In Situ Calibration of a Proton Particle Telescope using the SUNY Geneseo 1.7 MV Tandem Pelletron Accelerator

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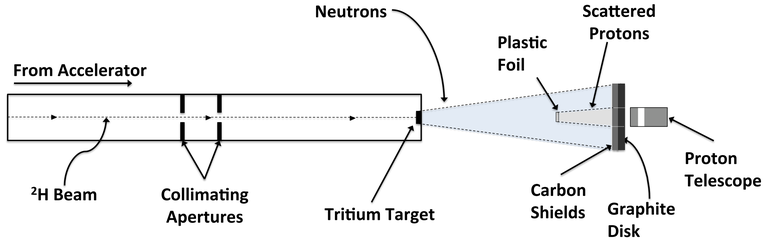
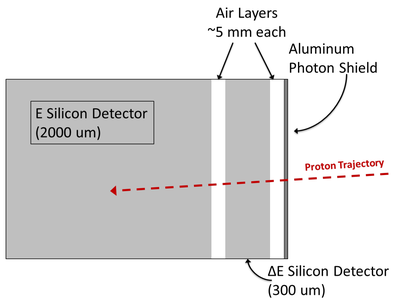
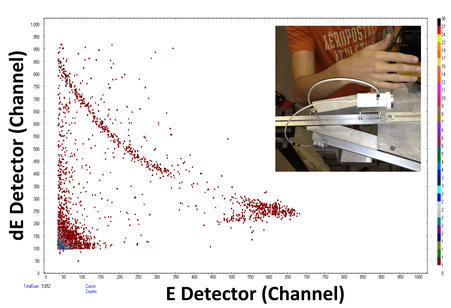
Motivation



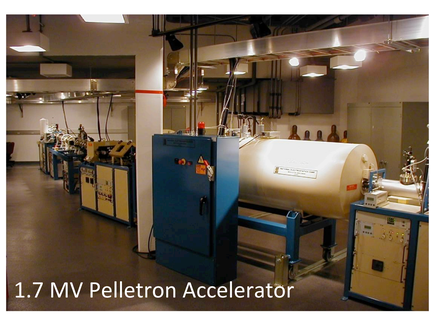
The particle telescope was constructed for an experiment in progress at Ohio University's Edward's Accelerator Laboratory. The experiment seeks to measure the ^{12}C(n, 2n) reaction cross section for neutron energies between 16 - 26 MeV. Before striking the ^{12}C activation sample, the neutrons first pass through a polyethylene foil, elastically scattering protons out of the foil. The number of scattered protons detected in the telescope can be correlated to the neutron fluence during activation of the ^{12}C sample. The telescope resolved the recoiling coincidence plot, providing a reliable monitor of neutron fluence.

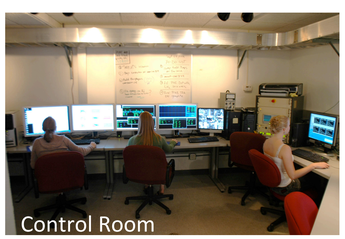
Proton Particle Telescope

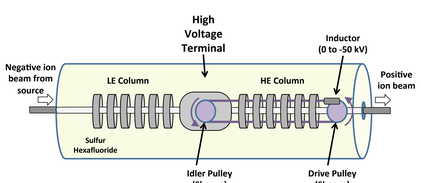




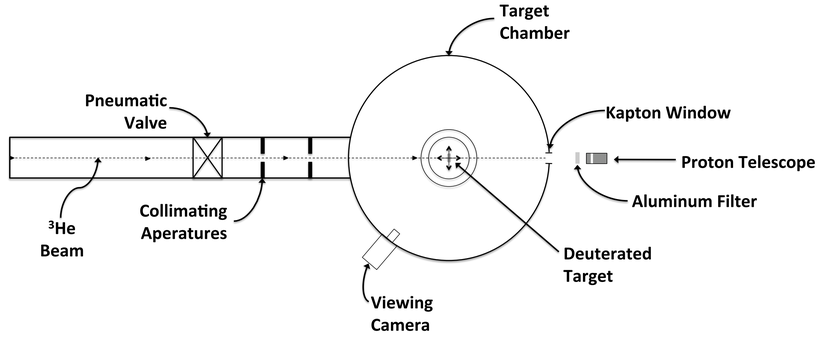
Tandem Pelletron Accelerator



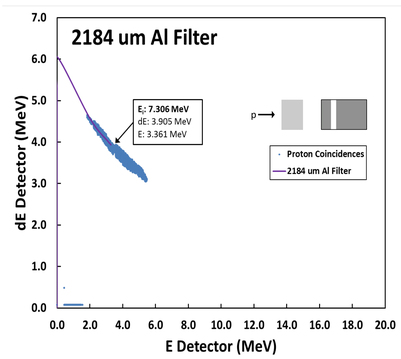


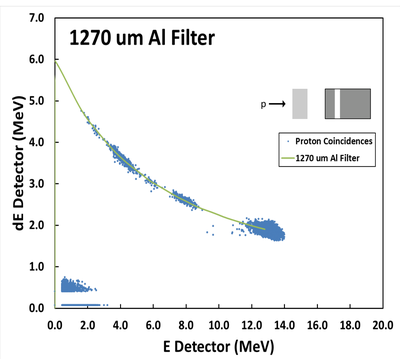


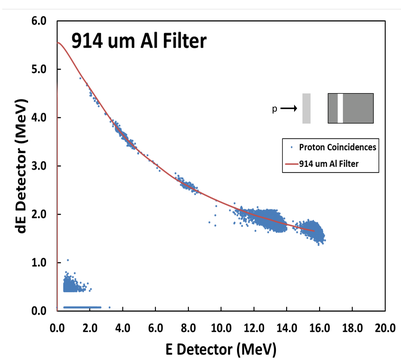
Telescope Calibration

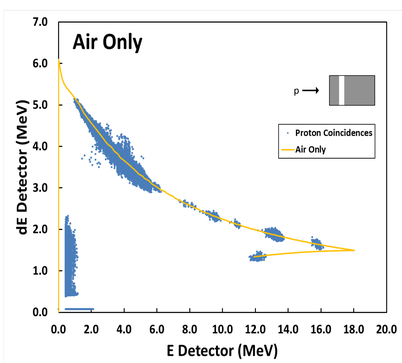


A beam of 4.5 MeV ^{3}He ions struck a thin deuterated target in vacuum where 22.55 MeV protons were created via the ^{2}H(^{3}He, p)^{4}He reaction. These protons entered atmosphere through a thin Kapton window located at 0°. The particle telescope was mounted on axis with the beam so that protons with the maximum energy would be detected. The proton energy was changed by inserting aluminum filters of various thickness (above). The detected protons formed an island on a two-dimensional coincidence plot that tracked the theoretical response function of the telescope (below).









Energy Deposition Code

Generate stopping power tables from SRIM transport code

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Interpolate smooth stopping function from tables

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Iteratively determine energy loss in each detector for any proton energy

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Extract loss function for protons in ΔE and E detectors

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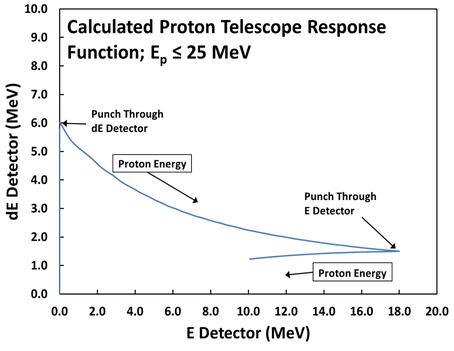
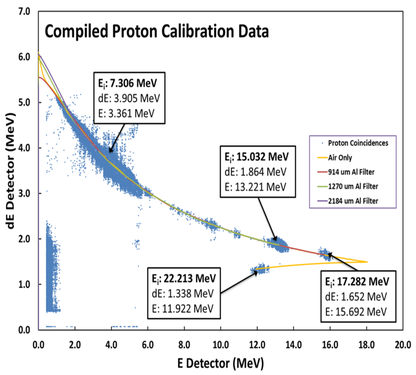
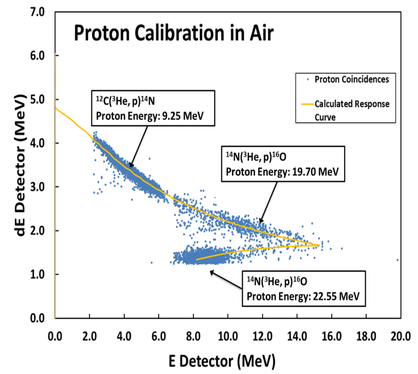
Construct telescope response function



Results





Experimental Area