1.

```
R1 = uncertainties.ufloat(10000, 0.05*10000)
R2 = uncertainties.ufloat(82000, 0.05*82000)
Cf = uncertainties.ufloat(10**(-12), 0.05*10**(-12))
G2 = R2/R1/Cf
print("Gain = ", G2, "F^-1")
```

✓ 0.2s

```
Gain =  (8.2+/-0.7)e+12 F^-1
```

2.

```
G1 = uncertainties.ufloat(0.264, 0.001)
E_alpha = uncertainties.ufloat(5.486, 0.001)
#conversion factor from MeV to J
Vpp = G1*G2*E_alpha*1.60218*10**(-13)
print("Vpp = ", Vpp, "V")
```

✓ 0.4s

```
Vpp =  1.90+/-0.16 V
```

3) Estimated typical pulse $\approx$ 352.46 mV

<u>Data Used</u> All voltages $\pm$ 3 mV

Amp - 479.9 mV

=> 10% - 48.0 mV

=> 90% - 431.9 mV

10% to 90% rise time - $2.69 \pm 0.10\ \mu s$

=> 37% - 177.6 mV

100% to 37% decay time - $74.11 \pm 0.10\ \mu s$

times measured have appropriate magnitudes

3.

$0.8\,\mu Ci = 2.96\times10^{4}$ decays/s

Measured over 120s period - cutoff at 800 bins => 56 mV

Estimated total counts = $(2.96\times10^{4}$ decays/s$)(120s)$

$= 3.552\times10^{6}$ decays

Measured total counts = 351083 counts

5.

This count is likely off because the source does not radiate in one direction so the sensor will not be able to detect all of the alpha particles emitted by the source.

6) Stopping power at 5 MeV = S = 1000 MeV cm^2/g

Mylar density = 1.4 g/cm^3

Air density = 1.2×10^{-3} g/cm^3

For Mylar $0 = 5\,MeV - 1000\,MeV\,cm^2/g \cdot 1.2\times10^{-3}\,g/cm^3\,\Delta d$

$\Delta d = 4.2$ cm

For Mylar $0 = 5\,MeV - 1000\,MeV\,cm^2/g \cdot 1.4\,g/cm^3\,\Delta d$

$\Delta d = 3.6\times10^{-3}$ cm

6.

7) We will measure the energy with different numbers of Mylar sheets (2.5 μm) between the ^{241}Am and detector. The air cannot be considered negligable due to the gap needing to be large enough to fit the Mylar sheets.

Distance between ^{241}Am and detector - 8.9 mm

$0 = 5\,MeV - 1000\,MeV\,cm^2/g \cdot \left(1.2\times10^{-3}\,g/cm^3\,(0.89) + 1.4\,g/cm^3\,\Delta d\right)$

$\Delta d = 2.8\times10^{-3}\,cm$

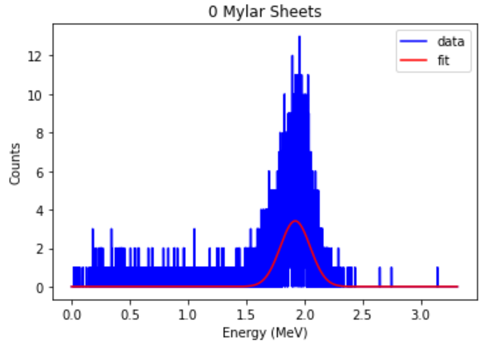
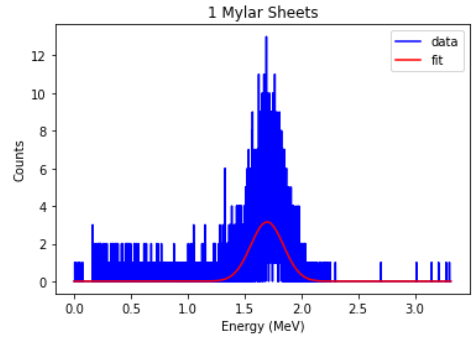
$\frac{\Delta d}{2.5\mu m} = 11.2$

∴ We can use ~11 sheets of Mylar

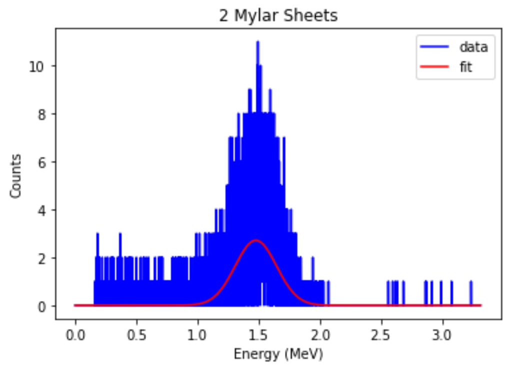
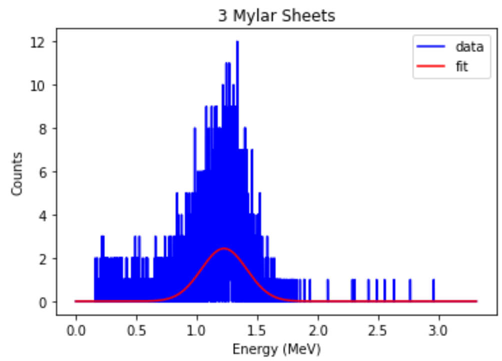
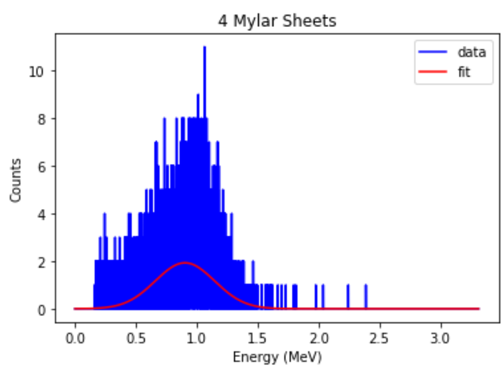
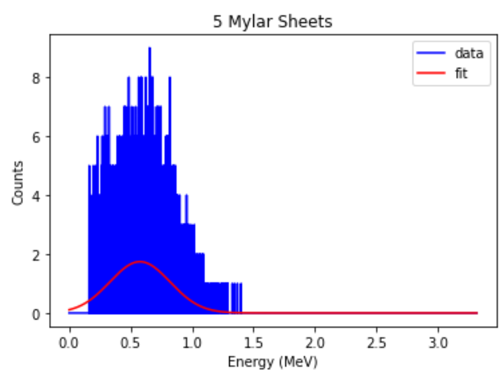
all Multichannel Analyser settings are the same as part 5

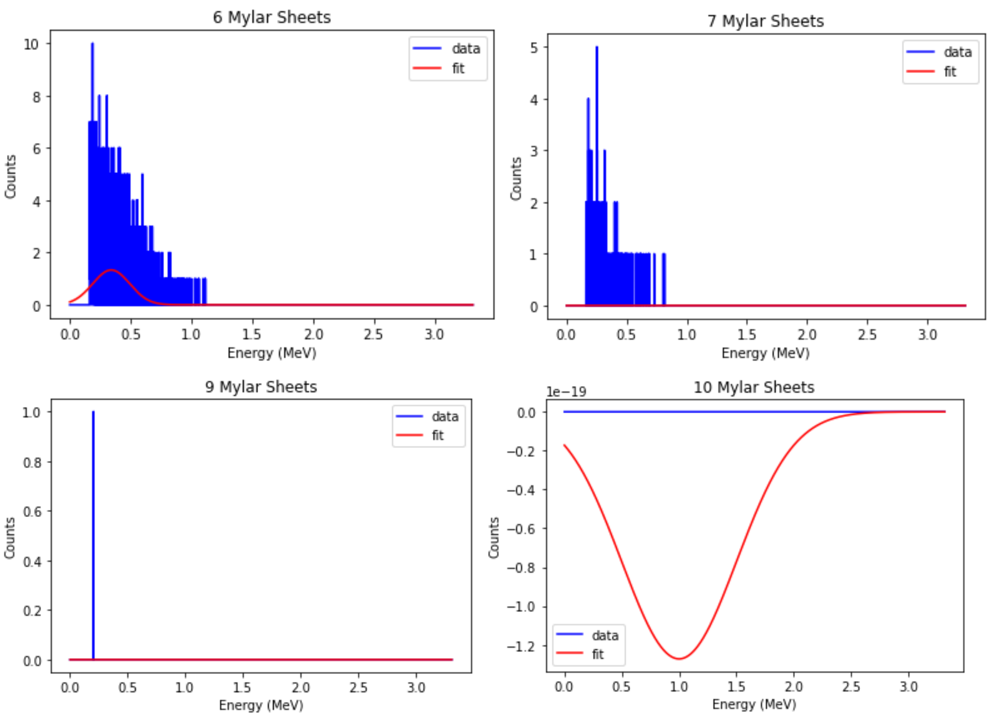
7.

11.2 sheets of 2.5μm mylar will result in the alpha particle having 0 energy when it reaches the detector. The number of mylar sheets that will result in an inability to detect the alpha particles will be lower than this because of the noise threshold.

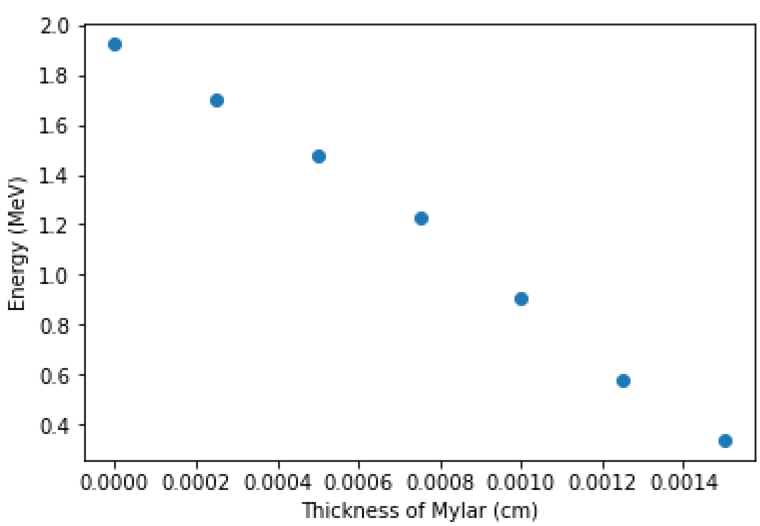

0 Mylar Sheets
data
fit
Counts
Energy (MeV)

1 Mylar Sheets
data
fit
Counts
Energy (MeV)

9.


2 Mylar Sheets
data
fit
Counts
Energy (MeV)

3 Mylar Sheets
data
fit
Counts
Energy (MeV)

4 Mylar Sheets
data
fit
Counts
Energy (MeV)

5 Mylar Sheets
data
fit
Counts
Energy (MeV)



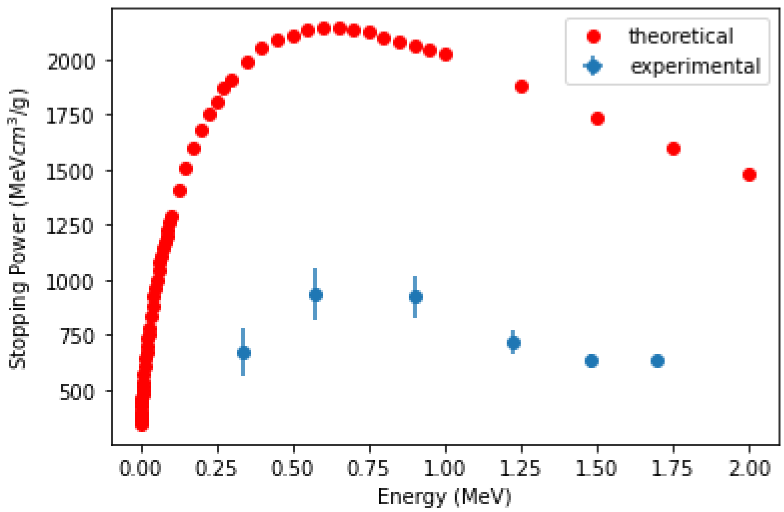
For 7 mylar sheets and up the fit fails because the peak shifts into the noise region where data was exluded so the fit function can not produce a good fit as half the data is missing.



10.

If the graph is extrapolated to 0, meaning the air is not in between the detector and source, then the known full energy of the alpha particle would be obtained. As more mylar sheets are added, the energy of the dectected alpha particles decreases. In this region the realtion apears to be linear.

11.



The measured data appears to have the same shape as the theoretical data, but the amplidute is significantly lower. This implies that the alpha particles are losing siginifcantly more than the predicted energy loss as it passes through the mylar sheets and air. This could be bacuse of some interaction when it changes medium or the mylar sheets may be thicker than reported. The shets were not taught and had some wrinkles. This would make the effective thickness of the sheets larger than the thickness of the sheet. Thus the ploted energy vs thickness of mylar graph would be compressed horizontally, increasing the slope and stopping power with it.