In this case, the electric force qE can be written as

$$qE = \frac{4}{3}\pi r^3(\rho - \rho_{air})g + 6\pi\eta r v_\uparrow = 6\pi\eta r(v_g + v_\uparrow). \tag{6}$$

Finally we have

$$q = \frac{6\pi\eta r(v_g + v_\uparrow)}{E}. \tag{7}$$

When the electric field is reversed, so that the electrostatic force and particle velocity point *down*, you can show that

$$q = \frac{6\pi\eta r(v_\downarrow - v_g)}{E}, \tag{8}$$

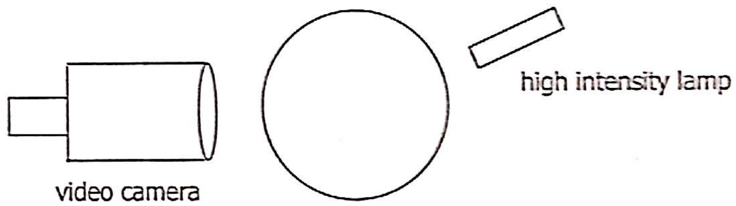
where $v_\downarrow$ is the velocity measured when the electrostatic force is *down*.

The experiment thus consists of measuring terminal velocities of the polystyrene spheres (our "droplets") as they move under the influence of gravity alone (v_g) and with applied electric fields ($v_\uparrow$ or $v_\downarrow$, depending on the direction of E).

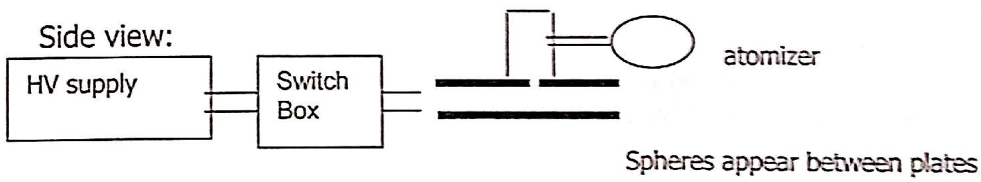
Apparatus

A sketch of the apparatus is shown below.

Top view:



Side view:



This is a modern version of the experiment. You will observe the spheres using a video camera and make velocity measurements by observing their motion on a video monitor.

The main part of the apparatus consists of two aluminum plates separated by a circular lucite ring. This ring separates the plates by a distance 0.750 in. A solution of microspheres is squirted into a container attached to the upper plate, and the spheres fall through a small 0.5 mm diameter hole into the viewing volume. The central region