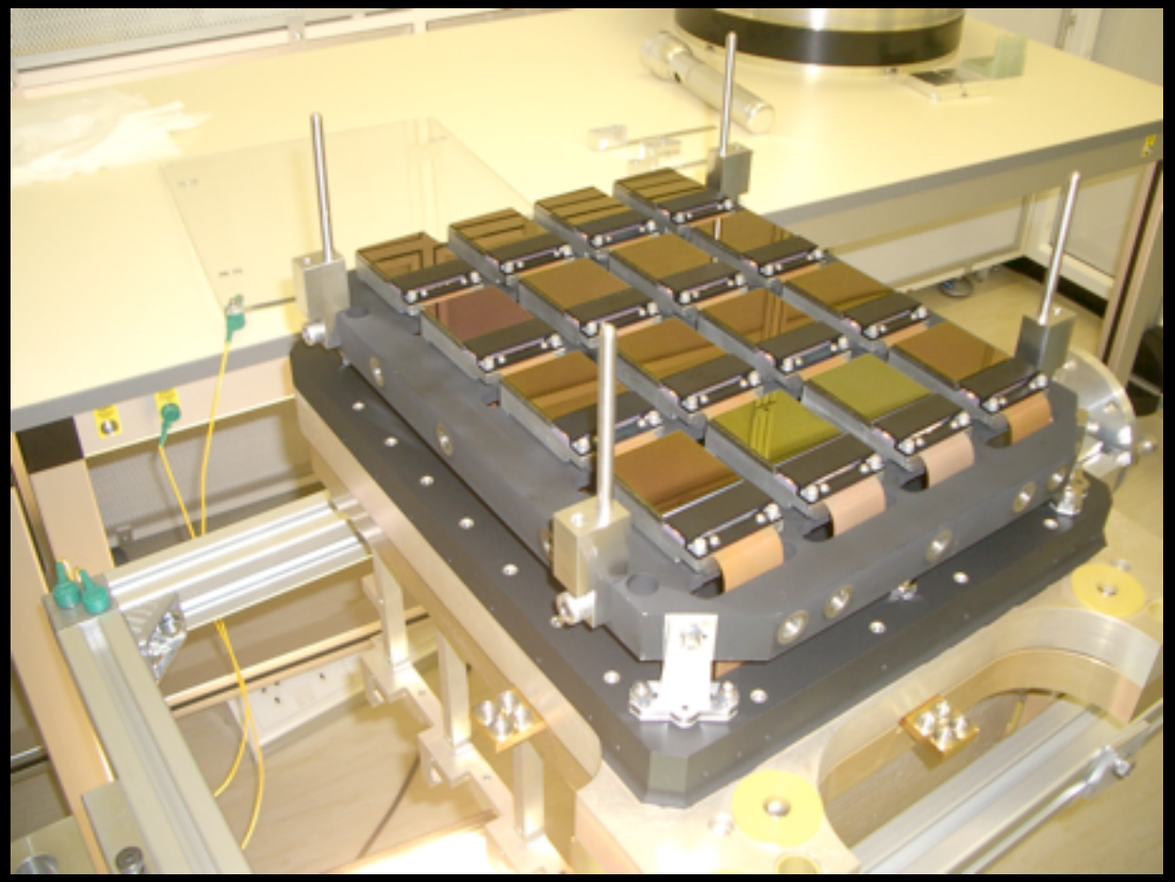
UltraVISTA

H. J. McCracken for the UltraVISTA consortium

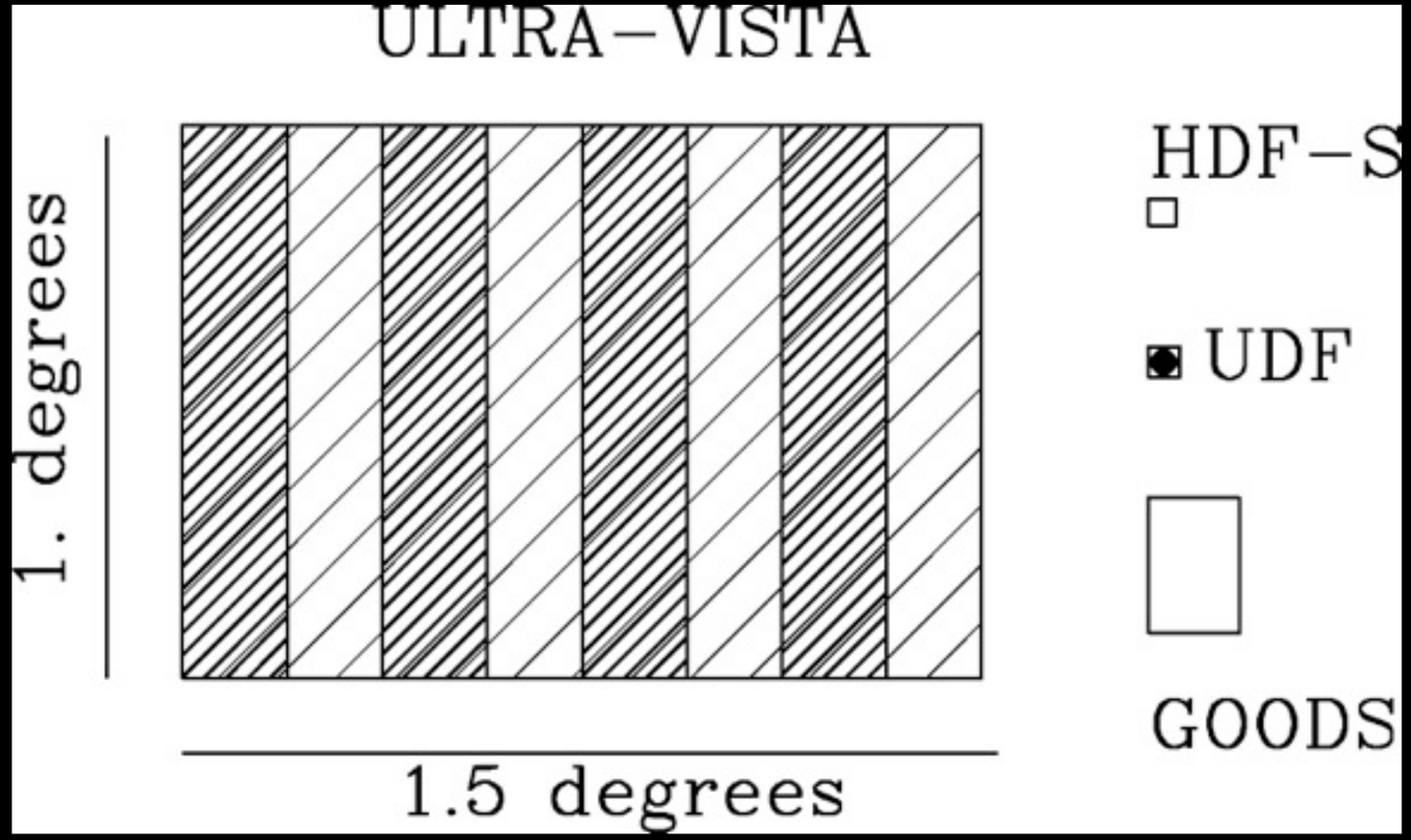
VISTA: Paranal, Chile



VIRCAM: 67 mega-pixel camera (1.5 sq. deg)
About ~3-4 more efficient than any other current NIR camera

UltraVISTA – deepest public survey with Vista telescope

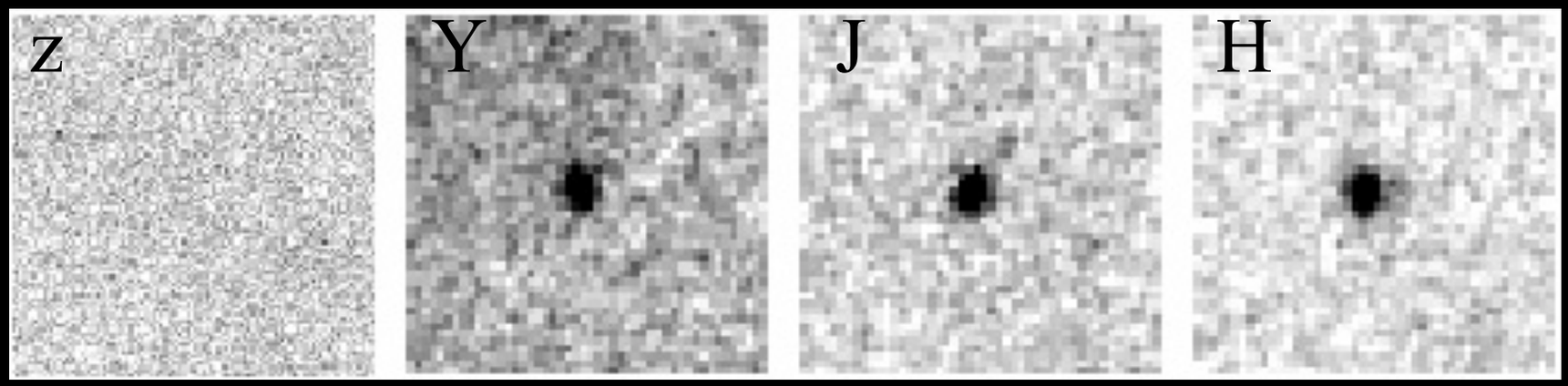
- PIs Dunlop, Franx, Le Fevre, Fynbo
- DEEP - 0.73 sq. deg., Y=26.7, J=26.6, H=26.1, K=25.6 (1408 hr)
- WIDE – 1.50 sq. deg., Y=25.3, J=25.2, H=24.7, K=24.2 (212 hr)
- Narrow-band survey, at 1.185 microns (z = 8.8 for Lyman-alpha) (180 hr)
- 1800 hours over 5 years – started Jan 2010

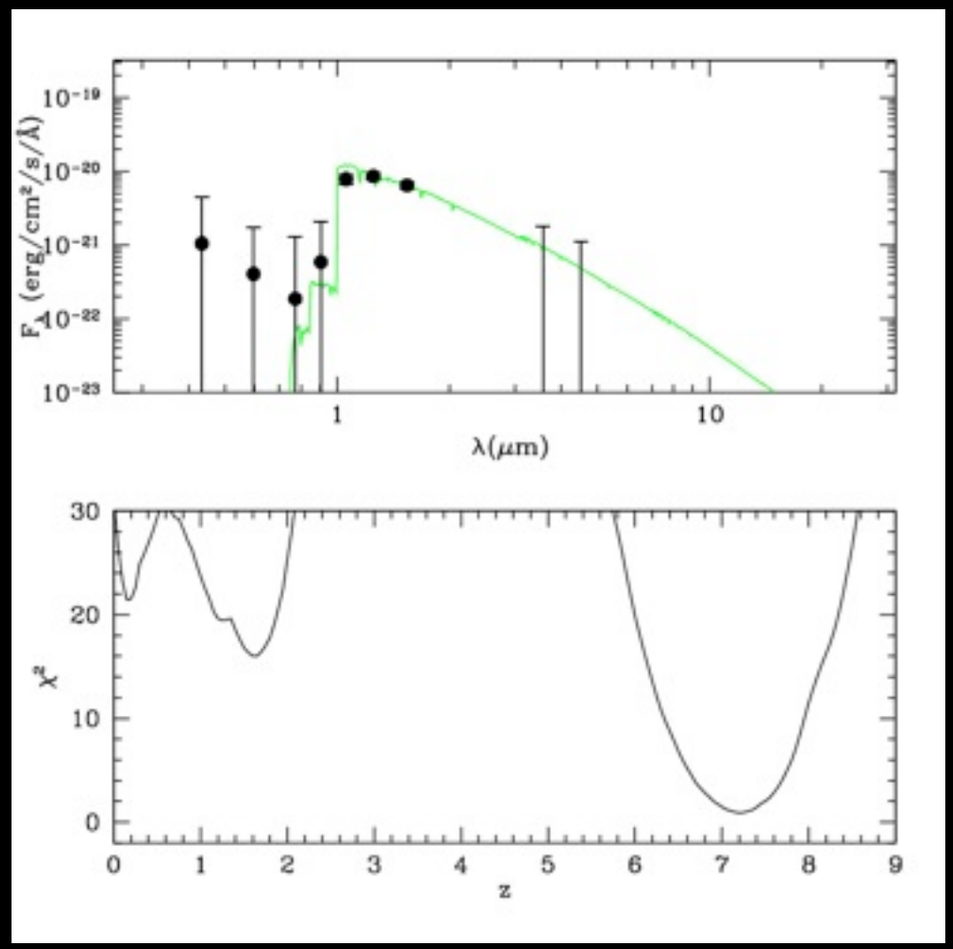


First ESO data release
March 2012
Phase 3 release
Oct 2012

Finding z ~ 7 Lyman break galaxies

McLure, Dunlop et al. 2010





ID No. 835 $z_{phot} = 7.20$

Luminosity function at z = 7 taking shape

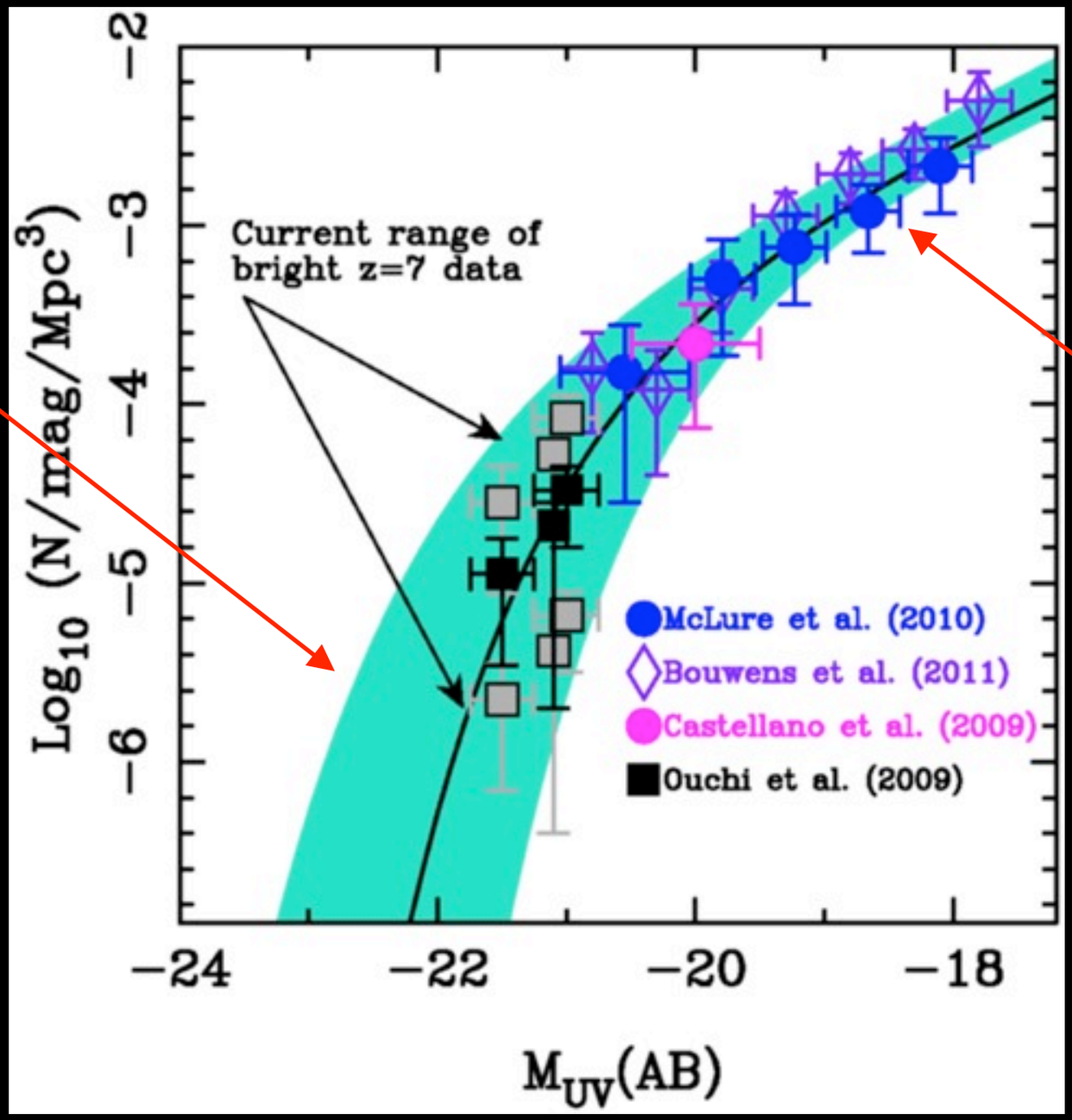
Seems that M* fainter by another ~ 0.5 mag since z = 6

Lack of constraint
on exponential cut-off

Galaxy formation
- onset of feedback?

Can provide
information
on the star-formation
efficiency in haloes
at z~6

May provide
clustering
information?

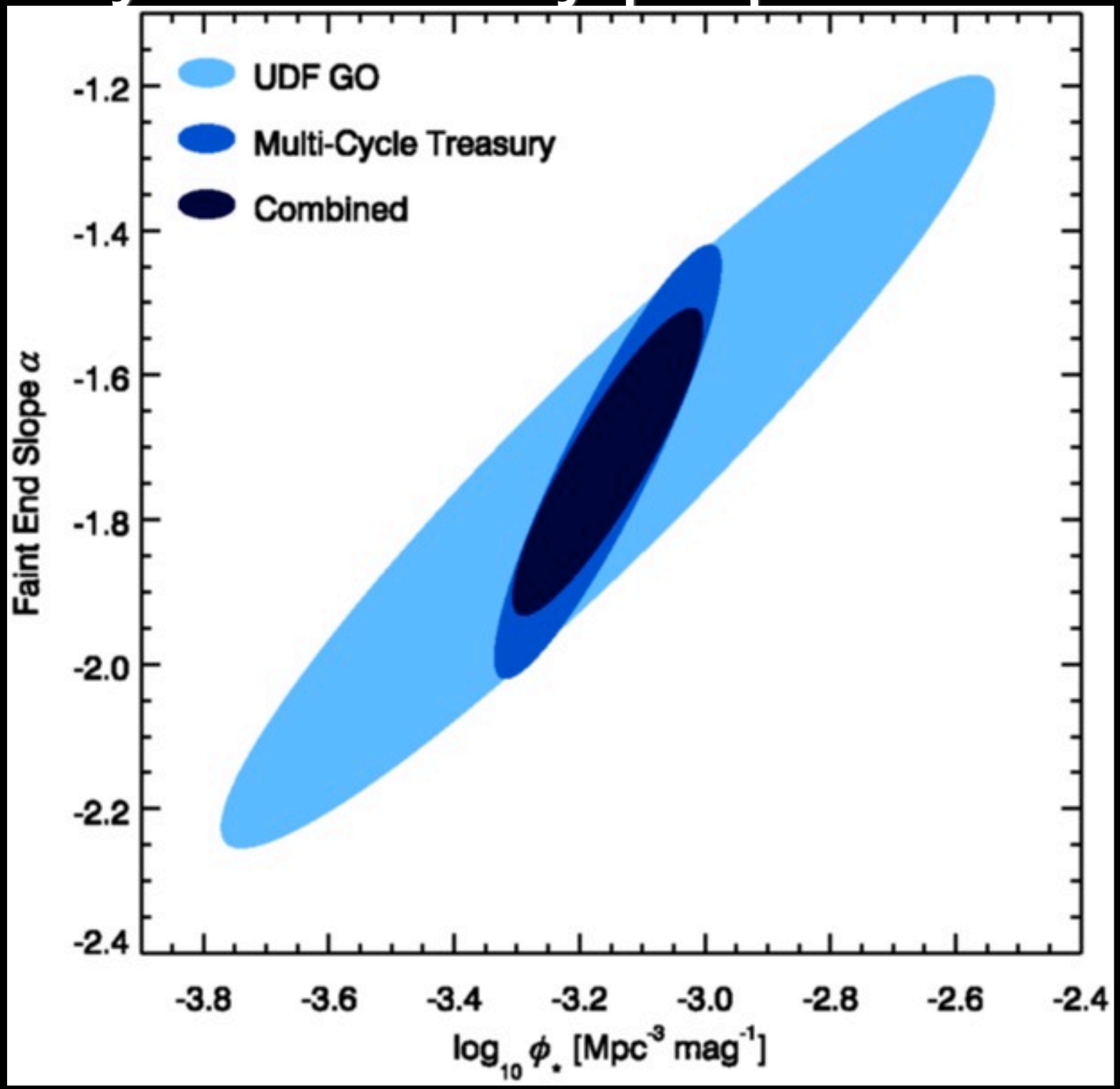


Debate over
faint-end slope

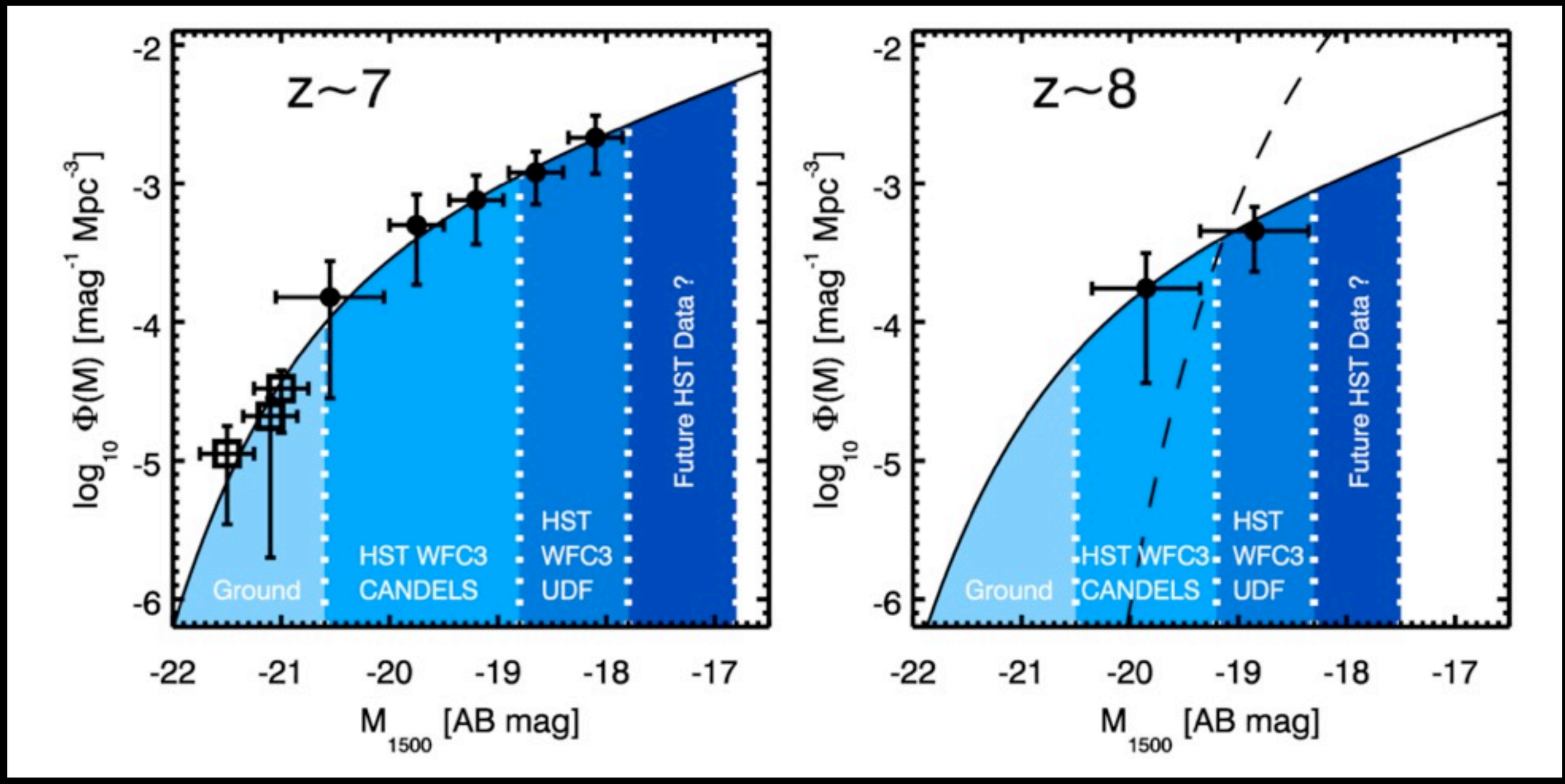
Important for
reionization

Dunlop (2012)
see also Bouwens et al. (2011), and Grazian et al. (2011)

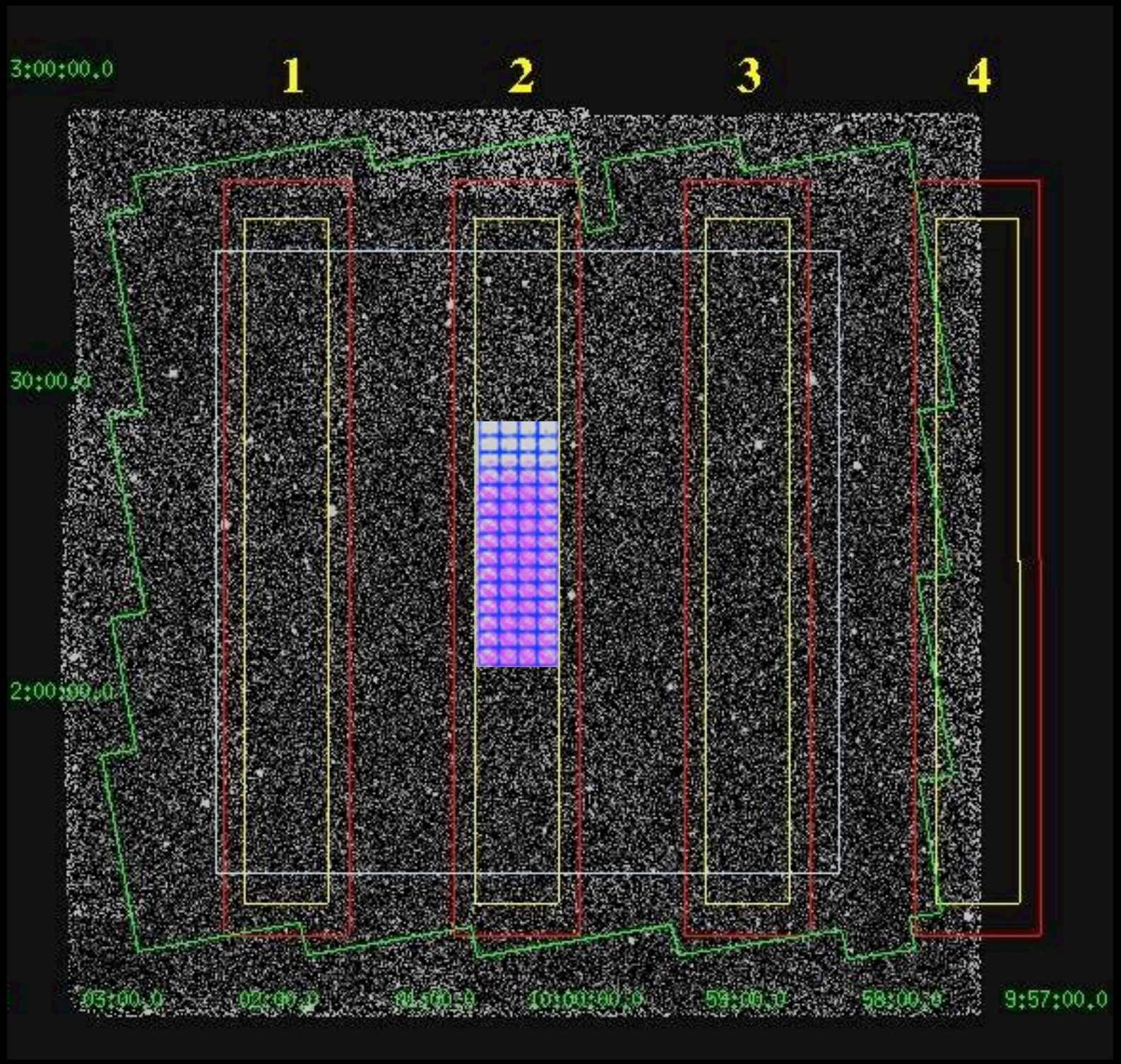
HST Multi-cycle treasury proposal - CANDELS



Building the wedding-cake……



UltraVISTA + CANDELS

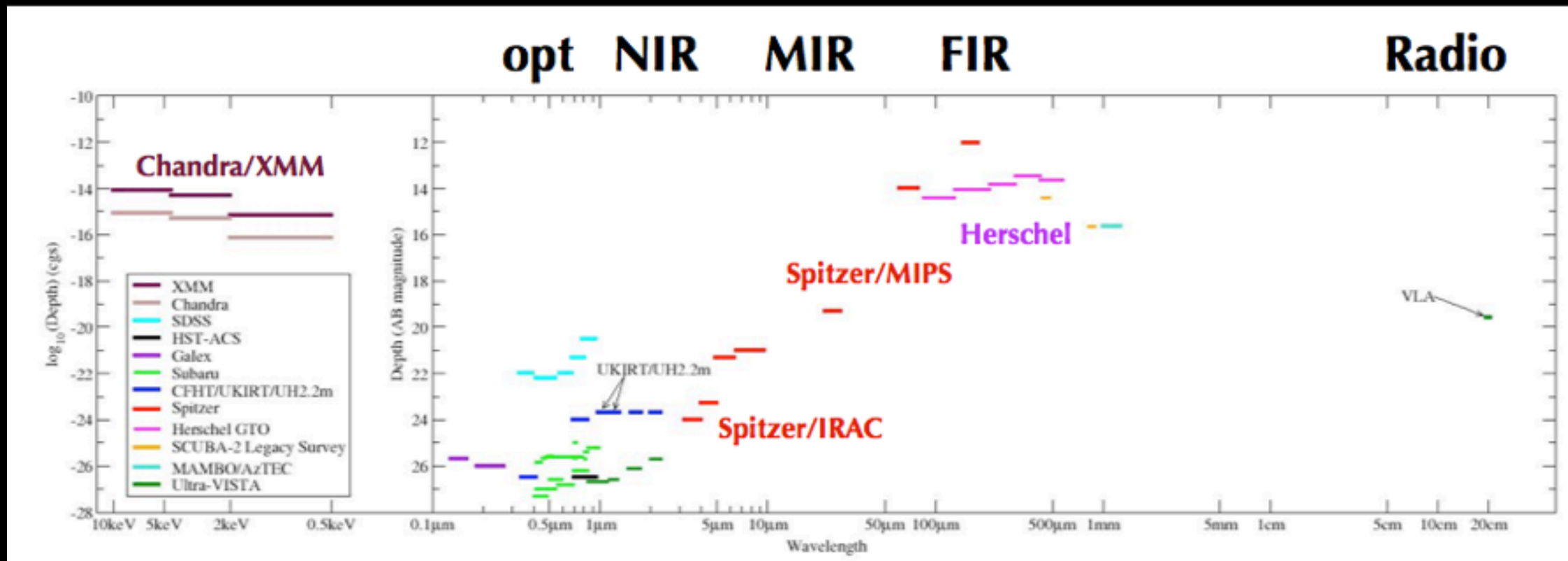


COSMOS

The COSMOS field is a unique region of the sky to study galaxy formation and evolution

Broad-band and medium band Subaru data, GALEX, VLT, Herschel, CFHTLS (D2) (more than 25 imaging bands)

Also a unique and large spectroscopic sample (the ideal laboratory to perfect photometric redshift techniques)

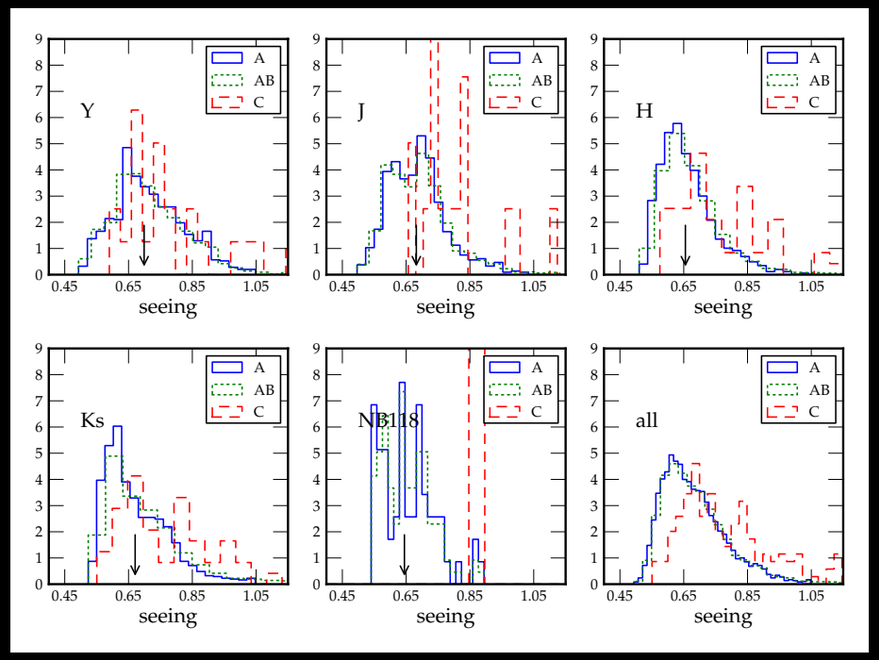


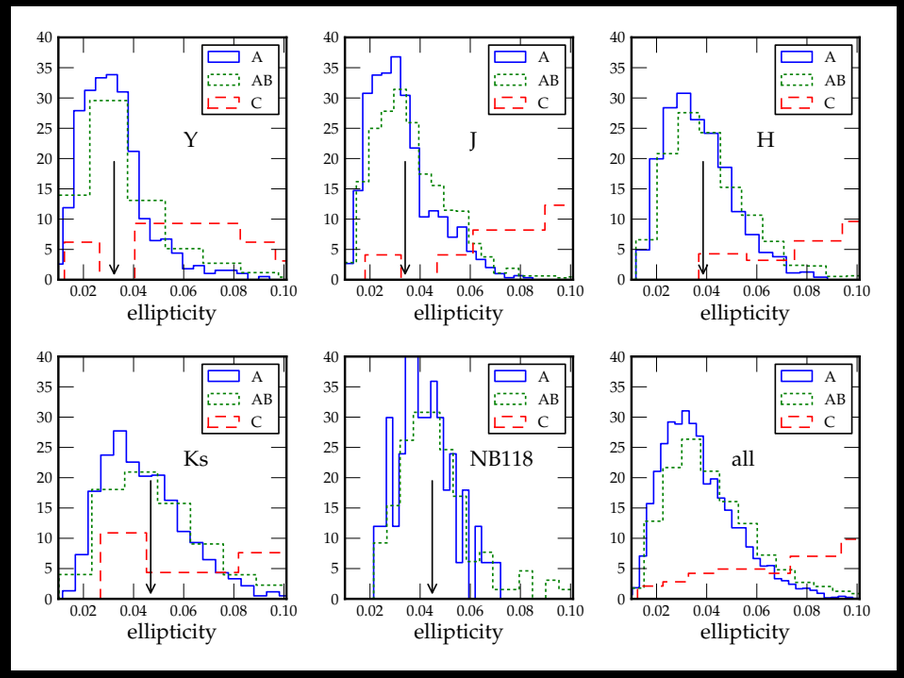
Introducing UltraVISTA DR1

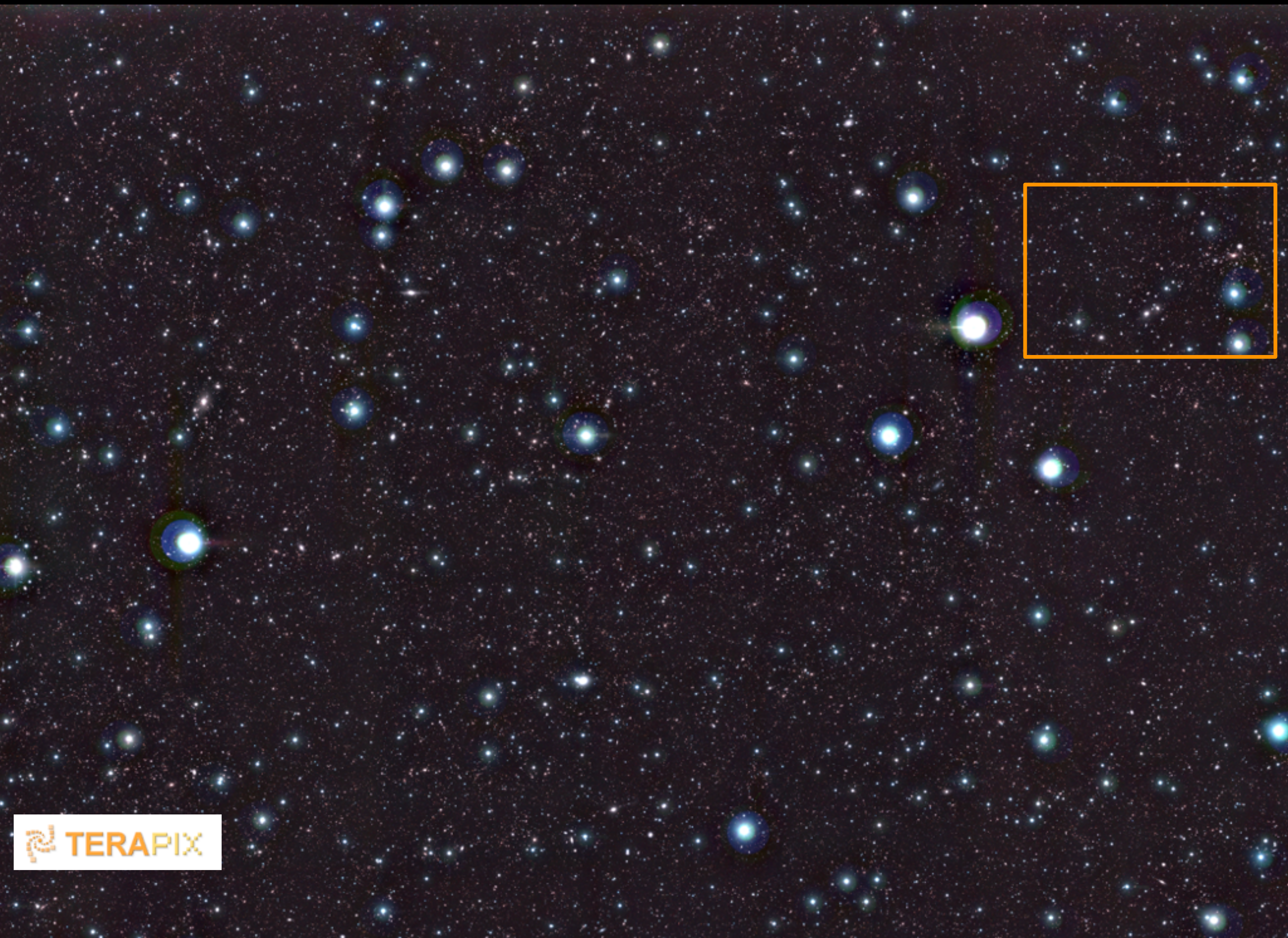
DR1 contains all data taken between 5 December 2009 and 19 April 2010 – already **deeper** and with **better wavelength coverage** and seeing compared **all previous data NIR data** taken on the field over the last five years! Covers 1.6 deg^2 in COSMOS.

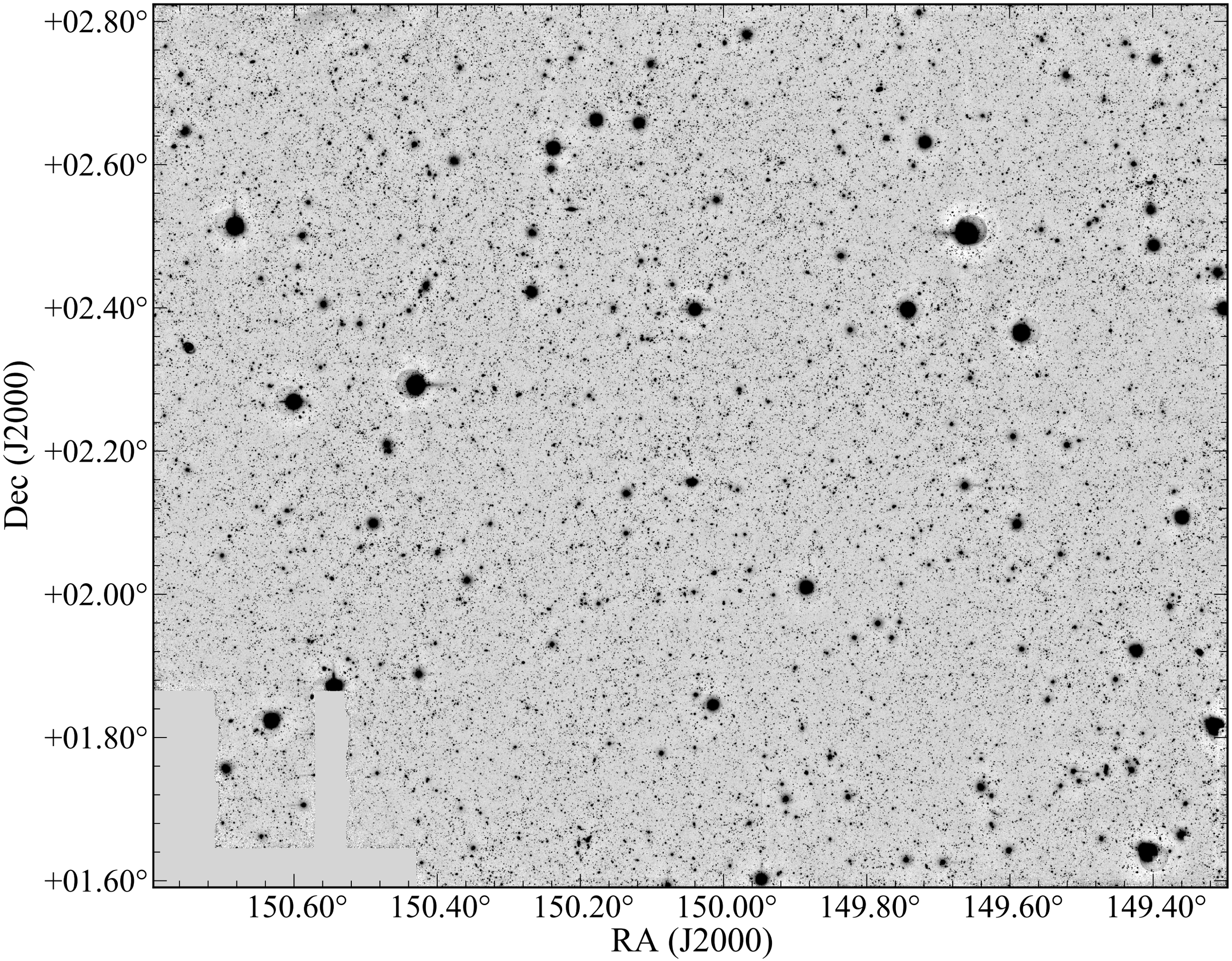
All 8000 images were **visually inspected** enabling us to find a few percent of images which had doubled PSF due to guiding / tracking problems.

Data reductions start from the **individual non sky-subtracted images**; double-pass sky-subtraction takes place on the TERAPIX cluster (~1 month of cpu time)






TERAPIX

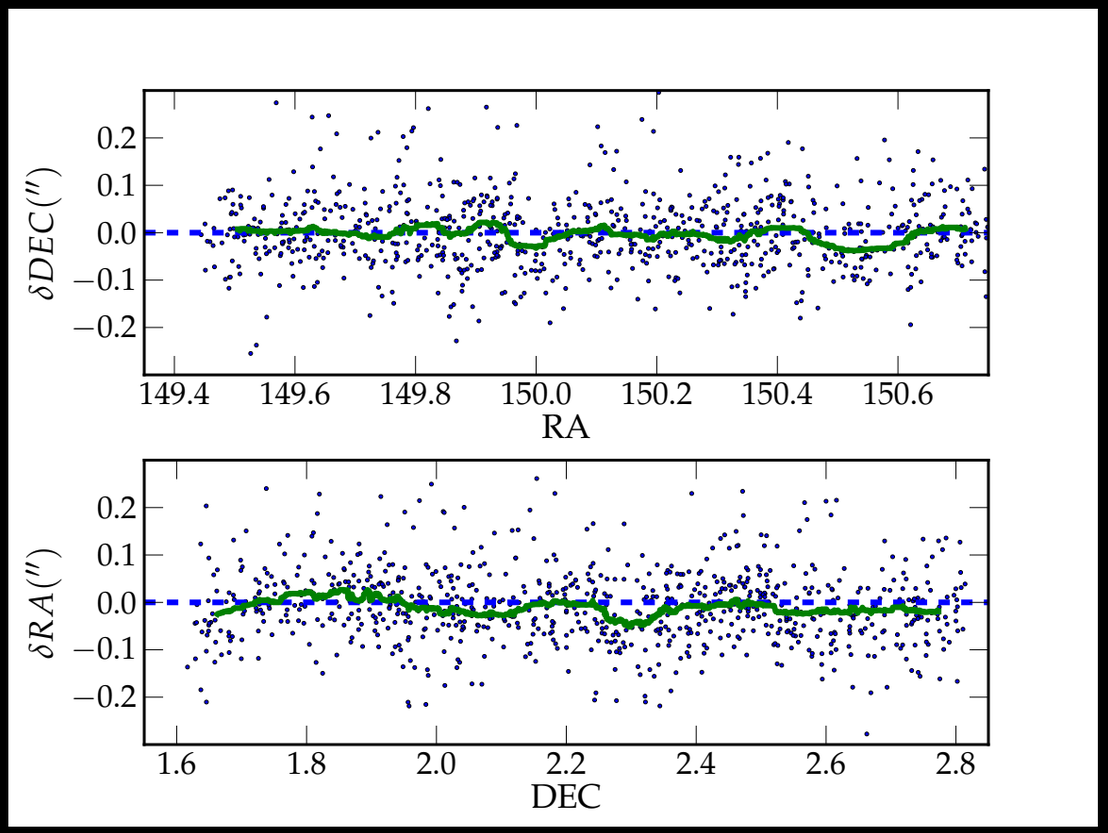

+02.80°
+02.60°
+02.40°
+02.20°
+02.00°
+01.80°
+01.60°
Dec (J2000)
150.60°
150.40°
150.20°
150.00°
149.80°
149.60°
149.40°
RA (J2000)

« Tennessee legislature boldly sets the science clocks back 150 years
More M95 supernova news: progenitor found! »

An ultradeep image that's *full* of galaxies!

What happens when you take a monster 4.1 meter telescope in the southern hemisphere and point it at the same patch of sky for 55 hours?

This. Oh my, *this:*



DEPTH AB 5σ–2”apertures ± 0.1m

Y	J	H	Ks	NB
24.6	24.4	23.9	23.7	22.9

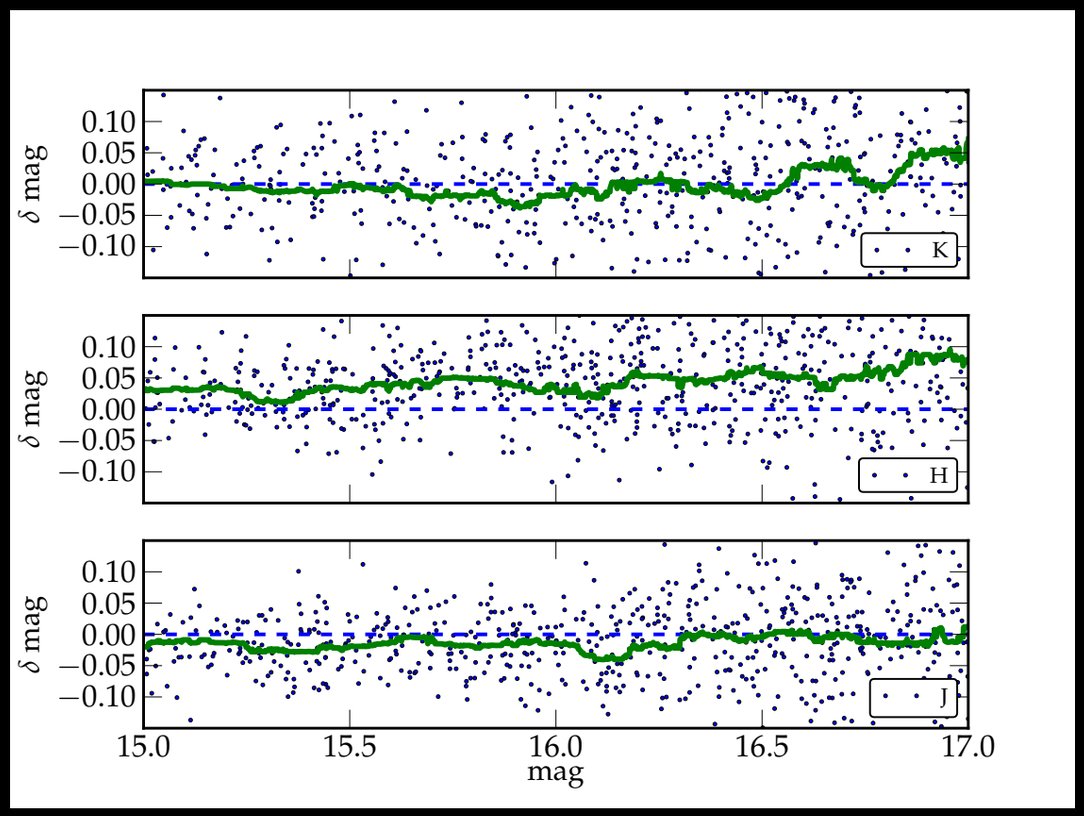
Seeing on all stacks is 0.8±0.1”

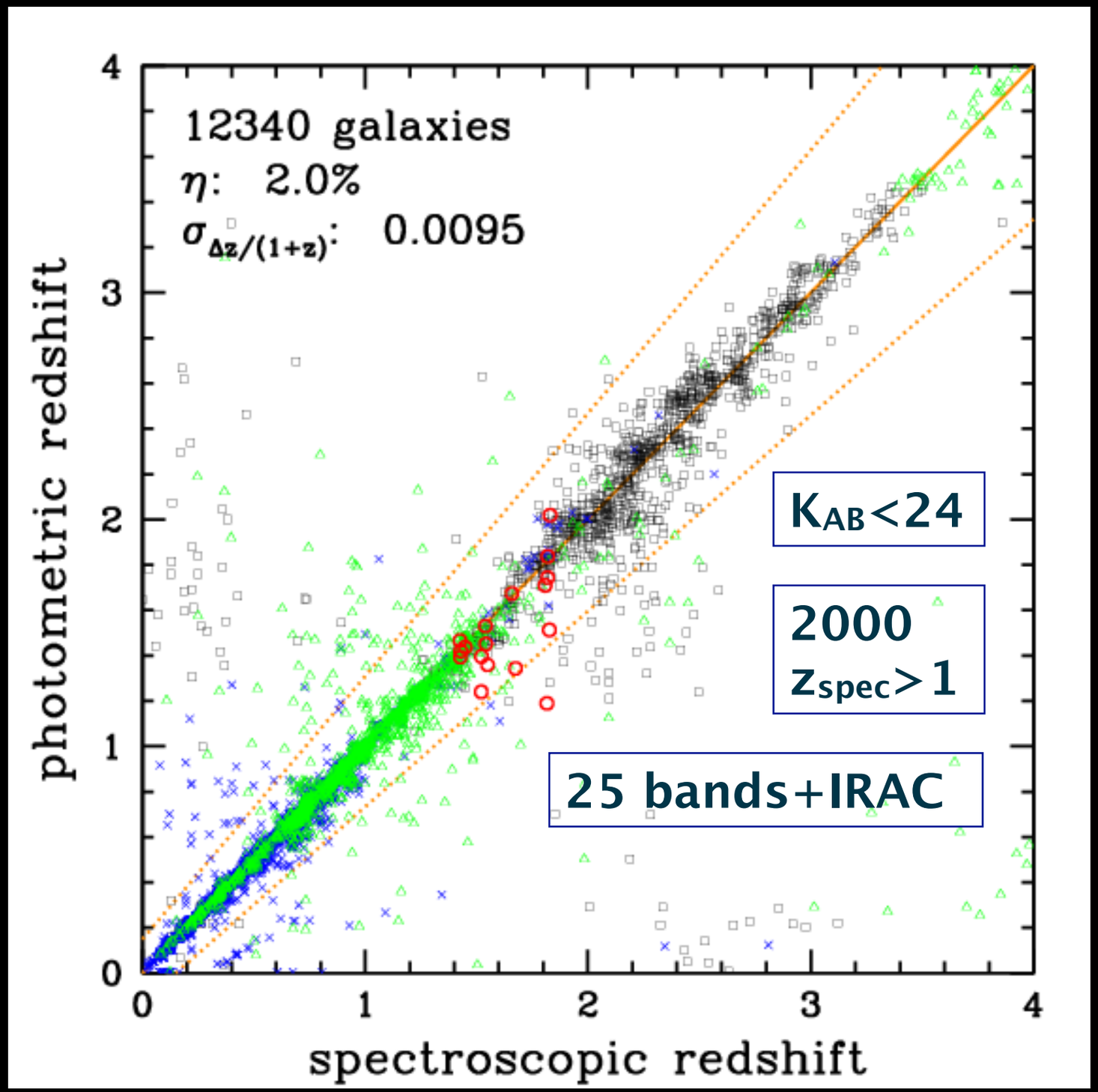
Stacks, catalogues available from ESO Phase 3, CDS Strasbourg

Extensive quality-control checks carried out on data products

Individual images are resampled directly to the **COSMOS pixel grid** of 0.15”/pixel, taking advantage of excellent seeing / image quality of VIRCAM

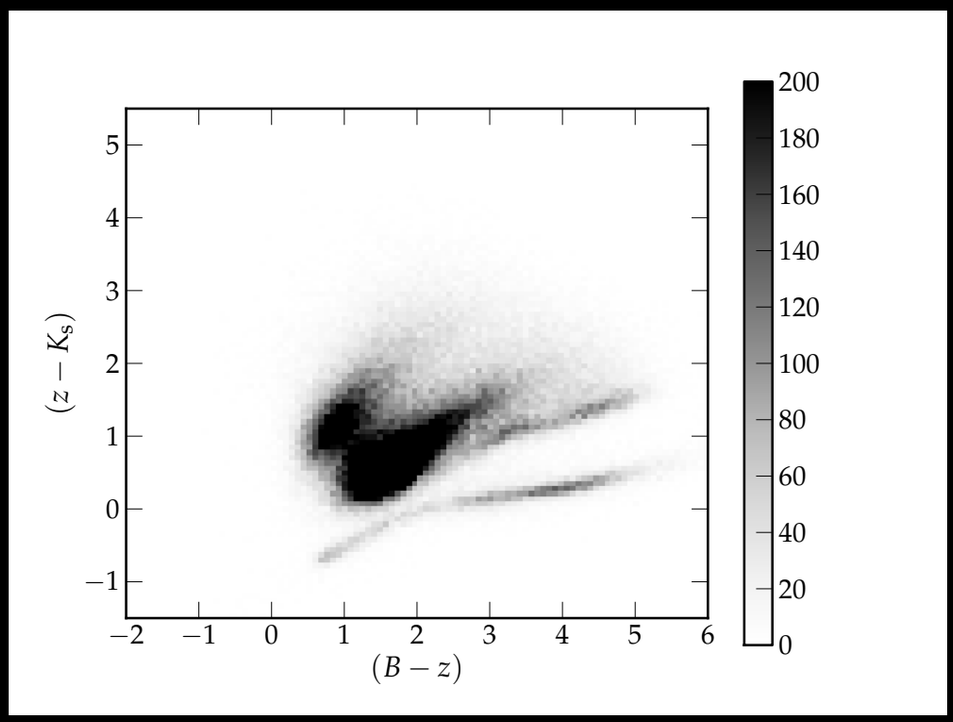
UltraVISTA survey paper: McCracken et al. 2012, A&A, 544, 156





Deep, high quality photometry now **enables new science** at z~2 (mass function, clustering) and pushing further down the mass function and allowing us to see M* galaxies out to z~2

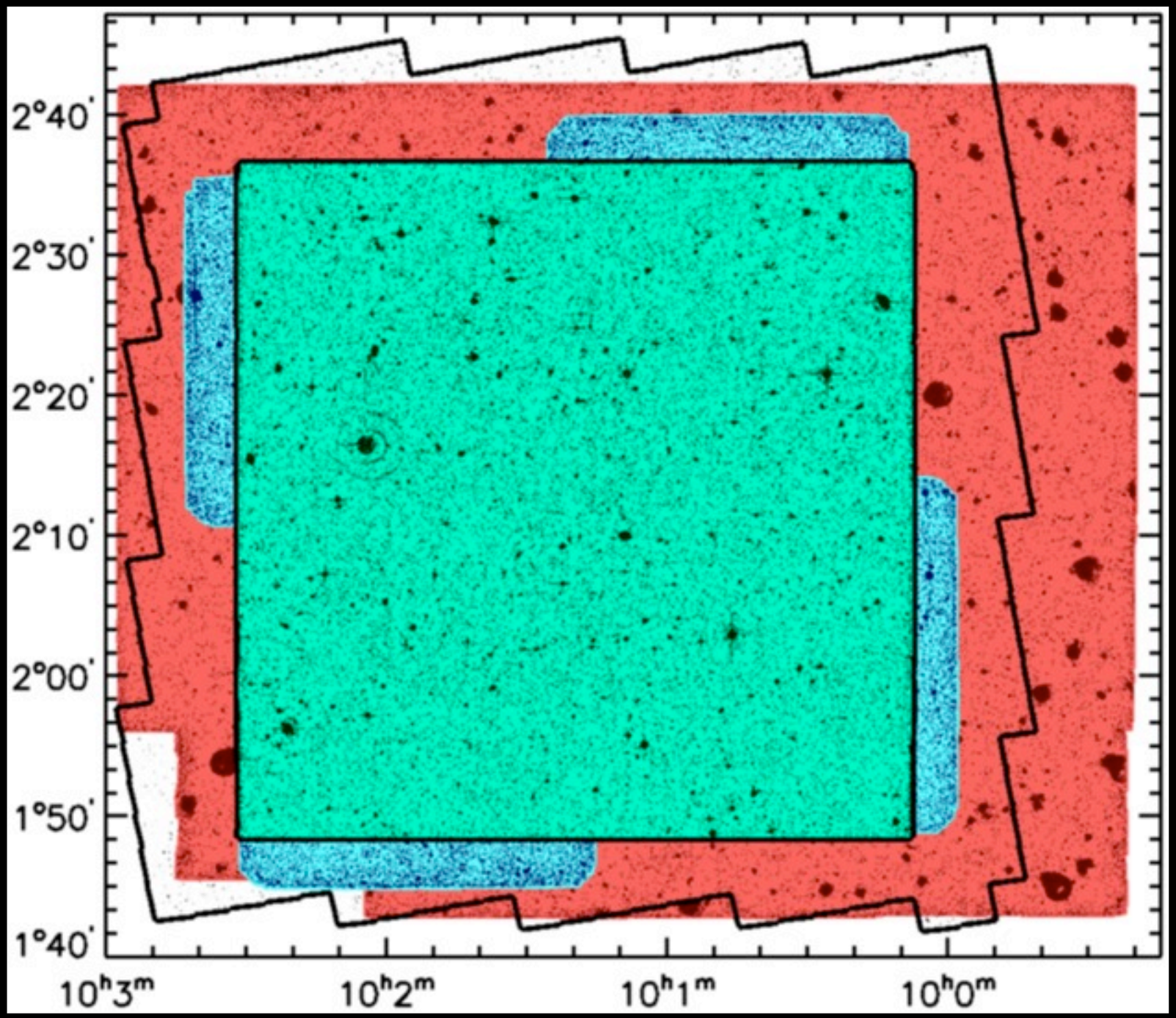
addition of Y helps at $1<z_{phot}<2$



UltraVISTA + COSMOS (25 band) means we can now compute **reliable bias-free** photometric redshifts at $1<z<3$ (O. Ilbert et al + FMOS +zCOSMOS + DEEP2 spectra)

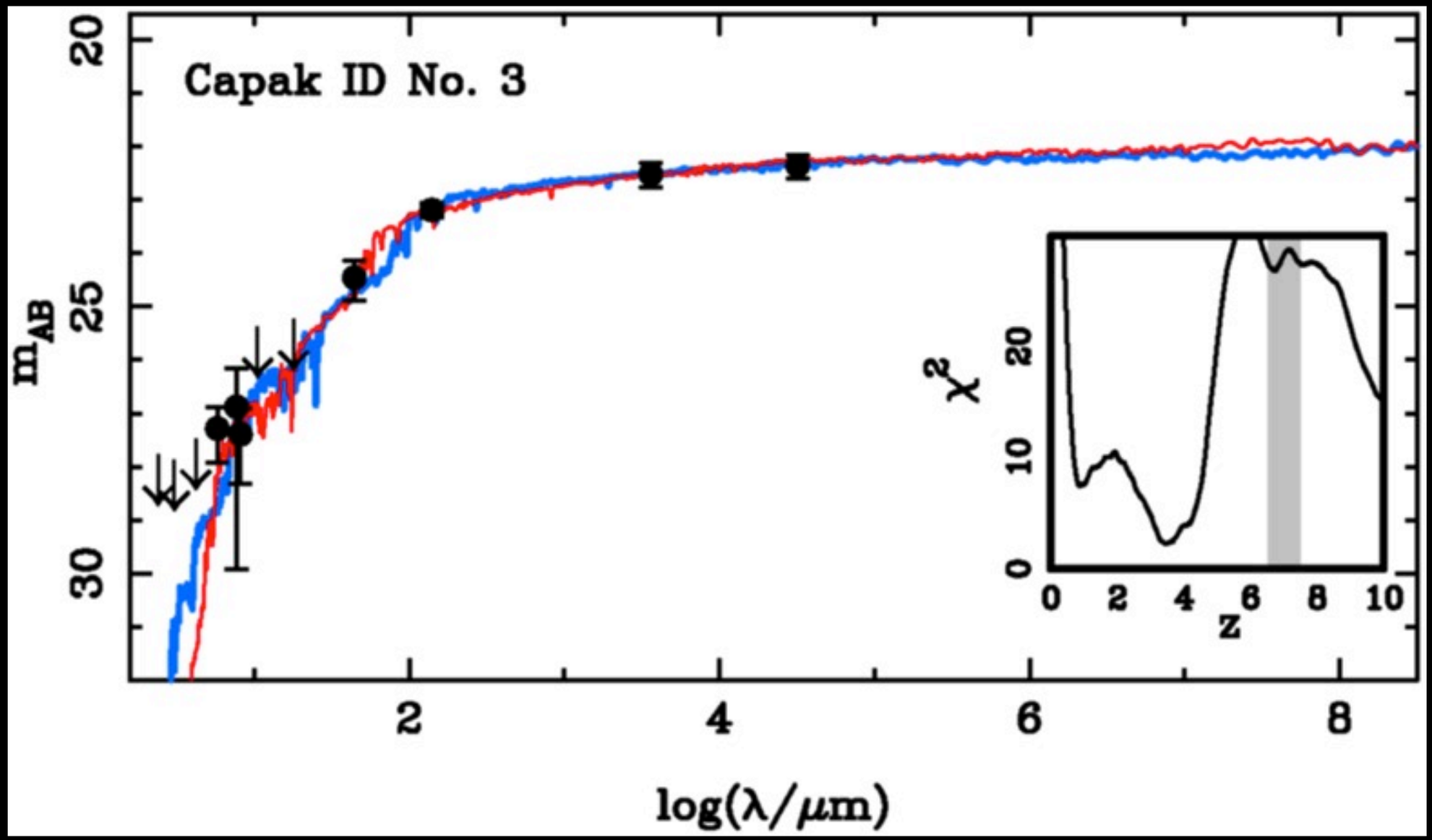
Combine UltraVISTA with deep CFHT/Subaru/HST optical imaging

Bowler, Dunlop et al. (2012)



Objects selected on Y+J catalogue

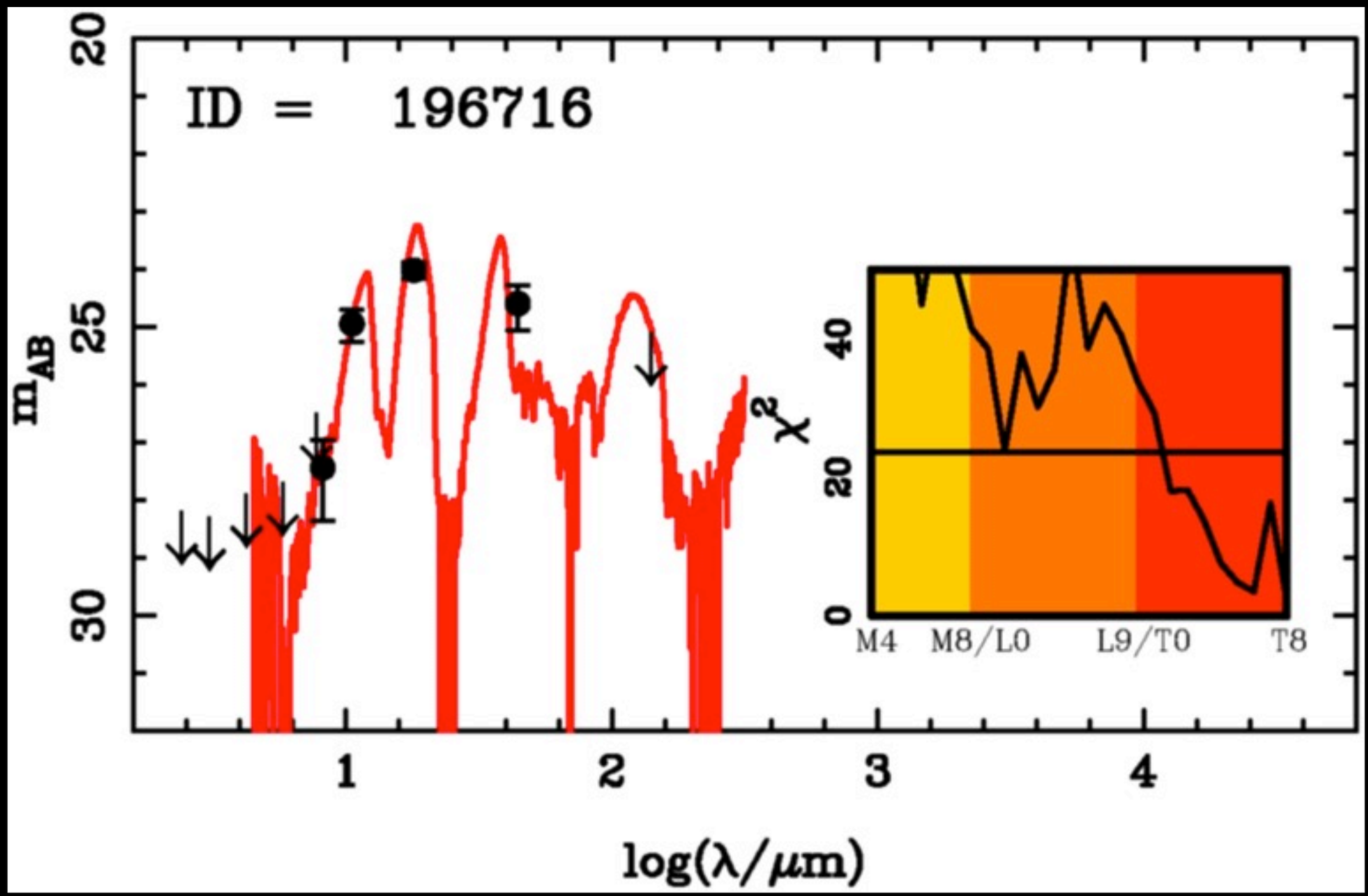
First check out previous claims of very luminous (H~23-24) galaxies at z > 7 Capak et al. (2011)



All are in fact red galaxies at much lower redshifts z = 2 - 4

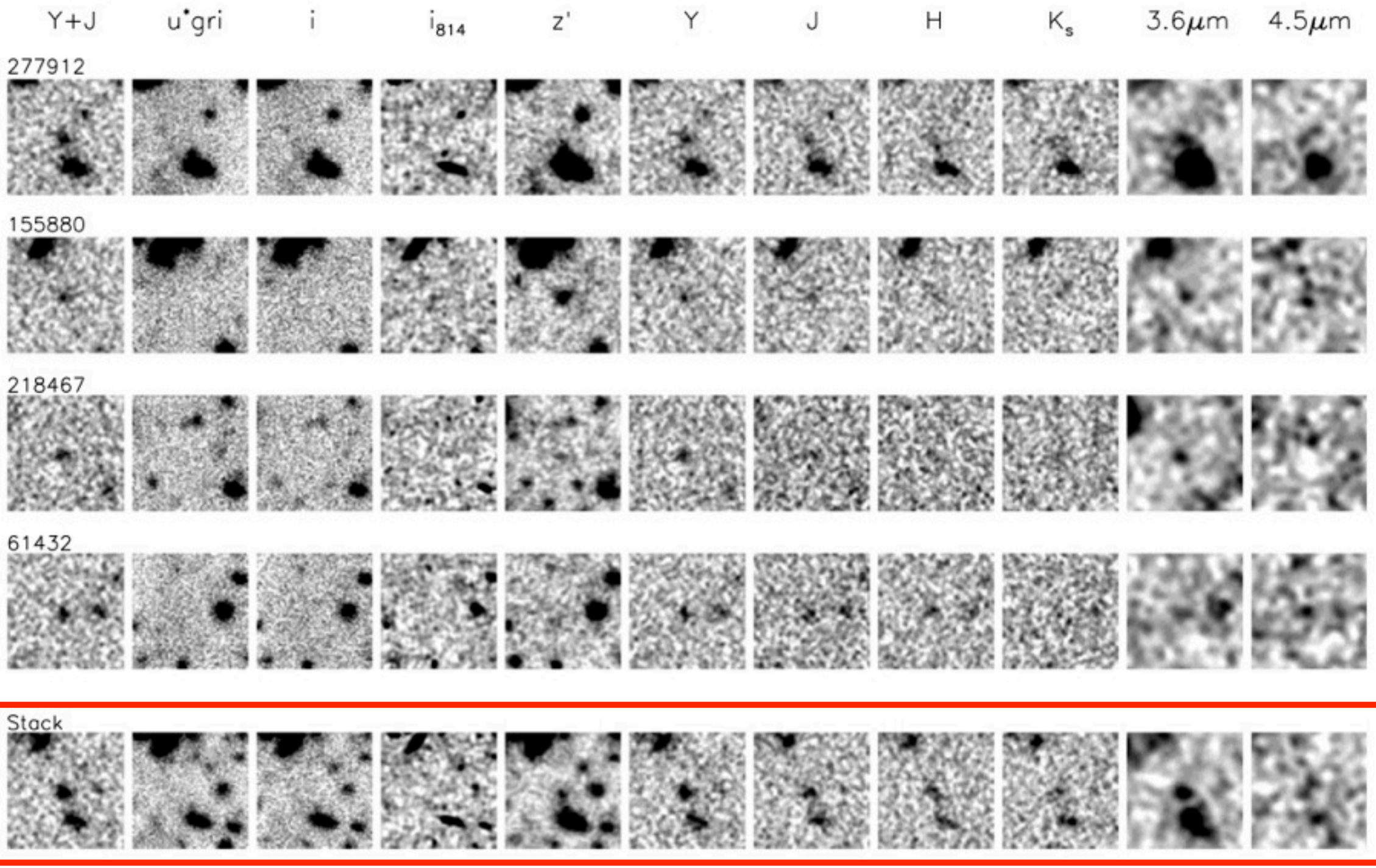
Other major challenge is distinguishing z = 7 galaxies from T dwarfs

Big problem for ground-based surveys at J ~ 25



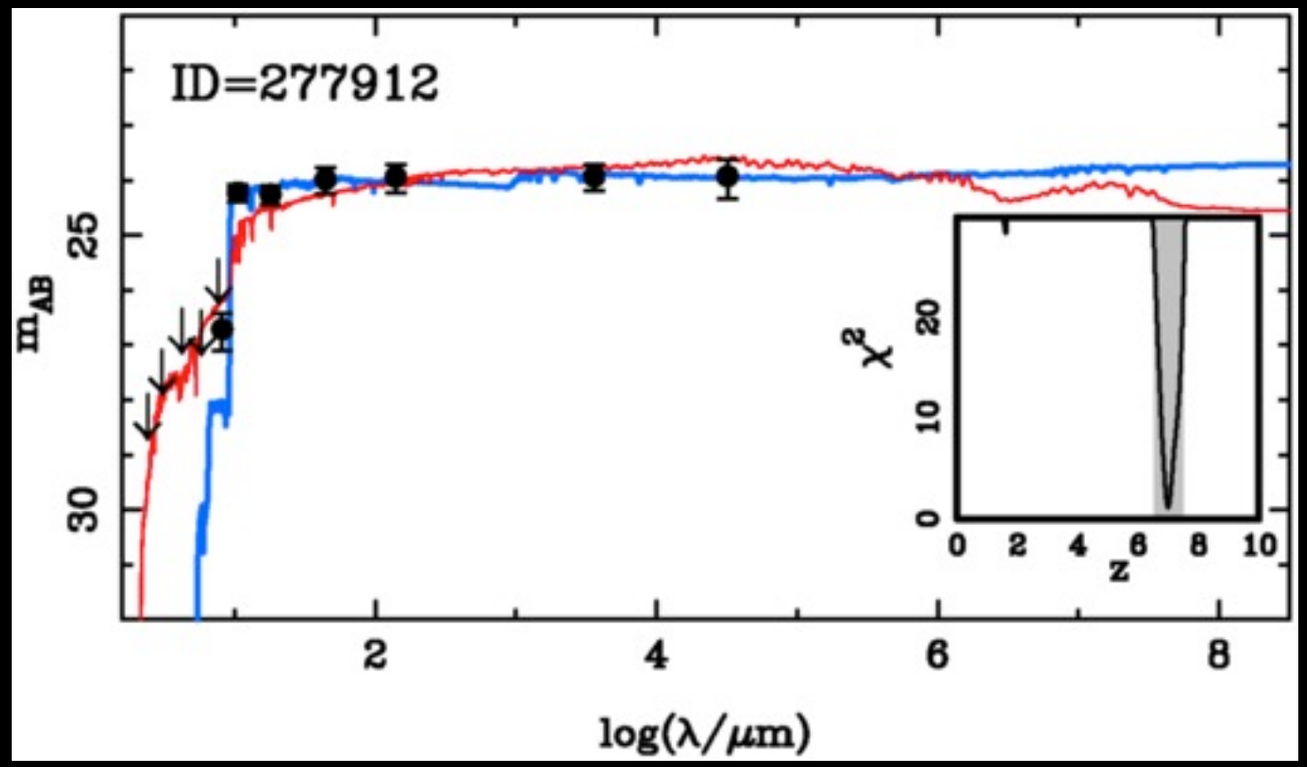
UltraVISTA robust z ~ 7 galaxies

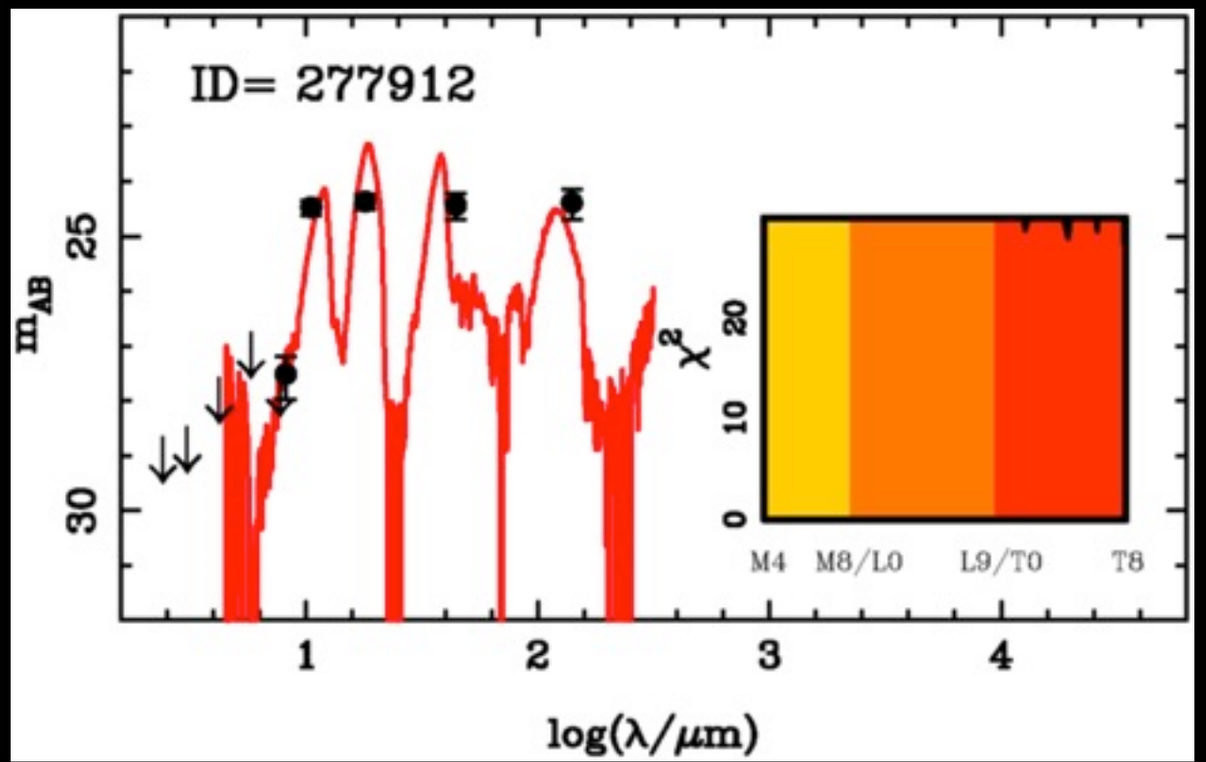
Bowler, Dunlop et al. (2012)

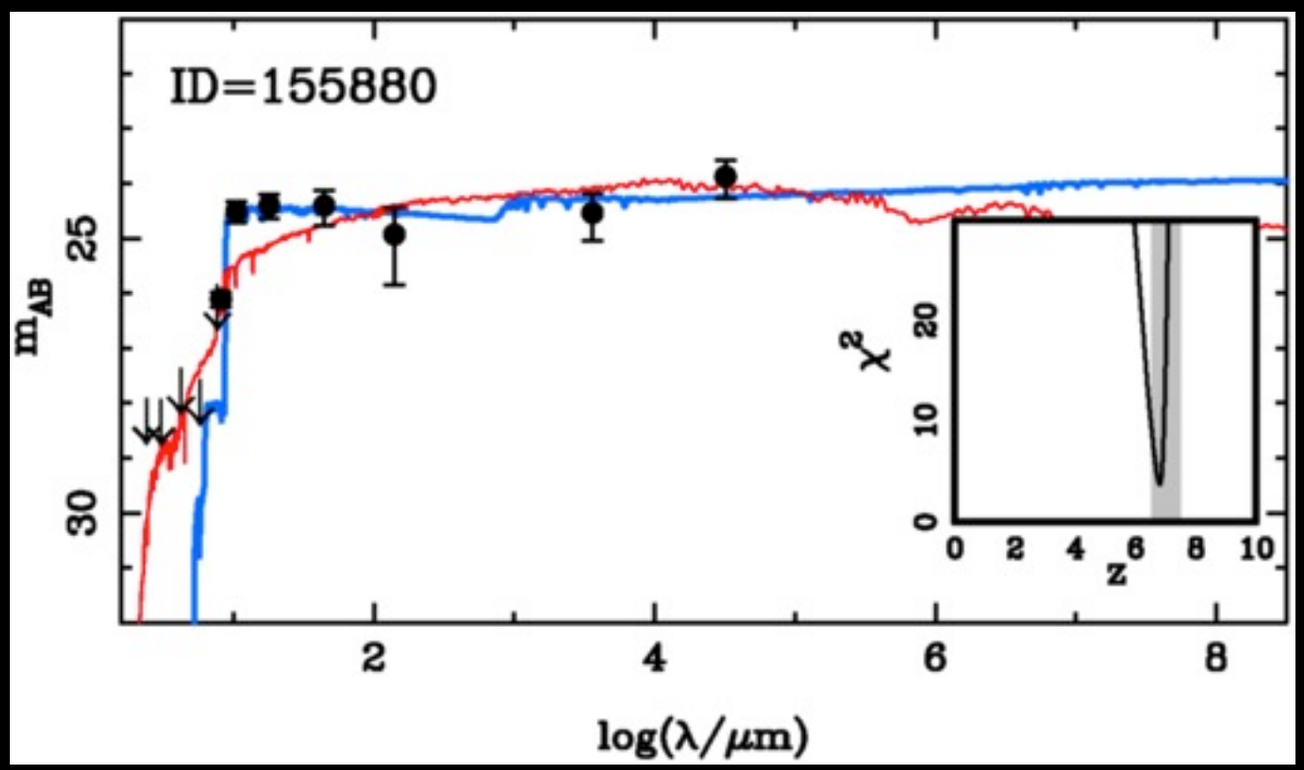


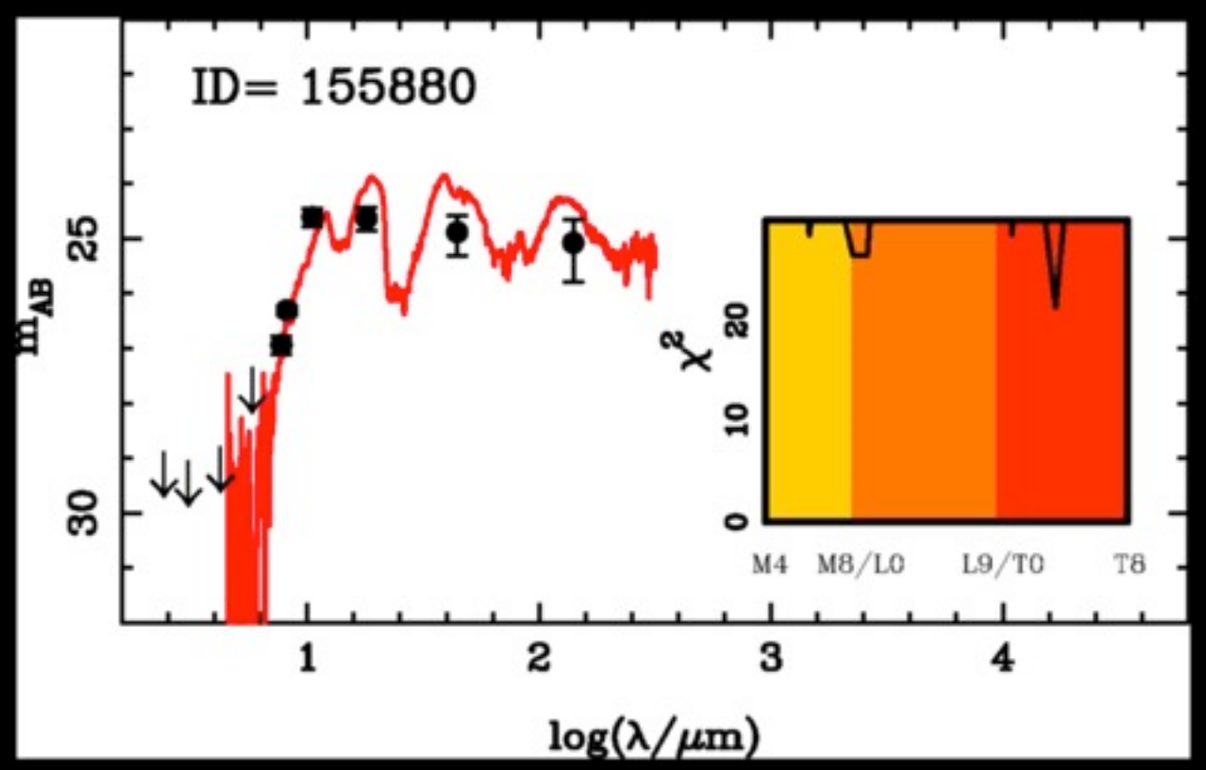
UltraVISTA robust z ~ 7 galaxies

Bowler, Dunlop et al. (2012)

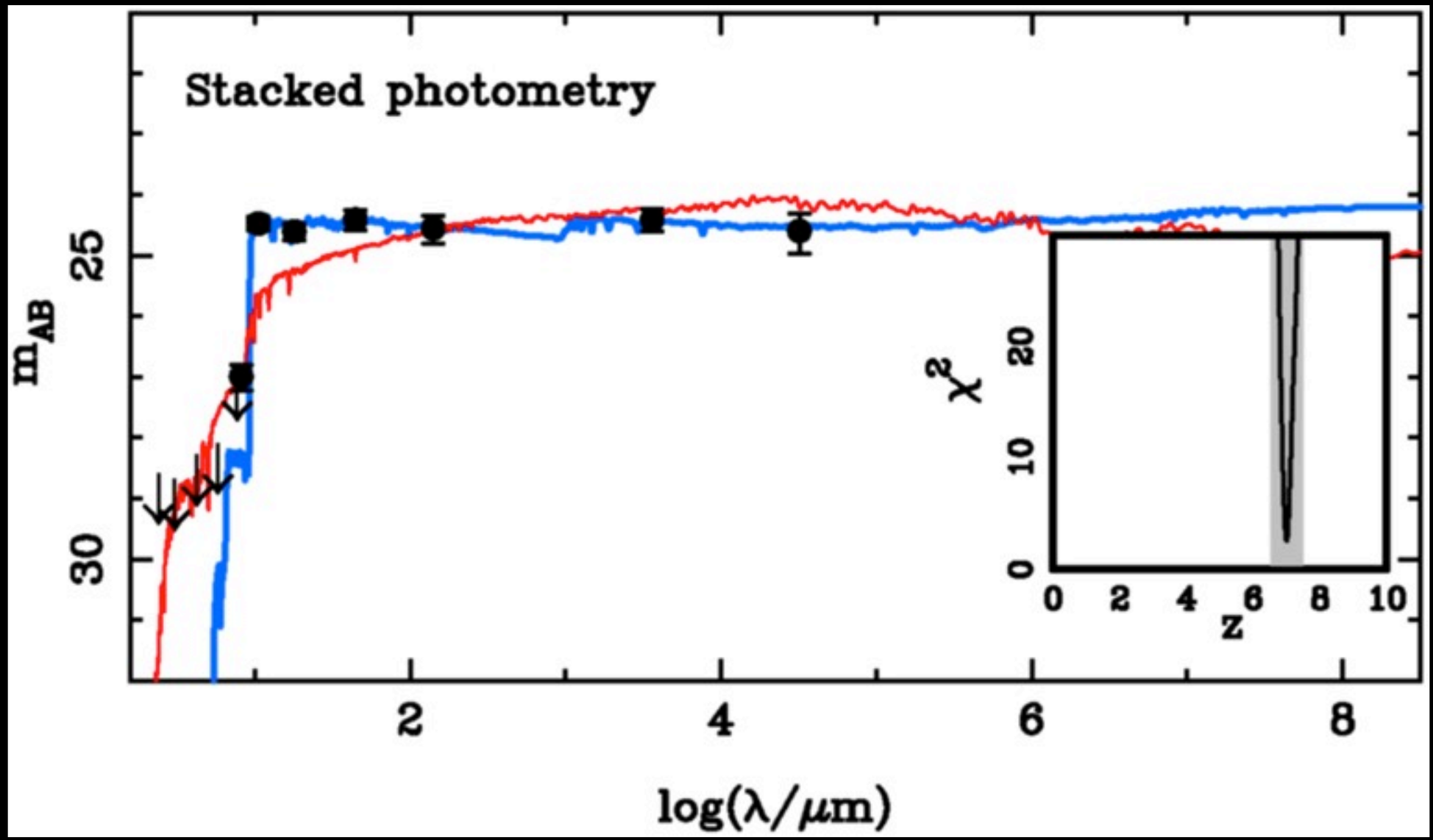






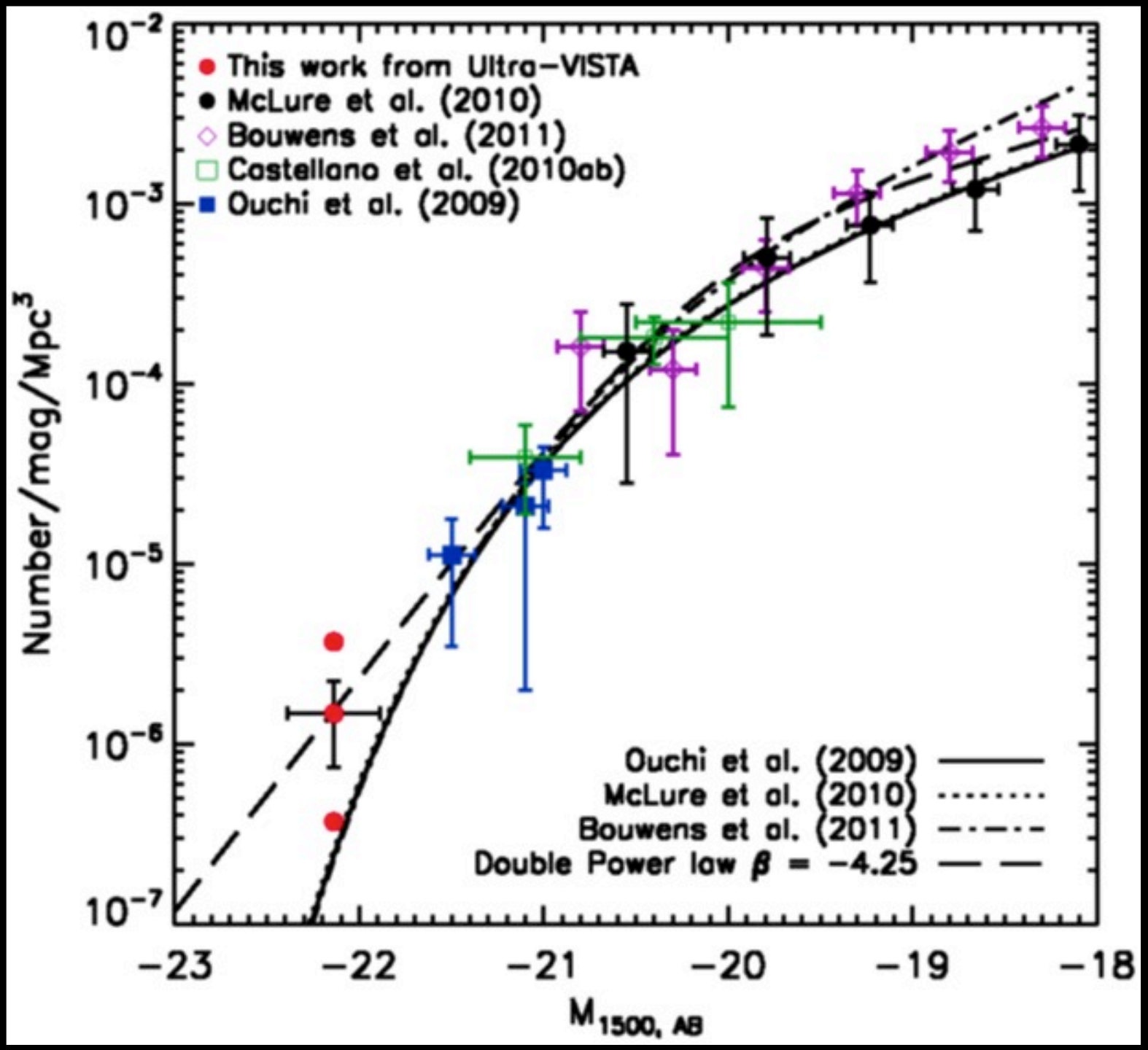


Stack of best 4 UltraVISTA z ~ 7 galaxies: z = 6.98 +- 0.05



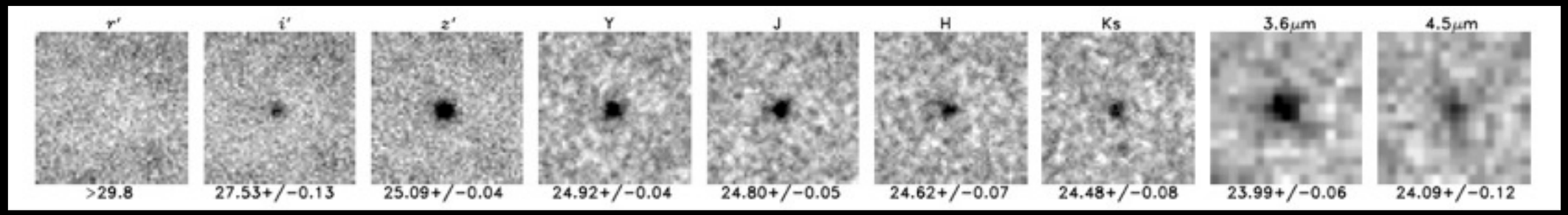
Bright end of z = 7 Luminosity Function

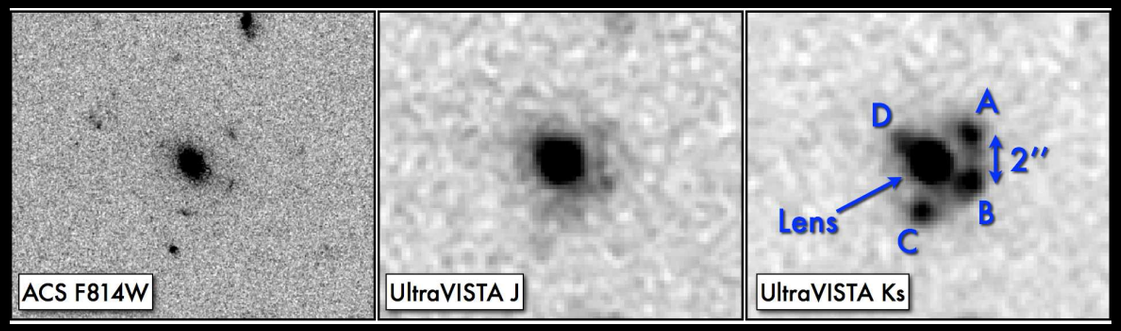
Bowler., Dunlop et al. (2012)



Other UltraVISTA science:

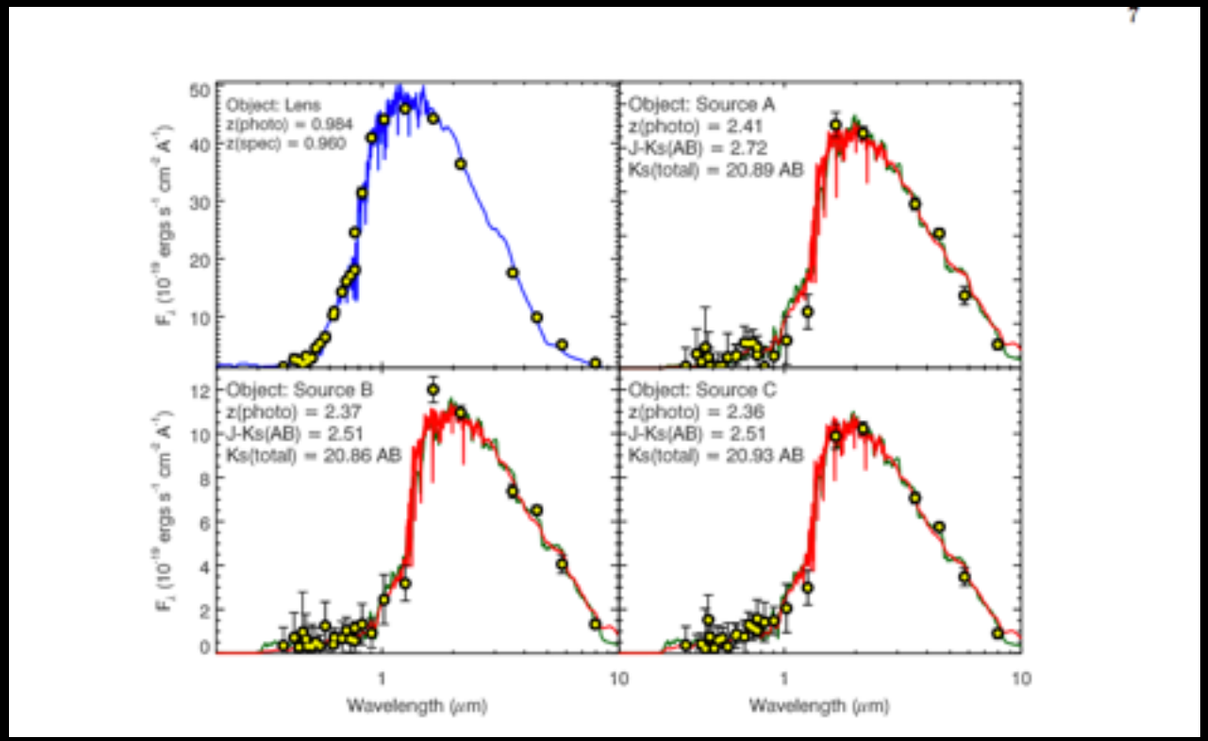
Willott et al 2012: z~6 galaxies: UltraVISTA+CFHTLS+VIDEO





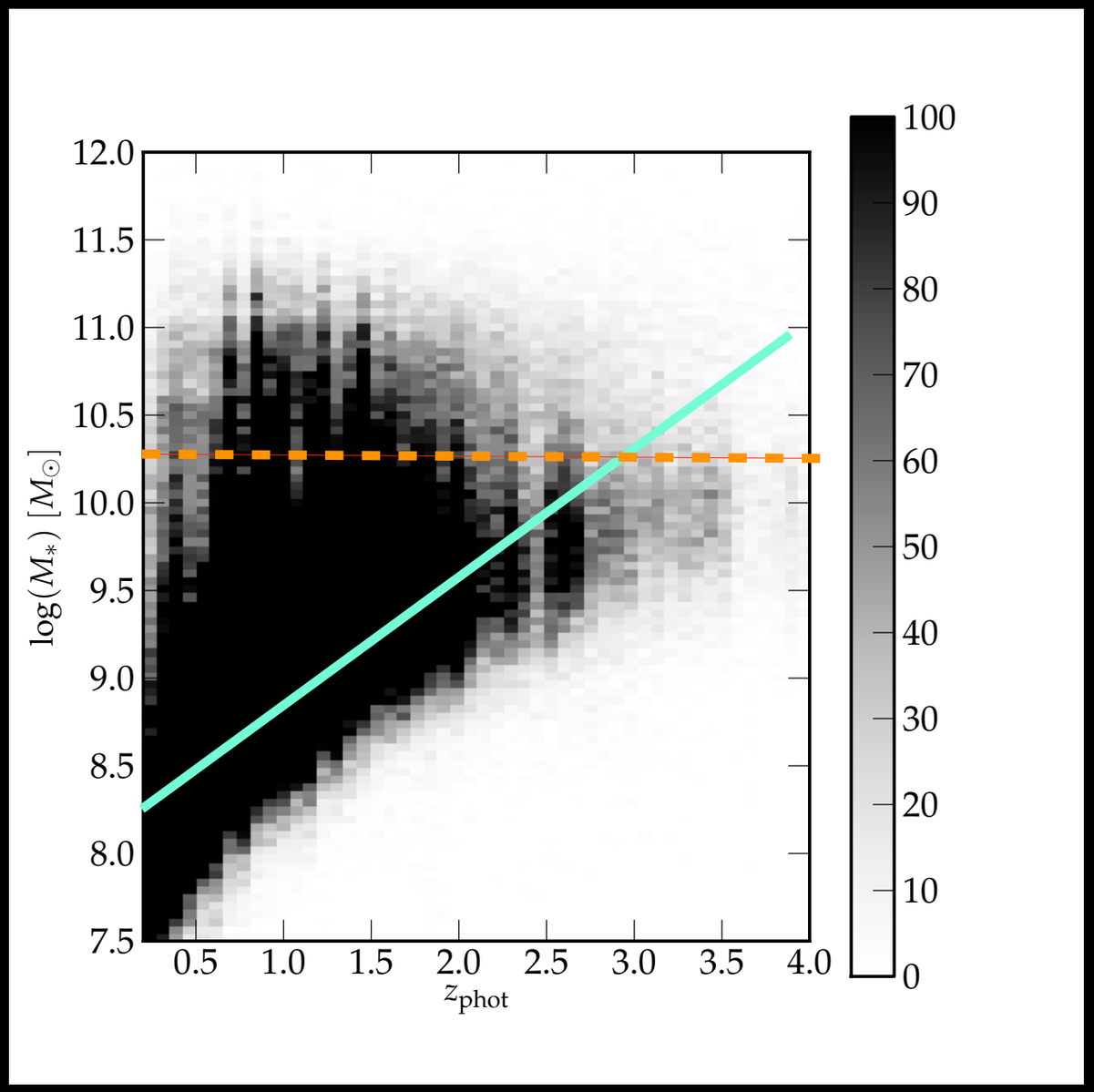
Muzzin et al 2012: three background z~2 lensed by foreground elliptical

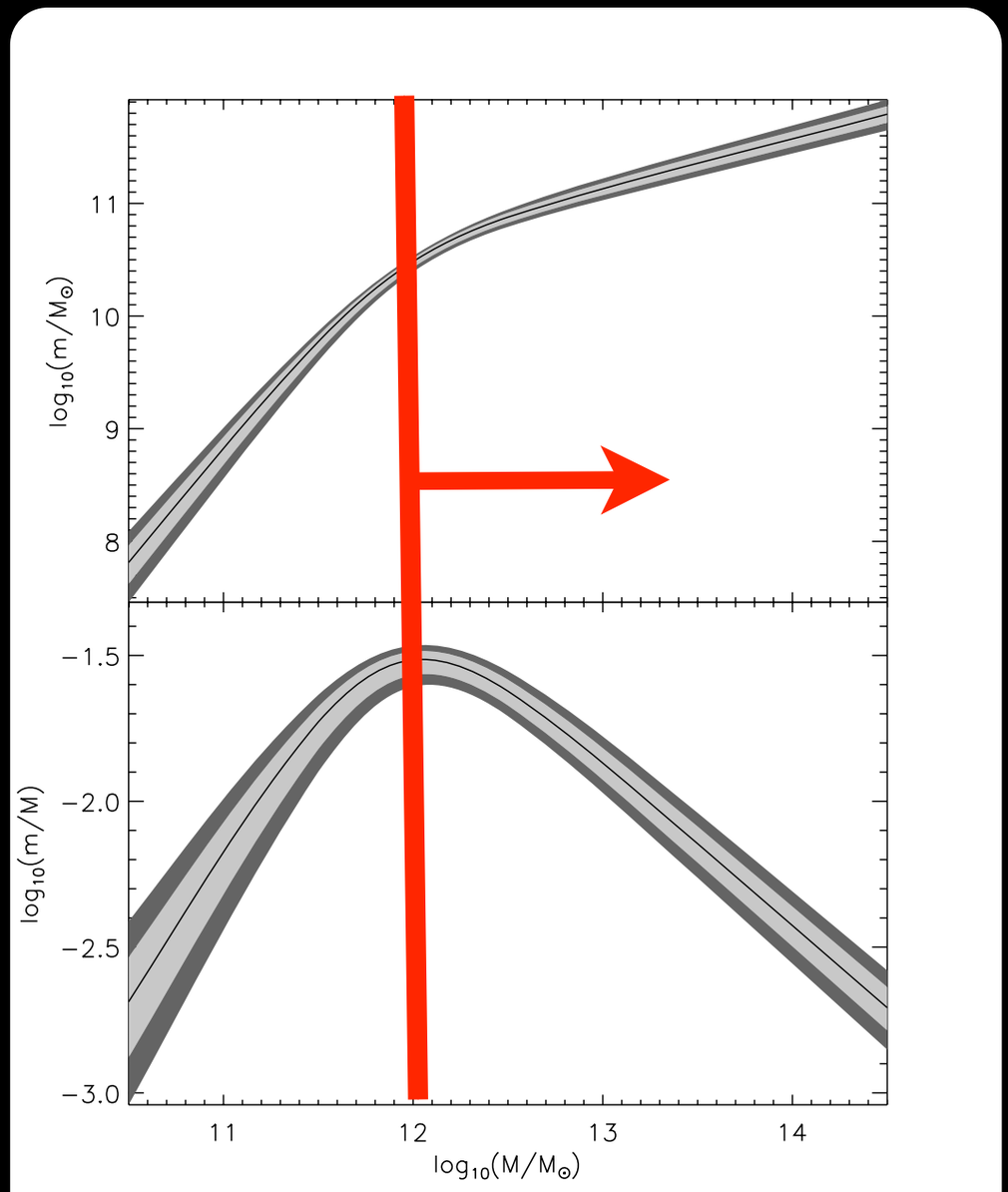
+ at least another six COSMOS-related articles in press or being prepared



Stellar mass-halo mass relationship at z~2

Wolk et al, in prep, Ilbert et al. in prep





z~0

How does the characteristic mass where galaxy formation efficiency reaches a maximum vary with redshift?

Data is complete enough to make this measurement right out to z~2!

Upcoming DR2 data release

DR2 will contain all data taken between 5 December 2009 and April 2012, in total around 22,000 images

The total amount of Ks data in DR2 contains a significant fraction of the total amount of Ks data which will be taken for UltraVISTA

Wide survey component is now complete

DR2 now goes much deeper on the “deep stripes area”:

Y	J	H	Ks	NB
25.3	24.8	24.5	24.8	23.8

Over 0.73 deg^2

Almost surpasses the final UDS DR10 and includes Y-band data and with better seeing

Survey completion now expected in 2017

0.15 mag makes a big difference because of the steep mass function at z~7