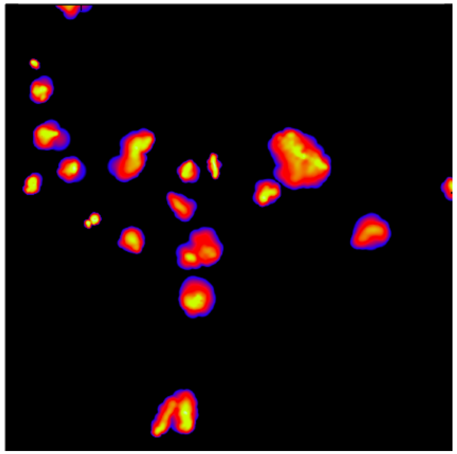

Tracing Cores to Stars

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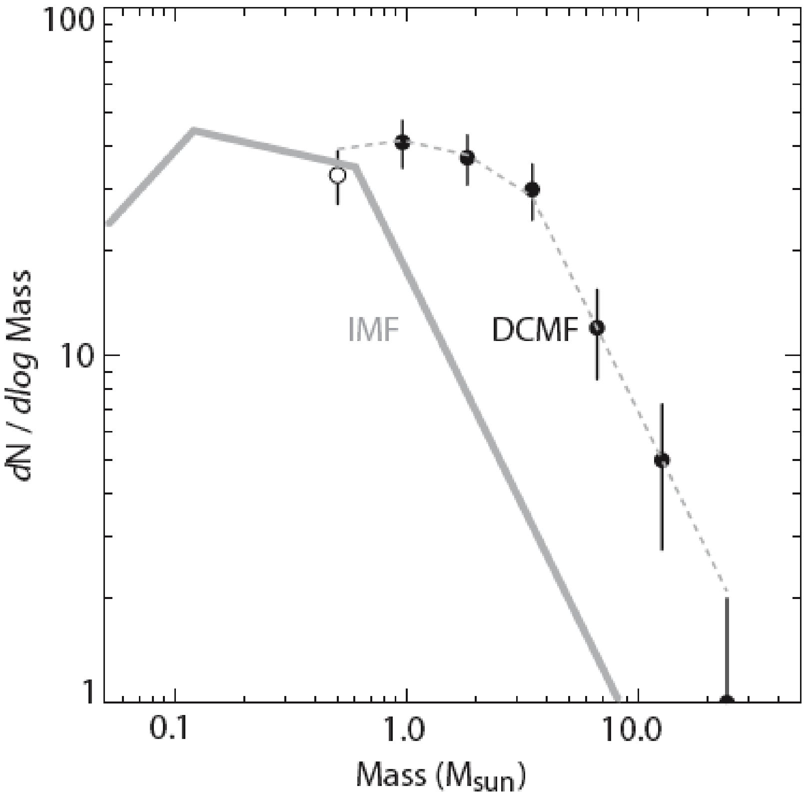
Ian Bonnell, Paul Clark

University of St-Andrews

The CMF and the IMF



Alves et al 2007

- CMF resembles IMF
- Some have proposed a 1-1 correspondence

eg.

- Alves et al 2007: efficiency 1/3

- Simpson et al 2008: efficiency 1/5 (2/5 with multiplicity)

Connecting the CMF & IMF

- Turbulence and fragmentation generates structure of Molecular Clouds

  -Vazquez-Semadeni et al 1995, Ballesteros-Paredes et al 1999, Klessen 2001

- Clump mass results from from this structure

  -Padoan & Nordlund 2002, Hennebelle & Chabrier 2008

- Models connect core masses to stellar masses

  - Myers 2008, Goodwin et al 2008

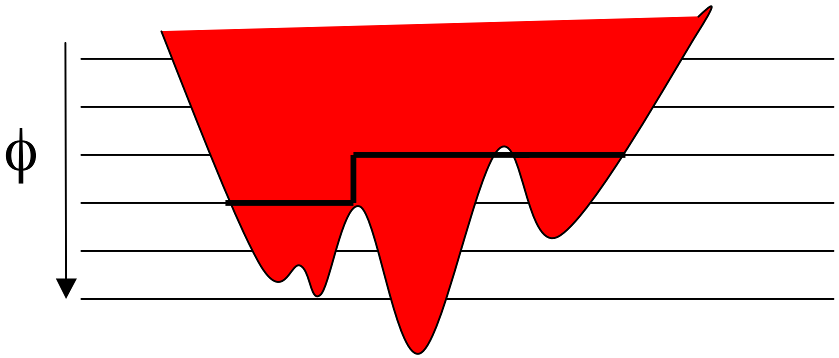
- But clump evolutionary scheme has a small effect on resulting IMF.

  - Swift & Williams 2008

- Accretion during evolution could be a function of environment

  -Bonnell & Bate 2006

Using Potential

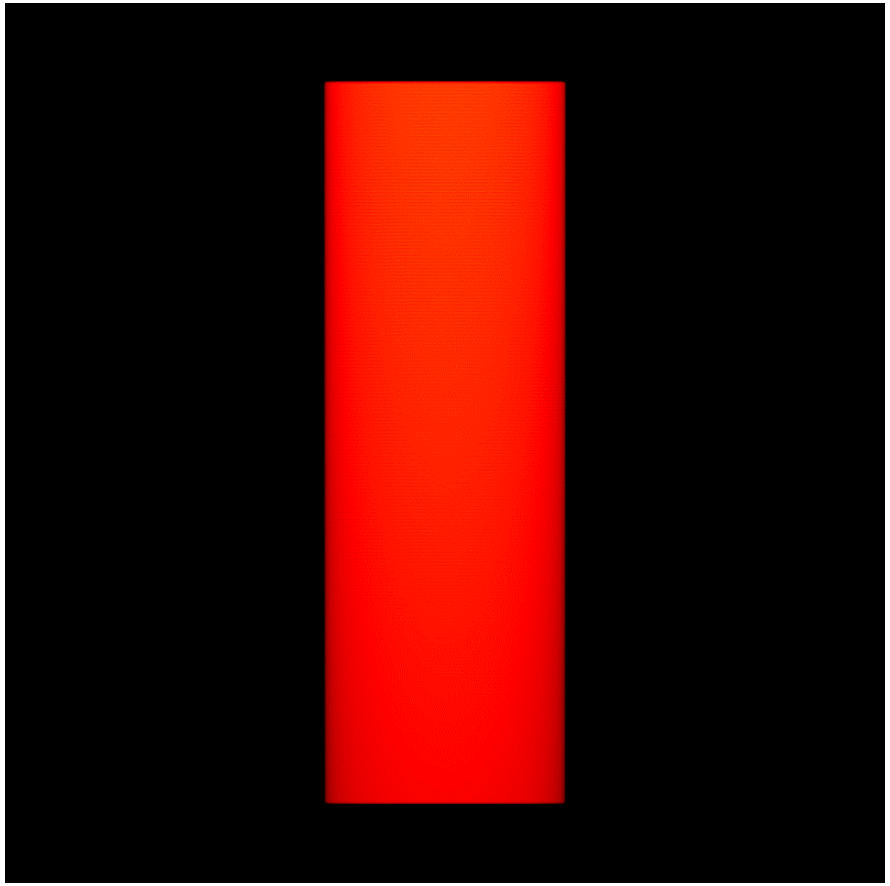


- The same technique as a conventional clumpfind in density or emission, but using potential.

- Potential distribution is smoother than the density.

- Potential determines how the mass flows and at what point a clump will collapse.

The Simulation

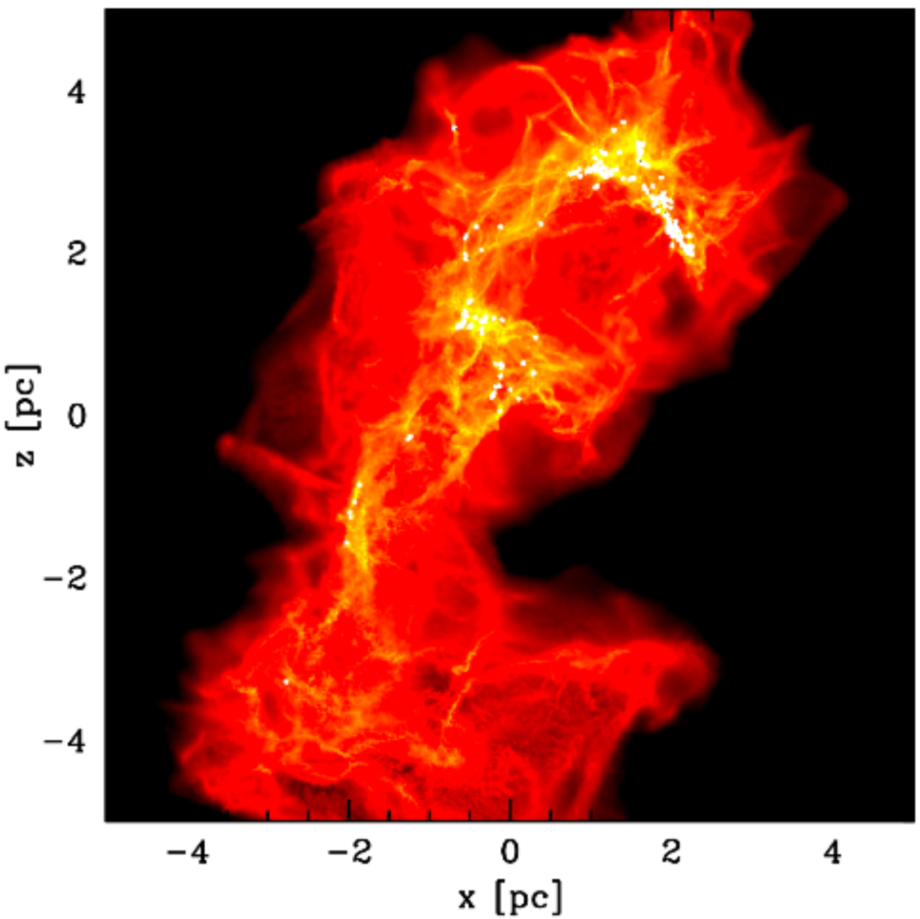


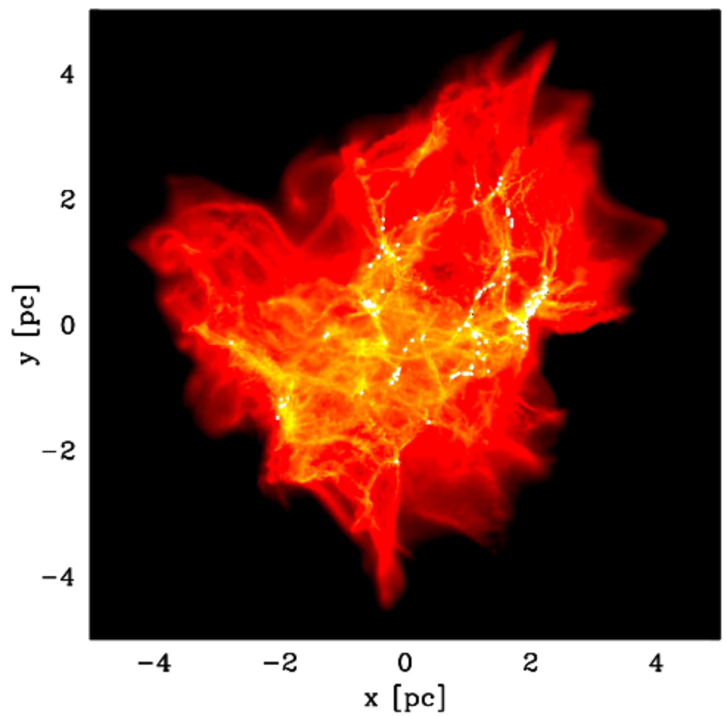
Roughly based on Orion A

- 10 000 M_{sol}
- Smooth Particle Hydrodynamics
- 5 million particles
- Barytropic equation of state

  -Larson 2005
- Sink particles for Star formation
- Shocks
- Self gravity
- Decaying turbulence
- No feedback or magnetic fields

The Simulation

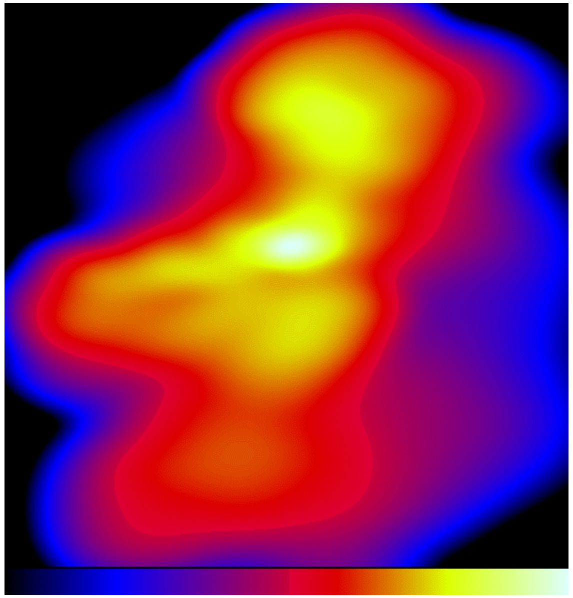




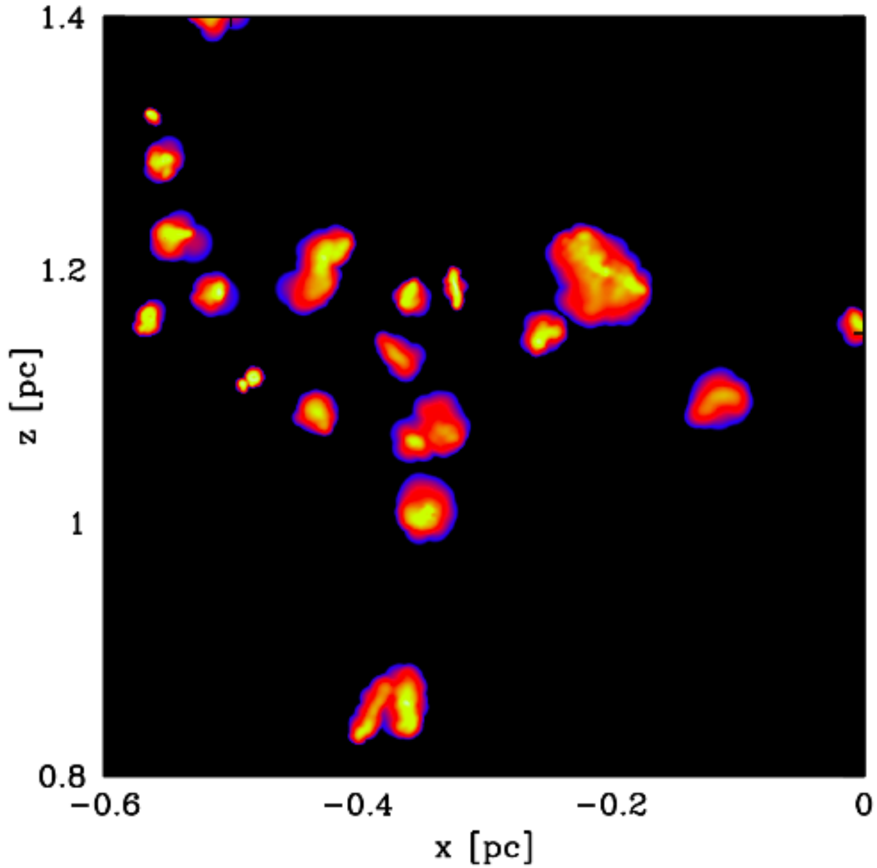
white = 10 gcm^{-2}

red = 0.001 gcm^{-2}

Shapes

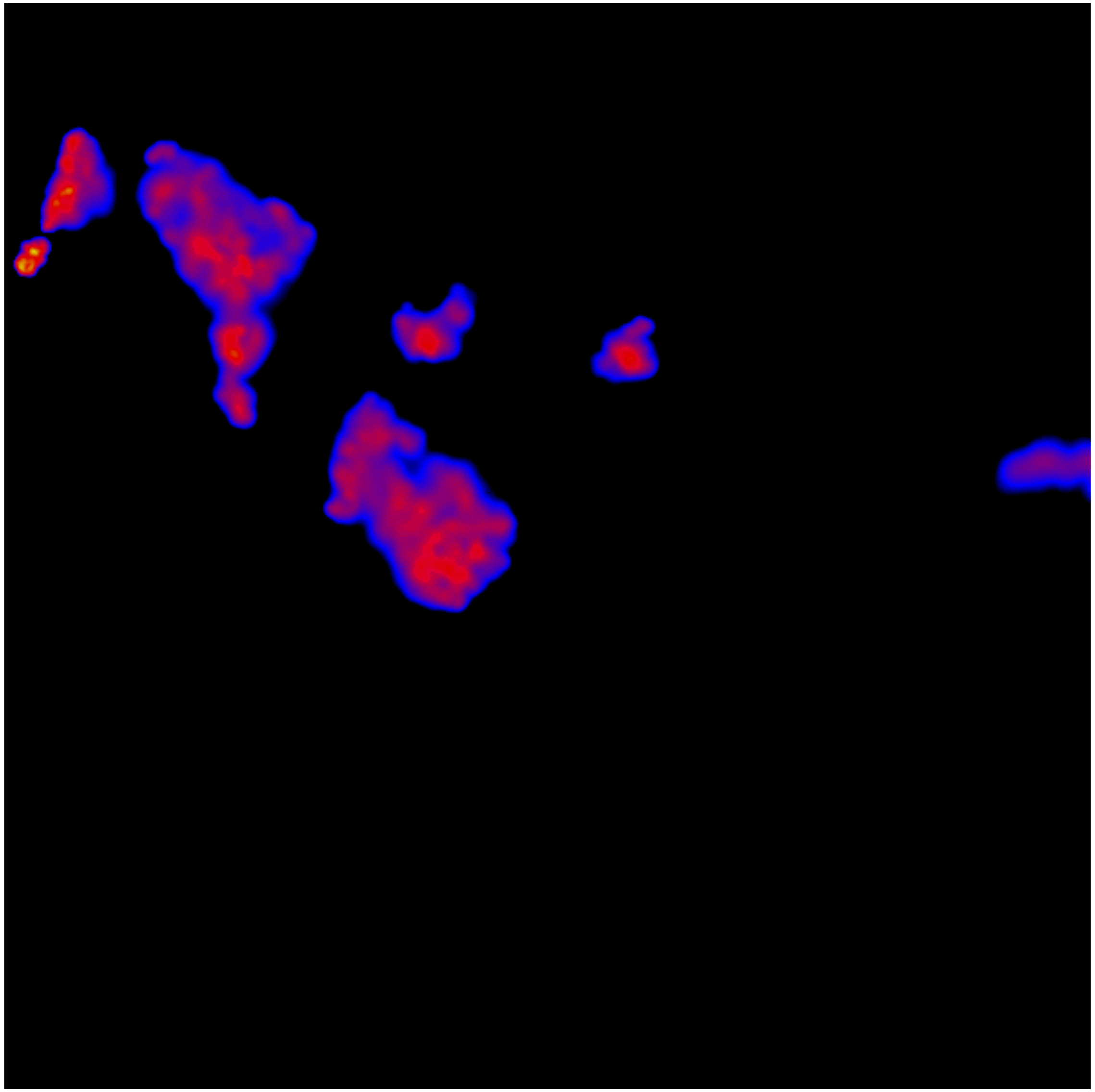


- quasi-spherical
- elongated
- substructure

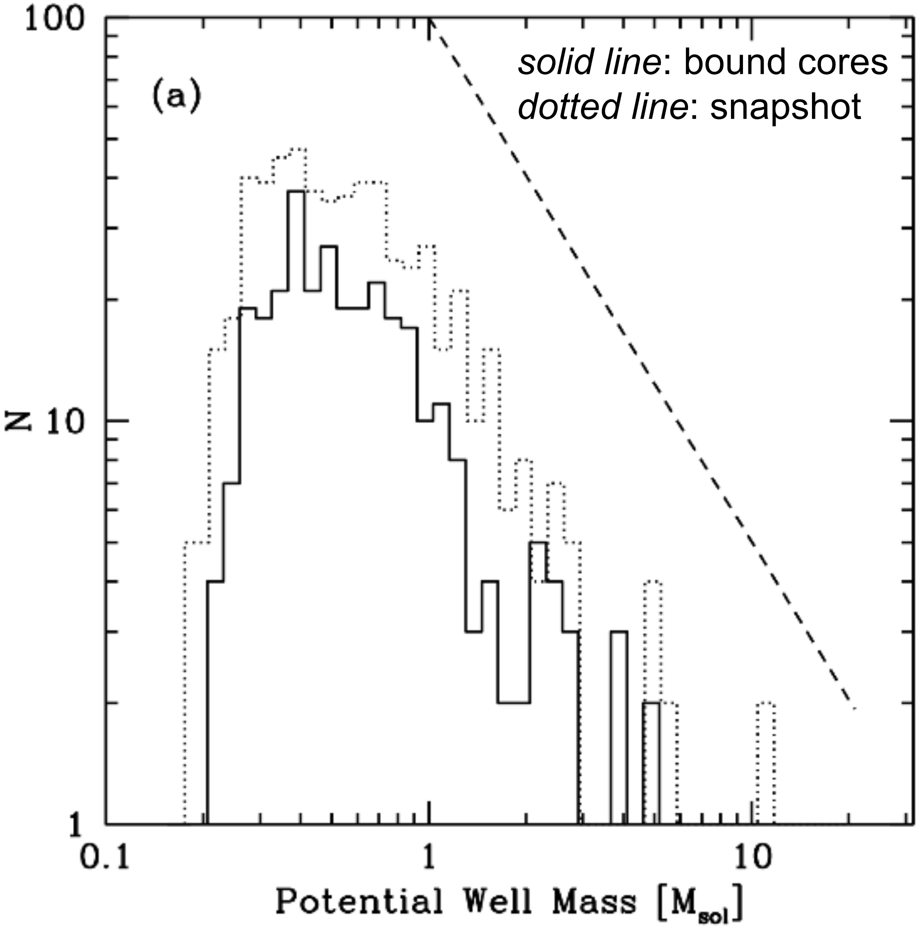


Colours depict density; 0.001gcm^{-1} *(blue)* to 10 gcm^{-1} *(yellow)*.

Evolution of the pre-stellar p-cores with time.



Clump Mass Function

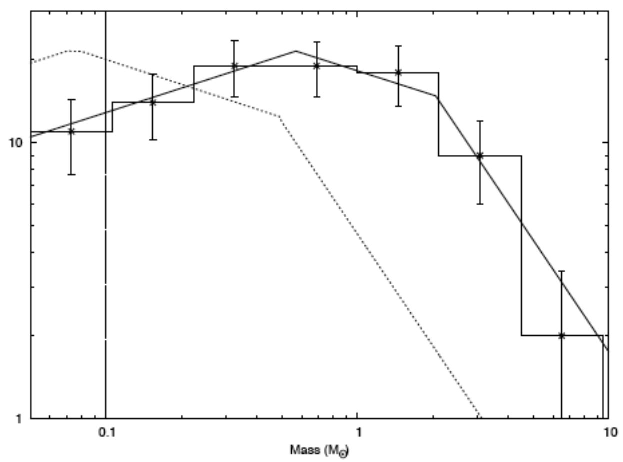


•Both populations have the same distribution in log space.

• Strong resemblance to the IMF.

• Masses comparable to those in observed CMF's

e.g. Motte et al 1998, Simpson et al 2008, Enoch et al 2008

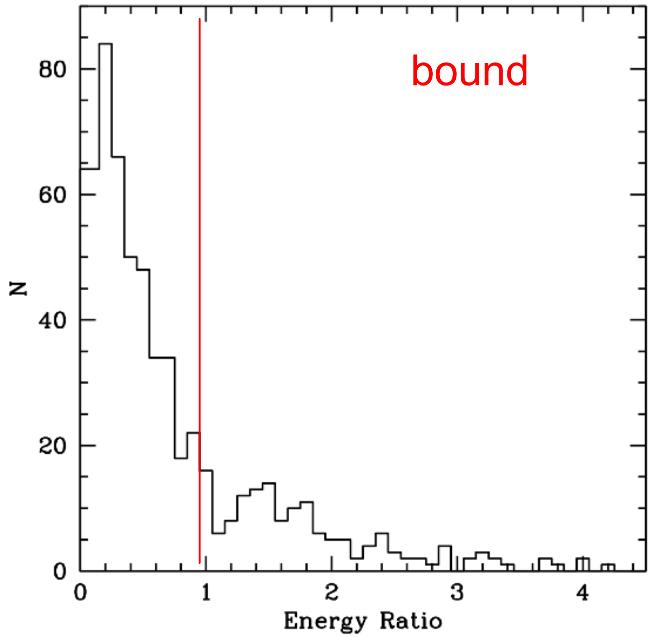


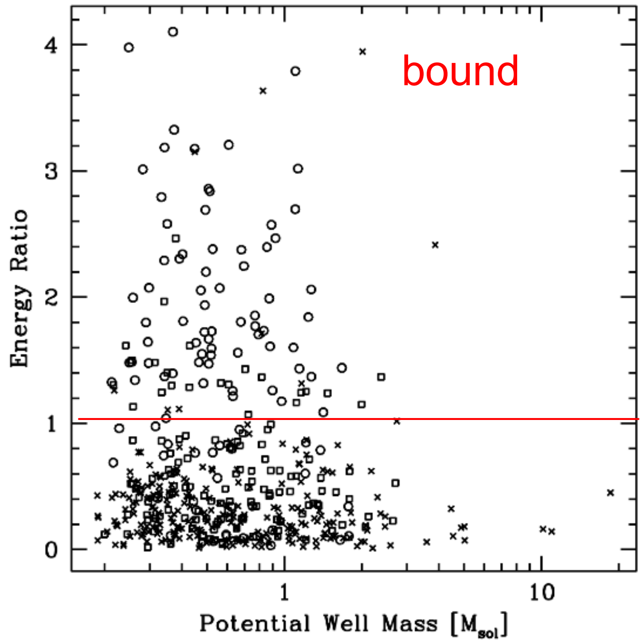
Which Cores are Bound?

•In the Snapshot population only 24% of the p-cores are bound.

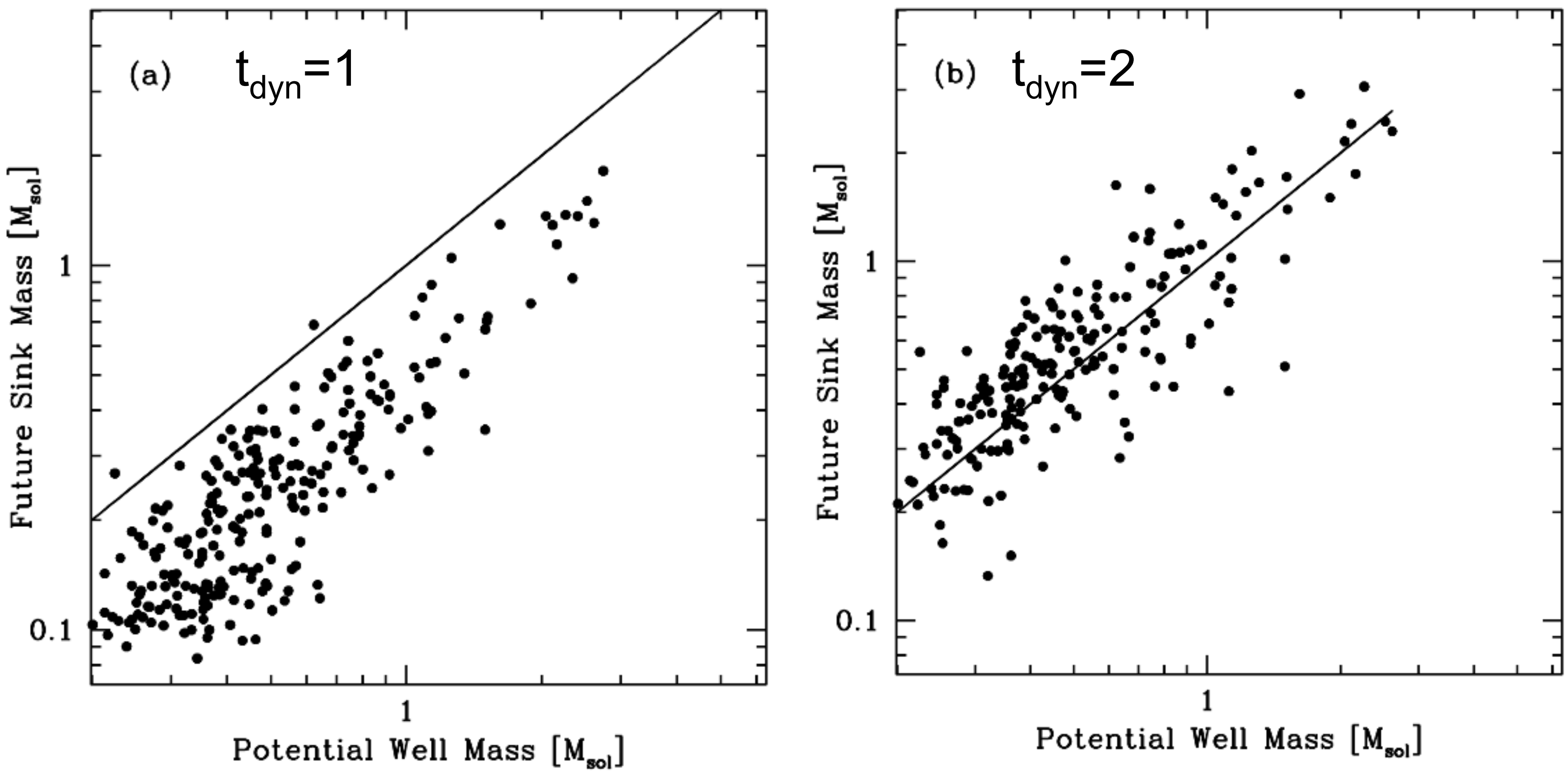
•There is no strong correlation between binding and mass.

- a uniform sampling of clumps form IMF



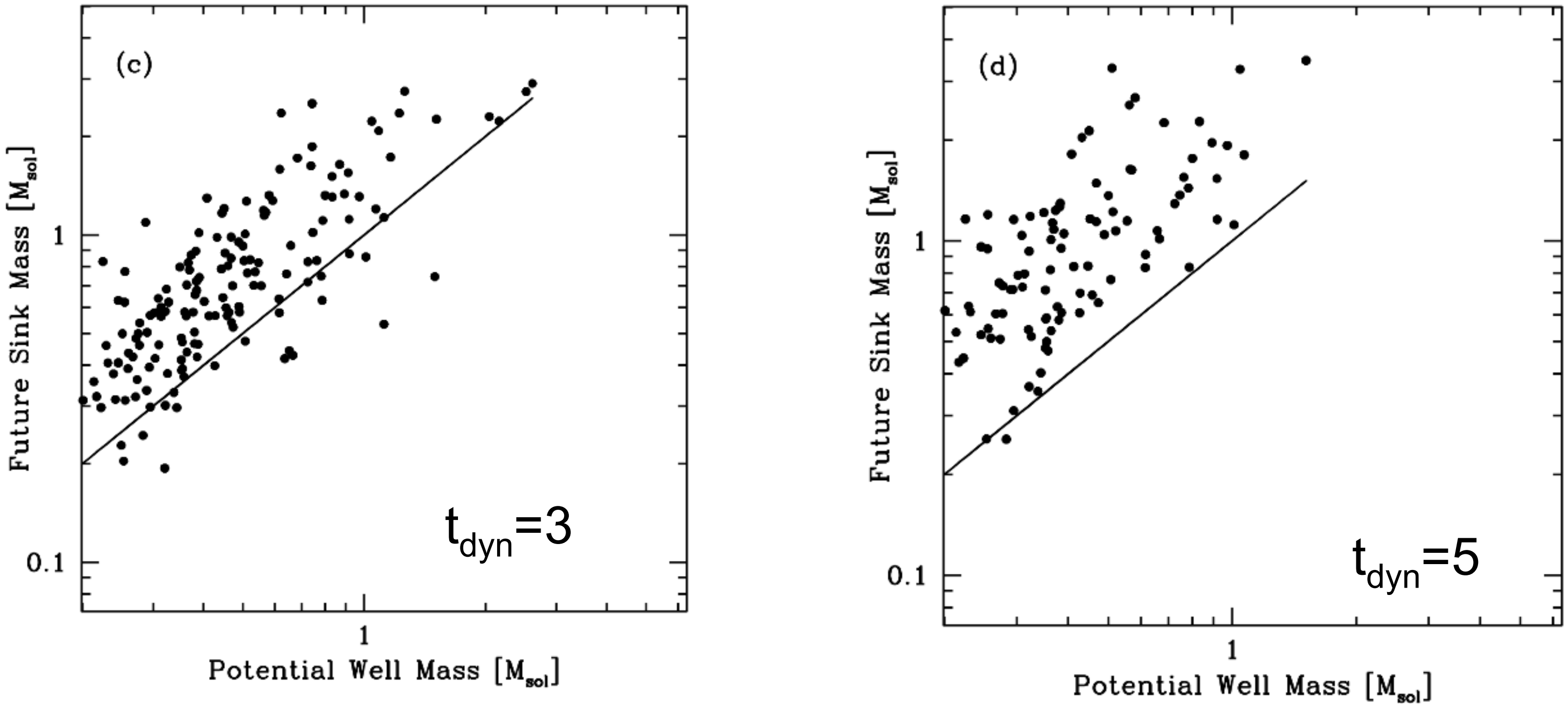


Core to Star



There is now a clear correlation, but with considerable scatter. At 2 t_{dyn} there is about a 1-1 relationship.

Core to Star



With successive dynamical times the relationship gets increasingly tenuous. Correlation decreases with accretion.

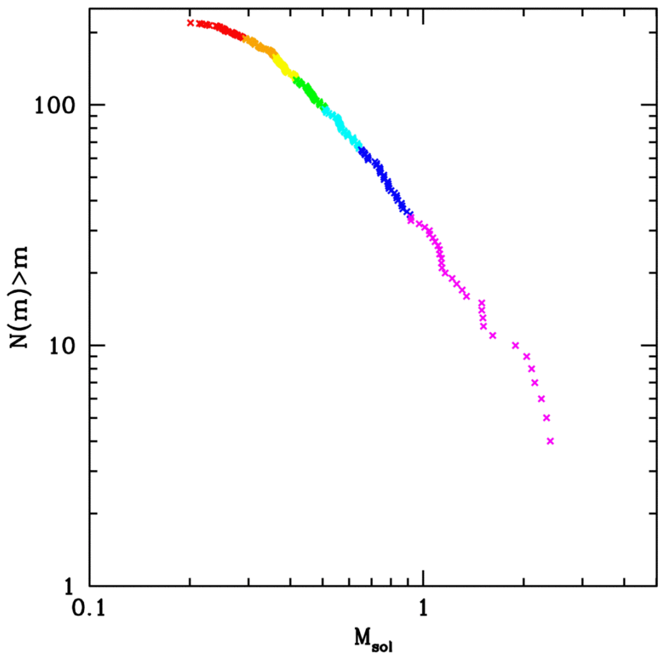
Accretion continues beyond initially bound material, core environment is important.

The Resultant CMF

To investigate where the potential clumps will end up on the IMF we trace their evolution.

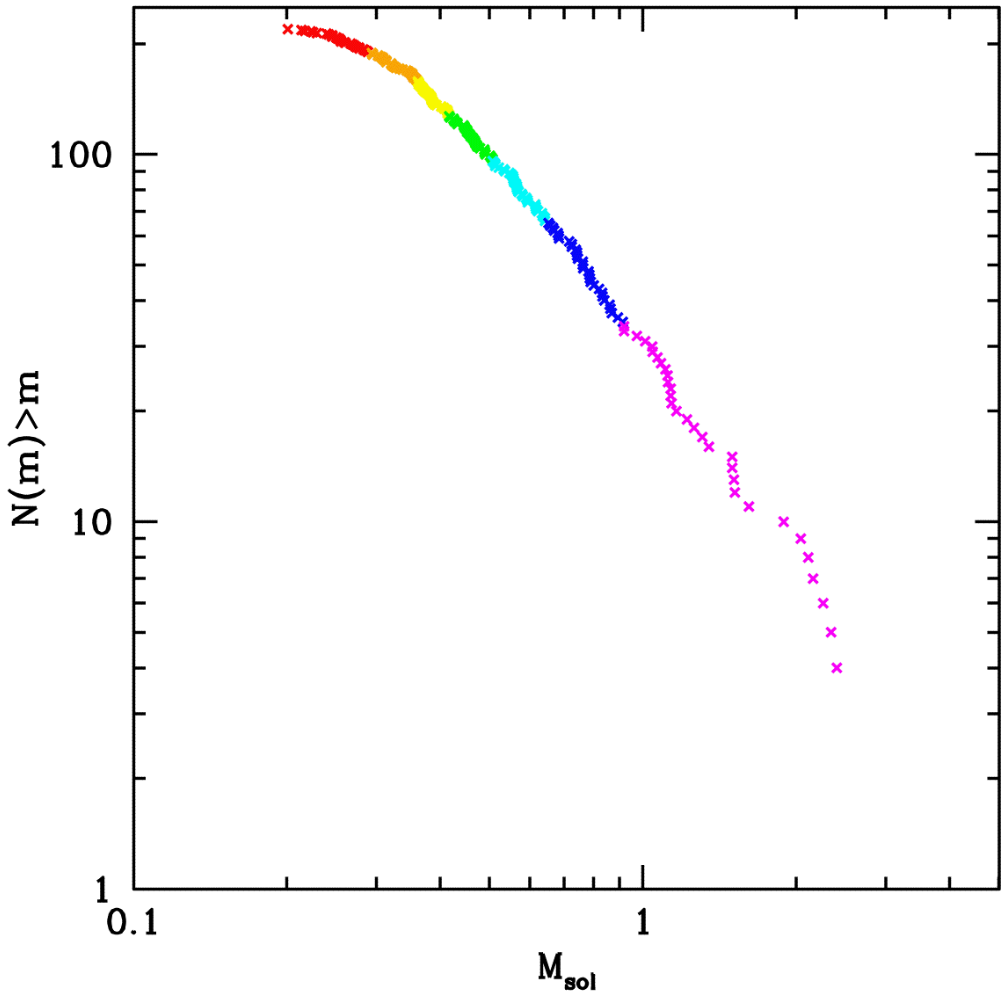
• P-cores binned and coloured by mass.

•Colours kept the same for the resulting sink at each successive dynamical time.

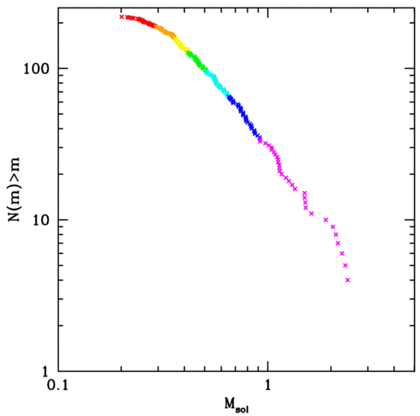


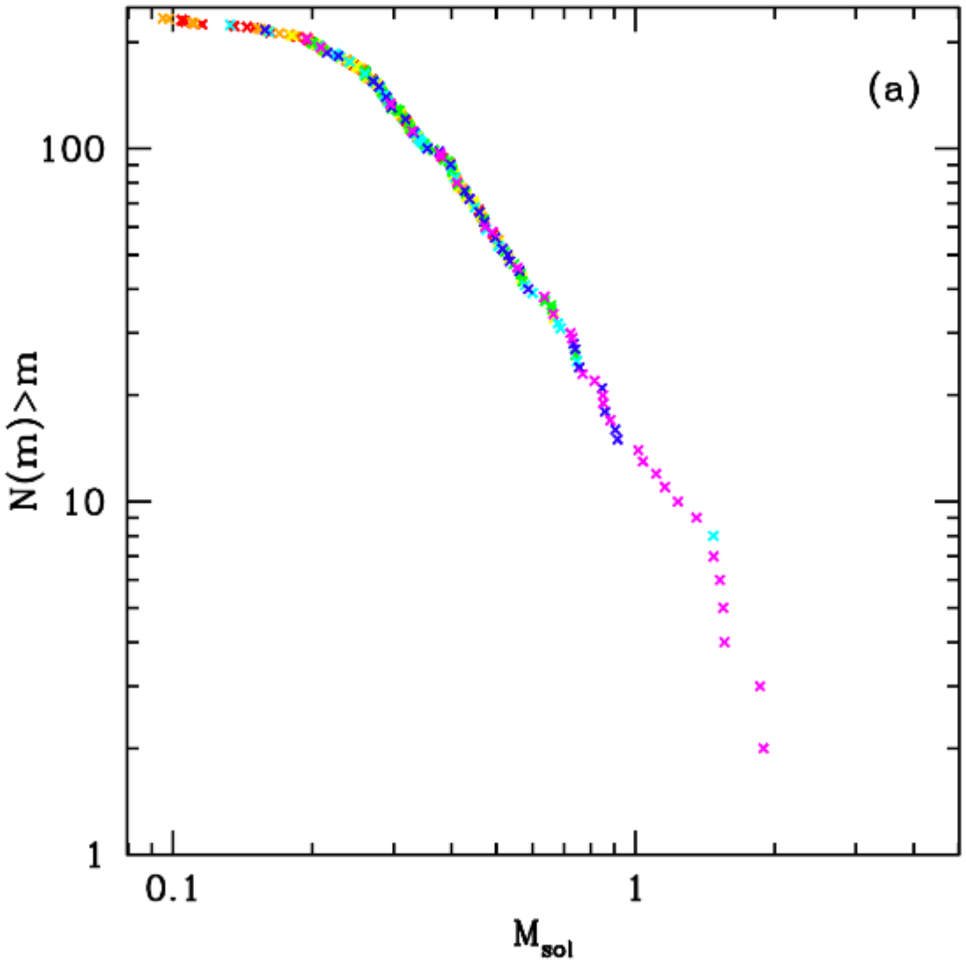
CMF of bound clumps

Connection



Connection

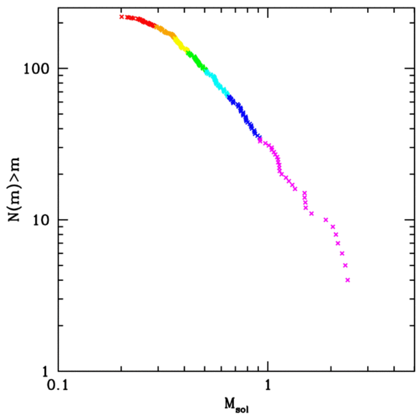


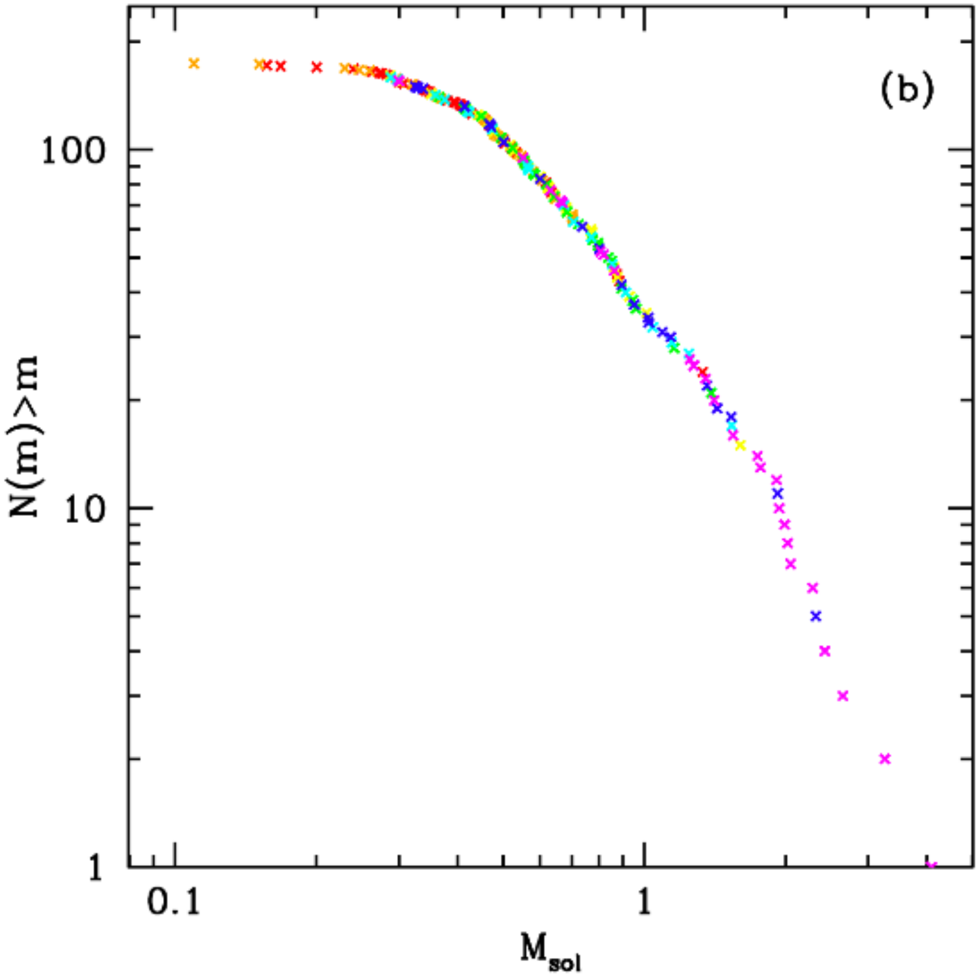


sinks:

t_{dyn}=1

Connection

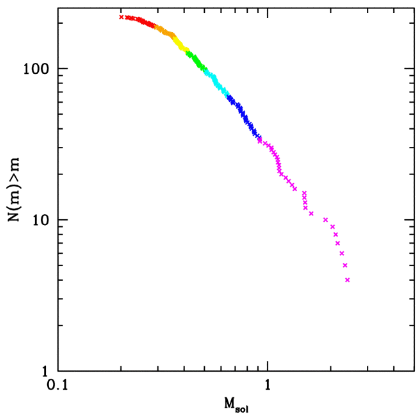


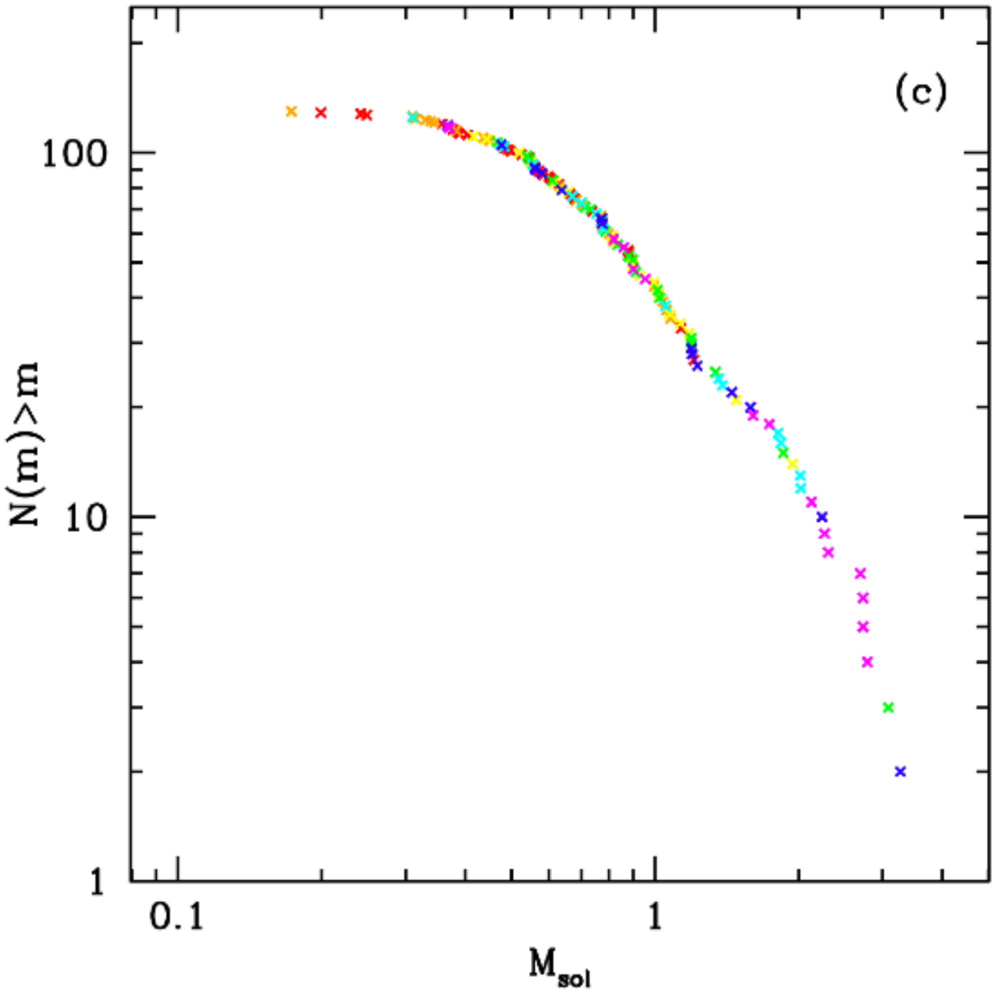


sinks:

t_{dyn}=2

Connection

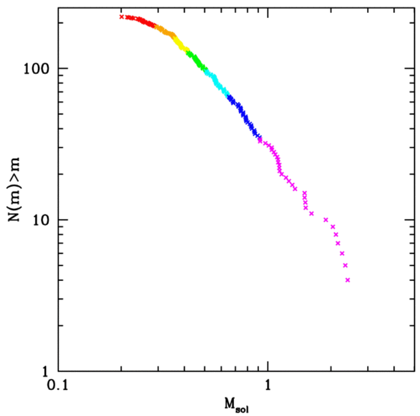


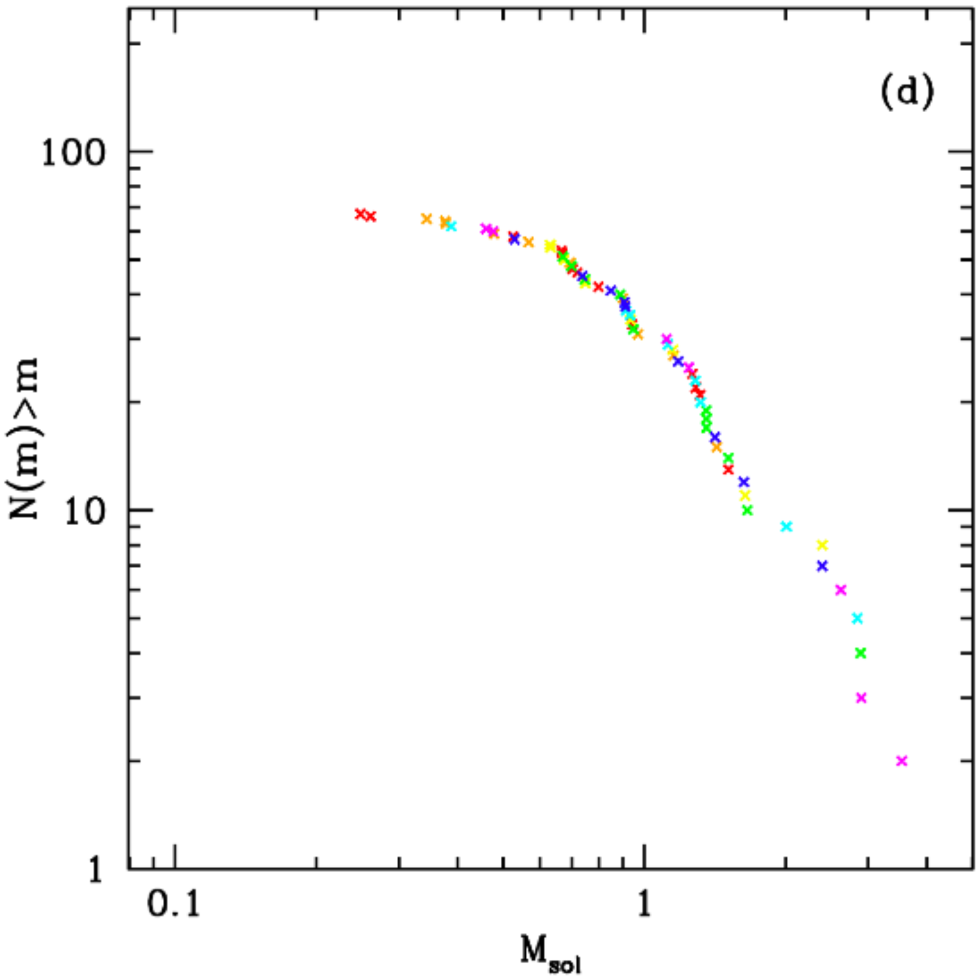


sinks:

t_{dyn}=3

Connection





sinks:

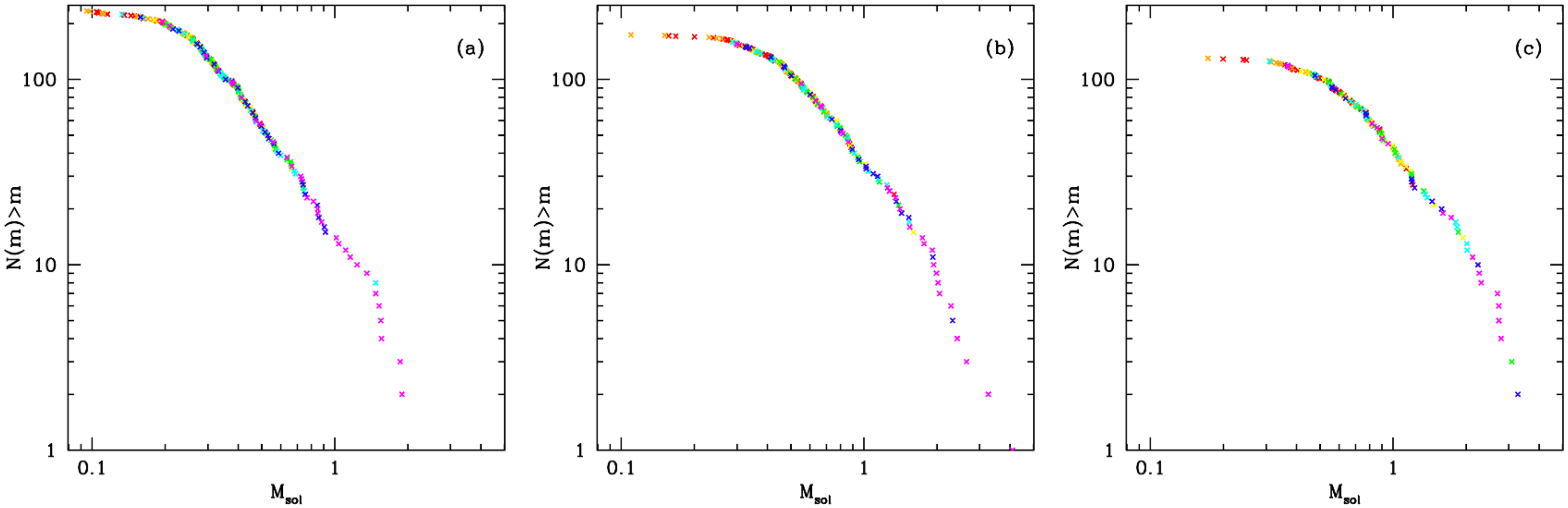
t_{dyn}=5

Connection

•There is a higher probability for a more massive p-core to form a more massive sink.

•But for individual cores no reliable predictions can be made.

•Most likely due to environmental factors



Conclusions

- Bound potential cores similar to smallest scale observations
- Bound p-core mass function genuinely resembles IMF
- More massive p-cores are more likely to form more massive stars
- But for an individual p-core no accurate predictions can be made
- Environmental factors are involved in core evolution