Do galaxy morphologies really affect the efficiency of star formation during the phase of galaxy transition?

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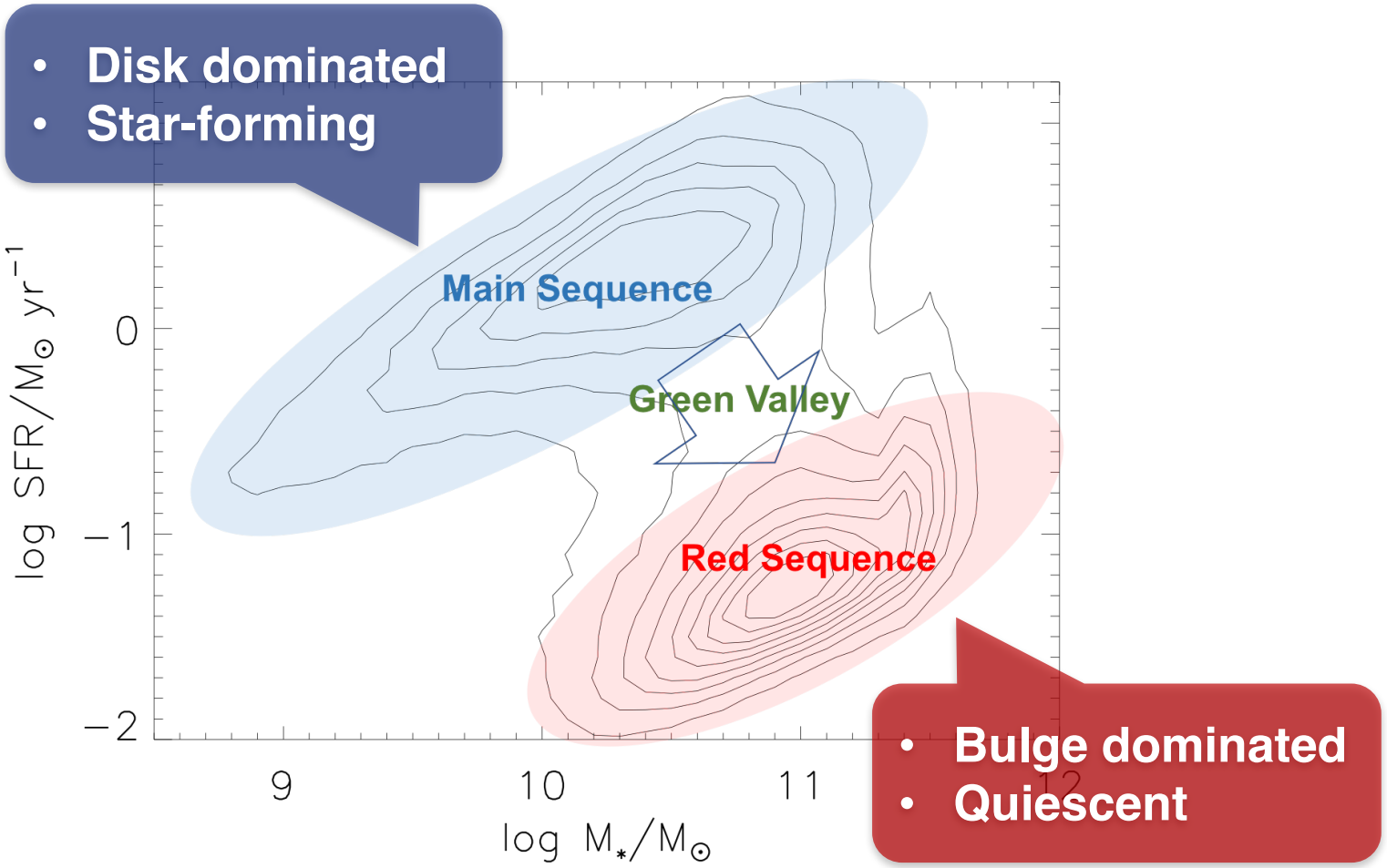
SF quenching

Galaxies migrate from MS to RS by “quenching of their star formation”.

What triggers SF quenching? How galaxies migrate?

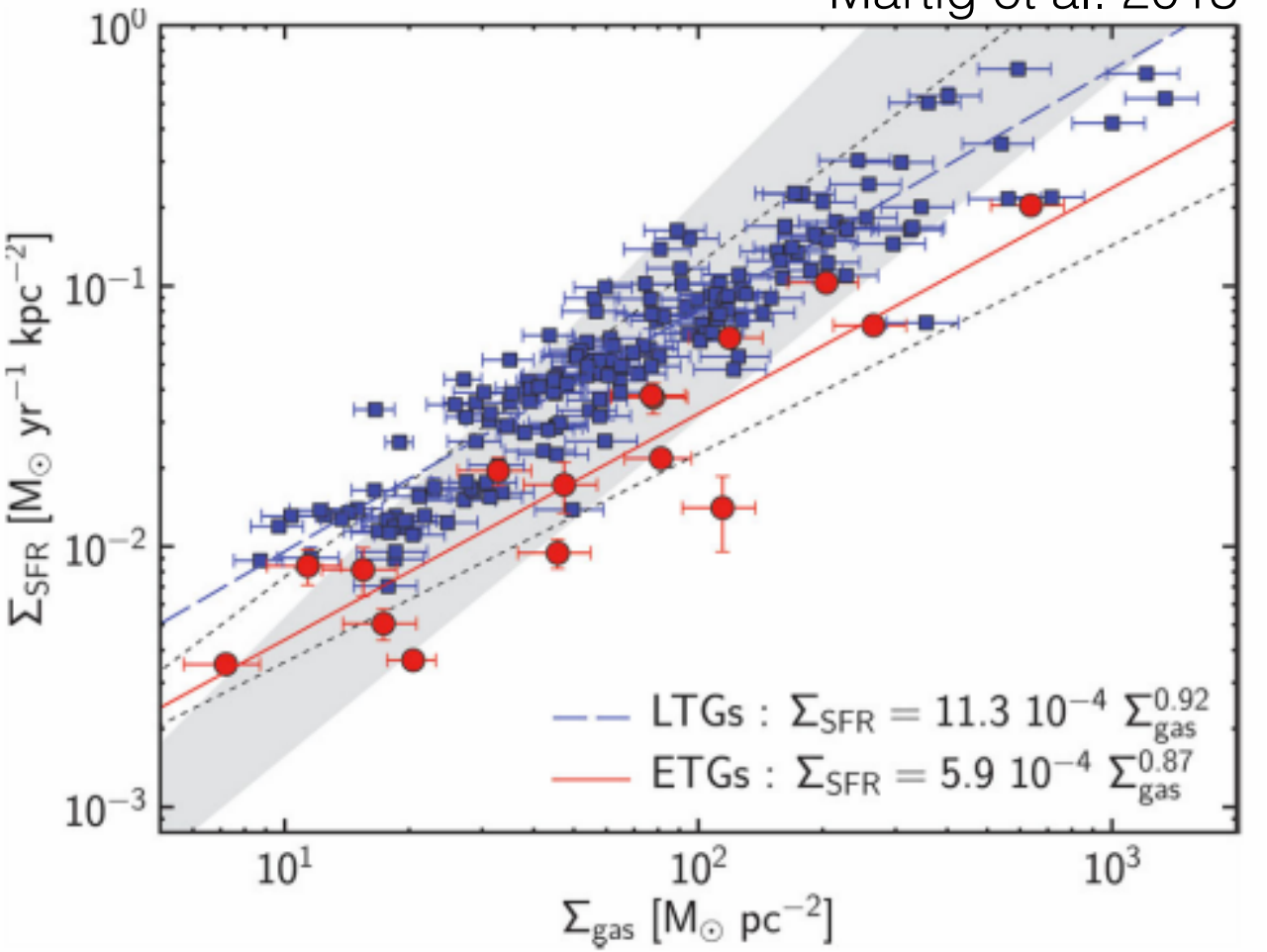


Morphological quenching

ETGs (bulge) have lower star formation efficiency than LTGs (disk).

-> Galaxy morphology may control star formation within galaxies.

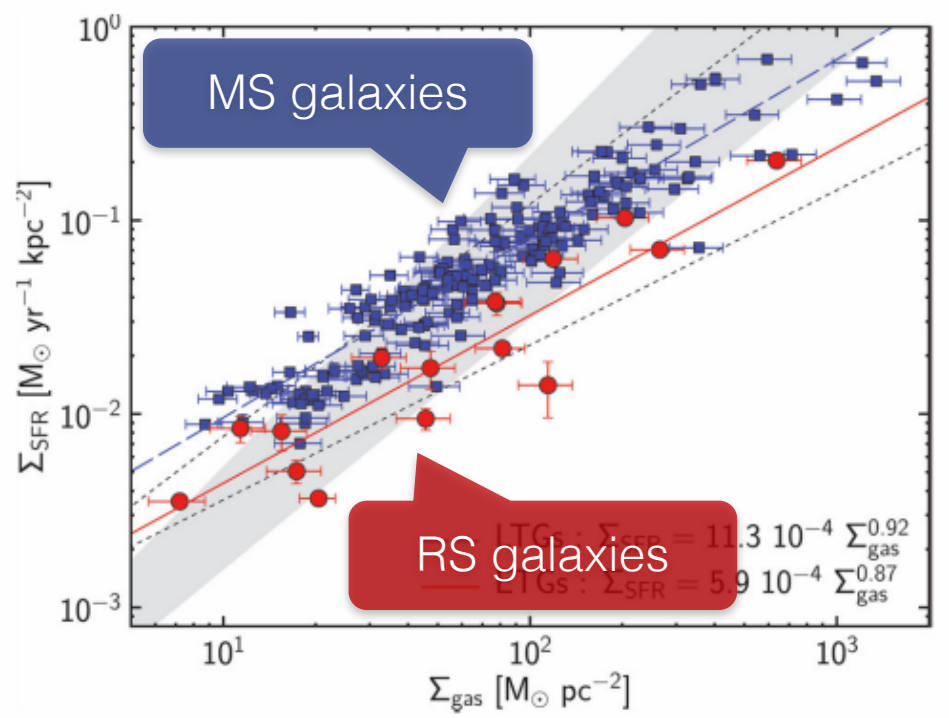
Martig et al. 2013



Does morphology really affect SF quenching?

However, previous studies compare LTGs in MS and ETGs in RS.

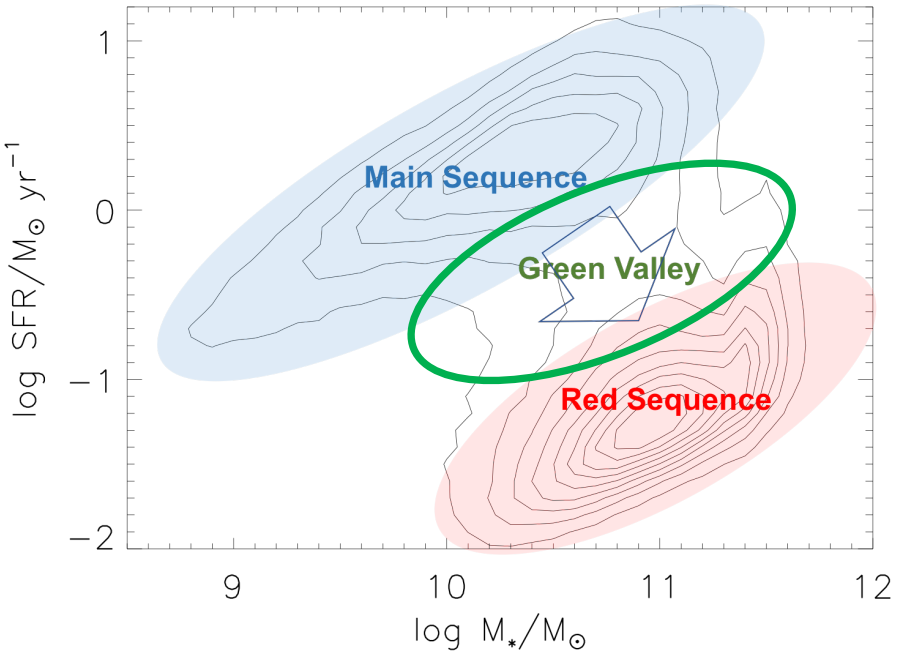
-> Have we seen the real effect of MQ?



To assess the effect of galaxy morphologies on SF quenching, we have to compare the galaxies in the process of SF quenching, but having completely different morphology.

Comparison of green-valley galaxies

green-valley galaxies are in the phase of galaxy transition.
Comparison between SFE of LTGs and ETGs in green-valley is fair.

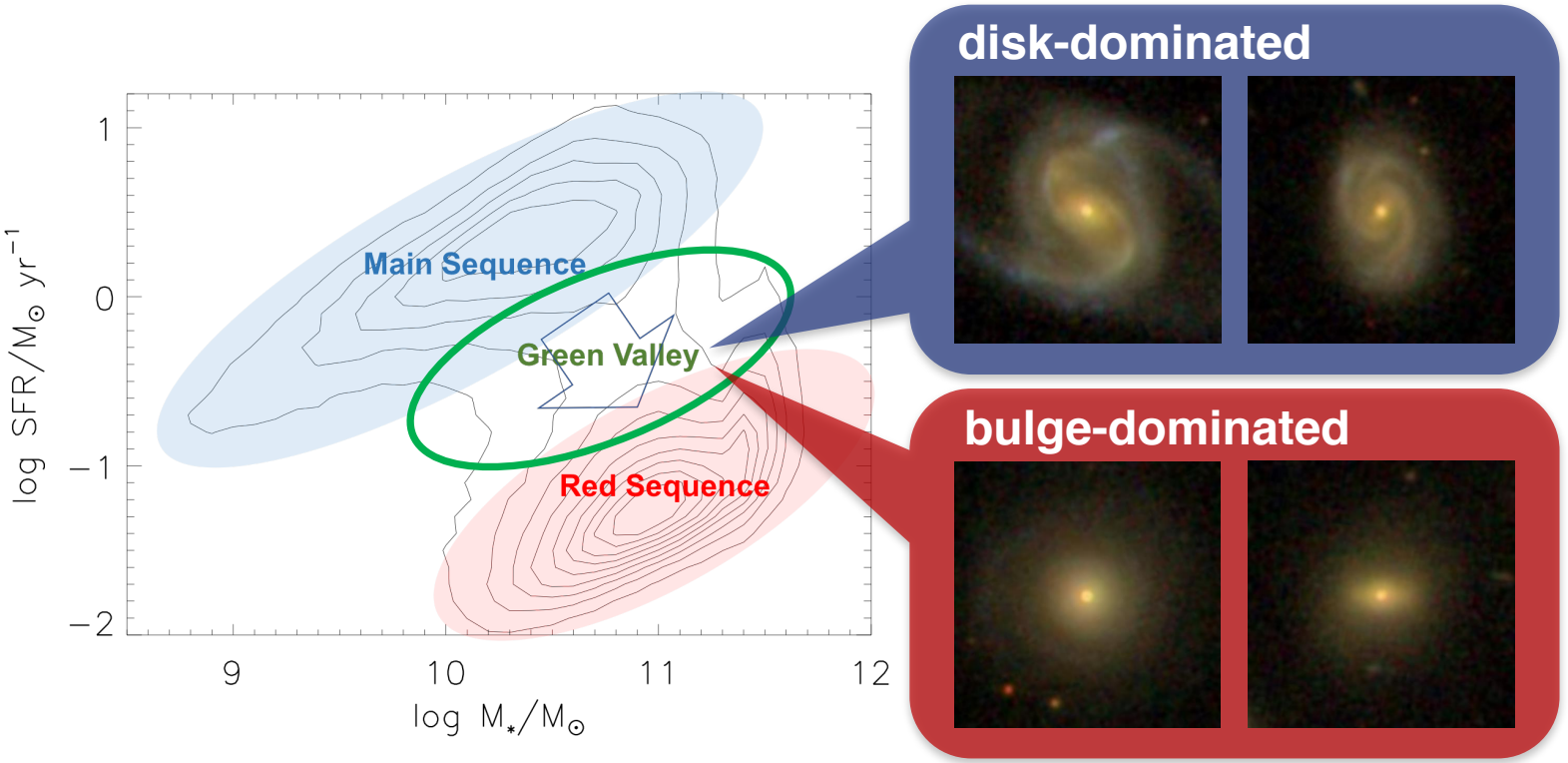


This study

Construct two galaxy sample:

- located on green-valley + disk-dominated
- located on green-valley + bulge-dominated

Compare their SFEs to judge MQ really affect SF quenching.

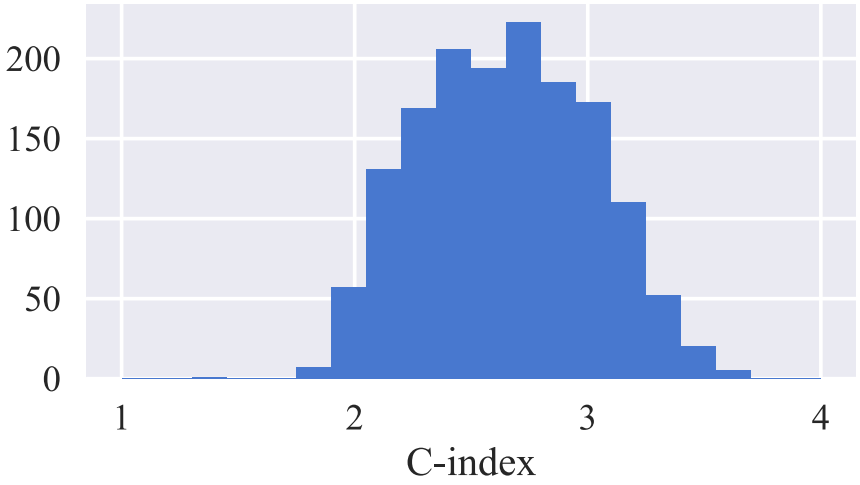


Sample selection

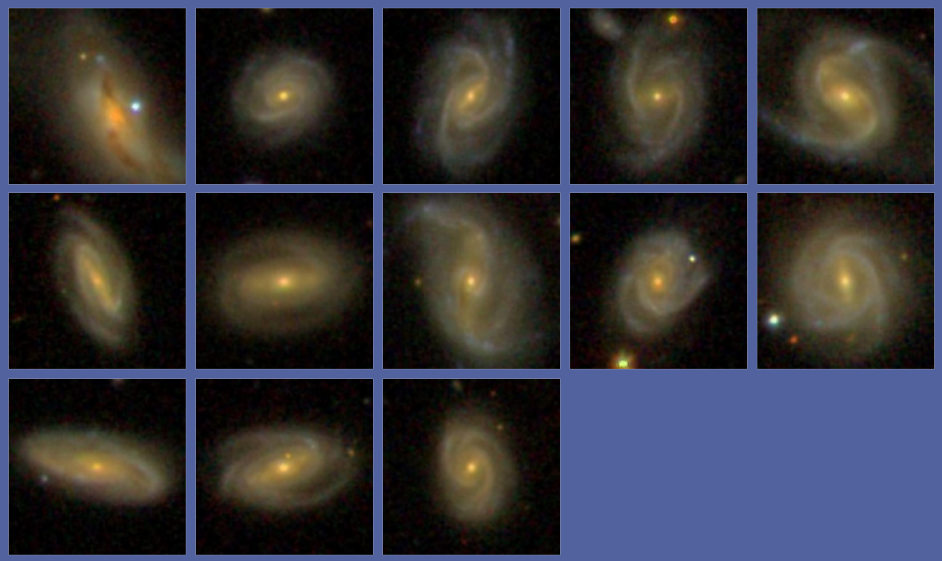
SDSS DR7 spec catalog with GALEX-WISE-SDSS catalog

selection criteria

- 0.025 < z < 0.05
- 10.8 < log M_* < 11.2
- -11 < specific SFR < -10
- C-index (= R90/R50 at *r* band)
  - C-index < 2.2 for disk
  - C-index > 2.8 for bulge



Disk + green sample: 13 galaxies



Bulge + green sample: 15 galaxies

CO(J=1-0) data

CO(1-0)

- 115 GHz
- Useful tracer of molecular gas mass.

CO(1-0) observation at Nobeyama 45m

- 2017 semester (2017/12, 2018/1, total: 150hr)
- FOREST (ON-ON mode)

CO(J=1-0) data

CO(J=1-0) observation at Nobeyama 45m

- 2017 semester (2017/12, 2018/1, total: 150hr)
- FOREST (ON-ON mode)

+ xCOLD GASS (Saintonge et al. 2017)

- extra galactic CO survey with IRAM 30m
- Total: 532 galaxies
- 5 disk
- 21 bulge
- 22 intermed (2.2 < C < 2.8)

for all sample,

$$\mathrm{M_{H_2}\,[M_\odot] = \alpha_{CO}\,[M_\odot\,(K\,km\,s^{-1}\,pc^{-2})^{-1}]L_{CO}\,[K\,km\,s^{-1}\,pc^2]}$$

$$\alpha_{CO} = 4.3$$

$M(H_2)$ – SFR relation

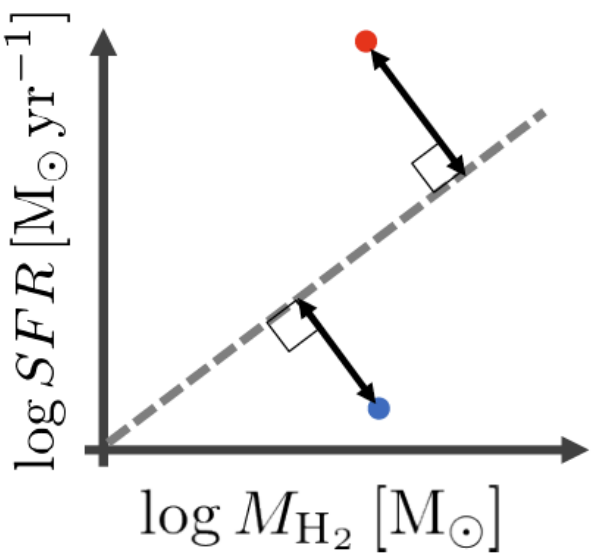
Do disk+green and bulge+green galaxies have same relation?

Preliminary result

Statistical test

KS test
-> p-value = 0.37

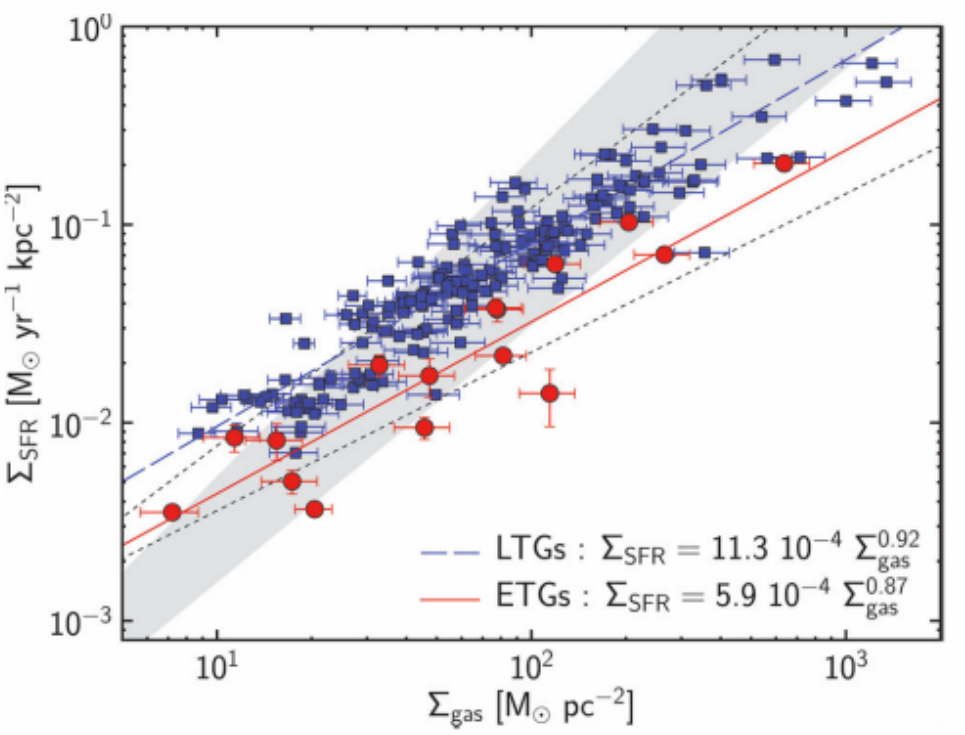
Both disk+green and bulge+green galaxies follow the same M(H_2) and SFR relation.



Preliminary result

How we interpret an inconsistency of results?

Due to the bias?



Preliminary result

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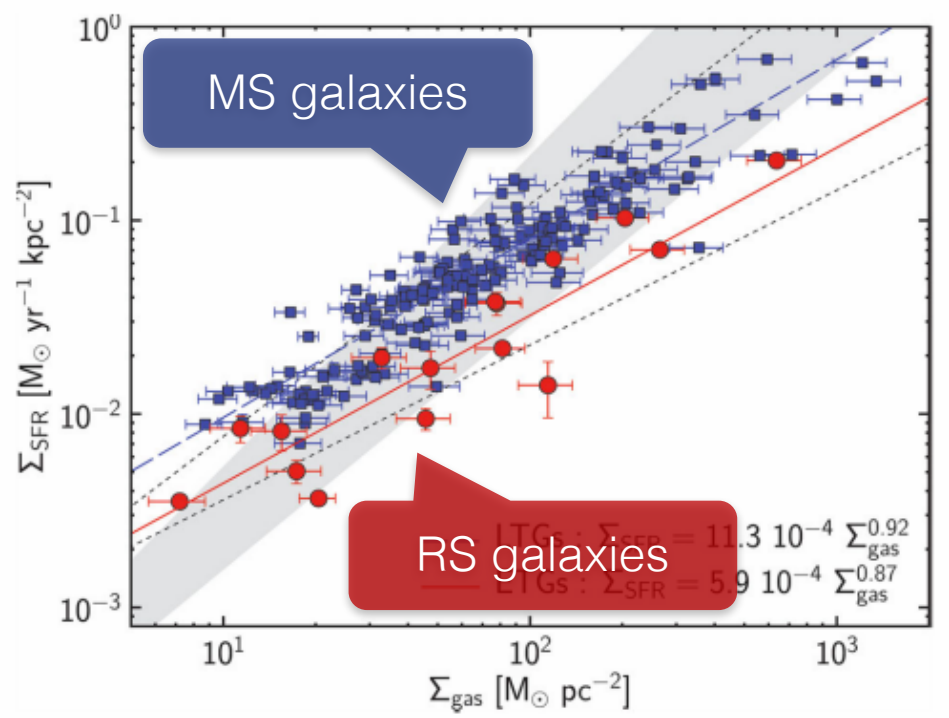


To assess the effect of galaxy morphologies on SF quenching,
we have to compare the galaxies in the process of SF quenching,
but having completely different morphology.

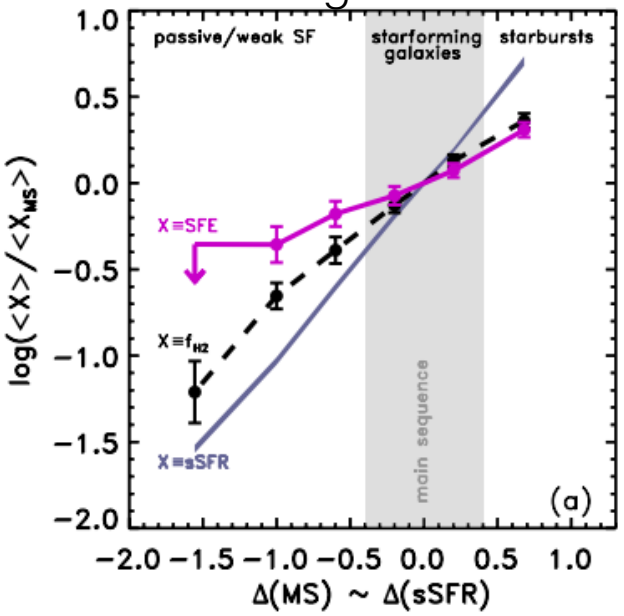
C-index vs SFE

SFE (=SFR/M(H_2)) increase with sSFR(=SFR/M_*).
(similar trend to Saintonge et al. (2012).)

However, it is independent of morphological types.

Preliminary result

Saintonge et al. 2012



Summary

- We performed the CO observation to investigate the morphological dependence of SFE.
- We found that both disk+green and bulge+green galaxies follow the same M(H_2) and SFR relation.
- SFE increases with sSFR, and this relation is independent of galaxy morphology.