COLLEGE PHYSICS LABORATORY EXPERIMENT

PROJECTILE MOTION

THEORY

The maximum horizontal distance $D$ covered by a projectile launched with initial speed $v_0$ and angle $\theta$ at an initial height $H$ is predicted to be

$$D(\theta) = \frac{v_0^2}{g} \cos \theta \left[ \sin \theta + \sqrt{\sin^2 \theta + \frac{2gH}{v_0^2}} \right]. \quad (1)$$

When the initial velocity $v_0$ is unknown, it can be measured experimentally as

$$v_0 = D \sqrt{\frac{g}{2H}}, \quad (2)$$

by launching the projectile horizontally ($\theta = 0$) from a fixed height $H$ and measuring the horizontal distance $D$ traveled.

MATERIAL & PROCEDURE

- **Material**: Projectile launcher with protractor, steel ball, and measuring tape.

- **Procedure**
  - Set projectile launcher horizontally at a fixed height $H$ and measure the maximum horizontal distance $D$ (perform three trials).
  - Calculate mean value and uncertainty of initial speed $v_0$, as given by Eq. (2).
  - Set launcher at different angles (at least ten) and measure height $H$ and maximum horizontal distance $D_{ex}$ for each angle.
DATA ANALYSIS

• For each angle, calculate the predicted maximum horizontal distance $D_{th}$, as given by Eq. (1).

• Graph the experimental maximum horizontal distance $D_{ex}$ versus the predicted maximum horizontal distance $D_{th}$.

• Calculate the mean value and uncertainty of the slope of your graph.

• The theoretical value for the slope of your graph is exactly 1; Calculate the percent uncertainty and percent error on your experimental slope.