Deep multi-color surveys to trace the stellar mass assembly

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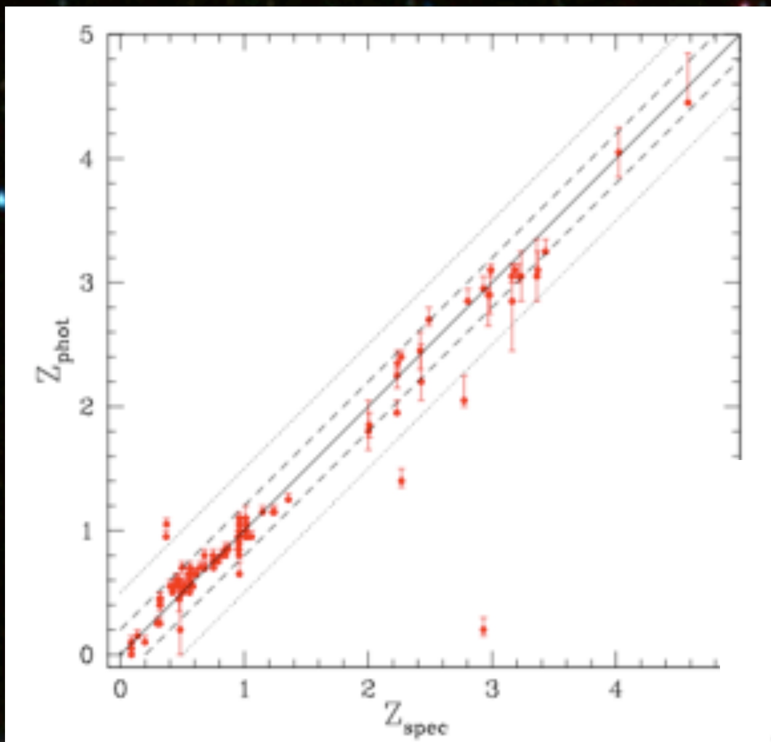
2006

why deep multi-color surveys ?

- provide sources to be targeted in spectroscopy
- physical parameters

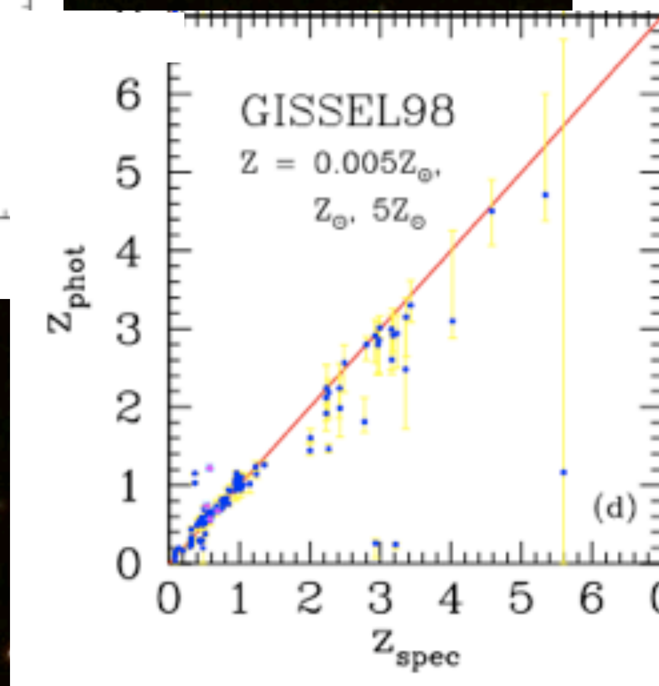
  luminosity/spectral type/stellar mass
- galaxy structural parameters (morphology, lensing)
- photometric redshifts or color-color selection to isolate a redshift range

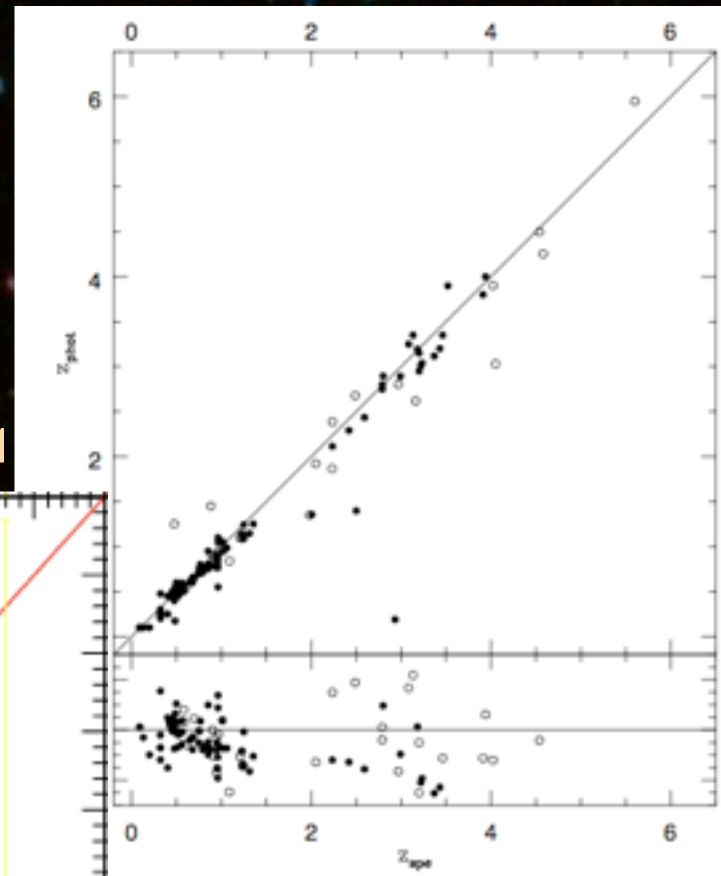
Photometric redshifts for all faint sources



Arnouts et al. 1999

Bolzonella et al. 2001



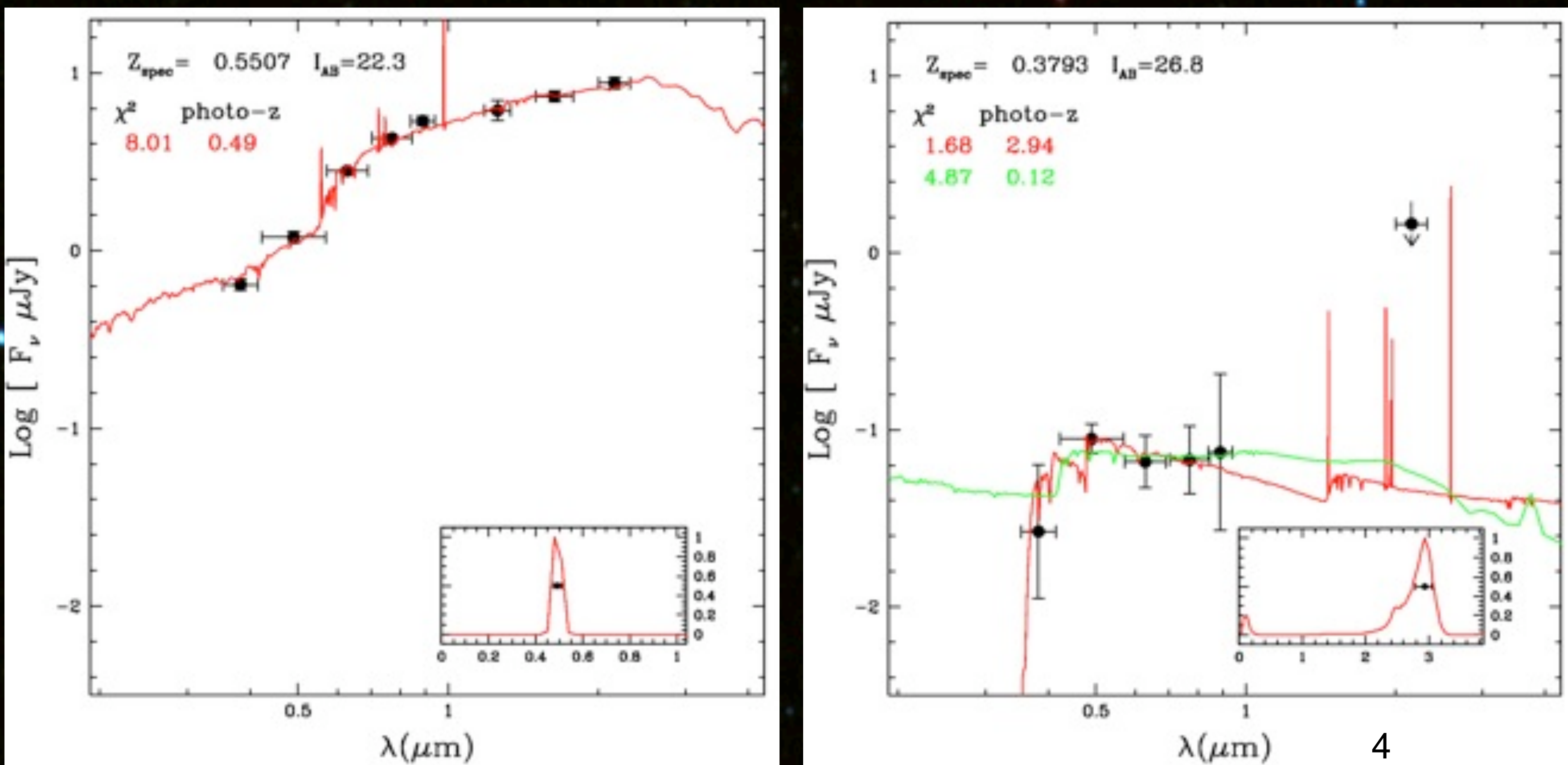


Fontana et al. 2000

Hubble Deep Field

Accurate photometric redshifts

- a good λ sampling around the Balmer/Lyman breaks
- deep data



Test of the photo-z methods

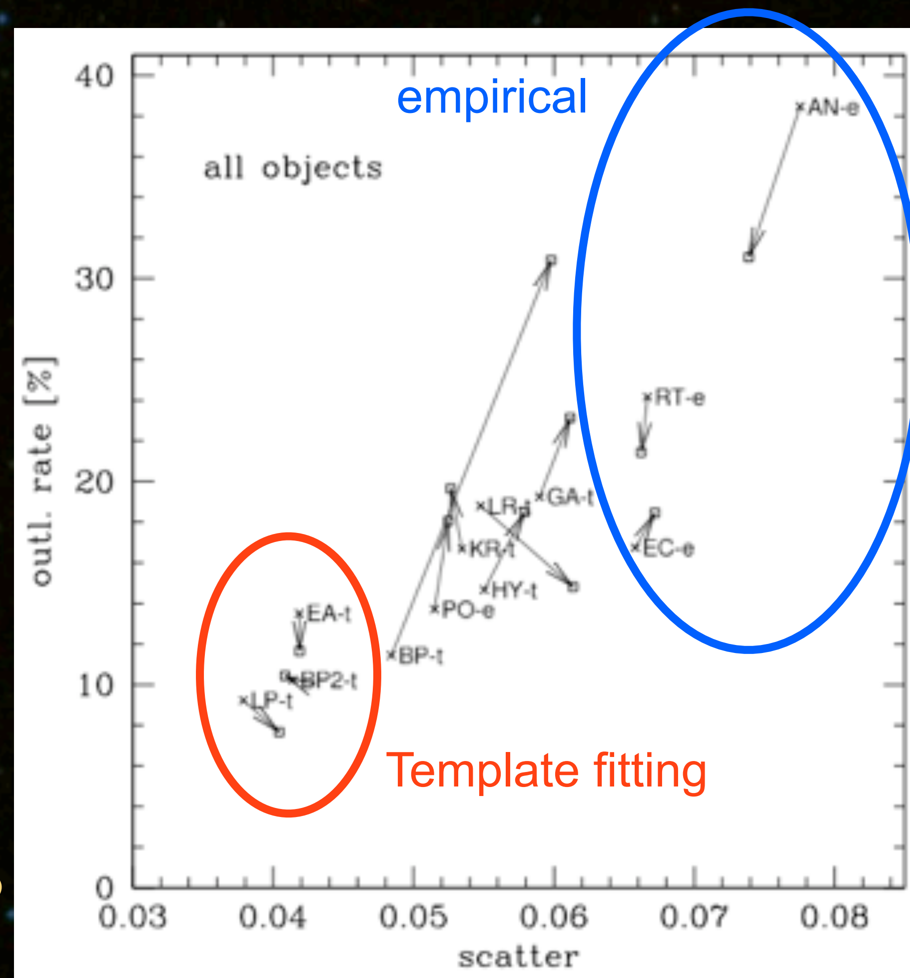
PHoto-z Accuracy Testing

blind test of 18 codes

with GOODS data

➢ template fitting

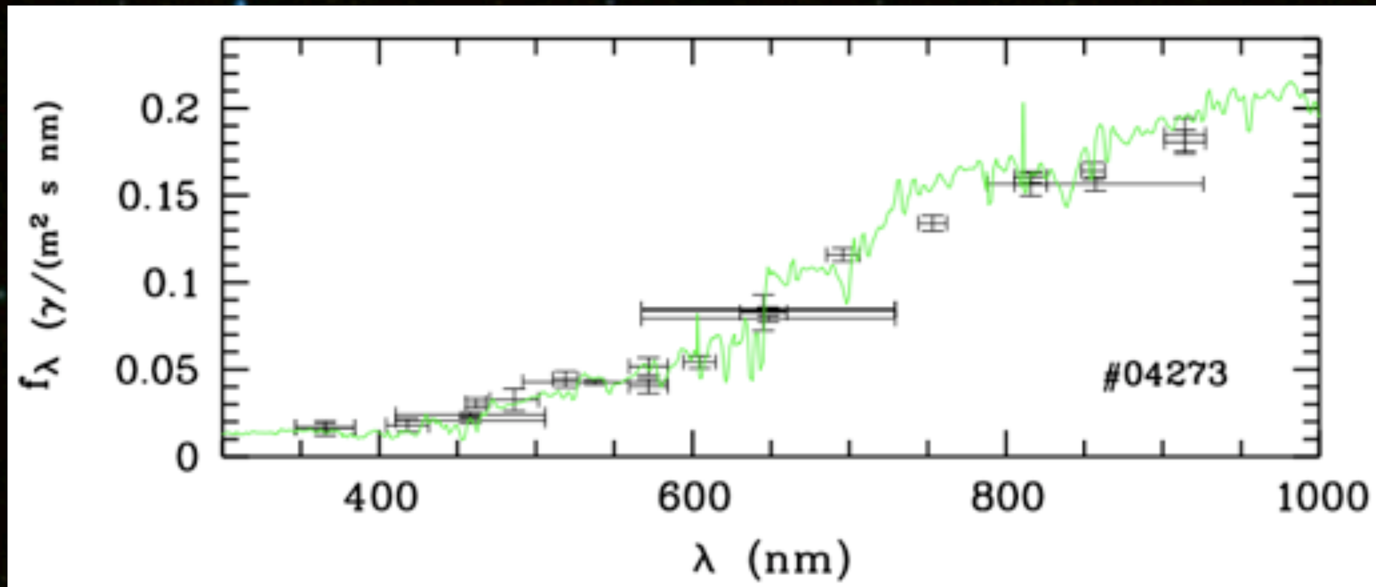
works better in deep surveys



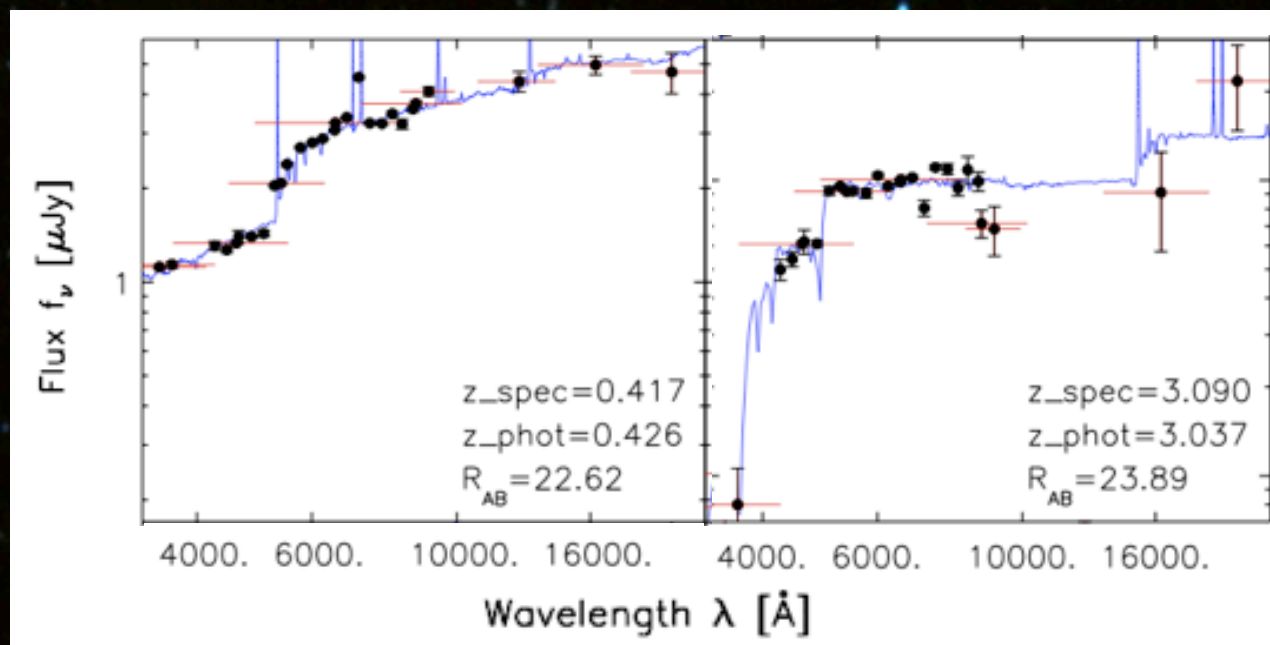
Hildebrandt et al. 2010

Template fitting with medium bands

COMBO-17
Wolf et al. 2004



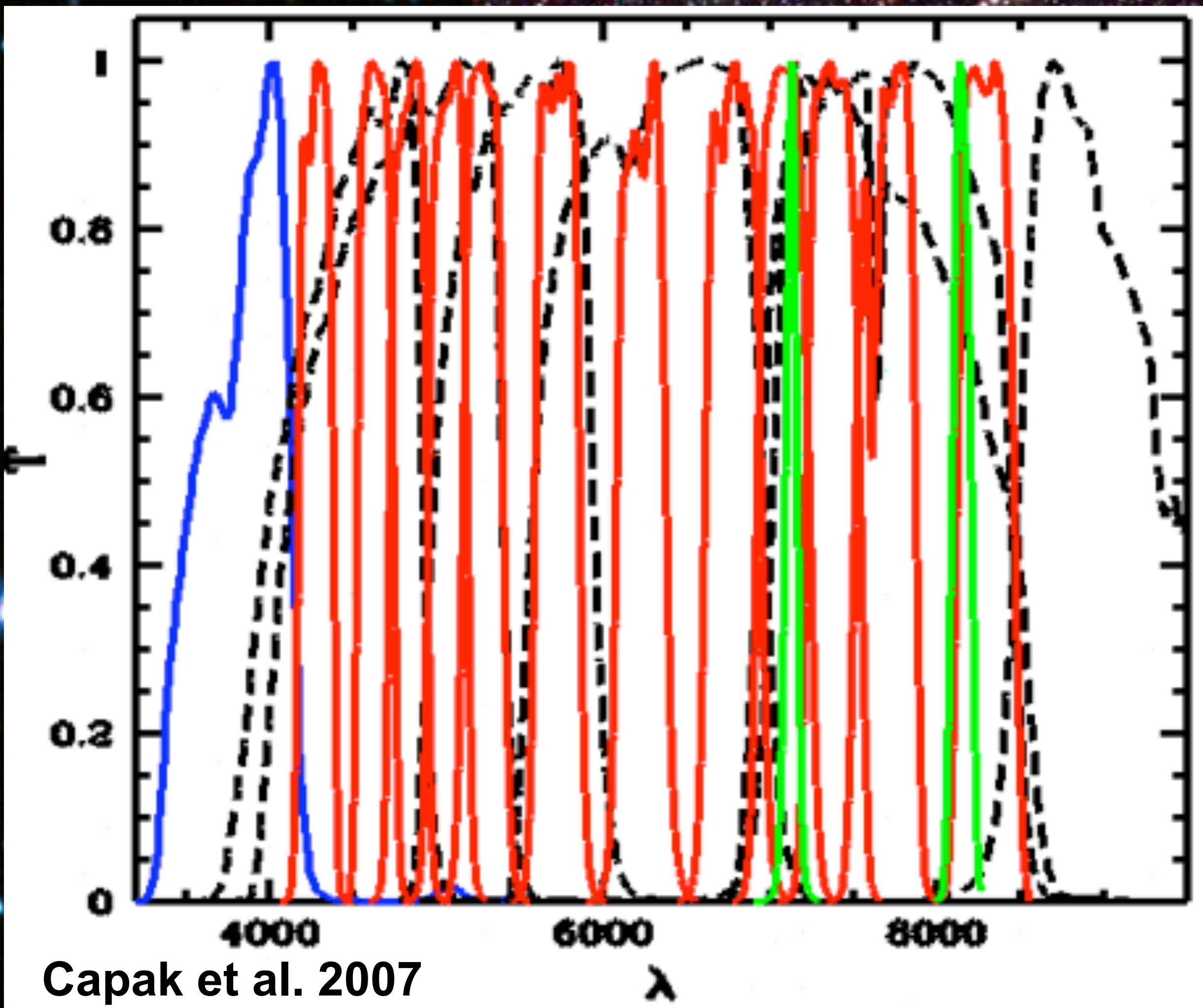
Cardamone et al. 2010



The COSMOS multi-color data

30 bands over 2 deg^2

540,000 sources at i'<25.5



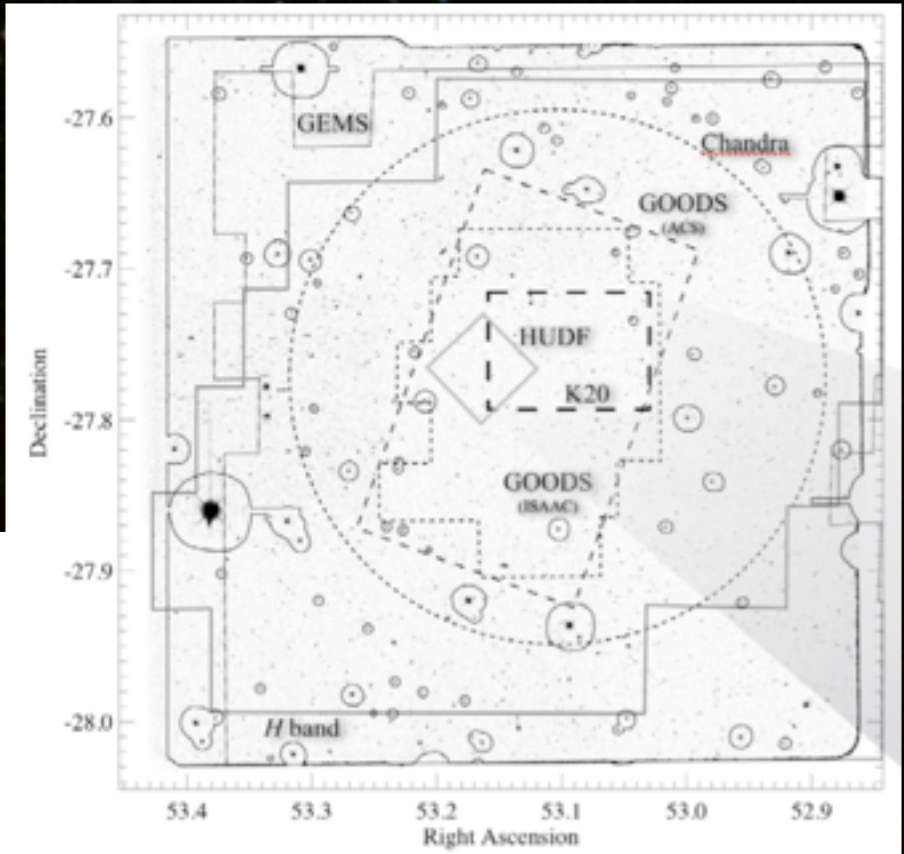
Capak et al. 2007

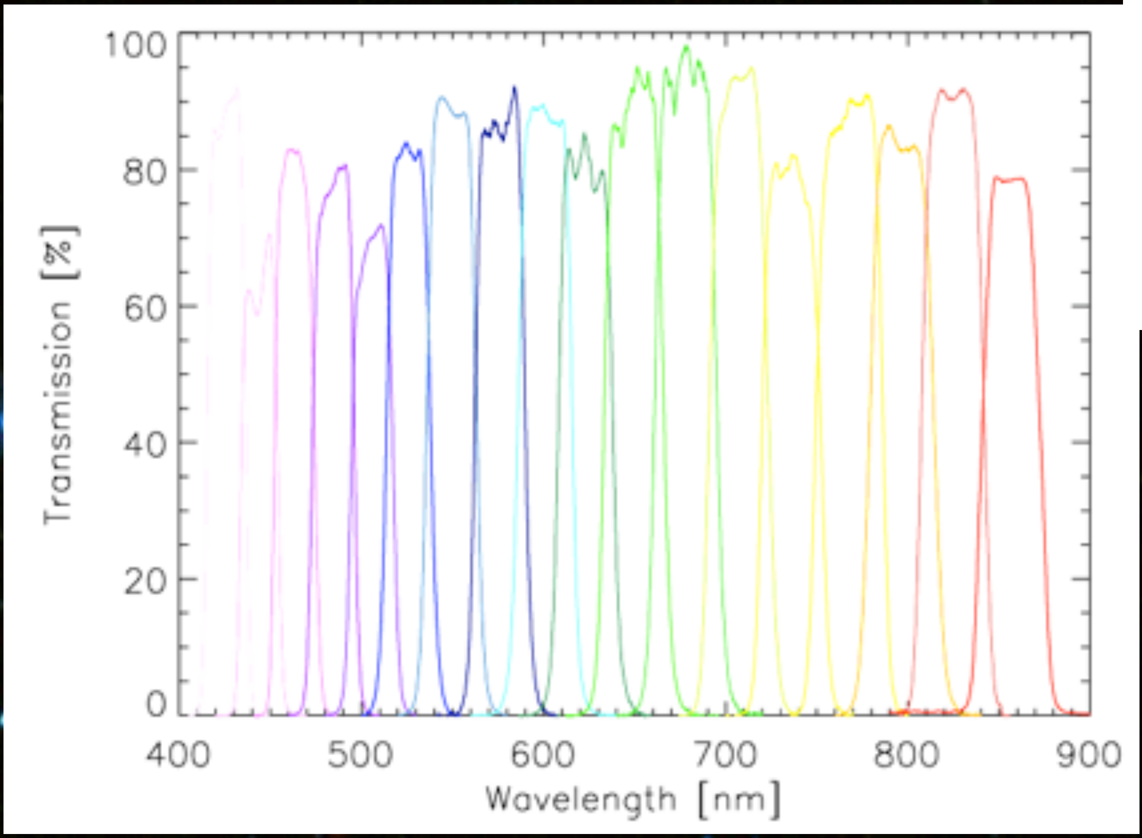
x6 Subaru

The CDFS multi-color data

18 medium bands from Subaru

- ➢ 32 bands 40,000 sources over 0.25 deg^2

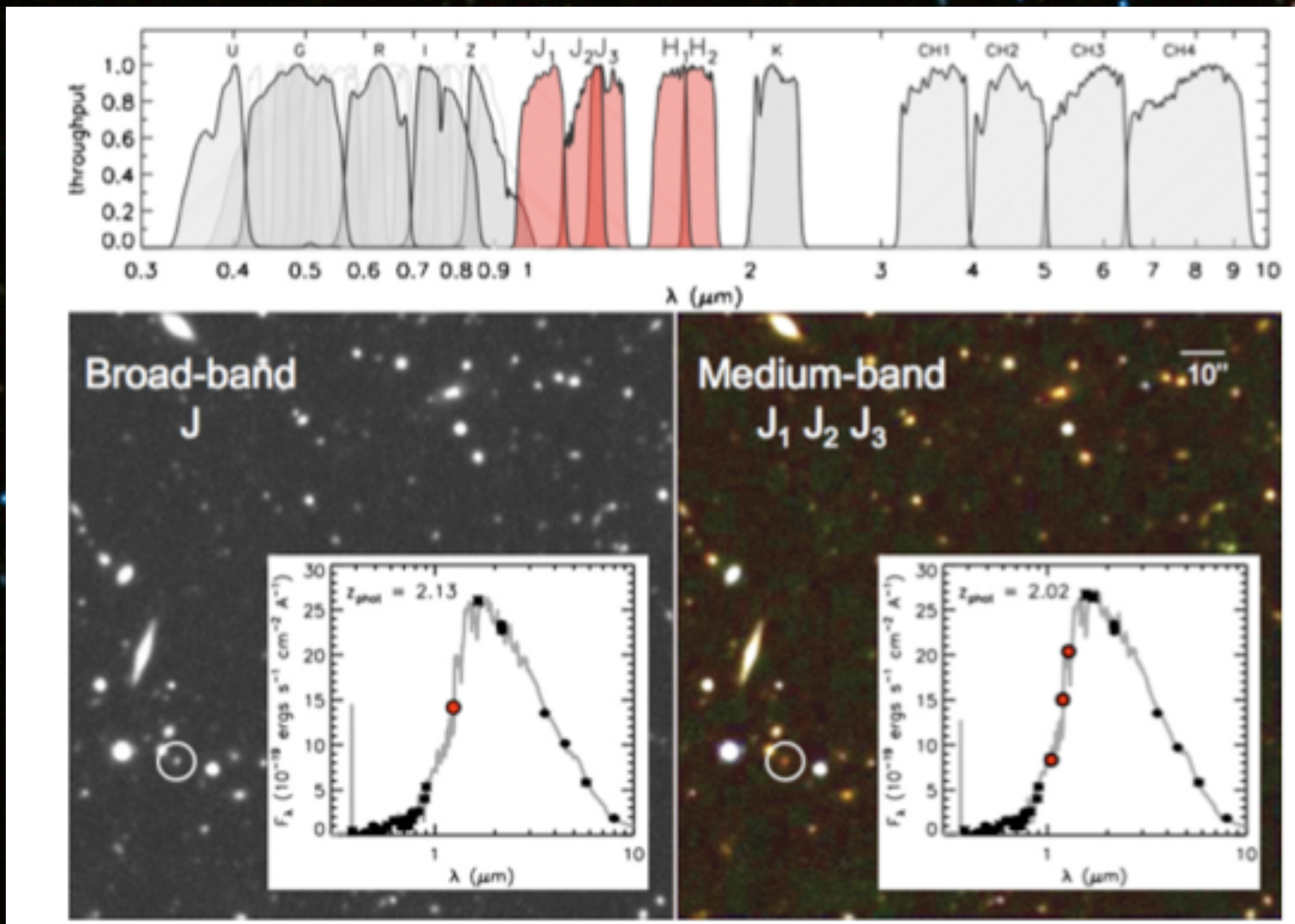




Cardamone et al. 2010

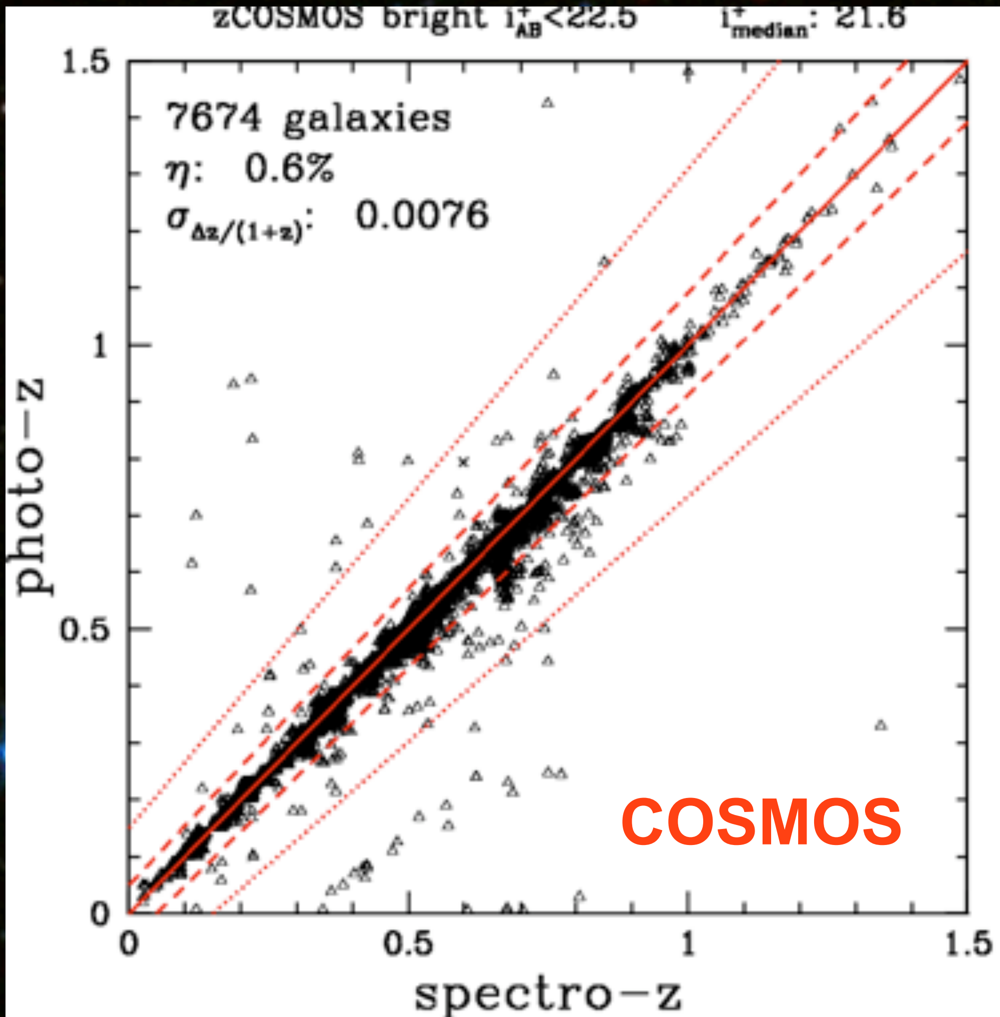
NEWFIRM survey

4 medium bands in NIR over 0.25 deg^2

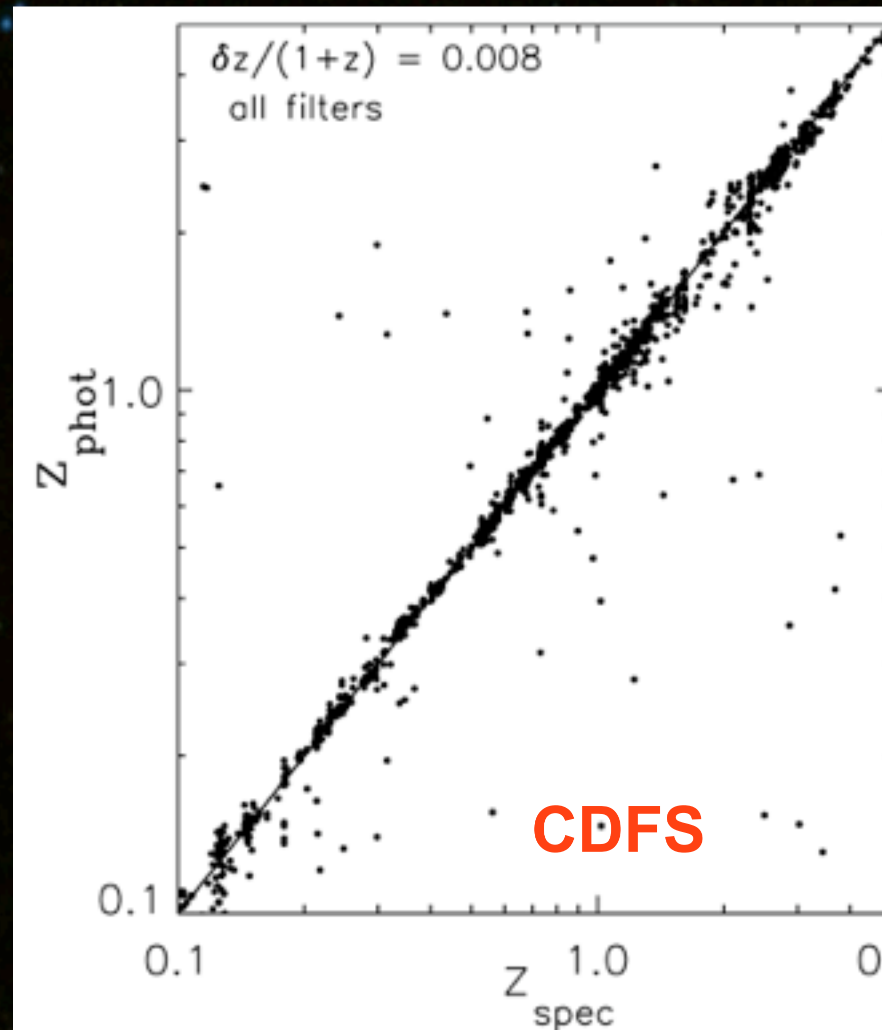


Van Dokkum et al. 2010

1-2% accurate at z<1.3



Ilbert, Capak, Salvato et al. 09



Cardamone et al. 2010

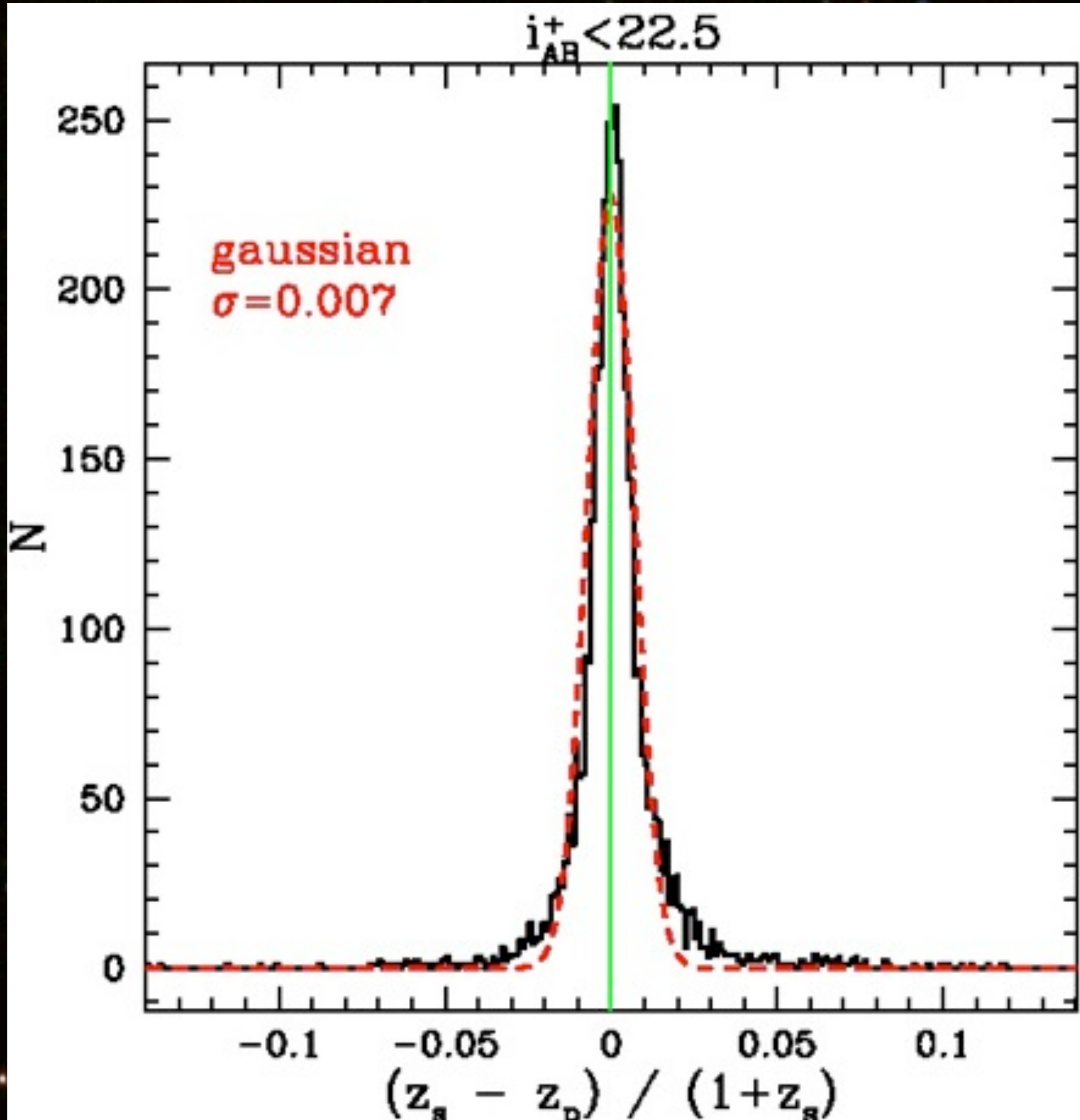
Importance of the medium bands

With

medium bands

$\sigma_{dz/(1+z)}$ < 1%

at i'<22.5



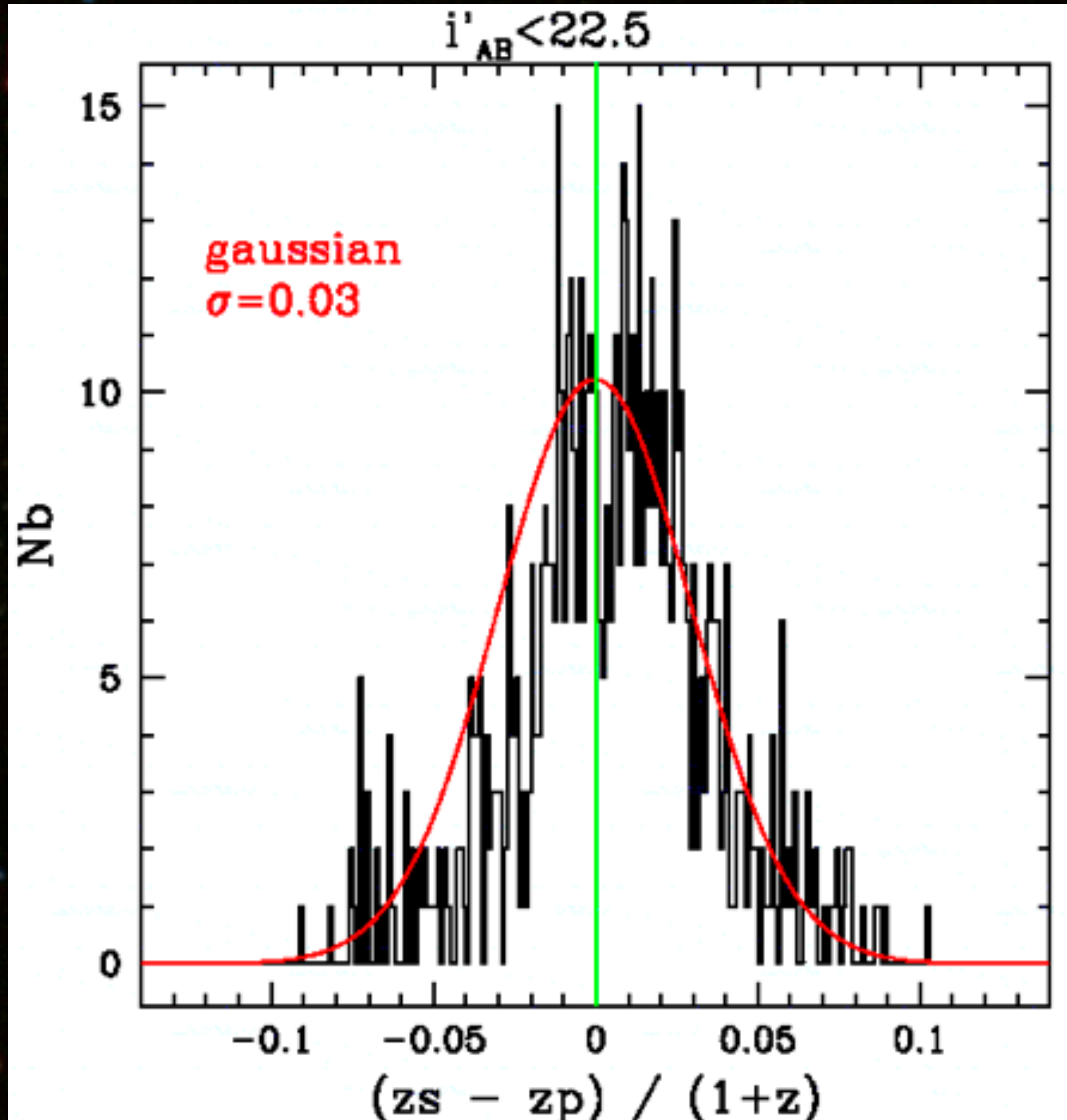
Importance of the medium bands

Without

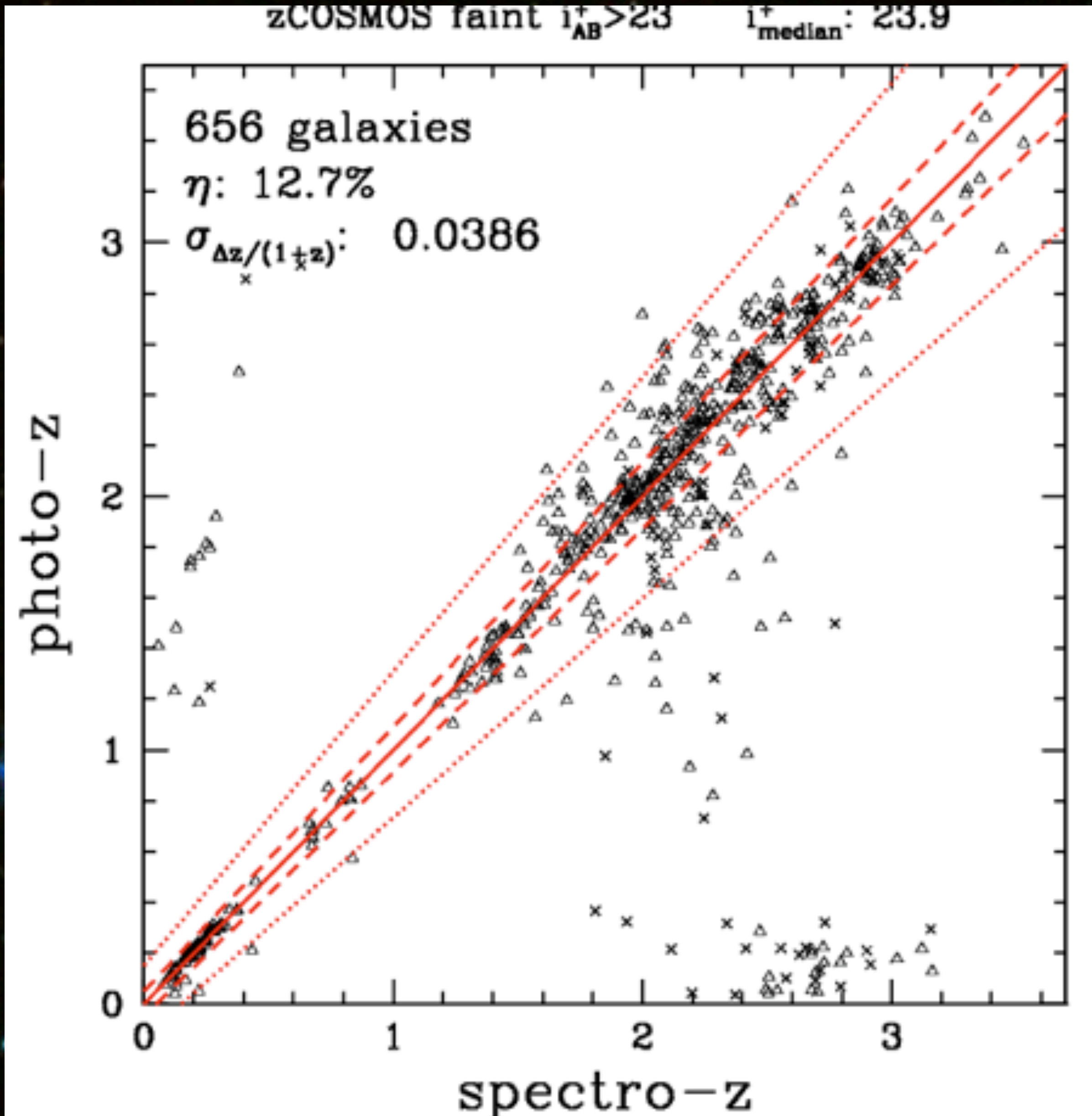
medium bands

$\sigma_{dz/(1+z)}$ ~ 3%

at i'<22.5



accuracy at z>1.3

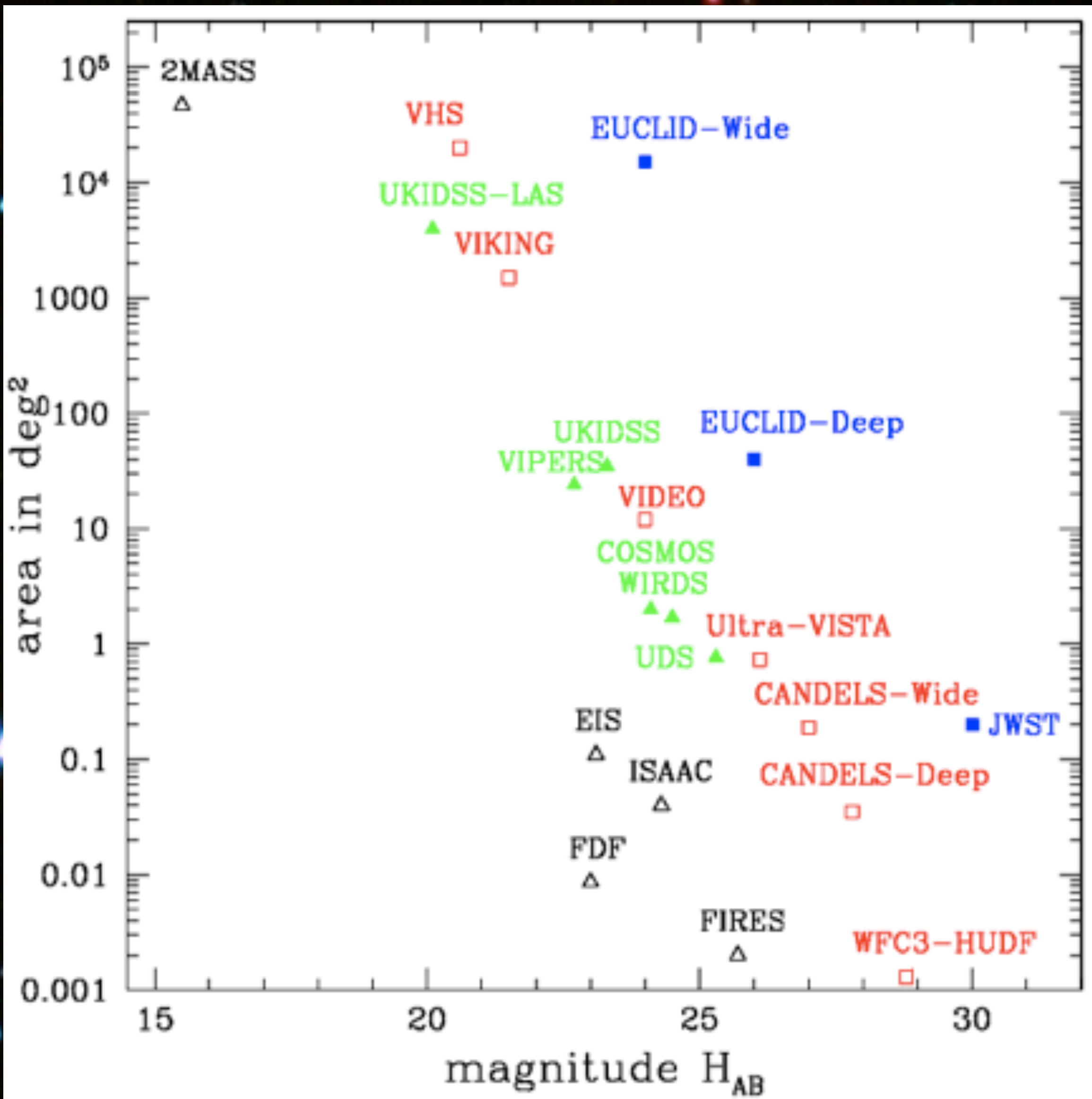


Balmer break redshifted in NIR

➢ need a good λ coverage in NIR

➢ need deep NIR

Near-infrared surveys



WIRCAM, WFCAM

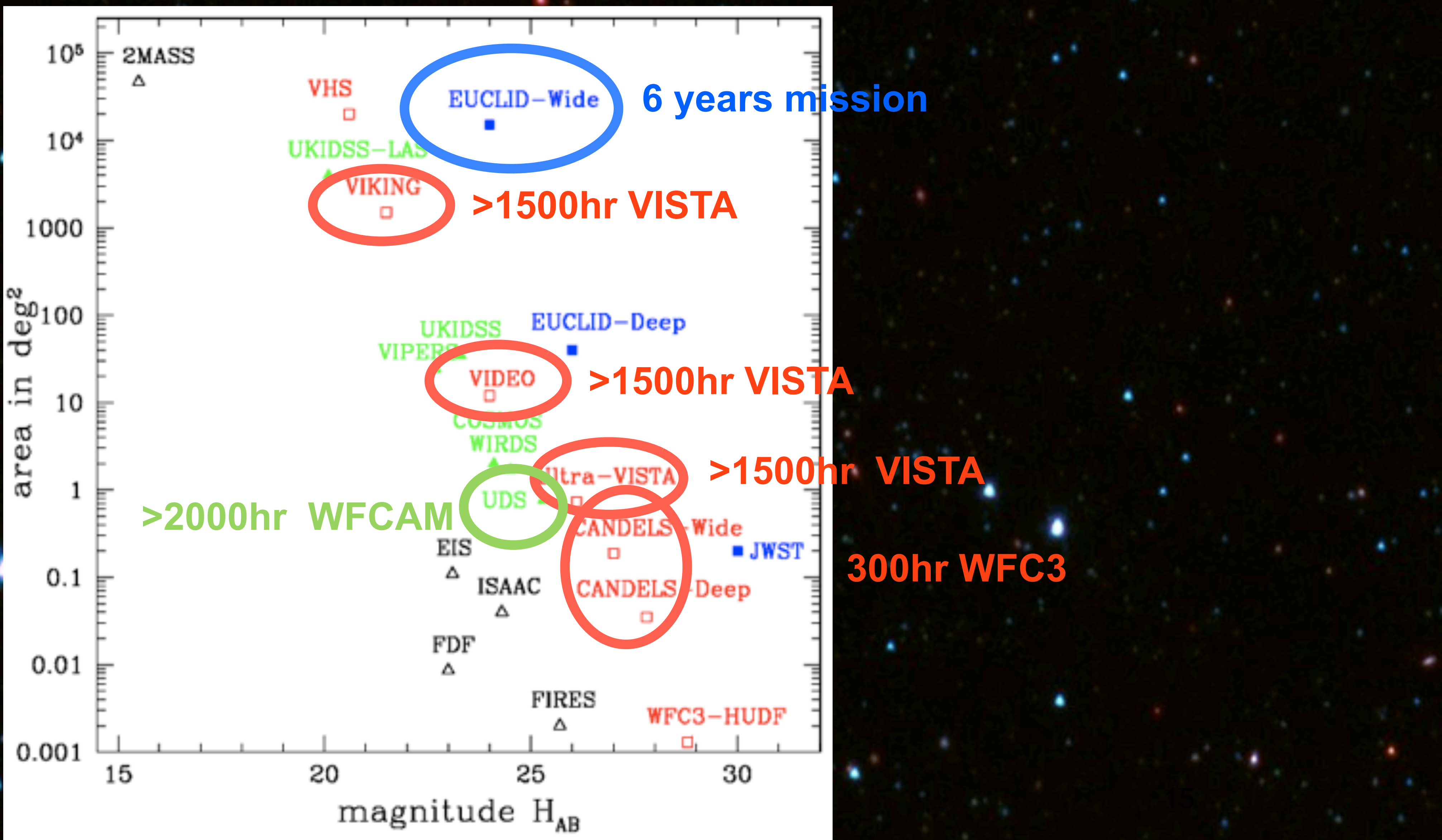
done in the last 5 years, almost done

VISTA, WFC3

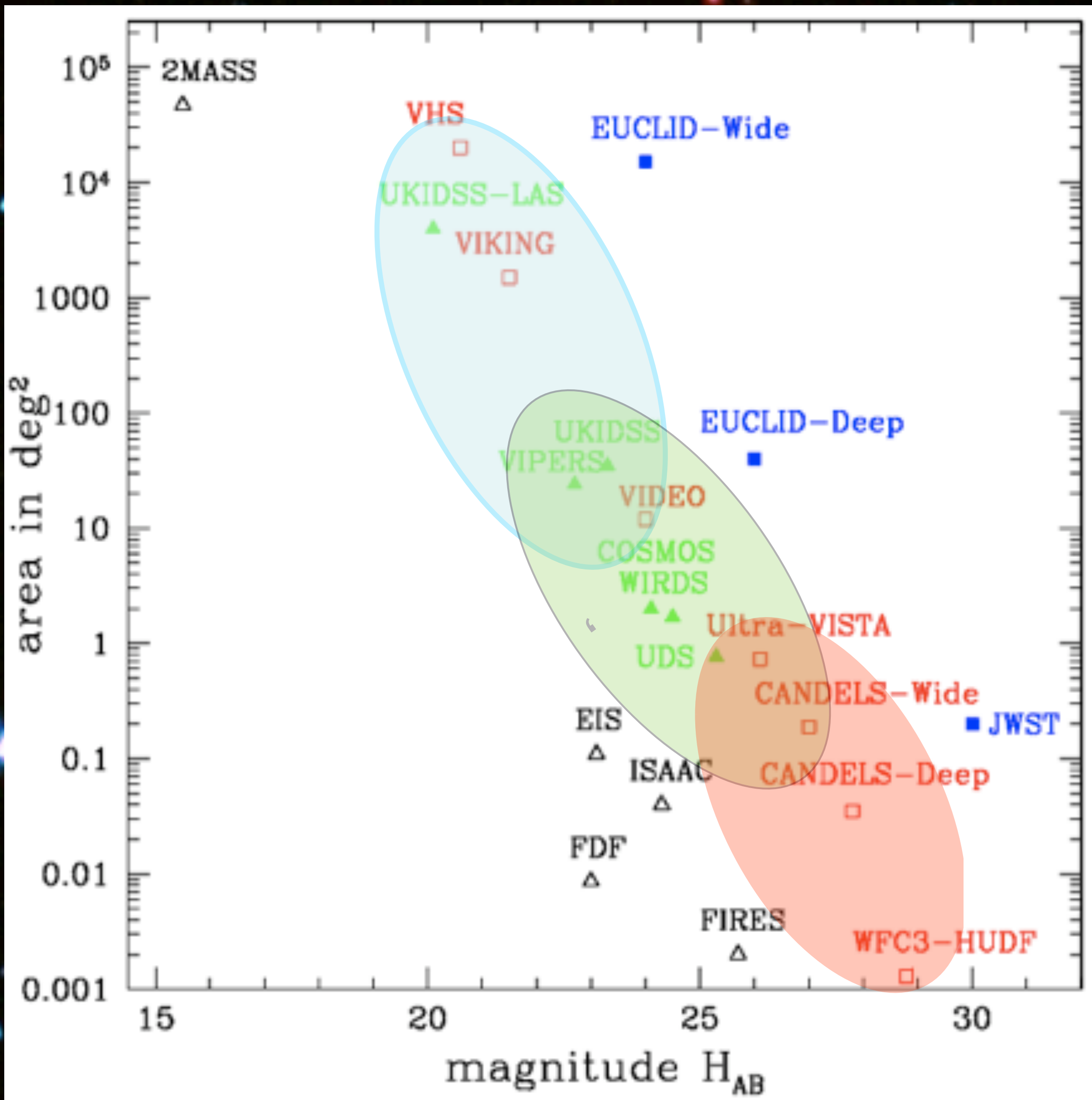
on-going, next 5 years

In 10 years

Near-infrared surveys



Near-infrared surveys

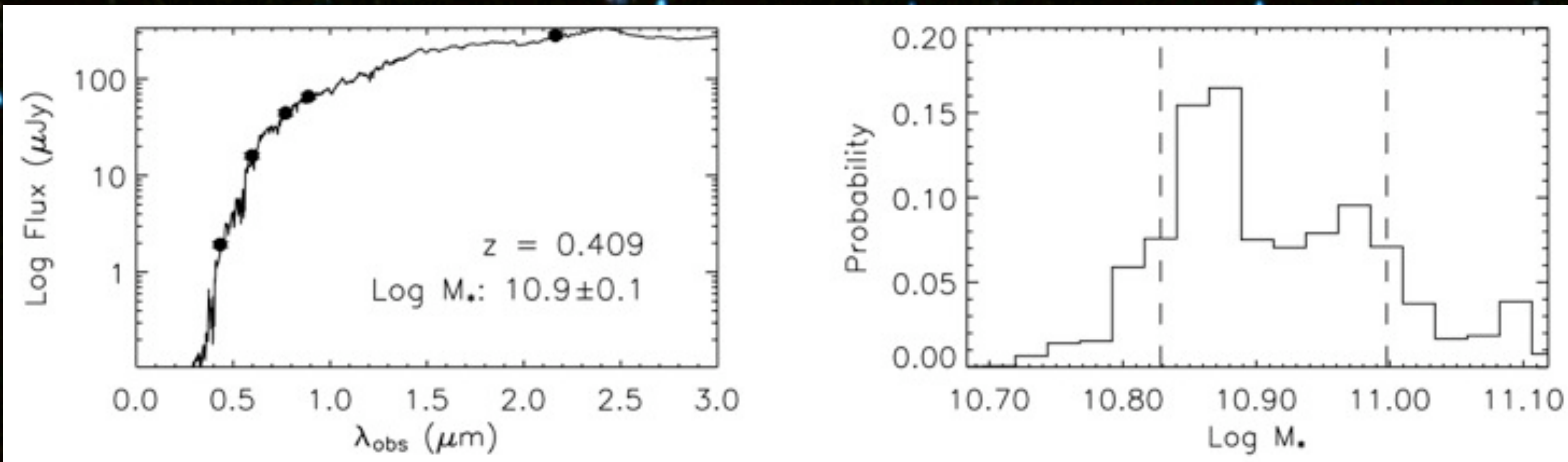


environment at z~0.2, cluster counts, lensing, high-z QSO

galaxy evolution at 0.5<z<6 mass assembly

highest redshift galaxies z>6

stellar mass estimate

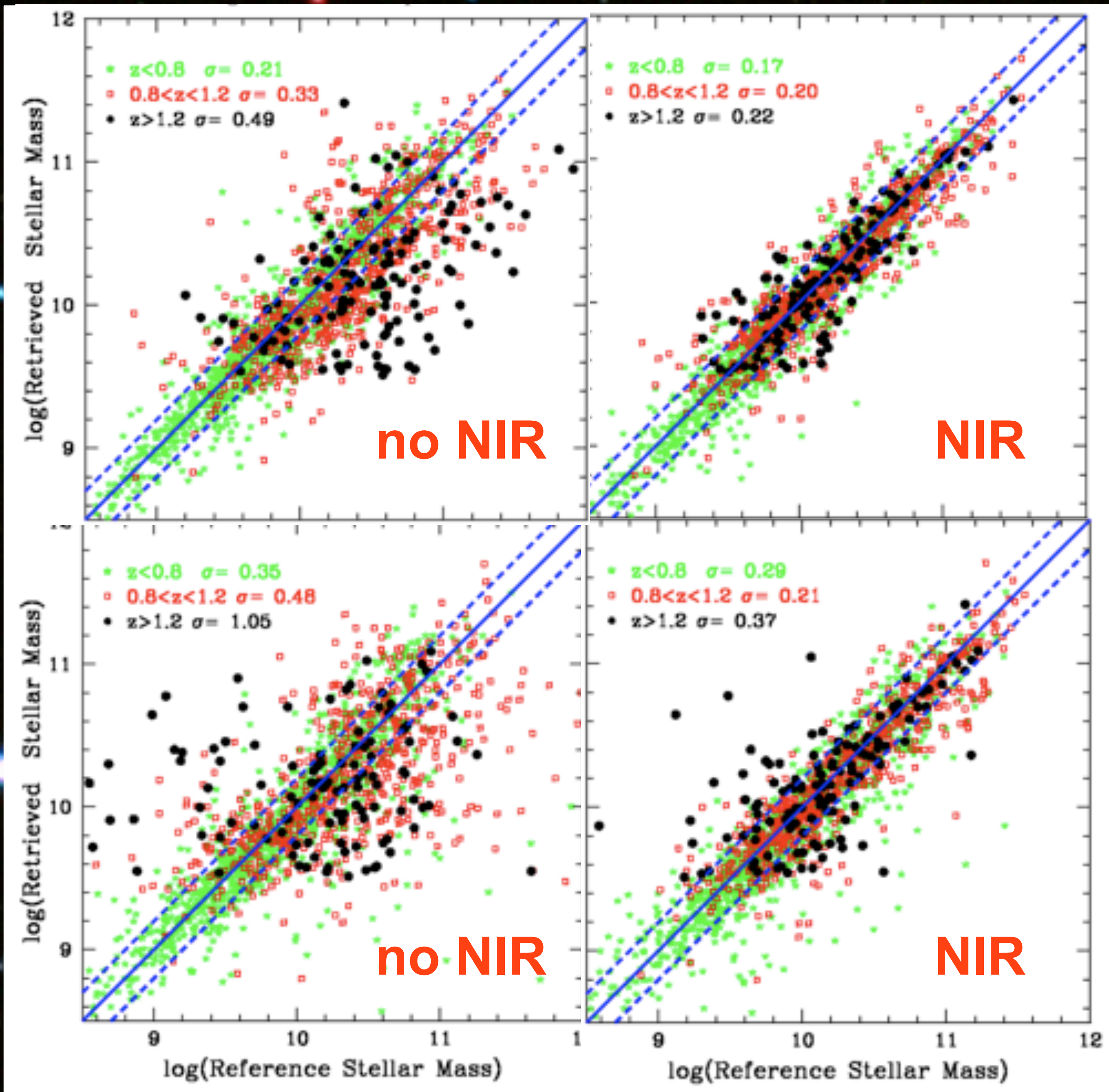


Bundy et al. 2005

Assume a SED library (BC03, Maraston 05, CB07, ...)

Best-fit template ➪ stellar mass

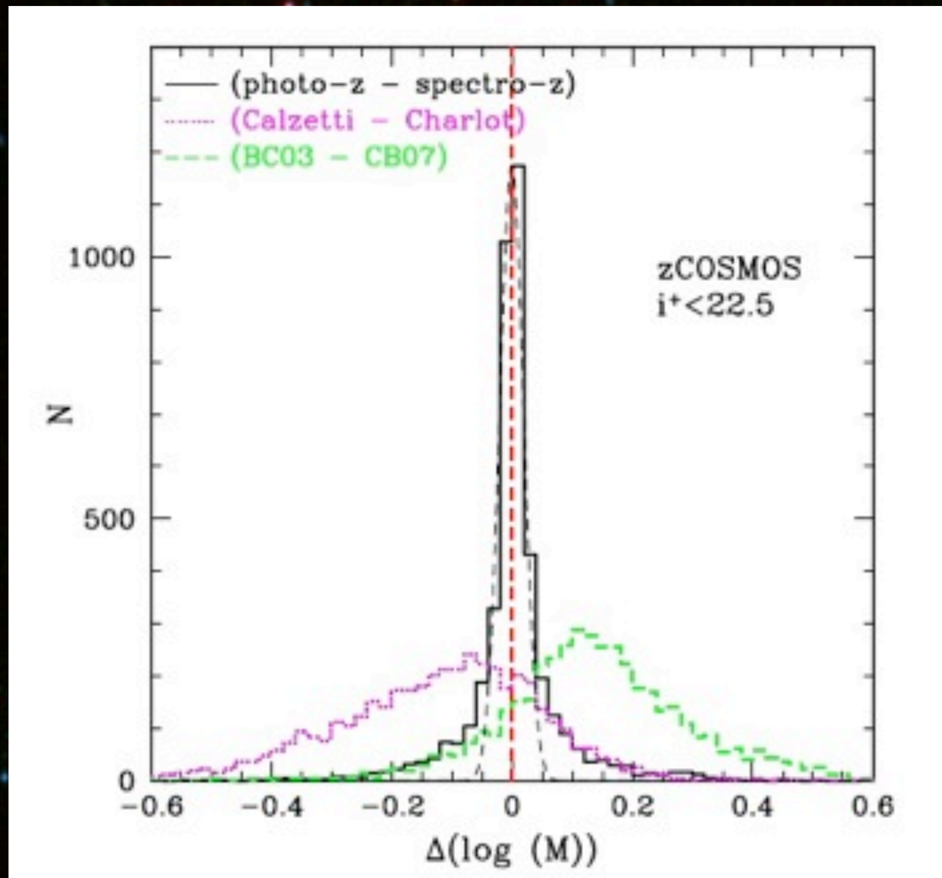
NIR for accurate stellar masses



spec-z

photo-z

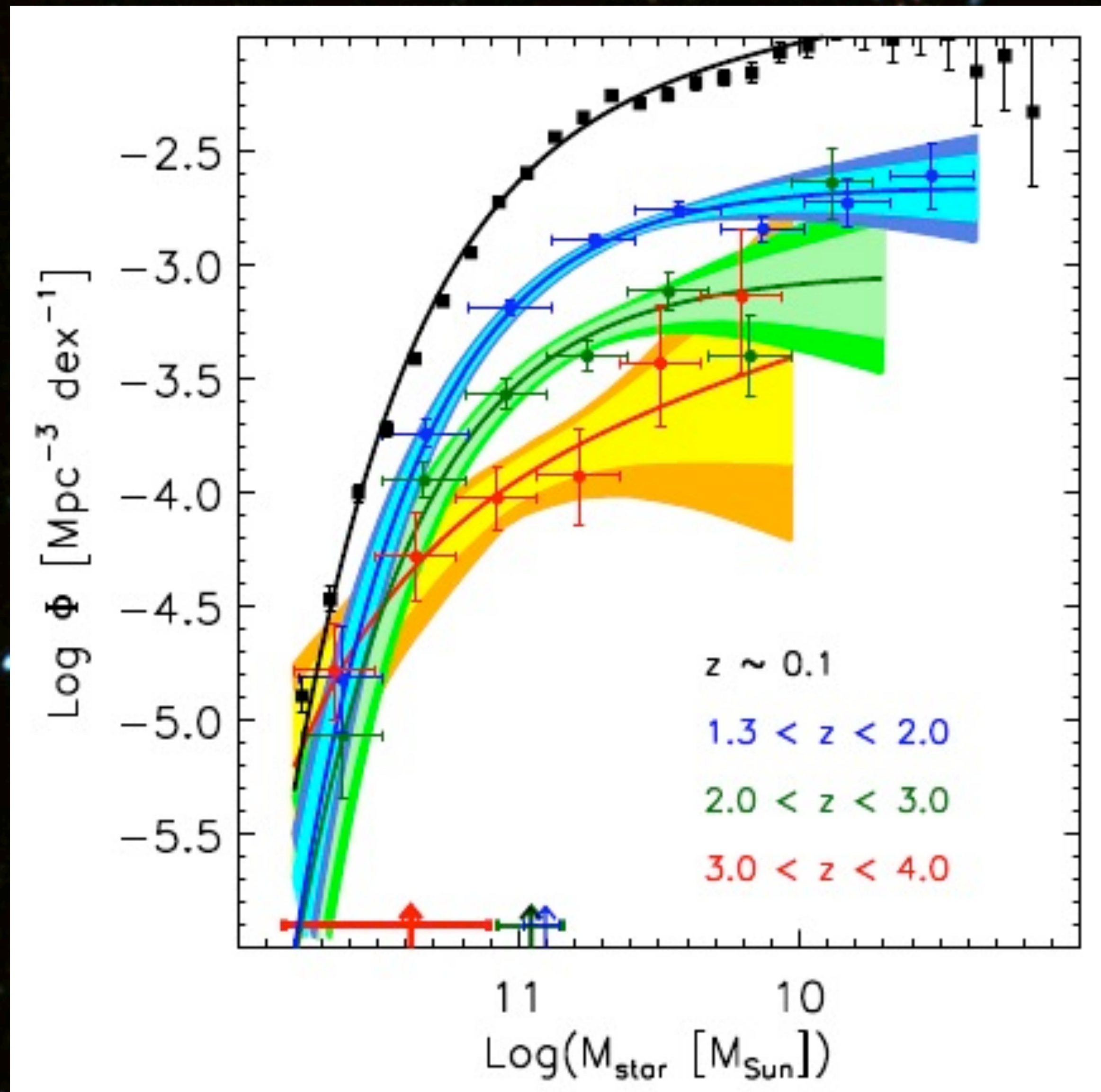
impact of the model in the stellar mass estimate



Systematic uncertainties dominated by the SED library with 1% accurate photo-z and deep NIR

global stellar mass function

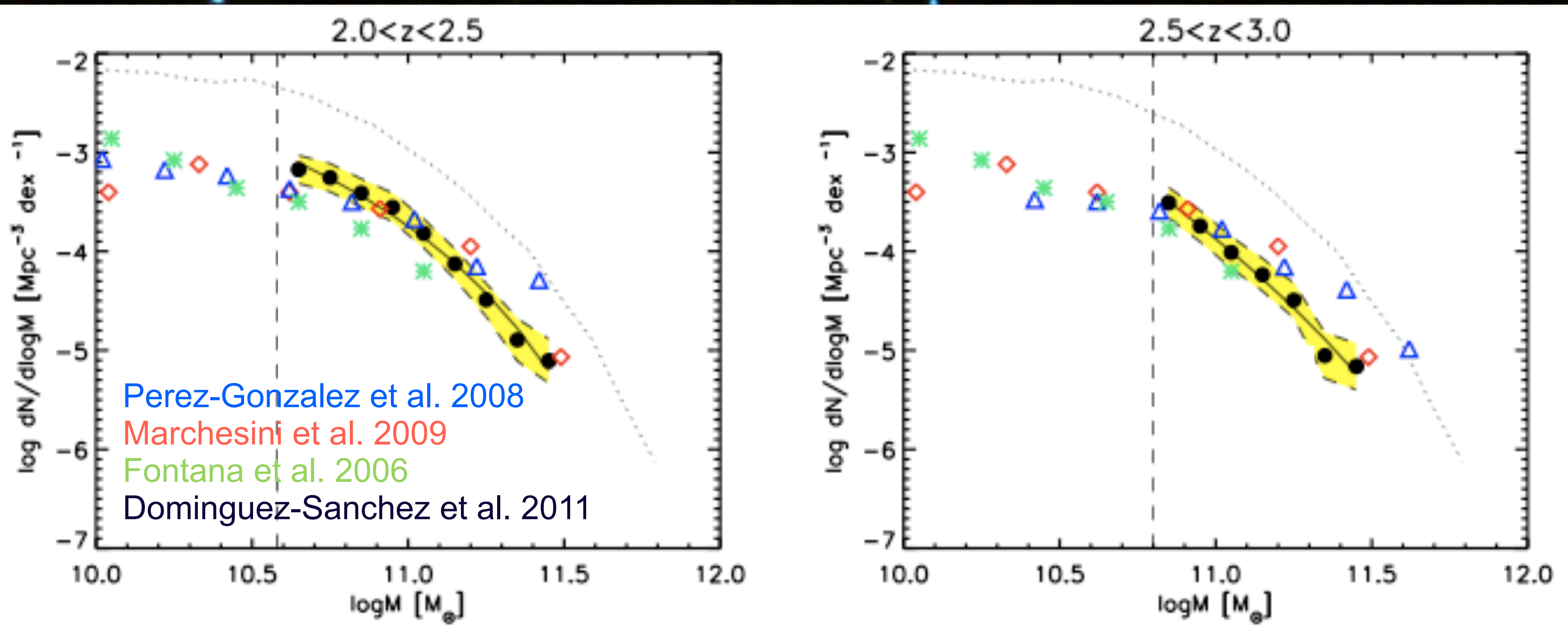
Massive galaxies already in place at z~4 ?



Marchesini et al. 2009

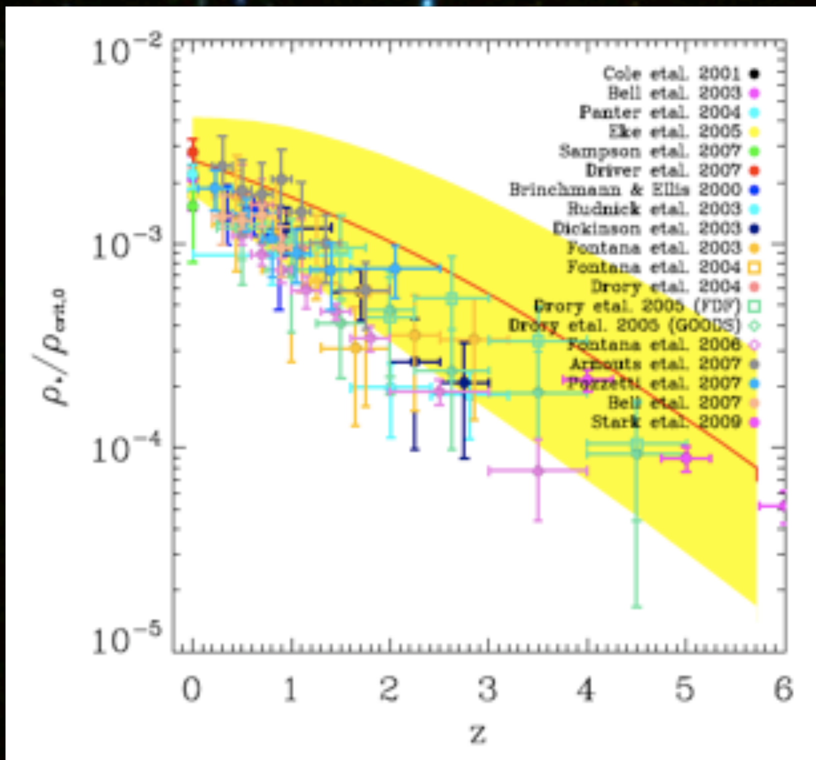
global stellar mass function

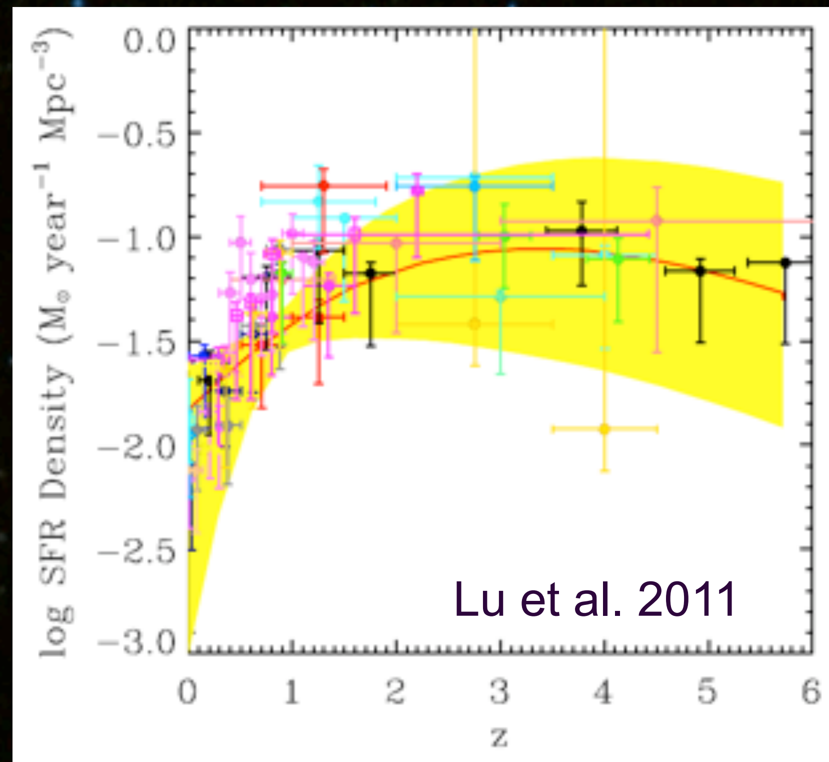
Factor 3 discrepencies at the high mass end in current estimate at z>2



Dominguez-Sanchez et al. 2011

Tension between star formation history and stellar mass assembly



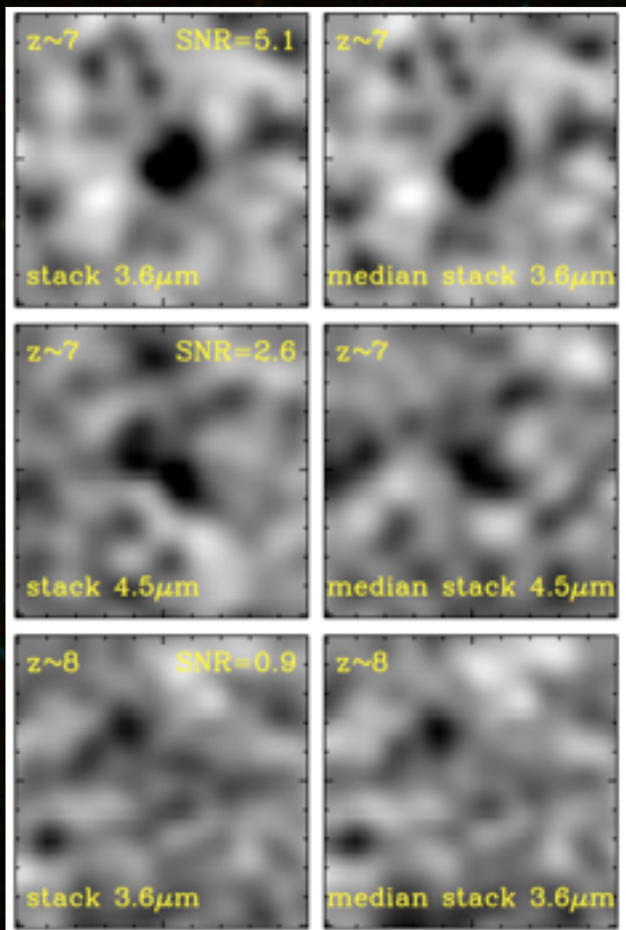


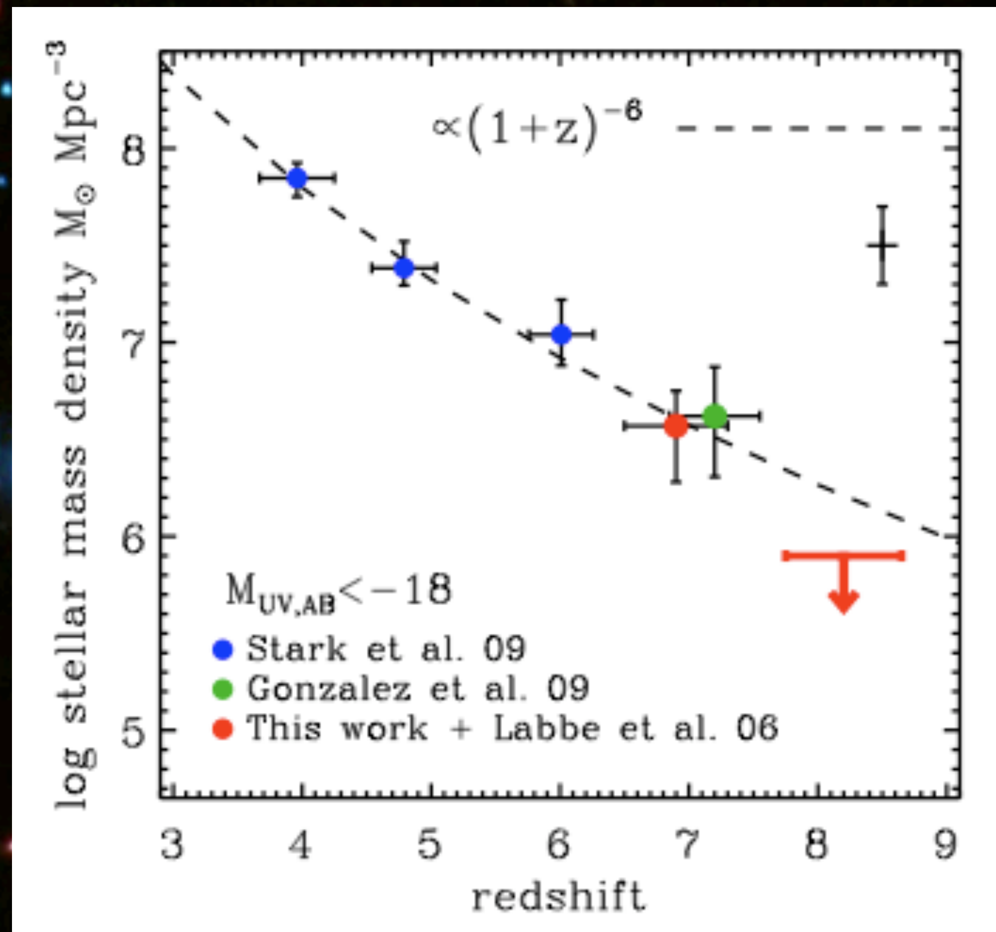
change of IMF with z ?

Uncertainties in SFR/mass estimates at z>1 ?

First analysis at z>6

Stack in IRAC of z>6 candidates

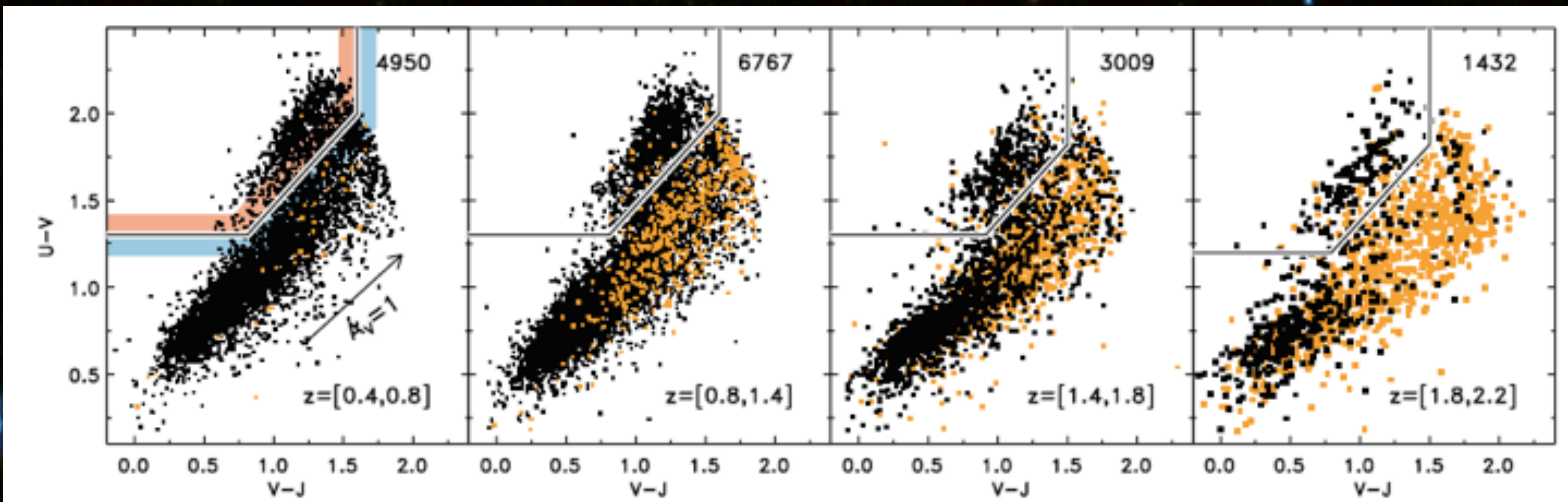




Labbe et al. 2010

Select the quiescent population

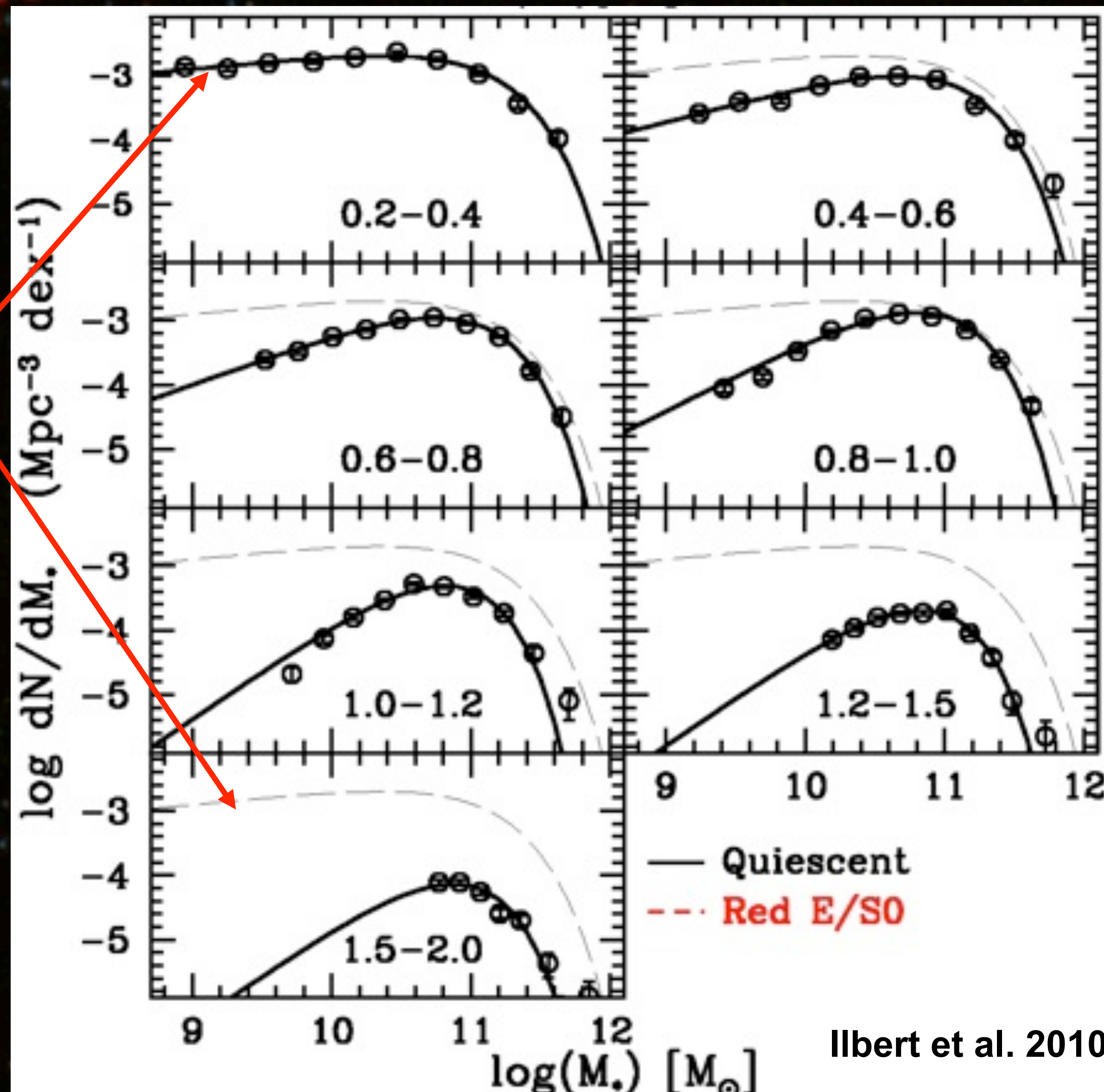
color-color selection to distinguish between quiescent and dusty galaxies



Brammer et al. 2011

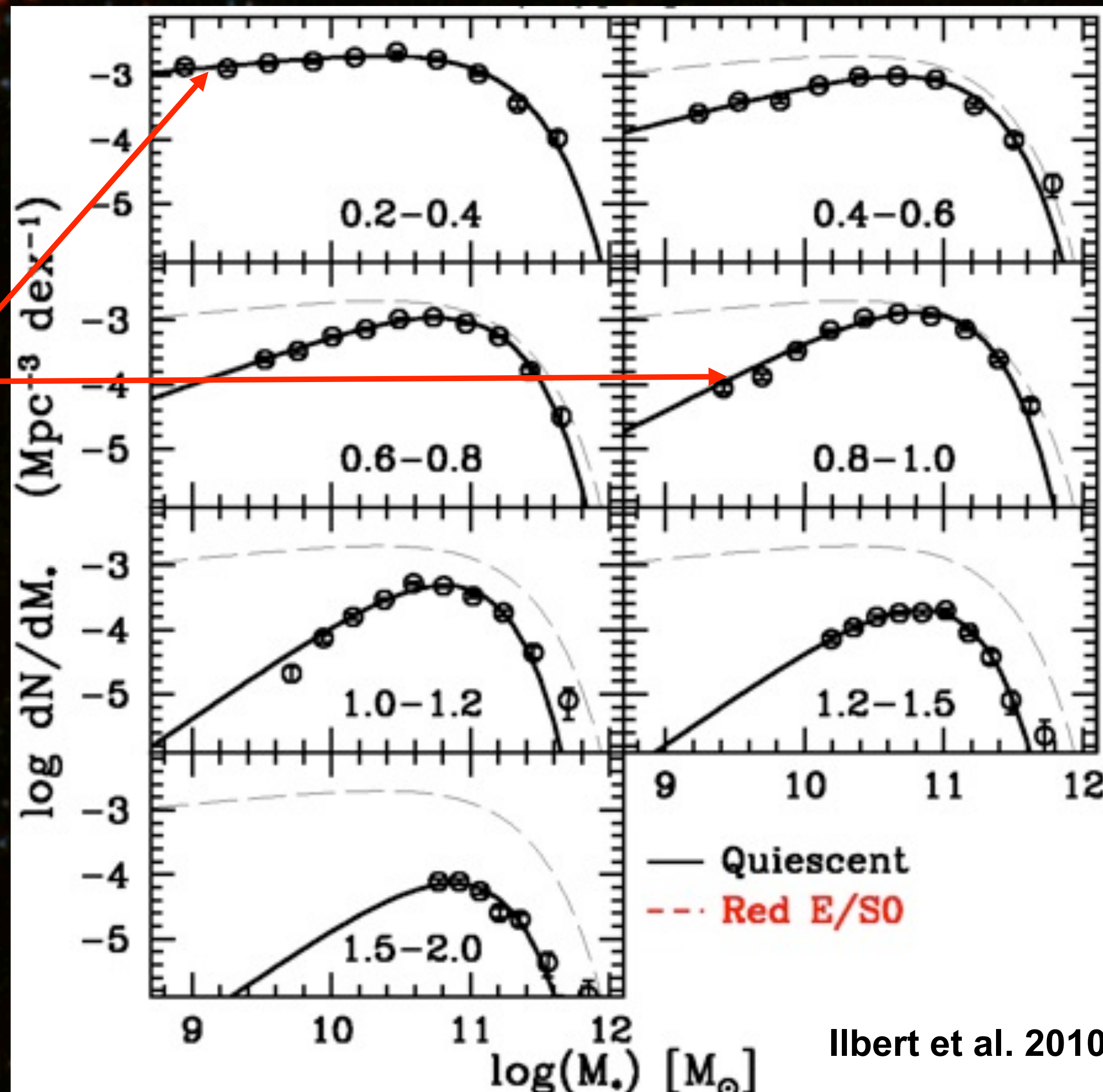
Stellar mass function of the quiescent population

dashed reference 0.2<z<0.4



Stellar mass function of the quiescent population

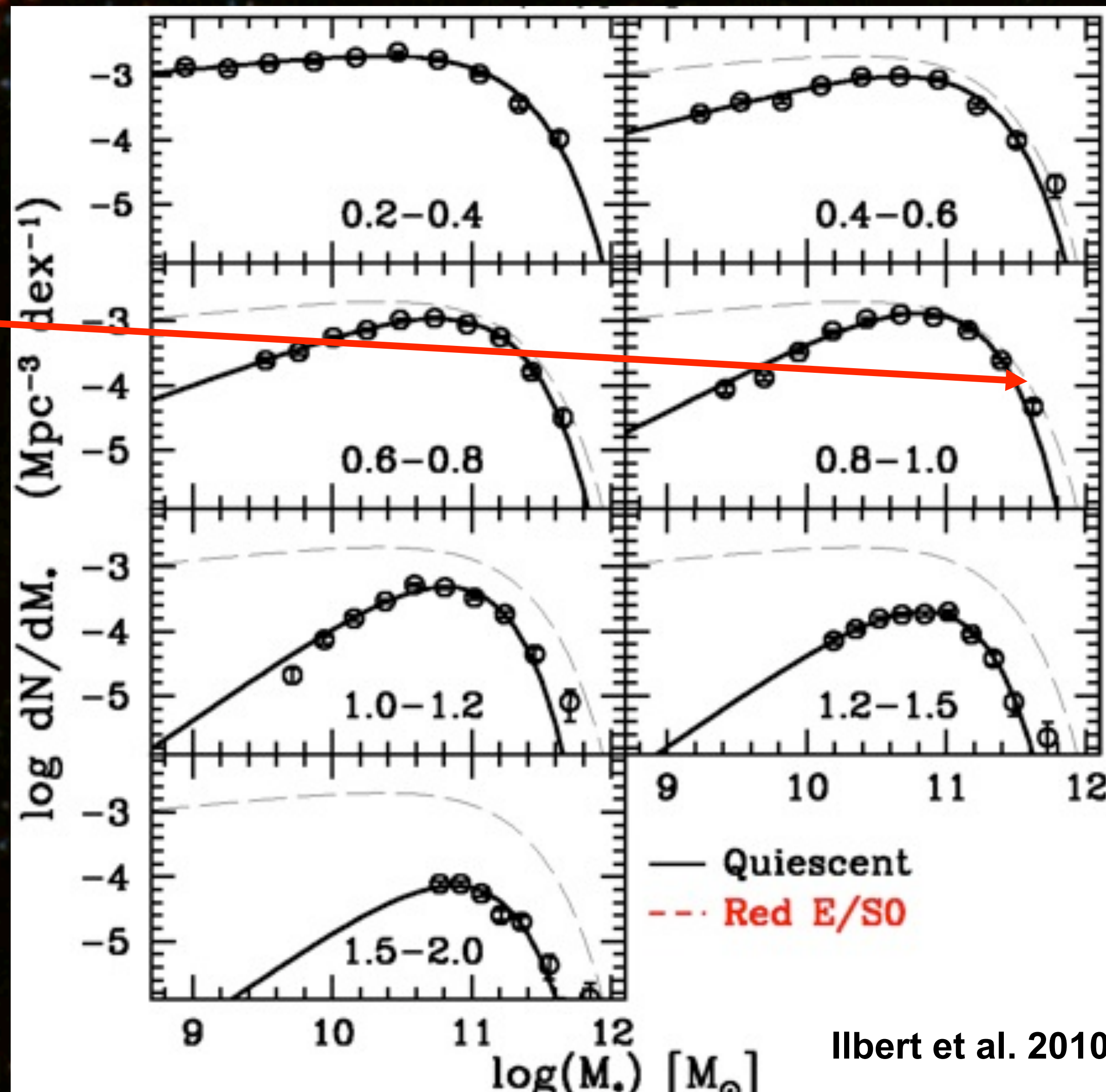
low mass quiescent
created at z<1



Ilbert et al. 2010

Stellar mass function of the quiescent population

Massive quiescent are already in place at z~1



Stellar mass function of the quiescent population

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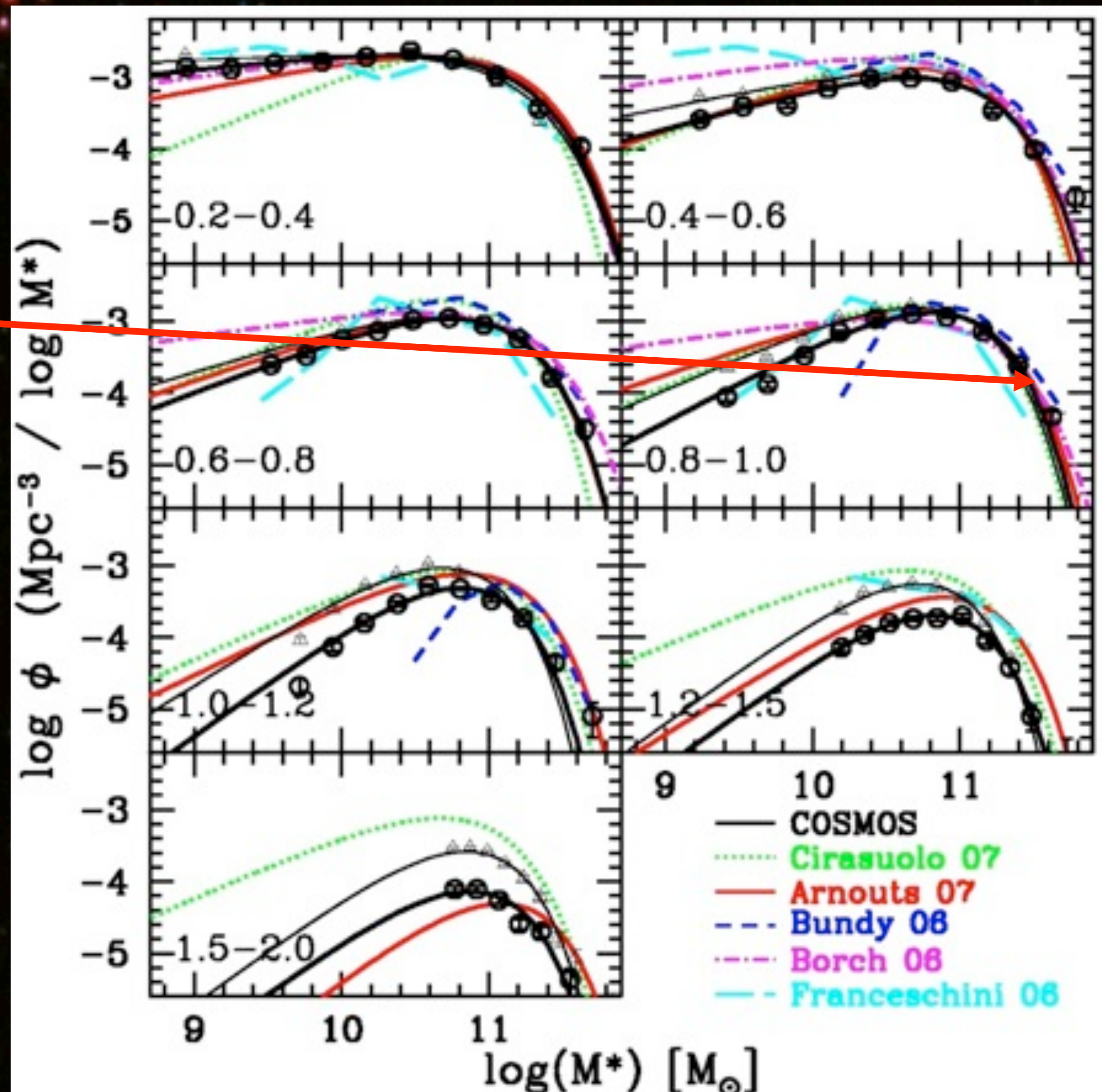
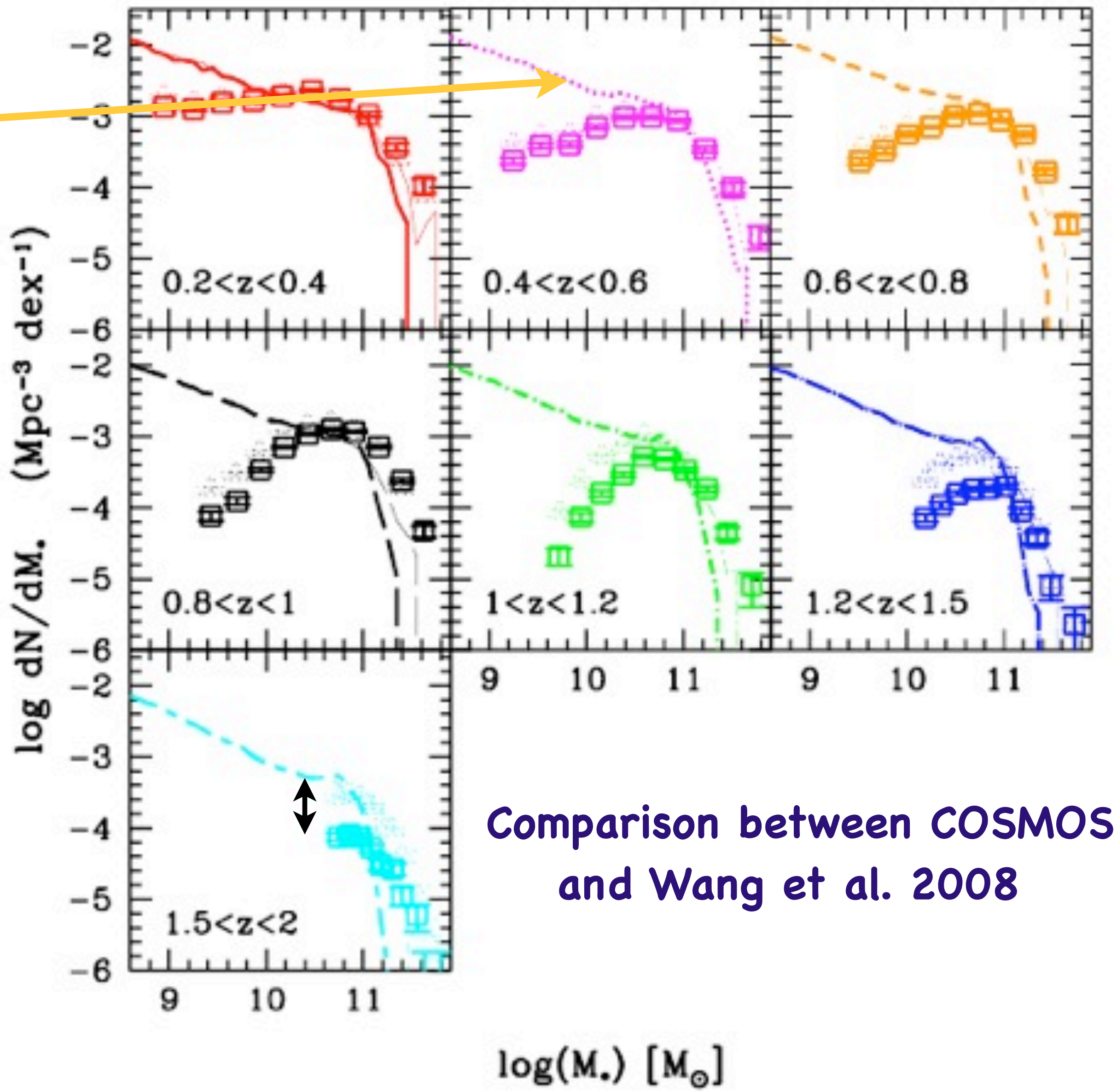


Quiescent in semi-analytical models

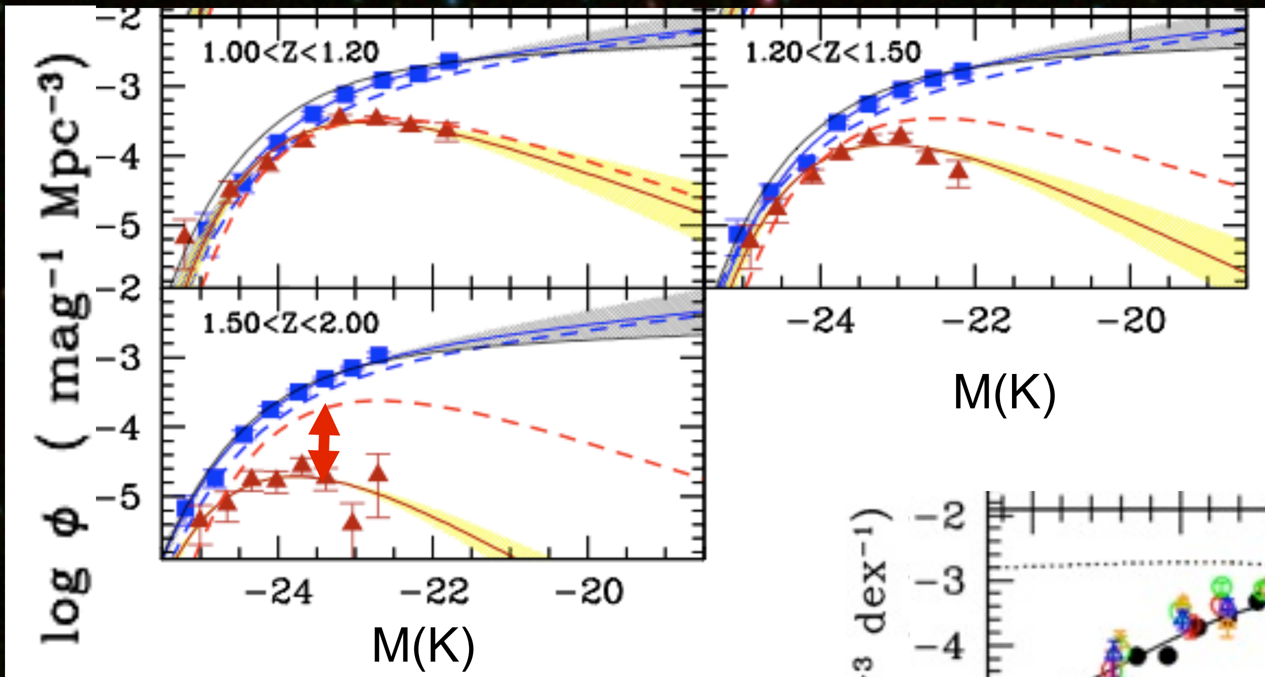
Too steep slope in model

quenching too efficient for low mass galaxies

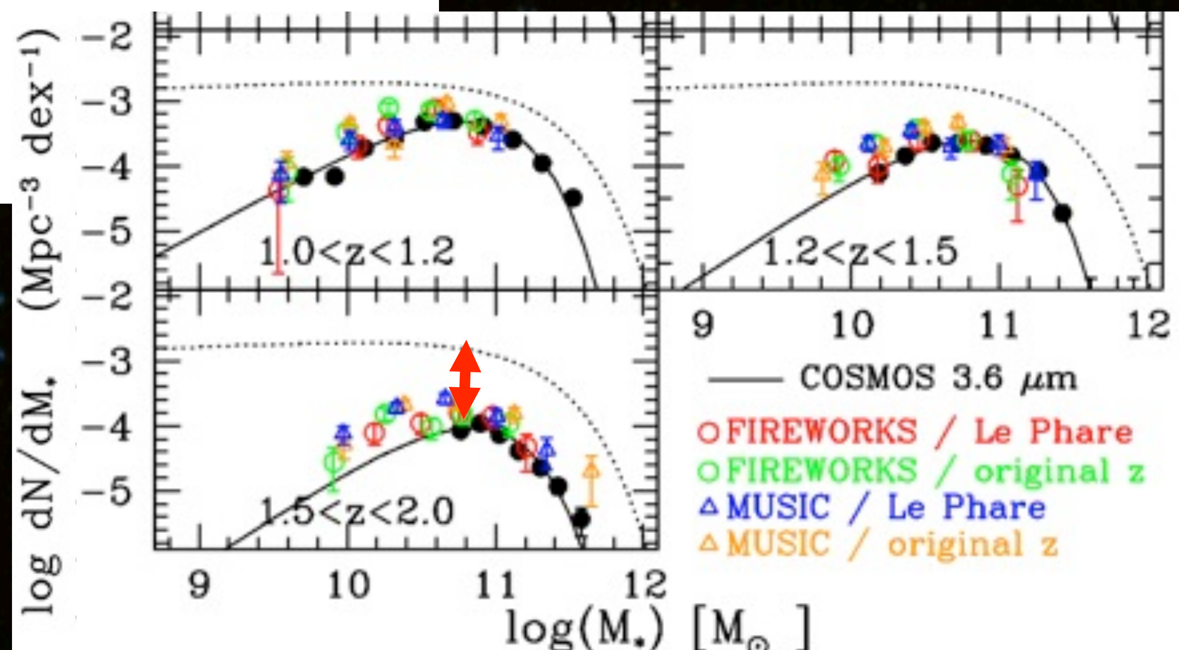


Comparison between COSMOS and Wang et al. 2008

Stellar mass function of the quiescent population at z>2

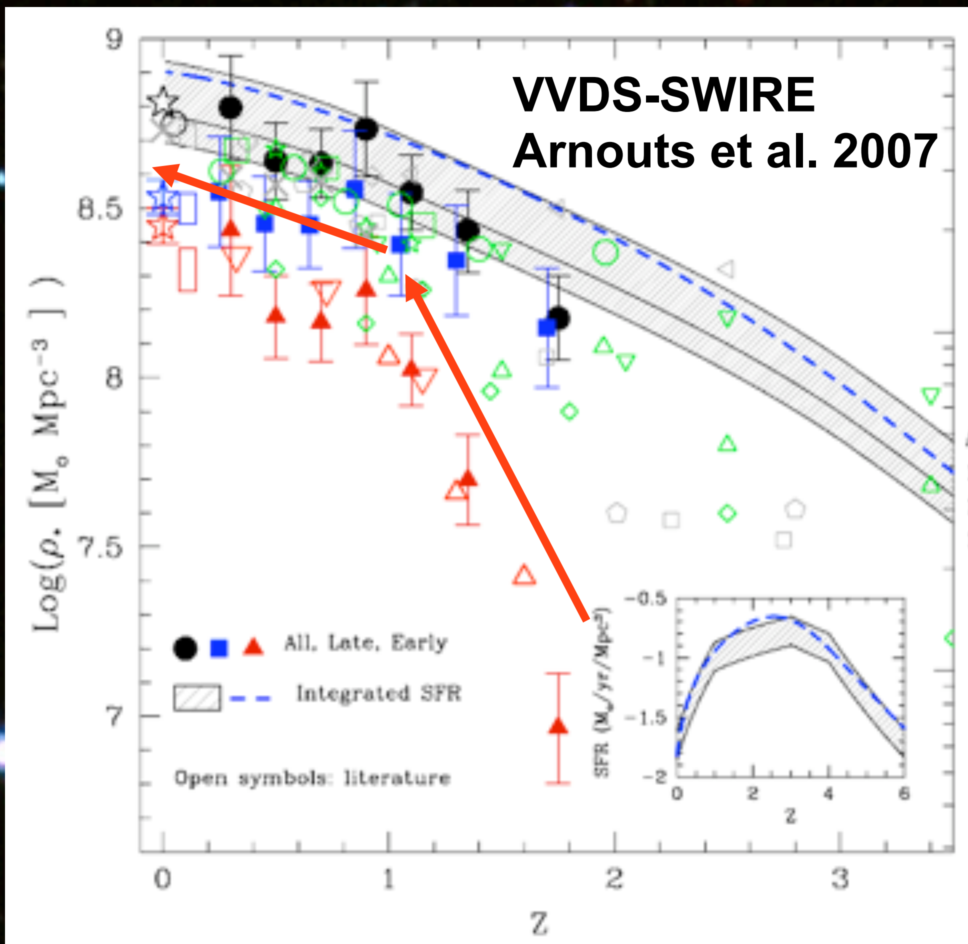


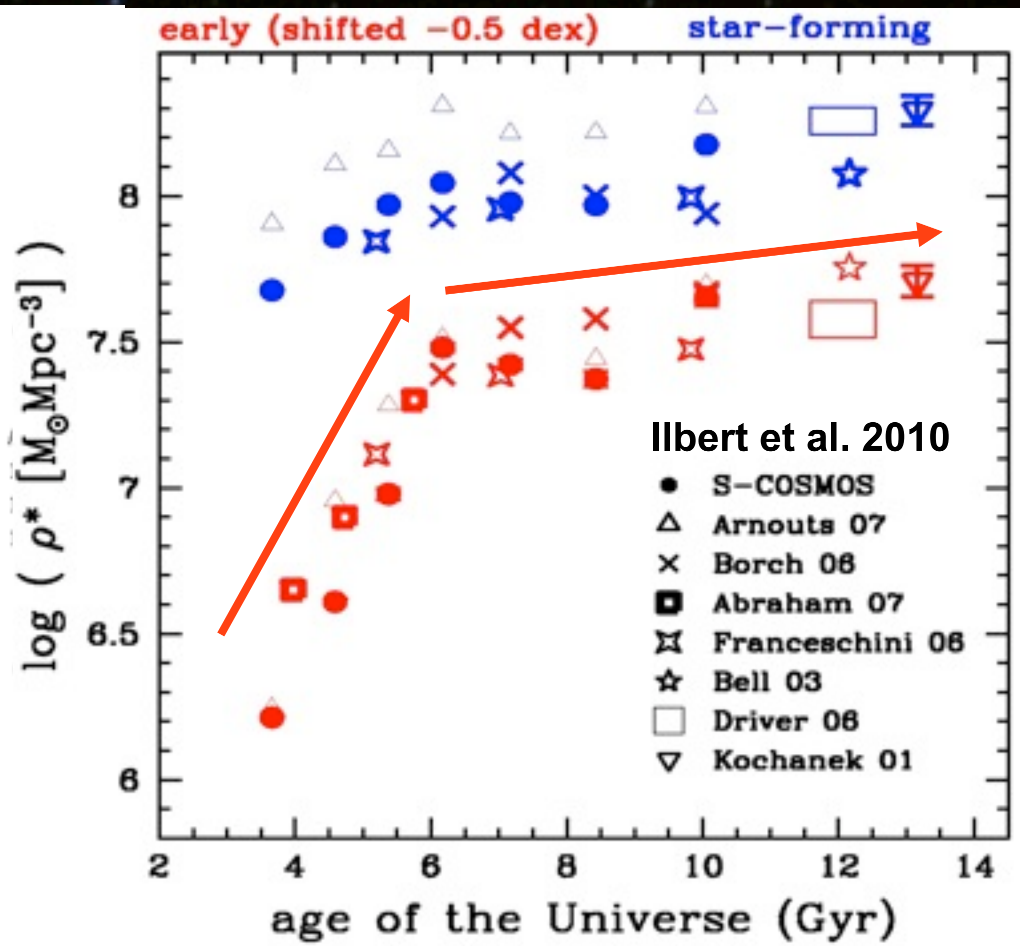
VVDS-SWIRE
Arnouts et al. 2007



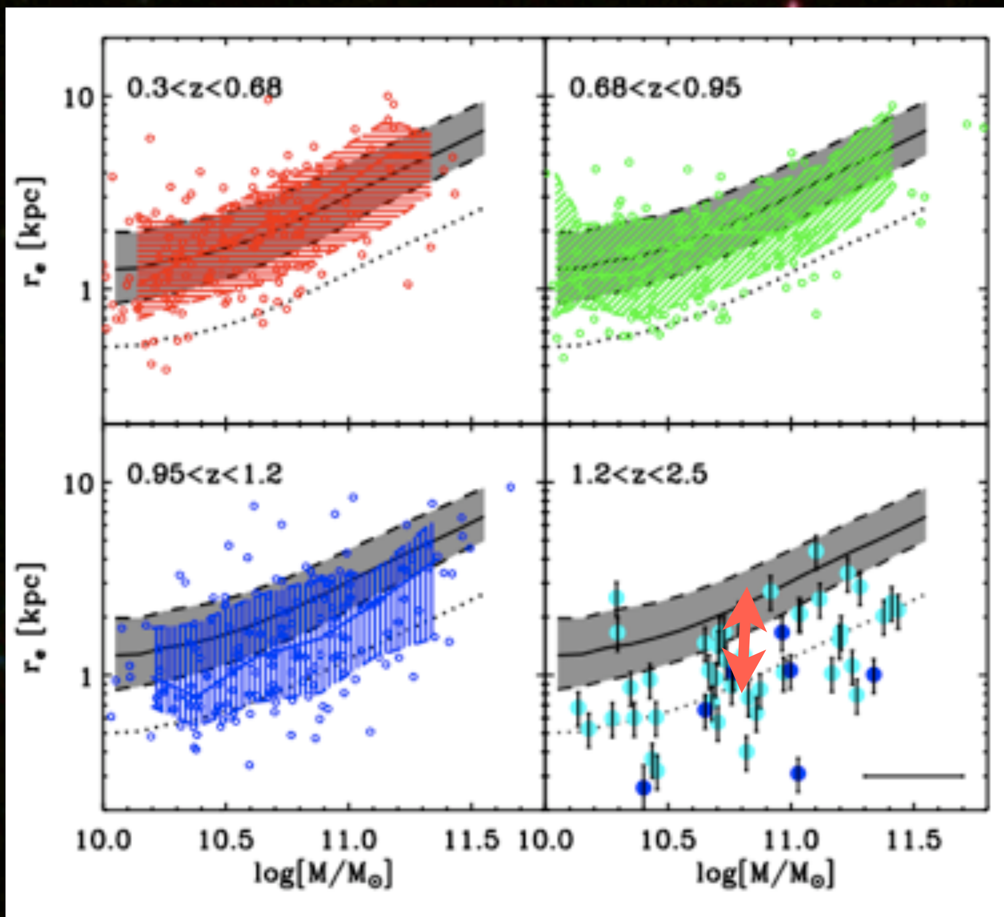
Rapid increase in density at 1<z<2

Stellar mass density of quiescent galaxies





Link structural parameters and galaxy stellar masses



Quiescent galaxies more compact at z~2

confirmed with WFC3

Cassata et al. 2011

Link structural parameters and galaxy stellar masses

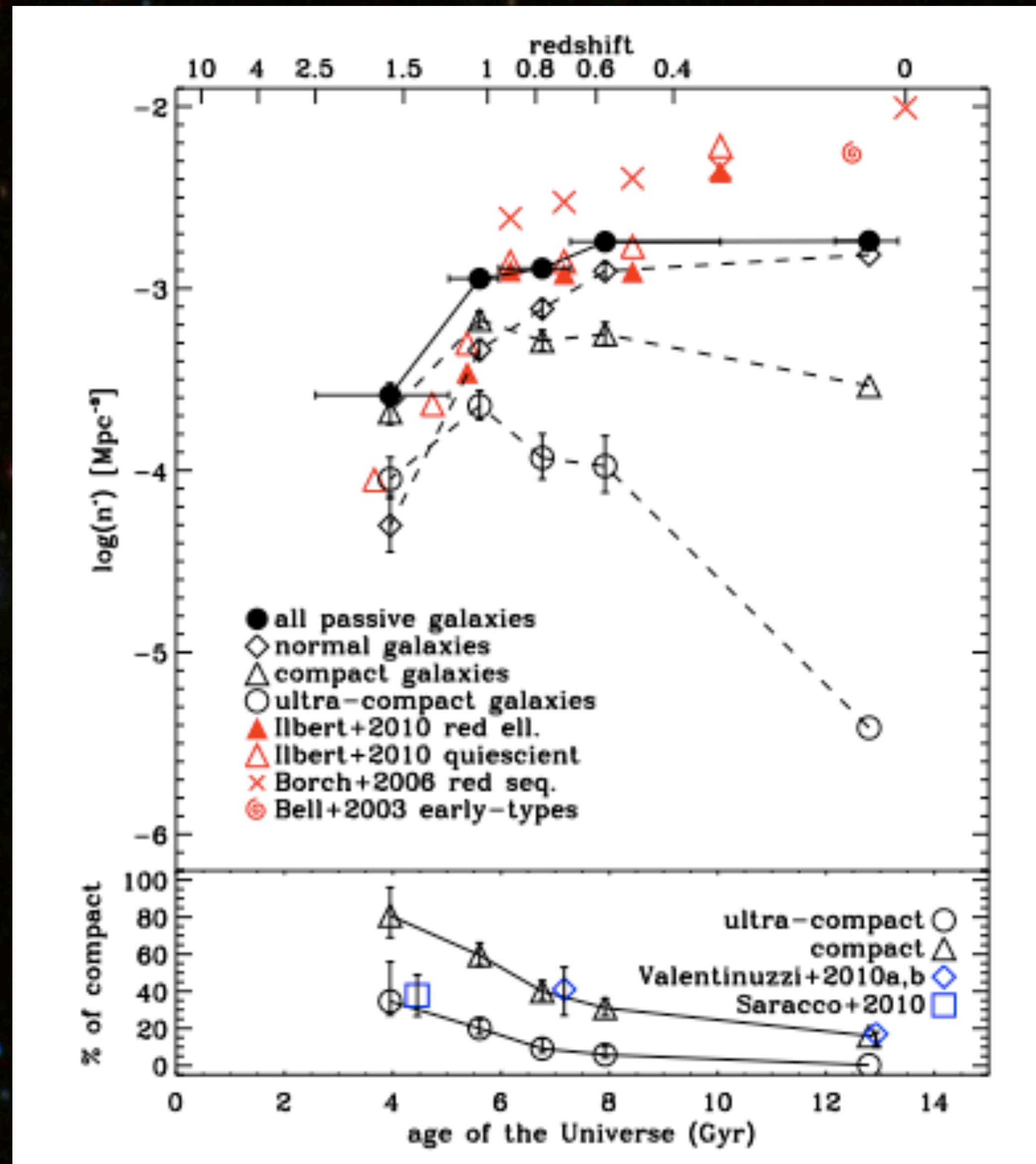
compact galaxies

dominate at z>1

✓ minor mergers ?

✓ Adiabatic expansion ?

✓ Progenitor bias ?



Cassata et al. 2011

conclusions

- density and size of the massive quiescent galaxies evolve much faster at z>1
- Possible tension between SFR history and mass assembly at z>1.5
- Peak of SFR at z~2

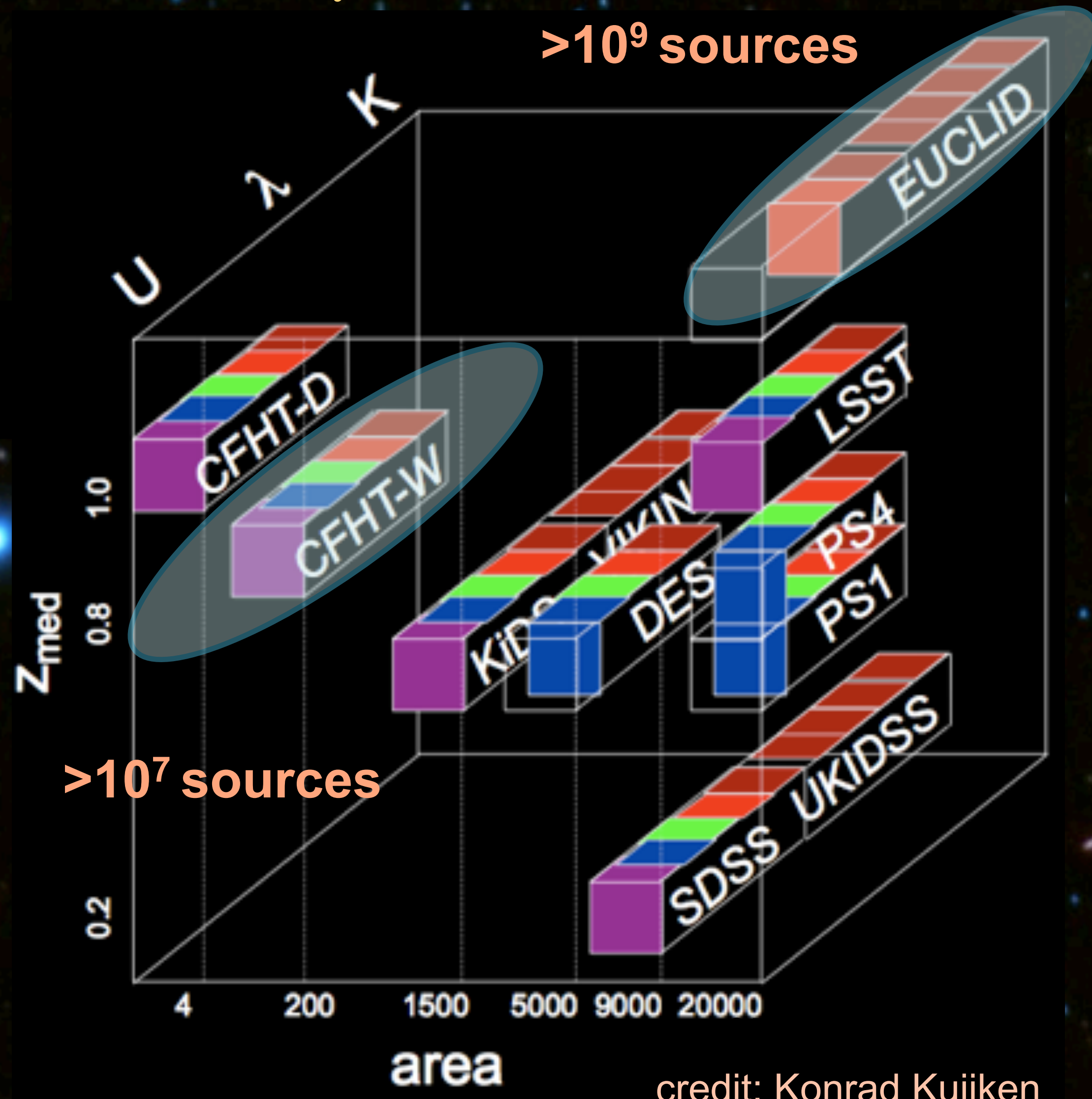
➢ VISTA and WFC3 in the next 5 years to study 1<z<3 in great detail

Szomoru et al. 2011

conclusions

Numerous deep optical/NIR surveys in the next decade for weak lensing

➢ rely on photo-z



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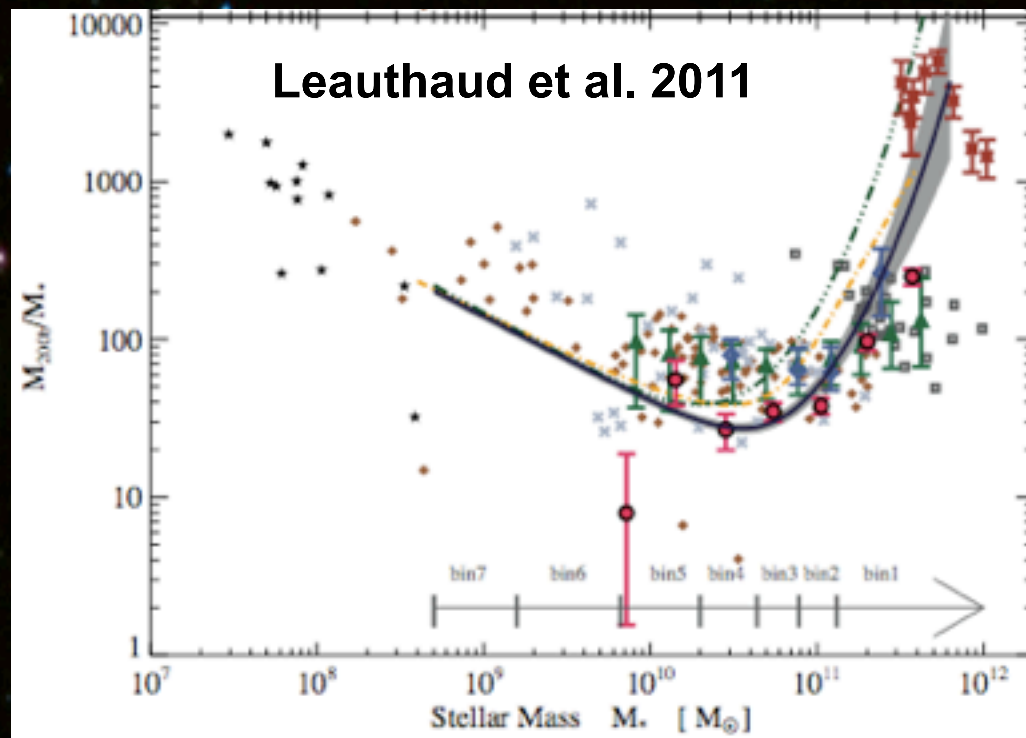

Combine weak lensing,

stellar mass function,

correlation function

➢ link stellar mass assembly with DM halo masses