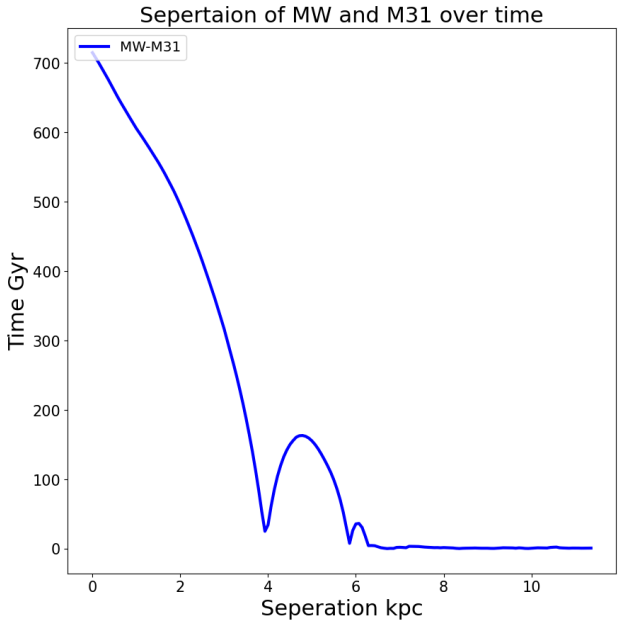
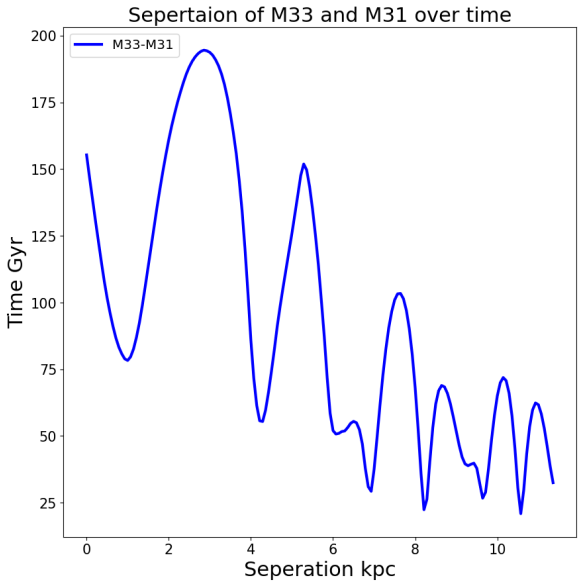
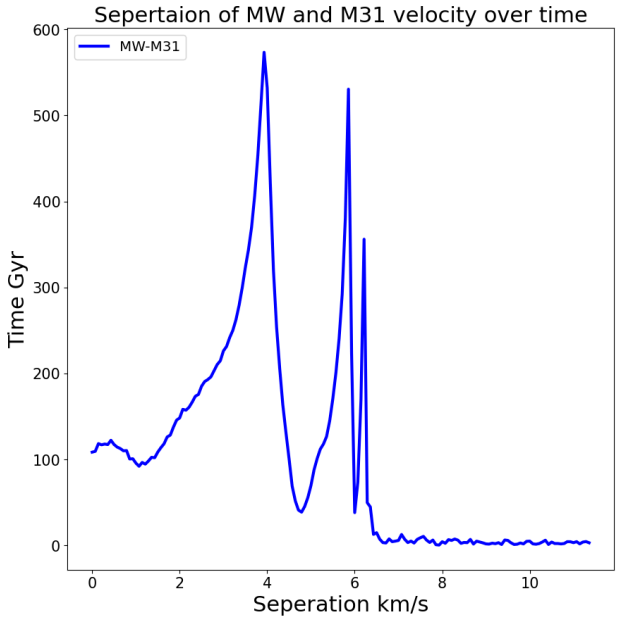
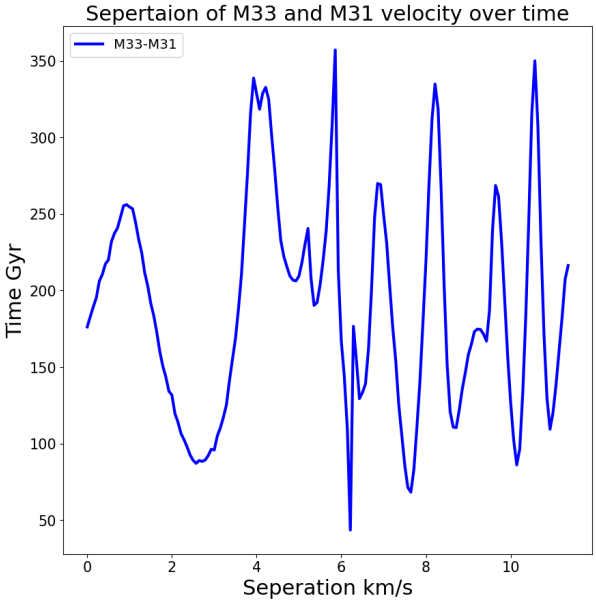
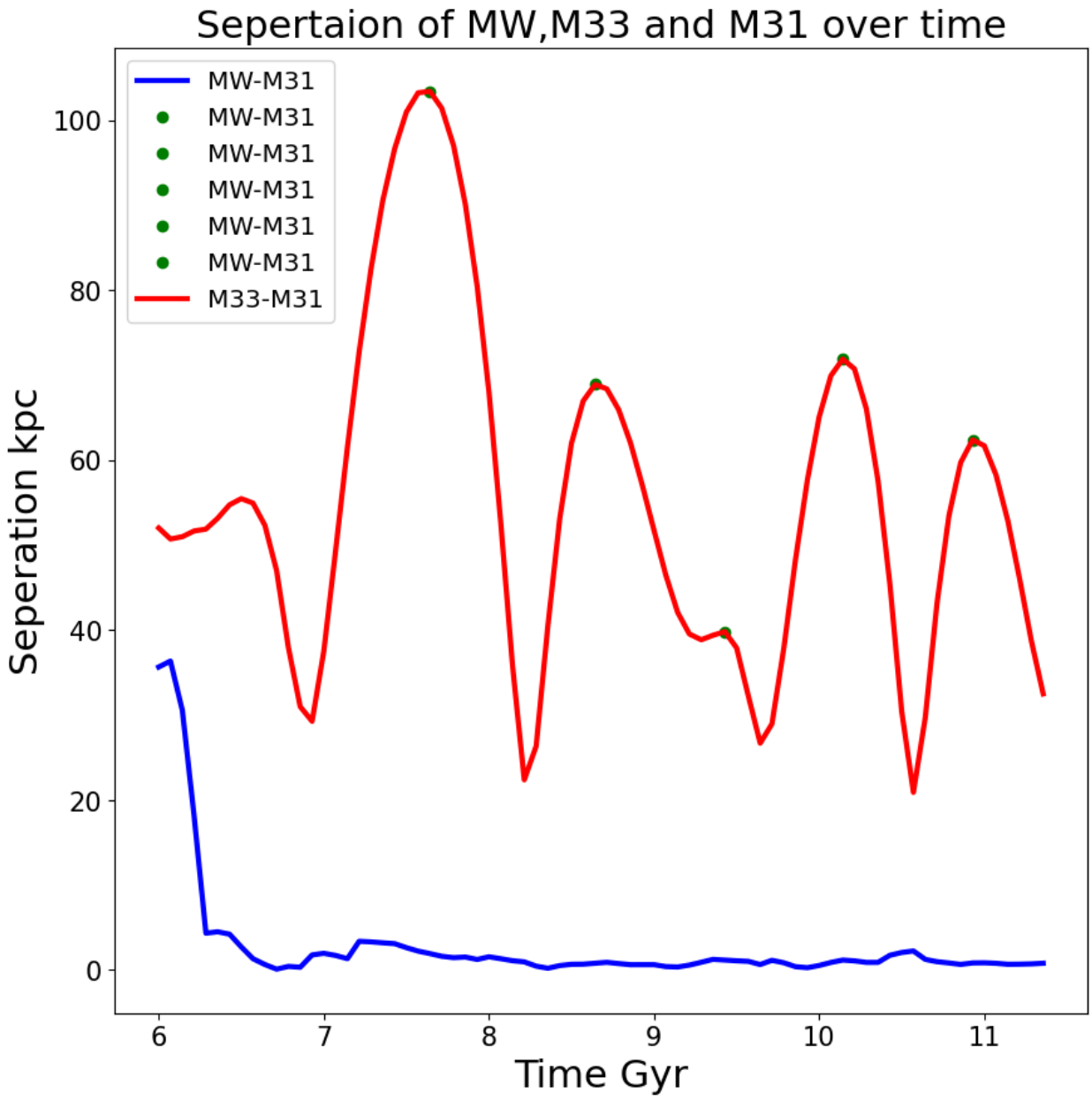

Sepertaion of MW and M31 over time
MW-M31
Time Gyr
Seperation kpc


Sepertaion of M33 and M31 over time
M33-M31
Time Gyr
Seperation kpc


Sepertaion of MW and M31 velocity over time
MW-M31
Time Gyr
Seperation km/s


Sepertaion of M33 and M31 velocity over time
M33-M31
Time Gyr
Seperation km/s



#Q.1

There will be two close encounters between MW and M31 in the future, not including the final collision.

#Q.2

#When the galaxies are closest to each other, the smallest distance separation, they have the largest difference in velocities. in short the separation and relative velocity have an inverse relationship, when one goes up the other goes down

#Q.3

MW and M31 collide around 6.25 Gyr. This is then the separation becomes relatively flat compared to the rest of time after this time M33 continues to orbit the combined MW and M31. It oscillated between 20-110 kpc, gradually getting closer to the remnant as time went on. These oscillations are more frequent than before the merge

#Q.4

If we take the first apocenter after 6 Gyr (103 kpc separation, at 7.643 Gyr) and the last (62.4 kpc, 10.929 Gyr) we can find the slope then the slope is roughly the rate of decay. We find that 103.4-62.4/10.929-7.643~-12.5kpc/Gyr or considering this recording is over about 3 oscillations ~-13.7 kpc/oscillation. If the galaxy is 75 kpc away it will collide in 75 kpc/12.5 kpc/Gyr or 6 Gyr or 5.47 oscillations. Assuming constant rate of decay and consistent oscillations.