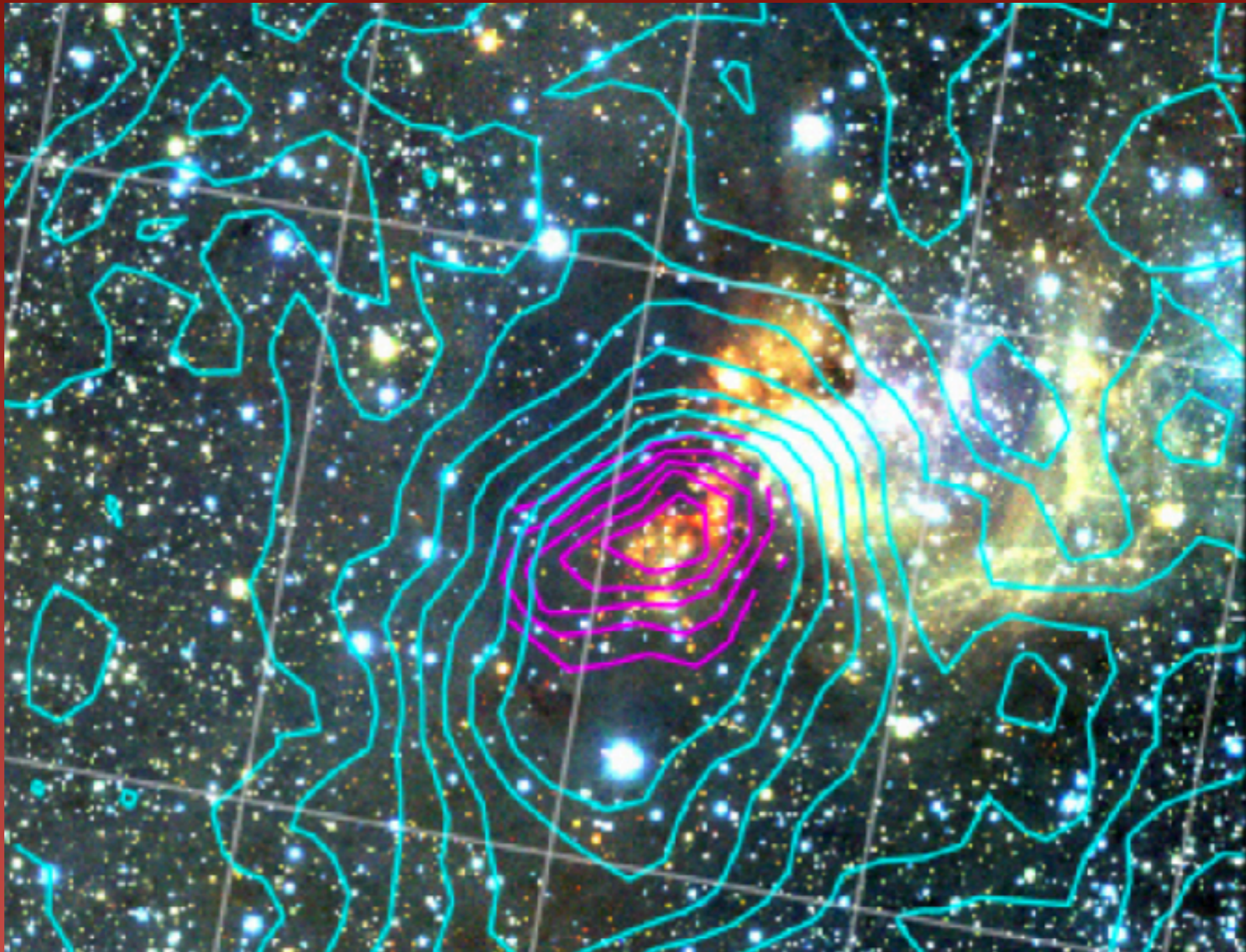


A massive star cluster in the making



Morten Andersen

Peter Barnes, Jonathan Tan, Guido de Marchi, Jouni Kainulainen

How massive star clusters are formed is poorly known

- Very short time scale, relatively rare and distant
- Is formation fast or slow? (relative to the ff time)
- Few good candidates. Once exposed from molecular clump they are “old”

However, star formation has to have begun

- Excludes objects like e.g. “the brick” in the Galactic Center region
- Sign of ongoing collapse necessary

Good candidate identified

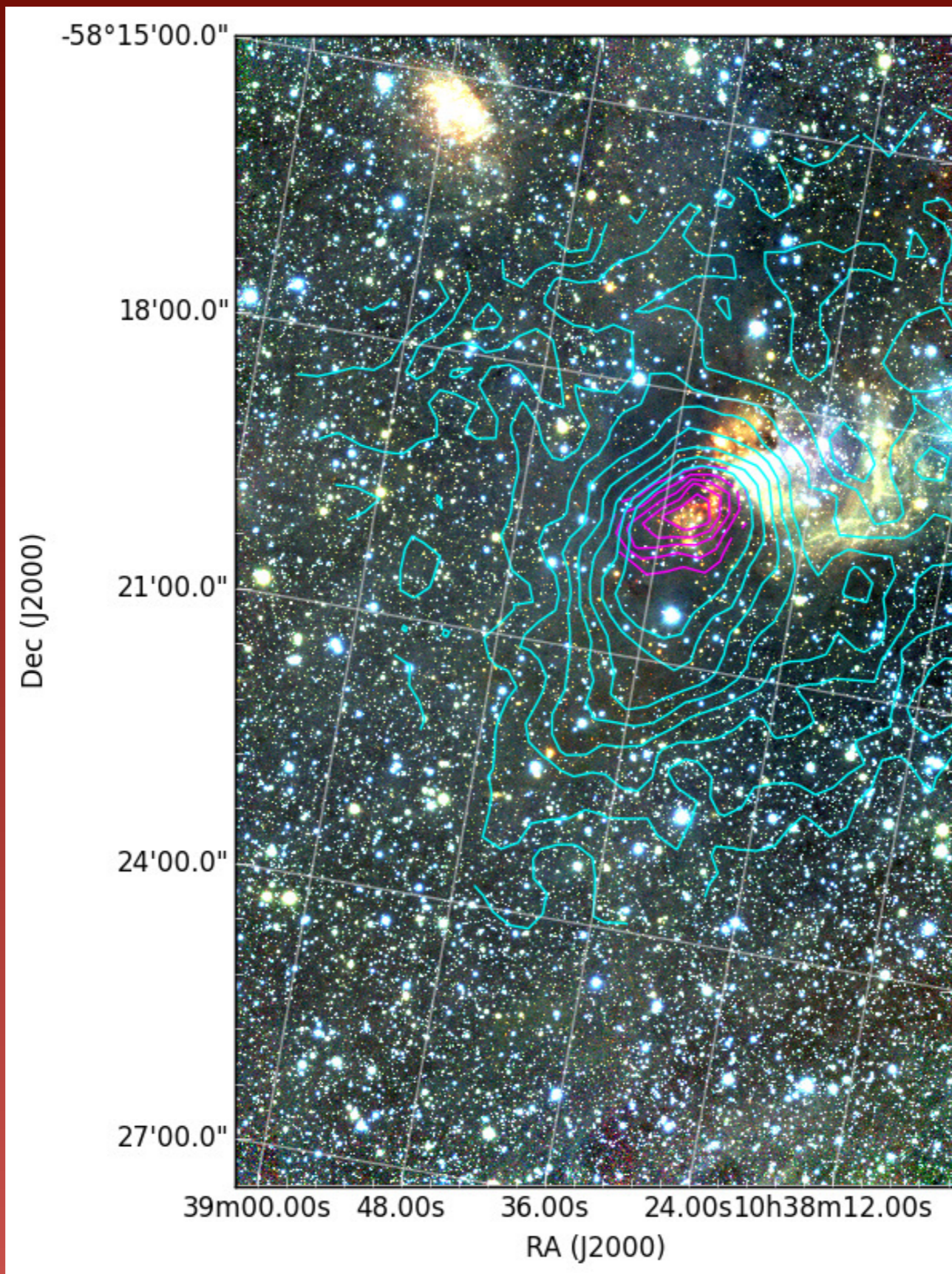
- Identified in the CHaMP survey (Barnes et al)
- Large molecular infall; sign on star formation
- Large mass ($> 1000 M_{\text{sun}}$ of gas) in order to create
ONC-like object
- Sufficiently close (2.3 kpc) to resolve the region
- Part of the general Carina complex

Large molecular infall

- HCO⁺ line analysis suggest infall of 0.03 Msun/yr
- Total mass uncertain, at least 2000 Msun (dust)
- Could be up to 10⁴ Msun (line data)
- Few red sources identified in shallow observations

Deep large field of view near-infrared imaging to reveal the stellar population

- VLT HAWK-I JHKs imaging. $\sim 0.5''$ seeing.
- Total area covered is $8' \times 12.7'$ ($5.5 \times 8.5 \text{ pc}$)
- 50% Complete down to $K_s = 19 \text{ mag}$
- Corresponding to below the peak of the field IMF
(For $A_k < 2$)



Andersen et al. 2017, in review



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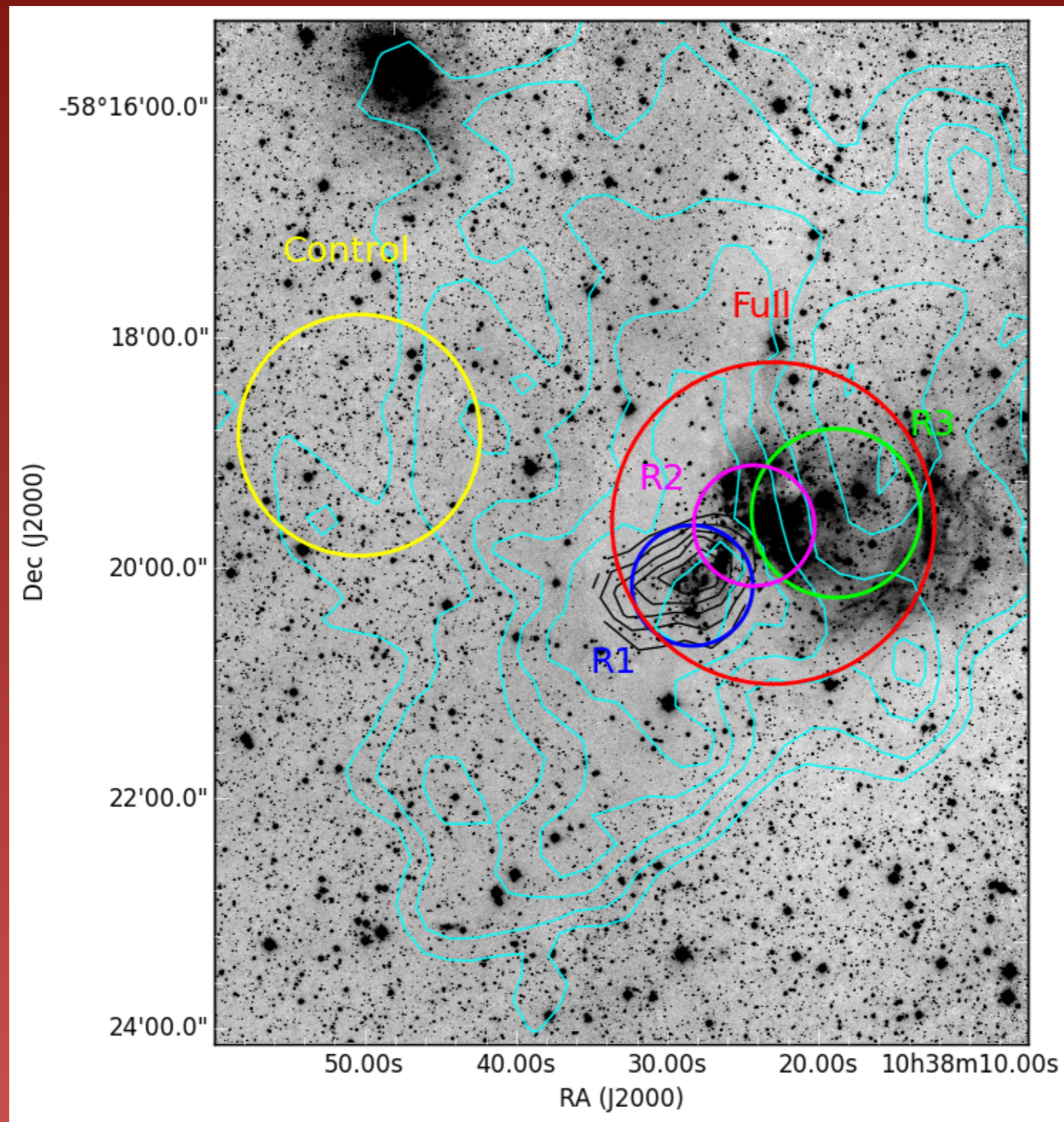
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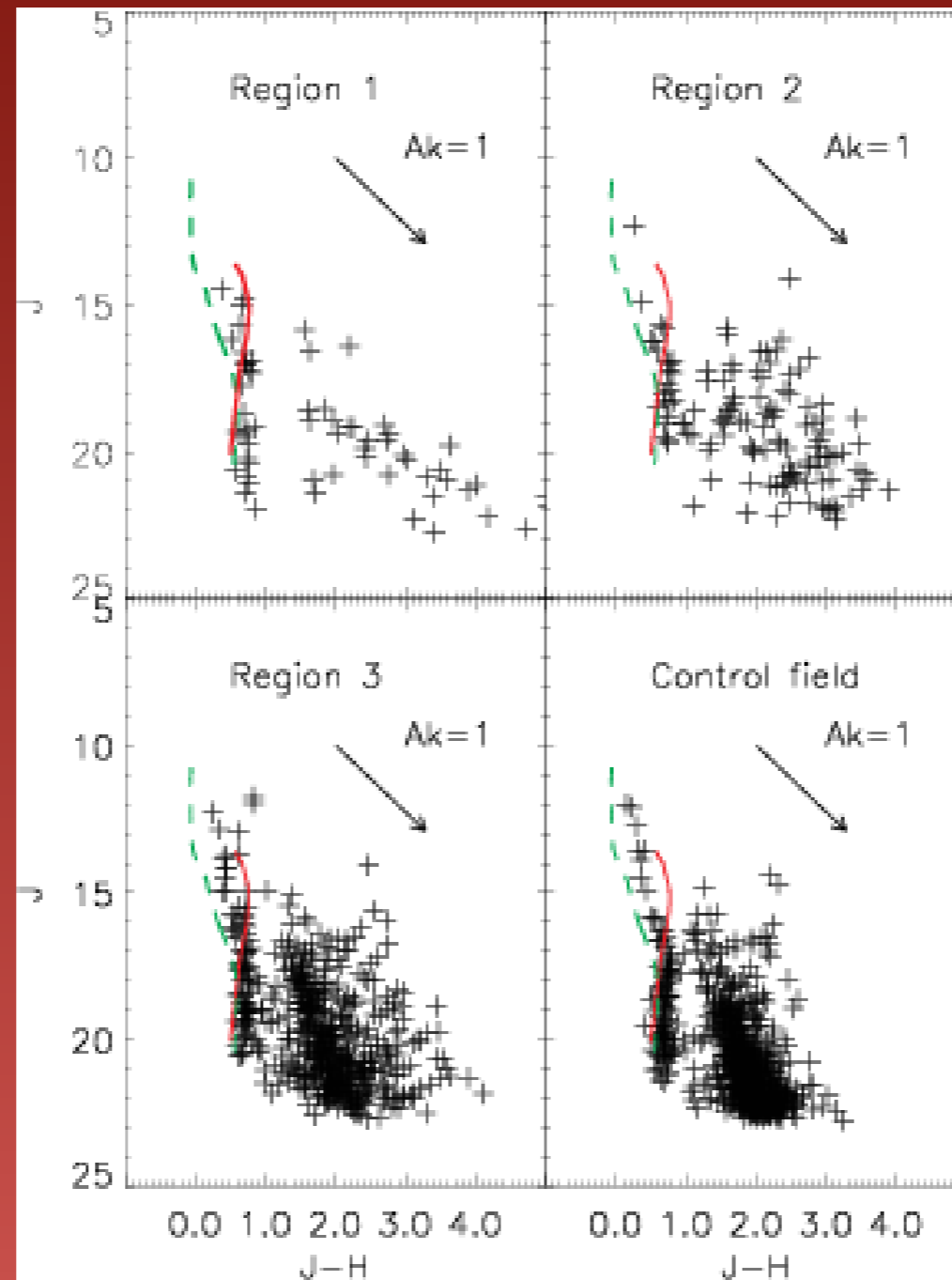
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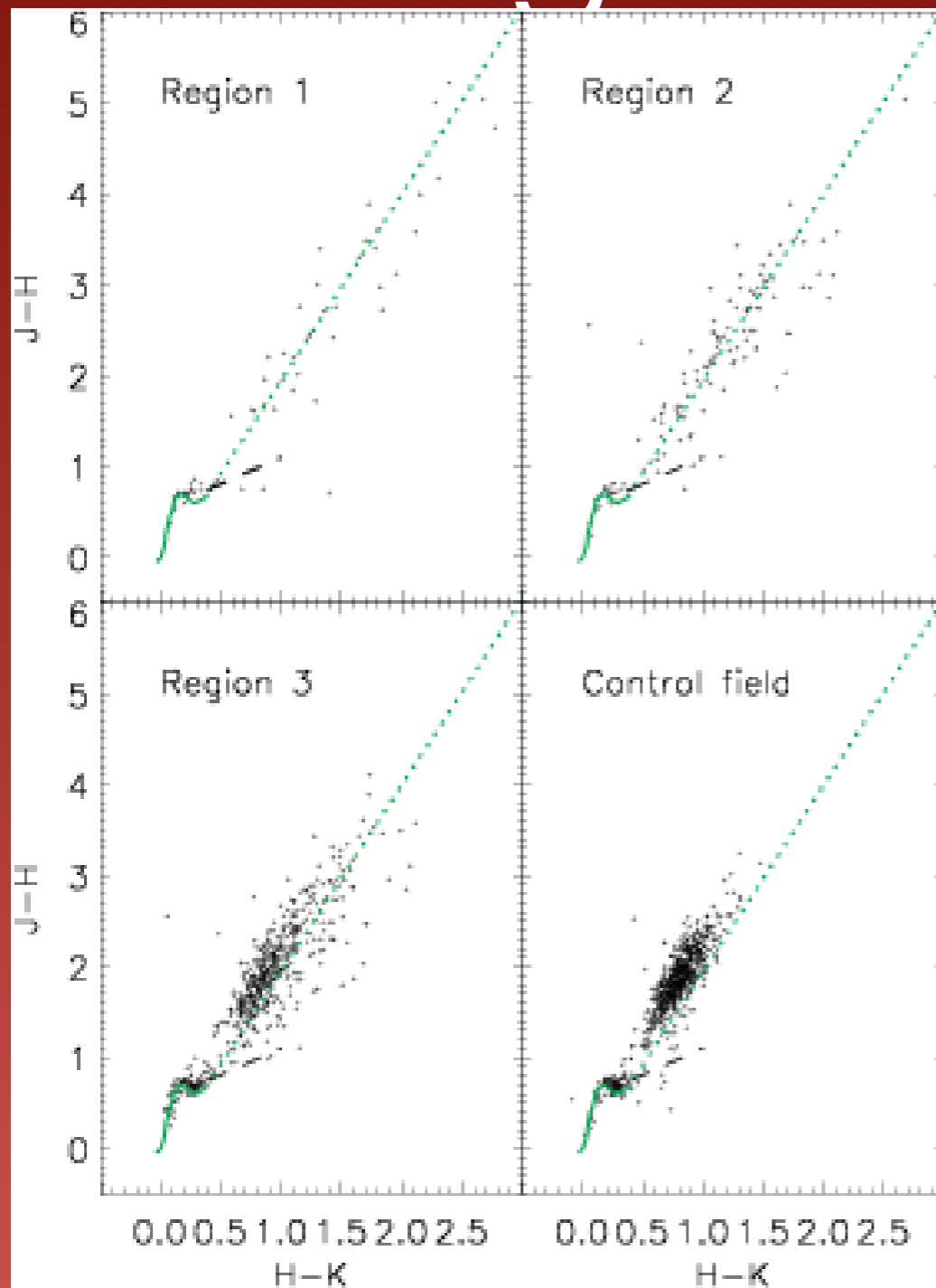
Three main regions identified



Large differences in extinction

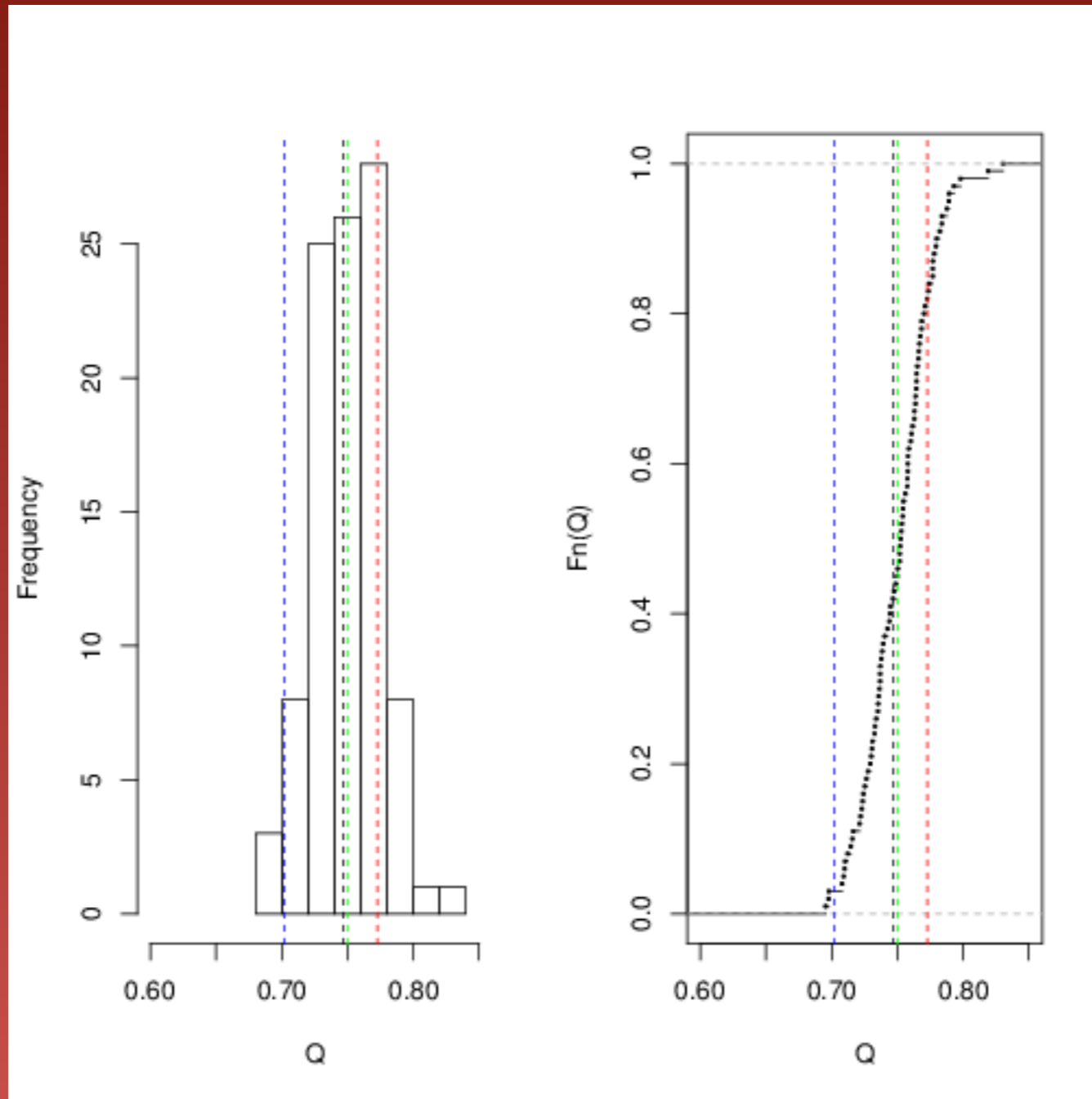


Large disk fractions



Disk fractions 27-44%
(small fraction in control field)

Tentative indications of stellar sub-structure



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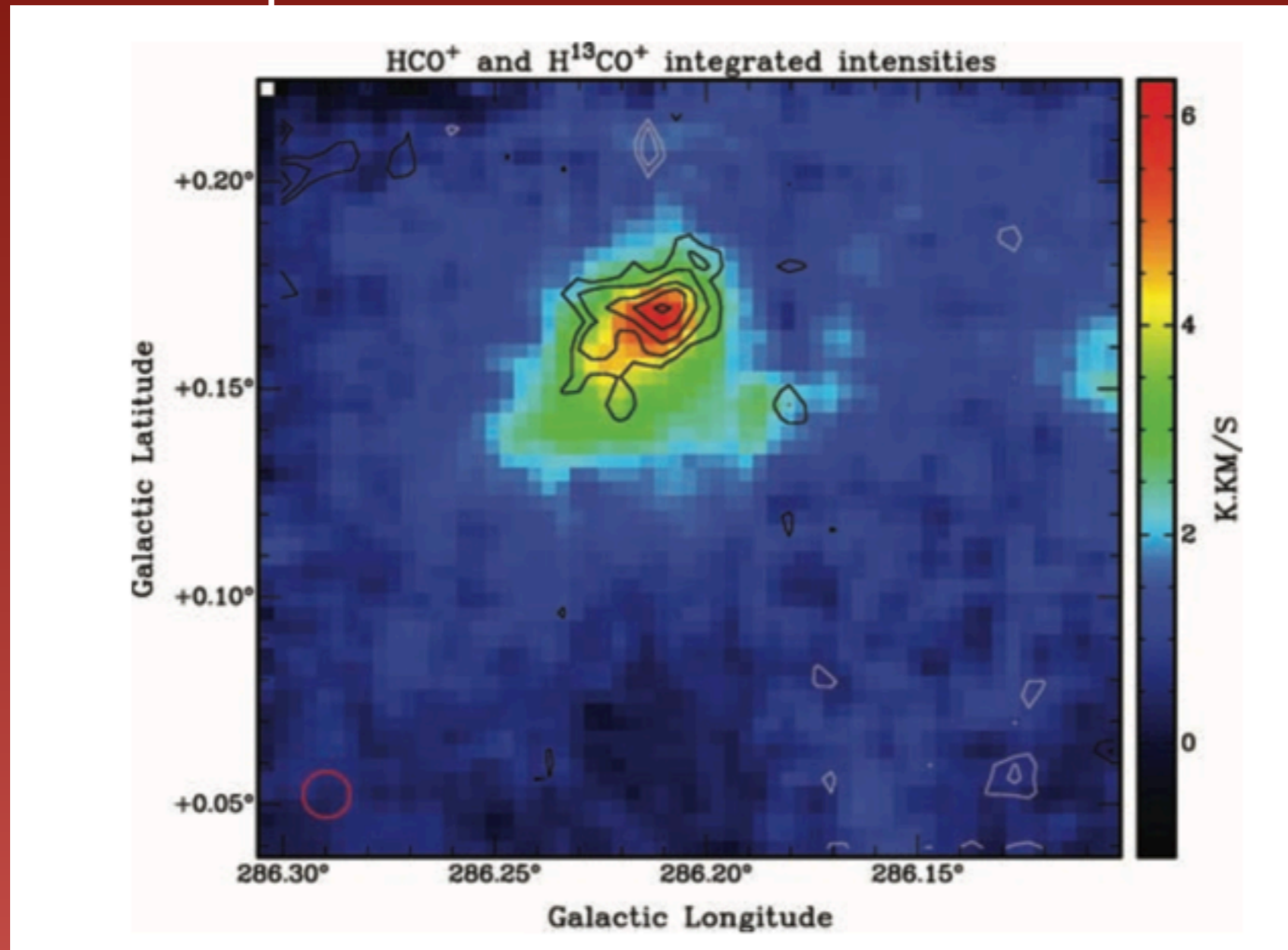
Stellar mass compared to gas mass still low

- At least 2000 Msun in the region
- currently $\sim > 250$ Msun in stellar content (not complete)
- Infall still ongoing so expected the total stellar mass increases

Proper motions revealing sub-clustering

- Multi-epoch HST WFC3 observations
- Can reveal proper motions down to few km/s
- (also provide deeper J band photometry)
- Will provide better completeness in the extinct regions
- Data analysis ongoing

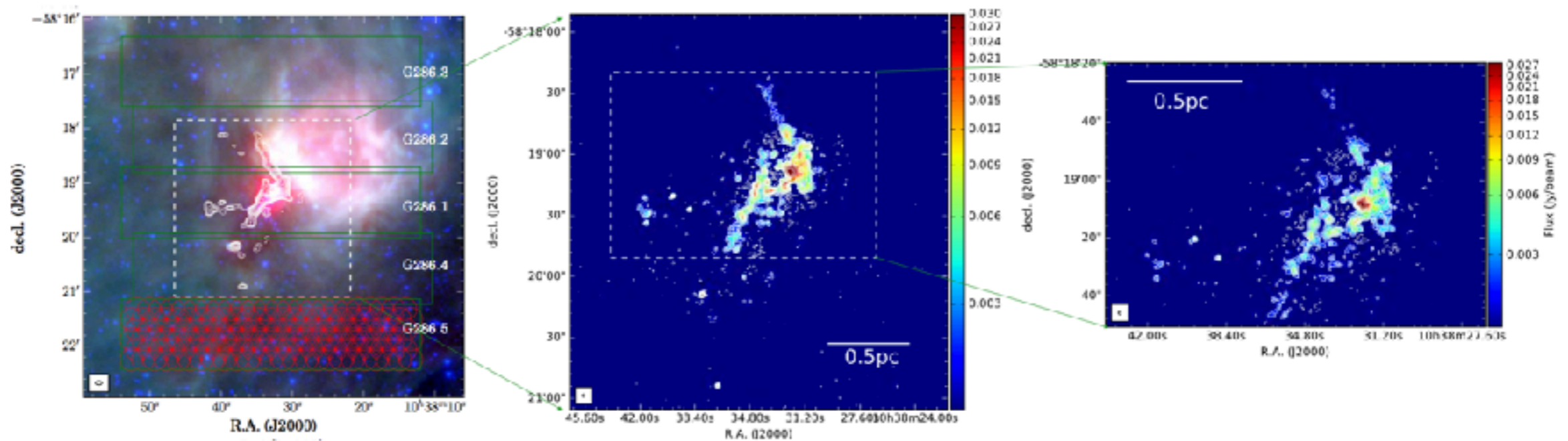
Revealing the molecular core spectrum with ALMA



Barnes et al. 2010

Single dish not able to resolve the clump

Revealing the molecular core spectrum with ALMA



Cheng et al., submitted

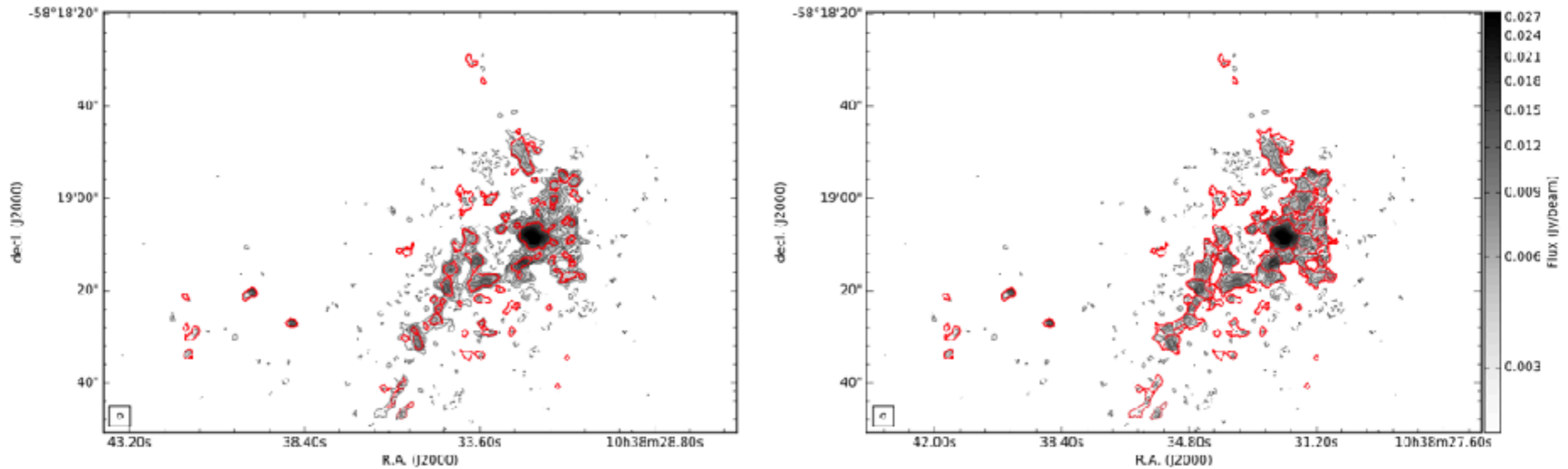


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Quite some sub-structure



Cheng et al., submitted

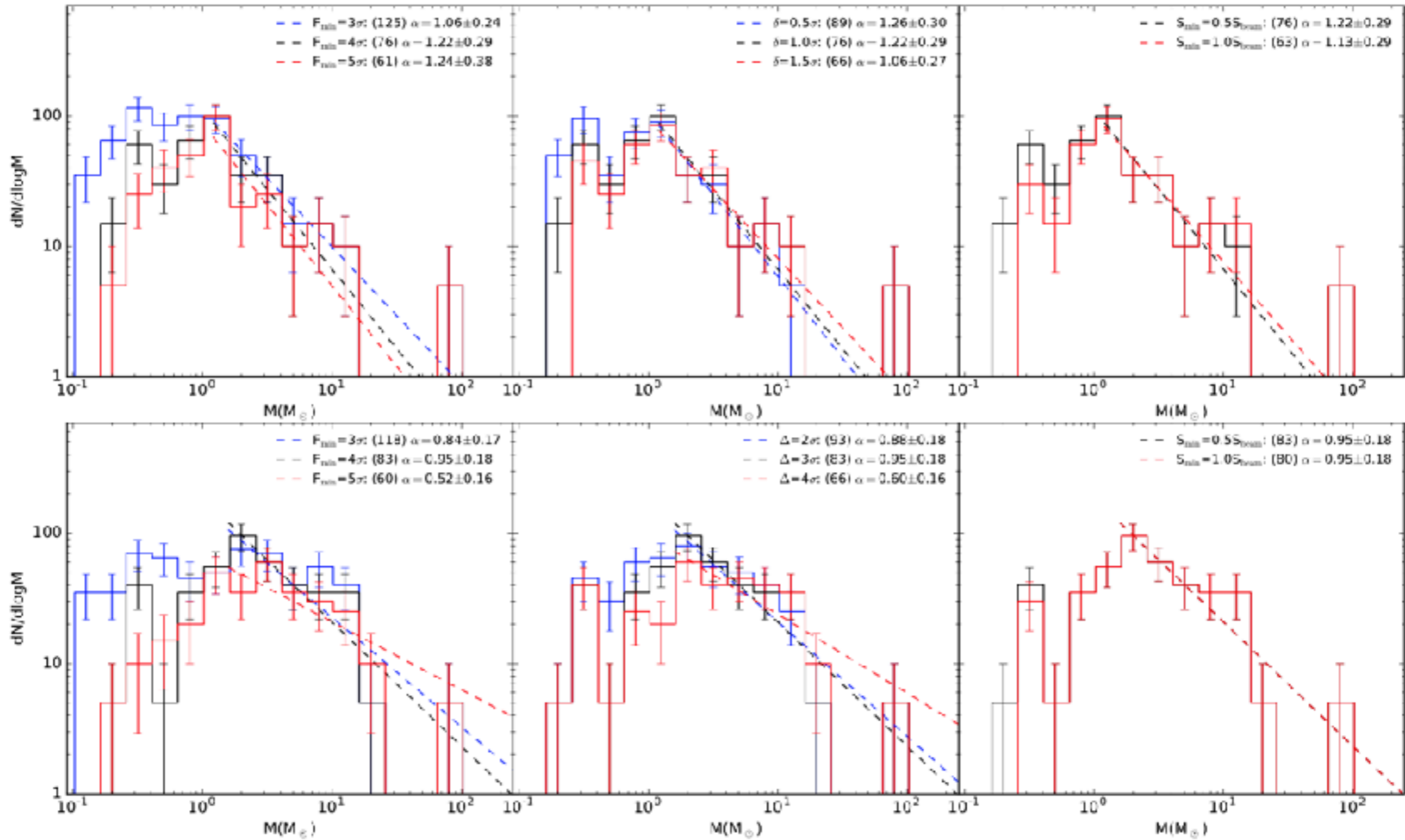


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Quite some sub-structure



Cheng et al., submitted



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Summary

- Obtained deep JHK VLT photometry of G286+0.17
- Probing the stellar content below 0.2 Msun
- High disk fraction for all the clusters (27-44 %)
- Tentative signs for sub-structure in the stars in the infalling clump
- Gas mass still 10 times the stellar mass