Pathways to quench galaxies in SIMBA cosmological simulation and observations

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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. ($\tau_q/t_H$)
SIMBA simulation & quenching timescale

SIMBA cosmological simulation
- box size: $100 \, h^{-1} \, \text{Mpc}$
- 1024 baryon elements + 1024 DM particles

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

- SF threshold: $\text{sSFR}(z) > 1/t_H(z)$
- quiescent threshold: $\text{sSFR}(z) < 0.2/t_H(z)$
- time that galaxies taken to cross two thresholds, scaled to the age of uni. $(\tau_q/t_H)$
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
Super-colour analysis (SCA) — mock observations and analysis

Combined with the quenching timescales measured with SFHs
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.
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!