M33 - M31 Positions

M33 - M31 velocities

The simulation contains many more orbits than the analytical solution. The overall shape of the orbit is also much smaller in the simulation.

This is likely due to the lack of influence of the Milky Way in the analytical solution. Additionally the two methods have different approaches, the simulation is numerical. This leads to errors in the analytical orbit adding up over time, which is a good fit for about 1 Gyr.

Adding in the influence of the Milky Way could be done by treating the system as a restricted three body problem, with M33 being affected by the gravity of the other two galaxies but having no influence on their motion.