Lessons from the Bolocam Galactic Plane Survey

Miranda K. Dunham
Yale University
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Bolocam Galactic Plane Survey

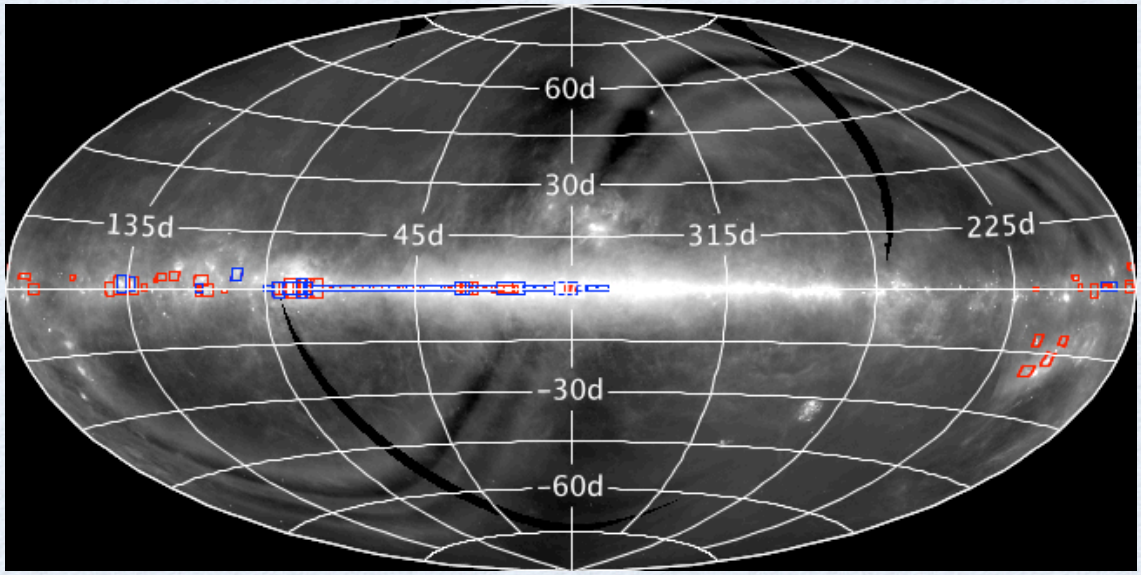
- Aguirre et al. (2011); Rosolowsky et al. (2010)

Ginsburg et al. 2013, in prep

Version 2 Data Release:

- additional observations: 20 sq. deg. in 3rd/4th quadrants
  2 sq. deg. in 1st quadrant
- improved atmospheric subtraction process
  - spatial recovery of emission
  - reduced negative bowls around bright sources
- resolved flux calibration offset seen in v1.0; no offset necessary for v2.0
- improved pointing accuracy
- cataloged 8,552 sources
  - 548 in expanded regions
- statistical properties of the

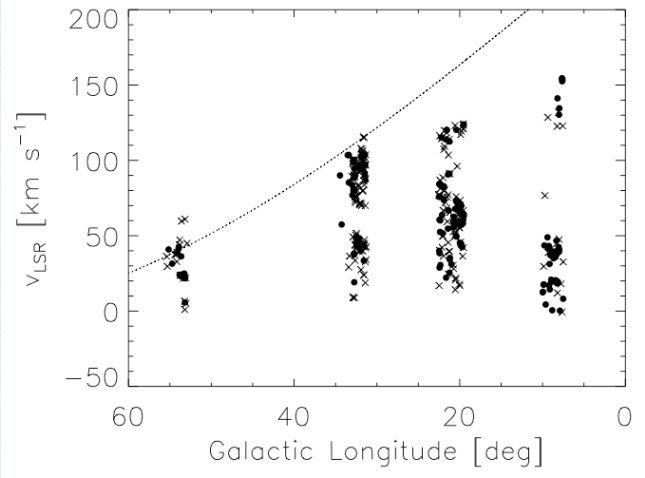
http://irsa.ipac.caltech.edu/data/BOLOCAM_GPS/



Spectroscopic Surveys

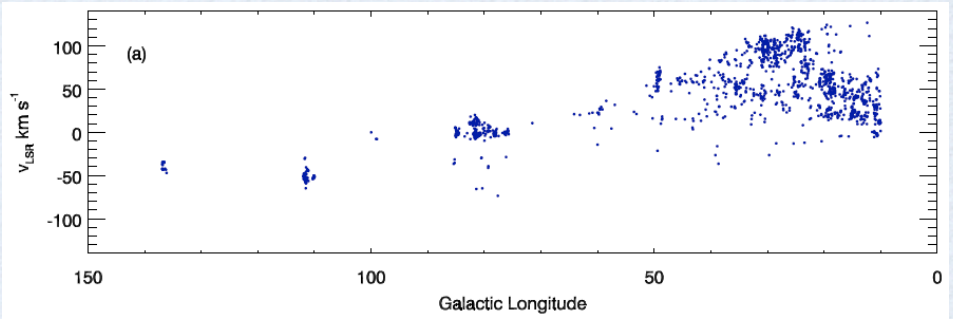
- Ammonia: 771 sources observed with the GBT (Dunham et al. 2010, 2011)

broke ambiguity for 456 sources

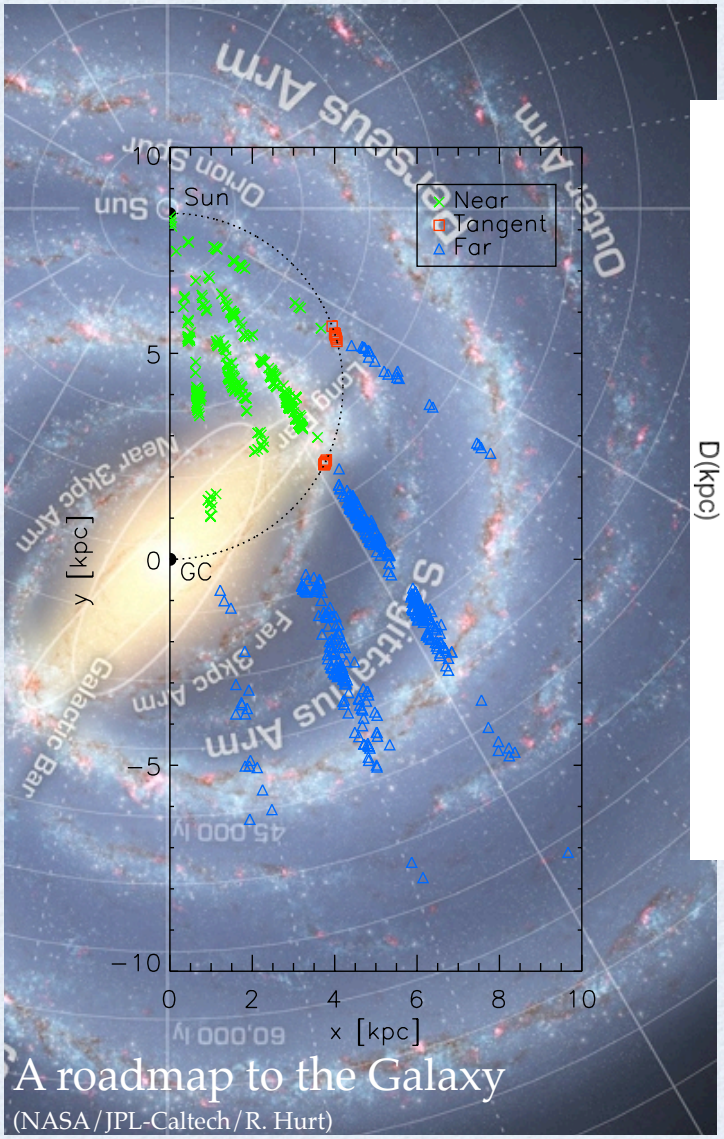


- HCO^+ and N_2H^+: 1882 observed with the HHT (Schlingman et al. 2011)

broke ambiguity for 529 sources



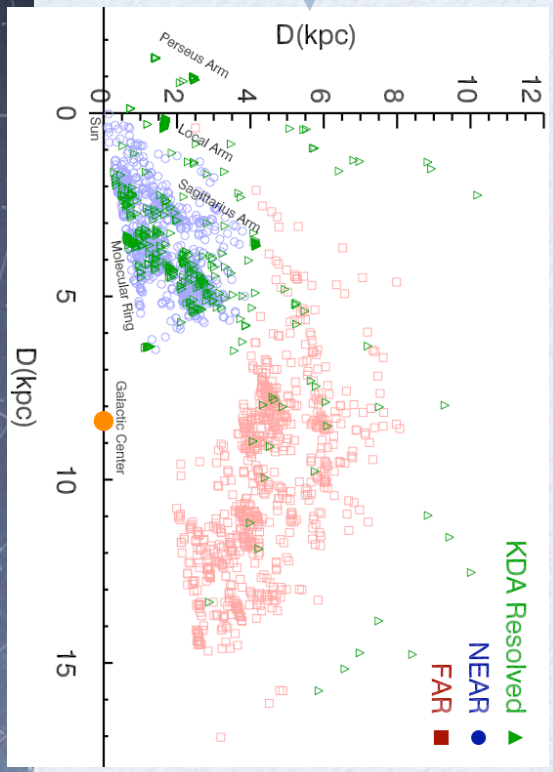
Galactic Structure

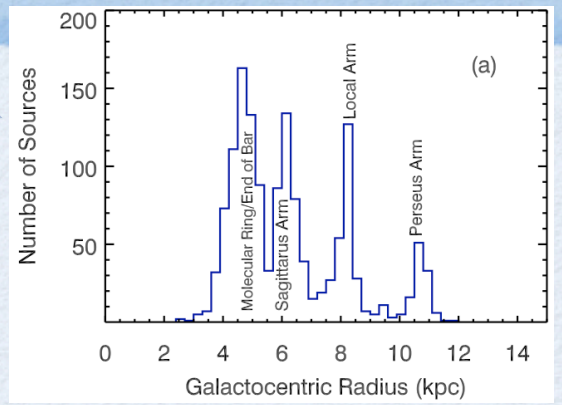


A roadmap to the Galaxy

(NASA/JPL-Caltech/R. Hurt)

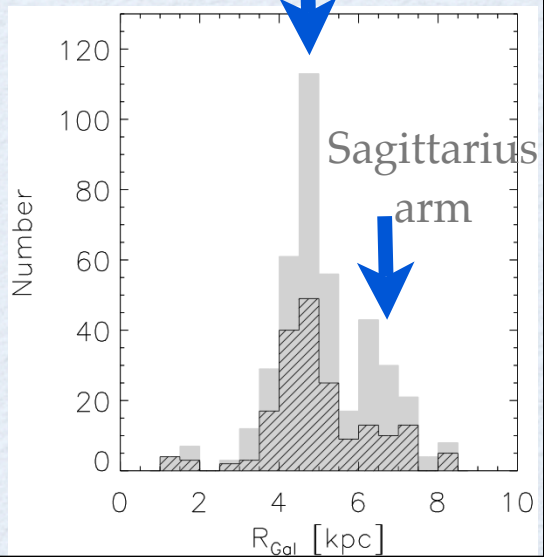
HCO^+ & N_2H^+



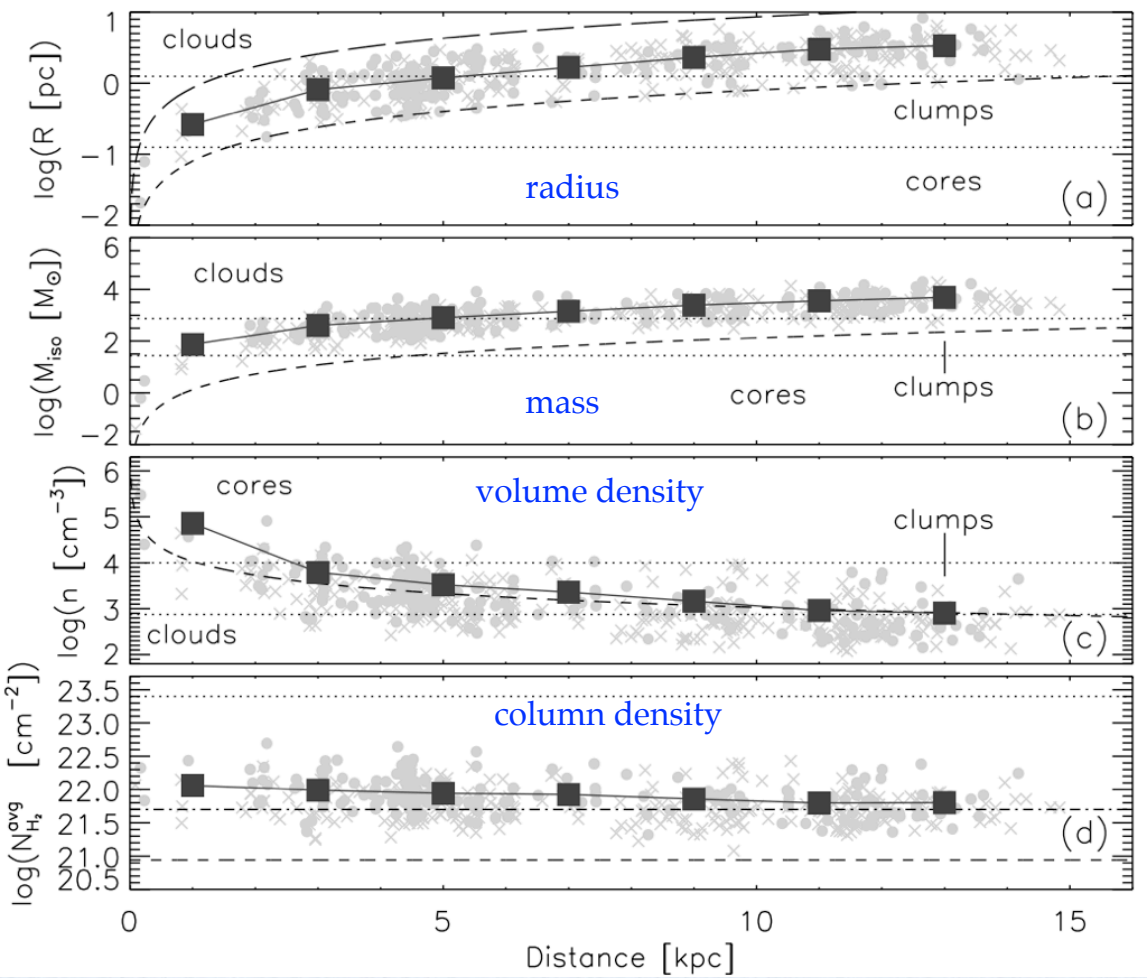


5 kpc molecular ring bar/Scutum arm

NH_3



Physical Properties

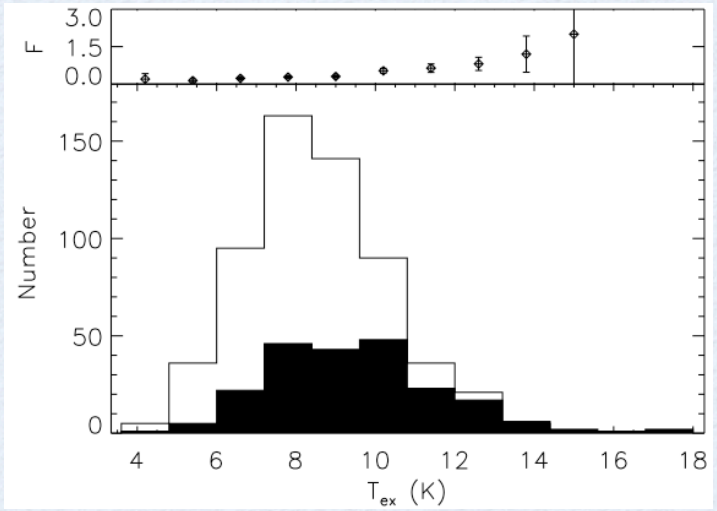


- HCO^+, N_2H^+ sample:
  - 529 sources with known d
  - median properties:
    - d = 2.65 kpc
    - R = 0.752 pc
    - M(20 K) ~300 M_{sun}
    - n = 2.4 x 10^3 cm^{-3}
- NH_3 sample:
  - cores: d < 2 kpc
  - clumps: 2 kpc < d < 7 kpc
  - clouds: d > 7 kpc

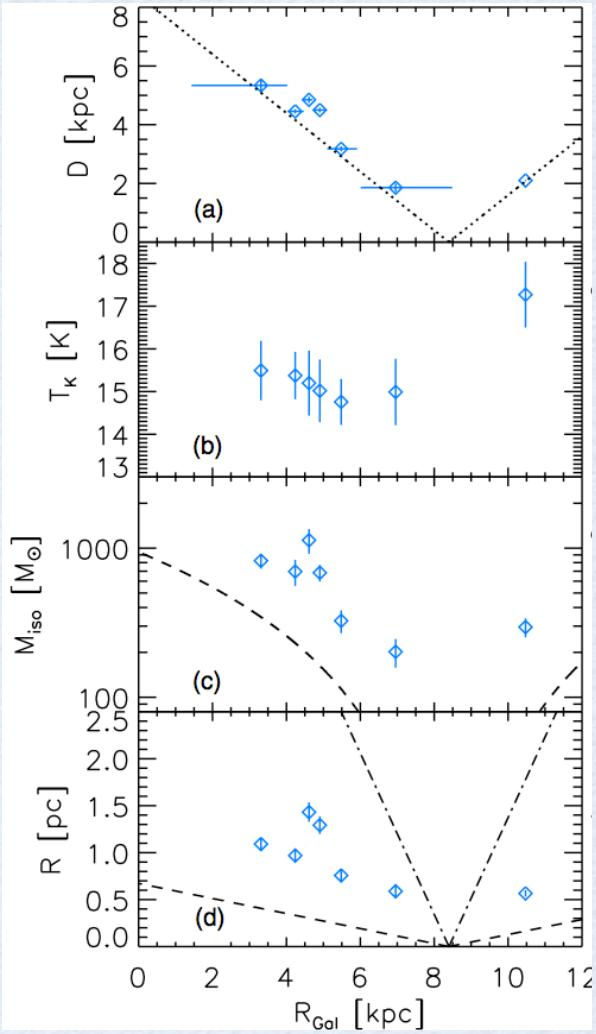
Physical Properties

- ^{13}CO GRS survey found clouds within the molecular ring are warmer, larger, and have higher masses, column densities, and contain more clumps than those outside the molecular ring.

- These trends are not seen in BGPS sources, suggesting the environment affects the large-scale molecular clouds while the higher density (n~10^3 cm^{-3}) clumps are unaffected by environment.

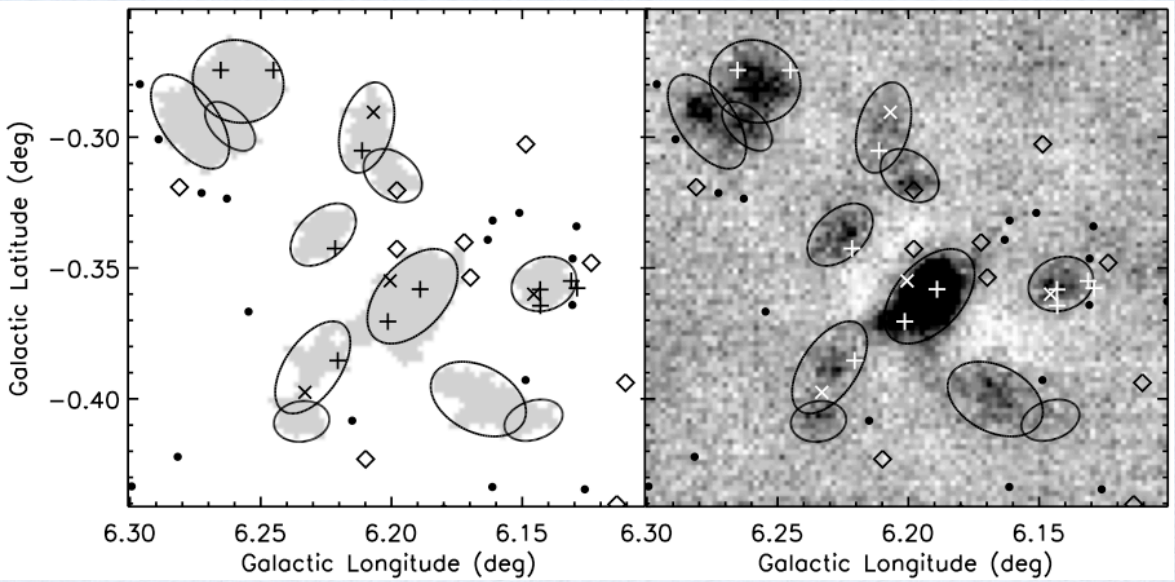


Rathborne et al. (2009)



Star Formation Activity in BGPS Sources

- Compared the BGPS catalog to *GLIMPSE* Red Source catalog (Robitaille et al. 2008), *Extended Green Objects* catalog (Cyganowski et al. 2008), and the Red MSX Source catalog (Hoare et al. 2004; Urquhart et al. 2008)
- 49% of the BGPS sources within $10° < l < 65°$ contain at least one mid-IR source
- 20% of all BGPS sources are estimated to contain a mid-IR source after accounting for chance alignments



Star Formation Activity in BGPS Sources

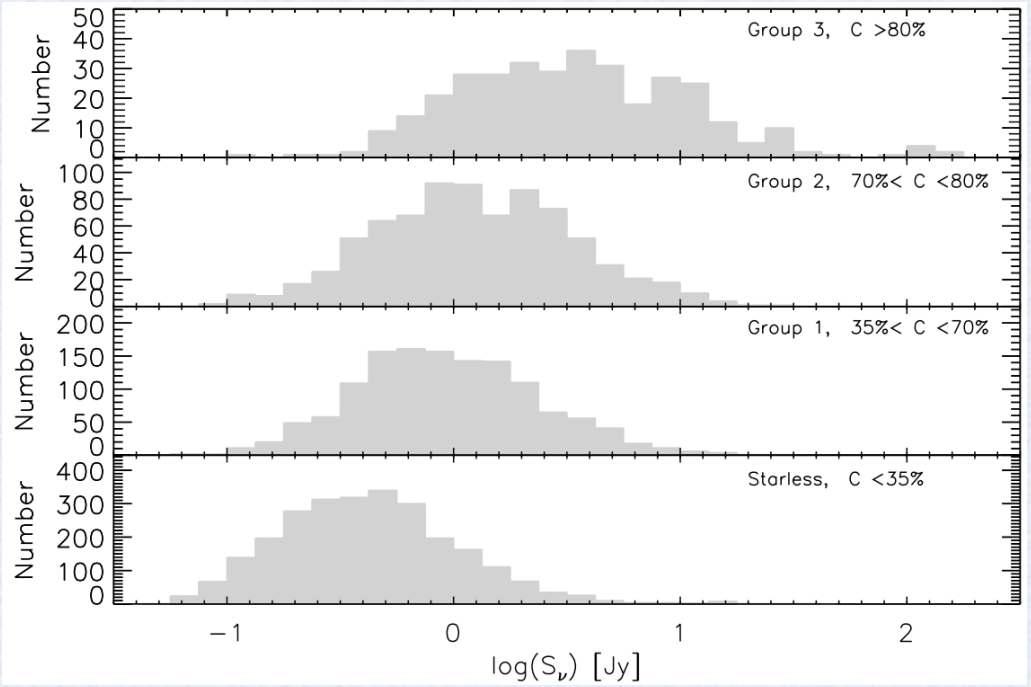
total # BGPS sources

340

793

1,324

2,610

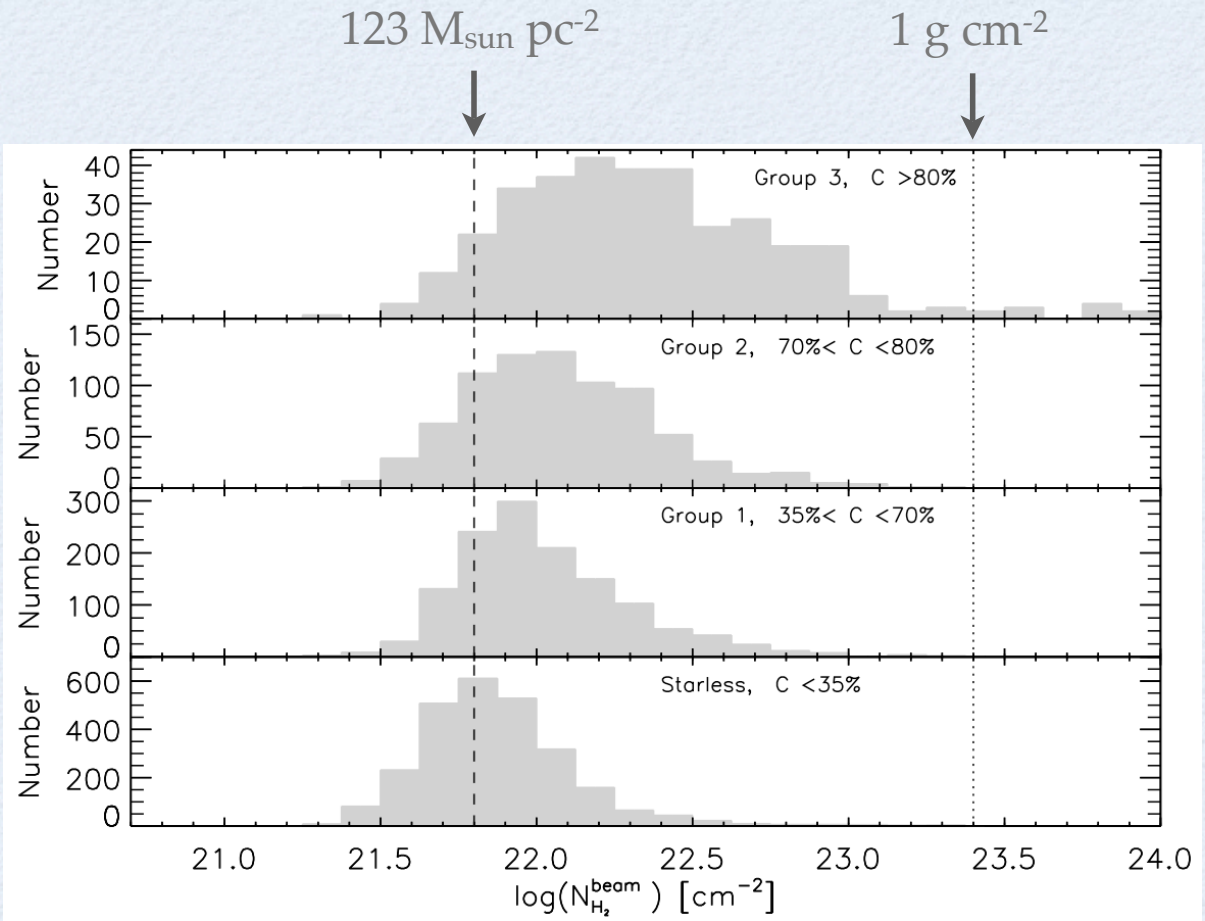


increasing probability of star formation

- We compare to the inner Galaxy NH_3 study to determine mean gas properties for each group
  - group 3: $\langle T_K \rangle = 22.0 \pm 5.9$ K
  - group 2: $\langle T_K \rangle = 16.1 \pm 4.3$ K
  - group 1: $\langle T_K \rangle = 14.8 \pm 3.9$ K
  - group 0: $\langle T_K \rangle = 14.0 \pm 3.2$ K

The mean σ_v and N_{NH3} also increase with group number.

Physical Properties with SF Probability



- Σ_{th} = 123 M_{sun} pc^{-2}: threshold above which star formation is more efficient (Heiderman et al. 2010; Lada et al. 2010)
- Σ_{th} = 1 g cm^{-2}: threshold required to prevent fragmentation and form a massive star (Krumholz & McKee 2008)

Summary

- Characterized the physical properties (radius, mass, density, temperature, etc) of a relatively unbiased sample of star-forming regions
- Begun to place the BGPS sources in a larger context, including location within the Galaxy
- In conjunction with other data sets, the BGPS is an incredibly powerful data set for studying bulk properties of star-forming regions throughout the Galaxy.