Tidal evolution of M33's dark matter halo

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1 Introduction

My proposed topic is on the tidal evolution of M33's dark matter halo. Tidal evolution describes how the gravitational force the galaxy experiences from neighboring galaxies, known as tidal force, changes over time. This force usually changes based on proximity, since it's a gravitational force, so as galaxies get closer to each other we can see how these massive conglomerates of dust, gas, and stars interact with each other. This becomes even more complicated when we take dark matter into account, for which we have a limited understanding of how it affects its surroundings other than gravitationally. This is important since it helps us better understand dark matter, and how it influences galactic evolution's, interactions, and collisions. M33 is particularly interesting since it has no bulge, which allows us to compare how mass composition affects dark matter ratios. Dark matter dominates the total mass of most galaxies, and yet can only be detected based on its gravitational affect on surrounding objects. M33 has a higher baryon fraction than the Milky Way, despite having no bulge and less halo mass. Open questions include what dark matter actually is, how it has effects on galaxy collisions, and how it affects tidal forces. [3] [1]

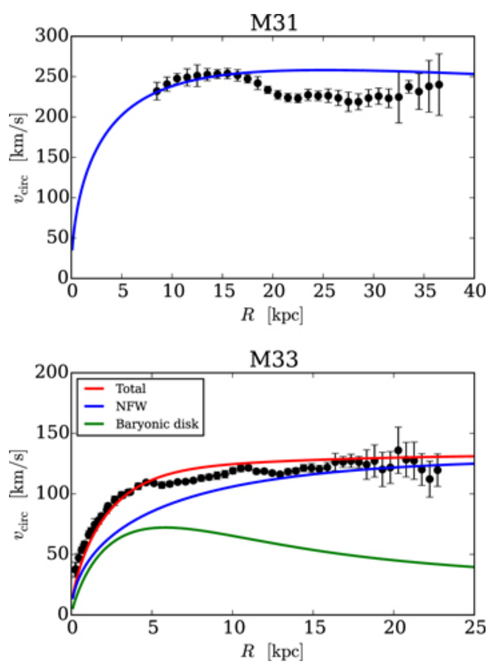

Figure 1: Rotation Curves for M33 and M31 [2]

2 Proposal

1. I will be addressing question 2
2. I will have to take a mass profile for M33 over several snapshots. To do this, I'll have to modify/combine both my MassProfile.py and orbitCOM.py scripts to observe how the mass profile changes over time. I'll utilize the HernquistMass and EnclosedMass functions from MassProfile.py and the principles used in orbitCOM to model the change in time, if any. I'll probably have to take a magnitude of MassProfile results so they can be better graphed over time.
3.

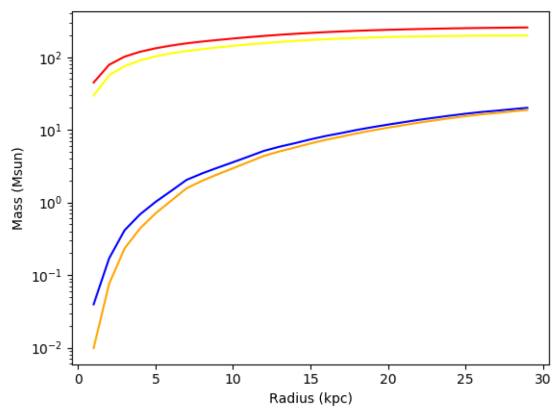

Figure 2: Mass Profile for M33 at 0th snapshot

4. I predict that M33's dark matter profile will become less concentrated with time, due to the surrounding galaxies tugging on M33. I doubt this will be well fit by a Hernquist model, since it is only a model that assumes certain conditions. As M33 approaches its neighboring galaxies, the conditions will no longer be met and the mass profile will shift with time.

References

[1] Green et al. The tidal evolution of dark matter substructure - i. subhalo density profiles. 2019.

[2] Semczuk et al. Tidally induced morphology of m33 in hydrodynamical simulations of its recent interaction with m31. 2018.

[3] Izaskun San Roman. The formation and evolution of m33 as revealed by its star clusters. 2012.