# Color Magnitude of M103

By Dylan De La Pena and Justin Perea

# Why Color Magnitude Diagram?

We wanted to make an attempt at some real Astronomy

To gain more experience with photometry

One night of observing

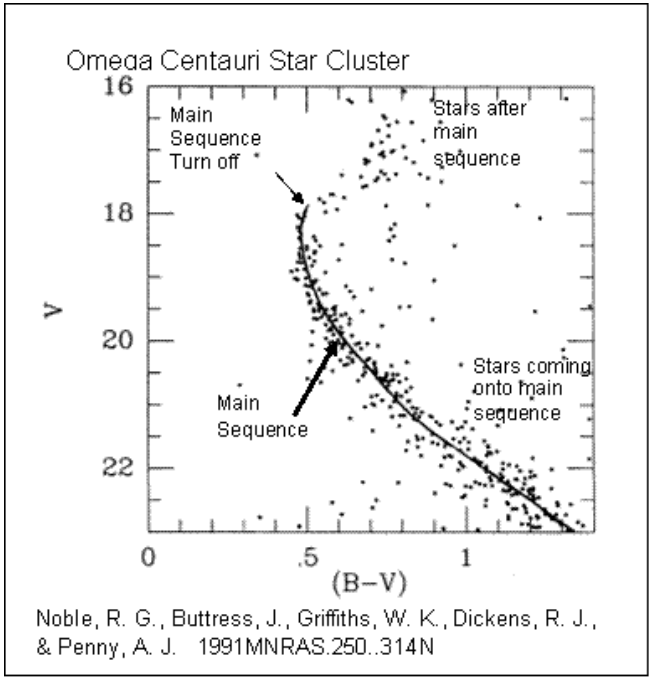
# What is a color magnitude diagram?

Plot of Color vs Magnitude

- Color indicates temperature

Capable of finding-

- Age of cluster
- Mass of stars at main sequence turn off
- Distance of star cluster



# Why M103?

Open cluster (less stars)

Viewing time and position was optimal

Well catalogued stars

Freestarcharts.com. "Messier 103 - M103 - Open Cluster | Free Star Charts." *Messier 103 - M103 - Open Cluster | Free Star Charts*. N.p., n.d. Web. 04 Dec. 2016. <http://freestarcharts.com/messier-103>.

# M103

Open cluster

RA: 01h 33.2m

Dec: +60 42’

Constellation- Cassiopeia

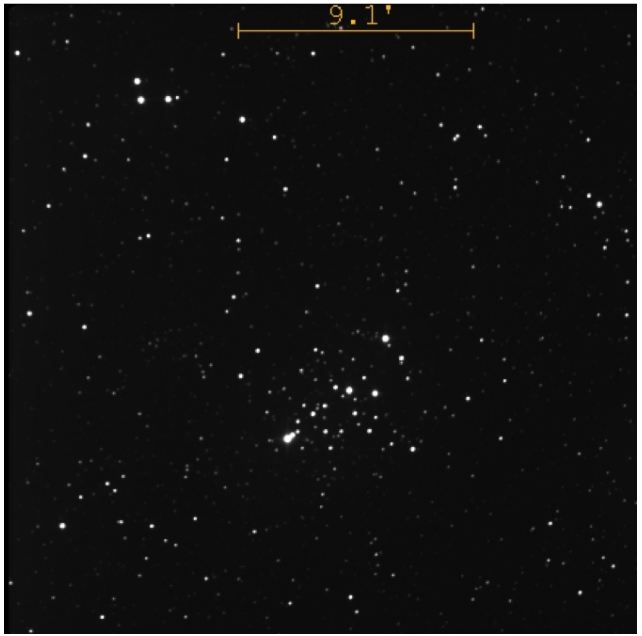
Around 172 stars

10,000 light years away

Strube 13.1 is a red giant not part of cluster

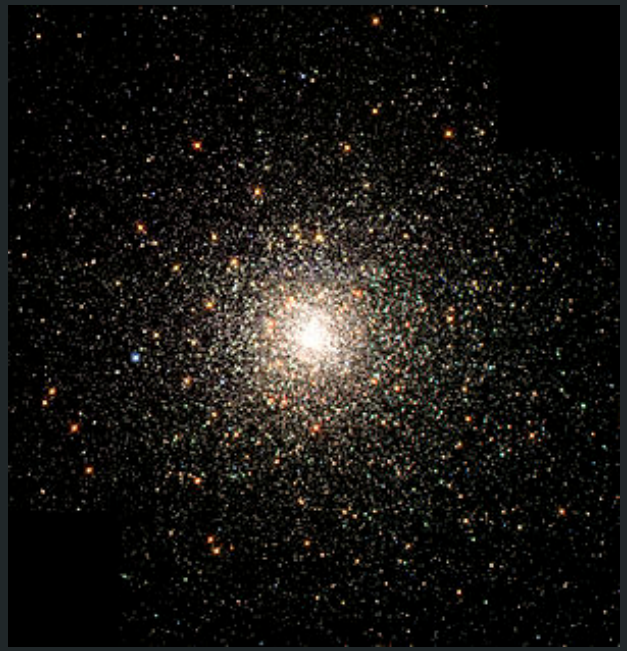
Freestarcharts.com. "Messier 103 - M103 - Open Cluster | Free Star Charts." *Messier 103 - M103 - Open Cluster | Free Star Charts*. N.p., n.d. Web. 04 Dec. 2016. <http://freestarcharts.com/messier-103>.

# Open Cluster




M103: Our image

# Globular Cluster



M80
The Hubble Heritage team (1999-07-01). "Hubble Images a Swarm of Ancient Stars". *HubbleSite News Desk*. Space Telescope Science Institute. Retrieved 2006-05-26.

# Equipment & Software

20” telescope at Skyview observatory

The Sky program

CCD with Johnson-Cousins filters

CCD Soft

AstroImageJ

# Observation

Series of 20 images

B filter flats at 0.7 seconds

V filter flats at 4.2 seconds

0.7 seconds of Flatdarks

4.2 seconds of Flatdarks

http://www.phys.ttu.edu/~ozprof/skyview17.jpg

# Observation Continued

3 series of 60 images for our B filter science images with a 20 second exposure

2 series of 120 images for our V filter science images with a 10 second exposure.

Lastly 10 Dark images at 10 and 20 second exposure

http://www.phys.ttu.edu/~ozprof/skyview17.jpg

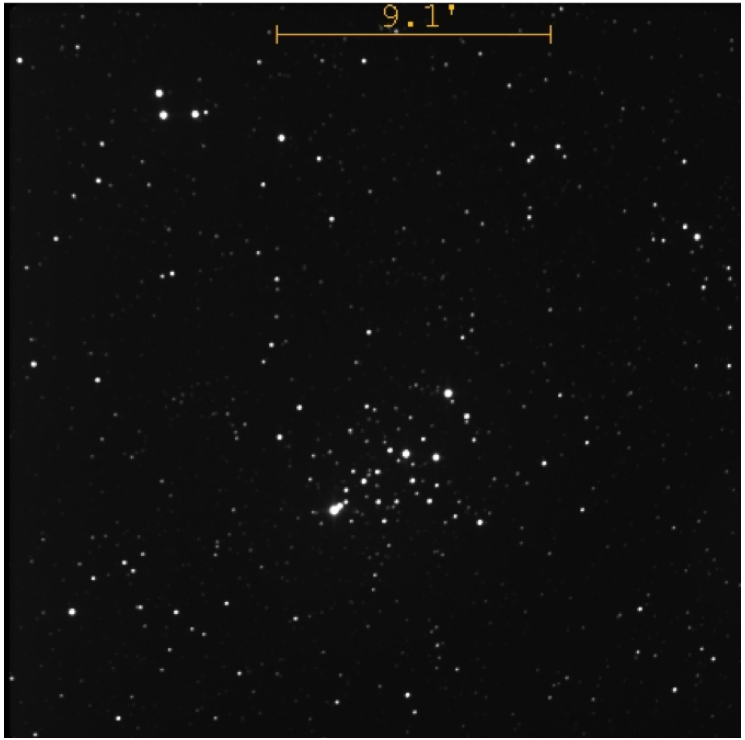
# Reduction of images

Using CCDsoft we median combined our B and V filtered flats to make two master flats

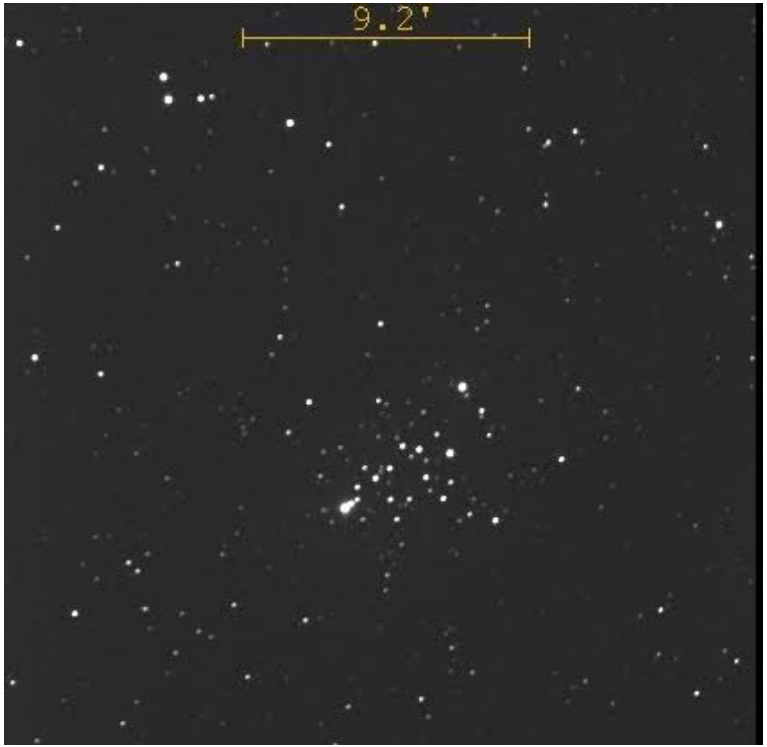
Then we median reduced our darks to make two master darks for each filter and exposure time

We then aligned our science images to combine them as our final images.

# Final Combined Images

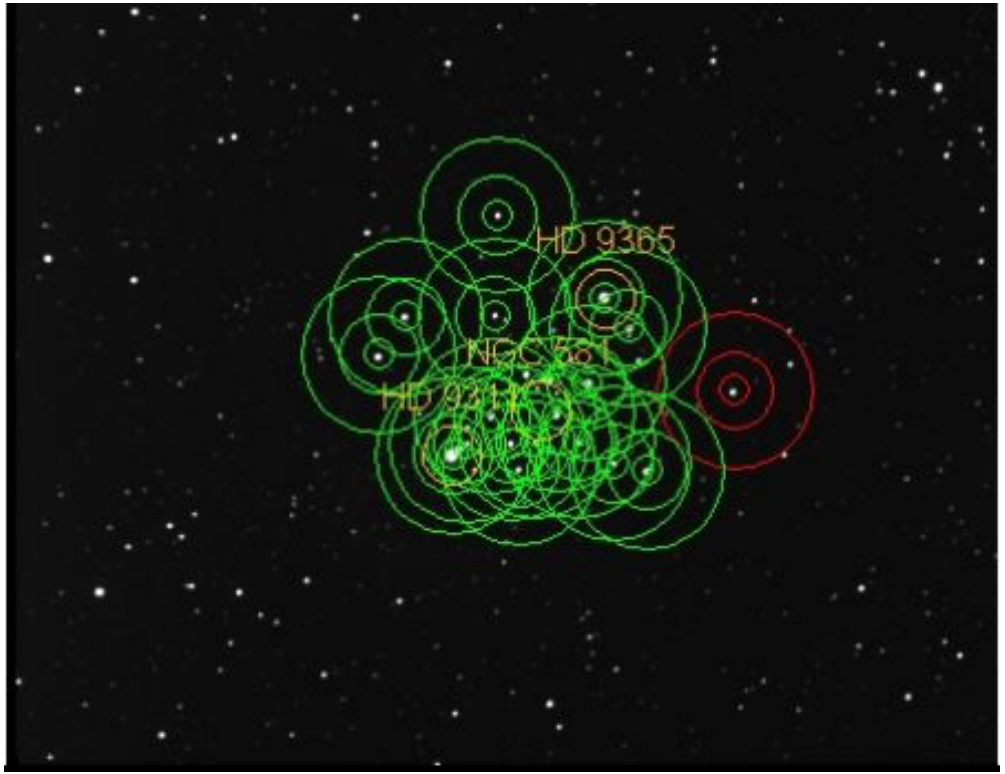



Visible FIlter




Blue FIlter

# AstroImageJ-Aperture



# Choosing a Guide Star

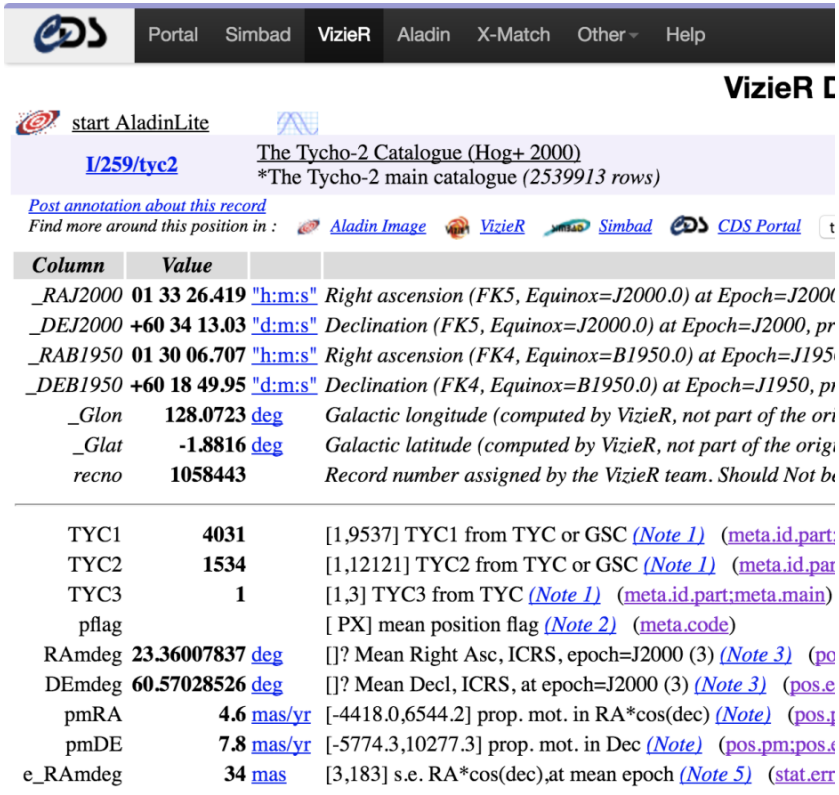
A star well catalogued using VizieR

Needed to know

magnitude in both B and V filter

RA and Dec

Corresponds to star aperture we took




"VizieR." *VizieR*. N.p., n.d. Web. 04 Dec. 2016. <http://vizier.u-strasbg.fr/viz-bin/VizieR-5?-ref=VIZ583f7992090b&-out.add=.&-source=I%2F259%2Ftyc2&recno=1058443>.

# Reference Star

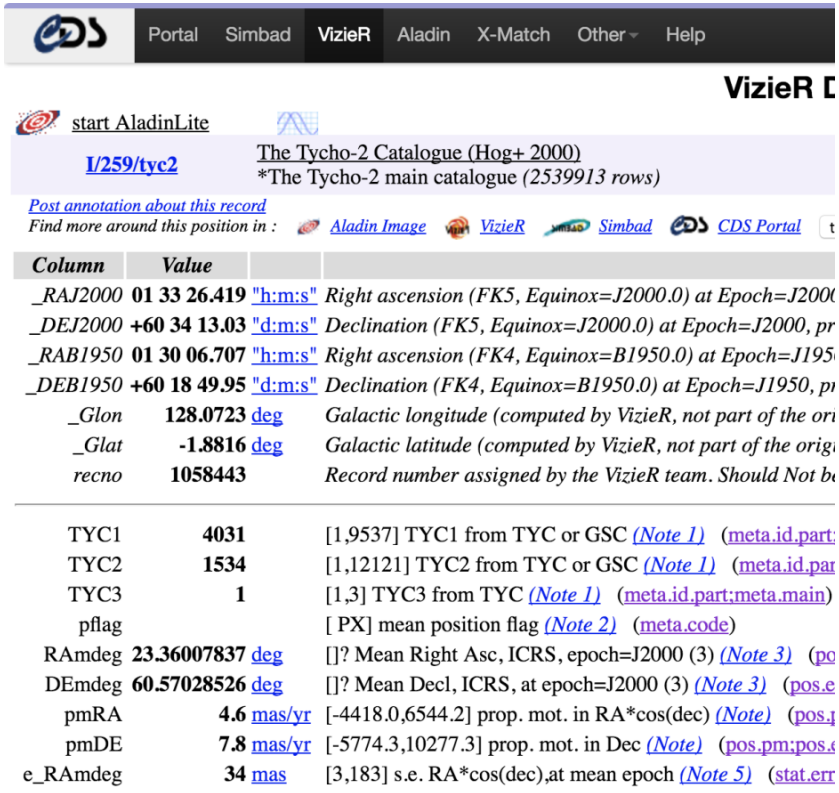
Name: TYC1 4031

RA: 01 33 26.419

Dec: +60 34 13.03

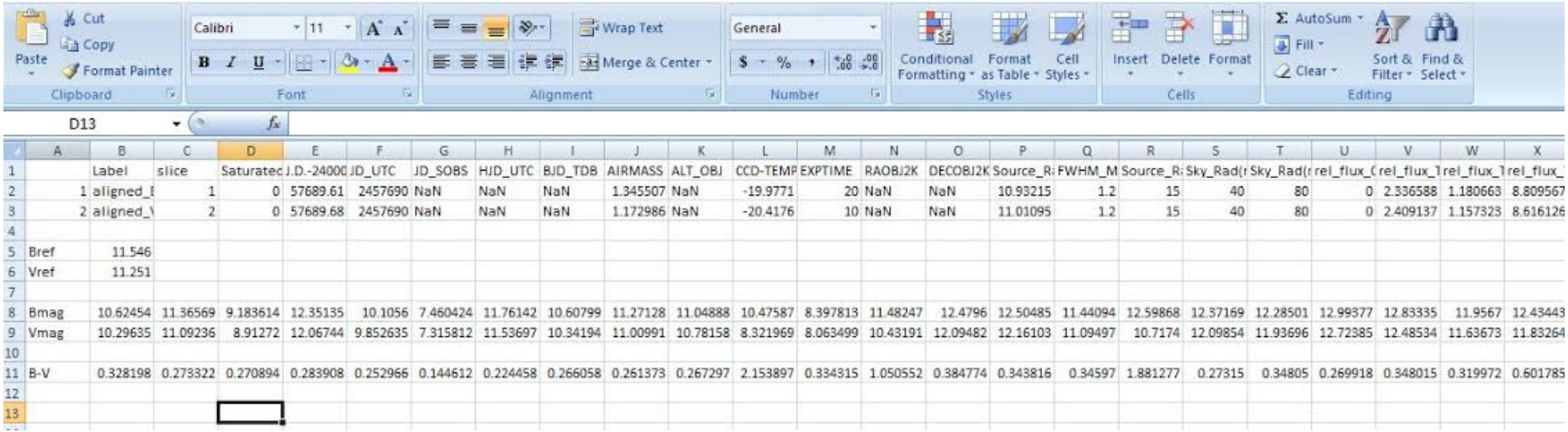
B-mag: 11.546

V-mag :11.251




"VizieR." *VizieR*. N.p., n.d. Web. 04 Dec. 2016. <http://vizier.u-strasbg.fr/viz-bin/VizieR-5?-ref=VIZ583f7992090b&-out.add=.&-source=I%2F259%2Ftyc2&recno=1058443>.

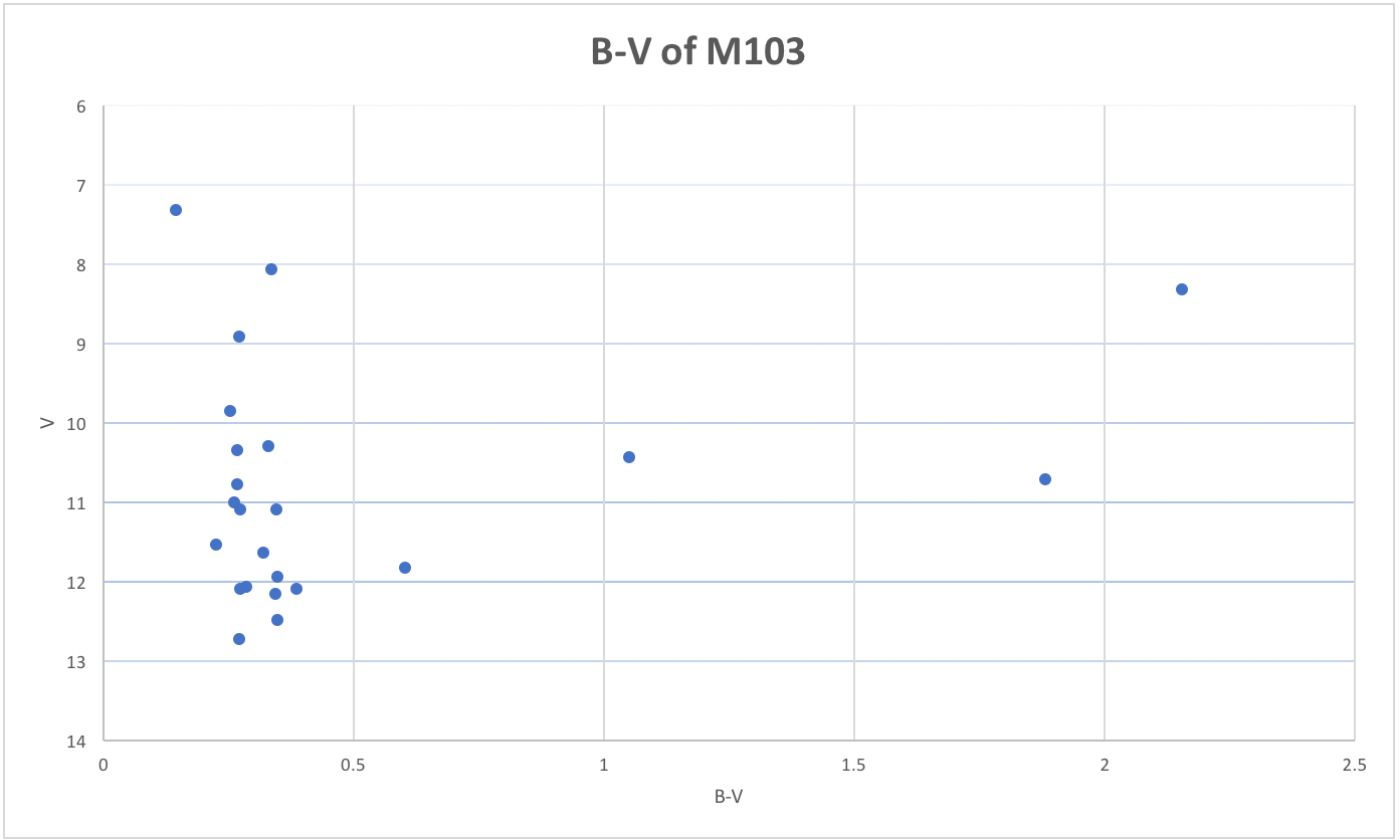
# Calculation of data



| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | Label | slice | Saturated | J.D.-24000 | JD_UTC | JD_SOBS | HJD_UTC | BJD_TDB | AIRMASS | ALT_OBJ | CCD-TEMP | EXPTIME | RAOBJ2K | DECOBJ2K | Source_R | FWHM_M | Source_R | Sky_Rad(r | Sky_Rad(r | rel_flux_( | rel_flux_1 | rel_flux_1 | rel_flux_ |
| 2 | 1 | aligned_I | 1 | 0 | 57689.61 | 2457690 | NaN | NaN | NaN | 1.345507 | NaN | -19.9771 | 20 | NaN | NaN | 10.93215 | 1.2 | 15 | 40 | 80 | 0 | 2.336588 | 1.180663 | 8.809567 |
| 3 | 2 | aligned_V | 2 | 0 | 57689.68 | 2457690 | NaN | NaN | NaN | 1.172986 | NaN | -20.4176 | 10 | NaN | NaN | 11.01095 | 1.2 | 15 | 40 | 80 | 0 | 2.409137 | 1.157323 | 8.616126 |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Bref | 11.546 | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Vref | 11.251 | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Bmag | 10.62454 | 11.36569 | 9.183614 | 12.35135 | 10.1056 | 7.460424 | 11.76142 | 10.60799 | 11.27128 | 11.04888 | 10.47587 | 8.397813 | 11.48247 | 12.4796 | 12.50485 | 11.44094 | 12.59868 | 12.37169 | 12.28501 | 12.99377 | 12.83335 | 11.9567 | 12.43443 |
| 9 | Vmag | 10.29635 | 11.09236 | 8.91272 | 12.06744 | 9.852635 | 7.315812 | 11.53697 | 10.34194 | 11.00991 | 10.78158 | 8.321969 | 8.063499 | 10.43191 | 12.09482 | 12.16103 | 11.09497 | 10.7174 | 12.09854 | 11.93696 | 12.72385 | 12.48534 | 11.63673 | 11.83264 |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | B-V | 0.328198 | 0.273322 | 0.270894 | 0.283908 | 0.252966 | 0.144612 | 0.224458 | 0.266058 | 0.261373 | 0.267297 | 2.153897 | 0.334315 | 1.050552 | 0.384774 | 0.343816 | 0.34597 | 1.881277 | 0.27315 | 0.34805 | 0.269918 | 0.348015 | 0.319972 | 0.601785 |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | | | | | | |

$m_2=-2.5\log(F_2/F_1)+m_1$

# B-V Diagram



# Advice For Future Students

Pay attention to CCD Soft and AstroImageJ labs

Bring Finder Charts

Bring bug spray (zika)

Be patient

Be warm

Bring entertainment

- Use red cellophane on devices
- Twilight app for phones

Read user guide for AstroImageJ before starting

Photos.com

# Conclusion

Overall our project was a great learning experience to get our foot in the door for real astronomy.

Learned to

- Run a computer linked telescope
- Rotate the dome
- Take calibration images
- How to use The Sky, CCD Soft, and AstroImageJ
- Reduce images
- Multi-aperture photometry
- Using a catelouge
- Basics of B-V diagrams