DUNE DAQ Status and News

04.09.24

Alessandro Thea



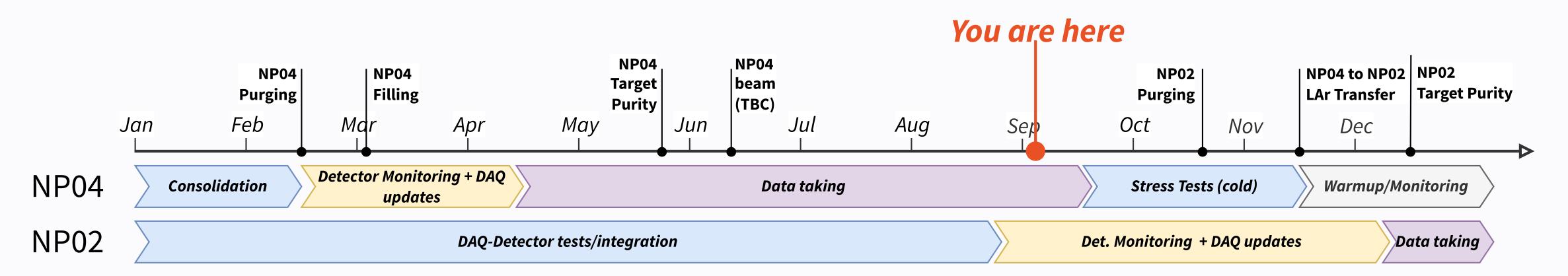
Overview

- ProtoDUNE Operations
- DUNE-DAQ Developments
- FD Preparation for installation
- ND Ongoing activities





ProtoDUNE Operations



- NP04 entering 9th week of beam
 - 2 extra weeks extension wrt initial allocation
 - Last day of beam : Sep 18th
 - 4 weeks of detector stress tests in cold
 - Warm up through year-end
- NP02 Closure ongoing
 - Cooldown and fill in November
 - Beam in 2025





NP04 Overall DAQ Performance

W. Ketchum, A. Oranday, M.Rigan, A.Sctuz, I. Hristova,

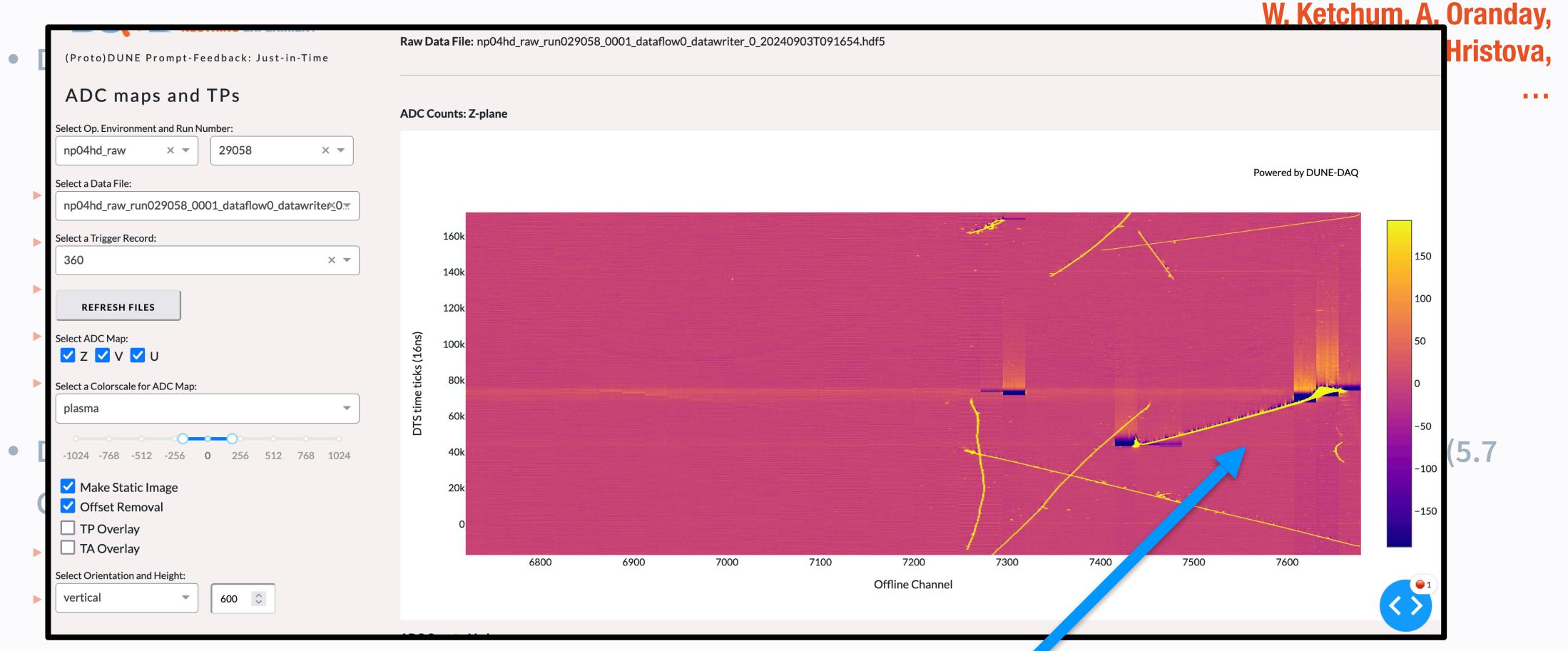
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- DAQ trigger records are ~142 MB in total size
 - ◆ 3 ms readout window for TPC (0.25 ms before trigger, 2.75 ms after)
 - 5.5 ms total readout window for all other components (2.75 ms before, 2.75 ms after)
 - ► TPC readout (streaming, unbiased): 107 MB
 - "Streaming" (unbiased) PDS readout in APA1: 25 MB
 - "Self-triggered" PDS readout in APAs 2-4: 9 MB
 - Trigger Primitives (from TPC, inside trigger record): 1 MB
 - Additional data from CRT, CTB, timing, high-level trigger objects is negligible
- DAQ is stable collecting data at ~15 Hz average trigger rate (2.1 GB/s), up to ~40 Hz instantaneous rate (5.7 GB/s)
 - Using 8 datawriter applications writing to SSD storage volumes
 - Limitation overall data rate is bandwidth from readout servers to data storage servers
- Integration of all external components (CRT, laser calibration) complete





NP04 Overall DAQ Performance



Integration of all external components (CRT, laser calibration) complete

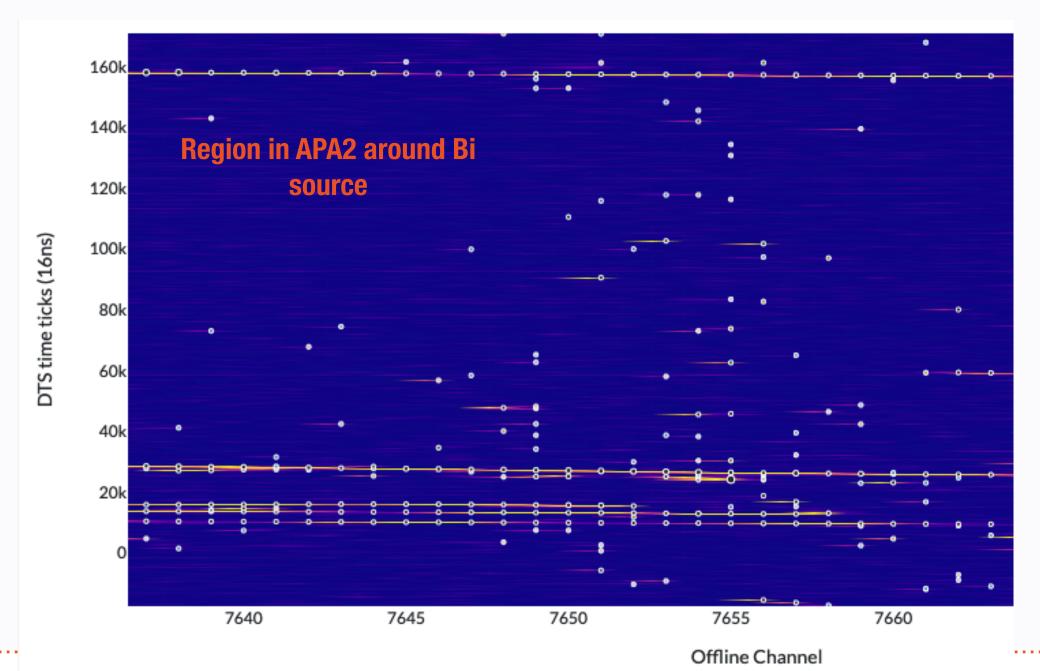


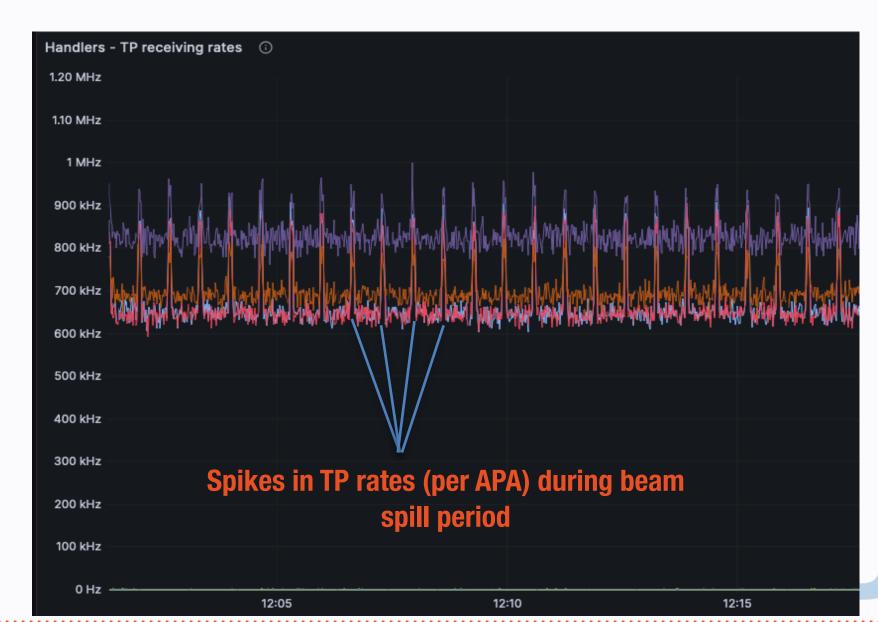


NP04 Trigger Primitives

A. Oranday, M.Rigan, A.Sctuz, I. Hristova

- In addition, stably collecting trigger primitives from collecting planes and storing in TP stream files
 - Very high (~3 MHz) total TP rate, ~160 MB/s, due to surface operation
 - ► TP performance very good clearly showing sub-MeV signals
 - ► TP generation on induction planes also demonstrated, but readout on all planes not stable with high (> 1 Hz) trigger rates (well beyond conditions for FD)
 - ► TPs have proven to be a remarkably good indicator of detector conditions



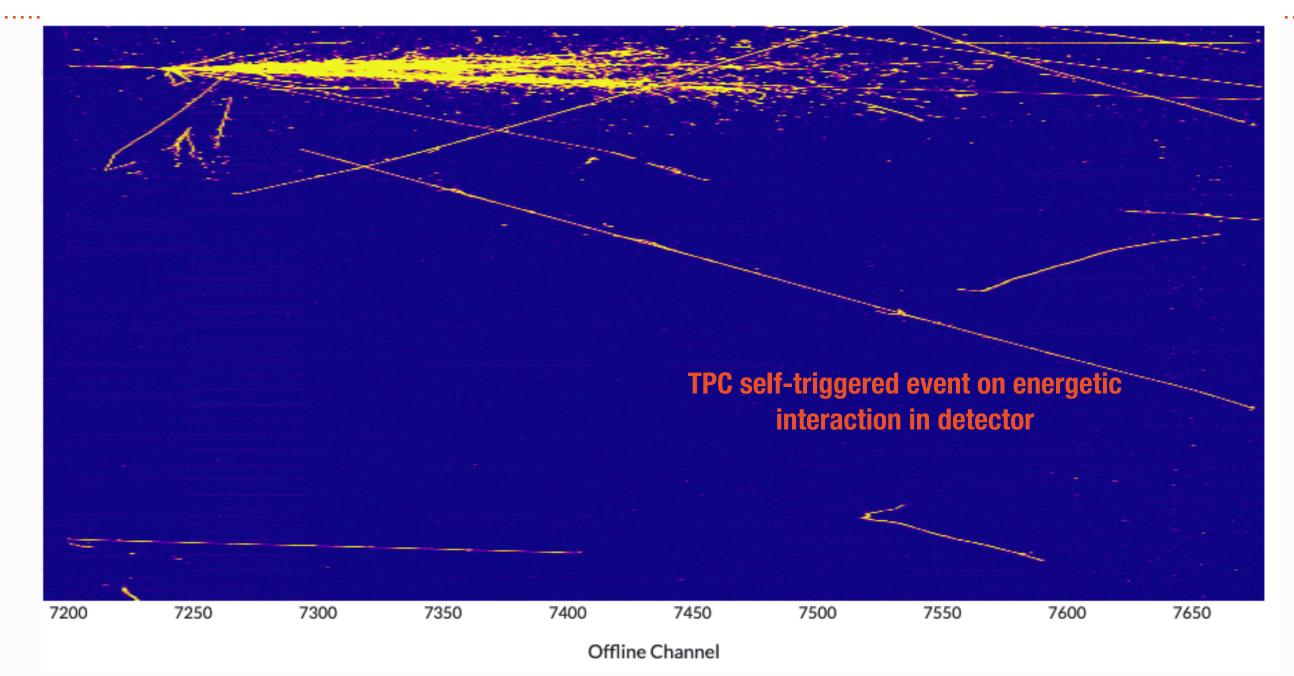






NP04 Post-beam run plans

- Test software-driven trigger stability and demonstrated running multiple algorithms
 - 'ADCSimpleWindow' algorithm previously tested and working stably



- DAQ performance testing
 - Focus on testing new readout server (np04-srv-031) with real data
 - Demonstrated running 2 APAs w/ TPG in both v4 and v5
 - Push to running 4 APAs w/ TPG
 - SN readout to local storage (10-100s sample)
 - Can also try to make time for other stress testing that benefits from detector data (e.g. storage server testing)



DUNE DAQ @ NP02

- Integration effort started long ago, with mixed success
 - Only bottom CRPs are controlled, synchronised and readout via DUNE-DAQ.
 - Top CRPs and PDS partially/not integrated yet
- Discussed with VD Technical Coordination about NP02 monitoring during purge,
 cooldown and fill
 - ► Tentative goal: monitor the entire NP02 via DAQ
- Other systems
 - Cosmic Ray Taggers: positive first discussion with Grenoble and Bern groups (June)
 - Beam Instrumentation: NP04 BI to be reused for NP02
 - ◆ The Penn Central Trigger Board will provide beam triggers once more





DAQ-Detector integration

Bottom Drift Electronics integrated with DAQ since '23

- One of the first system transitioning to Ethernet Readout in June '23
- CRP 4 + 5 regularly monitored by BDE experts via DAQ
- Continuous monitoring started in preparation to TCO closure

• Top Drift Electronics

- Preliminary integration tests with timing ('23) and readout ('24) completed.
- No integration for controls yet
- Testing at scale (2 CRPs) and full integration with DUNE-DAQ still pending

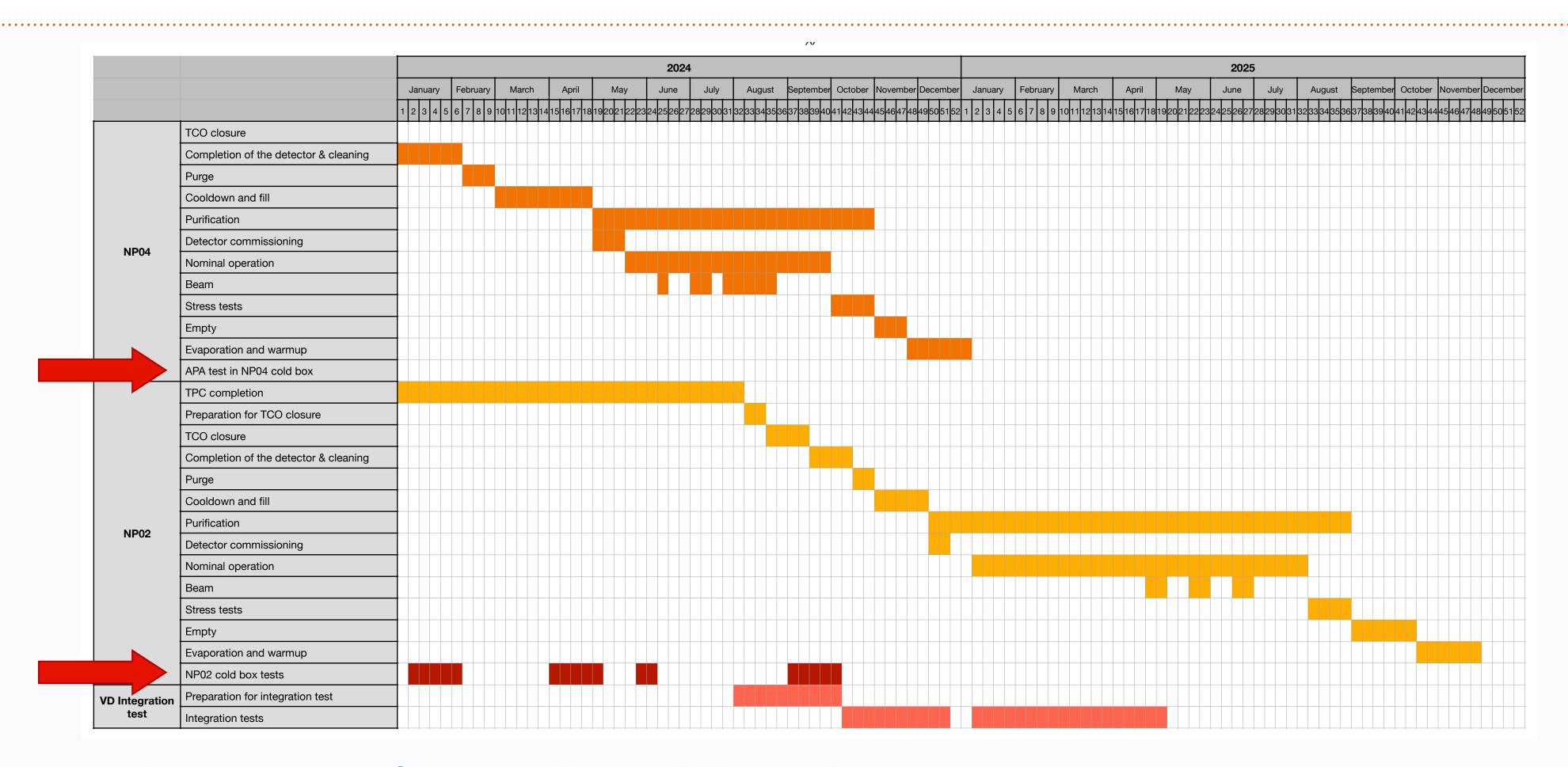
PDS

- Integration with target hardware (DAPHNE v3) not started due to production delays
- 2 DAPHNE v3 expected at CERN by end of September
- Initial detector PDS monitoring via DAPHNE v2
 - to be swapped for v3 when





Overall EHN1 schedule



- Requested DAQ support for VD and HD coldboxes in autumn
 - Planning ongoing, DAQ hardware at EHN1 possibly stretched





DUNE DAQ Developments

- DAQ development plan heavily affected by operations at ProtoDUNE
 - Significant amount of effort diverted to NP04 readiness and support in the Q2 and Q3
 - But operations offered many highly valuable opportunities to validate the system at scale, identify and fix issues
- Main developments in 2024 (ongoing)
 - New Configuration System
 - New Run Control
 - New Operational Monitoring infrastructure
 - Appfwk review implementation





New Configuration System - conffwk

Timeline

- Prototype started in autumn '23
- Proof of concept inv5.0 engineering release (May '24)
- First detector support in v5.1 (July '24)
- Support for NP02 monitoring in v5.2 (October '24)

Key features

- Based on the ATLAS configuration system (OKS+config packages)
- System configuration described as a collection of elements and their relationships via an abstract schema
 - ◆ XML schema and data files
- ► Includes a programmatic interface to read/write configurations in C++/Python
 - Data Access Layer DAL
- Provides tools for editing schema and configurations
 - schema_editor and dbe

G. Crone, E. Flumerfelt, G. Lehmann Miotto

- Presentations (March DAQ GM)
 - Giovanna: <u>TDAQ Configuration</u>
 - Eric: The OKS Configuration Framework

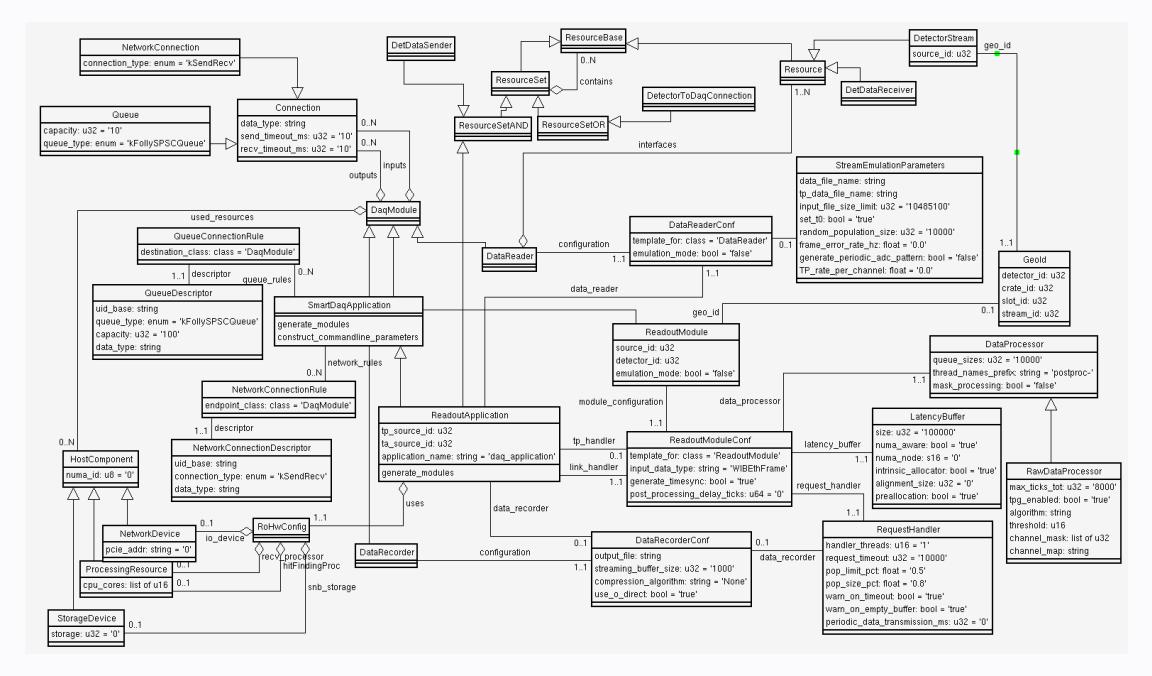




TDAQ System Description - confmodel & app model

G. Crone, E. Flumerfelt, G. Lehmann Miotto

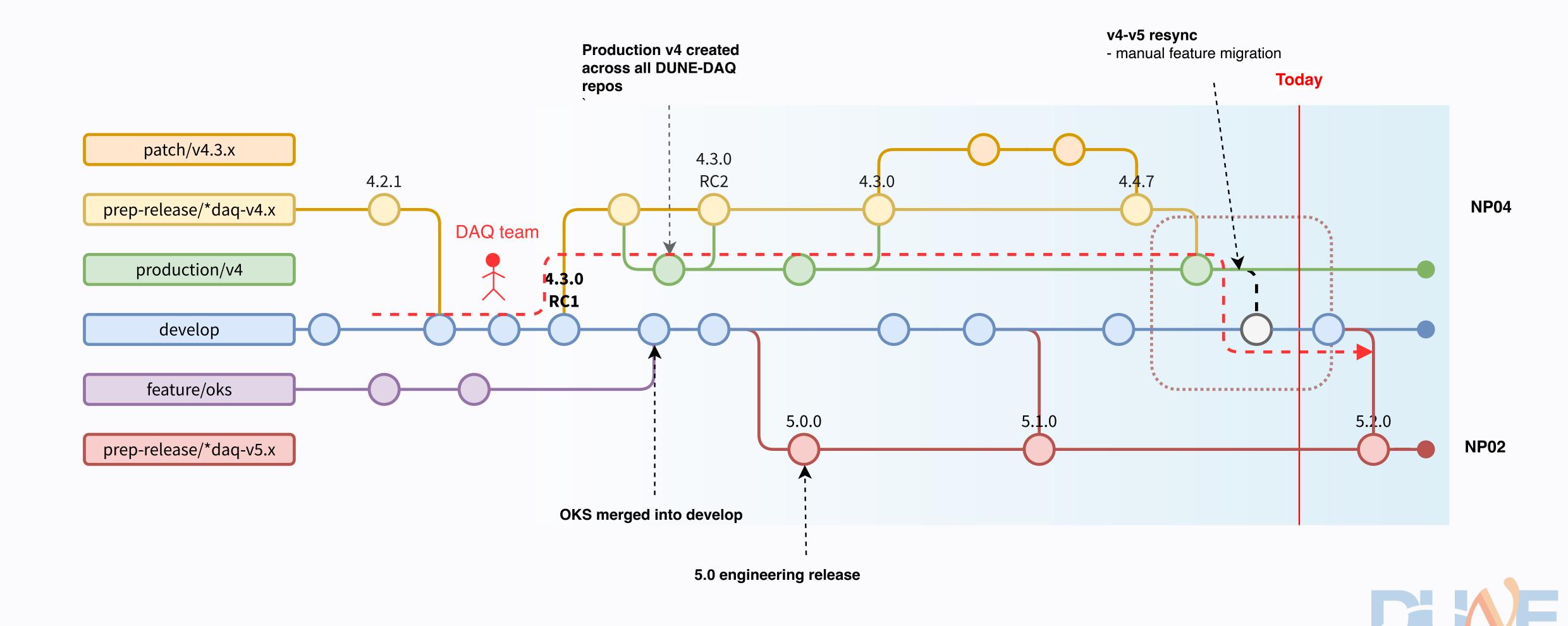
- Main challenge so far: design of the TDAQ system representation as OKS schema
 - Applications, Controllers, Hosts, FSM, Segments,... descriptions
 - DAQ applications and modules description
 - including handling of large numbers of modules via automatic generation (SmartApplication pattern)
 - Description of detector-readout connectivity
 - DAQ modules settings optimisation
 - Component enabling/disabling ...
- TDAQ model exercised at NP02
 - https://gitlab.cern.ch/dune-daq/online/ehn1-daqconfigs
 - CRP4 and 5 routinely readout using this model
- Next steps
 - Testing TDAQ model flexibility and maintainability in operations context
 - and in development context (i.e. regression tests)
 - Prepare specialised tools to for modifying/editing TDAQ configurations







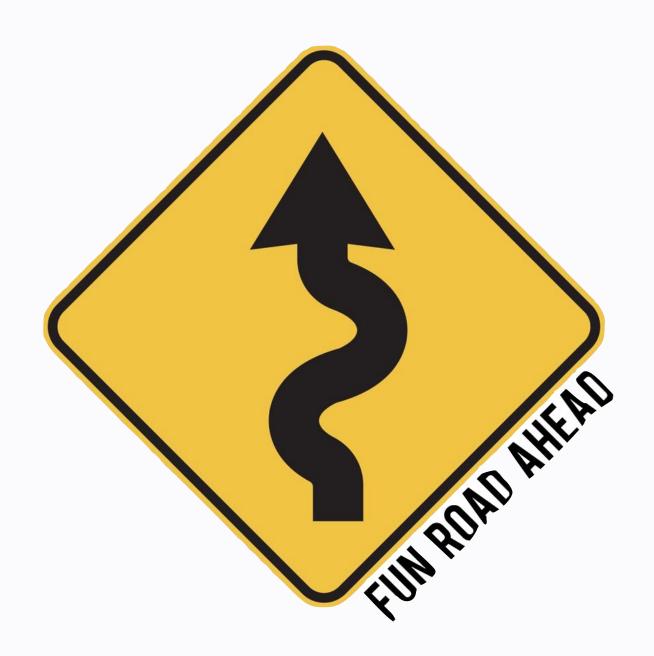
DUNE DAQ Development Lines



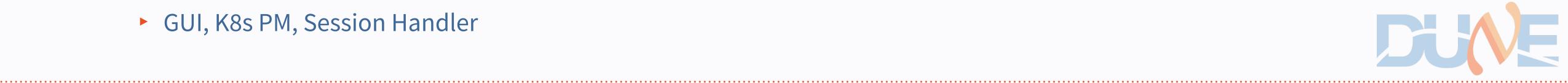
New Run Control: Drunc

P.Lasorak, P.Plesinak

- Short term goals (DUNE-DAQ v5.2): readiness for NP02 operations
- Development didn't stop over the Summer
 - Made it more DAQ developer-friendly (FSM sequences, connectivity service)
 - Run archiving facilities integrated (ELisA, run registry)
 - Bugfixes (zombie processes)
 - Documentation rewrite
- More features over the next month
 - User/shifter-friendly (hide more logging, hide/remove expert interactions)
 - Support Integration tests (a.k.a. batch mode)
 - ERS/Opmon integration
 - Timing system integration (maybe)
- Longer term
 - GUI, K8s PM, Session Handler



Thanks for your patience and submitting issues We're not there yet, but working hard to be!





DUNE DAQ v5.2

Release status/progress <u>here</u>

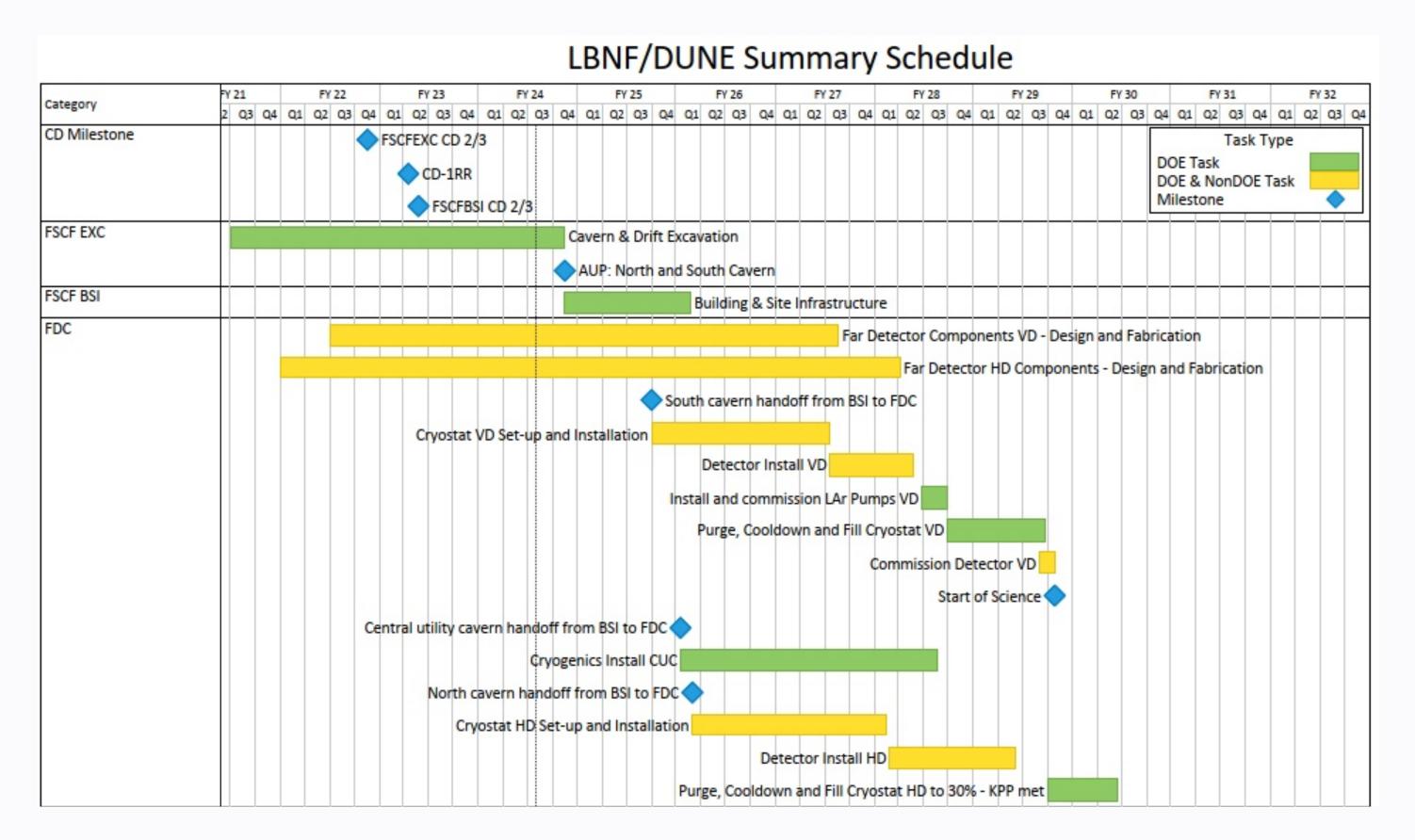
- Forward-porting of v4 features and fixes
- Consolidation of many packages
- A sizeable number of of tasks in advanced state
 - despite August/Summer!

WBS NUMBER	R TASK TITLE	wно	PCT OF TASK COMPLETE	JUL				Q3 AUG			SEP			OC.	Т		Q4 NOV			DEC		
			COMPLETE	1 8	_		29 5					23 3	0 7			3 4		8 25	2 9			
	fddaq-v5.2.0																					
1	Sspmodules porting	Giovanna	100%					8	c d													
2	Daphnemodules porting	Marco	0%							е	es	C	ı									
3	Daphne v3 support	?	0%									es			d		····					
	Timing			-																		
.1	Complete initial OKS timing implementation	Stoyan	100%						С		d			<u></u>	·····i							
1.2	Complete hsi implementation	Stoyan	20%						2		d											
1.3	Complete the WR-DTS parts	Stoyan	0%								ď											
.4	GIB support	Stoyan	50%						5		d											
1.5	Timing-drunc integration	Stoyan	30 %						3		u u				<u>i</u>		<u>i</u>					
1.6		Stovan	100%																			
	Fanout fw for FIB prototype	Stoyan	100%						С													
2	Core SW - Readout	A1 1	1000																			
2.1	Port TDE readout support from v4	Alessandro	100%				8	С			d											
2.2	Create hw resources model for Readout	Roland	0%	_								C										
2.3	Establish model for generating correct pinning file from OKS	Roland	0%			<u> </u>					<u>!</u>	С	1		<u>!</u>		<u>!</u>		<u></u>			
2.4	Implement pinning file generation	Roland	0%									С	1									
2.5	Test callbacks for TPs exchange	Alejandro	50%						5						<u>.</u>				<u> </u>			
2.6	Port all WIB data processing updates from v4 (+ repackaging)	Alejandro	80%						8		d								,			
2.7	Adjust schema to have per plane TP handlers	Giovanna	80%			<u> </u>			8		<u>i</u>			<u> </u>	<u>i</u>							
2.8	Simple TPG enabling/disabling	Giovanna/Alejandro	90%						9													
2.9	Support for multi-ip	Alessandro																				
3	Core SW - Others																					
3.1	Optimise handling/post-processing of unordered data	Roland/Giovanna	60%						6													
3.2	Unification of command API for controllers and appfwk	Eric	0%												i							
.3	Action plans in OKS and appfwk	Eric	100%					7	С													
3.4	Introduce new operational monitoring of apps and modules	Marco	50%				5		5			d										
3.5	Port improved TPStreamWriter warnings from v4 to v5	Kurt	0%									d										
4	Trigger				i																	
ļ.1	Implement ctb in v5/oks	Marco	0%									es			d							
4.2	Implement generic pre-scaling / channel filetring	Artur	100%					9	С								·····					
4.3	Fix operational monitoring for trigger (incl TPs)	Michal	90%						6 8		d											
1.4	Port new Trigger Algorithms & bugfixes from v4	Artur	100%		<u>i</u>					С		<u> </u>			<u>i</u>		<u>i</u>		<u>i</u>		<u> </u>	
	Port MLT changes from v4 (pileup ignoring, sub-det ro																					
4.5	windows)	Artur	50%						1		d											
1.6	Port HSI(Timing, CTB, CIB)TCM changes from v4	Artur	100%					9	С													
4.7	Fixing trigger emulation in v5 (including replay)	Artur	0%										d									
4.8	Porting per-plane TA-making	Artur	0%								d				i		i					
5	CCM																					
5.1	Support partial sequences of commands	Pawel	100%				С															
5.2	Drunc modify error propagation policies (across controllers)	Pawel	100%						С													
5.3	Drunc integration testing / batch mode	Pierre	90%		·· ·				9		d											
5.4	Use ERS for error reporting in run control	Pierre	10%								d											
5.5	Publish operating metrics in run control	Pawel/Pierre	0%	<u> </u>							4				<u>:</u>							
5.6	Shifter friendly shell (split unified shell from pm, logging,)	Pawel/Pierre	0%	-							-	6										
5.7	Drunc unit testing (if time allows)	Pawel	0%			<u> </u>					<u>i</u>		•		d	<u>i</u>	<u>i</u>		<u>i</u>			
5.8	Dynamic app control port numbers (needs to be discussed)	rawei	30%												u							
		M. Dada		<u> </u>		<u> </u>					<u>!</u>				<u>i</u>	<u>i</u>	<u>i</u>					
5.9	Opmon upgrade	M. Roda	100%					С														
.10	Network monitoring & dashboards	Marco/Alec	50%							5	d											
1	Release prep			_																		
.1	Consolidate integration tests	Kurt	0%	_	<u> </u>	<u> </u>					d				<u>!</u>		<u> </u>					
.2	Update integration and system tests	Kurt/Eric	0%								d											
.3	Update DB area for NP02 in EHN1	Giovanna	80%		<u></u>	<u> </u>				8	<u>!</u>			<u> </u>	<u>i</u>		<u>i</u>					
5.4	Configuration tools for NP02 DB management at EHN1	Wes	0%																,			
	Testing of nightly	?	0%																			
0.4		Dannia	00/			1 I																
	Deployment of rc-fddaq-v5.2.0 into EHN1	Bonnie?	0%									i										
5.4 5.5 5.6	Deployment of rc-fddaq-v5.2.0 into EHN1 Pre-release testing	?	0%										d									



Far Detector: Installation Schedule

- DAQ Development and
 Procurement schedule driven
 by FD installation schedule
- Swap of the installation order of FD1-HD and FD2-VD completed in June
 - Later start, but shorter installation and fill time of the first module
 - Includes extra caverns delivery and CUC AUP delays



Installation dates largely stable since then

J. Macier - May DUNE CM

But some unresolved conflicts between DAQ and detector installation activities require a follow up





Far Detector: DAQ Procurement after Detector Swap

- Reminder: FD installation drives the DAQ procurement schedule
 - "DAQ procures as late as possible"
- Procurement and Production Readiness dates
 - ► Installation of the first module (VD) delayed by ~7 months
 - DAQ PRR schedule reviewed
 - ◆ Timing, Readout network and DAQ Servers PRR delayed to early 2025 to make use of the extra time for testing and value engineering studies
 - ◆ Updates on *Readout and Storage Server PRR preparation* in the next two talks by Roland and Wes
- Procurement Strategy
 - Two-stages installation model not necessarily advantageous for the first module (installation < 1year)</p>
 - Alternative approaches are being discussed, also taking into account FA procurement constraints



Near Detector: Updates

- New effort: Henry Wallace @ RHUL, also spending time on CCM
- ND DAQ: Being updated to be compatible with v5, work in progress
- Main driver for autumn 2024: ND review process
- Many PDR and FDR processes for ND subsystems
- Goal: DAQ Interface Control Documents (ICDs) completed by ~1 December





Near Detector: ICD updates

- ND-LAr
 - Mature technology for charge readout (=FDR this year)
 - Developing technology for light readout (=PDR this year)
 - Clear path to ICD
- TMS
 - Technology selection recently made (=PDR this year)
 - Sharing information to work out any friction points
 - Path to ICD
- SAND
 - In progress of setting up a meeting





Summary

- We're leaving in interesting times!
- The long-awaited NP04 run is nearing the end
 - But it's not over yet!
- NP02 will offer different challenges
 - First demonstrator at scale of the VD technology
- Focus shifting back to developments for DUNE
 - New configuration system, run control, operational monitoring now available and in use
 - Discussion of 2025 development plans to start soon
- Far Detector installation schedule update
 - Procurement plan being reviewed in light of the new timeline
 - Interactions with other parties during installation being checked for conflicts
- Near Detector DAQ interfaces being finalised for the early 2025 detector reviews



