

# ASTR 400B Research Assignment 2

Aidan Gibbs

March 1, 2018

The general topic I originally selected for my research project was the dark matter halo evolution of the Milky Way/M31 major merger remnant. Dark matter halo evolution is an important topic to galaxy evolution, because every galaxy is formed and evolves within a dark matter halo. While we cannot directly observe dark matter, and we have yet to discover any interactions with regular matter, the halo nevertheless impacts the galaxy through its gravitational potential. Furthermore, the mass of the dark matter halo is typically above 90% of the mass in the galaxy, making it a dominant force that alters the kinematics and structure of the regular matter components. Without studying the dark matter halo during a merger, we cannot hope to fully understand the process of galaxy evolution.

The questions I would like to study in my project focus on the dark matter halo kinematics. How do the rotation and dispersion velocities of the MW/M31 halos evolve as the merger progresses? How do the halo kinematics of MW/M31 components compare to each other? How does the escape speed of the remnant evolve with time, and how does this relate to halo relaxation?

The simulation data allows for the easy separation of the halo particles of the Milky Way and M31 at any time during the merger, and lists their positions and velocities. We already wrote code that calculates the rotation velocity at different radii using the interior mass, but I will need to write additional code to calculate dispersion velocities compared to rotation. I may also need to try different ways to analyze the halo particles velocities, such as looking at interior or exterior movement within the galaxies and remnant. Comparing the two galaxies against each other will only require keeping the particle analysis separate, though both halos could be analyzed together for the remnant. Calculating the escape speed of the remnant at different radii over time can be done by modifying our rotation velocity code. With the escape speed, I can look at what portion of halo particles are escaping, see how it changes with time, and see what areas of the halo the most particles are escaping from. This should help to characterize the relaxation of the halo.

At this time, I think I am capable of writing most of the code for this project in a timely manner. As I continue this project, however, I will spend more time looking at different analysis that have been done in literature to see how I can make my project more nuanced. I will also continue looking for codes that may be useful.