GCRF – RHUL CMOS Update

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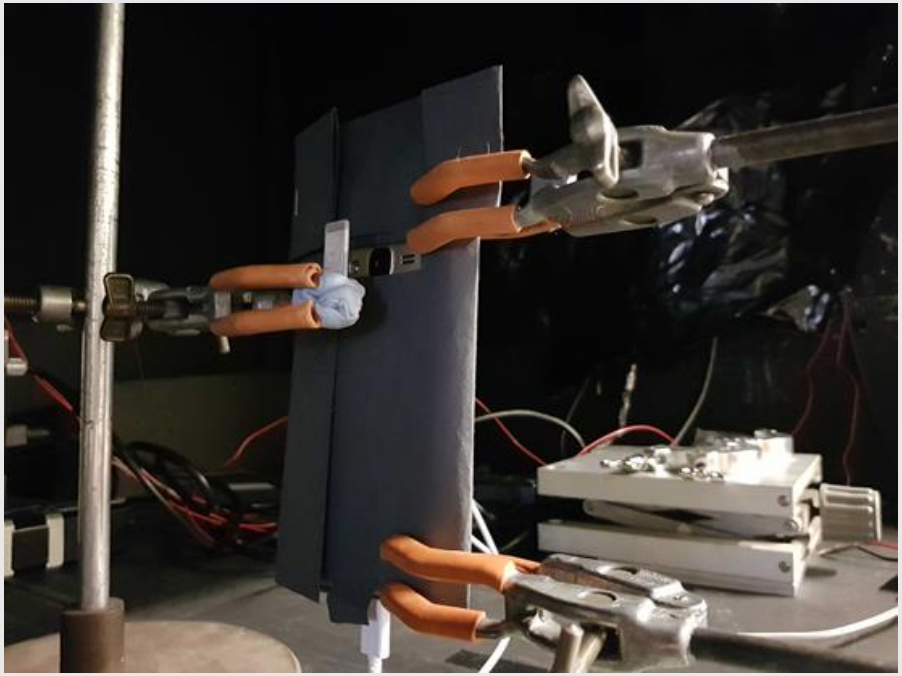
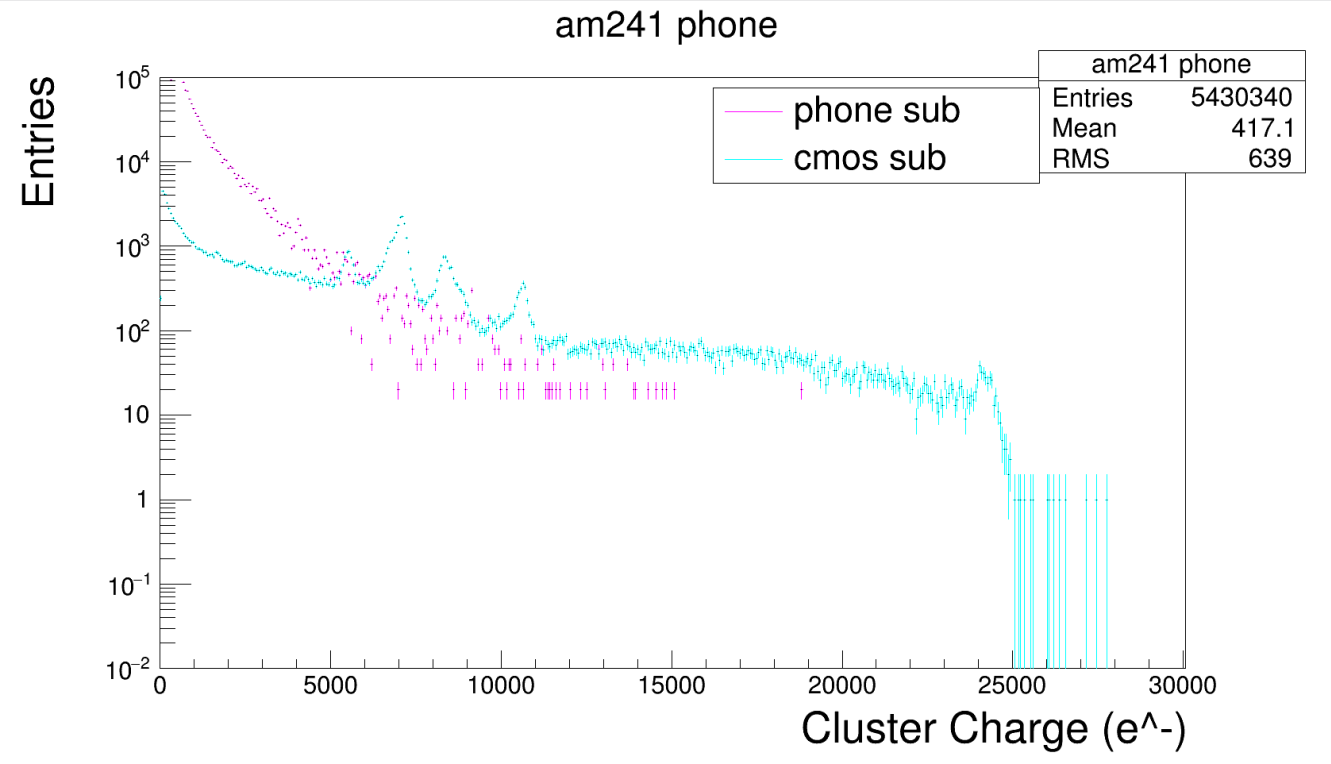
Mobile Phone Data

- Took background and am241 data with the phone
- Created a script to convert jpg phone data to fits files
- Consequently processed data and converted it into ROOT format



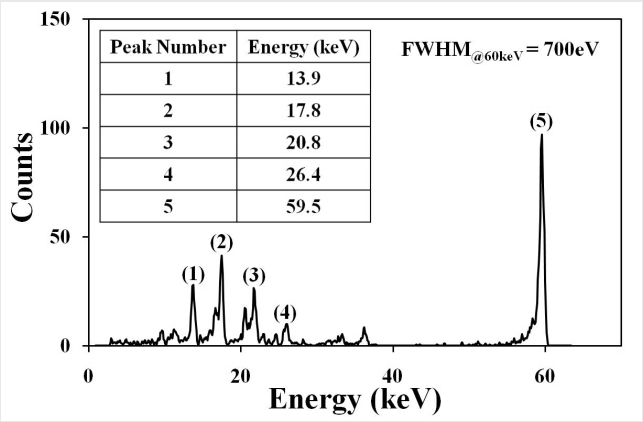
Mobile Phone Data

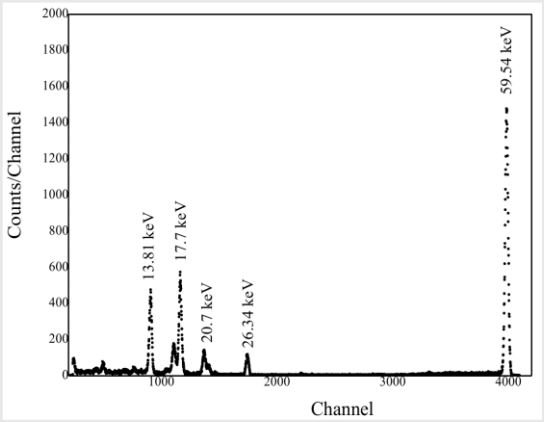


- Comparison between phone and cmos data for am241.
- Both are background subtracted and scaled to same running time
- Will continue investigating this data further but good to see we have signal on the phone!

Am241 Spectrum in Literature

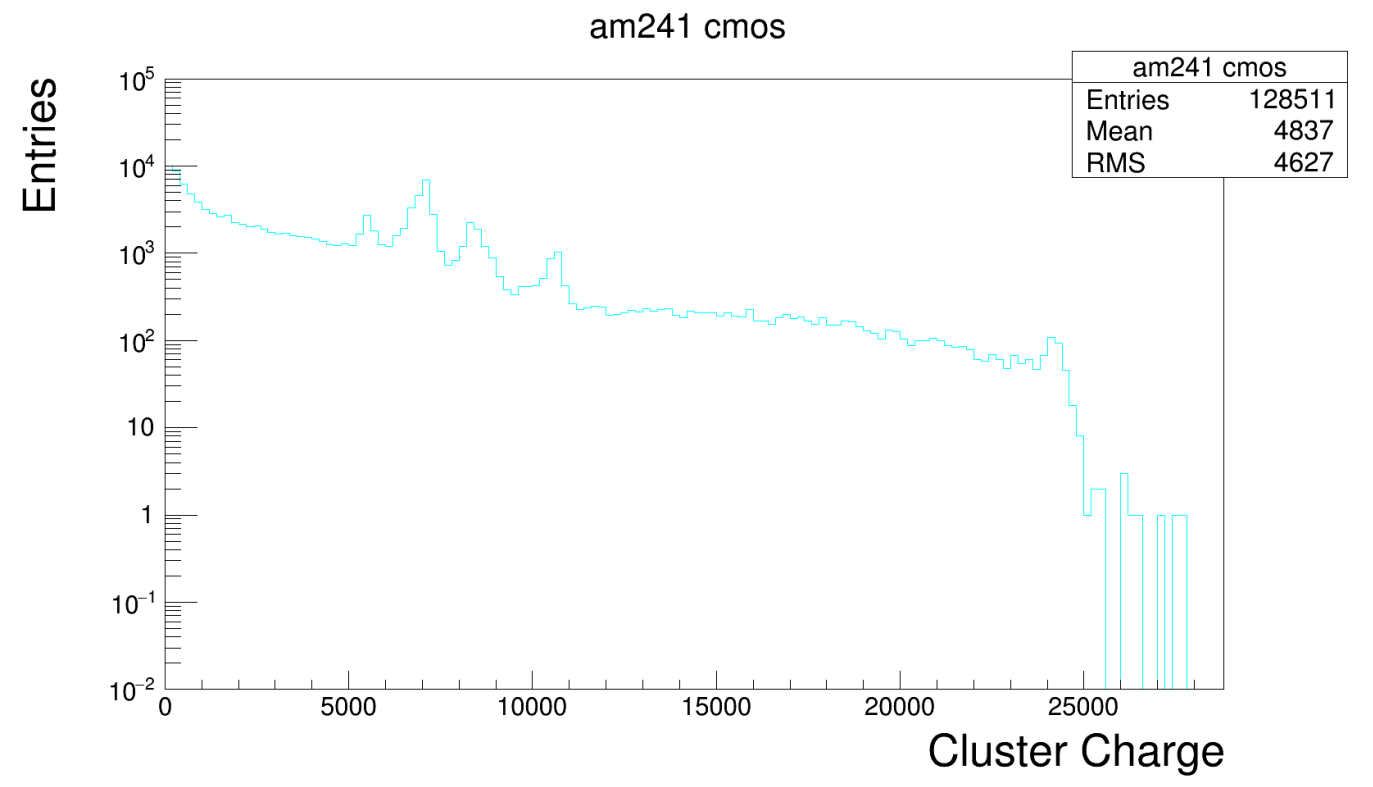
- One of our big issues has been that our Am241 energy spectrum does not match what is seen on Cenk's data or other scientific papers.
- We were constantly seeing a shift, so suspected our conversion factor from cluster charge to energy i.e. pair production energy, was not correct





Peak Number	Energy (keV)
1	13.9
2	17.8
3	20.8
4	26.4
5	59.5

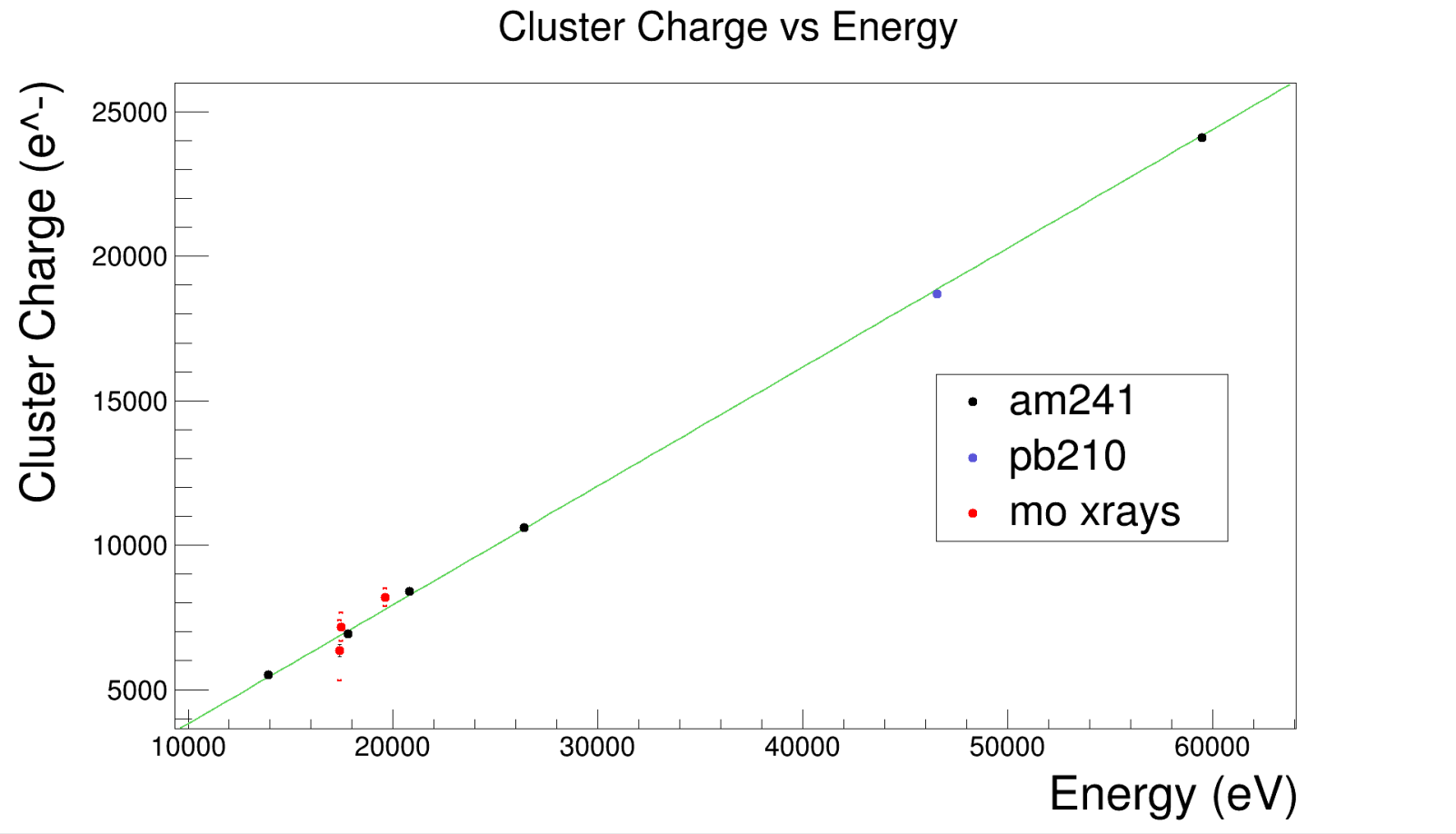
Our spectrum – Am241



This is our Am241 cluster charge spectrum

By using **Energy = Cluster Charge x Pair Production Energy (eV)** or plotting the peak cluster charges vs the expected peak energies, we could find the correct conversion factor

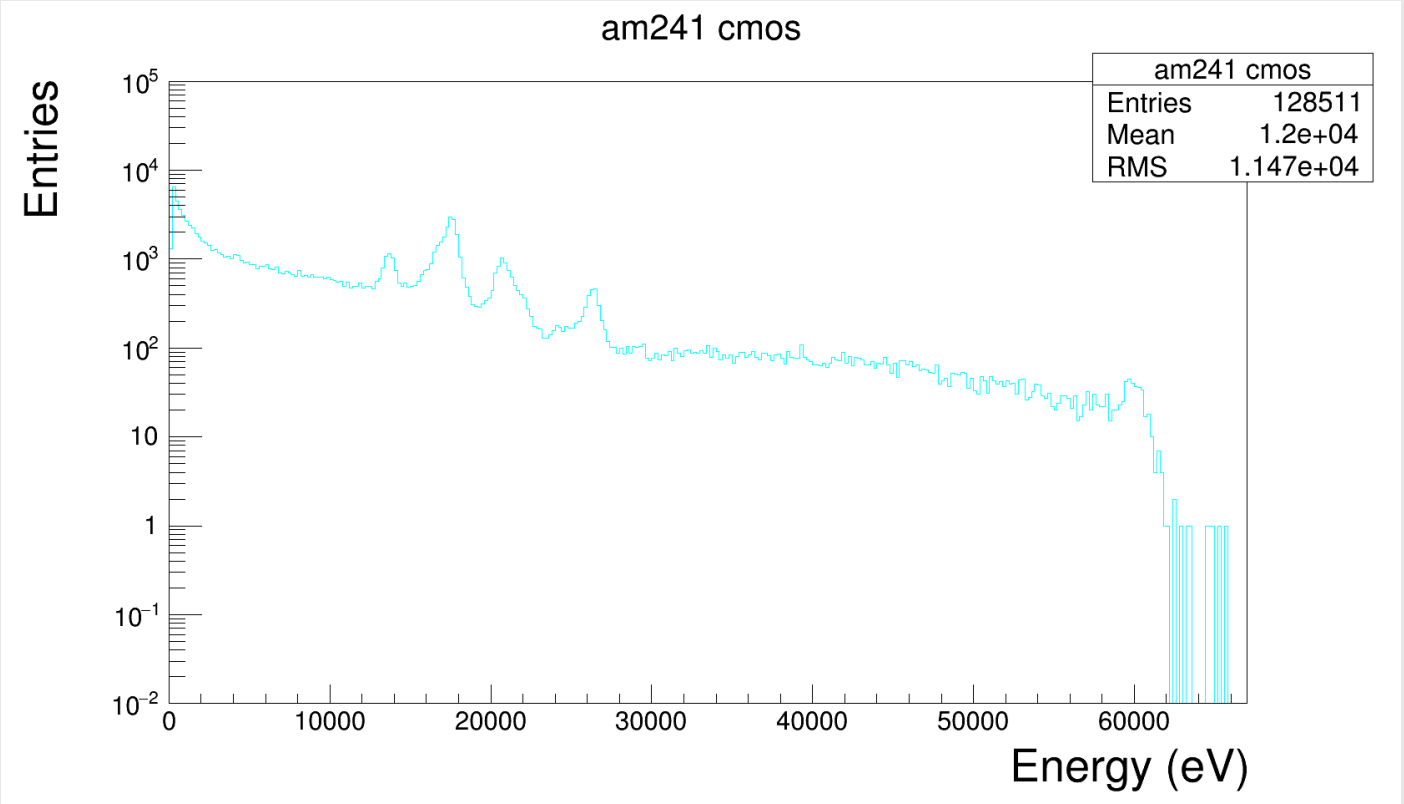
Our spectrum



We obtained the following value for the slope: $m = 0.403 = \frac{1}{Conversion\ Factor}$

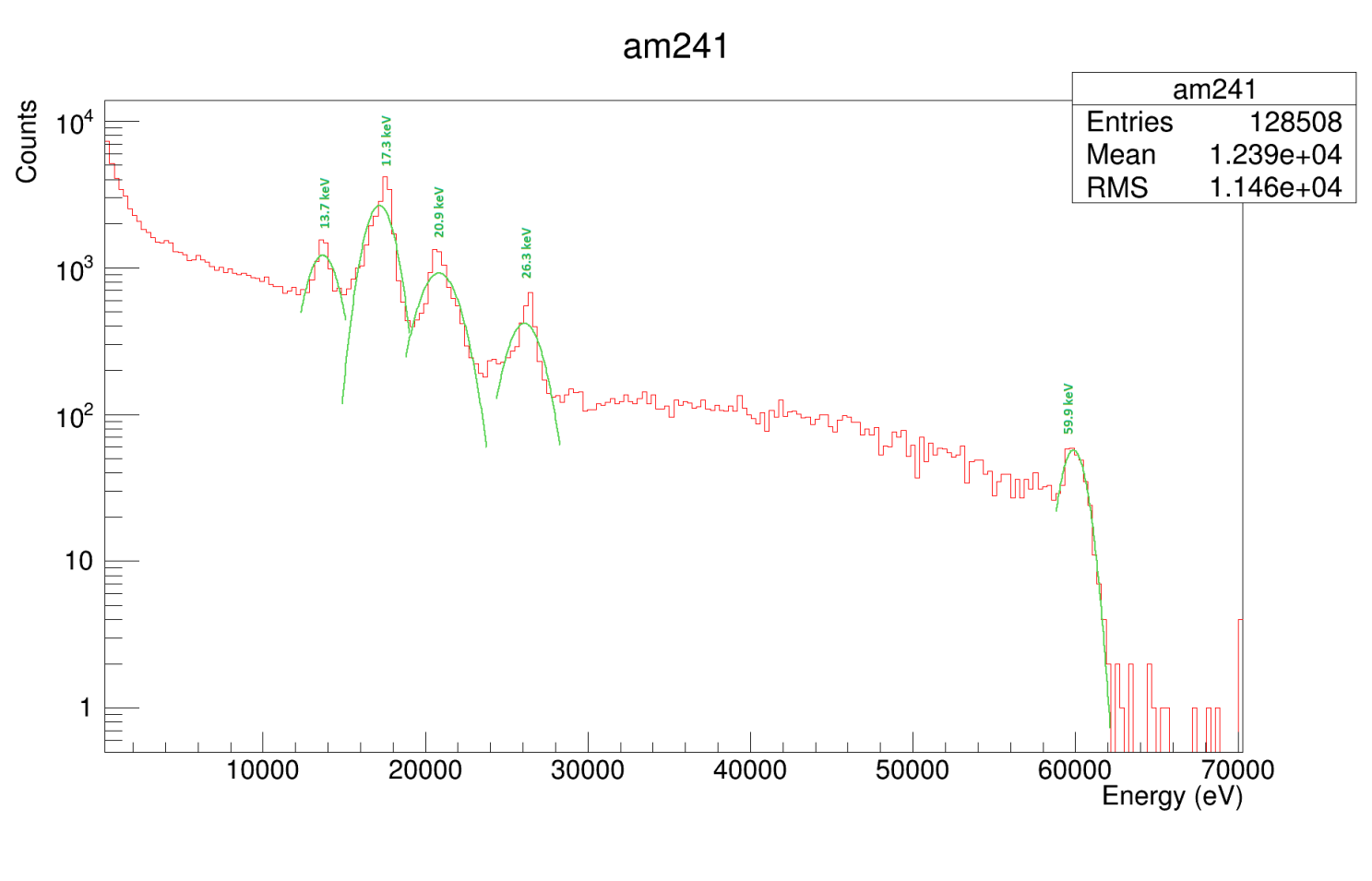
Our spectrum – Am241

This means that the Pair Production Energy = 2.48 eV (not 3.65 eV !)

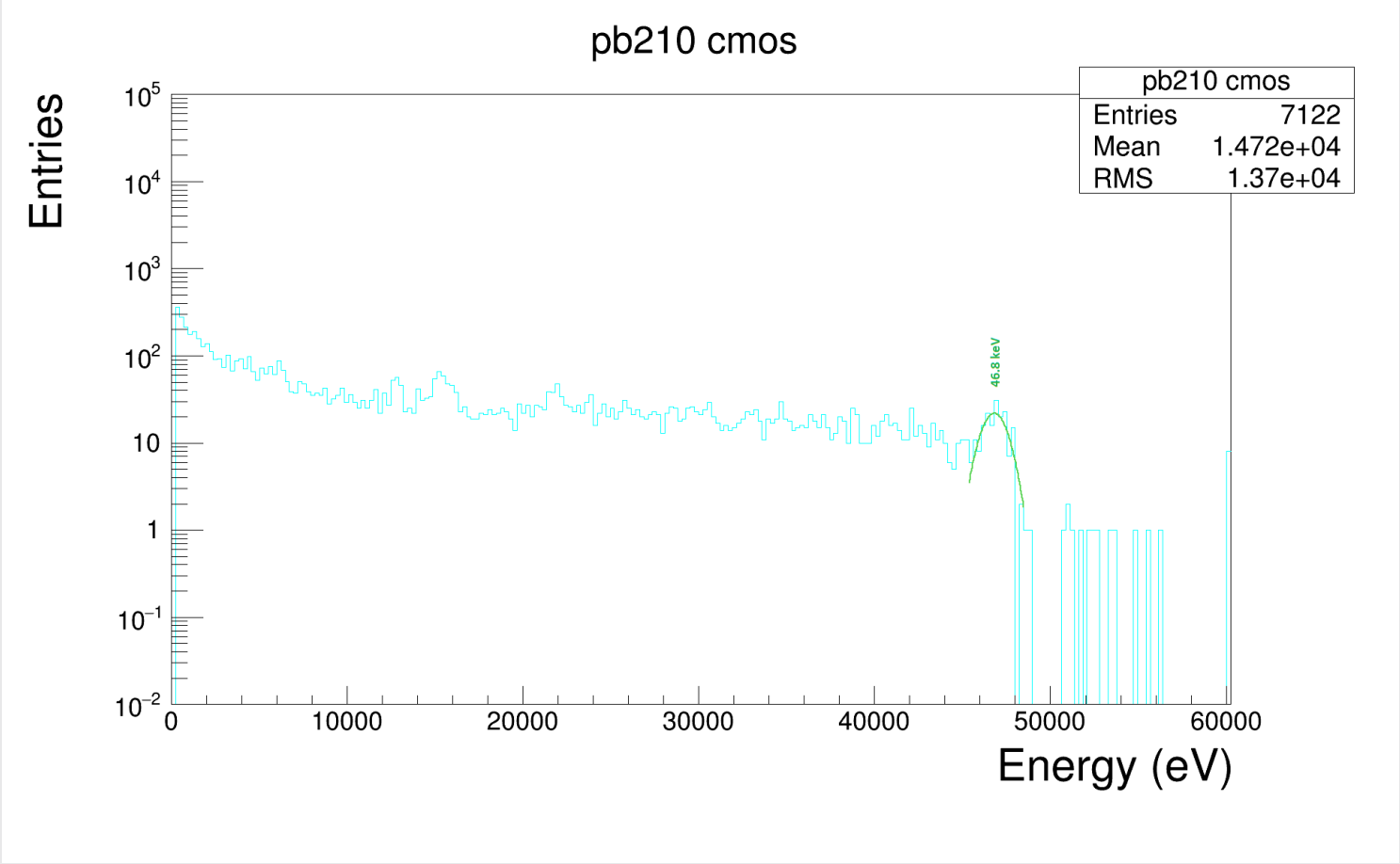


Peaks match energies seen on other papers… for Am241 and Pb210! (Please see next two slides)

Our spectrum – Am241

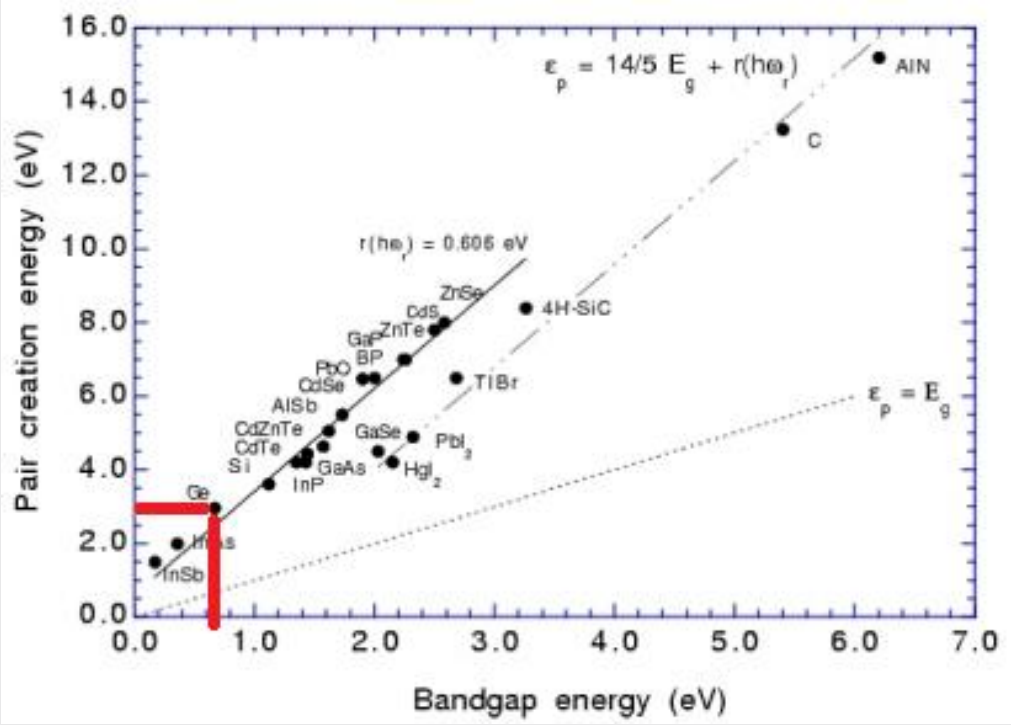


Our spectrum – Pb210



What material could it be…

- We are confident the conversion factor is correct
- However, this indicates that the sensor might not be made of Silicon or that the Silicon is doped with other materials
- The pair production energy for Germanium is very close to our value, but CMOS aren't usually made out of Germanium
- This information is proprietary to the company that made the camera, so we may never know what the sensor is made off



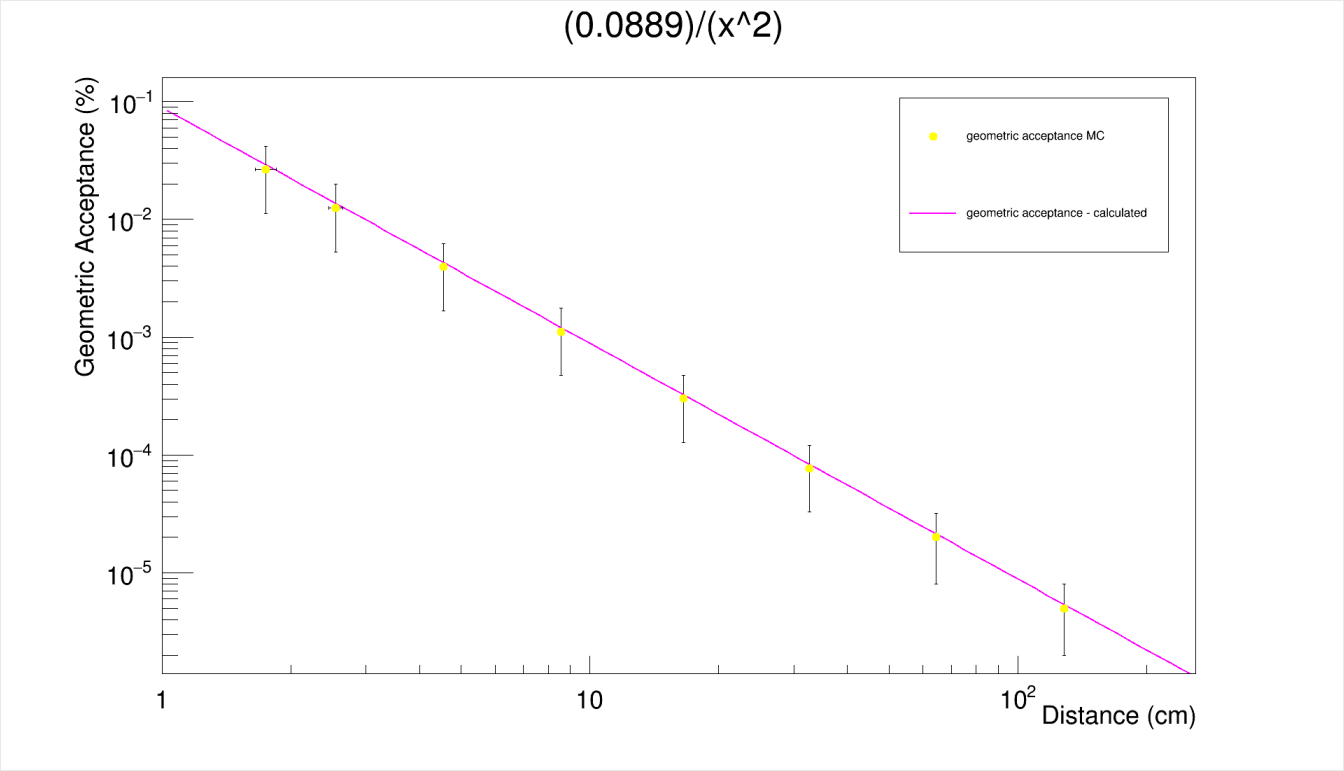
Geometric Acceptance

- Another topic I have been working on is to confirm that my calculation for the geometric acceptance of our set up is correct.
- Reminder that our geometric acceptance takes into account:
- Intersection of sphere of incidence of the source with the plane of the camera
- Fraction of incident sphere that reached the camera
- This brings us to:

$$\epsilon_G = \frac{A_{spherical\ cap}}{A_{sphere}} \frac{A_{camera}}{A_{camera\ plane}}$$
$$= \frac{\frac{48}{25}\pi x^2}{\frac{256}{25}\pi x^2} \frac{2.324}{\frac{39}{25}\pi x^2}$$
$$= \frac{0.0889}{x^2}$$

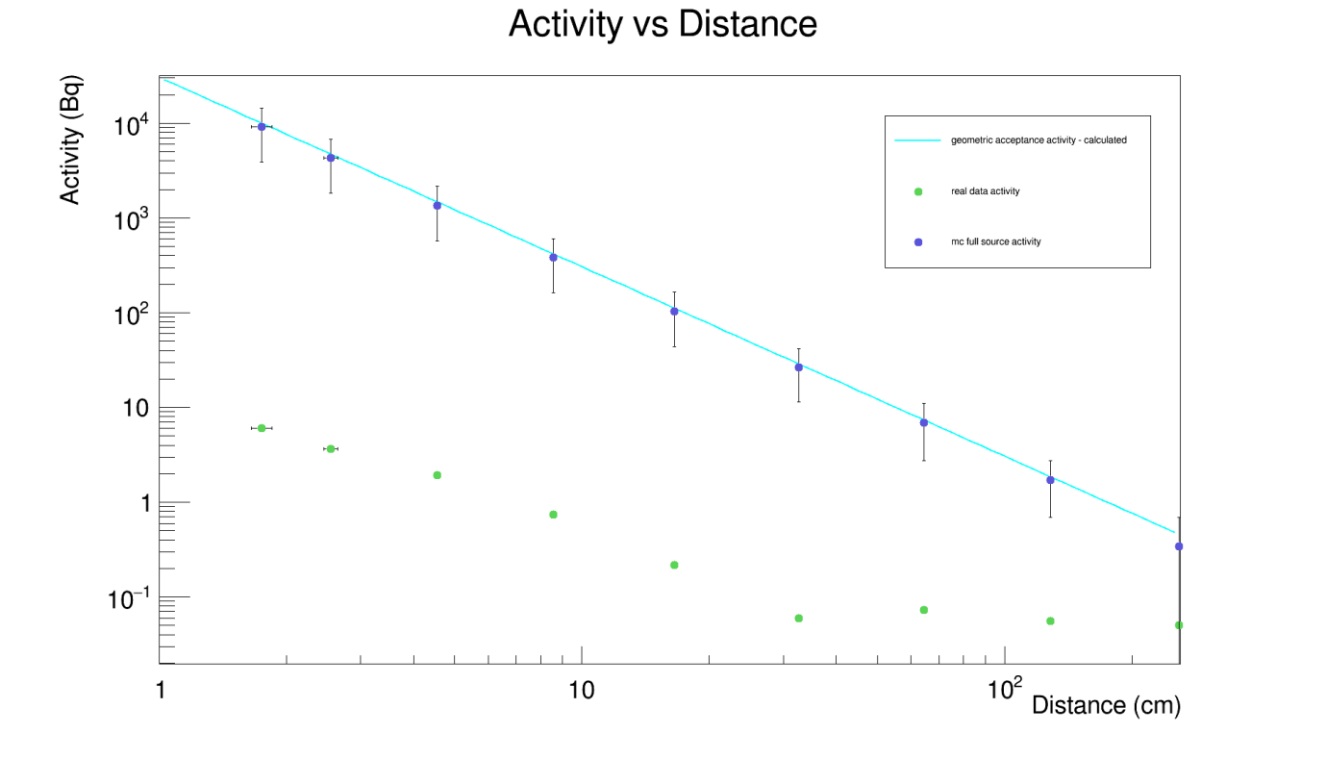
Geometric Acceptance

- This was confirmed by a MC simulation, as seen below, where we compare the calculated geometric acceptance expression with the MC simulation, for a source at different distances away from camera



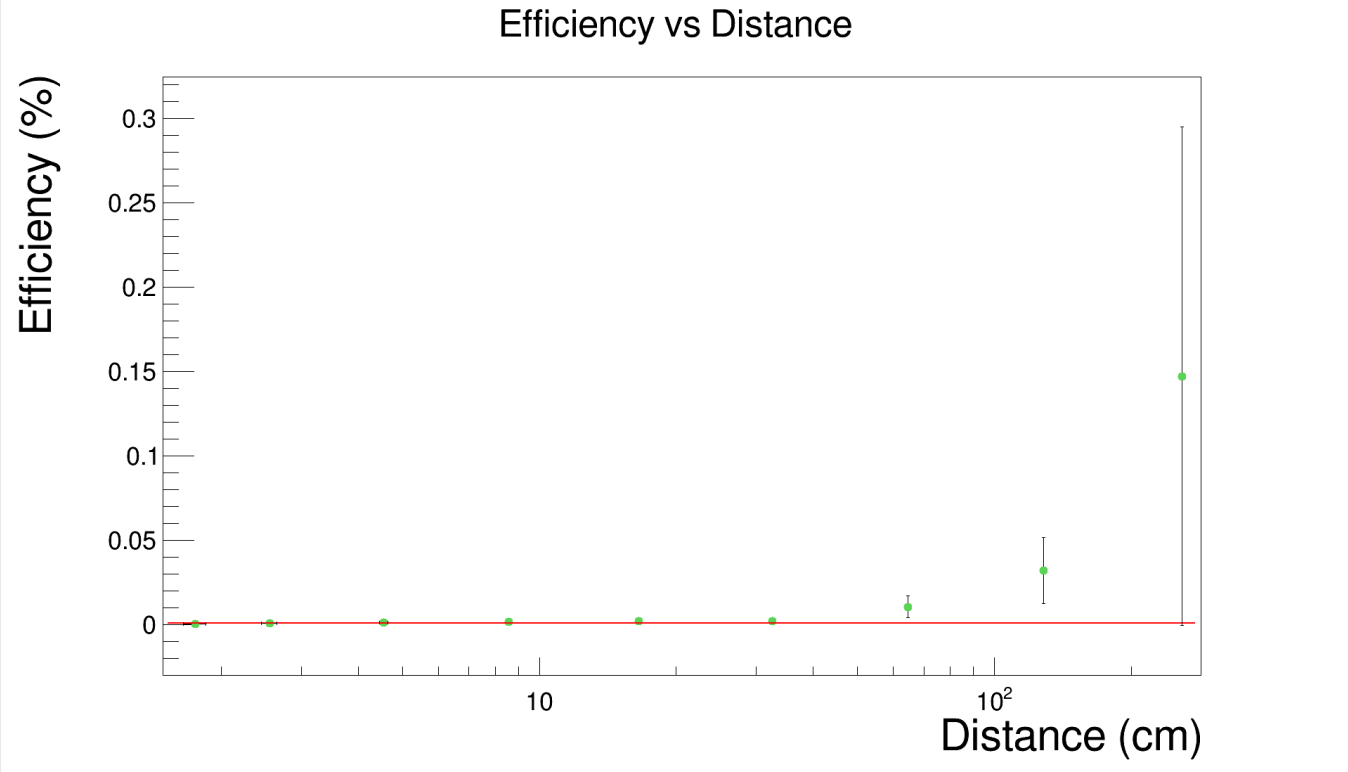
Activity – MC vs real data

- With this geometric acceptance, we could now compare the activity incident on the detector by the activity recorded on the detector
- The plot below compares real Am241 data (activity recorded) with the calculated Am241 x geometric acceptance (incident activity)



Intrinsic Efficiency

- The ratio of both provides us with the intrinsic efficiency of the CMOS
- Three last data points correspond to distances where background signal is stronger than source signal



Efficiency = 0.0010 +/- 0.0002