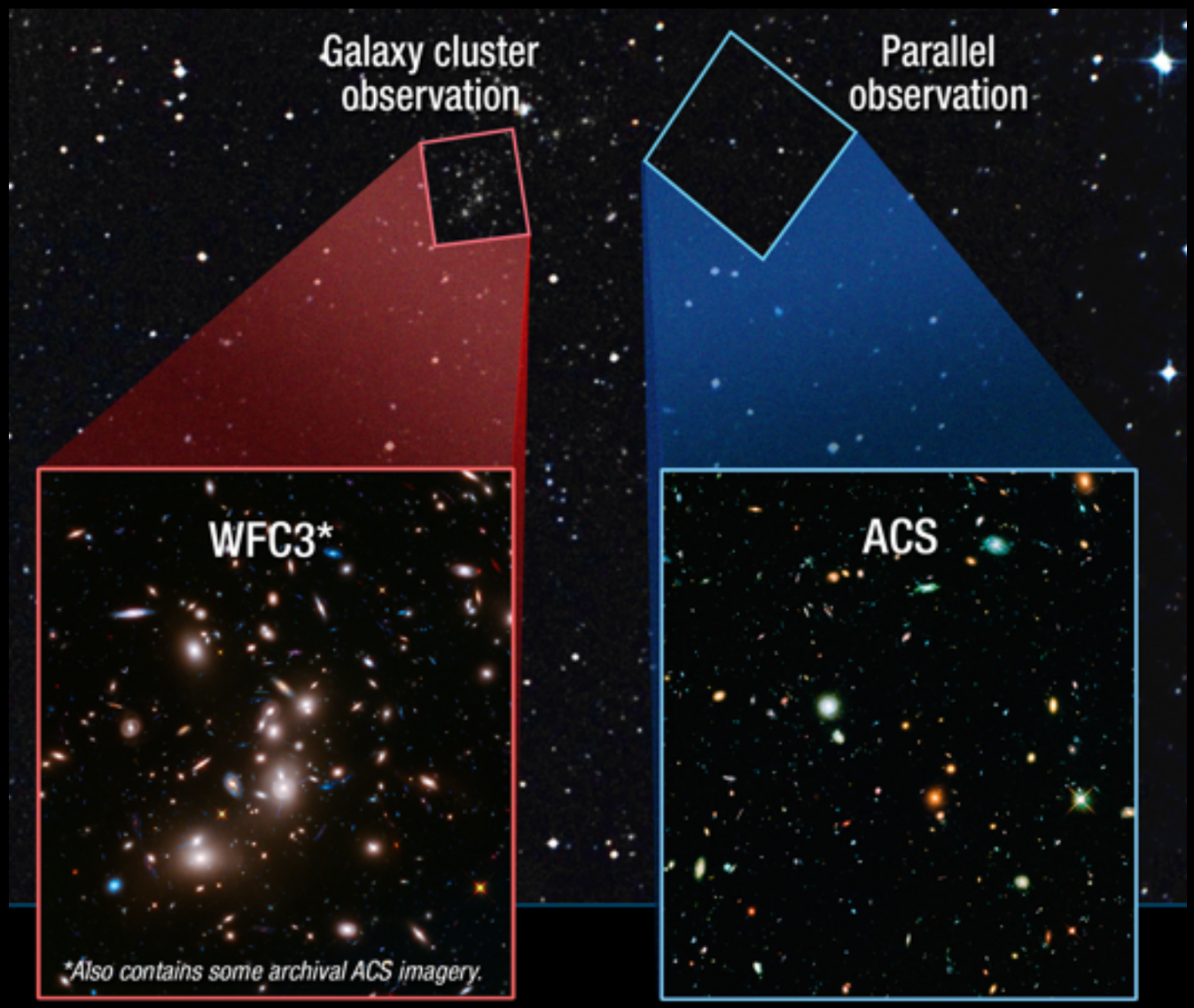
HUBBLE FRONTIER FIELDS:

THE BLANK-FIELD LUMINOSITY FUNCTION: CONSTRAINTS ON THE FAINT-END SLOPE WITH CANDELS+HUDF+HFF PARALLELS



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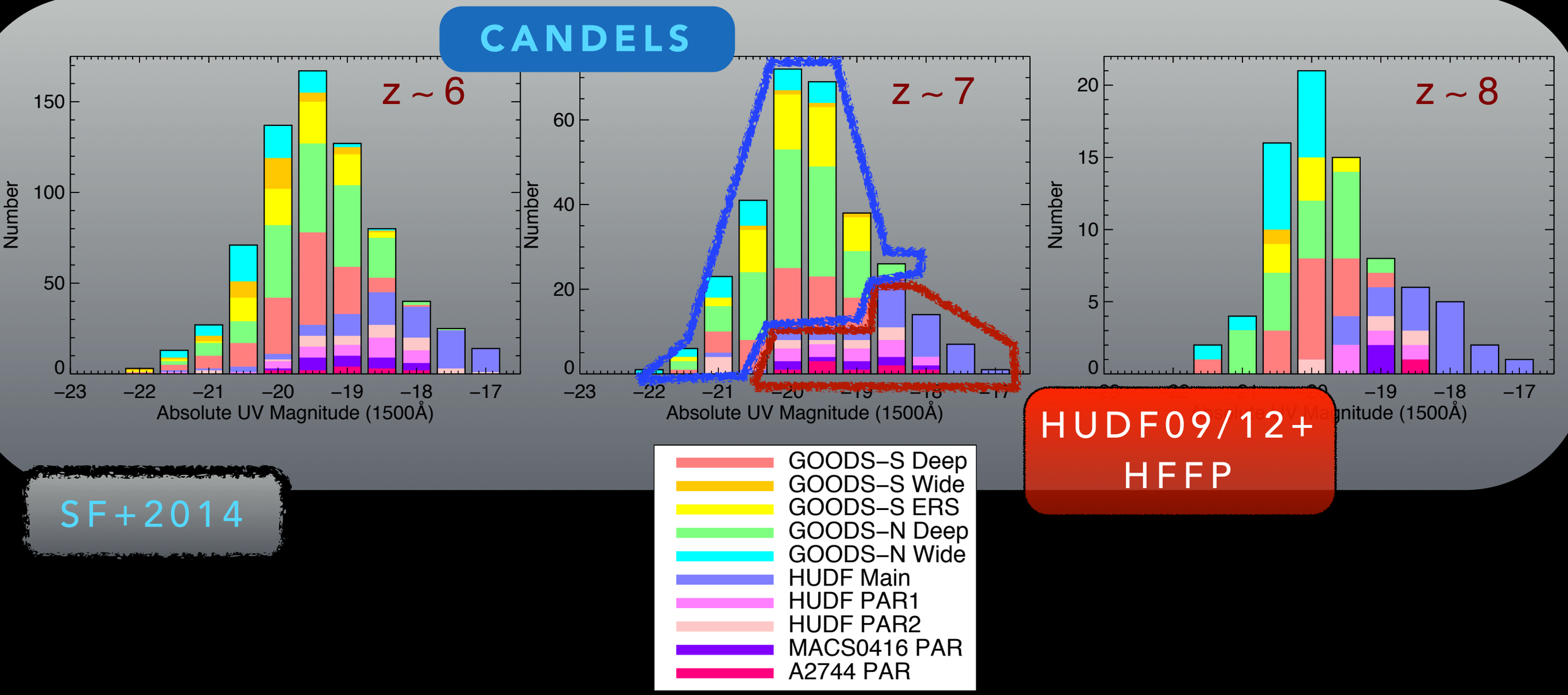
THE UNIVERSITY OF TEXAS AT AUSTIN

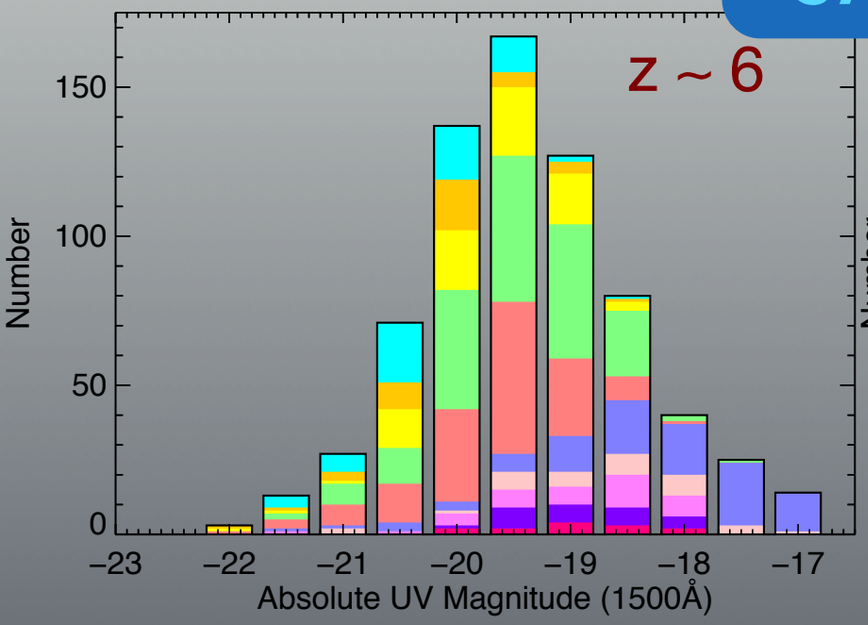
WIDE-AREA DATA IS A NECESSARY COMPLEMENT

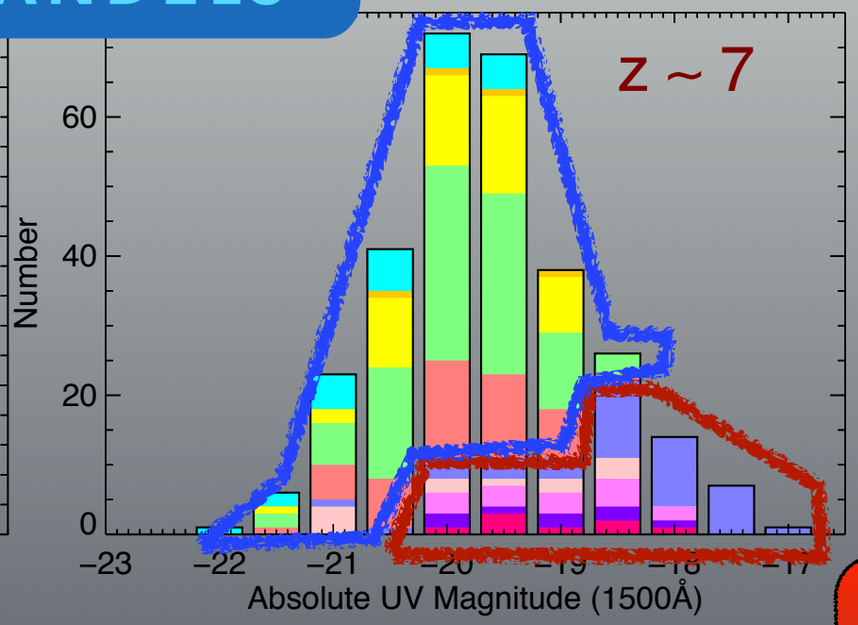


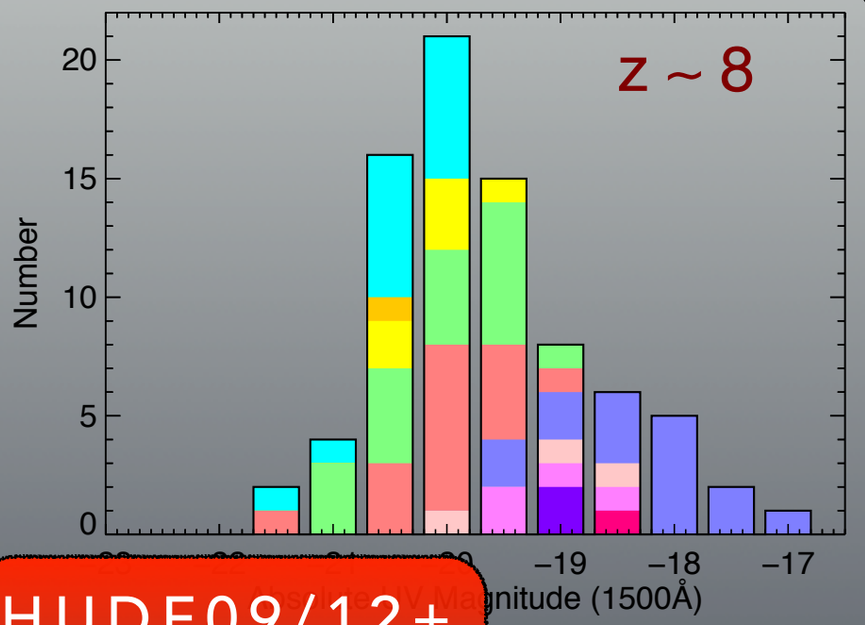
W
C

Field	Area (arcmin^2)	B_{435} (mag)	V_{606} (mag)	i_{775} (mag)	I_{814} (mag)	z_{850} (mag)	$Y_{098/105}$ (mag)	J_{125} (mag)	JH_{140} (mag)	H_{160} (mag)
GOODS-S Deep	61.6	28.2	28.6	27.9	28.1	27.8	28.2	28.1	—	27.9
GOODS-S ERS	41.4	28.2	28.5	27.9	27.9	27.6	27.6	28.0	—	27.8
GOODS-S Wide	35.6	28.2	28.7	28.1	27.9	27.9	27.3	27.6	—	27.4
GOODS-N Deep	67.6	28.1	28.3	27.9	—	27.7	28.1	28.3	—	28.1
GOODS-N Wide	71.7	28.1	28.4	27.8	—	27.6	27.3	27.4	—	27.4
HUDF Main	5.1	29.5	30.0	29.7	—	29.1	29.9	29.6	29.6	29.7
HUDF PAR1	4.7	—	29.0	28.8	—	28.5	28.9	29.0	—	28.8
HUDF PAR2	4.8	—	29.0	28.7	—	28.3	28.9	29.2	—	28.9
MACS0416 PAR	4.4	28.8	28.9	—	29.2	—	29.2	29.0	29.0	29.0
Abell 2744 PAR	4.3	29.0	29.1	—	29.2	—	29.1	28.8	28.8	28.9

CANDELS







SF+2014

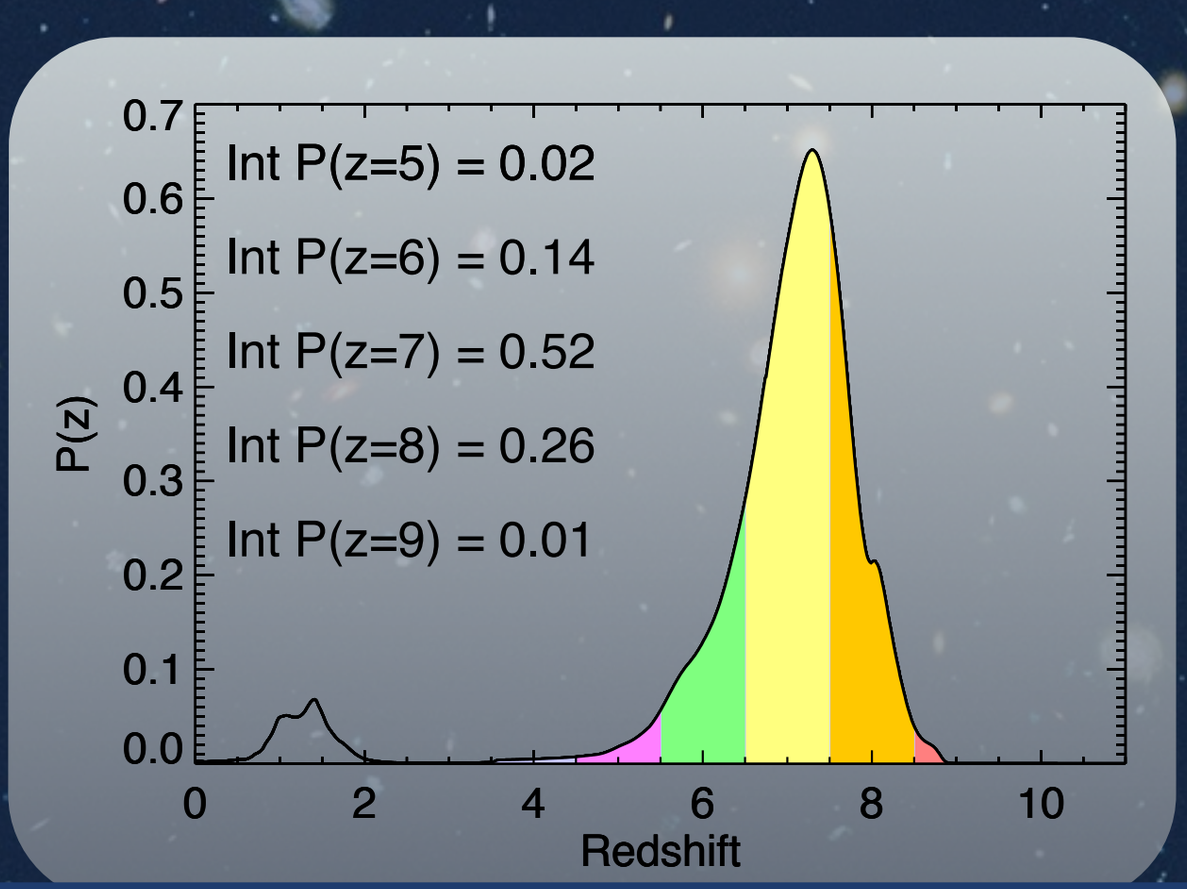
HUDF09/12+
HFFP

GOODS–S Deep
GOODS–S Wide
GOODS–S ERS
GOODS–N Deep
GOODS–N Wide
HUDF Main
HUDF PAR1
HUDF PAR2
MACS0416 PAR
A2744 PAR

SAMPLE SELECTION

Following SF+2010, 2012ab, 2013, 2014

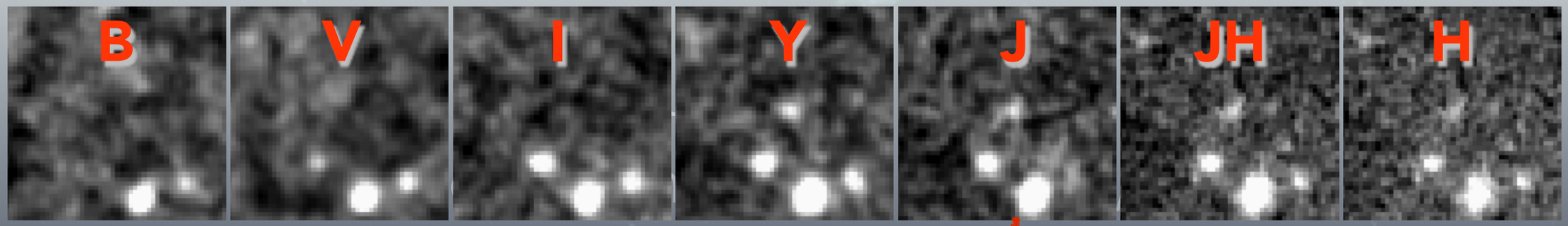
- >3.5σ in J_{125} and H_{160}, or >5σ detection in H_{160} (for z=9,10).
- Satisfy thresholds on P(z) quality.



GALAXY IN THE ABELL 2744 PARALLEL FIELD

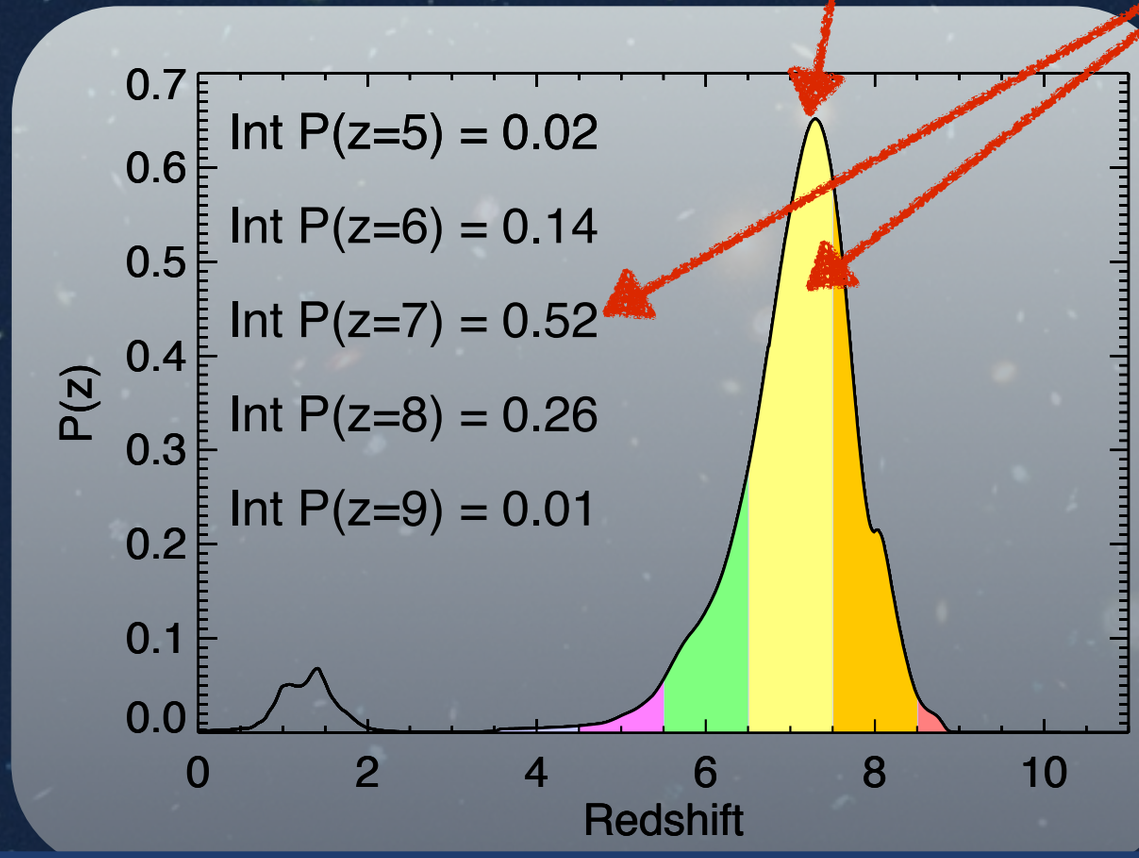
SAMPLE SELECTION

Following SF+2010, 2012ab, 2013, 2014



- Satisfy thresholds on P(z) quality.

This object goes into the z=7 sample.

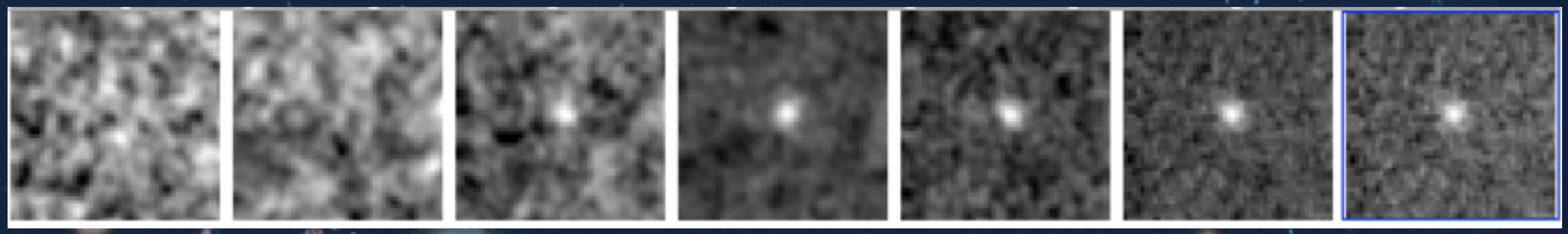


GALAXY IN THE ABELL 2744 PARALLEL FIELD

HFF PARALLEL FIELDS

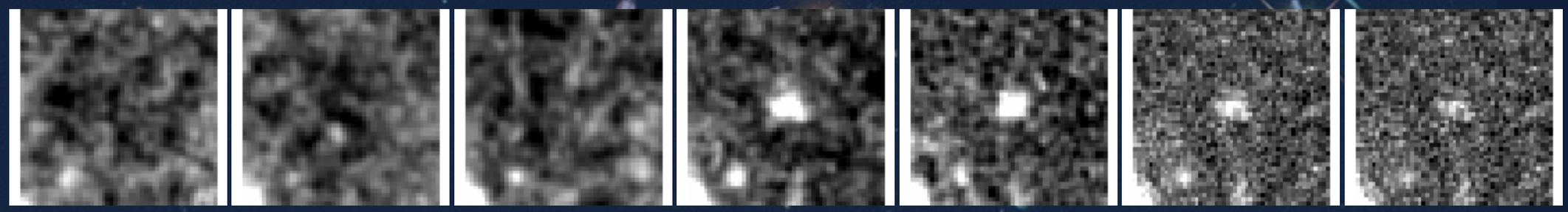
B V I Y J JH H

z=6 Abell 2744

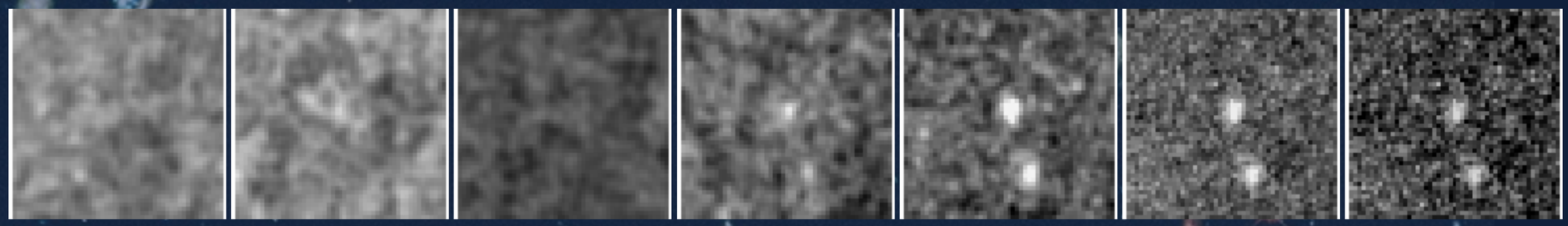


z=7 Abell 2744

z=7 MACS 0416

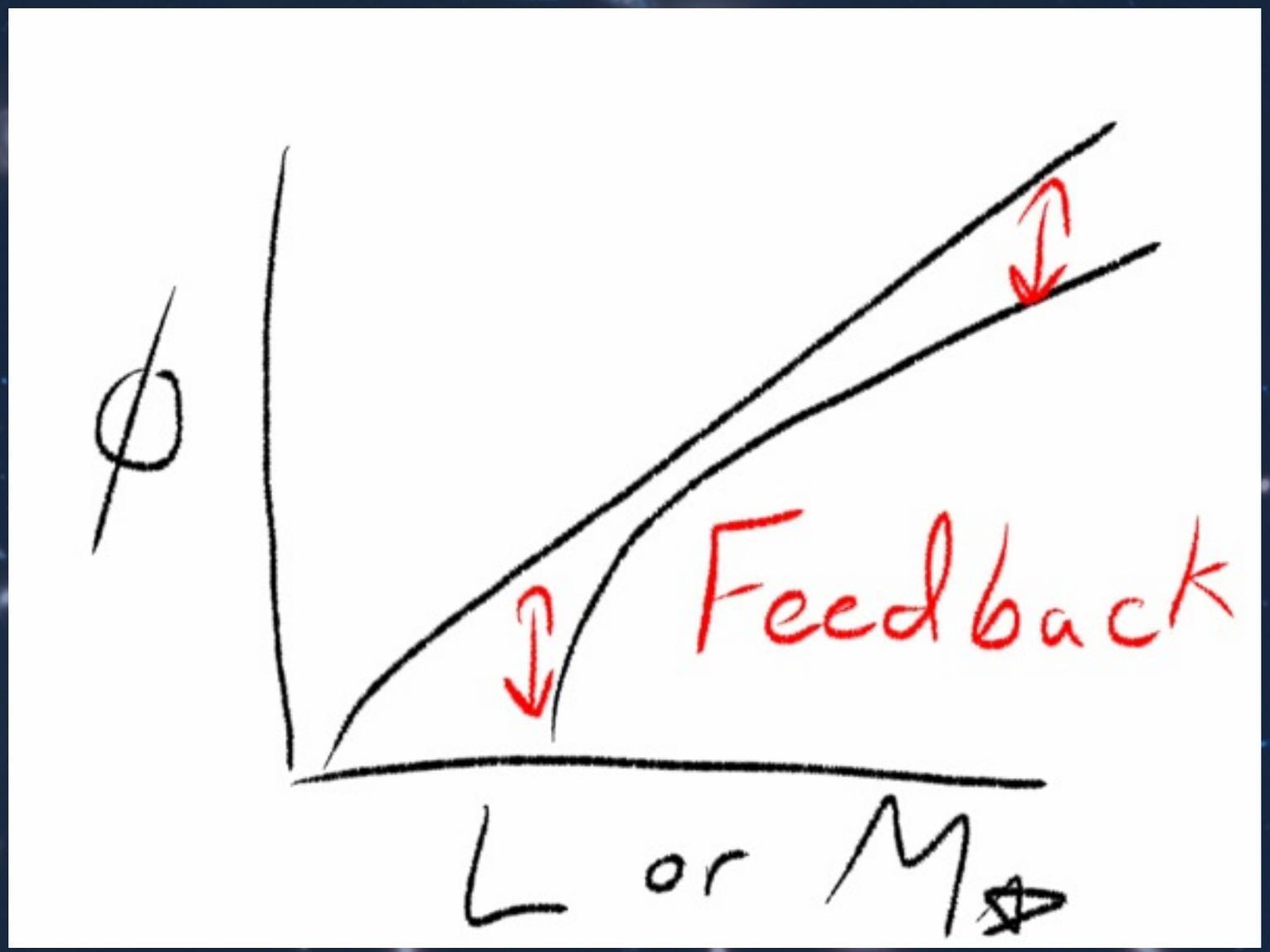


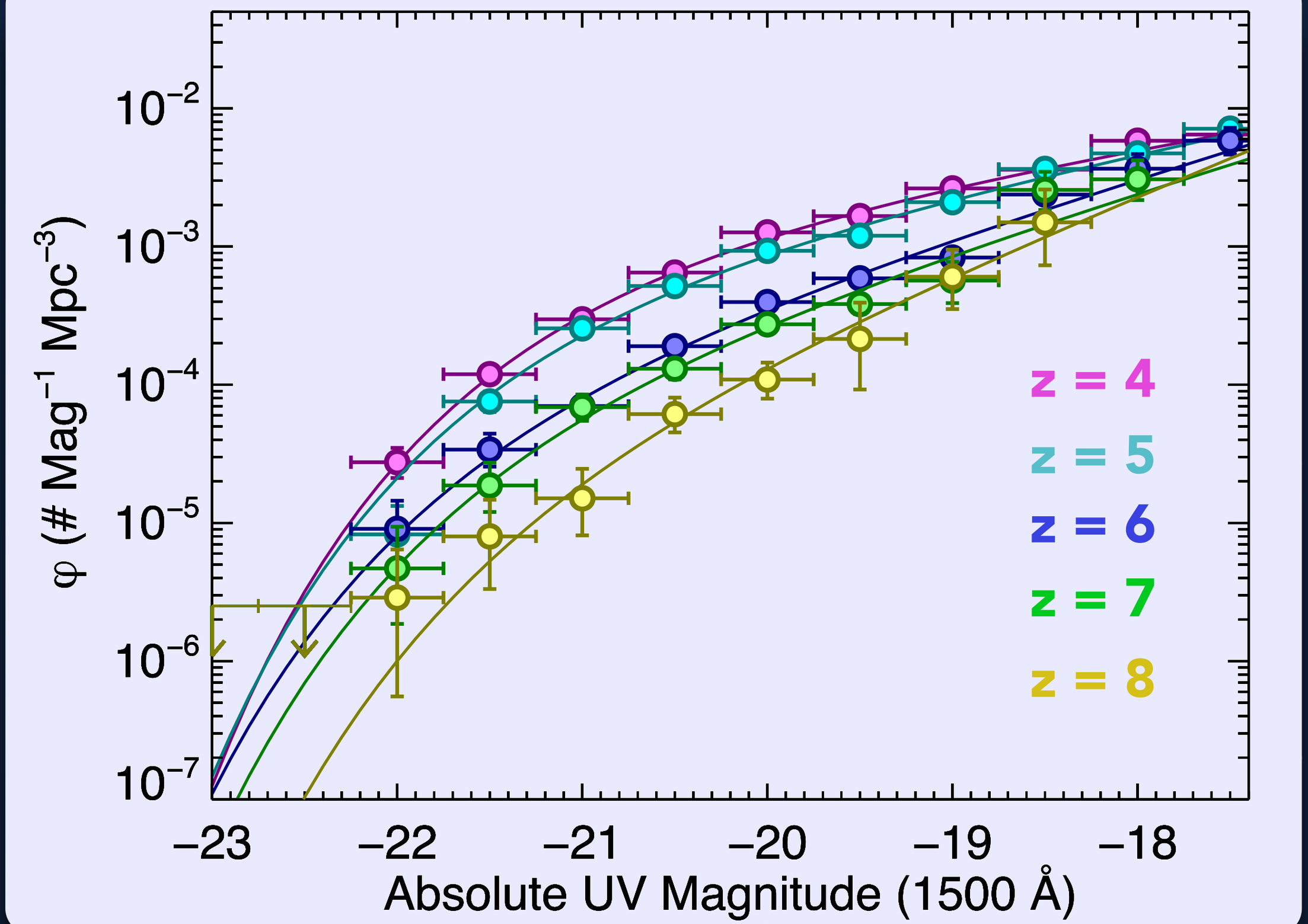
z=8 MACS 0416



THE LUMINOSITY FUNCTION

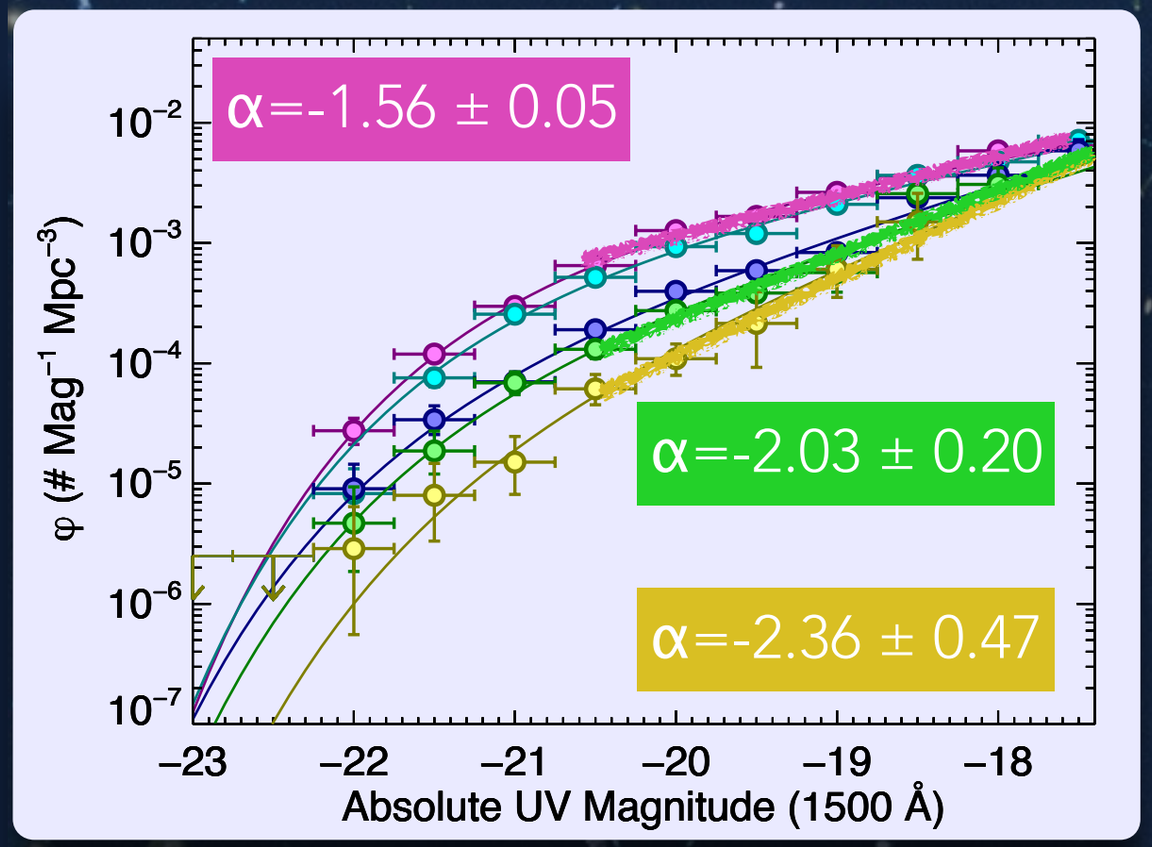
- The distribution of galaxy luminosities is one of the most fundamental measures of galaxy evolution.
  - In the distant universe, we see only the rest-frame UV light, so much work has been done to parametrize the UV luminosity function. It has a characteristic shape.

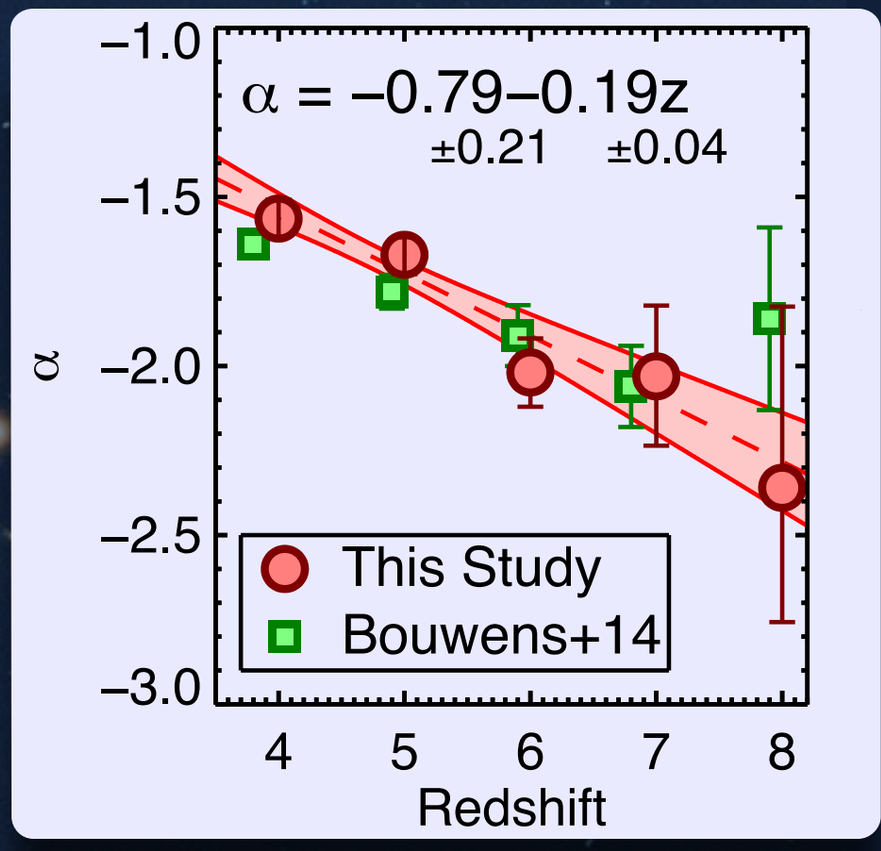



φ (# Mag^{-1} Mpc^{-3})
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
−23
−22
−21
−20
−19
−18
Absolute UV Magnitude (1500 Å)
z = 4
z = 5
z = 6
z = 7
z = 8

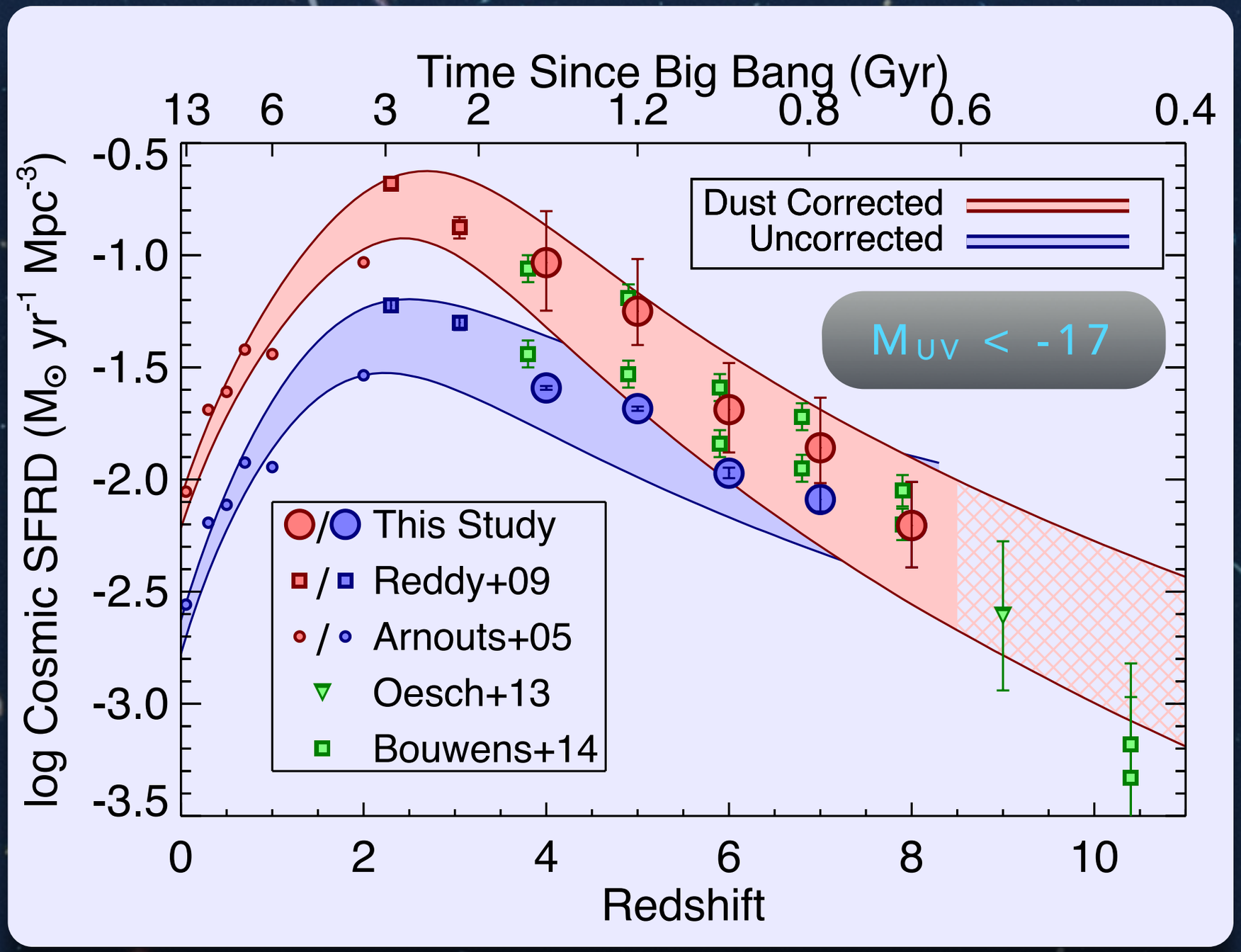
SF+2014

THE FAINT-END SLOPE EVOLVES SIGNIFICANTLY (4σ)





EVOLUTION OF THE COSMIC SFR DENSITY

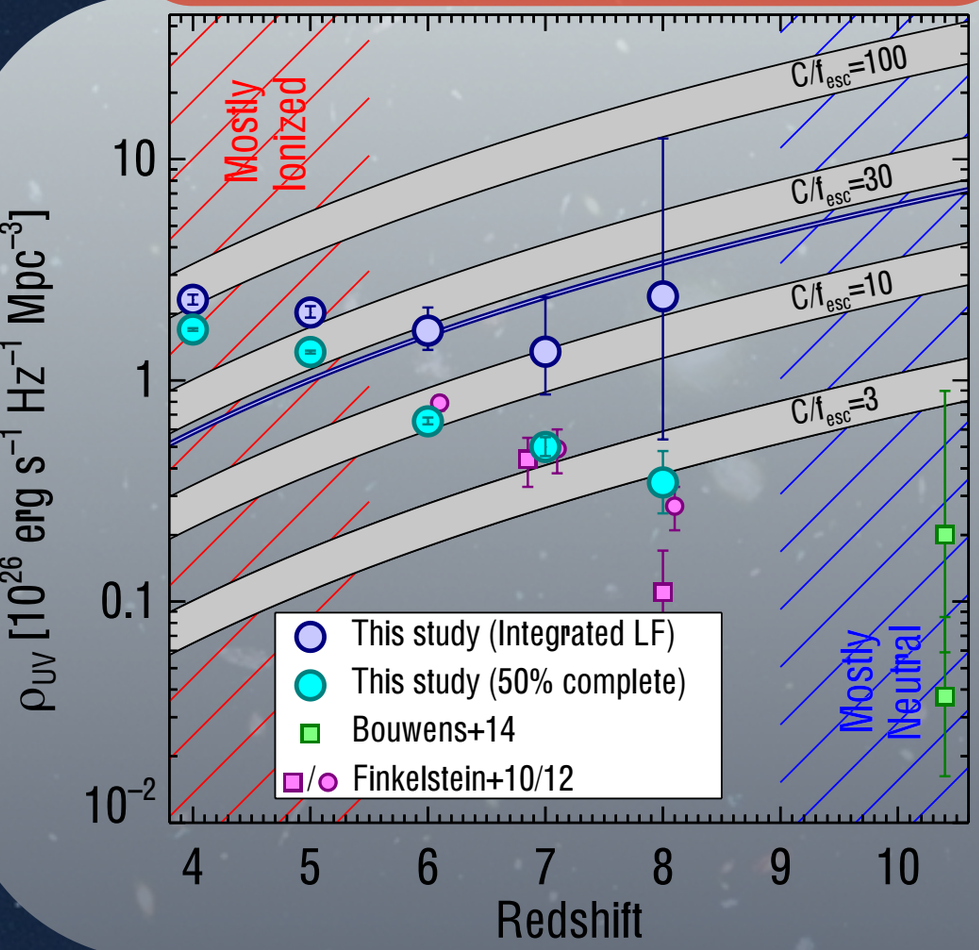


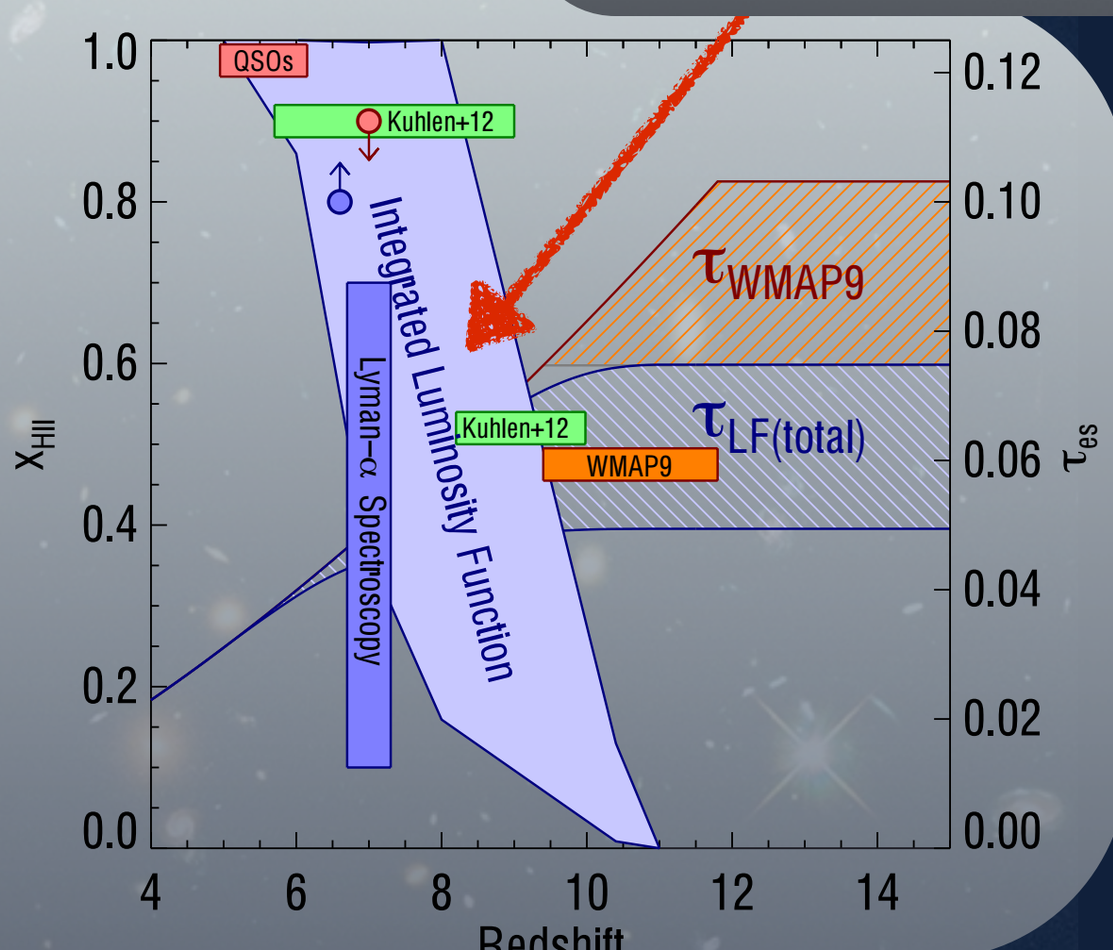
SF+2014

REIONIZATION

C=3, f_{esc}=13% (SF+2012)

UNCERTAINTY IN FAINT-END SLOPE IS STILL DOMINANT





68% confidence statements:

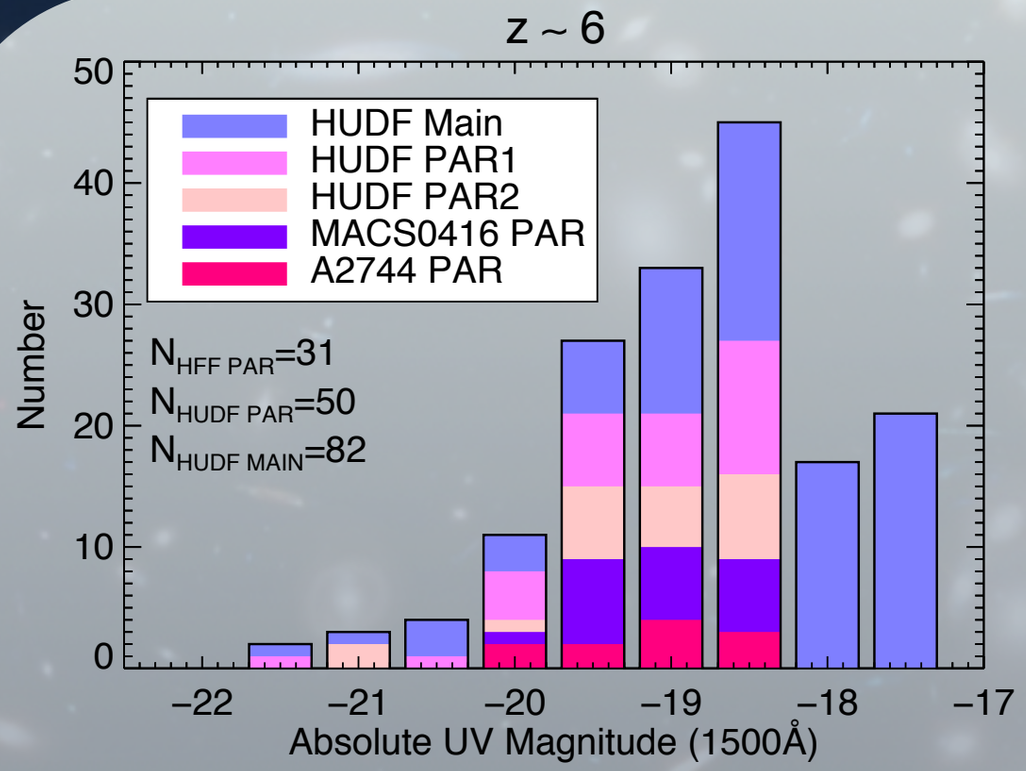
Volume ionized fraction > 90% at z=6

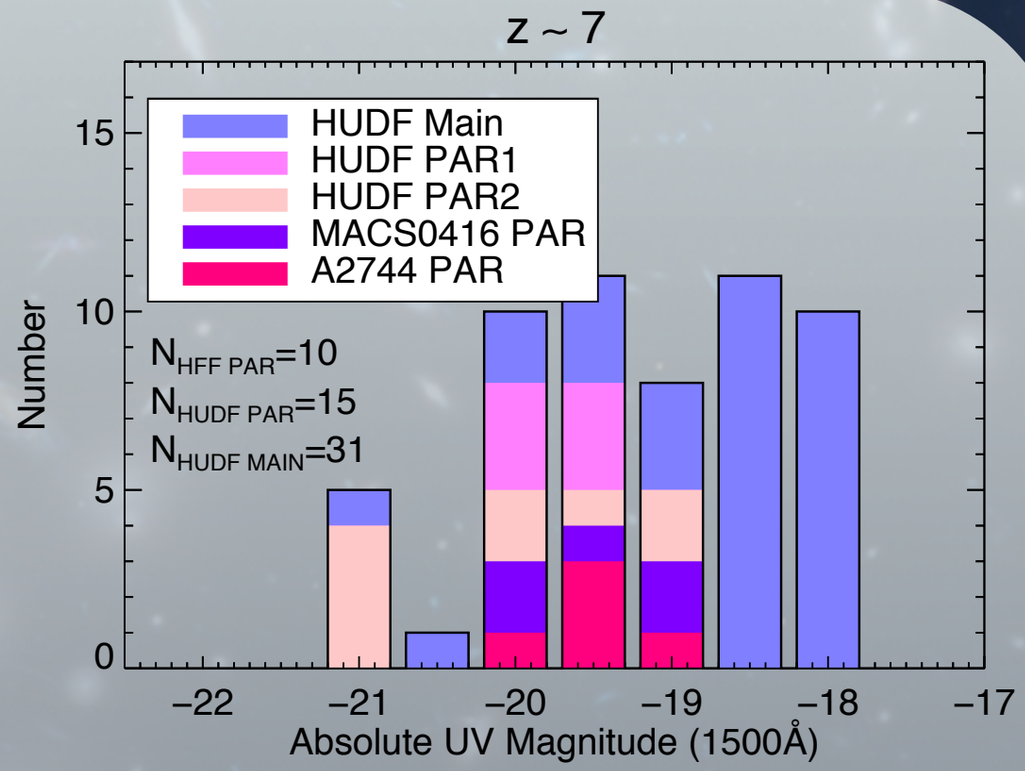
Volume ionized fraction > 20% at z=8

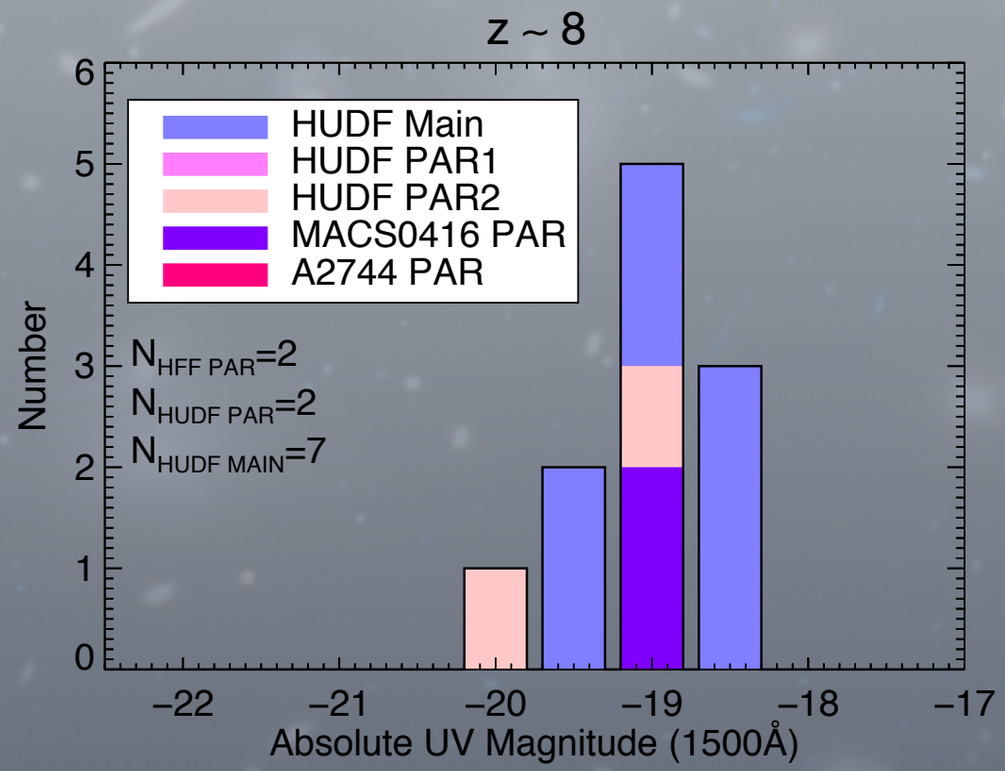
Midpoint of reionization (x_{HII}=0.5) = 6.7 - 9.4

UTILITY OF HFF PARALLEL FIELDS

NUMBERS ABOVE 50% COMPLETENESS LIMIT







Improvement in fractional error on **α**:

z=6: 5.2%

z=7: 10.2%

z=8: 20.7%

CONCLUSIONS

- Combining wide-area shallower data with deep programs is the best way to constrain the full shape of the luminosity function.
- The faint-end slope steepens with increasing redshift, from -1.5 at z=4, to -2 at z=7 (and possibly beyond at z=8).
- This provides a scenario for reionization which begins at z~10, completes at z~6, and has a midpoint at $6.7 < z < 9.4$.
    - Uncertainties are still high.
- The HFF parallel fields significantly add to constraints on alpha, and the full set of six fields will be valuable.