

Astrophysics III : Stellar and galactic dynamics

Exercises

Problem 1 :

Demonstrate that a Keplerian potential generates elliptical orbits.

Problem 2 :

Using the formula seen during the lectures, demonstrate the three Kepler law :

- The orbit of a planet is an ellipse with the Sun at one of the two focii.
- A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time.
- The square of a planet's orbital period is proportional to the cube of the length of the semi-major axis of its orbit.

Problem 3 :

Create a galaxy from a Plummer bulge, exponential disk and a NFW halo using `vc_galaxy.py`. Verify that the sum of the rotation curve for each component is identical to the one derived from the total potential.

Problem 4 :

For the galaxy generated in Problem 3, compare the contribution of each component to the vertical force (F_z) in the direction of the galactic disk, at a radius equal to that of the sun (~ 8 kpc). What about when the halo is the dominant contributor to the gravity of the galaxy?