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Do Massive Stars Form in Isolation?

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constellation

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Introduction

- de Wit et al. (2004) surveyed 43 O-type *field* stars.
- 12% found to be surrounded by a small cluster.
- Many were found to be runaways (see also Gvaramadze & Bomans 2008).
- 4(±2)% found to be in <u>apparent isolation</u>.
- 5% of B-type stars also observed in isolation.

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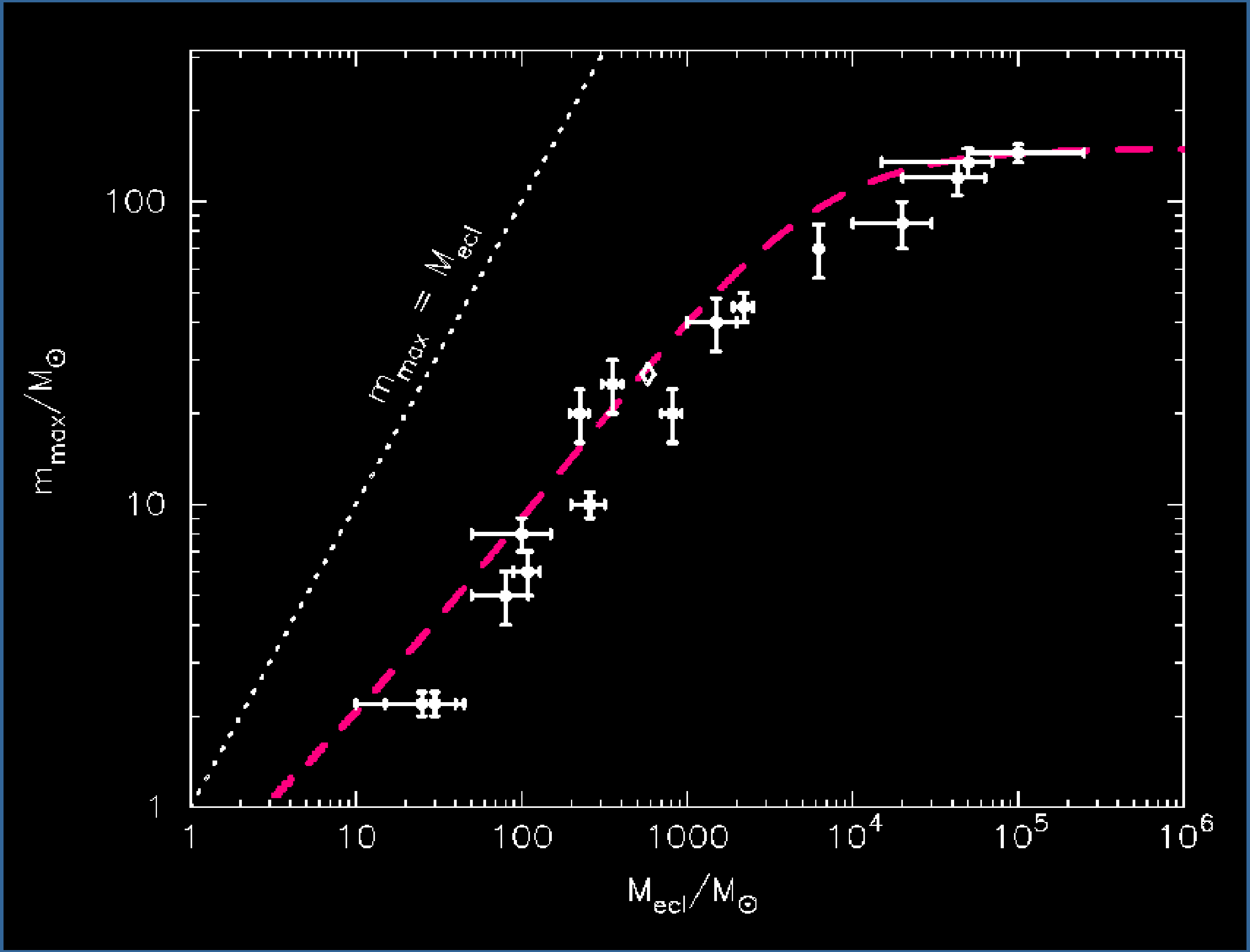
Introduction

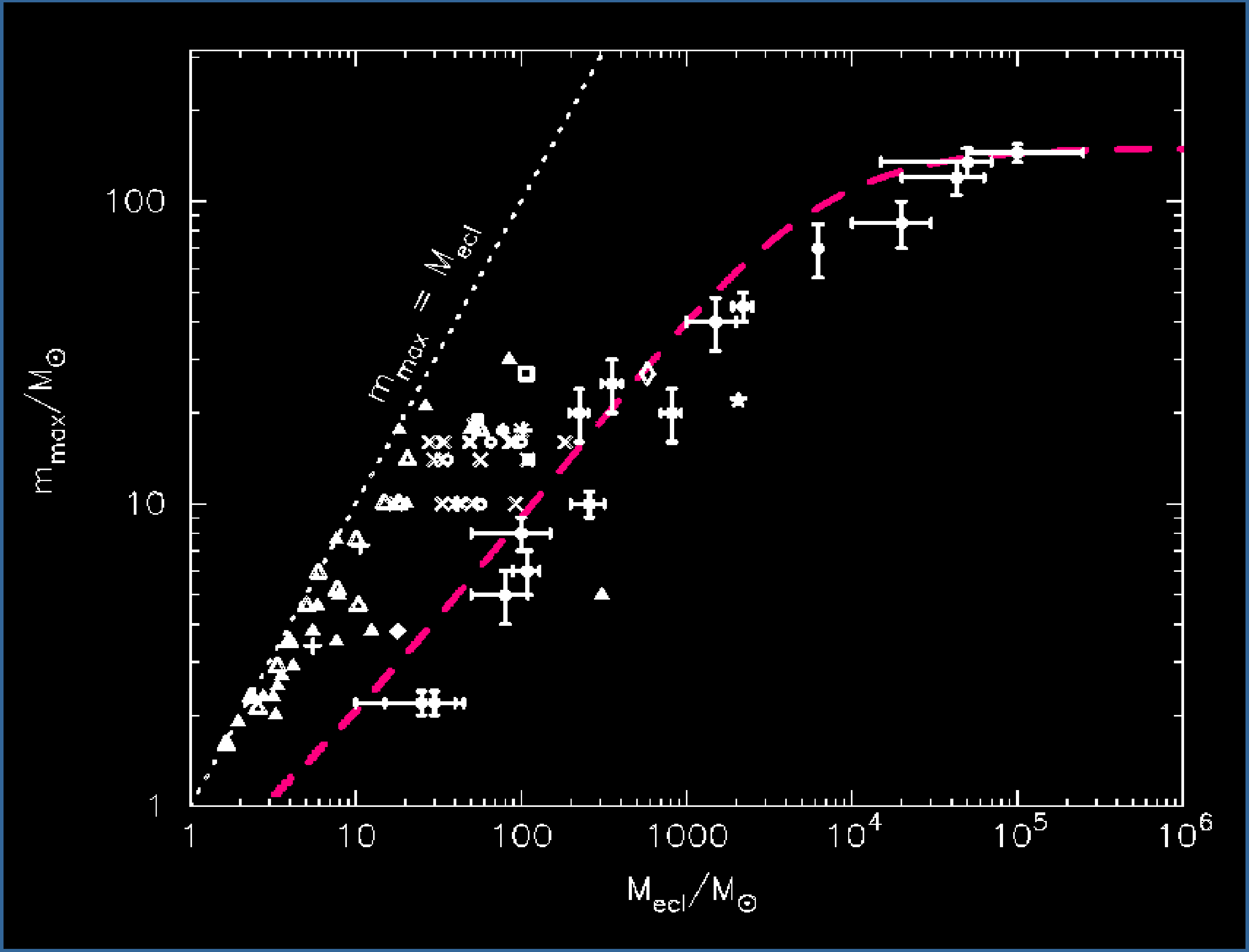
- 70 – 90% of all stars form in clusters.
- Cluster masses described by single-power law slope; β = 1.5 – 2.
- Stars in these clusters appear to form with a universal IMF (Kroupa 2002).
- Therefore, one O-type star forms per 200 – 300 $M_\odot$ of stars.
- Is the mass of the most massive star in the cluster governed by the mass of the cluster (Weidner & Kroupa 2004, 2006; Weidner et al. 2009)?

The CMMSM



$m_{max} = M_{ecl}$
$m_{max}/M_\odot$
$M_{ecl}/M_\odot$
100
10
1
1
10
100
1000
10^4
10^5
10^6

Low-mass Clusters



Simulations

- Cluster masses chosen at random from CMF.
- Stellar masses:

    i) randomly chosen from IMF

    ii) constrained by a fundamental CMMSM

- 'Isolated' O-type star fraction ($N_{(sing.)}/N_{tot}$):

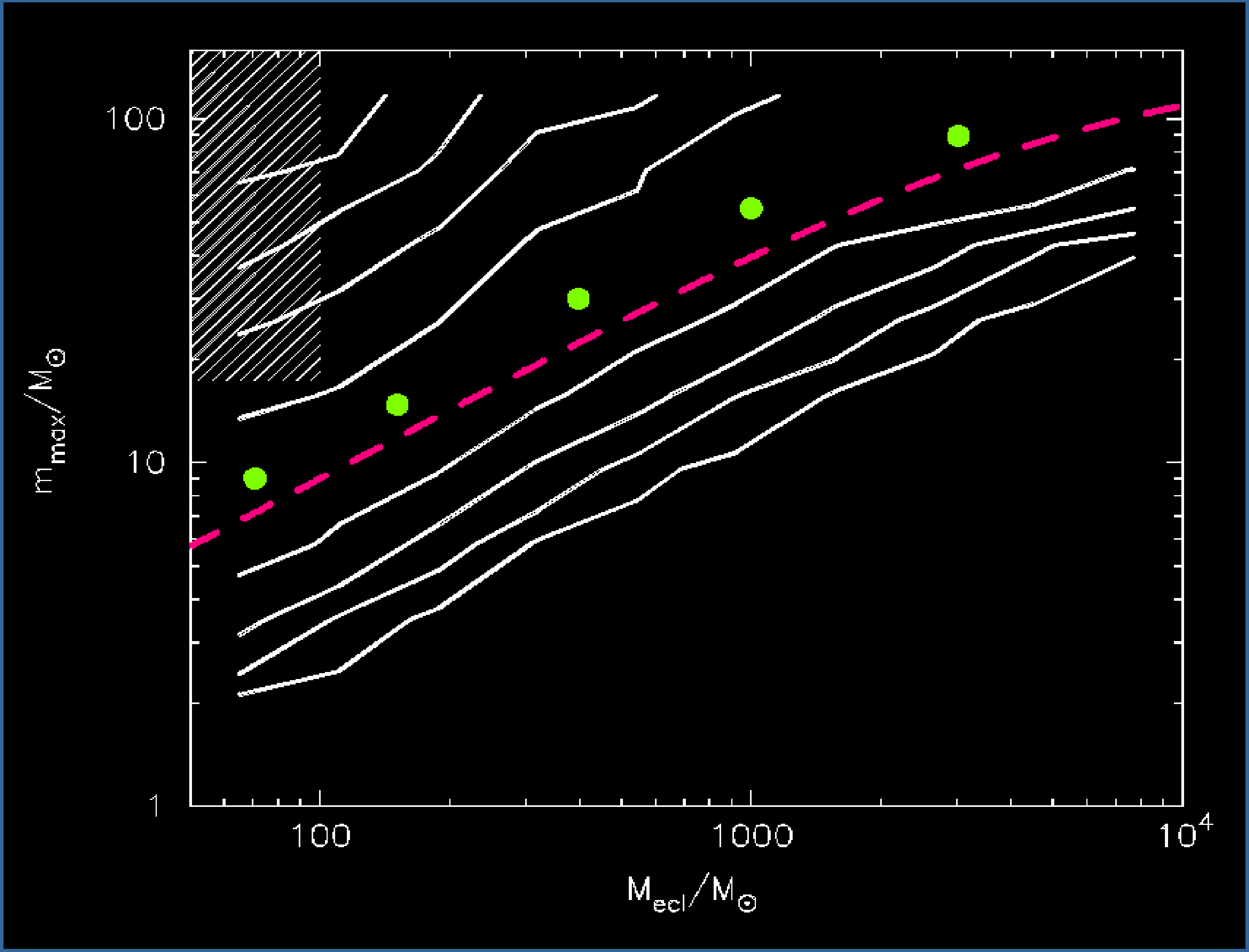
    i) 16% with no constraints

    5% if no B-type stars & $M_{ecl} < 100\ M_o$

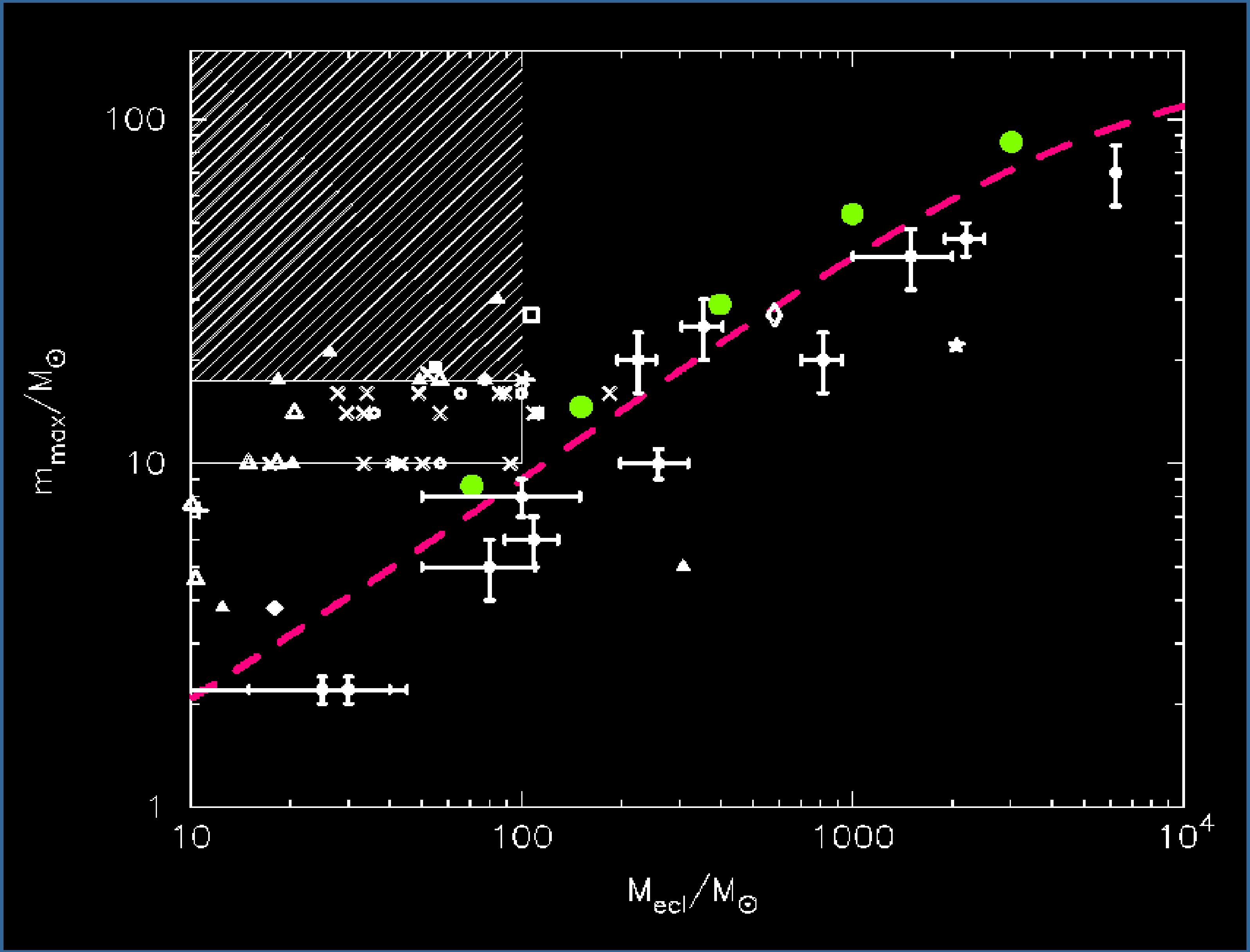
    ii) 4% with no constraints

    0% if no B-type stars & $M_{ecl} < 100\ M_o$

A median CMMSM?



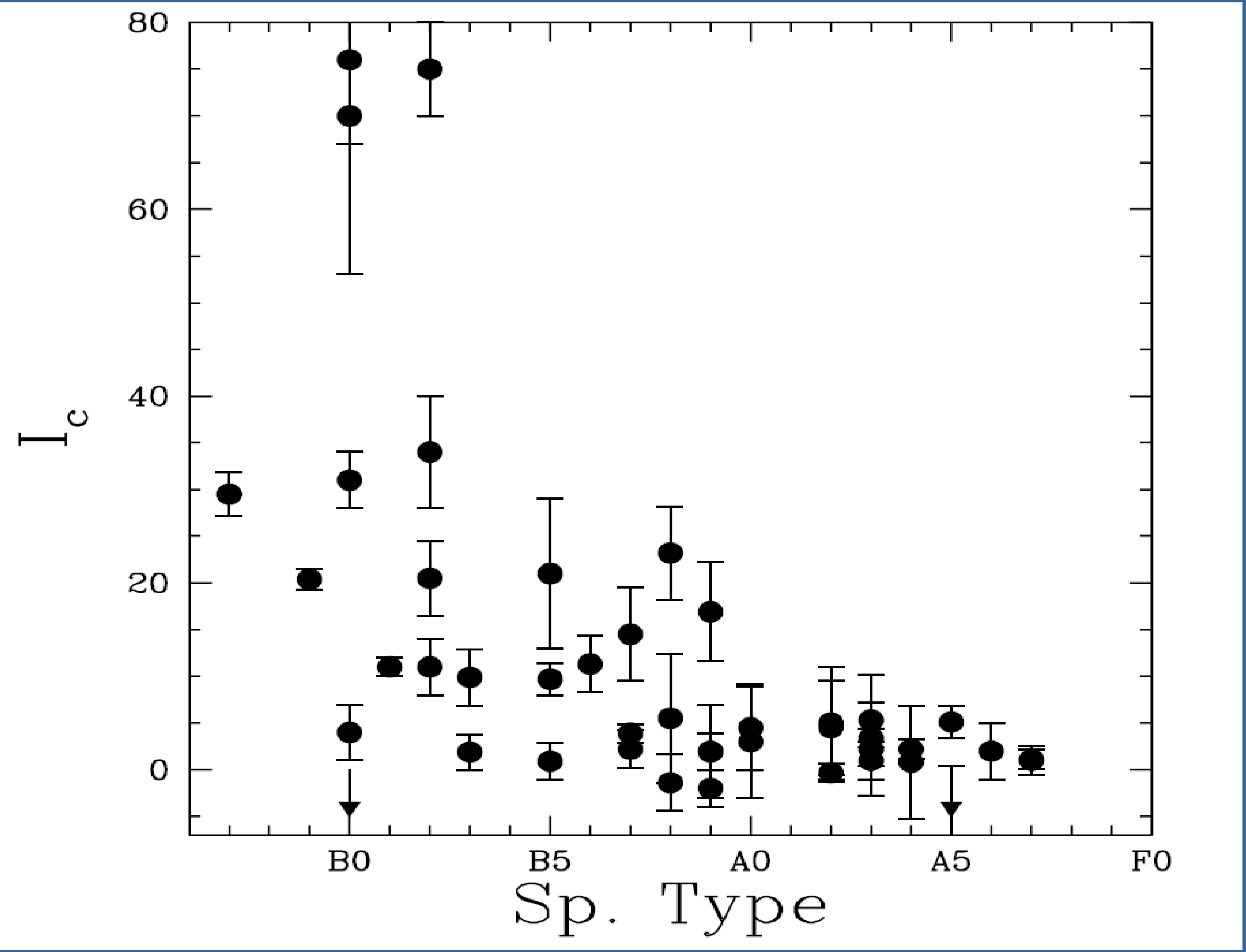
A median CMMSM?



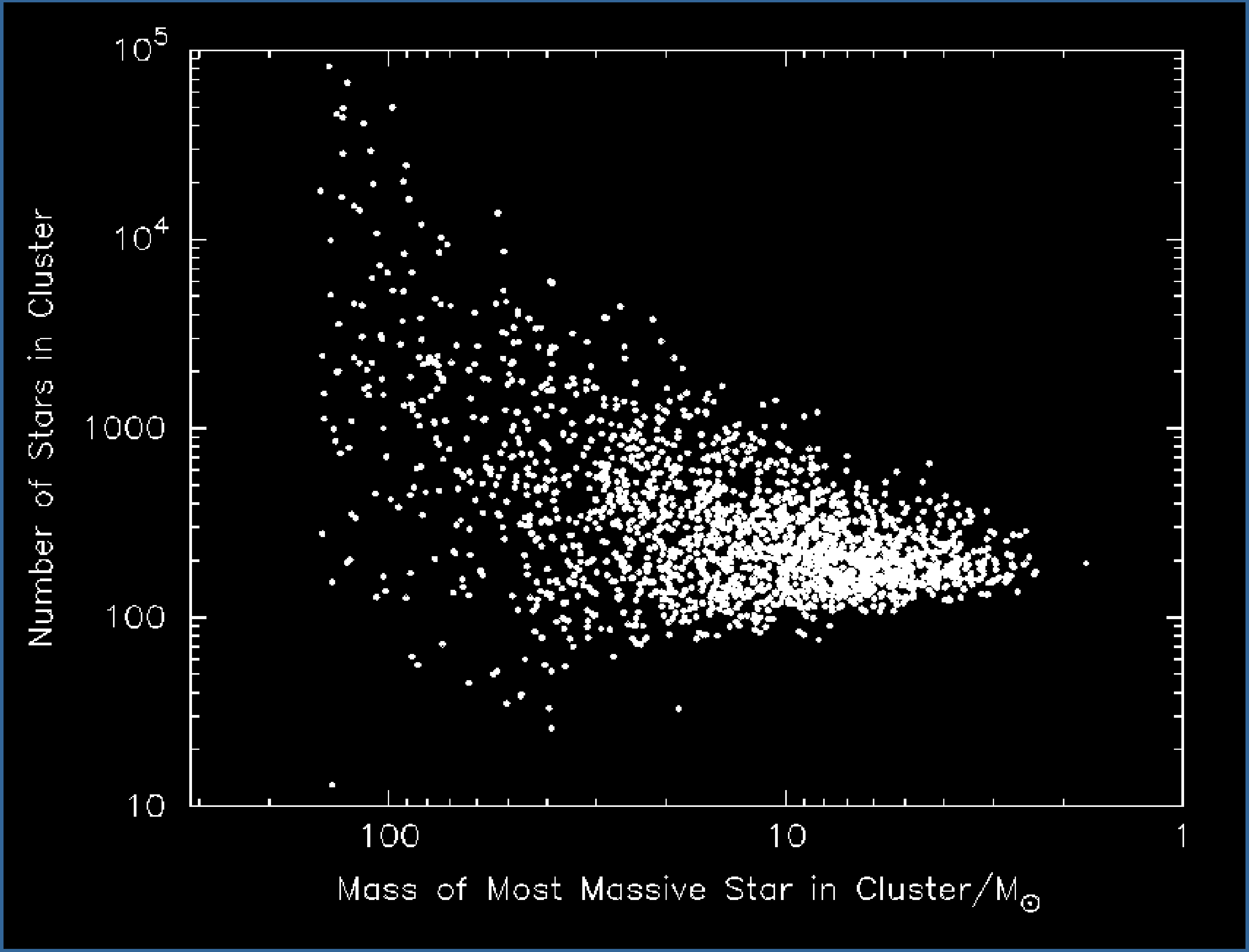
Other Massive Stars

- In a series of papers, Testi et al. (1997, 1998, 1999) looked for evidence of clustering around Ae/Be stars.
- They plotted the spectral type of the most massive star in the cluster against the cluster 'richness indicator' – i.e. cluster mass.

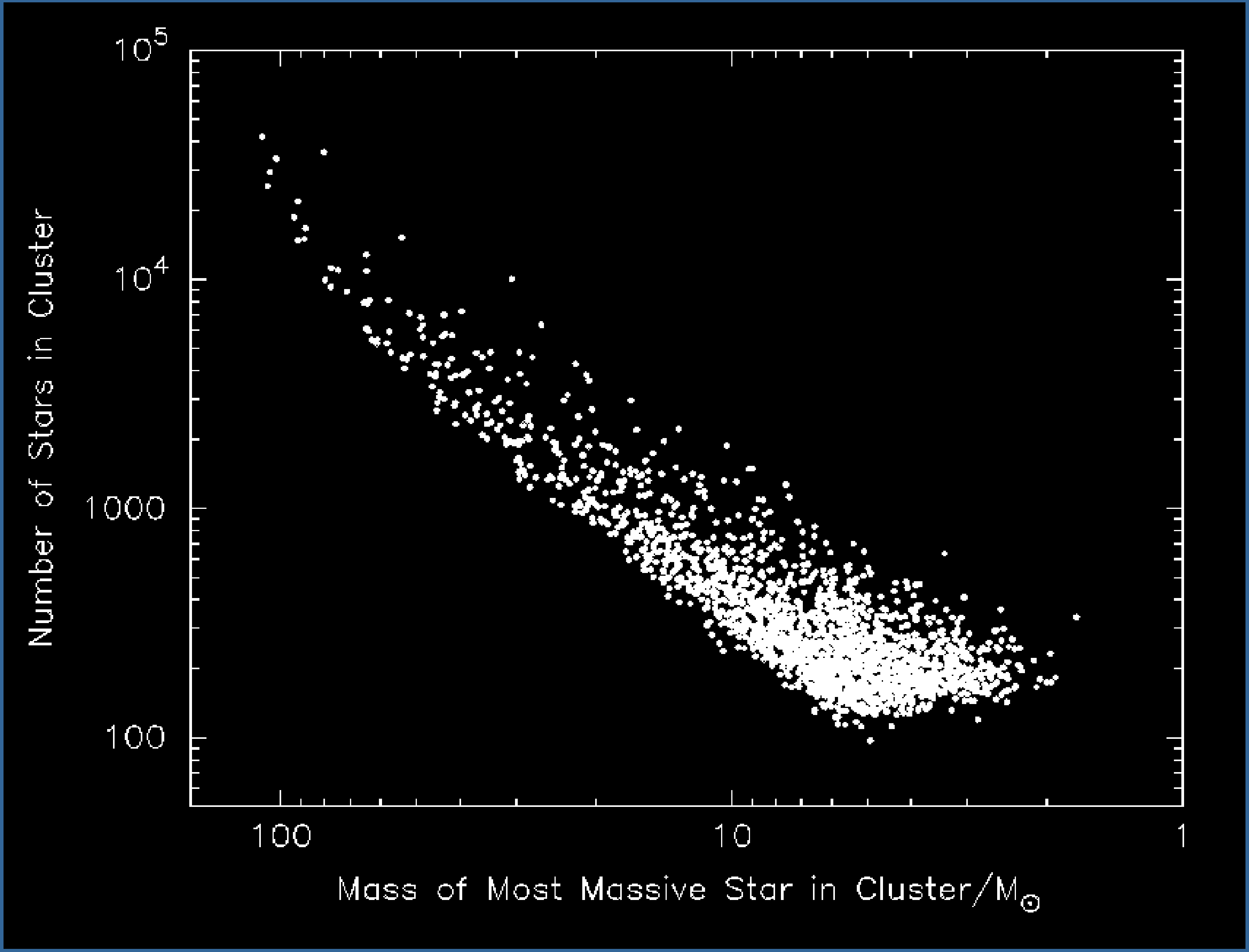
Other Massive Stars



Random Sampling



CMMSM



10^5
10^4
1000
100
Number of Stars in Cluster
100
10
1
Mass of Most Massive Star in Cluster/$M_\odot$

Conclusions

- 4±2% field O-type stars apparently isolated.
- Random sampling produces 5% of low-mass clusters, with a single O-type star.
- Random sampling also recovers the *statistical* CMMSM relation.
- We argue against it being fundamental.

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References

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- Maschberger & Clarke (2008), MNRAS, 391, 711
- de Wit et al. (2004), A&A, 425, 937
- Testi et al. (1999), A&A, 342, 515
- Testi et al. (1998), A&AS, 133, 81
- Testi et al. (1997), A&A, 320, 159