Measuring Velocity with a Ballistic Pendulum

Your goal in this experiment is to measure the speed v, and its uncertainty δv, of a projectile that is "shot" out of spring loaded launcher. Your measurement will use the "ballistic pendulum" which you studied in a homework problem. You will check your measurement by comparing the velocity measured using the kinematics of "falling" in the Earth's gravitational field. In both cases, come up with a value and uncertainty for v, and compare the two.

The equipment you'll need for this experiment includes one ballistic pendulum apparatus, and a meter stick. Scales are available for you to measure the mass of the pendulum bob and of the projectile, a metal ball. You don't need your computer and LoggerPro to make the measurement, but if you figure out some way that it can be useful, more power to you.

First, play around a little with the ballistic pendulum. The metal ball is shot into the "cup" that is the pendulum bob. Then, there is a ratchet that keeps the pendulum from falling back down after it reaches its maximum height. Try it a few times, and see how consistent it is. Use measurements of the maximum height of the pendulum to determine, with an uncertainty, the speed $v_{\text{meas}} \pm \delta v_{\text{meas}}$ of the ball when it leaves the launcher.

Then, use some ingenuity to figure out how to determine an independent "predicted" measure of the speed, along with its own uncertainty, that is $v_{\text{pred}} \pm \delta v_{\text{pred}}$. You can imagine firing the ball horizontally off the end of the table and measuring how far it travels, or perhaps firing it upward and seeing how high it gets. *Be Careful!* Don't hurt yourself or anyone else with flying metal balls!

In the end, as always, compare $v_{\text{meas}} \pm \delta v_{\text{meas}}$ with $v_{\text{pred}} \pm \delta v_{\text{pred}}$ and see to what extent the two overlap. Try making a list, as you go through the measurement, of possible sources of systematic error in this experiment. (There are several.)