



## **DUNE 10kt HD Initial Tests**

Dom Brailsford FD sim/reco meeting 1st July 2024

Thanks to Haiwang for providing Hydra/wirecell Thanks to Viktor for providing the latest 10kt HD geometry

## Introduction

- We have been using workspace geometries for physics studies due to computing footprint constraints
  - The largest footprint comes from the signal simulation and signal processing: memory and CPU time are prohibitively large out of the box
- Recent developments in wirecell (Hydra: previous talk) have potentially unlocked the signal simulation and signal processing for the full 10kt
- Workflows are now being configured for the horizontal drift 10kt geometry
  - Heavily reuses well-tested 1x2x6 HD sim/reco

## Branches for 10kt HD

- Larsoft: v09\_91\_00
- **dunesw**: dbrailsf\_dune10kt
  - Sets up job fcls
- dunesim: dbrailsf\_dune10kt
  - Sets up larg4 sensitive detector
- dunereco: hydra
  - Wirecell signal sim/sig proc for full 10kt (hydra)
- **dunecore:** feature/vpec\_add\_fd\_full\_geom\_gdml
  - Latest 10kt geometry

## Test sample

- Single particle gun muon
  - 5 GeV
  - Fired from near the edge APA into the detector
  - Shallow-ish angles
- Blue line is the true muon trajectory traced through the 10kt geom



# Computing footprint

Stage	Max mem. (GB)	Average time (s)	rage time (s) Producer		
Gen	0.7	0.002	SingleGen	0.002	
			LArG4Main	0.19	
G4	1.2	221	IonAndScint	0.04	
			PDFastSimPAR	220	
Dotoim	6 5	15/	WireCellToolkit	128	
Detaill	0.0	IJ <del>4</del>	OpDetDigitizerDUNE	26	
	1.0		GausHit	0.37	
Reco1		0.6	SpacePointSolver	0.17	
			DisambigFromSP	0.01	
			Pandora	2.7	
Reco2	2 <b>3.4 16</b>	160	EMTrackMichelID	82	
		100	PMAlgTrackMaker	12.5	
			•••	62	

**On-disk size is ~30MB per event (for all stages)** 

### **Event display**



### Event display

- Blue is the true muon
- Red is the reconstructed trajectory with Pandora
- Muon traversed two TPC boundaries and the reconstruction successfully merged



# Summary and to do list

- Mechanically, the 10kt sim/reco workflow (with wirecell/hydra) works
  - The output from the small stats look good (by eye)
  - Some sections of the workflow carry a large computing footprint
- TODO
  - Configure the beam window for generating GENIE events
  - Understand the larger chunks of the computing footprint
  - Run the validation system with this workflow to test with high statistics

# Gen (20 degree muon)

TimeTracker printout (sec)	DUNE abstract Min [External] DUNE a	approval form Avg bstract stomitted	for approval [Goog	Median	09159 RMS	Thevts u for yo usual for me to re
Full event raits	0.000162549	0.00248577	0.0070452	0.000249571	DUN <b>0.0032242</b>	3
<pre>source:EmptyEvent(read)</pre>	13.6959e-05 sta	9.04353e-05	0.000171681	6.2666e-05	05.84001e-05	3
simulate:rns:RandomNumberSaver	P1.0474e-05 Ph	6.3165e-05 he	0.000159154	1.9867e-05	6.79827e-05	3
simulate:generator:SingleGen	Hi <b>1.177e-05</b> aree	0.00159966	0.00476455	2.2659e-05	nd 0.00223792	3
[art]:TriggerResults:TriggerResultInserter	Dc5144eb06ooks	1.43973e-05	83.0761e-05	F 6.991e-06 k	<1.15882e-05	3
end_path:out1:RootOutput	1.021e-06	3.59633e-06	8.315e-06	1.453e-06	3.34126e-06	3
end_path:out1:RootOutput(write)	3.8857e-05	0.000576375	0.00163908	5.1183e-05 <sup>Ye</sup>	0.000751466	3
#MSG-i NuRandomService: RootOutput:out1@End	Job 01-Jul-2024	06:36:26 CDT	ModuleEndJob	ore clicking links c xternal sender Hi	nr DUNE	
Summary of seeds computed by the NuRandomSer Random policy: 'perEvent' algorithm version: EventTimestamp_v1	vice Frabhjot, Aleen [External] DUNE T This email originat					
Google 1,879						
Lancaster						
MemoryTracker summary (base-10 MB units used	This email originat This email originat attachments. [EXT	ostract submitted ted outside the Un [ERNAL] – This me	iversity. Check bef ssage is from an e	ne Form ore clicking links c xternal sender De		
Peak virtual memory usage (VmPeak) : 1464 Peak resident set size usage (VmHWM): 776.	.53 MB 589¢MBia, Justin (					
	External_Notifica This email originat	<u>tion for submissio</u> ed outside the Un	<u>e of DUNE Collabo</u> iversity: Check bef	<del>ration - Planary ta</del> ore clickina links c		
TrigReport Event summary						
TrigReport Events total = 3 passed = 3 faile	d = 0 thetrainline bus					
E Archive						
TrigReport Modules in End-path						
IrigReport Run Success Error	Name attachments. AUT					
TrigReport 3 3 0	outl					
TimeReport Time summary [sec] TimeReport CPU = 0.934645 Real = 1.576066						
Momony cummany Flago 1	attachments. Do n					
MemReport VmPeak = 1464.53 VmHWM = 776.589	DUNE abstract	approval form		24/0	)6/2024	

# G4 (20 degree muon)

TimeTracker printout (sec)	Min	Avg	Max	Median	RMS	nEvts	
Fullevent	196.185	<b>221.27</b> 2024 poster: pion-a	263.593	204.032	30.0977	JN 3 Nowal	
source:RootInput(read)	0.000256035	0.000351667	0.000522129	0.000276838	0.000120833	3 To: Bri	
simulate:rns:RandomNumberSaver	2.3512e-05	7.77933e-05	0.000185794	2.4074e-05	7.63683e-05	3	
simulate:largeant:larg4Main	0.177095	0.184385	0.193803	0.182256	0.00698521	3	
simulate:IonAndScint:IonAndScint	0.0393406	0.0399552	0.0409011	0.0396239	0.000678781	Thar <mark>3</mark> : you for y	
simulate:PDFastSim:PDFastSimPAR	195.432	220.481	262.745	203.265	30.0559	usual for me to	
[art]:TriggerResults:TriggerResultInserter	1.0755e-05	1.90243e-05	3.551e-05	1.0808e-05	1.16571e-05	3	
end_path:out1:RootOutput	2.204e-06	6.06333e-06	1.3531e-05	2.455e-06	5.28143e-06	3	
end_path:out1:RootOutput(write)	N0.535966 osl	avv 0.564178	0.611856	0.544712	og <b>0.033902</b>	3	
		nsioo=talkant-Ste	fiidd=======				

GMSG-i NuRandomService: RootOutput:out1@EndJob.01-Jul-2024.06:50:55 CDTni ModuleEndJob.ks.Uve.cold.him.and

DUNE abstract approval form	
loduleLabel.InstanceName <sup>e</sup> the University Check before clic	
ConAndScint.ISCalcAlg	
PDFastSim.photon	
DFastSim.scinttime	
argeant	
External DONE abstract submitted for approval (Cobyle For	<del>nj=====</del> Ø 3 (
	[External] DUNE abstract submitted for approval [Google Form loduleLabel.InstanceName IonAndScint.ISCalcAlg DFastSim.photon DFastSim.scinttime argeant Patricia & Justin

mReport VmPeak = 2016.69 VmHWM = 1205.78 DUNE abstract approval form

# detsim (20 degree muon)

TimeTracker printout (sec)	This e <b>Min</b> origina	nted out AV9 the Un	iversity.Max.ck bef	ore c <b>Median</b> nks	or RMS	nEvts
Full event	126.488	154.597	203.822	133.482	34.9242	3
source:RootInput(read)	0.000321813	ati <b>0:00345096</b> sio	n ( <b>0.00524862</b> bo	ra <b>0.00478246</b> ta	0.00222081	3
simulate:tpcrawdecoder:WireCellToolkit	This <b>117-901</b> igina	ated 01270734e Un	iversi <b>146. 429</b> bef	ore ci <mark>118,872</mark> ks	or 13.2255	3
simulate:opdigi:OpDetDigitizerDUNE	atta7h95325 [EX	26.2209° m	essao <b>56.7334</b> an e	xtern 13.976 r H	<sup>Justin</sup> 21.7153	3
simulate:rns:RandomNumberSaver	1.5041e-05	6.15843e-05	0.000154368	1.5344e-05	6.56081e-05	3
[art]:TriggerResults:TriggerResultInserter	8.016e-06	1.50377e-05	2.8545e-05	8.552e-06	9.55363e-06	3
end_path:out1:RootOutput	2.472e-06	5.847e-06	1.2348e-05	2.721e-06	4.59803e-06	3
end_path:out1:RootOutput(write)	0.62728	0.638221	0.658198	0.629186	or 0.0141469 inable	3
	thetrainline bu	isiness		25/	06/2024	
MemoryTracker summary (base-10 MB units used	Texternal Your B D This email origina	ooking Confirmatio	n 290/852096 iversity. Check bef	ore clickina links	e or	
	attachments. Do					
Peak virtual memory usage (VmPeak) : 8410 Peak resident set size usage (VmHWM): 6492	0.23 MB 2.72UMBE abstrac					

# Reco1 (20 deg muon)

TimeTracker printout (sec)	[ExterMinDUNE a	abstractAvg mitted	for appMaxI [Goog	gle Fo <b>Median</b>	3 O RMS	nEvts
Full event	at 0:562171 (EX	TEF <b>0.653427</b> s me	ssa <b>0.804269</b> an a	one on 10,593842 Deal		3
source:RootInput(read)	0.00017172	<sup>8</sup> 0.000232571	0.00033539	0.000190602	7.31118e-05	3
reco:gaushit:GausHitFinder	[E0:365286tific	atio <b>0:369666</b> ssior	n o <b>f0.1374231</b> 1abo	rati@ <b>.369481</b> y ta	0.00365443	3
reco:spsolve:SpacePointSolver	T 0.0934346 in a	nted 0:173415 Uni	ver0.309918 bef	ore 01.116894ks or	0.0969957	3
reco:hitfd:DisambigFromSpacePoints	0.0176585	0.0192031 me	0.021661	0.0182899	0.00175698	3
reco:rns:RandomNumberSaver	1.7532e-05	5.53463e-05	0.000130956	1.7551e-05	5.34641e-05	3
[art]:TriggerResults:TriggerResultInserter	8.743e-06	1.56783e-05	2.9511e-05	8.781e-06 <sup>5/00</sup>	9.78118e-06	3
end_path:out1:RootOutput	2.408e-06	5.844e-06	1.2225e-05	2.899e-06	4.5165e-06	3
end_path:out1:RootOutput(write)	0.0847628	0.0905599	0.0975232	0.0893938	0.00527426	3
	• thetrainline bu	Isiness		25/06	6/2024	

attachments. Do not reply to this automated email. If you need assistance plea...

Peak virtual memory usage (VmPeak) : 5002.31 MB Peak resident set size usage (VmHWM): 1048.04 MB

24/06

## Reco2 (20 deg muon)

Full event	154.154	160.143	164.849	161.428	4.45969	3
source:RootInput(read)	Glassdoor0.000536006	0.00106974	0.00201775	0.000655461	0.000672118	ar network preferer 3
reco:linecluster:LineCluster	Just in at Lanc <mark>osted bovers</mark>	0.173771 <sup>s en</sup>	<sup>nploye</sup> 0.18554 <sup>and</sup>	0.169895	0.00848139	3
reco:trajcluster:TrajCluster	0.703679	0.771496	0.900419	0.710391	0.0912033	Glassgoor
reco:pandora:StandardPandora	2.29312	2.74453	3.53526	2.40521	0.560998	Just in <mark>3</mark> t Lancaster
reco:pandoraTrack:LArPandoraTrackCreation	0.0235611	0.0296299	0.0385715	0.0267573	0.00645586	To: Do <b>3</b> ninic Brailsfo
reco:pandoraShower:LArPandoraModularShowerCr	eation 0.234249	0.284688	0.354233	0.265583	0.0508122	Reply- <b>B</b> : Glassdoo
reco:pandoracalo:Calorimetry	0.114903	0.190992	0.23867	0.219402	0.0543749	3
reco:pandorapid:Chi2ParticleID	0.000202883	0.00058606	0.00134082	0.000214476	0.000533718	3
reco:trkshowersplit:TrackShowerHits	0.0214843	0.0224226	0.0235508	0.0222326	0.000854292	3
reco:pmtrack:PMAlgTrackMaker	Uber Eats 9.35814	12.5501	15.9087	12.3836	2.67684	3
reco:pmtrackcalo:Calorimetry	lt's been a w <b>0.0534947</b> at's	ne <b>0.0570082</b> ats	0.059558	0.0579718	0.00256742	3
reco:pmtrackpid:Chi2ParticleID	Browse thrc0.000264689	0.000280584	0.000290788	0.000286276	1.13896e-05	3
reco:pmtrajfit:PMAlgTrajFitter	membership tc3:64515Ube	anand4.90468sl E	njoy £5.187982v Fe	e on <b>151-18906</b>	0.934201	3
reco:pmtrajfitcalo:Calorimetry	0.120835	0.201746	0.242439	0.241964	0.0572131	3
reco:pmtrajfitpid:Chi2ParticleID	BWFO - V0.000209601	0.000249999	0.00027638	0.000264016	2.90082e-05	3
reco:pmtracktc:PMAlgTrackMaker	Dominic get a 7852694anic	Waln <b>8:92581</b> , Bro	oken 19985538	9.3951	1.00684	3
reco:pmtracktccalo:Calorimetry	Ending Soon 0.0754187 R	0.0944027	s Lico. 127247 1kg	0.0805424	0.0233184	3
reco:pmtracktcpid:Chi2ParticleID	o.000314567	0.000332646	0.000346205	0.000337166	1.33057e-05	3
reco:pmtrajfittc:PMAlgTrajFitter	6.13312	8.83165	14.0814	6.28048	3.7126	3
reco:pmtrajfittccalo:Calorimetry	0.0479835	0.0515862	0.0545332	0.052242	0.00271381	3
reco:pmtrajfittcpid:Chi2ParticleID	0.00045644	0.000476482	0.00051233	0.000460675	2.54075e-05	3
reco:blurredcluster:BlurredClustering	5.56572	8.23416	9.83854	9.29821	1.89972	3
reco:emtrkmichelid:EmTrackMichelId	81.3853	82.622	83.3401	83.1406	0.878276	3
reco:emshower:EMShower	Wilson C=0.00607916	0.00689143	0.00845543	0.00613968	0.00110619	3 I New
reco:cvnmap:CVNMapper	Booking Con 0.0221676 W	0.0298515	0.044865777	0.0225213	0.0106176	3
reco:cvneva:CVNEvaluator	Booking Detail0.90381, nu	1.54649717	2773 <b>2.82975</b> ks	0.905916	0.907401	3
reco:energyrecnumu:EnergyReco	Wilson Carlile 4:02714r Do	minic <b>5: 83256</b> d. Y	our b <b>7.05728</b> II se	et pl/6.41326	1.30342	3
reco:energyrecnue:EnergyReco	0.00714511	0.00863338	0.0104886	0.00826637	0.00138944	3 29 June
reco:energyrecnc:EnergyReco	MyMemory0.153286	0.155013	0.157016	0.154736	0.00153507	3
reco:energyrecnumurange:EnergyReco	Get Active, Ge <b>3-97807</b> O H	luawe <b>546795</b> ess B	land i <b>61.86776</b> 1elp	6.19267	1.23425	3 "OK"
reco:energyrecnumumcs:EnergyReco	Plus more gread 98247 and	well b5i 7799 duct	s to ki <b>7:00938</b> 0ur S	Sumn6:34785	1.29935	3
reco:opdec:Deconvolution	UK Returns   0:793508/lob	0.825001	o.860511 ealt	0.820985	0.0275007	<sub>3</sub> Former E
<pre>reco:ophitspe:OpHitFinderDeco</pre>	_ 8.33495	8.65908	8.85214	8.79016	0.230589	3
reco:opflash:OpFlashFinder	0.0105104	0.012096	0.0151597	0.010618	0.0021668	3 Pros - Fle
reco:rns:RandomNumberSaver	Your Card was removed from 1.819e-05	8.50657e-05	0.000217771	1.9236e-05	9.38378e-05	3
[art]:TriggerResults:TriggerResultInserter	9.933e-06	1.65733e-05	2.9345e-05	1.0442e-05	9.03332e-06	3 Cons - Ha
end_path:out1:RootOutput	2.518e-06	5.716e-06	1.1637e-05	2.993e-06	4.19127e-06	3
<pre>end_path:out1:RootOutput(write)</pre>	Haiwang Y <b>0</b> .896995	0.913084	0.925985	0.916273	0.0120479	3

@HaiwangYu pushed 2 commits. 75037ed wire geom file 7cbe419 rm debug

MemoryTracker summary (base-10 MB units used)

Peak virtual memory usage (VmPeak) : 8448.89 MB ve 1 Peak resident set size usage (VmHWM): 3386.96 MB ve 1