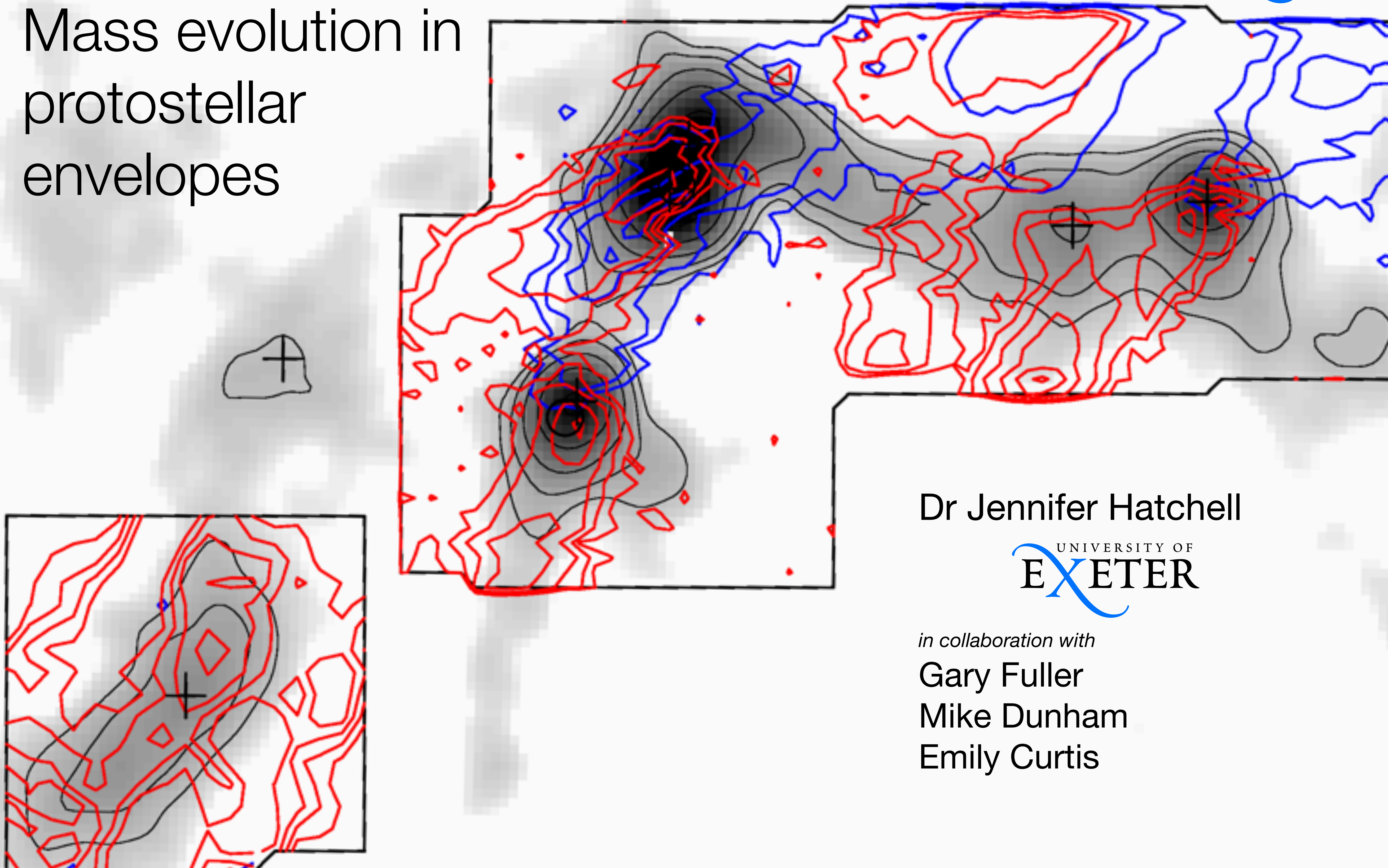
Mass evolution in protostellar envelopes



Dr Jennifer Hatchell
UNIVERSITY OF EXETER

in collaboration with
Gary Fuller
Mike Dunham
Emily Curtis

Class 0 protostars

DR JENNIFER HATCHELL

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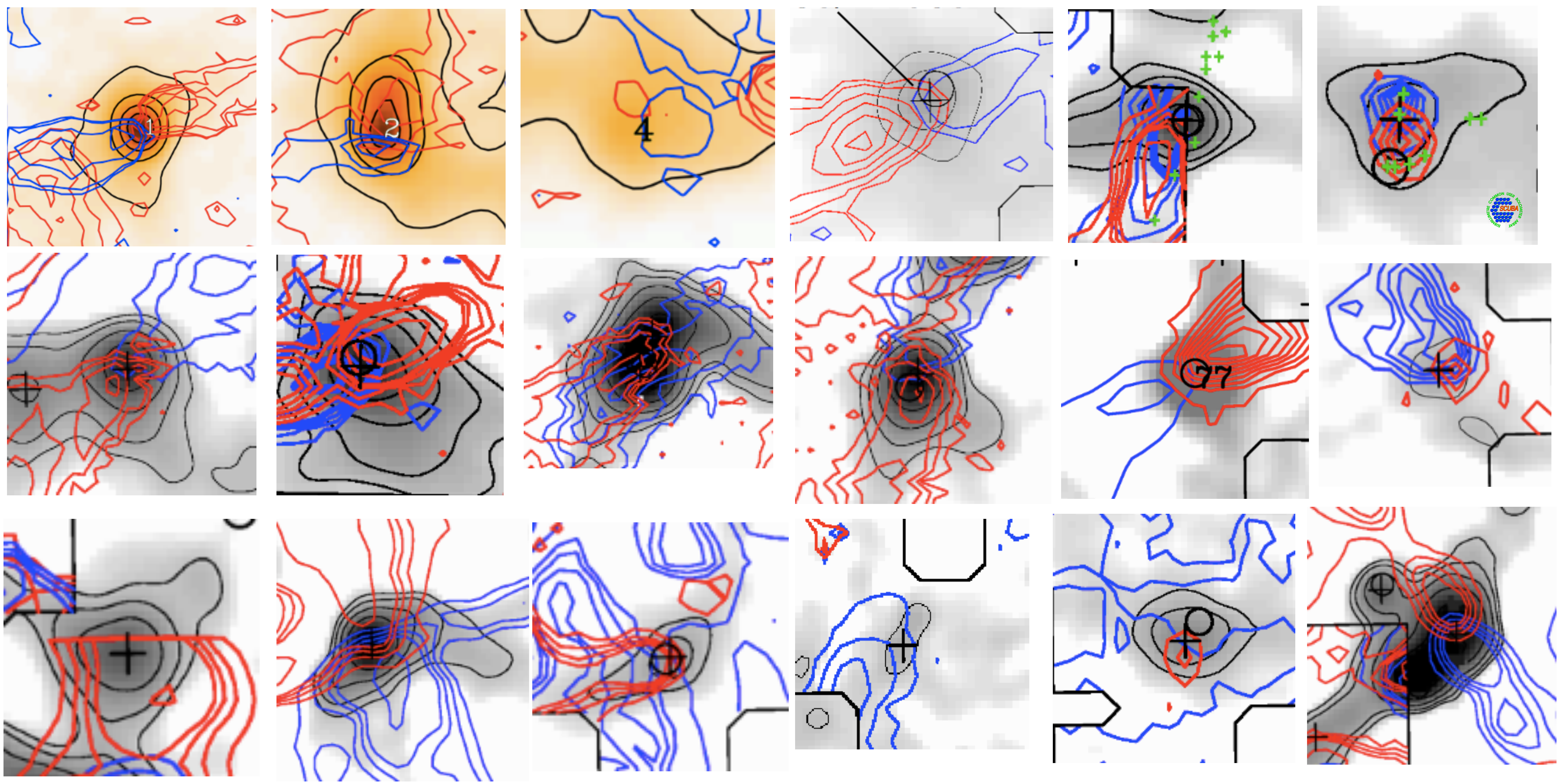


0.1pc / 20,000AU

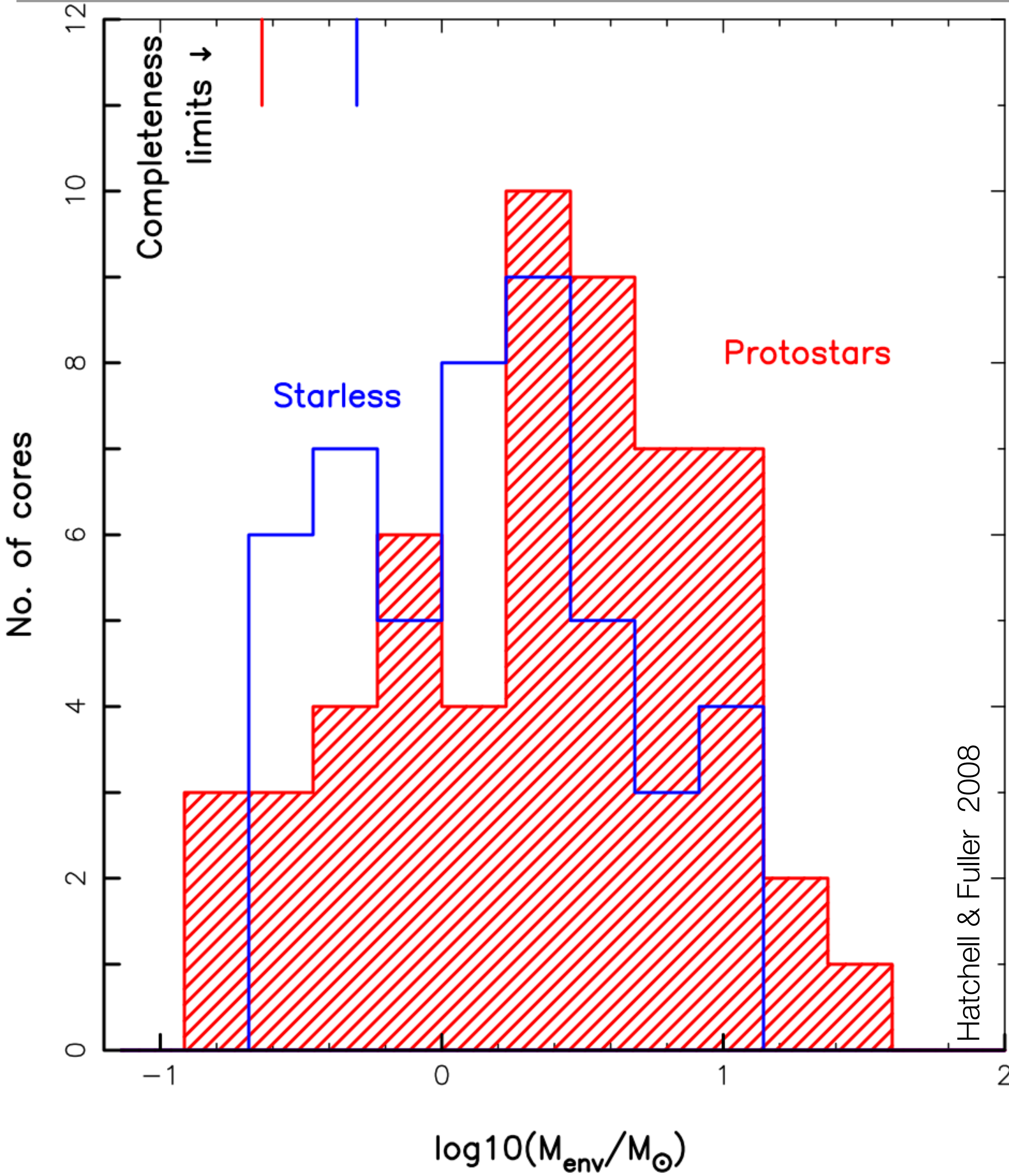
Continuum : SCUBA

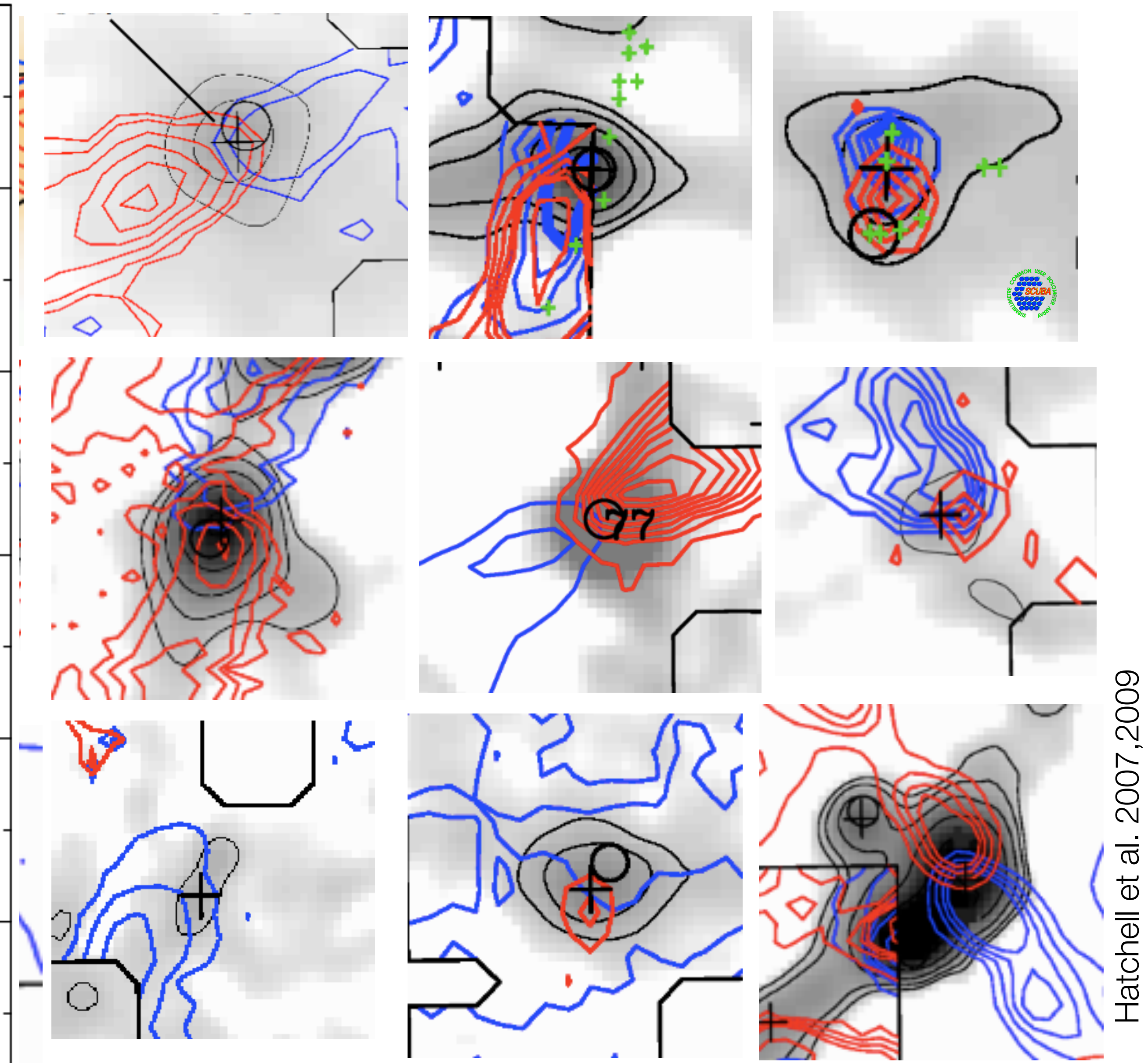
CO 3-2: JCMT RxB / HARP

Hatchell et al. 2007,2009

Class 0 protostars

Dr Jennifer Hatchell





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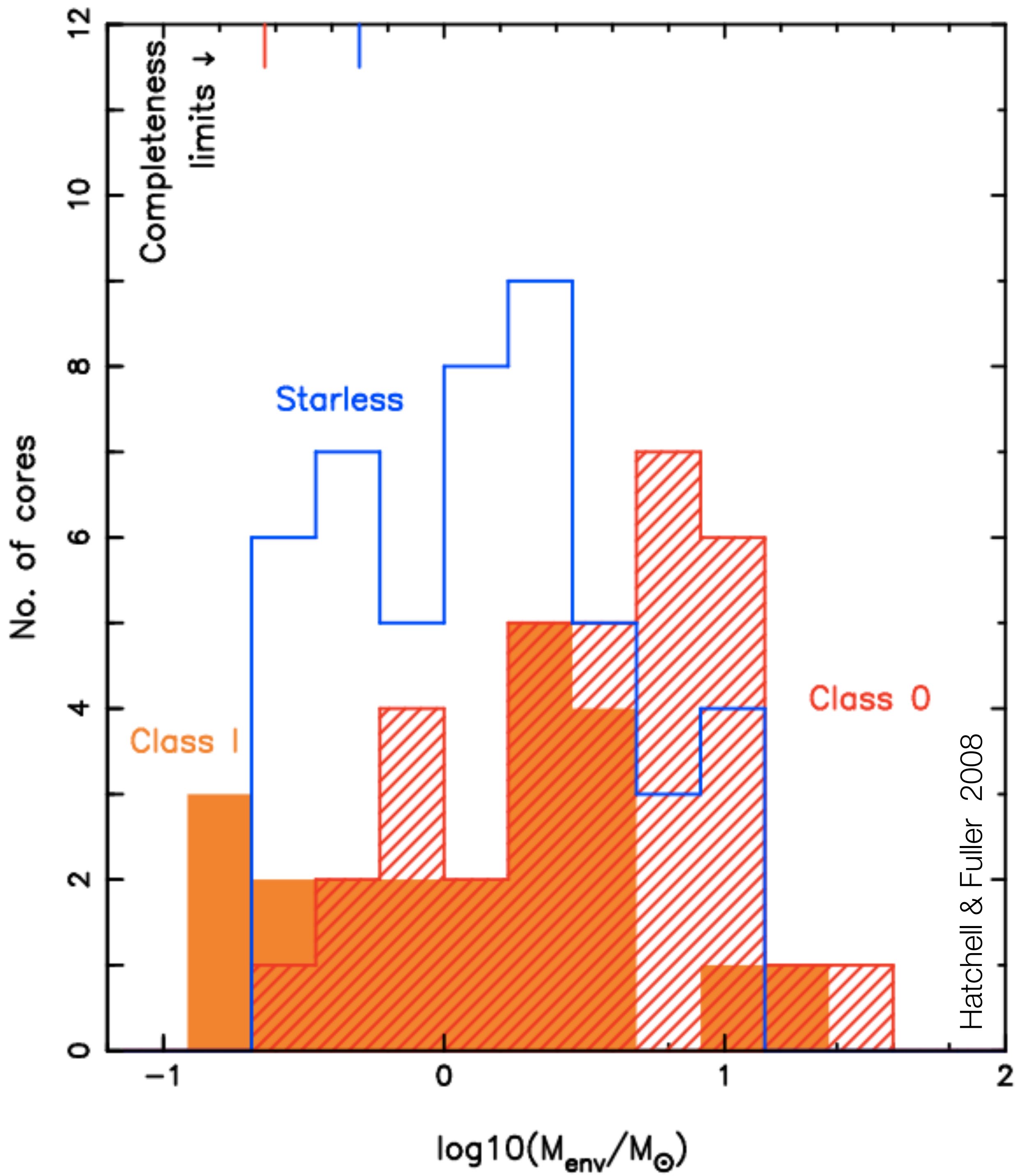

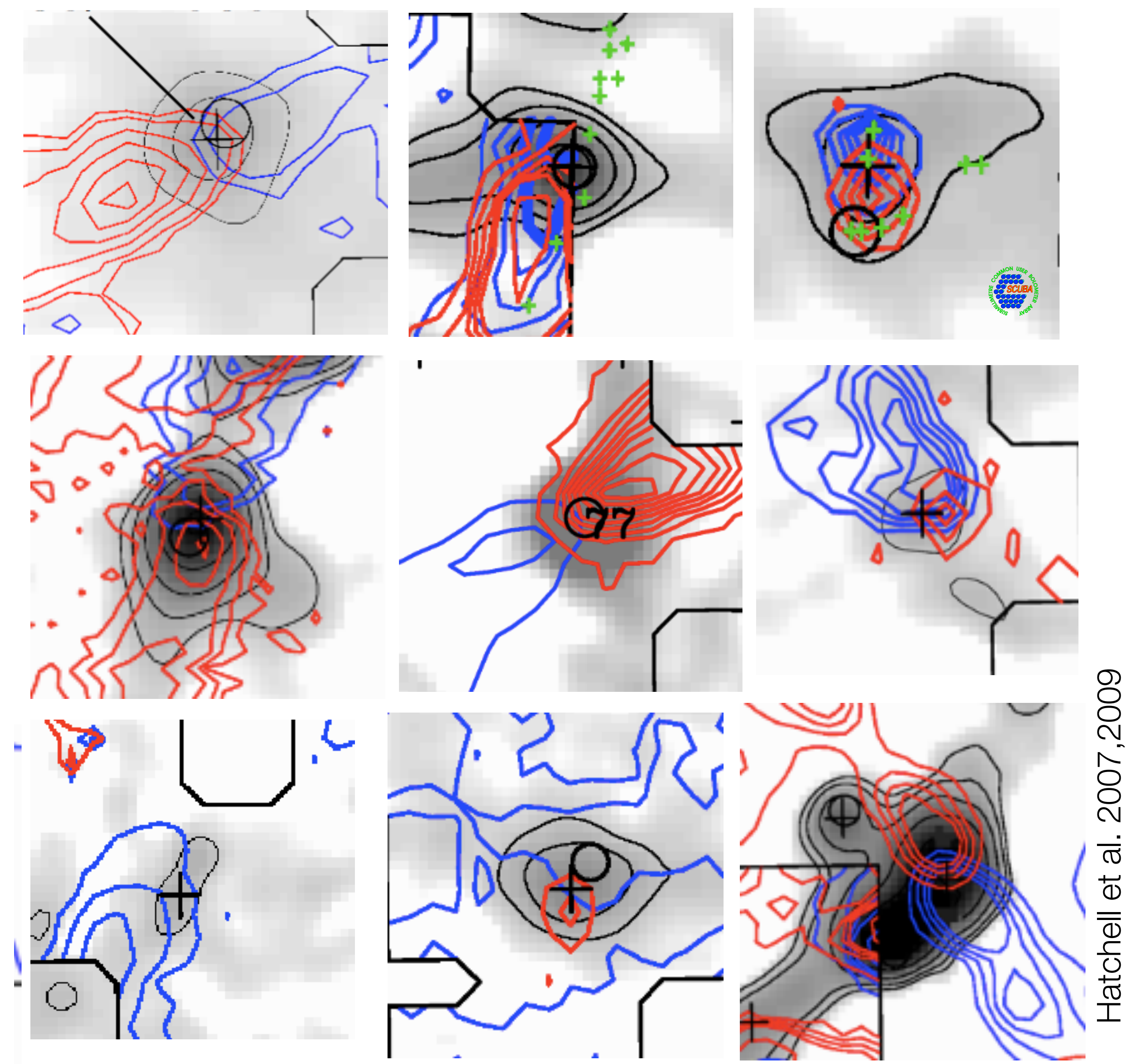

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Envelope mass evolution

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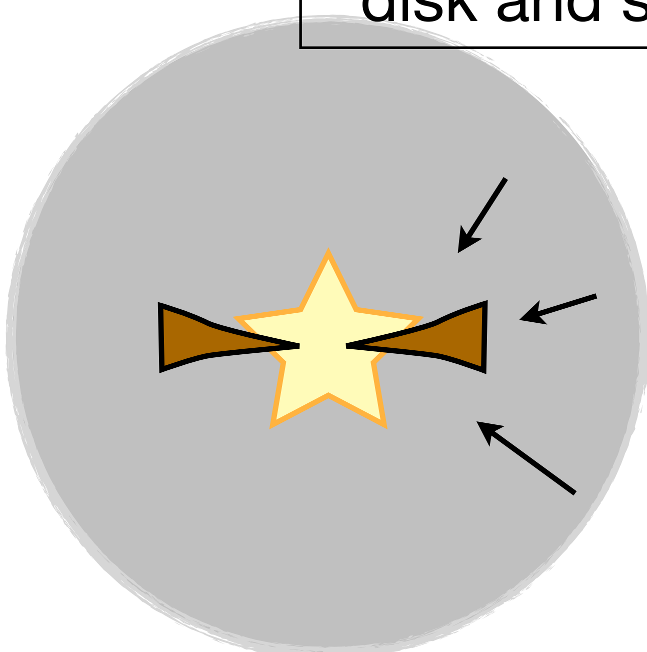
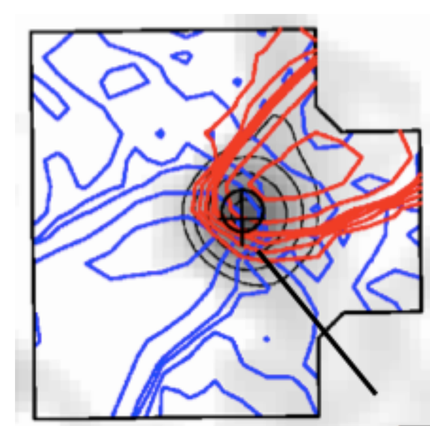
$$\dot{M}_{\rm env} = -\dot{M}_{\rm acc} - \dot{M}_{\rm outflow} + \dot{M}_{\rm cloud}$$

Accretion onto disk and star

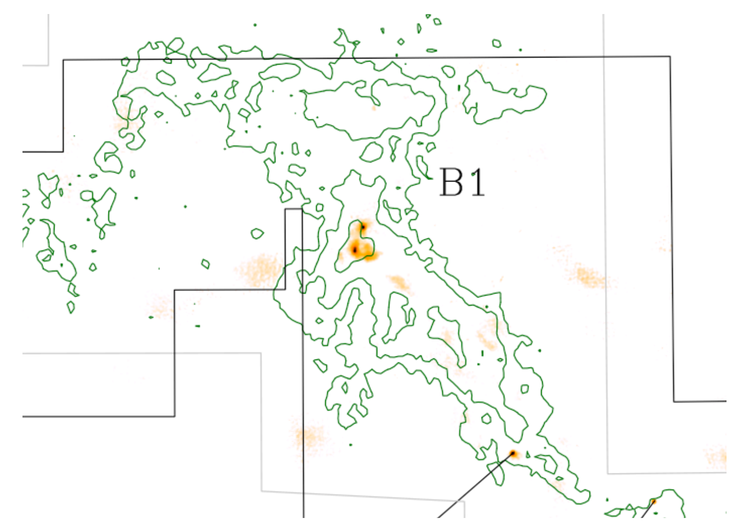


Mass loss in jet and molecular outflow



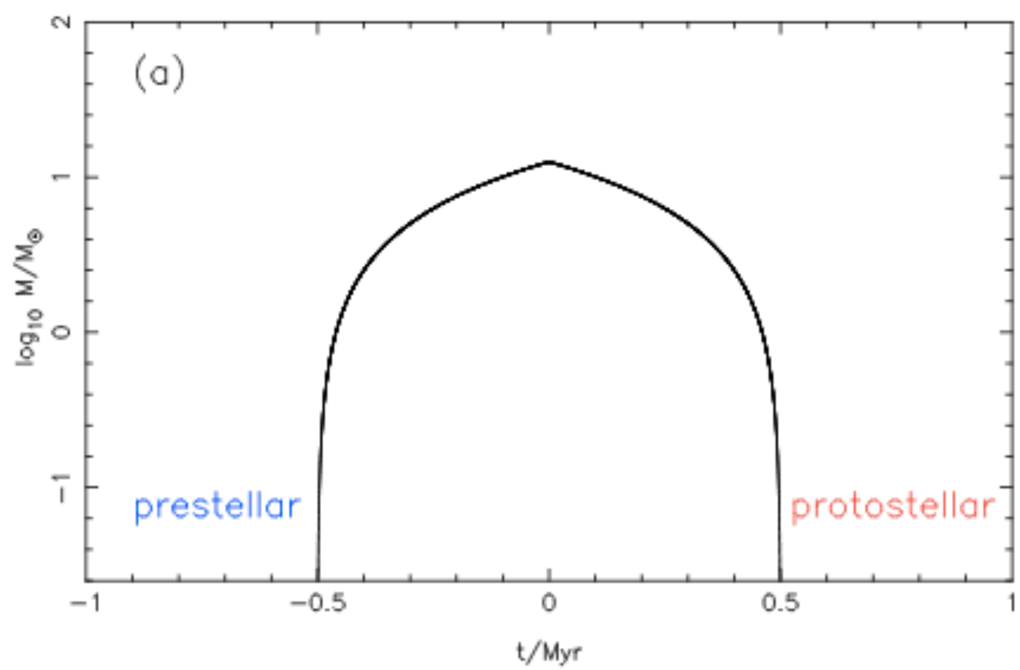
Hatchell et al. 2009

Mass accretion from cloud



Core Mass Evolutionary Diagrams (CMEDs)

Dr Jennifer Hatchell | University of Exeter



Core Mass Evolutionary Diagrams

How many objects we see at a given mass depends on the time they spend at that mass

- 1: single mass population population with constant mass loss

Core Mass Evolutionary Diagrams (CMEDs)

Dr Jennifer Hatchell

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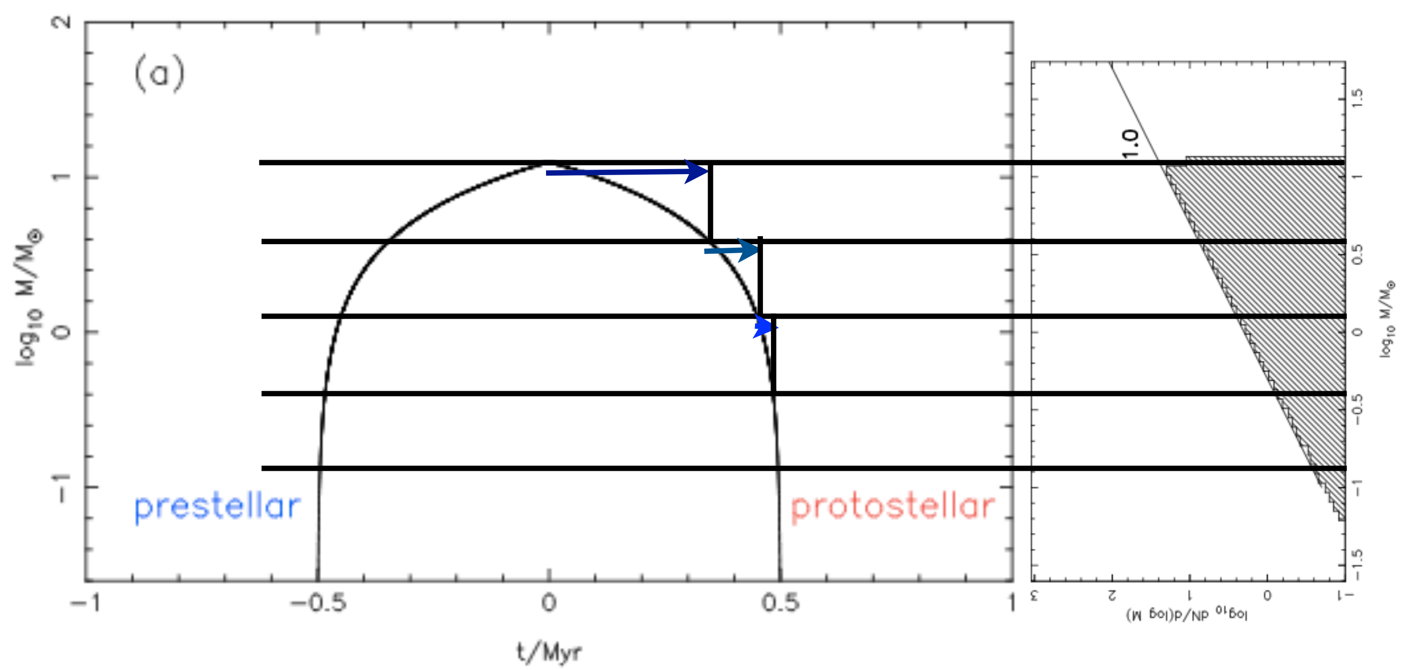

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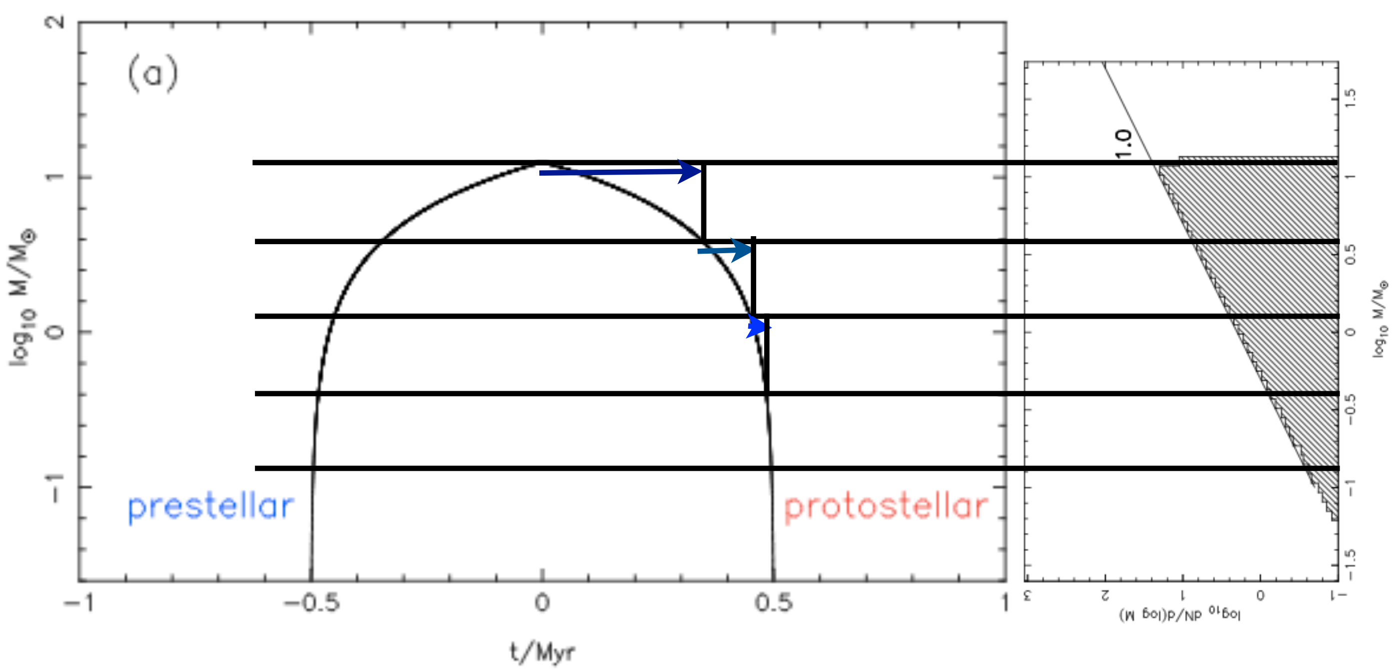

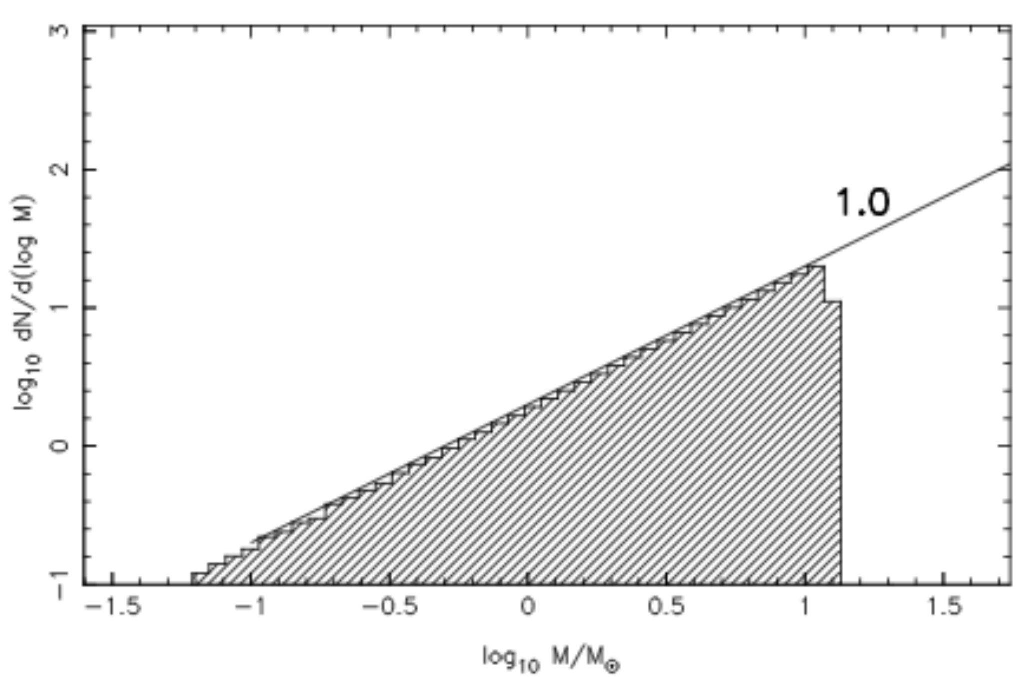

Hatchell et al. 2008

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Core Mass Evolutionary Diagrams (CMEDs)

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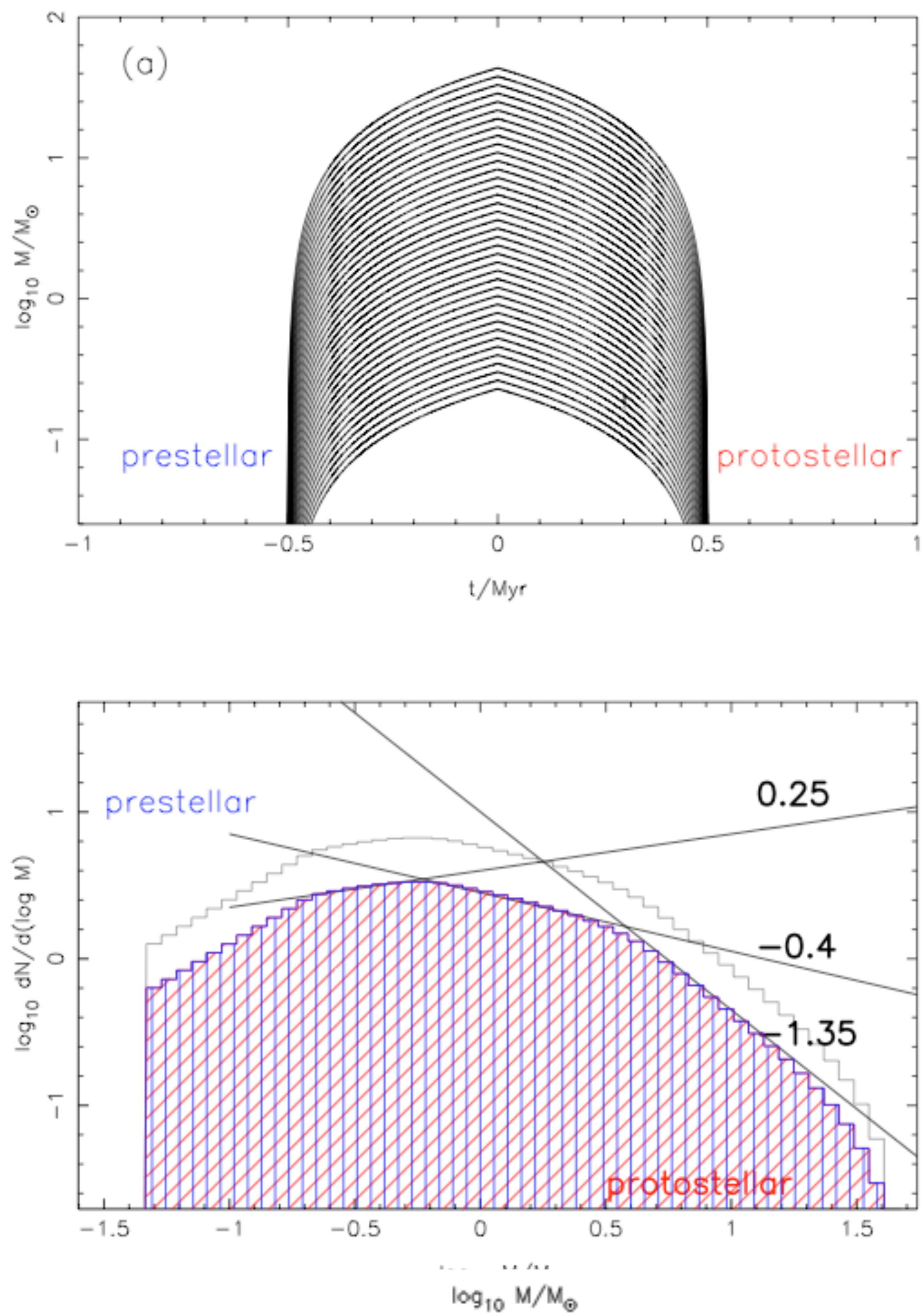

Hatchell et al. 2008

Core Mass Evolutionary Diagrams

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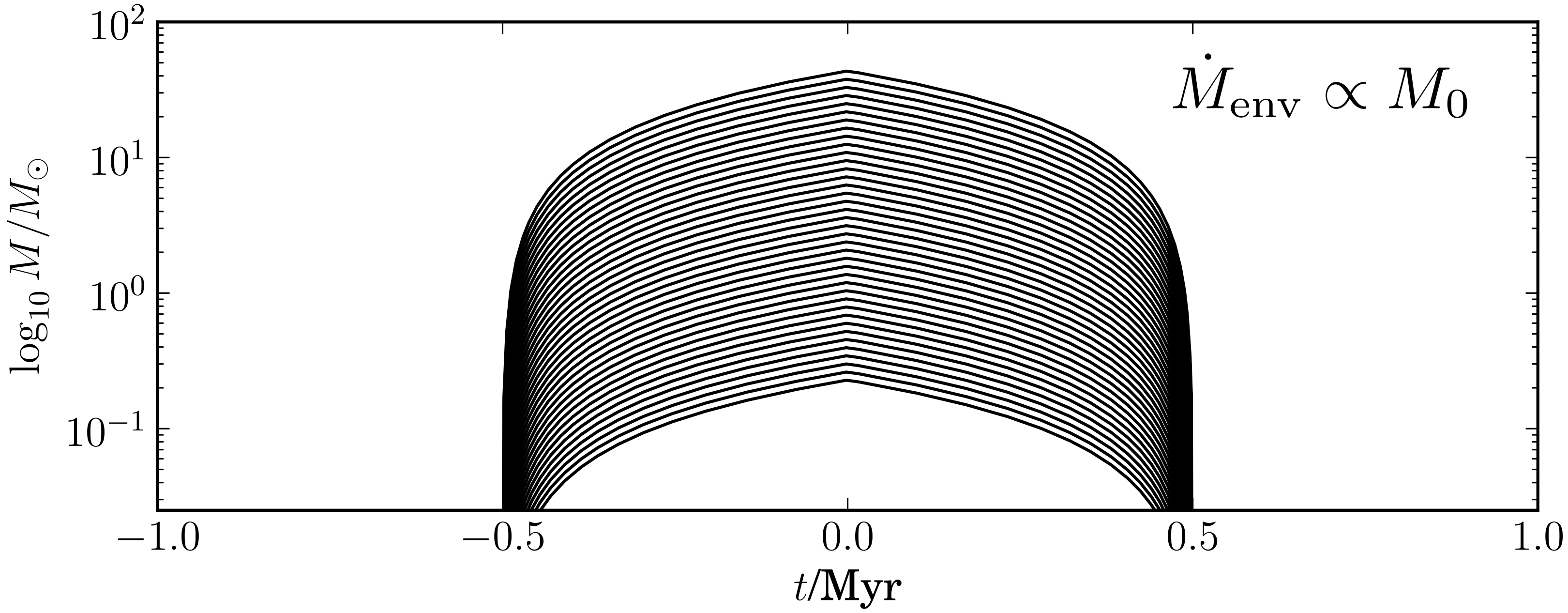
- 2: IMF-like source population with constant mass loss

Class 0 CMEDs



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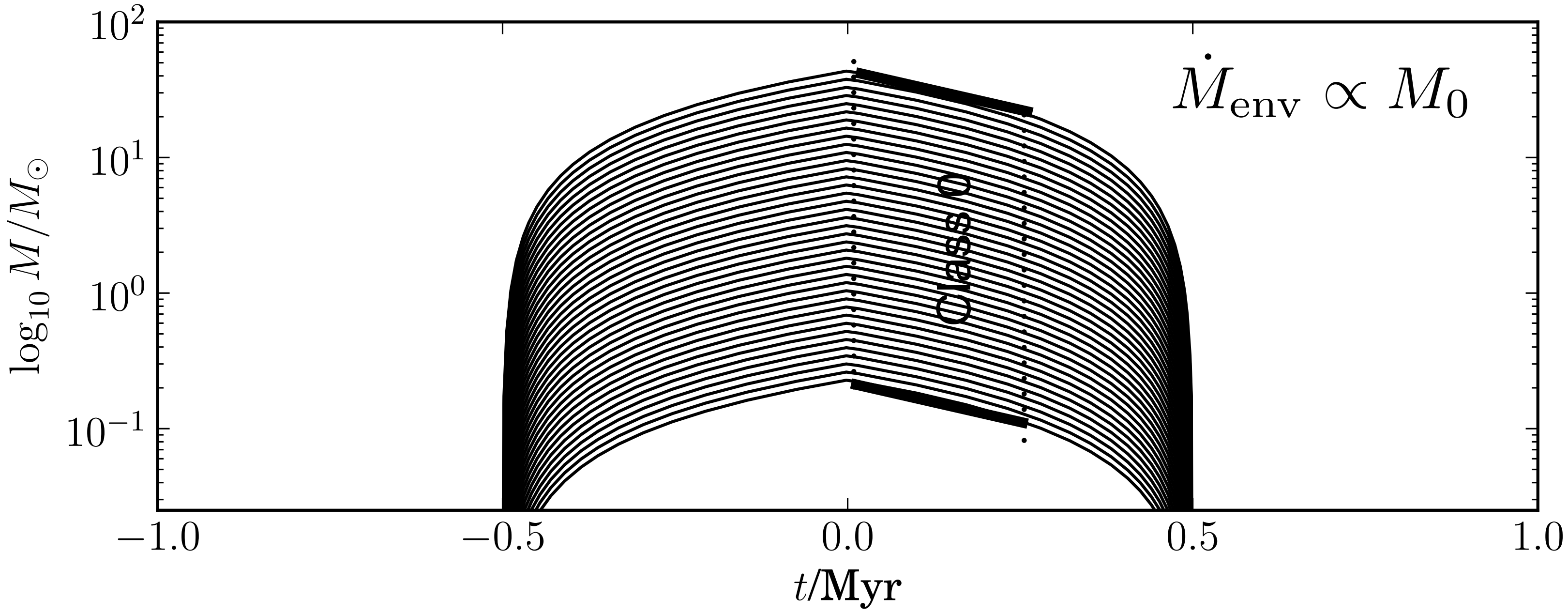

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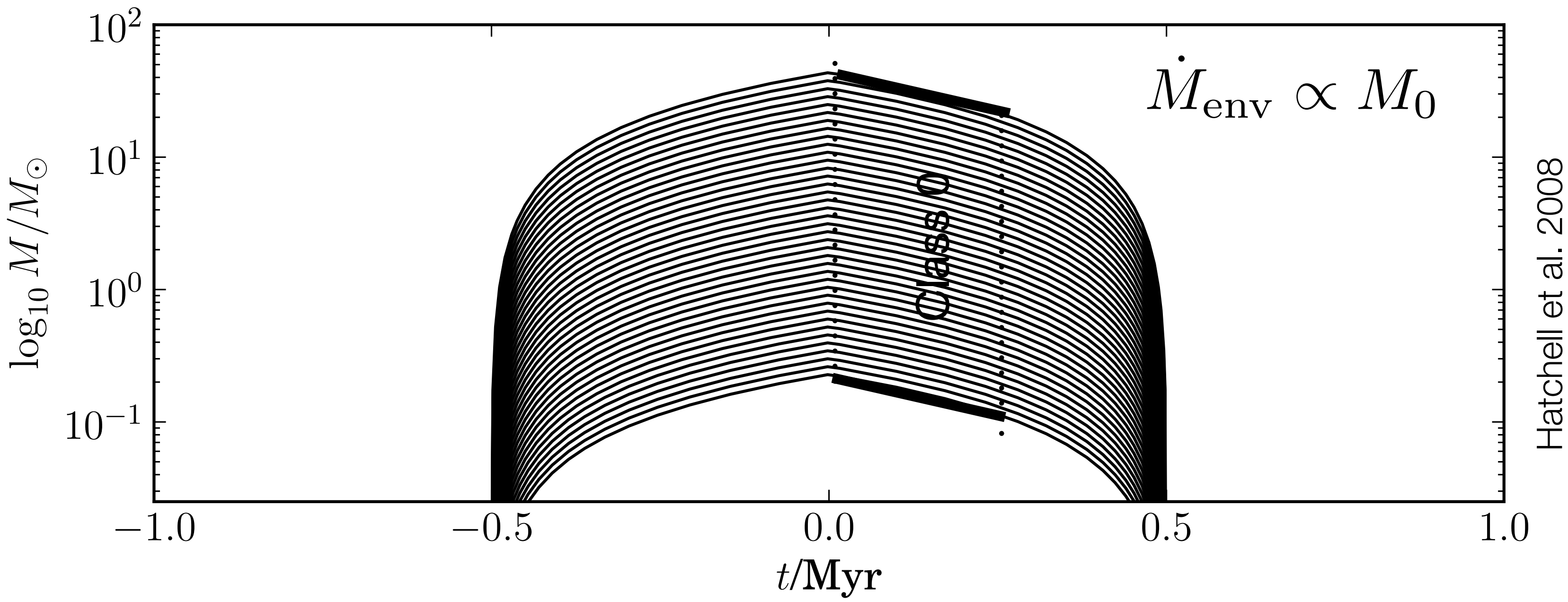

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Class 0 CMEDs

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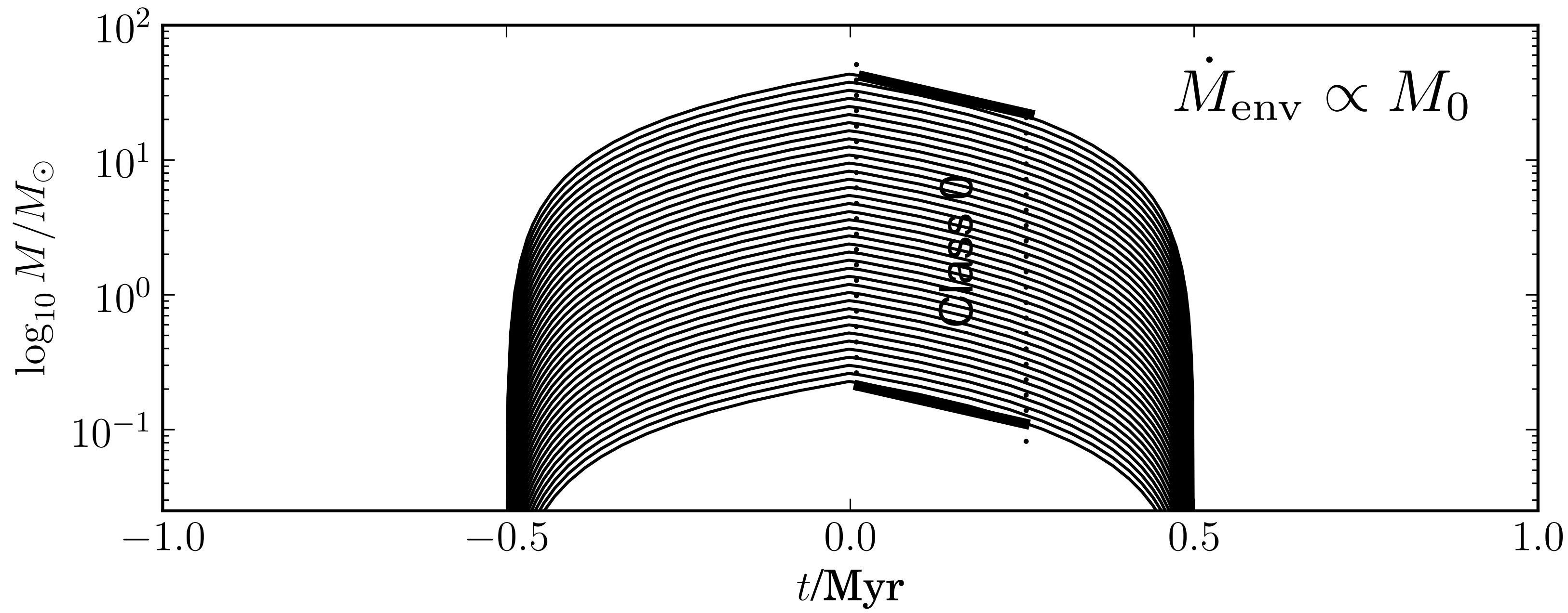

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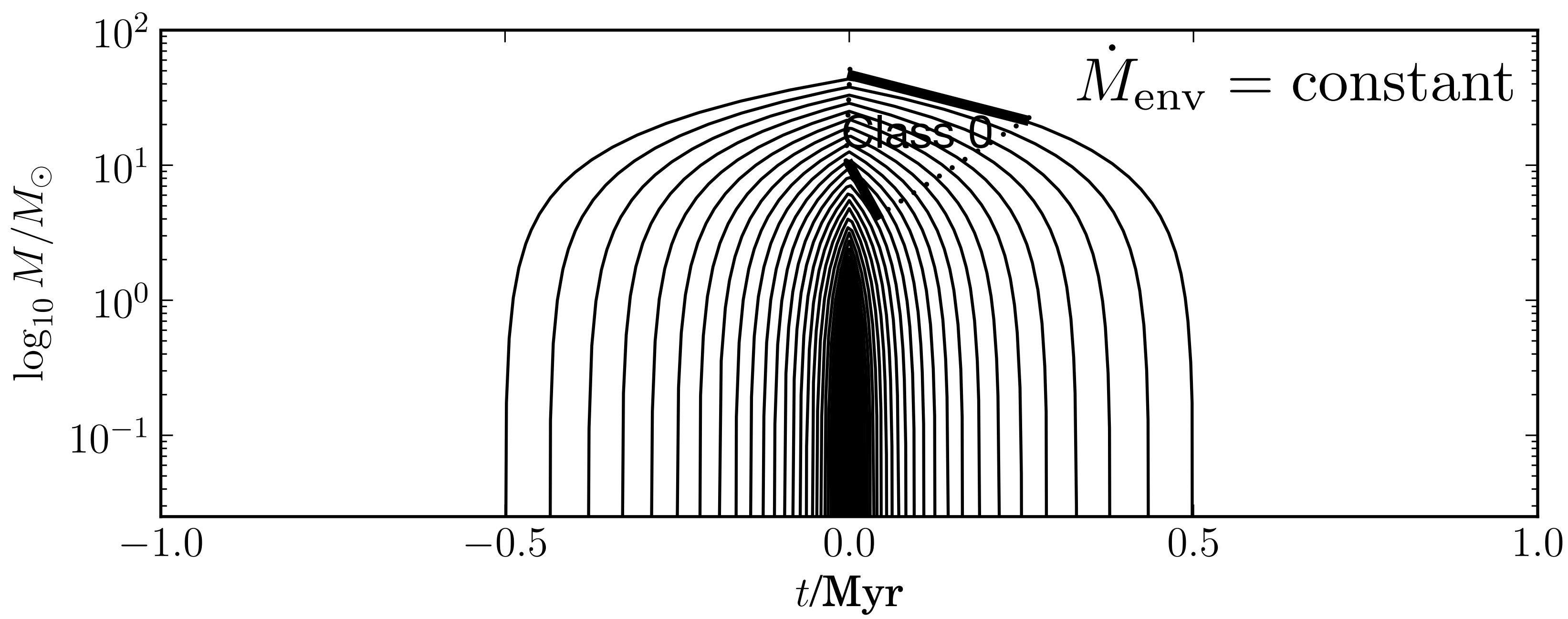

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Mass evolution for Class 0s
1. Accretion

$$\dot{M}_{\rm env} = -\dot{M}_{\rm acc} - \dot{M}_{\rm outflow} + \dot{M}_{\rm cloud}$$

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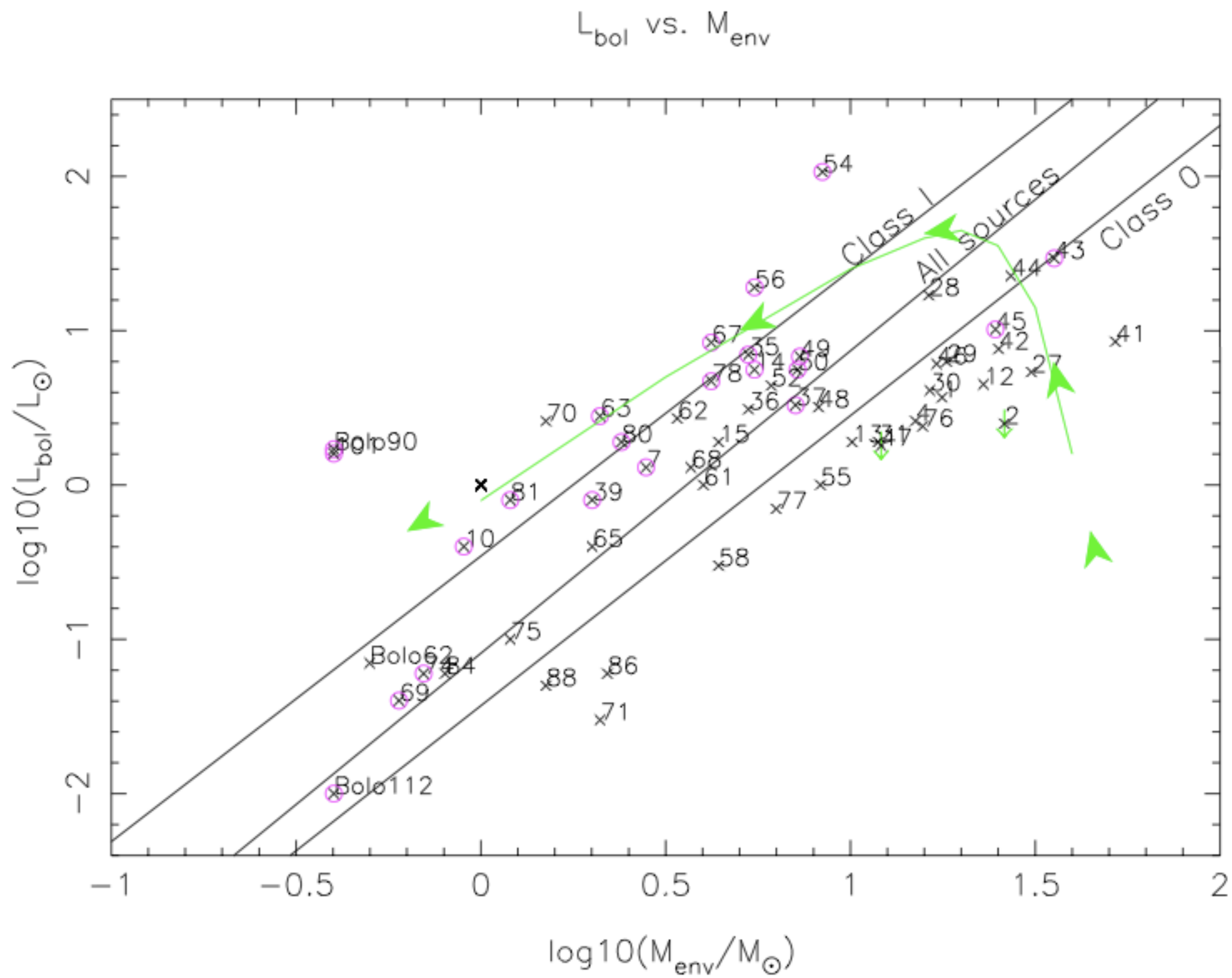

Hatchell et al. 2007

Mass evolution for Class 0s
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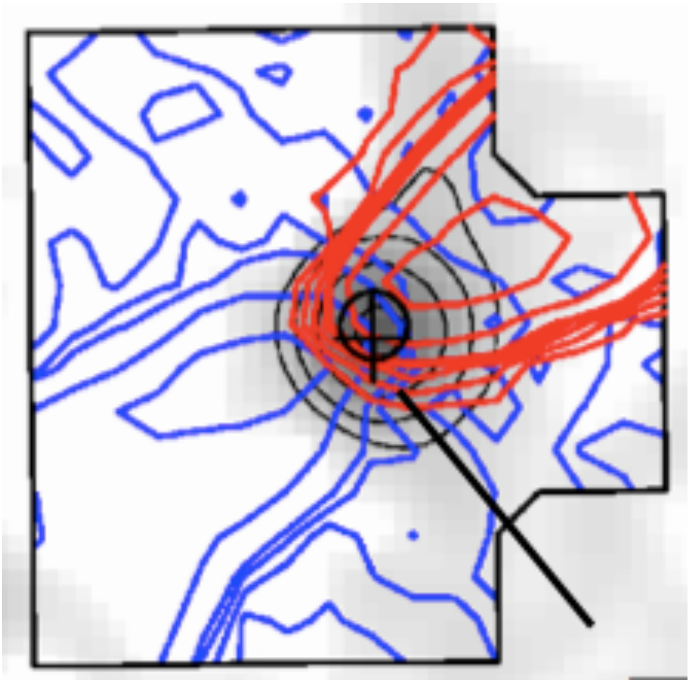

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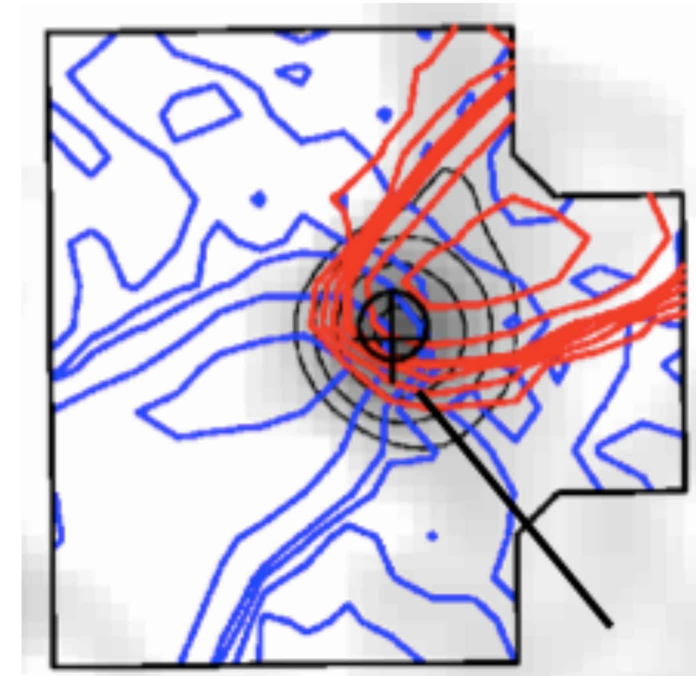

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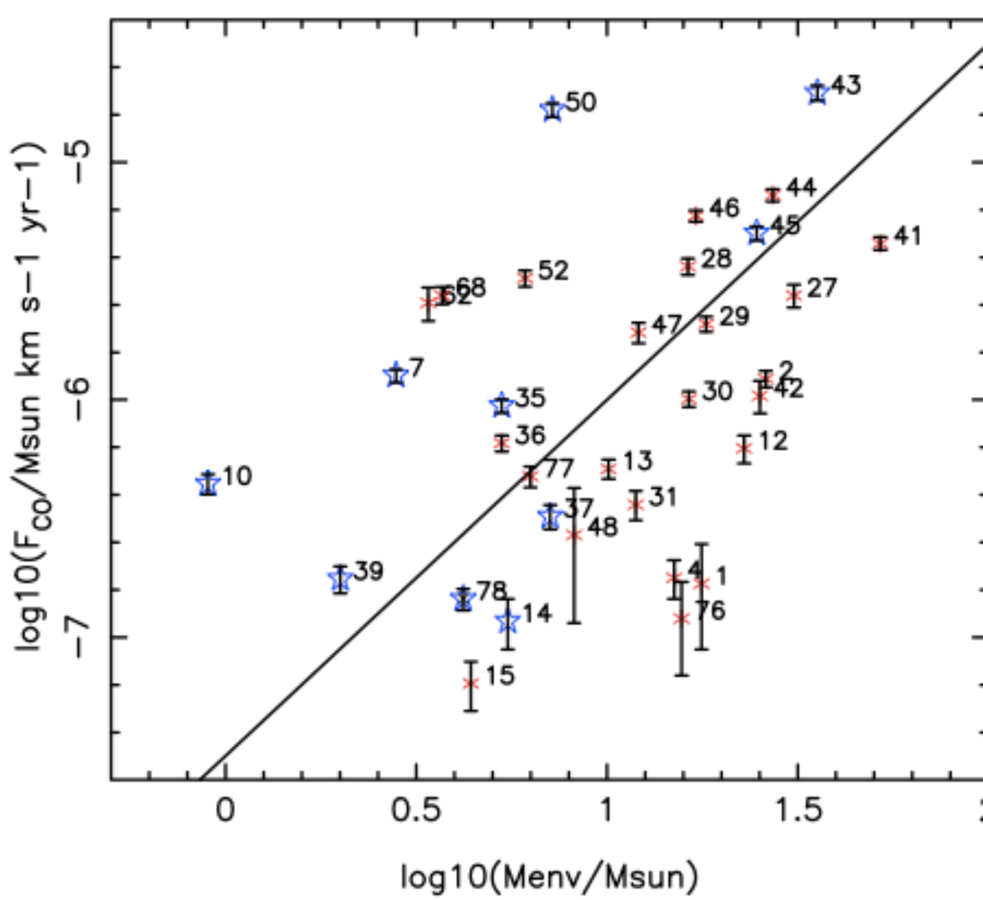

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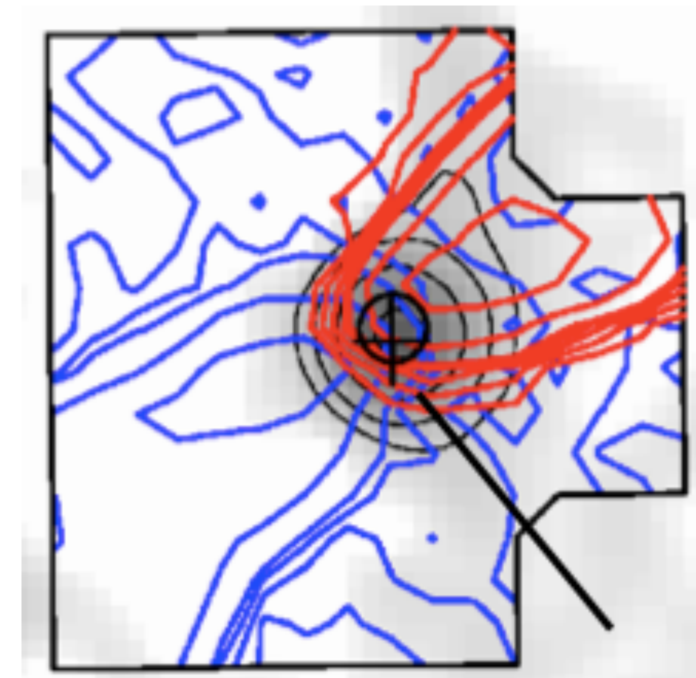

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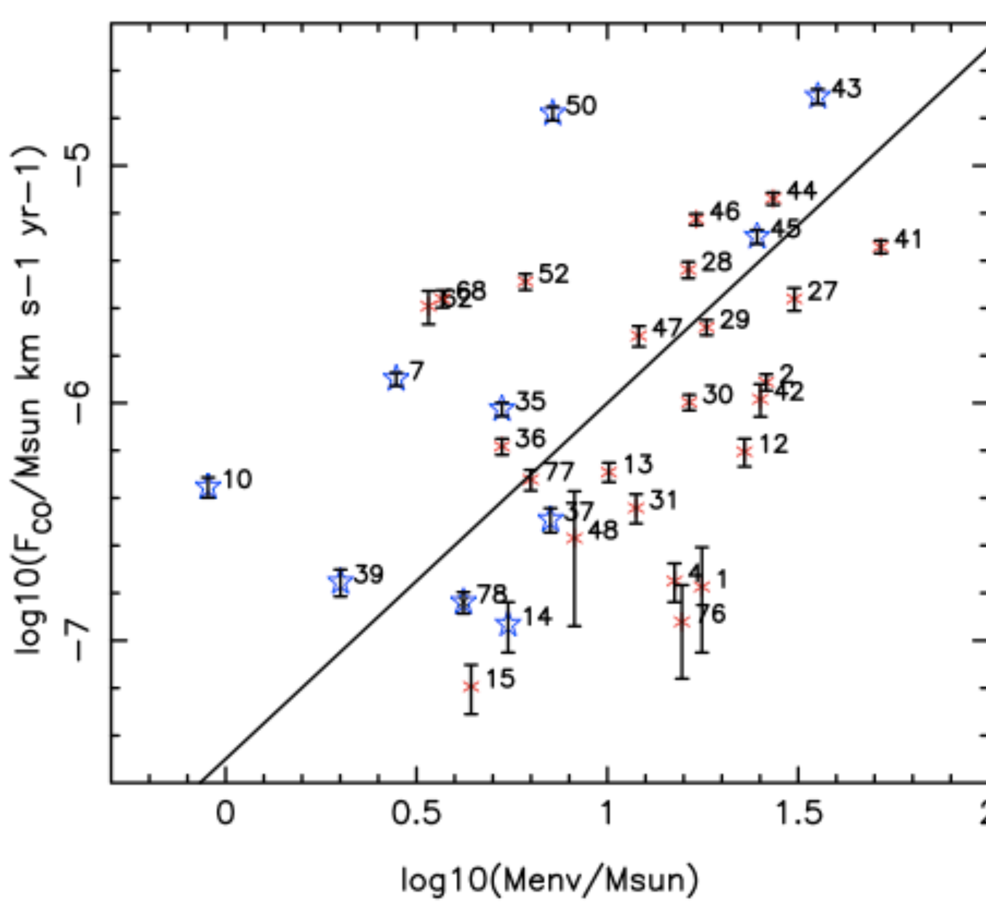
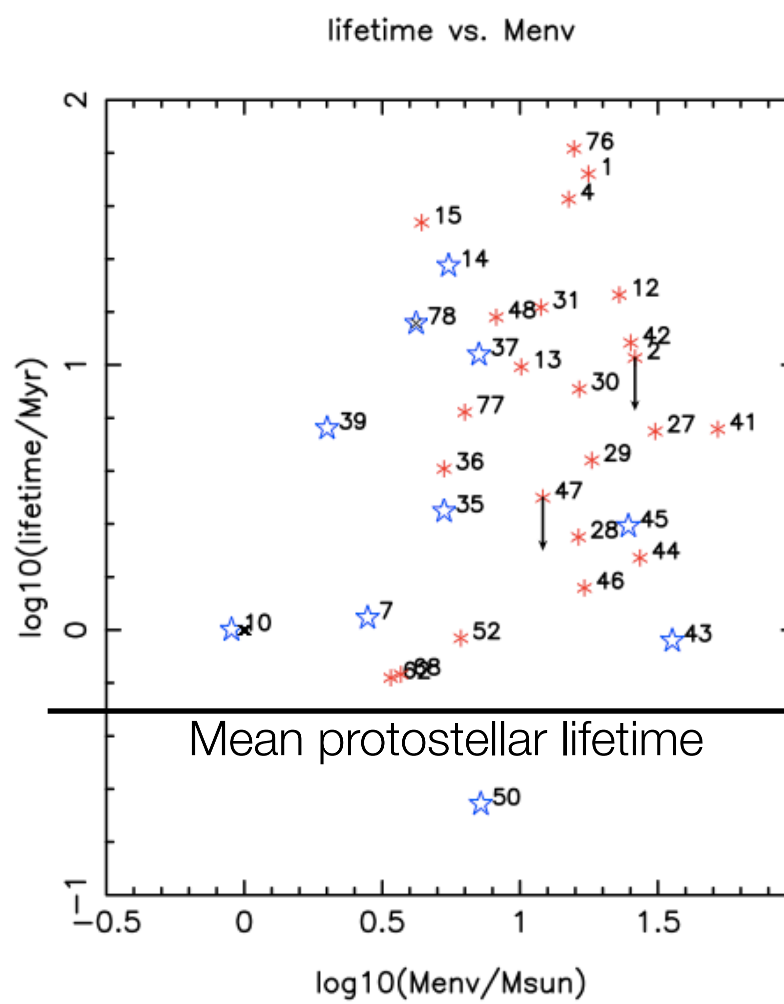


Hatchell et al. 2009



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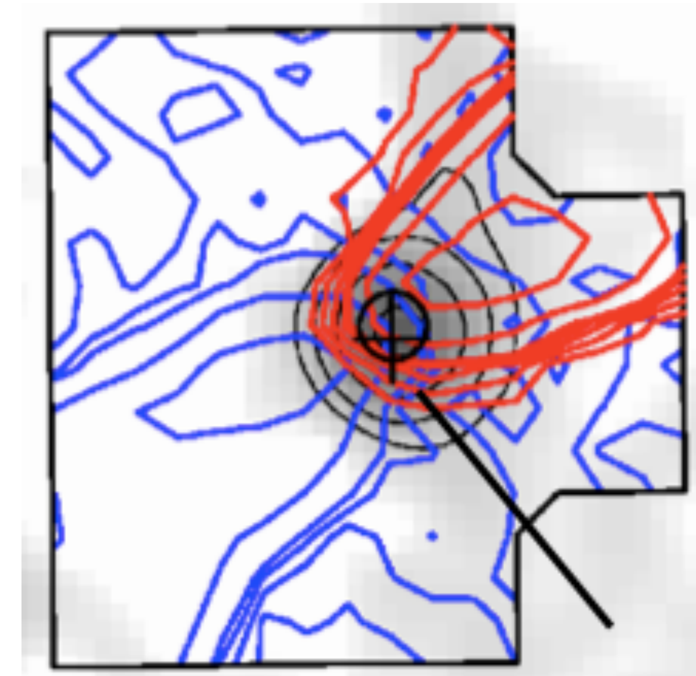

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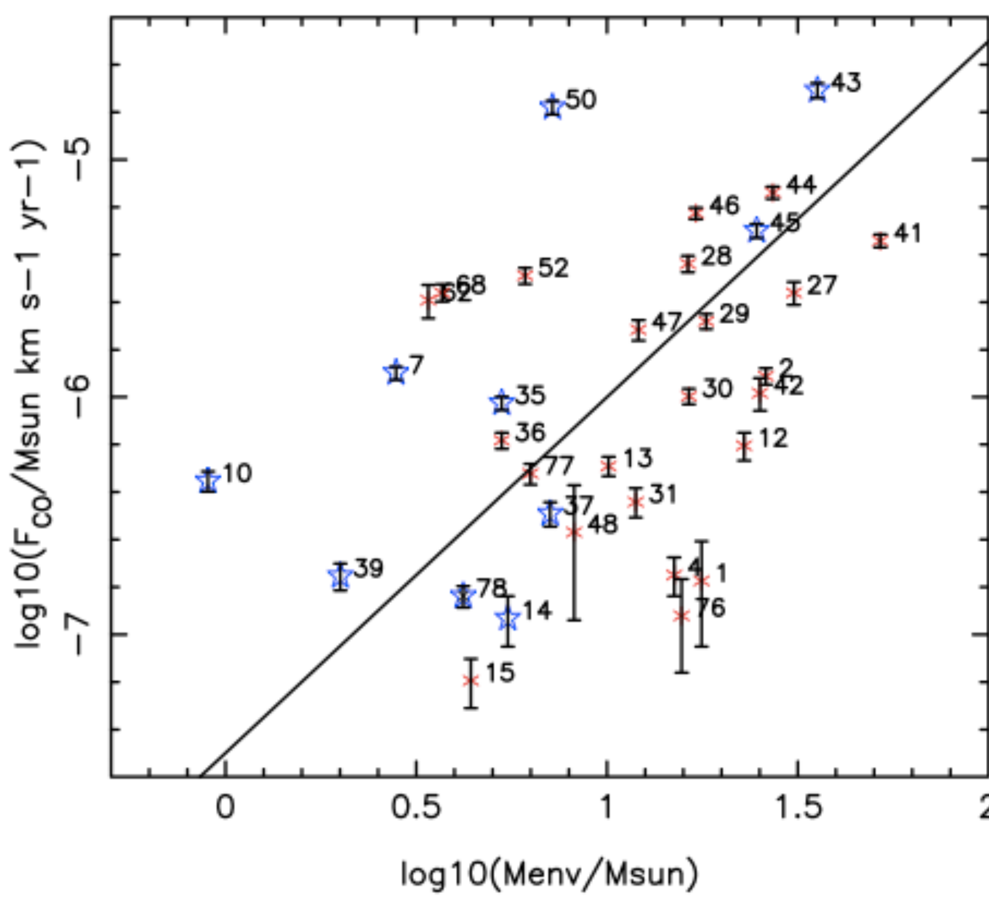

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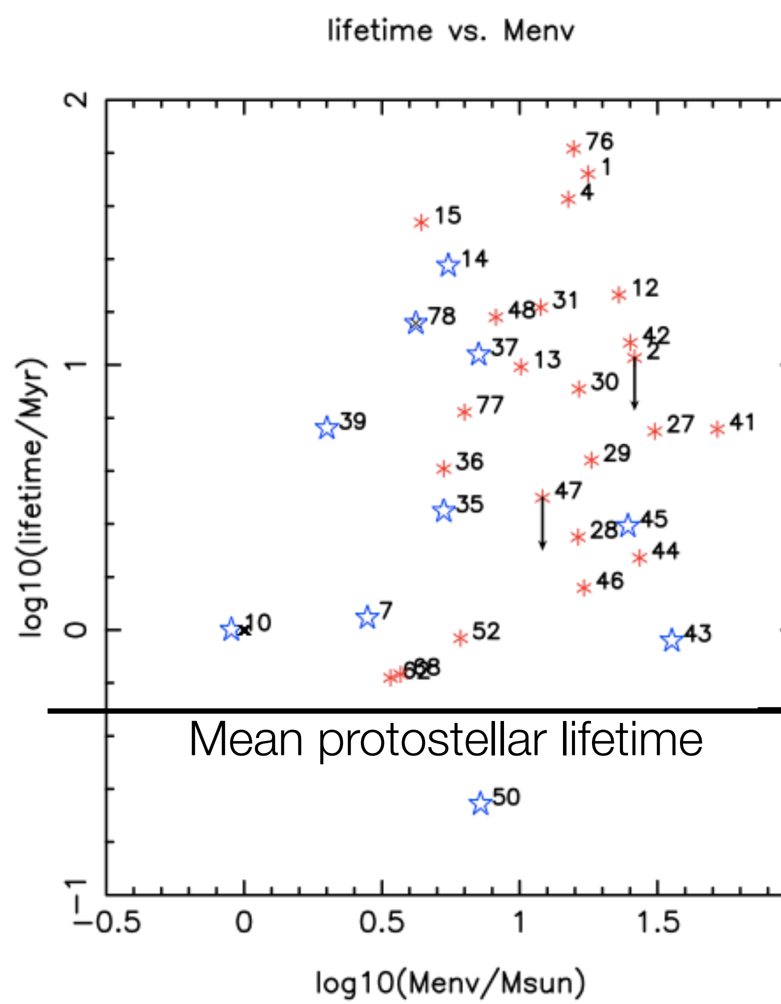
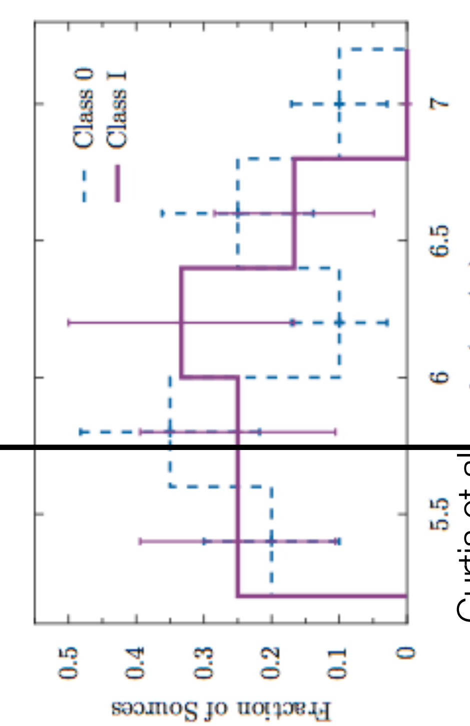


Hatchell et al. 2009



Curtis et al 2010

Mass loss for Class 0s
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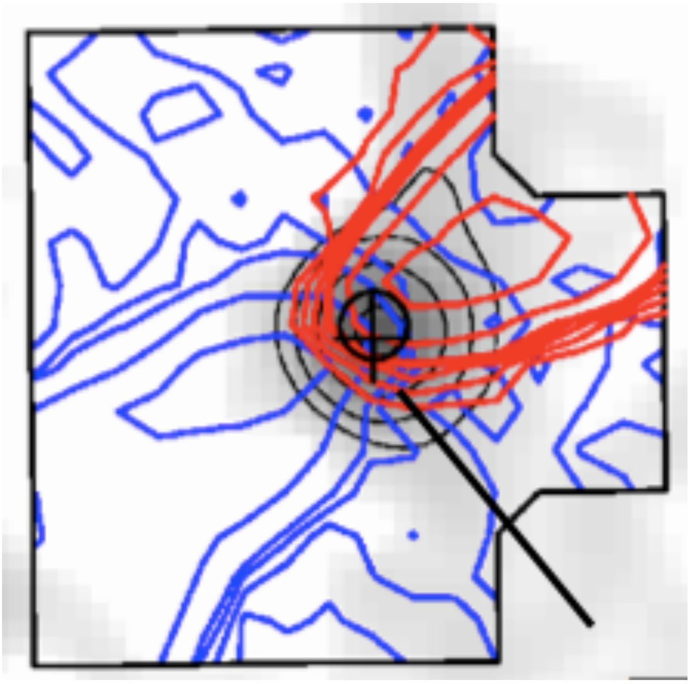

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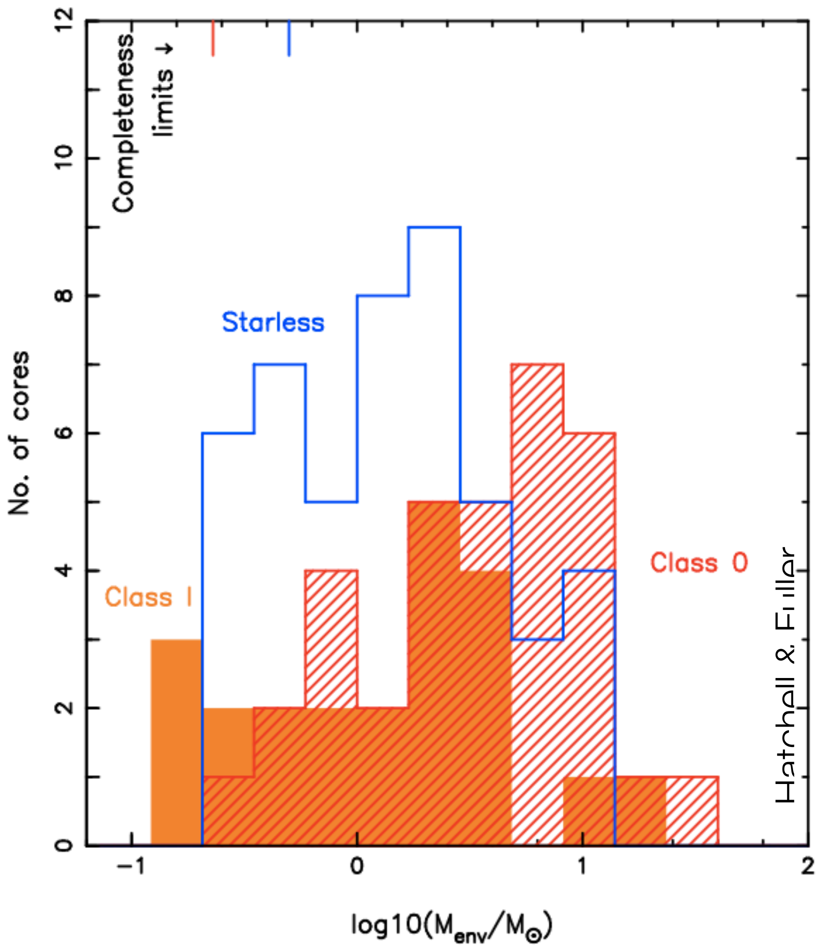

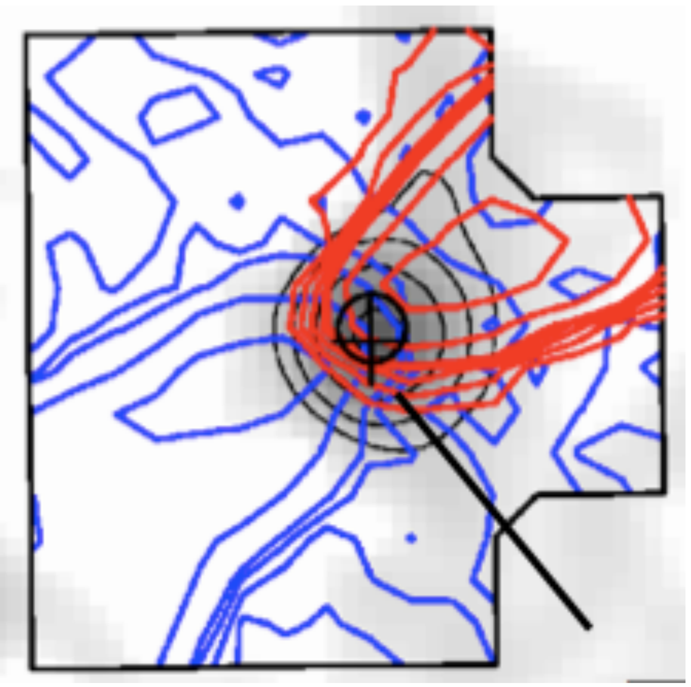

Hatchell et al. 2009

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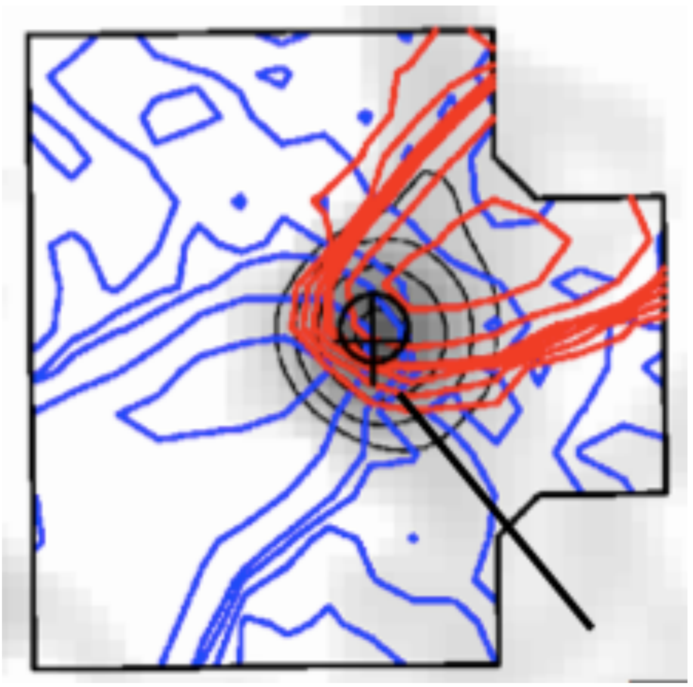

Hatchell et al. 2009

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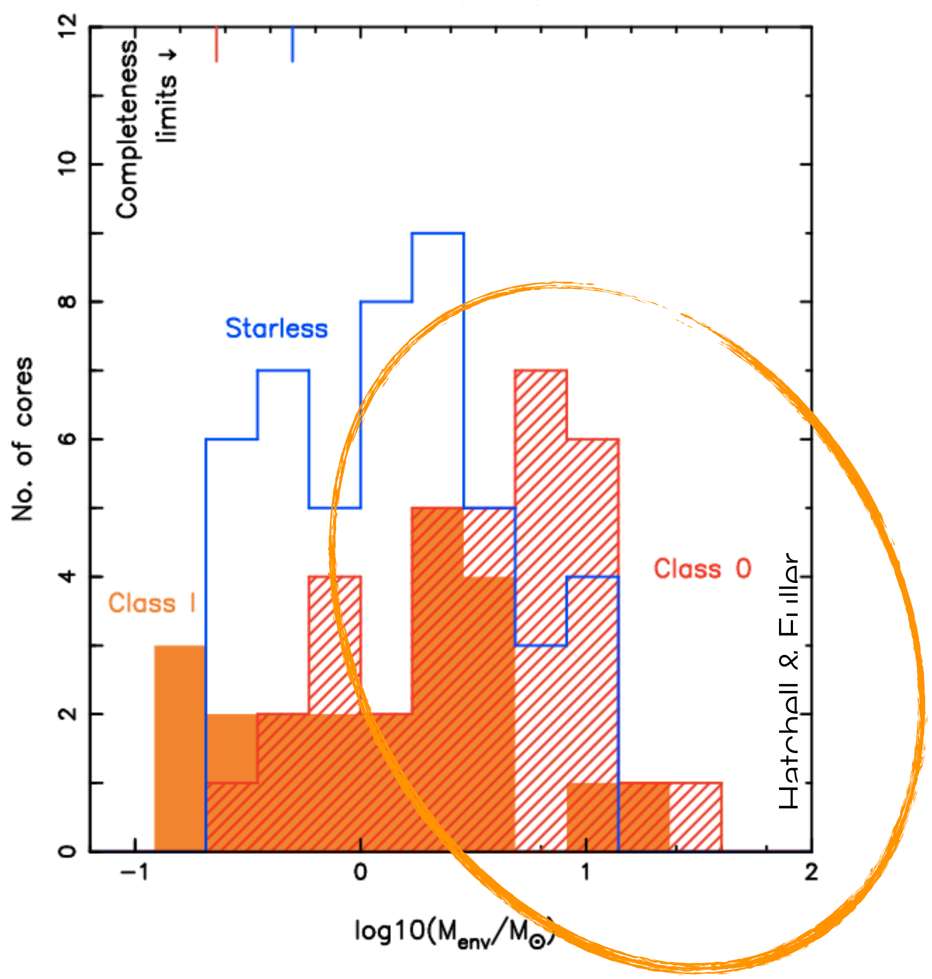

+ Clump-core accretion

- Core ablation

Class 0 CMEDs

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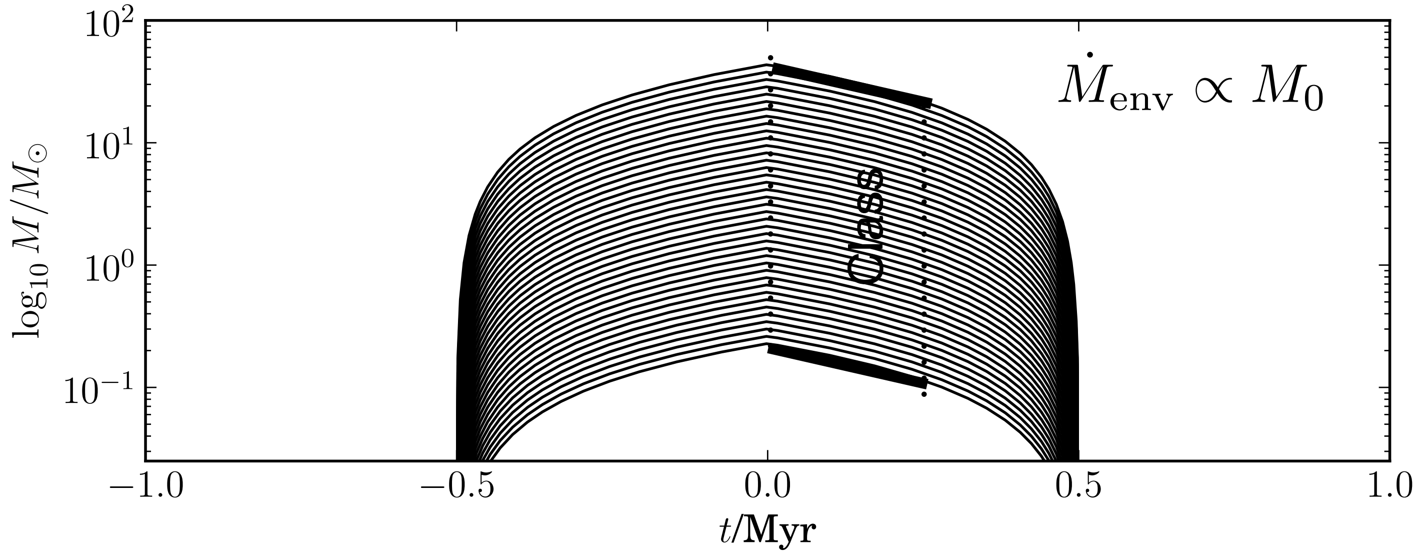

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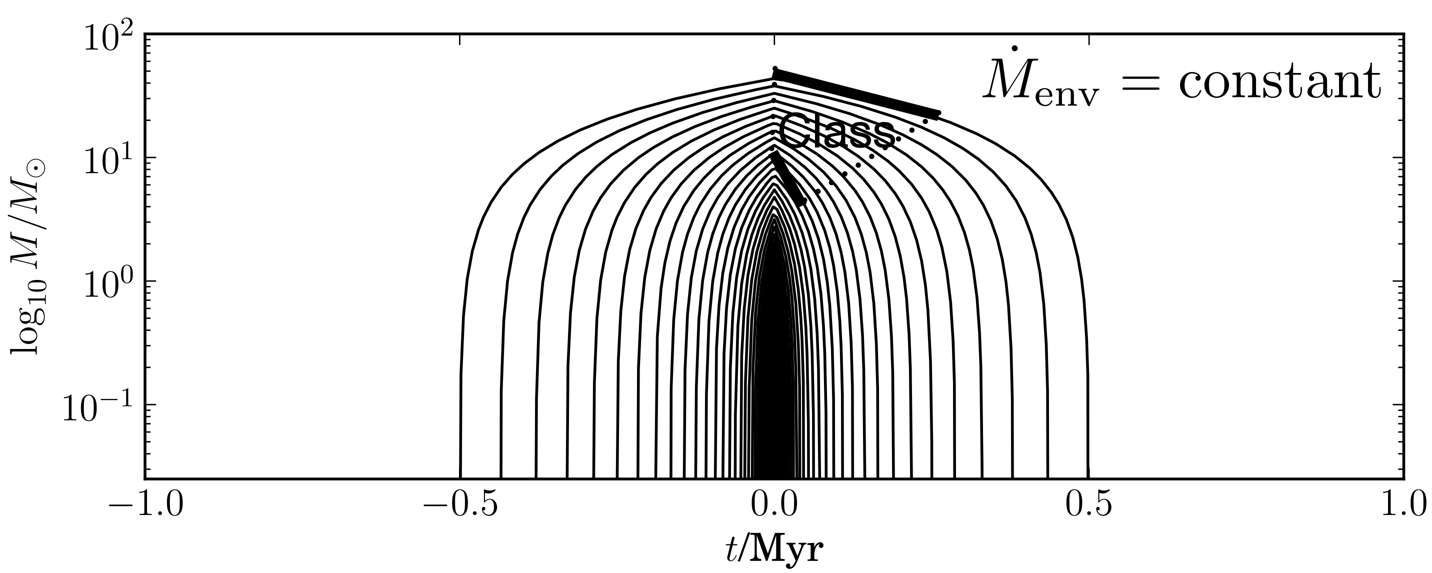

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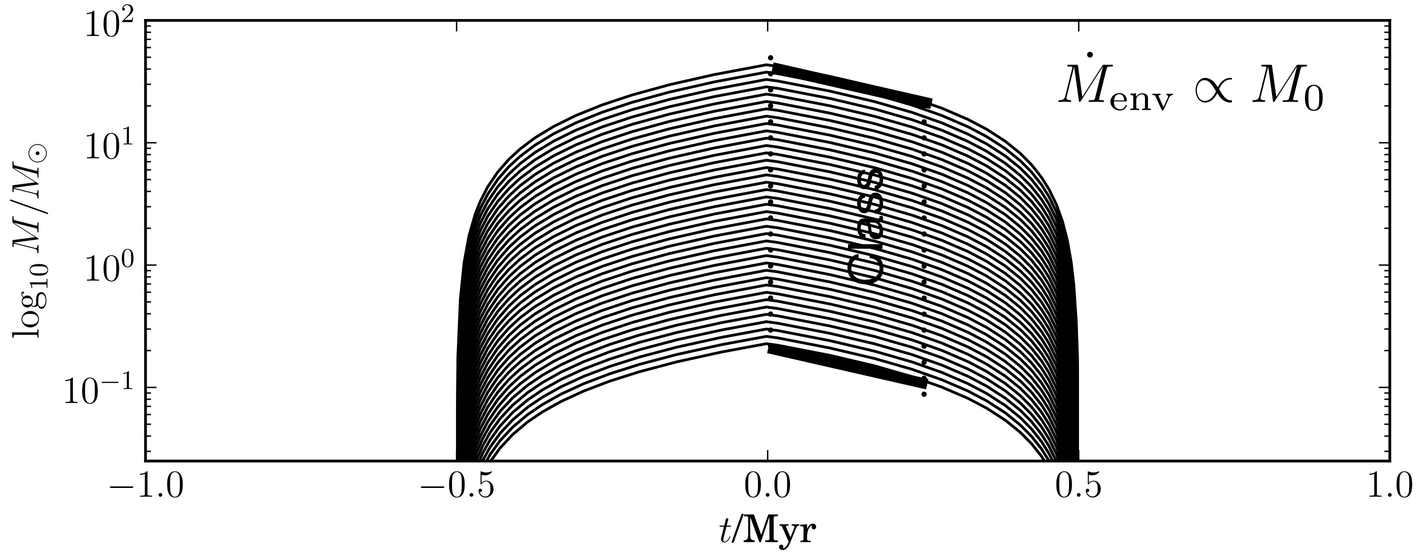

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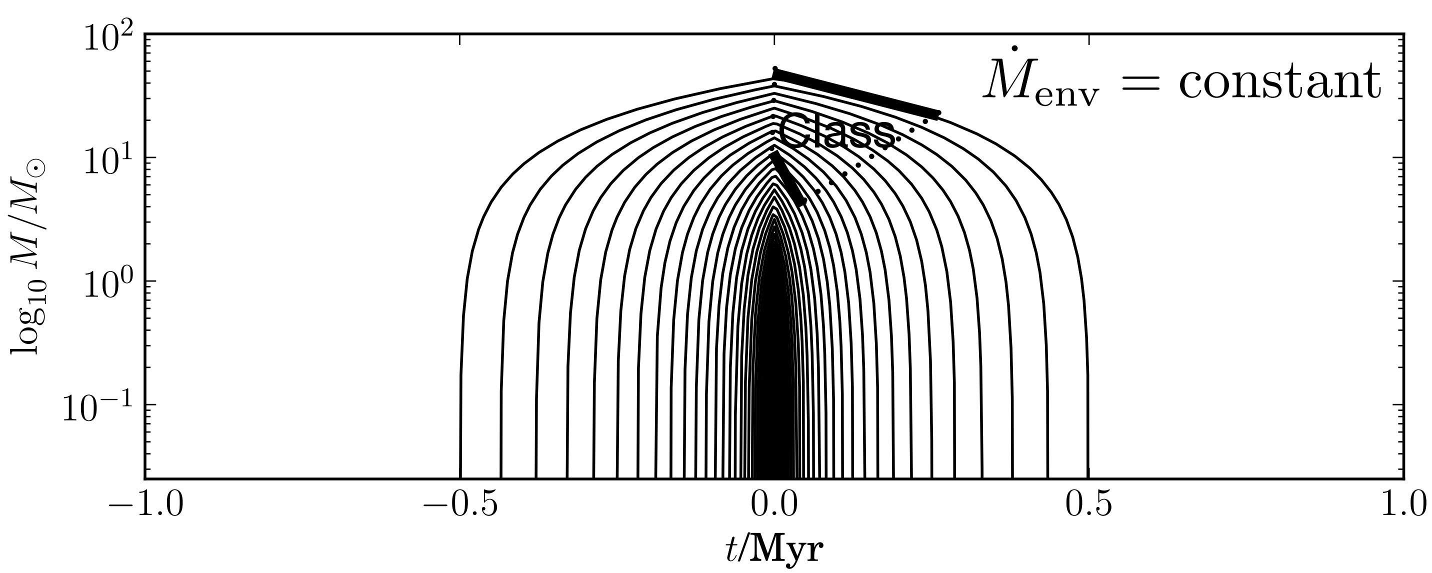

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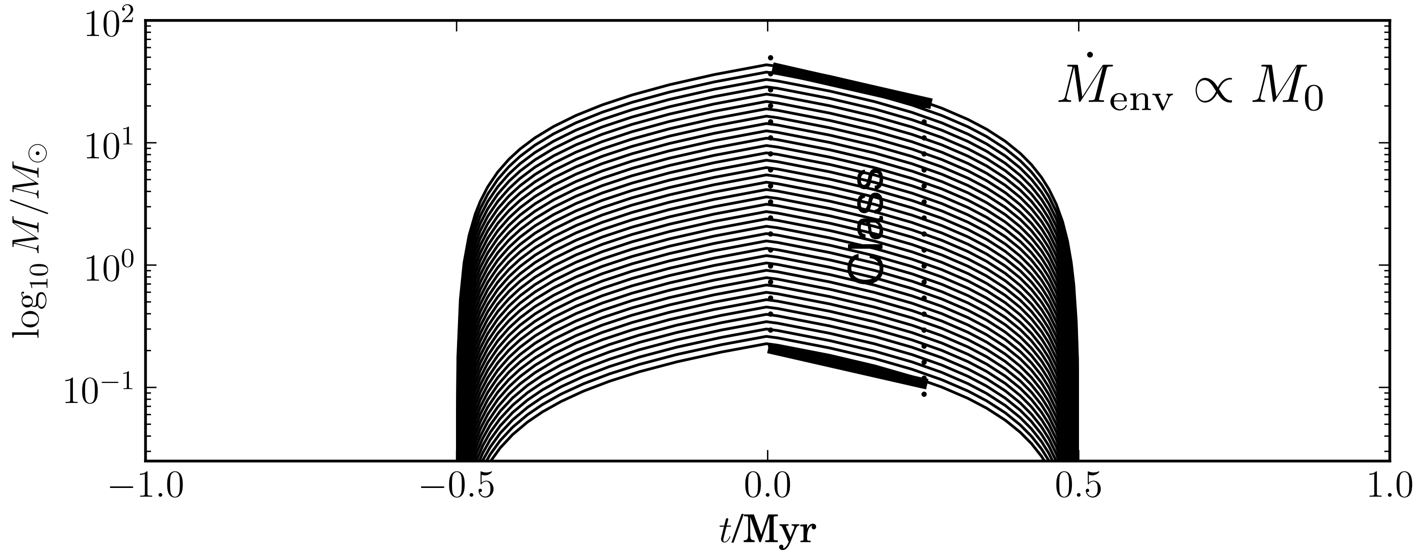
$\propto M$ $\propto M$ small??



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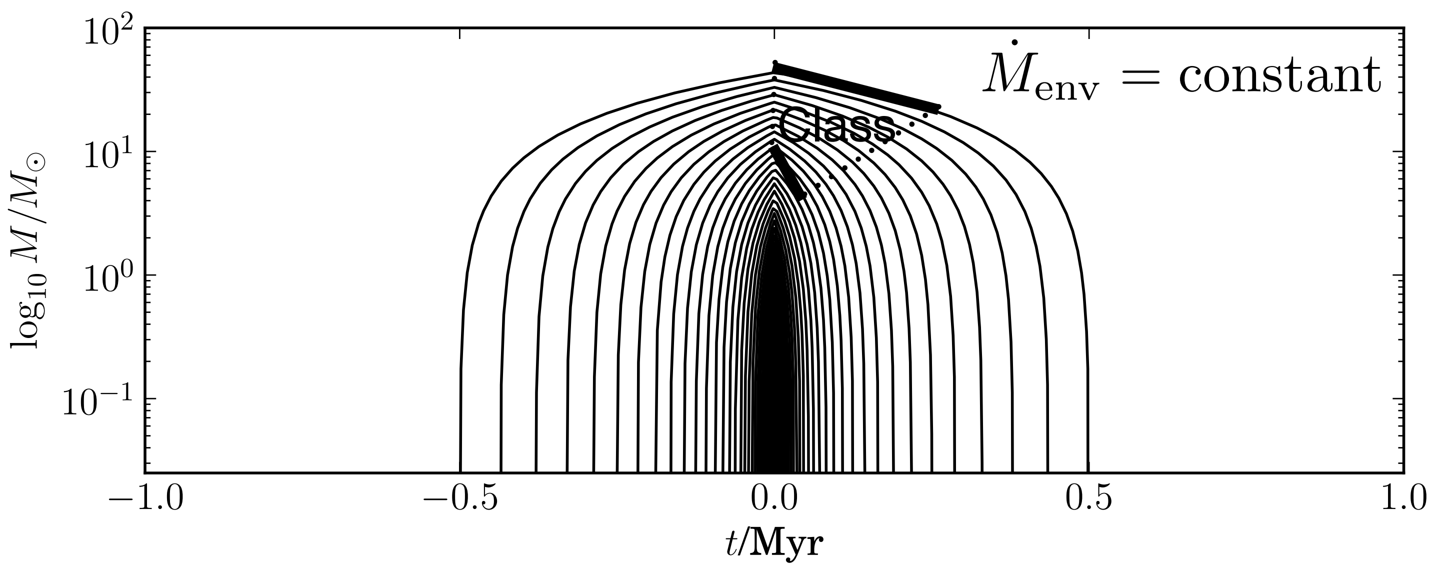

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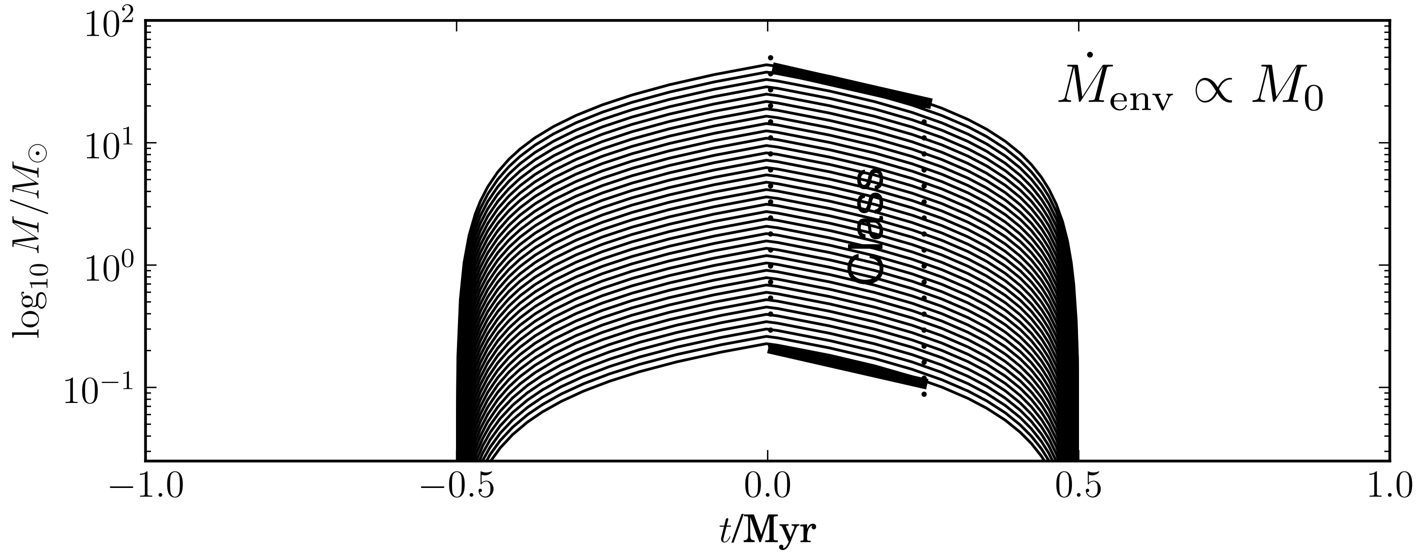

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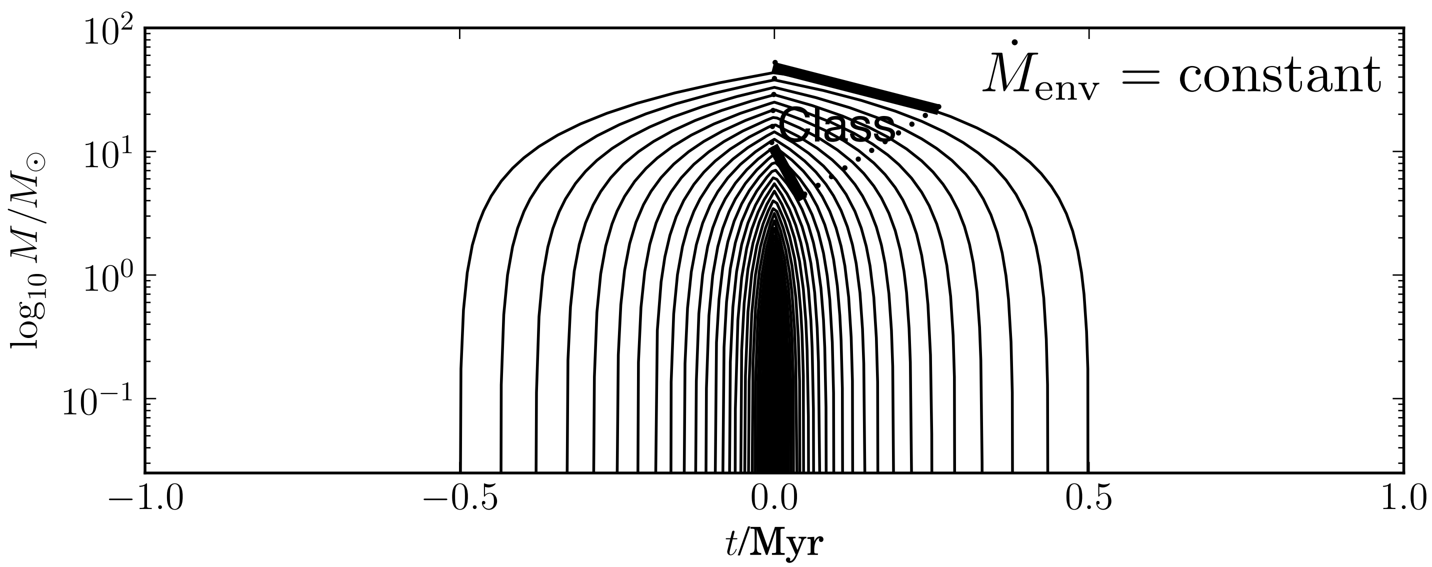

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Class 0 mass function

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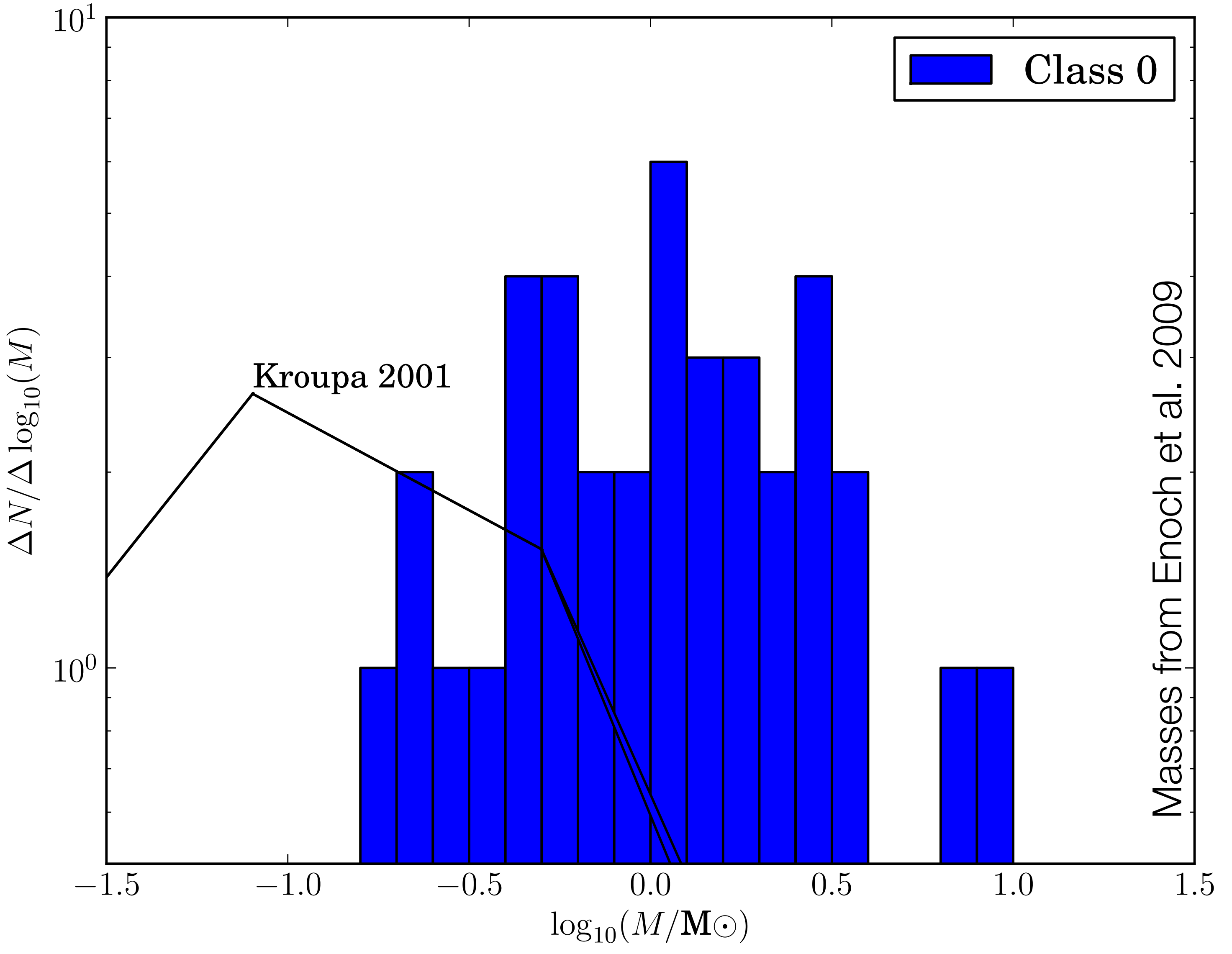

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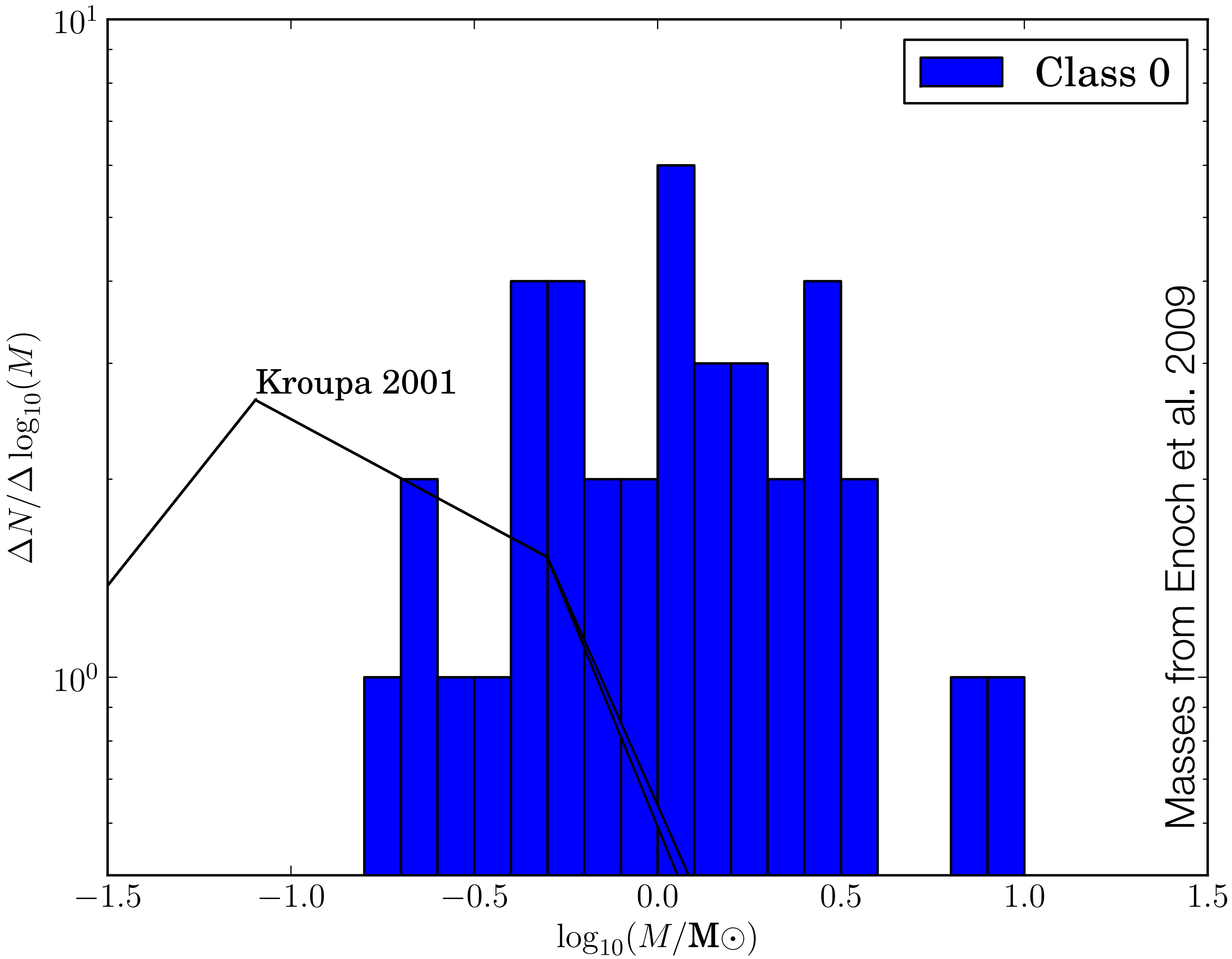

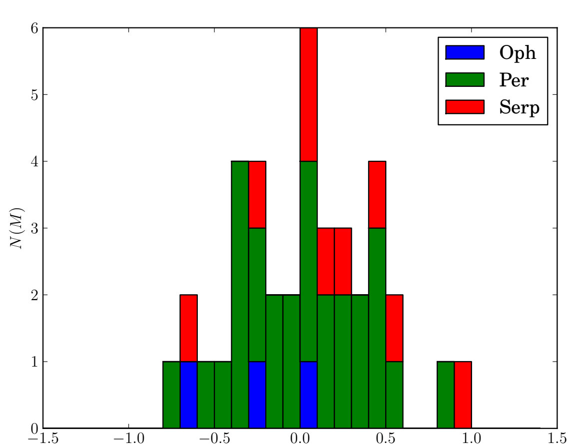

Masses from Enoch et al. 2009

Class 0 mass function

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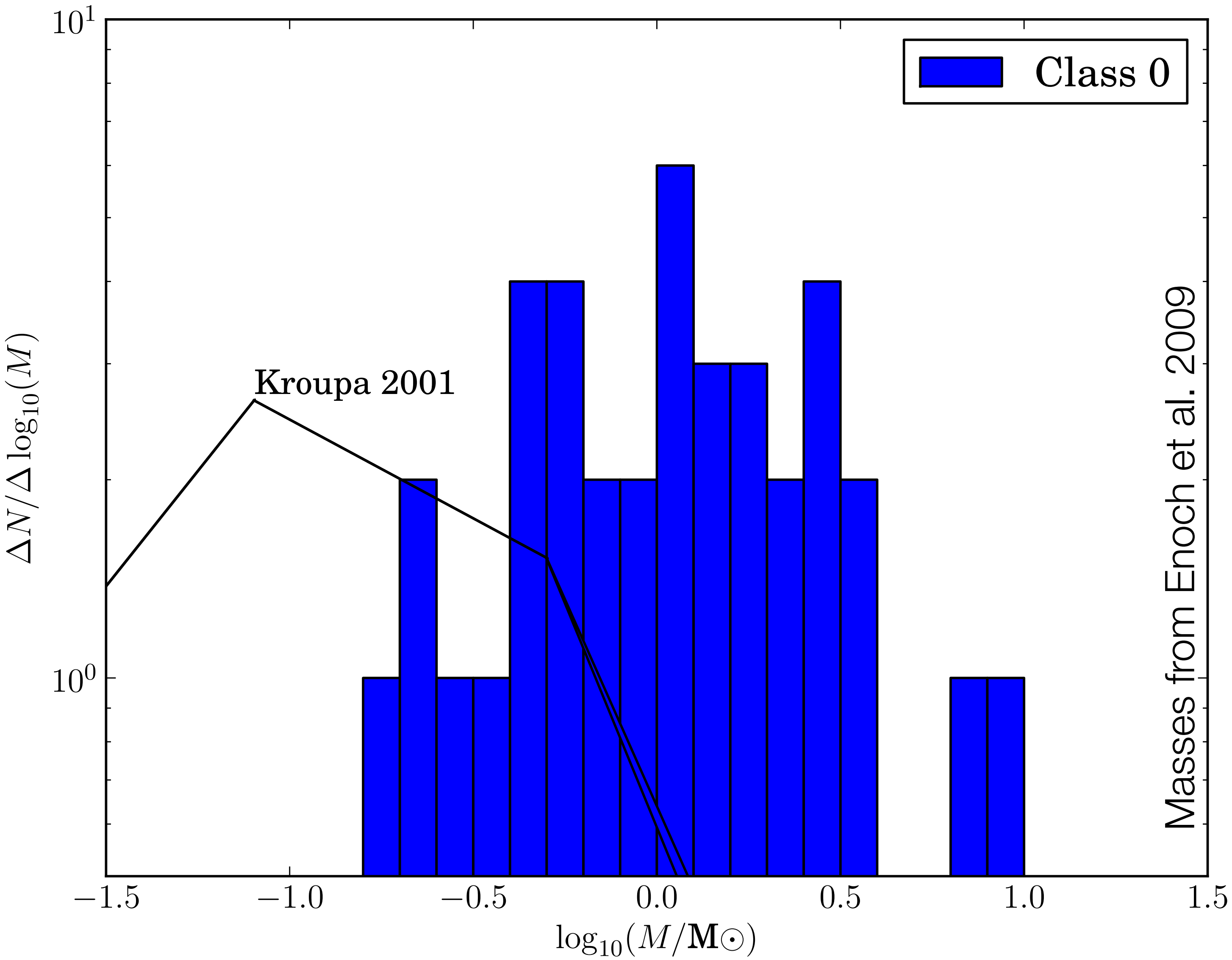
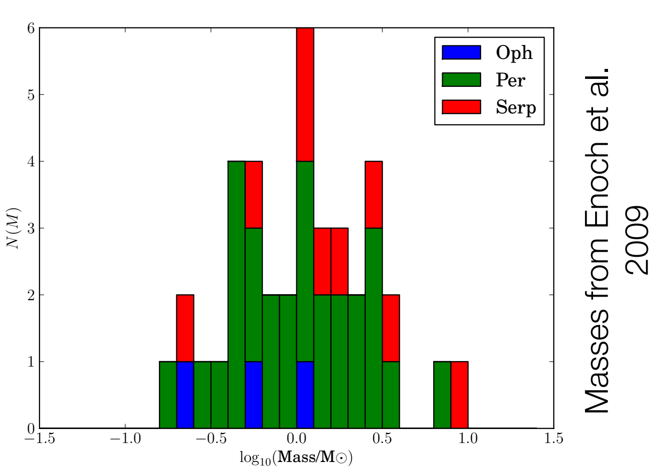




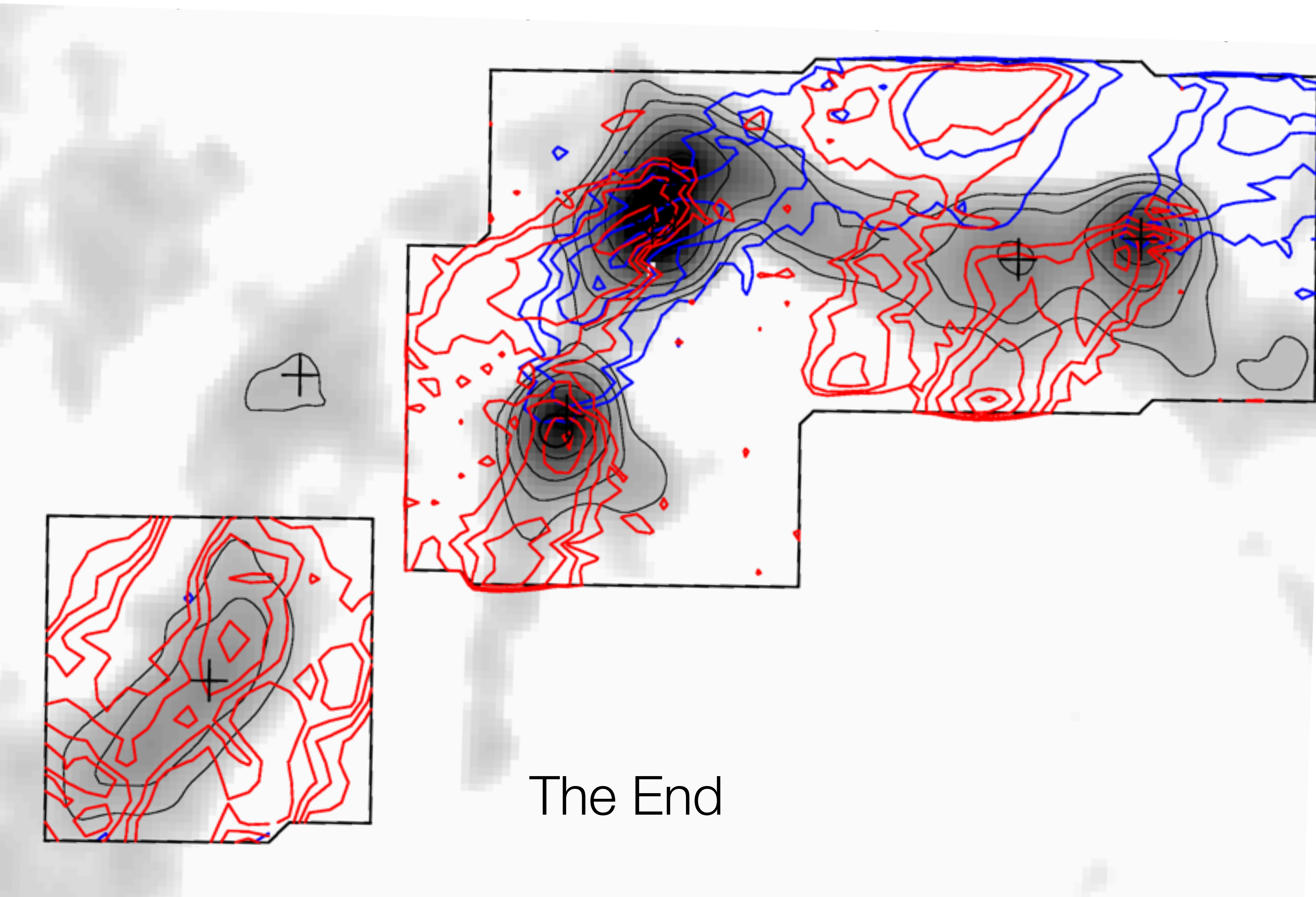
CONCLUSIONS

- Class 0 core masses represent the range of core masses which form stars
- Mass evolution affects both what you see (core masses) and what you get (stellar masses)
- If the time spent in the Class 0 phase does not vary much with mass, ie.

$$\dot{M}_{\rm env} \propto M$$

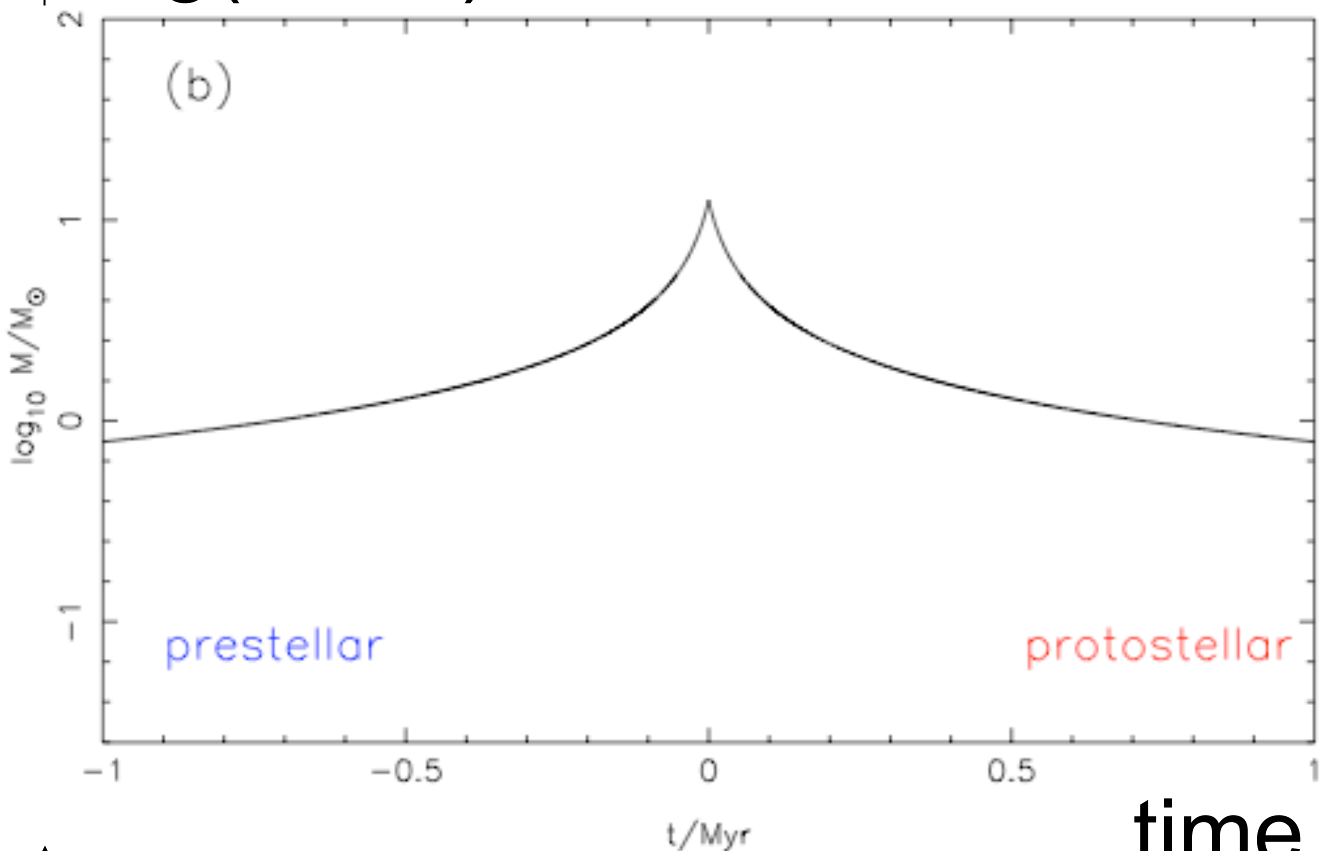
then the Class 0 mass function is representative of the core masses from which stars actually form

- There is some evidence (luminosity, outflows) that this is the case, but it needs further work.



The End

log(mass)



time

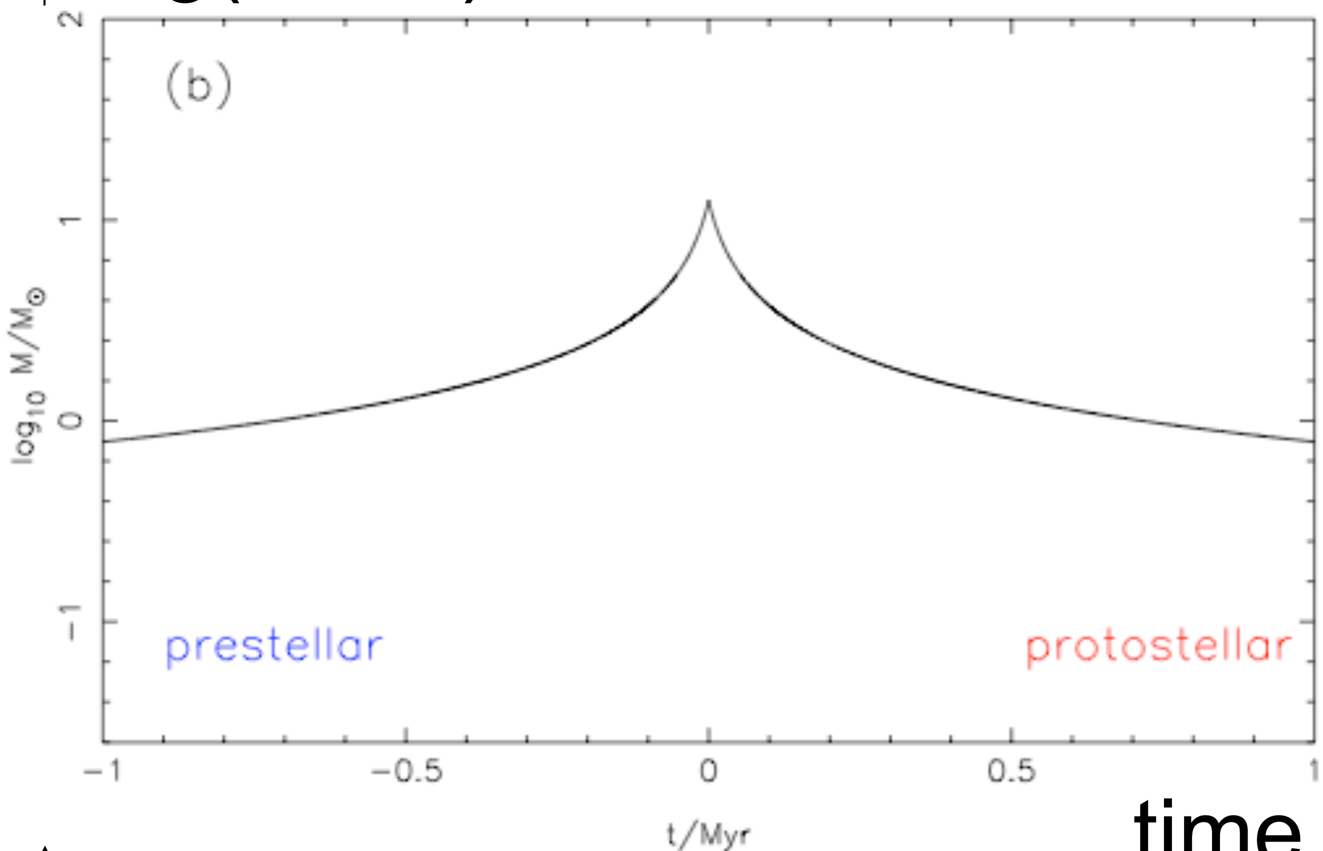
CMEDs (b) single and pathological

$$m = (\gamma|t| + m_{\rm peak}^{-\gamma})^{-1/\gamma}$$

$$\gamma = 1.35$$

08

log(mass)



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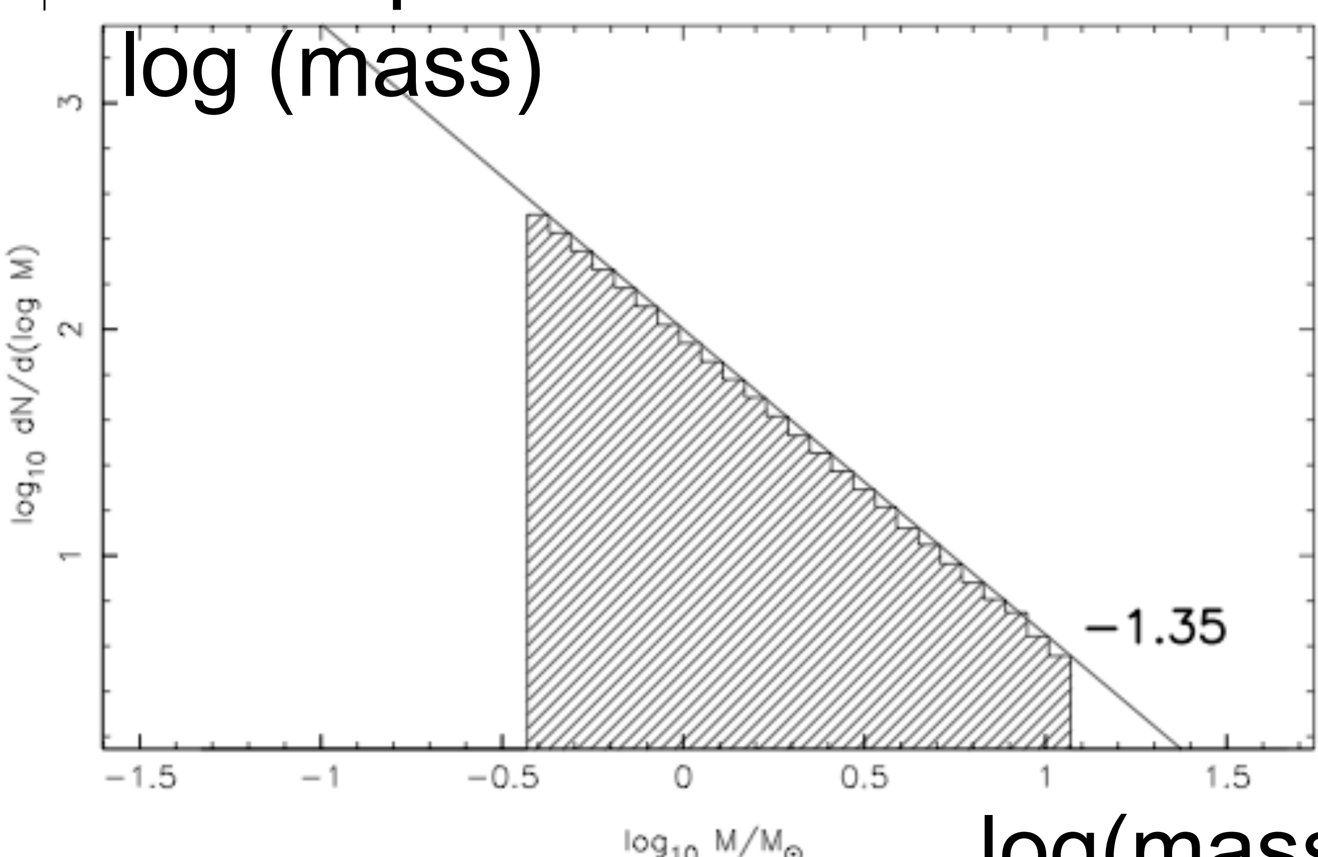
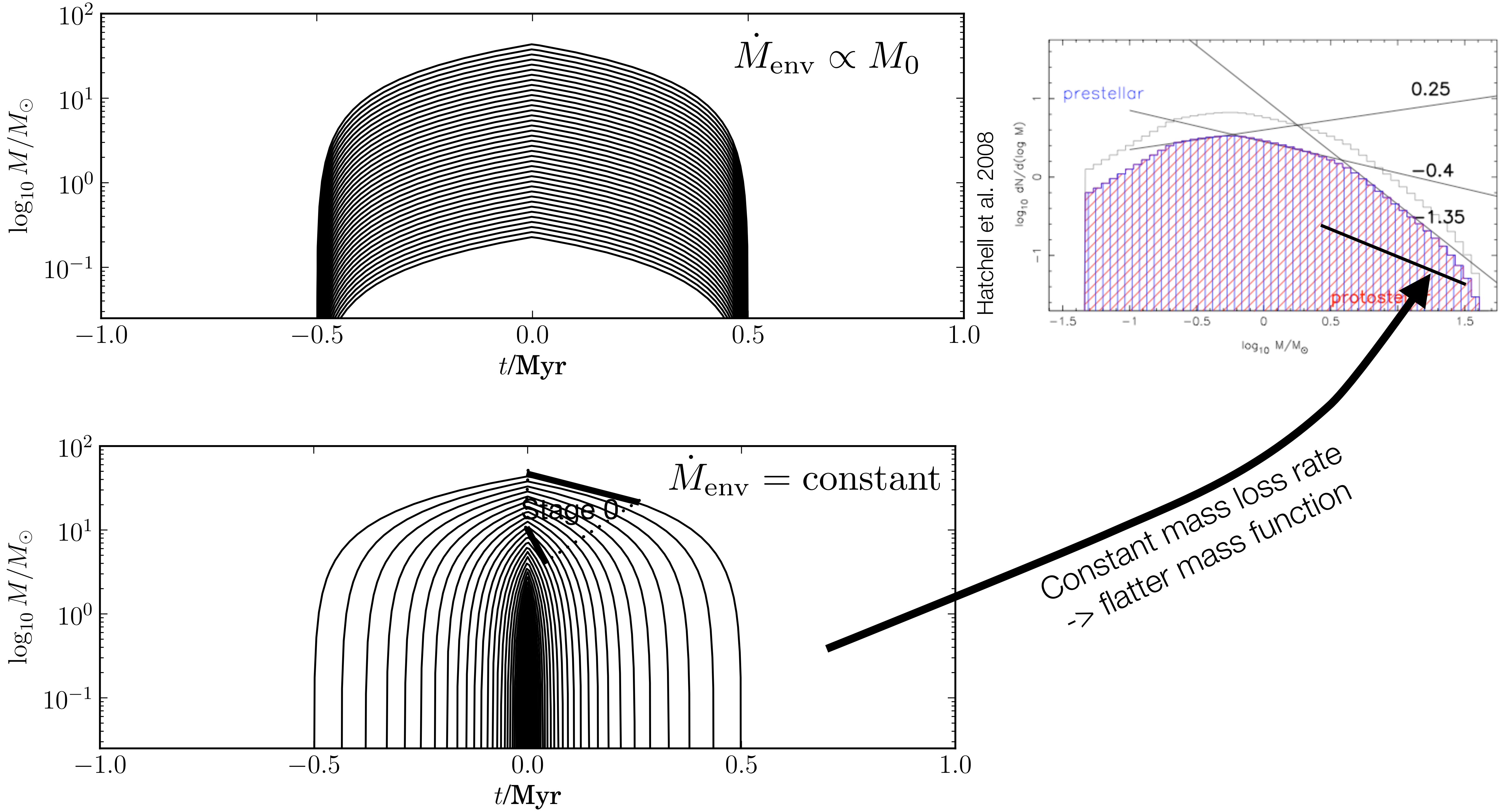
Cores per unit log (mass)



log(mass)

Class 0 timescales



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