Using Strong Gravitational Lensing to Study Dwarf Galaxies at ~~High~~ Low Redshifts(1<z<3)

(UV Luminosity Function)

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Alavi et al 2016 (submitted to ApJ), arXiv160600469A

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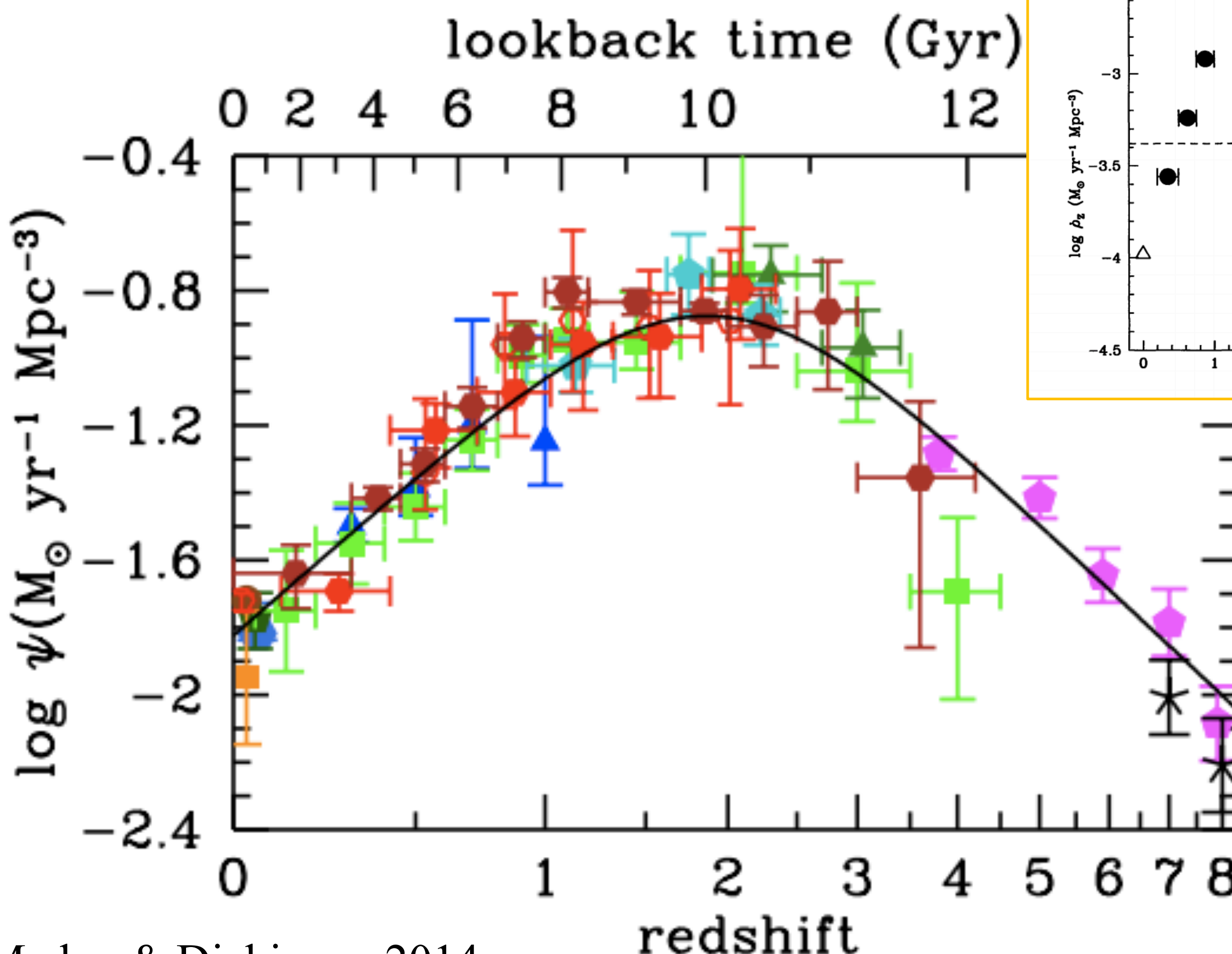
ASTRONOMY UCR

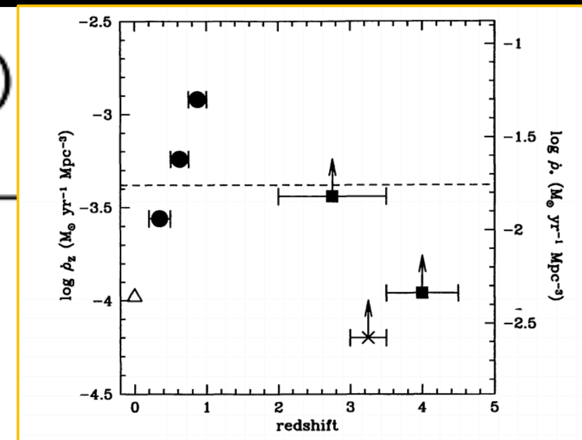
FRONTIER FIELDS

UC RIVERSIDE UNIVERSITY OF CALIFORNIA

Motivation : Peak Epoch of Star Formation Rate Density (1<z<3)

Madau et al, 1996





Madau & Dickinson 2014

Motivation :Where Is the Other half of Ultraviolet Light During the Peak Epoch?

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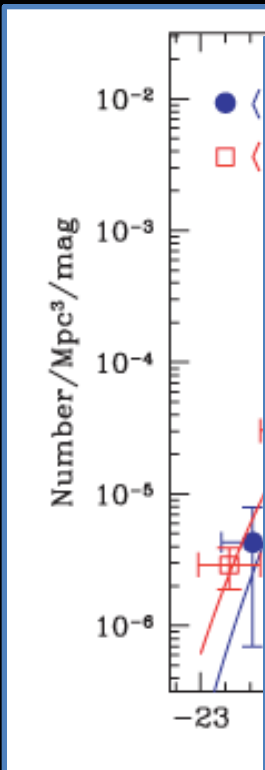

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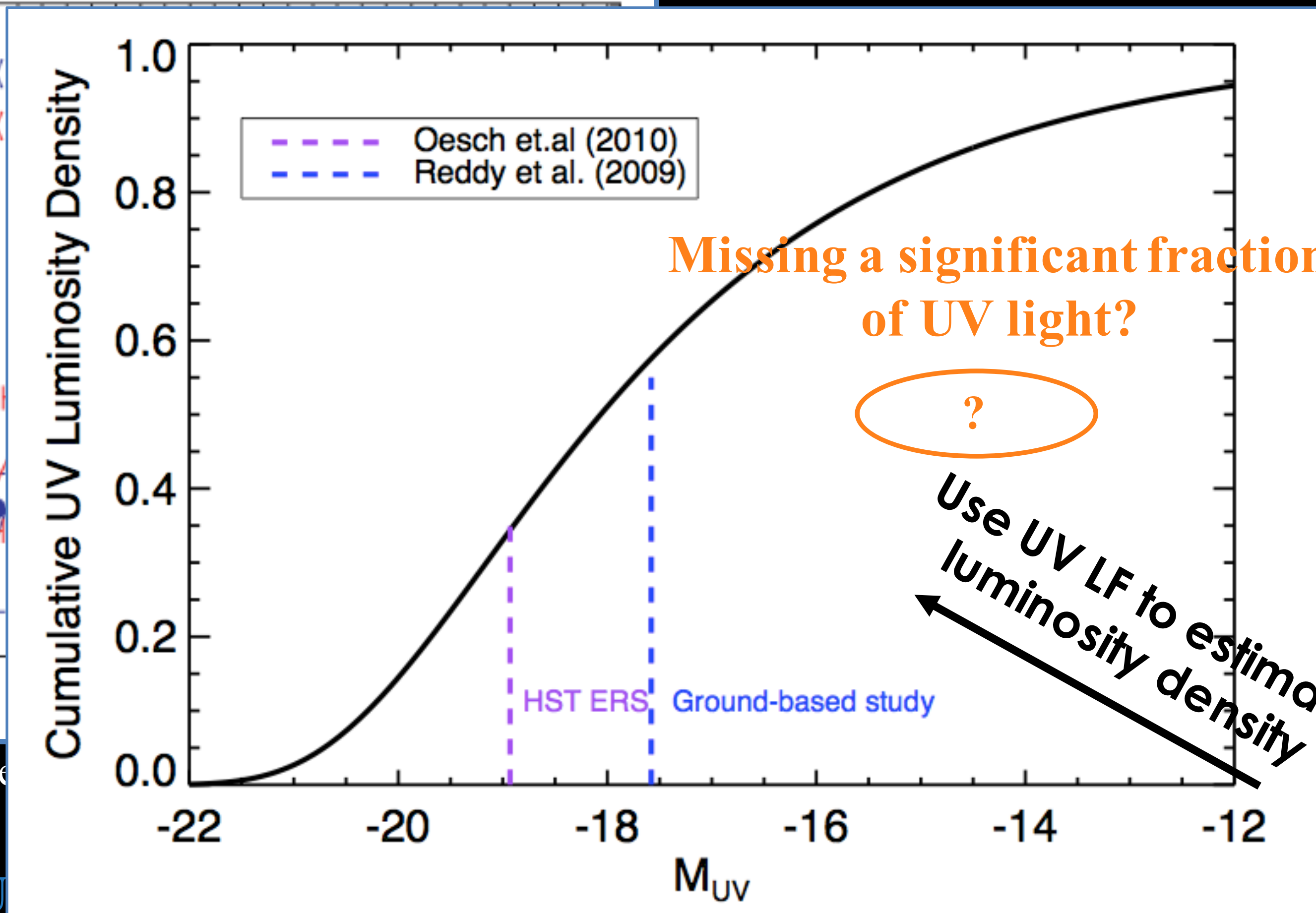
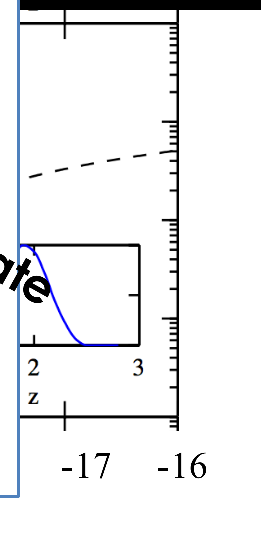
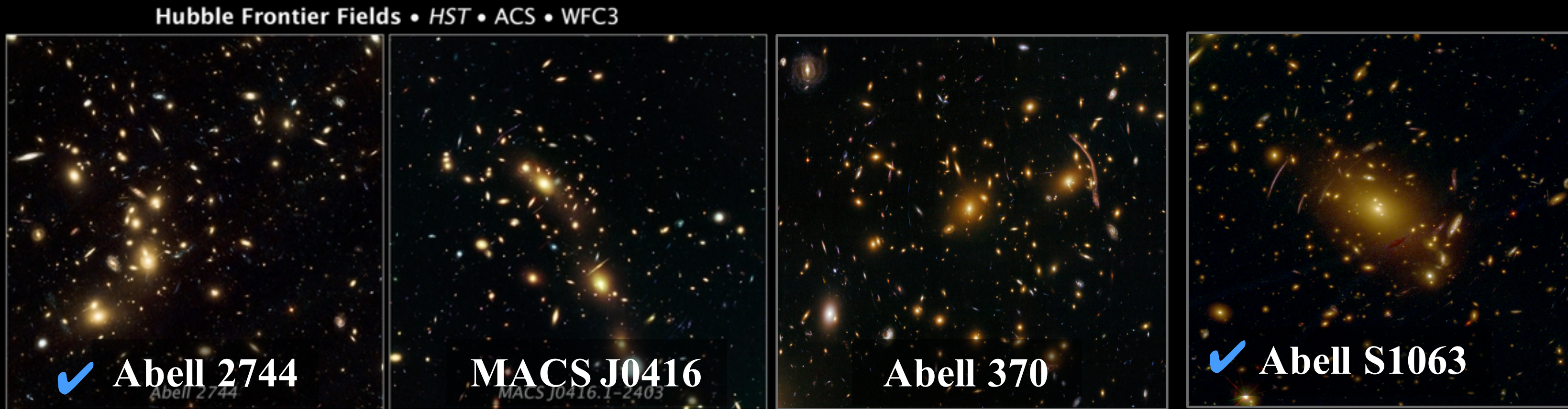
Early U



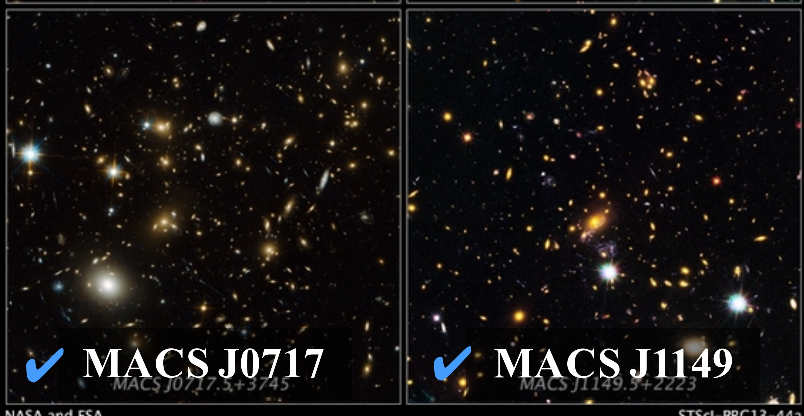


Oesch et al., 2010

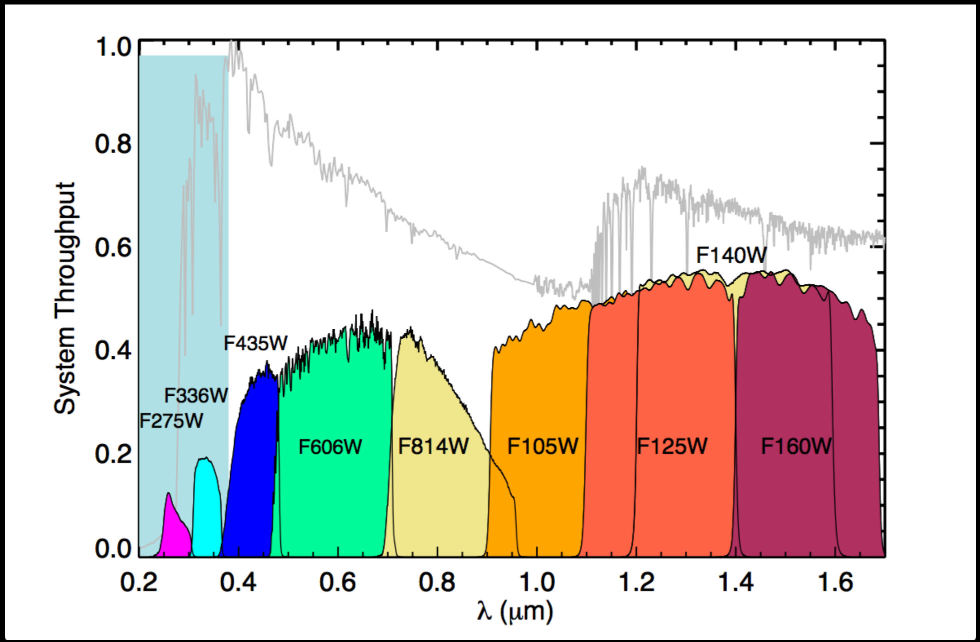
UV Frontier: Legacy Near-UV Imaging of the Frontier Fields (Siana, et al. in prep)



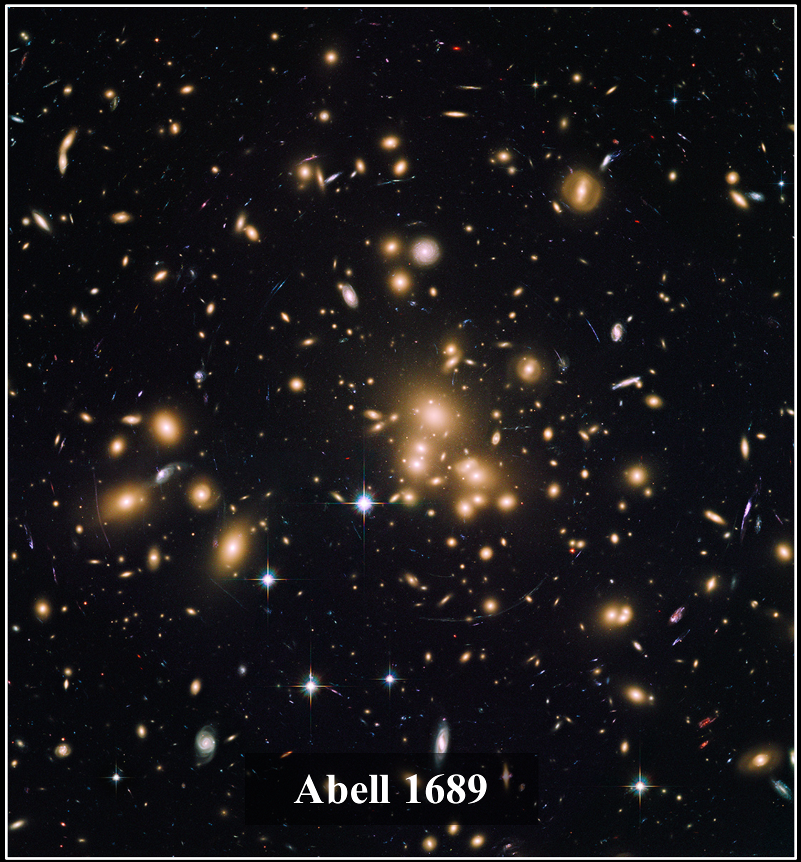
Credit: NASA/ESA/J. Lotz & M. Mountain,STScI, the Hubble SM4 ERO Team, and ST-ECF



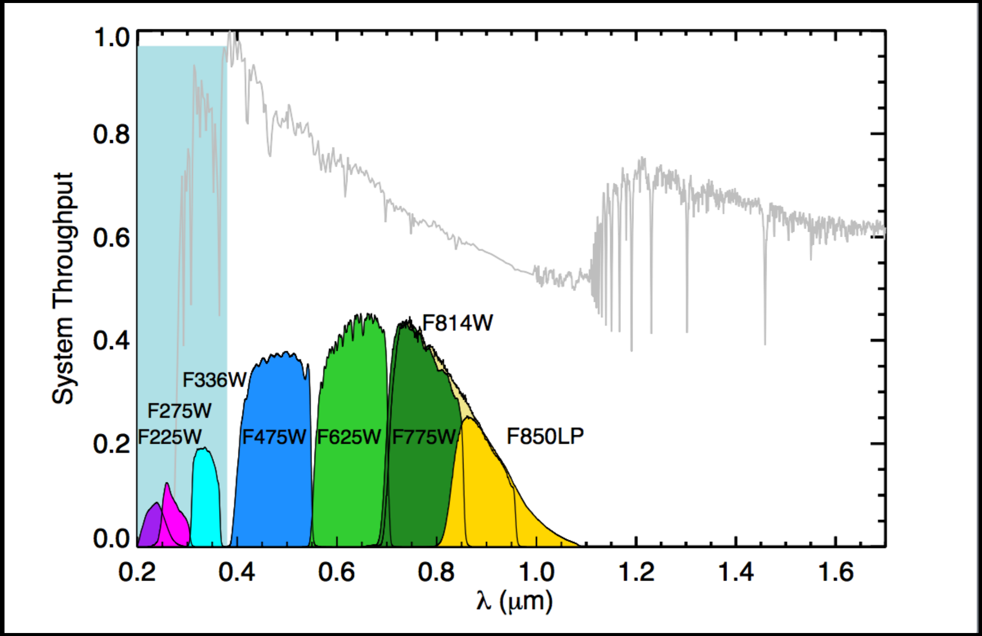
- Frontier Fields:140 HST DD orbits, including 70 ACS + 70 WFC3/IR orbits
- **UV Frontier Fields: 8 orbits in F275W and F336W**



UV Abell 1689



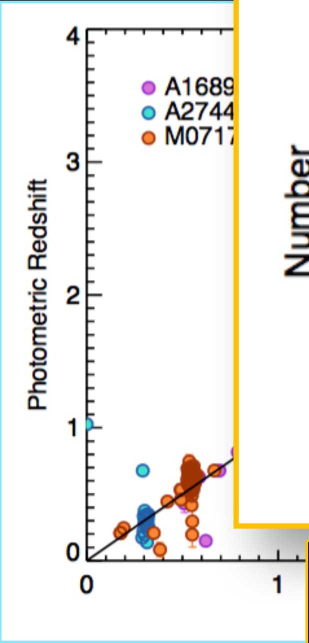
- Abell 1689: 10,30, 18 orbits imaging in F225W, F275W and F336W.

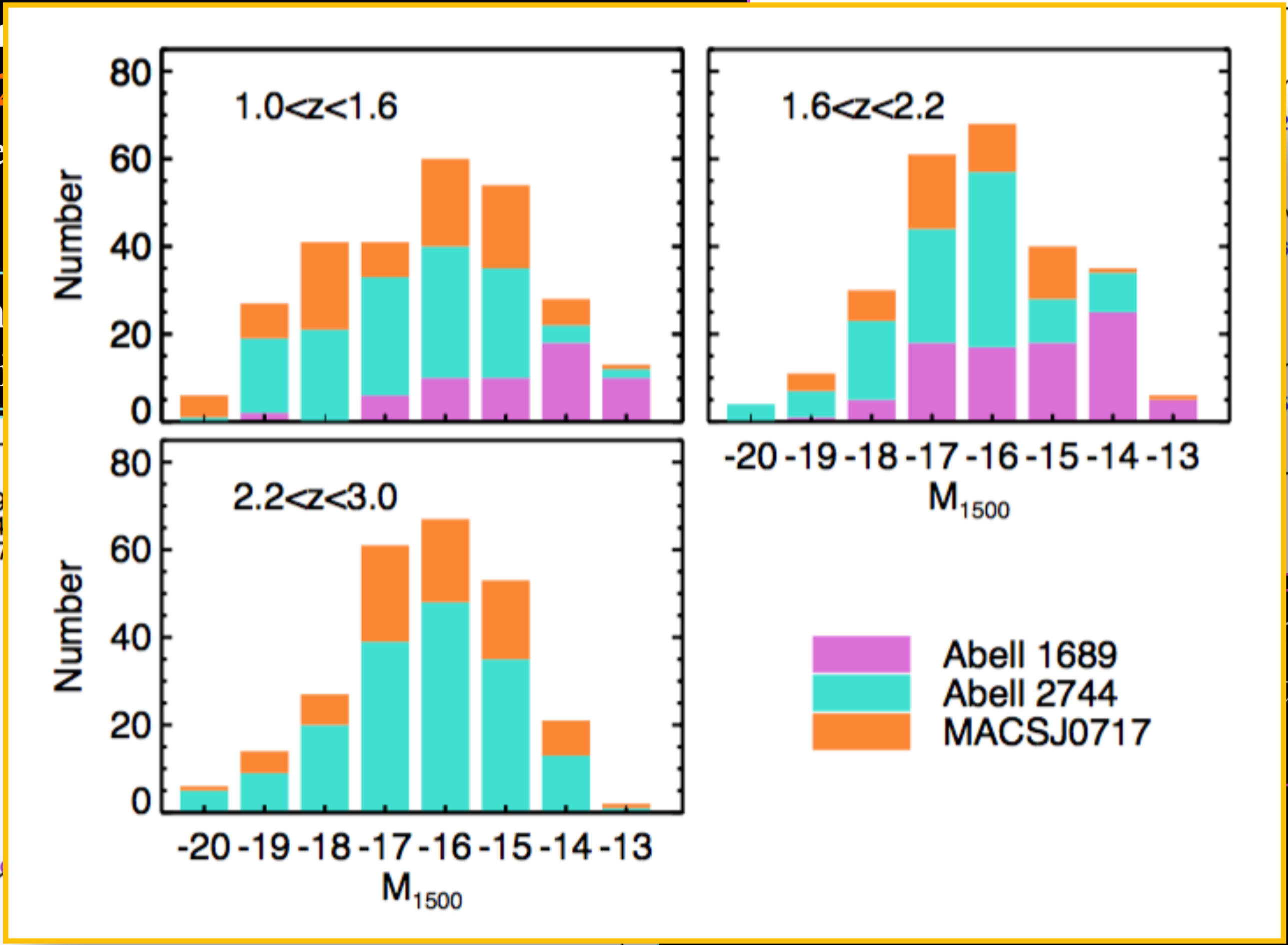


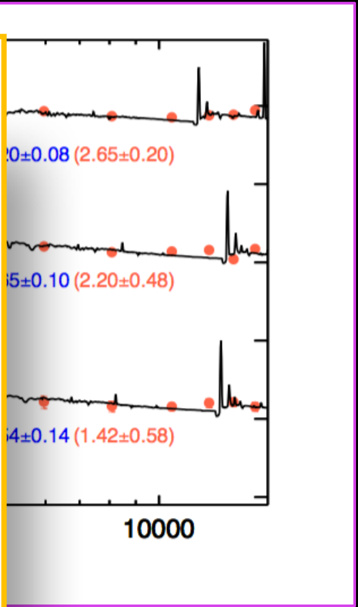
Sample Selection

- Photometr
(**M_{UV} <-12**
252 galaxie

Comparison
spectroscopi







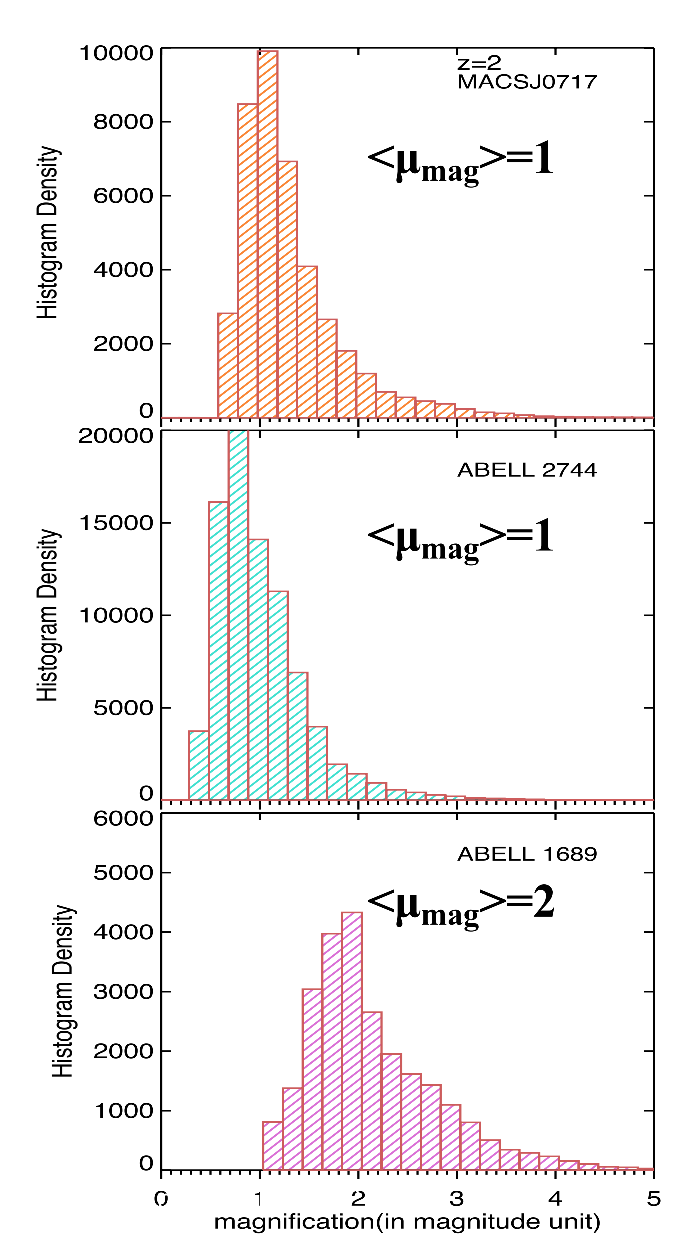
an break and
ometric redshift

The intrinsic absolute UV magnitude (i.e., corrected for lensing magnification)

Alavi et al., 2016 (submitted to ApJ)

Lensing Models

Magnification distribution



- HFF lens models from The Cluster As Telescopes (CATS) team.
- MACSJ0717: Limousin et al., 2016
- Abell 2744: Jauzac et al., 2015

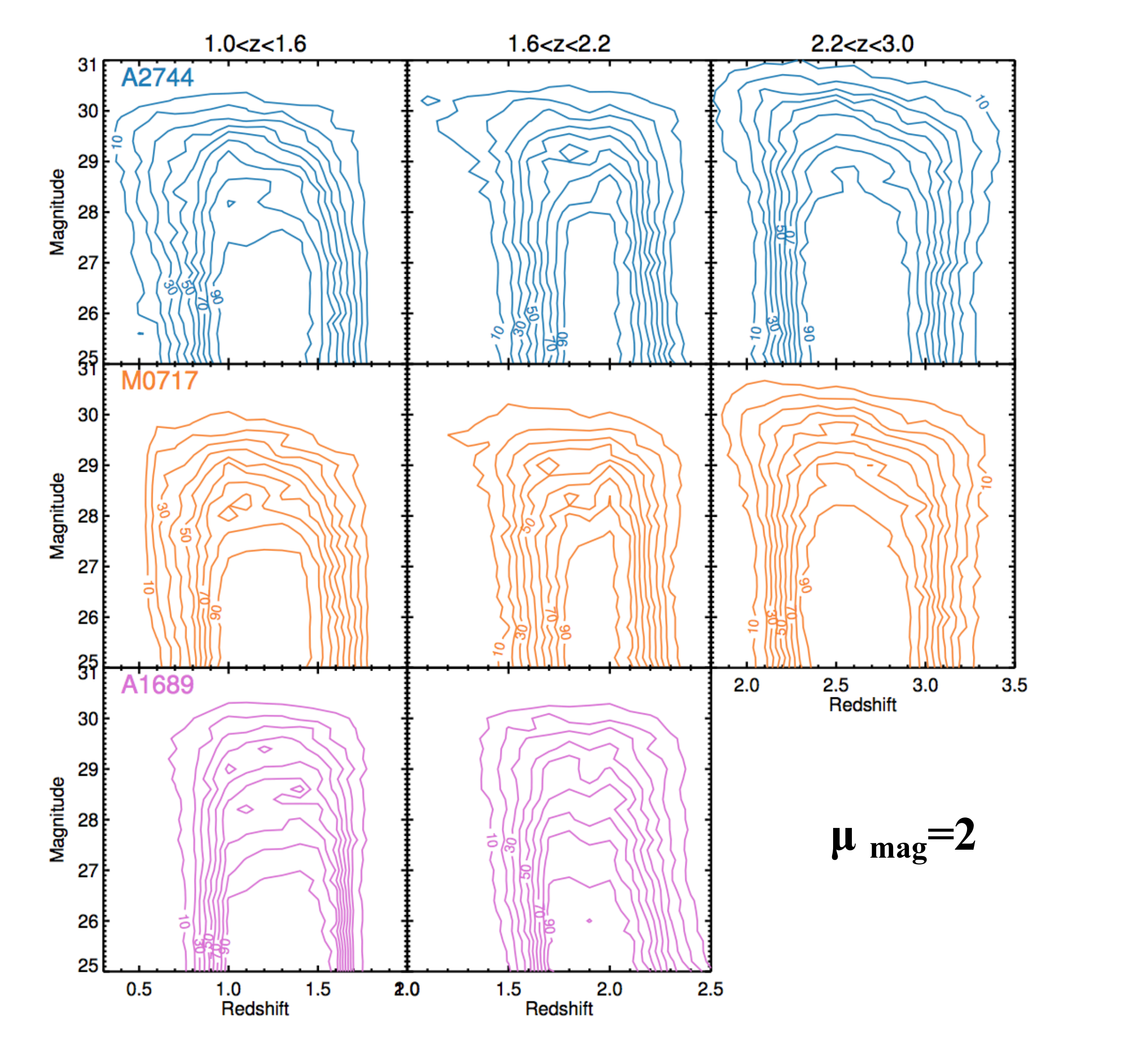
- ABELL 1689: Limousin et al., 2007

Completeness Simulation

Very important but no time!

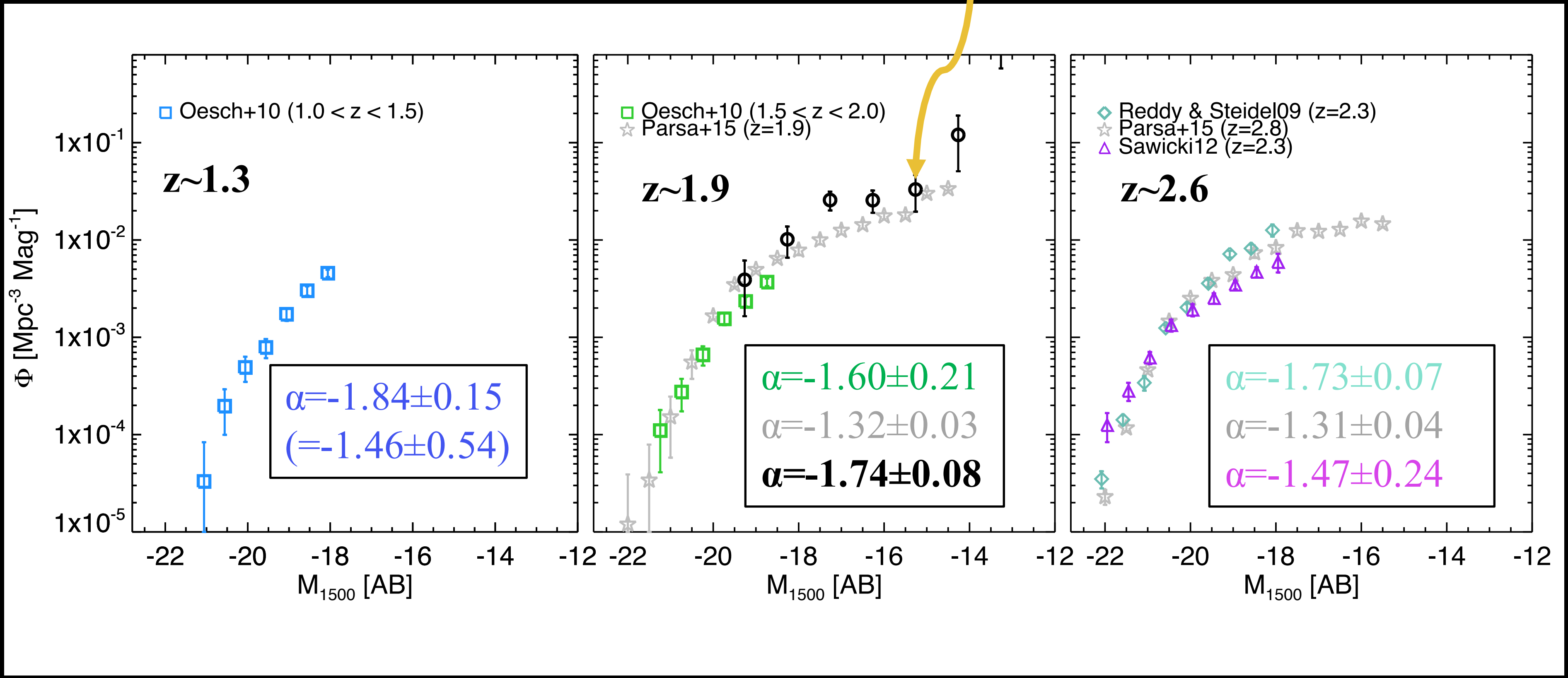
- In order to connect the observed galaxies to the underlying population of all star-forming galaxies, we need to precisely estimate the completeness of our sample. $C(m, z, \mu)$

- Size distribution
- The effect of lensing magnification and shear



UV Luminosity Function

z=2 LBG in Abell 1689 , Alavi et al., 2014



- Maximum Likelihood fitting to individual galaxies
- Modify the MLE technique to account for different sources of uncertainties (photometry, photometric redshifts, lens models)

UV Luminosity Function

Alavi et al., 2016 (submitted to ApJ)

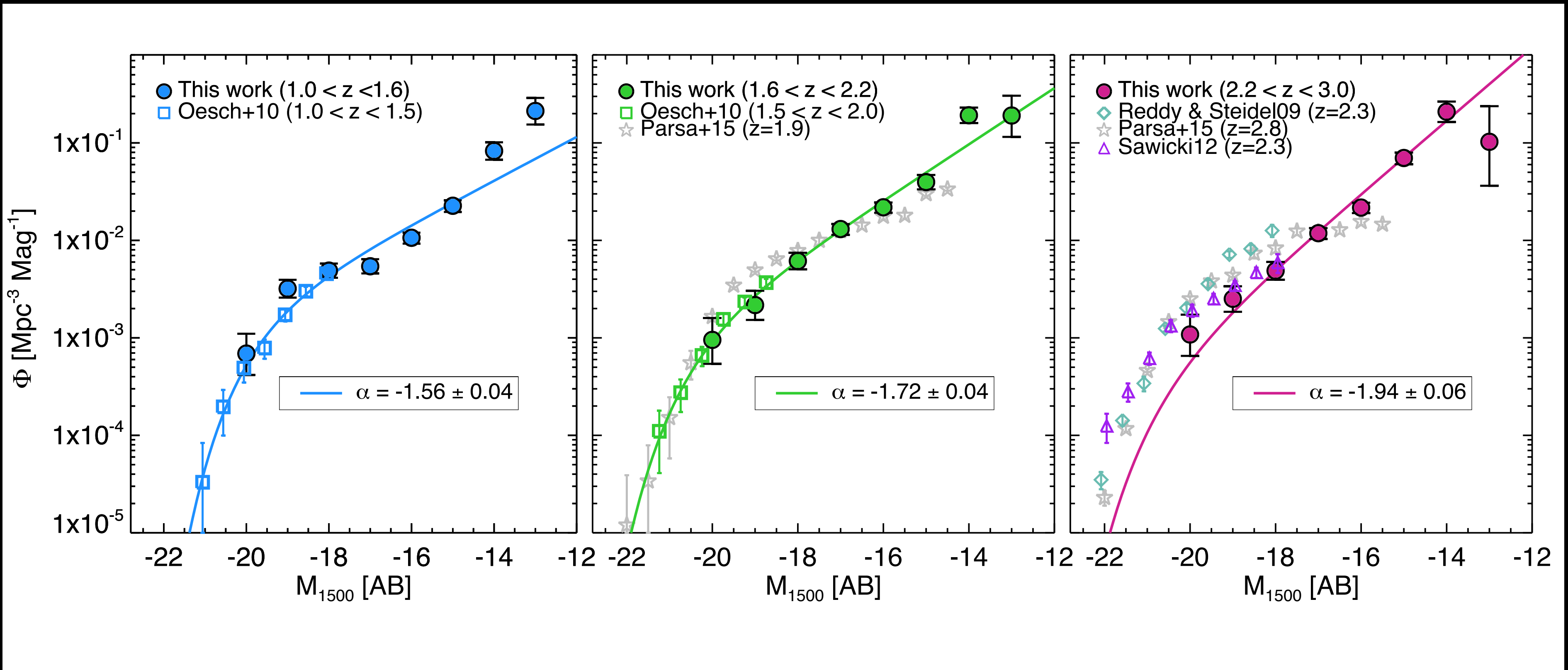
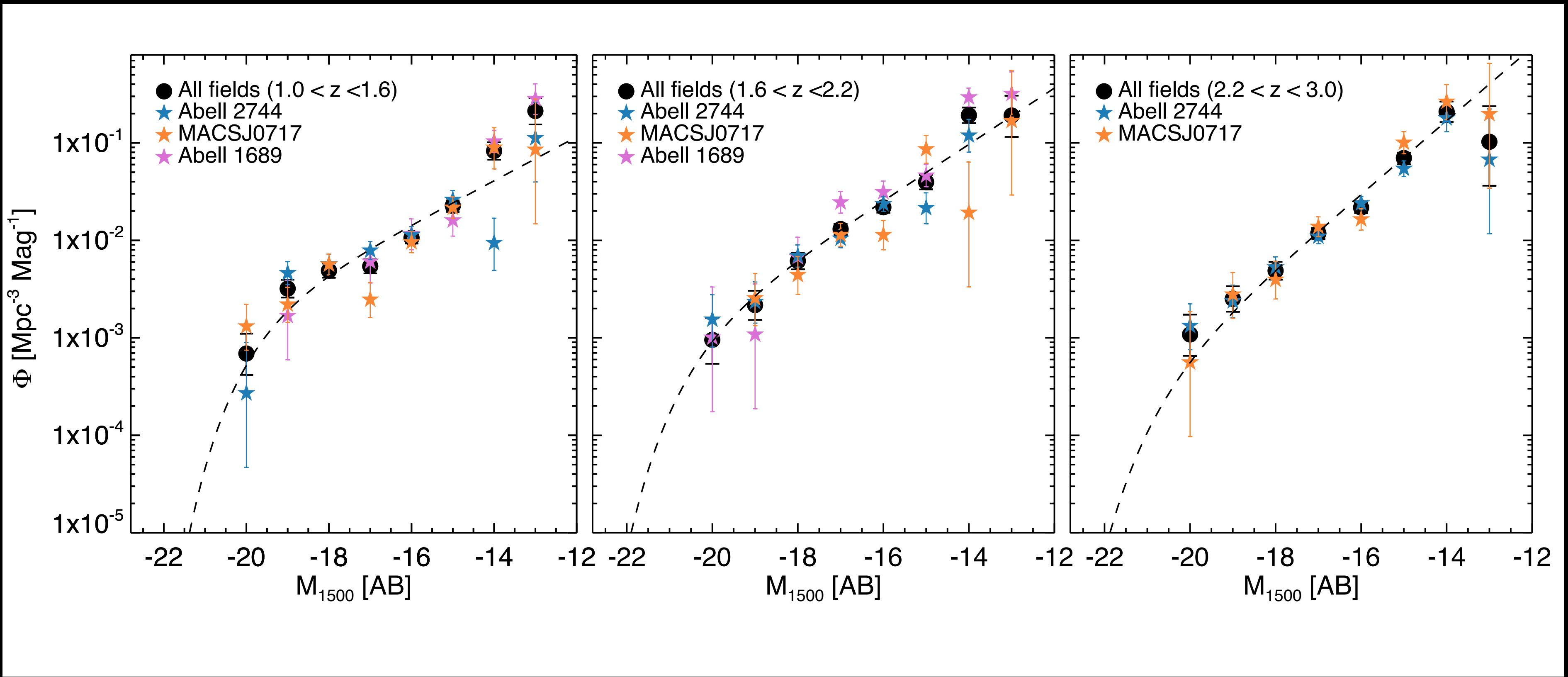


Table 3
Best-fit Schechter Parameters for UV LFs

z	α	M*	$\phi^*(10^{-3}\mathrm{Mpc}^{-3}\ \mathrm{mag}^{-1})$
		Photometric redshift LF, MLE fitting	
$1.0 < z < 1.6$[a]	-1.56±0.04	-19.74±0.18	2.32±0.49
$1.6 < z < 2.2$[a]	-1.72±0.04	-20.41±0.20	1.50±0.37
$2.2 < z < 3.0$[b]	-1.94±0.06	-20.71±0.11(prior)	0.55±0.14

UV Luminosity Function

Alavi et al., 2016 (submitted to ApJ)



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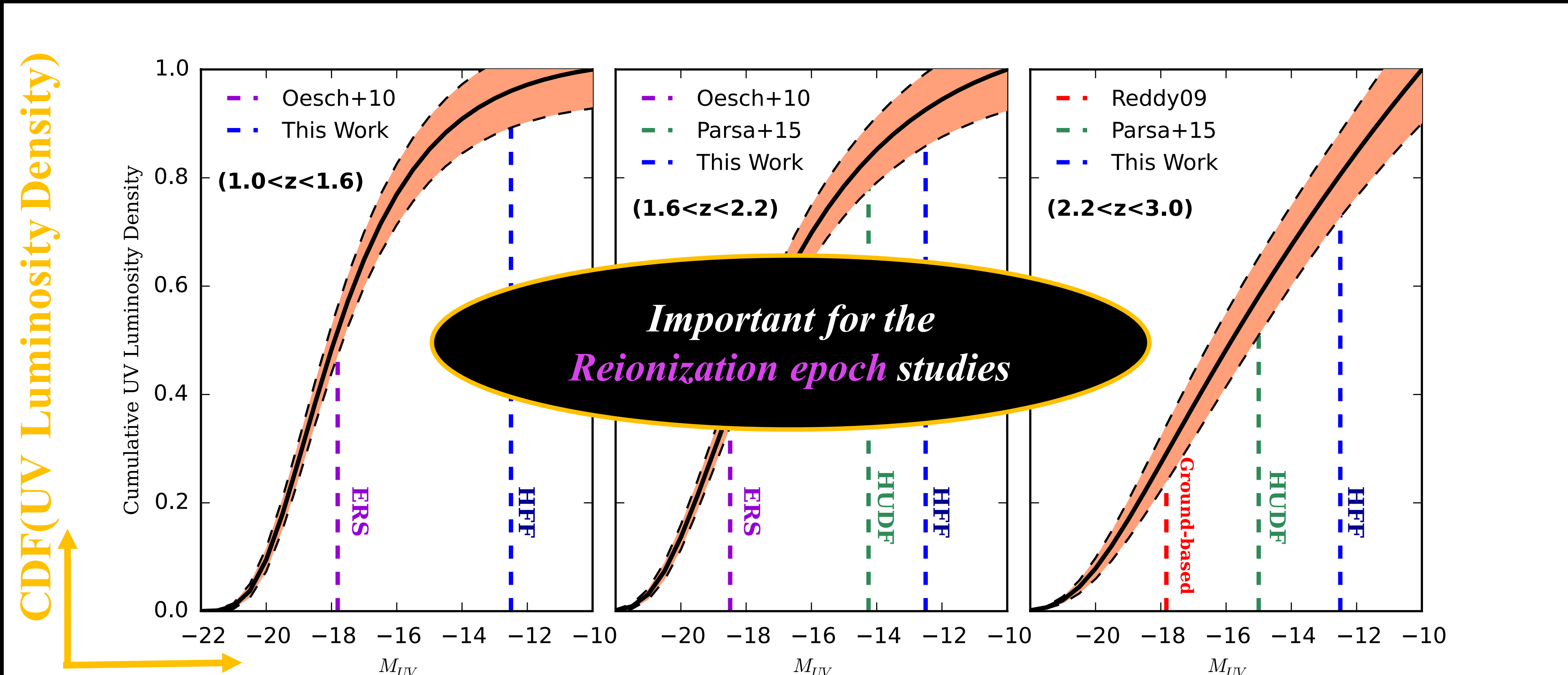
UV Luminosity Density

Alavi et al., 2016 (submitted to ApJ)

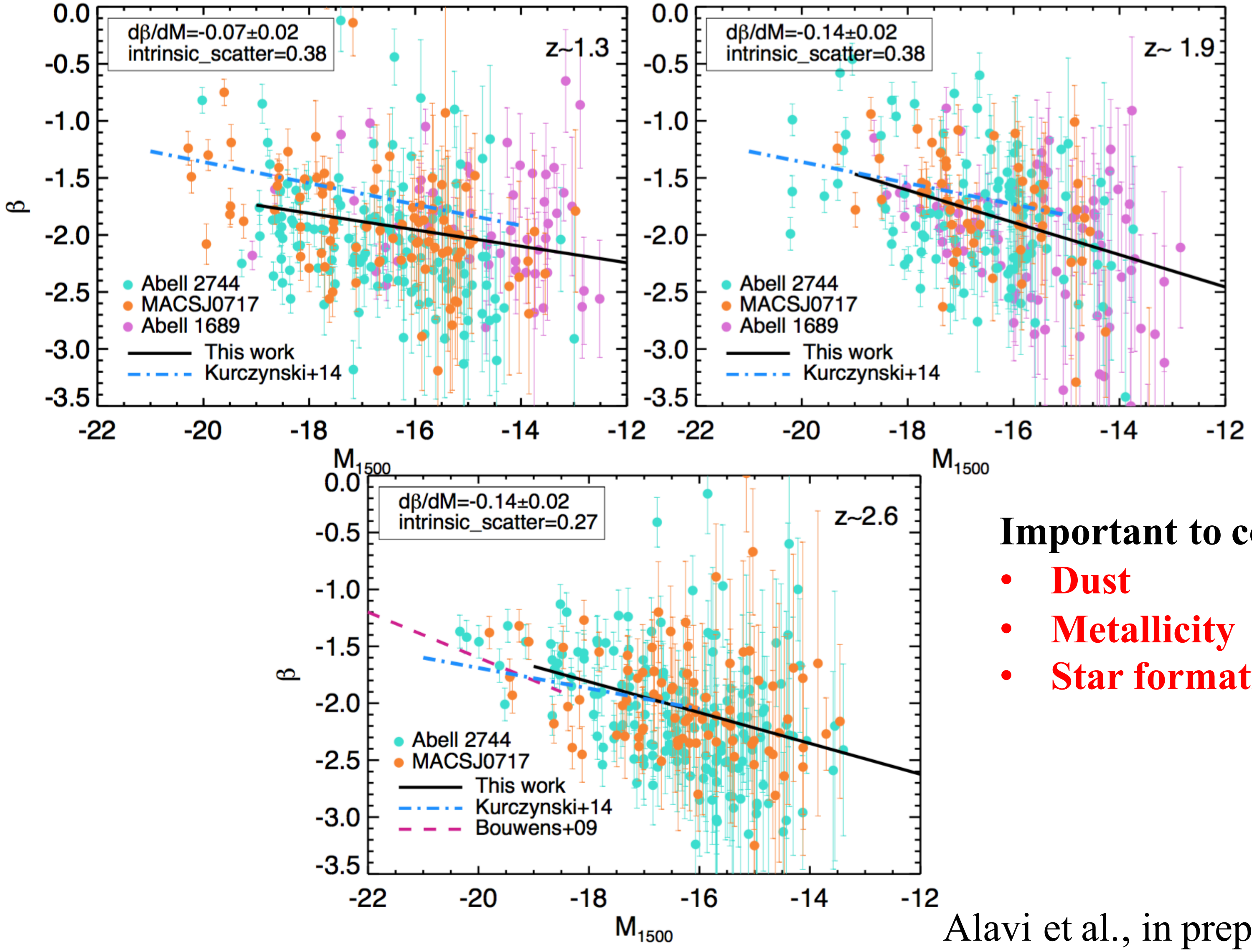


$\mathbf{M_{UV}}$

The faint dwarf galaxies ,$-18.5 < M_{1500} < -12.5$, comprise the majority of the unobscured UV luminosity density (58%, 55%, and 59% of the total UV luminosity density at z ~ 1.3, z ~ 1.9, and z ~ 2.6, respectively)

UV Spectral Slope and Dust Attenuation of Dwarf (ongoing work)

Measuring the UV Spectral Slope(Preliminary)



Important to consider:

- **Dust**
- **Metallicity**
- **Star formation history**

Alavi et al., in prep

Bursty Star Formation History

Observation

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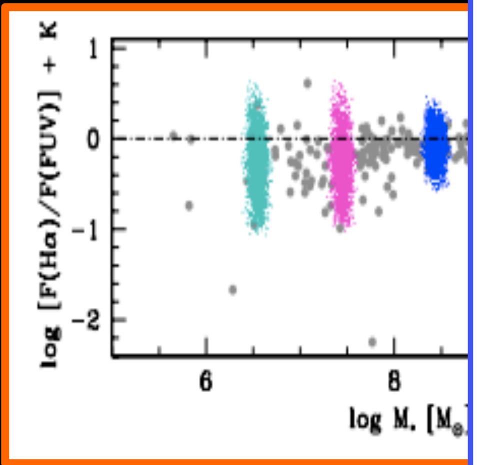
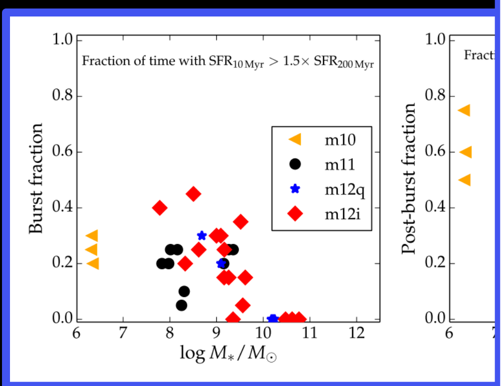
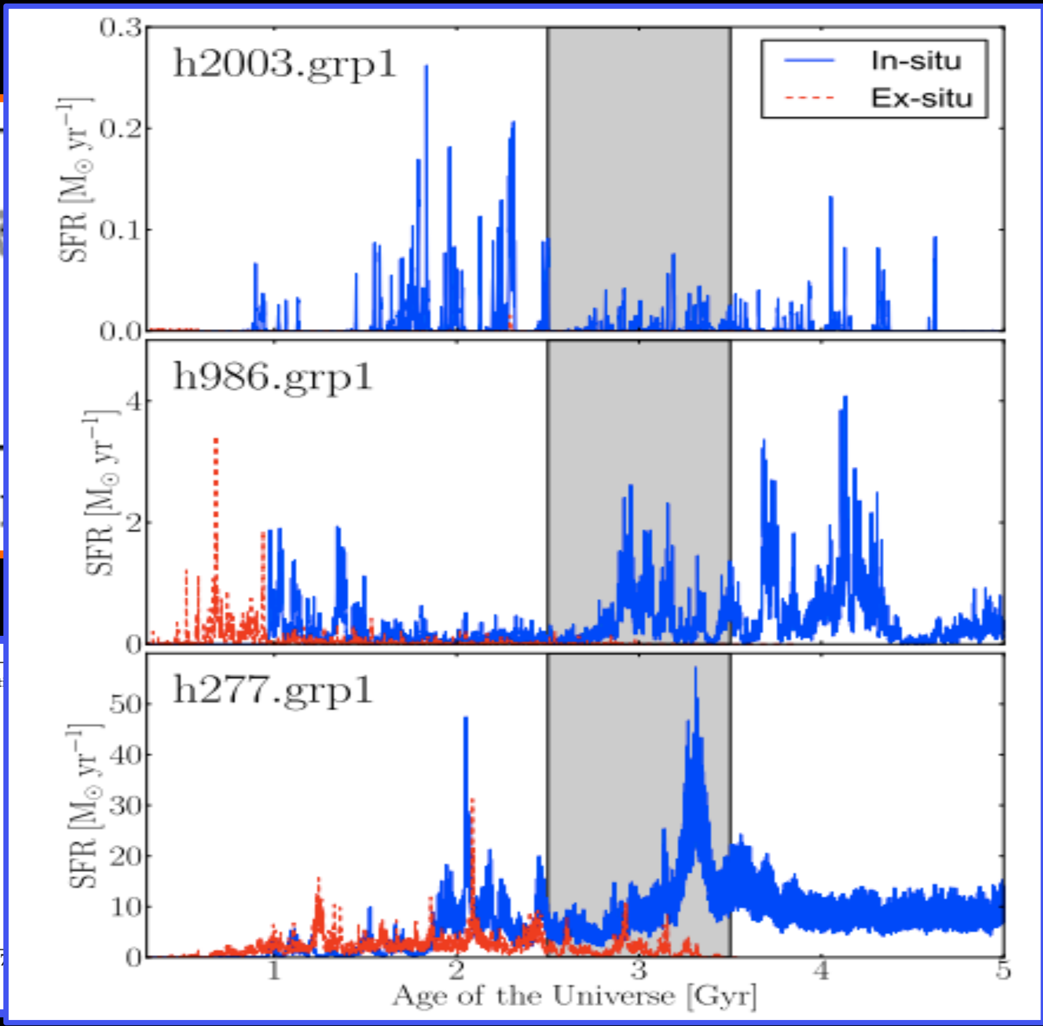


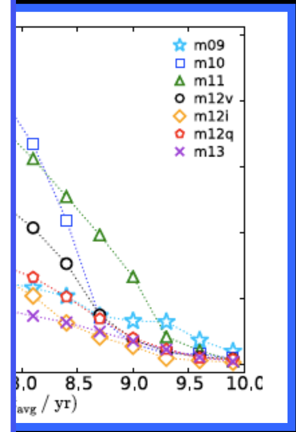
Weisz+12



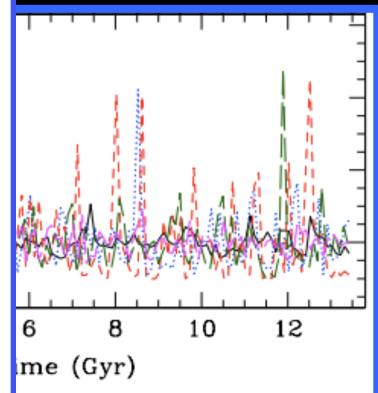
Sparre+15



Dominguez+14, Governato+12

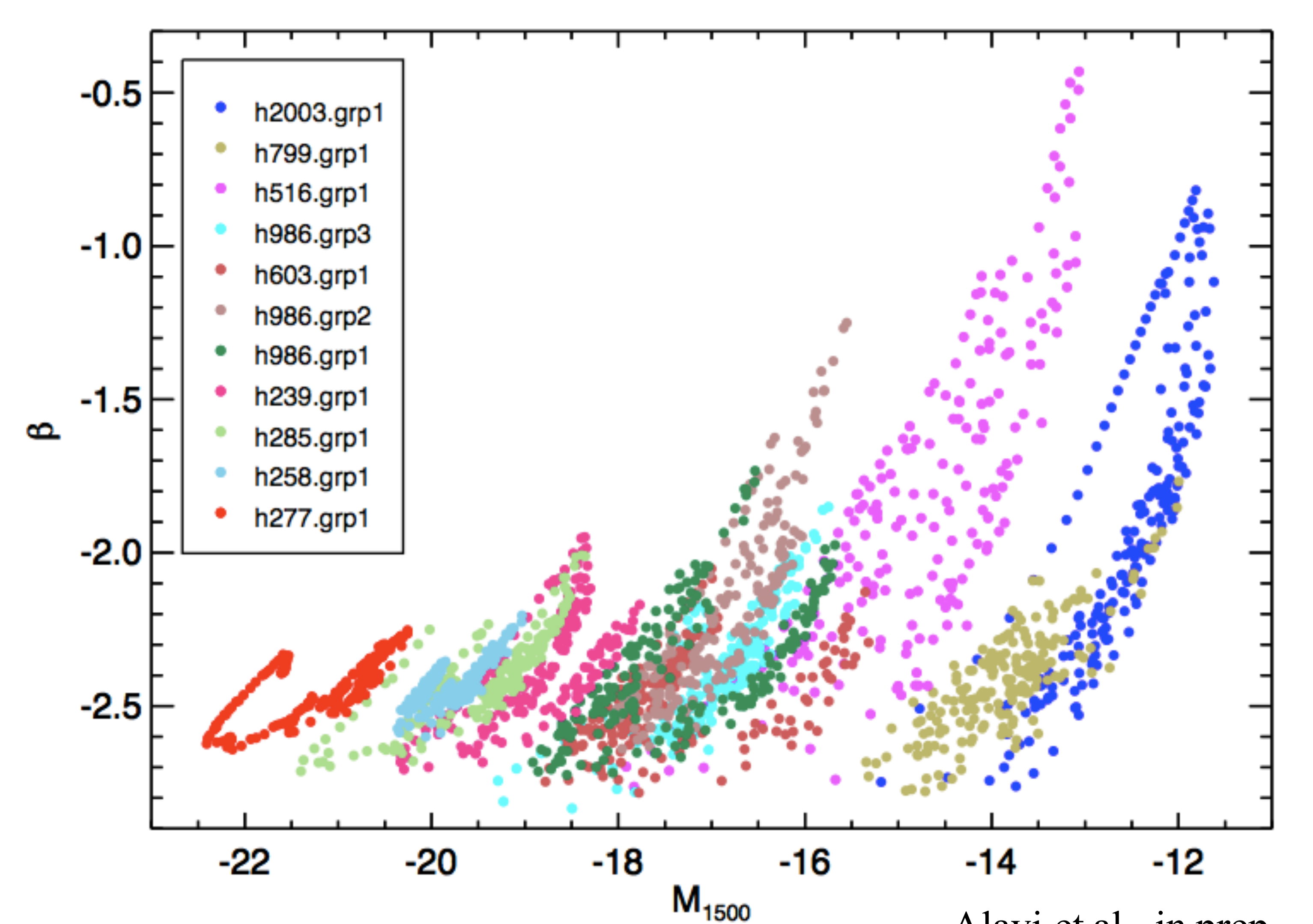


Hopkins+14



Trujillo-Gomez+13

Bursty SFHs in Low Mass Simulated Galaxies Changes UV Continuum Slope



Alavi et al., in prep

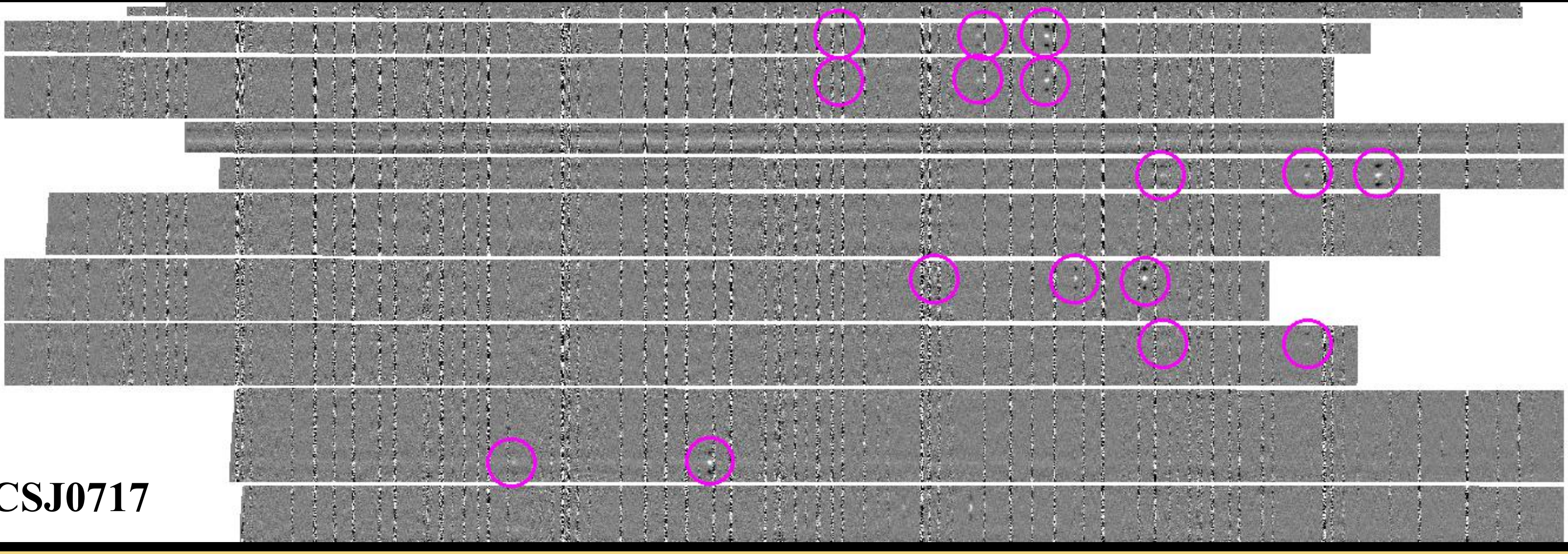
Future Work:
Near-IR Spectroscopy with MOSFIRE

Data:

- MOSFIRE spectra on A1689, MACS J0717, MACS J1149
- In total, 132 galaxies with spectroscopic data (7 nights)
- K, H, J and Y band

Goals:

- Dust attenuation using Balmer decrement (Hα/Hβ)
- Metallicity
- UV/Hα ratio, as an indicator of bursty SFH



MACSJ0717

SUMMARY

- Thanks to the lensing magnification, we can extend the UV LF measurements down to very faint luminosities of $M_{UV} = -12.5$ at $1 < z < 3.$, with $\alpha = -1.56 \pm 0.04$, $\alpha = -1.72 \pm 0.04$ and $\alpha = -1.94 \pm 0.06$ for $1.0<z<1.6$, $1.6<z<2.2$ and $2.2<z<3.0$, respectively.

- Our steep UV LFs show no sign of turnover down to MUV = −12.5.

- The faint galaxies ($-18<M_{uv}<-12.5$) contribute the majority (50%-60%) of the total unobscured UV luminosity density during the peak epoch of cosmic star formation

- Future work: what causes the large intrinsic scatter in the UV slope at low luminosities?

Alavi et al., 2014,
Alavi et al., 2015