

What I Am Doing

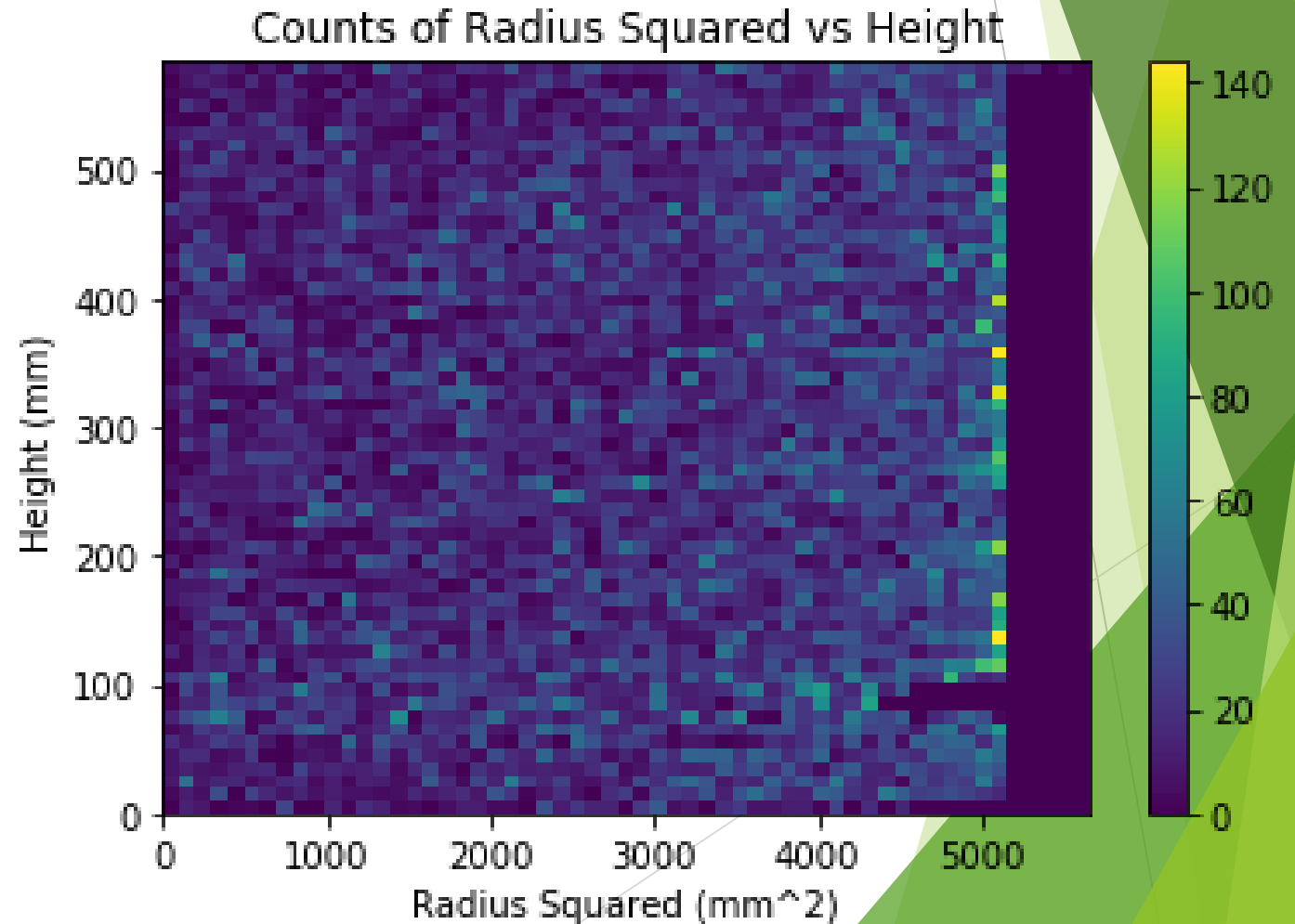
Simulating Thoron Decay Chain in Phase 1

Today's Slide is [Here](#)

Plots!

Concerns

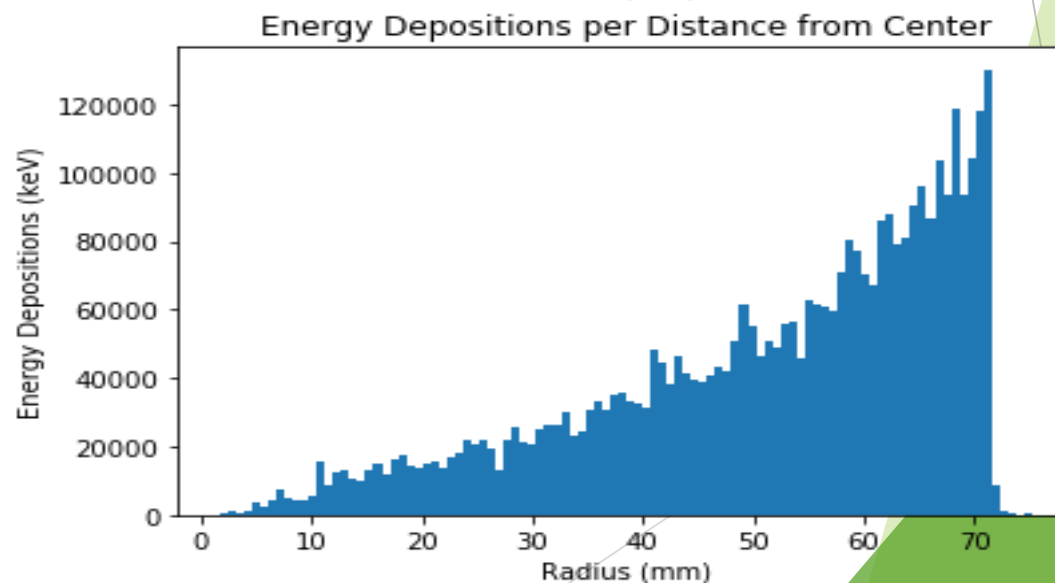
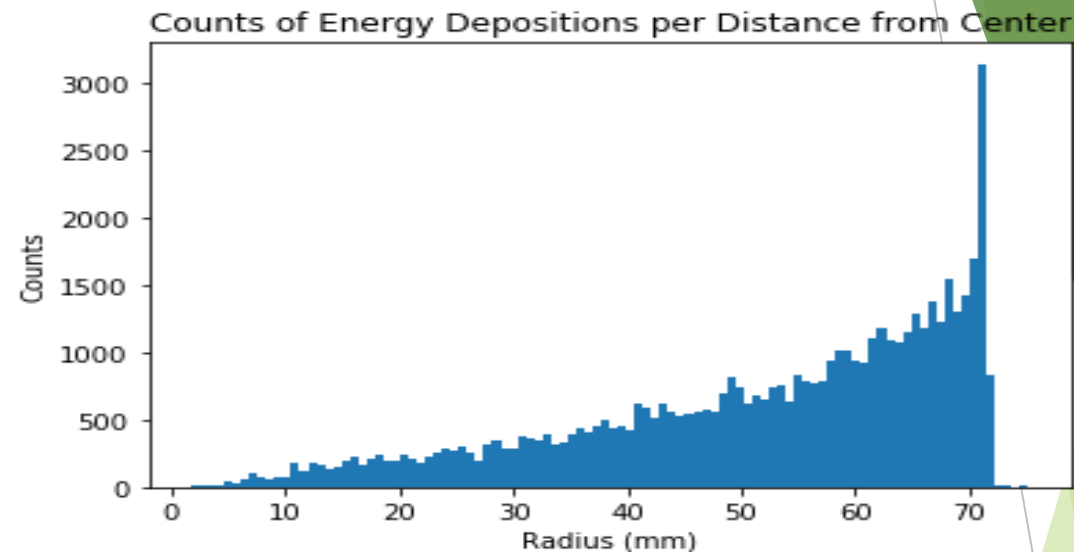
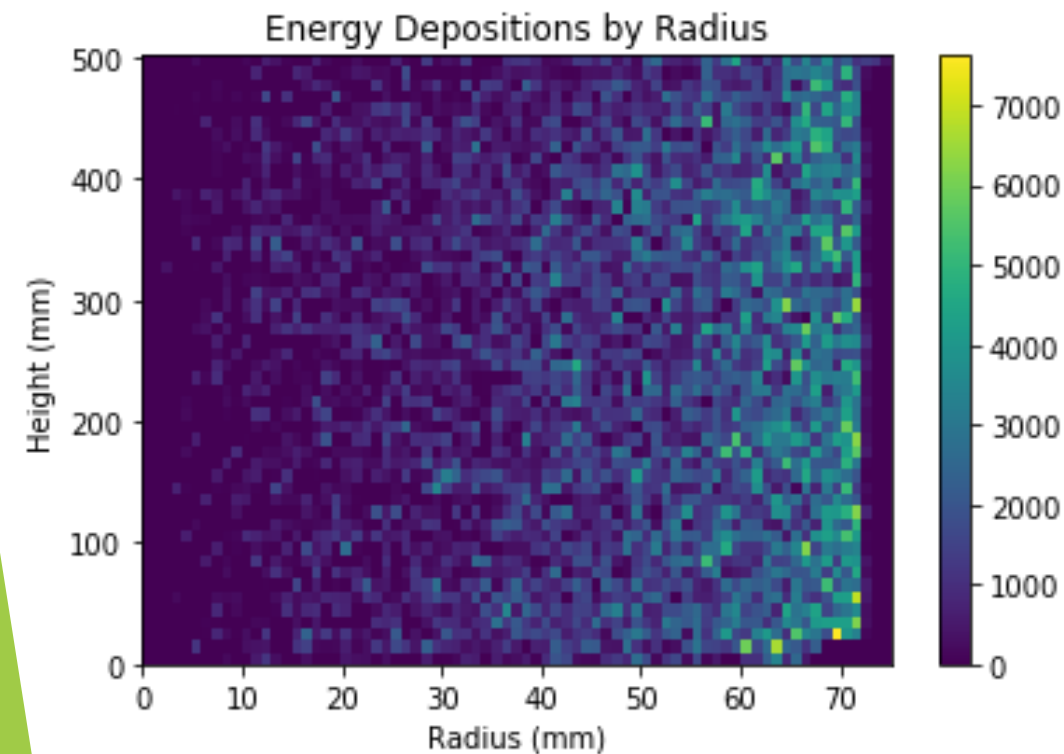
- ▶ Time threshold?
- ▶ Does not line up exactly with parameters (especially height)
- ▶ Gap at 100mm height



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

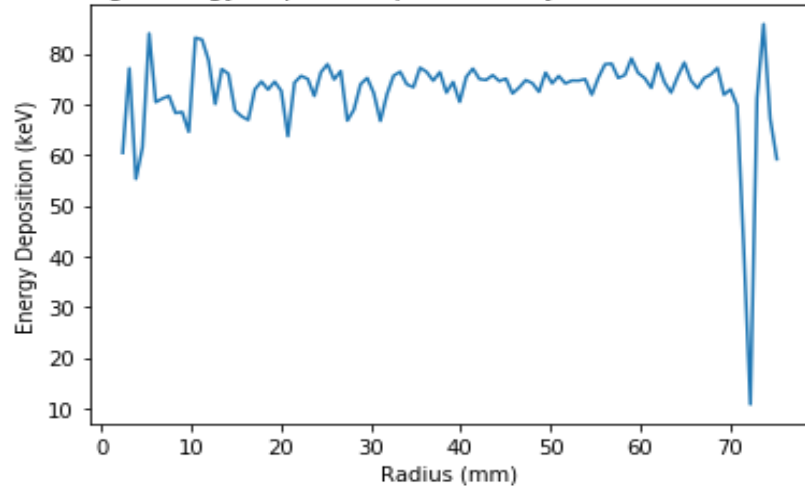
- ▶ Find decay rates in area
- ▶ Fix geometry problems
- ▶ Other materials?

Thermal Neutron Scattering

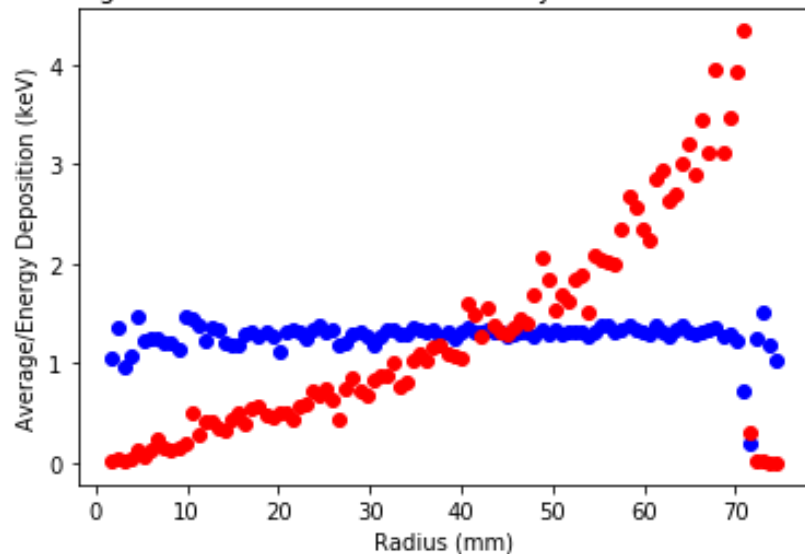
- ▶ https://indico.cern.ch/event/245281/contributions/1564676/attachments/420136/583408/thermal_physics_validation_argarcia.pdf
- ▶ <http://pubs.cnl.ca/doi/pdf/10.12943/CNR.2017.00002>

Average Energy Deposition

Average Energy Deposition per Event by Radius (Pre-Clustering)

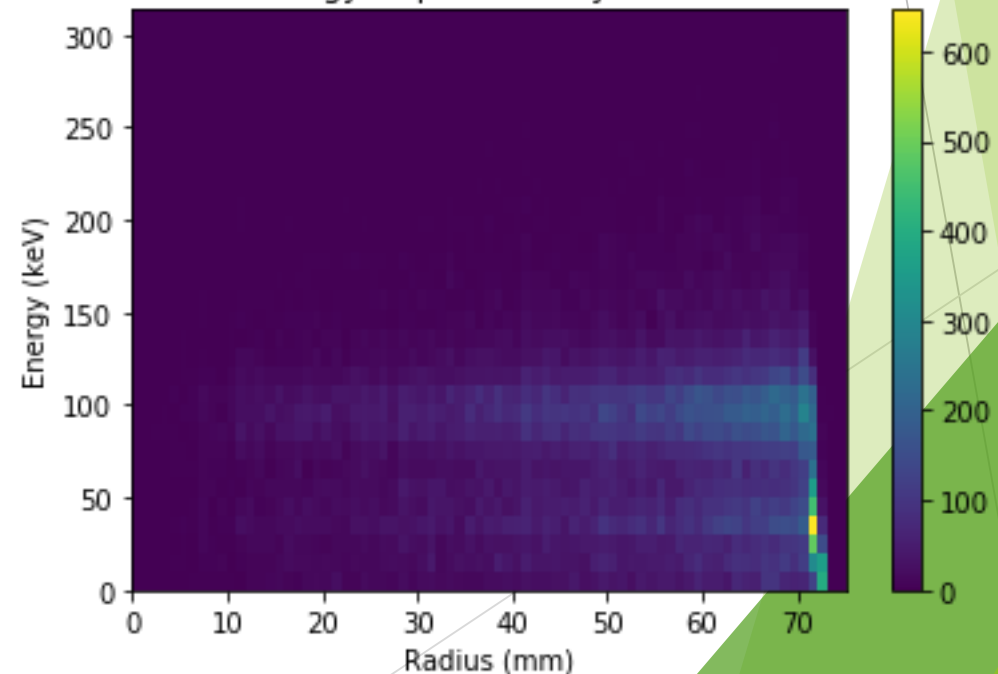


Average ED (Blue) and Total ED (Red) by Radius (Pre-Clustering)



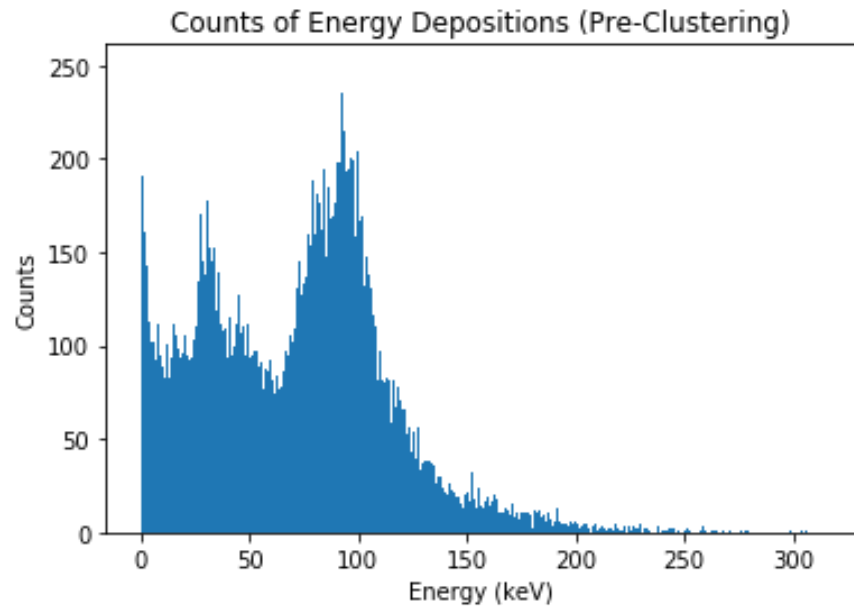
- Why is there so little energy degradation until it is close to the center?
- Why is there a sudden drop at the edge, but regular events past it?
- Why are there so many small-energy events at the edge, but fewer later on?

Energy Depositions by Radius

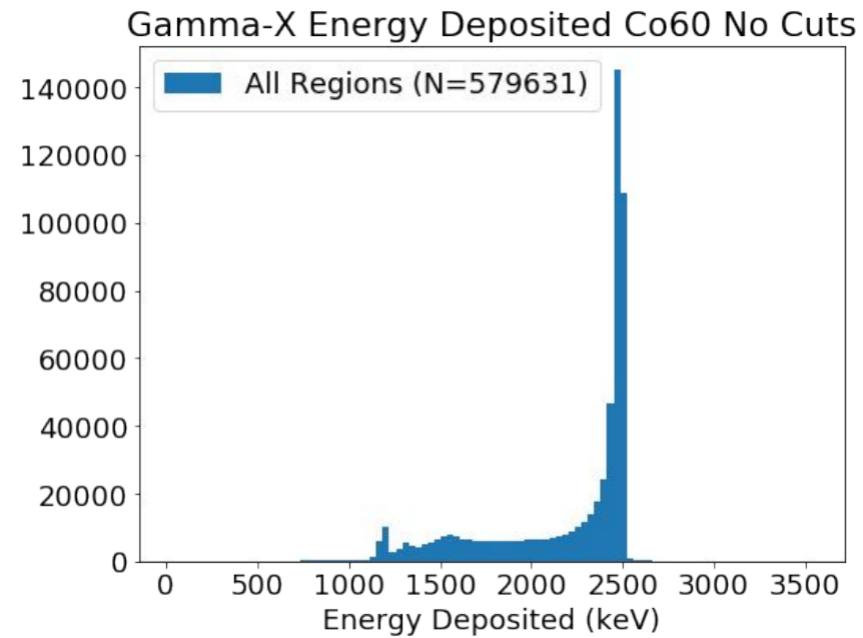


Energy Histogram Very Far Off

Mine

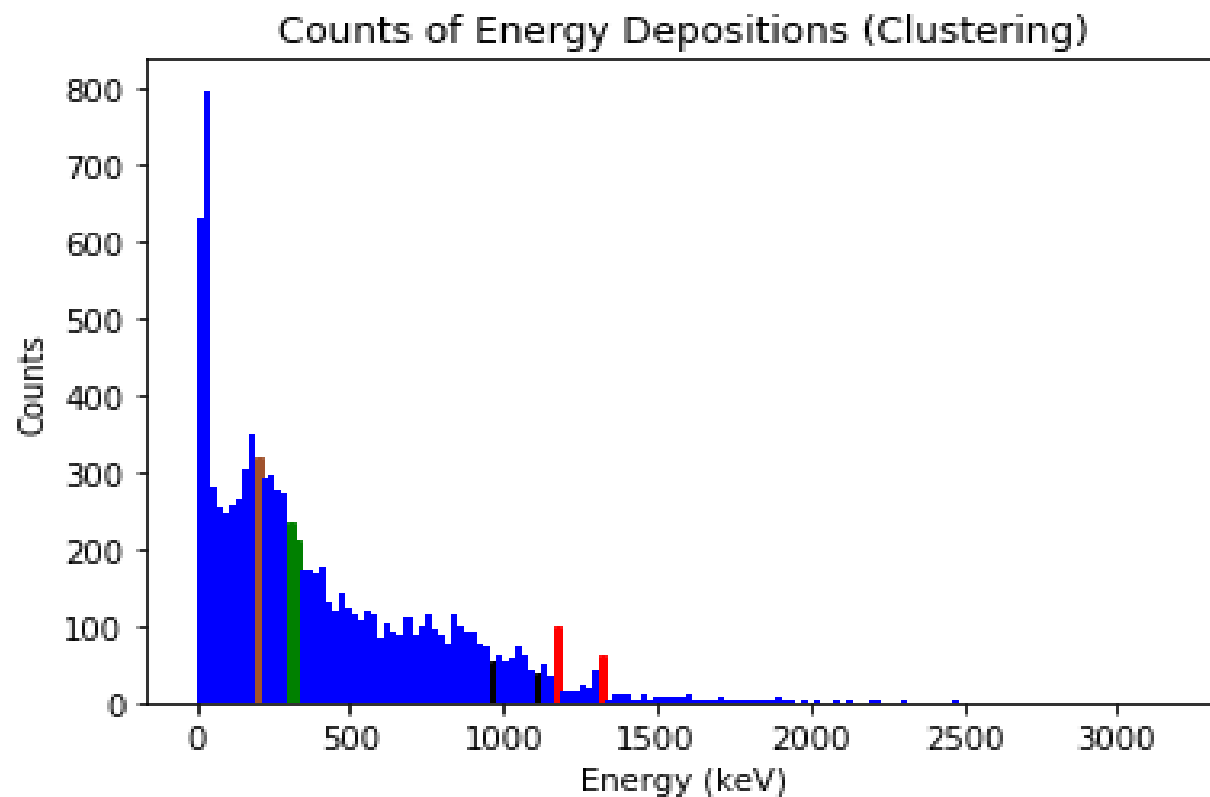


Jonathan's



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)

$^{60}_{27}\text{Co}$	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

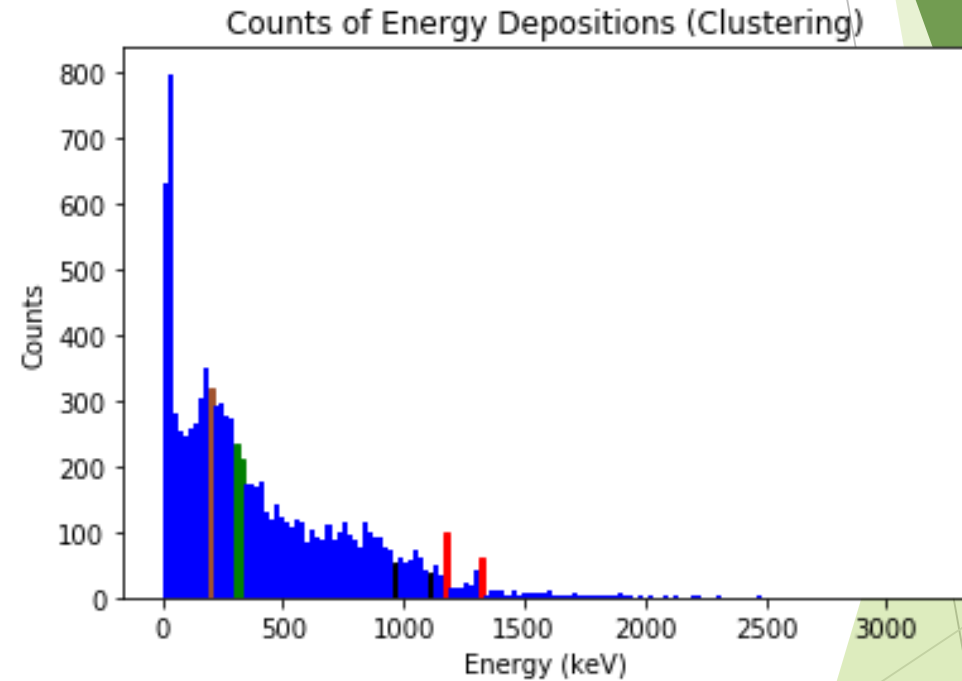
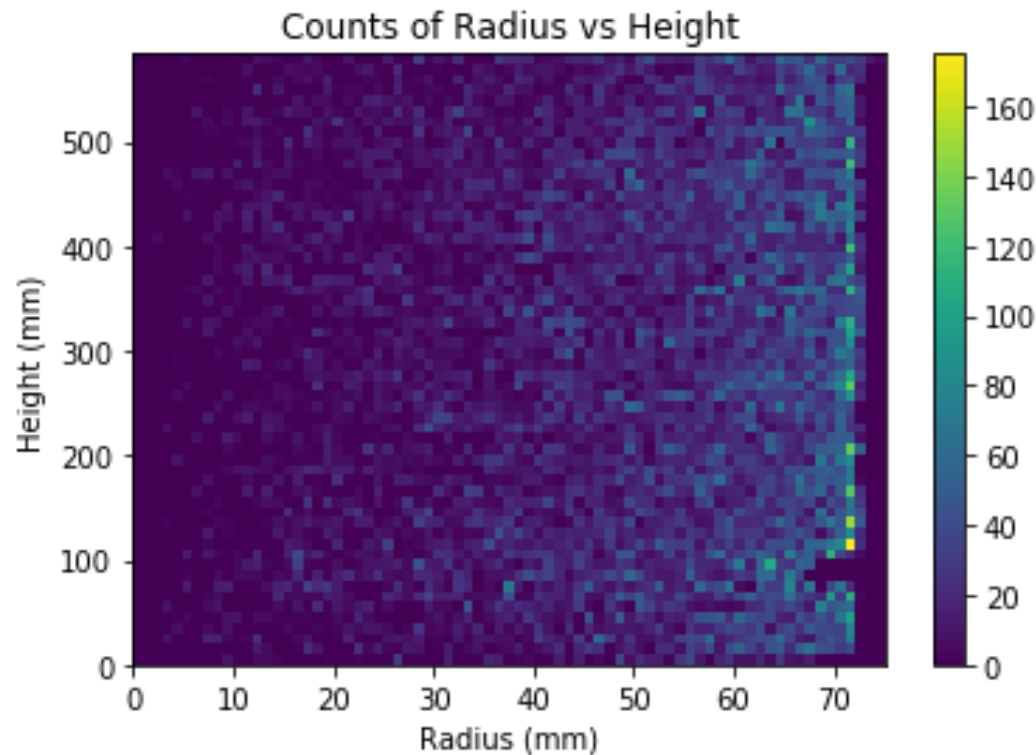
Do

- ▶ 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

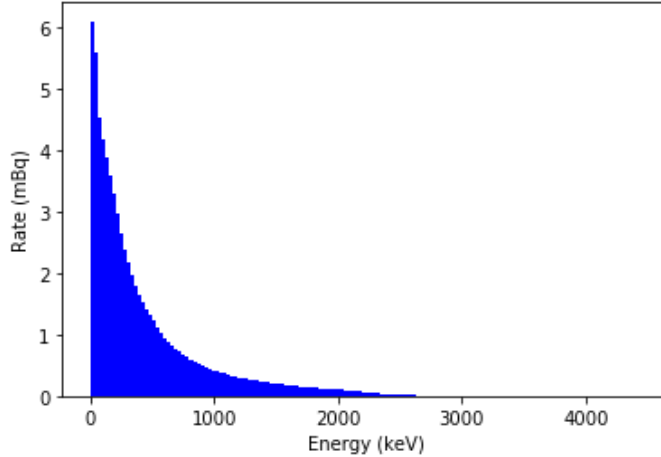
- ▶ Got Submission Script/Macro running
- ▶ Plotted by position
- ▶ Plotted by energy/histograms of energy
- ▶ Included Clustering
- ▶ Included Accurate Values
- ▶ Other elements
- ▶ Measured rate above energy threshold
- ▶ Cable Making (Minor)
- ▶ More components w/ More Decays (In Progress)

Plotting By Position/Energy/Clustering

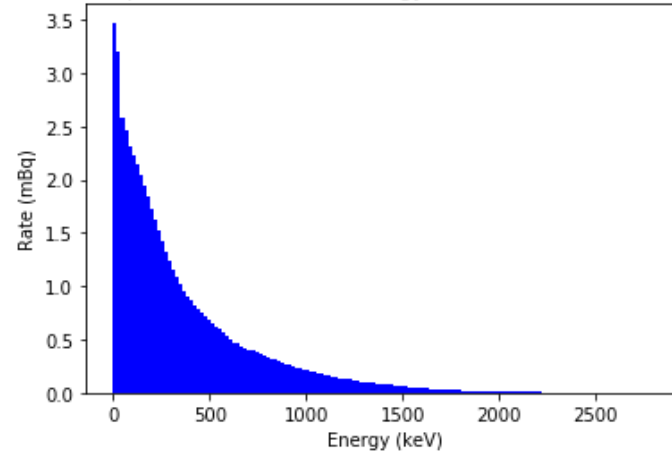


Accurate Values/Rate/More Elements

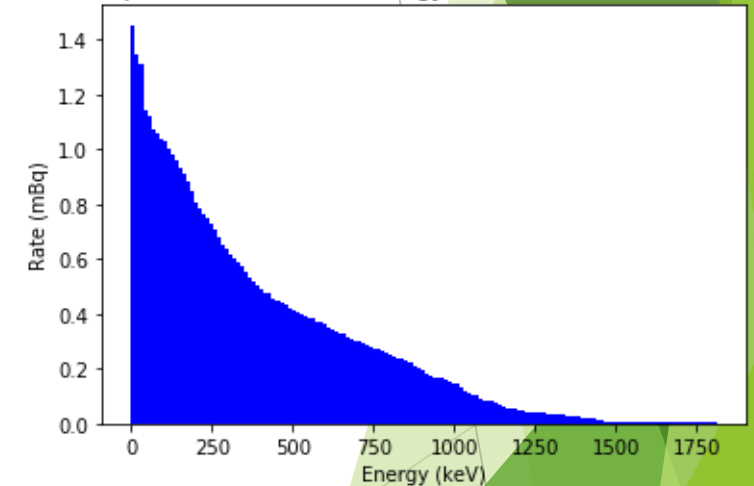
Th232 Deposition Rate Above Energy Threshold (Base = 5.52 mBq)



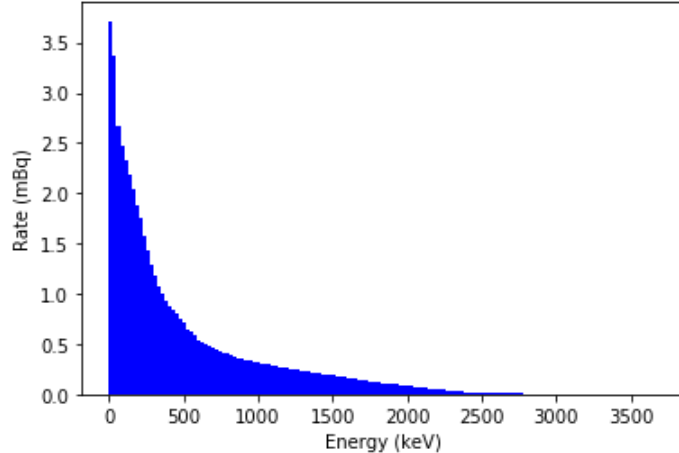
U238 Deposition Rate Above Energy Threshold (Base=3.68 mBq)



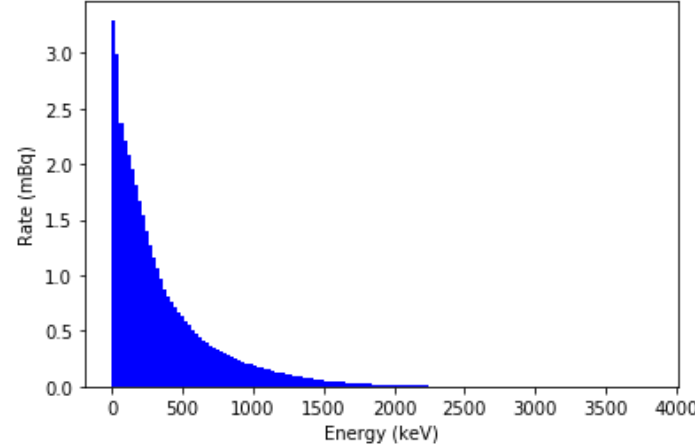
K40 Deposition Rate Above Energy Threshold (Base = 22.08 mBq)



Th228 Deposition Rate Above Energy Threshold (Base = 5.52 mBq)



U234 Deposition Rate Above Energy Threshold (Base = 3.68 mBq)



Goals For Fall 2017 Semester

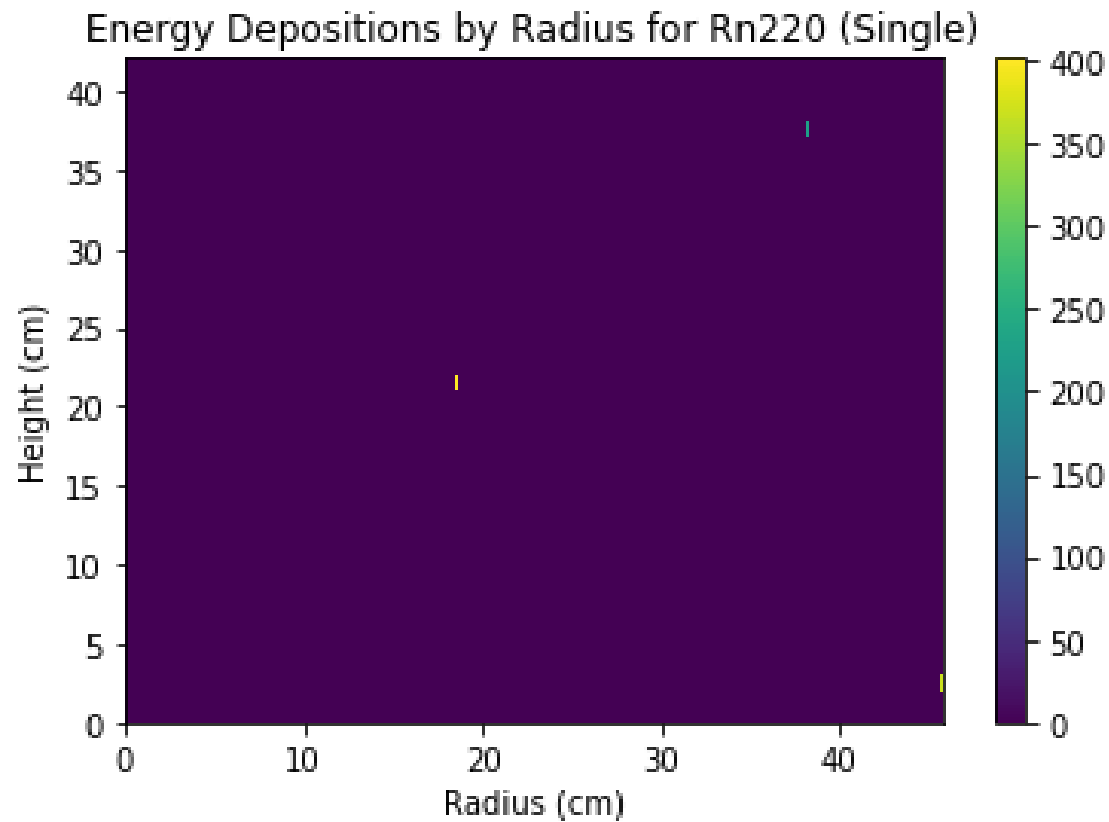
- ▶ Research Tasks
 - ▶ More Components
 - ▶ Give LZ-value estimate range
 - ▶ Errors (And More Events)
 - ▶ Thorium Alpha Energies
- ▶ Conceptual Knowledge
 - ▶ What Specific Impact Do Decays Have on Experiment
- ▶ Technical Knowledge
 - ▶ Learn More C++; be able to write code in C++ instead of Python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

K40 Background Sources

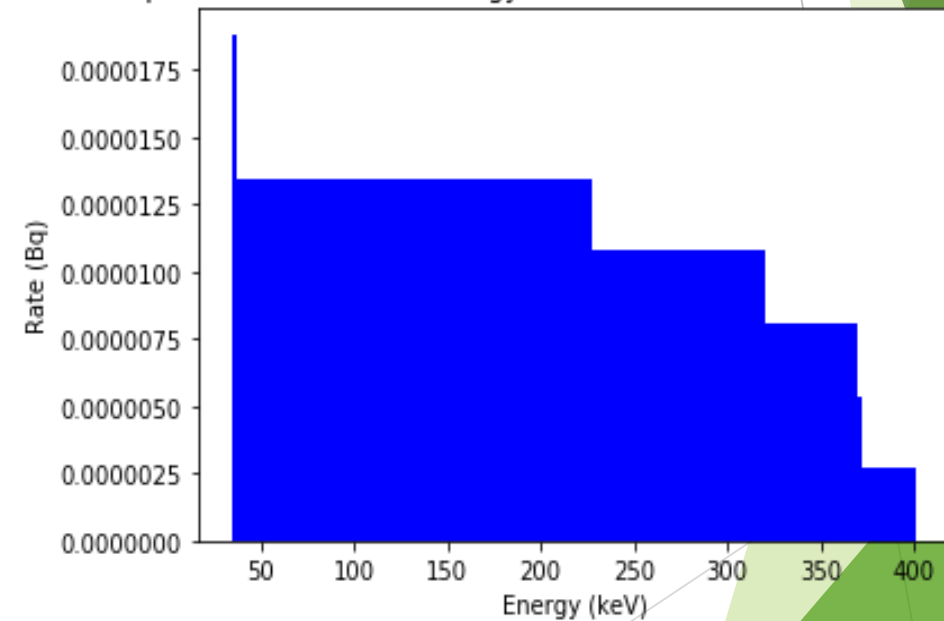
- Each source @ 1mBq/kg
- Rate is for > 0 keV
- Issues

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
TPCptfeConelInLiquid	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
activeLXeFFRegion	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
TPCptfeConelInGas	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



Rn220 Deposition Rate Above Energy Threshold (activeXe) (Base=0.02689924 Bq)



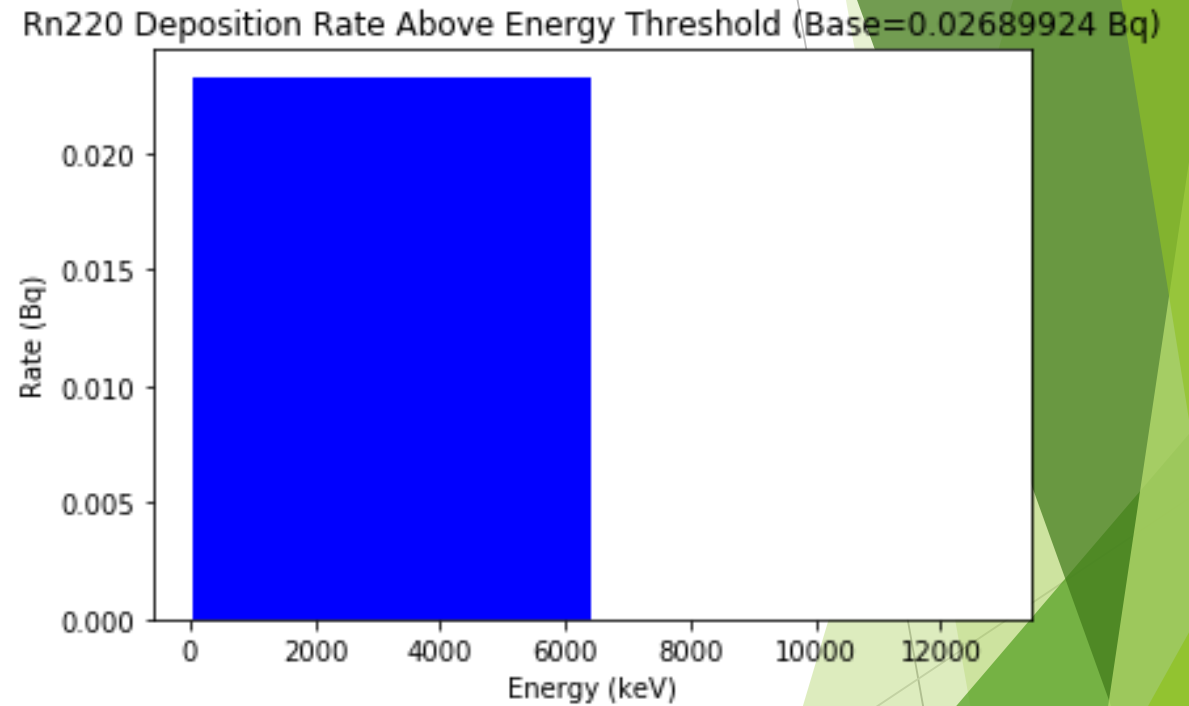
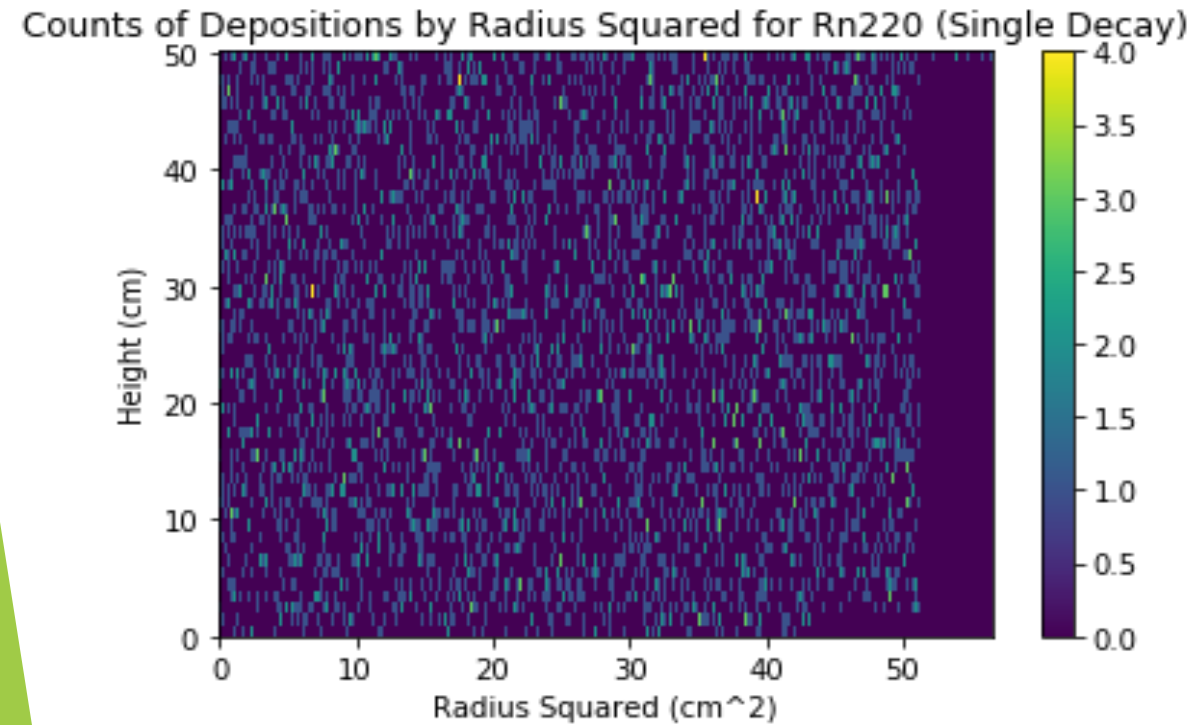
To Work On

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

Tasks/Issues From Last Week

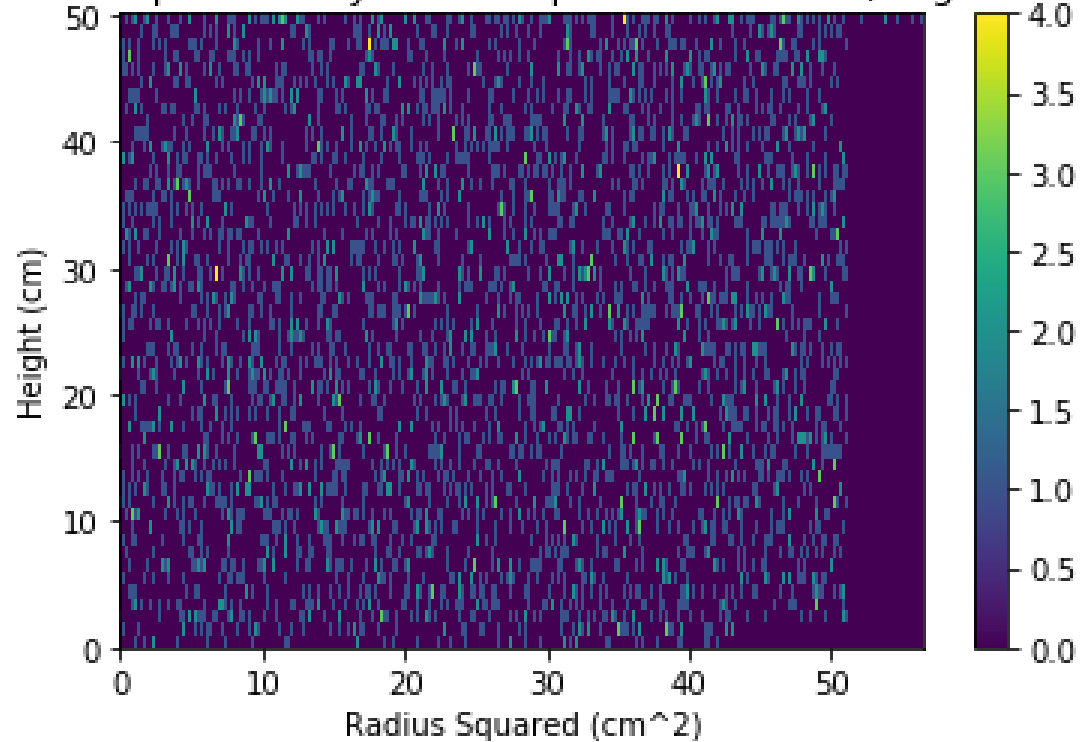
- ▶ Data For Other Elements-
 - ▶ I looked at single decays of Radon 220 and Polonium 216, as I thought that they would be the most important for calibration
- ▶ So Few Events/Bad Energies-
 - ▶ Combination of coding error and old BACCARAT
- ▶ Bad Geometry-
 - ▶ Was looking at r^2 , so units check out

Thoron Single Decay

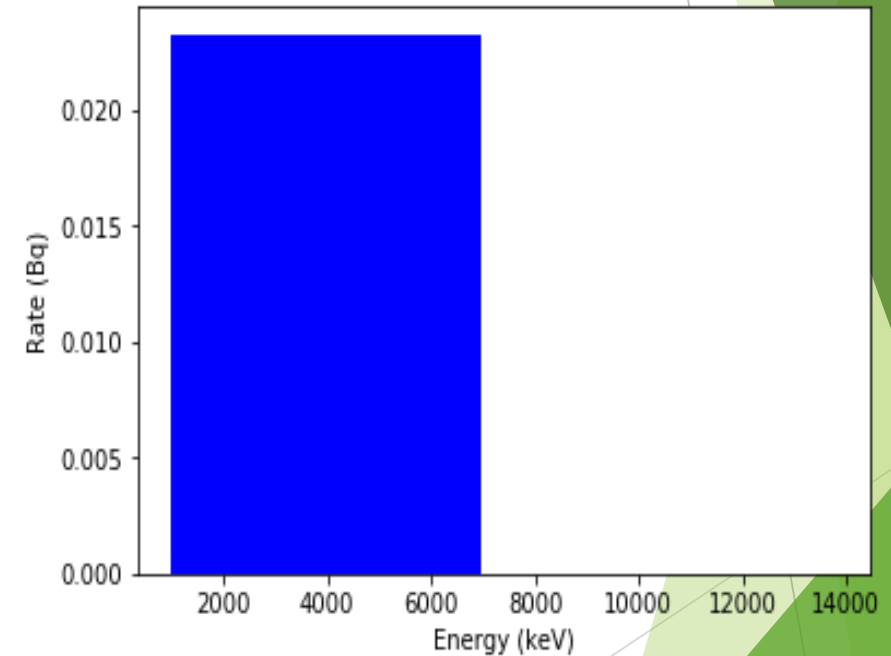


Polonium Single Decay

Counts of Depositions by Radius Squared for Po216 (Single Decay)



Po216 Deposition Rate Above Energy Threshold (Single Decay) (Base=.026899235 Bq)



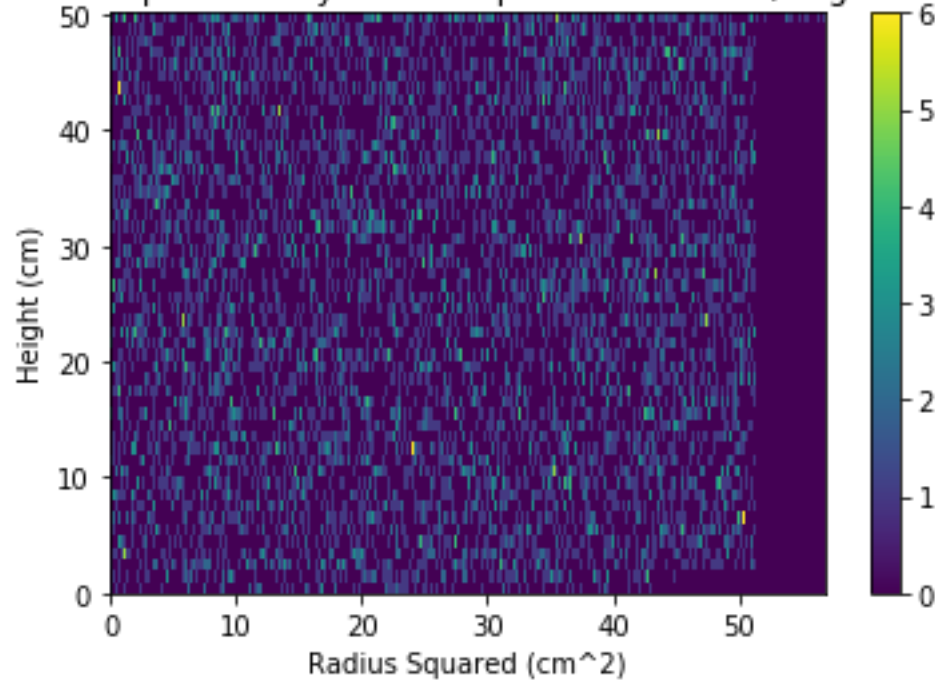
For Next Week

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

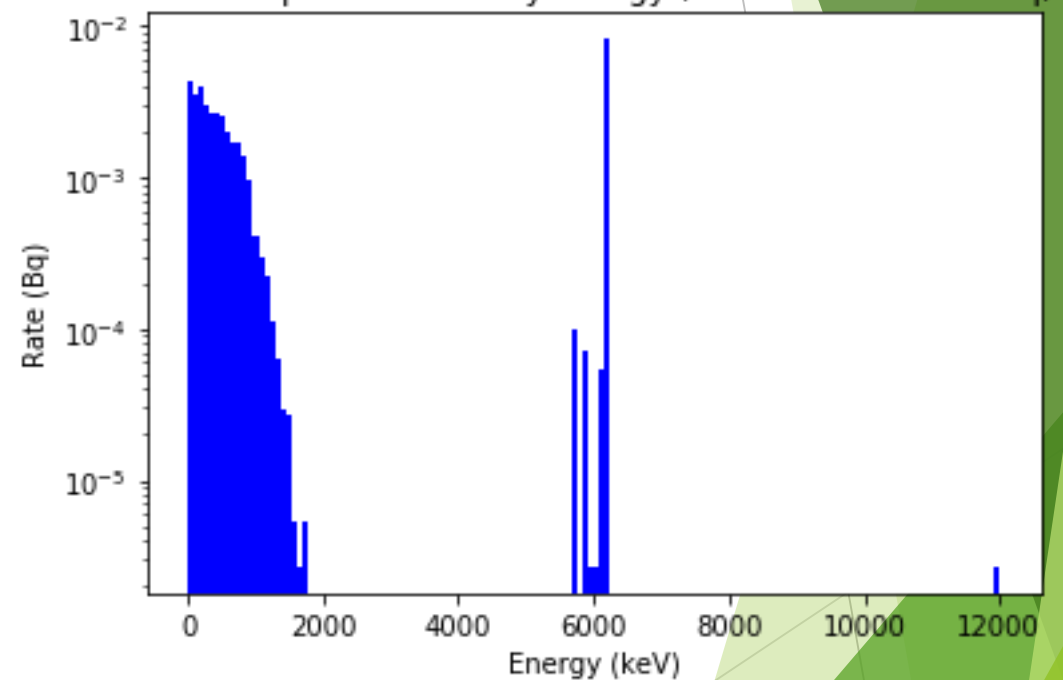
10/25/17

New Geometry + Full Chain

Counts of Depositions by Radius Squared for Bi212 (Single Decay)



Bi212 Deposition Rate By Energy (Base=0.02689924 Bq)



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

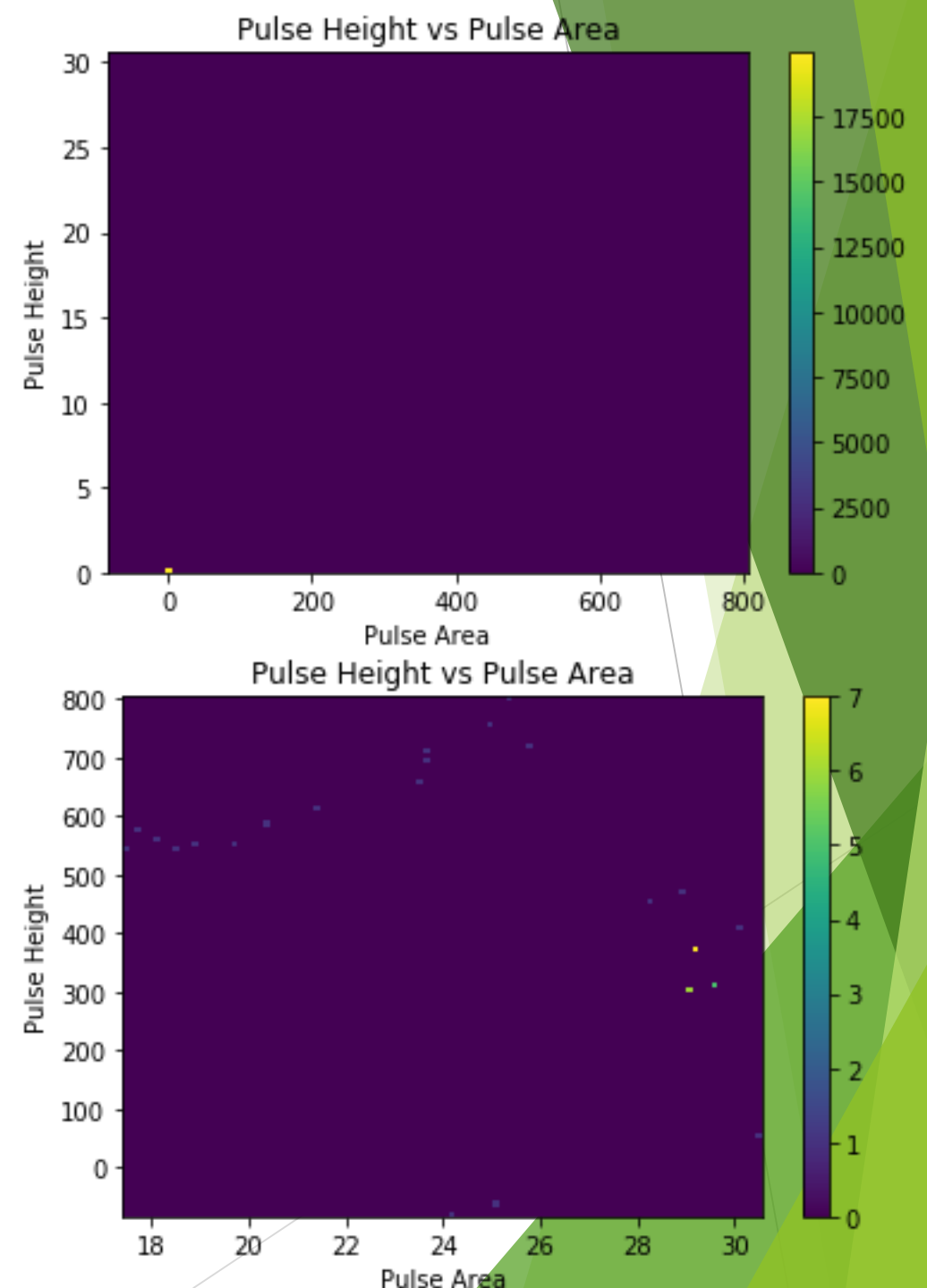
- ▶ Running into “make” issue with ElectronicsSimulation
 - ▶ Made post on systemtestanalysis to help resolve
- ▶ Made pdsf account
 - ▶ Errors making both BACCARAT and ElectronicsSimulation

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)

9/20/18

► Main Tasks:

- Be able to get sims all the way through Lzap
- Until I have a topic for my thesis, do thoron calibration simulations?

► Progress:

- BACCARAT, ElectronicsSimulation, and Lzap all up-to-date and compiled on lzlogin
 - Unable to compile on pdsf
- Am able to run BACCARAT sims fine, but issues with BaccMCTruth

► To Do:

- Fix BaccMCTruth so sims go through
- Prepare for thesis topic?