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RCNP Week 2 Report

During the second week of our time spent at the RCNP, we continued to work on the angular correlation experiment, this time implementing the cobalt-60 into our trials. First, however, we measured and recorded the peak position change in the MCA readings as we altered the gain coming from the shaping amplifier. Then, we worked with Ideguchi-san and Mukul to set up a place to begin calibrating both the efficiency and the energy of each scintillator with a radioactive cobalt-60 source. We used a sample of cobalt-60 from 2017 to ensure that our resulting signal would be strong enough to calibrate each scintillator (ours was ~ 16 kBq). After confirming that our readings in the MCA were, in fact, cobalt-60, we were able to begin calibrating the efficiency and energy. To calibrate the efficiency, we took measurements from the PMT, through a shaping amplifier, then to the MCA. We took measurements where the scintillator was 6cm, 10cm, and 14cm away from the cobalt source then compared the readings and strengths of each peak in the MCA. Then, using the same method, we were able to use the “range of interest” function in the MCA to find the exact peak centroid values from the 1174 keV and 1332 keV emission spectra and plotted them to find the slope and y-intercept of the respective line. This allowed us to then create a set of parameters which would show which channel value in the MCA correlates to which keV level.

After we had created the set of parameters, we had to analyze the data which we had collected to understand the efficiency calibration. By creating a Python script, we were able to simply input the .csv file and we would receive the Gaussian fit, background signal, and fitted Gaussian with the background subtracted for our cobalt gamma ray peaks from each scintillator. By comparing the number of counts under each of the cobalt emission peaks to the expected number of counts using the activity from the source, we were able to get the true efficiency calibration. Once we had completed the calibrations, we can now begin on creating a coincidence circuit for the scintillators to carry out our angular correlation. While we work on the coincidence circuit, we also retested the background readings from each scintillator using the calibration settings to understand what the peaks we got in our first test correspond to. We were able to see the potassium-40 and bismuth-214 emission lines from the environment around us.