Merging of quenched dwarf galaxies

By Carol, Kristian, and Lea

Goal of the project

Investigate if a merger of two quenched low mass dwarf galaxies can trigger star formation

Literature

- Gao et al., *Merger-induced star formation in low-metallicity dwarf galaxy NGC 4809/4810*, 2023

- Baron et al., *Star formation and molecular gas properties of post-starburst galaxies*, 2023

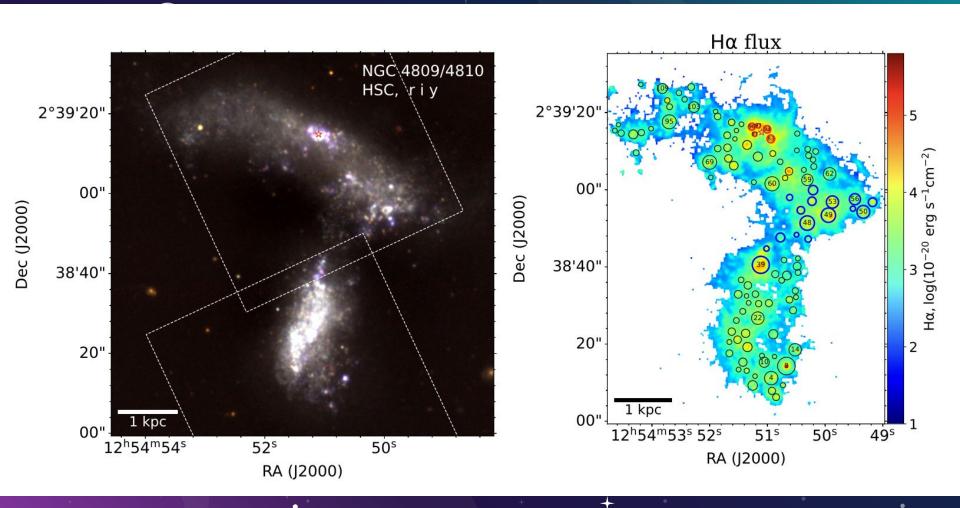- Li et al., *The Subtle Effects of Mergers on Star Formation in Nearby Galaxies*, 2023

- Rathore et al.,*Star-forming S0 Galaxies in SDSS-MaNGA: fading spirals or rejuvenated S0s?*,2023

- Pearson et al., *Effect of galaxy mergers on star-formation rates*, 2019

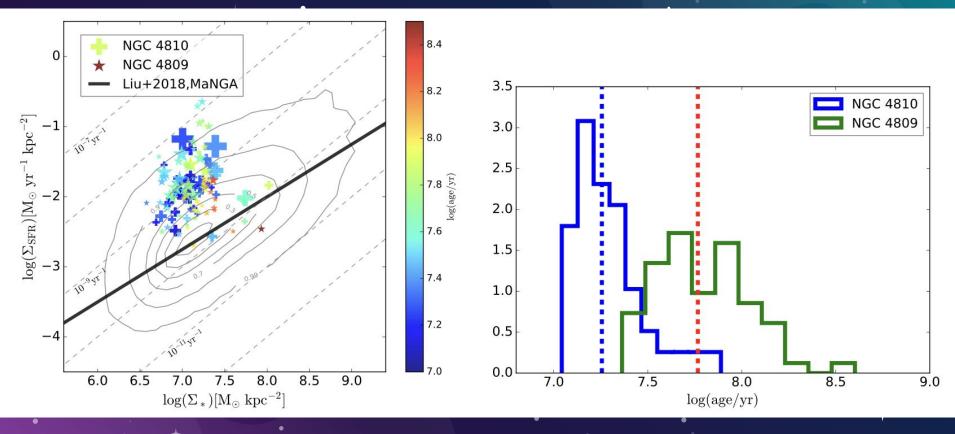# Gao et al., *Merger-induced star formation in low-metallicity dwarf galaxy NGC 4809/4810*, 2023

"<u>The merging stage of two dwarf galaxies can induce starburst activities at the interaction areas, despite the metal-deficient environment.</u> Considering the <u>high specific SFRs and different stellar ages</u>, we propose that the interaction initially triggered star formation in NGC 4809 and then drove star formation in NGC 4810."

"In NGC 4809, the star formation rate <u>remains constant with time</u>, whereas in NGC 4810, <u>the stellar mass assembly process is more efficient</u>. These might indicate that galaxy interaction first destabilize the molecular gas cloud in NGC 4809, then transport molecular gas into NGC 4810 and create new stars."

NGC 4809/4810
HSC, r i y

Hα flux

Rathore et al., *Star-forming S0 Galaxies in SDSS-MaNGA: fading spirals or rejuvenated S0s?*, 2023

"S0 galaxies are known to be in general red and non-star forming"

"in our sample of SF-S0s, star-formation has been rejuvenated, with <u>minor mergers likely to be a major driver</u>"

Baron et al., *Star formation and molecular gas properties of post-starburst galaxies*, 2023

"Our results show no contradiction with the common galaxy evolution picture, where <u>the decrease in SFR is due to the consumption of molecular gas by the starburst.</u>"

Li et al., *The Subtle Effects of Mergers on Star Formation in Nearby Galaxies*, 2023

"Among low-redshift galaxies, <u>galaxy mergers</u>, including those that involve gas-rich and nearly equal-mass galaxies, <u>exert a minimal impact on their SFR, specific SFR, or star formation efficiency.</u> Starbursts are rare. The star formation efficiency of gas-rich, minor mergers even appears suppressed."

"Contrary to popular wisdom, we find no excess of star-bursts in gas-rich, major mergers. Gas-rich, minor mergers, if anything, form stars even less efficiently than non-merging galaxies."
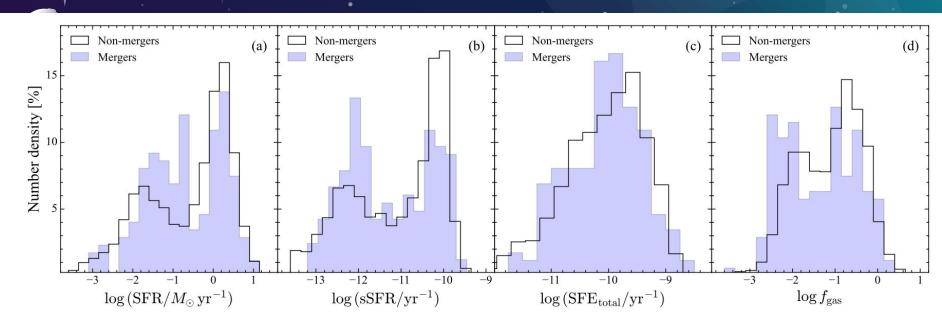
Figure 4. Distribution of (a) SFR, (b) sSFR, (c) SFE, and (d) gas-to-stellar mass ratio $f_{\rm gas}$. Mergers and non-mergers are denoted as filled and open histograms, respectively.

Pearson et al., *Effect of galaxy mergers on star-formation rates*, 2019

"<u>Galaxy mergers have little effect on the SFR</u> of the majority of merging galaxies compared to the non-merging galaxies. The typical change in SFR is less than 0.1 dex in either direction. Larger changes in SFR can be seen but are less common. The increase in merger fraction as the distance above the galaxy main sequence increases demonstrates that <u>galaxy mergers can induce starbursts</u>."
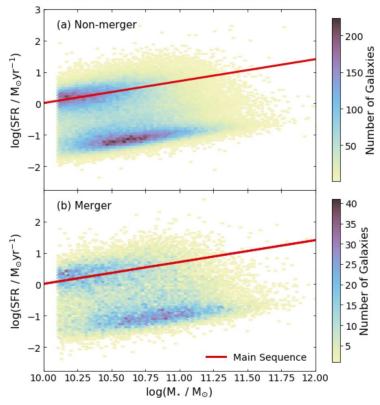
Fig. 9. SFR-$M_\star$ plane populated with (*a*) non-merging galaxies and (*b*) merging SDSS galaxies. The colour indicates the number density from low (light yellow) to high (dark purple). Overlaid in red is the MS that has been fitted to all star-forming galaxies. As can be seen, the distributions of the merging and non-merging galaxies are similar with respect to the plotted MS.
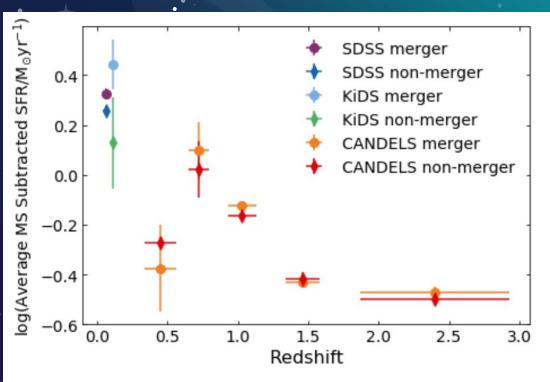
Fig. 13. Average MS subtracted SFR of star-forming galaxies for SDSS merging (purple circle) and non-merging (dark blue diamond); KiDS merging (light blue circle) and non-merging (green diamond); and CANDELS merging (orange circles) and non-merging (red diamonds) galaxies. As can be seen, the change in SFR between the merging and non-merging galaxies is typically small.

Planned phases of the project

Step 1: Single gas cloud

- Setup simple spherical cloud
- Hydrodynamics and gravity
- Check star formation rate of cloud
- Fine-tune until SFR goes to 0

Step 2: Merging gas clouds

- Create two gas clouds
- Set initial conditions for merger
- Observe SFR before and after merger
- See if this simple setup can trigger star formation

Step 3: Realistic dwarf galaxy

- Using GalactICS package, set initial conditions to resemble actual quenched dwarf galaxies including non-gas components

Step 4: Final code

- Combine everything:
    - Realistic quenched dwarf galaxies
    - Merger of 2 galaxies
- Plot star formation rate as function of time