The Blue Straggler population in the outer-Halo Globular Clusters

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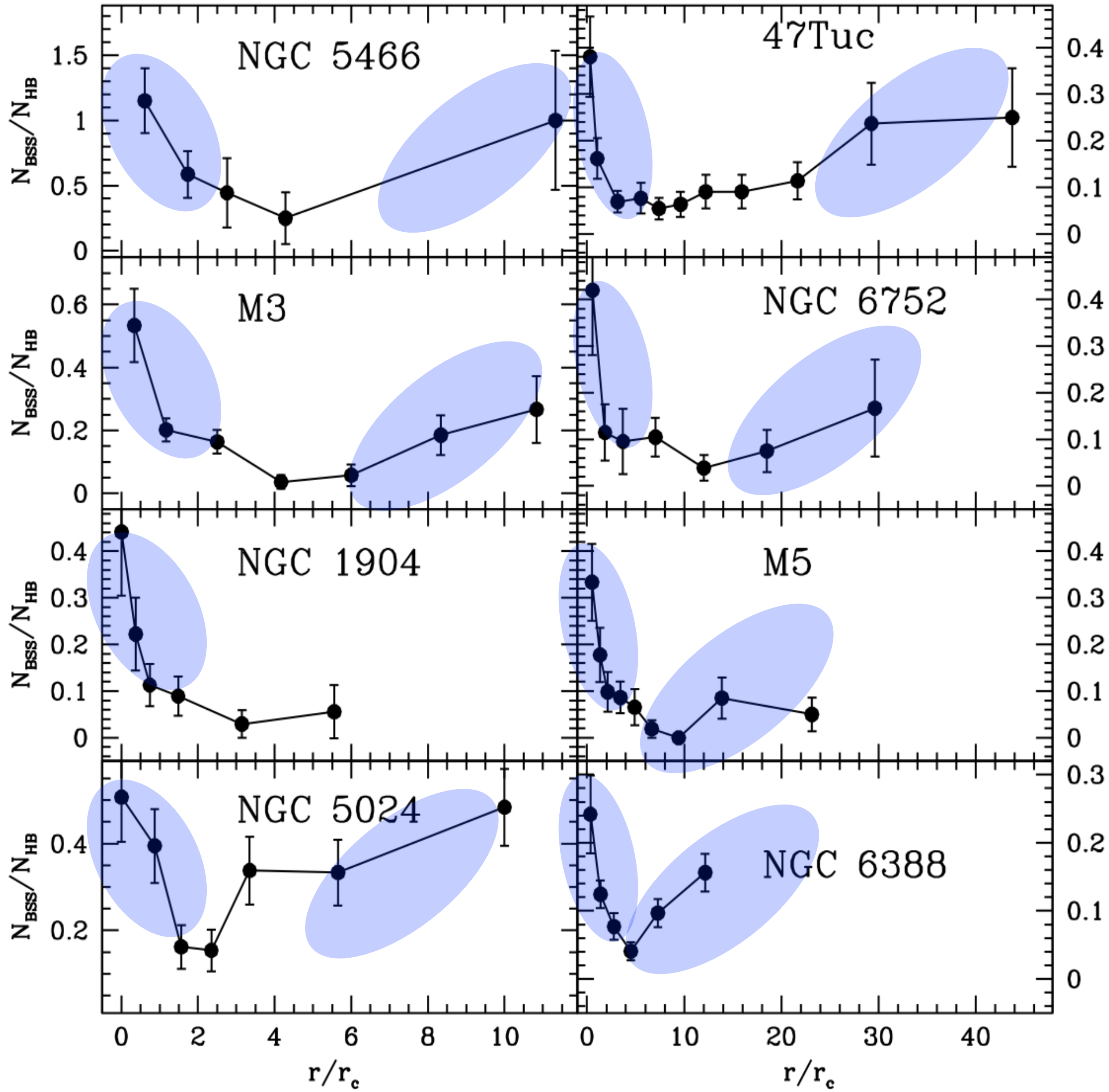
Cosmic-Lab

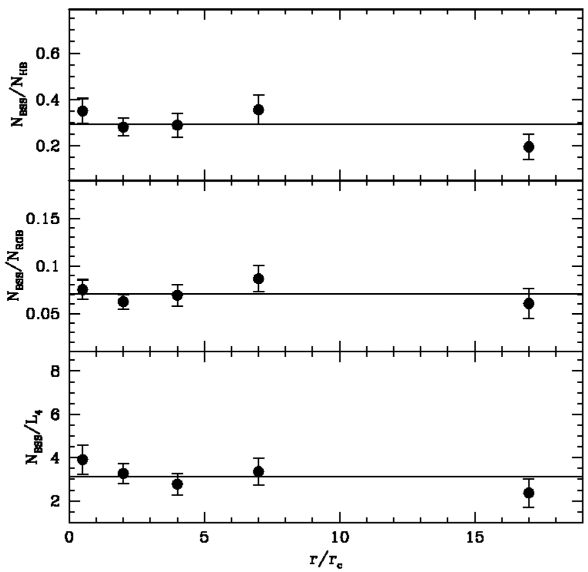
Results from Beccari et al. 2011, ApJL, 737, 4
Beccari et al. 2012, ApJ, 754, 108



Important signatures of the dynamical evolution of the parent cluster is imprinted in the BSS radial distribution

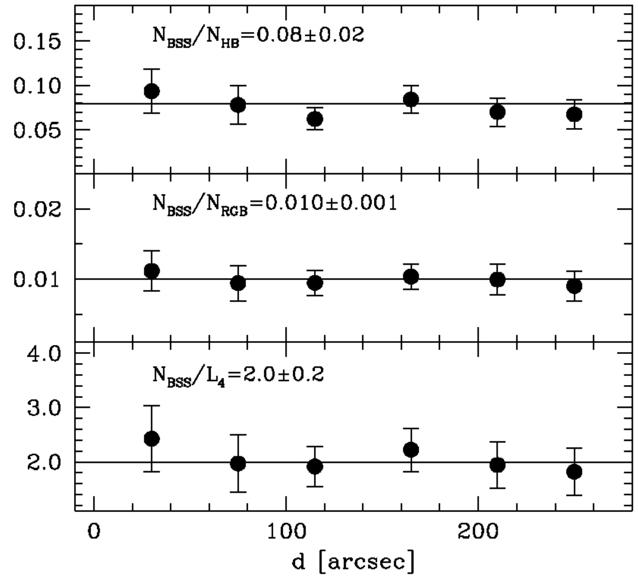
NO SIGNATURE OF MASS SEGREGATION

NGC 2419



Dalessandro et al. (2008)

ωCen



Ferraro et al. (2006)

BSS: the case of Palomar 14

Palomar 14: Halo cluster
d ~ 74Kpc
t ~ 10.5 Gyr
t_h ~ 20 Gyr

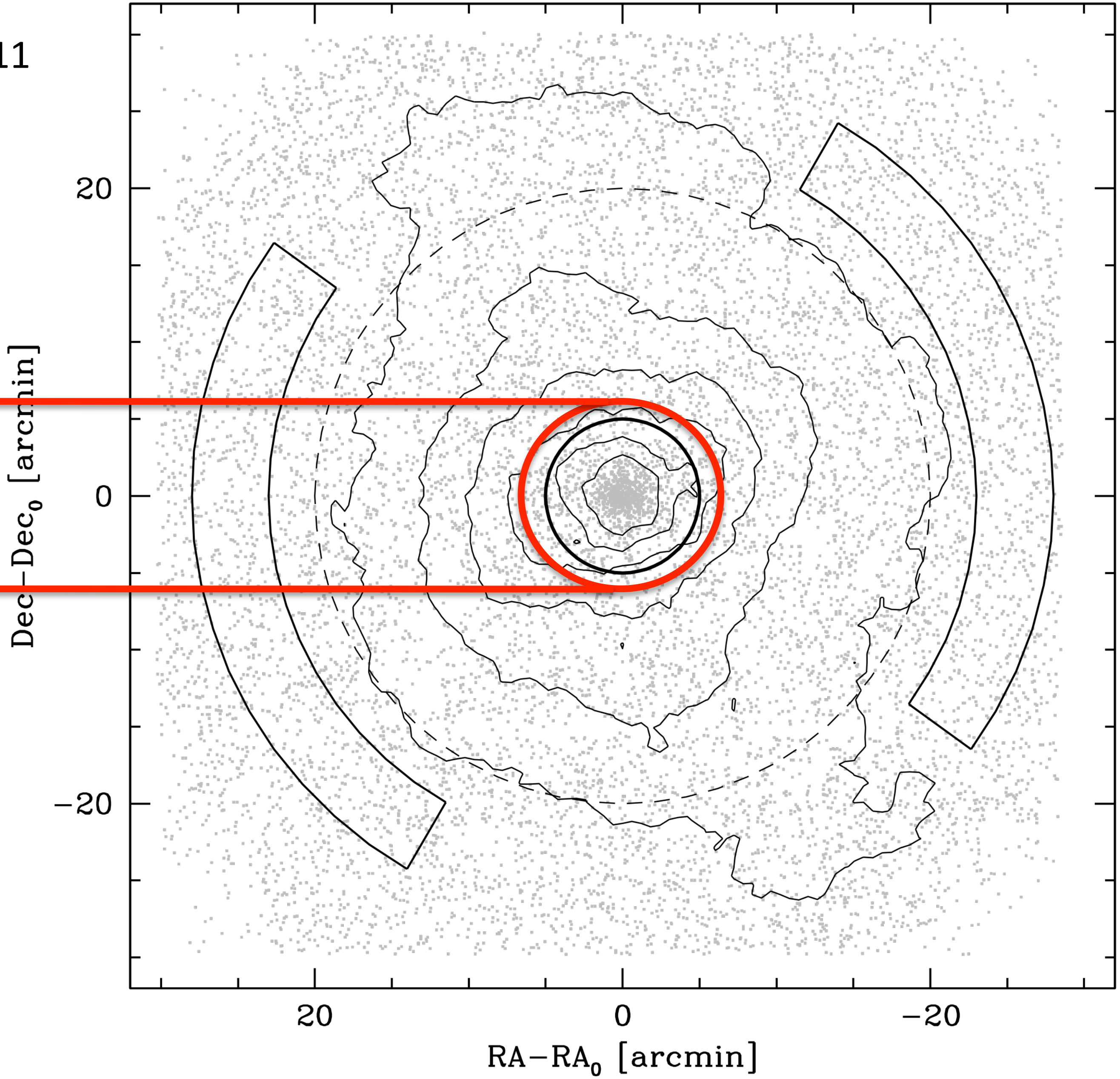
- The best candidate to test alternative theories of gravity (Baumgardt et al. 2005; Sollima & Nipoti 2010; Sollima et al. 2012);
- very small velocity dispersion (σv = 0.38 ± 0.12 km/s; Jordi et al.2009)
- Tests with artificial clusters indicate that this is not compatible with the fbin> 20% expected in a low density cluster (Küpper & Kroupa, 2010)
- The cluster MF between 0.53 and 0.79Msun is significantly flatter than canonical (Jordi et al. 2009);

↓ formed with only few low-mass stars

↓ it is mass segregated and lost most of its low-mass stars through interaction with the Galactic tidal field

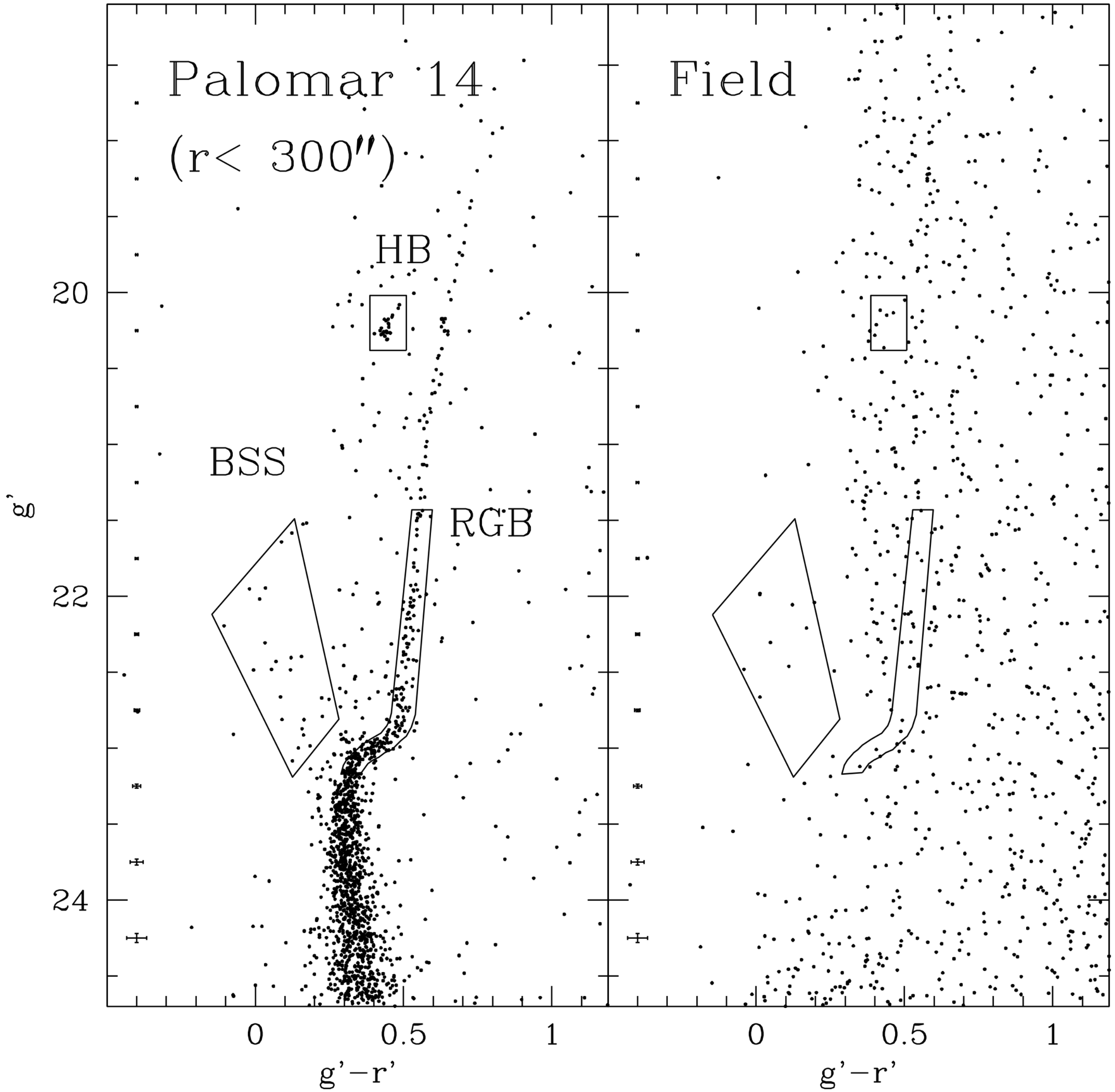
BSS: the case of Palomar 14

Sollima et al. 2011

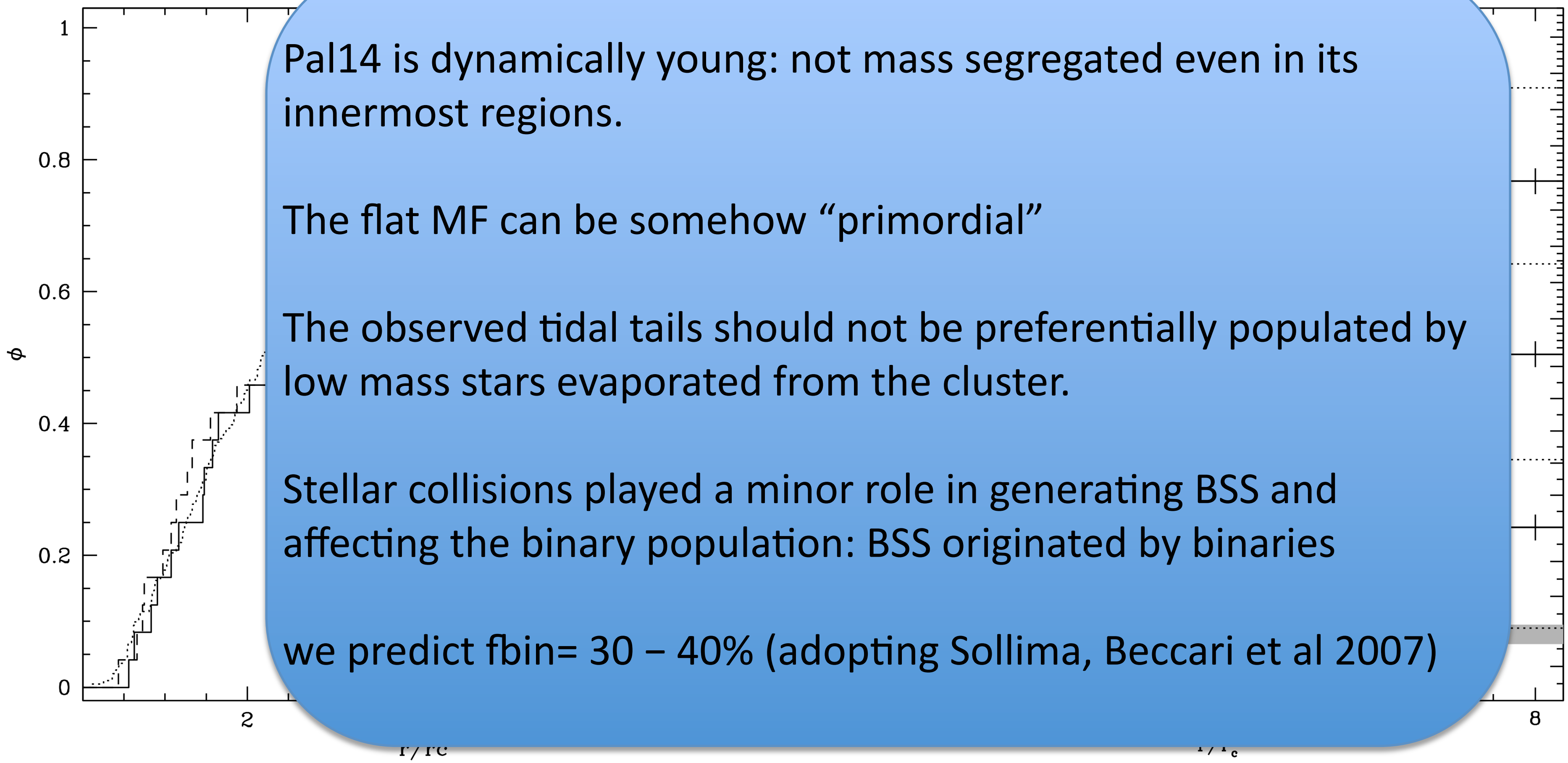


~8rc
~2rh

BSS: the case of Palomar 14



BSS: the case of Palomar 14



Pal14 is dynamically young: not mass segregated even in its innermost regions.

The flat MF can be somehow “primordial”

The observed tidal tails should not be preferentially populated by low mass stars evaporated from the cluster.

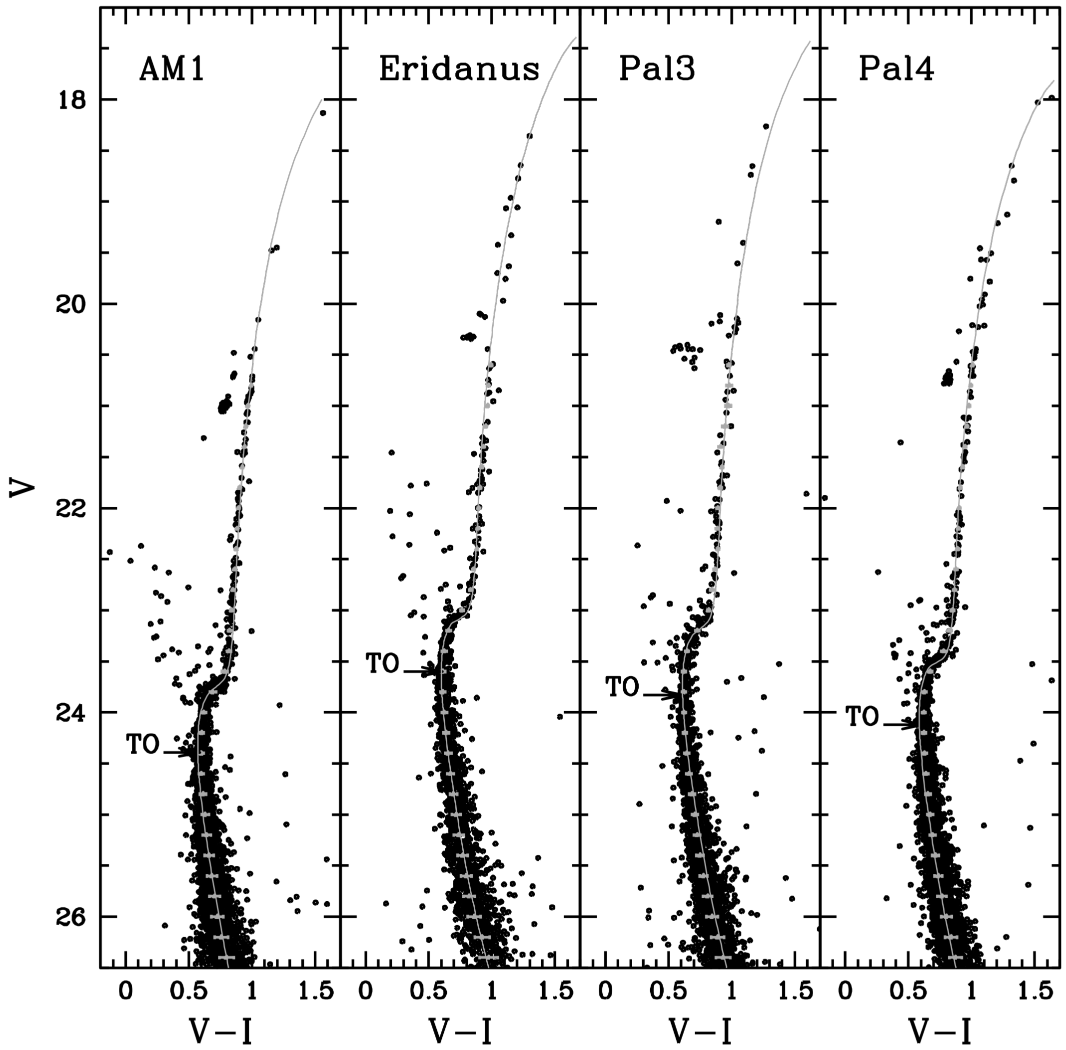
Stellar collisions played a minor role in generating BSS and affecting the binary population: BSS originated by binaries

we predict fbin= 30 – 40% (adopting Sollima, Beccari et al 2007)

Halo GCs

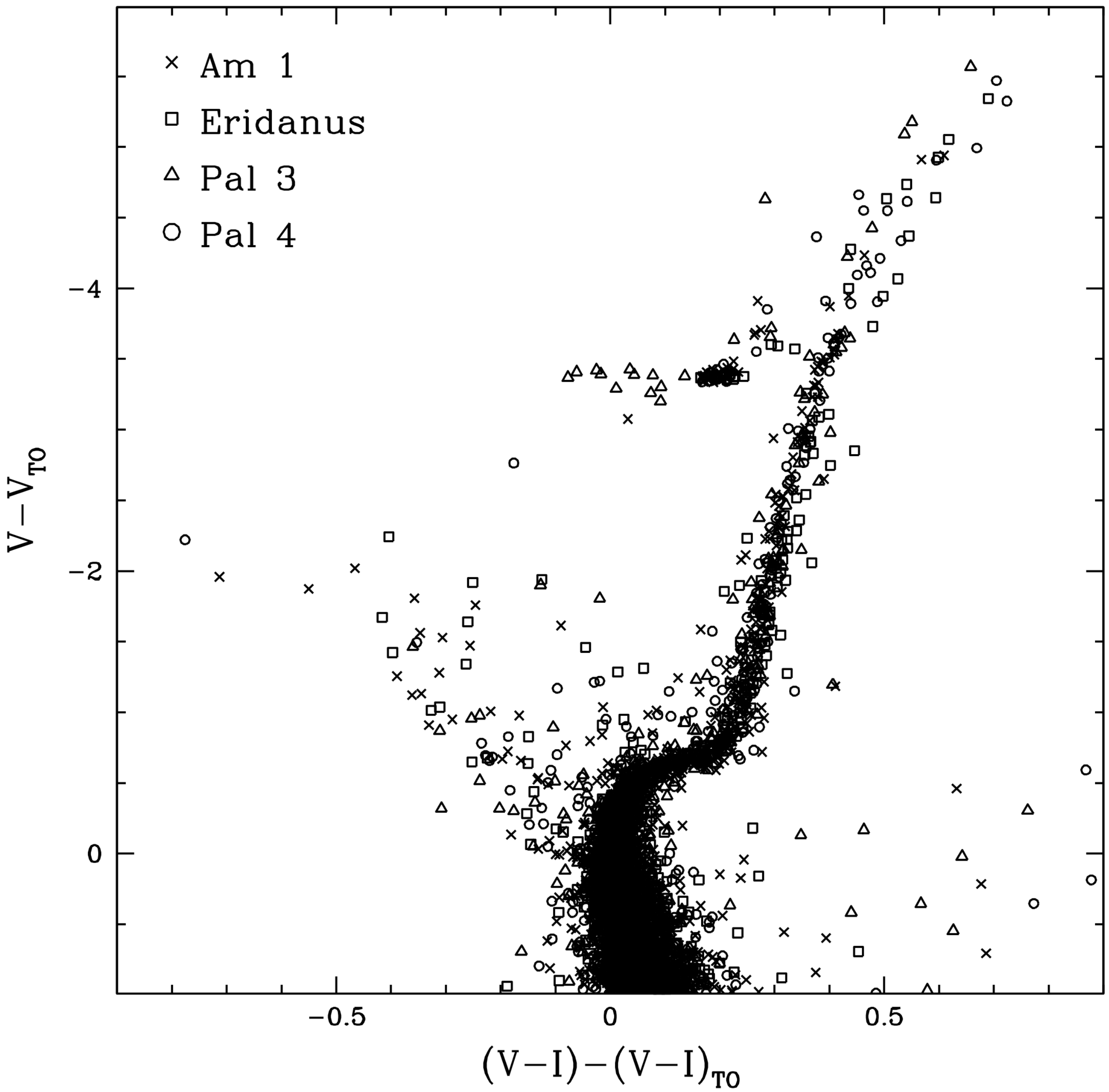
Rgc>50Kpc

Palomar 3
Palomar 4
Eridanus
AM 1
Palomar 14
NGC2419



HST data used by
Stetson et al. 1999
Dotter et al. 2008

Halo GCs



ALL ARE:

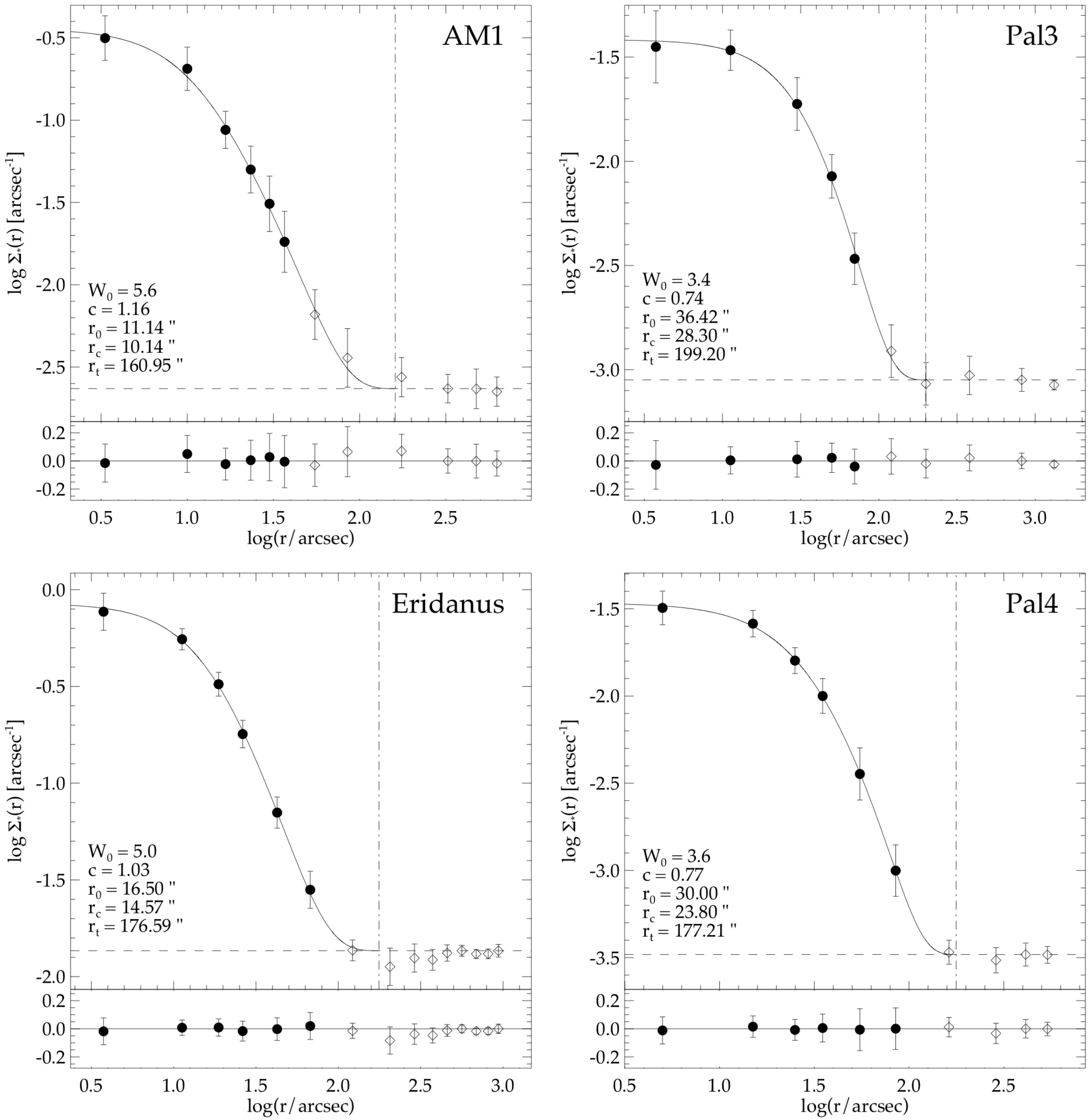
>Metal poor [Fe/H]~-1.5
>With red HB (second parameter)
>younger than inner-Halo GCs (~10Gyr vs ~12 Gyr)

Radial density profile

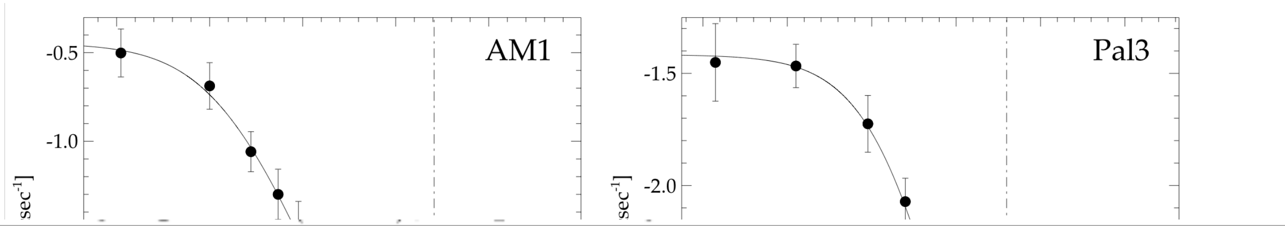
Fit with a single mass King model

Structural parameters

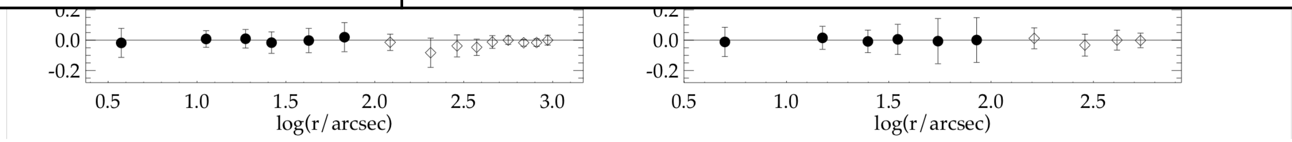
Half-mass relaxation time t_h



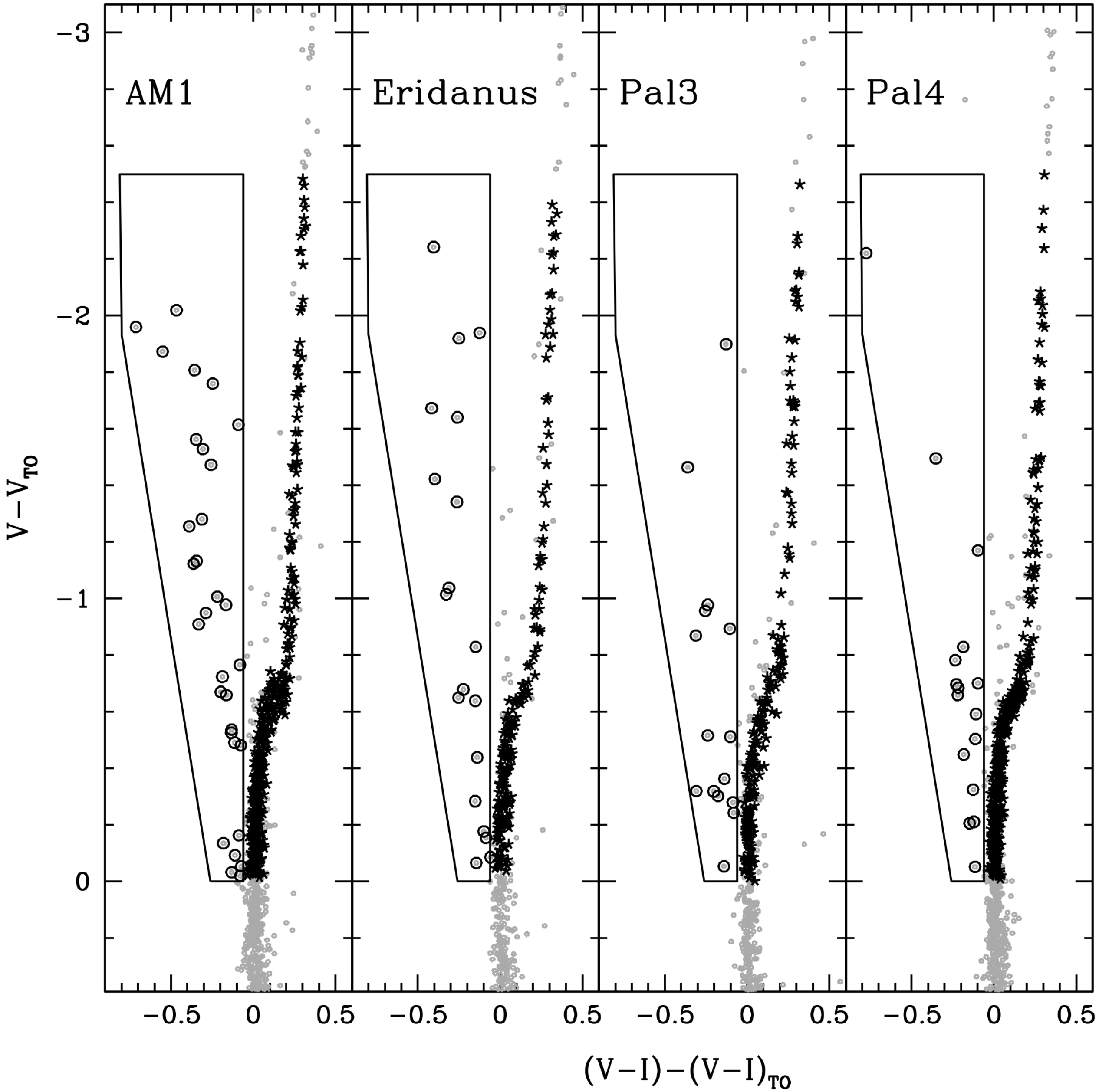
Radial density profile



Cluster	Age [Gyr]	$\log(M_{cl})$ [$M_\odot$]	W_0	c	r_0 [pc]	r_c [pc]	r_t [pc]	$\log(\rho_0)$ [$M_\odot/\mathrm{pc}^3$]	$\log(t_{rc})$ [yr]	t_h [Gyr]
AM1	11.0	4.10	5.60	1.16	6.59	5.99	95.12	0.48	9.02	3.5
Eridanus	10.5	4.26	5.00	1.03	7.20	6.35	77.01	0.06	9.32	5.0
Pal3	11.0	4.48	3.40	0.74	16.40	12.74	89.72	0.04	9.95	8.9
Pal4	10.5	4.62	3.60	0.77	15.87	12.59	93.77	0.18	9.96	10.2
Pal 14	10.5									19.9
NGC2419	12									18.0

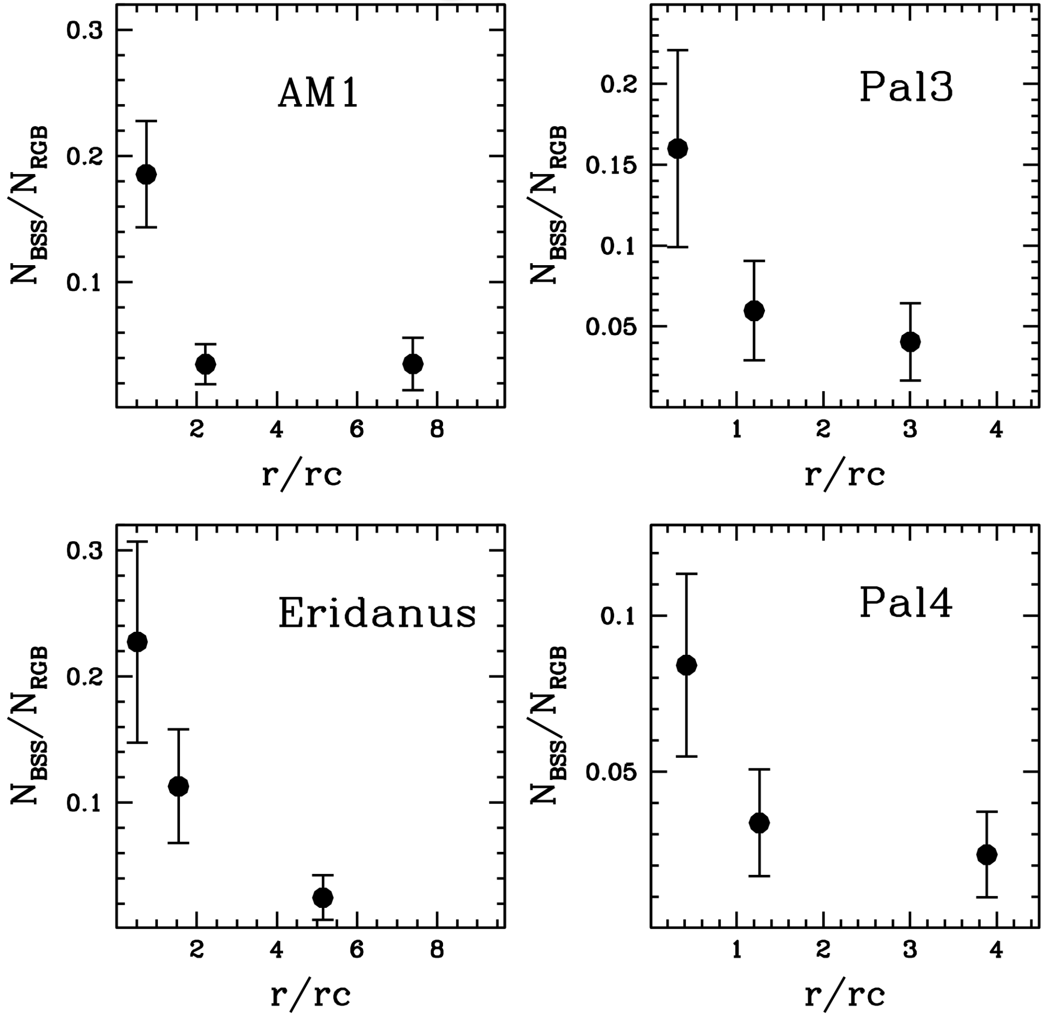


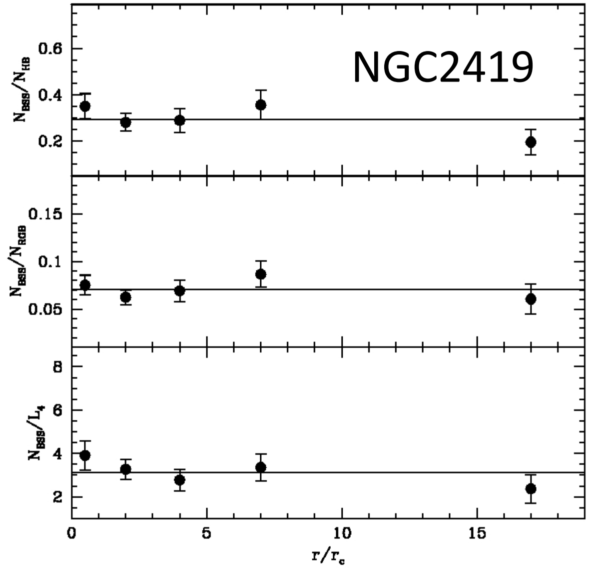
BSS in the Halo GCs

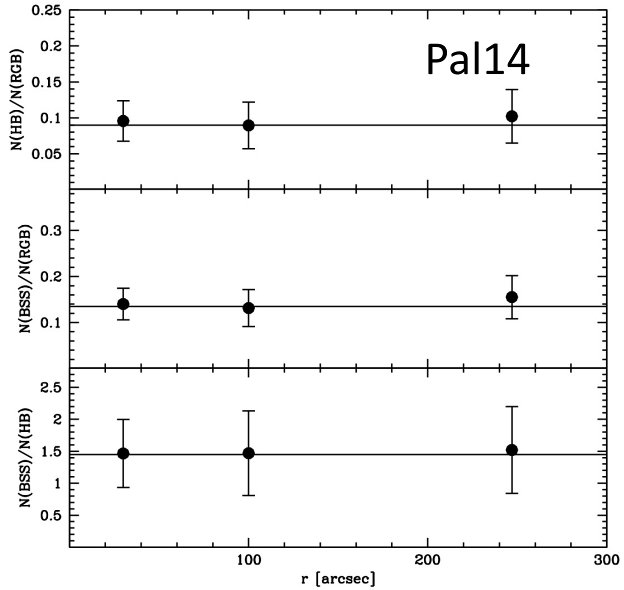


BSS in the Halo GCs

1-the radial distribution in the central regions







BSS in the Halo GCs

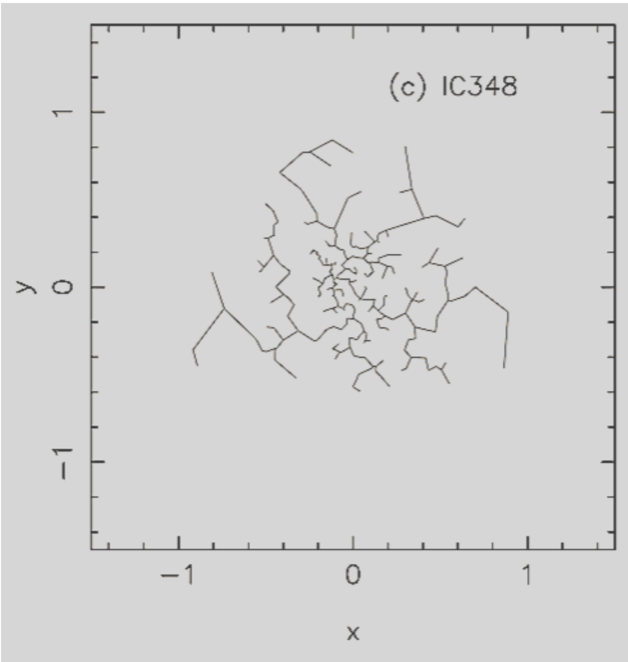
2-the Minimum Spanning Tree

The MST of a sample of points is the path connecting all points in a sample with the shortest possible path length, which contains no closed loops (see e.g. Prim 1957)

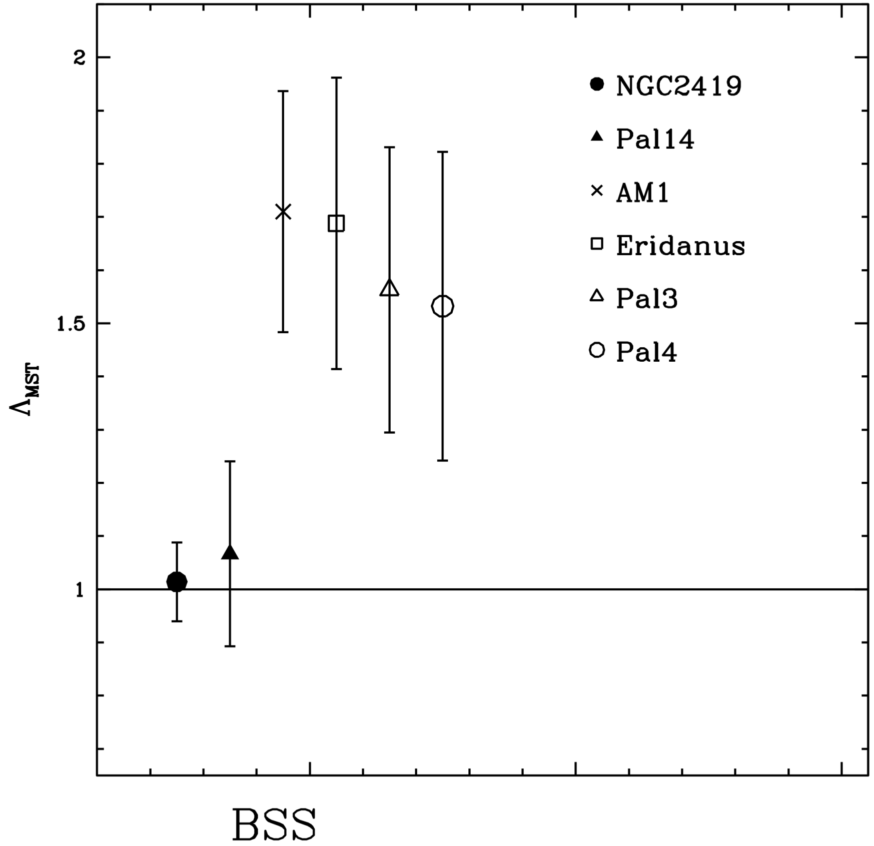
$$\Lambda_{MST} = \frac{< l_{ref} >}{l_{massive}}$$

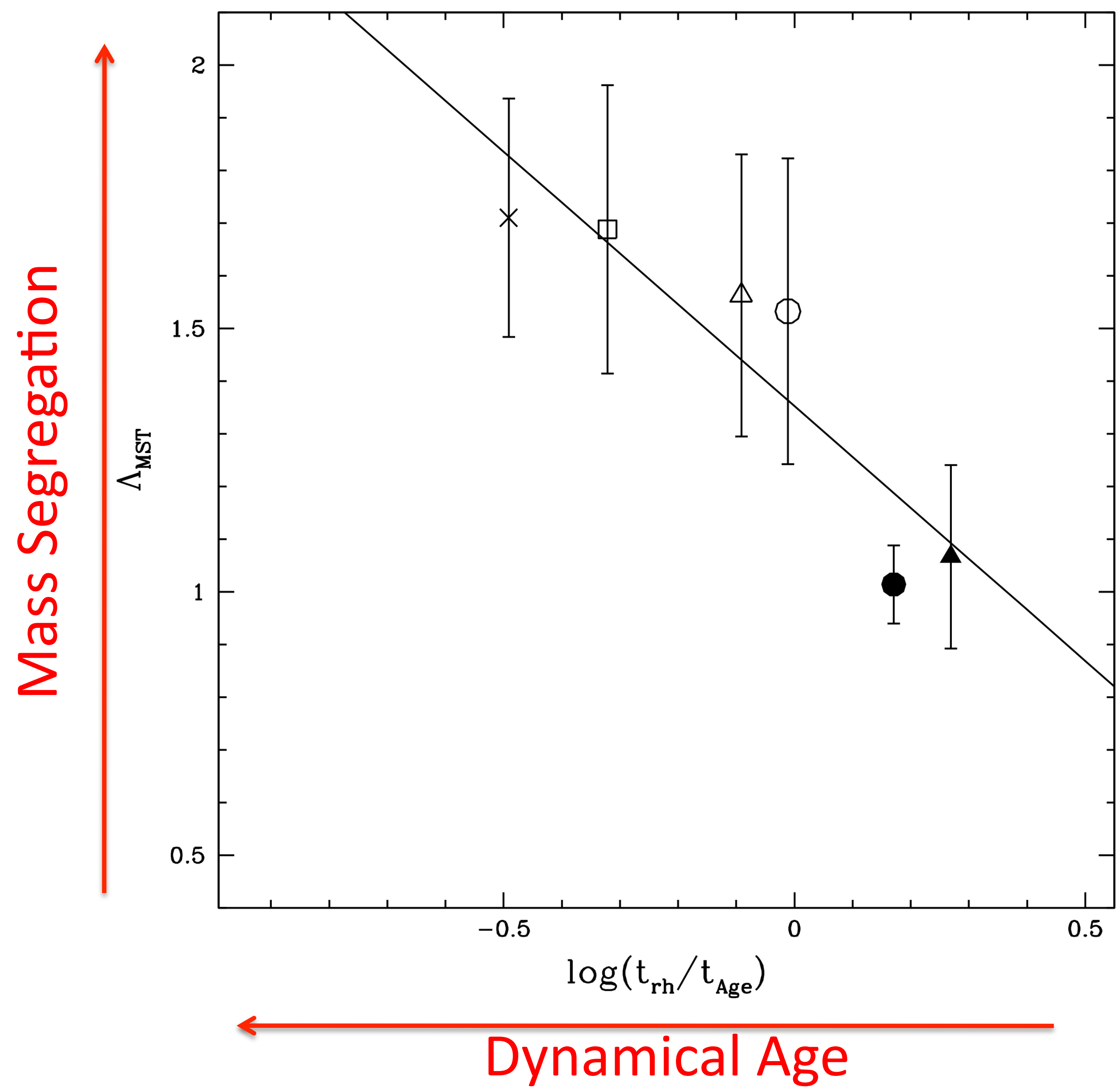
>1 MASS SEGREGATION

=1 NO MASS SEGREGATION



Cartwright and Whitworth (2004)





Mass Segregation
2
1.5
1
0.5
Λ_{MST}
−0.5
0
0.5
$\log(t_{rh}/t_{Age})$
Dynamical Age