1 Background

The *coefficient of restitution* is a quantity that can be used to measure how elastic a collision is. For a one-dimensional collision[1] between two objects, it is defined as the ratio of their relative velocities after and before the collision:

$$e = \frac{v_{af} - v_{bf}}{v_{bi} - v_{ai}} \tag{1}$$

2 Tools

You have a smooth track and two carts. When arranged a certain way, magnets in the carts will repel them away from each other, and can act as soft bumpers. There are masses that are designed to sit on the carts without sliding around very much. Use a motion detector to track the motion of each cart.

It is recommended to use *momentum and energy collision* file in the *physics with Vernier* folder of Logger Pro; this file is configured so that you can calibrate the two detectors to work together. The motion detectors will be facing opposite directions, so it is important to perform the calibration step to make sure both detectors agree on which direction is positive.

3 Task

Determine the coefficient of restitution for two carts colliding with repelling magnets used as bumpers. Report your result as $e = \overline{e} \pm \sigma_e$ where $\overline{e}$ is the average and σ_e is the standard deviation.

4 Follow-up topics

As part of the discussion section of the lab report, be sure to answer the address following topics:

1. What would it mean if $e = 0$? Describe such an interaction.
2. What would it mean if $e = 1$? Describe such an interaction.
3. What would it mean if $e > 1$? Describe such an interaction.
4. You work in product development at a toy company, and you are tasked with determining the coefficient of restitution of a rubber bouncy ball. You drop it from a height H onto a very massive, very rigid metal platform. The ball rebounds to a height $h < H$. Derive an expression for the coefficient of restitution of the rubber ball.

[1] For 2D or 3D collisions it's a bit more complicated; coefficient of restitution is generally only used in one-dimensional cases.