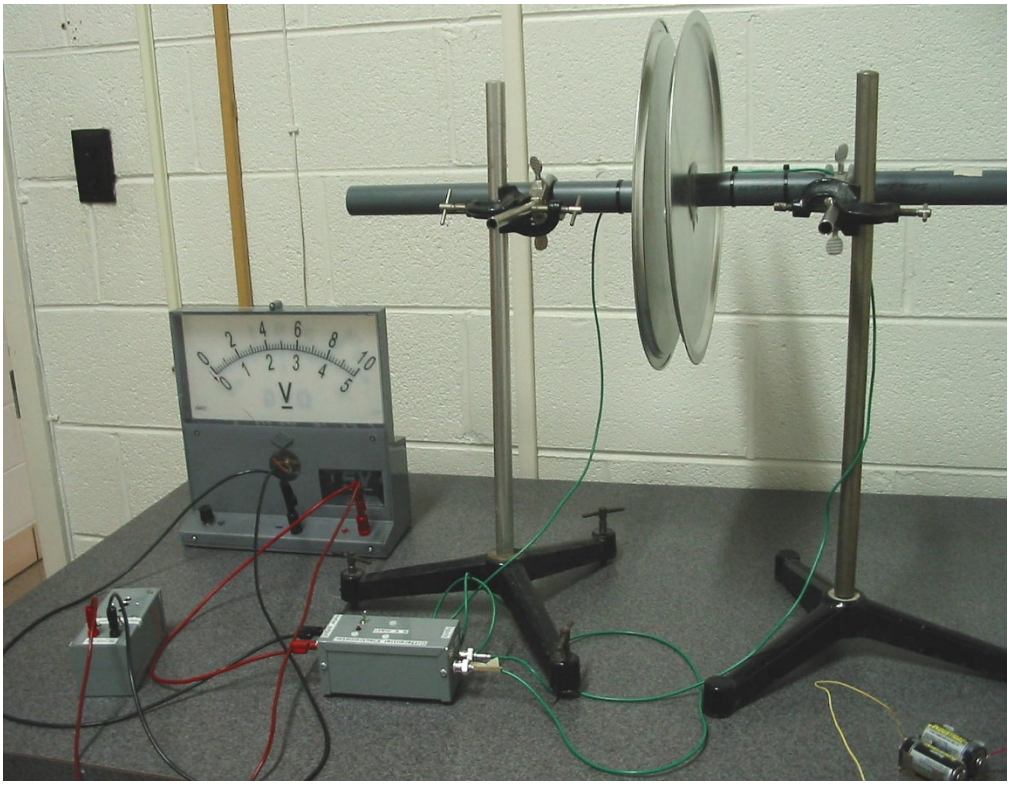
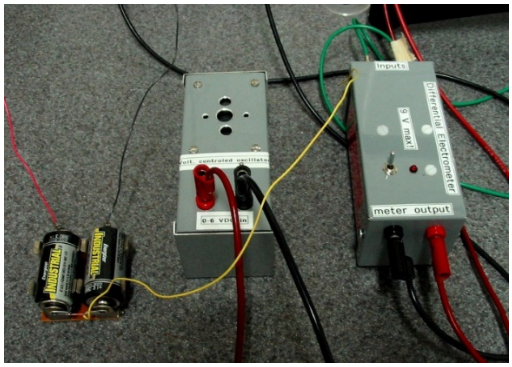
Capacitance



Capacitance Demo

The Electrometer



Accessories

Purpose: Demonstrates *Q=CV* and dielectrics.

This demo consists of a capacitor made from two pizza pans. The voltage on them can be measured without losing any charge using a differential electrometer.

Each plate connects to the electrometer via BNC cables and connectors. The electrometer outputs the difference in input voltages to a conventional voltmeter. The electrometer inputs are very high impendence op amps (≈ TΩ), and will be destroyed by static voltages, so:

DO NOT USE ANY HIGH VOLTAGE (STATIC) SOURCE!

Two C-Cells are provided to supply either the 1.5 or 3 volts needed for the demo. As an accessory, we have a voltage-controlled oscillator that can be connected in parallel with the meter. It gives additional, audio feedback for the voltage—which I find useful.

There are two basic demos to do:

1) $Q = CV$
With the plates as close as possible (nylon spacers prevent them touching) use the batteries to put 1.5V on the capacitor. Then pull the plates apart and the voltage increases! Push them back together again and the voltage returns to 1.5V. This is a nice, counterintuitive, demo to spark some interest.

Explanation 1: Since the charge is constant, and the capacitance is decreased, the voltage must increase.

Explanation 2: For and ideal capacitor, the E-field depends only on the charge (density) and remains constant when the plates are moved. The voltage ($=d\times E$) thus has to increase.

Movie example: capacitance avi

2) Dielectric effect on capacitance

This takes a bit of practice. With the plates separated, put on a potential of 3V. Then carefully stick the sheet of (paper covered)

plastic between them. If you are careful (do not touch the plates), you can see the voltage decrease as the dielectric reduces the capacitance. Upon removal, the voltage goes back up. The closer you can keep the plates together, the better the effect.

Movie example: dielectric avi

Note: I have included a pair of alligator-clip leads that hook to the electrometer. These can be used with real capacitors: it works pretty well to show what happens when you put two in parallel.

See Electrometer Plans for more information.

Extra Equipment: ‘Big’ Fischer meter or some other meter, and banana cables (rack).

Location: Shelf E1