

DAQ Developments at Daresbury

Nuclear Physics Community Meeting 2026

Carl Unsworth¹

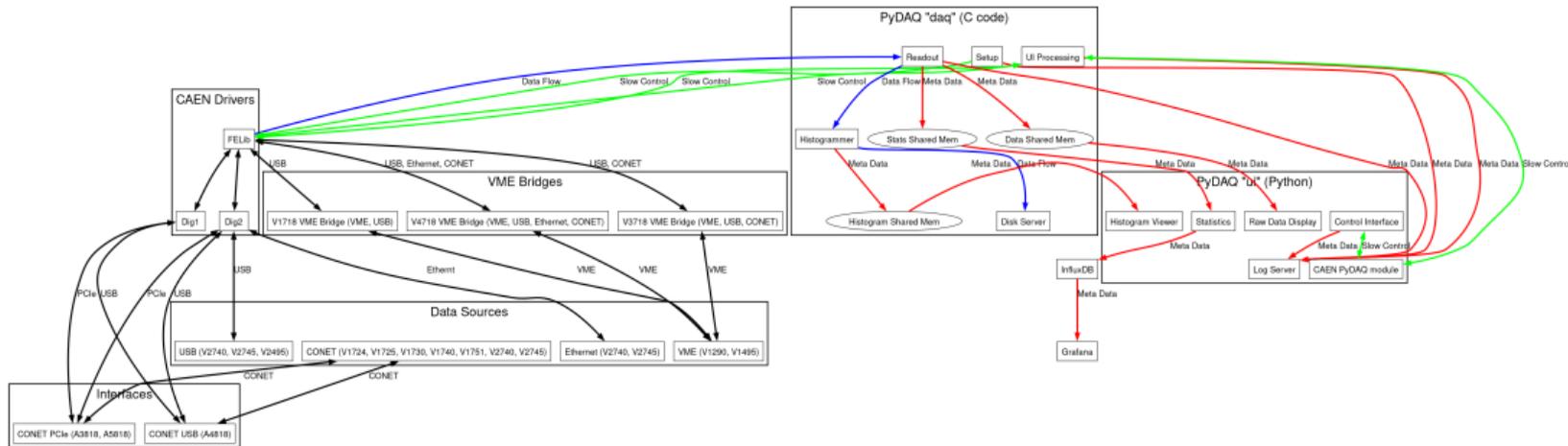
¹STFC Daresbury Laboratory

January 8, 2026



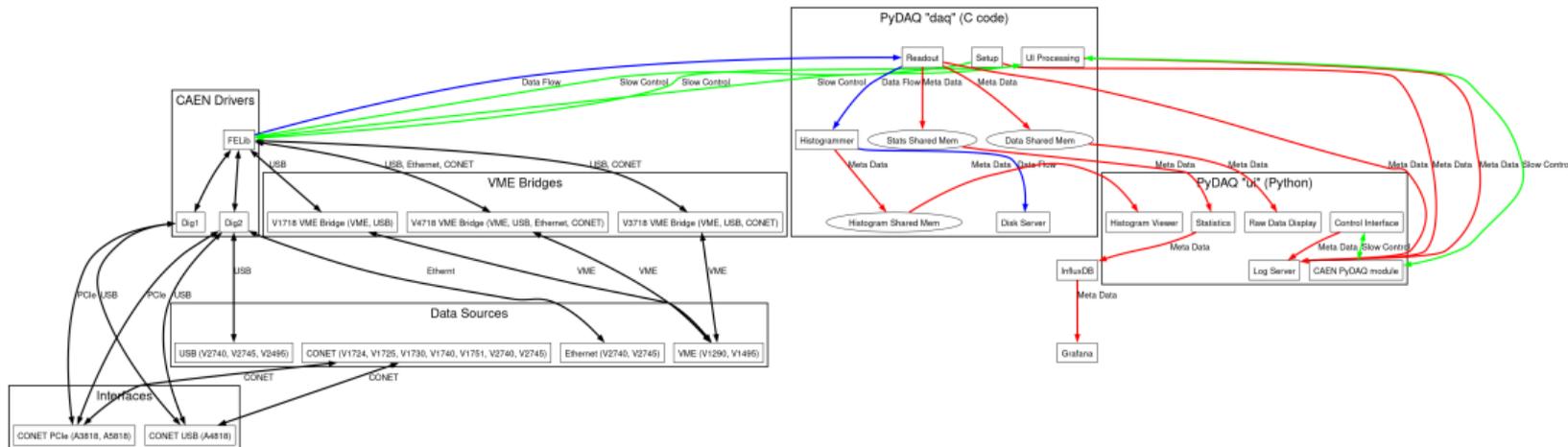
Science and
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- PyDAQ is a framework of reusable DAQ components we are developing.
- Replaces old MIDAS framework with more modern technologies (TCL + C → Python + Flask + C).



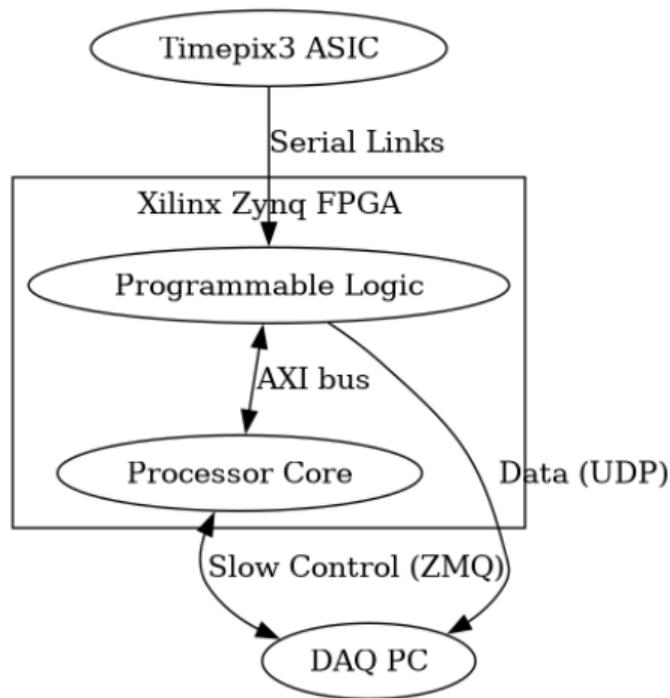
STFC Nuclear Physics Group CAEN Readout Software Architecture (Draft)

- First usable version released to community at a meeting in Jan 2025.
- About time for an update...

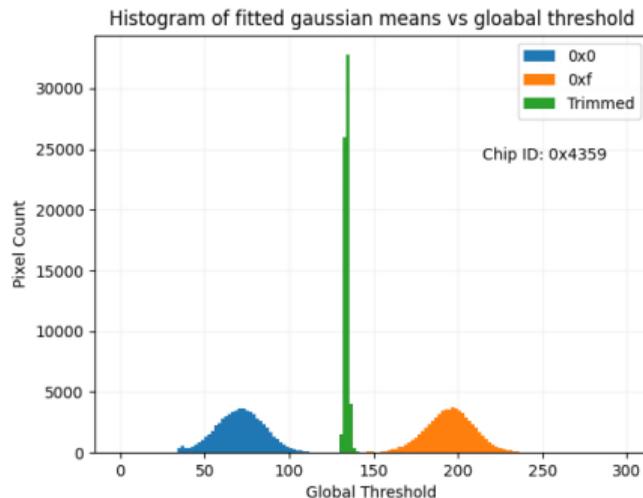


STFC Nuclear Physics Group CAEN Readout Software Architecture (Draft)

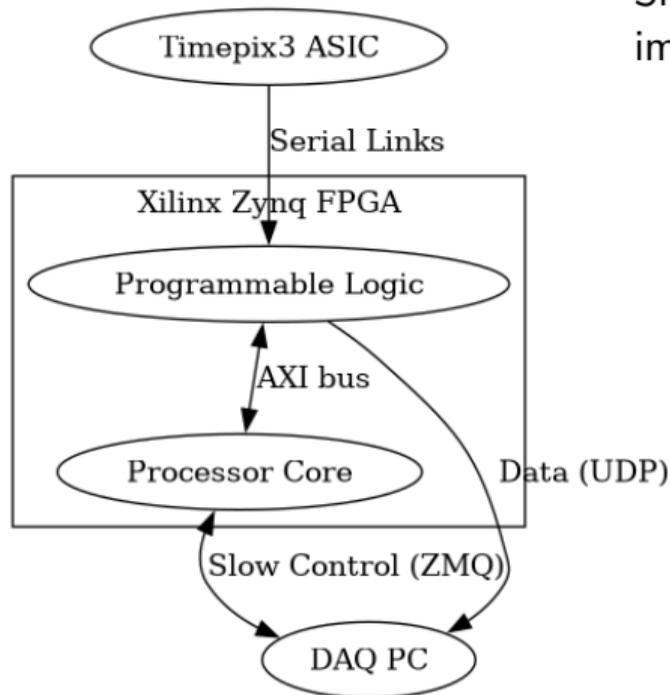
Timepix3 Readout



- First system delivered to Glasgow in July.
- Fully working but readout speed less than the target 10 Gb/s.
- Includes automated ASIC pixel calibration routines (Thanks to Matt Russell).



Timepix3 Readout

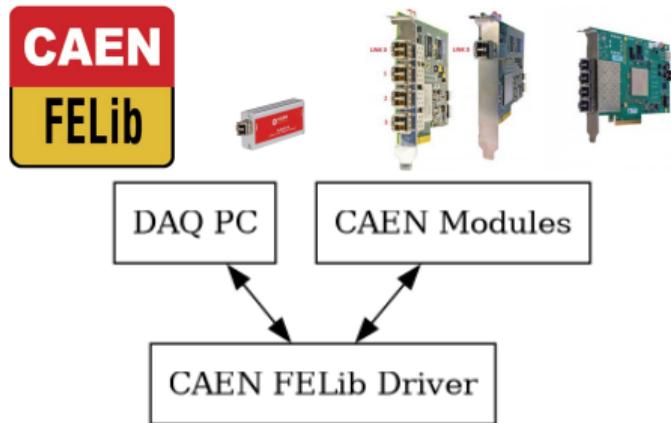


Since then we have worked on some software improvements:

- Integrated new library for interprocess communication "ZeroMQ".
- Tools for UI e.g. improved network configuration for UDP link.
- Speed of link from FPGA to PC being worked on. Current best is 6 Gb/s (target is 10).



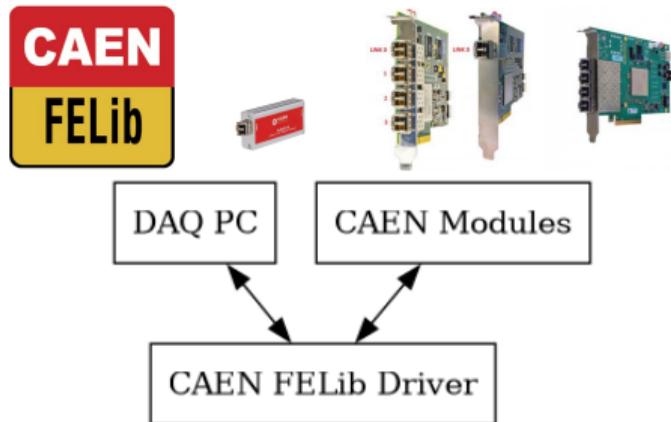
CAEN Digitiser Readout



- CAEN readout software supports both the new and old generations of CAEN hardware.

- We were excited in May to use it at an accelerator for the first time for the HYPATIA tests.
- It works! Data correctly read out at high speed and properly synchronised with existing DALI DAQ.
- But there were problems for us to address...

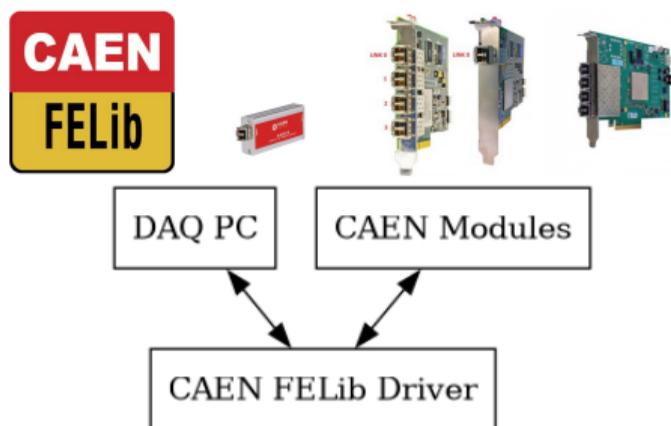
CAEN Digitiser Readout



- CAEN readout software supports both the new and old generations of CAEN hardware.

- Sorting the data was harder than it needed to be (Sorry and thanks Kathrin Wimmer!).
- Example sort code dropped some events due to a bug. Although all events were properly recorded on disk (Thanks Nigel Warr!).
- It was possible to corrupt a settings file!
- Online histogram viewer was clunky!

CAEN Digitiser Readout



- CAEN readout software supports both the new and old generations of CAEN hardware.

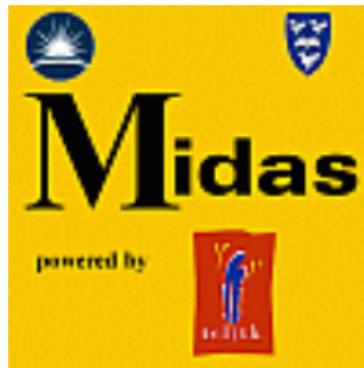
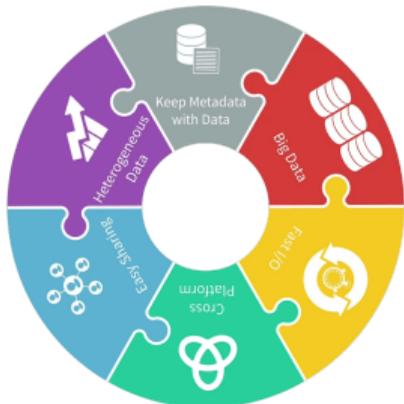
Solutions:

- Data parsing code from DAQ now available as a ".o" → Easy to include in your code.
- Test data sets with known content to be replayed as part of test procedure. (New apprentice Tom Nelson-Smith to help out with this)
- Settings versioning. Test readback of known values to ensure module is working before saving.
- New histogram viewer! (Thanks to Alan at ATC, more later)

Data Formats and Sorting

We would like feedback from the community on the desired/required data format. We will provide a simple sort code to parse any data format we produce. Options:

- **Required** Raw data received from electronics (with small header if needed for interpretation).
- **Used in new JYFL DAQ** HDF5 "Hierarchical Data Format 5"
- ROOT
- MIDAS "TDR"

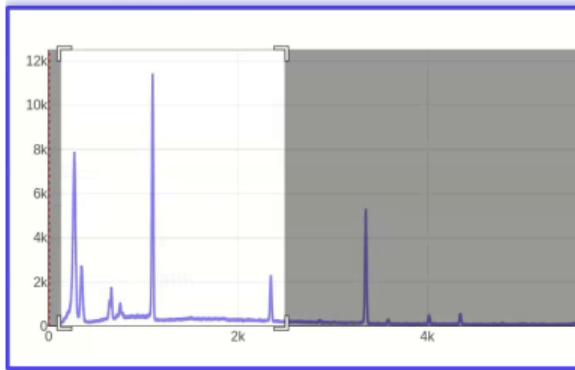


Histogram Viewer

- Great new histogram viewer developed for us by Alan Stokes at ATC!
- New design → DAQ just sends bin contents to web browser and image is generated in-browser by Javascript.
- Responsive "click and drag" interface for zooming, ROI, etc.
- Simple fitting and automated calibration. (plus Export to ROOT TH1F for more complex fitting).
- Option to save layout for commonly viewed sets of histograms.

Histogram Viewer

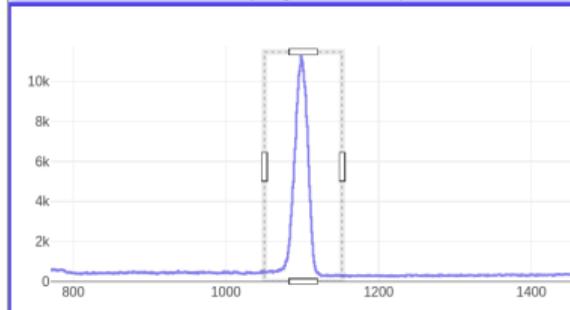
Current Histogram



Histogram Viewer

Current Histogram

Total Accumulated Count: 254031 (Range: 1050 to 1152)



DASSIE and AI



Digital Acquisition Signal System for
Innovative Experimentation

- DASSIE is our new digitiser project.
- Device will be mounted on a drone for radiation surveying.
- Much more info from Mos and Philippos later.
- We are working with Hartree Centre to develop an AI analysis framework for mapping radiation fields or searching for source amid background.
- Development of an efficient DAQ → AI pipeline might be useful in other projects where real-time analysis is needed.

Thank you!

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<https://gitlab.stfc.ac.uk>