Astrophysics IV, Dr. Yves Revaz

 $\begin{array}{l} \text{4th year physics}\\ 09.04.2025 \end{array}$

<u>Exercises week 8</u> Spring semester 2025

EPFL

Astrophysics IV : Stellar and galactic dynamics Exercises

<u>Problem 1</u> :

Show that the following relations hold :

$$A(R) \equiv \frac{1}{2} \left(\frac{v_c}{R} - \frac{\mathrm{d}v_c}{\mathrm{d}R} \right) = -\frac{1}{2} R \frac{\mathrm{d}\Omega}{\mathrm{d}R}$$
$$B(R) \equiv -\frac{1}{2} \left(\frac{v_c}{R} + \frac{\mathrm{d}v_c}{\mathrm{d}R} \right) = -\left(\Omega + \frac{1}{2} R \frac{\mathrm{d}\Omega}{\mathrm{d}R} \right)$$
$$\Omega = A - B$$
$$\kappa^2 \equiv \left(R \frac{\mathrm{d}(\Omega^2)}{\mathrm{d}R} + 4\Omega^2 \right) = -4B(A - B) = -4B\Omega$$

<u>Problem 2</u> :

Derive the relation between R and \dot{R} in the z = 0 plane (approximation of the third integral), if we assume that the total angular momentum is conserved in an axisymmetric potential.

<u>Problem 3</u> :

Derive the Hamilton equations of motion of a particle in a potential Φ inside a uniformly rotating reference frame $\vec{\Omega}$.

<u>Problem 4</u> :

Using the scripts MAPPING.PY and MAPPING-RZ.PY, explore the surface of section discussed during the lectures.