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Project 1

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1. OBSERVATIONS

We planned to observe NGC4567 for our galaxy and M44 for our star cluster. B, V, and I were the filters we planned to use for observation. After focusing we were to start with M44 because it would be more ideal for observing earlier in the night, while NGC4567 would be higher in the sky later in the night. For M44, we were to take repeated exposures in each filter for times of 10, 20, 40, and 60 seconds, increasing exposure time if we were not risking saturation of the science target. The same thing would be done with NGC4567, but exposure times could be increased to 60, 90, 120, and 150 seconds. Unfortunately, despite several attempts to observe we were foiled by nefarious technical gremlins or ran afoul of the god of weather, so for the rest of the report I am using the data for NGC6946 and NGC188. As such there is no observing log attached at the end of this report. We could have taken a selfie but forgot to since we never had a complete observing run.

2. RESULTS

First I will describe the results for NGC6946, and then I will discuss the results for NGC188

2.1. *NGC6946*

Imaging was done in the G, U, and I filters. First, a pixel by pixel median bias was created from all the biases to create a master bias. Then, the master bias was subtracted off of each flat. Then, the flats for each filter needed to be combined to create a master flat. This was done by taking the median of all the flats at each pixel, also correcting for the different exposure times of some of the flats. Then each image was divided by the master flat for the corresponding filter of the image. As a final measure to clean up the image, the median of each image was subtracted out, as this flux is mostly coming from sky. The G, U, and I filters were the combined into an RGB image shown in Figure 1.

2.2. *NGC188*

Imaging was done in the G and R filters. Each image went through the same process of data reduction described above for NGC6946. A subimage was then created in each filter around the star cluster specifically,

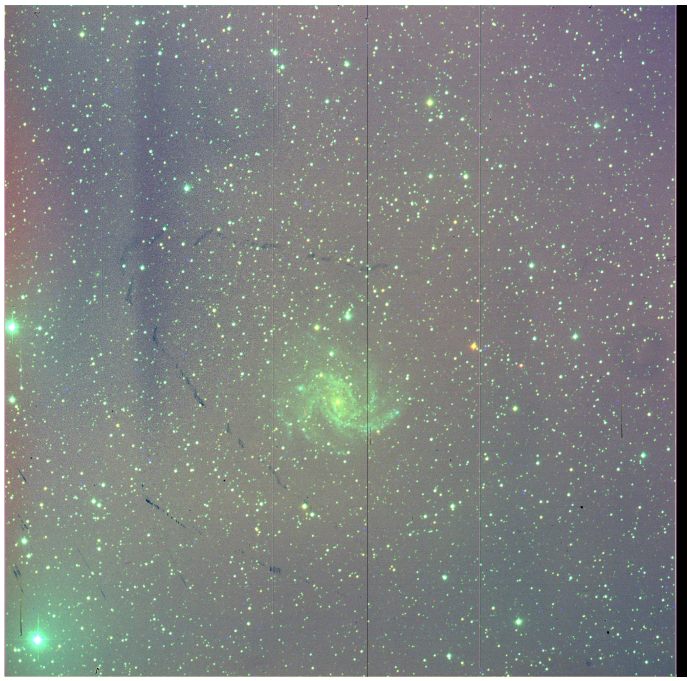

Figure 1. The galaxy NGC6946. The galaxy is dominated by green and blue, indicating the dominance of younger stars in the galaxy. This tells us that the galaxy itself is younger.

to cut down on outside contamination. Both images were uploaded to Astrometry.net in order to get WCS heading for both. Now with WCS headers for both, the R filter was reprojected onto the g image so that the images lined up. Then sourceextractor was run, using the reprojected R image as the detection image. 7 connected pixels were required to define a source, with a S/N of at least 1.5. The resulting catalog of fluxes and positions was then matched with PANSTARRS to allow for calibration of the instrumental fluxes. A zeropoint was found for both the R and G filters, allowing for the recalculation of the instrumental fluxes into apparent magnitudes. From here, color magnitude diagrams could be created for G and R, as shown in Figure 2 and Figure 3.

After this, CMD 3.3 was used to generate isochrones to be used to estimate the age of the star cluster. I fit isochrones of 3 billion years, 6.5 billion years, 6.75 billion years, 7 billion years, and 10 billion years. The absolute

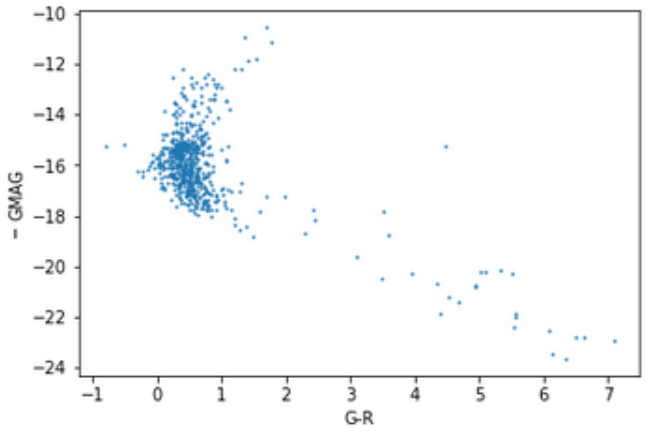

Figure 2. G Filter Color Magnitude Diagram for the star cluster NGC188. Note the y axis Gmag is the negative of the actual Gmag.

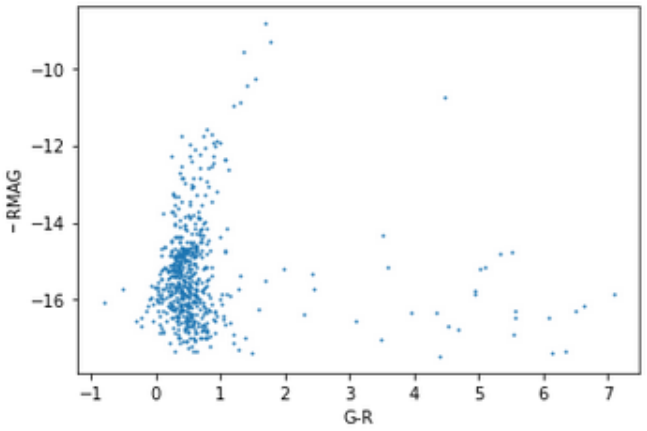

Figure 3. R Filter Color Magnitude Diagram for the star cluster NGC188. Note the y axis Rmag is the negative of the actual Rmag.

magnitudes were converted to apparent magnitudes using a distance to NGC188 of 1.66kpc and assuming no significant dimming from dust. Figure 4 shows three PANSTARRS G filter isochrones versus the Gmag color magnitude diagram. Figure 5 shows this for the Rmag color magnitude diagram.

3. DISCUSSION

3.1. *NGC6946*

Looking at the galaxy image, blue and green dominate the galaxy. This is indicative of a younger galaxy, containing primarily O, B, and A stars. Older galaxies would show up as more red, dominated by older red giants.

3.2. *NGC188*

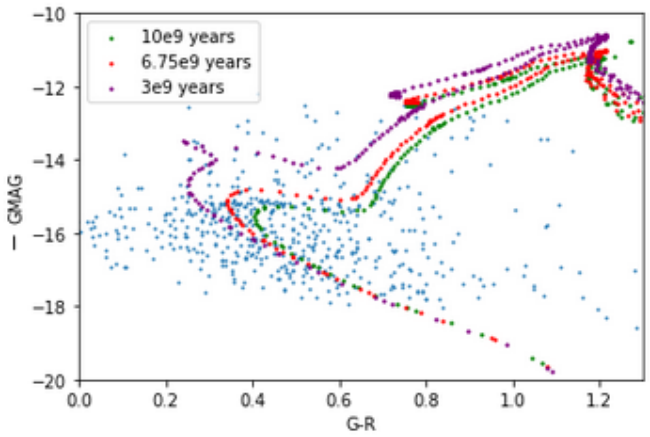

Figure 4. Gmag Isochrones at 3 billion, 6.75 billion, and 10 billion years. Age appears to be at least 6.5 billion years.Note the y axis Gmag is the negative of the actual Gmag.

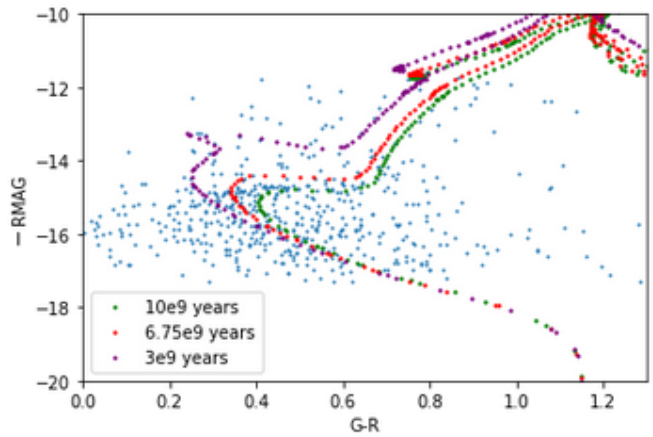

Figure 5. Rmag Isochrones at 3 billion, 6.75 billion, and 10 billion years. Age appears to be at least 6.5 billion years. Note the y axis Rmag is the negative of the actual Rmag.

Looking at the isochrones plotted against the data, it is hard from this data to determine exactly where the different branches and the main sequence turnoff are in the data. Of the isochrones plotted, the 6.75 billion year old one looks like the best fit, but none of them are particularly convincing. brightness at tip of red giant branch, giant branch clump, and main sequence turn off. The density of stars drops off pretty dramatically at G 15mag, which seems to be the top of the main-sequence. Above this magnitude the distribution of stars travels more or less vertically up the diagram, indicating the presence of the giant branch.