Hi-GAL: Mass and Luminosity Functions of the Cores

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1.1 The Hi-GAL Survey

Hi-GAL is a survey of the galactic plane in the range |l|<60 and |b|<1, making use of PACS and SPIRE in parallel mode. Images of the continuum emission at 70, 170, 250, 350, and 500 μm have been obtained, with angular resolution from 5" to 36".

1.2 Goals of this work

Our main goal, within the Hi-GAL collaboration, is to determine the distribution of mass and luminosity of the *pre-* and *proto*-stellar cores in the two SDP fields, and their lifetimes. To this purpose, we want to analyze how different assumptions and parameterization of the source-finding and SED extraction pipeline may affect the derived parameters. Here, we present some preliminary results, specifically for the SDP field at l=59º.

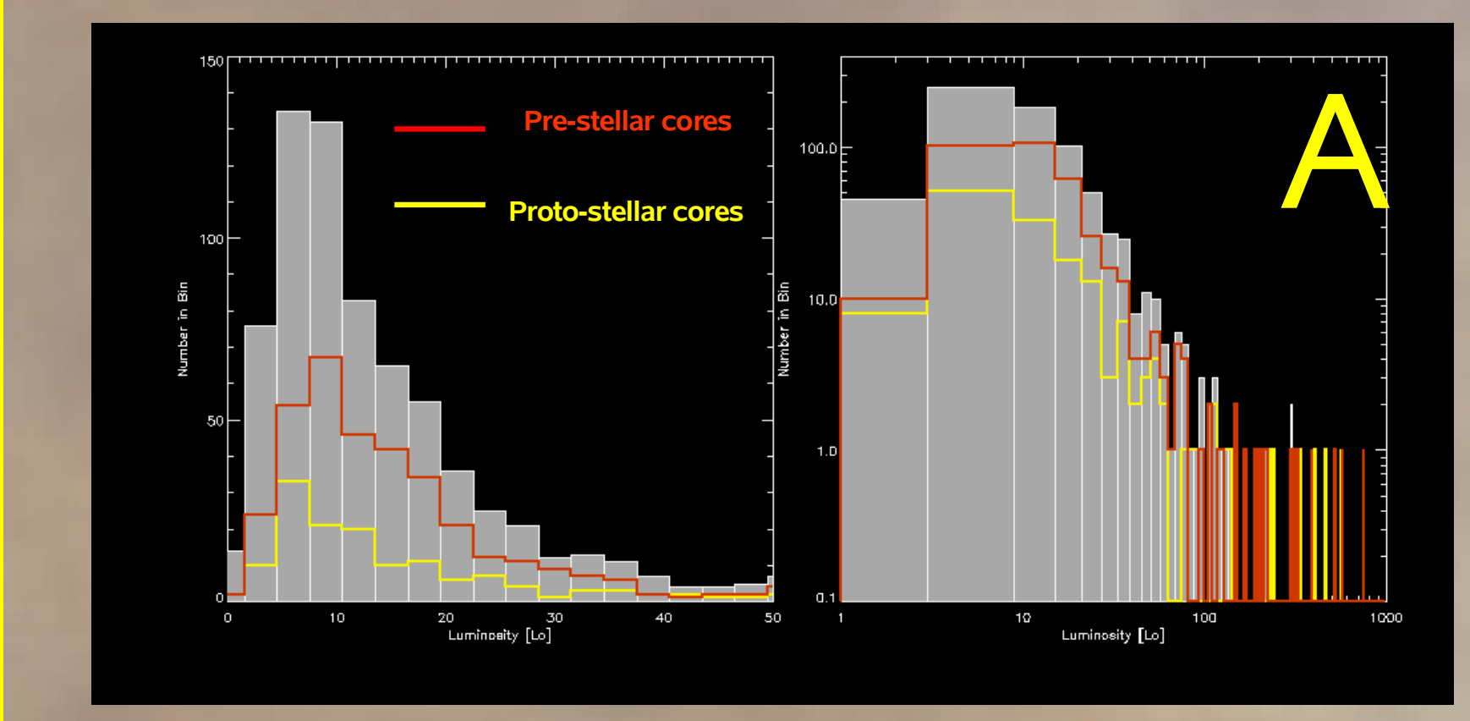
2. Source-Finding and Flux-Extraction Algorithm

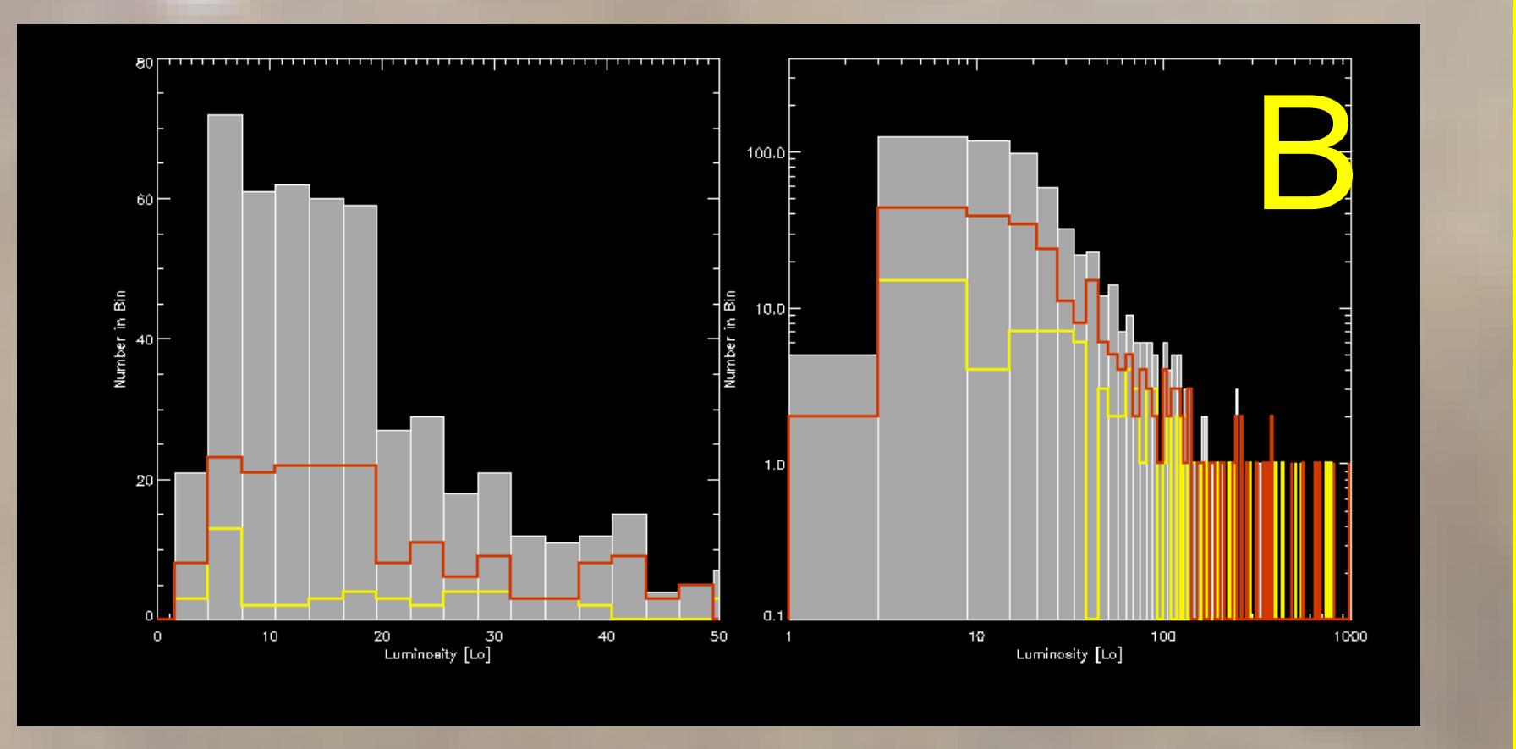
The source extraction and source property fitting techniques are similar to those used during analysis of the BLAST05 and BLAST06 maps (Chapin et al. 2008, Netterfield et al. 2009, Olmi et al. 2009).

A beam-equivalent-sized Mexican-hat wavelet type convolution is applied to the 170 and 250 μm maps, which identifies objects in the confused images by subtracting a local background. Peaks above a threshold in both maps form the candidate source list. The 170 and 250 μm candidate lists, containing all locations, sizes, and approximate flux densities of the sources, are merged and used to determine fluxes at all other wavelengths.
This algorithm is applied in parallel with the method described by Elia et al. (2010).

The physical parameters are finally derived from a single-temperature, greybody fit to the cores SED.

3. Distribution of Luminosity



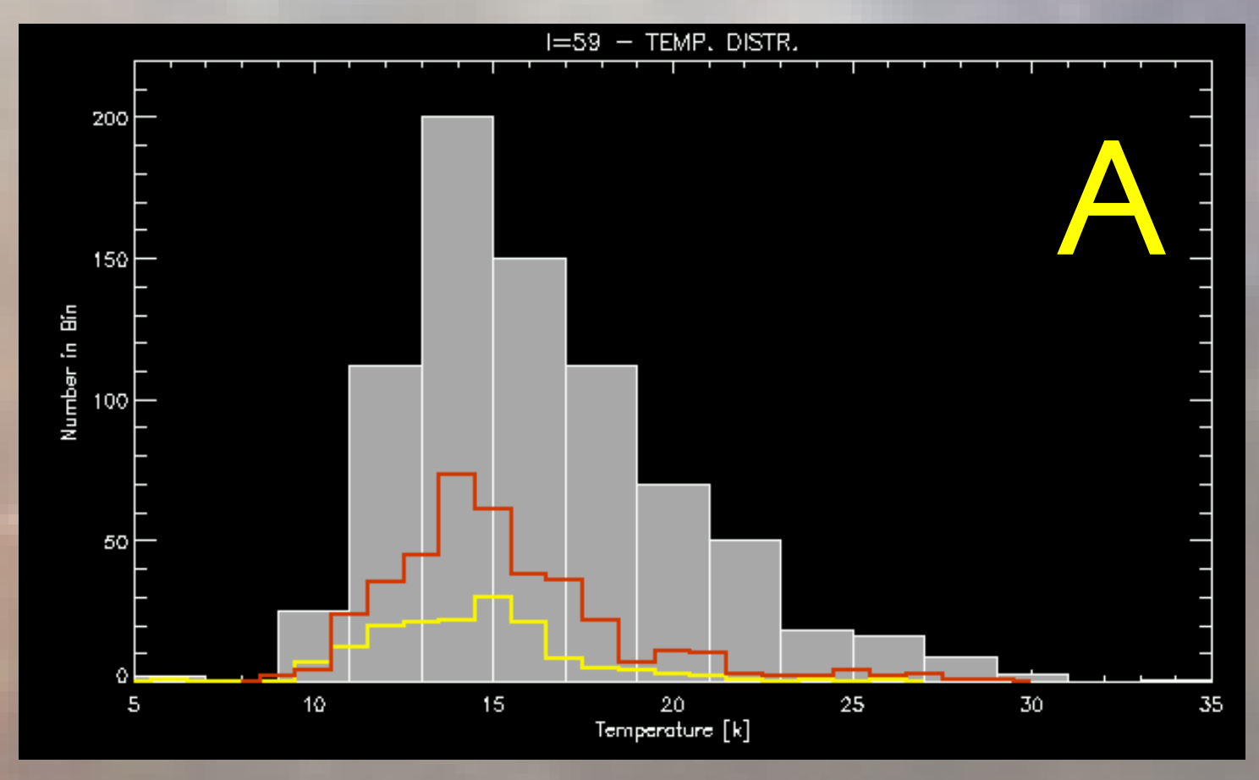


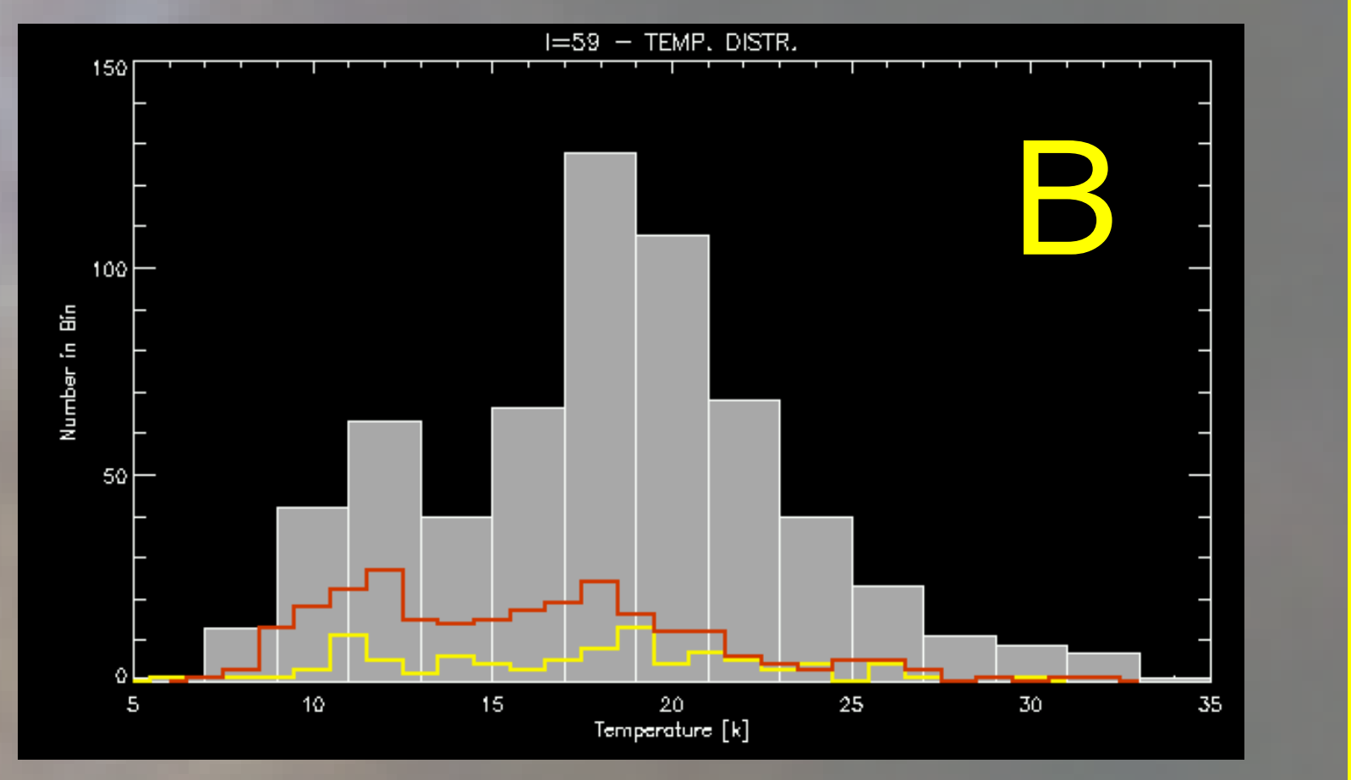
Two examples are shown here, from the l=59º field.

- **Run A** (left panel) : the dust spectral index, β, and the distance (as determined by Chapin et al. 2008) are fixed, whereas the 170 and 70 μm fluxes are used as upper limits.

- **Run B** (right panel): β is variable; the distance is determined for each core as described by Russel et al. (submitted); the 170 and 70 micron fluxes are used as detections.

4. Distribution of Temperature

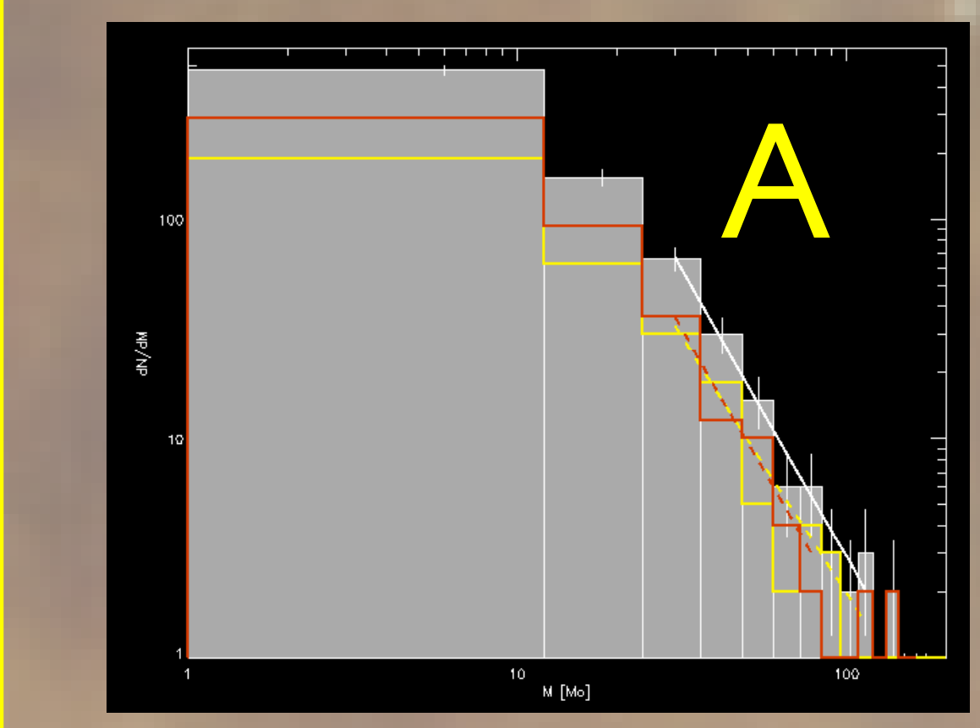




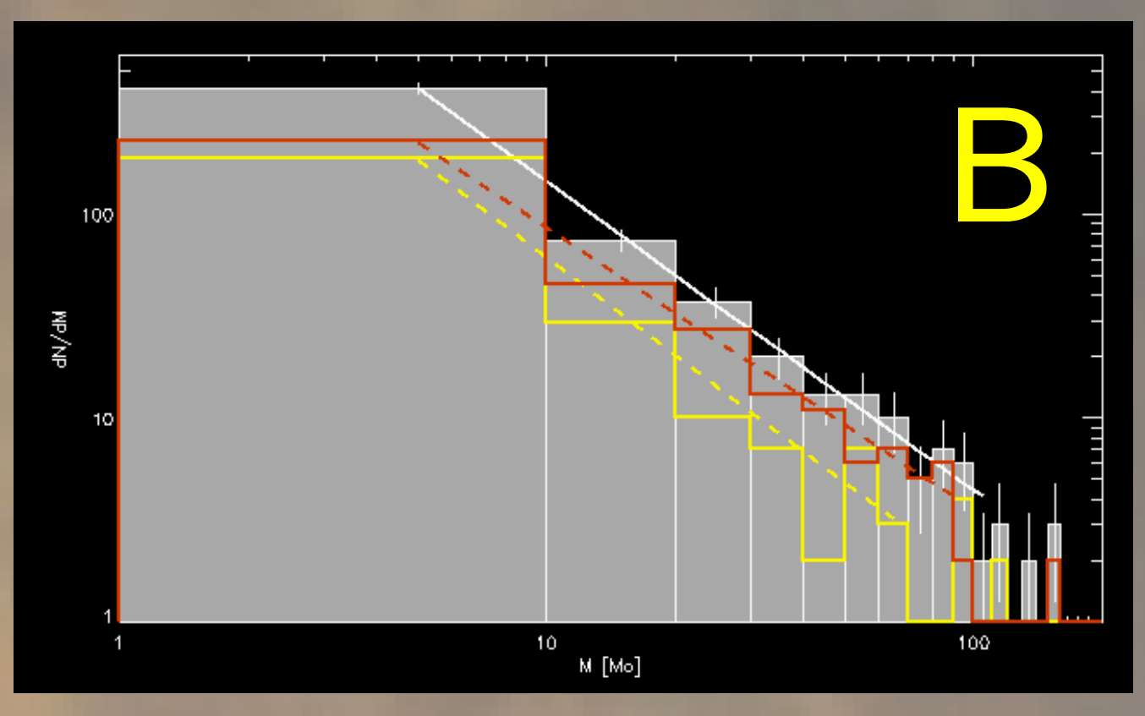
The distribution of temperature is clearly single-peaked in run A. However, run B shows an overall shift of the distribution toward higher temperatures and, possibly, two temperature peaks.

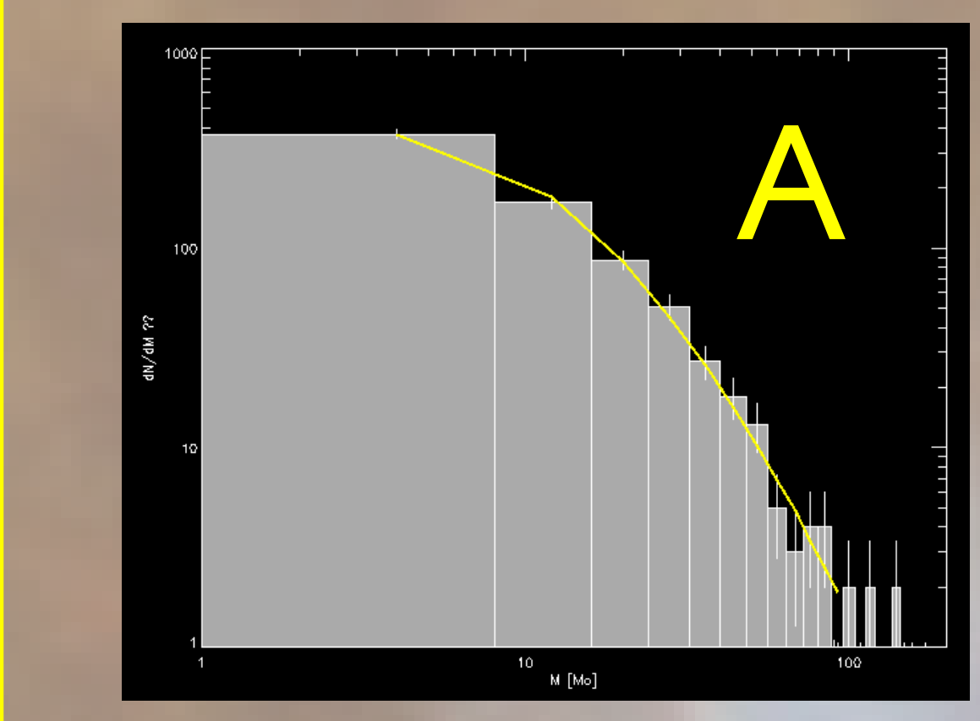
The overall shift is a consequence of the constraint on the SED determined by the 170 and especially the 70 μm fluxes. It confirms the importance of accurate photometry at the shortest wavelengths. As for the two peaks, we are currently investigating whether this is a real effect or an artefact.

5. Core Mass Functions

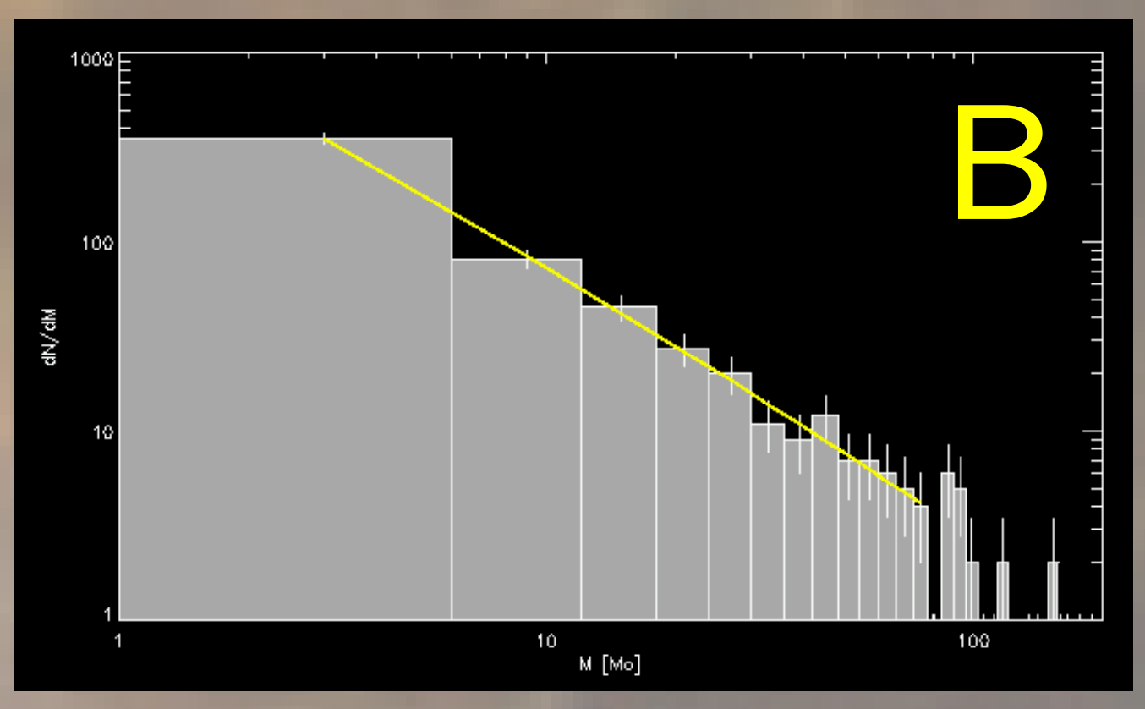


Linear fits





Log-normal fits



The CMF shows additional different features. Run A cannot be fit by a single power law of type $dN/dM \sim M^{\alpha}$, and is steeper ($\alpha \approx -2.5$) than run B (top row). The latter can be fit by a single power law ($\alpha \approx -1.4$), shallower than Salpeter's IMF. These differences can also be noted in the log-normal fits (bottom row).

6. Core Lifetimes and Conclusions

We have used two methods to estimate the cores lifetime:

(1) Following Netterfield et al. (2009), we estimated the SFR per mass interval, per year in the l=59º region as $F = dN_*/(dM_* dt) = 3\times10^{-4}\ M_*^{-2.3}\ (M_o^{-1} yr^{-1})$, then the characteristic time for cores to form stars is:

$$t_{core} = (dN_*/dM_*)/F = 5.8\times10^{7}\ (M_{core}/\ 20\ M_o)^{-0.3}\ \ yr \qquad \text{(run A)}$$

(2) In this method, more massive cores are more likely to produce multiple stars (Goodwin et al. 2008). The conversion $M_{core} \rightarrow M_*$ is taken from Adams & Fatuzzo (1996), yielding for intermediate and high-mass stars:

$$t_{core} = 3.5\times10^{9}\ M_{core}^{-2.2} / (1 + 1M_o / M_{core})\ \ yr \qquad \text{(run A)}$$

Using the 1st method, if the CMF is steeper than Salpeter's IMF (as in run A), then high-mass cores are found to evolve more quickly than low-mass cores (the opposite happens for run B). However, with the 2nd simple model, high-mass cores evolve more quickly also in run B.