# What I Am Doing

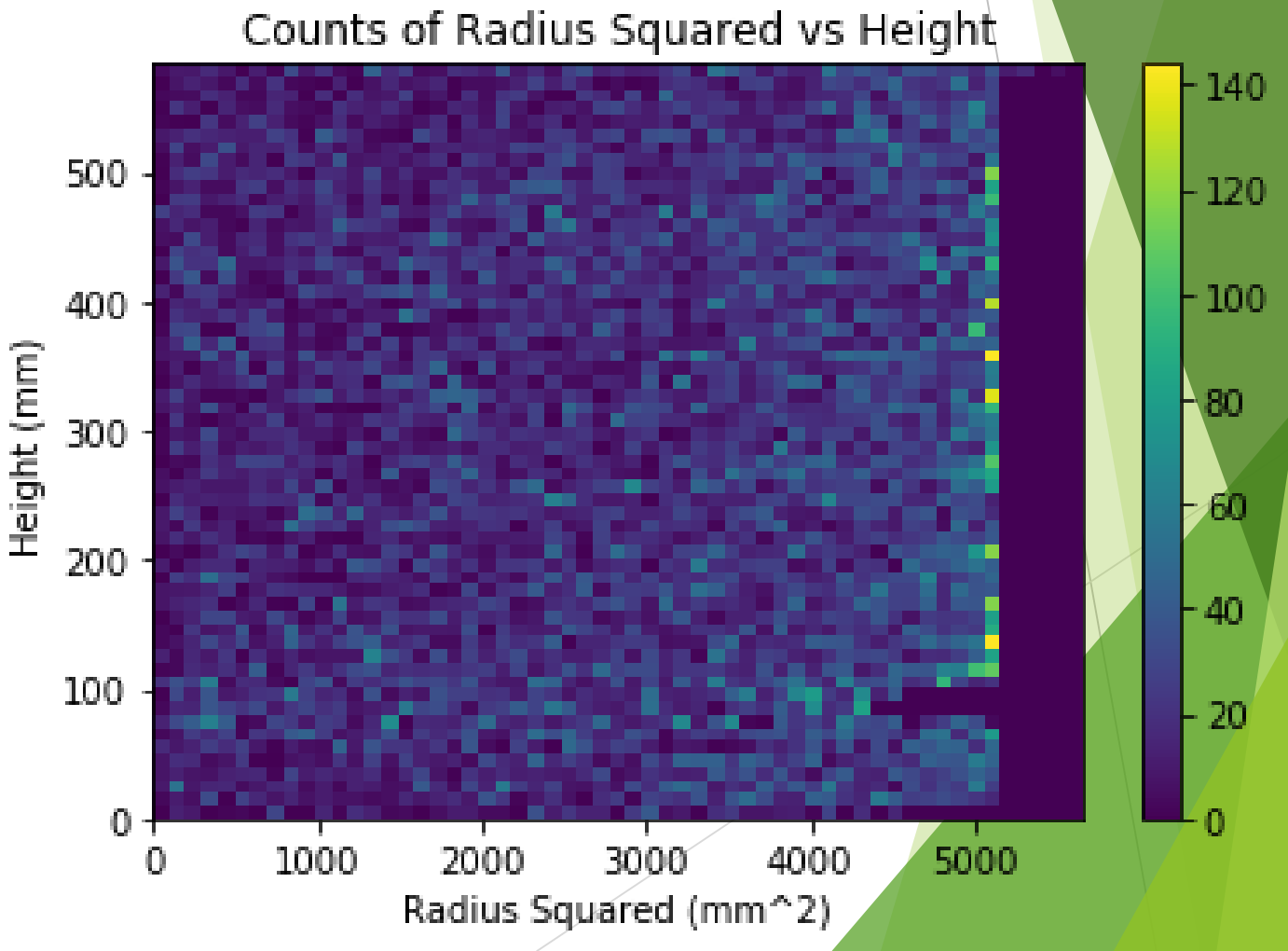
Simulating Thoron Decay Chain in Phase 1

Today's Slide is Here

# Plots!

Concerns

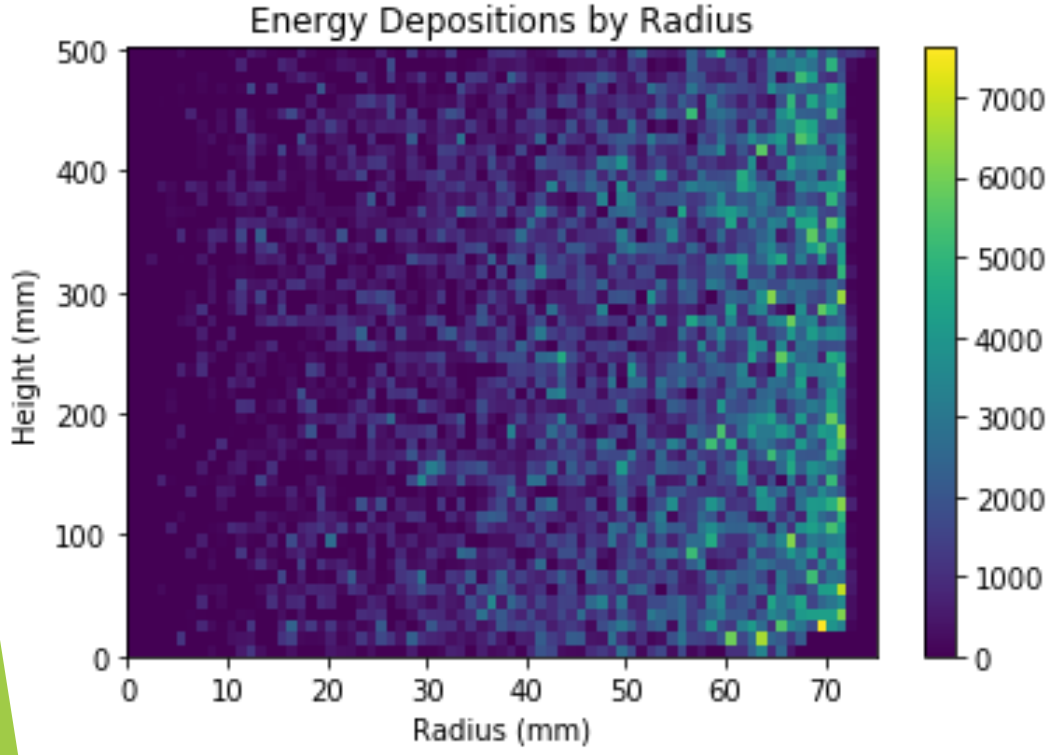
- Time threshold?
- Does not line up exactly with parameters (especially height)
- Gap at 100mm height

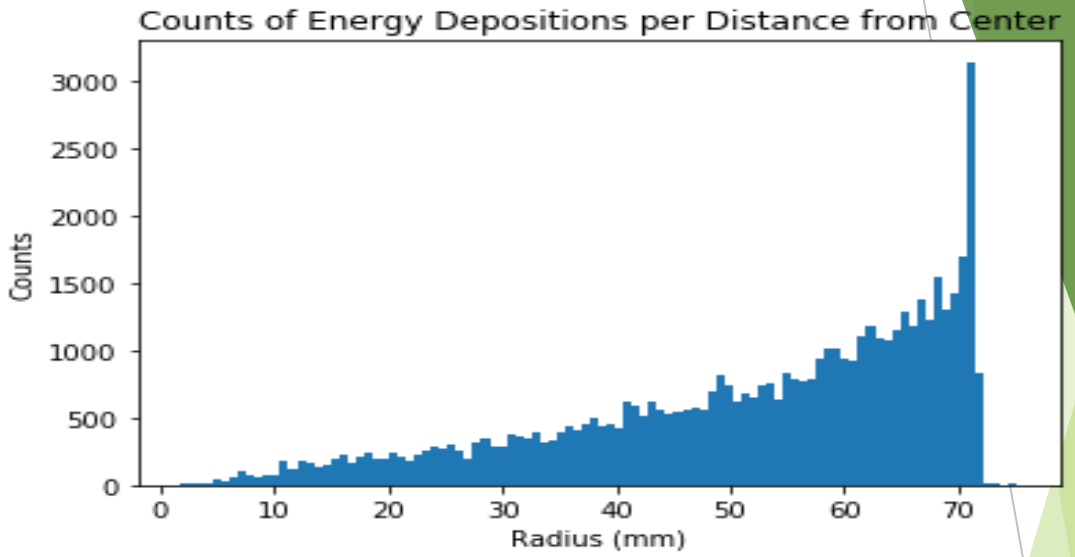


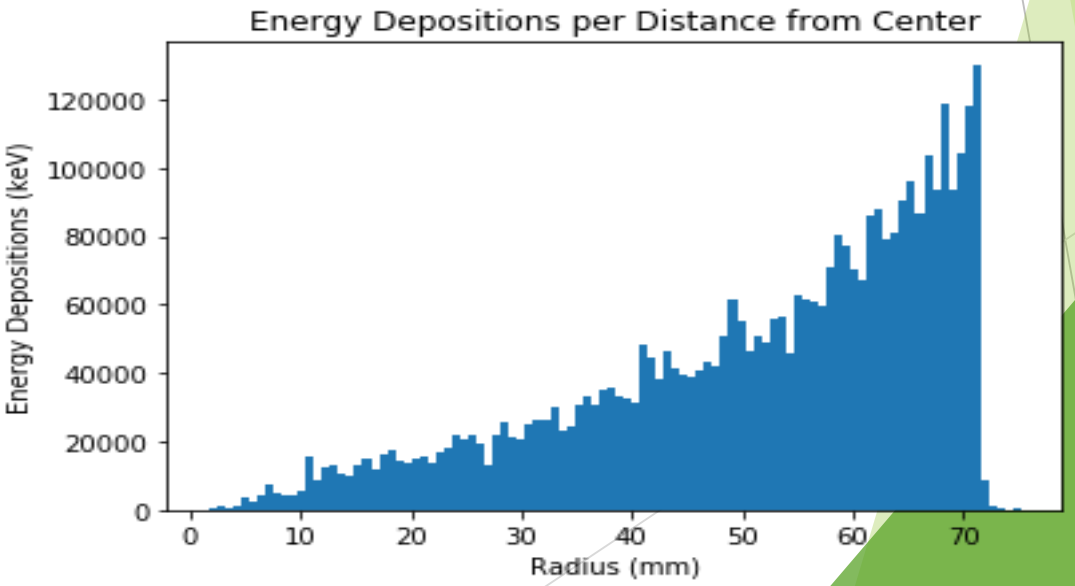
# Still To Do

- Fix Current Issues
- Use Energy Values Instead of Counts
- Try Simulating Decays from Bottom
- Possibly other Materials?

# Energy Depositions and Correct Dimensions



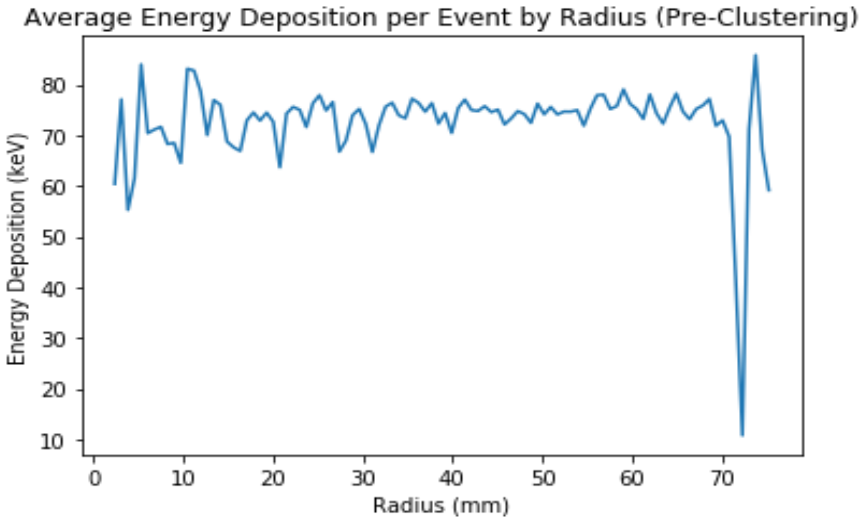
# Still To Do

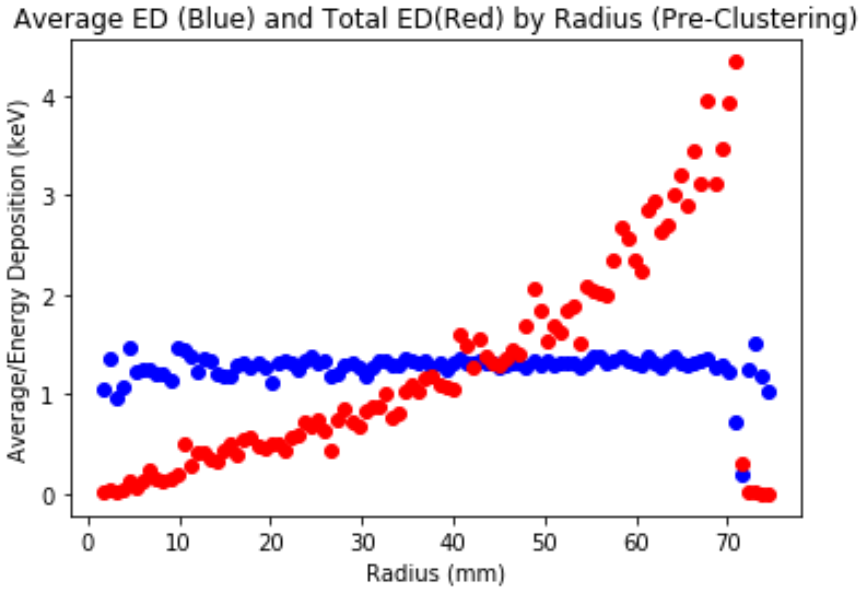
- Find decay rates in area
- Fix geometry problems
- Other materials?

# Thermal Neutron Scattering

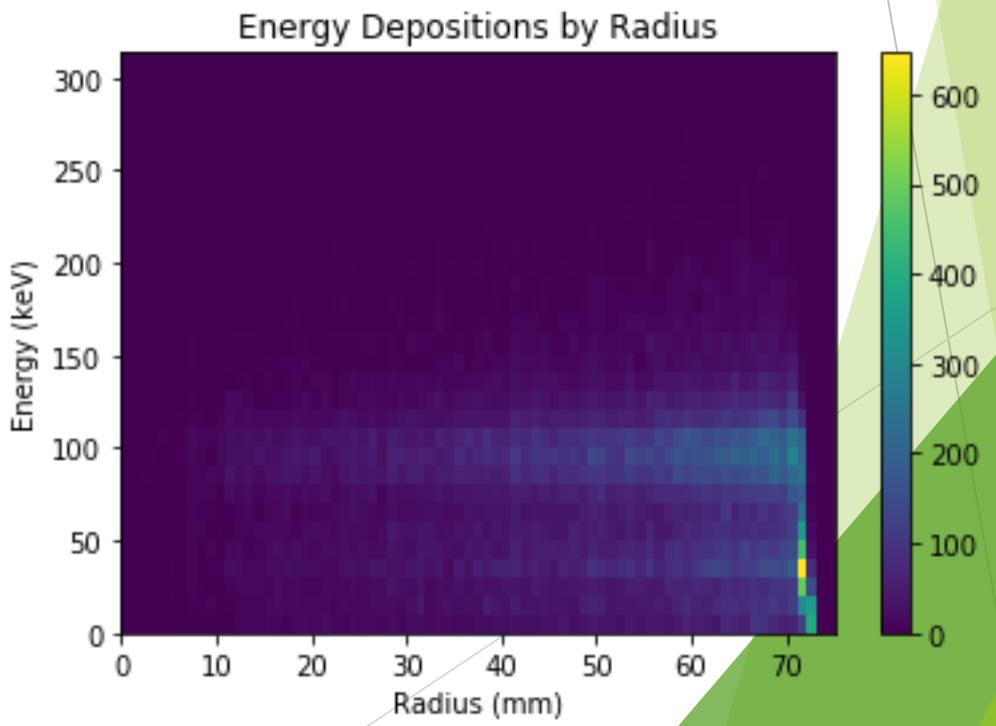
- https://indico.cern.ch/event/245281/contributions/1564676/attachments/420136/583408/thermal_physics_validation_argarcia.pdf
- http://pubs.cnl.ca/doi/pdf/10.12943/CNR.2017.00002

# Average Energy Deposition



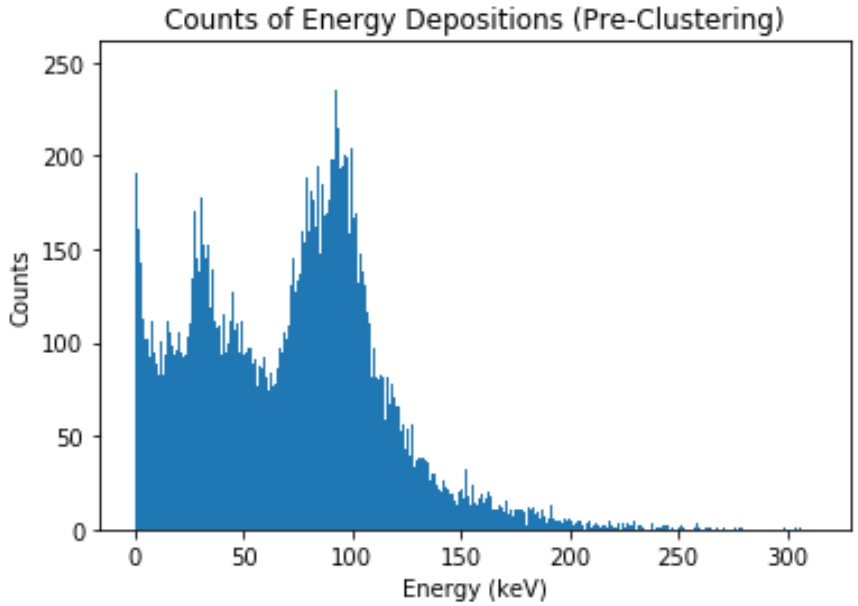




- Why is there so little energy degradation until it is close to the center?
- Why is there a sudden drop at the edge, but regular events past it?
- Why are there so many small-energy events at the edge, but fewer later on?

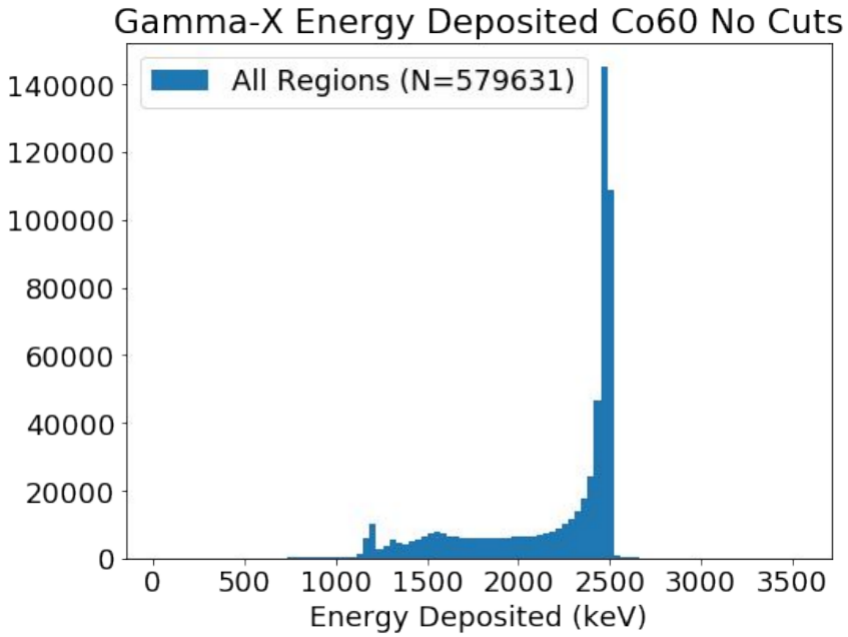


# Energy Histogram Very Far Off

## Mine

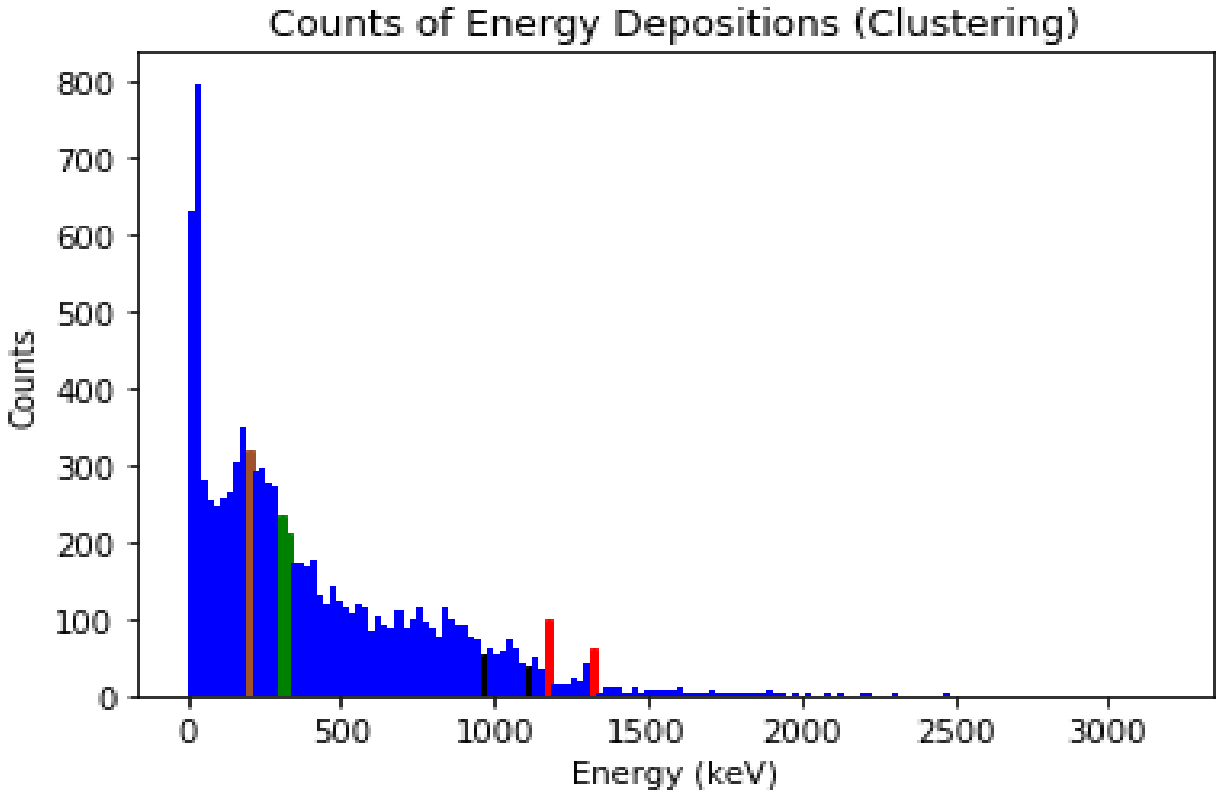



## Jonathan's



# Now With Clustering

## Post-Clustering




## Expected Values (keV)

- Brown=E' (204, 208)
- Green=$\beta^{-}$ max (316)
- Black=$E_e$ (966,1112)
- Red=Photopeak (1173,1333)

| | | | | | | |
|---|---|---|---|---|---|---|
| $^{60}_{27}Co$ | 5.271 y | $\beta^-$ | 0.316 | 100% | 1.173 | 100% |
| | | | | | 1.333 | 100% |

# Still to Do/Answer

## Read

- *Why I am getting so many events well above 1333 keV?
- *What types of events are causing the very small, but numerous energy deposits?
- Why are there relatively few events at photopeak (compared to other measurements)?
- What other energy values do I want to look at?
- Understand equations that I am using

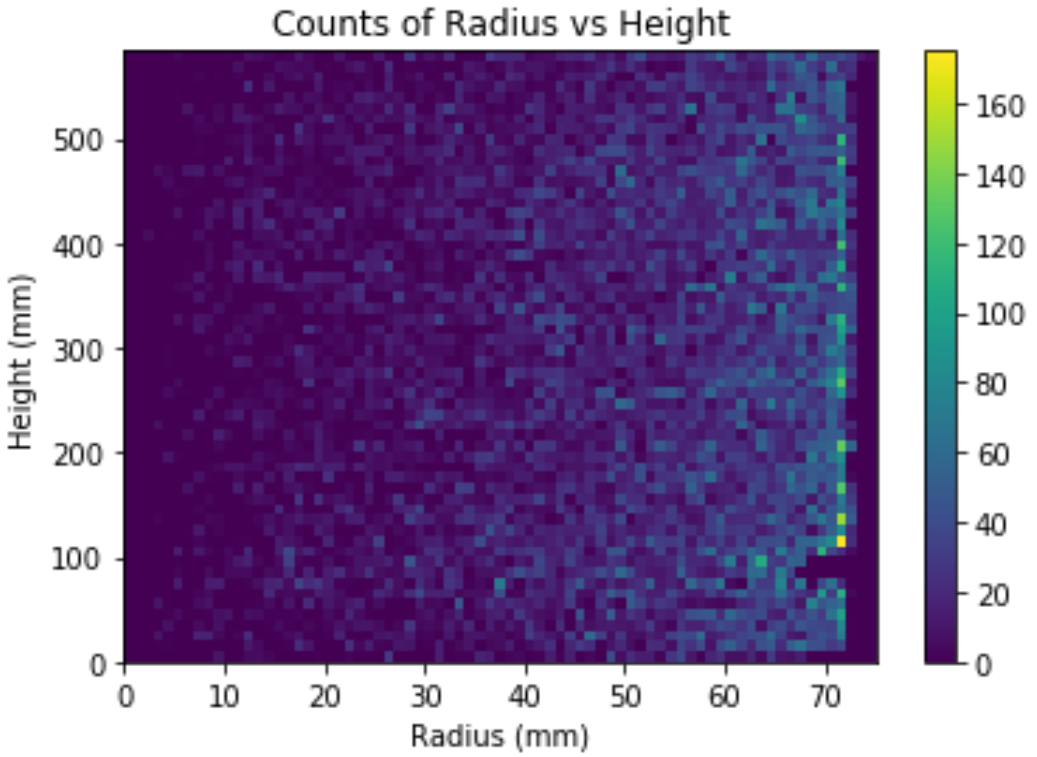
## Do

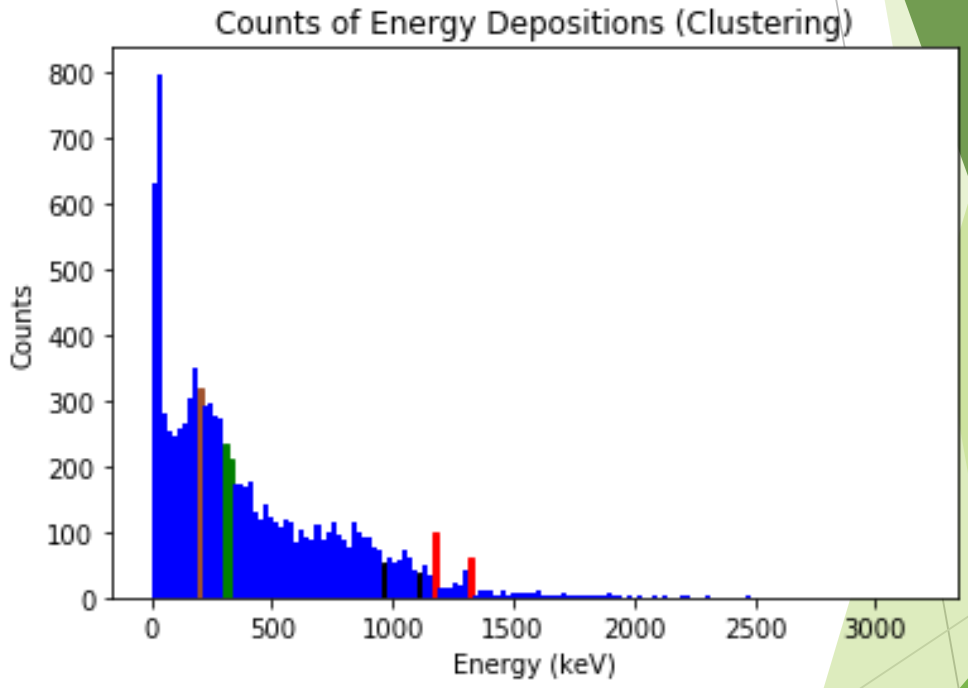
- Find values of other energy factors (escape peaks, detector efficiency, etc.)
- Create rough model of what I should be seeing (ideally)
- Keep reading

# Summer Overview

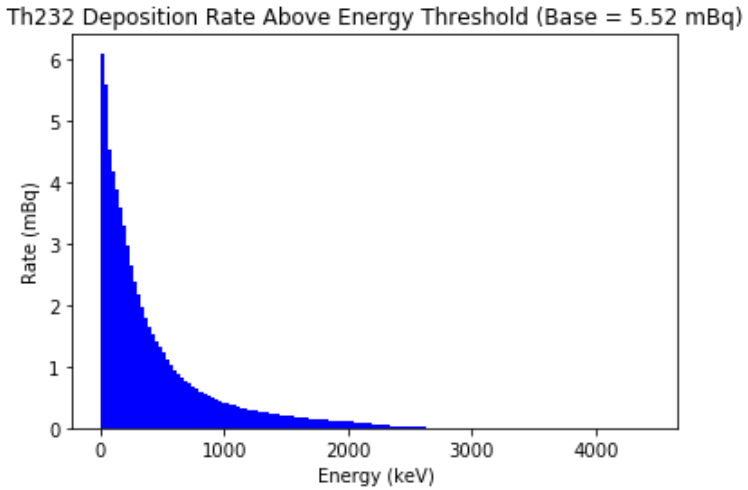
- Got Submission Script/Macro running
- Plotted by position
- Plotted by energy/histograms of energy
- Included Clustering
- Included Accurate Values
- Other elements
- Measured rate above energy threshold
- Cable Making (Minor)
- More components w/ More Decays (In Progress)

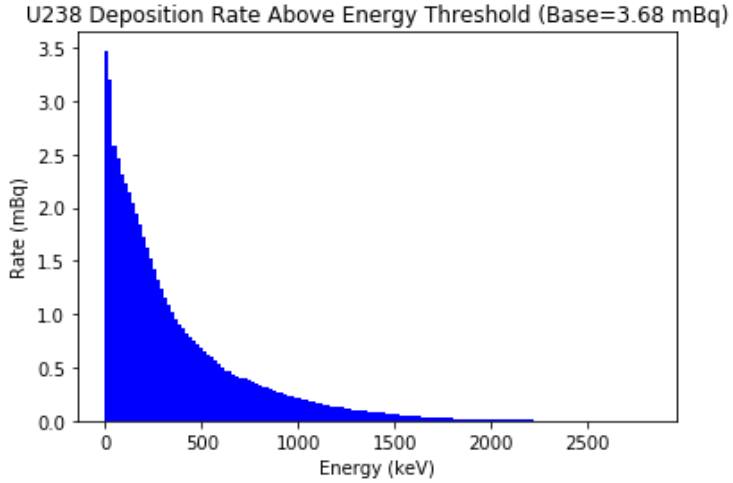
# Plotting By Position/Energy/Clustering

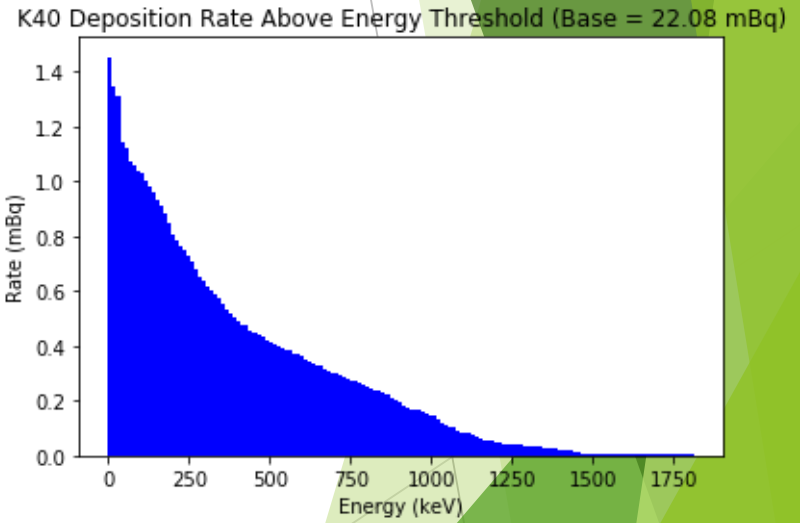


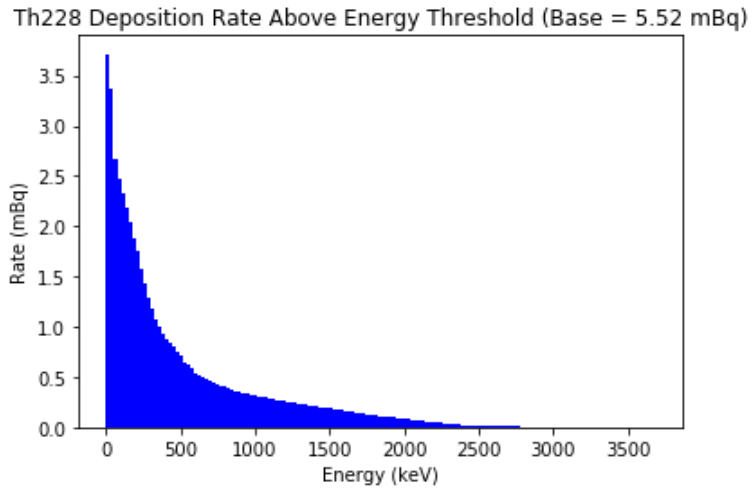



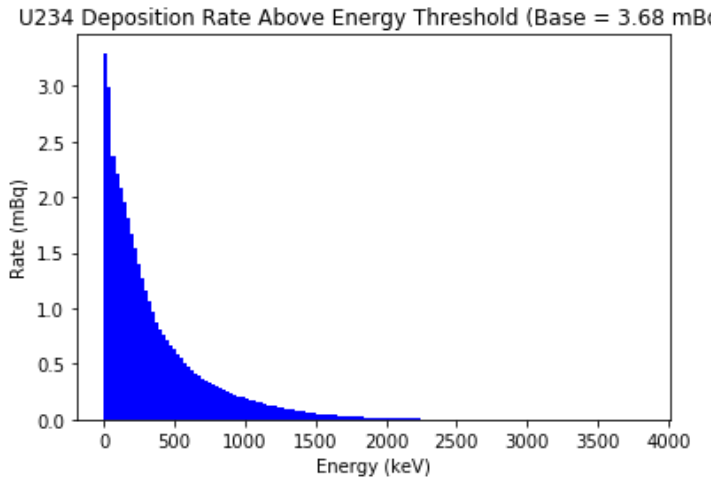
# Accurate Values/Rate/More Elements



# Goals For Fall 2017 Semester

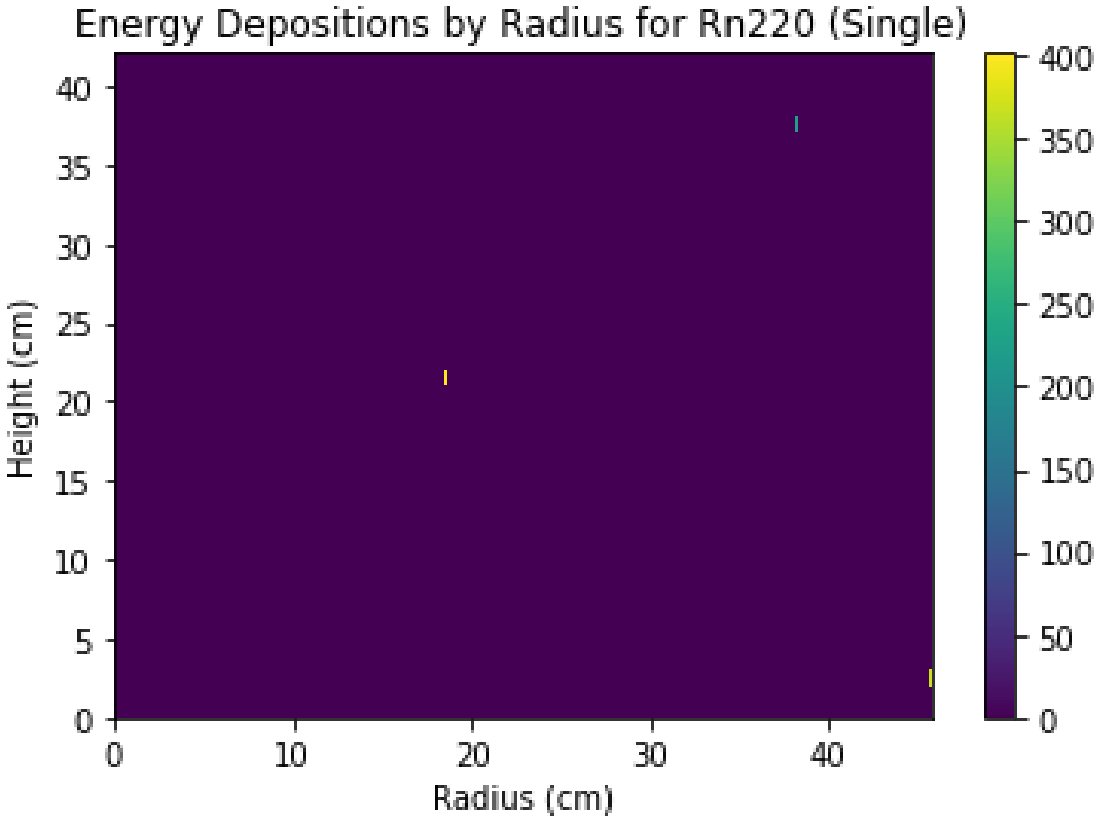
- Research Tasks
  - More Components
  - Give LZ-value estimate range
  - Errors (And More Events)
  - Thorium Alpha Energies
- Conceptual Knowledge
  - What Specific Impact Do Decays Have on Experiment
- Technical Knowledge
  - Learn More C++; be able to write code in C++ instead of Python
  - Getting Better at ROOT

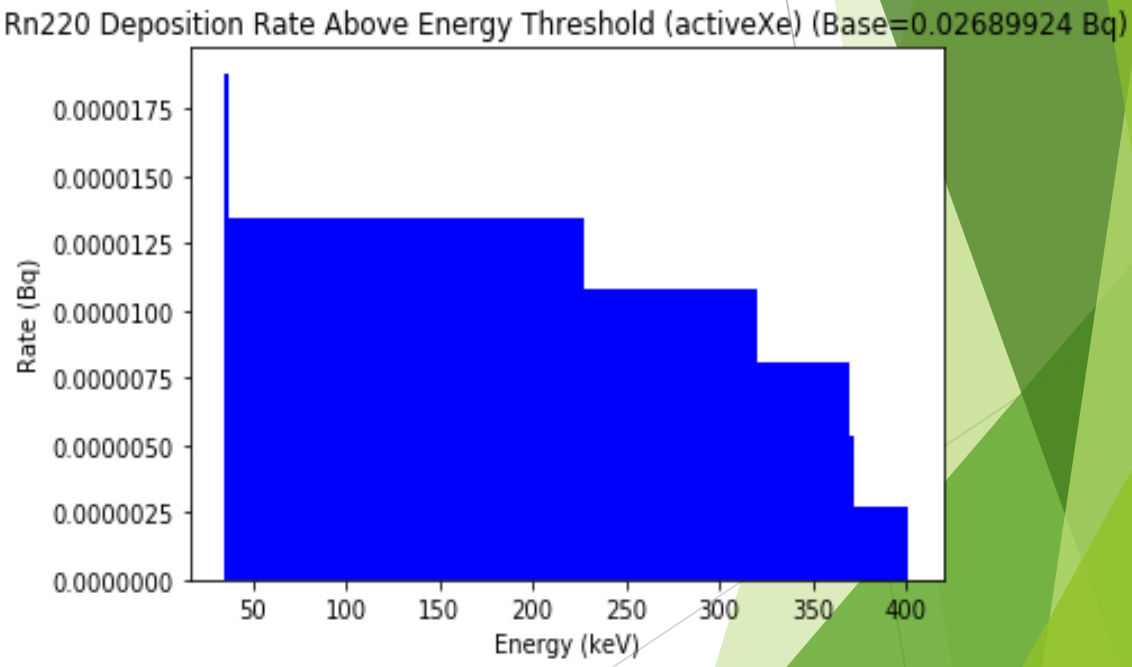
# K40 Background Sources

- Each source @ 1mBq/kg
- Rate is for > 0 keV
- Issues

| Volume Name | Mass (g) | Other masses | K | % |
|---|---|---|---|---|
| VacuumSpaceOuterCryoVessel | 1.22E-20 | | 8.52E-29 | 0.7 |
| InnerCryoVessel | 78576.8 | | 2.81E-03 | 3.572002652 |
| LiquidXenonInnerCryoVessel | 48918.7 | 96588.6 | 1.29E-03 | 2.64 |
| GasXeInnerCryoVessel | 243.699 | 257.436 | 2.39E-06 | 0.98 |
| TPCptfeInLiquid | 13548.2 | | 8.91E-04 | 6.58 |
| TPCptfeConeInLiquid | 1531.61 | | 5.05E-06 | 0.33 |
| gridRingInLiquid | 108.655 | | 4.93E-06 | 4.54 |
| PeekSpacerArc1 | 7.09061 | 7.09144 | 2.67E-07 | 3.77 |
| PeekSpacerArc2 | 2.57045 | 2.56987 | 9.77E-08 | 3.8 |
| PeekSpacerArc3 | 2.57033 | 2.57025 | 1.00E-07 | 3.89 |
| PeekSpacerArc4 | 2.57021 | | 6.84E-07 | 26.63056824 |
| PeekSpacerArc5 | 2.57049 | 2.57035 | 6.84E-07 | 26.62766741 |
| peekSpacersInGas | 47.5447 | | 1.73E-06 | 3.64 |
| gridRingInGas | 108.664 | | 4.93E-06 | 4.54 |
| activeLXeRFRegion | 3643.83 | | 9.66E-05 | 2.65 |
| activeLXeFFRegion | 23253.3 | | 1.52E-02 | 65.23999991 |
| activeGXeFFRegion | 2.10509 | | 2.33E-07 | 11.09 |
| AnodeGridHolder | 0.05311 | | 5.53E-09 | 10.42 |
| CathodeGridHolder | 7.8301 | | 9.22E-07 | 11.77 |
| GateGridHolder | 7.86043 | | 1.04E-06 | 13.19000004 |
| BottomGridHolder | 8.14317 | | 7.08E-08 | 0.87 |
| anodeGridRingSupportInGas | 1114.76 | | 2.93E-05 | 2.63 |
| TPCptfeConeInGas | 871.769 | | 2.62E-05 | 3 |
| top_pmtR9288_adapter | 162.704 | | 3.11E-06 | 1.91 |
| top_pmtR9288_quartzWindow | 10.6158 | 10.6159 (ad) | 3.07E-07 | 2.89 |
| top_pmtR9288_realVacuum | 5.76E-24 | 5.76301e-24 (ad) | 1.23E-31 | 2.128739756 |
| topR9288_PMT_Photocathode_1 | 4.21468 | | 1.11E-07 | 2.63 |
| top_pmtR9288_flashing | 1.11387 | 1.11377 (ad) | 2.97E-08 | 2.67 |
| top_pmtR9288_aluminumBody | 51.4667 | 51.4608( ad) | 1.03E-06 | 2.01 |
| TopPMT | 0.33035 | | 1.48E-08 | 4.49 |
| bottom_pmtR9288_adapter | 162.726 | | 3.25E-07 | 0.2 |
| bottom_pmtR9288_quartzWindow | 10.6158 | | 2.34E-08 | 0.22 |
| bottom_pmtR9288_realVacuum | 5.76E-24 | | 1.09E-32 | 0.189900764 |
| bottomR9288_PMT_Photocathode_1 | 4.21483 | | 7.17E-09 | 0.17 |
| bottom_pmtR9288_flashing | 1.11391 | | 1.89E-09 | 0.17 |
| bottom_pmtR9288_aluminumBody | 51.463 | | 2.11E-07 | 0.41 |
| BottomPMT | 63.5921 | | 3.12E-07 | 0.49 |
| Total | 1.73E+05 | | 2.03E-02 | 11.78823734 |

# Thoron Calibration



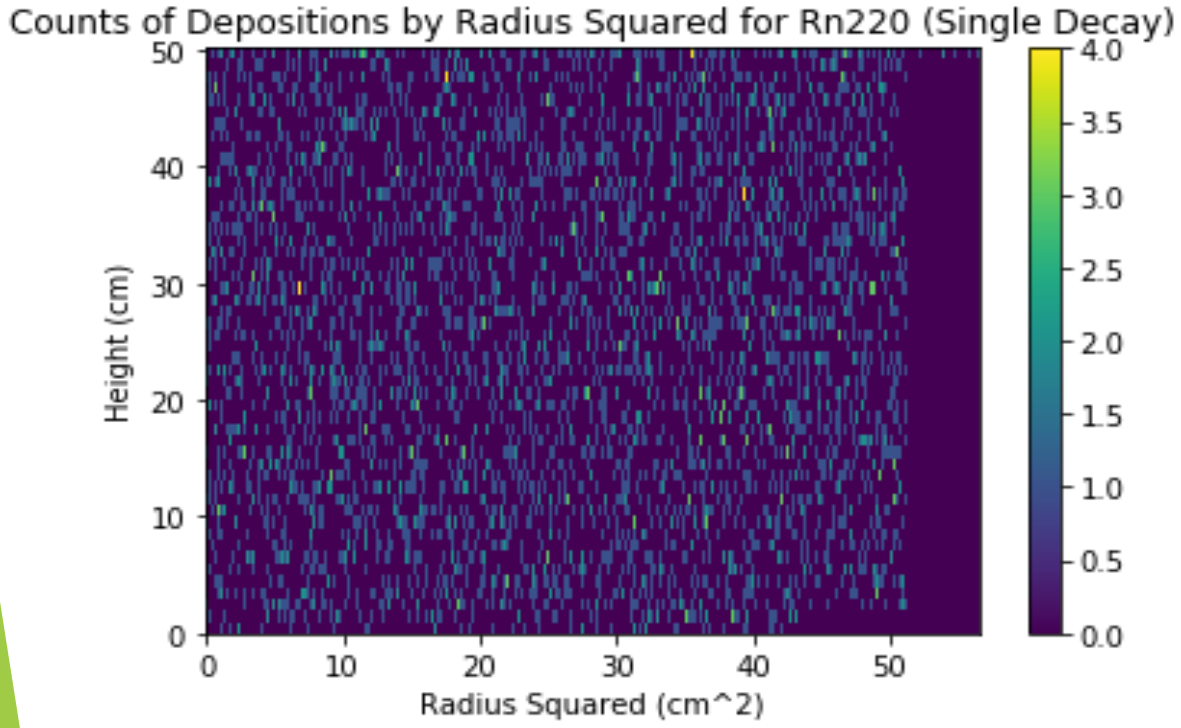
# To Work On

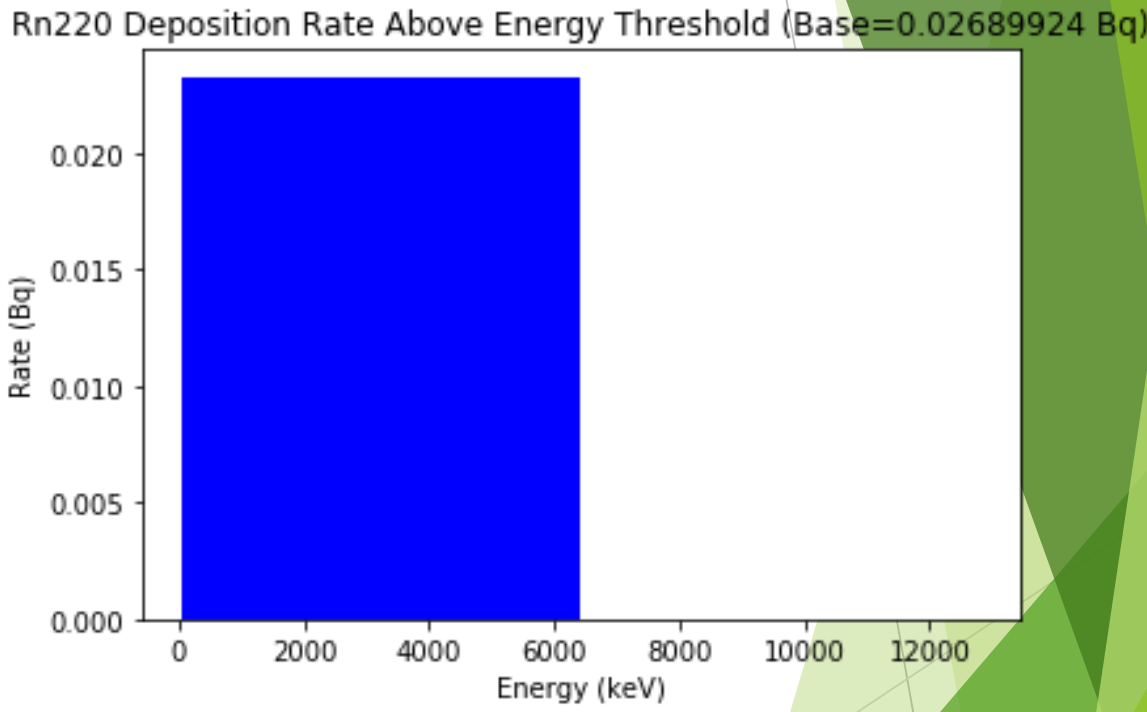
- Backgrounds for other elements
- Give energy threshold histograms
- Better statistics for Thoron calibration source

# Tasks/Issues From Last Week

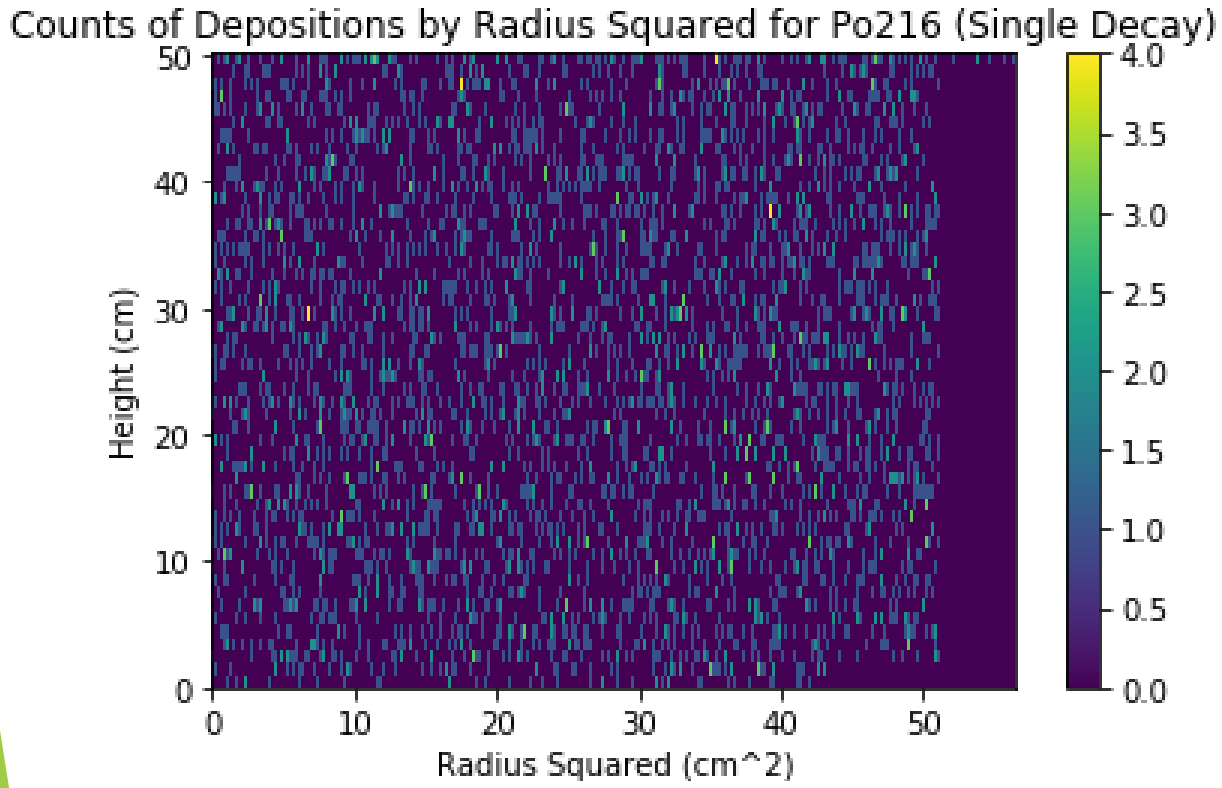
- Data For Other Elements-
  - I looked at single decays of Radon 220 and Polonium 216, as I though that they would be the most important for calibration
- So Few Events/Bad Energies-
  - Combination of coding error and old BACCARAT
- Bad Geometry-
  - Was looking at r^2, so units check out

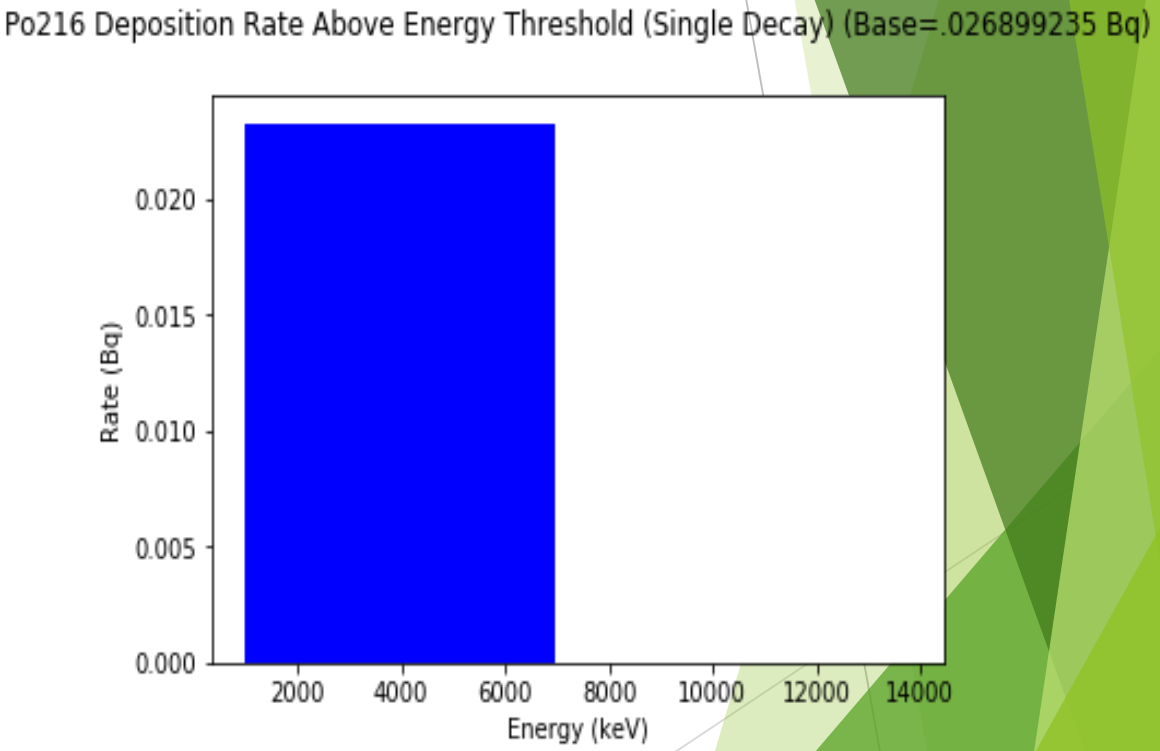
# Thoron Single Decay



# Polonium Single Decay

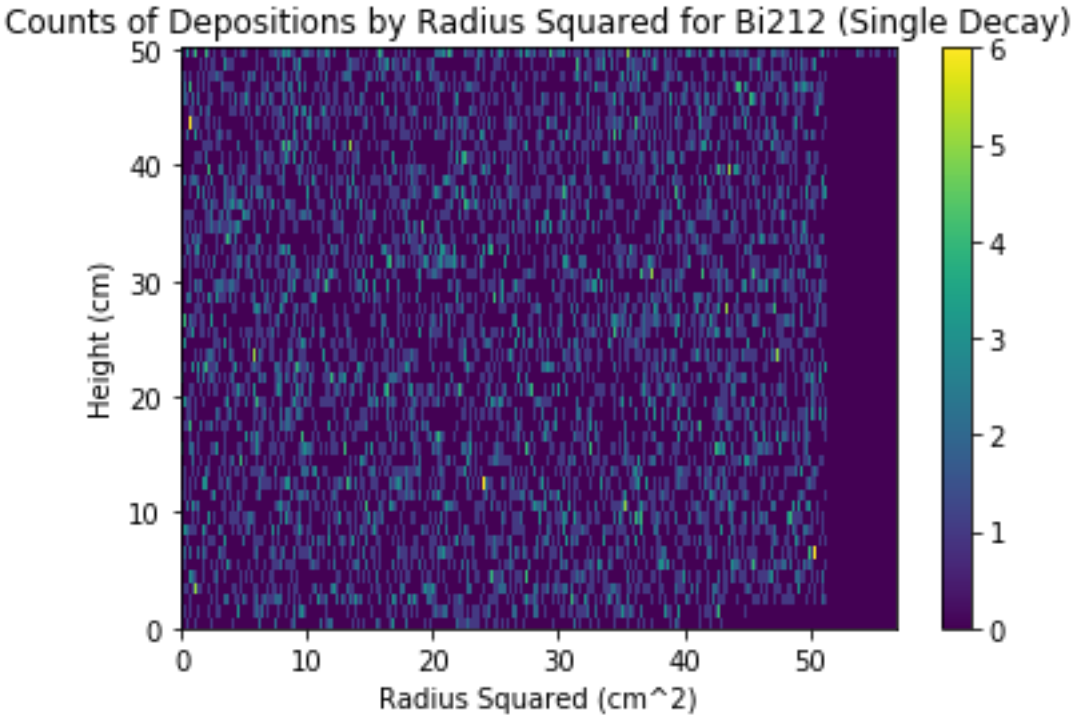


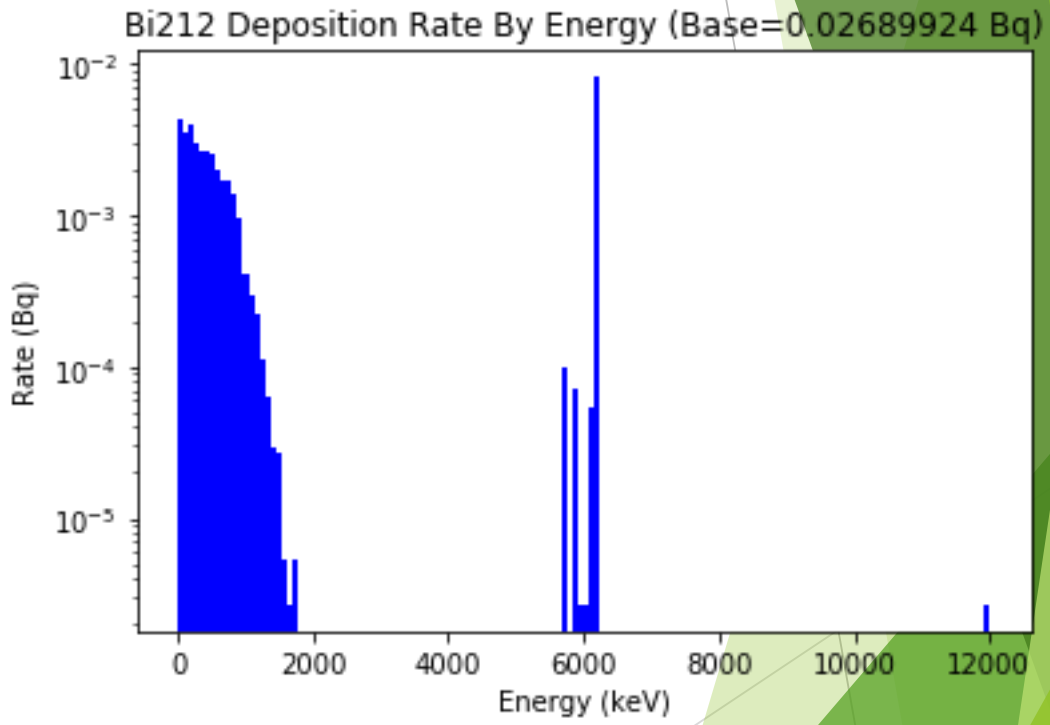



# For Next Week

- Use Updated Geometry
- Look into using DER to produce “fake data”

# 10/25/17
# New Geometry + Full Chain



# DER and Lzap (Moving Forward)

- Get Phase 1 DER config file from systemtestanalysis channel
- Get LZAP?

- Finish DER User Manual
- Try to understand physics behind S1 and S2 events

# 11/8/17

- Simulated decays w/ optical photons
  - Only about 20 events
- Talked to Theresa about using DER with Phase 1
  - Says to use her branch
- Read some more about physics about S1 and S2

# 2/6/18

Get Phase 1 Simulations to Run on Various Analysis Code

- Worked with Theresa and TJ
  - Weird time zones -> slow responses
  - Vague errors
- Try to get code working locally instead
- I (apparently) be able to make it work the whole chain
- BaccMCTruth errors (Permission denied?)