DISTURBED BLUE STARS BEARING CLUES TO CLUSTER PROPERTIES (BLUE STRAGGLERS)

Sourav Chatterjee
John M. Fregeau
Frederic A. Rasio
Northwestern University

WHAT CAN WE TELL ABOUT THE PRIMORDIAL BINARY FRACTION OF THE CLUSTER FROM THE BSS POPULATION?

BSS AND BINARITY

NGC 2419

- GC distance 91.5 kpc (Dalessandro et al. 2008)
- distance from the Sun 87±4 kpc (Dalessandro et al. 2008)
- heavy element content z ~ 0.0002 (Ferrarro et al. 1999)
- r_c ~ 8.4 pc r_h ~ 24.5 pc r_t ~ 214 pc (Dalessandro et al. 2008)
- central density ~ 25 $M_\odot / pc^3$ (Pryor & Meylan 1993)
- t_{relax} at r_c ~ 6 Gyr, at r_h ~ 18 Gyr (Dalessandro et al. 2008)
- $N_{BSS} > 230$ (Dalessandro et al. 2008)

NGC 2419 like cluster

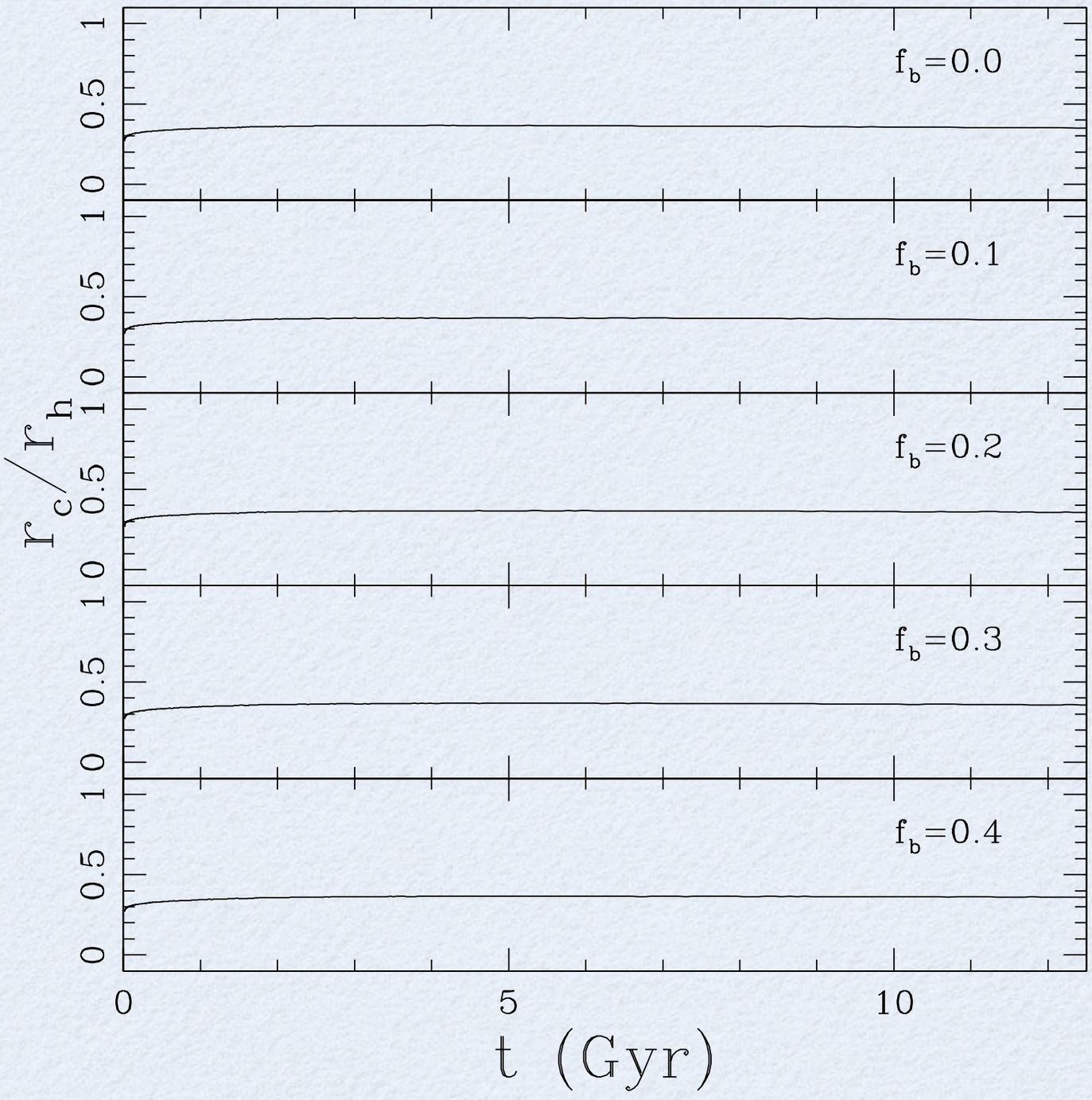
- King profile
- $w_0 = 7$
- Virial radius = 20 pc
- Kroupa IMF in the range 0.1 - 18.5 $M_\odot$ (no black holes)
- primordial binary fraction 0, 10, 20, 30, 40%

NGC 2419 like cluster

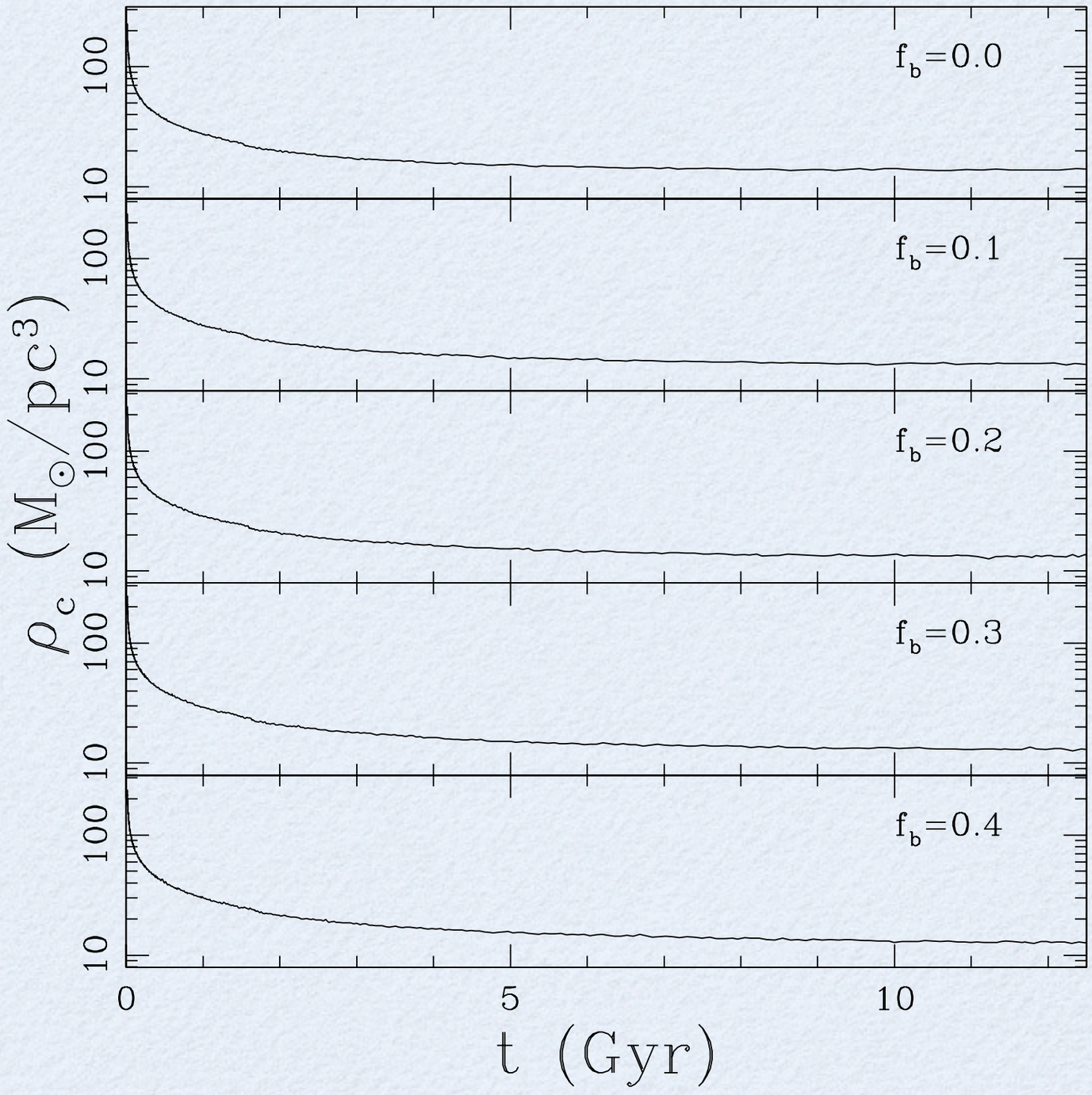
- King profile
- $W_0 = 7$
- Virial radius = 20 pc
- Kroupa IMF in the range 0.1 - 18.5 $M_\odot$ (no black holes)
- primordial binary fraction 0, 10, 20, 30, 40%

$t_{relax,half\ mass} \sim 17.4$ Gyr

NGC 2419 like cluster: r_c/r_h

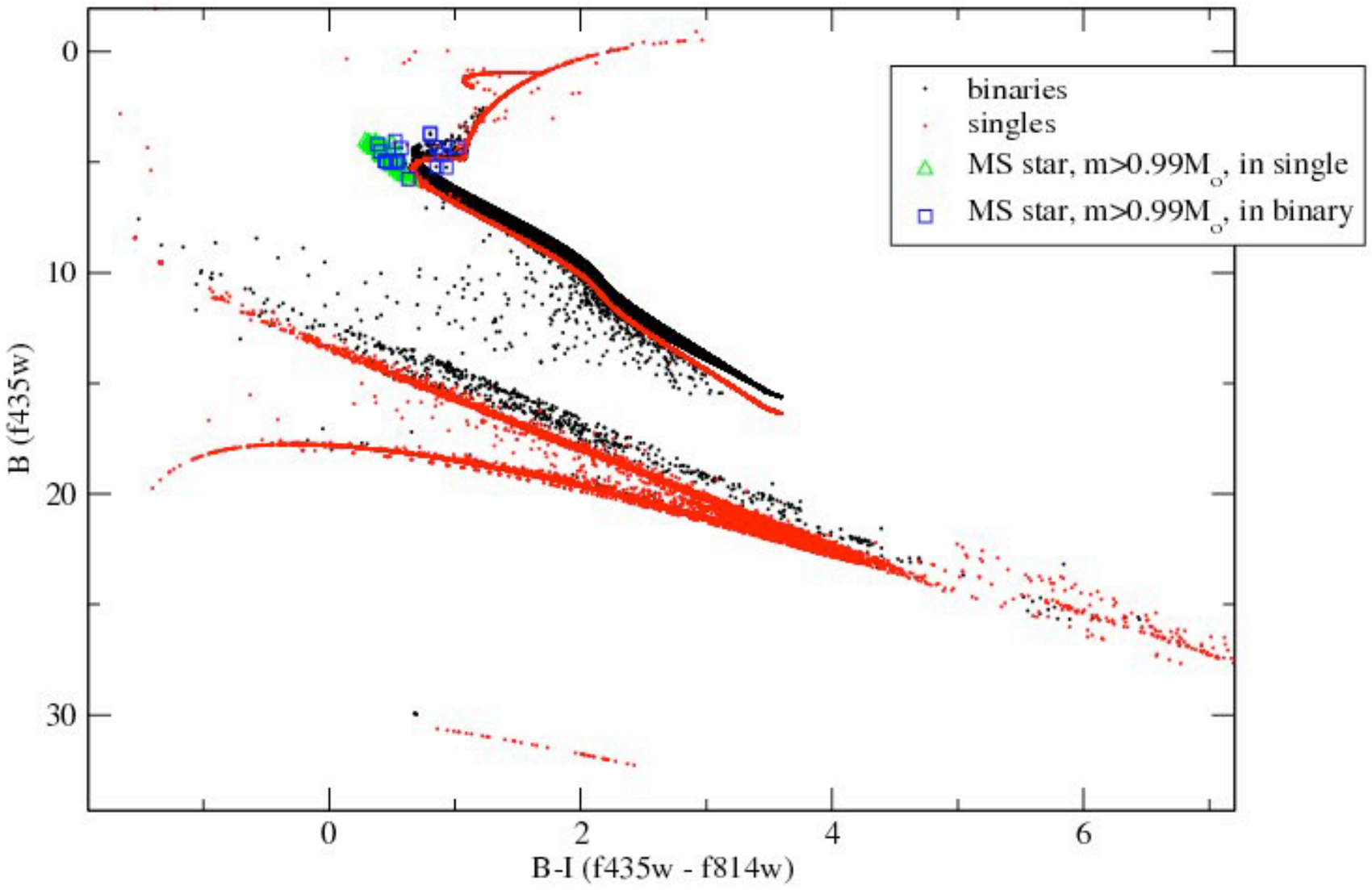


NGC 2419 like cluster: central density



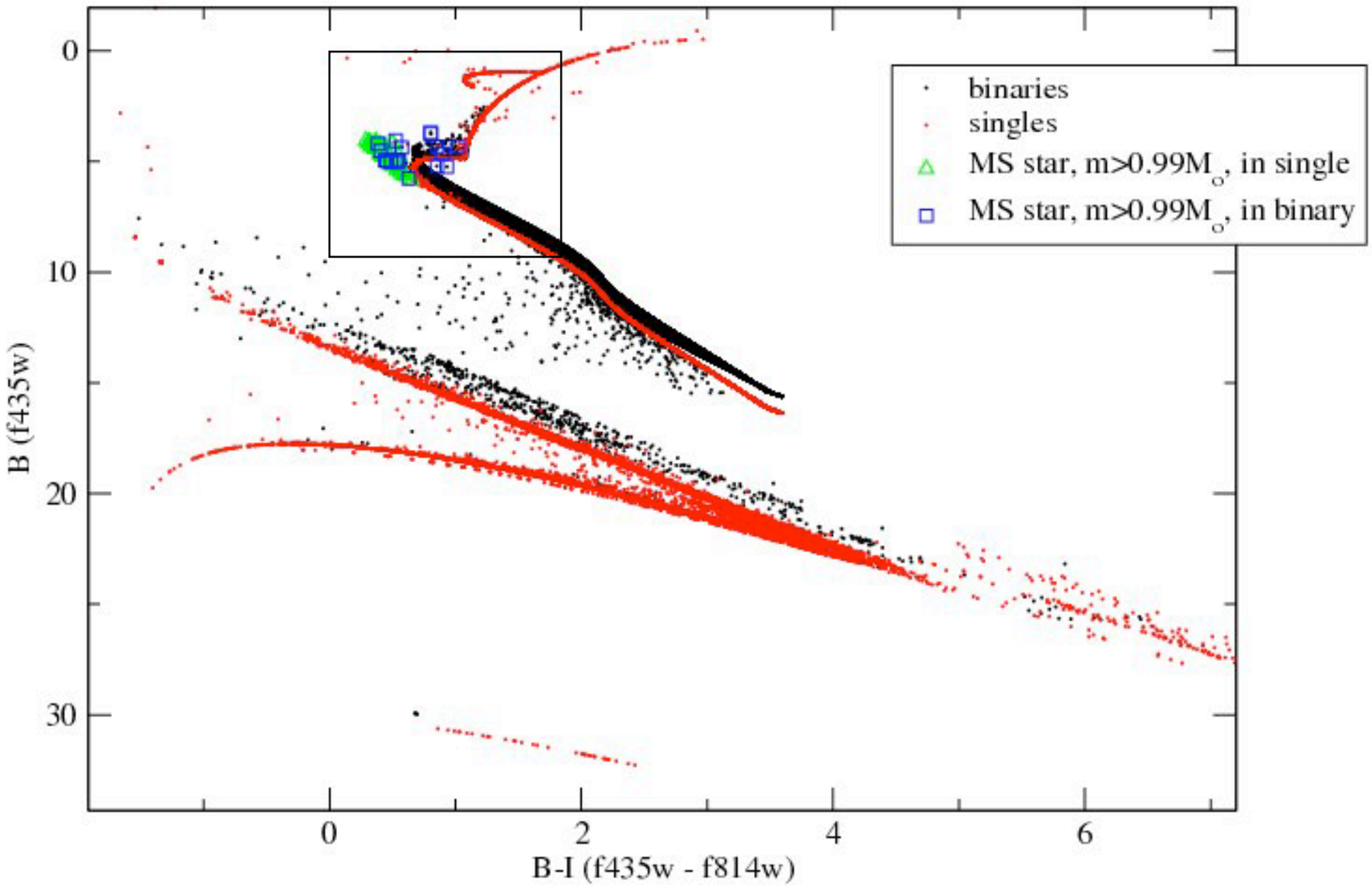
NGC 2419 like cluster: CMD

primordial binary fraction = 0.1



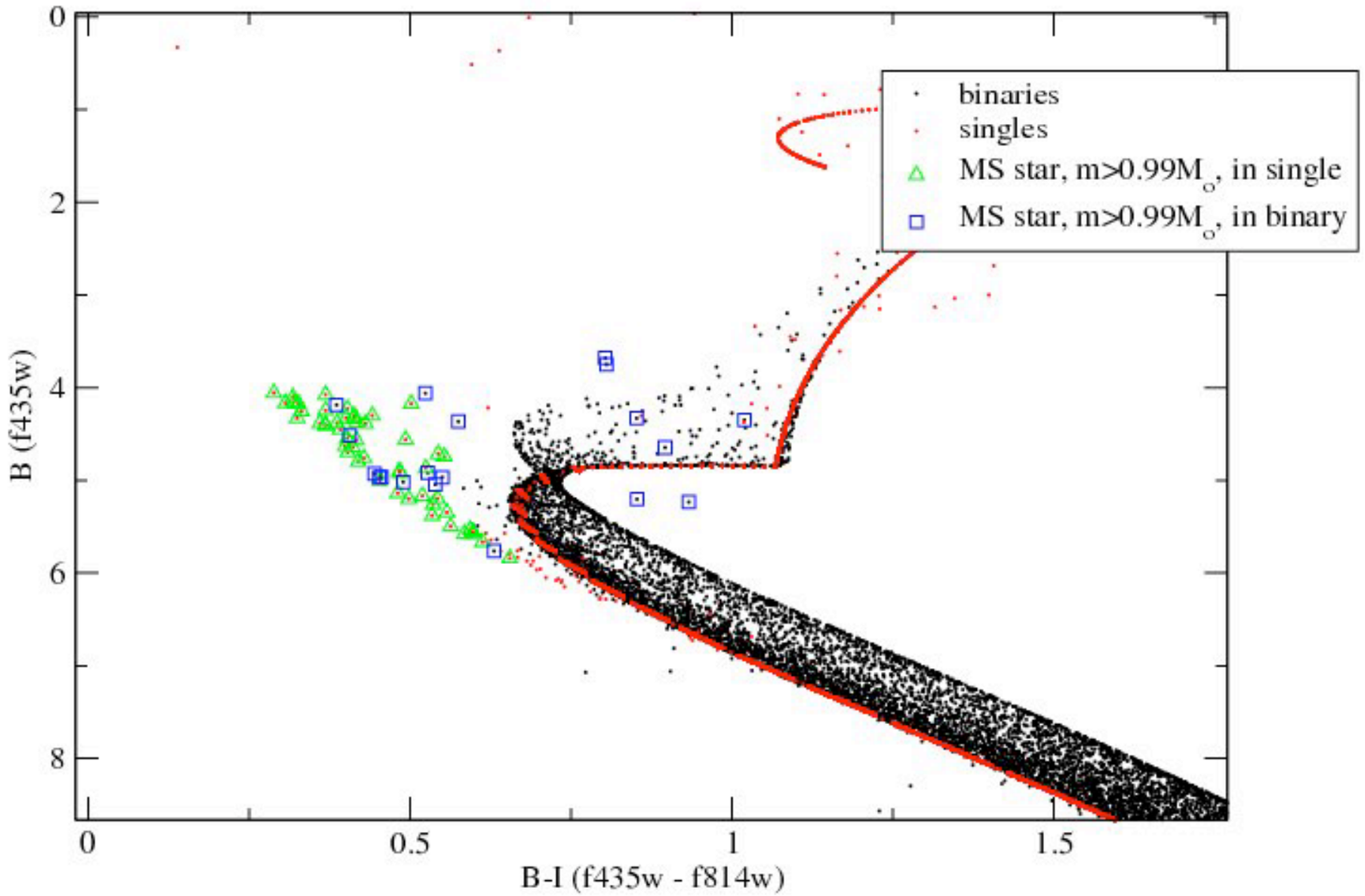
NGC 2419 like cluster: CMD

primordial binary fraction = 0.1



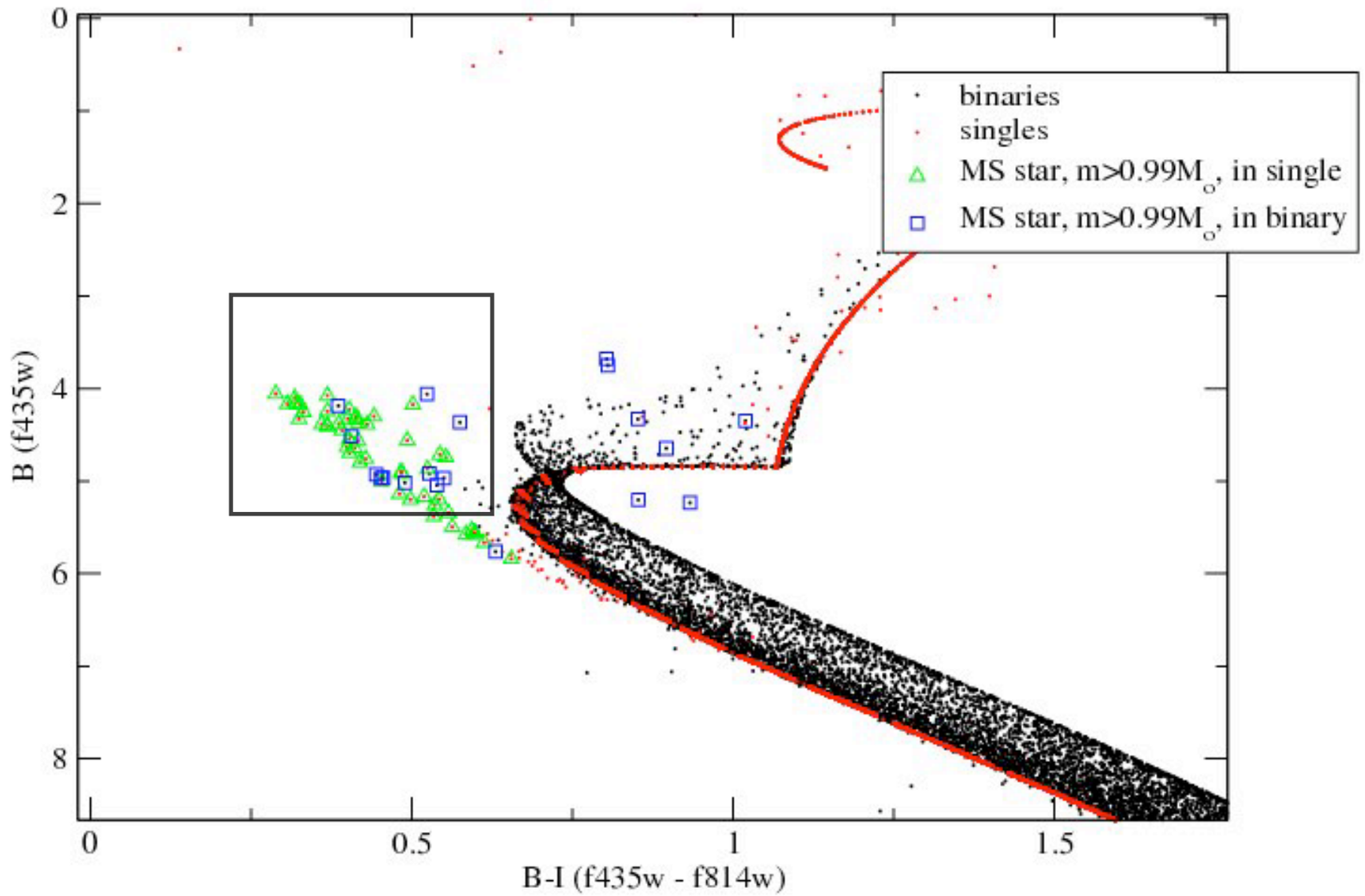
NGC 2419 like cluster: CMD

primordial binary fraction = 0.1



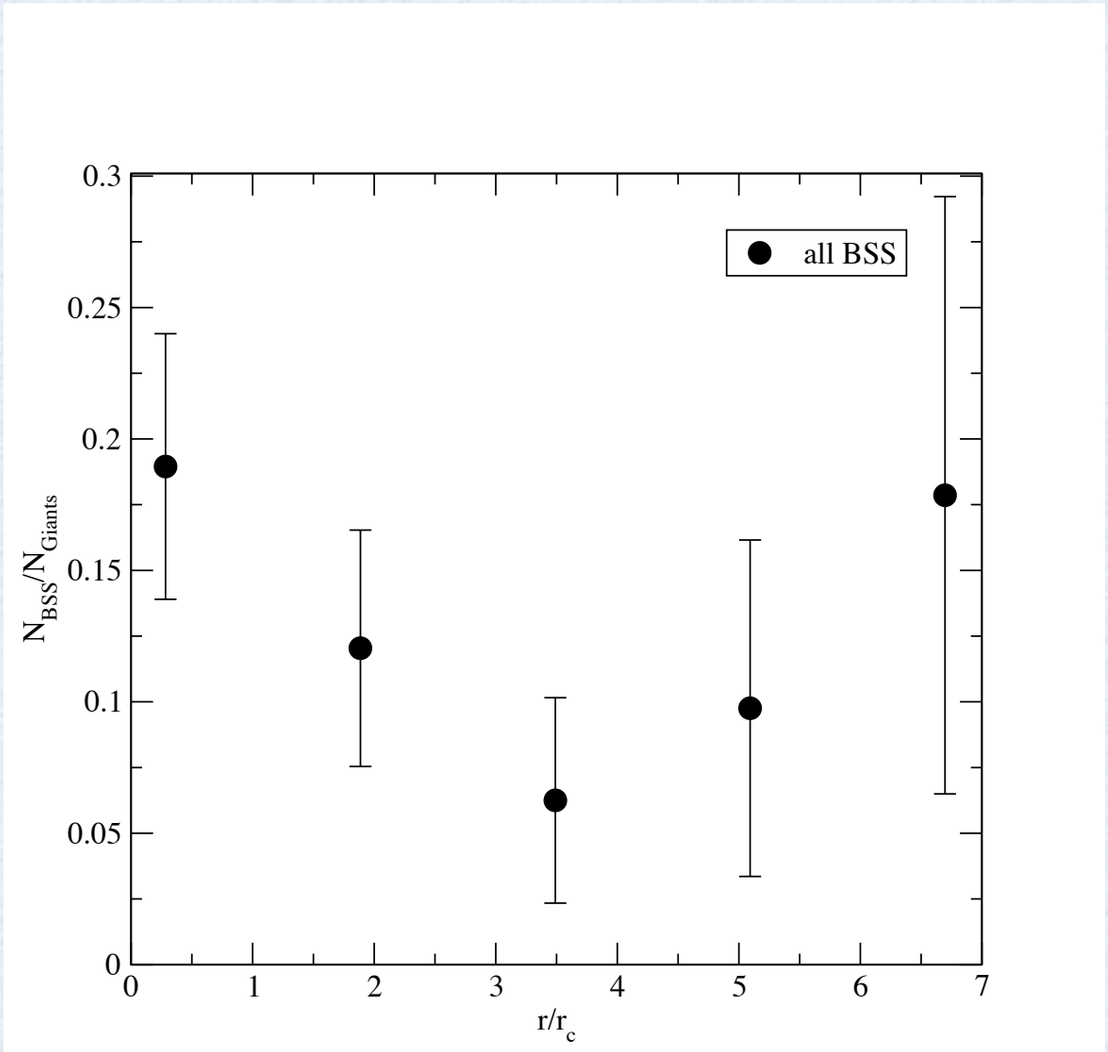
NGC 2419 like cluster: CMD

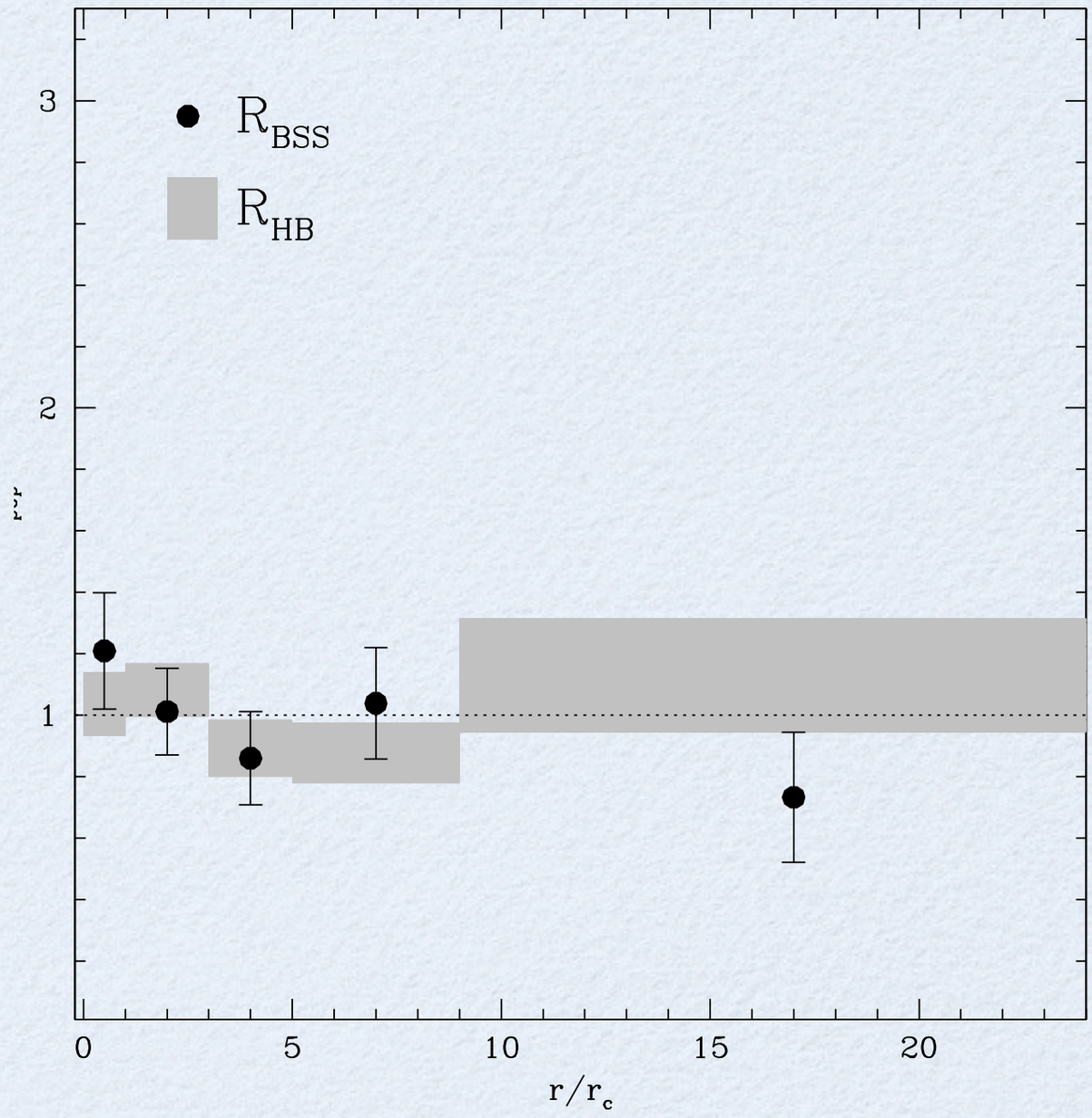
primordial binary fraction = 0.1



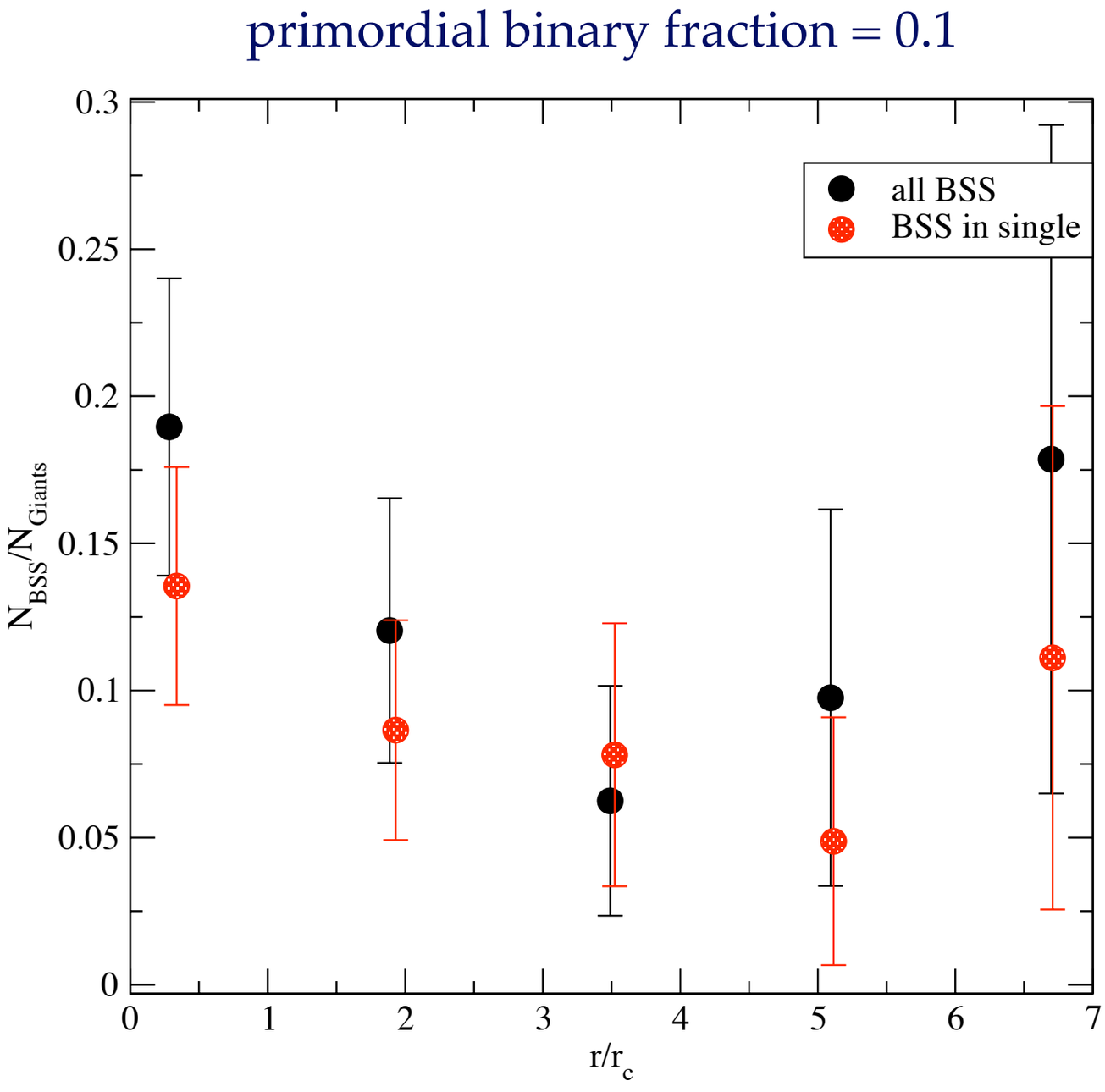
NGC 2419 like cluster: radial distribution

primordial binary fraction = 0.1

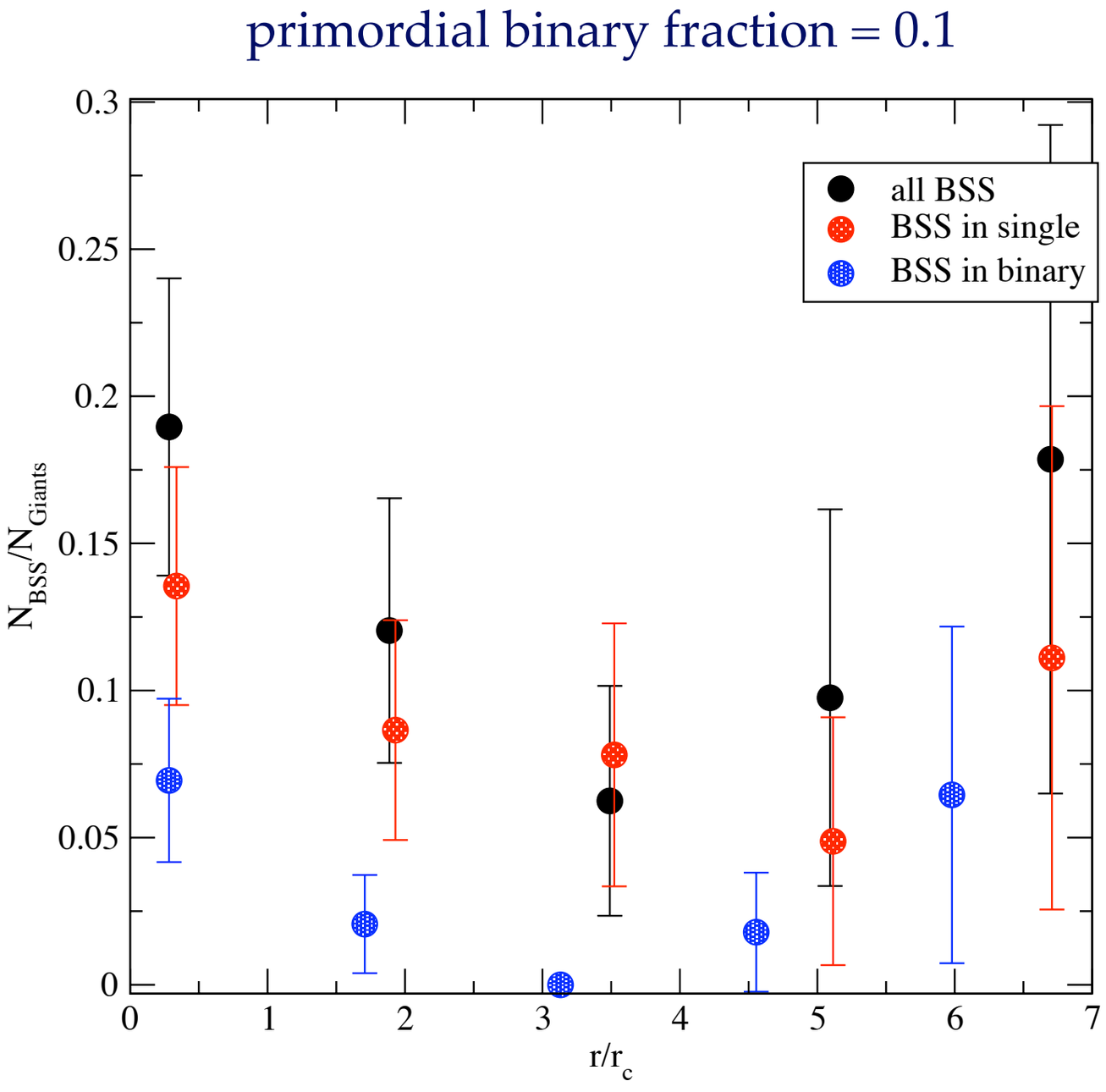




NGC 2419 like cluster: radial distribution

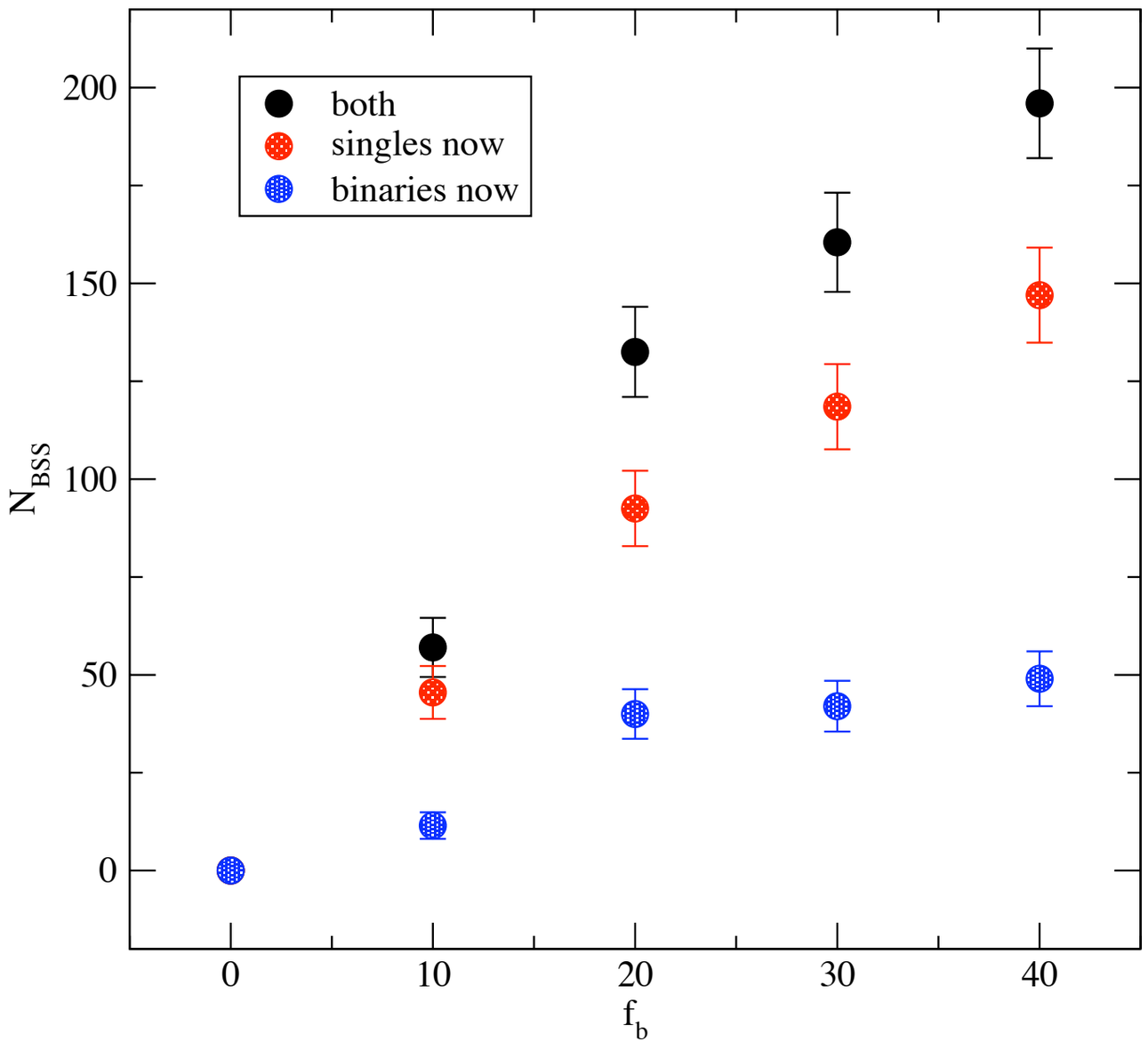


NGC 2419 like cluster: radial distribution



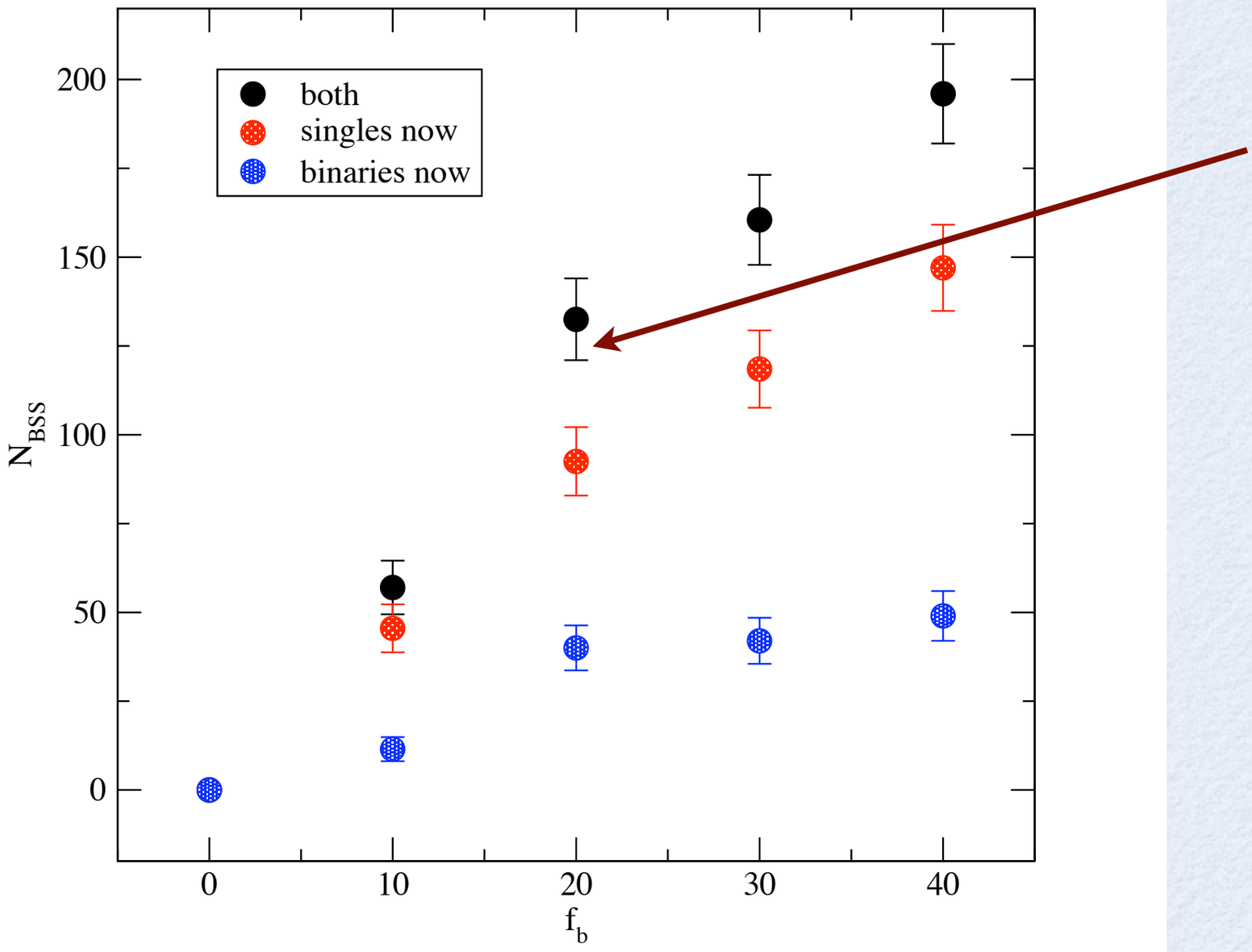
BSS AND BINARITY

NGC 2419 like cluster: primordial f_b and N_{BSS}



BSS AND BINARITY

NGC 2419 like cluster: primordial f_b and N_{BSS}



Concerns (need help, suggestions)

- How to make the definition of BSSs more robust?
  - observationally it can be done only by eye
- How strongly can the simulated N_{BSS} be compared with the observed
  - color conversion

What can we learn from the shape of the BSS radial distribution?

BSS AND RELAXATION

- King profile
- $w_0 = 7$
- Virial radius = 5 pc
- Kroupa IMF in the range 0.1 - 18.5 $M_\odot$ (no black holes)
- primordial binary fraction 10%

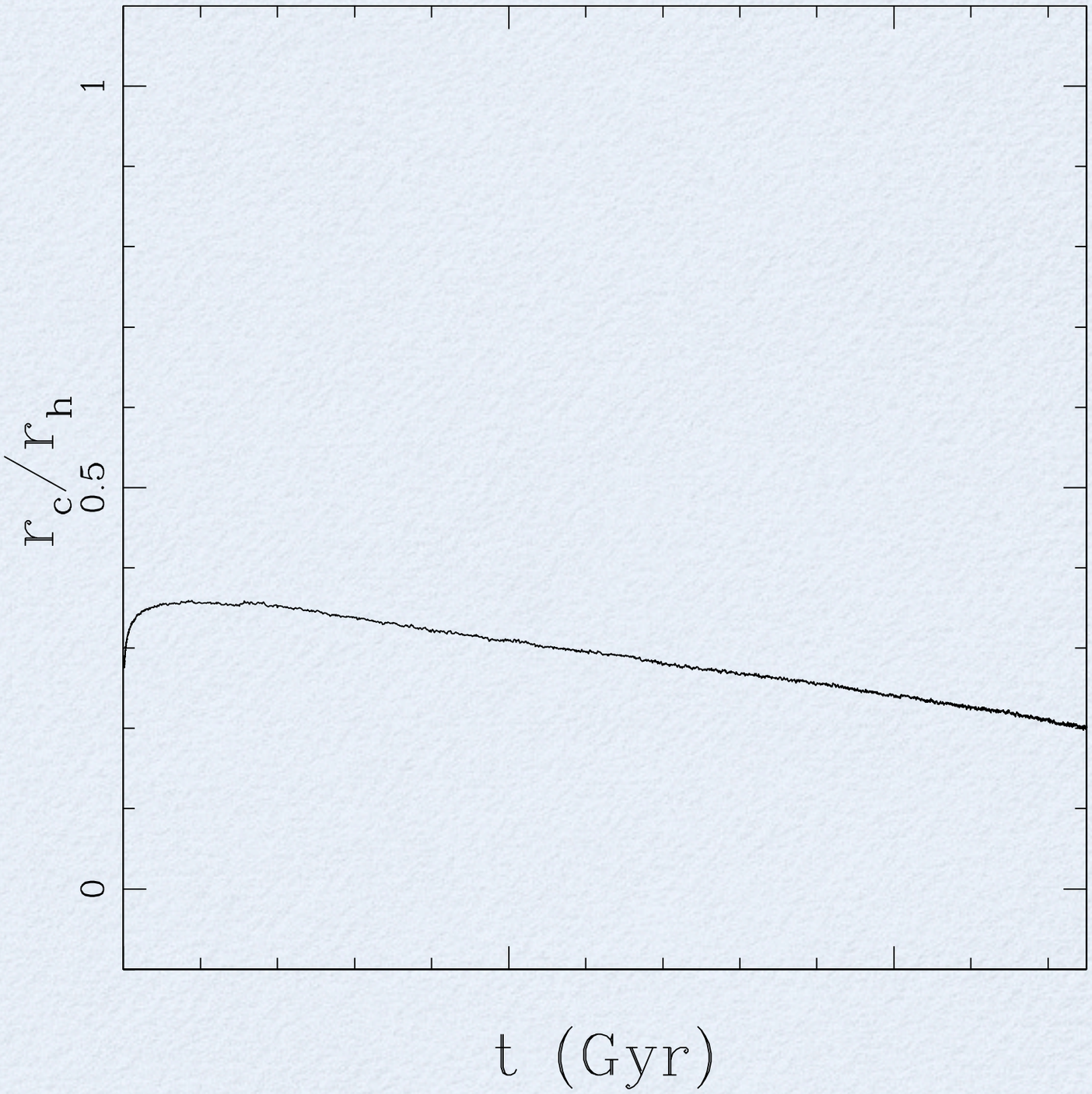
BSS AND RELAXATION

- King profile
- $W_0 = 7$
- Virial radius = 5 pc
- Kroupa IMF in the range 0.1 - 18.5 $M_\odot$ (no black holes)
- primordial binary fraction 10%

$t_{relax,half\ mass} \sim 2.2$ Gyr

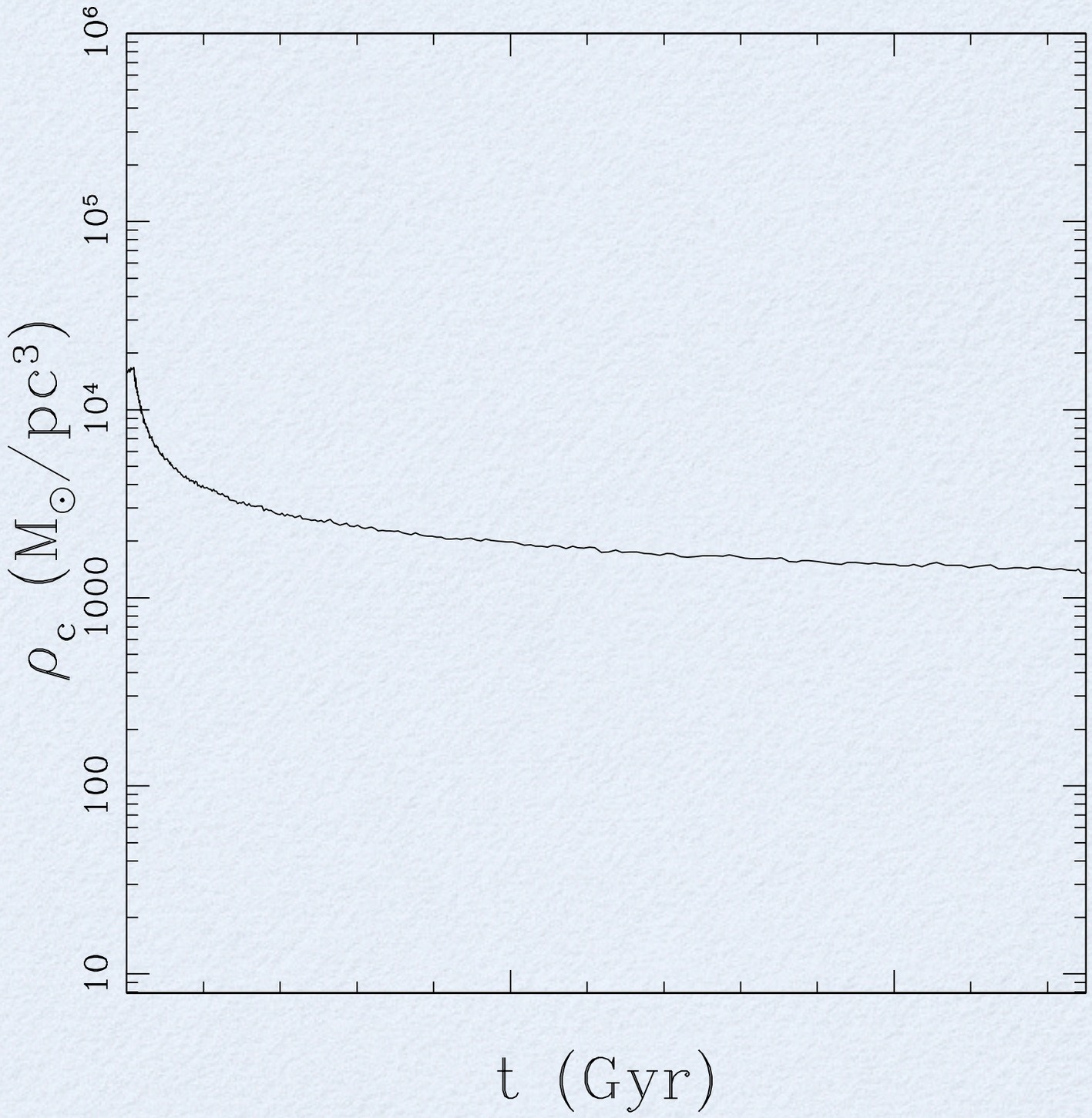
BSS AND RELAXATION

r_c / r_h



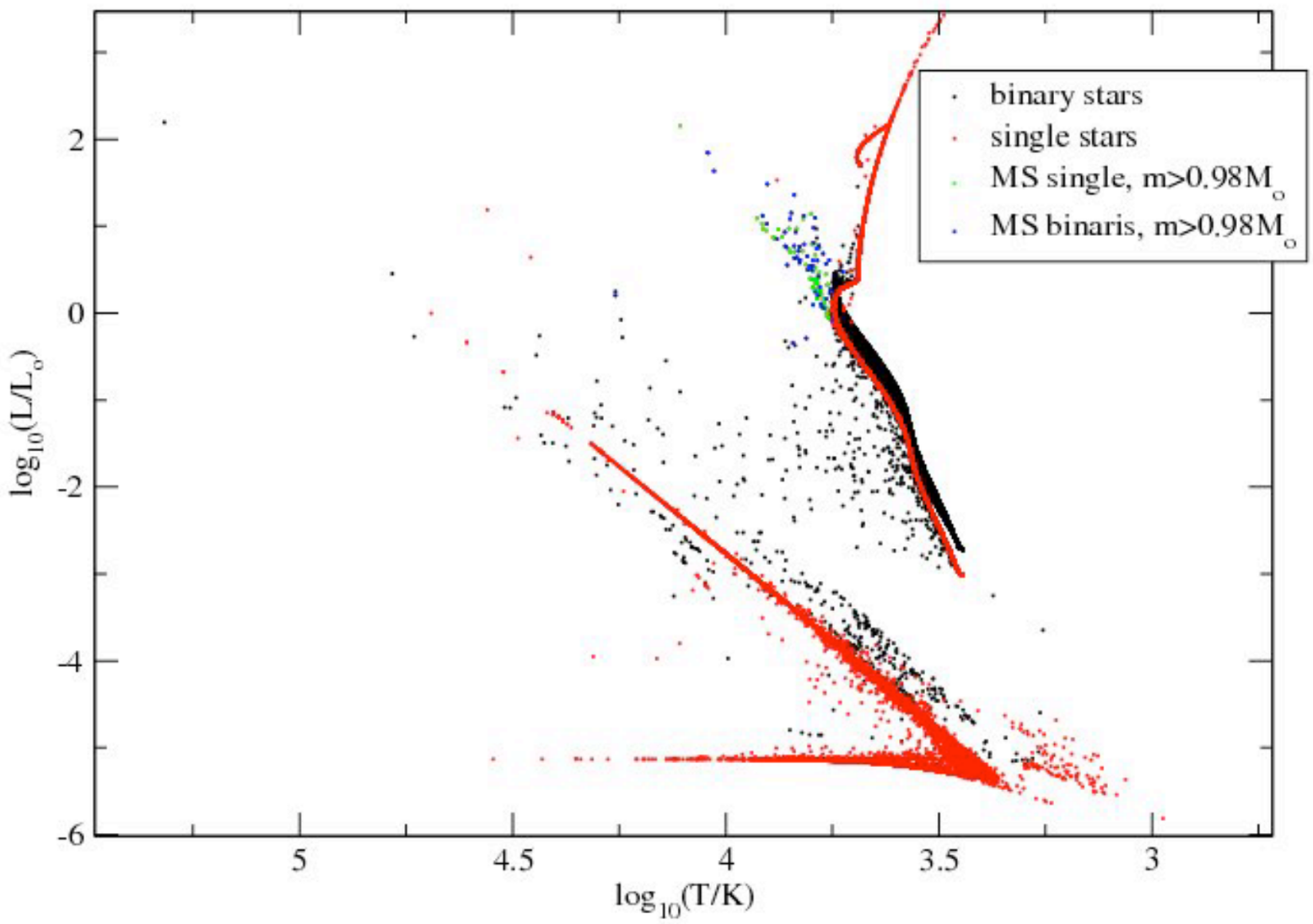
BSS AND RELAXATION

central density



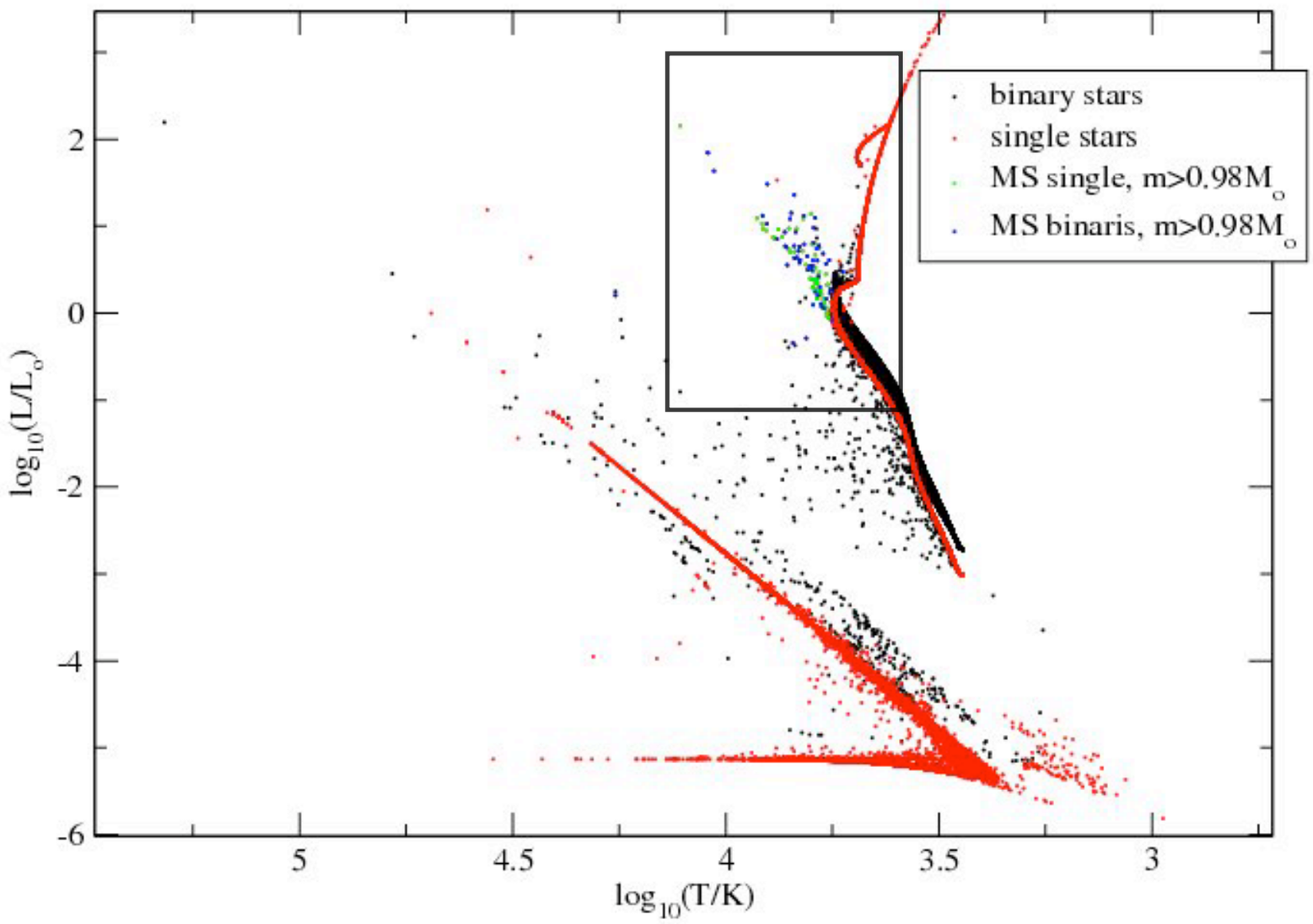
BSS AND RELAXATION

$\log_{10}T$ vs $\log_{10}L$



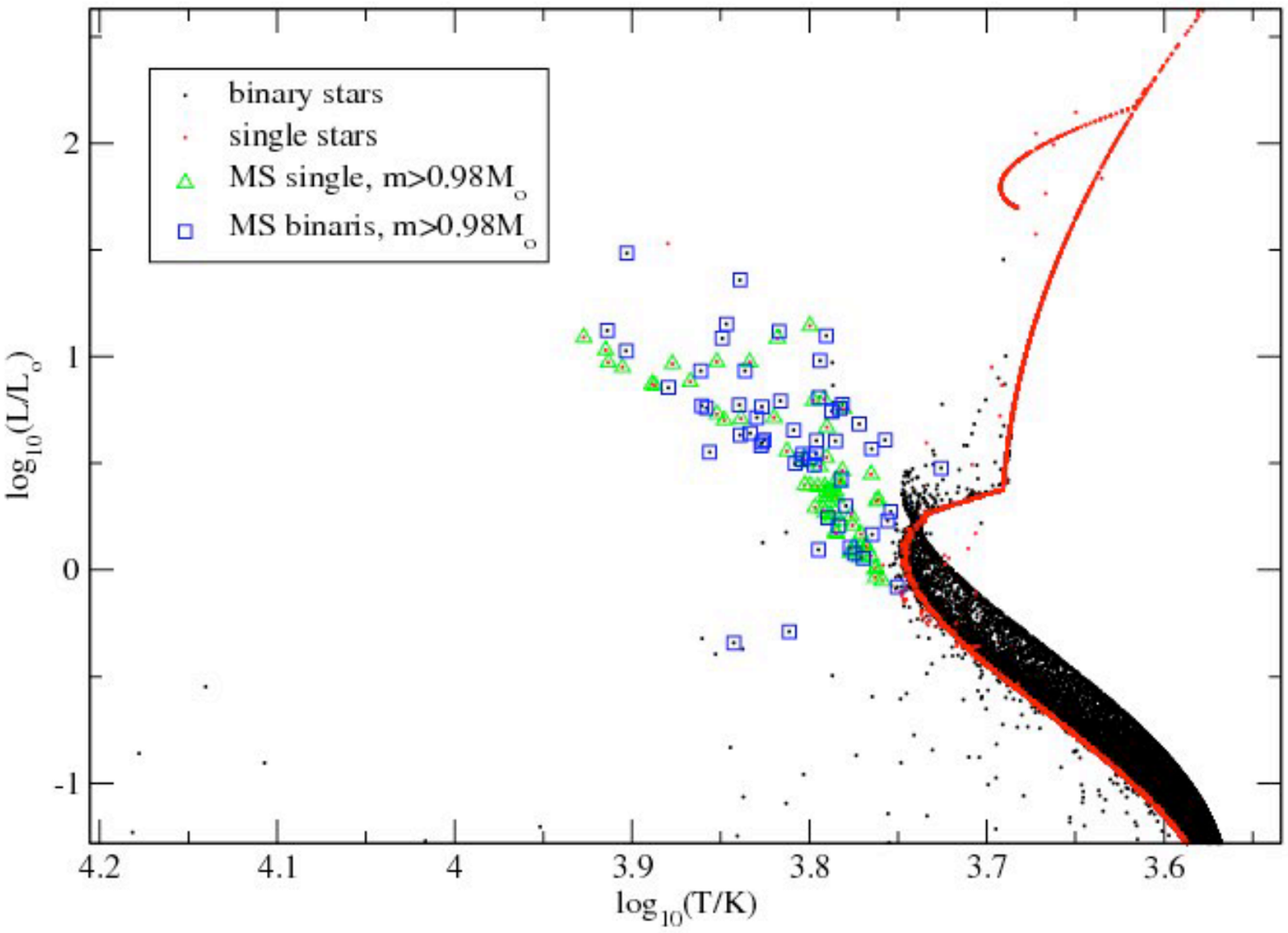
BSS AND RELAXATION

$\log_{10}T$ vs $\log_{10}L$



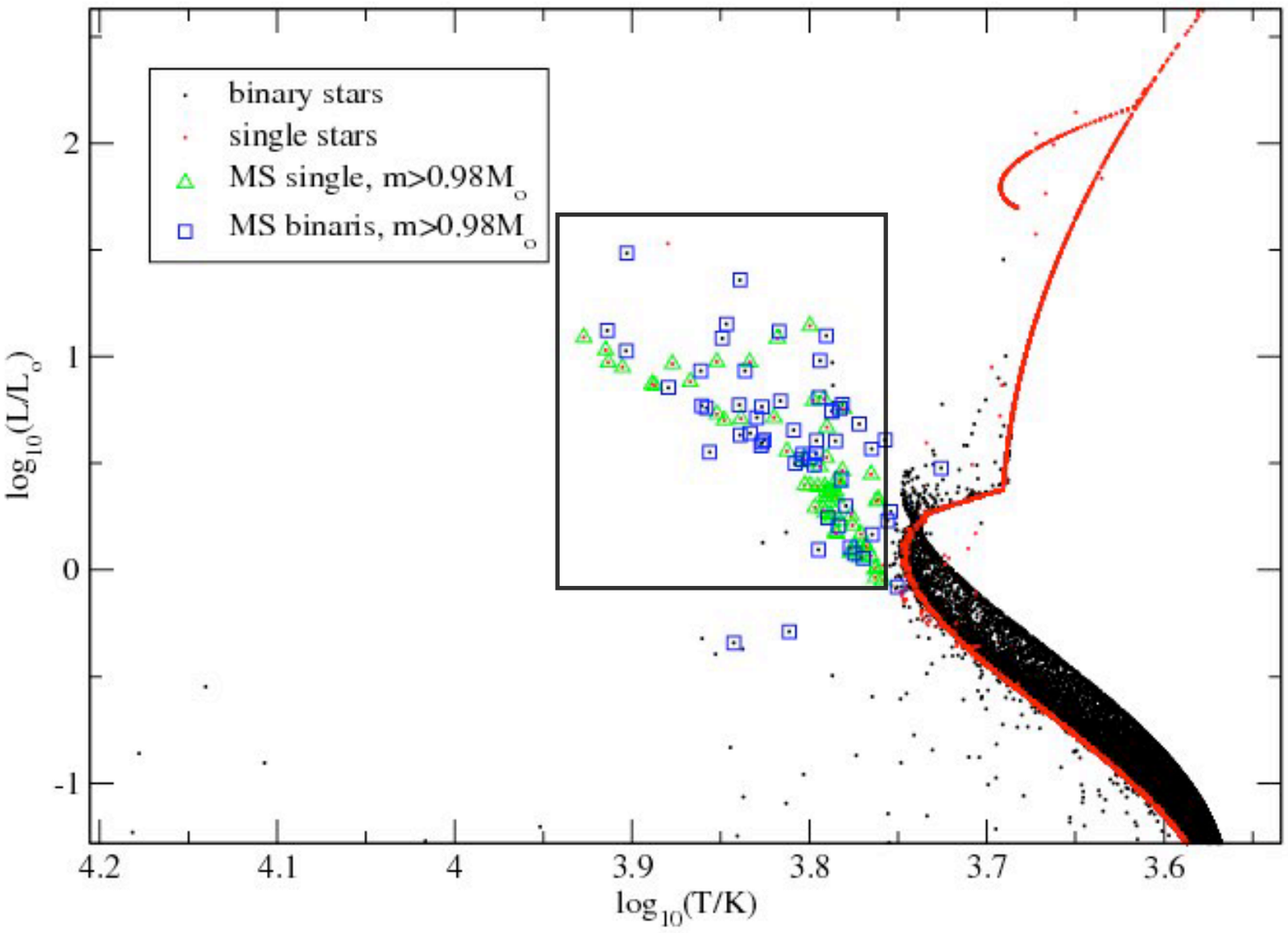
BSS AND RELAXATION

$\log_{10}T$ vs $\log_{10}L$



BSS AND RELAXATION

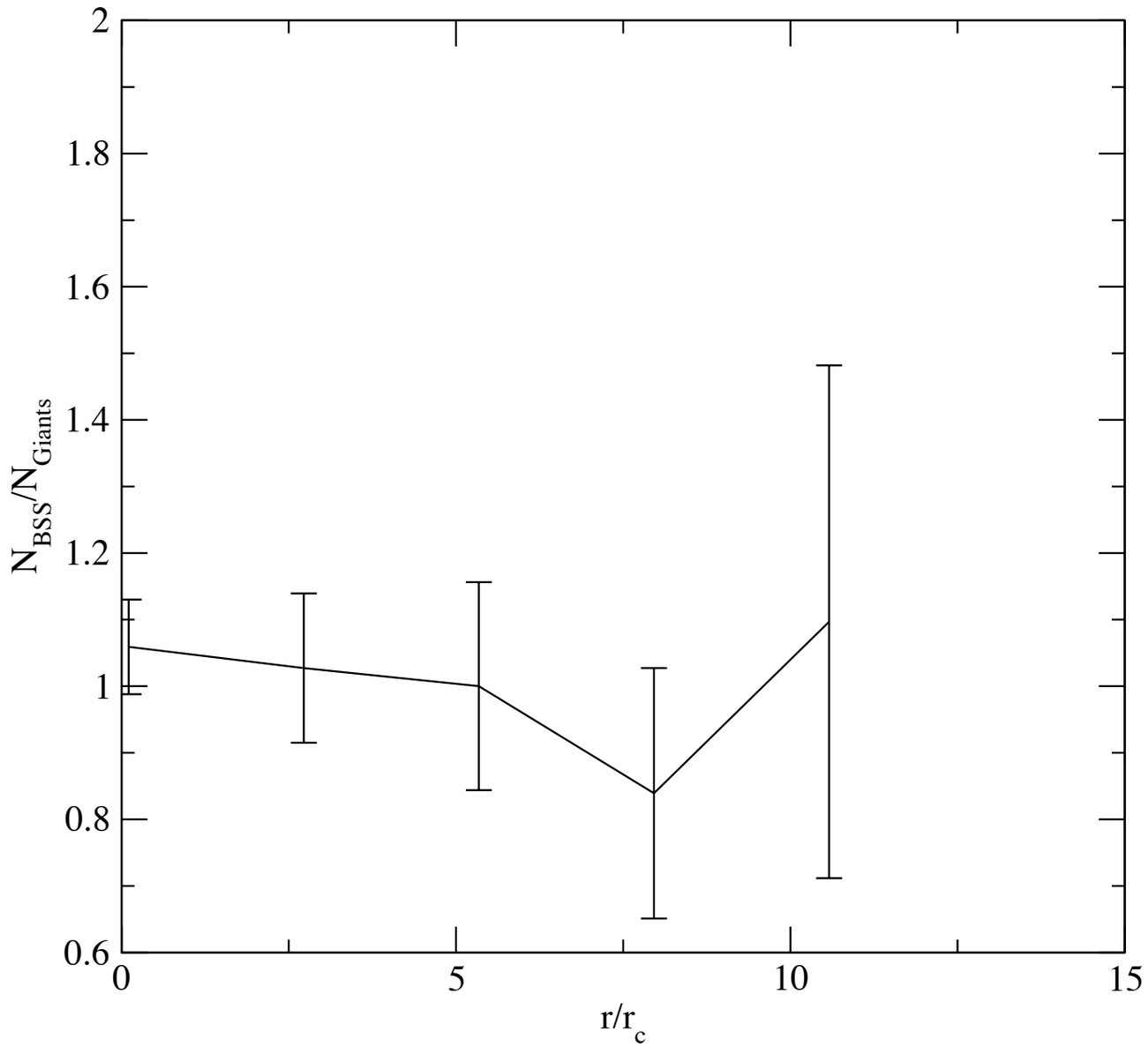
$\log_{10}T$ vs $\log_{10}L$



BSS AND RELAXATION

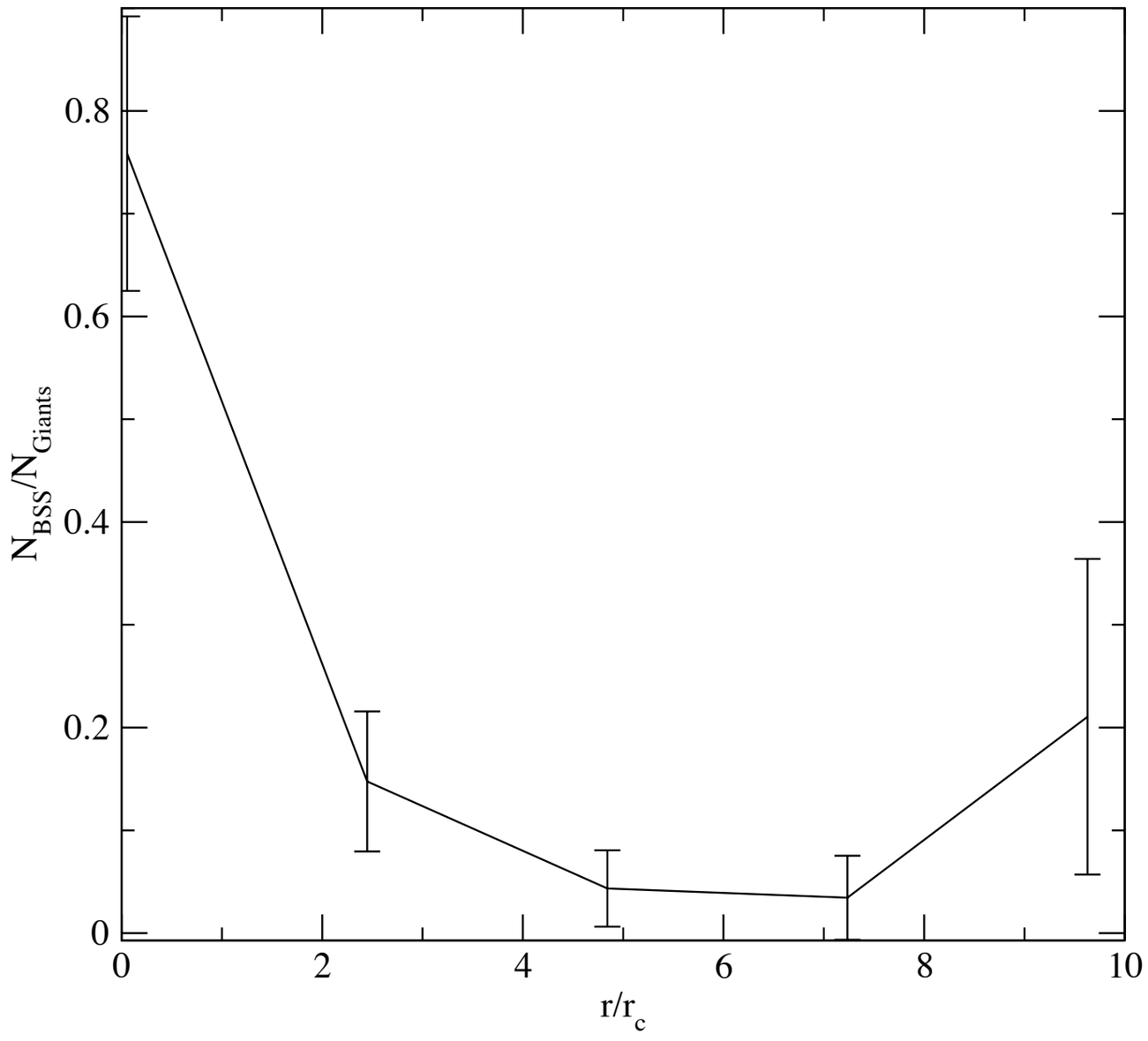
BSS radial distribution

Age ~ 2.5 Gyr; ~ 1 $t_{relax,\ half\ mass}$



BSS radial distribution

Age ~ 12.5 Gyr; ~ 6 $t_{relax,\ half\ mass}$



BSS AND RELAXATION

time evolution of BSS radial distribution

BSS AND RELAXATION

time evolution of BSS radial distribution

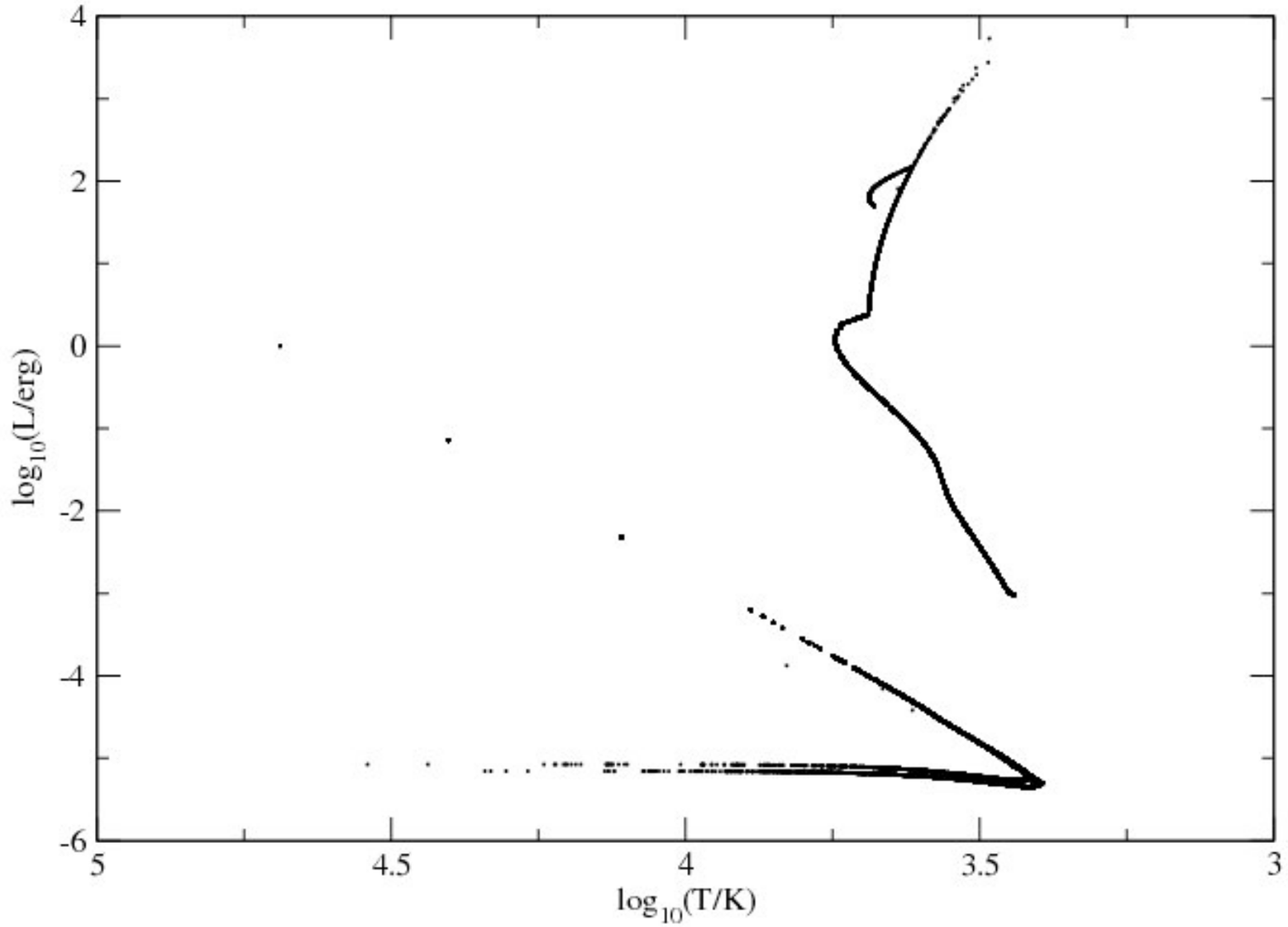
BSS AND RELAXATION

Future thoughts, concerns

- BSSs are rare compared to the other stars
- Need one characteristic reference population that remains a good choice throughout the evolution time of interest (in particular for young clusters)
- Branching ratios of different BSS production channels
- Luminosity distribution of the BSSs
- Time evolution of the BSS mass distribution
- Testing the zone of avoidance model

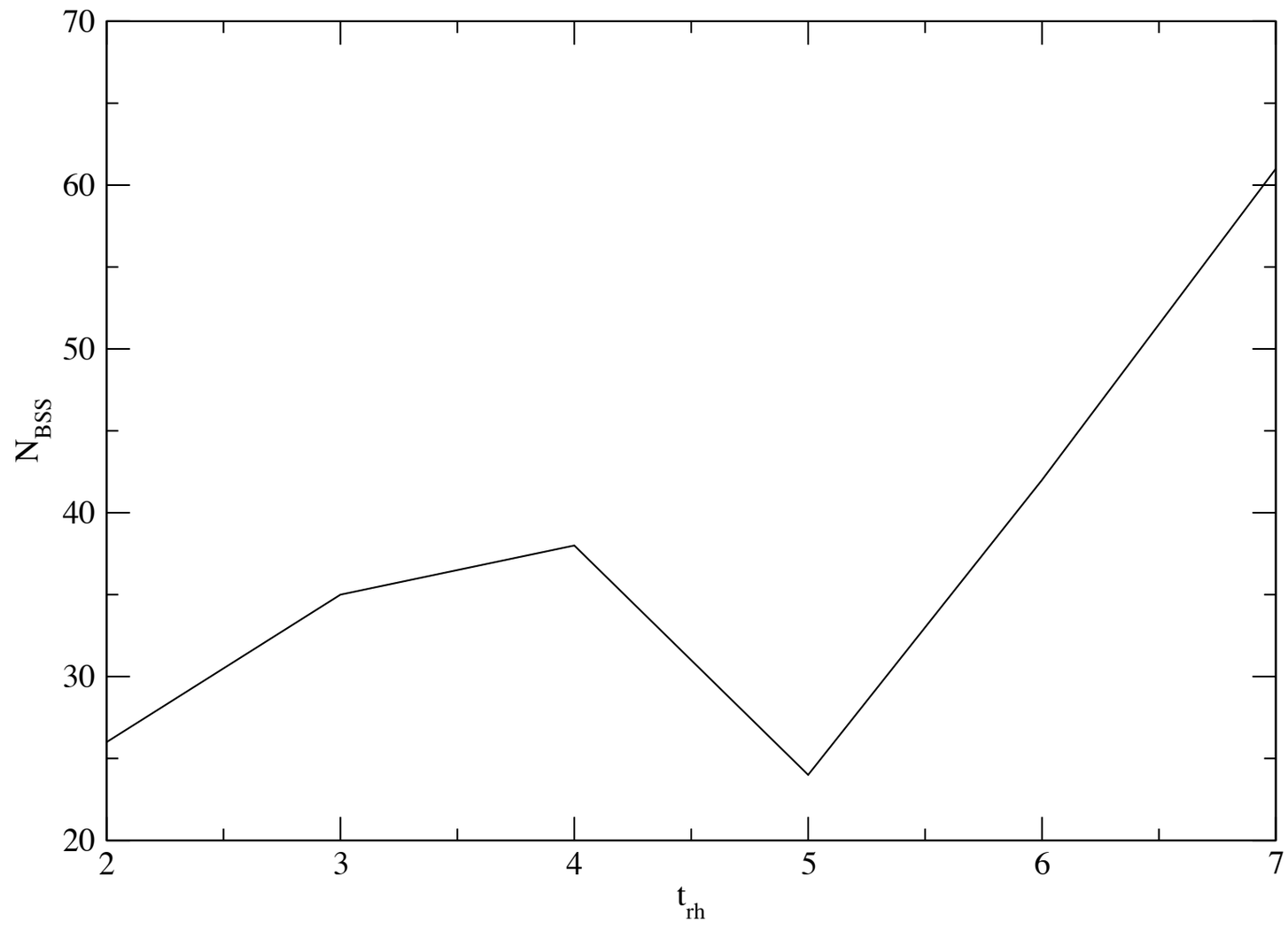
NGC 2419 like cluster: CMD

primordial binary fraction = 0



BSS AND RELAXATION

time evolution of N_{BSS}



BSS AND RELAXATION

time evolution of BSS radial distribution