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RCNP Week 6 Report

This week consisted of our preparation for beam time, as well as the experiment using the beam itself. Luckily, we were able to have access to the germanium detector last Friday which allowed us to set it up and begin tests. Unfortunately for us, however, the original germanium detector that we were planning on using does not have a good vacuum state meaning it would become wet from condensation when left in the H-course. Also the baseline, after high voltage was applied, never stabilized. Because of this, we changed our plan and decided to use the segmented GRAPE germanium detector. The first challenge that we faced was figuring out where to place our detector. Since the first choice was easily placed on the ground, we had envisioned using a 48cm distance from the crystal to the beam target. Since we had to change detectors, we could no longer use this setup and had to place it on a table with the crystal hanging over the edge, underneath the target by about 10cm. We also decided to use the same sodium iodide scintillators we had used before in this experiment to compare the energy spectra given by each detector. This NaI detector was placed 21cm away from the target by using an adjustable table on top of another frame.

After we prepared the H-course for our beam time, we began making tests for background spectra from both detectors, completed energy calibrations using europium-152, and matched the gain with each of the shaping amplifiers and the sum-amp. Since the germanium detector has 18 output signals, we must use the sum-amp to combine them and send the entire signal through only one shaping amp. This required extensive gain matching to ensure that the signal would not have bad resolution.

On Friday, we began using the beam for our experiment. The beam is a 4He2+ alpha particle beam with a lab energy of 28.5MeV. Our target was a sample of Gadolinium-156 which had a thickness of 1.175mg/cm^2 and our resultant was Dysprosium-158. When we started using the beam, we had to first calibrate it so that it was in-line with our target position, then, we had to adjust the beam intensity to a point where we would not see too much “dead time” in the detector. If the intensity is too high, we will have pile up on the germanium detector which will negatively affect our signal and cause excess “dead time”. After choosing a current of 1nA, we saw that the signal was giving us ~10% dead time when comparing to “live time”. We decided that this was good enough for our trials and began taking data.

The first trial that we took involved using all 18 channels from the germanium detector as well as the sodium iodide detector. Immediately we could see a drastic difference in the resolution of NaI and Ge which also proved that the NaI data would not be useful for us during this experiment as the resolution was too wide. We also saw that, by using all 18 channels from our Ge detector, our resolution was not as good as it could be by just using one of the segments on the crystal that was facing the target. After we acknowledged this, we decided to take more trials using one segment on each side of the crystal and three segments on only the side facing the target. This gave us much better resolution than using all the channels (we went from ~6-7 keV of resolution to ~2.4 keV). We continued to run data trials for ~2-3 hours per trial and continued to analyze the data we could during the time in which the beam was on. We also attempted to make coincidence measurements using the “coincidence mode” on the MCA which was not as successful as our ROOT script was while using “list mode” in the MCA (“list mode” simply takes timestamps of each count during our experiment).

Our plan for the coming weeks consists of analyzing each of the trials we ran during beam time and interpolating the data which we have collected. We have lots of data that we need to sort and analyze in order to understand the rotational band of 158-Dy, as well as the coincidence in the gamma emissions and the difference between each segments’ signal.