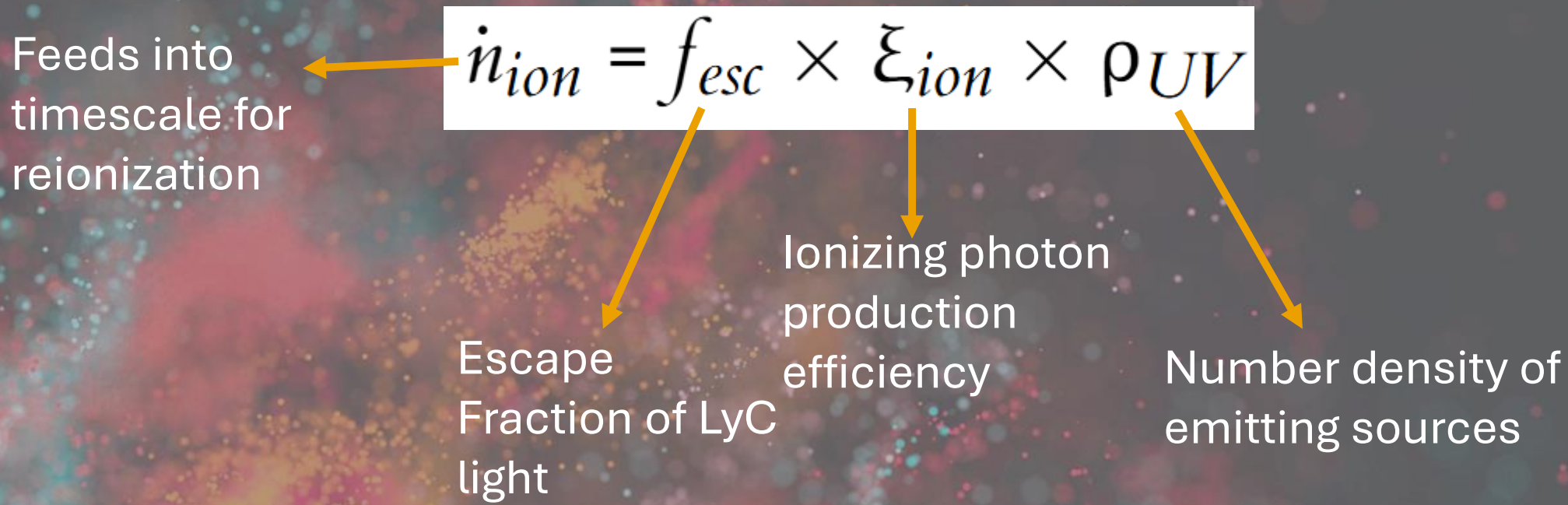
On the Model Dependence of the ionizing photon production efficiency

What are we really measuring

The Ionizing Photon Production Efficiency

The Ionizing Photon Production Efficiency



The Ionizing Photon Production Efficiency

$$\dot{n}_{ion} = f_{esc} \times \xi_{ion} \times \rho_{UV}$$

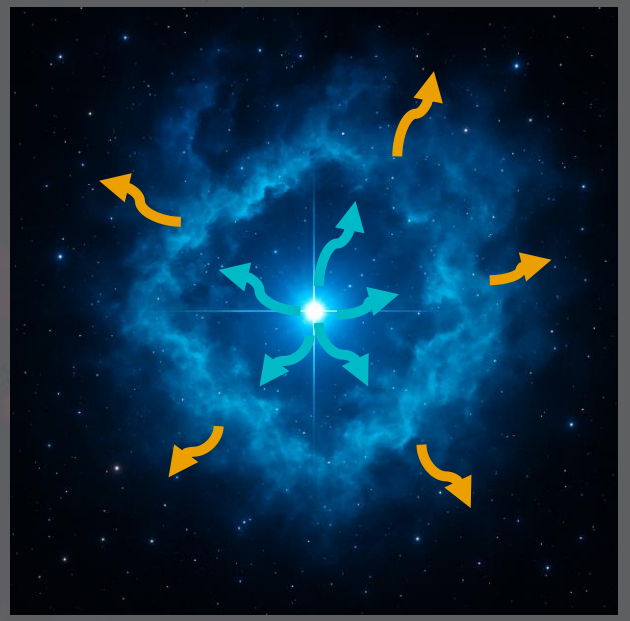
$$\xi_{ion} = \frac{N(H^0)}{L_{UV}}$$

Ionizing radiation

The Ionizing Photon Production Efficiency

$$\mathrm{N(H^0)} = 7.28\times10^{11} L(H\alpha)$$

$$\xi_{ion} = \frac{N(H^0)}{L_{UV}}$$

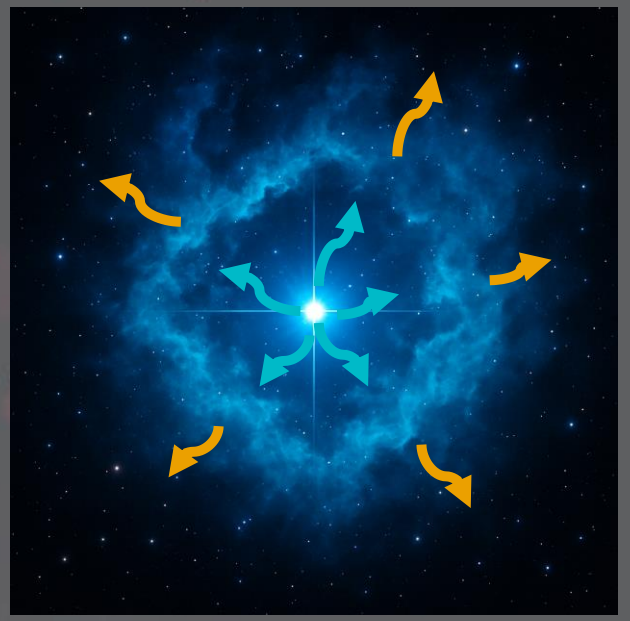


The Ionizing Photon Production Efficiency

$$\mathrm{N(H^0)} = 7.28\times10^{11} L(H\alpha)$$

$$\xi_{ion} = \frac{N(H^0)}{L_{UV}}$$

Luminosity density of non-ionizing UV component



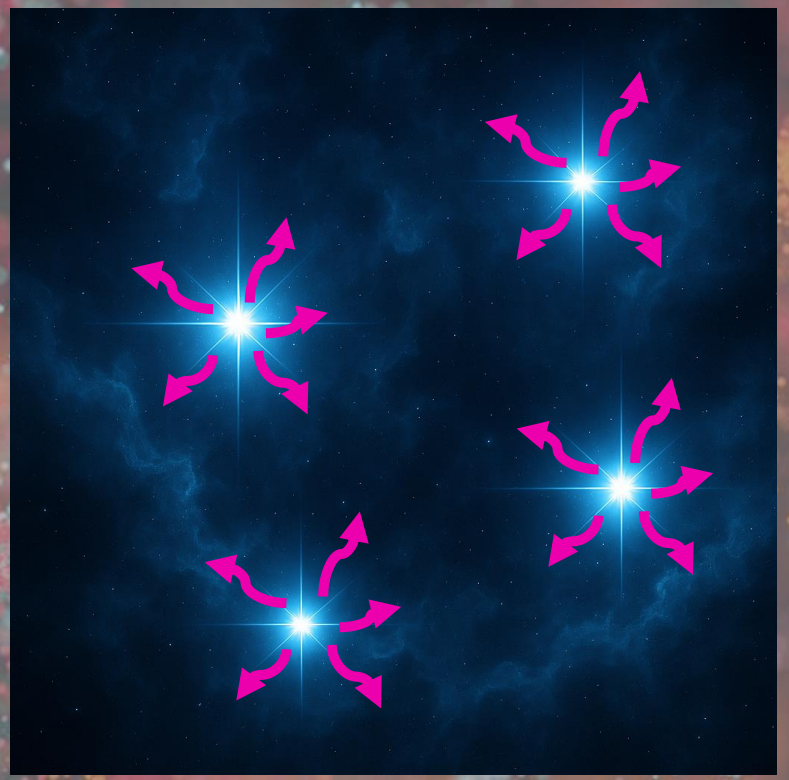
LyC

Ha

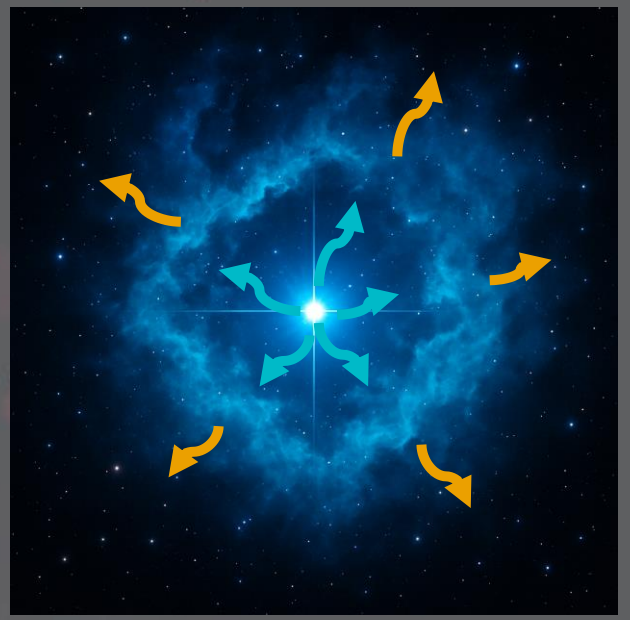
The Ionizing Photon Production Efficiency

$$\mathrm{N(H^0)} = 7.28\times10^{11} L(H\alpha)$$

$$\xi_{ion} = \frac{N(H^0)}{L_{UV}}$$



Non-ionizing UV



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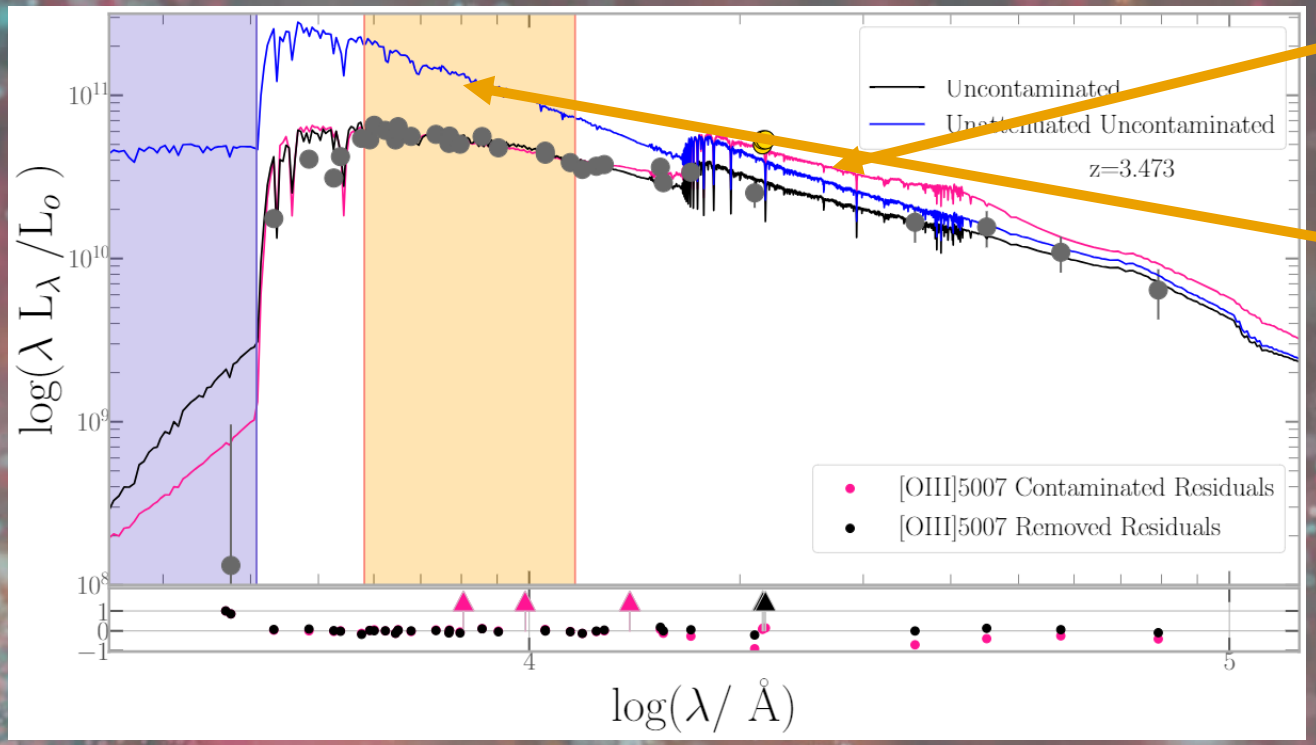
Ha

The Ionizing Photon Production Efficiency

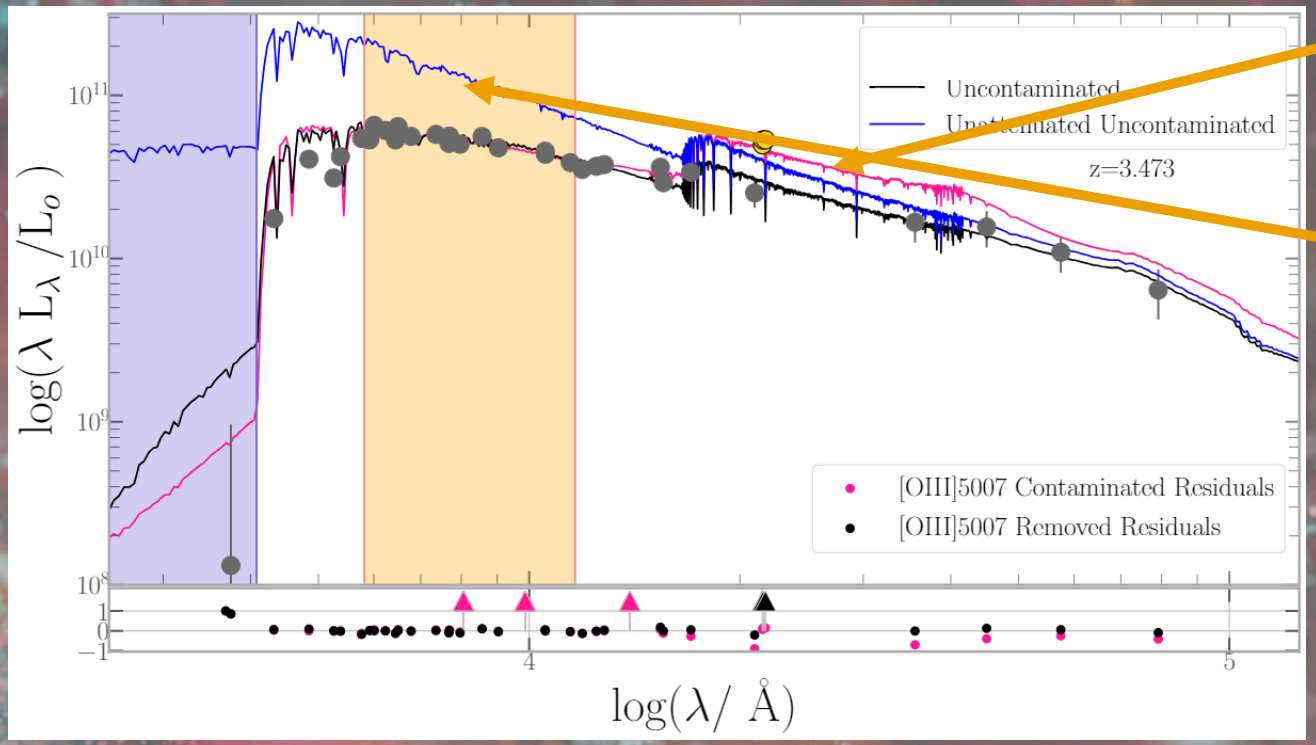
$$\mathrm{N}(\mathrm{H}^0) = 7.28\times10^{11} L(H\alpha)$$



$$\xi_{ion} = \frac{N(H^0)}{L_{UV}}$$

The Ionizing Photon Production Efficiency

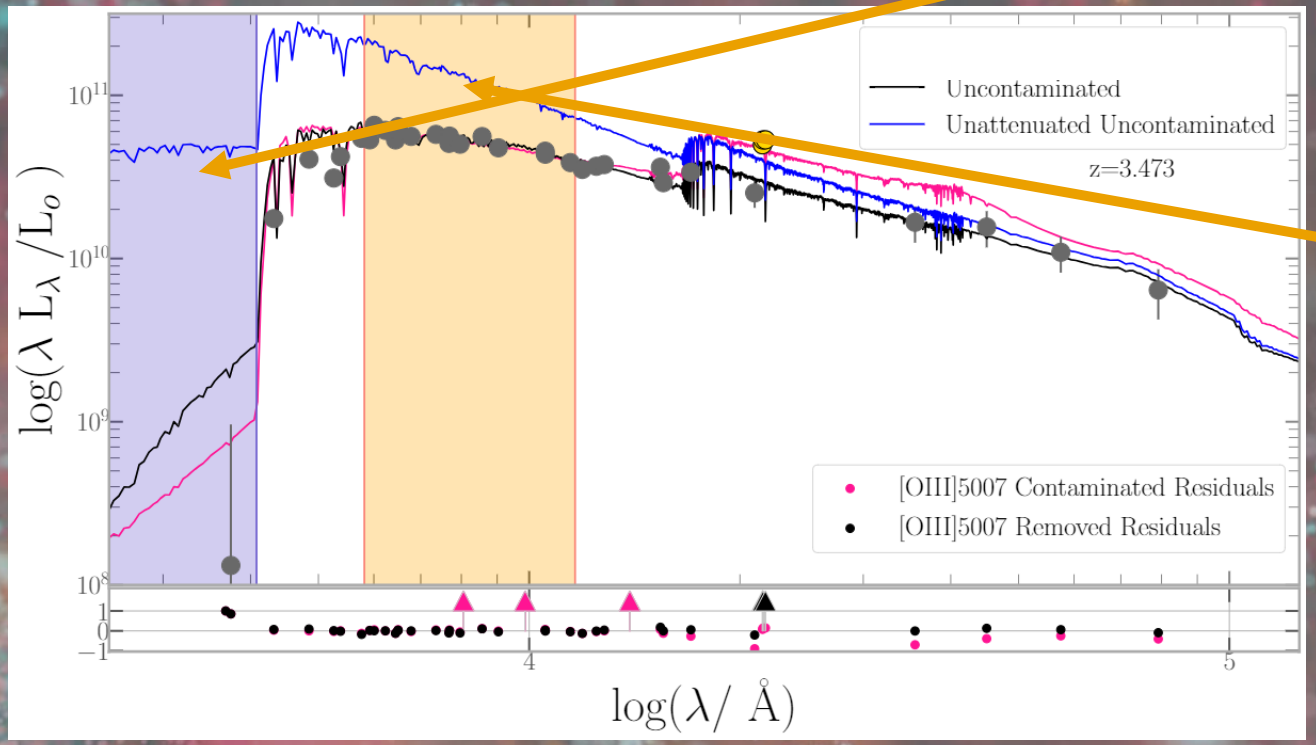
$$N(H^0) = 7.28 \times 10^{11} L(H\alpha)$$



$$\xi_{ion} = \frac{N(H^0)}{L_{UV}}$$

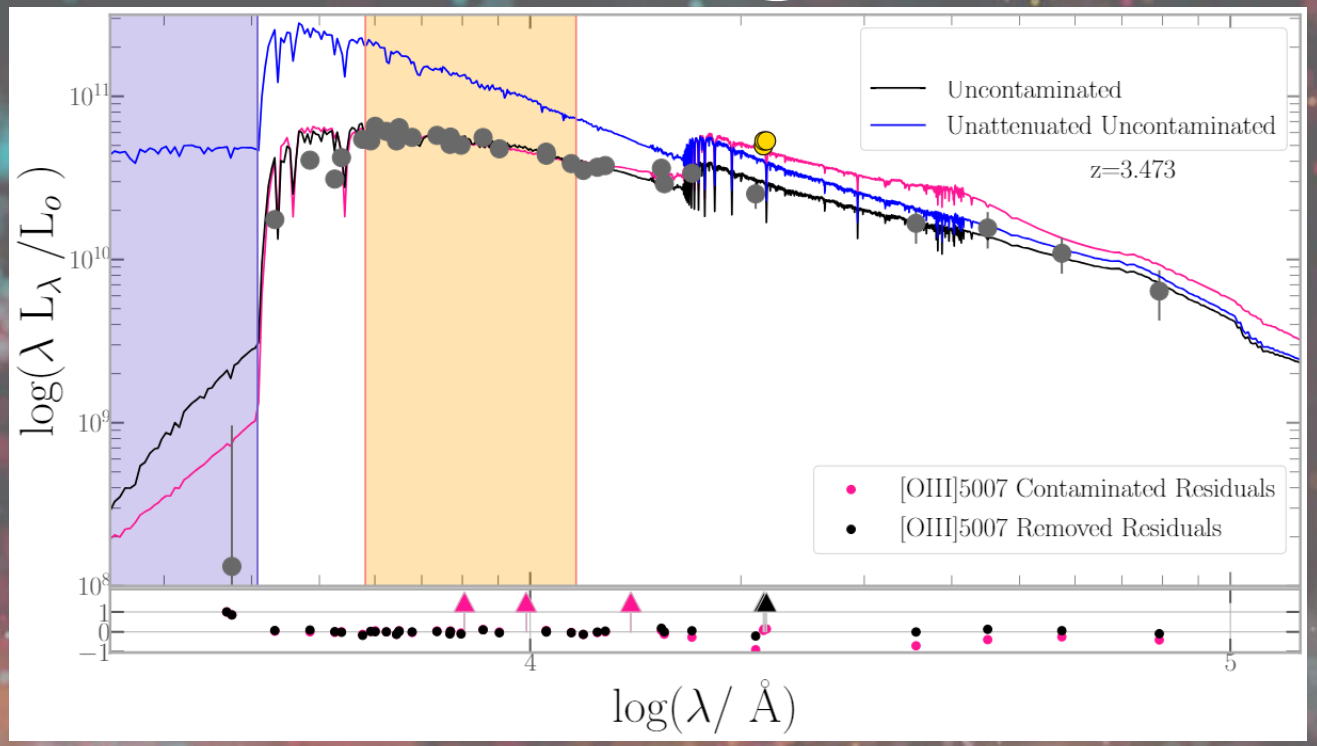
The Ionizing Photon Production Efficiency

$$\int_{c/912\mathring{A}}^{\infty} L_\nu (h\nu)^{-1}$$



$$\xi_{ion} = \frac{N(H^0)}{L_{UV}}$$

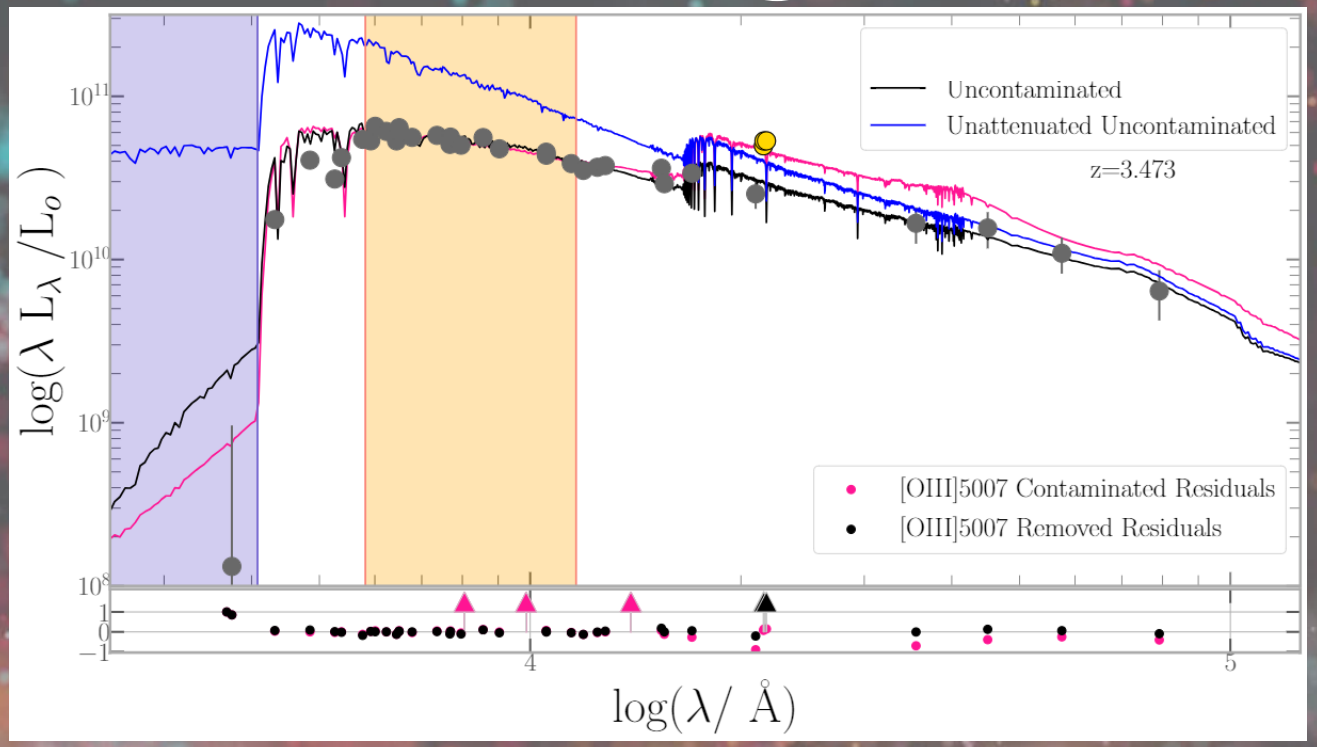
SED Modelling



$$\xi_{ion} = \frac{N(H^0)}{L_{UV} \times c_{rec}}$$

$$\int_{c/-\infty}^{c/912\mathring{A}} L_\nu (\mathrm{h}\nu)^{-1}$$

SED Modelling



Stuff that emits	Stuff that absorbs
Star Formation History	Dust attenuation (and re-emission)
AGN	Photoionization
Stellar Population Synthesis	IGM absorption

$$\xi_{ion} = \frac{N(H^0)}{L_{UV} \times c_{rec}}$$

$$\int_{c/-\infty}^{c/912\mathring{A}} L_\nu (\mathrm{h}\nu)^{-1}$$

SED Modelling

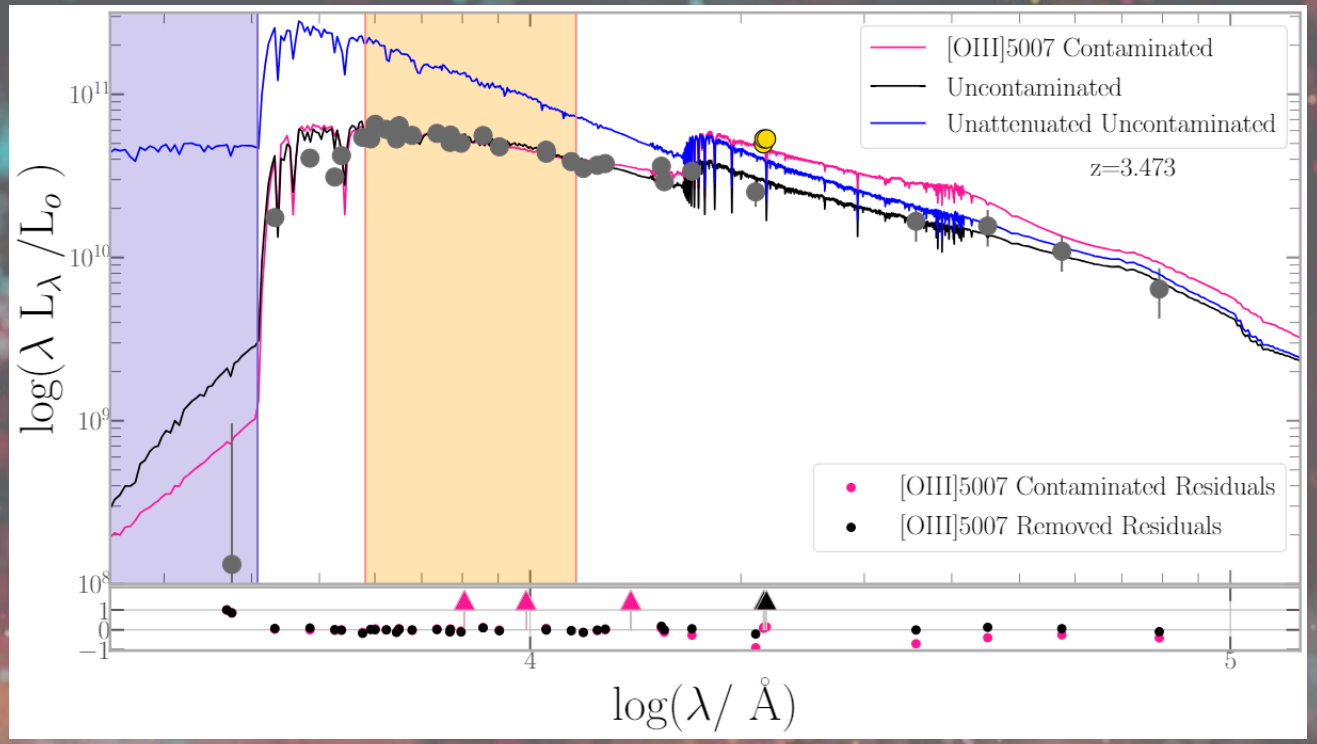
Burst Implementation

Stuff that emits	Stuff that absorbs
Star Formation History	Dust attenuation (and re-emission)
AGN	Photoionization
Stellar Population Synthesis	IGM absorption

$$\xi_{ion} = \frac{N(H^0)}{L_{UV} \times c_{rec}}$$

$$\int_{c/-\infty}^{c/912\mathring{A}} L_\nu (\mathrm{h}\nu)^{-1}$$

EoR Analog Sample

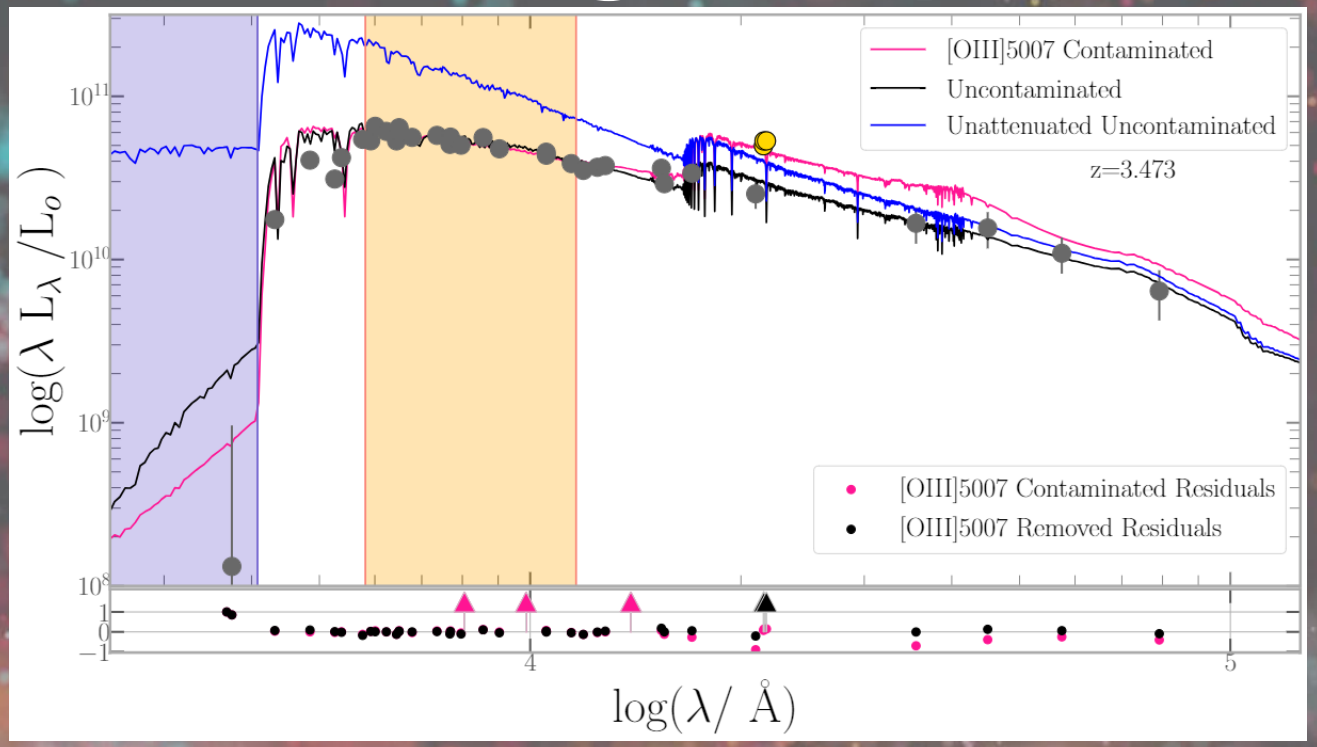


These galaxies are morphologically more similar than low redshift galaxies

Decent photometric coverage across a wide/useful range

Directly accessible LyC

EoR Analog Sample



Smith 2022

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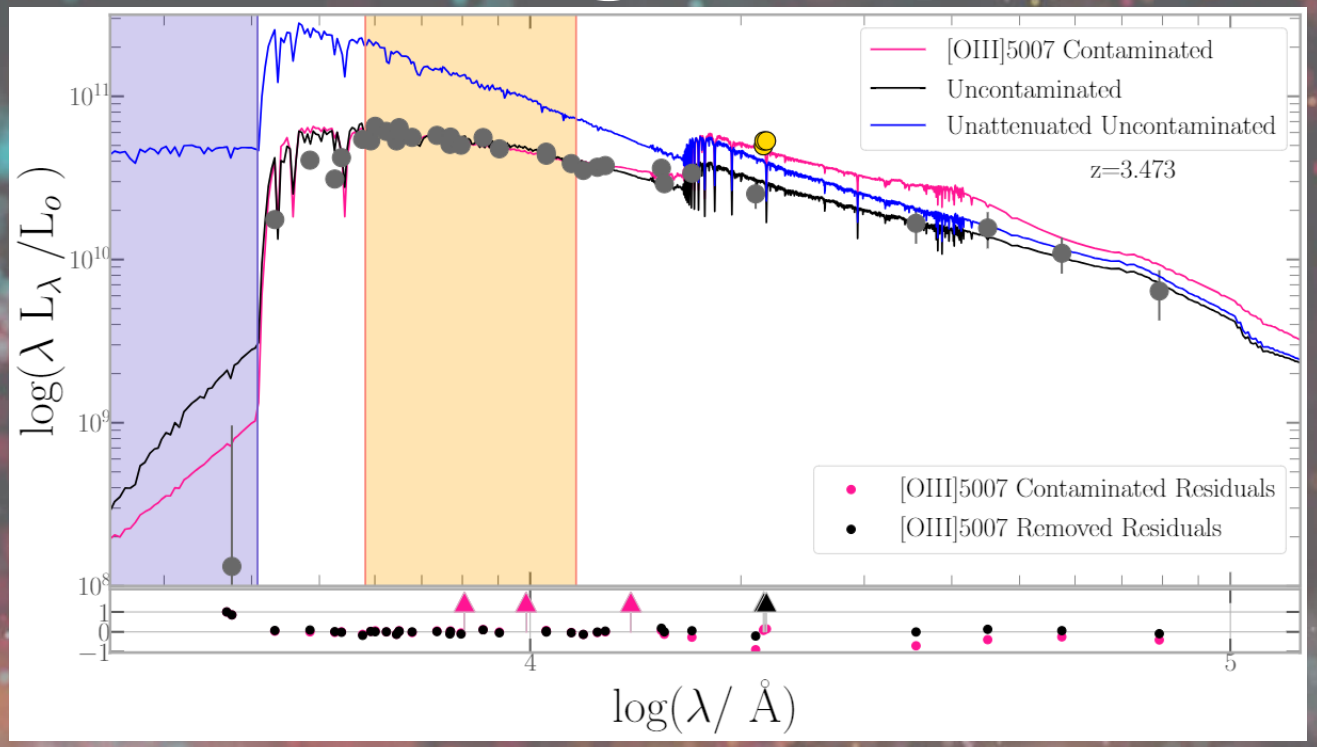

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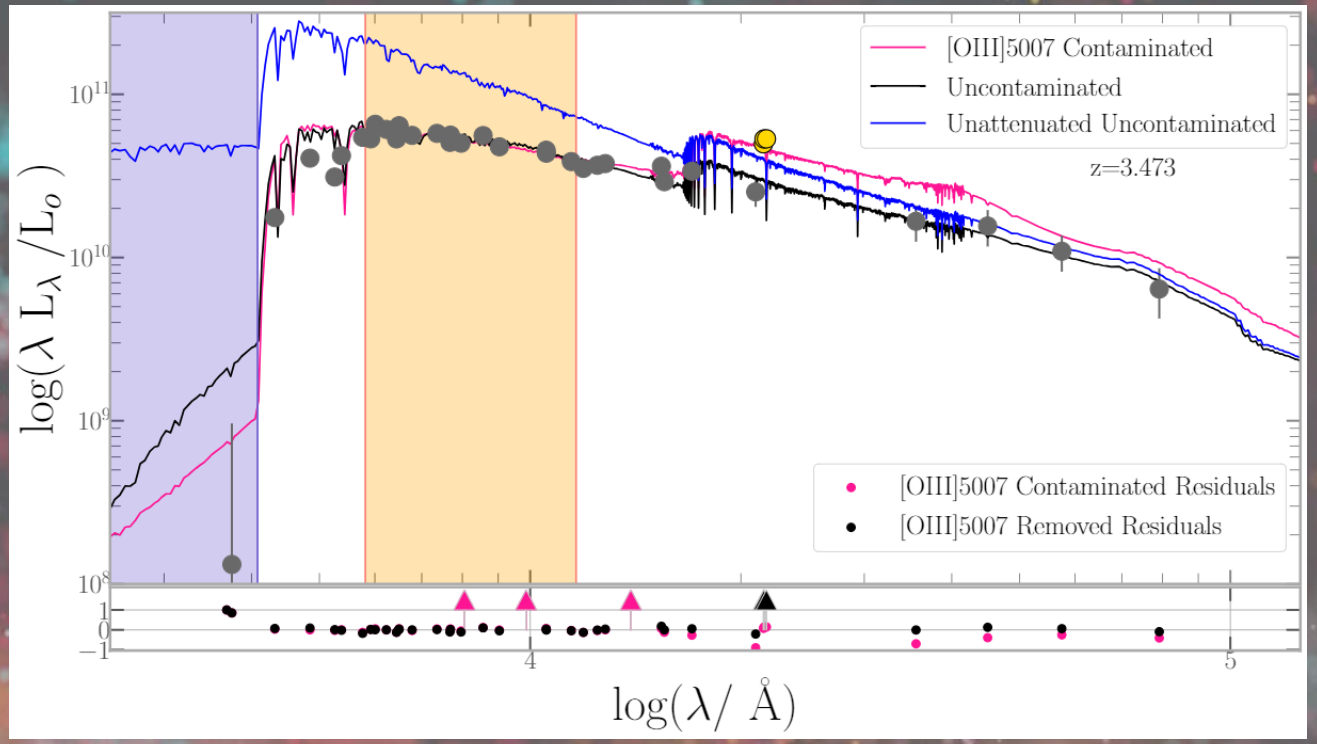

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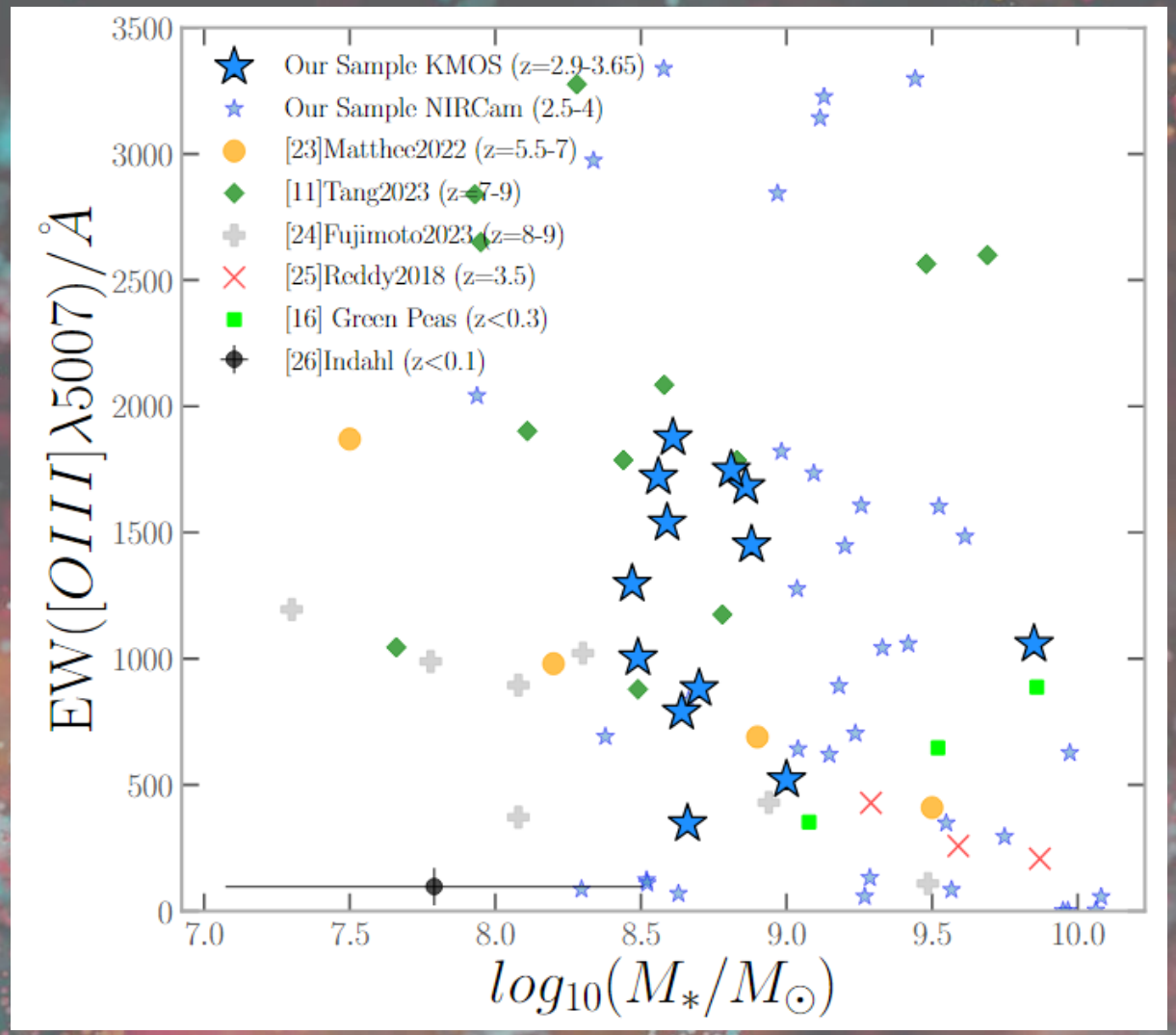
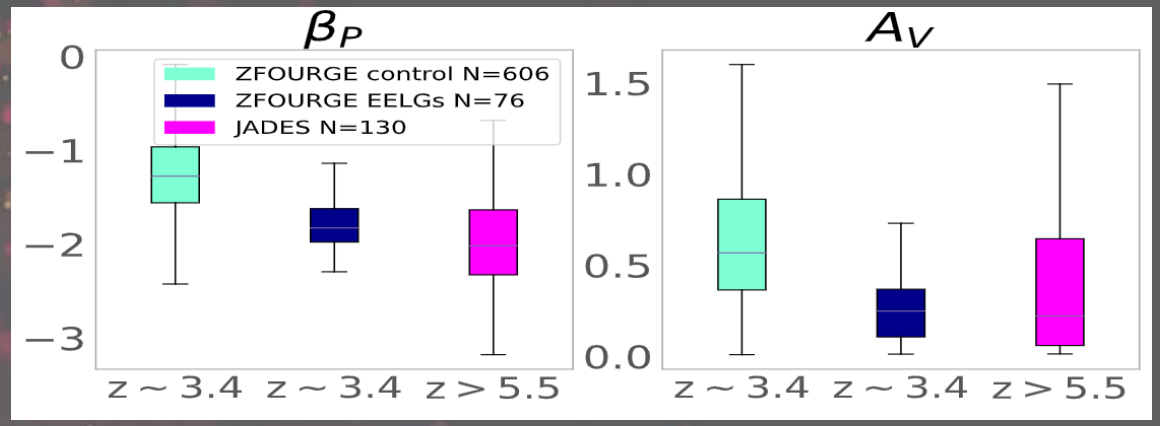
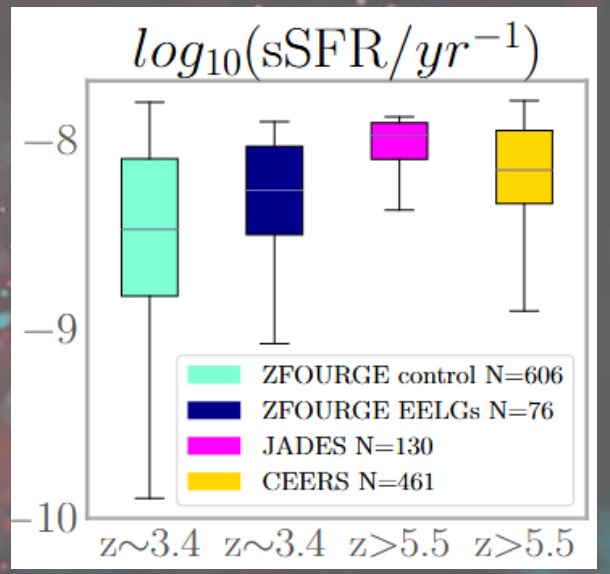
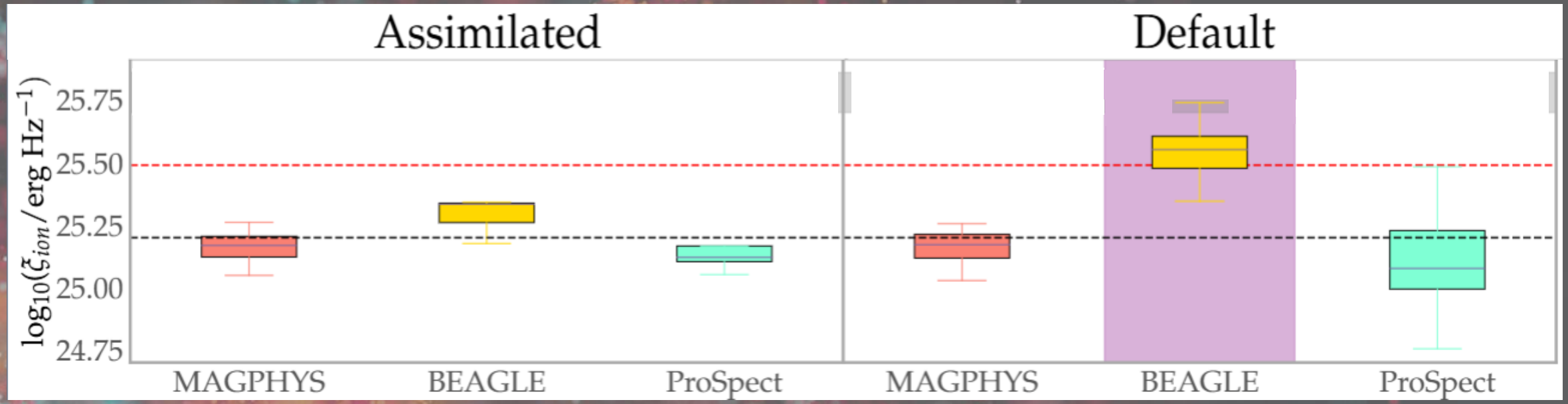




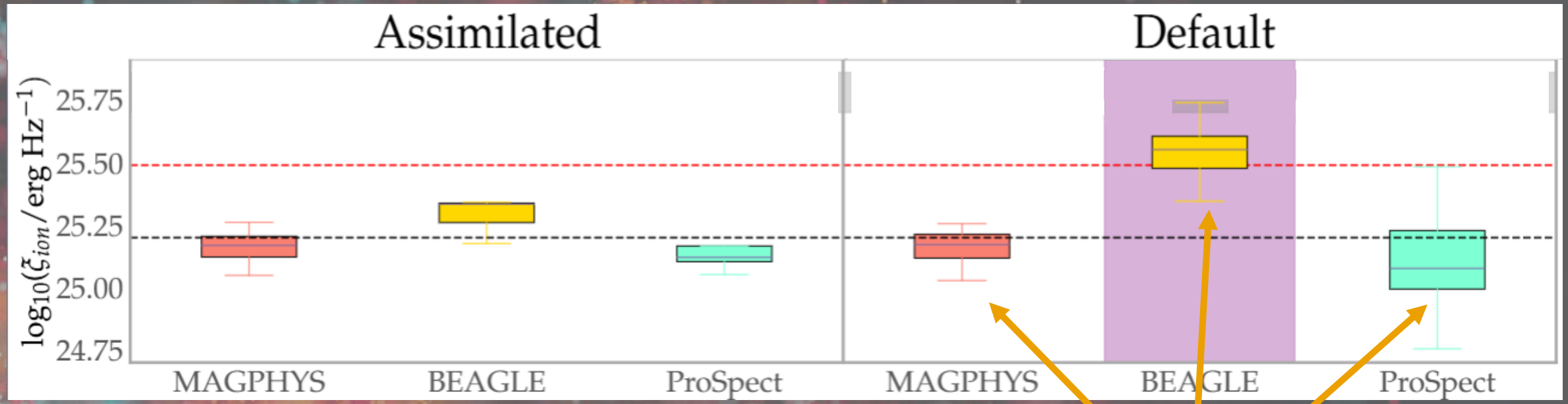


Jaiswar 2024

Proof of concept

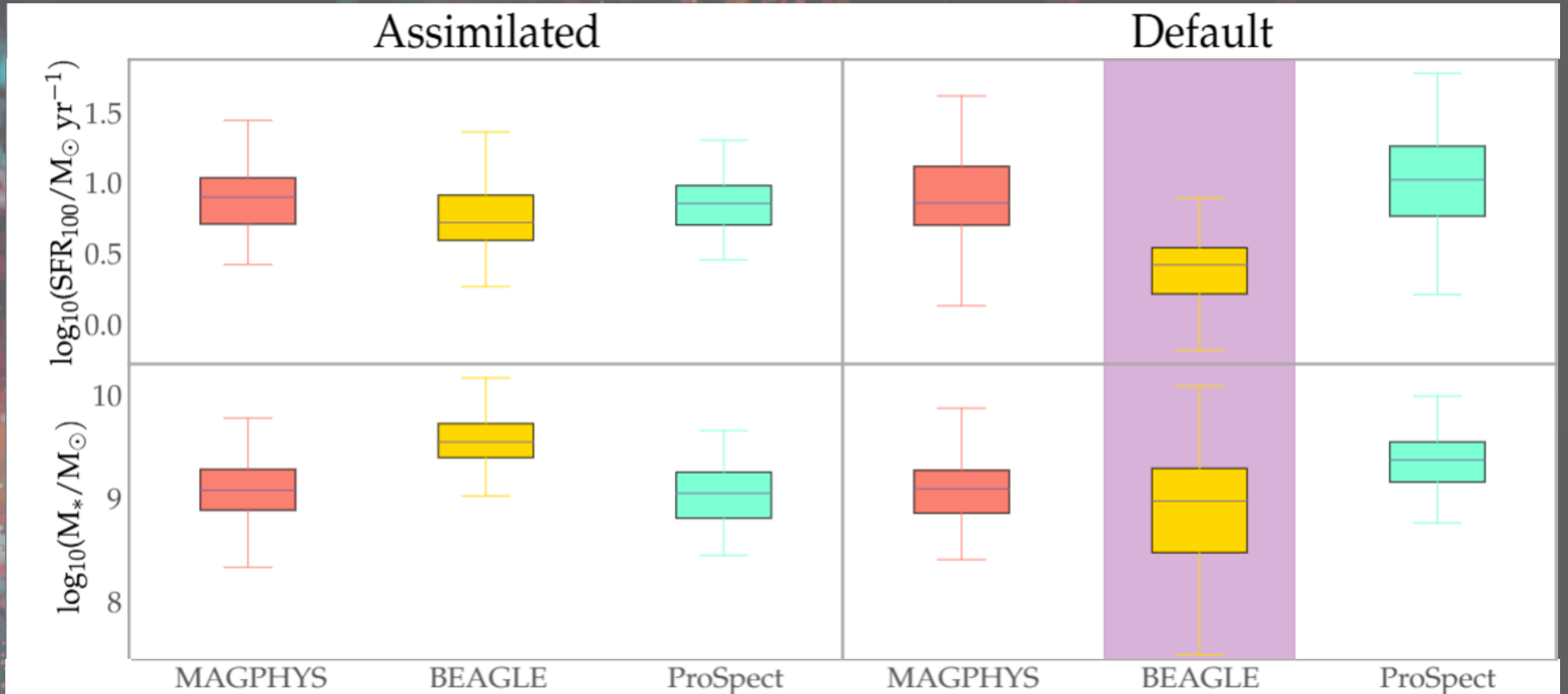


Proof of concept



The exact same galaxies

Proof of concept



Star Formation History

MAGPHYS

Delayed Exponentially declining

DaCunha 2008

Robotham 2020

ProSpect

Exponentially Declining

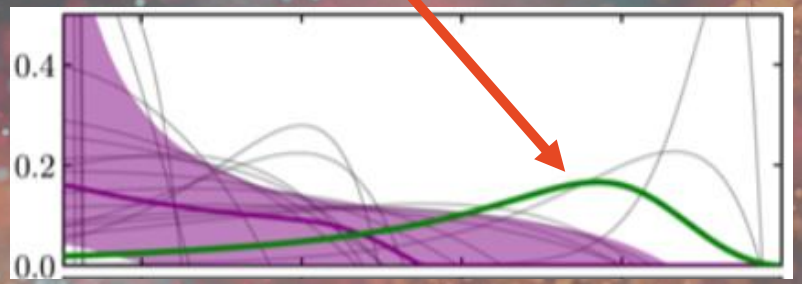
Constant

Truncated Skewed Normal

Star Formation History

MAGPHYS

Delayed Exponentially declining



Carnall 2019

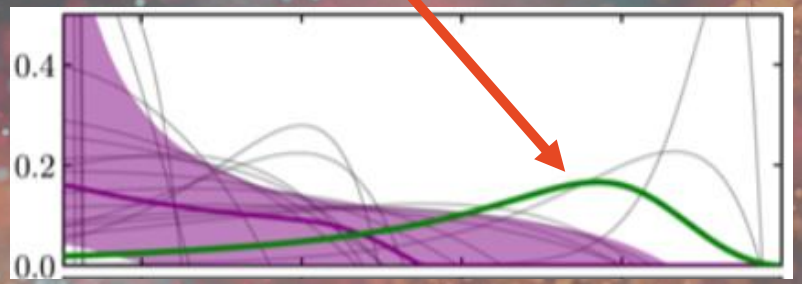
ProSpect

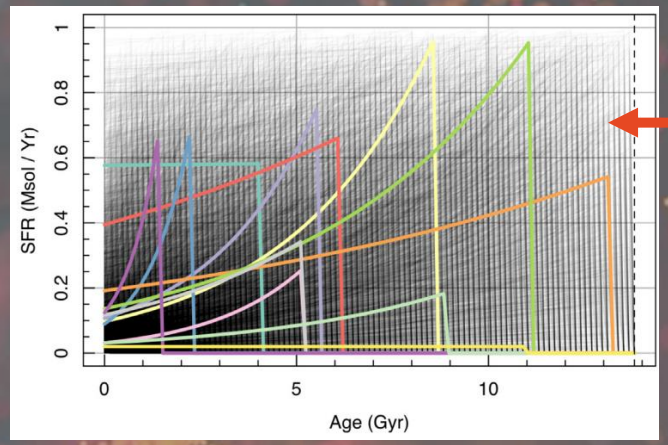
- Exponentially Declining
- Constant
- Truncated Skewed Normal

Star Formation History

MAGPHYS

Delayed Exponentially declining



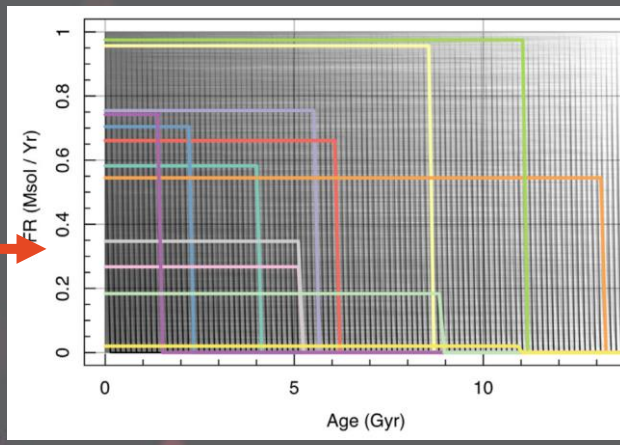


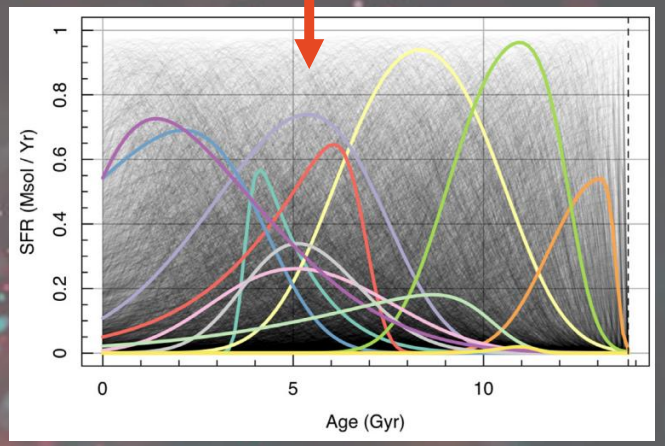
ProSpect

Exponentially Declining

Constant

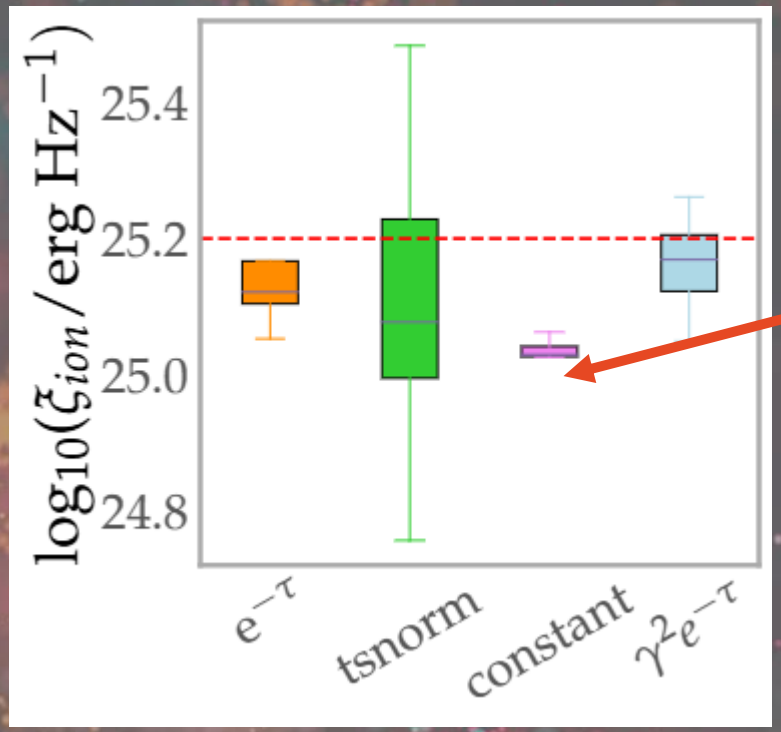
Truncated Skewed Normal

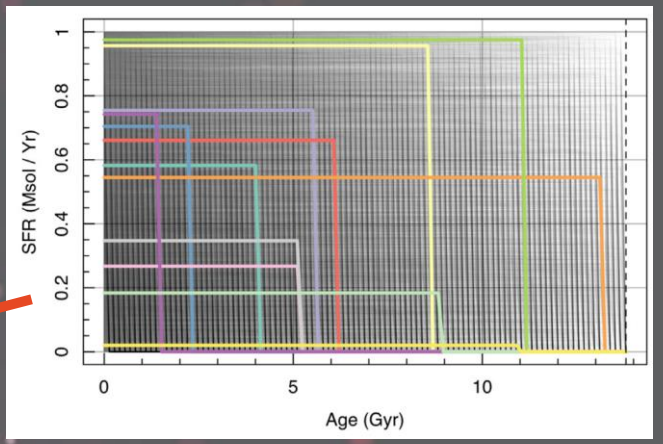




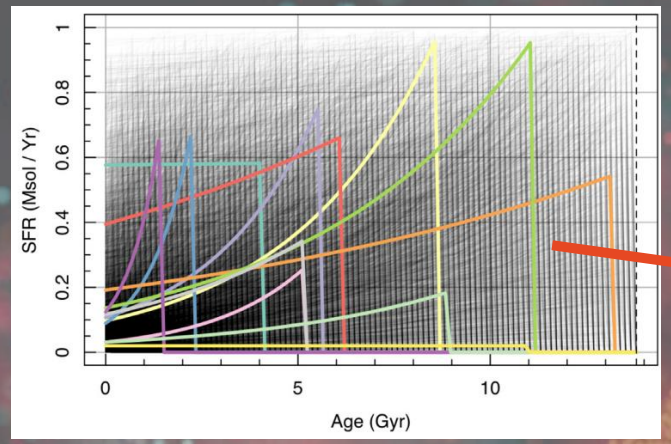
Robotham 2020

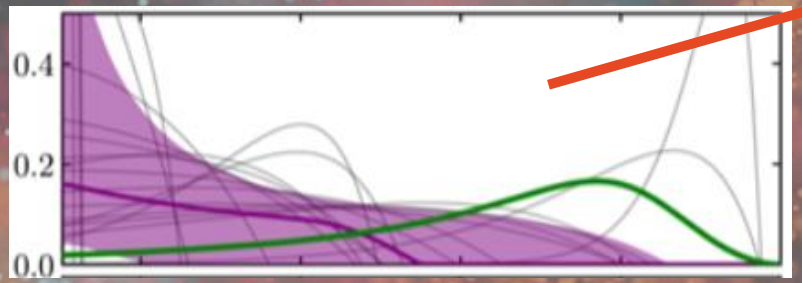
Star Formation History

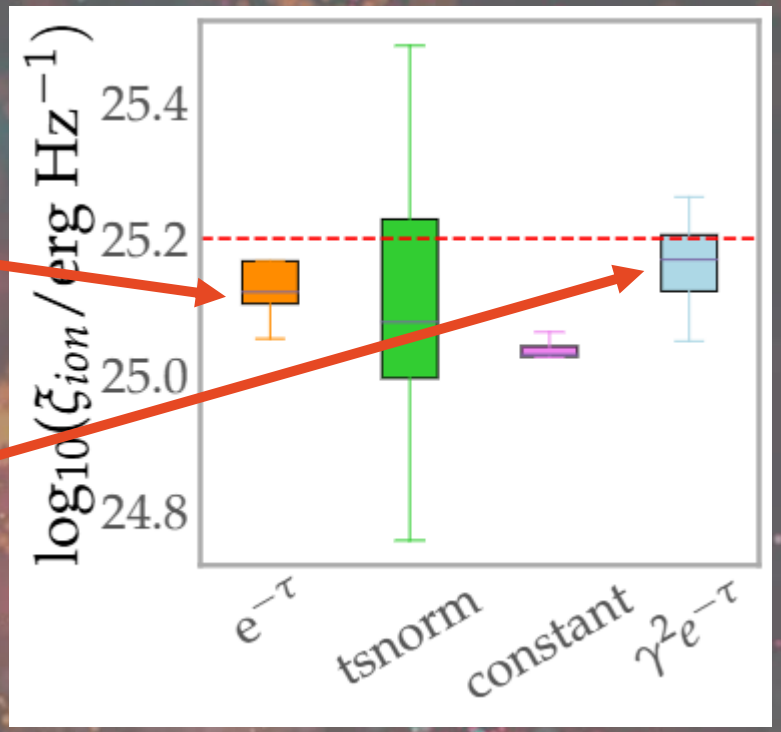


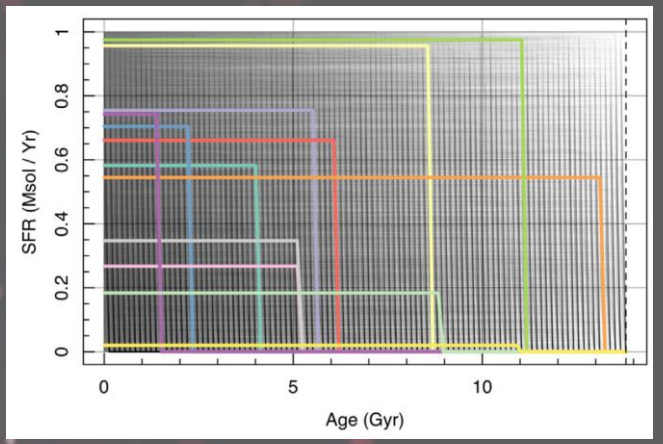


Star Formation History

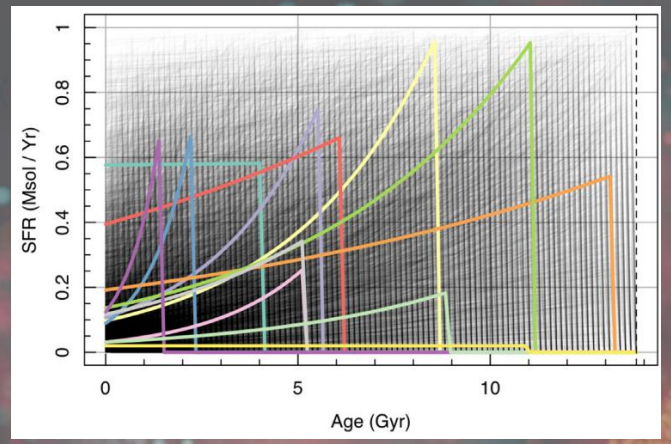


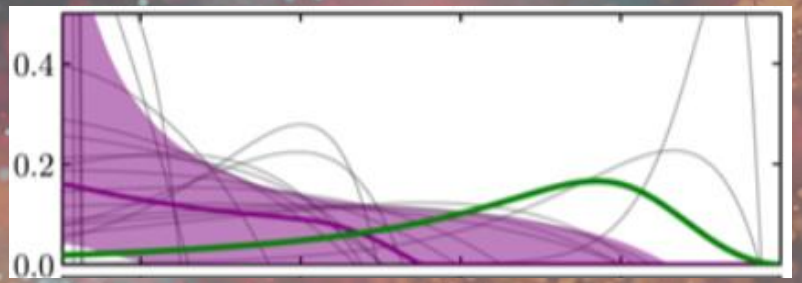


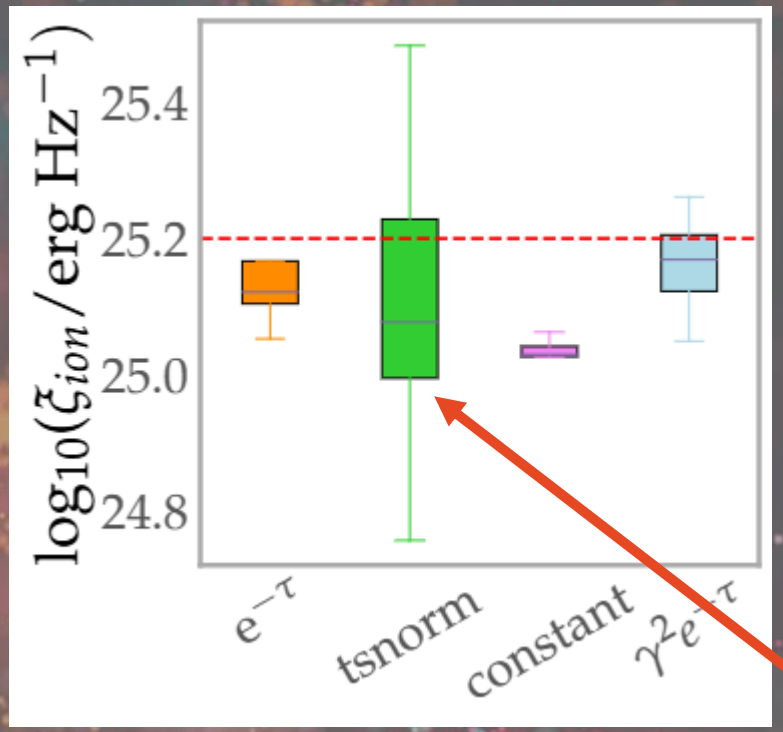


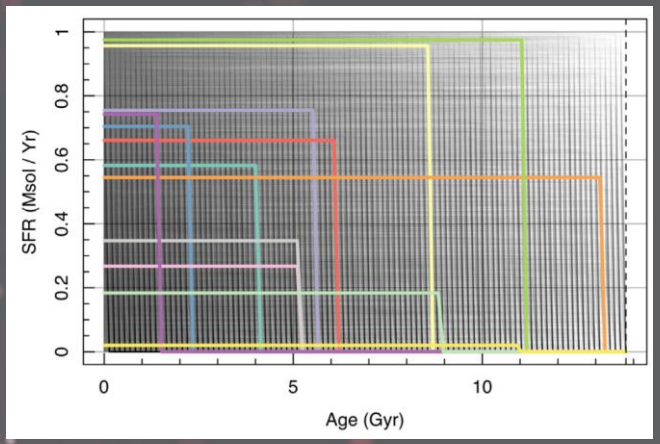


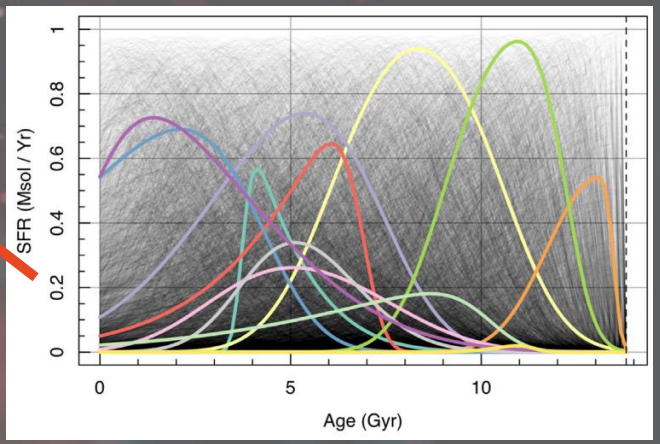
Star Formation History



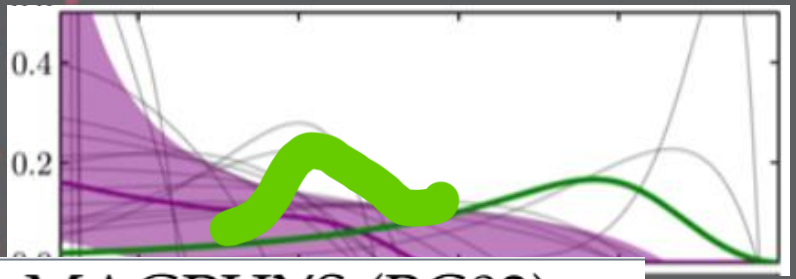


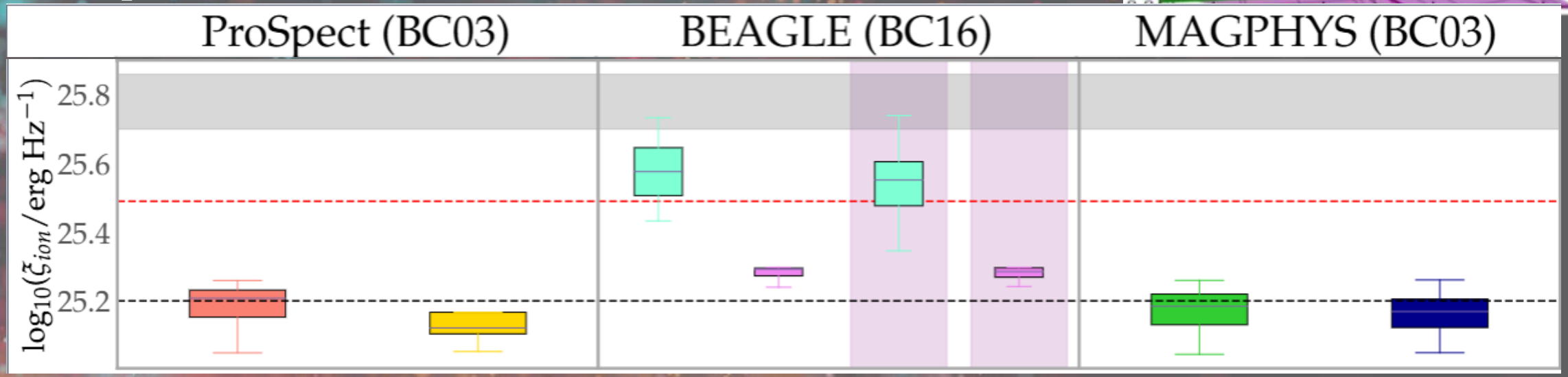






Star Formation History- Burst Implementation





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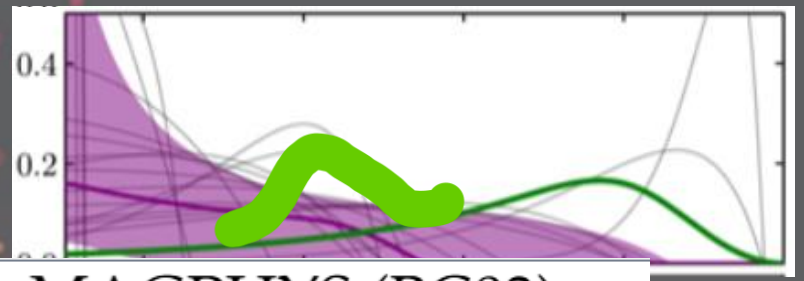

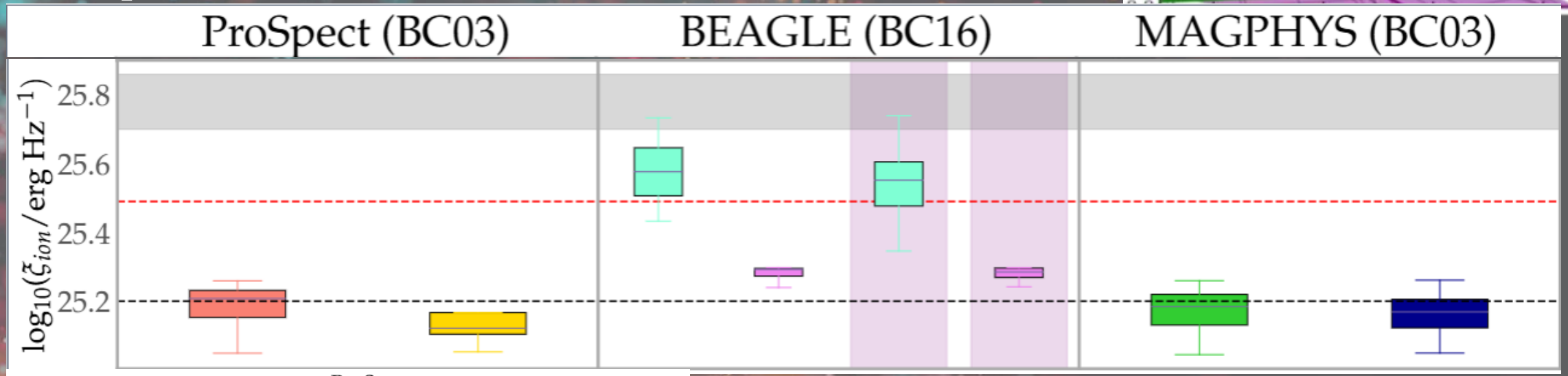

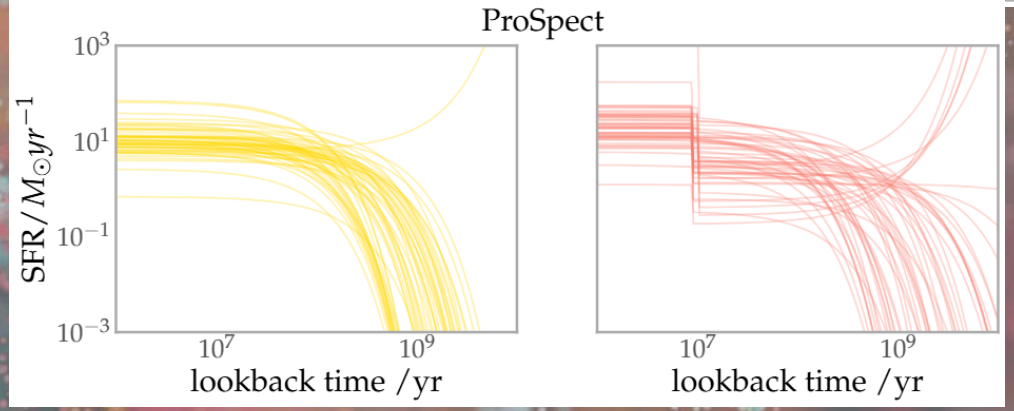

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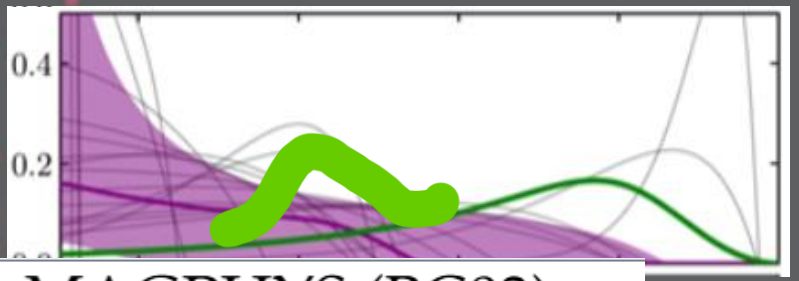

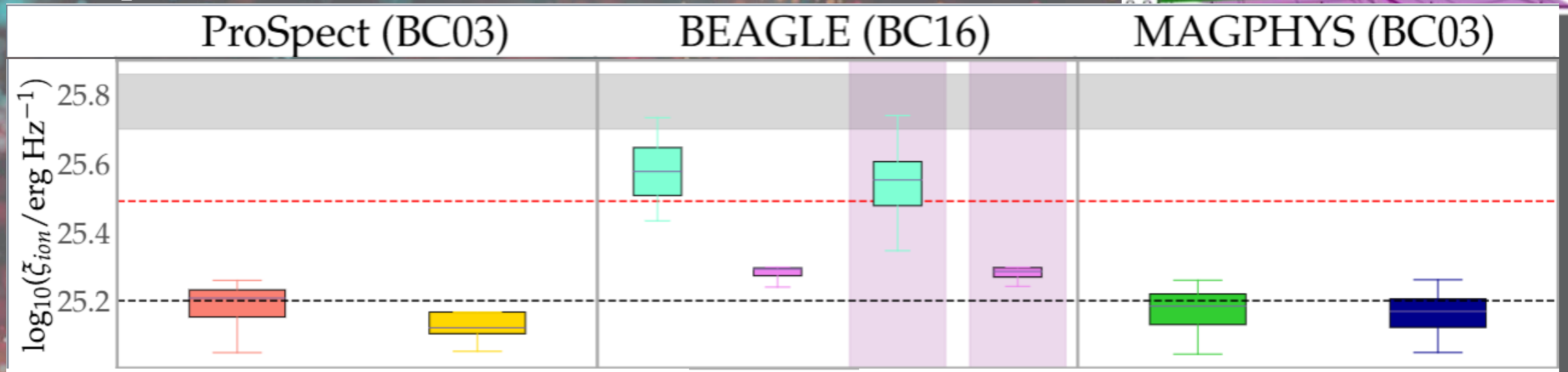

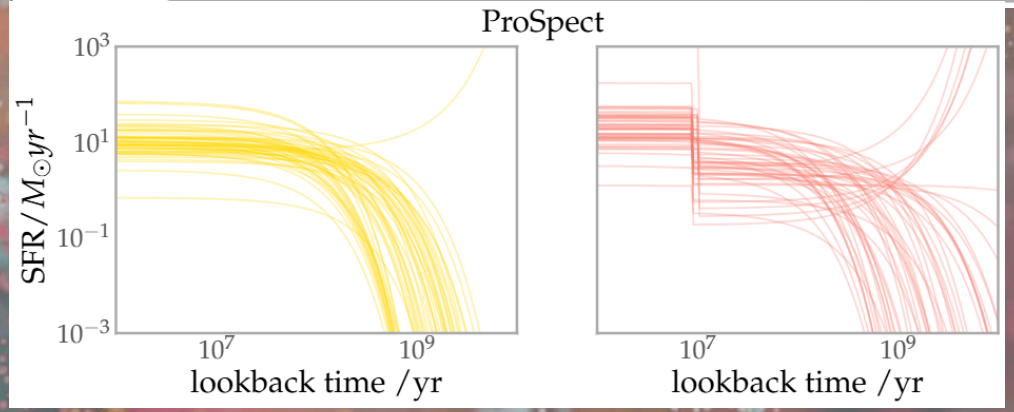

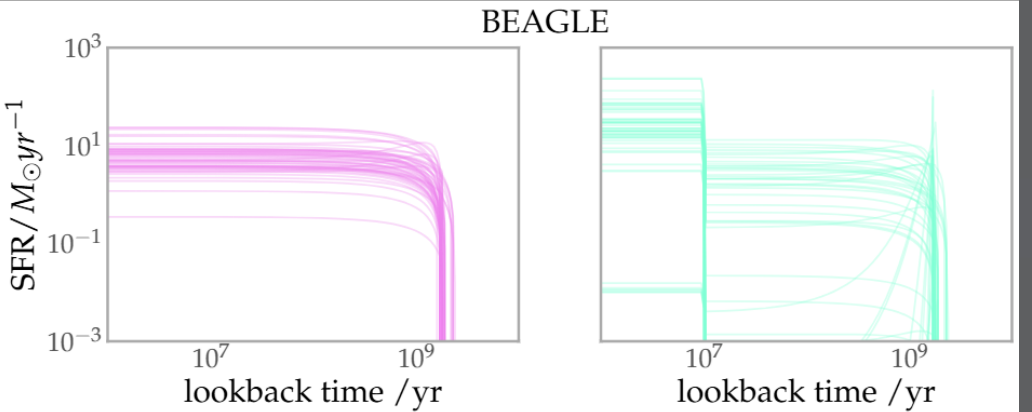

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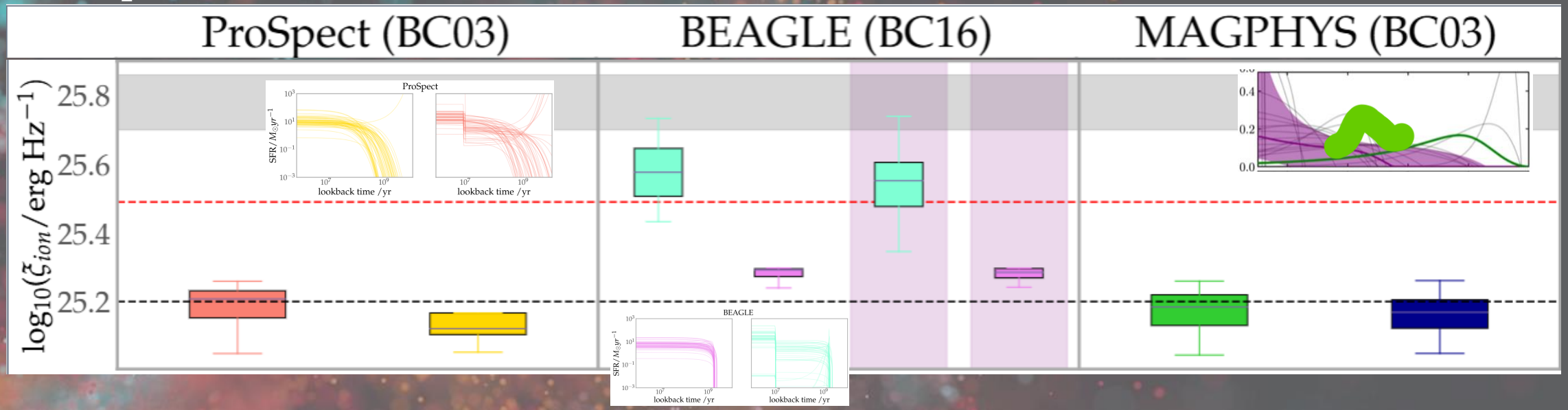
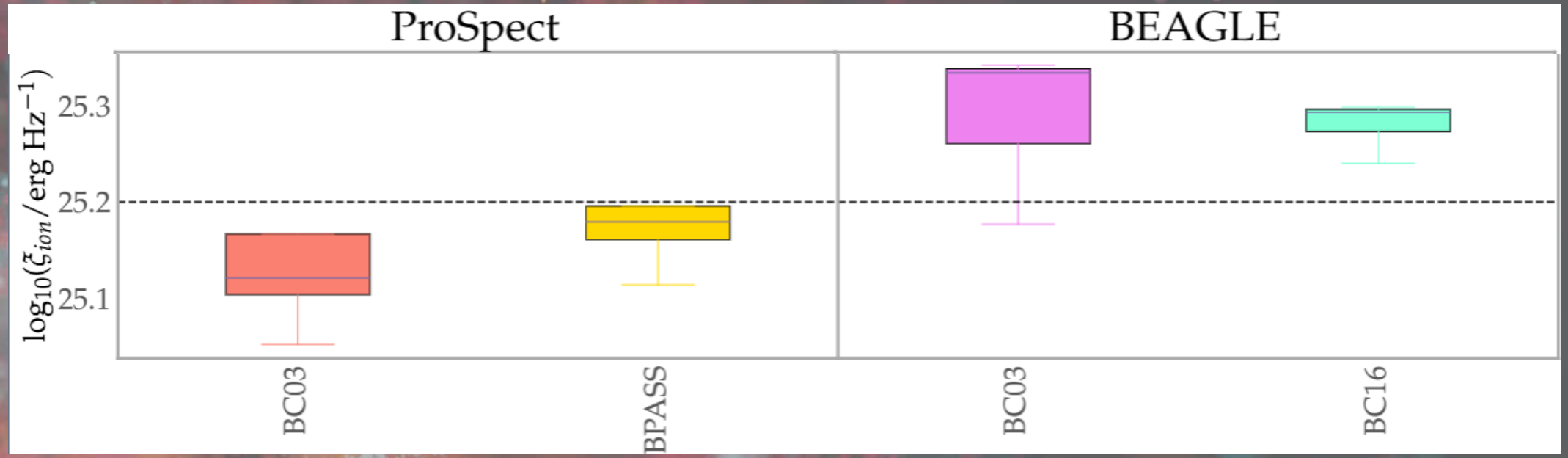
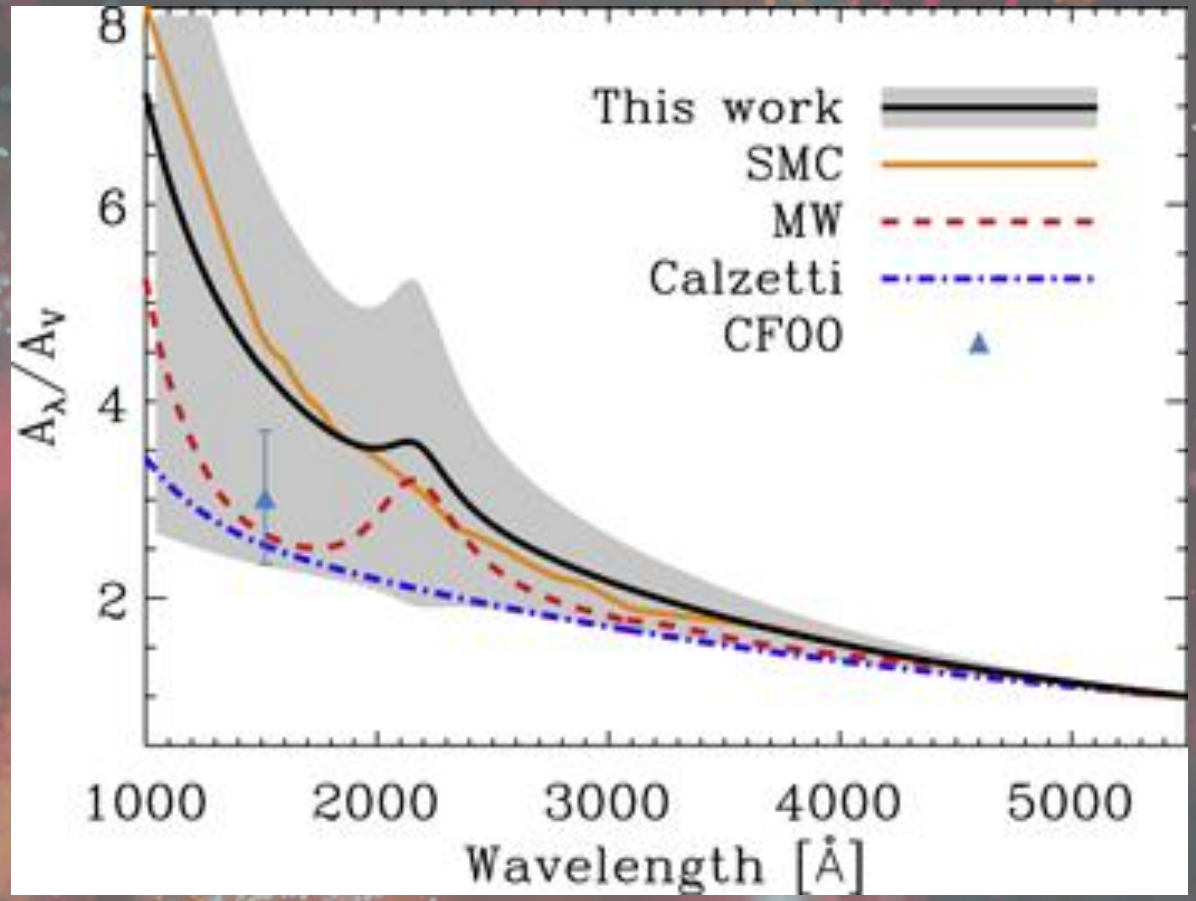


Stellar Population Synthesis

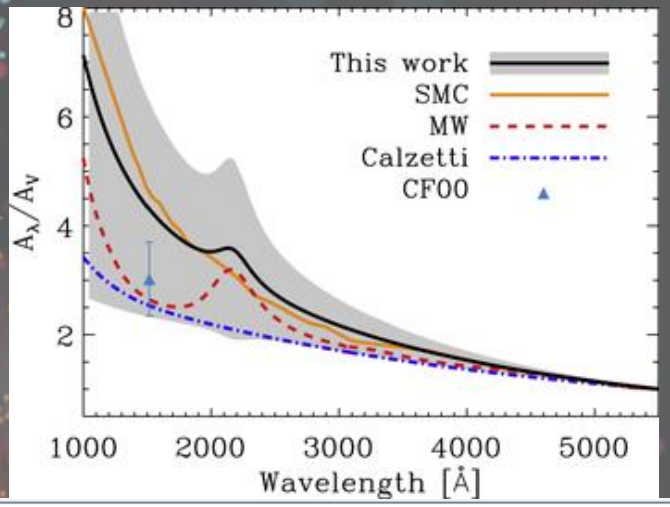


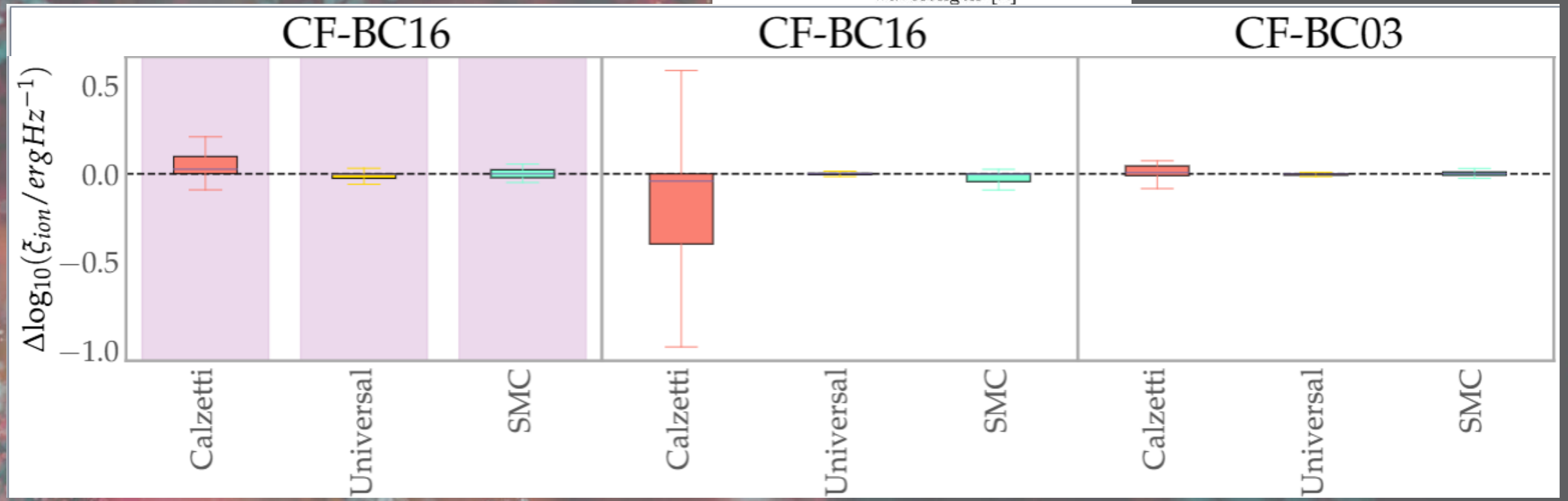
Dust Model



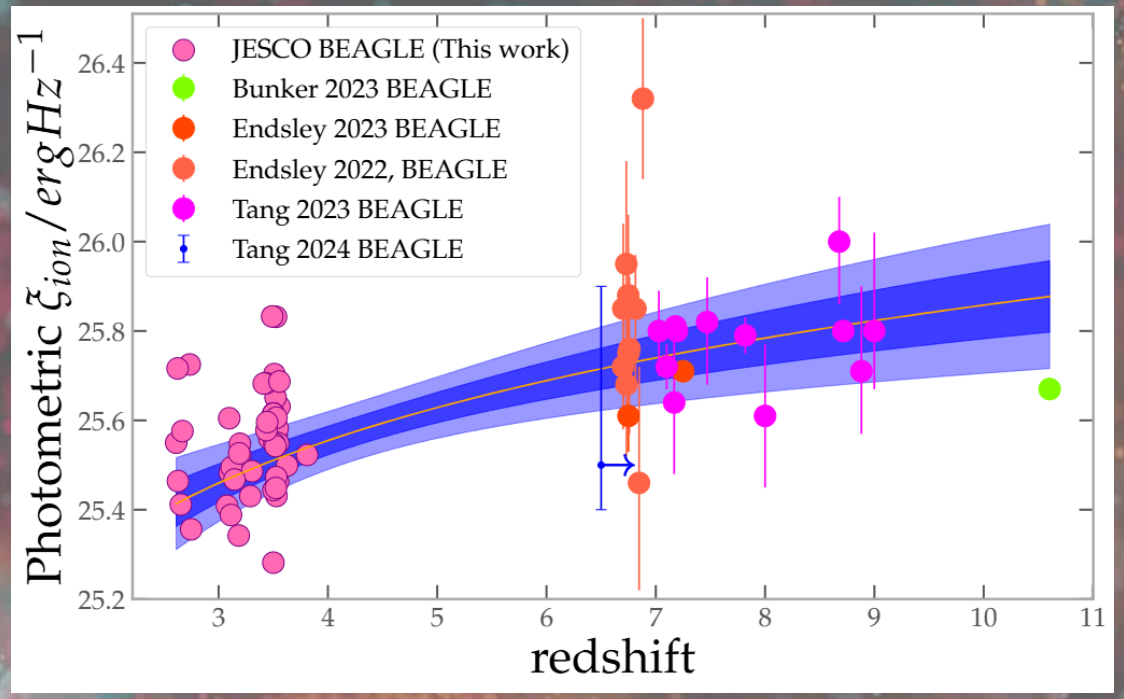
Salim 2020

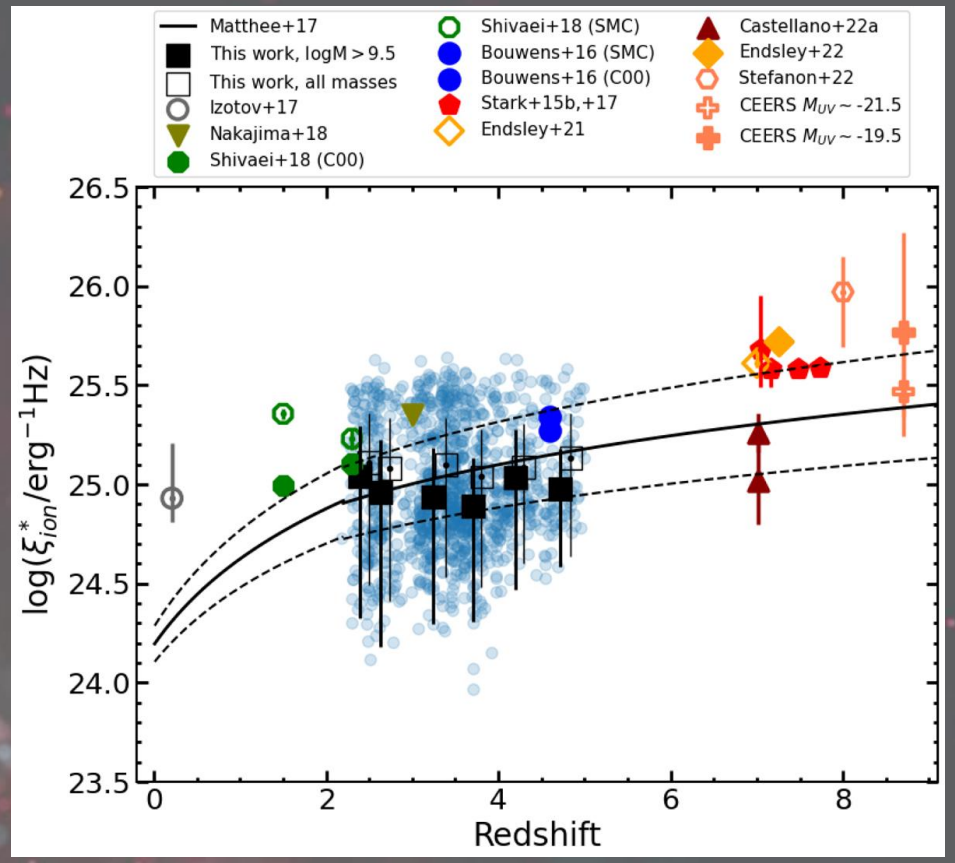
Dust Model


This work
SMC
MW
Calzetti
CF00
A_λ/A_V
8
6
4
2
1000
2000
3000
4000
5000
Wavelength [Å]

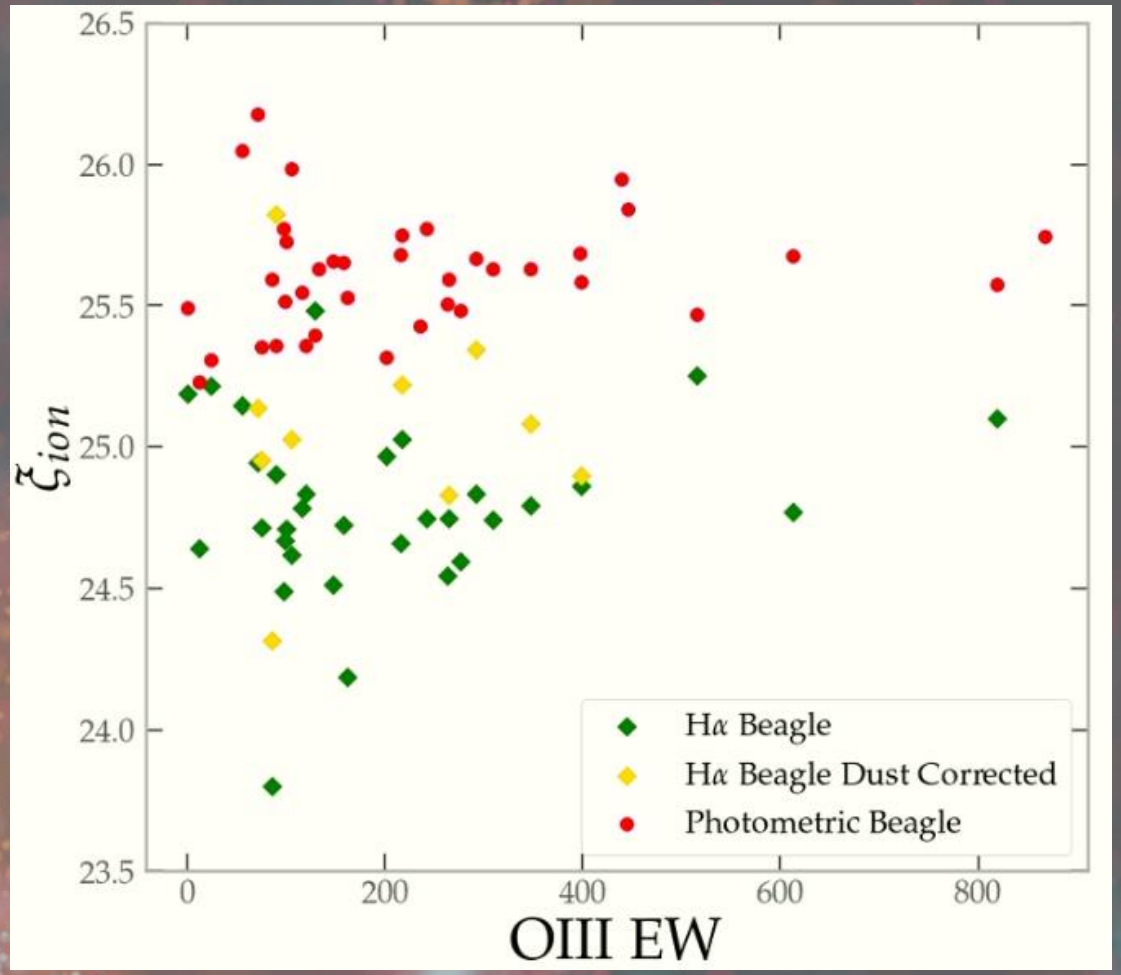

CF-BC16
CF-BC16
CF-BC03
$\Delta\log_{10}(\xi_{ion}/erg\,Hz^{-1})$
0.5
0.0
−0.5
−1.0
Calzetti
Universal
SMC
Calzetti
Universal
SMC
Calzetti
Universal
SMC

Redshift Evolution



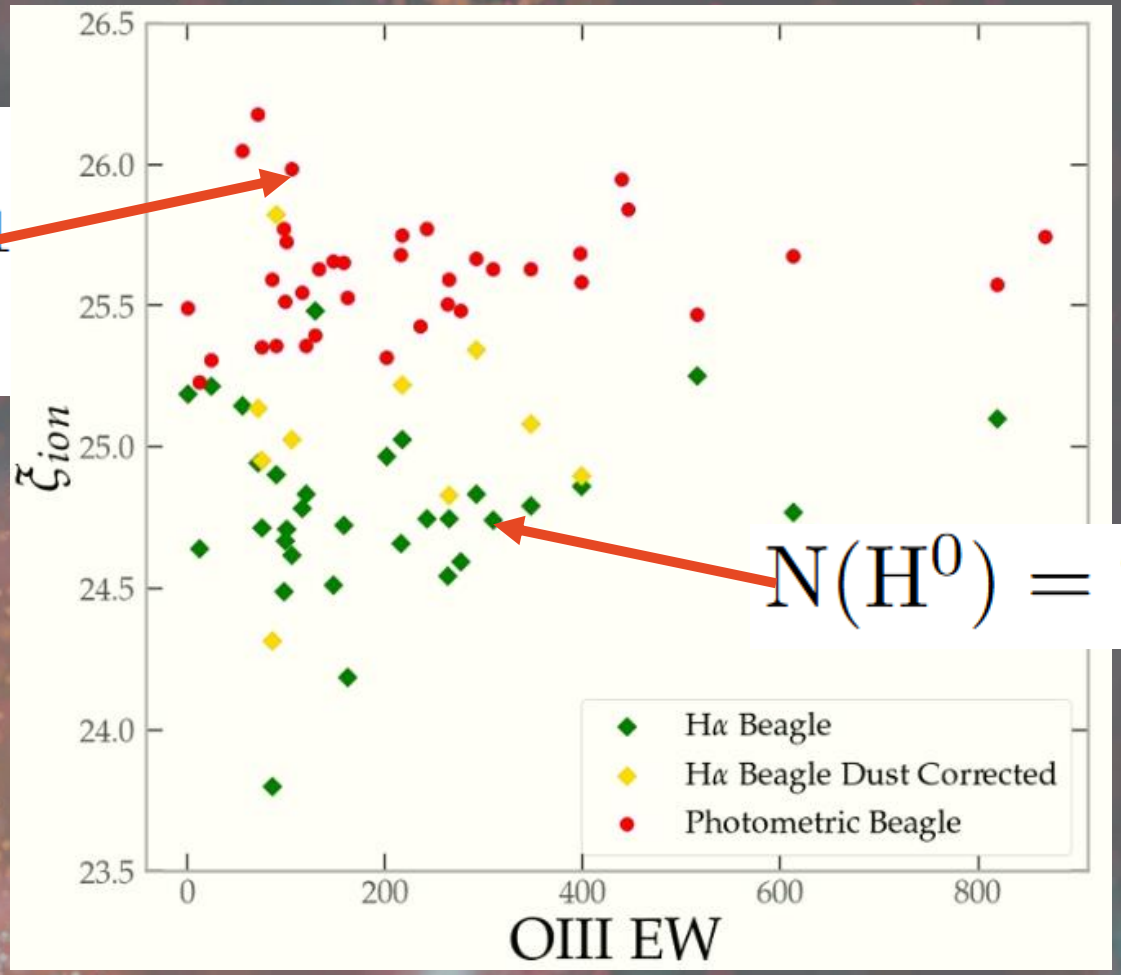


Other Factors



Other Factors

$$\int_{c/-\infty}^{c/912\mathring{A}} L_\nu(\mathrm{h}\nu)^{-1}$$



$$\mathrm{N(H^0)} = 7.28\times10^{11} L(H\alpha)$$

On the Model Dependence of the ionizing photon production efficiency

What are we really measuring

Supplementary Slide