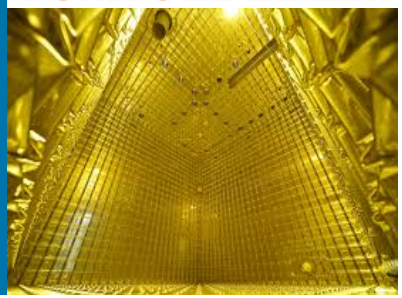
PDS TDR NEEDS AND PLANS



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PDS TDR Needs and Plots

- Need complete TDR by early July
  - -Demonstrate successful implementation, operation, and analysis of PDS (at high level) with ProtoDUNE

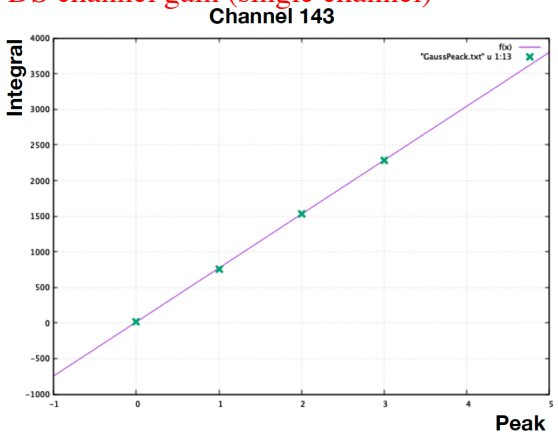
- What is suggested for inclusion in TDR in terms of PDS topics
  - -PDS Gain and Stability
  - -PDS Energy Scale Linearity and Resolution
  - -PDS Time Resolution and PDS/TPC Time Matching
  - -PDS Michel Reconstruction/Timing
  - -Detector Light Yield (PE/MeV)
  - -PDS Light Collector Stability Plots

- When focusing on TDR also think about first ProtoDUNE Publications
  - -TDR results coupled to plans/needs for first publication

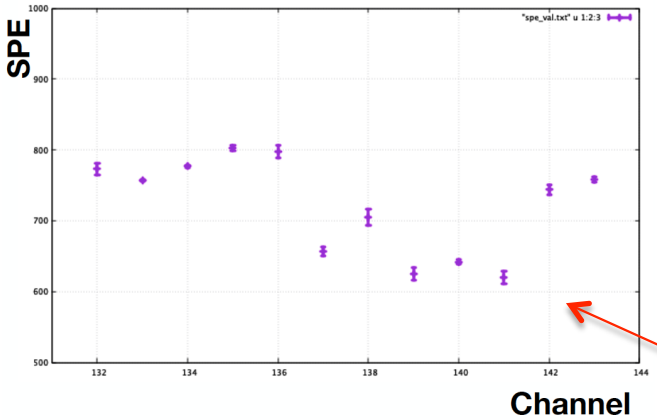
PDS Gain and Stability

- ARAPUCA Plot Examples (from Dante) => for TDR + first journal publication

PDS channel gain (single channel)

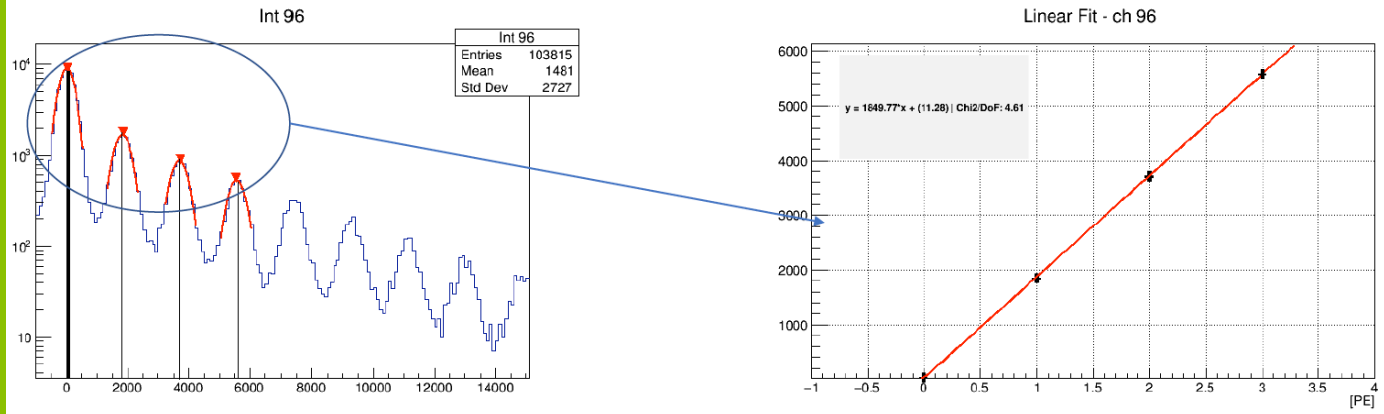


PDS SPE channel gain (ARAPUCA channels)



Make the plot for all ARAPUCA channels and for three tome periods (DCM data taken Nov, Jan/Feb, March/April)
-make overlay plot with data from different periods

- Double-Shift Bars (from Chris) => for first journal publication
  -Make equivalent set of plots



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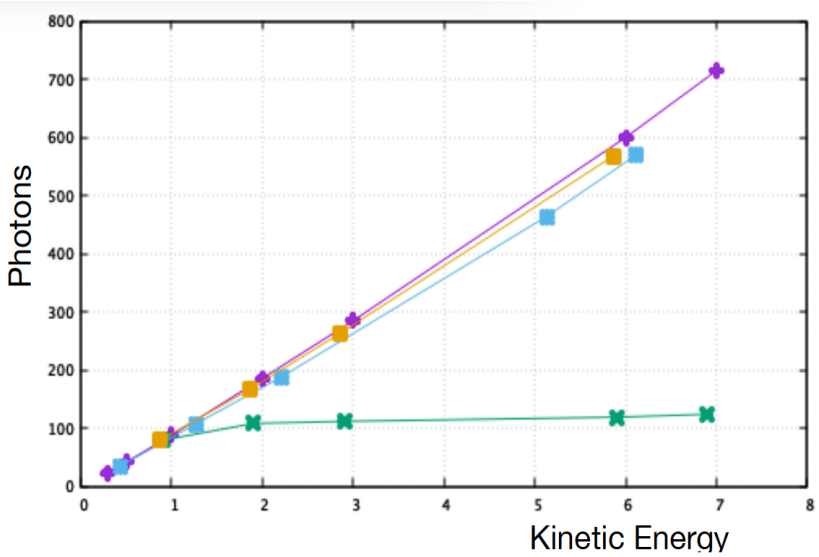
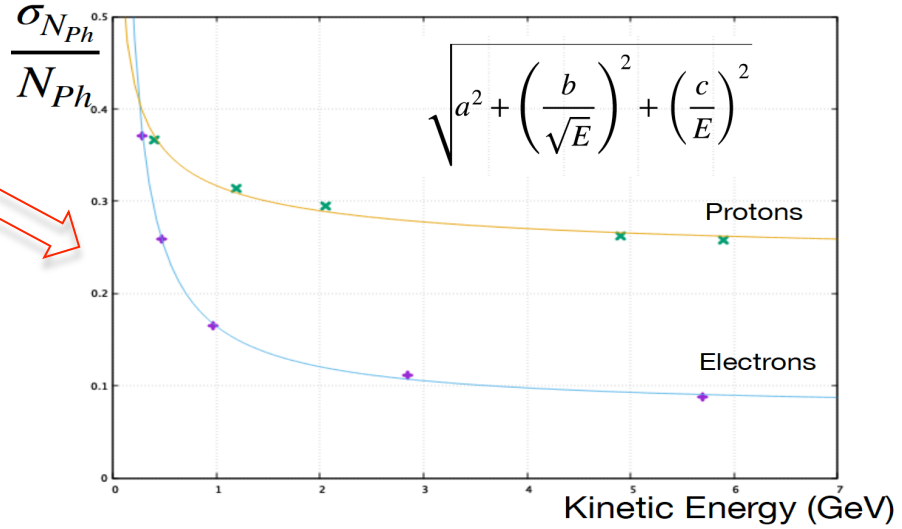
PDS Energy scale linearity and resolution

- Measure the mean number of photo-electrons collected by the ARAPUCA for different beam particle energies (work by Dante)

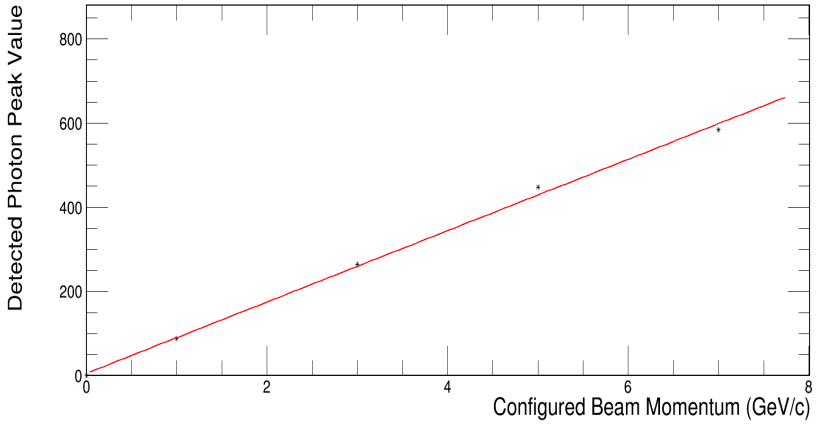


Green = Muons
Purple = Electrons
Blue = Protons
Yellow = Pions

ARAPUCA alone



- Plot by Leon ("mixed" particle beam)

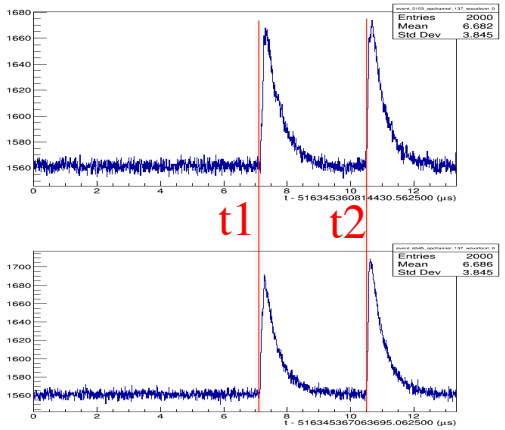


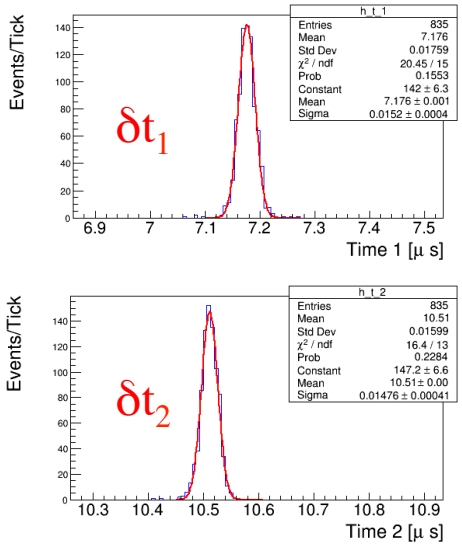
Have energy-linearity and energy-resolution plots for beam electrons and protons for TDR (light yield in A.U.)?

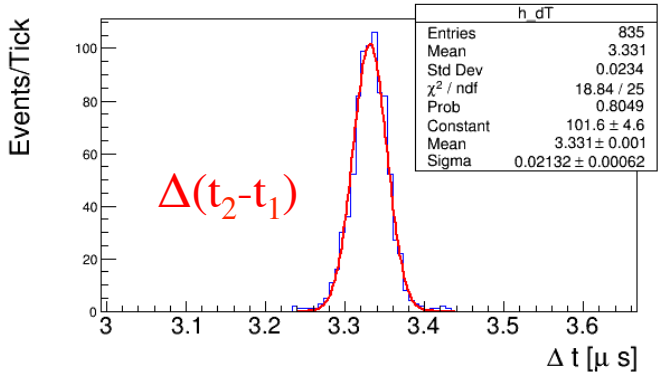
PDS Time Resolution and PDS/TPC Time Matching

- Distributions of time (t1) of the first pulse wrt external trigger, and/or time (t2) of the second pulse wrt trigger provide an estimate of ARAPUCA's time resolution with SSP readout (ZD)

PDS waveforms from DCM UV light

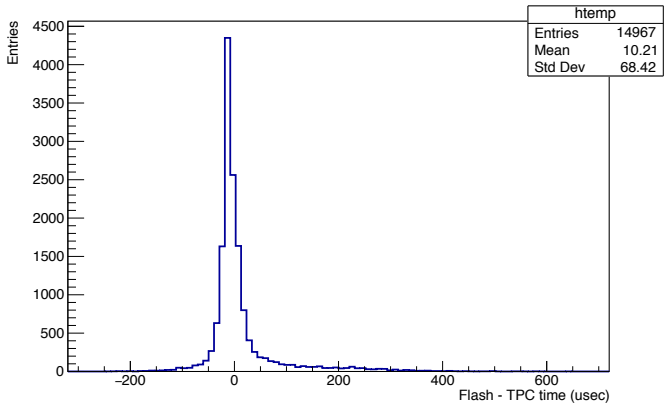




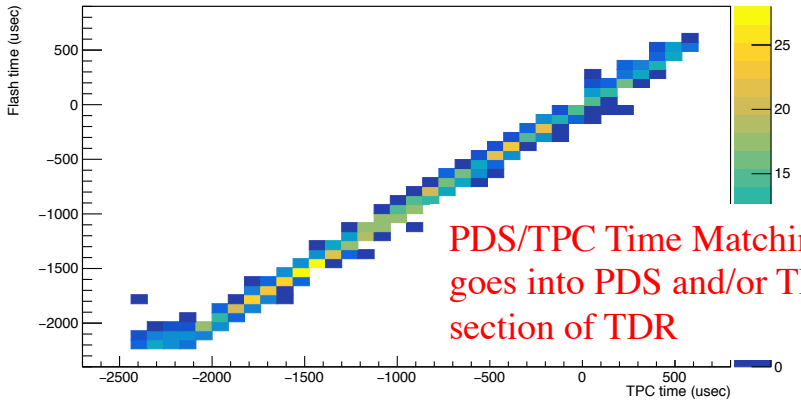


This would fit in PDS performance part of TDR, and/or within calib/monitoring section of TDR

- Analysis of cathode-crossing muon tracks, used to determine T0 of these events by matching APA times between two drift volumes, and matching it against light flashes (Aleena)



Difference in the time stamps from two independent systems, with μ's cathode-crossing tracks

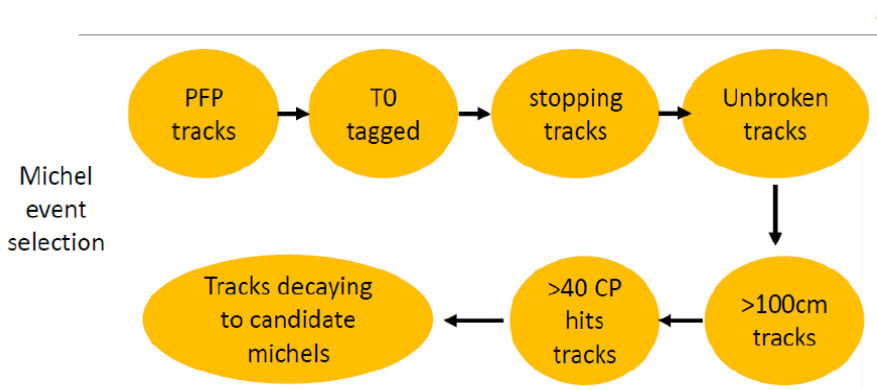


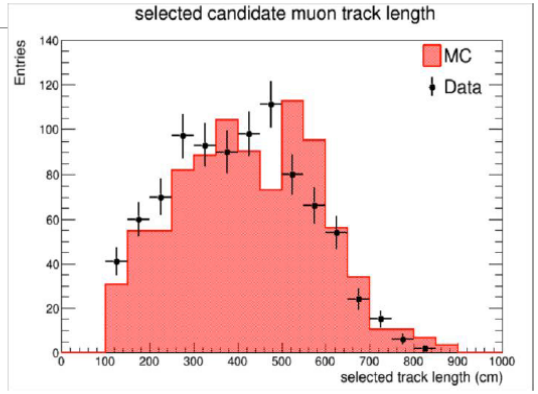
PDS/TPC Time Matching goes into PDS and/or TPC section of TDR

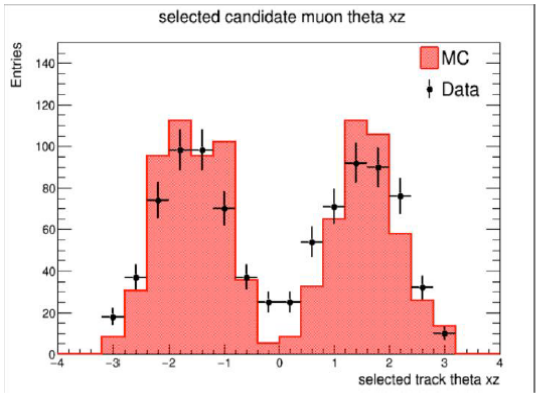
-Need update this analysis with improved light reconstruction (as implemented by Kyle)

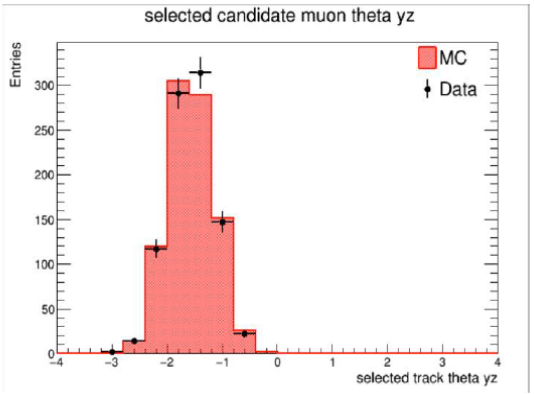
PDS Michel Reconstruction/Timing

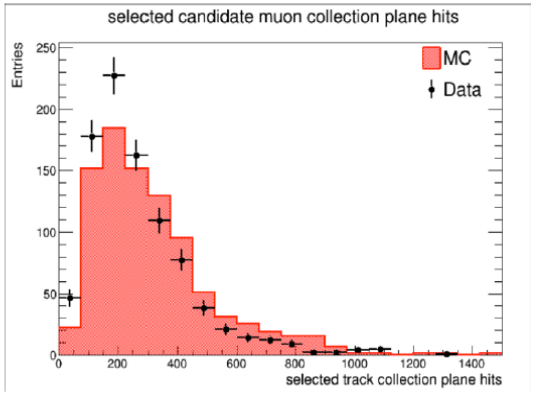
- This would be a bonus for TDR and was suggested for the first publication
  -Aleena's work











-No PDS component in Michel analysis yet but it is defining Michel sample that we need to observe/verify by PDS => work ongoing by Aleena, Zelimir with an attempt to meet the TDR schedule
-basically wants "Michel time since muon" plot for Michels identified by TPC

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PDS Light Yield (PE/MeV)

- Get the PDS light yield from 7 GeV/c beam electrons (or similar beam sample) and/or from CRT tagged muons
  - -needs understand attenuation and relative light yields (need MC match the data)
  - -Bryan, Dante, others => might be ready in a month time scale
  - -Also proposed for the first ProtoDUNE publication

PDS Light Collector Stability Plots

- Demonstrate Stability of wavelength shifter and optical properties of photon collectors
  - -Stability plot that shows a cumulative light yield as a function of time (Oct/Nov, Jan/Feb, Mar/April) for CRT tagged cosmic ray muons
  - -Stability plot of DCM light yield at stable amplitude as a function of time (Nov, Jan/Feb, Mar/April)

Anything else for TDR?

- Will bring back this topic at next ProtoDUNE PDS Operations and Analysis meetings

BACKUP

Proposed ProtoDUNE Papers and PDS chapters

Design, construction and operation of the ProtoDUNE-SP Liquid Argon TPC

8 PhD characterization

- 8.1 Non-responsive sensors/channels
- 8.2 Test Pulse (Flasher): Single PE calibration and stability
- 8.3 PhDetector(s) Efficiency (PE/Ph)

First results on ProtoDUNE-SP Liquid Argon TPC performance from a test beam run at CERN Neutrino Platform

7 PhD response

- 7.1 Single PE rate
- 7.2 Light Signal Calibration
  - 7.2.1 Detector Light Yield (PE/MeV) from 7 GeV/c beam electrons
  - 7.2.2 Low Energy Signals (Michel Electrons)