

# PHYS 105

## In-class exercise 9.2(a)

### Suborbital Motion: Air Resistance

Now restore the effects of air resistance. Reinststate the “ $\beta v^2$ ” term to the acceleration:

$$\begin{aligned}a_x &= -\frac{GMx}{r^3} - \beta vv_x \\a_y &= -\frac{GM y}{r^3} - \beta vv_y.\end{aligned}$$

As before, include the decrease in density with altitude by taking

$$\beta = 10^{-5} e^{-(r-R)/h},$$

where  $h = 7$  km.

Answer the following questions:

- By how much does the range decrease compared to the previous problem?
- What value of  $v_0$  is needed to restore the range in the previous problem to 1 percent accuracy?
- What is the maximum possible range for this value of  $v_0$ ? At what value of  $\theta$  ( $\theta_{max}$ ) does it occur?