Constraints on star formation in the Taurus L1495 cloud from SPIRE/PACS observations of dense cores as part of the Herschel Gould Belt Survey

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Summary

- Catalogue of dense starless cores in L1495/B211/B213 region of Taurus Molecular Cloud, derived from *Herschel* PACS/SPIRE continuum images 70—500 μm (*cf* Palmeirim et al. 2013)
- SED fits to greybody dust models => mean dust temp., core mass, column density
- Classify core as gravitationally bound (prestellar) if mass > (BE critical mass)/2 (Konyves et al. 2010)
- Largely complete for $M > 0.1\ M_{sun}$ (prestellar) and $M > 0.02\ M_{sun}$ (unbound cores, including those located in less dense, off-filament regions)
- All of the detected prestellar cores lie on filaments
- Prestellar core mass function (CMF) consistent with lognormal form
- Overall starless CMF (unbound + prestellar) is *not* lognormal
  - No evidence for low-mass turnover
- Density probability distribution function *is* lognormal except for high-density tail attributable to prestellar cores
  - Consistent with models of supersonic turbulence + self gravity

Herschel Gould Belt Survey

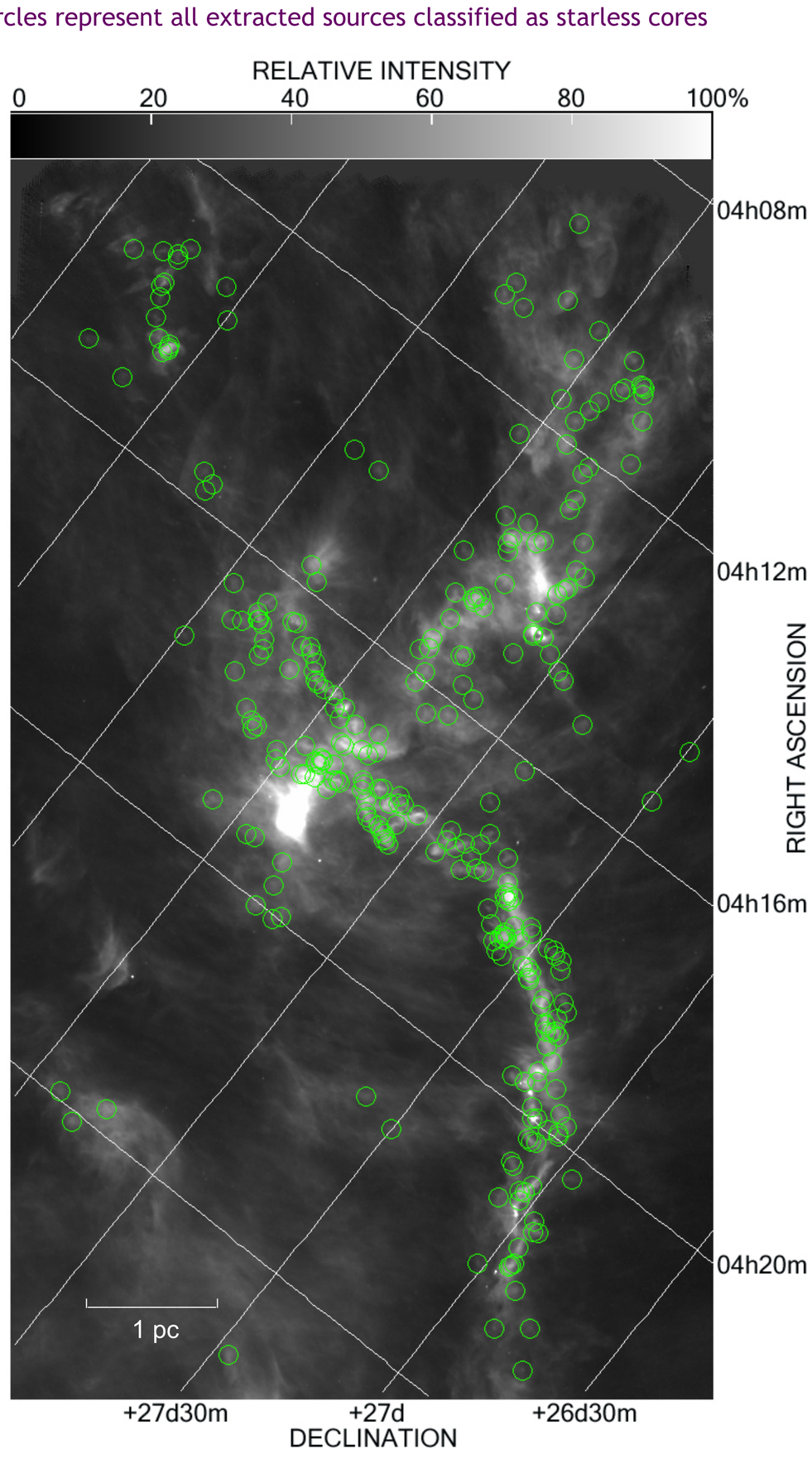
- Major goal: Characterize the prestellar CMF and the link between the CMF/IMF and cloud structure over the densest parts of Gould Belt (André et al. 2010)
  - 15 nearby molecular clouds, including Taurus
- Principal product: Catalogue of all detected dense cores & protostellar objects
  - Present work is one installment of the dense cores section of catalogue

Data analysis

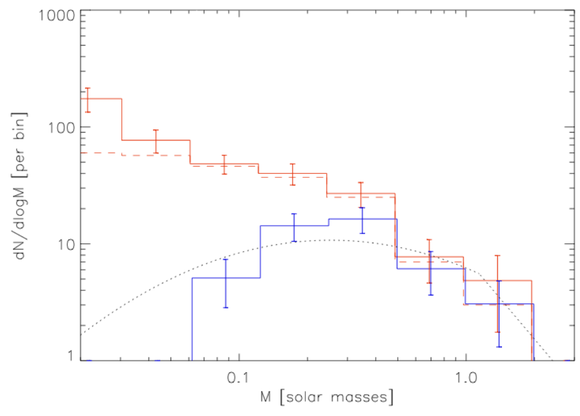
- Source detection via *getsources* (Men'shchikov et al. 2012)
- Source classification — principal conditions for classification as starless core:
  - robustly detected in 160—500 μm range & column density map *and*
  - not detected at 70 μm (to exclude protostellar objects) *and*
  - not coincident with known extragalactic object

Starless core locations on 250 μm continuum image

- Field of view = 4^0 x 2^0
- Green circles represent all extracted sources classified as starless cores



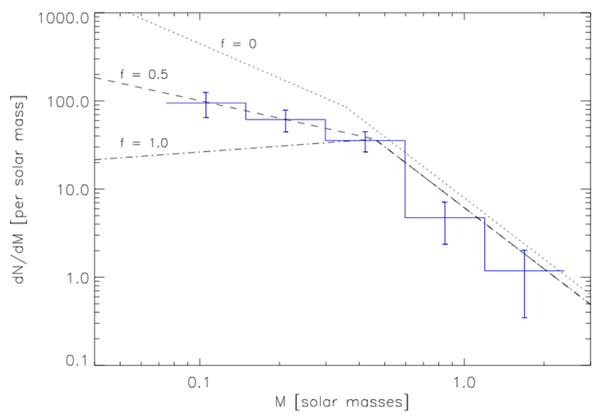
Core Mass Function



Blue: Prestellar core CMF (*dN/dlogM*)

Red: Overall starless core CMF (*solid: corrected for incompleteness; dashed: uncorrected*)

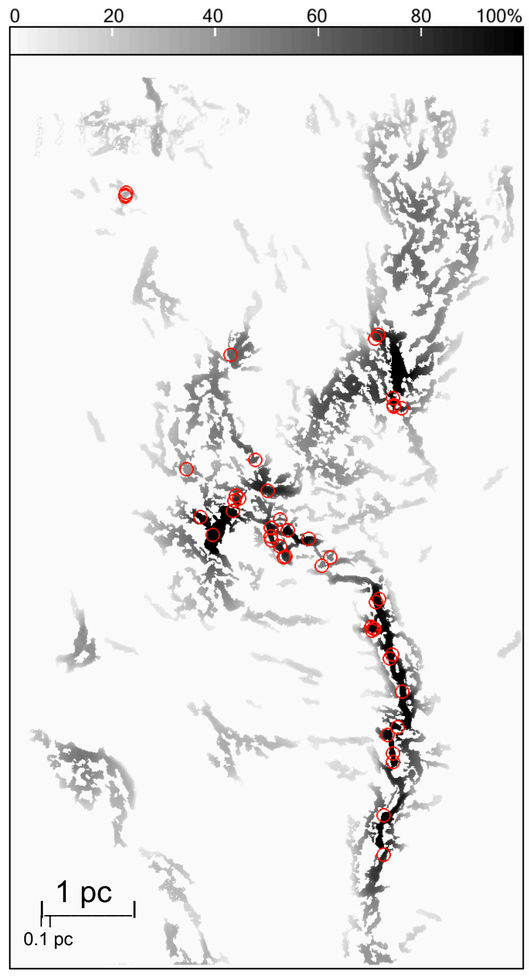
Dotted: Chabrier (2003) stellar system IMF - scaled in mass by 1.15



Blue: Prestellar core CMF *(in the alternate dN/dM representation to facilitate comparison with Kroupa's segmented power law IMFs)*

Dotted, dashed, dash-dot: Kroupa (2012) stellar system IMFs (*f* = assumed binary frac.) - scaled in mass by 0.7

Prestellar core locations on filamentary column density map

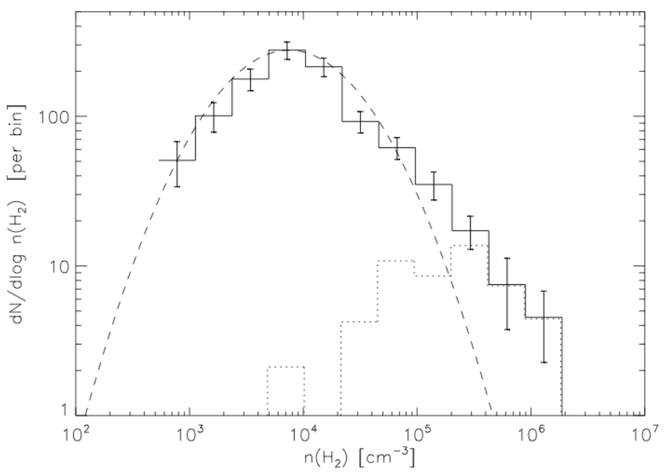


Greyscale represents column density of filamentary structures

- estimated using *getfilaments* (Men'shchikov 2013)
- 100% scale => 15 M_{sun}/pc
- Red circles represent prestellar core locations

Conclusion: All of the detected prestellar cores lie on filaments

Probability Distribution Functions



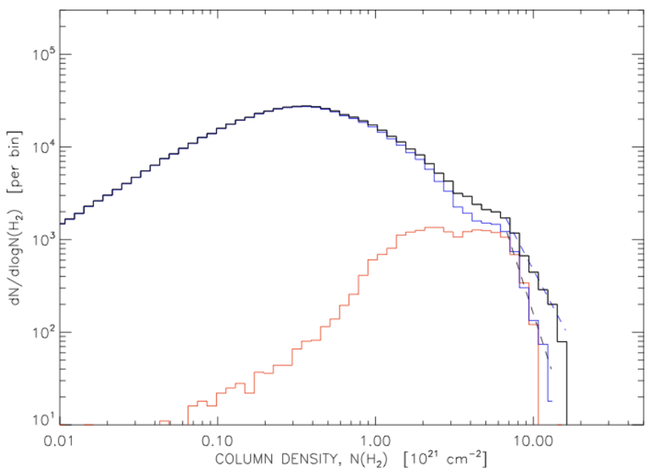
VOLUME DENSITY

Solid: All starless core extractions

Dotted: Prestellar cores only

Dashed: Lognormal, variance of log density, *s* = 1.23

Conclusion: Consistent with simulations of supersonic turbulence + gravity; power-law tail is due to prestellar cores (see e.g. Kritsuk et al. 2011)



COLUMN DENSITY
(background-subtracted)

Black: All pixels

Red: Prestellar cores only

Blue: All pixels except for the immediate vicinity (within 60") of bright protostars

Conclusion: Prestellar cores account for only part of high column density tail; highest column densities are due to protostellar envelopes

References

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