MW+M31 Stellar Major Merger Remnant: Stellar disk particle distribution/morphology

ZEHAO DONG[1,*]

[1] *Department of Astronomy, University of Arizona, 933 N Cherry Ave, Tucson, AZ, 85721, United States*
[*] *zehaodong@arizona.edu*

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Abstract

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1. INTRODUCTION

In approximately 4 billion years, the Milky Way and M31, also known as the Andromeda Galaxy, are anticipated to collide and merge, creating a stellar major merger remnant (van der Marel et al., 2012). This paper aims to investigate the distribution and morphology of stellar disk particles within the resulting remnant formed from the merger between the Milky Way and M31 galaxies. Studying the stellar disk particle distribution is crucial for advancing our understanding of galactic evolution, as mergers are pivotal in determining the morphological and star formation characteristics of galaxies (Barnes Hernquist, 1992; Duc et al., 2013).

Galactic mergers, such as the one predicted between the Milky Way and M31, share similarities with the overall process of galactic evolution, including changes in composition and star formation rates over time. Delving into the stellar disk particle distribution of the merger remnant can elucidate the relationship between galaxy mergers and morphology, as well as the composition of the remnant in connection to its age and the mass ratios of the merging galaxies (Querejeta et al., 2015; Pearson et al., 2019).

Our current knowledge of galaxy mergers stems from both observational data and computational simulations. Toomre Toomre (1972) posited that spiral galaxy mergers often result in elliptical remnants, whereas Querejeta et al. (2015) proposed the formation of S0 galaxies after galactic collisions. Pearson et al. (2019) debated the role of mergers in influencing star formation rates, noting that only 10-20 % of mergers exhibit bursts of star formation. Given the substantial masses of both the Milky Way and M31, the merger could potentially be dry, yielding a remnant dominated by older stars within several million years. It is essential to recognize that while some inferences have been made regarding the remnants of the Andromeda and Milky Way merger, these conjectures are not exhaustive or entirely accurate. Consequently, many open questions in the field remain, including whether the merger will be dry, the classification of the remnant, and if the remnant will resemble the Milky Way, Andromeda, or neither.

Through the analysis of stellar disk particle distribution and morphology in the remnant of the Milky Way and M31 merger, this study seeks to enhance our understanding of galaxy formation and evolution, particularly in the context of similar-mass barred-spiral galaxy mergers. The insights gleaned from this research will enable a more comprehensive grasp of the impact of mass and structure on the merger remnant and the broader implications for galaxy interactions and mergers in the universe.

2. PROPOSAL

A. Specific question to be addressing

What is the distribution of stellar particles from M31 vs the MW? Are the profiles different?

B. Method to simulation

To investigate the distribution of stellar particles from Andromeda versus the Milky Way, we need to acquire simulation data for both galaxies, focusing on stellar disk particle positions and velocities at different time steps. We will assume that the Milky Way and M31 are gas-poor, making the merger "dry," and not account for gas particles. Subsequently, the particle data can be used to determine the merger time, and the snapshots can also be identified corresponding to the merged systems. For each galaxy, we will analyze the particle data to determine the spatial distribution of stellar particles. We will calculate the center of mass and relative distances of the particles from the center for both galaxies.

Next, we will compute the radial distribution of stellar particles for both the Milky Way and M31 by calculating the number of particles as a function of distance from the center of mass. We will normalize the distribution by the total number of particles in each galaxy.

After analyzing the particle data and radial distribution, we will compare the radial distributions of stellar particles between the Milky Way and M31 at different stages of the merger process, including before, during, and after the merger. We can use MATLAB to analyze the differences between the radial distributions at each stage. Plots and visualizations can be created to represent the distribution of stellar particles in both the Milky Way and Andromeda.

C. figure that illustrate methodology

D. Hypothesis

Our hypothesis is that the distribution of stellar particles from M31 and the Milky Way will differ, leading to distinct profiles for the two galaxies. This is based on the assumption that the mass ratios and structural properties of the merging galaxies will influence the distribution of stellar particles during the merger process (Querejeta et al., 2015; Pearson et al., 2019). Given that the Milky Way and M31 have different masses and structures, we anticipate that their profiles will not be identical. Consequently, these differences may contribute to the overall morphology of the merger remnant and affect its classification as an elliptical or lenticular/S0 galaxy.

3. REFERENCE

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