

NP04 analysis organization

- Thursday meetings will disappear (discussed on Fridays) So this will be to forum for NP04 PDS analyses.
- **1st goal:** PDS performance paper by the end of the year. See talk by Anselmo:

<https://indico.fnal.gov/event/66606/>
- Sign up for the new [list of analyses tasks](#).
- Use the [#pd-sim-reco](#) channel to discuss your analysis! Open to everyone, easier to bring new contributors!
- Report on this meeting, not only results, but also the status of the analysis!
- Contact Laura P. and J. Soto!
- [Waffles](#) is being used for the first data analyses.
- [Waffles](#)+LArSoft workshop soon.

New analysis task spreadsheet

#	Scope	Priority	Task item	Deliverables	People responsible	People collaborating	Emails	Status	Link to results	Main WG	Other WGs
1	Performance studies	High (paper)	IV curves and Vbd	IV curves and Vbd for all channels, estimate differences between HPK and FBK, and compare with the paper.	Anna Balbonni			Ongoing		PD consortium	DRA
2	Performance studies	High (paper)	Noisy and problematic channels	TBD	Federico Galizzi			Ongoing		PD consortium	DRA
3	Performance studies	High (paper)	Single PE characterization	SPE template per channel, quantitative comparison between channels, stability over time.	Henrique Souza Federico Maritza Renan			Ongoing		PD consortium	DRA
4	Performance studies	High (paper)	Time profile studies	Tau slow/fast, Ratio slow/fast per channel, vs drift field, over time. Toy montecarlo to estimate the systematic error of the deconvolution for cosmic data.	Henrique Souza			Ongoing		PD consortium	DRA
5	Performance studies	High (paper)	Time profile studies	Same, for beam data	Henrique Souza			Ongoing		PD consortium	DRA
6	Performance studies	High (paper)	Time profile studies	Same, for CRT data				Ongoing		PD consortium	DRA
7	Performance studies	High (paper)	Gain vs voltage, SNR, calibration (Using LCS)	Gain vs voltage and SNR per channel, stability over time + comparsion with the paper.	Julio Ureña Federico Laura Perez			Ongoing		PD consortium	DRA, Calib

- **4 scopes (code colors):** Performance, physics analysis, MC development and software tools.
- Tagged by **priority**, and defined **deliverables**.
- It aims to help monitoring and prioritizing analyses.
- 2 tabs: NP04 and NP02.
- Please, review the tasks, and contact us to sign up/correct current assignments.

Status of PDHD simulation

- Daphne decoder in place: Ensure to run v10, to have the [fixed Daphne-LArSoft mapping](#).
- Forthcoming radiological generators to decay0 ([PR](#)).
- Three fast simulation are available.
 - SemiAnalytical model (include timing) -> New standard [soon](#).
 - **A computable graph (do not include timing)**.
 - Photon libraries (include timing from the hybrid model)
- Workflow rearranged, to make it simple for CG and PL.
- New [Detsim module](#) will be merged soon (details in the next slides).
- The **deconvolution+reconstruction modules** (Maritza, Viktor, PR also ready to merge).

New PDHD module

```
protodunehd_opdigi: {  
  CrossTalk: 0.09 # % for 45% PDE HPK from fig 15 DOI 10.1088/1748-0221/19/01/T01007  
  DarkCountRate: 415 # in Hz 26*36mm2 * 48SiPMs = 415 Hz from fig 13 DOI  
10.1088/1748-0221/19/01/T01007  
  DefaultSimWindow: true # true for simulating the 2 drift-time windows.  
  TimeBegin: -20 #in us, starting of the DAQ readout window, not used if DefaultSimWindow:  
true  
  TimeEnd: 20 # in us,ending of the DAQ readout window, not used if DefaultSimWindow: true  
  ExportWaveformTree: false # true to export waveforms in a plain tree too.  
  FullStreamingChannels: [120,121,122,123,124,125,126,127,  
128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,  
148,149,150,151,152,153,154,155,156,157,158,159]  
  InputModules: [  
    "PDFastSim",  
    "PDFastSimExternal" #this module is only used when simulating with the semianalytical  
model.  
  ]  
  LineNoiseRMS: 4.5 #Based on F. Galizzi's study, see https://indico.fnal.gov/event/66616/  
  Padding: 400  
  Pedestal: 13000 # or baseline  
  SPETemplateMap: [ ["SPE_DAPHNE2_FBK_2022.dat" ,  
[4,14,24,34,40,42,45,46,47,49,50,52,55,56,57,59,60,62,65,66,67,69,70,72,  
75,76,77,79,84,85,86,87,94,95,96,97,104,105,106,107,114,115,116,117,120,  
121,124,125,127,129,130,131,134,135,137,139,140,141,144,145,147,149,150,  
151,154,155,157,159]],  
["SPE_DAPHNE2_HPK_2022.dat",  
[0,1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,18,19,20,21,22,23,25,26,27,28,29,  
30,31,32,33,35,36,37,38,39,41,43,44,48,51,53,54,58,61,63,64,68,71,73,74,  
78,80,81,82,83,88,89,90,91,92,93,98,99,100,101,102,103,108,109,110,111,112,  
113,118,119,122,123,126,128,132,133,136,138,142,143,146,148,152,153,156,158]]]  
}
```

```
SelfTrigger_DaphneThreshold: 65 #Daphne selftrigger configuration, default threshold for  
self-trigger channels.  
SelfTrigger_DaphneThresholdMap: [[45,[34,24,14,4]]] #Customized daphne selftrigger  
threshold,  
#only 4 channels have a threshold of 45ADC  
SelfTrigger_Pretrigger: 128 # Daphne selftrigger configuration, number of pretrigger  
samples.  
SelfTrigger_ReadoutWindow: 1000 #Daphne selftrigger configuration  
CustomPDEperOpDet: true # true to use PDEVector  
PDE: 3 #percent. Not used if CustomPDEperOpDet is true  
PDEVector:[2.17,2.17,1.59,1.59,2.22,2.17,1.59,1.59,2.17,2.17,2.17,2.17,1.59,1.59,  
2.22,2.17,1.59,1.59,2.17,2.17,2.17,2.17,1.59,1.59,2.22,2.17,1.59,1.59,2.17,2.17,  
2.17,2.17,1.59,1.59,2.22,2.17,1.59,1.59,2.17,2.17,1.58,1.59,2.22,1.59,2.17,2.22,  
1.58,2.22,2.17,2.22,1.58,1.59,2.22,1.59,2.17,2.22,1.58,2.22,2.17,2.22,1.58,1.59,  
2.22,1.59,2.17,2.22,2.22,2.17,2.22,1.58,1.59,2.22,1.59,2.17,2.22,1.58,2.22,  
2.17,2.22,1.59,2.17,1.59,2.17,1.58,1.58,1.58,2.22,2.17,1.59,1.59,2.17,1.59,2.17,  
1.58,1.58,1.58,2.22,2.17,1.59,1.59,2.17,1.59,1.59,2.22,2.22,1.58,2.22,2.17,1.59,2.22,1.58,2.17,  
1.59,1.58,2.22,1.59,1.58,2.22,1.58,2.17,1.59,1.58,2.22,1.59,1.58,1.59,1.58,2.22,1.58,  
2.17,2.17,2.22,2.22,1.59,1.58,1.59,1.58,2.22,1.58,2.17,2.17,2.22,2.22,1.59,1.58,  
1.59,1.58] # percent, based on Eur. Phys. J. C 84, 1004 (2024) details on L. Perez's  
#talk, https://indico.fnal.gov/event/66616/  
CustomSPEAmplitudeperOpDet: true  
SPEAmplitude: 15 # not used if CustomSPEAmplitudeperOpDet: true, used vector instead  
SPEAmplitudeVector:[  
15.11, 14.73, 14.65, 15, 11.41, 14.84, 16.14, 14.9, 16.27, 15.88,  
...  
11.31, 12.2, 15.07, 15.16, 11.43, 10.65, 11.6, 11.11, 16.74, 12.1  
] # Based on F. Galizzi's study, see https://indico.fnal.gov/event/66616/  
SSP_LED_DigiTree: false # true to generate a tree for debugging purposes  
module_type: "OpDetDigitizerProtoDUNEHD"
```

New PDHD samples

Small PDHD samples focused on light data to validate simulation (only up to detsim, and only PDS):

/eos/user/j/jsotooto/PDHDSamples/Cosmics: Corsika+radiologicals

- 2 samples, LArSoft v9 and v10.

/eos/user/j/jsotooto/PDHDSamples/electronsampl: One 50MeV electron per event, placed randomly within the TPC.

- 1 bigger sample with MC data, PL only.
- 1 sample with PL+SA+PL.
- 1 small sample for benchmarking (table in the left)

2 output files:

- LArSoft detsim file with all information.
- Detsim_hist:
 - Opdigi: Plain tree with waveforms, format compatible with Waffles.
 - Mc truth information anatree (for electron sample only).
 - Photoncounter: Plain tree with the number of photons arriving to each opdet.

Volunteers to validate the simulation?

```
TrigReport ----- Event summary -----
TrigReport Events total = 10 passed = 10 failed = 0

TrigReport ----- Modules in End-path -----
TrigReport      Run      Success      Error Name
TrigReport      10       10         0 out1

TimeReport ----- Time summary [sec] -----
TimeReport CPU = 33.323955 Real = 23.429348

MemReport ----- Memory summary [base-10 MB] -----
MemReport VmPeak = 2450.06 VmHWM = 1051.55

Art has completed and will exit with status 0.
```

	Memory	CPU
Semianalytical model	1500±200	4±4
Computable Graph	2400±40	40±3
Photon library	1500±0.1	2.8±0.3

Simulation tasks

#	Scope	Priority	Task item	Deliverables
27	MC Development (LArSoft) ▼	Medium	Include photon propagation time in the computable graph.	Modify CompGraph module, to include the semianalytical time model.
28	MC Development (LArSoft) ▼	Low	Include TF1 photon propagation time in the photon library simulation	Modify photon visibility service to read TF1 map.
29	MC Development (LArSoft) ▼	Medium	Benchmark of the three fast photon simulations.	CPU time + memory consumption for both PL
30	MC Development (LArSoft) ▼	High	Validation of the simulation workflow step y step	Plot photons received vs photons produced (Visiblity), plot photons received vs Photon detected (PDE)
31	MC Development (LArSoft) ▼	Medium	Include the full Ar volume in the simulation for PL and CG.	Update gdm1 and simulation workflow. First see how this would affect in the semianalytica model workflow.
32	MC Development (LArSoft) ▼	High	Validation of the efficiency of the deconvolution + reconstruction (LArSoft)	Plot reco PEs over number of PEs being detected by the opDet. Study the effect of using different SPE templates in this.
33	MC Development (LArSoft) ▼	Medium	Computable graph performance studies	Benchmark of the Computable graph using different number parameters, comparing computation time and simulation accuracy.
34	Tools/software development ▼	Medium	Introduce the classes for Waffles to read the simulated waveforms.	

Scope	Priority	Task item
MC Development (LArSoft) ▼	High	Correct the scintillation time tool for xenon-doped LAr.
MC Development (LArSoft) ▼	High	Integrate PMTs in the workflow
MC Development (LArSoft) ▼	High	Validation of the simulation workflow step by step
		Detsim stage able to lead with: <ul style="list-style-type: none"> - 2 channels per opDet. - Ar+Xe light. - XArapucas+PMTs. - Daphne self-trigger. - Quartz covered XArapucas+PMTs.
MC Development (LArSoft) ▼	High	