Who's Your Mom-entum? Lab Protocol

Physics

For this lab, you will need to set up laptops, two motion sensors, and use two dynamics carts – along with a few bar masses in order to change the parameters of the collisions you will be observing. The motion sensors should be set up at opposite sides of the tracks and you will need to angle the sensors slightly so that each cart shows up clearly on the velocity graphs (at least in the middle third of the track).

Start by experimenting with collisions using different carts, different masses, and different *elasticities* (carts that bounce off each other versus carts that stick together). Observe how the carts react when they collide. Make sure you can interpret the velocity graphs generated by the motion sensors.

After you've gotten a feel for what you are looking at, follow the steps below. Make sure you and your group work thoughtfully and take careful notes. Finishing this lab protocol during class will help ensure you can get through all the data collection for the lab report during the next class period.

1. Set up two elastic carts with the exact same mass. Roll them from opposite ends of the track towards each other, doing the best job you can to make sure they have visibly different velocities. Repeat until you feel like you've gotten a good trial with clear graphs from the motion sensors. **In your notes, sketch the resulting motion graphs. From the graphs and tables on the computer, identify the average velocity of each cart in the immediate time period of the collision (just before and just after the collision).**

2. Repeat step 1, but this time use carts with different masses. **In your notes, calculate the momentum of each cart AND the total momentum of both carts combined – both before and after the collision.**

3. Repeat step 2, but this time use inelastic carts. Again, **in your notes, calculate the momentum of each cart AND the total momentum of both carts combined – both before and after the collision.**

4. Now, consider the carts a little differently – as two separate systems instead of one combined system. This means that momentum is no longer conserved (for either cart). Therefore, we can think of the interaction between the carts in terms of impulse. Set up elastic carts, with a new set of different masses. With your group, discuss how you can measure the change in momentum of either cart, and how you can use that information to make an approximate estimate of the size of the force between the two carts. **In your notes, show your calculations and explain how you can generalize them so that they apply to any collision between elastic objects (using data from the motion sensor).**