# Charge and Electric Forces

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## Experiment Overview

In this practical the students  investigate electric charges and forces using a Van De Graaff generator and a range of everyday objects. The practical spans two laboratory sessions, with the first dedicated to studying some basic properties of charge, and designing their own experiment to test Coulomb's Law; and the second implementing their experiment and analysing the results.

## Aims and Objectives

The aim is to teach the fundamentals of charge and electric fields (attraction/repulsion/polarisation/Gauss's Law, Faradays cages...) with the simplest possible experiments, and to teach experimental methods by leaving significant parts of the practical open-ended. During the first lab session, the students are lead through the kind of experiments you can do with Van De Graaff generators. This allows them to test basic ideas of charge and field, but also develop techniques that will be useful in the second lab session. If they form a hypothesis to describe an experimental result, they're expected to come up with independent methods to test the hypothesis. For example, in Section 5.1 a Faraday cage effect is responsible for the packing form not moving when inside a tin. They are encouraged to design an experiment to verify that the tin does act as a Faraday (assuming that they form the correct hypothesis of course). They could, for example, look at the polarisation forces on a ball dangled into the tin. Prior to the second lab session the students are required to design their own experiment to test Coulombs Law, with assistance provided by tutors and staff. It is emphasised that Coulombs Law is notoriously challenging to test so they should not necessarily expect their experiment to be a complete success – this is part of experimental science. They will not be marked on their final results themselves, but rather on their justification of their experiment and their analysis and explanation of their results.

## Level of Experiment

First Year

## Keyword Descriptions of the Experiment

**Domain**
electricity, charge

**Specific Descriptors**
charge, polarisation, potential, Gauss?s Law, Electric field, conductors in electrostatic equilibrium

## Course Context

The course is first year modern physics, covering electricity, magnetism, optics, relativity, and quantum physics. The electricity and magnetism part of the course teaches basic properties of charge and magnets, all the way to Maxwell's Equations where it culminates.

## Prerequisite Knowledge and Skills

This lab requires knowledge of basic properties of charge, polarisation forces, conductors in electrostatic equilibrium, electric fields, potential, Gauss's Law, and Faraday cages.

## Time Required to Complete

**Prior to Lab:** 1 hour (in between two sessions)
**In Laboratory:** six hours
**After Laboratory:** two hours (write up report and analyse)

## Experiment History

The experiment was developed over Christmas 2009-2010, and is being run for the first time this semester. No similar experiments could be found at other universities to base this experiment on, so it was developed 100% from scratch.