ProtoDUNE-VD PDS simulation and analysis

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ProtoDUNE-VD PDS simulation and analysis

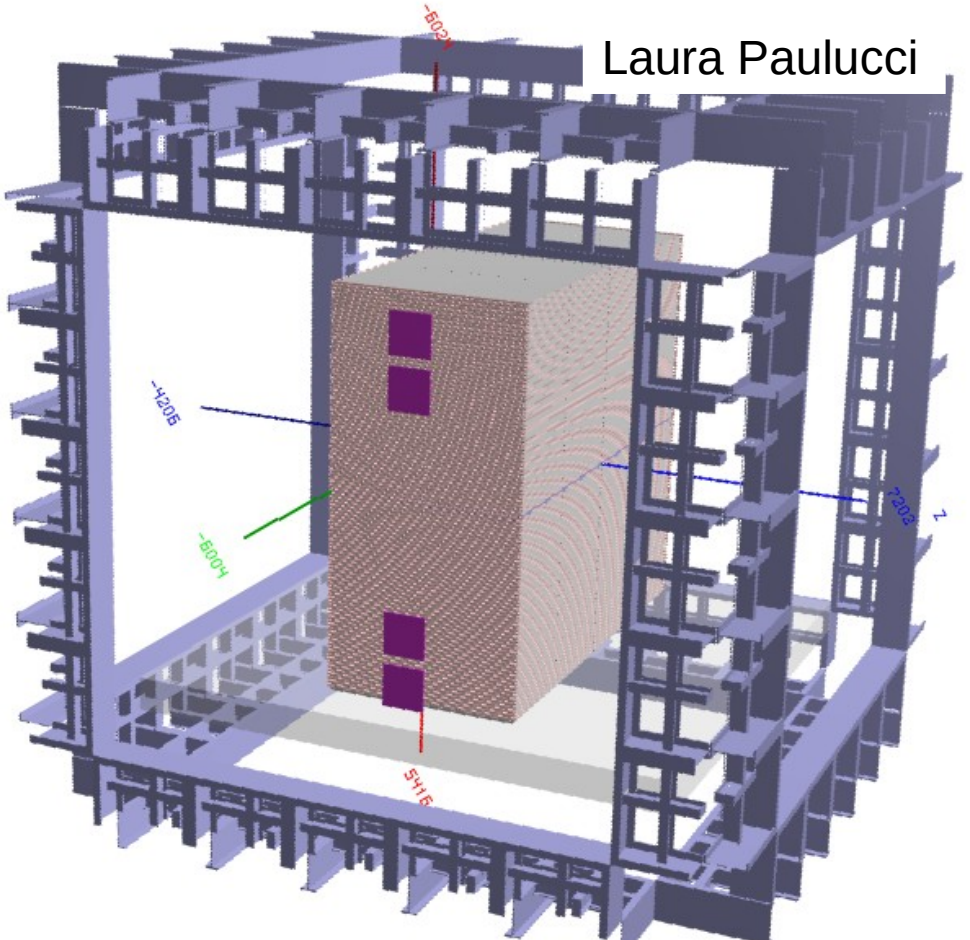
- Ongoing efforts for ProtoDUNE-VD
  - Software for simulation and data analysis
  - Aim: LArSoft full chain implementation
- Tests, coldboxes and previous pDUNE-SP&DP data results to validate pDUNE-VD simulation
- Indentify needs to organize effort:
  - Analysis software tools, simulation, measurements of interest,...

ProtoDUNE-VD PDS simulation

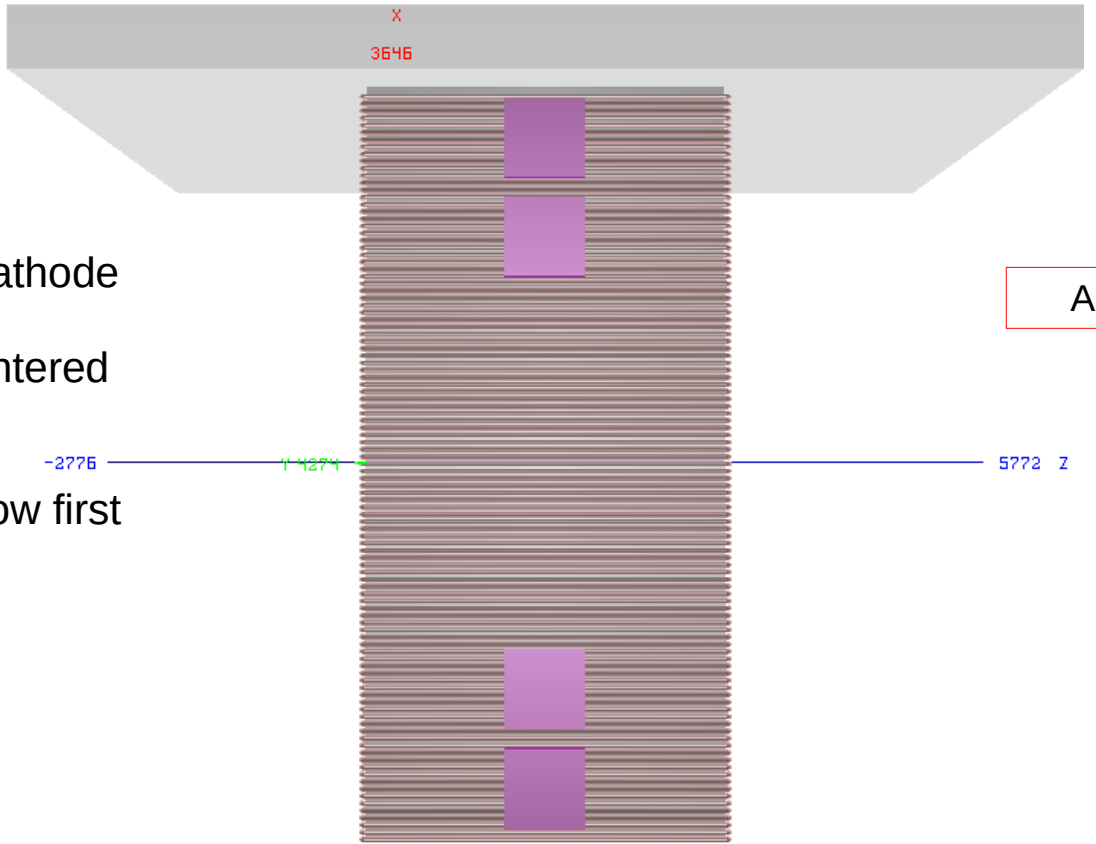
- Geometry description in LArSoft
  - Vertical Drift (TDR), Coldbox #1&2 (TPC+PDS)
- Light production and propagation description
  - Charge and light correlated (dE/dx, E): LArQL
  - Hybrid (semi-analytic on active volume, library outside) or DL-GAN approach
- Digitization and reconstruction

ProtoDUNE-VD geometry

- Initial geometry adapted from the ProtoDUNE-DP geometry
  - Includes PDS and field cage
  - Under evaluation by PD-VD software coordination
  - Drift in the X direction as in FD2-VD geo due to reconstruction issues
    - Bad for cosmic generator → needs to be fixed



- Membrane: 8 single-sided 60 x 60 cm^2 X-Arapucas
- Better have them all and not need them than the other way around

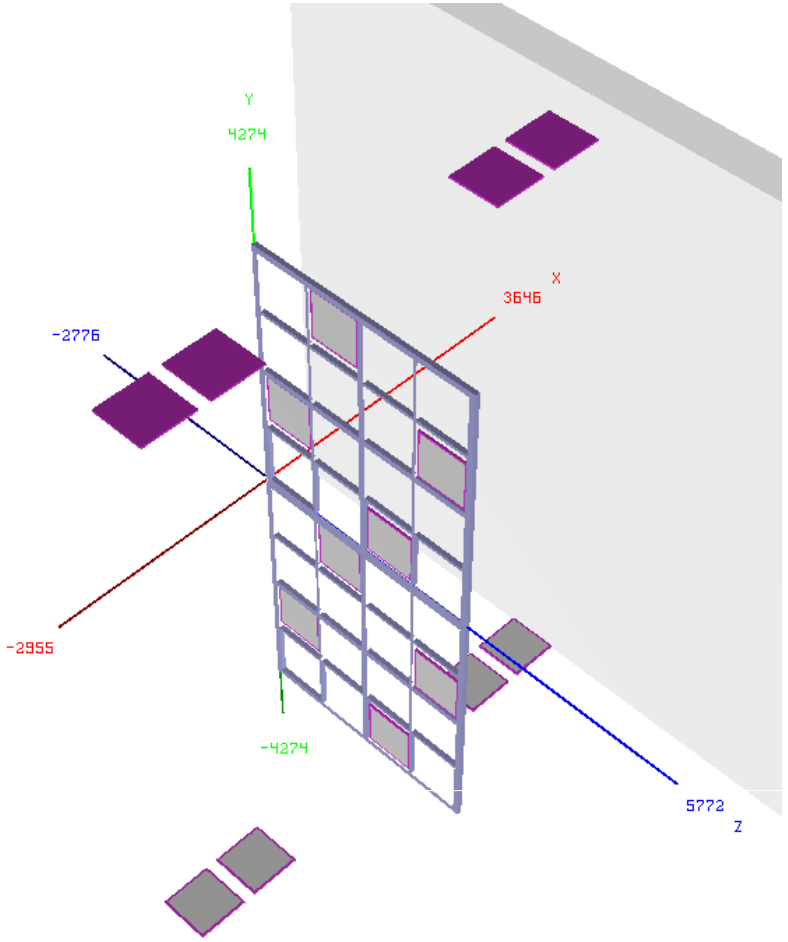


- Symmetric about cathode
- 60cm behind FC
- First X-Arapuca centered 50cm below CRP
- Second X-Arapuca centered 80cm below first

Any change?

- Cathode: 8 double-sided 60 x 60 cm^2 X-Arapucas

- Checkers disposition
- No cathode mesh (but could possibly be included)

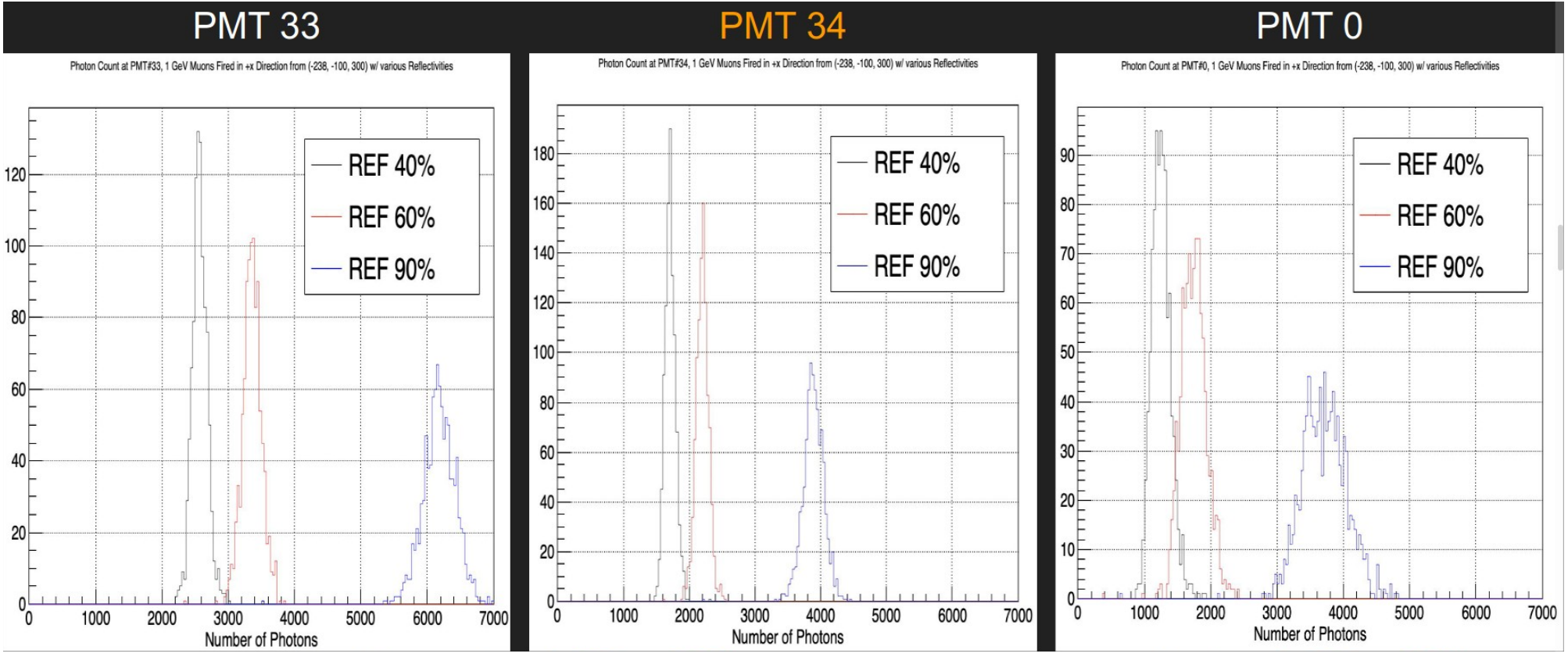


Any change?

ProtoDUNE-VD PDS simulation

- Once geometry is included in the DUNE code
  - Fast optical simulation can be developed
  - Computable Graph method (Muve and Alex)
- Once beam simulation set, can start beam events evaluation
  - Wenqiang (10th Aug. talk): Niko and Jake
  - Preliminary studies: J. Smith, W. Shi
    - At MC-truth level and pDUNE-DP geometry
    - Number of reaching photons from a distance

arriving photons: 1 GeV muons ~2.8 m distance



From J. Smith talk (PD Simulation and Physics WG – July 25th)

ProtoDUNE-VD PDS sim validation

- Strong development on the X-Arapuca ongoing
  - Optical components, Si sensors, electronics
  - Tiles efficiency, signal charateristics
- Geometry and optical properties for protoDUNE materials
  - Cage field, grid, cathode, anode, LAr, etc.
  - Reflectivities, transmission, refractive index, Rayleigh, absorption length.

ProtoDune-VD PD analysis

- Calibration and monitoring
  - Multiple PEs plot, charge and max amplitude
  - Gain vs applied bias voltage, SNR, calibration factor
  - Crosstalk & afterpulses
  - Time resolution
  - Response stability overtime
- Cosmics
  - Signal characteristics:
  - Baseline, noise
  - SPE: amplitude, rise, fall, etc
  - Sensor efficiency (track, MC light estimate)
  - Time resolution (distance, track)
- Beam
  - Beam characteristics, particle types
  - Sensor efficiency (MC light estimate)
  - Time resolution (distance, track)
  - Energy related measurements?

Tentative tasks list

- Software development
  - Simulation implementation & studies
    - Geometry, optical properties, primary gen.
    - Light production and propagation
    - Full X-Arapuca tiles response
  - Calibration, monitoring, reconstruction tools
- Analysis activities
  - Stablish schedule for main topics
  - People/groups involvement