



Profiling Globular Clusters at TTU Skyview Observatory



Nathaniel Rose¹, Darien Perla¹, Cheslee Hibler¹, Vallia Antoniou^{1,2}

¹Texas Tech University, Department of Physics & Astronomy

²Center for Astrophysics | Harvard-Smithsonian

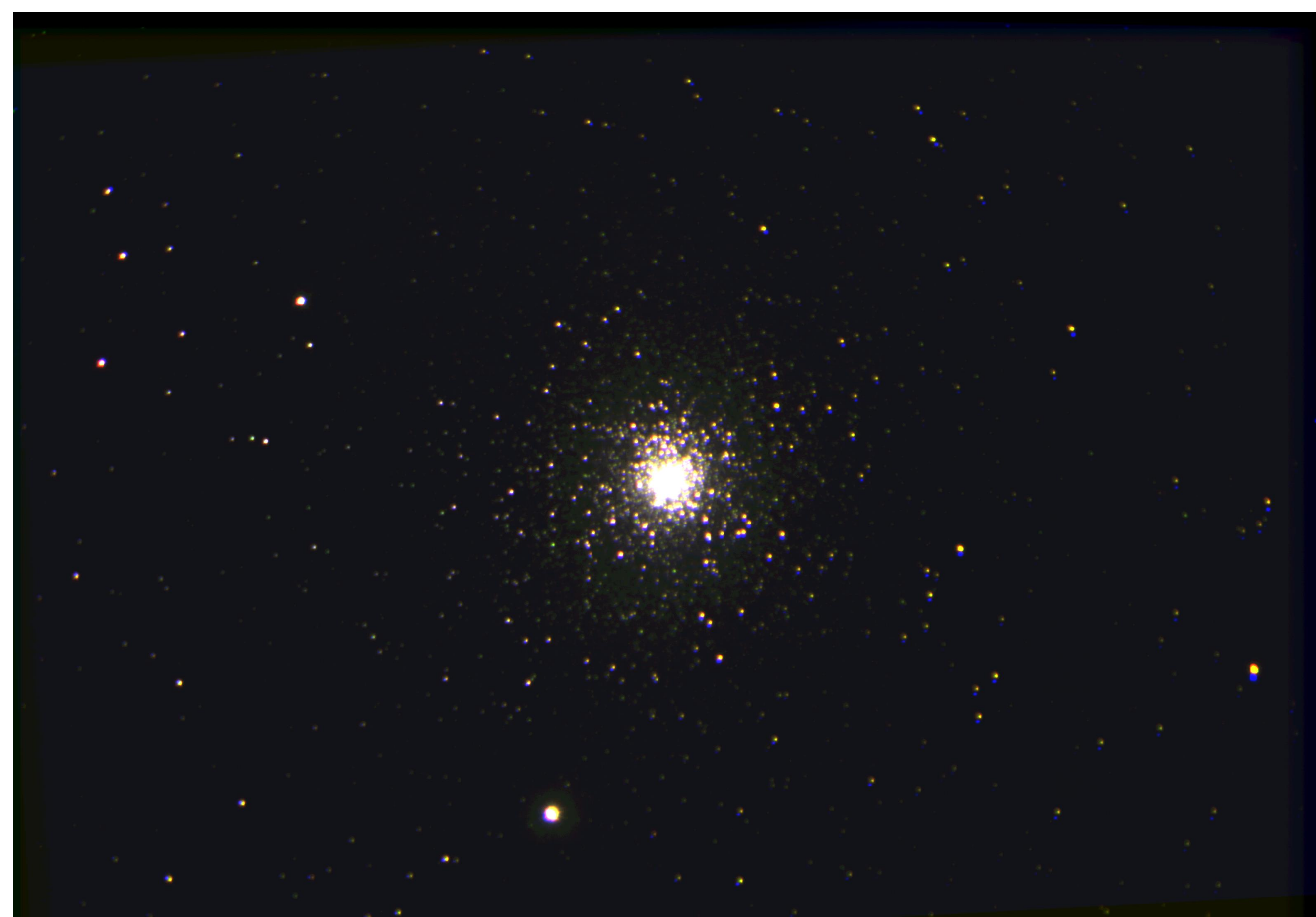
Abstract

In the universe, celestial bodies tend to become gravitationally bound to one another. Examples of this are seen in subjects such as galaxies, planetary systems, and globular clusters. Globular clusters (GC) are dense, spherical accumulations of stellar populations. It has been observed that these systems occupy the halo of the Milky Way, which is the oldest section of our Galaxy. Because GC are comprised of old stars, they have a low abundance of heavy elements. Due to the stars within a GC forming within a similar point in time, these systems serve as cosmic clocks. The most massive star left on the Main Sequence provides the cluster's age through a process called isochrone fitting. The isochrone is a curve on the color-magnitude diagram (CMD), a scatter plot depicting the relationship between absolute magnitude, and collectively color and temperature, that represents a population of stars of the same age but with different masses. We have selected several GC to observe from Texas Tech's Preston Gott Skyview Observatory, utilizing complementary metal oxide semiconductor (CMOS) detectors on 12-inch telescopes and 3 photometric broadband SLOAN/SDSS filters. Two of the CMOS cameras were purchased using funds from the 2021 Texas Tech Alumni Association Excellence Award. By directly comparing the CMDs of the different clusters and later each of them with CMDs found in the literature, we can (a) identify different CMD features based on the different stellar populations and their evolutionary stage each cluster hosts; (b) address the reliability of our Observatory equipment for research investigations. We conclude that the equipment is reliable for both undergraduate labs and research projects, thus offering for the first time the opportunity to undergraduate students to obtain, analyze, and publish their own data obtained from the TTU Skyview Observatory.

Introduction

Messier 15 (M15) is a globular cluster located in the constellation Pegasus. It has a visual band brightness of 6.2 mag (SEDs Messier Catalog), and it has a metallicity $[Fe/H]$ of -2.37 dex (Boyles, et al. 2011, ApJ, 742, 51). It is estimated to be 12 billion years old (Koleva, et al. 2008, MNRAS, 385 (4), 1998). Our observations were gathered in the r' , g' , and i' of the Johnson-Cousins UBVRI system on 08/14/2023 and 08/17/2023.

Fig. 1: Color image of M15, comprised of r' (red), g' (green), and i' (blue), produced from our observations.



Data Analysis

After visual inspection of the gathered images in each filter, 466 good quality science images were left in g' , 359 in r' , and 345 in i' . The remaining images had current bias and dark current from the CMOS cameras subtracted, and they were flat-fielded to correct for the response variations across the field of view. Following this, aperture photometry was performed through AstrolmageJ. A color image of M15 was produced (Fig. 1)

Expected Results

We intend to produce a CMD through the programs AstrolmageJ, Aperture Photometry Tool, and Topcat. Through this diagram, we seek to determine characteristics of M15, such as age and its relationship with star types. We will compare our results to that of others, as seen in Fig. 2 and Fig. 3.

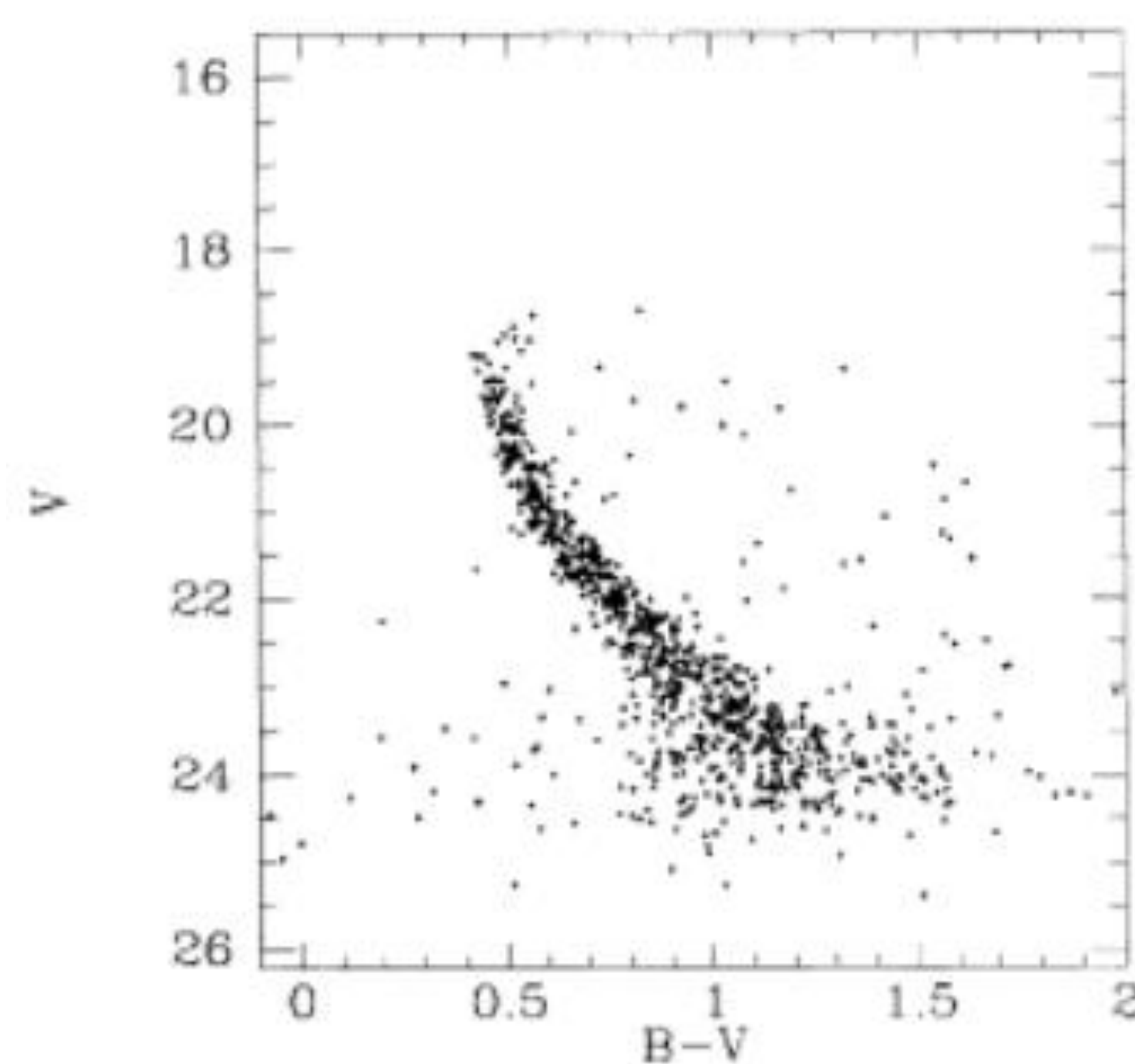


Fig.2: CMD of M15's deep field (Durrell & Harris, AJ, 105, 4).

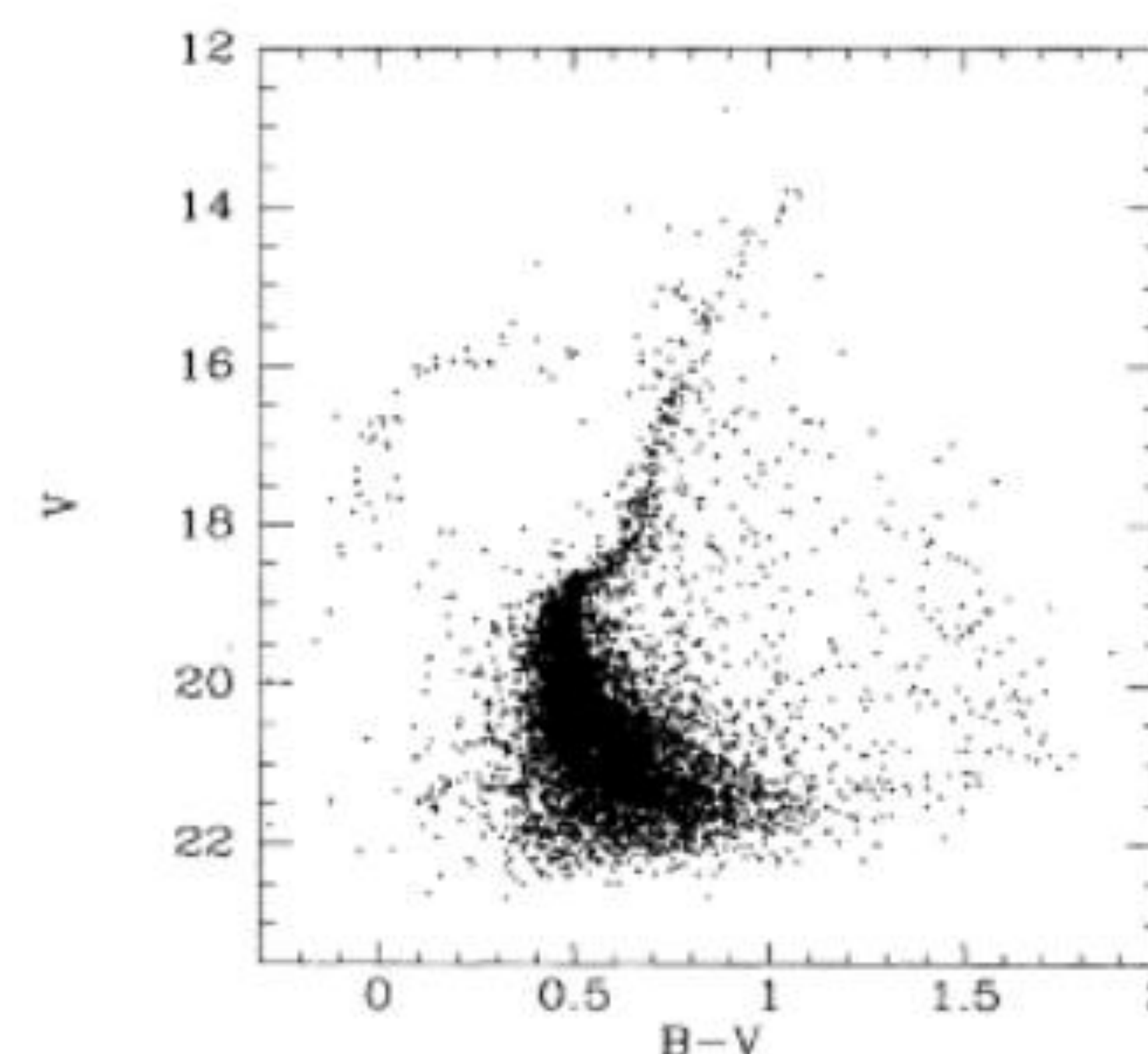


Fig. 3: CMD of all stars comprising M15 (Durrell & Harris, AJ, 105, 4).

Acknowledgements

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<https://www.astro.louisville.edu/software/astroimagej/>

Koleva, et al. 2008, MNRAS, 385 (4), 1998.

Durrell & Harris, AJ, 105, 4).

SEDs Messier Catalog.