

Simulation/ Reconstruction Needs for Calibration

Sowjanya, Kendall

Joint session with FD Sim/Reco
DUNE Physics Week
November 15 - 17, 2017
Fermilab

Many Calibration Quantities: not a complete list

TPC response model

Argon ionization energy
Electron drift velocity
 t_0 offsets
Electron lifetime
Recombination parameters
Electric field
Longitudinal and transverse electron diffusion
Wire positions/geometry
Wire field response
Channel gain
Overall electronics analog transfer function
Electronic crosstalk
Electronics noise, including correlated noise
ADC linearity (differential and integral).

Photon detector response model:

<similar list here>

(See Backup for more)

*Also, are effects
propagated to next level?
E.g. E-field distortions
propagated to
recombination?*

High level quantities

Position reconstruction biases
Direction reconstruction biases
Energy scale
Energy resolution
Particle ID efficiencies
Noise removal efficiencies
...
...

Particle response

Charged hadron propagation
Neutron response
...

On the Simulation
side
(Big Picture Needs)

*Want to know what model and what parameter values
went into simulation?*

E.g. drift velocity? Lifetime? E-field? Diffusion values?
Recombination models & parameters?

*Also, do we have knobs (fcl dials) to adjust these
parameters?*

*Goal: generate samples with varying parameters and
assess impact on physics*

Calibration Sources: not a complete list

- Purity Monitors
- Temperature monitors
- Survey
- Current monitors
- ν_{μ} CC events
- Michel electrons
- Stopping muons
- Stopping protons
- Muon Crossers, APA/CPA piercers
- Ar^{39}
- Laser system
- CRT tagger
- Other radioactivity

- Michel electrons
- ν_{μ} CC events
- π^0 mass peak
- Other decays (K^0 s...)
- Tagged events

On the
Reconstruction side
(Big Picture Needs)

Ideally would want to be able to reconstruct all calibration sources starting from Cosmic muons

High priority reconstruction topics (for now):

- Cosmic muon reconstruction
- Cosmic T0-tagging
- PDS T0 reconstruction
- Stopped muon filter
- Michel electron filter
- Calorimetric reconstruction to assess impact of various effects (dQ/dx to dE/dx)

Other (more focused) Needs?

- *Samples Production*
 - Cosmics, Radioactive sources, Unclear what can be done for Laser?
- *Importing tools from other LArTPC experiments*
 - Both reconstruction & Calibration tools
 - Special focus on MicroBooNE/ProtoDUNE
 - Especially calibration tools/techniques that are developed to implement an effect in Sim/Reco (fcl dials) and propagate a given calibration effect to next level

What we would like to know

- *Would like to hear from Calibration leaders what exists now in Sim/Reco for Calibration?*
 - Any issues with the current framework?
- *What is the process to for a new Sim/Reco request for Production and tools?*
- *Are Calibration related Sim/Reco tools already integrated into DUNE repositories?*
- *We understand this is a collaborative effort*
 - What help does Sim/Reco need from Calibration TF?
- *What issues do you see in Sim/Reco topics that can affect our (collaborative) path to TDR?*

Collaboration for TDR

- *For TDR, There will be aspects of calibration in Reconstruction (e.g. Calorimetric reconstruction) and detector Performance (?)*
 - Collaboration b/n both groups as we define the TDR structure
 - What about Technical Proposal?

Volume 2: Physics

- **Volume 2: Physics**

- DUNE Physics goals (primary, secondary, ancillary)
- Far Detector Reconstruction
- Long-Baseline Neutrino Oscillations
- Supernova Neutrinos
- Nucleon Decay
- Beyond the SM Physics
- Other Topics
- Near Detector Physics

Volume 3: FD-SP

- **Volume 3: Single-Phase Far Detector: Overview**

- Design Motivation
- Cryostat and cryogenics
- Overview of the Single-Phase Far Detector
- ProtoDUNE-SP
- Detector Performance
- **Volume 3A: APAs**
- **Volume 3B: High Voltage System**
- **Volume 3C: TPC Electronics**
- **Volume 3D: Photon Detection System**
- **Volume 3E: DAQ**
- **Volume 3F: Slow Controls and Cryogenic Instrum.**
- **Volume 3G: Installation and Integration**

Other thoughts/Comments from
the group?