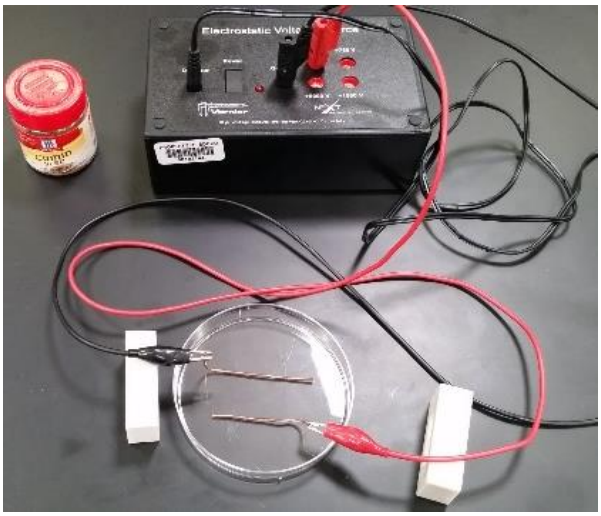
Physics 196 Lab 2: Electric Field Visualization

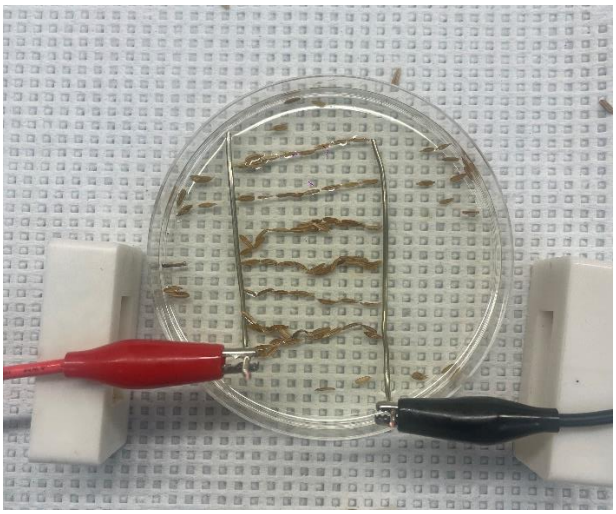
Equipment:

Electrostatic Voltage Source (Vernier), Power converter for Voltage Source, Petri Dish, Red and Black Banana-Alligator Lead, White support blocks, copper or aluminum wire, Safflower oil, cumin seeds, oil absorbent pad, oil recycle container, wire cutters.

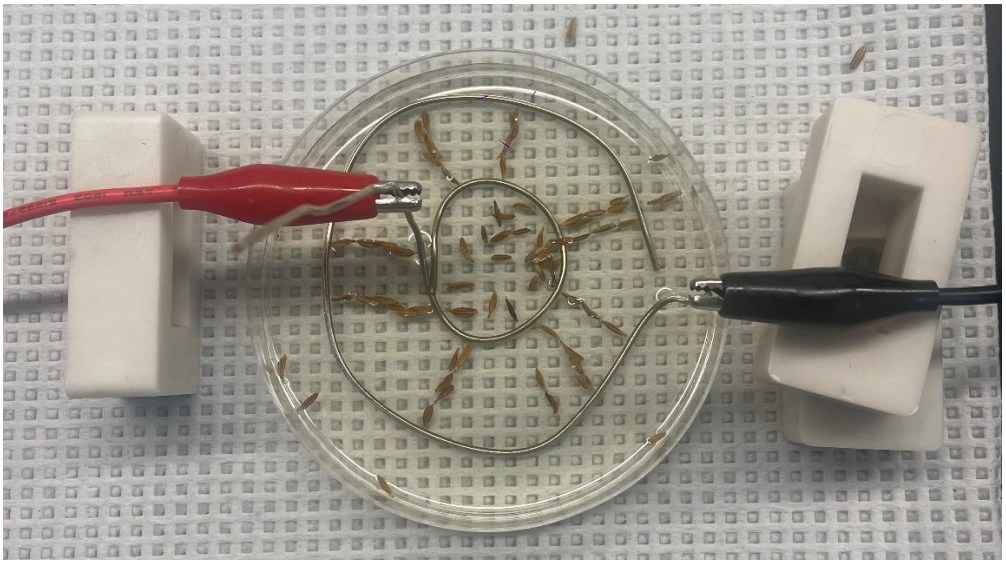
Layouts:



Experimental Equipment



Electric Field – Parallel Lines



Electric Field, Concentric Circles

Summary:

Students will use a High Voltage Electrostatic Source (3000 V output, current limited for student safety) connected to different shapes of conductive copper wire to create an electric field. This electric field can be visualized by immersing the wires in a shallow layer of oil poured into a Petri Dish, and sprinkling in elongated seeds (for instance Cumin seeds work well). The electric field induces a dipole moment in the seeds, causing them to rotate and line up with the field.

Prelab:

Assuming an 8 cm diameter Petri dish, draw in your notebook (to scale, actual size) five configurations of wire electrodes that you might construct and place in the oil, along with your prediction of what the electric field lines between the electrodes would look like. Configuration 1 should consist of two parallel wires. Configuration 2 should consist of a central small electrode (dot) and a large circular electrode at the perimeter. Configuration 3 should consist of 2 small electrodes (dots) separated by about 5 cm. Choose 2 other configurations that interest you. (Examples are a "dot and a line", "concentric circles", "two dots inside a circle", "two parallel curvy snakes", "dot and a corner shaped wire", etc. use your imagination).

Lab:

The set-up, equipment and procedures for this week's laboratory are straightforward to describe. Therefore, this week's lab provides a good opportunity for writing a complete description in your laboratory notebook of what you are doing, what you are trying to achieve, what your results are, and how they compare to what you were expecting.

You will work in teams of two, using a Vernier Electrostatic Voltage Source (suggested output 3000V) to charge wire electrode shapes inside a Petri dish partially filled with Safflower oil to create an electric field. Cumin seeds sprinkled on the top of the oil should line up with the direction of the electric field and allow you to visualize its direction at different locations in the Petri dish. You will shape your own wire electrodes (wire and wire cutters will be made available). The oil only needs to be deep enough to cover the wires. It should be possible to swap out different wire electrode shapes, re-using the same oil with the cumin seeds in it. The pictures on the first page show a sample set-up, the result using parallel line electrodes, and the result using concentric circles. It is useful to support the electrical leads coming in on blocks so that the electrodes lie flat in the oil without tipping up. Add seeds slowly until you get reasonable electric field visualization results. Be patient while the seeds settle into position. Try to avoid getting oil on the alligator clip leads or on the table. (Pads will be provided to go under the experiment). When finished, dispose of the oil in the provided waste container.

Specific Visualizations:

Create configurations 1, 2, and 3 from the pre-lab, observe the electric field, sketch what you see in your notebook, and discuss your results and how they compare to your predictions. Do the same for at least three other electrode configurations chosen from your pre-lab ideas or those of other students in the class. Feel free to swap electrodes between teams to save on wire. Have fun, and try to get a feel for how electric field lines behave close to conductive surfaces. Be sure to write a complete description of the experiment in your lab notebook, including materials used, labelled experimental diagram including electrical connections, procedures, results and conclusions.