Bursty Star Formation In Dwarf Galaxies

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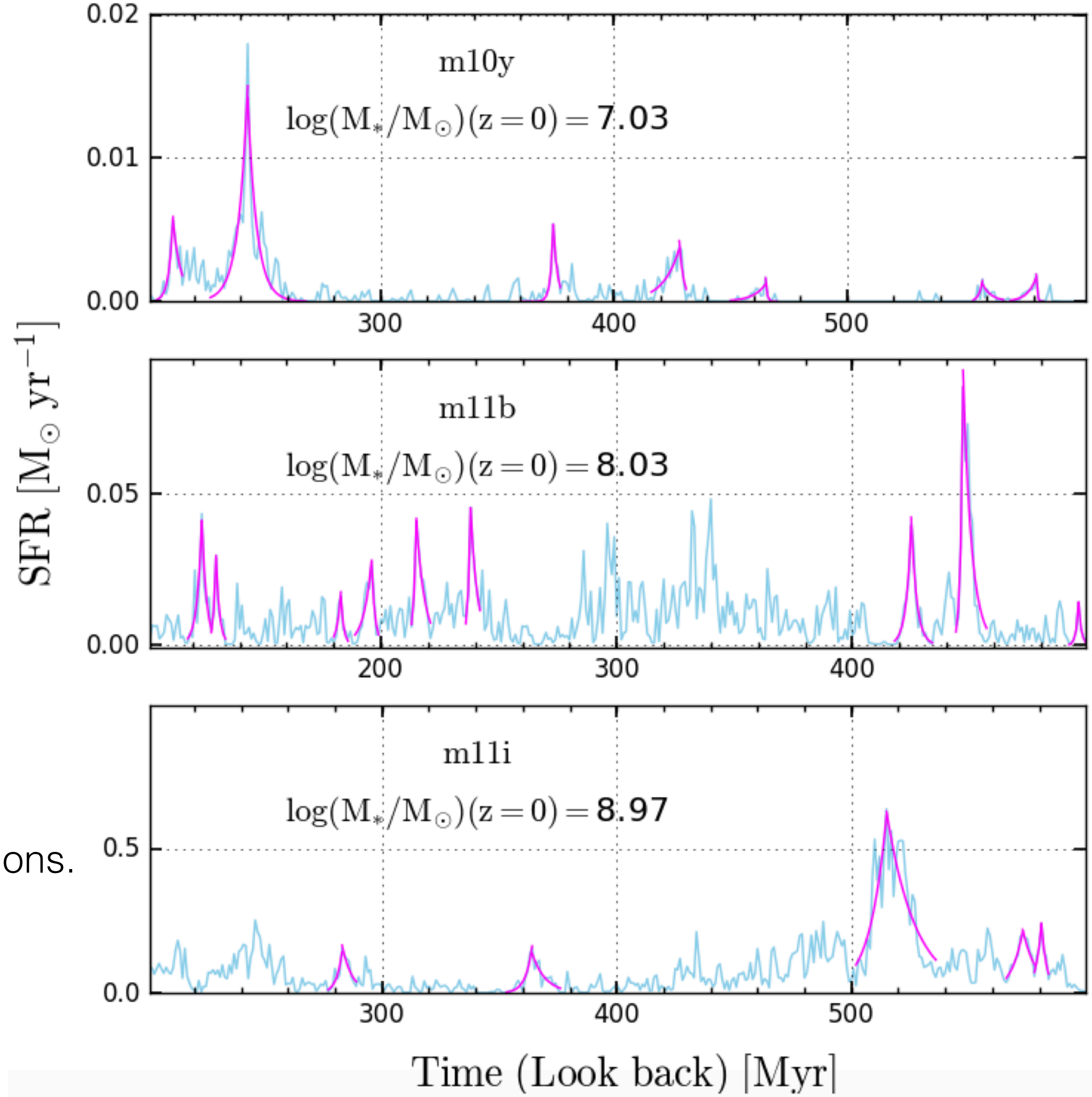
FIRE-2 SFHs (Hopkins et al. 2018)



Emami et al. (2018)

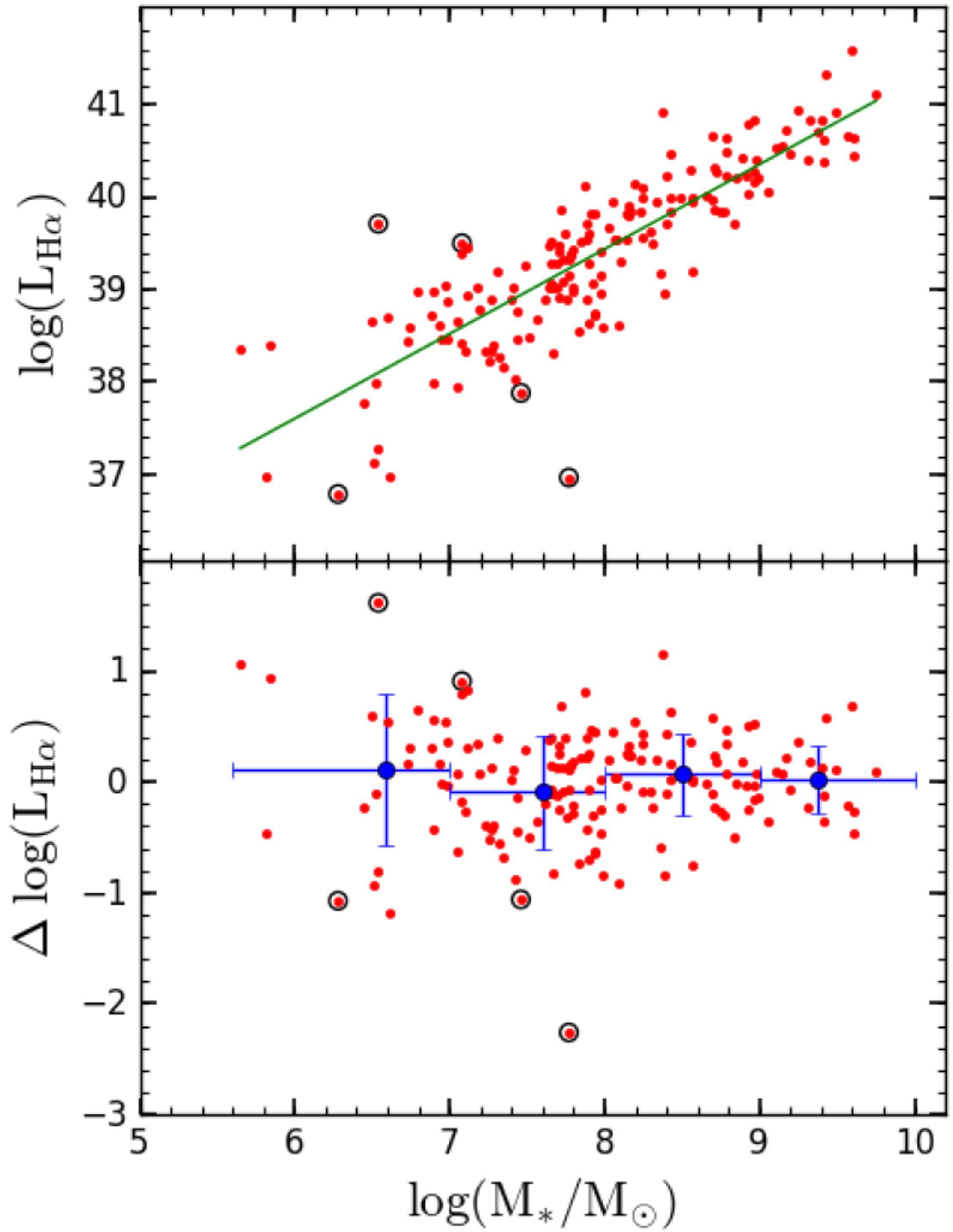
- Is this real?
- Implications for feedback prescriptions.
- If so, what are the implications for interpreting observables.

Characterizing Bursty Star Formation
z=0

Emami et al. (2018)

Lee et al. 2009, Meurer et al. 2009, McQuinn et al. 2010, Weisz et al. 2012,
Iyer et al. 2019, Caplar et al. 2019

- Large scatter in SFR-M* locally in dwarf galaxies
- Data from:
  - Lee et al. (2009)
  - Weisz et al. (2012)

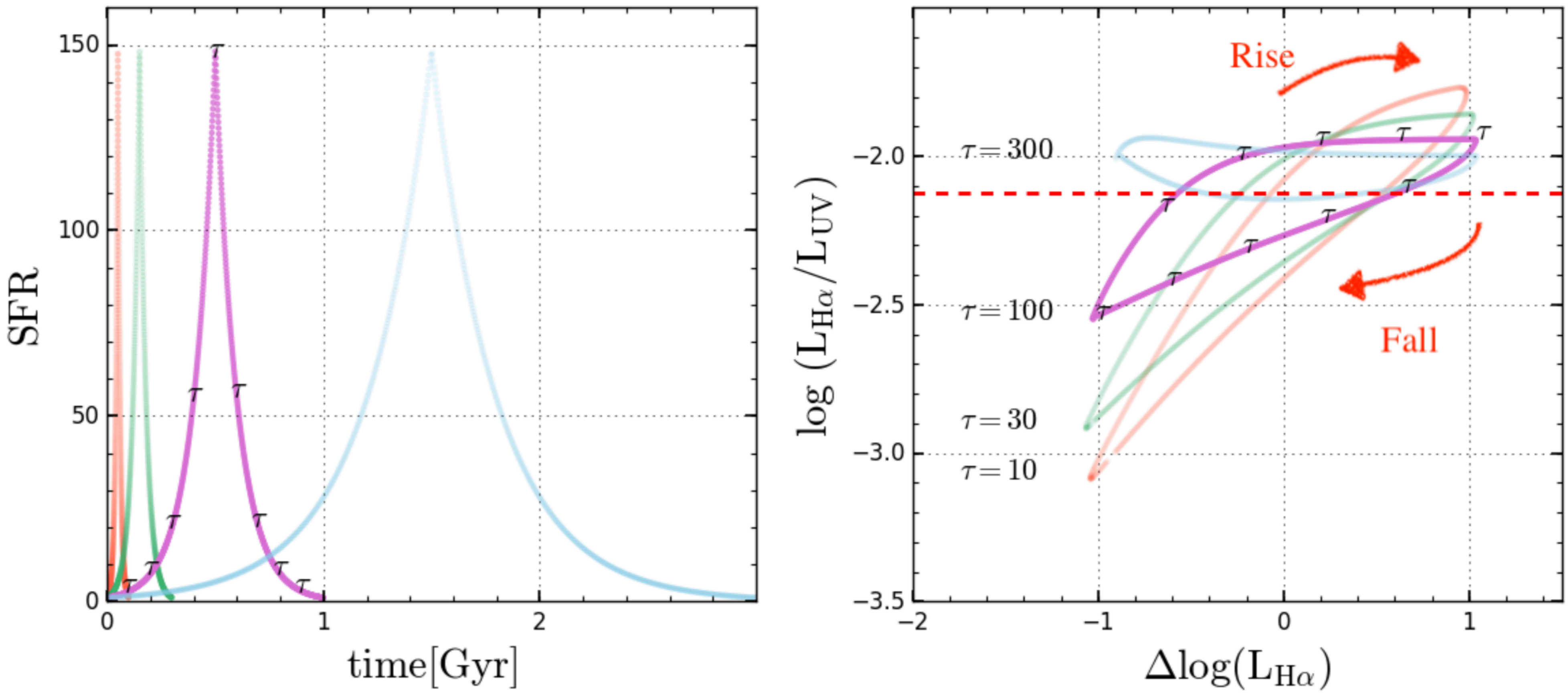


Emami et al. (2018)

$L_{H\alpha}$ → ~3-5 Myr

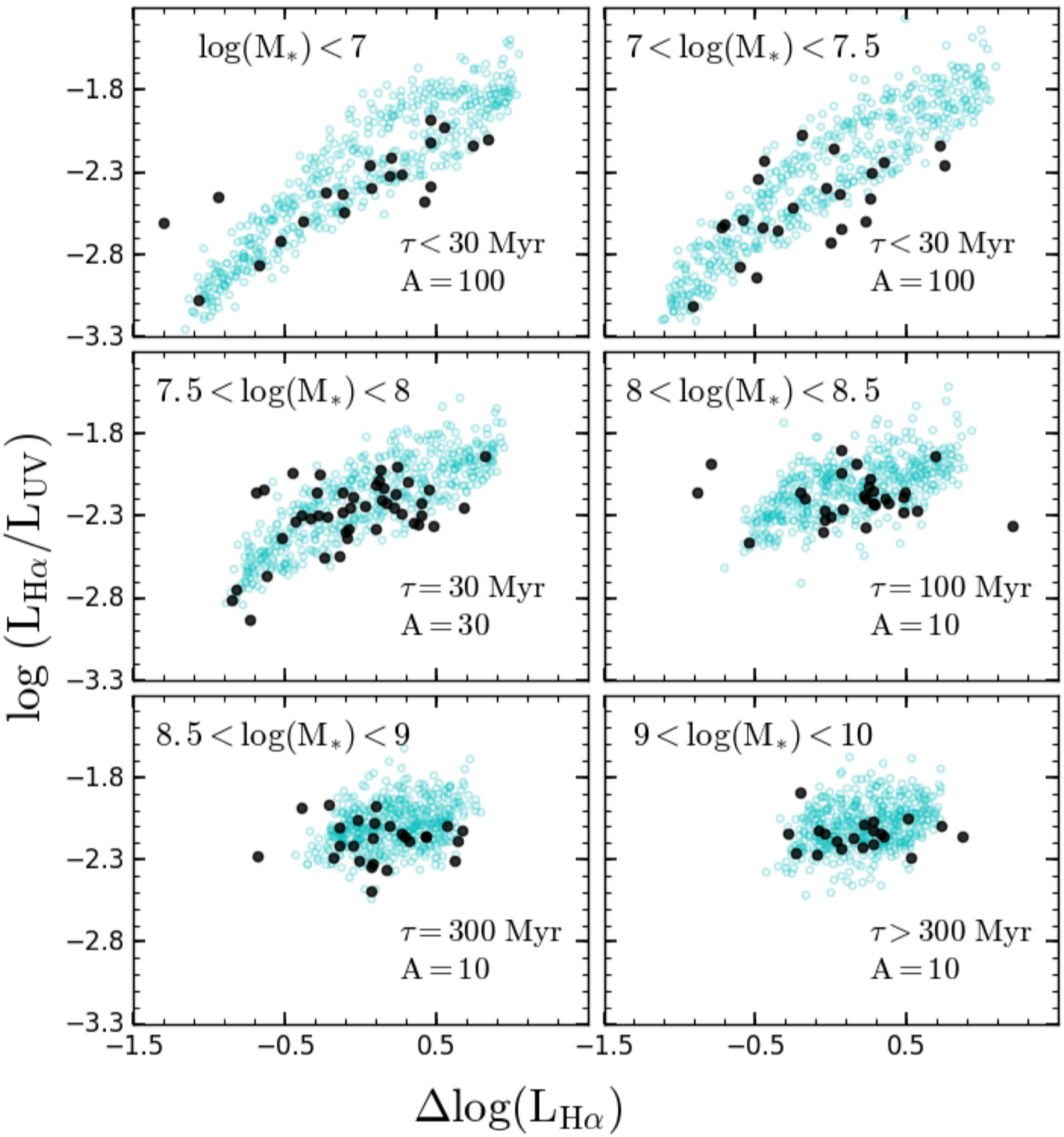
L_{UV} → ~20-100 Myr

Emami et al. (2018)



- Ask less of the data. Didn't try to fit duty cycle (duration/period).
- What is the timescale for star formation?

Emami et al. (2018)

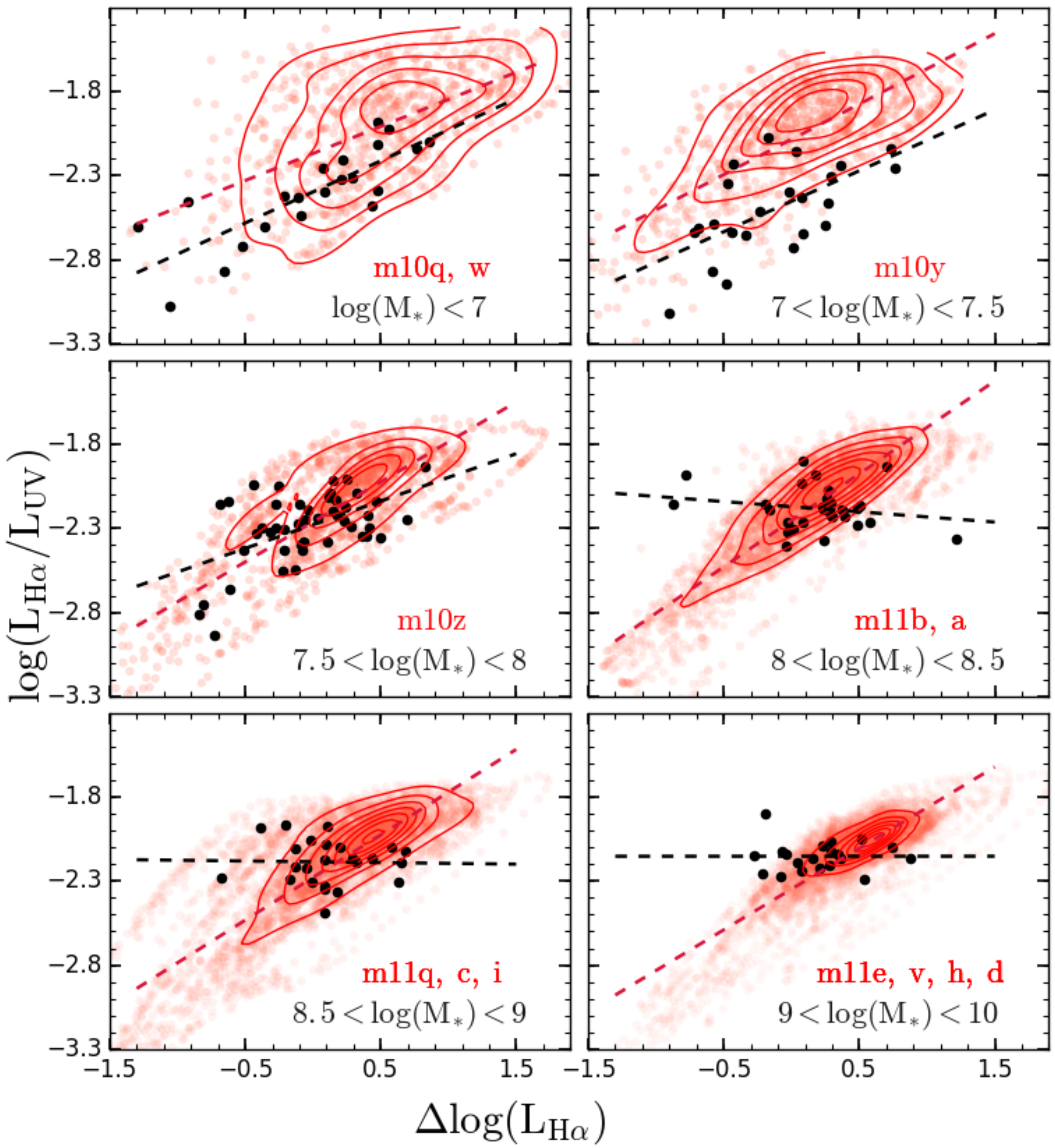


Black: Data

Blue: Model

- Dwarf galaxies are bursty.
- $\tau < 30$ Myr @ $M_* < 10^8$

Emami et al. (2018)

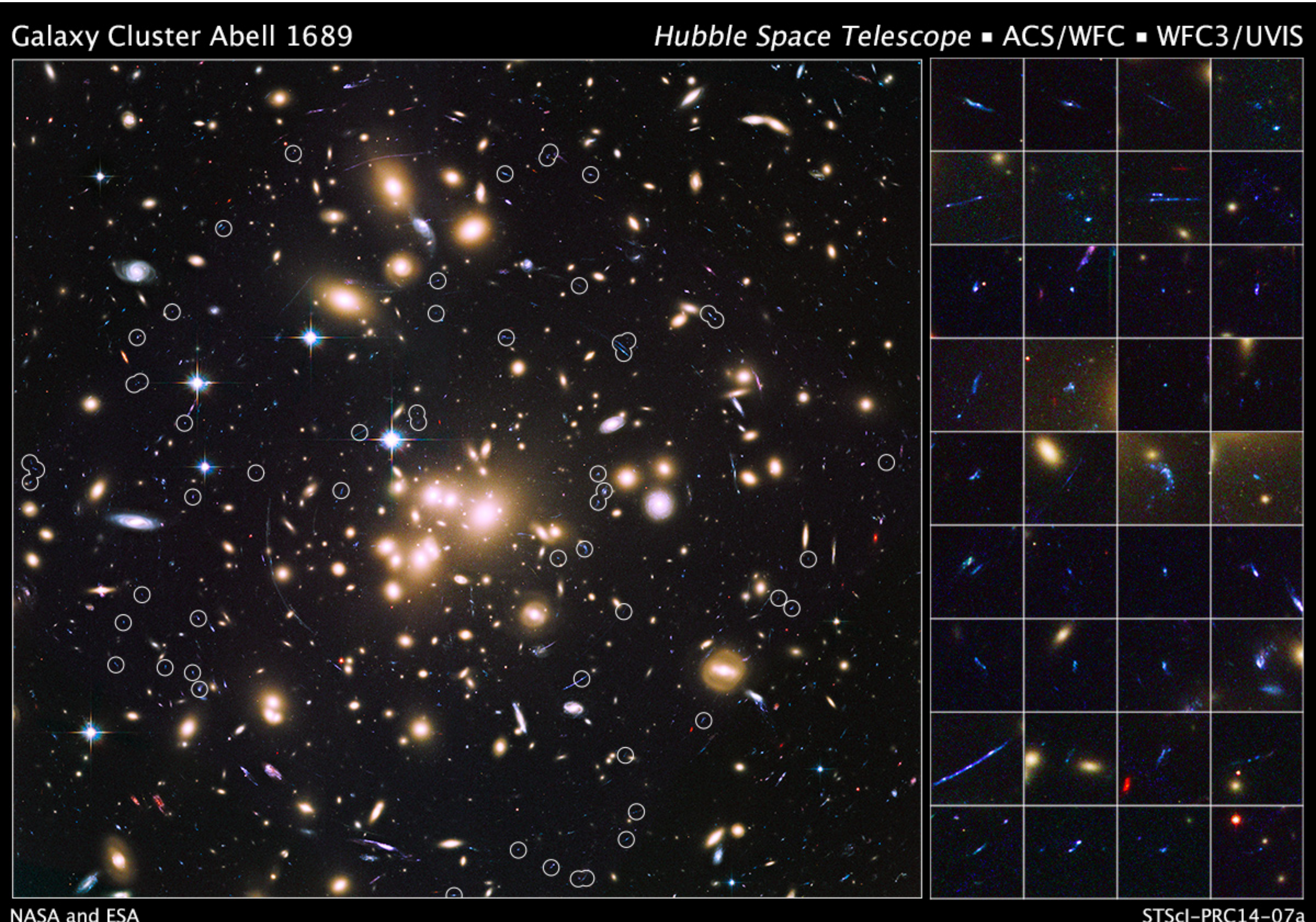


Black: Data

RED: FIRE-2 Simulations

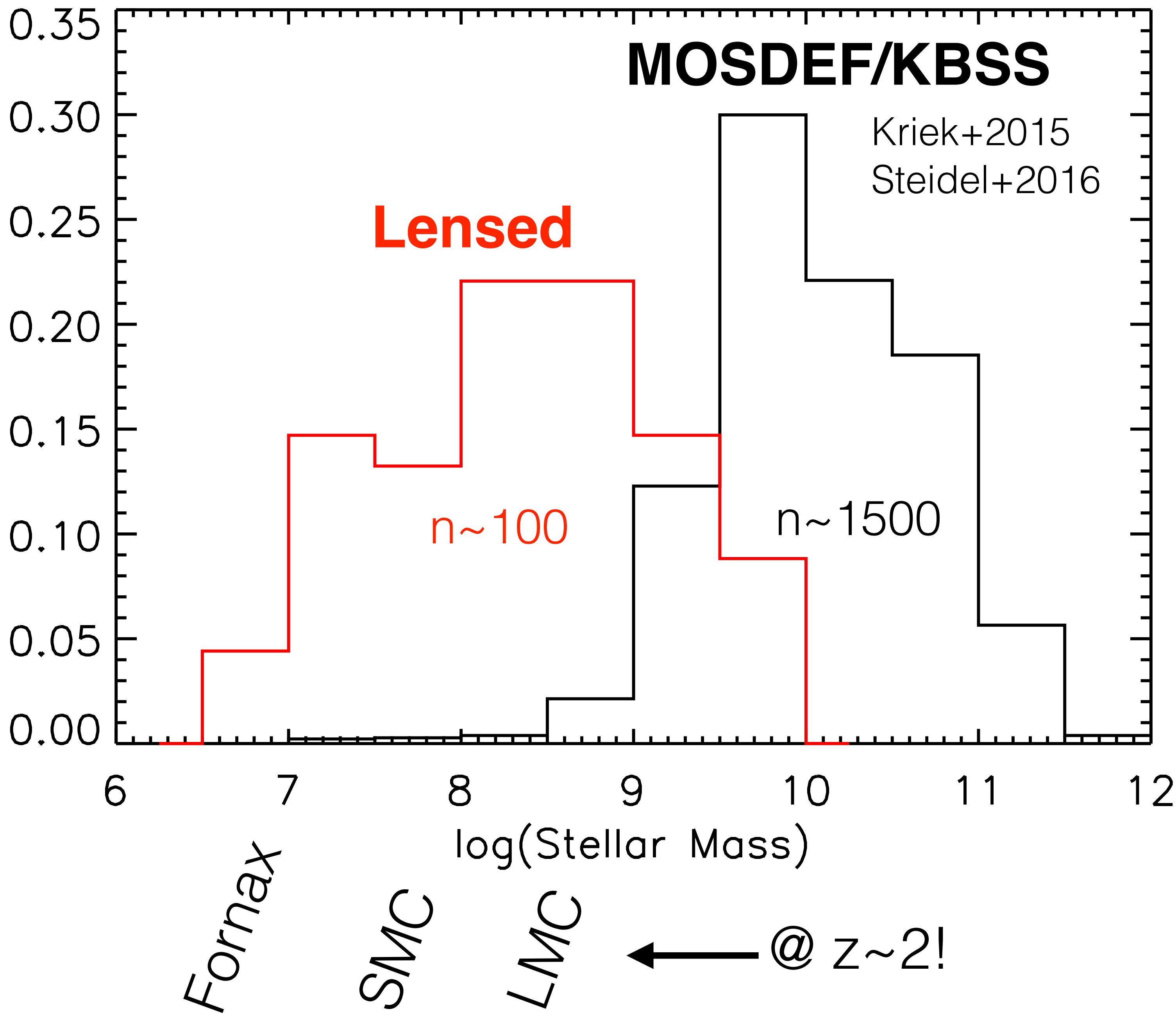
- Reasonable agreement with time scales and amplitudes of dwarf galaxies.
- Primary difference is in the more massive galaxies: FIRE-2 galaxies seem to be changing on shorter timescales than observed.

Bursty Dwarf Galaxies at z~2



Alavi et al. (2014, 2016)

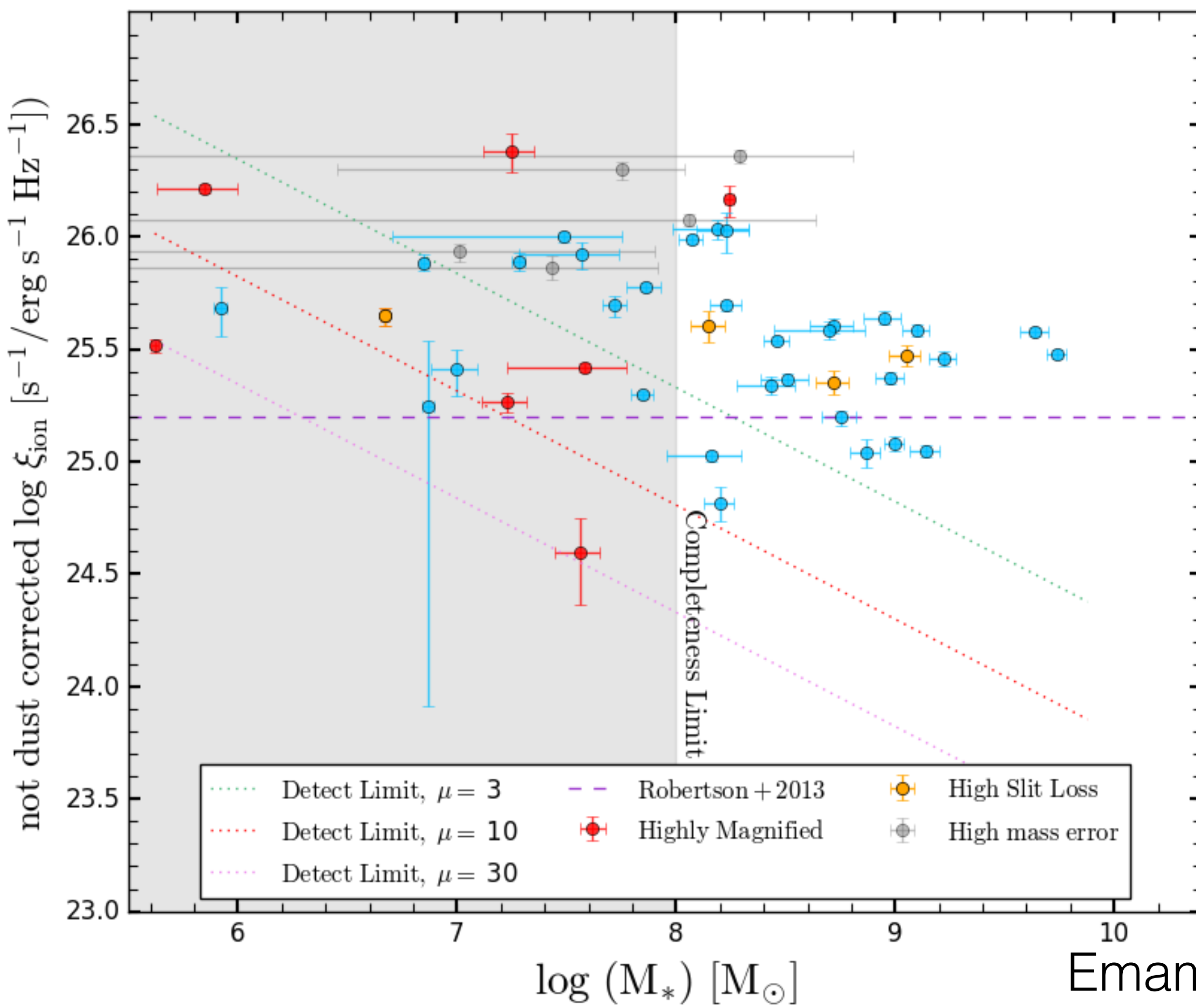
Keck Spectroscopic Follow-UP



Ionizing Photon Production Efficiency

$$\xi_{ion} = \frac{\text{Ionizing Photon Rate}}{L_{UV}} = C\frac{L_{H\alpha}}{L_{UV}}$$

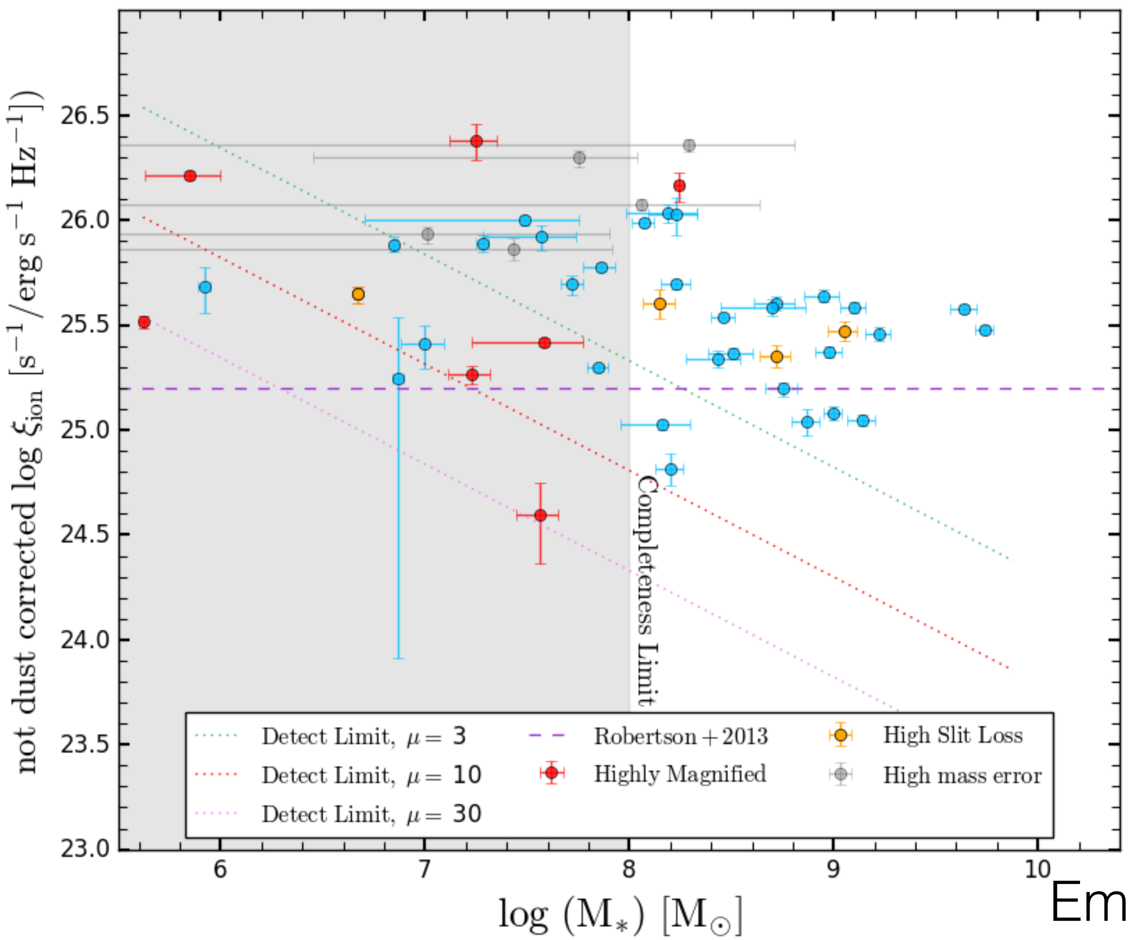
$$C\frac{L_{H\alpha}}{L_{UV}}$$



Emami et al. (in prep.)

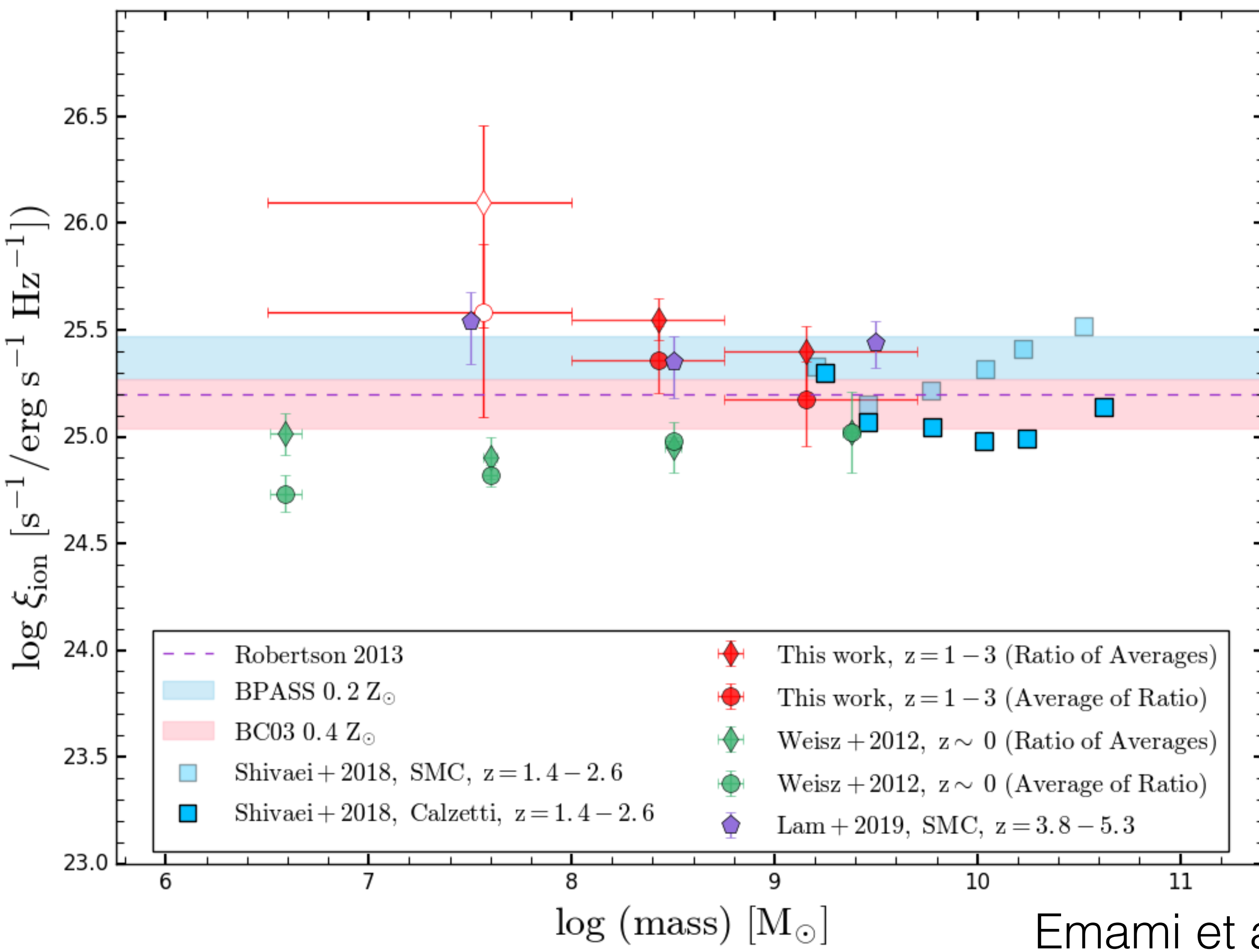
Ionizing Photon Production Efficiency

- Question #1: What is the "typical" galaxy?
  - Median or average of $\log(\xi_{ion})$
- Question #2: What is the conversion from luminosity functions to ionizing photon production rate (per unit volume)?
  - Add up all ionizing photons divided by total UV luminosity density.

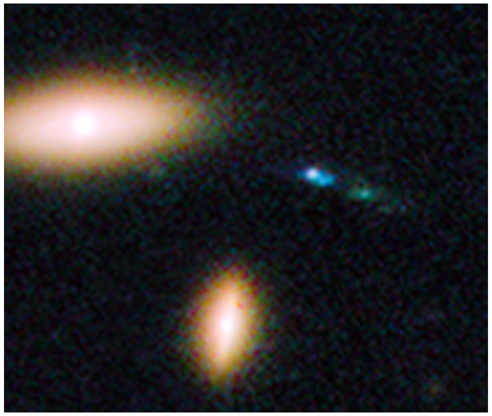


Emami et al. (in prep.)

- ~0.2 dex more ionizing photons when considering bursty SF.
- Small trend with stellar mass at z~2
- Evolution of 0.3 dex (factor of ~2) from z~2 to z~0 (iron deficiency in early universe) (a la Steidel et al. 2016).

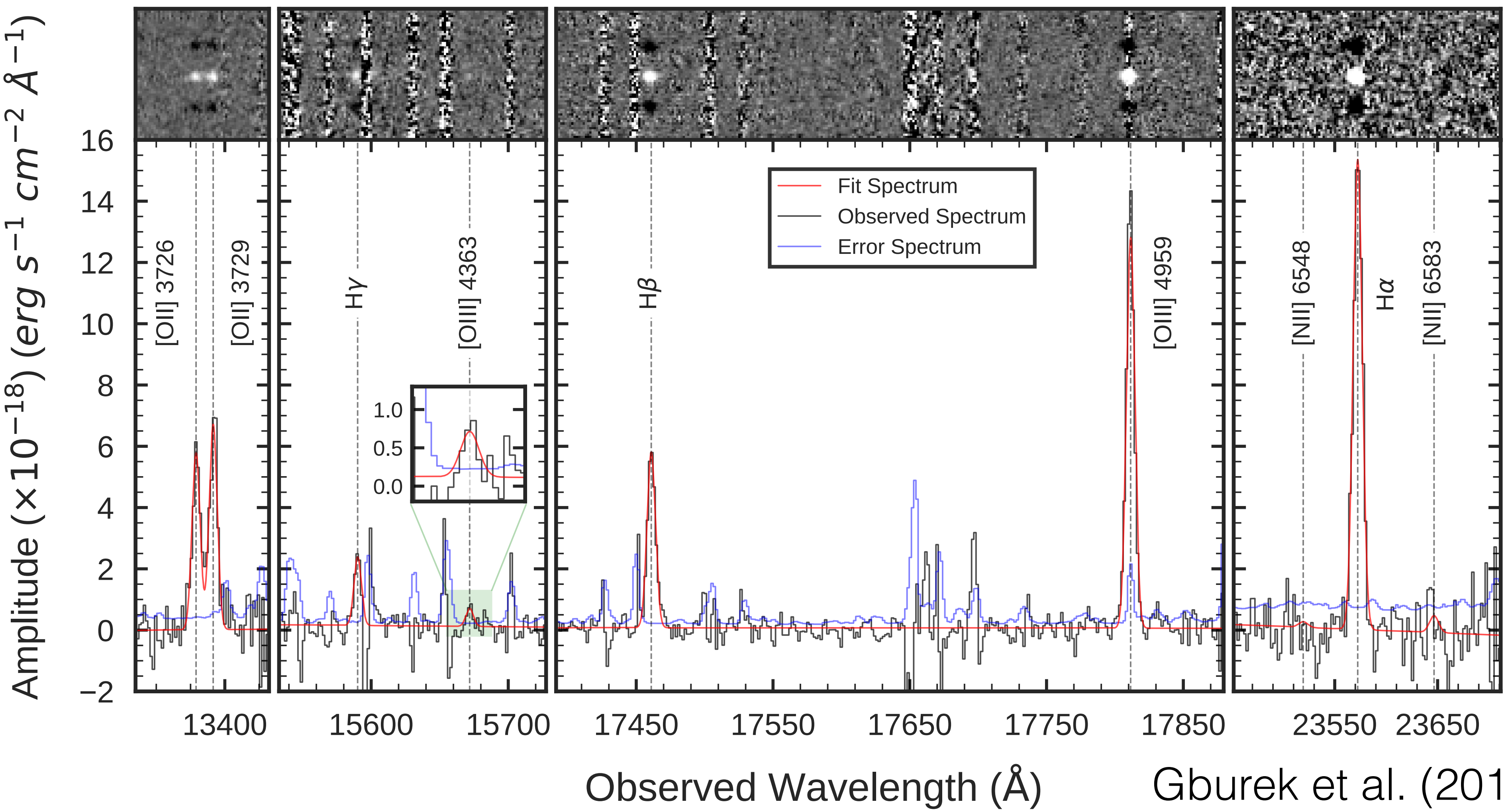


Emami et al. (in prep.)



z_{spec}	2.59
Magnification	8
$\log(M_{stel})$	~ 8.1
M_{UV}	-18.7
12+log([O/H])	8.06±0.12 (1/4 Z_{solar})

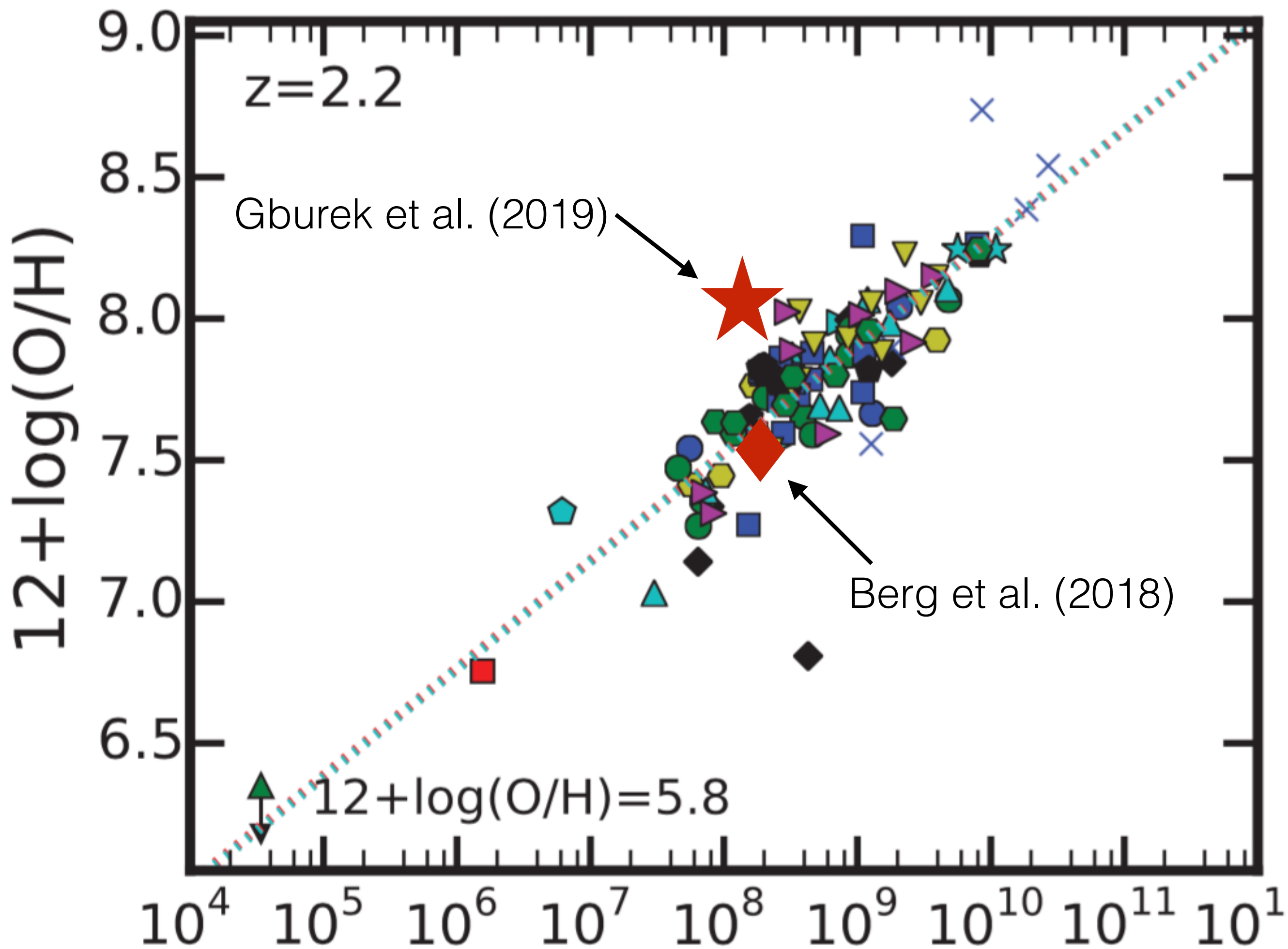
Gburek et al. (2019)
arxiv:1106.11849



Gburek et al. (2019)

Mass-Metallicity Relation

- A likely increased scatter in mass-metallicity relation at low mass.



FIRE: Ma et al. 2016

Conclusions

- z~0
  - Galaxies "bursty" at $M_* < 10^8 M_\odot$.
  - Timescale for SFR changes disagrees with FIRE-2 sims at *high* mass.
- z~2
  - Galaxies "bursty" at least up to $M_* \sim 10^{8.5} M_\odot$.
  - No ξ_{ion} change with mass.
  - Evolution of ξ_{ion} with redshift.
  - Fe/H evolution with z more important than O/H change with mass.

  - Likely a large scatter in O/H at low metallicity, possibly due to bursty SF.