

ASTR 400B Research Assignment 1

Due: Feb 21st 2023 5 PM

Here is a link to an article, images, and videos about the simulation you are to use as the basis of your research project. <https://hubblesite.org/contents/news-releases/2012/news-2012-20.html>

In this class you will explore a particular research topic and answer specific questions using the provided simulation of the future fate of the MW-M31-M33 system.

For Research Assignment 1, you must create a PDF using LaTeX that lists:

1. The Research Project Topic Heading (1-5), or propose your own
2. The specific research question(s) you will study (from the bulleted list within the topic heading), or propose your own.

Upload the PDF to your github repository by the deadline.

The easiest way to generate LaTeX documents is using online editors like overleaf.com

Possible Topics (or make up your own !!) :

1. Stellar Streams of M33 (during and after the MW-M31 merger)
 - M33's streams' dynamics - velocity gradients, velocity dispersion and how they change in the combined MW+M31 potential?
 - How well do M33's streams trace the orbit of M33? How does this behavior evolve and why does this happen?
 - How and when do M33's streams form?
2. Tidal transformation of Satellites (M33):
 - Stars: Evolution of the internal stellar structure and dynamics of M33 and mass loss rates
 - Dark matter: Evolution of M33's dark matter halo, mass loss rates and changes to internal dark matter profile and dynamics.
3. MW/M31 Galaxy Major Merger Remnant: Stellar remnant and formation of elliptical galaxies

- Kinematic Evolution of Bulge and Disk (rotation, dispersion profile, angular momentum) - How well is the remnant described as a classical elliptical galaxy?
 - Density Profile Evolution of Bulge and disk - How well is the remnant described as a classical elliptical galaxy?
 - Properties of bulge particles within the elliptical, specifically. (density profile, kinematics - velocity dispersion, angular momentum) What is the contribution of the bulge to density profile of the remnant?
4. MW/M31 Halo Major Merger Remnant: Dark matter halo evolution
- Kinematic Evolution (rotation, dispersion profile, angular momentum)
 - Density Profile Evolution
5. Galaxy Merger Sequence of MW and/or M31: baryonic evolution through close encounters
- how does the rotation curve of each galaxy evolve (disk and/or bulge) ?
 - how does the velocity dispersion of each galaxy evolve ?
 - how does the stellar density profile of the disk evolve (disk and/or bulge) ?
 - how do the bars within both galaxies evolve? What happens to those bars after the merger?
 - what is the evolution of stellar debris in tidal tails and bridges?
6. What is the fate of stars at the Sun's location (8 kpc from center of the Galaxy) - but in M31's disk?
- Do M31 Solar particles get ejected from the system or captured by M33? Lie at larger or smaller radii? Move faster or slower ?
 - Visualize the night sky from the perspective of an observer on an M31 Sun throughout the merger. (visualize the location of components of the original galaxies within the merged remnant, or visualize kinematics).