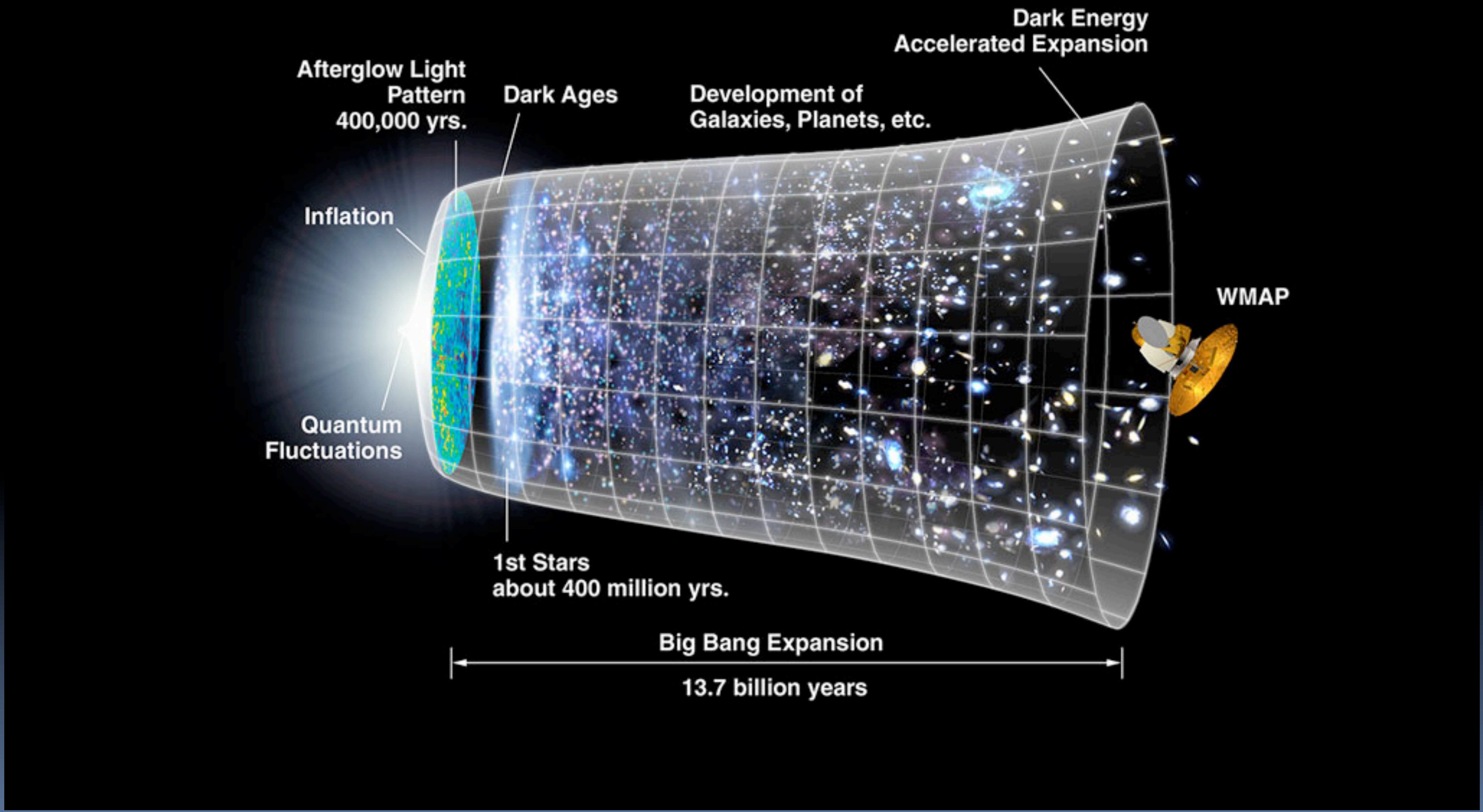
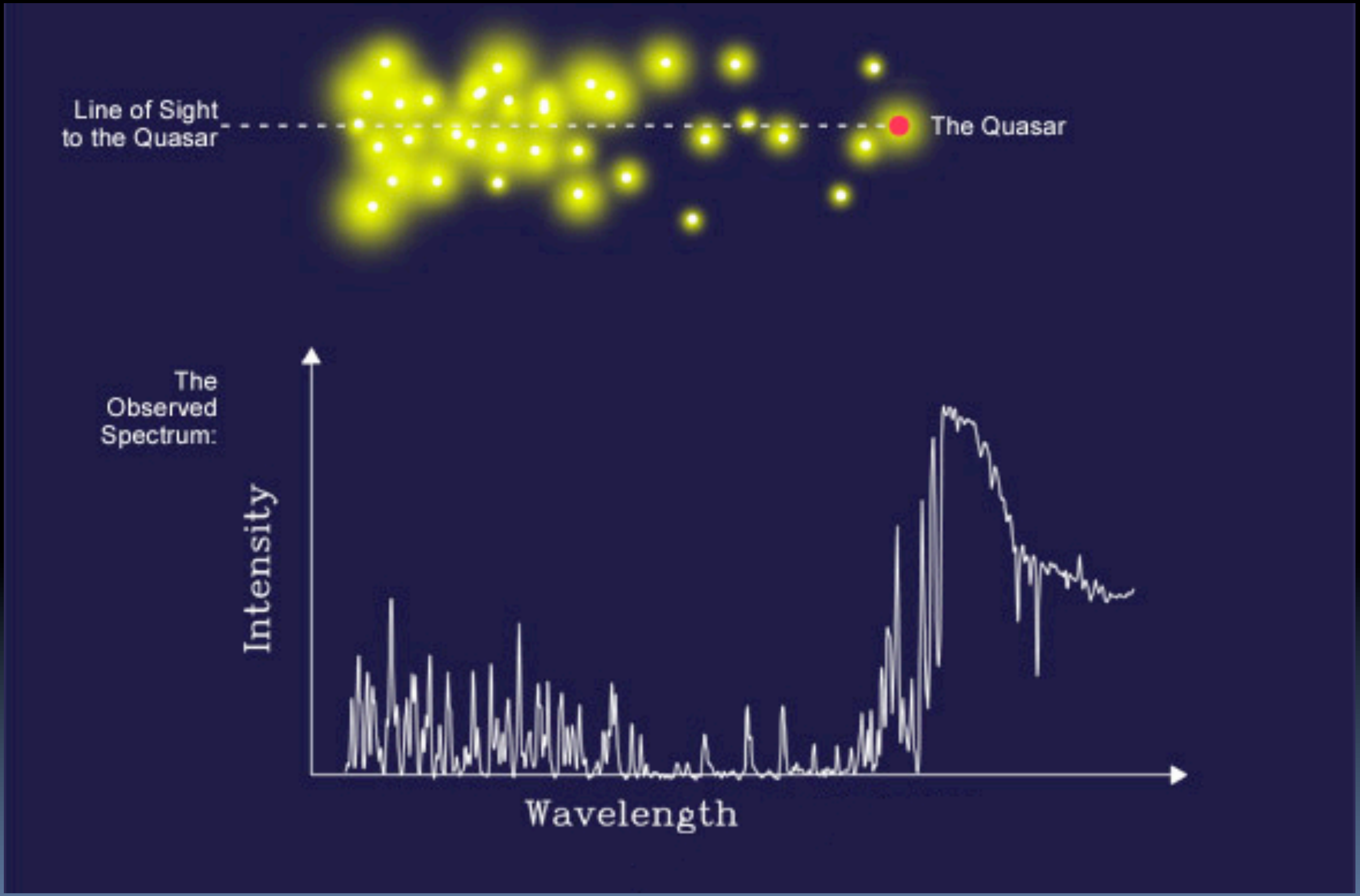
STAR-FORMING GALAXIES AT Z≈8-9 FROM *HST*/WFC3: IMPLICATIONS FOR REIONIZATION

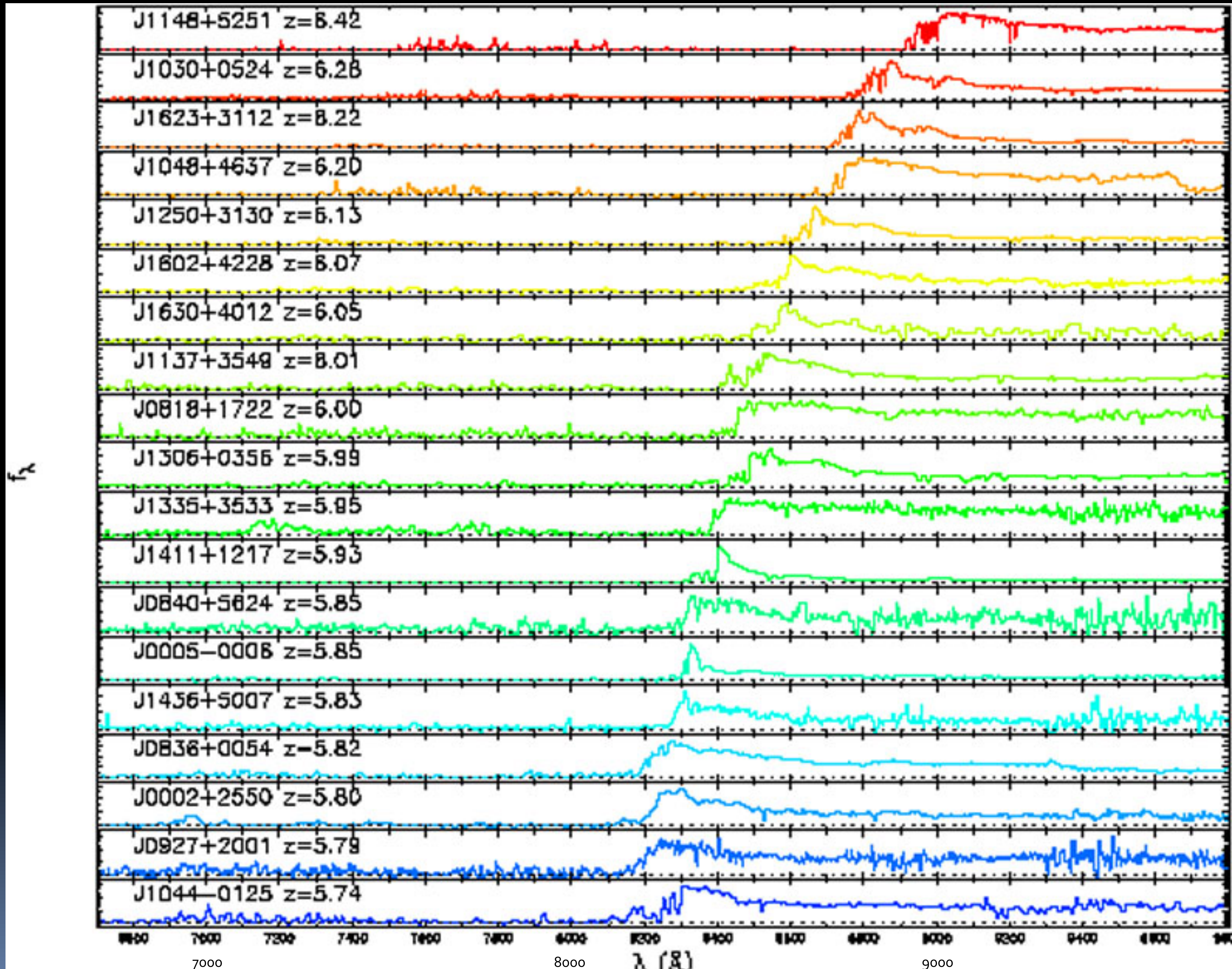
Silvio Lorenzoni, Andy Bunker, Stephen Wilkins, Joseph Caruana

Reionization



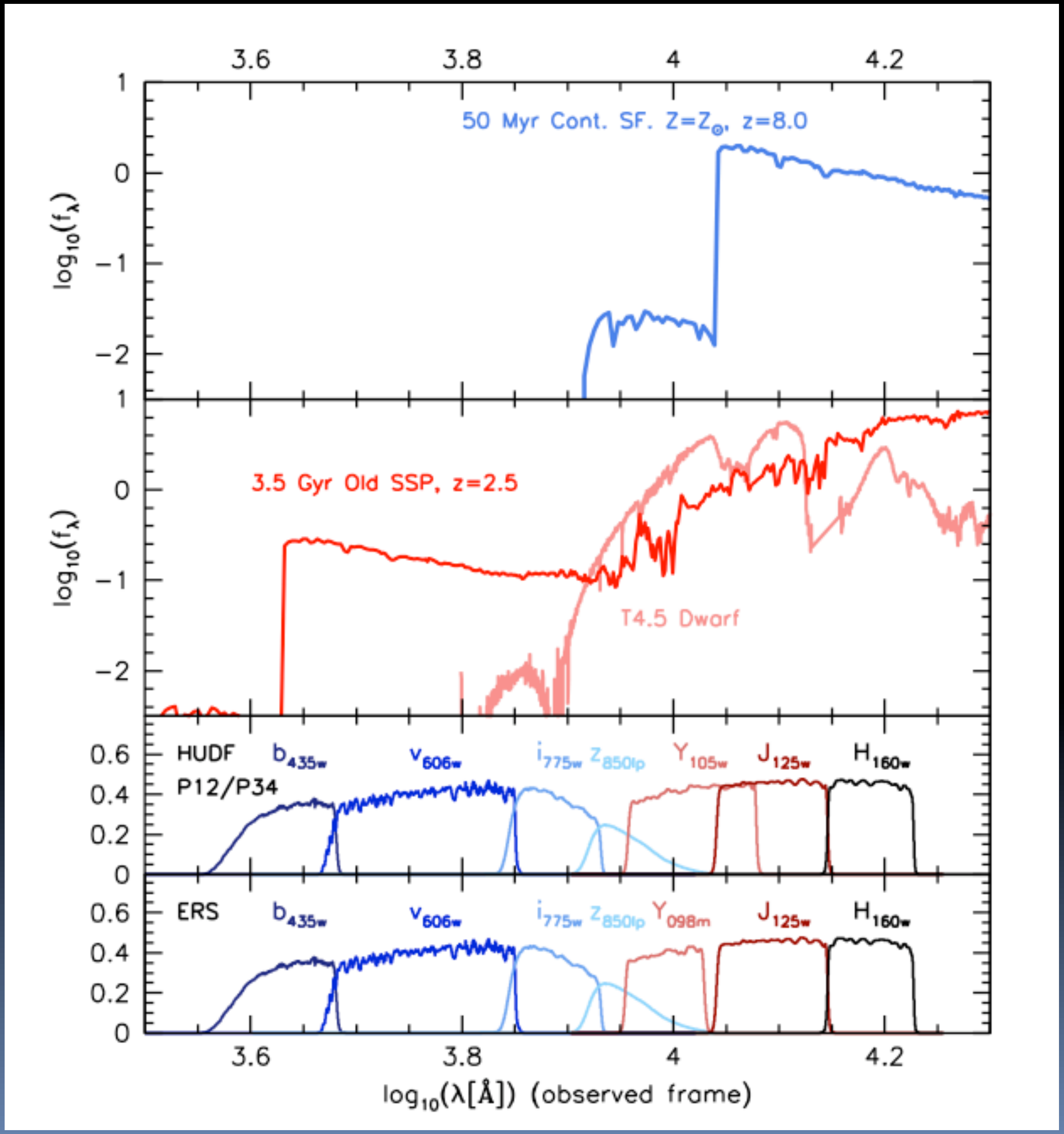
Gunn-Peterson effect





Fan et al. (2006), AJ 132 117

Lyman break technique



Data

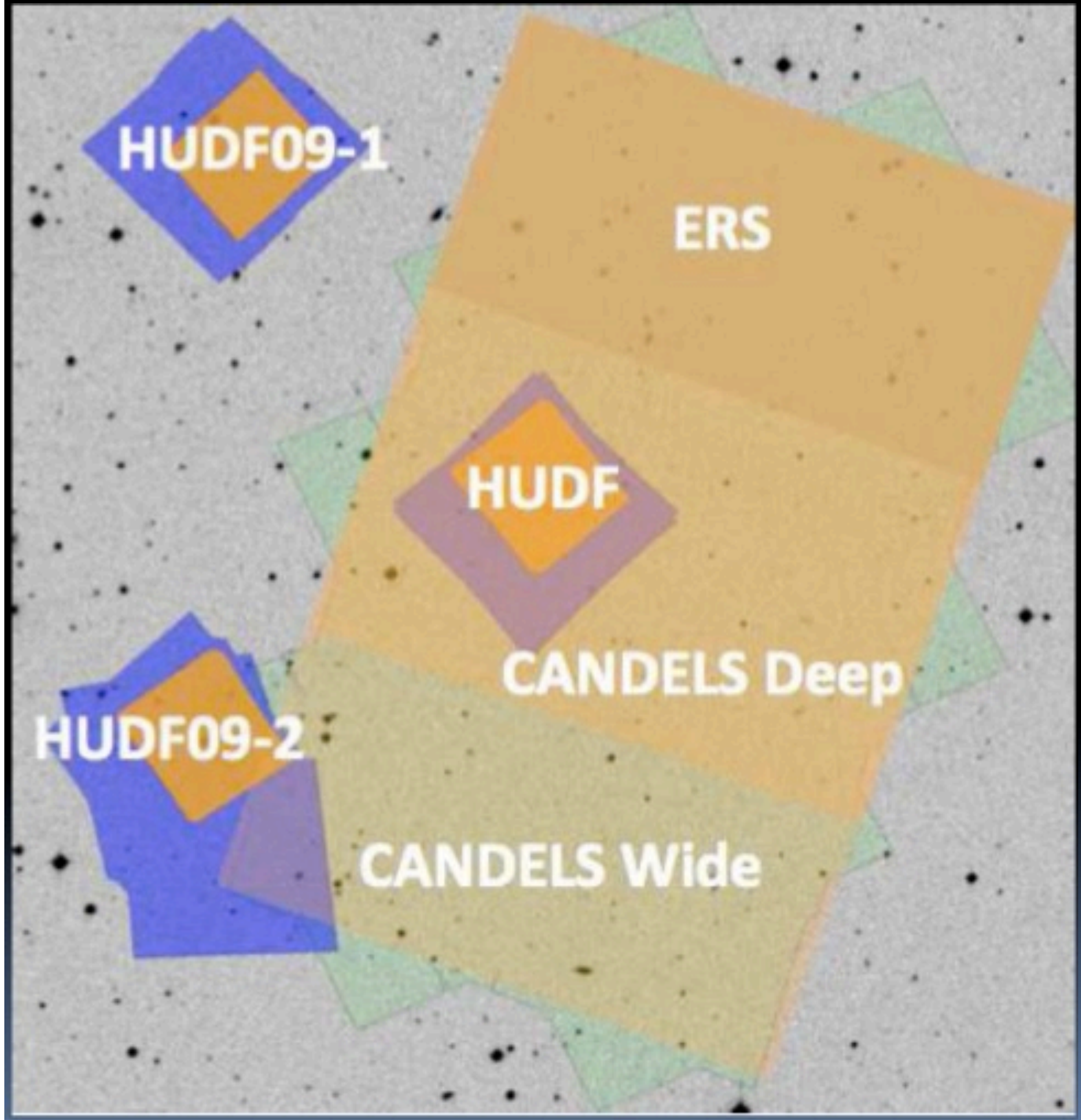


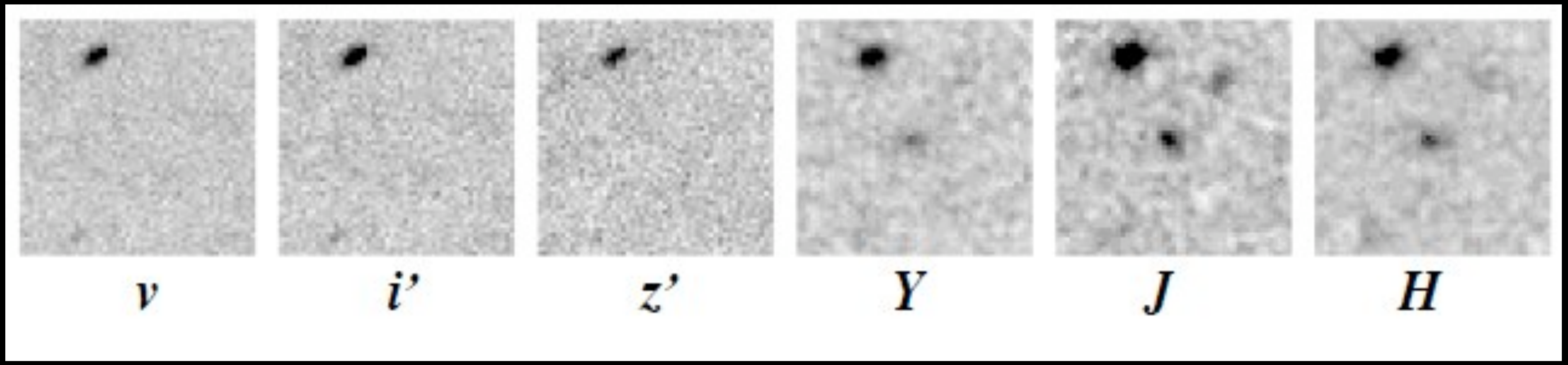
figure from Oesch et al. (2011), arXiv:1105.2297

exposure times in ksec

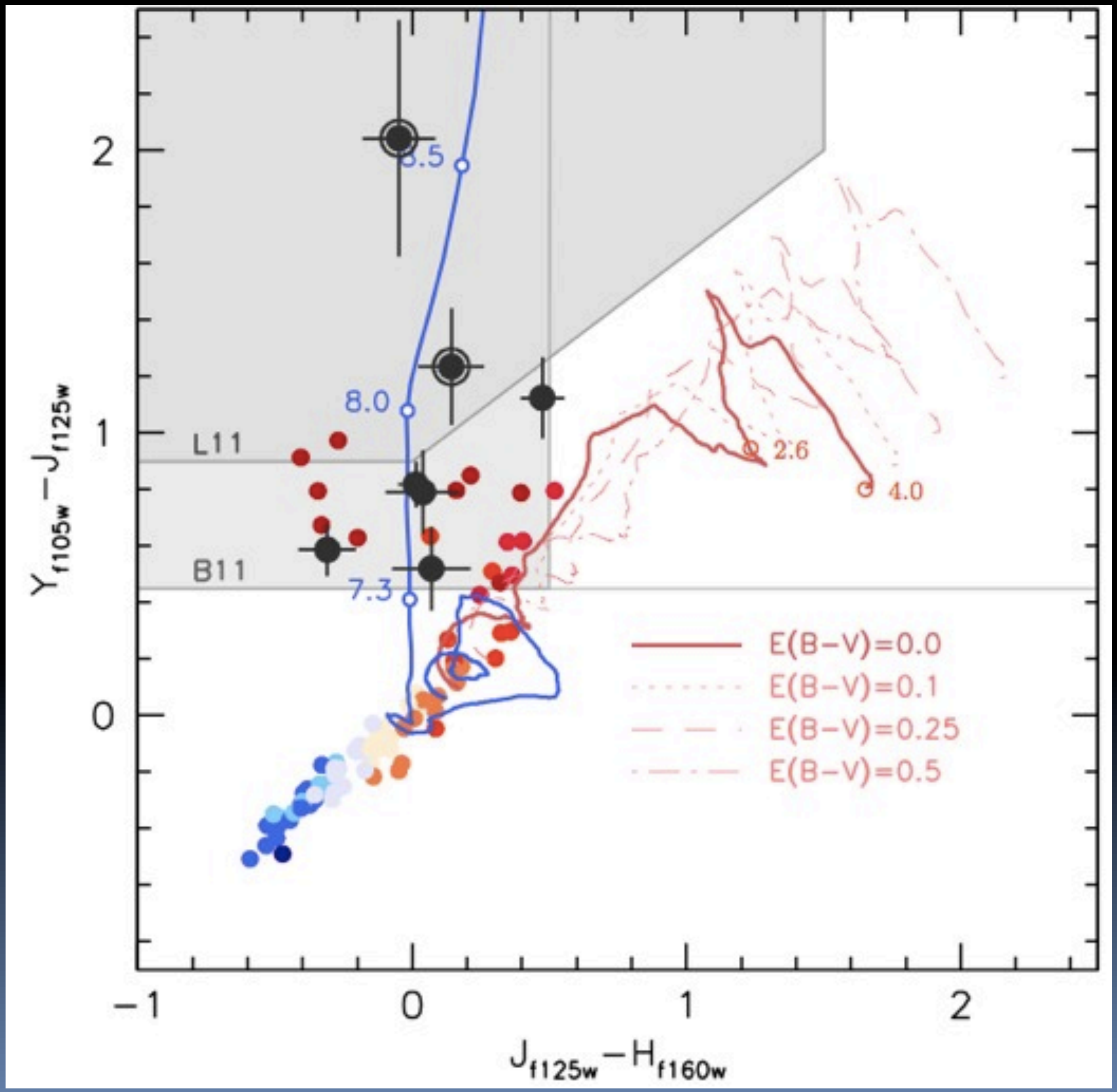
	Y-band	*J*-band	*H*-band
HUDF	28.1	44.8	75.8
HUDF09-2	28.1	39.3	47.7
HUDF09-1	16.8	33.7	5.6
ERS	2.6	2.6	2.6
CANDELS wide	2.7	2.1	2.1
CANDELS deep	8.1	7.4	7.7

(in case you didn't notice, it's over)

Candidates



Selection criteria

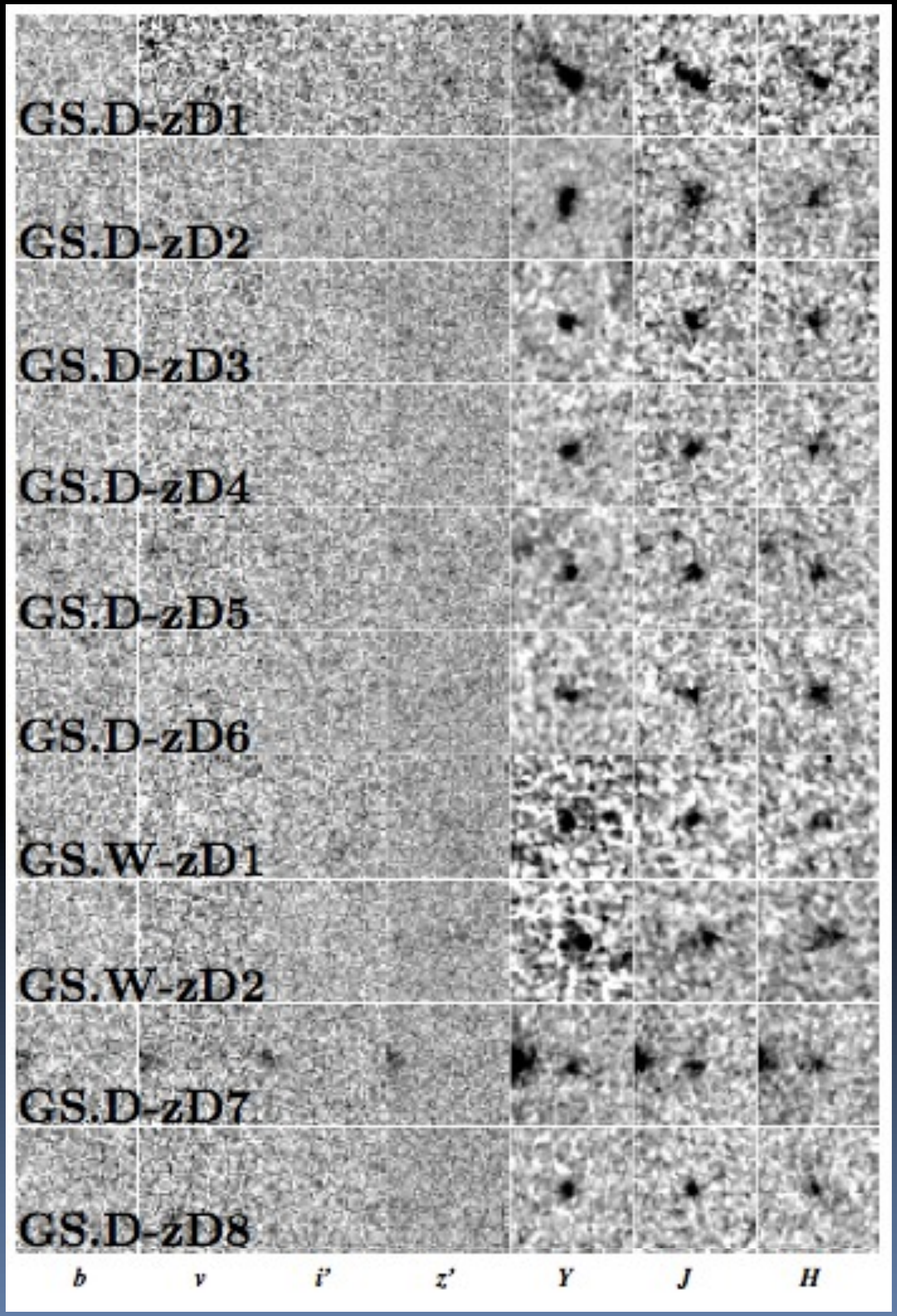


- >5σ detection in two bands longwards of the break
- <2σ non-detection in optic
- colour criteria

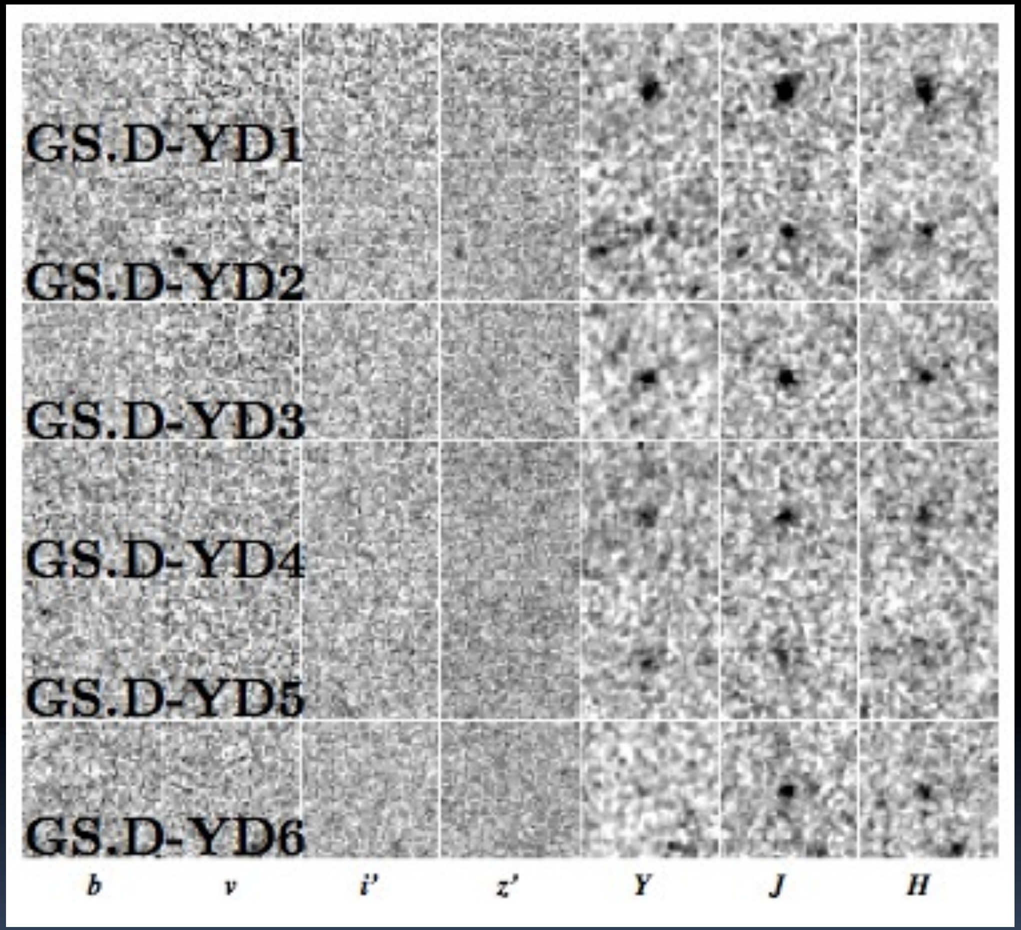
(in case you didn't notice, it's over)

CANDELS candidates

z'-drops



Y-drops



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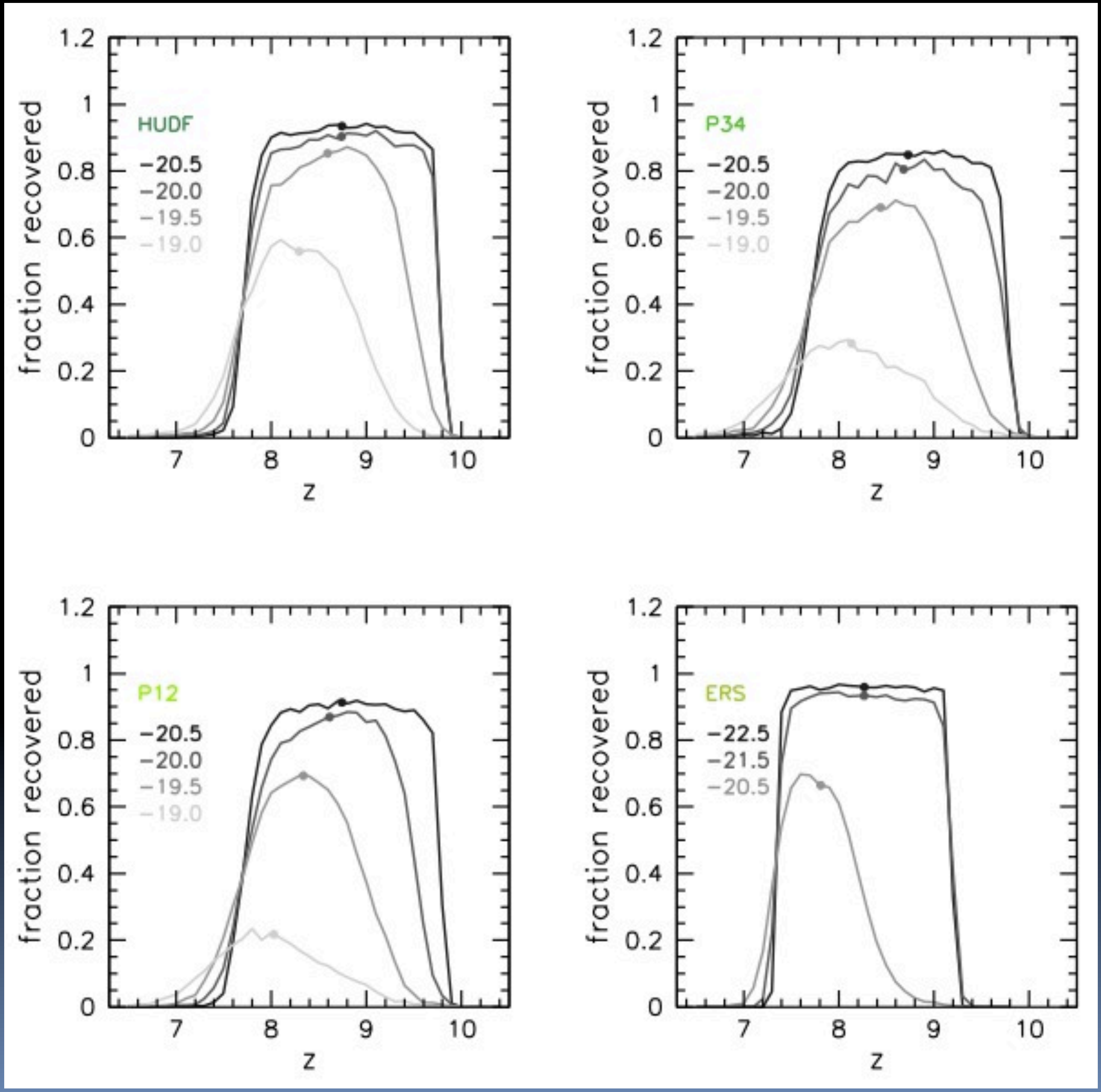

HUDF
−20.5
−20.0
−19.5
−19.0
P34
−20.5
−20.0
−19.5
−19.0
P12
−20.5
−20.0
−19.5
−19.0
ERS
−22.5
−21.5
−20.5
fraction recovered
z

Luminosity functions

$$\phi(L)dL = \phi^* \left(\frac{L}{L^*}\right)^\alpha e^{(-L/L^*)}\, d(L/L^*)$$

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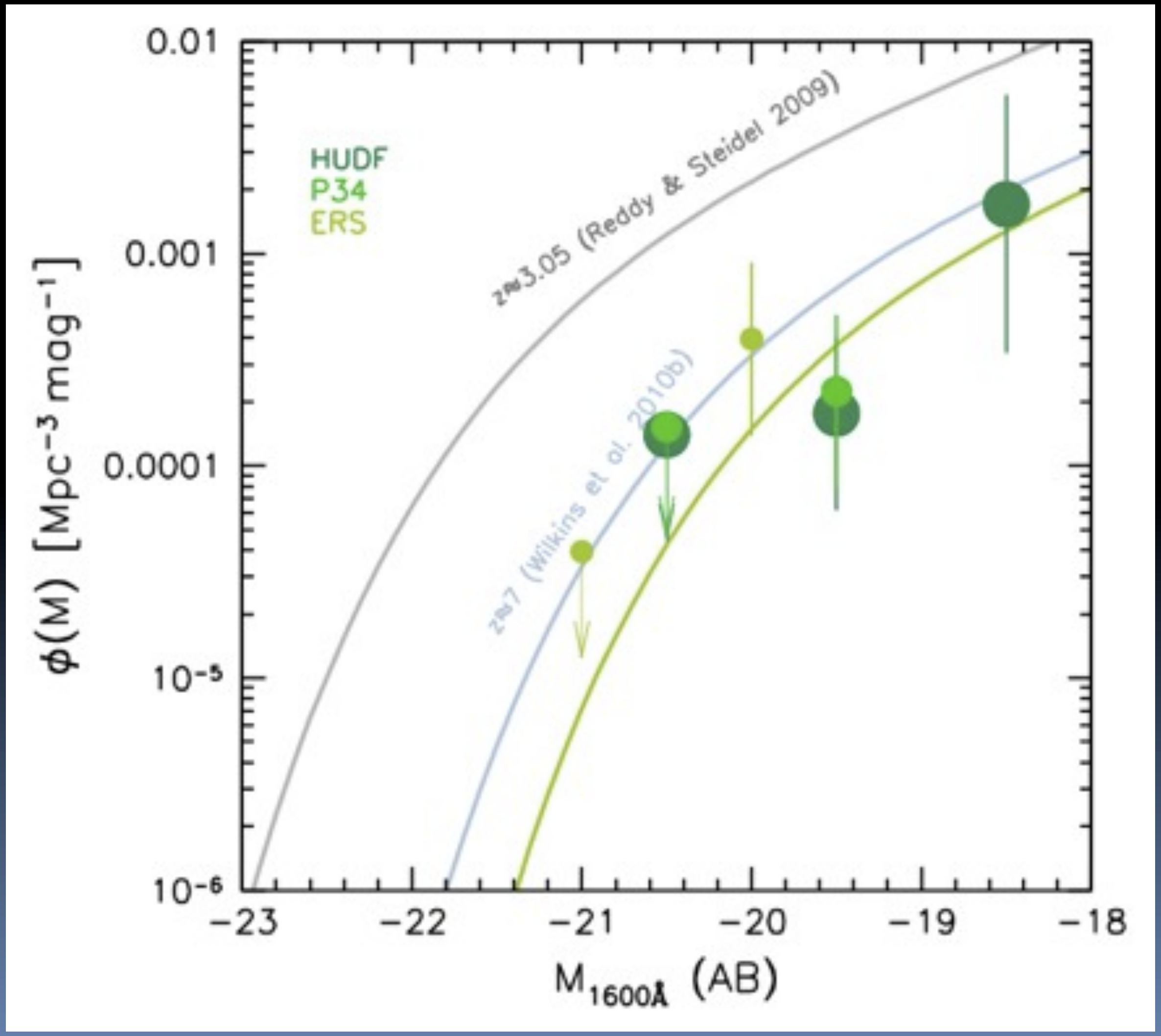
Luminosity functions

$$\phi(L)dL = \phi^* \left(\frac{L}{L^*}\right)^{\alpha} e^{(-L/L^*)}\, d(L/L^*)$$



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Luminosity functions

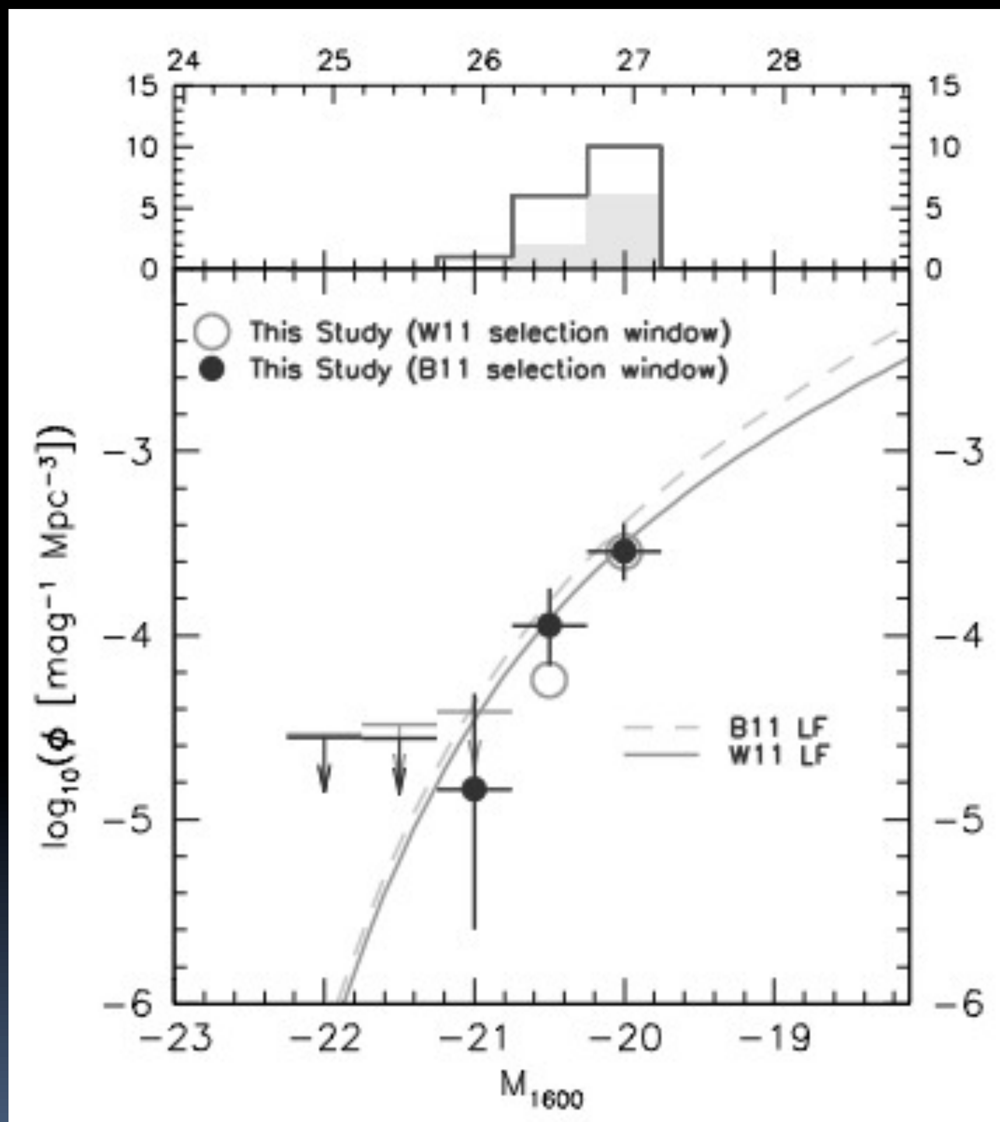
$$\phi(L)dL = \phi^* \left(\frac{L}{L^*}\right)^\alpha e^{(-L/L^*)} d(L/L^*)$$

$$\phi(M)dM = (0.4\, ln10)\, \phi^*\, 10^{0.4(\alpha+1)(M^*-M)}\, e^{-10^{0.4(M^*-M)}} dM$$

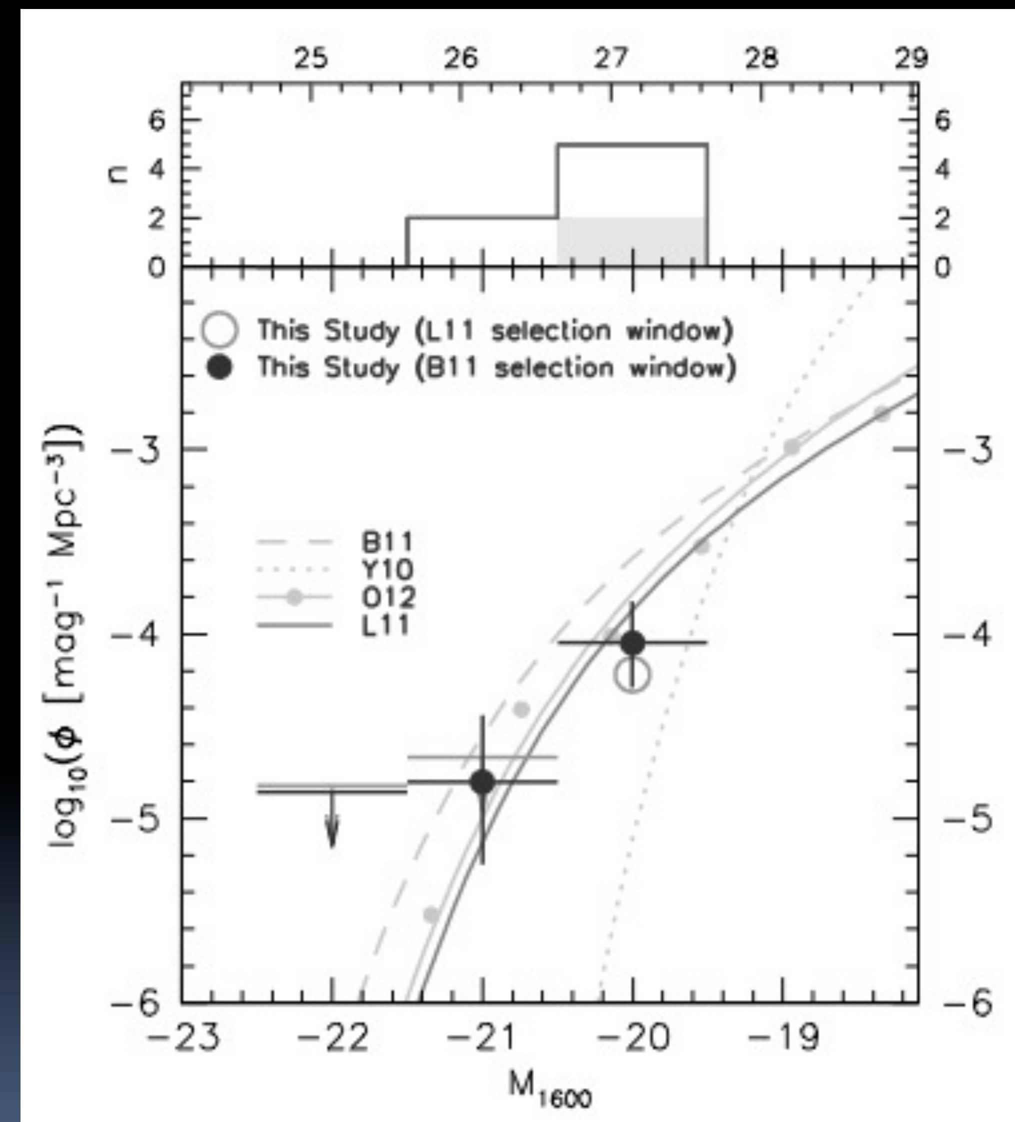
(in case you didn't notice, it's over)

Luminosity functions

z ~ 7



z ~ 8



(in case you didn't notice, it's over)

Luminosity functions

z ~ 7

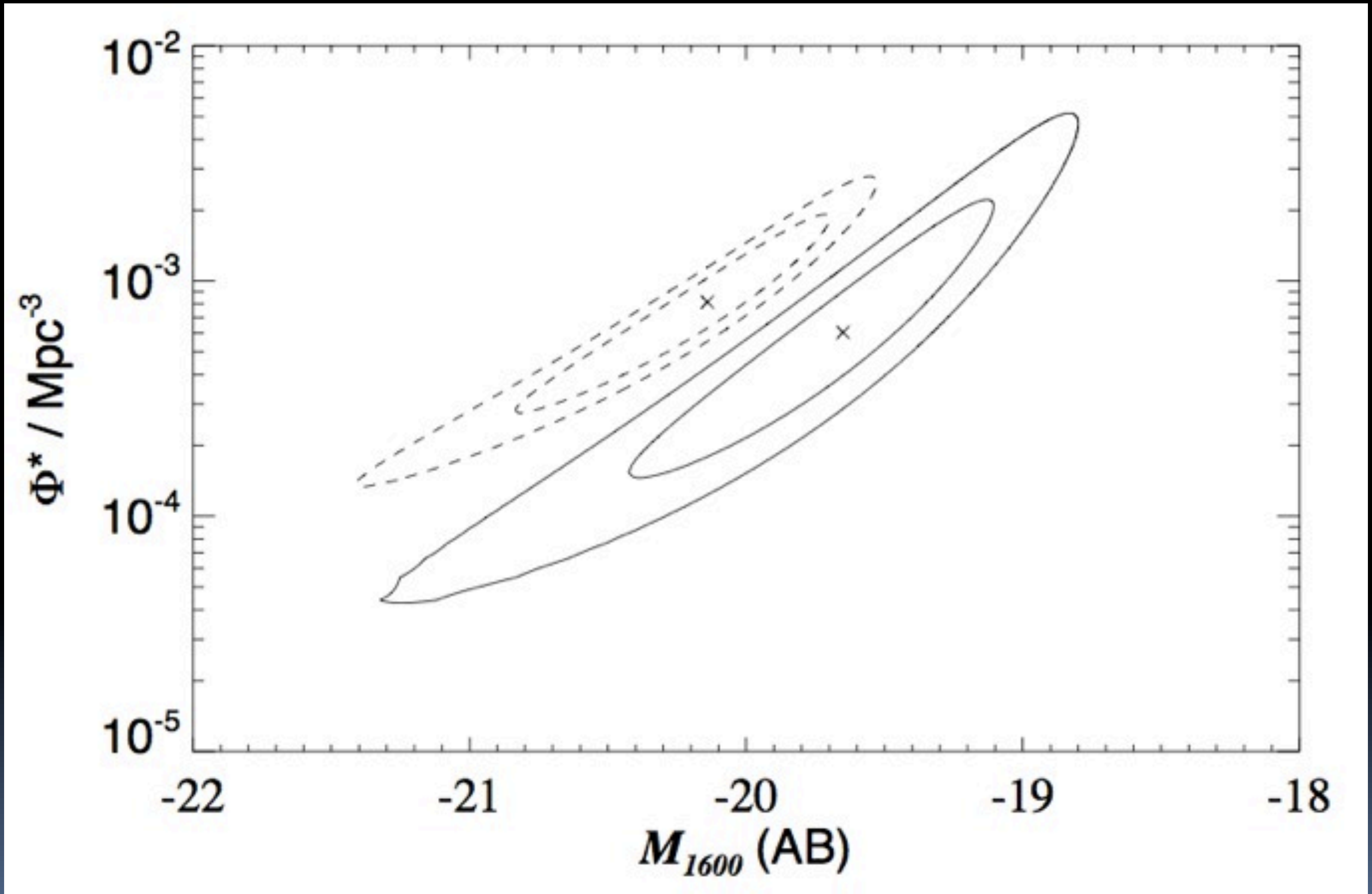
α	M* [AB mag]	ϕ* [Mpc−3]
-1.5	-19.75	0.00159
-1.7	-19.93	0.00119
-1.9	-20.14	0.00081
-2.1	-20.40	0.00049

z ~ 8

α	M* [AB mag]	ϕ* [Mpc−3]
-1.5	-19.42	0.00088
-1.7	-19.53	0.00075
-1.9	-19.66	0.00060
-2.1	-19.80	0.00046

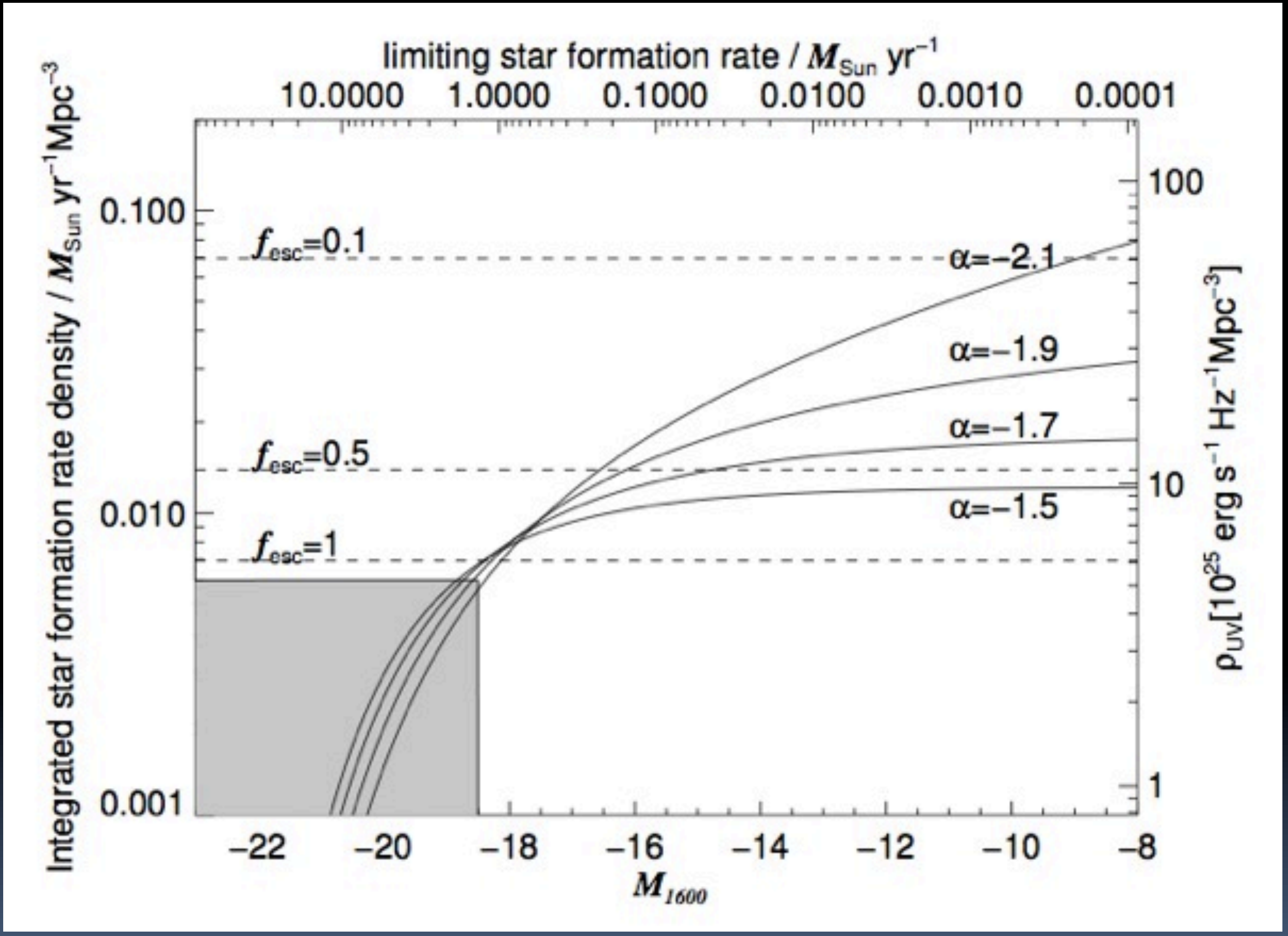
(in case you didn't notice, it's over)

LF evolution



(in case you didn't notice, it's over)

Implications for reionization



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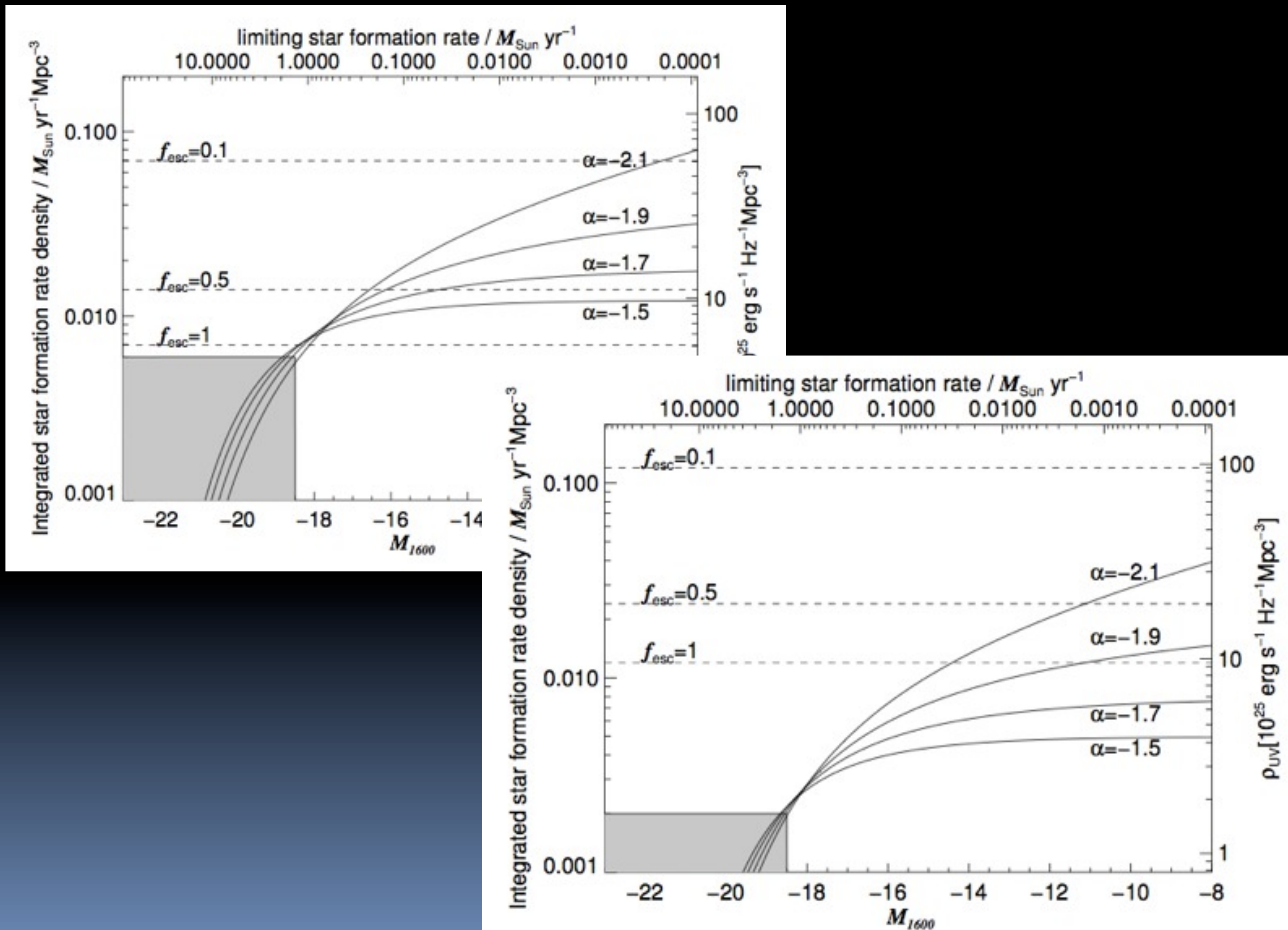
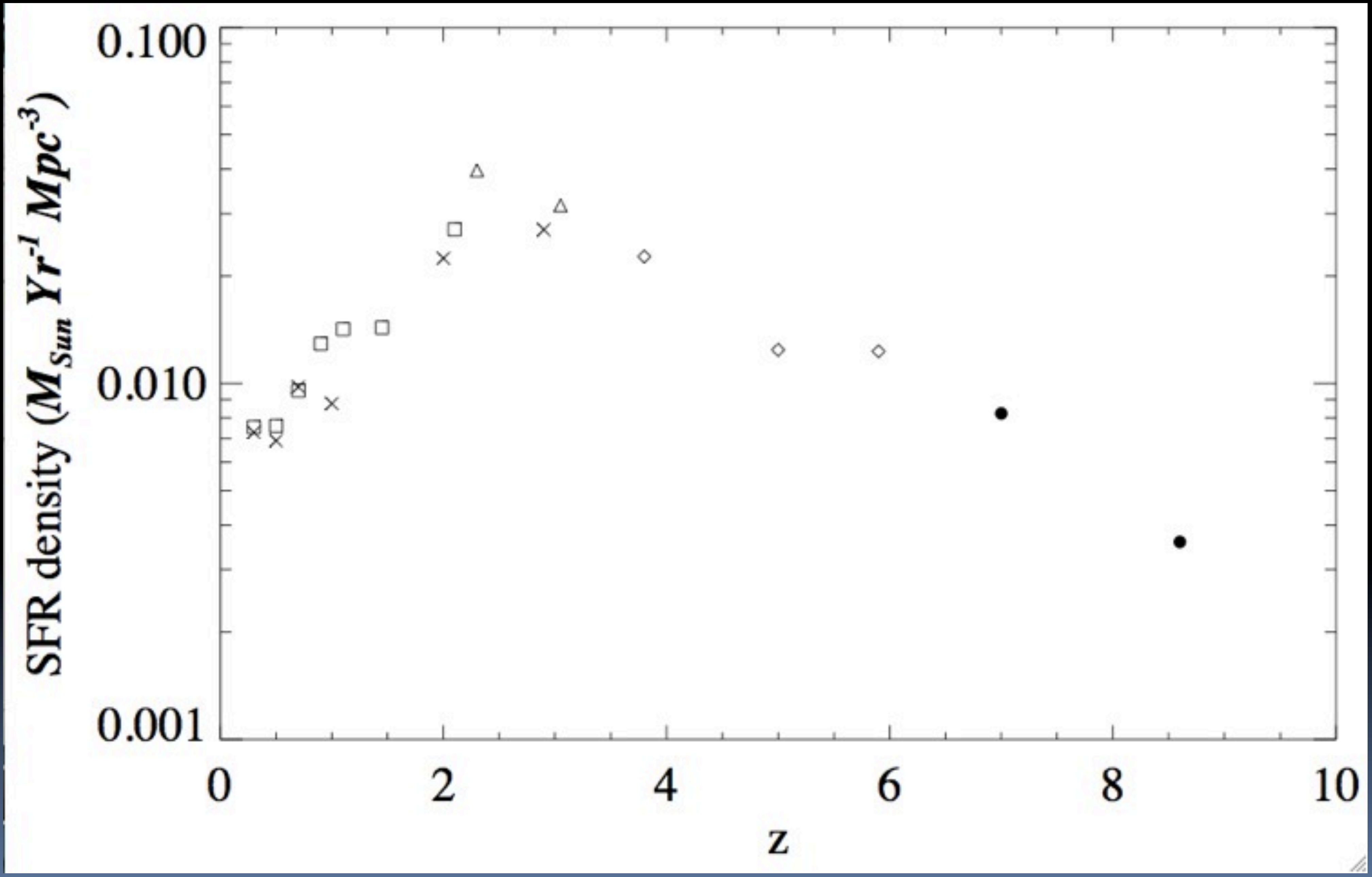
Implications for reionization



SFR density evolution with redshift



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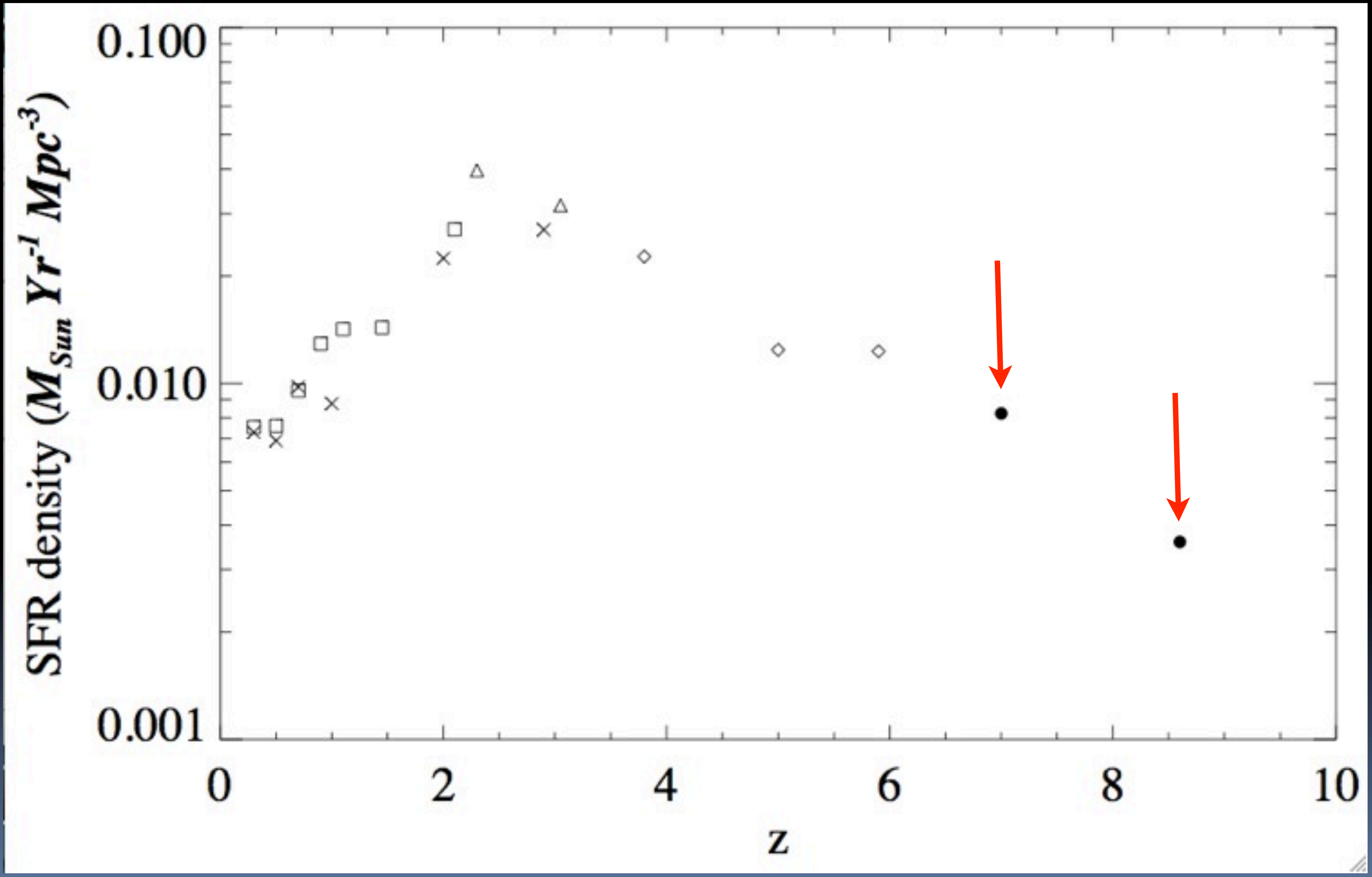
SFR density evolution with redshift



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Conclusions

LF evolution:

clear from z=3

evidence for evolution from z=6-7 to z=8-9

both in phi and M*

not enough data to constrain faint end slope.

Reionization:

candidates we detect have insufficient flux for reionization, but a steep faint end slope, low metallicity population and a top heavy IMF could all be factors that might provide enough ionizing photons

Conclusions

Text

(in case you didn't notice, it's over)

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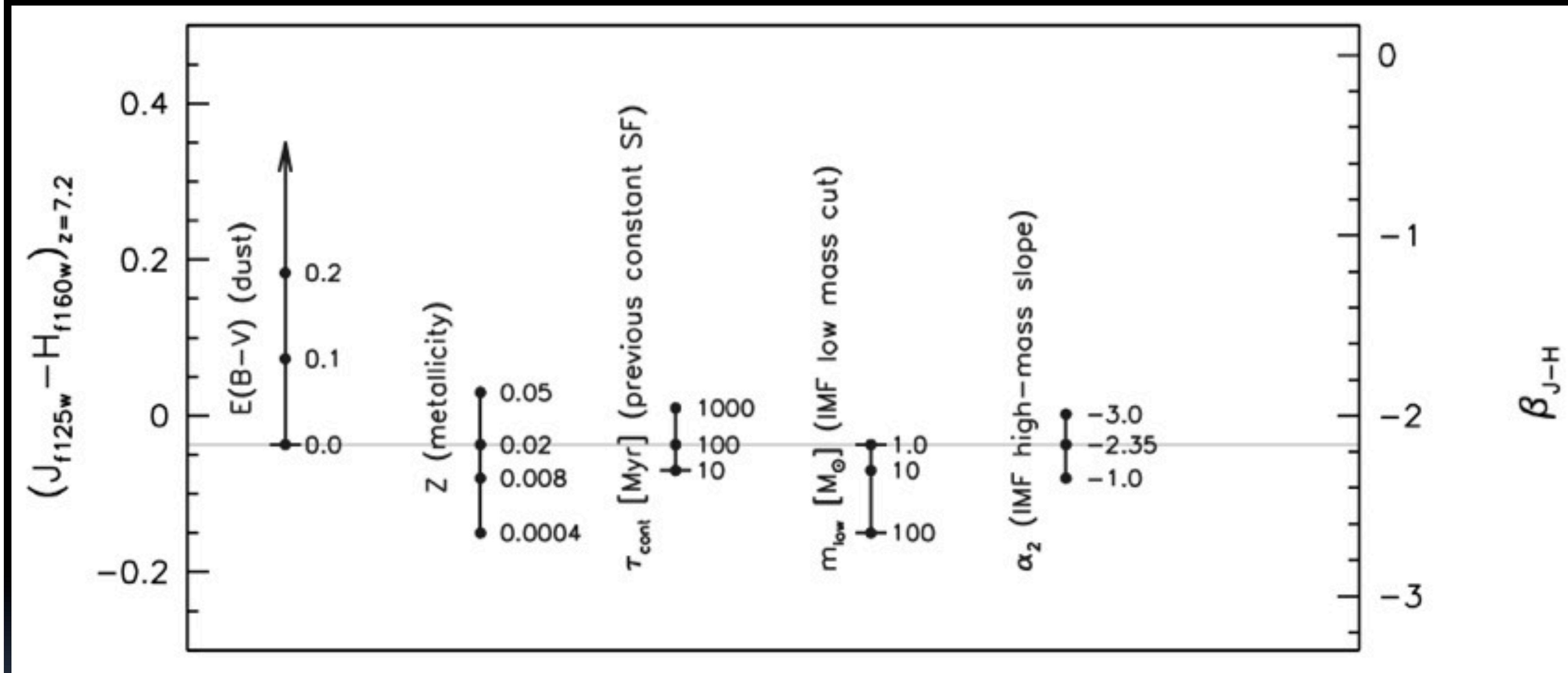

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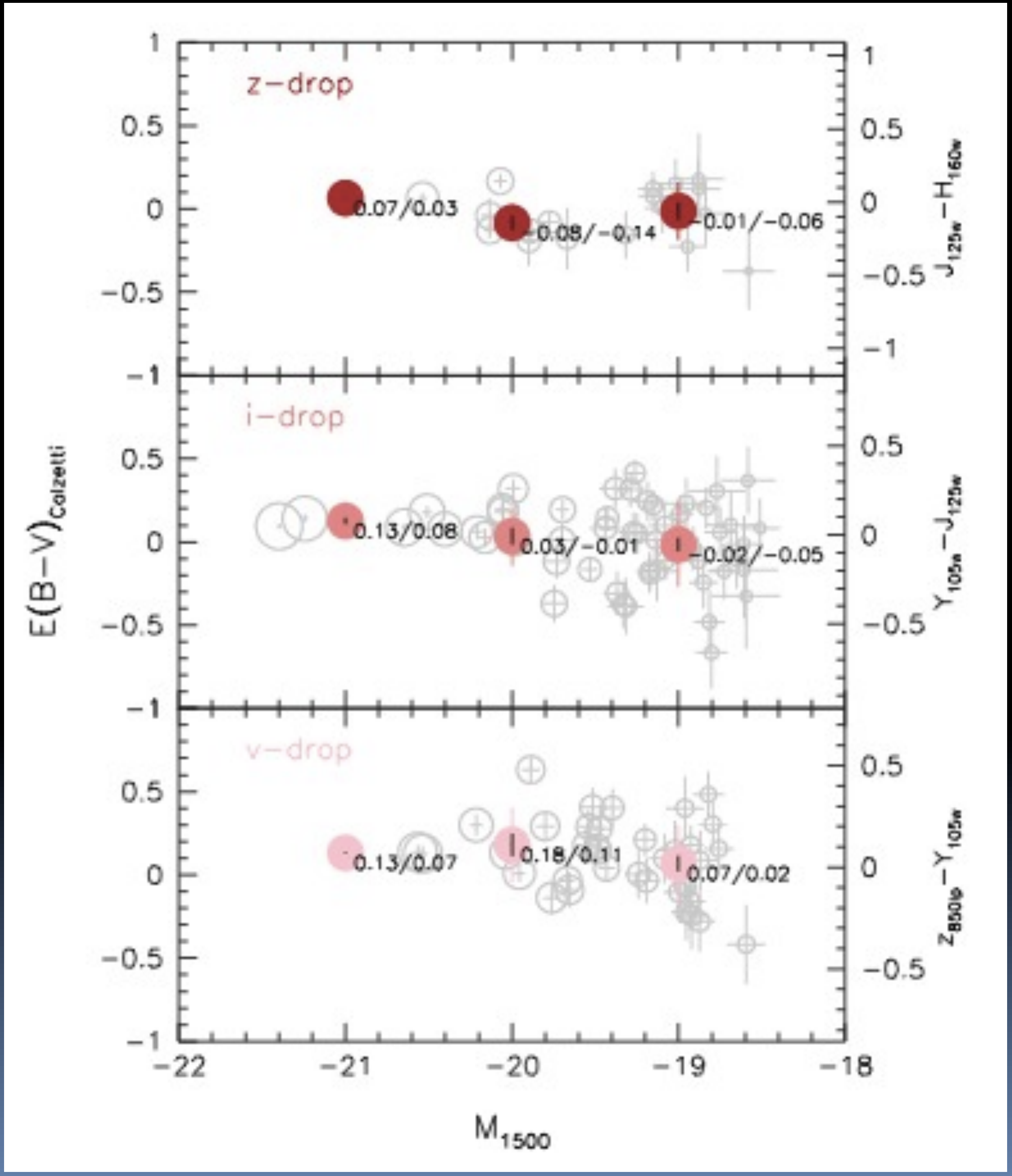
Luminosity dependence



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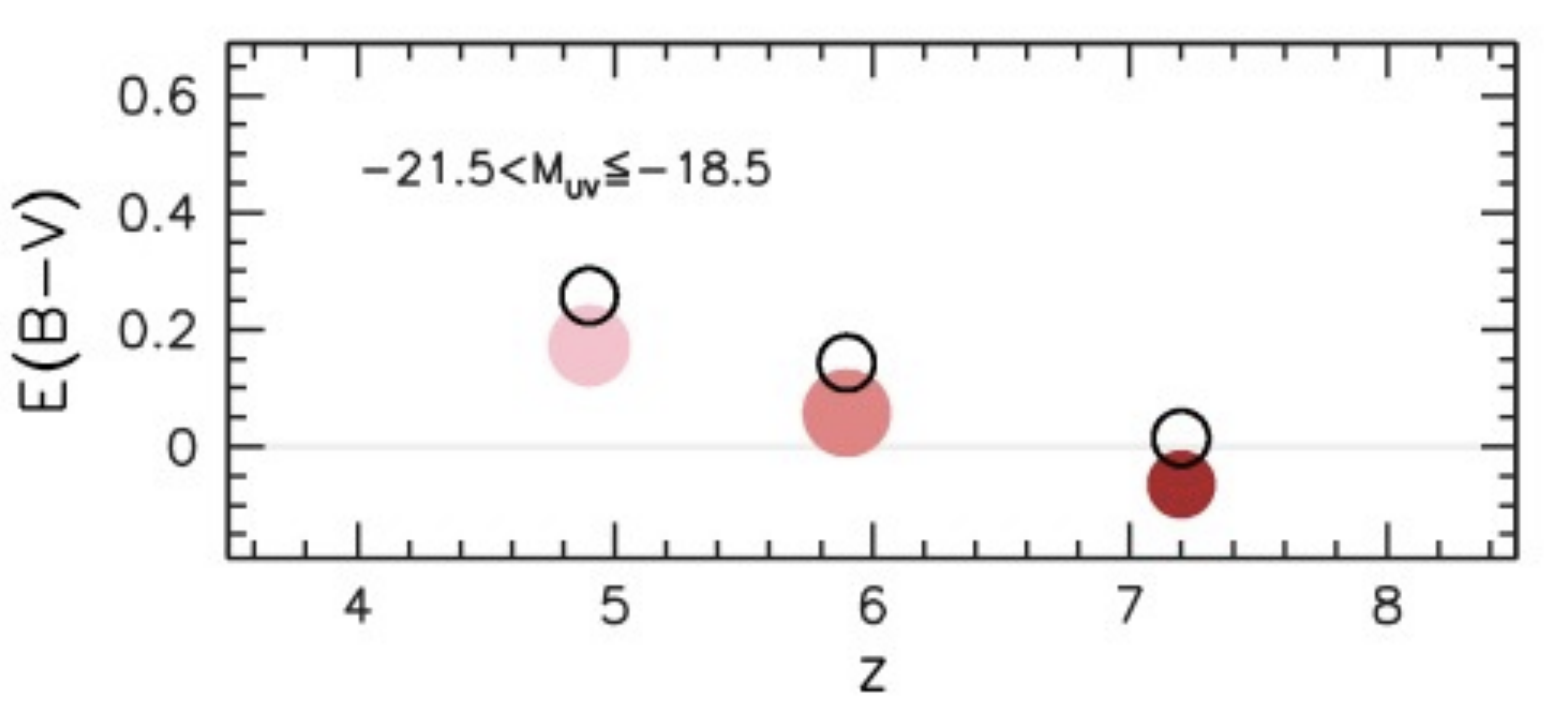
Redshift evolution



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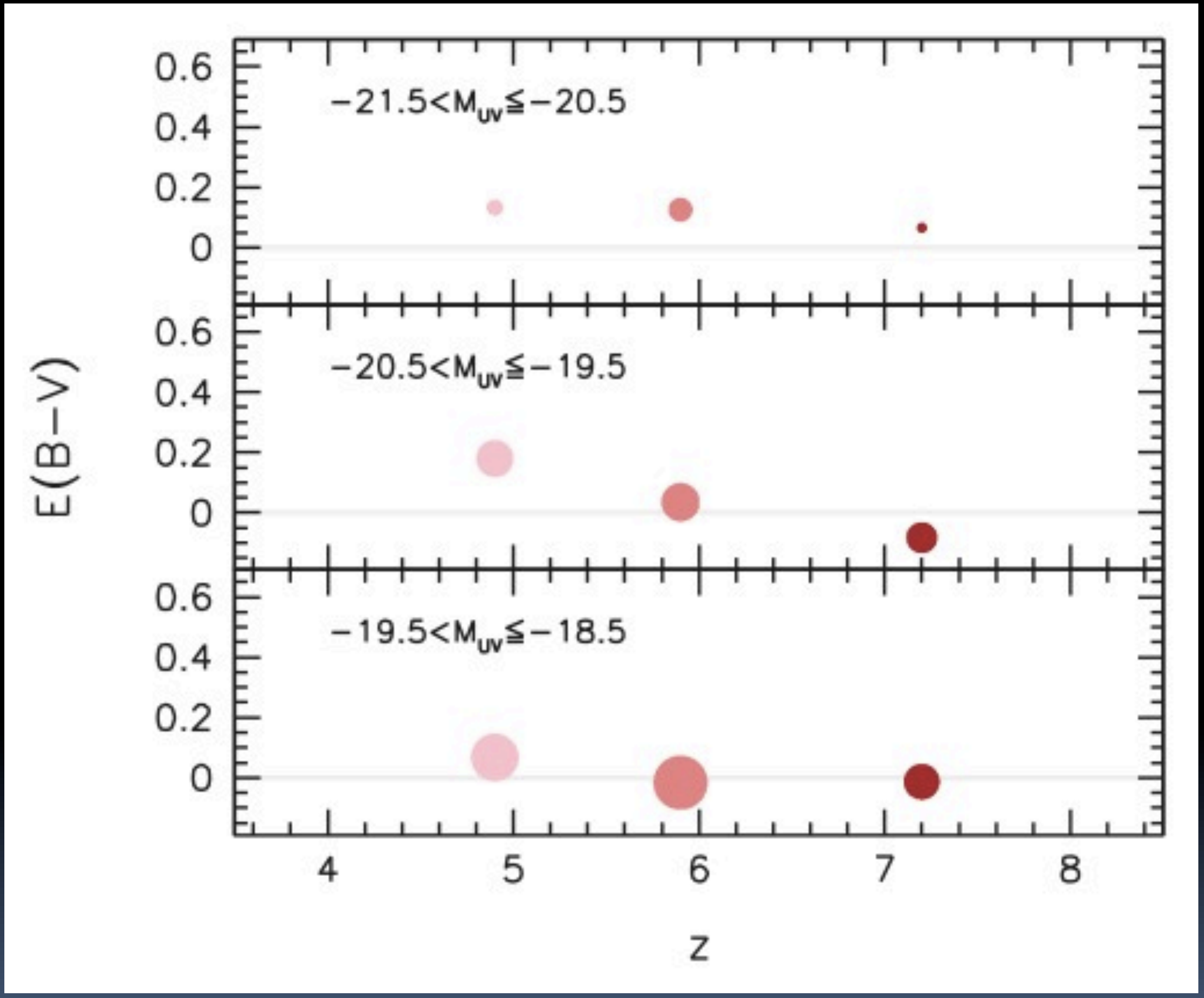
Redshift evolution



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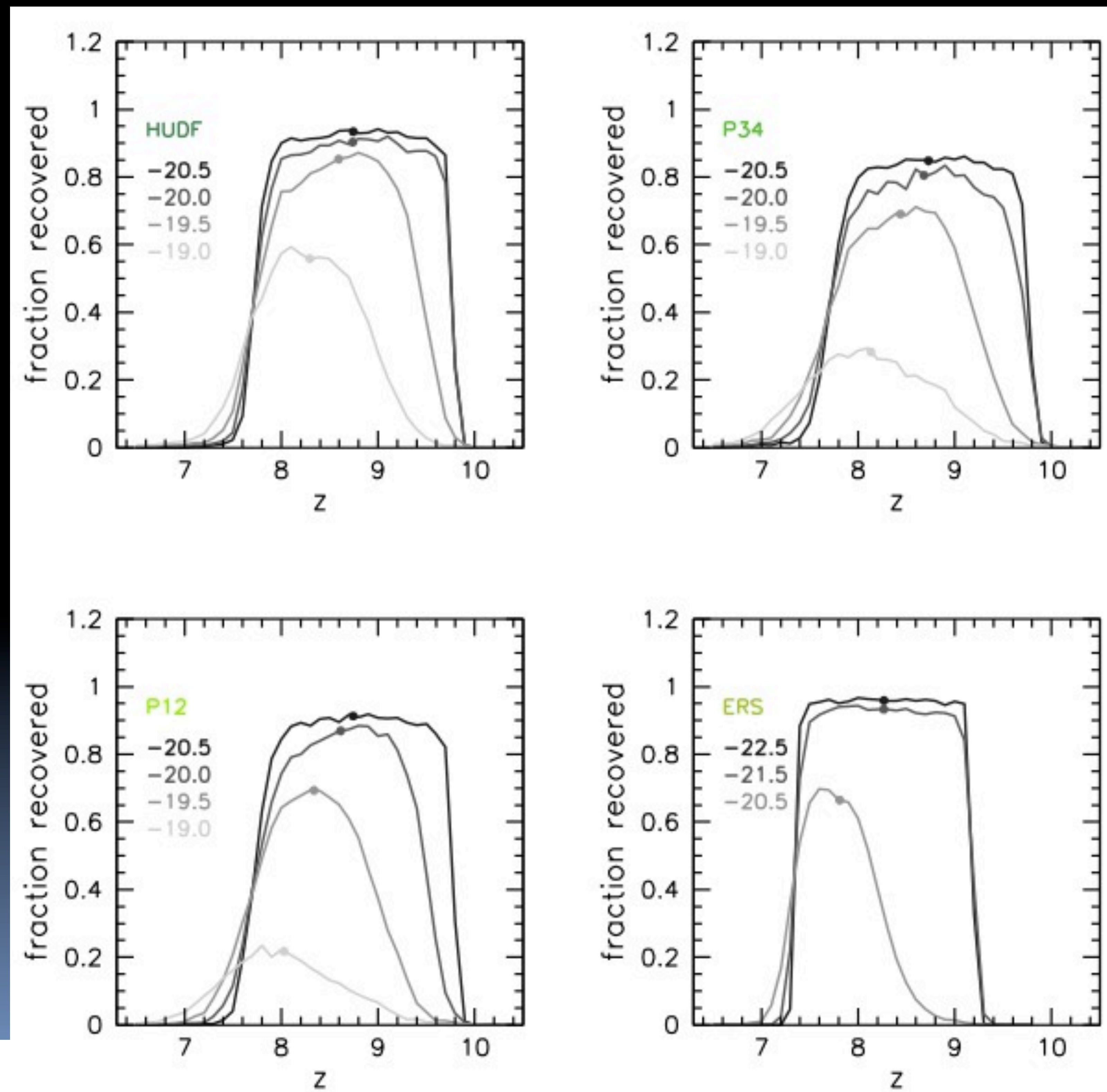
HUDF
−20.5
−20.0
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P34
−20.5
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−19.5
−19.0
P12
−20.5
−20.0
−19.5
−19.0
ERS
−22.5
−21.5
−20.5
fraction recovered
z
1.2
1
0.8
0.6
0.4
0.2
0
7
8
9
10

s over)

(in case you didn't notice, it's over)

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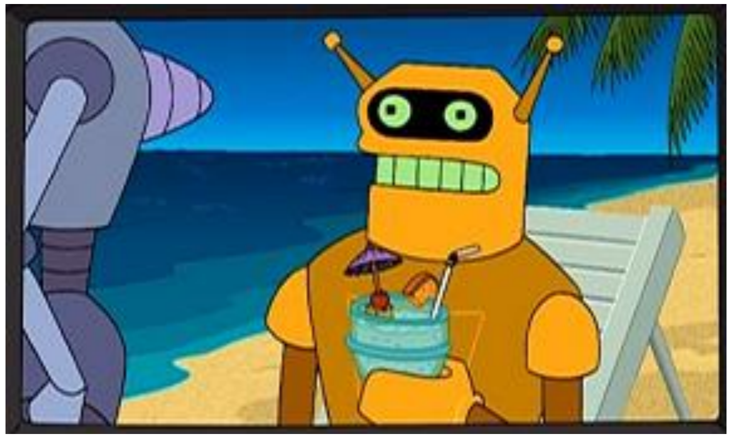

UV properties of high redshift galaxies

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UV properties of high redshift galaxies

Wilkins et al. (2011), MNRAS 417 717

Selection of v-, i- and z-drops with $M_{1500} < -18.5$, covering a redshift range of $4.7 < z < 7.7$

(in case you didn't notice, it's over)

Default scenario

- 100 Myr continuous star formation history
- solar metallicity (Z = 0.02)
- Salpeter IMF
- no dust

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$$f_\lambda \propto \lambda^\beta$$

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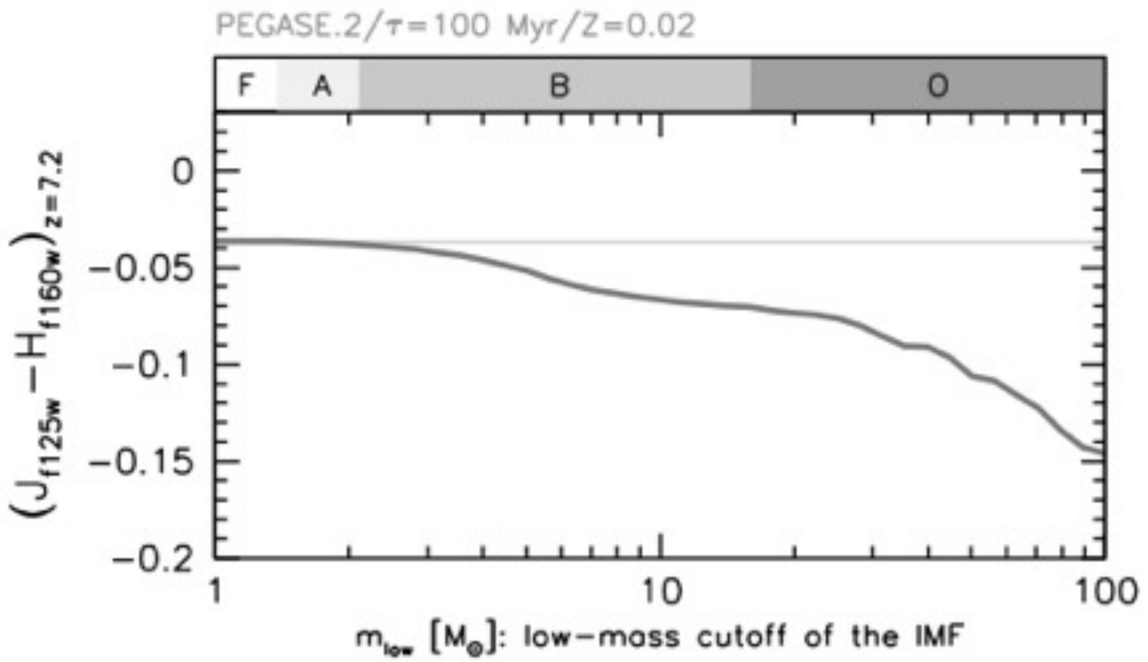

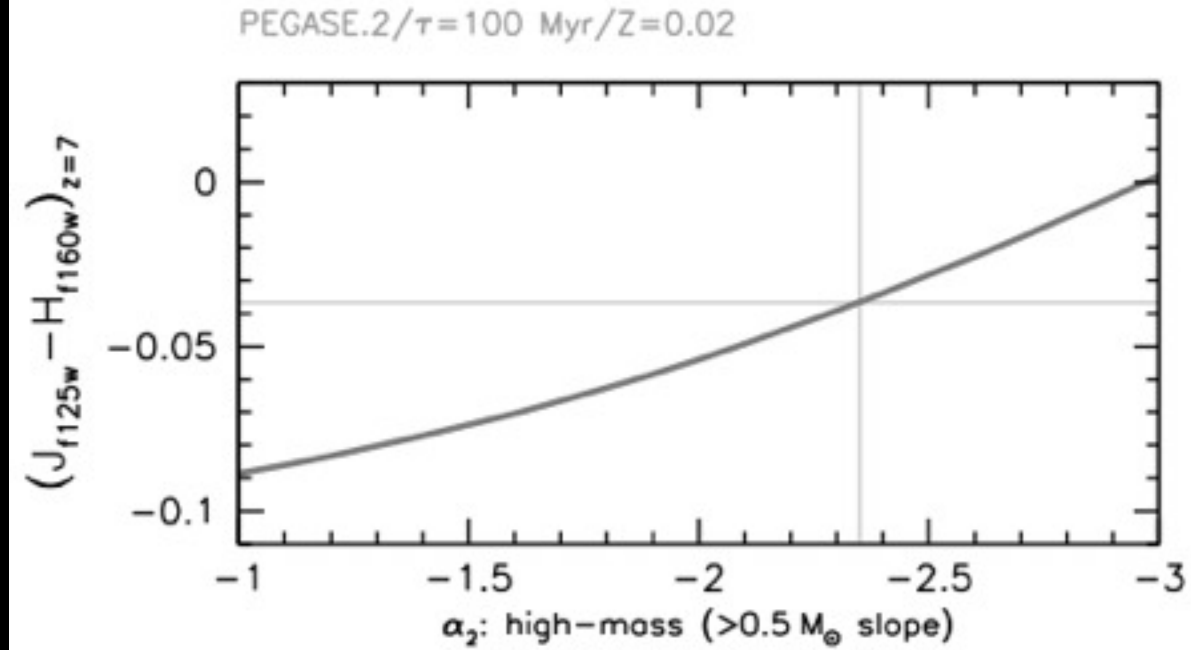

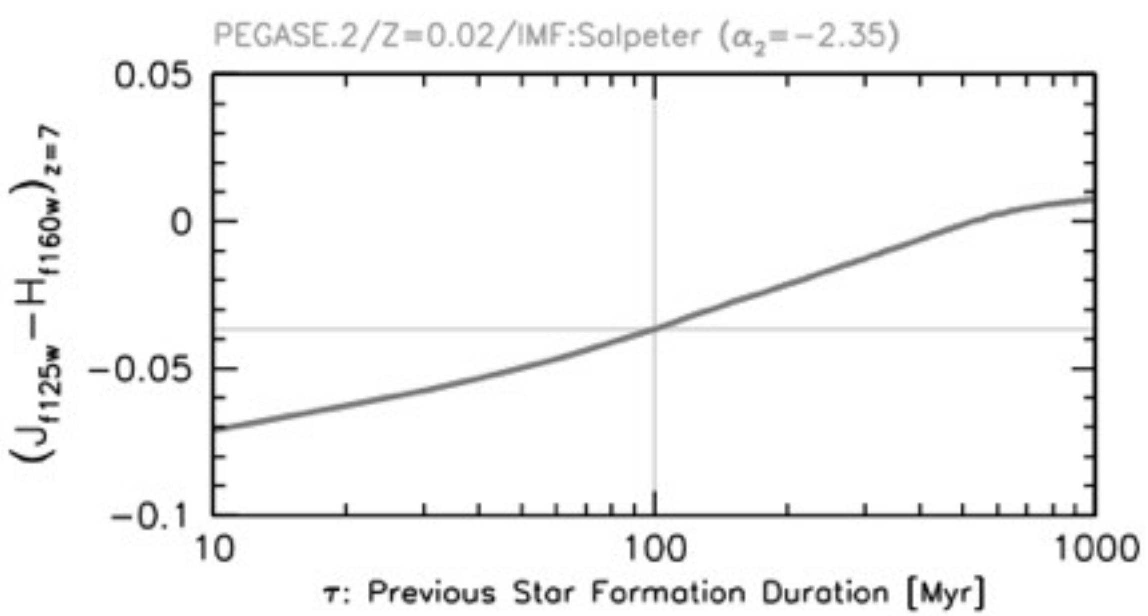

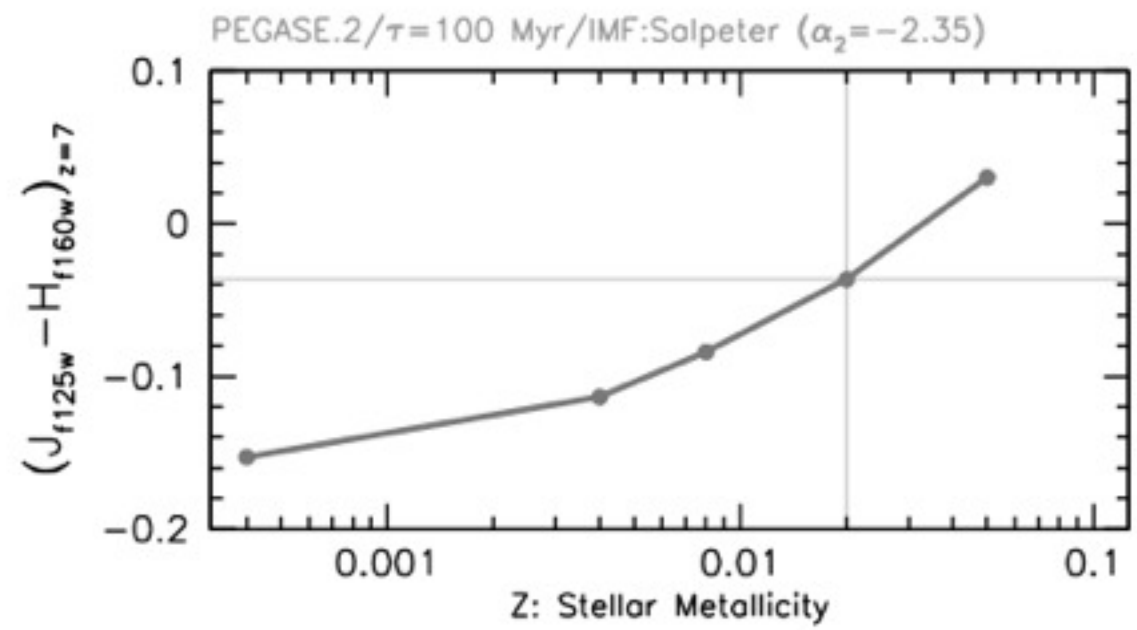

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WFC3 exposure times, in ksec (number of exposures).

Field ID	Y-band[a]	J-band	H-band	J_{AB} 7σ limit
HUDF	28.1 (20)	44.8 (32)	75.8 (54)	28.65
P34	28.1 (20)	39.3 (28)	47.7 (34)	28.33
P12	16.8 (12)	33.7 (24)	5.6 (4)	28.22
ERS	2.6 (6)	2.6 (6)	2.6 (6)	27.16

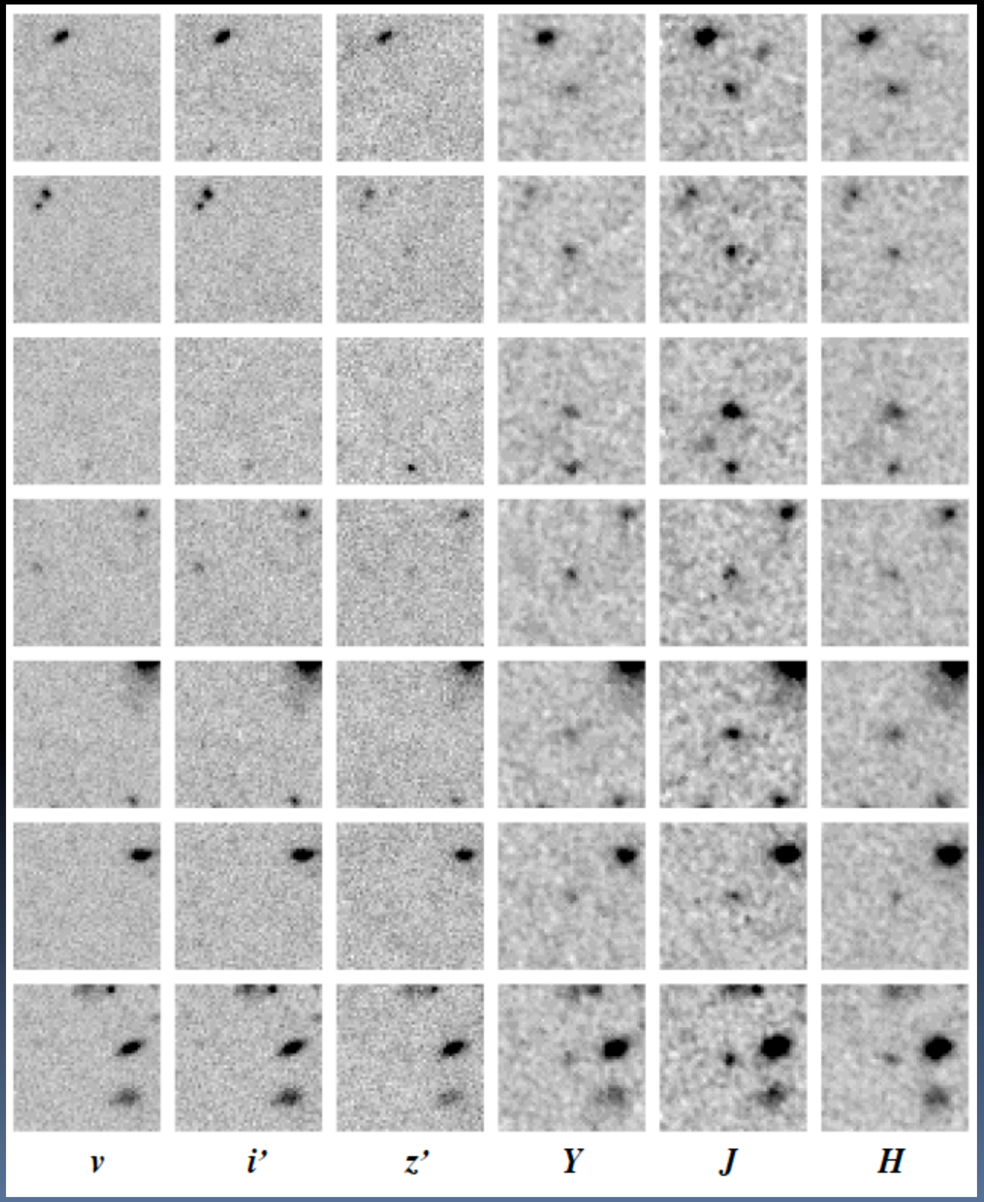
[a] Y_{098m} for the ERS fields and Y_{105w} for the *HUDF*/P12/P34 fields.

Table 1. The total exposure time (in ksec) is listed for each filter, with the number of individual exposures given in parentheses. The final column gives the 7σ magnitude limit in the J-band.

α	M^*_{1600} [AB mag]	ϕ^* [Mpc^{-3}]	ρ_{1600} [10^{25} erg s^{-1} Mpc^{-3} Hz^{-1}] ($\dot{\rho_*}$ [M$_\odot$ yr^{-1} Mpc^{-3}]) $M_{1600} < -18.5$ (SFR > 1.5 M$_\odot$ yr^{-1})	< -13 (> 0.01 M$_\odot$ yr^{-1})	< -8 ($> 10^{-4}$ M$_\odot$ yr^{-1})
−1.5	−19.34	0.00117	1.65 (0.0022)	4.61 (0.0060)	4.88 (0.0064)
−1.7	−19.5	0.00093	1.71 (0.0022)	6.22 (0.0081)	7.27 (0.0095)
−1.9	−19.66	0.00070	1.73 (0.0023)	9.05 (0.0119)	13.46 (0.0176)

Table 6. The best fit values of M^*_{1600} and ϕ^* for s Schechter function assuming fixed $\alpha \in \{-1.5, -1.7, -1.9\}$ together with the UV luminosity densities (and star formation rate densities in parentheses) determined by integrating the luminosity function down to various limiting absolute magnitudes.

Candidates



Data

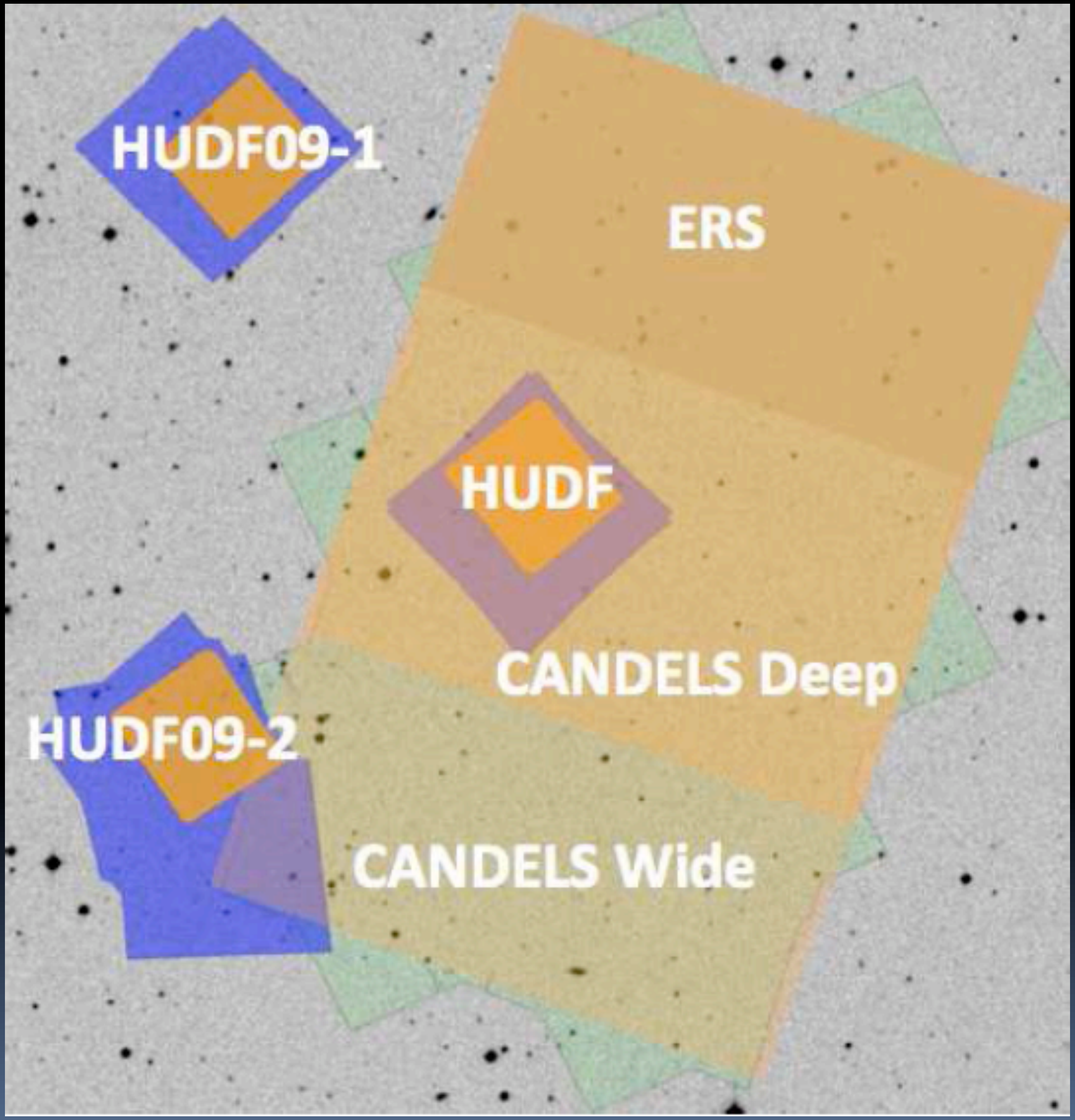


Figure from Oesch et al. (2011), arXiv:1105.2297

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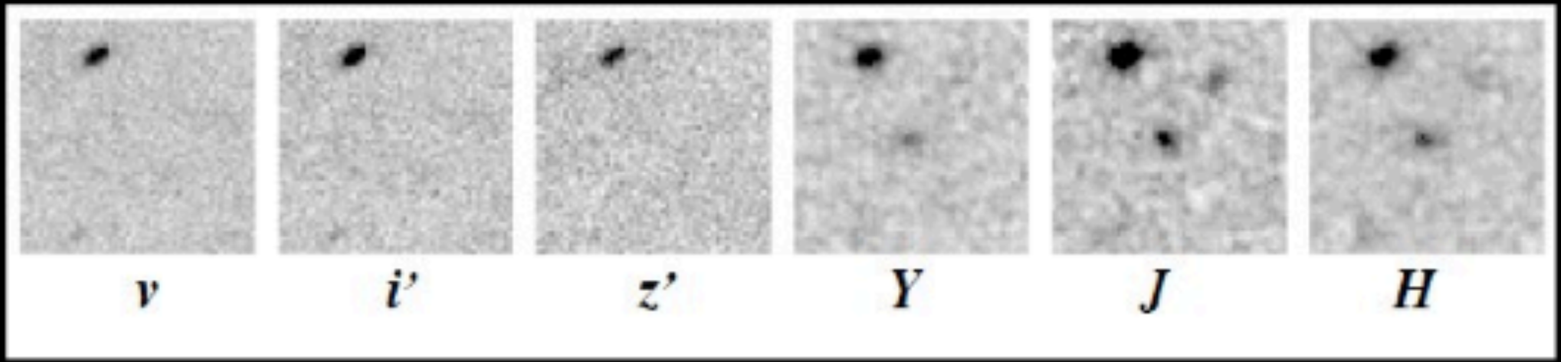

Future

Spectroscopic confirmation of candidates (ongoing)

More data (CANDELS program)