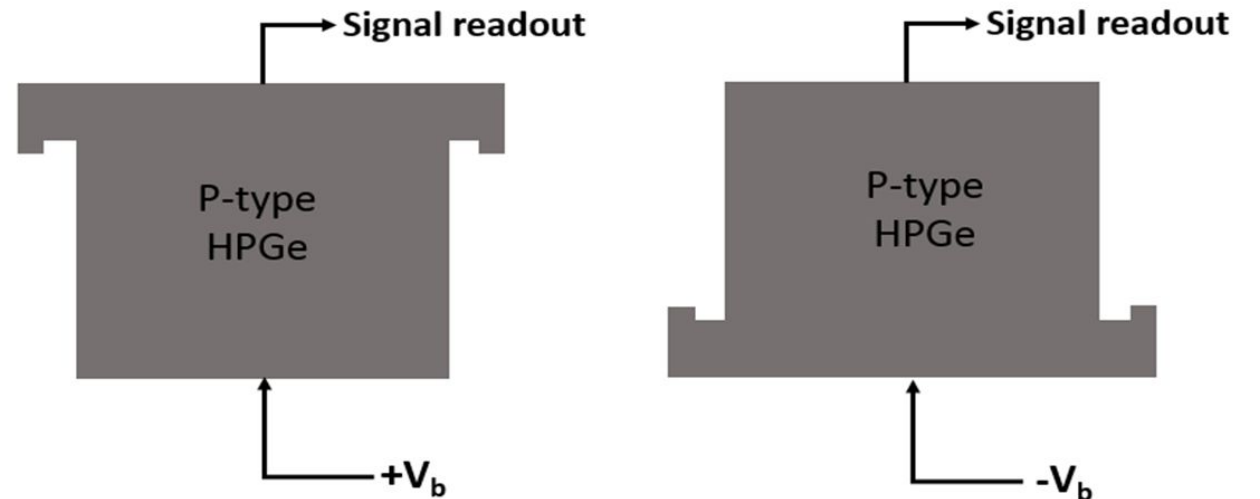


Research Update 2

Abbie Woodard

Research Goals

- Improve energy resolution of HPGe Detectors
 - low background counting
 - spectrum analysis
- Convolutional Neural Networks
 - unknown peak identification



Energy Spectrum

HPGe Detector Mordred

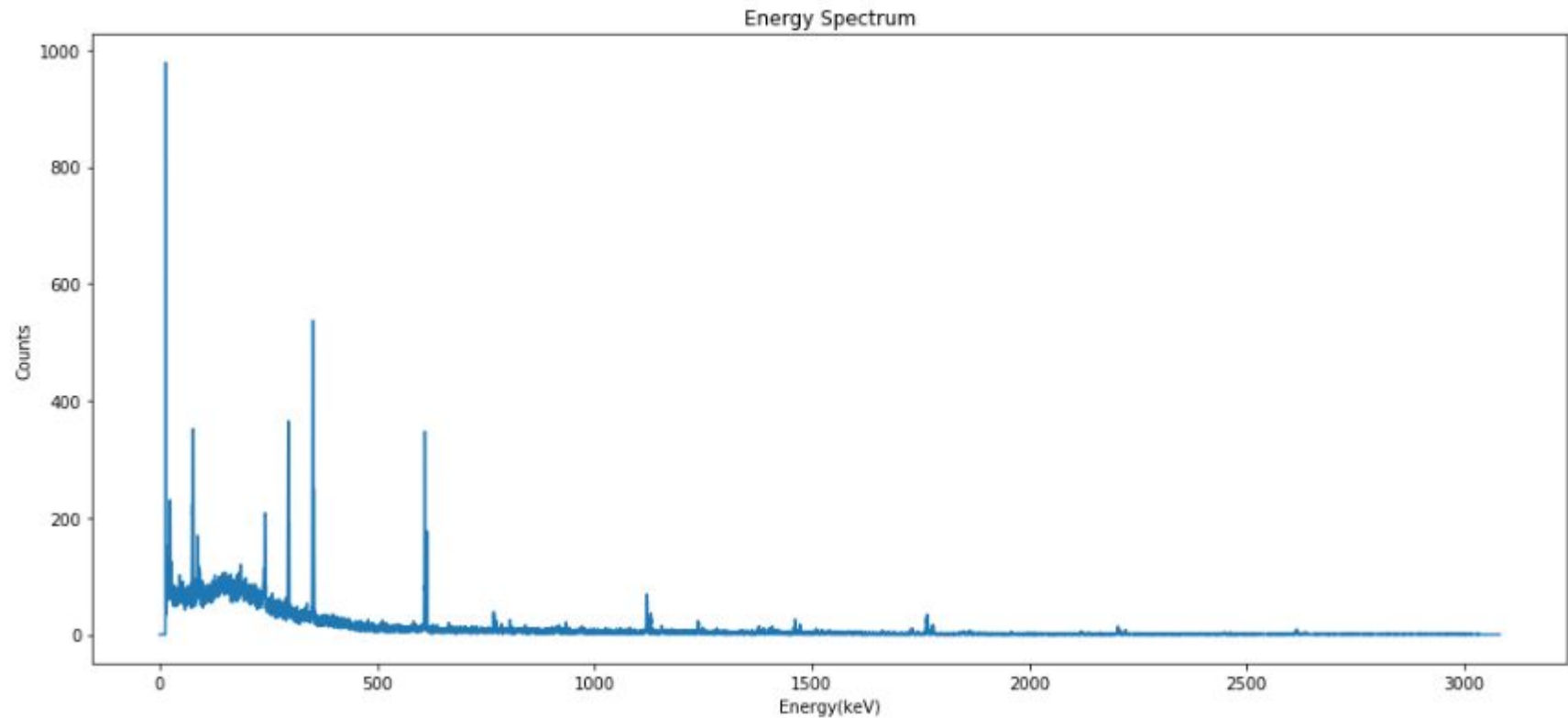
-Seven-day Run

Energy

-0 to 3000 keV

Number of Entries

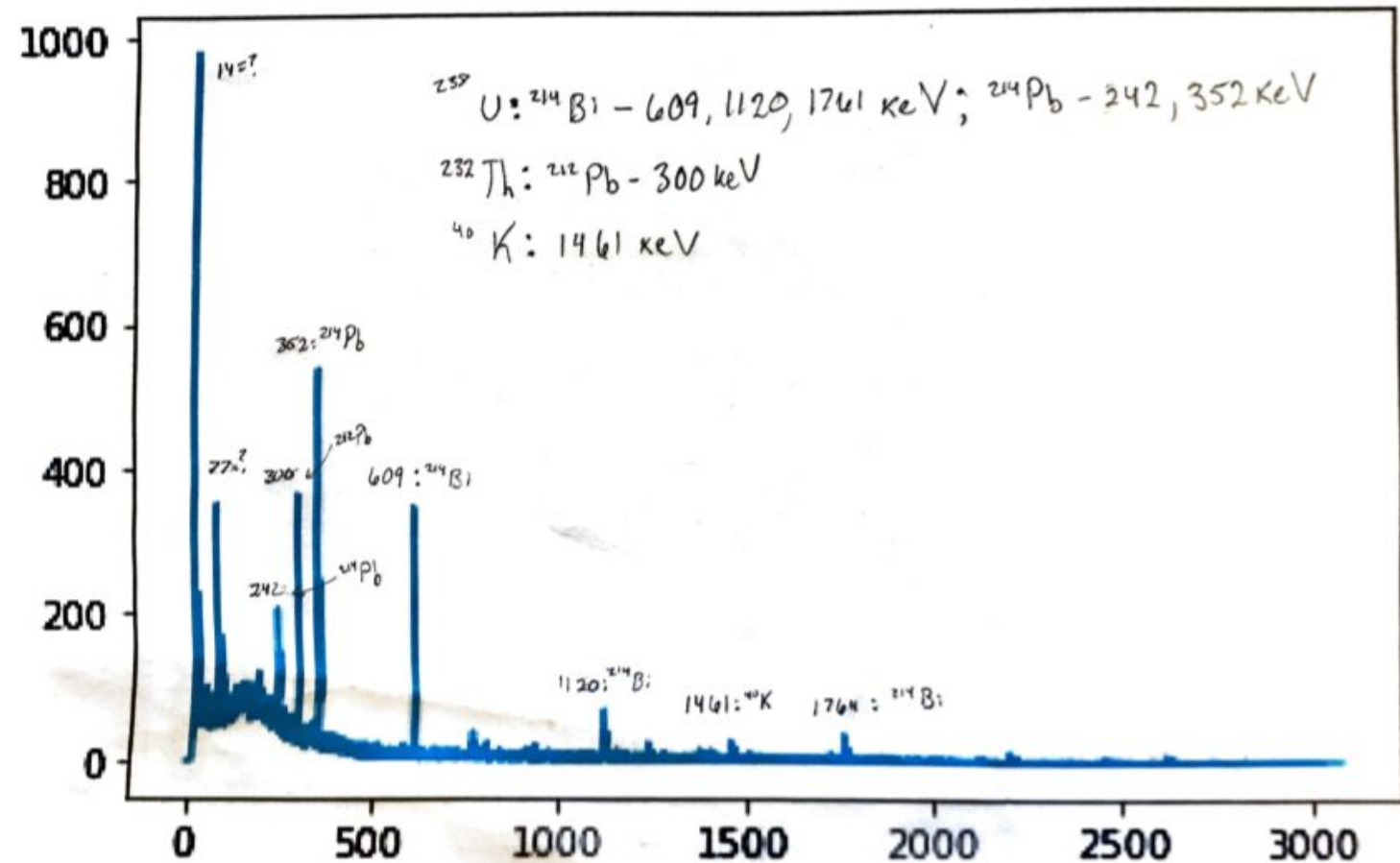
-0 to 1000 Counts



Labeled Energy Spectrum

Radioisotopes

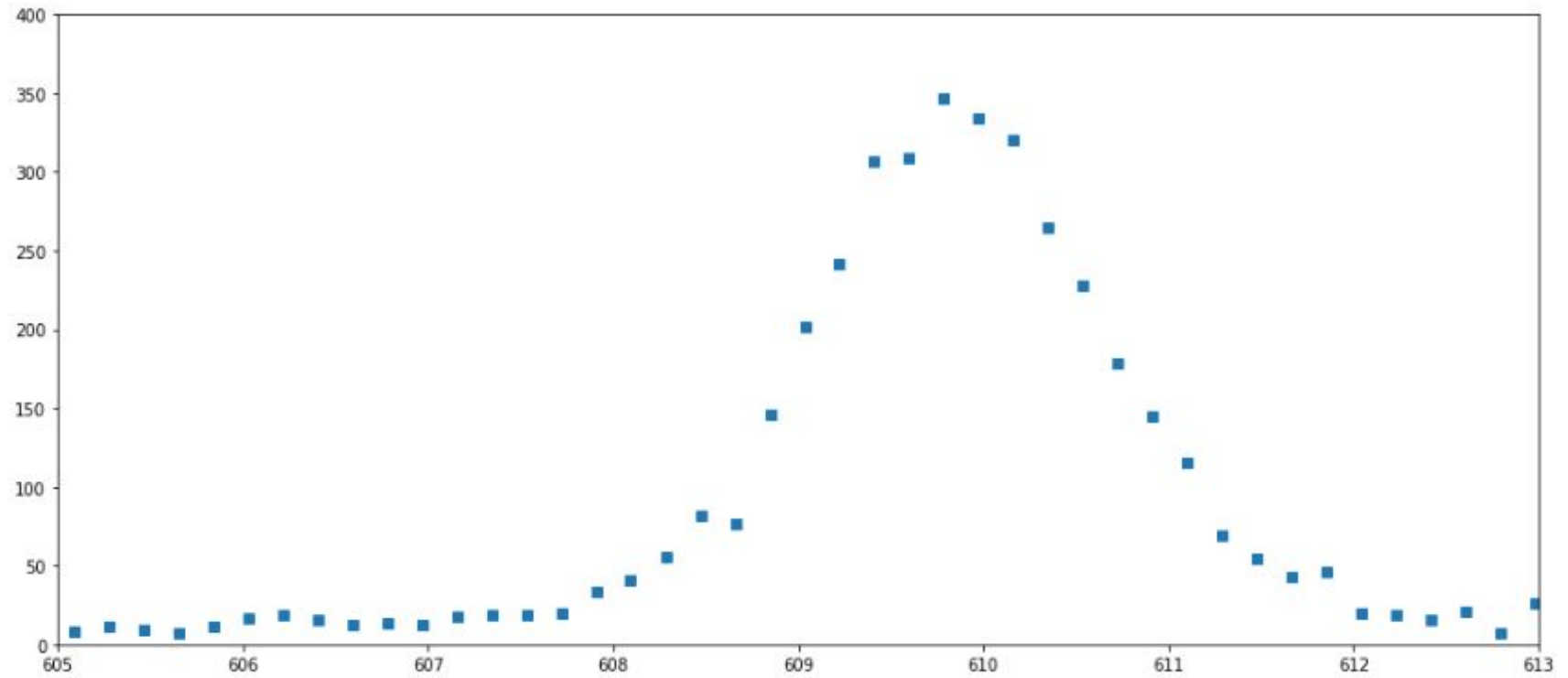
- U-238
- Th-232
- K-40



Fitting Algorithm

- Parameters
 - height
 - energy
 - sigma
- Gaussian Fitting

$$f(x) = ae^{-\frac{(x-b)^2}{2c^2}}$$



Single Peak

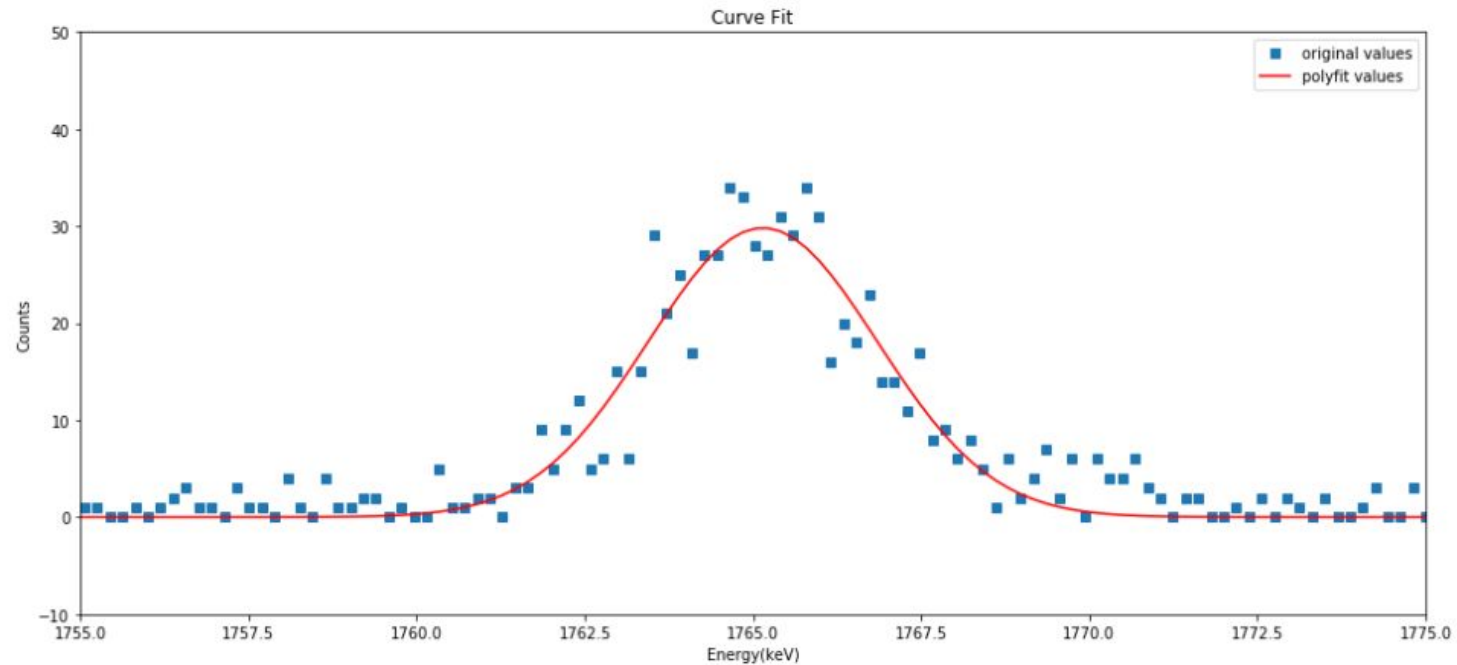
```
#single gaussian function
def gaussian(x, amp, mu, sigma,):
    return amp * np.exp(-((x - mu)**2)/(2*sigma)**2)

#least squares fit
popt, pcov = curve_fit(gaussian, x, y, p0=[30, 1765, 1,])

amp = popt [0]
mu = popt[1]
sigma = popt[2]
FWHM = 2.355*sigma

yvals = gaussian(x, amp, mu, sigma,)

#parameters
print('amp:', amp)
print('mu:', mu)
print('sigma:', sigma)
print('FWHM:', FWHM)
```



```
amp: 29.80369560809009
mu: 1765.1465994572177
sigma: 1.2051260910209696
FWHM: 2.8380719443543834
```

Double Peak

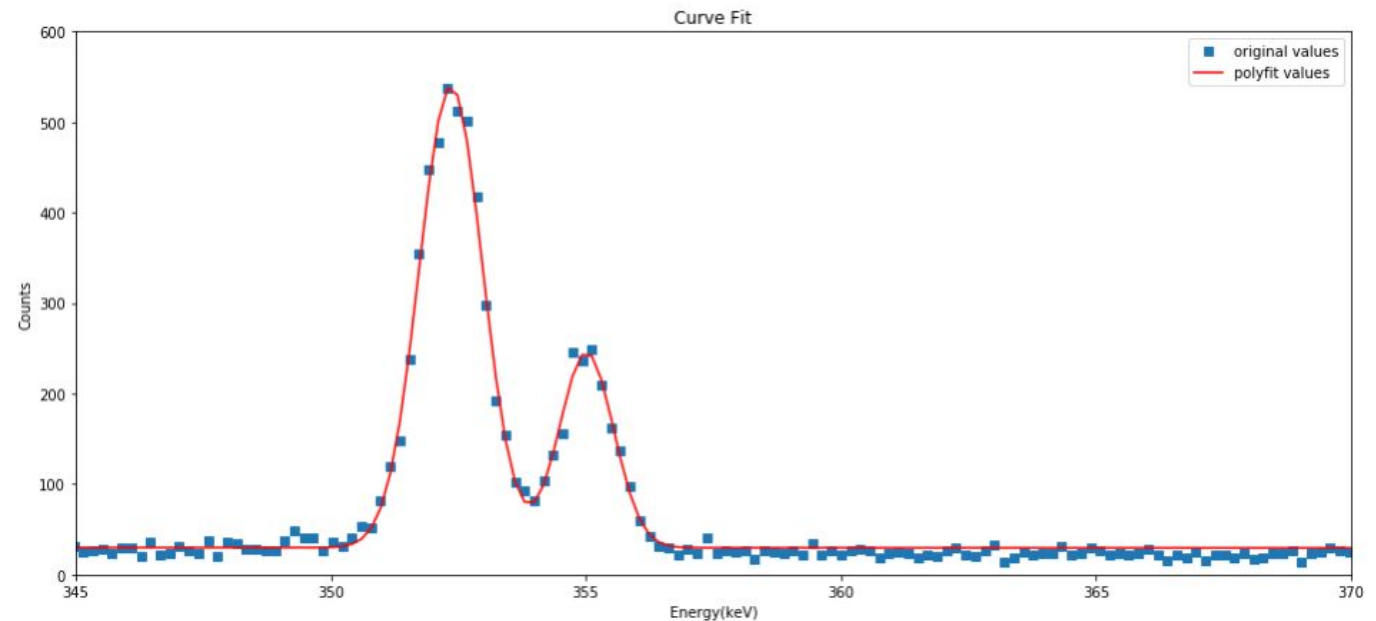
```
#double gaussian function
#sum w/ linear background function
def gaussian2(x, amp, mu, sigma, amp2, mu2, sigma2, m, b):
    return amp * np.exp(-((x - mu)**2)/(2*sigma)**2) + \
           amp2 * np.exp(-((x - mu2)**2)/(2*sigma2)**2) + (m*x + b)

#least squares fit
popt, pcov = curve_fit(gaussian2, x, y, p0=[550, 352, 1, 270, 356, 1, 0, 30])

amp = popt [0]
mu = popt[1]
sigma = popt[2]
amp2 = popt[3]
mu2 = popt[4]
sigma2 = popt[5]
m = popt[6]
b = popt[7]
FWHM = 2.355*sigma
FWHM2 = 2.355*sigma2

yvals = gaussian2(x, amp, mu, sigma, amp2, mu2, sigma2, m, b)

#parameters
print('amp:', amp)
print('mu:', mu)
print('sigma:', sigma)
print('amp2:', amp2)
print('mu2:', mu2)
print('sigma2:', sigma2)
print('m:', m)
print('b:', b)
print('FWHM:', FWHM)
print('FWHM2:', FWHM2)
```



```
amp: 510.6416805892063
mu: 352.35409759997594
sigma: 0.4398507587241479
amp2: 215.9367461060639
mu2: 355.0113046359733
sigma2: 0.37642753432180276
```

```
m: -0.01584426335043425
b: 35.222914357680736
FWHM: 1.0358485367953683
FWHM2: 0.8864868433278454
```



Future Plans

- Refining Energy Resolution
 - subtracting background from gaussian peak
 - neural network integration