Stellar Bars in the Illustris TNG simulation

Yetli Rosas-Guevara

DIPC

collaborating with Silvia Bonoli (DIPC), Massimo Dotti (U Milan), Tommaso Zana (U Milan) and the TNG team

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Stellar Bars

- Stellar bars are non-axisymmetric stellar distributions and are believed to play a role in the secular evolution of the galaxies (e.g. Athanassoula 1992).

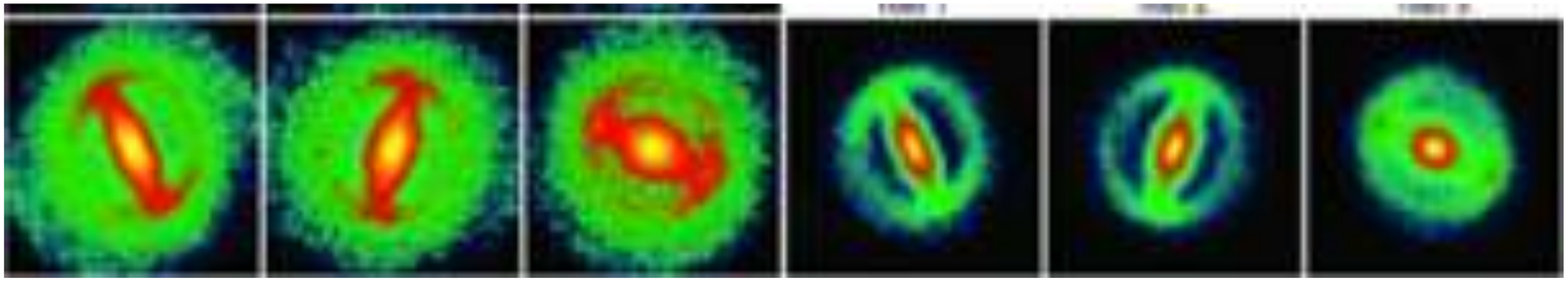
Credit: NASA/ESA Hubble Space Telescope

- Bars are common features in disc galaxies in the Local Universe (more than 30% in massive disc galaxies, e.g. Gavazzi et al. 2015).

IDEALISED GALAXIES

Used to study the effects of specific properties in the formation of the bar, such as halo shape and the relative gas fraction in the disc.

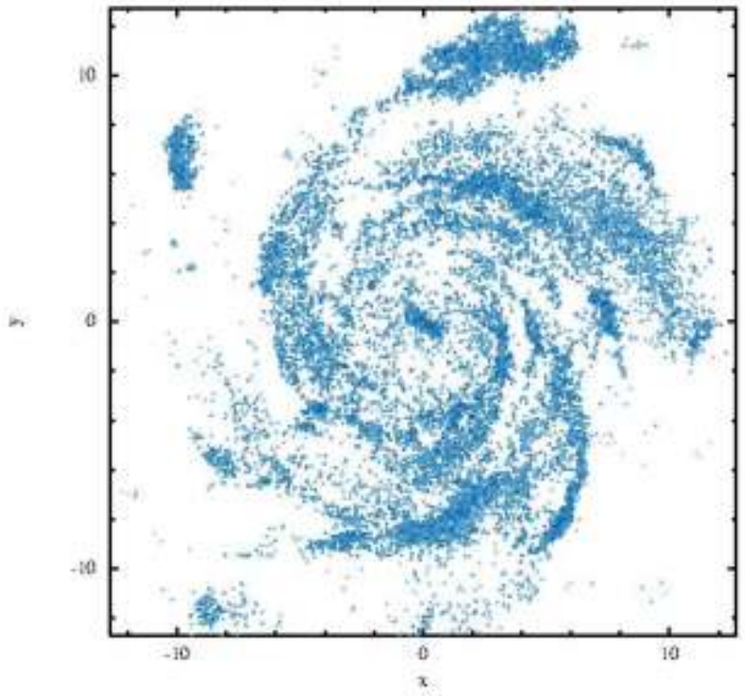
(Athanassoula, Machado et al. 2013)



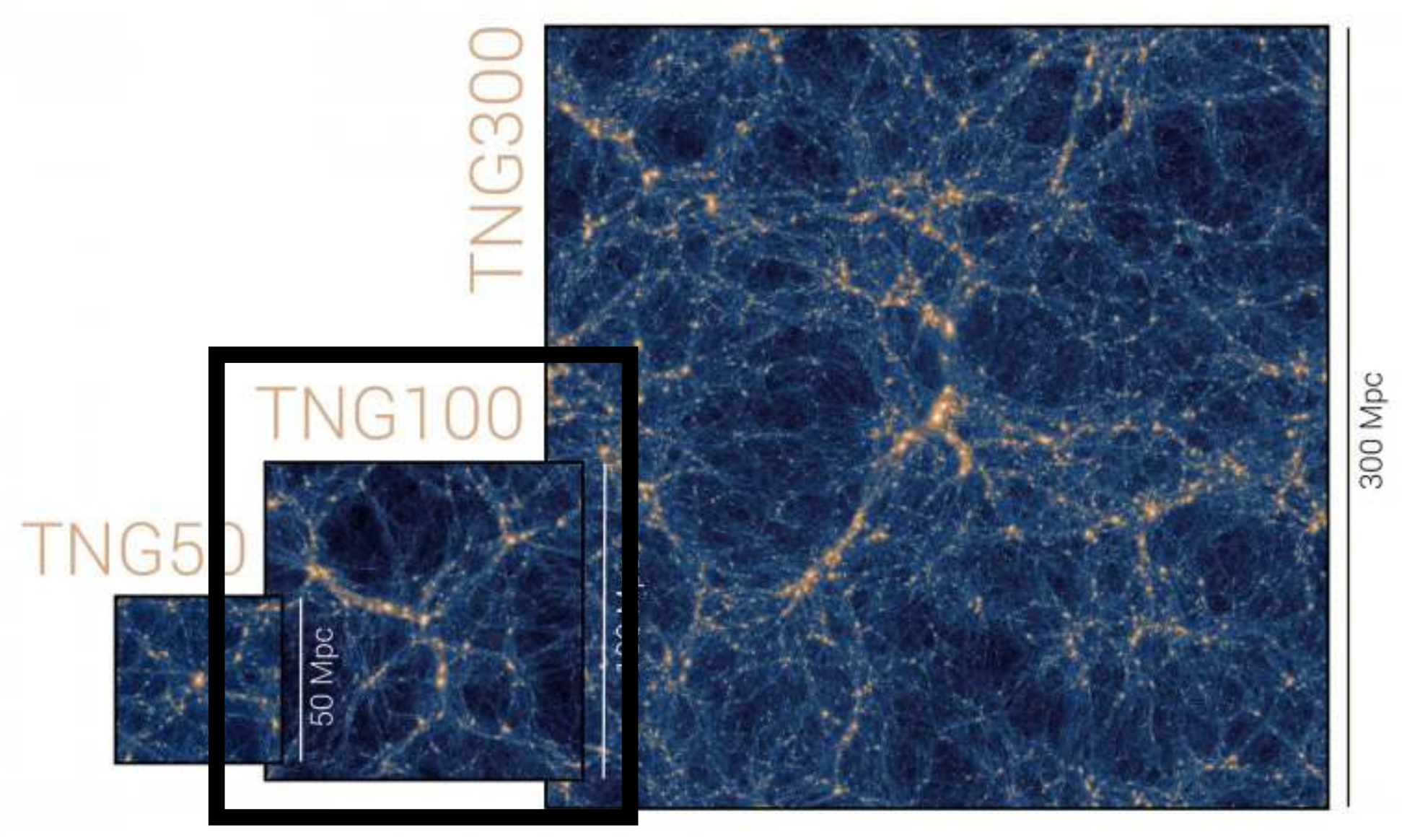
ZOOM-IN SIMULATIONS

Used to study
 the evolution of a bar in a Milky-Way like galaxy and the gas response due to the bar (Spinoso, Bonoli et. al. 2016)

ErisBH simulation



The Illustris TNG simulations



Credit: TNG team

Weinberger et al., 2017, Nelson et al., 2017, Pillepich et al., 2018)

Bar Sample in the Ilustris TNG

Galaxies with stellar mass larger than $10^{10.5}$ M_{sun}

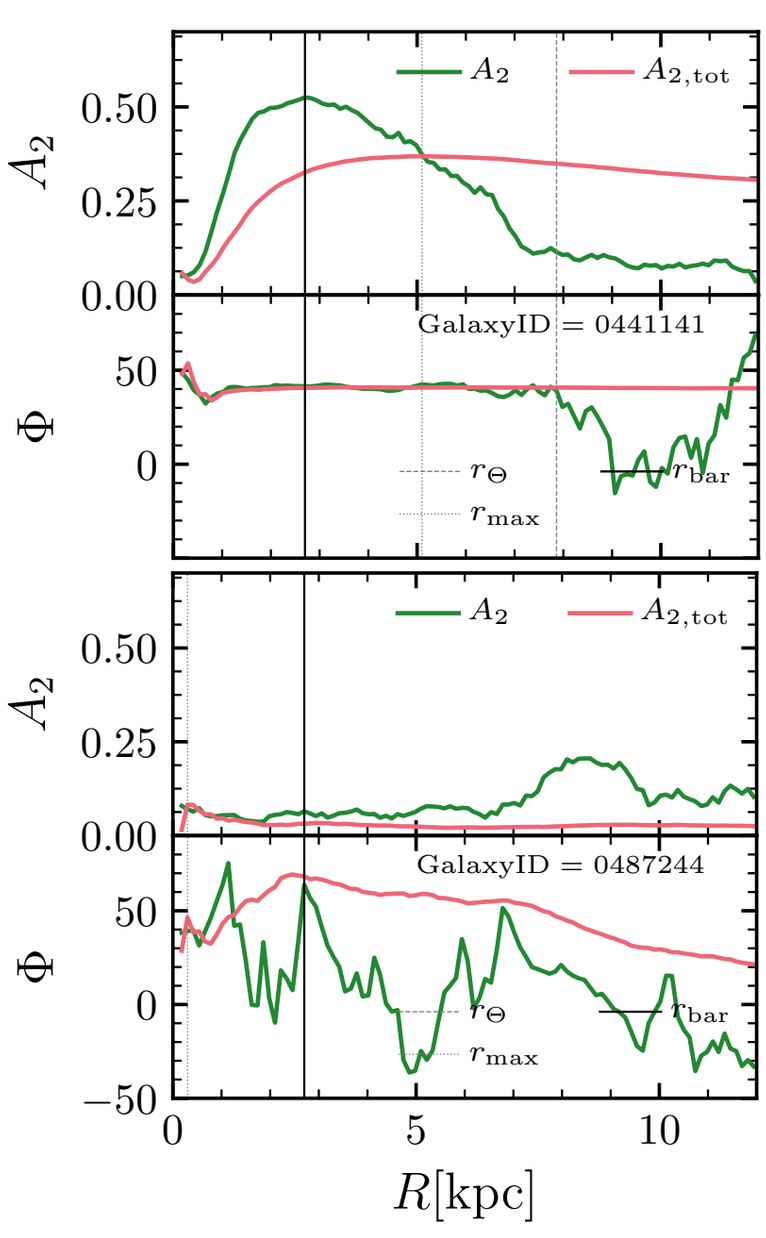
Bulge and disc components were kinematically identified (Genel et al. 2015)

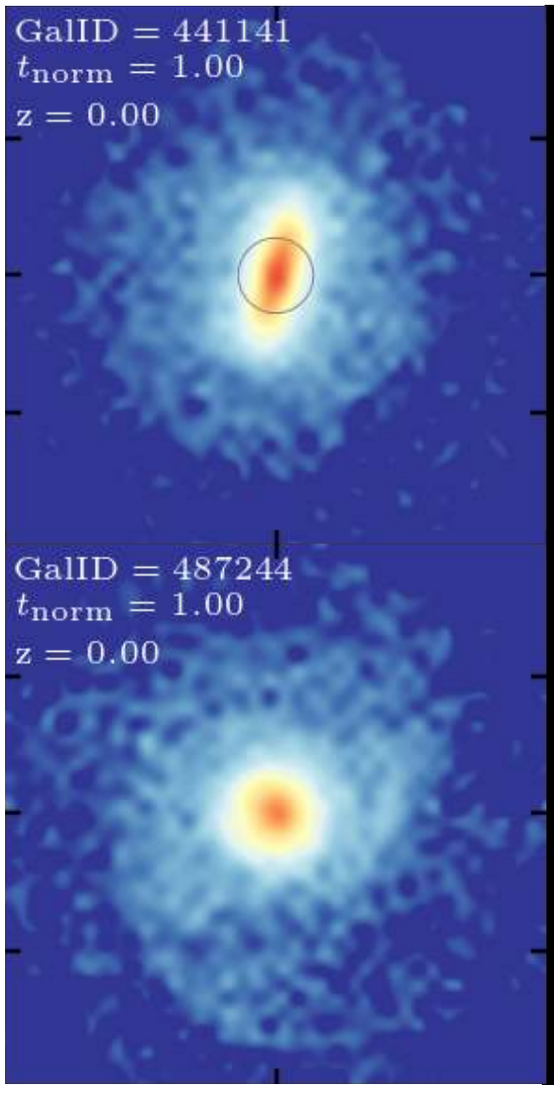
Galaxies with dominant disc component (D/T>0.5) and
Clear morphology ((D/T+B/T)>=0.7)

Bar examples in Illustris TNG

Bar finder based on the Fourier decomposition of stellar surface density (Zana et al. 2018)

Bar strength





Stellar surface density

Mock Images Nelson et al. 2018

Bar Sample in the Illustris TNG

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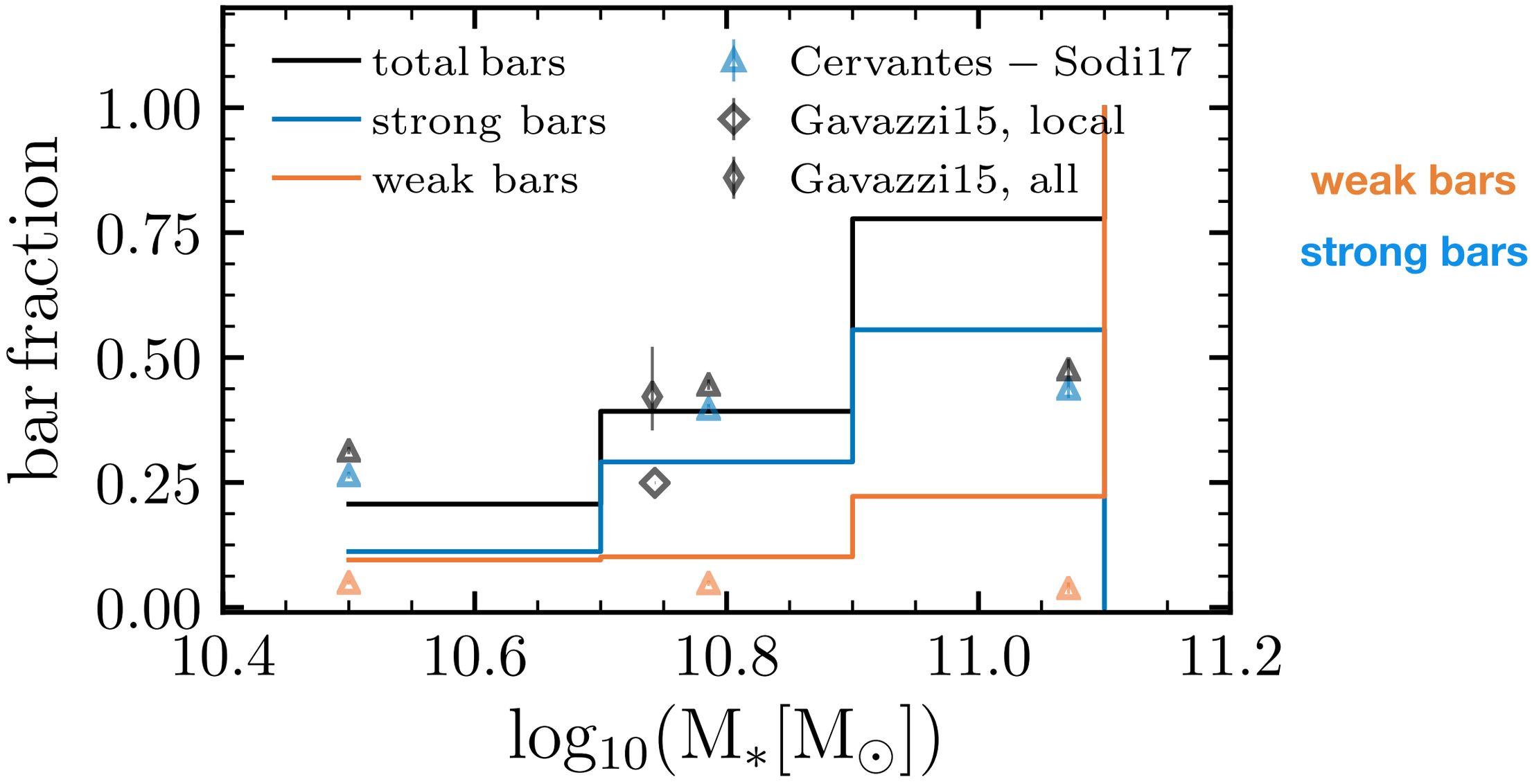
	Sample	number of galaxies	bar fraction
A2>0.3	strong bars	58	0.20
0.2<A2<0.3	weak bars	32	0.11
A2<0.2	non-bars	197	0.69

total bar fraction =0.31

Bar fraction as a function of stellar mass



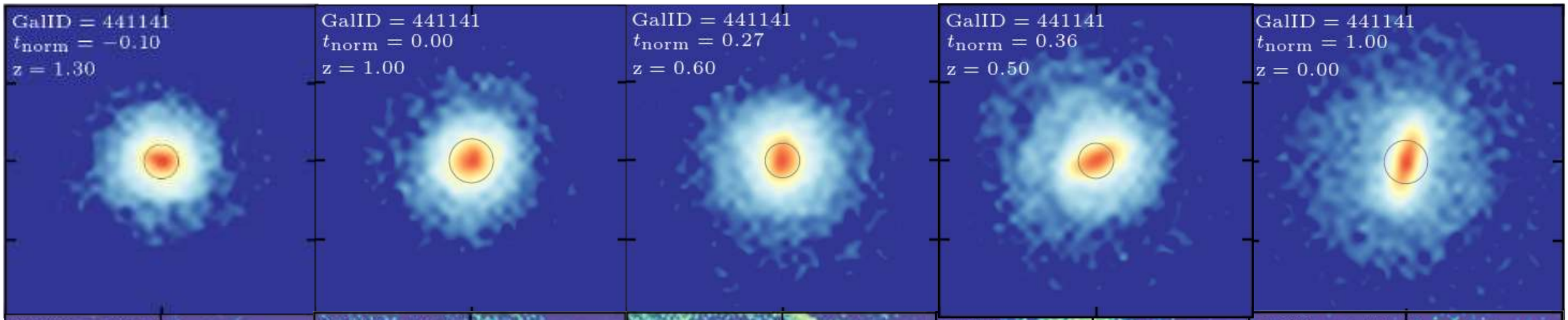
weak bars

strong bars

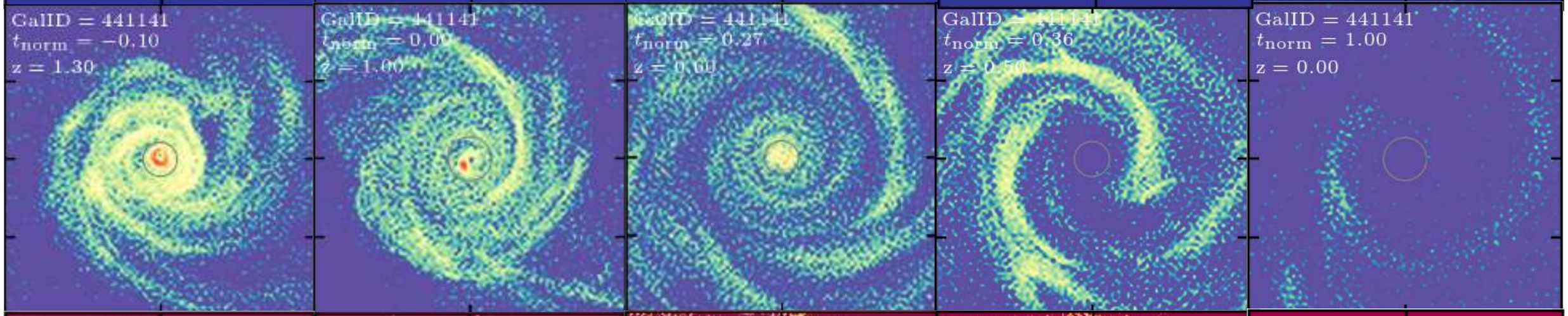
Evolution of strongly-barred galaxies

Bar formation → **Today**

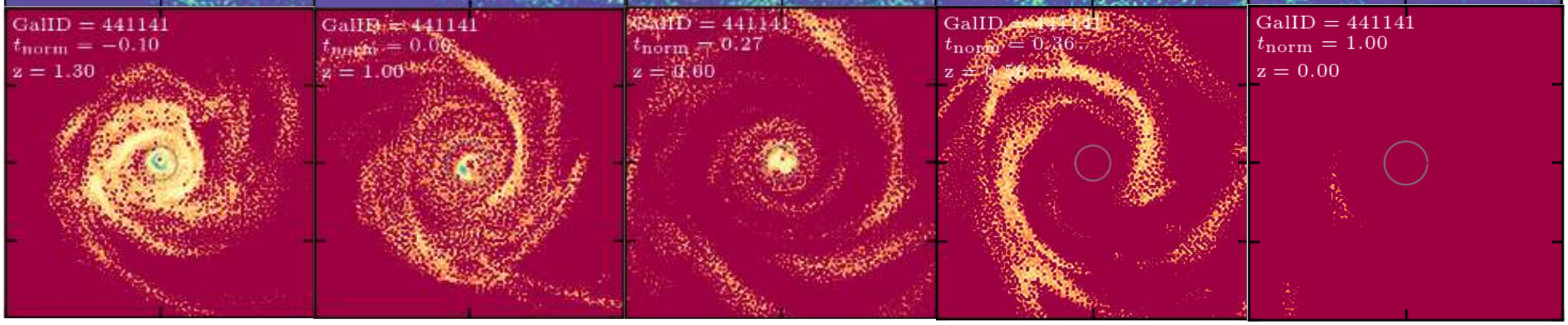
Stars



Gas



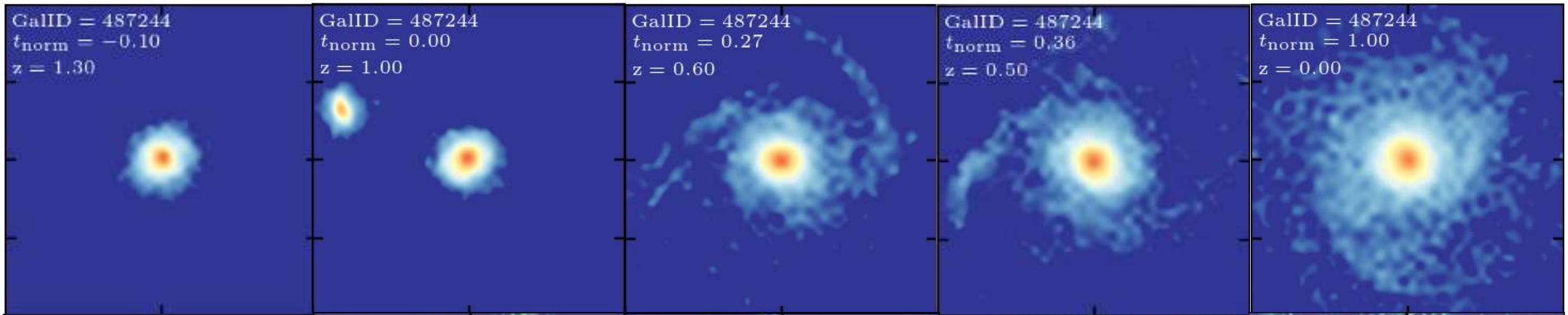
SFR



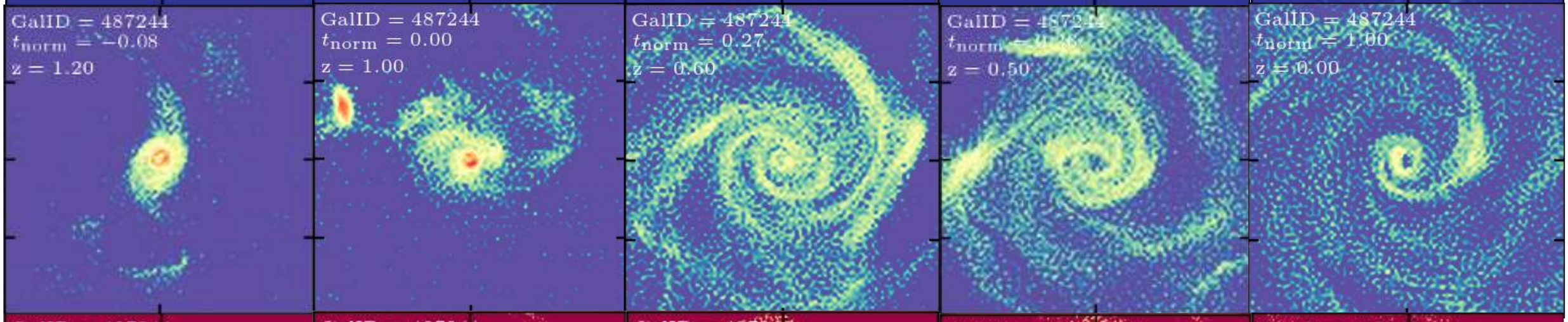
Evolution of unbarred galaxies

Bar formation → **Today**

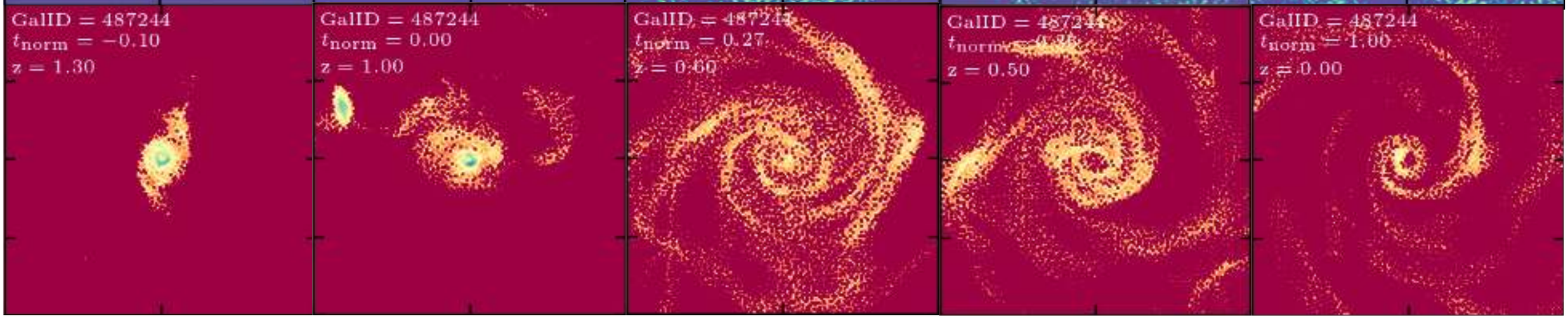
Stars



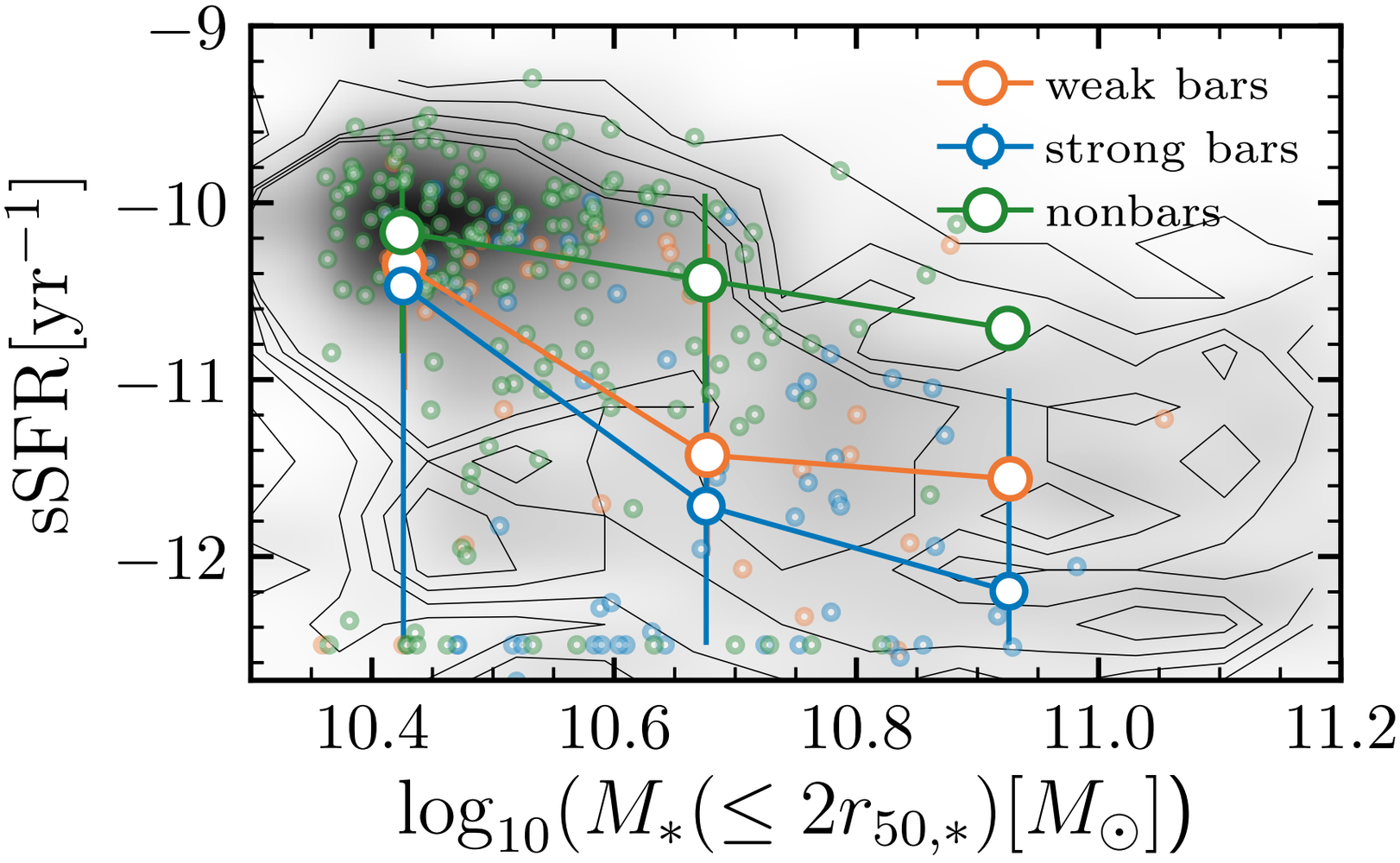
Gas



SFR



The sSFR-Stellar mass Diagram

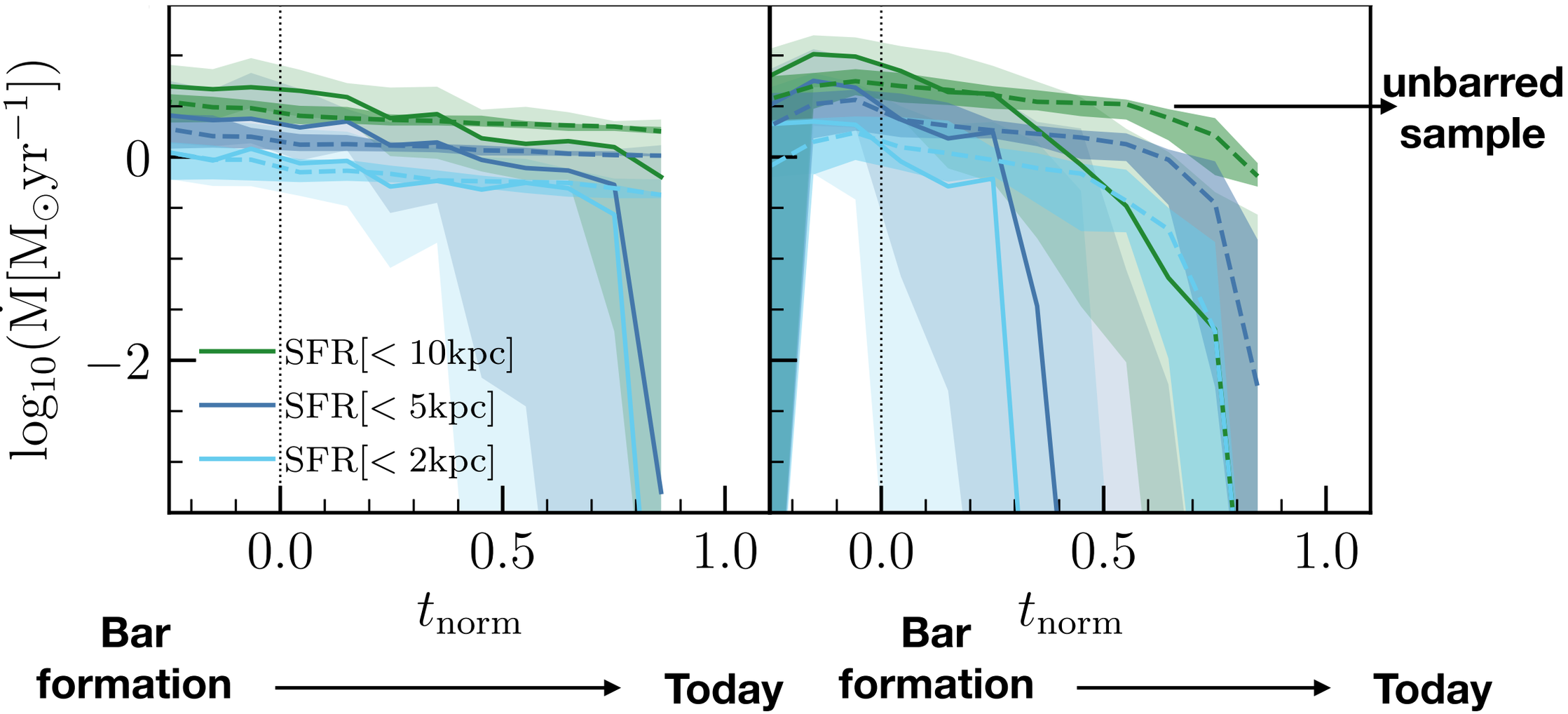


non bars

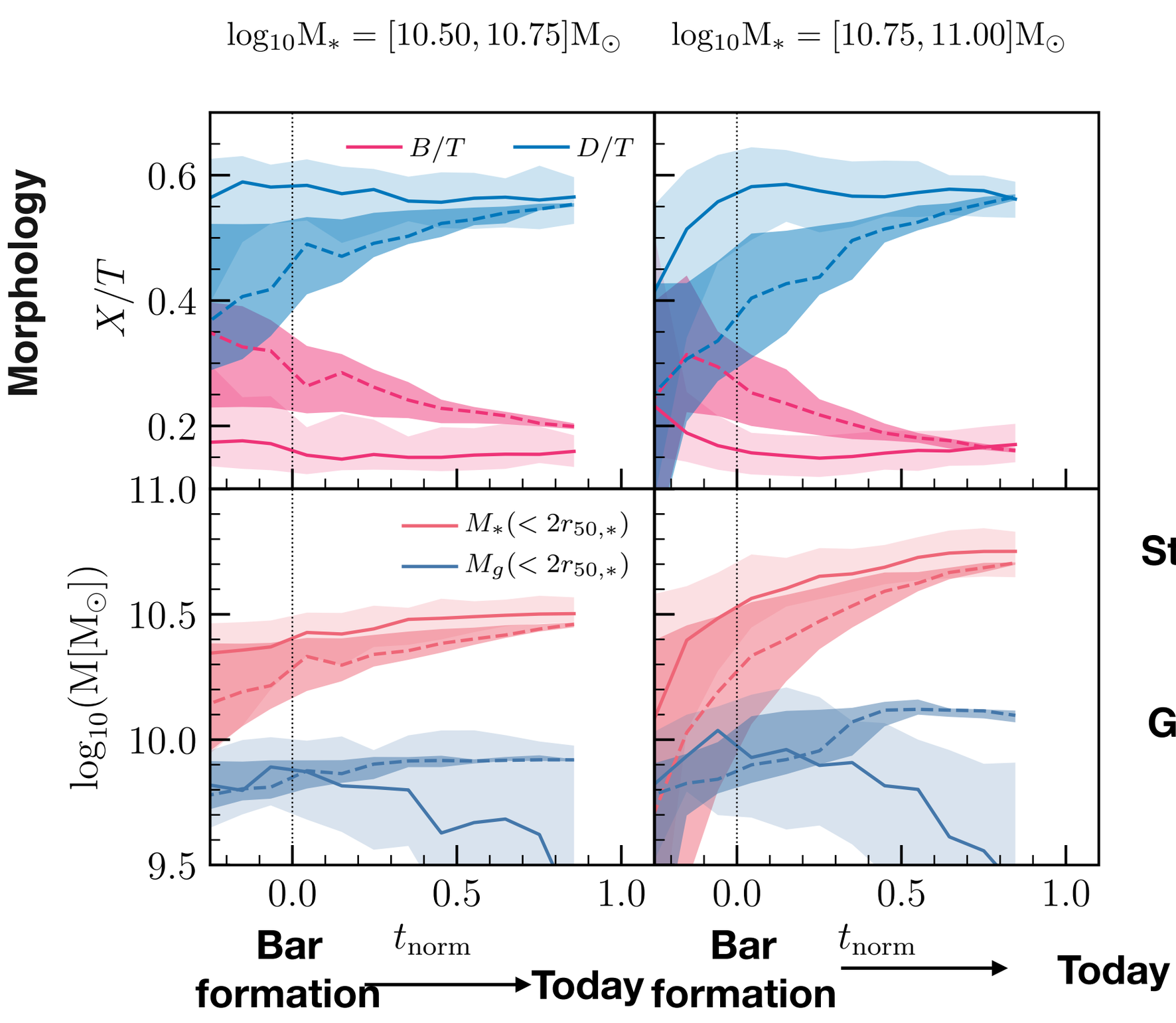
weak bars

strong bars

Evolution of strongly-barred galaxies



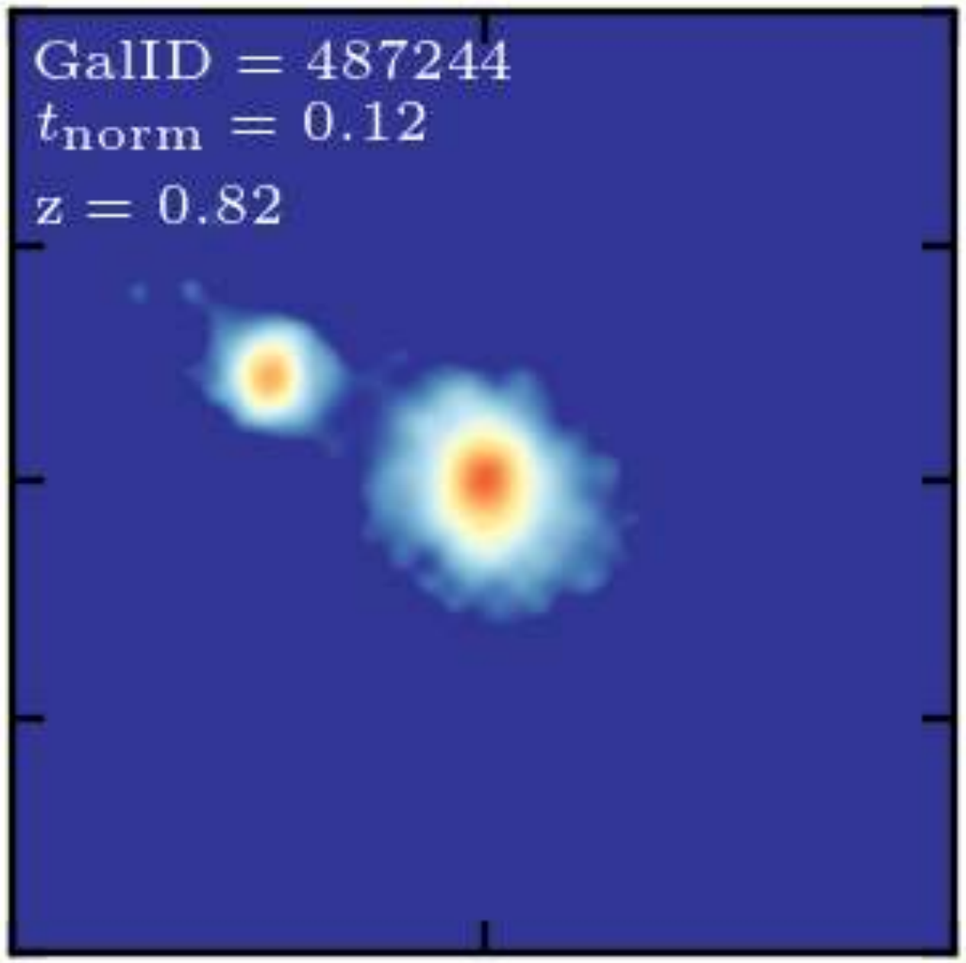
Evolution of galaxies



Merger histories

- Barred and unbarred galaxies present relative quite merger histories.

- **A difference is presented in minor merger histories at late times:** A larger fraction of Unbarred galaxies (17%, 56%) experience at least one minor merger than the fraction of the strongly-barred galaxies (2%, 33%) after the formation of the bar



Summary

- There are differences between the evolution of strongly barred and unbarred galaxies

- Morphology is different at times where the bar is not a transient structure anymore (bar age): strongly-barred galaxies present smaller bulge than unbarred counterparts

- It seems that the central part of the strongly barred galaxies have lower star formation rates in comparison to the unbarred galaxies (for the most massive galaxies in our sample)

- Merger histories are more quiet in strongly barred galaxies than those in unbarred galaxies

- Future steps: Understanding the fate of the gas in the central part.

THANKS!