Correction Energy with Modified SiD Model

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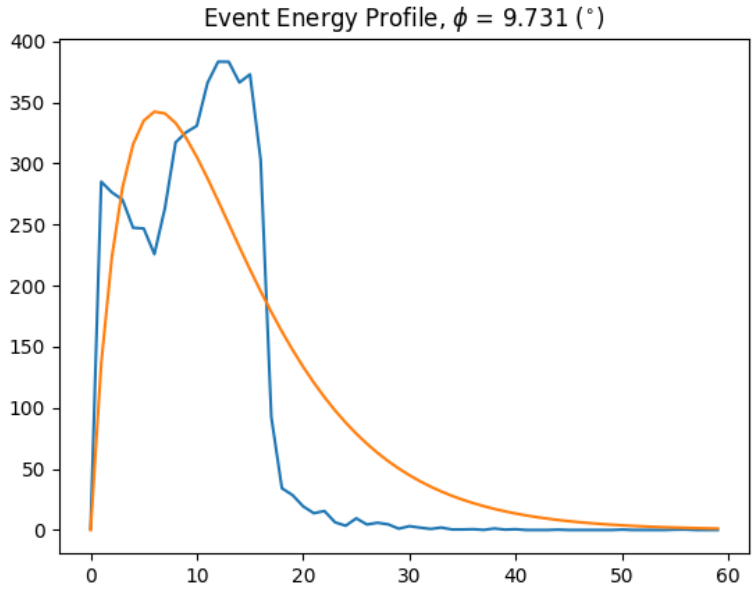
Updated Geometry Model

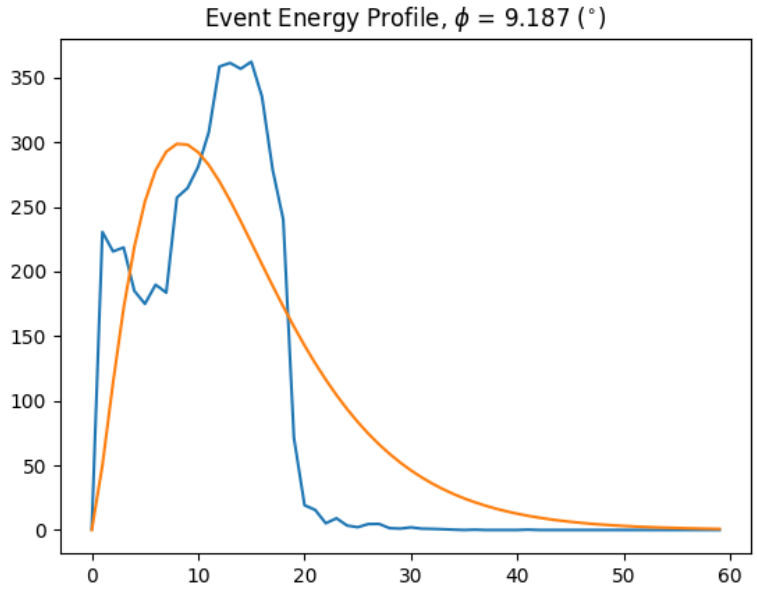
- Fixed layer geometry model to account for overlapping region

```
def layer(hit):
    ecal_rmin=1264.
    ecal_layer_width=3.75
    r=math.sqrt(hit[0]**2+hit[1]**2)
    phi=my_atan2(hit[1],hit[0])
    ecal_rmin_adjusted=0
    ecal_layer_width_adjusted=0
    if phi%(math.pi/6)>(4.03*math.pi/180.0) and phi%(math.pi/6)<(15.0*math.pi/180.0)
       and r>ecal_rmin/math.cos(phi%(math.pi/6)-math.pi/6):
       ecal_rmin_adjusted=ecal_rmin/math.cos(phi%(math.pi/6)-math.pi/6)
       ecal_layer_width_adjusted=ecal_layer_width/math.cos(phi%(math.pi/6)-math.pi/6)
    else:
       ecal_rmin_adjusted=ecal_rmin/math.cos((phi+math.pi/12)%(math.pi/6)-math.pi/12)
       ecal_layer_width_adjusted=ecal_layer_width/math.cos((phi+math.pi/12)%(math.pi/6)-math.pi/12)
    return max(int((r-ecal_rmin_adjusted)/ecal_layer_width_adjusted),0)
```

Energy-per-Layer Problem

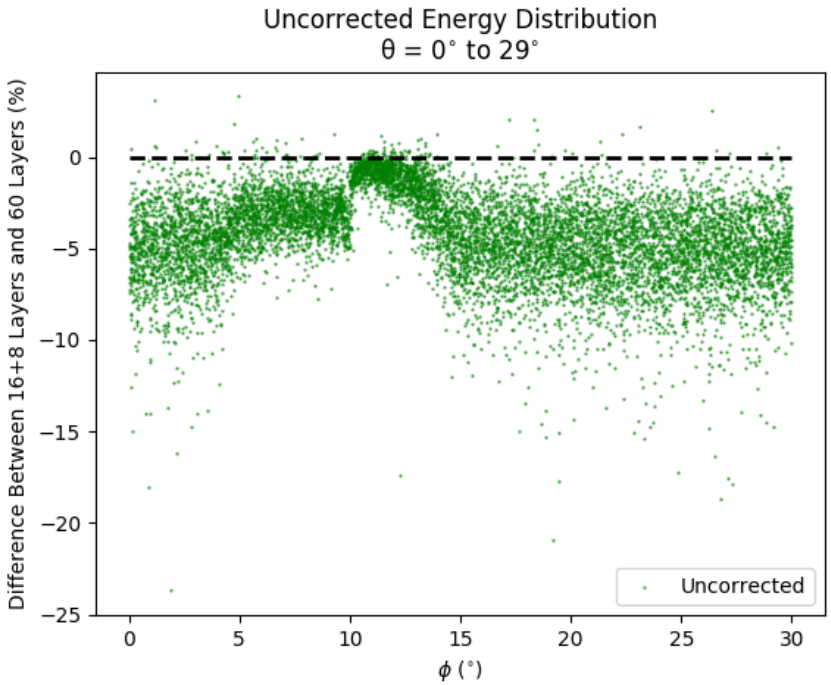
- In overlapping region, treating layer numbers the same as in non-overlapping regions distorts shower profiles
- Prevents standard best-fit method from working

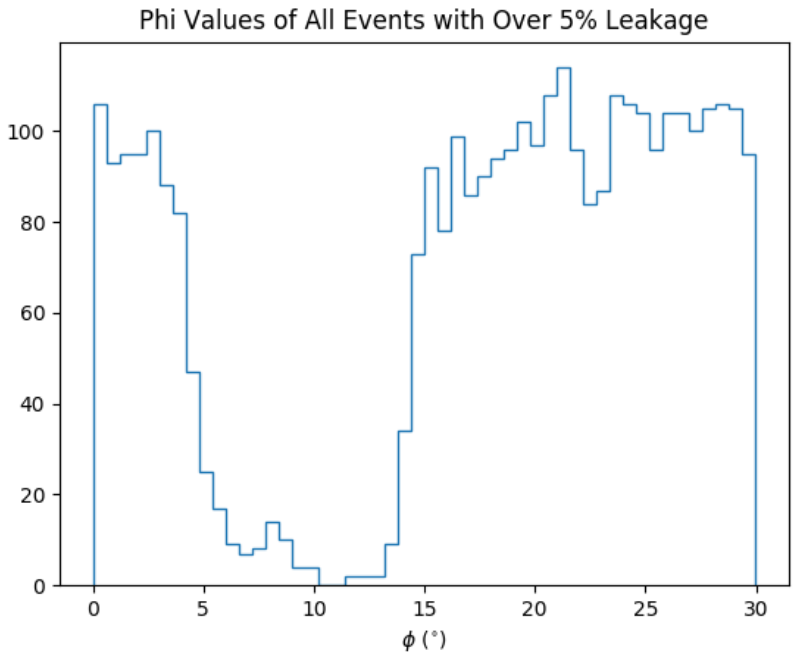




Preliminary Solution: Doubling Method

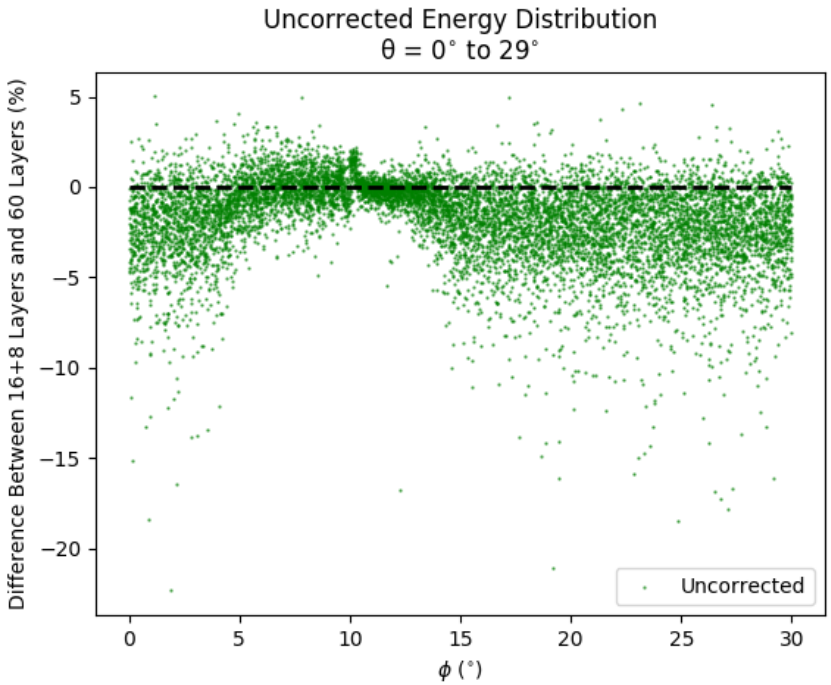
- Layers dropped due to under-sampling simulated as **equivalent to deposit in next layer of ECal**
- Poor performance: under-predicts energy (as expected)

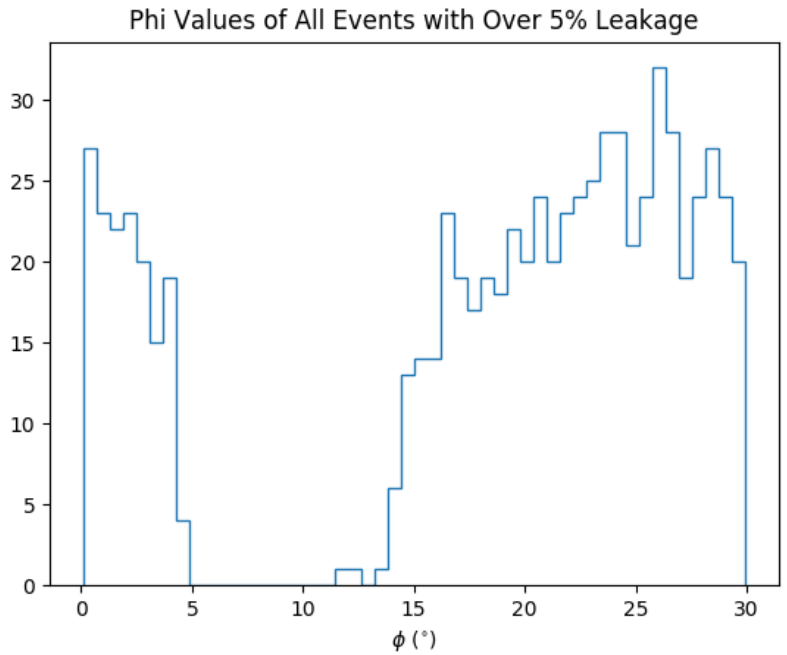




Preliminary Solution: Averaging Method

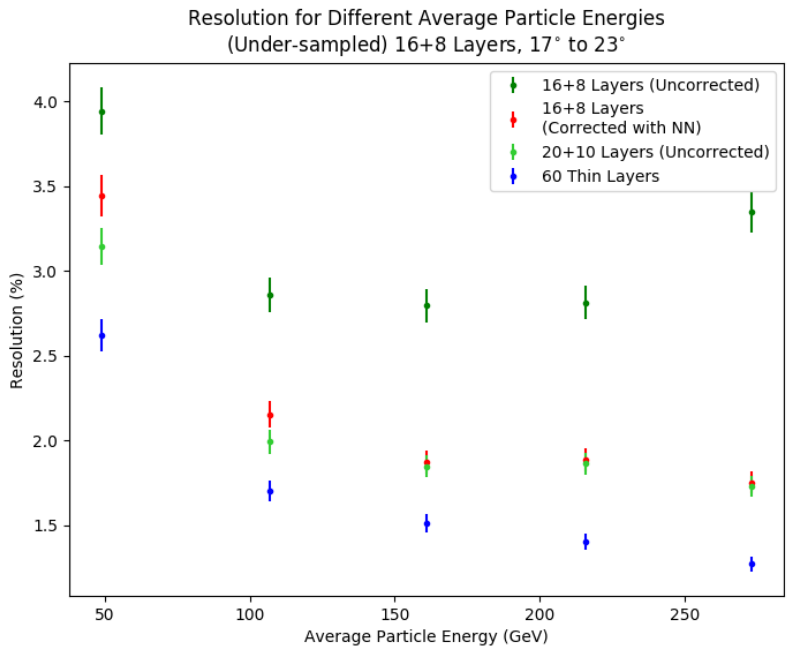
- Layers dropped due to under-sampling simulated as **average of neighboring deposits**
- Performs better than doubling method

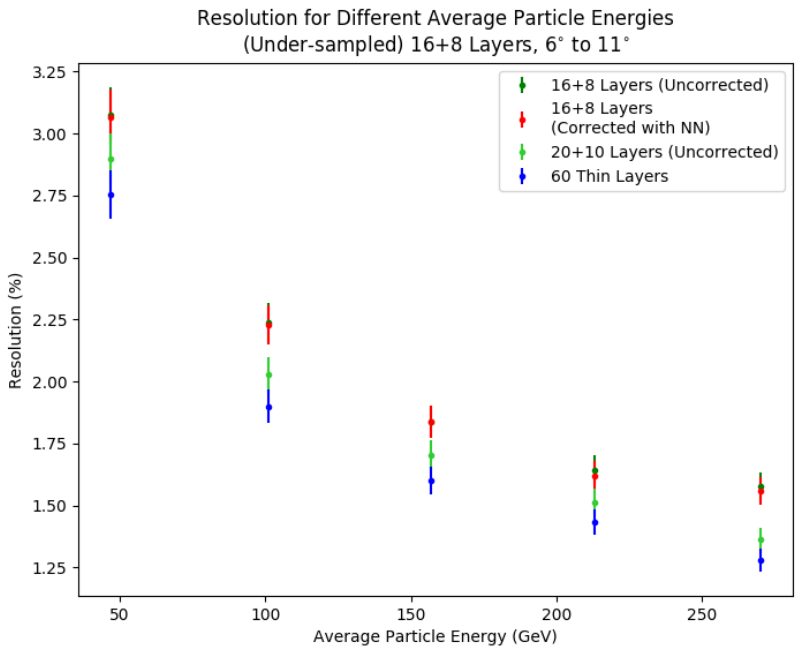




Preliminary Solution: Averaging Method

- Strong resolution correction
- More thin layers in overlap leads to less need for resolution correction





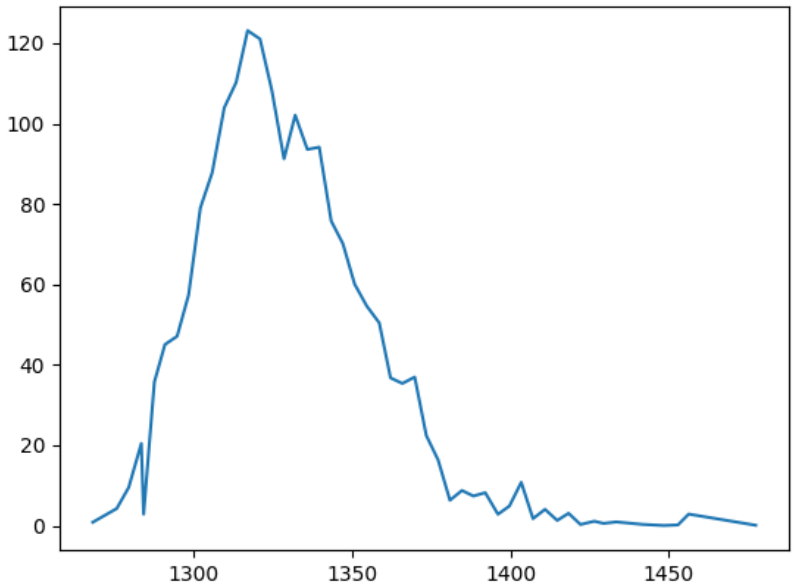
Alternate Layer Representation

- **Distorted energy profiles limit ability to analyze showers and understand shower behavior**
- Solution: separate data from modules in overlapping region
- Algorithm overview:
  - Test if energy deposit is in overlapping region
  - If in overlap, treat energy in each module separately (i.e. energy in 120 layers, instead of 60)
  - Keep track of radius for each deposit in the overlap

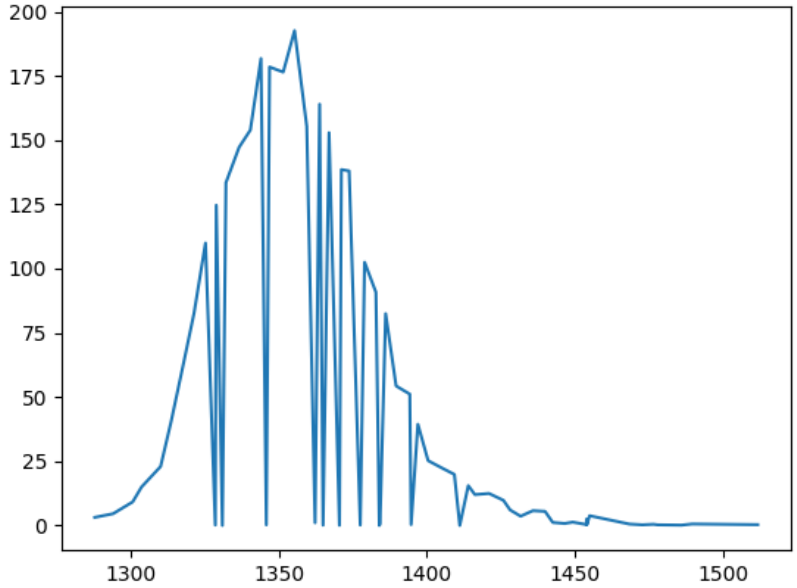
Radius-Based Profiles

- Plotting energy profiles as energy vs radius instead of energy vs layer
- This fixes the shape of the profile but leads to numerous low-deposit layers near the overlapping region, as **only part of the shower passes through each module**

Phi = 28.93°



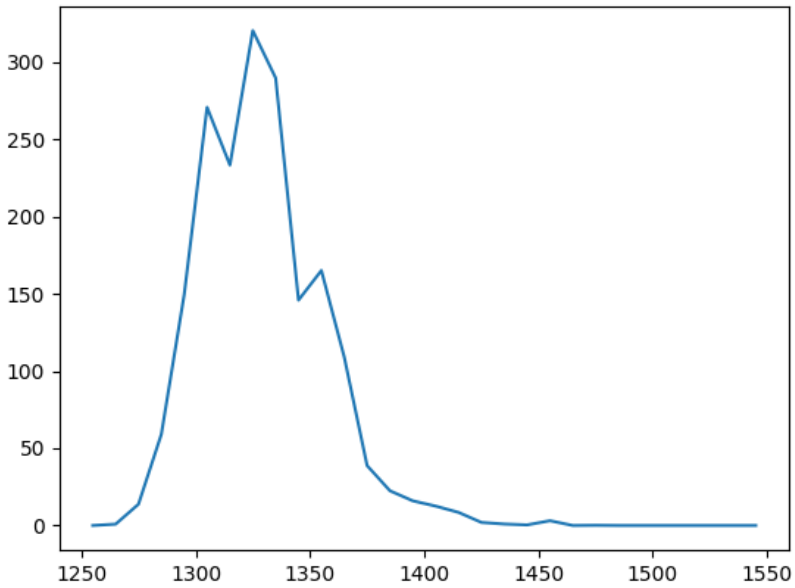
Phi = 17.38°



Binning by Radius

- Binning solves the issue of low-deposit layers, allows for profile analysis
- However, radius-based binning also ignores the fact that some of the **under-sampled layers may be low-deposit layers**

Phi = 28.93°



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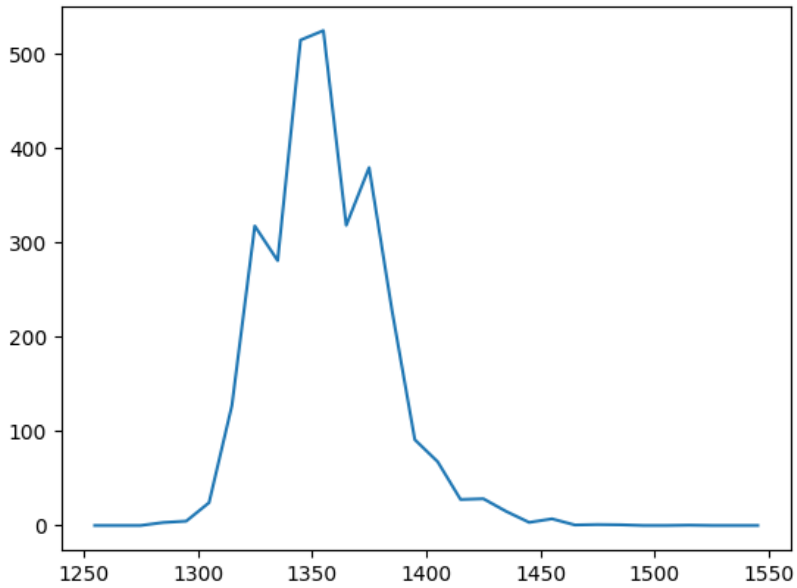

Plotting Profiles for Each Module Separately

- Allows for profile analysis without ignoring low-deposit layers
- Low-deposit layers inconsistent in deposition trend
- Deposits in low-deposit layers are low enough that best-fit correction is not as important

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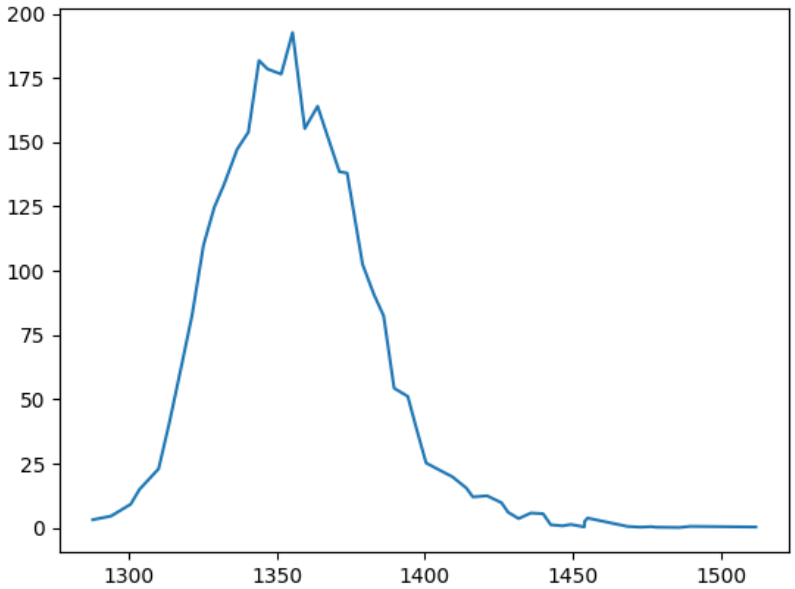
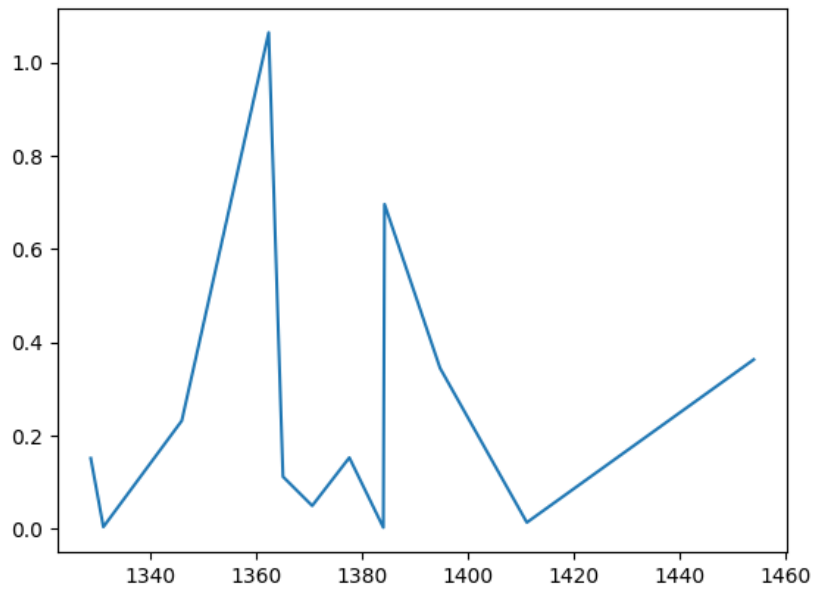
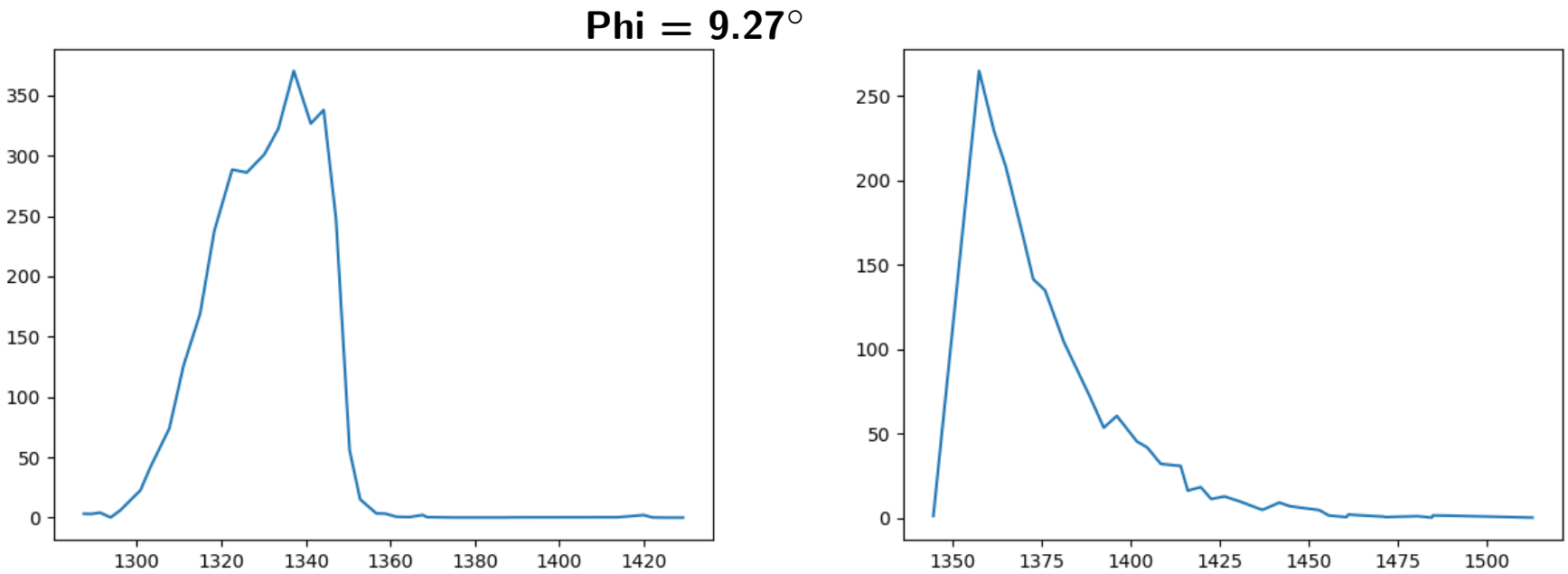




Plotting Profiles for Each Module Separately

- Some events have large deposits in both modules
- In this case, energy deposit trends are consistent enough to apply a best fit



Next Steps

- Implement best-fit method which approximates deposition in each module separately
- Alter NN framework to use radius data and treat modules separately
- Reevaluate NN performance