PANning for Particles

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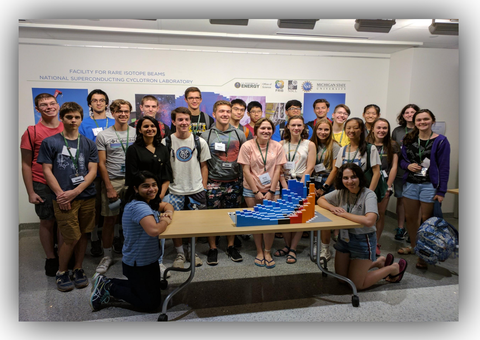
Day 1: Introduction to Nuclear

Chart of Nuclides

In this activity, we built a LEGO model of part of the chart of all isotopes between H-1 and Ne-24.

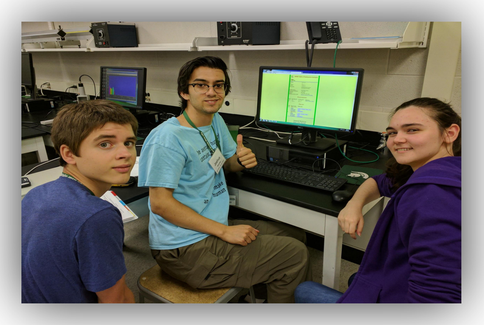
Marble Nuclei Activity

In this activity, we used “nuclei” made up of magnetic marbles to simulate what occurs in a particle accelerator. We set up a target nucleus in a bin and dropped a second through a set of PVC pipes to mimic acceleration. When one stable “nucleus” hit the other, protons and neutrons broke off, creating a new isotope.



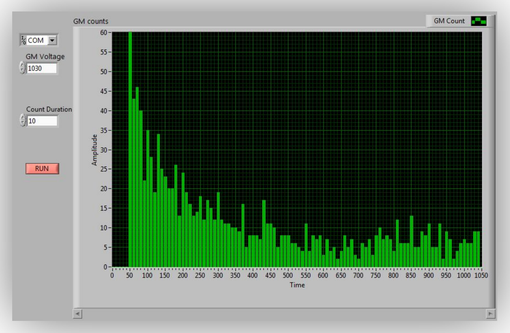
Day 2: Gamma Spectroscopy Experiment

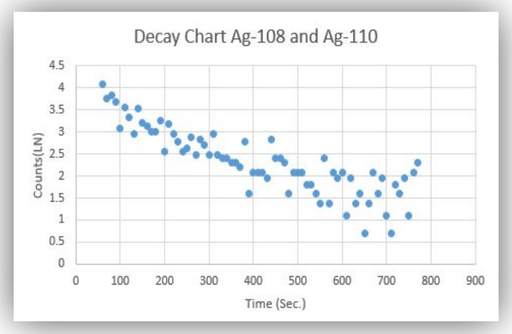
Purpose: We identified an unknown isotope by detecting gamma radiation with a gamma spectrometer.
Methodology: We had to calibrate the software by using samples of Cs- 137 and Co-60 with known energies to associate channels with specific levels of energy. Then we ran the sample of the unknown isotope through the spectrometer to find the energy point at which the gamma rays peaked and compared that number to a pre-existing database.
Results: The detector peaked at 816 keV, reporting a margin of error equal to 10.1 keV, estimated by the FWHM. After searching the database, we determined that the isotope had been Mn-54, as it had a half life on the scale of days and a percent disintegration around 90% for gammas.



Day 3: Half-Life Decay Scheme

Purpose: Create a chart depicting the decay of Ag-108 and Ag-110 to predict the half lives of the two elements.
How did we make it: An AmBe neutron source was used to transmute natural silver to Ag-108/110.
Methodology: A GM counter and computer were used to pick up the radiation and chart the changing counts over time. The slope of the chart at certain sections would be used to find the half life for both isotopes.
Results: For Ag-110, the half life was found to be 56.35 seconds while the half life for Ag-108 was found to be 3.61 minutes. The results had 129% and 50% error respectively. However, this had been due to the little time taken for measurements as well the non-linear nature of the decay scheme.





Day 4: Nuclear Properties with EDF Theory

We learned about the properties of nucleons and used theoretical models to predict radioactive decay in isotopes of various elements. Given proton and total nucleon count, the program was able to generate the particle states for the proton and neutron orbitals. Using this data, we were able to determine the theoretical bounds of which isotopes could exist for a given element.

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