The Star Formation Properties of Merging Galaxies at 0.3<z<2.5

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Why study high-z galaxy mergers?

- The merging of two galaxies with similar mass (major mergers) can make profound changes in the morphology and the properties of galaxies.
Why study high-z galaxy mergers?

❖ The merging of two galaxies with similar mass (major mergers) can make profound changes in the morphology and the properties of galaxies

❖ Their fraction seem to increase with redshift

Most of studies of major mergers at $z>1$ have focus on global statistics (e.g. merger rate) and not impact on properties

In this work, we focus on the SF properties of high-z merging galaxies
We select galaxies with **two intact nuclei** separated by few kpc (**just before coalescence**).
Method to Select Mergers

Lackner et al. 2014

A. Early-Stage
Selection of galaxy pairs with separations <100 kpc

B. Pre-coalescence
We select galaxies with two intact nuclei separated by few kpc (just before coalescence).

C. Post-Merger
Selection of galaxies with disturbed morphologies
Select bright regions in an image.

Restrictions on the properties of these regions to select galaxy pairs at close separation.
Apply method to near-IR HST/F160W images

- Selection of mergers in rest-frame optical/NIR out to z=2.5
- Centered on ~5700 galaxies with $M_{\text{star}} > 10^{10} M_{\odot}$ and $0.3 < z_{\text{best}} < 2.5$ in CANDELS (COSMOS, AEGIS, GOODS-N, GOODS-S, UDS) fields
- Match selected regions with 3D-HST catalogs (Skelton+14, Momcheva+16) to find properties
- Use redshifts to separate potential mergers from line of sight contaminants
Final Sample of Mergers

- **Primary Sample:** 130 merging systems (8.3<logM_{star}<11.5)
- Projected distance 3-15 kpc
- Major Mergers constructed using a cut in stellar mass ratio
- 0.3<z<2.5

- **High-mass sample:** 64 systems (both galaxies with M_{star}>10^{10}M_{sun}, Guo+12)

We will focus mostly on this sample
Use UVJ colors to separate galaxies by type

Whitaker et al. 2015
Martis et al. 2016
Use UVJ colors to separate galaxies by type

Separate Galaxies

Quiescent (36%)
Star-forming dusty (42%)
unobscured (22%)

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Separate Mergers

Wet (53%)
Mixed (22%)
Dry (25%)

Whitaker et al. 2015
Martis et al. 2016
Examples of Merger Types
Examples of Merger Types
Wet mergers are dominant at higher $z$

Fraction dry mergers increases with cosmic time
Fraction dry/mixed/wet mergers

- Wet mergers are dominant at lower $M_{\text{star}}$.
- Fraction dry mergers increases with $M_{\text{star}}$.
Fractions of w/m/d mergers roughly constant with separation.
Definition of Starburst

Starbursts

The Main Sequence of SF galaxies

SFR (Msun/yr) vs. Mass (Msun)

0.5 dex
Starbursts

Star-forming merging galaxies

Includes Primary sample

MS fit Whitaker+14
Comparison SF activity in Mergers & non mergers
KS test: No difference

12% of the merger sample are starbursts

All the starbursts are dusty SF galaxies and are in wet mergers

High $f_{\text{gas}}$?
Higher fraction of starbursts (20%) in merging galaxies

Higher enhancement in SF activity in low mass merging galaxies

\( \text{KS test: Different population} \)

At masses \( \log(M_*/M_\odot) < 10 \)
As the total mass of the merging system increases, the SF activity of the less massive member is more affected. The SF activity of the less massive member has higher sSFR in the following cases:

- Both log(M/M) < 10: 31%
- One log(M/M) > 10: 37%
- One log(M/M) > 10.5: 56%

Which of the merging galaxies is more affected?

- If m1 < M1, m1 is more affected.
- If m2 < M2, m2 is more affected.
Conclusions

- We find no significant difference between the star formation activity in mergers and nonmergers ➔ In agreement with recent simulations (e.g. Fensch+17). This merger sample is still in early stage yet to reach its maximum SF activity.

- Lower mass and dusty merging galaxies are more affected by interaction ➔ SF enhancement depends on properties of the galaxies.