

Status and Plans for Radioactive Source

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DUNE Calibration Consortium
Phone Meeting 15-Feb-2019

Radioactive Source Status/Plans 1 (Simulations)

- James Haiston performs LArSoft sims and beta-tests CalibrationTree (from Jason):
 - > consistency check by simulating the gamma-ray spill-in and a virtual “spill-out”
 - > crucial for trusting simulated gamma attenuation length (-> FTs location issue)
- James Haiston simulates deployment of a weak neutron source (in a small capsule)
 - > AmBe+Cf-252 emulating BGs response for “false” trigger efficiency

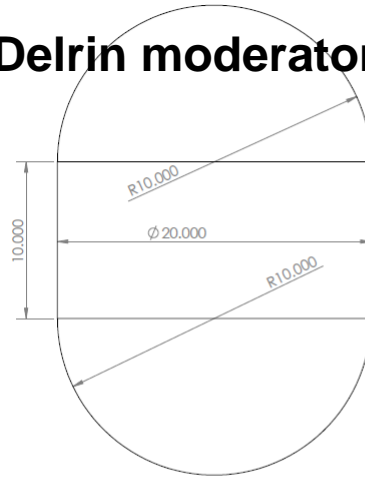
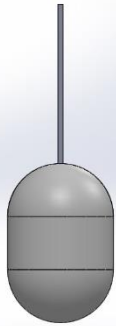
To be Done:

- Explore tolerable neutron level spilling in from gamma source using simulations
 - > will define minimum required radius of moderator (and its cylinder height)
- DAQ: explore APA cluster trigger (and the resulting trigger efficiency)
- Check out new optical light yield for combined PDS + APA signals giving T0 for low-E (-> probe a combined PDS+APA DAQ trigger efficiency for solar neutrinos)

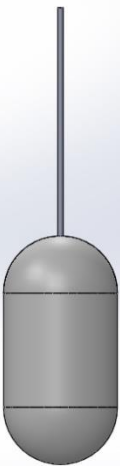
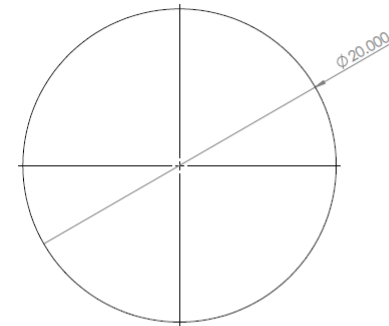
Radioactive Source Status/Plans 1 (Simulations)

- Explore tolerable neutron level spilling in from gamma source using simulations
- > will define minimum required radius of moderator (and its cylinder height)

our default Delrin moderator design



Note: All dimensions are in cm



Or does it need to be e.g. higher?

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Radioactive Source Status/Plans 2 (ProtoDUNE)

- Explore what we can learn from a potential ProtoDUNE SP deployment:
 - Full mechanical deployment to demonstrate technical feasibility and safety
 - Better use only dummy source for test deployment due to high cosmic BGs?
 - Externally placed strong neutron source (AmBe+Cf-252) emulating BGs response
 - Any other externally placed neutron source with customized neutron energy?

(fine-tune 'penetration depth' with moderator thickness,
demonstrate usefulness of such external and internal deployments for FD)

Radioactive Source Status/Plans 3 (Mechanics/Funds/FTEs)

- Mechanical Deployment System:
combine shipping of existing system with DC FD decommissioning (TBA),
plan refitting and mock-up at SDSMT in high bay area
- Start planning Cf-252, nickel and Delrin moderator procurement for prototyping
- Pursue funding opportunities for prototyping
- Seek other collaborators (if interested shoot me email, please!)
- Start regular working group meetings

The DUNE CalibrationTree

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Abstract

Charge and Light are handled in separate simulation paths in **dunetpc/LArSoft**. As a result of these chains, and the shortcuts used to simulate light efficiently, it becomes extremely difficult to disambiguate truth in large events. This is especially problematic for low energy physics events simulated with the full radiological background, where there is simply too much information in the readout for the user to easily disambiguate it themselves. With our groups recent updates to the **PhotonBackTracker**, combined with the addition of the **ParticleInventory** and earlier update of the **BackTracker**, a simple path appears to do charge and light matching to MCTruth.

Perform consistency checks before official release

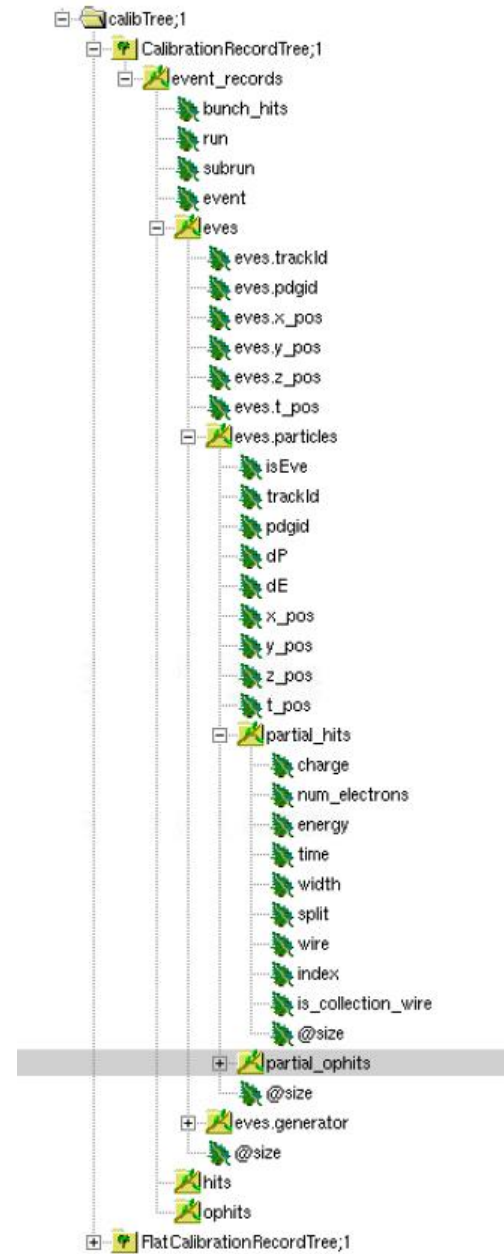
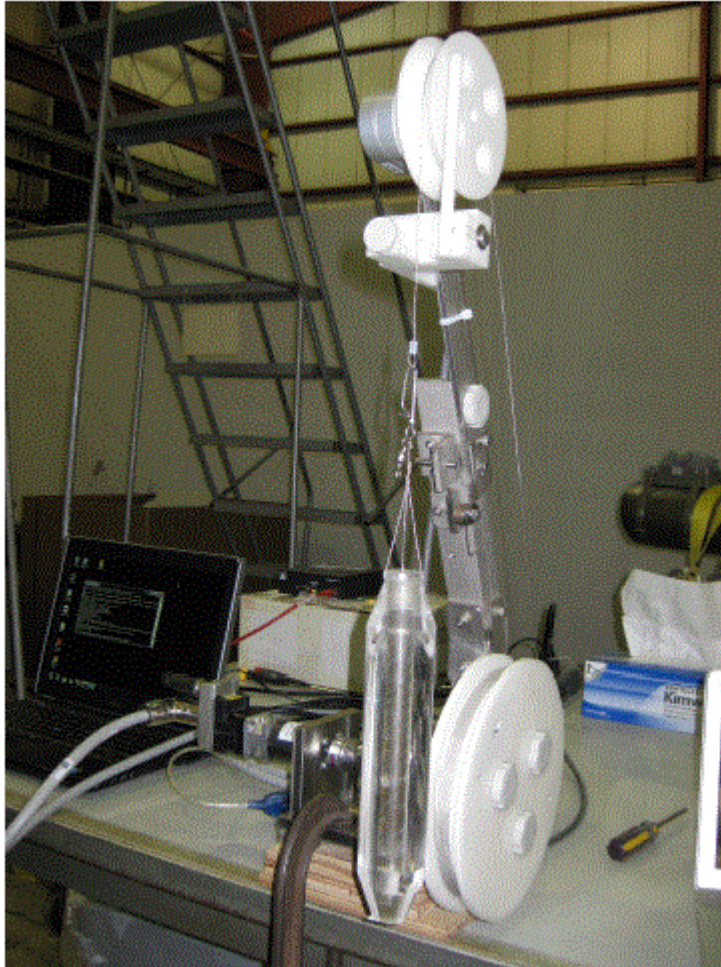


Figure 3: The structure of the CalibrationTree.

Double Chooz System Decommissioning and DUNE Refitting



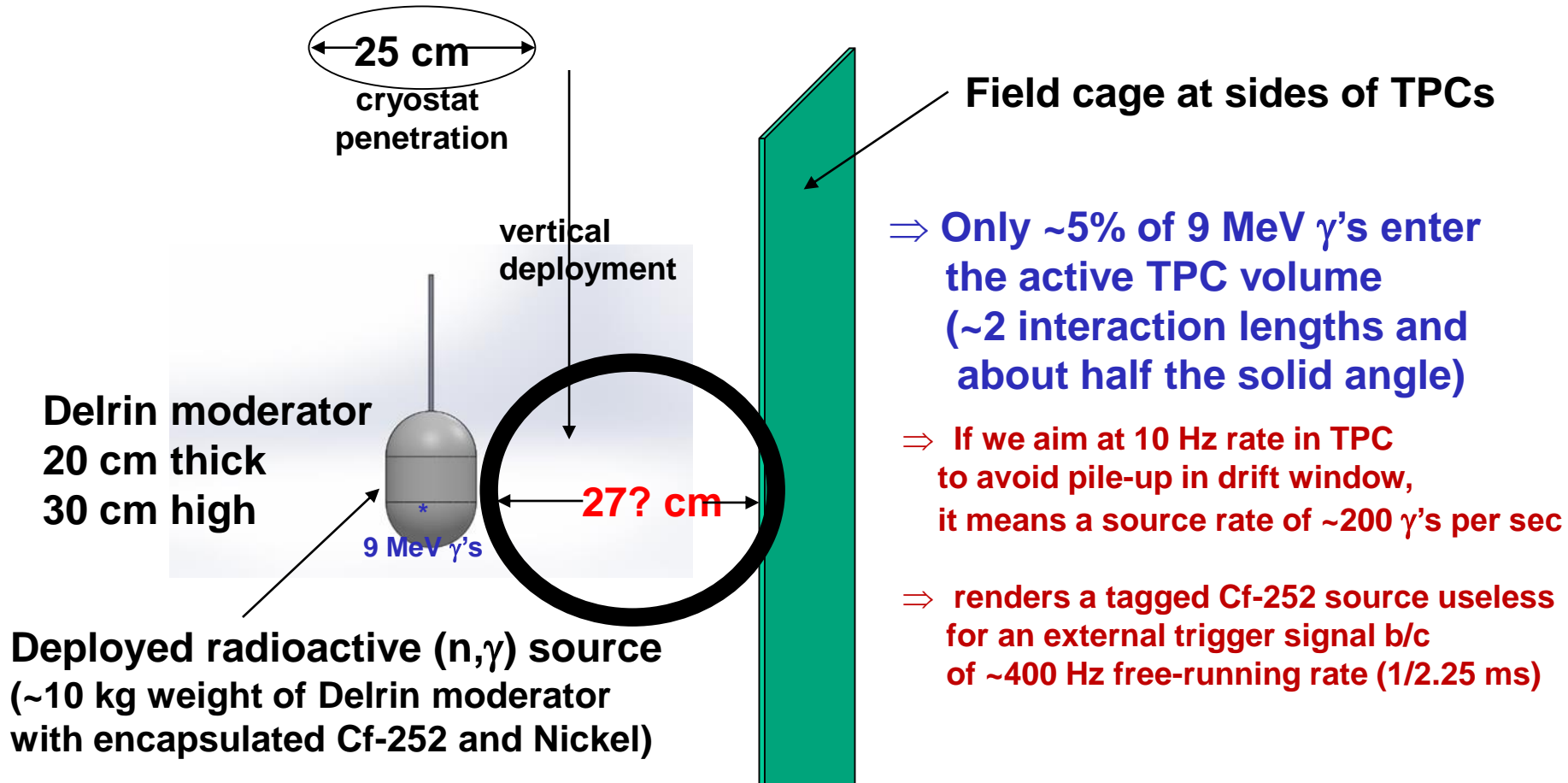
Combine shipping of already boxed up ND system with DC FD decommissioning (date TBA by DC collaboration)

In case the FD decommissioning does not happen this summer, we will ship the already boxed up ND system by end of summer 2019 separately



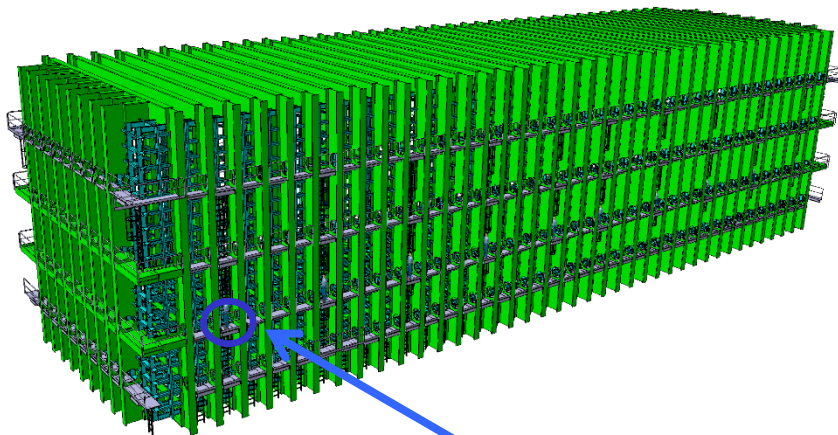
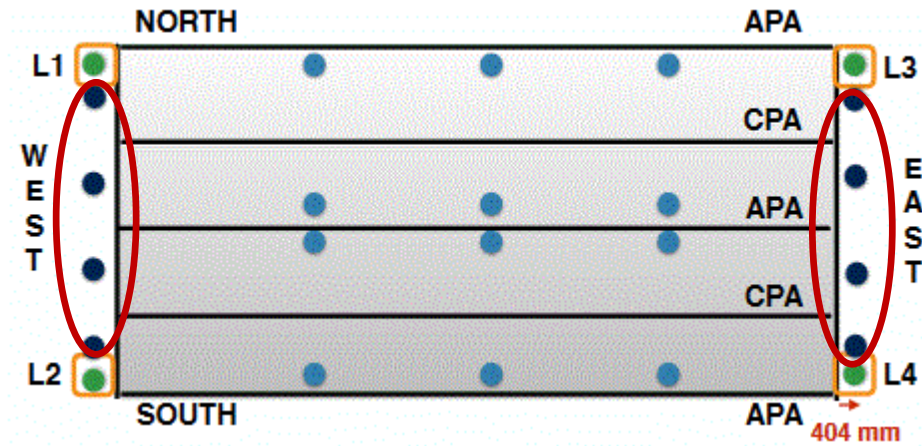
Does Recent TPC Translation Jeopardize This Deployment Scheme?

$$318.66 \text{ mm} - (250 \text{ mm diameter} / 2) + \sim 80 \text{ mm shrinkage} = 273.66 \text{ mm}$$



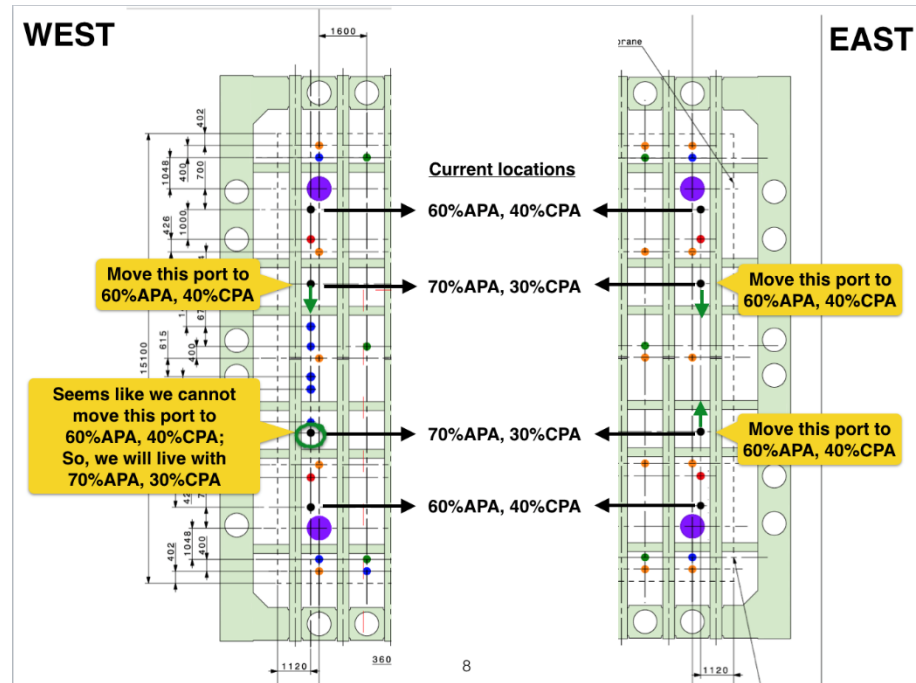
Do we need guide-wires or guide-tubes?
(check on currents with fluid dynamic sims of SDSU)
Would be one of first things installed in cryostat
due to access restrictions at east (or west) end inside cryo

Sort Out Feedthrough Locations/Options after Recent TPC Translation...

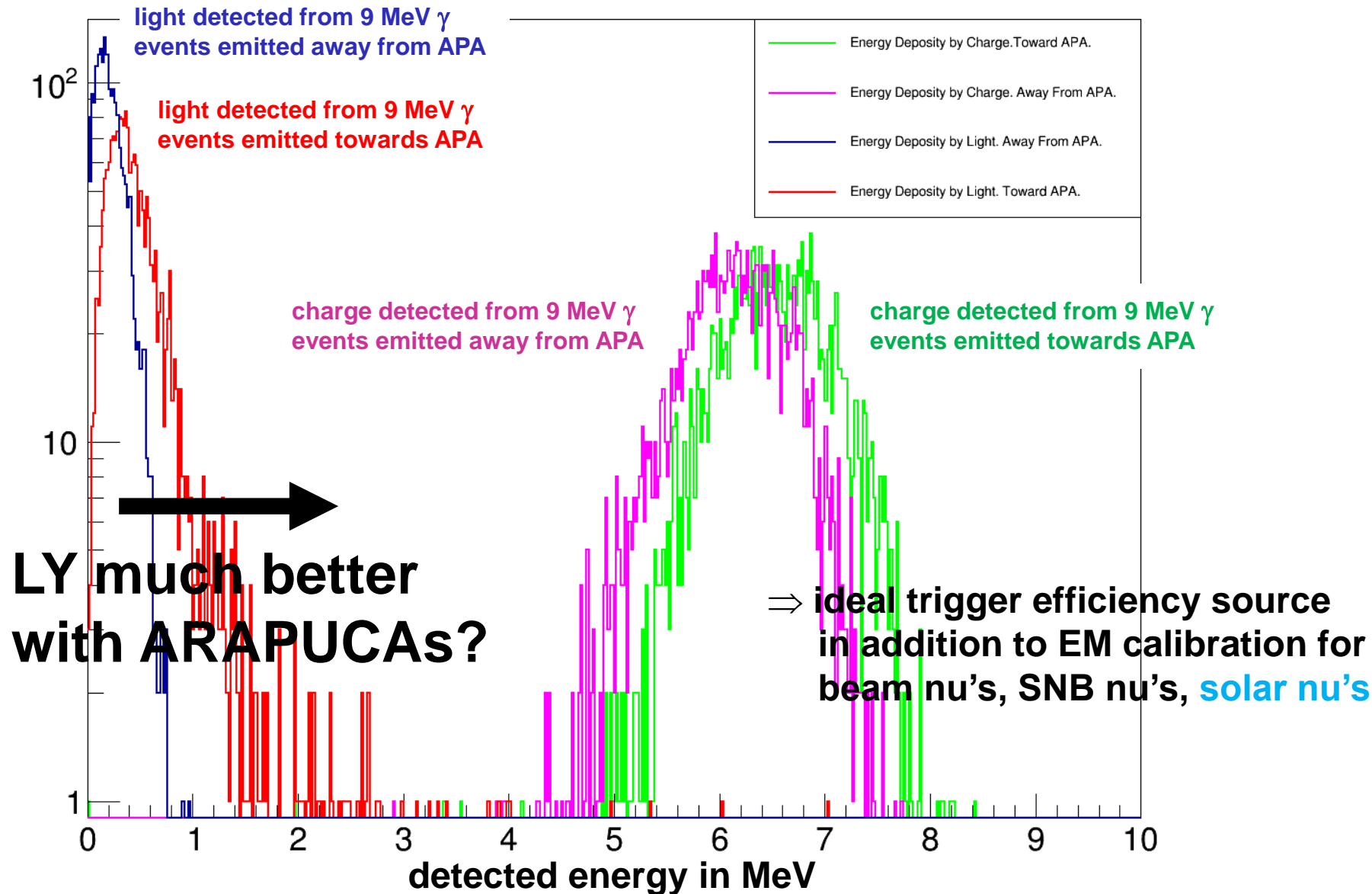


People for Scale

Old Positions before TPC Translation:
 8 most relevant feedthroughs per cryostat for external radioactive source deployments are at 60% to 70% of full drift length away from APA

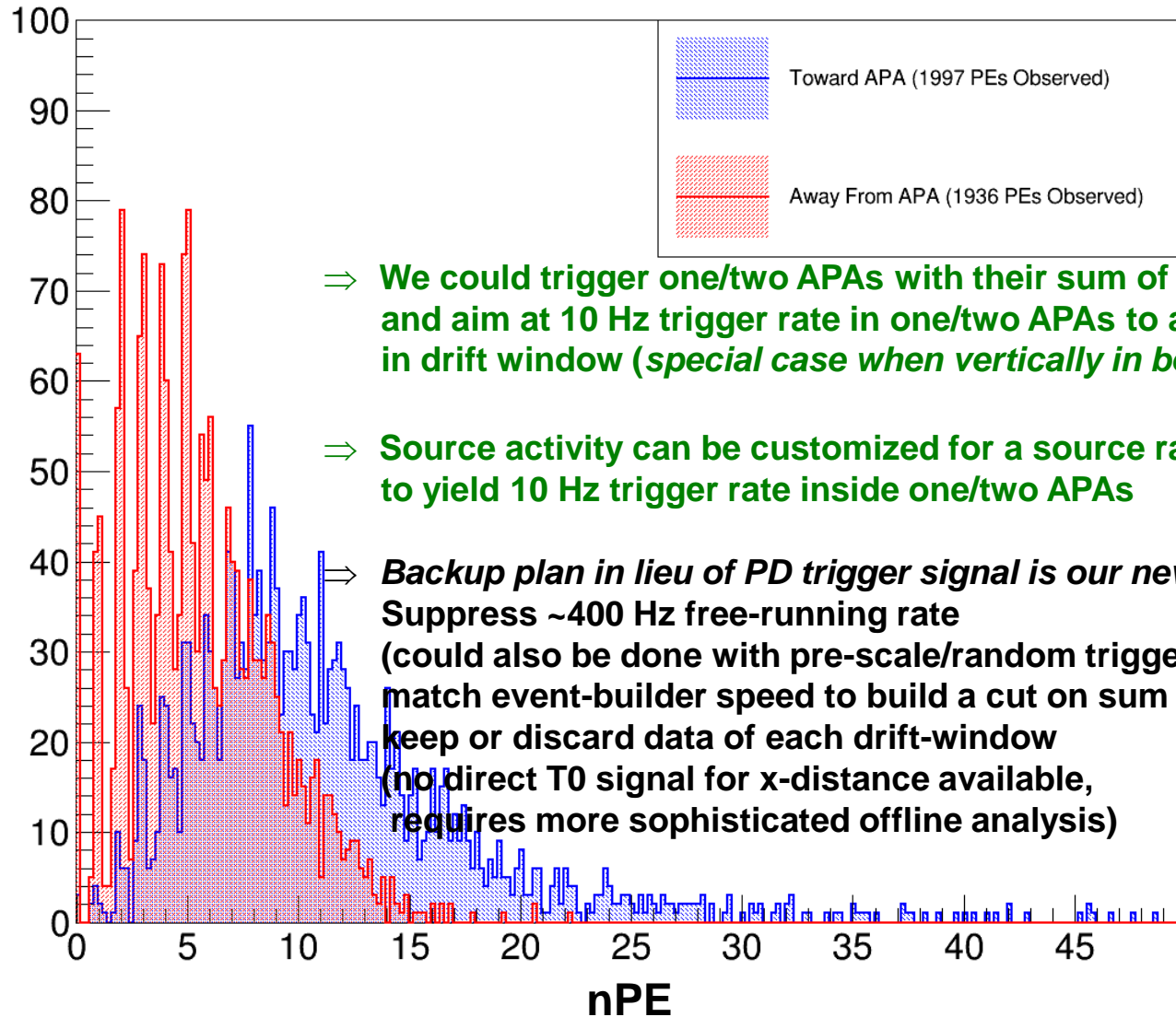


In Charge and Light Detected Energies in Active TPC Volume



Light Detected in nPE for Preferred PD Triggering w/ T0

nPEs per Eve collected by PDs. 9MeV γ 's at 150cm X



⇒ We could trigger one/two APAs with their sum of PDs signals and aim at 10 Hz trigger rate in one/two APAs to avoid pile-up in drift window (*special case when vertically in between 2 APAs ?*)

⇒ Source activity can be customized for a source rate of ~ 200 γ 's per sec to yield 10 Hz trigger rate inside one/two APAs

⇒ **Backup plan in lieu of PD trigger signal is our new default:**
Suppress ~ 400 Hz free-running rate (could also be done with pre-scale/random trigger) and match event-builder speed to build a cut on sum of charge signals to keep or discard data of each drift-window (no direct T0 signal for x-distance available, requires more sophisticated offline analysis)