ProtoDUNE Beam Software Topics

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Outline

- Beam Instrumentation Simulation Updates from BIG

- Beam Interface Updates for MCC10

- Beam/TPC Data Merging, Beam/TPC Data Product (Slides from Aug Collaboration Meeting)

- Beam/TPC Matching

- Use LArSoft beam interface to populate beam DB (Slides from DRA Bi-weekly meeting)

- Beam Instrumentation Detectors Digitalization

Beam Instrumentation Simulation Update

- MCC9/Previous version of beam simulation files needs rotation because of the missing of the last two bending magnets

  - The magnets are included in the newer version of beam simulation files for MCC10

- Previous version of beam simulation files in coordinates transformation including rotation and units conversion

  - The newer version of beam simulation files implements coordinates that are parallel to the edges of the cryostat and do not need rotation

- The implementation of BP5/ BPROFEXT, which will be used for beam/tpc matching together with BP4

- On-going The "merged" beam simulation files, which has the effect of H2 beam on H4/NP04 are partially available

- (More info please see the links in the back-up slides)

New coordinates in beam sim

- Implemented the (current) shielding of H4-VLE
- Detector now modeled with several layers
  - New coordinate system used in ROOT NTuples
- NTuples available in eos:
/eos/experiment/neutplatform/protodune/
npmcproddisk/beamgroupdisk/SP/20170607/BEATCH-31/

Additional detector plane
"NP04front" at location
"DUNE-FR" (BEATCH-31)
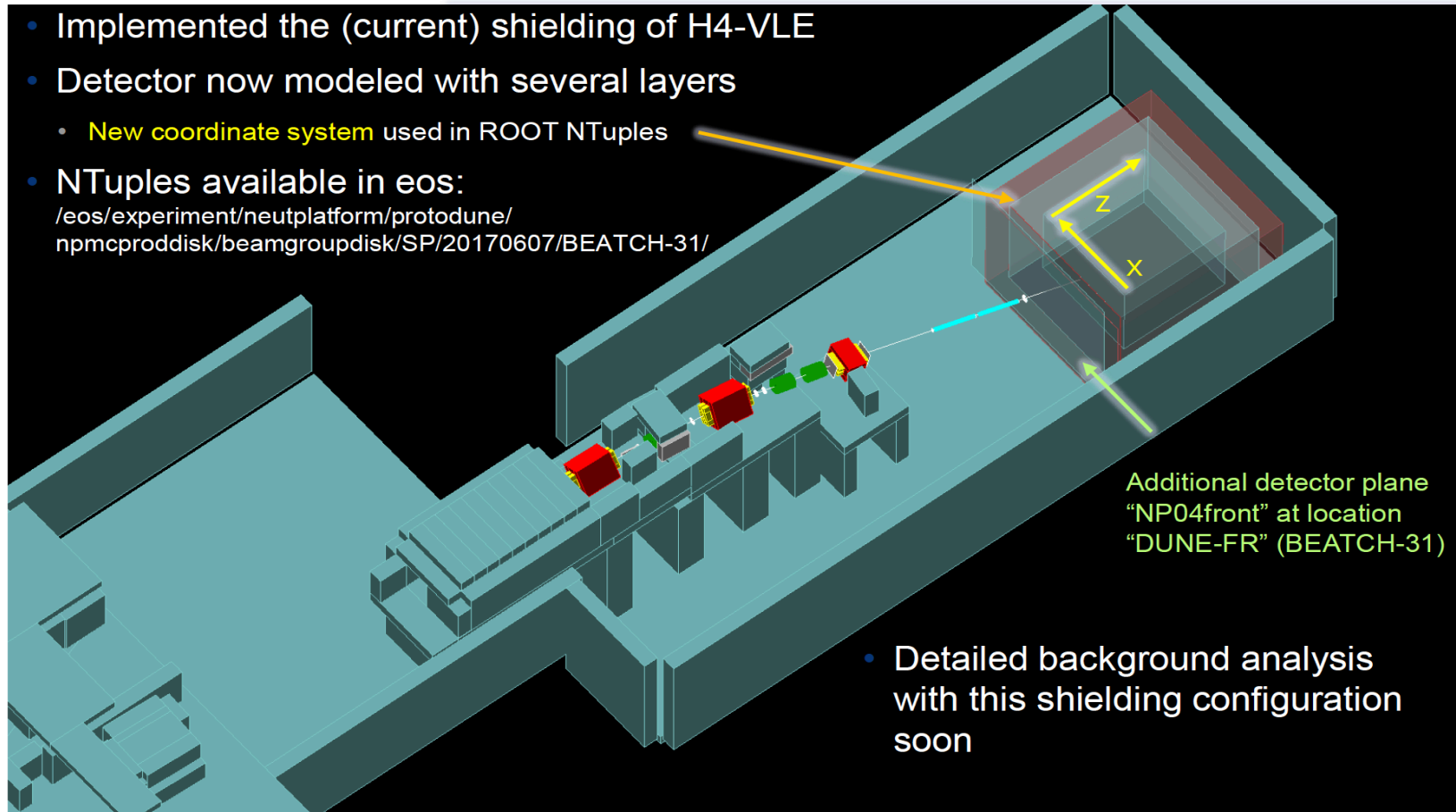
- Detailed background analysis
with this shielding configuration
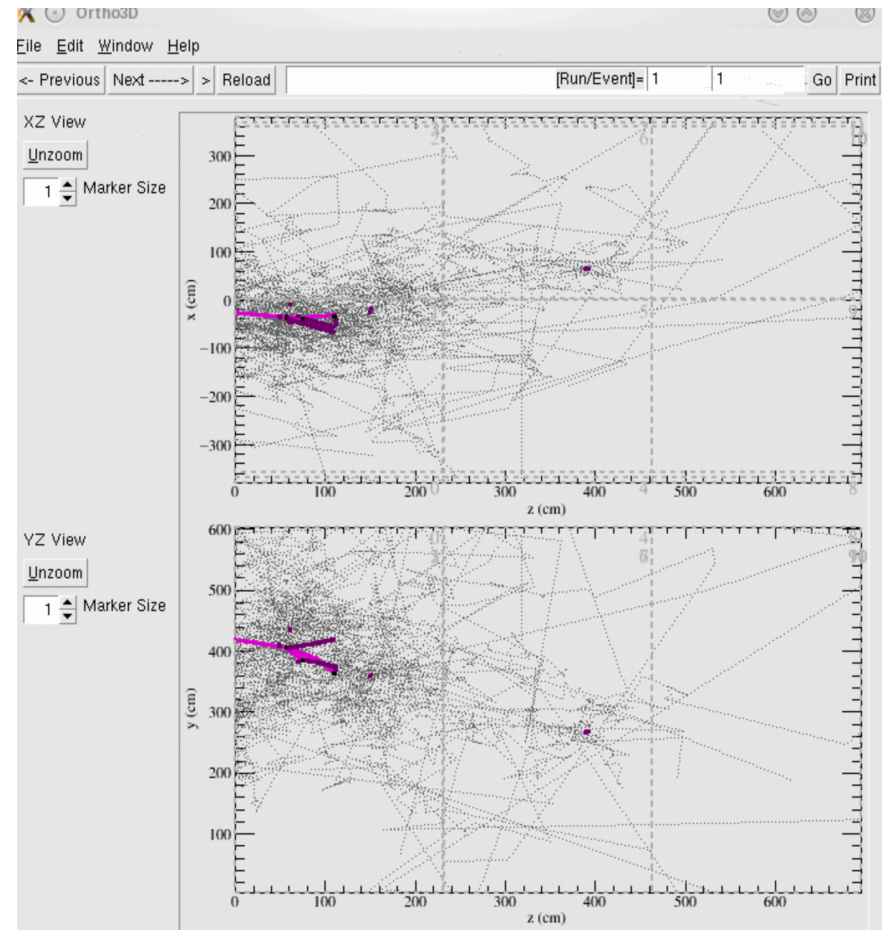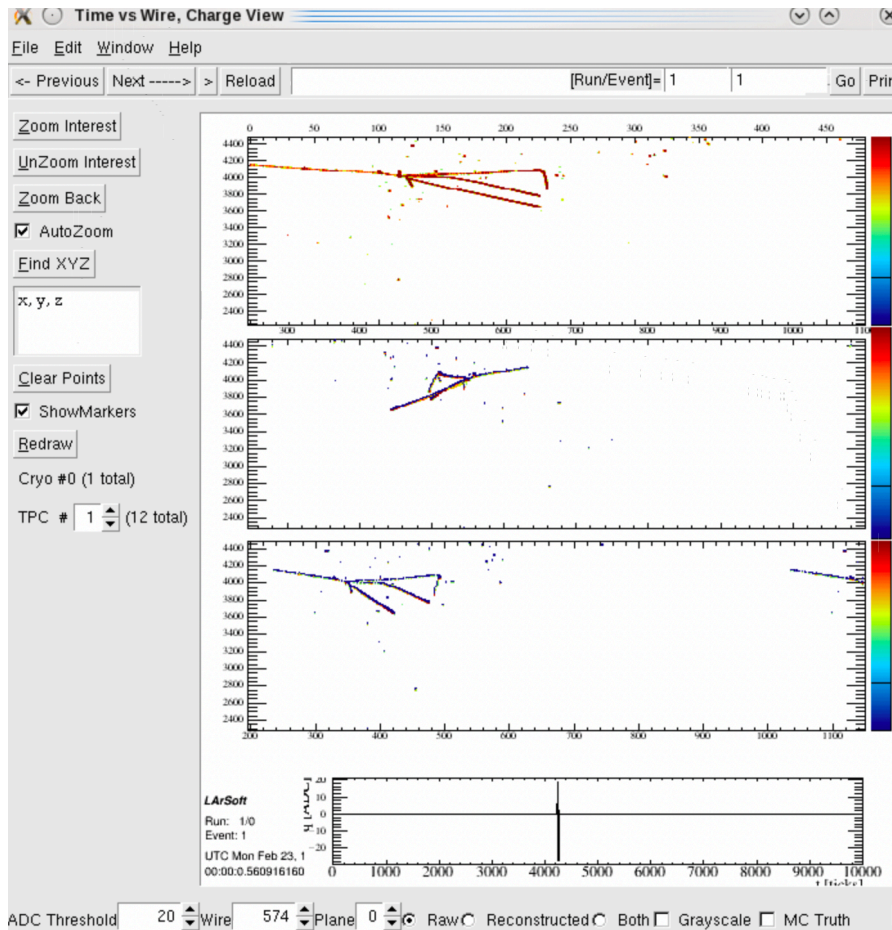soon

07.06.2017   M. Rosenthal, N. Charitonidis

Beam Interface Updates for MCC10
(Samples available)

Beam/TPC Merging

- In MCC9 only the last point of beam instrumentation simulation information is saved in the Monte Carlo samples

- A data product & the beam interface implementation module is available for beam and TPC merging that works with both the former version of beam simulation files and the newer version of beam simulation files

- MCC9 version available on my git branch and MCC10 version (slight modification based on the MCC9 version) is locally available in my area

- Tested and compatible with the newer larsoft version v06_56_00

- Benefits: Will not need y-momentum and PDGid searching/matching to relate the beam particles to TPC events

Beam-TPC Merging (Cont.)

Simulation – reconstruction chain tested for new beam simulation files

```
Begin processing the 5th record. run: 1 subRun: 0 event: 5 at 15-Nov-2017 00:48:02 CST
PRINCIPAL TYPE: Event
SinglesGen.. | generator..... | ....................... | std::vector<sim::ProtoDUNEbeamsim>.... | ...1
SinglesGen.. | generator..... | ....................... | std::vector<simb::MCTruth>............ | ...1
SinglesGen.. | rns........... | ....................... | std::vector<art::RNGsnapshot>......... | ...1
SinglesGen.. | TriggerResults | ....................... | art::TriggerResults.................. | ...-
G4.......... | largeant...... | ....................... | std::vector<sim::OpDetBacktrackerRecord> | ..60
G4.......... | rns........... | ....................... | std::vector<art::RNGsnapshot>......... | ...2
G4.......... | TriggerResults | ....................... | art::TriggerResults.................. | ...-
G4.......... | largeant...... | ....................... | std::vector<simb::MCParticle>........ | .847
G4.......... | largeant...... | ....................... | std::vector<sim::AuxDetSimChannel>... | ...0
G4.......... | largeant...... | ....................... | art::Assns<simb::MCTruth,simb::MCParticle,void> | .847
G4.......... | largeant...... | ....................... | std::vector<sim::SimChannel>......... | 2490
G4.......... | largeant...... | ....................... | std::vector<sim::SimPhotonsLite>..... | ..60
Detsim...... | TriggerResults | ....................... | art::TriggerResults.................. | ...-
Detsim...... | opdigi........ | ....................... | std::vector<raw::OpDetWaveform>...... | .623
Detsim...... | daq........... | ....................... | std::vector<raw::RawDigit>........... | 4280
Detsim...... | rns........... | ....................... | std::vector<art::RNGsnapshot>......... | ...1
Reco........ | TriggerResults | ....................... | art::TriggerResults.................. | ...-
Reco........ | pmtrajfit..... | kink............... | std::vector<recob::Vertex>......... | ...0
Reco........ | pandora...... | ....................... | std::vector<recob::PCAxis>........... | ...6
```

Beam-TPC Merging (Cont.)

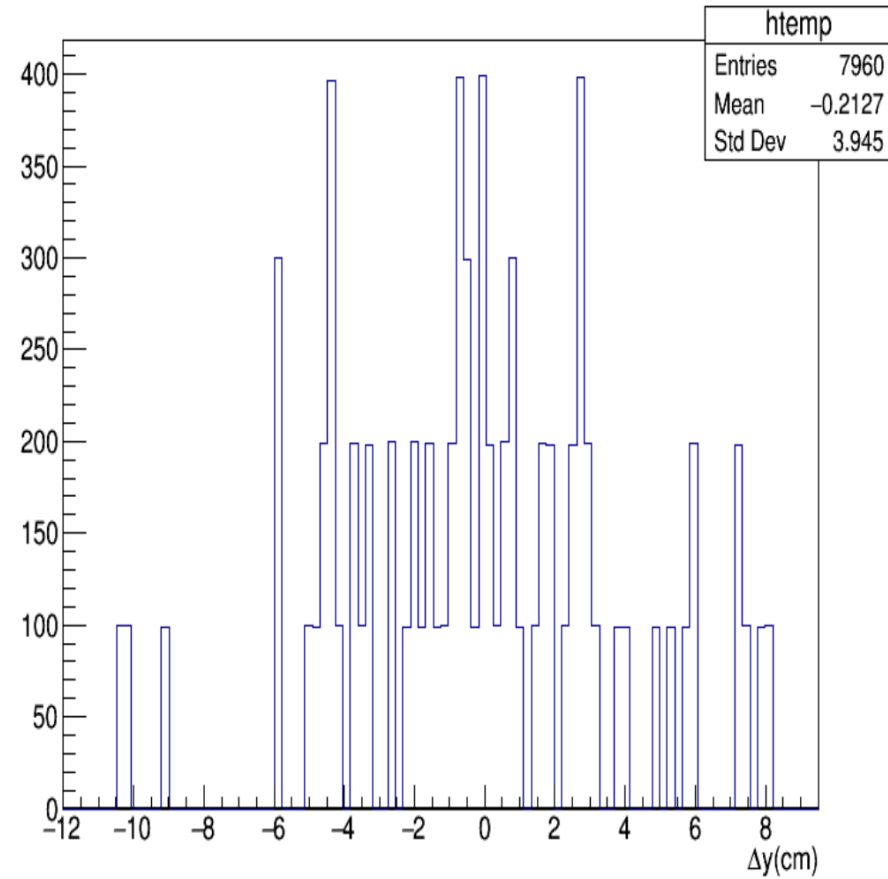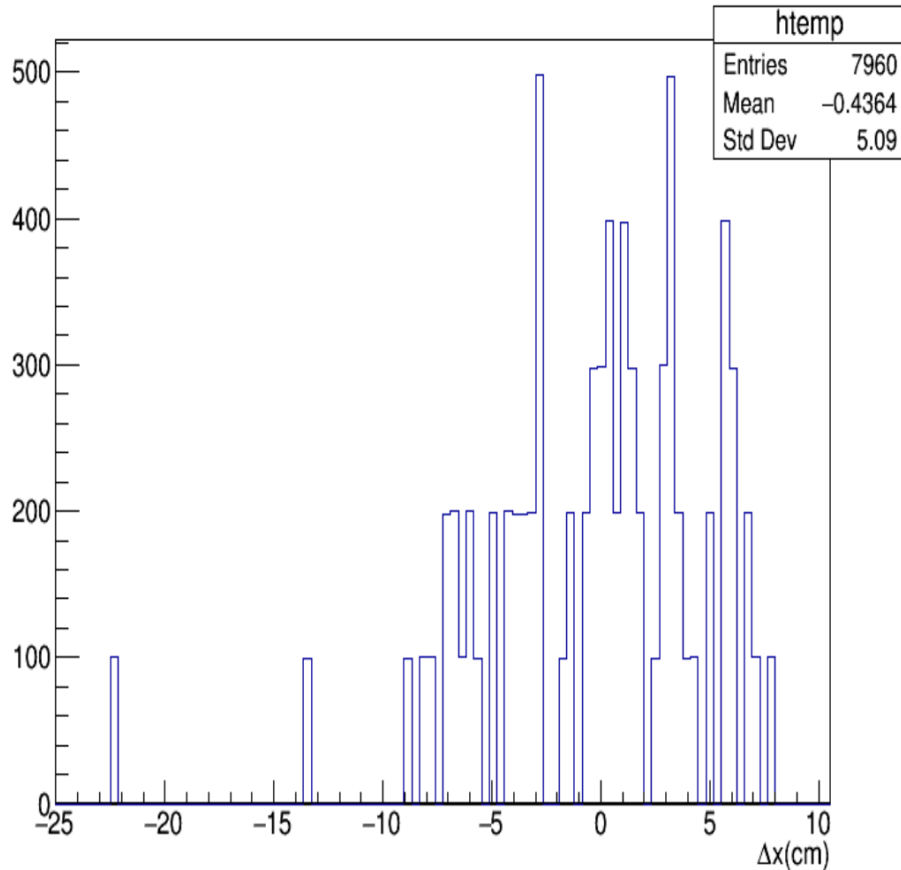Simulation – reconstruction chain tested for new beam simulation files
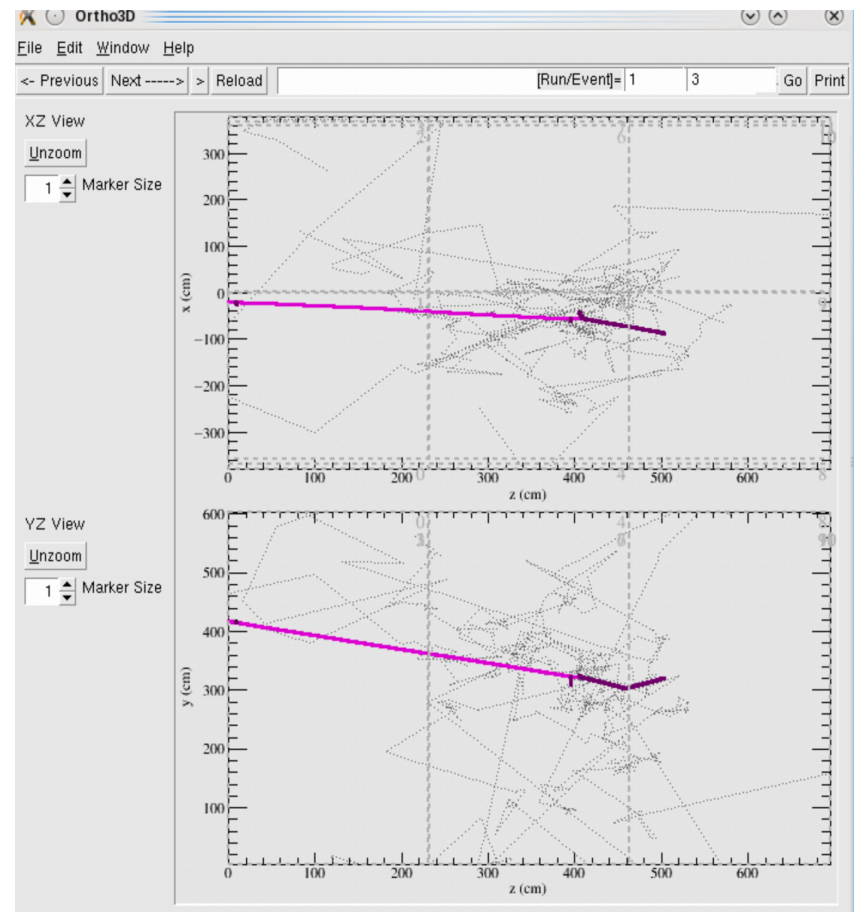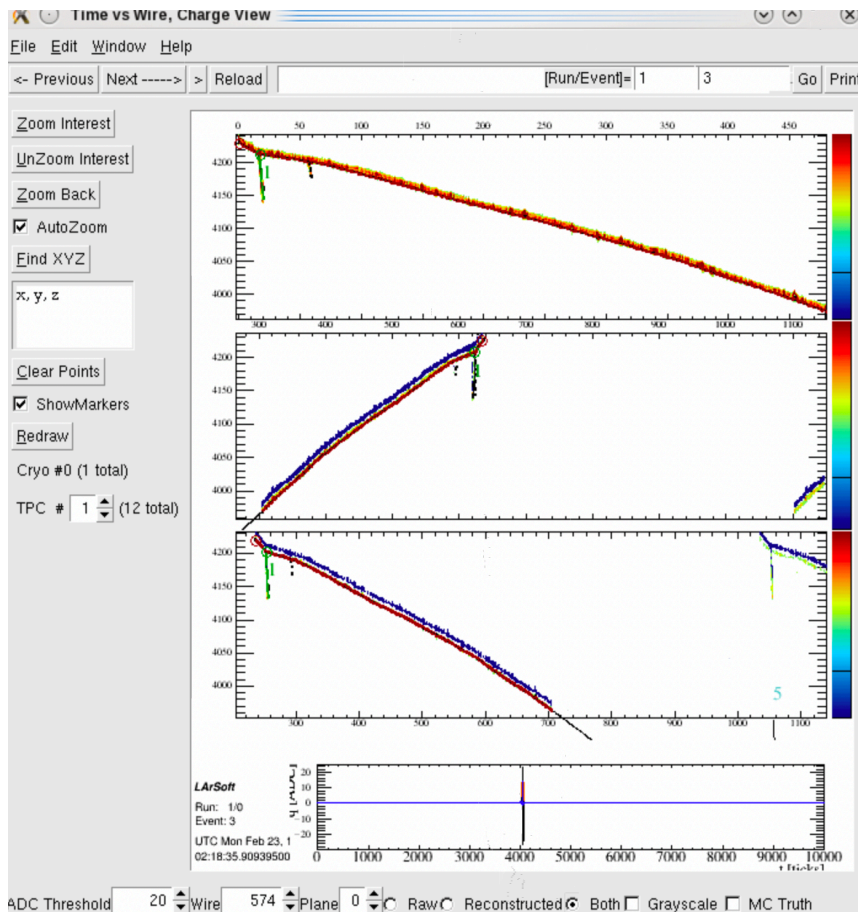
Beam- TPC Matching

MCTruth and BP4 Projection Position Comparison
Hoping to merge the effort

Beam DB fake data generation using larsoft (beam interface) - Regarding time stamps

- Original beam simulation time stamps seem invalid

- Might also be useful to MCC10 events to have realistic time stamps?

- In MCC9, the number of overlays from the beam is N = I(2R)/s, where I = 10^6, R = 4ms and s = 4.8s (=1666)

- For each event, with triggered beam event centered at zero, overlaid time stamps are a uniform distribution from -4ms to 4ms

- Since Beam DB require realistic time stamps to request the data, we will need realistic time stamps for the events of each spill and the events in between two spills.

- The time interval for each triggered beam event is 0.04 second and make 120 events per 4.8 seconds spill (25 Hz) based on the information from the TDR (Nth triggered beam event starts at time N*0.04s with overlaid interactions uniformly distributed from -4ms to 4ms away from the center

Beam DB fake data generation using larsoft (beam interface)

- Regarding beam instrumentation digitalization

- Regarding how beam interface should assign continuous run and sub-run numbers / time stamps each job submission

- Make relations between event time stamps and run numbers using the empty event time stamp plug-in modules in ArtCore and Nutools

Back-up Slides and Links

- July beam simulation updates by Marcel
  https://indico.fnal.gov/event/14693/material/slides/0?contribId=0

- About beam/TPC merging

  https://indico.fnal.gov/event/13293/session/6/contribution/120/material/slides/0.pdf

- About DB data generation using larsoft

  https://indico.fnal.gov/event/15355/contribution/2/material/slides/0.pdf

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