Fate of Sun analogs in Andromeda

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ABSTRACT

This is an abstract.

Key words: Galaxy Merger, Galaxy Interaction, Merger Remnant, Elliptical Galaxy

1 INTRODUCTION

1.0.0.1 When the merger of our galaxy with Andromeda takes place, the Sun analogs that reside in M31 are a mystery as to what happens. In this paper I am going to go over the fate of the stars in M31, that are the same distance from the center of the galaxy like our sun is, 8 kpc away from the center of the galaxy. This is for the galaxy merger process and after the merger completes. A galaxy merger is when multiple galaxies collide, and the gravitational pull forces the galaxies to become one.

1.0.0.2 "A galaxy is a gravitationally bound collection of stars whose properties cannot be explained by a combination of baryons and Newton's laws of gravity." This is the definition of a galaxy from (Willman & Strader 2012 AJ). Galaxy evolution however is the galaxy changing its components over time as stars get more massive, gas forms new stars, and even the colors can change. Knowing what happens to these stars in the galaxy and running simulations will tell us more about what could possibly happen to our solar system and the Milky Way, and just the general structure as well for M31 at this distance within. We can also find out what happens to the stars physically and chemically at this distance, and see how it impacts that region for the dust and gas. We can also find out the change of velocities, and then find the new distance these stars will be at after the merger.

1.0.0.3 We know that by the time the collision begins, our Sun will be a red giant and will have already ate up Mercury, Venus, and maybe Earth. We also know that when the merger takes place the final product galaxy will end as a giant elliptical galaxy, changing the structure for the spiral arms and the dust and gas ratios within the distance. An elliptical galaxy is a galaxy that is in an ellipsoid shape with long arms. The Sun will most likely end up at a larger distance from the center of the Milky Way and Andromeda merged galaxy, than it is currently from the center of the Milky Way. Possibly more than 50 kpc. (van der Marel + Besla, 2012). Figure 1 is that of the radial distribution of the candidate suns with respect to the MW and M31 remnant. A galaxy remnant is the final product of a galaxy merger. Knowing that the galaxies are fairly similar in many characteristics, we can use our own estimation of the Sun to help find what could happen to the M31 stars.

1.0.0.4 Active questions in the field include:

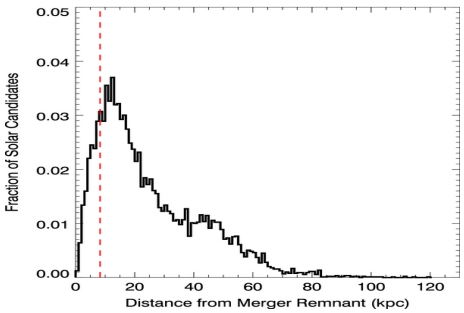

Figure 1. This image is from the simulation paper and is Figure 8. This is the radial distribution of candidate suns with respect to the center of the MW–M31 remnant, at the end of the N-body simulation (t = 10Gyr) for the canonical model. The red dashed line shows the current distance of about 8.29kpc of the Sun from the center of the Milky Way.

- How will the velocity of the solar systems change?
- How will the local density of stars change?
- How could the stars pass by the systems and potentially change the system structure as well as the stars compositions?
- If Earth is still around, how could life be impacted?
- How do the positions of the Sun analogs change? (In merged remnant vs. today)

1.0.0.5 Image from paper

1.0.0.6

2 THIS PROJECT

In this paper we will study the Sun analogs in M31. We will look at the original positions of these analogs in the xy-plane, then showing how it changes over time and as the merger takes place. We will look at the movement of these analogs over time, see what has changed.

2.0.0.1 The main question to answer is, how do the positions of the Sun analogs change? This is important to know for how the stars move around in a galaxy when the mergers take place, also knowing the likelihood of the solar systems changing.

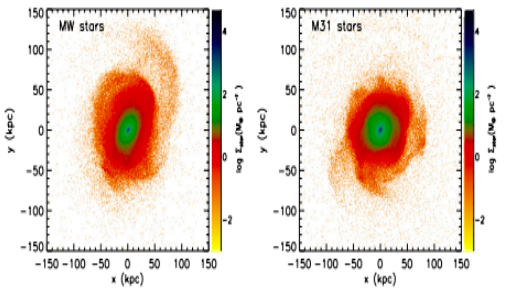

Figure 2. This figure shows the distribution of luminous particles at the end of the N-body simulation (t = 10Gyr) for the canonical model. From left to right, particles originating in the MW and M31. The color scale indicates the surface mass density. I will use this to find the star densities as a function of the merger remnant vs. time.

3 METHODOLOGY

The simulations I will be using are for the MW and M31 merger and studying the stars that are about 7 - 9 kpc away from center of the galaxy. An N-body simulation is where there are an N number of particles and simulates the movement of the particles, randomly but with respect to gravity and physical equations.

3.0.0.1 To find the positions of the Sun analogs, I will use the data for the stars that are within 7 - 9 kpc of the center in M31 and track the star density as the merger takes place for this region. Seeing how many stars are within this distance before the merger begins, then seeing how many are there after the merger finishes. Also seeing how the star density changes at the different regions around the center, and going outward to see how the other regions changed as well. I will use code that finds the percent of stars within 8kpc before the merger then after. To find the amount of stars that get unbound, I will track certain regions of M31 and see how the star density changes, as well as trying to find the escape velocities, of the specific regions. Then to find the percentage I will use the same methodology as the first question.

3.0.0.2 My code will compute how much of the Sun analogs stayed in the same positions and how many of them moved. Seeing the amount that are there at the start of the simulation and then the amount that are there at the end. Also during the intervals, keeping a running count.

3.0.0.3 The plots I need to make are the xy-plane of the two galaxies during the merger process. A top down view will give a clear view of where the Sun analogs are then over a movie type simulation, show the movement of the stars.

3.0.0.4 I believe that within 8kpc of the center of the galaxy for M31, the amount of stars will be less. More specifically I believe that many other stars will occupy this space, and many stars from before will be much farther. So less stars than before the merger, but many new stars in this region that came from further. The fate of the stars in this region to me is very random, many stars being pushed further, and some going through collisions and potential chemical changes. I believe this happens from the potential collisions between stars, as well as the general structure of the MW - M31 remnant changing and settling in to a new structure, which will be elliptical.

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APPENDIX A: SOME EXTRA MATERIAL

This paper has been typeset from a TEX/LATEX file prepared by the author.