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**ESO: Walmsley (co-PI), Bontemps, Cesaroni, Deharveng, Herpin, Lefloch, Molinari, Motte, Minier,**

**Nyman, Reveret, Risacher, Russeil, Schneider, Testi, Zavagno**

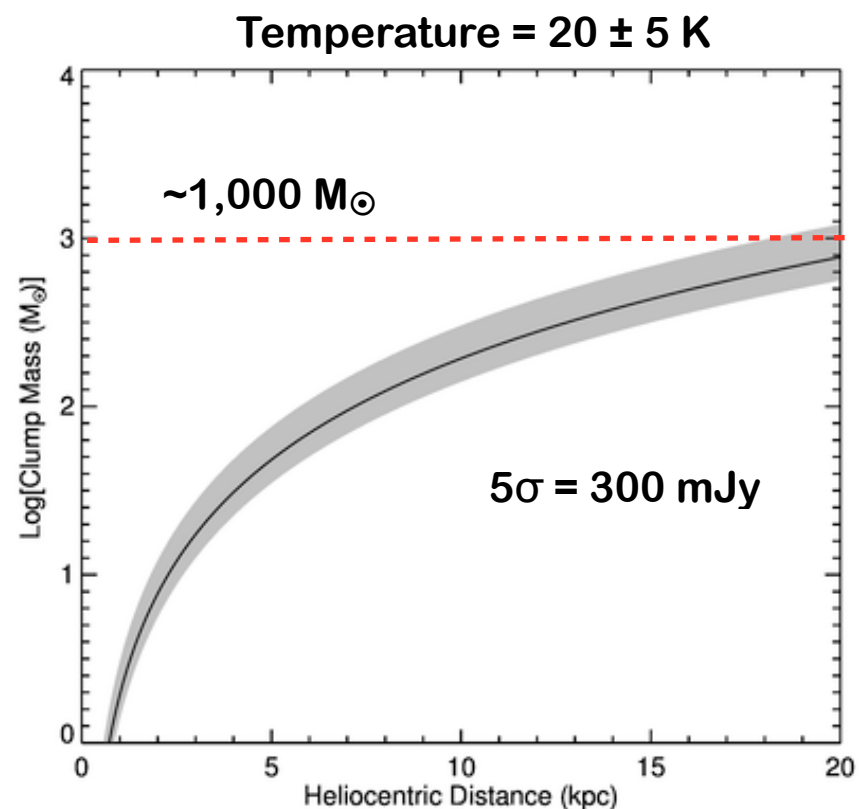
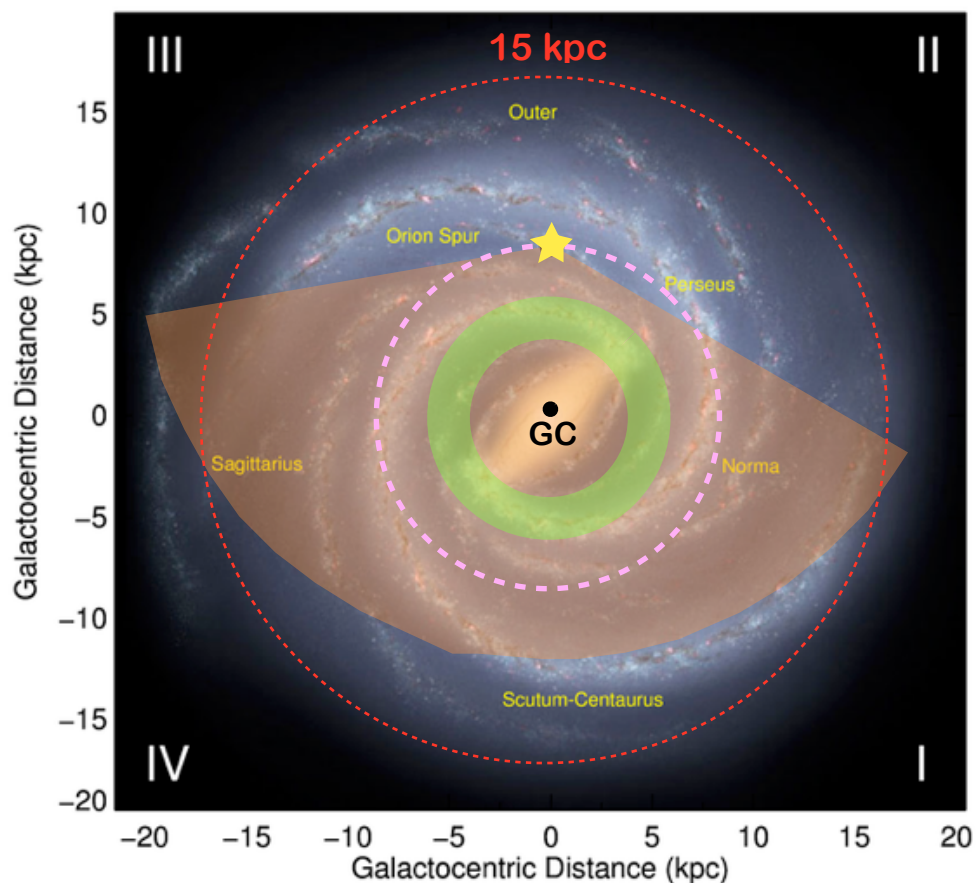
**Chile: Bronfman (co-PI), Contreras, Garay, Mardones**

- Overview of the ATLASGAL Survey
- Compact Source Catalogues
- Identification of Massive Star Forming Clumps
- Results
- Summary

# Overview of the ATLASGAL Survey

## Survey Summary

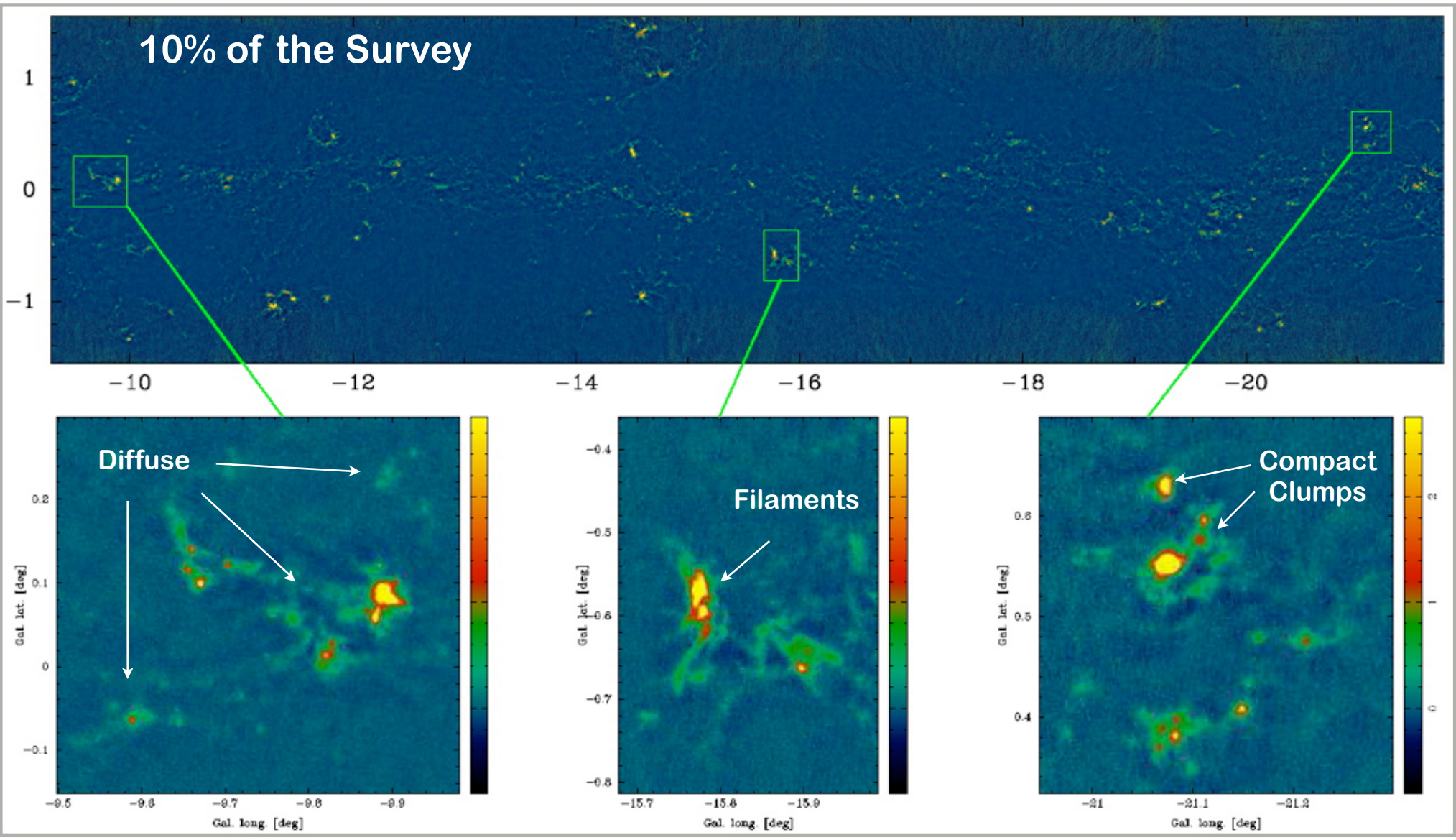
- APEX 870  $\mu\text{m}$  continuum survey of the inner Galactic plane ( $280^\circ < l < 60^\circ$ ,  $|b| < 1.5^\circ$ )
- LABOCA: Large APEX BOlometer CAmera (MPIfR) — 295 element bolometer camera
- Covers 420 sq. degrees with ang. resolution of  $\sim 19''$  and sensitivity of  $\sim 60$  mJy/beam
- Covers  $\sim 60\%$  of the Galactic disk but almost all of the region within the Solar Circle
  - covers  $\sim 90\%$  of all dense molecular gas in the Galaxy





# Overview of the ATLASGAL Survey

## Submillimetre Emission: Structure of the Dust



# Compact Source Catalogues

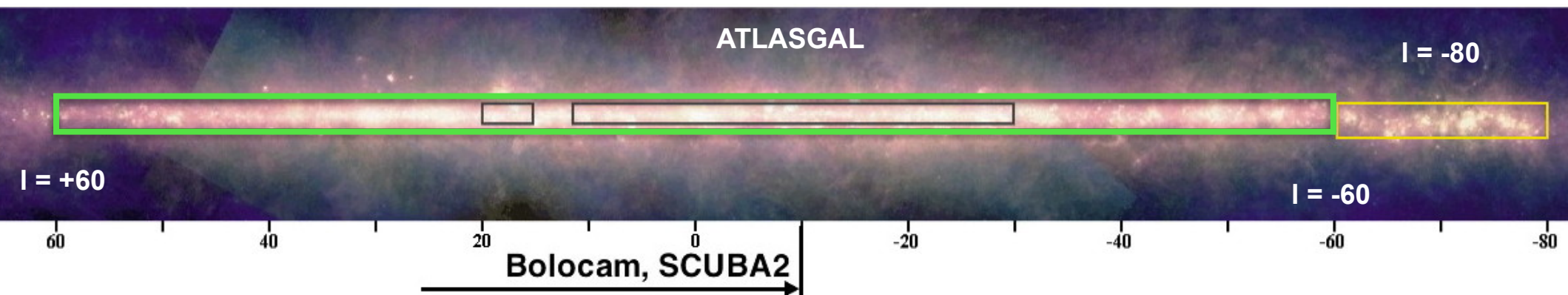
## Source Extraction

- Compact Source Catalogue produced using SExtractor on the reduced maps
  - Identified ~ 10,000 sources — Contreras et al., 2013 & Urquhart 2014

- GaussClump Source Catalogue produced using Multi-resolution filtering (wavelets) to remove extended emission and GaussClump
  - Full catalogue consists of ~ 10,000 sources — Csengeri et al., 2014

The CSC and GC are very complementary, with the former better probing the whole clump structure while the latter probing the gas directly associated with the SF

Both catalogues are 99% complete for sources with peak fluxes  $> 6\sigma$



### The ATLASGAL Database Server

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**Cone Search**

Enter an ATLASGAL source name or coordinates and a search radius.

Source name or coordinates:	AGAL012.403-00.467
Search radius (arcsec):	60

Example inputs: 18:14:24.42 -18:24:36.2 or AGAL012.403-00.467 or 12.403 -00.467

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**Advanced Search Facilities and Data Products**

- [Basic Search Engine](#)
- [Access to Calibrated Tiles](#)
- Batch Search (Available soon)
- Postage Stamp Server (Available soon)
- [Private Pages](#)

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**Reference and Acknowledgments**

Please use the following references in any publication that makes use of ATLASGAL data or the Compact Source Catalogue as well as any additional references specific to individual data sets used:

[Schuller et al. 2009, A&A, 504, 415 \(ADS\)](#)

[Contreras et al. 2013, A&A, 549, 45 \(ADS\)](#)

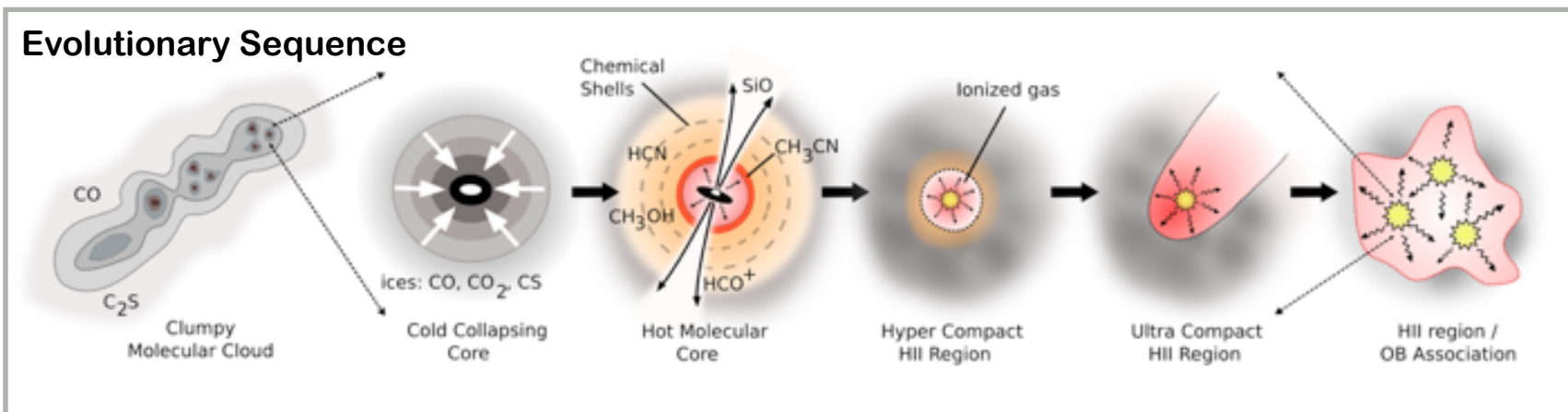
Please include the following acknowledgement in any published material that makes use of this database or any of its data products:

The ATLASGAL project is a collaboration between the Max-Planck-Gesellschaft, the European Southern Observatory (ESO) and the Universidad de Chile.

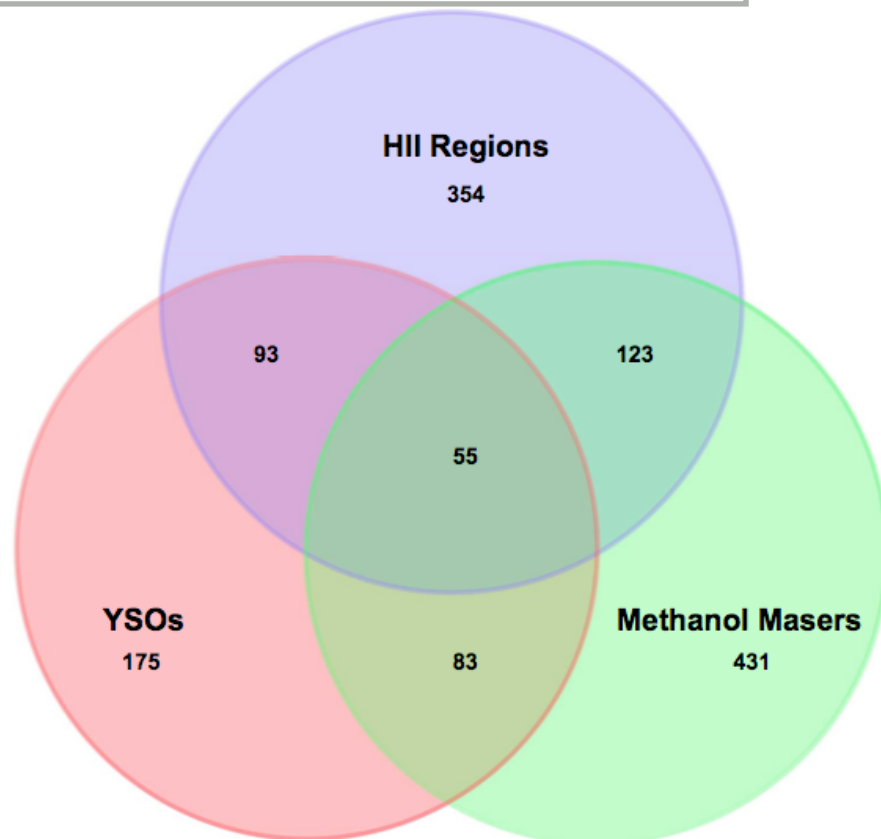
[http://atlasgal.mpifr-bonn.mpg.de/cgi-bin/ATLASGAL\\_DATABASE.cgi](http://atlasgal.mpifr-bonn.mpg.de/cgi-bin/ATLASGAL_DATABASE.cgi)

# Identification of Massive Star Forming Clumps

## Galactic Plane Surveys



- Submillimetre dust emission
  - ATLASGAL, JPS & SaSSy
- CORNISH 5 GHz VLA Continuum survey
  - UCHII regions
- The Red MSX Source Survey — **MYSOs**
  - + UCHII regions
- The **Methanol Multibeam (MMB)** Survey
- Identified ~1700 embedded sources matched to 1300 dusty massive star forming clumps

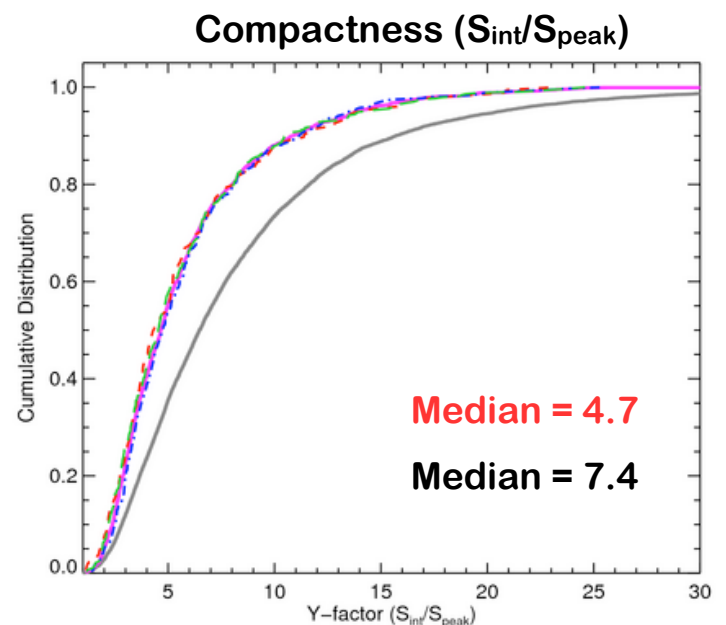
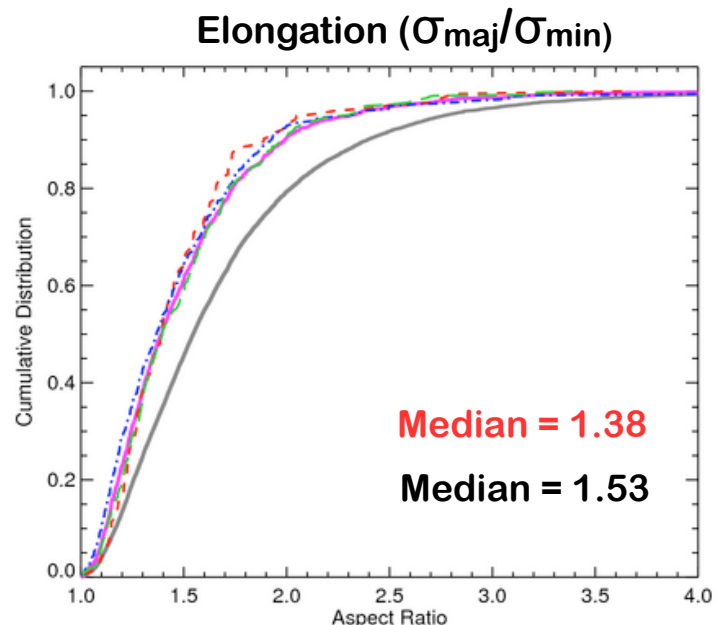
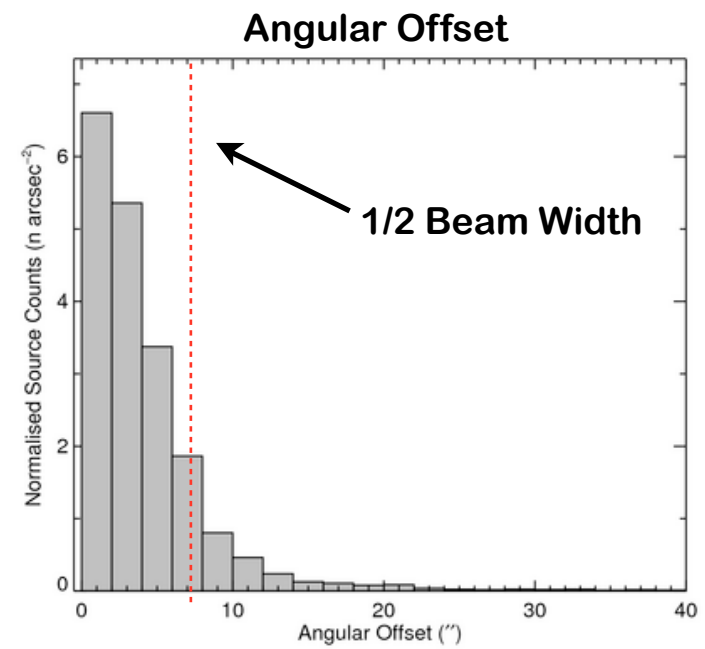




# Results

## Clump Structure

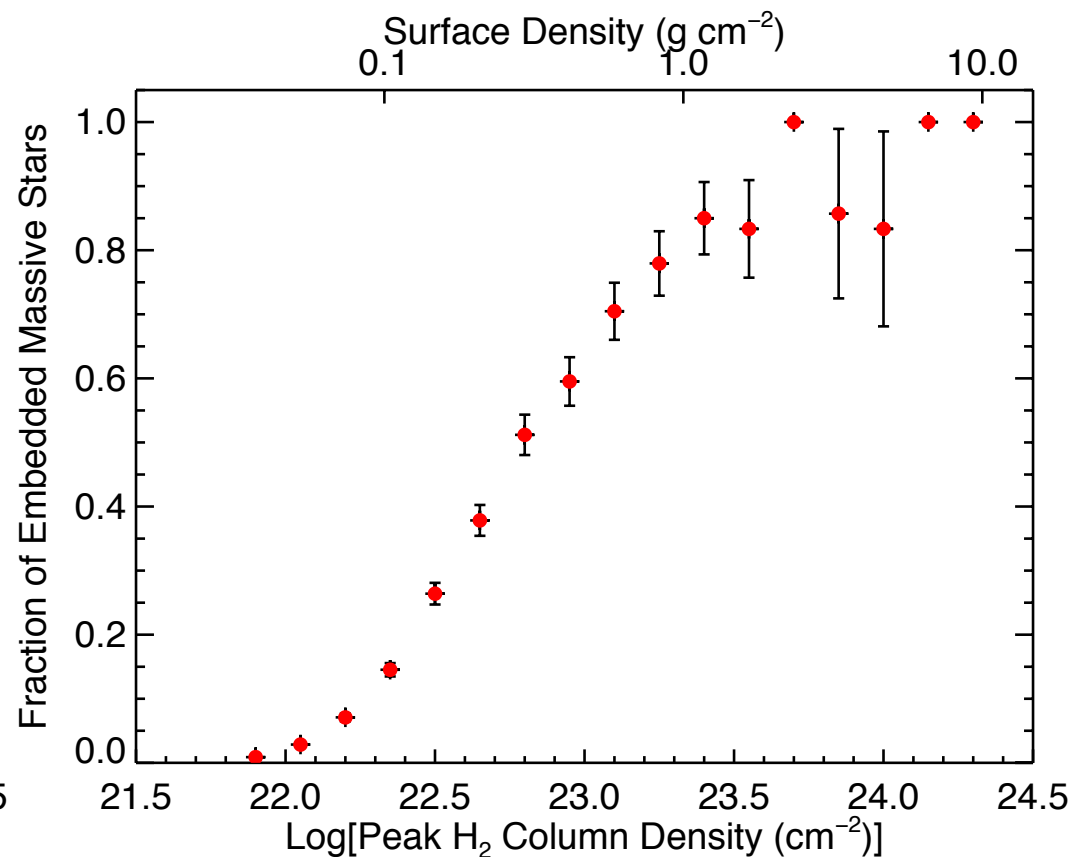
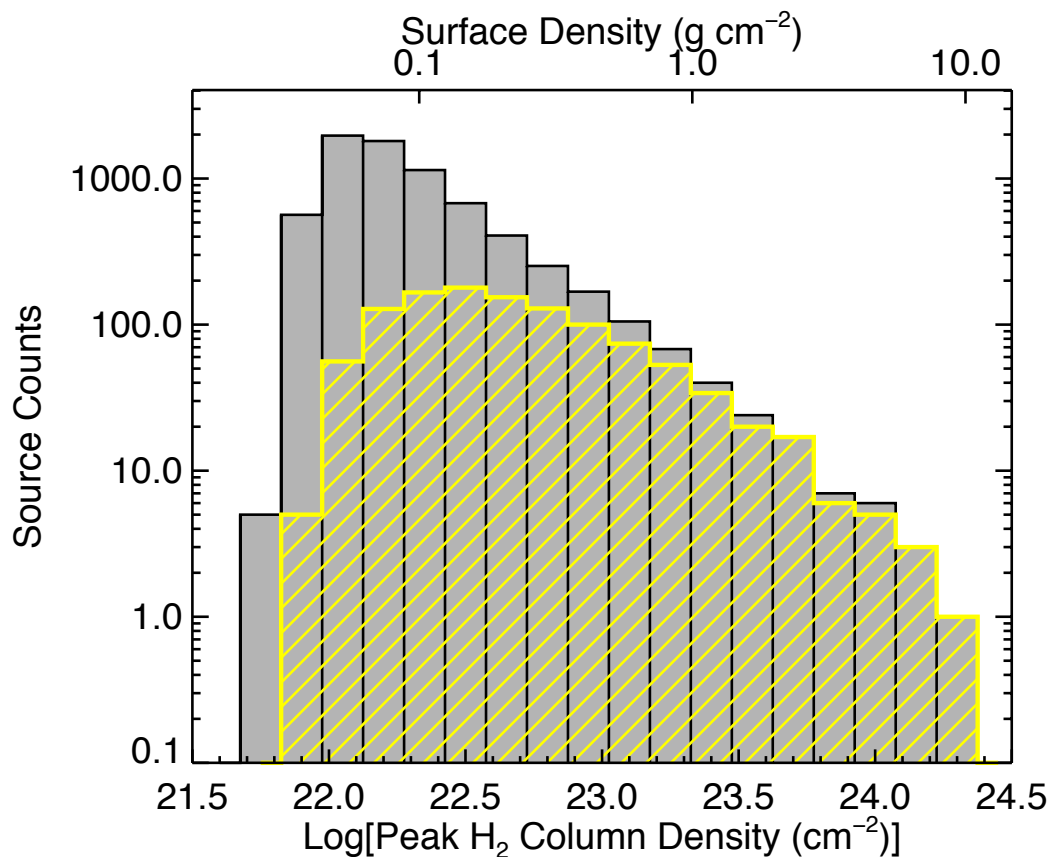
- Massive star formation is strongly correlated with regions of highest column density found towards the centre of their host clump
- The structure of the MSF clumps is significantly different from the general population
  - more spherical and centrally condensed
- There is no difference between these parameters for any of the subsamples
  - the structure of the host clump changes little during the formation process





# Results

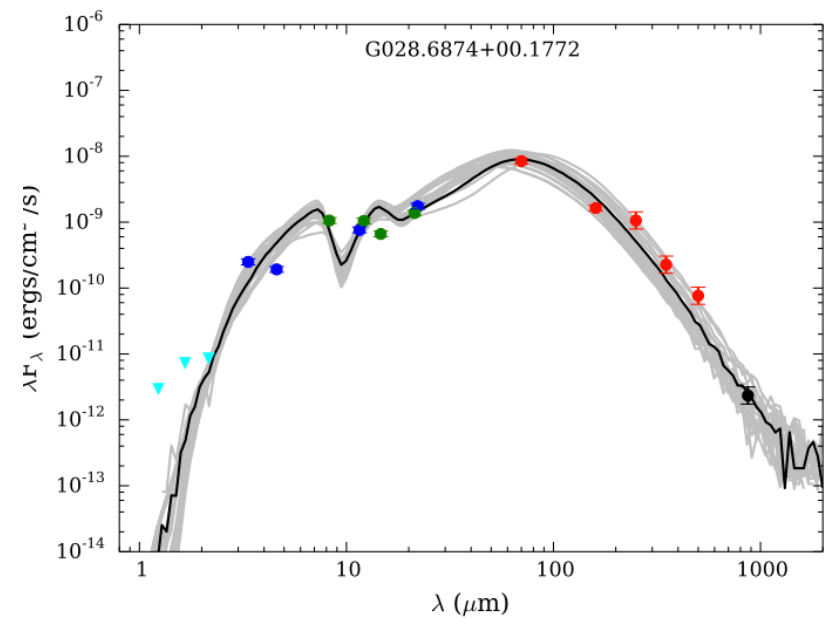
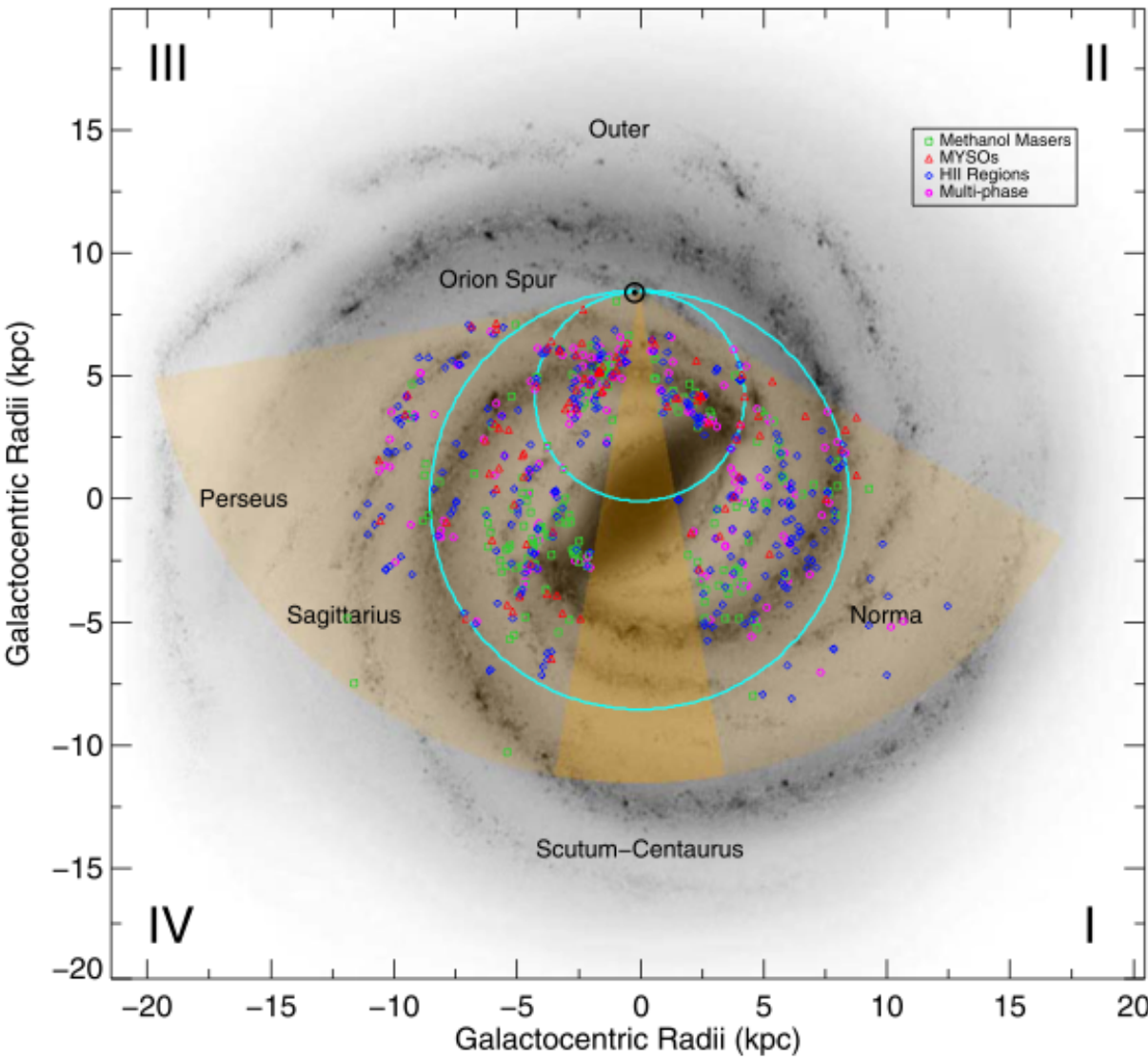
## Column Density Distribution



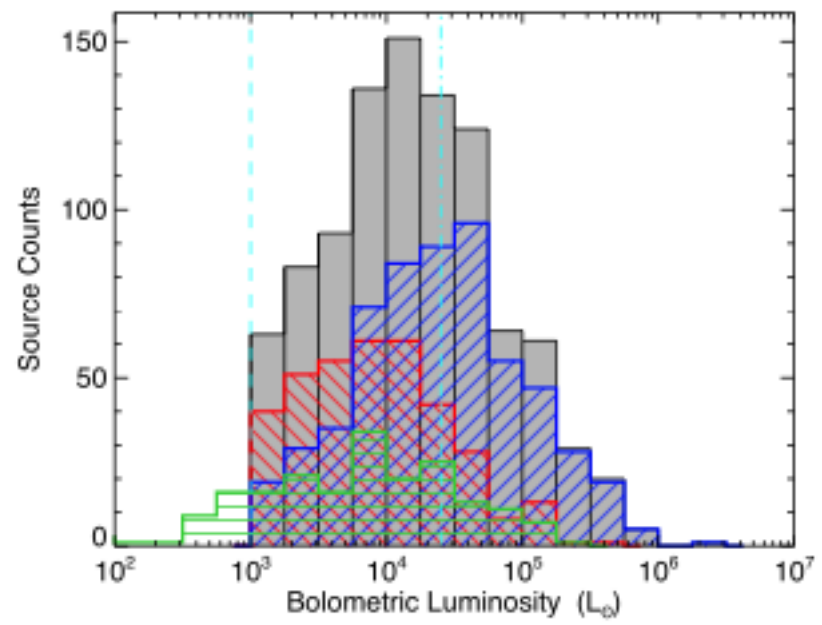
- There are very few high column density clumps outside the Galactic Centre region not already associated with massive star formation
- Supports a fast star formation timescale with the pre-stellar phase for the most massive clumps being so short it's effectively unobservable
  - see also analysis presented in Csengeri et al. 2014 on more compact structures

# Results

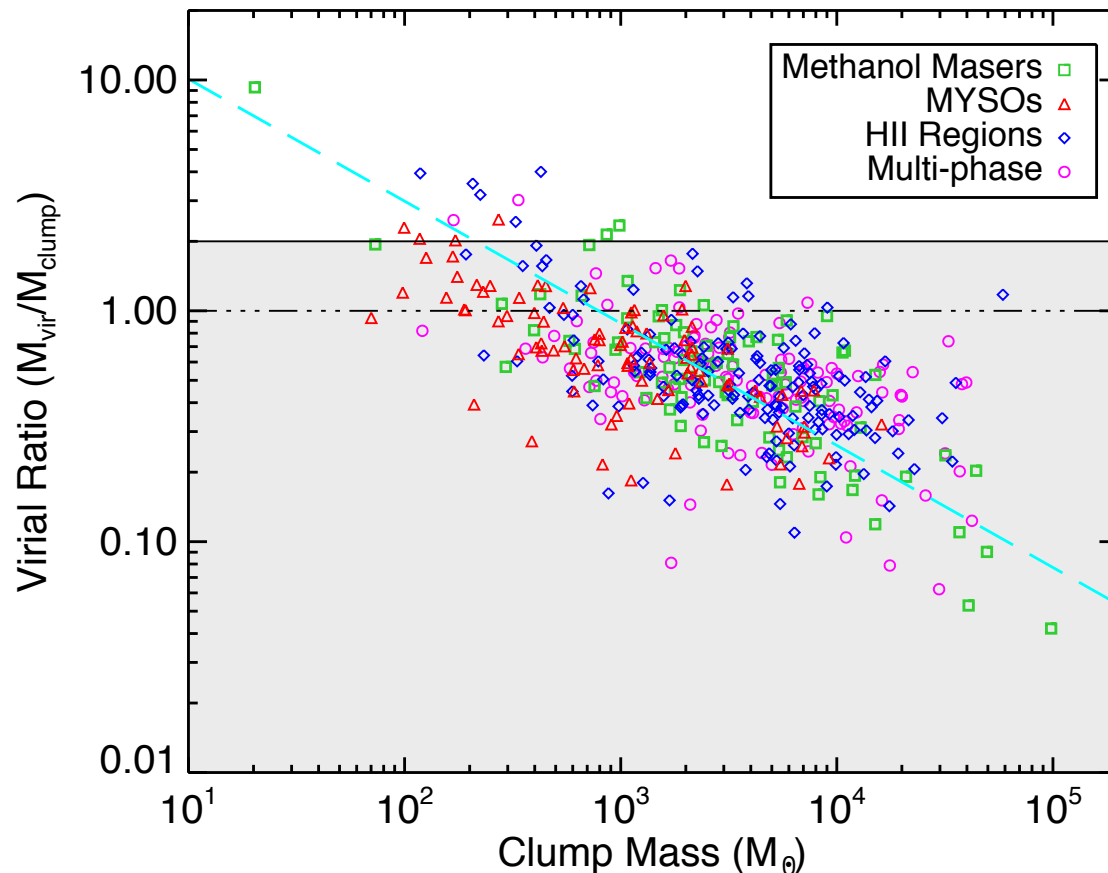
## Galactic Distribution of Massive Star Formation



Mottram et al. in prep.



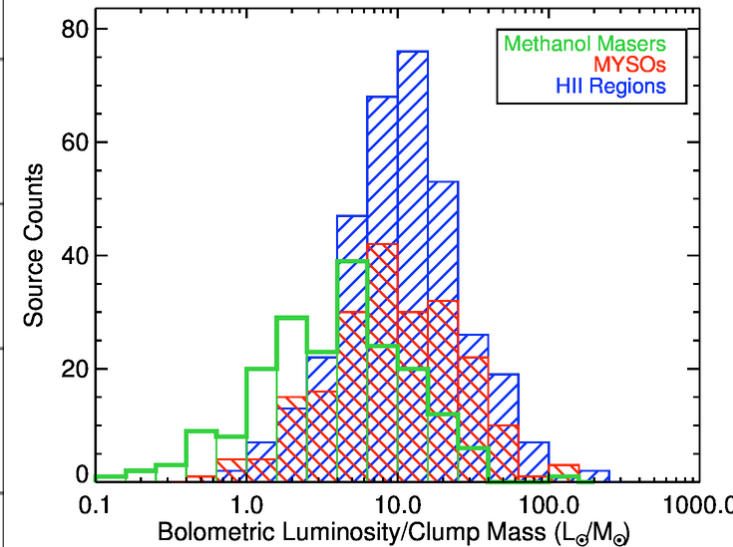
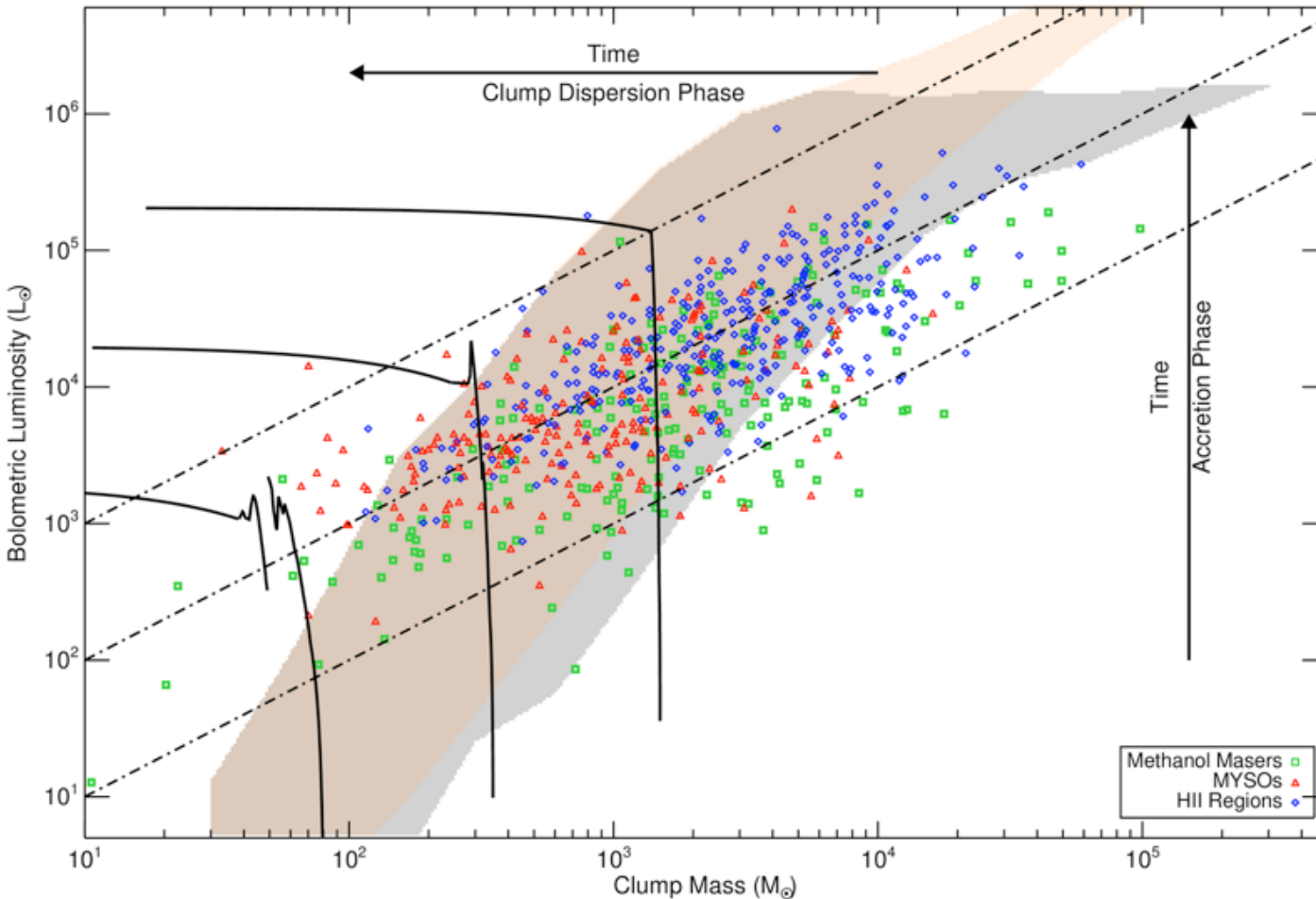
# Virial Parameter-Clump Mass Relation



- Nearly all MSF clumps are unstable to global gravitational collapse without the presence of significant magnetic support
- However, even if strong magnetic fields are present they are unable to prevent more local regions collapsing since they are all forming massive stars

# Results

## Luminosity-Mass Relation



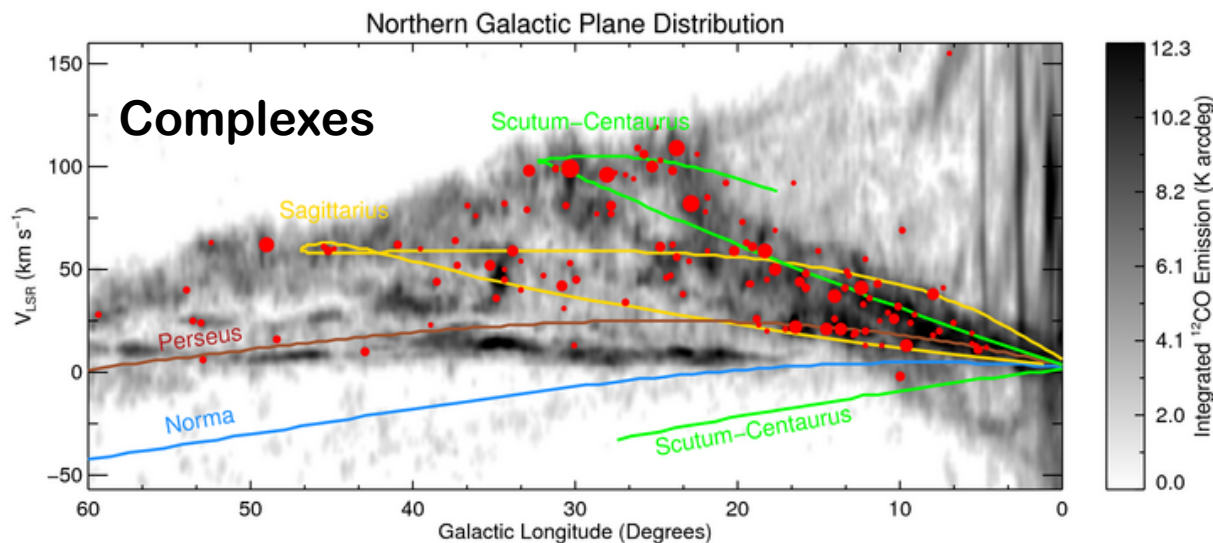
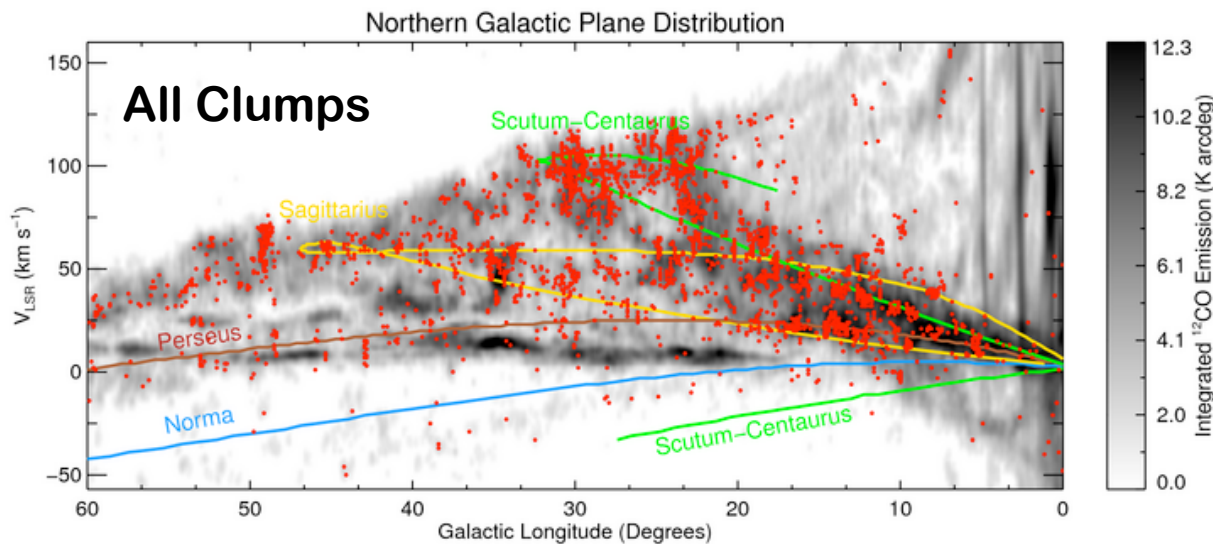
- MYSOs and HII regions are at similar stages in their evolutions but methanol masers are genuinely younger
- Estimated the SFE for Galaxy-wide sample of embedded massive stars



# Results

## Further Work

- The ATLASGAL clumps associated with MSF amount to ~20% of the sample
- Work is already underway to extract molecular line emission towards the rest of the population
  - 80% complete
- Using a friend-of-friends algorithm to identify complexes; this will significantly reduce the number of distances required
- We find ~200 complexes that are associated with ~75% of all clumps
- The largest 50 complexes are associated with ~50% of all sources



- The ATLASGAL survey provides a complete inventory of dense molecular clumps located throughout the inner Galactic disk → 10,000 sources
- Cross-matching these sources with other MSF surveys we have identified ~1300 MSF clumps (20% of the total sample) including most important embedded phases
- These will be used to investigate:
  - the evolutionary sequence of massive stars and estimate the statistical lifetime of each stage and evaluate initial conditions and environment in the star formation process
  - star formation as a function of clump mass, luminosity and Galactic location
- Identify interesting objects e.g., massive protostellar clusters and transition objects

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