Measurement of target thicknesses

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Several thin CD_2 targets have been obtained in order to measure the photon strength function of ^{60}Fe using the ^{59}Fe(d,p)^{60}Fe reaction [1,2]. The thicknesses of the targets are labeled based upon the production process; however, the precise knowledge of the target thickness improves the quality of the measurement. Therefore, the target thicknesses are being measured using energy loss with an alpha source. The alpha particles lose energy as they pass through the target, and the amount of energy lost is dependent on the thickness of the target. The energy loss in the target was measured when the targets were at 0° and 45° relative to the line between the source and the silicon detector. The experimental set up is shown in Fig. 1. Thorium-228 was used as the alpha source.

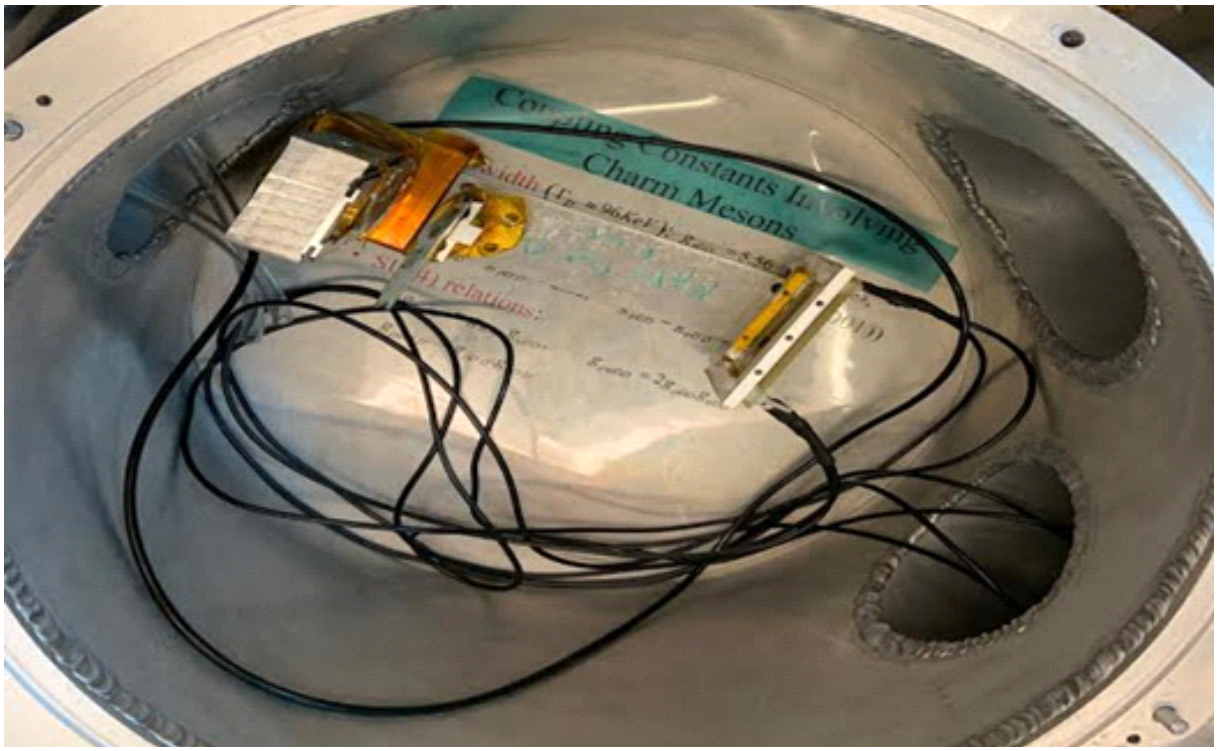

Fig. 1. Experimental setup. A quadrant Si detector was used to detect the alpha energies. A target at 0° refers to when the target is perpendicular to the direction of travel of the alpha particles.

Almost the full complement of targets has been measured in this way. Runs without a target were done in between the target runs to ensure the calibrations were consistent from one run to the next. Each of these runs has now been calibrated. Fig. 2 shows one such calibrated run, thorium-228 source on the silicon detector. The peaks should range from 5.685 MeV to 8.785 MeV.

The calibrated measured peak energies from the thorium-228 source were compared to calculations of energy loss using CycSrim calculations, which are based upon the Stopping Range of Ions

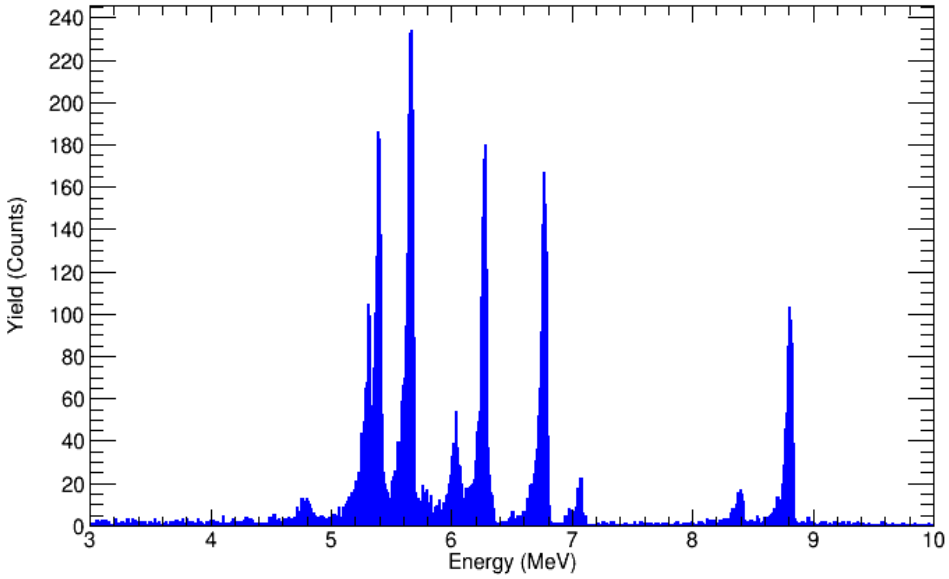

Fig. 2. Calibrated spectrum of ^{228}Th source used for target thickness measurements.

in Matter (SRIM). The percent difference between the measured energy of the alpha particle and the expected energy, based upon SRIM, is shown in Fig. 3 below for two different assumptions of the thickness for one representative target. Analysis of this data is ongoing.

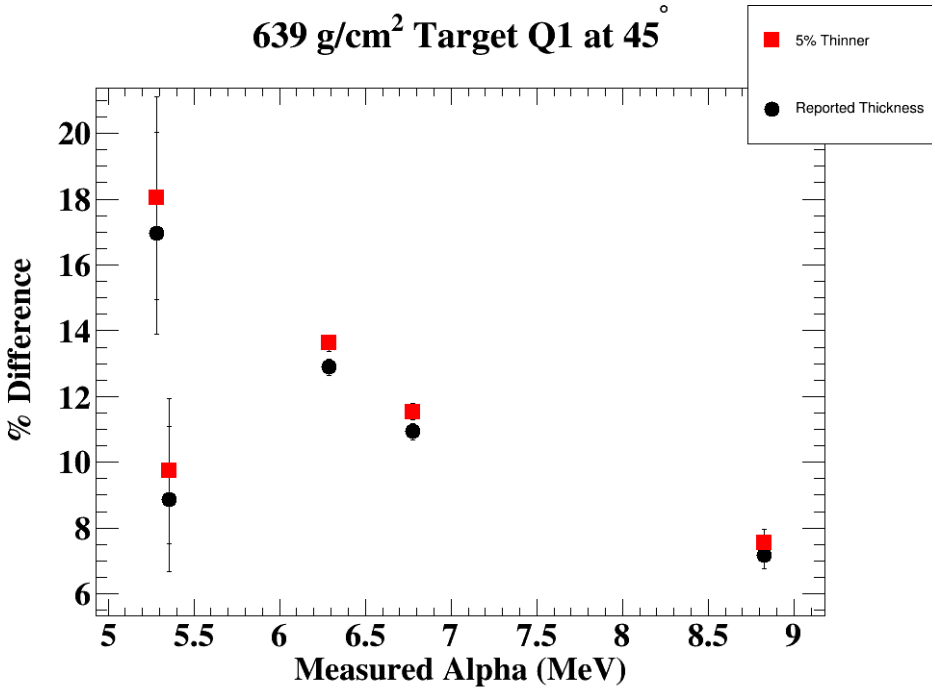

Fig. 3. A 639 g/cm^2 target at 45°. This shows the percent difference between the measured and calculated alpha energy (MeV). This was also done to a 5% thinner target than was reported.

[1] A.B. M
p. II-18
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[2] A.B. McIntosh *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2018-2019), p. II-21.