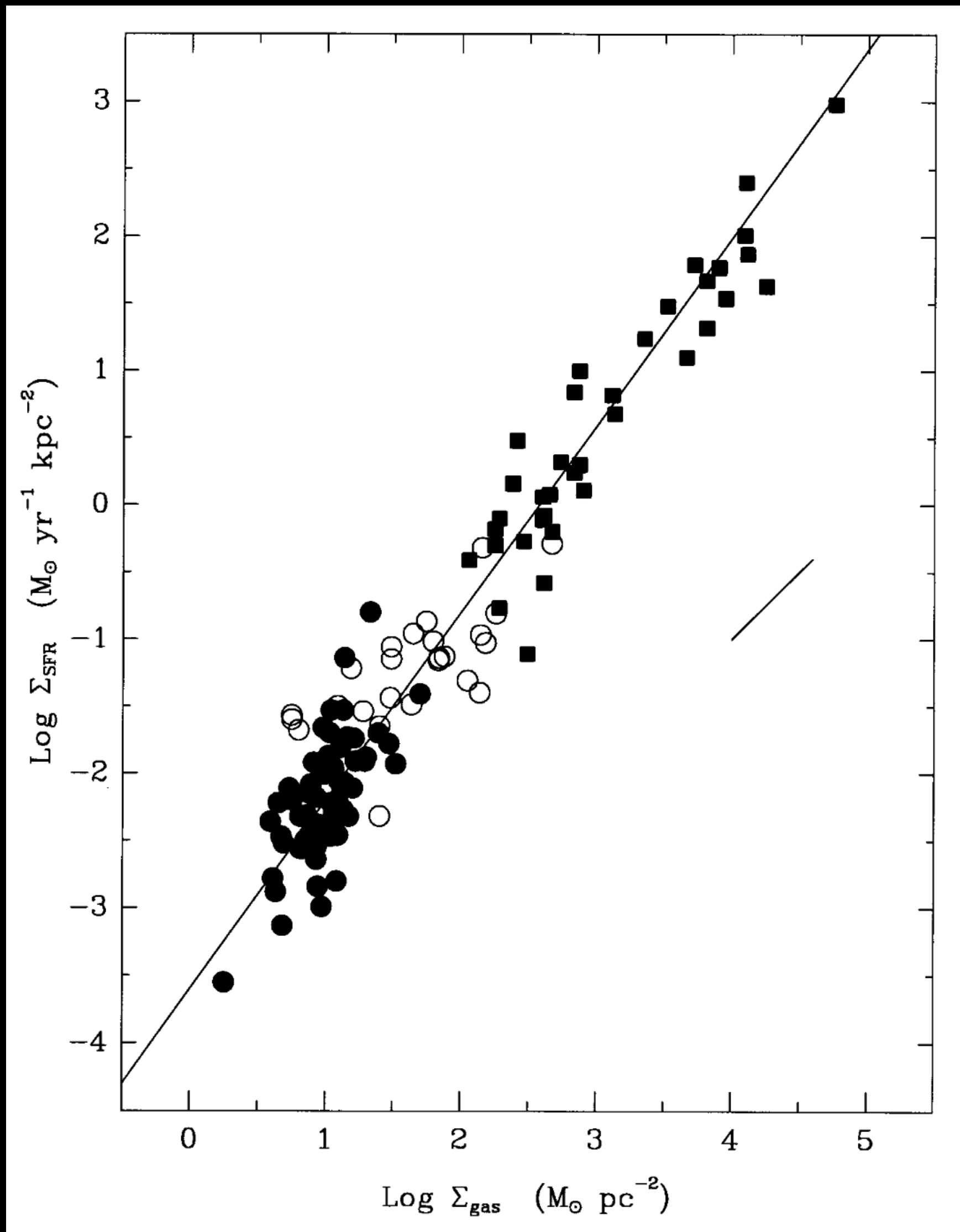# MAJORS

Massive, Active, JCMT-Observed Regions of Star Formation

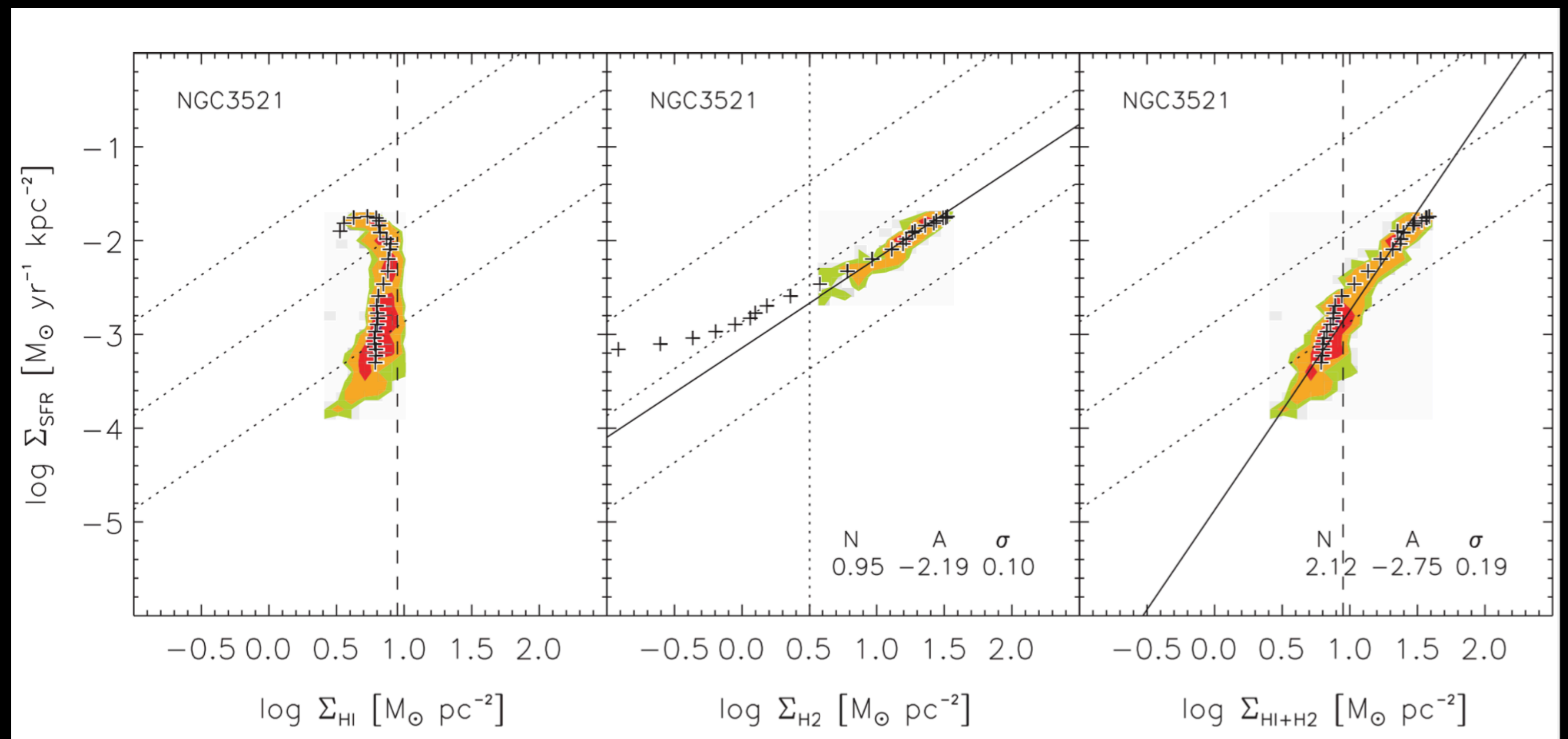**David Eden - JCMT Users' Meeting - February 24th, 2022**

Talk Outline

- Motivation - Empirical Scaling Relations

- MAJORS - Massive, Active, JCMT-Observed Regions of Star formation

- Suitability of HCN and HCO+ as dense gas tracers

- Sample Selection
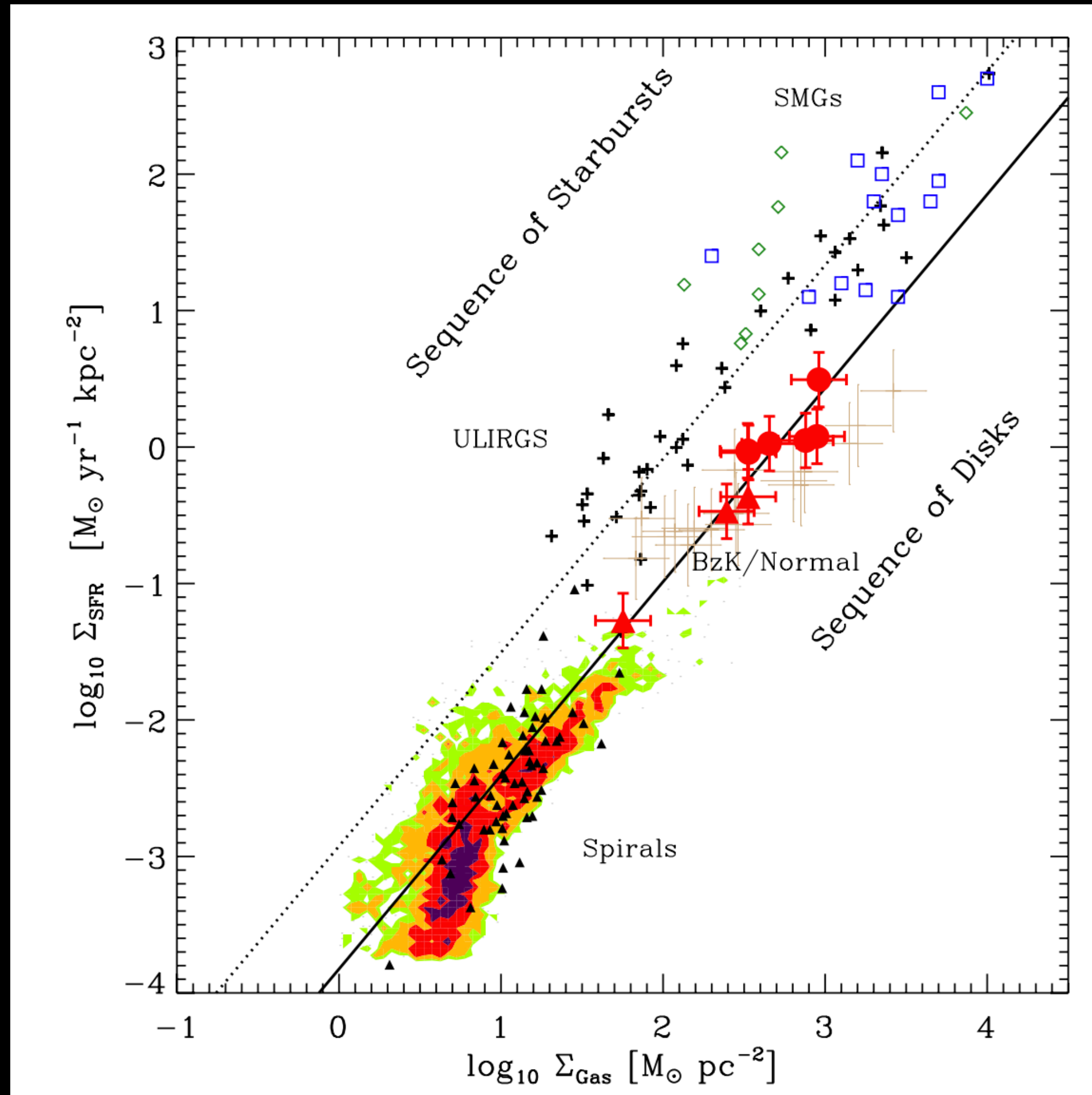
- Science Goals

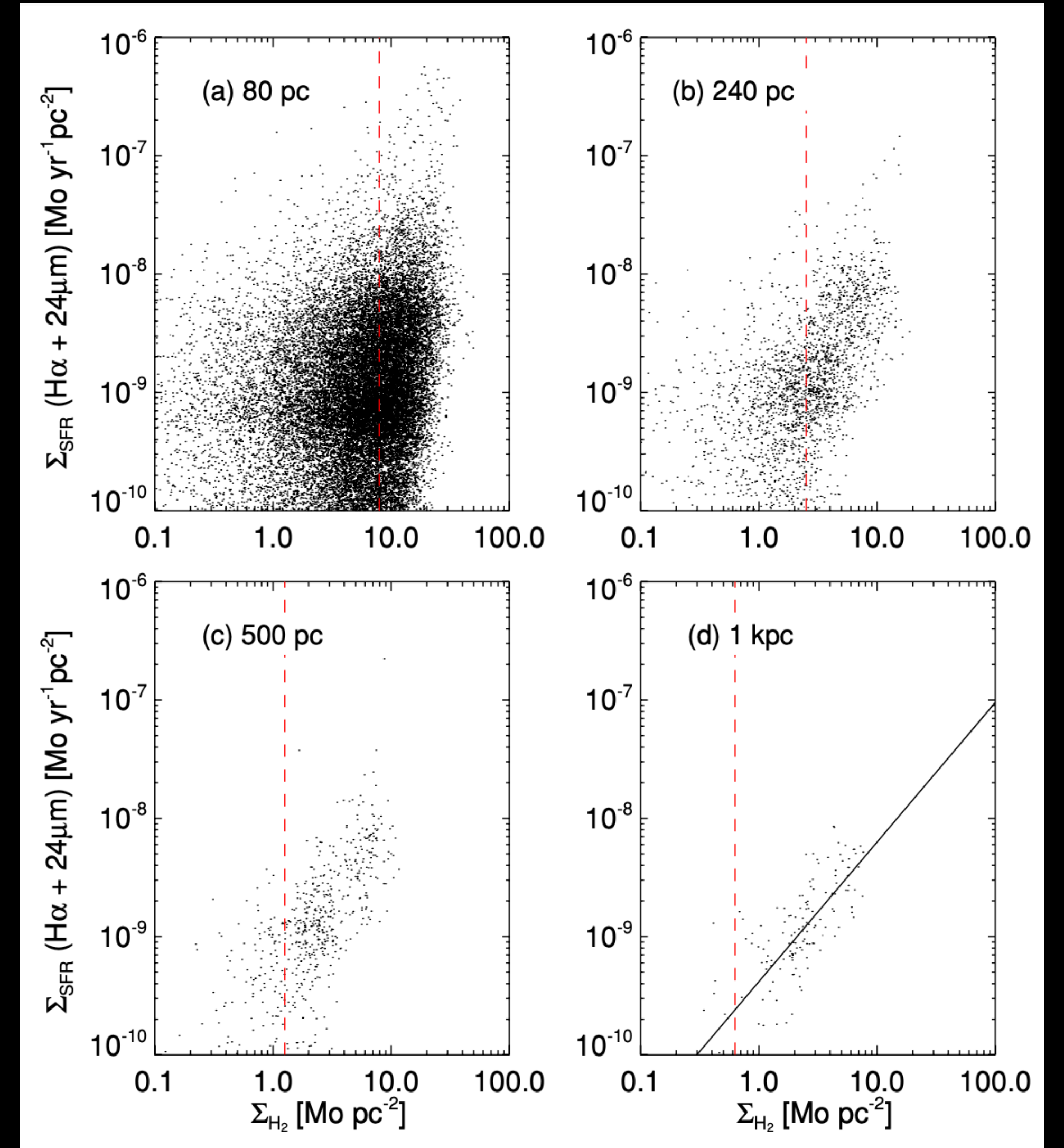# Empirical Scaling Relations

Kennicutt94
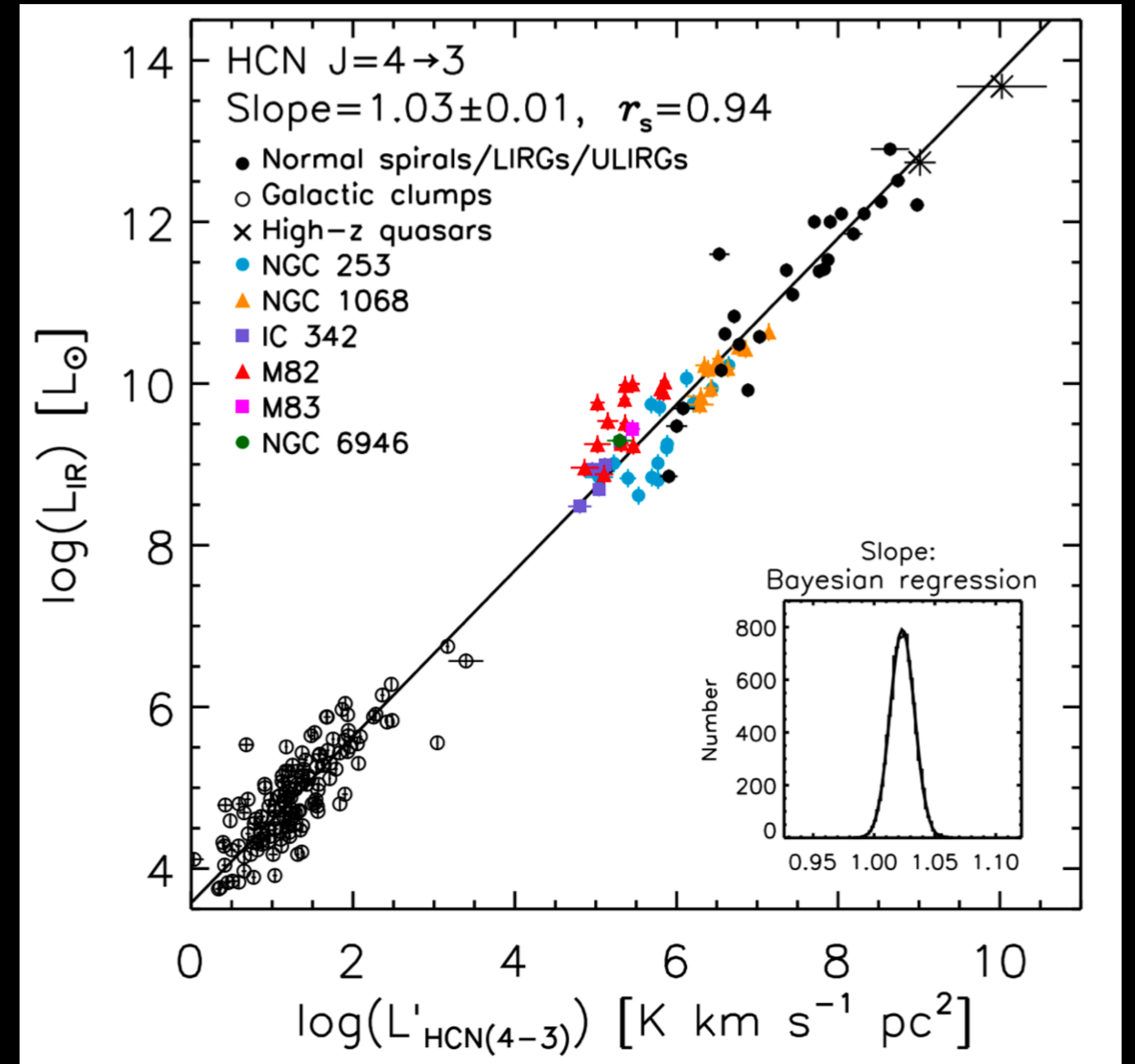
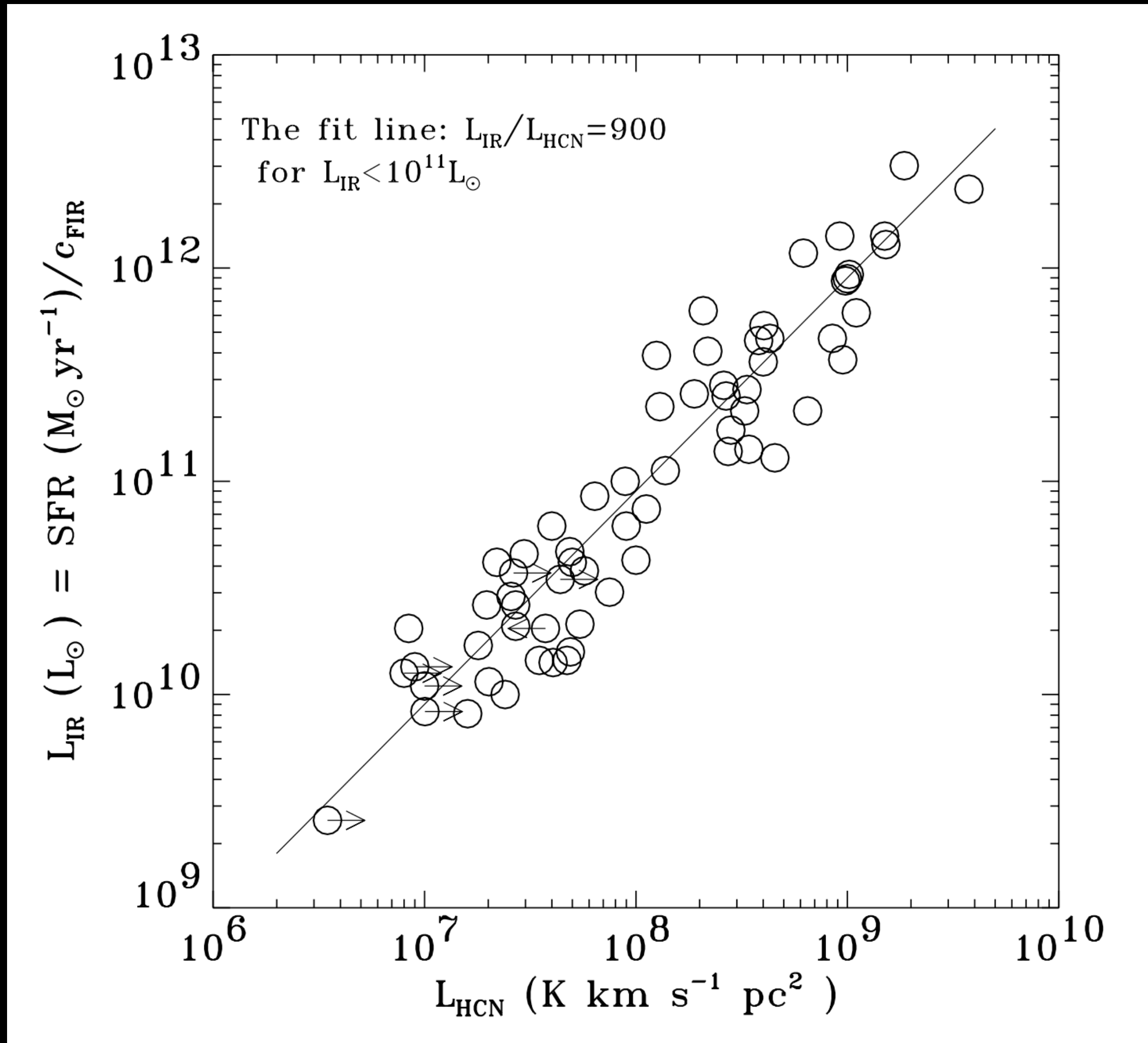Bigiel+08

Empirical Scaling Relations

Daddi+10

Onodero+10

Dense Gas Star-Forming Relationships

MAJORS
## Massive, Active, JCMT-Observed Regions of Star Formation

976 hours of Grade 4 time

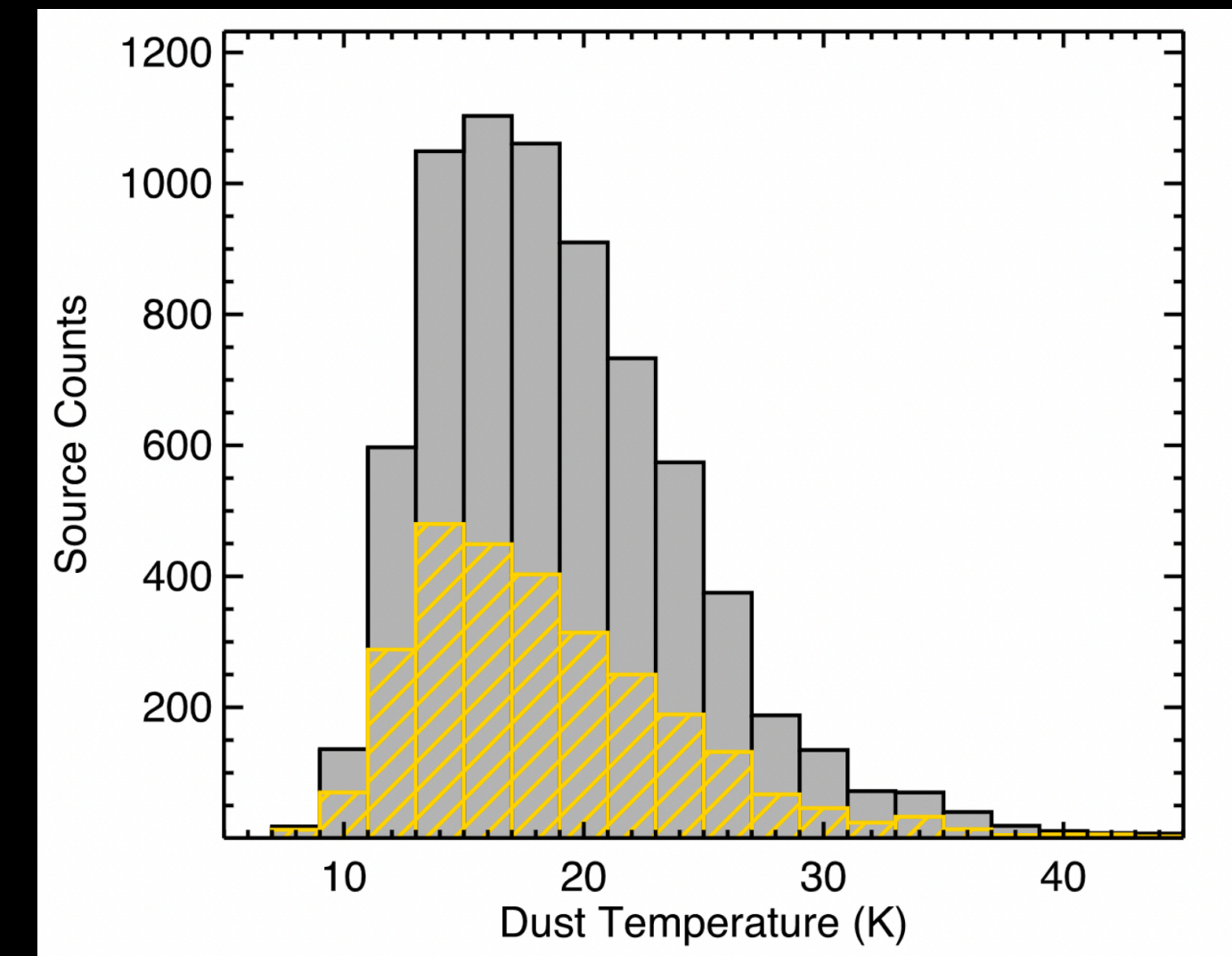'Ū'ū : simultaneously tuned to observe HCN and HCO$^+$ J = 3-2

Observe 108 star-forming regions, or dense-gas accumulations, across the Galaxy, in the Inner (96) and Outer Galaxy (9) and in the Central Molecuar Zone (3).

HCN J=3-2: Suitability for dense gas studies

Effective critical density: 7.3×10^4 cm^{-3} (20K) and 2.5×10^4 cm^{-3} (50K) (Shirley15)
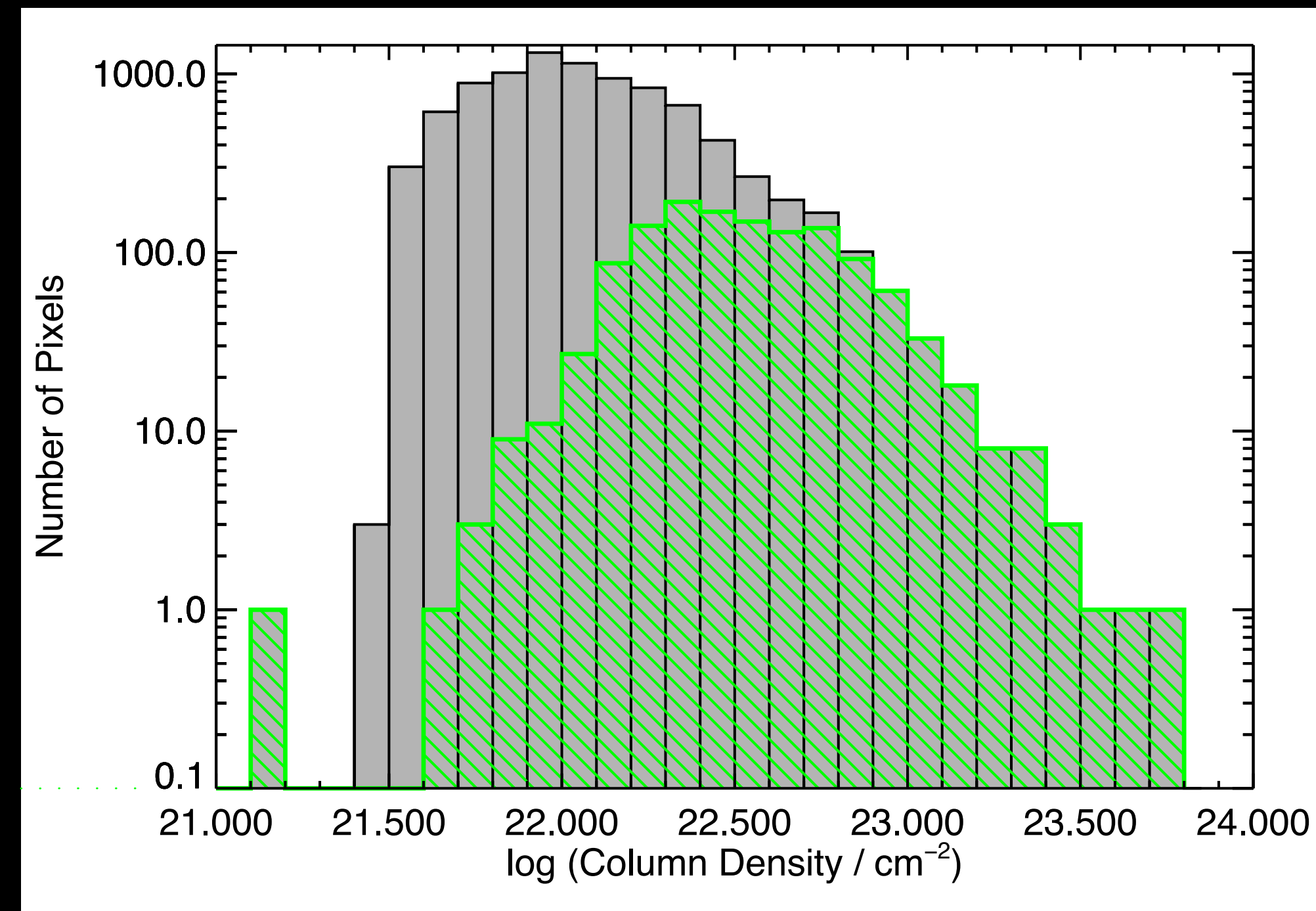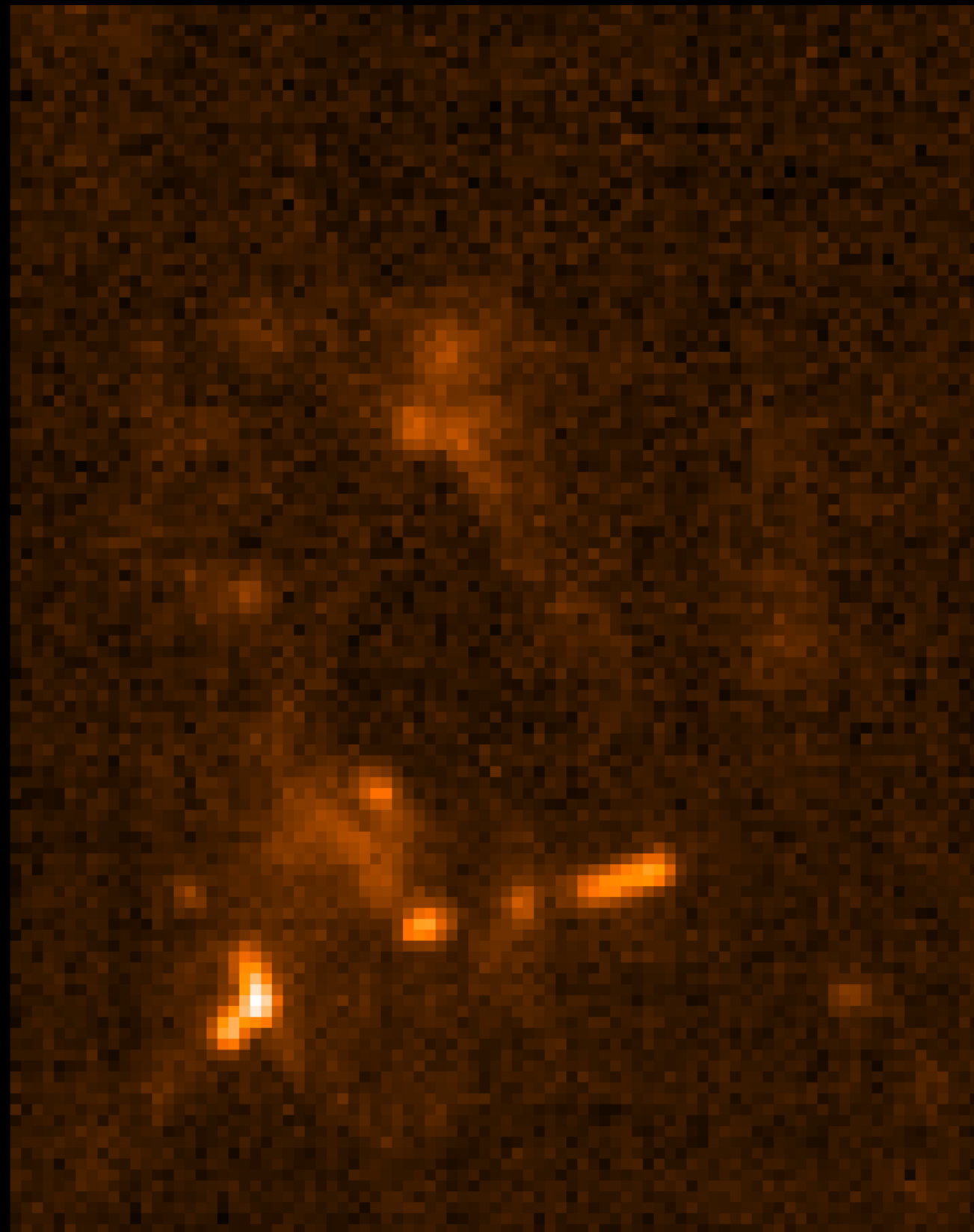
Urquhart+18
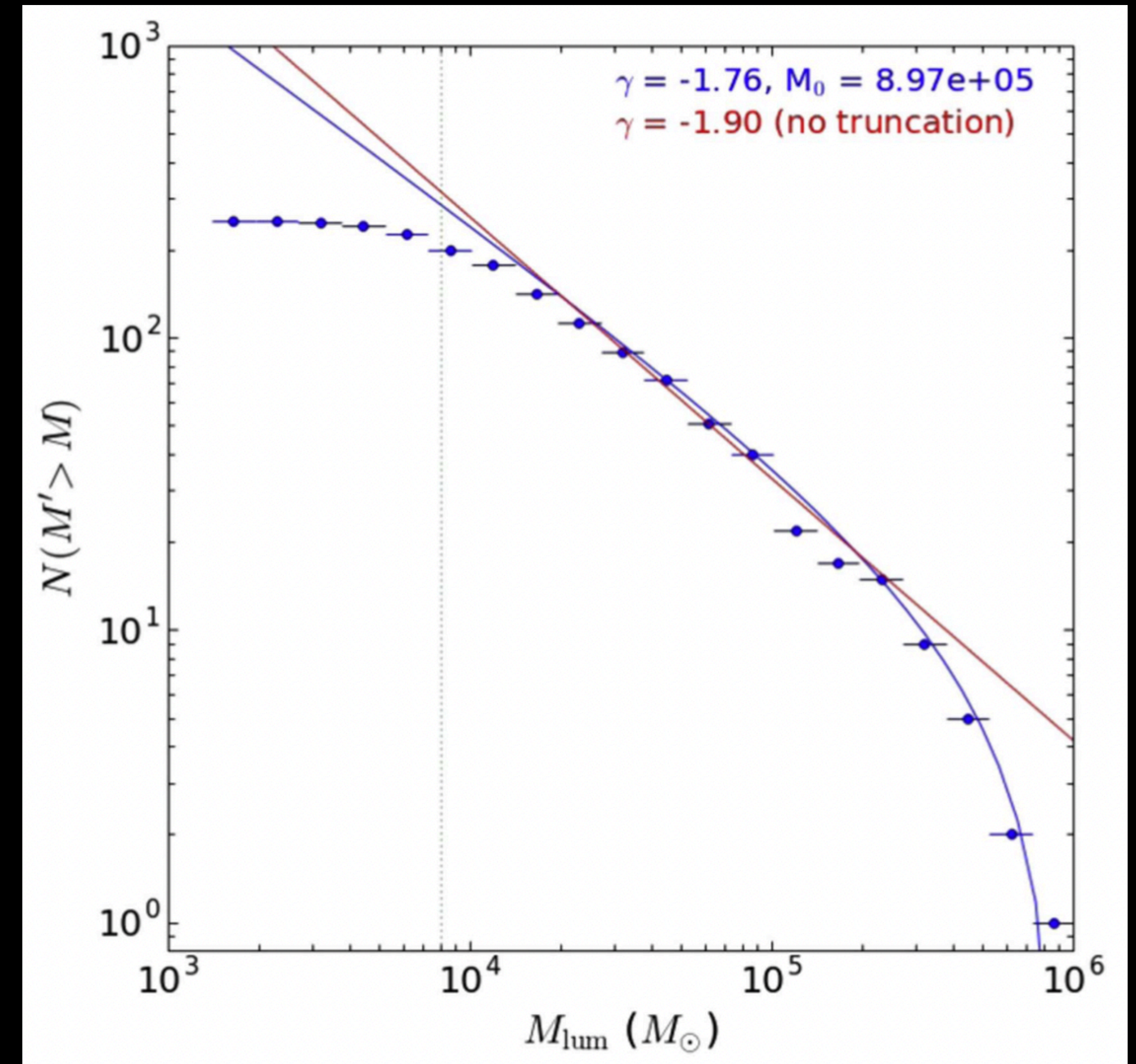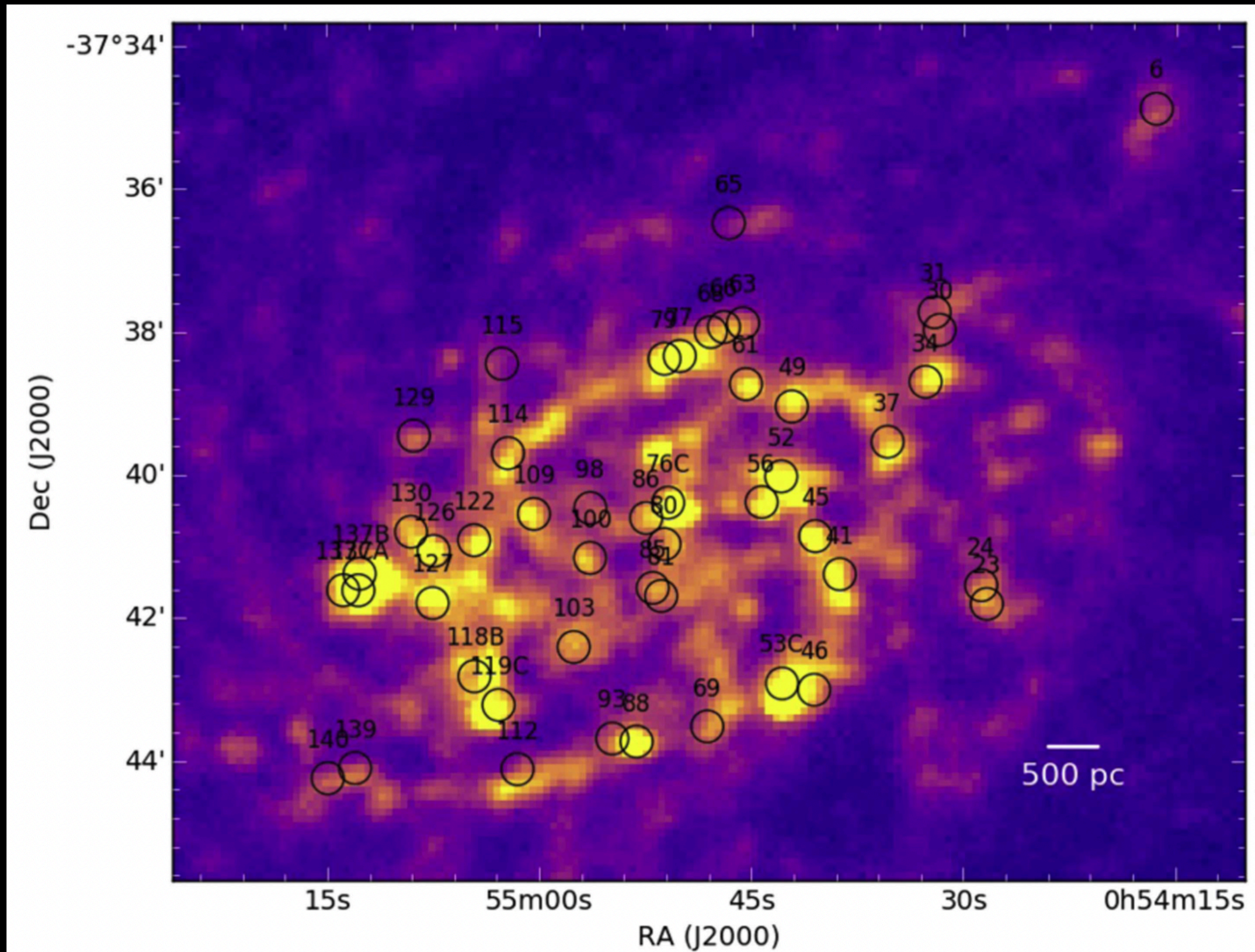

Herschel data: Palmeirim+13
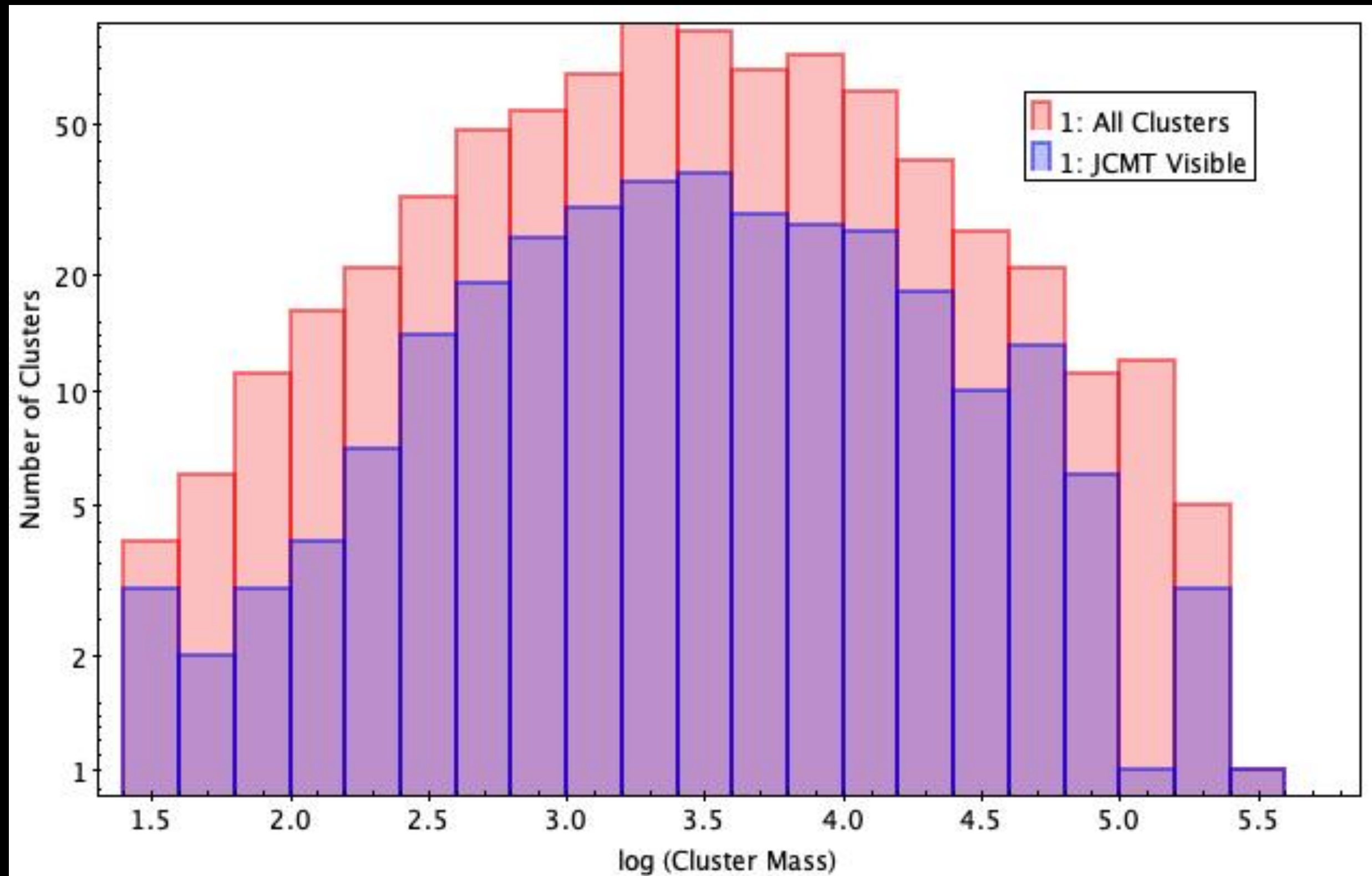
MAJORS Sample Selection

ALMA Completeness Limit - NGC300

GMC Completeness Limit: 8×10^3 $M_\odot$

Faesi+18

MAJORS Sample Selection
ATLASGAL Clusters - Inner Galaxy

Urquhart+18

Limit of 8 x10^3 M$_\odot$, 96 clusters in the longitude range ℓ = 5° - 60°

Inner Milky Way (outside of the central 10 degrees)

74% of the dense-gas mass
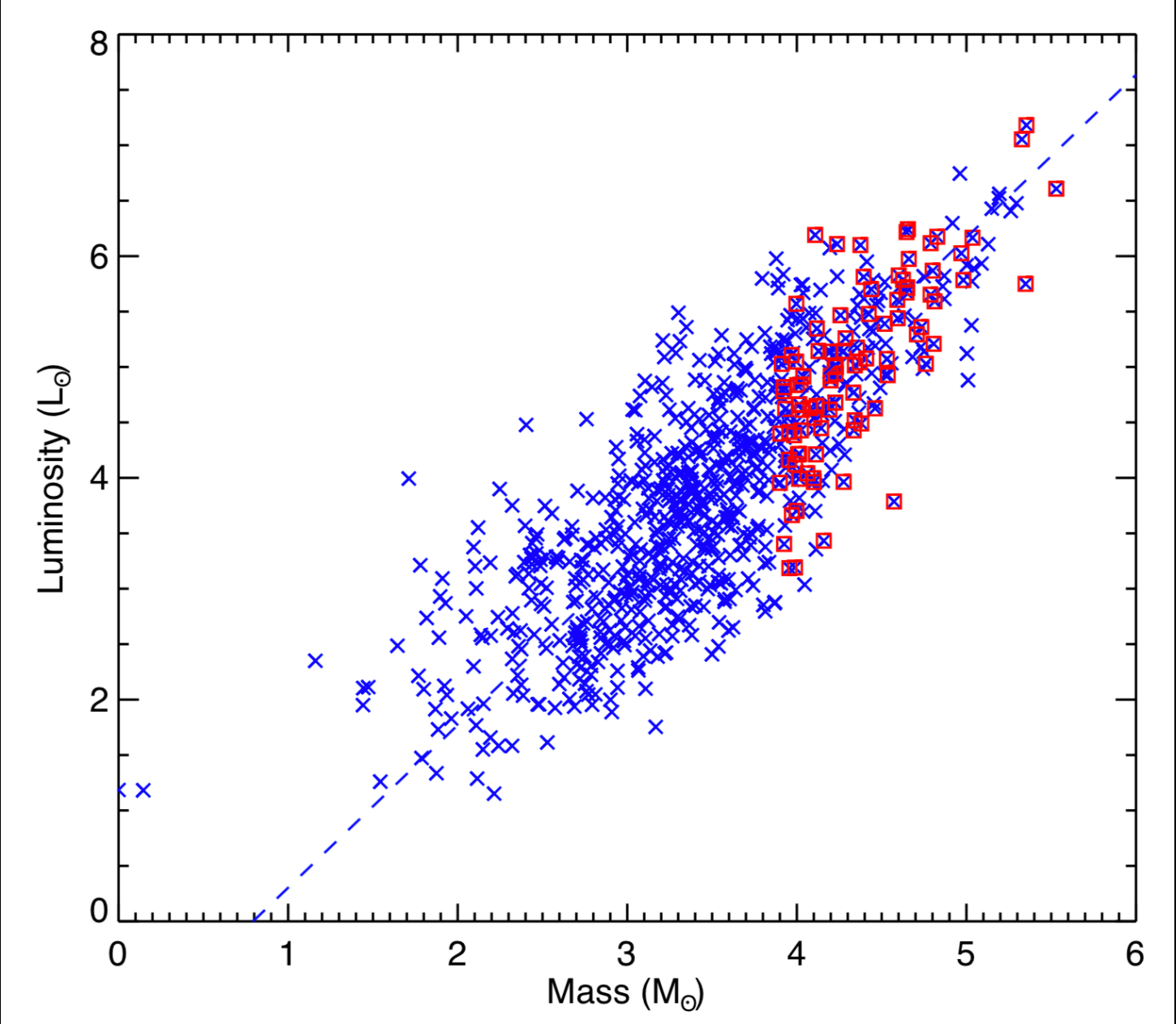
86% of the dense-gas luminosity

MAJORS Sample Selection
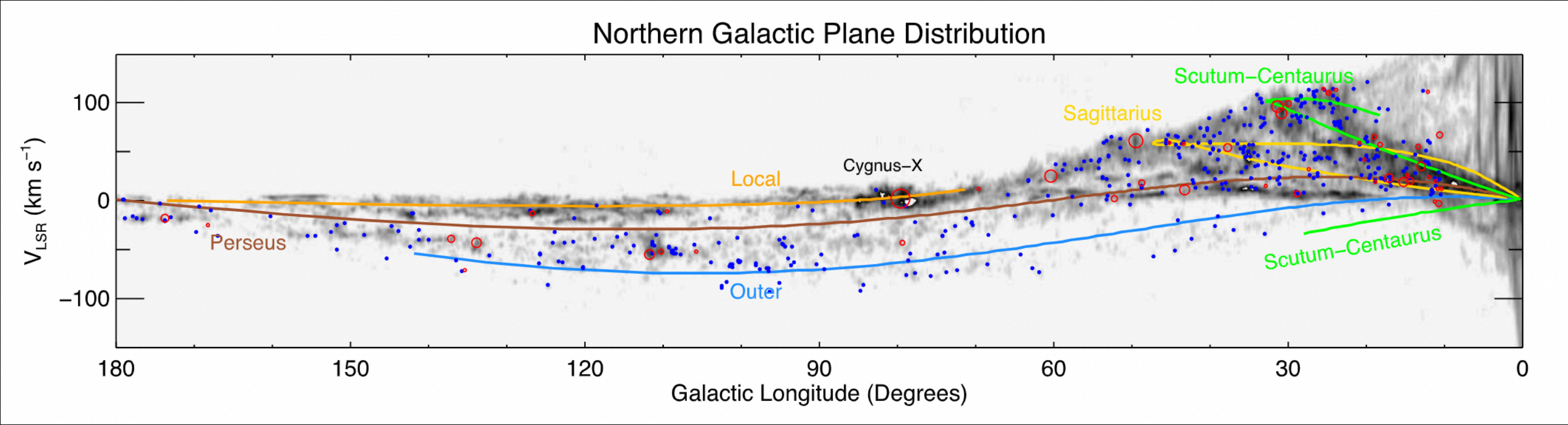
Outer Galaxy

ℓ = 60° - 240°

Luminosity limit: 3 x10^4 L$_\odot$

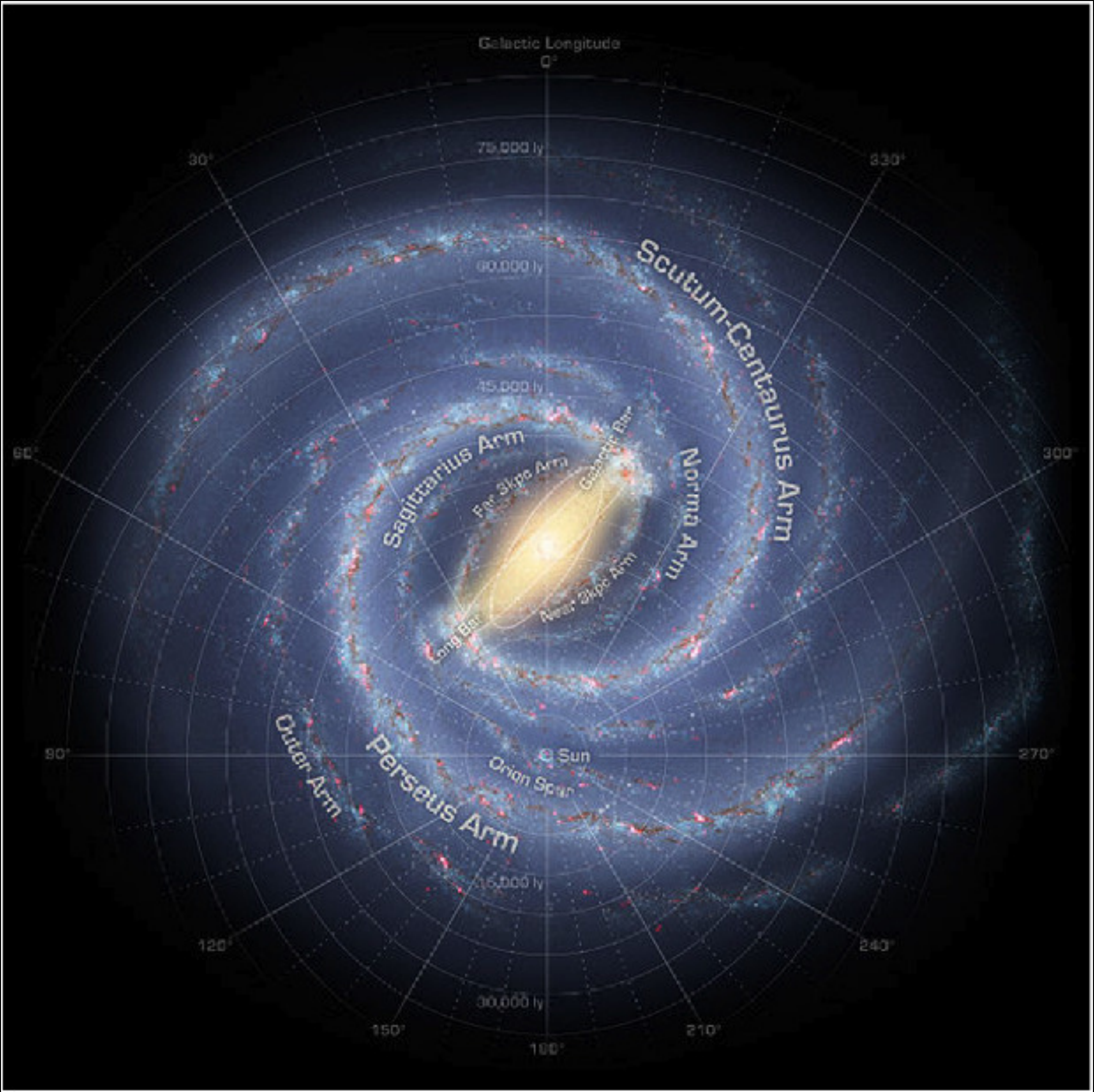9 clusters, 7 to be observed

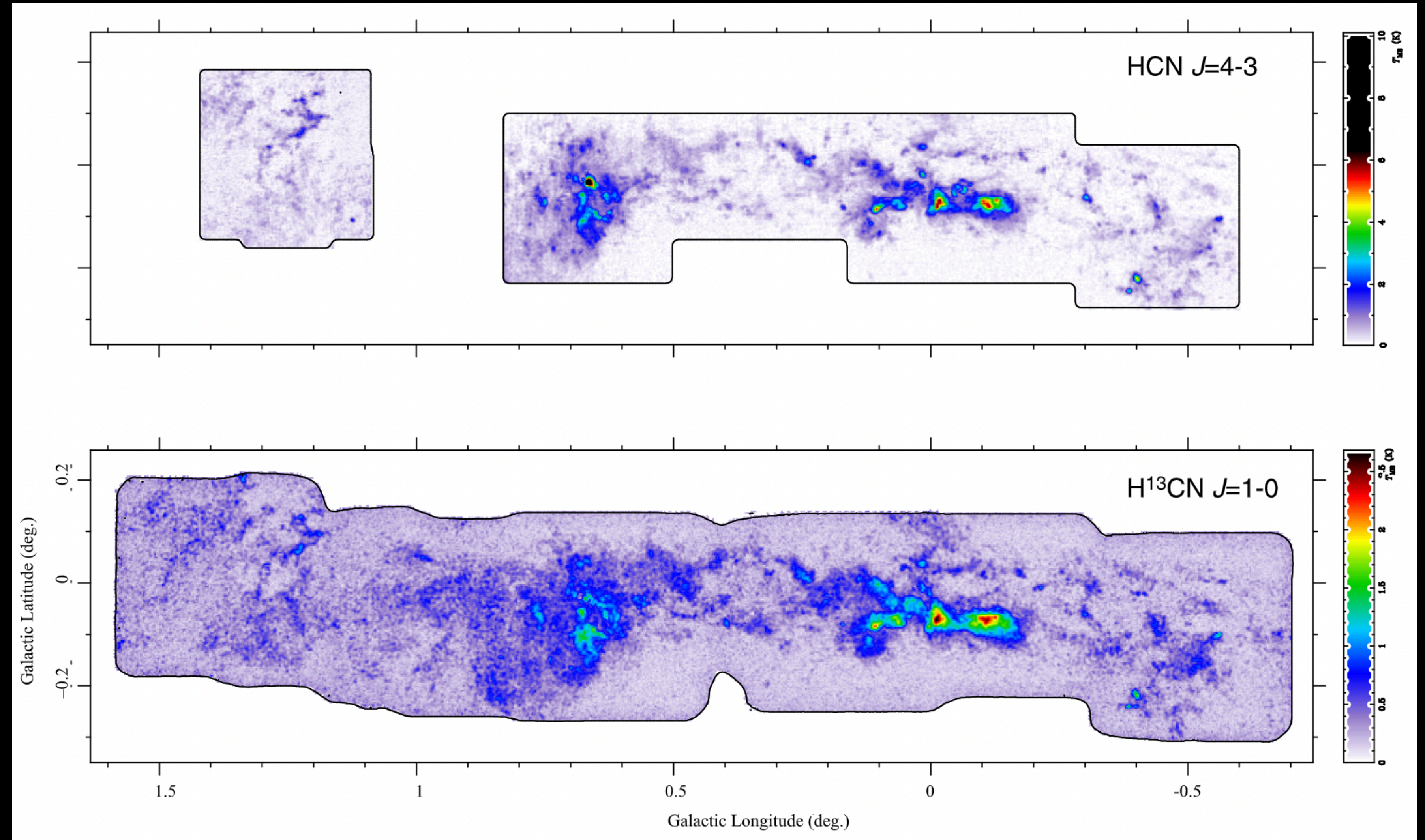Remaining two DDT time

Urquhart+18

Urquhart+13

MAJORS Sample Selection
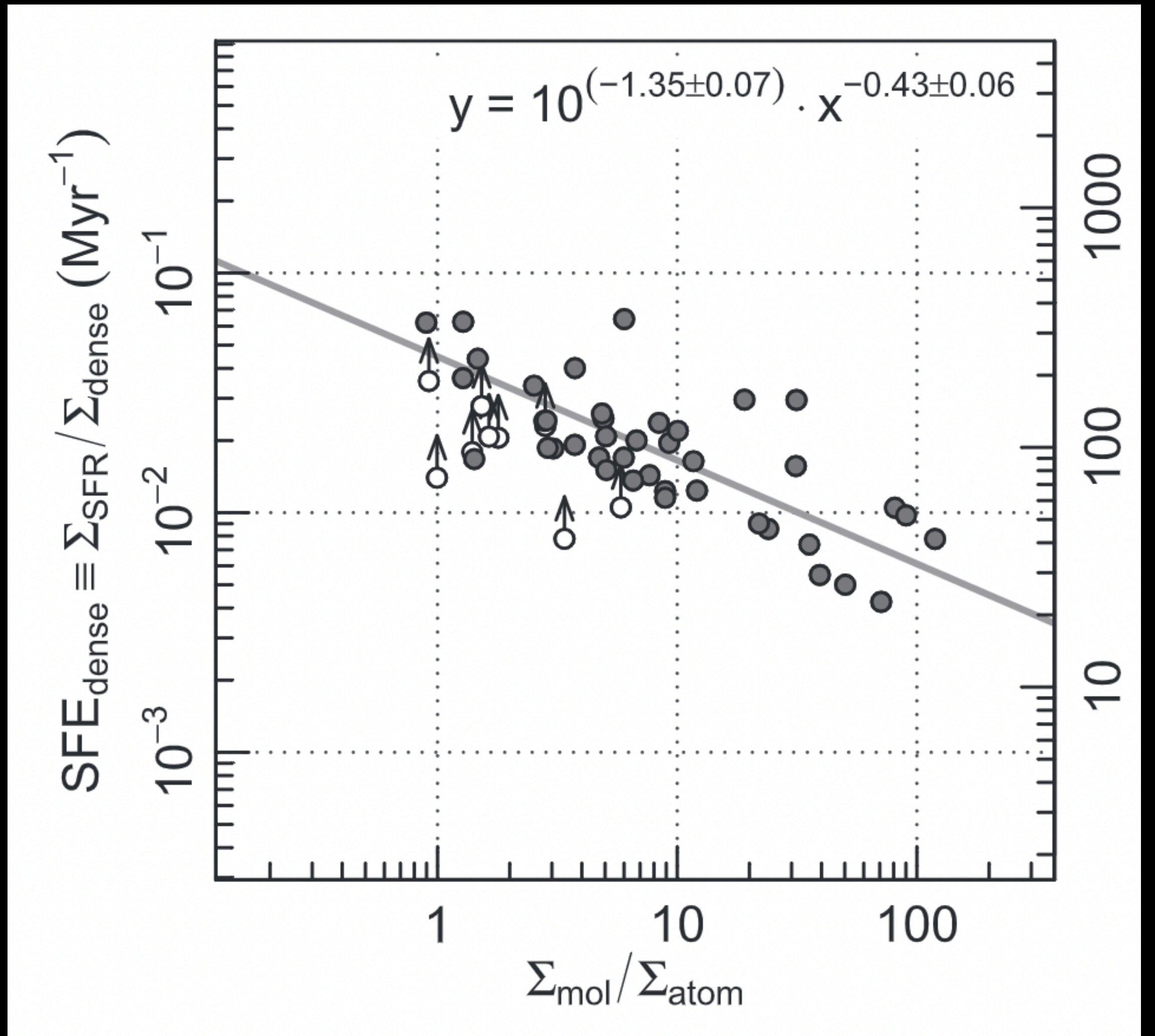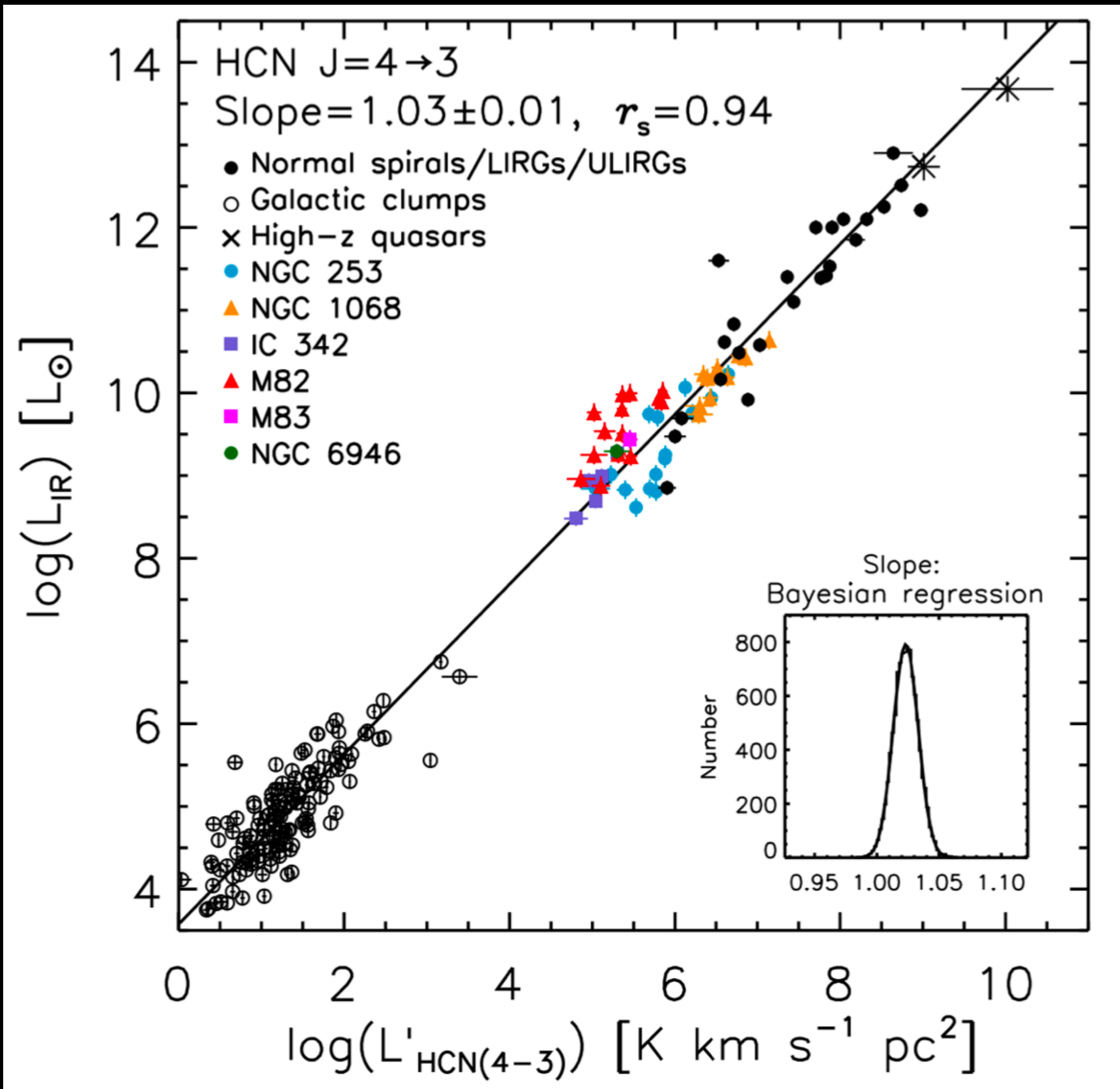## CMZ

3 areas of HCN J=4-3 emission
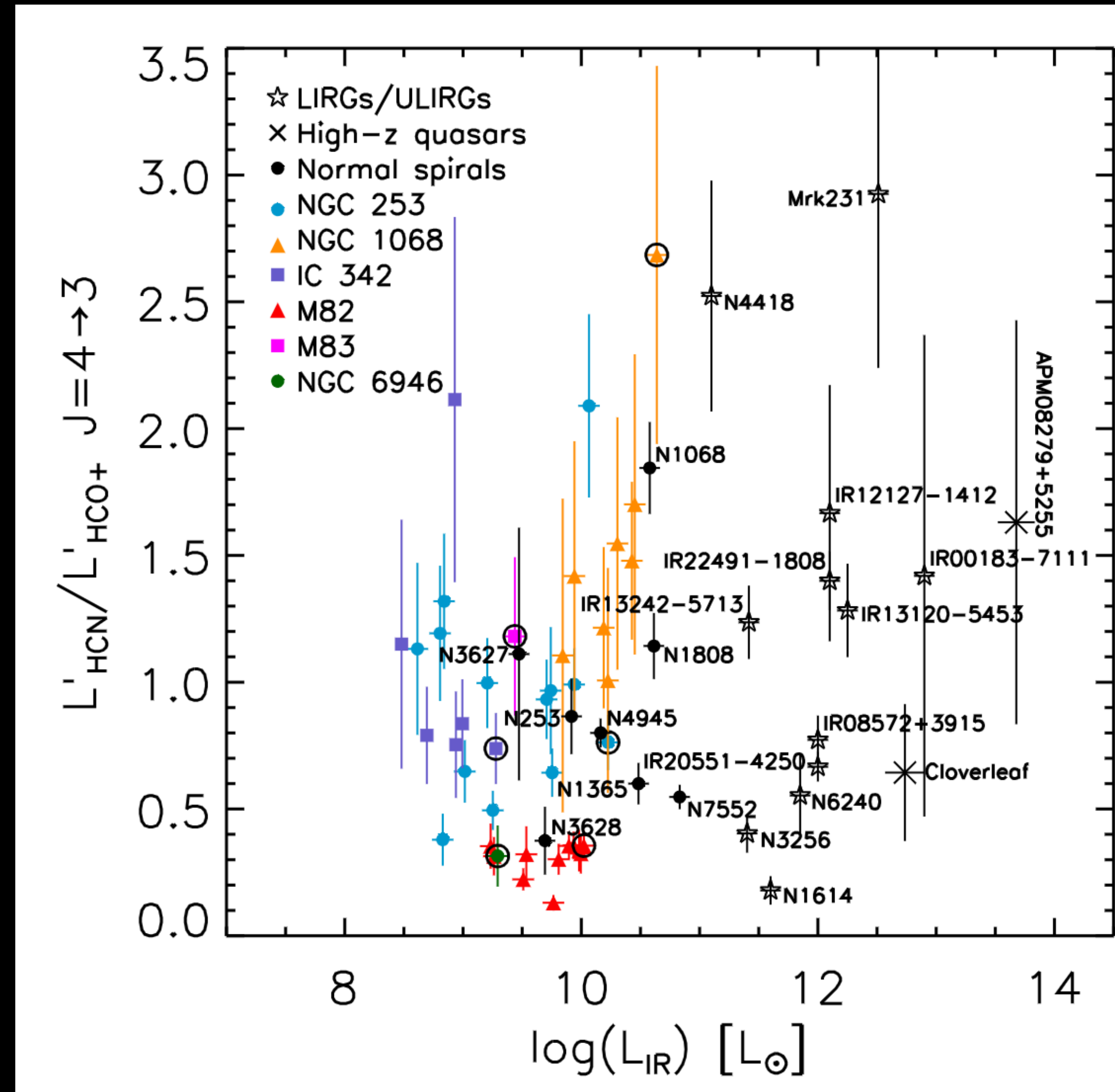
CMZ: 10% Milky Way molecular gas

80% Milky Way dense gas

Tanaka+18

Science Goals

L_{IR} - L_{gas} and star-formation relations

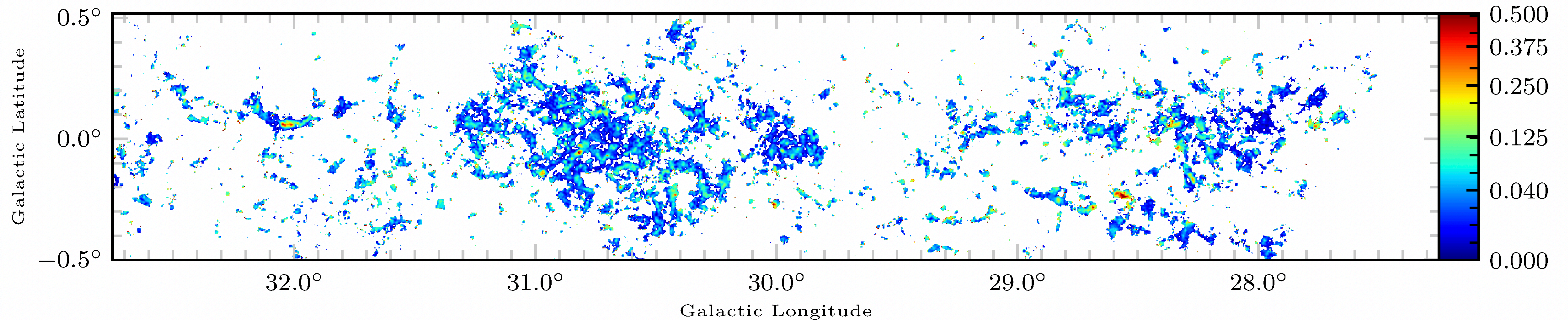# Science Goals
Line Ratios

Tan+18

Science Goals
Gas dynamics
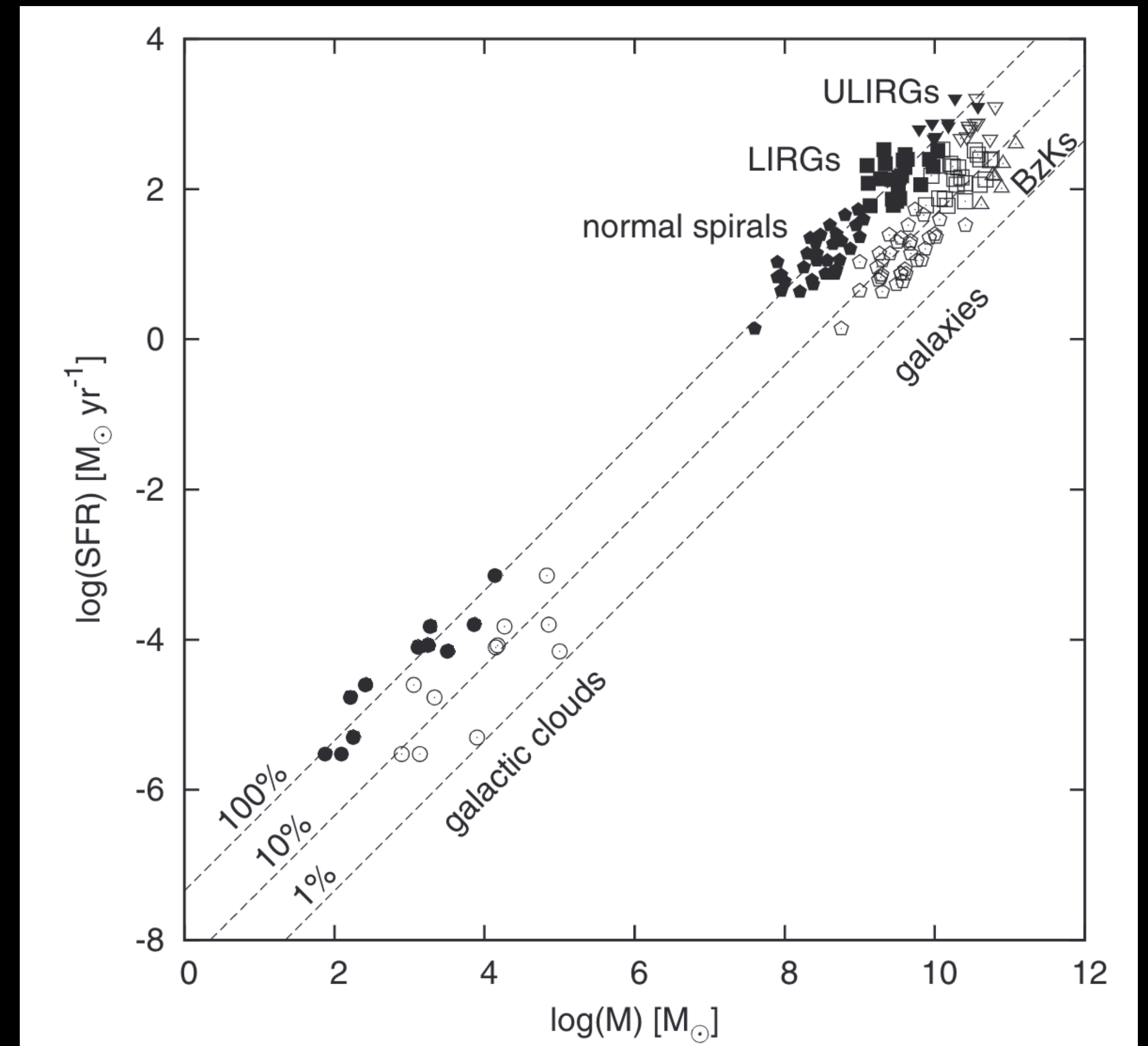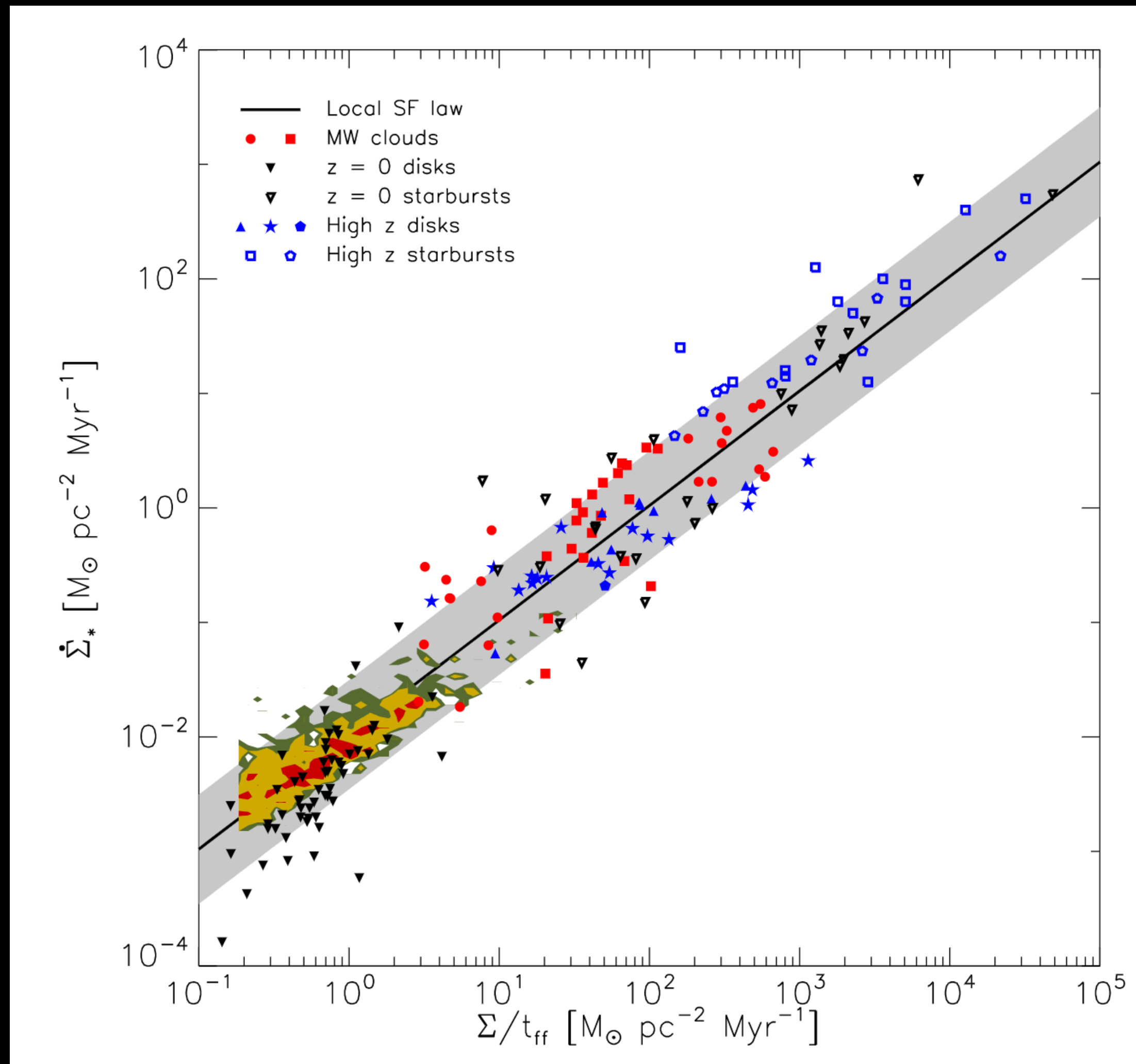
Science Goals
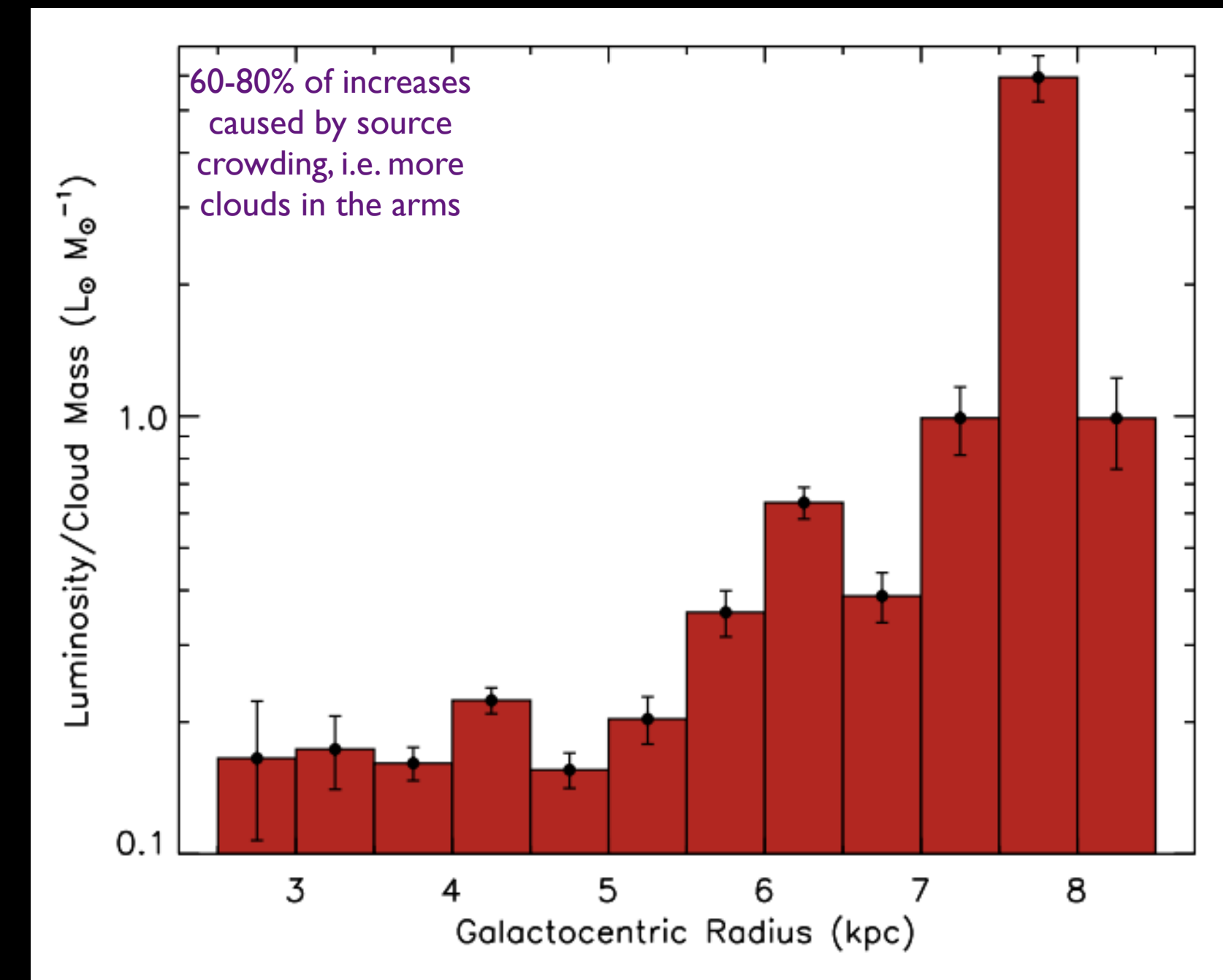## DGMF Maps

Eden+21
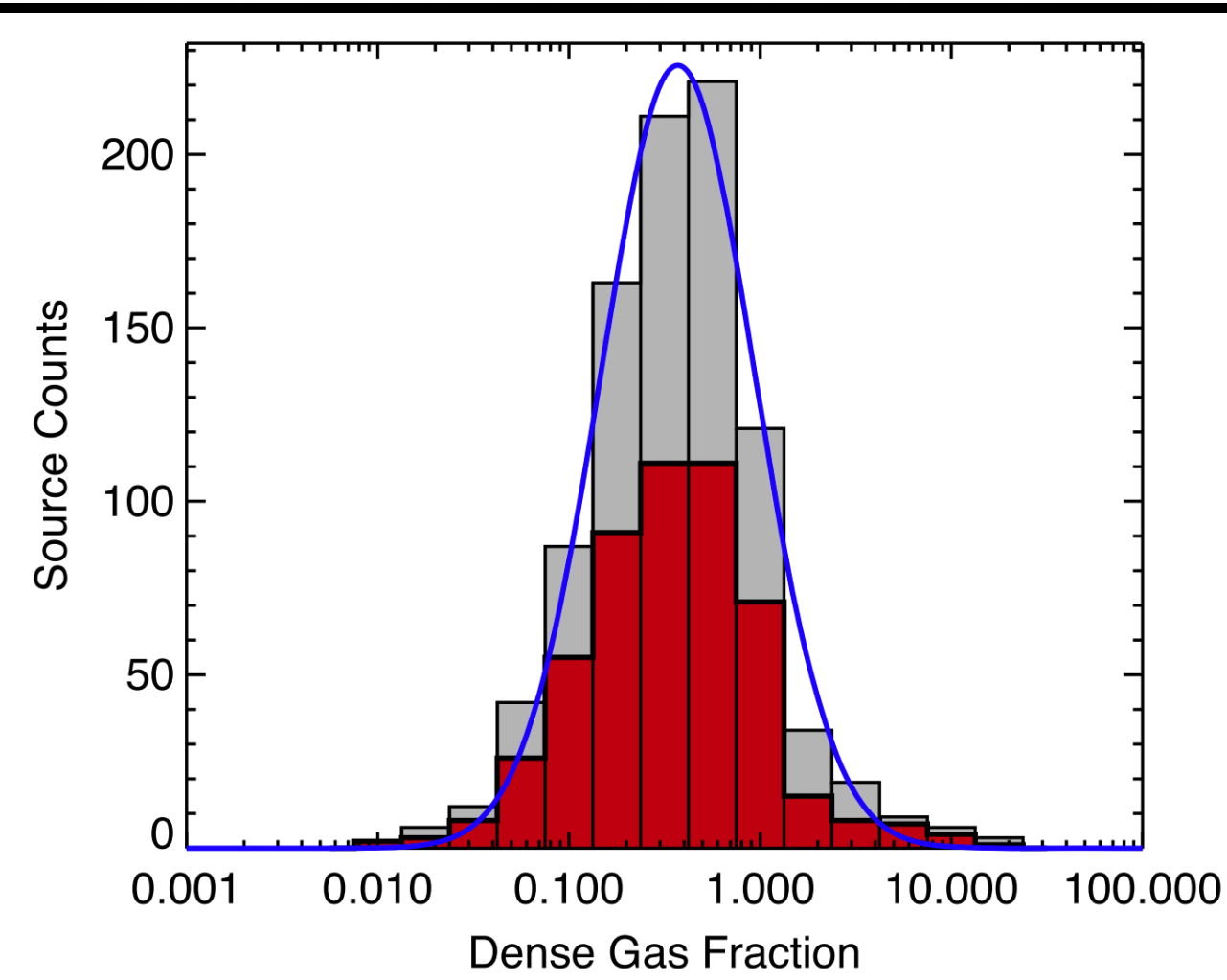
Urquhart+21

Science Goals
Clump Mass Functions
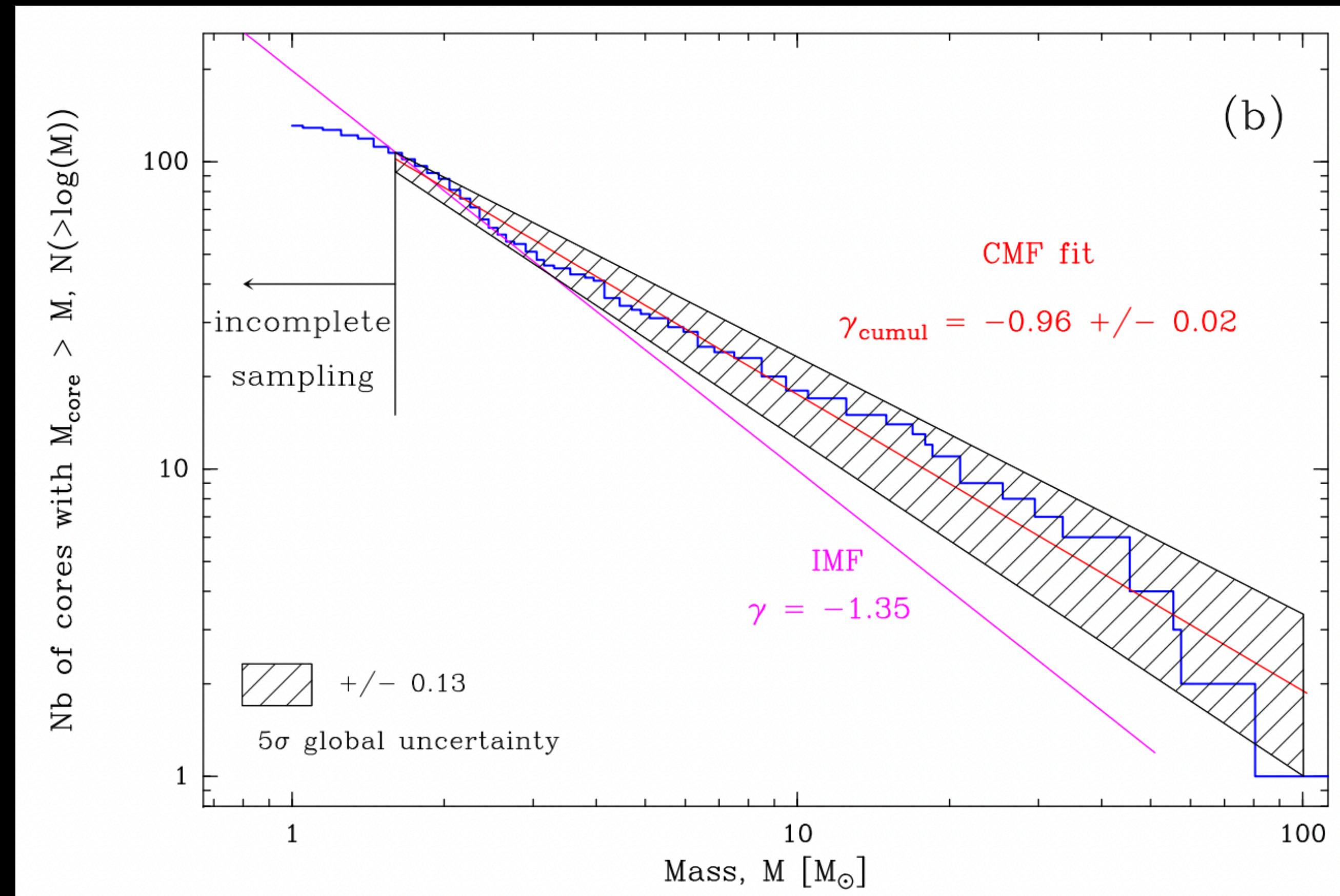
Motte+18
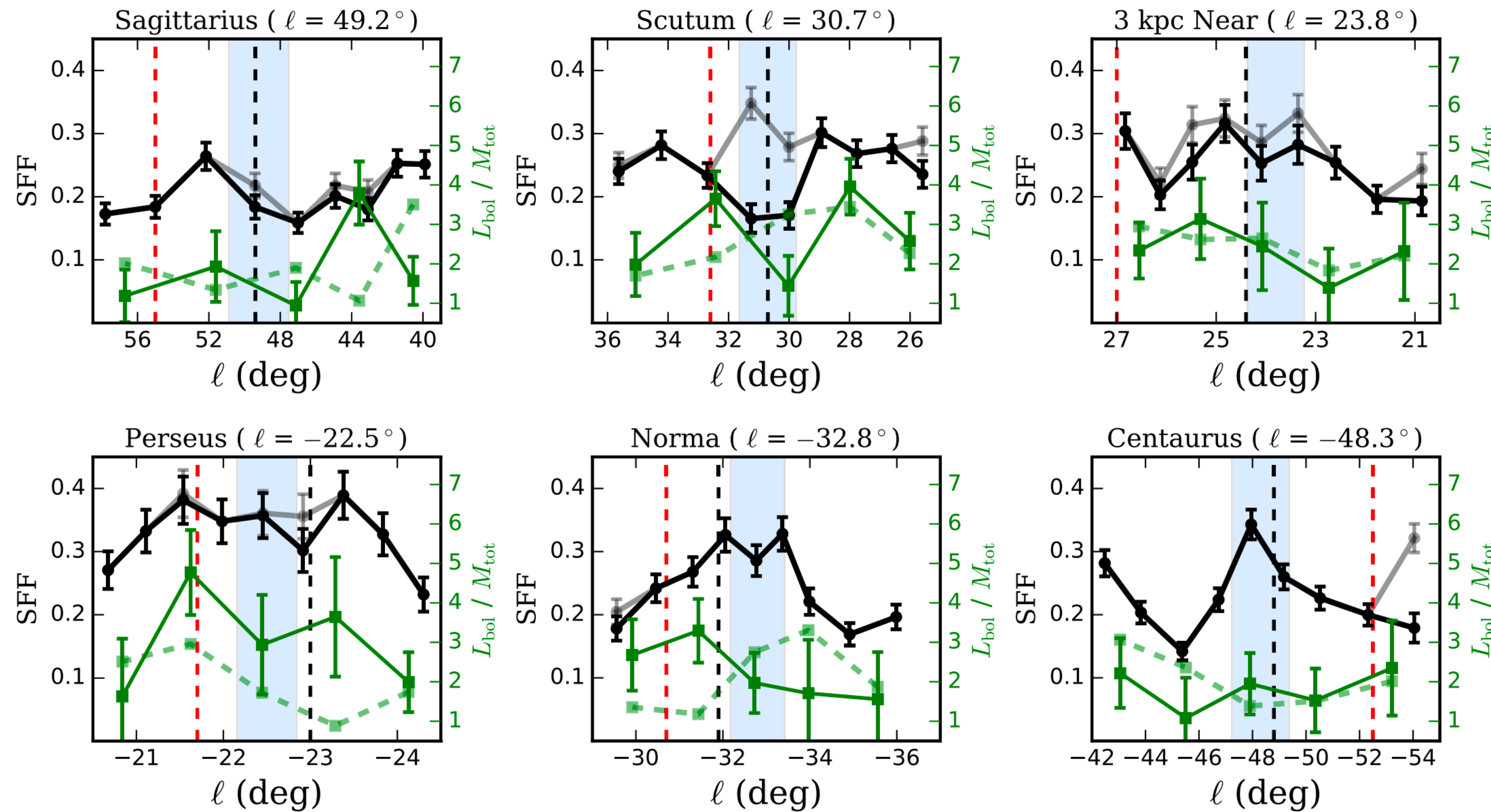
Science Goals
Active star-forming regions

60-80% of increases caused by source crowding, i.e. more clouds in the arms

Moore+12

Ragan+18

Science Goals
Active star-forming regions

60-80% of increases caused by source crowding, i.e. more clouds in the arms
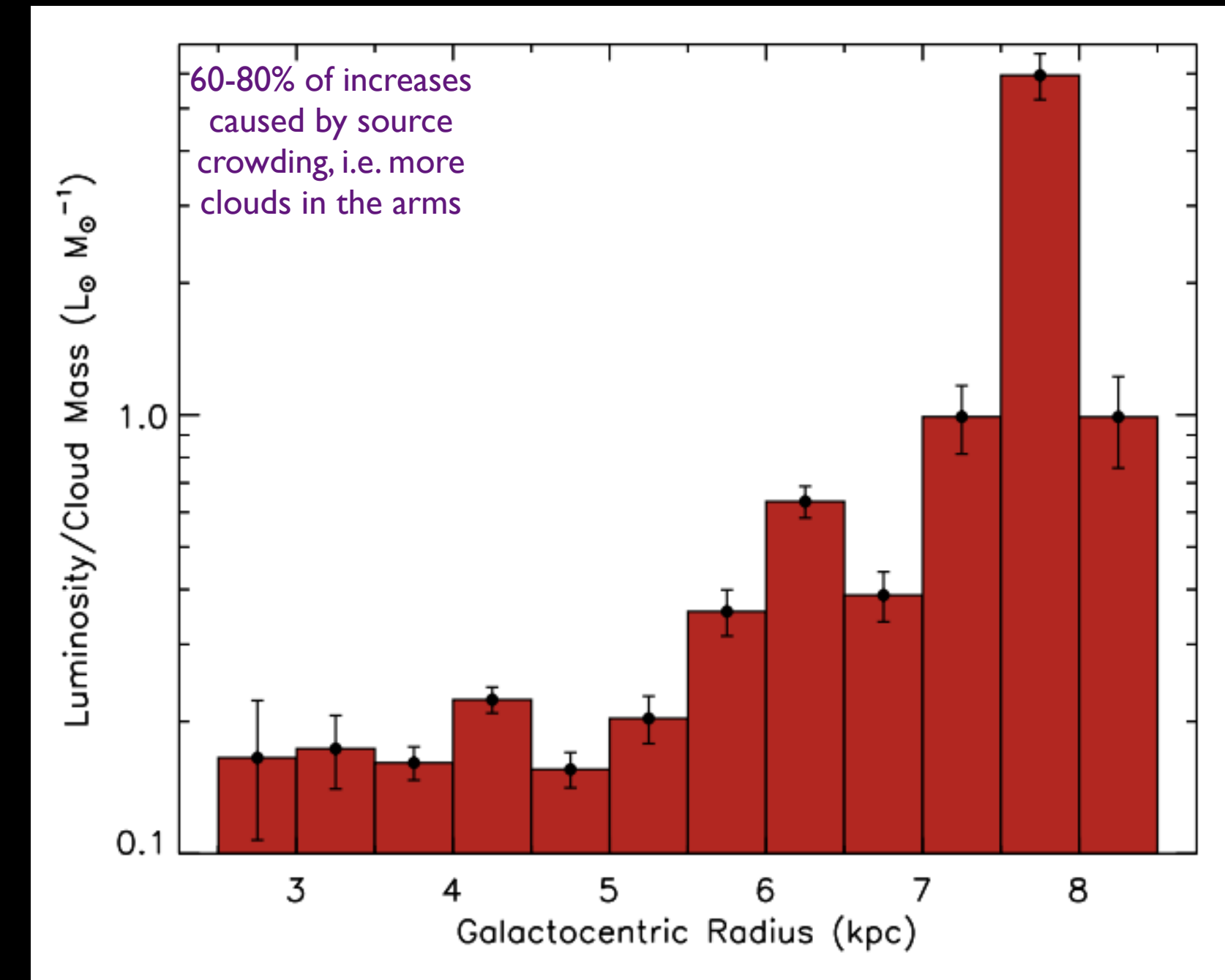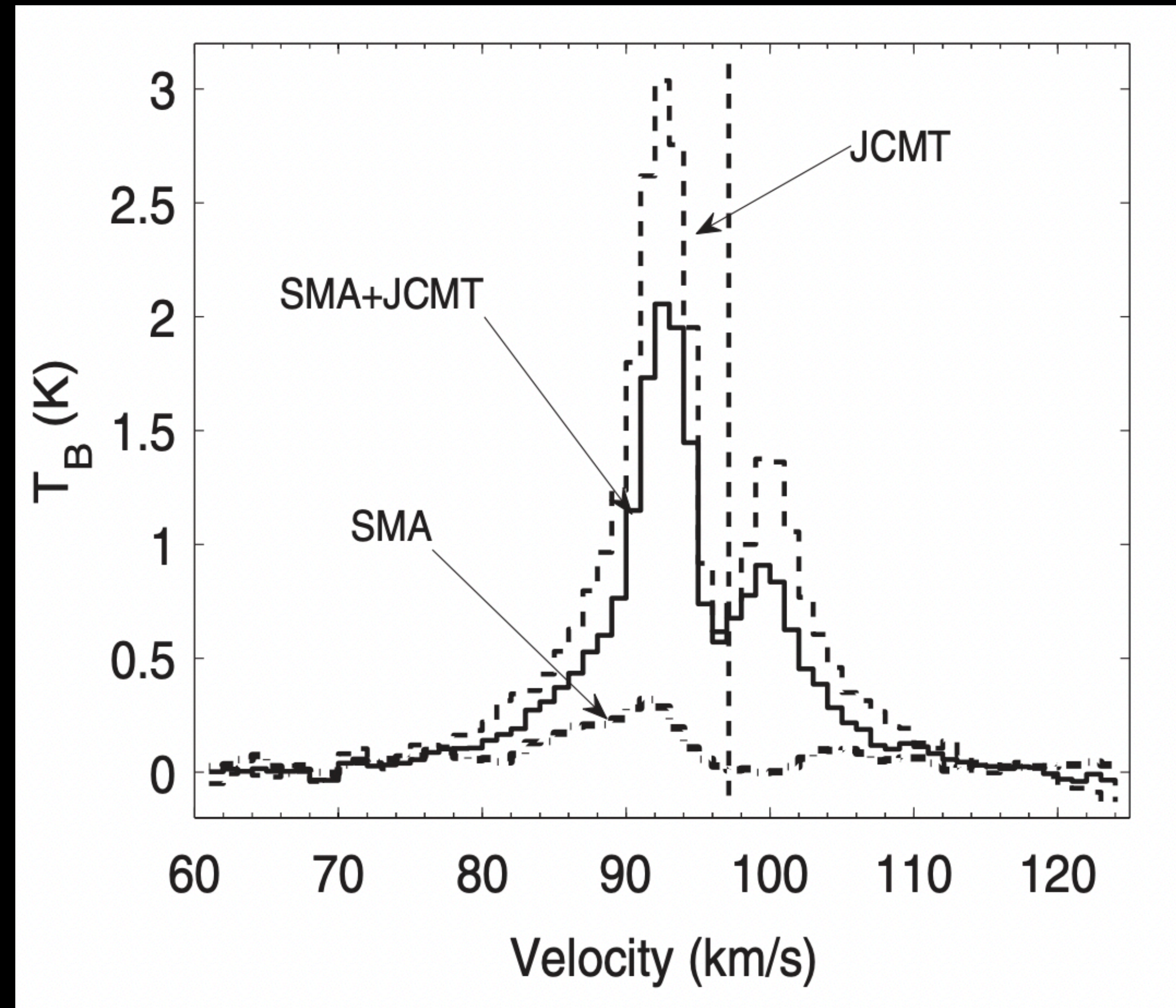
Science Goals

Molecular outflow and infall rates

Liu+11

Summary

- MAJORS - Massive, Active, JCMT-Observed Regions of Star formation

- 108 regions across the Galaxy observed in HCN and HCO$^+$ J=3-2

- Goals: vary from looking at Galactic star formation, all the way to determining how stars form in high-redshift systems.