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DM Halo Merger Remnant: Density Profile/Shape (Pre vs Post Merger)

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1. INTRODUCTION

Dark matter halo evolution MW-M31 merger remnant. We have known for some time now that our galaxy, the Milky Way (MW), is on track to (full on collision?) eventually collide with M31, the Andromeda Galaxy, located at about 2.5 million light years from us. Throughout this process, each galaxy's dark matter halo will merge too. This is one of the key aspects of halo formation and evolution. Halos form in hierarchical order where small structures merge with other halos forming denser and more massive structures. The attempt of this project is to understand the process of galaxy mergers and the effect that has on the structure and the mass distribution of the halo remnant.

Dark matter makes up five sixths of all matter and it is scattered thought the universe forming a network of filaments. A halo of dark matter is defined as the point where these filaments intersect and form higher density structures. This spherically dense structures are where we find galaxy groups and clusters (Drakos et al. 2019a). Therefore, the understanding of the evolution and assembly of dark matter halos is key to understand galaxy formation and evolution and vice versa. The study of this relationship is also of great importance to develop a better understanding of our current cold dark matter theory.

There has been many studies to understand the structure of cold dark matter halos. Observationally, halos tend to have a triaxial mass distribution, that is, different distribution and length in each axis (Knebe & Wießner 2006). N-body simulations like those used in Abadi et al. (2010), have shown that the assembly of the central galaxy affects the three dimensional shape of the halo as it tends to be more axisymmetrical, almost oblate in the presence of a central galaxy. In the simulations where baryonic matter has was ignored, the halo tend to be more prolate so the question of why in observations halos are triaxial remains unanswered (Abadi et al. 2010).

Another question that remains unanswered is the effect that mergers have on halo structure. Simulations that have been done to study major mergers between dark matter halos, e.g. Drakos et al. (2019a), have shown that that the remnant tends to be larger and more elongated along the merger axis resulting in a prolate or oblate structure. The density profile of the remnant also seems to increase as a function of radius without having a significant change in the central density compared to the individual halos. These results seem to be similar in simulations where baryonic matter is accounted for. However, other results have reported a decrease in the central density and there is no explanation yet for that. These simulations have only used isolated and equal mass halos; how halo assembly occurs between different mass mergers and other surrounding halos is still an open are for investigation. (Drakos et al. 2019b)

2. PROPOSAL

The questions I will be addressing are the following

1. What is the final density profile? Is it well fit by a Hernquist profile?
2. Is it more or less concentrated than the MW or M31 before they merged?
3. Is the 3D dark matter distribution spheroidal? or elongated like an ellipsoid?
4. What does terms like prolate, oblate, or triaxial halos mean?
5. Where is the "end" of the halo? How might we define this?

To approach these questions I will be also plotting the isodensity contours from each galaxy at time=0 and at then plot these contours after the have merge. In order to visualize the structure of the remnant I will calculate the ratio of densities in the three axes. I expect these figures to be very similar to those of Figure 1 shown below with density profile increasing as a function of radius and a prolate or oblate structure rather than a triaxial distribution.

REFERENCES

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Drakos, N. E., Taylor, J. E., Berrouet, A., Robotham, A. S. G., & Power, C. 2019a, MNRAS, 487, 993

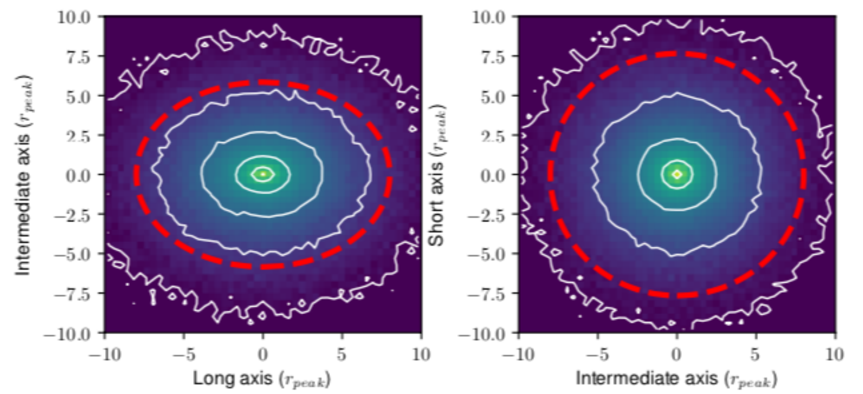

Figure 1. Drakos et al. (2019a) Isodensity contours of halo remnant in white.

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Knebe, A., & Wießner, V. 2006, PASA, 23, 125