Quenching or Bursting?

Physical Processes in Green Valley Galaxies and the Star Formation Acceleration

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Physical Processes in Green Valley Galaxies and the Star Formation Acceleration

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Camila de Sá Freitas
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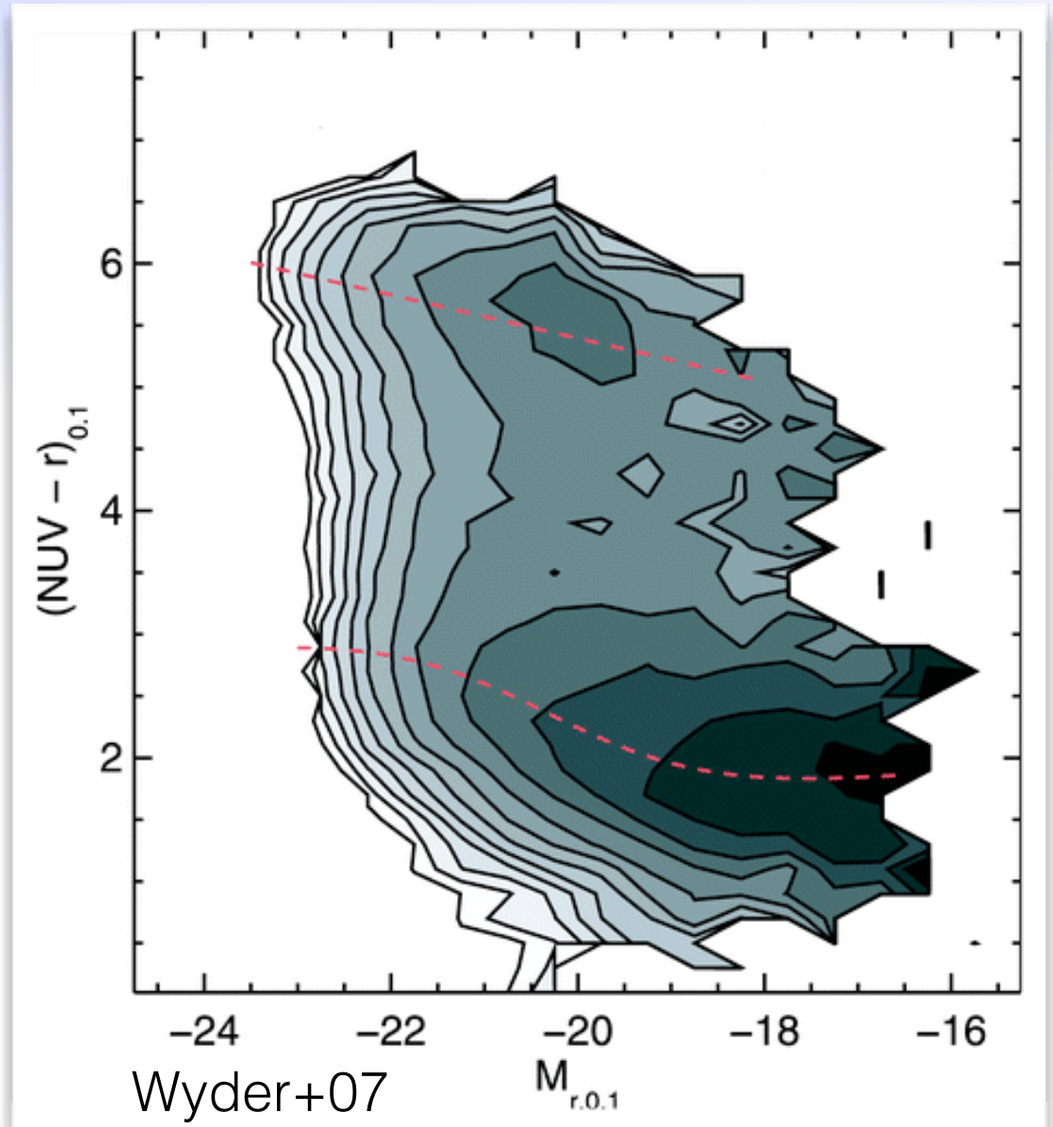
Chris Martin (Caltech)
Behnam Darvish (Caltech)
David Sobral (Lancaster)
Kartik Sheth (NASA)

Bimodality in galaxy properties

The color bimodality

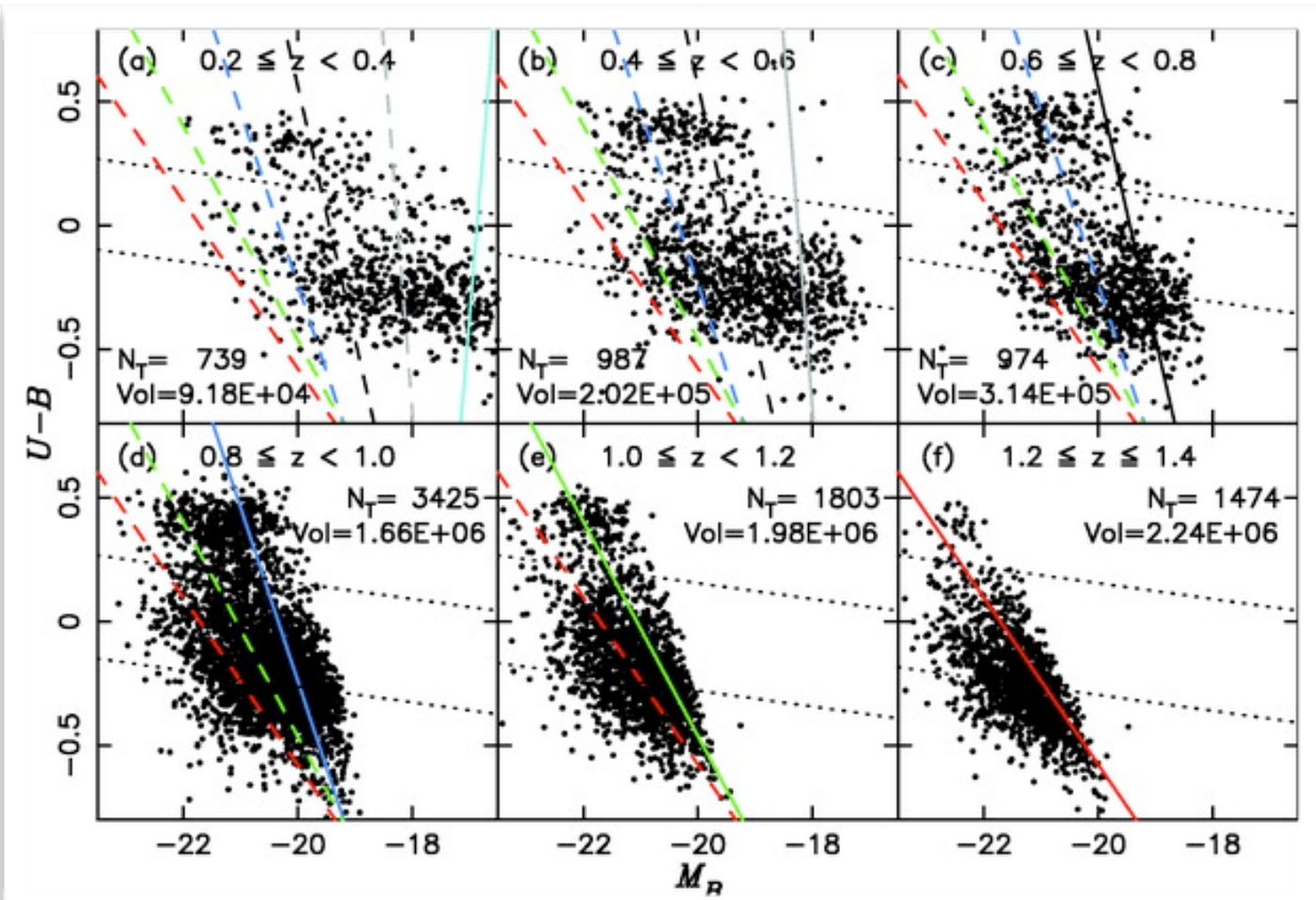


Wyder+07

z~0.1

“Green valley” indicates that the evolution happens rapidly

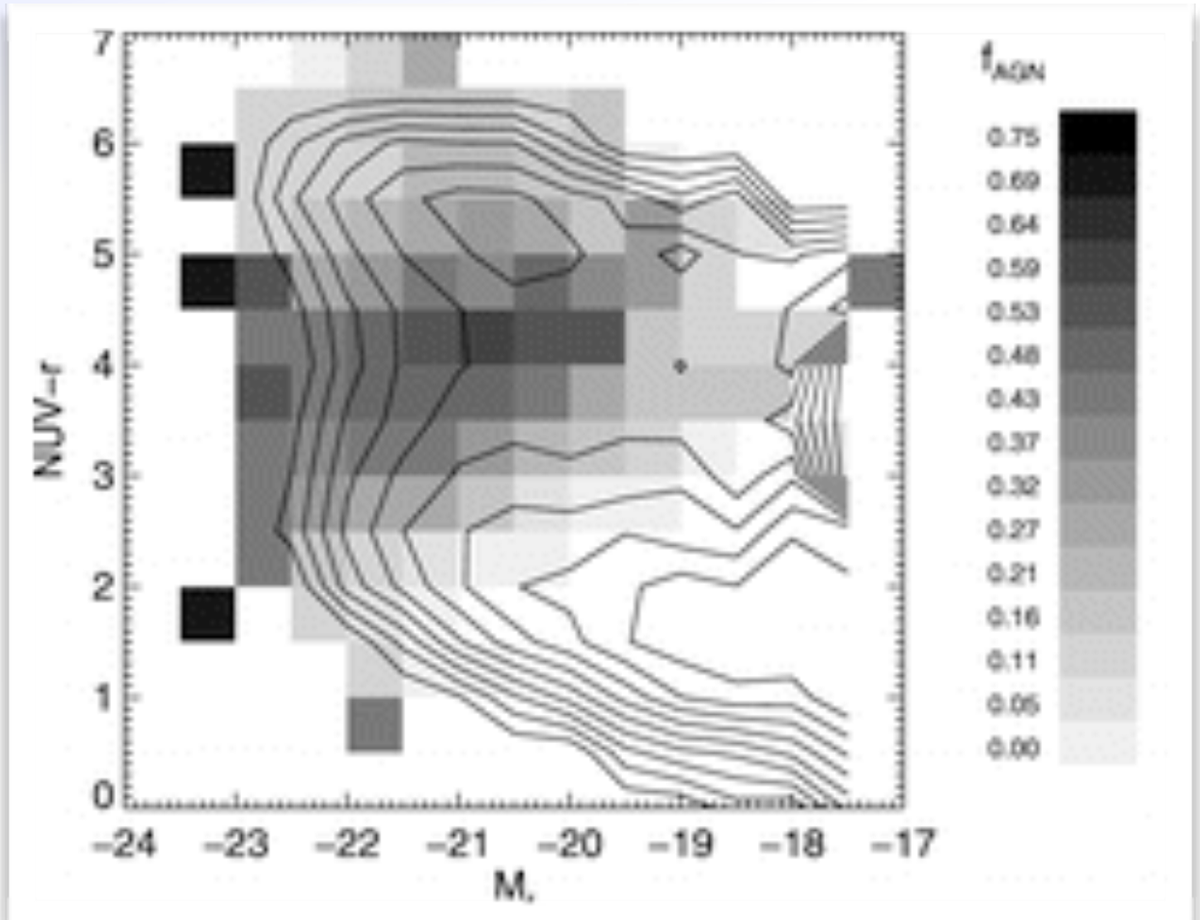
z~1.0



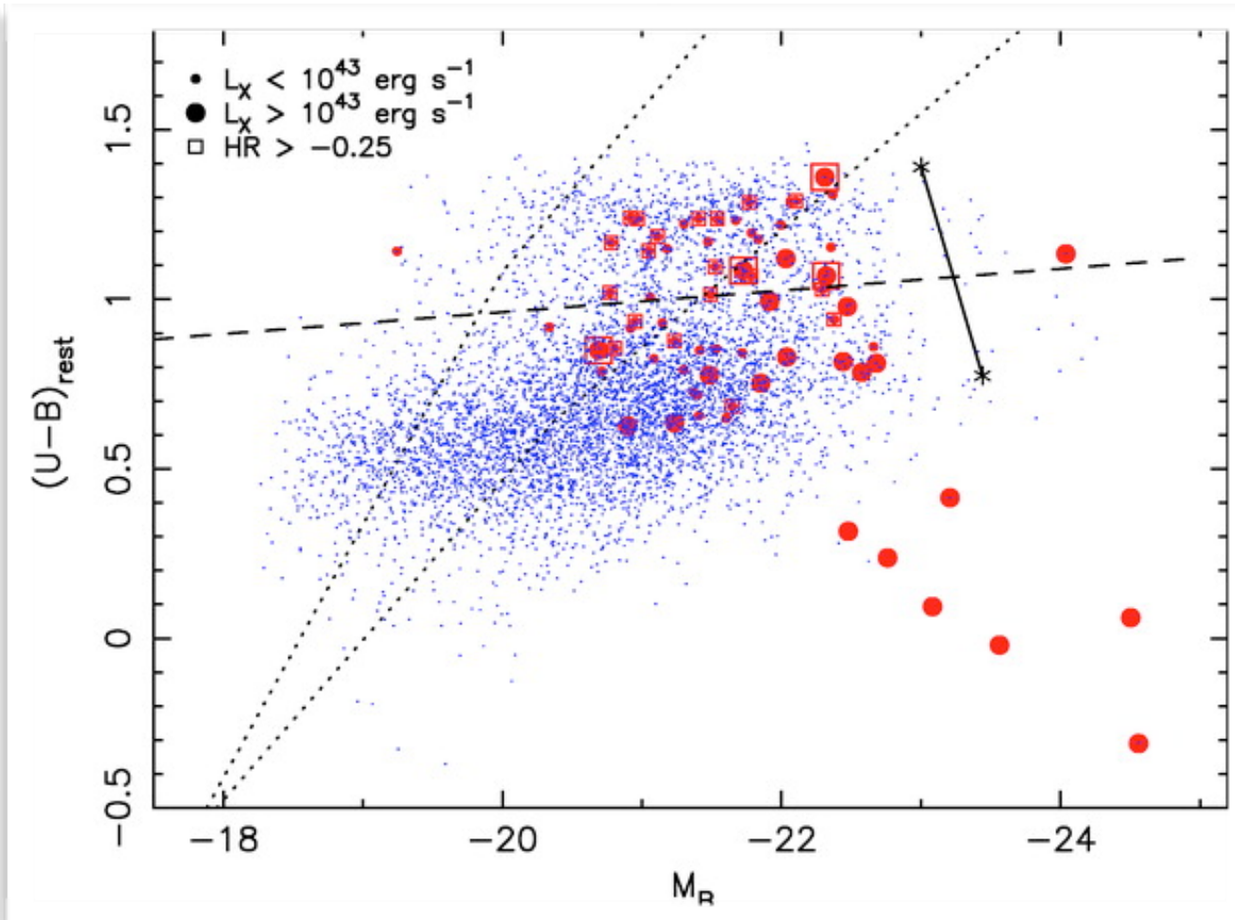
Willmer+06

Bimodality in galaxy properties

How is star formation quenched? AGN?



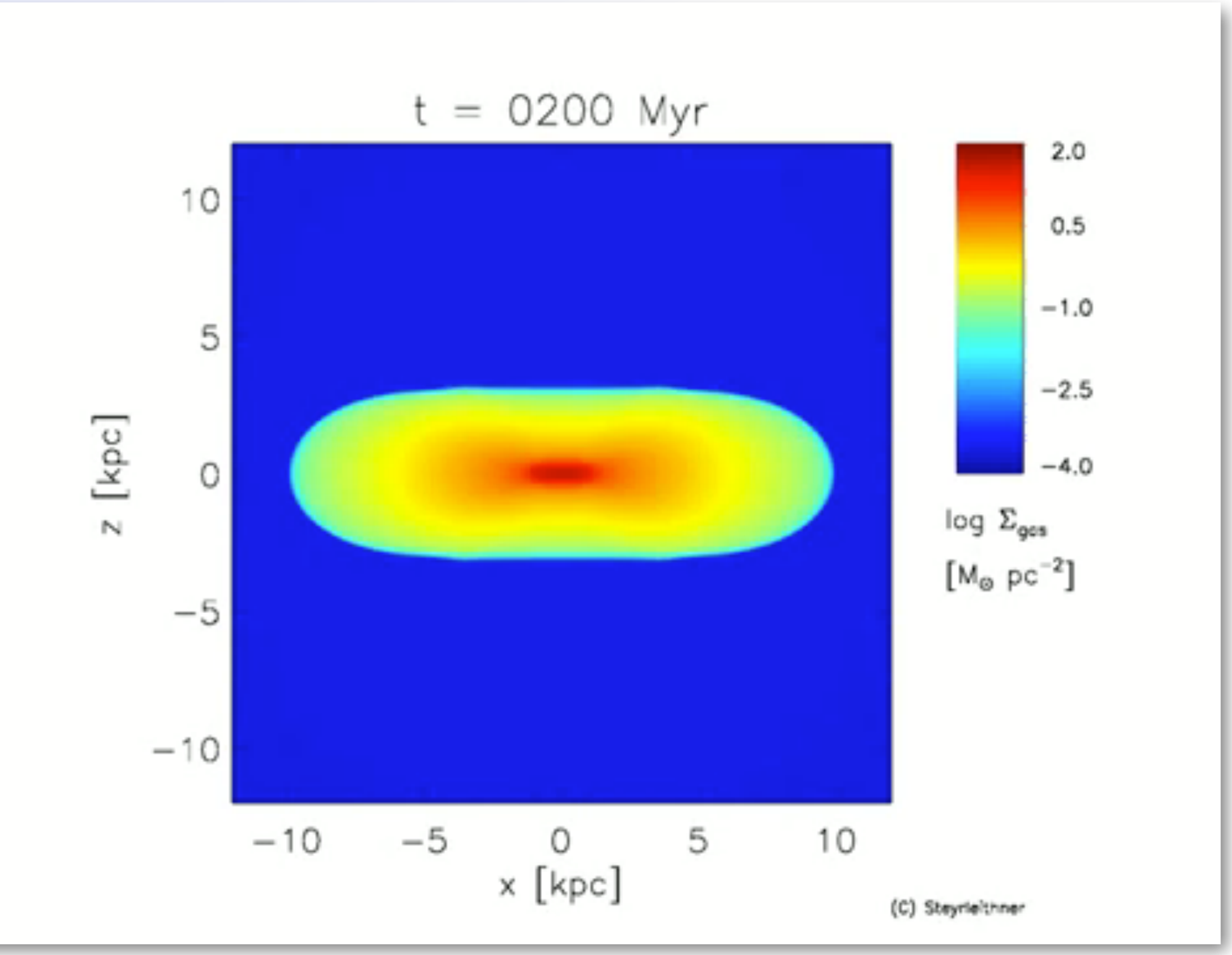
Martin+07



Nandra+07

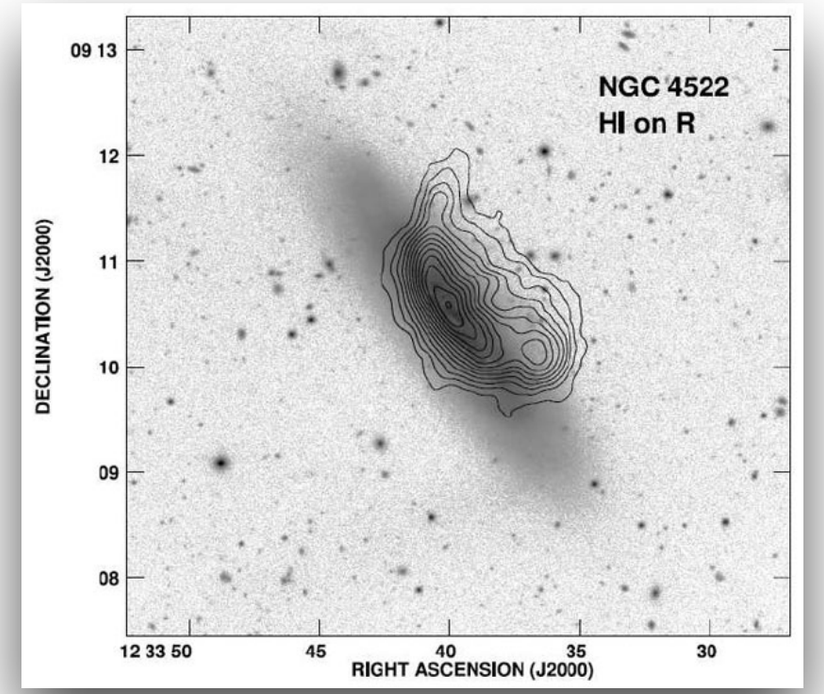
Bimodality in galaxy properties

How is star formation quenched?
Environmental effects?



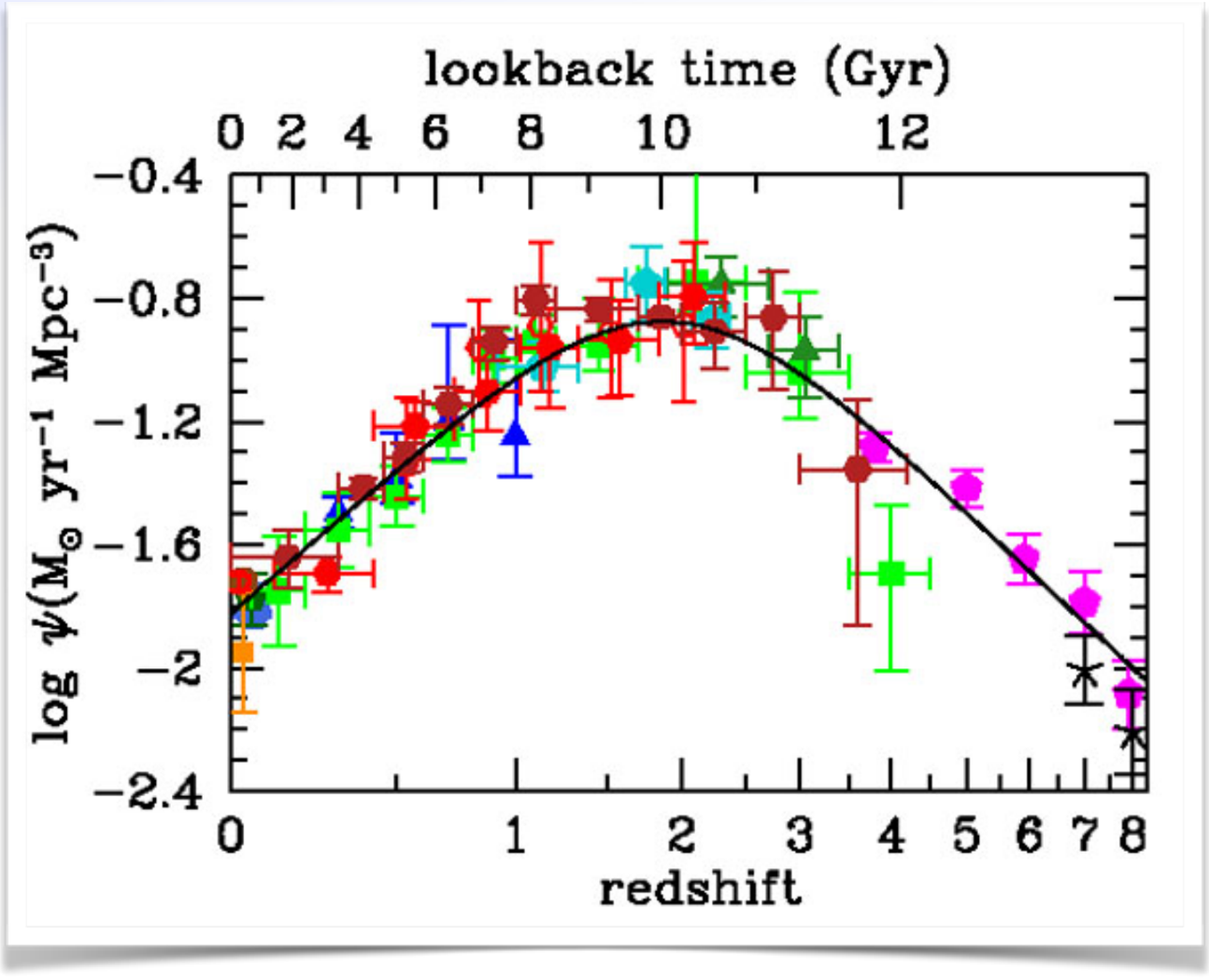
Steyrleithner+15

Kenney+04



Ebeling+14

High-redshift: a different universe

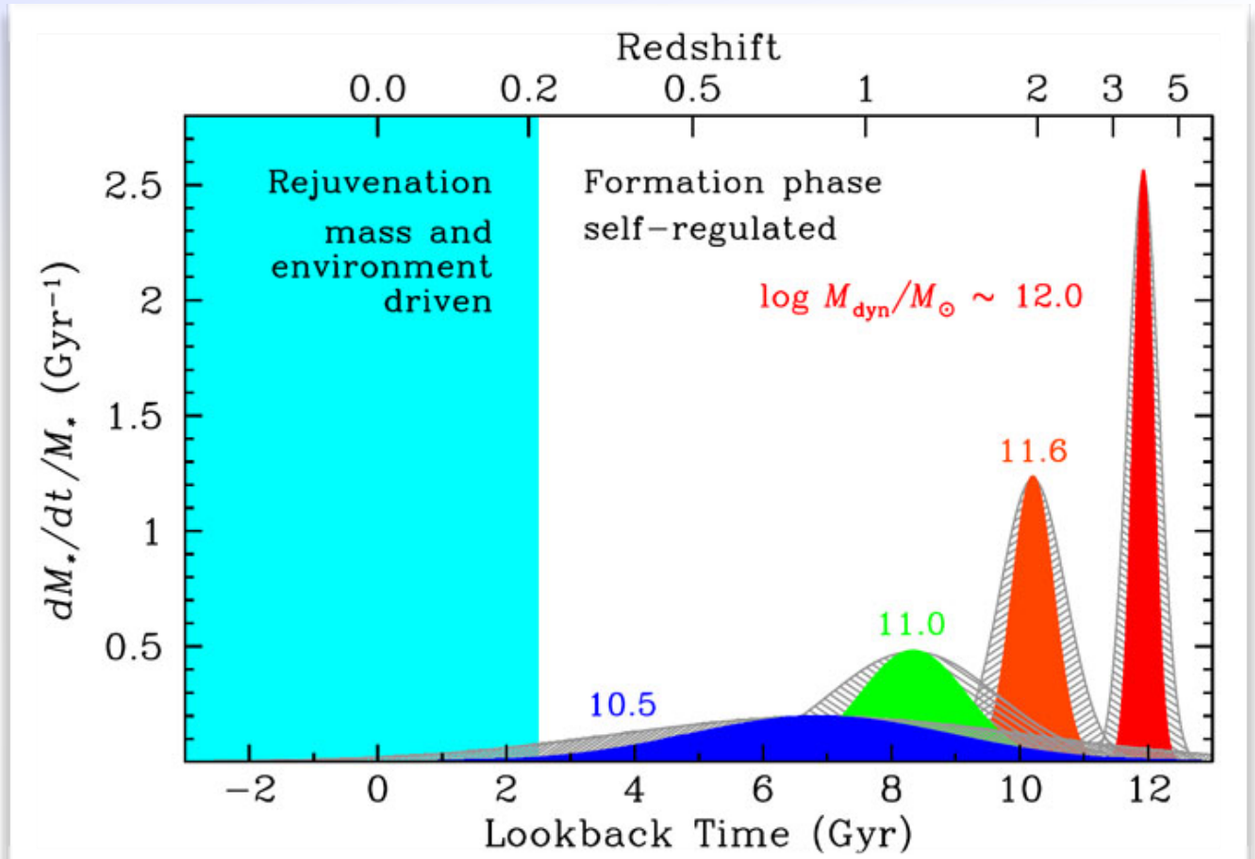


Madau & Dickinson 14

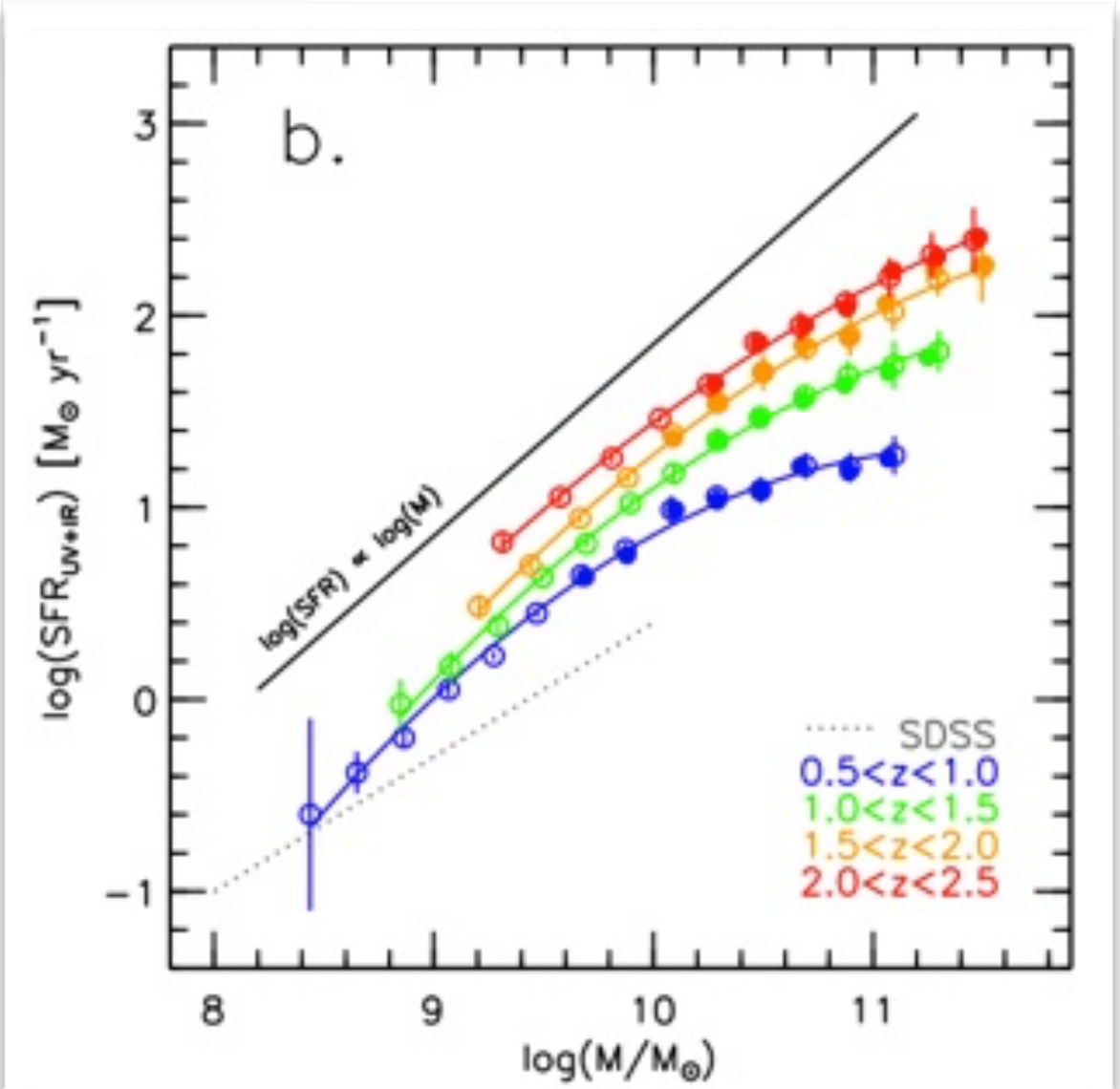
The universe was forming stars more rapidly in the past

High-redshift: a different universe

Downsizing!!



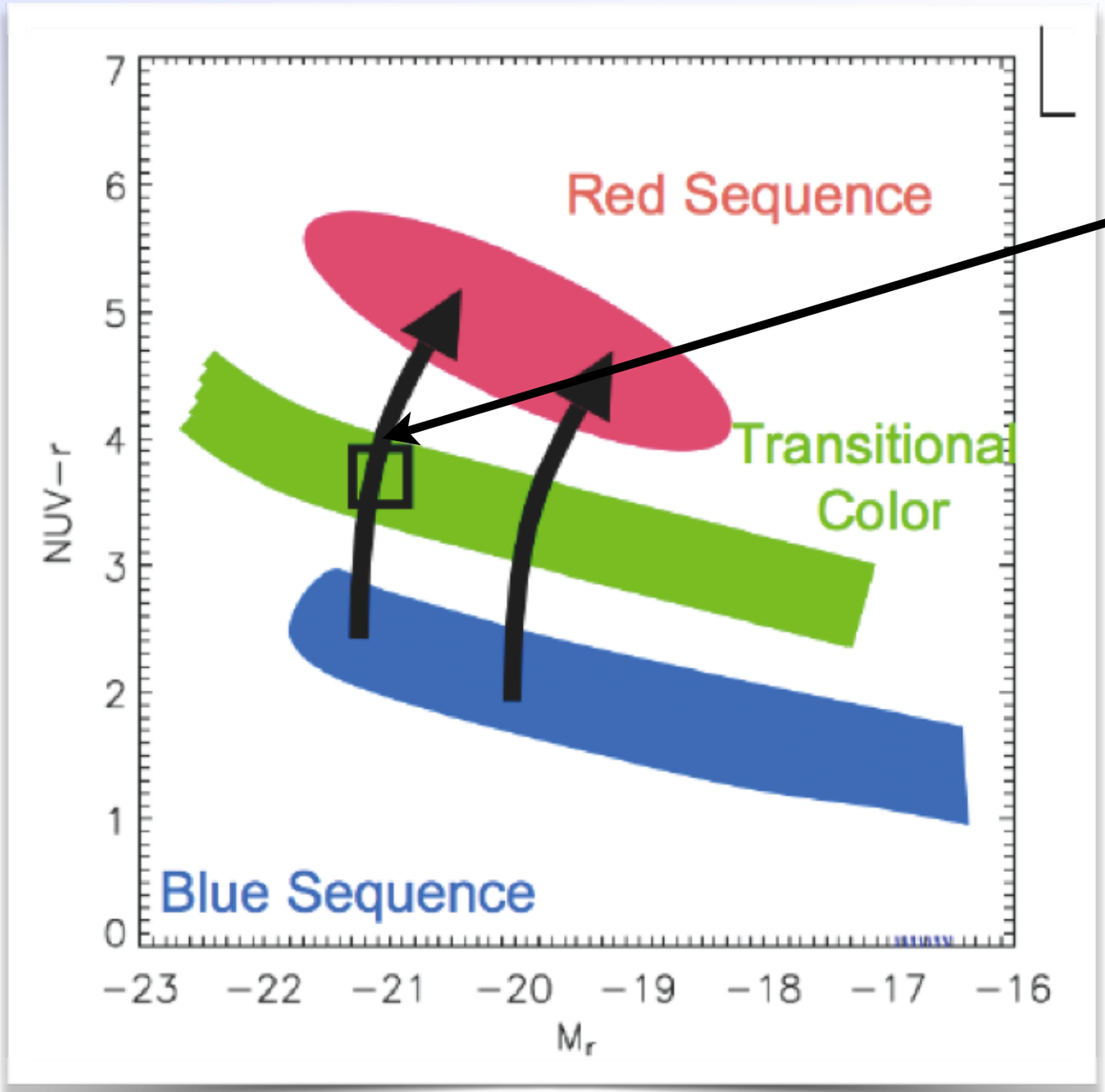
Thomas+10



Whitaker+14

Measuring quenching timescales

The mass flux density

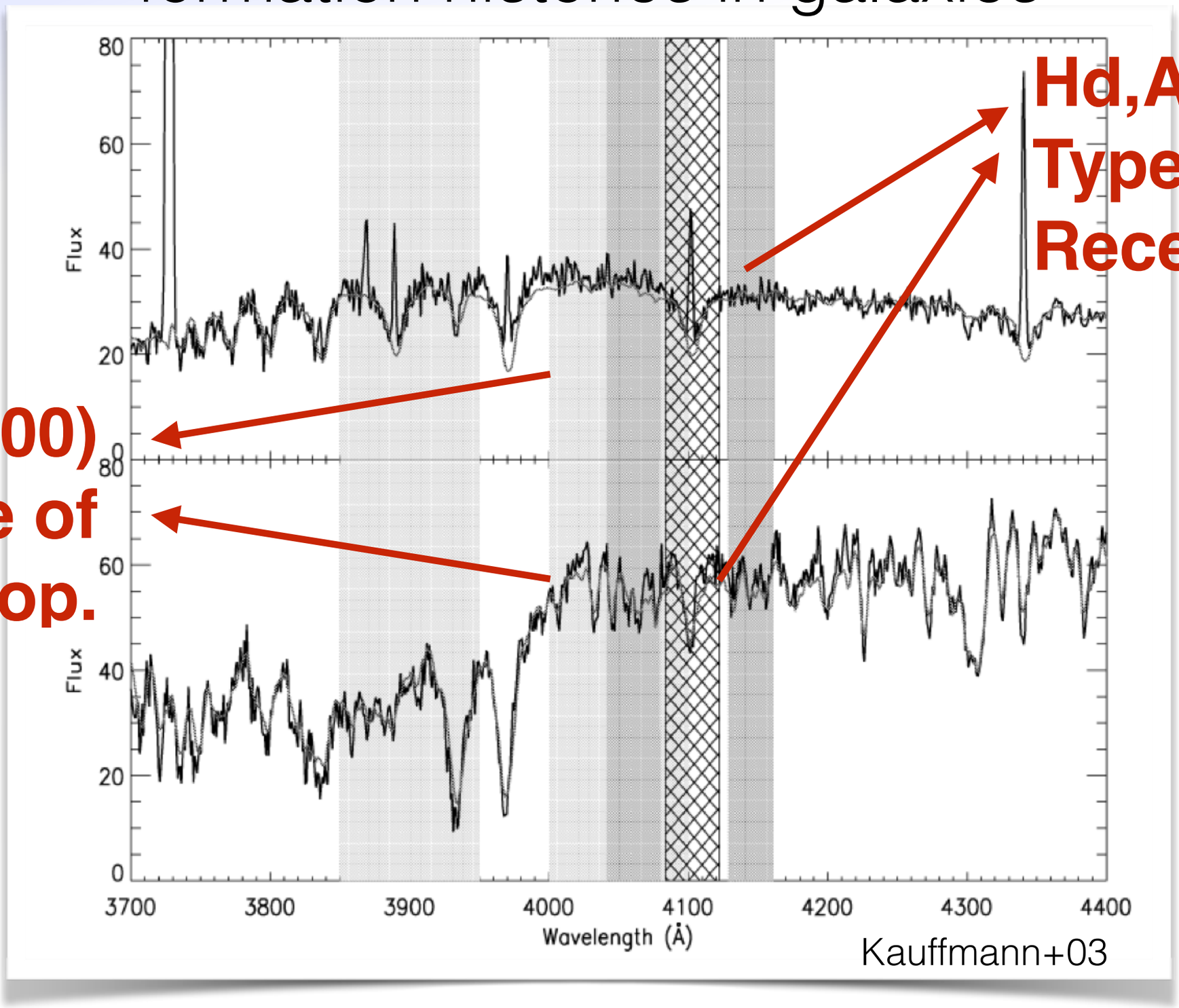


- Mass
- Number density
- Timescales

$$\dot{\Phi}(M_r, NUV - r) = \dot{\Phi}_B(M_r)\langle\tau(M_r, NUV - r;\xi)\rangle$$

Measuring quenching timescales

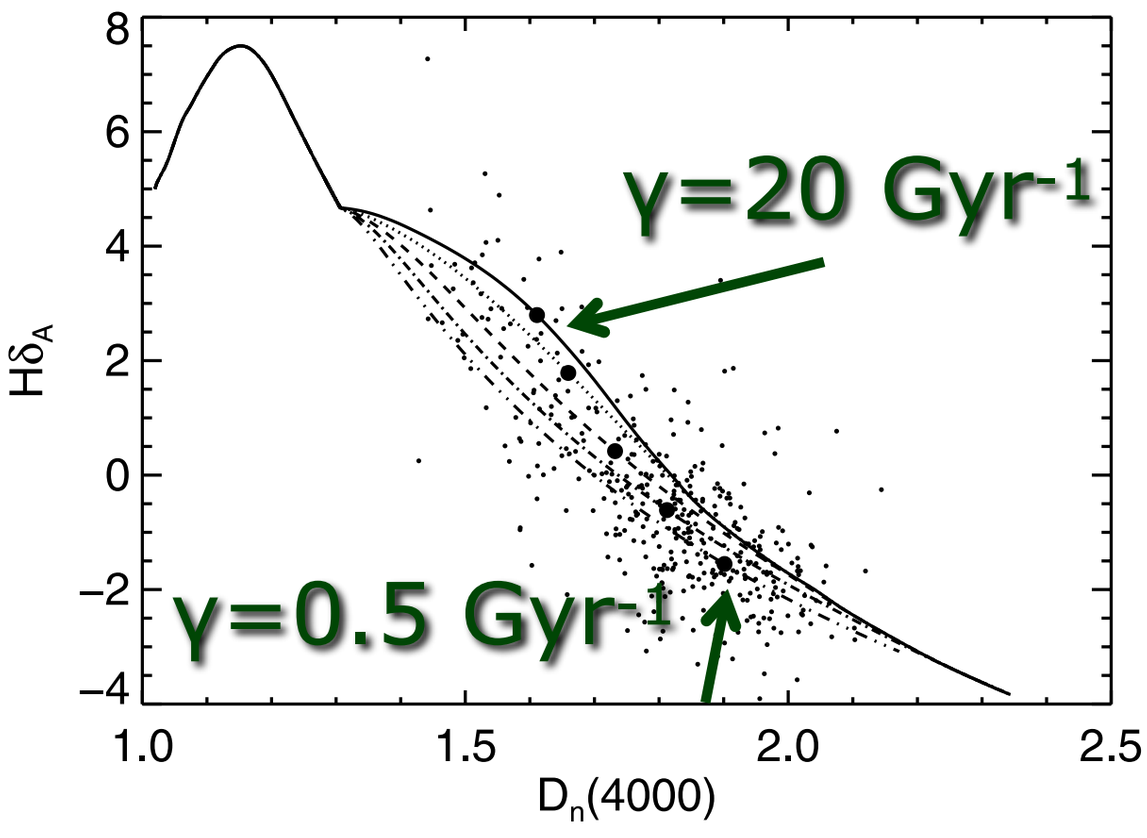
Spectroscopic indices to study star formation histories in galaxies

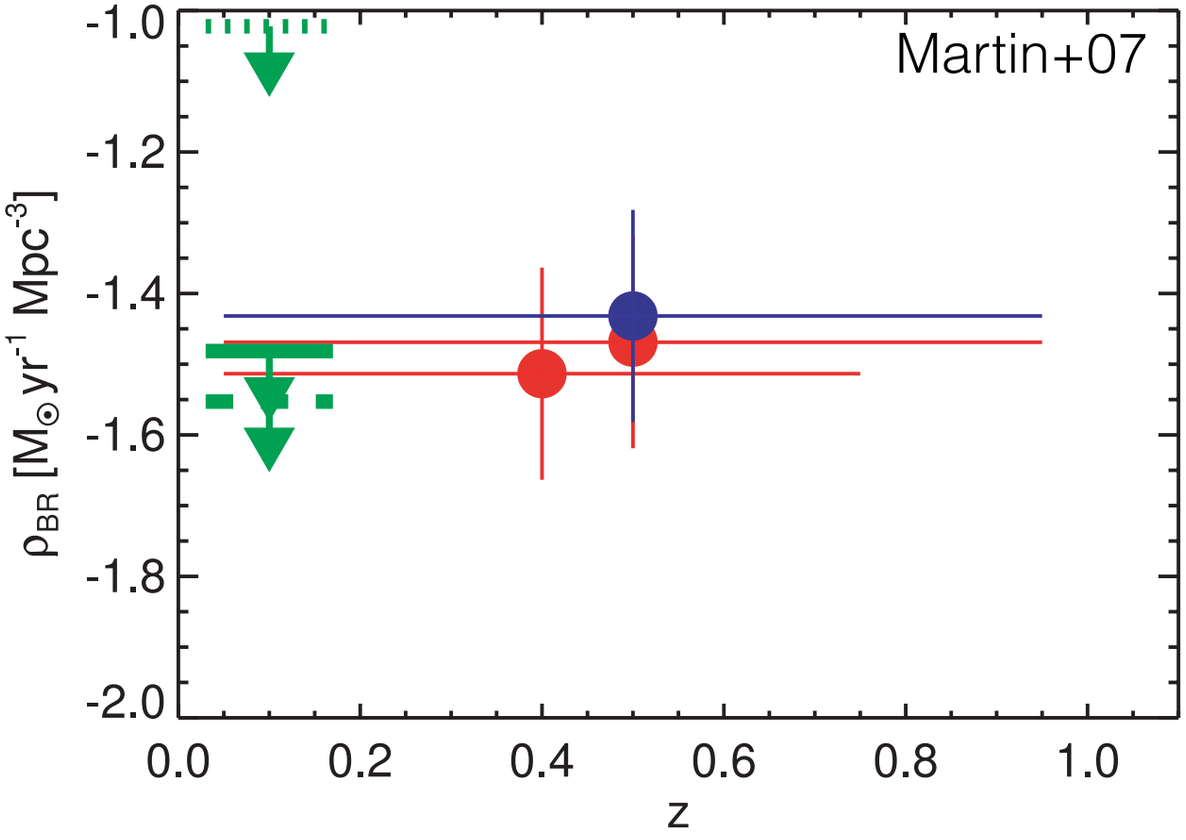


Measuring quenching timescales

$$SFR(t) = \begin{cases} SFR(t_0) & t < t0 \\ SFR(t_0)\, e^{-\gamma t} & t > t0 \end{cases}$$

The mass flux density in the green valley and the evolution of the red sequence agree

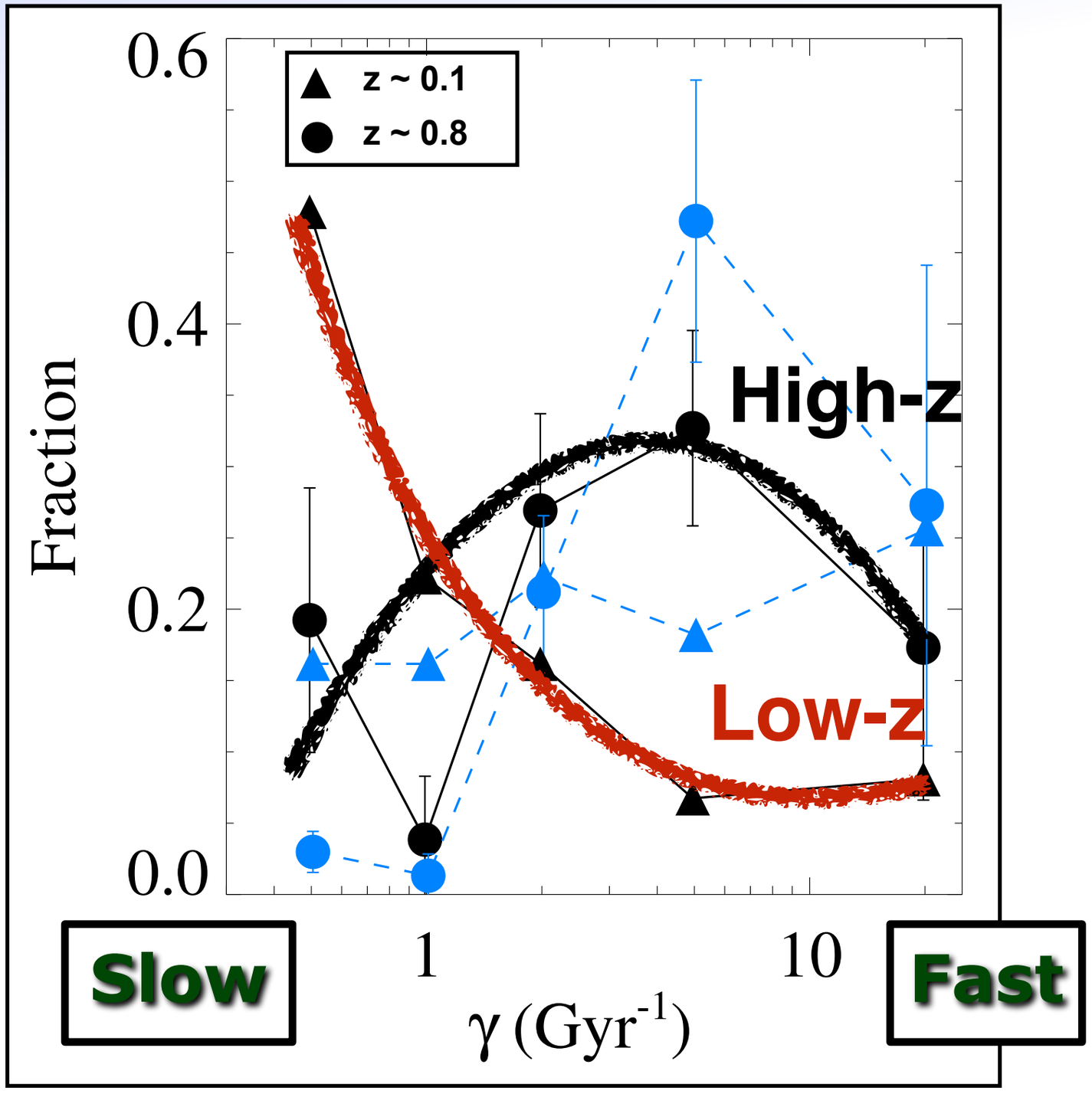




Measuring quenching timescales

Absorption lines in r~24 galaxies => NEED 8-10m telescopes!

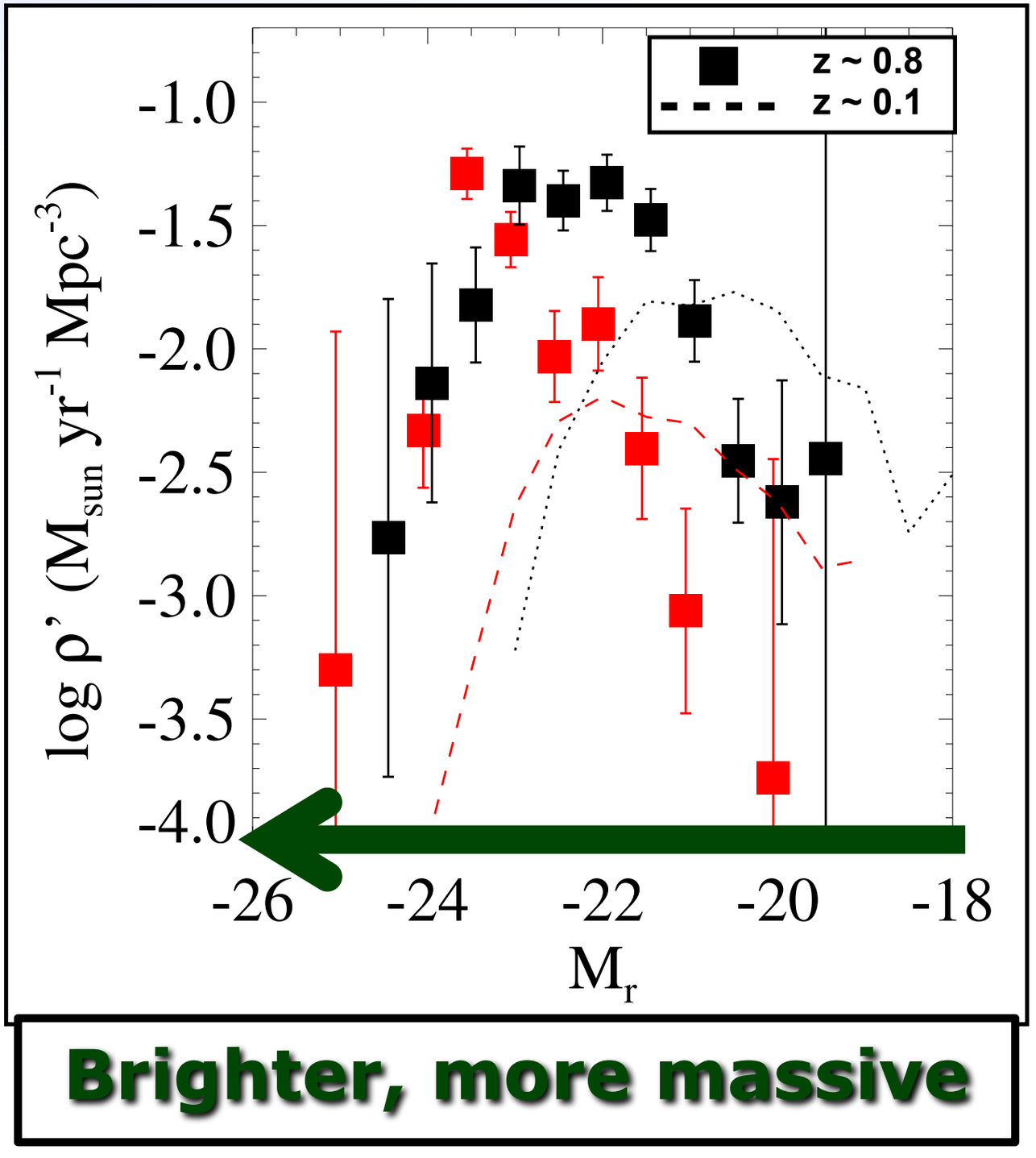
Galaxies move through the green valley faster at z~0.8



Gonçalves+12

Measuring quenching timescales

Mass flux density happens in fainter, less massive galaxies in recent times



Gonçalves+12

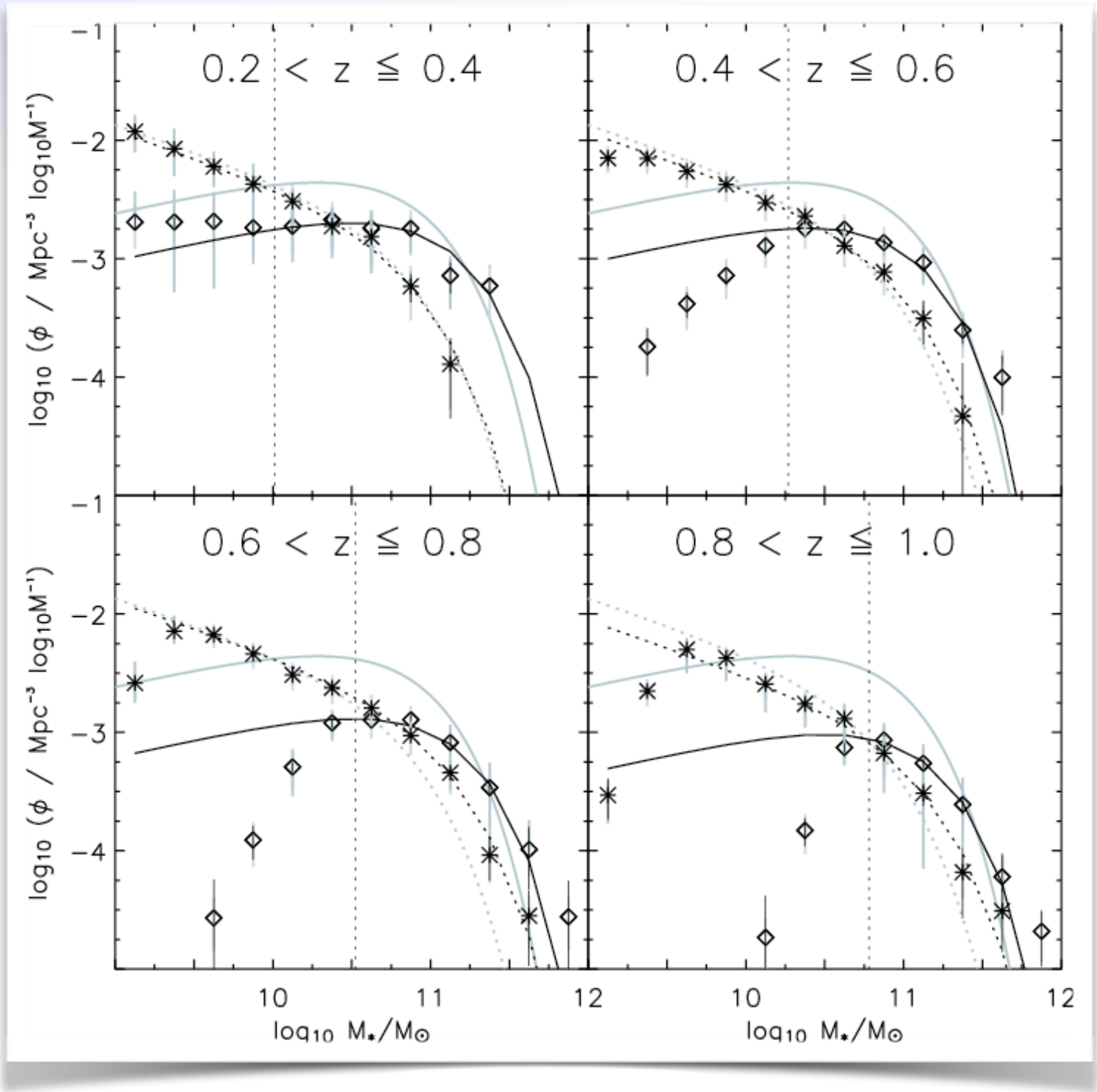
Measuring quenching timescales

"Top-down scenario for the evolution of the red sequence:

Massive red galaxies are formed early from the quenching of massive star-forming objects

The process then evolves to low-mass galaxies in the local universe

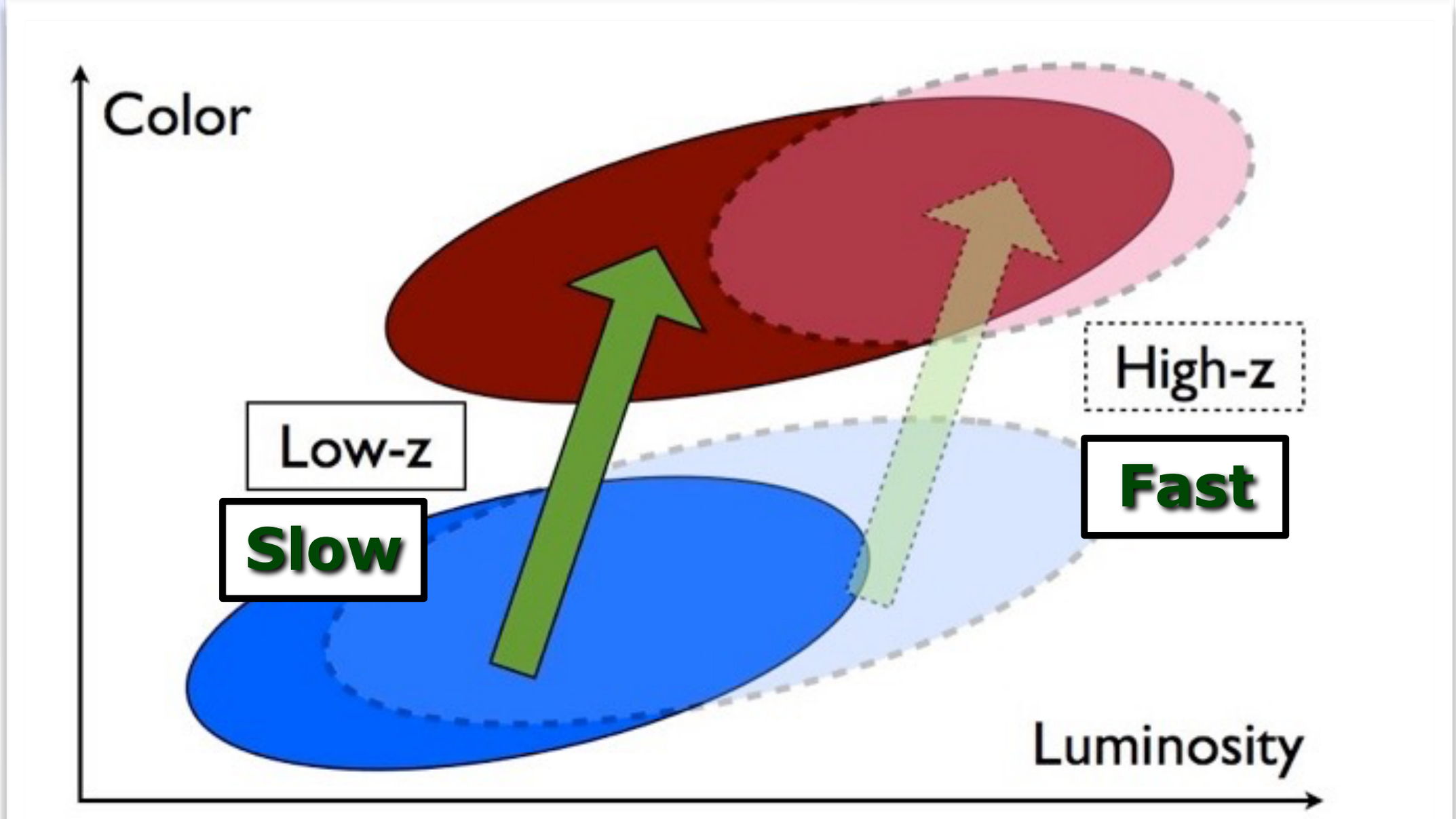
Downsizing of quenching!



Borch+06

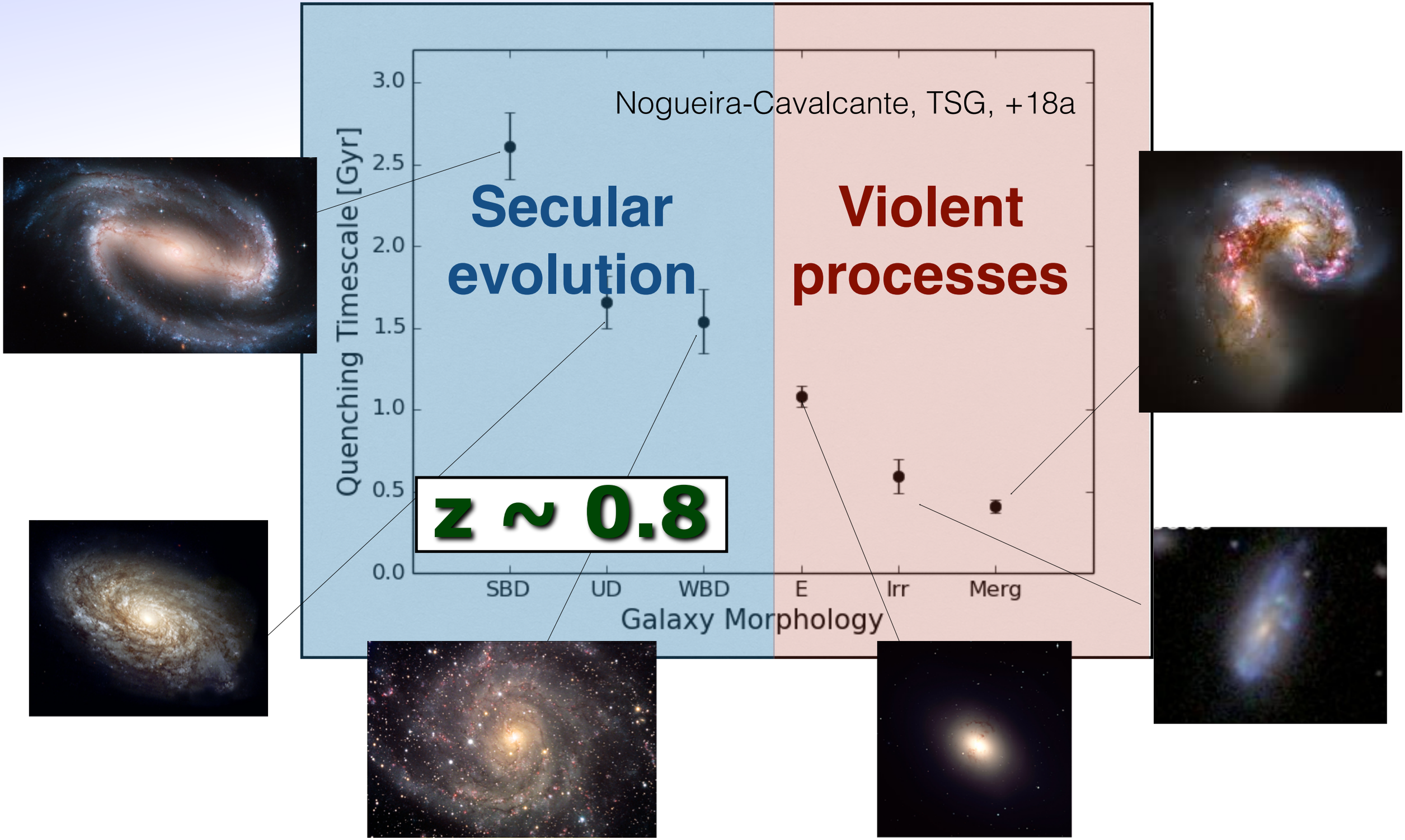
Measuring quenching timescales

Evolution of the CM diagram



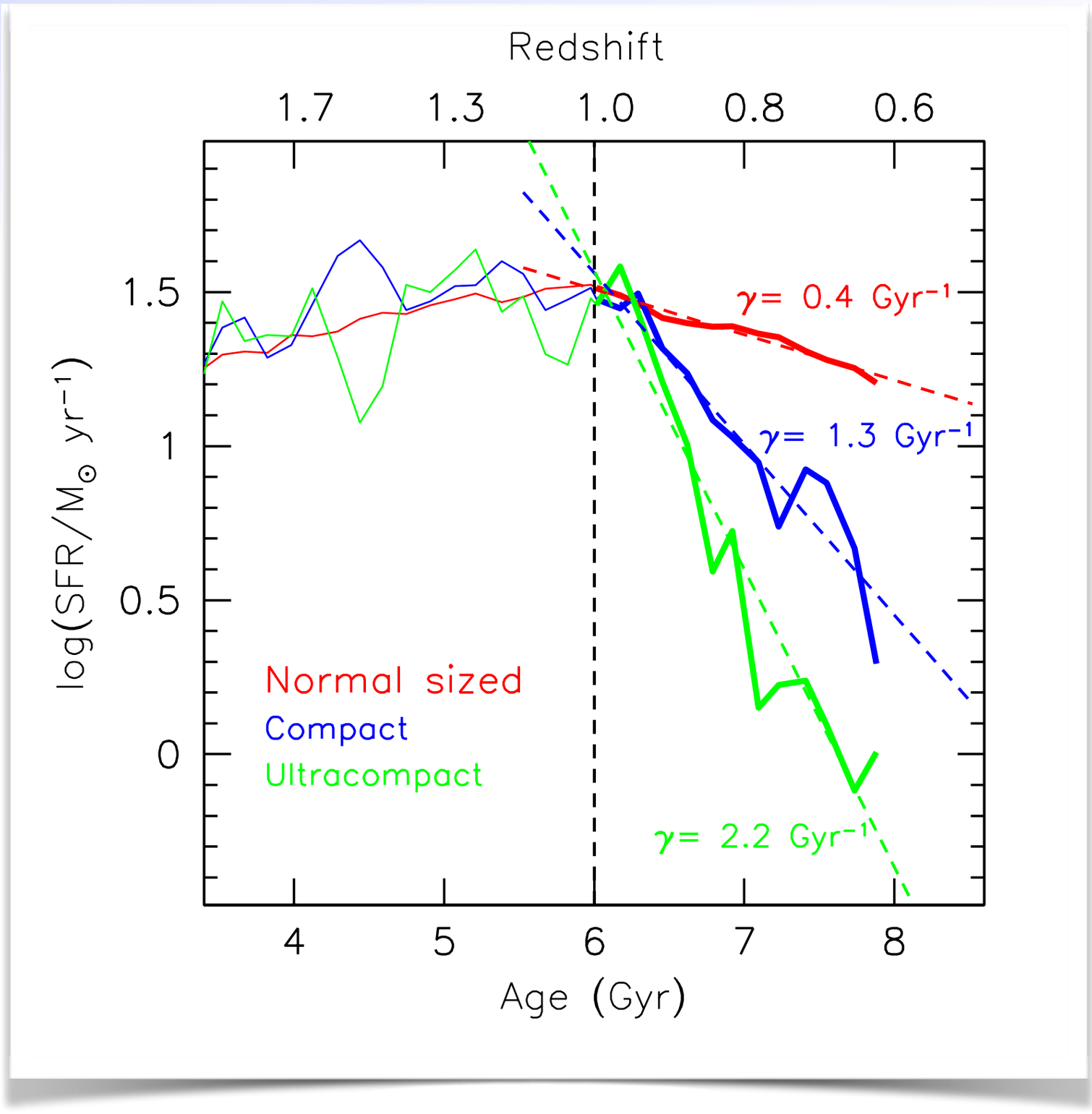
Quenching processes

Quenching as a function of morphology



Quenching processes

Quenching as a function of compactness



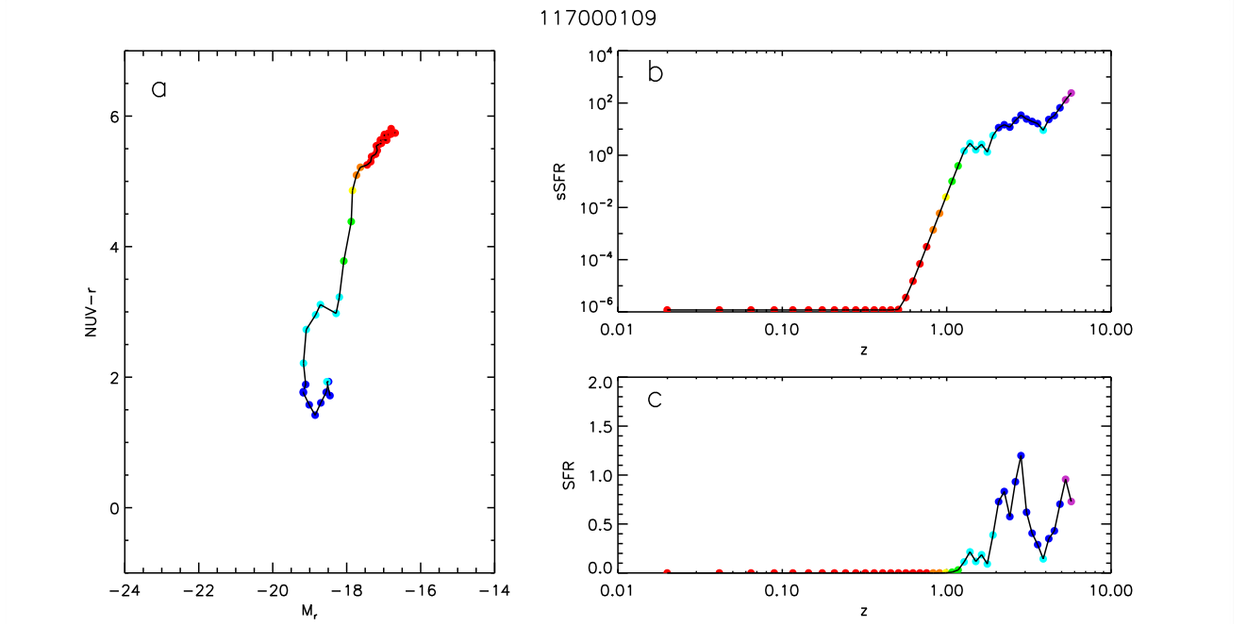
Compact galaxies quench faster!

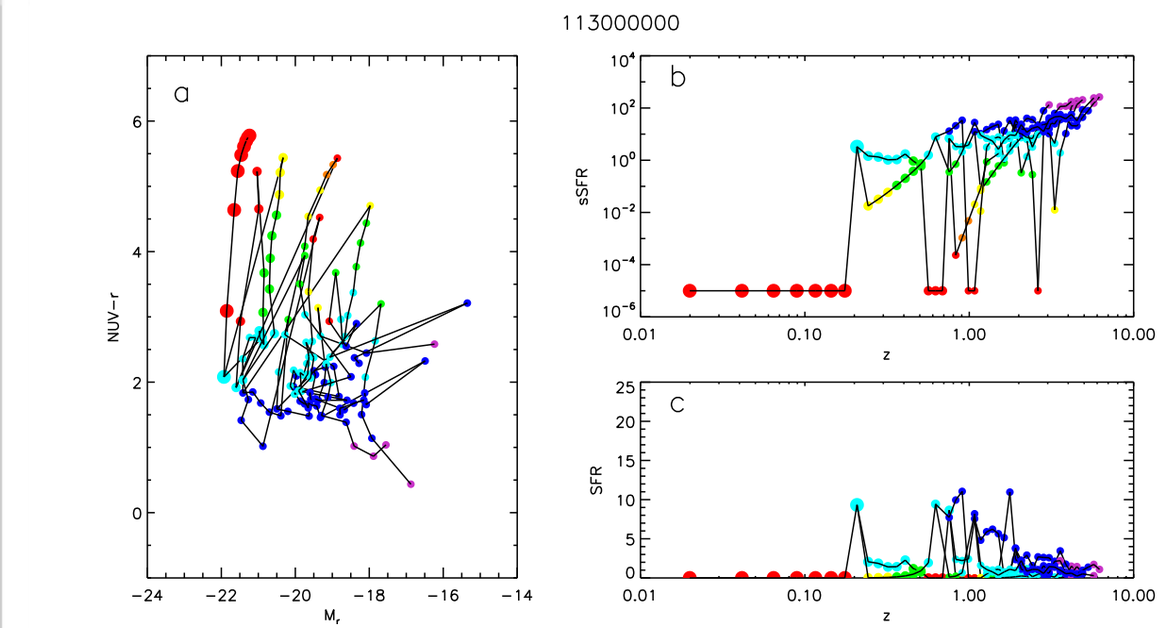
Comparison with Illustris simulation: stronger feedback

Nogueira-Cavalcante, TSG, +18b, submitted

Quenching processes

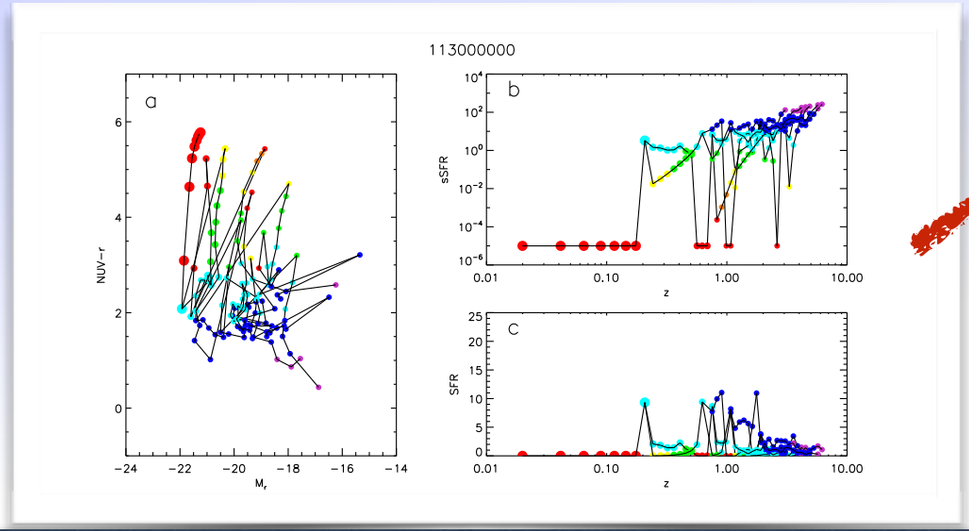
What if we use realistic SF histories?
Can we recover physical parameters?





Martin, TSG +17

Quenching processes



Stellar Population models

Mass, Z, SFH, etc.

Can we recover
physical parameters?

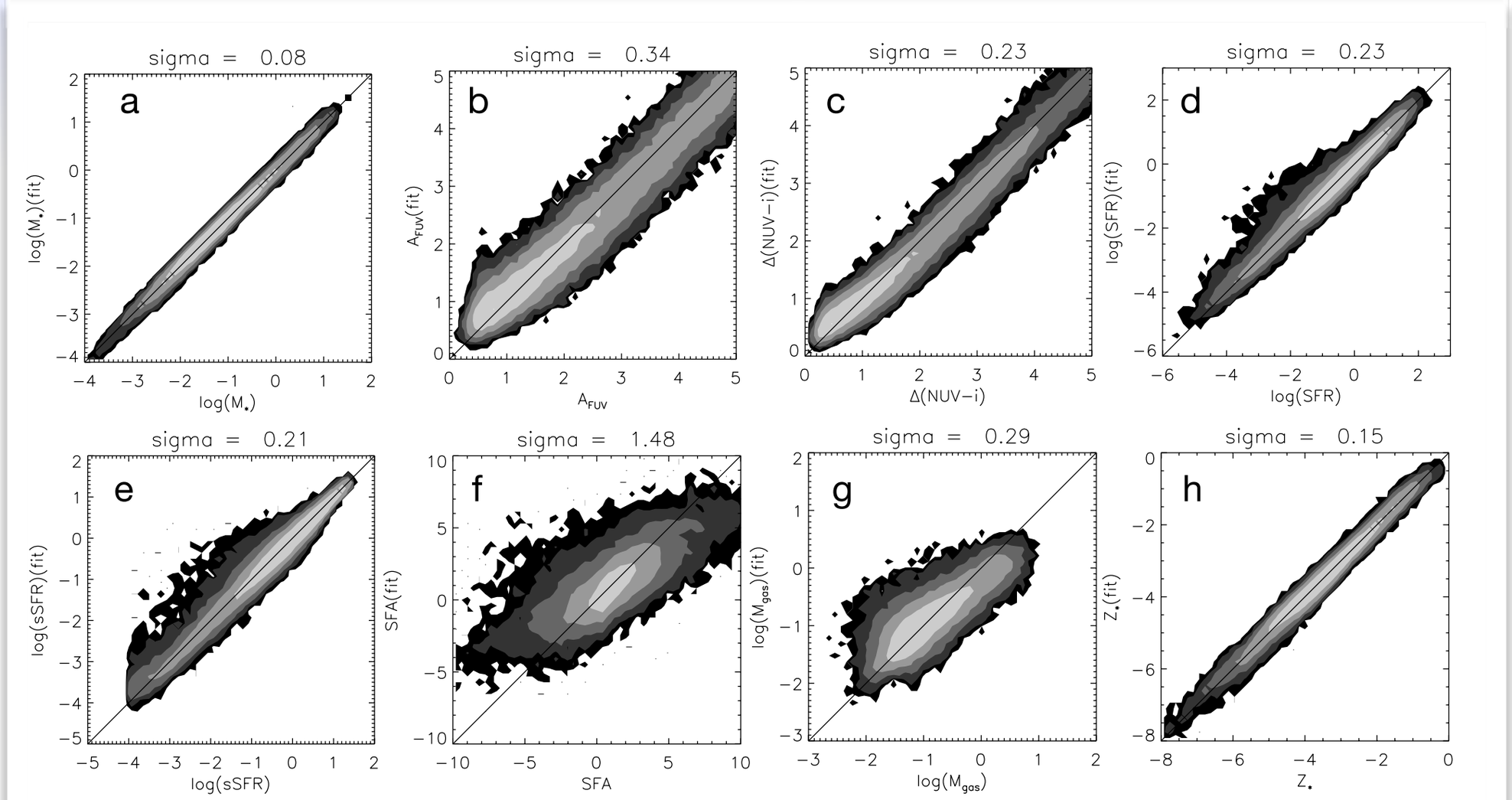
?

Photometry +
spectroscopy

Quenching processes

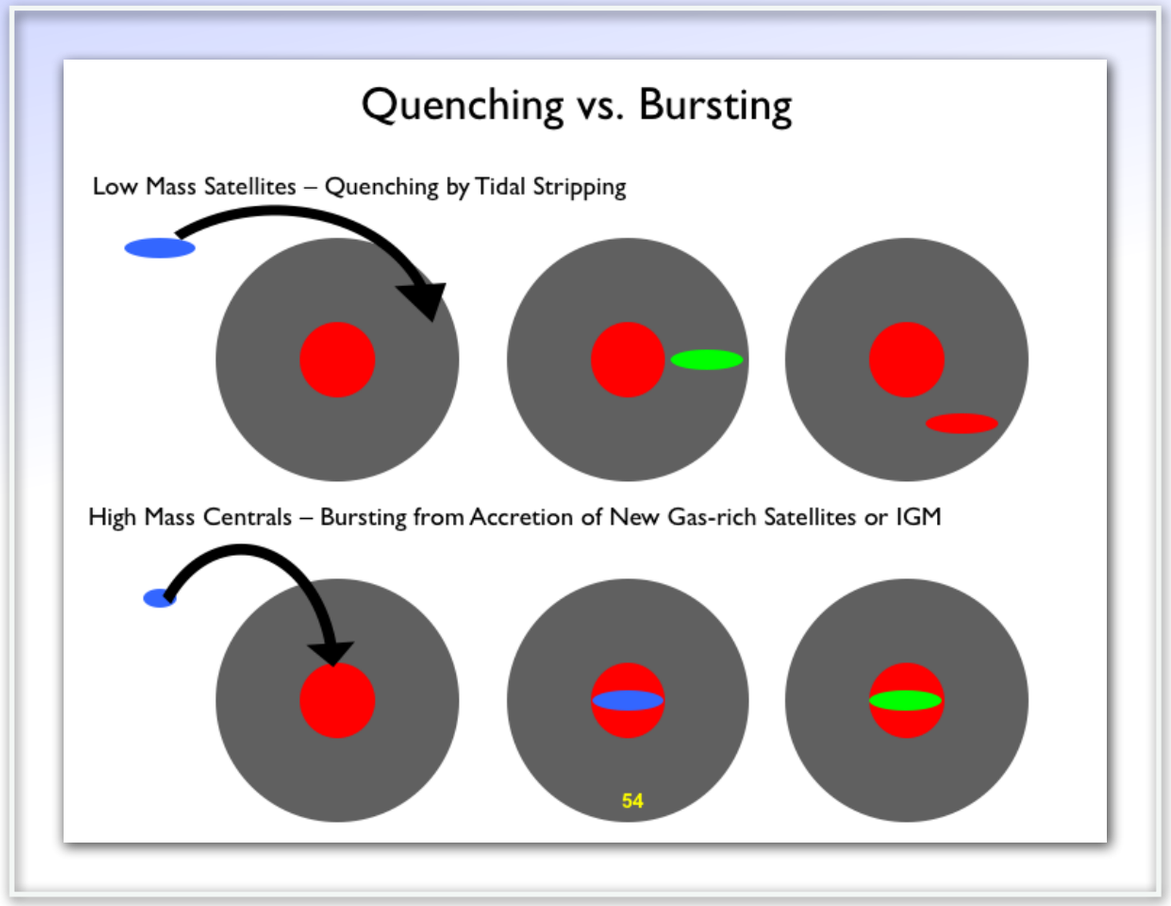
Can we recover physical parameters?
Yes we can!

Martin, TSG +17



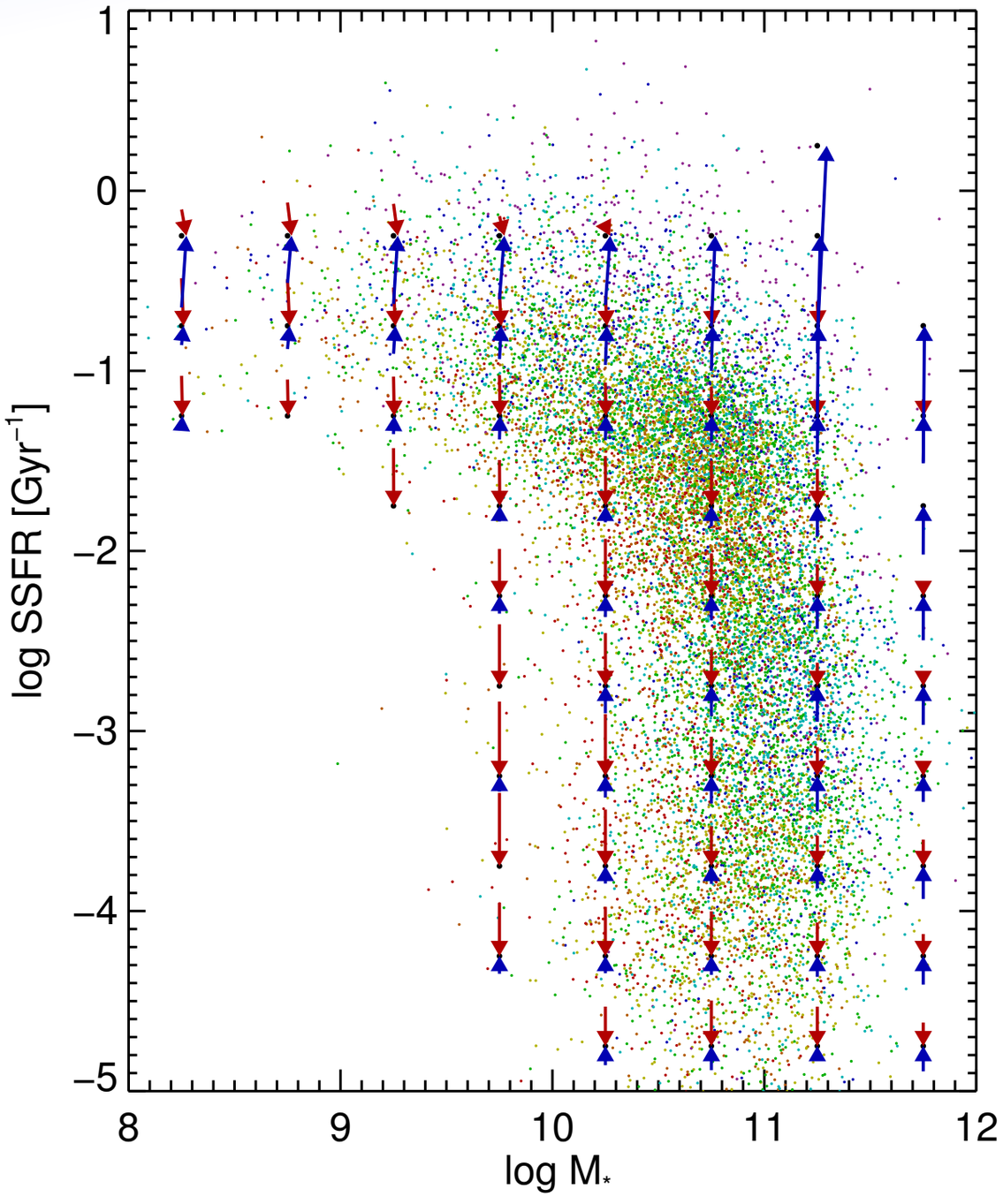
Linear regression on photometry and spectroscopic indices

Quenching processes

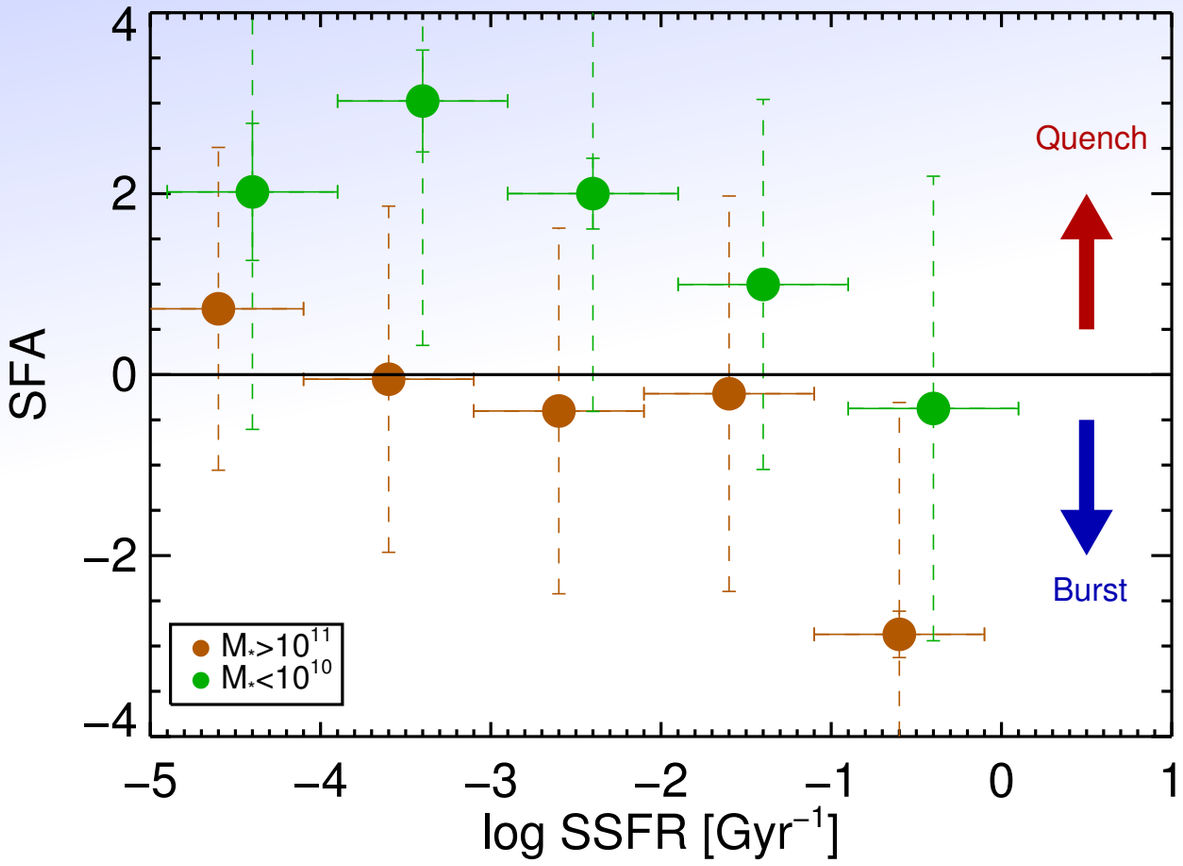


We can now detect quenching X bursting

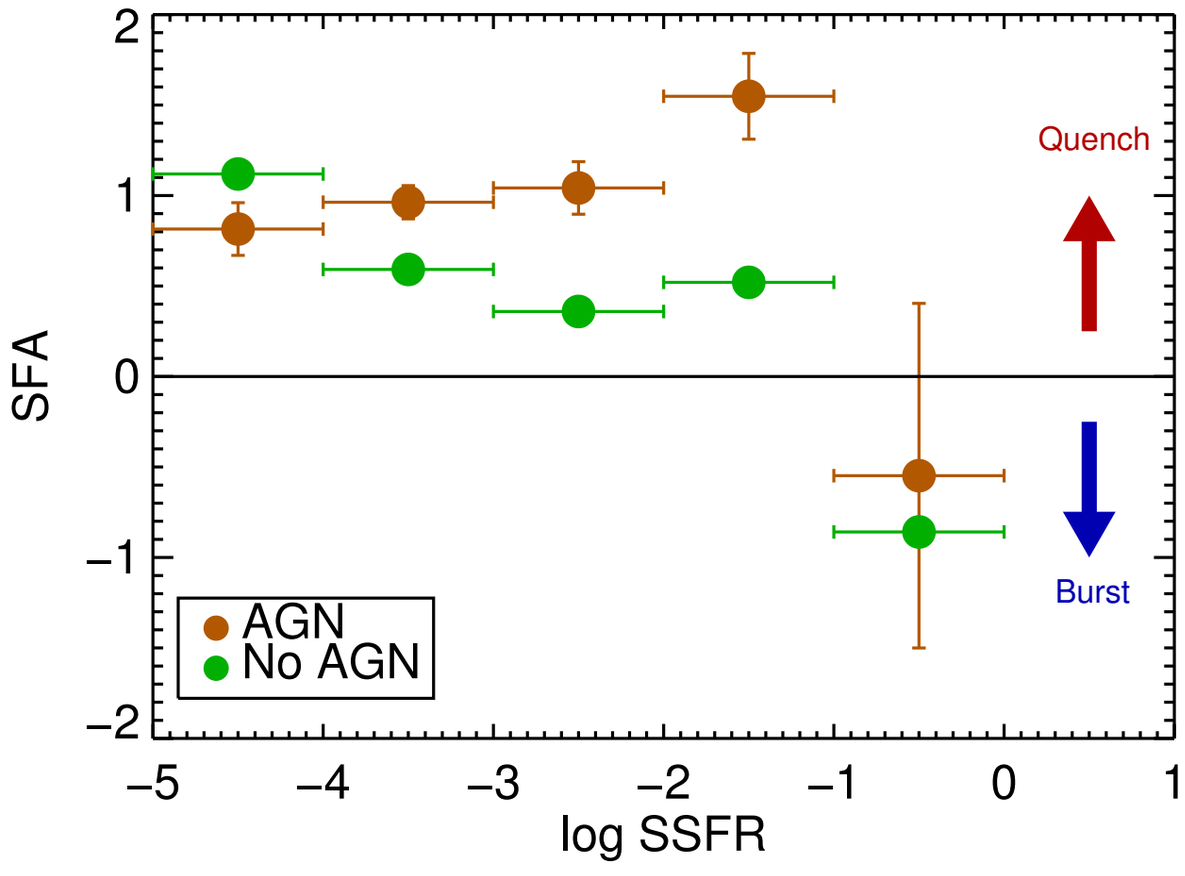
Martin, TSG +17



Quenching processes



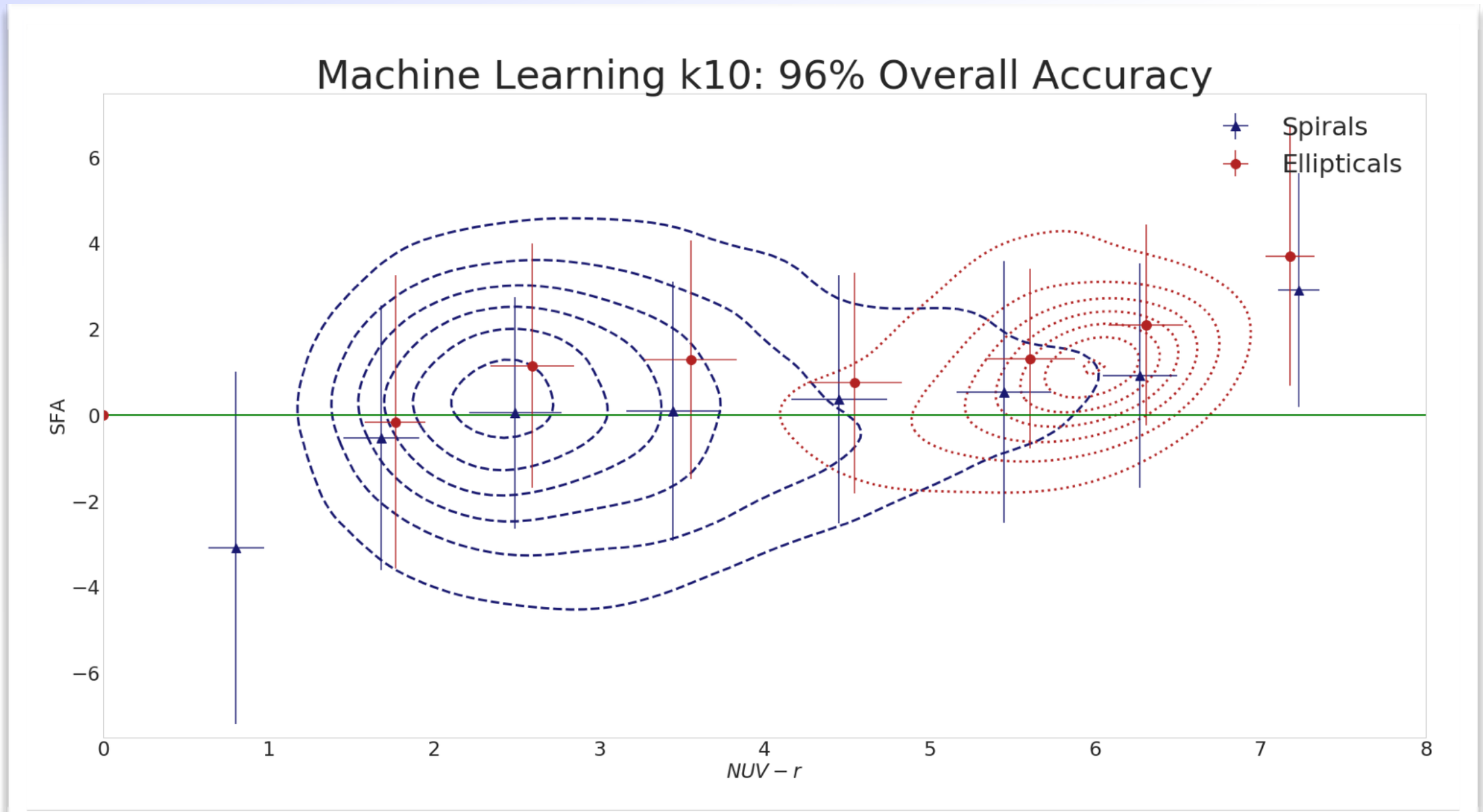
Low-mass galaxies are quenching today, high-mass are bursting



AGN activity helps quench star formation

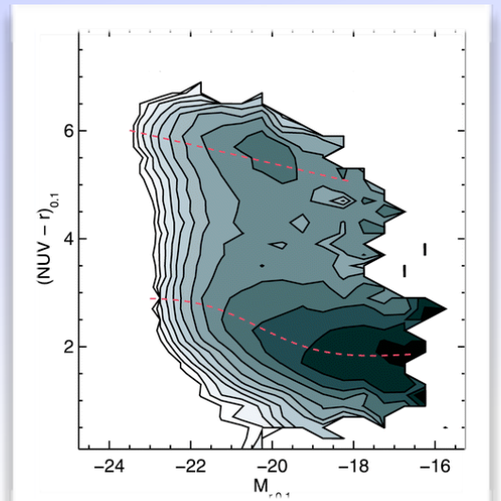
Martin, TSG +17

Quenching processes



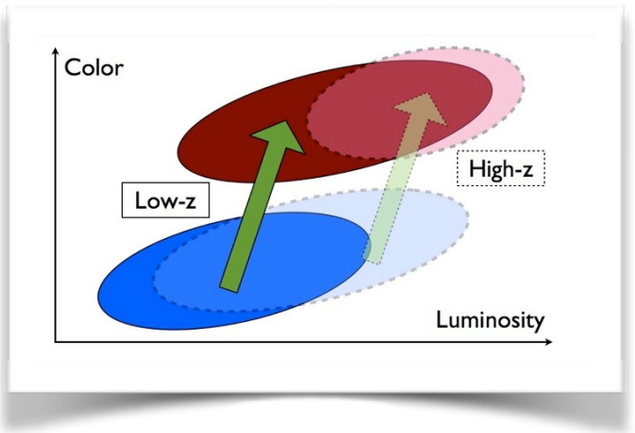
Freitas, TSG in prep.

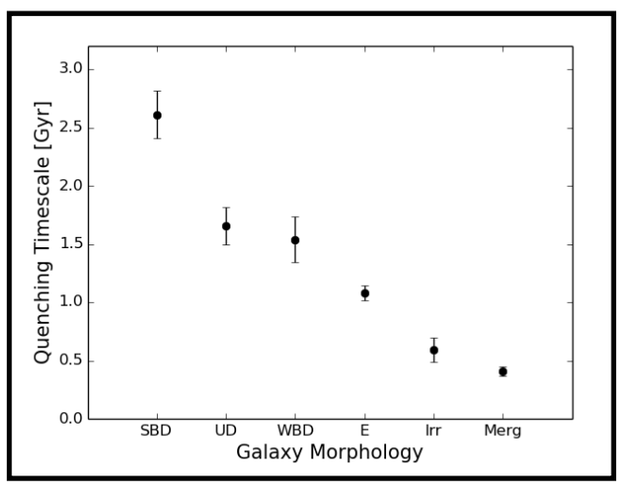
Conclusions

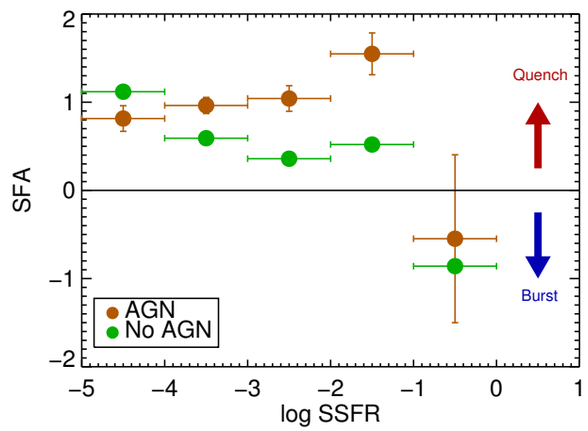


Galaxies are bimodal, fast quenching of star formation

Different processes at high-z, faster quenching, downsizing







Slower quenching in (barred) spirals, faster quenching in AGN hosts