**PHYS 1301**

# Radioactivity Range

## Introduction

Radioactivity is the spontaneous decay or transformation of the nucleus of an atom, as a result of which particles are emitted from the nucleus. These particles are typically either electrons (called beta particles $\beta$), helium nuclei (called alpha particles $\alpha$) or photons of high energy (gamma particles $\gamma$). The particles released from a radioactive material will be slowed down and eventually stopped when moving through another substance (such as air or solid barrier) due to collisions with the atoms of that substance. In this lab you will investigate using very weak, and therefore safe, sources of radioactivity the penetration of beta particles in air and other materials.

## Equipment

Cobalt Co-60 (weak beta radioactivity source sealed in a plastic disc), Geiger counter and tube, source holder, ruler. You will be using one of two types of Geiger counter, either a smaller green portable counter or a larger plug-in counter. Note which type you have been given. If you are not sure how to operate your counter at any stage, ask the instructor for assistance.

## Procedure

1. The $\beta$ particles are emitted from the side of the disc without the label on it. Sealed weak sources are safe to handle but try to keep handling to a minimum and keep your fingers away from the emitting side of the disc.
2. Turn on your Geiger counter (remove the red cap from the tube if you have a portable counter) and set the scale knob to the largest scale. Turn the volume down so it is not too irritating.
3. (Portable counter) Place the beta radiation source Co-60, emitting side up, on a sheet of card and slide the card into the top rung (Rung 1) of the source holder. To take accurate readings you will need to hold the Geiger tube in the top part of the plastic source holder.

   (Plug-in Counter) Use the small metal magnetized source holder to attach the beta radiation source Co-60, emitting side down, to the scale on the casing of the counter about 1cm from the end of the tube.

4. Adjust the scale knob until you can get a readable result. Waiting to take mid-point of the fluctuating readings, record the counts per minute (cpm).
5. Place a piece of paper between the source and the Geiger tube and record the counts per minute.
6. Place a piece of lead between the source and the Geiger tube and record the counts per minute.
7. Repeat step 4 (not steps 5 and 6) in the following way:

   (Portable counter) - Record cpm for the source in each of the other rungs.

(Plug-in counter) - Record cpm for the source placed at 1cm intervals.

When you are done, turn off your Geiger counter and put the sources back in their containers.

## Analysis

Plot cpm against distance in cm (the distance between each rung is 0.5 cm) and sketch the best smooth curve through your data. The zero for distance can be arbitrary, we are just interested in how cpm changes with distance.

### Conclusions

What can you conclude about the relationship of cpm to distance from the source? Be as precise as you can in your statement. Does this make sense from the discussion about radioactivity in the introduction?

What can you conclude about how easily β particles pass through air, paper, and lead? Does this make sense from the discussion about radioactivity in the introduction?