Pathways to quench galaxies in SIMBA cosmological simulation and observations

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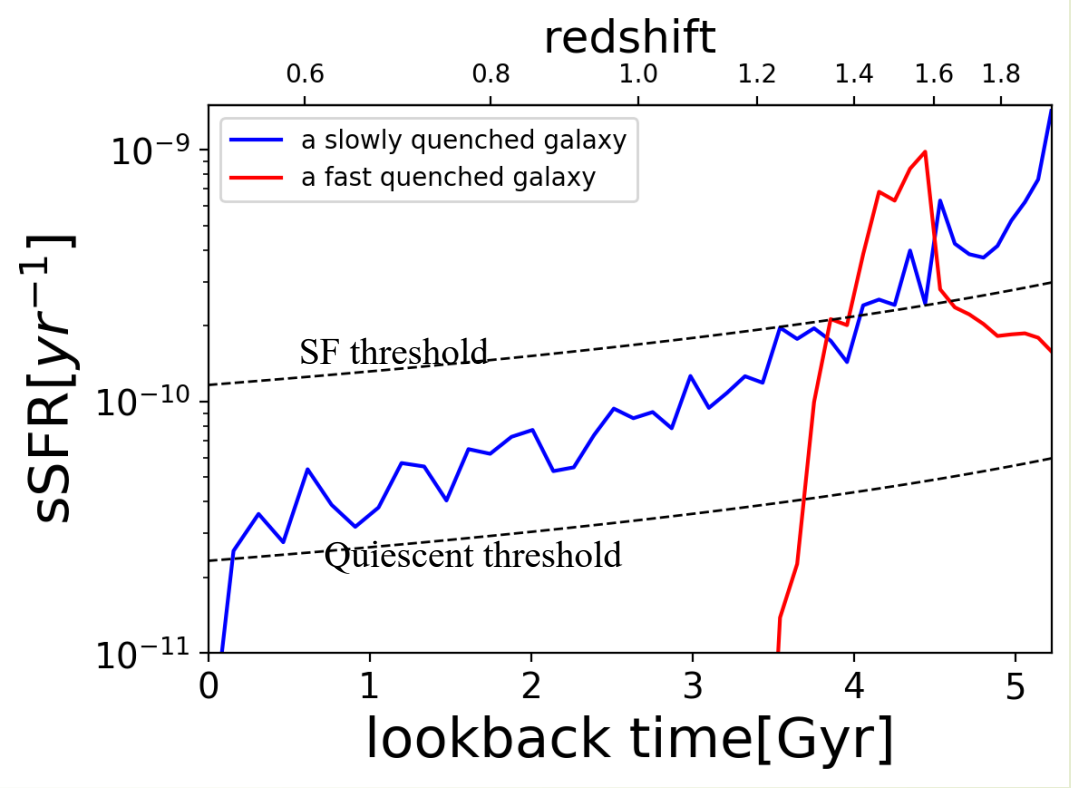
Paper: Zheng et. al. 2021, in prep

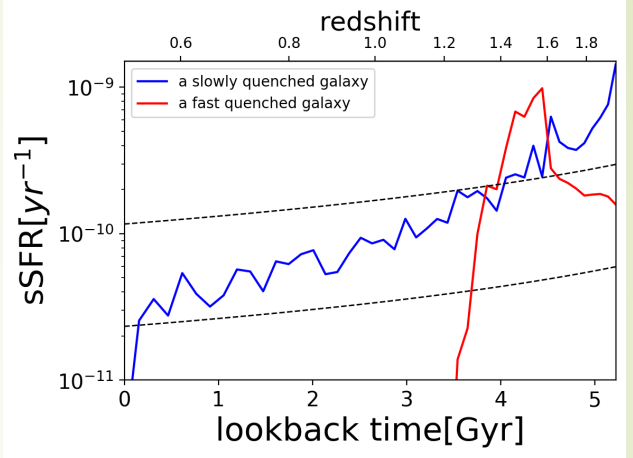
Pathways to quench galaxies

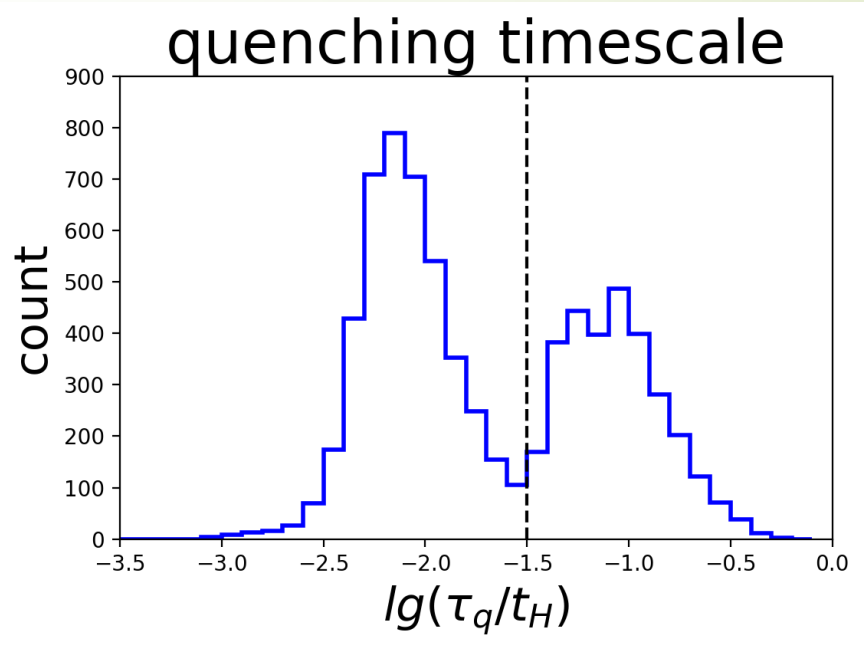
- The fast(rapidly) route ($\lesssim$ 300 Myr)
- The other route(s) (slow ones)
- Can we identify different routes?
- What's their relatively importance to the growth of the red sequence?



SIMBA simulation & quenching timescale

- SIMBA cosmological simulation
  - box size: 100 h^{-1} Mpc
  - 1024^3 baryon elements + 1024^3 DM particles
  - z = 320 to 0
  - dichotomy BH feedback models
- Measurement of quenching time-scale
  - SF threshold: sSFR(z) > $1/t_H$ (z)
  - quiescent threshold: sSFR(z) < $0.2/t_H$ (z)
  - time that galaxies taken to cross two thresholds, scaled to the age of uni. (τ_q/t_H)





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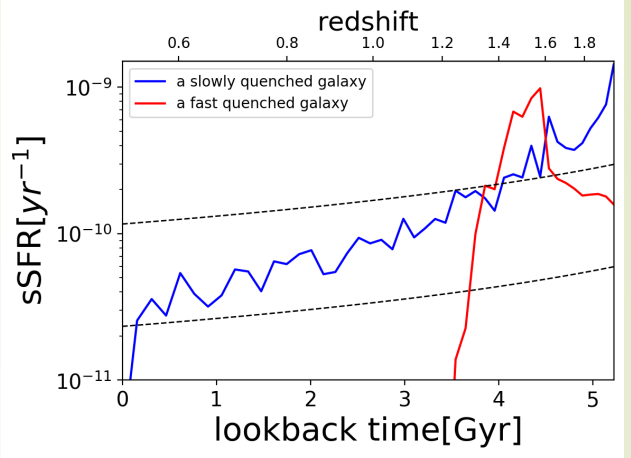
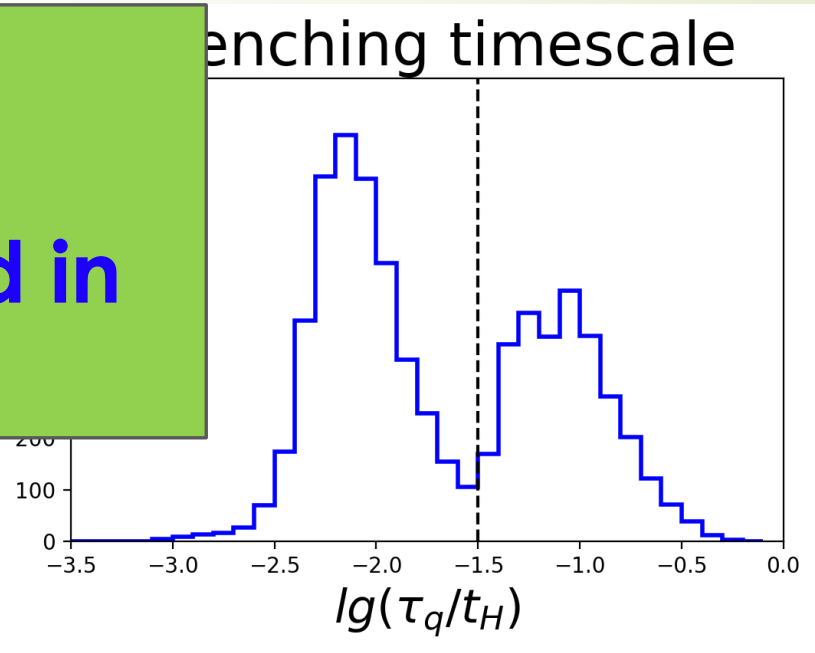
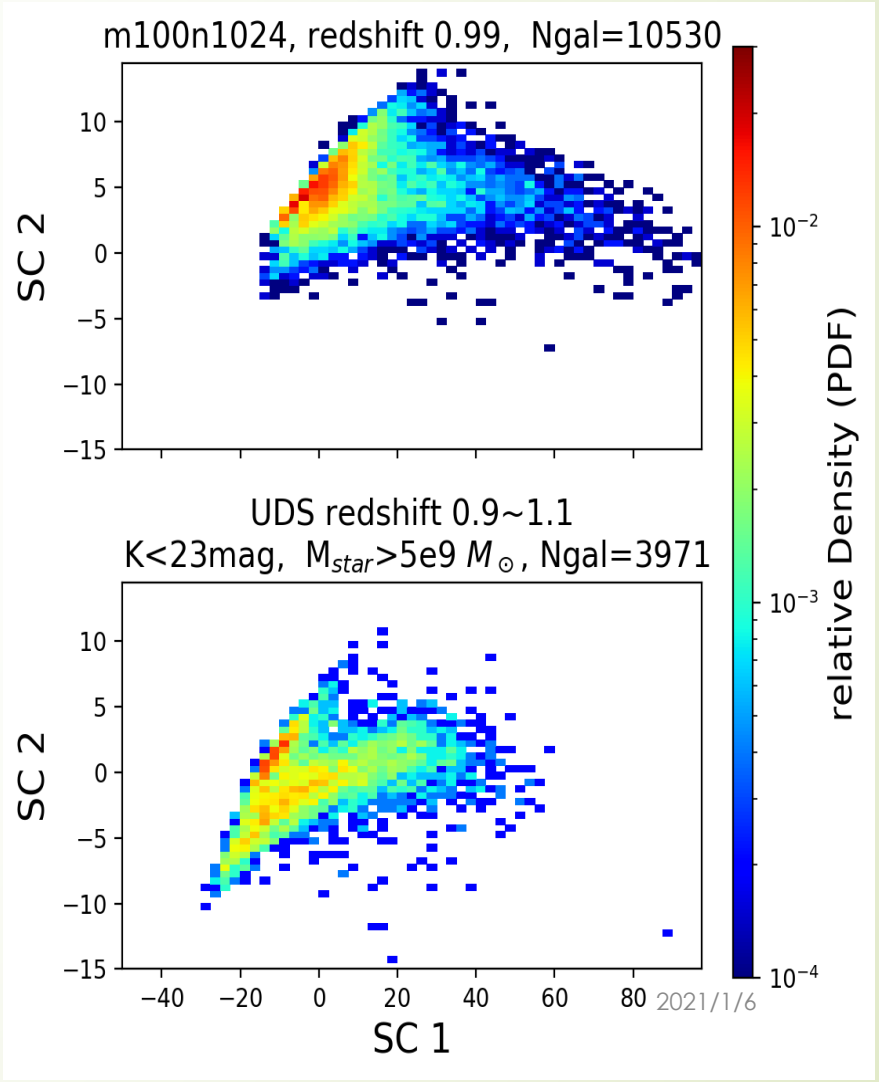
Problems solved?
Not really!
SFHs are not easy to be acquired in observations.





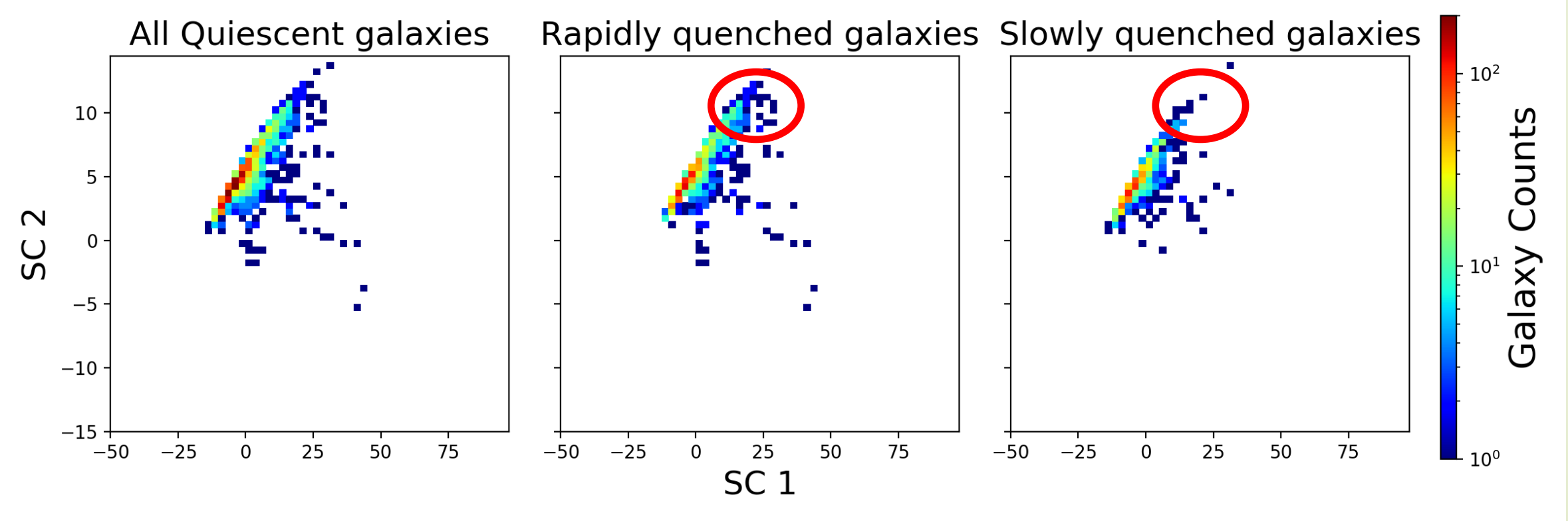
Super-colour analysis(SCA) —— mock observations and analysis

- Principal component analysis that classifies the spectral type from the multi-wavelength photometry data
- Mock photometry
  - stellar population synthesis (FSPS package)
  - dust effect: Line Of Sight Extinction (pyloser package)
  - apply filters



Super-colour analysis(SCA) —— mock observations and analysis

- Combined with the quenching timescales measured with SFHs



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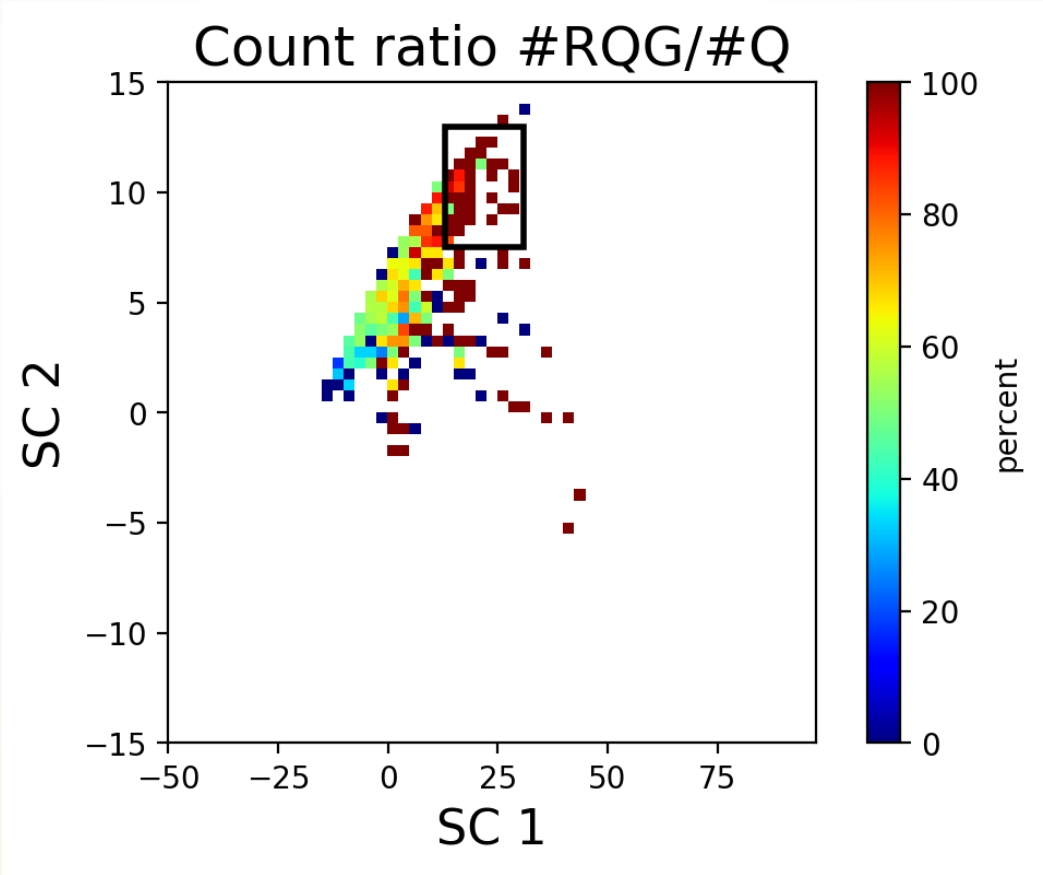
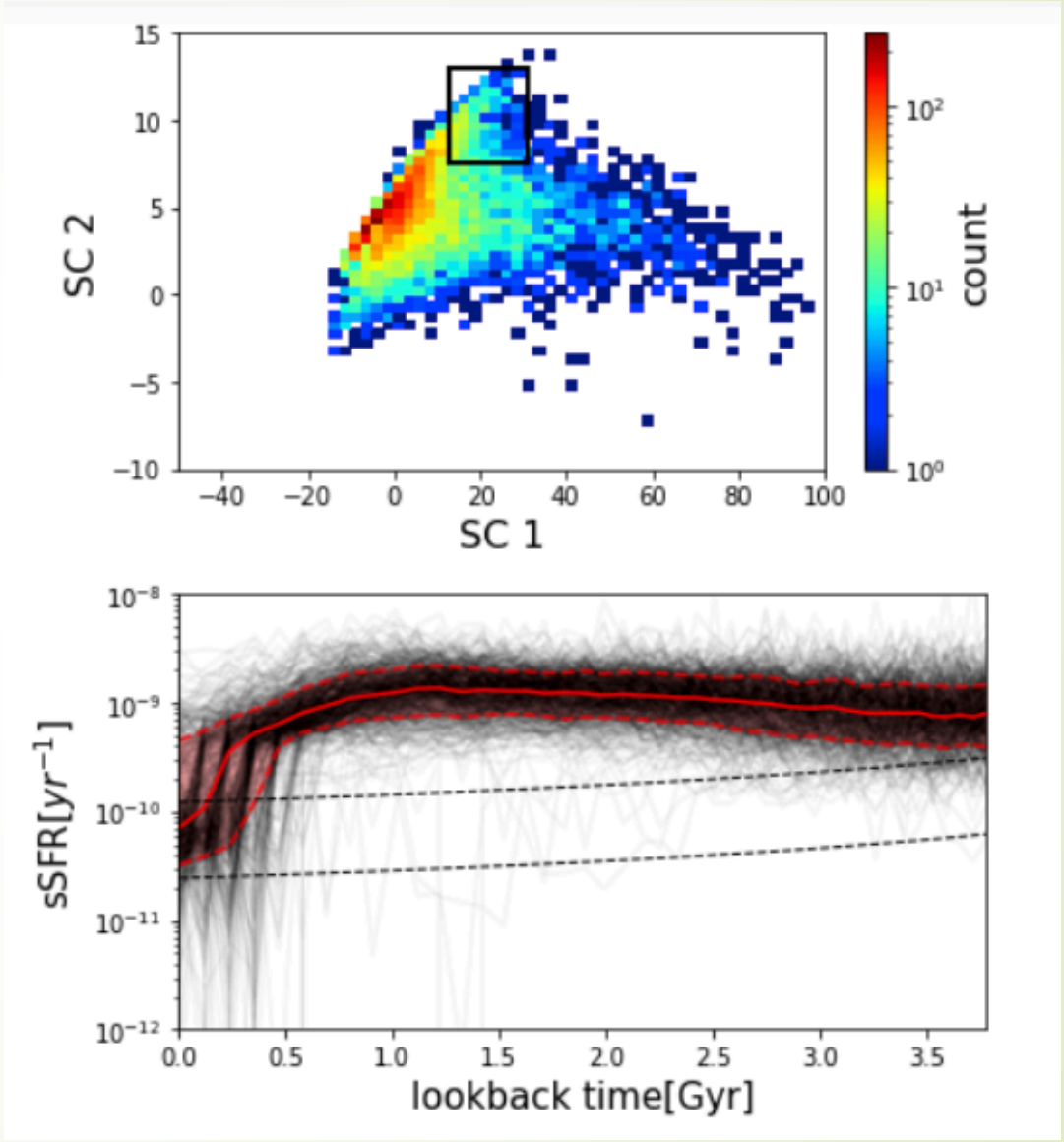


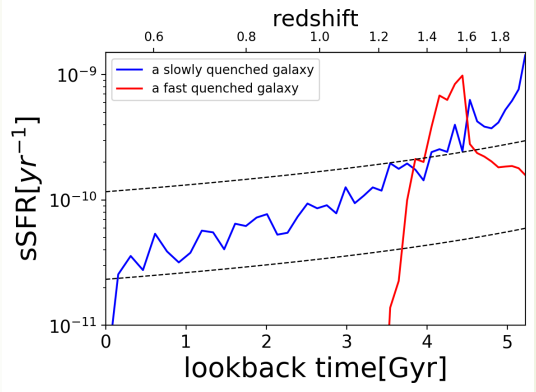
The “box”

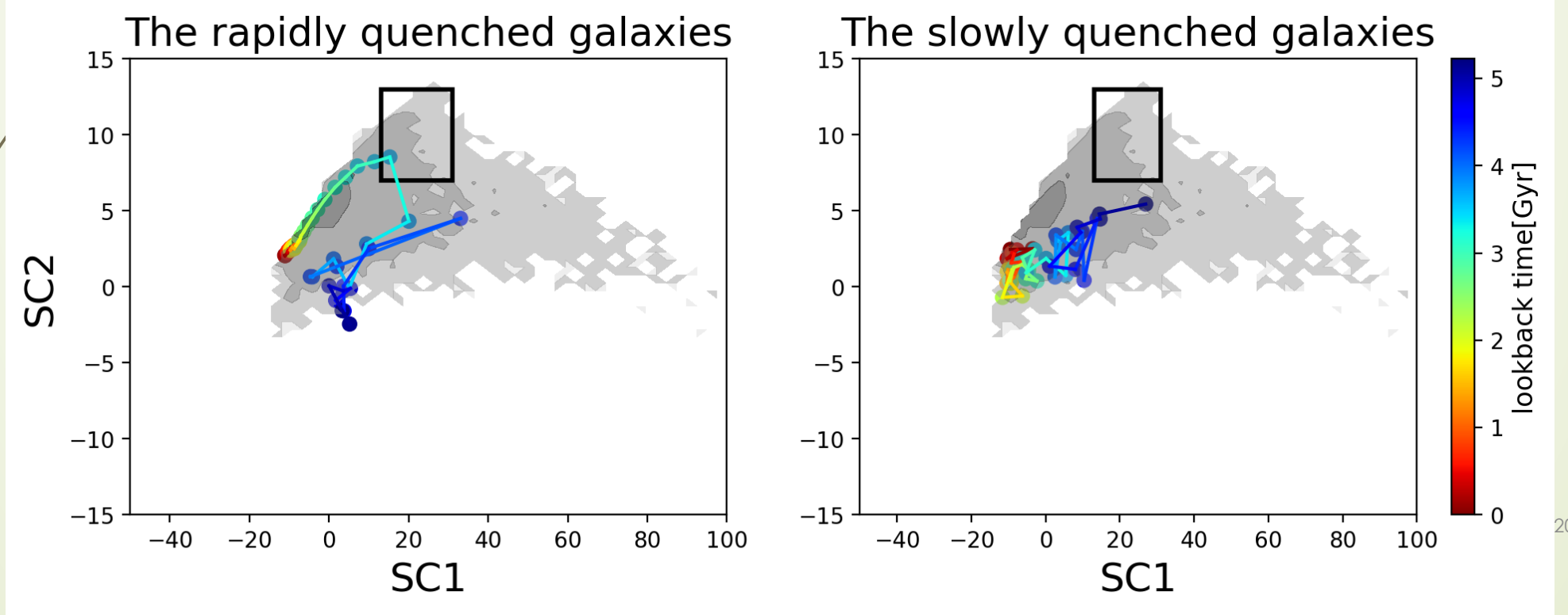
- All the quiescent galaxies are rapidly quenched.
- Non-quiescent galaxies mostly display sharp drops in their recent SFHs and descend to the red sequence in the next Gyr.



Box defined rapidly quenched galaxies

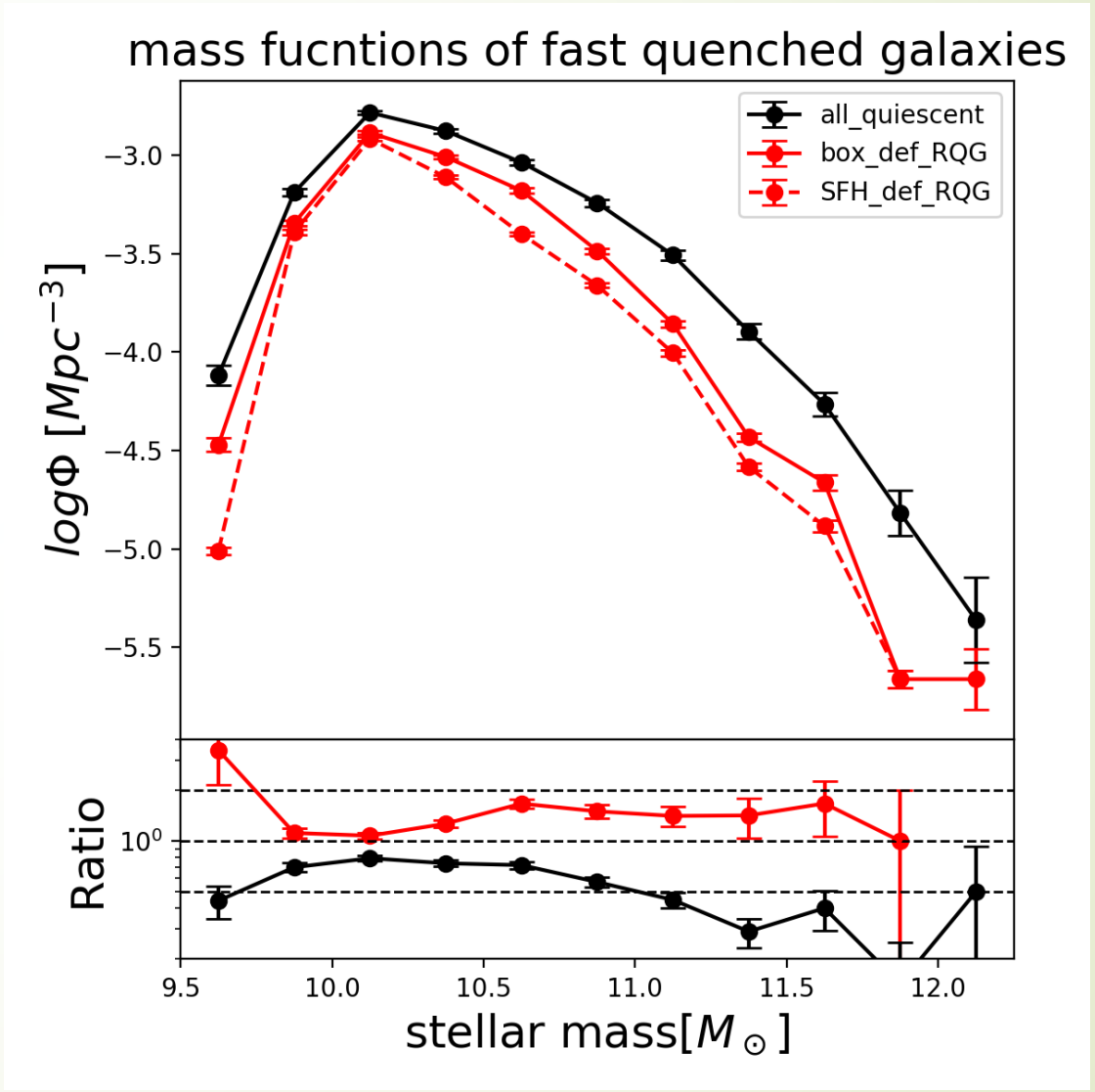
- We defined rapidly quenched galaxies as the quiescent galaxies that once enter the candidate region





Rapidly quenched galaxies(RQG)

- 3646/5255 (~69%)
- 54% of the mass growth of the red sequence
- The importance of the rapidly quenching route decreases with the stellar masses of the quiescent galaxies.
- The mass function of the **box** defined RQG overall matches that of the **SFH** defined RQG



Summary

- There are different pathways to quench galaxies: fast route and others.
- We apply the super-colour analysis (SCA) to the mock mock multi-wavelength photometry data of Simba galaxies.
- Combined with the SFHs, we find an interesting region in the super-colour parameter space, in which all the quiescent galaxies are rapidly quenched.
- By defining fast quenched galaxies as the quiescent galaxies that once enter the candidate region, we find 69% quiescent galaxies are fast quenched at z=0.5, contributing about 54% to the mass growth of the red sequence.
- The importance of the fast quenching route decreases with the stellar masses of the quiescent galaxies.

Thank you!