Star-formation activity in isolating and interacting low-mass galaxies

Jing Sun, Kat Barger, Hannah Richstein

Physics and Astronomy Department, TCU

Abstract:

Interaction between galaxies is of critical importance to the formation and evolution of galaxies. We are conducting a study on both isolated and interacting low-mass galaxies to determine how their environment impacts their star-formation ability. We compare the features of gas and stars in isolated and interacting galaxies to examine the differences and similarities. The interaction-triggered star-formation activity will be further discussed to analyze how the internal properties of galaxies are influenced by the outer environment. This investigation is based on data from the fourth-generation Sloan Digital Sky Survey (SDSS-IV) / Mapping Nearby Galaxies at Apache Point Observatory (MaNGA), and is part of the project No.0285 in SDSS-IV.

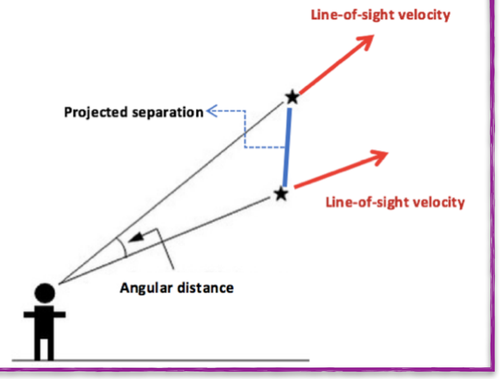
Sample selection criterion

Inspired by the Magellanic system nearby (about 50 kpc away from the Galactic center), the samples in this work are selected based on three criterions:

1. *Stellar mass* : $5\times10^8\ M_\odot \leq M_\star \leq 6\times10^9\ M_\odot$
2. *Morphological type* : *Not elliptical*
3. *Minor/major axis ratio* : $b/a \geq 0.7$ *(face-on)*

The projected separation (*dproj*) and the difference in line-of-sight velocity (Δv_{LOS}) to the nearby galaxies will be calculated for each sample. There are 4 groups of samples will be introduced in this work:

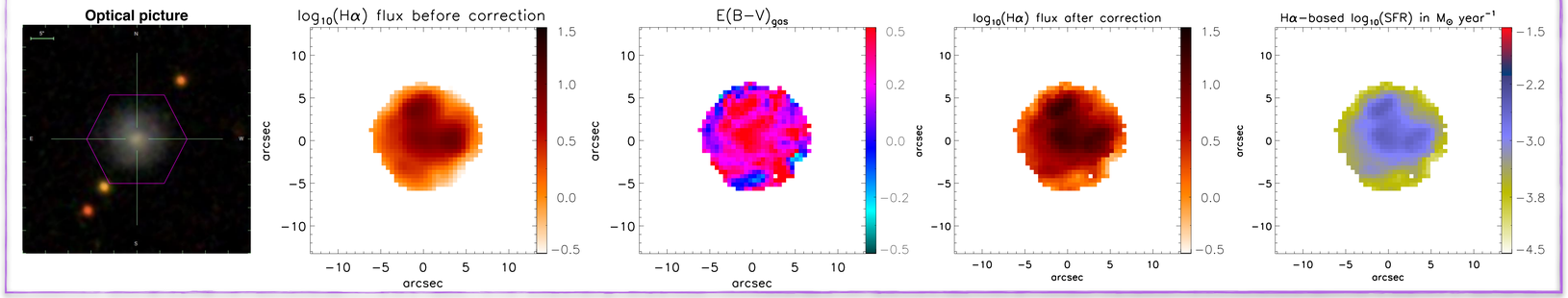
1. *Control samples (G1)* ▲
   - *Do not have any neighbors within 1500 kpc.*
2. *Isolated dwarf-paired samples (G2)* ■
   - *Have low-mass 1st-neighbor within 150 kpc.*
   - *Do not have massive neighbor within 1500 kpc.*
3. *Non-isolated dwarf-paired samples (G3)* ●
   - *Have low-mass 1st-neighbor within 150 kpc.*
   - *Have massive neighbor within 1500 kpc.*
4. *Massive-paired samples (G4)* ✦
   - *Have massive 1st-neighbor within 150 kpc.*



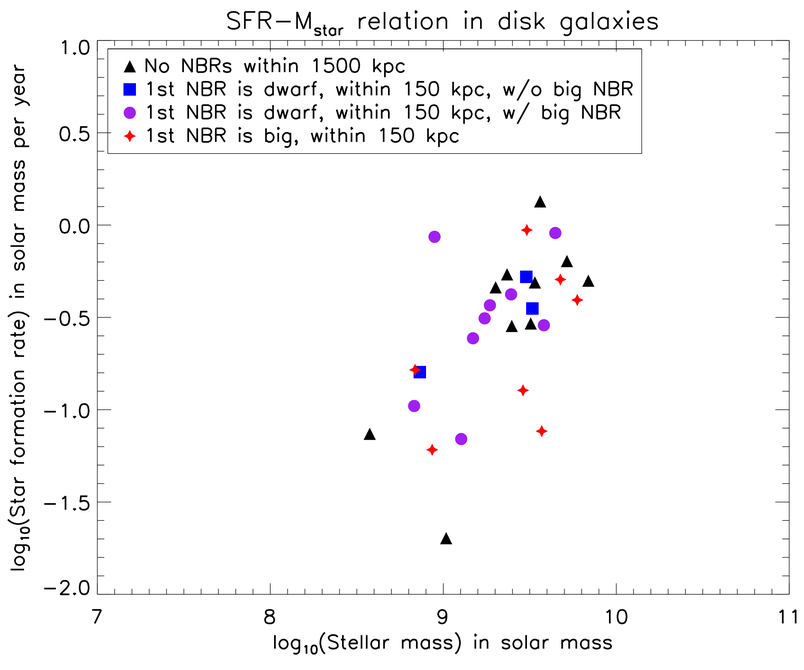
Reddening correction and star-formation rate calculaion.

Light that scatters on dust grains appears redder. Before we explore the properties of our galaxies, we need to correct for this dust effect. The E(B-V) map is presented to show the degree of reddening. The current star-formation rate (SFR) can be calculated from the amount of ionized hydrogen gas, which traces the stellar activity inside the galaxy. One of the G1 galaxies (PlateIFU=8711-6103) is shown below as an example.

- The central SFR (in the logarithm) of galaxies in G1, G2, G3, G4 is -3.15, -3.33, -3.54, -3.10, respectively.



Evidences indicate that galaxy evolution is influenced by merger events. We conduct an investigation on how galaxies in interacting pairs evolve differently than those in isolation. This poster shows the current star-formation activities in different galaxy systems. By analyzing the similarities and differences in the star-formation rate, the scenario in evolution during the merger event will be further discussed in the future.



Star-formation activities in these galaxies

Conclusions so far,

Galaxies in G1 have the highest total SFR than galaxies in other groups, which suggests that low-mass galaxies may have a different scenario of merger event. Massive galaxies usually will have an enhanced SFR during the interaction, but the low-mass galaxies do not have a sufficient strong gravity to hold their gas during this procedure. Therefore, the star-formation activities in low-mass galaxies is difficult to be maintained due to the lack of fuel.

Galaxies in G1, G2, and G3 have a higher total SFR than galaxies in G4, which demonstrates that a massive neighbor within 150 kpc clearly weaken the star-formation activities in both interacting and non-interacting low-mass galaxies. Due tho their smaller size, low-mass galaxies are very easy to lose their gas when there is a massive neighbor nearby.

Galaxies in G2 have a higher central SFR than galaxies in G3, which indicates that the interaction between low-mass galaxies will be affected by a massive neighbor. Gas in low-mass galaxies are easy to be stripped by a massive neighbor, which may cause the galaxies in G3 do not have enough gas to fuel the central star-formation activities. It is not clear yet why the total SFR is increased when a nearby massive galaxy exists.

SDSS data is extracted to obtain the total star-formation rate (SFR) and the total stellar mass of each galaxy samples. The SFR-M⋆ relation is shown above.

- The average total SFR (in the unit of solar mass per year) of galaxies in G1, G2, G3, G4 is 0.46, 0.34, 0.39, 0.32, respectively.