VD Hit reconstruction and Pandora

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Samples

- **In the following slides, the samples under consideration are:**

HD: MCC11 _dune10kt_1x2x6_mcc11_lbl_reco

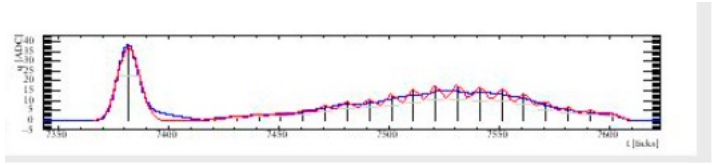
VD: prodgenie_nu_dunevd10kt_1x8x6_3view_30deg

- **Also took a first look at the new VD production for the TDR:**

FDVDPRod2_nu_30deg_NoRawDigits_reco_v09_53_00d02

Outline

- Looking at VD samples reconstruction performance, we noticed a discrepancy between HD (MCC11) and the new VD samples https://indico.fnal.gov/event/55098/
- Especially noticeable for protons and pions
- Taking a look at a few events in Pandora



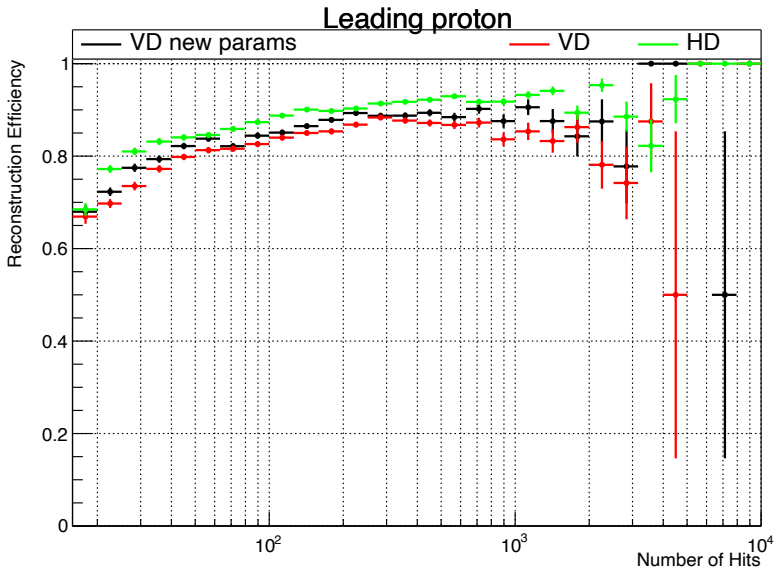
- The following parameters differ between the HD and VD samples:

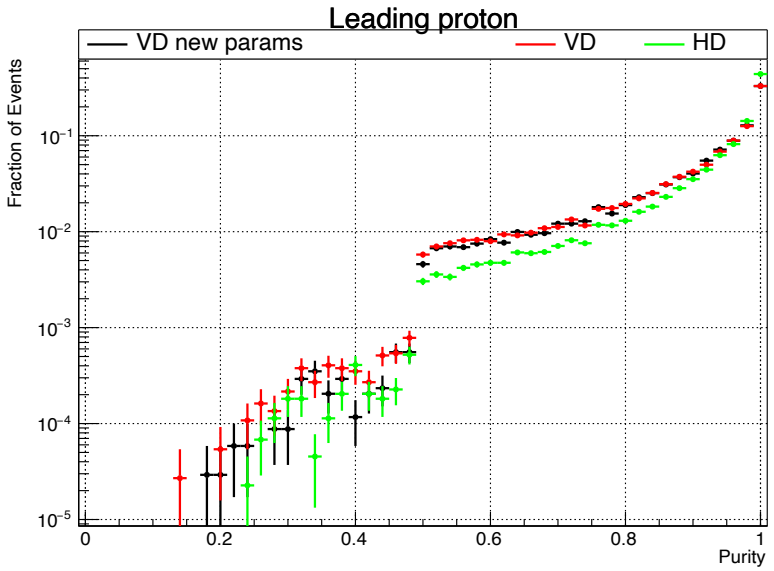
physics.producers.gaushit.LongMaxHits: [1, 1, 1] (was 25 for VD)
physics.producers.gaushit.LongPulseWidth: [16, 16, 16] (was 10 for VD)

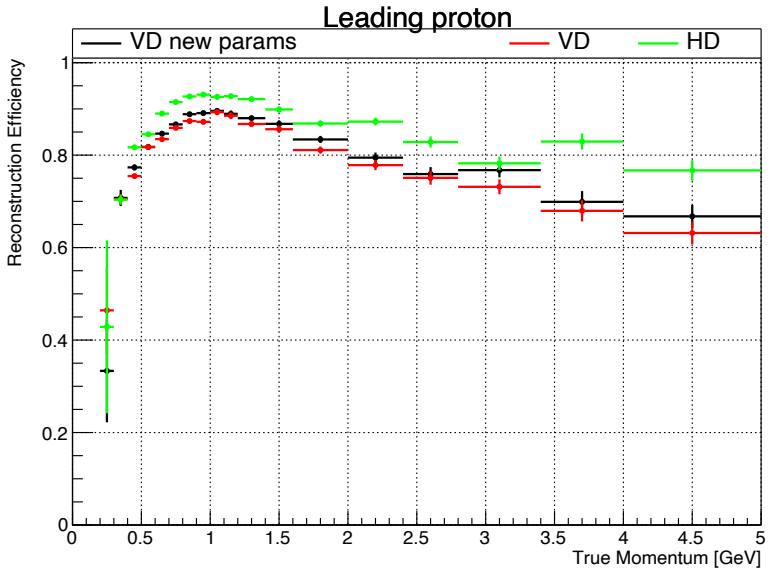
Number of hits to split a long waveform in
Width of the pulses in pulse train
(always set to be EndT - StartT
when LongMaxHit = 1)*

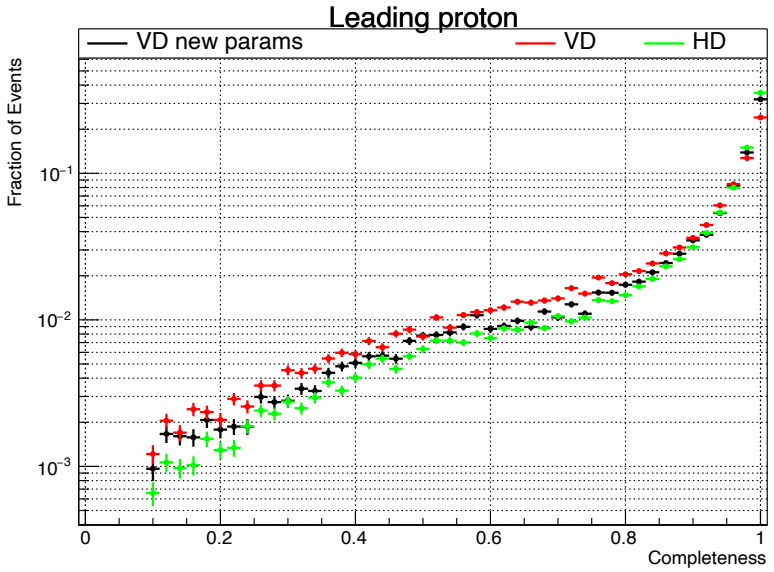
*https://github.com/LArSoft/larreco/blob/develop/larreco/HitFinder/GausHitFinder_module.cc

Efficiency with/without new gaushit params

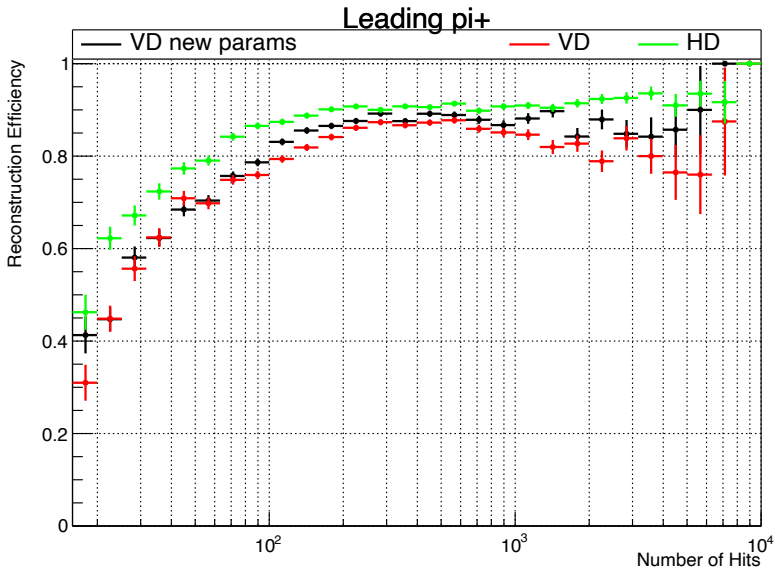


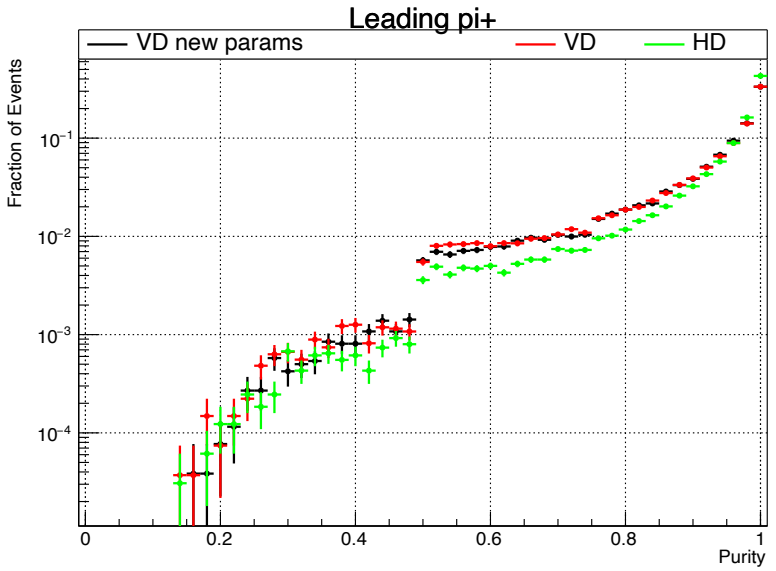


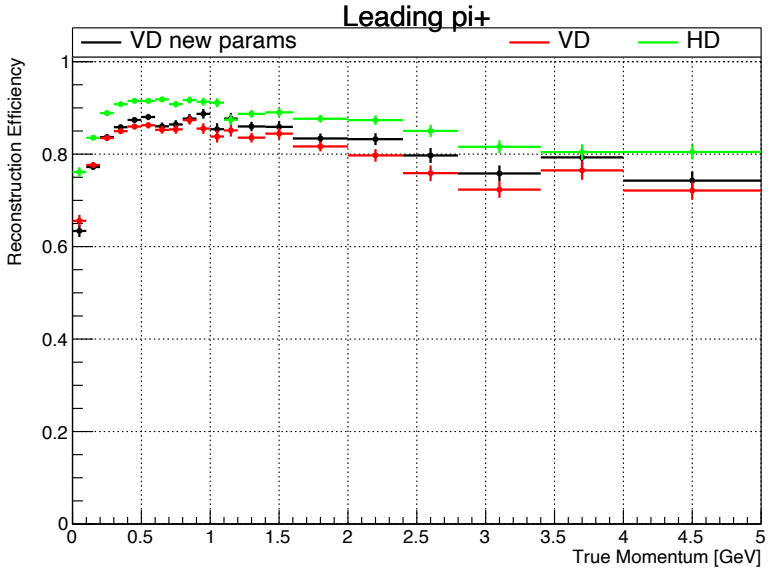


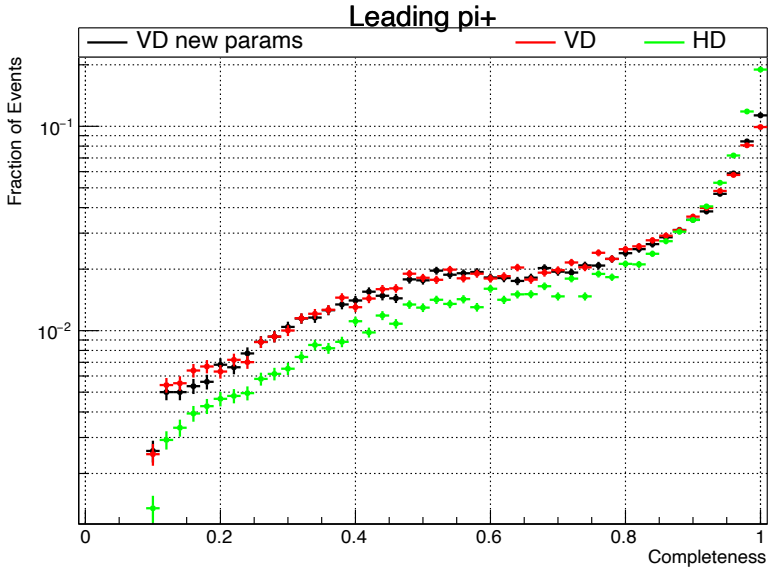


Efficiency with/without new gaushit params (2)





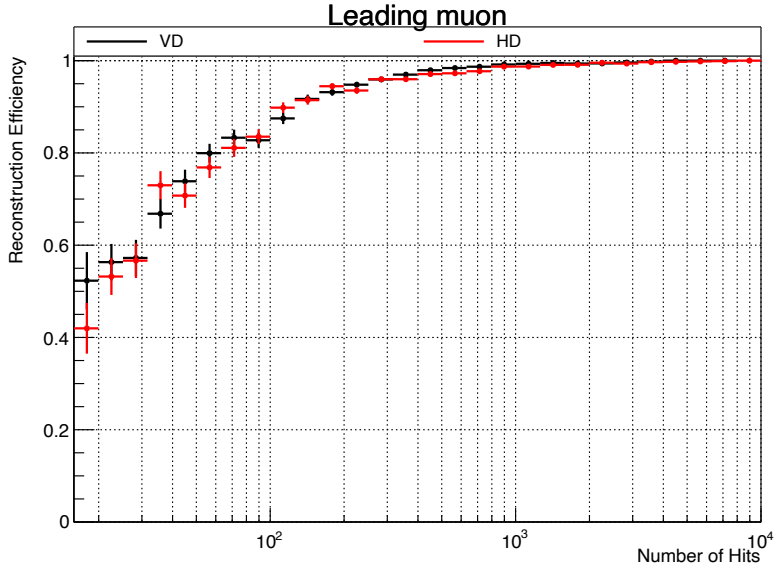


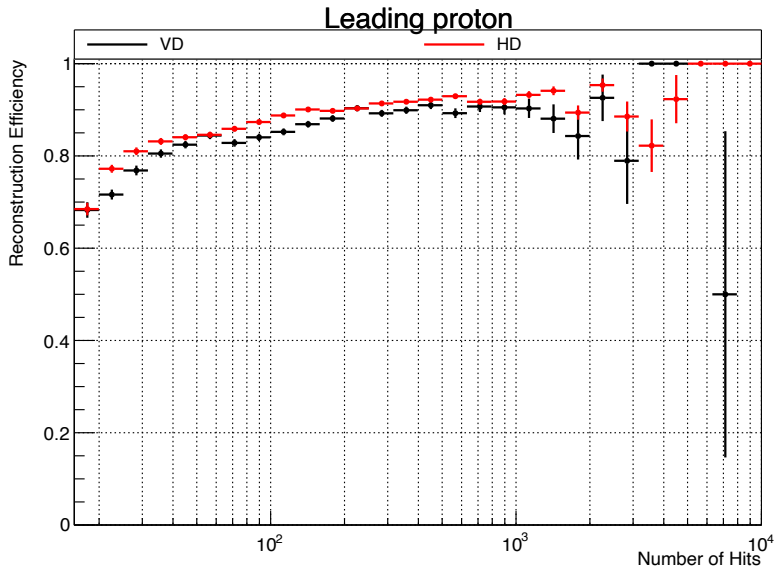


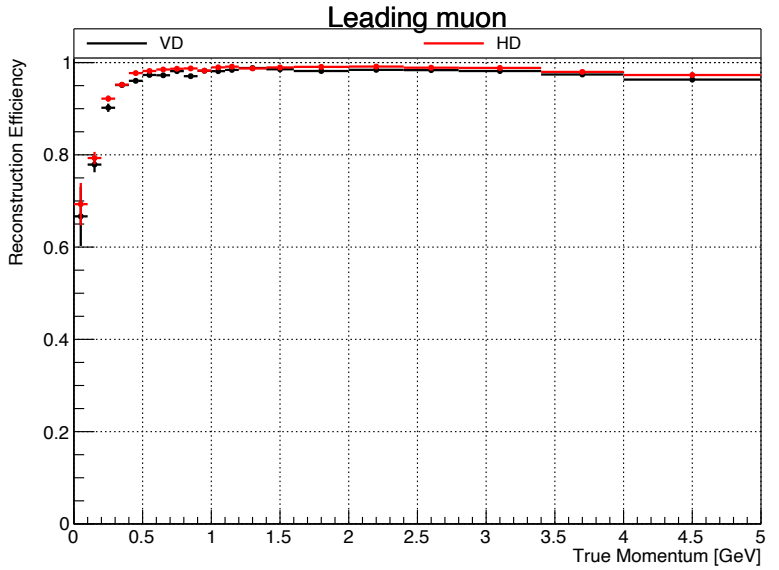
New VD production efficiency studies

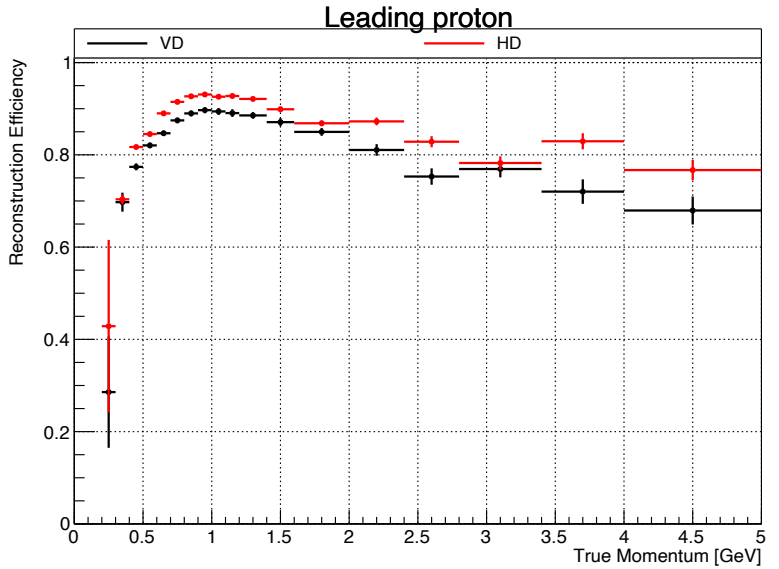
- Work is ongoing for studying the performance of the new VD production for the TDR
- We plan to include plots of :
  - Leading lepton reconstruction efficiency vs true momentum
  - Leading lepton reconstruction efficiency as a function of angles
- For now, have taken a first look at leading muon/proton efficiency

New VD production efficiency studies (2)









Original patrec-driven performance metrics*

- Try to match MC particles with reconstructed particles
  (reconstructable MC particles: > 5 hits per view in at least 2 views, > 15 hits in total)

- **Efficiency:** fraction of reconstructable MC particles with at least one matched reconstructed particle

- For each MC/reconstructed particle pair:
  - **Purity:** How many reco particle hits belong to best matched true particle?
  - **Completeness** : How many true particle hits are assigned to best matched reco particle?

- **Correct event fraction:** fraction of events with exactly one reconstructed particle matched to each target MC particle, passing quality cuts on n. of shared hits (>5), purity (> 50%), completeness (>10%)

* MicroBooNE Pandora paper: arXiv:1708.03135v1

LongMaxHits and LongPulseWidth use in Gaushit

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```
int nHitsThisPulse = (endT - startT) / longPulseWidth;

if (nHitsThisPulse > fLongMaxHitsVec.at(plane))
{ nHitsThisPulse = fLongMaxHitsVec.at(plane); longPulseWidth = (endT - startT) / nHitsThisPulse; }
```