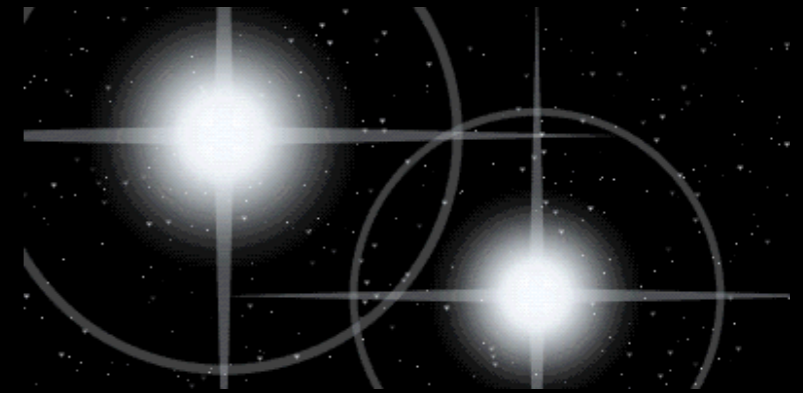


Stellar Density



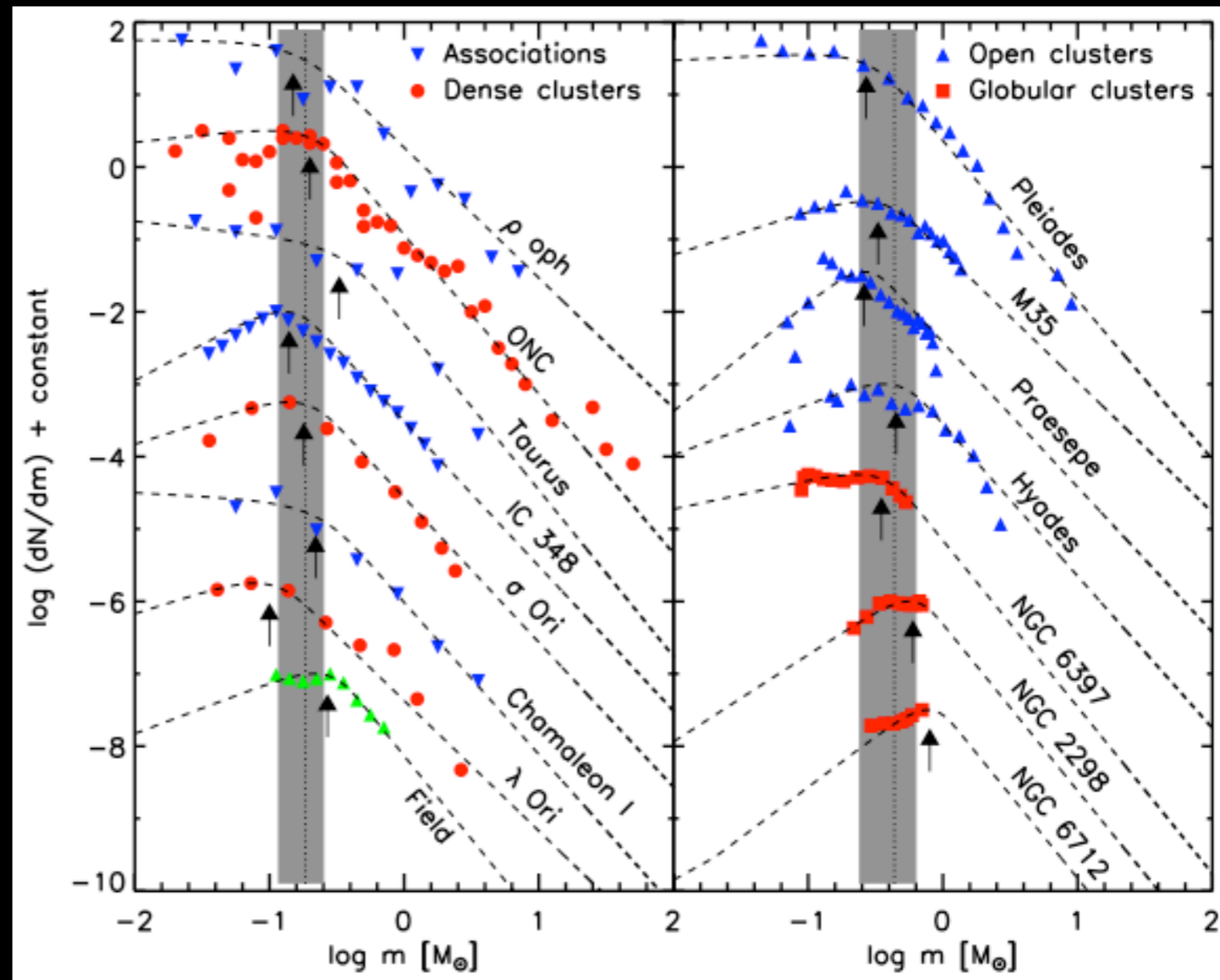
Multiplicity

Robert King (Exeter)

Richard Parker (ETH Zurich), Jenny Patience (Exeter) &
Simon Goodwin (Sheffield)

Motivation

- Multiplicity is a basic imprint of SF process
- IMFs can mask multiplicity
- But multiplicity seems to be environment-dependent



de Marchi et al. 2008 & Bastian et al. 2010

Galactic SFRs Densities



~2.4 pc
Taurus DSS



~2.4 pc
L1688 2MASS/Montage

Galactic SFRs Densities



~ 2.4 pc
LI 688 2MASS/Montage



~ 1.9 pc
IC 348 Muench et al. 2003

Galactic SFRs Densities



~1.9 pc
IC348 Muench et al. 2003



~0.8 pc
ONC McCaughrean

Galactic SFRs Densities



~0.8 pc
IC348 Muench et al. 2003



~0.8 pc
ONC McCaughrean

Galactic SFRs Densities



~0.8 pc
ONC McCaughrean

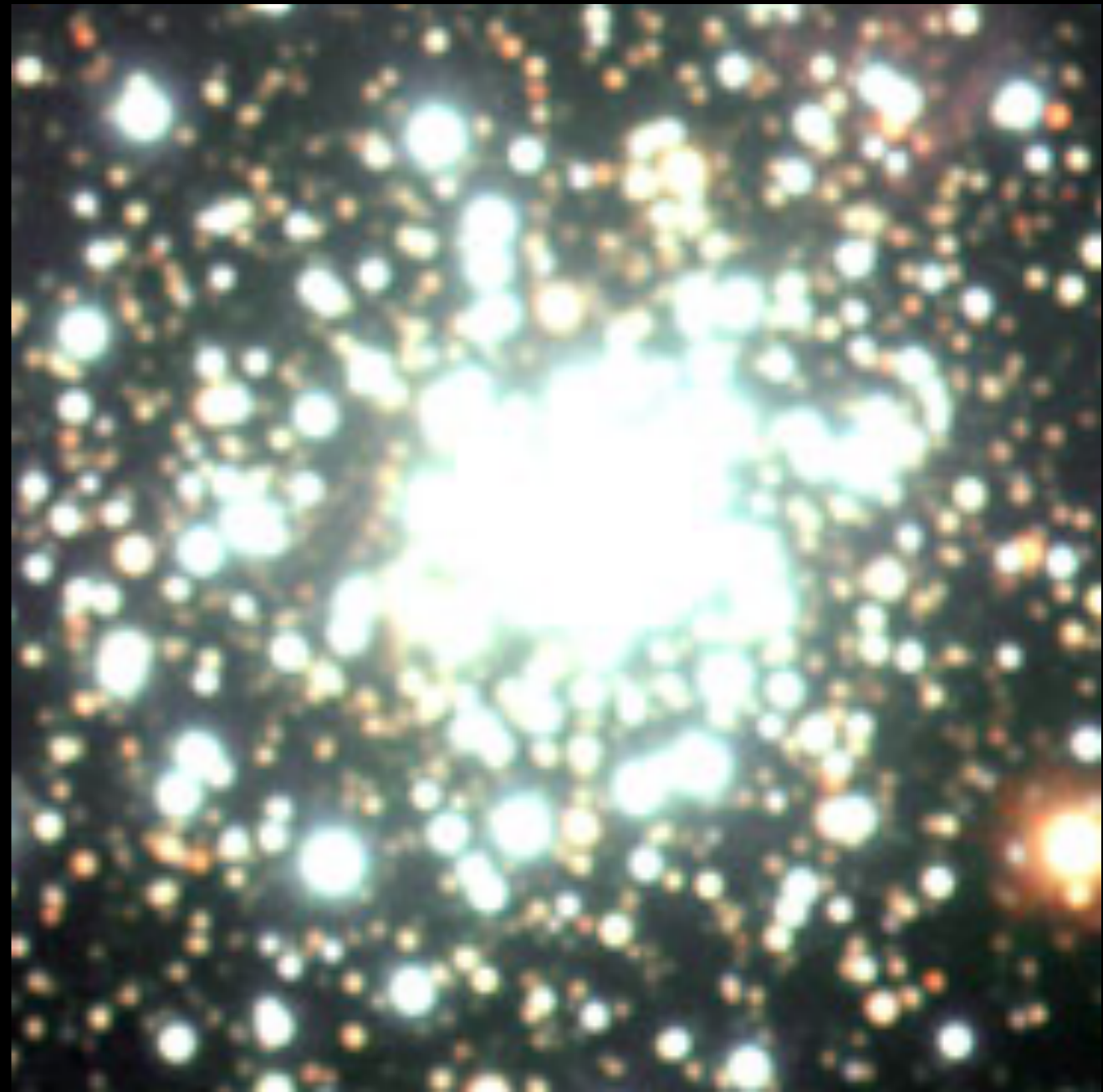


~6.0 pc
NGC3603 ESO

Galactic SFRs Densities



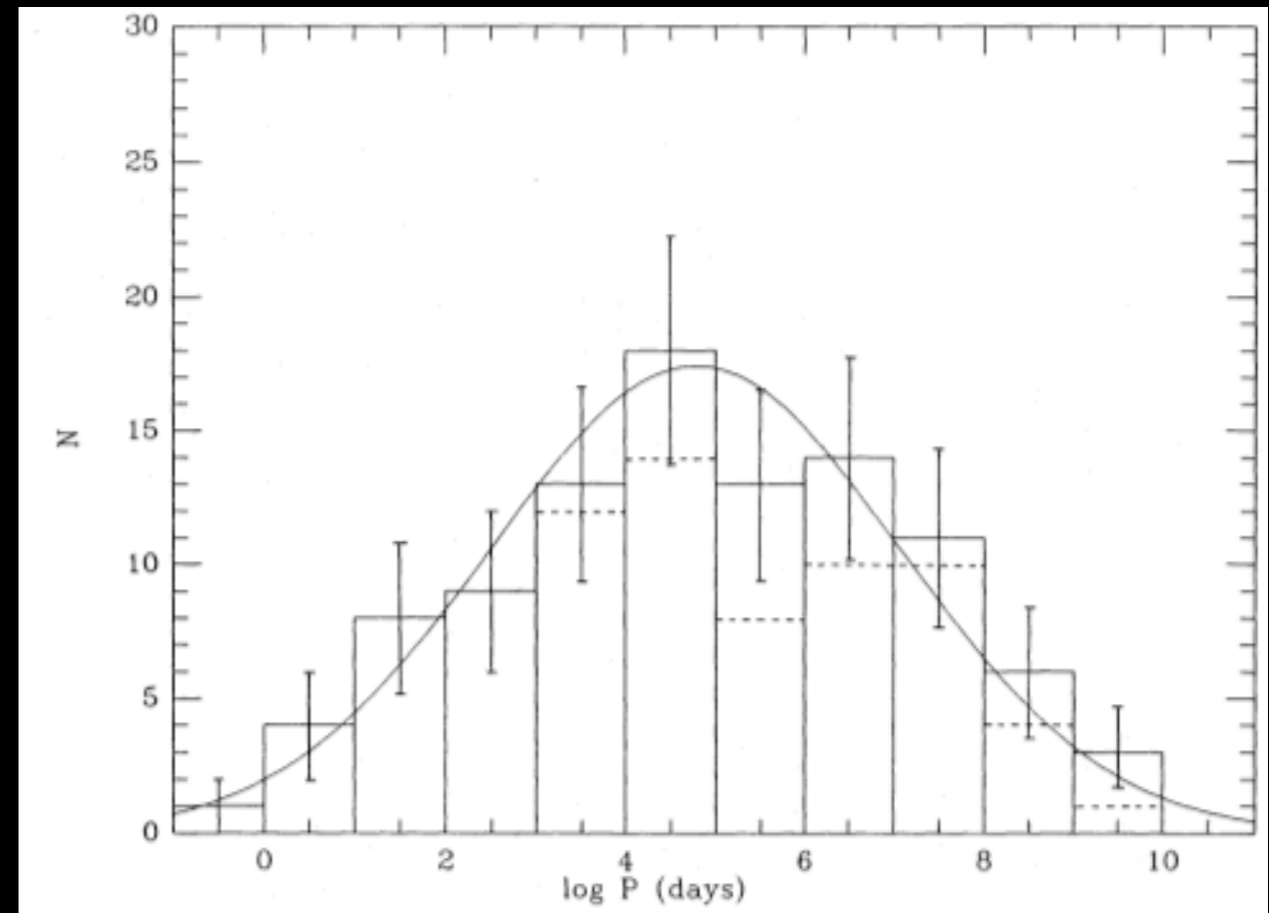
~0.8 pc
ONC McCaughrean



~0.8 pc
NGC3603 ESO

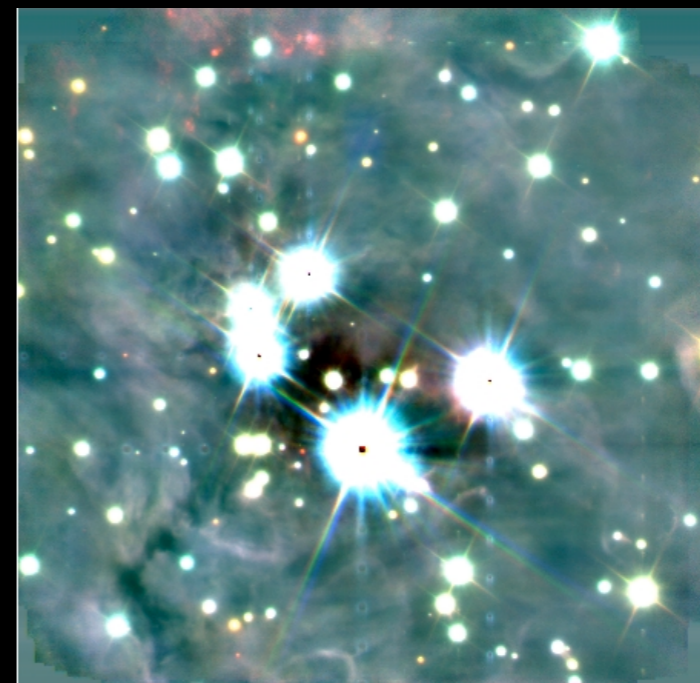
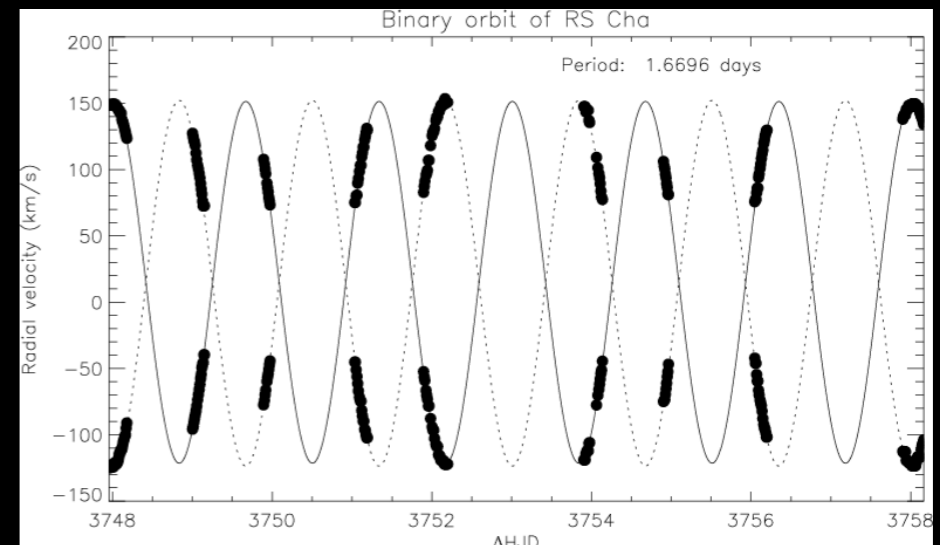
Previous Studies

- Duquennoy & Mayor 1991 measured sep. distribution in solar neighbourhood
- High multiplicity in Taurus and Ophiuchus
 - Ghez et al. 1993, Leinert et al. 1993
- ONC
 - Prosser et al. 1994, Koehler et al. 2006



Where are those binaries?

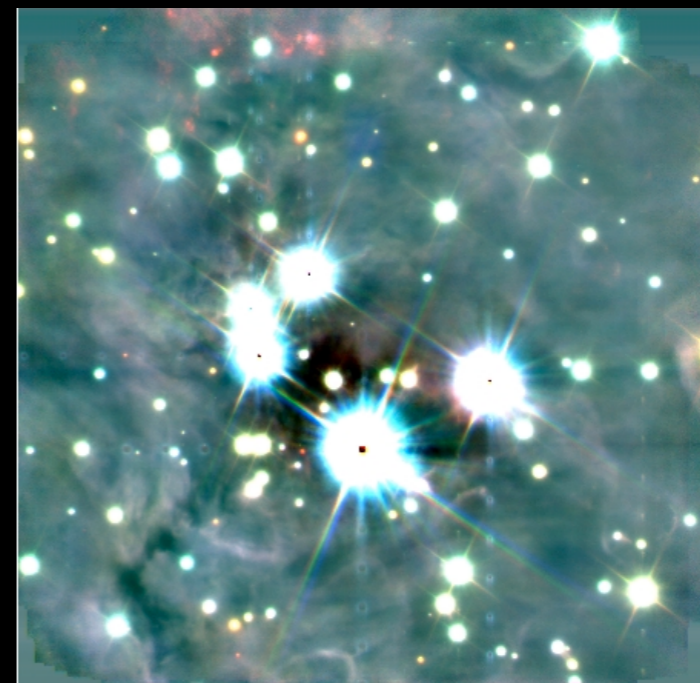
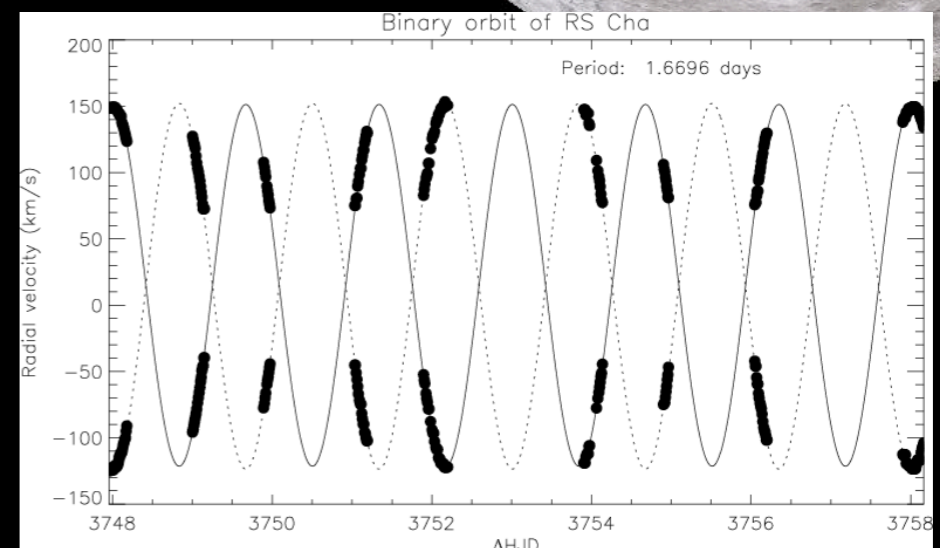
- Spectroscopic Binaries
- Direct Imaging (& speckle imaging)
- Interferometry & Lunar Occultations



MAD/ONC
Buoy et al. 2008

Where are those binaries?

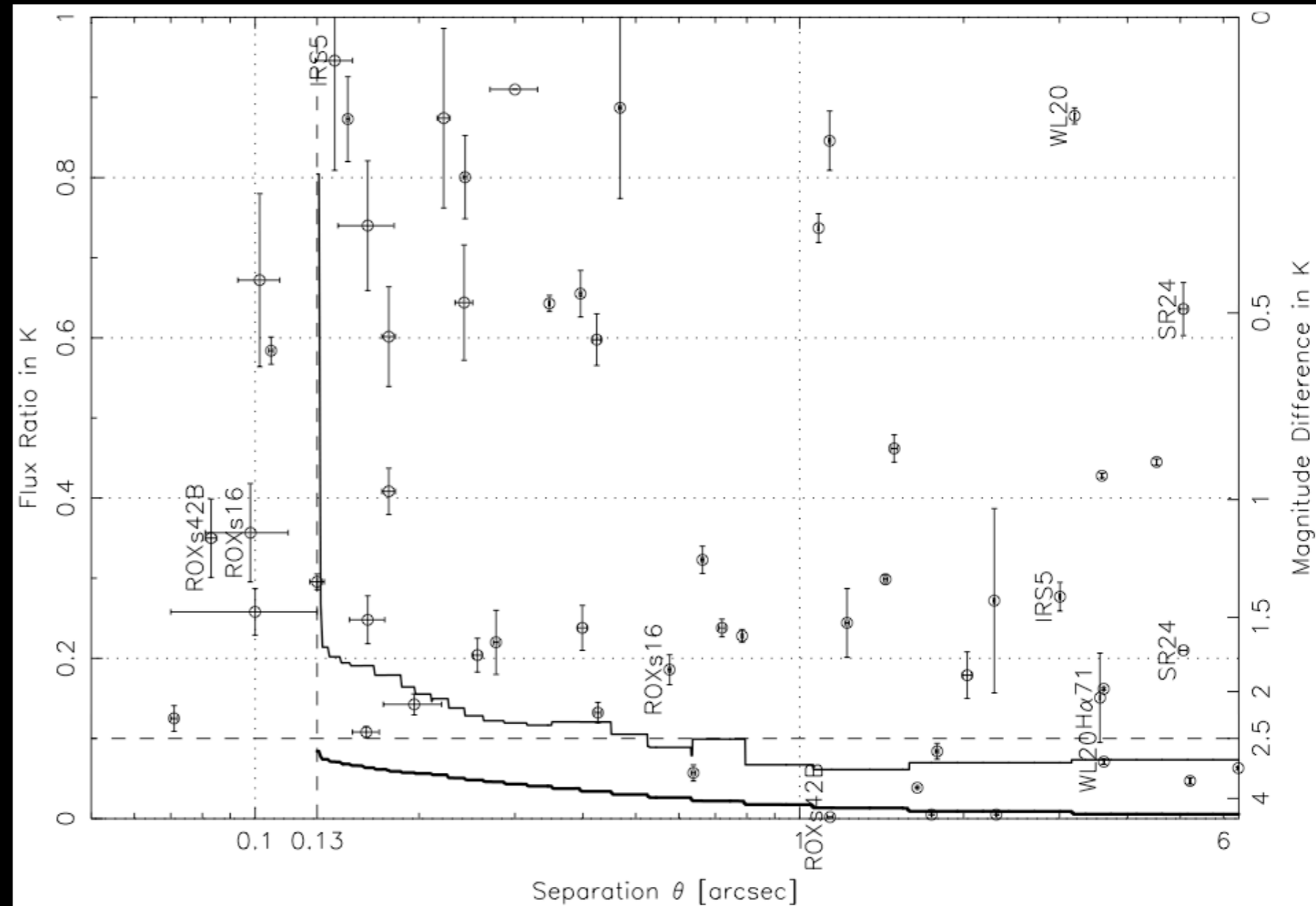
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MAD/ONC
Buoy et al. 2008

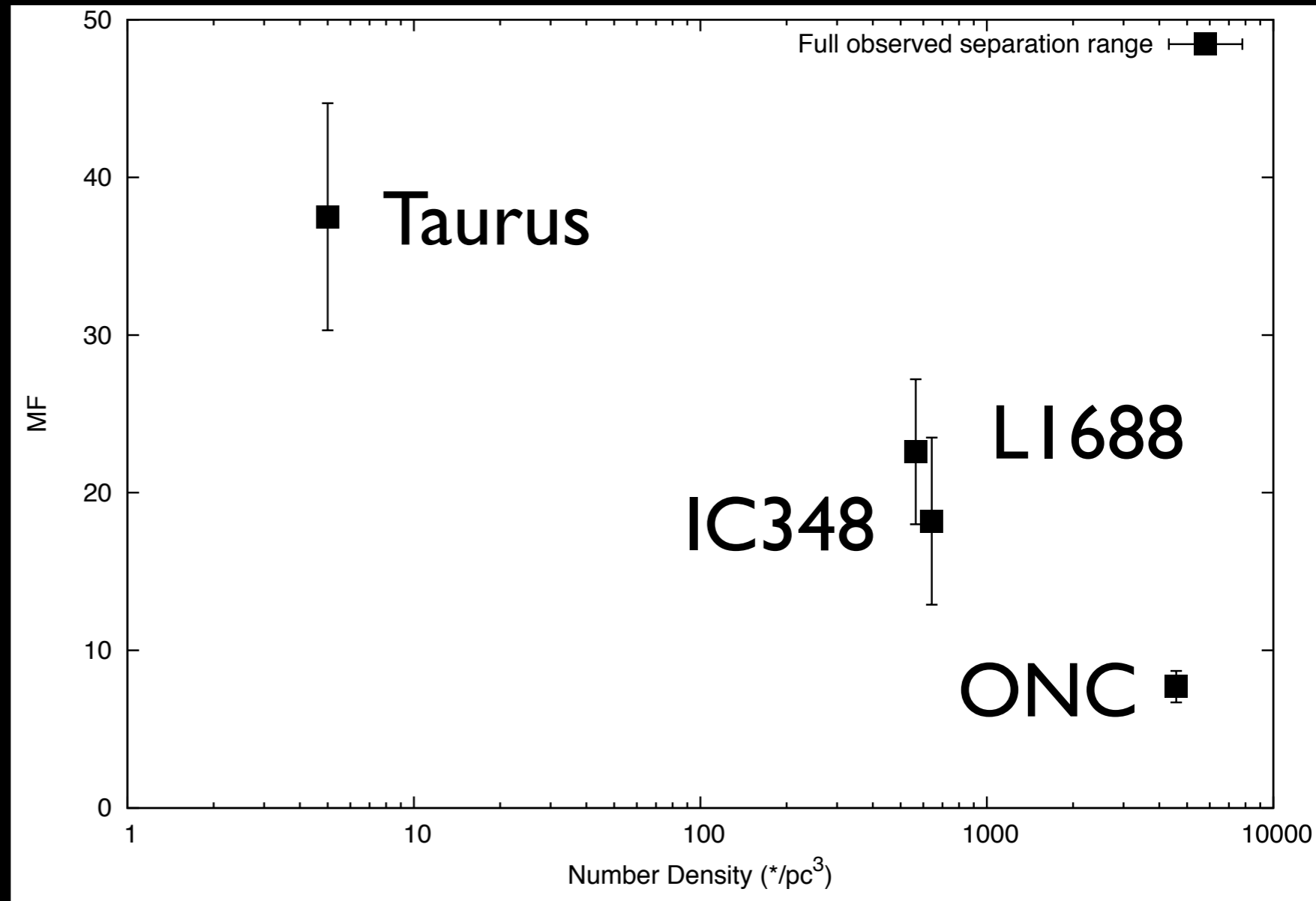
So what's the problem?

- Separation ranges probed
- Flux ratio sensitivity
- Different distances
- Small samples



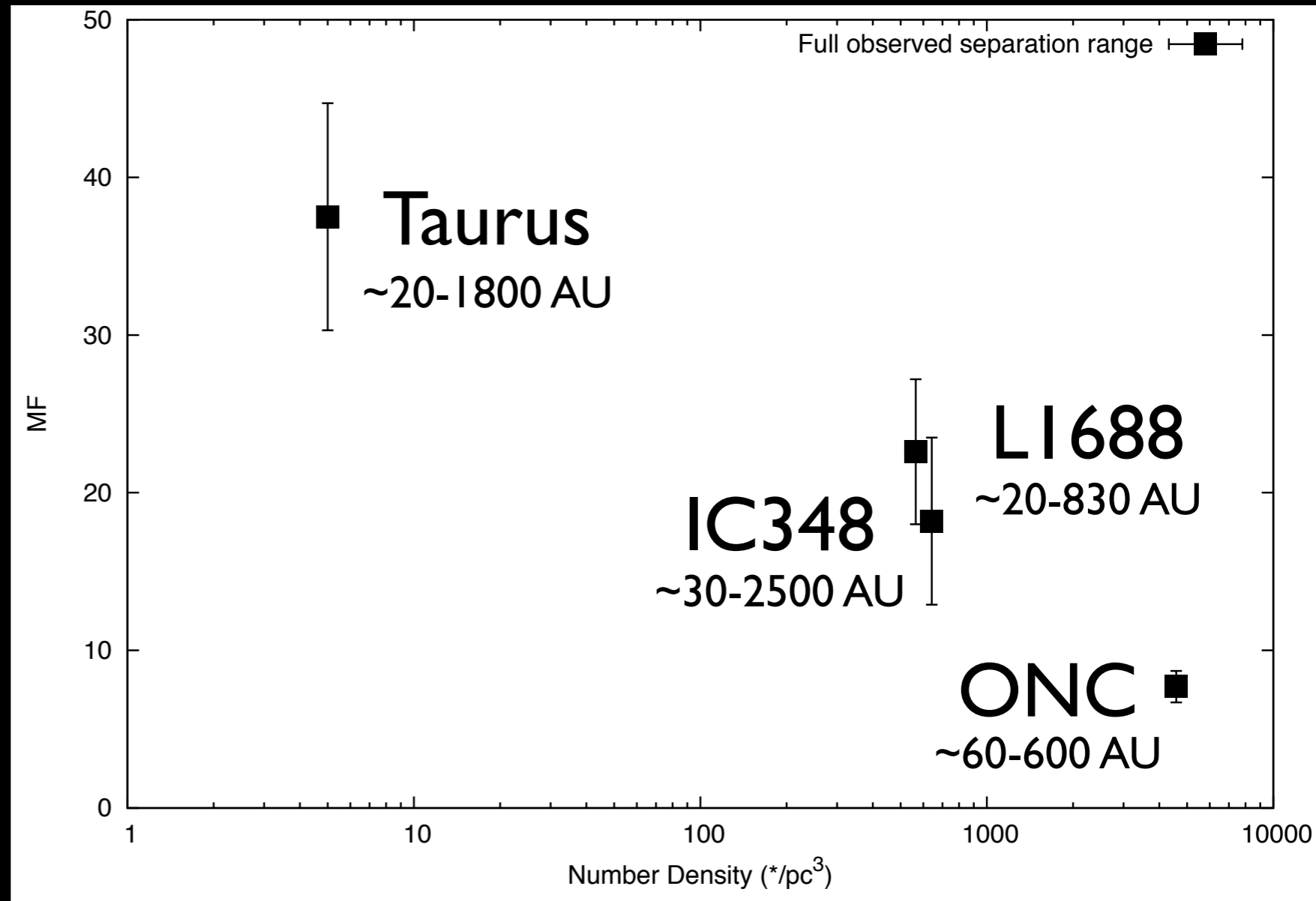
Our Comparison

- Multiplicity Fraction over observed sep. ranges
- Density defined within 0.25 pc of centre
- Taurus (Leinert+ 1993)
- L 1688 (Ratzka+ 2005)
- IC348 (Duchene+ 1999)
- ONC (Reipurth+ 2007)



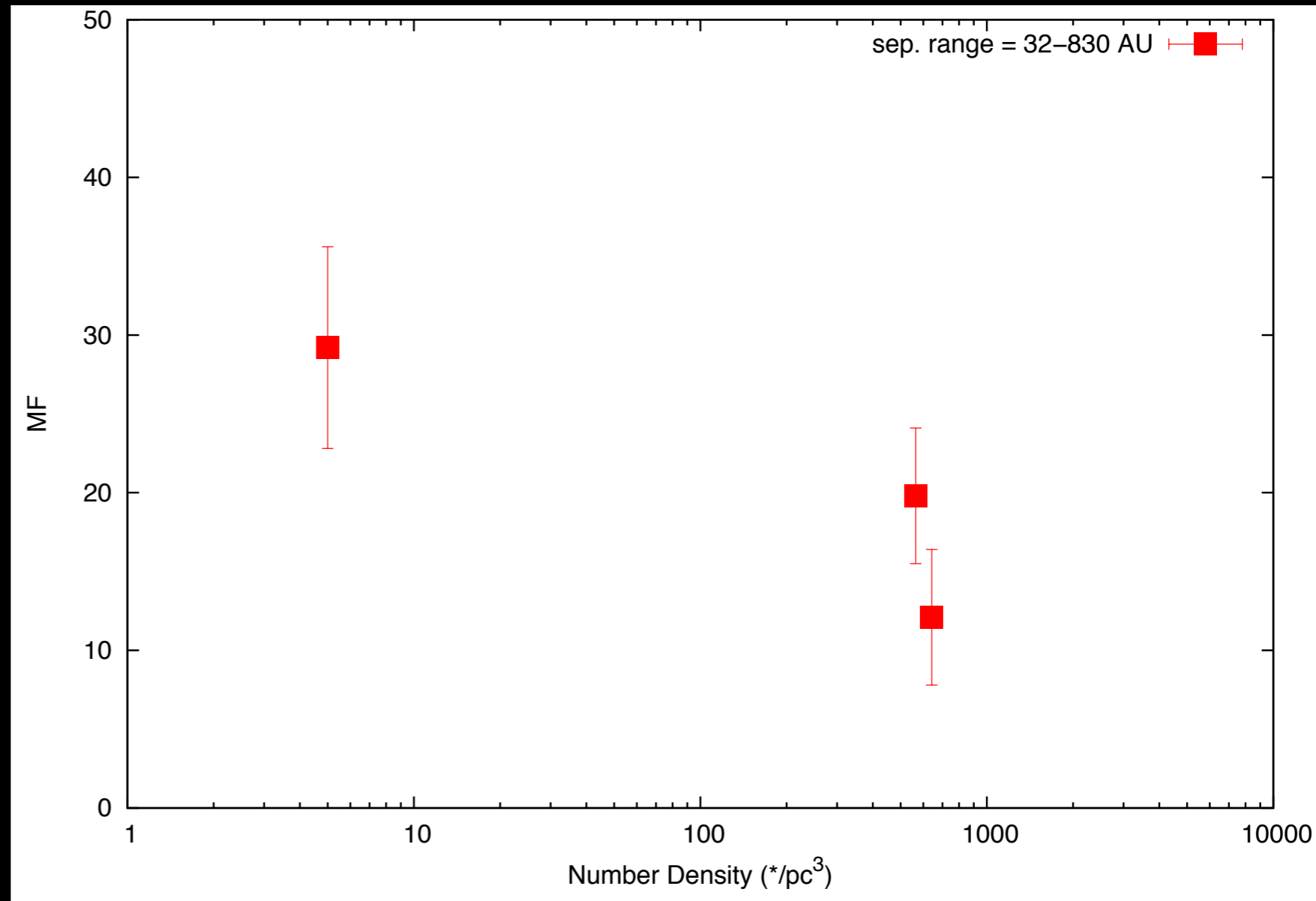
Our Comparison

- Multiplicity Fraction over observed sep. ranges
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- Taurus (Leinert+ 1993)
- L 1688 (Ratzka+ 2005)
- IC348 (Duchene+ 1999)
- ONC (Reipurth+ 2007)



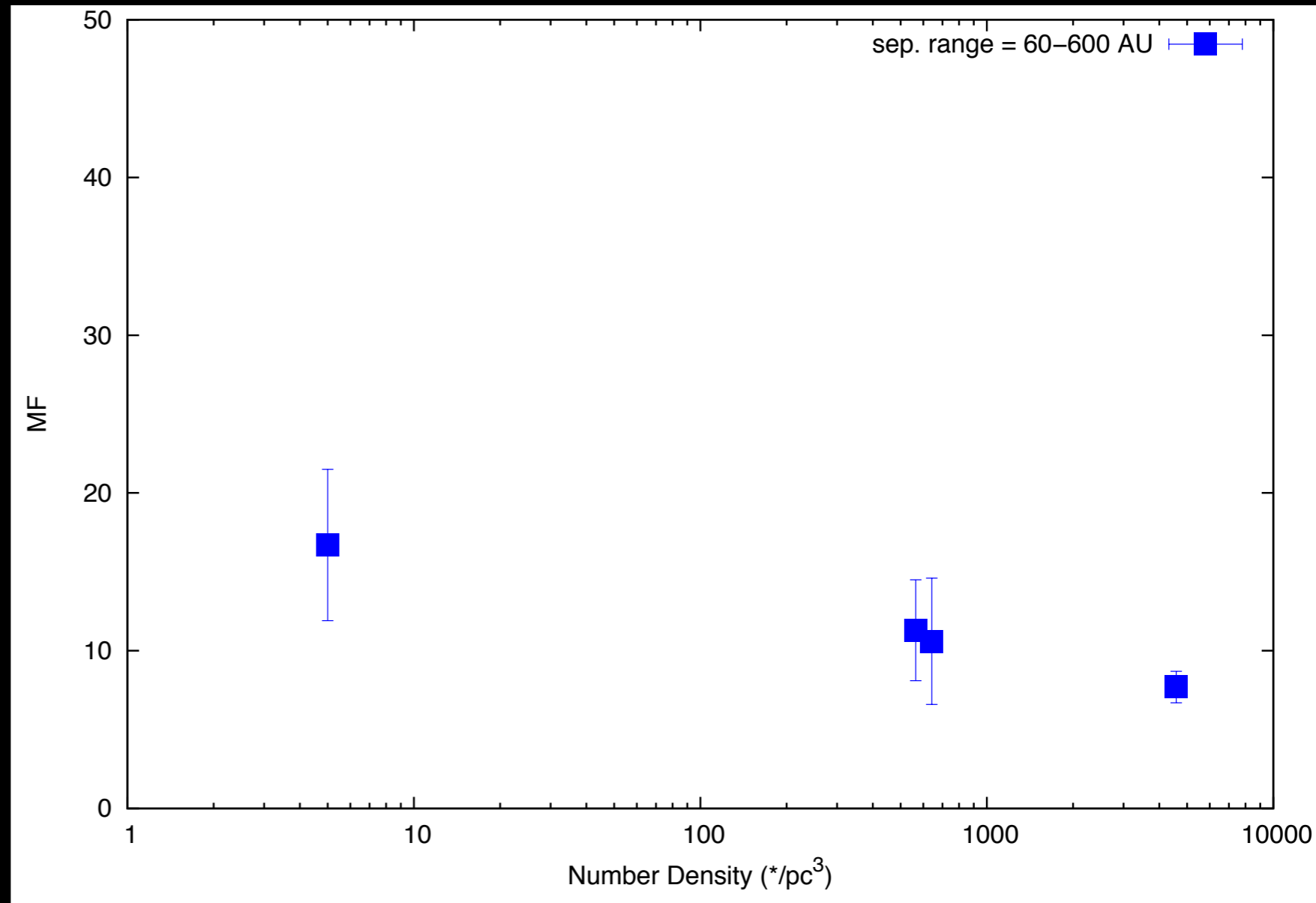
Our Comparison

- Multiplicity Fraction over common sep. range 32-830 AU
- Density defined within 0.25 pc of centre
- Taurus, L 1688 (Oph), IC348



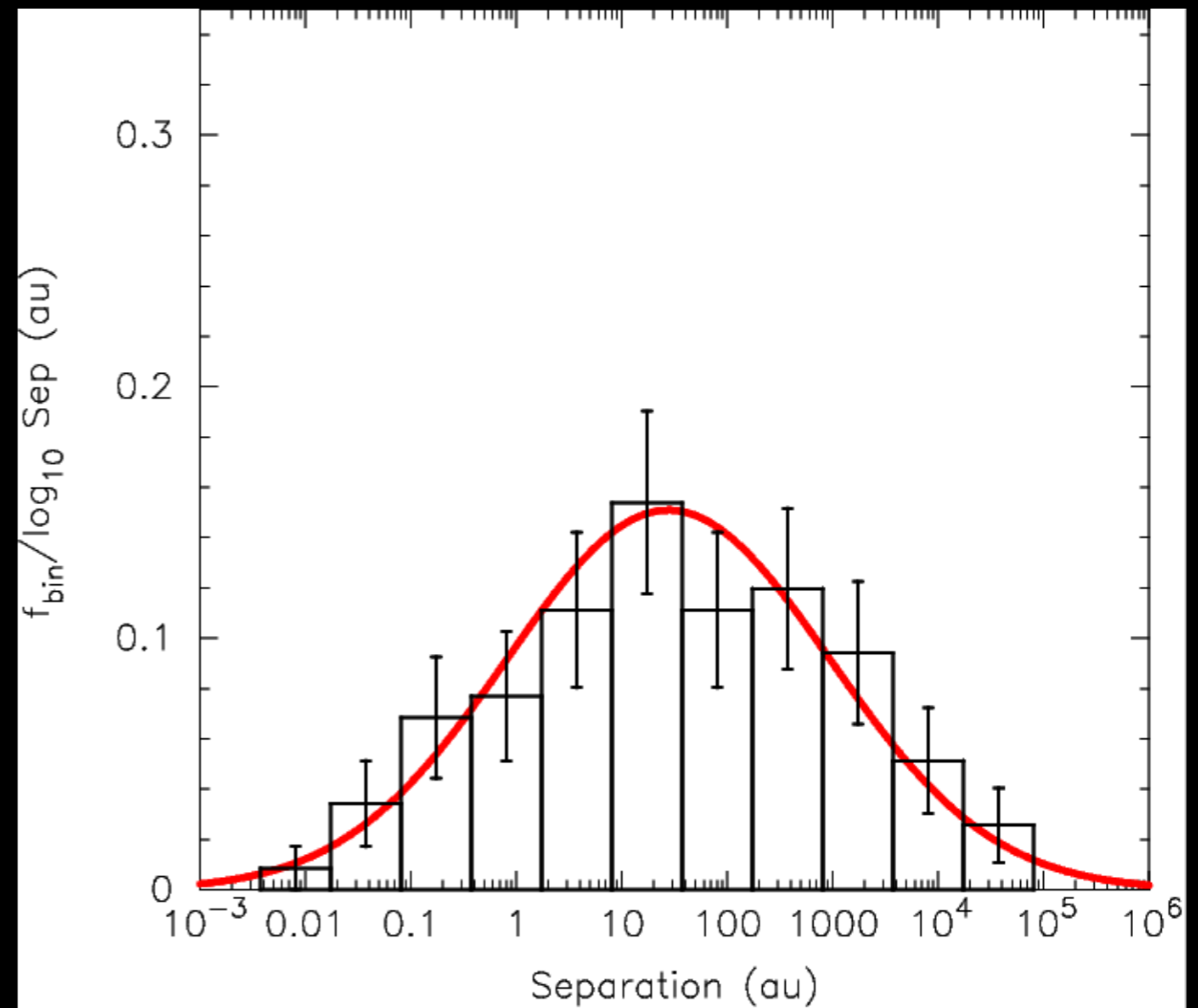
Our Comparison

- Multiplicity Fraction over common sep. range 60-600 AU
- Density defined within 0.25 pc of centre
- Taurus, L 1688 (Oph), IC348 and ONC



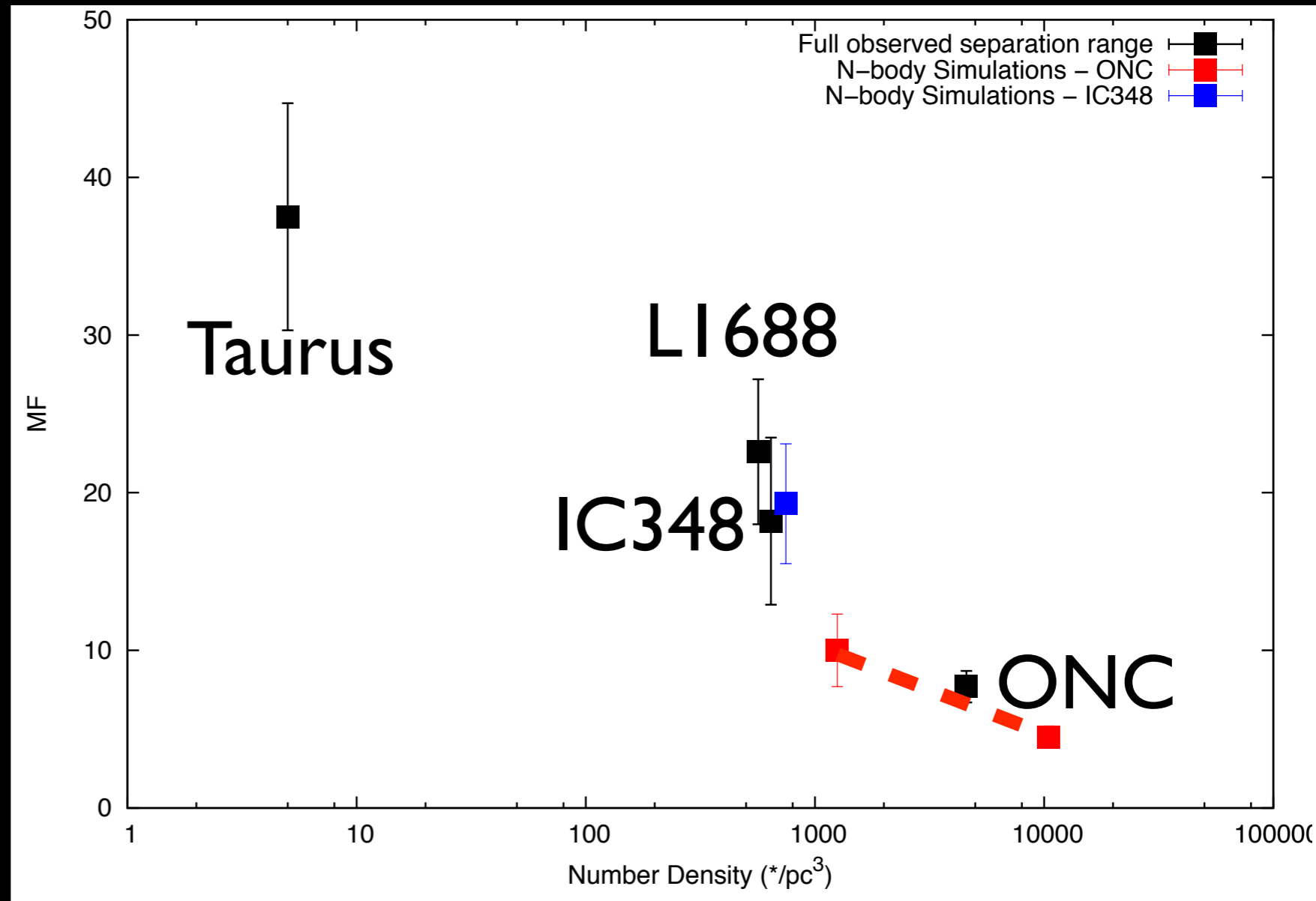
Simulation Setup

- N-body simulations (Parker et al. 2009)
 - N=200 - 1500 stars
- Distribute mass in a Plummer sphere with characteristic half-mass radii
 - 0.1, 0.4, 0.8 pc
- Primary masses from Kroupa IMF
 - Companion mass from flat mass ratio distribution
- Assume an initial binary fraction
 - 100% or field-like
- Evolve for 1 Myr...



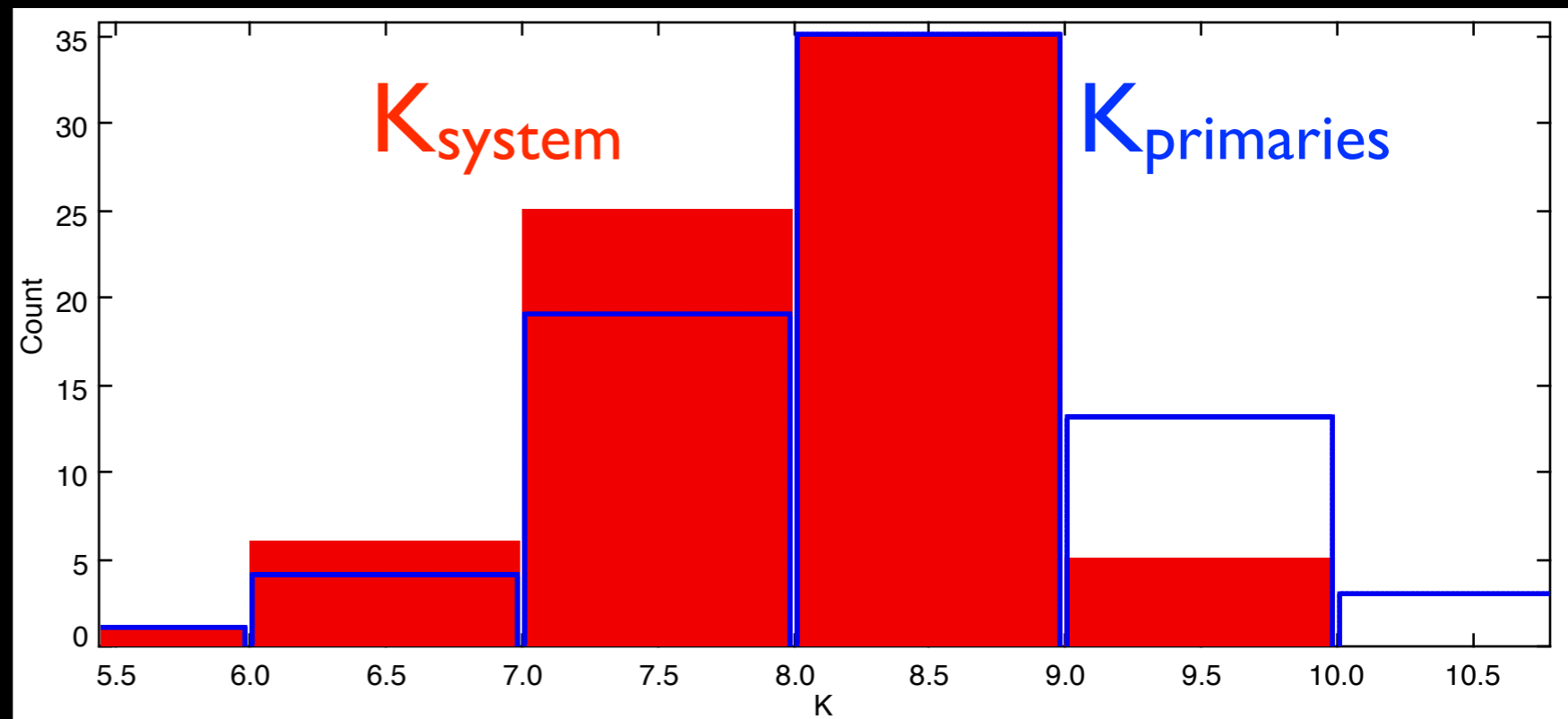
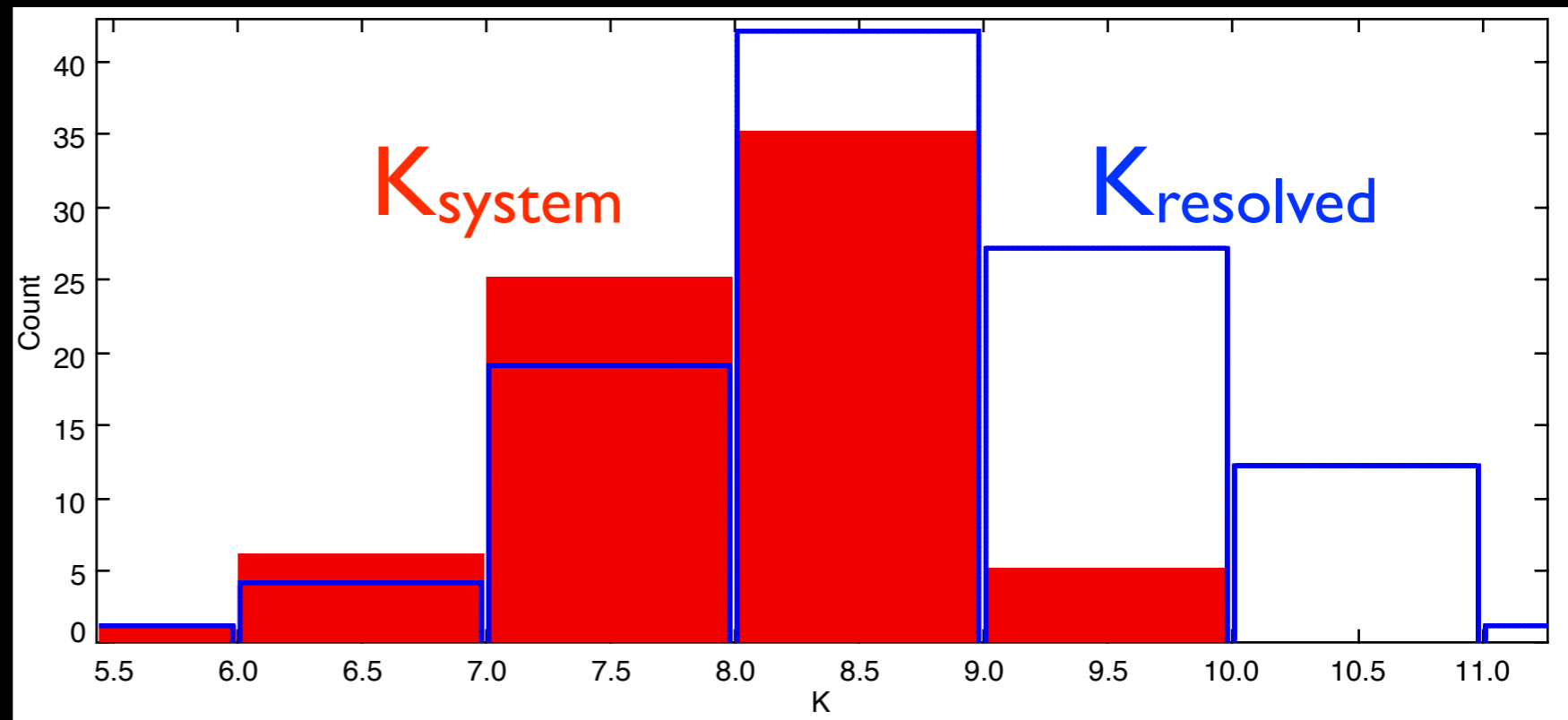
Simulation Results

- Simulations tailored to each region
- Number of stars
- 1/2 mass radii
- Densities



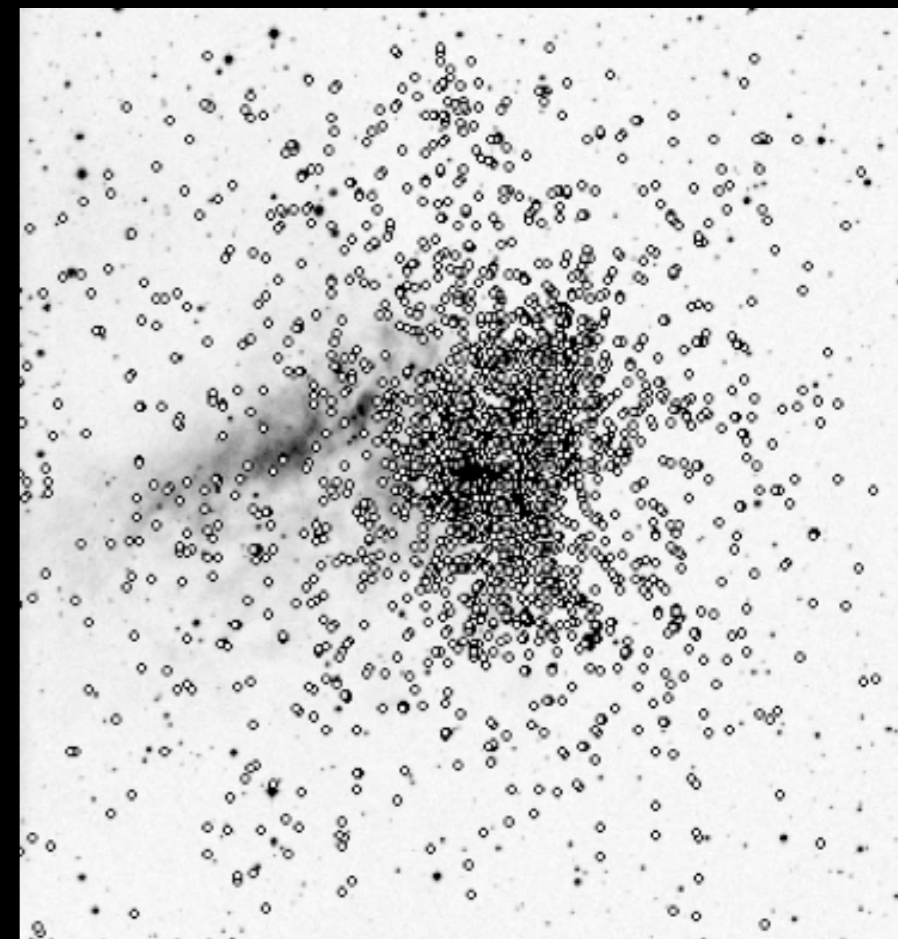
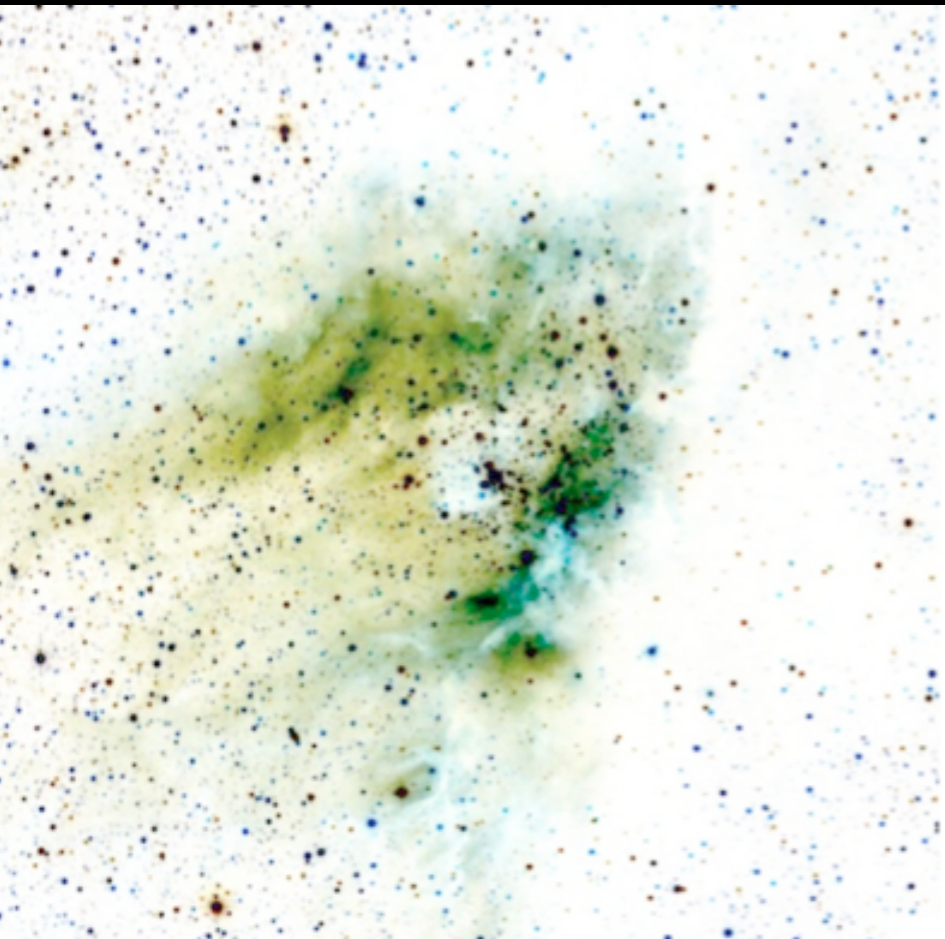
What does this mean for IMFs?

- Unknown multiplicity can lead to uncertain mass estimates



So what about denser regions?

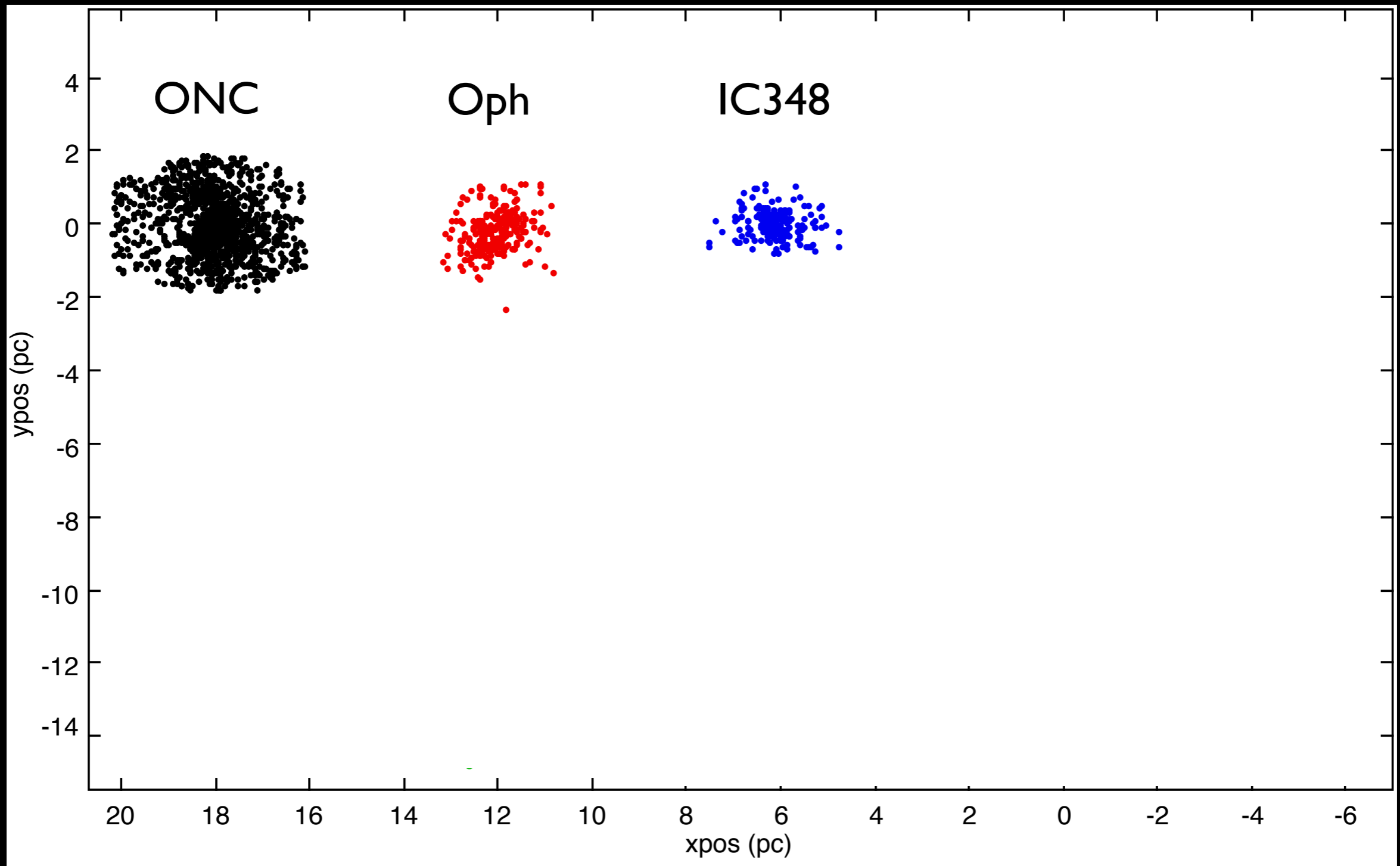
- We are using X-ray bias to probe multiplicity in 10 High-Mass, High Density SFRs
- Probe separation range that is unresolved to direct imaging
 - < 800 AU @ 1.6 kpc



Conclusions

- Denser region -> Fewer Binaries
- Can be explained by stellar encounters
- Not necessarily casual
- Wish list...
 - Multiplicity in denser SFRs - On its way!
 - Multiplicity at earlier stages (e.g., Duchene et al . 2007)

Range of Galactic SFRs



Range of Galactic SFRs

