

Nuclear instrumentation

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1. Determine the thickness of the ΔE detector

To determine the thickness of the ΔE detector, we'll take a look at the requirements: "Deuterons need to have an energy of at least 13.3 MeV to be detected by the system", This means that either of the thresholds isn't reached. I.e either the deposited energy in the silicon detector isn't above the threshold or the one in the Germanium detector isn't above 5.2 MeV. we'll vary the width of the ΔE detector and see when the threshold energy of the Ge E detector is no longer reached:

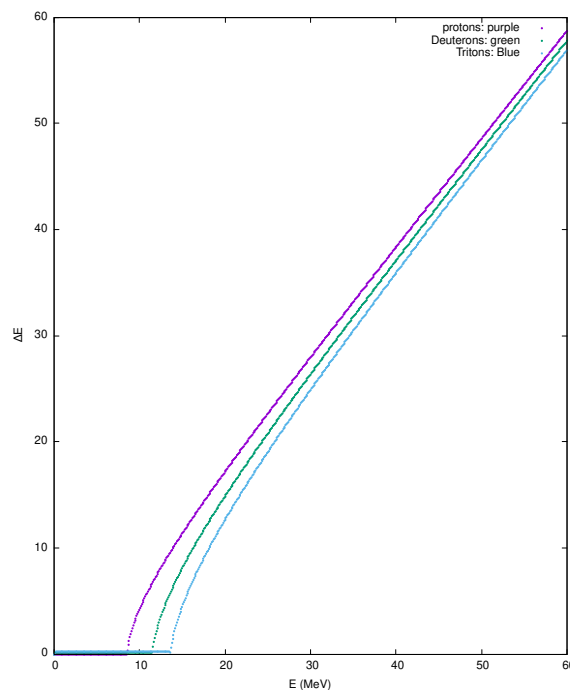
13.3 MeV Deuteron

A deuteron with this energy still barely gets detected, looking at the energy deposit in function of the width we can see that the Germanium detector gets past its threshold for a width of 0.0533 cm:

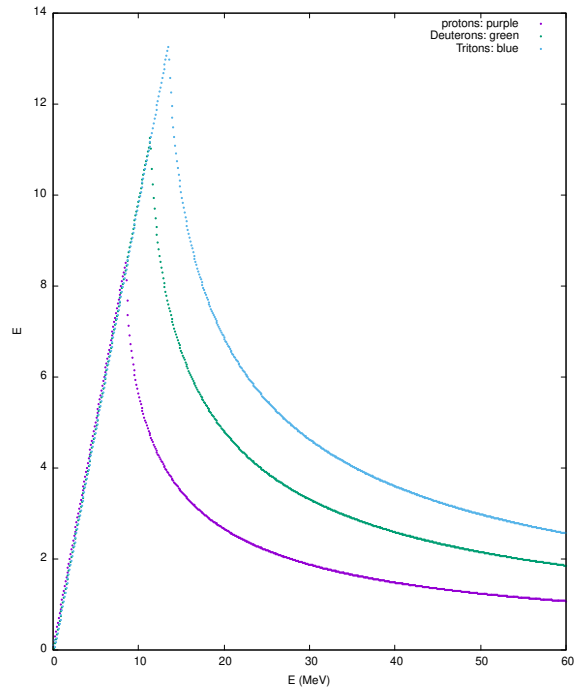
Width (cm)	Energy loss ΔE Detector (MeV)	Energy loss E detector (MeV)
0.0533	7.772	5.20667
0.05335	7.78273	5.19593

So we conclude the width to be 0.0533 cm or $533\mu\text{m}$.

2. Proton, Deuteron and Triton Energy Loss



It's clearly visible on the above plot that a ΔE -E detector can discriminate between the different particles as soon as the energy is high enough for the particle to be detectable in the detector as the lines above are separate. In effect we need the two plots, also the energy loss in the Germanium detector:



If we for example have a proton of 30 MeV that falls in onto the detector, from the ΔE detector we see an energy transfer of 28 MeV, this could be identified with a proton of 30 MeV but also a Deuteron of 33.4 MeV or Triton with 34.6 MeV. But if we look at the observed energy in the Germanium detector we'll see 1.88 MeV, and we see from the plot above that this can only come from a 30 MeV proton, as Deuteron of 33.4 MeV would deposit around 3 MeV and Triton of 33.4 around 4 MeV.