I. Introduction

*NOTE: Please take colored pencils and a rolling-ruler with you to lab.*

For better or worse, collisions are a part of everyday life. They are also an important part of the field of physics. For example most of the information concerning elementary particles is gained from studying collisions. As should be apparent from the previous lab, it is important to study linear momentum when attempting to understand what happens during a collision. A related concept that often gives added insight into collisions is the center of mass.

In class, we’ve found that in an elastic collision, the total momentum vector is conserved and total kinetic energy is conserved.

In this lab we will do an experiment on our air table in an attempt to verify conservation of linear momentum and study the behavior of the center of mass for 2-D collisions.
II. Objectives

At the end of this activity, you should:

1. Be able to calculate and observe conservation of Linear Momentum during a collision.

2. Be able to calculate to see if there is a conservation of Kinetic Energy (i.e. was this truly an Elastic Collision?).

3. Be able to observe that since total momentum vector is constant, then the CoM must travel in a straight line with constant speed.

III. Needed Equipment

Your instructor will show you the experimental setup, which consists of a the 2-D Kinematics air table we used in Lab2 this time with an IRON puck and an Aluminum puck, a scale close to the air table, carbon paper, and plain paper. **In addition, the students should bring colored pencils and a rolling ruler to class.** An additional straight edge would be helpful, but not necessary.

IV. Turn in your Pre-lab/homework problem if assigned.

V. Discussion

Your instructor will demonstrate the experimental setup, the required procedures, and how to take data. **Safety is job number one!**

1. Level the table by turning the legs. The legs should turn easily using the knurled portion of the legs. The nut at the top of each leg should be snug against the table. This time the table stays level and is **NOT** placed on an incline!

2. **Do not turn the power on until told by your instructor.** The high voltage is only to be applied when the pucks are in motion. (If the high voltage is on for an extended time while both pucks are stationary, holes will be burned in the carbon paper and carbon will build up on the glass surface.)

3. The carbon paper should not be folded. The carbon paper should be placed face up (carbon side up) on the glass. Then plain paper should be placed on top of the carbon paper.

4. Turn the air on slowly. The air pressure should be just high enough so that the puck floats smoothly with a minimum of friction. If the air pressure is too high, erratic motion may result.
VI. Procedure

To avoid wasting paper, practice launching the two pucks a few times (including “creating” sparks with the power off). The data are easiest to analyze if the paths of the two pucks make a broad X-shaped pattern.

A. Preliminary Data:

A.1. Measure and record the masses of the two pucks. Be sure you keep straight which one is iron and which one is aluminum.

B. Experiment: An Elastic Collision in 2 Dimensions

B.1. Once you are satisfied you can launch the pucks satisfactorily, launch them for a real data run. As soon as you launch the pucks, step/press on the spark switch, so that the pucks leave a spark record on the paper of their locations as a function of time. A spark frequency of 10 Hz (that is, 1 spark every 0.10 s) works well.

C. Data Analysis:

C.1. To begin your data analysis, find the position of the center of mass of the two-puck system. Do this for three sets of data points before the collision, and three sets after the collision. If the total momentum vector is constant, then the CoM must travel in a straight line with constant speed. Did this happen in your experiment? Discuss this in your conclusion.
C.2. Measure the speeds of the pucks before and after the collision. Use these speeds to determine whether or not kinetic energy is conserved in your collision. If it isn’t conserved, how much non-conservative work was done during your collision? Discuss this in your conclusion, too.

VII. Lab Report to Hand In:

A. Spark record of your collision on spark paper with the following on it: Write the names of all of your lab partners on your lab report.

B. Analysis as outlined in Part C above.

C. Discussion as outlined in Part C.1 and C.2 above.

VIII. Clean-Up

A. End of Lab Checkout: Before leaving the laboratory, please tidy up the equipment at the workstation and quit all running software.

B. The lab station should be in better condition than when you arrived and more importantly, should be of an appearance that you would be PROUD to show to your legal guardians during a “Parents Weekend.”

C. Have your instructor inspect your lab station and receive their permission to leave the Lab Room.

D. You SHALL follow this procedure doing every lab for BOTH SP211 and SP212!

Many thanks to Dr. Huddle for his assistance in producing this Laboratory procedure; specific references can be supplied on request. LCDR Timothy Shivok