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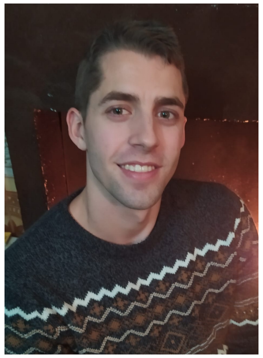
Data Quality Monitoring

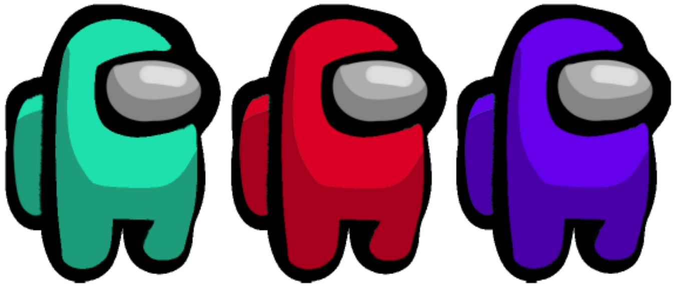
DQM Team

Pip Hamilton


Juan Miguel Carceller

Stefano Vergani

Postdocs



Callum Cox

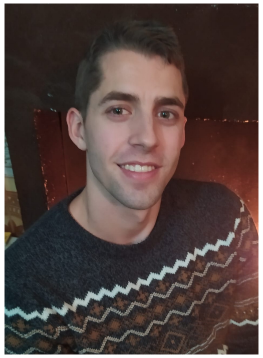
Matthew Man

Students

DQM Team

Pip

Hamilton



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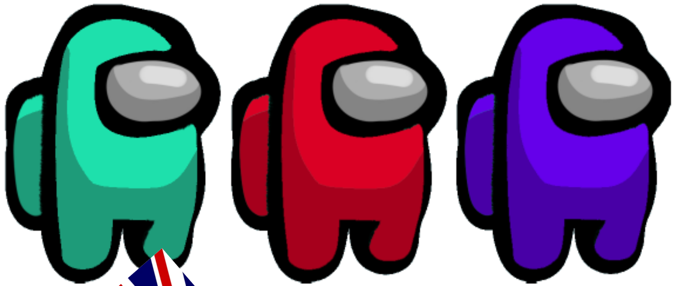

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DQM Charge

The DQM provides a framework to:

- Sample data from each detector as it is being collected.
- Perform automated analysis of the data quality.
  - Generate alerts.
  - Produce useful derived quantities/plots.
- Display these monitoring plots and results on a web platform accessible anywhere in the world.
- Keep a complete historical record of data quality.

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- Keep a complete historical record of data quality.
- ~~Monitor non-physics data.~~ **OUT OF SCOPE**

$$\begin{tikzcd}[row sep=small] & \text{CCM} \\ \text{OUT OF SCOPE} \arrow[ur] \arrow[dr] & \\ & \text{Slow Controls} \end{tikzcd}$$

System Overview

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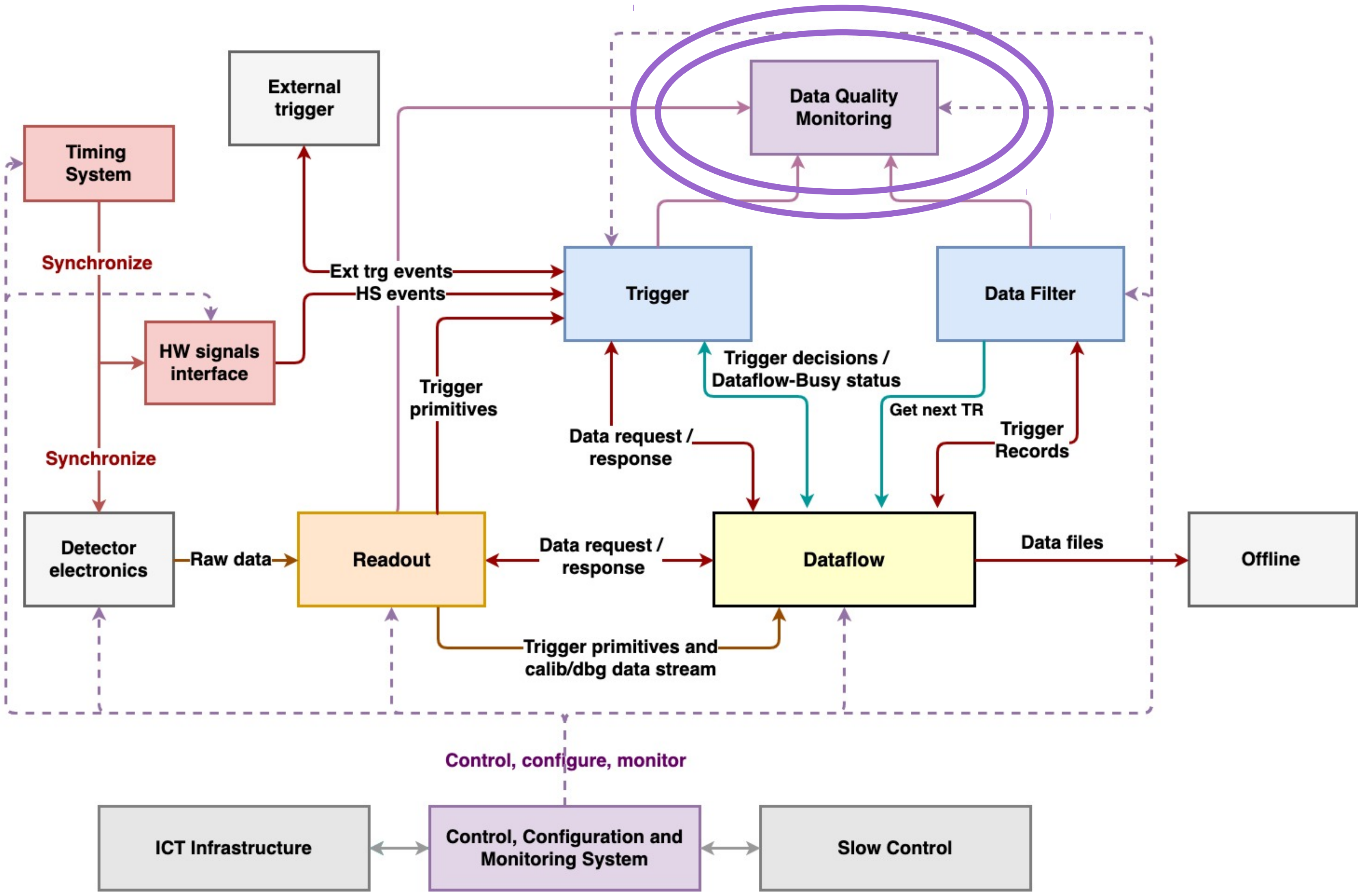

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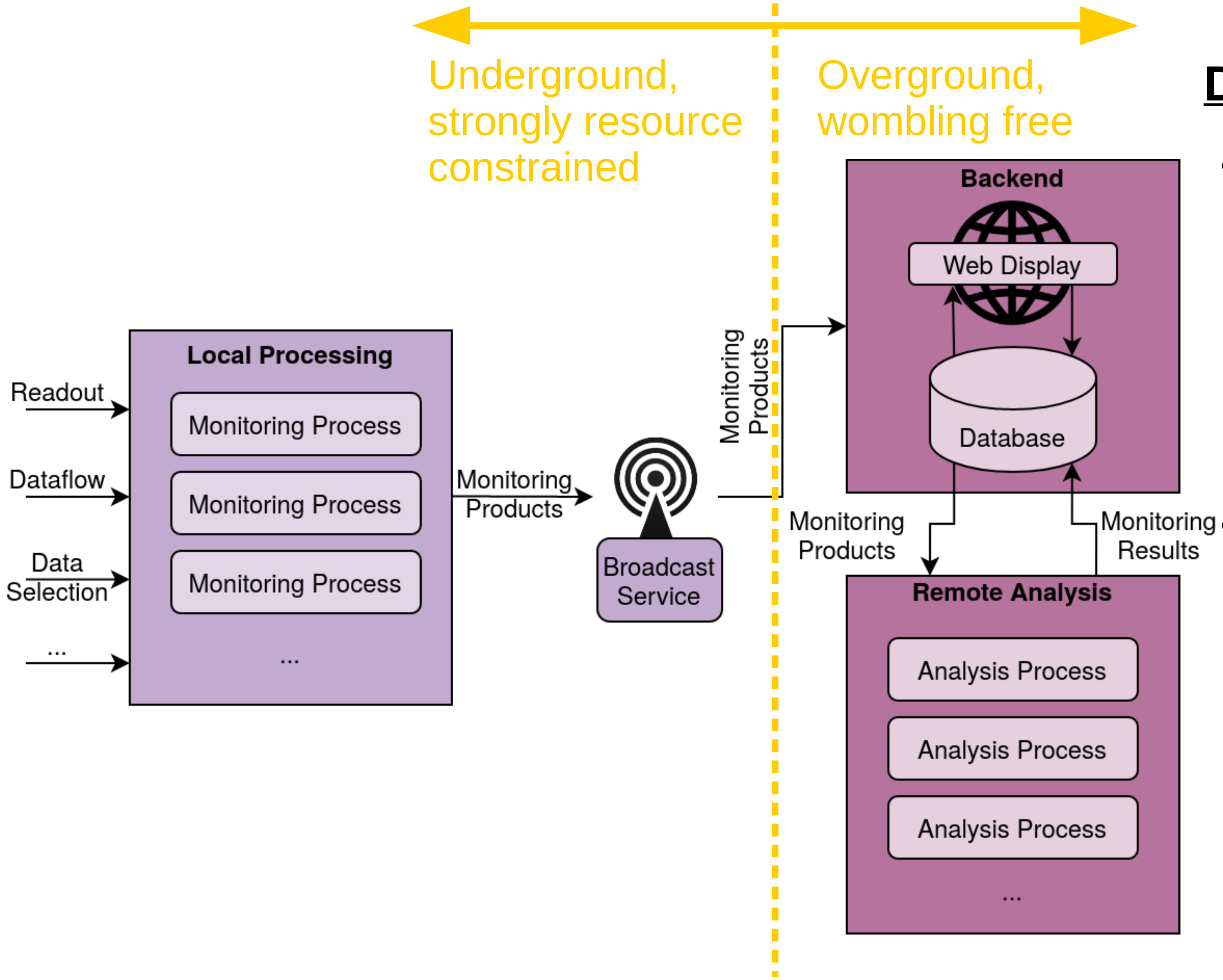
System Overview



DQM Glossary

- **Monitoring Product:** data container (e.g. plot) derived from sampled data stream, summarising detector state for inspection.
- **Monitoring Result:** data container (e.g. plot) derived from monitoring products, making a determination about the detector state.

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Local Processing

- Processing constraint: 1 core per APA.
- Written in C++ with minimal external dependencies:

  https://github.com/DUNE-DAQ/dqm

- Samples input data at configurable rate + for configurable window.
- Multithreaded to run an arbitrary number of monitoring algorithms in parallel.

Current monitoring products:
- RMS ADC per channel
- σ of ADC per channel
- FFT of ADC per channel

Current monitoring inputs:
- Raw data from readout
- Trigger primitives from dataflow.

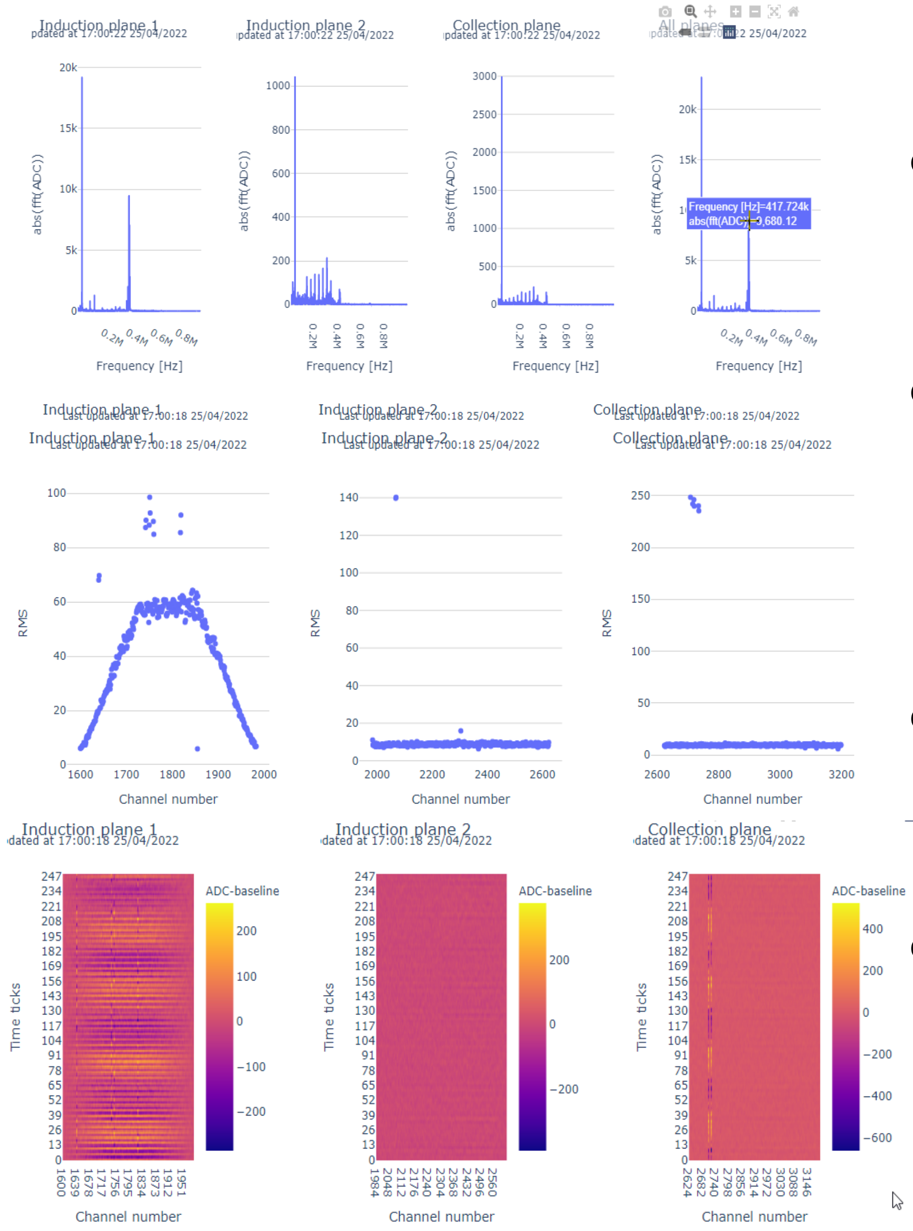
- Transmits to the remote system components through Apache Kafka broadcast service.
- Longest-standing part of the DQM system; served 2 cold box deployments.

Backend

- The ‘backend’ encompasses both the web display and the database that serves it.
- Original system built with C#, ASP.NET architecture.
- After departure of Y. Donon (CERN), proved impossible for us to maintain.
- New python/django system built from scratch by J. M. Carceller (UCL):

  https://github.com/DUNE-DAQ/dqm-backend
- Serving this current coldbox run.

Backend



- Main instance currently accessible on np04.
- Displaying FFTs, standard deviation and RMS ADC per plane/channel.
- Mouseover tooltips for detailed inspection.
- Extendable by design.

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Remote Analysis

- Written in python, intended to run in the same location/on the same filesystem as the backend.
- Set up to run a configurable list of ‘plug and play analyses’ in parallel.
  - 1st milestone analysis: generating per-channel alarms when ADC RMS/s goes out of statistically significant bounds (e.g. 2σ excursion).
- Manages input to analysis processes by watching the directories of the backend database for new files.
- Last ‘work in progress’ segment of the system. Targeted for release alongside DUNE-DAQ v3.2 (mid-September).

Remote Analysis

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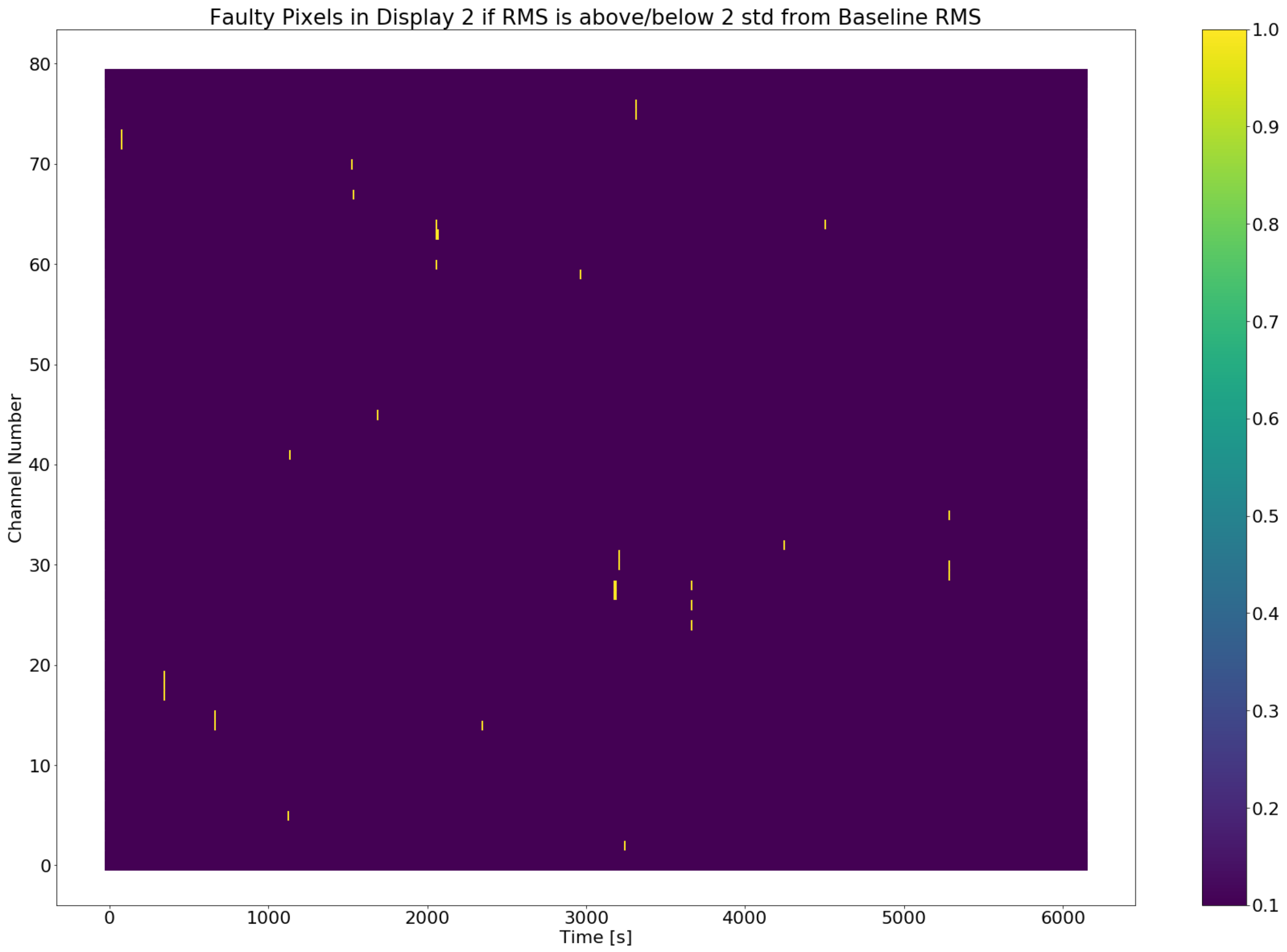

Summary

- **2 systems out of 3 stable and providing continuous service for current DAQ.**
- **Remote analysis package under intensive development, targeted for v3.2**

- **Future work:**
  - **Local Processing**
    - Expansion of inputs:
      - Data Selection
      - Photon Detection System
      - Near Detector Systems
  - **Backend**
    - Deployment in kubernetes.
    - Deepening web display navigation.
    - Possible database upgrade.
  - **Remote Analysis**
    - First deployment of prototype
    - Expansion of available analyses.