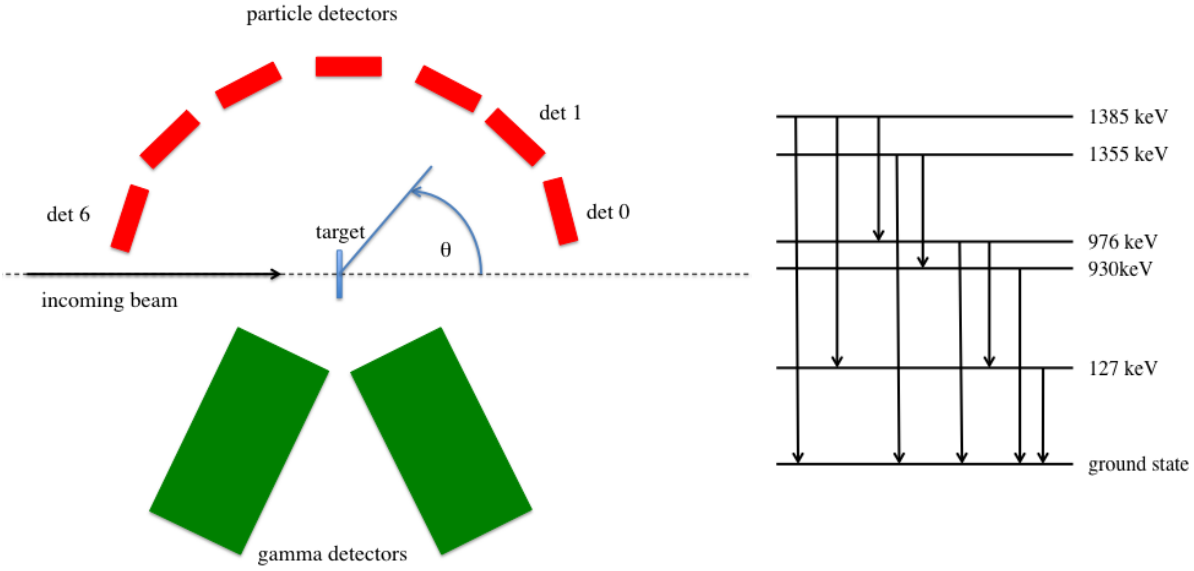
Computing and data analysis for physicists
Final projects

due Dec. 11, 2015

The goal of the experiment was to find the angular distribution of particles inelastically scattered from a 1385 keV level of a nucleus. Unfortunately, the resolution of the particle detectors was not good enough to separate particles scattered of different energy levels in the target. However, the level from which the particle is emitted can be identified by the γ-ray emitted in coincidence with that particle. The level scheme of with the observed energy levels and emitted γ-rays is shown in the figure.

Particle detectors (red), each spanning 5 degrees, were located around the target at 7, 22, 47, 67, 92, 127 and 177 degrees. The γ-rays were detected by two ideal detectors on the opposite side of the target (green). Assume that the γ-ray detectors always detect the full energy with 100% efficiency and that γ-rays from the target are emitted isotropically.

During an experiment, particles emitted from the target were detected in coincidence with γ-rays, i.e. only events that included both a particle and a γ-ray were written to disk. The data were saved into a .dat file, each line containing the gamma ray energies from two γ-detectors, particle detector number that "fired" and the particle energy.



- Write a stand-alone code that converts the data file into a ROOT tree. Use make to compile it.

- Write a data-analysis macro to find the particle angular distribution following these steps:
  - Determine which γ-rays are emitted in a cascade following the excitation of the 1385 keV state, create energy histograms for particles coincident with these γ-rays for each of the detectors. Determine the number of events in these histograms.
  - Using TGraph create a graph of number of particle counts as a function of the detection angle. Don't forget the error bars!
  - Fit the graph to determine the angular distribution function. Hint: the angular distribution is described by a trigonometric function.

The SAKAI submission should include:

- the "converter" with its Makefile,
- the ROOT file with a tree,
- the "analysis" macro,
- TGraph with the fit result.

Make sure the names of the files uploaded include your last name. The files with the code should meet the standards described in the syllabus. The figures have to be "publication ready", i.e. have axis properly labeled, include legend and/or title, fonts and line thicknesses/colors should be easy to read.