Camera/Telescope Details

Aperture: $D = 10$ inches $= 254$ mm

Wavelength: $\lambda \approx 5080$ Angstroms $= 508$ nm $= 0.508$ microns $= 0.000508$ mm

FWHM $= 1.22\frac{\lambda}{D} = 1.22\frac{0.000508}{254} = 0.00000244$ radians $= 0.503$ arcseconds

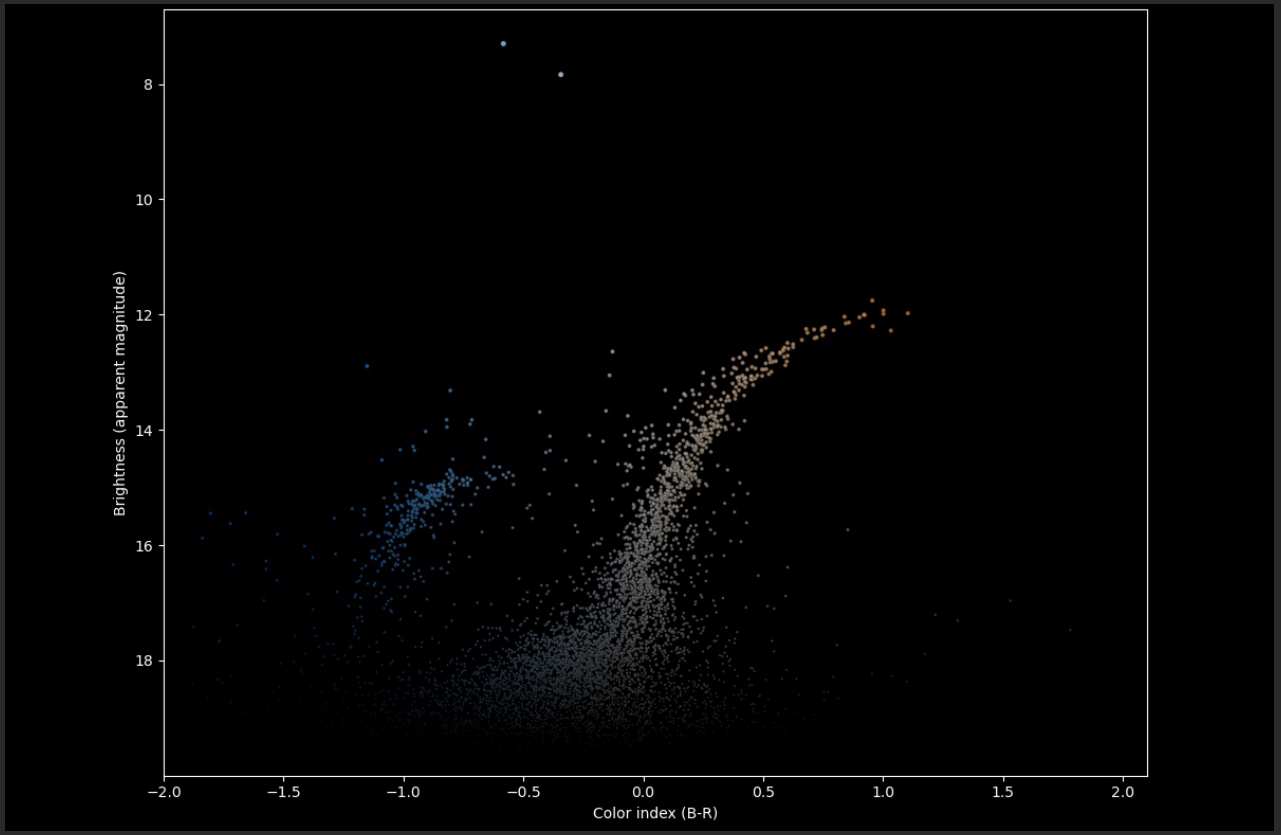
Focal Length: $f = 90$ inches $= 2286$ mm

FWHM in microns $= 0.00000244$ radians $\times$ 2286 mm $\times$ 1000microns/mm $=$ 5.58 microns

Pixel Size: 6.4 microns/pixel

FWHM in pixels: $5.58/6.4 = 0.87$ pixels

Measuring Distances: RR-Lyrae and M13



Assuming that the distance to RR-Lyrae is known, we can overlay an image of RR-Lyrae on an image of M13 to estimate the distance to the cluster.

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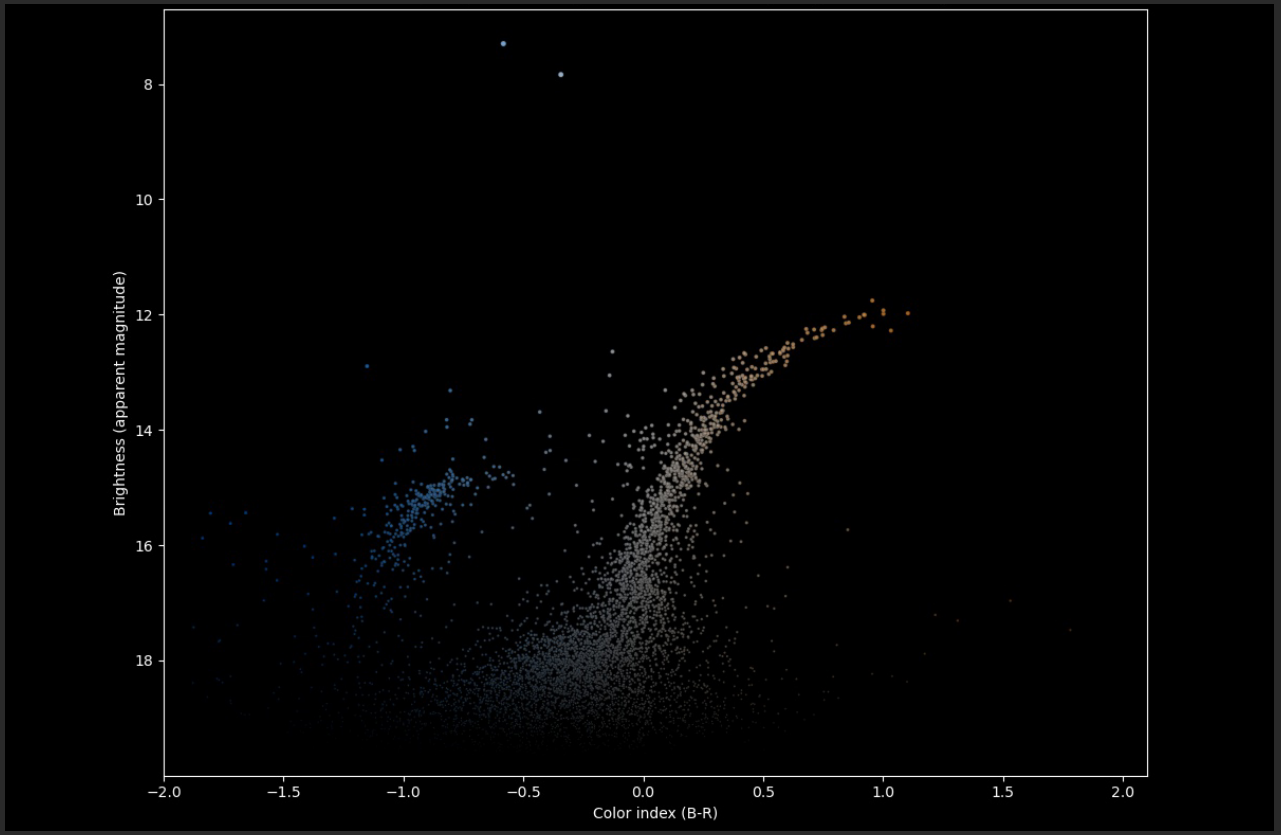

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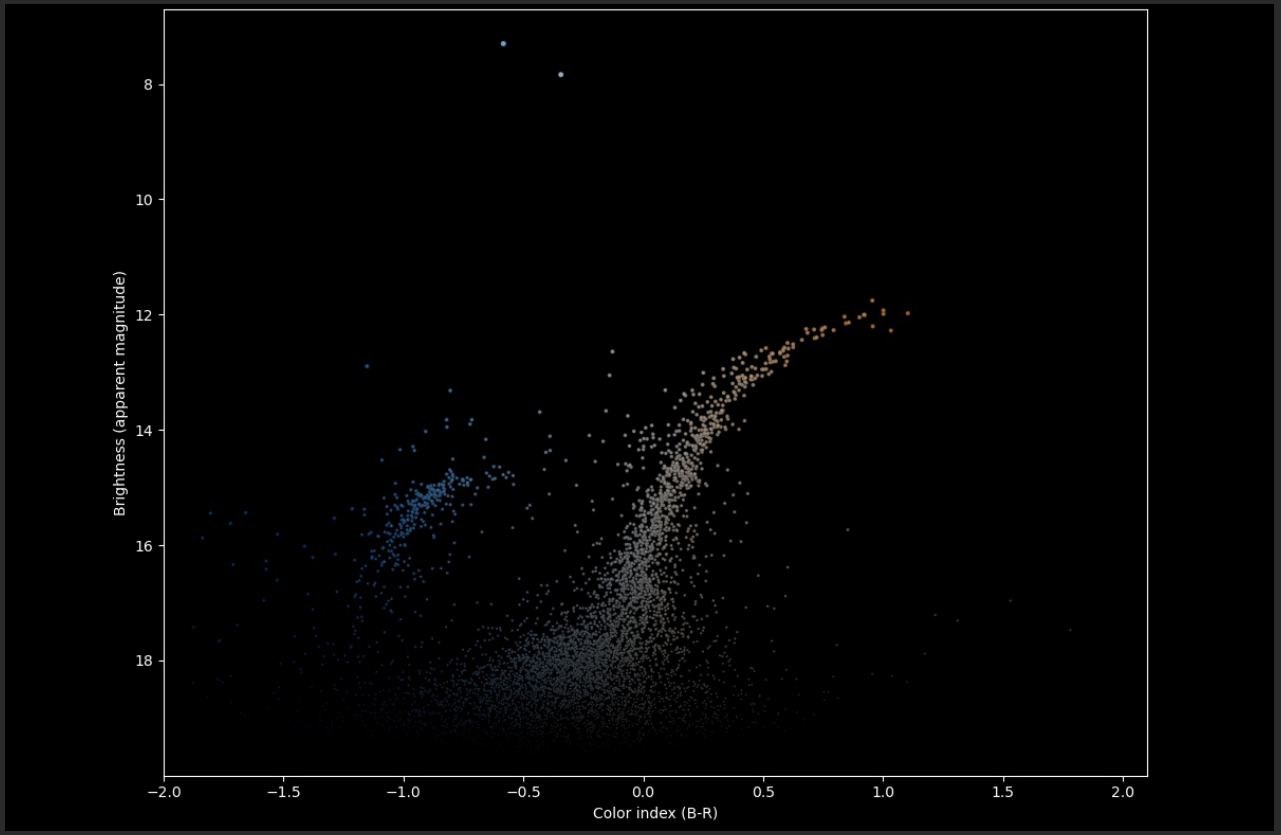

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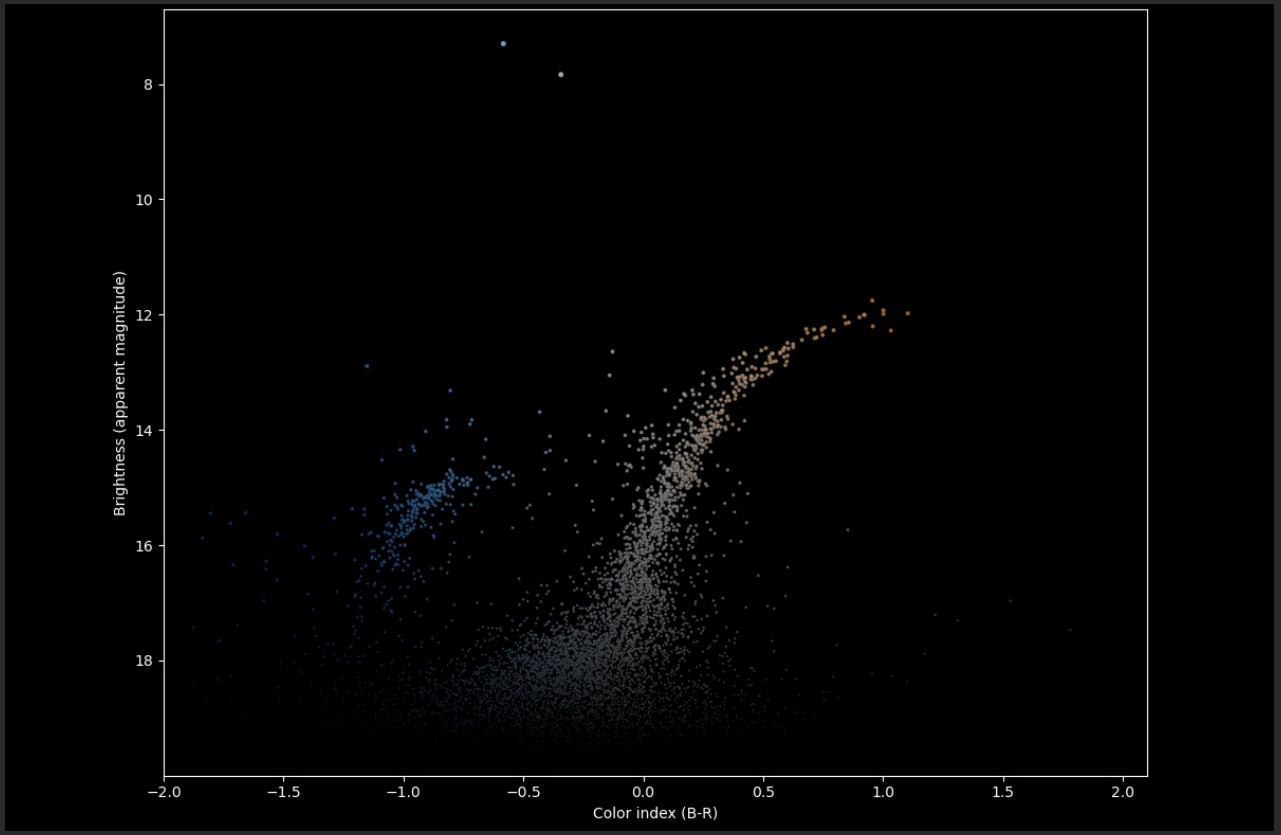

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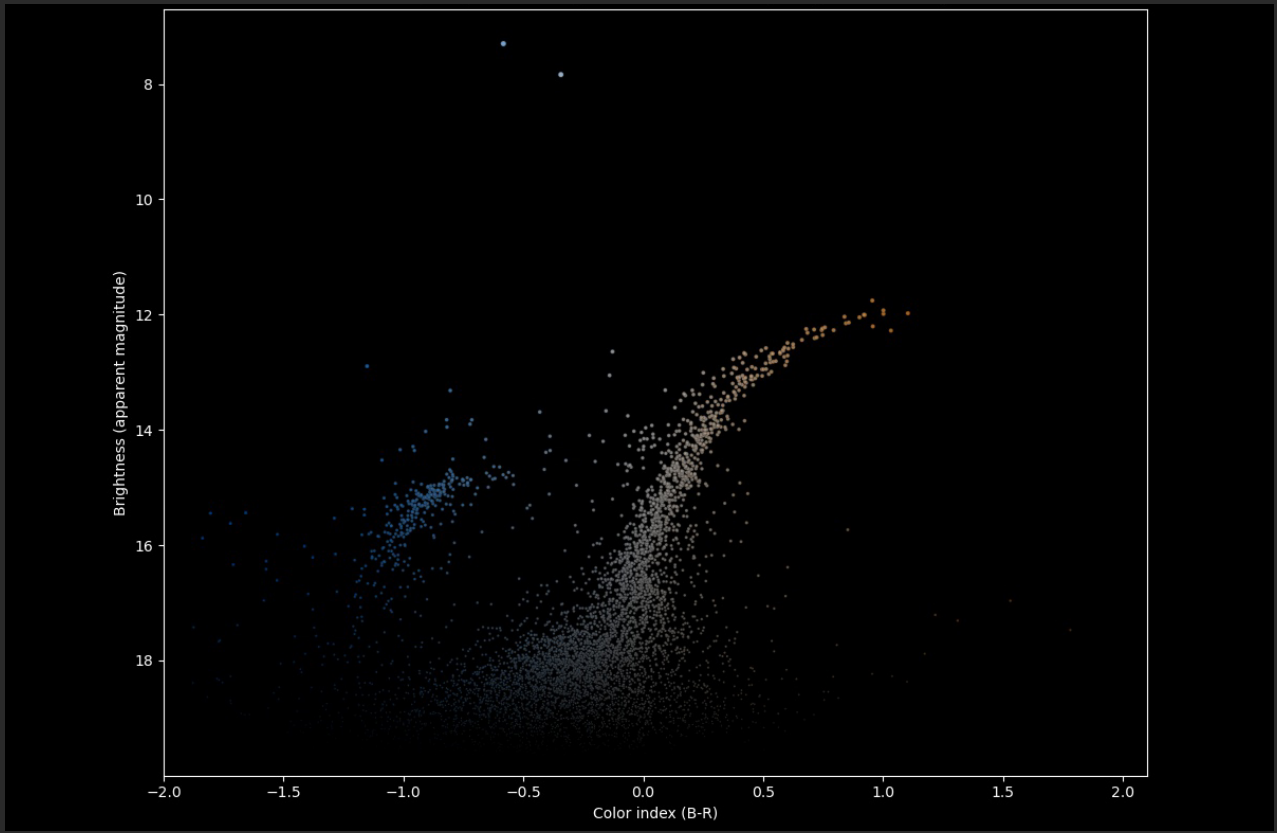

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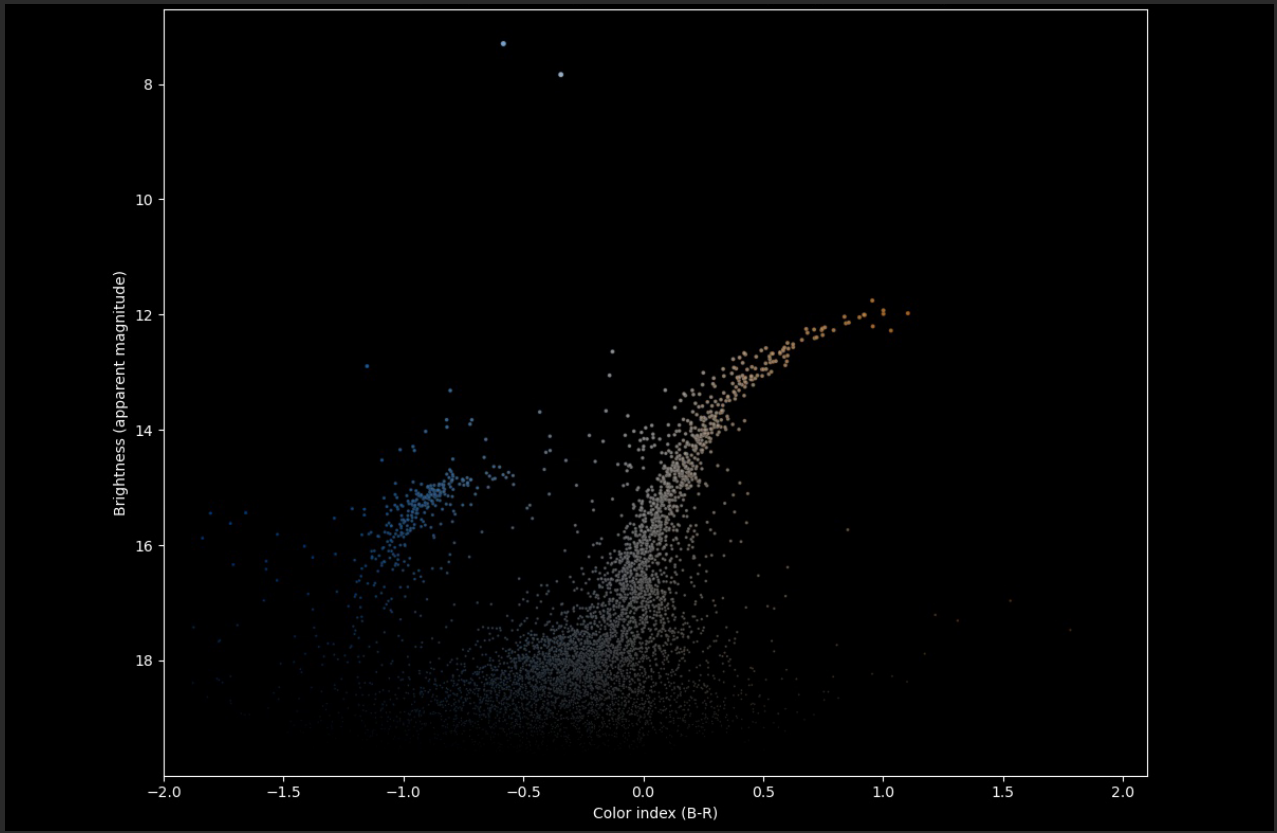

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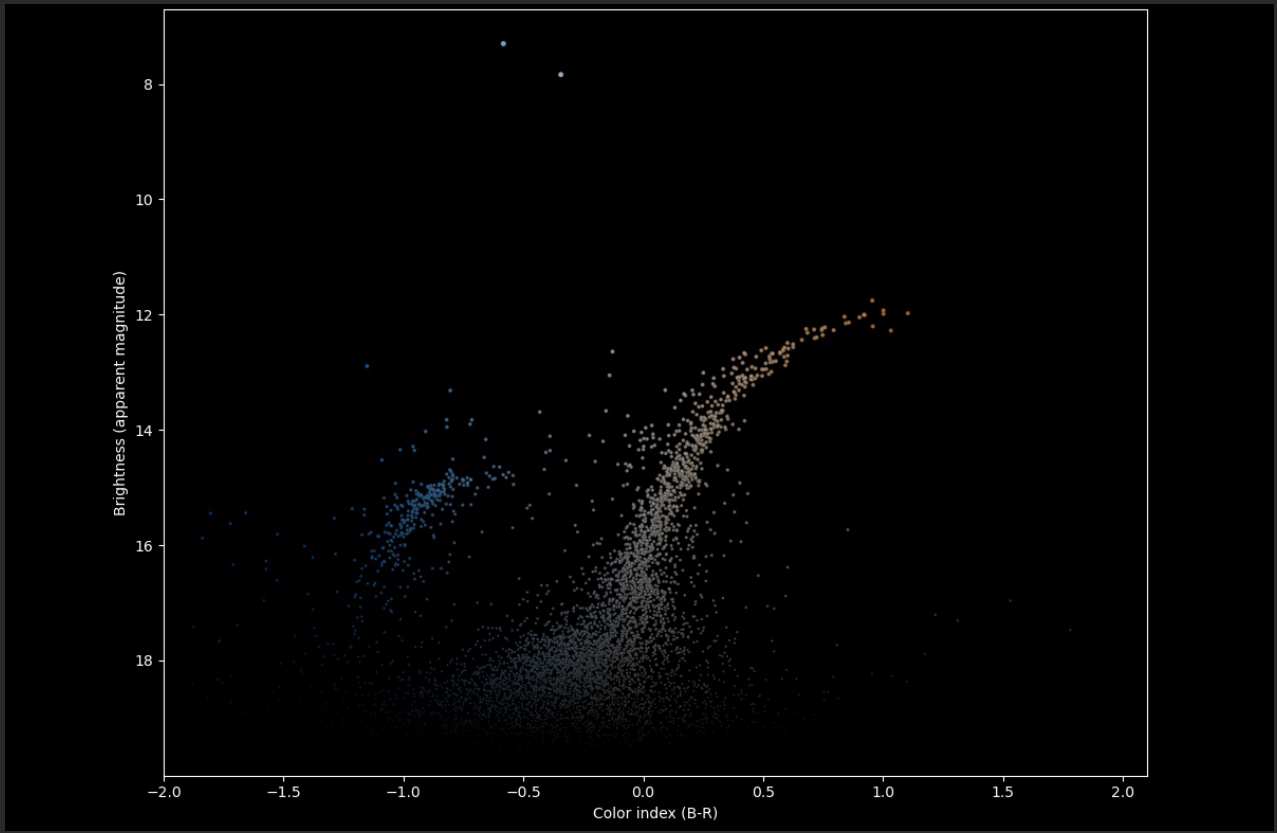

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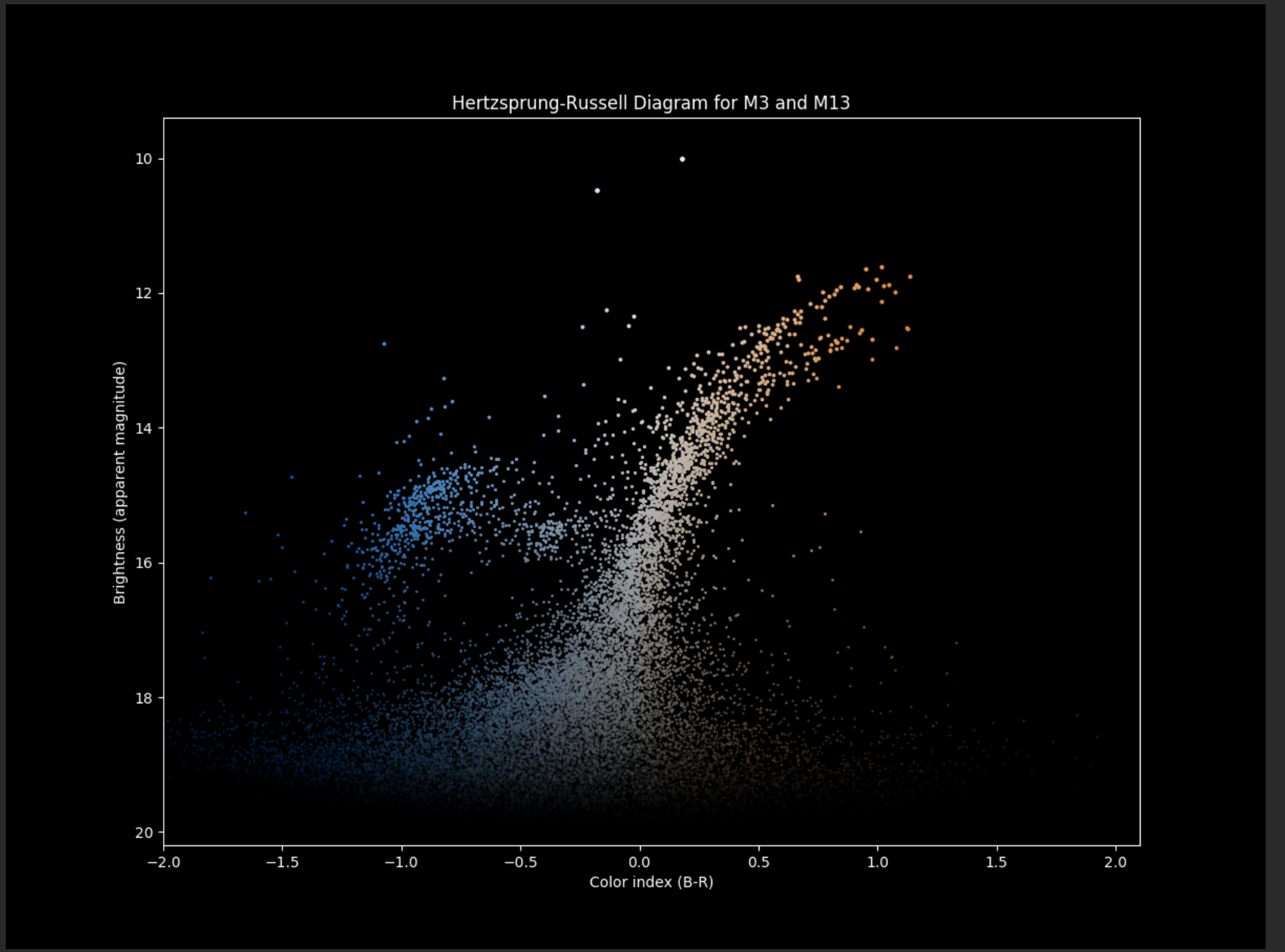
M3/M13 Comparison: Here's M3

M3/M13 Comparison: Here's M13

M3/M13 Comparison



M3/M13 Comparison

Click here to download the Python code.

The fits files can be accessed here:
https://vanderbei.princeton.edu/FRS_131/python/fits_files/m3-RGB.fit
https://vanderbei.princeton.edu/FRS_131/python/fits_files/m13-RGB.fit

Here's the output from Python:

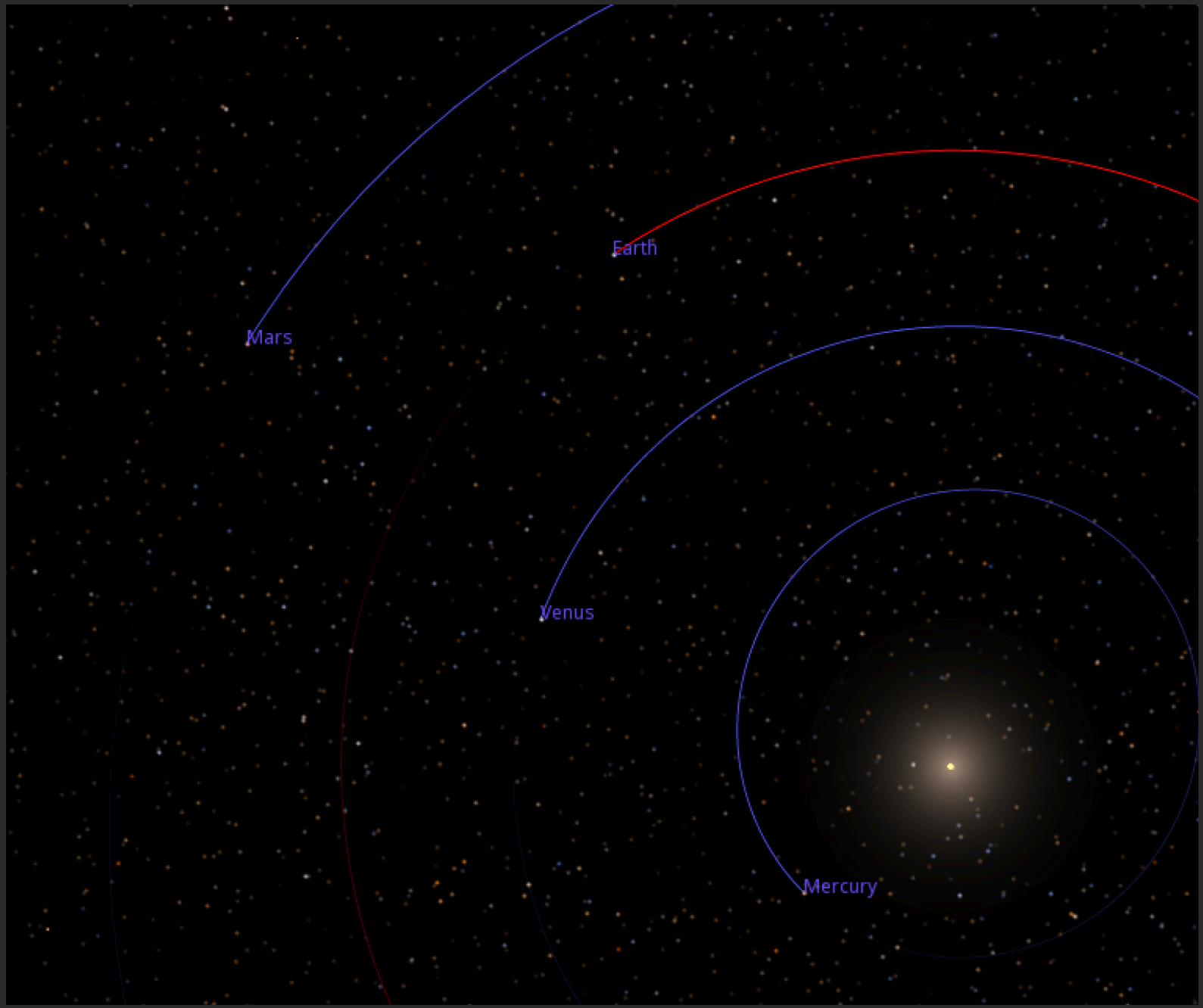
```
difference in brightness is about 0.7 magnitude
difference in flux = 10^(0.7/2.5) =  1.90546071796
relative distance factor = sqrt(flux) =  1.3803842646
```

From Wikipedia, we see that the true distances are:

```
M3 = 10.4 kpc and M13 = 6.8 kpc
true distance ratio = 10.4/6.8 =  1.52941176471
```

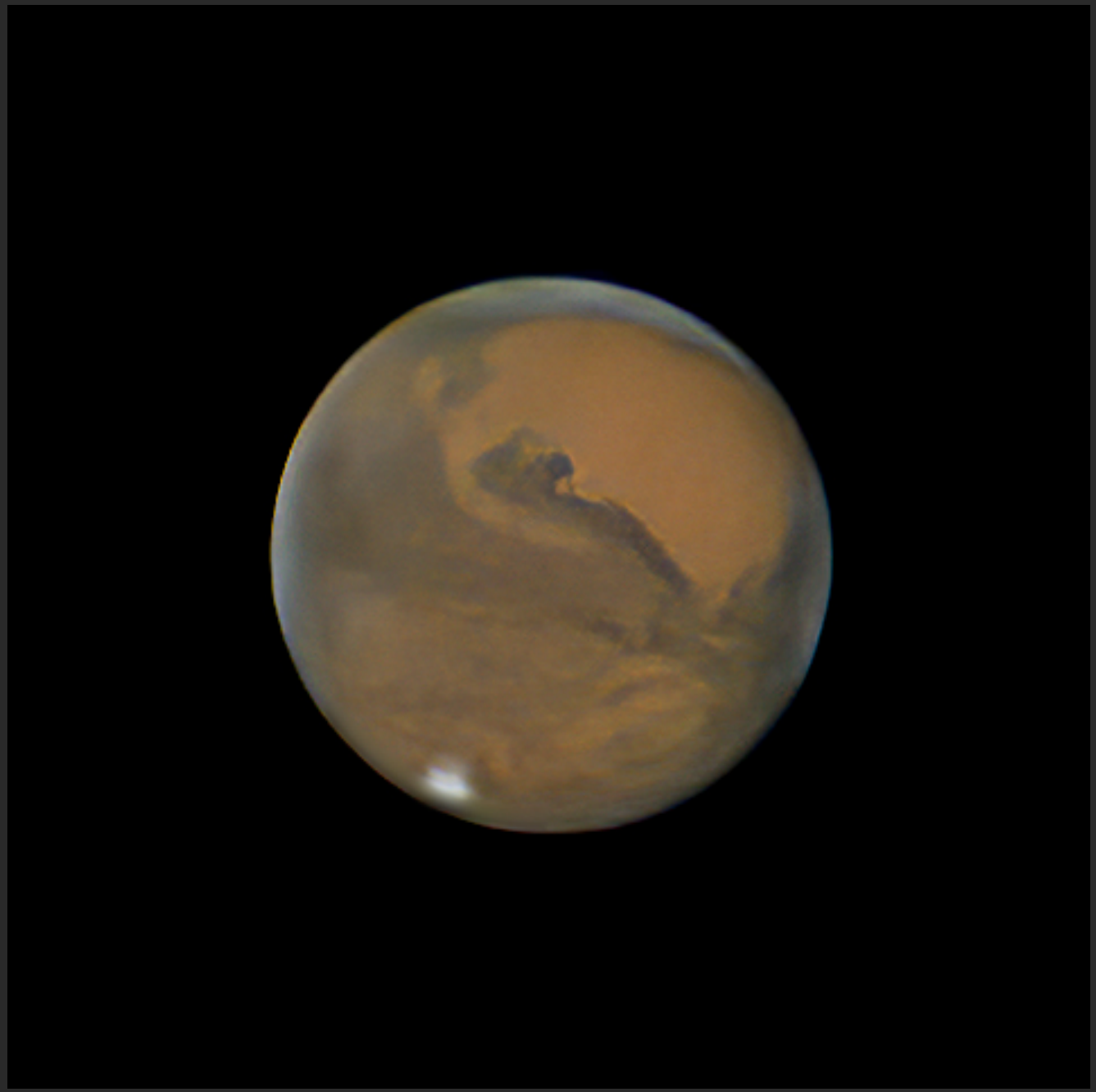
A Brief Step Back Toward Home

Earth "Passed" Mars in Oct. 2020



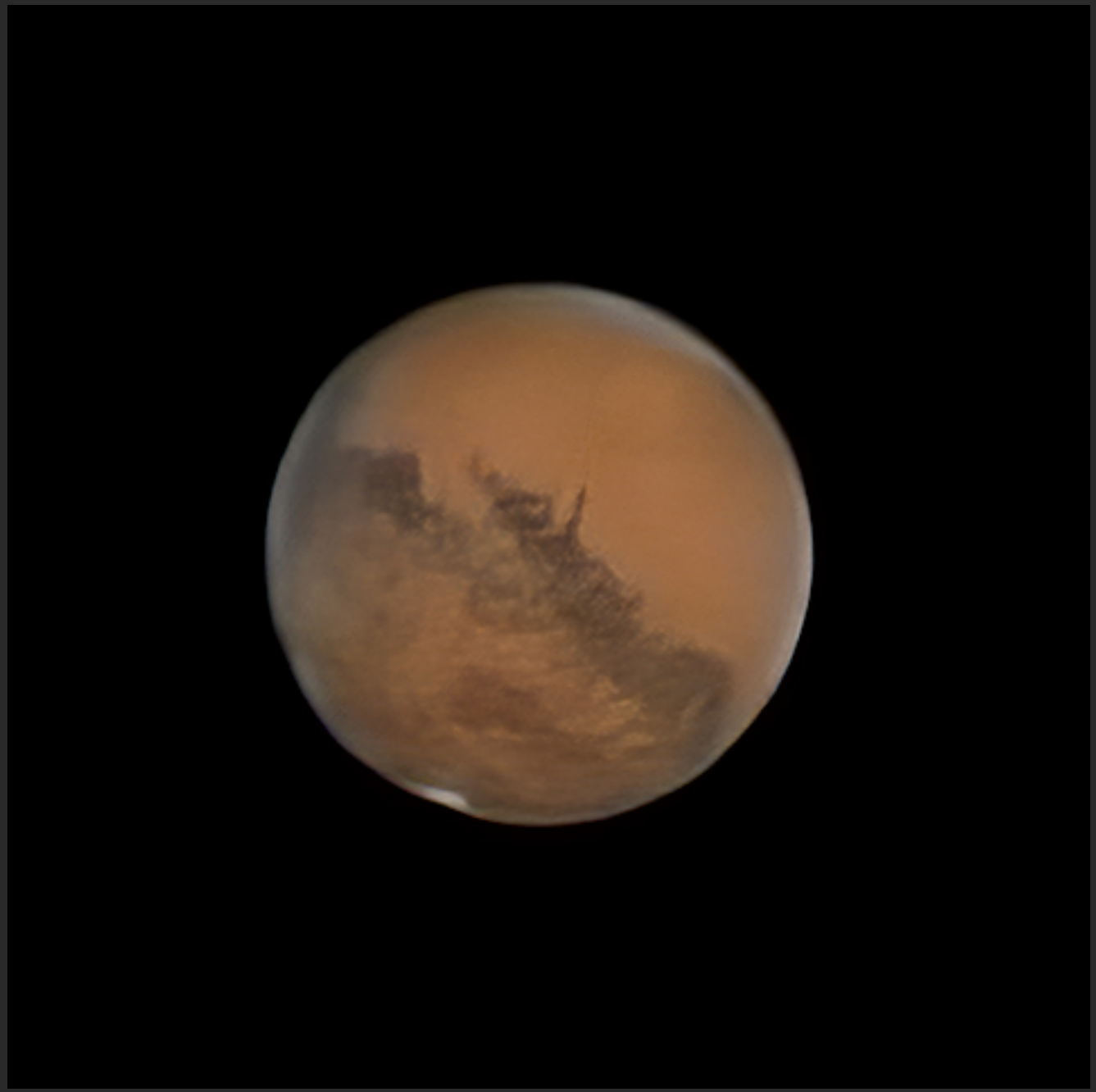
Mars

Oct. 6, 2020



Mars

Oct. 18, 2020



Questions?

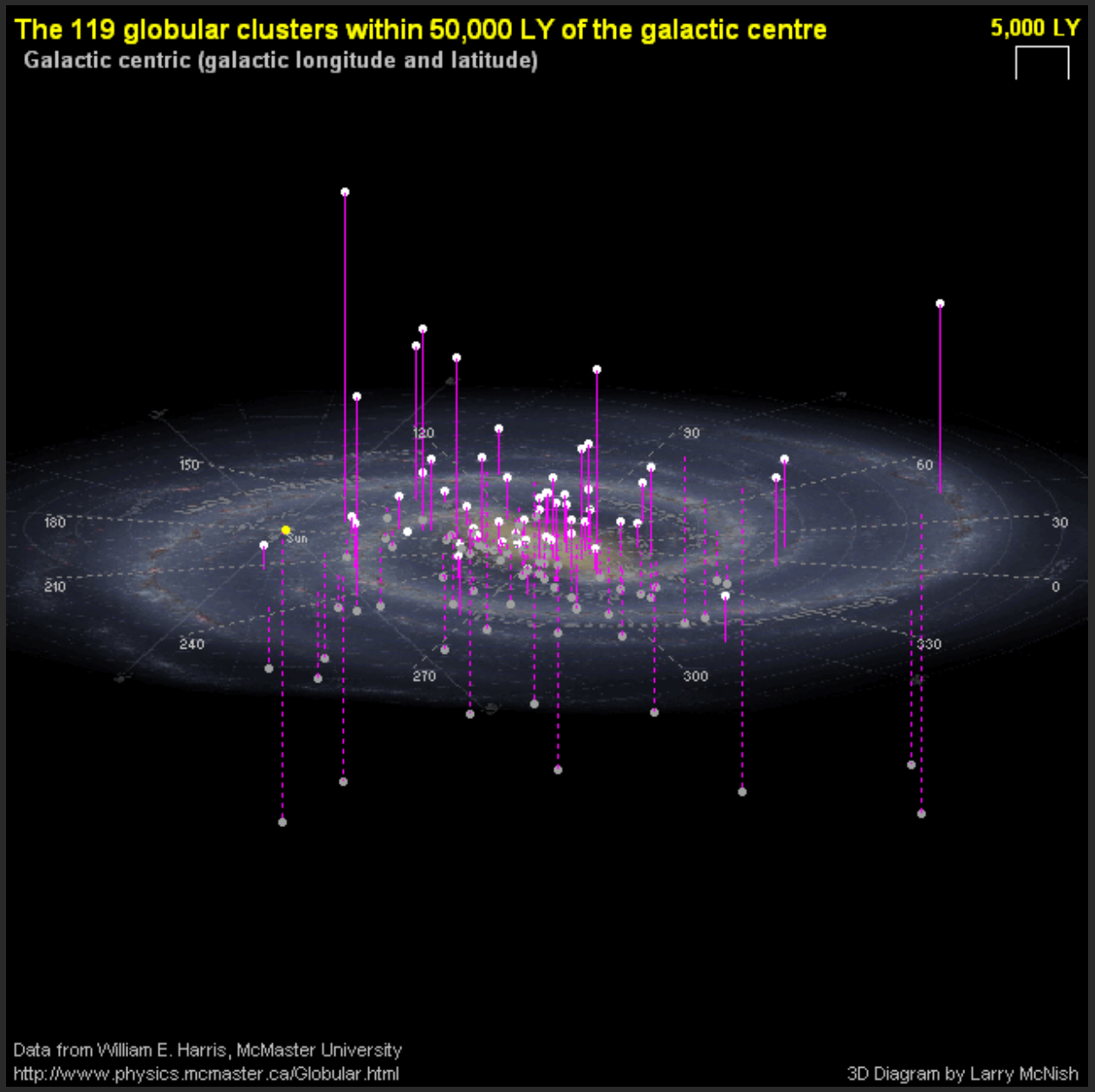
Moving Further Out

Robert J. Vanderbei

2023

Freshman Seminar 131

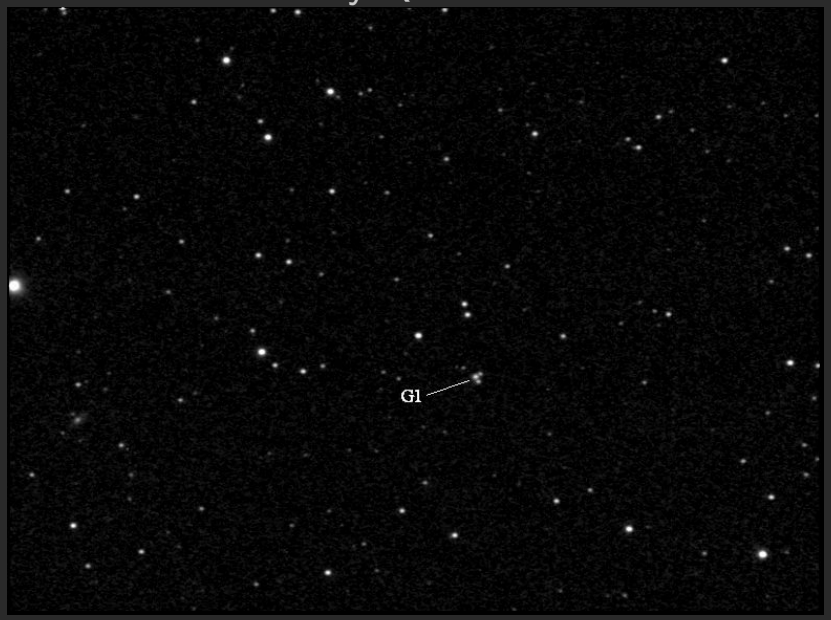
http://vanderbei.princeton.edu/


The 119 globular clusters within 50,000 LY of the galactic centre
Galactic centric (galactic longitude and latitude)
5,000 LY
120
90
60
150
180
30
Sun
210
0
240
330
270
300
Data from William E. Harris, McMaster University
http://www.physics.mcmaster.ca/Globular.html
3D Diagram by Larry McNish

M31 – A Nearby Galaxy

Mayall-II – A Globular Cluster Near M31

My Questar



Hubble Space Telescope

Some More Slides...

Stars Have Various Colors

Here's a pair of binary stars...

Albireo...

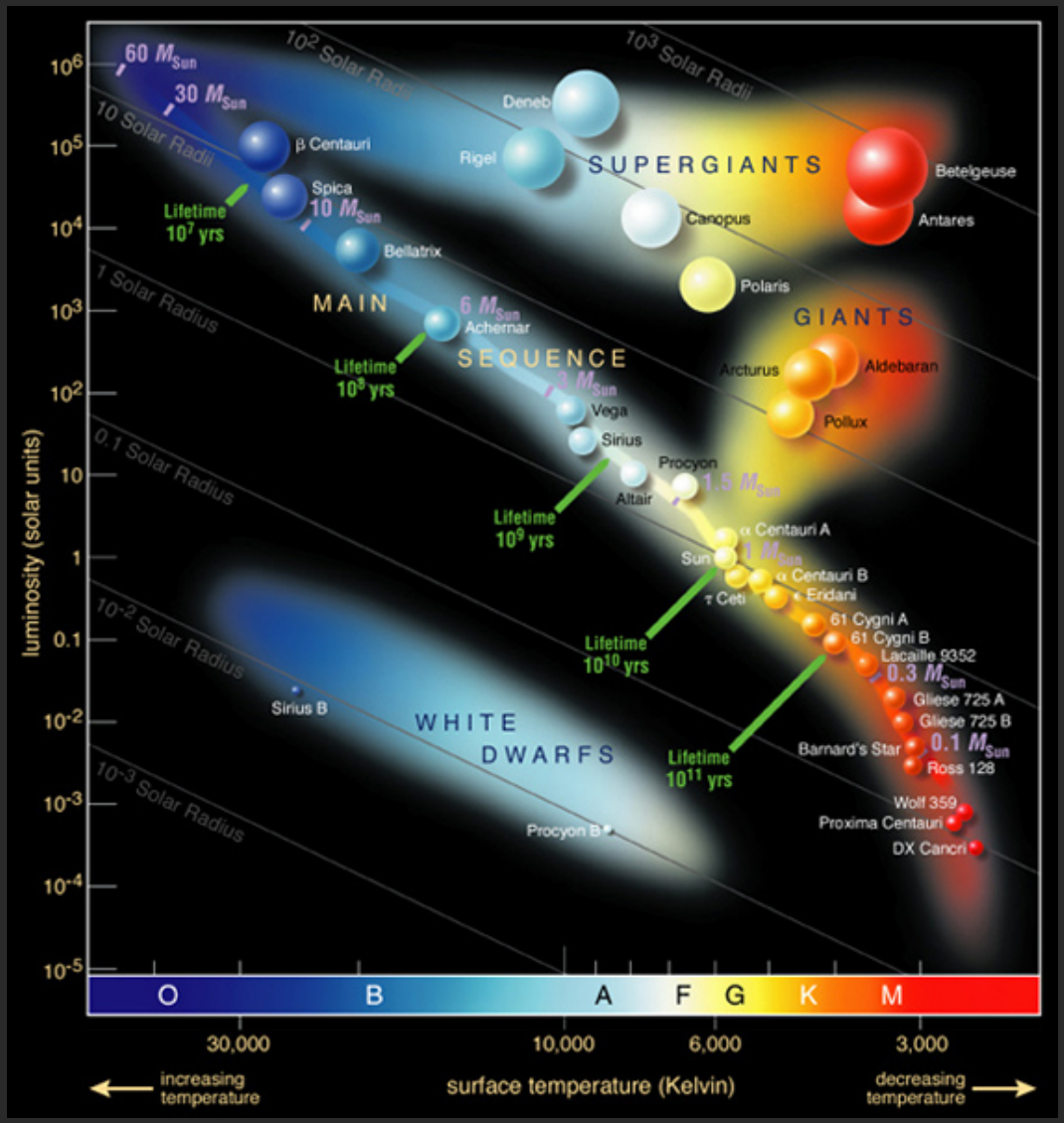
ϵ-Bootes...

The Coathanger asterism...

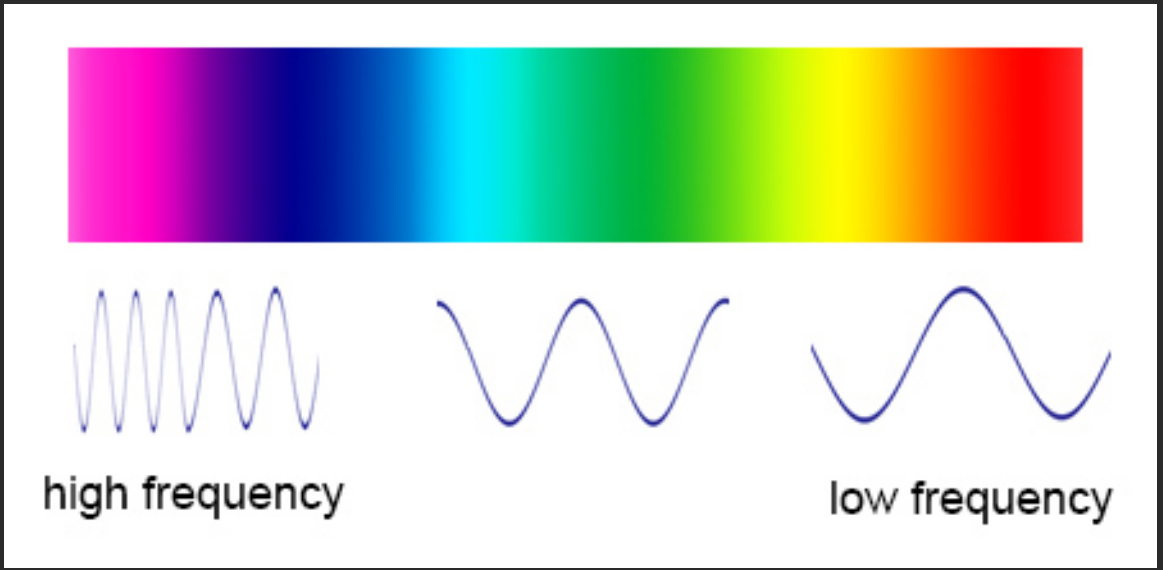
Open Cluster NGC 7789...

Globular Cluster M13...

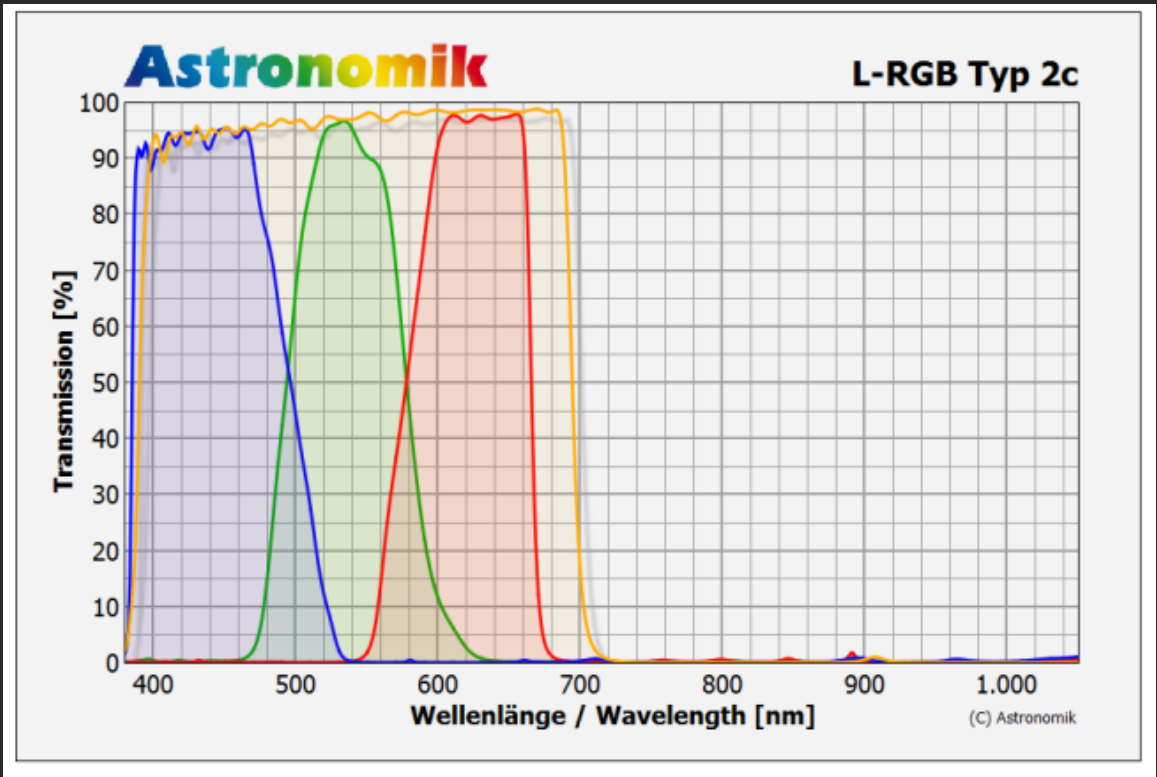
Hertzsprung-Russell Diagrams



Red Orange Yellow Green Blue Indigo Violet



LRGB


Astronomik
L-RGB Typ 2c
Transmission [%]
100
90
80
70
60
50
40
30
20
10
0
400
500
600
700
800
900
1.000
Wellenlänge / Wavelength [nm]
(C) Astronomik