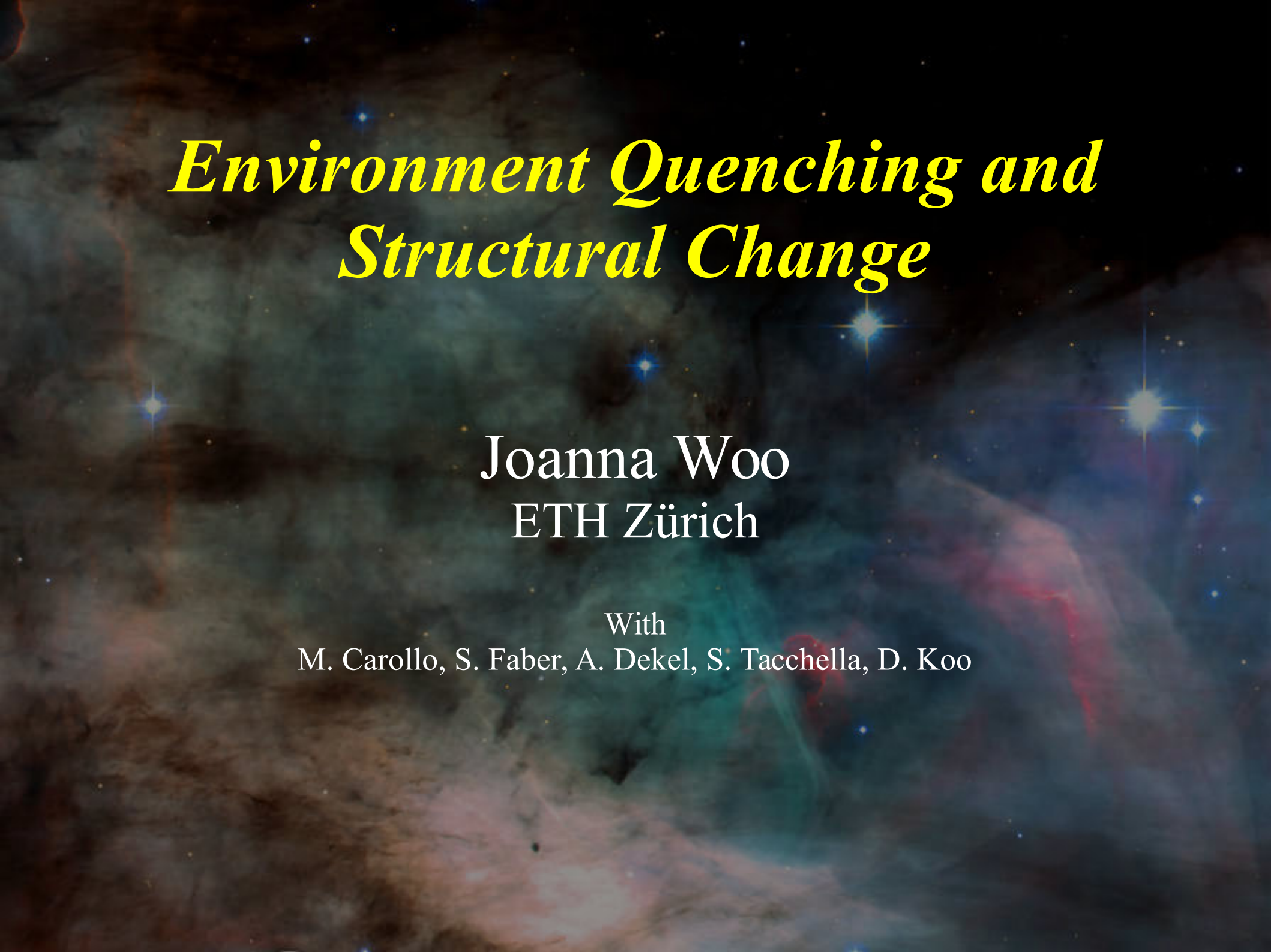


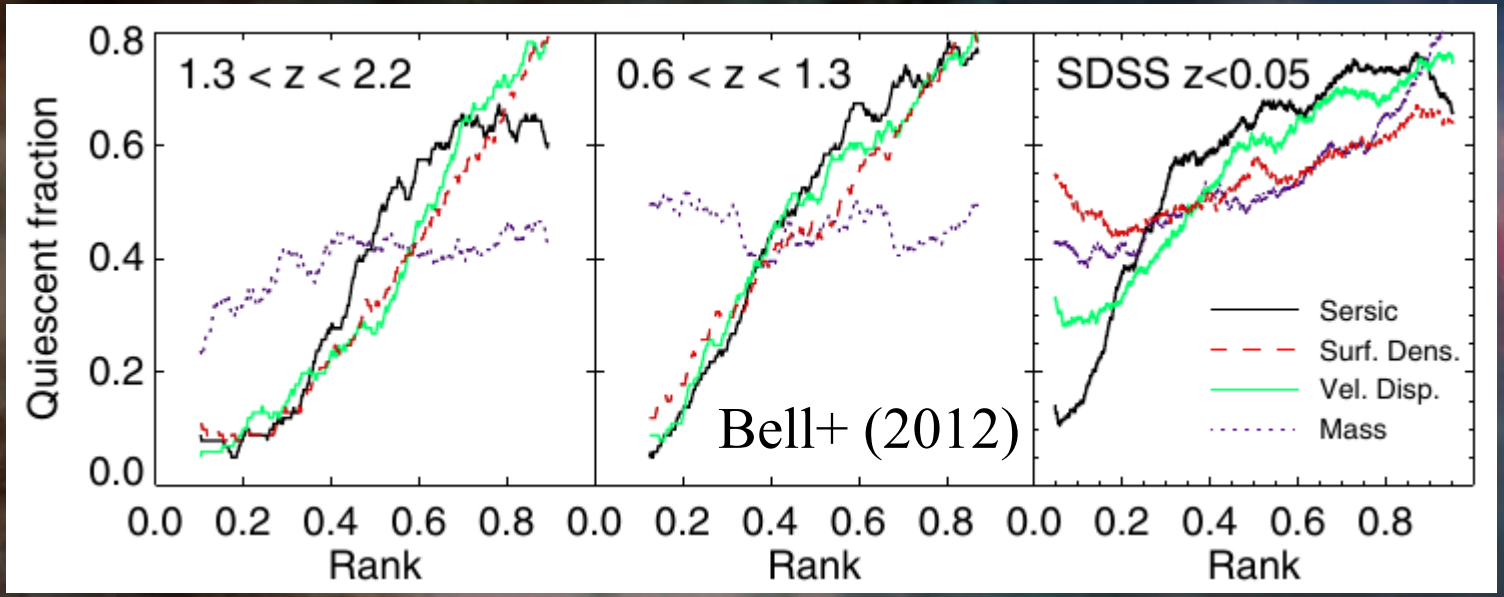
Environment Quenching and Structural Change

Joanna Woo
ETH Zürich

With
M. Carollo, S. Faber, A. Dekel, S. Tacchella, D. Koo

What we know about quenching so far

- Studies in quenching reveal correlations between:
  - Morphology and quenching



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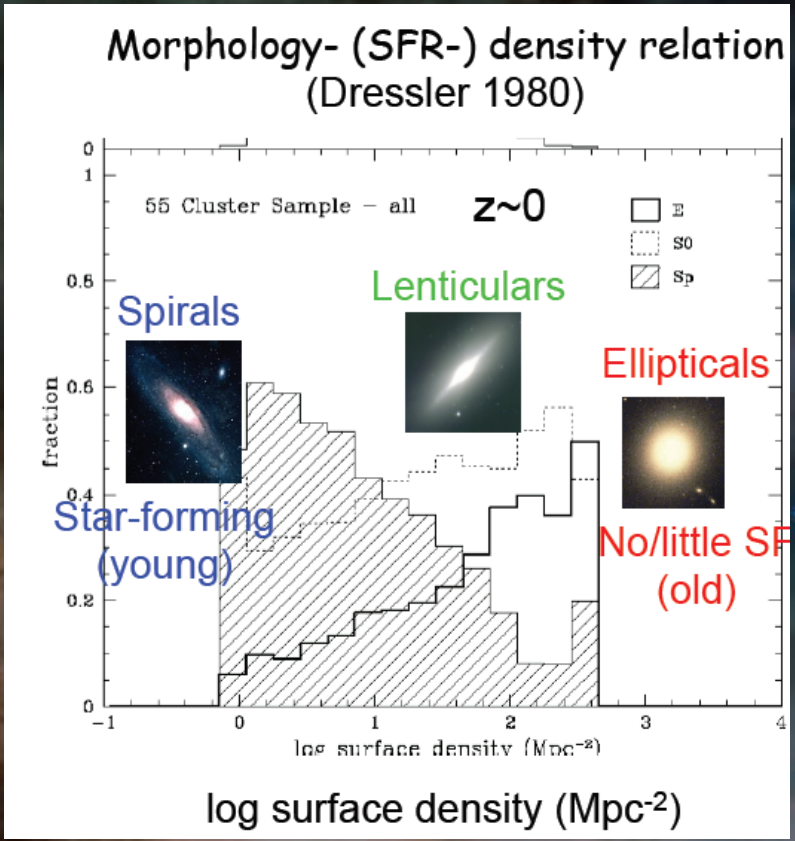
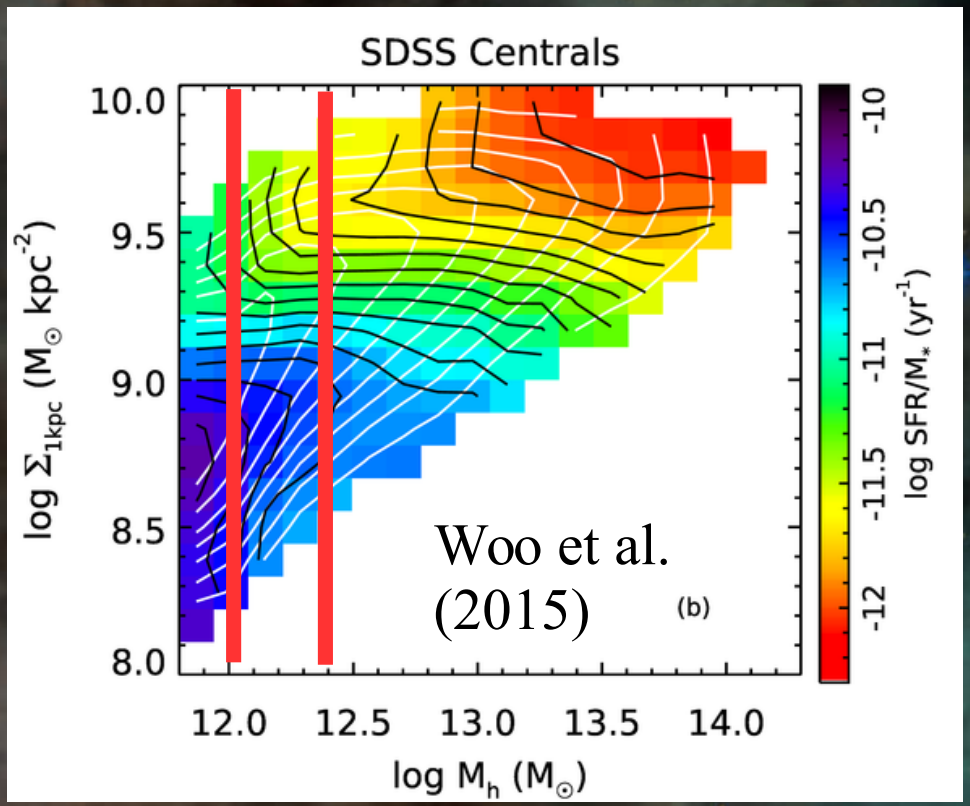
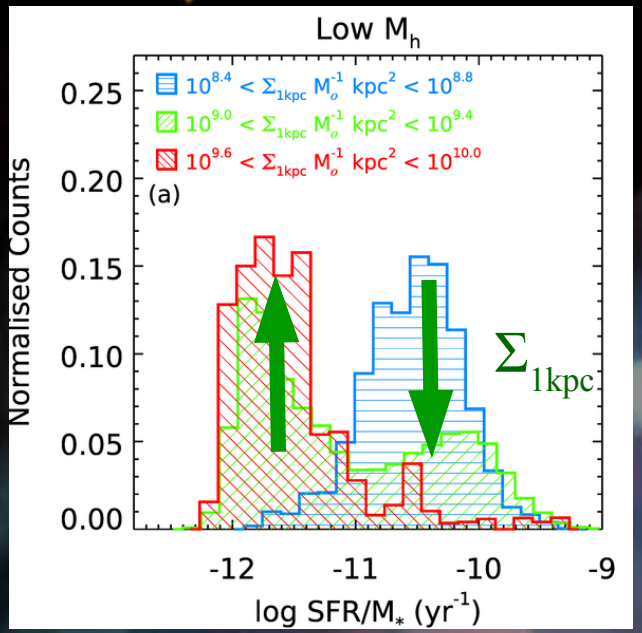


What we know about quenching so far

- Studies in quenching reveal correlations between:
  - Morphology and quenching
  - Morphology and environment
  - Environment (M_{halo}) and quenching

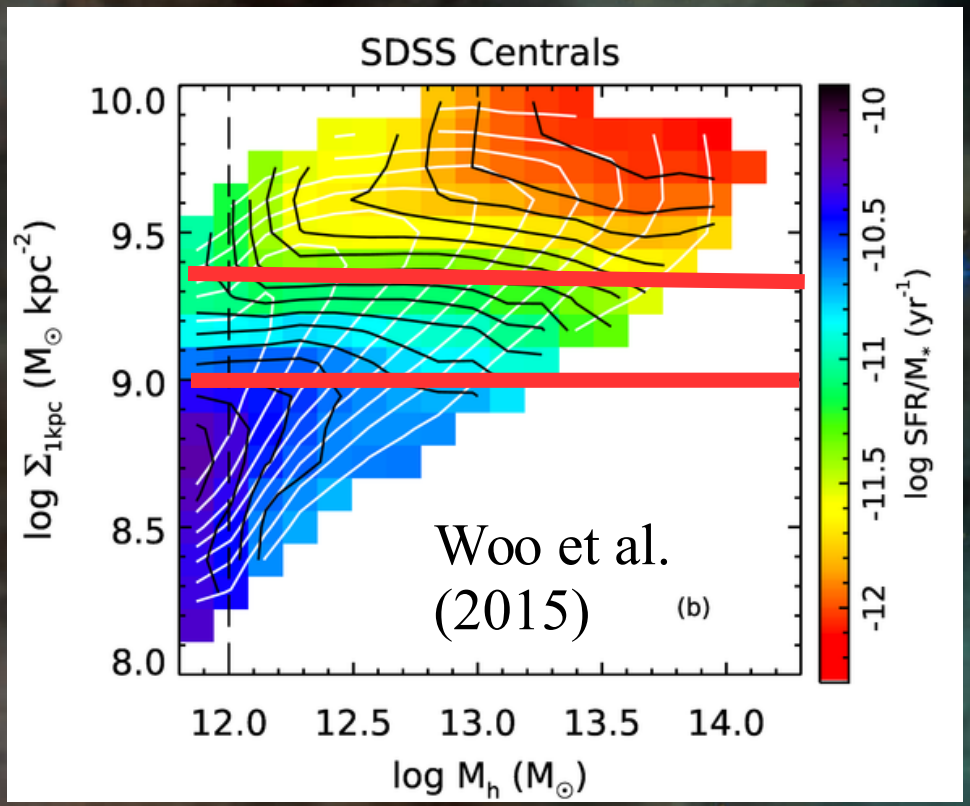
Morphology and Environment: Centrals

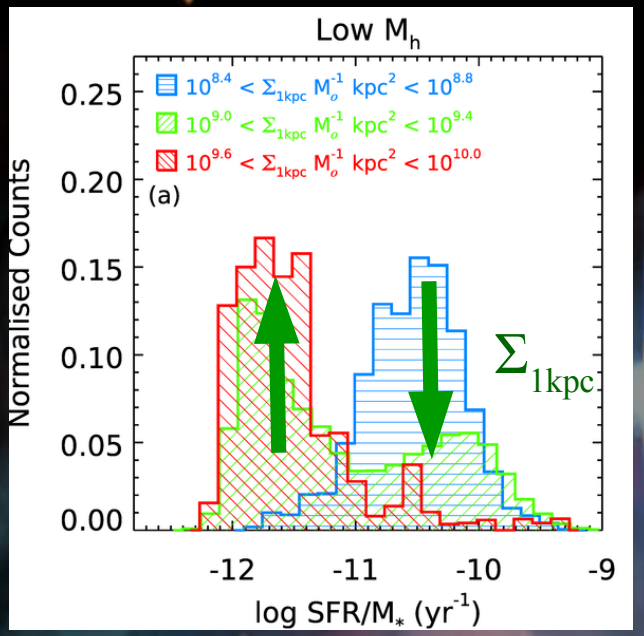


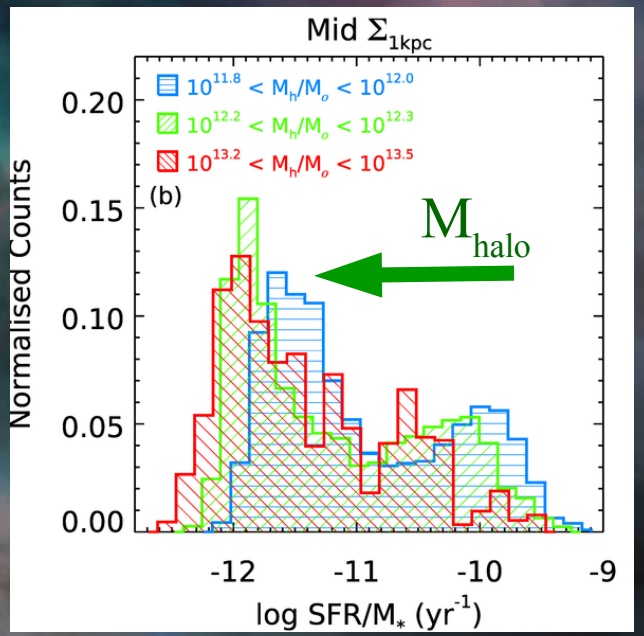


Both the halo and Σ_{1kpc} are *independently* correlated with central "quenching"

Morphology and Environment: Centrals







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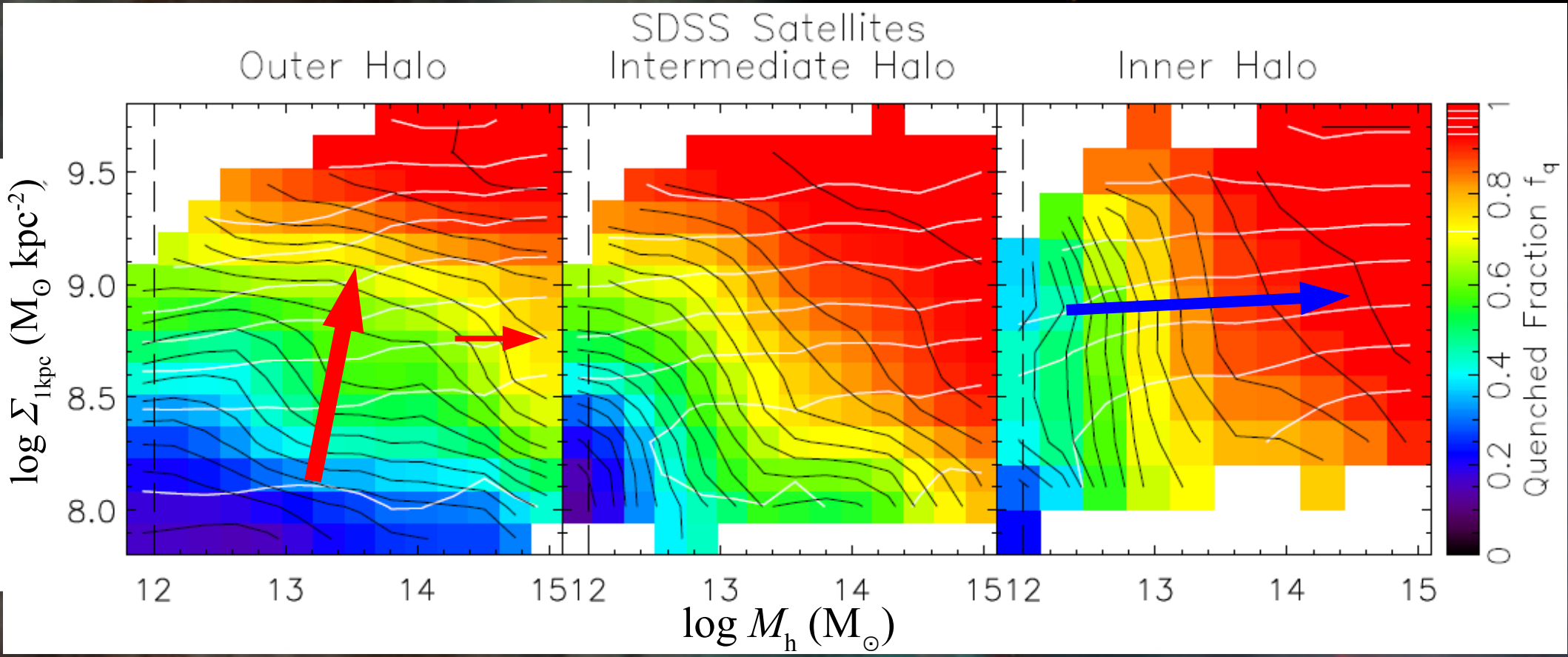
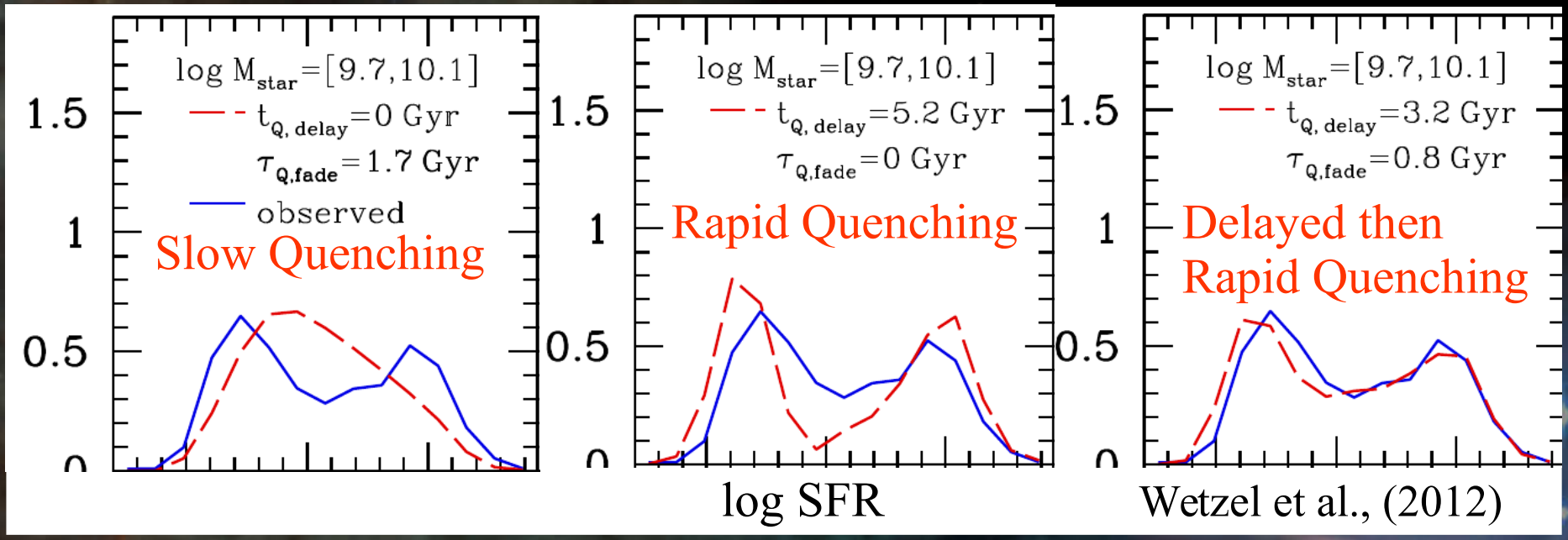
Morphology and Quenching: Satellites



Halo mass and Σ_{1kpc} are correlated with satellite quenching in different regions of the halo

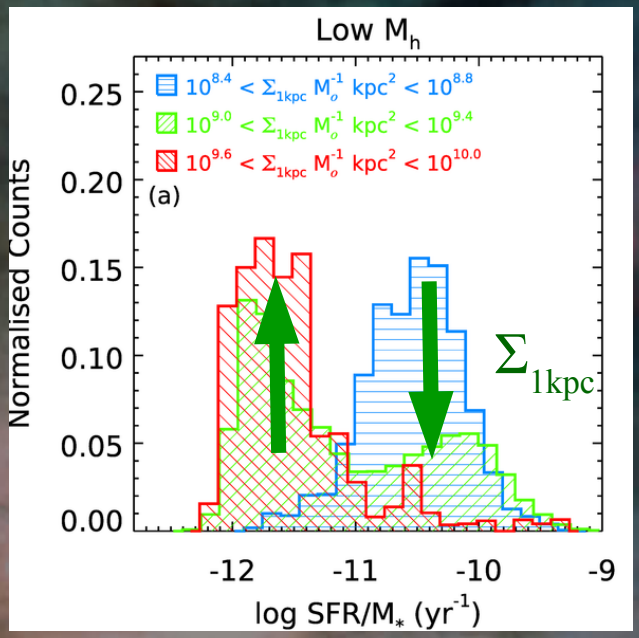
Woo et al., (2015)

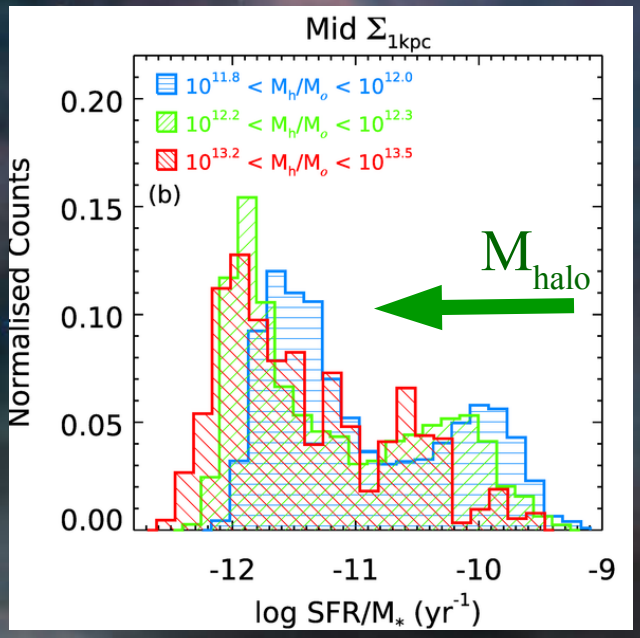
Satellites: Delayed-then-Rapid Quenching?



Delayed-then-rapid quenching not a unique solution

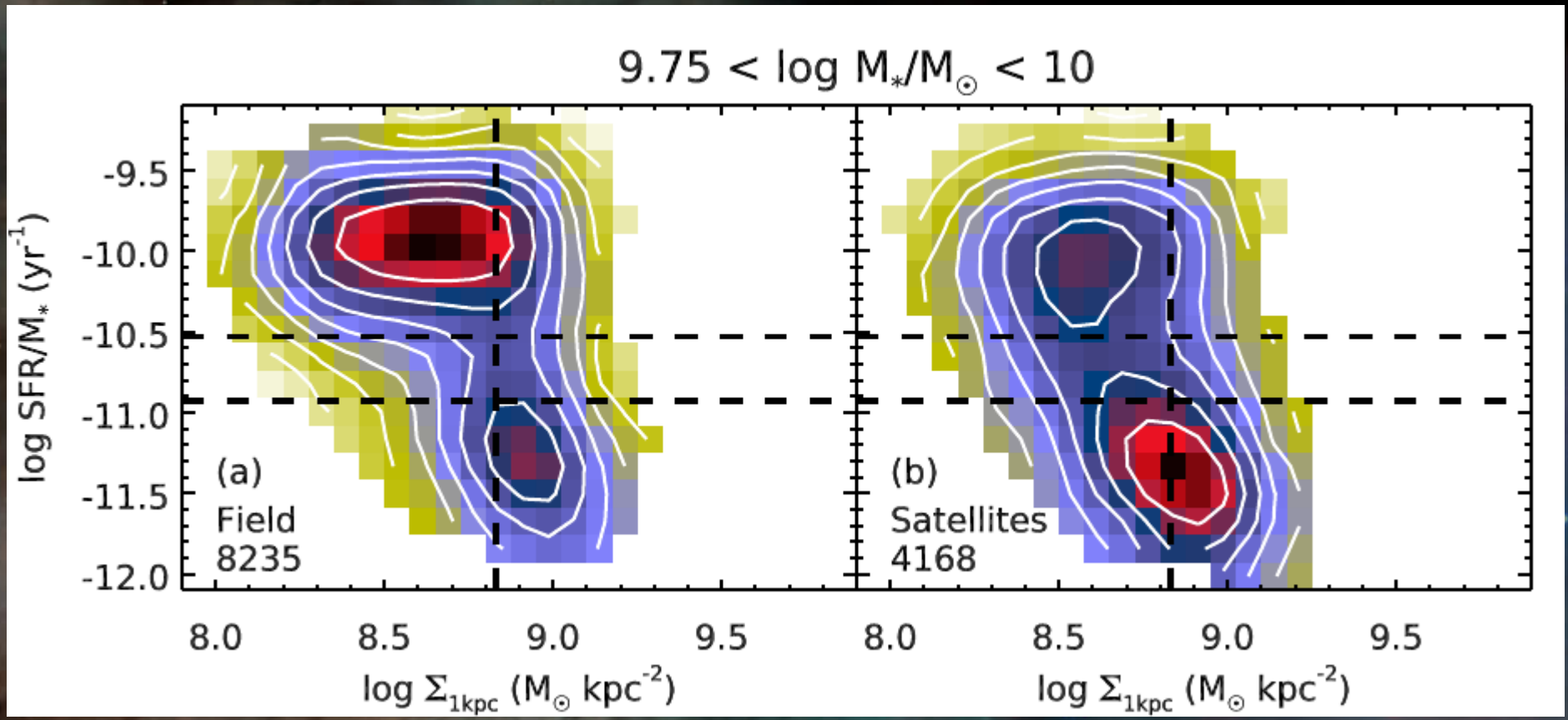
Alternatives:
- Slow + Fast quenching
- Early + Late quenching





Woo et al., (2015)

Morphology and Quenching: Satellites vs. the Field



Satellites occupy different regions of sSFR-Σ_{1kpc}

Woo et al., (2016) arXiv:1607.06091

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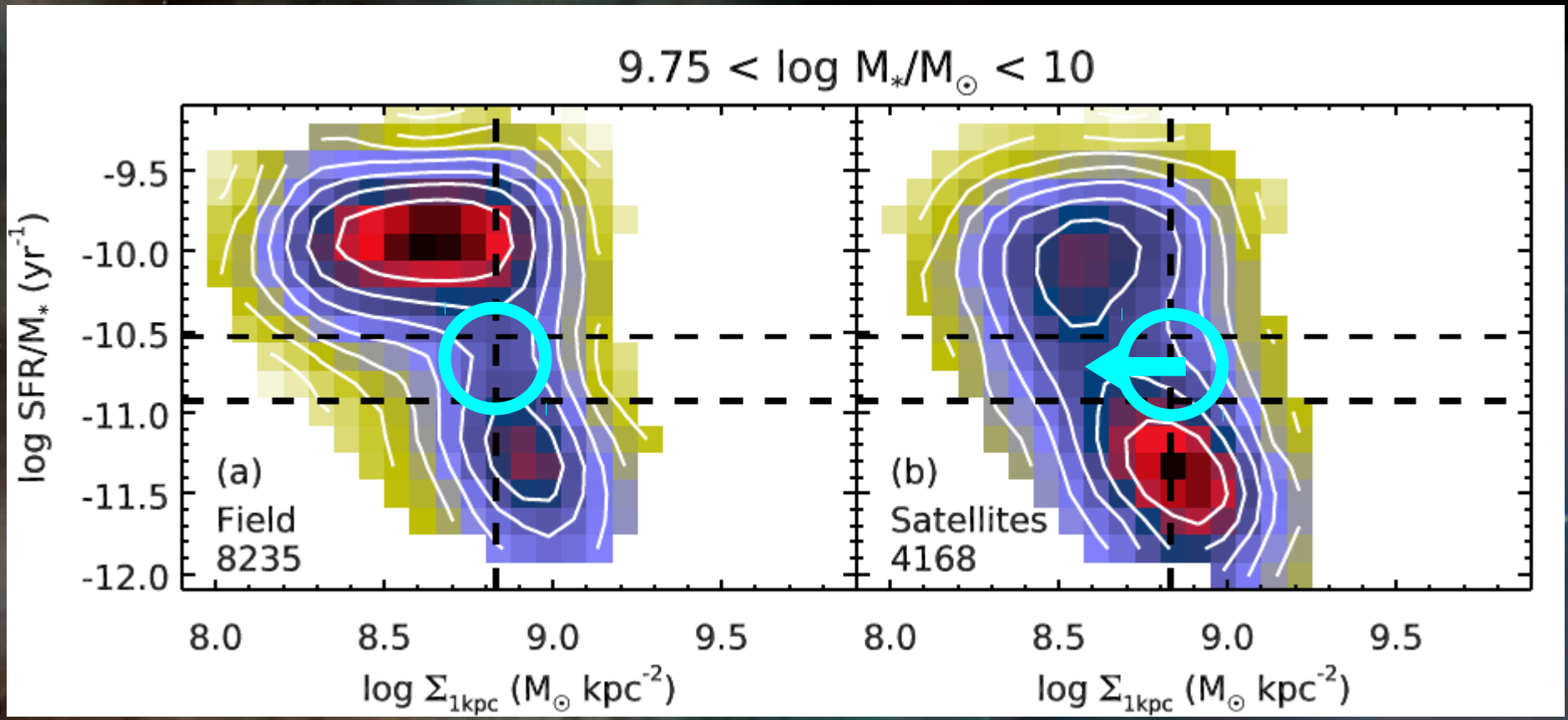

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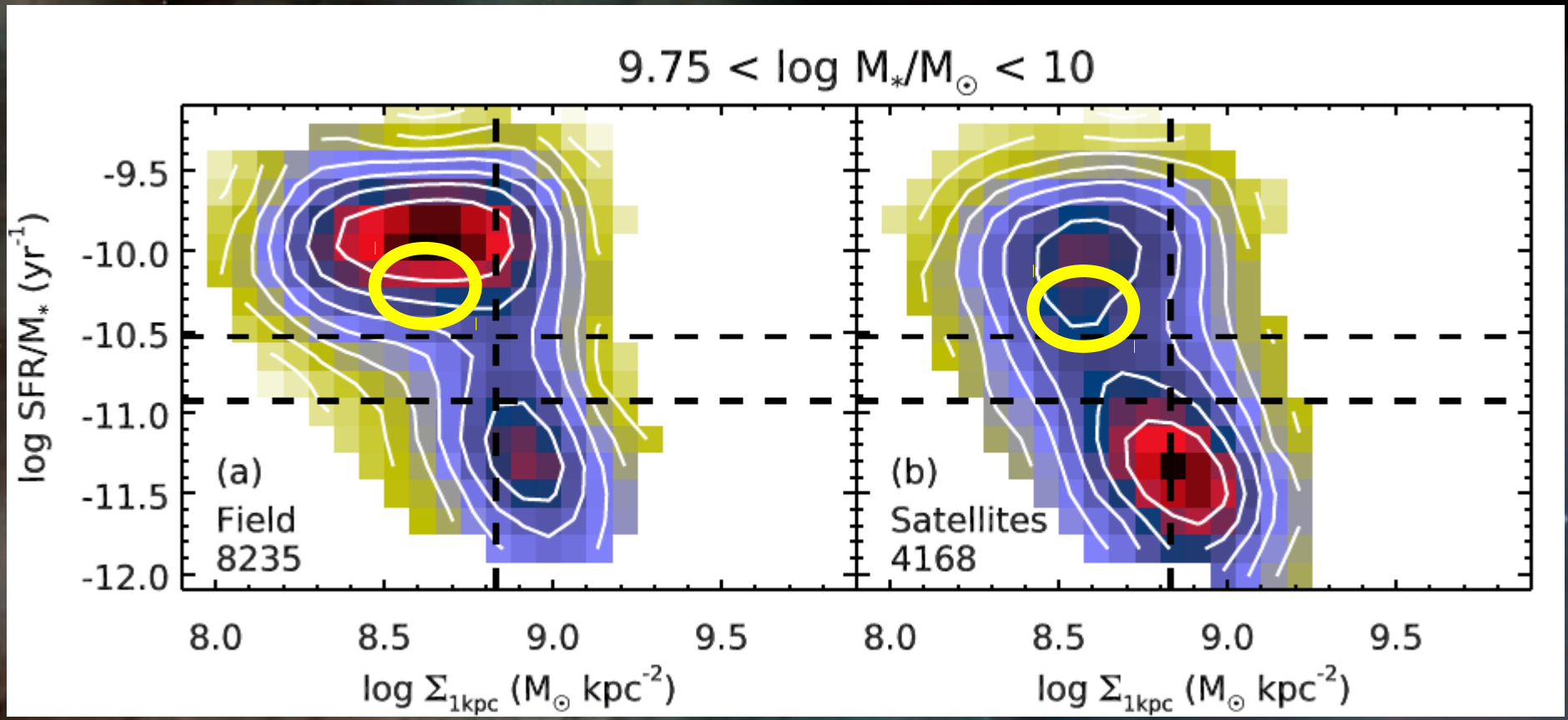

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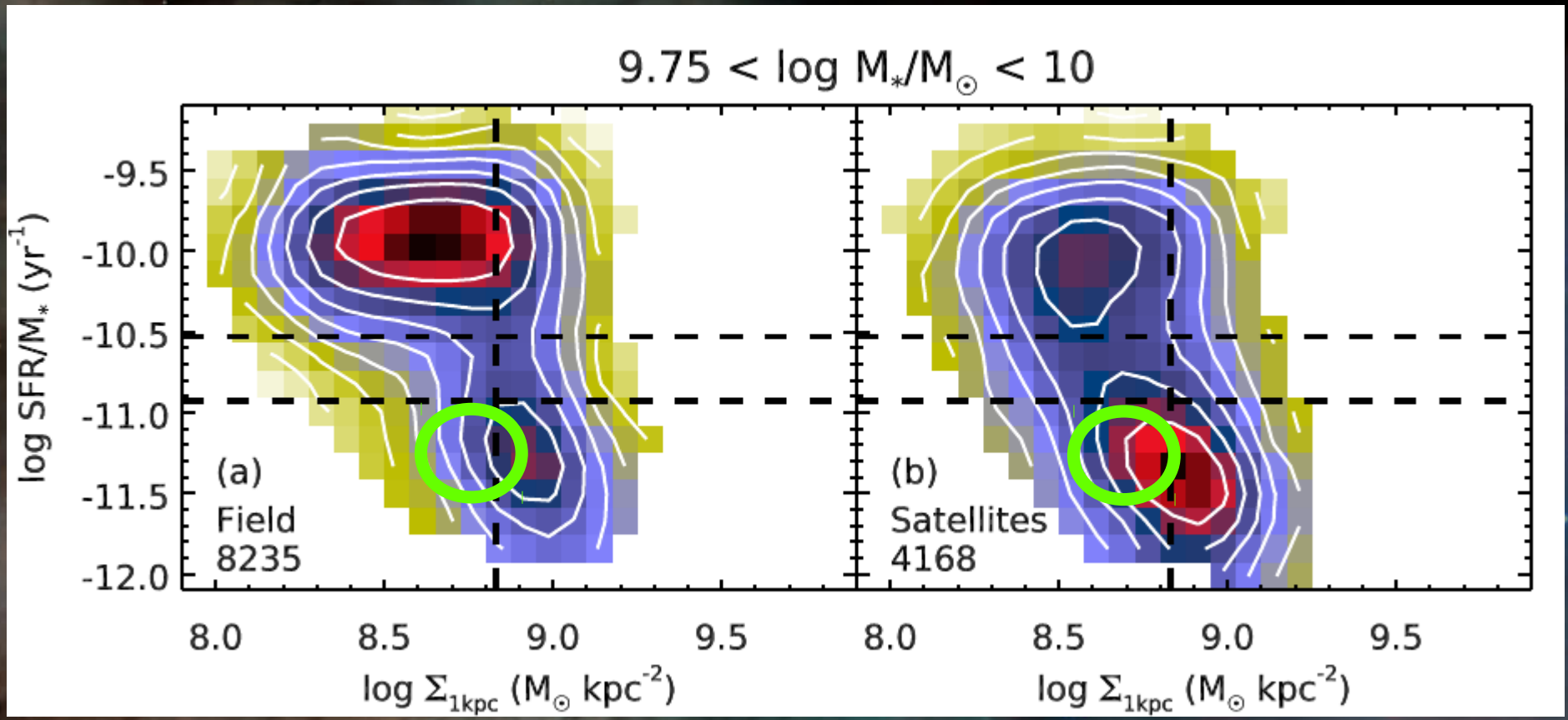

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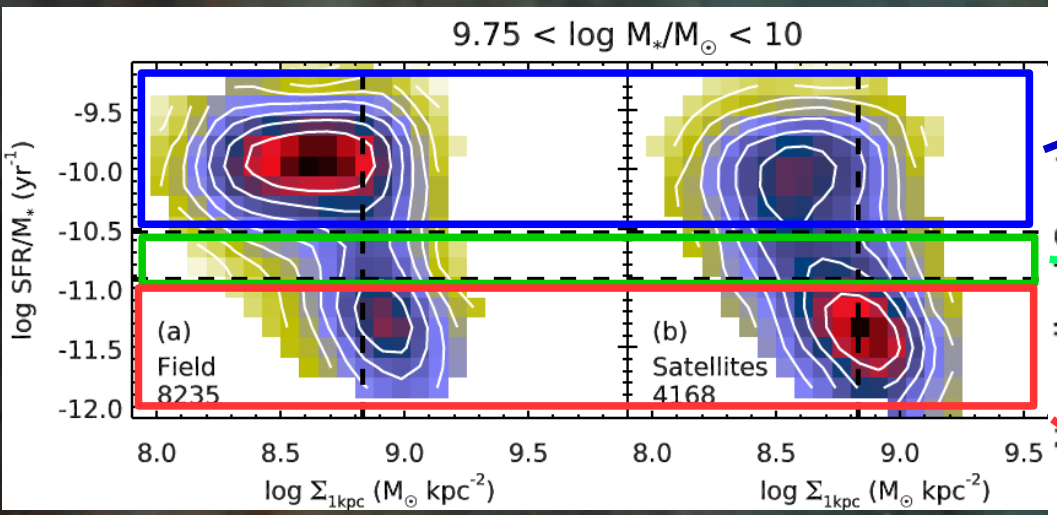
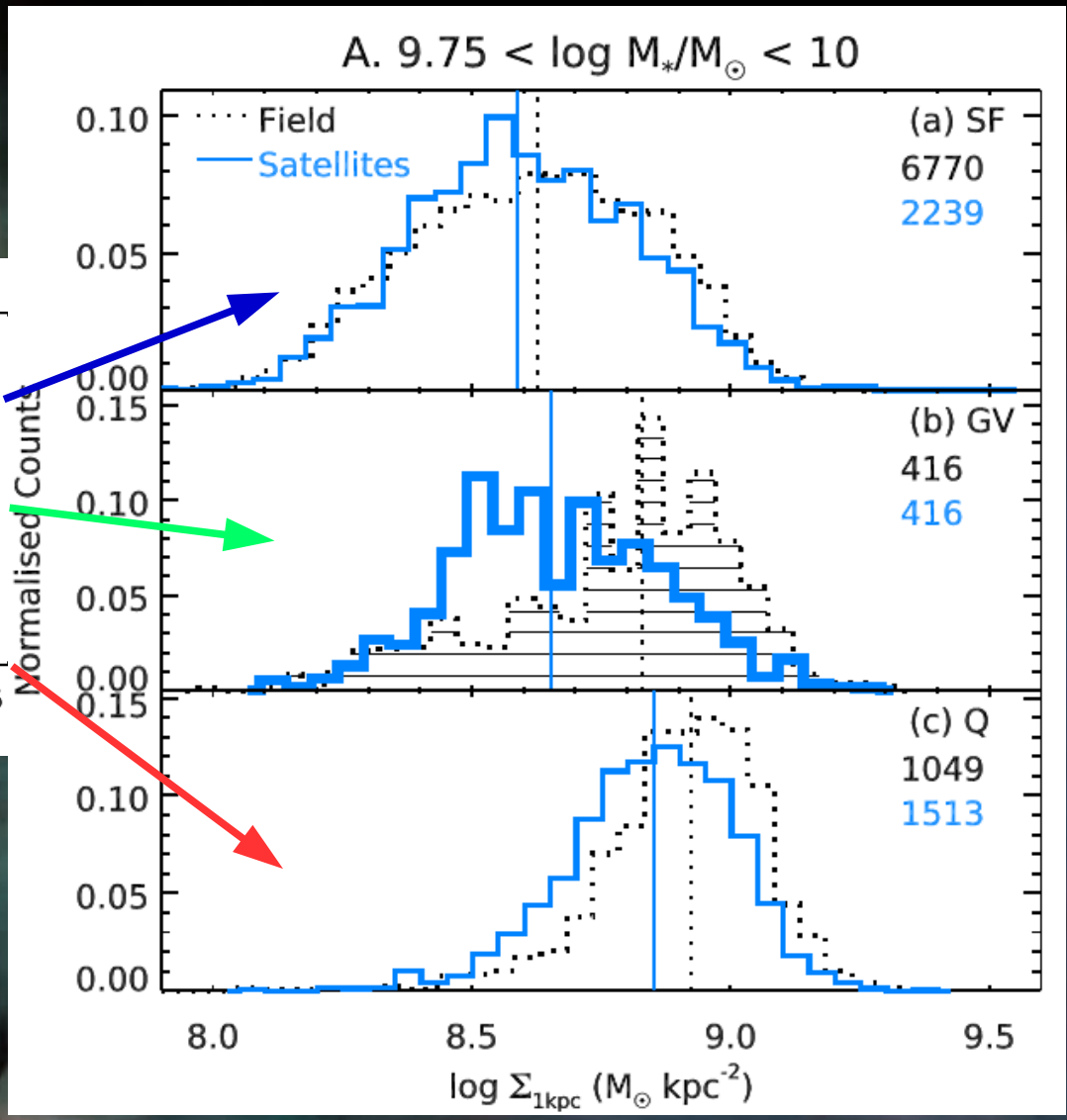
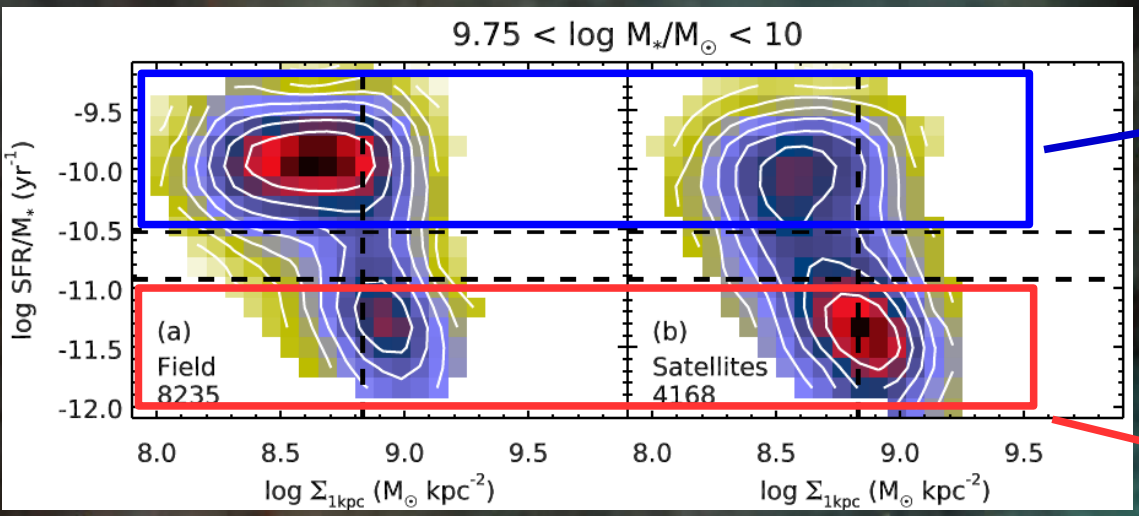
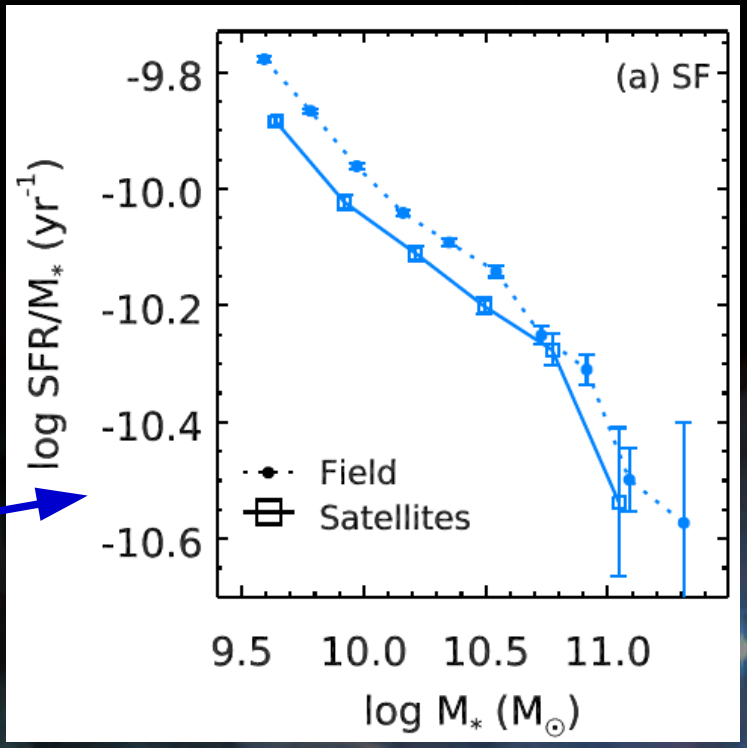


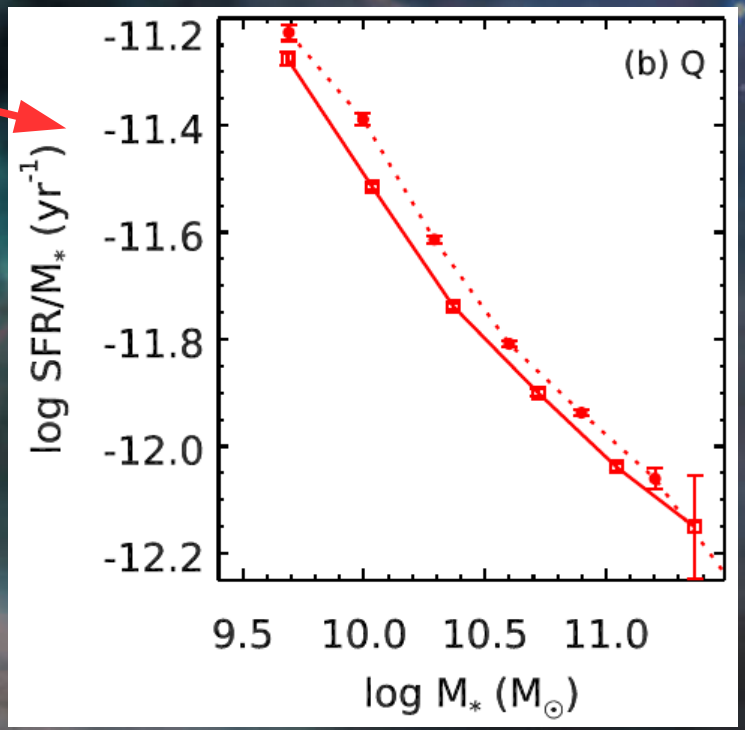


- GV of satellites:
  - Lower Σ_{1kpc} than GV of field
  - Similar range of Σ_{1kpc} as SF satellites
- Quenched satellites:
  - Slightly lower Σ_{1kpc} than quenched field
  - But still higher than Σ_{1kpc} of SF satellites

Woo et al., (2016) arXiv:1607.06091

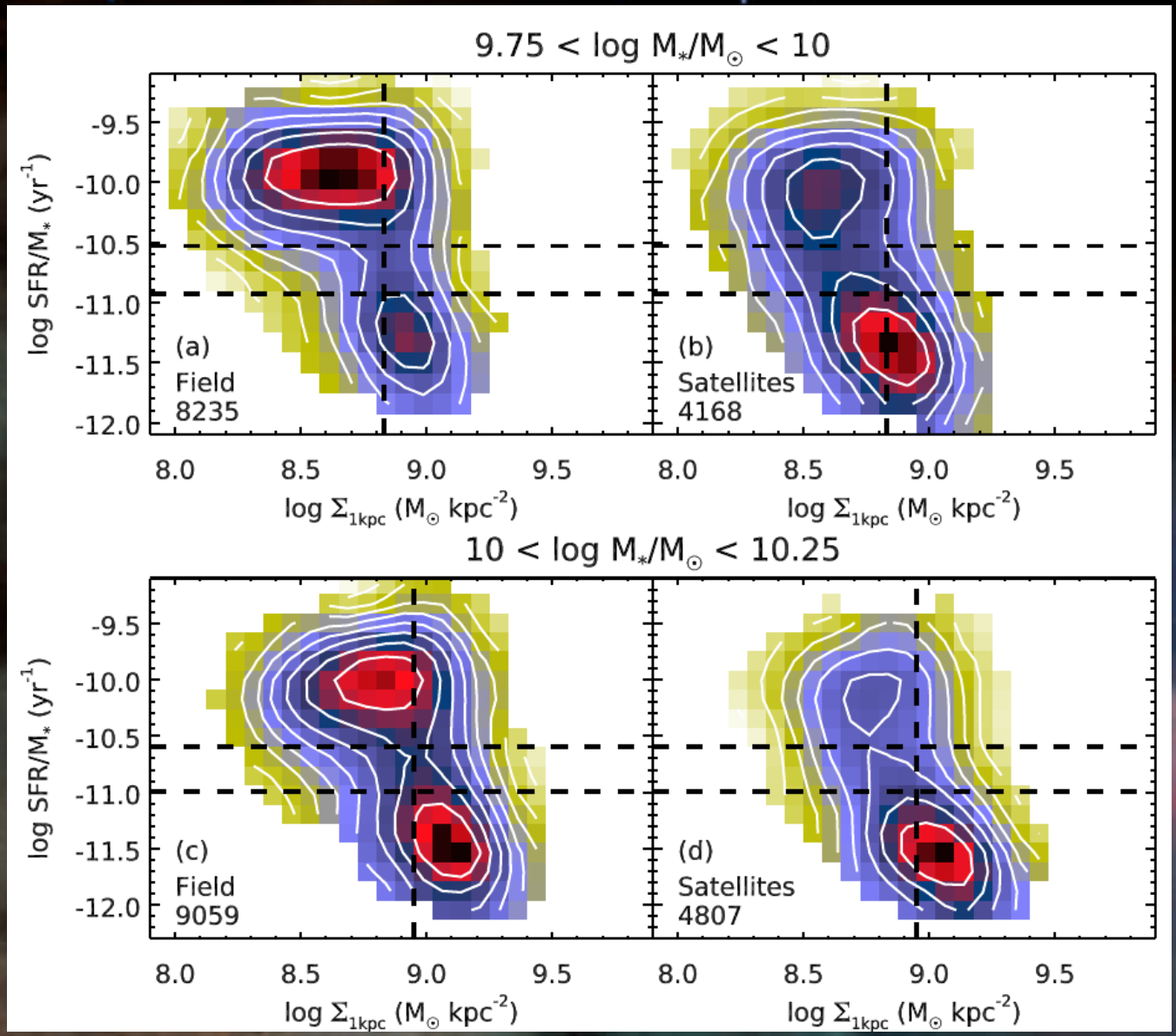






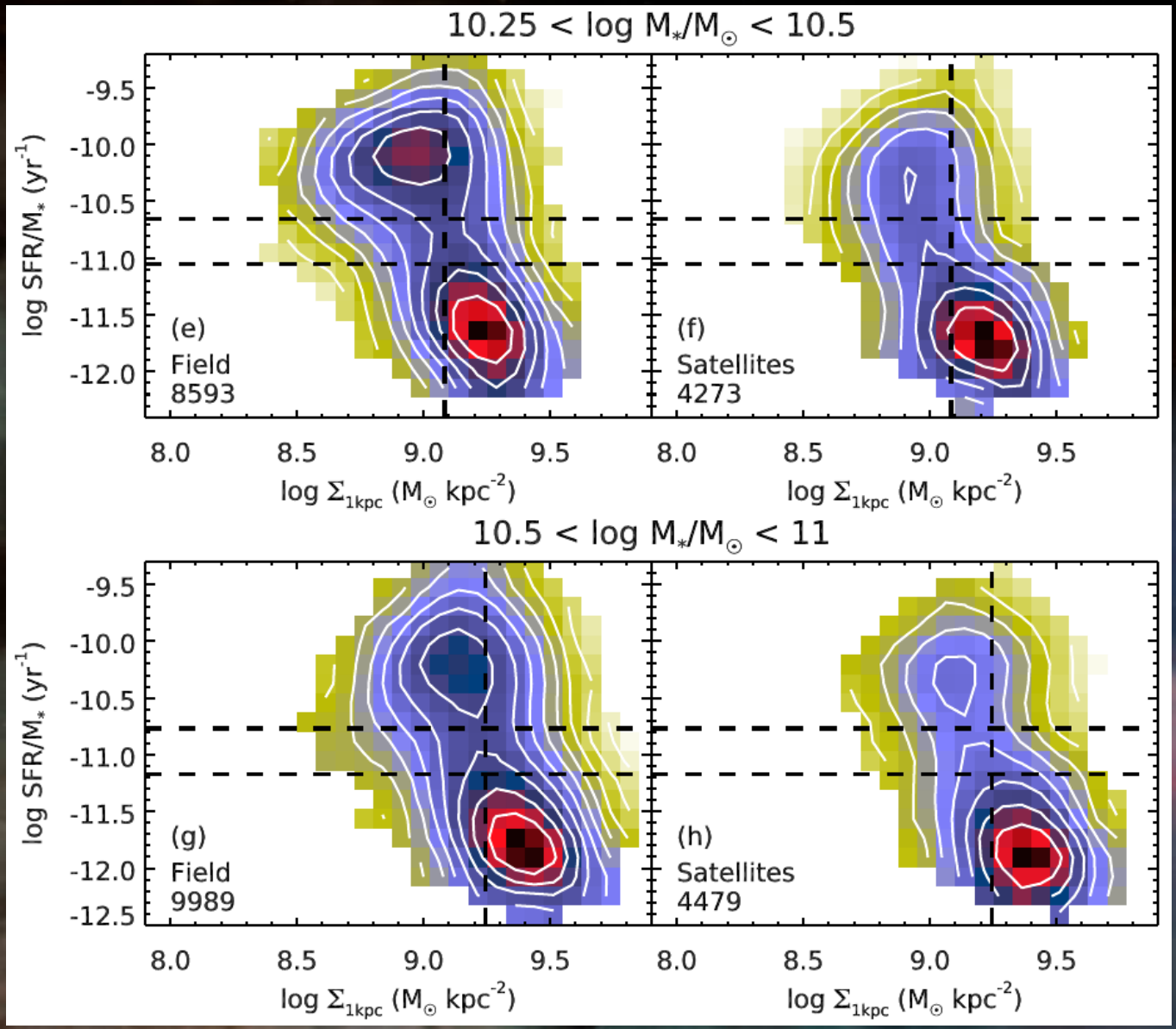
The main sequence of satellites is shifted compared to the field

Woo et al., (2016) arXiv:1607.06091



Differences in sSFR-Σ_{1kpc} decrease with M_*

Woo et al., (2016) arXiv:1607.06091



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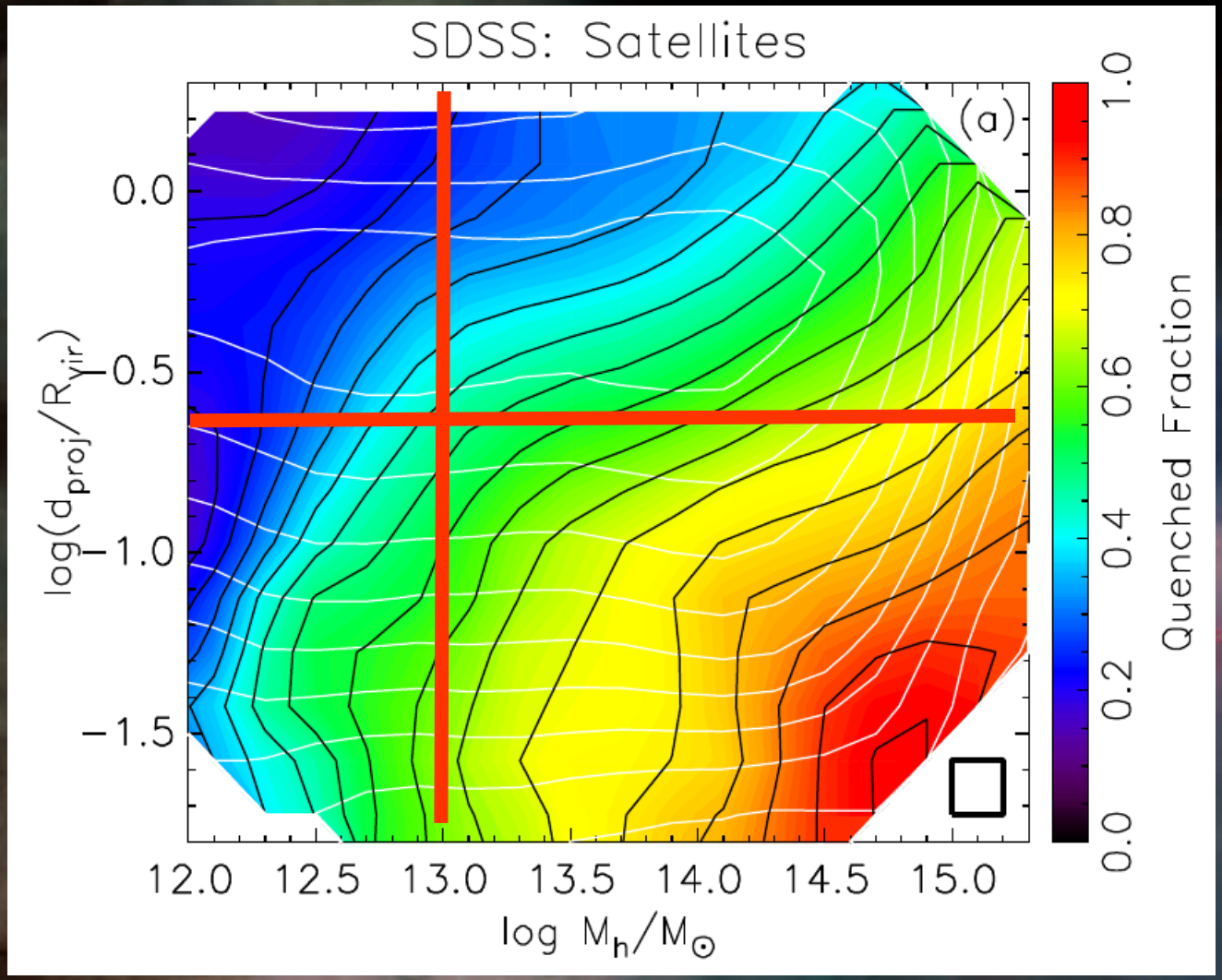
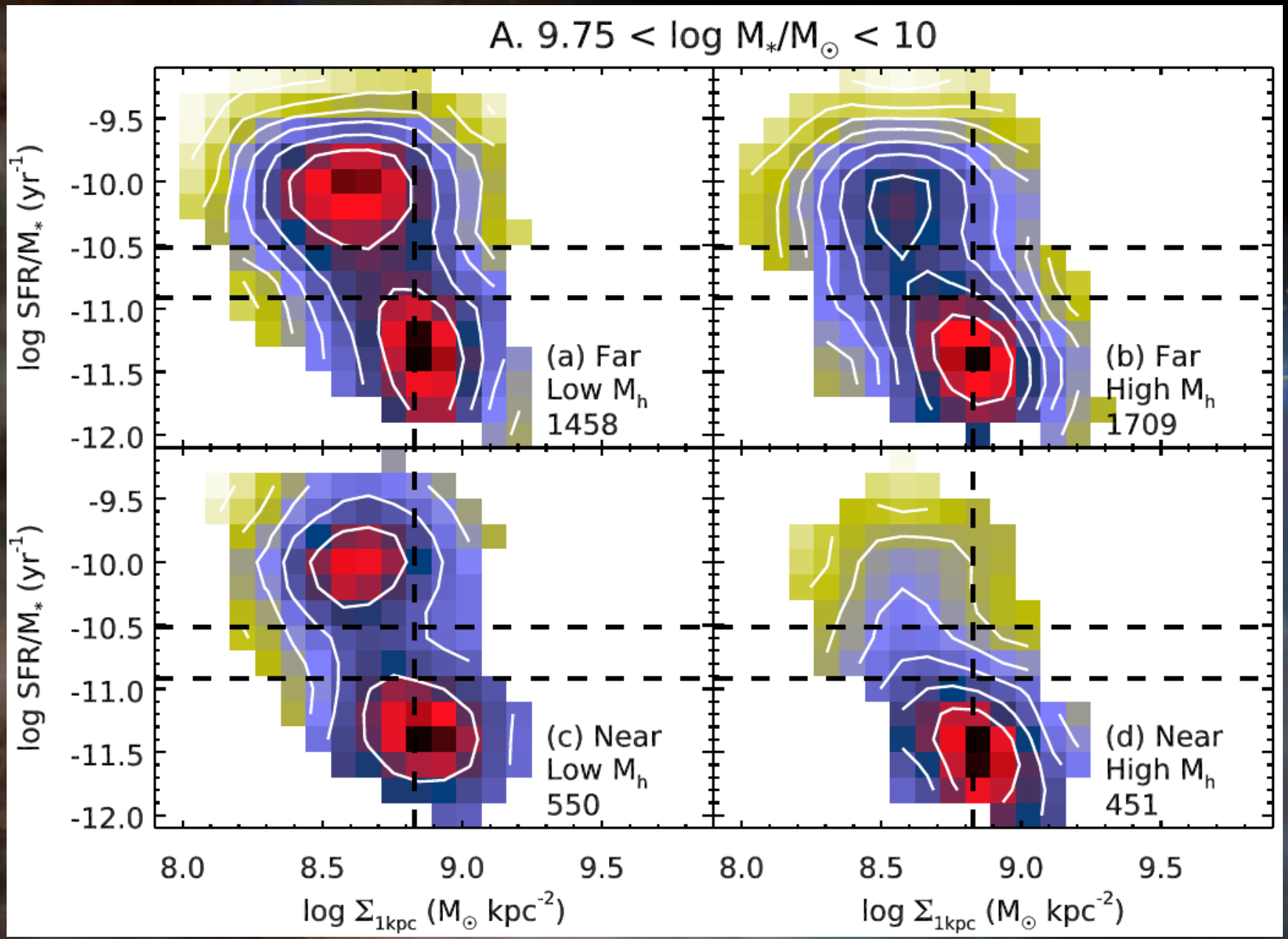
Satellite Quenching Depends on Environment



Woo et al., (2013)



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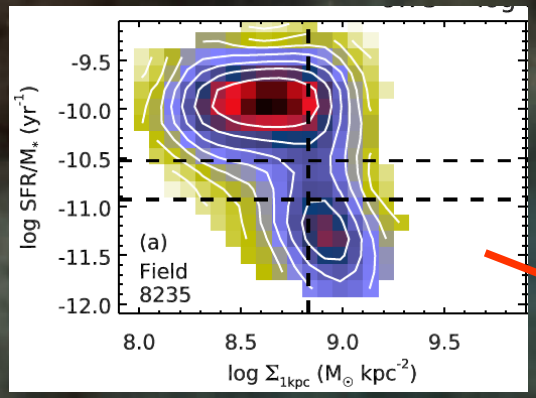
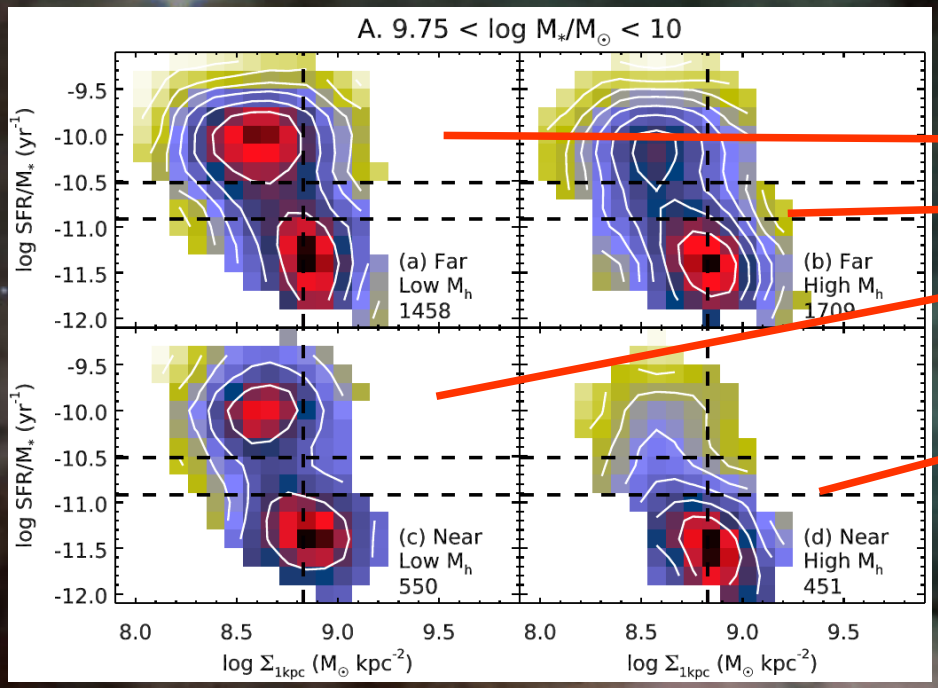
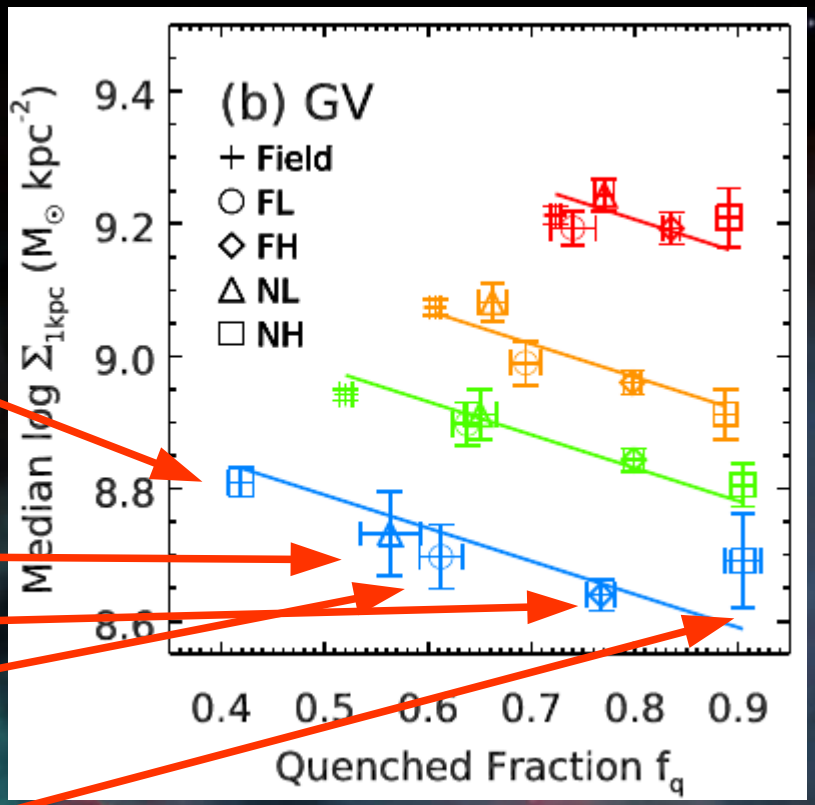
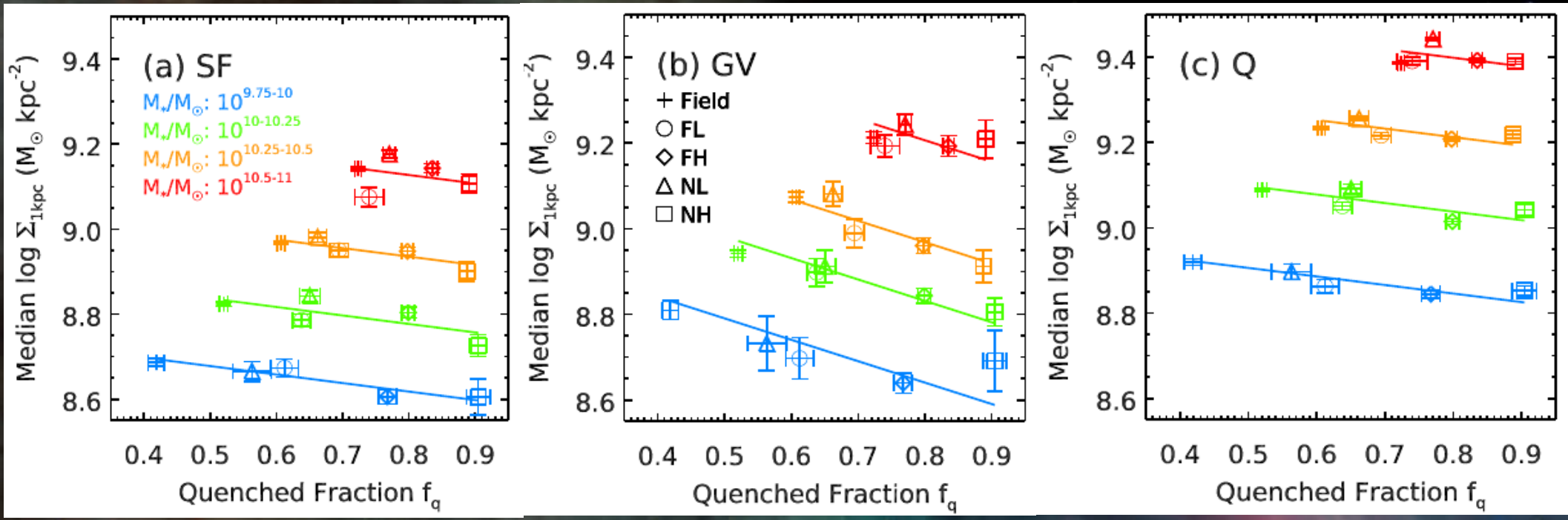






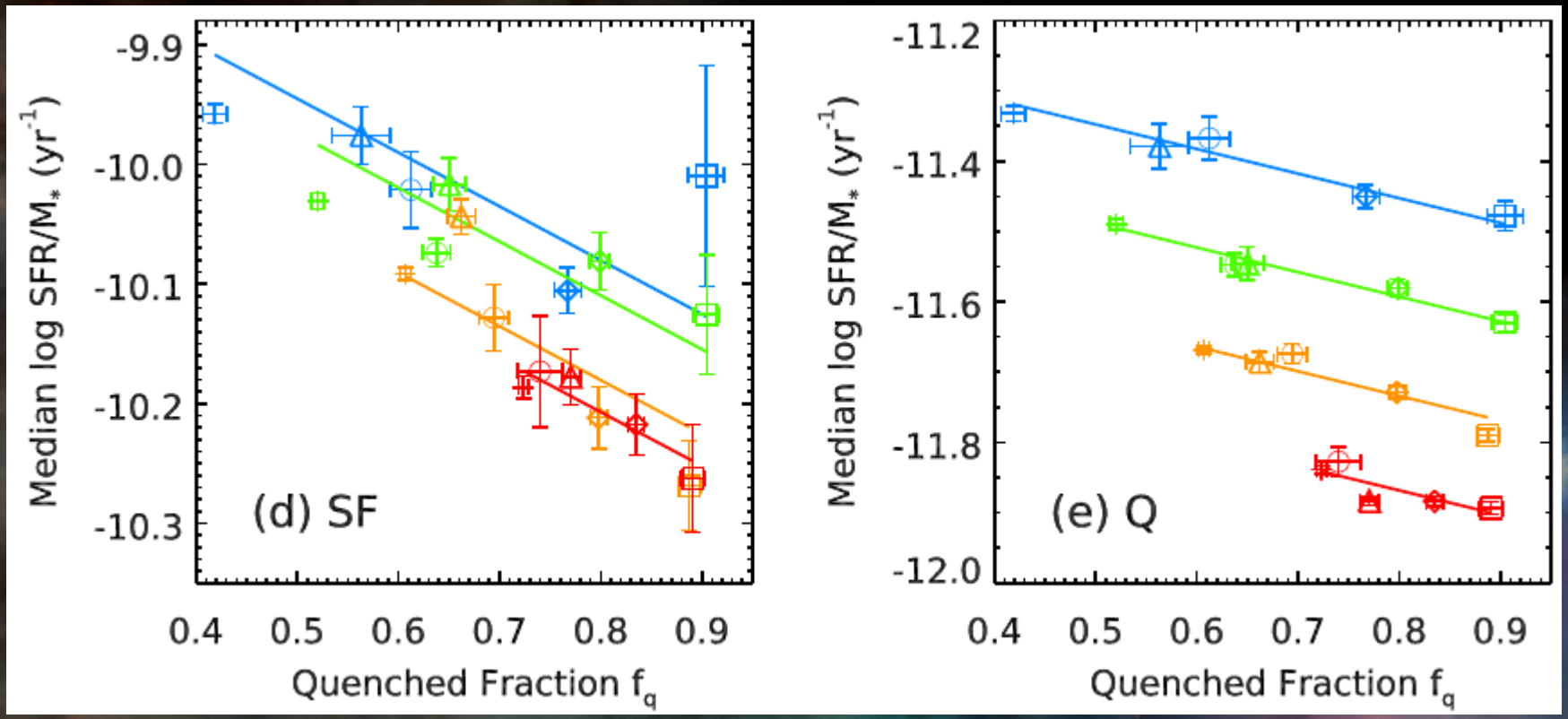
The position of the GV correlates smoothly with the "environment"

Woo et al., (2016) arXiv:1607.06091



Other features of the sSFR-Σ_{1kpc} correlates smoothly with the "environment"

Woo et al., (2016) arXiv:1607.06091



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Woo et al., (2016) arXiv:1607.06091

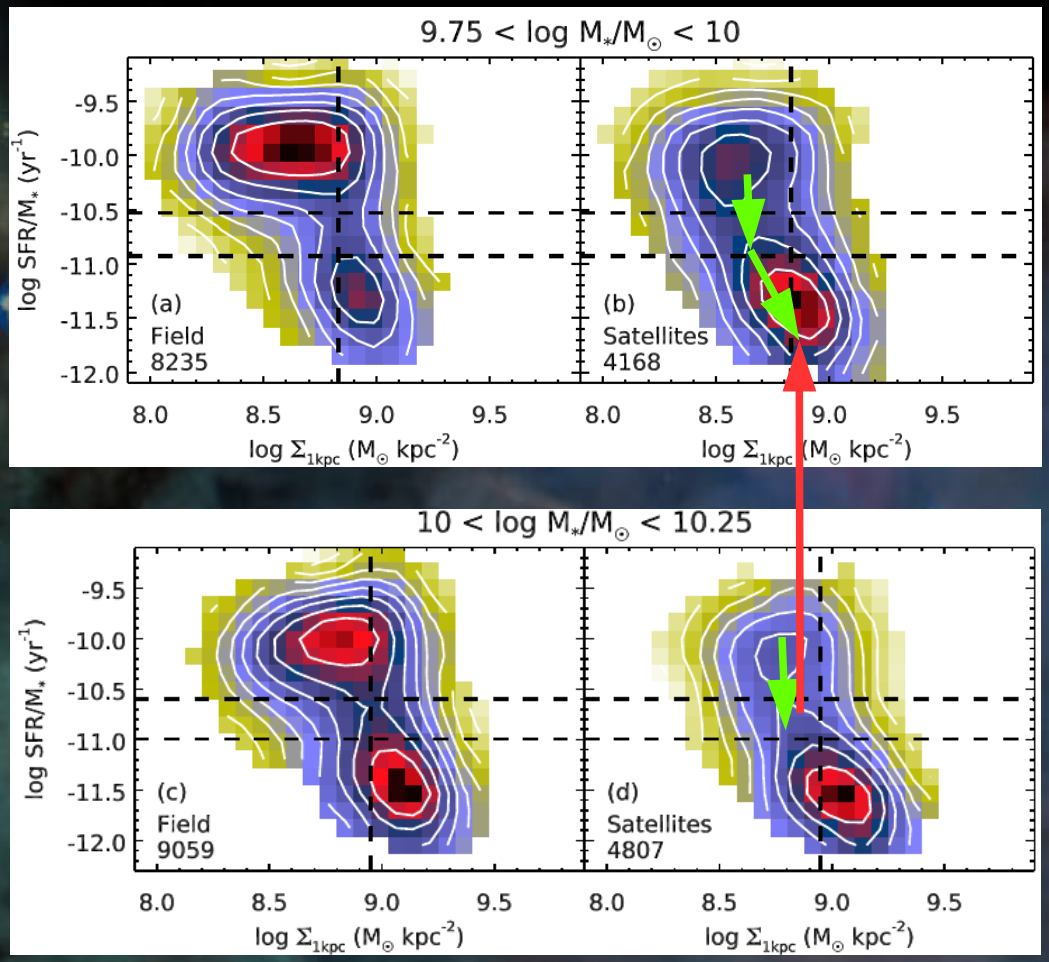
What We've Learned So Far

- Many features of the sSFR-Σ_{1kpc} vary smoothly with the environment
- Satellites *begin* quenching with range of Σ_{1kpc}
  - (assuming GV = transitioning)
  - What we'd expect for cluster processes
- But once they're *completely quenched* they have high Σ_{1kpc}

Why is Σ_{1kpc} for quenched galaxies always high?

- Something causes Σ_{1kpc} to increase, but only after the start of quenching
  - Ram pressure compression
  - Tidal compression
  - Tidally triggered instability
  - Harassment

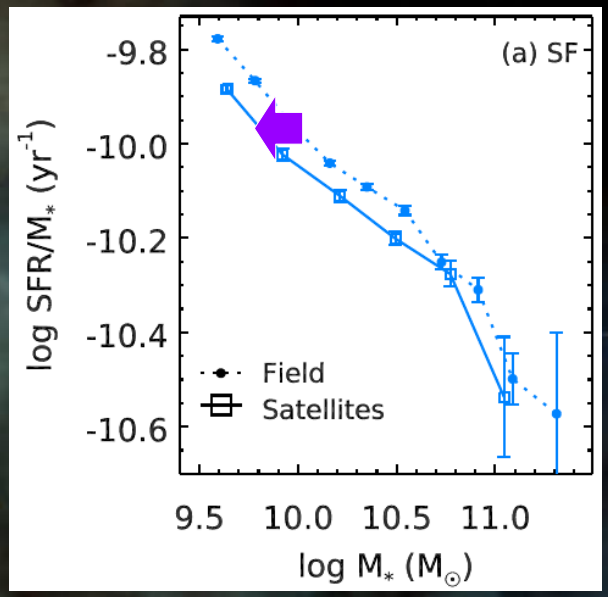
- Σ_{1kpc} never increases for individual satellites
  - "Progenitor bias" (van Dokkum & Franx 1996; Lilly & Carollo 2016)
    - High Σ_{1kpc} quenched earlier
    - GV: env. quenching kicking in now
  - Tidal stripping decreases M_*
    - Stripping happens after start of quenching

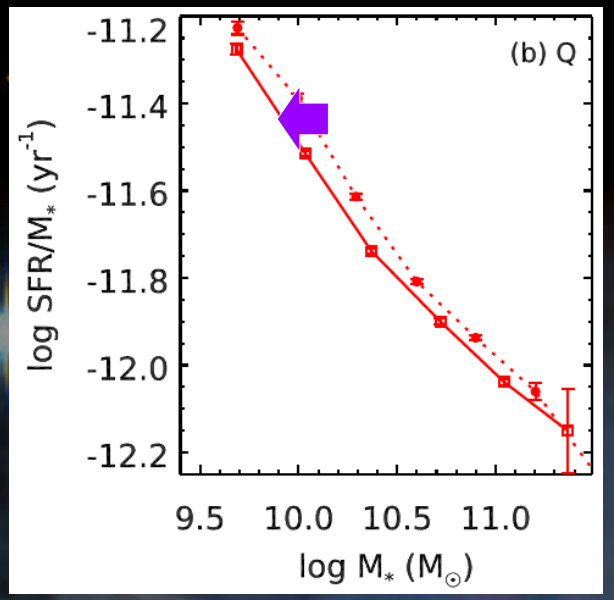


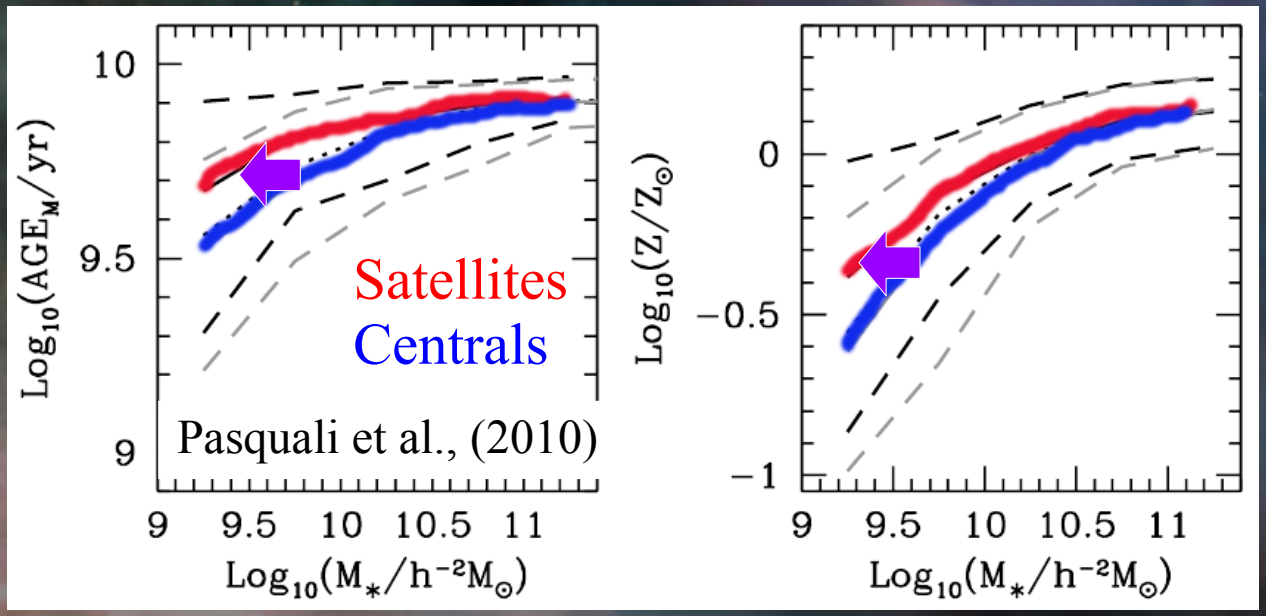
Woo et al., (2016) arXiv:1607.06091

Tidal Stripping?

Tidal stripping is consistent with several other observations







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Can in principle distinguish between these two types of scenarios:

- study the stellar populations in recently quenched/quenching satellites
- How much of the inner stars formed recently?

Stay tuned!
Test underway with MUSE observations of HCG 16!