What I Am Doing

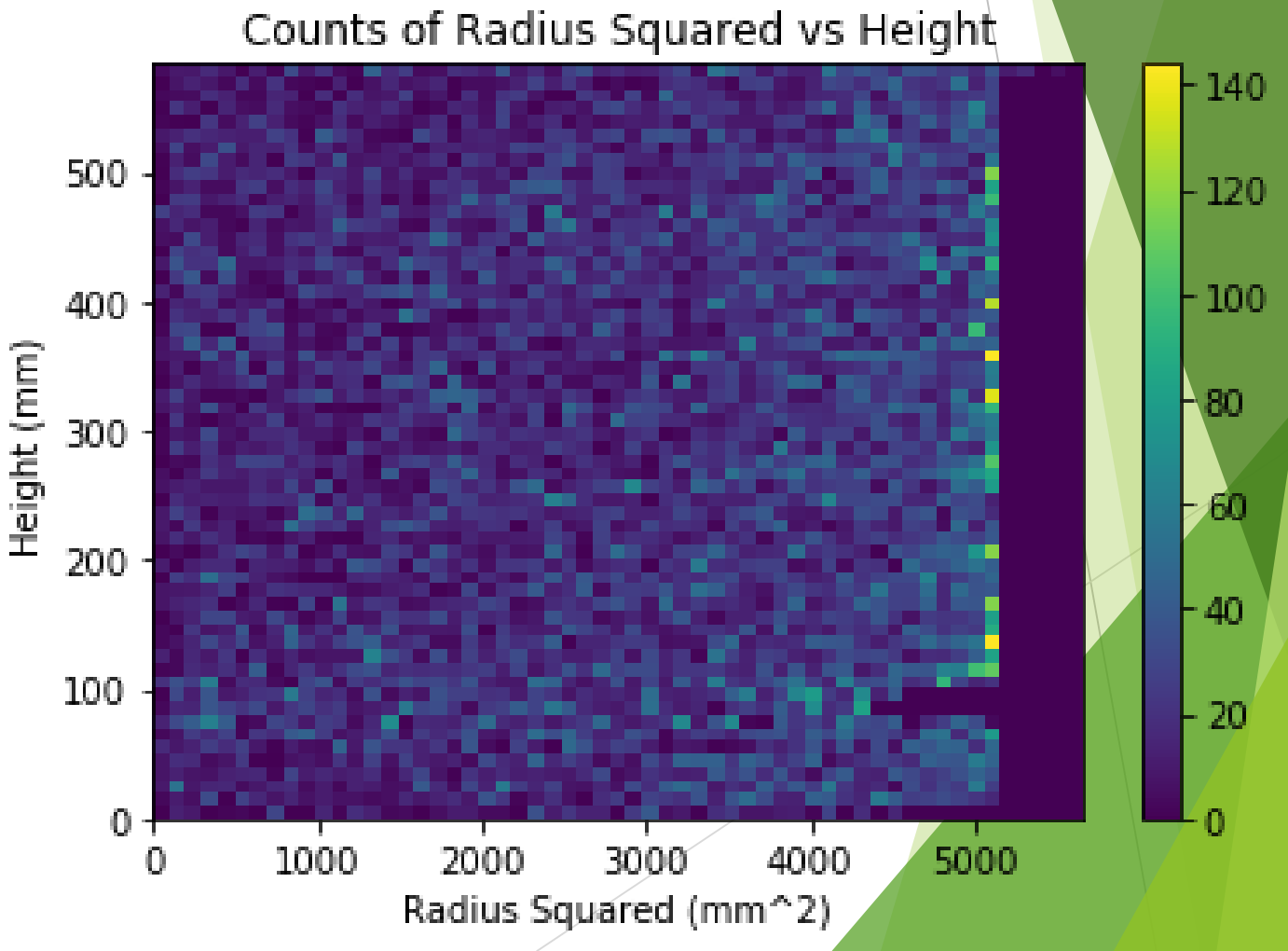
Simulating Thoron Decay Chain in Phase 1

Today's Slide is Here

Plots!

Concerns

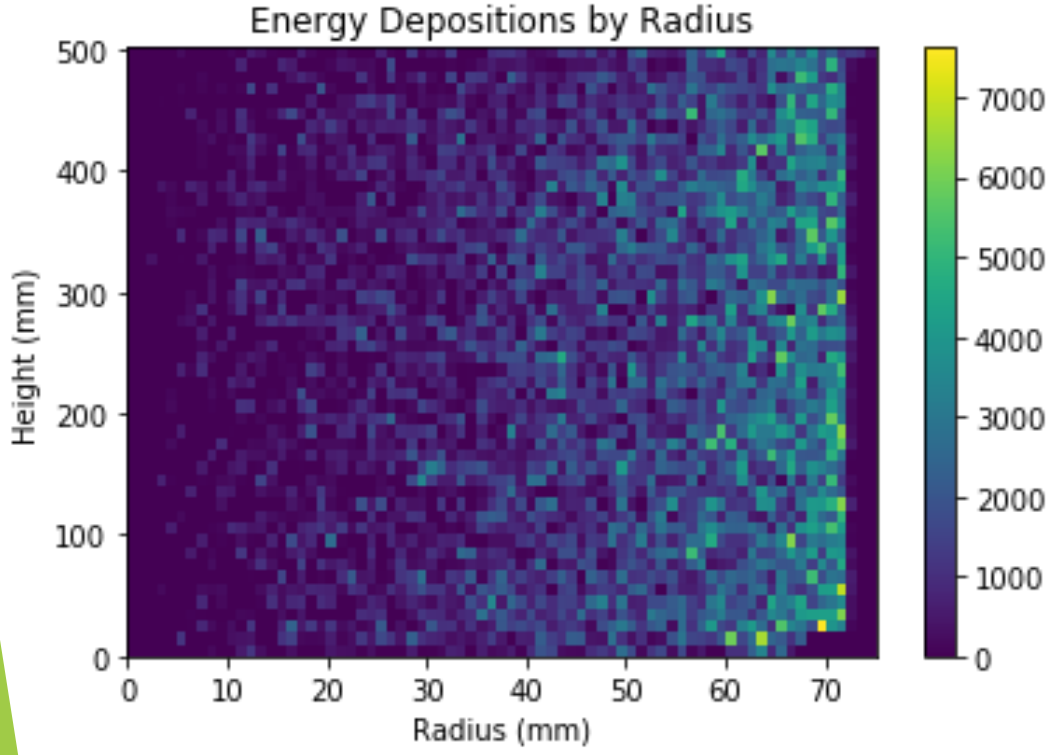
- Time threshold?
- Does not line up exactly with parameters (especially height)
- Gap at 100mm height

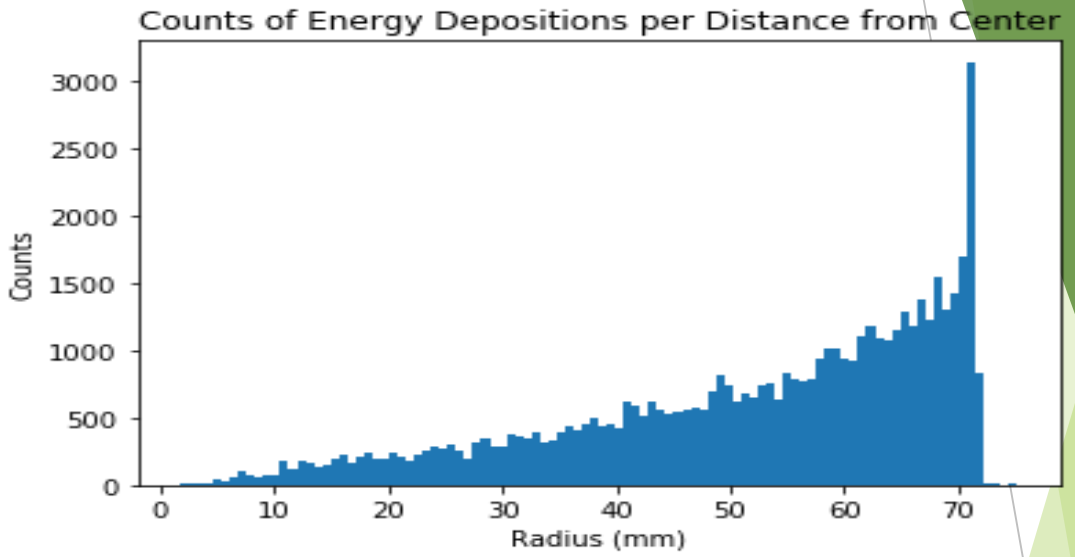


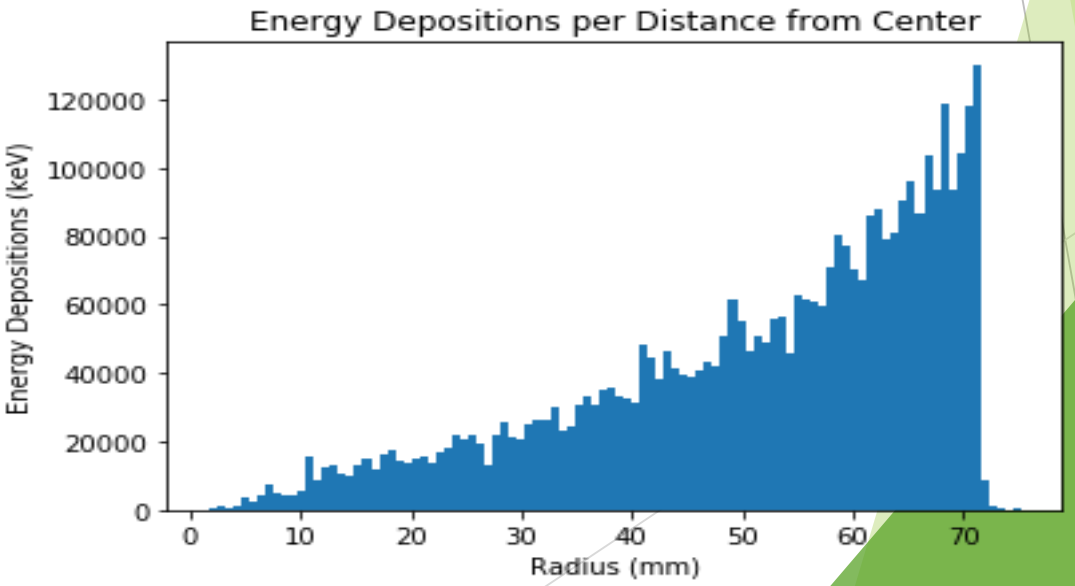
Still To Do

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

Energy Depositions and Correct Dimensions







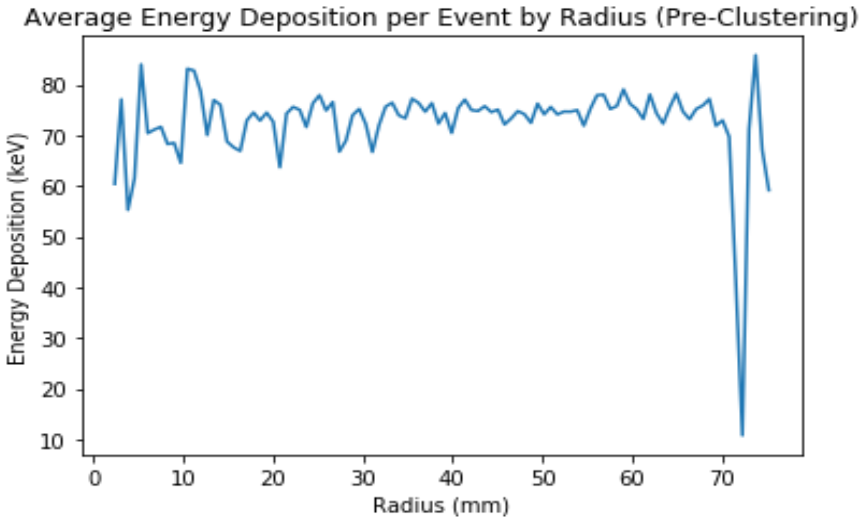
Still To Do

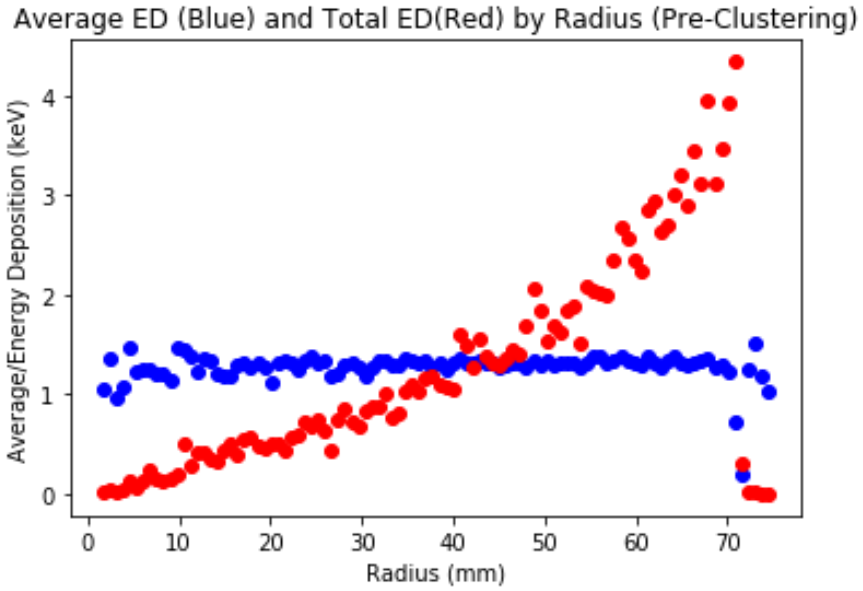
- Find decay rates in area
- Fix geometry problems
- Other materials?

Thermal Neutron Scattering

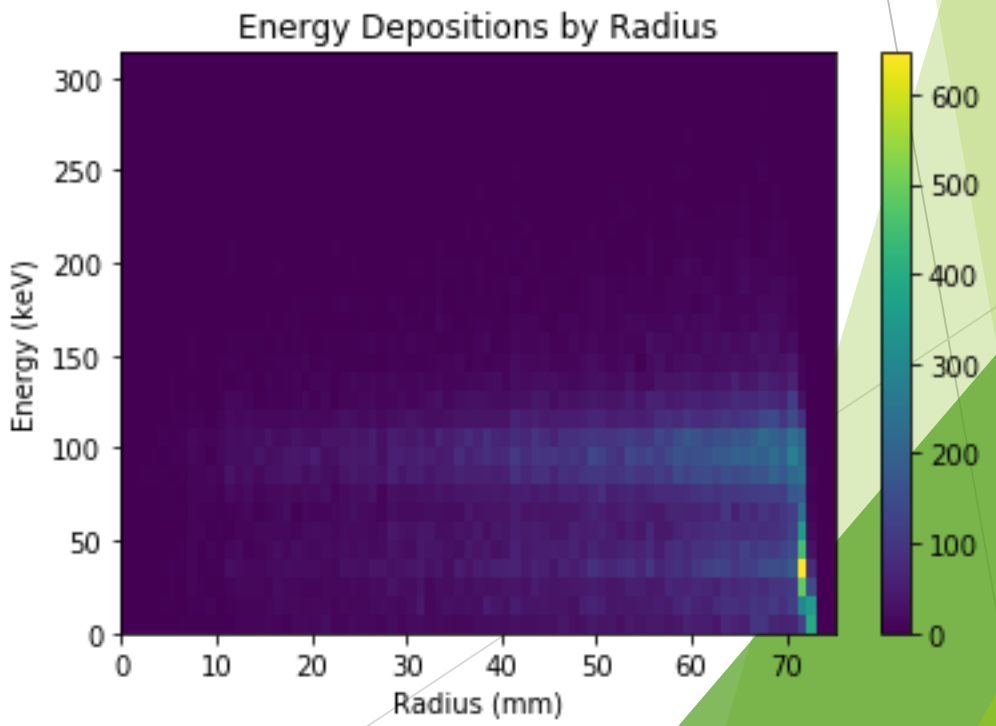
- https://indico.cern.ch/event/245281/contributions/1564676/attachments/420136/583408/thermal_physics_validation_argarcia.pdf
- http://pubs.cnl.ca/doi/pdf/10.12943/CNR.2017.00002

Average Energy Deposition



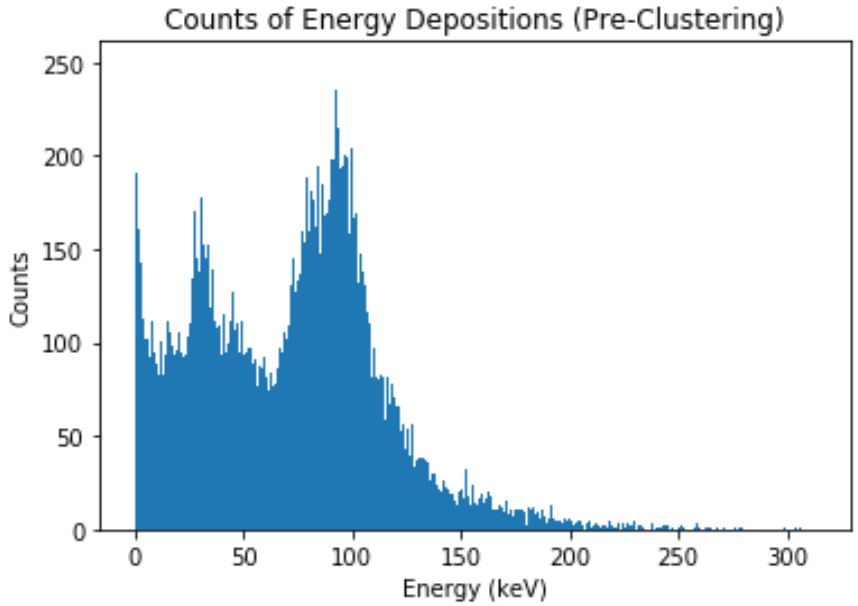


- Why is there so little energy degradation until it is close to the center?
- Why is there a sudden drop at the edge, but regular events past it?
- Why are there so many small-energy events at the edge, but fewer later on?

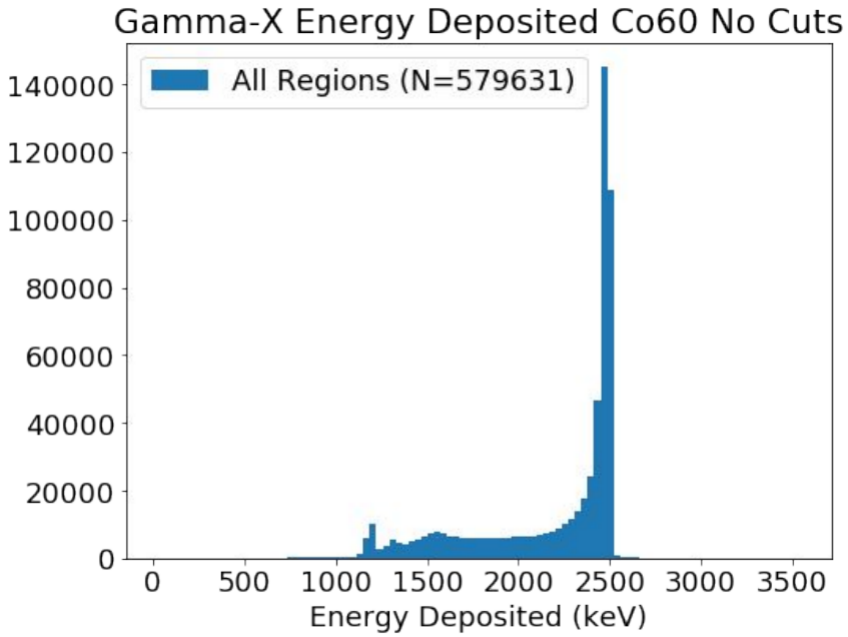


Energy Histogram Very Far Off

Mine

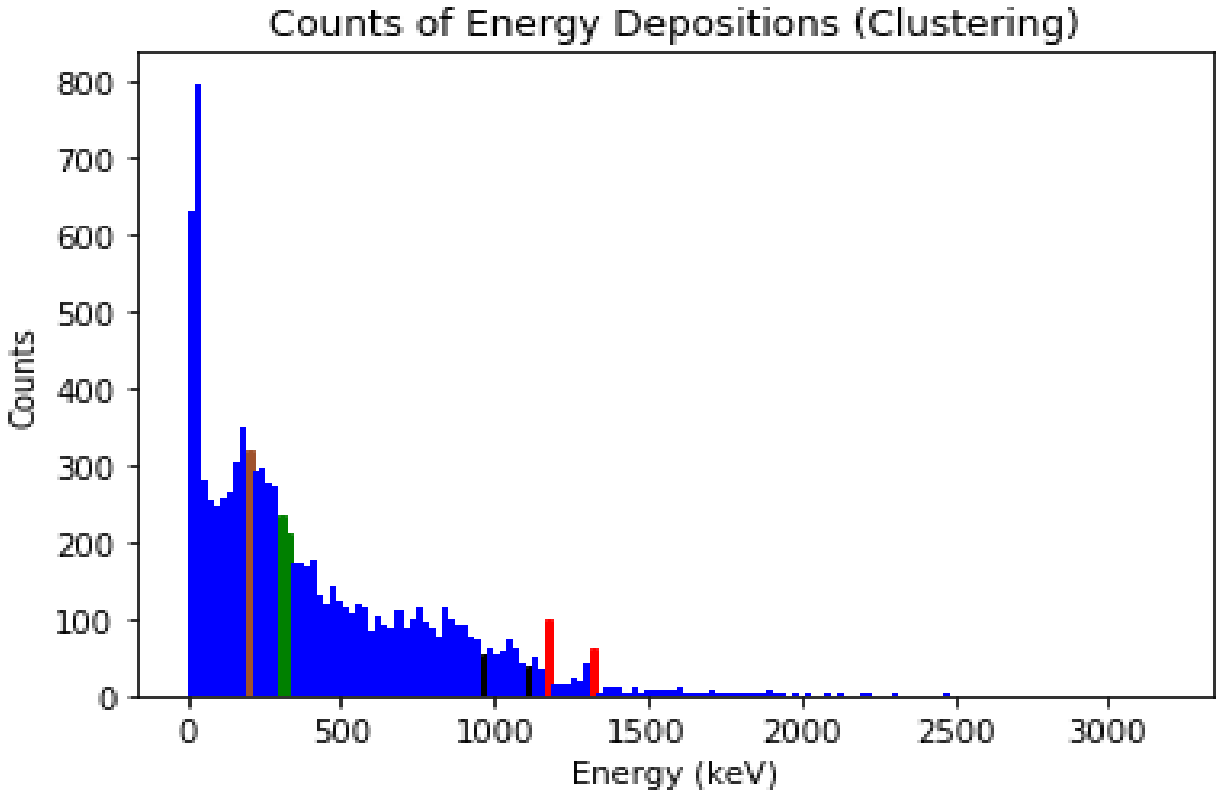


Jonathan's



Now With Clustering

Post-Clustering



Expected Values (keV)

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

$^{60}_{27}Co$	5.271 y	β^-	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

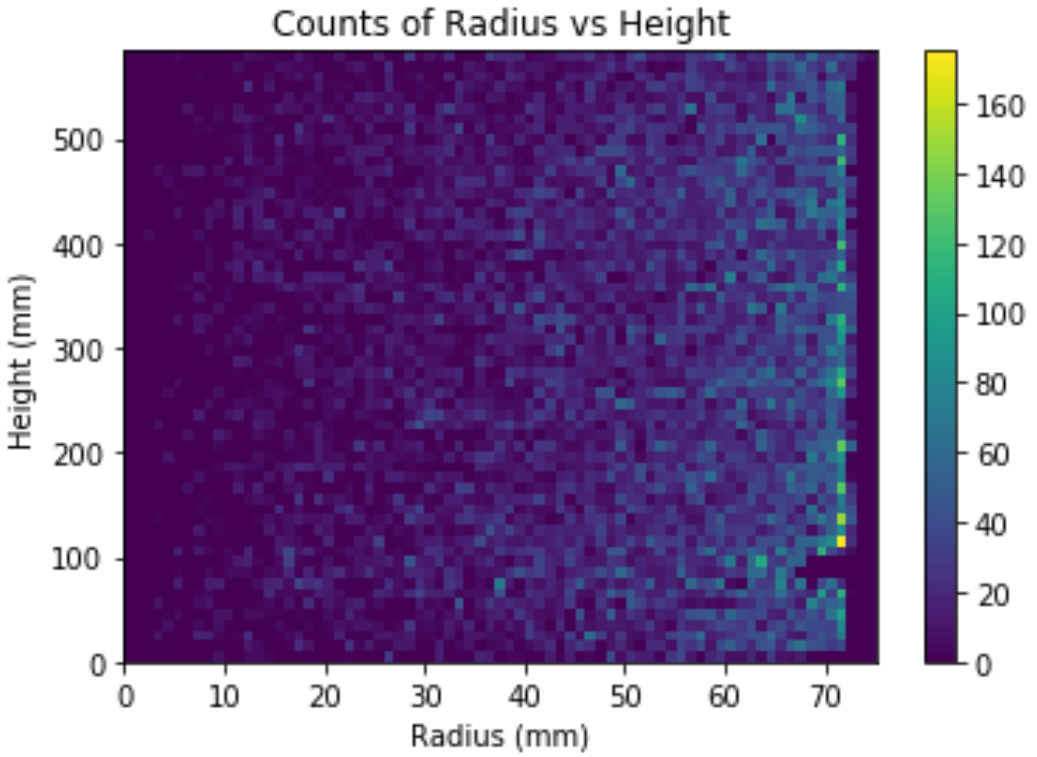
Do

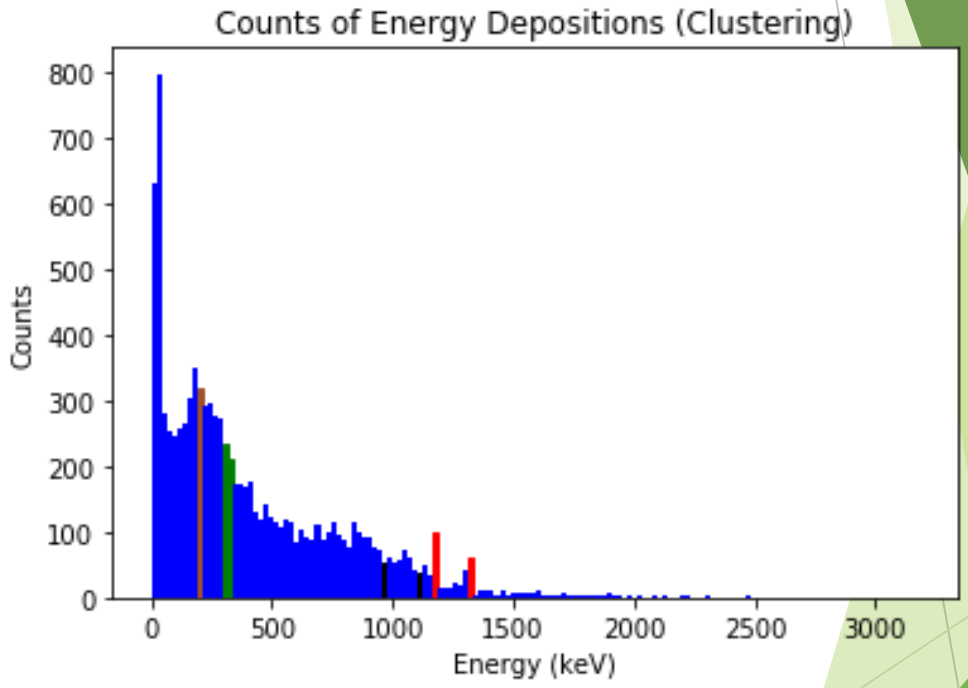
- Find values of other energy factors (escape peaks, detector efficiency, etc.)
- Create rough model of what I should be seeing (ideally)
- Keep reading

Summer Overview

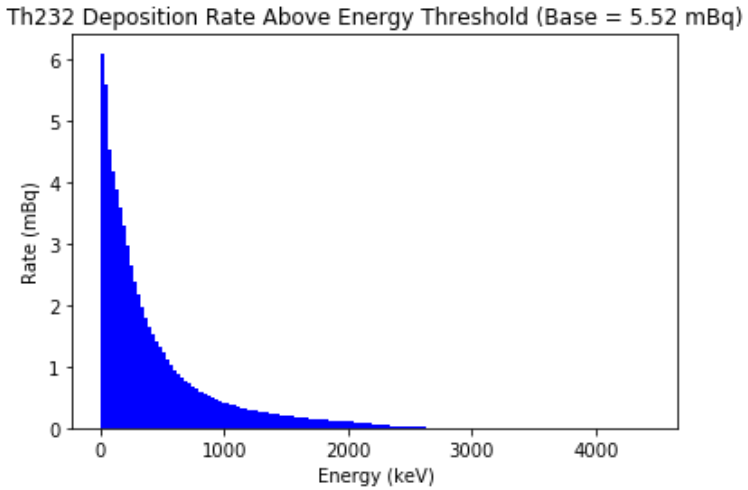
- Got Submission Script/Macro running
- Plotted by position
- Plotted by energy/histograms of energy
- Included Clustering
- Included Accurate Values
- Other elements
- Measured rate above energy threshold
- Cable Making (Minor)
- More components w/ More Decays (In Progress)

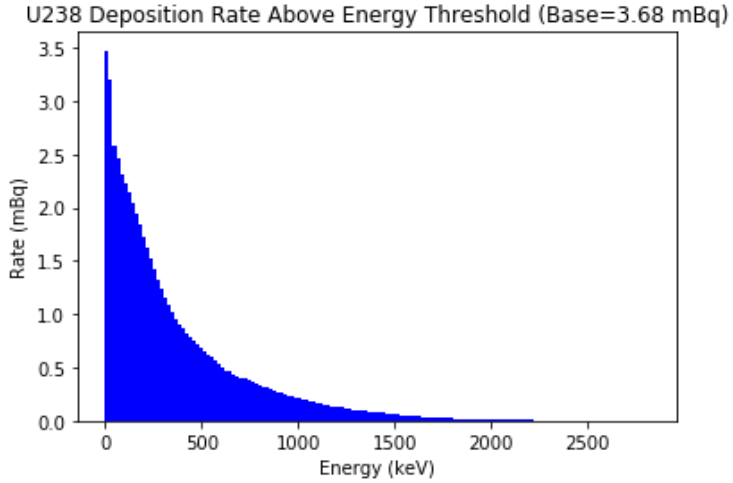
Plotting By Position/Energy/Clustering

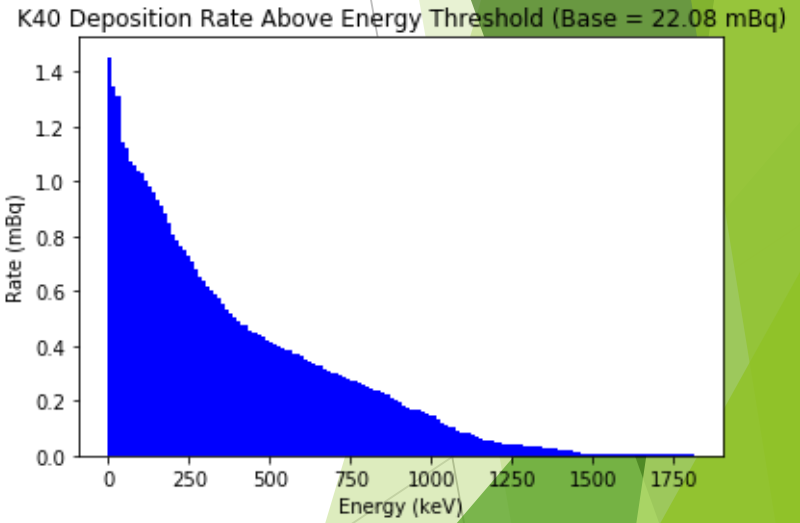


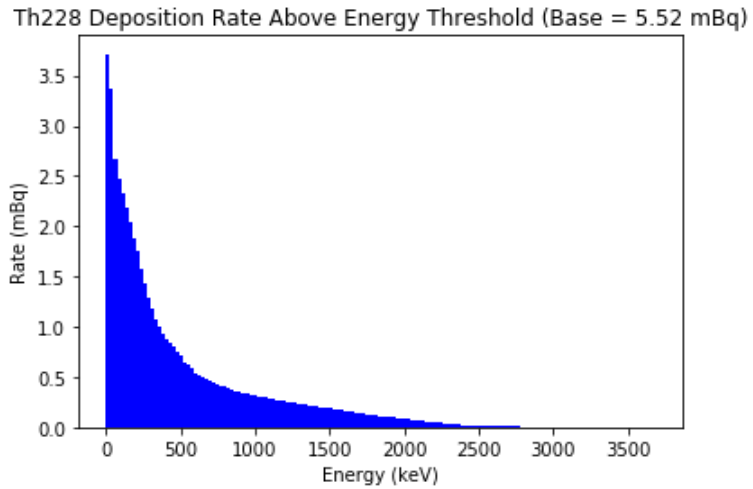


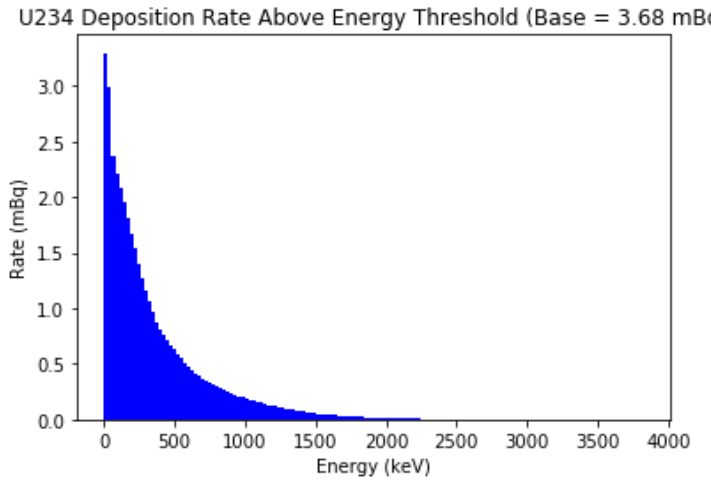
Accurate Values/Rate/More Elements











Goals For Fall 2017 Semester

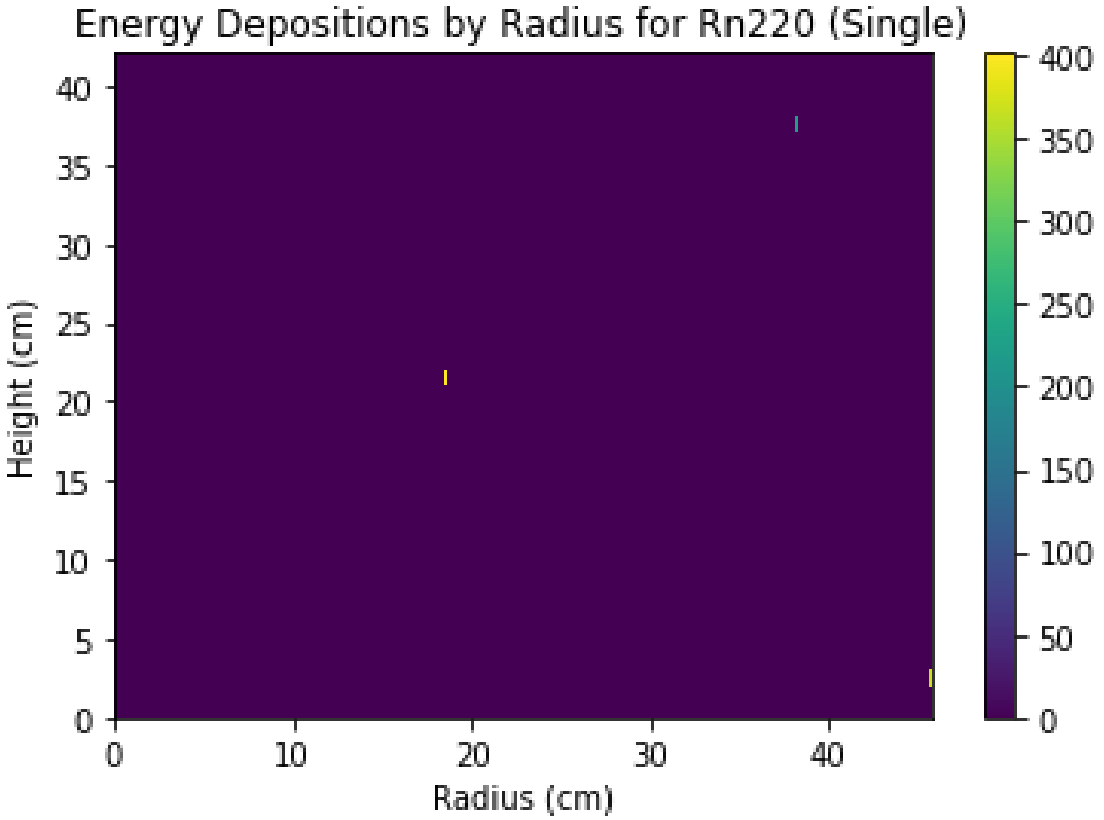
- Research Tasks
  - More Components
  - Give LZ-value estimate range
  - Errors (And More Events)
  - Thorium Alpha Energies
- Conceptual Knowledge
  - What Specific Impact Do Decays Have on Experiment
- Technical Knowledge
  - Learn More C++; be able to write code in C++ instead of Python
  - Getting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

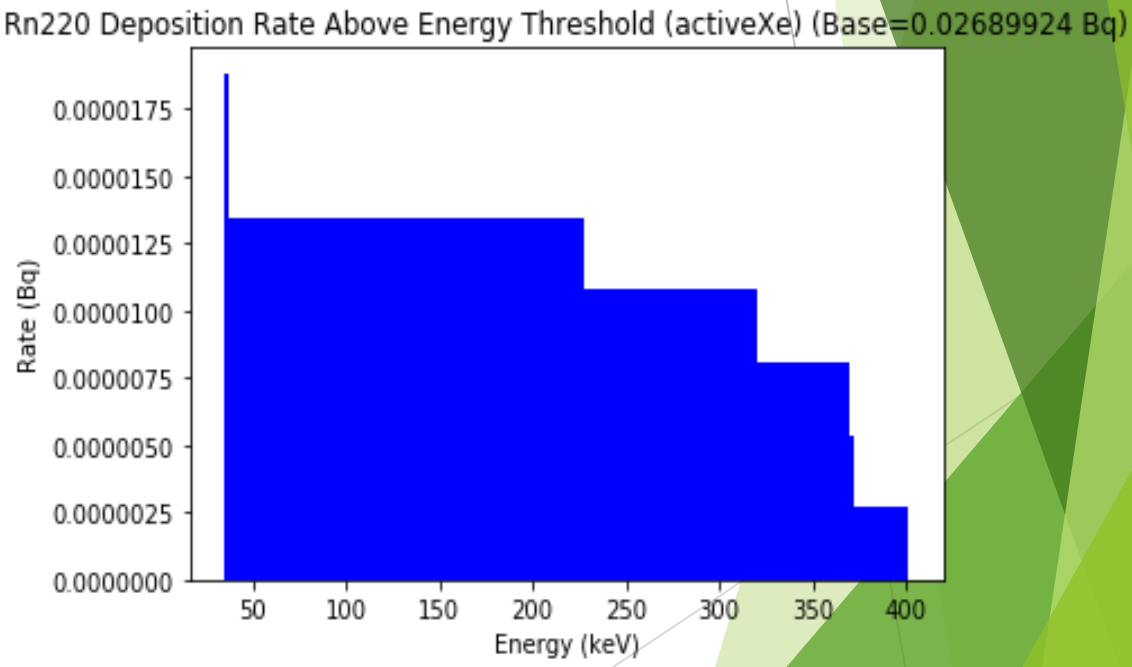
K40 Background Sources

- 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	7.091442	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





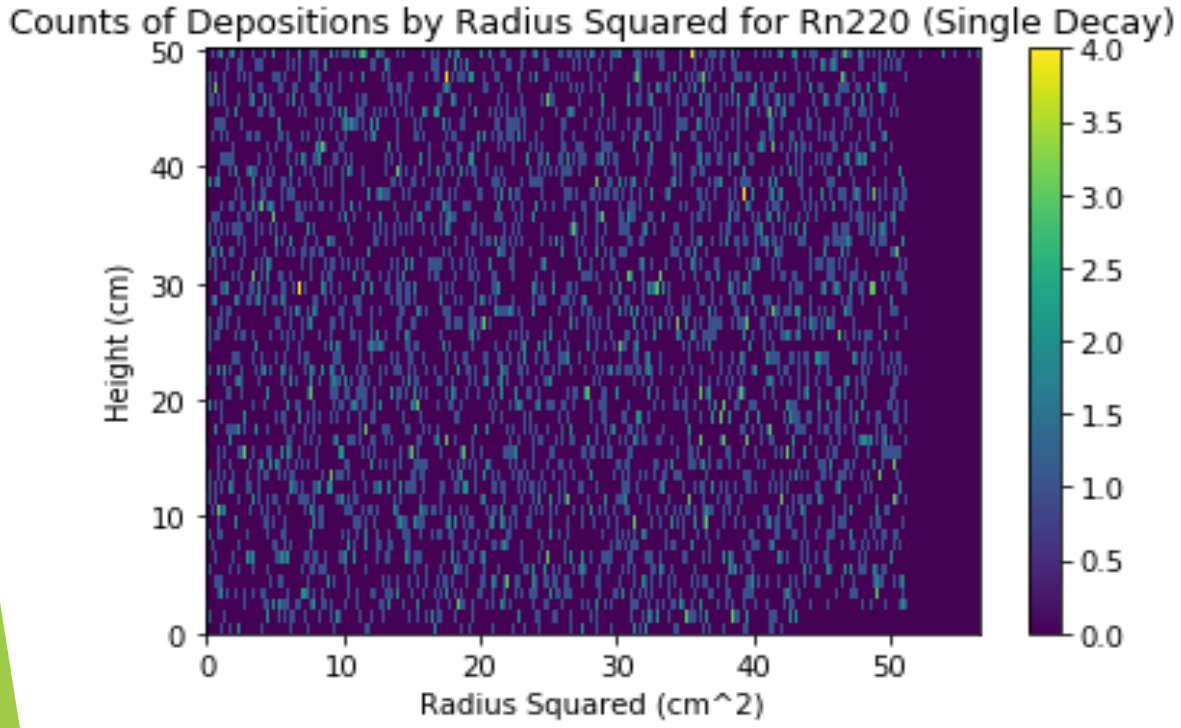
To Work On

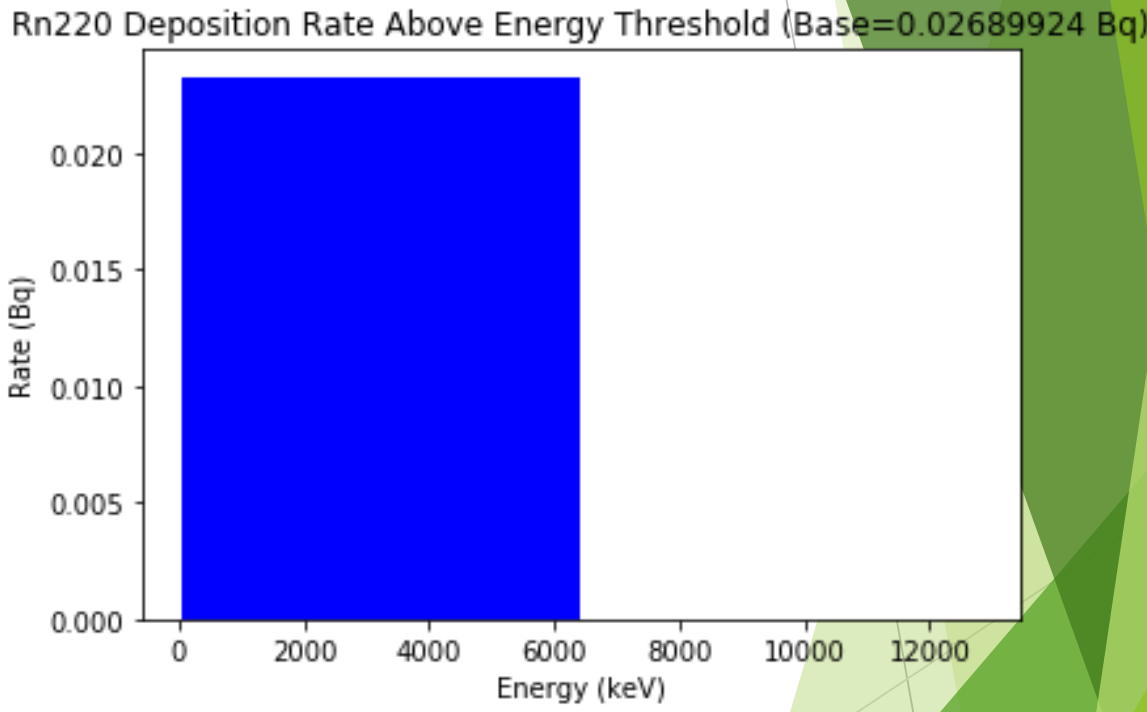
- Backgrounds for other elements
- Give energy threshold histograms
- Better statistics for Thoron calibration source

Tasks/Issues From Last Week

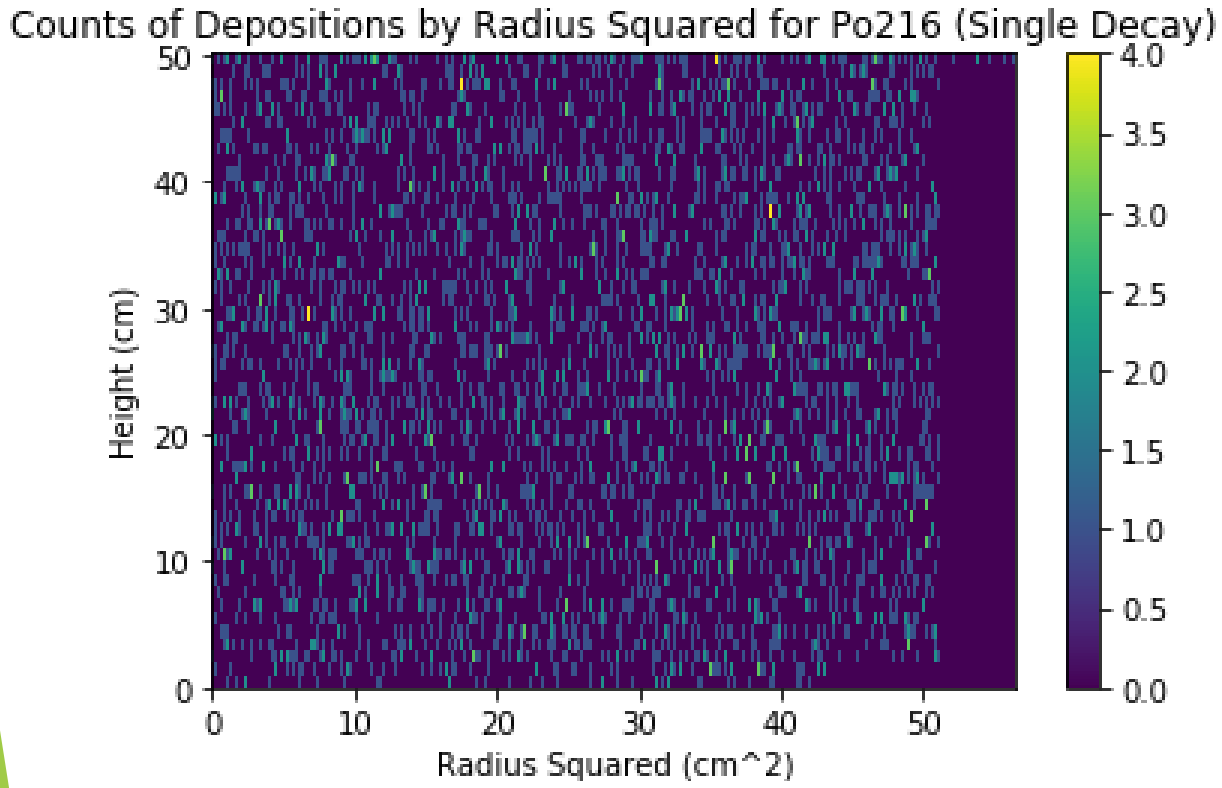
- Data For Other Elements-
  - I looked at single decays of Radon 220 and Polonium 216, as I though that they would be the most important for calibration
- So Few Events/Bad Energies-
  - Combination of coding error and old BACCARAT
- Bad Geometry-
  - Was looking at r^2, so units check out

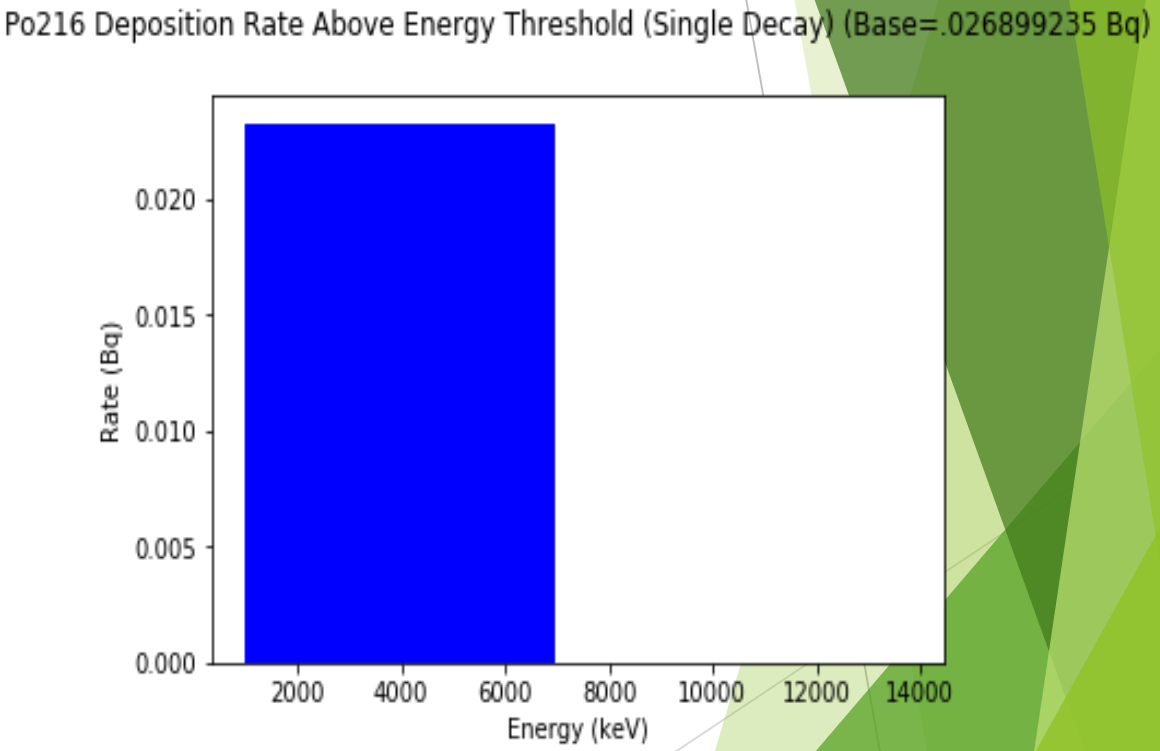
Thoron Single Decay





Polonium Single Decay

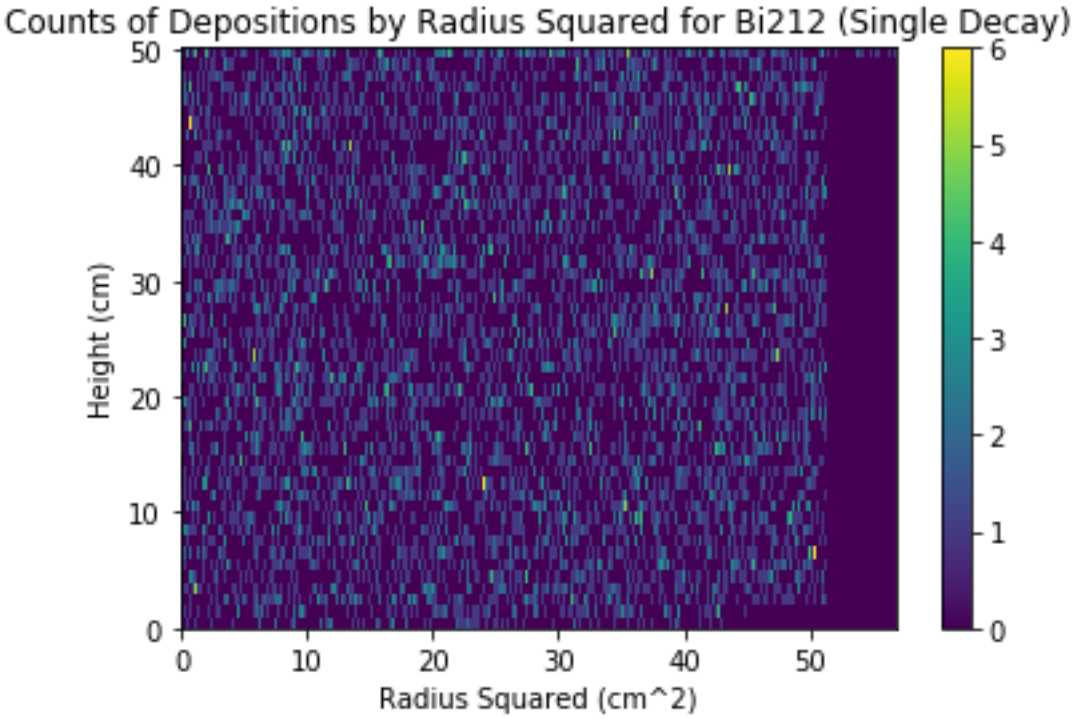


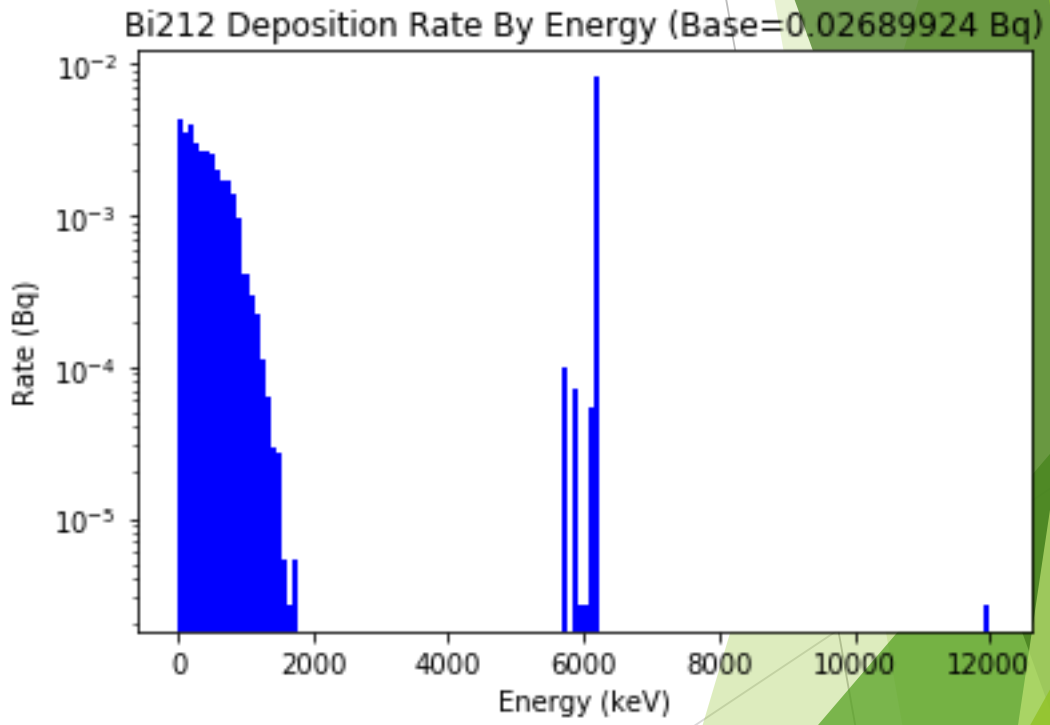


For Next Week

- 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?)

2/20/18

Get Phase 1 Simulations to Run on Various Analysis Code

- Running into “make” issue with ElectronicsSimulation
  - Made post on systemtestanalysis to help resolve
- Made pdsf account
  - Errors making both BACCARAT and ElectronicsSimulation

3/6/18

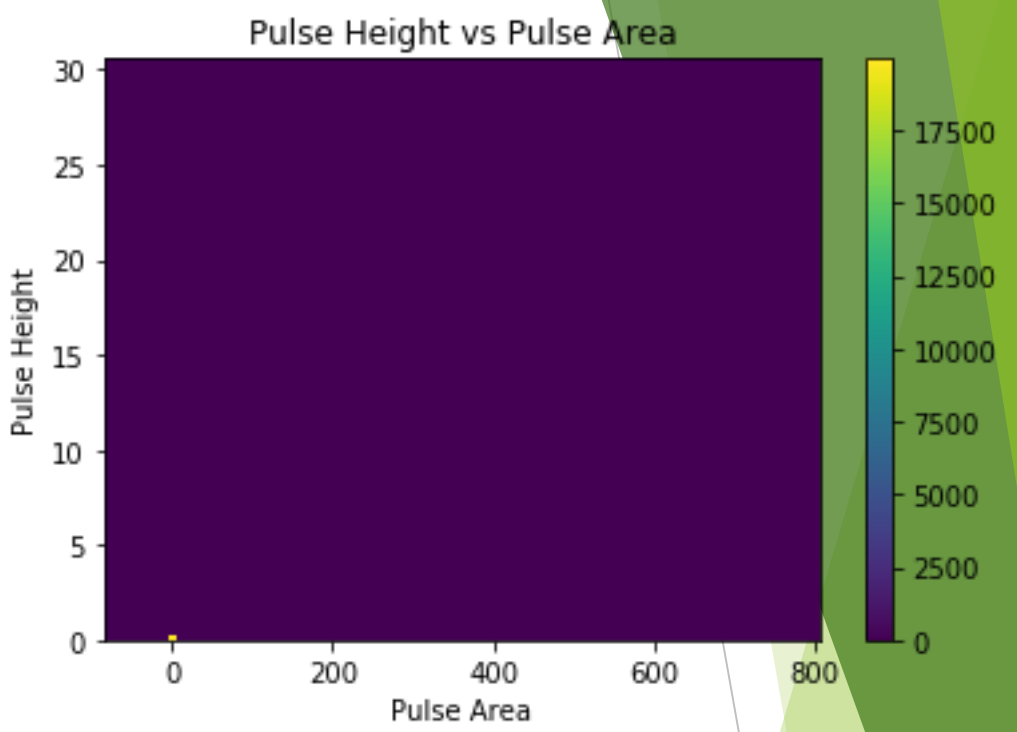
- Got DER to compile on lz login
  - Still trying to find exact problem with Theresa's setup.sh file
  - Got valid output
- Got LZap on lz login and pdsf
  - Getting different errors on pdsf and lz login

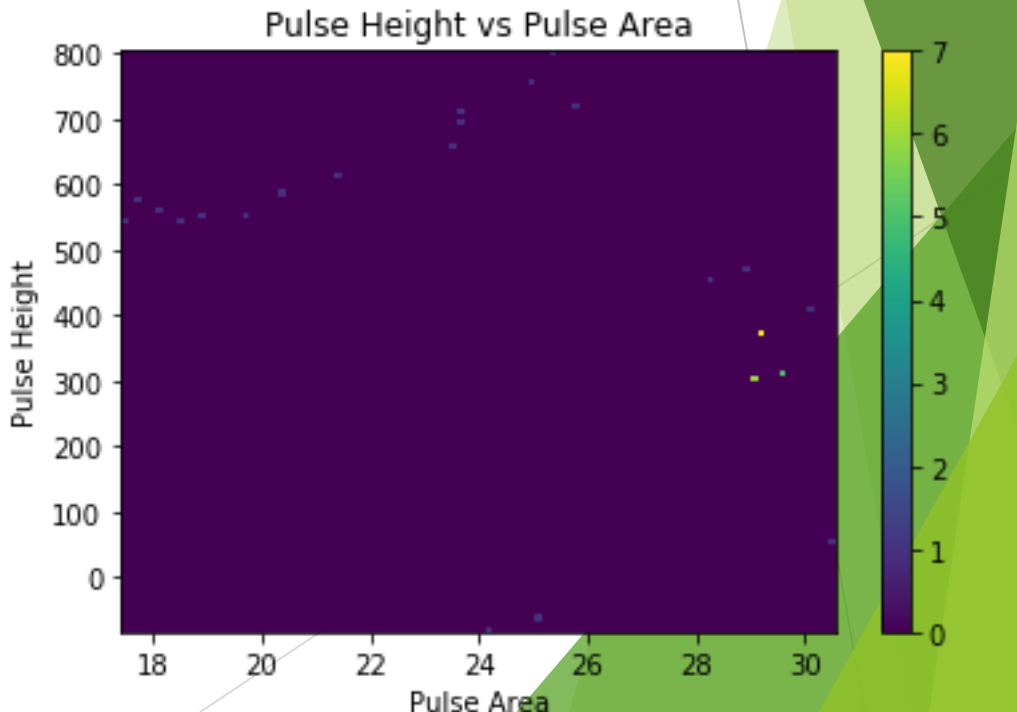
- To Do:
  - Narrow down error/solution for setup.sh file
  - Fix Lzap errors on either server

4/3/18

- Pulse Area vs. Pulse Height Graphs
- Don’t know units, so not very useful
- Don’t know how to interpret data
- Getting a lot of 0’s?
  - Only 38 are not [0,0]

- To Do:
- Other useful graphs
- Make sense of data





4/24/18

- Trying to update branches to get better simulation
- BACCARAT will update, but won't compile
  - TJ had branch that wouldn't, but I can't even after he fixed it
- DER will update/compile, but won't run correctly
  - Other two are more important, so I didn't spend much time on this
- Lzap will run, but possible errors (I think)
  - Pulse areas/heights are 0,0 (but the branches exist)