A HARP-B CO(3-2) map of M51

Investigating star formation processes on 600pc scales

Catherine Vlahakis (postdoc, Leiden Observatory)

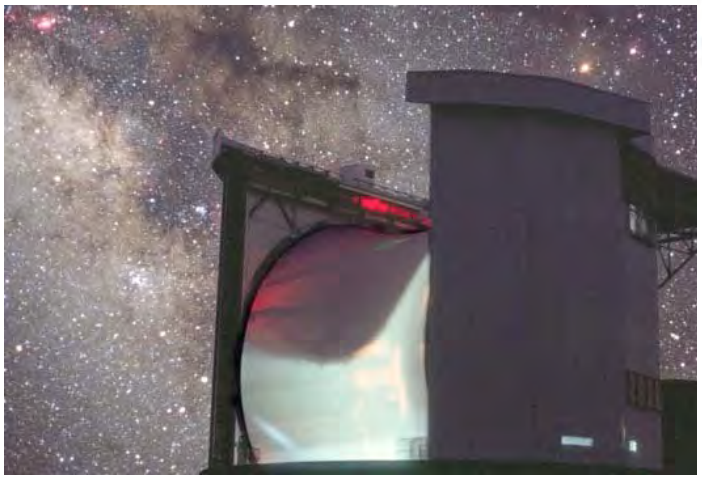
- Paul van der Werf (Leiden Observatory)
- Remo Tilanus (JAC, Hawaii)
- Frank Israel (Leiden Observatory)

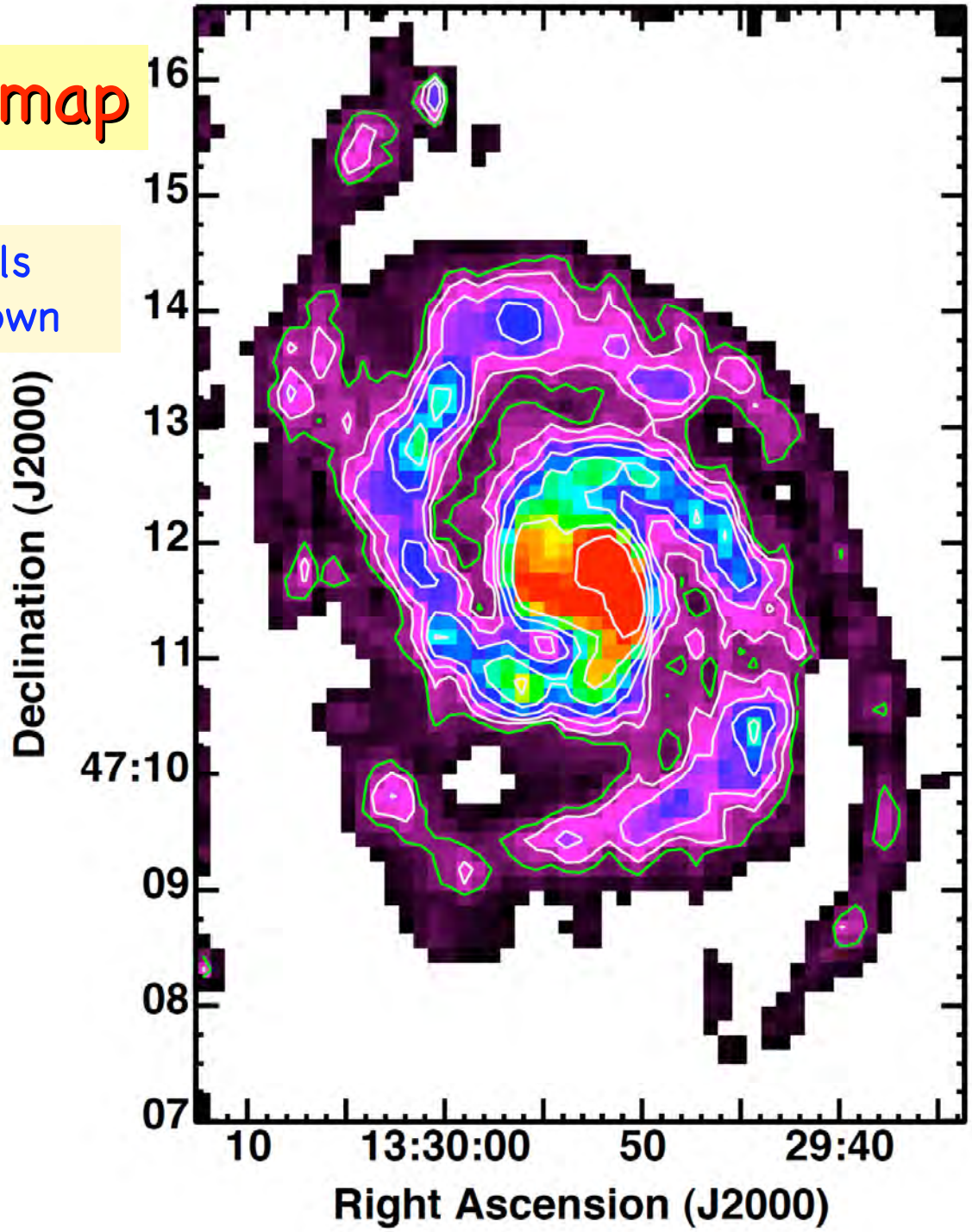
HARP-B CO(3-2) map

- 7.5″ (~300pc) pixels
- only pixels >3σ shown

- ~14″ beam
- analysis limited to 600pc scale

JCMT

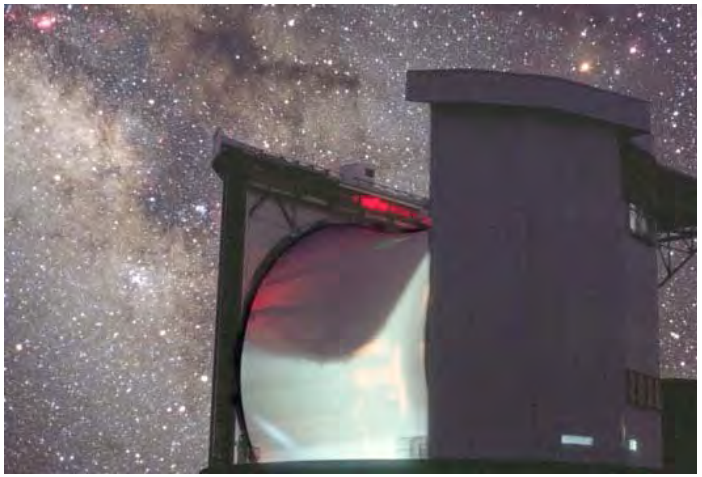


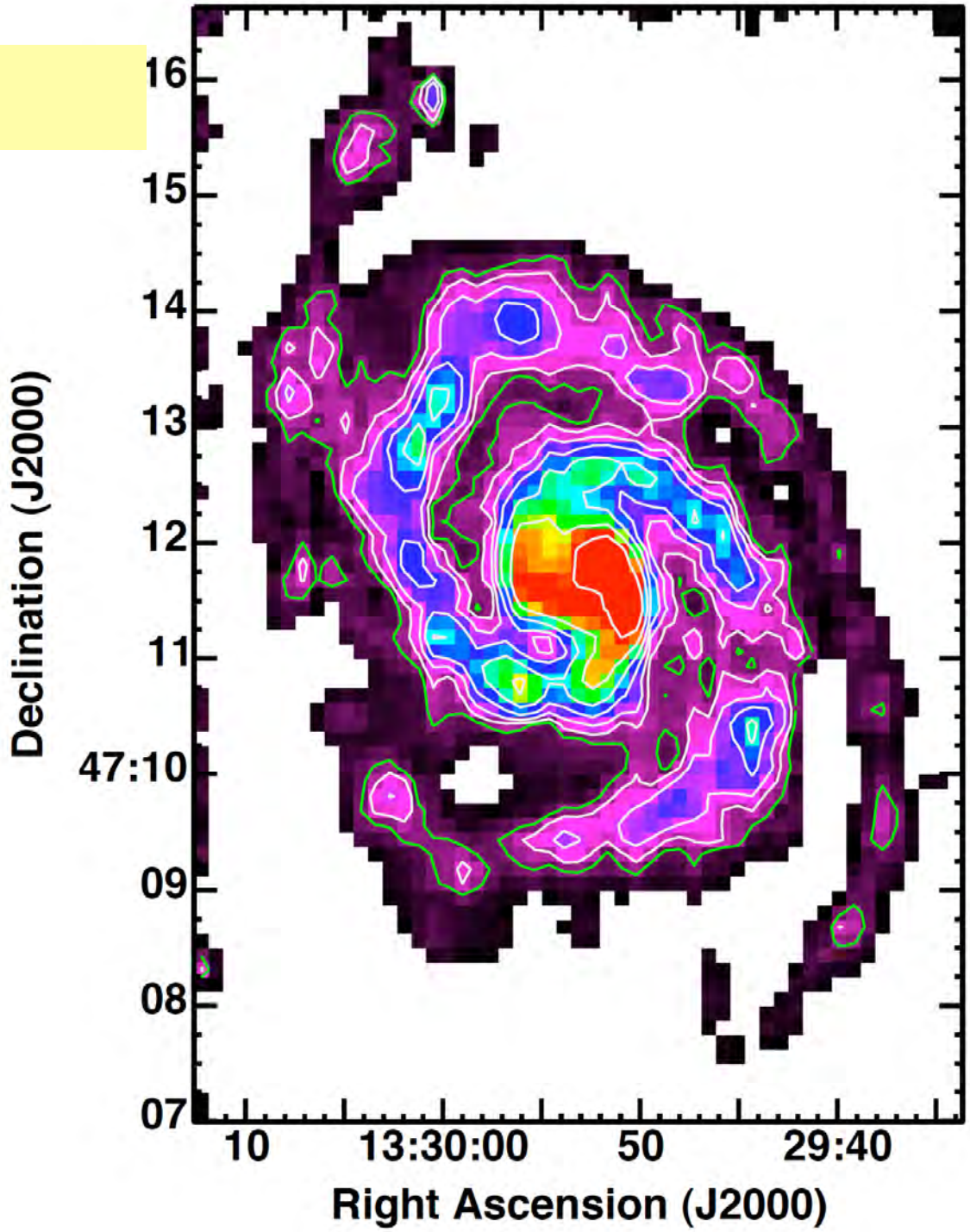


Some aims:

- CO (3-2/1-0) line ratio and distribution
- CO(3-2) vs CO(1-0) as a tracer of molecular gas
- Star Formation Law on ~600pc scales using CO(3-2)

JCMT

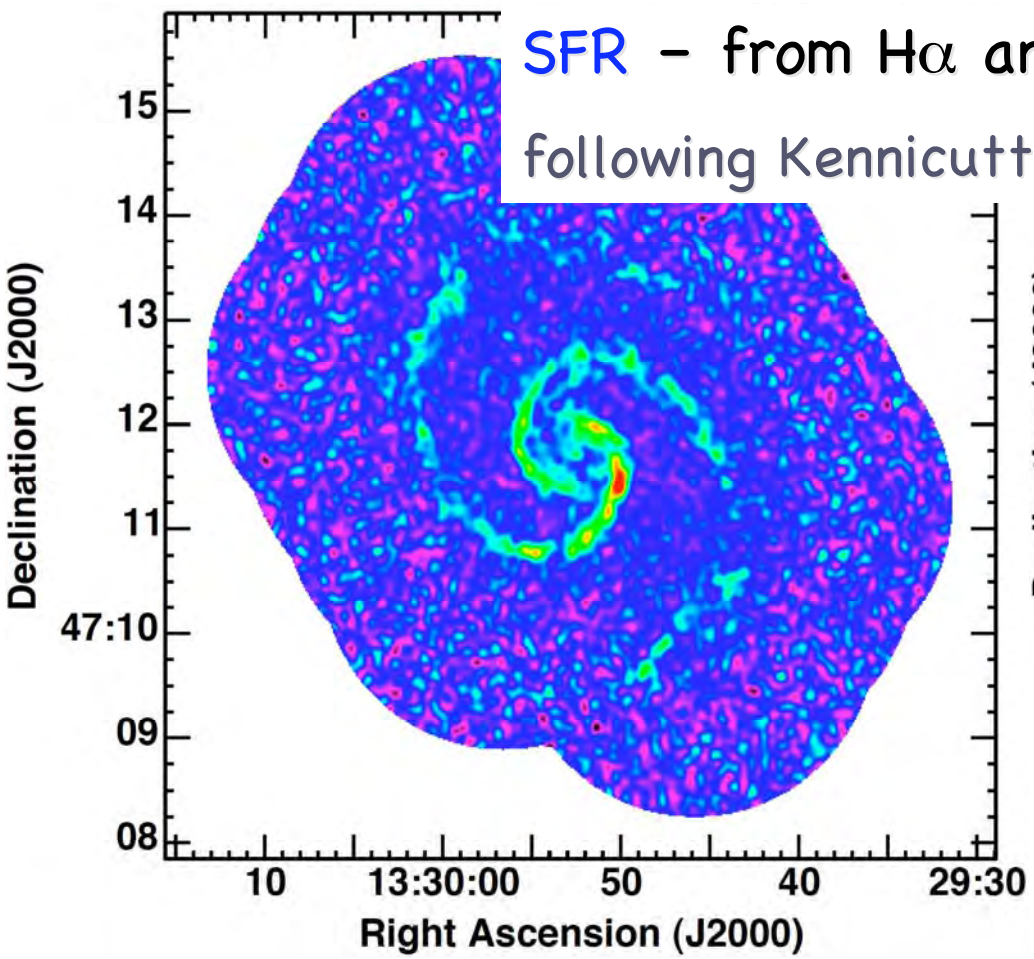


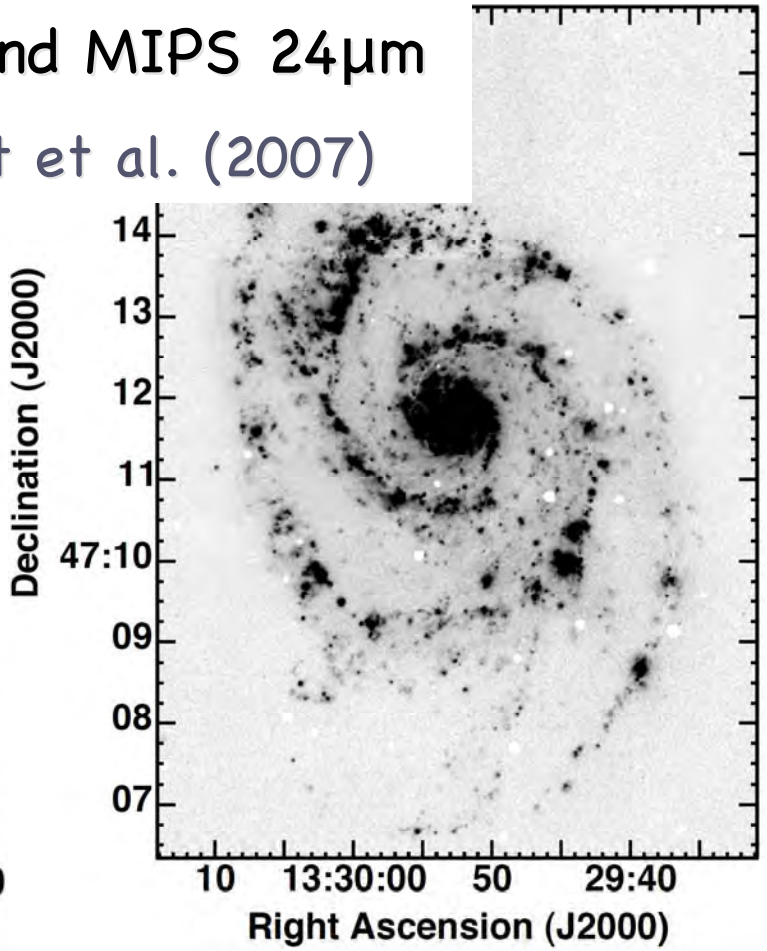


Other Datasets Used

SFR – from Hα and MIPS 24μm

following Kennicutt et al. (2007)





CO(J=1-0) (BIMA SONG)

Hα

And MIPS 24μm

(SINGS)

Analysis Method

matched psfs of each dataset to 14″

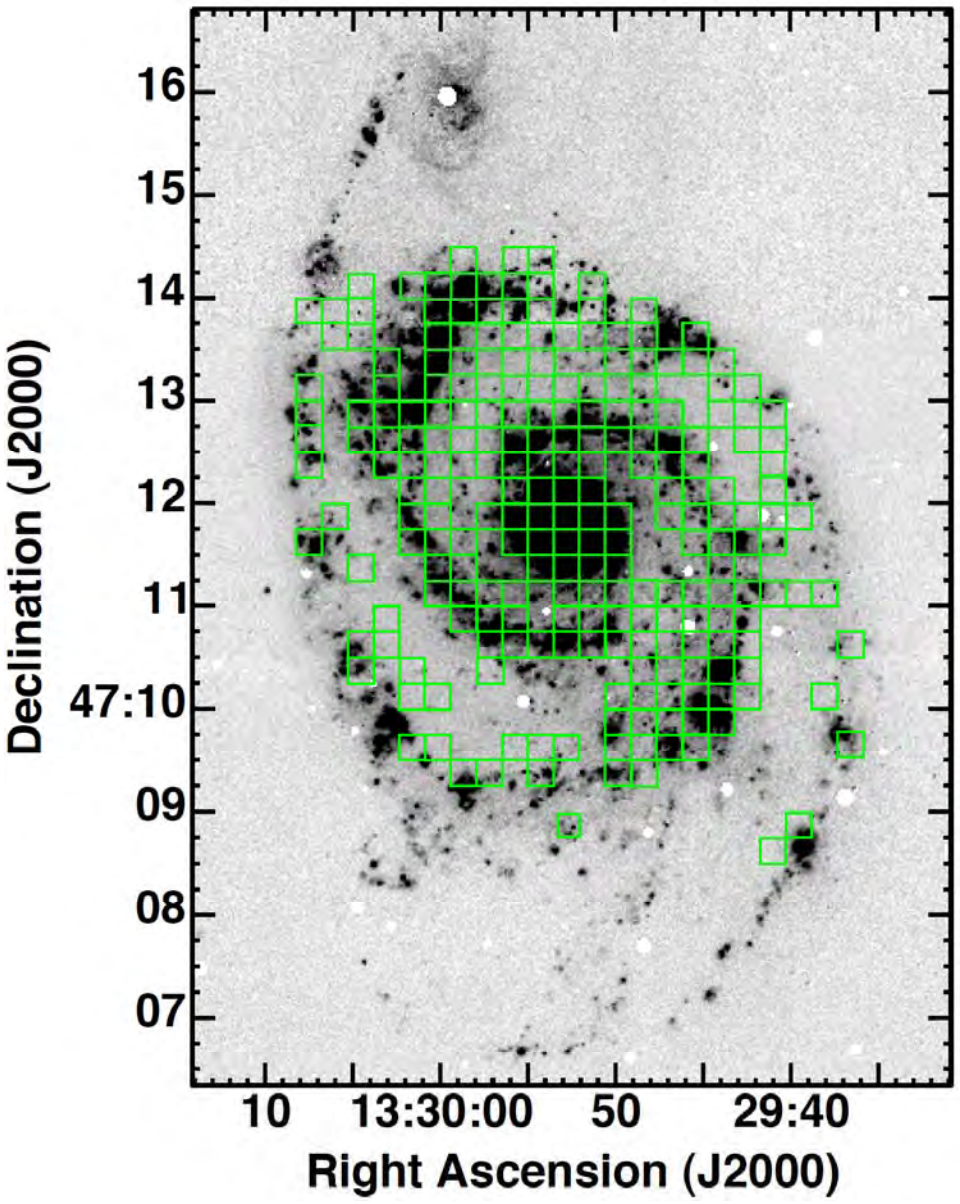
regridded to same 7.5″ pixel grid

measurements in grid of 15″ (600pc) regions

Chose regions >3σ in BIMA/HARP data (shown)

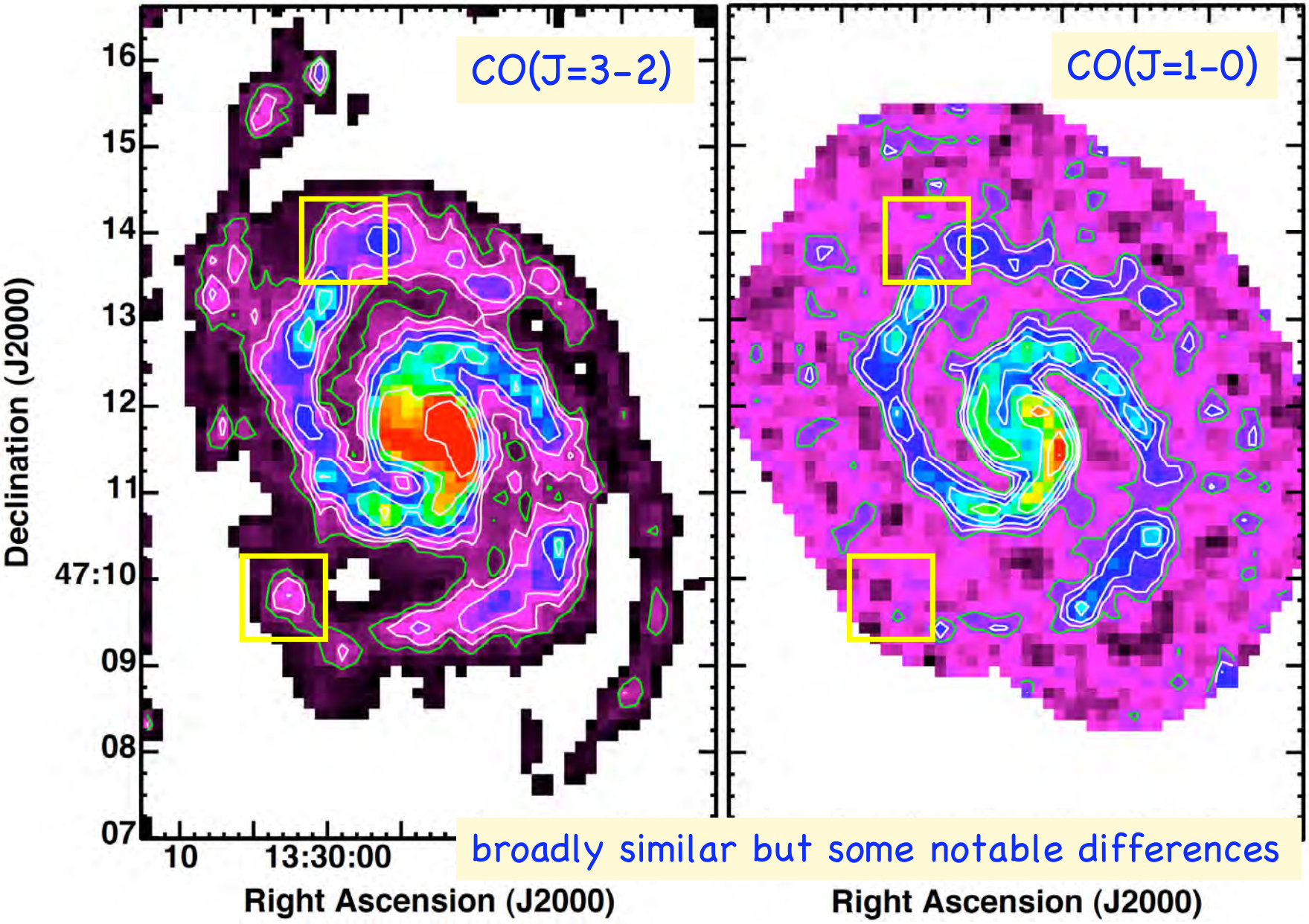
❖ 198 15″ (~600pc) regions

(not including small no. of CO or Hα upper limits)



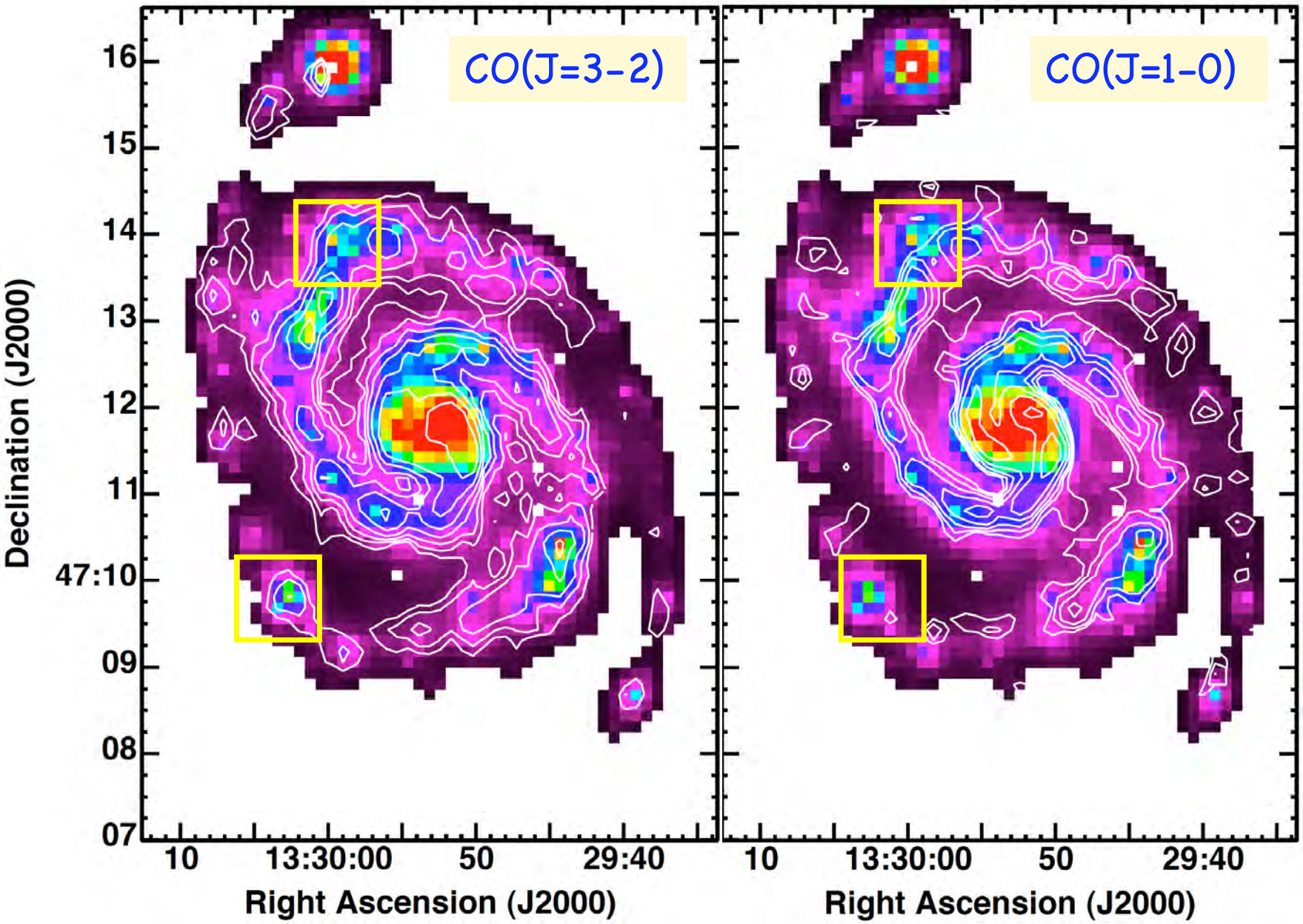
Results

Comparison of CO(3-2) & CO(1-0) distributions



broadly similar but some notable differences

Comparison of CO lines & SFR surface density



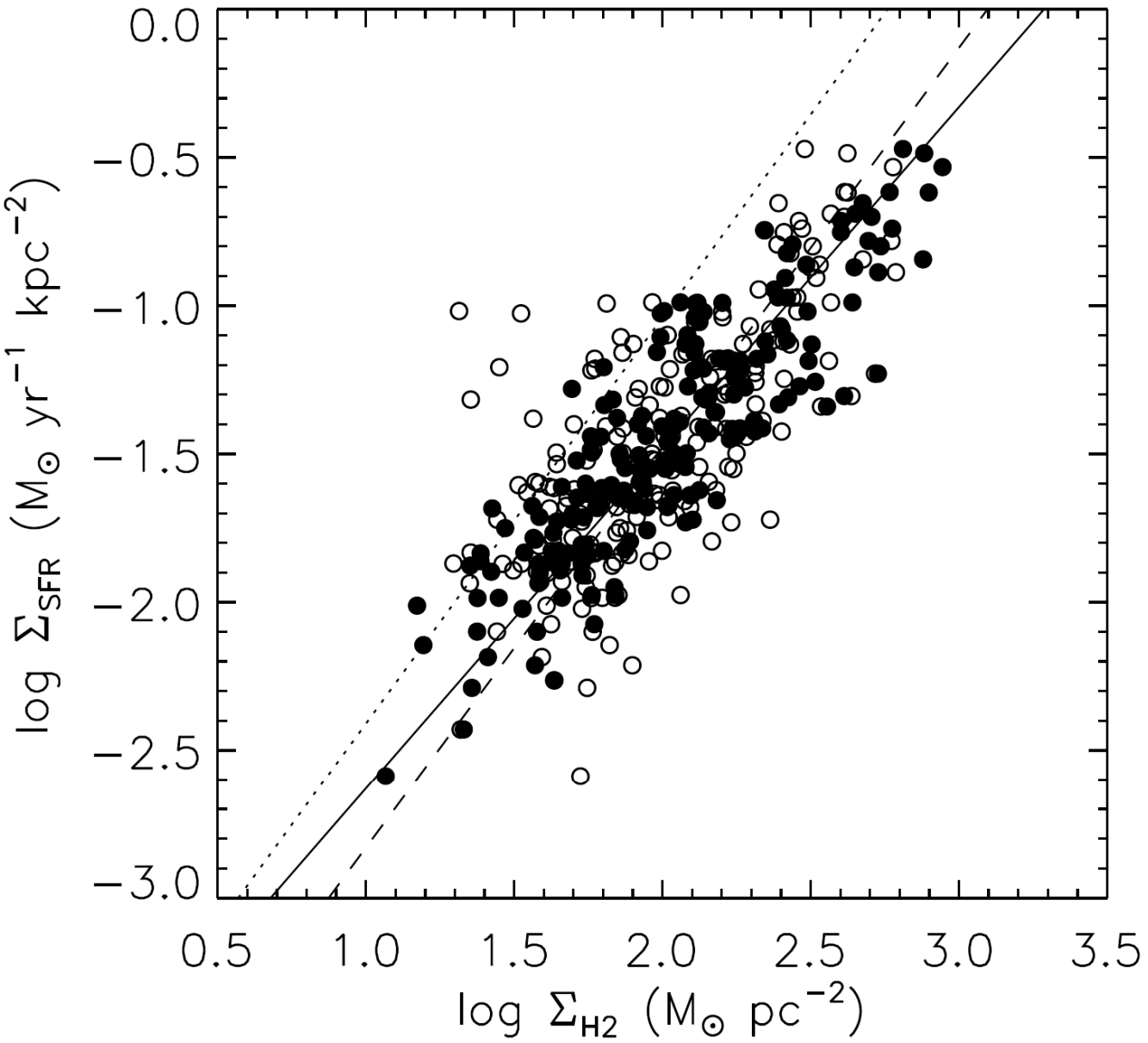
Star Formation Law

Correlation coef:

CO(3-2): 0.88
CO(1-0): 0.70

Slope:

CO(3-2): 1.15
CO(1-0): 1.35
Kennicutt et al. (2007): 1.37



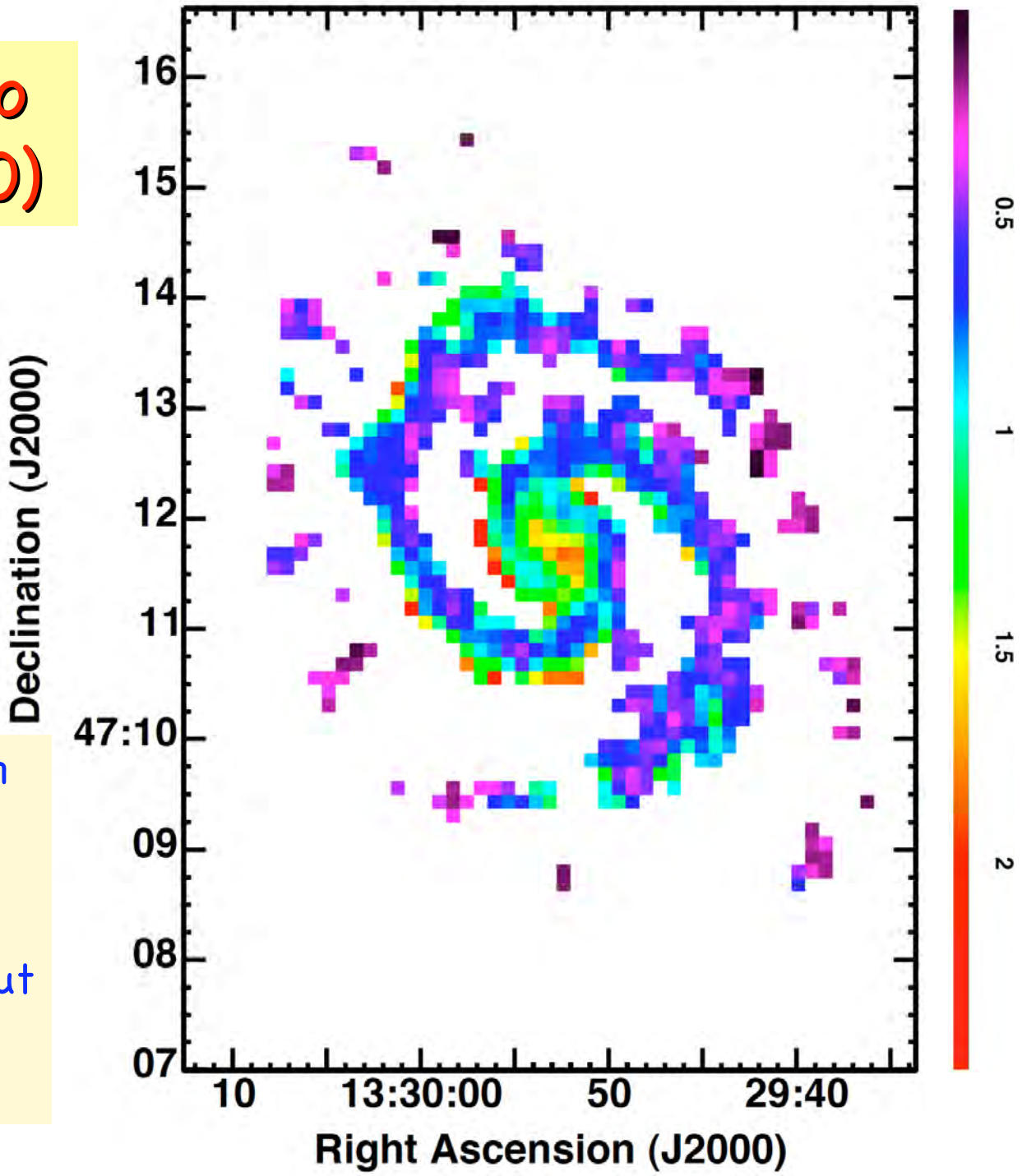
CO line ratio (J=3-2/J=1-0)

Over 15'' regions:
Median: 0.74

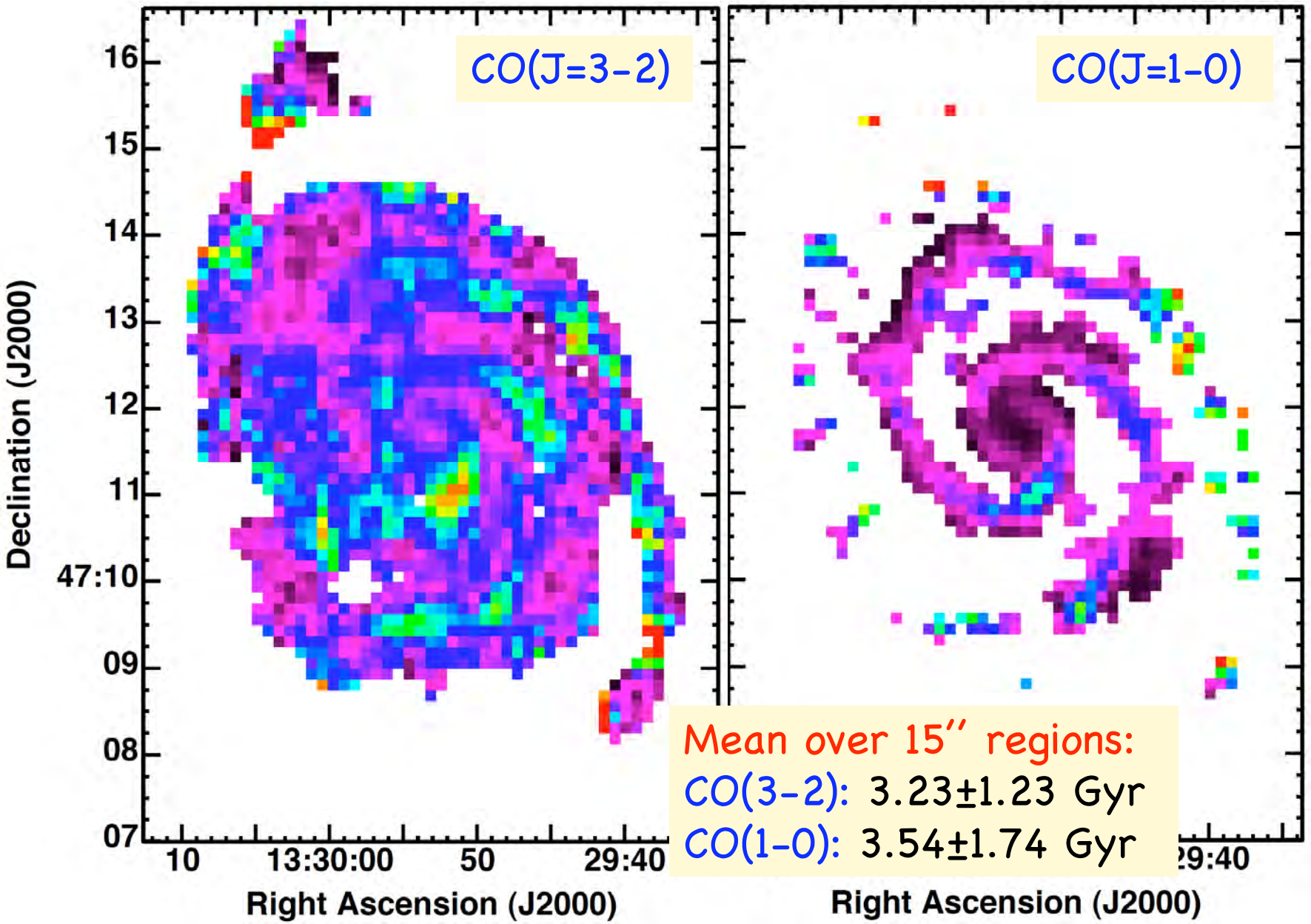
Over 7.5'' pixels:
Median: 0.64

Highest line ratios in centre

General trend to lower ratios as go out into spiral arms



Instantaneous Gas Depletion Timescale

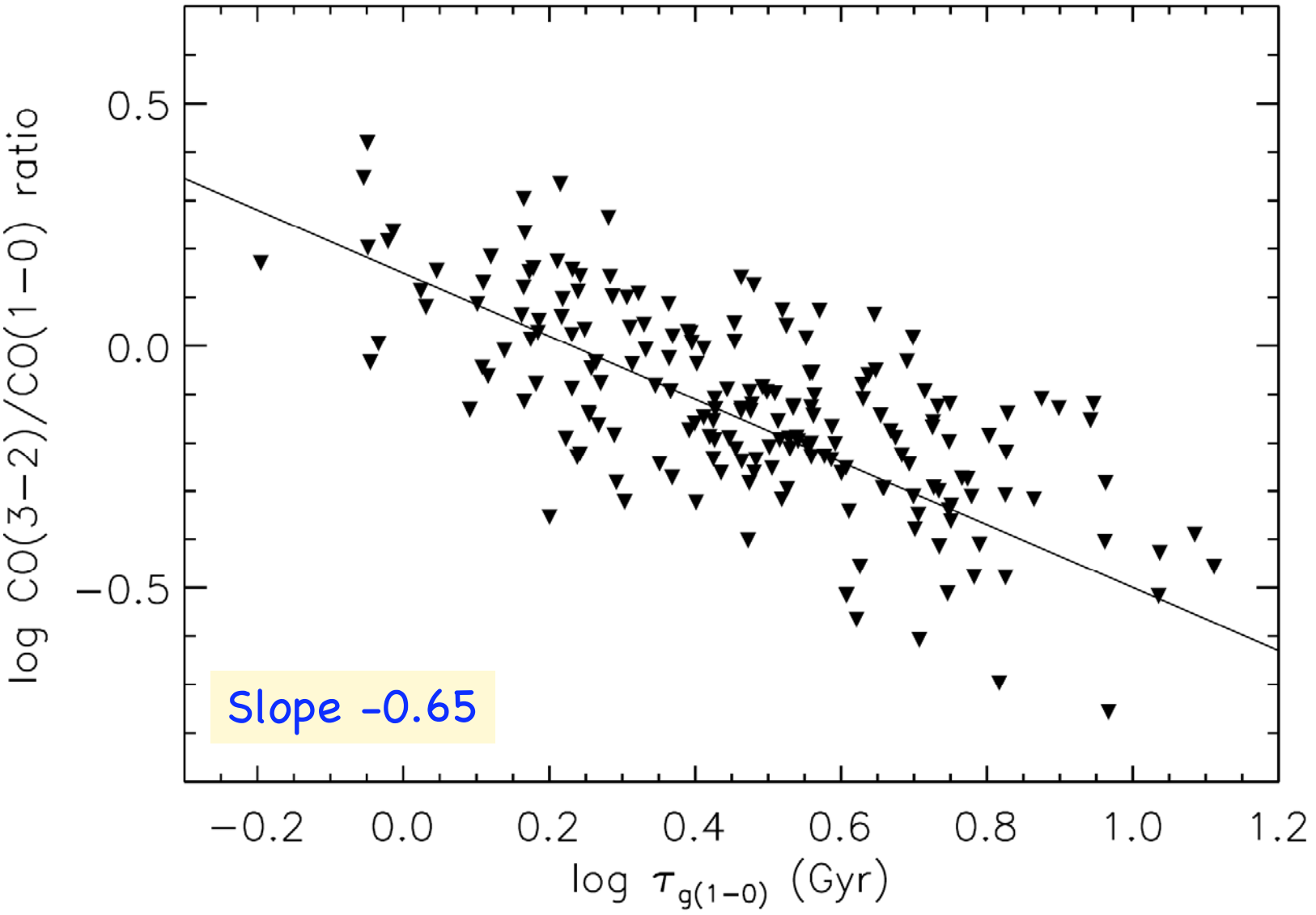


Mean over 15'' regions:

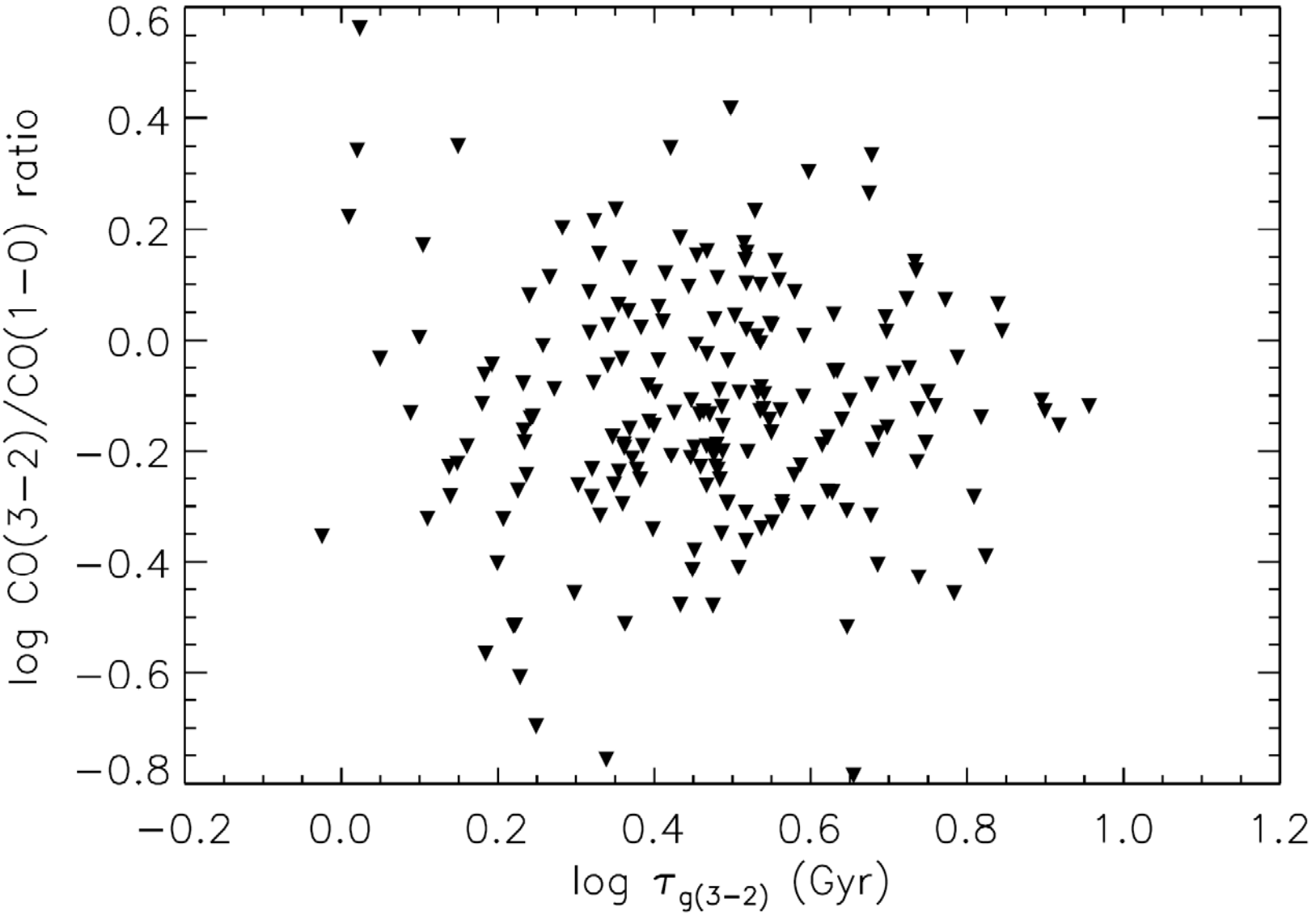
CO(3-2): 3.23±1.23 Gyr

CO(1-0): 3.54±1.74 Gyr

CO line ratio vs gas depletion timescale



CO line ratio vs gas depletion timescale



Summary

Comparison of the distributions of molecular gas as traced by CO(3-2) and CO(1-0)

Spatially resolved star formation law, on ~600 pc scales

- shallower slope for CO(3-2)
- tighter correlation for CO(3-2)

Other work not mentioned here includes e.g.

- gas-to-dust ratios (using SCUBA 850μm map)
- radial profiling
- etc...

Vlahakis et al. (in prep)