Investigating the star-formation quenching across cosmic time

A methodology to select galaxies just after the quenching of star formation

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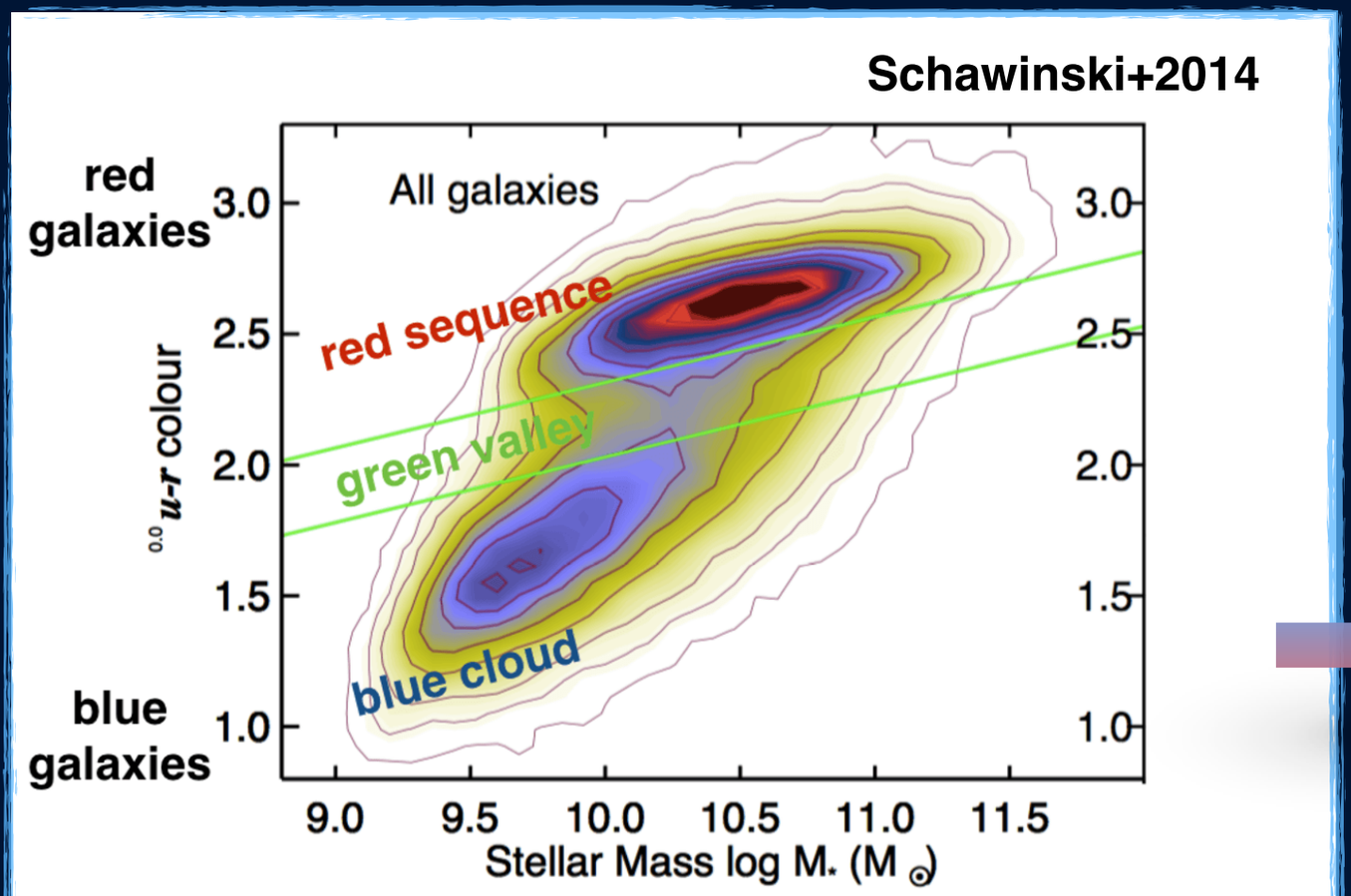
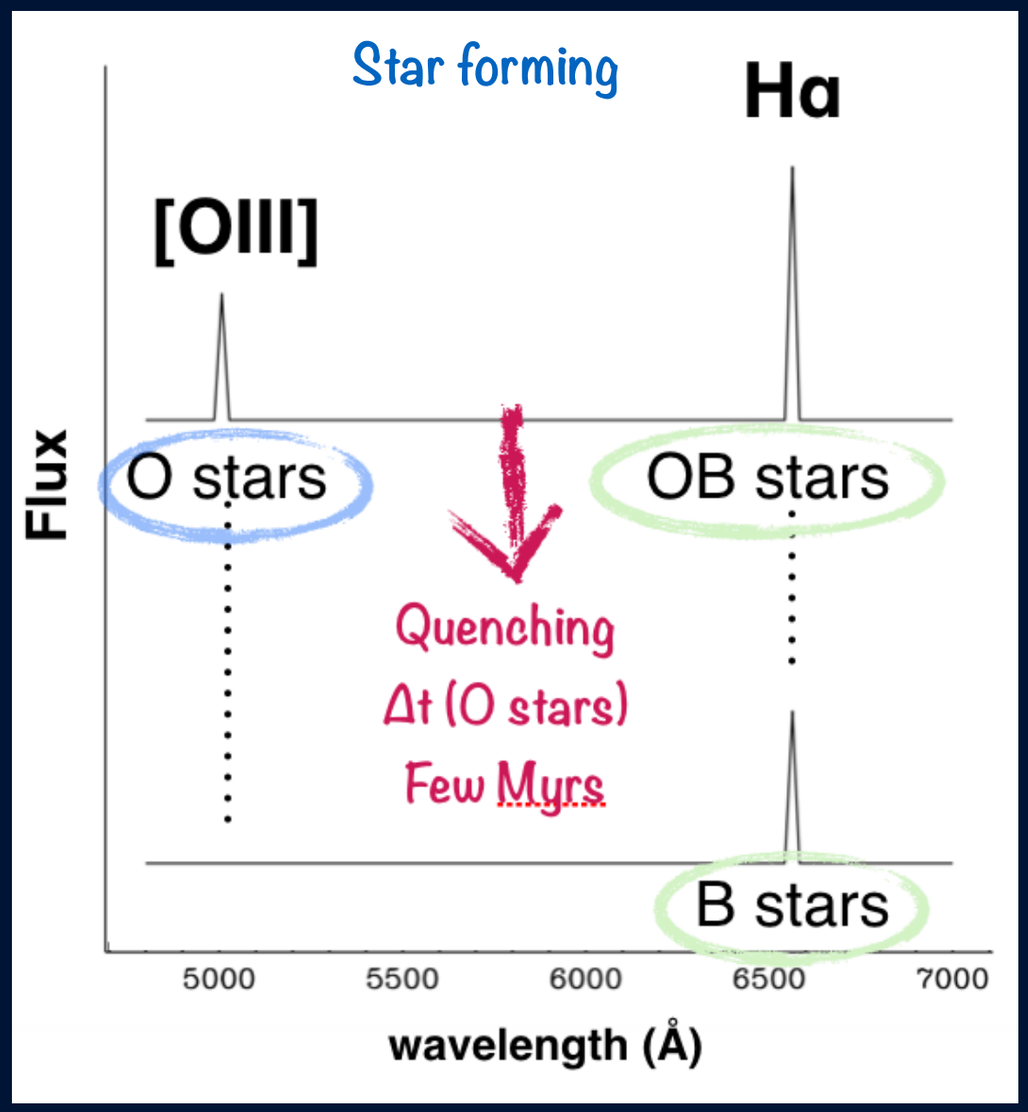
Context & Aims



Dichotomy between
star-forming
and
passive
galaxies

Define a method to identify galaxies which
just entered
the quenching phase

Approach



High-ionization lines
drop earlier than low-ionization lines
when star-formation stops

Suggested quenching diagnostics:

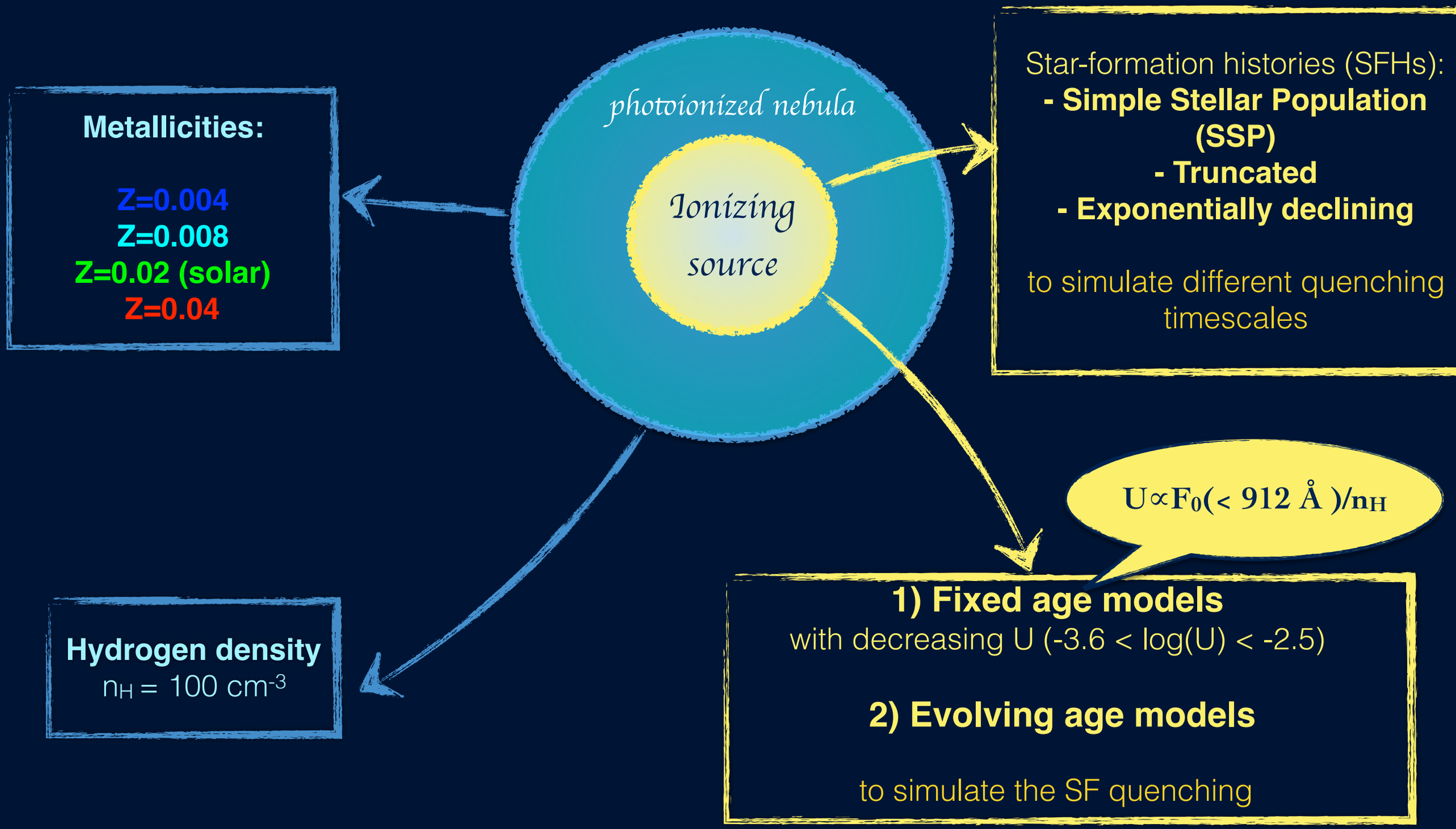
LOW ionization

[O III] λ5007/Hα
&
[Ne III] λ3869/[O II] λ3727

HIGH ionization

Method

CLOUDY photoionization code



Method

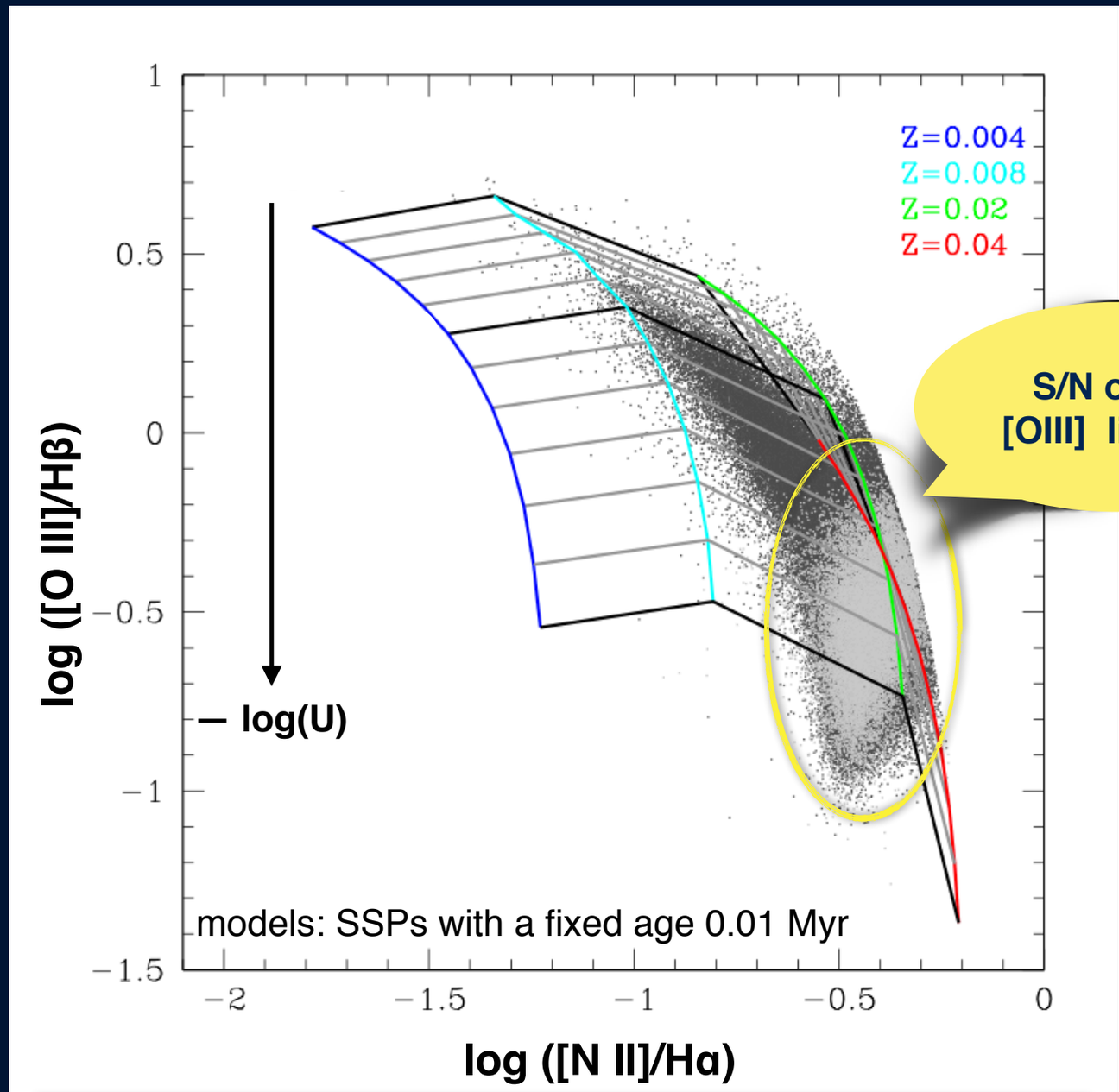
~174000 star-forming galaxies selected from the Sloan Digital Sky Survey Data Release 8

0.04 < z < 0.21

9 < log(M/M⊙) < 12

signal-to-noise ratio (S/N) of Hα line > 5

S.QUAI's TALK + Quai et al. 2017 (submit.) for furhter details

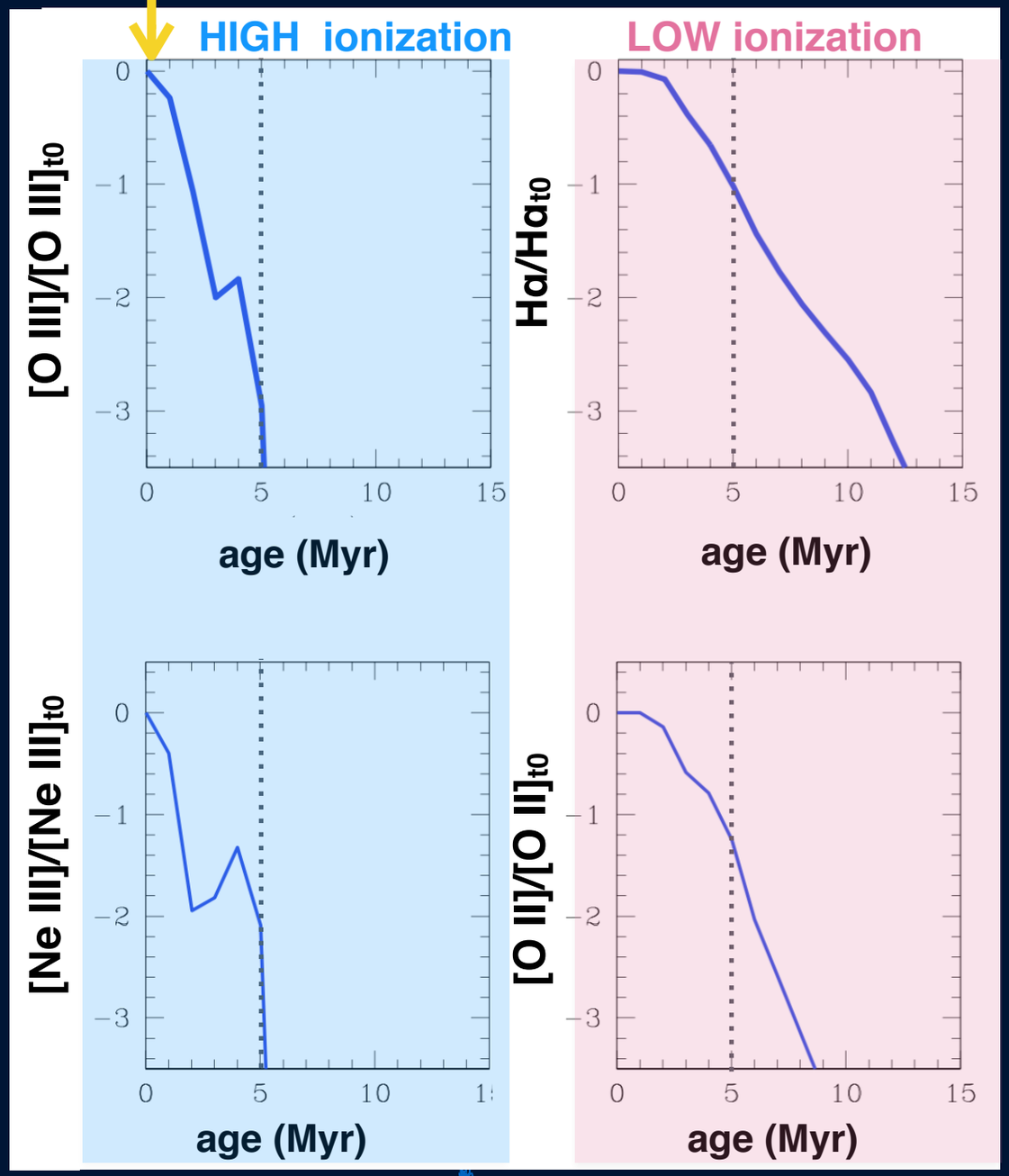


Reasonable agreement between models and data

Investigating the star-formation quenching across cosmic time

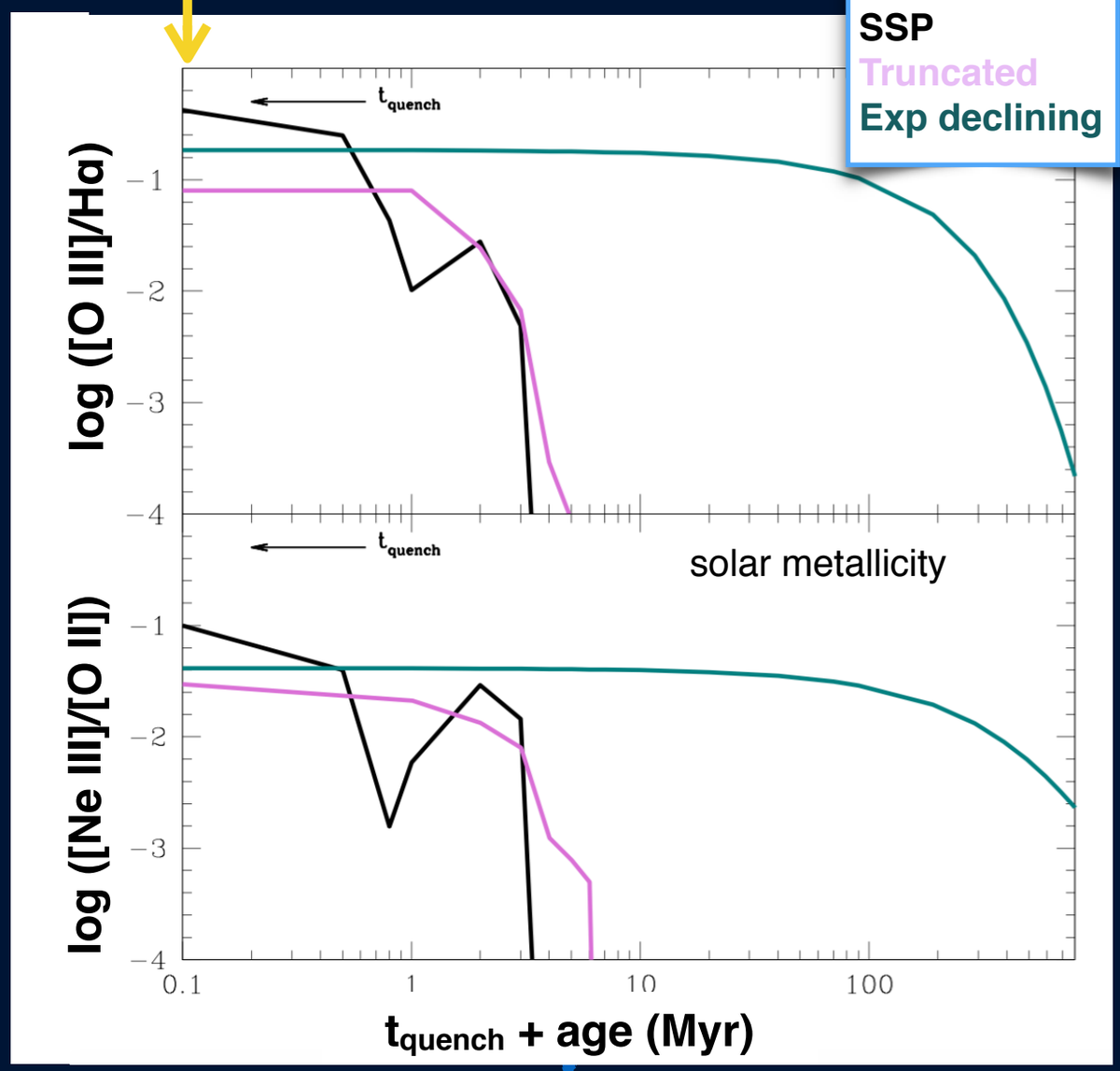
Results

still star forming at t=0



High ionization lines decline faster than low-ionization lines

still star forming at t=0



SHARP quenching: drop by a factor ~10 in ~ 6 Myrs

SMOOTH quenching: drop by a factor ~2 in ~ 90 Myrs

Results

From the derived quenching timescales t_Q

Expected fractions of quenching galaxies F_{QG}:

$$F_{QG}=t_Q \,/\, t_{DM}=t_Q \times sSFR$$

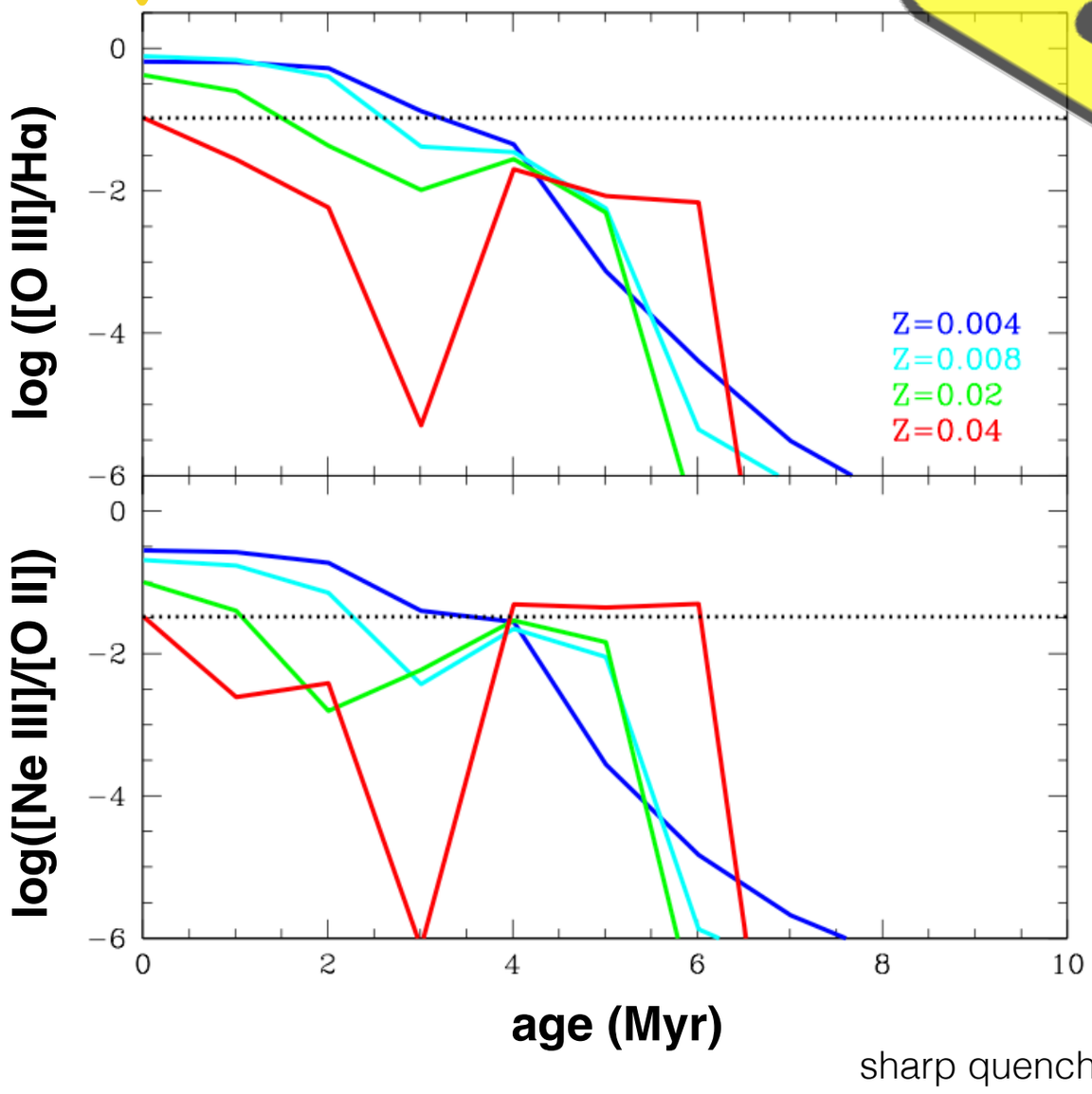
Doubling mass time

Quenching mechanism and its timescale

From the observed fractions of quenching galaxies F_{QG}

Results

still star forming at t=0



sharp quenching

Ionization/age-metallicity degeneracy

Younger HII regions with **higher metallicity**

AND

Older HII regions with **lower metallicity**

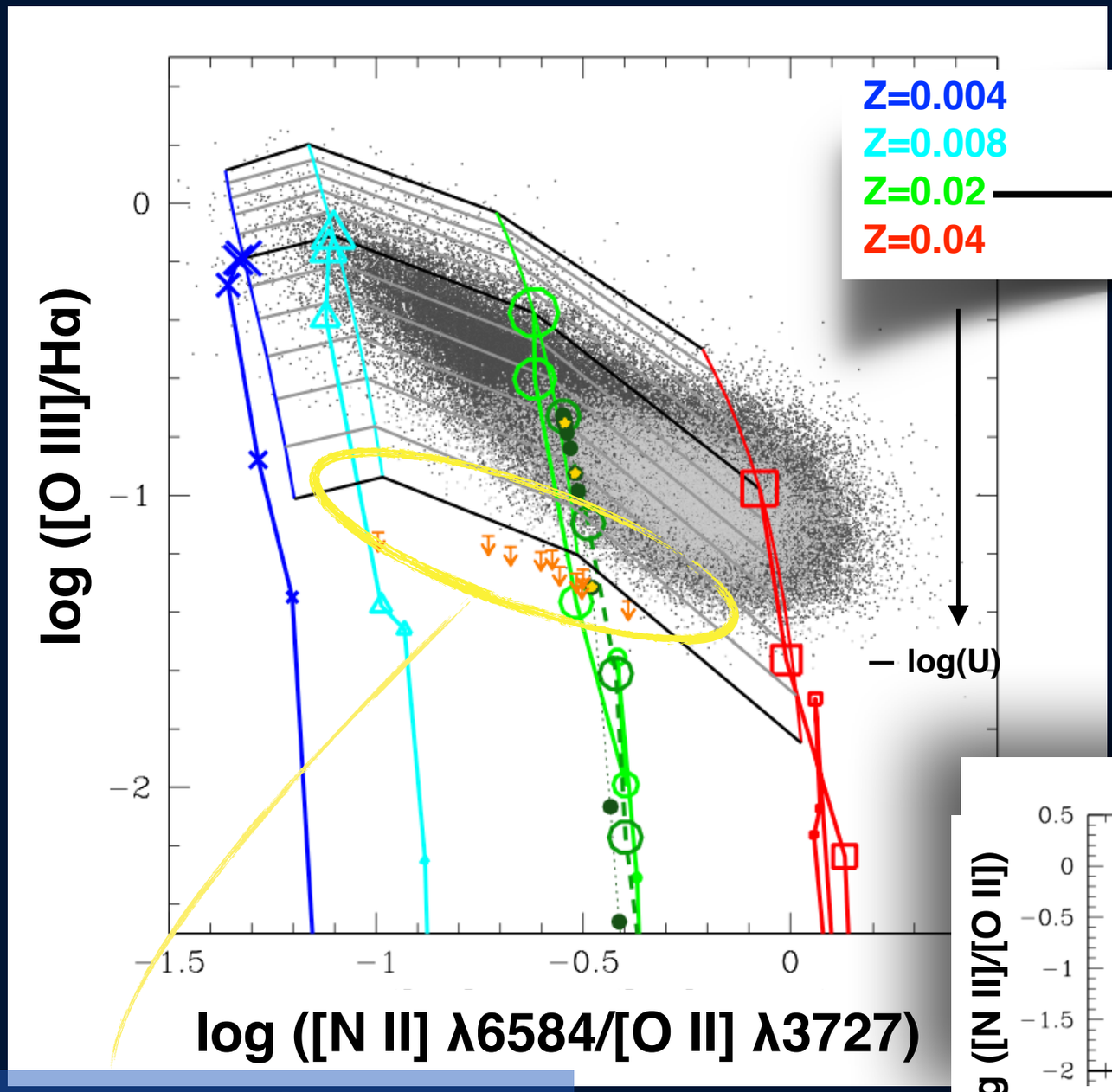
can produce the same value of the two emission line ratios

?

Results

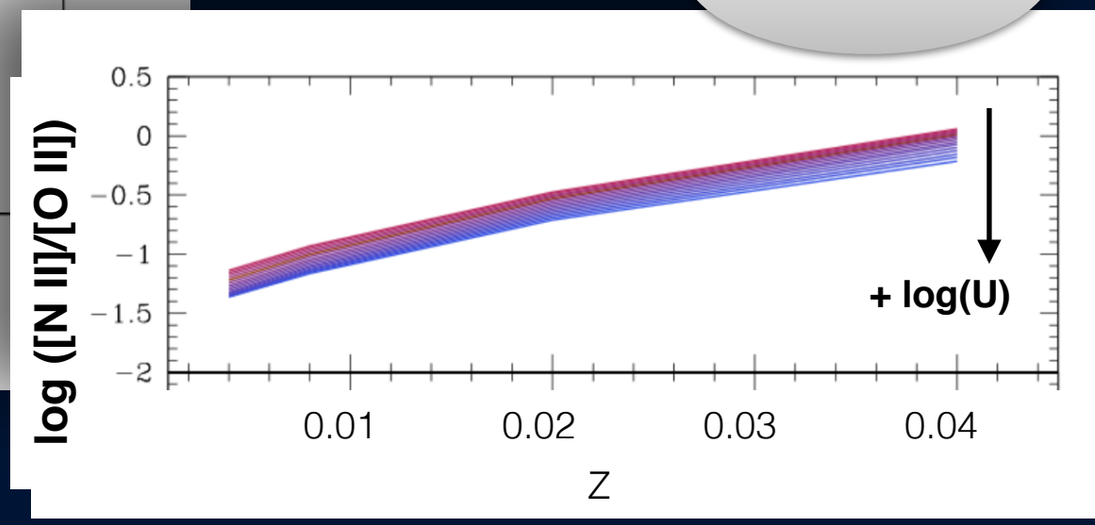
?

Pairs of emission line ratios can help!

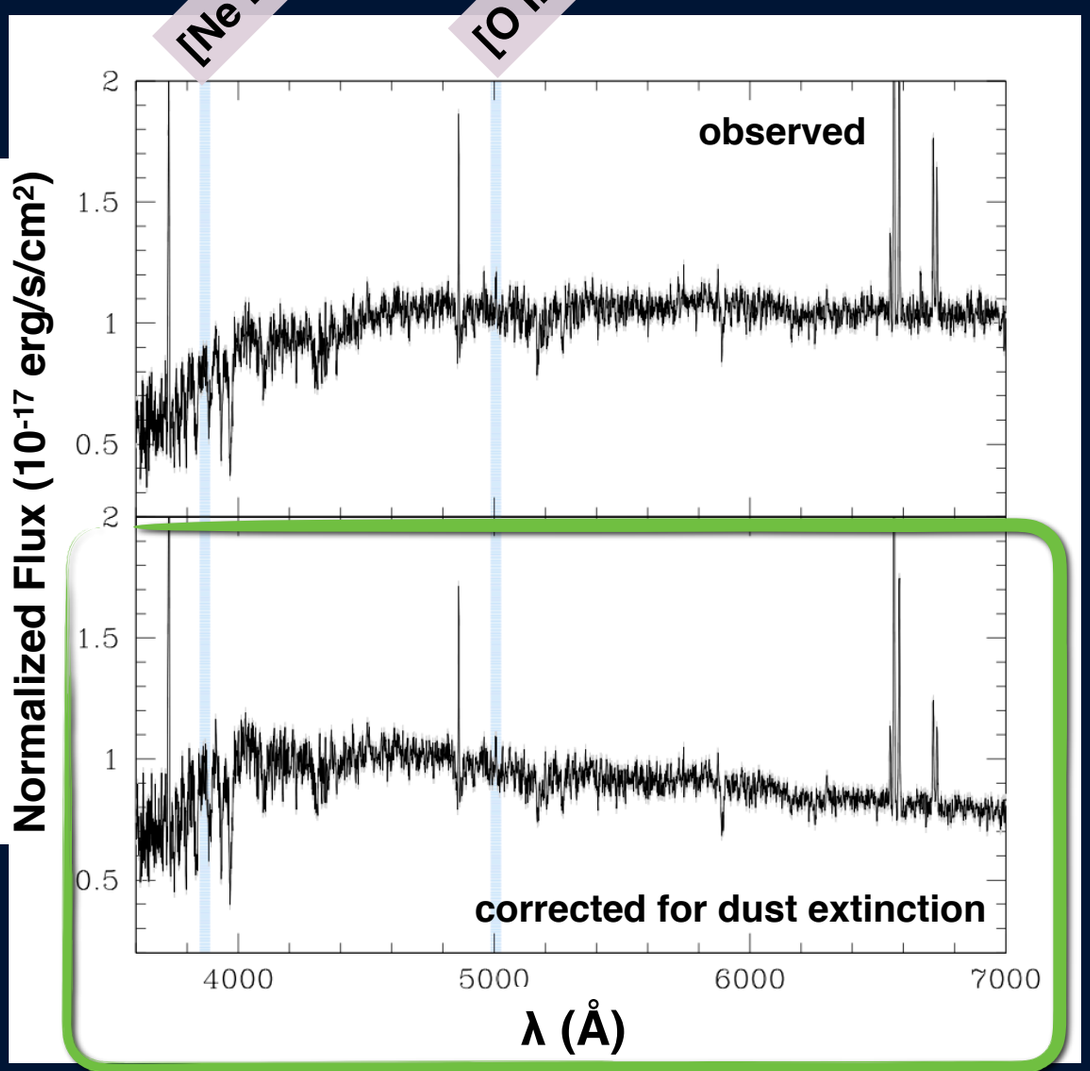


10 extreme galaxies with S/N([O III])<2

Nagao+06



Results

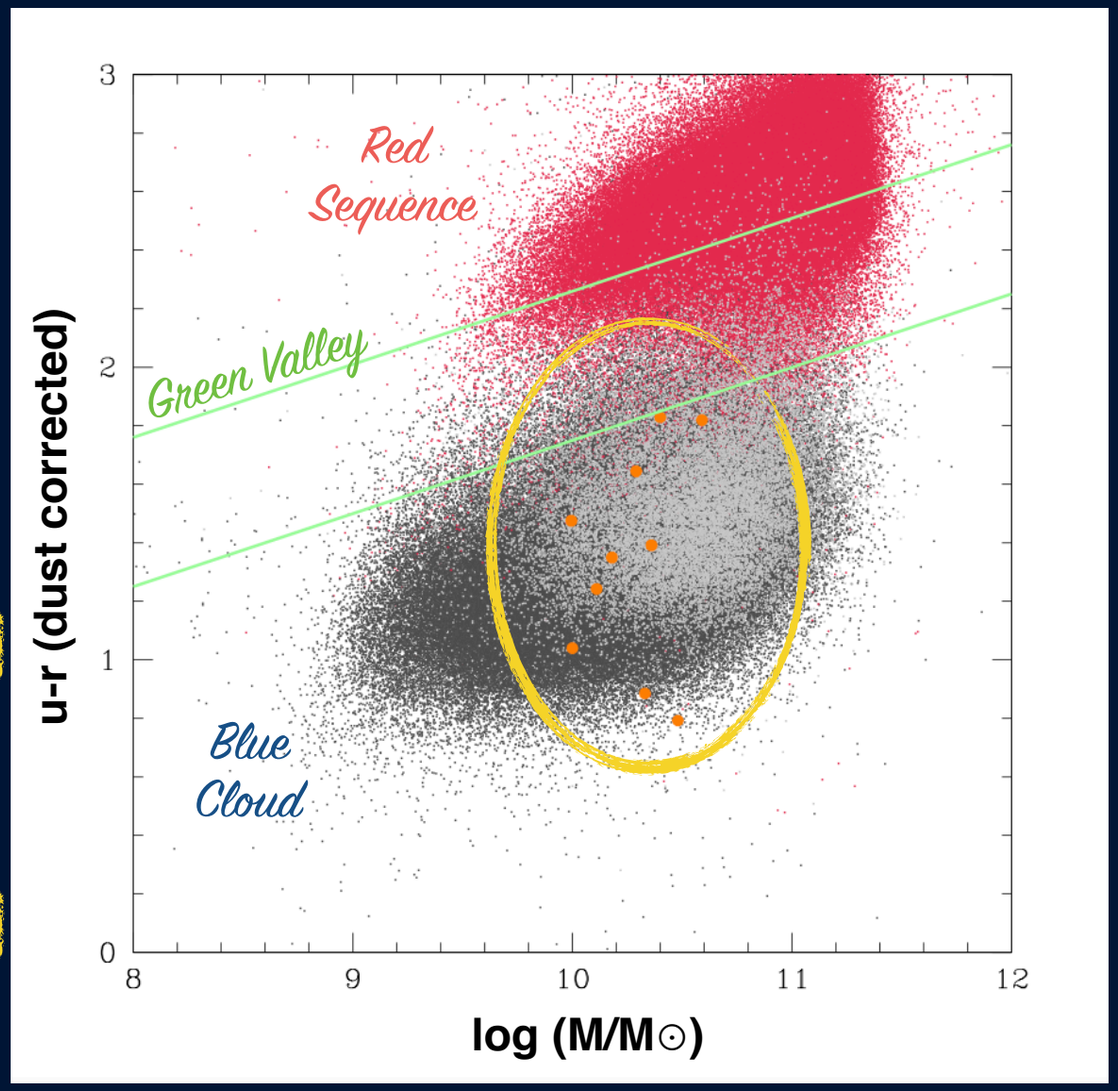


The Stacked spectrum of the 10 quenching galaxies lacks also of [Ne III]

The Stacked spectrum of the 10 quenching galaxies is blue

The 10 galaxies are bluer than green valley objects they could have just entered the quenching phase

S. QUAI's TALK +
Quai et al. 2017 (submitted)



Emission line ratios involving a high- and a low- ionization potential line are powerful tools to identify galaxies in the quenching phase dropping suddenly after the SF halt

Use pairs of emission line ratios involving a metallicity diagnostic to mitigate the age-metallicity degeneracy

10 extreme quenching candidates outside the Green Valley due to bluer colors —> They may be at the beginning of the quenching process

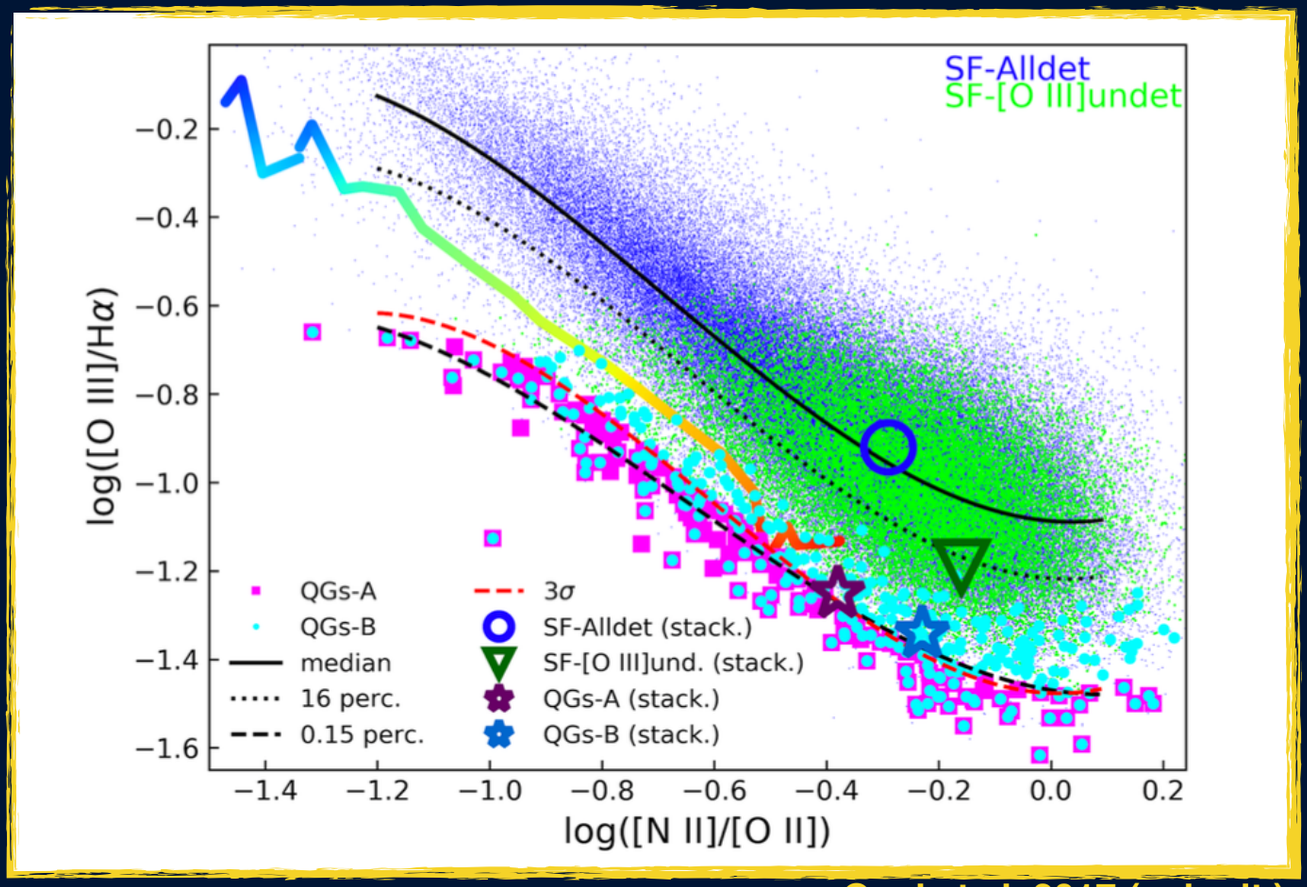
Conclusions

Applications

Define a complete sample of quenching candidates

S. QUAI's talk

Extend our method across cosmic time at higher redshifts (e.g. JWST, WFIRST, EUCLID)



Quai et al. 2017 (submit.)