ZCE 111
Assignment 3

Q1. Two Projectiles

- Two projectile are launched. Projectile is launched at location (0,0) at t=0. Projectile 2 is launched at location (95,100.0) at t=8.5 seconds later. The initial speed and angle are for the first projectile are 18 m/s and 49 Degree above the +x axes; while that for projectile 2 are 15 m/s and 56 Degree above the +x axes.
- (i) Write a code to display the simulation of the motion of these two particles.
- (ii) Calculate the distance between these two projectiles as a function of time between t=0 until t=16 seconds.
- (iii) What is the distance between them when t=7.9 s?

Q2. Two uncoupled pendulums

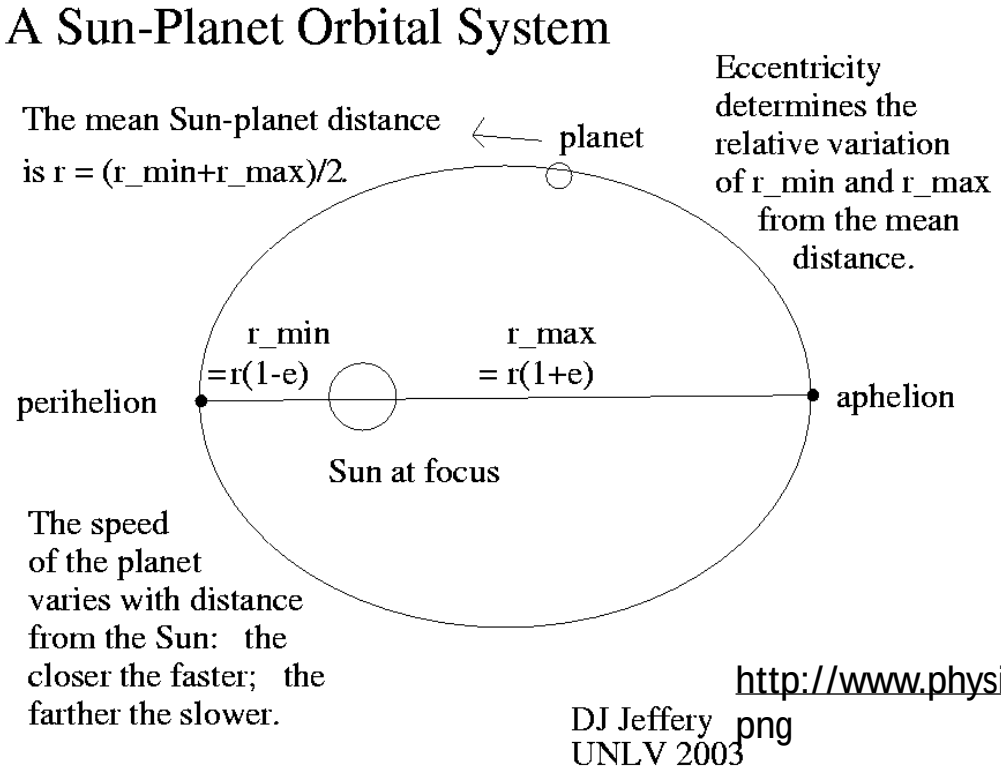
- (i) Simulate the motion of two uncoupled SHM pendulums with different lengths, released at different initial displacement angles, θ_{10} and θ_{20} from the vertical.
- (ii） For a fixed choice of initial displacement angles and lengths, plot the graph of phase difference between these two pendulums, defined as

$$\varphi(t) = \theta_2(t) - \theta_1(t)$$

where $\theta_2(t), \theta_1(t)$ are the displacement angles of the pendulums at time *t.*

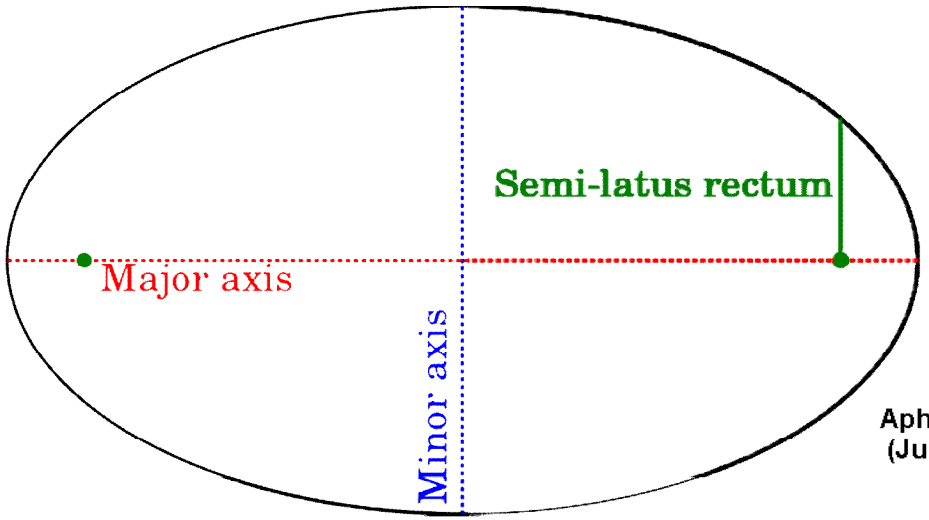
Q3. Sun-Earth-Moon three-body system

- The Earth M is circulating the Sun S which is located at the focus of an elliptical orbit, which geometry is explicitly shown in the figures.

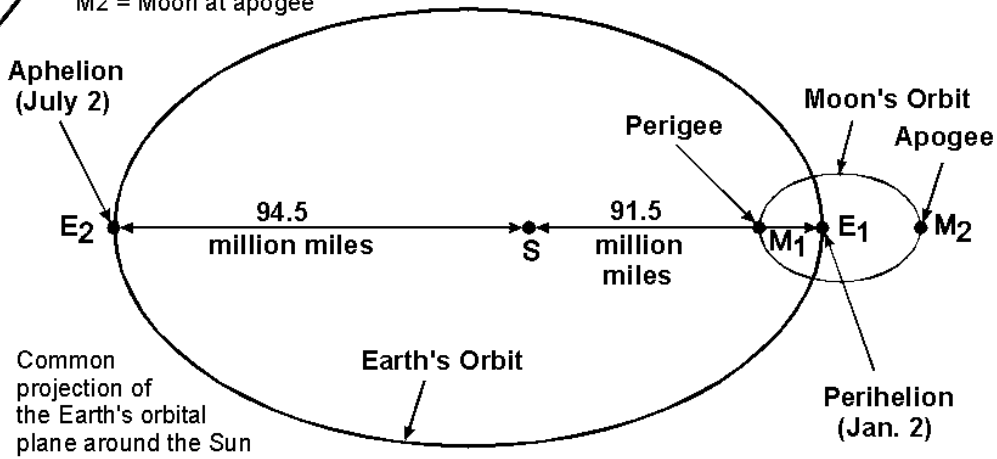


http://www.physics.unlv.edu/~jeffery/astro/ellipse/sun_planet.png

Moon (M) orbits around Earth (E)



S = Sun
E1 = Earth at perihelion (January 2nd)
E2 = Earth at aphelion (July 2nd)
M1 = Moon at perigee
M2 = Moon at apogee



Common projection of the Earth's orbital plane around the Sun (the ecliptic) and the Moon's orbital plane around the Earth.

Q3 (cont.)

- (i) Simulate the Earth's orbit around the Sun based on astronomical information provided.
- (ii) Find out the astronomical information of the elliptical orbit of Moon moving around the Earth from anywhere possible. Simulate the three-body system, the Earth orbiting the Sun, while the Moon orbiting around the Earth.
- (iii)Use your code to predict when moon ellipse will happen.
- Note: You have to think how to put your initial conditions in your simulation.