PHYS 105

In-class exercise 9.1(a)

Suborbital Motion: Curvature

Let's continue to increase the realism of our simulations. Start with the two-dimensional predictor–corrector scheme with "β-law" air resistance developed last time, and consider again a projectile launched with speed $v_0 = 1500$ m/s at an angle of 20° to the horizontal. Again take gravity to be uniform, $a_x = 0$, $a_y = -g = -9.80$ m/s^2, and use a timestep of $\delta t = 0.1$ s. For now, turn off the effects of air resistance by setting $\beta = 0$.

First include the *curvature* of Earth's surface in determining the end of the trajectory. From here on, it will be convenient to take Earth's *center* as the origin—apart from the initial value of y, the integrator is unchanged. Our initial position thus is $x = 0,\ y = R$, where $R = 6,400$ km $= 6.4 \times 10^6$ m is Earth's radius. We will terminate our calculation when $r = \sqrt{x^2 + y^2}$ becomes less than R, and interpolate all quantities to $r = R$ to determine the range (now measured *along* the surface), maximum height (now measured in the *radial* direction) and time of flight.

- By how much does the range change when curvature is considered?