Quenching of Centrals

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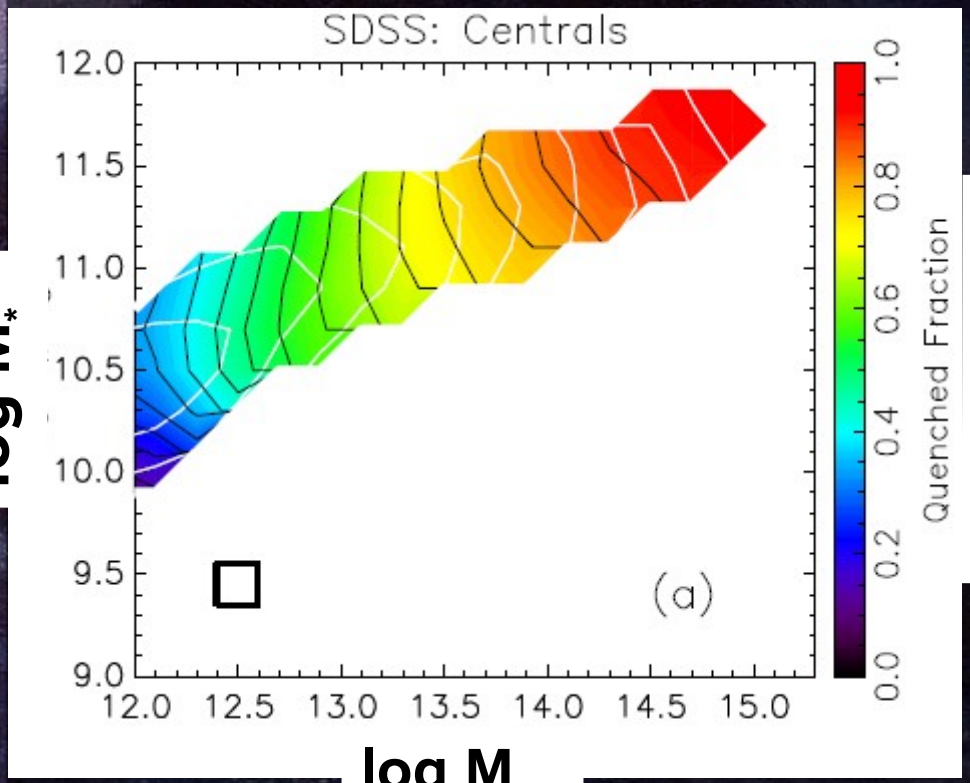
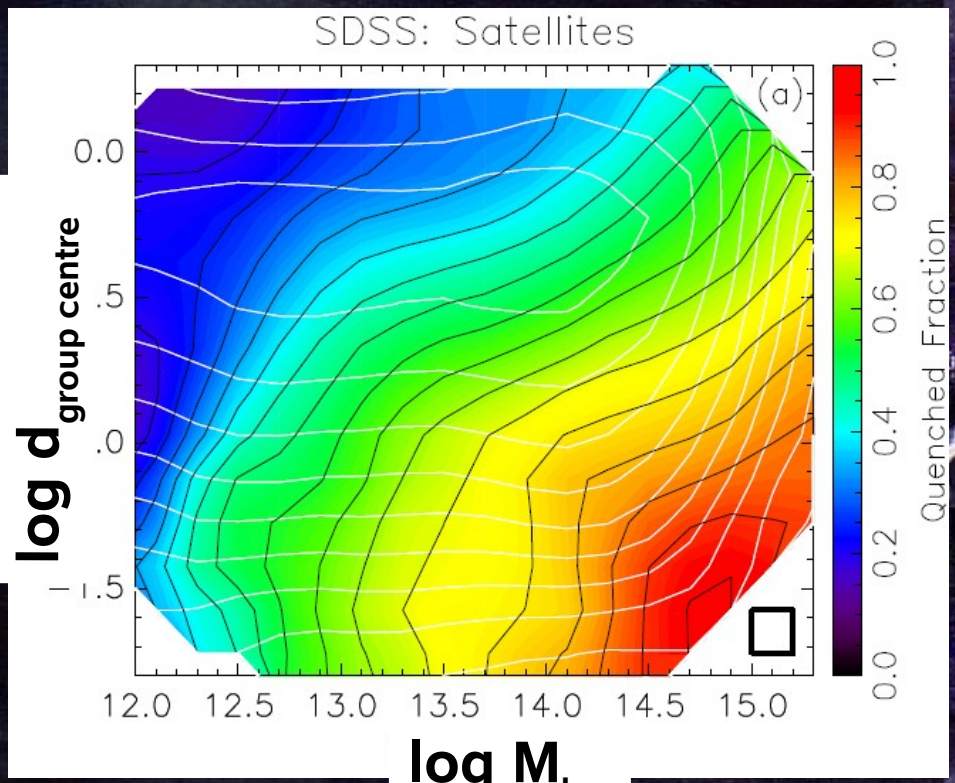
Quenching and Halo Mass

- The fraction of quenched centrals increases with M_h at fixed M_*

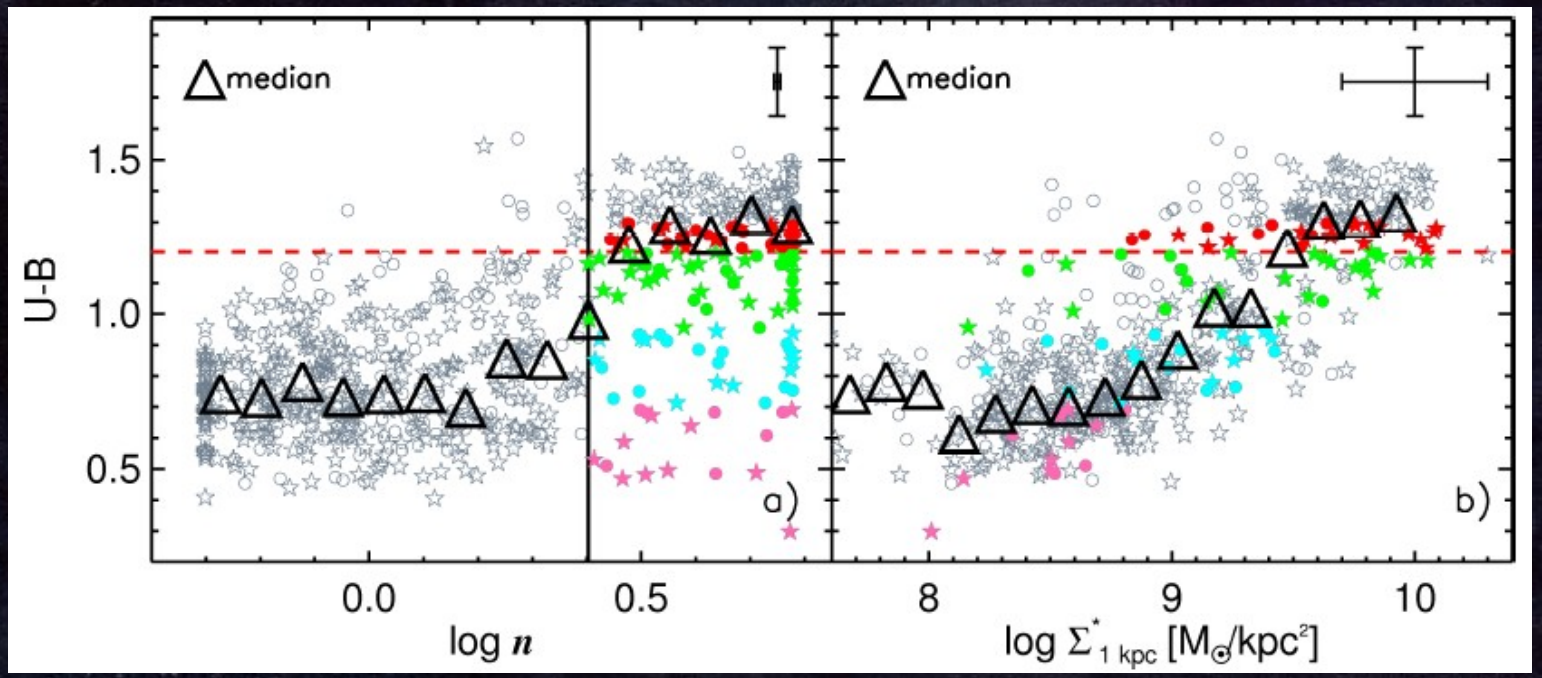




Woo, Dekel, Faber, Koo et al (2012)

Quenching and Galactic Structure

- Quenching also depends on inner structural/morphological properties (Cheung et al, Fang et al.: next two talks)



Cheung et al. (2012)

Questions

- What quenching mechanisms (halo/morphological properties) are important during which eras?
  - Specifically, how were today's quenched galaxies quenched (the last time) and when?
- Use the GalICS SAM (Hatton et al. 2003, Cattaneo et al. 2006, 2008)
  - implements quenching related to halo mass, structure (B/T) and gas exhaustion independently
- We can test the model's predictions by looking at the properties of *transitioning* galaxies

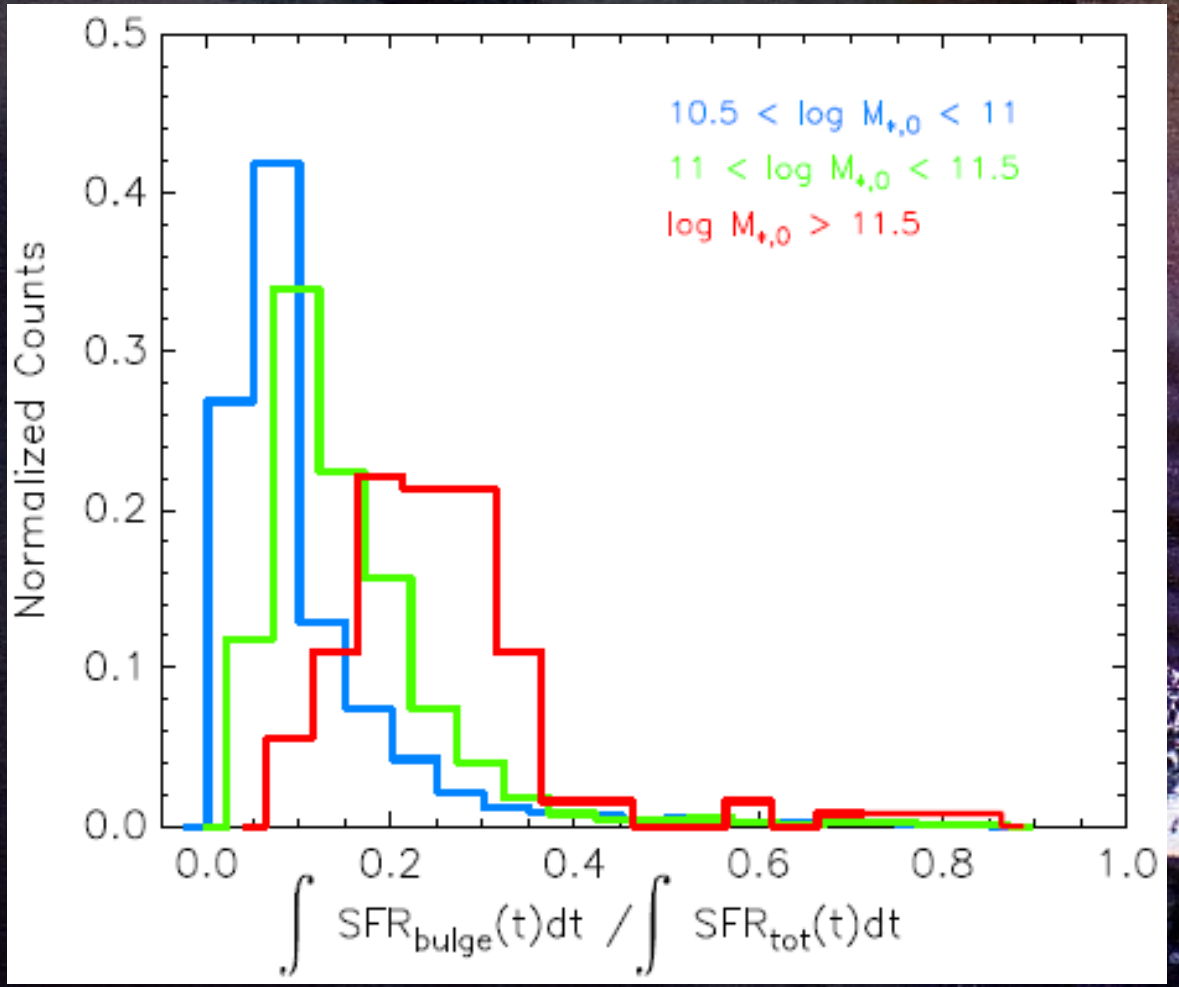
GalICS: Disc Formation

- baryons cool onto disc until DM halo reaches M_{crit}
- SF activated when $\Sigma_{gas} > 20\ m_p\ cm^{-2}$ (fit to the Kennicutt law)
- smooth gas accretion is the only mechanism by which disc acquires gas; disc SF is stream-fed
- light, dust, metals: STARDUST (Devriendt, Guiderdoni & Sadat 1999)

GalICS: Bulges

- Formed by two mechanisms:
- disc instabilities: mass transferred from disc to bulge in order to stabilize disc
  - SFR_{bulge} <= SFR_{disk} so that max(B/T) ~ 0.5
- mergers: fraction of disc mass that is transferred to bulge $\propto$ merger ratio
  - big bulges are linked to major mergers (only way to get B/T ~ 1)

- Most of the star formation in massive red galaxies is predicted to form in the disc (stream-fed SF) rather than added through mergers



Cattaneo, Woo, Dekel, Faber (2012)

GalICS: Sources of Quenching

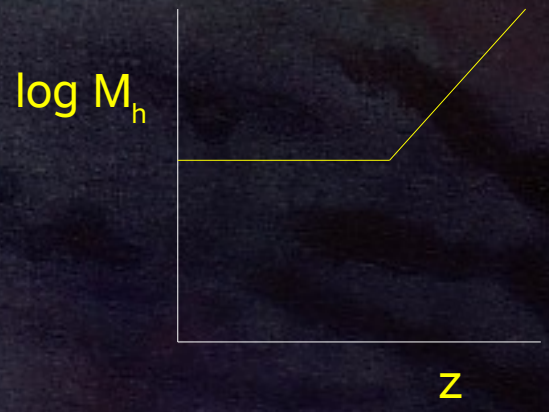
- 3 implementations:
  - Halo quenching:

    SFR=0 (cold gas removed) when M_h reaches M_{crit}

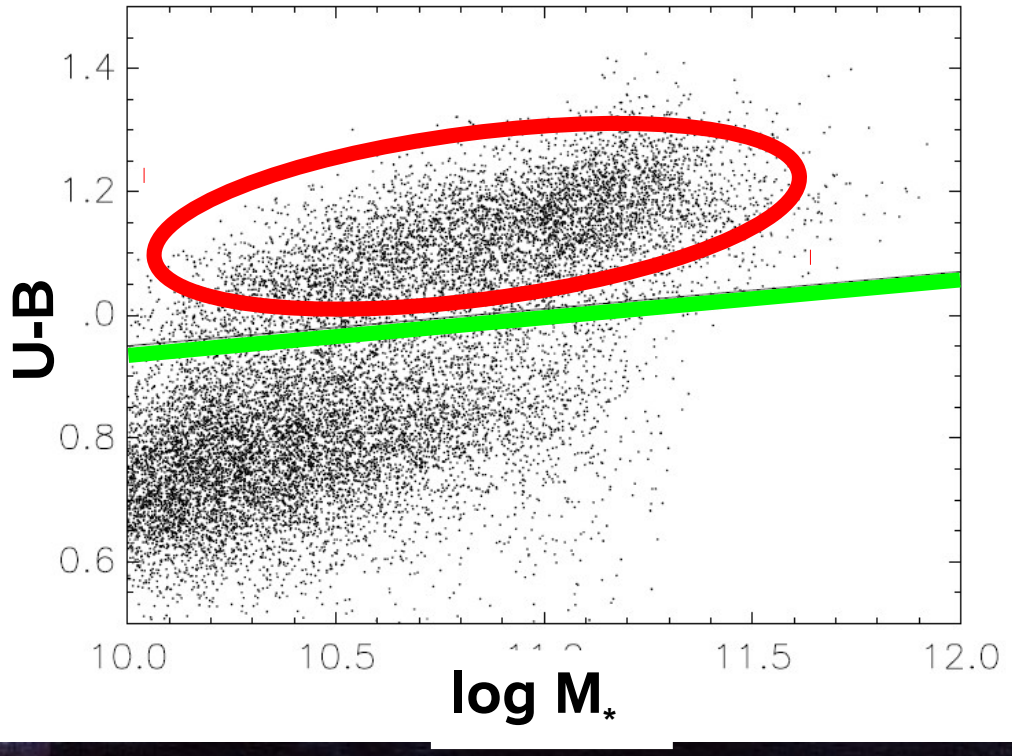
    - virial shock heating
  - Bulge quenching:

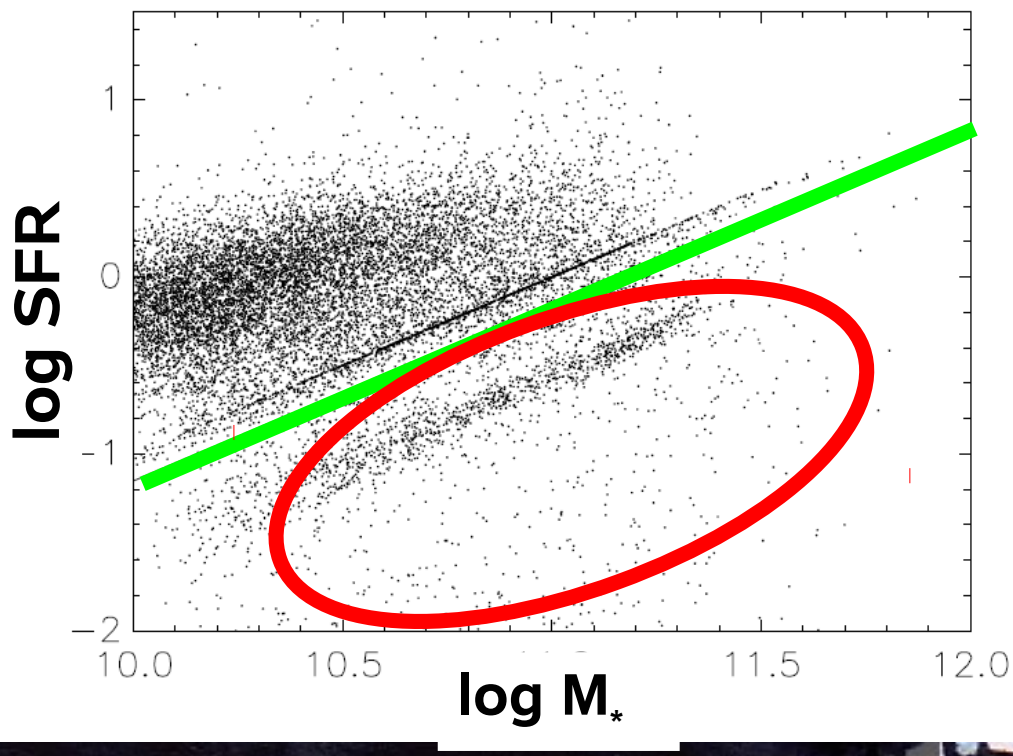
    accretion = 0 when $M_{bulge} > M_{disc}$

    - mergers induce BH growth → AGN feedback
    - morphological quenching; bulge growth stabilizes disc → inhibits spiral arms formation where SFR happens
  - Fading: (gas exhaustion)
    - SF in the disc happens only when the cold gas density is greater than 20 H cm^{-2}



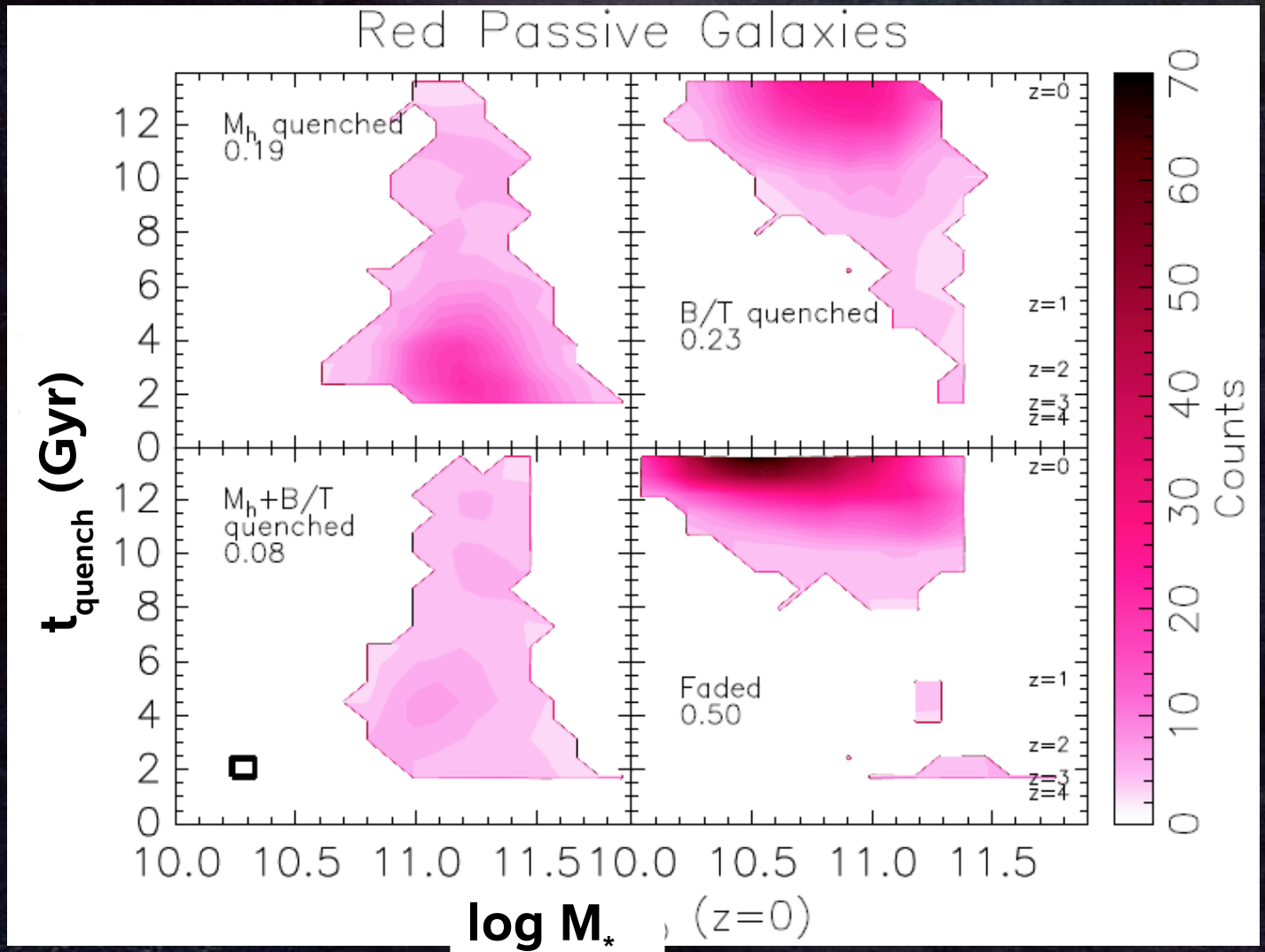
Definition of "Quenched"





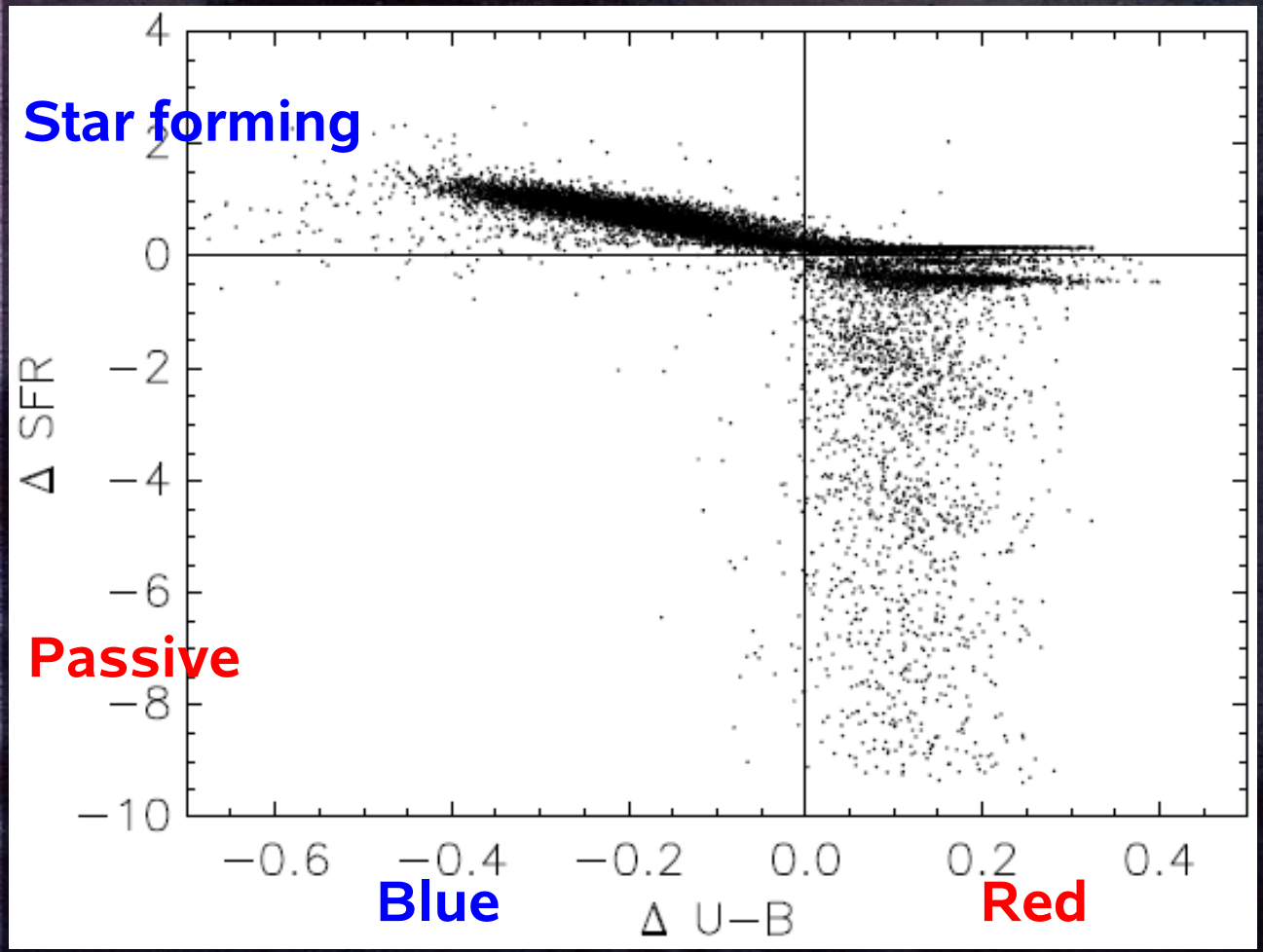
- Track their main progenitors to the LAST time they were blue and star-forming
  - see if $M_h > M_{crit}$ or B/T > 0.5 or neither (faded)

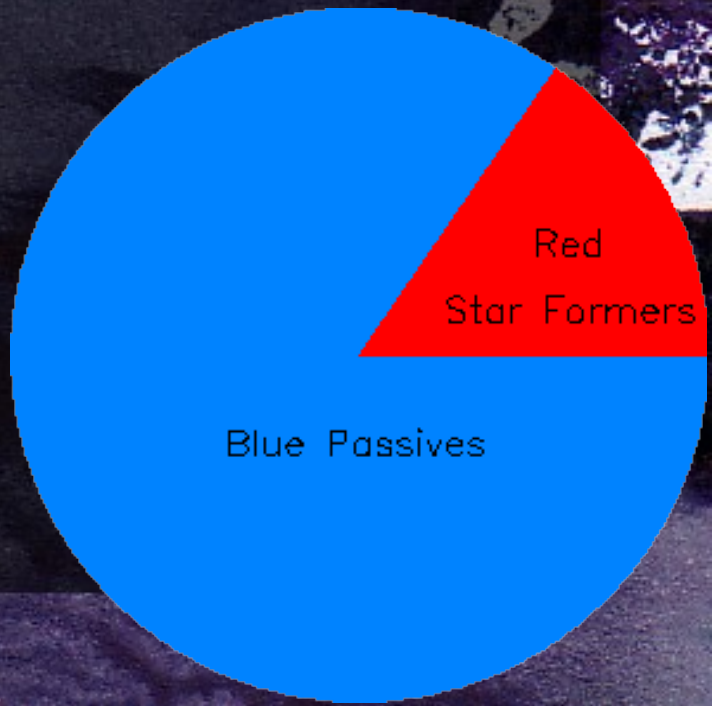
Quenching mechanisms and eras



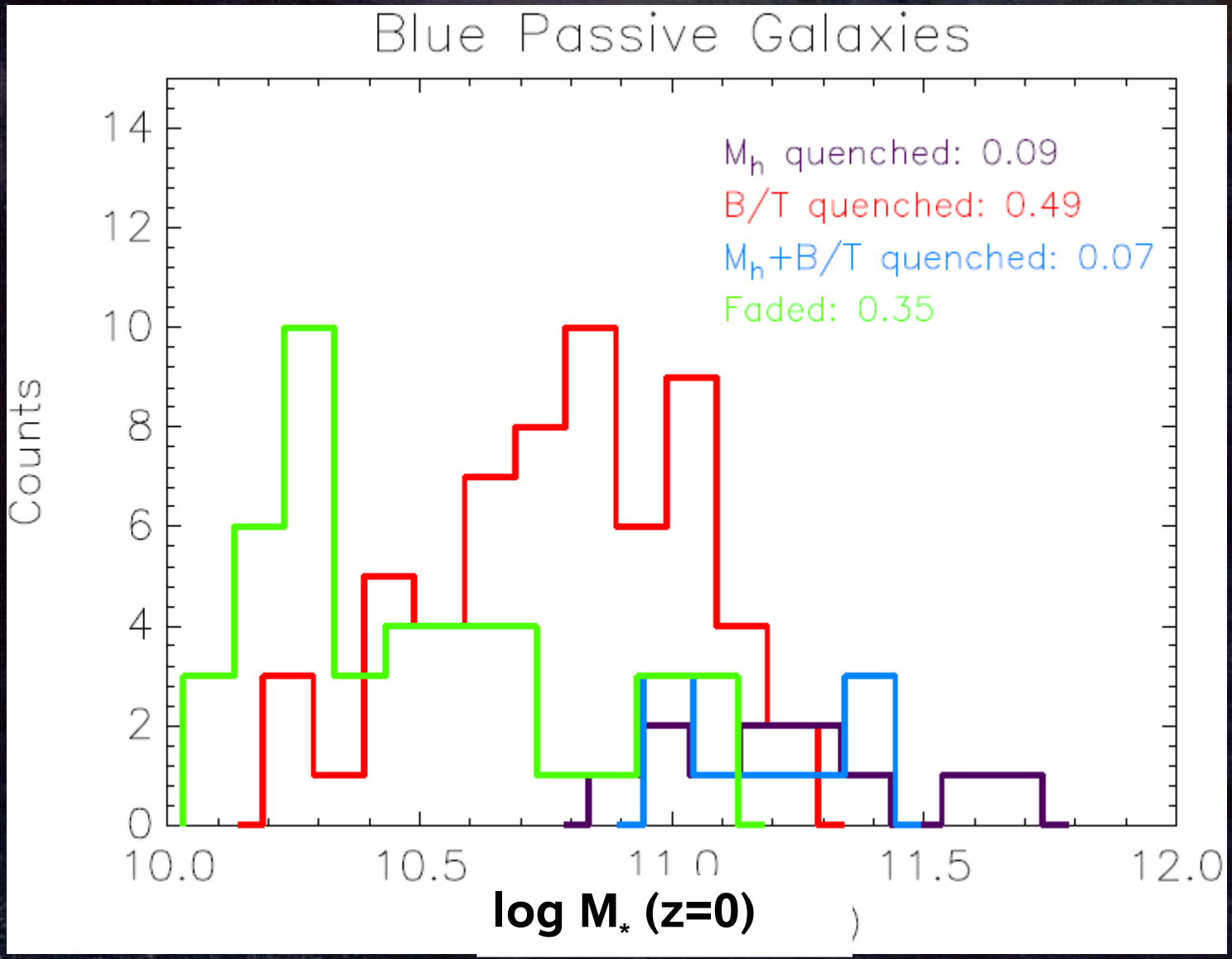
Woo et al, in prep. (see also Cattaneo et al. 2008)

Transitioning Galaxies in GallCS



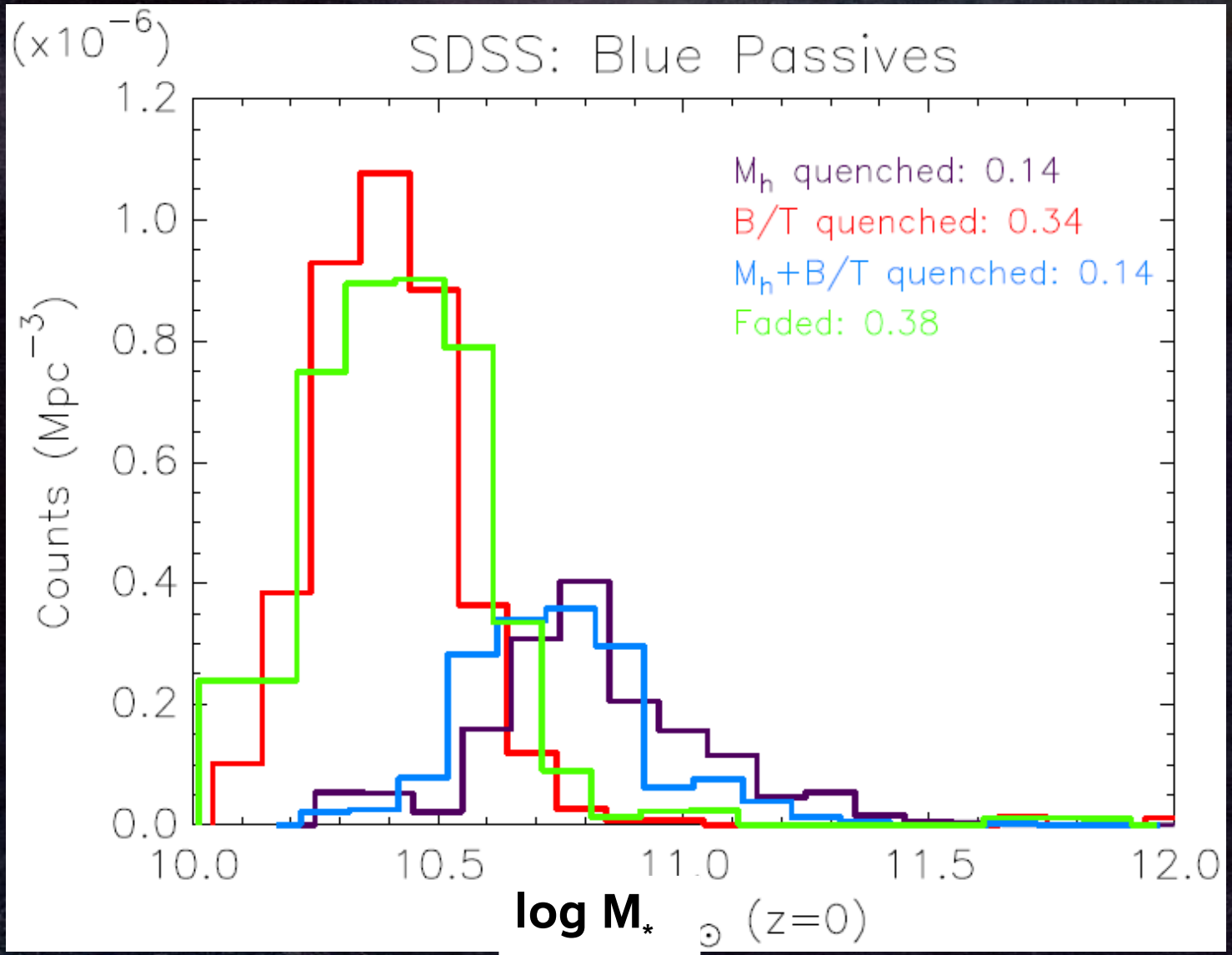


Blue Passives in GalICS at z=0



Woo et al, in prep

Blue Passives in SDSS



Woo et al, in prep

Summary

- GallCS predicts that
  - massive quenched galaxies likely experienced halo quenching and likely at high z
  - less massive quenched galaxies likely faded or experienced B/T-related quenching, and at low z
- Can test these predictions by looking at transitioning galaxies
  - GallCS predicts that transitioning galaxies are blue passives
  - blue passives in the SDSS are mostly faded or B/T-quenched as predicted
  - but the masses of B/T quenched galaxies are higher than predicted
- What about blue passives at higher z? Stay tuned!