

# Group Update

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Today's update starts on [slide 14](#).

# Current tasks

- Gamma-X events from calibration sources
  - Simulate LZ calibrations and see how they are impacted by gamma-x events
- Phase 1 optical maps
  - Improve the speed and accuracy of Phase 1 sims by adding in a map for S2 events
- Phase 1 Run 7 data analysis
- LUX 100T projection sensitivity paper
- LZ scale model

# Gamma-X from calibration sources

Possible sources:

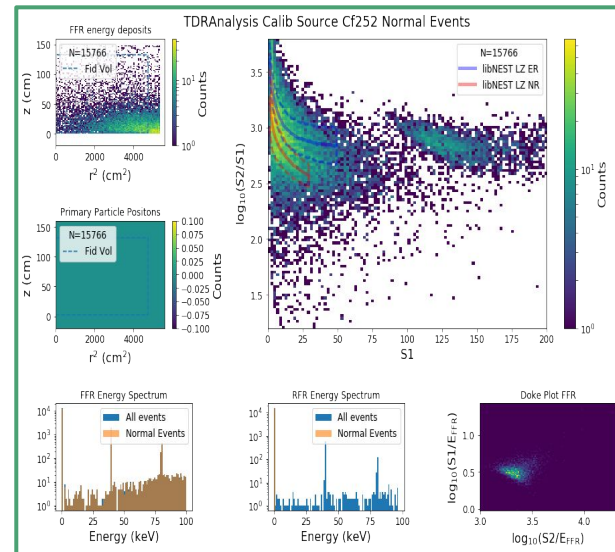
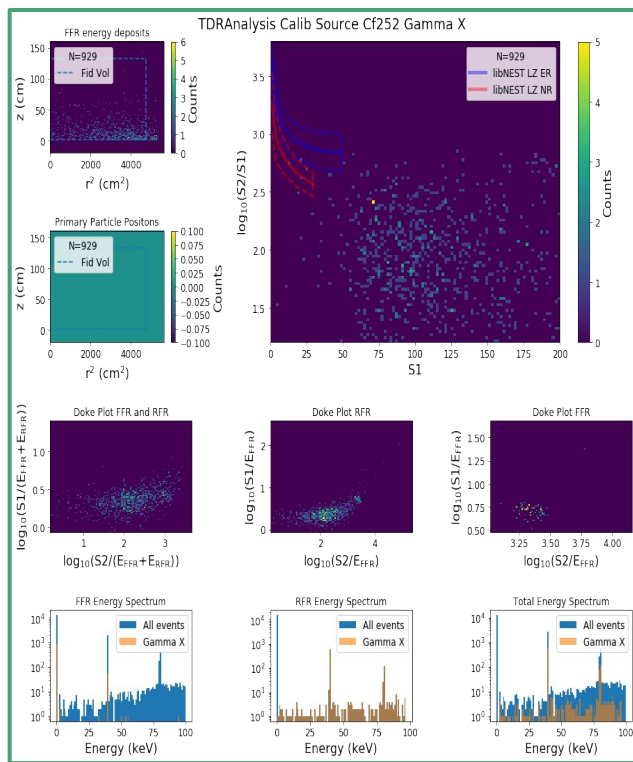
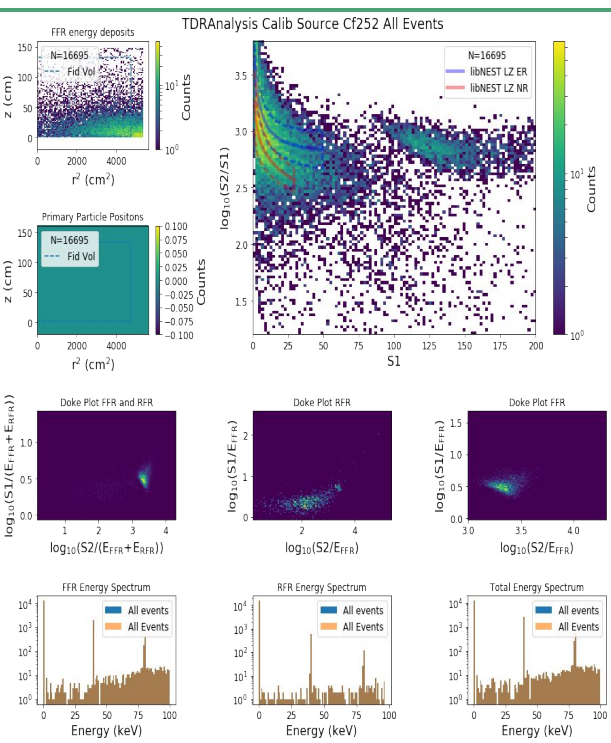
- AmLi (AmBe)
- $^{252}\text{Cf}$
- $^{228}\text{Th}$
- $^{57}\text{Co}$  (As a test)

All are CSD sources. Generate them in CSD tubes, located in the vacuum space, at  $z=0$  (cathode)

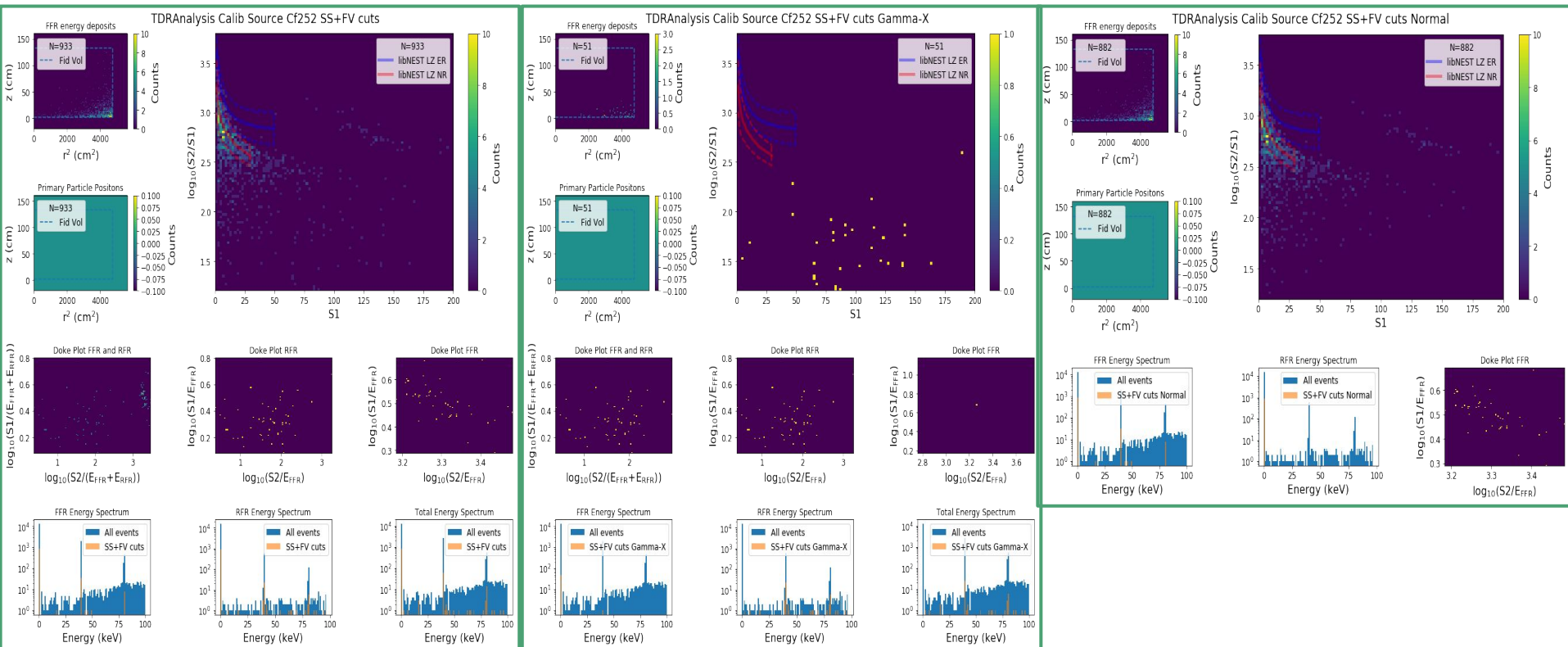
Table 7.0.1: Baseline calibration sources for LZ.

Isotope	What	Purpose	Deployment	Custom?
Tritium	beta, $Q = 18.6$ keV	ER band	Internal	N
$^{83\text{m}}\text{Kr}$	beta/gamma, 32.1 keV and 9.4 keV	TPC (x, y, z)	Internal	Y
$^{131\text{m}}\text{Xe}$	164 keV $\gamma$	TPC (x, y, z), Xe skin	Internal	Y
$^{220}\text{Rn}$	various $\alpha$ 's	xenon skin	Internal	N
AmLi	( $\alpha, n$ )	NR band	CSD	Y
$^{252}\text{Cf}$	spontaneous fission	NR efficiency	CSD	N
$^{57}\text{Co}$	122 keV $\gamma$	Xe skin threshold	CSD	N
$^{228}\text{Th}$	2.615 MeV $\gamma$ , various others	OD energy scale	CSD	N
$^{22}\text{Na}$	back-to-back 511 keV $\gamma$ 's	TPC and OD sync	CSD	N
$^{88}\text{Y}$ Be	152 keV neutron	low-energy NR response	External	N
$^{205}\text{Bi}$ Be	88.5 keV neutron	low-energy NR response	External	Y
$^{206}\text{Bi}$ Be	47 keV neutron	low-energy NR response	External	Y
DD	2,450 keV neutron	NR light and charge yields	External	N
DD	272 keV neutron	NR light and charge yields	External	Y
$^{133}\text{Ba}$	356 keV gamma	OD and TPC	CSD	N
$^{60}\text{Co}$	1173, 1333 keV gamma	OD, TPC energy scale	CSD	N
$^{124}\text{Sb}$	23 keV neutron	low-energy NR response	External	N

# Calibration results (Cf252)



# Calibration results (Cf252) Single Scatter and FV cuts



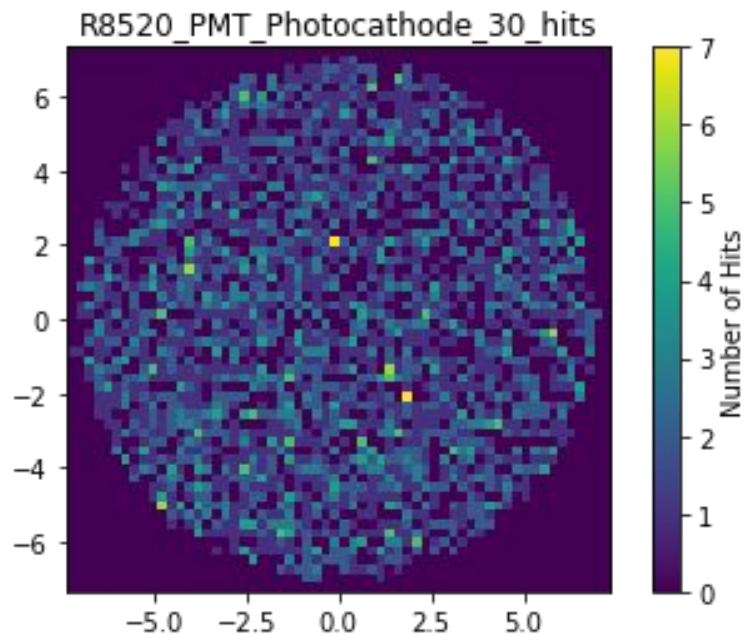
# Calibration results

- AmLi (AmBe)
  - Only AmBe working in BACCARAT
  - Results are similar to shown for  $^{252}\text{Cf}$
- $^{252}\text{Cf}$ 
  - Little impact of gamma-x at low energies
  - Potentially 1% gamma-x contribution at higher energies
- $^{228}\text{Th}$ 
  - Events seen are near the walls
  - None are gamma-x
  - Nice ER band S1/S2 spectrum
- $^{57}\text{Co}$ 
  - 2/2,000,000 events made it into the liquid
  - Neither of them were gamma-x

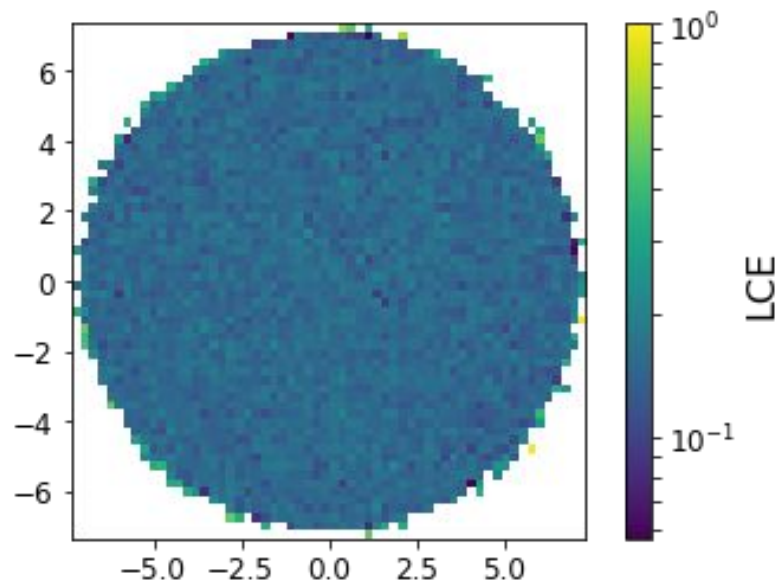
# Phase 1 optical maps

- Used the scripts from Amy to make maps of  $\sim 10$  million photons distributed in the liquid xenon for S1s and in the gas for S2s
- Implemented in BACCARAT
- Leaves LZ sims intact and unaffected
- Simply calls the phase 1 map instead if running phase 1 sims

# Phase 1 photon maps (S1)



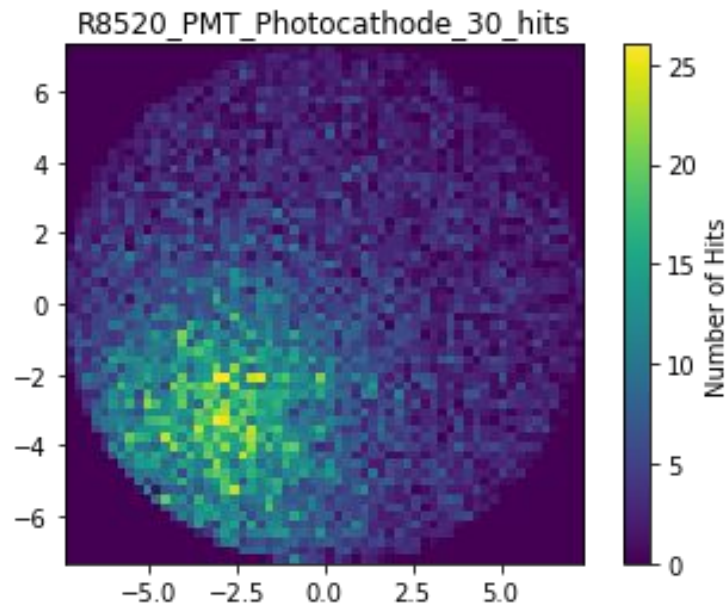
Example of a single PMT



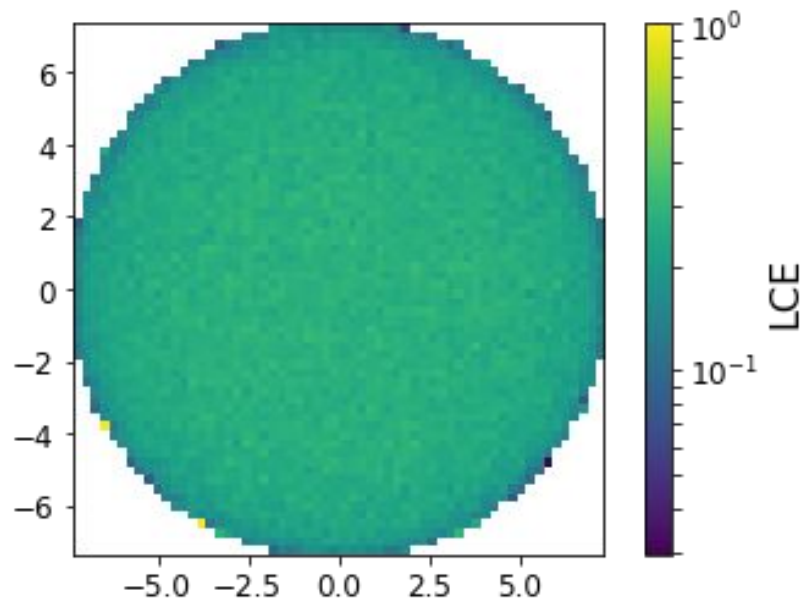
Combined light collection efficiency  
Avg: 14.8% With QE: ~4.4%



# Phase 1 photon maps (S2)



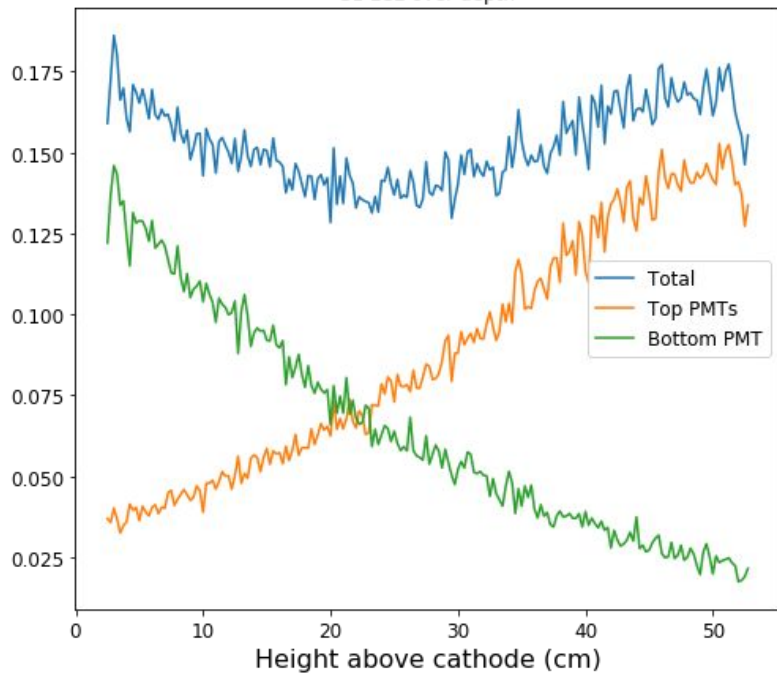
Example of a single PMT



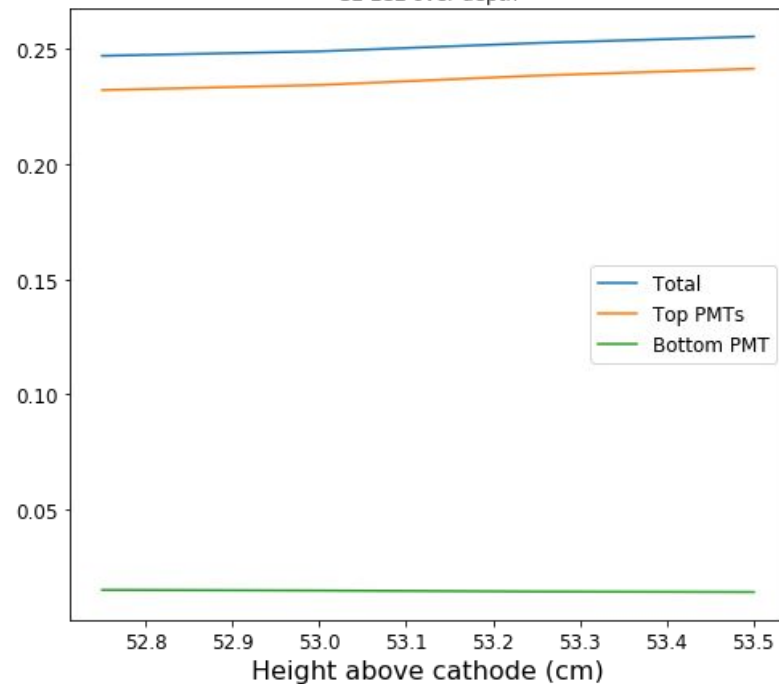
Combined light collection efficiency  
Avg: 24.7% With QE: ~7.4%

# LCE as a function of depth

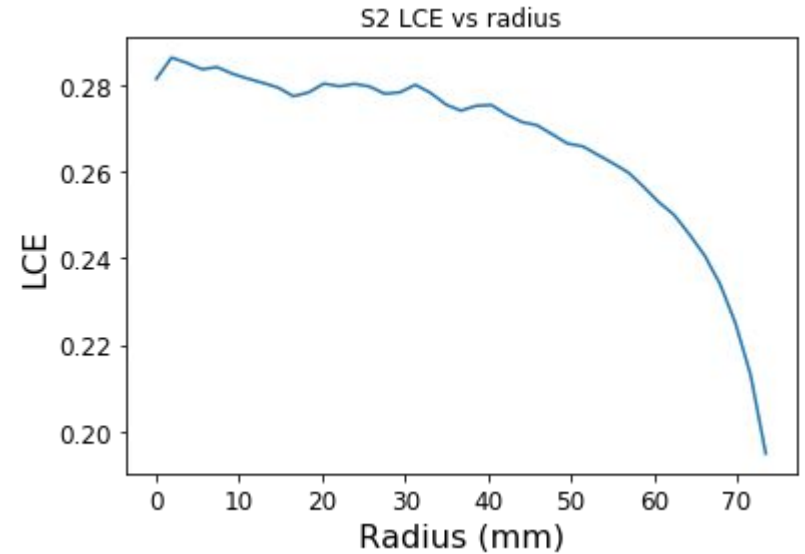
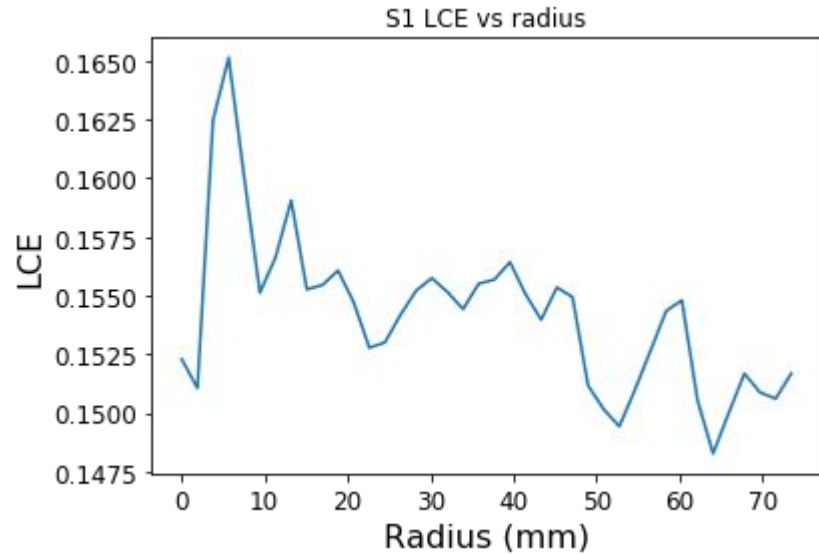
S1 LCE over depth



S2 LCE over depth



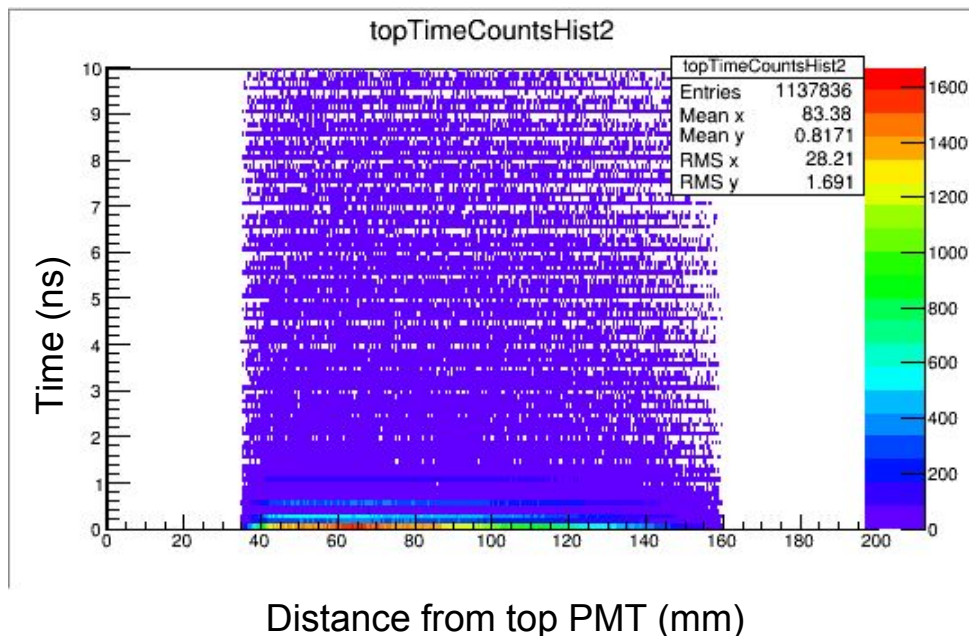
# LCE as a function of radius



# Time maps included

Time maps are needed by BaccMCTruth so needed to be simulated separately.

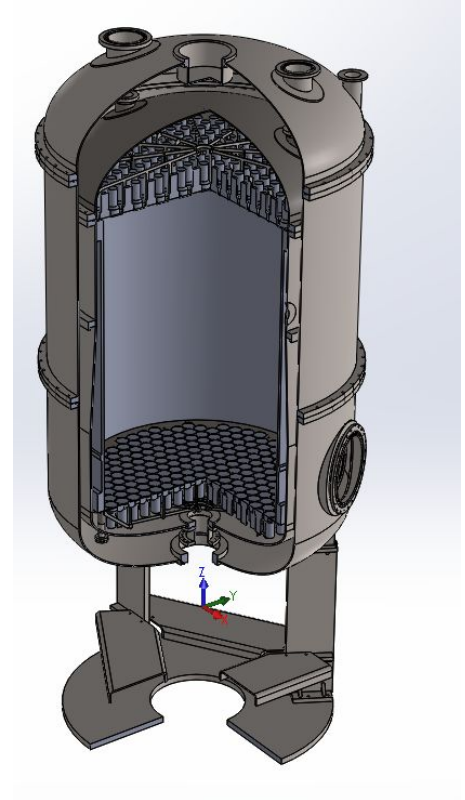
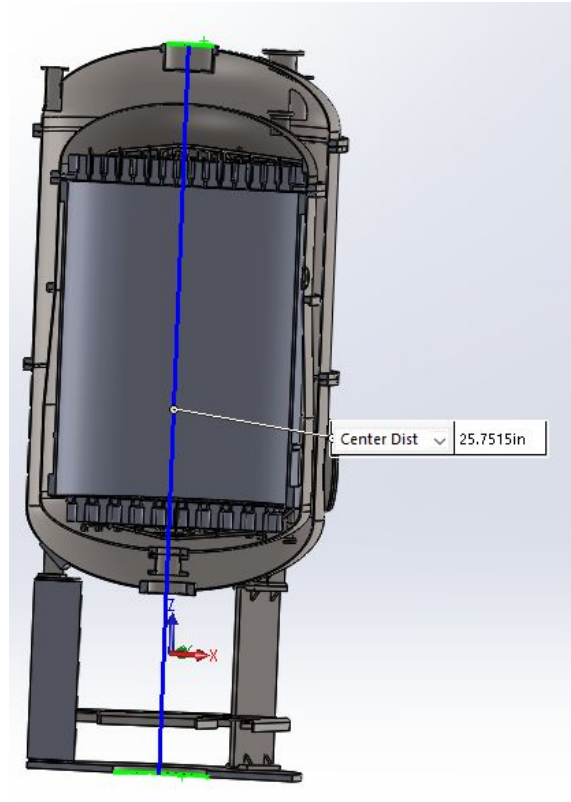
Shown here for S2 events.



# LZ Scale Model

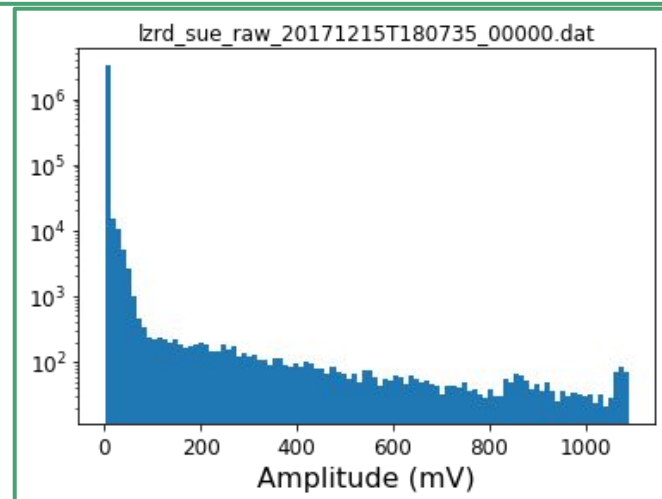
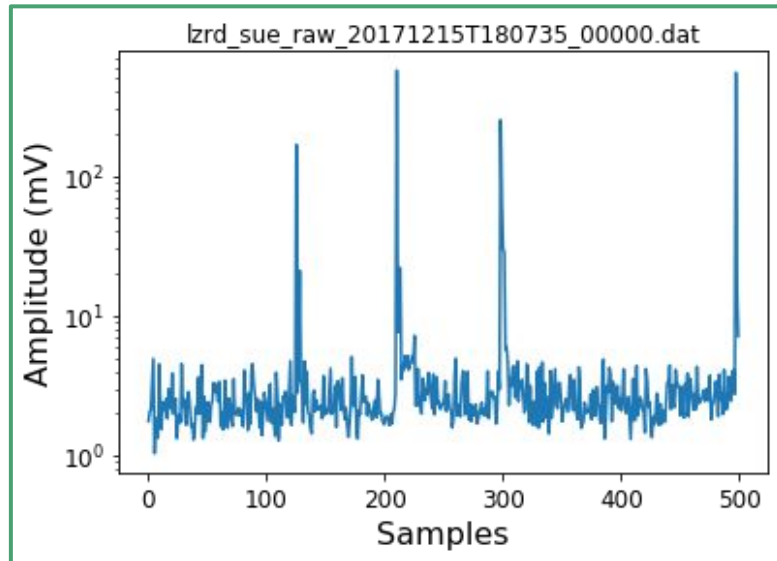
Ready to 3D printing  
modifications.

Need 3D printer specs to  
adjust minimum thicknesses,  
overdraft

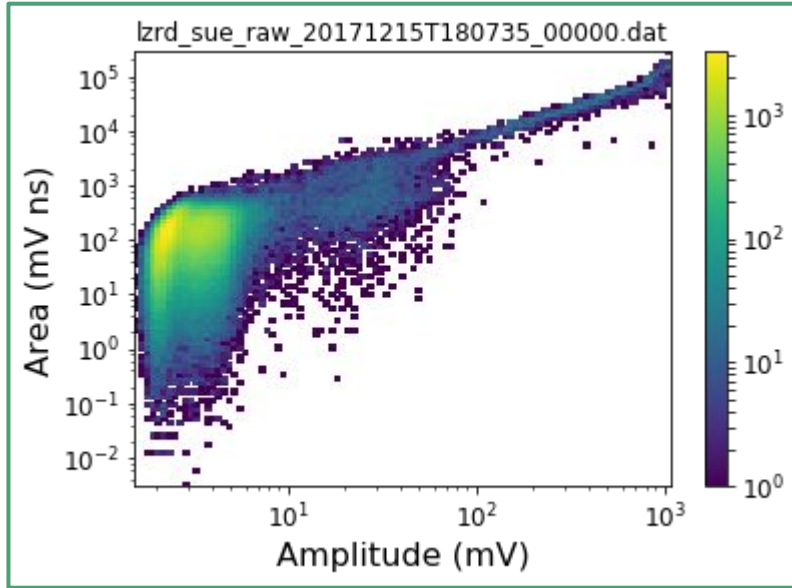


# Phase 1 Run 7 analysis

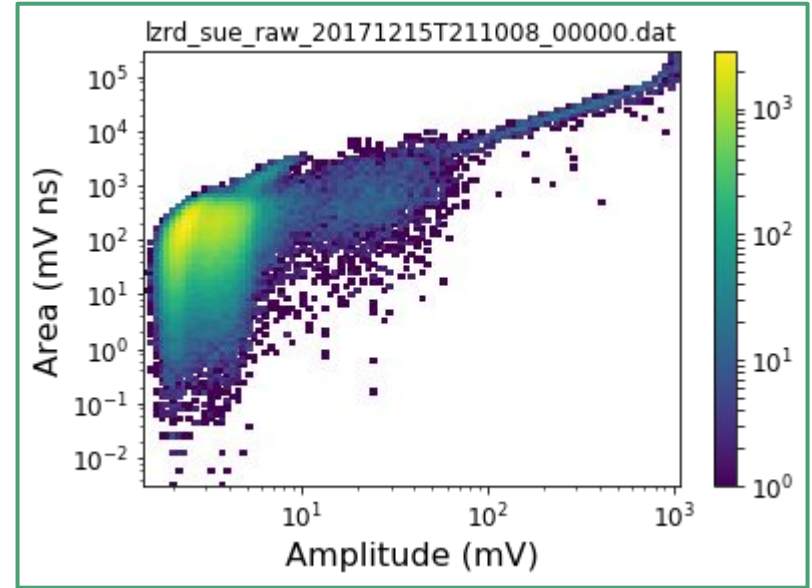
- Progress has been slow
- No quick way to transfer data between SLAC and Izlogin
- Have 8 data files from run 7
- Been looking at noise that occurred while the gas test was running
- Right shows the gas test off case



# Amplitude Area plot for the two cases



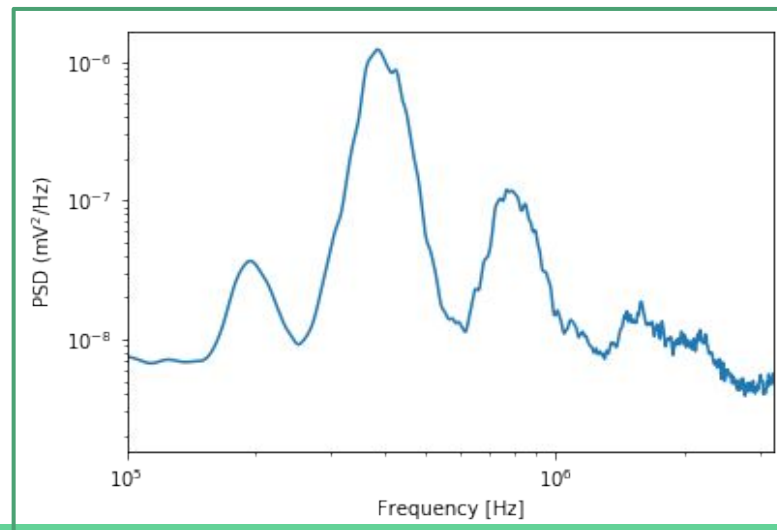
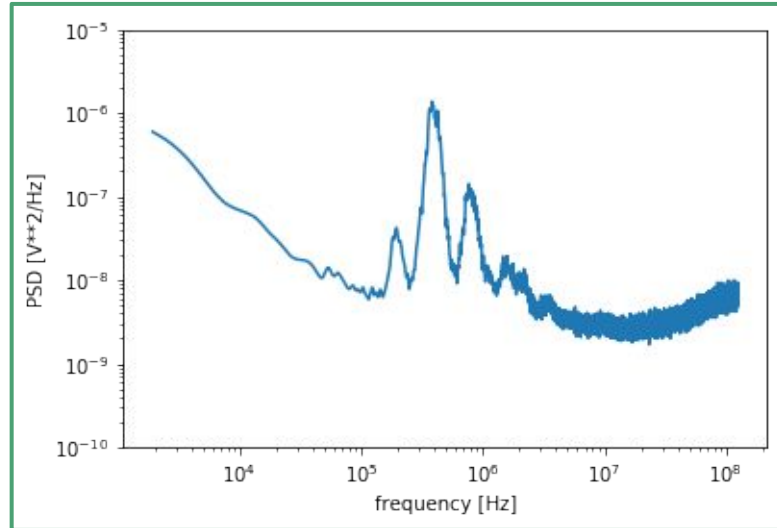
Gas test off



Gas test on

# Digitizer noise power

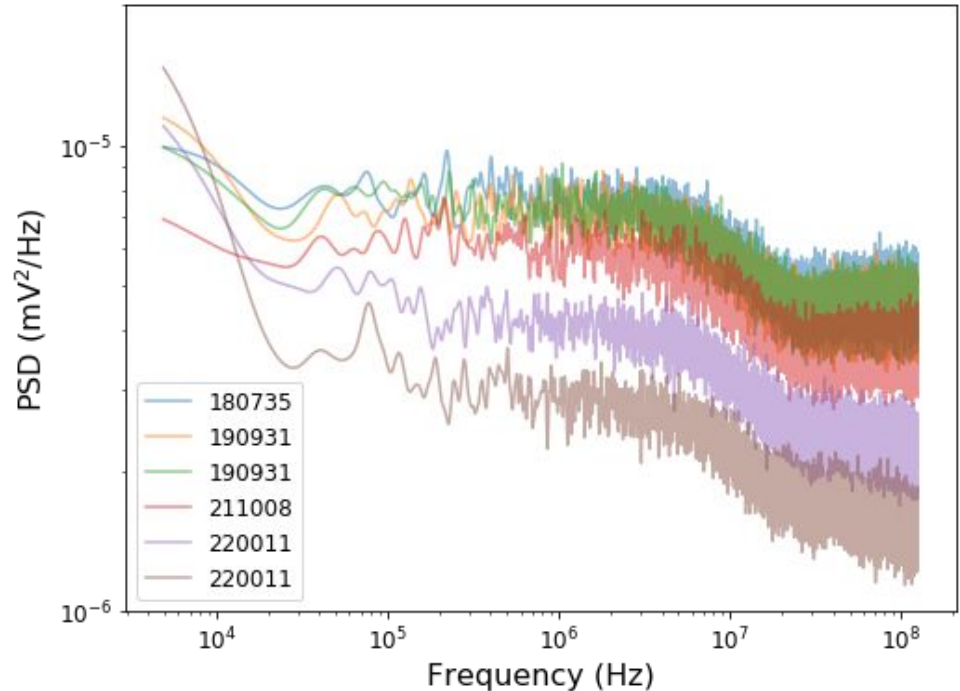
- All fields and PMTs were off
- Only digitizer noise
- See peak at 372 kHz
- Assuming that the data was collected at 250 MHz





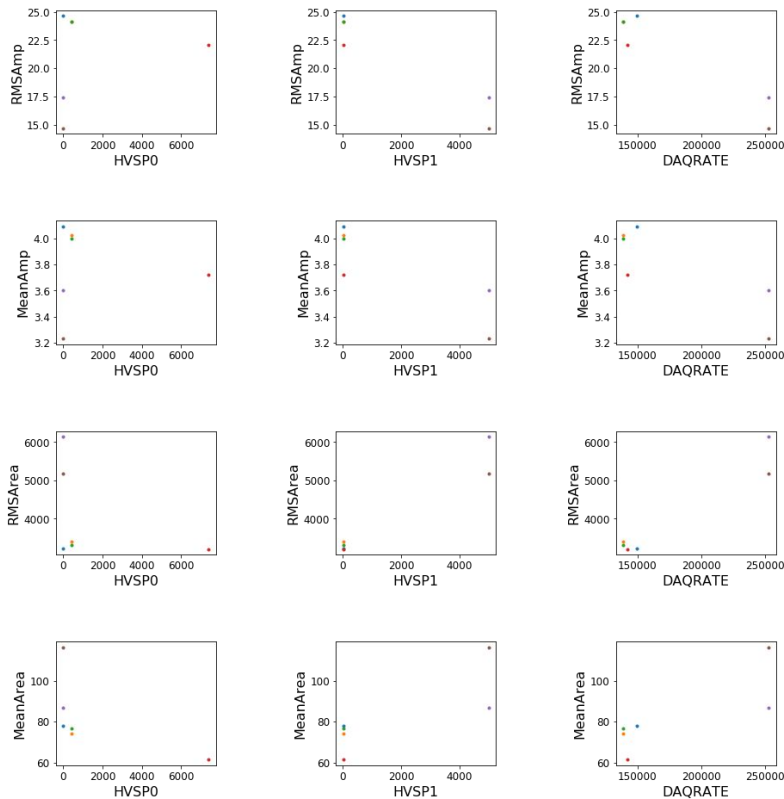
# Noise Power at different gas test voltages

- Don't see a significant difference between gas test on and off
- Blue, orange and green are all the same voltage in Phase 1 with different voltages in gas test



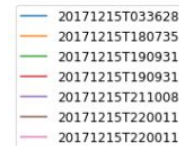
# Quantities vs. Field values

- Plots of RMS amplitude and area, and Mean amplitude and area versus power supply voltage for different channels
- Don't see a strong correlation between gas test voltage and RMS and Mean signals



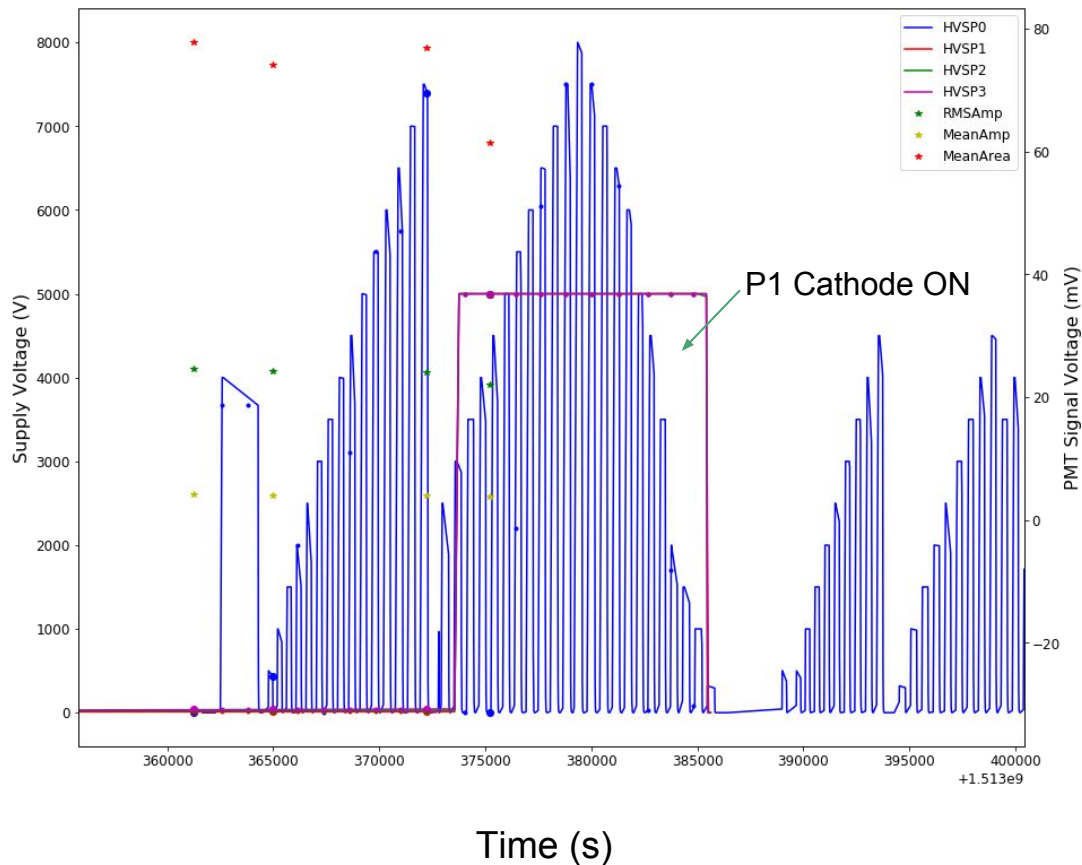
Gas test voltage

P1 Cathode Voltage



# Signals over time

- Stars indicate PMT signal mean and rms values
- Blue line is gas test supply voltage
- Purple line is Phase 1 supply voltage



# 100 T sensitivity projections

- Plan to put spectra into NEST with LUX data
- Want to focus on major contributors to the background
  - Radon
  - Neutrinos
- These are 75% of LZ backgrounds
- Plan to take NEST output and feed into PLR

