Bridging the Gap between Galactic and Extragalactic Star Formation: The Case of NGC 300

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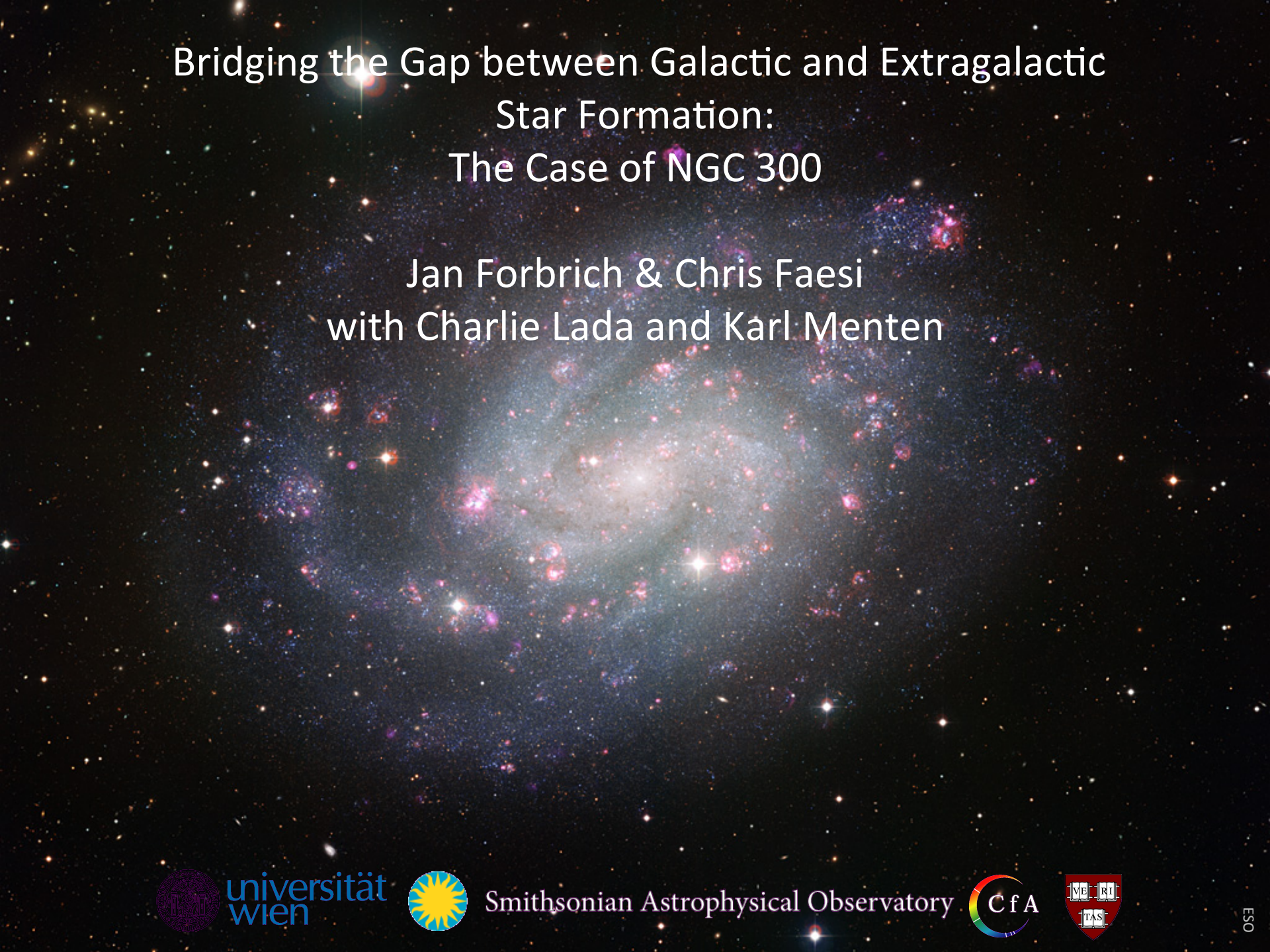
with Charlie Lada and Karl Menten

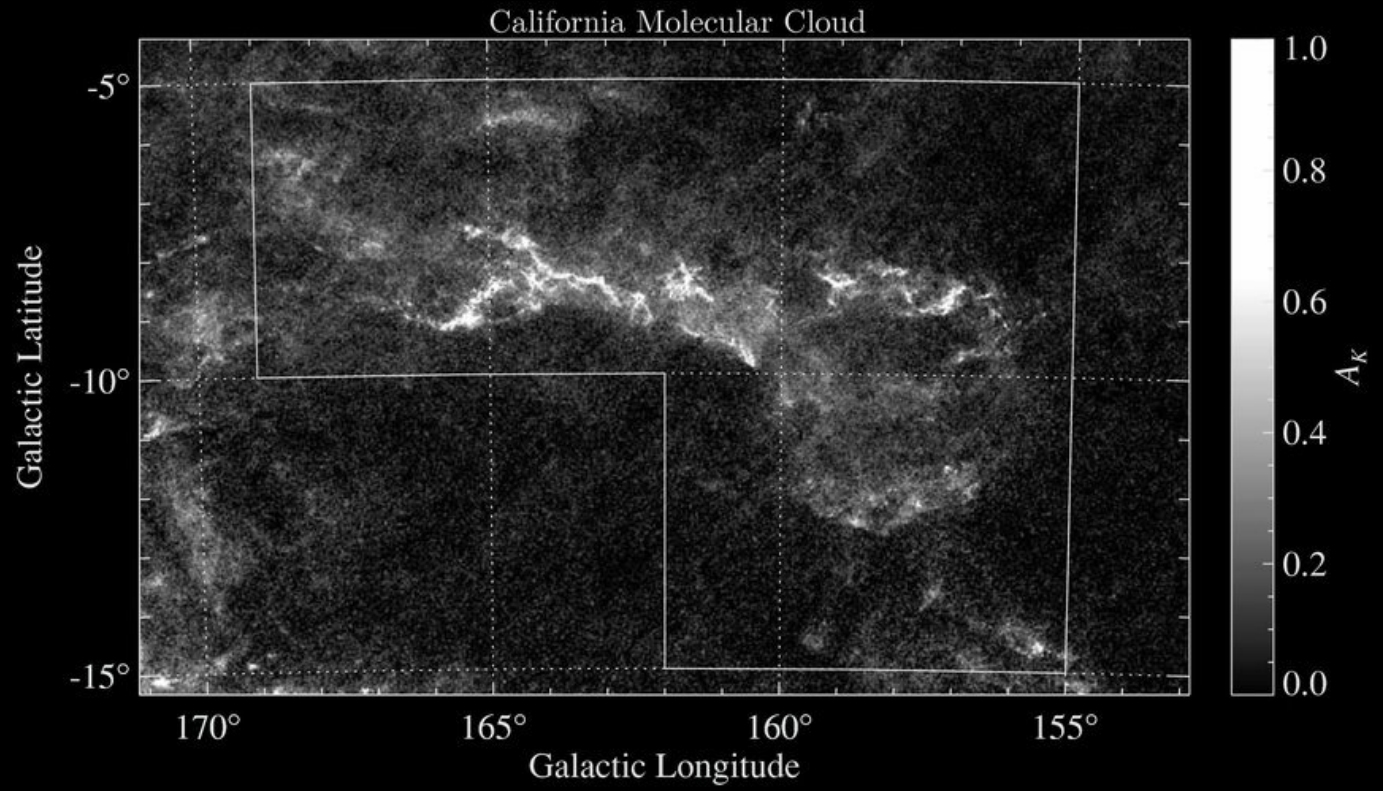


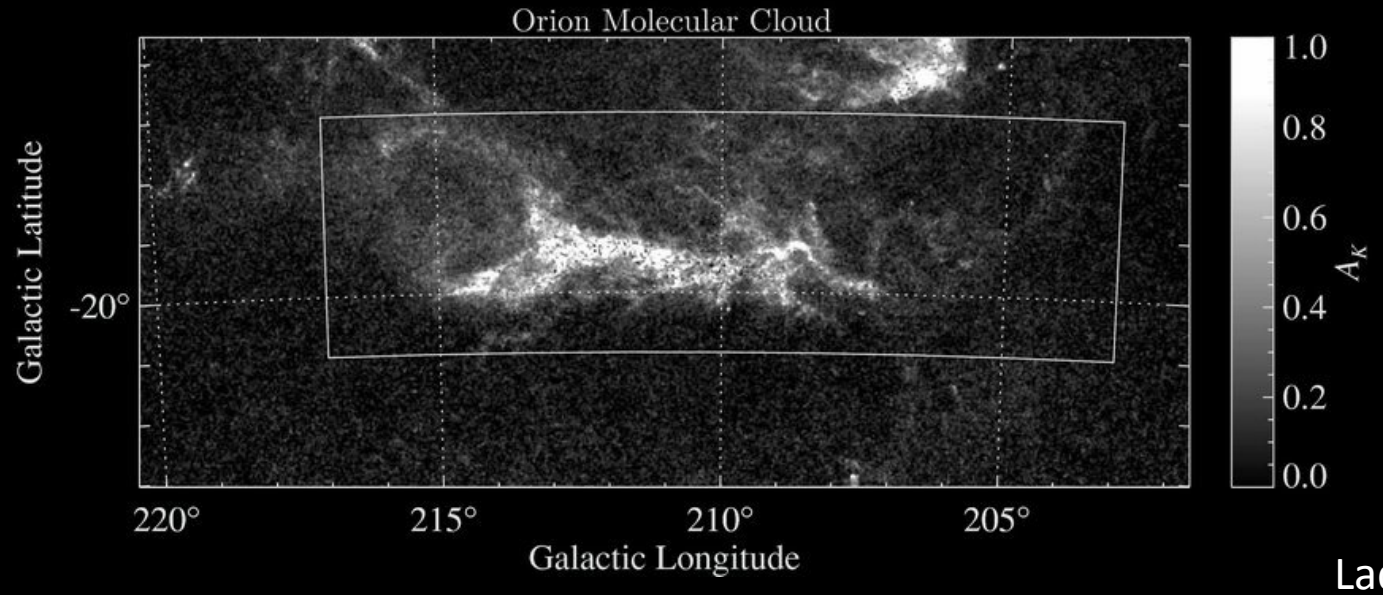
universität wien
Smithsonian Astrophysical Observatory
CfA

ESO

M(ρ Oph) ~ 2 M(Pipe), but SFR(ρ Oph) ~ 15 SFR(Pipe)

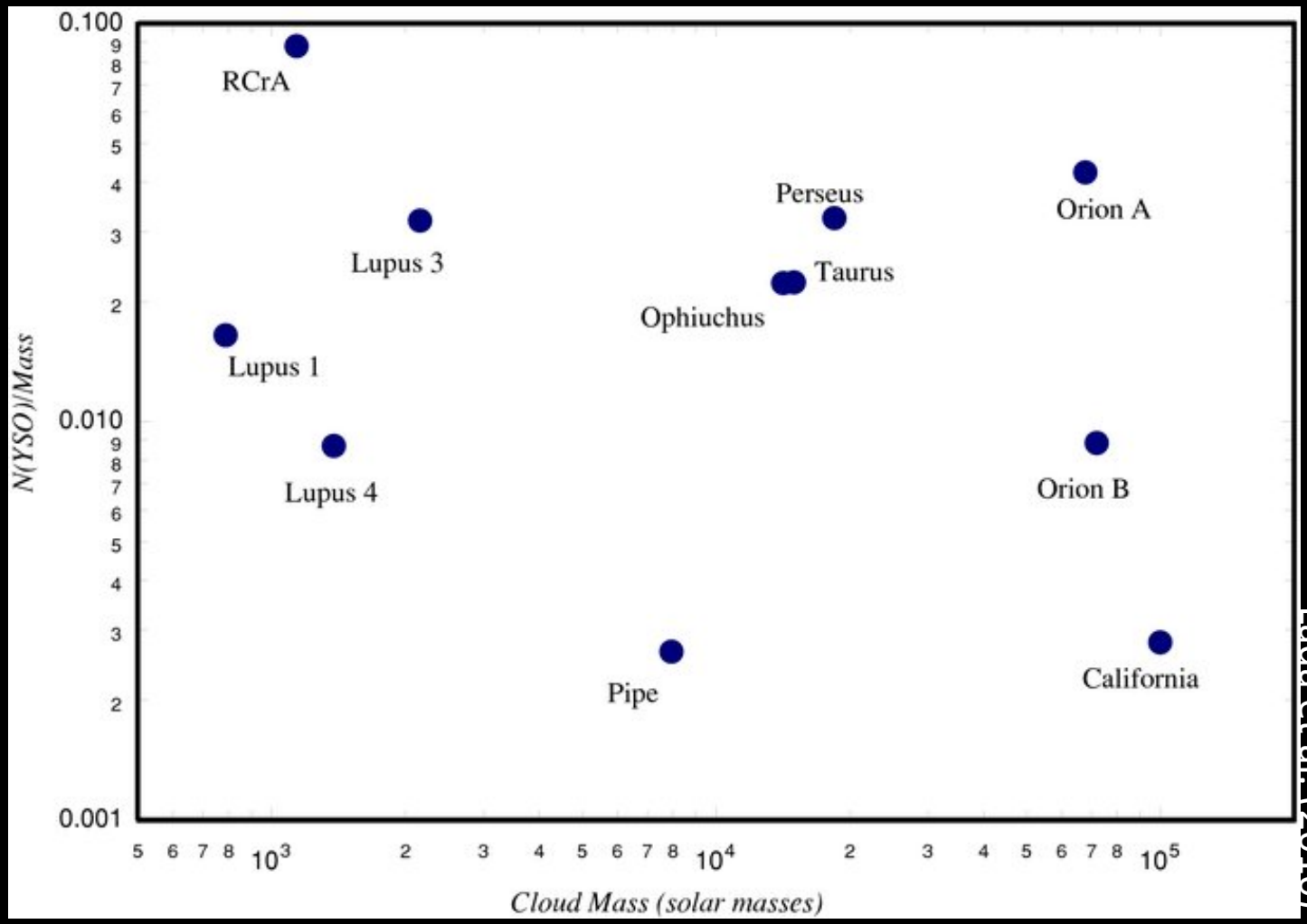
Forbrich et al. (2010)





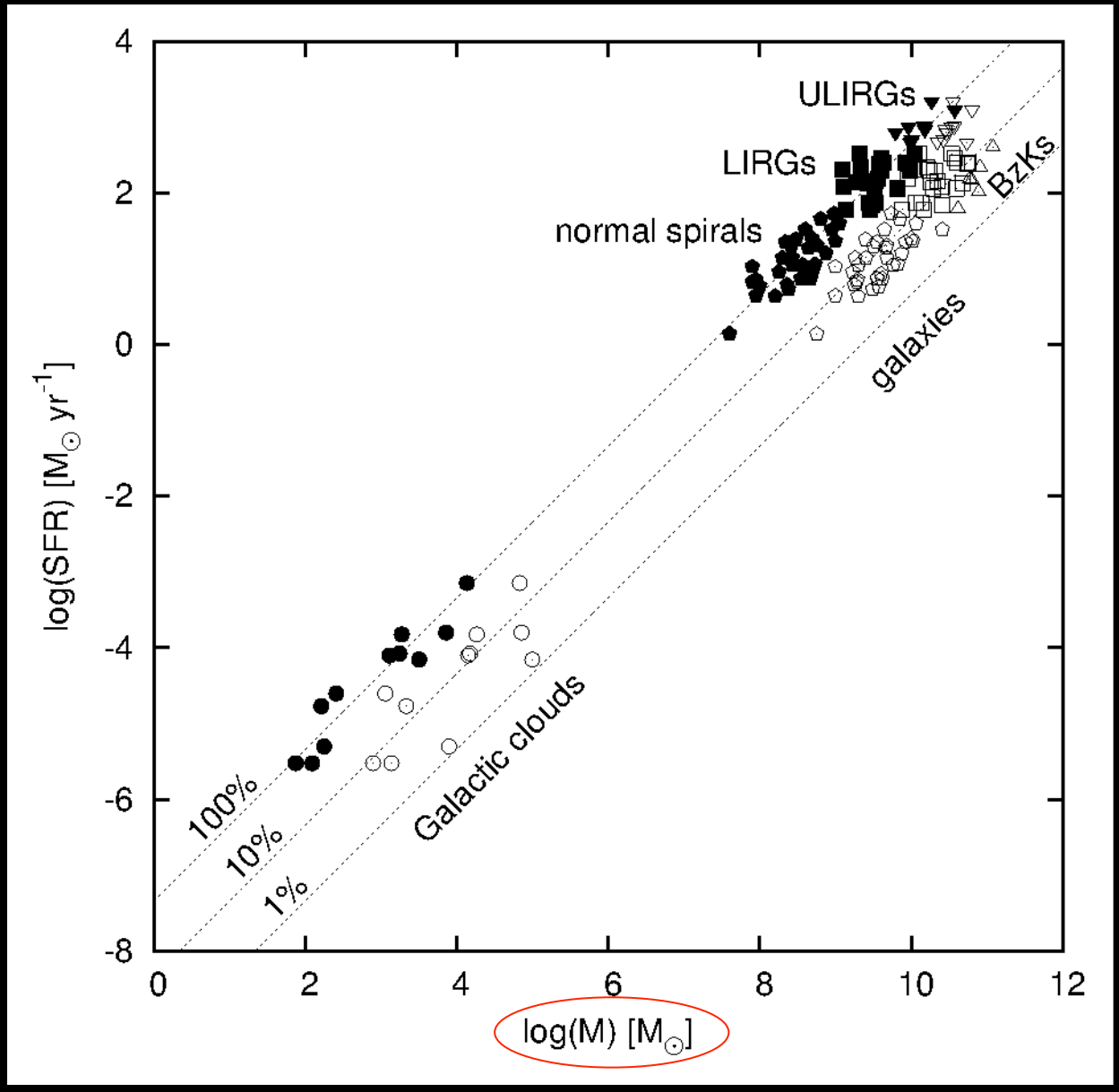
Lada et al. 2009

A local inventory...



Lada et al. (2010)

In local clouds, SFR per unit cloud mass shows large variations, independent of cloud mass.



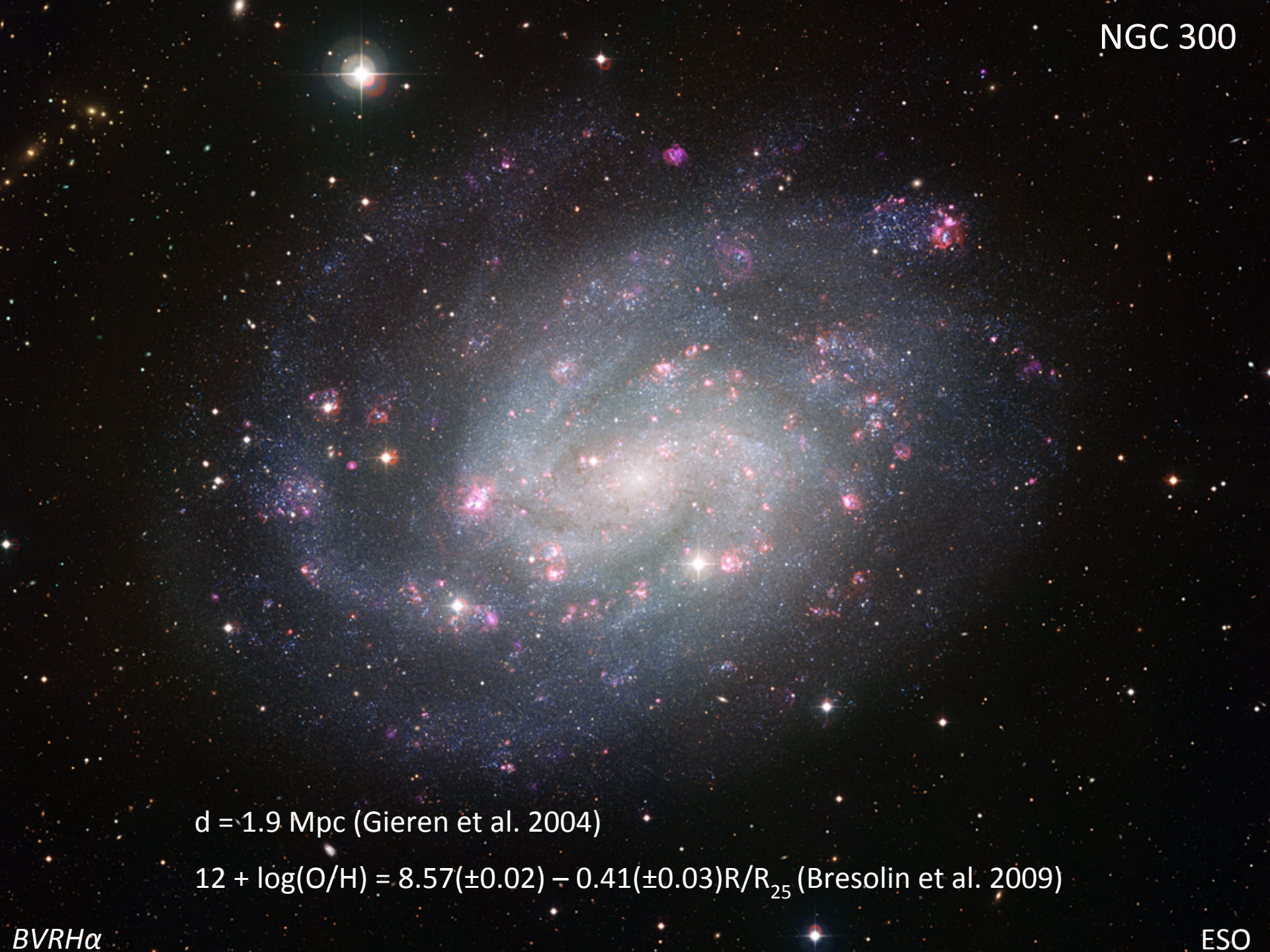
Lada, Forbrich, Lombardi, & Alves (2012)

WANTED

...a larger sample of molecular clouds on scales < GMC (~100 pc)... but...

...since expanding the local sample is difficult, we need to resolve GMCs in a nearby galaxy...

...ideally with the possibility of observing molecular tracers also of the dense gas (ALMA).


NGC 300
d = 1.9 Mpc (Gieren et al. 2004)
12 + log(O/H) = 8.57(±0.02) – 0.41(±0.03)R/R25 (Bresolin et al. 2009)
BVRHα
ESO

Step 1

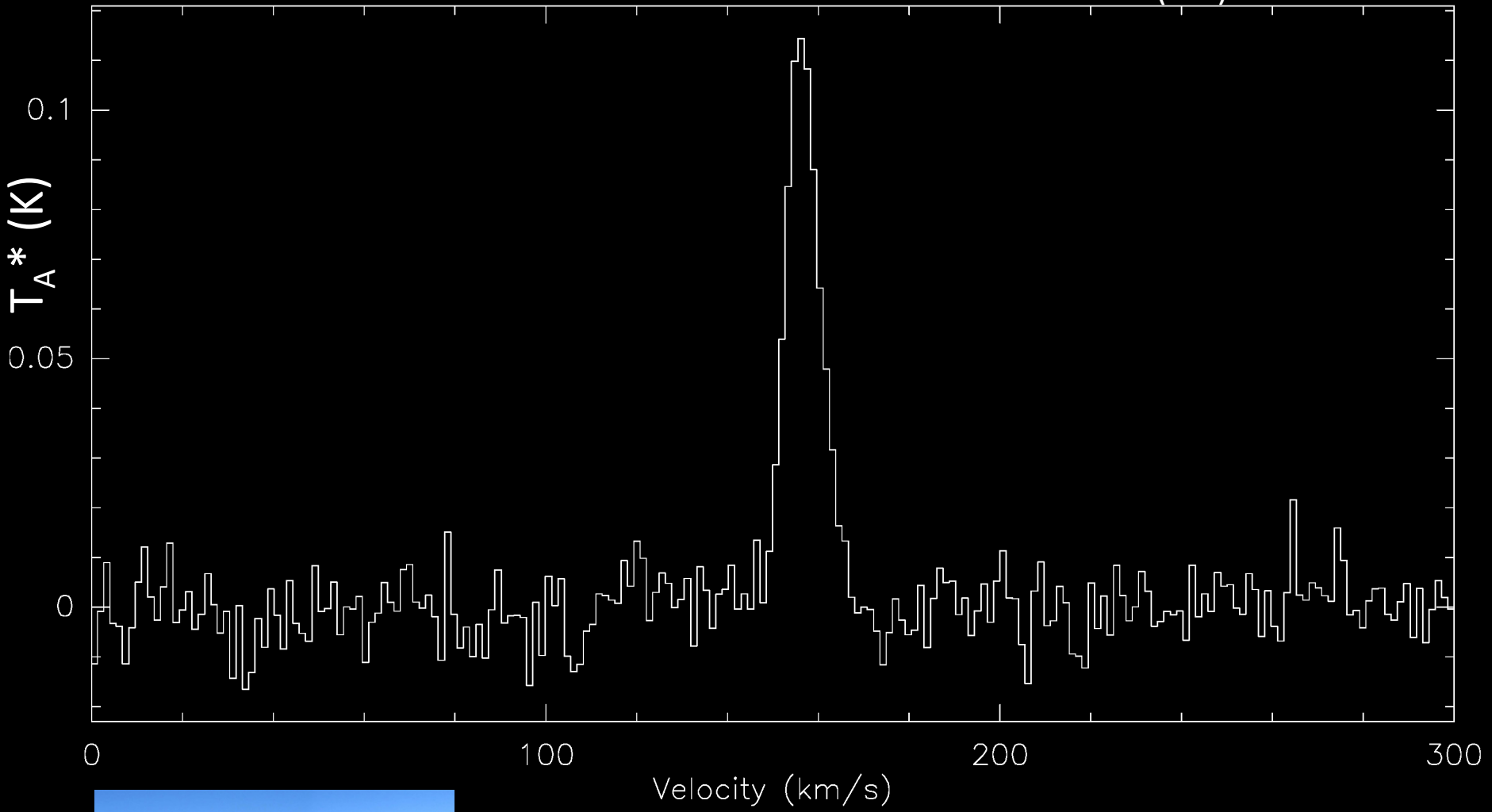
Obtain measurements of the total gas content of star-forming regions in CO(2-1) with APEX, with a beam size corresponding to ~ 250 pc.

In 100h of observing time, we observed 76 H II regions from Deharveng et al. (1988), detecting 34 of them.

FIGURE 1a. — Hα photograph of NGC 300, obtained by M. Tarenghi at the prime focus of the ESO 3.6-m telescope with the red corrector. The exposure time was 1 h 30 min.

Deharveng et al. 1988

APEX CO(2-1) DCL88-79

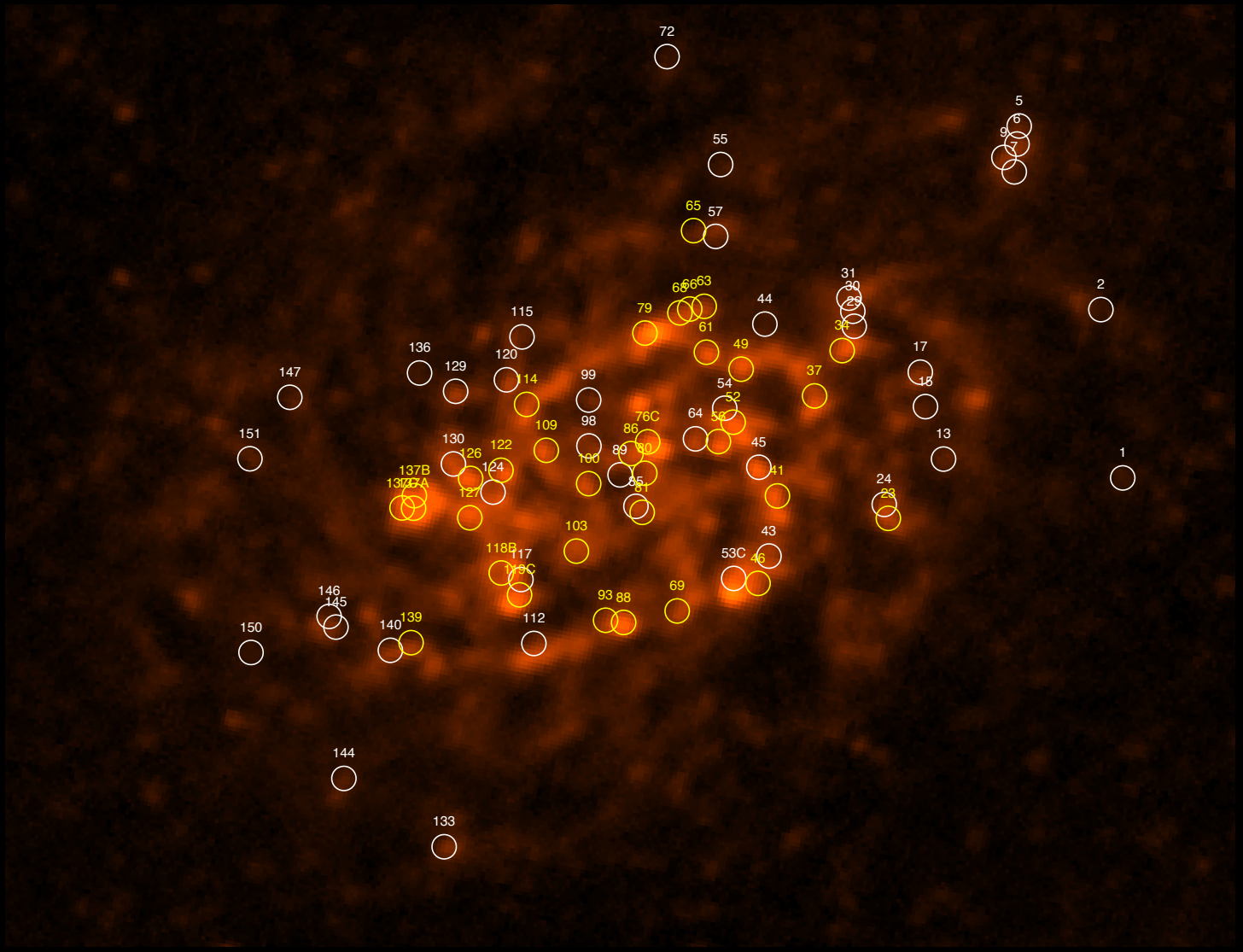


… to be followed up with the Submillimeter Array and ALMA to study cloud morphology and the beam filling factor.

Step 2

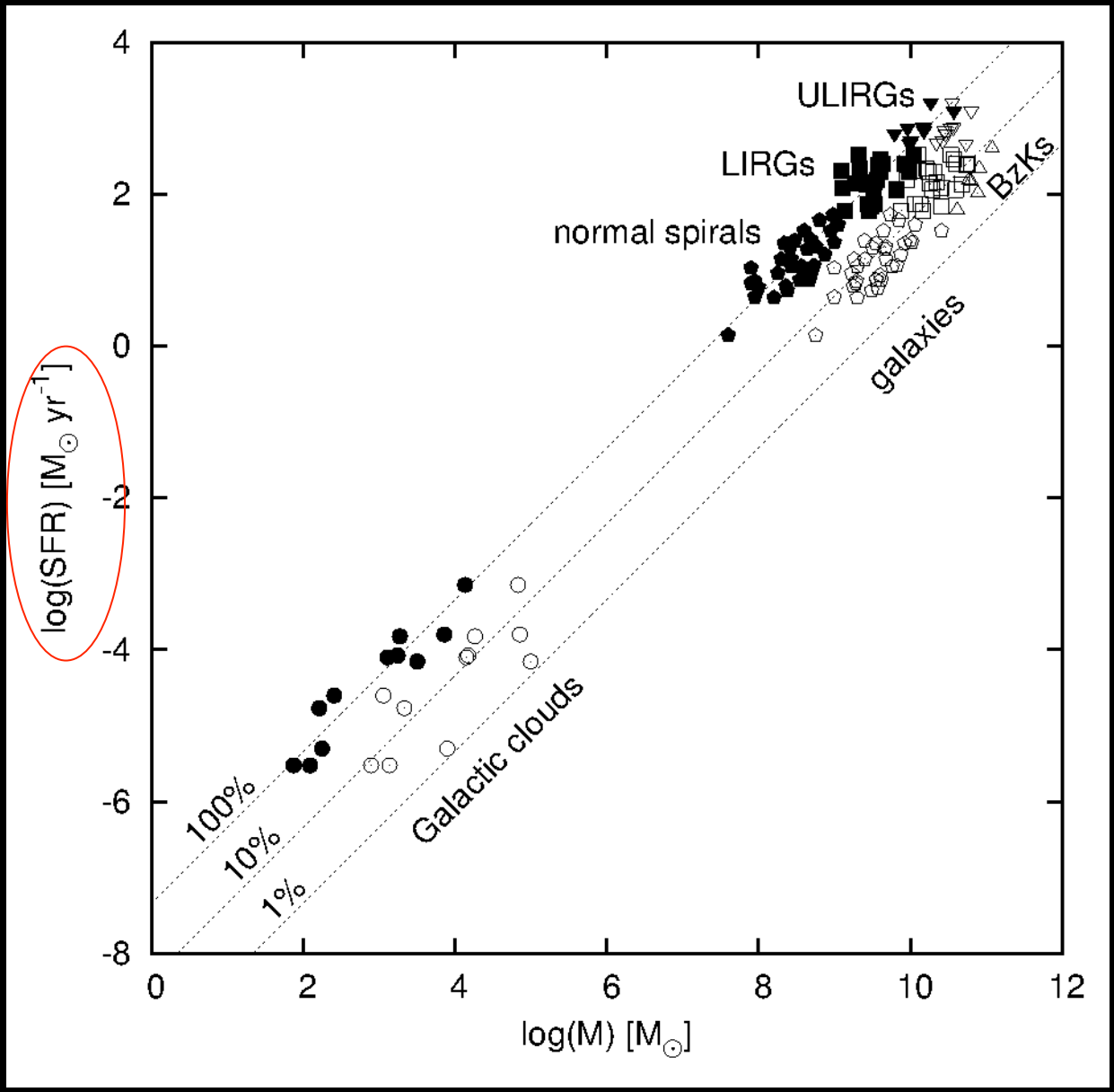
Use submillimeter continuum mapping of the entire galaxy with *Herschel* to put the H II regions and the CO measurements into context.

34/76 regions detected in CO



Herschel/SPIRE 250 µm

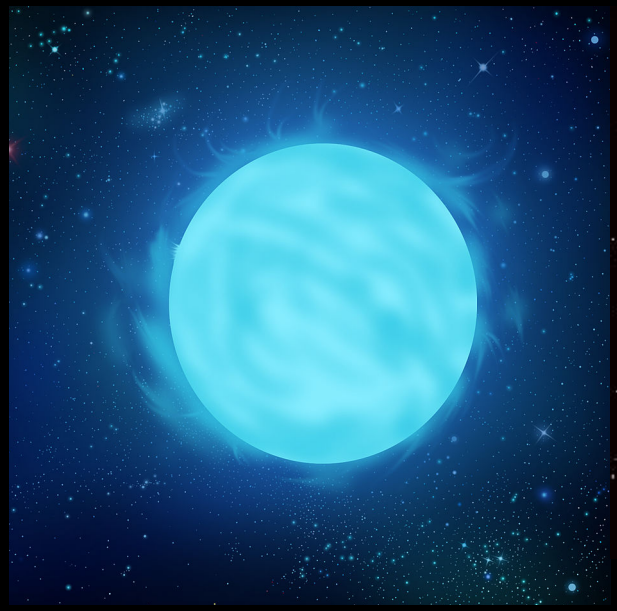
Step 3: Characterize star formation activity



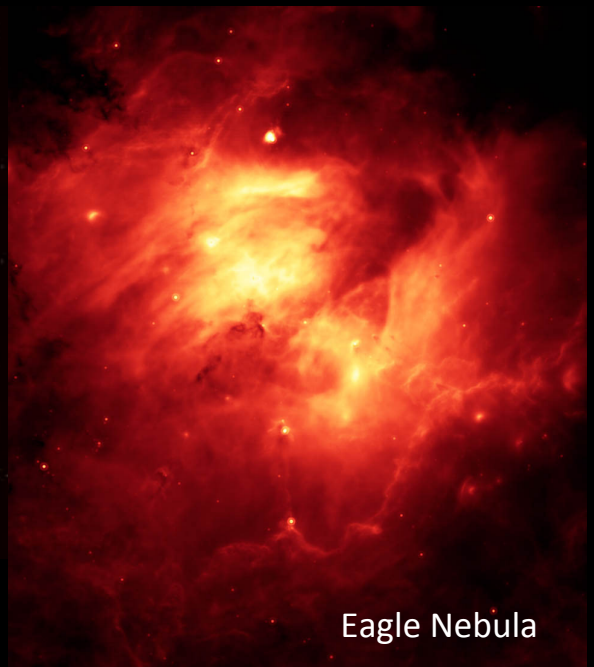
Lada, Forbrich, Lombardi, & Alves (2012)

A Multiwavelength Approach

- UV traces direct photospheric emission
- Hα traces ionizing photons
- 24um traces dust emission (reprocessed UV)

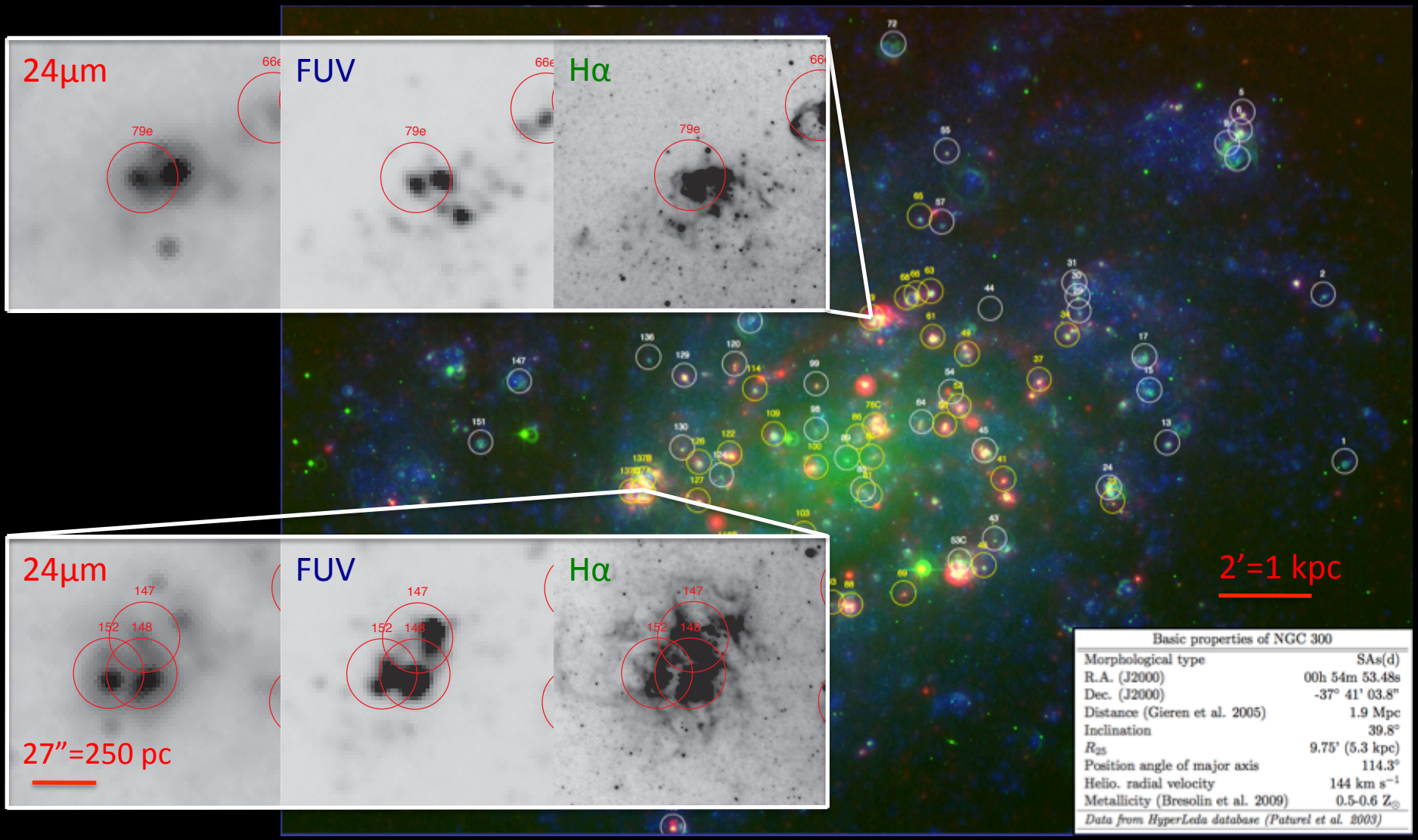


Sh2-242

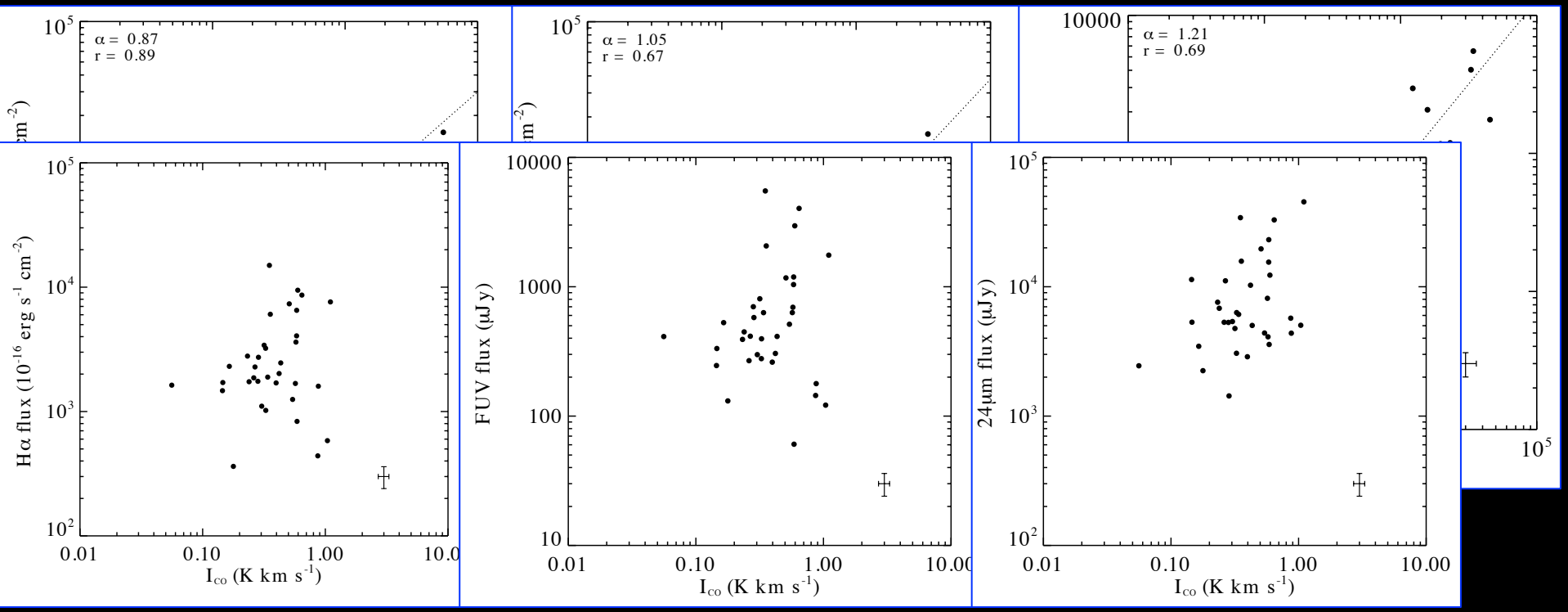


Eagle Nebula

Zooming in to 250 pc



SF Tracers Correlate…



…but none individually correlates with CO

Direct Modeling with SB99

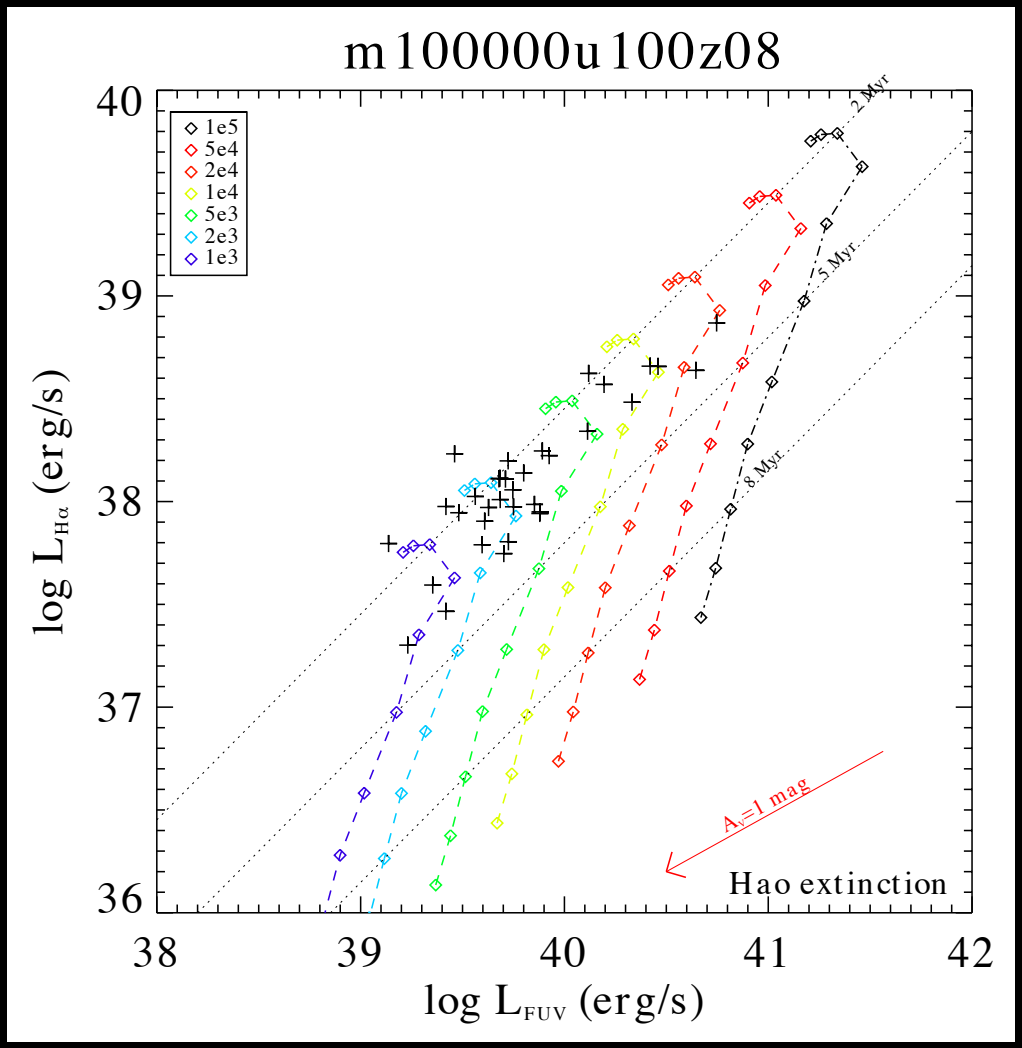
Starburst99 (Leitherer+1999)

- Instantaneous Burst
- Z=0.4 $Z_\odot$
- 100 $M_\odot$ IMF upper mass limit

Derive:

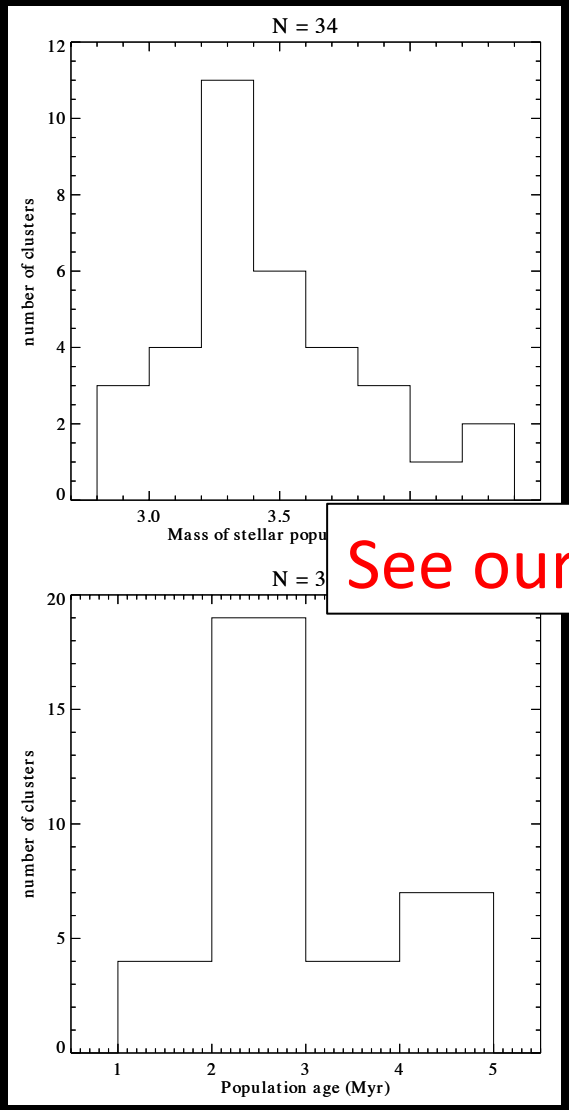
- stellar mass
- population age

SFR ~ M / τ

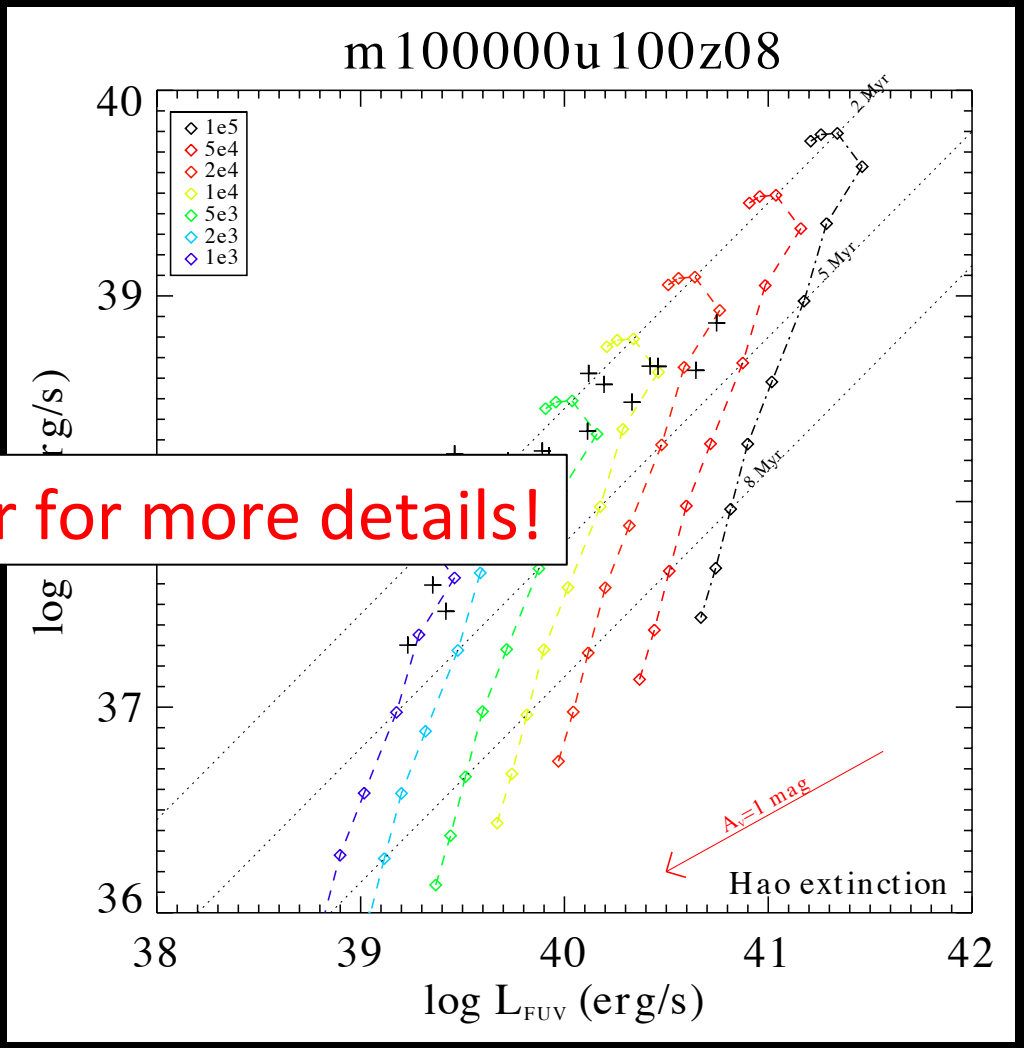


Faesi, Forbrich, Lada & Menten, in prep.

Deriving Cluster Properties

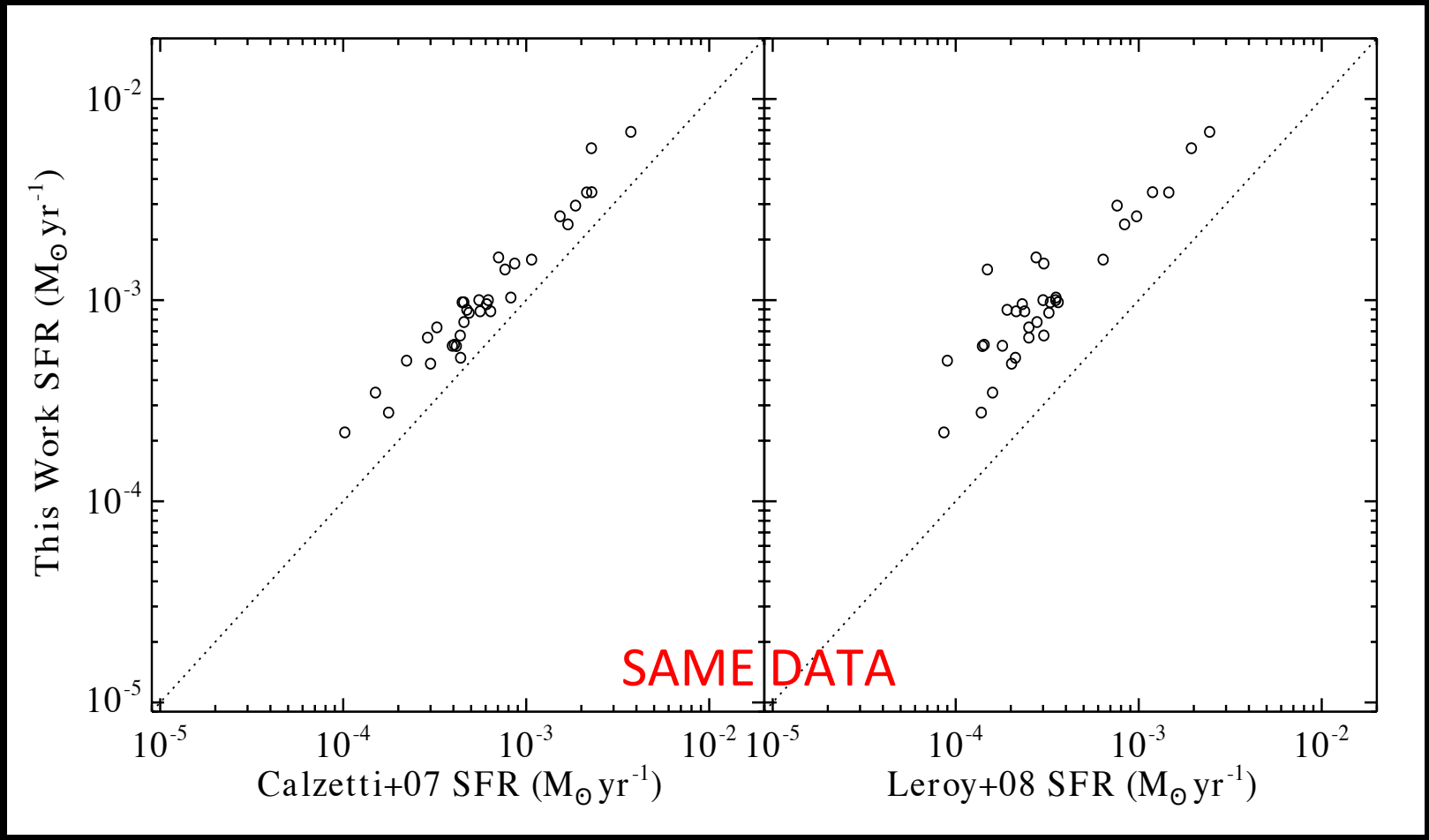


See our poster for more details!



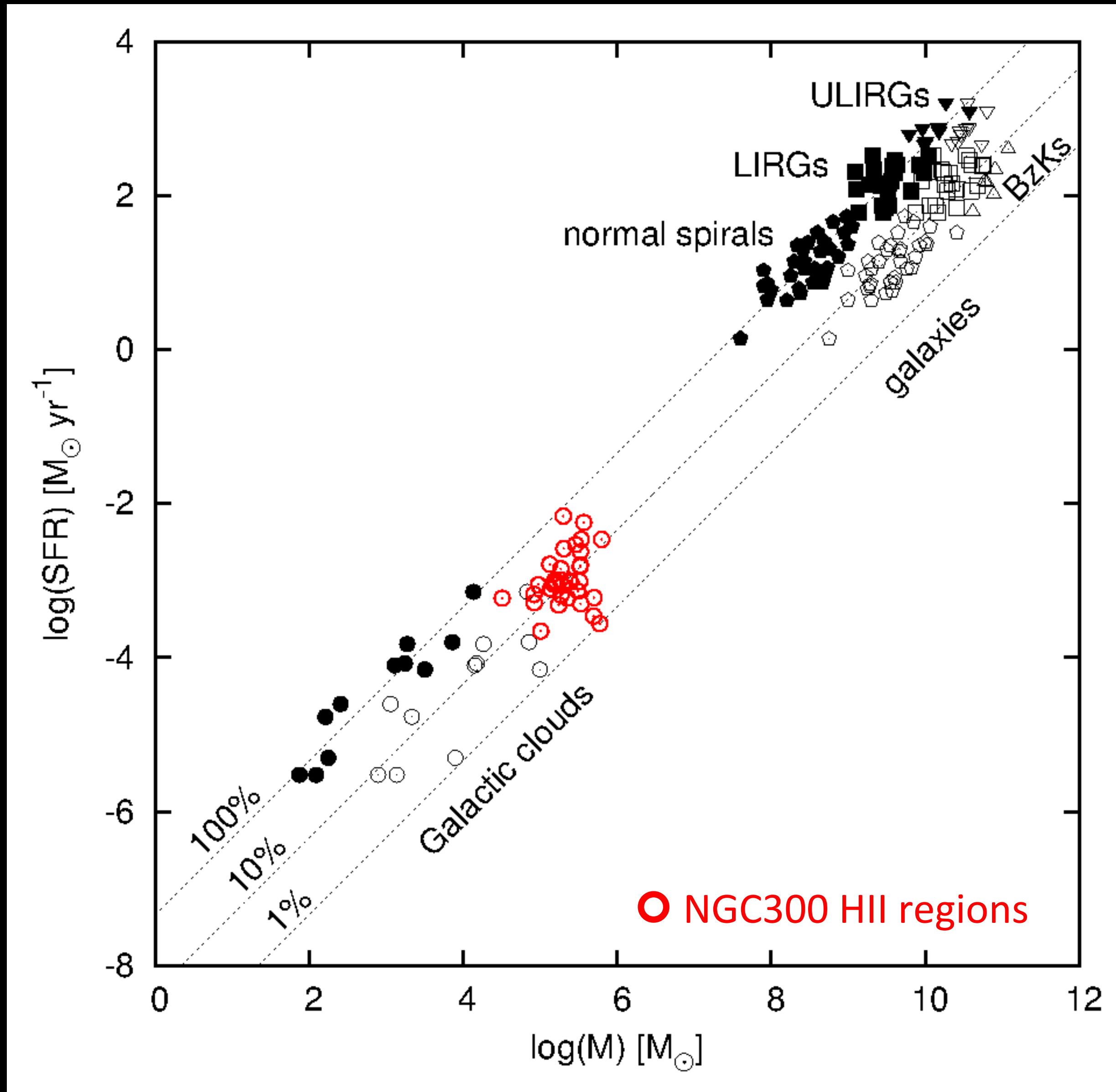
Faesi, Forbrich, Lada & Menten, in prep.

SFRs: Results



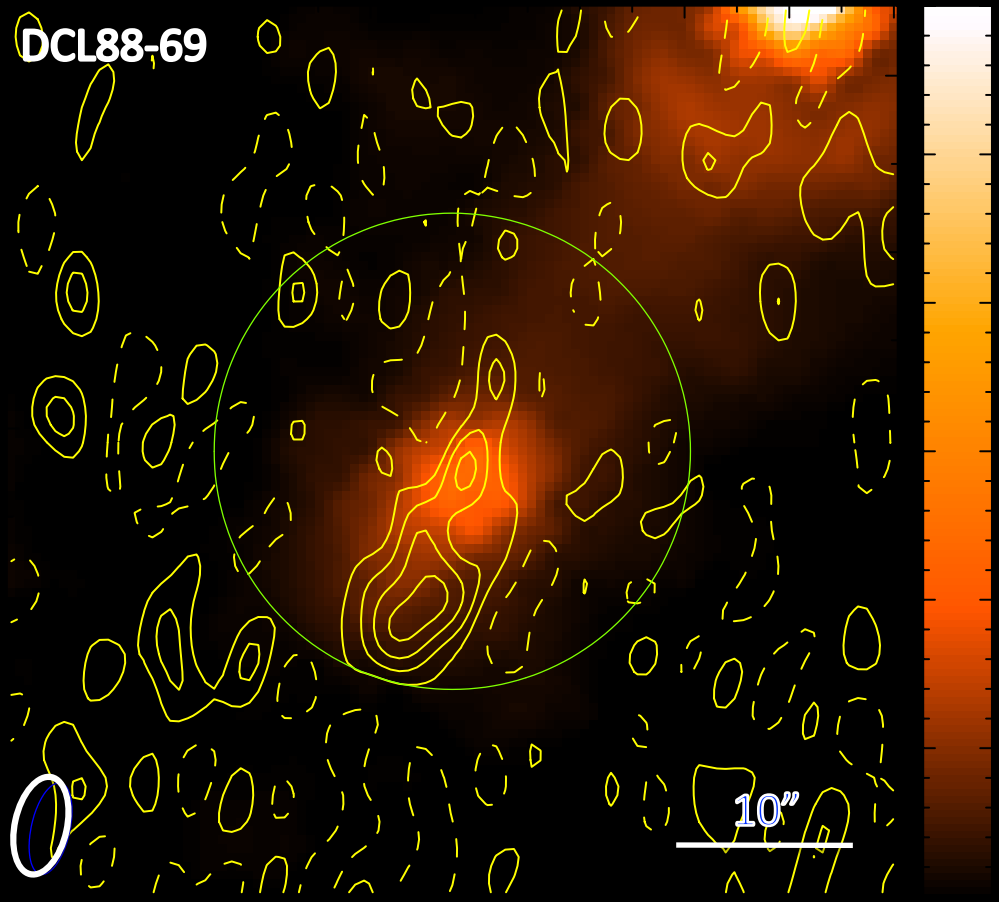
Hα+24μm

FUV+24μm



Lada, Forbrich, Lombardi & Alves (2012)

Zooming in further



SMA CO(2-1) contours on Spitzer/MIPS 24μm image
(0.4 Jy/beam km/s contours)

Summary & Prospects

- We have studied molecular gas and star formation at 250 pc scales in NGC 300 using a combination of UV, Hα, mid/far-IR, mm datasets
- We derive SFRs for 34 CO-detected H II regions using direct population synthesis modeling
- SFR-M_{mol} scaling fully consistent with local clouds (and with external galaxies)
- Ongoing/future higher-resolution studies of molecular gas (including dense gas) [SMA, ALMA]

Hybrid SFR Tracers

$$\mathrm{SFR}\ [M_\odot\ \mathrm{yr}^{-1}] = 5.3\times10^{-42}\,[L_{H\alpha,obs} + 0.031\,L_{24\mu m}]$$

(Calzetti+ 2007)

$$\mathrm{SFR}\ [M_\odot\ \mathrm{yr}^{-1}] = 0.68\times10^{-28}\,L_{\nu,FUV} + 2.14\times10^{-43}\,L_{24\mu m}$$

(Leroy+ 2008)