Stellar Profile of Milky Way - M31 Major Merger Remnant

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ABSTRACT

Context. The goal of this project is to examine the stellar disk density profile of the major merger remnant of the Milky Way - M31 galaxies in detail, and compare the resultant brightess profile to that of the Sersic and de Vaucouleurs models.
Aims. Build upon code used to make high-resolution Mass and Density plots, as well as brightness profile plots used in class.
Methods. TBD
Results. TBD
Conclusions.

Key words. galaxy merger – galaxy structure – galaxy evolution – galaxy formation – galaxy interaction – galaxy morphology – galaxies: individual (M31) – galaxies: individual (Milky Way)

1. Introduction

It is well-known that 3.5 Gyr from now, our galaxy and Andromeda (M31), loacted 2.5 million light-years away, will begin to interact, and eventually merge into an elliptical galaxy. After this, star formation will cease, as the remnant will be gas-poor and solely dispersion-supported. When examining the stellar disks of both galaxies, we know from class that the disk of the Milky Way has a luminosity of approximately $L_\nu = 1.5 \times 10^{10}$, it has ripples, a predominant ring ("Monoceros Ring"), at 20 kpc, and a scale length of $r_\alpha = 2.4$ kpc, and the M31 disk has a luminosity of about $L_\nu = 2.7 \times 10^{10}$, it has approximately 3 rings, dominant at 10 kpc, and a scale length of about $r_\alpha = 4 - 5$ kpc. The disk supports the idea that M31 is the more massive of the two galaxies, and has had a more violent, accretion history. The ultimate goal is to understand what happens structurally to the stellar disks of the two galaxies and describe the resultant brightness profile of the new elliptical galaxy.

2. Looking at the Stellar Disk Density Profile

(Barnes 1992) discusses that, while most of the ellipticals we currently observe appear to be the result of major mergers, this is not the only process that alters galaxy structure. At the moment, M31 and the Milky Way have differing overall structures, but are both very gas-rich and have similar star-forming rates, on the order of 1 $M_\odot$ per year. This will ultimately change after the two collide, and I would personally like to attempt to better understand how the stellar disk component is altered.

The questions I would like to begin to answer include:

1. What does the stellar density profile look like post-merger?
2. How does this compare to other models, including the Sersic profile?
3. How does the M/L ratio change?
4. Does this align with typical elliptical galaxy predictions?

I would like to go about attempting to answer these questions by looking at the current brightness profiles of the galaxies, observing the stellar disks changing throughout a range of Snapshots, and then ultimately comparing the resulting stellar disk to past galactic archaeology work done on mergers with similar progenitor types, such as those found in (Querejeta 2015).

The surface brightness profiles of M31 and the Milky Way are roughly exponential profiles and well-described in the papers (Gilbert 2012) and (Schodel 2014), so I would be able to compare the post-merger profile with the pre-merger profiles of the two galaxies relatively well. I would also compare this to the Sersic profile, which describes exponential galaxies with n, the sersic index, between 2 and 6. Theoretically, the resulting elliptical galaxy should agree with this profile for n 4, otherwise known as the de Vaucouleurs profile, which goes as $r^{1/4}$.

My hope is to combine code used in OrbitCOM.py, CenterOfMass.py, ReadFile.py (and possibly others), as well as templates used in the In Class Labs to create high-resolution density plots of the merger remnant's stellar disk, and plot its brightness profile using the new Mass-to-Light ratio, and see if it fits well with the Sersic profile and de Vaucouleurs profile.

References

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