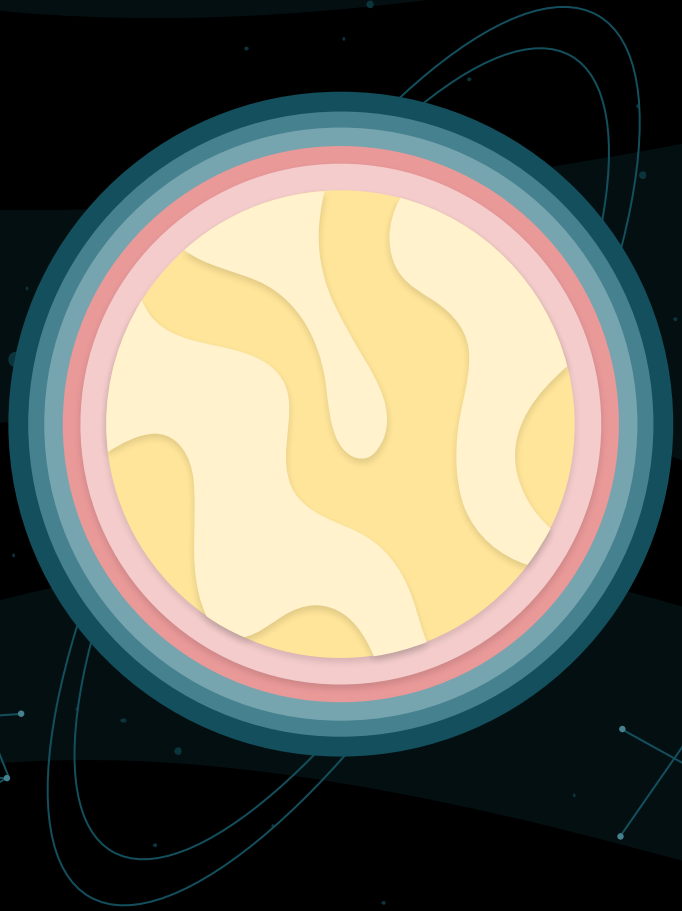
Main Sequence Fitting



Paul McSlarrow, Brandon Rodriguez,
Zachary Hauck, & Teddy Brewer

TABLE OF CONTENTS

01 TOPIC

What is our topic & why are we interested in this topic?

02 DATA

Where did we get & how did we prepare our data?

03 ANALYSIS PROCESS

How we analyzed our data

04 CONCLUSIONS

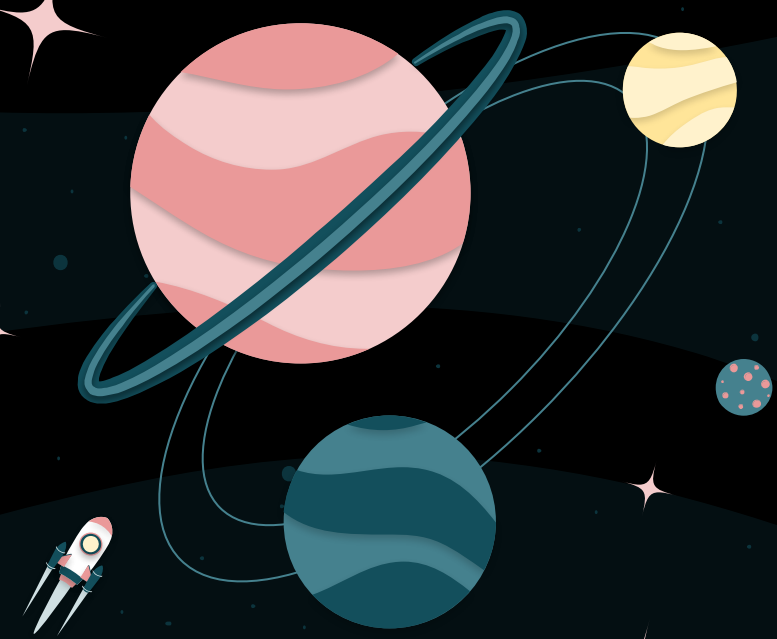
What did we conclude from our analysis

05 HURDLES

What problems did we encounter and how would we do the problem differently

01

TOPIC



A CLOSER LOOK

MS - Fitting

Determining distance to stellar clusters using Main Sequence Fitting

HR Diagram

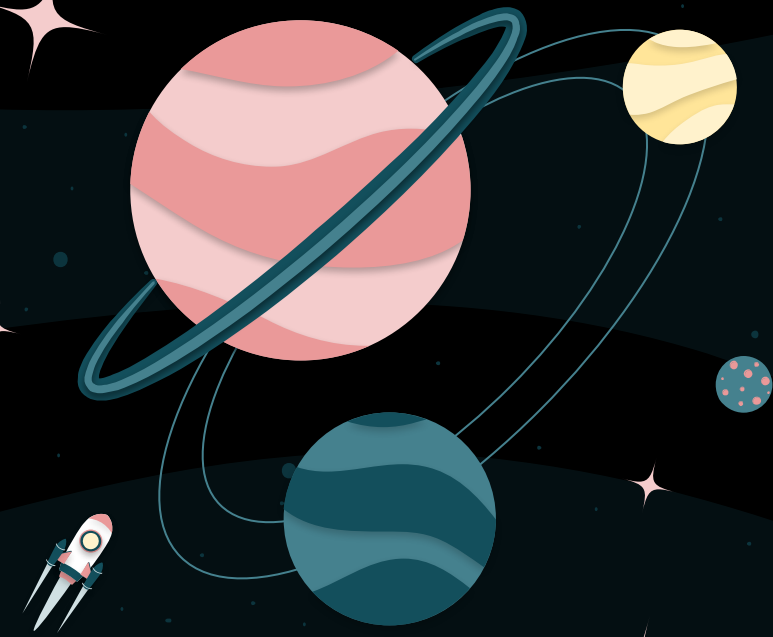
Analyzing the distribution of stars in an HR diagram

Comparison

Comparing observed data from the cluster with theoretical models and adjusting distances until the main sequence aligns with known models

02

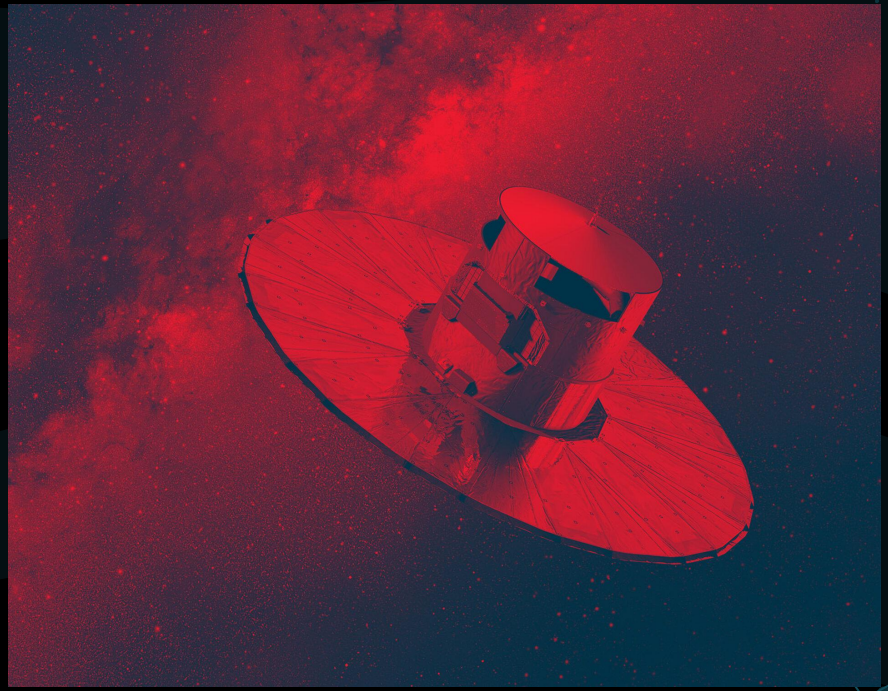
DATA



WHERE WE GOT OUR DATA

GAIA ARCHIVES

- Map of the Milky Way
- Variety of parameters to choose from
- Easy to find clusters

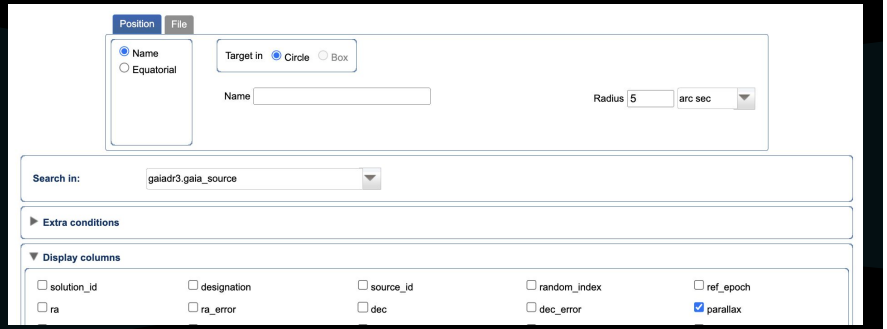


ABOUT MESSIER OBJECTS

Catalogued by the French astronomer Charles Messier

- Almost all Messier objects among the closest to Earth in their respective classes
- Consists of a diverse range of astronomical objects
    - Star clusters, nebulae, galaxies, etc.

DATA CLEANING/PREP



Using Gaia Archives

- Easy to remove or select desired columns
- Include specific conditions

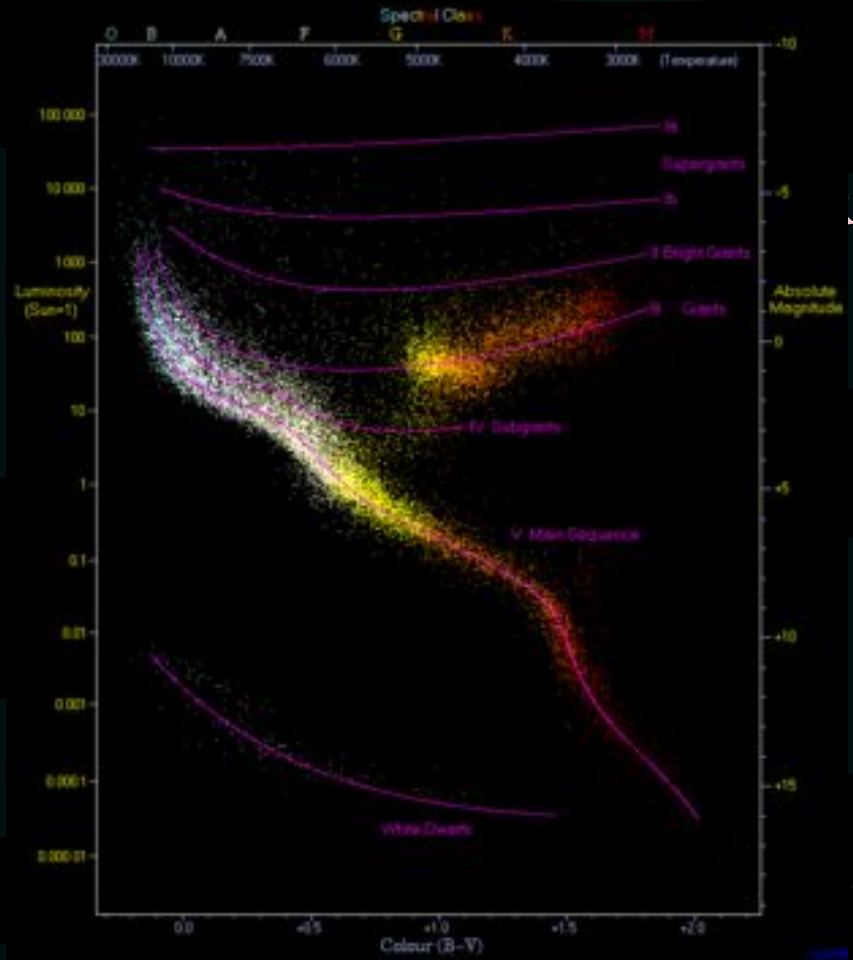
No data cleaning needed

- [x] parallax
- [ ] pmra_error
- [ ] ra_pmra_corr
- [ ] parallax_pmra_corr
- [ ] astrometric_n_good_obs_al
- [ ] astrometric_excess_noise_sig
- [ ] pseudocolour_error
- [ ] pmdec_pseudocolour_corr
- [ ] new_matched_transits
- [ ] ipd_frac_odd_win
- [ ] scan_direction_strength_k4
- [ ] duplicated_source
- [ ] phot_g_mean_mag
- [x] phot_bp_mean_mag
- [x] phot_rp_mean_mag
- [x] phot_rp_n_blended_transits
- [ ] radial_velocity
- [ ] rv_visibility_periods_used
- [ ] rv_amplitude_robust
- [ ] vbroad
- [ ] grvs_mag_nb_transits
- [ ] ecl_lon
- [ ] has_xp_continuous
- [ ] has_mcmc_gspphot
- [ ] classprob_dsc_combmod_star
- [ ] logg_gspphot_lower
- [x] distance_gspphot
- [ ] azero_gspphot_upper

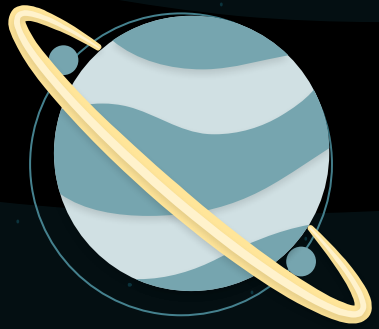
03

ANALYSIS PROCESS

The HR Diagram



Why utilize clusters?



How Can we utilize Main Sequence Fitting to accurately estimate the distance to a stellar cluster?

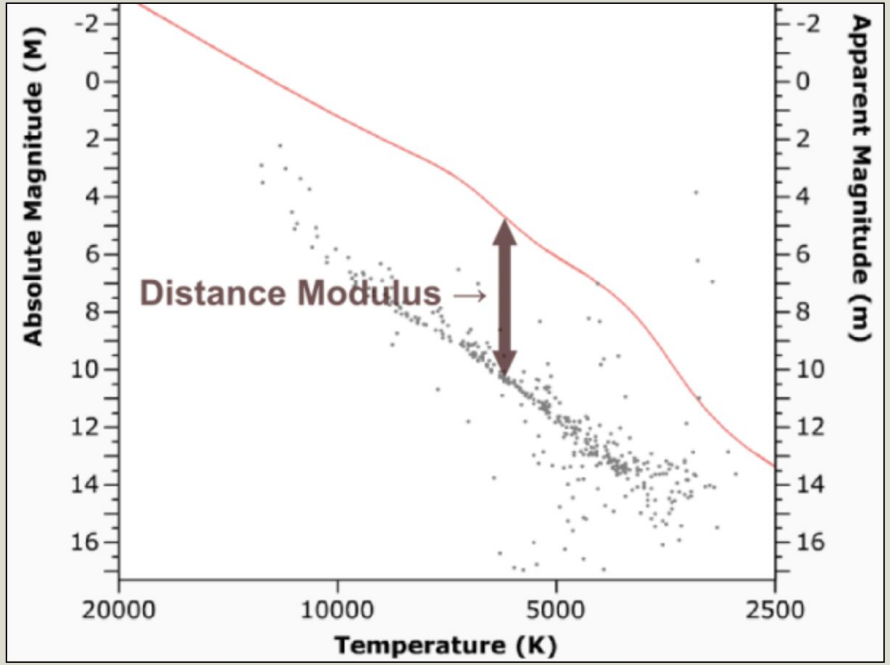
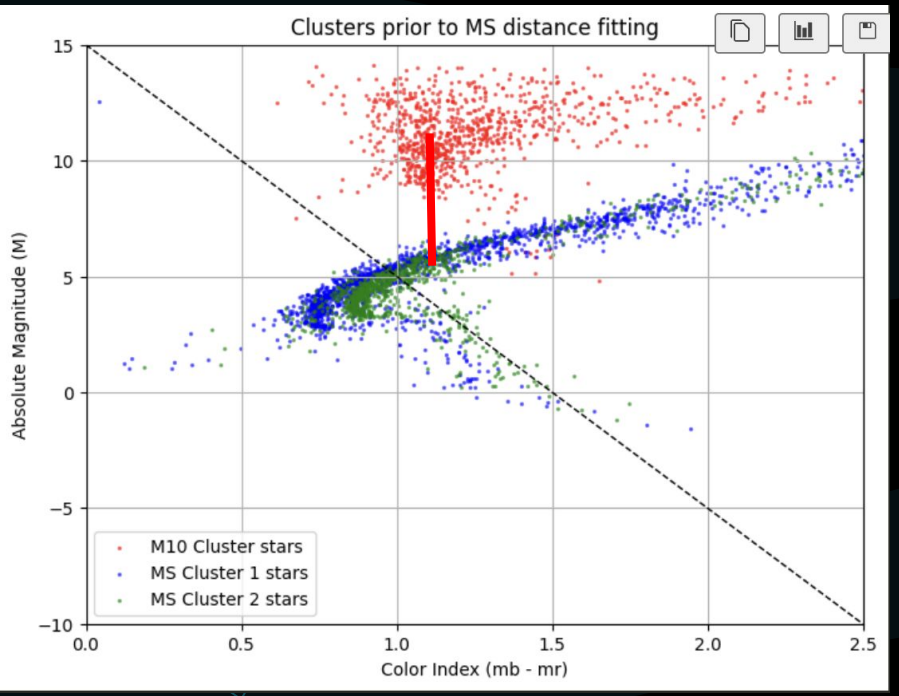
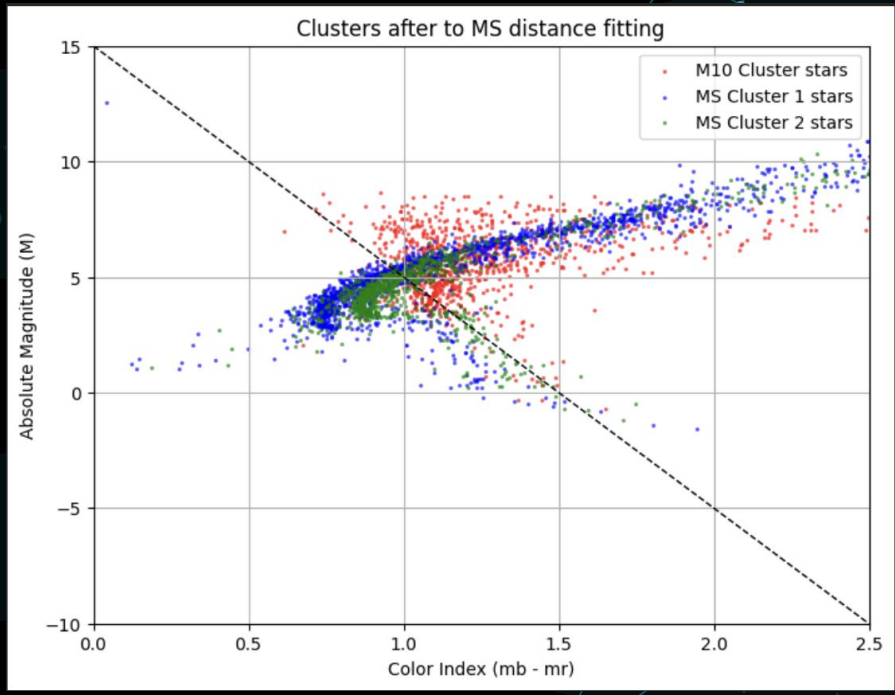


Figure 1: The difference between the apparent magnitude of the cluster and the absolute magnitude of the main sequeunce line is the distance modulus used in the main sequence fitting technique.

Any difference in position between the main sequences must be due to the distance of the cluster


Clusters prior to MS distance fitting
Absolute Magnitude (M)
Color Index (mb - mr)
M10 Cluster stars
MS Cluster 1 stars
MS Cluster 2 stars

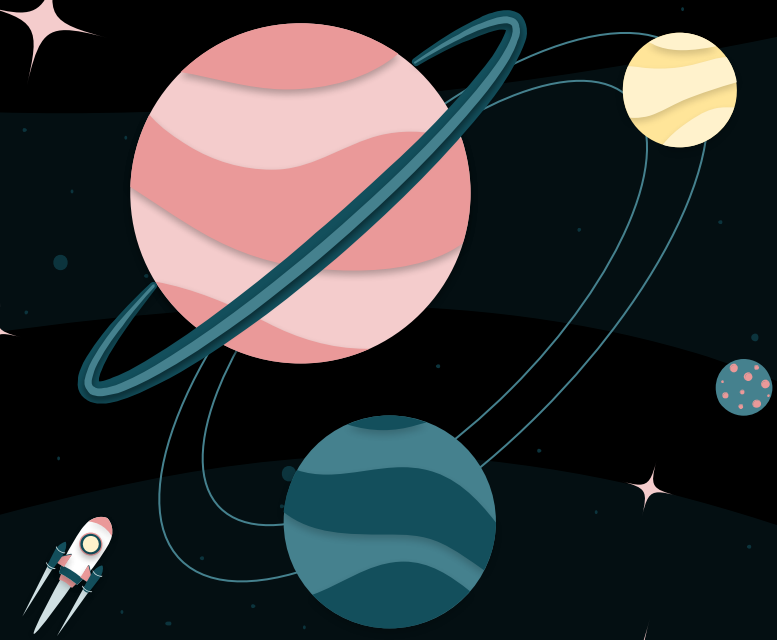

Clusters after to MS distance fitting
Absolute Magnitude (M)
Color Index (mb - mr)
M10 Cluster stars
MS Cluster 1 stars
MS Cluster 2 stars

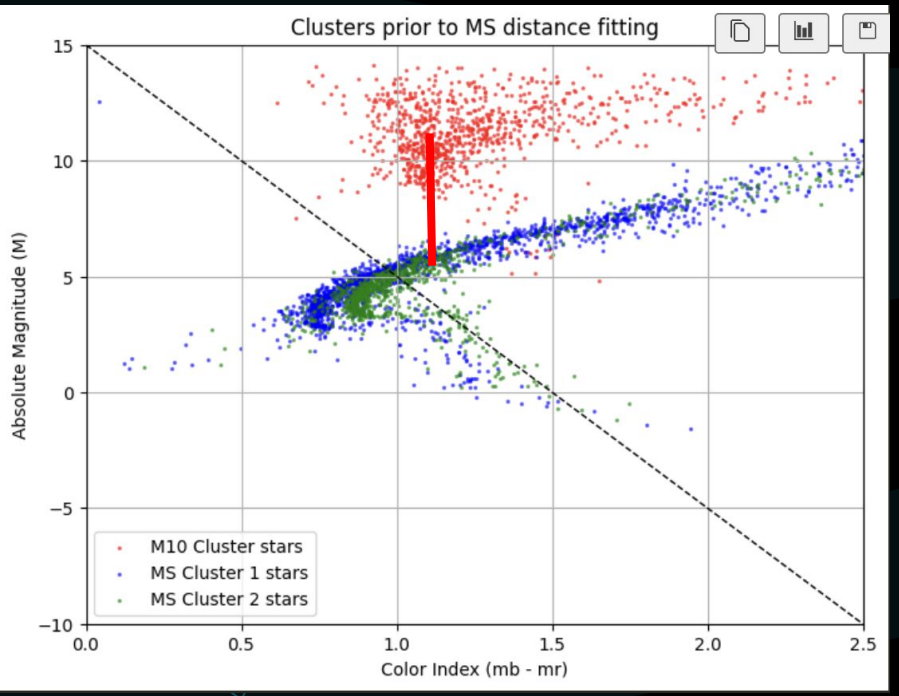
Problems with MS Fitting

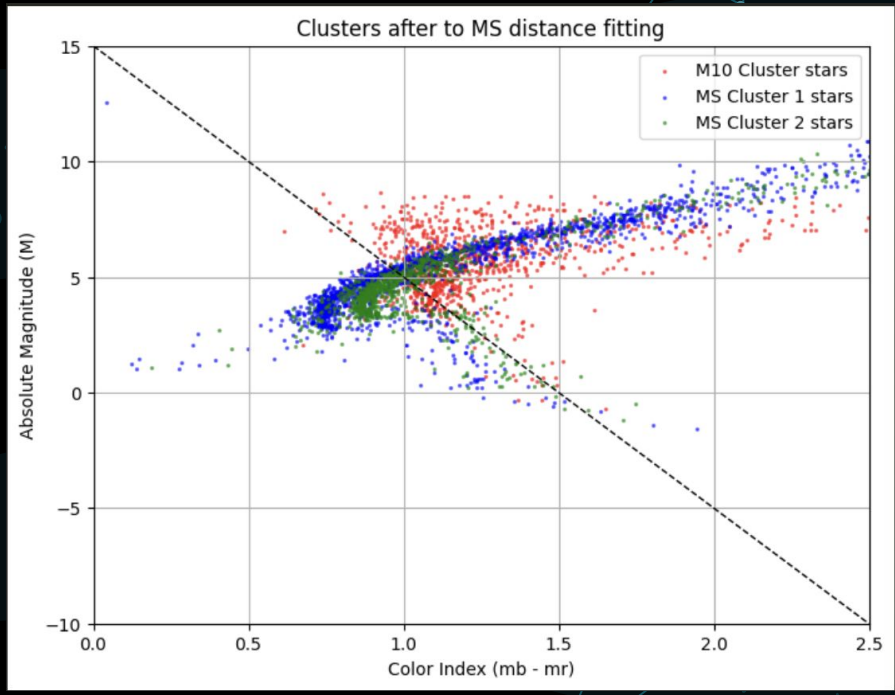
1. Main Sequence Evolution
2. Mass Transfer from Companions
3. Non-Member Inclusions

04

CONCLUSIONS

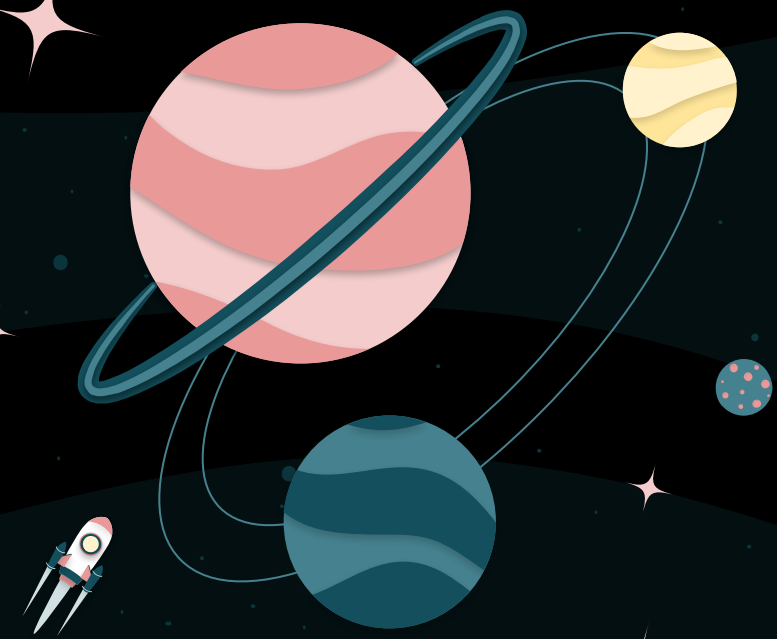



Clusters prior to MS distance fitting
Absolute Magnitude (M)
Color Index (mb - mr)
M10 Cluster stars
MS Cluster 1 stars
MS Cluster 2 stars


Clusters after to MS distance fitting
Absolute Magnitude (M)
Color Index (mb - mr)
M10 Cluster stars
MS Cluster 1 stars
MS Cluster 2 stars

05

HURDLES



HURDLES

PREVIOUS

- Project idea wouldn't work
- Previous data set had too many N/A
- Limited time

Calculations

Could not find reliable method to get temperature

TIME

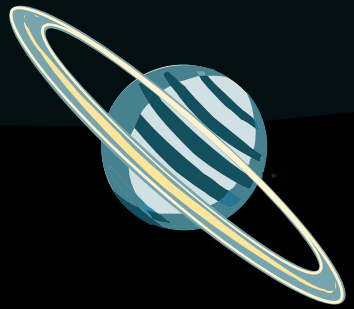
We ran out of time

MGMR/MB

Struggled to get MGMR/MB from dataset

REFERENCES

- https://www.esa.int/Science_Exploration/Space_Science/Gaia/%28archive%29/0/%28type%29/video
- https://gea.esac.esa.int/archive/
- http://www.physicsbootcamp.org/sec-Luminosity-of-Stars.html
- https://arxiv.org/pdf/1008.0815
- https://astro.unl.edu/naap/distance/cluster_fitting.html#:~:text=Main%20sequence%20fitting%20also%20determines,cloud%20of%20gas%20and%20dust.
- https://en.wikipedia.org/wiki/Messier_object

THANKS!

Do you have any questions?