SURP Final Write Up

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In our project, we have utilized the EAGLE database, a very large simulation, containing data on about a million galaxies and their relative properties such as SFR (star formation rate) to test if we can make predictions about the properties of a particular galaxy based on its assembly history. Specifically, we grouped galaxies based on the closeness of SFH (star formation history) to exponential functions governed by a single parameter. This allowed us to draw conclusions and trends about the differences of each group when compared to each other. Both our approaches will enable us to predict how galaxies like our own Milky Way may look like in future and predict their early history.

The assembly history of a galaxy is the plot of the mass it has accumulated as a fraction of its final mass over time. After analyzing and grouping galaxies based on different criteria such as different percentiles, oscillating growth, late and early growth, we detected some unique correlation in properties, particularly in SFH. However, our results did not indicate anything substantial and a more revealing analysis would benefit from a large sample size, and potentially other properties. Instead, we conducted an analysis on galaxies grouped based on their SFH closeness to analytic models governed by a parameter called tau. This produced many key results, notably a trend showing that as the parameter increased, the time it took the corresponding galaxy group to accumulate 50% of its final mass also increased for higher percentile galaxies (e.g. 50th and 84th), albeit with a large scatter (figures 1). This is to be expected as lower tau values induce a sharp initial rise in SFR which naturally leads to earlier growth. However, for lower percentiles (e.g. 16th percentiles) the trend did not establish in either direction, which is surprising. A future goal of our research is to investigate the case of this phenomena in depth.

We hope to develop and refine our methods even further in the hope of being able to apply this to nearby galaxies, and predicting their past and future properties based on simple measurements.

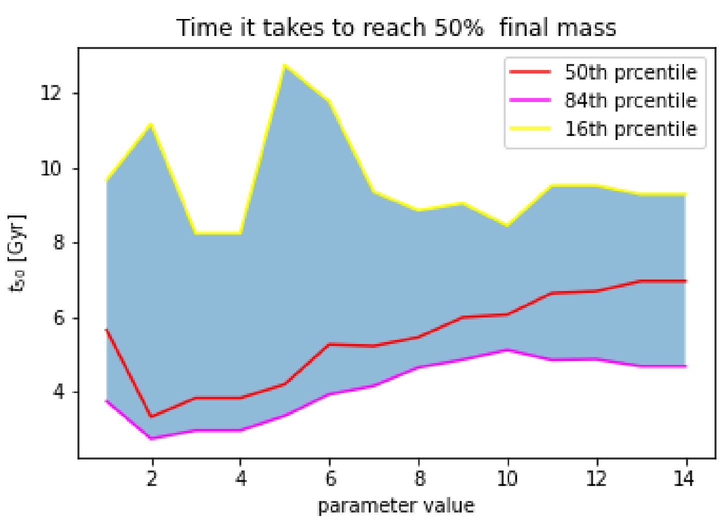

Figure 1: An illustration of the relationship between the parameter "tau" (on the x-axis) and the time "t50" (in billions of years; Gyr) it takes a corresponding galaxy to accumulate 50% of its final mass. The median value (50th percentile) is shown in red, while the 16th and 84th percentiles are shown in yellow and pink, respectively. The blue shaded region includes the 68% of galaxies that lie between the 16th and 84th percentiles. As predicted, the higher percentiles (i.e. galaxies that have small t50 values and more rapid assembly times) follow the predicted correlation where "t50" increases with "tau", but for the lower percentiles the trend breaks down and it becomes random. This difference is very interesting and will be investigated in future work.