MOSEL SURVEY: EXTREMELY WEAK OUTFLOWS IN EPOCH OF REIONISATION ANALOGUES AT Z~3

Anshu Gupta

ASTRO 3D Fellow
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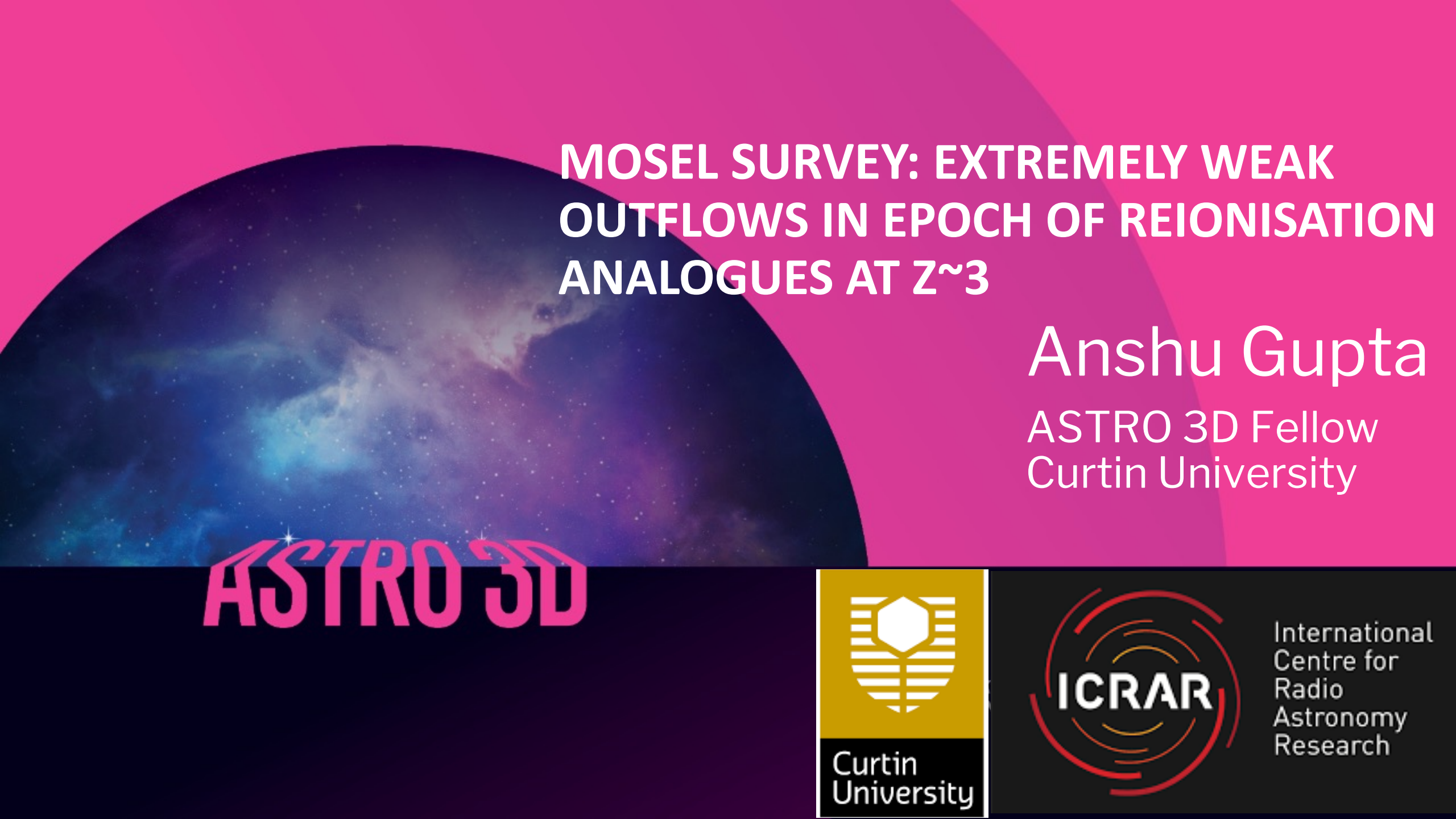
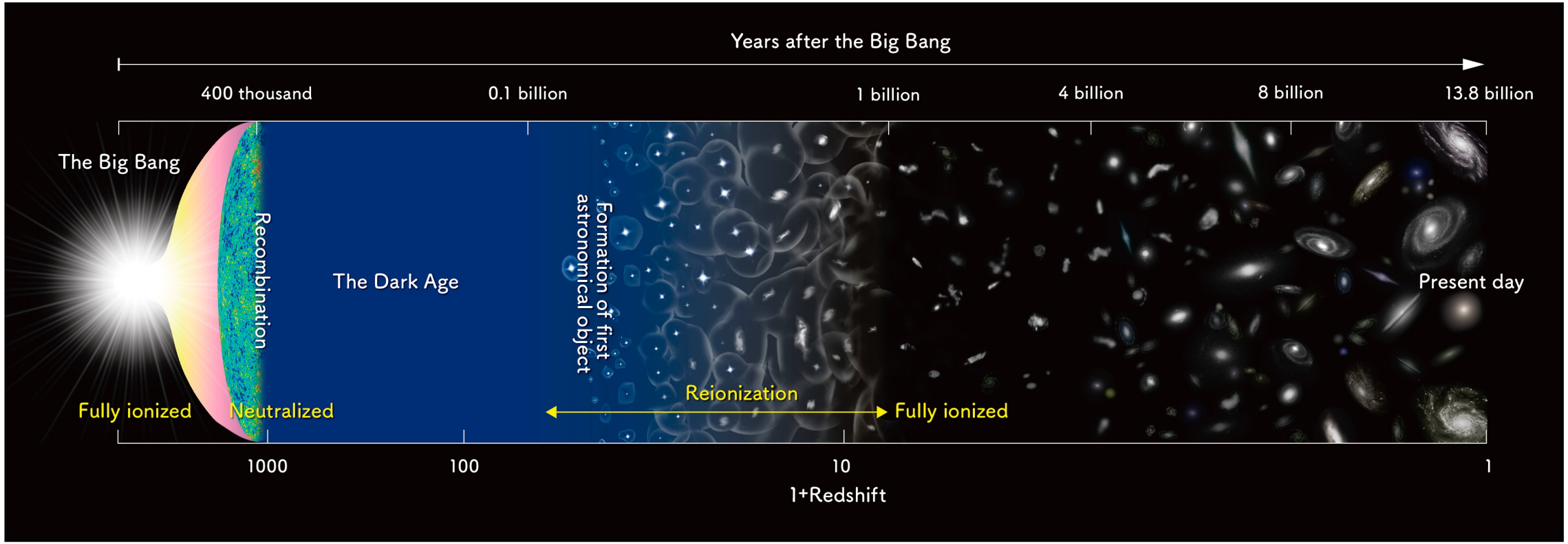


Curtin University

ICRAR International Centre for Radio Astronomy Research

RE-IONISATION OF THE UNIVERSE



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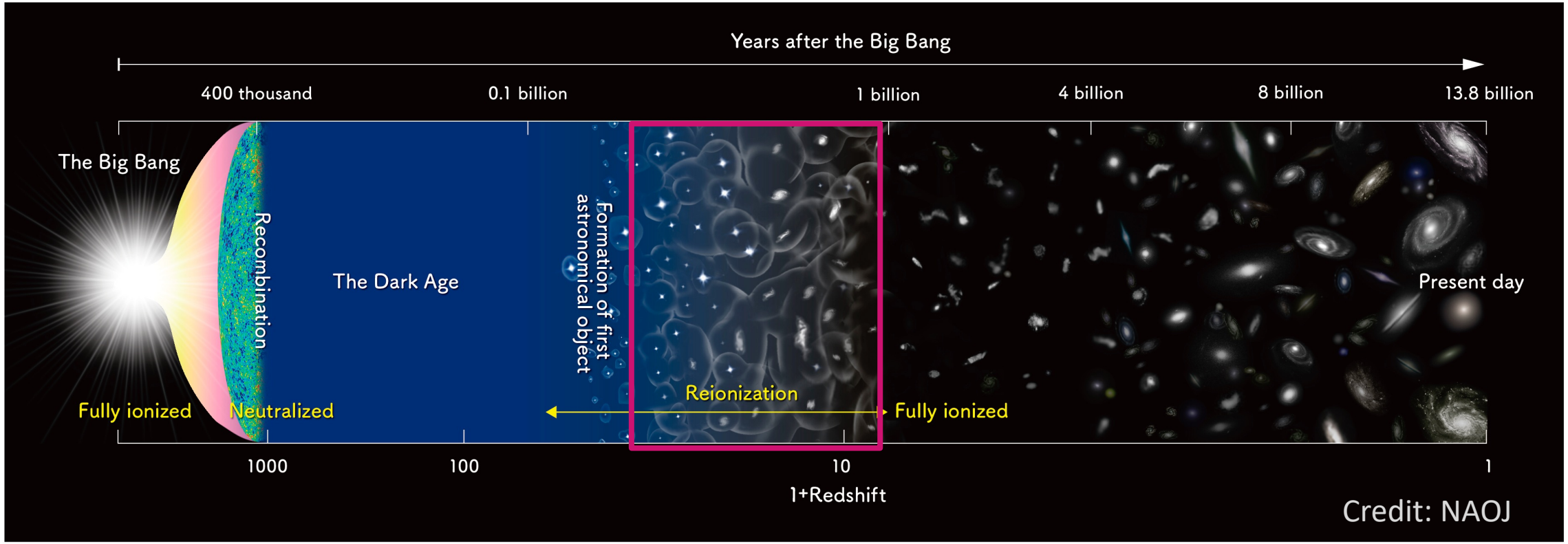
RE-IONISATION OF THE UNIVERSE



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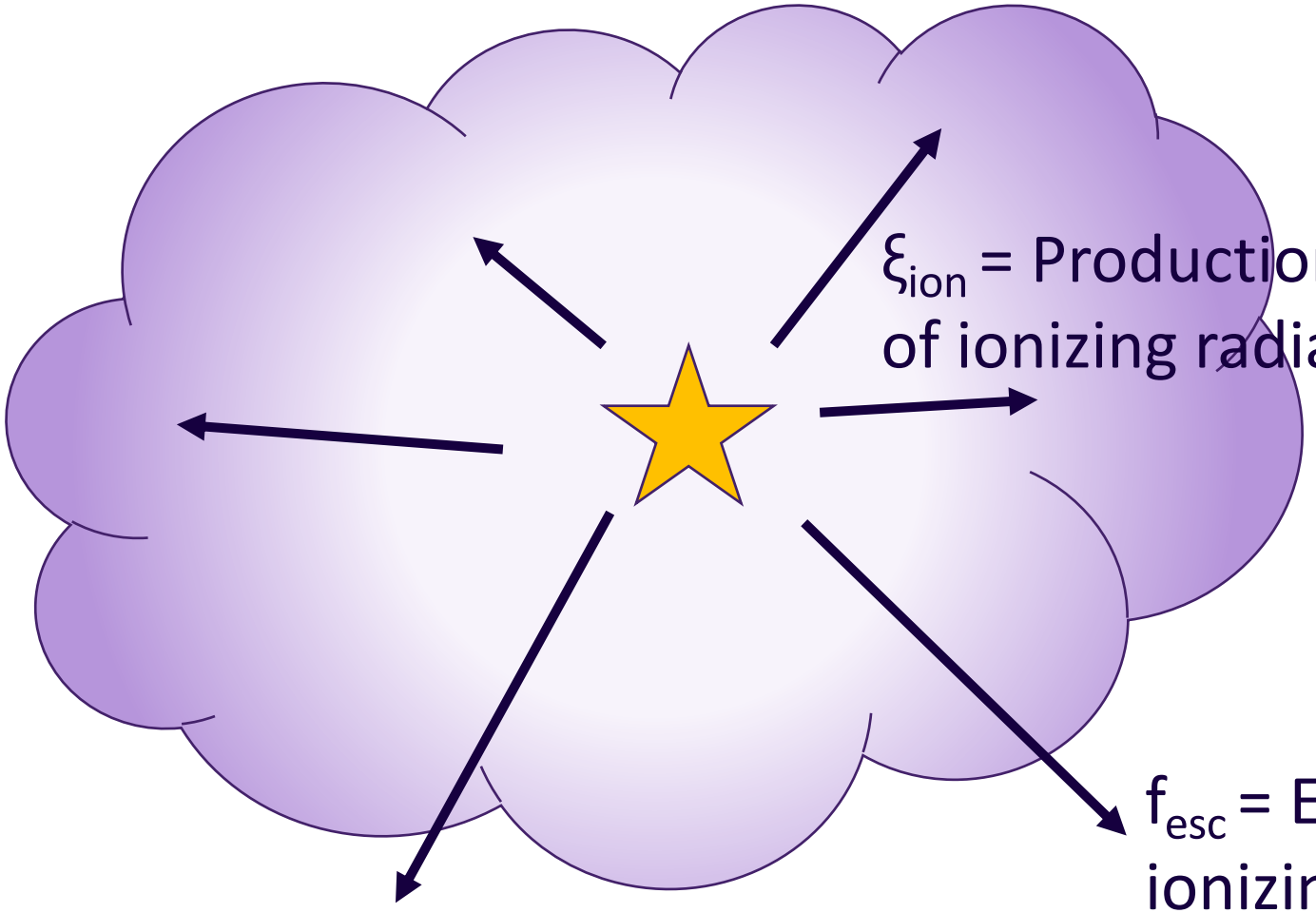

ξ_{ion} = Production efficiency of ionizing radiation

f_{esc} = Escape fraction of ionizing radiation

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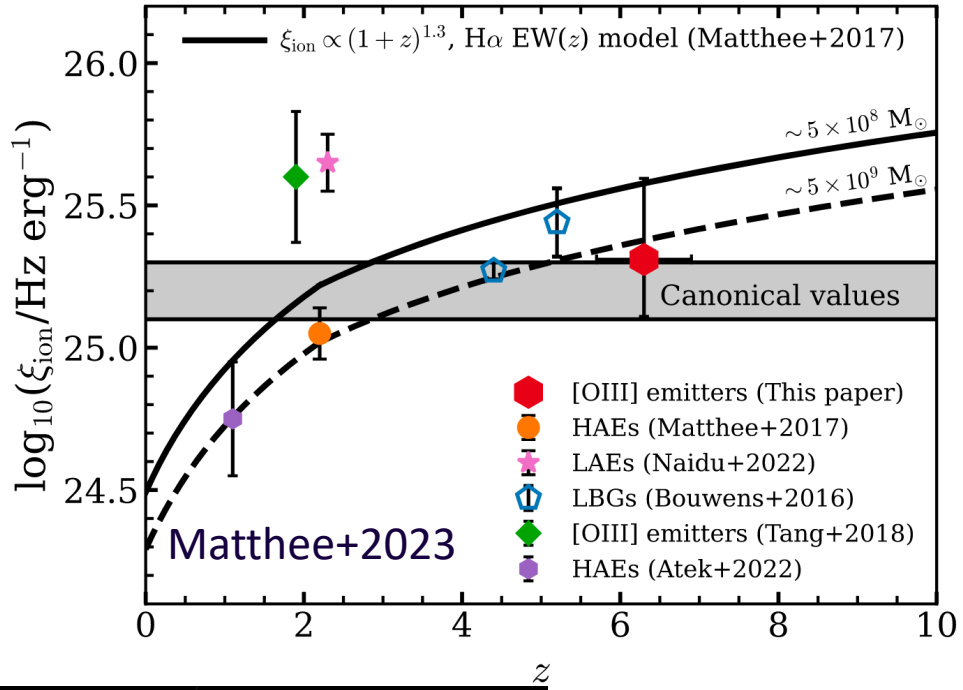
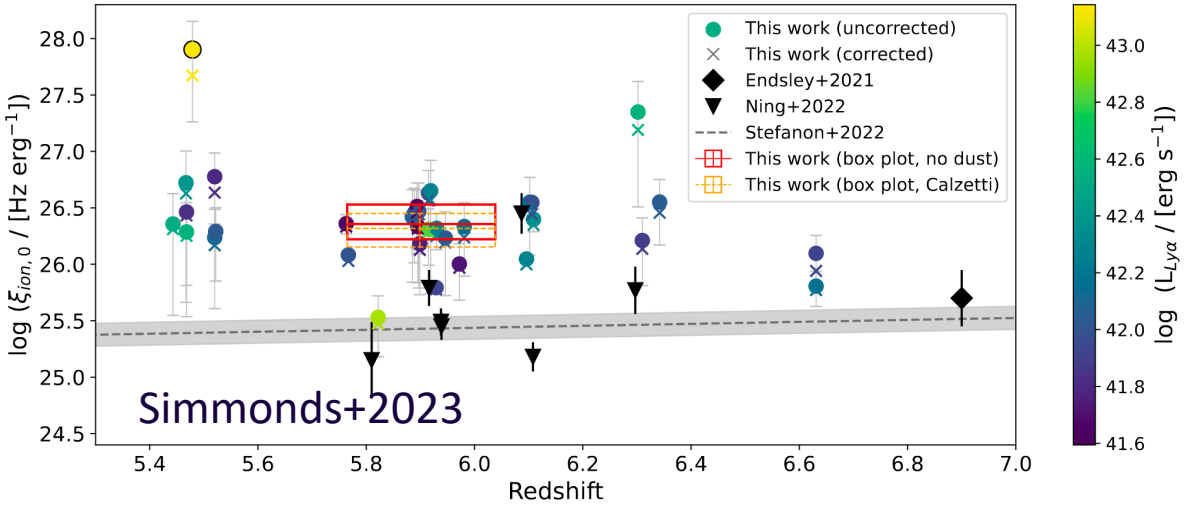
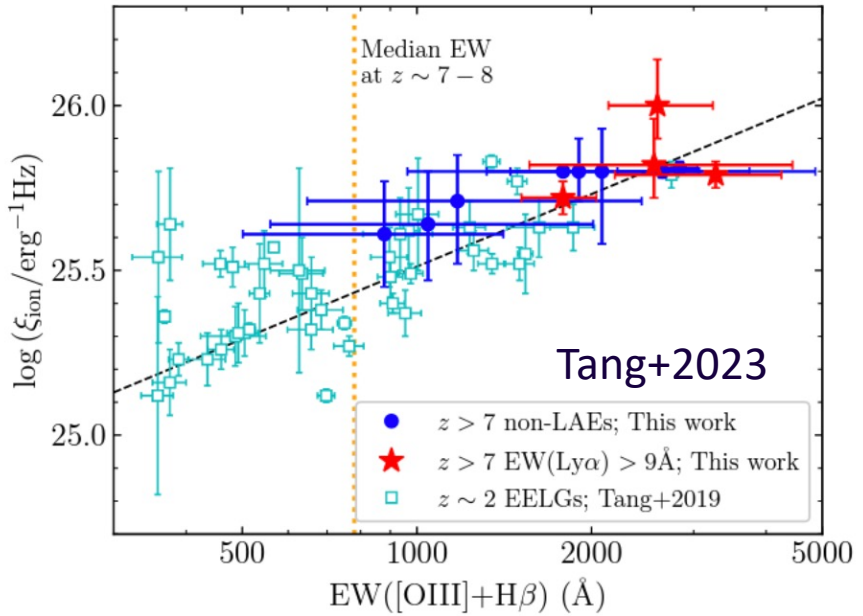
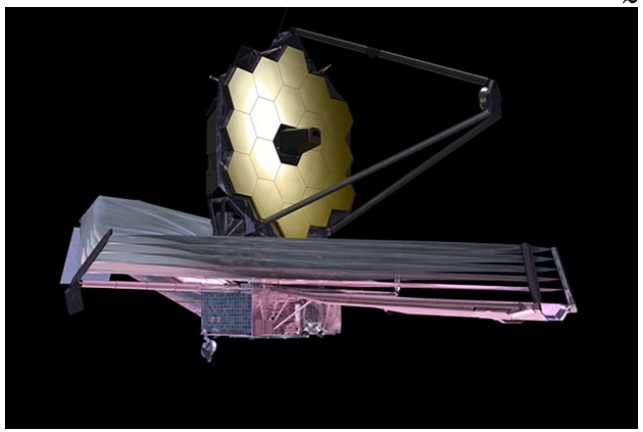
IONISING PHOTON PRODUCTION DURING EOR









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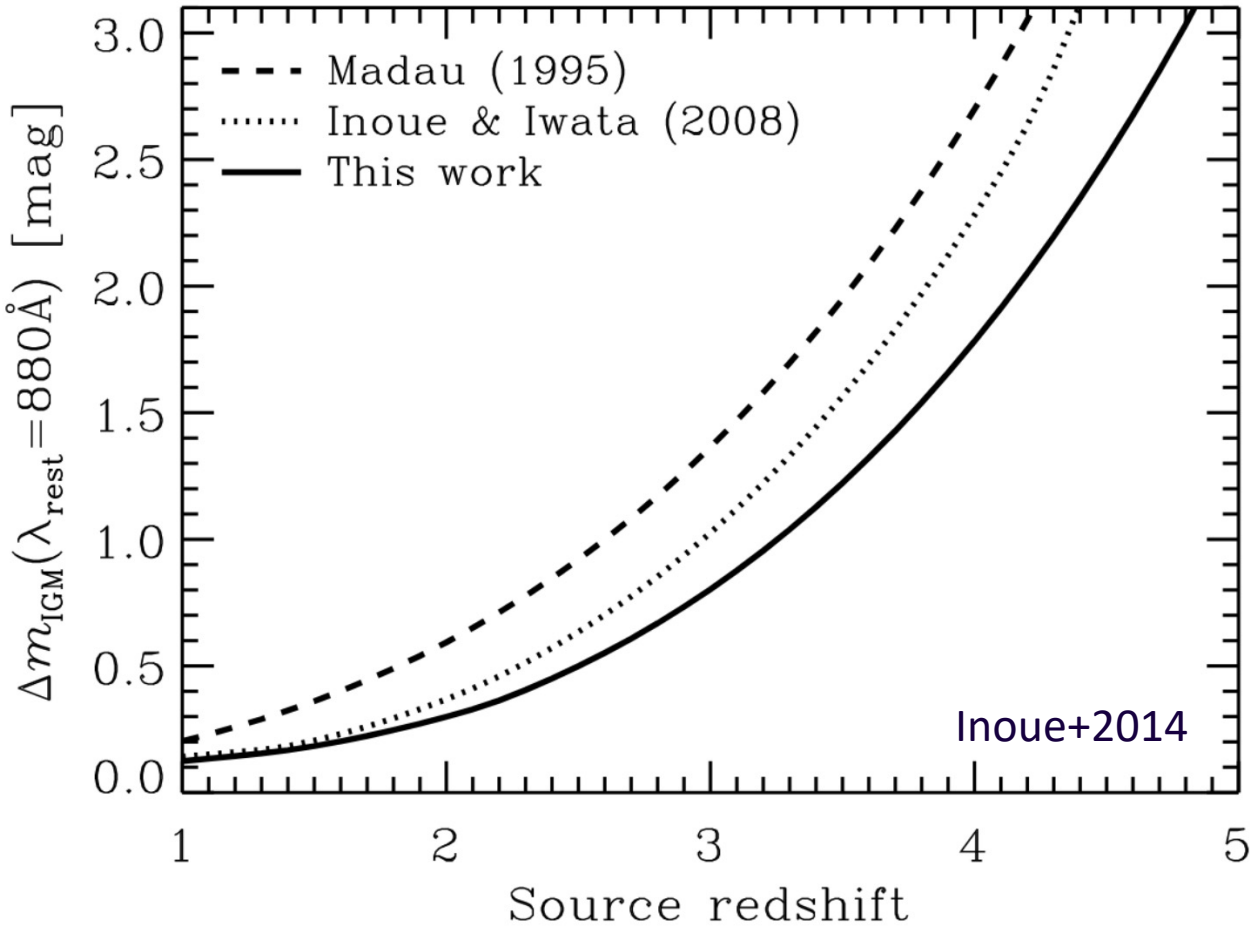
ESCAPE FRACTION

IGM Absorption



Intergalactic medium absorbs all Lyman-continuum photons at z>6

Solution: Low redshift analogs

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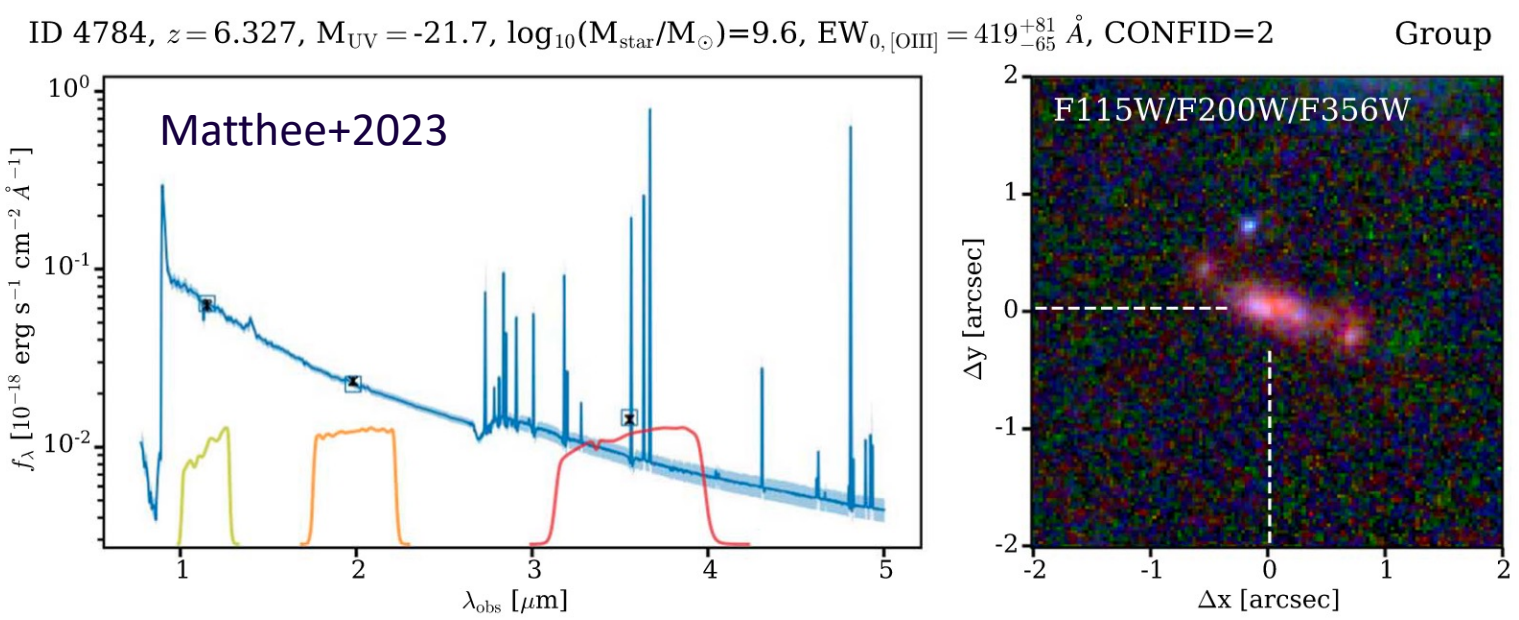

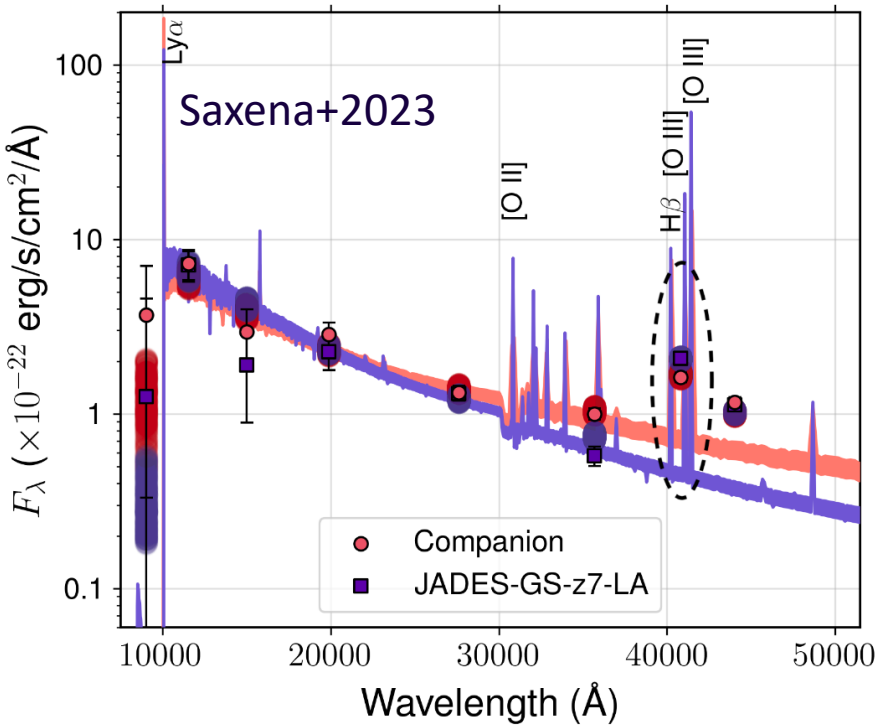

Limited photometric sampling for most z>6 galaxies.

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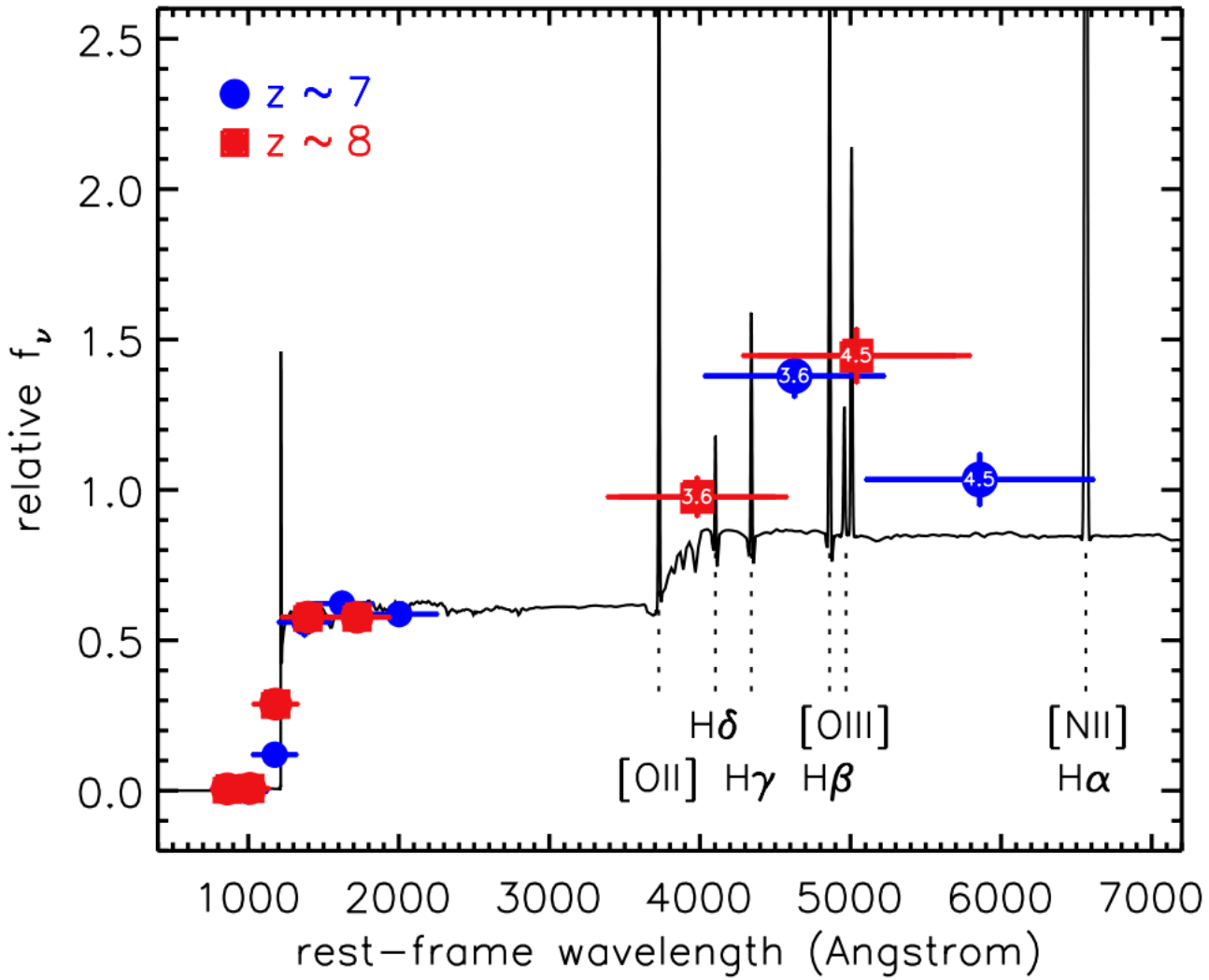
SOURCES OF RE-IONISATION – EXTREME EMISSION FEATURE



Low stellar mass, high star formation rate result in high emission line equivalent widths.

Labbe et al., 2013

See also Roberts-Borsani et al. 2016; Stark et al. 2017; De Barros et al. 2019; Endsley et al. 2020

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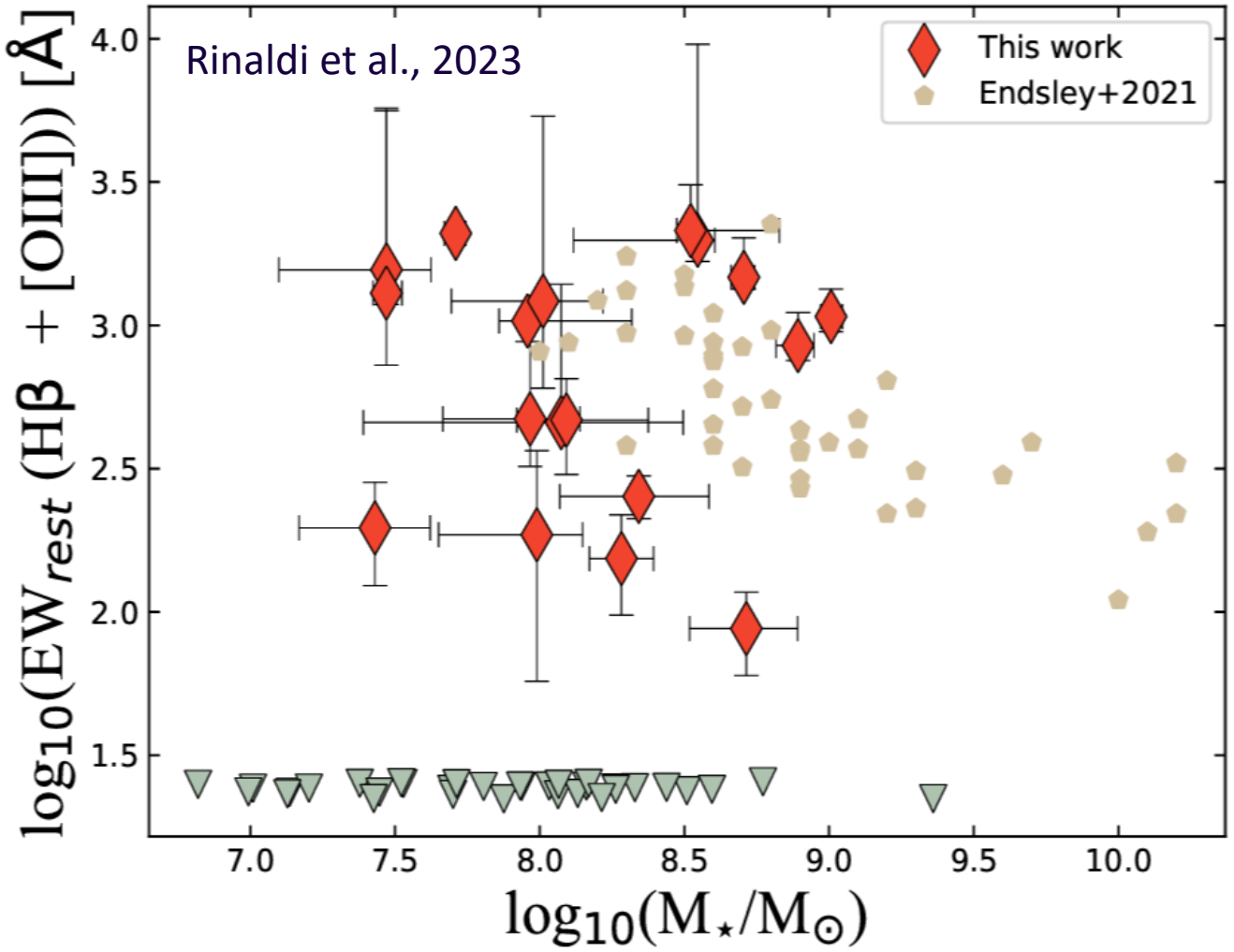
SOURCES OF RE-IONISATION – EXTREME EMISSION FEATURE



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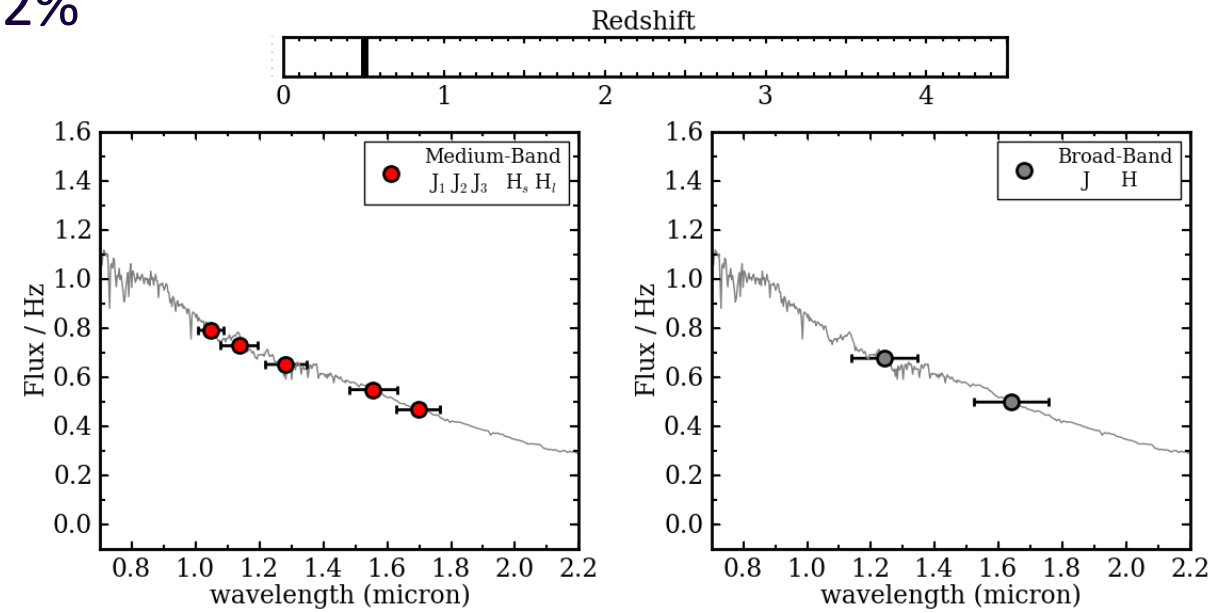
EXTREME EMISSION LINE GALAXIES AT 2.5<Z<4

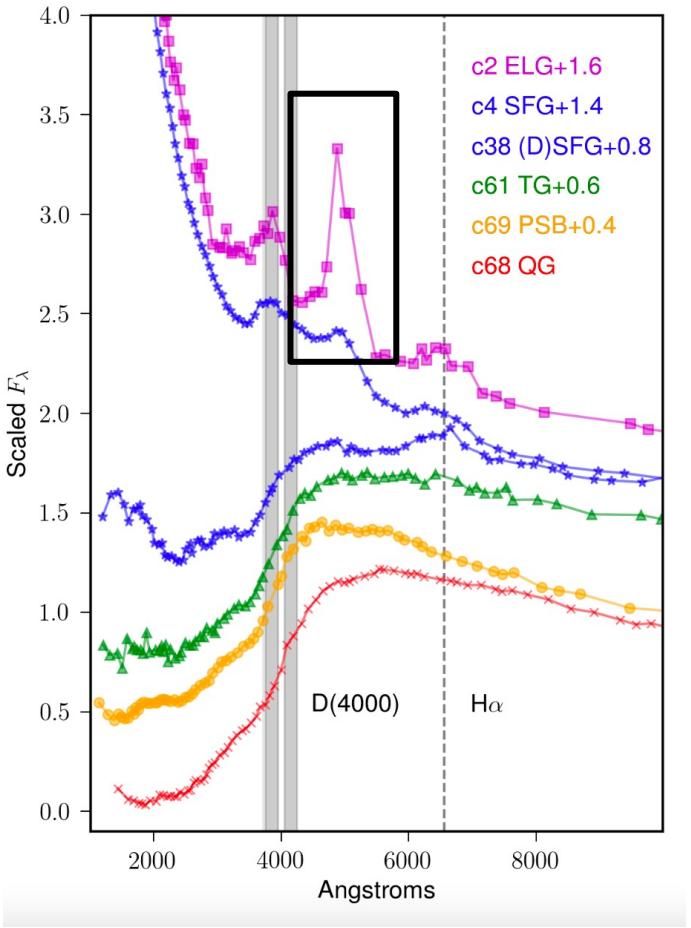
ZFOURGE Survey

Deep medium band photometry in J ad H band gives σ(photo_z) < 2%



Credit: Adam Tomczak

Forrest et al., 2018



~100 galaxies Extreme emission line galaxies at 2.5<z<4 with [OIII]+Hbeta EW > 600A

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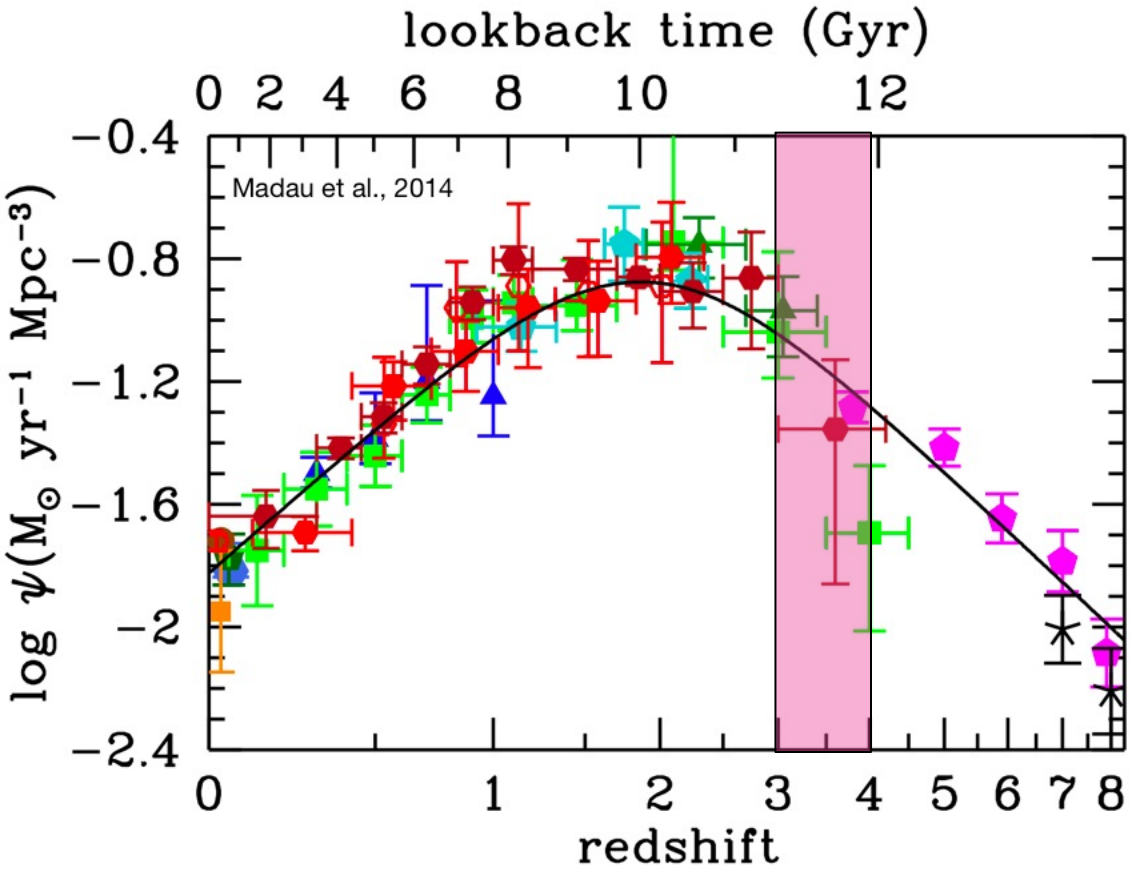
MOSEL SURVEY

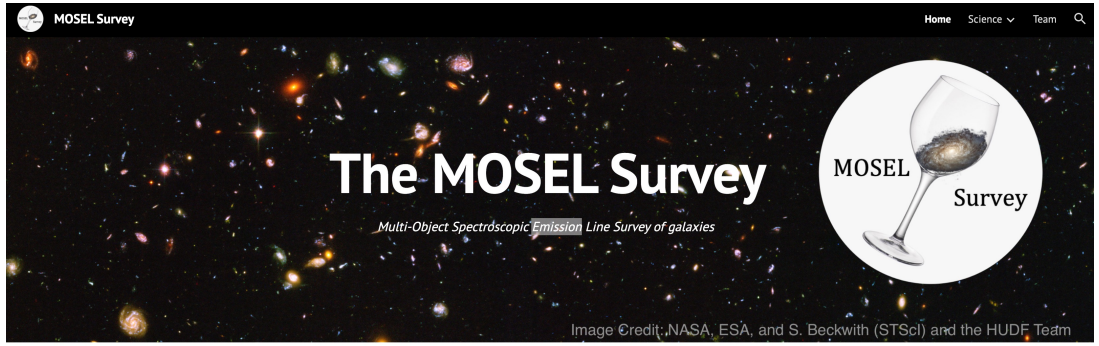
MULTI-OBJECT SPECTROSCOPIC EMISSION LINE SURVEY



Tran,.., Gupta et al., 2020

Census of emission line galaxies when Universe was only 1 billion-year-old with Keck/VLT.

Website:
https://sites.google.com/view/moselsurvey/home



Rise and fall of star formation 12 billion years ago

Named after the beautiful wine regions in Germany, The Multi-Object Spectroscopic Emission Line (MOSEL) survey is an ongoing survey of star-forming galaxies around 12 billion light years away. The main objective is identify factors affecting the rise and fall of star formation activity in young galaxies.

Our targets include some of the most intensely star forming galaxies at $z=3-4$ that are analogs to the galaxies during the epoch of reionization. These analogs we will help us estimate the production efficiency of hydrogen ionizing photons and the growth of the ionization bubbles created by the "first galaxies" in the first billion years.

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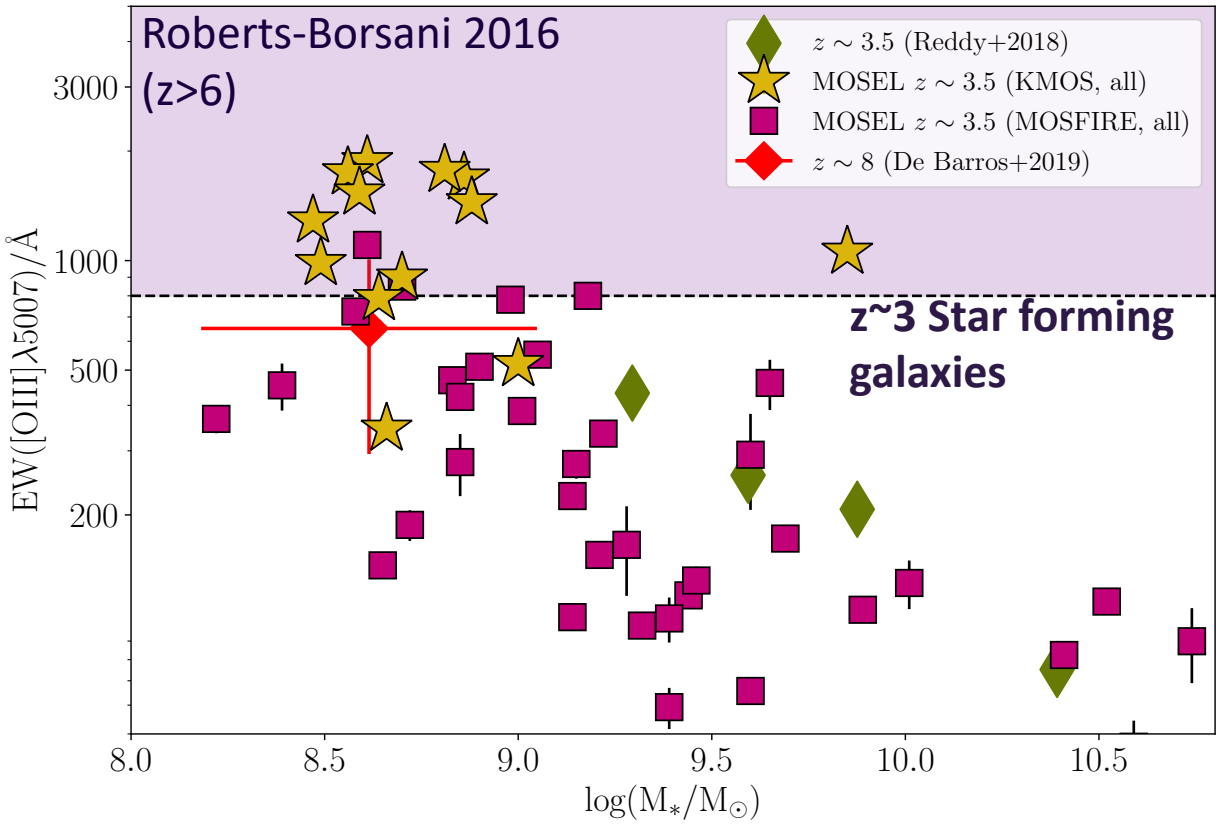
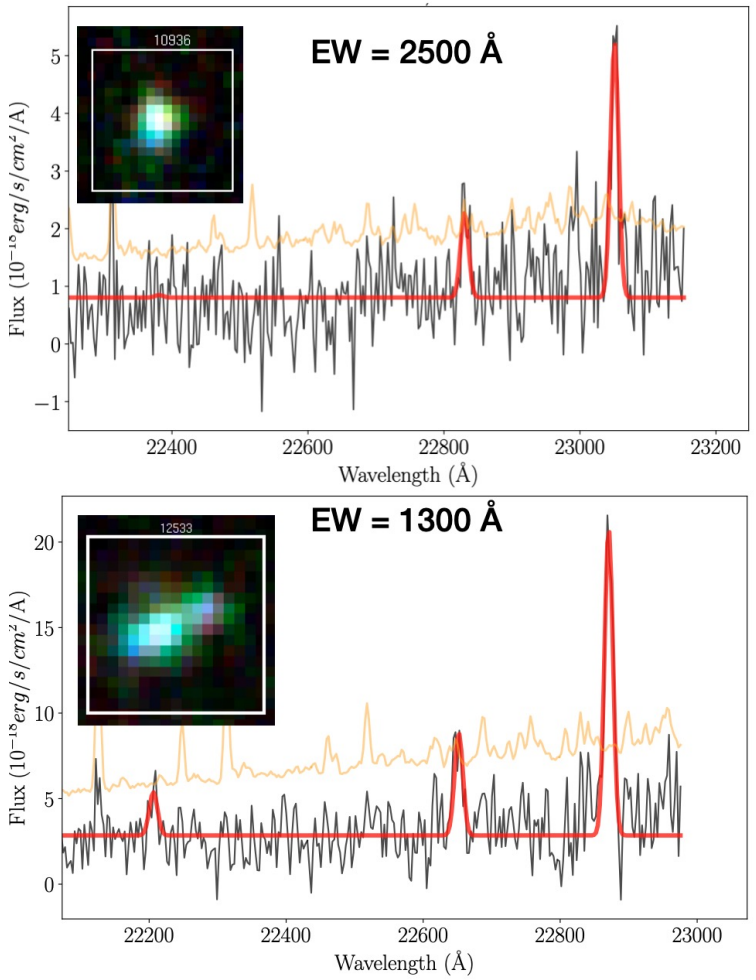
CONFIRMING THE EXTREME EMISSION FEATURE

Targets:

MOSFIRE/Keck –[OIII]+Hβ EW > 200 Å

KMOS/VLT - [OIII]+Hβ EW > 600 Å





Gupta et al., 2023

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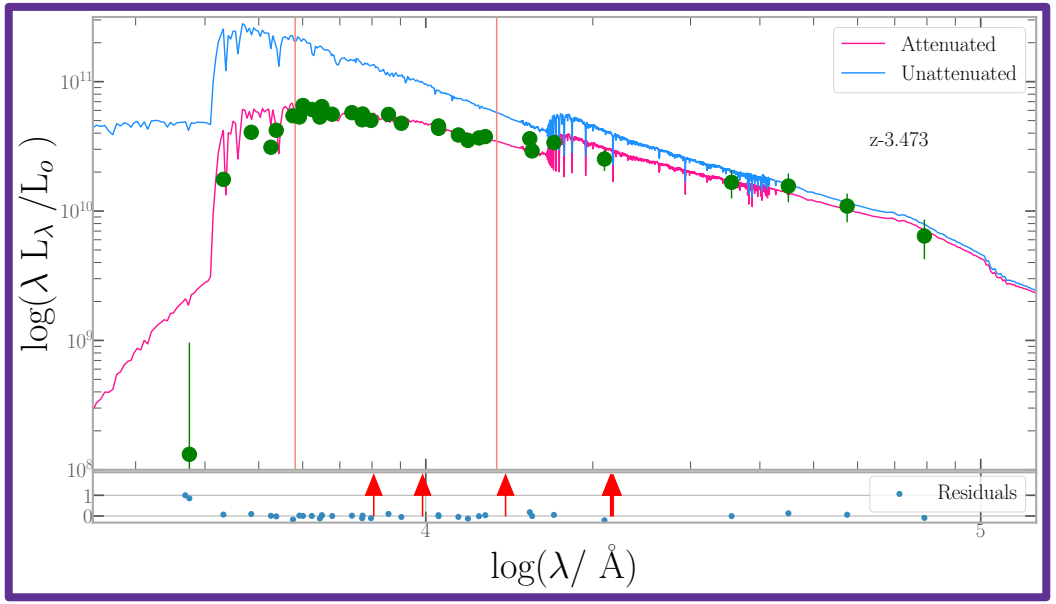
PHYSICAL PROPERTIES OF EELGS

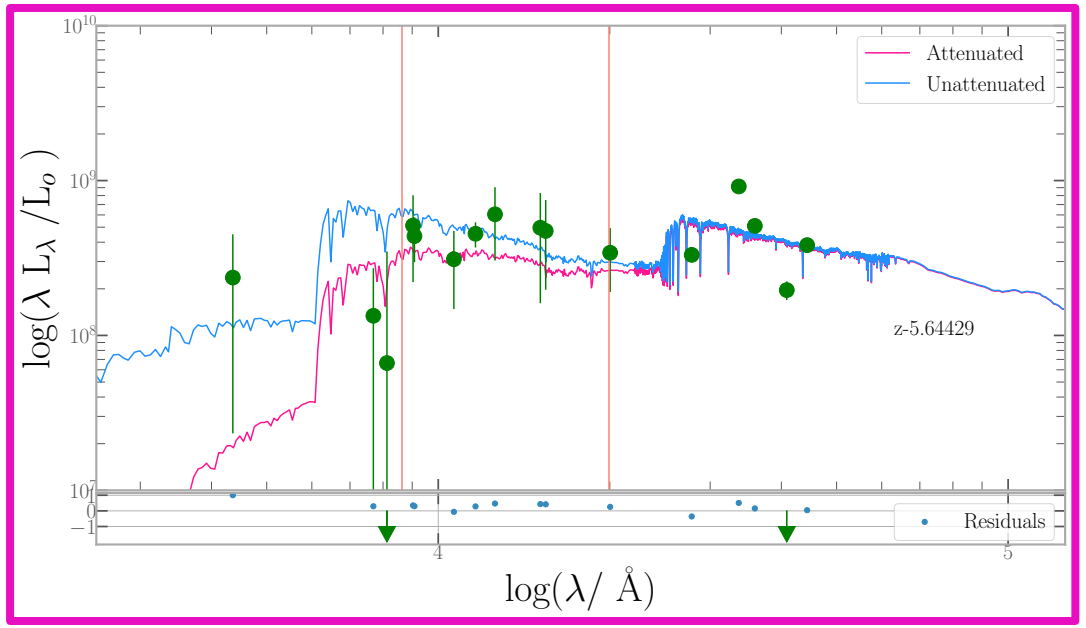
Using MAGPHYS SED-fitting code (Da Cunha+2008)



EELGS – ZFOURGE z~3

Ravi Jaiswar

JADES – z~6



Jaiswar, Gupta et al., in prep

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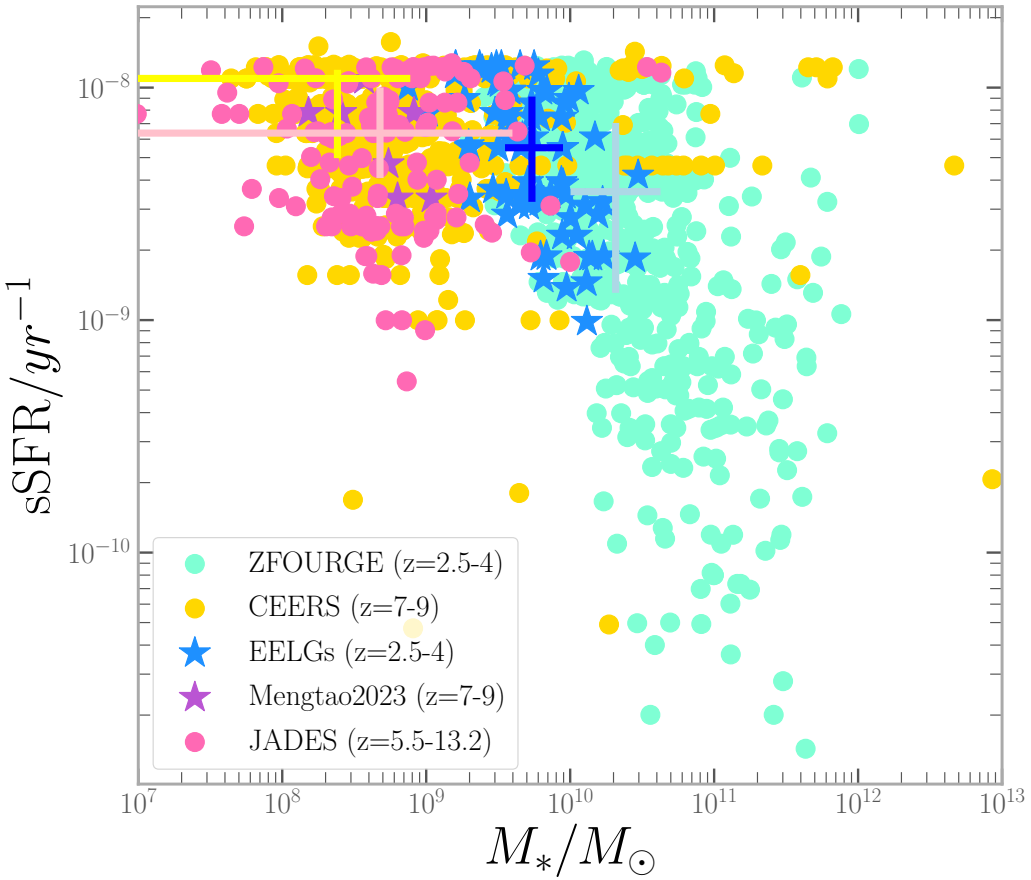
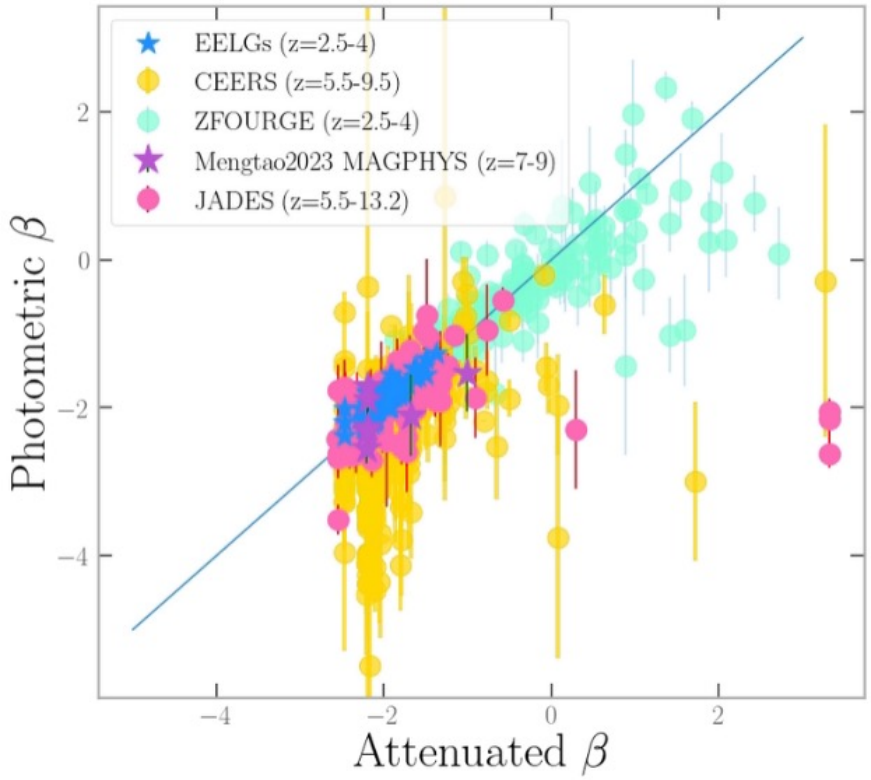
EELGs

- 0.5 dex higher sSFR and steeper UV-slope compare to z~3 galaxies.
- Better match with galaxies at z>6.



Jaiswar, Gupta et al., in prep



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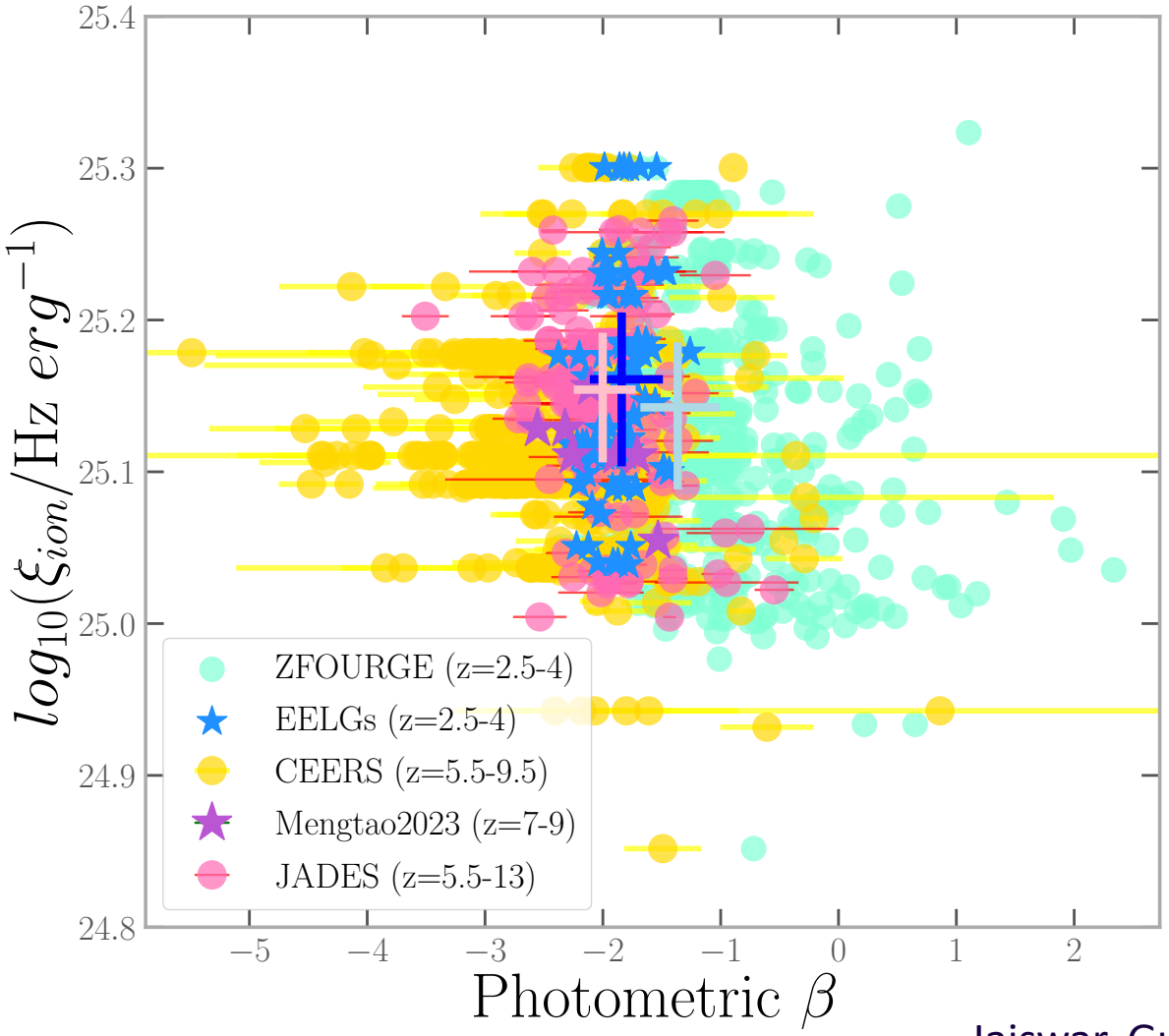

The ionizing photon production efficiency seems to be similar across all samples.

Jaiswar, Gupta et al., in prep

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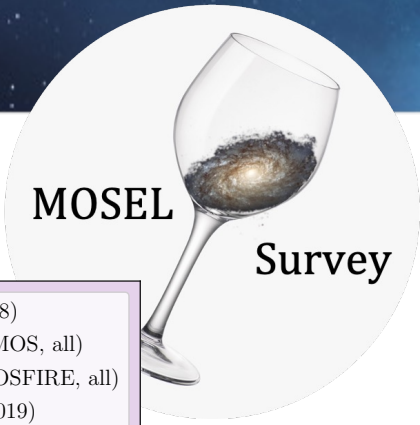
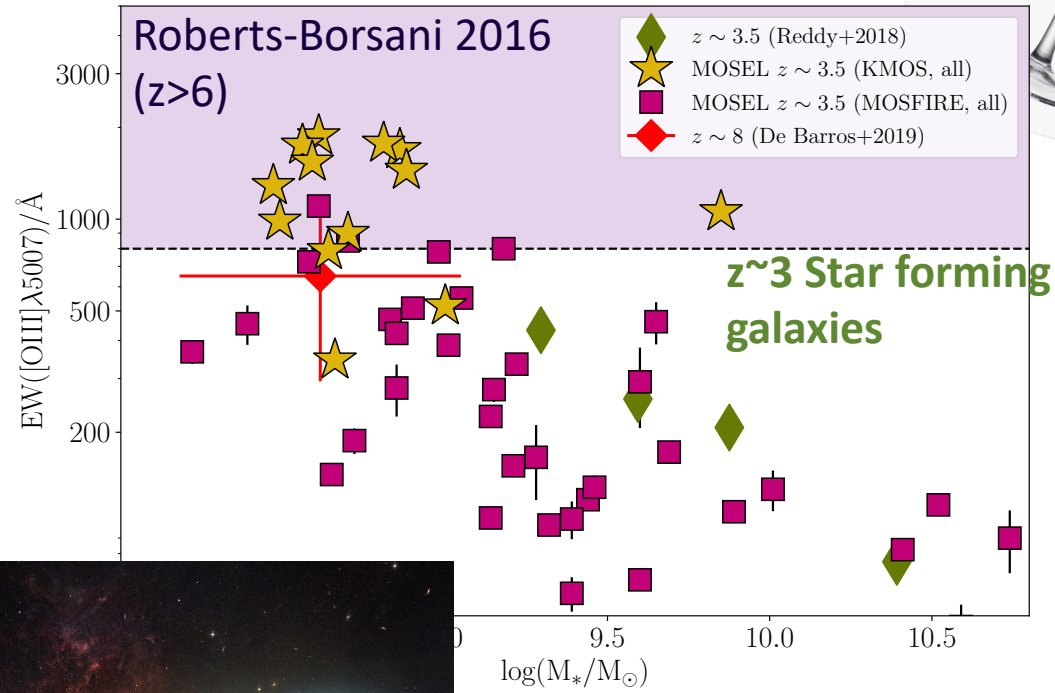
OUTFLOWS IN EXTREME EMISSION LINE GALAXIES

- Transport baryons and metals out of the interstellar medium and are responsible for the chemical enrichment
- Estimate strength of feedback from star formation
- Shuts-down star formation





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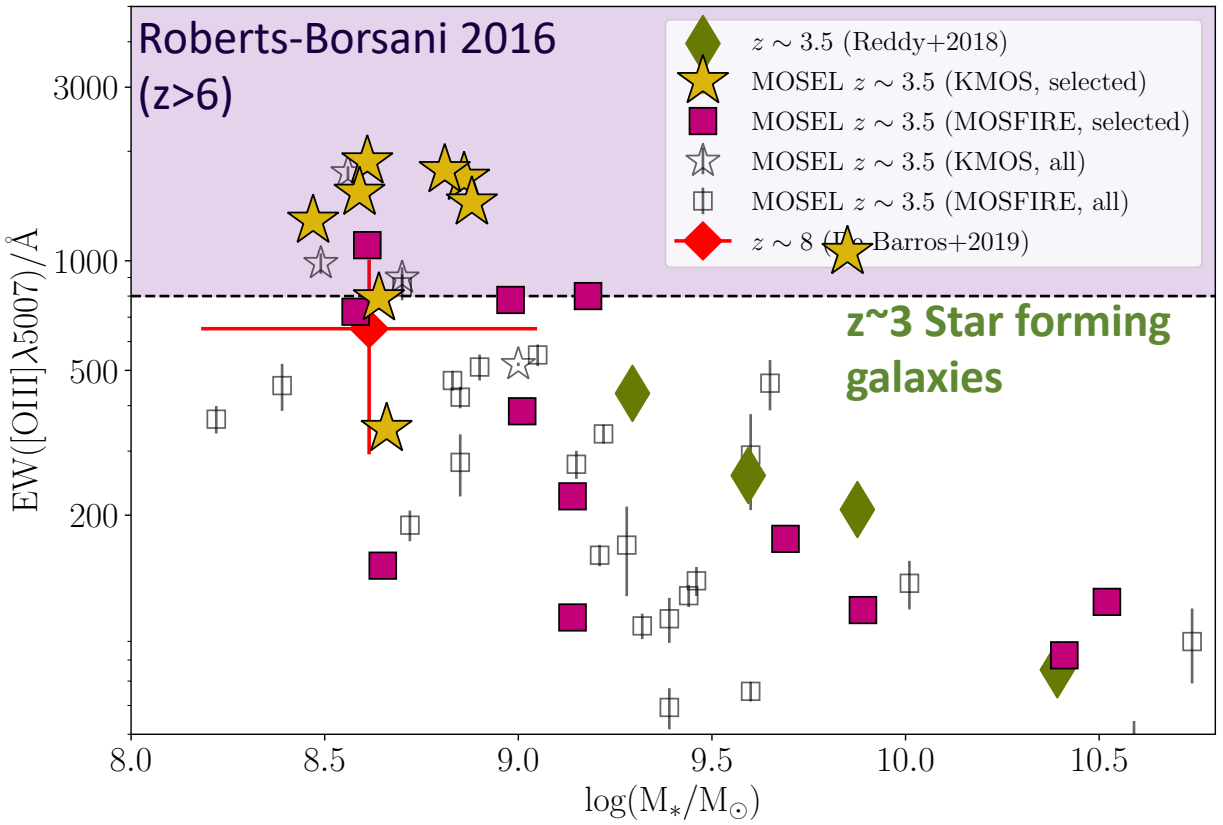
CONFIRMING THE EXTREME EMISSION FEATURE

Targets:

MOSFIRE/Keck –[OIII]+Hβ EW > 200 Å

KMOS/VLT - [OIII]+Hβ EW > 600 Å



Remove galaxies with sky contamination within +/- 500km/s

Gupta et al., 2023

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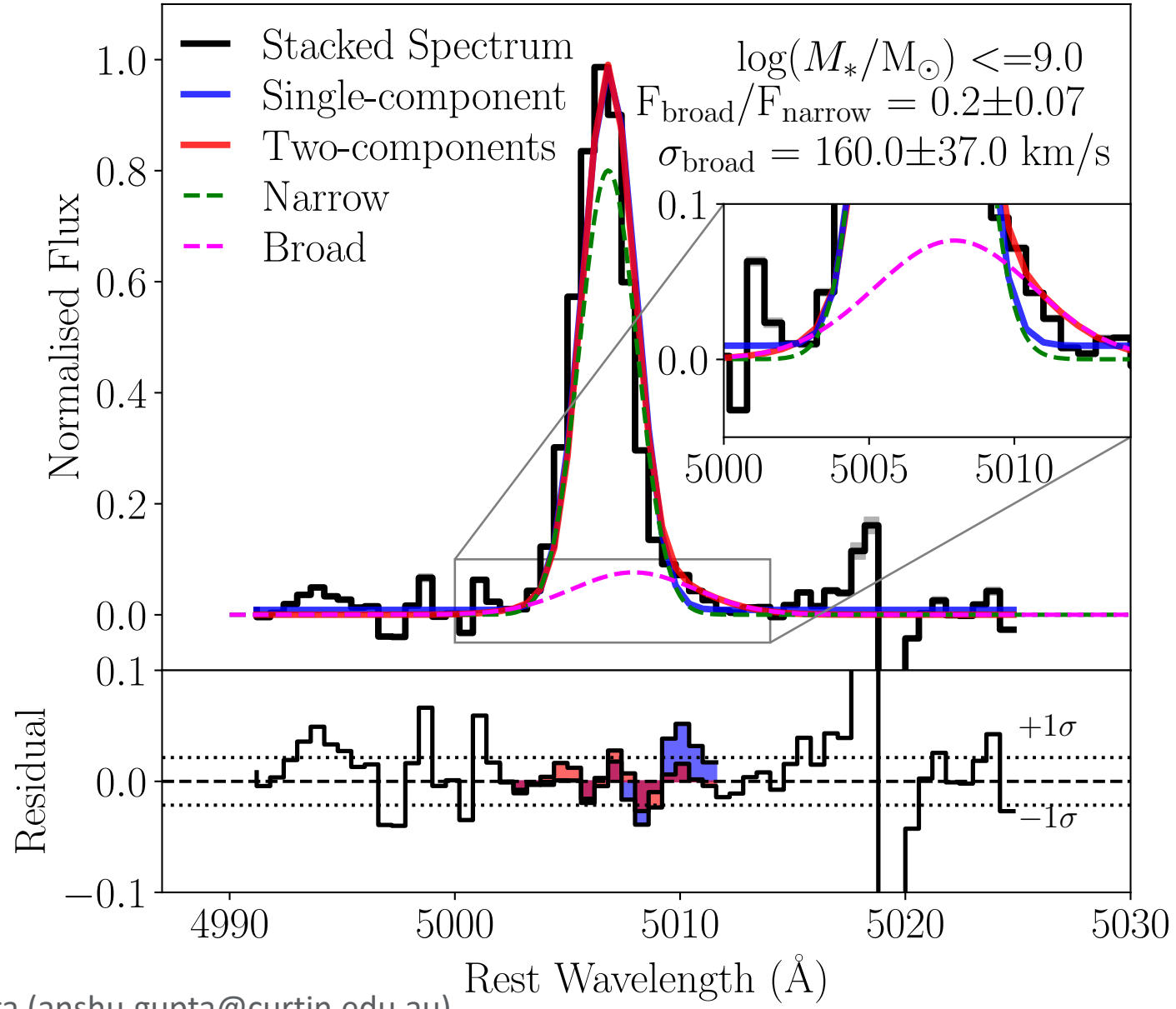
DETECTION OF BROAD COMPONENT



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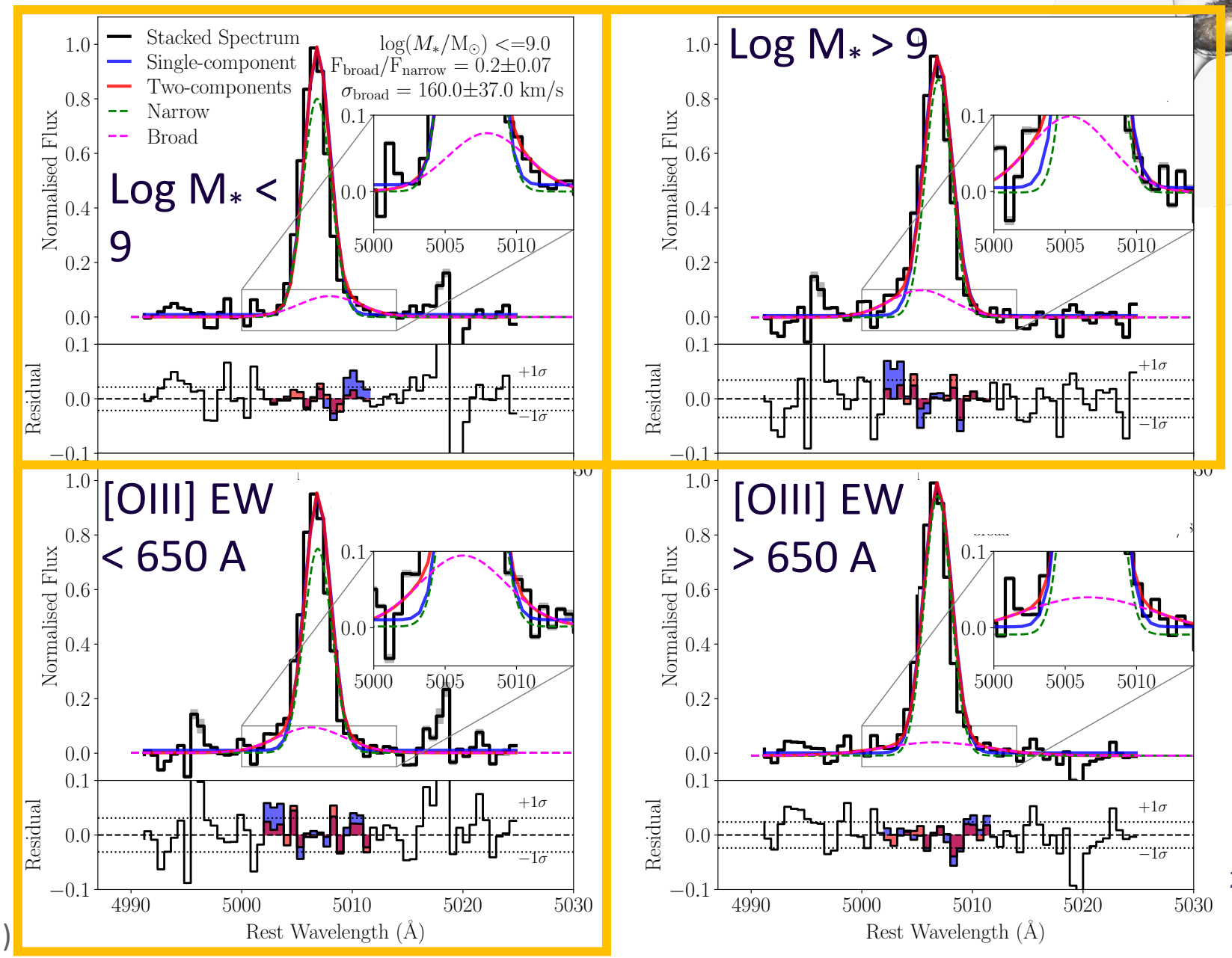
Weak broad component detected in all expect galaxies with [OIII] EW > 650 A



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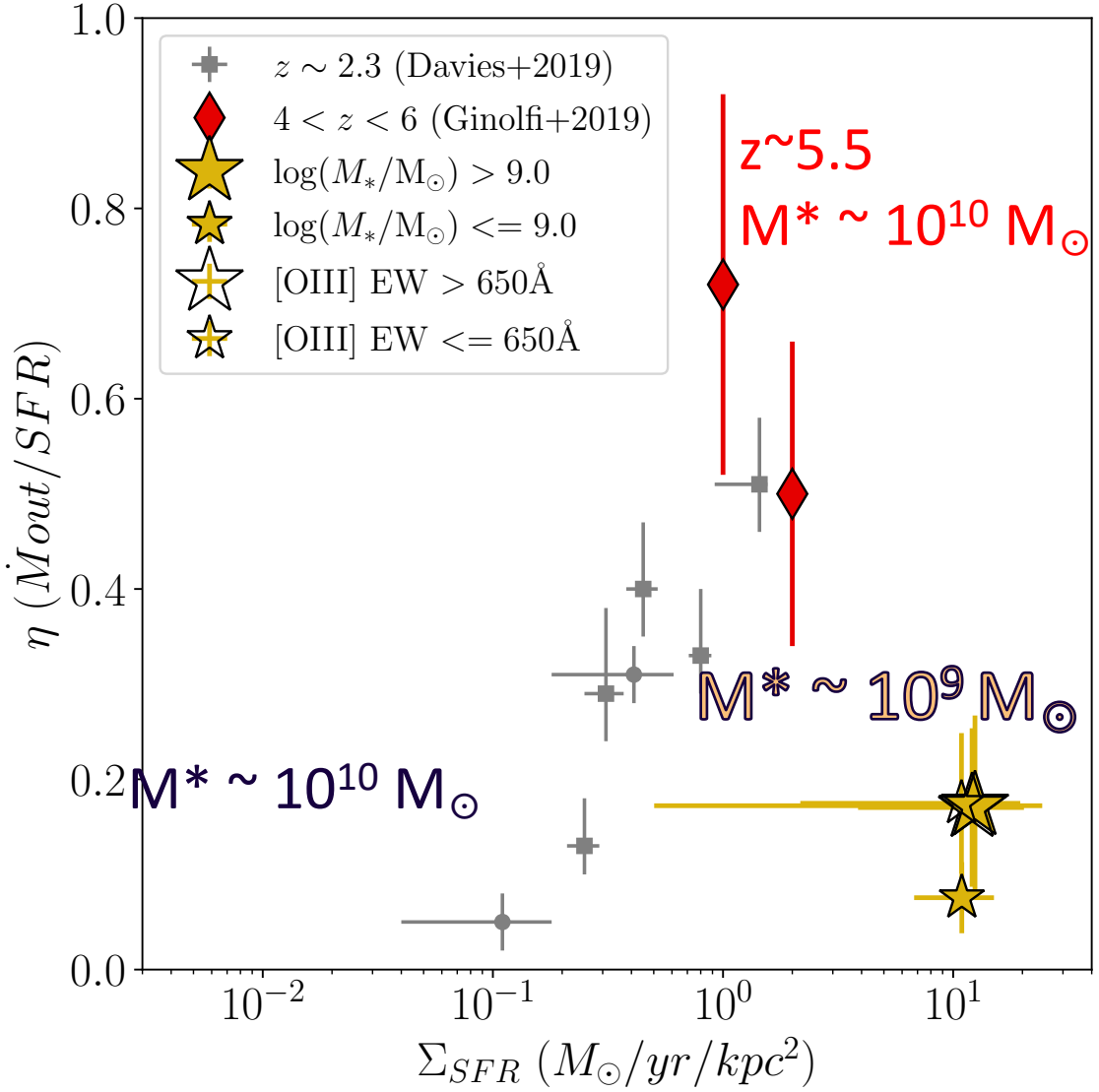
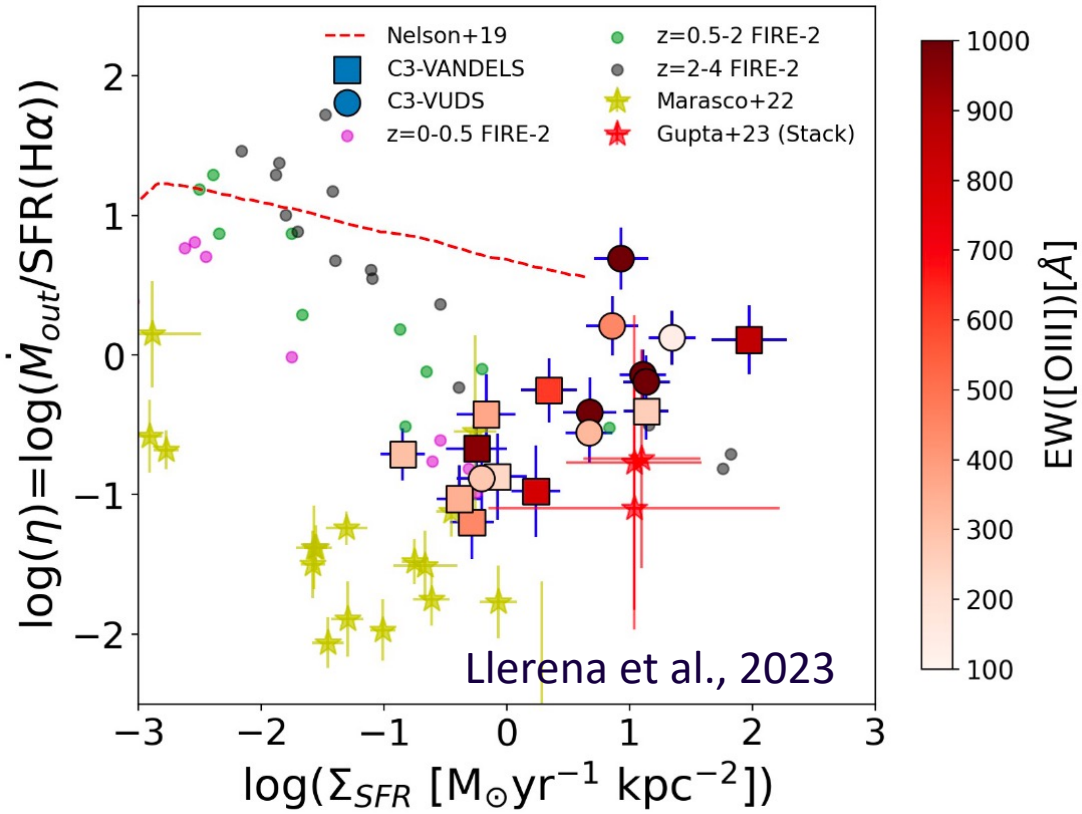
OUTFLOW EFFICIENCY

Mass loading factor in EELGs is similar to low stellar mass galaxies at z~2 even if their SFR is 10 times higher.





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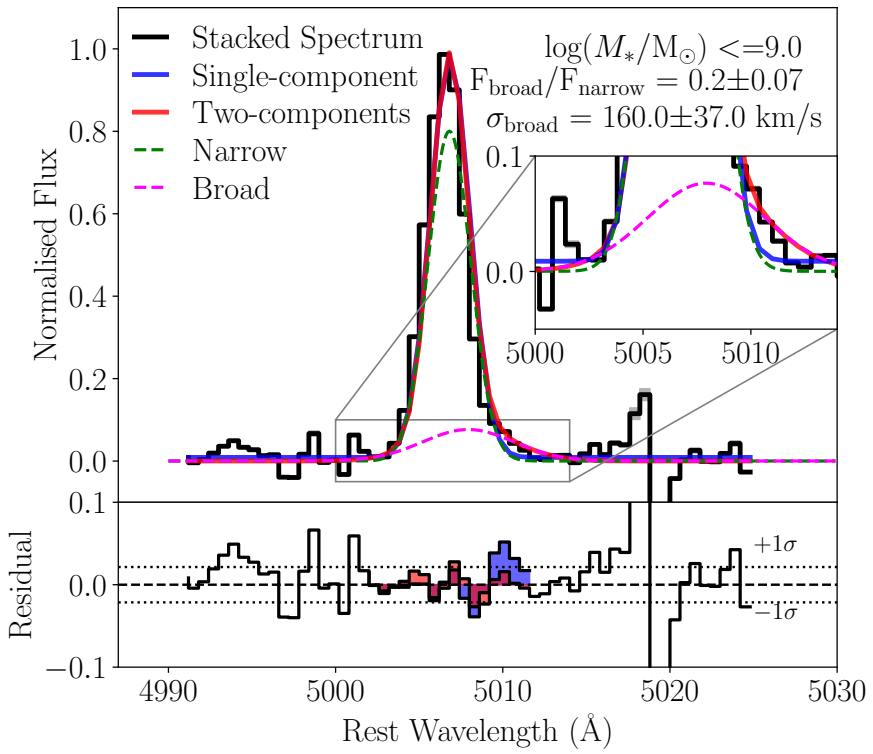
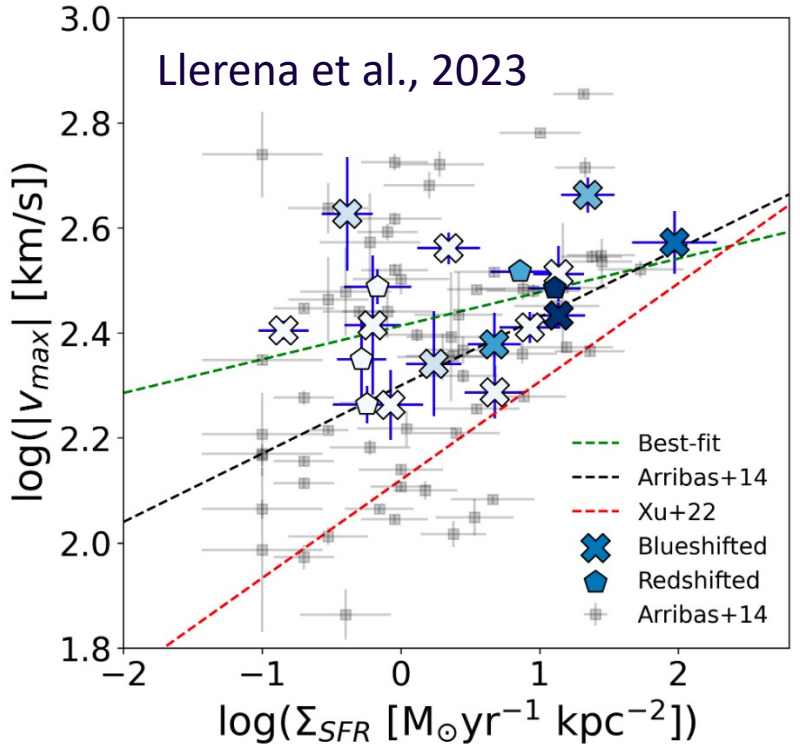
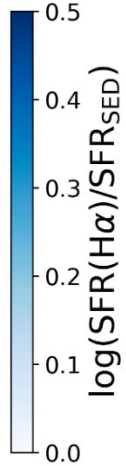
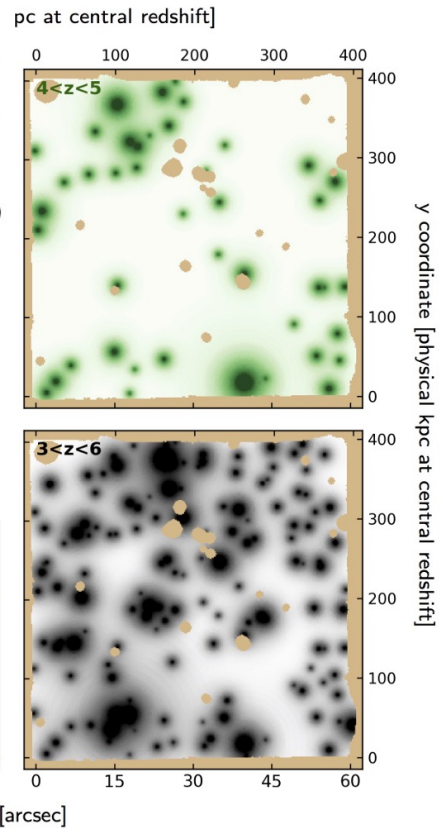
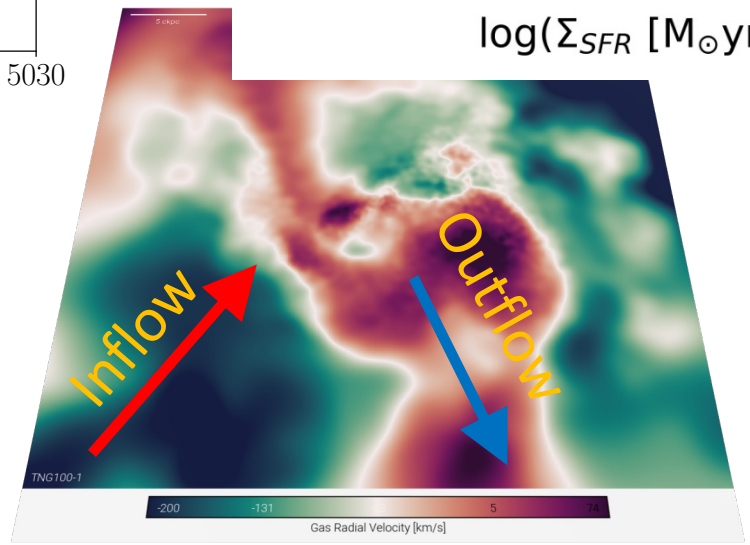
GAS INFLOWS?











Wisotzki et al., 2018

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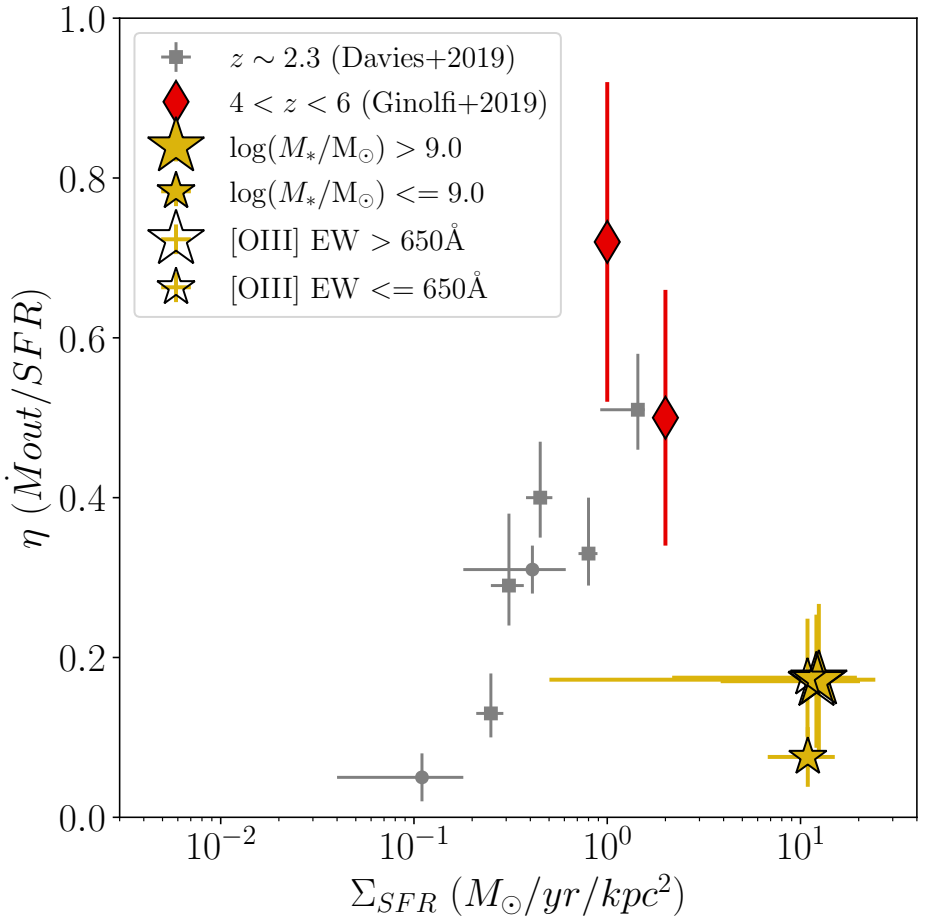
MOSEL SURVEY: EXTREME EMISSION AT Z~3

Results

- Mass loading factor of EELGs is similar to low mass galaxies at z~2
- No correlation with [OIII] EW

Implications

- Maybe large-scale winds suppressed in super star-forming regime and high mass galaxies driving early enrichment of the universe, Or
- Most of outflowing gas resides in other phases of ISM and need other tracers such as NaD



SCAN ME

https://arxiv.org/abs/2211.13763

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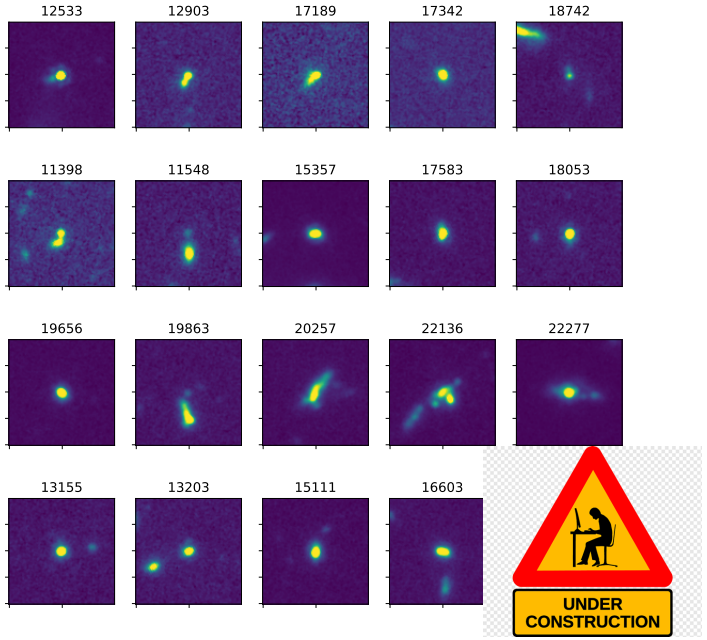
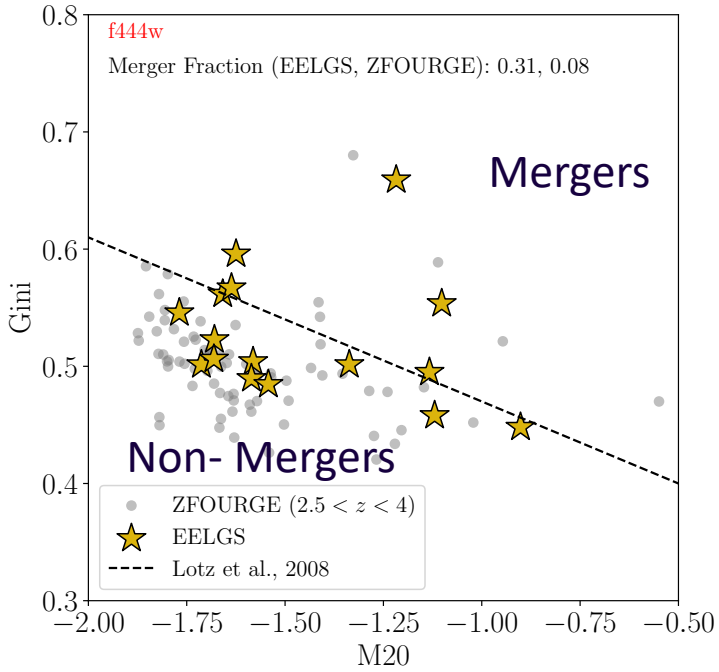
MOSEL SURVEY: ORIGIN OF EXTREME EMISSION AT Z~3

Future Work

- Proposed for FORS2/VLT to target LyC region for EELGs
- Testing the effect of different SFH and SPS models on production efficiency of ionizing photons
- Using deep NIRCam imaging from the JADES survey to determine if mergers are driving the extreme emission feature.





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