SBD Calibration

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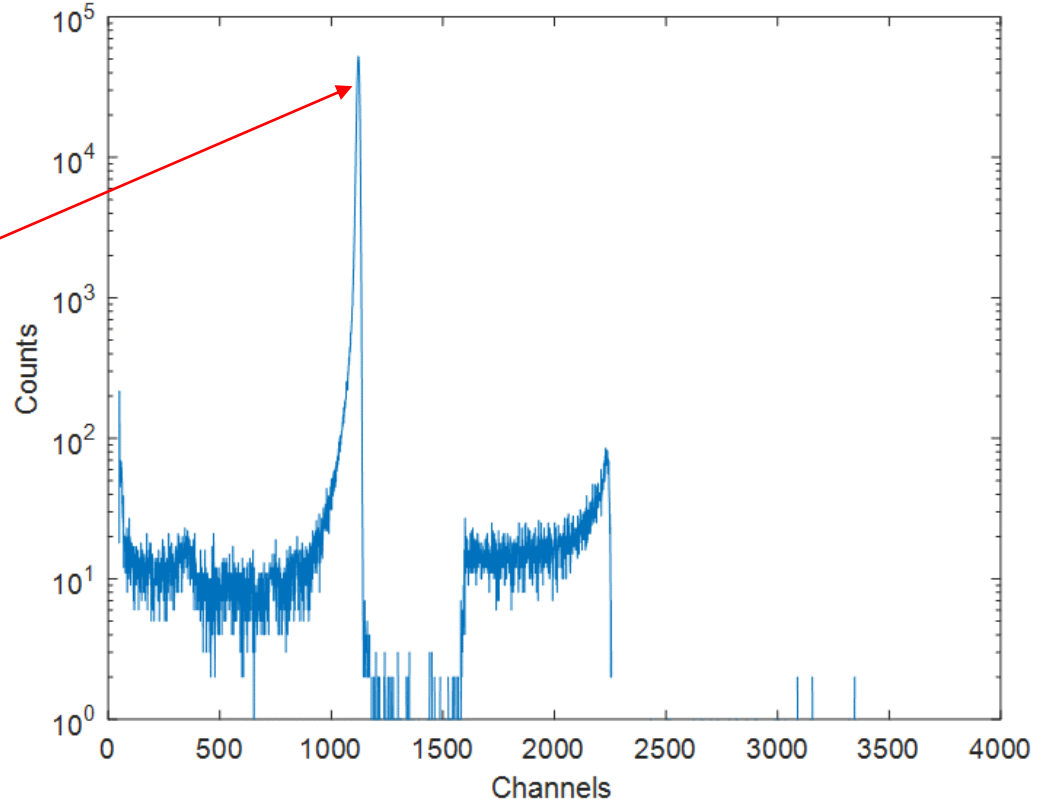
Deuterons off Gold and Aluminum

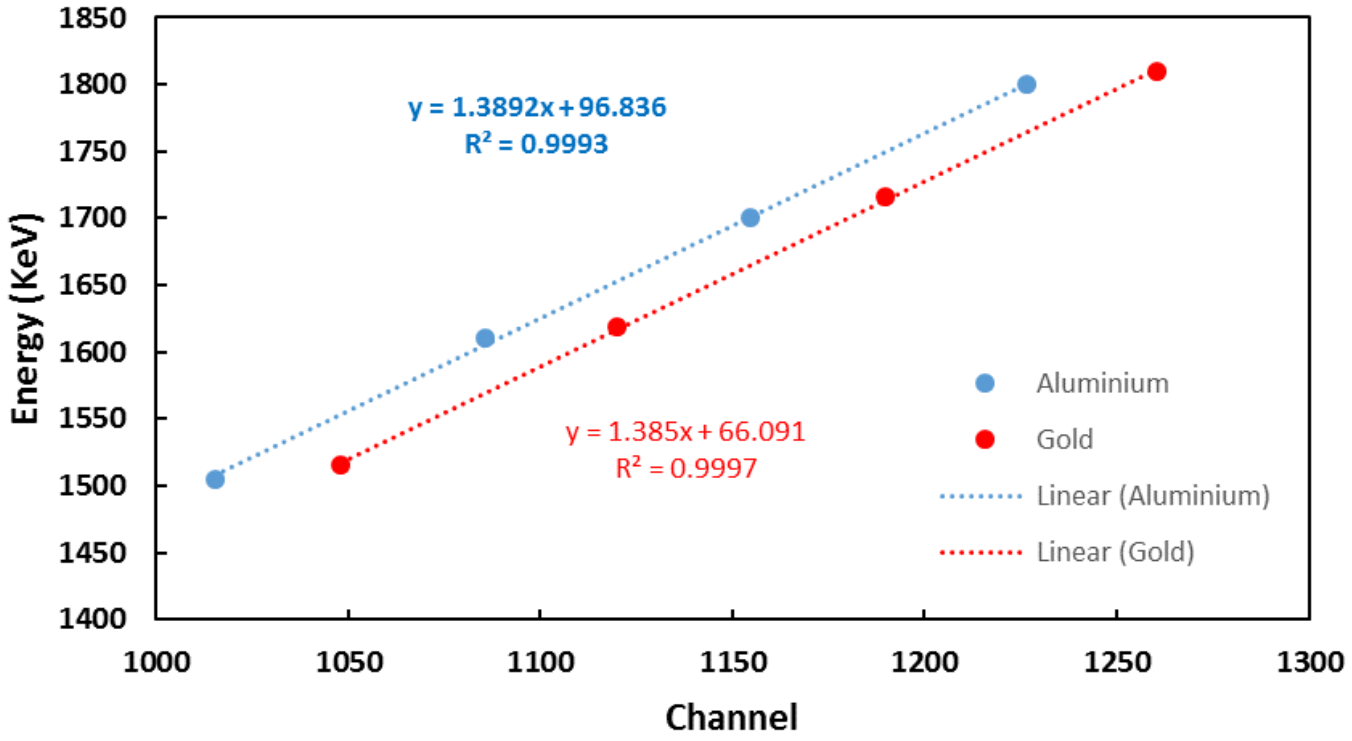
Calibration Method

- Scattered Deuterons off of Gold and Aluminum at different energies
- Calibrated off of centroid of peak
- 1.621 deuterons off gold at 20deg
- Use Ski Sickness to predict the scattered energy of the deuteron



Gold and Aluminum

Scattered deuterons off Gold and Aluminum at different energies



Taking into account target thickness

Known

$\phi = 45°$

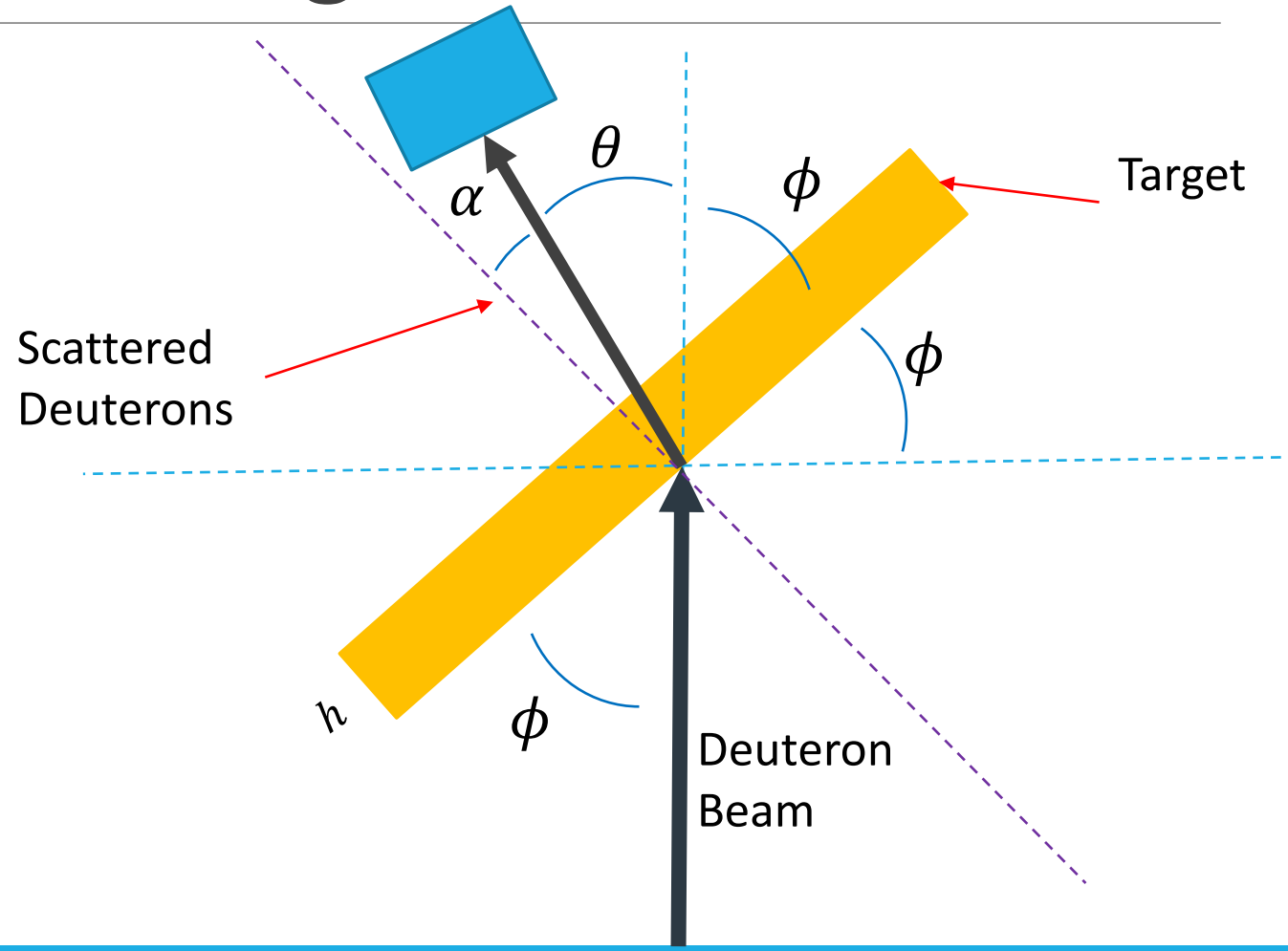
$\theta = 20°$

$h_{Au} = 0.09\mu m$

$h_{Al} = 0.78\mu m$

$\alpha = 90 - \phi - \theta = 25°$

$$x = \frac{h}{\cos\alpha}$$



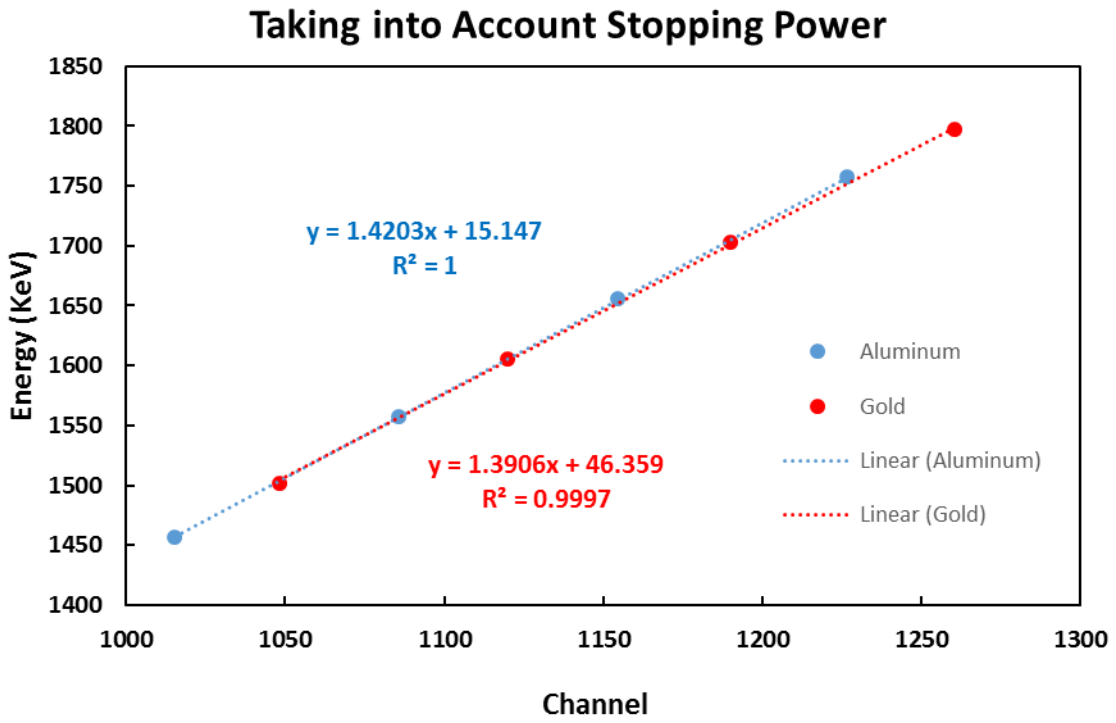
Adjusting for Stopping Power

$$E_{Adjusted} = E_{Ski\ Sickness} - x \cdot dE/dx$$

Where

x: Adjusted thickness of Target

dE/dx: Energy loss per micron, taking into account energy of deuteron and target element. Assumes deuteron scattered at the front of the target.

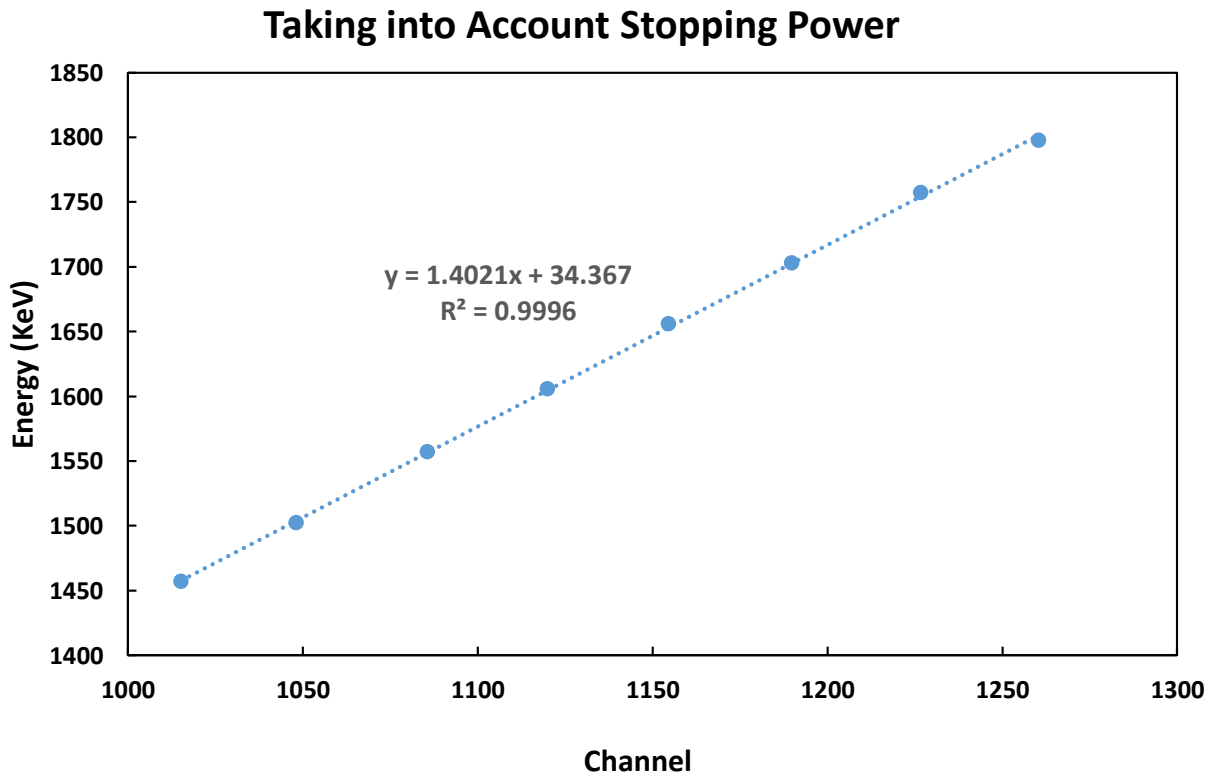


Final Calibration

Fitting Aluminum and Gold

Best Fit Line

$$\mathrm{E\ (KeV)} = 1.4021\ \mathrm{Ch} + 34.367$$



Alpha Source Calibration

Calibration Energies

Radium 226 Source:

Ra 226 – Rn 222	α: 4784.35 KeV
Rn 226 – Po 218	α: 5489.48 KeV
Po 218 – Pb 214	α: 6002.35 KeV
Po 214 – Pb 210	α: 7686.82 KeV
Po 210 – Pb 206	α: 5304.33 KeV

Source #1 (Thin Source)

Surface Barrier Detector Settings

Detector: BU-011-050-500

Bias: 60V

Gain: 13.10

Distance to source : ~20cm

Adjusted Pole-to-Zero

Example of a Surface Barrier Detector

Setup

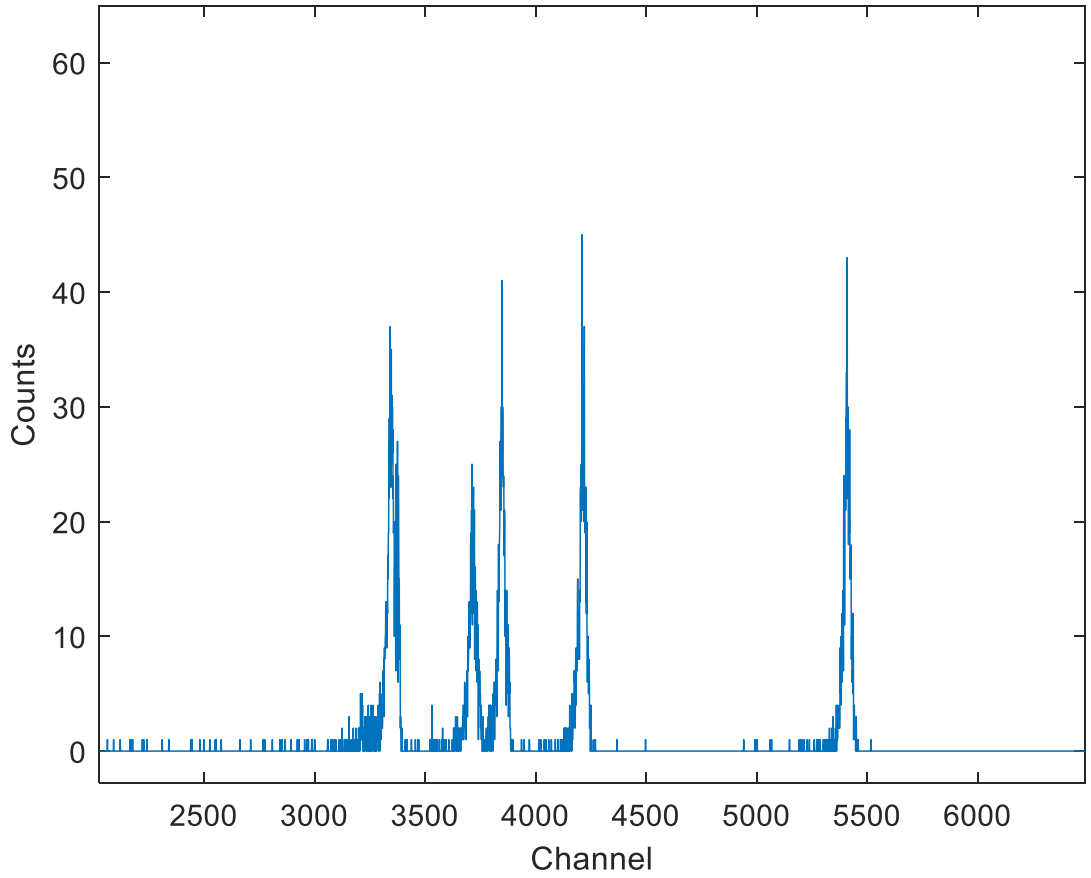
Ra 226

Alpha Source

Surface Barrier Detector

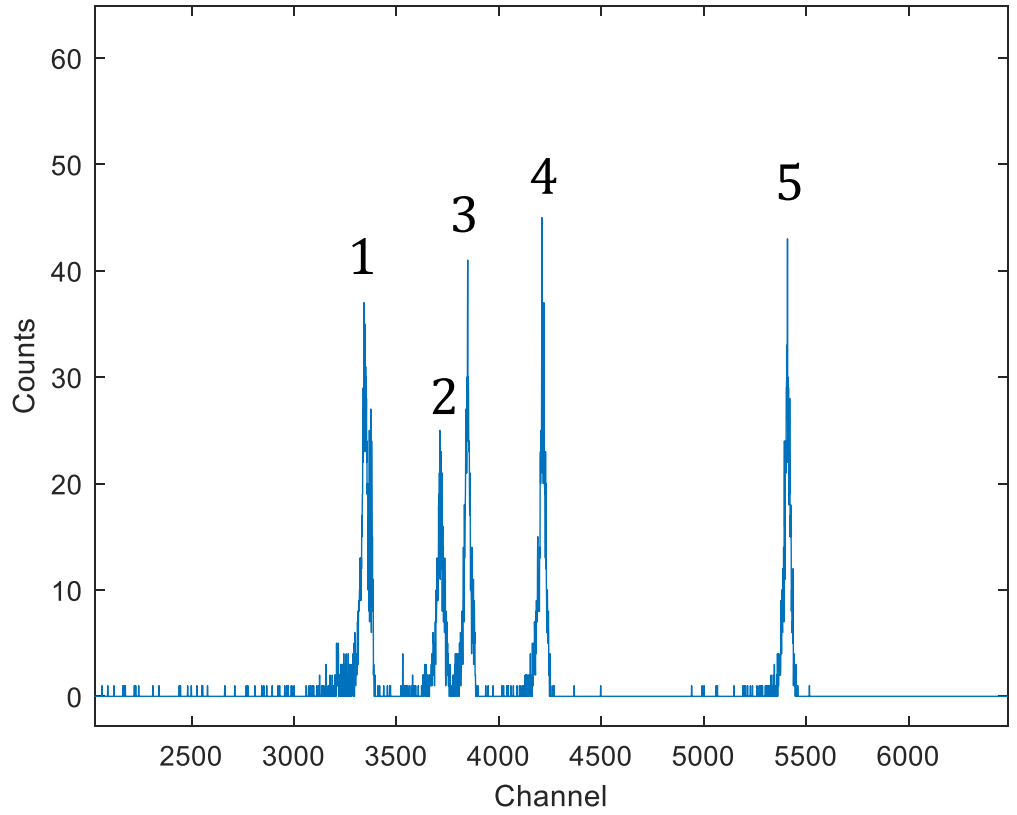
Uncalibrated Spectrum

Uncalibrated spectra
Run time: ~10hr



Counts per Peak

Peak	Counts
1	1003
2	798
3	1111
4	1127
5	1084



Getting Energy

Outline:

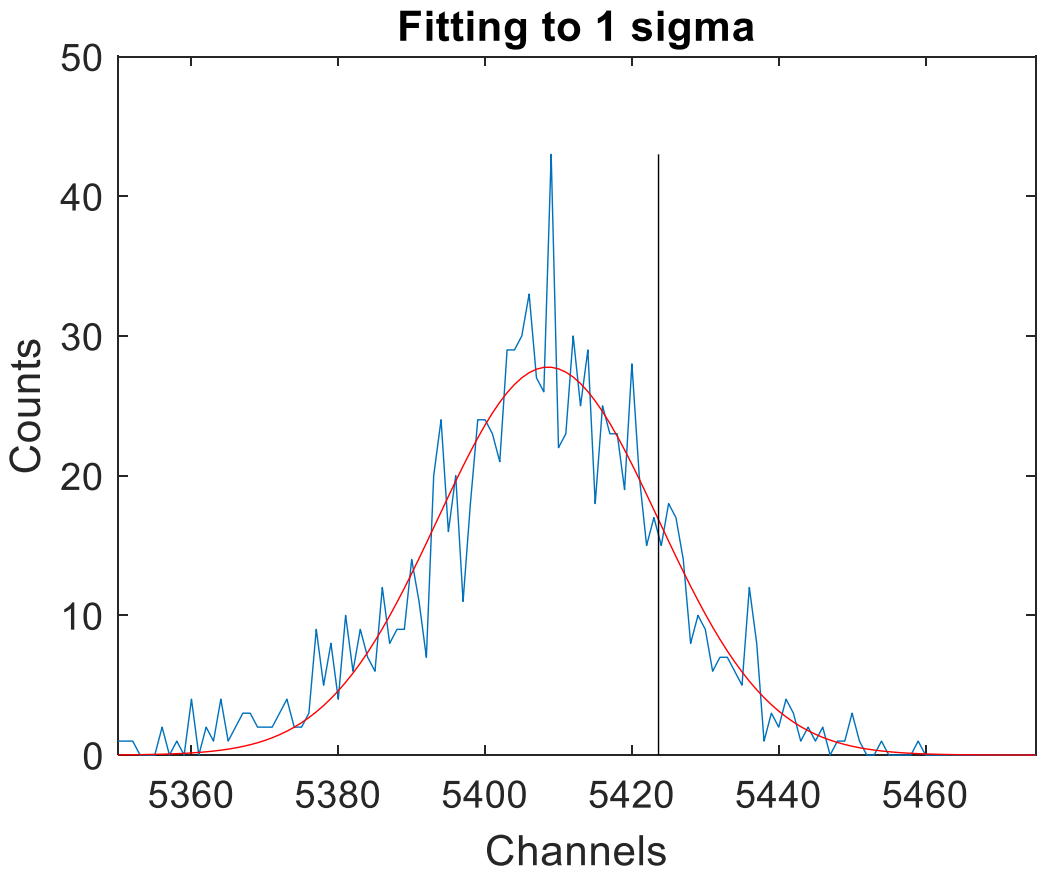
1. Fit each peak with a Gaussian,

$$f(x) = Ae^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

2. Calibrate the birth energy of the alpha particle to the $\mu + n\sigma$

Calibrating to $\mu + \sigma$

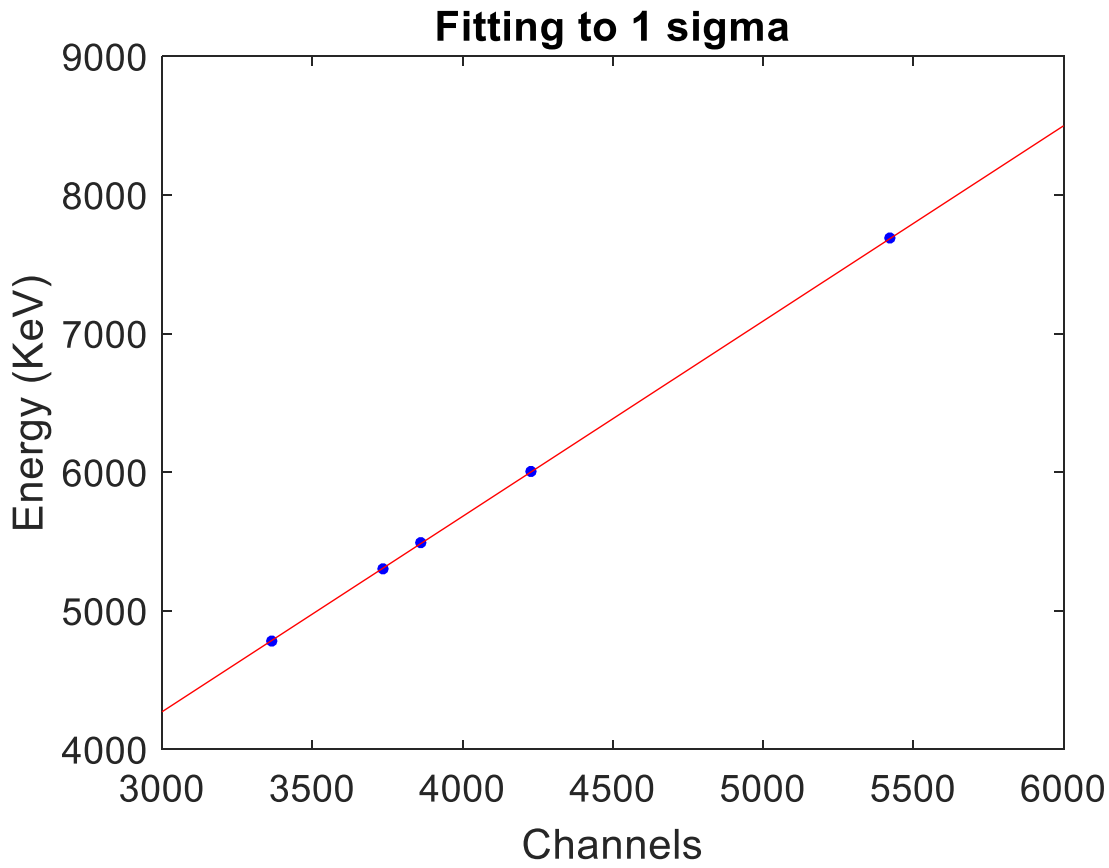
Quantity	Value (Channels)
μ	5408.6
σ	15.0637
1σ	15.0637
FWHM	35.47



Calibration to $\mu + \sigma$

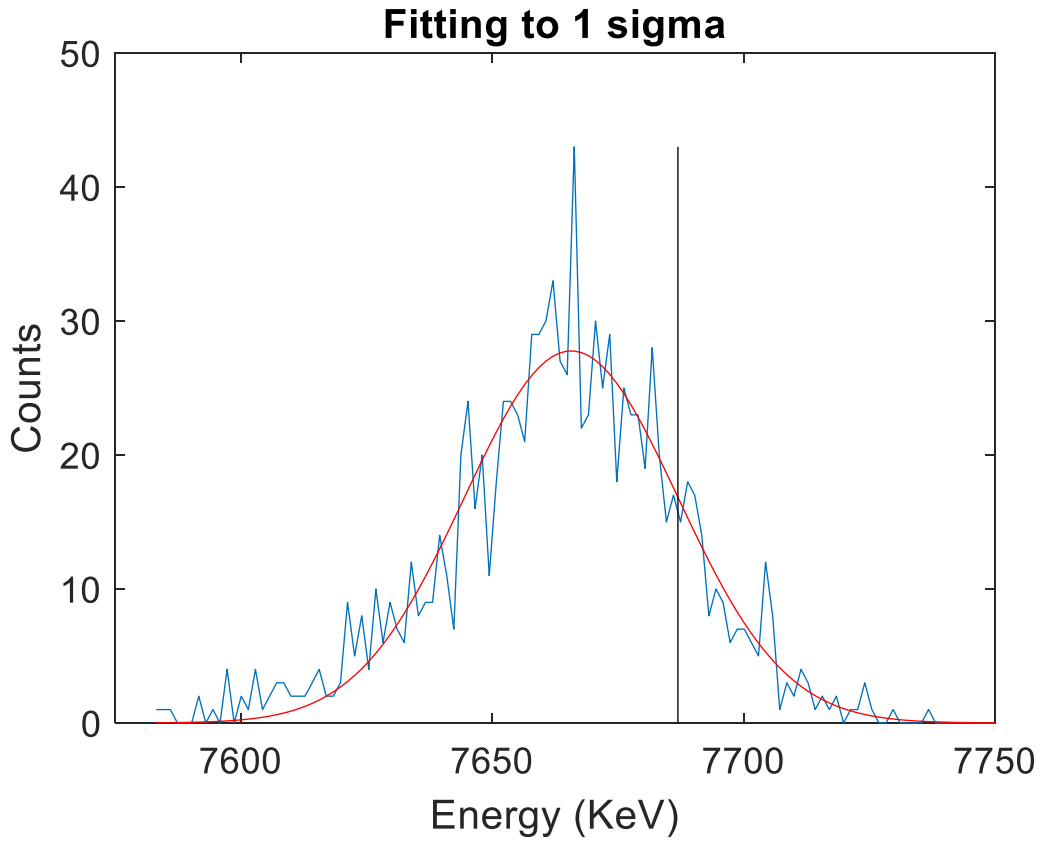
Best Fit Line:

$$\mathrm{E\ (KeV)} = 1.4091\ \mathrm{Ch} + 44.5023$$



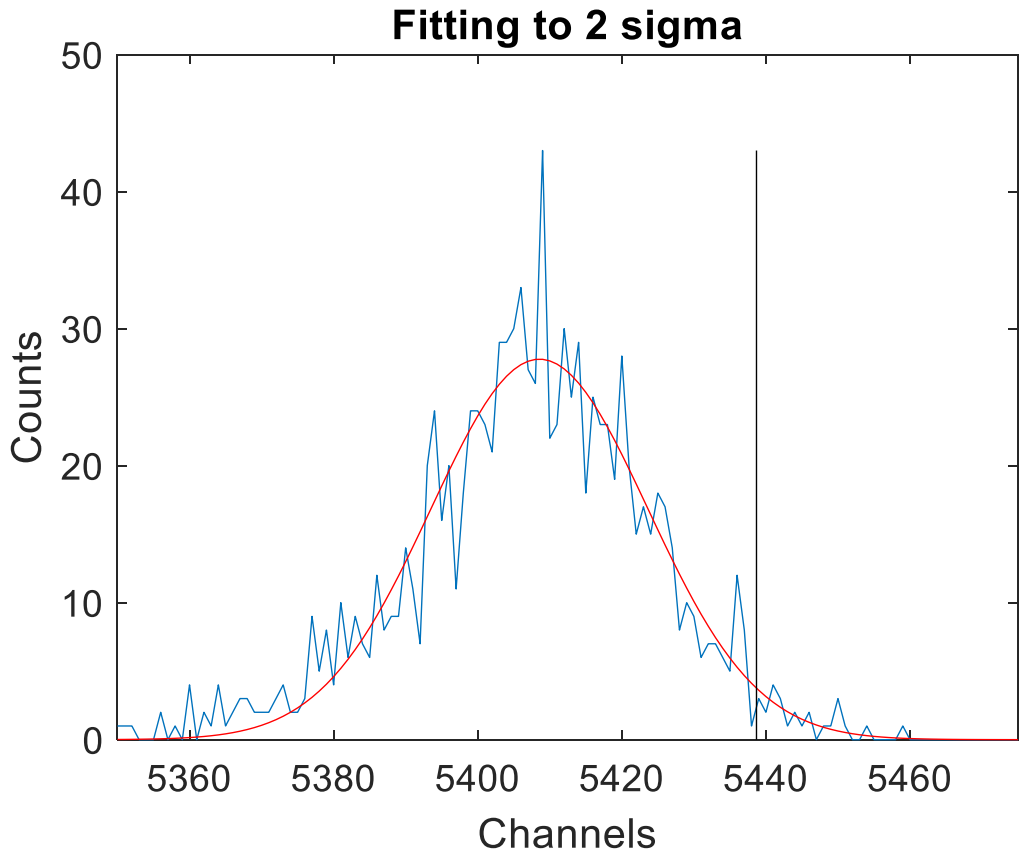
Result $\mu + \sigma$

Quantity	Value (Energy (KeV))
μ	7665.6
σ	21.2260
1σ	21.2260
FWHM	49.9833



Calibrating to $\mu + 2\sigma$

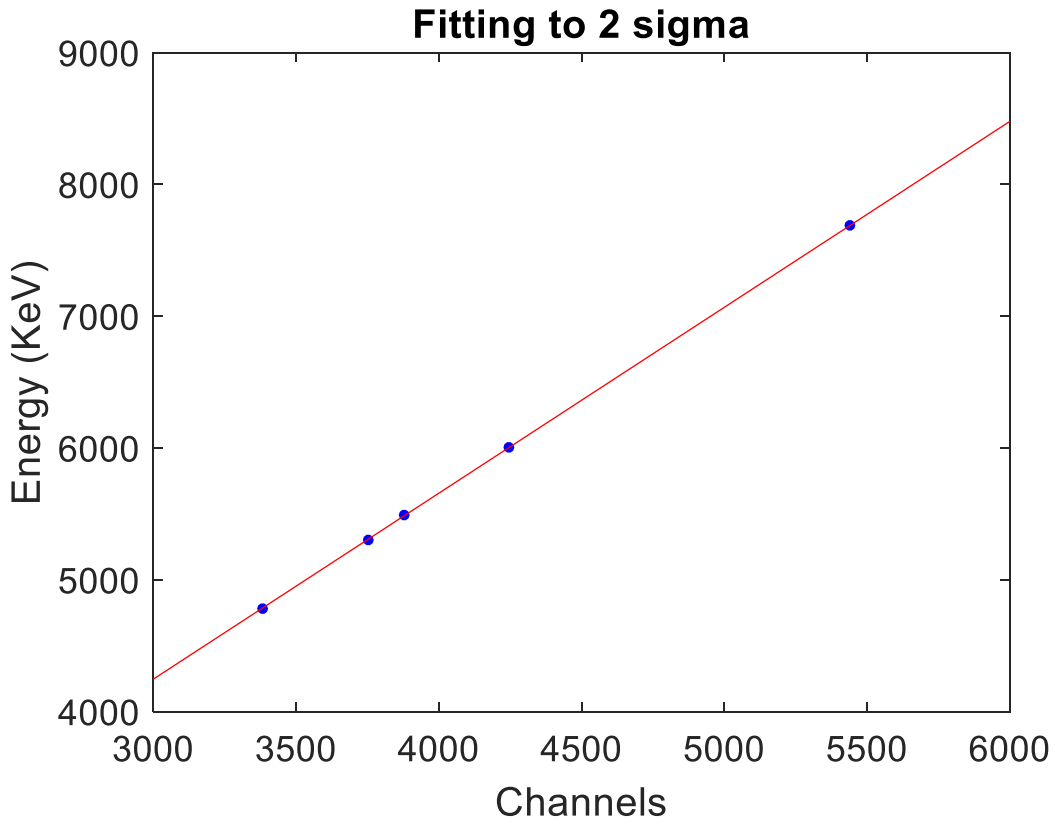
Quantity	Value
μ	5408.6
σ	15.0637
2σ	30.1274
FWHM	35.47



Calibration to $\mu + 2\sigma$

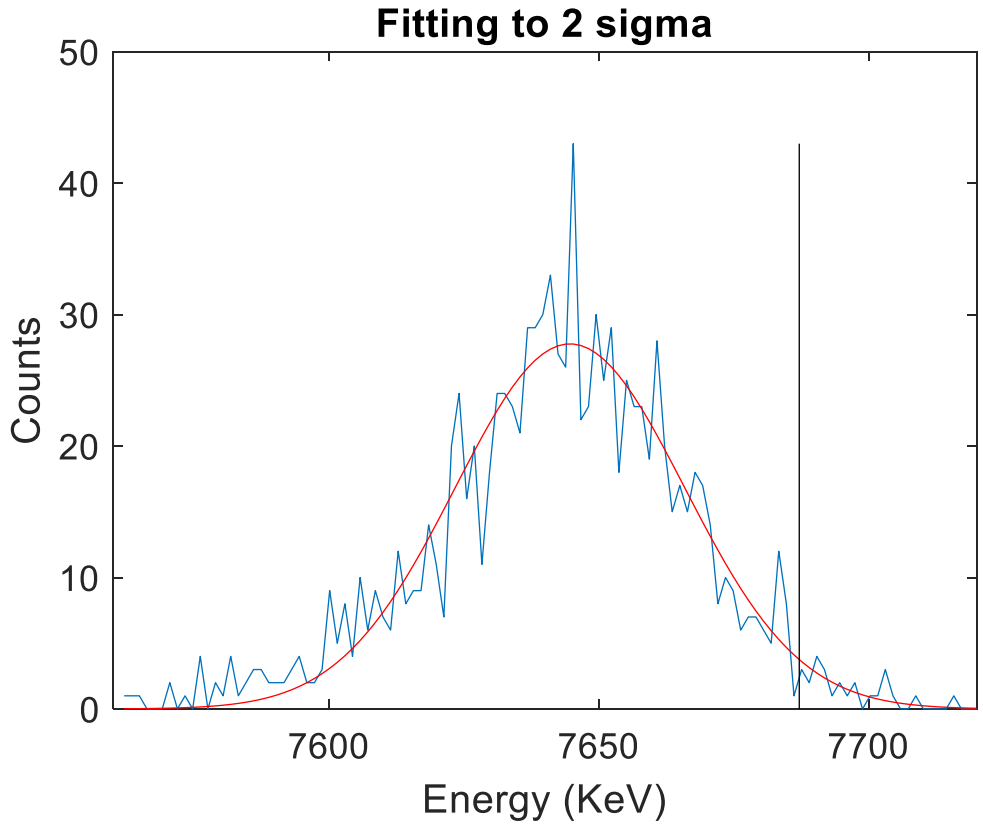
Best Fit Line:

$$\mathrm{E\ (KeV)} = 1.4105\ \mathrm{Ch} + 15.6728$$



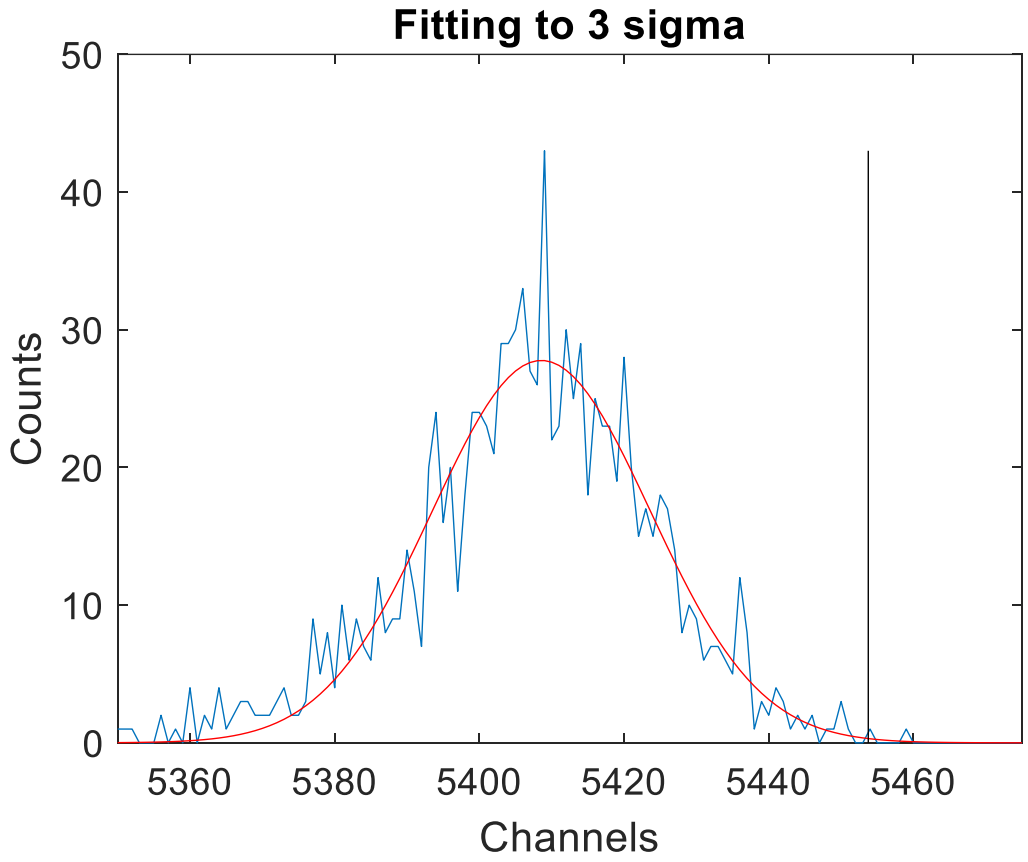
Result $\mu + 2\sigma$

Quantity	Value (Energy (KeV))
μ	7644.7
σ	21.2479
2σ	42.4959
FWHM	50.0351



Calibrating to $\mu + 3\sigma$

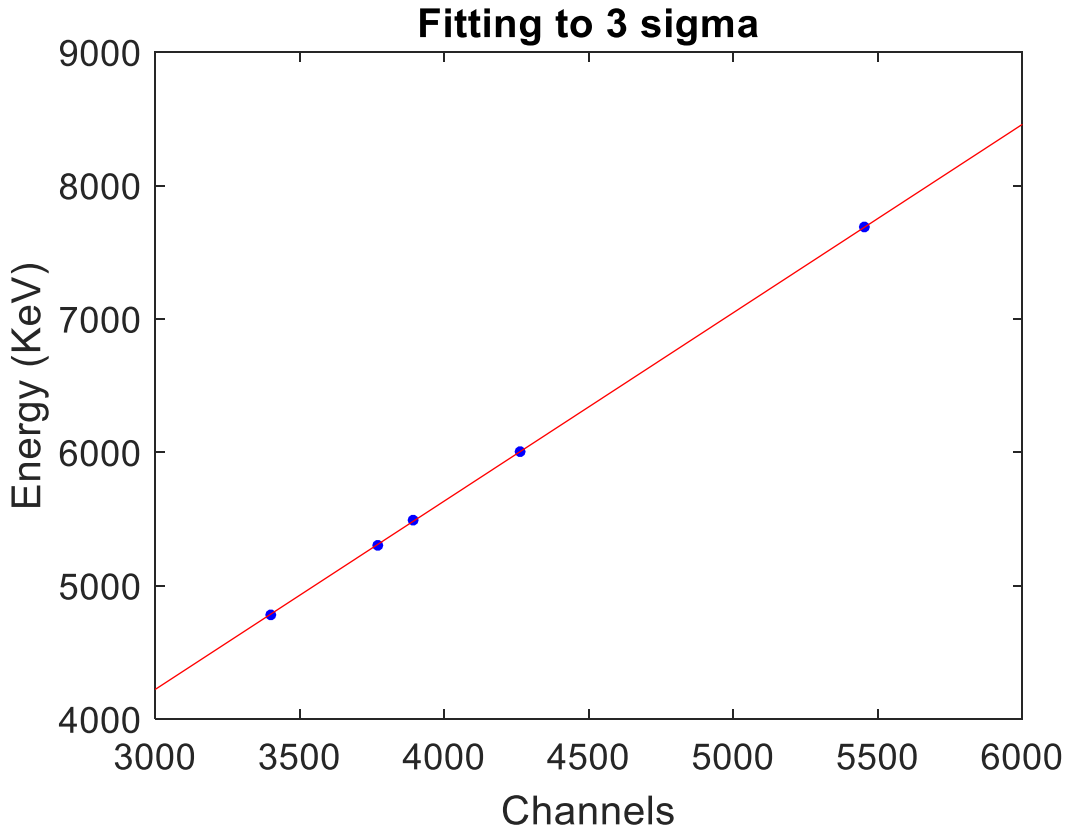
Quantity	Value
μ	5408.6
σ	15.0637
3σ	45.1912
FWHM	35.47



Calibration to $\mu + 3\sigma$

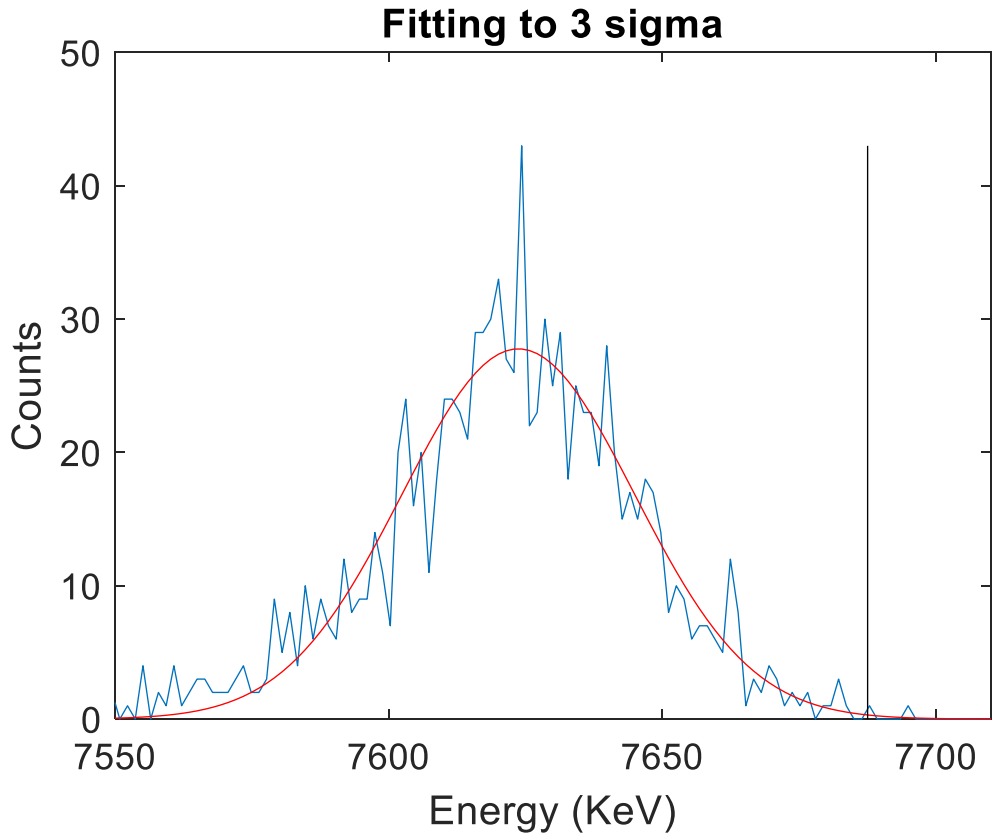
Best Fit Line:

$$\mathrm{E\ (KeV)} = 1.4120\ \mathrm{Ch} - 13.1961$$

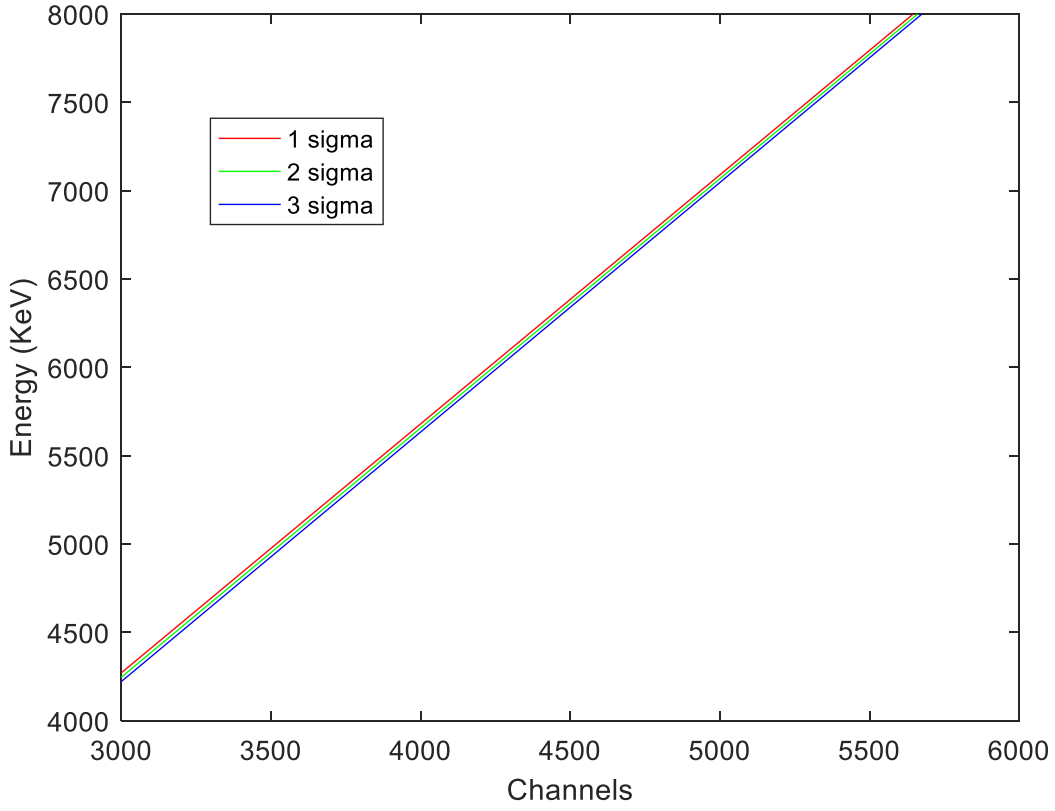


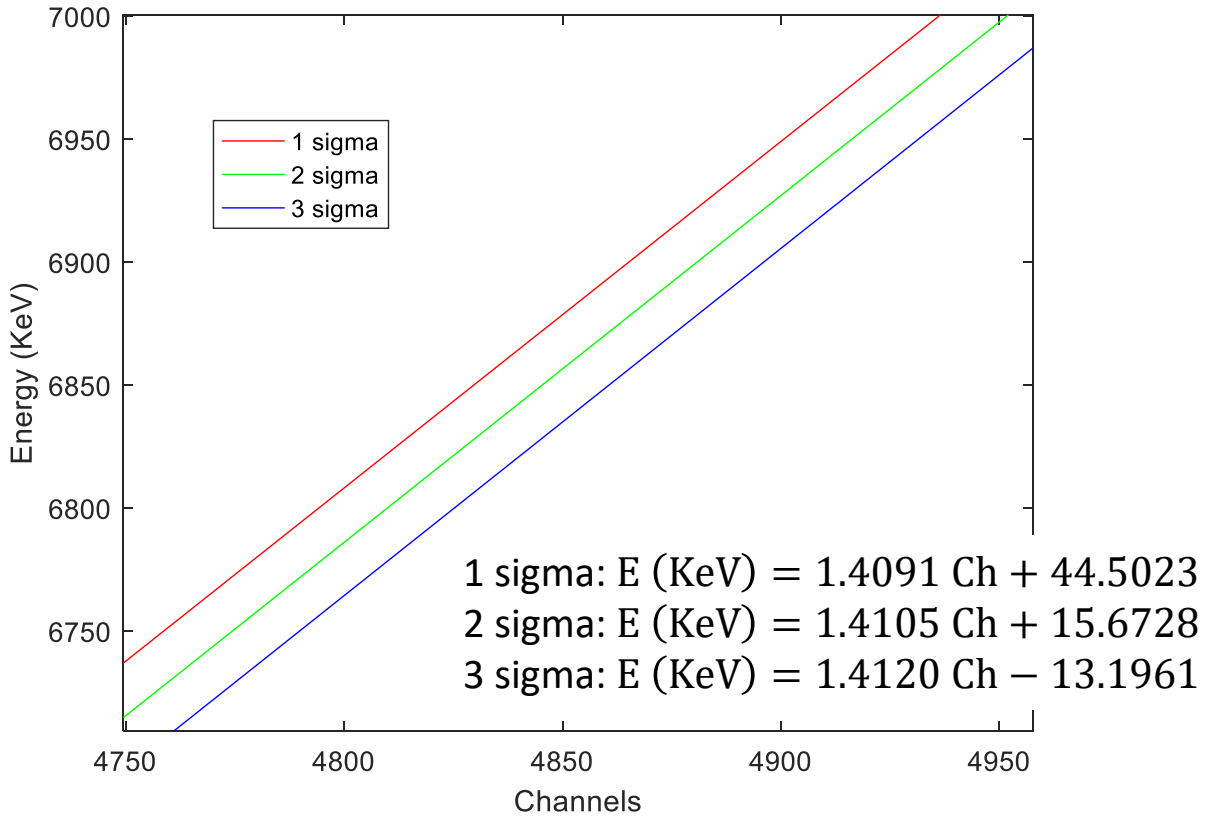
Result $\mu + 3\sigma$

Quantity	Value (Energy (KeV))
μ	7623.7
σ	21.2699
3σ	63.8097
FWHM	50.0868



Alpha Calibration: Best Fit Lines





Comparison of all Best Fit Lines over the deuteron calibration energy range

Calibration	Energy of Channel 1119.91
1 sigma	1622.6 KeV
2 sigma	1595.3 KeV
3 sigma	1568.1 KeV
Deuterons	1604.6 KeV

1.621 MeV deuterons off gold
Centroid Channel: 1119.91
Predicted Energy: 1605.6 KeV