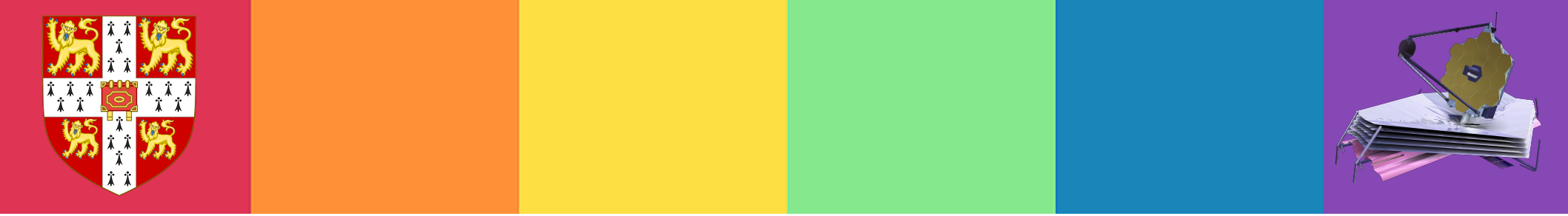


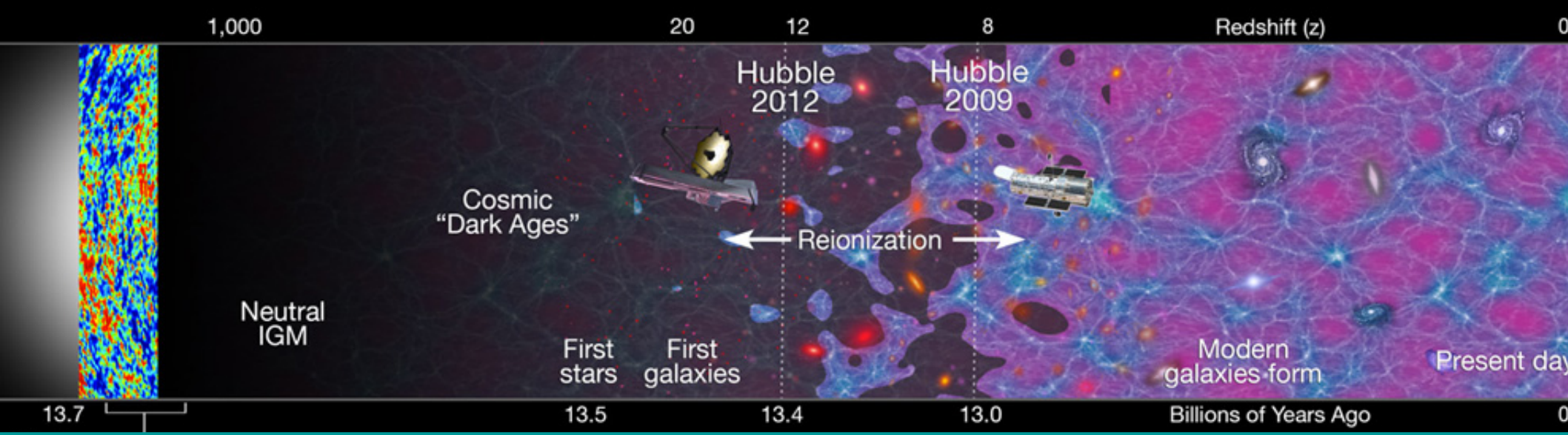
Tiktok: @cambridgephysics

Unveiling the sources of reionisation with JWST

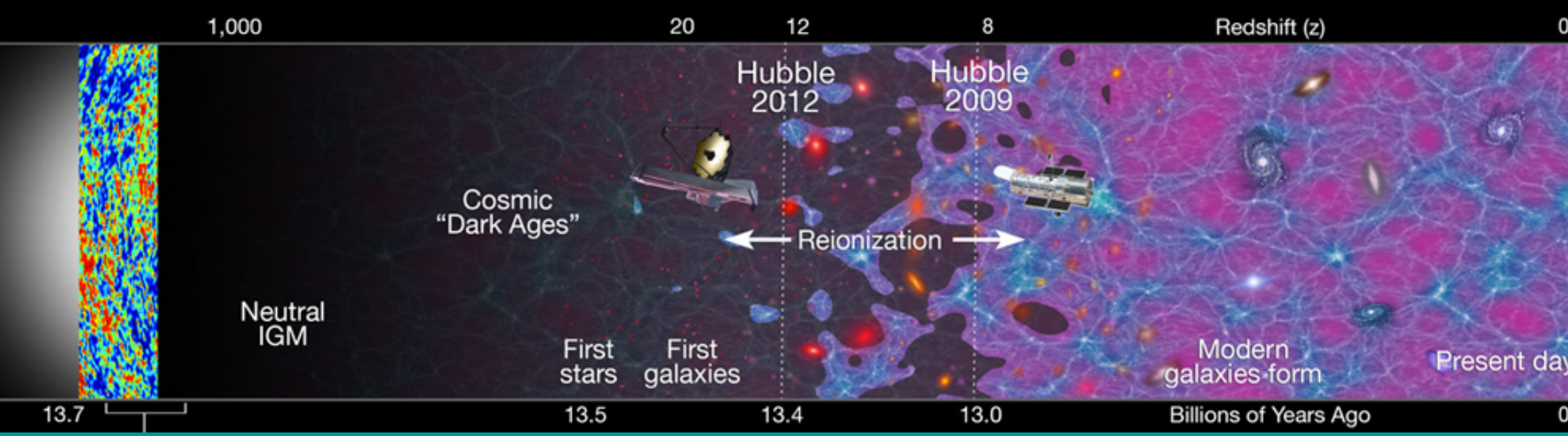
Charlotte Simmonds (cs2210@cam.ac.uk; K16)
Sandro Tacchella, Callum Witten, Will McClymont...
+JADES

JWST ADVANCED DEEP EXTRAGALACTIC SURVEY
https://jades-survey.github.io/
Youtube: @jades-survey

Kavli Institute for Cosmology Cambridge
KICC



Motivation: EoR



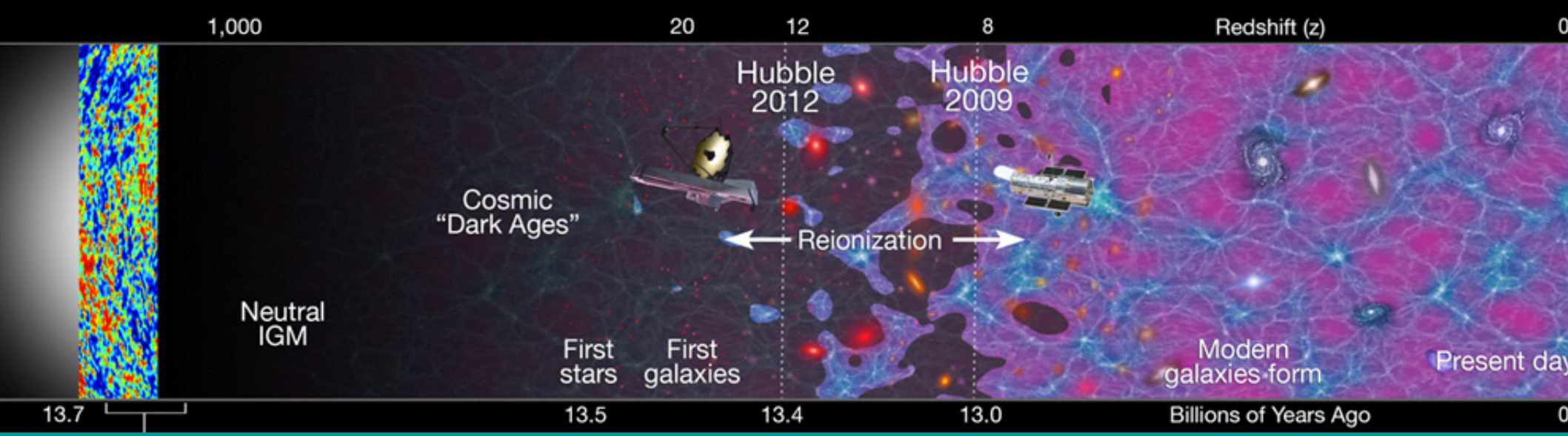
Motivation: EoR

Why are star forming galaxies at the EoR cool to study?

- Because they could be responsible for ionising the Universe!
  (e.g. Robertson+2013,2015; Naidu+2020; Trebitsch+2020)

→ Dominate the budget of reionisation?

$$\dot{N}_{\rm ion}(z) = f_{\rm esc} \times \xi_{\rm ion}(z) \times \rho_{\rm UV}(z)$$



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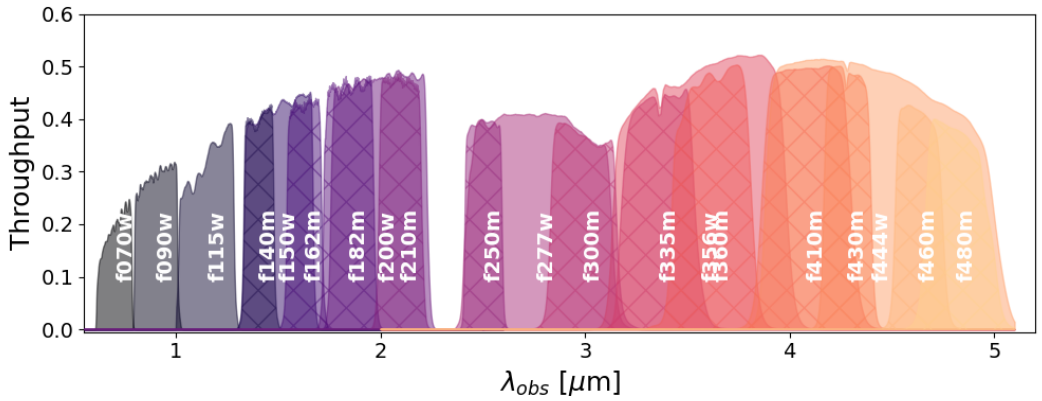
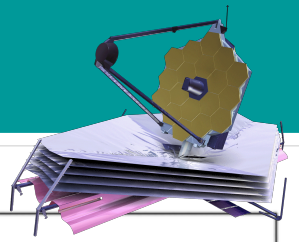
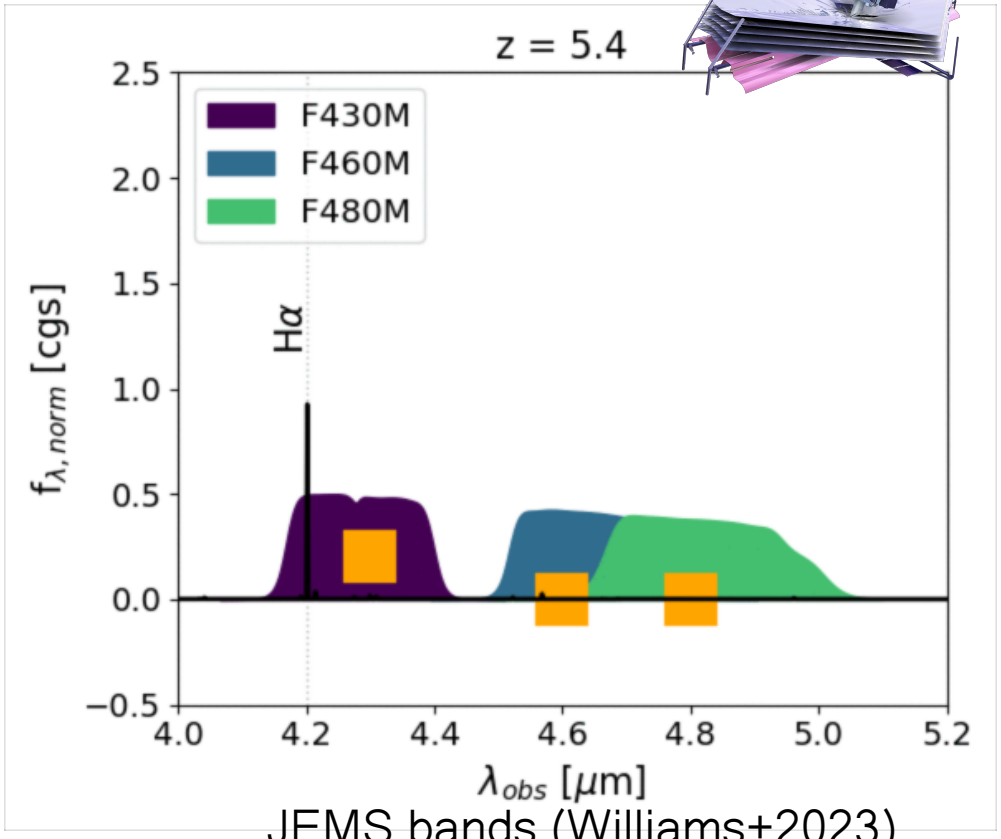
$\xi_{\rm ion}(z)$ → Hα, [OIII] Em. Lines as tracers

Estimating emission line fluxes with NIRCam Deep photometry (Rieke+2023)

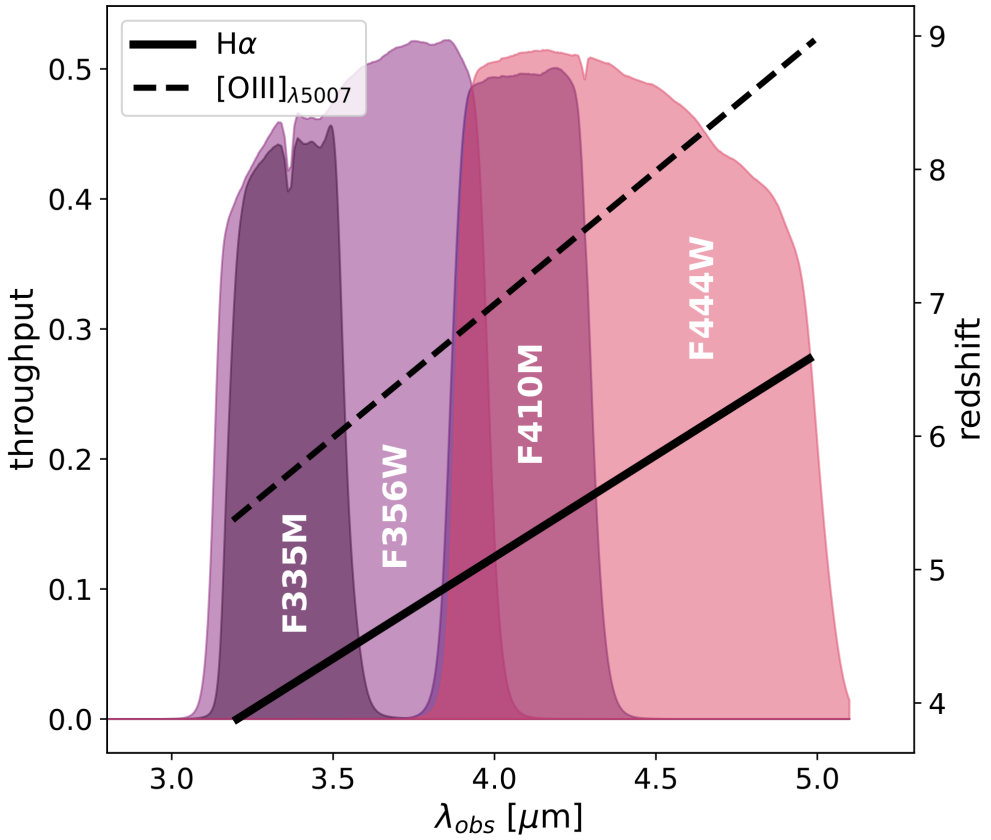






JEMS bands (Williams+2023)

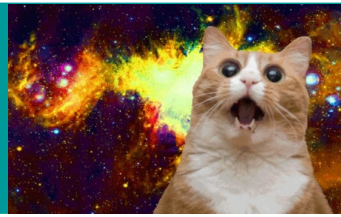
Simmonds+2023b (eprint arXiv:2310.01112)

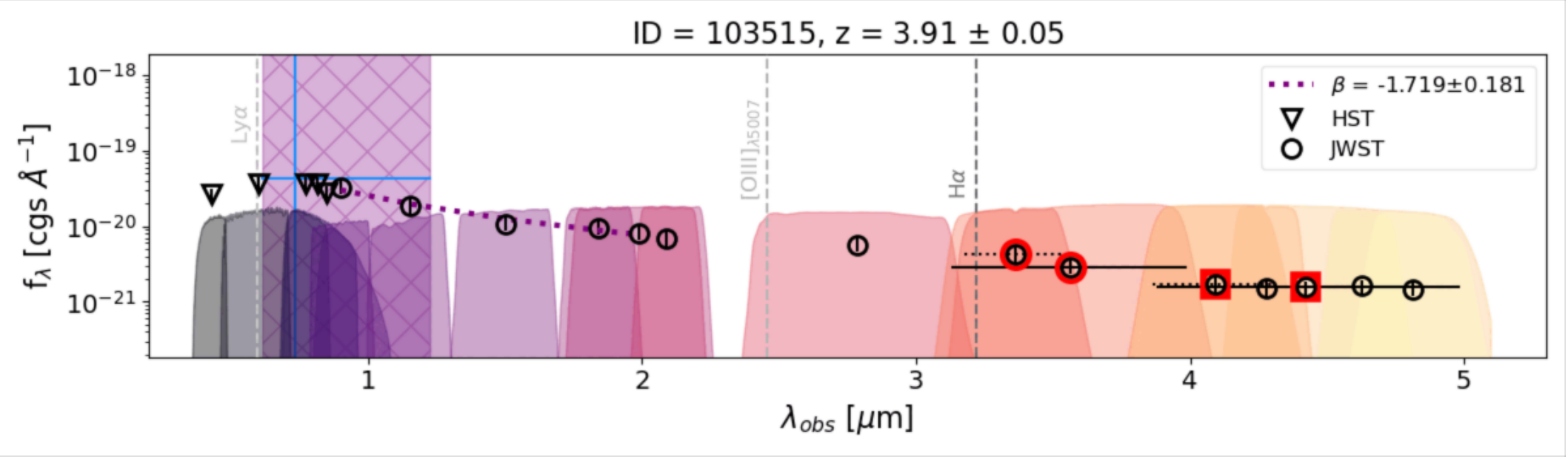


In latest work, we use the medium-wide pairs F335M-F356W and F410M-F444W to estimate Hα and [OIII] fluxes up to z~9 for 677 galaxies

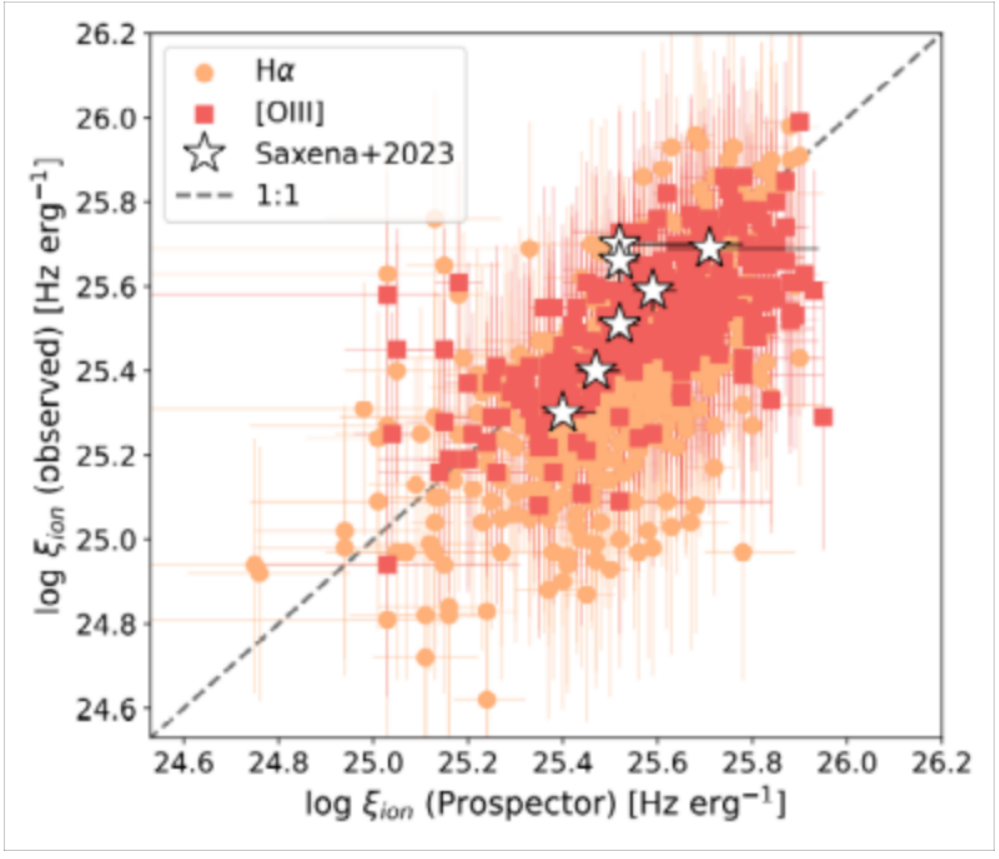
Hα and [OIII] can be used to estimate the ionising photon production efficienty, ξ_{ion}
(Chevallard+2018, Tang+2019)

SEDs: UV slopes (β) and line fluxes





How good are our ξion estimations?
Comparison between Ha, [OIII] and Prospector* methods

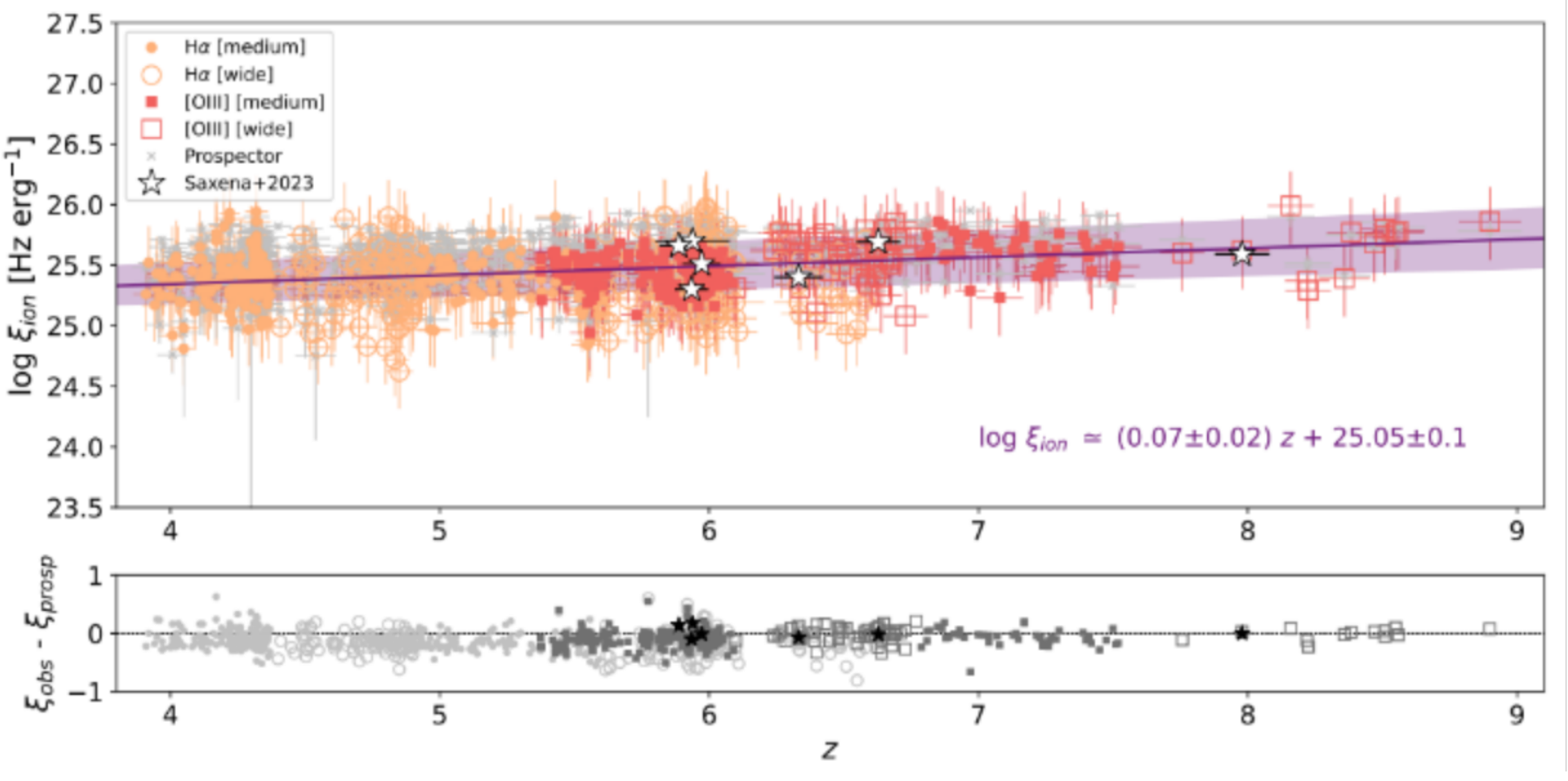


Very promising agreement from all methods

Prospector has access to the full best-fit SED and, contrary to the emission line methods, it can integrate the ionising spectra to infer ξion

*Johnson+2019,2021

ξ_{ion} evolution with redshift



Some things to keep in mind

Our sample is population limited

(because we impose emission line detections)

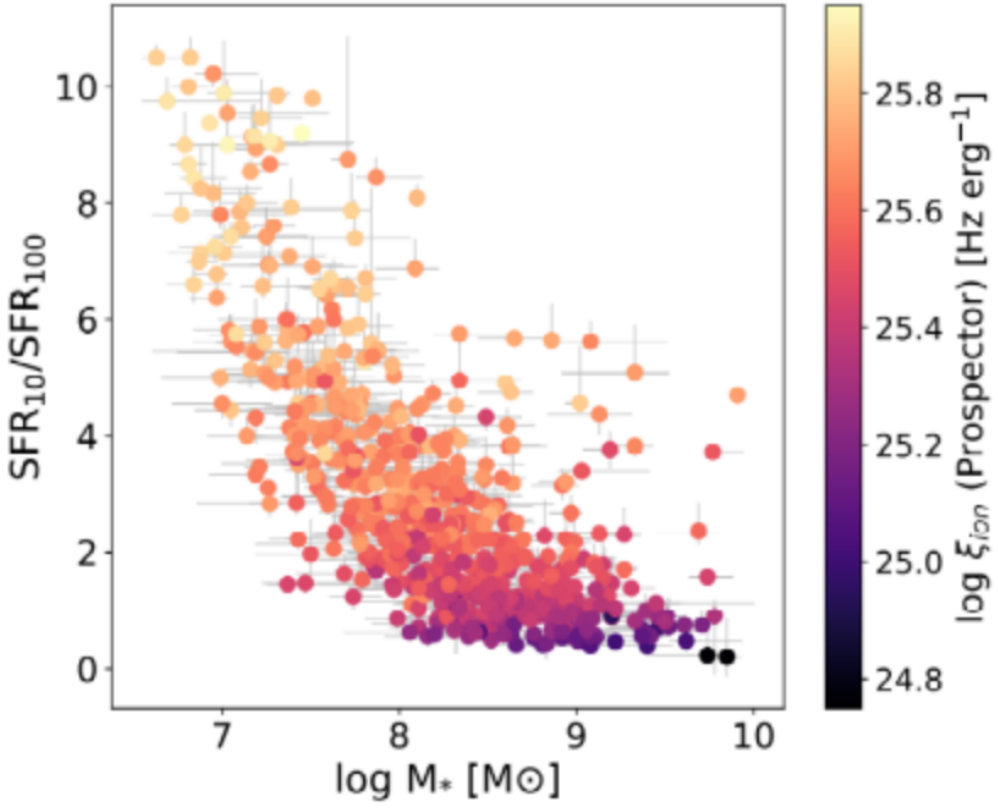
However, this is a special population

(most likely representative of the culprits responsible for the reionisation of the Universe)

We find the ionising photon production efficiency increases with redshift...

What drives this behaviour?

Nature of ξ_{ion} evolution with redshift

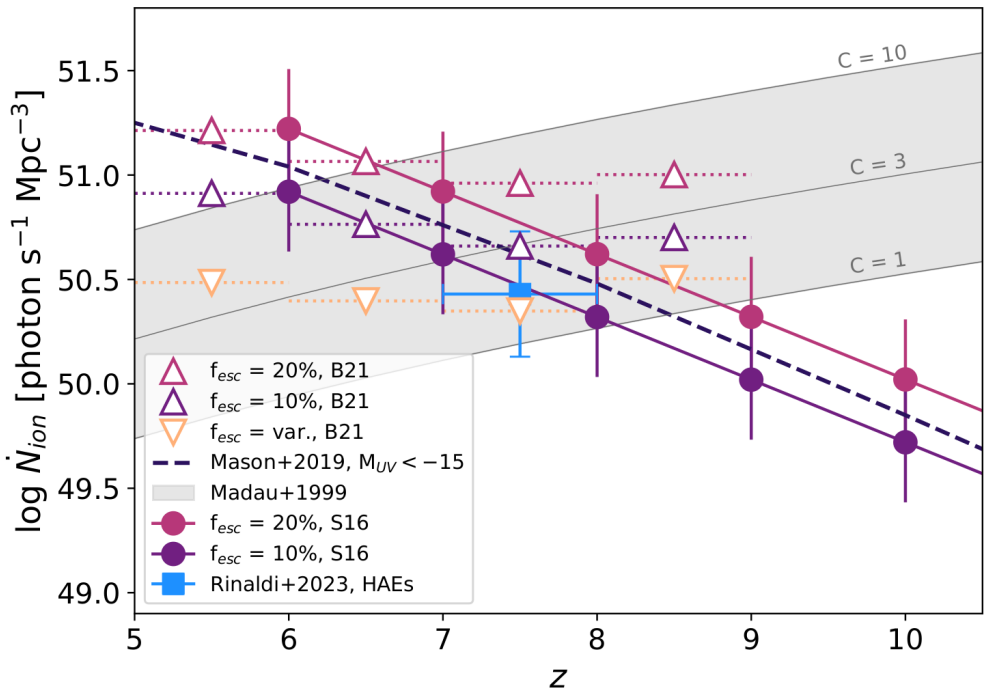


We investigate the properties inferred by Prospector (e.g., stellar mass, ionisation parameter, age…) and find the highest correlation between ξ_{ion} and burstiness of the star formation histories

The **burstiness is driven by the stellar mass** due to stellar feedback (more important at low masses)

*Note, low mass galaxies are also fainter in the UV

Broader context: cosmic ionising photon production (Nion)



We use Bouwens+2021/Song+2016 UV luminosity functions, combined with our ξion-MUV correlations and different escape fraction prescriptions

$$\dot{N}_{\rm ion}(z) = f_{\rm esc} \times \xi_{\rm ion}(z) \times \rho_{\rm UV}(z)$$

If the ξion from this work is representative of high-z galaxies, **then these galaxies produce enough ionising photons to reionise the universe**

Conclusions + Future prospects

We find that **low-mass faint galaxies are more efficient in producing ionising radiation**, this is driven by the burstiness of their SFHs

These kind of galaxies are likely responsible for reionising the Universe!

In a next work, we will use Prospector to quantify the contribution of different galaxy populations to the budget of reionisation (i.e. not just ELGs)