DAQ Management Report

DUNE DAQ Consortium Board - 07.10.24

Alessandro Thea
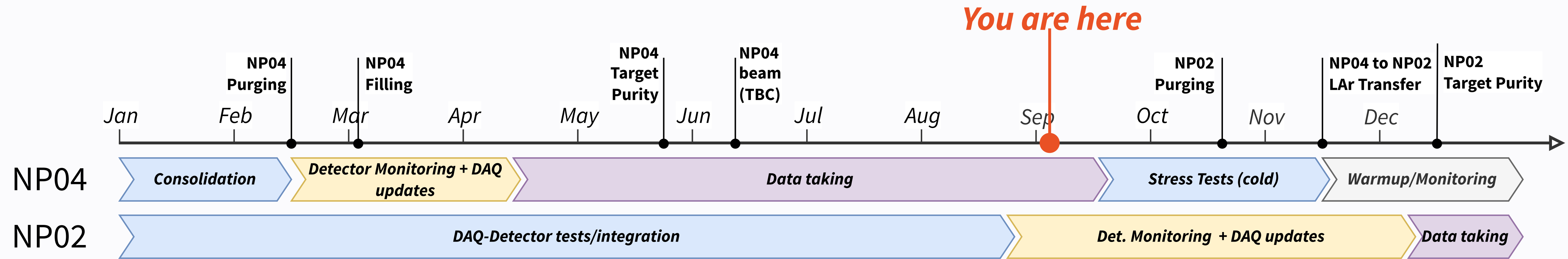
Overview

- **ProtoDUNE Operations**

- **DUNE-DAQ Developments**

- **FD - Preparation for installation**

- **ND - Ongoing activities**

ProtoDUNE Operations

You are here

Timeline markers (NP04): NP04 Purging, NP04 Filling, NP04 Target Purity, NP04 beam (TBC), NP02 Purging, NP04 to NP02 LAr Transfer, NP02 Target Purity

Months: Jan — Feb — Mar — Apr — May — Jun — Jul — Aug — Sep — Oct — Nov — Dec

NP04: Consolidation | Detector Monitoring + DAQ updates | Data taking | Stress Tests (cold) | Warmup/Monitoring

NP02: DAQ-Detector tests/integration | Det. Monitoring + DAQ updates | Data taking

- **NP04 completed 10 weeks of beam**
  - ‣ 2 extra weeks extension wrt initial allocation
  - ‣ Last day of beam : Sep 16th
  - ‣ 4 weeks of detector stress tests in cold
  - ‣ Warm up and monitoring throughout the end of 2024/beginning of 2025

- **NP02 Closure ongoing**
  - ‣ Cooldown and fill expected in November
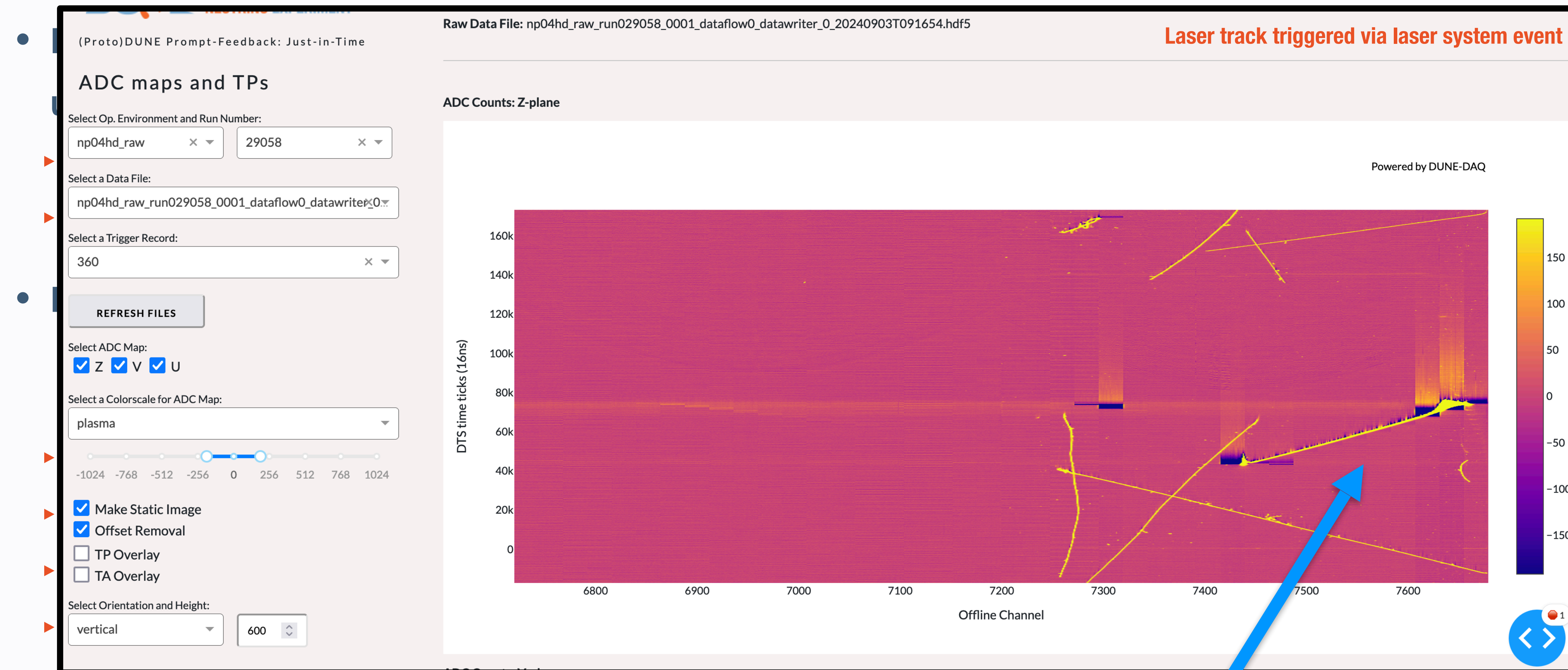 - ‣ Beam time will be requested for first half of 2025

NP04 Overall DAQ Performance

T.Alves, W.Dallaway, I.Hristova, M.Man, A.Oranday, M.Rigan, P.Plesniak, M.Roda, A.Stucz, D.Vargas

- **DAQ stay collected 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

- **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

- **Integration of *all external systems* (CRT, laser calibration) completed**

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T.Alves, W.Dallaway, I.Hristova, M.Man, A.Oranday, M.Rigan, P.Plesniak, M.Roda, A.Stucz, D.Vargas

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NP04 Trigger Primitives

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

- **In addition, stably collected trigger primitives from collection planes and stored 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
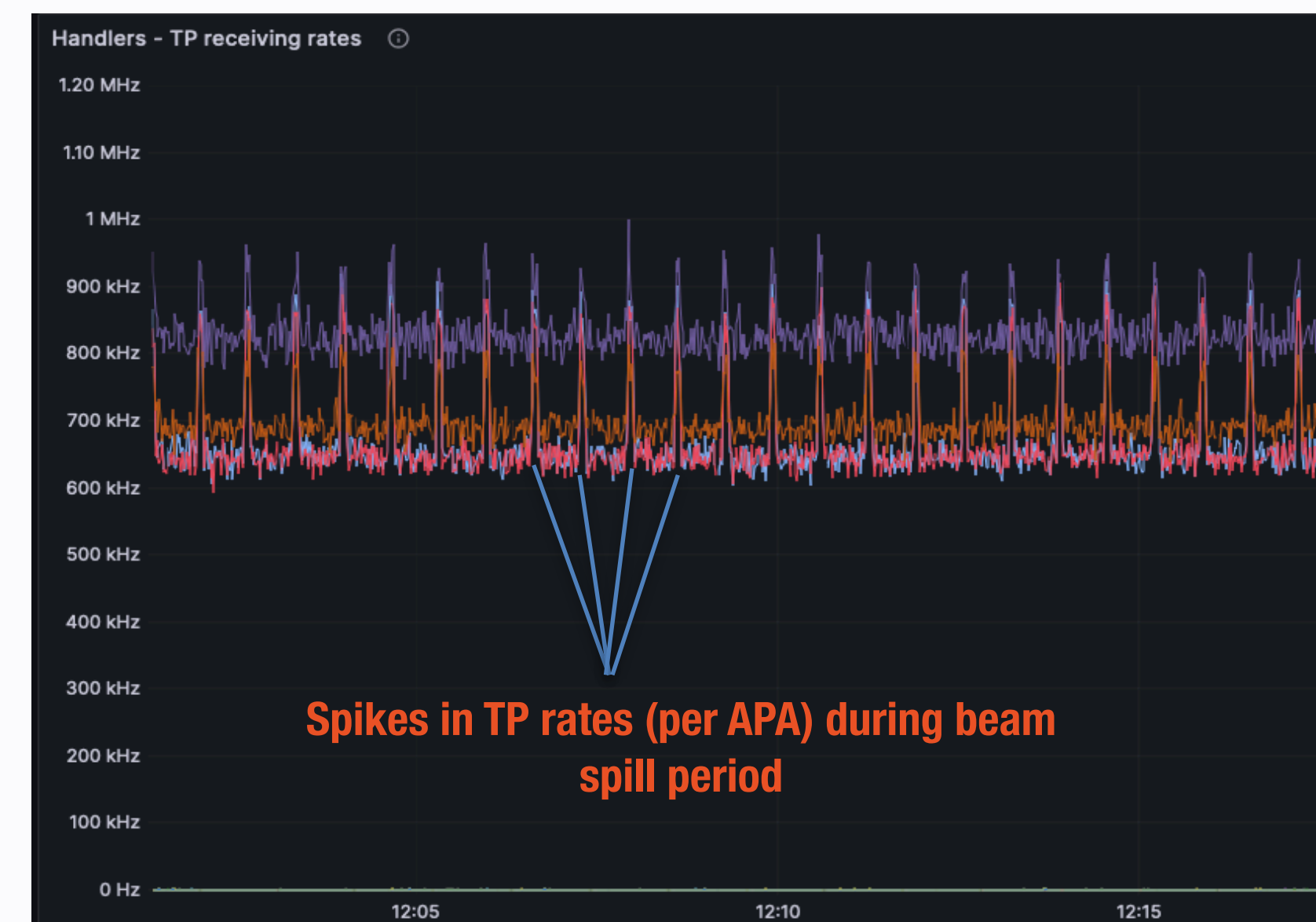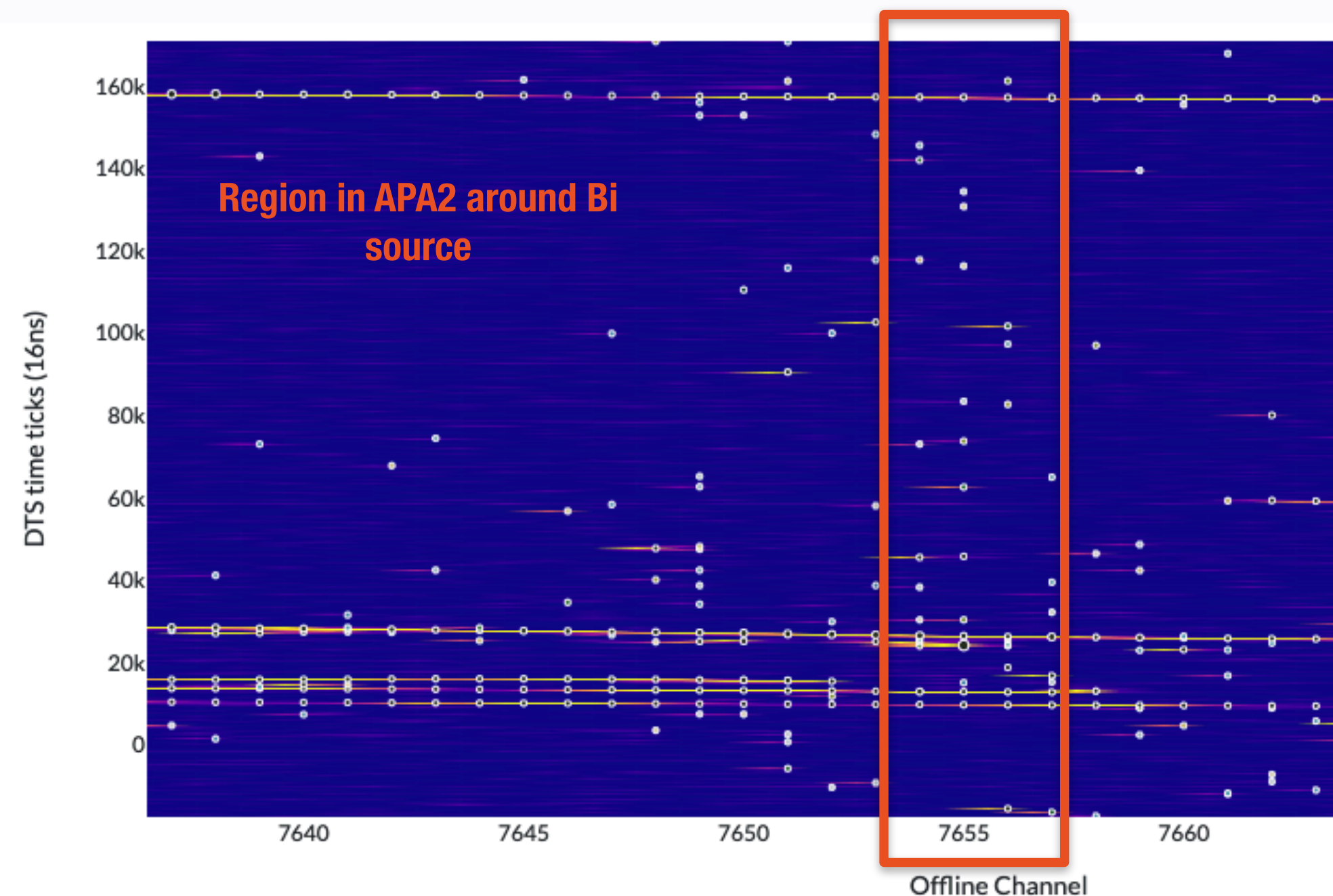
NP04 Post-beam run plans

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

TPC self-triggered event on energetic interaction in detector

- **DAQ performance testing (this week)**
  - ‣ 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)
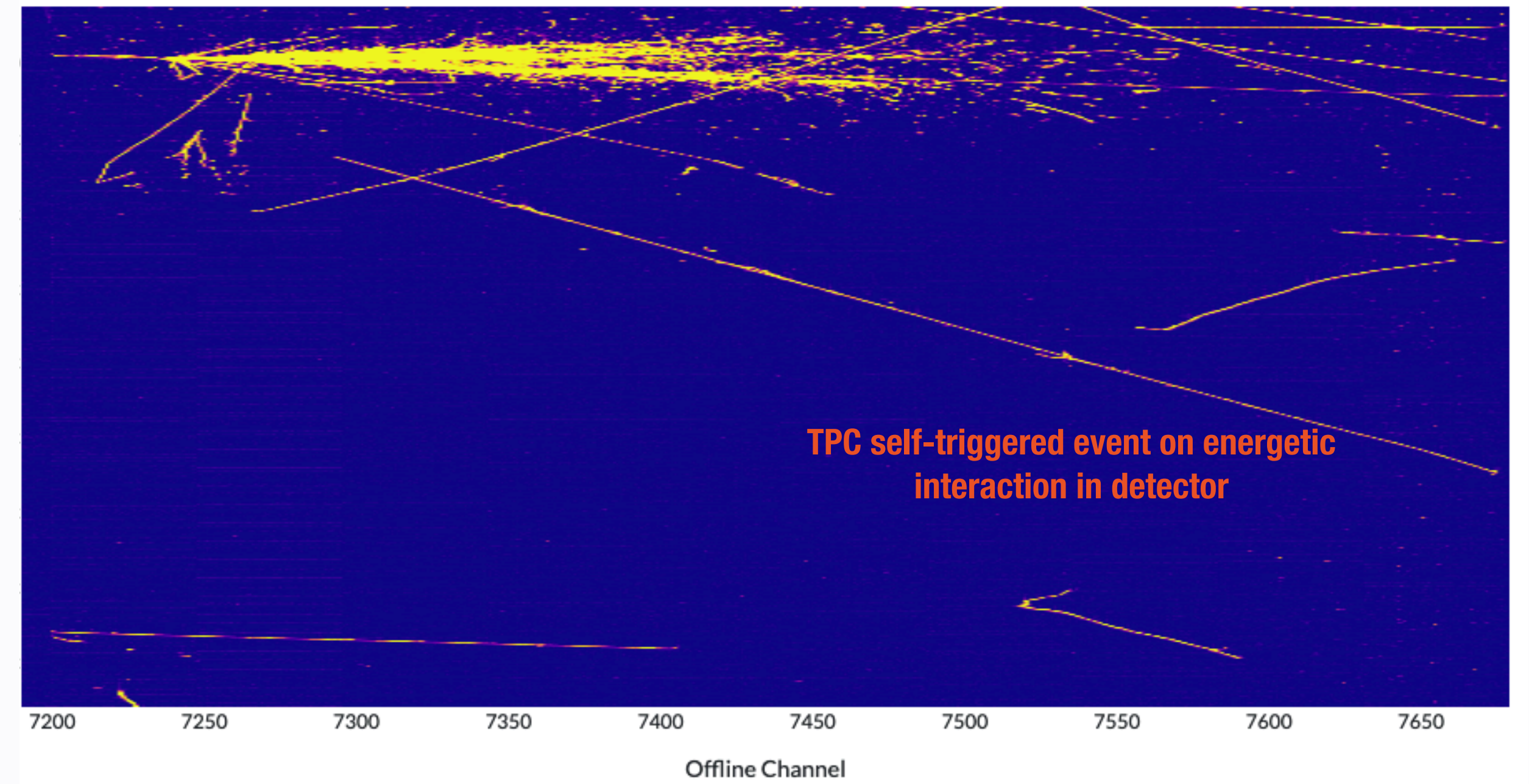
DUNE DAQ @ NP02

- **Integration effort with VD detector systems started long ago, with mixed success**
  - ‣ Currently bottom CRPs are the only system 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
  - ‣ Likely: monitor BDE + PDS (legacy hardware) and complete integration in parallel

- **Other systems**
  - ‣ Cosmic Ray Taggers: positive first discussion with Grenoble and Bern groups (June)
  - ‣ Beam Instrumentation: NP04 BI to be moved to NP02
    - ◆ The Penn Central Trigger Board will provide beam triggers once more

DAQ-Detector integration status

- **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 ready

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Overall EHN1 schedule

- **Requested DAQ support for VD and HD coldboxes in autumn**
  - ‣ Planning ongoing, DAQ hardware likely sufficient after rationalisation of the EHN1 setup

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 existing issues

- **Main developments in 2024 (ongoing)**
  - ‣ New Configuration System
  - ‣ New Run Control
  - ‣ New Operational Monitoring infrastructure
  - ‣ Appfwk review implementation

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New Configuration System - conffwk

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

- **Timeline**

  ▸ Prototype started in autumn '23

  ▸ Proof of concept in v5.0 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

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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**

  ‣ 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

Production v4 created
across all DUNE-DAQ
repos

v4-v5 resync
- manual feature migration

Today

patch/v4.3.x

prep-release/*daq-v4.x   4.2.1

DAQ team

4.3.0
RC2   4.3.0   4.4.7   NP04

production/v4

4.3.0
RC1

develop

feature/oks

OKS merged into develop

prep-release/*daq-v5.x   5.0.0   5.1.0   5.2.0   NP02

5.0 engineering release

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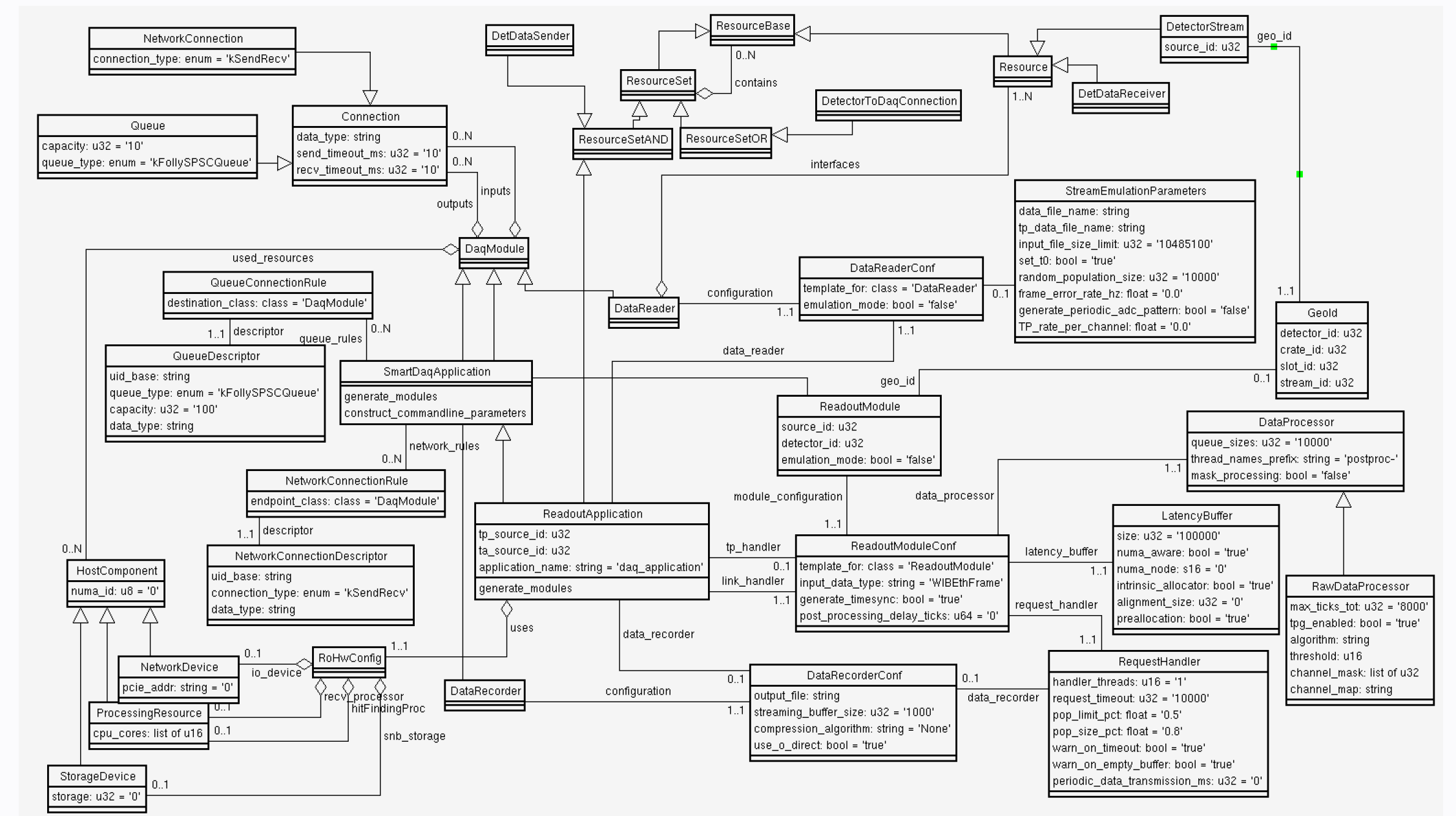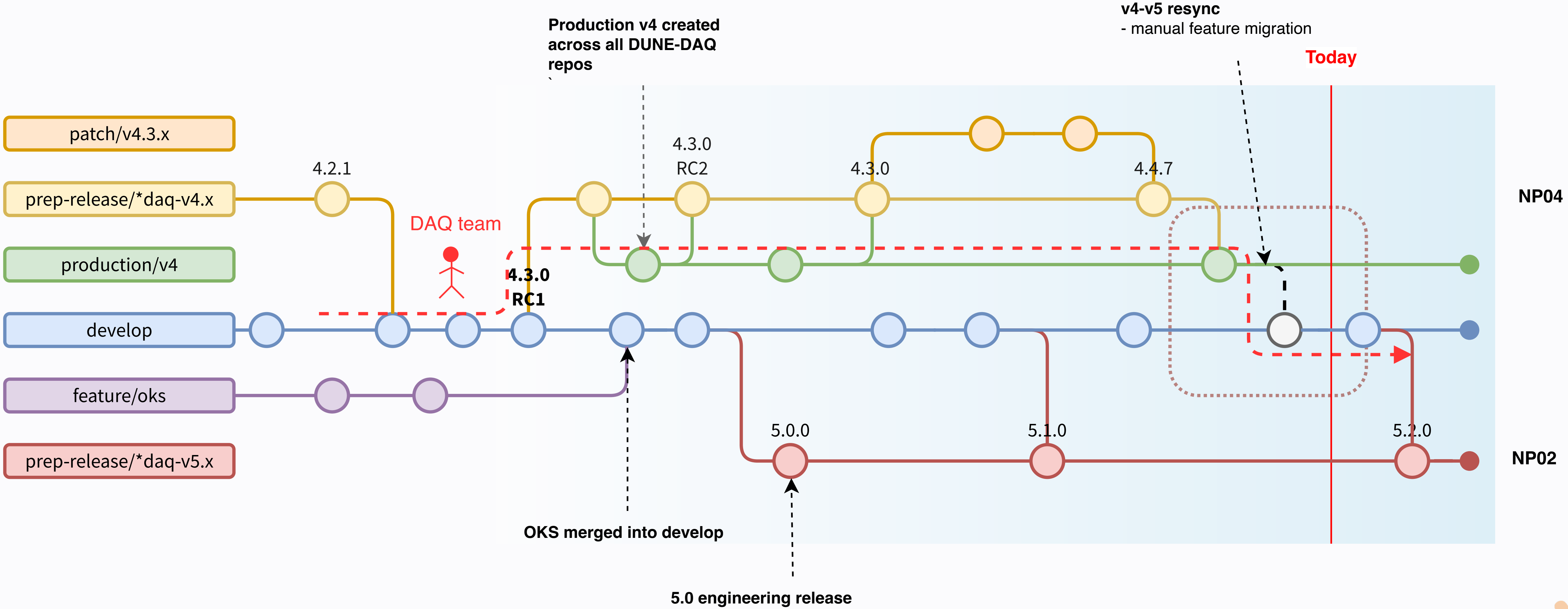
New Run Control : Drunc

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)
  - ‣ Many bugfixes
  - ‣ Documentation rewrite

- **More features in v5.2**
  - ‣ **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
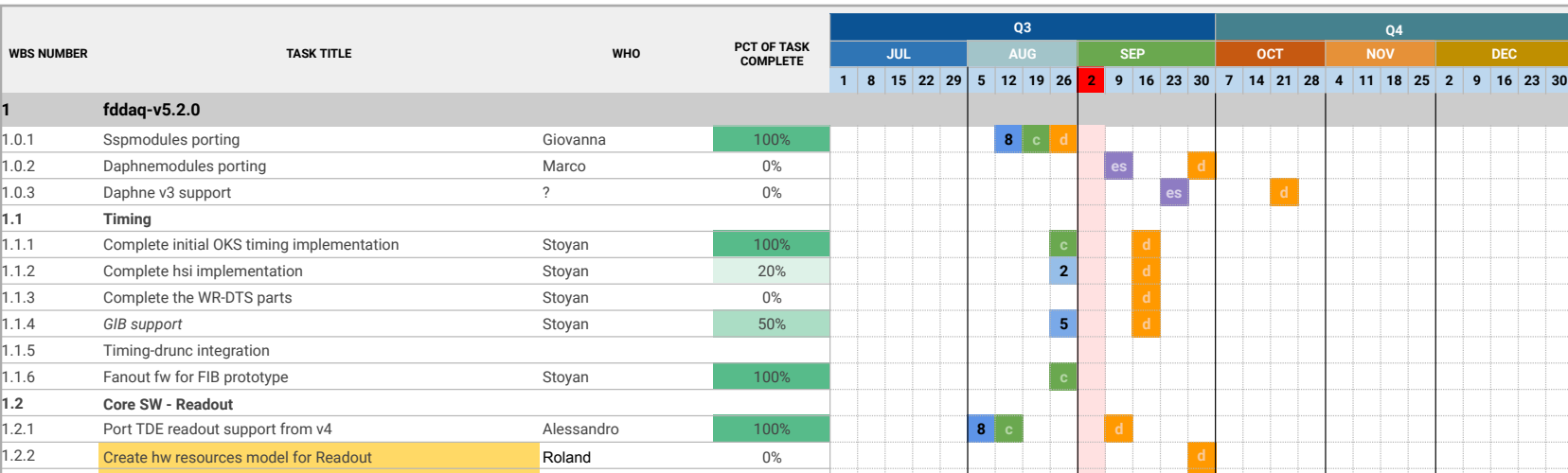
DUNE DAQ v5.2

Release Coordinator : E.Flumerfelt

Release status/progress

▸ Consolidation around new configuration and run control systems for NP02 operations

▸ Recovery of testing infrastructure in v5

▸ Forward-porting of v4 features and fixes

▸ Consolidation of many packages

▸ Good progress over the summer but large number of changes challenging to handle

▸ Target release date : Oct 21st

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
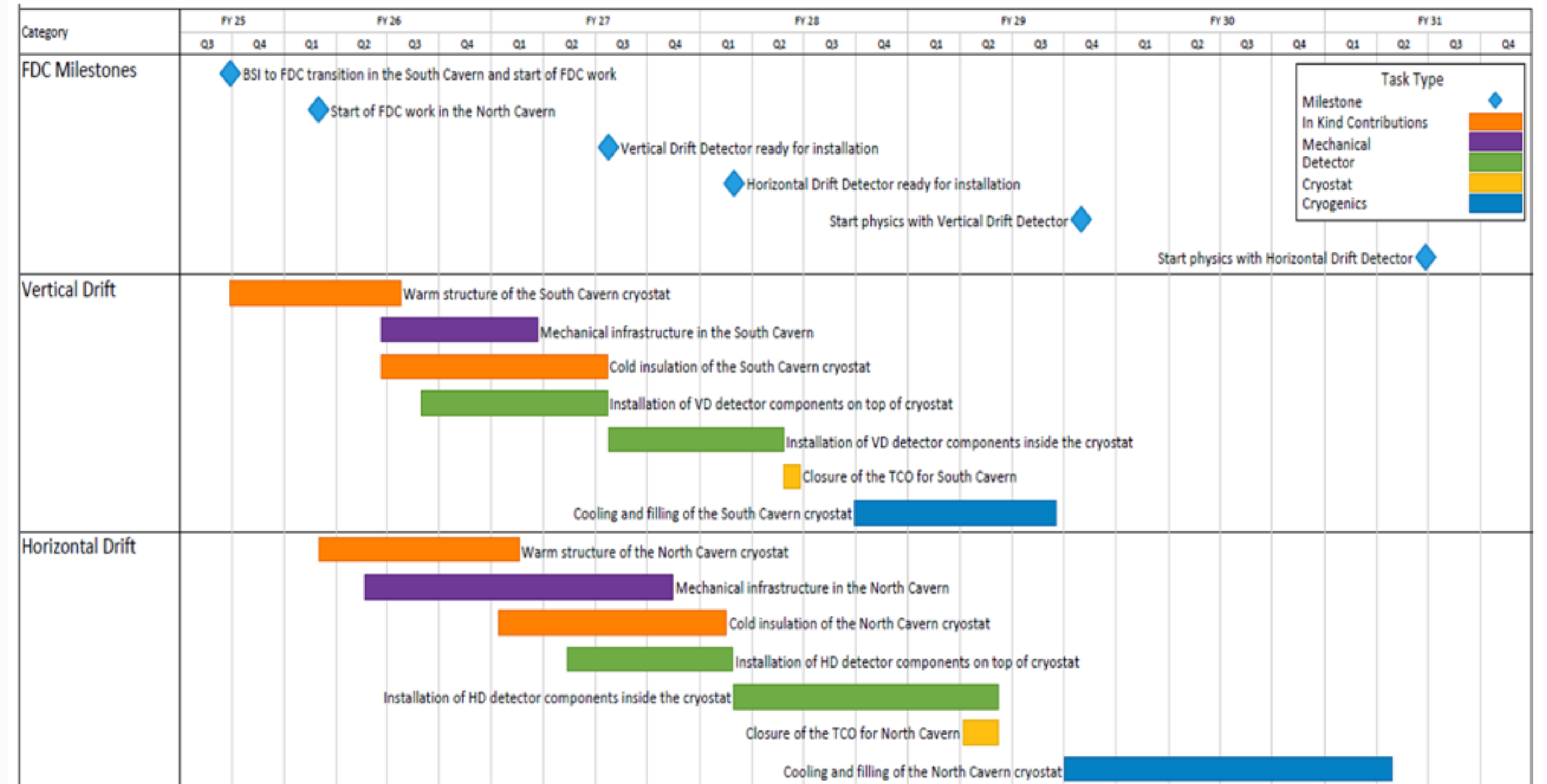
M. Nessi - Sep. DUNE CM

- Installation dates largely stable since then
  - ‣ Some clashes between DAQ and detector installation activities need following up
    - ◆ as well as a review of dependencies
  - ‣ Attempt to increase the contingency between DAQ and detector installation ongoing

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 updated
    - ◆ Timing, Readout network and DAQ Servers PRR delayed to early 2025 to make use of the extra time for testing and value engineering studies

- **Procurement Strategy**
  - ‣ Procurement plan under taking into account VD shorter installation and cooling schedule, and national funding 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

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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

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NP02 DAQ Run Coordinator

- **The ProtoDUNE DAQ run coordinator role was created in Q1 2024 times support the NP04 operations**

- **The ProtoDUNE DAQ coordinator**

  ‣ Is the point of contact with NP04 Run Coordination and other NP04 subsystems

  ‣ Is responsible for the organisation of DAQ expert shifts

  ‣ Is responsible for DAQ experts training

  ‣ It represents the DAQ at weekly NP04 meetings and daily meetings

- **W. Ketchum, who has served as DAQ run coordinator for NP04, and previously as DAQ EHN1 integration coordinator, is due to go back to FNAL in April 2025**

  ‣ I would like to take the opportunity to thank Wes for his tireless effort and for the success of the NP04 run.

- **The DAQ is looking for a new DAQ Run Coordinator to lead the preparation and the NP02 DAQ operations**

  ‣ Please contact me if you have a suggestion for a candidate

- **Ideally the new DAQ Run Coordinator should overlap with Wes as much as possible.**

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Summary

- **The NP04 run is now completed**
  - ‣ The DAQ is supporting and participating in a stress test campaign waiting for the LAr to be transferred

- **A different set of challenges is expected at NP02**
  - ‣ 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 expected to start soon

- **Far Detector installation schedule update**
  - ‣ Procurement plan being reviewed in light of the new timeline and constraints
  - ‣ Interactions with other systems during installation being checked for conflicts

- **Near Detector DAQ interfaces being updated for the early 2025 detector reviews**

- **The consortium is looking for a DAQ Run Coordinator for NP02**