Radioactive Source Update

Juergen Reichenbacher, Jason Stock, James Haiston
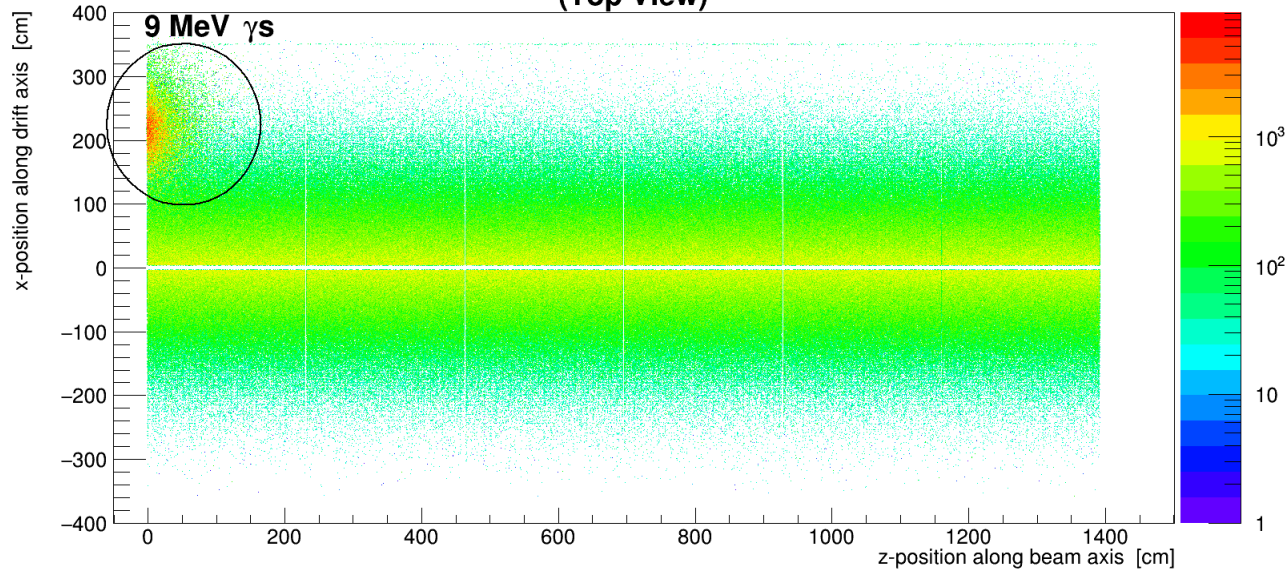
DEEP UNDERGROUND NEUTRINO EXPERIMENT

DUNE Calibration Consortium

Meeting

Apr 5, 2019

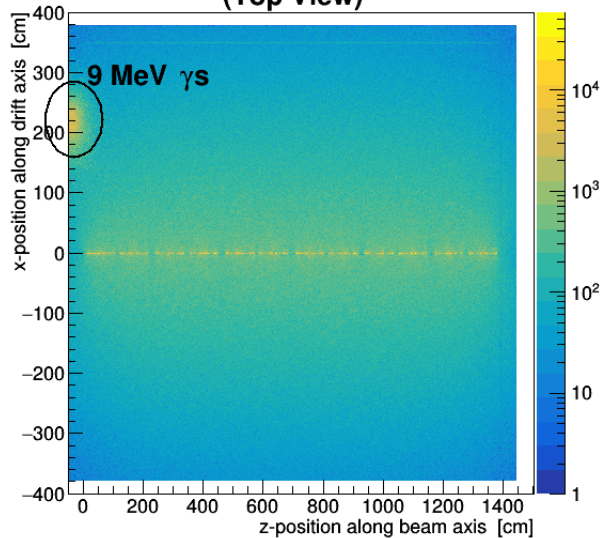# *Issues for Light Simulation in new LArSoft versions*

- New light simulation scheme in LArSoft since Mar 15, 2019 (v08_13_01)
  in which maps are substituted by new analytical method
  and Arapucas with order of magnitude higher LY are implemented
  (full FD possible soon? -> Good for neutron BGs)

- "Virtual" radioactive source deployment already found problems
  in PD simulation and the involved recent LArSoft changes

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PhotoElectrons vs ADCU collected per Eve.

9 MeV γs

pes detected from outside field cage
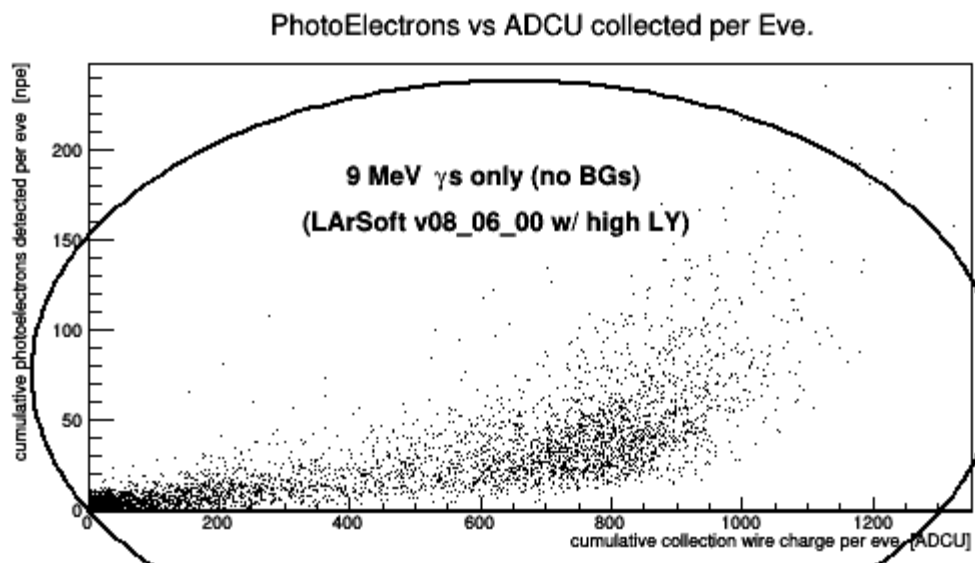
PhotoElectrons vs ADCU collected per Eve.

9 MeV γs only (no BGs)
(LArSoft v08_06_00 w/ high LY)

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ADCU Seen by ZX Particle Positions
(Top View)

9 MeV γs

ADCU Seen by ZX Particle Positions with cut on partials at 90.0 ADCU
(Top View)

9 MeV γs (after cuts)
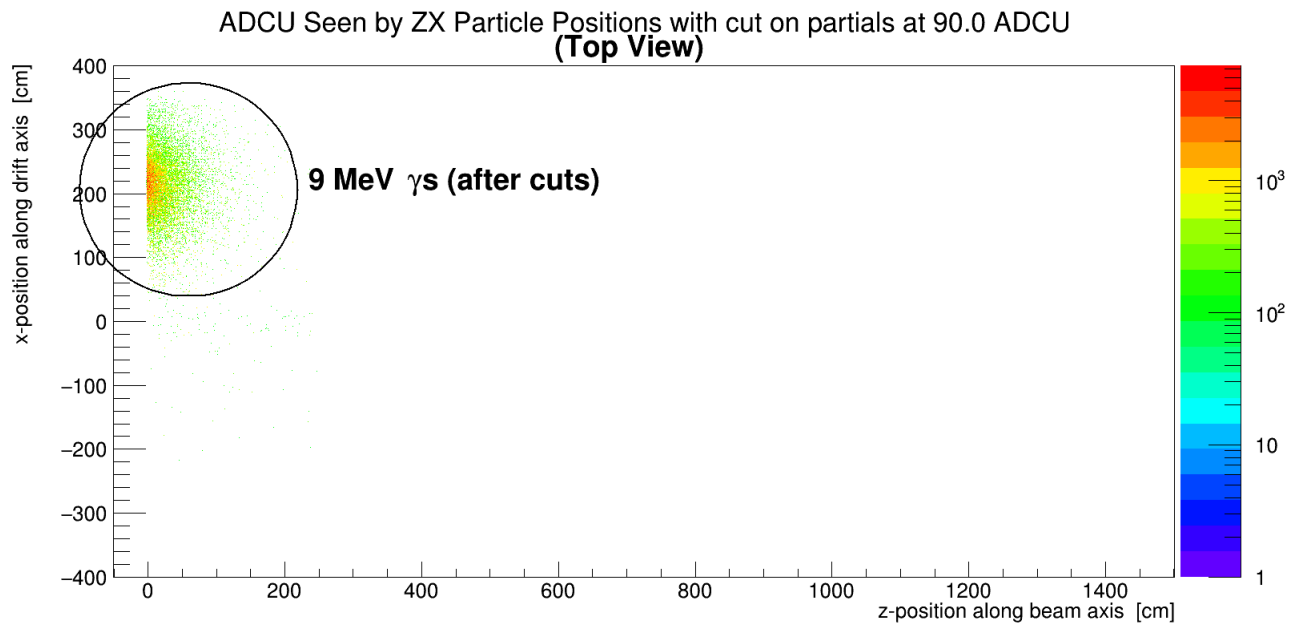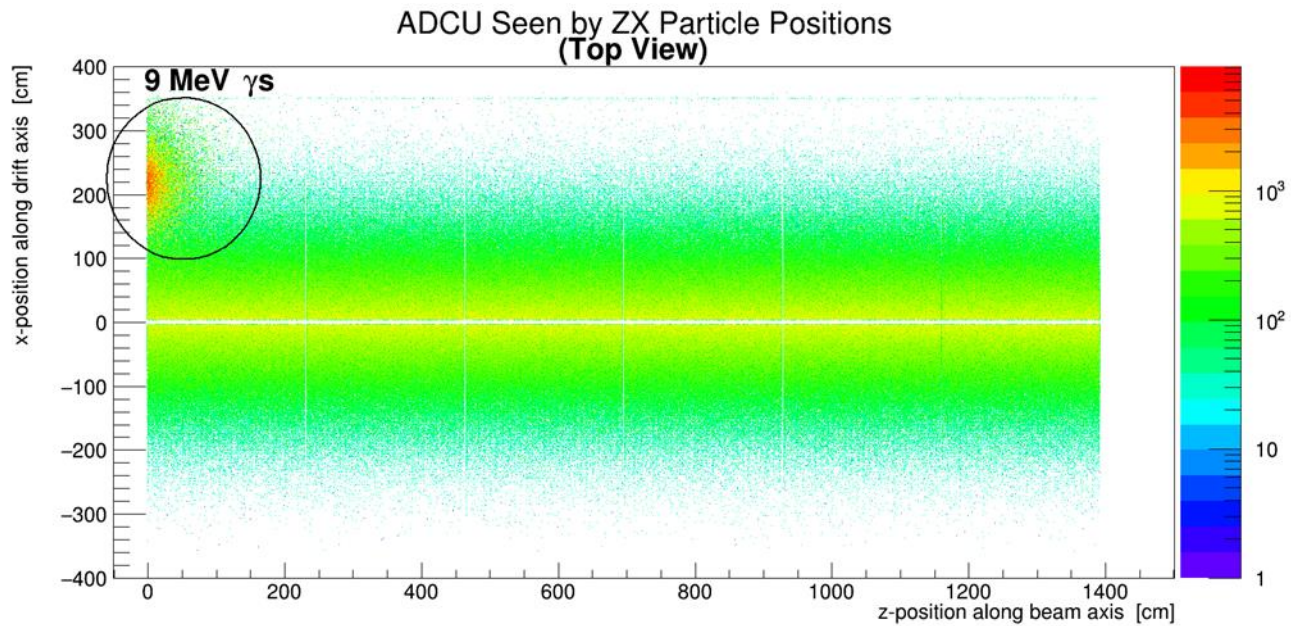
PEs Seen by ZX Particle Positions (Top View)
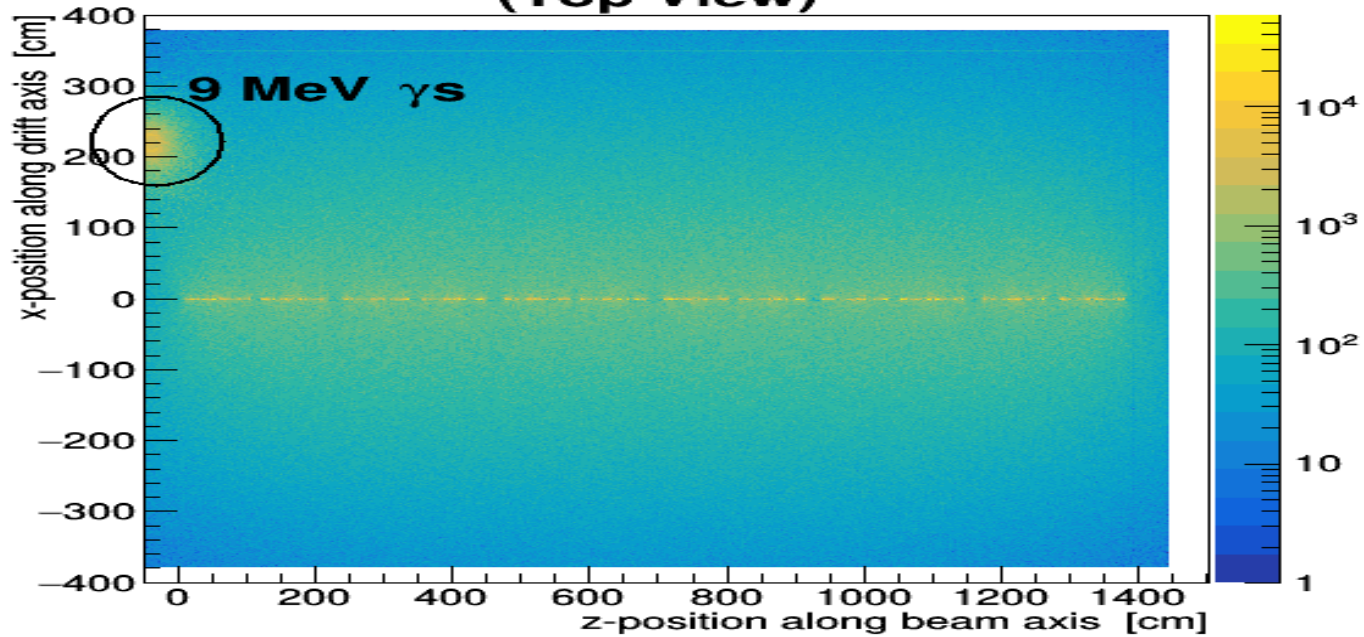
PEs Seen by YX Particle Positions with npe cut

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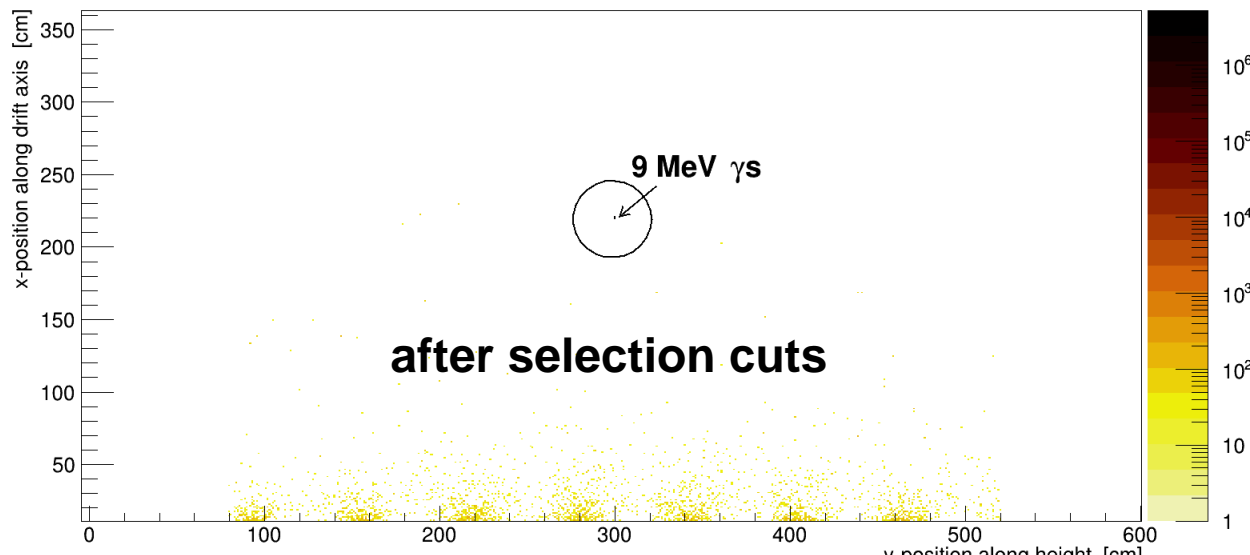
partial hit time distribution [μs]
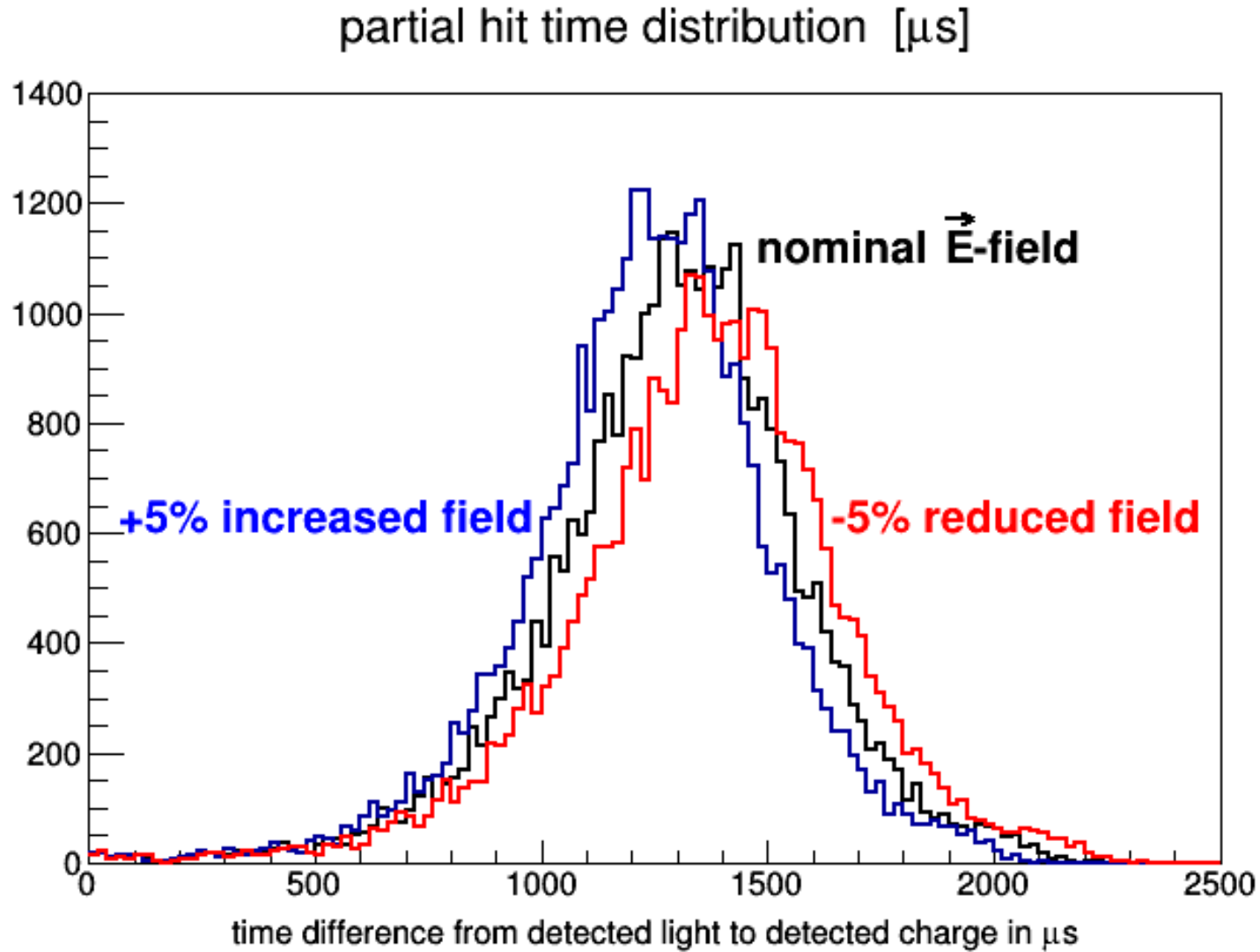
-> Can measure E-field unambiguously at 1% level

partial hit time distribution [μs]

Plot showing partial hit time distribution. Curves labeled: **3.5 ms e⁻ lifetime** (blue), **nominal e⁻ lifetime of 3 ms** (black), **2.5 ms e⁻ lifetime** (red). X-axis: time difference from detected light to detected charge in μs. Y-axis ranges from 0 to 1400.
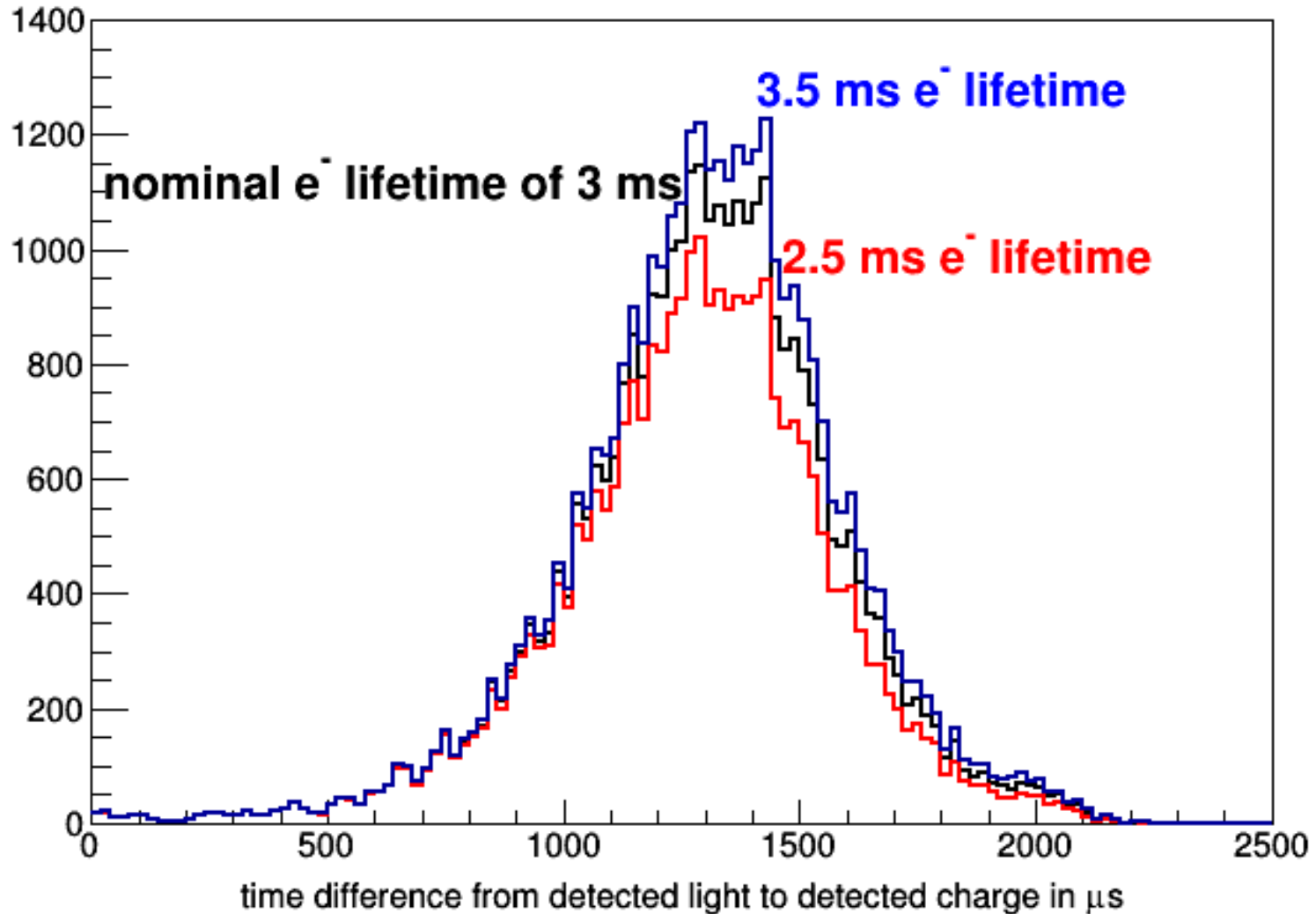
-> works for electron lifetime too

Histogram of Eve Charge collected with partial cut at 90.0 ADC for τ=3.5ms

(all after cuts)

$\vec{E}$ **-5%** $\vec{E}$ **+5%**

τ **= 2.5 ms** τ **= 3.5 ms**

cumulative per eve detected charge on collection wires [ADCU]
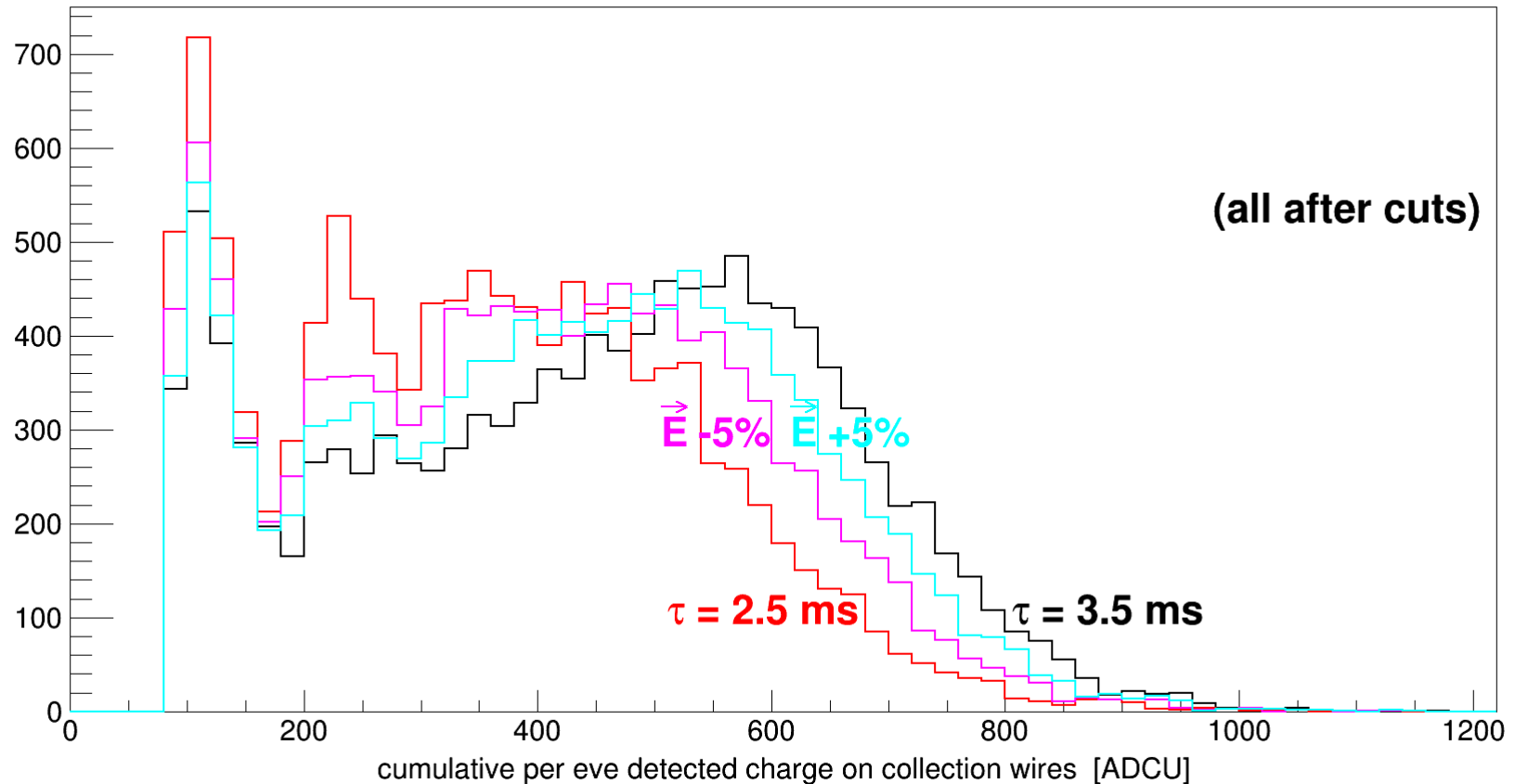
**-> Can measure electron lifetime unambiguously at 1% level
after knowing E-field at 1% level from hit time distribution**

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flat_event_records.ophit_opchan

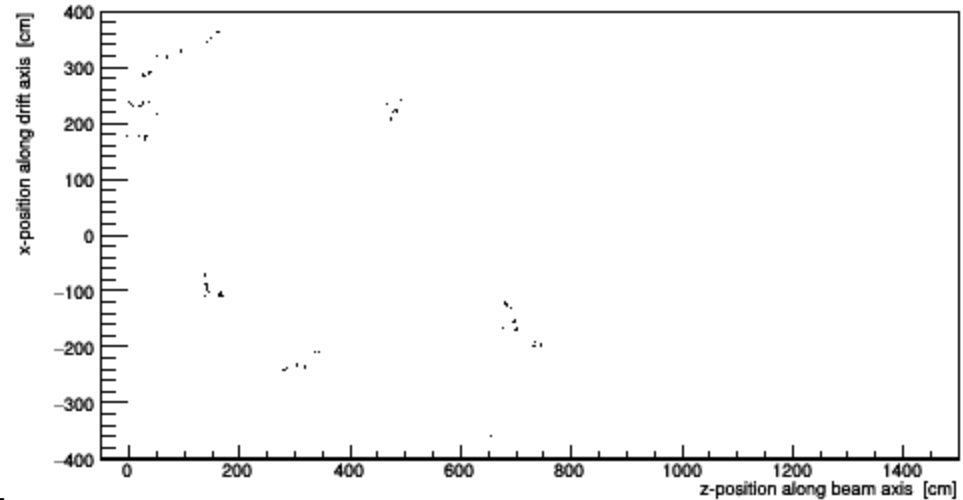| htemp	
Entries	1118014
Mean	224.7
RMS	139.3

9 MeV γs
at x=220 cm, y=300 cm, z=-40 cm
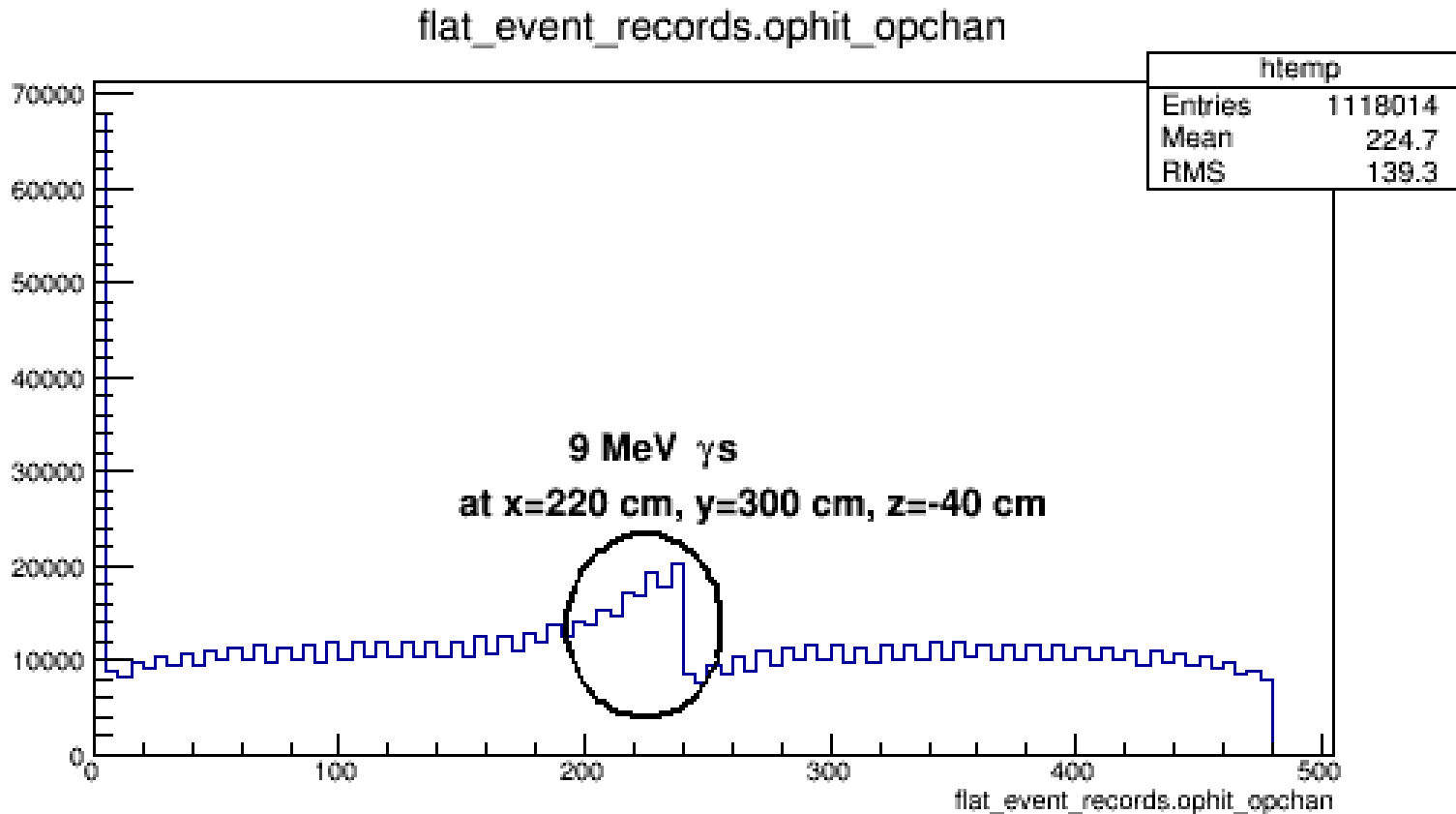
-> Simple test of Arapuca channel responses as we deploy along vertical height

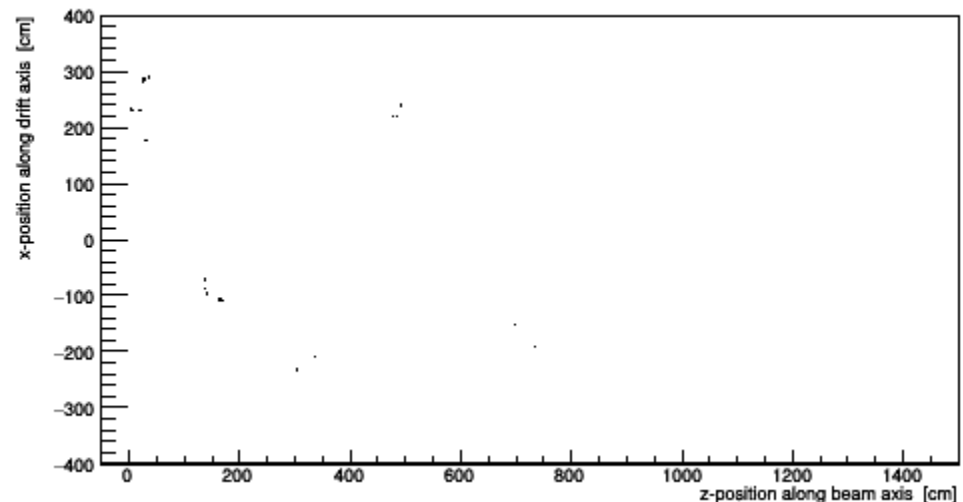# *Deploy Am-241 Source to Measure Response to 40Ar(alpha, gamma) Background*

10 – 15 MeV de-excitation gamma rays from 40Ar(alpha, gamma) happening in LArSoft at x=220 cm, y=300 cm, z=-40 cm

corresponding to a cross section of order of microbarns

PEs Seen by ZX Particle Positions

ADCU Seen by ZX Particle Positions

Results:

Juergen: 125 Hz (default simulation)

Guanying: 81 Hz (by construction)

Vitaly: 72 Hz (after scaling)

A. Borkum **(and Pierre Lasorak)**