

# What I Am Doing

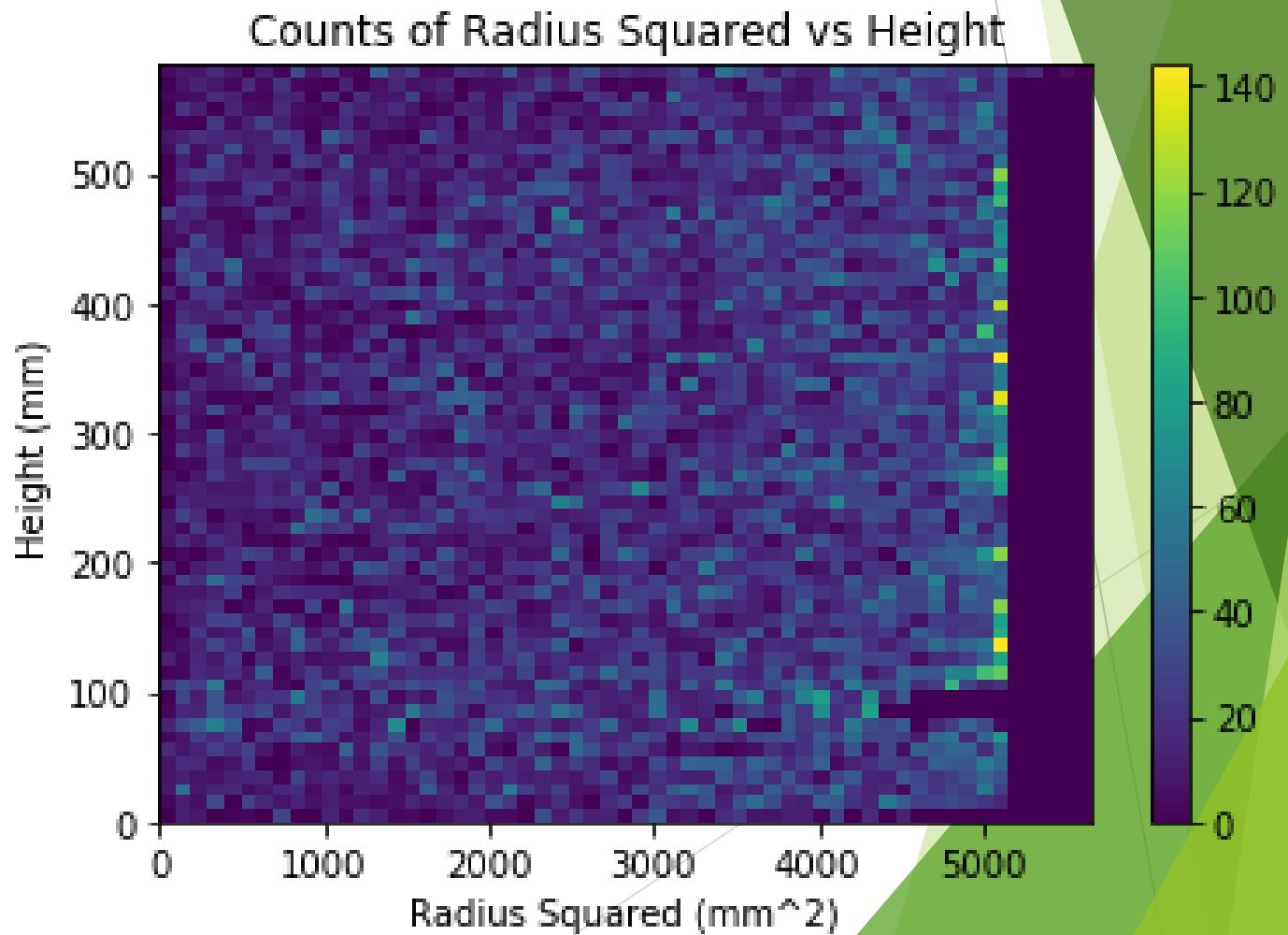
Simulating Thoron Decay Chain in Phase 1

Today's Slide is [Here](#)

# Plots!

## Concerns

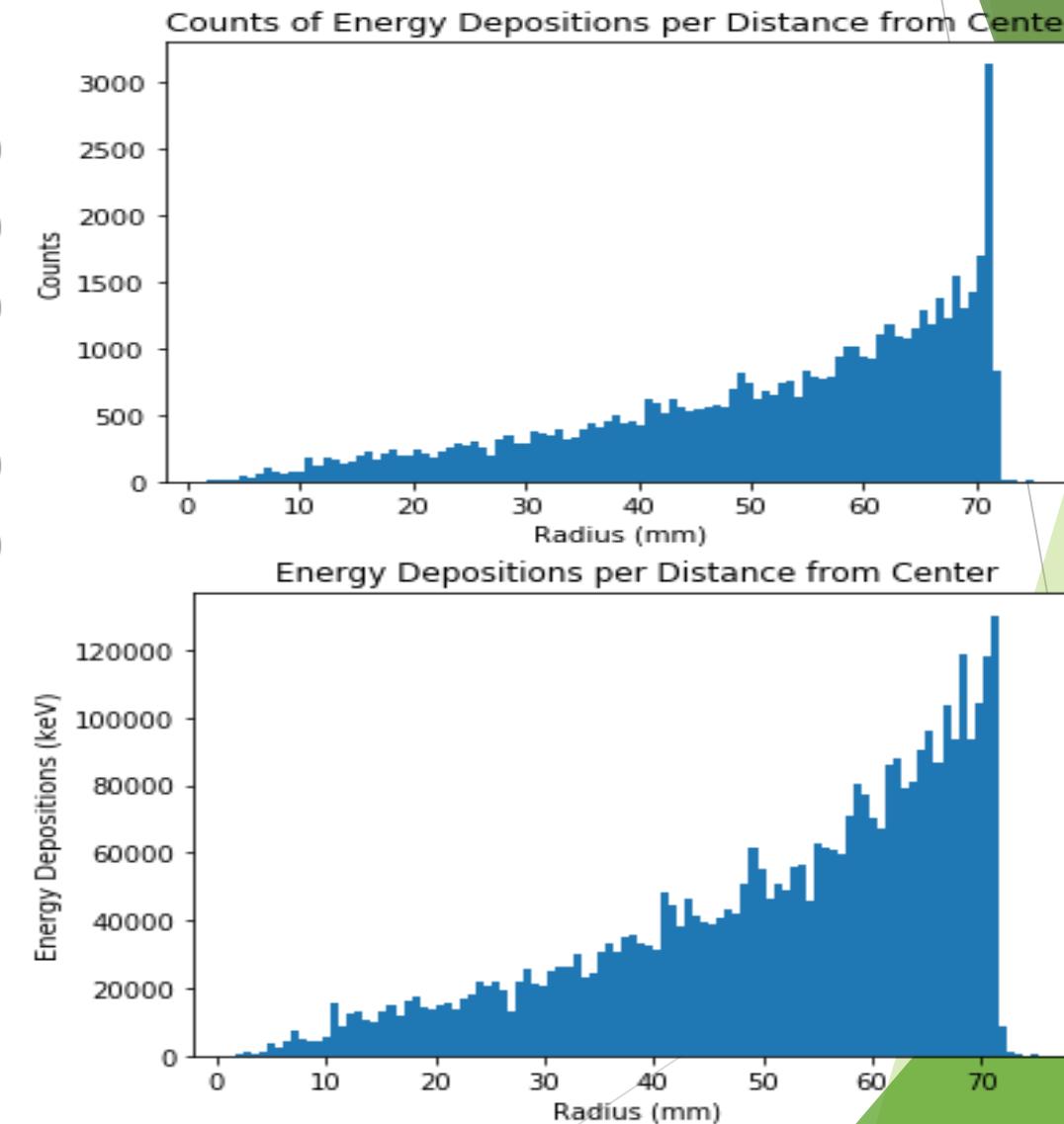
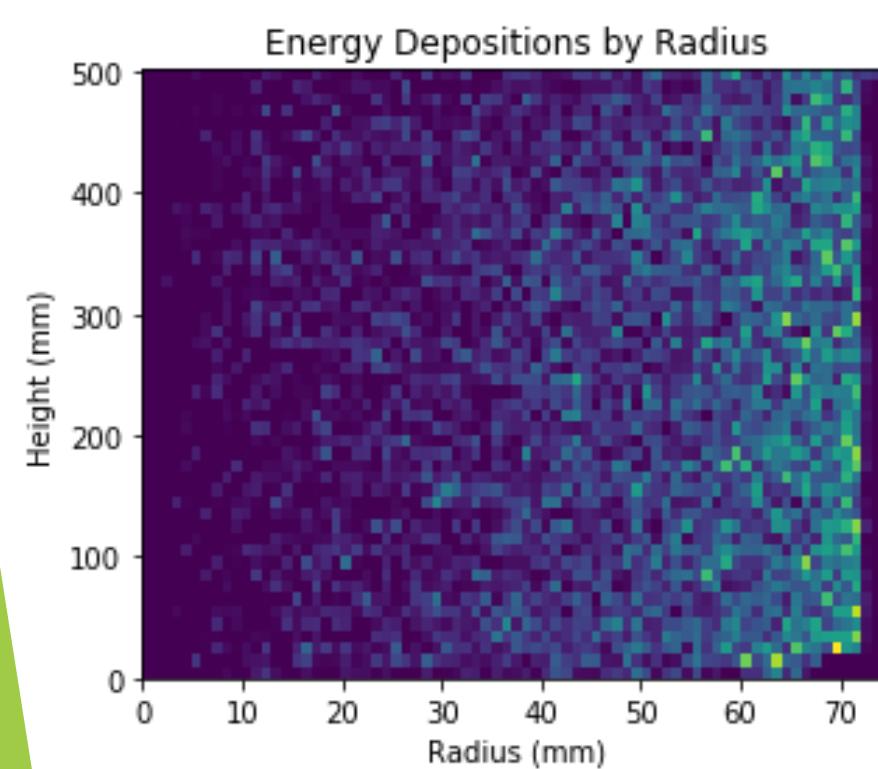
- ▶ Time threshold?
- ▶ Does not line up exactly with parameters (especially height)
- ▶ Gap at 100mm height



# 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



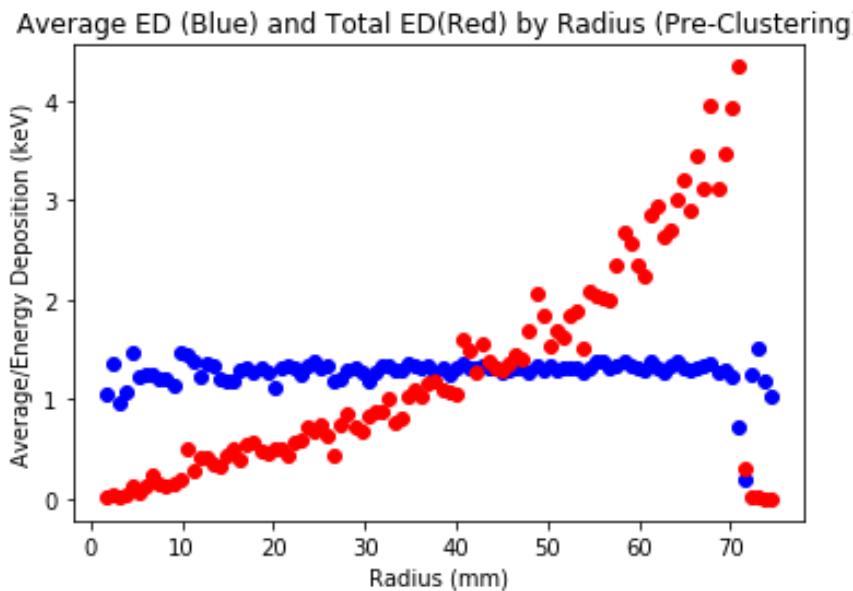
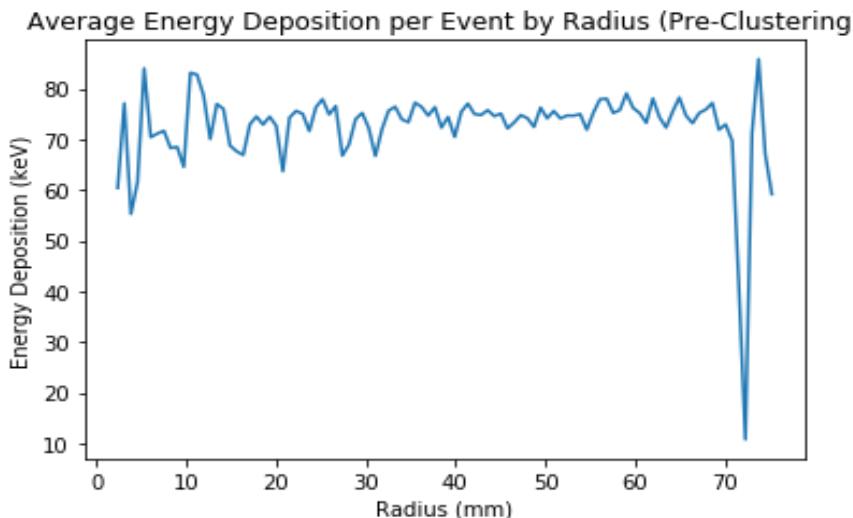
# Still To Do

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

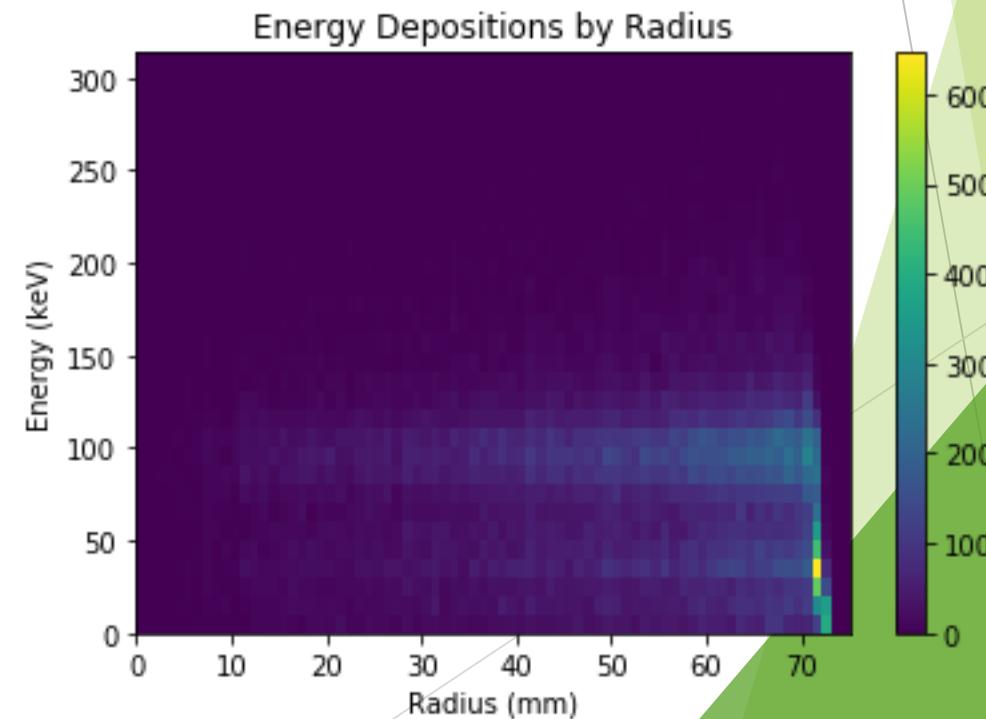
# Thermal Neutron Scattering

- ▶ [https://indico.cern.ch/event/245281/contributions/1564676/attachments/420136/583408/thermal\\_physics\\_validation\\_argarcia.pdf](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

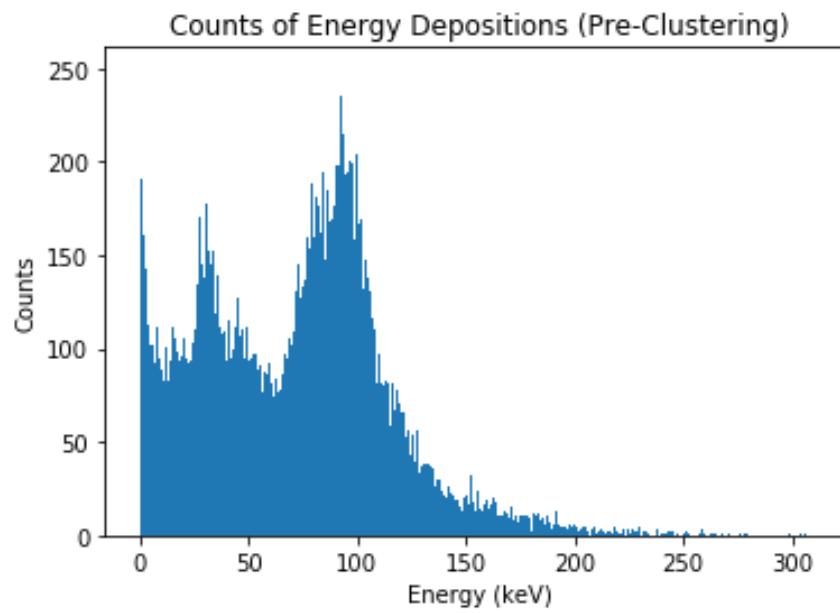


- Why is there so little energy degradation until it is close to the center?
- Why is there a sudden drop at the edge, but regular events past it?
- Why are there so many small-energy events at the edge, but fewer later on?

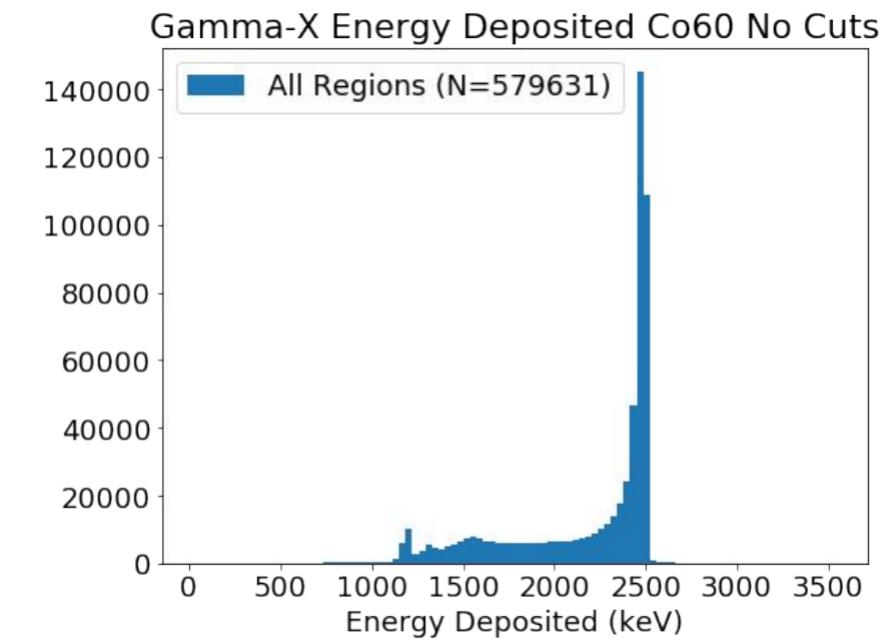


# Energy Histogram Very Far Off

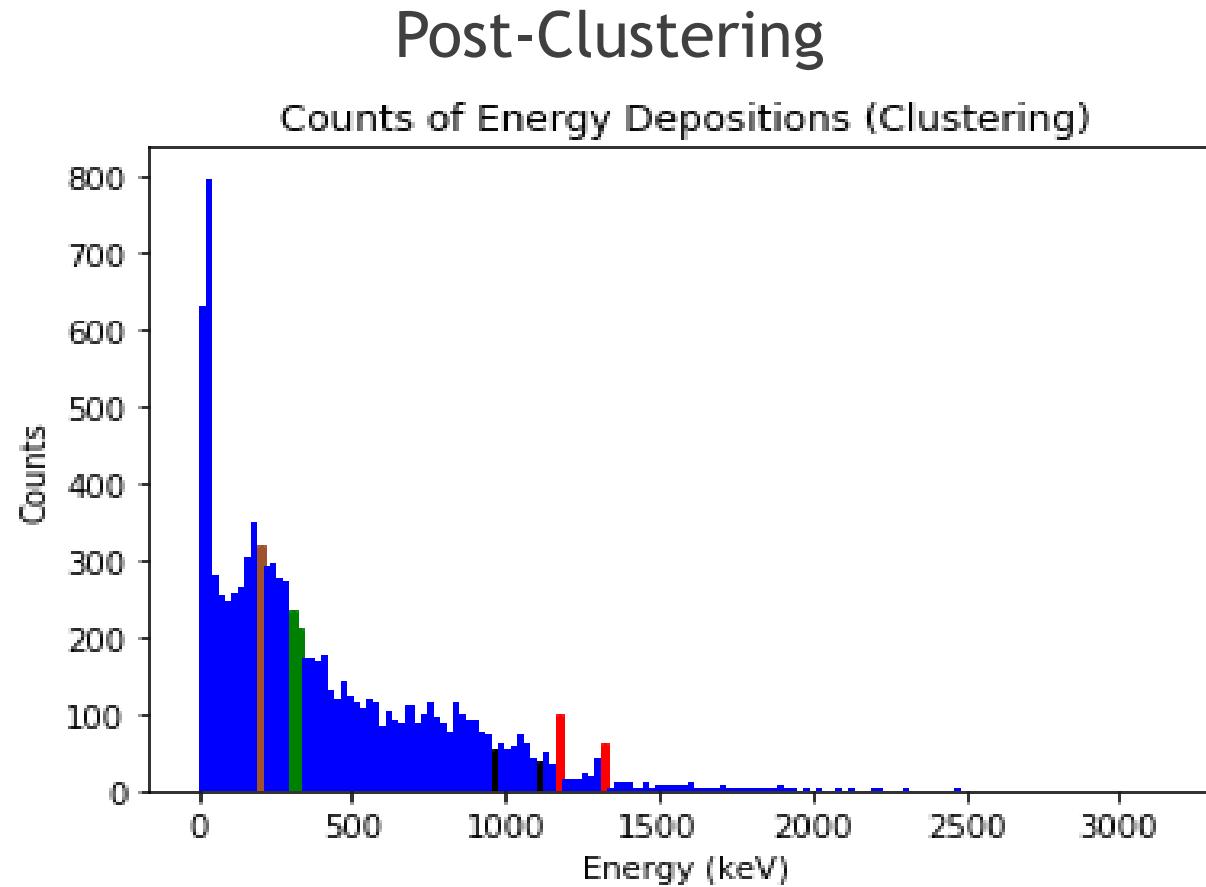
Mine



Jonathan's

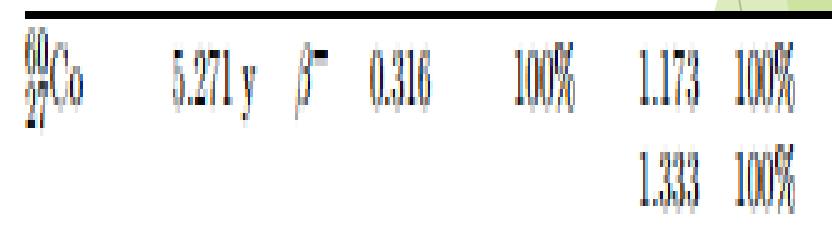


# Now With Clustering



## Expected Values (keV)

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



# 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

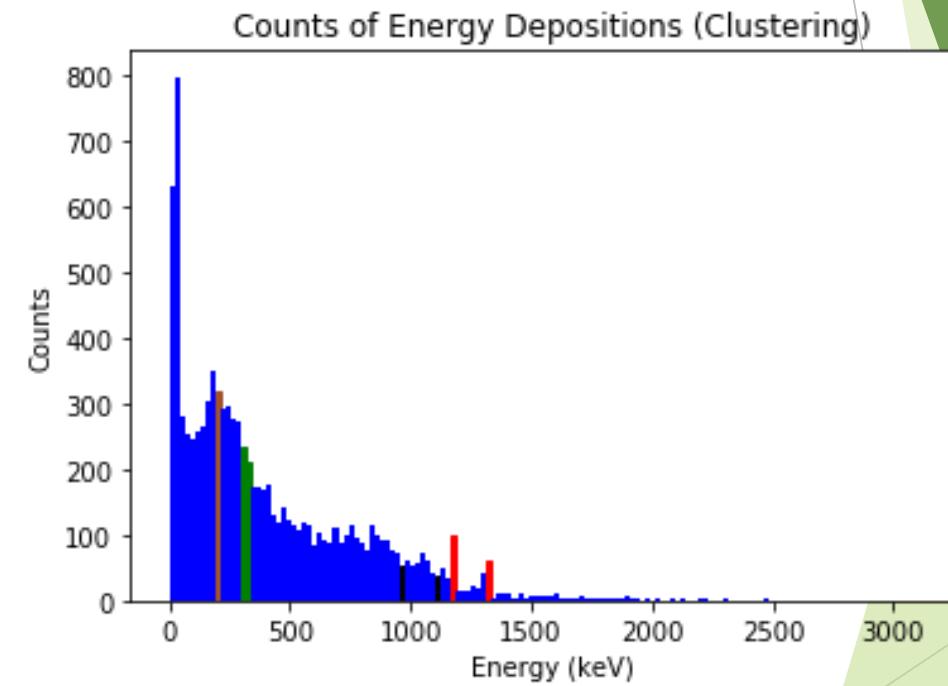
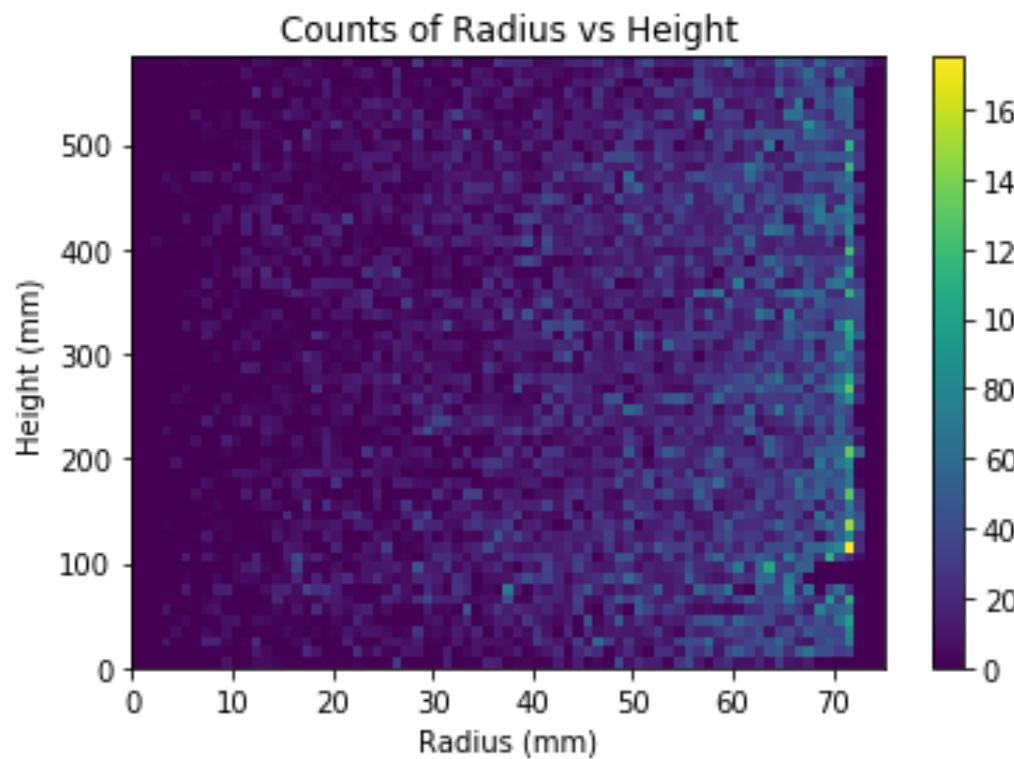
## Do

- ▶ 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

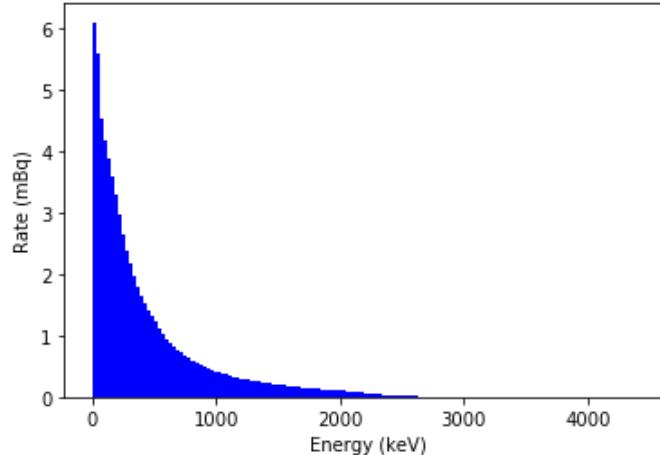
- ▶ Got Submission Script/Macro running
- ▶ Plotted by position
- ▶ Plotted by energy/histograms of energy
- ▶ Included Clustering
- ▶ Included Accurate Values
- ▶ Other elements
- ▶ Measured rate above energy threshold
- ▶ Cable Making (Minor)
- ▶ More components w/ More Decays (In Progress)

# Plotting By Position/Energy/Clustering

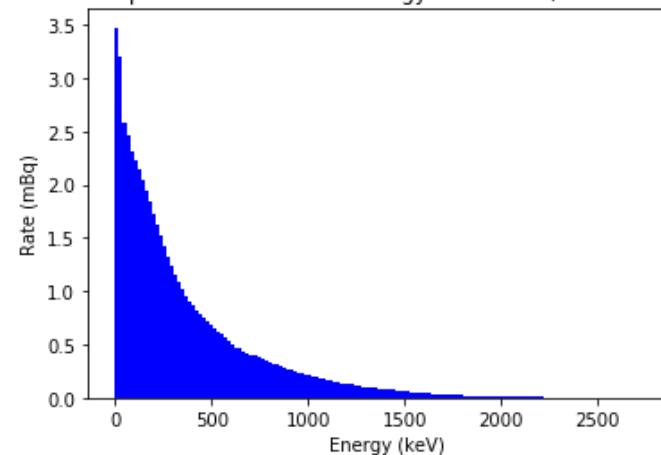


# Accurate Values/Rate/More Elements

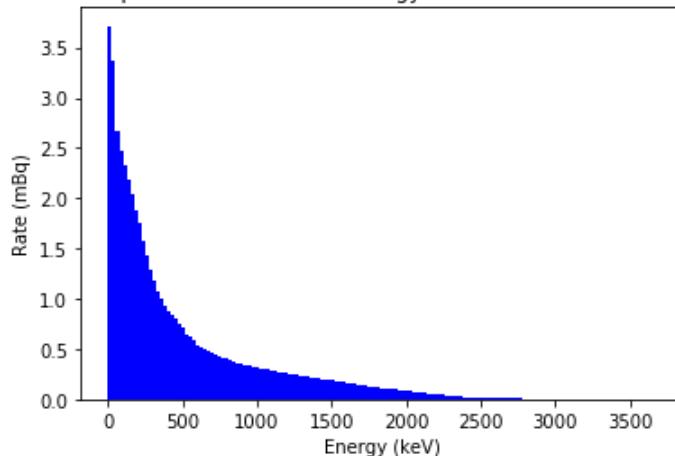
Th232 Deposition Rate Above Energy Threshold (Base = 5.52 mBq)



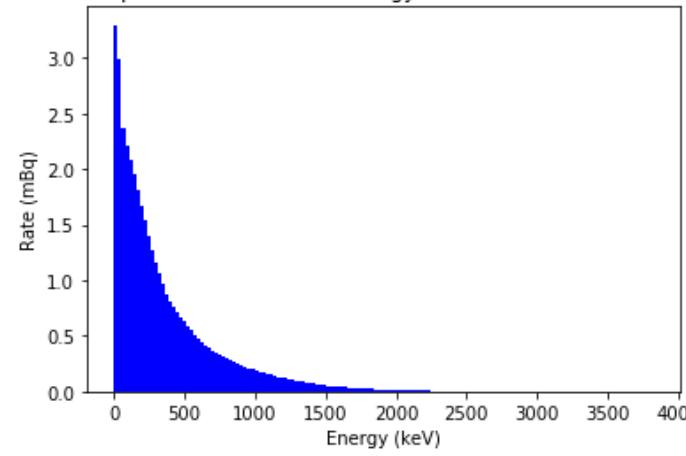
U238 Deposition Rate Above Energy Threshold (Base=3.68 mBq)



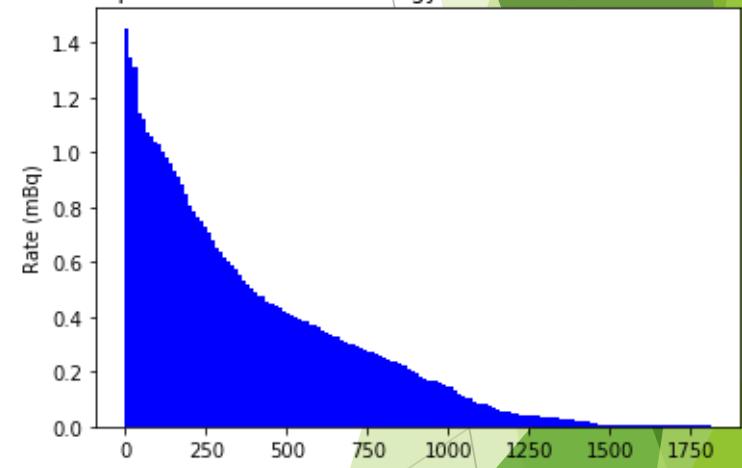
Th228 Deposition Rate Above Energy Threshold (Base = 5.52 mBq)



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



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



# Goals For Fall 2017 Semester

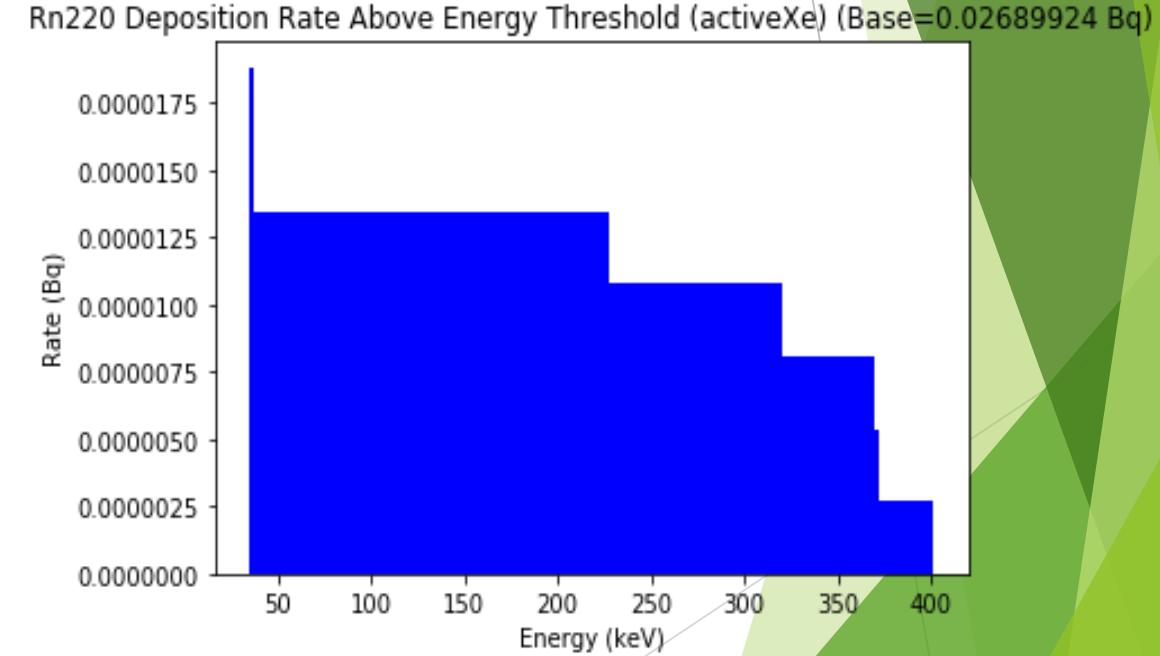
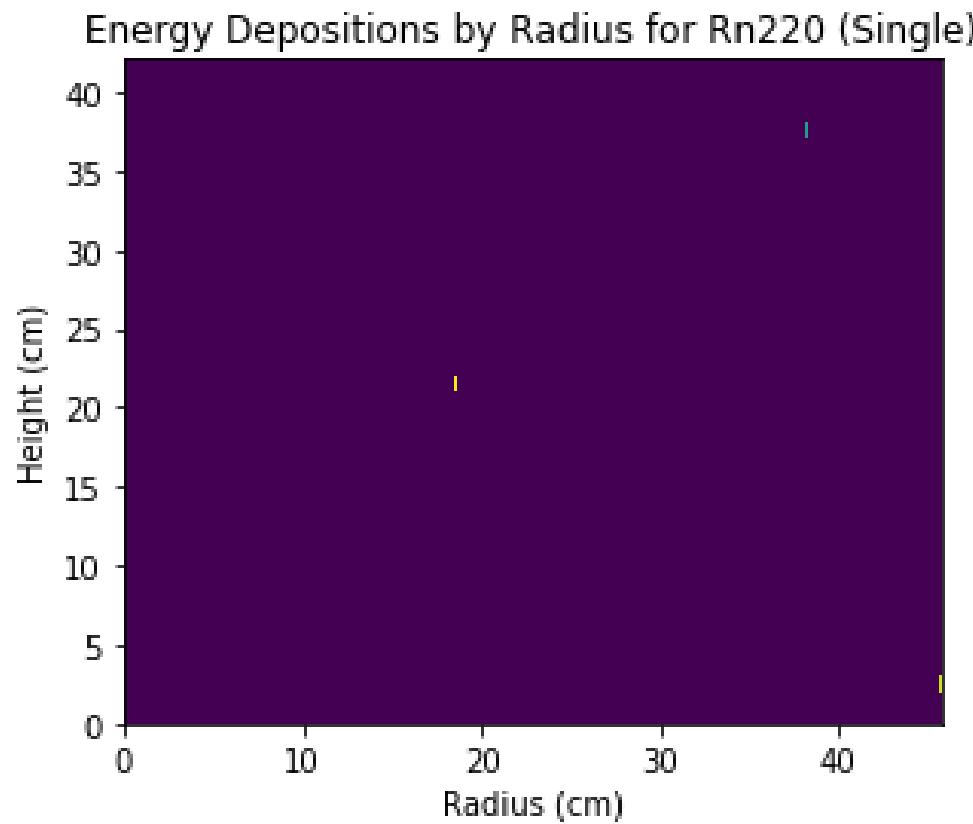
- ▶ Research Tasks
  - ▶ More Components
  - ▶ Give LZ-value estimate range
  - ▶ Errors (And More Events)
  - ▶ Thorium Alpha Energies
- ▶ Conceptual Knowledge
  - ▶ What Specific Impact Do Decays Have on Experiment
- ▶ Technical Knowledge
  - ▶ Learn More C++; be able to write code in C++ instead of 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	96588.6129E-03		2.64
GasXeInInnerCryoVessel	243.699	257.4362.39E-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	7.091442.67E-07		3.77
PeekSpacerArc2	2.57045	2.569879.77E-08		3.8
PeekSpacerArc3	2.57033	2.570251.00E-07		3.89
PeekSpacerArc4	2.57021	6.84E-07		26.63056824
PeekSpacerArc5	2.57049	2.570356.84E-07		26.62766741
peekSpacersInGas	47.5447	1.73E-06		3.64
gridRingInGas	108.664	4.93E-06		4.54
activeLxErRegion	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



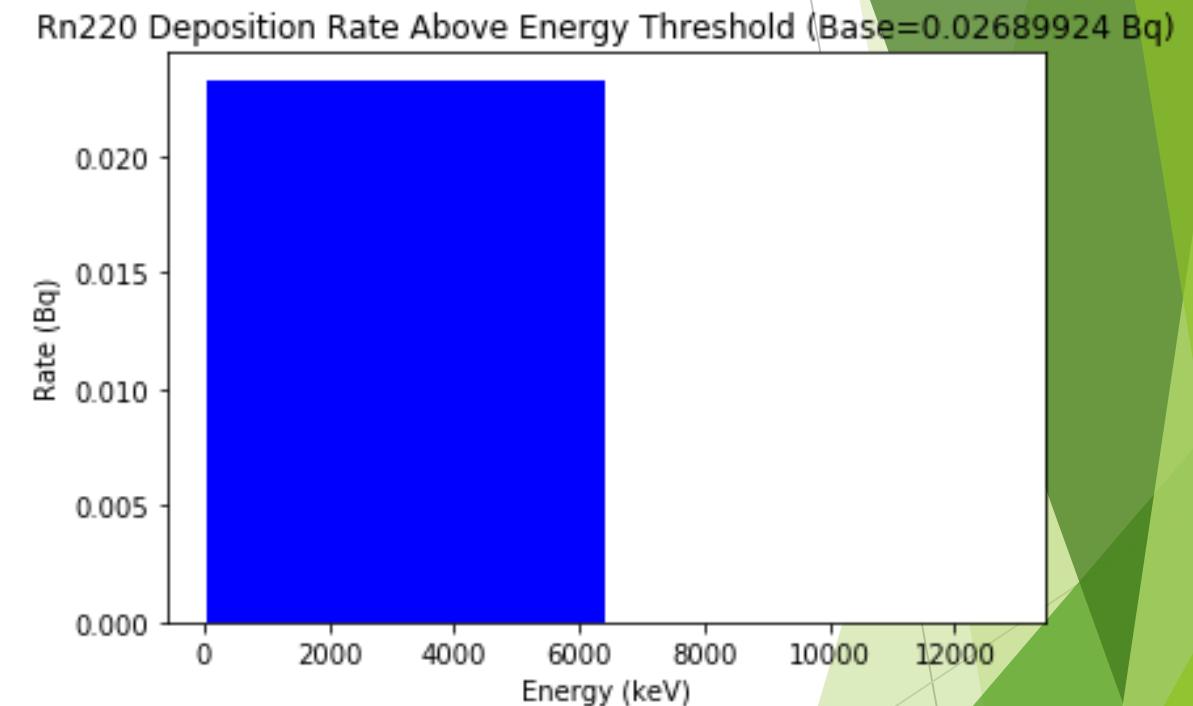
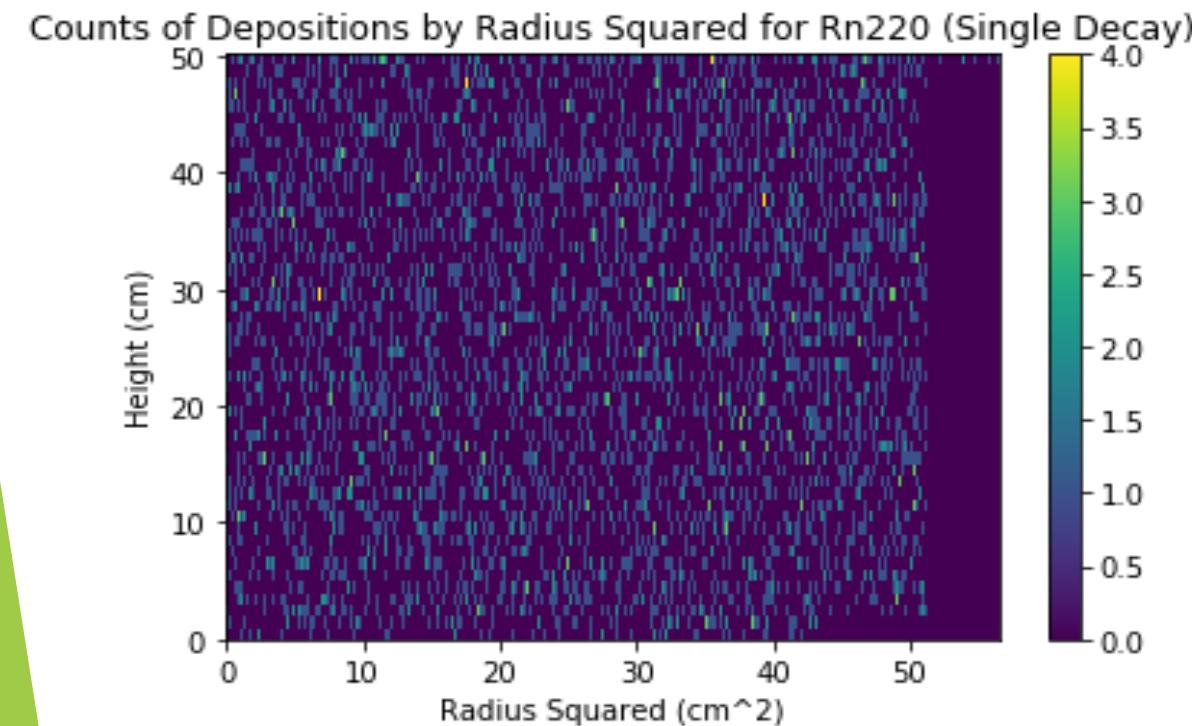
# To Work On

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

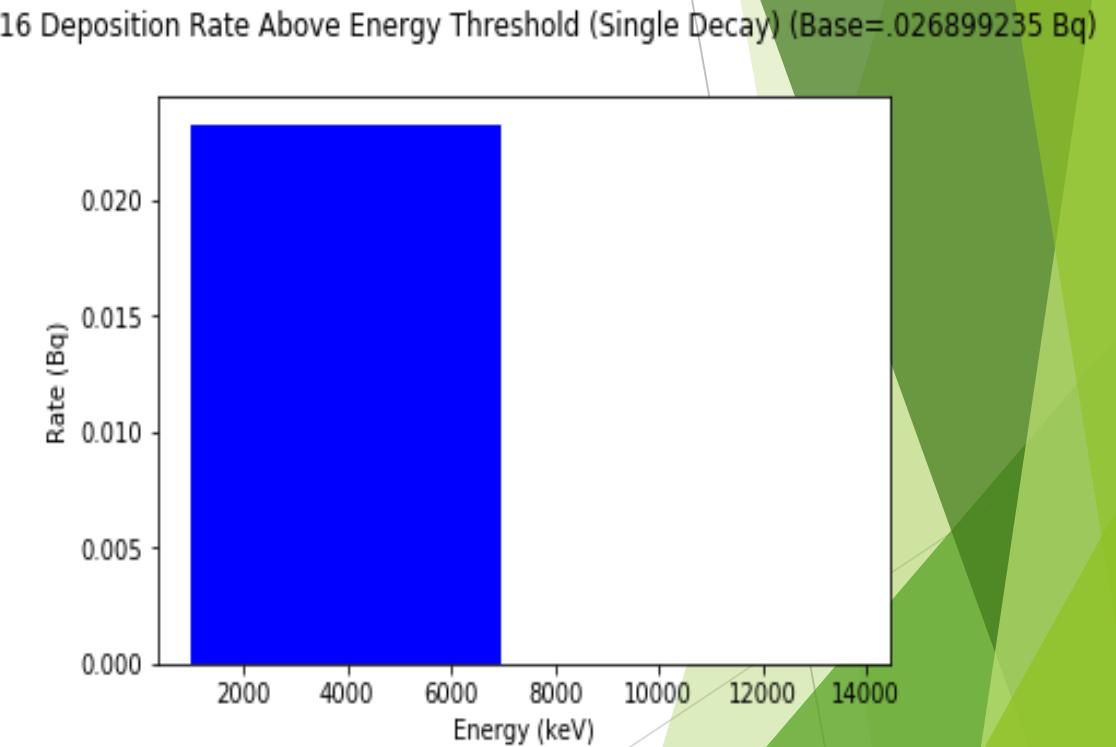
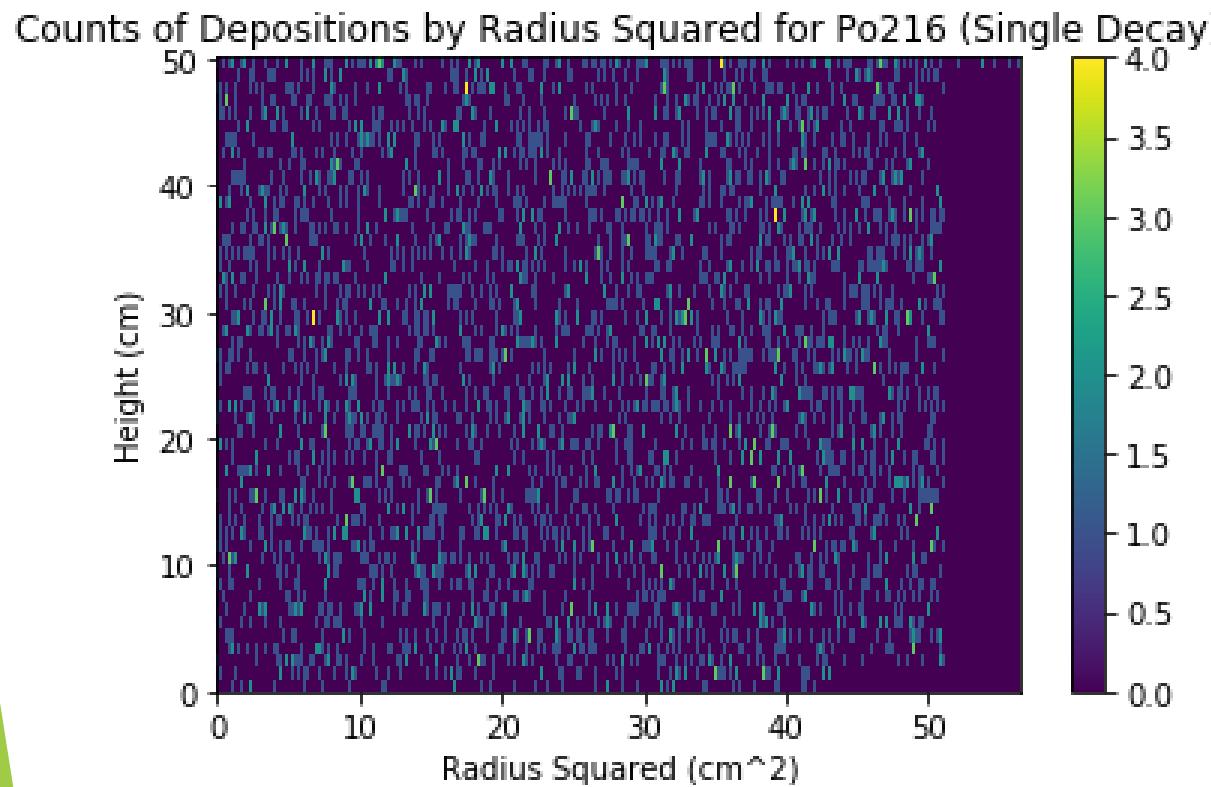
# Tasks/Issues From Last Week

- ▶ Data For Other Elements-
  - ▶ I looked at single decays of Radon 220 and Polonium 216, as I 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

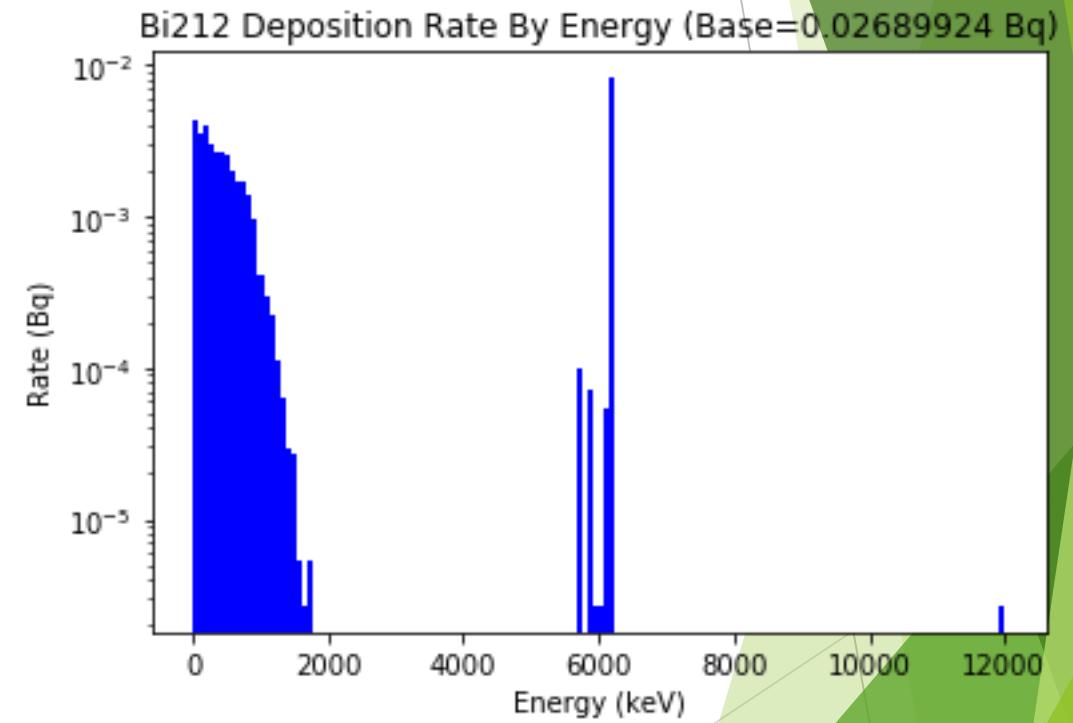
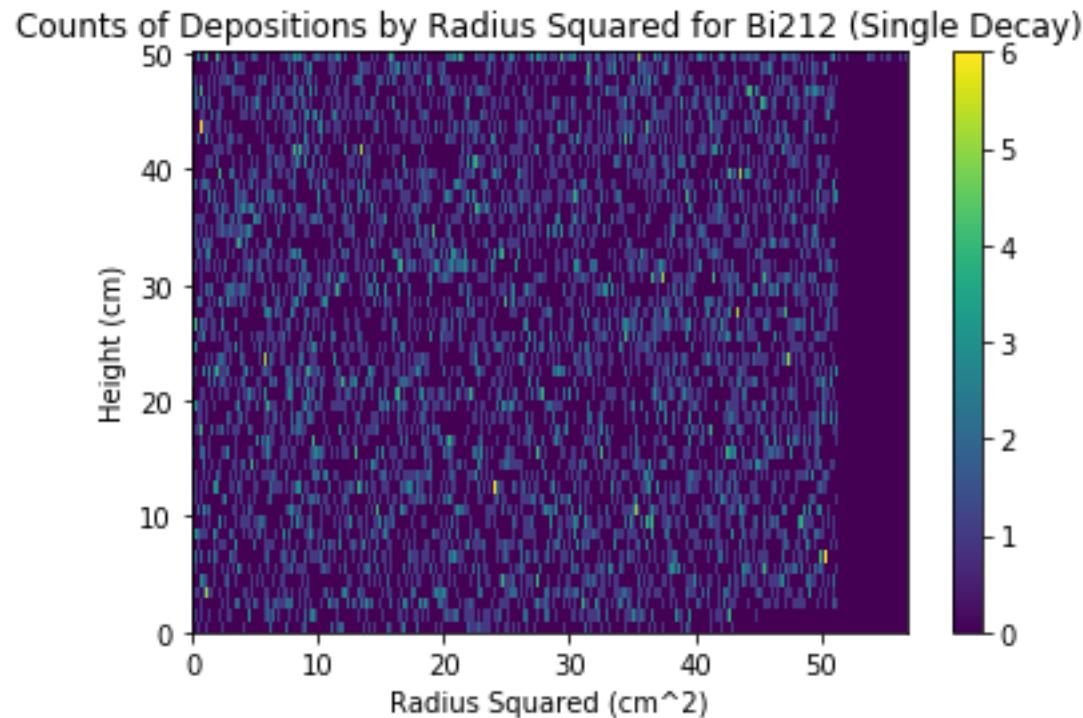


# For Next Week

- ▶ 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

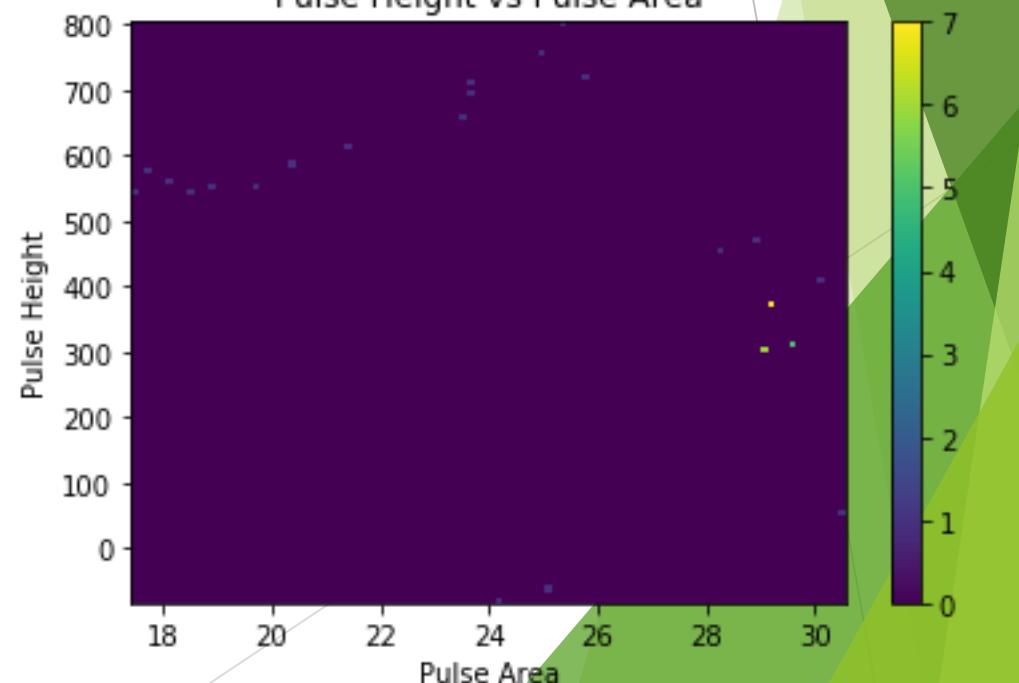
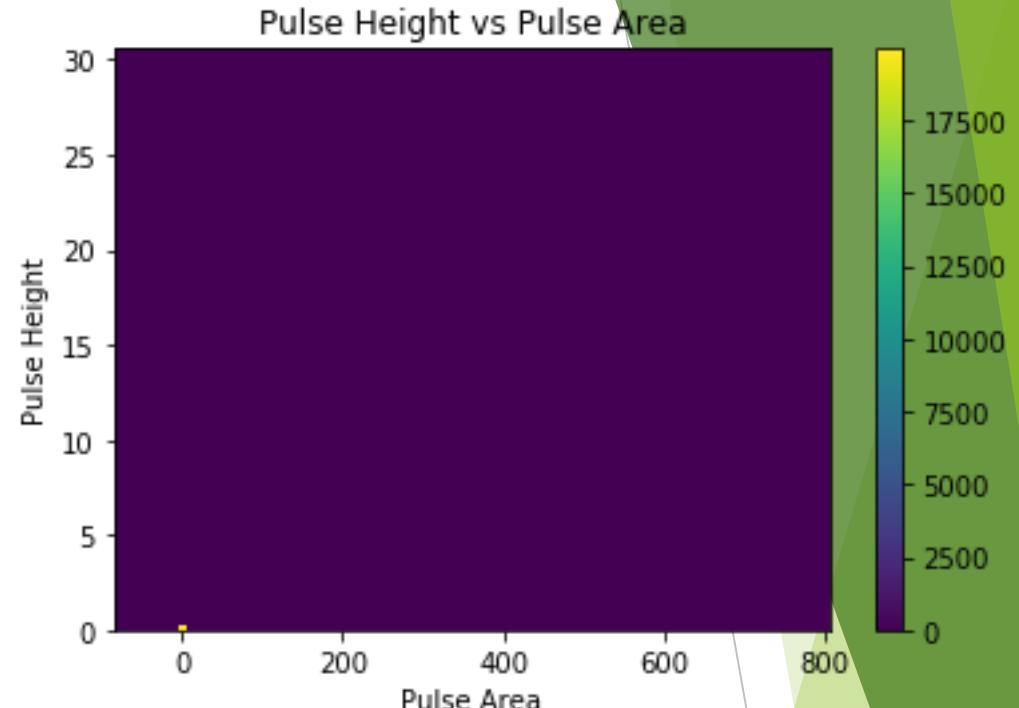
- ▶ Running into “make” issue with ElectronicsSimulation
  - ▶ Made post on systemtestanalysis to help resolve
- ▶ Made pdsf account
  - ▶ Errors making both BACCARAT and ElectronicsSimulation

# 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)

# 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?