Millikan Oil Drop Experiment

**Object:** To show that electric charge is quantized and to determine the magnitude of the elementary charge by analyzing the motion of charged oil drops in an electric field.

**Experiment:**



Oil was sprayed through an atomizer into the Millikan chamber. A voltage was applied so that the electric force would oppose gravity on negatively charged drops. The drops were viewed through a microscope with a micrometer to measure the distance a drop travelled in a certain time interval. A negatively charged drop was selected, and its terminal velocities with the electric field off and the field on were measured by timing how many seconds it took for the drop to move ten scale divisions. The float voltage of the drop was determined by varying the voltage until the drop appeared to stop moving. This procedure was carried for 10 total drops.

**Discussion:** We obtained a value of (1.62 +/- 0.13) x 10-19 C for the elementary charge. The accepted value of 1.602 x 10-19 C lies on this interval. Sources of error included electric fields from the building that were unaccounted for. The drops were being constantly bombarded by air molecules and consequently underwent Brownian motion. These two effects caused the drops to not move exactly as theory predicted, often jerking to the side slightly when they should have only exhibited vertical motion.

**Conclusion:** The data from our experiment suggests that there is an elementary electric charge. Each drop was an integer multiple of 1.62 x 10-19 C within error, and therefore it seems that charge can only be transferred to and from each drop in multiples (1.62 +/- 0.13) x 10-19 C. It is obvious that the value of the magnitude of the elementary charge is on the interval [1.49 , 1.75] x 10-19 C. This verifies the basic principal that 1.602 x 10-19 C of negative charge is carried by the electron and charge is transferred between objects by transferring electrons.

**Summary:** Using the procedure developed by Millikan, we determined that electric charge is quantized and that the value of the elementary charge bust be somewhere between 1.49 x 10-19 C and 1.75 x 10-19 C. The charge of 10 oil drops was determined and it was found that each drop had an integer multiple of the elementary charge. To determine the charge on each drop, we analyzed the motion of the drop at terminal velocity both when subjected only to gravitational and drag forces and when under the influence of an electric field as well.