Astrosat UVIT Investigation of Globular Cluster NGC 2808

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Abstract

NGC2808 is a metal poor and massive globular cluster in the southern sky. Contrary to the earlier accepted norm of co-eval stellar population in Globular Clusters, NGC2808 has been found to comprise of multiple stellar populations. We have observed this cluster in a number of UV filters (5 NUV and 2 FUV) using UVIT-AstroSat. Our motivation is to investigate the properties of various UV bright stellar populations such as Horizontal Branch, Red Giant Branch, Post-RGB etc, including their distribution across the cluster. The data from the UVIT-Astrosat observations have been reduced and photometry carried out on the images to obtain the catalog of UV bright stars.

Introduction

Globular clusters are an important link for us to understand the evolution of low mass stars. They are known to have stars that are formed at the same epoch from the molecular cloud having uniform chemical composition. Thus the stars evolve only based on their initial masses. This is reflected in Color-Magnitude diagram of the Globular Clusters. CMDs are good test of predicted stellar evolutionary models of low mass stars with observed cluster properties. This is achieved by fitting isochrones to the CMDs obtained. Isochrones are theoretical CMDs, for the cluster of given age and chemical abundance, which are used to estimate age and chemical composition of a cluster.

Some of the very hot stellar population is UV bright. UV population of GCs is dominated by Horizontal Branch stars, UV bright stars. UV bright stars is the name designated by Zinn et al. (1972) to the stars that lie above HB and are bluer than red giants. These stars have magnitude in the 'U' band brighter than all other cluster stars. This group of stars also comprise of Blue horizontal branch (BHB) stars, Extreme Horizontal branch (EHB) stars, post-HB stars, post-AGB stars, post-early AGB stars (P-EAGB) and AGB-manque stars (Moehler,2010). Another exotic class of UV bright objects is `blue hooks'.
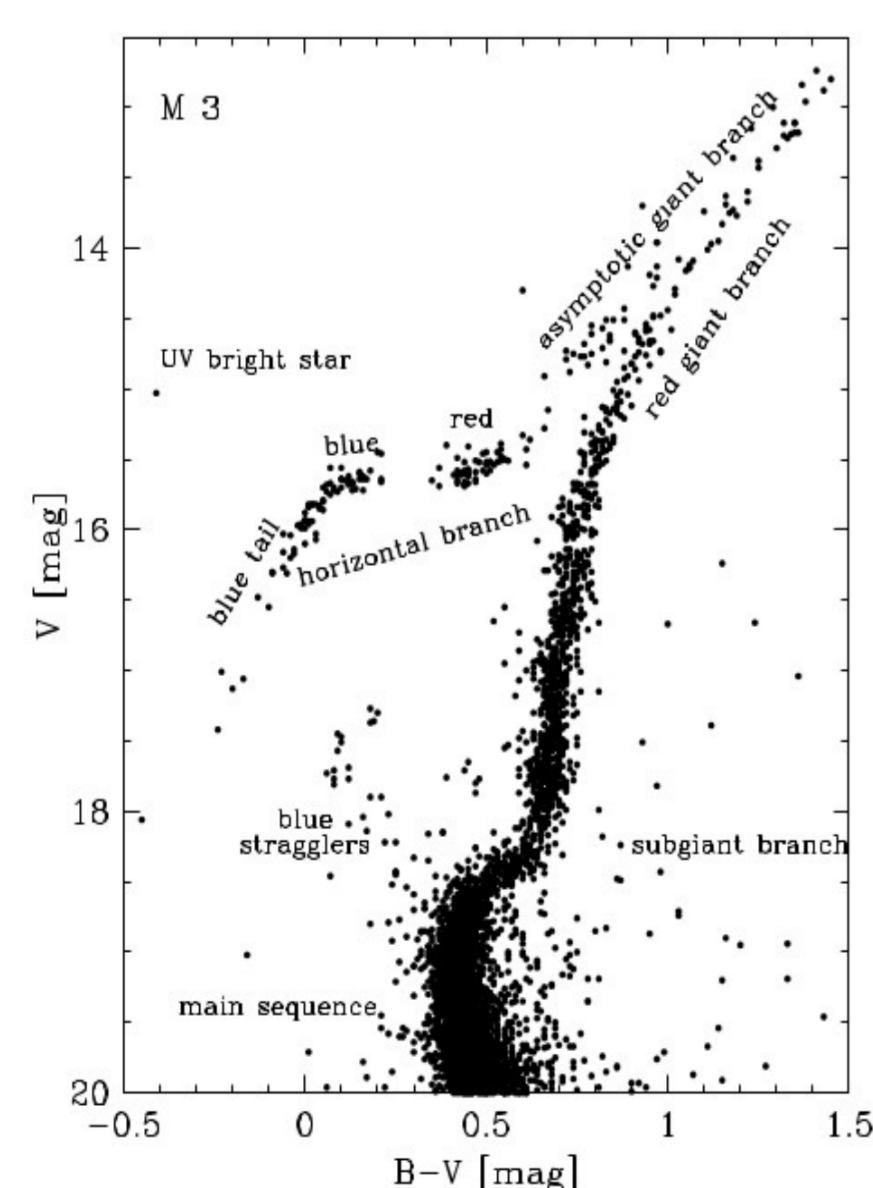

Figure 1. CMD of the M3 (Buonanno et al. 2004).

NGC 2808

NGC 2808 is a distinguished case of peculiar horizontal branch. It is known that HB of NGC 2808 is rather unusual. It has both red and blue HB stars, completely lacking intermediate objects. This is evident from the multimodality in the distribution of stars in CMD of the cluster (Sosin et al. 1997).
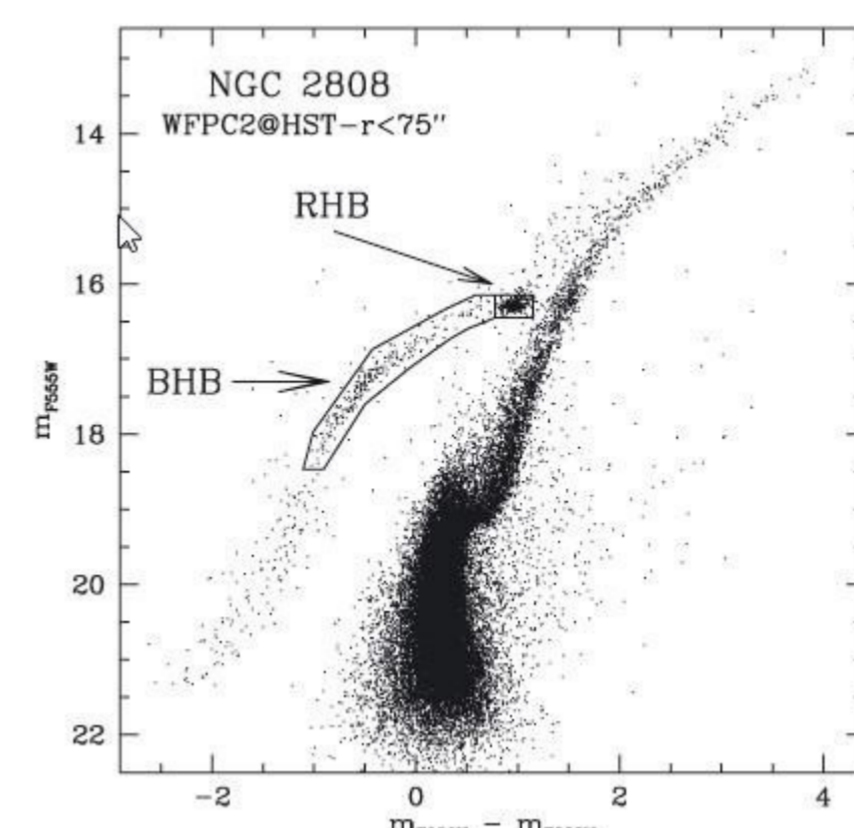

Figure 2. Optical CMD of the NGC 2808 showing HB.

UVIT Images

NGC 2808 was observed by UVIT in seven UV filters(2 FUV and 5 NUV). Details of observations and other parameters are mentioned in Table.1.
Data analysis is briefly described:

- **Photometry**: All the seven filters were subjected to aperture and profile fitting photometry. The results are combined to formulate a master catalogue with all the detected sources.
- **Error Calculation:** Error in magnitude is calculated using error propagation formula. We have taken into account error in ZP magnitude and error in photon counts.
- **Dereddening:** Using values for E(B-V)=0.18 (Dalessandro et al. 2012) for NGC 2808 and R_v=3.1 for milky way, we have determined the extinction values in various passbands. These values are also mentioned in the table.
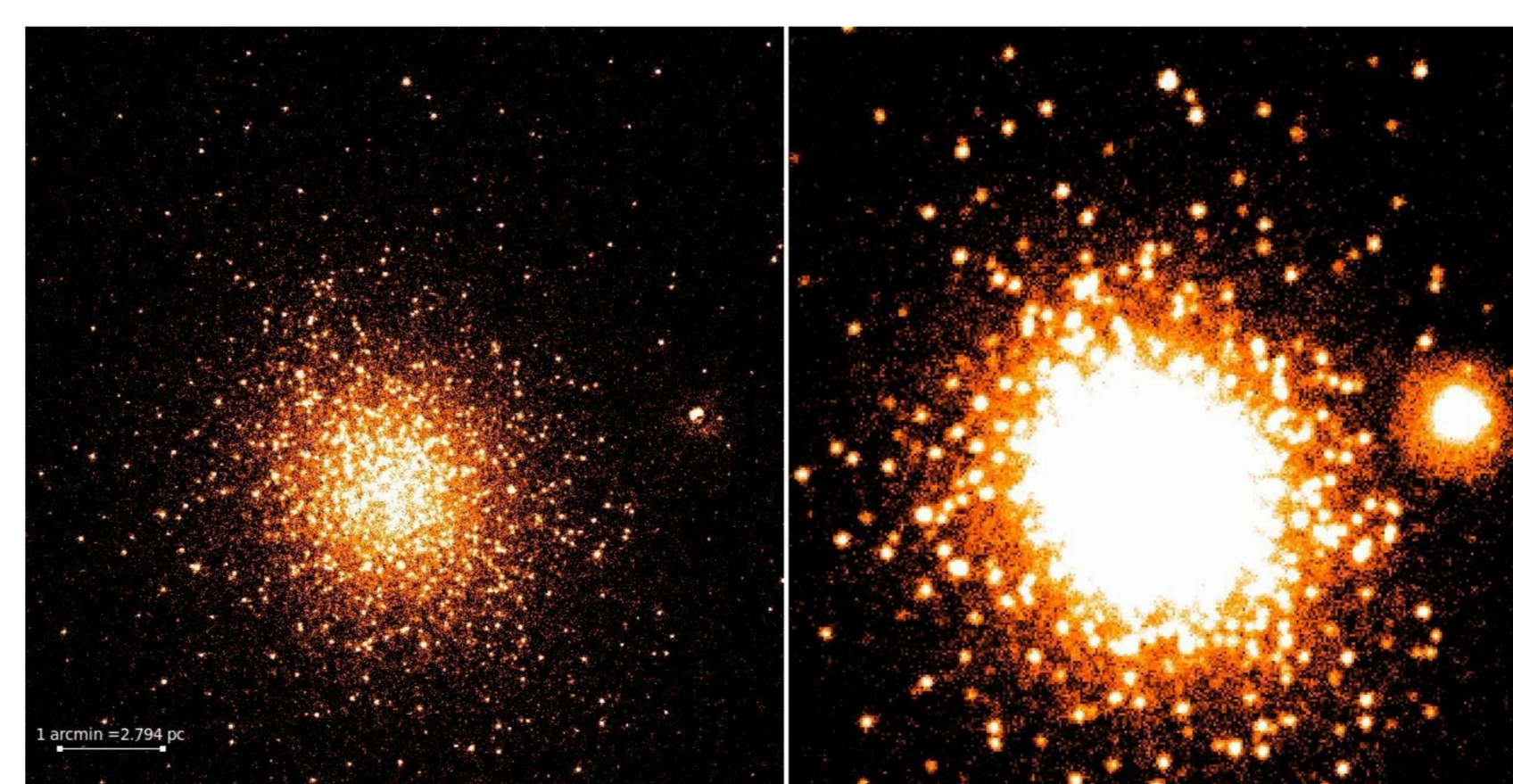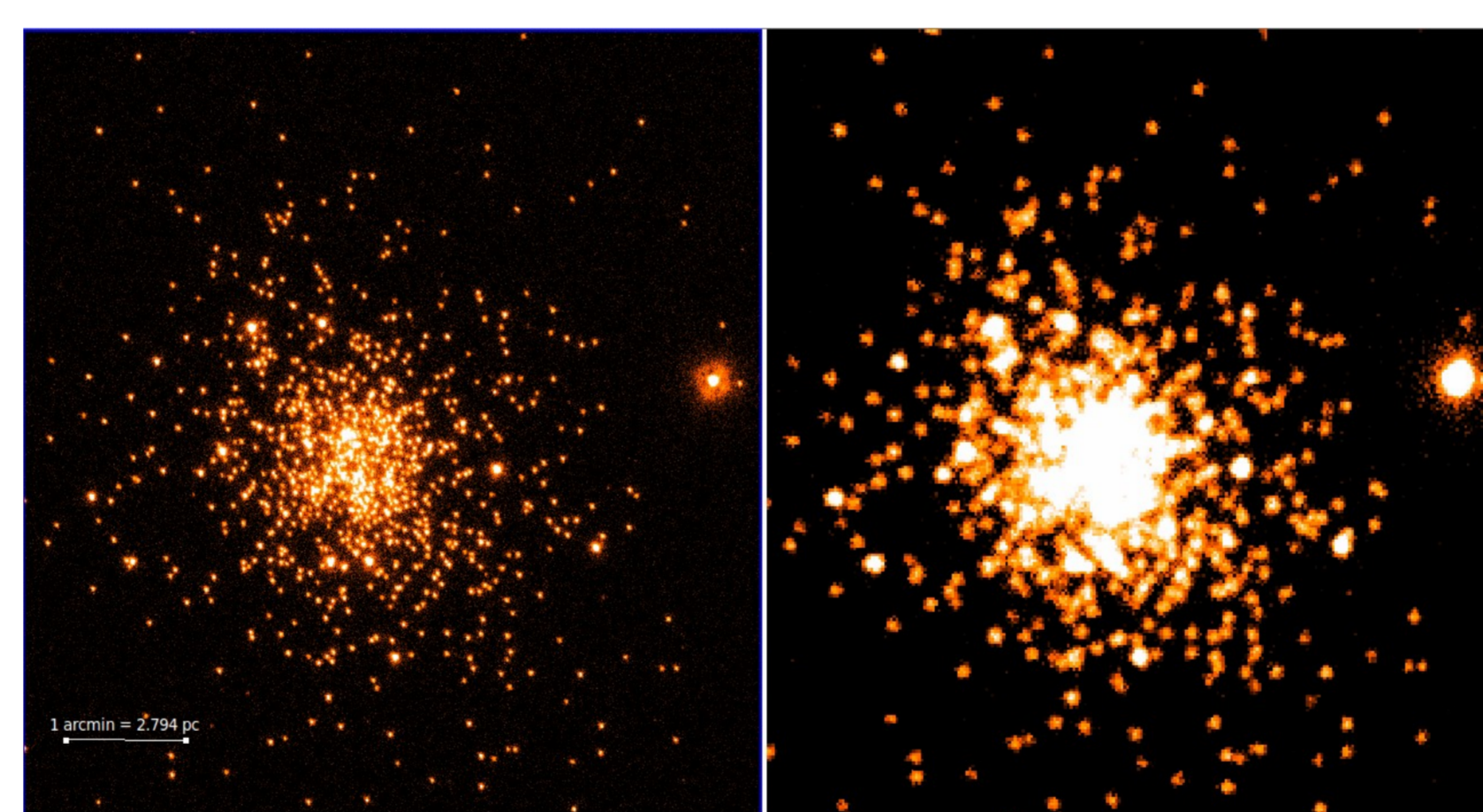

Figure 3. FUV(above tile) BaF2, (Left) UVIT vs (Right) Galex images Of NGC 2808. NUV (below tile) Silica-1 UVIT (Left) vs Galex(Right).

Filter	Mean$_\lambda$(A)	ZP mag	A$_\lambda$ (mag)	Exposure Time(sec)
F154W/BaF2	1541	17.765	1.46	4172
F169M/Sapphire	1608	17.453	1.43	3553
N242W/Silica-1	2418	19.81	1.39	403
N219M/NUVB15	2196	16.59	1.77	477
N245M/NUVB13	2447	18.50	1.36	348
N263M/NUVB4	2632	18.18	1.18	348
N279N/NUVN2	2792	16.50	1.09	2639

Table 1. Details of observations

Results

PSF calculation: PSF is found to be uniform across the FOV:
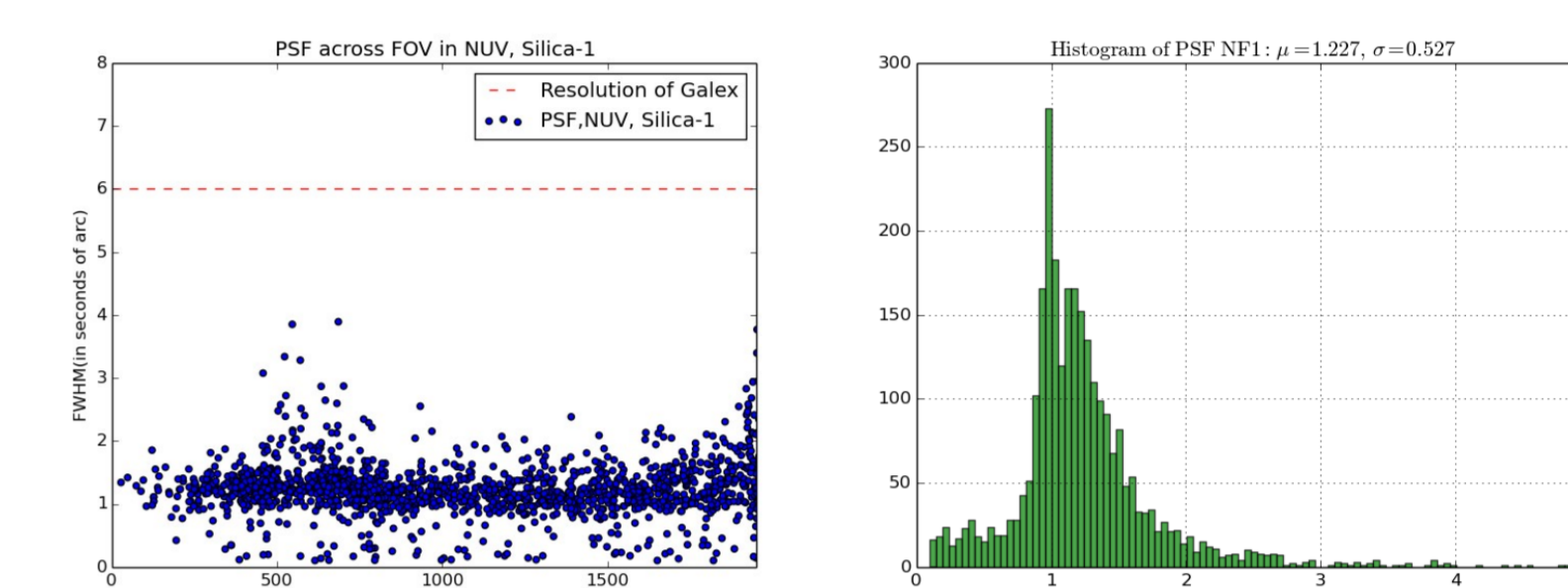
HB and PAGB stars: We have identified Horizontal branch stars and PAGB stars from catalogues by Moni Bidin et al. 2011 and Schiavon 2012.
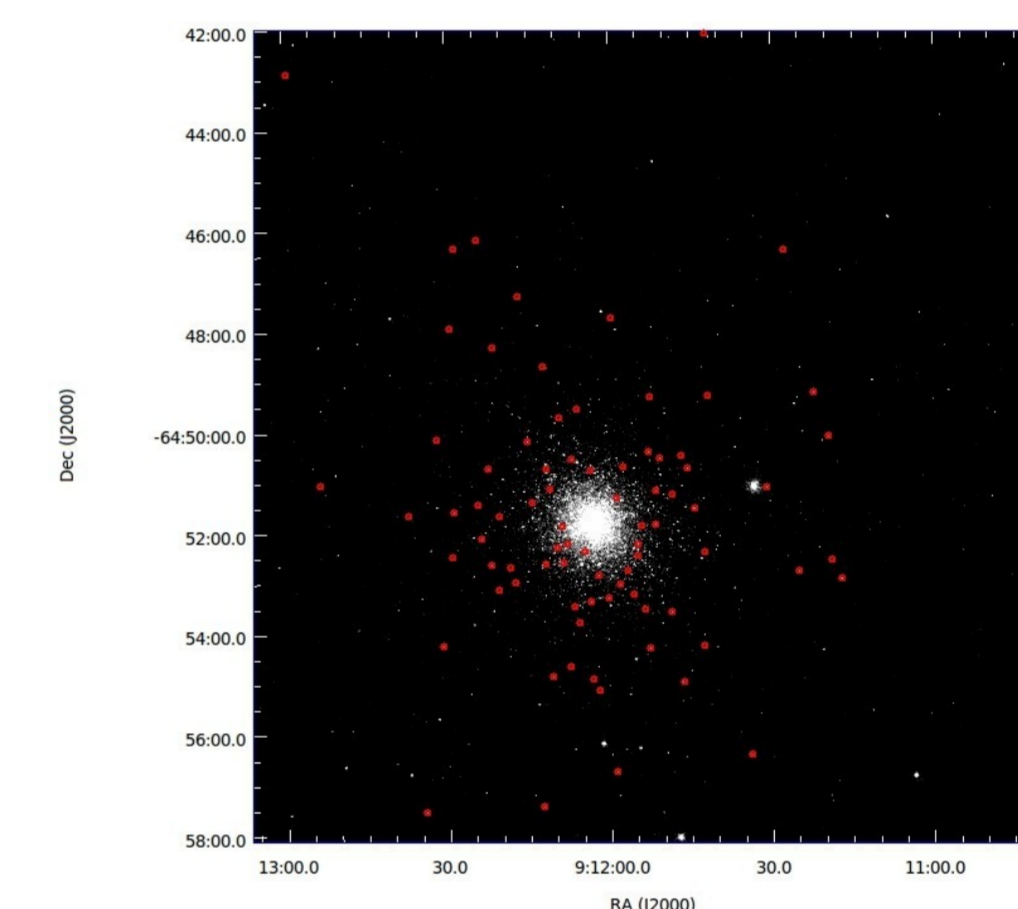

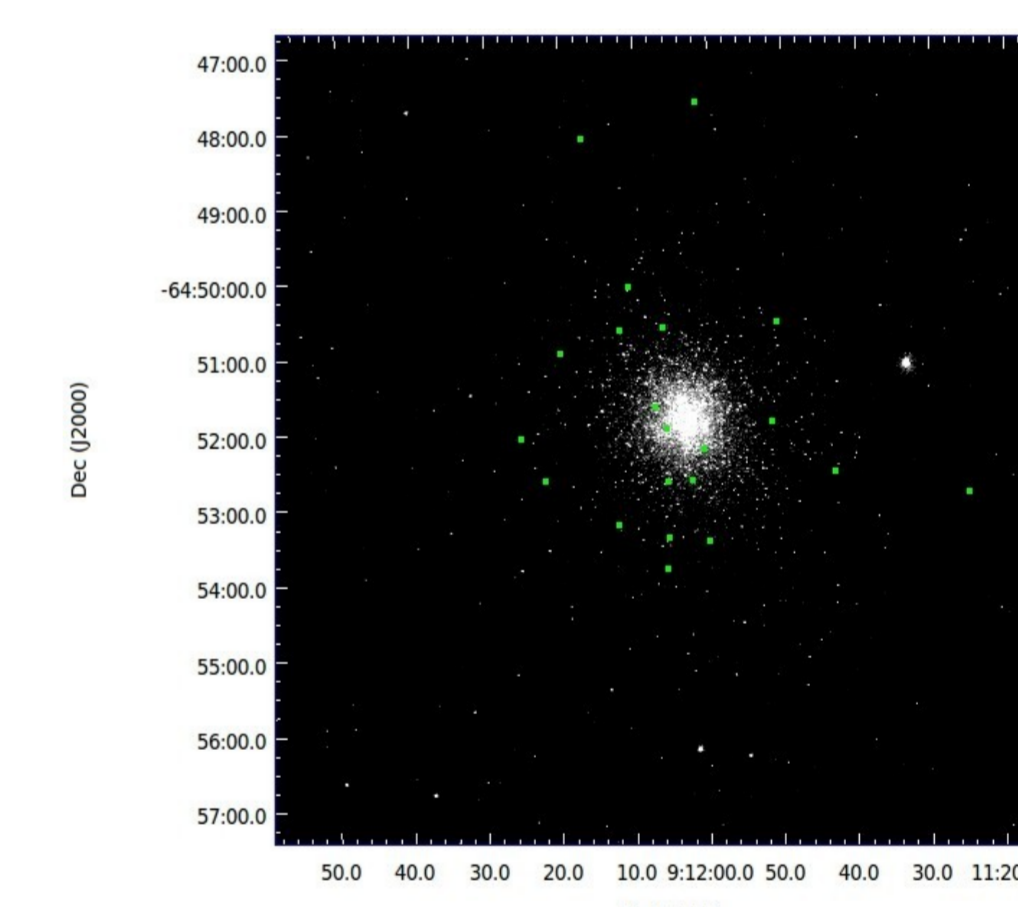Figure 4. Identified Horizontal branch stars in NGC 2808 (Moni Bidin et al. 2011)

Figure 5. Identified PAGB branch stars in NGC 2808 (Schiavon et al. 2012)

Conclusions

- Magnitudes and Errors are calculated and a consolidated catalogue is formed.
- Identification of stars belonging to various evolutionary stages.
- Color-magnitude and color-color diagrams to be constructed using these catalogues.
- Locating other classes of hot UV population in the cluster using the identified stars in that group.
- Fit isochrones of different metallicity and ages.

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