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
   \( 0.5 \leq L \leq 20 \) 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:
   \( \ln \left( \frac{\rho}{\rho_0} \right) = x \ln \left( \frac{M}{M_0} \right) \), \( x < 0 \), \( x = x(L) \)
4) Self-similar density scaling as expected for turbulent structures
5) Equipartition of energies:
   \( |W| \sim f_{\text{th}} E_{\text{kin}} \), \( 1 \leq f_{\text{th}} \leq 4 \), (wkin\{1-4\})
   \( |W| \sim 2E_{\text{kin}} + 2E_{\text{th}} \) (wkin2th2)
   \( |W| \sim 2E_{\text{kin}} + E_{\text{mag}} \) (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 \( \langle \rho \rangle \). 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 CIMFs 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 \(-0.8 \leq \Gamma \leq -1 \), typical for CO clumps.
- Further insights into physics of the dendrogram objects would allow for derivation of the CIMF within the ‘cloudlet model’.