

PDS automatic validation

DUNE FD Sim-Reco Meeting

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...with a huge help from Vito Di Benedetto,
Andy Chappell and Pablo Barham Alzás

Continuous Integration Workflow - production

Motivation

Monitor simulation/reconstruction performance after any **change** in the code by **validating** a sample against a given **reference**.

Production workflow

Simulation workflow follow the “standard” adopted within PDS studies in the low-energy WG

- ▶ 100k events simulated by MARLEY with flat energy spectrum
- ▶ `sim` and `reco` stages for light only
- ▶ ≈ 2 h run time

```
...  
[gen]  
FHiCL = prodmarley_nue_flat_dunevd10kt_1x8x14_3view_30deg.fcl  
...  
  
[g4]  
FHiCL = supernova_g4stage1_dunevd10kt_1x8x14_3view_30deg.fcl,  
        standard_g4stage2_dunevd10kt_1x8x14_3view_30deg.fcl  
...  
  
[sim]  
FHiCL = standard_detsim_dunevd10kt_1x8x14_3view_30deg_light.fcl  
...  
  
[reco]  
FHiCL = standard_reco_dunevd10kt_1x8x14_3view_30deg_light.fcl  
  
git lar_ci:feature/mib_pds_ci  
    cfg/dune/grid_workflow-DUNE_vd_pds_validation.cfg  
    cfg/dune/grid_workflow-DUNE_vd_pds_reference.cfg
```

🔗 MiB-DunePDS - Lab/**duneana**
including few extra-analyzers and
the analysis stage configuration `fhicl`

📄 `standard_ana_marley_opflash.fcl`

```
...
analyzers:
{
  analysistree: @local::dune10kt_analysistree // from AnalysisTree.fcl
  vdfmatch: @local::marley_vdfmatchana // from FlashMatchAna.fcl
  opflashana: @local::dunefd_opflashana // from OpFlashAna.fcl
  simphotons: @local::dunefd_simphotonsana // from SimPhotonsAna.fcl
}
...
```

`SimPhotons_module.cc`

(originally from Pablo Barham Alzás)

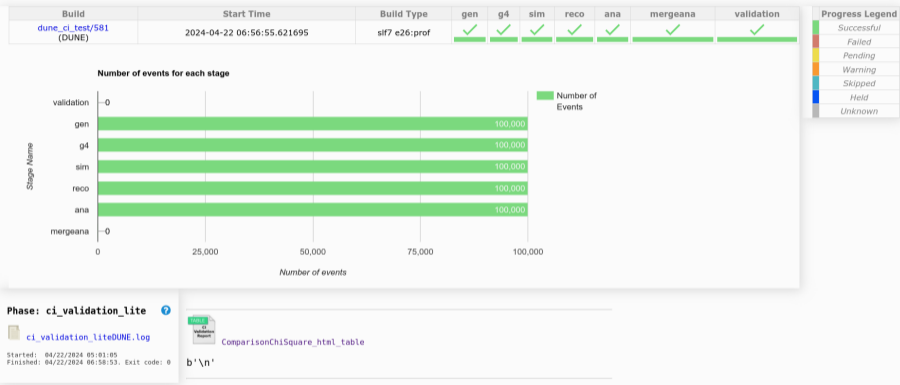
Collect for each opDet
the `SimPhotonsLite` objects (time, hit)
produced by any instance of the light simulation
(PDFastSimAr, PDFastSimXe, External Ar/Xe, ...)

⚠ Warning

Because of correction factors in Ar/Xe scintillation
light, results should be considered even *more*
preliminary

Validation - results

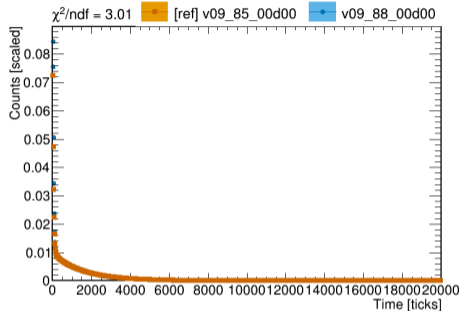
DUNE VD PDS VALIDATION v09_88_00d00



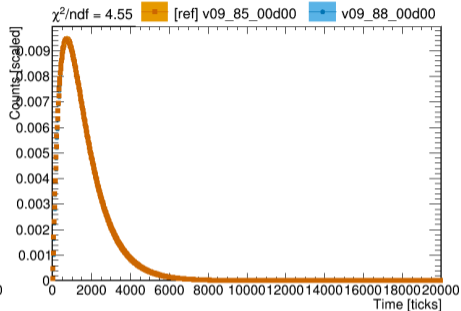
Still an issue with the transfer of the validation stage products (despite the ✓)

Scintillation properties: time profile

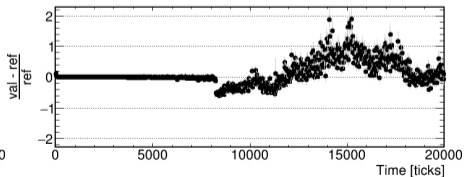
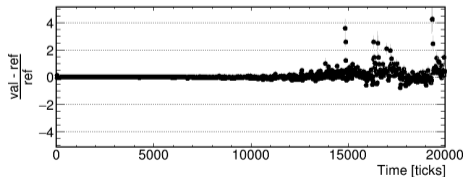
Ar photons time profile



Xe photons time profile

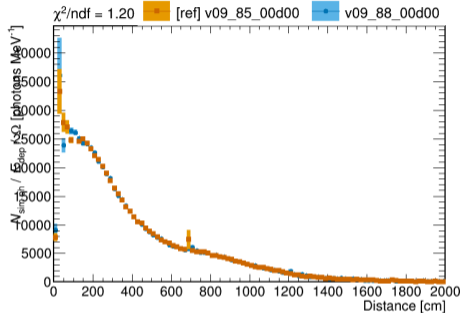


Check time distribution of SimPhotonsLite objects collected by all OpDets (PDFastSimeAr and PDFastSimXe) only

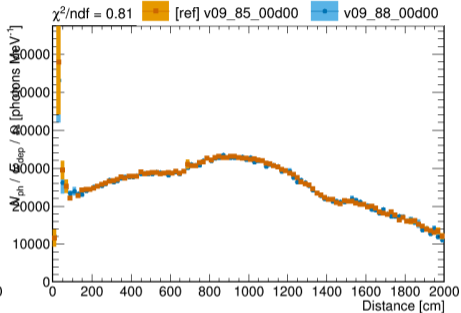


Transport properties: light attenuation

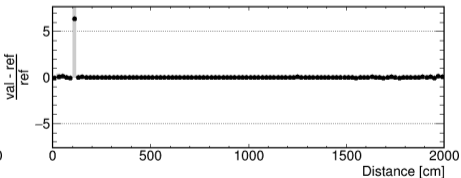
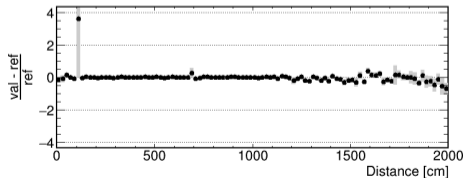
Ar scintillation profile vs distance from optical detector



Xe scintillation profile vs distance from optical detector

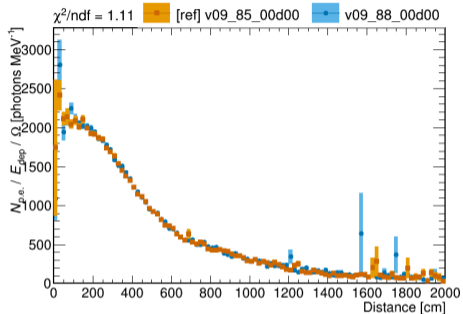


$N_{\text{sim ph}}^{\text{Ar/Xe}} / E_{\text{dep}}$
 corrected for scint
 pre-scaling,
 Ar/Xe corrections and
 solid angle fraction
 $\Omega = A / (4\pi d^2) \hat{r} \cdot \hat{n}$

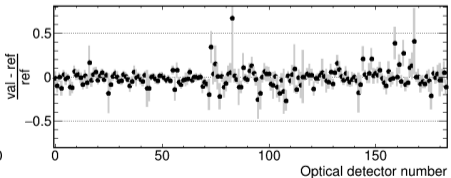
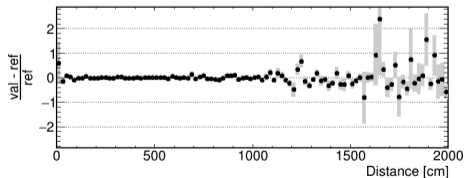
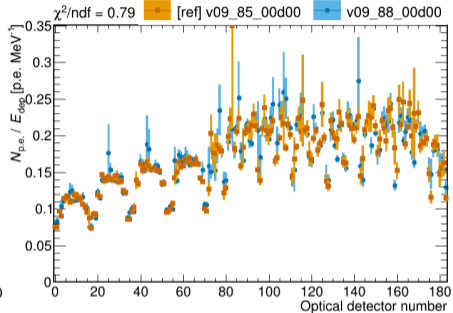


Reconstructed p.e.: light attenuation & avg charge per OpDet

Reconstructed photoelectrons vs distance from optical detector

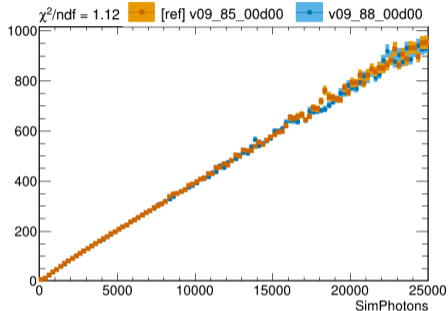


Average nr of photoelectrons / E_{dep} per optical detector

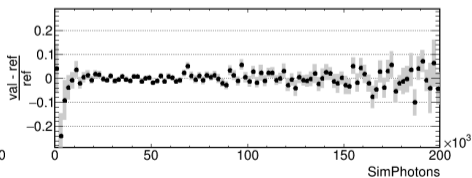
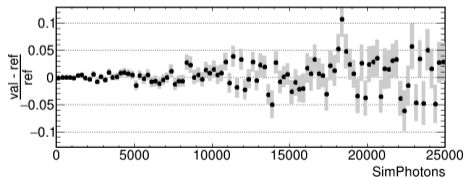
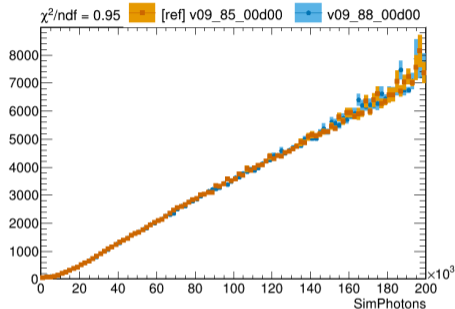


Reconstructed p.e.: signal proportionality

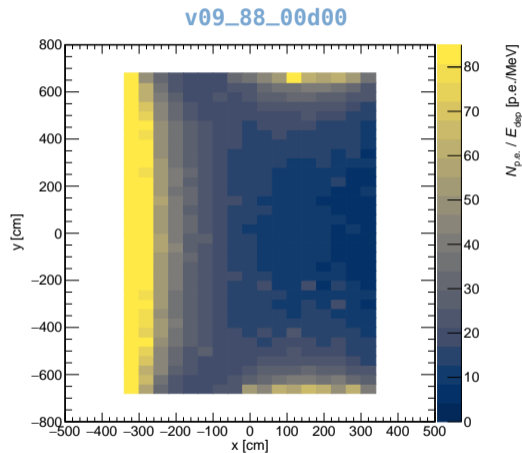
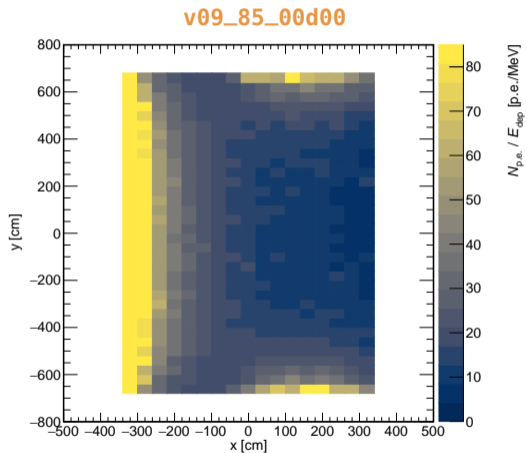
Reconstructed p.e. vs True SimPhotons (per OpDet)



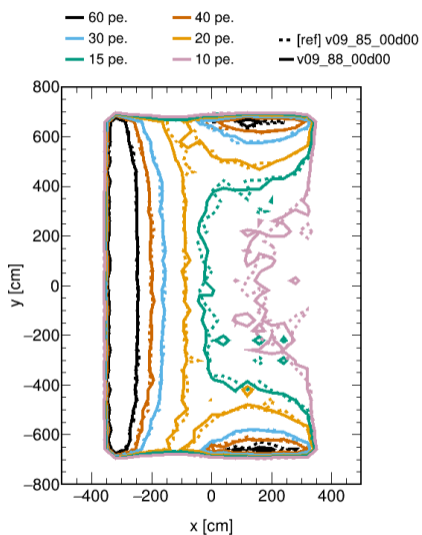
Reconstructed p.e. vs True SimPhotons (total)



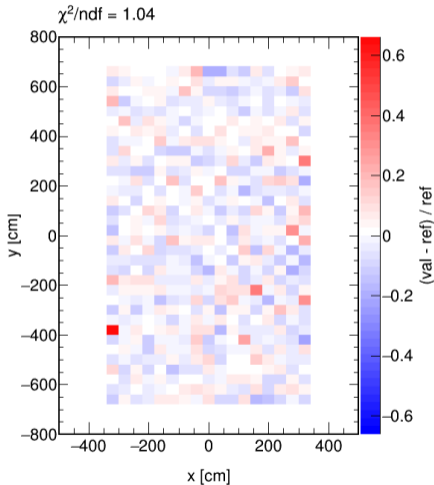
Effective Light Yield map



Effective Light Yield map



Effective Light Yield



Outlooks

- ▶ PDS automatic validation (almost) ready for use
Issue in validation stage to be fixed soon
- ▶ Looking forward for feedback!
More plots? Fewer plots?
e.g., Possibility to include a comparison with a lightmap
derived from the Semianalytical/ComputableGraph
Fast Simulation model.
[see G. Brunetti, <https://indico.fnal.gov/event/56743/>]

