

Interacting galaxies in the IllustrisTNG simulations

– II: Star formation in the post-merger stage

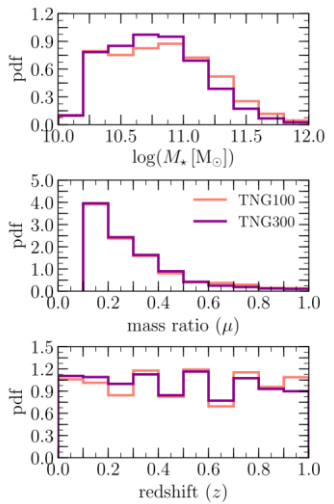
Hani+2020 arXiv: 2001.04472

Galaxy mergers are a major evolutionary transformation whose effects are borne out by a plethora of observations and numerical simulations. However, most previous simulations have used idealised, isolated, binary mergers and there has not been significant progress on studying statistical samples of galaxy mergers in large cosmological simulations. We present a sample of 27,691 post-merger (PM) galaxies ($0 \leq z \leq 1$) identified from IllustrisTNG: a cosmological, large box, magneto-hydrodynamical simulation suite. The PM sample spans a wide range of merger and galaxy properties (M_* , μ , f_{gas}). We demonstrate that star forming (SF) PMs exhibit enhanced star formation rates (SFRs) on average by a factor of ~ 2 , while the passive PMs show no statistical enhancement. We find that the SFR enhancements: (1) show no dependence on redshift, (2) anti-correlate with the PM's stellar mass, and (3) correlate with the gas fraction of the PM's progenitors. However, SF PMs show stronger enhancements which may indicate other processes being at play (e.g., gas phase, feedback efficiency). Although the SFR enhancement correlates mildly with the merger mass ratio, the more abundant minor mergers ($0.1 \leq \mu < 0.3$) still contribute $\sim 50\%$ of the total SFR enhancement. By tracing the PM sample forward in time, we find that galaxy mergers can drive significant SFR enhancements which decay over ~ 0.5 Gyr independent of the merger mass ratio, although the decay timescale is dependent on the simulation resolution. The strongest merger-driven starburst galaxies evolve to be passive/quenched on faster timescales than their controls.

これまでのmergerに関するnumerical simulationは

idealized, isolated, binary merger

▷ IllustrisTNGでcosmological environmentでのpost-merger(PM)の大規模サンプルを作り、観測と同じ手法でmergerの星形成への影響を探る (Interacting pairsについてはPatton+2020)



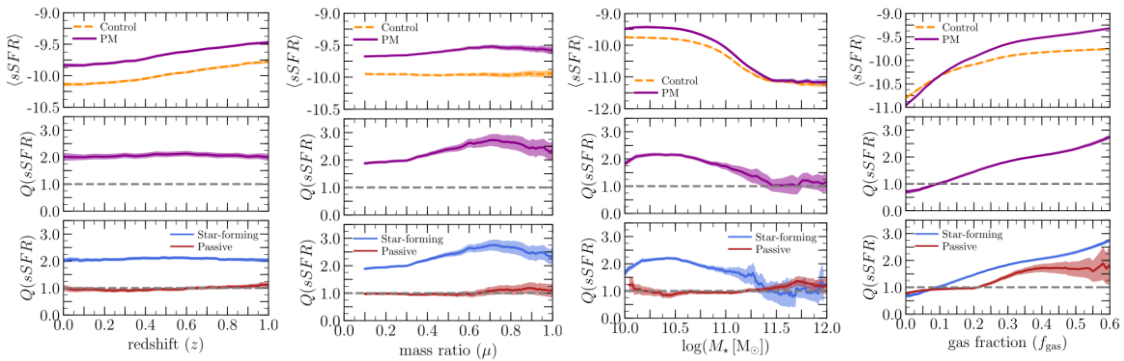
- Control sample
- 直近2Gyrにmergerなし
 - 星質量が同じ
 - 2Mpc半径の密度が同じ
 - 最近接銀河までの距離が同じ
 - SF/passiveの分類が同じ
 - 同じsnapshot(redshift)

星形成活動比較の指標

$$Q(sSFR) = \frac{\langle sSFR_{\text{pm}} \rangle}{\langle sSFR_{\text{control}} \rangle}$$

星形成促進の依存性

- Post-mergerはcontrolの2倍程度の $\langle sSFR \rangle$ ($Q(sSFR) \sim 2$)
 - ほぼSF-PMによるもので、passive-PMはcontrolと変わらない
 - f_{gas} についてはpassive-PMでの依存性が見える
 - ▷ f_{gas} を揃えたcontrol sampleにしてもSF enhanceは残る
 - 同じ f_{gas} でもSF-PMの $Q(sSFR)$ がpassive-PMより高い
- 他の要素が重要 (gas phase, feedback, SFE)



その後の進化: 同定されたPMをsimulationで追う

controlは(i)同じsnapshotから(ii)PMと同定されたときのcontrolをそのまま(ii*)PMと同定されたときのcontrolが同じ分類(SF/passive)のもののみ

SFR enhancement

- post-mergerのSFR enhancementは ~ 500 Myrで減衰する
- 始めの $\sim 100-250$ MyrのSFR enhancementはmergerのmass ratioに依存する

SFR suppressing

- 特に強いmerger由来のstarburstを経験した銀河はそれらのcontrol sampleより短いタイムスケールでpassiveに進化する

