1. How many close encounters will the MW and M31 experience in the future?
Two close encounters – the number of times when the MW-M31 distance reaches a local minimum (at the global minimum, the two have merged)
2. How is the time evolution of the separation and relative velocity related?
When the galaxies are closest, they exert the strongest gravitational force on each other so they accelerate quickly, leading to faster speeds.
3. When do M31 and the MW merge? (you might need to zoom in on the plot - try a log y axis). What happens to M33's orbit when they merge?
M31 and MW merge when their mutual distance reaches ~0 at ~6.5 Gyr. At this point, the rate at which M31 and M33's distance decreases shrinks.
4. BONUS: what is roughly the decay rate of M33's orbit after 6 Gyr (ratio of the difference between two successive apocenters and the orbital period; you don't need to be precise). If this rate is constant, how long will it take M33 to merge with the combined MW+M31 remnant if it is at a distance of 75 kpc?
The four apocenters are at ~6.8, ~8.8, ~10, and ~11 Gyr, with distances of ~110, ~90, ~80, ~70 kpc. Taking the first apocenter distance to not represent a steady state, the rate of decrease in the steady state is ~10 kpc/Gyr. So it will take ~7.5 Gyr for M33 to merge with M31-M33.