

104-cm Sampurnanand Telescope Golden Jubilee

Study of open clusters using meter class telescopes

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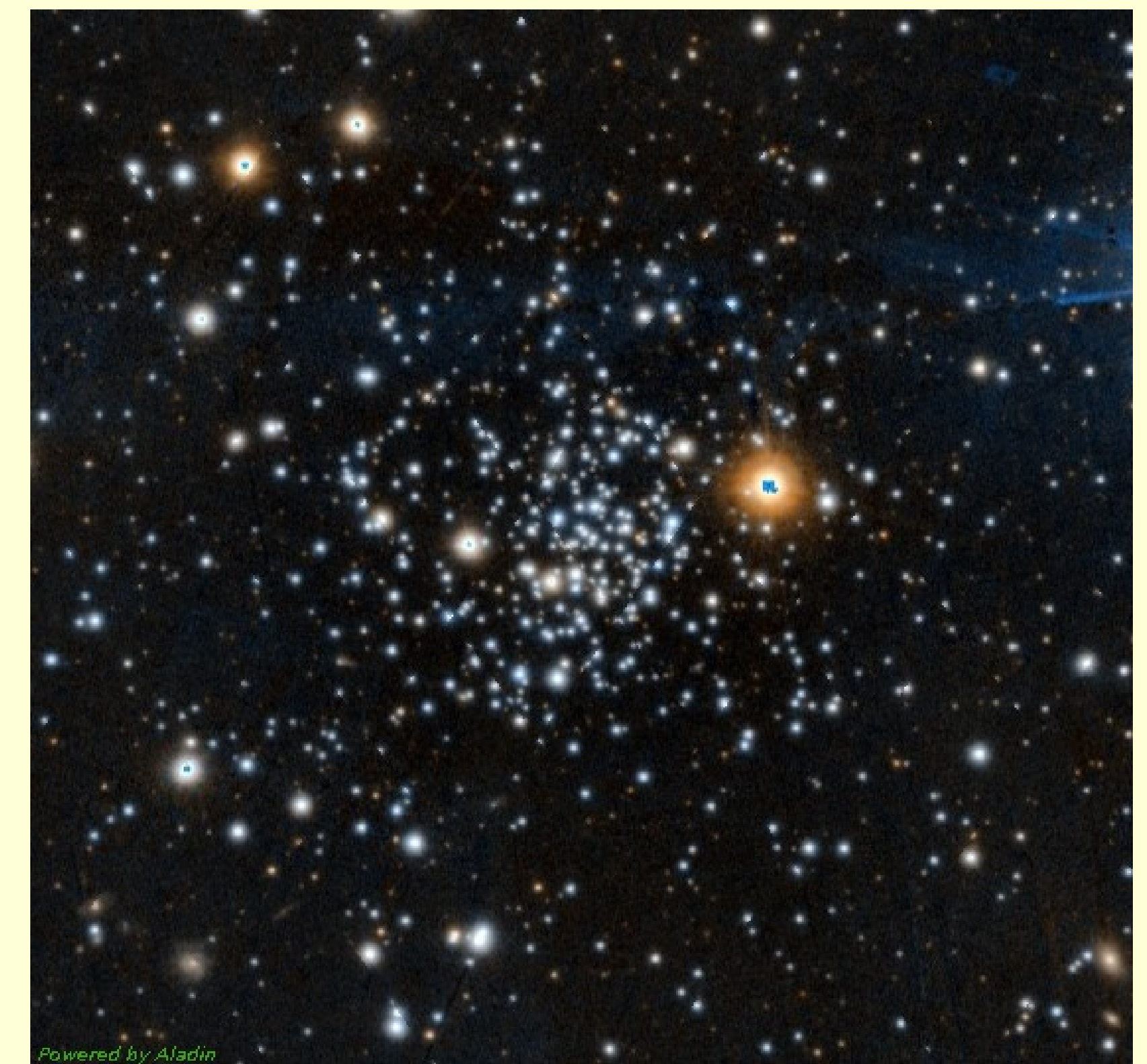
Abstract

Open star clusters are the groups of sparsely populated, gravitationally bound sibling stars. These clusters are the important tools to study the Galactic disc and have been used for this purpose since long time. The young clusters are tracers of spiral arms hence have been used to determine the spiral arm structure whereas the older one are excellent tools to study the kinematics, structure and chemistry of the Galactic disc. Since one can determine the properties of stars in clusters accurately as compared to the field stars, open clusters are better objects to determine the large-scale properties of the disc population in our Galaxy. They orbit near the Galactic plane. Hence, constantly disturbed by tidal forces originating from Galactic disc and the molecular clouds. This disturbance along with the dynamical evolution of the clusters change the structure of open clusters. We studied open cluster NGC 1193 using data from 104-cm Sampurnanand Telescope located at ARIES Nainital. We calculated the fundamental properties of the cluster using isochrone fitting. NGC 1193 is a old (4.79 Gyr) cluster and have distance around 4 kpc. We also studied the luminosity function for this cluster and found that it is increasing for all clusters except a dip at the end, which is due to the evaporation of fainter stars. This cluster is dynamically relaxed and have mass segregation.

Data-set

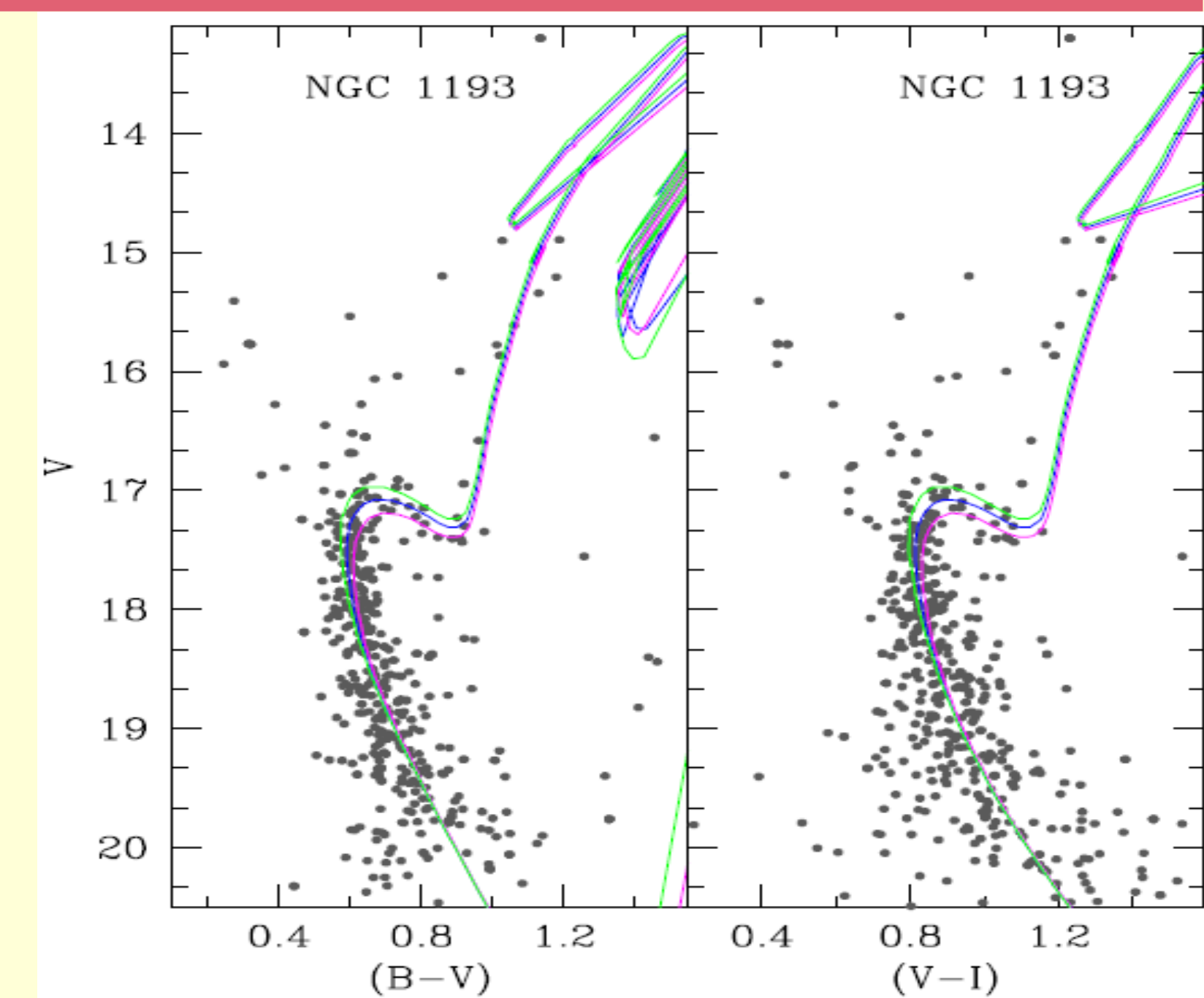
- Photometric data in BVI bands have been observed from 104-cm Sampurnanand telescope, ARIES, Nainital, India.
- We have taken proper motion and parallax data from Gaia DR3 catalogue.

Image showing 6.5'x6.5' area of the cluster NGC 1193 taken from PanSTARRS.



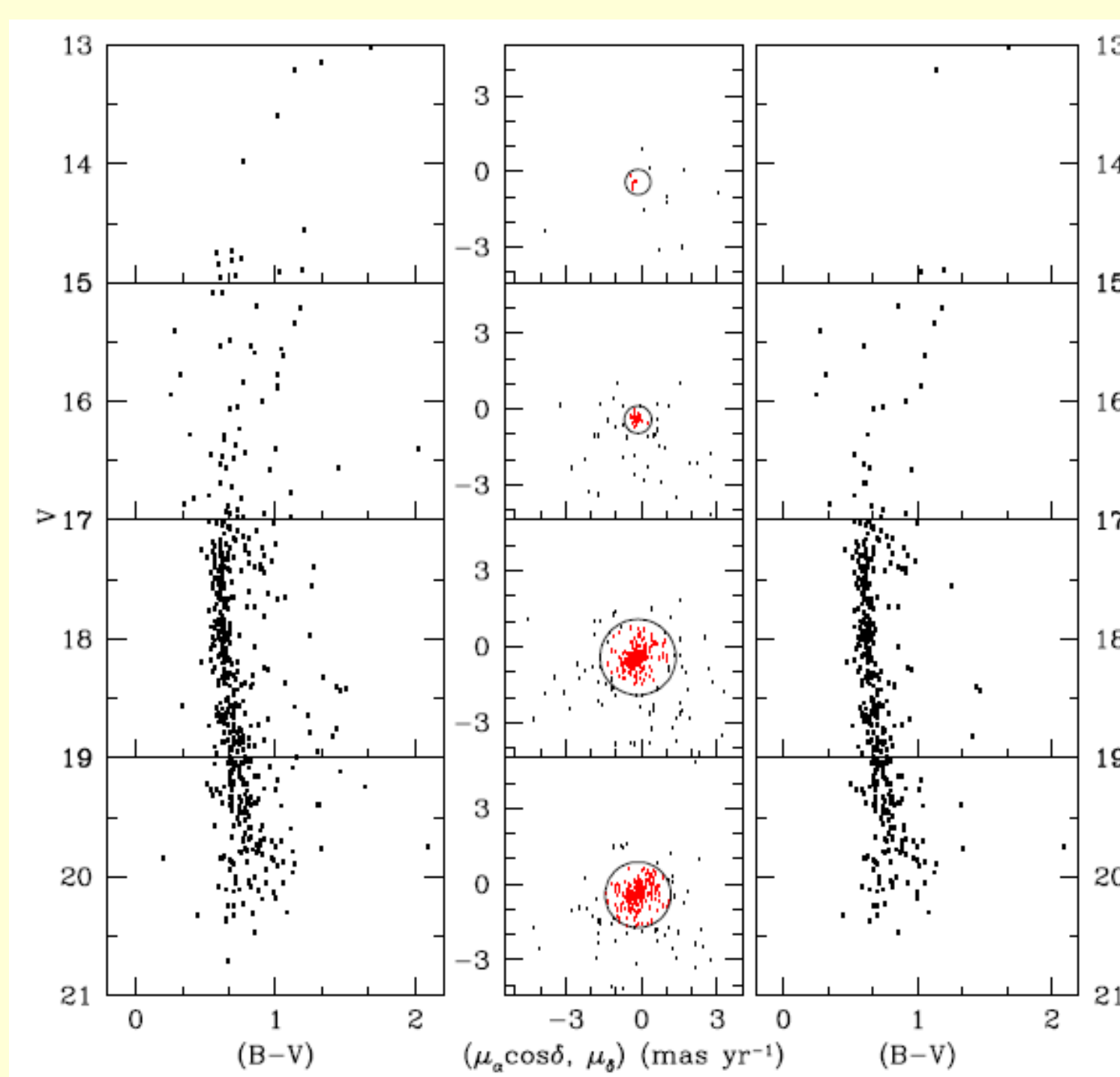
Cluster parameters and dynamical status

- The fundamental parameters of the cluster are determined by fitting the isochrones from as shown in Figure. In this CMD, we have only used the cluster members selected from VPD.
- The best fitted isochrone is of age 4.79 Gyr. From this we also found that the value of $E(B-V)$ as 0.13 mag, Z as 0.008 and distance as 5.005 kpc.

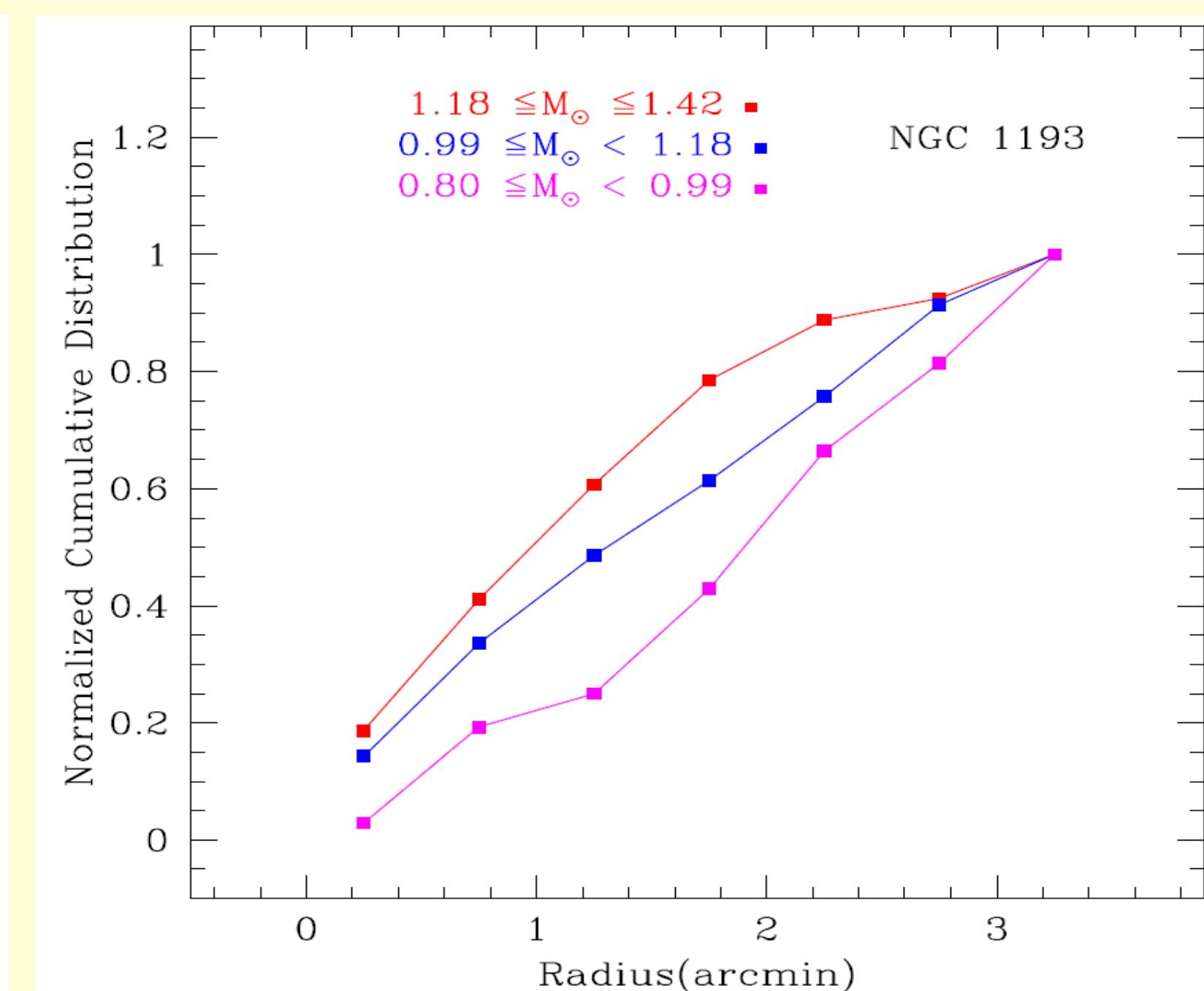
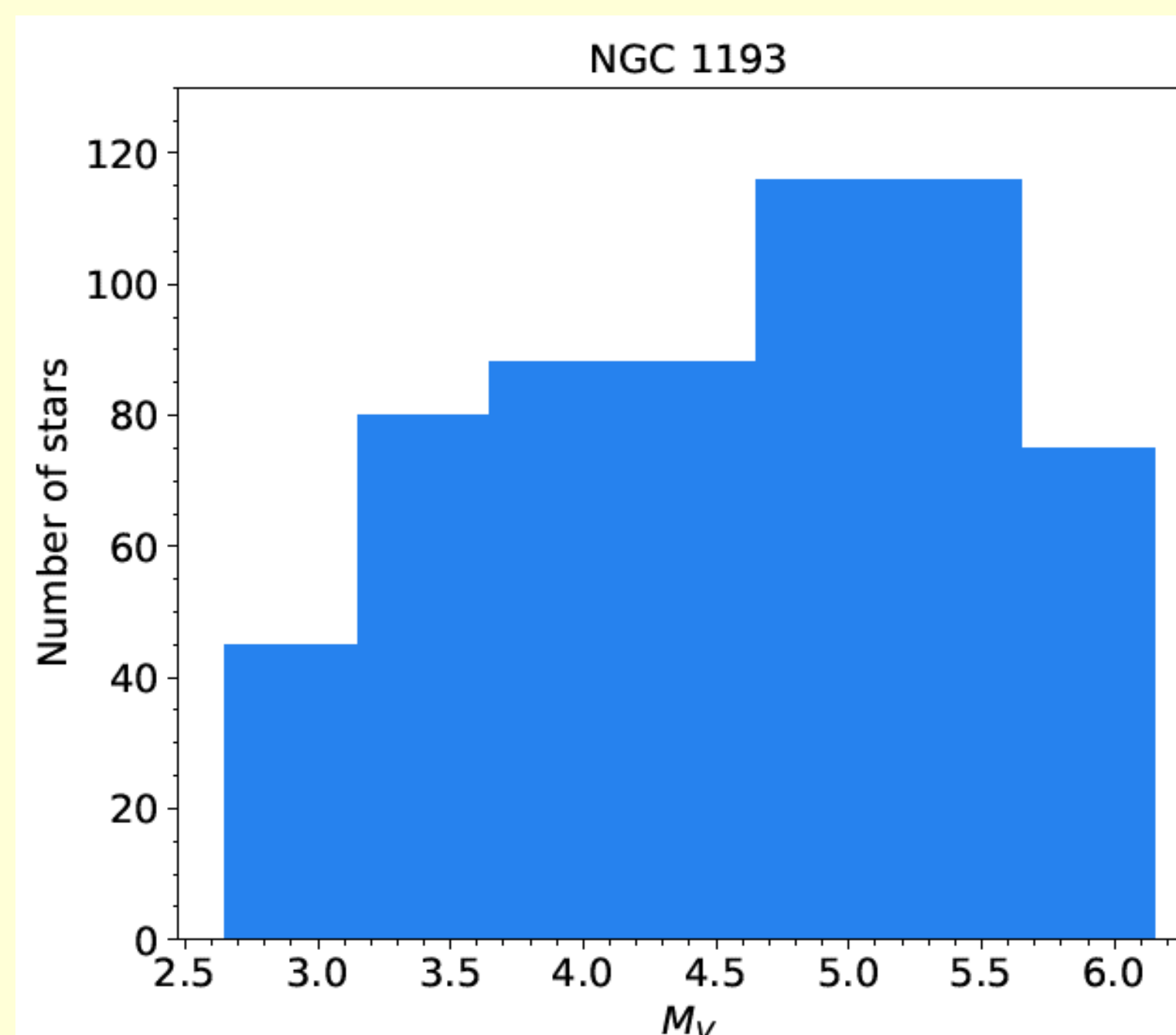


Cluster member selection

With the help of Gaia EDR3 proper motion data, we selected the cluster members. Vector point diagrams (VPDs) show kinematical distribution of stars. The VPD is shown in the middle panel of the Figure. Two distinct population of stars are visible in the VPD, in which tightly distributed stars are the cluster members and the scattered stars represent the field population. Left and right panels of the figure show colour-magnitude diagrams (CMDs) of total and member stars selected with the help of VPD respectively.



By the visual inspection of the VPDs, we define the centre and radius for tightly bound population of stars. We made this selection in such a manner that field star contamination is minimized and possible faint member stars are saved. we used different circle radius in different magnitude bins because of the larger measurement errors in proper motion data for fainter stars .



- As shown in the left figure the cluster have an increasing luminosity function which indicate the presence of faint members of cluster within the cluster.
- Normalized cumulative distribution curve for the cluster shown in right figure gives a hint of mass segregation in the cluster.

Orbits of the cluster

- We used the Galactic potential models described in Rangwal et al. (2019) to derive the orbits of the cluster. We integrated the orbits backward in time equal to the age of the cluster and derived the orbital parameters for the cluster.
- The left figure shows top picture and right figure shows side view of the orbit. The blue triangle and red circle denote present day and birth position of cluster in the Galaxy.
- We found that the cluster is orbiting in a circular orbits around the Galactic center which bobbles up and down from the Galactic disc and looks like a box.
- The cluster born in the thick disc of the Galaxy and the present position is similar to it. The cluster is also orbiting beyond the solar circle (we have taken Galactocentric distance of the Sun as 8.3 kpc). Hence this cluster is not heavily affected by Galactic tidal forces so may have a longer life span.

