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

JINGLE pilot sample and CO luminosity estimators

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SHAO

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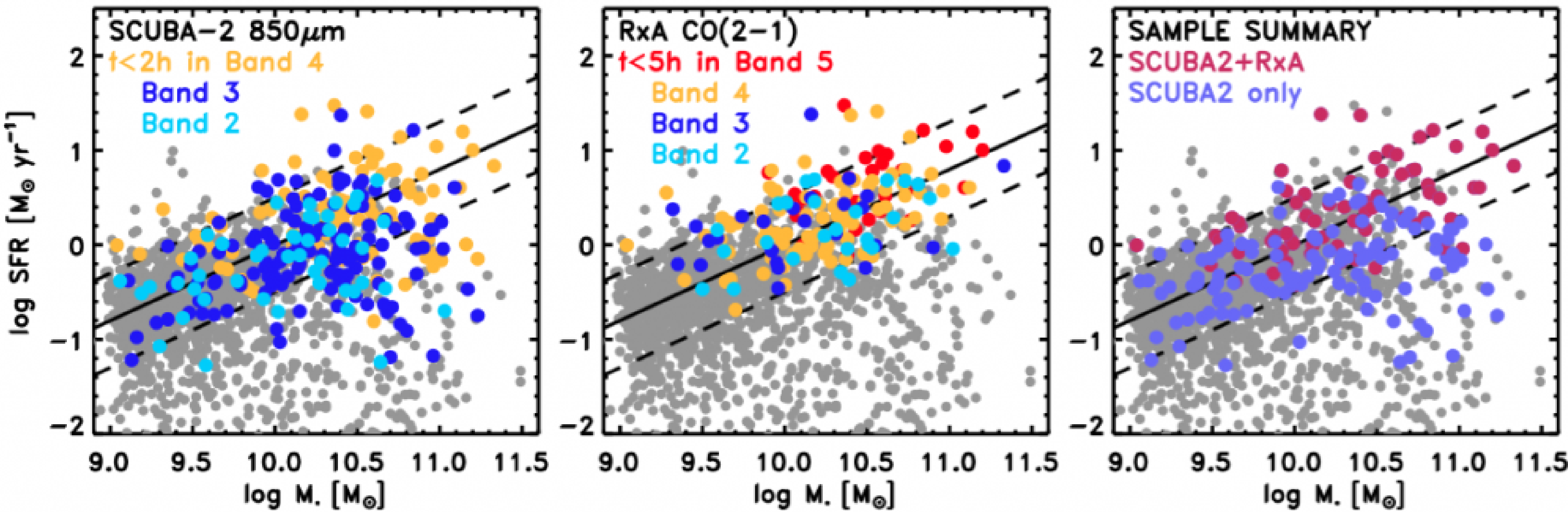
EAO Sub-mm Future Program
May. 20-23,2019 @PMO

JINGLE: The JCMT dust and gas In Nearby Galaxies Legacy Exploration



integrated 850μm continuum measurements for 190 Herschel-selected galaxies

integrated CO(2-1) line fluxes for 75 of these galaxies

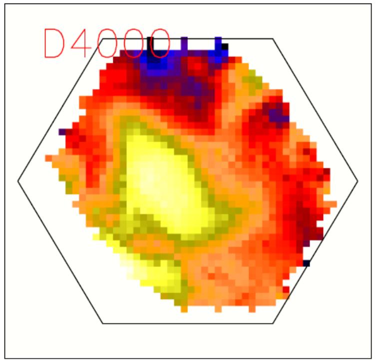
Outline

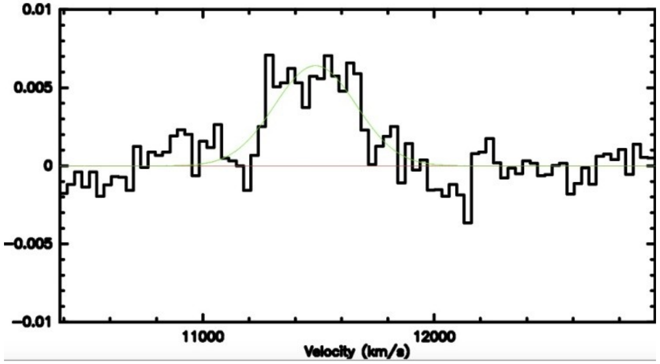
- ✤ Motivation
- ✤ Sample: CO observation
  Data reducation
- ✤ Results: Properties of the sample
  M_{H2} estimator
  Derived R21
- ✤ Summary

Motivation

resolved stellar properties

integrated gas properties





- 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

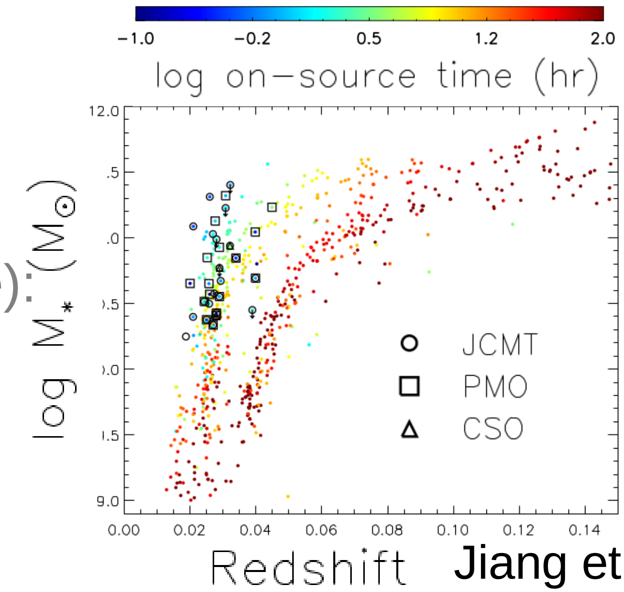
☆Total on-source time: 16.5 hr

☆Observed sources:16 detections and 5 upper-limits

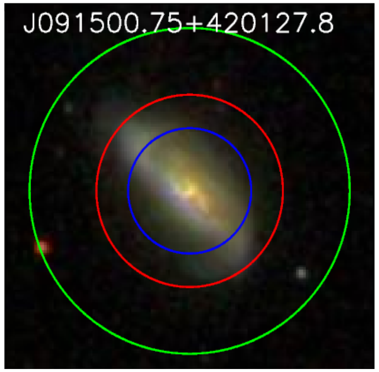
CSO CO2-1 Observation

☆ Total on-source time: 3hr

☆ Observed sources: 3detections



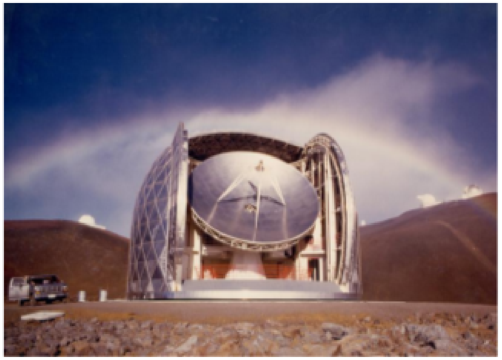
Jiang et al. 2015



PMO
CSO
JCMT

DLH (PMO 13.7m)

JCMT



CSO

Molecular gas vs Global stellar properties

To compute the mass of molecular gas:

$$M_{mol} = \alpha_{CO} L_{CO} \quad \alpha_{CO} = 4.3 M_{\odot} (K\,km/s)^{-1}$$

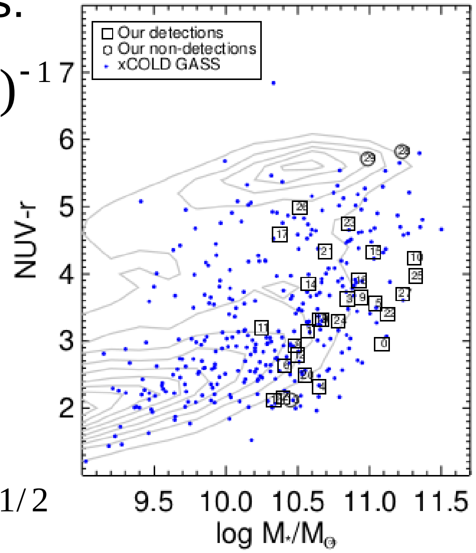
$$L_{CO} = 2453 S_{CO} \Delta v D_L^2 / (1+z)$$

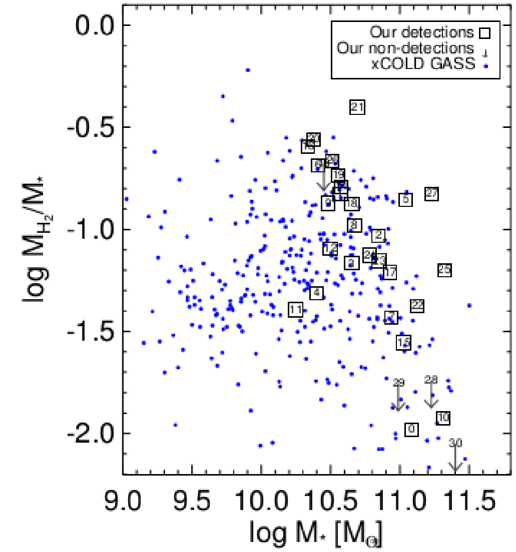
$$R21 = 0.7$$

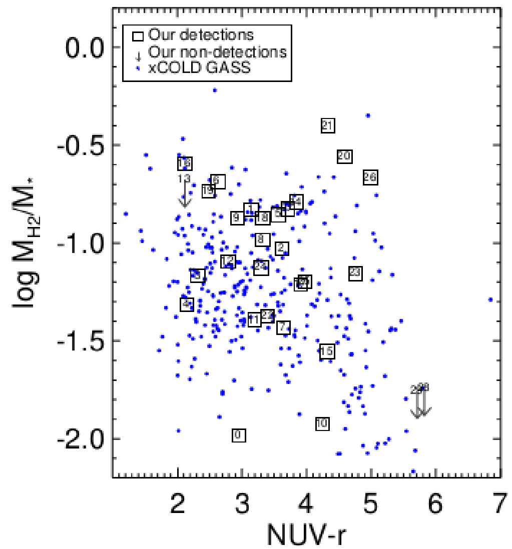
To get the standard error:

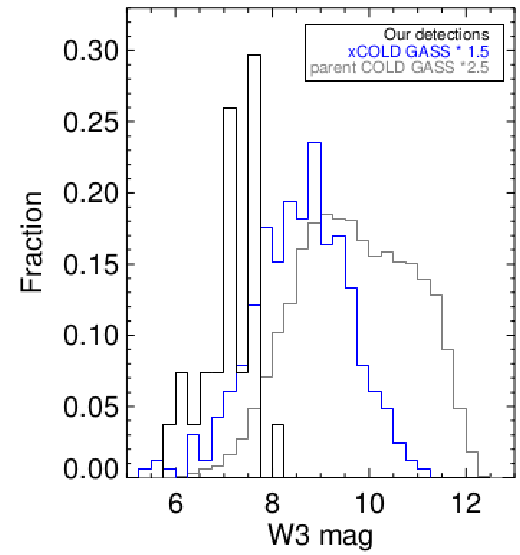
$$N = T_{rms} \Delta v_{FWZI} / [f(1 - \Delta v_{FWZI}/W)]^{1/2}$$

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

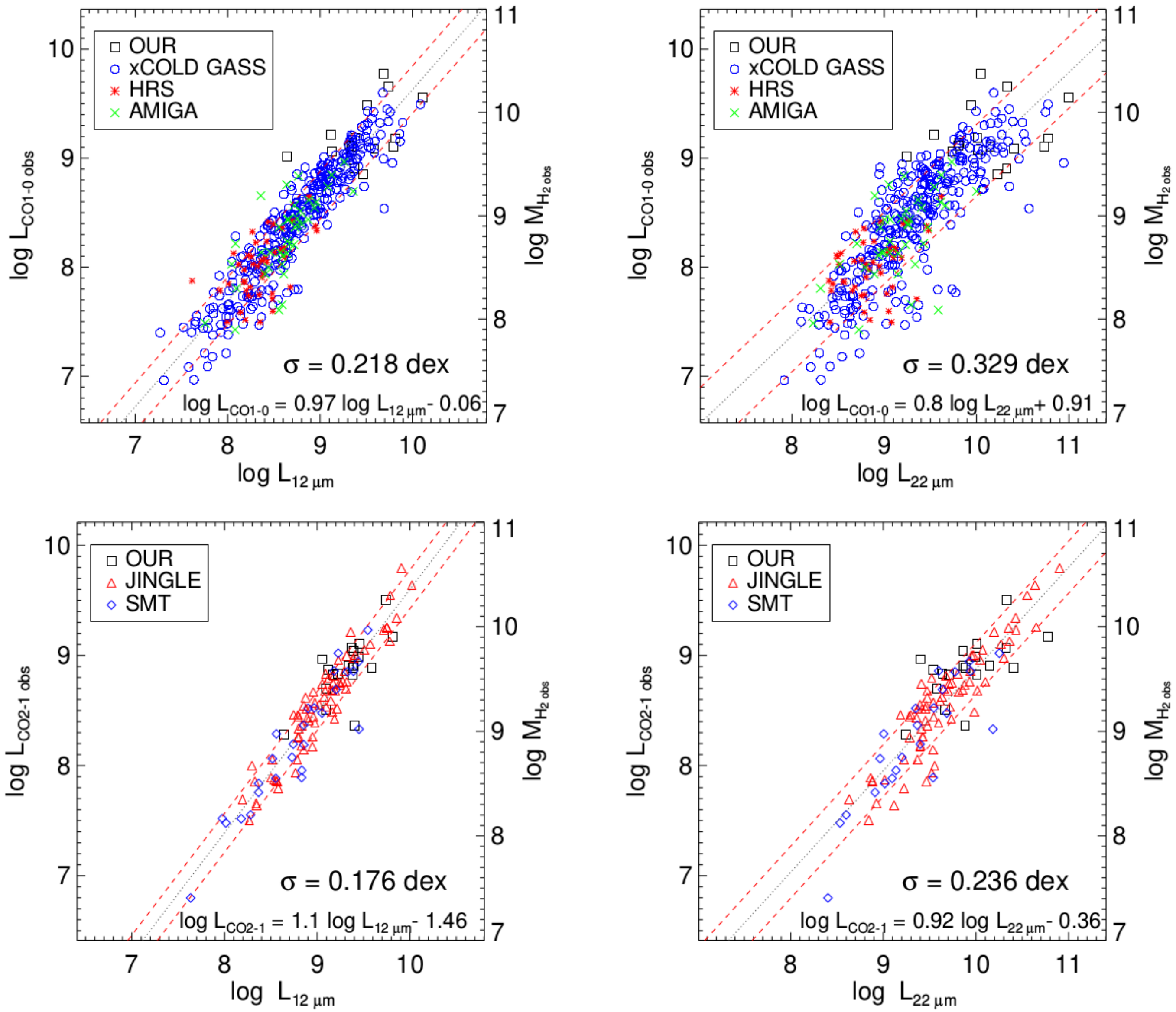








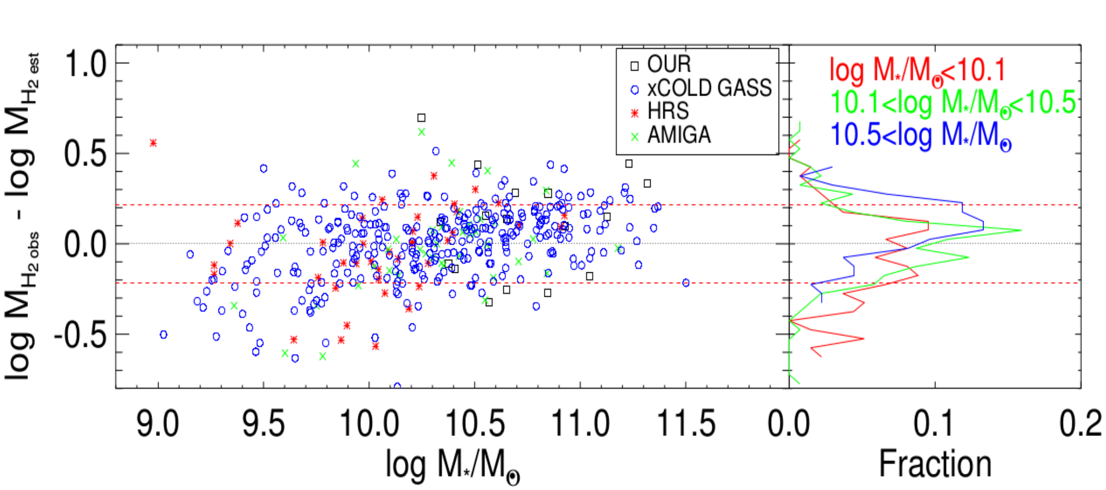
The Relationship between M(H2) and 12μm

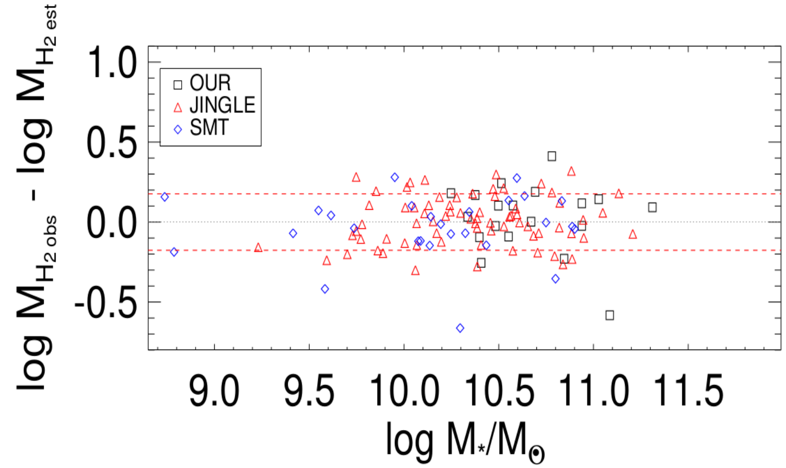


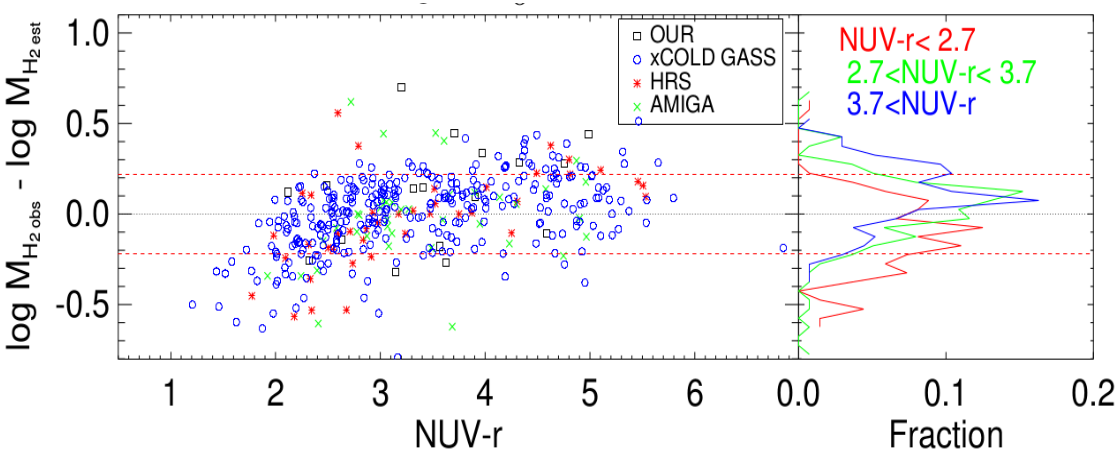
M(H2) is most tightly correlated with 12μm luminosity.

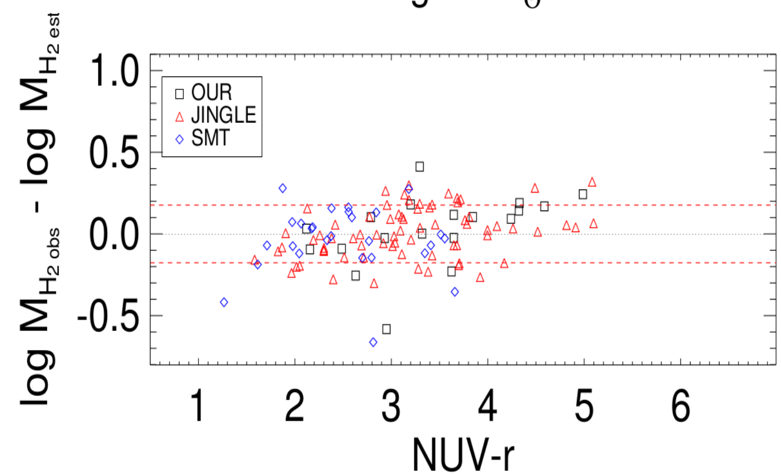
$L_{12\mu m}$ can be used to estimate H2 mass.

Residual in the CO vs W3









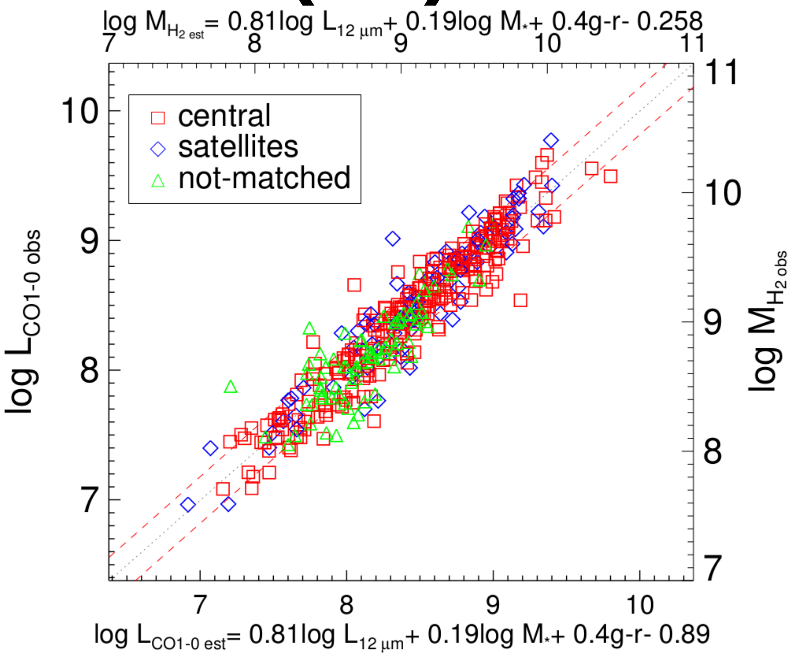
The residual depend on stellar mass and color.

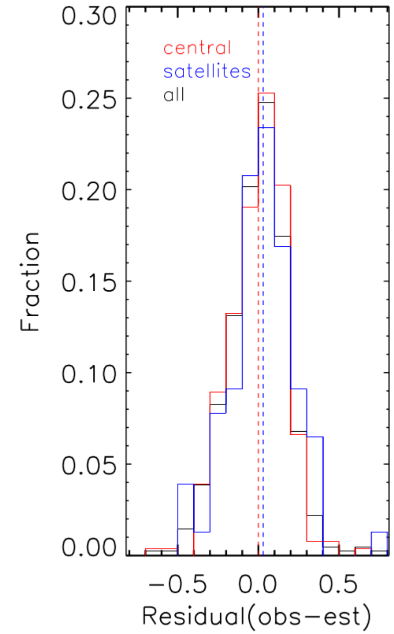
Low mass > low metallicity

Low NUV-r > strong UV radiation

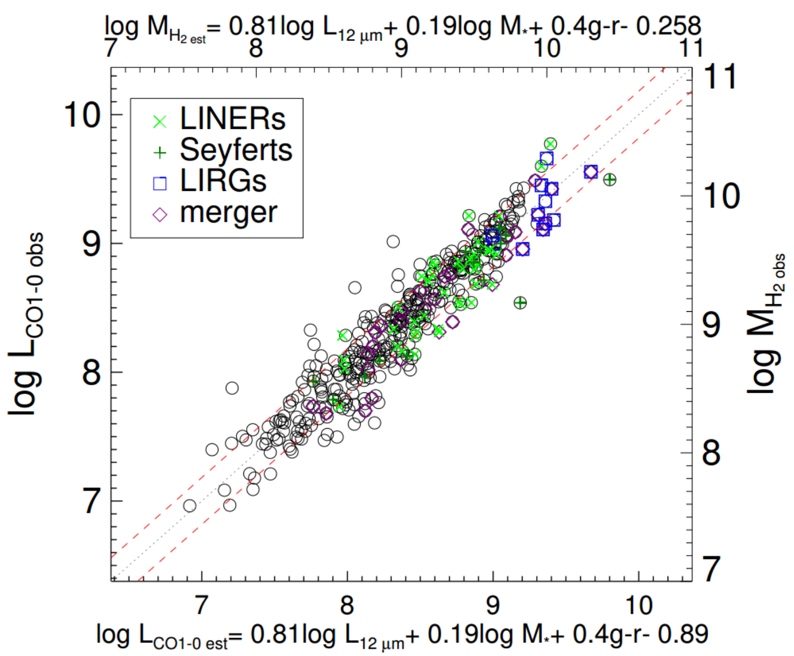
> photodissociation of CO

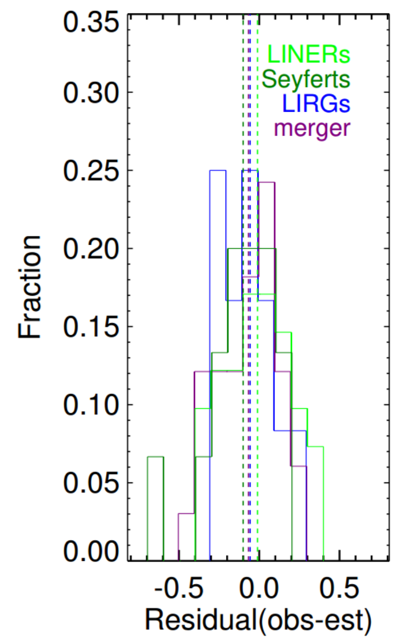
New M(H2) estimations





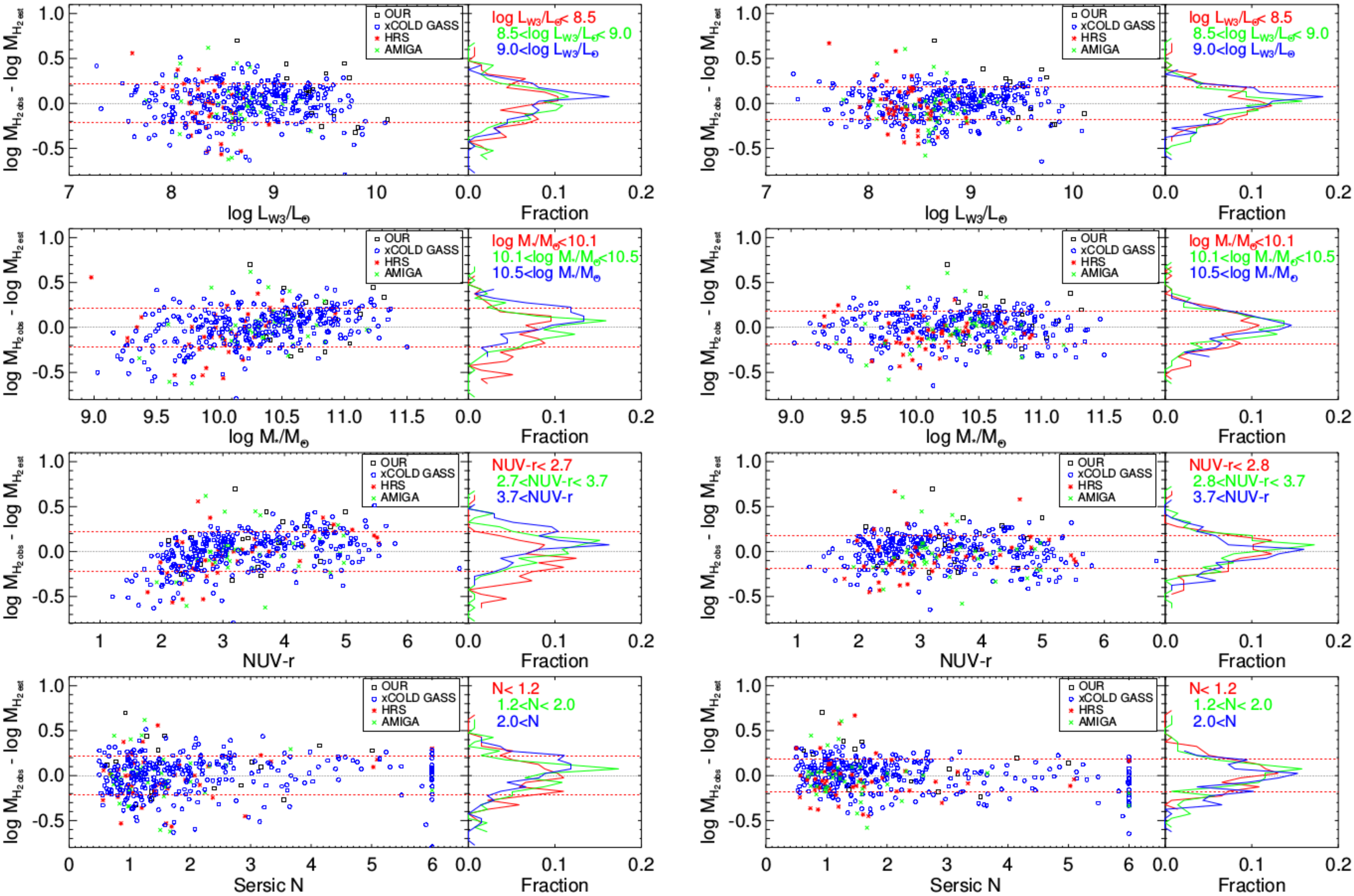
The new estimation is well behaved for central and satellites.





The effect of some particular galaxy populations is not significant.

No systematic bias



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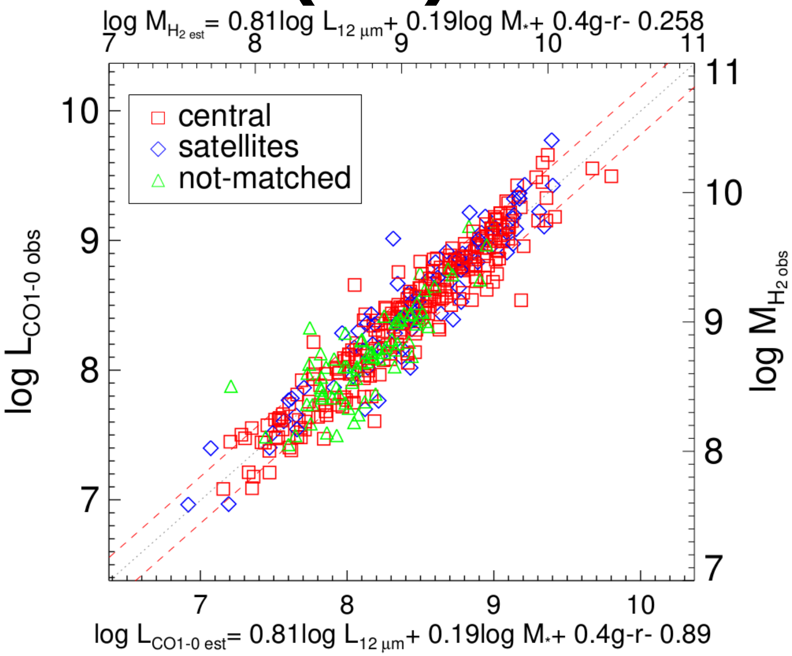

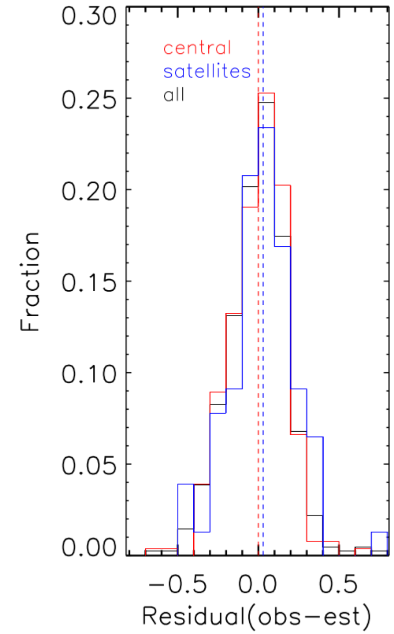

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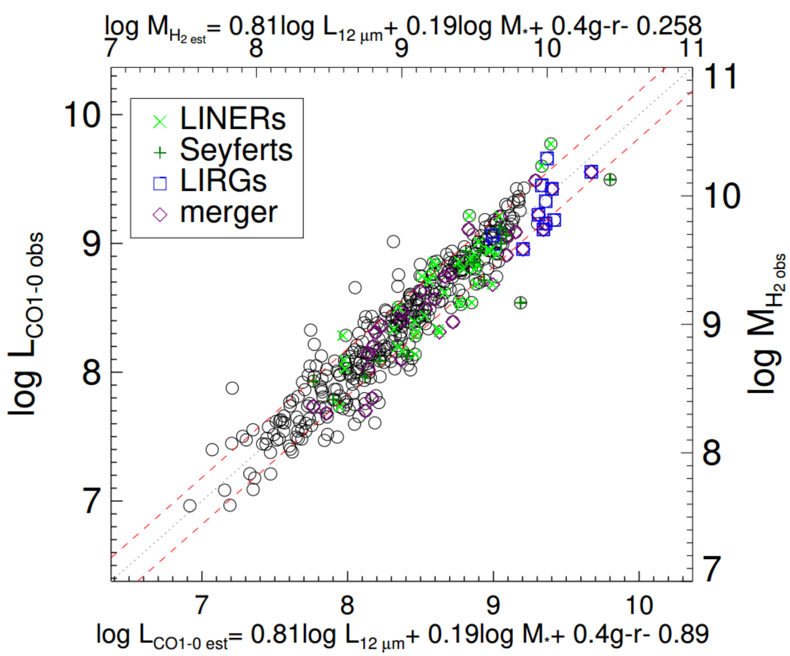

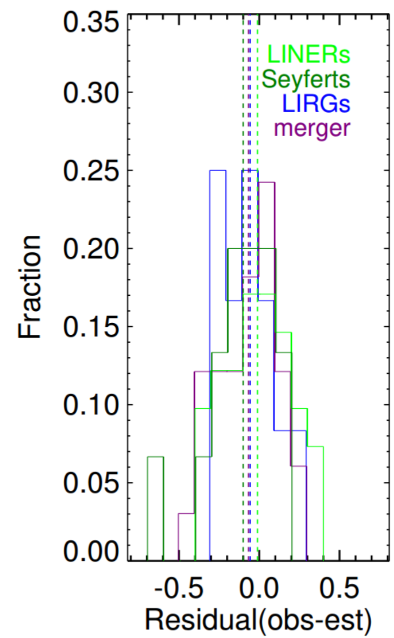

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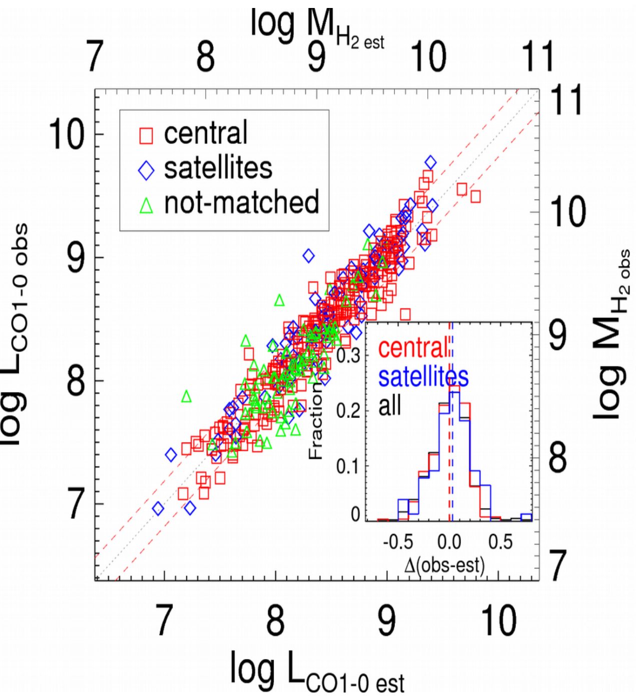
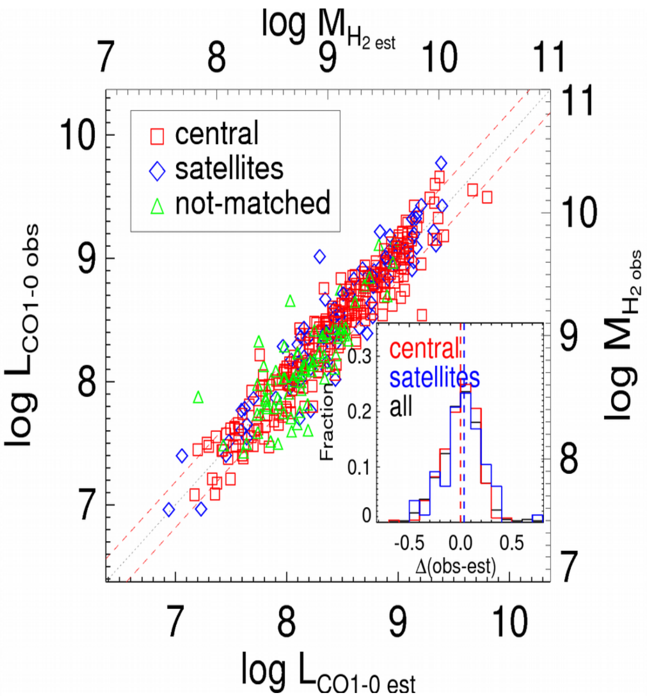
Alternative estimations

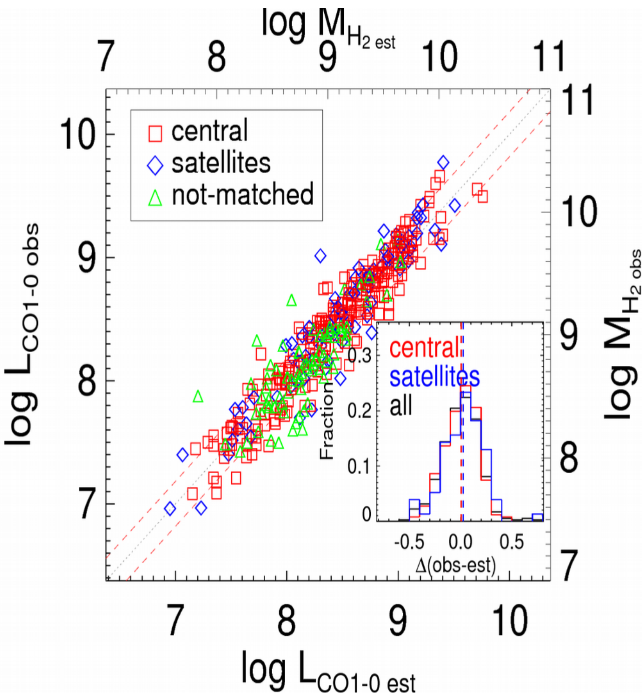
z & g-r



r & g-r

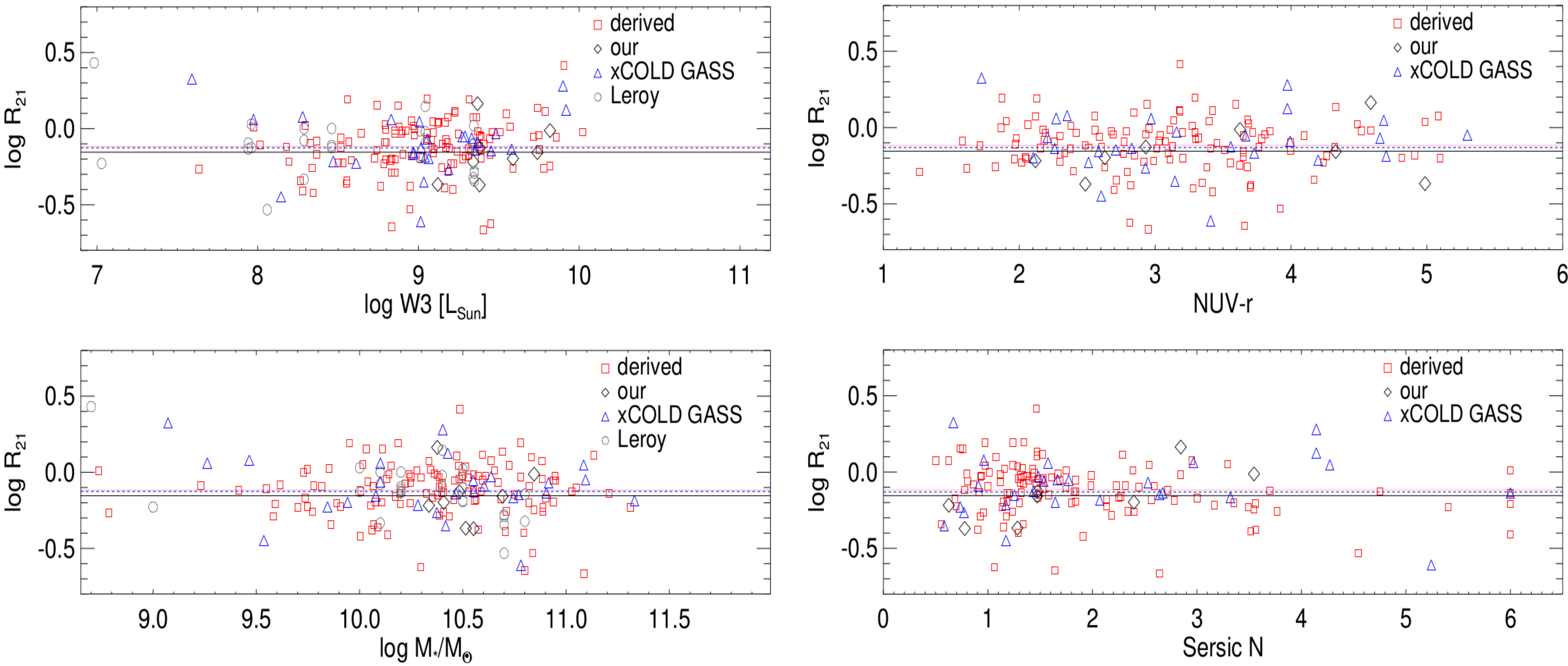


z & r



These alternative estimations with optical luminosities or color also work well.

Derived R21



The derived R21 show similar dependence and distribution as observed ones

Summary

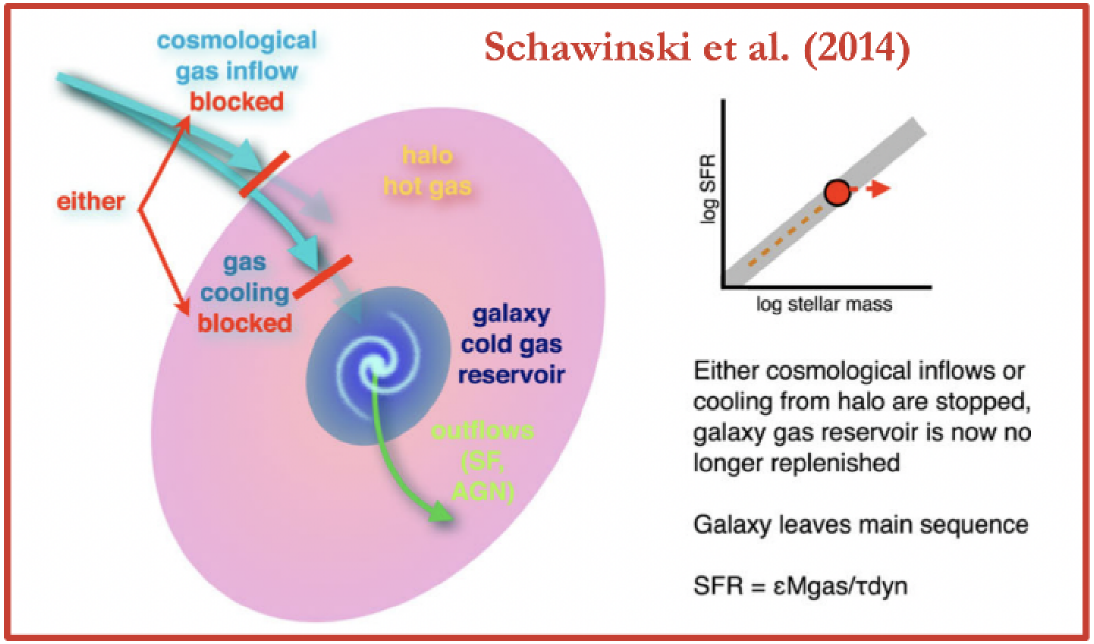
1.We have obtained integrated CO(J=1-0) data for 17 mid-infrared bright MaNGA galaxies,and CO(J=2-1) data for 22 random selected MaNGA galaxies, with overlapped observations for 8 galaxies.

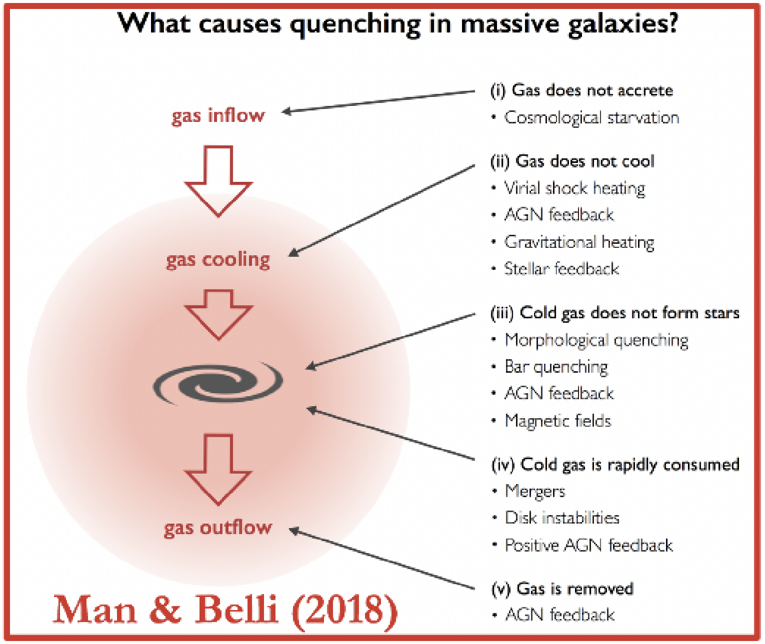
2.Combining this sample with others obtained from literatures, we confirm the tight relation between 12μm and CO emission.

3. Corrected with some optical parameters, this new CO estimation work well for all kinds of galaxies including star-forming galaxies, early type galaxies, AGNs, even interacting galaxies and LIRGs.

Next steps:
1)More applications
2)More test for different galaxy populations and on different scales.

Next step





Estimated gas vs. environments

Estimated CO mass ↓ Estimated CO map

Estimated CO mass > Galaxies with abnormal SFE or gas content

Estimated CO map > Interesting regions

→ More analysis or observation

Thank you !