中国科学院上海天文台
SHANGHAI ASTRONOMICAL OBSERVATORY,
CHINESE ACADEMY OF SCIENCES

Linking the molecular gas content of galaxies with spatially resolved star formation history

Yang Gao (高扬)
SHAO

Collaborators: Ting Xiao, Cheng Li, Yu Gao, Christine D. Wilson, José R. Sánchez-Gallego, Xue-Jian Jiang, Lin Lin and some others

JCMT Users Meeting 2018
Seoul National University

Outline

- Motivation
- Data : CO observations
- Results: Properties of the sample

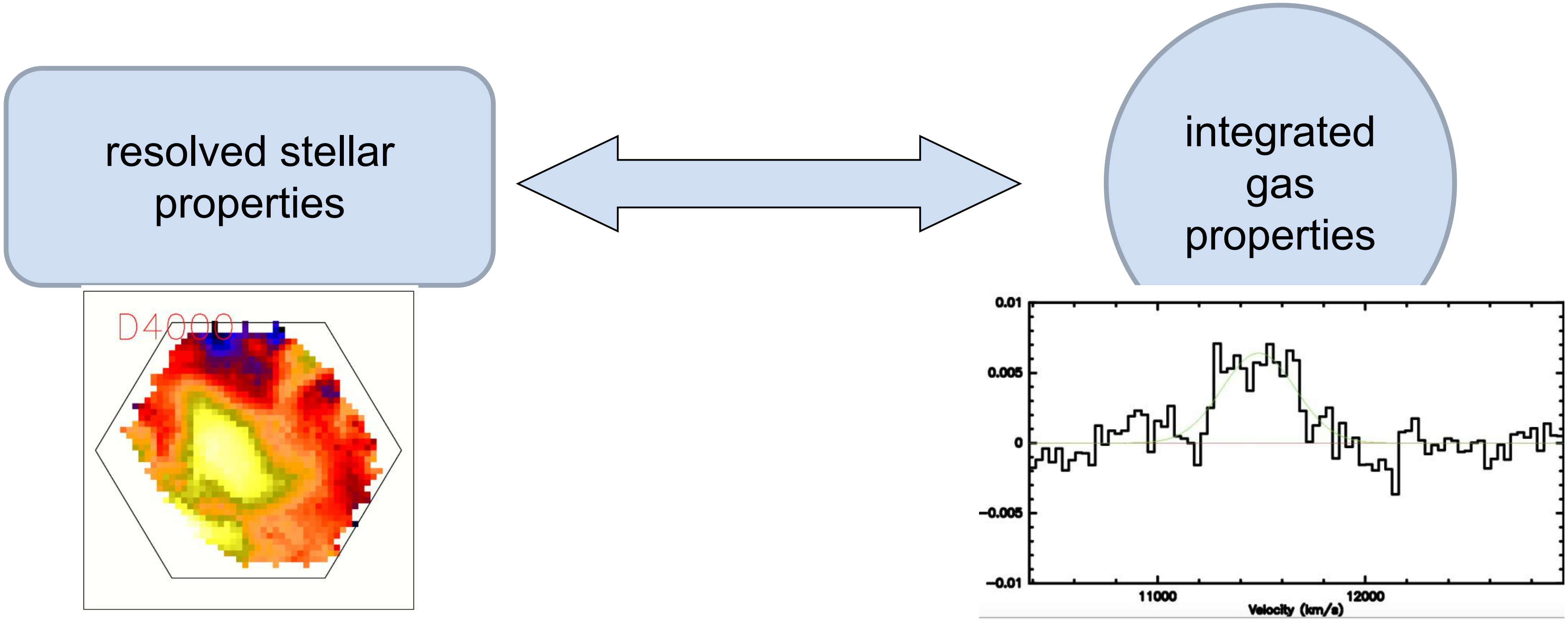
  M_{H2} estimator

  H2 vs. SF and SFH:
  With integrated parameters
  With 2D parameters
- Summary

Paper I (Data; Results: Properties of the sample, M_{H2} estimator)

Paper II (H2 vs. SF and SFH: With integrated parameters, With 2D parameters)

Motivation



- We want to probe correlations of the total cold gas content of galaxies with their spatially-resolved properties and processes.

- We combine the 2-d spectroscopy data provided by MaNGA with CO measurements from PMO/JCMT/CSO spectra.

Observations

PMO13.7m CO1-0 Observation

☆ The criteria of the sample (based on MPL-3 sample):
5h<RA<18h; z<0.05; flux_12um> 28mJy

☆ Total on-source time: 78 hr

☆ Observed source:17 detections(S/N >7)

JCMT CO2-1 Observation (the JINGLE pilot program)

☆ Total on-source time: 16.5 hr

☆ Observed sources:16 detections and 5 upper-limits

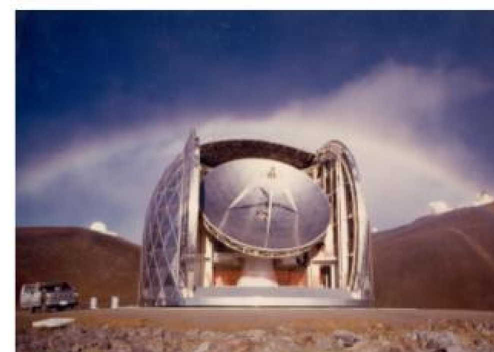
CSO CO2-1 Observation

☆ Total on-source time: 3hr

☆ Observed sources: 3detections

DLH (PMO 13.7m)

JCMT



CSO

Molecular gas vs Global stellar properties

To compute the mass of molecular gas:

$$\mathrm{M}_{mol} = \alpha_{CO} L_{\mathrm{CO}} \quad \alpha_{\mathrm{CO}} = 4.3 M_{\mathrm{O}} (K\,.km/s)^{-1}$$

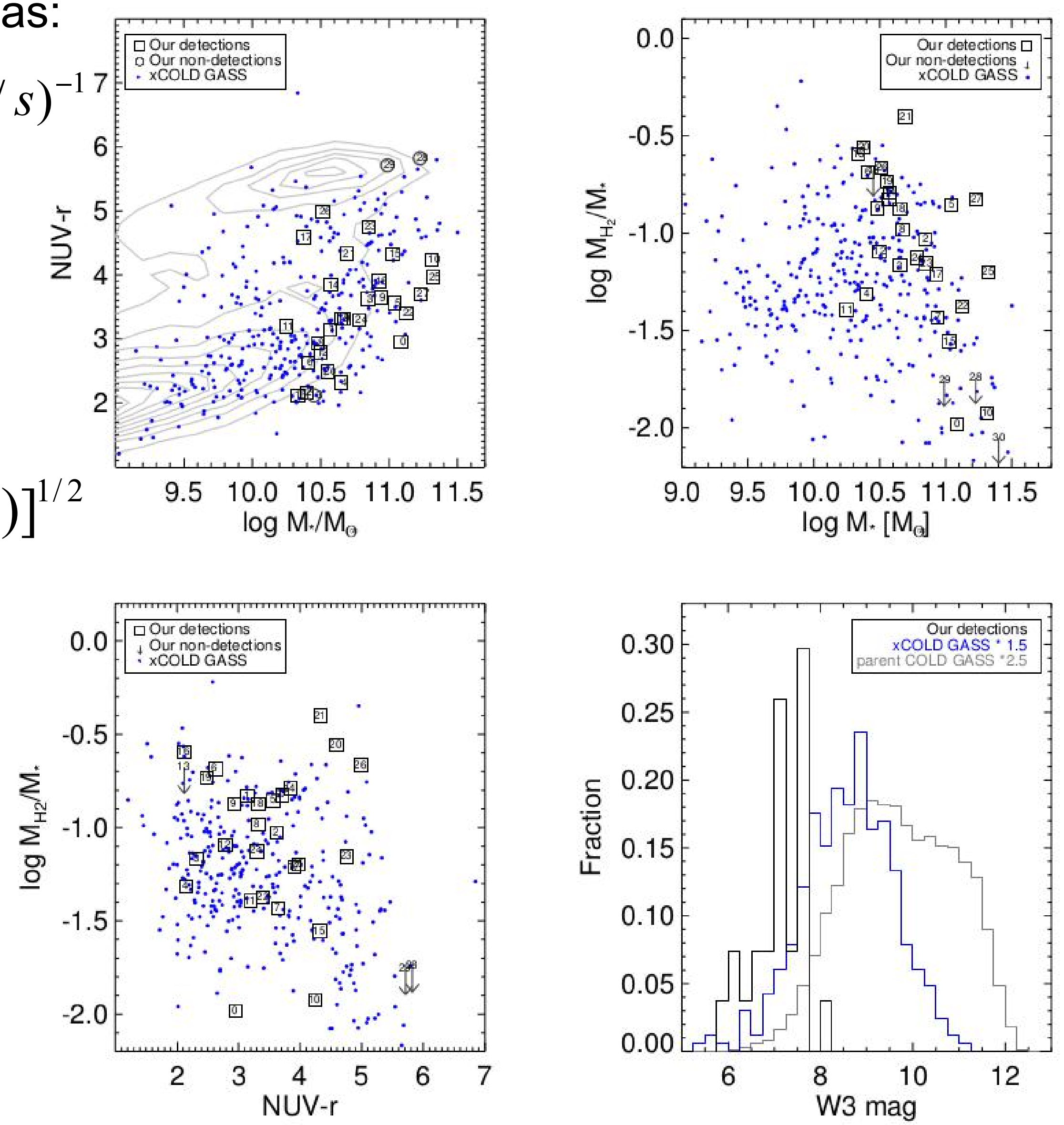
$$\mathrm{L}_{\mathrm{CO}} = 2453 S_{CO} \Delta v D_L^2 /(1+z)$$

$$R21 = 0.7$$

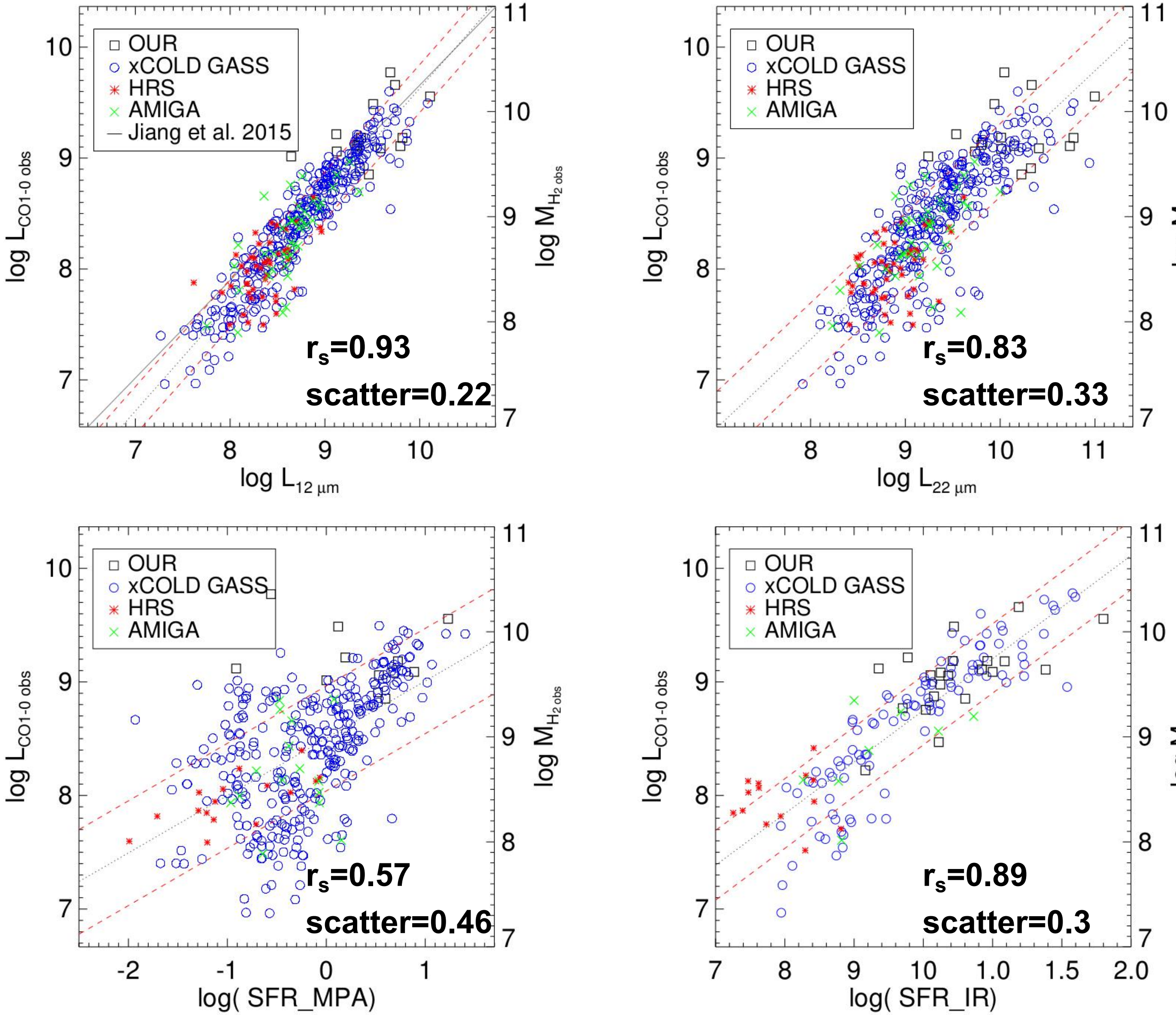
To get the standard error:

$$\mathrm{N} = T_{rms} \Delta v_{FWZI} /[f(1 - \Delta v_{FWZI}/W)]^{1/2}$$

Gao et al. 1996,Solomon et al. 1997 ,Balatto et al. 2013



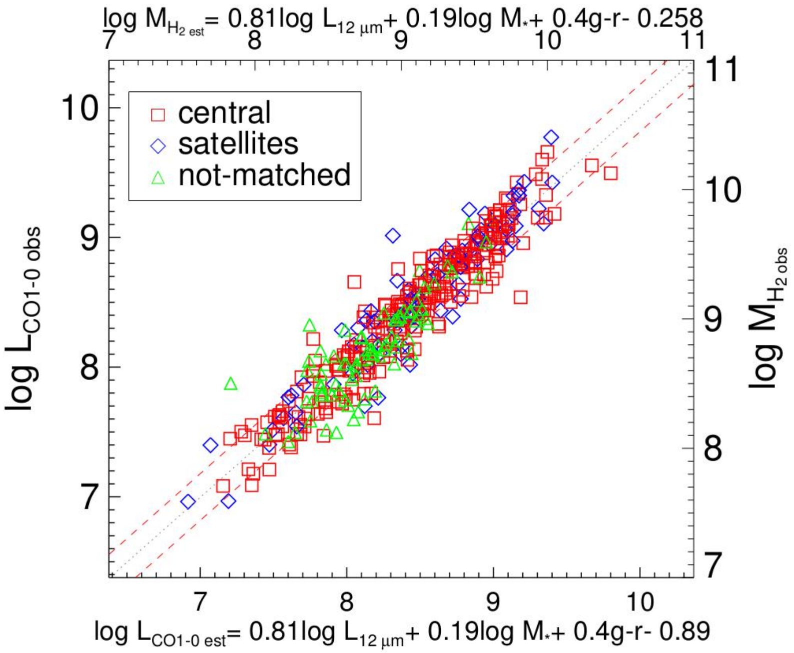
The Relationship between M(H2) and 12μm

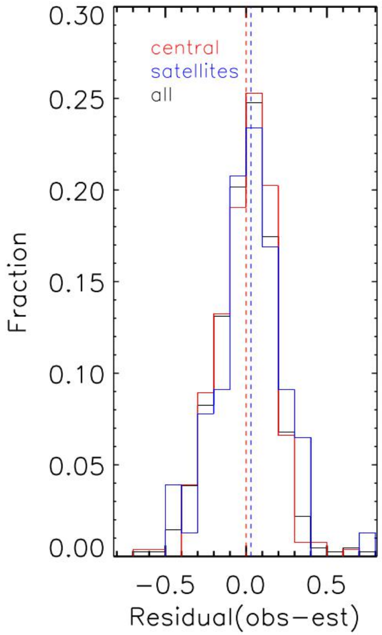


M(H2) is most tightly correlated with 12μm luminosity.

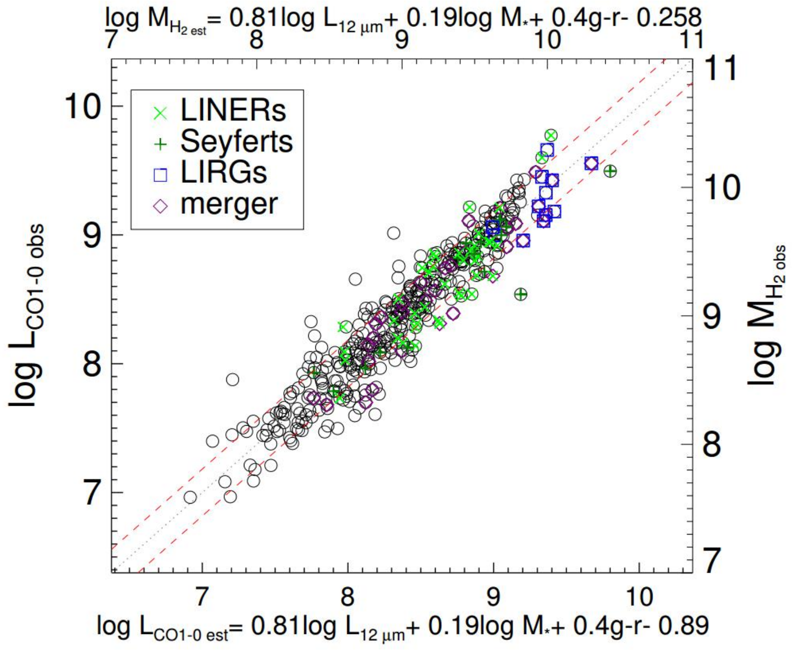
$L_{12\mu m}$ can be used to estimate H2 mass.

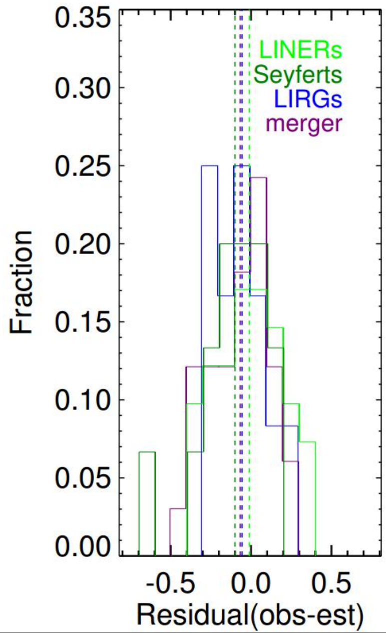
New M(H2) estimations





The new estimation is well behaved for central and satellites.

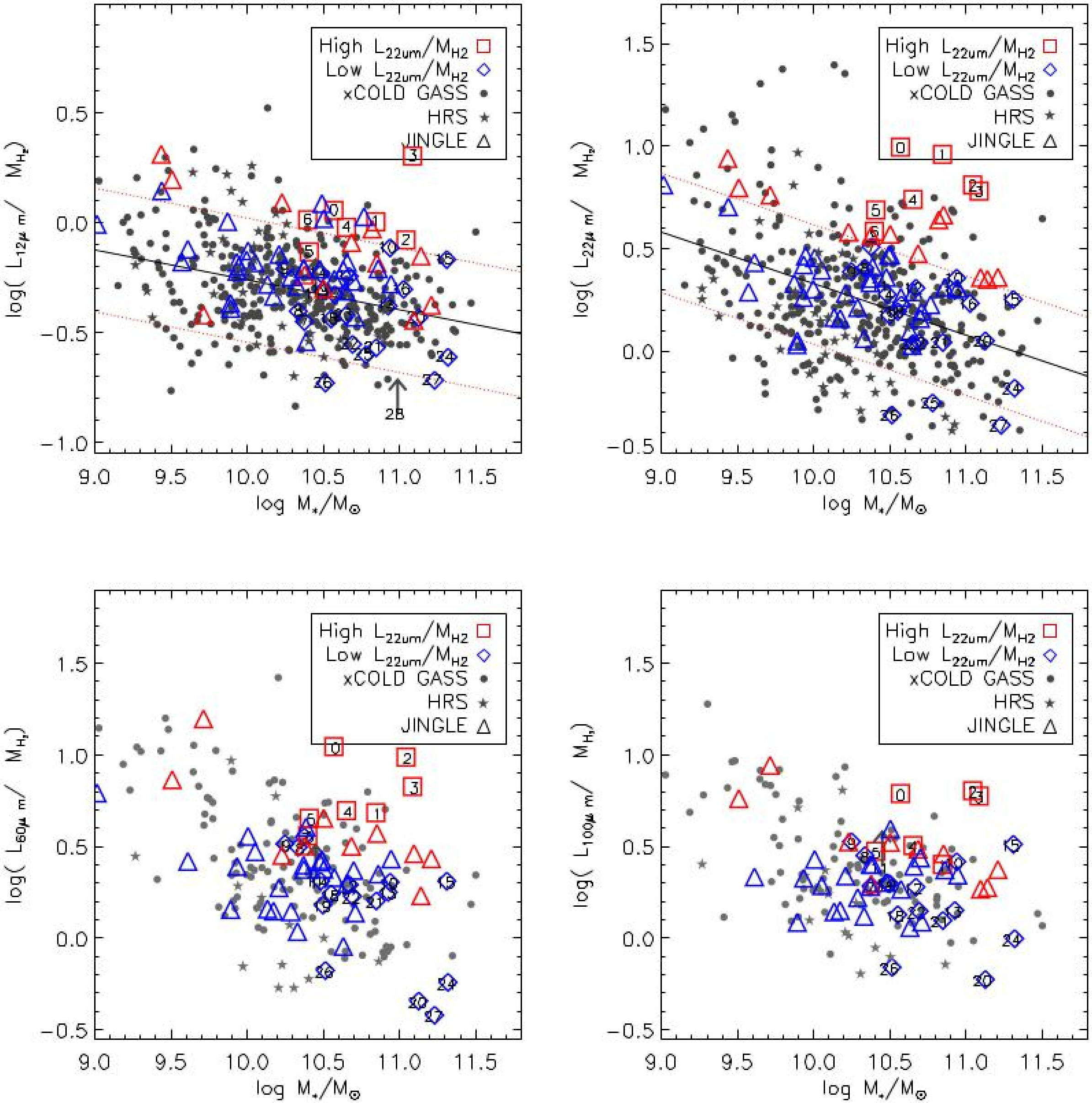




The effect of some particular galaxy populations is not significant.

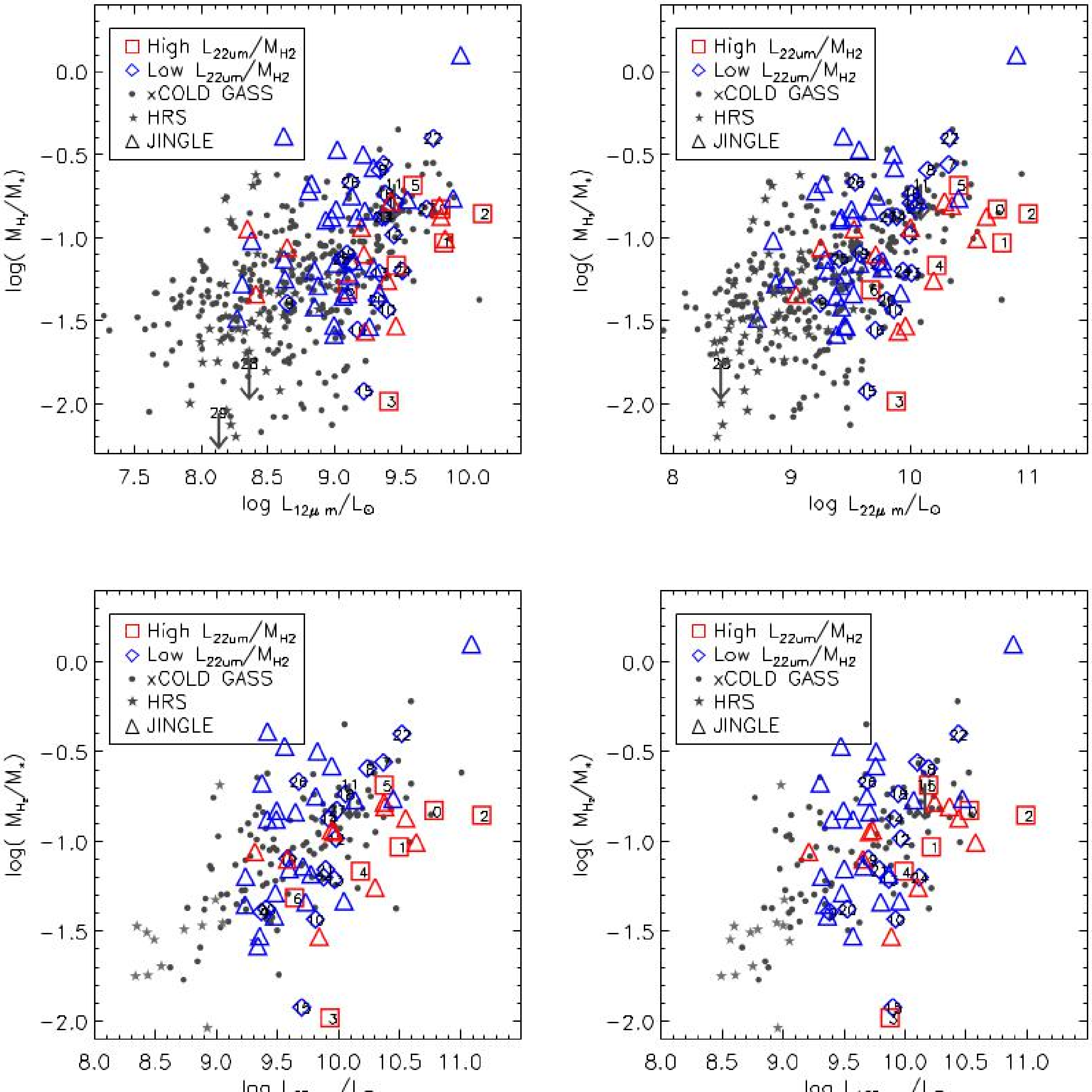
Some alternative relations with optical luminosities

Galaxies with relatively high mid-infrared luminosities



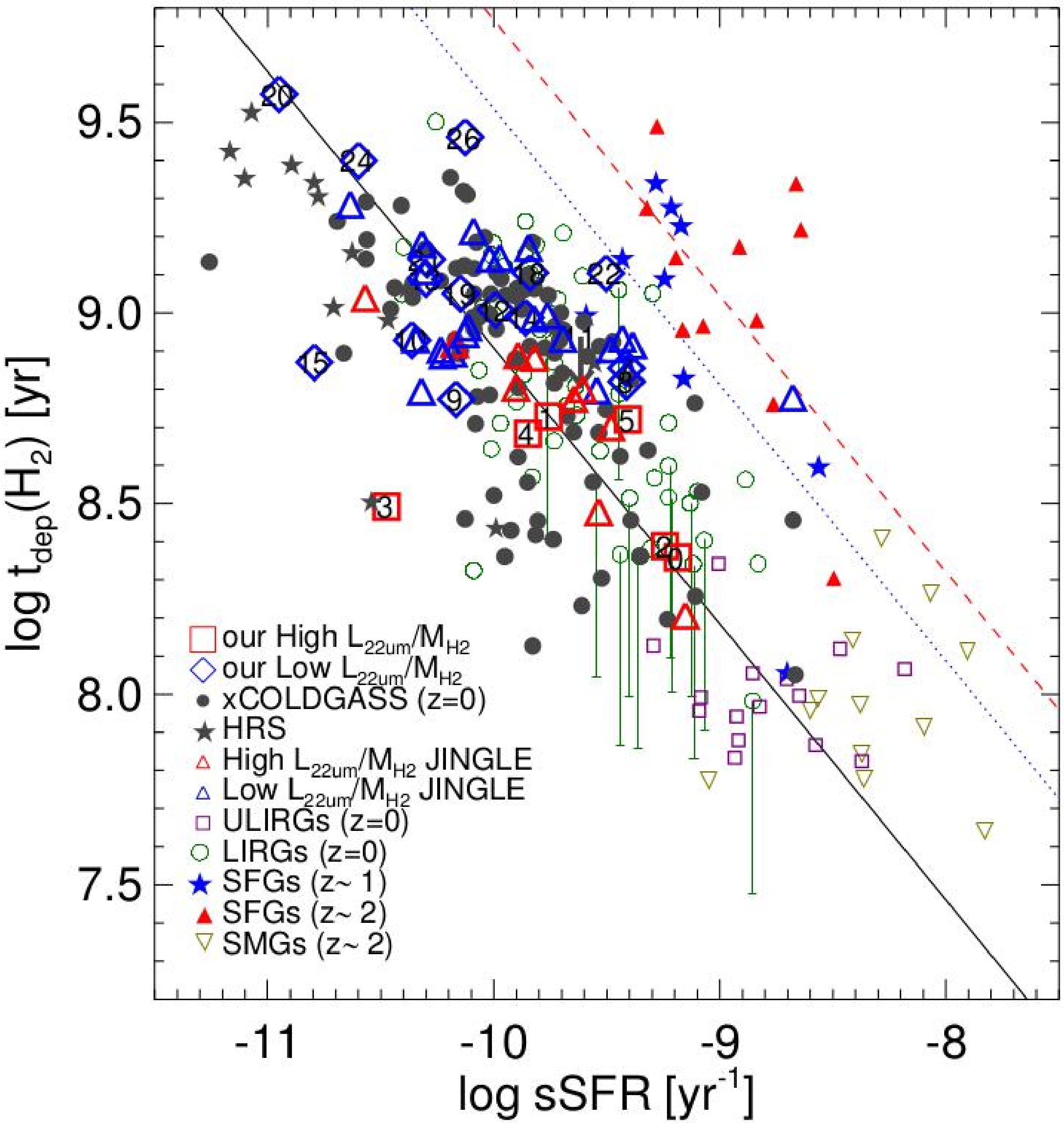
We find some galaxies with higher L_{IR}/M_{H2} at fixed M_*

Galaxies with relatively high mid-infrared luminosities



These galaxies have normal molecular gas fraction, but exceeded infrared emission

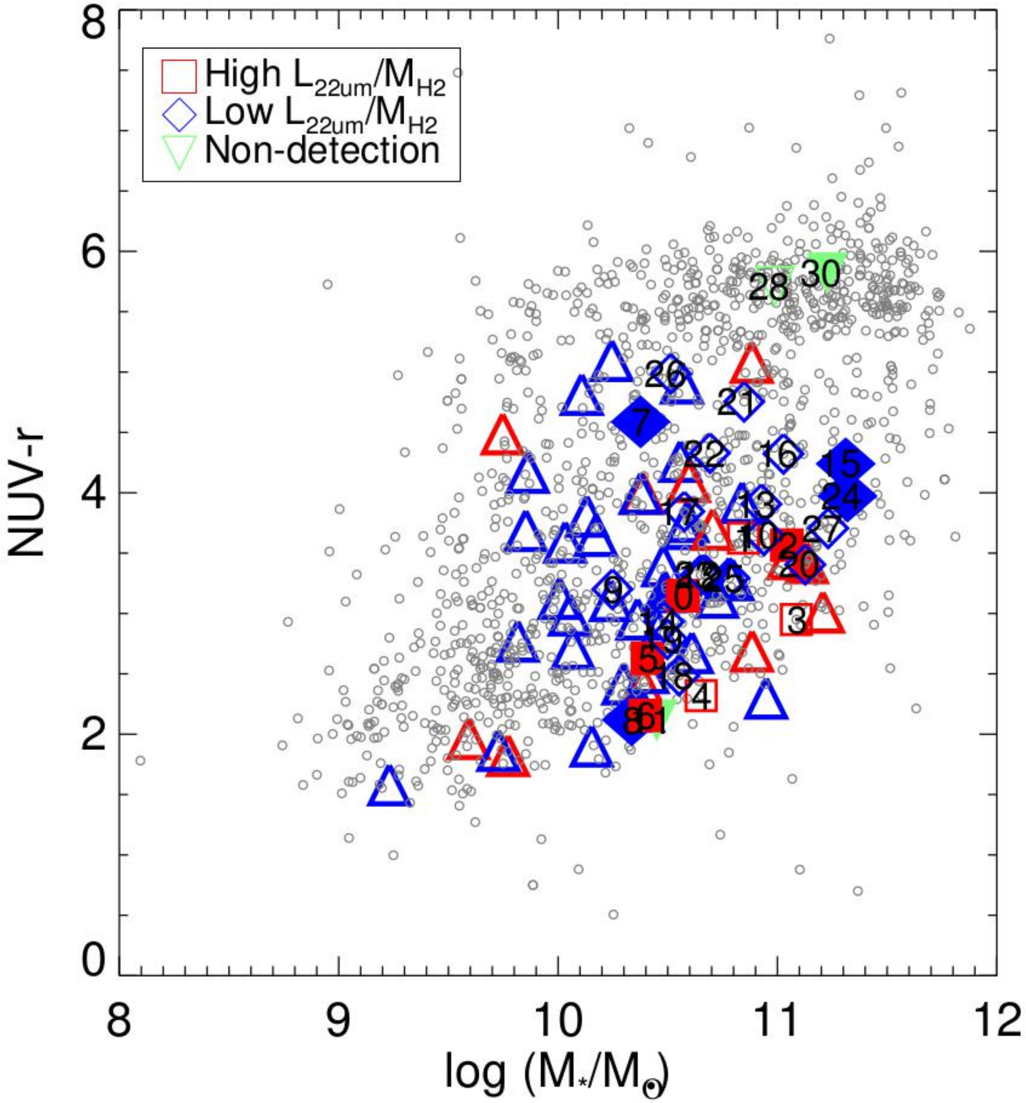
Galaxies with relatively high mid-infrared luminosities



The region of these galaxies are between local SFGs and local LIRGs in the diagram of t_{dep}(H2) vs. sSFR.

Their increased sSFRs is more likely due to dynamical disturbance or interaction.

Galaxies with relatively high mid-infrared luminosities



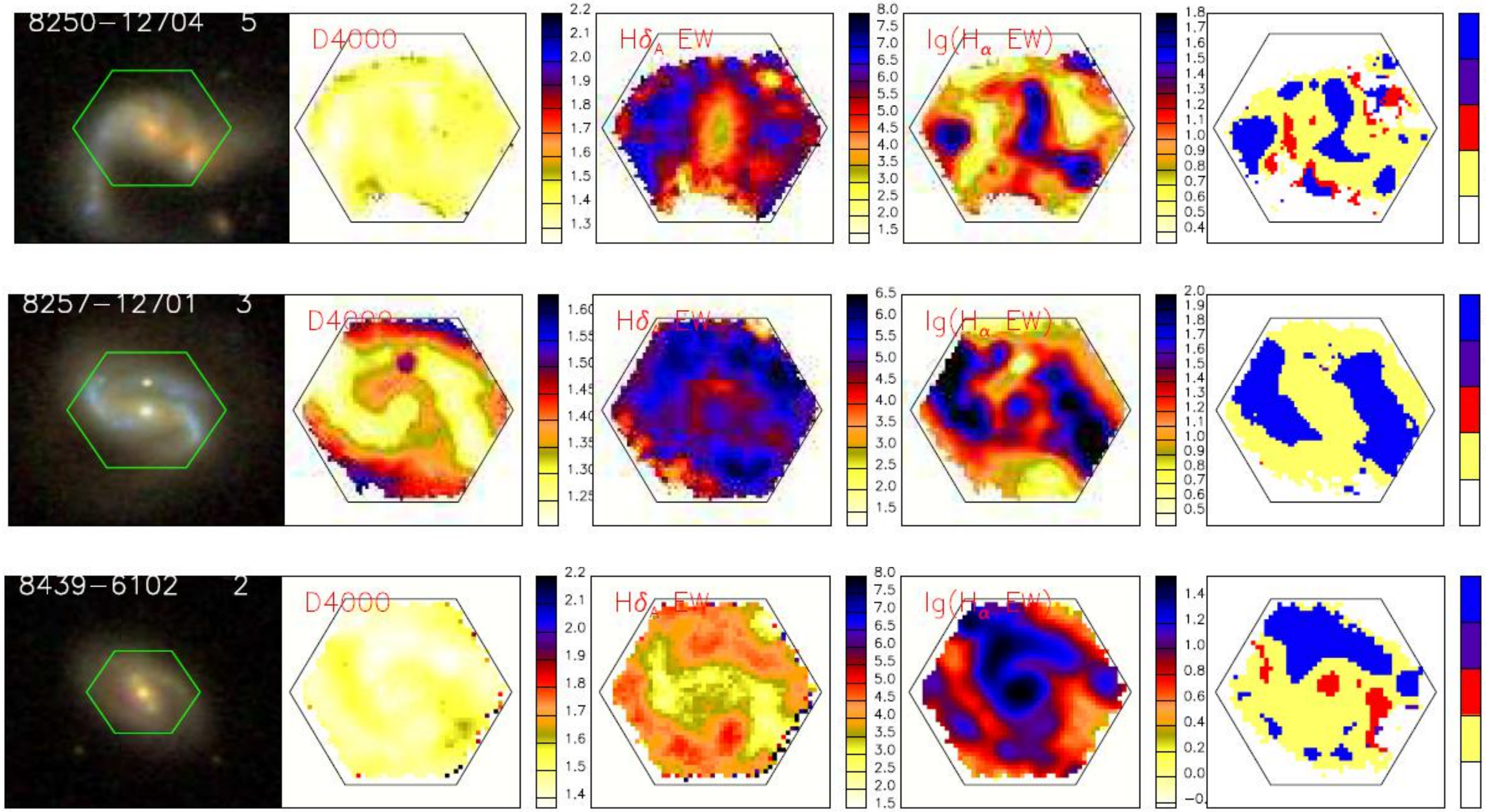
merger/interaction: 4/7

merger/interaction: 4/20

The fraction of galaxies with interaction in high L_{IR}/M_{H2} sample is significantly larger than the fraction in low L_{IR}/MH2 sample.

Galaxies with relatively high mid-infrared luminosities

D4000 **$H\delta_A$** **H_α** **BPT**



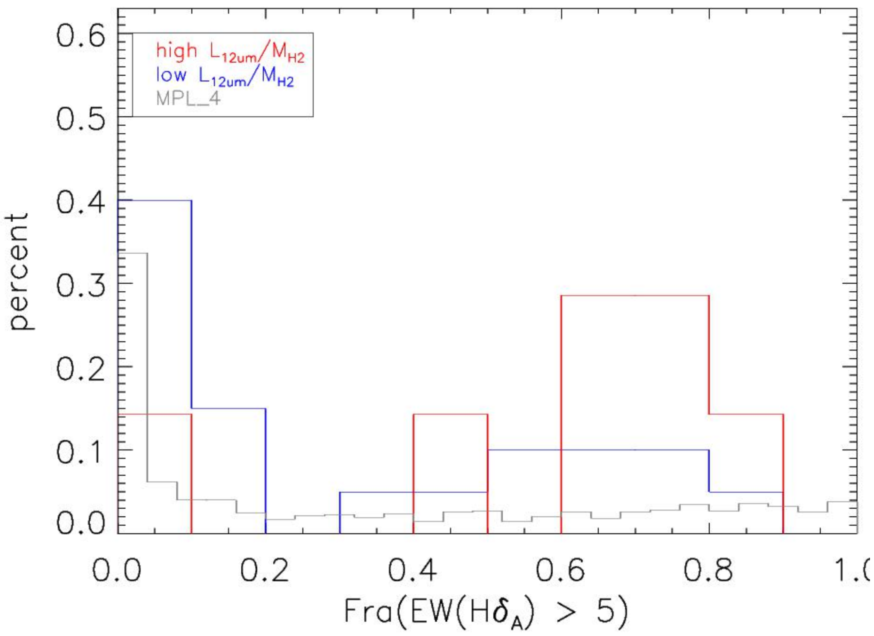
merger

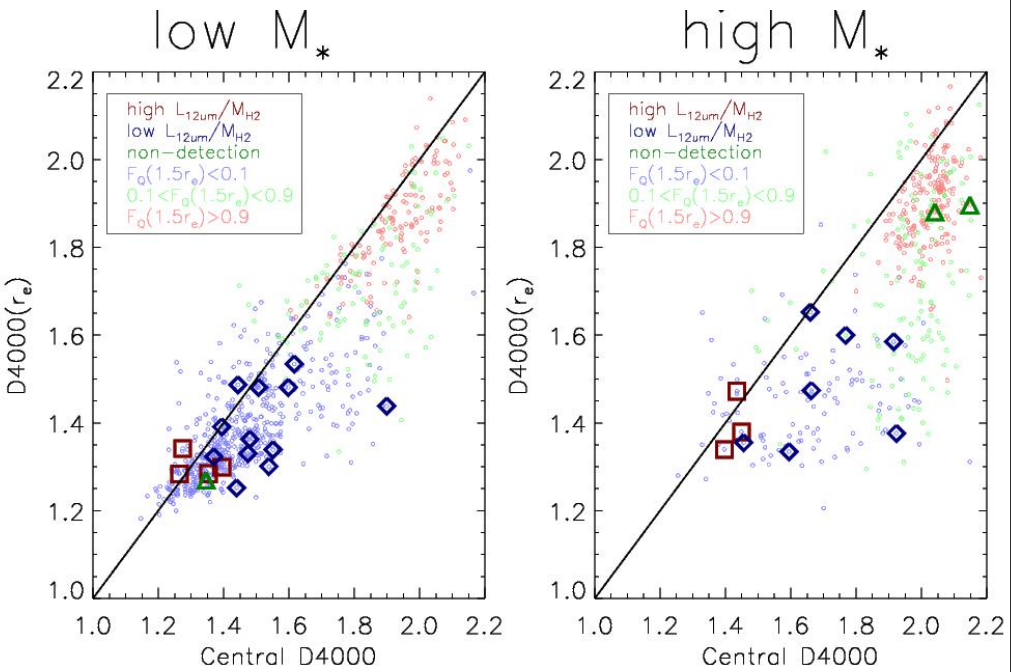
non-merger

central AGN

Their MIR luminosity is enhanced by the warmer dust heated by intense (post) star formation or AGN.

Galaxies with relatively high mid-infrared luminosities





For these mid-infrared bright galaxies:

Most regions are with high EW(Hδ_A)

D4000 is low in both central and outer regions

These galaxies are fully star-forming galaxies before evolving into the partly quenched phase.

Summary

1.We have obtained integrated CO(J=1-0) data for 17 mid-infrared bright MaNGA galaxies,and CO(J=2-1) data for 22 random selected MaNGA galaxies, with overlapped observations for 8 galaxies.
2.We confirm the tight relation between 12μm emission and M(H2).
3.We correct the M(H2) estimation with some optical parameters.
4.We found that most of the galaxies with relatively high mid-infrared luminosities are triggered by interactions/mergers to form stars and consume the cold gas.

Next steps:
1)add multibands data to analyse the SFHs.
2)analyse the influnces of molecular gas on SFHs with models and simulations.
3)enlarge our CO sample(select from MPL_5).

Thank you！