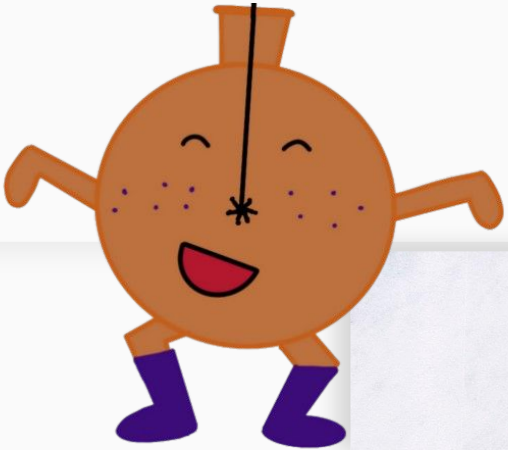
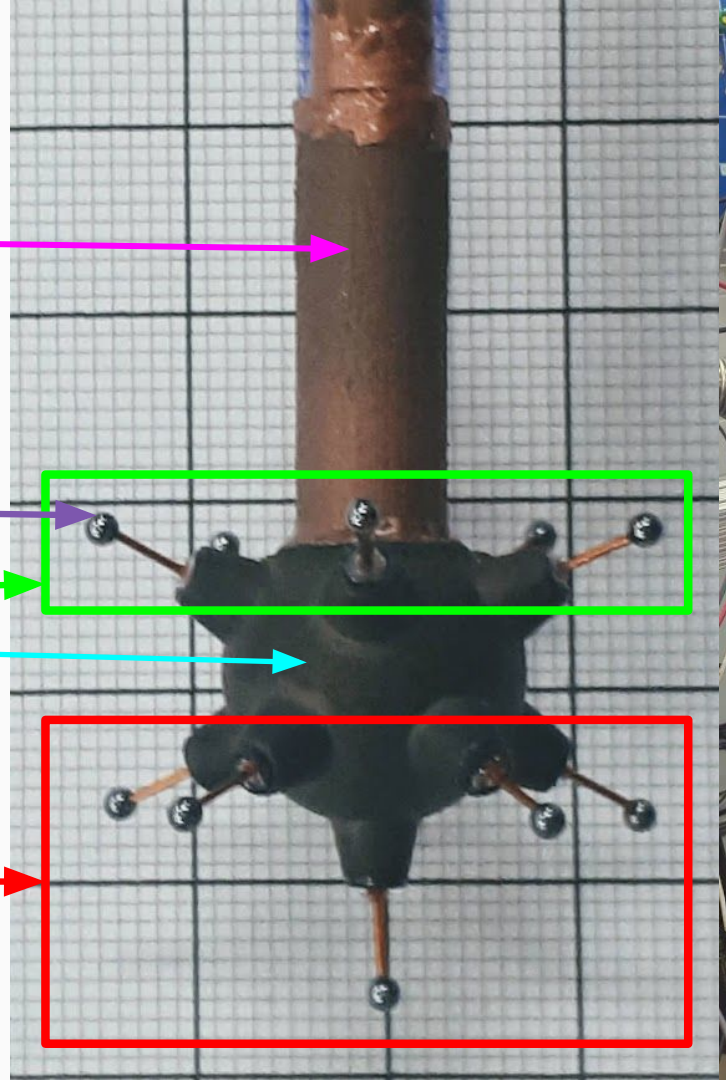
Sensor Calibration Using Americium-Aluminum in the NEWS-G Experiment at SNOLAB

By: Qwin Goodwin

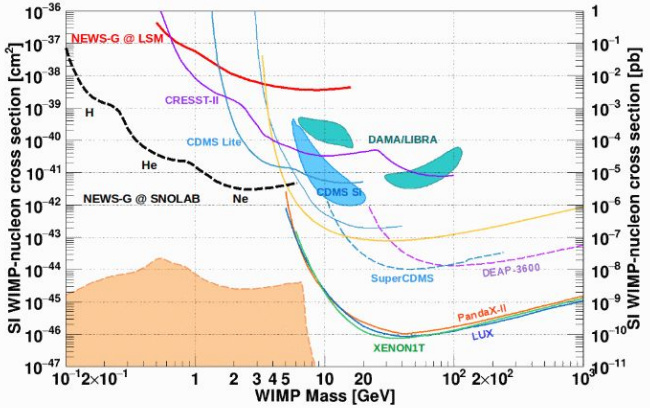


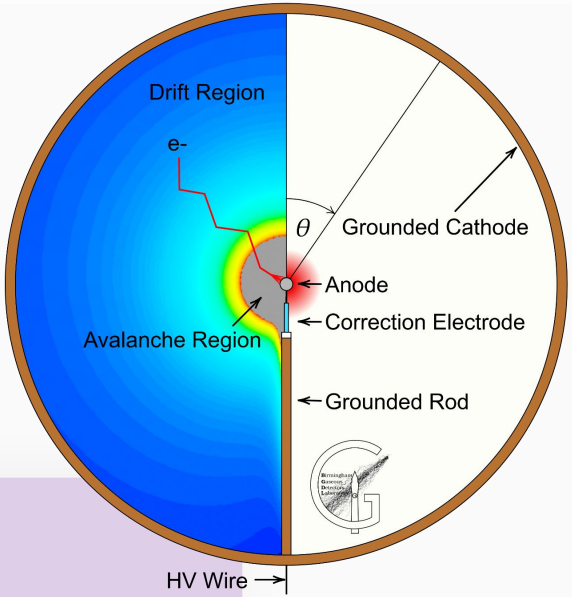
Setup



Theory

- A sphere is filled with concentrated gas, in this case a mixture of 98% argon and 2% CH4.
- A high voltage is applied to the anodes on the sensor.
- When a particle interacts with the gas, it causes an ionization event, creating an ionization electron.
- This electron is then attracted to the nearest anode where it is detected.
- It is then possible to find what caused the ionization event.
- The hope is that a low mass dark matter particle interacts with the gas and is detected.



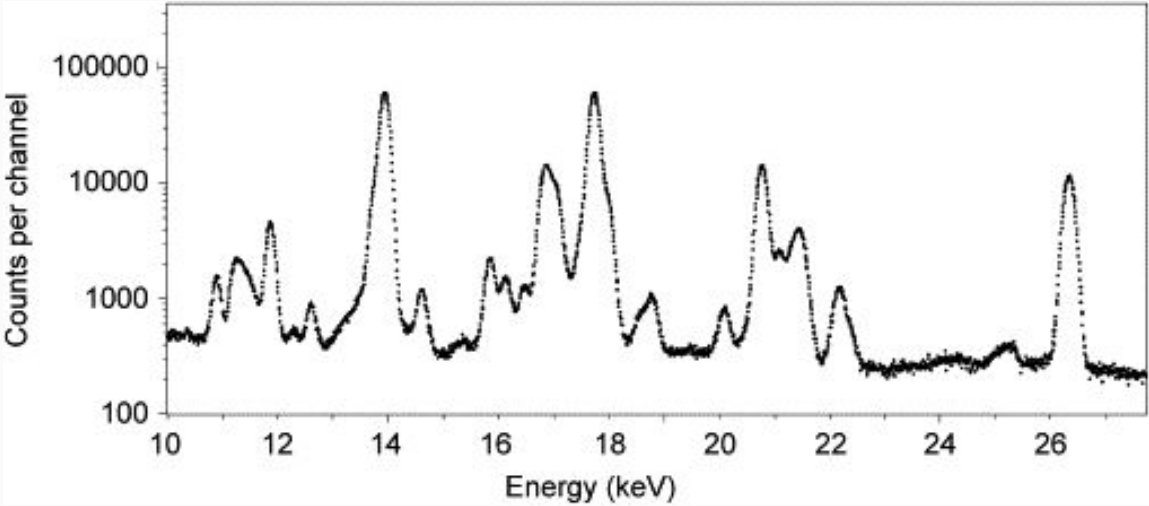


Goal

- Calibrate a new sensor to replace the one at SNOLAB.
- Take data using an americium-aluminum source on different parts of the sphere.
- Characterize each anode by seeing how they detect the 1.5 keV X-rays from aluminum caused by trapped alphas.
- See how consistent the gain is across each anode, i.e. does the 1.5 keV signal have the same energy across each anode.
- If each anode is working properly, replace the sensor used at SNOLAB.

Americium Spectrum

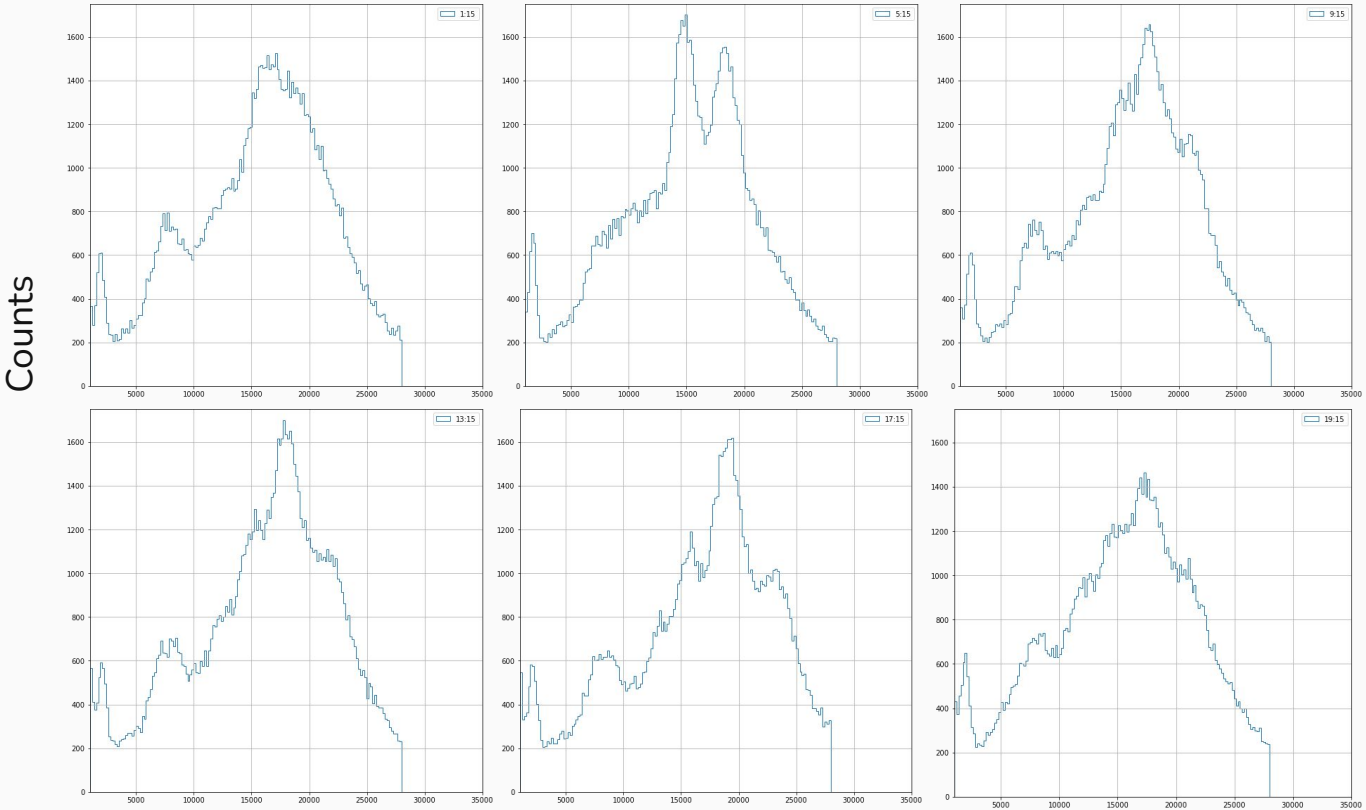
- The hope was that the 13.9 and 17.8 keV lines from americium would also be visible.
- There is also a 6.4 keV line from iron fluorescence caused when an X-ray reaches the shell of the sphere without interacting with the gas.



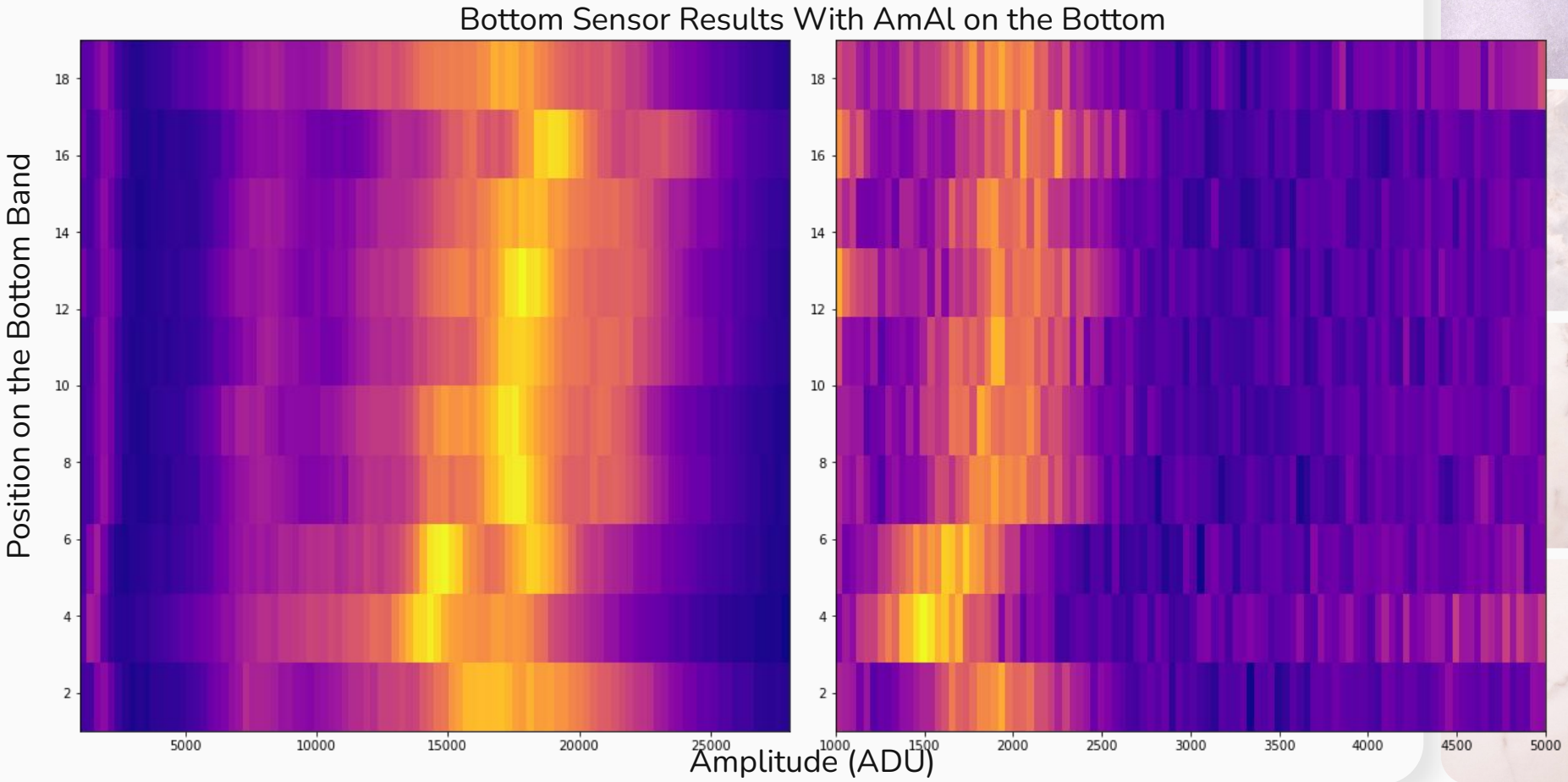
Initial Results

- A constant 1850 V is applied across both channels.
- For this presentation only the bottom sensor results will be looked at for sake of time.

Bottom Band Sensor Results With AmAl on Bottom Band

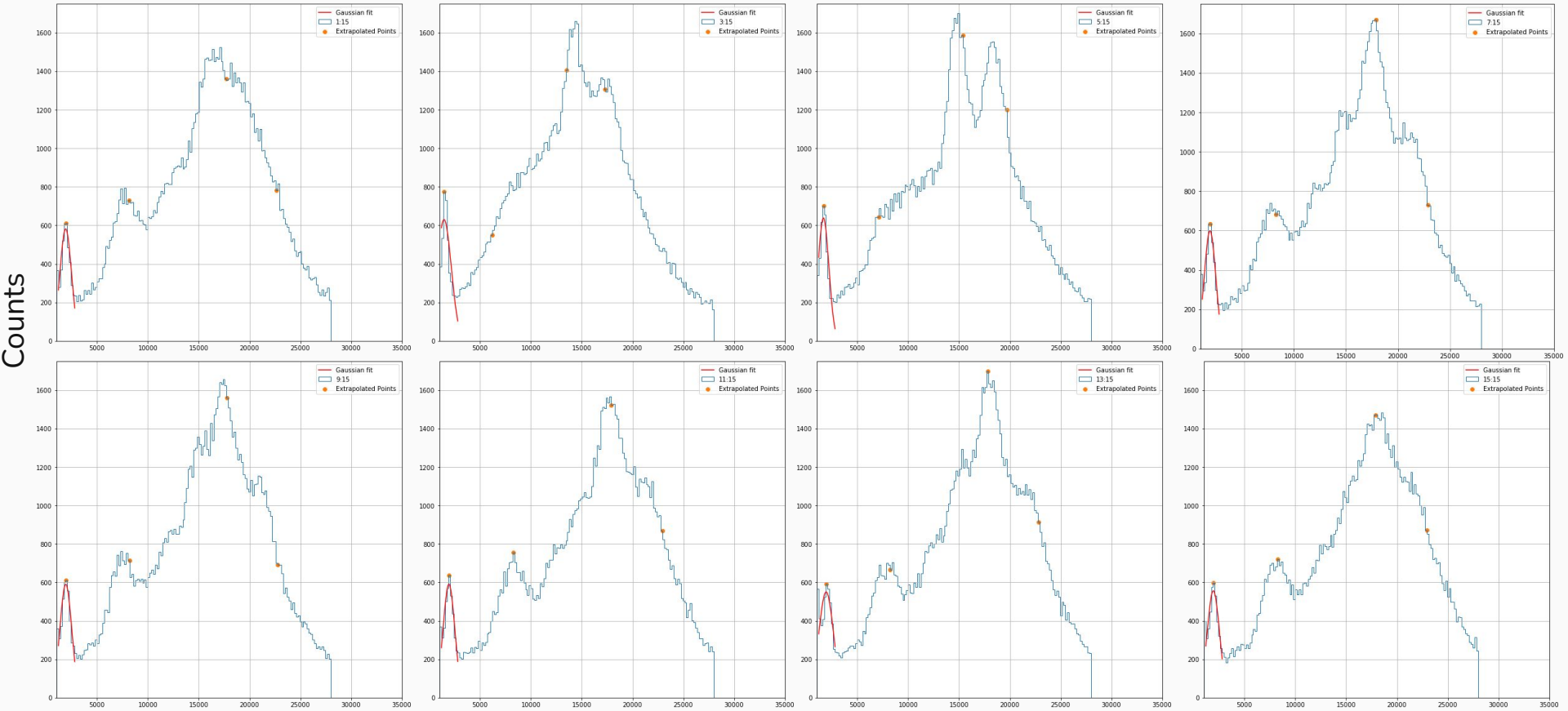


2D Histograms



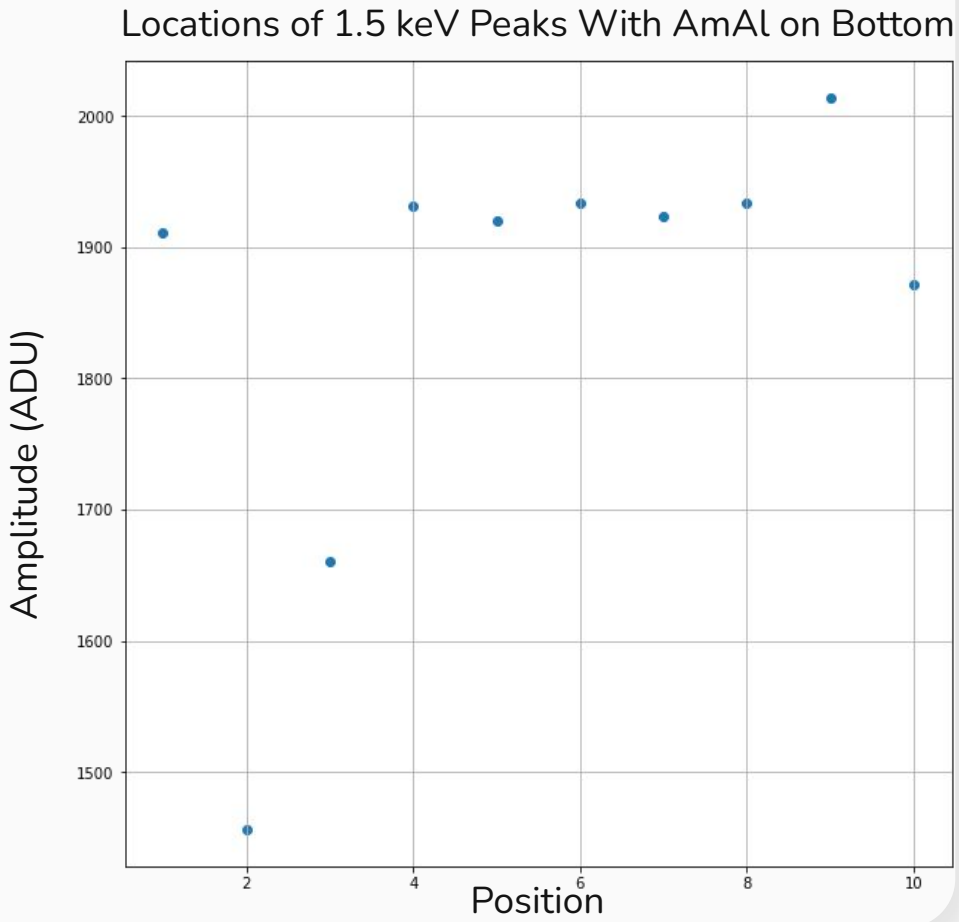
Gaussian Fits and Extrapolated Points

Bottom Band Sensor Results With AmAl on Bottom Band

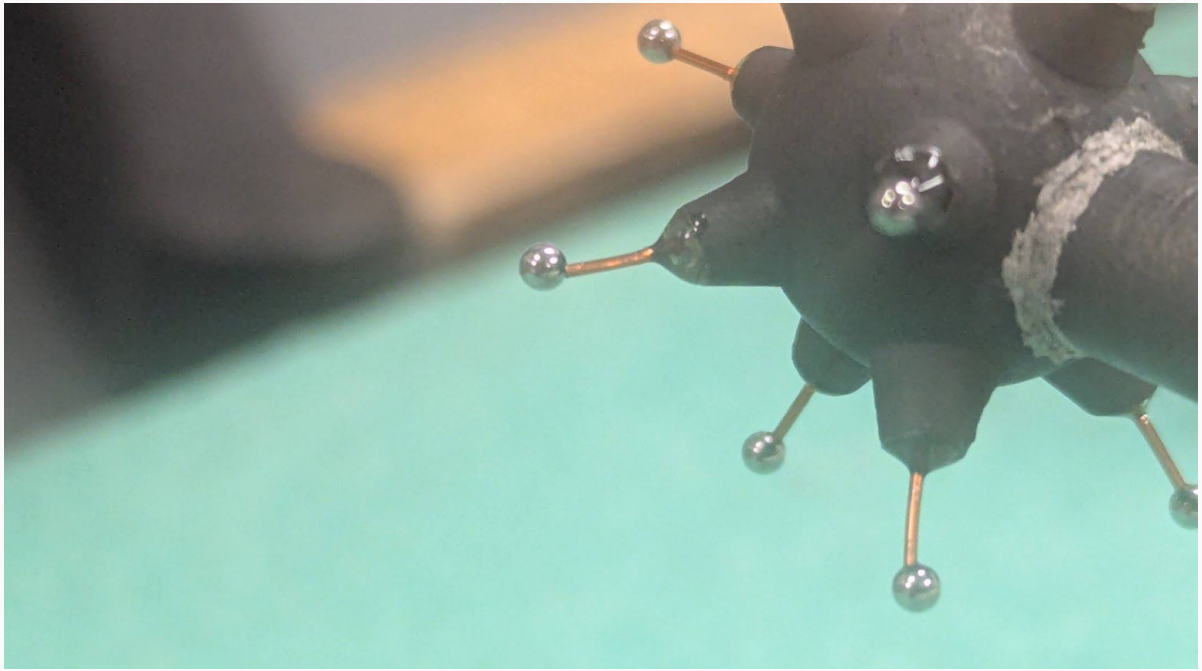


Gain Differences

- There are two major outliers in the data.
- The percent difference between the largest and smallest value is 32.2%.
- The gain is fairly consistent otherwise.
- The next step was to look at the anodes in the position of the gain difference.



Cause of Different Gain



Conclusion

- The experiment was quite successful!
- The sensor works quite well and all the anodes detected the 1.5 keV X-rays.
- The gain differences between the anodes have now been characterized.
- The new sensor is currently installed at SNOLAB.
- My other projects include, looking at applying a voltage across the umbrella, testing new materials for the umbrella and characterizing the behaviour of nitrogen gas in the detector.
- If you have any questions about this work or any other work, please come up to me and ask!