Dense Gas and Star Formation Rate in M51

Hao Chen

(Nanjing University)

Supervisors：

Qiusheng Gu (Nanjing University, China)
Yu Gao (Purple Mountain Observatory, China)
**Jonathan Braine** (Bordeaux 1 University, France)
Cooperators:
Jin Koda (Stony Brook University,USA)

Chen et al. ApJ 2015

Chen et al. ApJ 2017

Why study the gas and star formation in the galaxies?

Bule sequence

high

Feedback

IGM ——> gas <—— SF
(ISM) ——>

low

Red sequence
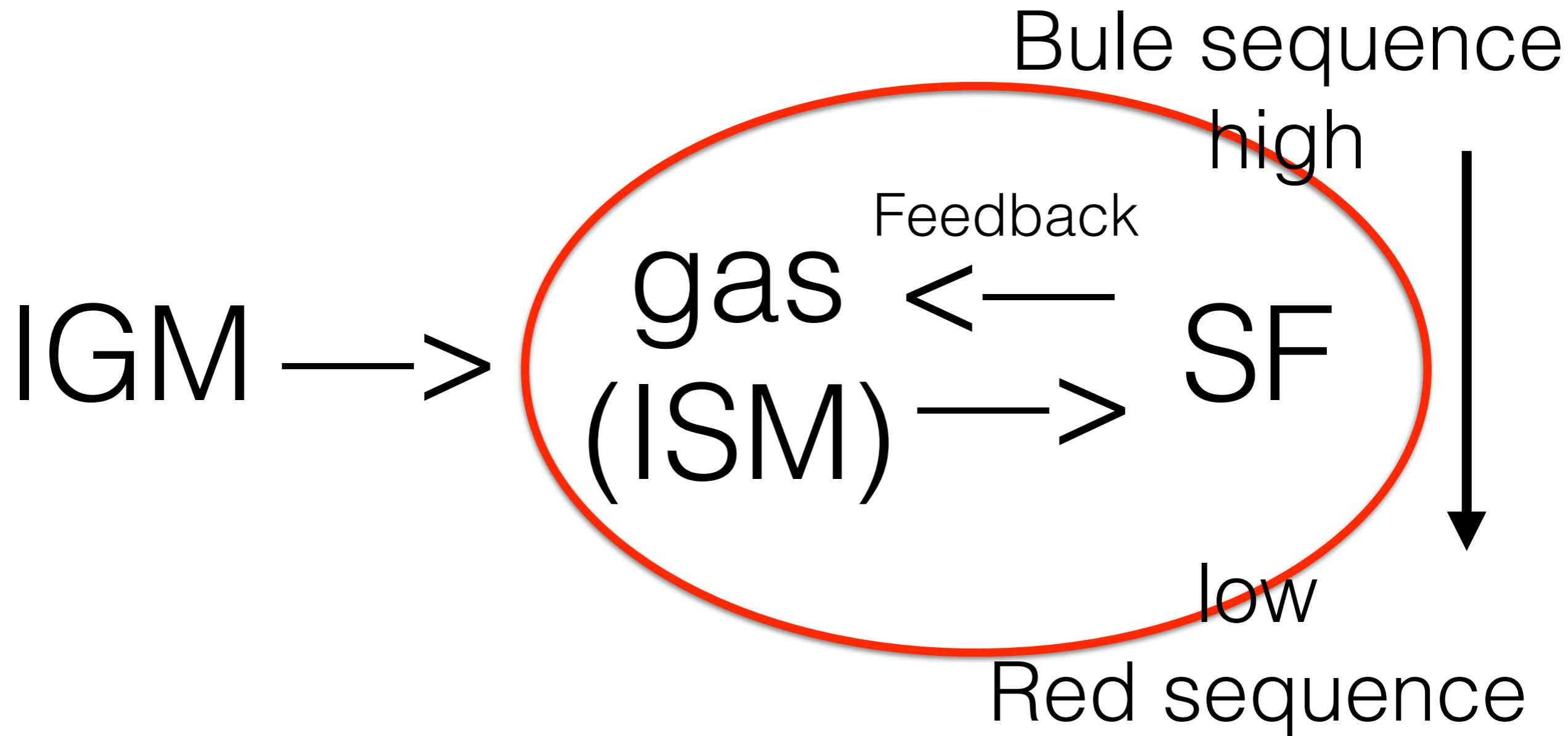
SFE ~ SFR/M(gas)~IR/HCN

Why study the gas and star formation in the galaxies?
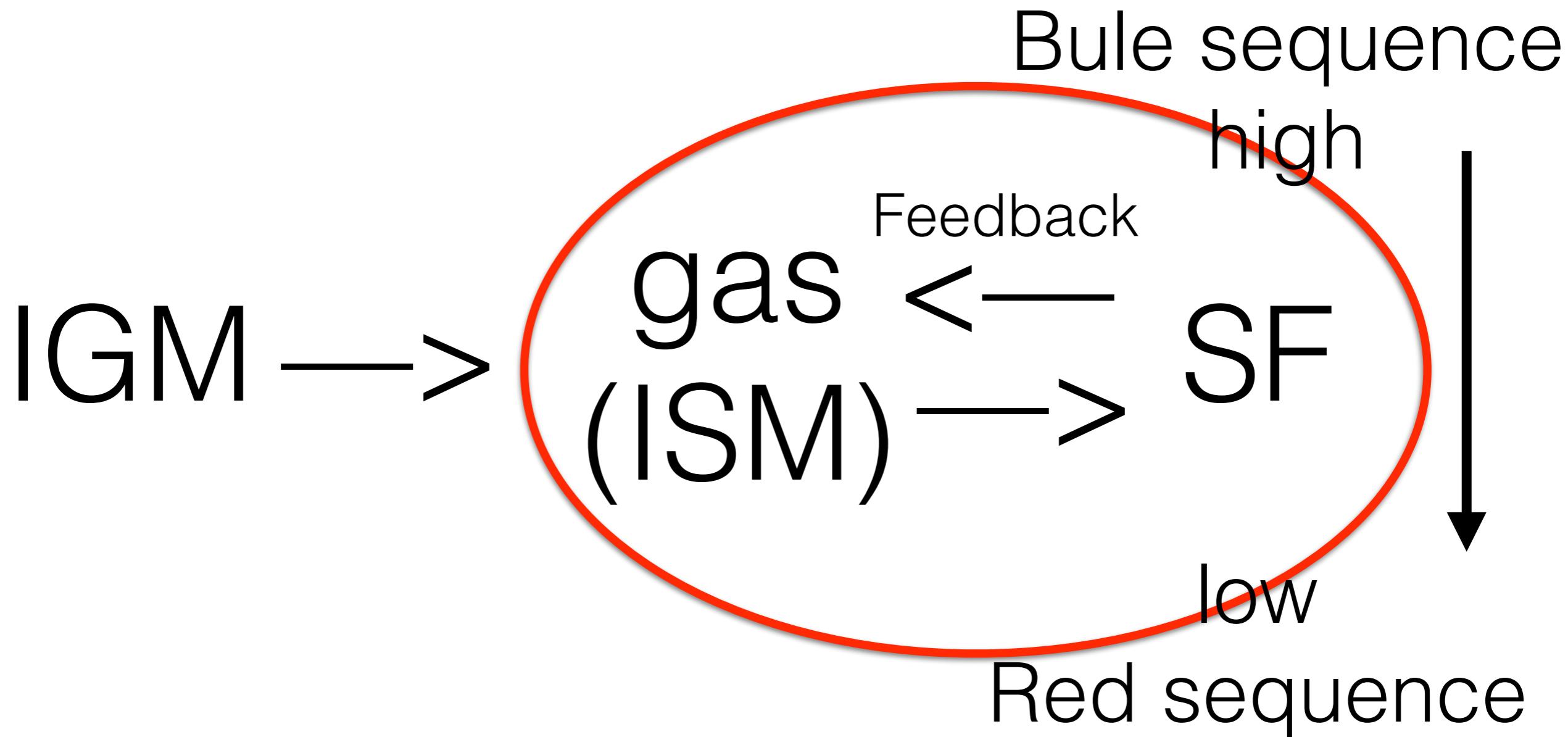
$$SFE \sim SFR/M(gas) \sim IR/HCN$$

HCN - IR linear relation

The fit line: $L_{IR}/L_{HCN}=900$ for $L_{IR}<10^{11}L_{\odot}$

IR (SFR)

LIRGs

Normal

HCN (dense gas)
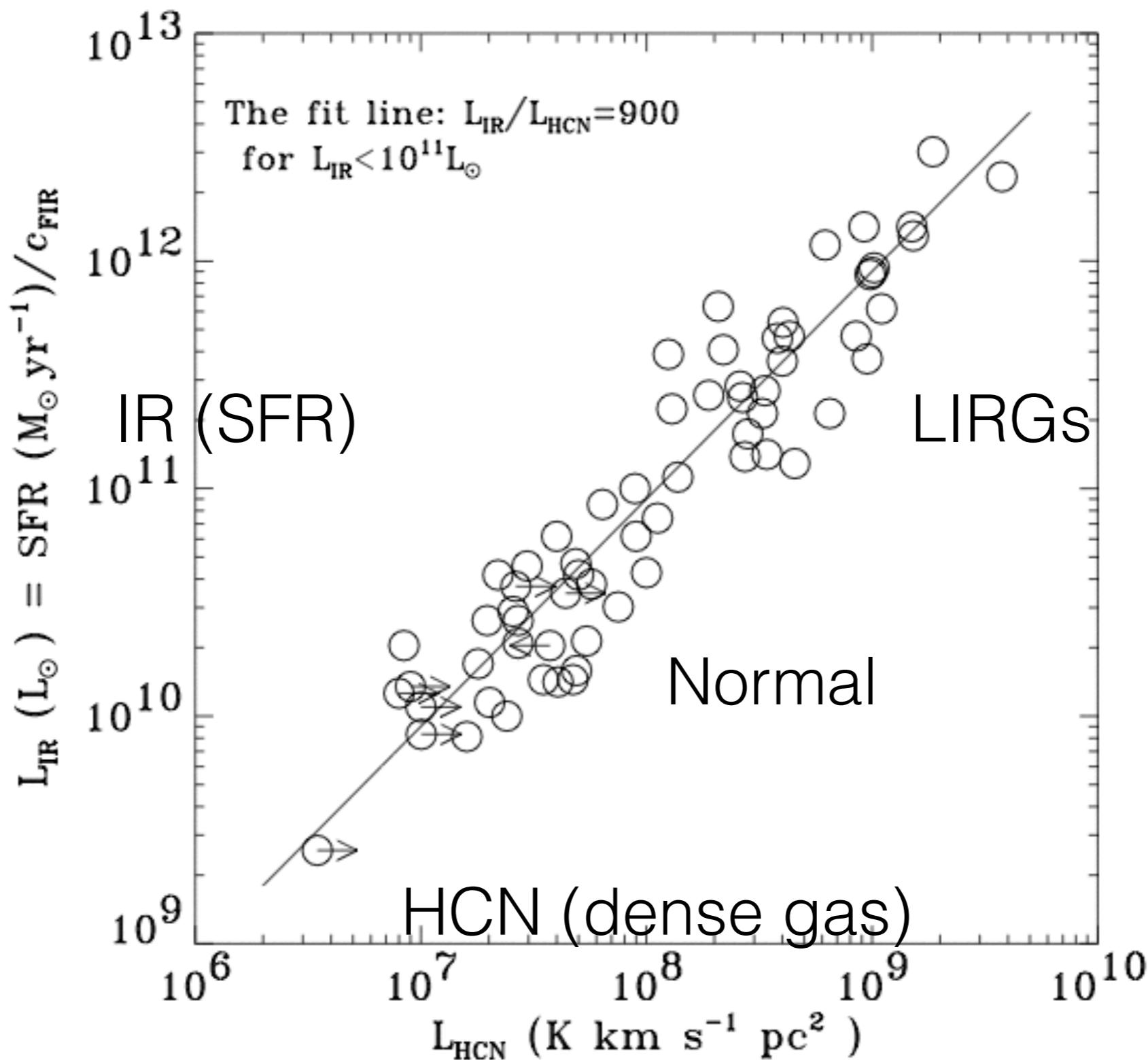
Fig. 1a

Gao & Solomon ApJ 2004

HCN 1-0 lines in M51
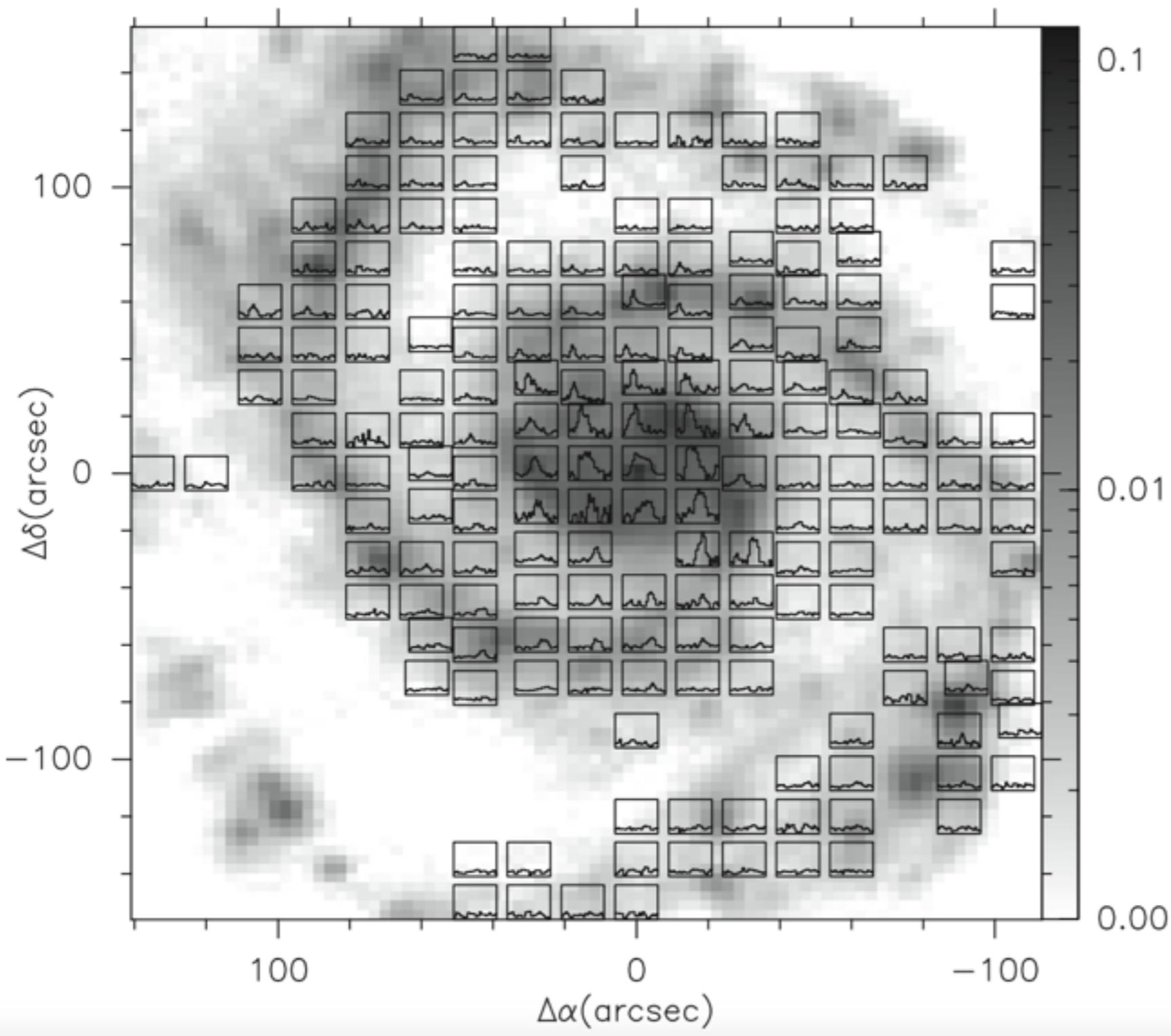
- HCN spectra observed with IRAM 30M

- grey map is 70 um map (Herschel VNGS project)

- IR - HCN point by point

Chen et al. ApJ 2015

HCN integrated intensity

(a)

ΔDEC (arcsec)

HCN

IR/HCN ratio (SFE)

(b)

IR/HCN

ΔRA (arcsec)
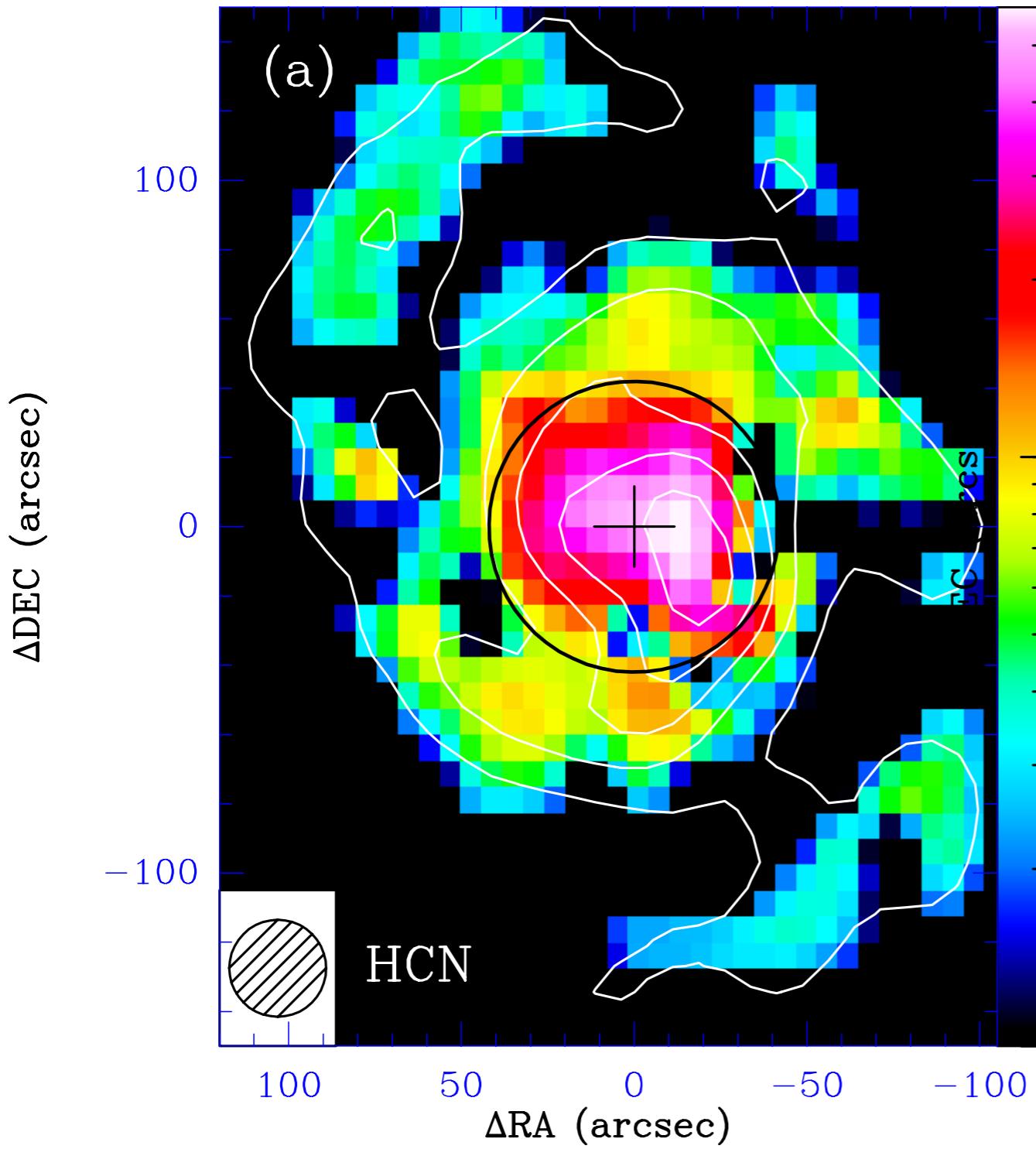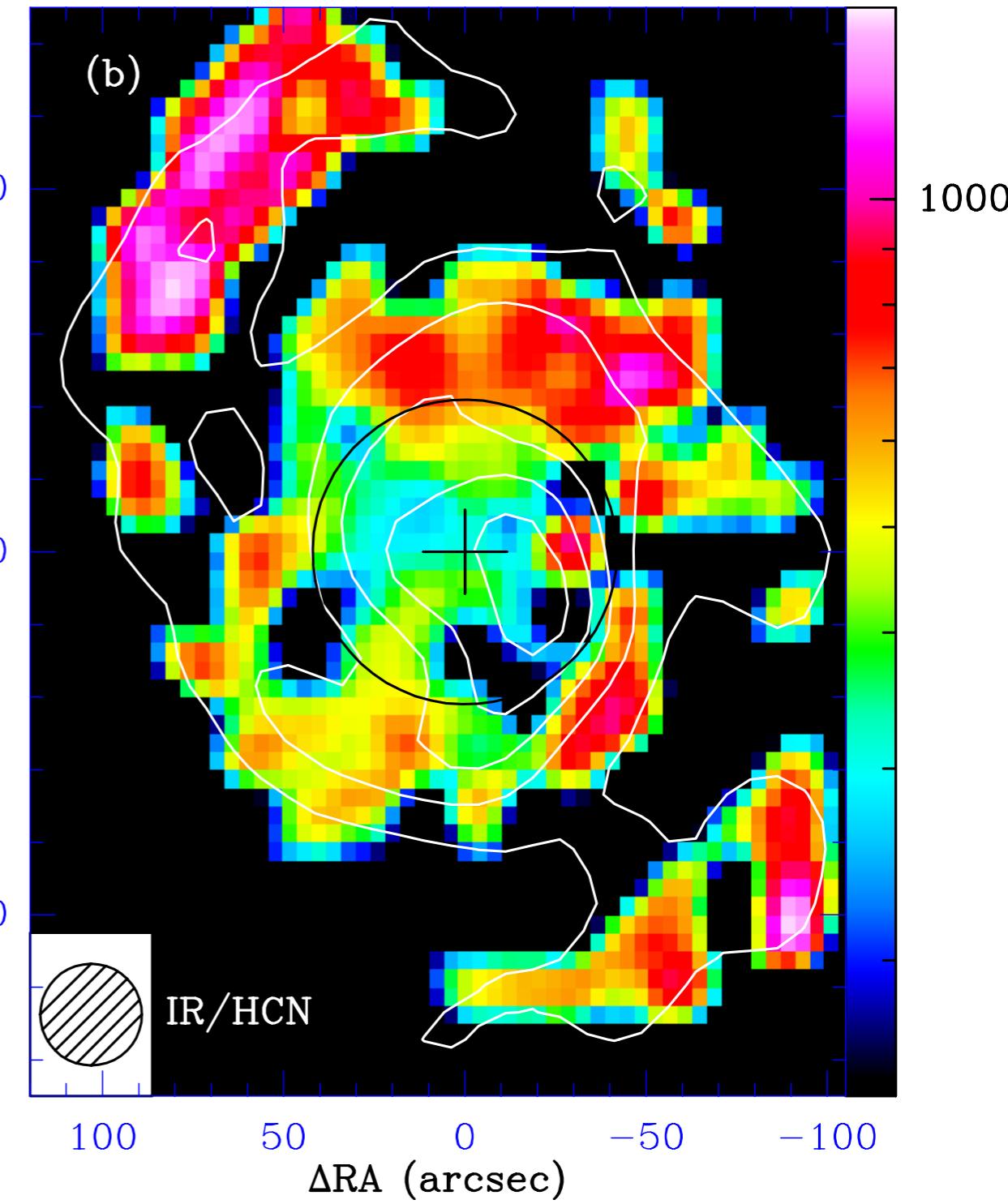
Chen et al. Apj 2015

IR/HCN gradient

- metallicity

- turbulence

- pressure

HCN/HCO+
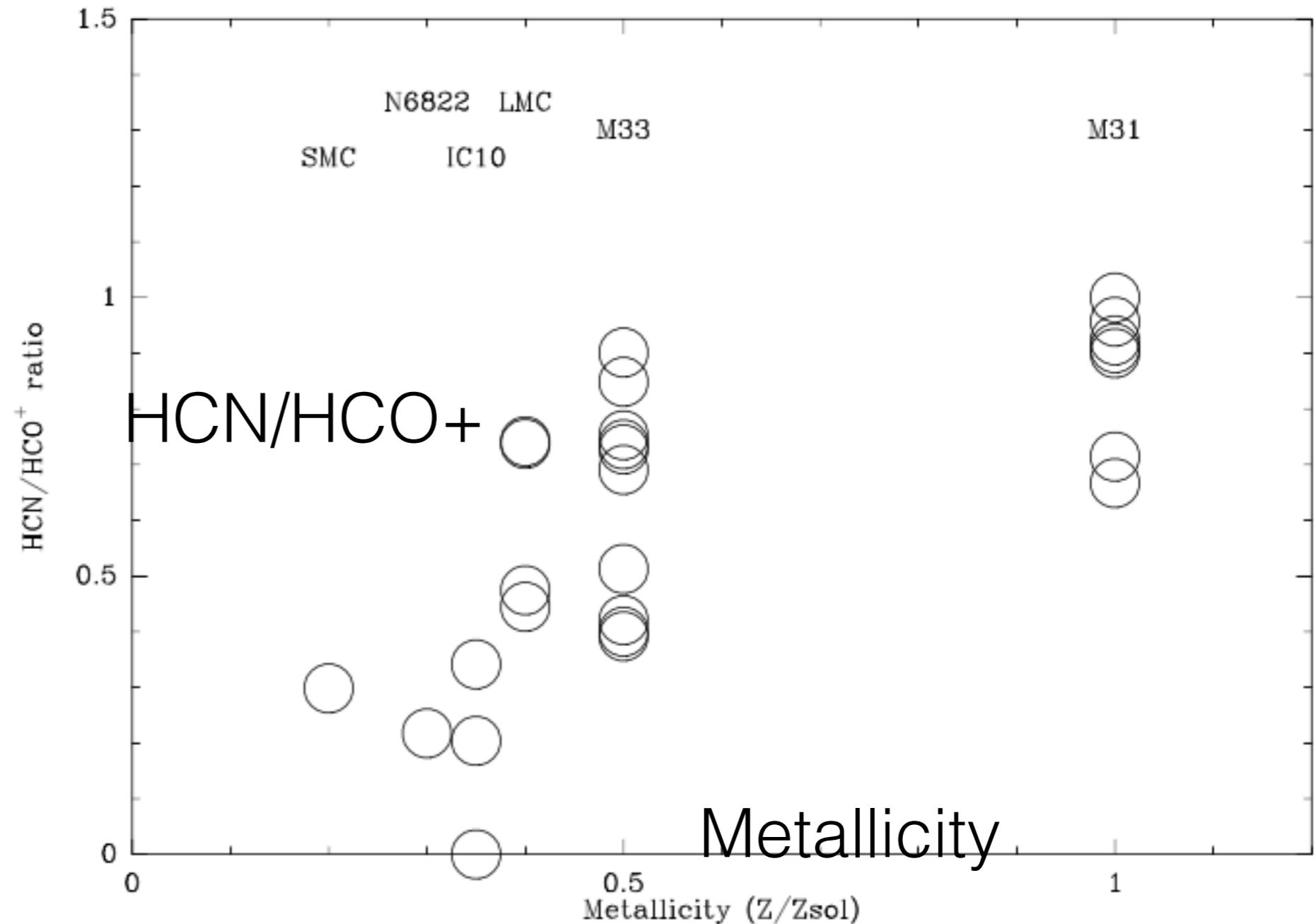
Metallicity

Braine et al. A&A 2016

IR/HCN gradient

- metallicity

- turbulence

- pressure

HCN/HCO+
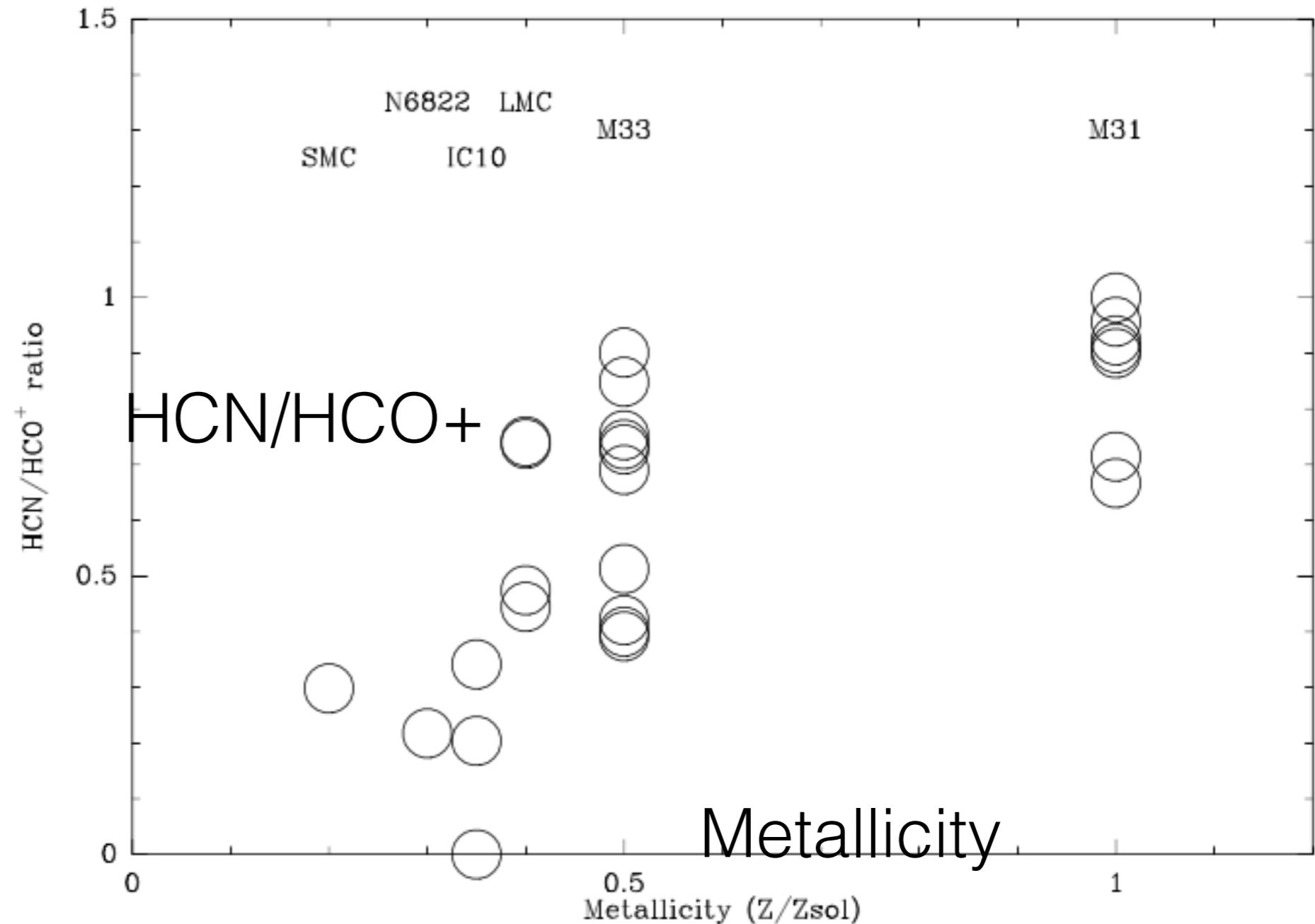
Metallicity

Braine et al. A&A 2016

Central starburst
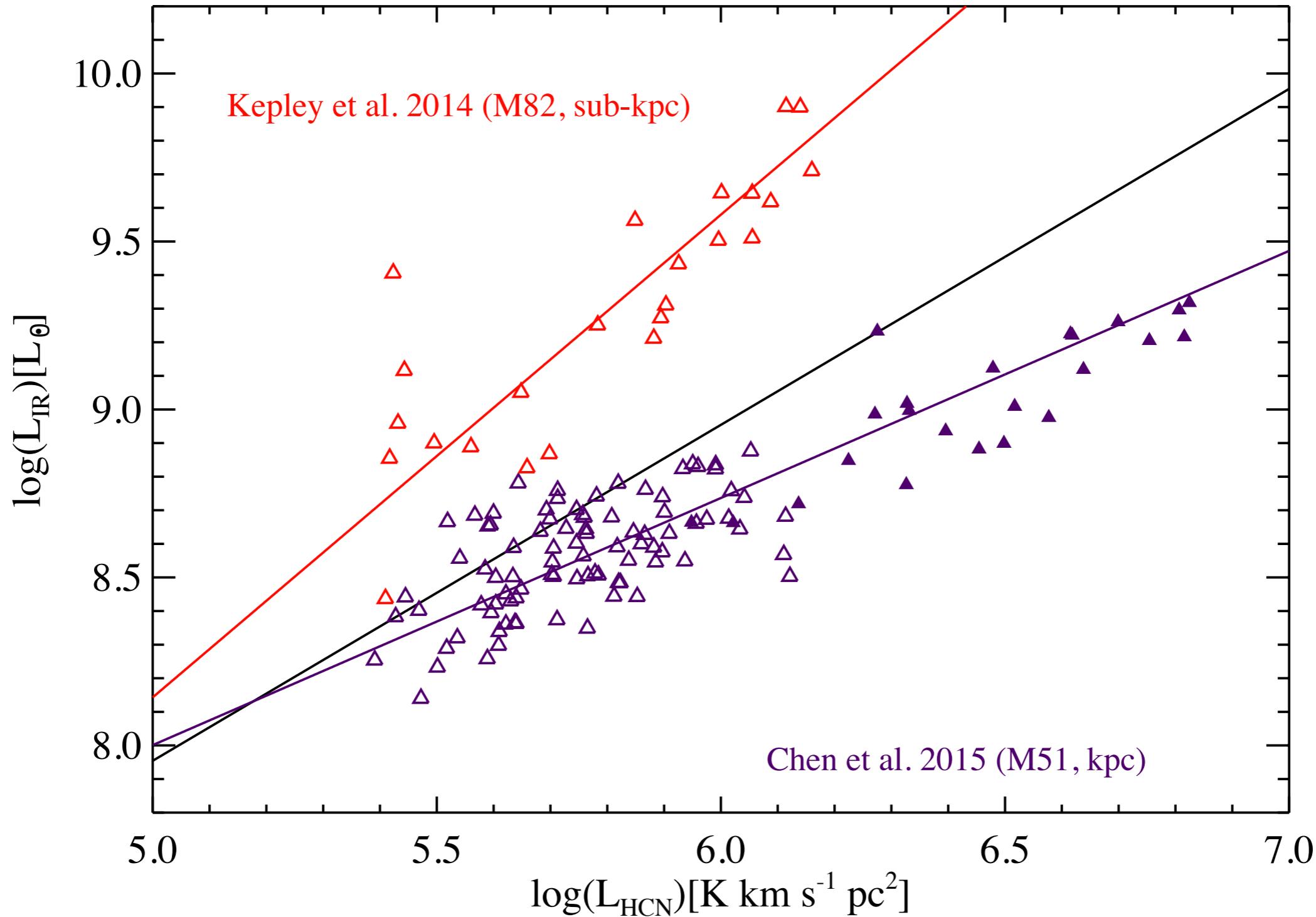
Dense Gas at GMA scale

Eliminate the radial variations of

- metallicity

- turbulence

- pressure
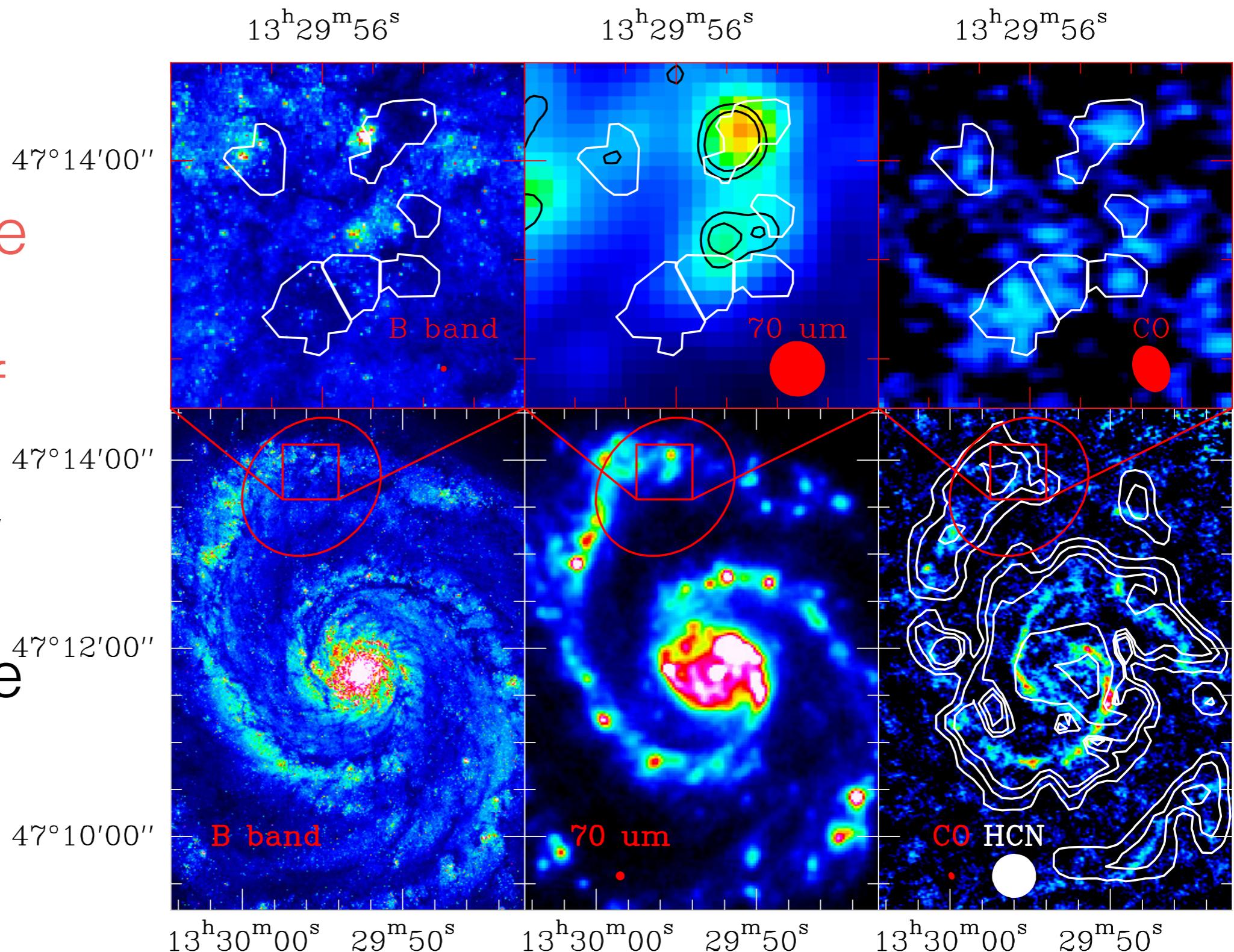
Chen et al. ApJ 2017

Dense Gas at GMA scale, with NOEMA

CO

HCN

HCO+

HNC
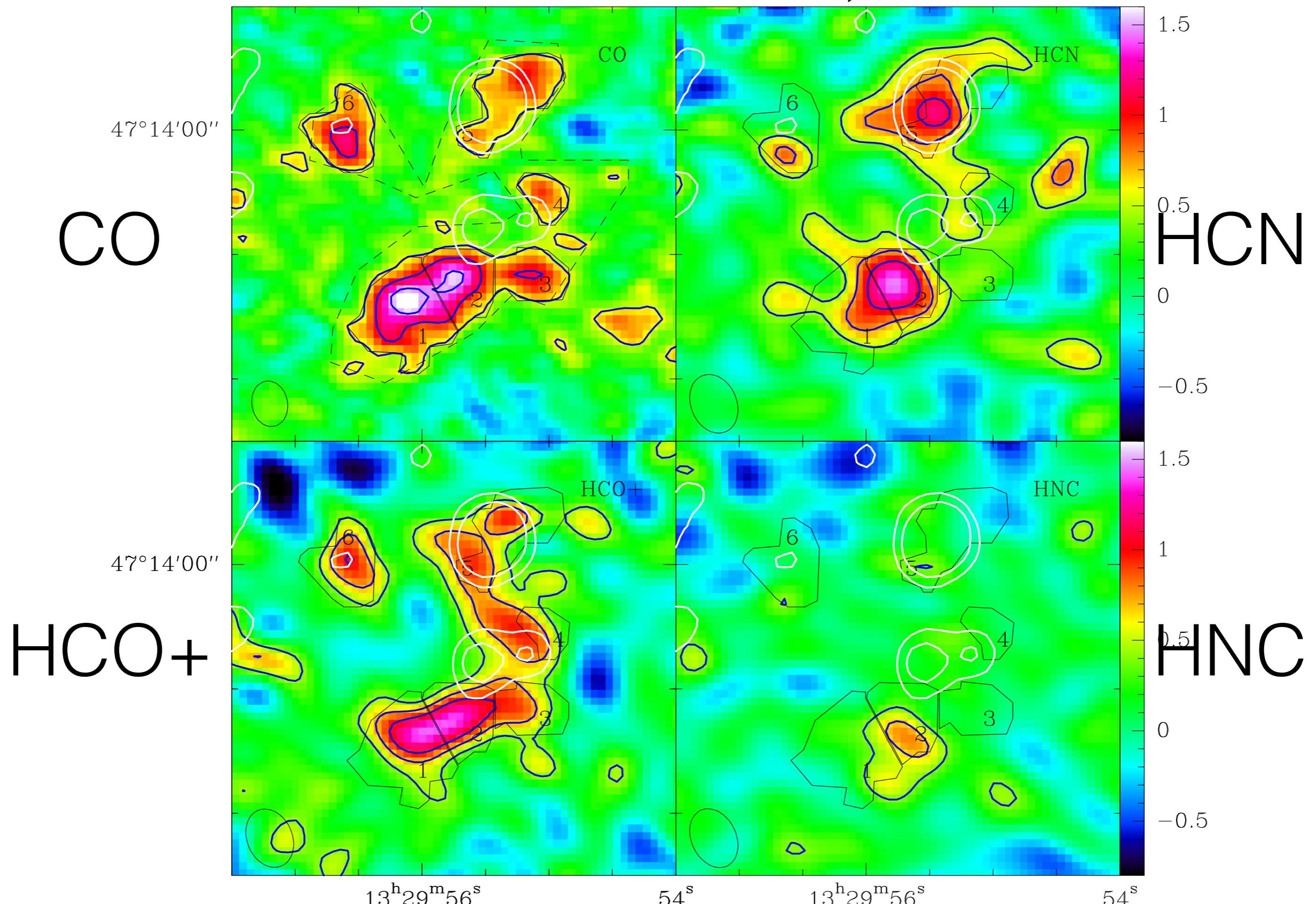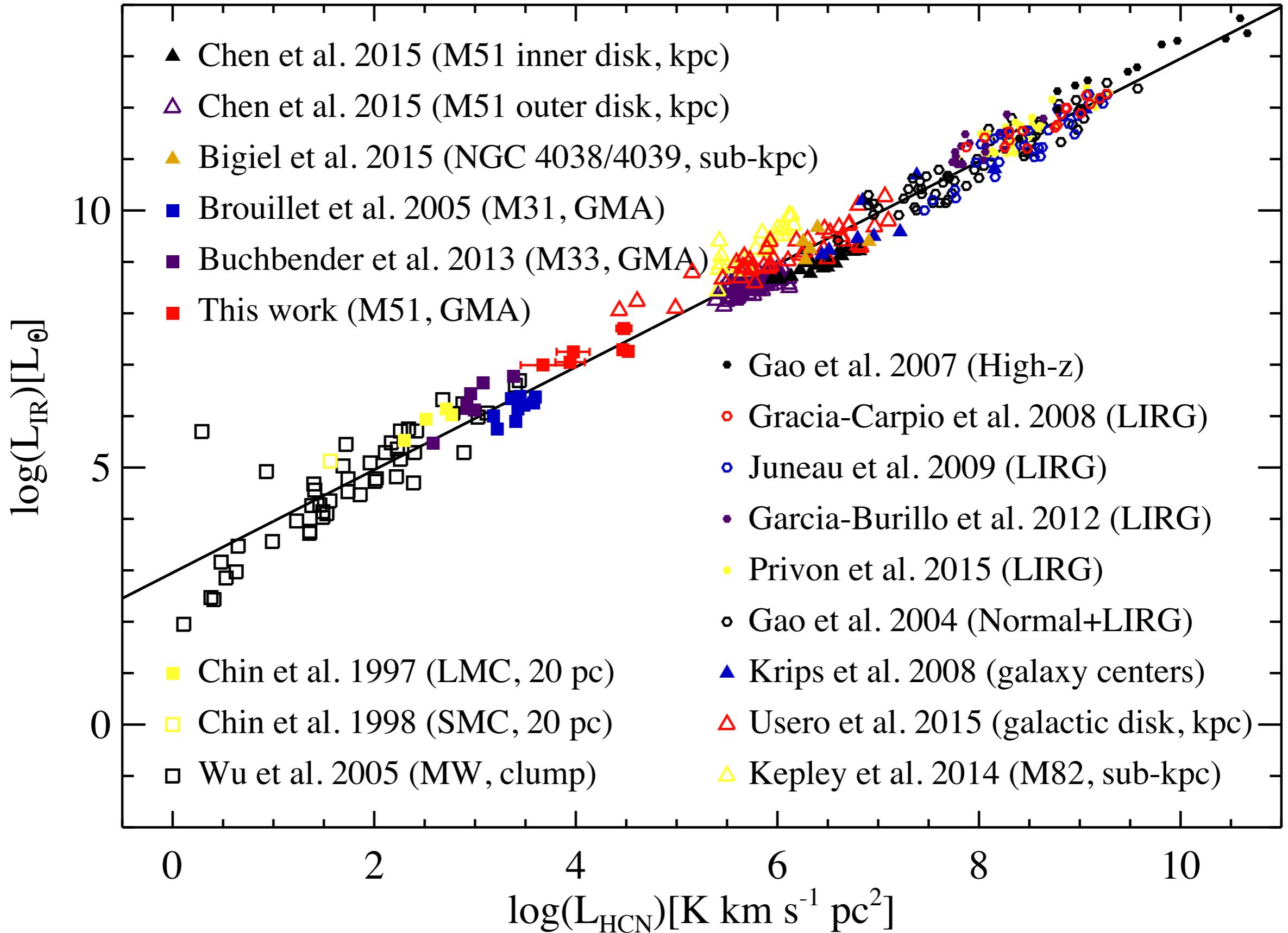
Chen et al. ApJ 2017
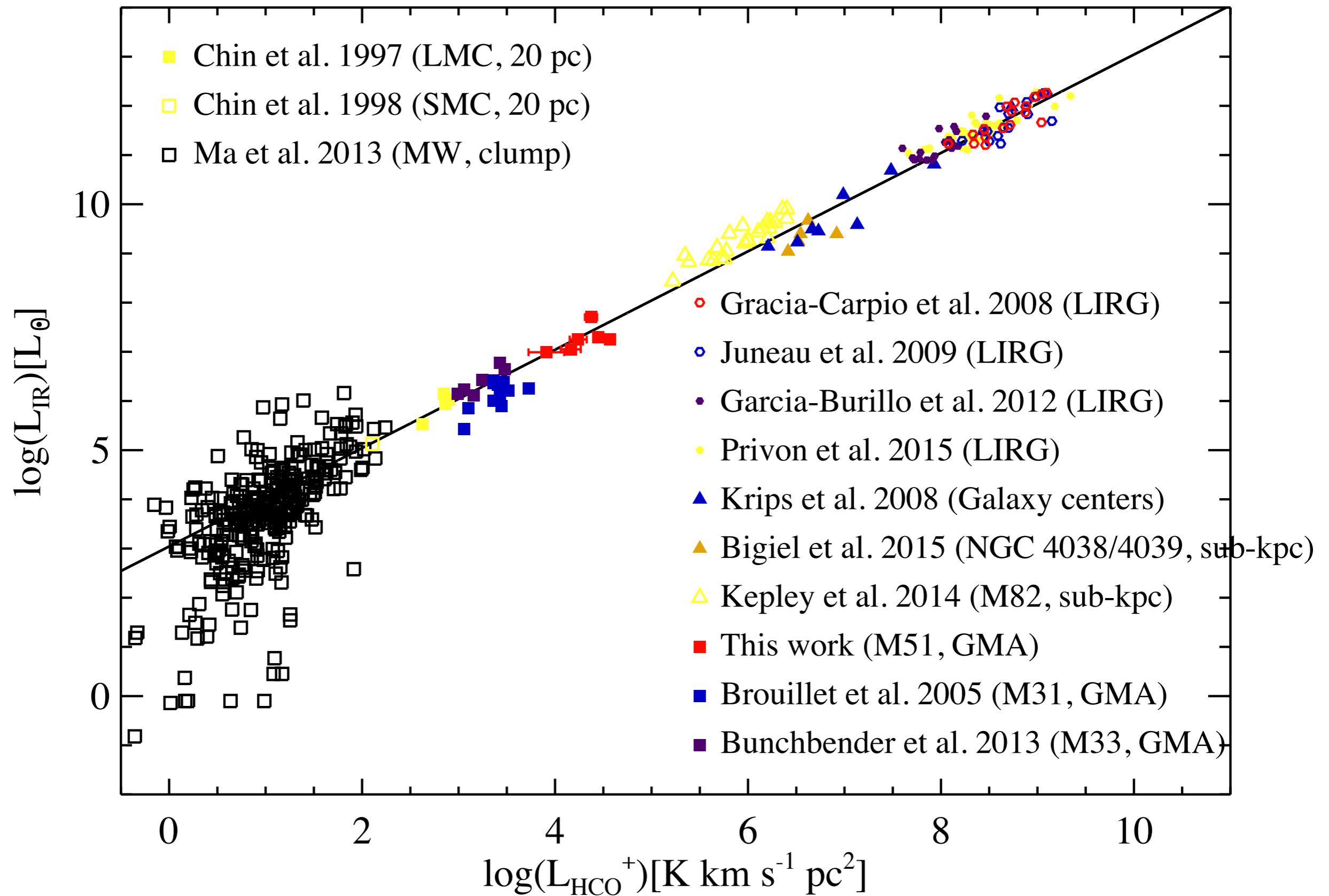
Chen et al. ApJ 2017
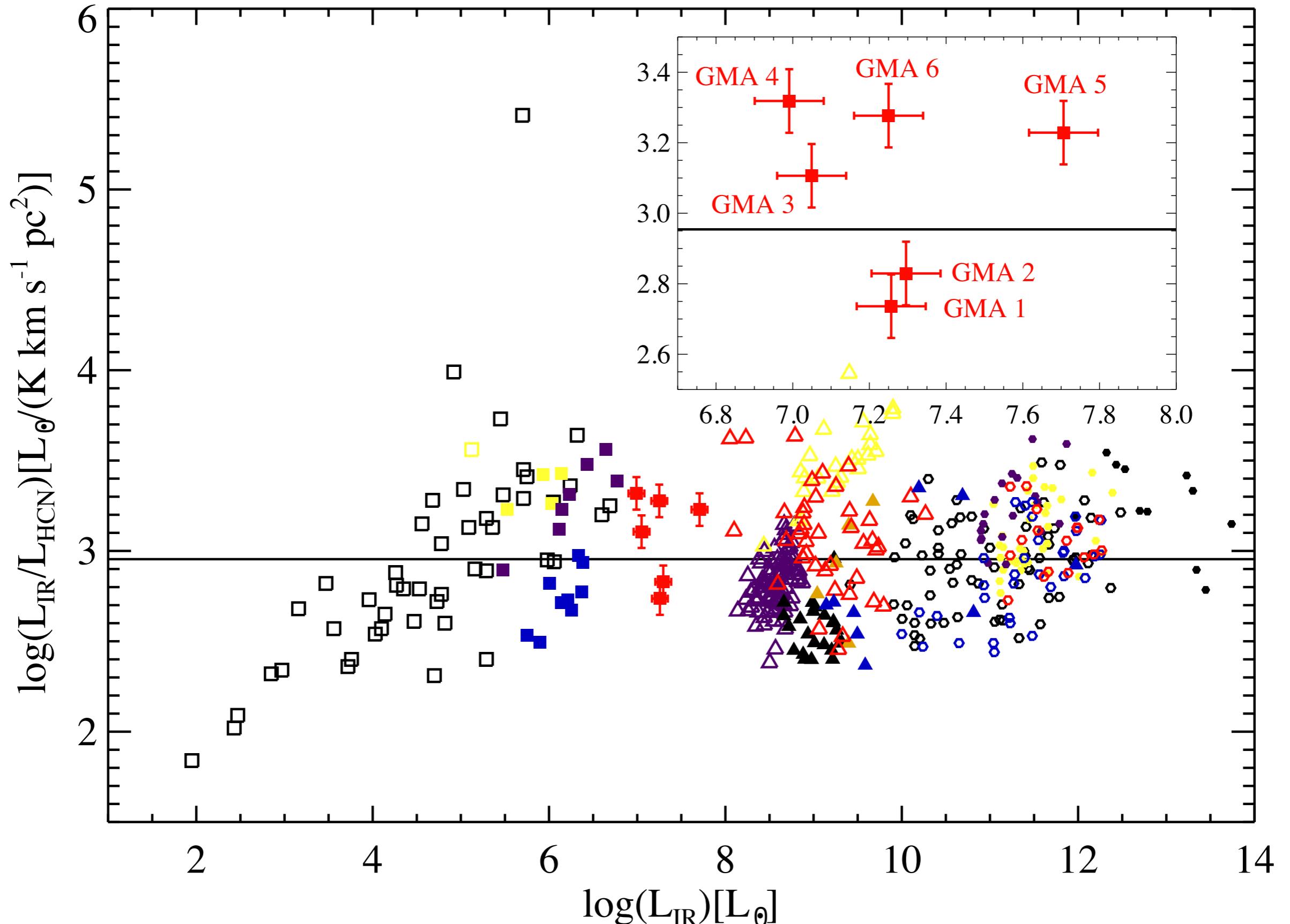
Chen et al. ApJ 2017
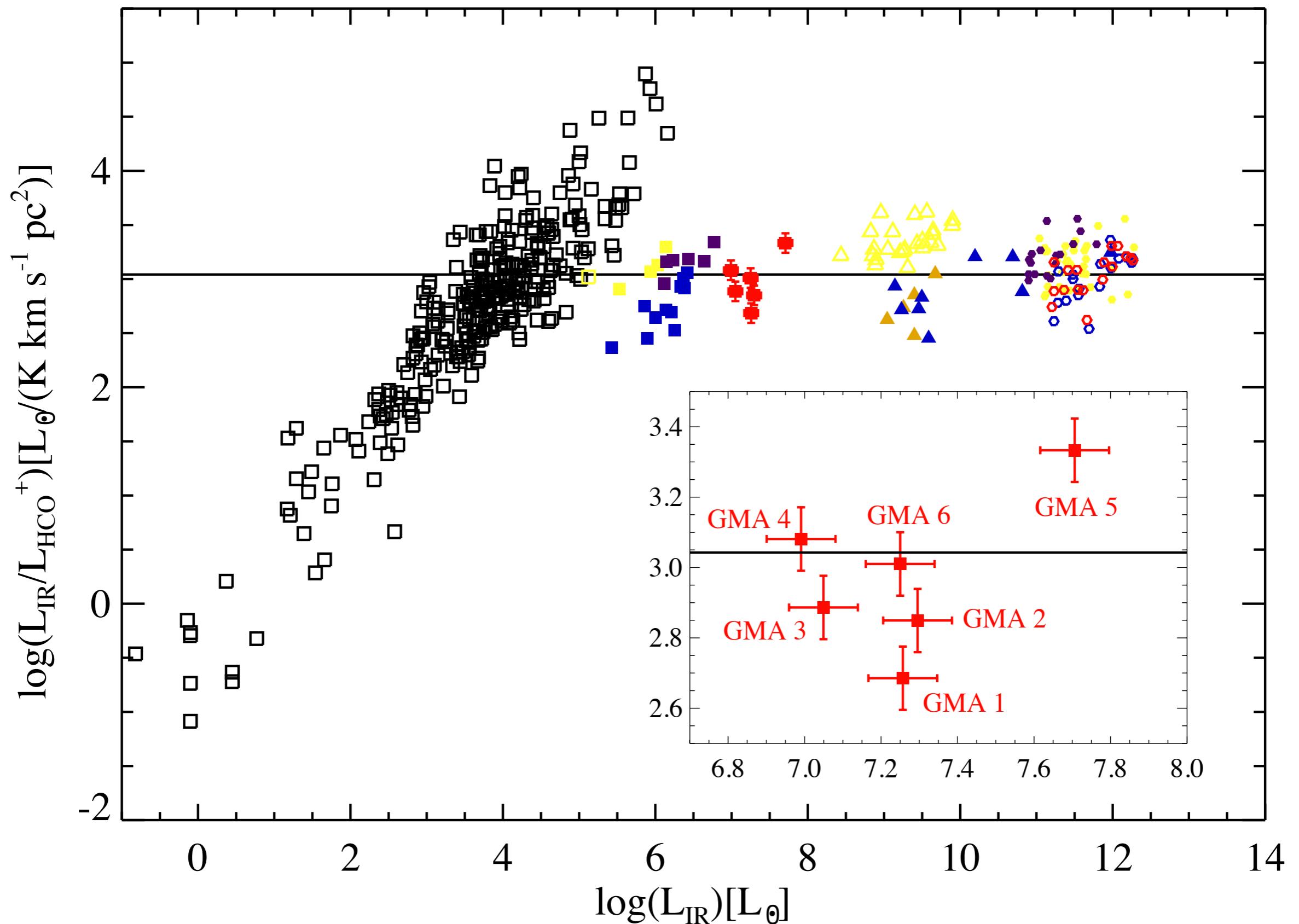
Chen et al. ApJ 2017

Chen et al. ApJ 2017

Thanks!