Determining the Color of the Milky Way Using Data from Sloan Digital Sky Survey

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Abstract

Why do we need to know the color of the Milky Way? Color is an important attribute for classifying galaxies. It is much more difficult for astronomers to determine the color of the Milky Way compared to other galaxies in the Universe, mostly because our Solar System lies within the Milky Way. To determine where the Milky Way lies in the color scheme, we can measure the colors of galaxies analogous to the Milky Way. These analogs are galaxies that match the milky way (given an uncertainty) in terms of star formation and total mass. We determine the matched galaxies in Python using data from the Sloan Digital Sky Survey (SDSS) and compare to two known catalogs: Meert and Simard. We then see that the Milky Way can be classified as a green-valley galaxy that is a very luminous red spiral in the local universe.

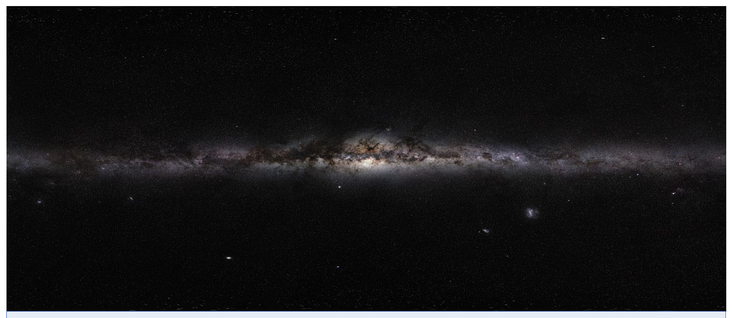

Figure 1. The view we have of our Milky Way. This is a much different view than when we look at other galaxies.

Galaxy Properties

Color is closely related to the luminosity of a galaxy, which are important factors when classifying galaxies. These factors depend on the age of the stars within the galaxy and the rate at which any new stars are being formed. Galaxies that appear blue typically have many young, hot, high-mass stars. Redder galaxies typically have older, warm, low-mass stars and a few high-mass stars. The high-mass stars are usually red giants or red supergiants and tend to be large in size but cooler in temperature.

Milky Way Analogs

The Milky Way Analogs (MWAs), shown in figure 2 to the right, are defined as galaxies that match the MW in total mass in stars as well as the star formation rate. We wanted galaxies that had a similar buildup of their stellar populations over time to the MW, since these parameters are closely related to color and luminosity. We now are redefining the list of MWAs to include selections based on galaxy morphology.

Color is Hard to Measure

We look at the MW at a bad angle to determine its color. We cannot look at it face on like when we look at other galaxies. We also have to look through dust which blocks and scatters some of the light emitted from galaxies.

Results

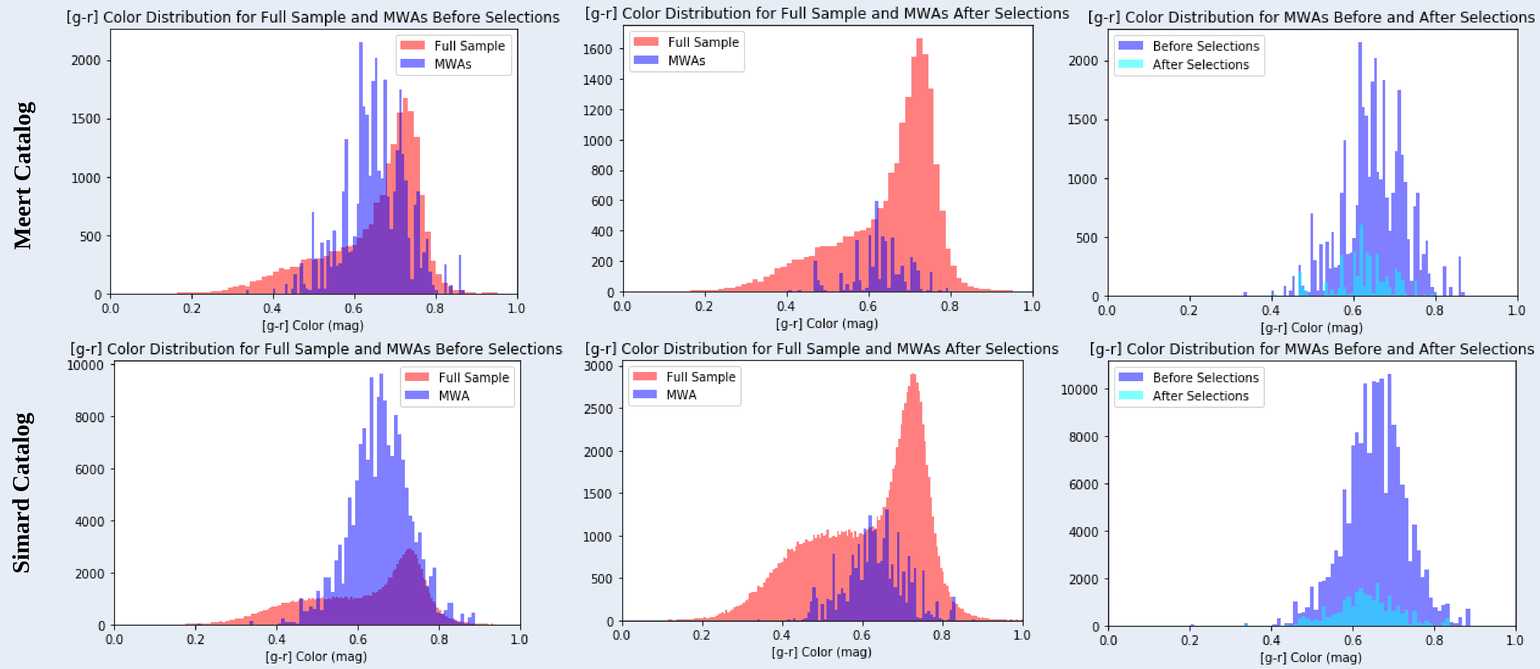

Figure 3. Comparison of the *g-r* color for the Meert and Simard catalogs before and after applying morphology selections to the data. Shown top left is the *g-r* distribution for the Meert full sample and the given MWAs before any selections are made. Top mddle shows the same data after morphology selections are applied to the MWAs. Shown top right is the *g-r* distribution for the Meert MWAs before and after the selections are applied, showing how the distribution changes. Bottom left shows the *g-r* distribution for the Simard full sample and the given MWAs before any selections are applied. The bottom middle shows the same data for Simard after the morphology selections are made and applied to the MWAs. Shown bottom right is the *g-r* distribution for the Simard MWAs before and after the selections are made. For both catalogs, the data tightens up after the MWA morphology selections are applied, giving us a more accurate representation of the MWAs.

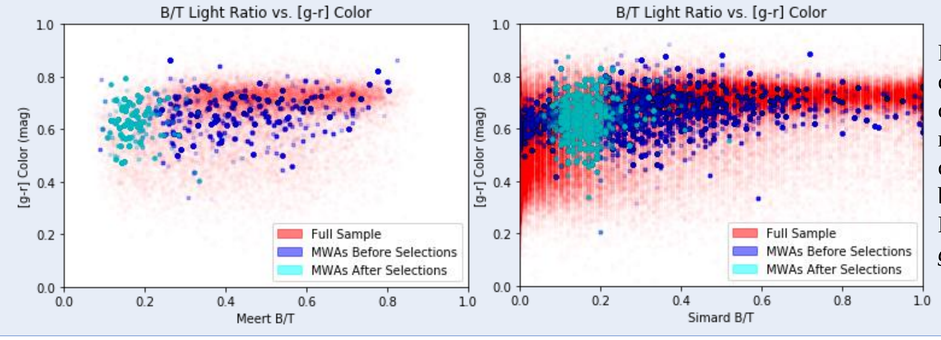

Figure 4. Comparison of bulge-to-total (B/T) light ratio vs. g-r color for the Meert and Simard catalogs. On the left shows the comparison of the full sample and the MWAs before and after morphology selections are applied. On the right shows the same comparisons with the Simard data. The teal colored regions on both graphs represents the galaxies closest to our MW. The MWs B/T ~ 0.15, which is about in the middle of the data points with a *g-r* color range of ~ 0.4 to 0.8 mag.

Conclusion

From the results we see that the Milky Way falls into the region where B/T=0.15 and *g-r* color within the range of 0.4 to 0.8 mag (the known value is ~0.6 mag). This tells us that when viewed from the outside the Milky Way can be classified as a green-valley galaxy.

References

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Meert A., Vikram V., Bernardi M., 2015 MNRAS 446 3943
Luc Simard et al 2011 ApJS 196 11

Acknowledgements

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