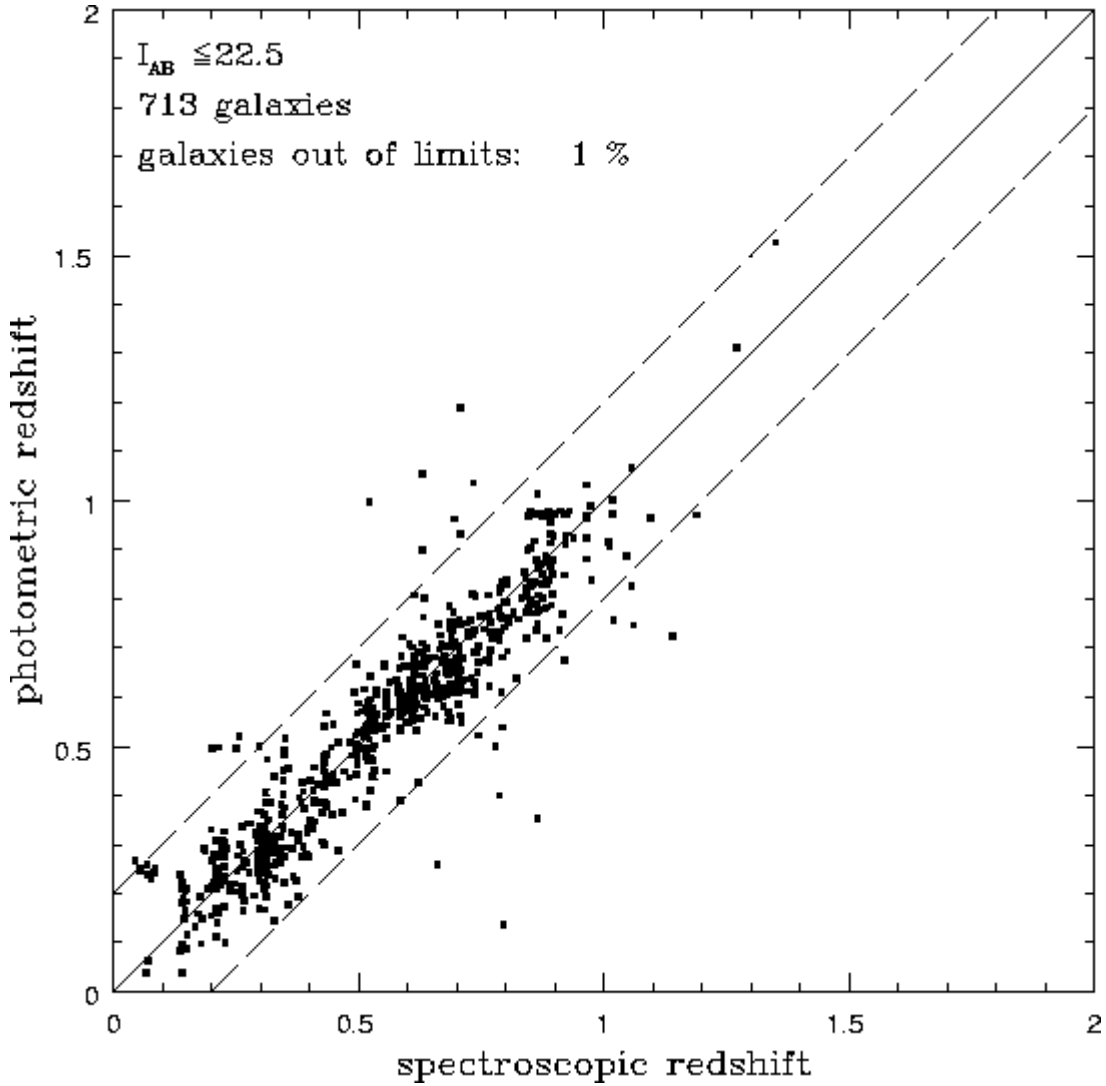
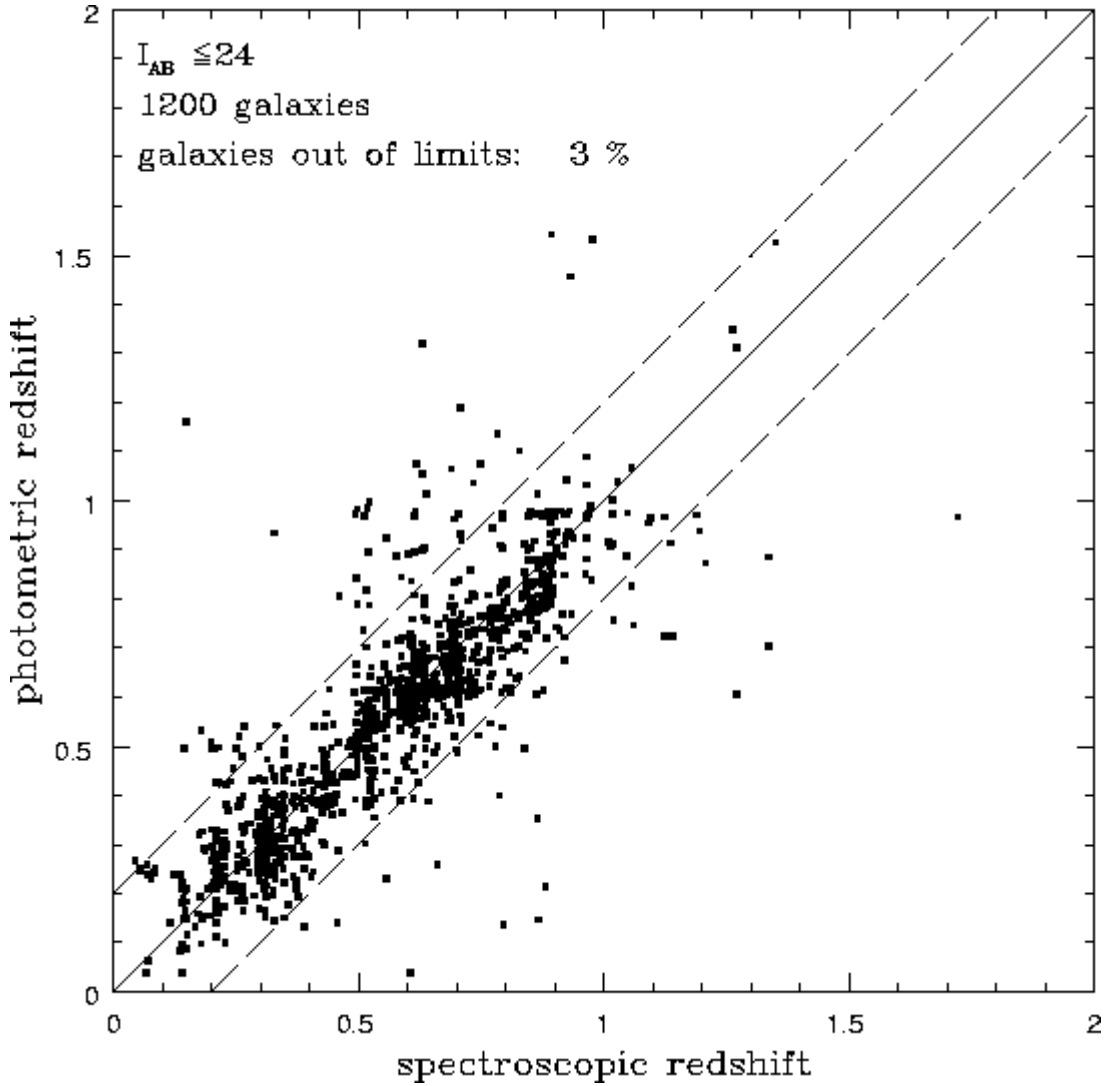
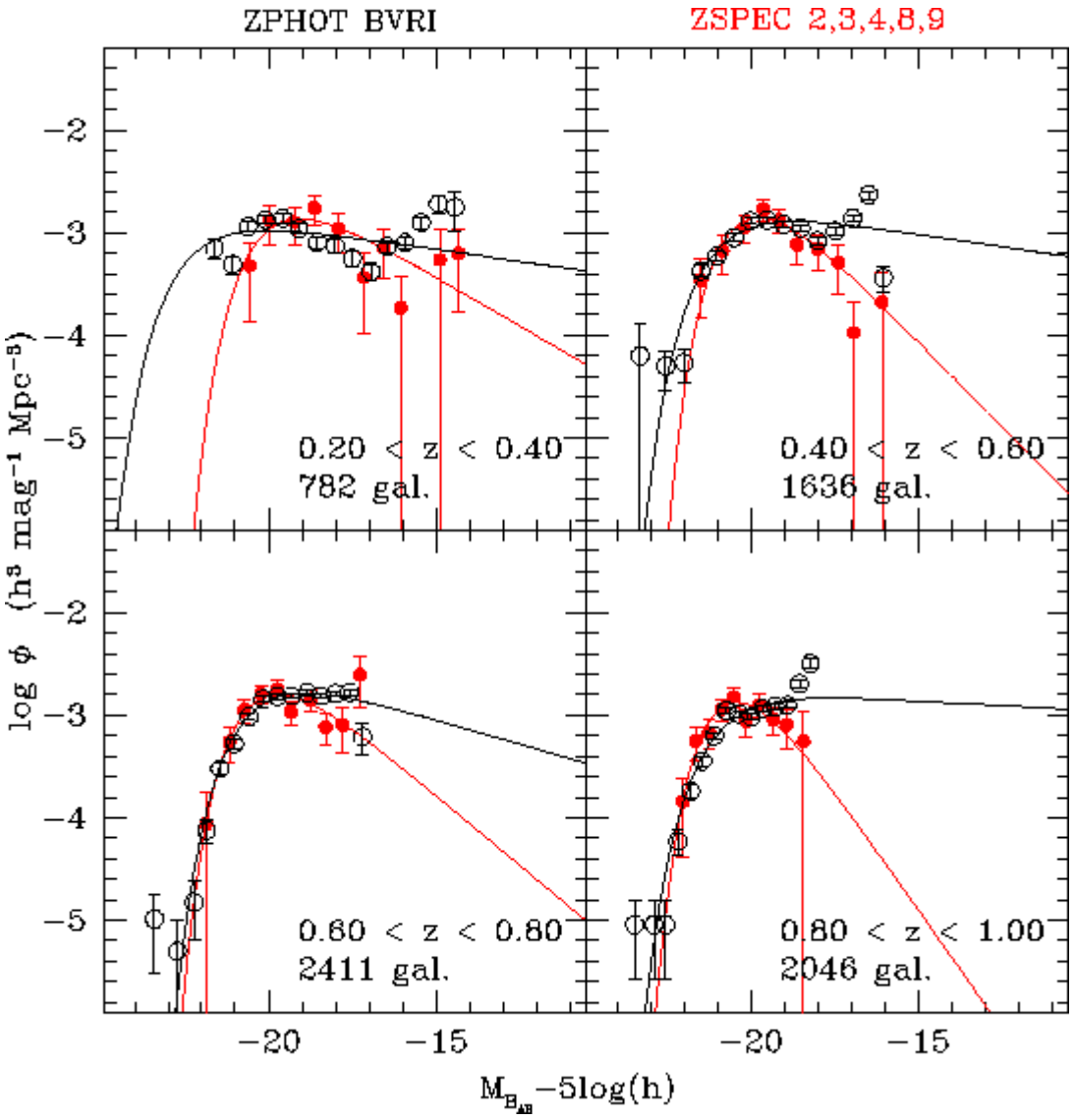

Type 1
Type 2
Type 3
Type 4
A
C
0.4
0.3
0.2
0.1
0
2
3
4
5


I_{AB} ≦22.5
713 galaxies
galaxies out of limits: 1 %
photometric redshift
spectroscopic redshift
0
0.5
1
1.5
2


$I_{AB} \leq 24$
1200 galaxies
galaxies out of limits: 3 %
photometric redshift
spectroscopic redshift
0
0.5
1
1.5
2



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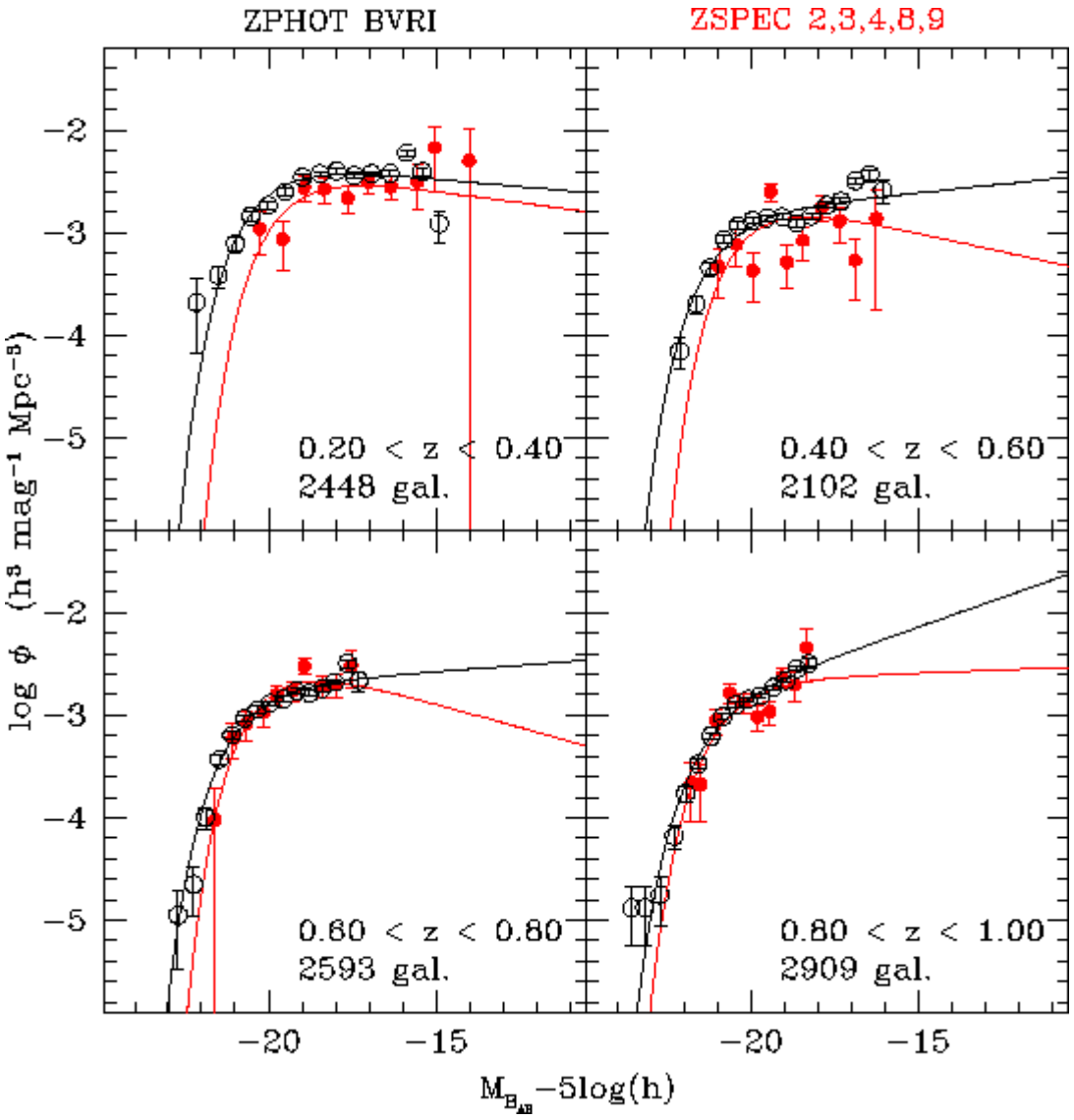
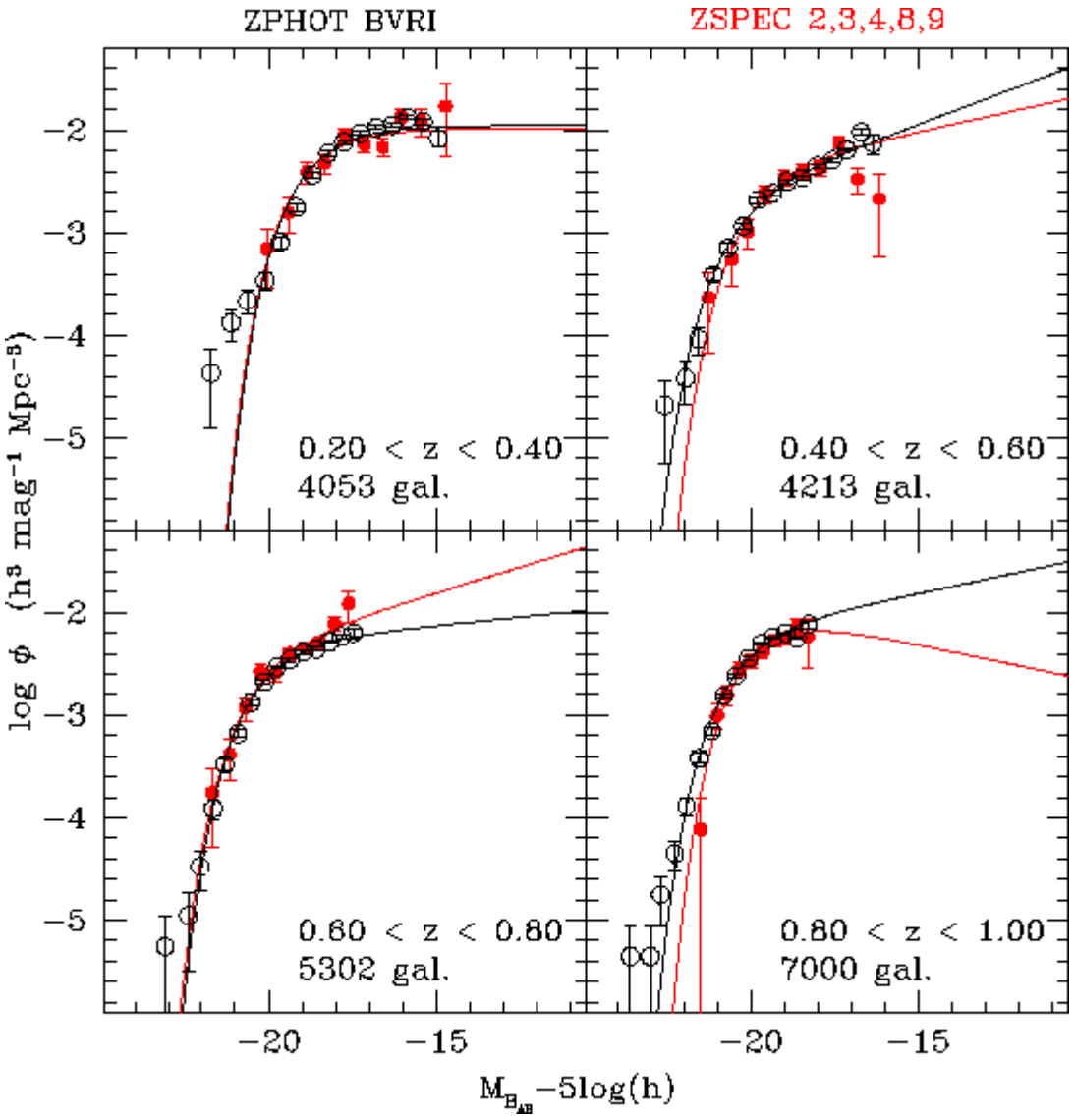
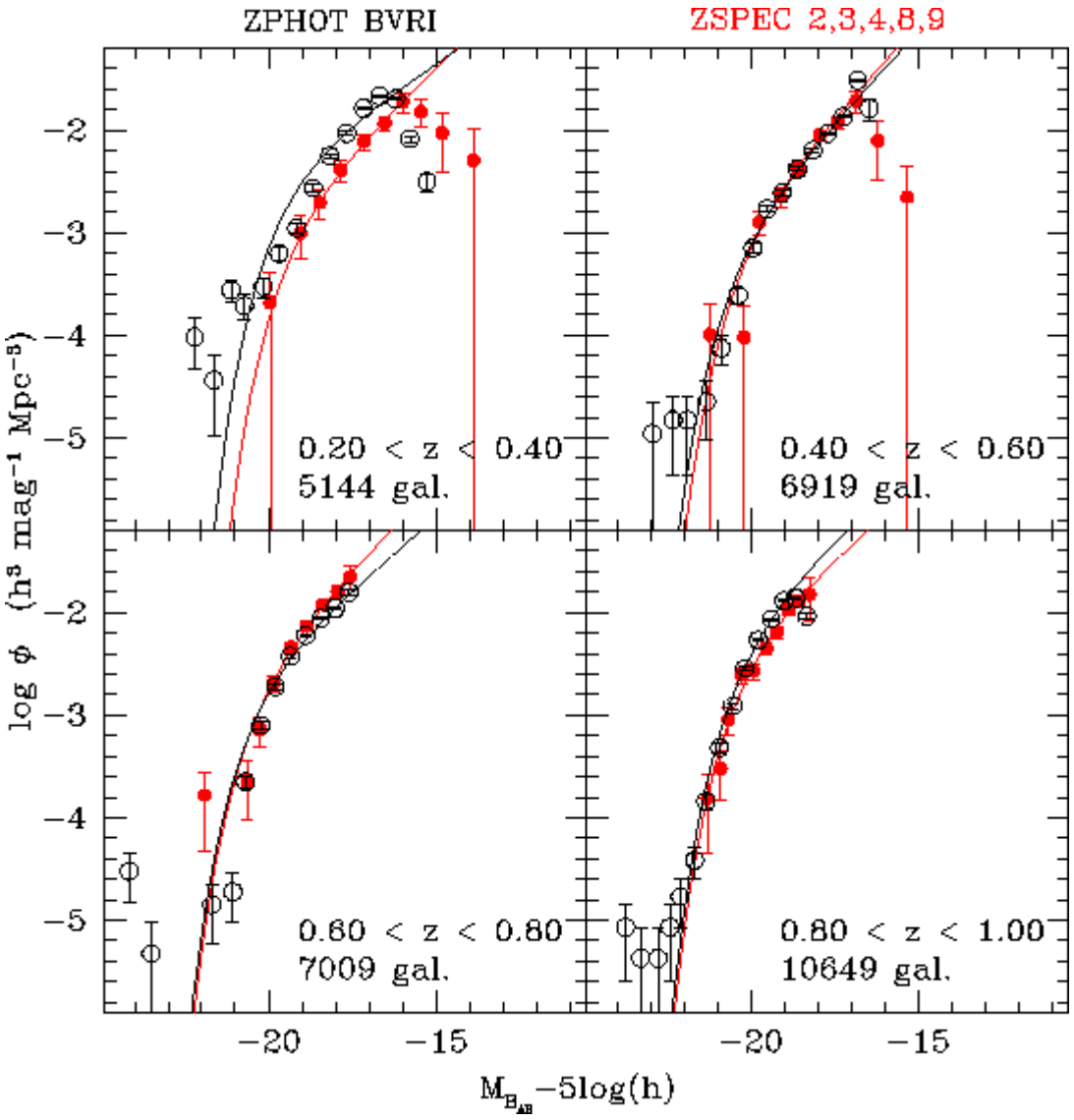

ZPHOT BVRI
ZSPEC 2,3,4,8,9
0.20 < z < 0.40
2448 gal.
0.40 < z < 0.60
2102 gal.
0.60 < z < 0.80
2593 gal.
0.80 < z < 1.00
2909 gal.
log φ (h³ mag⁻¹ Mpc⁻³)
M_B_AB−5log(h)
−2
−3
−4
−5
−20
−15


ZPHOT BVRI
ZSPEC 2,3,4,8,9
0.20 < z < 0.40
4053 gal.
0.40 < z < 0.60
4213 gal.
0.60 < z < 0.80
5302 gal.
0.80 < z < 1.00
7000 gal.
log φ (h³ mag⁻¹ Mpc⁻³)
M_B_AB−5log(h)
−2
−3
−4
−5
−20
−15



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