Blue Straggler Stars: setting up a dynamical clock for open clusters

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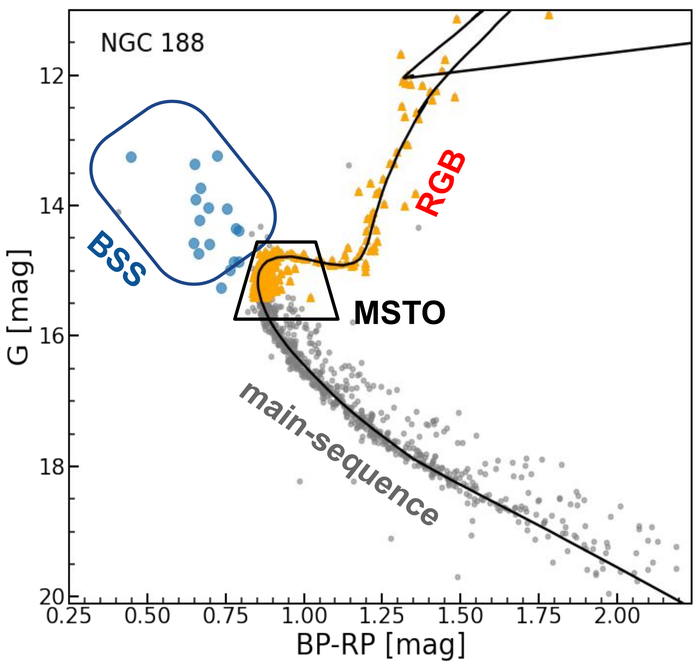
Blue straggler stars

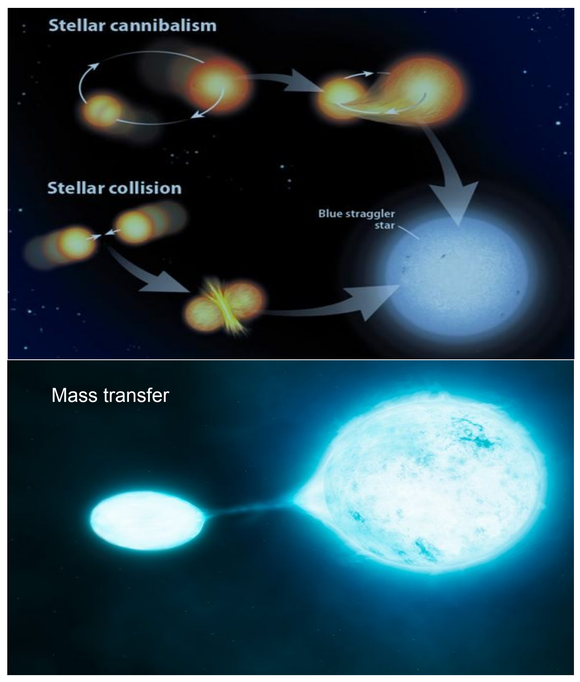
BSS are bluer and brighter than the main-sequence turn-off stars.

There location on CMD indicate that they are late bloomers.

Identified in all kinds of environments such as open clusters, globular clusters, Galactic field, and dwarf galaxies, etc.



How do they form?



What do we learn?

Products of complex multiple stellar interactions → **Among the most massive populations** (Shara et al. 1997)

↓

Dynamical Friction
DF leads them sink in the cluster center faster than any other cluster population (Chandrasekhar et al. 1943)

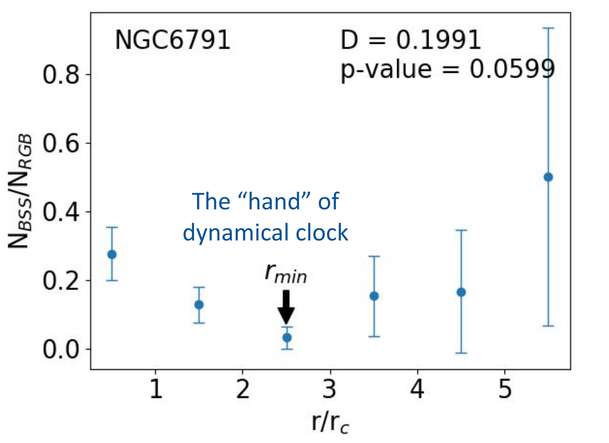
↓

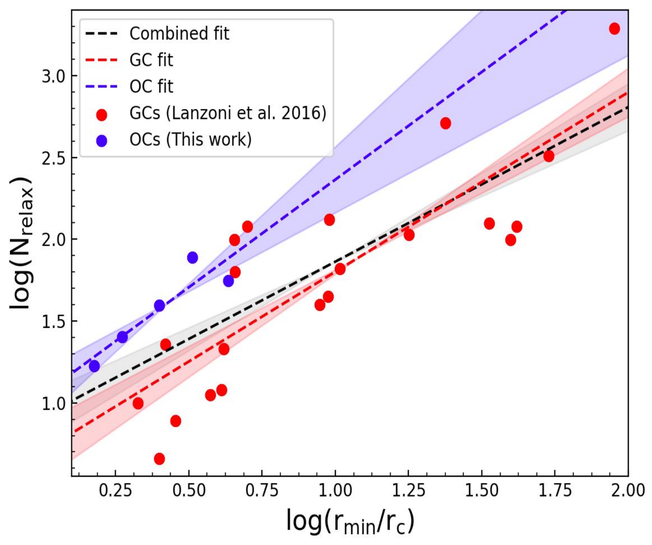
BSS can be used as a **tool** to probe internal dynamics of their parent clusters

1 BSS radial distribution (Dynamical clock)

(7 OCs; Vaidya et al., 2020)

- Identified members of 7 OCs using *Gaia* DR2 data.
- Estimated fundamental, structural, and dynamical parameters, and r_{min} in the BSS radial distribution.



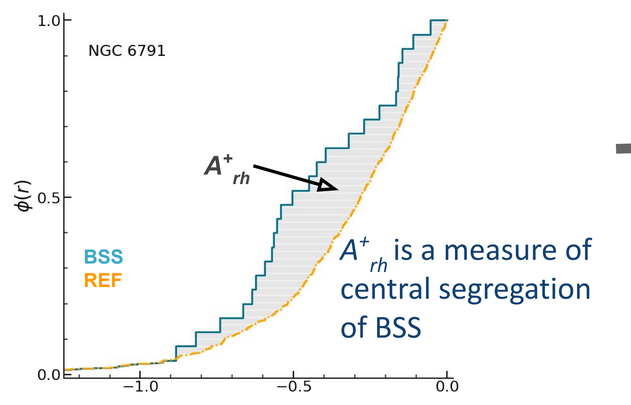


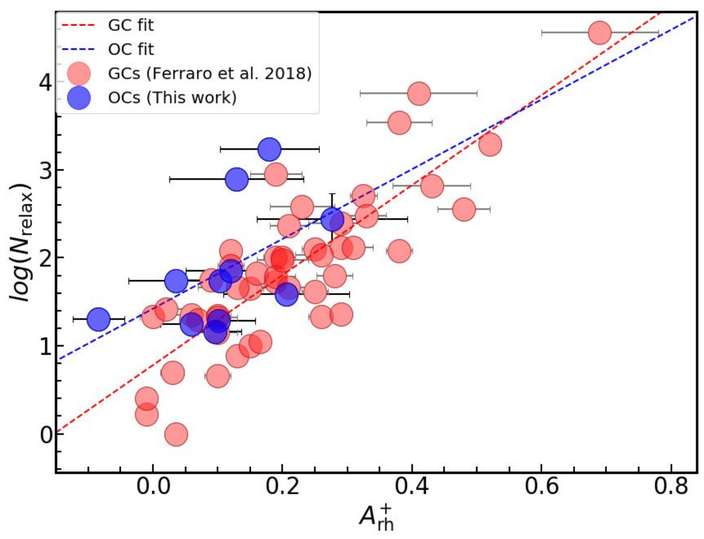
- 5 OCs → Bimodal BSS radial distribution → Intermediate dynamical age
- 2 OCs → Flat BSS radial distribution → Dynamically young

2 BSS cumulative radial distribution

(11 OCs; Rao et al., 2021)

- A^+_{rh} is the area enclosed between cumulative radial distributions of BSS and reference population up to half-mass radius of a cluster (Alessandrini et al. 2016).
- Taken members and BSS of 11 OCs from literature.
- Estimated A^+_{rh} using MSTO, SGB, and RGB stars as reference population.
- Estimated N_{relax} (cluster age/t_{rc}).

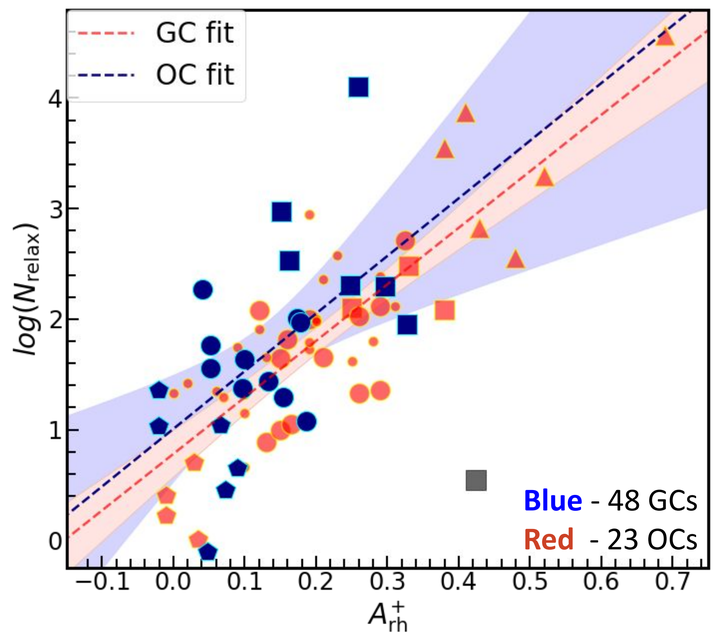




3 BSS cumulative radial distribution

(23 OCs; Rao et al., under review)

- Identified members of 23 OCs using **ML-MOC** algorithm (Agarwal et al. 2021) on Gaia EDR3 data and estimated their A^+_{rh} using MSTO and MS stars as reference population.
- Ages: 1.6 - 9 Gyr and Distances: 0.84 - 8.9 kpc
- Estimated N_{relax} (cluster age/t_{rc}).



Based upon the A^+_{rh} vs $\log(N_{relax})$ relation shown in the above Figure and the previous known classifications of GCs into different dynamical ages, OCs are divided into the three following classes of dynamical ages

- Class I: Least evolved clusters
- Class II: Intermediate dynamical age I
- Class III: Intermediate dynamical age II
- Melotte 66, a peculiar OC
- Core-collapsed GCs

Summary & Future prospect

- BSS can be used as tool to probe dynamical ages of OCs as well along with GCs.
- NGC 2682 is found to be the most evolved OC, while Berkeley 18 is the least evolved OC. Melotte 66 is an exceptional OC because none of its dynamical and physical parameters correlates with its BSS segregation level.
- We will investigate the reason for one to many mapping in the A+ vs N_{relax} parameter space.

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If you have any queries or suggestions, I am available on
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