Exercise 7. Weight 4 points. Due Wednesday Mar 15

Consider a binary stellar system, similar to our solar system. It contains 2 central stars with masses of 10^{30} kg. It also contains 3 satellites with masses of 10^{27} kg. The initial positions and velocities are given in the table below.

Newtons constant can be taken as $G=6.67\text{x}10^{-11}\text{kg}^{-1}\text{m}^{-3}\text{s}^{-2}$.

Calculate the positions and velocities of the stars and the satellites at 10^6, 10^7, 10^8, 10^9, 10^{10} s, and try to do this as accurately as possible, with Bulirsh-Stoer (StepperBS) and with Runge-Kutta (StepperDopr5). You may assume Newtonian mechanics (no general relativity corrections, instant forces).

Give the positions and velocities of the bodies at the end of these integration times. Verify the accuracy by integrating back in time (you can do that by just running odeint from the end time to the start time) and comparing the coordinates and velocities of all bodies with their start values. Target accuracy should be such that all positions are accurate within 100 m after 10^8s (3 years).

Assume reasonable step sizes and accuracies: note that a relative accuracy of 10^{-12} is fine for radii r, but not for x,y,z or vx,vy,vz (which can be 0m and 0m/s).

Body	X	Y	Z	Vx	Vy	Vz
	(Gm)	(Gm)	(Gm)	km/s	km/s	km/s
Star 1	20	0	0	0	30.042	
Star 2	-20	0	0	-0.03	-30	
Satellite 1	400	0	0	0	18.3	-1.6
Satellite 2	0	150	0	30	0	0
Satellite 3	16	0	0	0	-60.3	1.6