

# DUNE DAQ Status and News

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04.09.24

Alessandro Thea



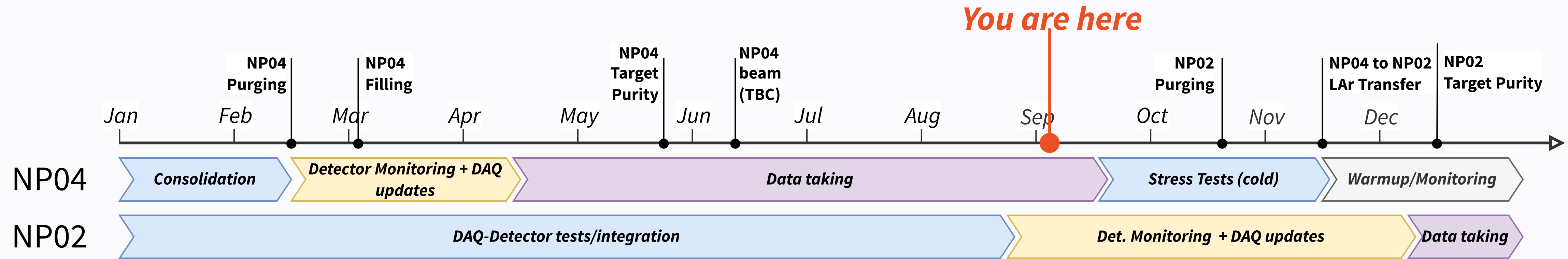
# Overview

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- 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 18<sup>th</sup>
  - ▶ 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,  
...

- 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

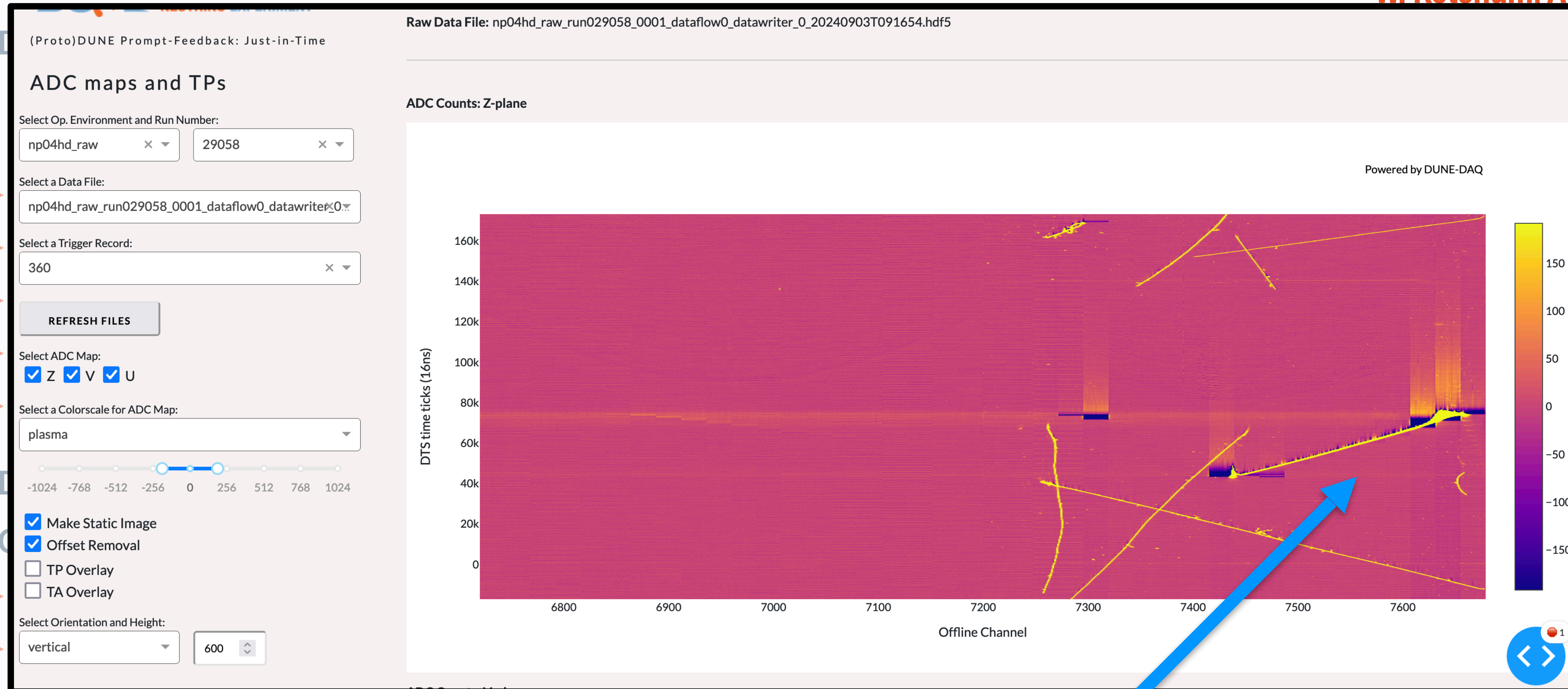




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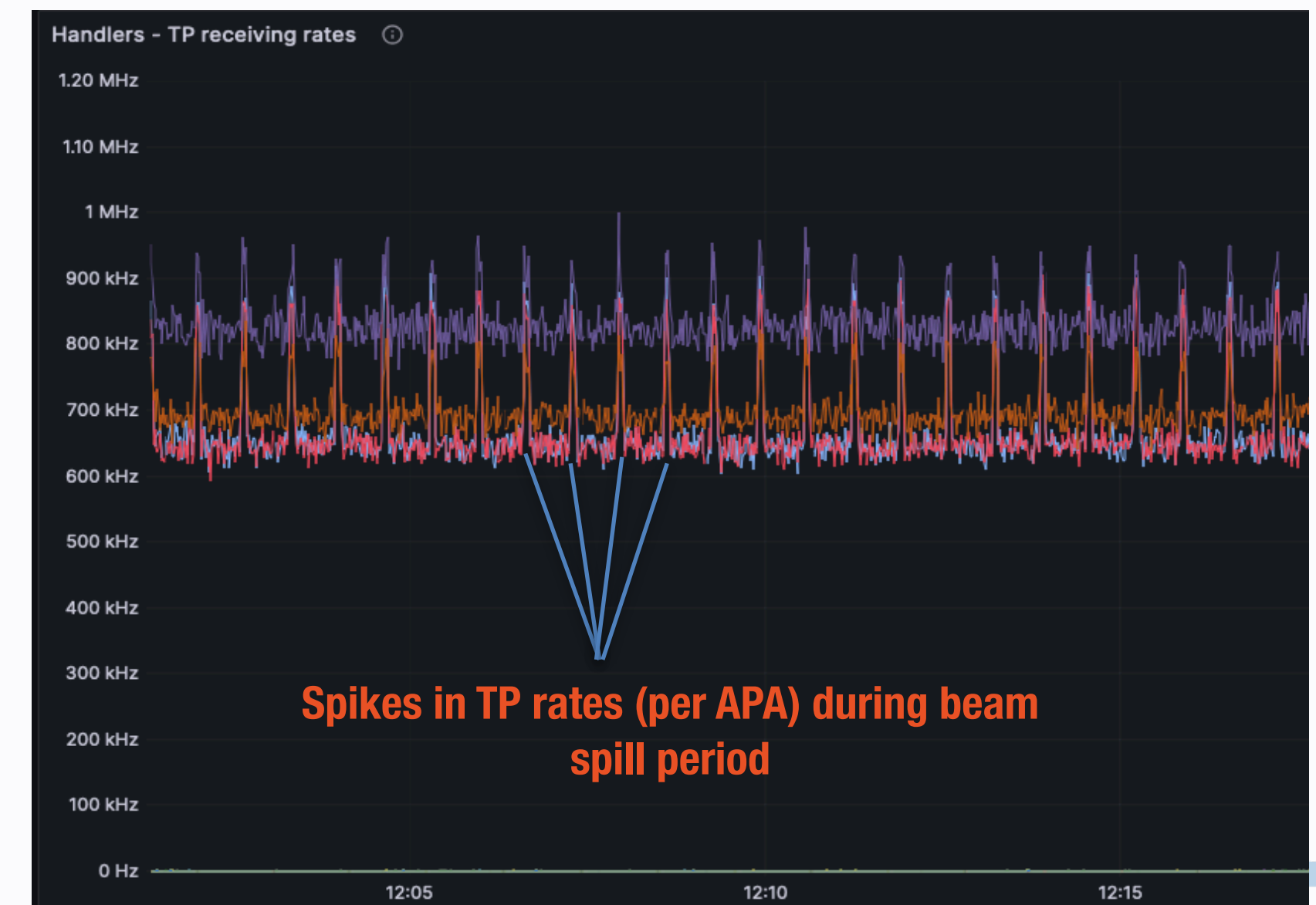
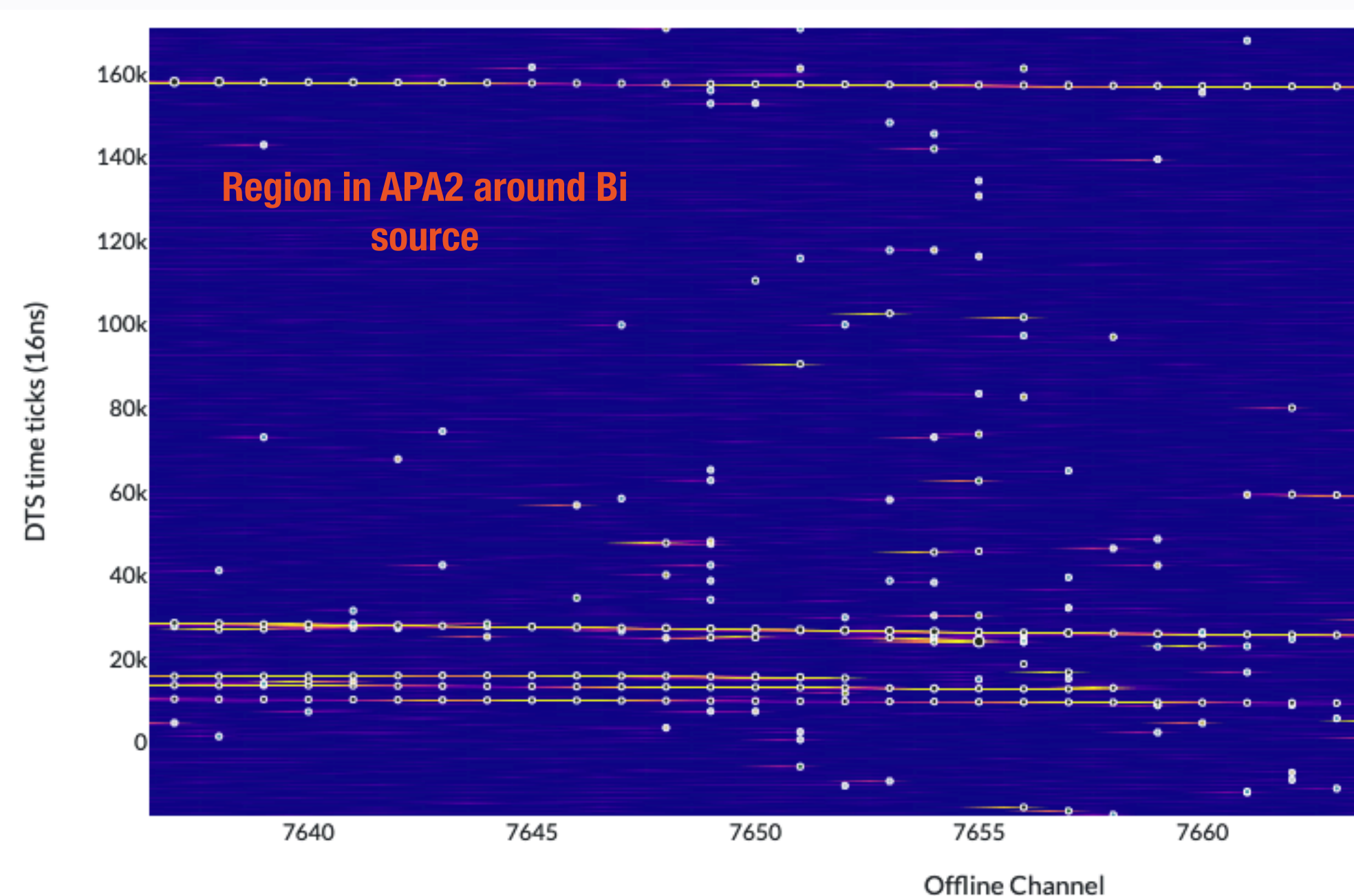




# NP04 Trigger Primitives

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

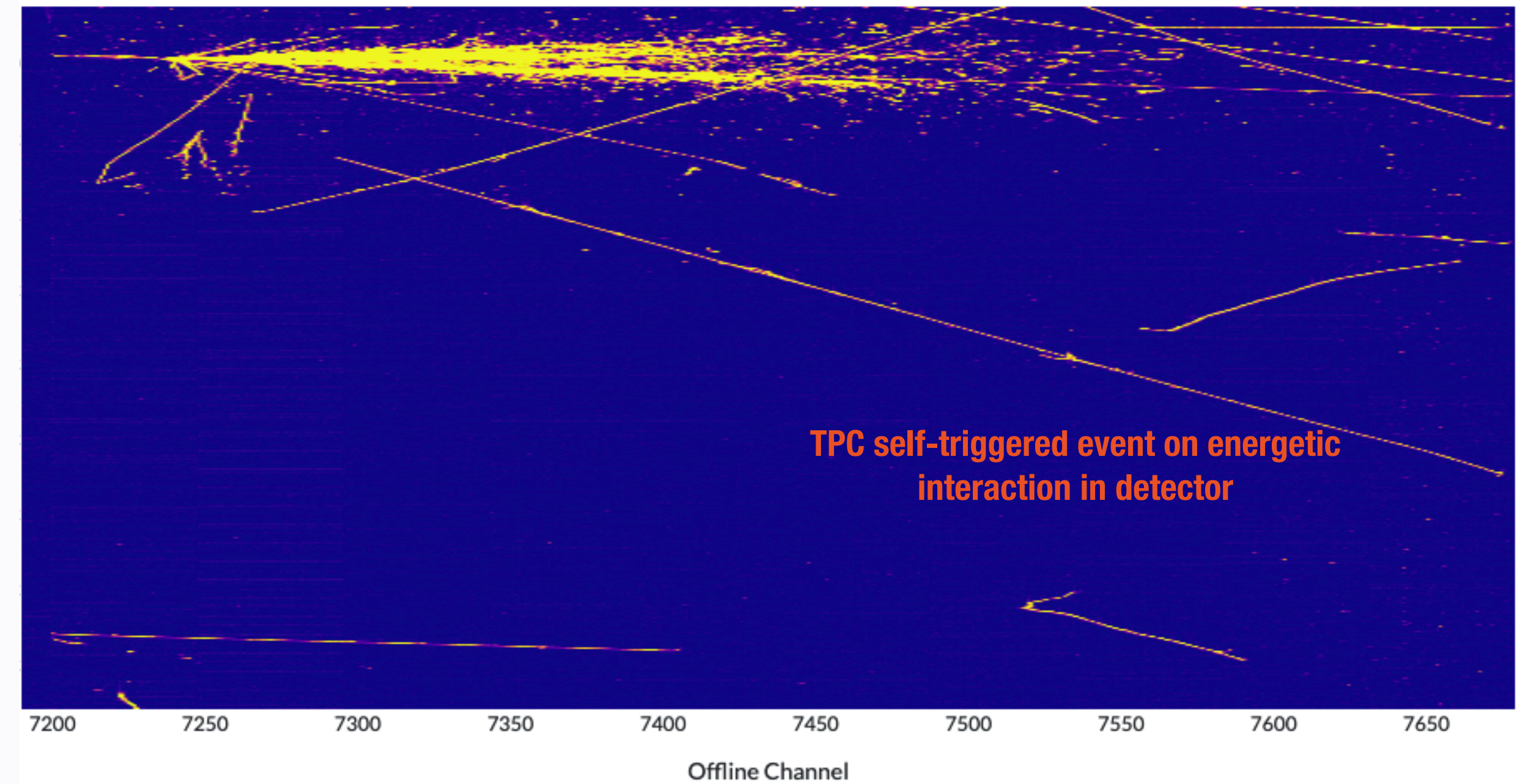
Powered by DUNE-DAQ

- 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

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- **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





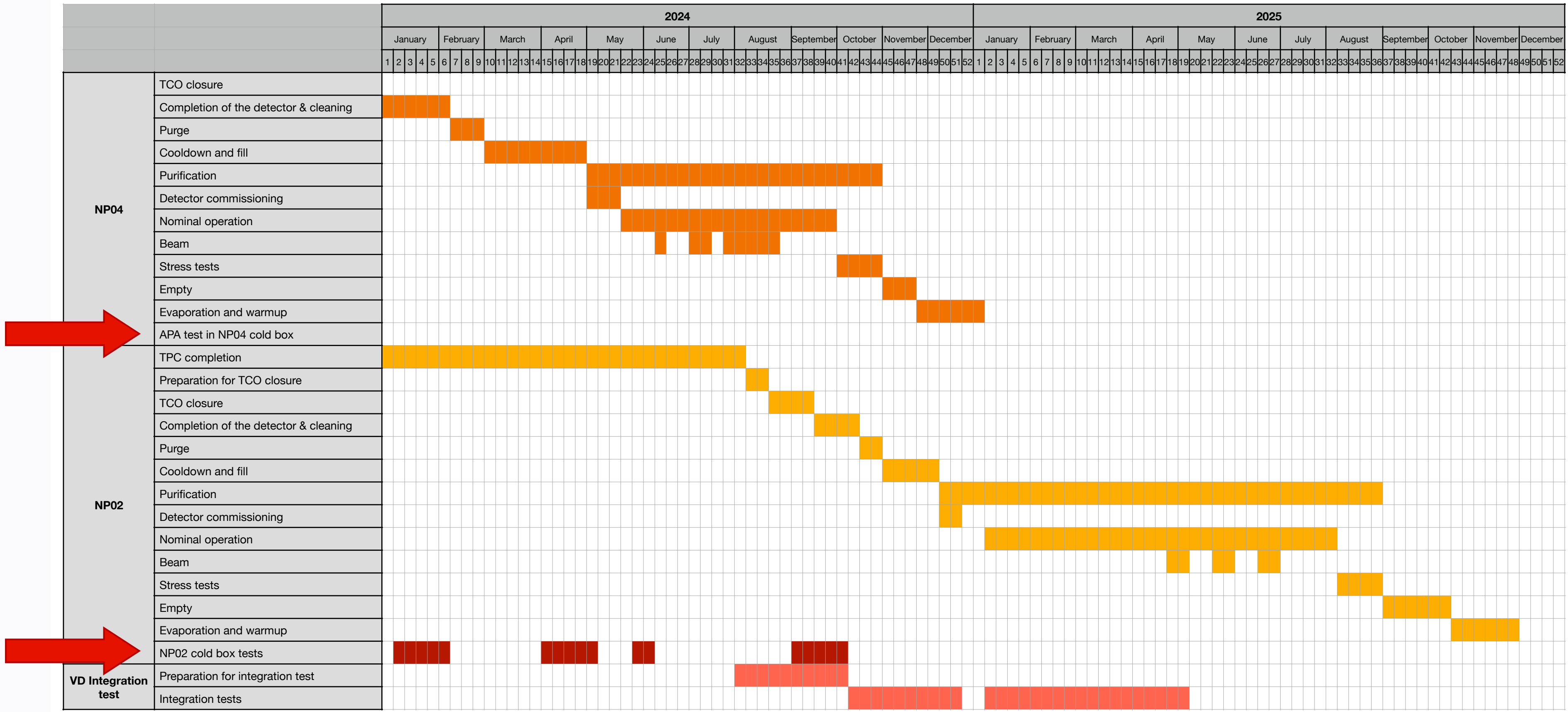
# DAQ-Detector integration

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- **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

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- **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

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

- **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 db

- **Presentations (March DAQ GM)**
  - ▶ Giovanna : [TDAQ Configuration](#)
  - ▶ 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

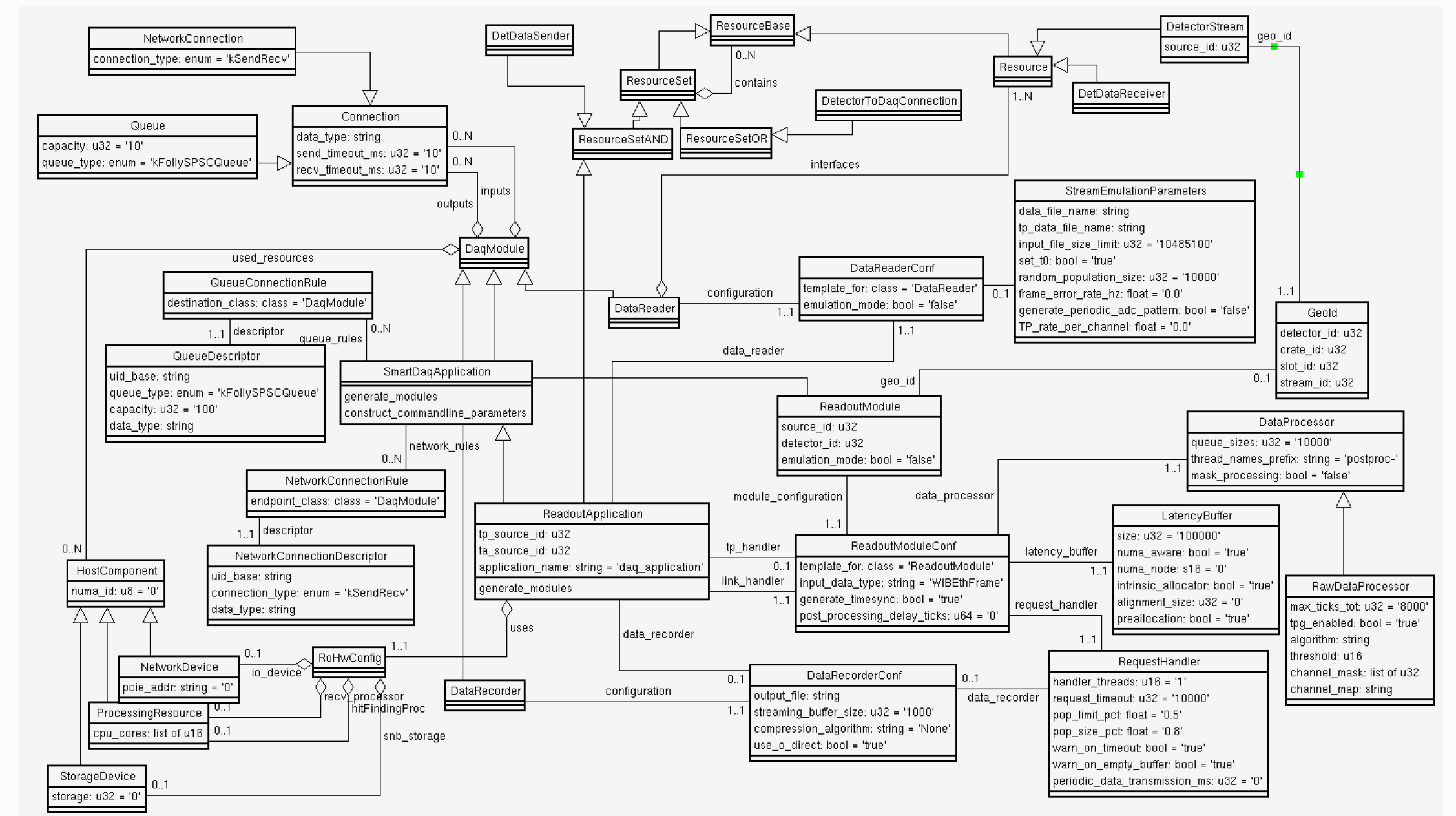
- ▶ Applications, Controllers, Hosts, FSM, Segments,... descriptions
- ▶ DAQ applications and modules description
  - ◆ including handling of large numbers of modules via automatic generation (SmartApplication pattern)
- ▶ Description of detector-readout connectivity
- ▶ DAQ modules settings optimisation
- ▶ Component enabling/disabling ...

- TDAQ model exercised at NP02

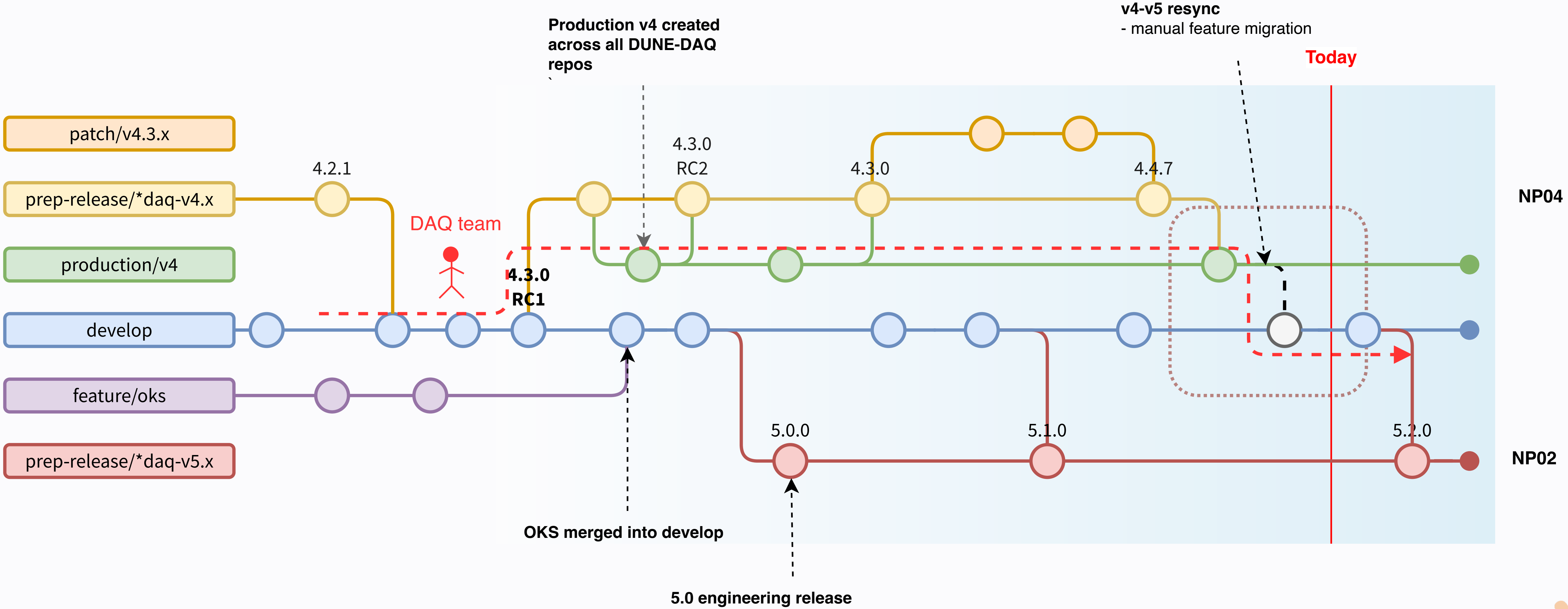
- ▶ <https://gitlab.cern.ch/dune-daq/online/ehn1-daqconfigs>
- ▶ CRP4 and 5 routinely readout using this model

- 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!









# Far Detector : DAQ Procurement after Detector Swap

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- **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)
  - ▶ Alternative approaches are being discussed, also taking into account FA procurement constraints



# Near Detector : Updates

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- 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

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- 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

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- 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

