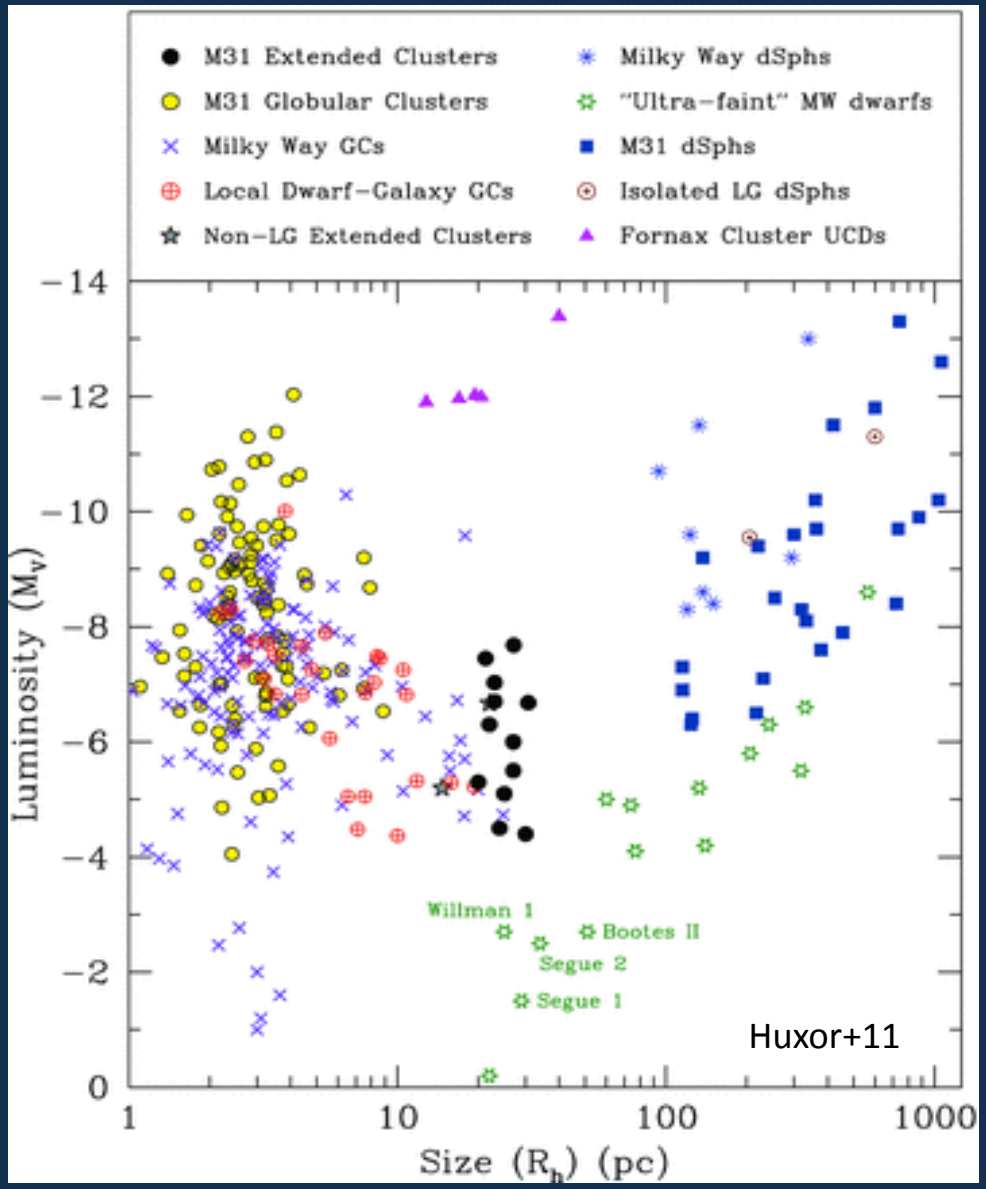
Models of Faint Galaxy Production through Star Cluster Evolution

Jarrod Hurley (Centre for Astrophysics & Supercomputing)

"Dynamics of Low-Mass Stellar Systems"
ESO, Santiago, Chile
April 4-8 2011

Sizes of low-mass stellar systems



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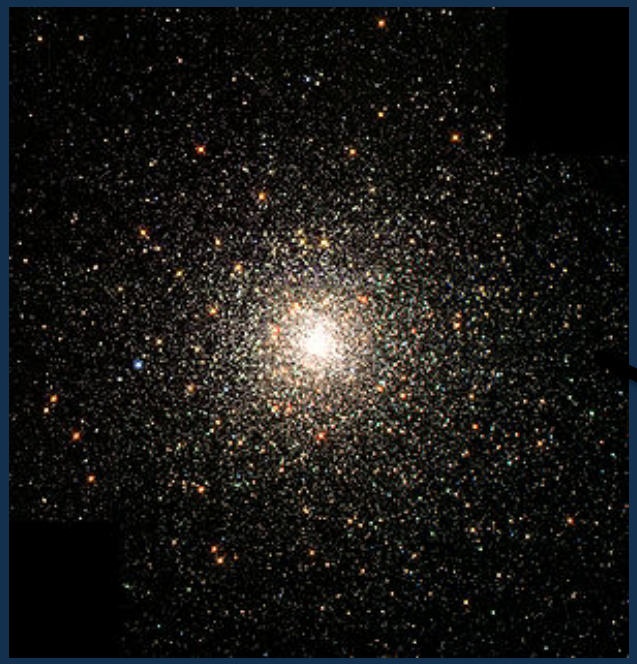
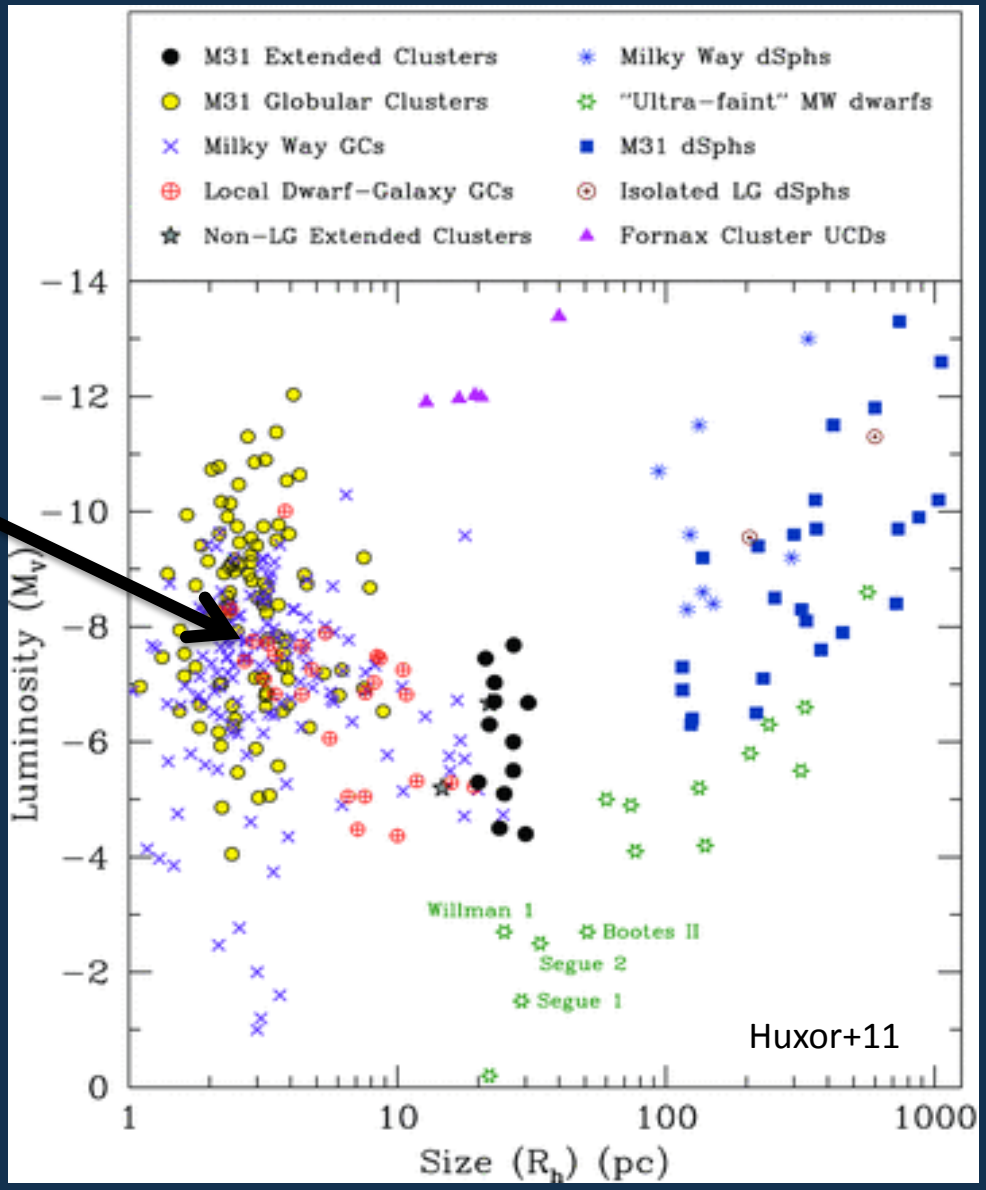


MW
M31



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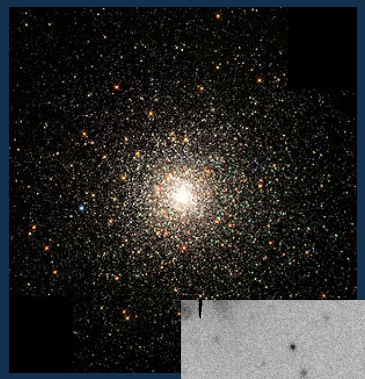

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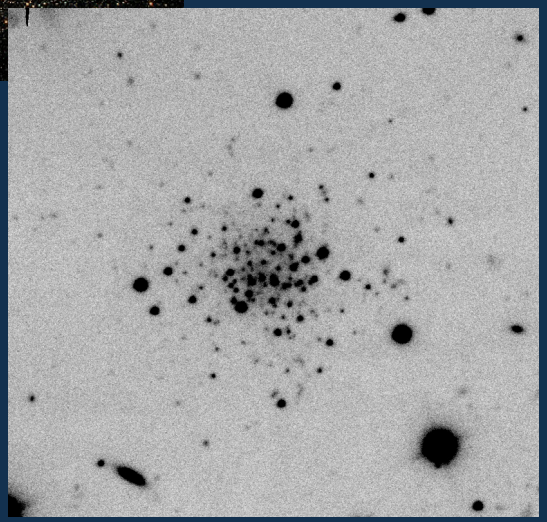
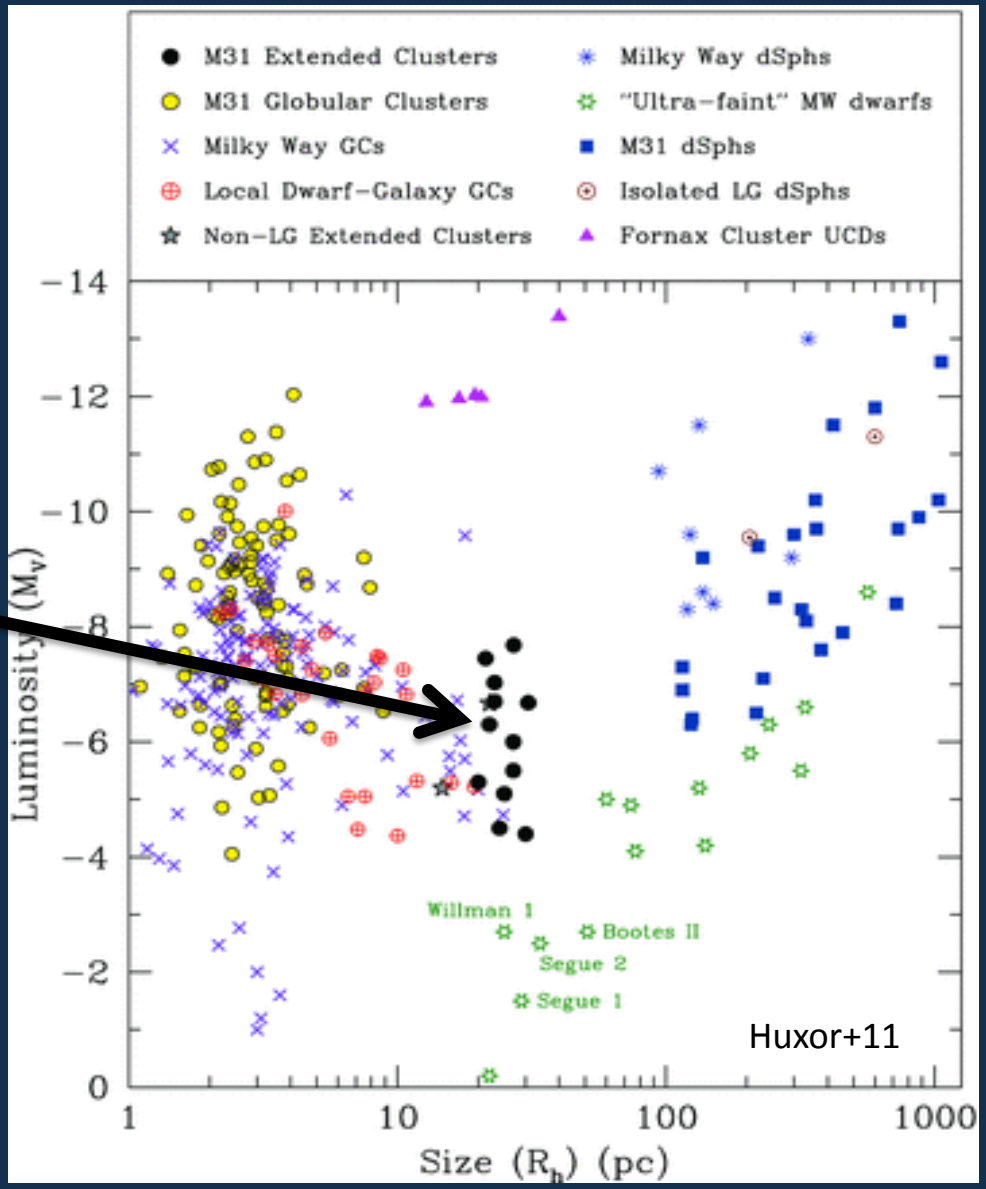


M31
dIrr



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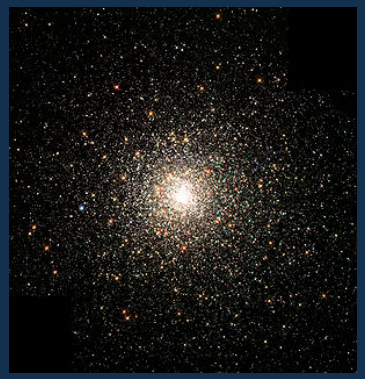

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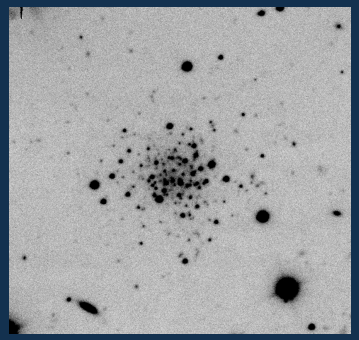
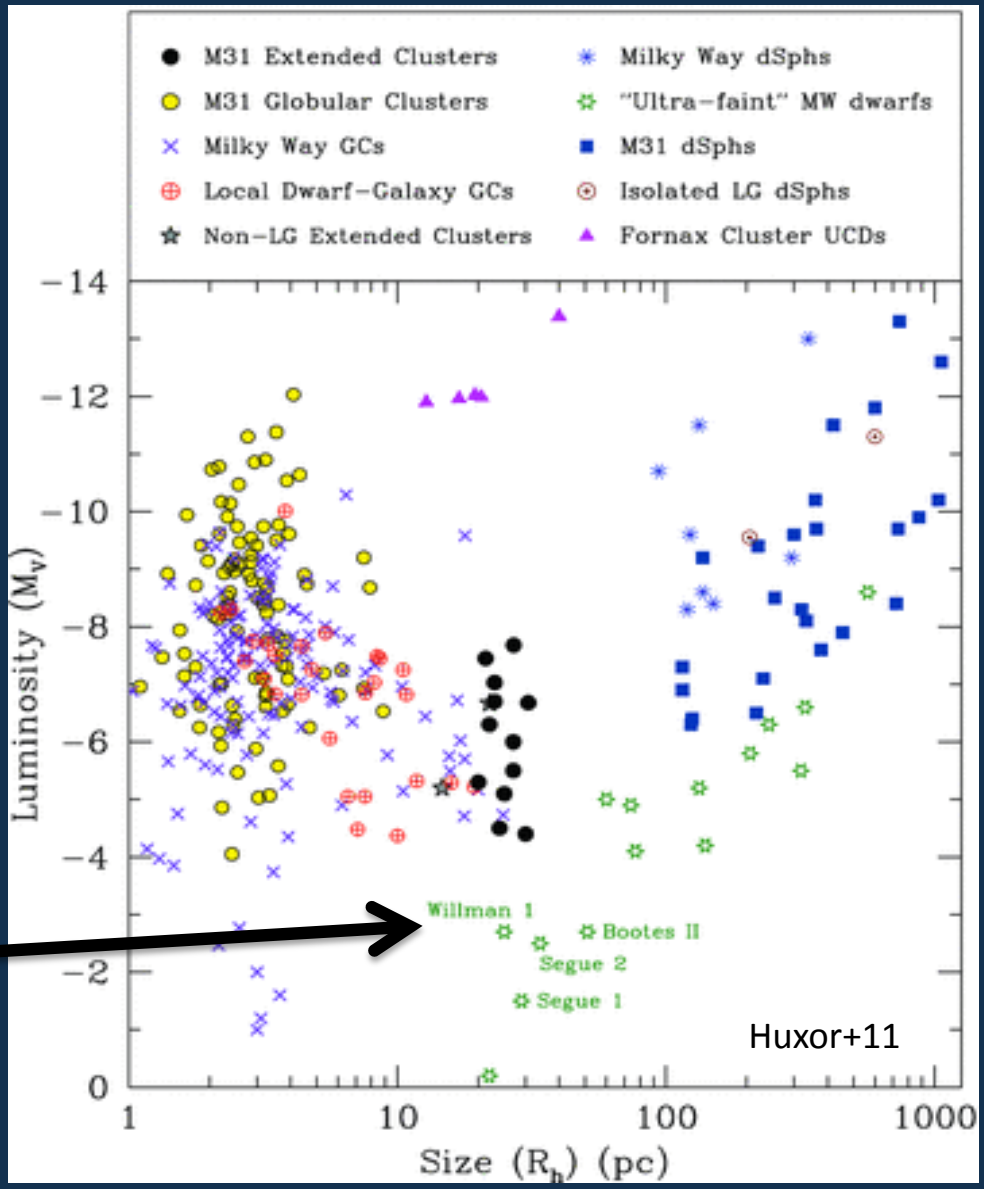
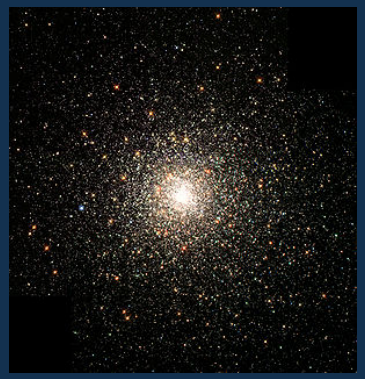


M31
dIrr

DM halo



simulations of low-mass stellar systems in different tidal fields



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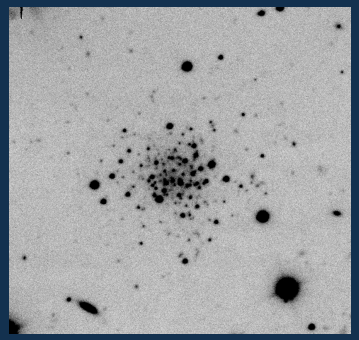

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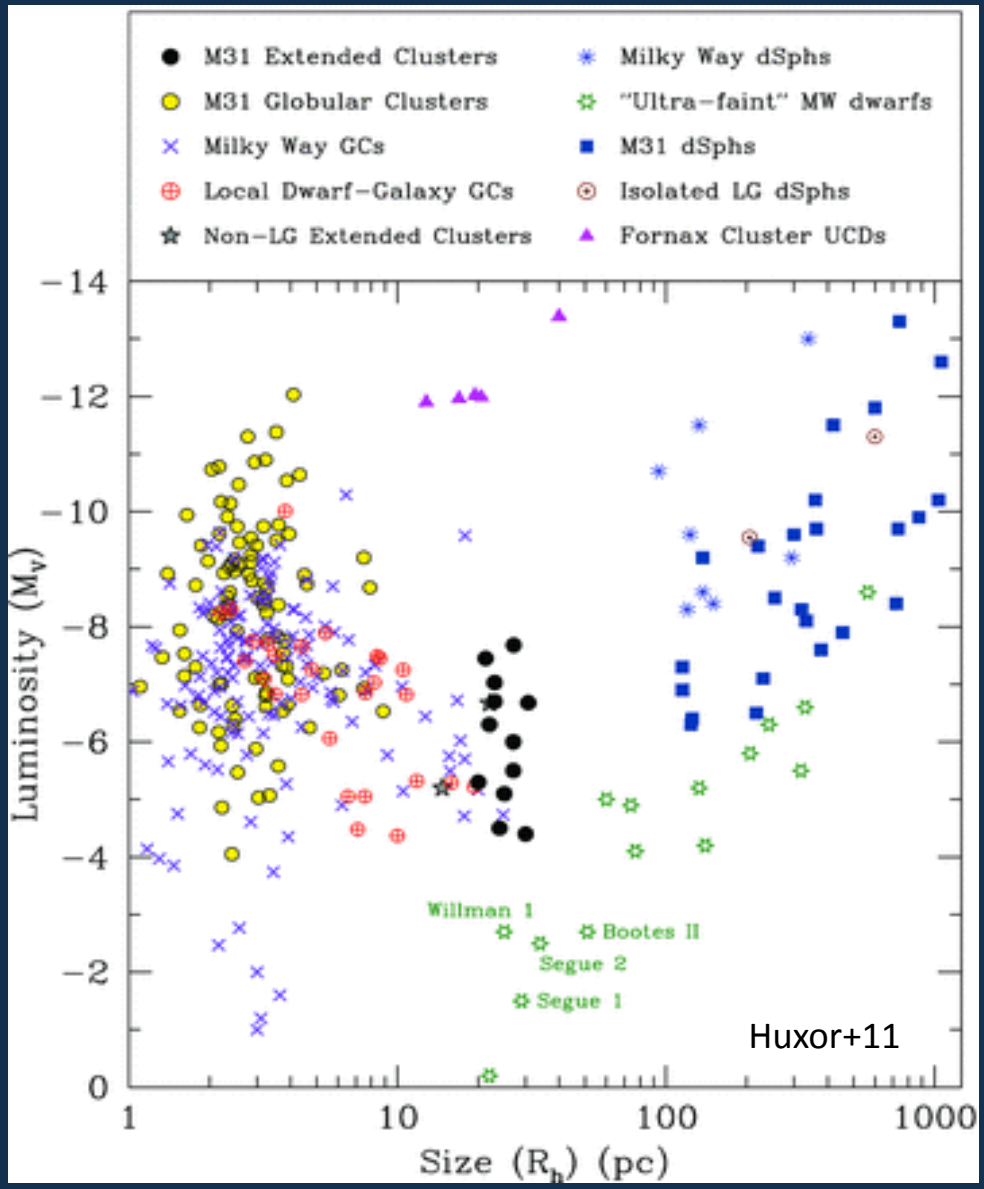

N-body simulation background

Equation of Motion

$$\ddot{r}_i = -G \sum_{j=1}^{N} \frac{m_j (r_i - r_j)}{|r_i - r_j|^3}$$

→ $O(N^3)$

→ special-purpose ~~GRAPE hardware~~ GPU

[NBODY4/NBODY6: Aarseth 1999; Aarseth 2003]

stellar evolution

binary evolution

techniques for few-body subsystems

tidal field

[Hurley et al. 2001]

[Mardling & Aarseth 2001; Mikkola 2006, etc.]

Models of Extended Clusters?

N = 100,000, 5% binaries, Z = 0.001, KTG IMF, Plummer/King

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R_{GC} = 10 kpc

$M_G = 9 \times 10^9\ M_{sun}$
point-mass
e.g. NGC6822

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point-mass or 3-component
e.g. M31

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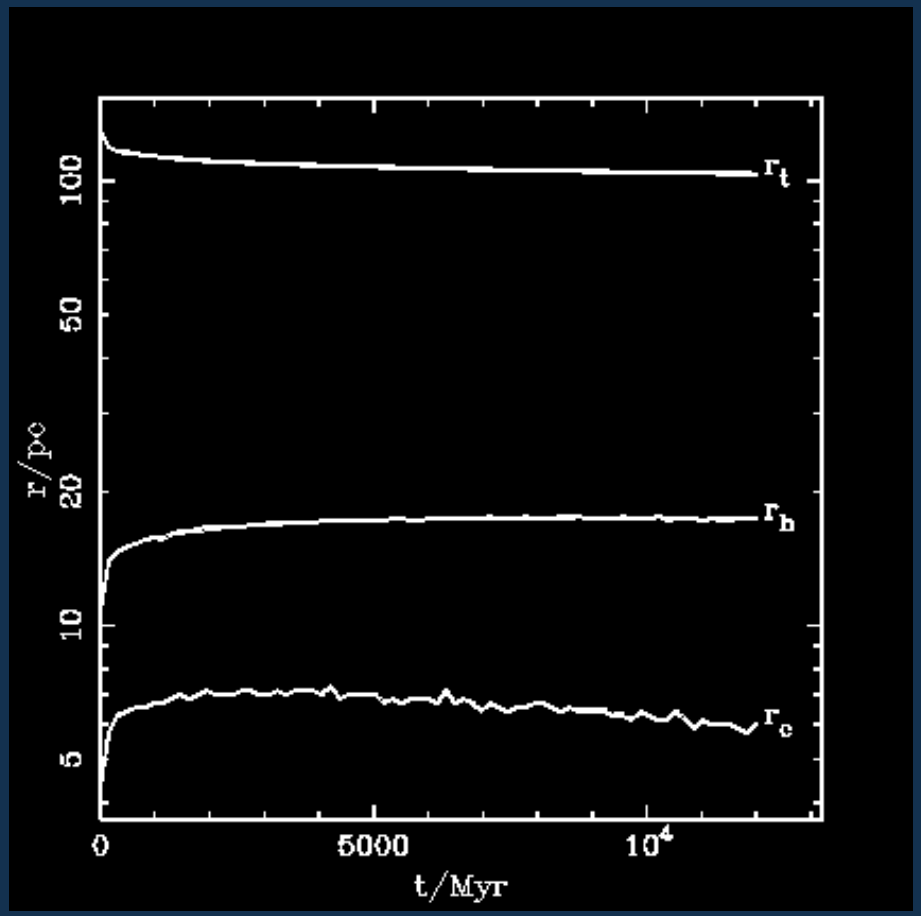
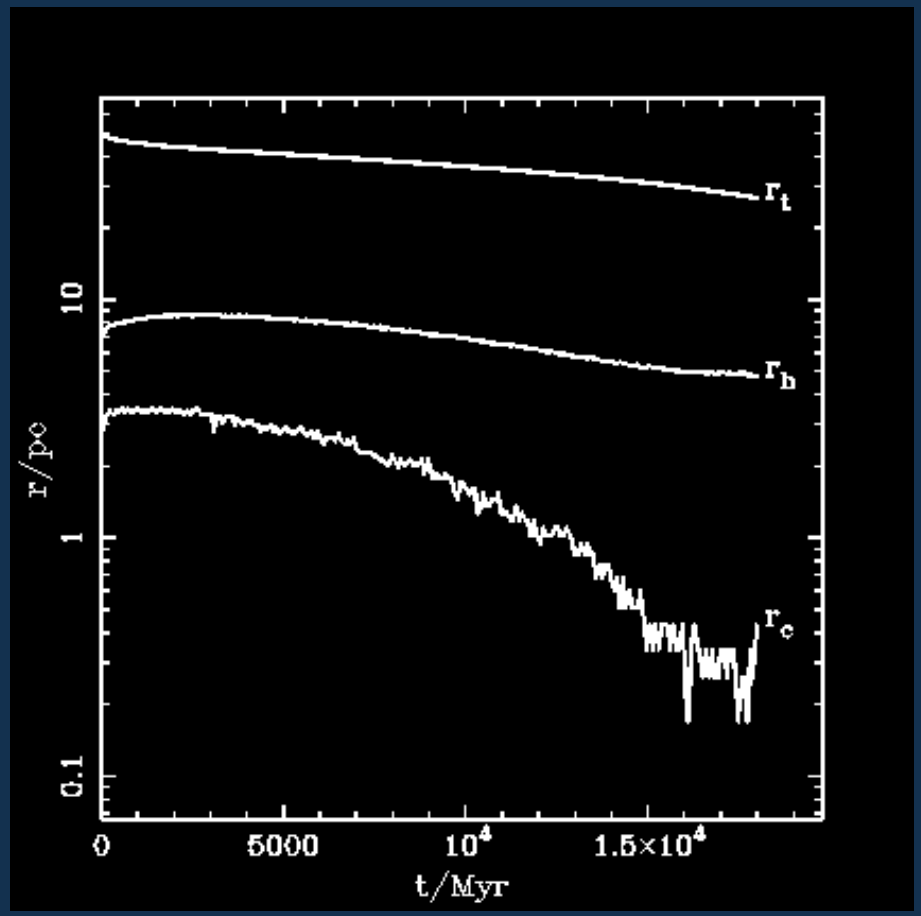
e.g. NGC6822



e.g. M31



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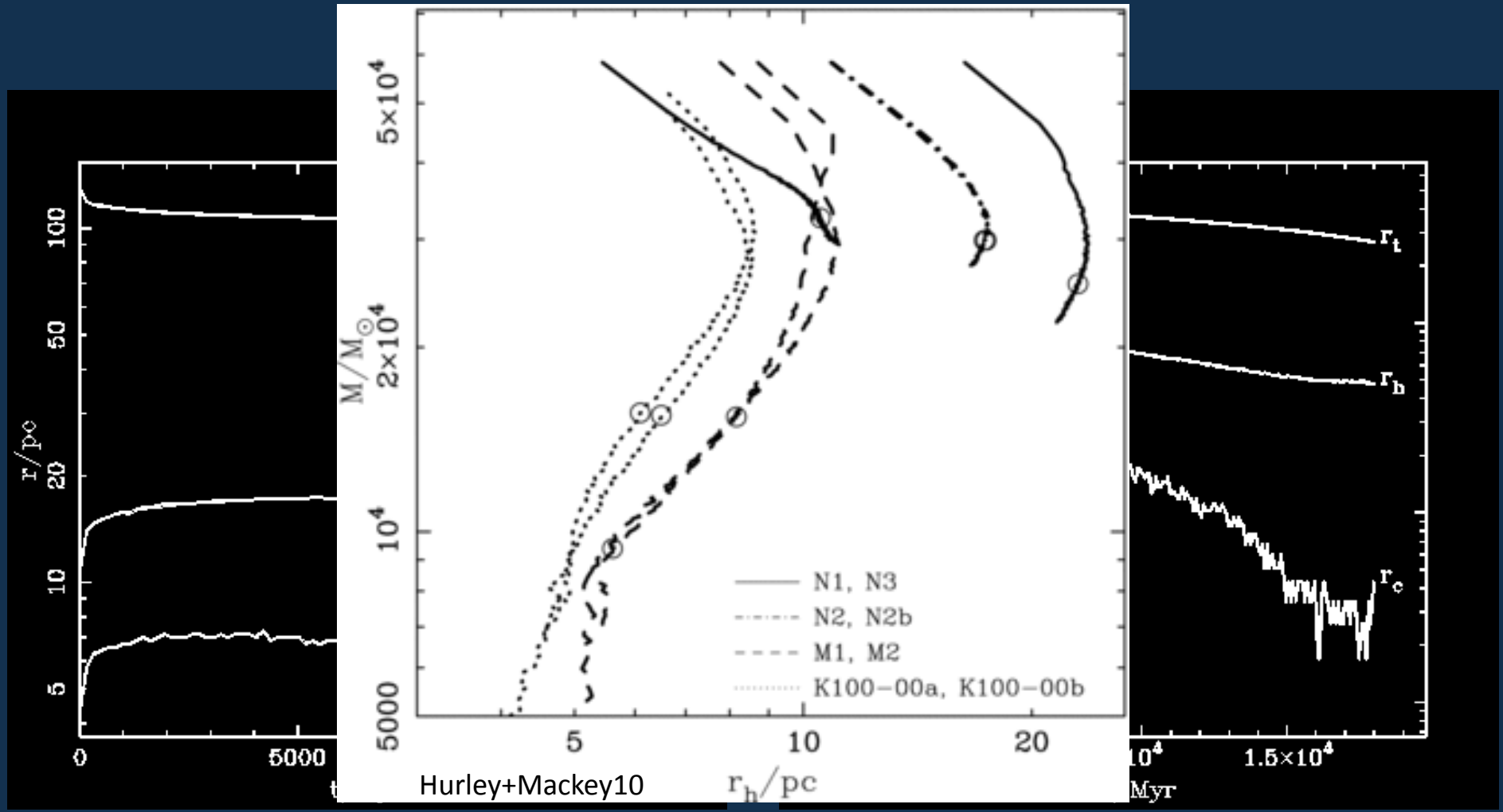

Hurley+Mackey10

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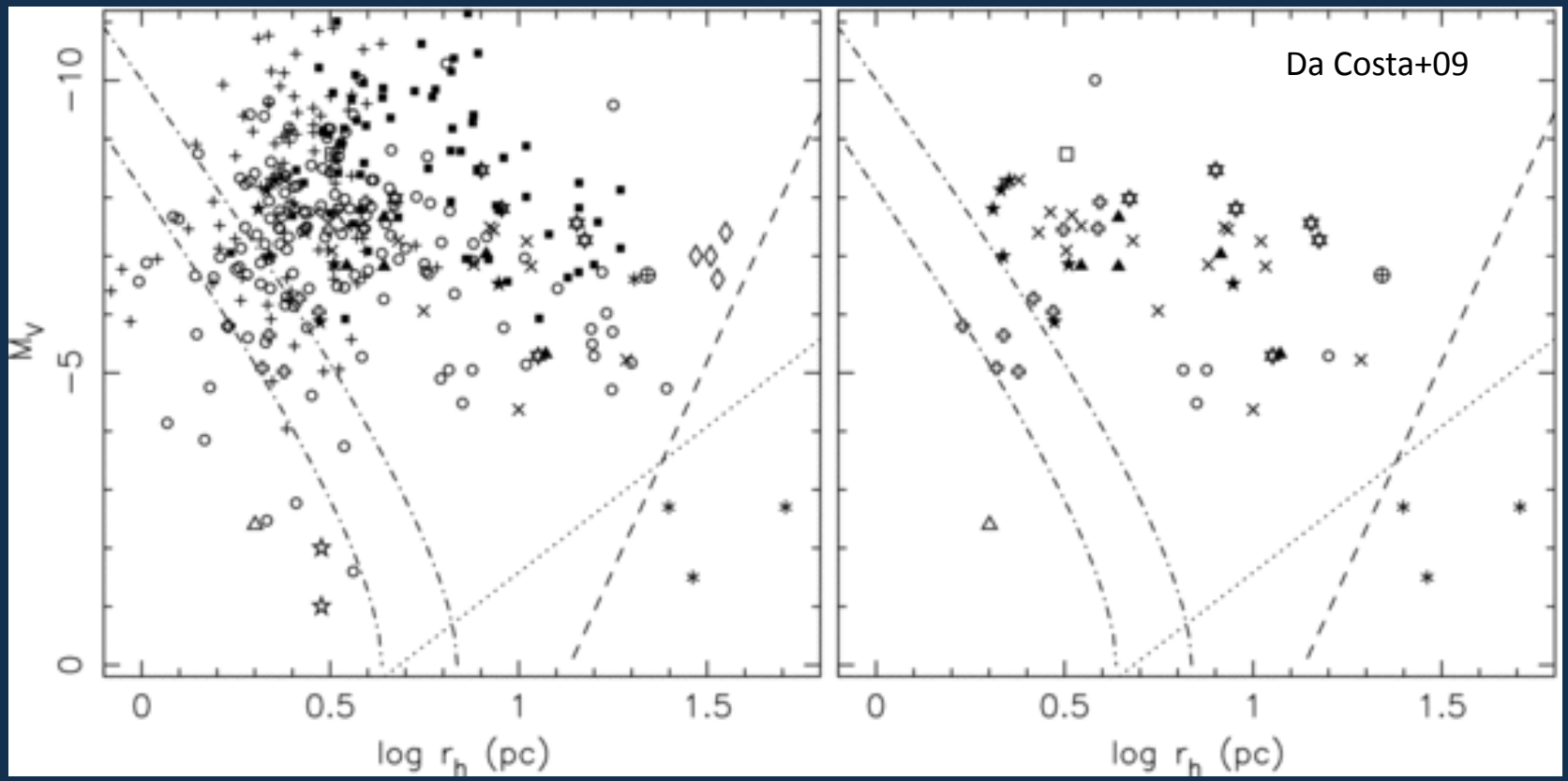

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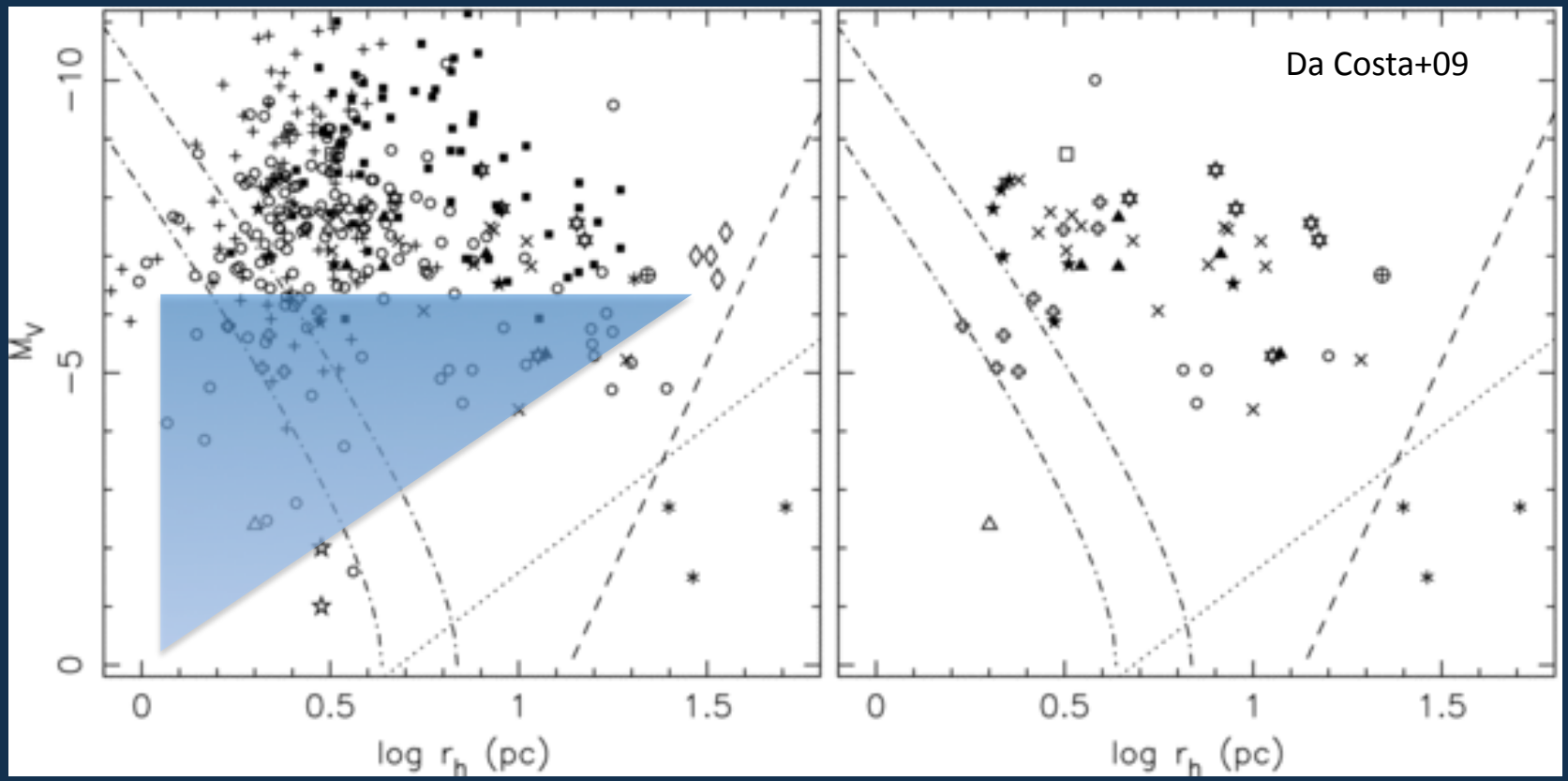
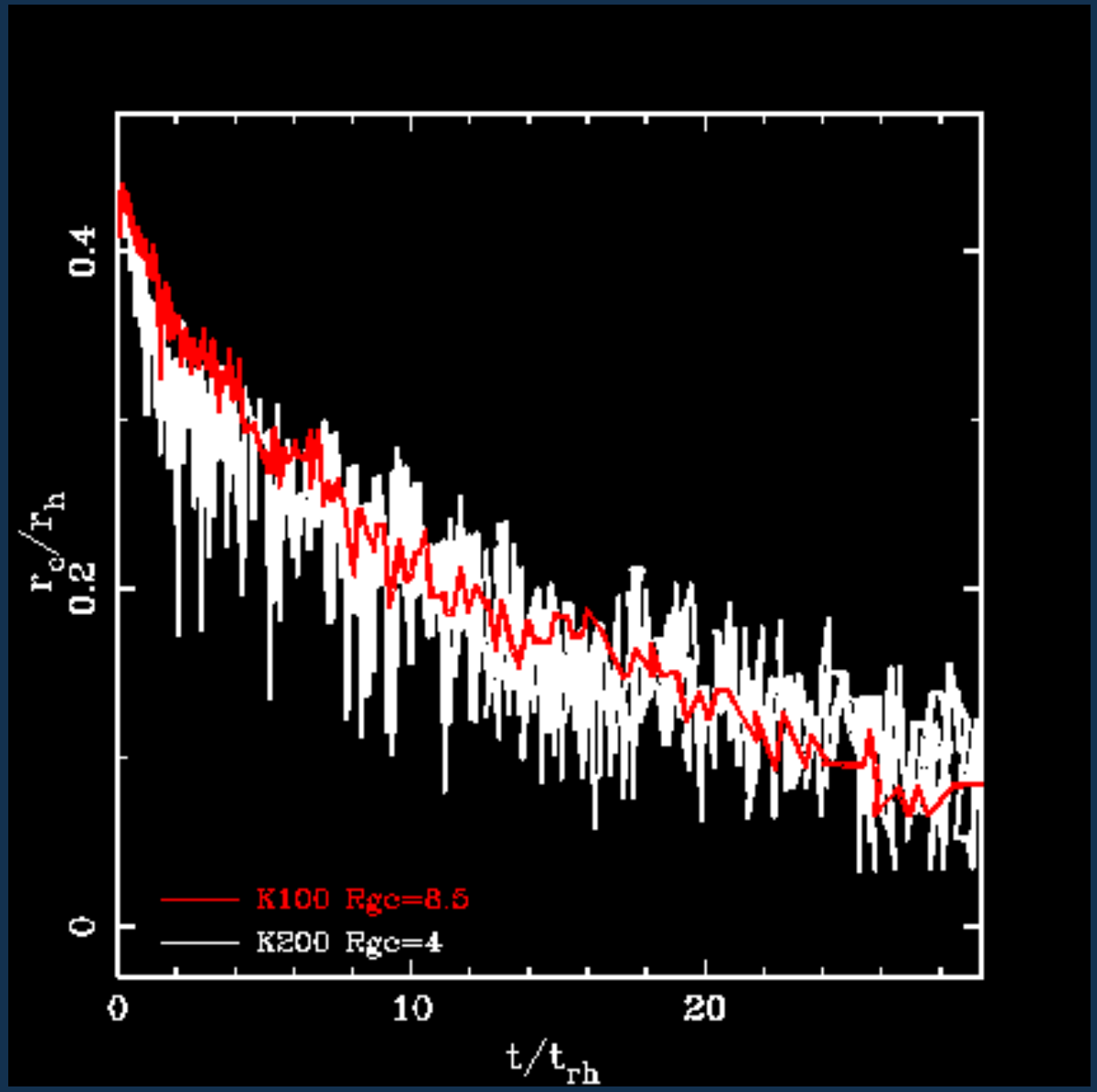


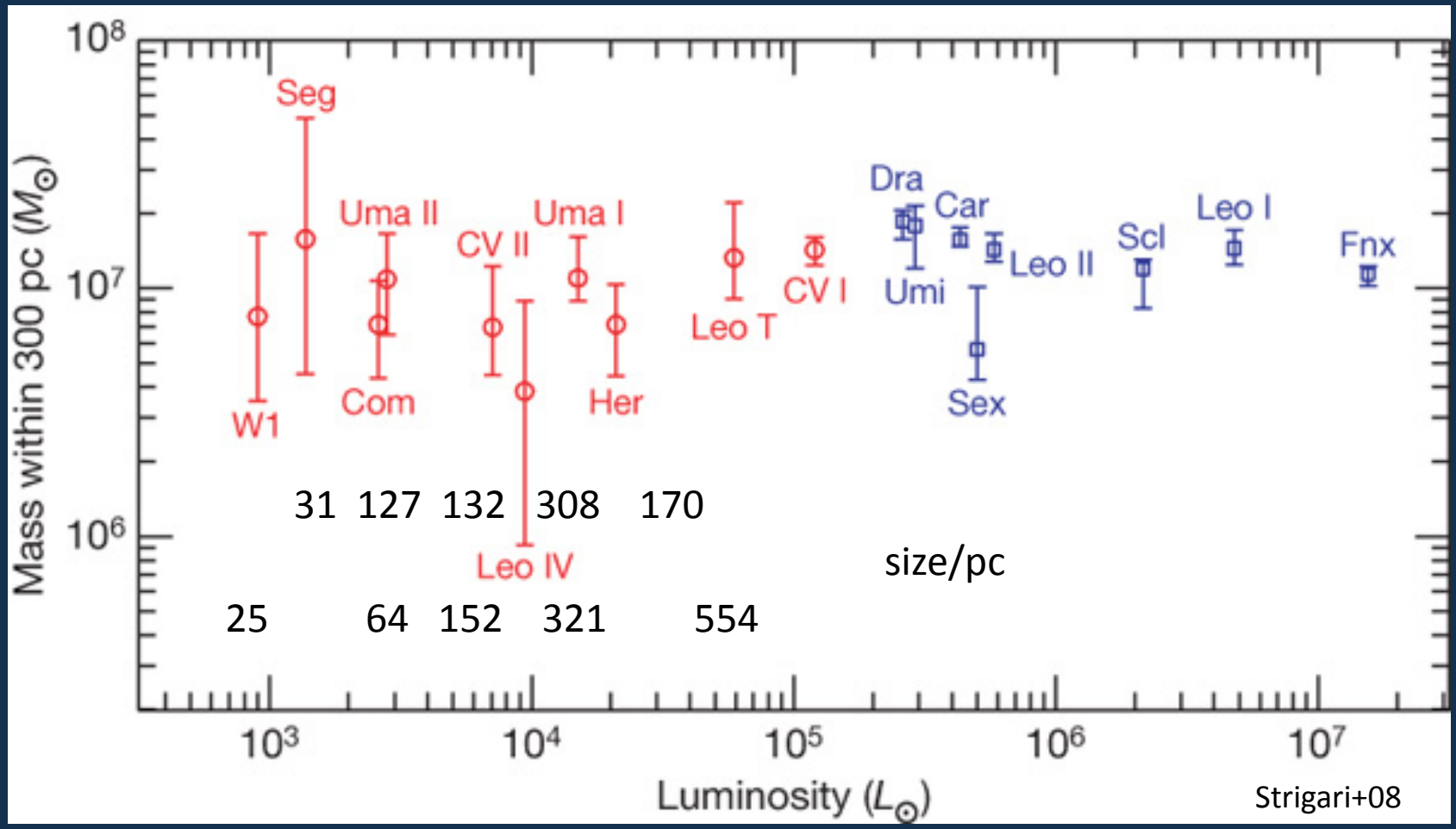
The *N* = 200,000 model



200k
2% binaries
R_{gc} = 4 kpc

100k
5% binaries
R_{gc} = 8.5 kpc

Models of Ultra-Faint Dwarfs?



sigma ~ 3-10 km/s

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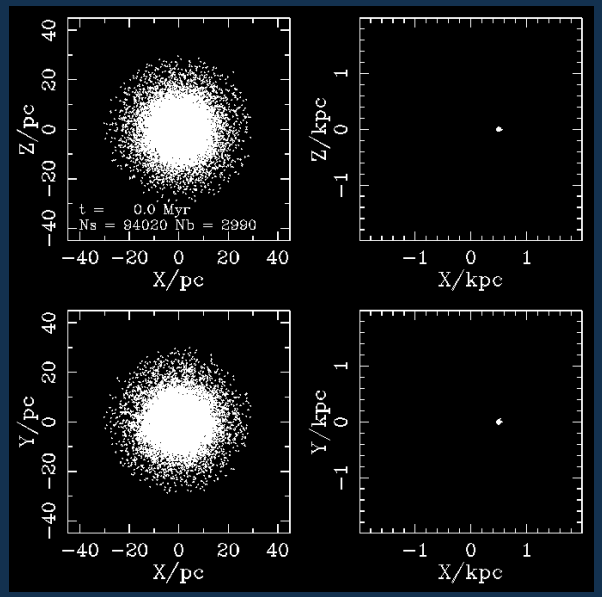

$M_{NFW} = 10^9$
c = 16
R_{gc} = 0.5 kpc

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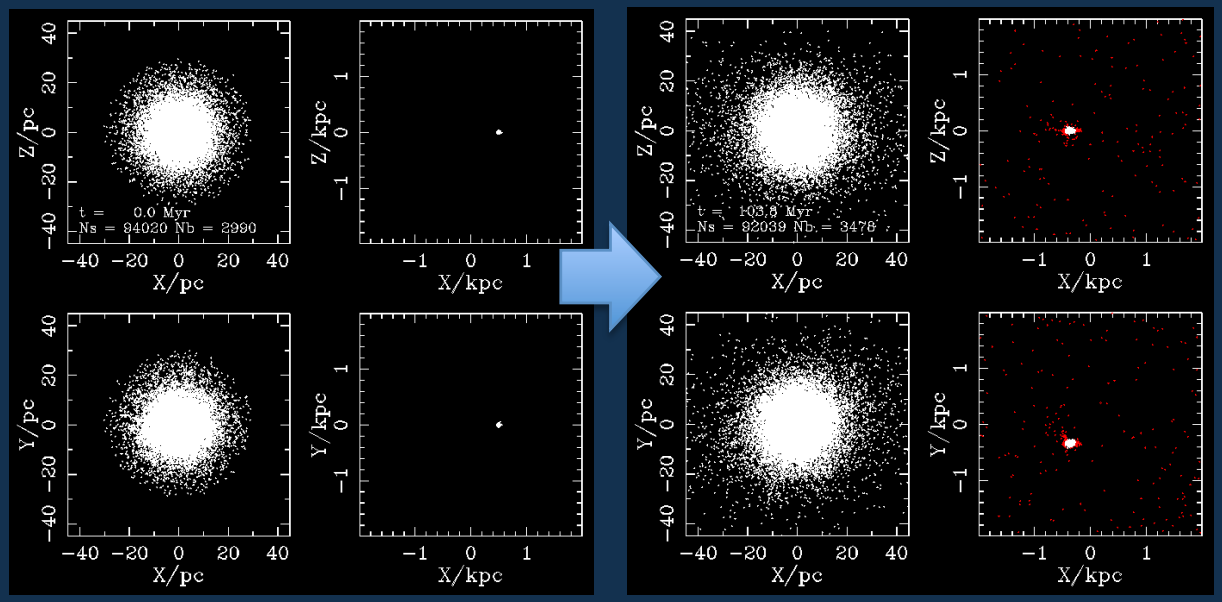

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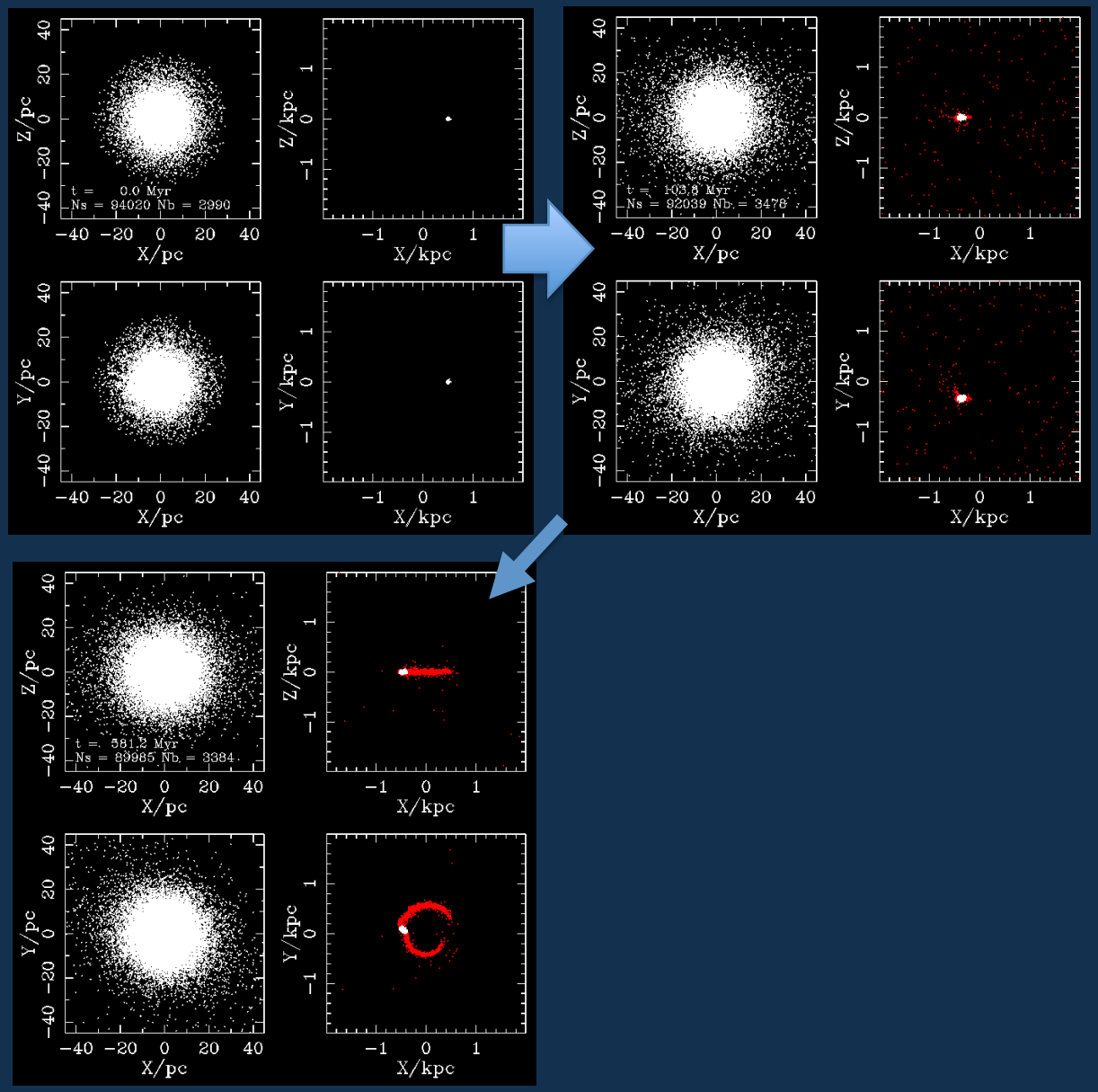

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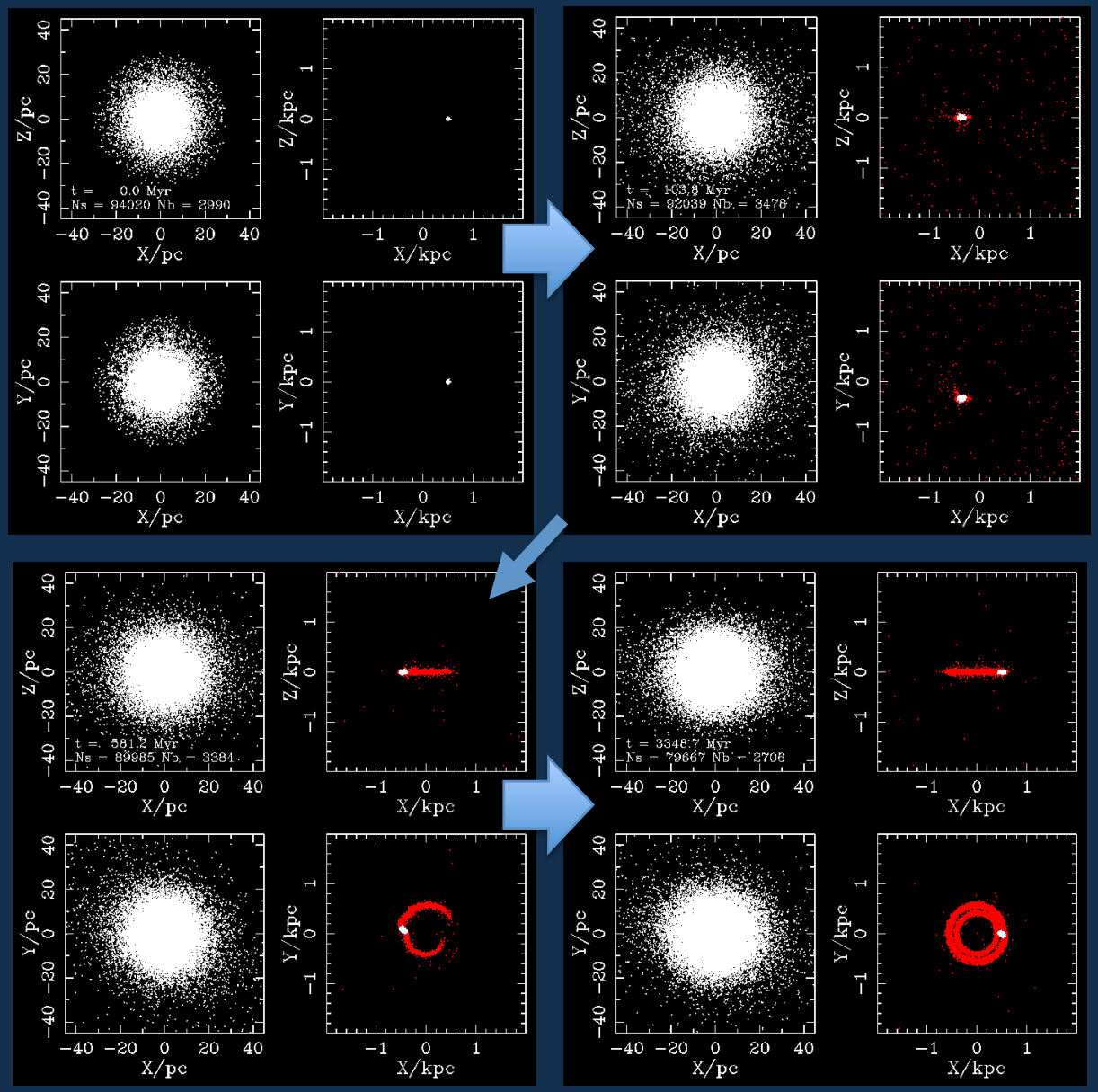

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Models of Ultra-Faint Dwarfs?

Star cluster near centre (R_{gc}=20pc), $M_{NFW} = 10^8$, c=20

N = 100,000, 5% binaries

N = 28,000, 40% binaries

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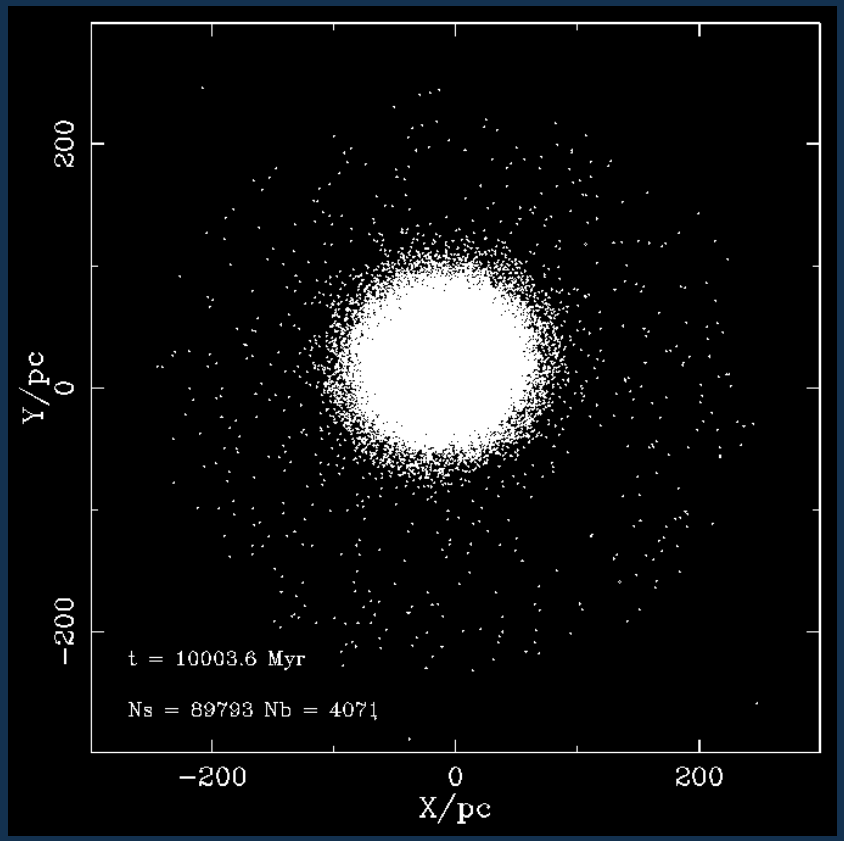

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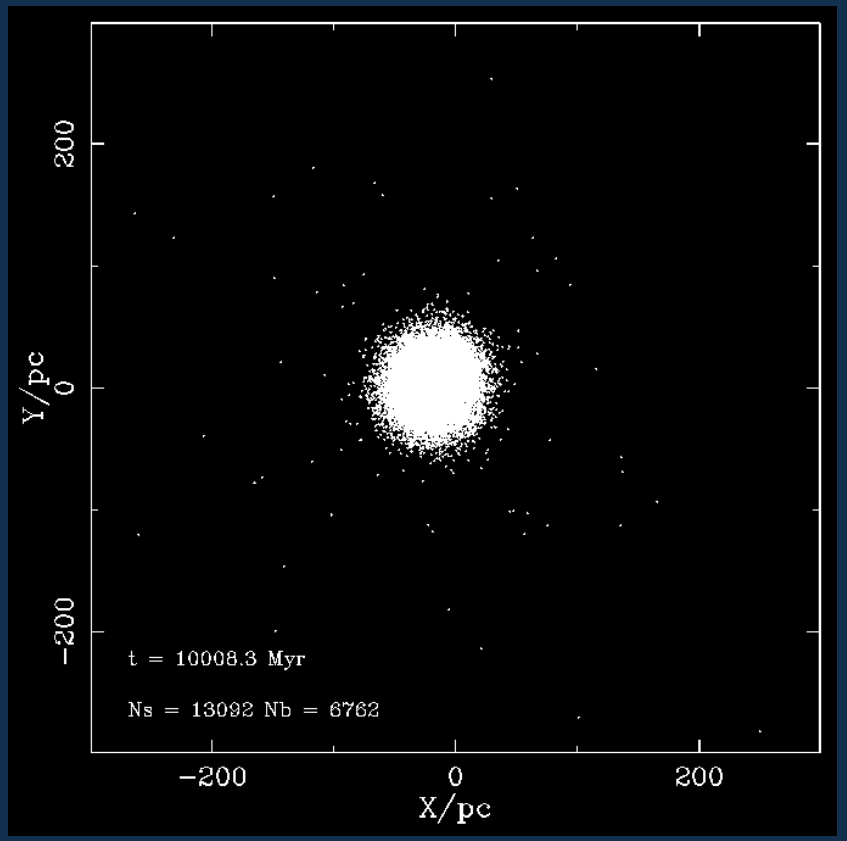

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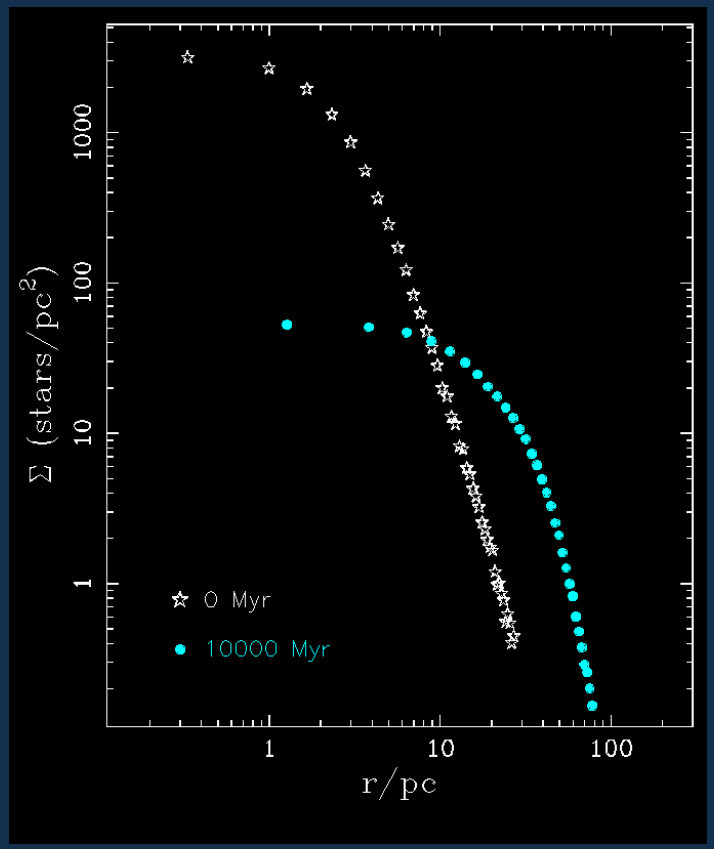

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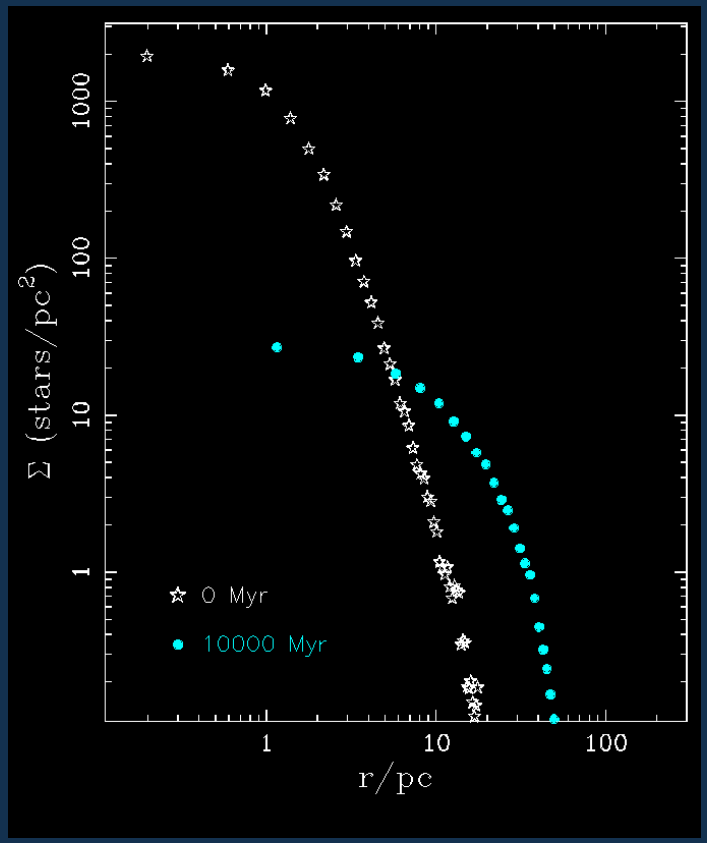

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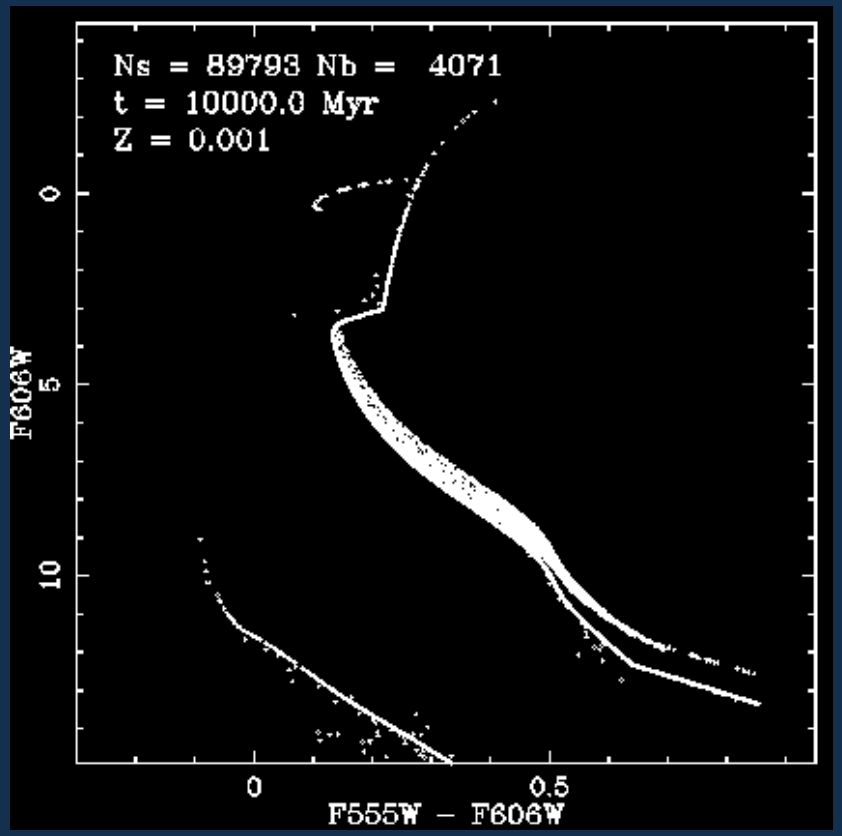

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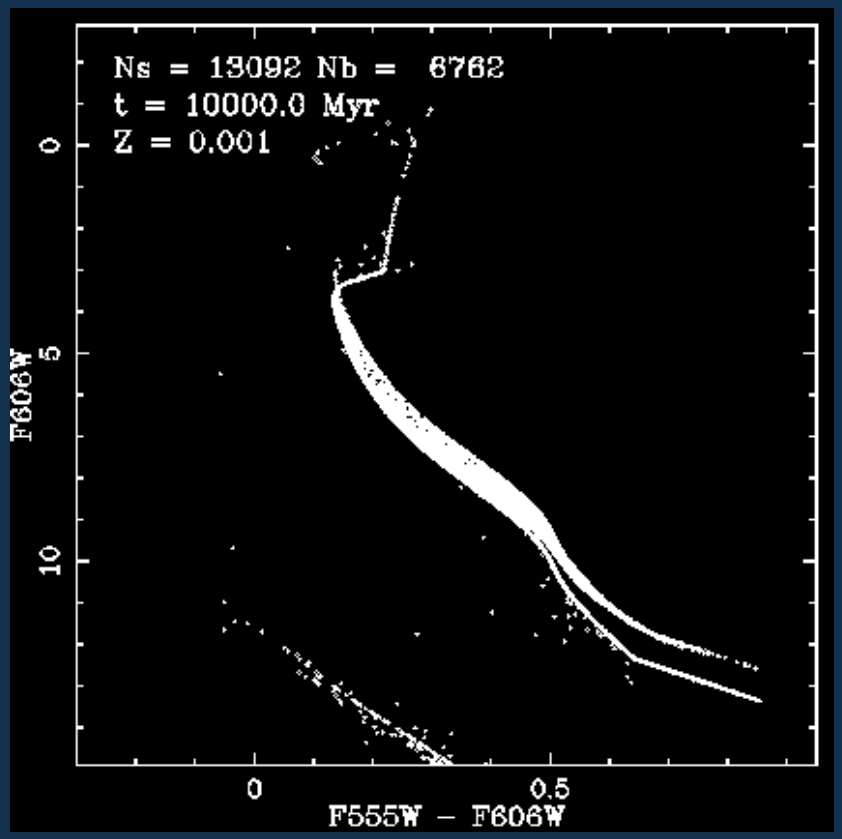

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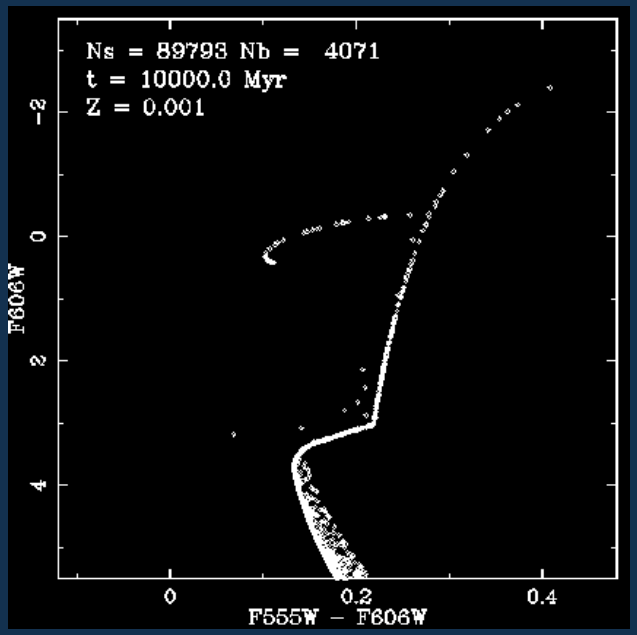

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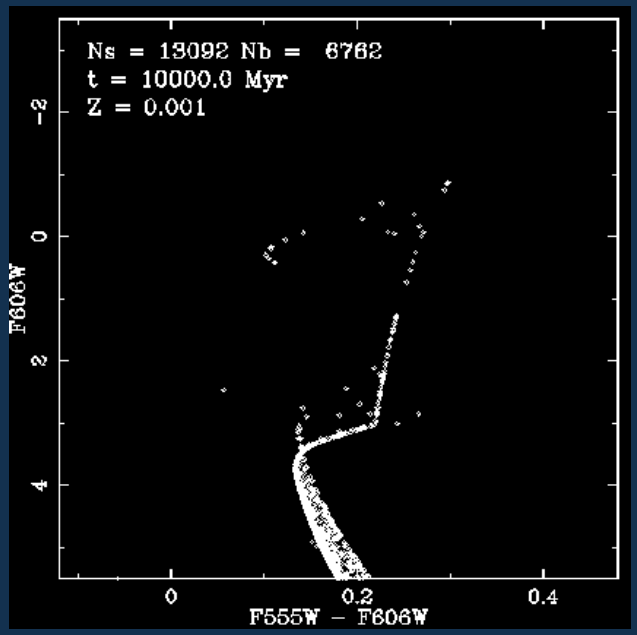

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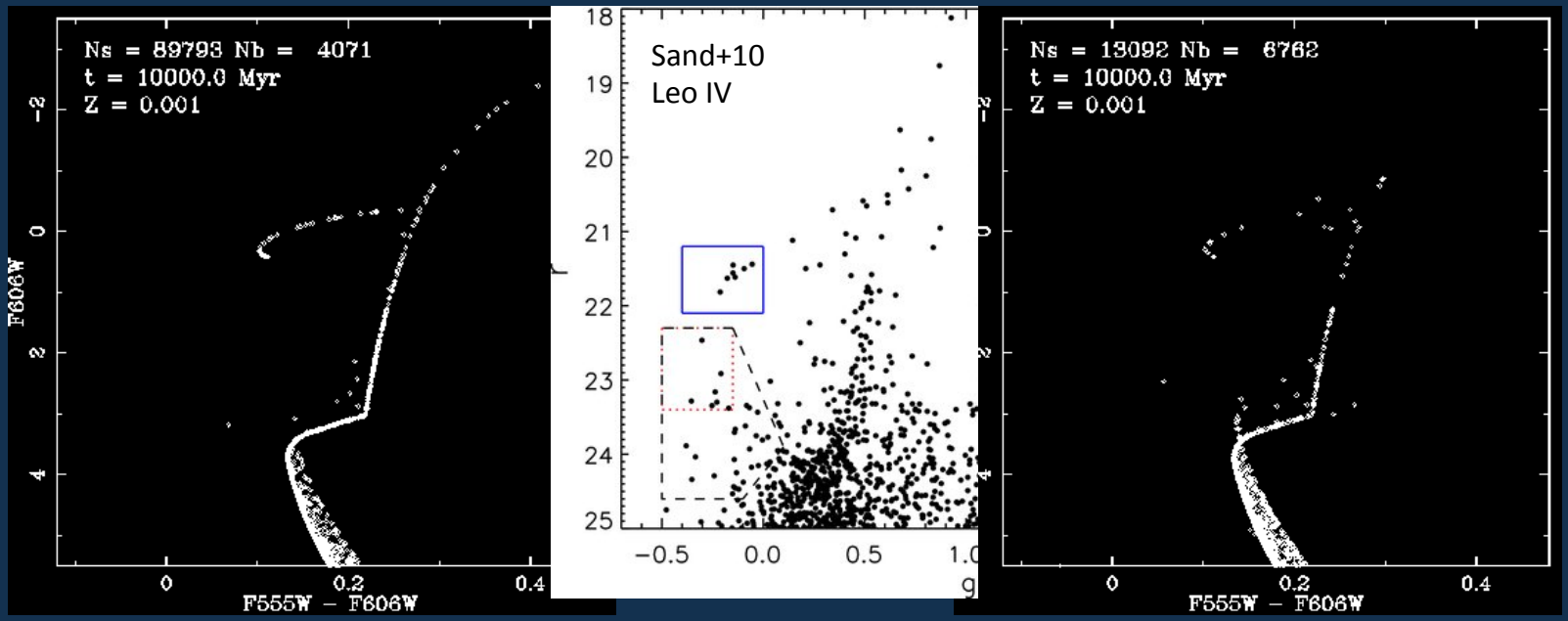

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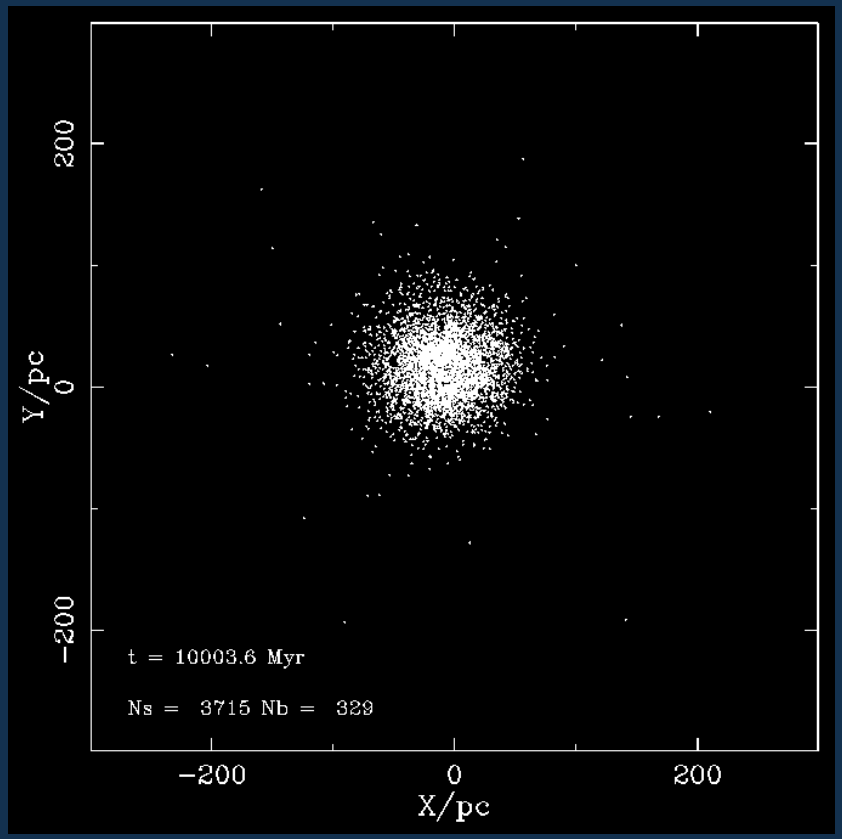

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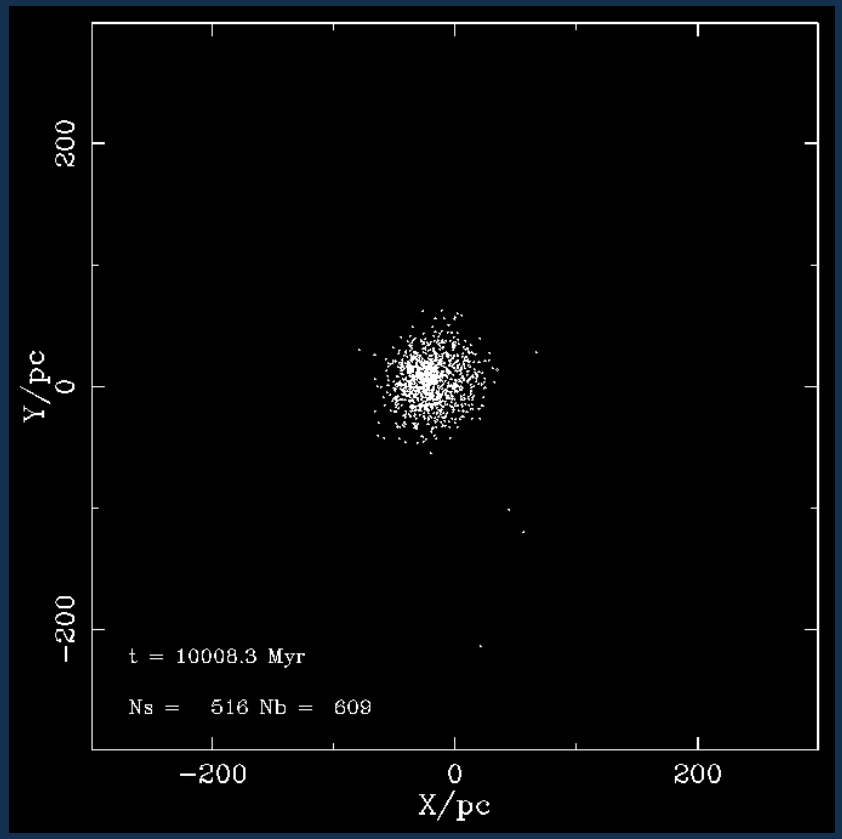

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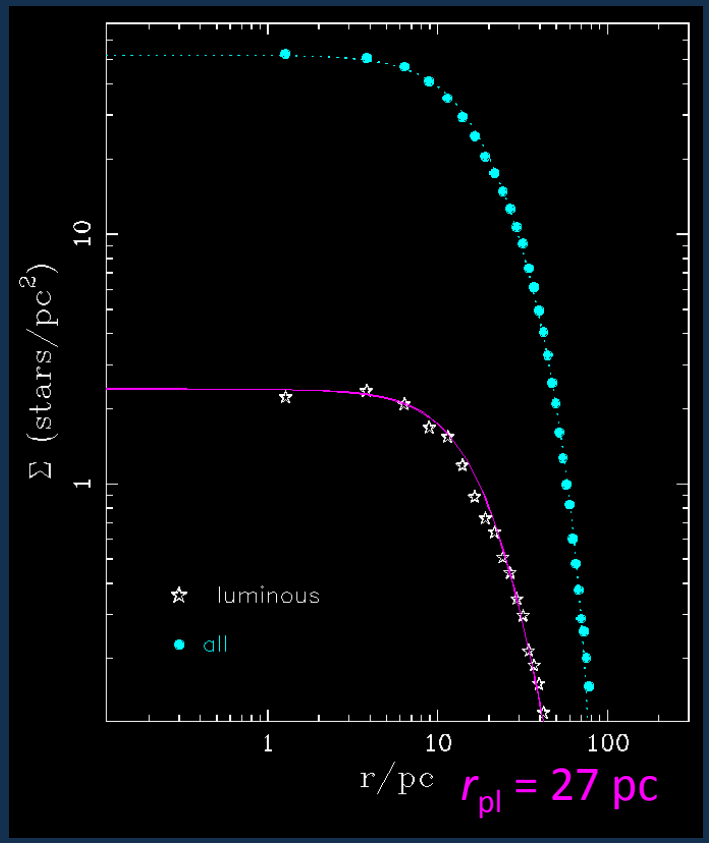

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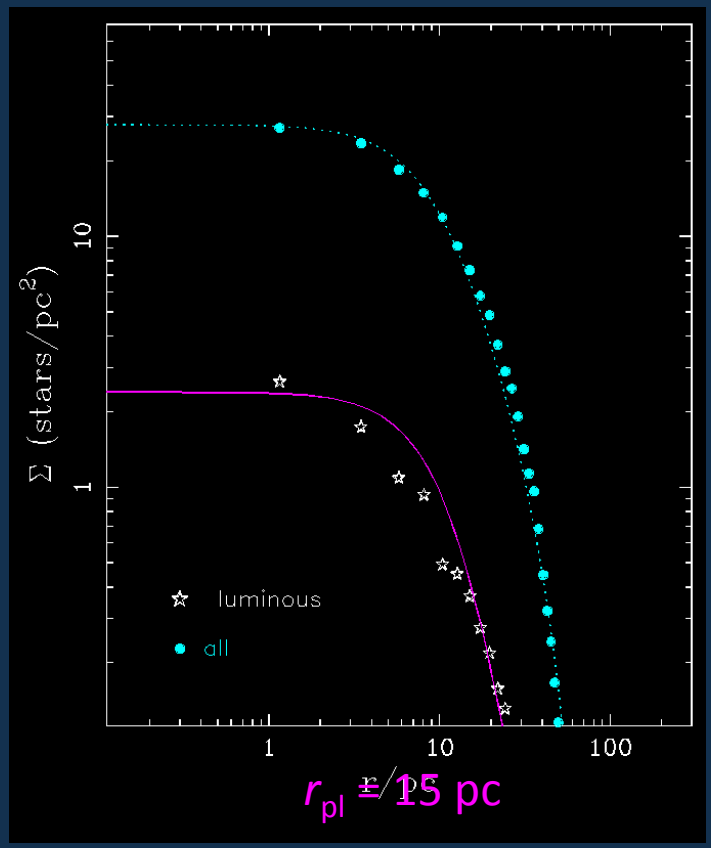

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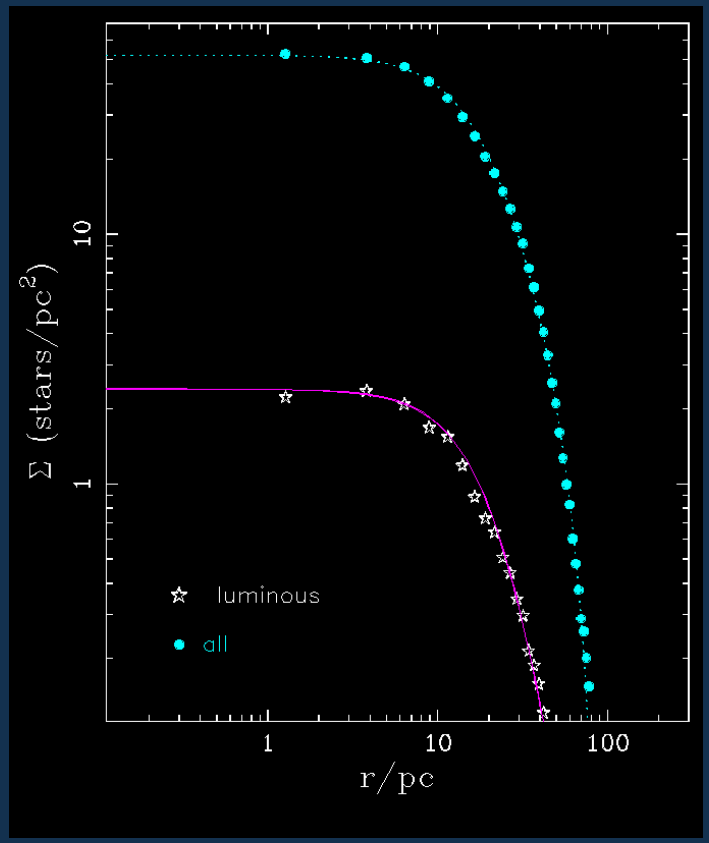

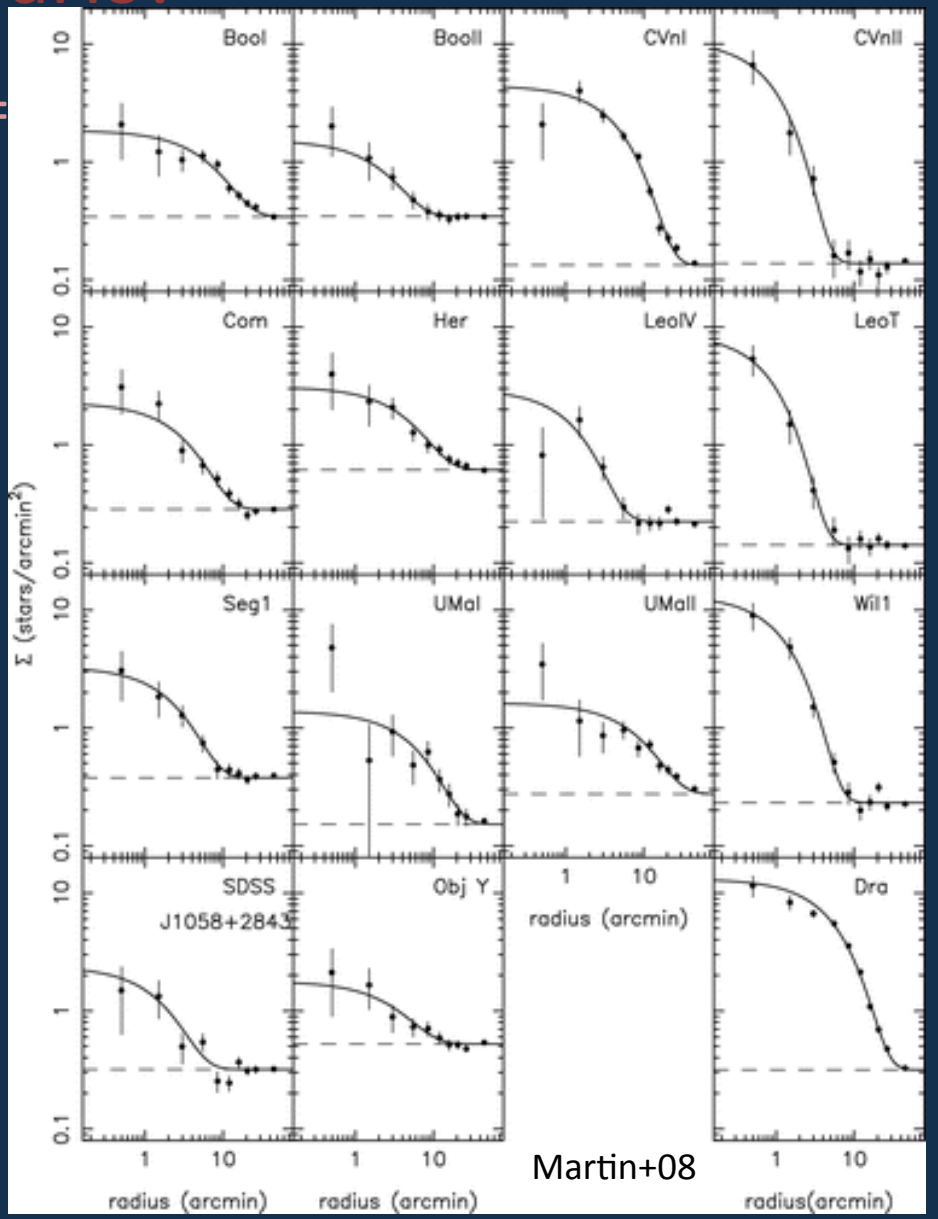

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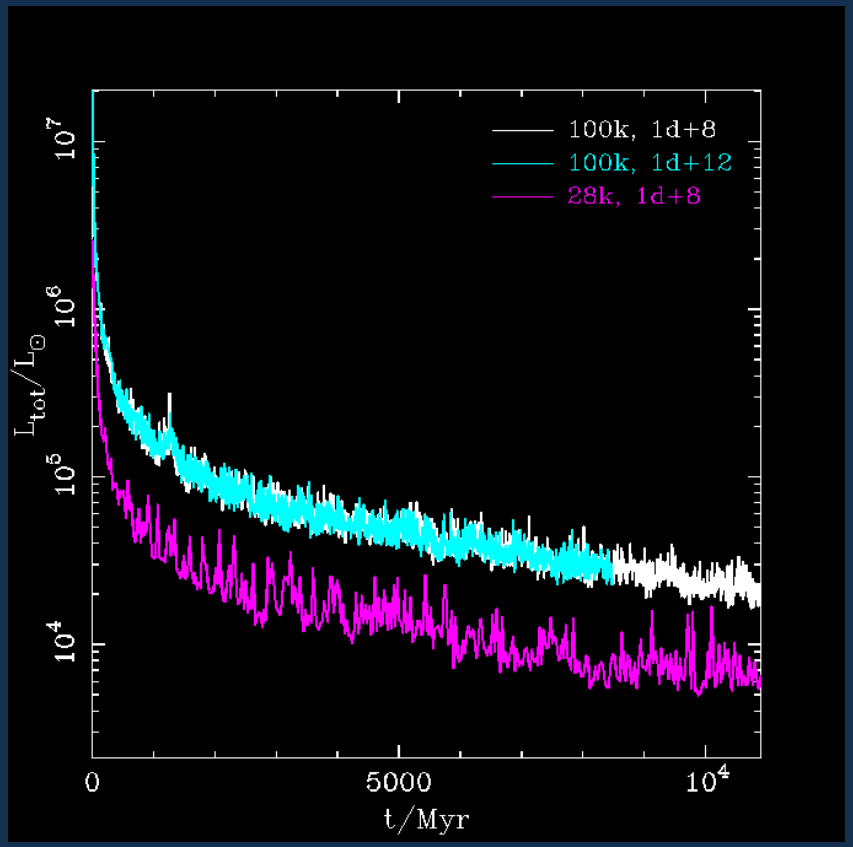

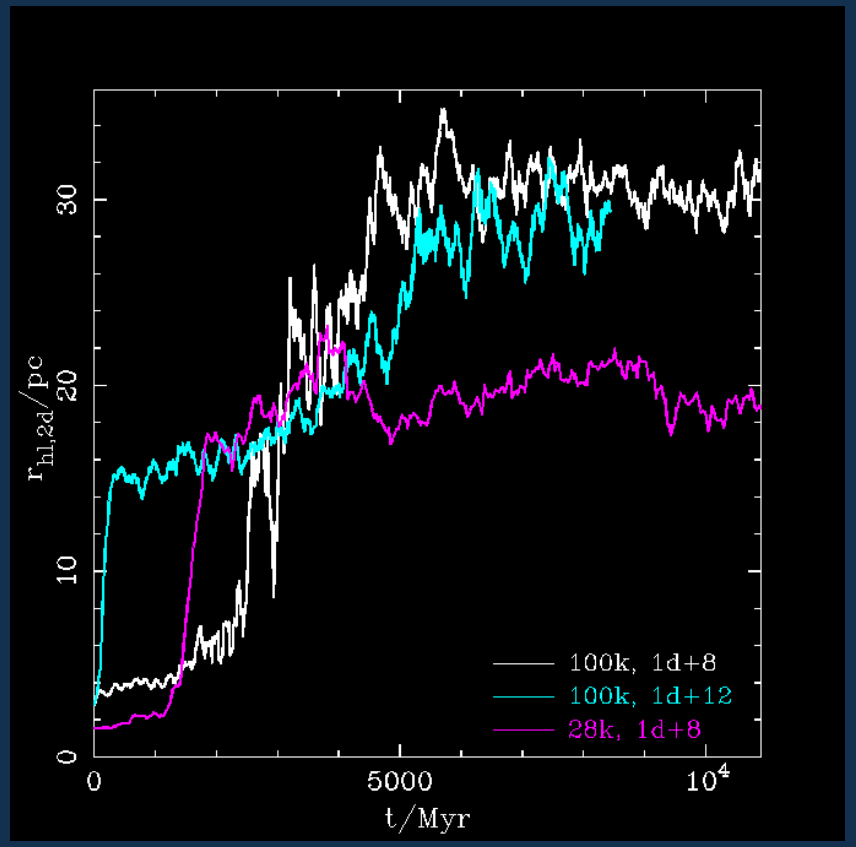

M_{300} ~ 0.7x10^7 M_{sun}

sigma ~ 5 km/s

Future …

- complex tidal fields
- definition of tidal radius?

- explore initial N, f_b, density, sigma …
  non-virial protoclusters, e.g. Hurley+Bekki08

- include gas?

- …

N-body simulation background