What I Am Doing

Simulating Thoron Decay Chain in Phase 1

Today's Slide is <u>Here</u>

Plots!

Concerns

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

Counts of Radius Squared vs 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/4 20136/583408/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



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

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top_pmtR9288_quart2Window 1.0.6158 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 1.1137 1(ad) 2.97E-08 2.01 top.pmtR9288_duminumBody 51.4667 51.4608(ad) 1.03E-06 2.01 topPMT 0.3325 1.48E-08 4.49 bottom_pmtR9288_dapter 1.02.55 0.22 0.22 bottom_pmtR9288_quart2Window 10.6158 0.34E-08 0.22 bottom_pmtR9288_realVacuum 5.76E-24 1.09E-32 0.18900764 bottom_pmtR9288_realVacuum 5.76E-24 1.09E-32 0.17 bottom_pmtR9288_flashing 1.11391 1.89E-09 0.17 bottom_pmtR9288_duminumBody 5.1463 1.11E-07 0.41 bottom_pmtR9288_duminumBody 5.1463 1.1E-07 0.41 bottom_pmtR9288_duminumBody 63.592 1.2E-07 0.49 bottom_pmtR9288_duminumBody 63.592 1.2E-07 0.49 bottom_pmtR9288_duminumBody 63.592 1.2E-07<	top_pmtR9288_adapter	162.704		3.11E-06	1.91
top.pmtR9288_realVacum 5.766-24 5.76301e-24 (a) 1.282-31 2.128739756 top.pmtR9288_flashing 4.21468 1.116.77 6.3 top.pmtR9288_flashing 1.11387 1.11377 (a) 2.976-08 2.07 top.pmtR9288_flashing 5.16667 51.4608 (a) 1.082-06 2.01 top.pmtR9288_dapter 0.3335 1.488-08 4.49 bottom.pmtR9288_quartzWindow 10.6158 2.3256-07 0.2 bottom.pmtR9288_realVacum 5.766-24 1.09E-32 0.189900764 bottom.pmtR9288_realVacum 5.766-24 1.09E-32 0.17 bottom.pmtR9288_realVacum 1.11397 1.89E-09 0.17 bottom.pmtR9288_flashing 1.11397 1.89E-09 0.17 bottom.pmtR9288_flashing 5.1.463 2.11E-07 0.41 bottom.pmtR9288_flashing 63.592 3.12E-07 0.49 bottom.pmtR9288_flashing 63.592 3.12E-07 0.49 bottom.pmtR9288_flashing 63.592 3.12E-07 0.49 bottom.pmtR9288_flashing 63.592 3.12E-07 0.49 bottom.pmtR9288_flashing 63.592 3.12E-07 <	top_pmtR9288_quartzWindow	10.6158	10.6159 (ad)	3.07E-07	2.89
top 4.21468 1.11E-07 2.63 top_pmtR9288_flashing 1.11387 1.11377 (ad) 2.97E-08 2.67 top_pmtR9288_flashing 51.4667 51.4608 (ad) 1.03E-06 2.01 top_pmtR9288_aluminumBody 0.33035 1.48E-08 4.49 bottom_pmtR9288_adapter 0.33035 1.48E-08 4.49 bottom_pmtR9288_quartzWindow 10.6158 3.25E-07 0.2 bottom_pmtR9288_realVacuum 5.76E-24 1.09E-32 0.189900764 bottom_pmtR9288_flashing 1.11391 1.89E-09 0.17 bottom_pmtR9288_flashing 5.1.463 2.11E-07 0.41 bottom_pmtR9288_flashing 63.5921 3.12E-07 0.49 Total 1.73E-05 1.20E-21 1.49E-03	top_pmtR9288_realVacuum	5.76E-24	5.76301e-24 (ad)	1.23E-31	2.128739756
top_pmtR9288_flashing 1.11387 1.11377 (a) 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 1.02.726 3.25E-07 0.2 bottom_pmtR9288_quartzWindow 10.6158 2.34E-08 0.22 bottom_pmtR9288_realVacuum 5.76E-24 0.99E-32 0.189900764 bottom_pmtR9288_flashing 1.11391 1.89E-09 0.17 bottom_pmtR9288_aluminumBody 51.463 2.11E-07 0.41 bottom_pmtR9288_flashing 63.5921 3.12E-07 0.49 Total 1.73E+05 2.01 1.202-20	topR9288_PMT_Photocathode_1	4.21468		1.11E-07	2.63
top_pmtR9288_aluminumBody 51.466751.4608(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 bottom_pmtR9288_flashing 1.11391 1.89E-09 0.17 bottom_pmtR9288_aluminumBody 51.463 2.11E-07 0.41 bottom_pmtR9288_aluminumBody 63.5921 3.12E-07 0.49	top_pmtR9288_flashing	1.11387	1.11377 (ad)	2.97E-08	2.67
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 bottom_pmtR9288_flashing 1.1139 1.89E-09 0.17 bottom_pmtR9288_aluminumBody 51.463 2.11E-07 0.41 BottomPMT 63.5921 3.12E-07 0.49	top_pmtR9288_aluminumBody	51.4667	51.4608(ad)	1.03E-06	2.01
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 bottom_pmtR9288_flashing 4.21483 7.17E-09 0.17 bottom_pmtR9288_aluminumBody 5.1463 2.11E-07 0.41 BottomPMT 63.5921 3.12E-07 0.49	TopPMT	0.33035		1.48E-08	4.49
bottom_pmtR9288_quartzWindow 10.6158 2.34E-08 0.22 bottom_pmtR9288_realVacuum 5.76E-24 1.09E-32 0.189900764 bottom_pmtR9288_flashing 4.21483 7.17E-09 0.17 bottom_pmtR9288_aluminumBody 1.1139 1.89E-09 0.17 bottomPMT 63.5921 3.12E-07 0.41 Total 1.73E+05 2.03E-02 1.78823734	bottom_pmtR9288_adapter	162.726		3.25E-07	0.2
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 1.1139 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 1.7823734	bottom_pmtR9288_quartzWindow	10.6158		2.34E-08	0.22
bottom 4.21483 7.77E-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 1.78823734	bottom_pmtR9288_realVacuum	5.76E-24		1.09E-32	0.189900764
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 1.78823734	bottomR9288_PMT_Photocathode_1	4.21483		7.17E-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 1.78823734	bottom_pmtR9288_flashing	1.11391		1.89E-09	0.17
BottomPMT 63.5921 3.12E-07 0.49 Total 1.73E+05 2.03E-02 1.78823734	bottom_pmtR9288_aluminumBody	51.463		2.11E-07	0.41
Total 1.73E+05 2.03E-0211.78823734	BottomPMT	63.5921		3.12E-07	0.49
	Total	1.73E+05		2.03E-0	211.78823734

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

Counts of Depositions by Radius Squared for Rn220 (Single Decay)



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

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?)