ASTR 400B Project Proposal

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Galaxy mergers are extraordinary phenomena to observe. Studying these merger events can shed some light on our understanding of how early galaxies may have formed, why we observe the types of galaxies we see today or in the past, examine how they may evolve over time, and how galaxies interact with one another. I will be examining simulation data of the merger event between two spiral galaxies, the Milky Way (MW) and Andromeda (M31), where I will primarily be analyzing their Bulge components both during and after the Merger. This is an important topic of study to investigate if we wish to understand the morphology galaxies and how the kinematics change before, during and after the merging process. I will study how the overall kinematics have changed over time discussing whether or not the kinematics are dispersion related or rotating. Do the particles become more or less tightly compact, do some get stripped away from their bulges? How does the overall size, structure, and density of the remnants bulge compare to that of MW and M31. Is it spheroidal or ellipsoidal? Does the density follow a Sersic profile?

To answer these questions, I will be using code that I have developed throughout the course such as CenterOfMass, MassProfile, OrbitCOM, etc., to examine various stages throughout the merger. These four stages will be at various points throughout the merging process. For example, at point A (which will be Snapshot 0) before the merger takes place, I will examine both MW and M31 bulge components and analyze their respective mass, density, total particles, size, and structure. These will be the before merger remnant conditions. Points B and C will be located after their first and second encounter and point D will contain the merger remnant. Analyzing the four points we can see how the structure and kinematics changes during close encounters and the final result of the two combining.

I will use OrbitCOM to make a plot of the Merging process which will have the selected points A, B, C, and D that I will do a in-depth study on how the bulge structure changes between interactions and merging event by generating bulge density plots and fitting contours of spherical or ellipsoidal symmetry of both face and edge on point of view, and investigate if the bulge is rotationally or dispersion supported which the CenterOfMass code will be used to do this, similar to In-class Lab 5.

I would like to use the MassProfile code to develop Mass/Velocity vs. Radius plots over all snapshots in N steps and overplotting the curves to view any changes between close encounters and final merging sequence.

We also know that the two galaxies merge at times greater than 6.5 Gyr, so I can explore the overall kinematics of snapshots of the remnant alone. As time progresses, the remnant will become more stable. This can pose a question of how long does it take for the remnant to become dynamically stable after the two galaxies merge and after stability is the does it support the random or rotational motion.

Another interesting question that I wish to answer is to examine the number of particles in each galaxy and change total number of particles in remnant has changed over time. This may require me to write some new code of adding to existing mainly using the ReadFile script which does return the number of total particles in some snapshot and the time. Iterating over all files in some N steps and storing the total number of particles and time into an array and then plotting the results.

Lastly, I would like to fit the merged remnant bulge density profile to a Sersic profile. To do so I will have to calculate the total mass of the merge remnant using CenterOfMass code. In order to do this I will have to acquire the same snapshots of MW and M31 find all bulge particles that define the bulge component of the remnant, and sum both galaxies bulges to find the total mass of the remnant bulge. I would also test a finite range of Mass to light ratios and various Sersic indices n, where n = 1, 2, 3, ..., N and calculate various reduced χ^2 values in order to test best fits of the Sersic Profile where these fits lie close to a value of 1.