On the Spatial Distribution of Far-IR Sources in the Galactic Plane?

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INTRODUCTION

✓ Spectral coverage reveals early phases of star formation (Elia et al., 2010).
⟹ Compact sources are mostly massive proto- and pre-stellar objects.

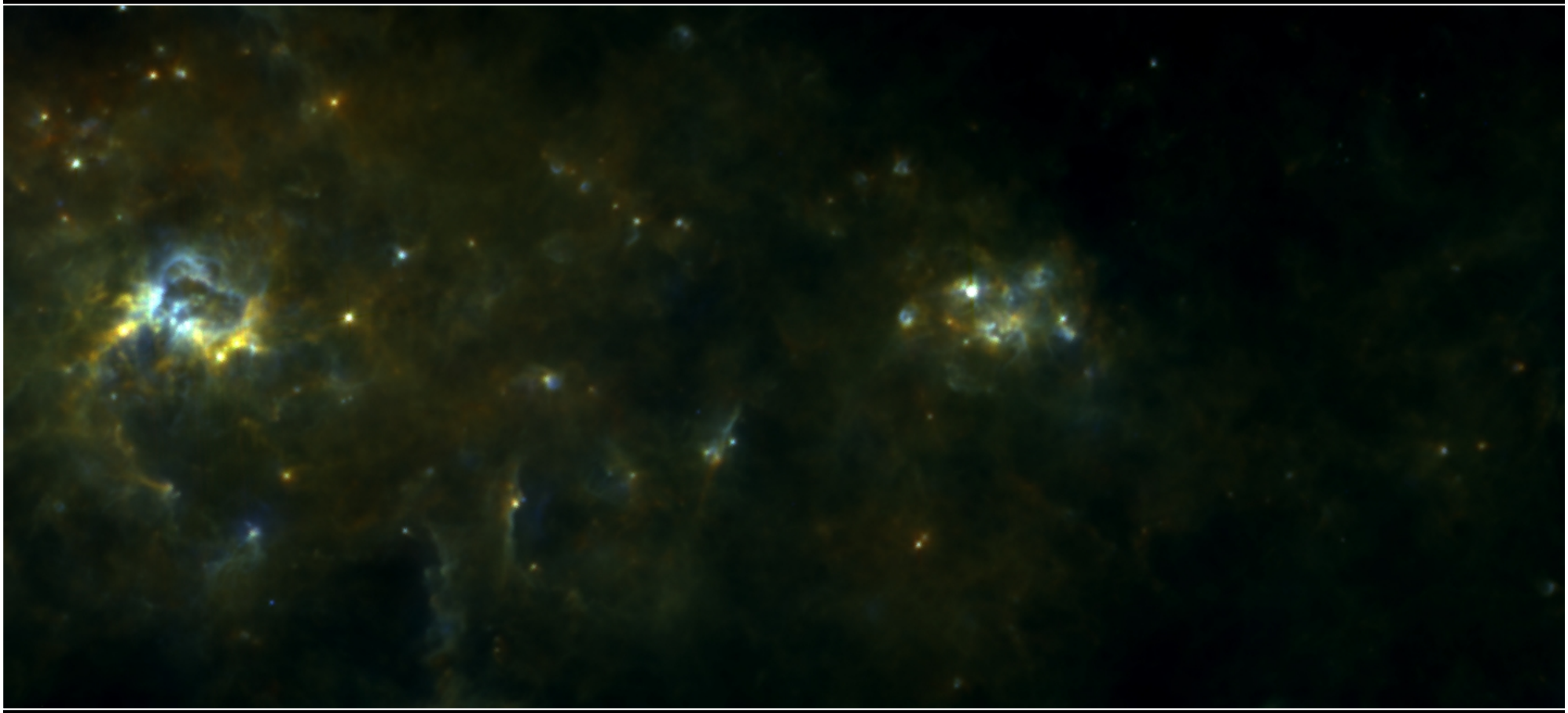
✓ The spatial distribution contains physical information relevant to GMC fragmentation, (triggered) star formation, etc.

✓ Hi-GAL SDP observations of two 2°x2° fields at Galactic longitude 30° and 59° (Molinari et al., 2010).

✓ Our goal is to **characterize the spatial distribution** of Hi-GAL sources by exploiting the Hi-GAL source catalog (Schisano et al.):

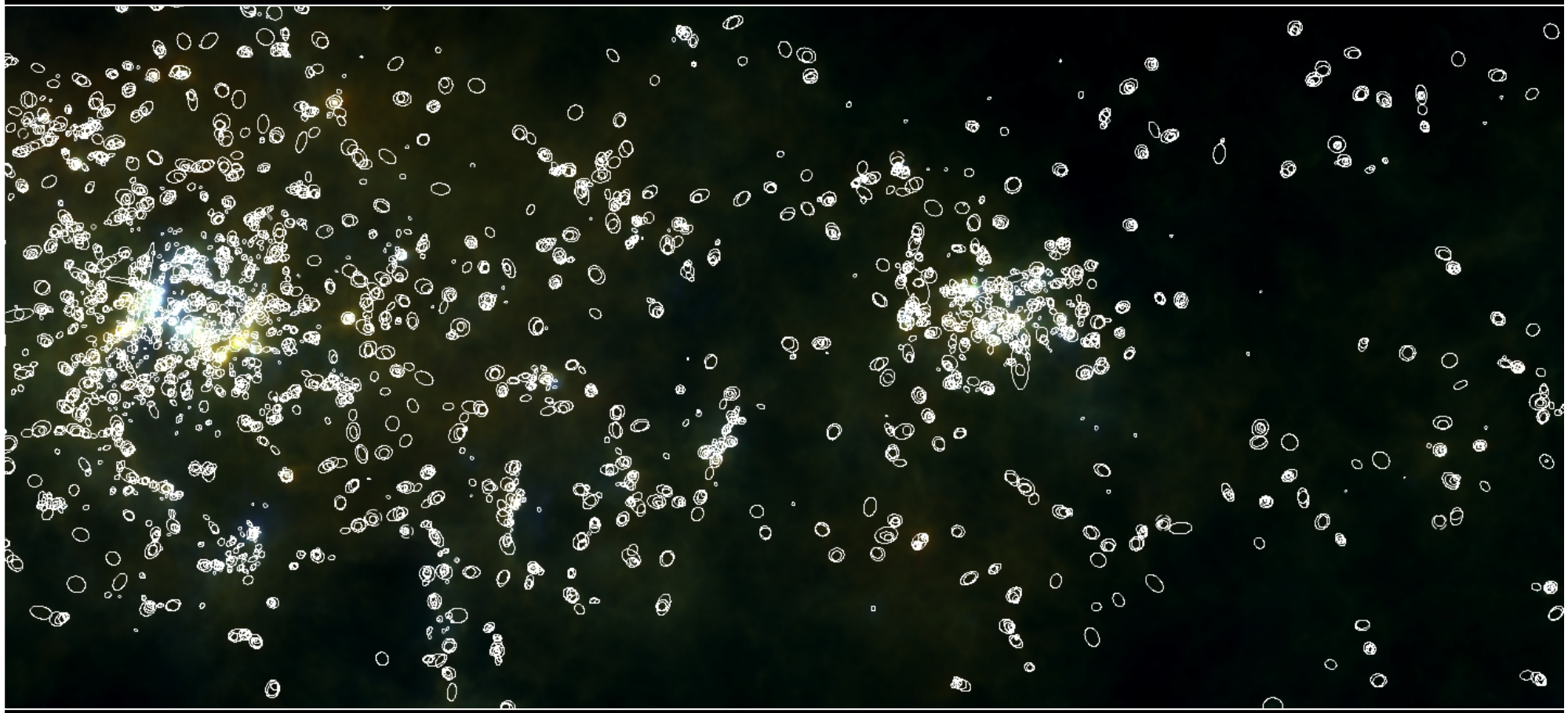
- detection based on 2nd order derivatives at each wavelength
- extraction based on 2D gaussian fitting at each wavelength
- bandmerging

3-color image at 70 160 250 μm



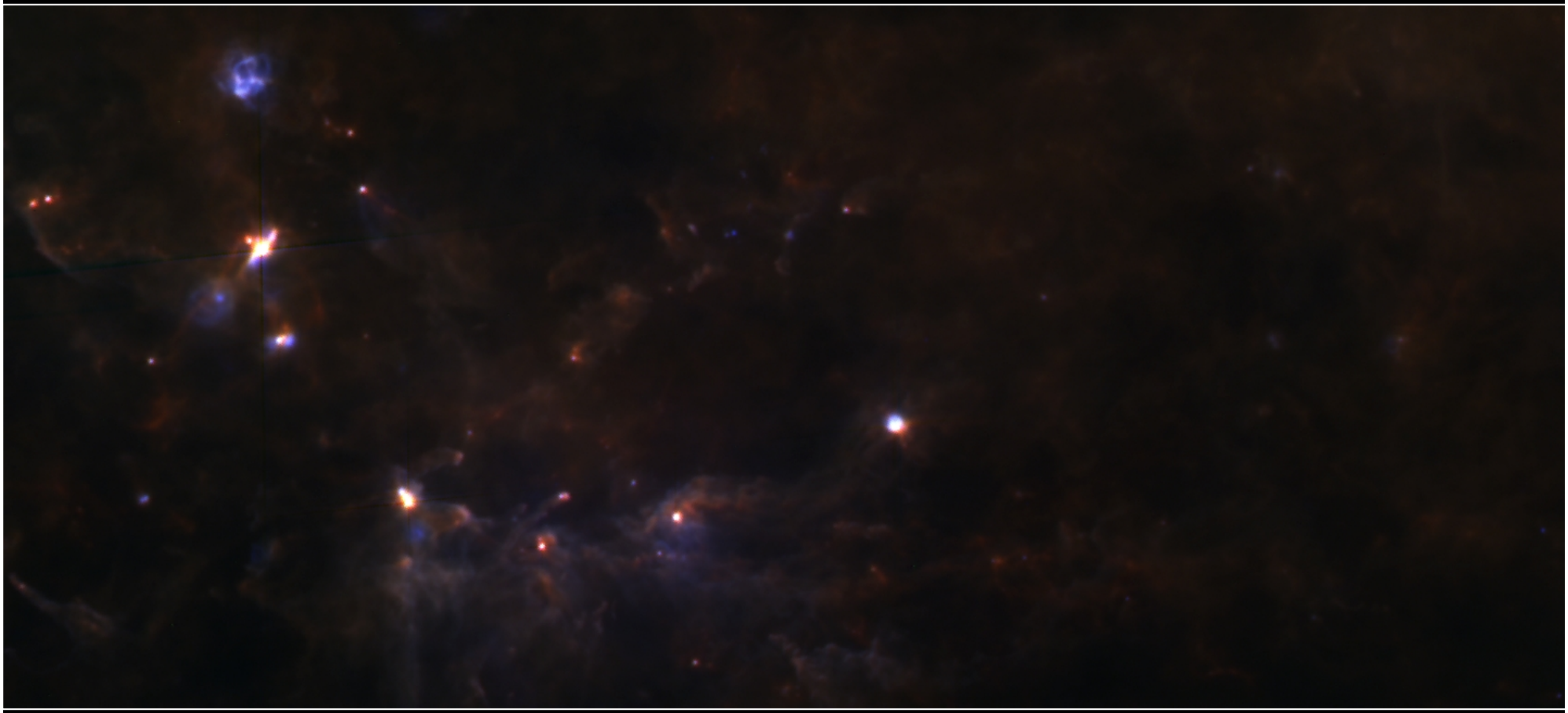
Hi-GAL SDP Observations, l = 30° field

1565 sources at l = 30° field
(1388 with distance estimates)



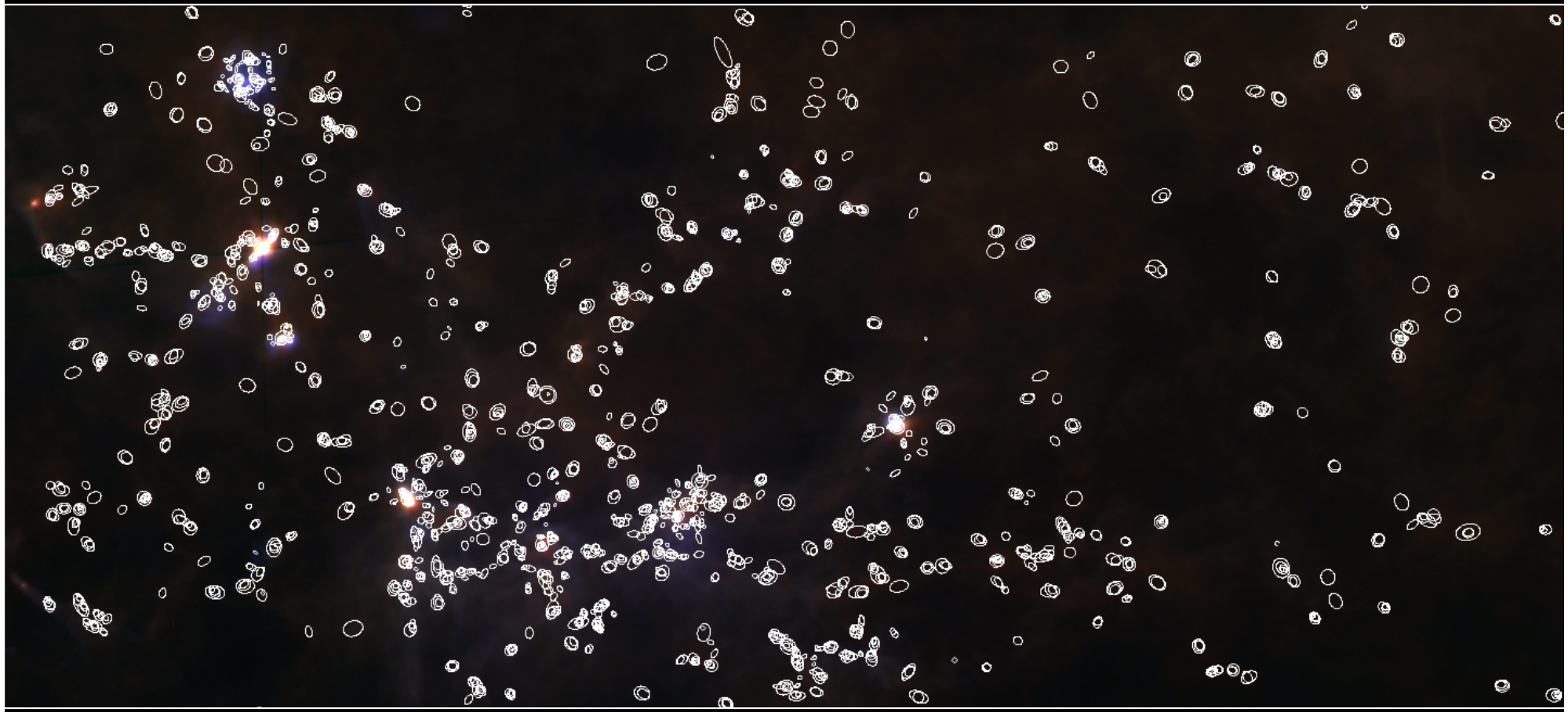
Band [μm]	70	160	250	350	500
# Sources Detected	698	679	758	785	592

3-color image at 70 160 250 μm



Hi-GAL SDP Observations, l = 59° field

1113 sources at l = 59° field
(718 with distance estimates)

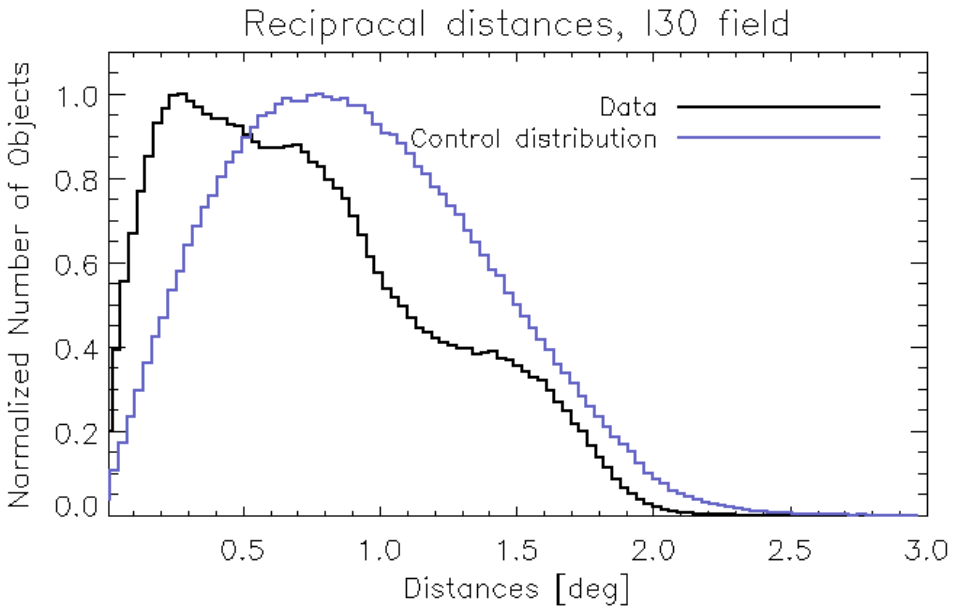


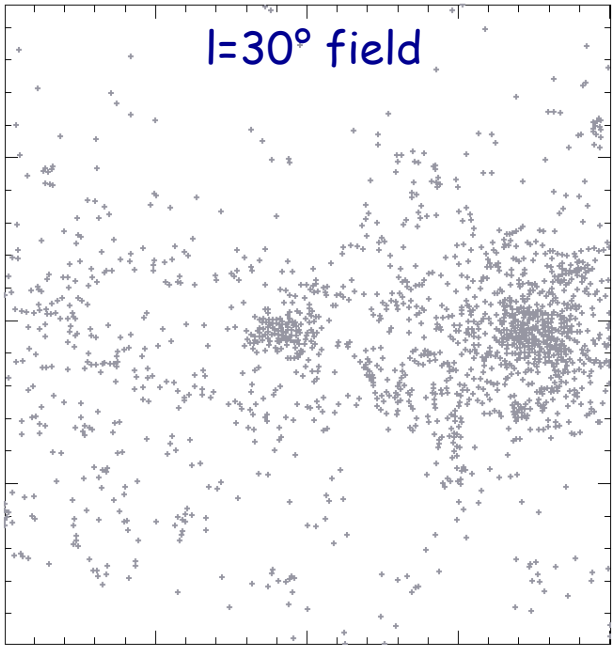
Band	70	160	250	350	500
# Sources Detected	336	389	675	578	515

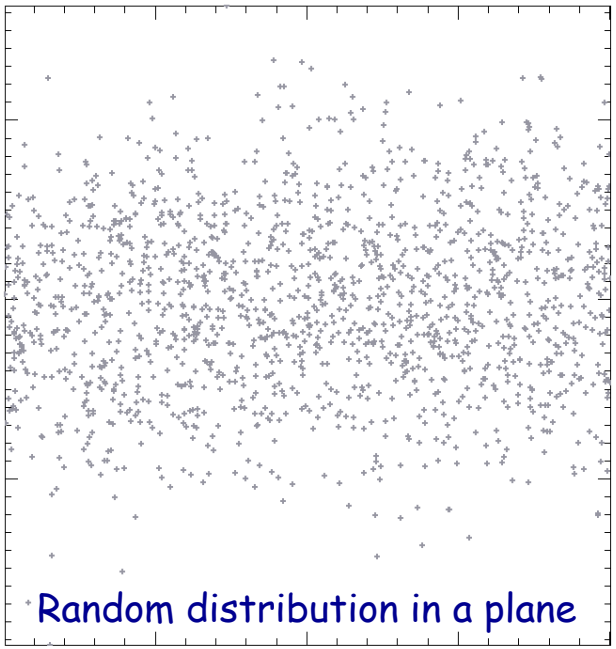
RECIPROCAL DISTANCE MATRIX

The reciprocal distance matrix
contains between-sources distances
(all distance scales).

First evidence for **source clustering** from comparison
of reciprocal distances with a control distribution.







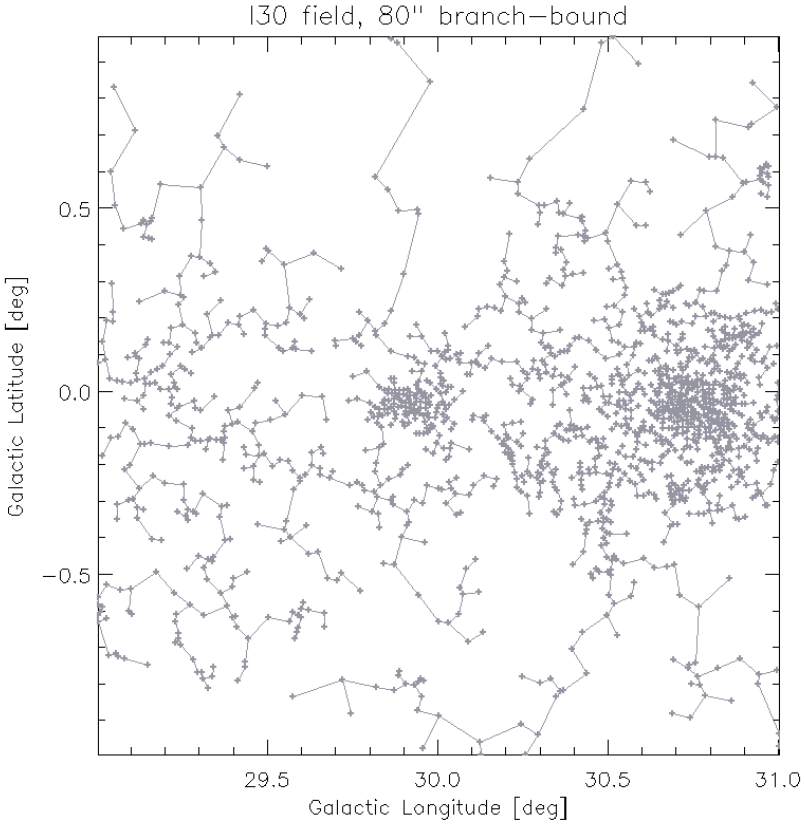
MINIMUM SPANNING TREE (MST)

MST growth consists in:

- connecting all sources by branches
- minimize the total length of the branches
- make no closed loops in the connections

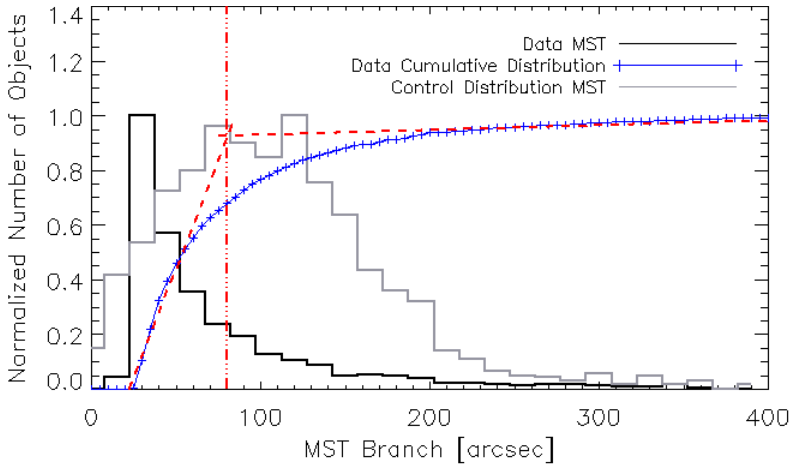
The code is based on Prim's algorithm.

Recent use of MST for cluster properties analysis in Gutermuth et al. (2009).



Definition of the cutoff branch through the branches histogram

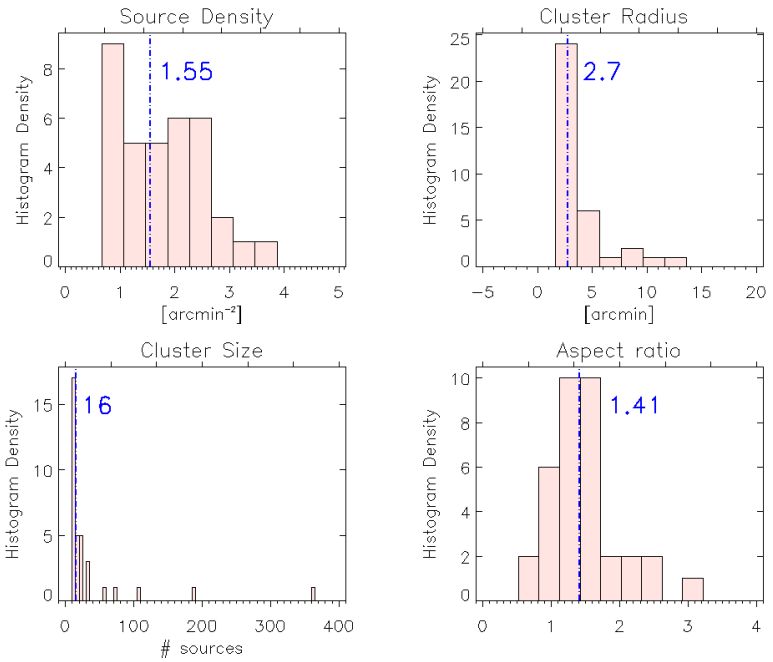
Clusters must have a minimum of 10 sources with $branch < branch_{cutoff}$.



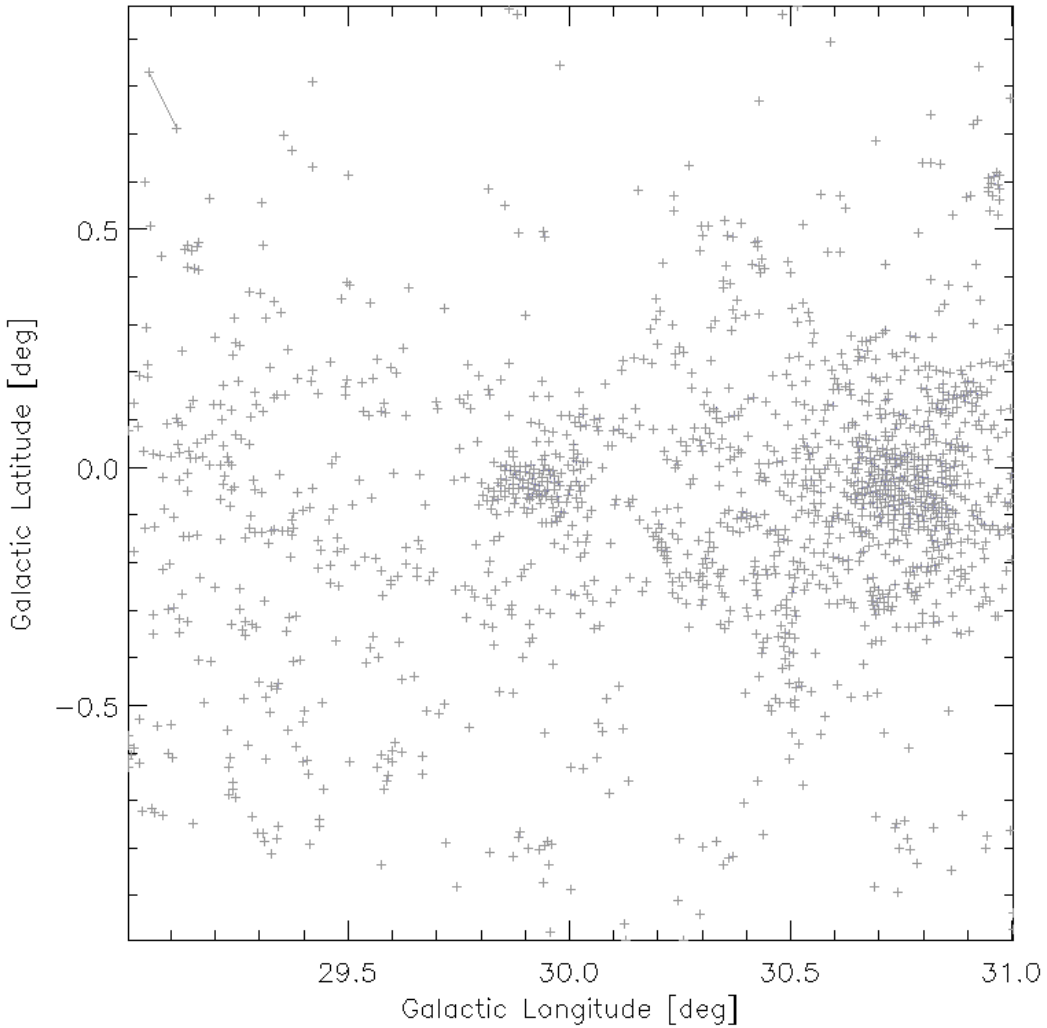
CLUSTERS FROM THE MST

Clusters statistics:

- ~1-4 sources.arcmin^{-2} (~0.1 arcmin^{-2} average)
- ~5 arcmin diameter
- Aspect ratio of about 1.4

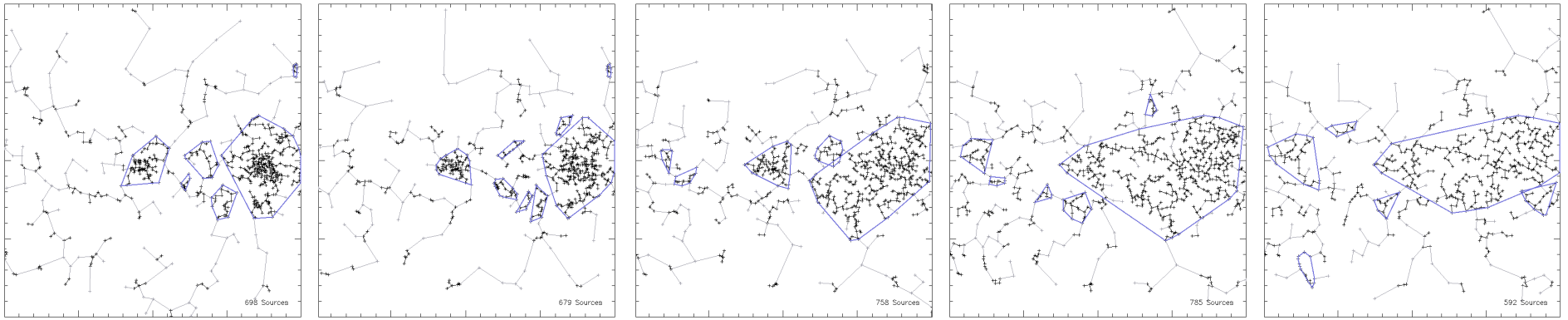


5-Bands MST

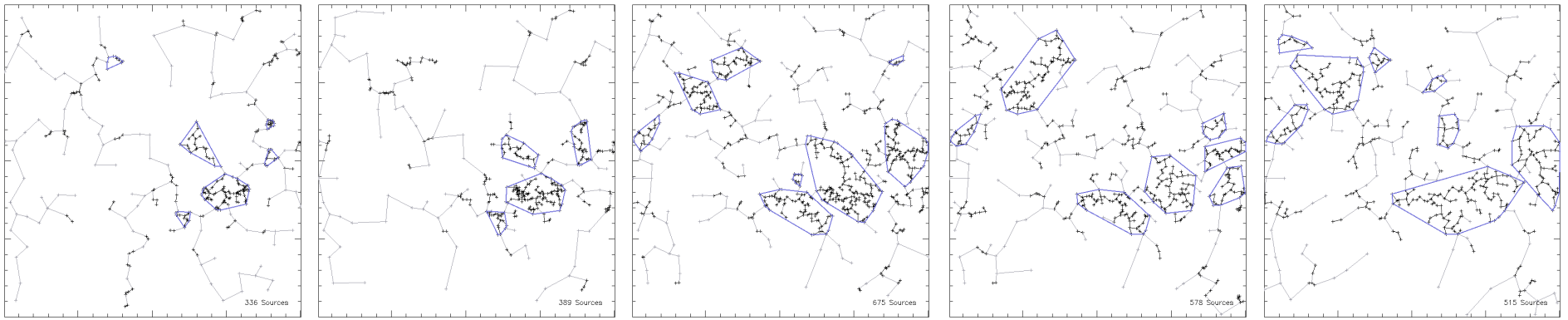


MULTI-WAVELENGTH MST

l=30° field



70 160 250 350 500

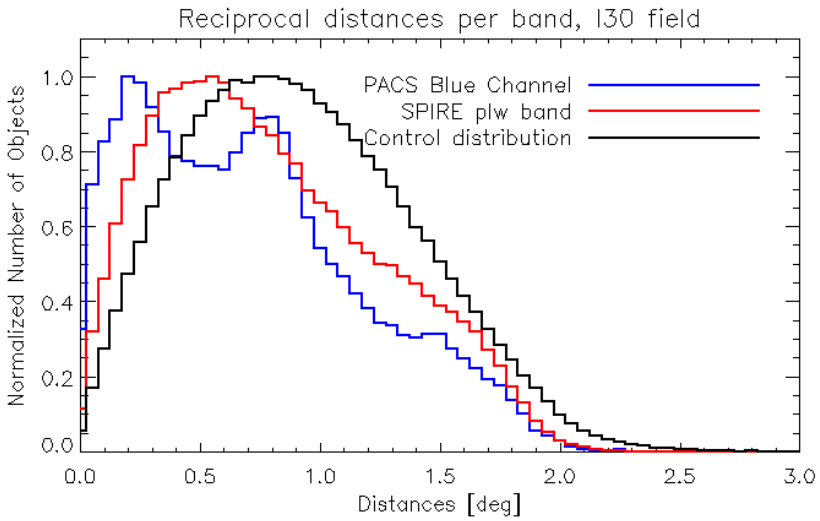


l=59° field

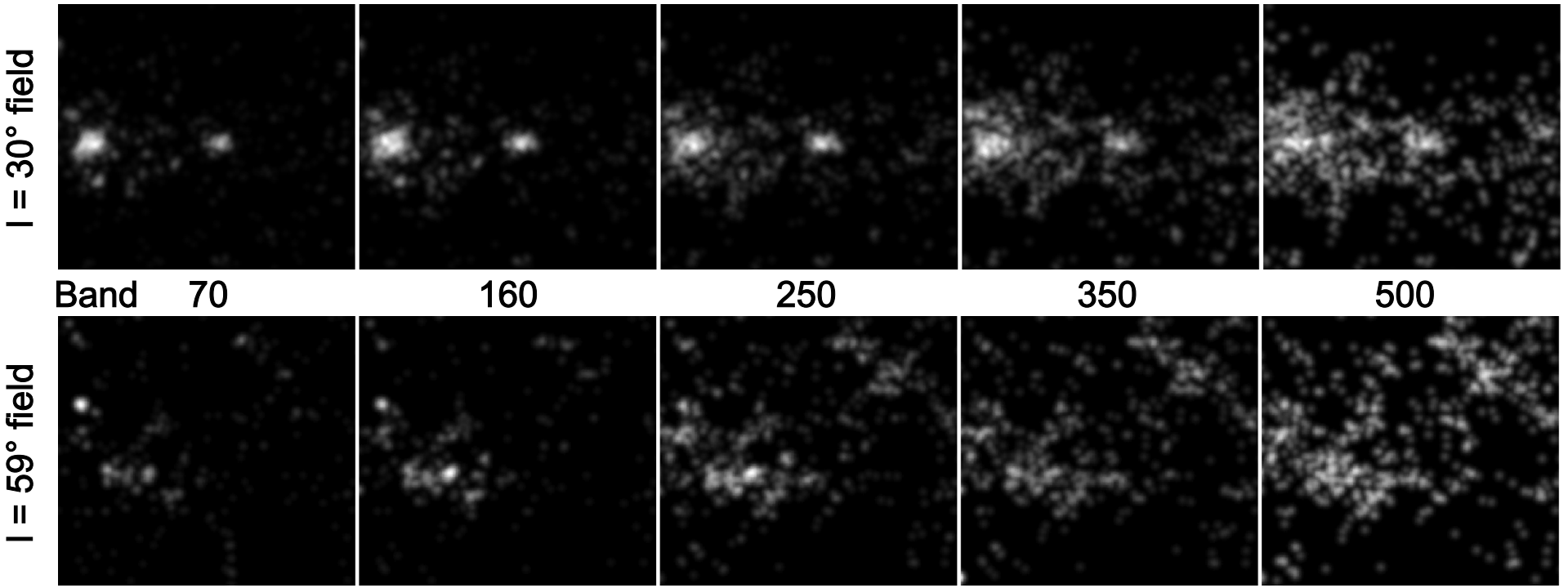
SPECTRAL DIMENSION

Continuous evolution of the source density as a function of wavelength (this is NOT a resolution effect).

Evidence for **different populations of objects** seen over one decade of wavelengths (protostars vs starless cores?).



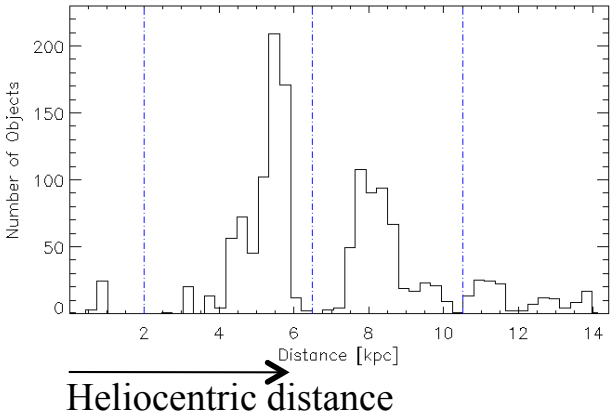
SOURCE DENSITY MAPS

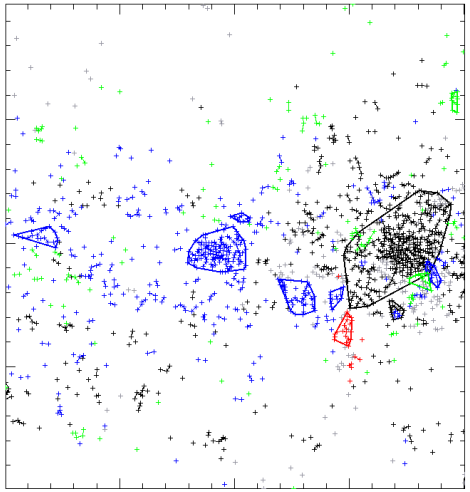


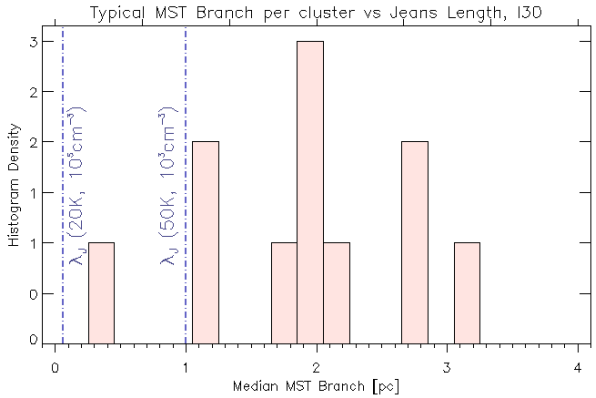
INCLUDING DISTANCE INFORMATION

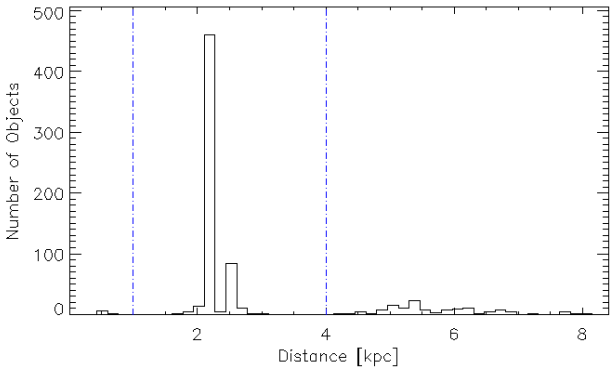
Large observation program from HiGAL consortium to measure distances to HiGAL sources (Russeil et al., poster P2.03). >90% sources have estimated distances.

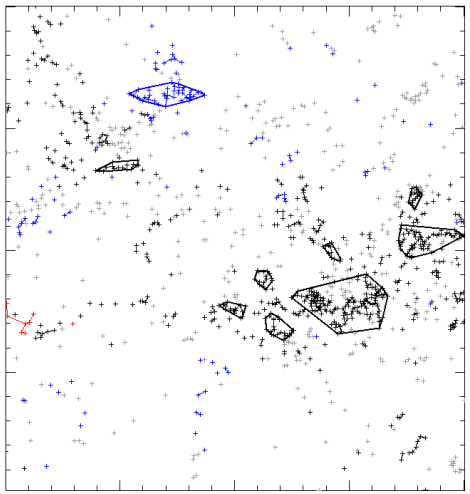
MST analysis per heliocentric distance slabs

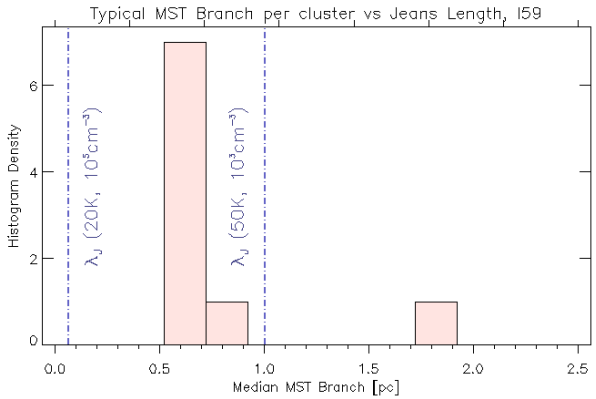












WORK IN PROGRESS

- Compute local Jeans Lengths from temperature maps, and density tracers (CO maps AND extinction for robustness check)

- Filter by source types and look for correlations with mass, evolutionnary stage, filaments, environment…

- Probe the physics of the clusters (Mass function of clusters)

- Questions:

  Why is there a wavelength dependence in the spatial distribution?
  Are protostar overdensities found around HII regions only?
  Is the distribution of starless cores homogeneous in molecular clouds?