



UNIÓN EUROPEA

Fondo Europeo de Desarrollo Regional
"Una manera de hacer Europa"



GOBIERNO
DE ESPAÑA

MINISTERIO
DE ECONOMÍA, INDUSTRIA
Y COMPETITIVIDAD



**GOBIERNO
DE ARAGON**

Actividades de investigación subvencionadas por Gobierno de Aragón



LIGHT-CONES WITH EMISSION LINES FOR J-PLUS SURVEY

SYNERGY BETWEEN N-BODY SIMULATIONS, SEMI-ANALYTICAL MODELS & EMISSION LINE MODELING

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ESA "Simulated skies for new-generation spectroscopic surveys"

24 April 2018

Madrid, Spain

MOTIVATION

- **Check pipelines**

- * Is there any bias in our code or selection?
- * What are the typical errors?

- **Test new ideas**

- **Physics behind our results**

MOTIVATION

MOCKS FOR NARROW BAND SURVEYS



C . Hernandez-Monteagudo

(Wednesday afternoon session)



S . Bonoli

(Wednesday afternoon session)

Narrow band survey J-PLUS

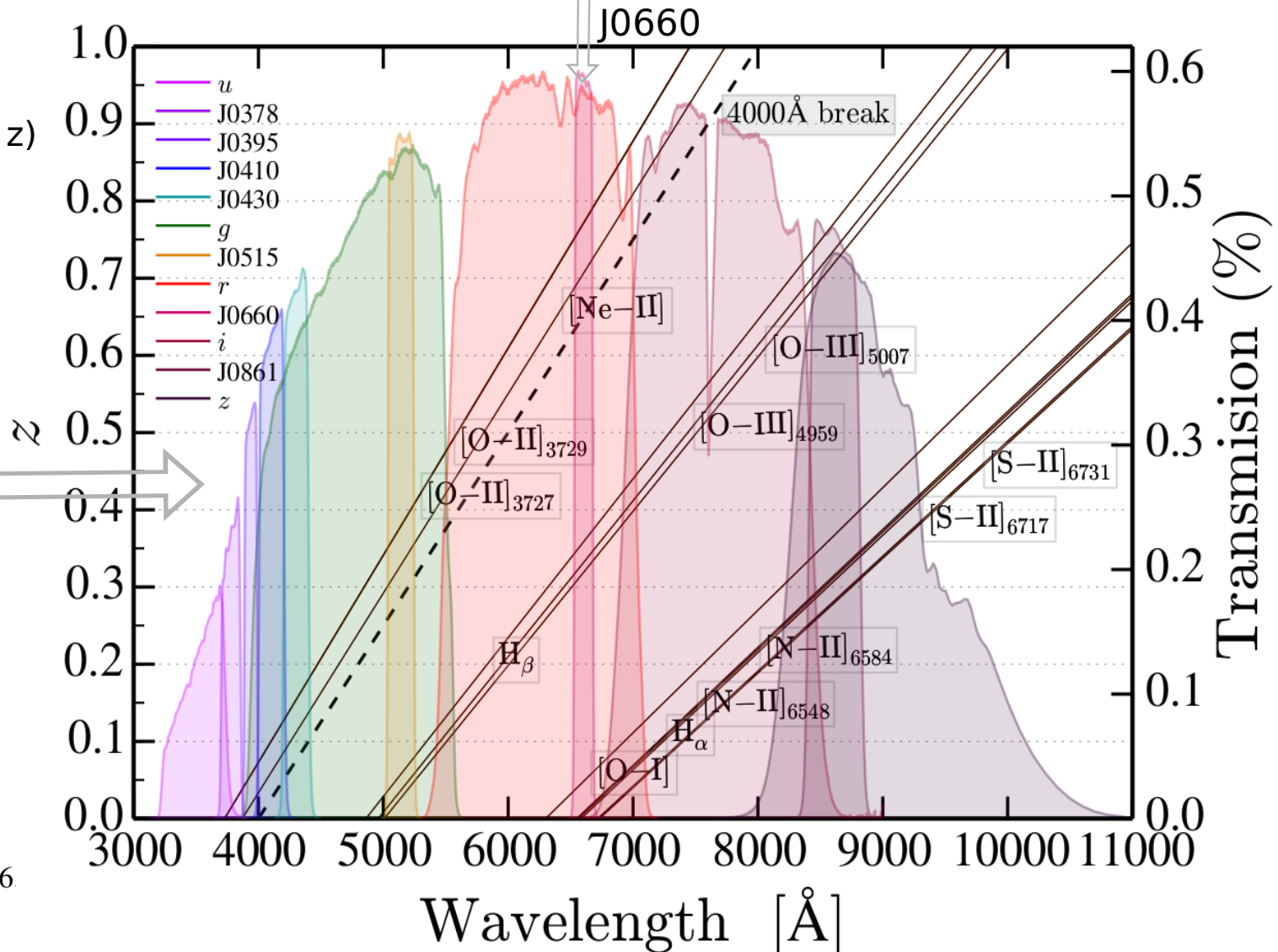


H_α $z = 0$
 $[O-III]$ & H_β $z = [0.3 - 0.35]$
 $[[O-III]]$ $z = [0.77 - 0.8]$

5 BROAD bands (u, g, r i, z)
7 NARROW bands

$[O-II]$ $z = 0$
 Ly_α $z = 2.2$

$$m_{AB} = -2.5 \log_{10}(f_\nu) - 48.6 \\
 = -2.5 \log_{10} \frac{\int S(\lambda) \lambda f_\lambda d\lambda}{c \int \frac{S(\lambda)}{\lambda} d\lambda} - 48.6$$



HOW DO WE CREATE A MOCK CATALOGUE?

Mimicking a survey

Predict a reliable
galaxy population:

**Galaxy formation
model**

Predict a good
galaxy spacial
distribution:

**Dark matter
N-body simulation**

Predict a emission lines:

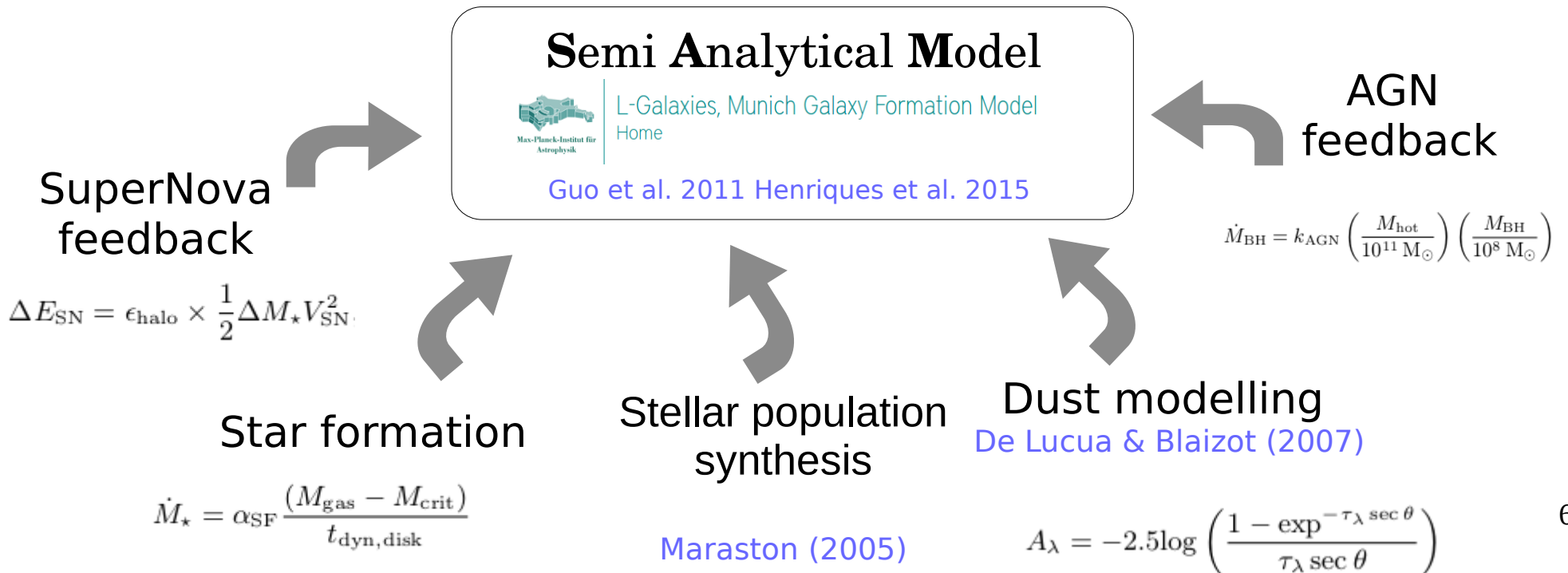
Emission line models

HOW DO WE CREATE A MOCK CATALOGUE?

Predicting a reliable galaxy population.

Allow us to track the cosmological evolution of galaxies

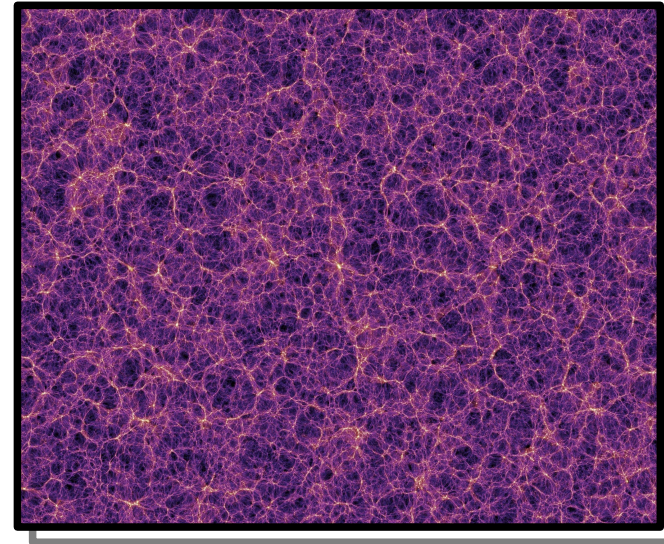
PHYSICAL MOTIVATED RECIPES



HOW DO WE CREATE A MOCK CATALOGUE?

Predicting a good galaxy spacial distribution

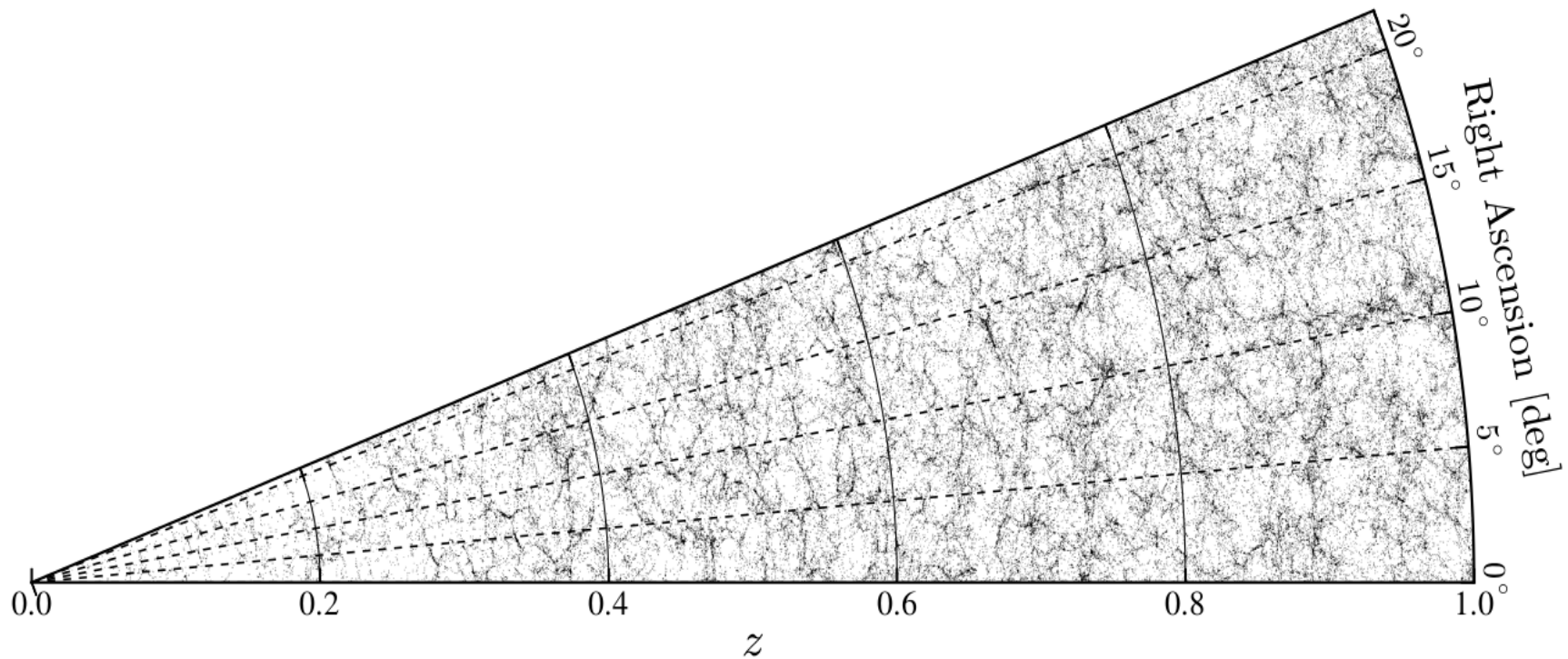
Dark matter simulation



Millennium simulation ([Springel et al. 2005](#))

HOW DO WE CREATE A MOCK CATALOGUE?

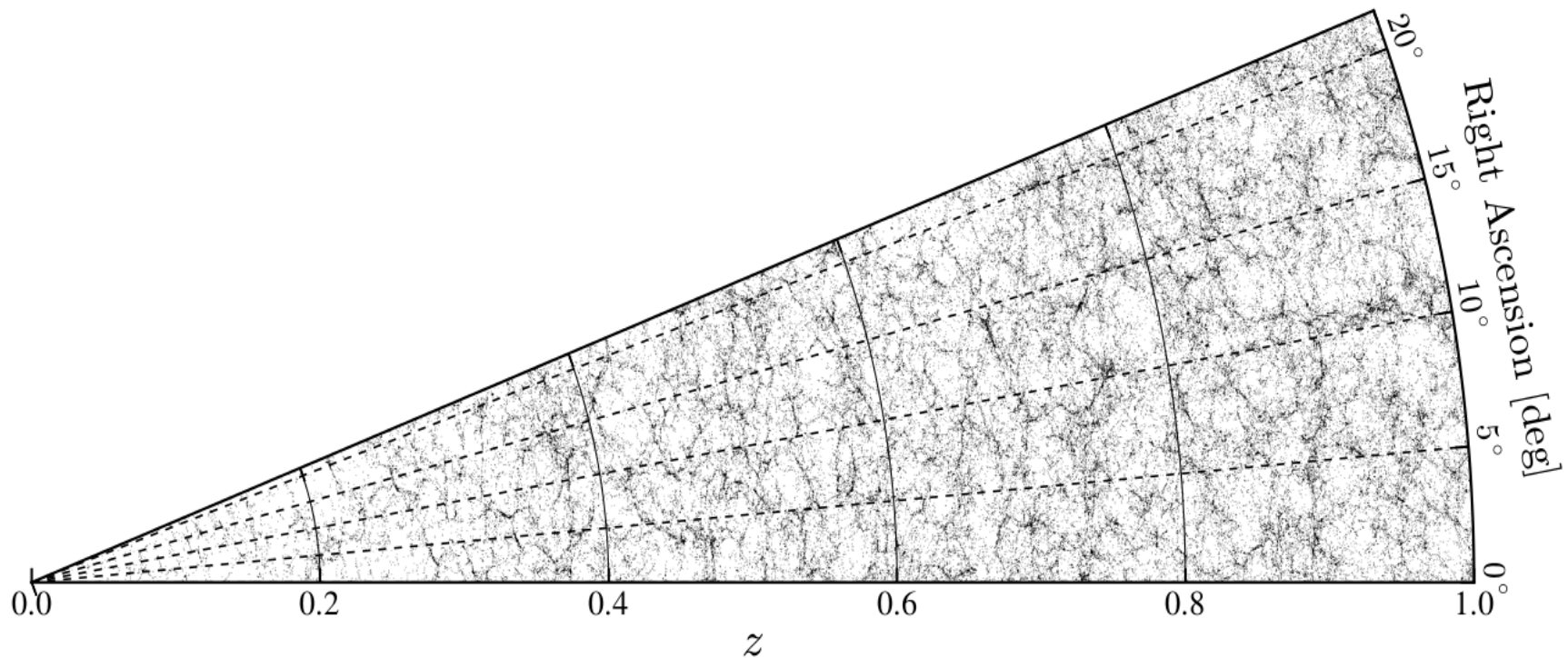
Mock light cone



Area $\sim 500 \text{ deg}^2$

HOW DO WE CREATE A MOCK CATALOGUE?

The SAM does not model the lines
The mock lacks emission lines!



Area $\sim 500 \text{ deg}^2$

HOW DO WE CREATE A MOCK CATALOGUE?

Predicting an emission line

Emission line modelling

Orsi et al. (2014)

Metallicity of galaxies
(Z_{cold})

$$q(Z) = q_0 \left(\frac{Z_{\text{cold}}}{Z_0} \right)^{-\gamma}$$

Ionization parameter
(q)

$$Z_0 = 0.012 \quad q_0 = 6.5 \times 10^7 \quad \gamma = 0.8$$

Line Flux
Models of

Levesque et al. (2010)

$$F_\lambda(\lambda, q, Z)$$

$$H_\alpha, H_\beta, Ly_\alpha, [O-II], [O-III]$$

$$[OI], [NIII], [SII], [NeIII], [CII], [NII]$$

INSTANTANEOUS

SFR

Luminosity

$$L(\lambda_j)$$

14 different lines!

HOW DO WE CREATE A MOCK CATALOGUE?

Predicting an emission line

Emission line modelling

Orsi et al. (2014)

Line Flux

Models of

Levesque et al. (2010)

$$F_{\lambda}(\lambda, q, Z)$$



Luminosity

$$L(\lambda_j)$$

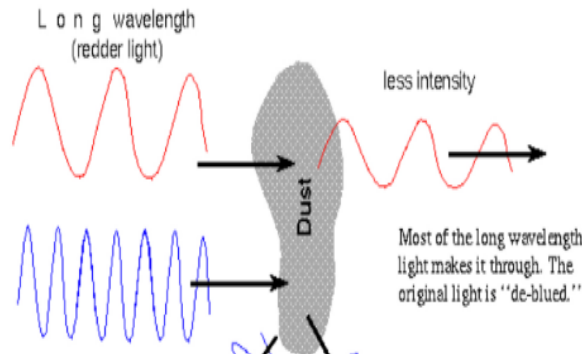


Luminosity DUST ATTENUATION

De Lucia & Blaizot (2007)

$$L_{corrected}(\lambda_j) = L(\lambda_j) * \frac{1 - e^{-\tau_{\lambda} \sec \theta}}{\tau_{\lambda} \sec \theta}$$

$$\tau_{\lambda} = C(z) Z_{cold} \frac{A_V}{A_B} \frac{A(\lambda)}{A_V}$$

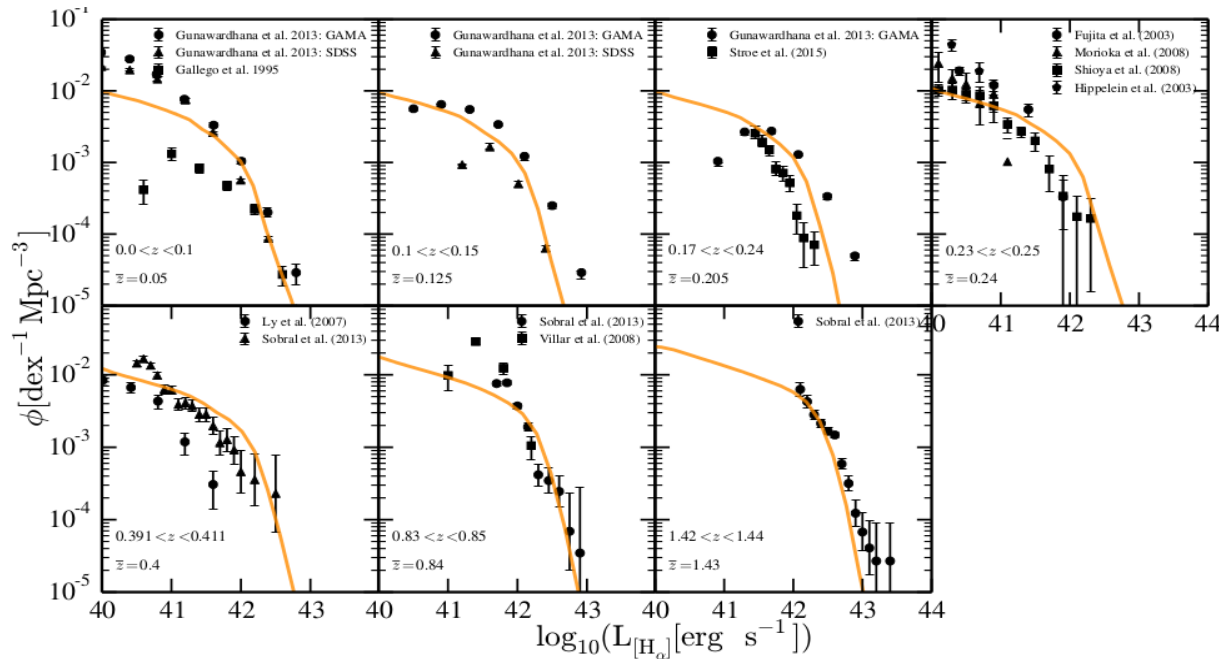


$H_{\alpha}, H_{\beta}, [O-II], [O-III]$

HOW DO WE CREATE A MOCK CATALOGUE?

Predicting an emission line

H_α

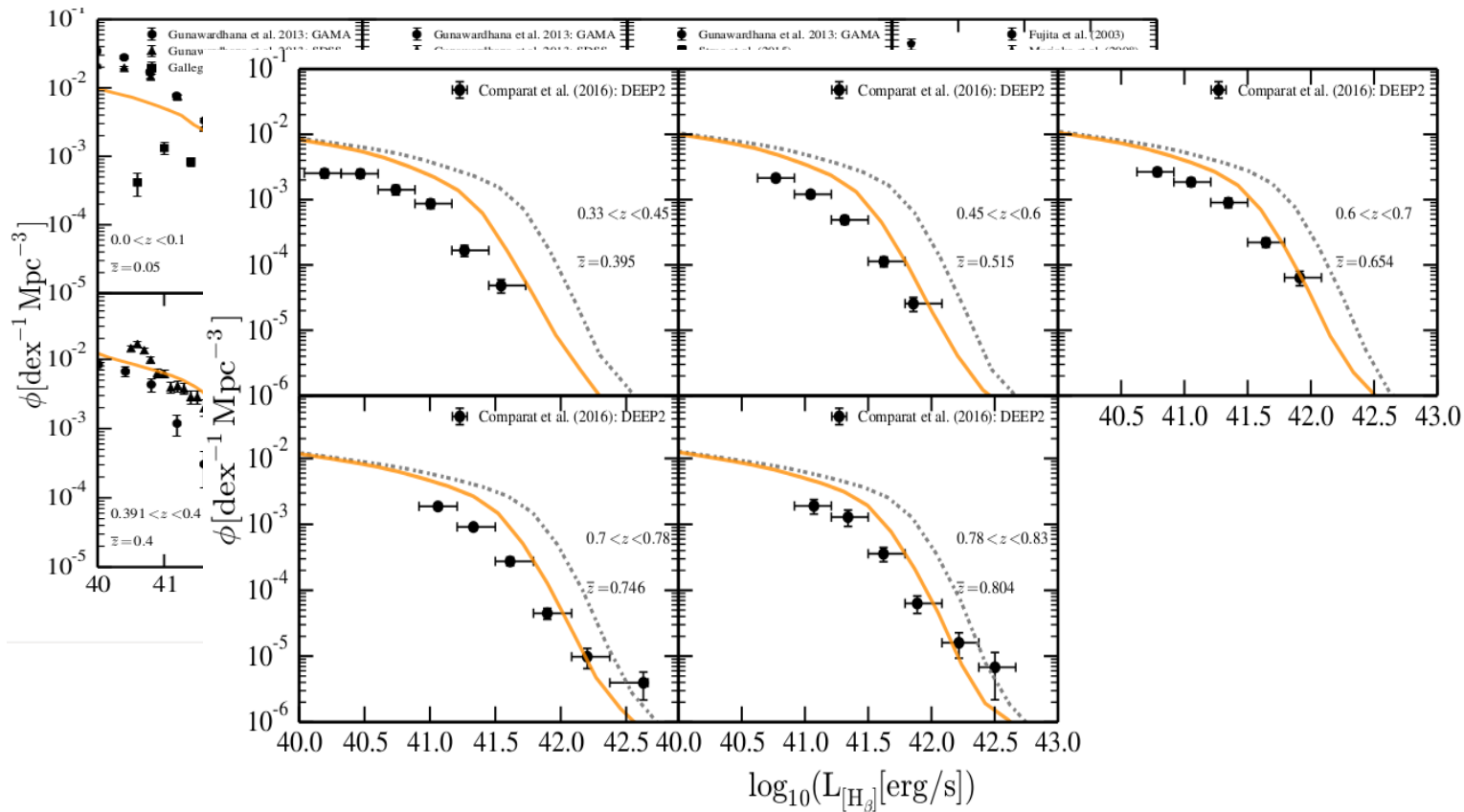


HOW DO WE CREATE A MOCK CATALOGUE?

Predicting an emission line

Dust corrected
No Corrected

H_{β}

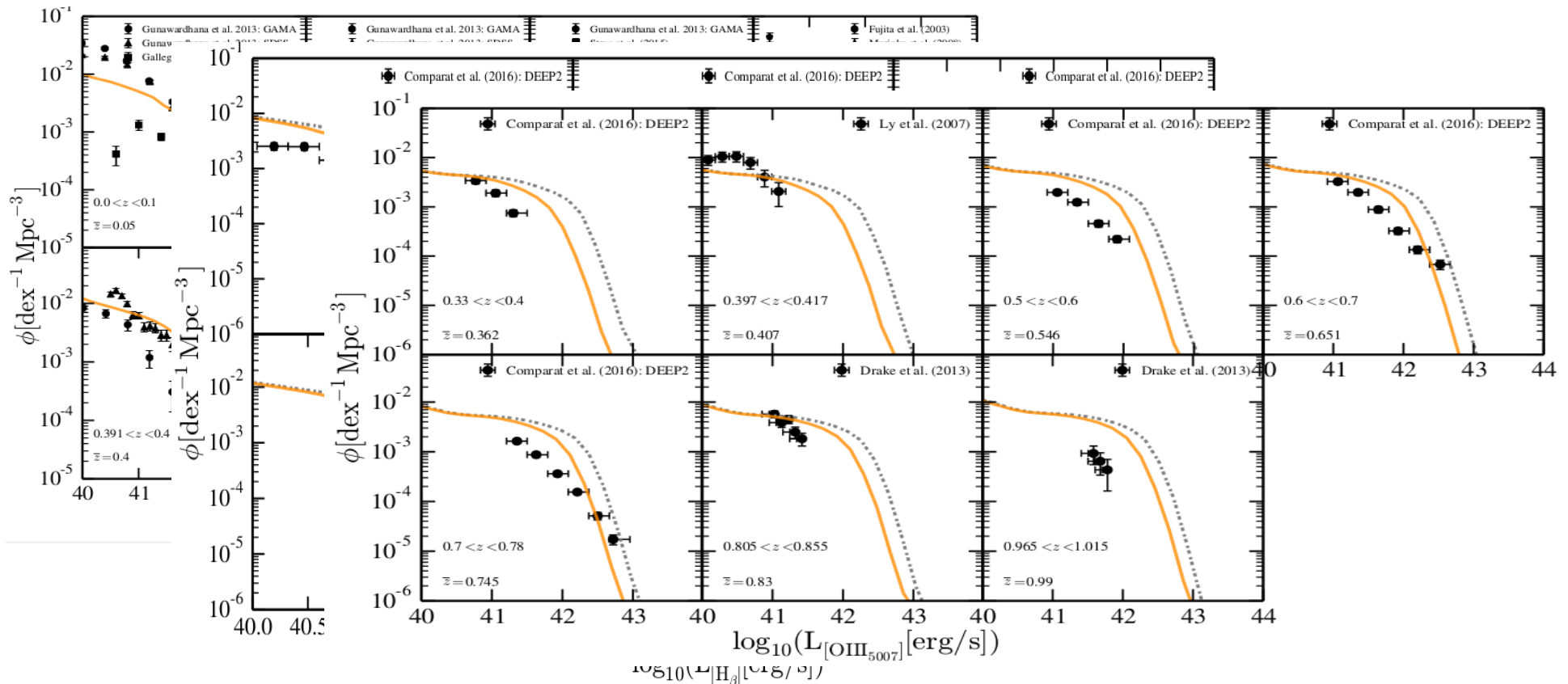


HOW DO WE CREATE A MOCK CATALOGUE?

Predicting an emission line

$$[O-III]_{5007}$$

Dust corrected
No Corrected

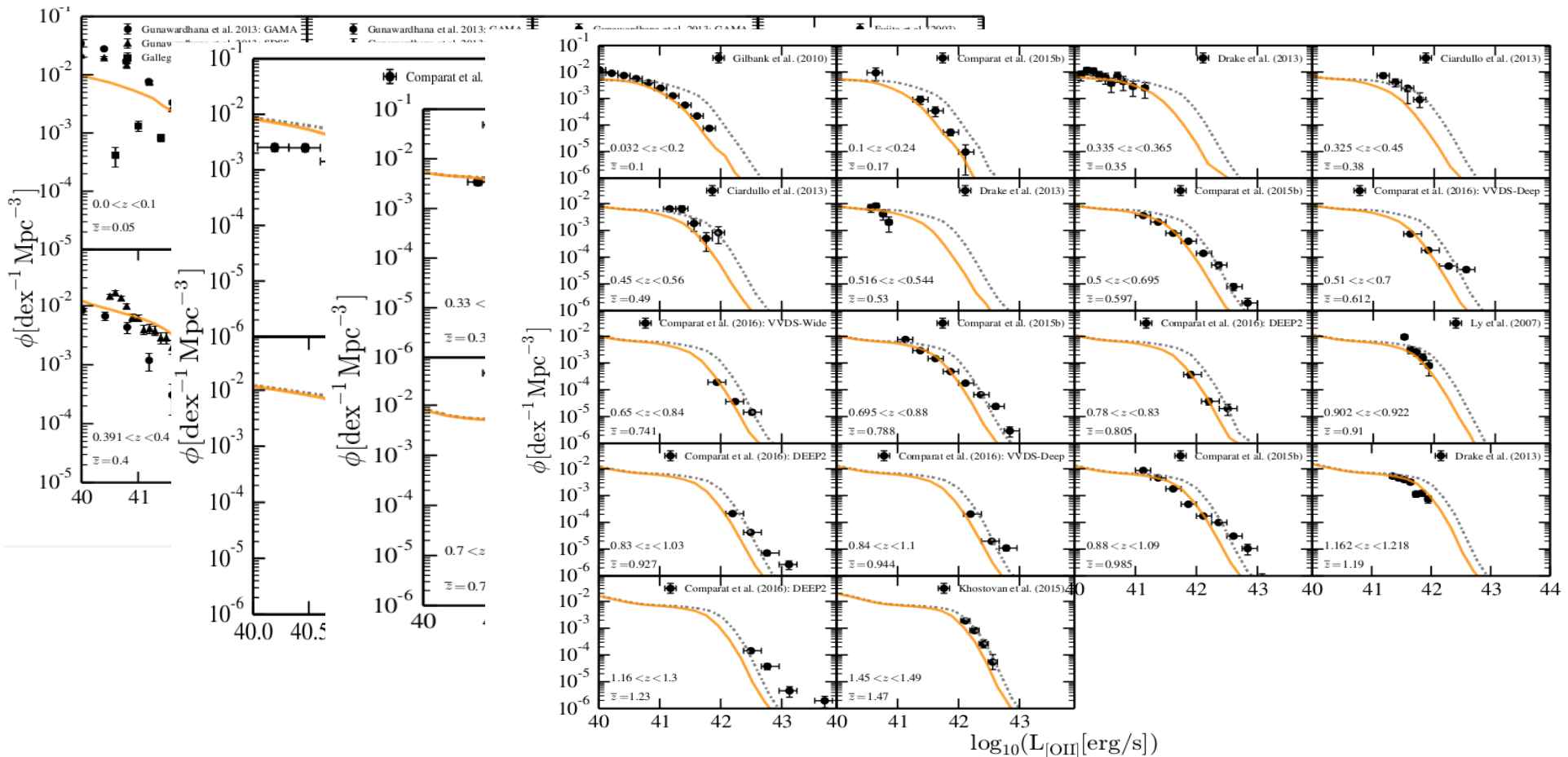


HOW DO WE CREATE A MOCK CATALOGUE?

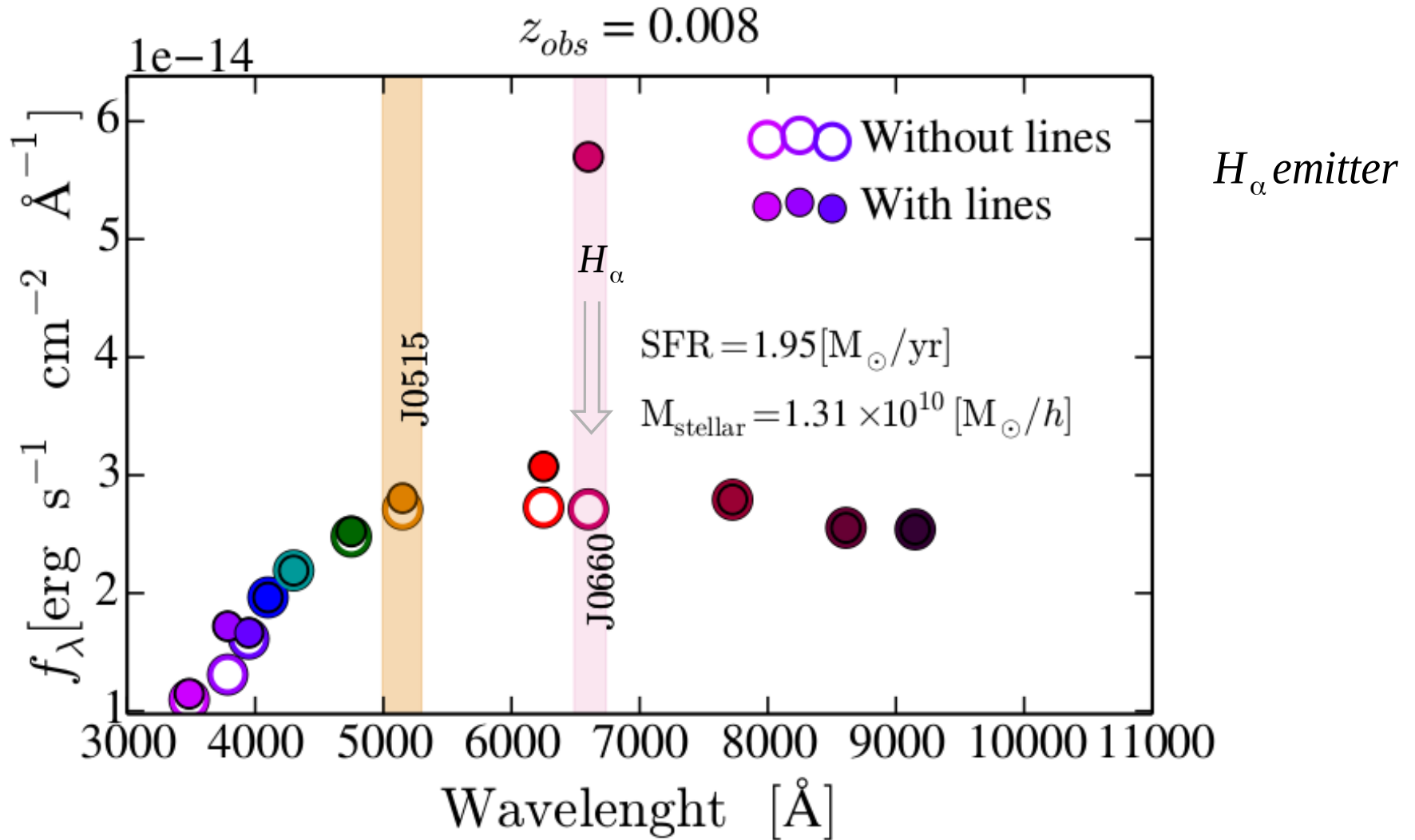
Predicting an emission line

$[O-II]$

Dust corrected
No Corrected

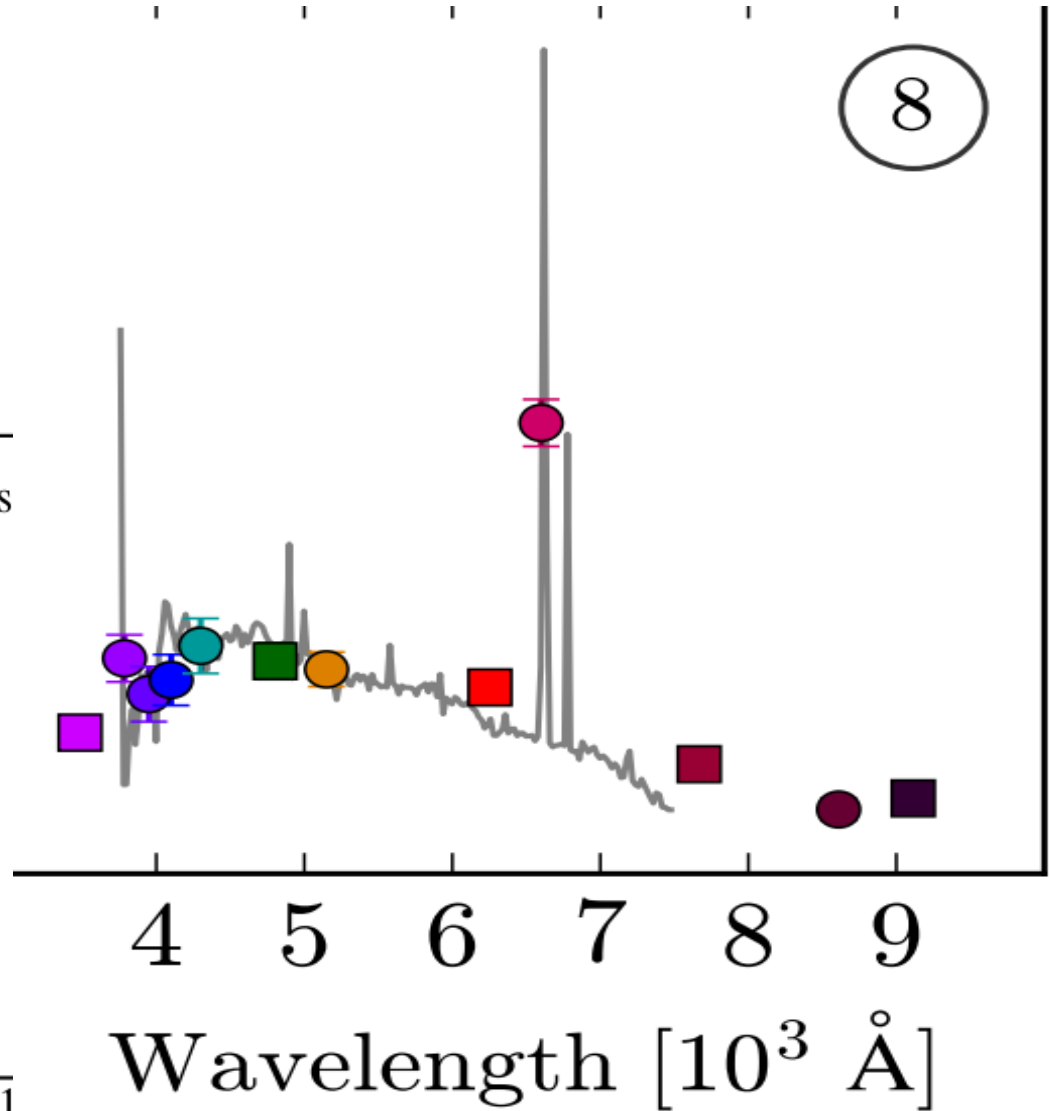
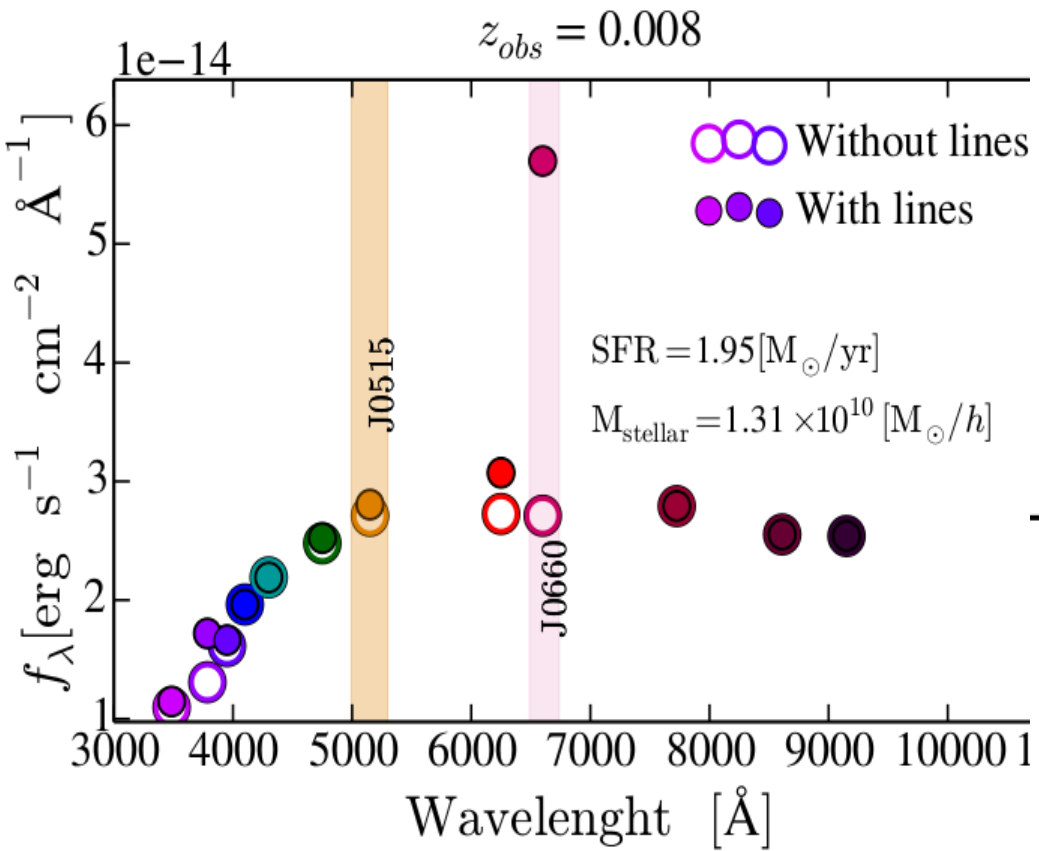


EXAMPLES

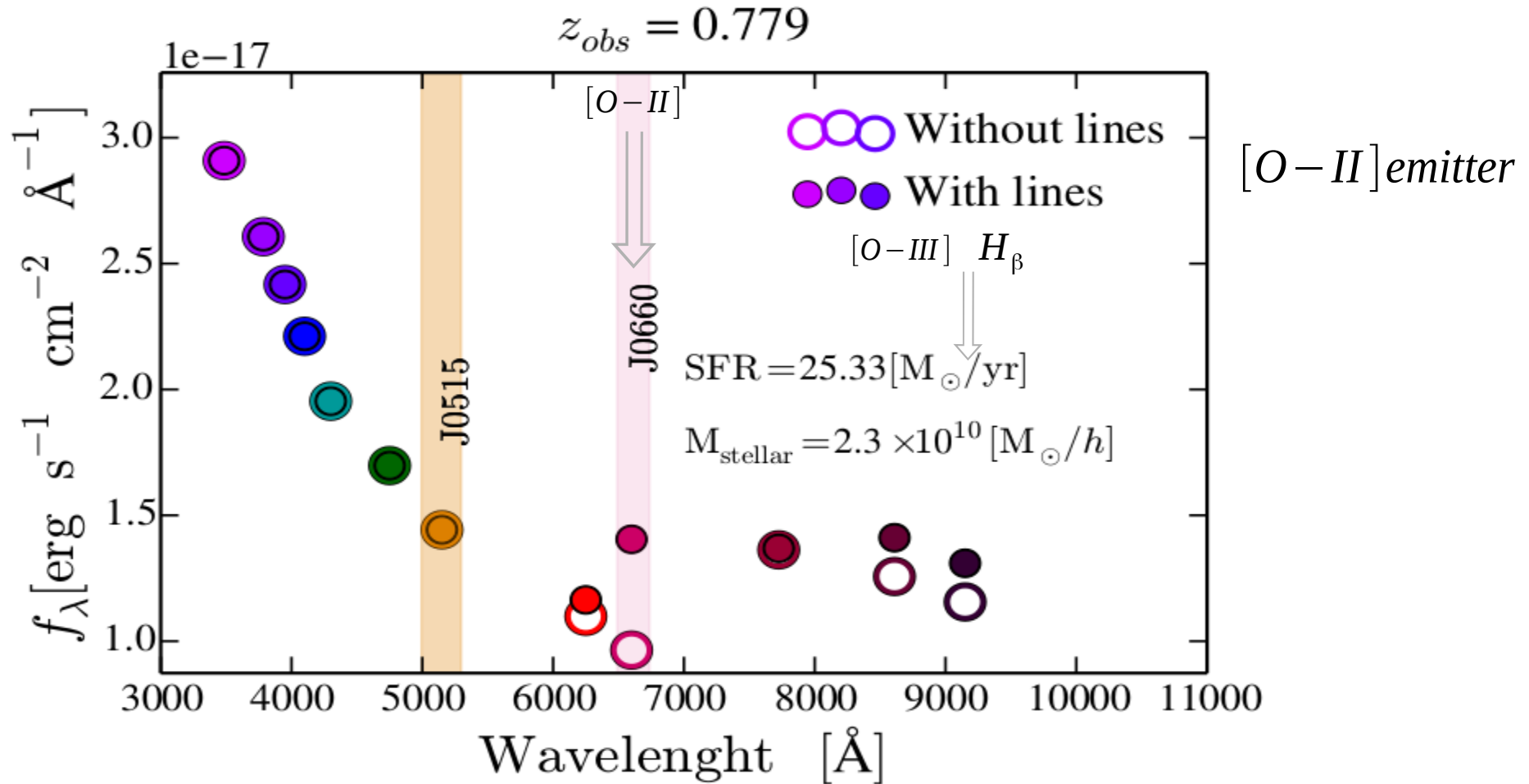


EXAMPLES

8



EXAMPLES



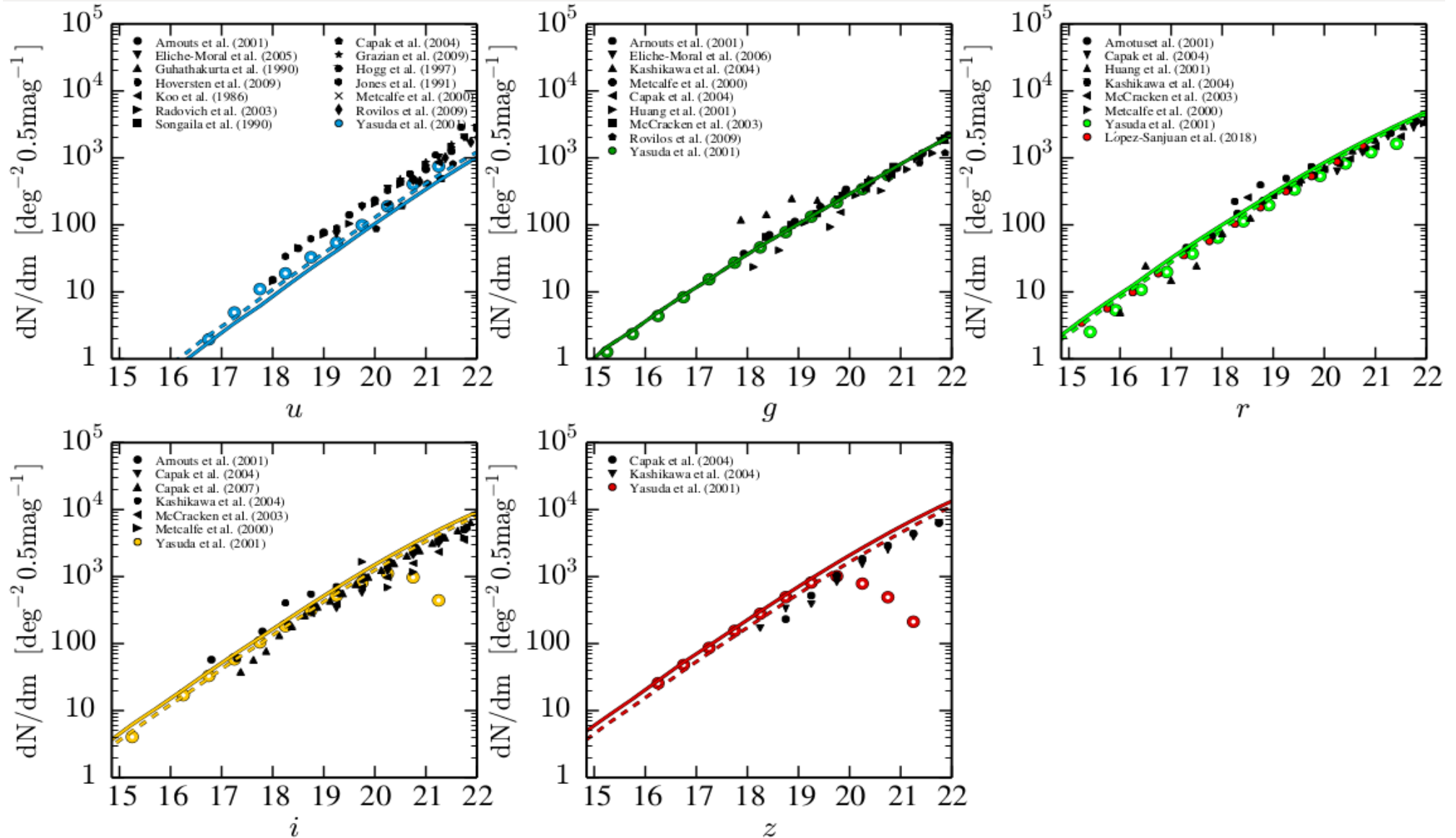
Use of JPLUS mock

We have a virtual survey

We can do tests!

Use of JPLUS mock

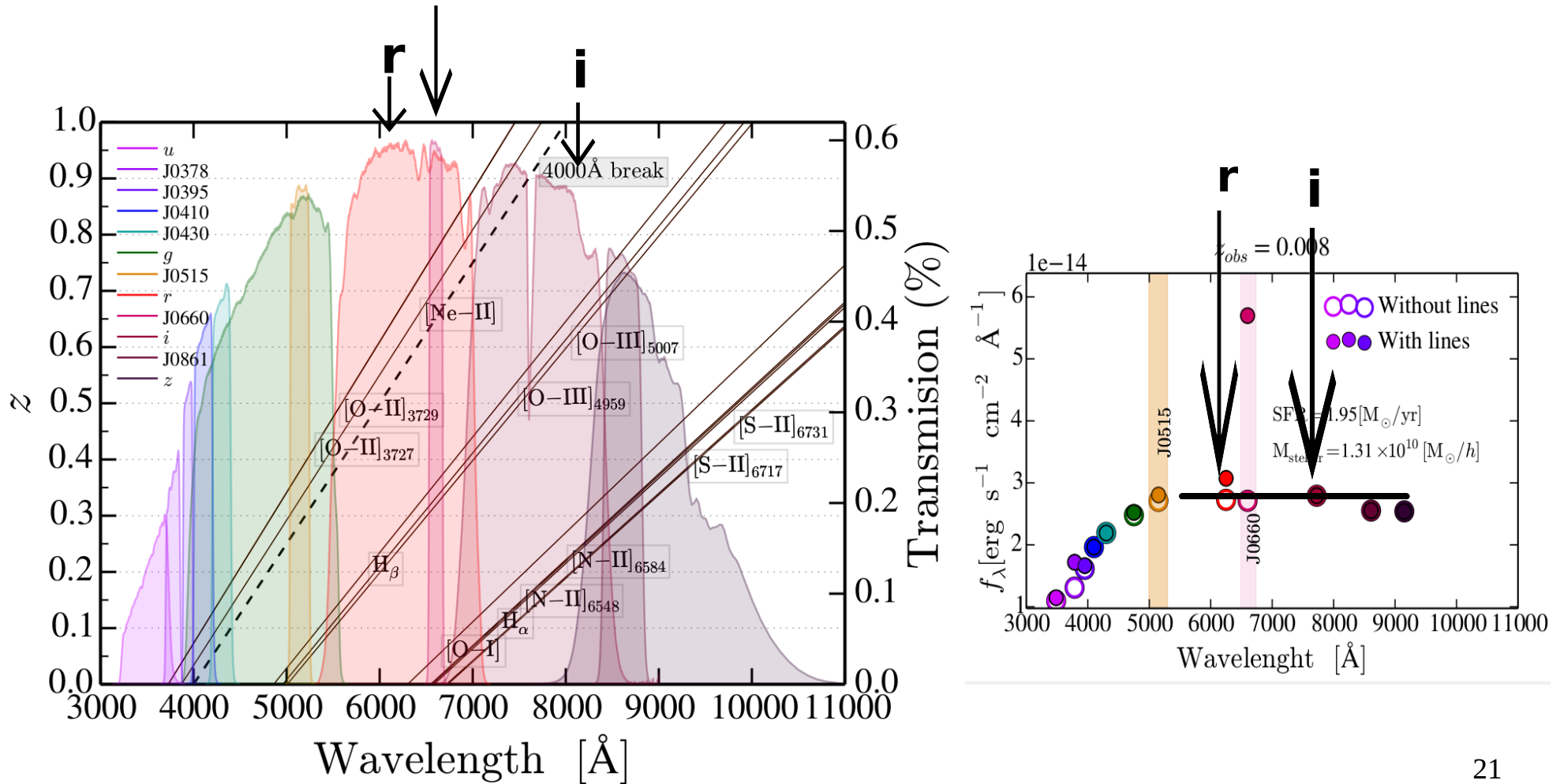
Check: NUMBER COUNTS



Use of JPLUS mock

Three filter method to extract emission lines (Vilella-Rojo et al. 2015)

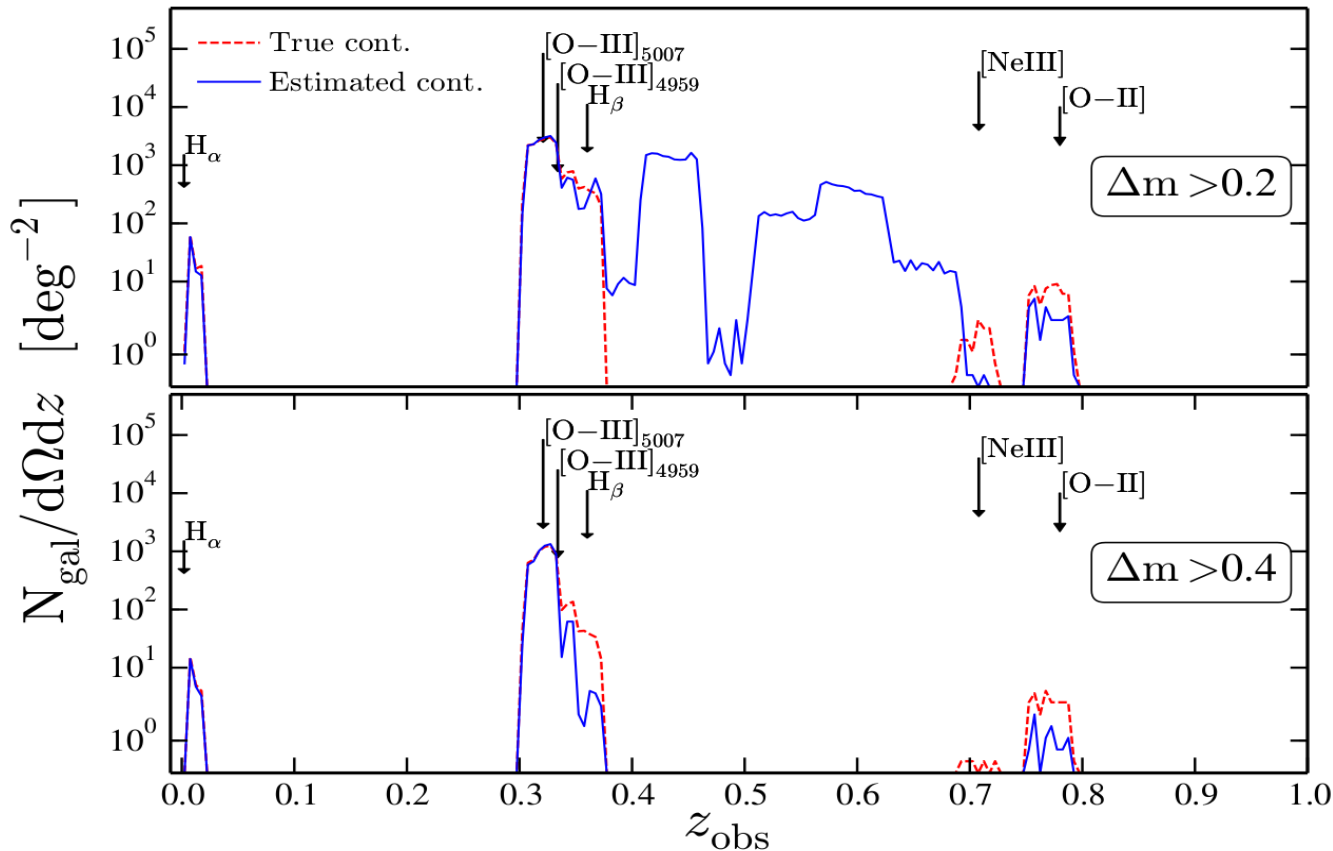
F6660 → Sensible to emission lines!



Use of JPLUS mock

EMISSION LINE DETECTION

Magnitude excess selection



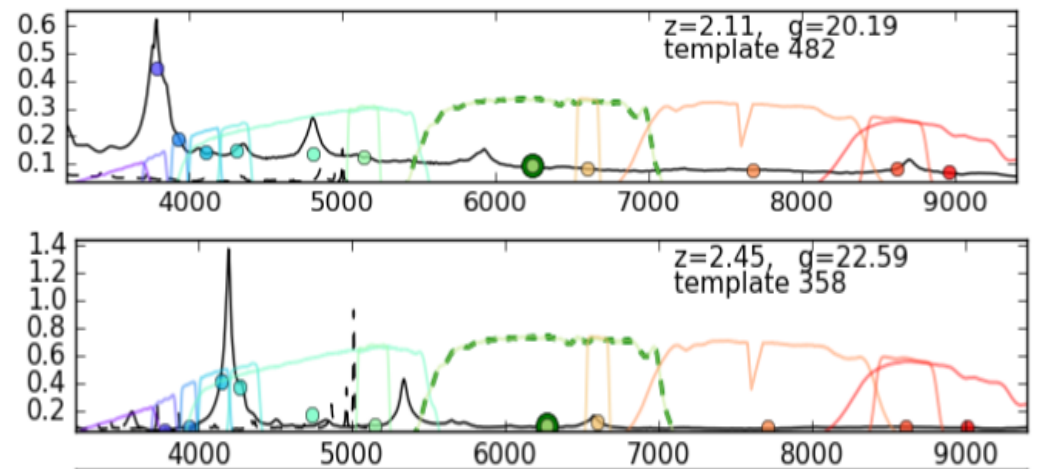
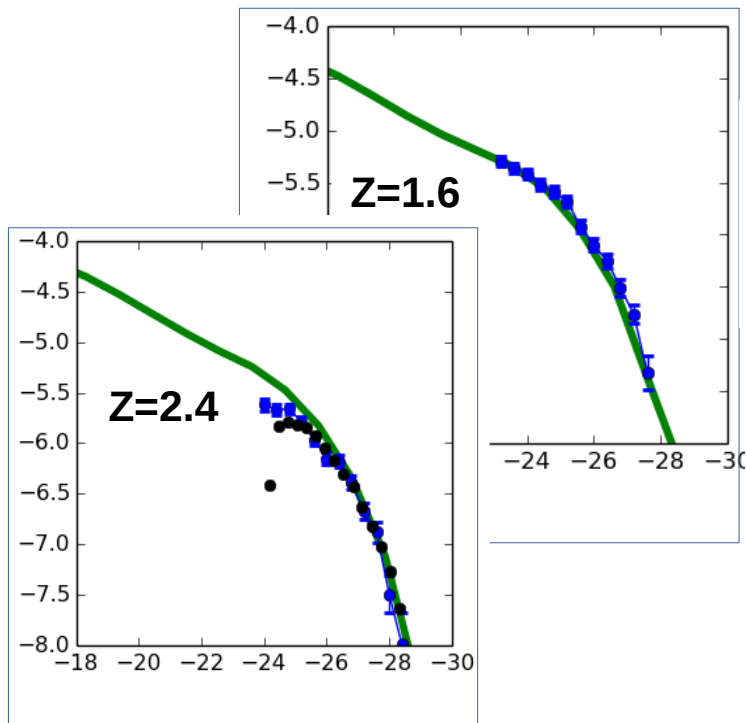
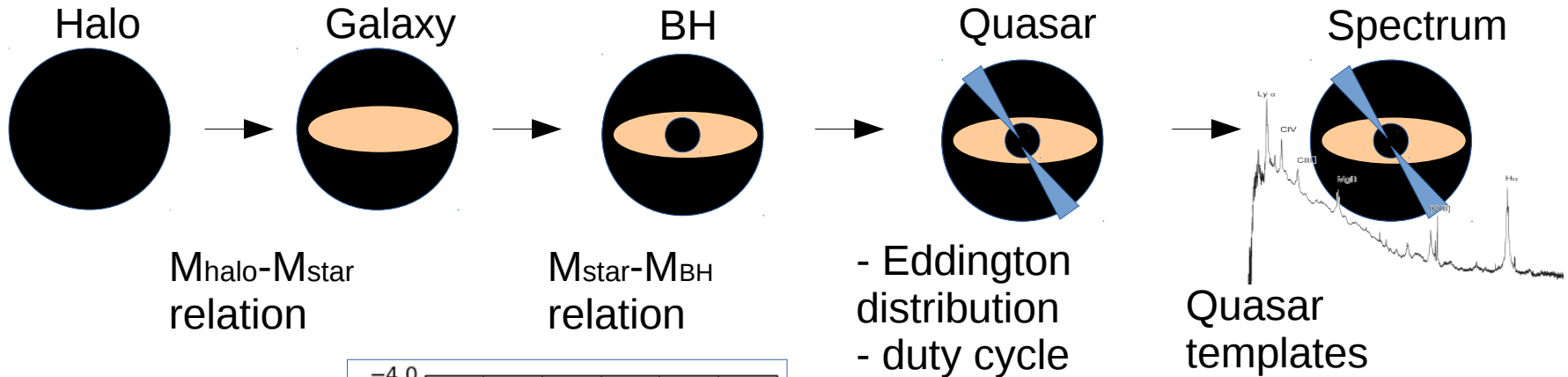
$$\Delta m = m^{J660} - m_C^{J660}$$

— $m_C^{J660, 3FM}$
— $m_C^{J660, TRUE}$

Interlopers 4000 A break

Use of JPLUS mock

QUASAR MOCKS



Conclusion

- 1 - Semi analytical model
- 2 - Dark matter simulation
- 3 - Emission line modelling
- 4 - Dust correction



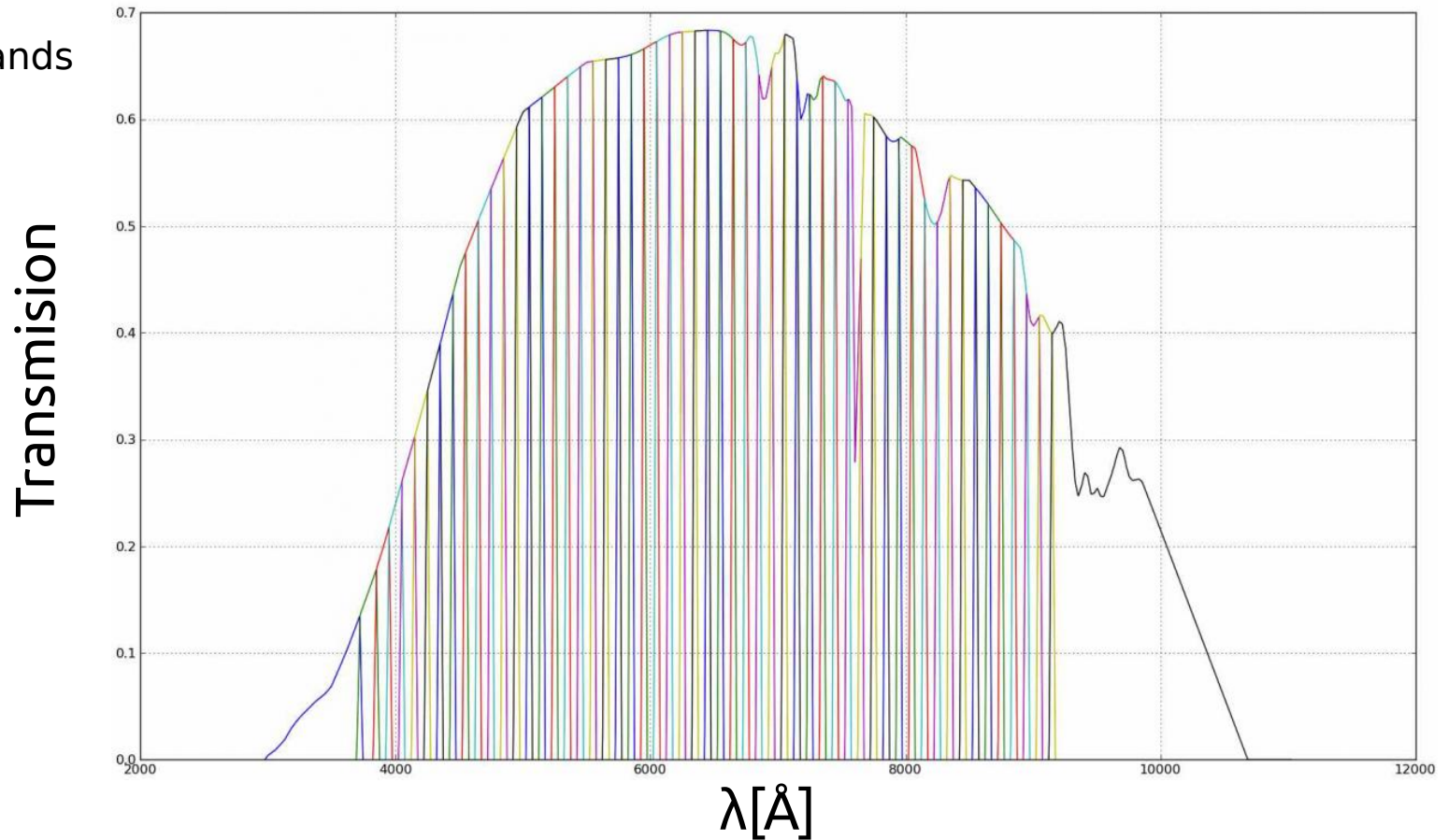
Mock catalogues for
PHOTOMETRIC SURVEYS

Future work

Apply the machinery to J-PAS survey

5 BROAD/MEDIUM bands

54 NARROW bands





C . Hernandez-Monteagudo

(Wednesday afternoon session)

S . Bonoli

(Wednesday afternoon session)

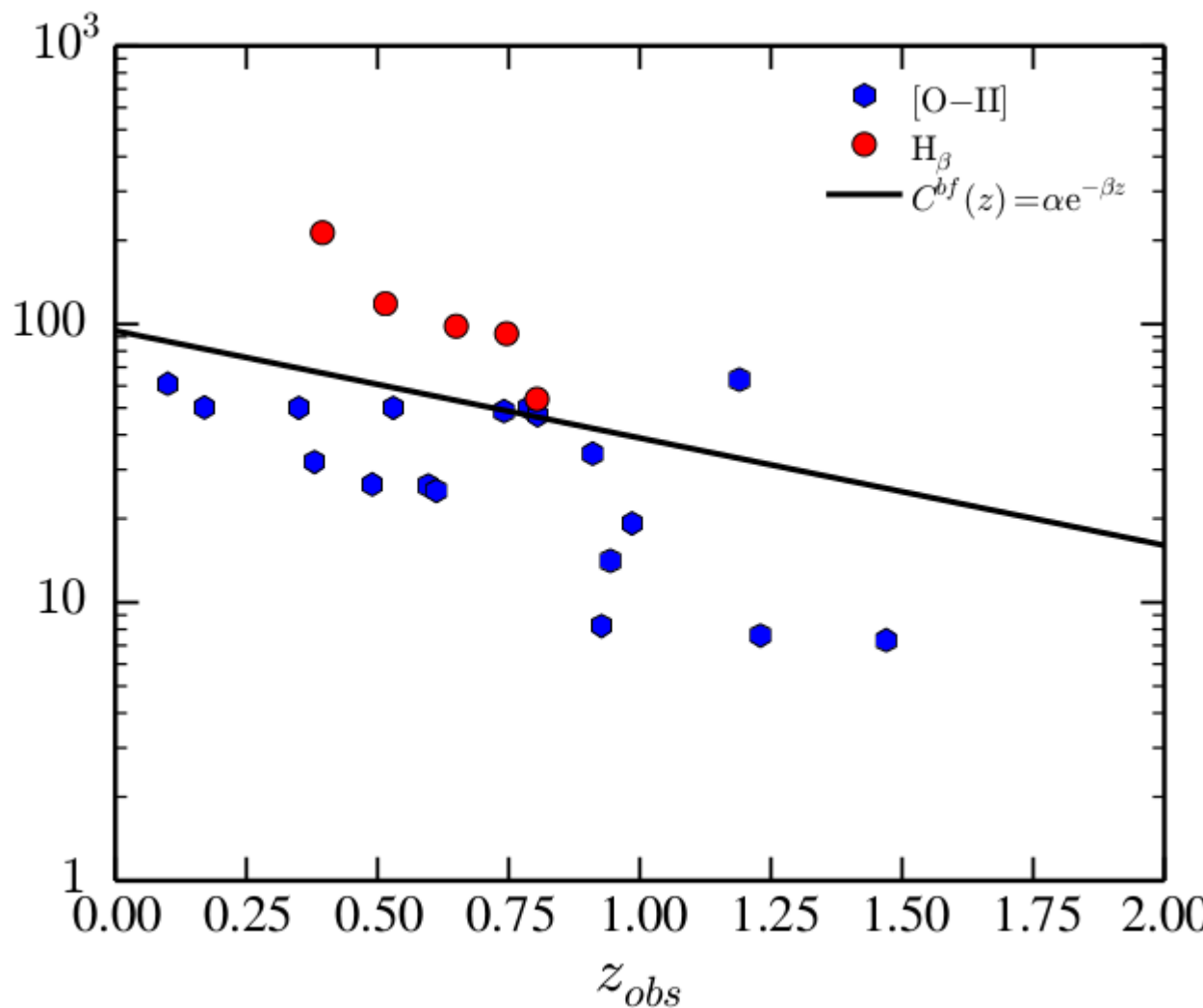


THANKS!



HOW DO WE CREATE A MOCK CATALOGUE?

Predict a



Levesque et al. (2014)

Line Flux
Models of

Levesque et al. (2014)

$$F_{\lambda}(\lambda, q, Z)$$

Dust

A_B

Line Flux
 F_{λ}
Evolution

$$F_{\lambda}(\lambda_j) \propto \frac{1 - e^{-\tau_{\lambda} \sec \theta}}{\tau_{\lambda} \sec \theta}$$

$$\frac{A_V A(\lambda)}{A_B A_V}$$

[O-II], [O-III]