Experiment 6
Natural Radiation

In this experiment, you will examine a soil sample of your choice. Your goal is

1. to determine how much potassium, by weight, that is in the soil. You should express your answer in percent by weight.
2. to determine the activity of Th^{232}, and hence the Thorium series, in in the soil.
3. to determine the activity of U^{238}, and hence the Uranium series, in the soil.
4. to check if there are any other isotopes in the soil sample (e.g. Cs^{137}). If there are, determine the activity of these isotopes in your sample.

The data will be taken before the experiment day and made available via the Java Applet on my home page.

I. Energy Calibration and resolution of the Ge detector

You first need to calibrate the detector for energy in order to identify the various peaks in our soil sample. In addition, you will measure the resolution of the Ge detector and compare with the resolution of the NaI gamma detector. To determine the energy/(channel number) we will use our normal standards:

Isotope	Energy (KeV)
Cs^{137}	661.657
Na^{22}	511.0034
	1274.53
Co^{60}	1173.237
	1332.501
Bi^{207}	569.702
	1063.662

Analysis of Environmental Sample

We will record data from at least three samples: a background, a soil or other environmental sample, and a KCl sample with the same detector source geometry as the

soils. You can use the Gaussian peak fit feature on the applet to determine the channel number and area (counts) under the appropriate photopeaks. From this data, you should be able to determine the isotope content in the sample. A useful quantity to plot is the **(counts/yield)** for each peak in the decay series. Remember to subtract the background counts from the photopeaks. We will discuss these ideas during the lab period.

Laboratory Write-up

You should turn in the following:
1. (2 points) An energy calibration graph, with calibration equation, from the standards. Your calculation of the resolution of the detector for the 662KeV photopeak of Cs^{137}.

2. (2 points) Your data and calculation for the percent potassium by weight in the soil sample.

3. (2 points) Your calculation for determining the efficiency of the detector for an energy of 1460 KeV for the geometry of the KCl sample.

4. (6 points) A table which lists the channel numbers of the peaks you measured, the energies of the gamma radiation, the yield of the radiation, and the counts/yield. You should use Excel, and can turn in the Excel spreadsheet.

5. (4 points) A graph of (counts/yield) as a function of energy for the sample.

6. (4 points) Your calculations for determining the relative (or absolute) activities of the Thorium and Uranium series in your sample, the potassium percent by weight, as well as any other interesting isotopes found in the soil.