6. Operation

1. Adjustment of apparatus
    a. Adjust the base feet while monitoring the leveling bubble to level the parallel polar plates horizontally.
    b. Turn the voltage adjusting knob in counterclockwise direction all the way to the end, put the changeover switch in the middle position, and connect the power cord.
    c. Rotate the eyepiece to focus the reticle without affecting the image observed in the eyepiece.
    d. Open the oil drop box, insert a focusing needle (for example, a pin), and adjust the focusing wheel until the focusing needle can be observed clearly in the microscope. Finally, remove the focusing needle and close the oil drop cover.
2. Measurement rehearsal
    a. Spraying oil: spray oil drops into the oil drop box through the spraying hole with a sprayer while observing the oil drops with the microscope. Do not spray too many oil drops into the oil drop box. Spraying once or twice should be sufficient.
    b. Controlling motion of oil drops: apply proper voltage to the polar plates (for example, 200 V), and push the unnecessary oil drops out of the oil drop box until several oil drops remain in the oil drop box moving down slowly. By toggling the changeover switch between upper and middle gears, the oil drops can move upward and downward, accordingly. Repeat this process several times to ensure the oil drops do not move out of the upper and lower limits (~ 2.0 mm field of view) of the reticle when observed in the eyepiece. It should be pointed out that the image observed in the eyepiece is inverse, so the moving direction of the oil drops observed under the microscope is just opposite to the direction of their actual movements.
    c. Selecting oil drops: one of the key challenges in this experiment is to select proper oil drops. If the oil drops are too large, their uniform falling speed will be too fast, resulting in more charges to be carried by these large oil drops and higher voltage to be applied to the polar plates. As a result, measurement accuracy will be decreased; on the other hand, if the oil drops are too small, they will be vulnerable to thermal motion and hence be difficult to control. In general, it is preferred to select oil drops in medium size and with slow rising or falling speed. If 200 V is applied to the polar plates, oil drops that

move across the entire field of view (2.0 mm) in 10 - 50 seconds are the suitable oil drops for this experiment.

d. Timing uniform motion of oil drops: select several oil drops at different moving speeds, and use a stop watch to time the falling or rising of the oil drops over a certain distance (for example, 2.0 mm). Synchronize the stop watch and the changeover switch, repeat the measurement several times.

3. Formal measurement

a. Oil spraying

b. Apply ~ 200 V to the polar plates to push unwanted oil drops out of the oil drop box until only several slow-moving oil drops remain in the chamber. Monitor one oil drop by focusing the oil drop with the focusing wheel so that the oil drop can be monitored clearly under the microscope. Measure the time required for the rising motion of the oil drop (observed as falling motion under the microscope) over a certain distance (2.0 mm).

c. Toggle the changeover switch to the middle position, and measure the time required for the falling motion of the oil drop over the same distance.

d. Repeat the above measurements for different oil drops (5 to 10 drops) to calculate the elementary charges as described in section 5.

To carry out the experiment, two students may cooperate with each other. For instance, one observes the oil drops and synchronizes the changeover switch and the stop watch; while the other student records the voltage readings and time.

Warning: <u>due to high voltage risk, using a volt or ohm meter to measure the voltage across electrodes is prohibited.</u>

4. Post-experiment cleaning

After the experiment, the oil-trap should be taken out and cleaned with dry cloth.