Preliminary analysis towards ^{55}Fe photon strength function using ^{54}Fe (d, p)^{55}Fe reactions with DAPPER

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Fall 2023

The Detector Array for Photons, Protons, and Exotic Residues (DAPPER) was assembled for the measurement of ^{55}Fe photon strength function. DAPPER is composed of an annular silicon detector(S3) for capturing protons emitted at backwards angle and 128 barium fluoride scintillators to measure gamma ray energies from the de-excitation of residues [1]. Photons strength functions serve an important role in constraining neutron capture reaction models for advancements in nucleosynthesis, stockpile science, and reactor design. During the DAPPER campaign the experiment was split into two modes, stable beam and radioactive beam mode. Stable beam mode would run DAPPER similar to previous campaigns using a high intensity beam on a deuterated polyethylene (CD2) target for high statistics on the silicon and barium fluoride detectors. Radioactive beam mode would utilize the fast Ionization Chamber (IC) from the GODDESS array while attenuating the beam for an optimal intensity for both the silicon detector and the IC. The attachment of the GODDESS ionization chamber allows for particle identification and the energy of the residues [2].

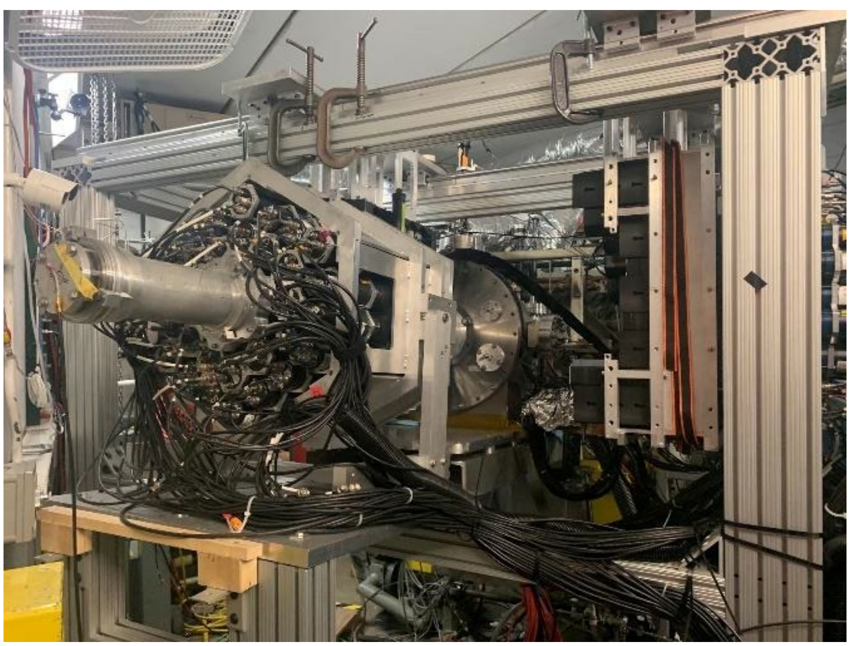

FIG. 1. A picture of DAPPER assembled during the experiment in stable beam mode.

Spring 2024

Review of the data collected in Fall 2023, the calibration of detectors has begun using an array of sources with known energies for both the silicon and barium fluoride during the experiment. Fig. 2

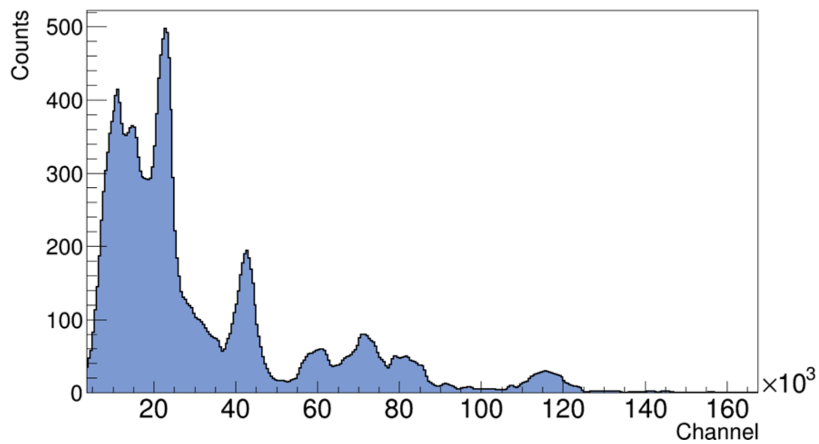

FIG. 2. ^{207}Bi Source run that is being used for the calibration of the barium fluoride detectors.

shows a ^{207}Bi source run for the barium fluoride detectors with the peaks at 20,000 and 40,000 channels, which are known gamma rays, also peaks between 60,000 to 120,000 are known alphas. At the moment there are still corrections needed for both the silicon and the barium fluoride detectors either in gain or calibration. The barium fluoride detectors suffer from gain offsets due to changing temperatures in the surrounding environment, however by using the internal alpha radiation from the radium contaminant, gain corrections can be done as a function of time. The silicon detector calibration was done using an alpha source, but needs slight gain corrections due to heating of pre-amps. Fig. 3 shows excitation energy vs angle calculated using inverse kinematics from the protons detected by the silicon detector for ^{55}Fe, however jags and offsets in the plot show a need for corrections in gain. Fig. 4 from the IC we get waveforms showcasing single and higher order hits close in time. Following the fitting of single hits, the plan is to find suitable

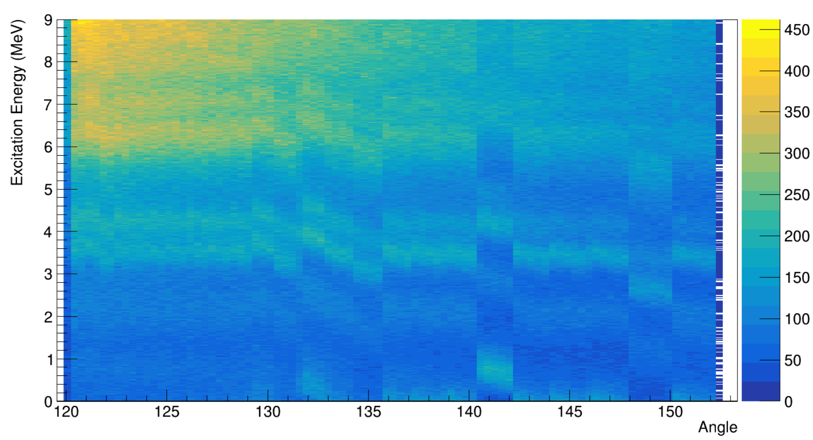

FIG. 3. Excitation energy vs angle for ^{55}Fe from the silicon detector.

methods that can allow for the disentanglement of multi-pulse waveforms. This fitting and disentanglement will allow us to extract the energy of single hits and multi-hits.

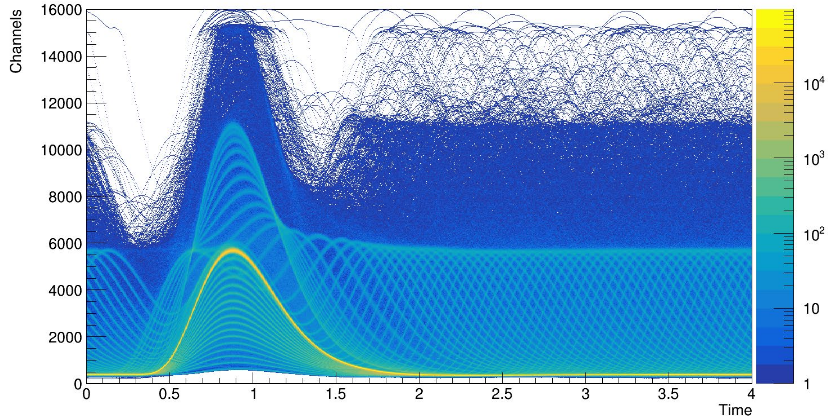

FIG. 4. Waveforms collected by the ionization chamber during the experiment.

[1] S3, https://www.micronsemiconductor.co.uk/product/s3/.
[2] S.D. Pain *et al.*, Physics Procedia **90**, 455 (2017).