Research Proposal

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1 Introduction

For this project I will be analyzing the evolution of the internal stellar structure of M33. During the merging of the Milky Way and M31, some material from M33 will be tidally stripped from the satellite. That is, due to the gravity field of the two larger galaxies, material from M33 will be removed and added to the merging system. This material can consist of gas, stars, and/or dark matter. This will affect the velocity and distribution of material in M33. By studying the evolution of this change, we can see how dramatically M33's internal structure changes. It is known that the tidal affects of galaxy mergers is what causes the formation of dwarf spheroidal galaxies.[1] M33 will be interesting to investigate because while it has around the same mass as the LMC, a dwarf galaxy of the Milky Way, it has a higher rotation curve. This makes it a satellite galaxy not a dwarf galaxy, so it will be useful to examine how it behaves throughout the simulation.

2 The Project

There are a few ways to examine the internal stellar structure of a galaxy. For this project I will be analyzing the evolution of the density profile of M33's stellar disk and looking for at what radius there is evidence of tidal truncation. I will then see how the stellar rotation curve evolves within this radius.

Tidal stripping is seen in the form of tidal streams connecting the interacting objects. The tidal radius, or break radius, is where this stream begins in the galaxies that is being stripped. At this point, material is no longer bound to the galaxy. This radius can be found by seeing where the slope of the density profile changes.[1] To plot the density profile, I will adapt the code made in the 5th in-class lab. In this lab we made density plots of the Milky Way at snapshot 0. I can change the initial inputs to read in the disk particles in M33 at snapshots before, during, and after the merger. I will still need ReadFile, and CenterOfMass to complete this. I can figure out which snapshots to use from out last homework where we mapped the orbits of the Milky Way, M31, and M33.

The tidal stream will likely form further into the simulation so by first looking at the density profile for M33 at a time close to the merger I can find the radius at which it develops. Then, write a code that will read in the velocity data for disk particles at the different snapshots that are within that radius from the center of mass. Plotting these velocities with their radius from the center will produce a rotation curve. Plotting the rotation curves of different snapshots onto one graph will be the easiest way to see how it changes. Depending on how the rotation curve changes it can be determined if M33 remains rotation supported or becomes more dispersion supported after the merger.

References

[1] Grzegorz Gajda Elena D'Onghia Ewa L Lokas, Marcin Semczuk. The resonant nature of tidal stirring of dwarf galaxies orbiting the milky way. *The Astrophysical Journal*, 810(10):100–110, 2015.