Recent Updates (Gamma-X, SLAC work, MDC, etc.)

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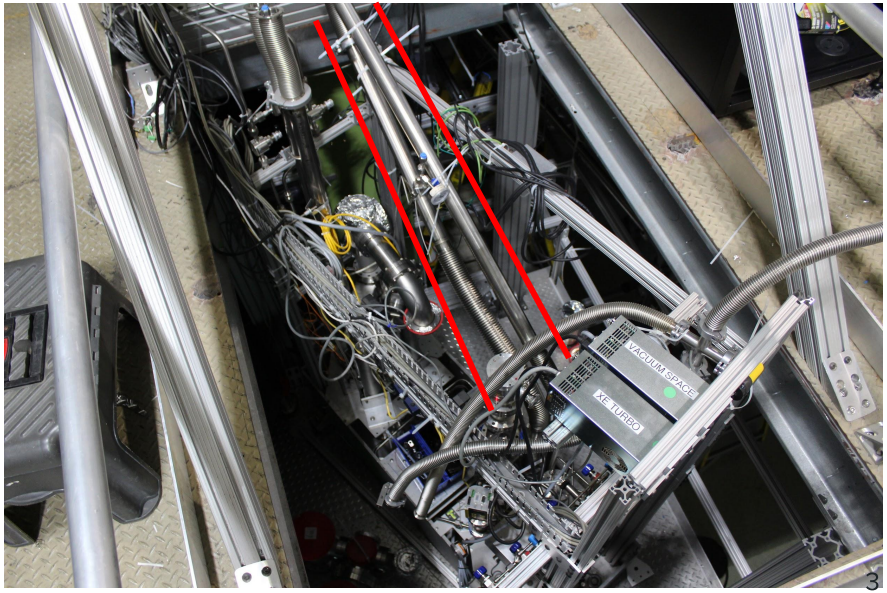
Todays update starts on slide 14

Summer in review

- “Finished” Gamma-X studies
  - More on this next
- Built Gas test and Phase 2 clean rooms
  - Gas test clean hood is currently in use
  - Phase 2 clean room is assembled but not cleaned
- Participated in MDC1
  - Calculated the electron lifetime for 30 days of simulated data which will hopefully look similar to real LZ data
  -

Thermosyphon lines

Replaced thermosyphon lines (marked in red) to make room for new Phase 1 breakout



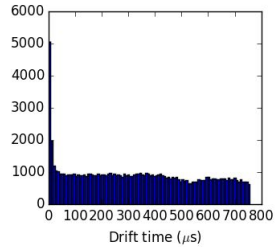
Clean rooms

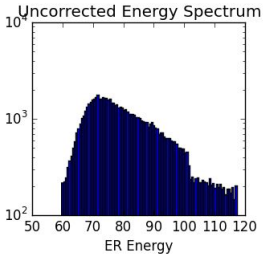
Gas test hood

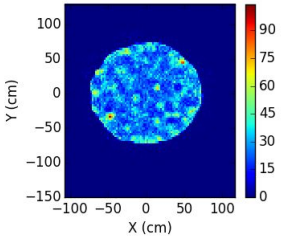
Phase 2 cleanroom

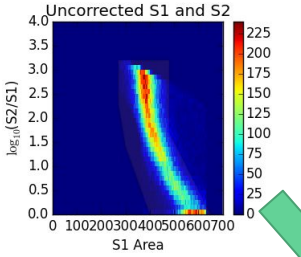
MDC 1

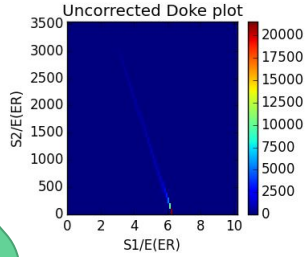
Day 1

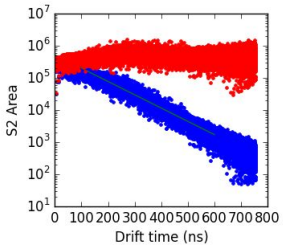


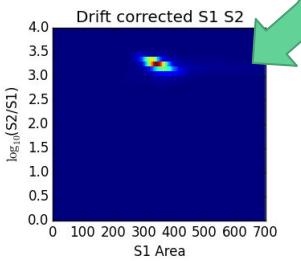


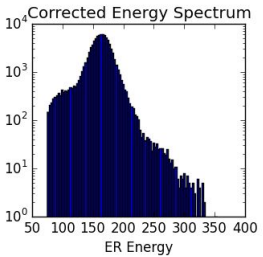




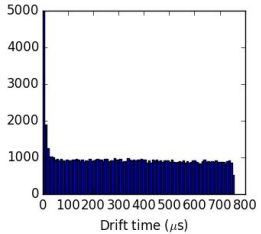


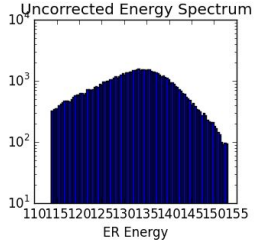


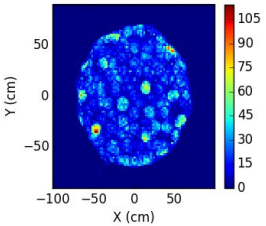


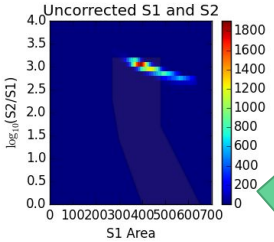


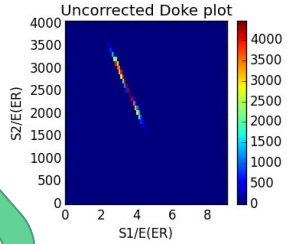
Day 30

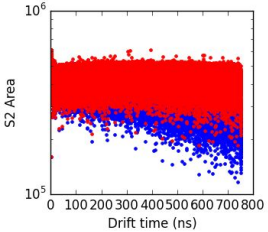


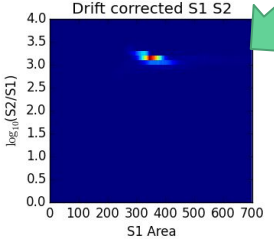


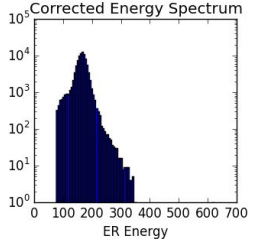




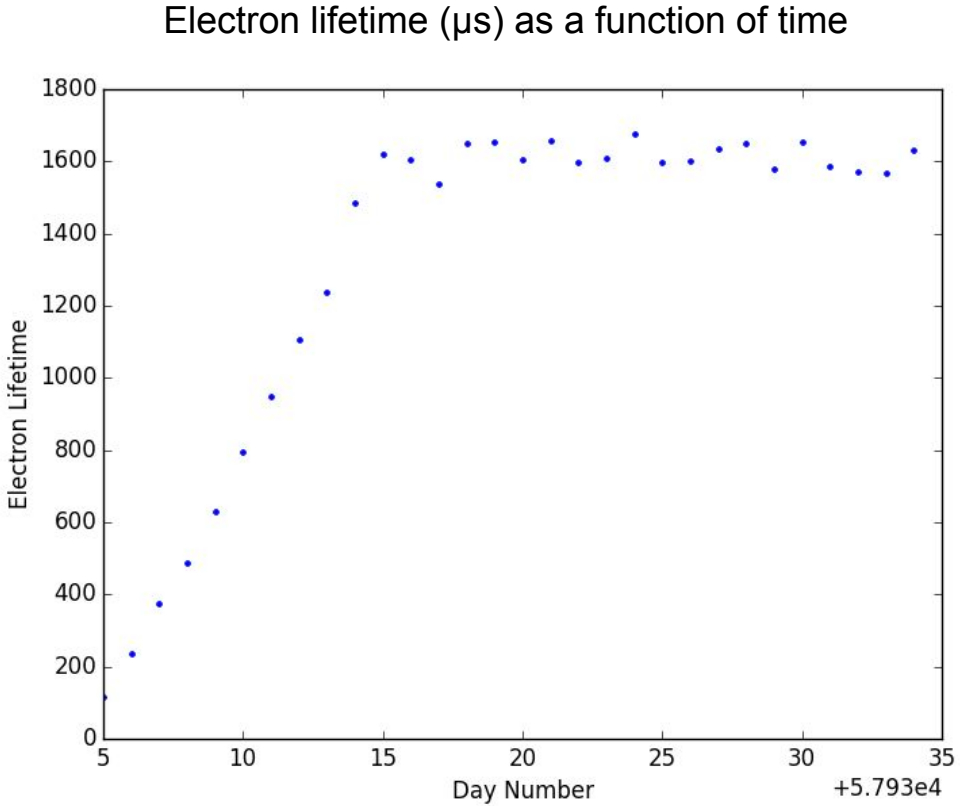








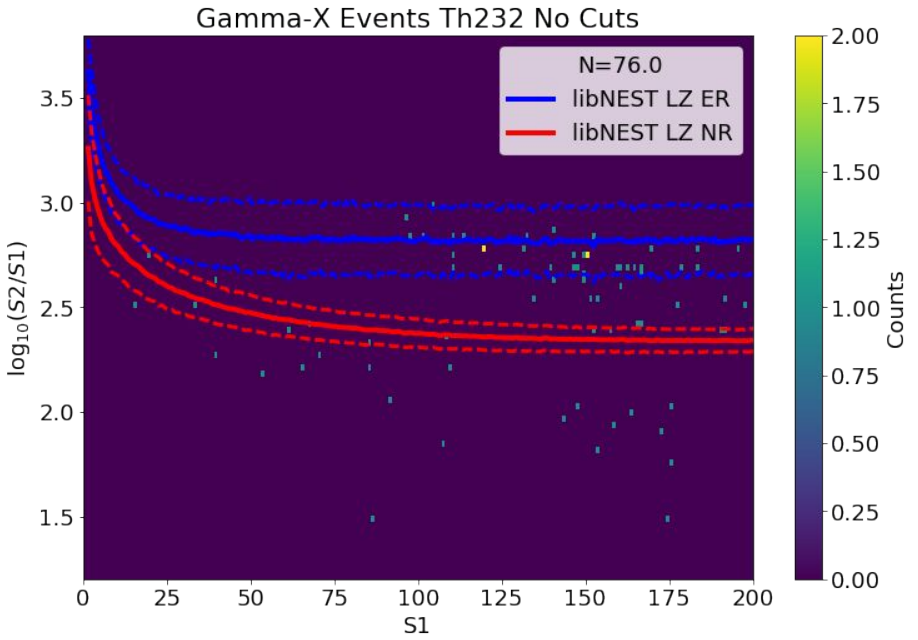
MDC 1 Electron Lifetime



Gamma-X

Wrote code to calculate the expected rate of Gamma-X events from the PMT windows.

Produced plots like the one on the right which show a large number of events in the WIMP search region (the left side of the red region)



Previous Gamma-X Results

Higher than all combined LZ backgrounds

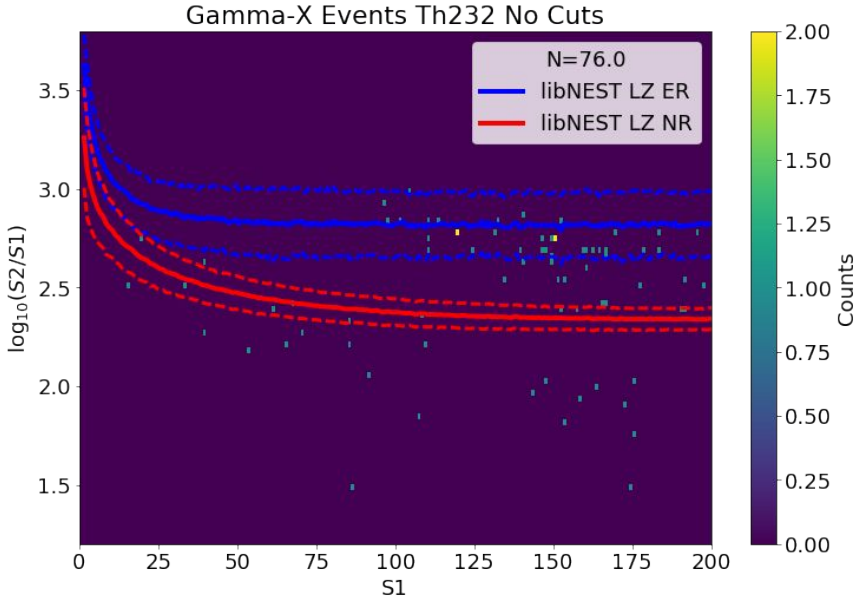
Source	Decays Simulated	Fraction which produce Gamma-X (all)	Fraction in WIMP search region (Depending on S1 S2 cut)	Approximate rate (assuming production from PMT windows and **no cuts**)
Th-232	14,900,000	0.012887 192507 Events	~ 4.0×10^{-7}	0.24 events per year
U-238	4,150,000	0.013739 57094 Events	~1.2×10^{-6}	3.83 events per year
Co-60	9,800,000	0.080683 790704 Events	~4.0×10^{-7}	0 (No Co60 in PMT windows)
K-40	9,400,000	0.004208 39559 Events	< 1.0×10^{-7}	< 0.13 events per year

Comparing Apples to Apples

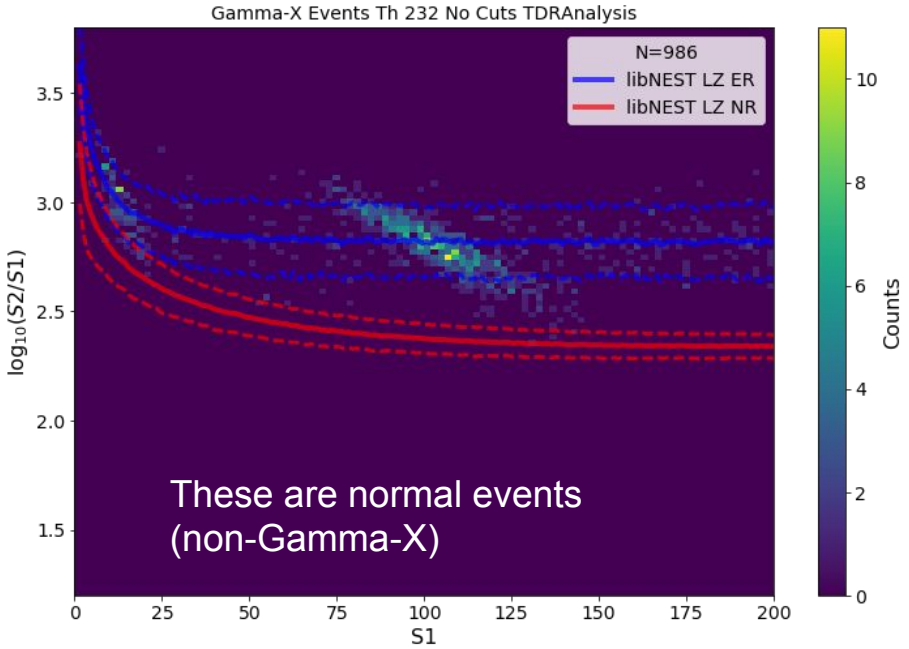
All of the LZ backgrounds are summarized in the backgrounds control table which follows a very specific procedure to generate background rates.
I was doing something similar but not exactly the same.
To see how well my rates compare with the total rates I modified the control table to work with gamma-x events.

Source	Mass (g/unit)	Mass (g)	Activity (mBq/kg)	Livetime equivalent	# beamOn	# beamOn E-scaled	# Surv. All	R-factor	Surviving 1000 days	Events Per year
U early (γ)	38.0	9158	13.21	1.39E+01	1.00E+07	1.45E+08	17.00	1.68E-08	1.75E-01	6.41E-02
U late (γ)	38.0	9158	0.75	2.43E+02	1.00E+07	1.45E+08	17.00	1.17E-07	6.98E-02	2.55E-02
Th (γ)	38.0	9158	1.01	1.85E+02	1.02E+07	1.48E+08	36.00	2.43E-07	1.94E-01	7.09E-02

Gamma-X Plots With New TDRAnalysis Method

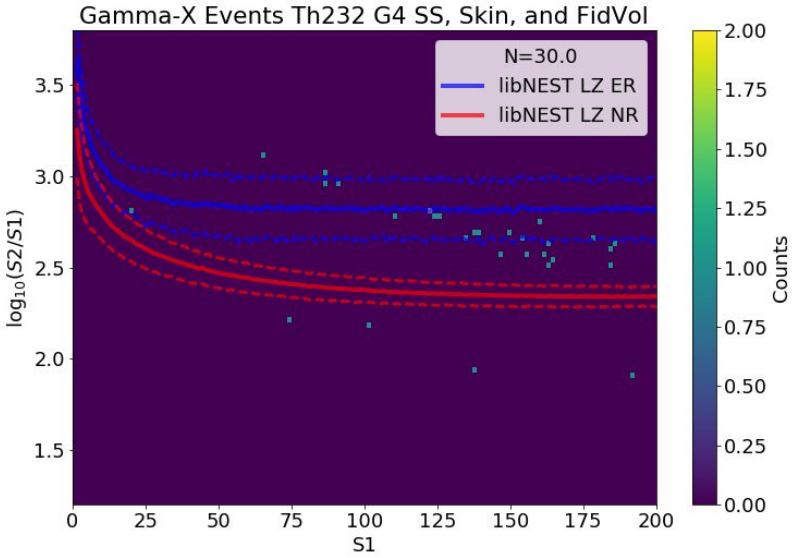


Old Method

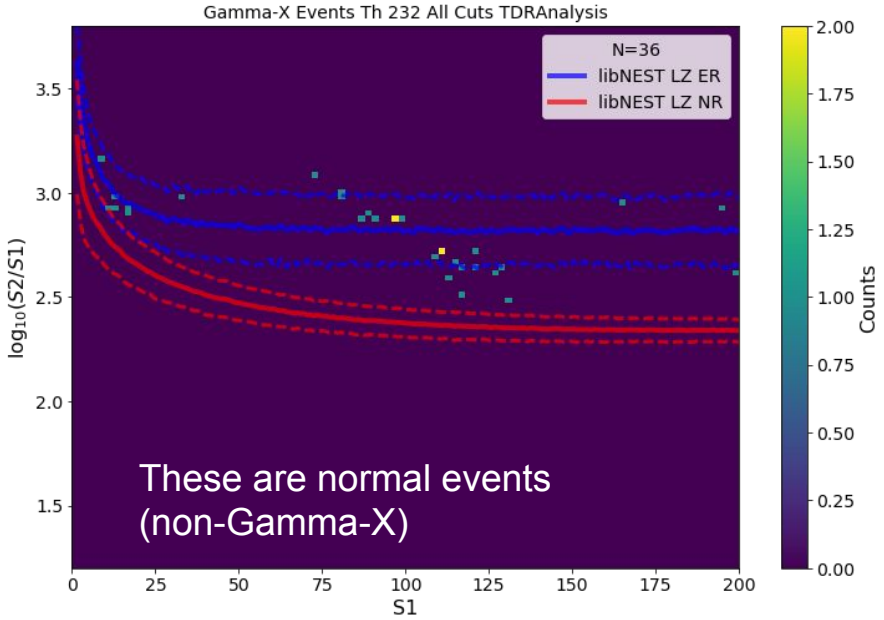


New Method

Gamma-X Plots With New TDRAnalysis Method W/ Cuts



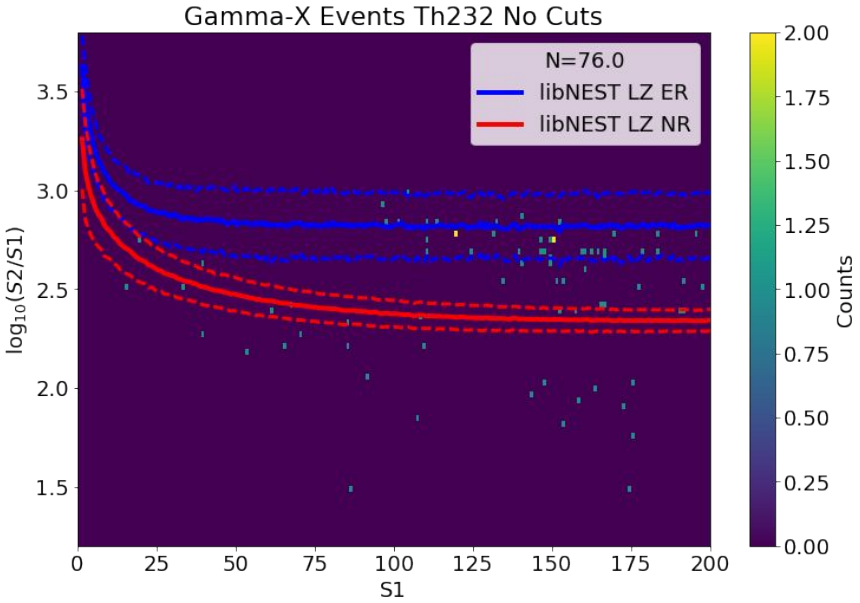
Old Method



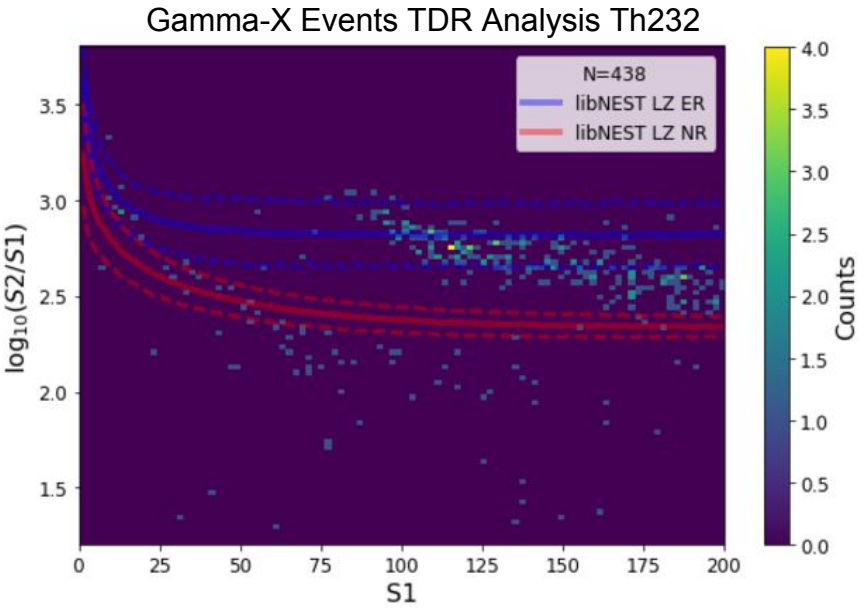
New Method

Latest Gamma-X Update

- Plots shown last week were only “normal” events



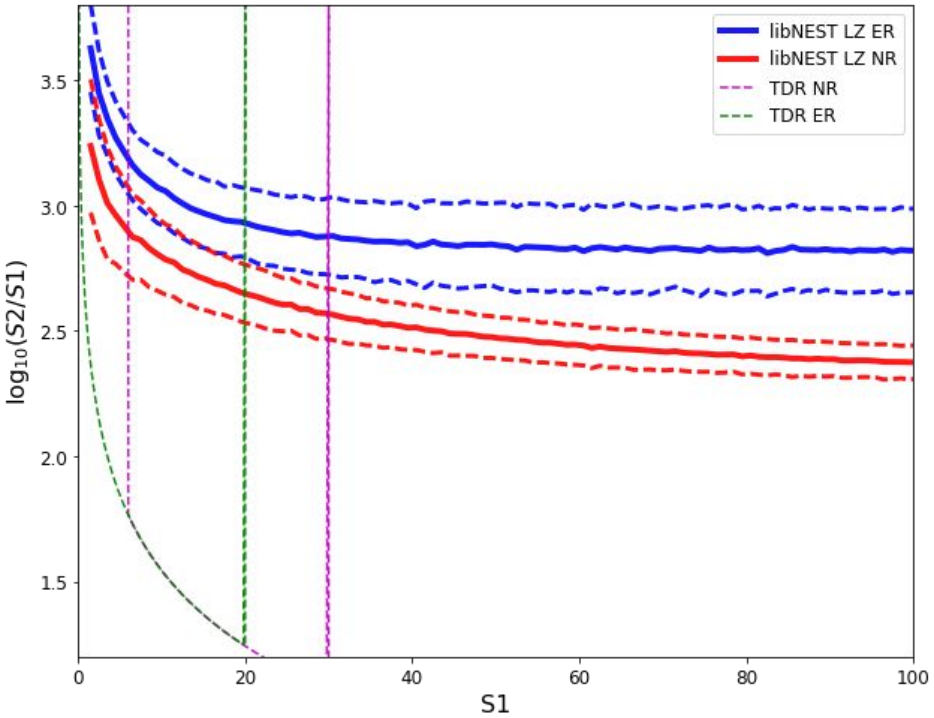
Old Method



New Method

TDR vs. My Cuts

- The TDR Analysis assumes that when ER events are produced that only ER events are seen. With that assumption it can make a more rough cut on S1 and S2. This only works for normal events, but not Gamma-X events.
- I will use all 4 cuts to be able to compare my rate to the TDR as well as provide a more accurate estimate of the rate



Fall 2017 Plan

- Gamma-X
  - Continue to improve and compare the Gamma-X result with those of others
  - Look for Gamma-X events in the MDC 1 data then see if there is some way to discriminate against them.
- Cable making
  - Will soon begin clearing out the server room
- Phase 1 Data Analysis
  - Assist with the Phase 1 analysis in run 7
- Cameras
  - Possibly work on cameras that would be able to run in cold gas or liquid xenon. These would likely need to be different than those used in Phase 2.