Modelling mass functions of clumps formed during the early MC evolution

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Basic assumptions of our statistical approach

1) Turbulent cascade in isothermal medium in the scale range $0.5 \lesssim L \lesssim 20$ pc, conditioning scaling laws of velocity and density according to Larson (1981).
2) Lognormal probability density distribution (PDF) at each scale L
3) Mass-density power-law relationship:

$$\ln\left(\frac{\rho}{\langle\rho\rangle}\right) = x \ln\left(\frac{m}{m_0}\right), \quad x < 0, \quad x = x(L)$$

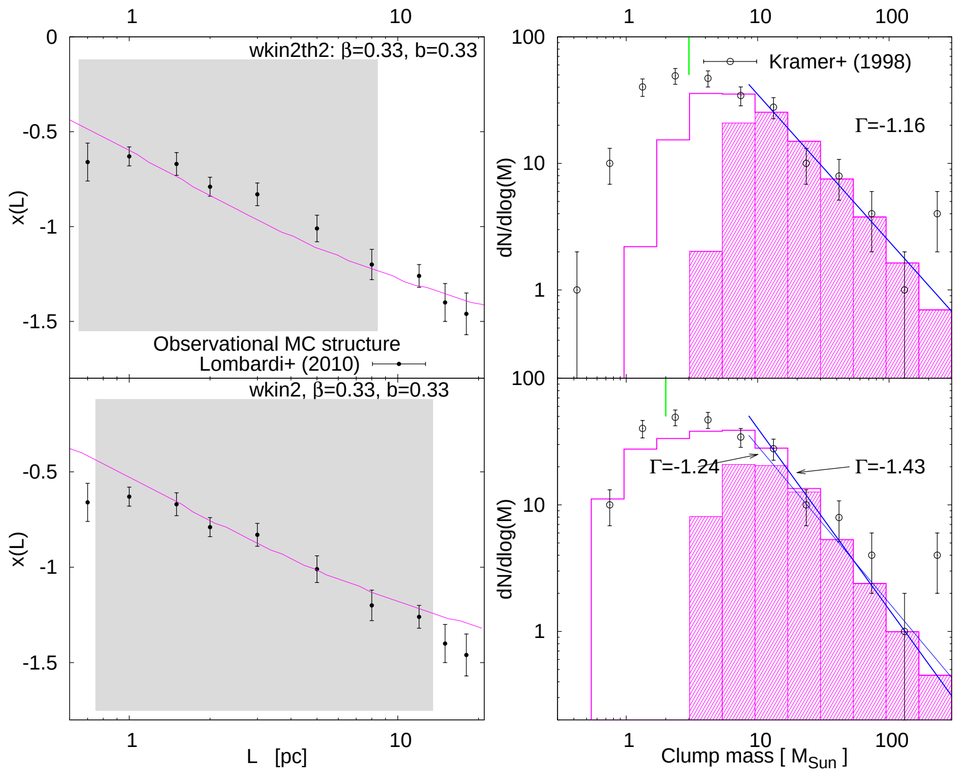
4) Self-similar density scaling as expected for turbulent structures
5) Equipartition of energies:
   $|W| \sim f_{\rm gk} E_{\rm kin}$, $1 \lesssim f_{\rm gk} \lesssim 4$, (`wkin{1-4}`)
   $|W| \sim 2E_{\rm kin} + 2E_{\rm th}$, (`wkin2th2`)
   $|W| \sim 2E_{\rm kin} + E_{\rm mag}$, (`wkin2mag`)

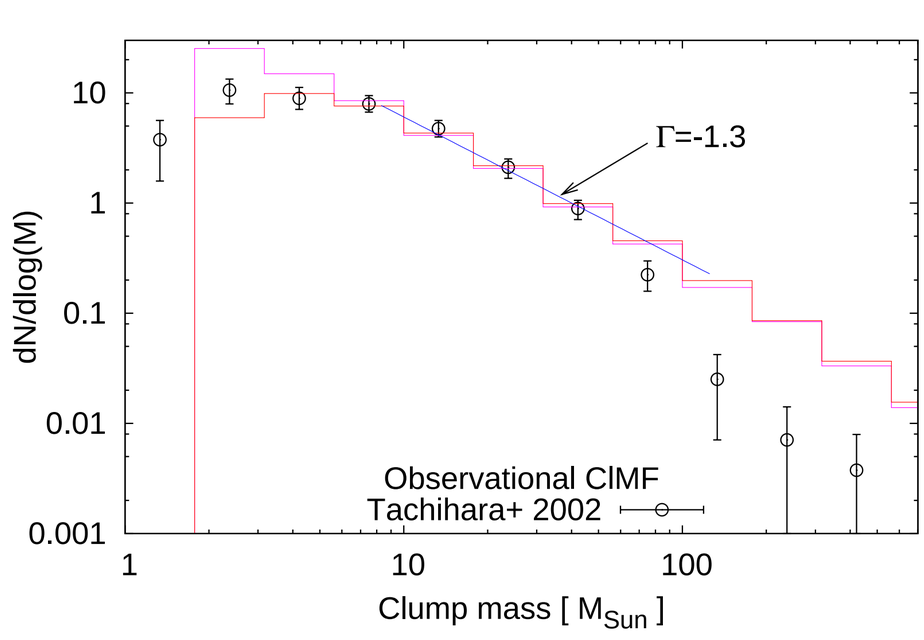
ALTERNATIVE MODELS WITHIN THE CHOSEN APPROACH

They are built according to the type of object for which the assumptions of mass-density relationship (3) and equipartition of energies (5) hold:

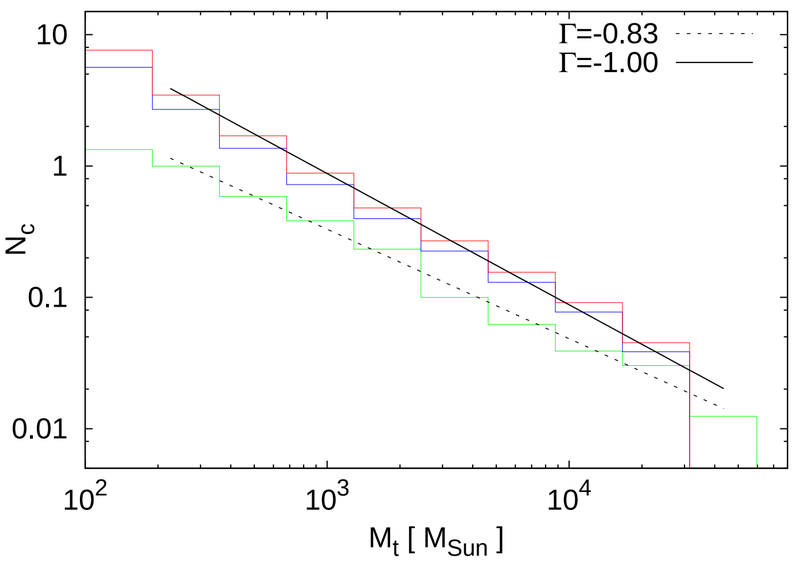
- Statistical ensemble of clumps ('ensemble model'): Populations (ensembles) of clumps generated at abstract spatial scale L obey a mass-density relationship with power-law index $x(L)$, derived from equipartition relation for their representative members ('typical clumps').
- Cloudlet, defined by a density cut-off ('cloudlet model'): A chosen energy equipartition (assumption 5) determines a density threshold in respect to the mean local density $\langle\rho\rangle_L$. Then the relationship (3) with a power-law index $x(L)$ describes the intrinsic mass-density scaling of structures built into the delineated cloudlet.

Clump mass function from the 'ensemble model'





Clump mass function from the 'cloudlet model'



Discussion

- The modelled high-mass ClMFs exhibit power-law slopes $\Gamma \sim -1$, as expected for fractal clouds (Elmegreen 1997). When only gravitationally unstable clumps are considered, the slope of their time-weighted high-mass mass function is similar to that of the stellar IMF: $\Gamma \sim -1.3$.
- The cloudlet mass function exhibit power-law slopes $-0.8 \lesssim \Gamma \lesssim -1$, typical for CO clumps.
- Further insights into physics of the dendrogram objects would allow for derivation of the ClMF within the 'cloudlet model'.