

DAQ Updates for BVR

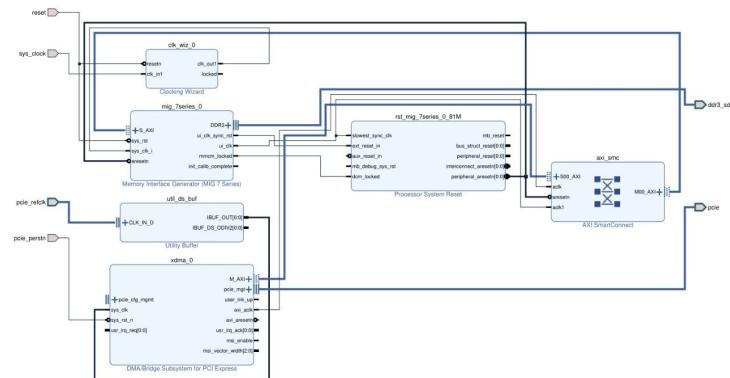
Jack Carlton
University of Kentucky

DMA over PCIe Prototype DAQ

- UKy teststand using Nereid development board
 - Kintex-7 FPGA
 - PCIe data transfer
 - Onboard RAM for buffering
- Firmware for pcie readout using [Xilinx DMA/Bridge Subsystem for PCIe Block](#)
 - Device control via [Xilinx DMA driver for linux kernels](#)
- MIDAS frontend for simple event construction
 - Uses custom [C++ library for simple read/write operations](#)



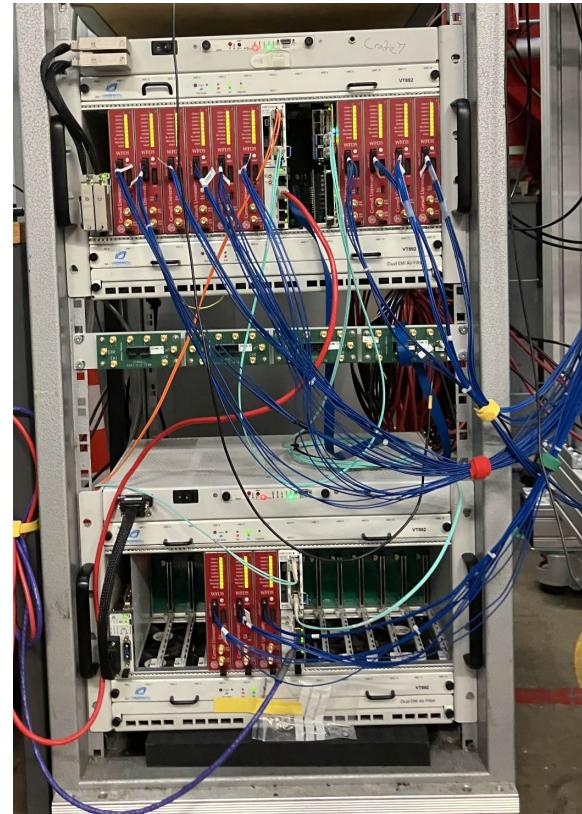
Nereid K7 PCI Express FPGA development board



Simplified block diagram for DMA transfer of data in the onboard RAM over PCIe

Calorimeter Prototyping DAQ

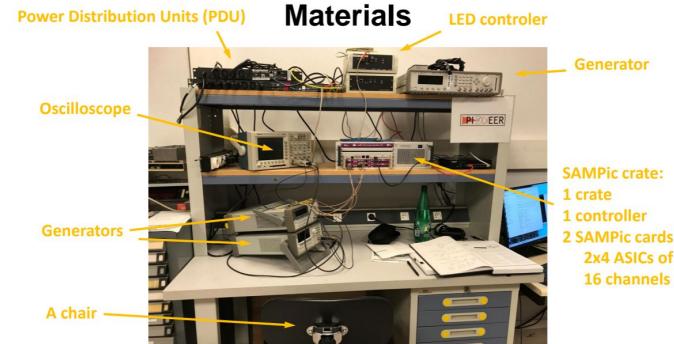
- Uses the same hardware as the g-2 experiment
 - 10 GbE based readout system
 - 800 MSPS Cornell digitizers
- Modified g-2 MIDAS readout software for broader test-stand use
 - LYSO calorimeter test stands
 - Used at PSI in November 2023 rectilinear LYSO crystal array test beam
 - Used at PSI in August 2025 tapered LYSO crystal array test beam
 - LXe calorimeter test stands



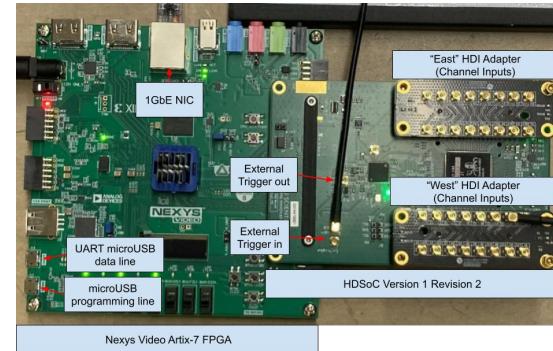
Two crate setup used at 2025 PSI LYSO testbeam

Readout Systems for ATAR DAQ Candidates

- SAMPic
 - 1 GbE based readout system
 - [MIDAS frontend](#) handles configuration and readout, built on existing [SAMPic-256ch C library](#)
 - 256 channel digitizer crate teststand in LPNHE, Paris
- HDSoC
 - 1 GbE based readout system
 - [MIDAS frontend](#) handles configuration and readout built on existing [naludaq python library](#)
 - 32 channel HDSoC digitizer board in UKy
- Comparative studies of rate, triggering, and deadtime performance are currently underway



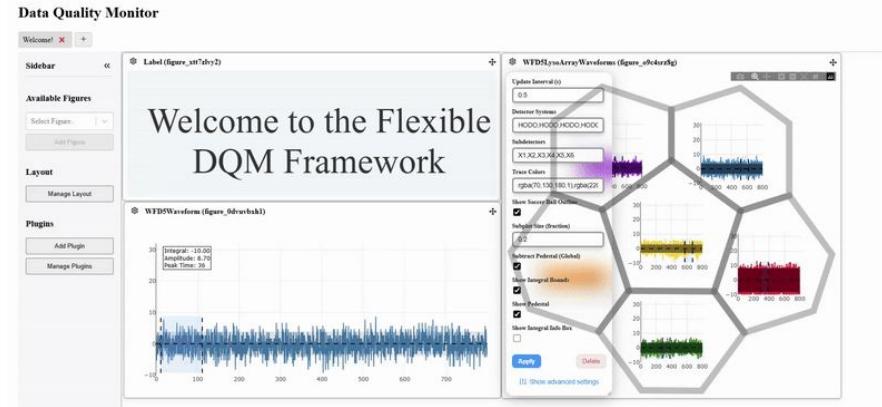
SAMPic teststand with remote access capabilities



Nalu Scientific's HDSoC FMC attached to a Nexys A7 video card

Supplementary Software

- ZeroMQ based event publisher application
 - Pulls live MIDAS events, processes them, and publishes to downstream clients
- Midas event unpackers
 - Convert MIDAS banks into structured ROOT data products
- Data quality monitor webapp
 - React-based, plugin-driven system for registering and displaying arbitrary figures
- These softwares are designed to be modular and flexible to support diverse PIONEER test-stand configurations



Example webpage view formed by an event publisher client

Auxiliary Slides

HDSoC Deadtime Scan (Results)

Parameter Space (793 combinations):

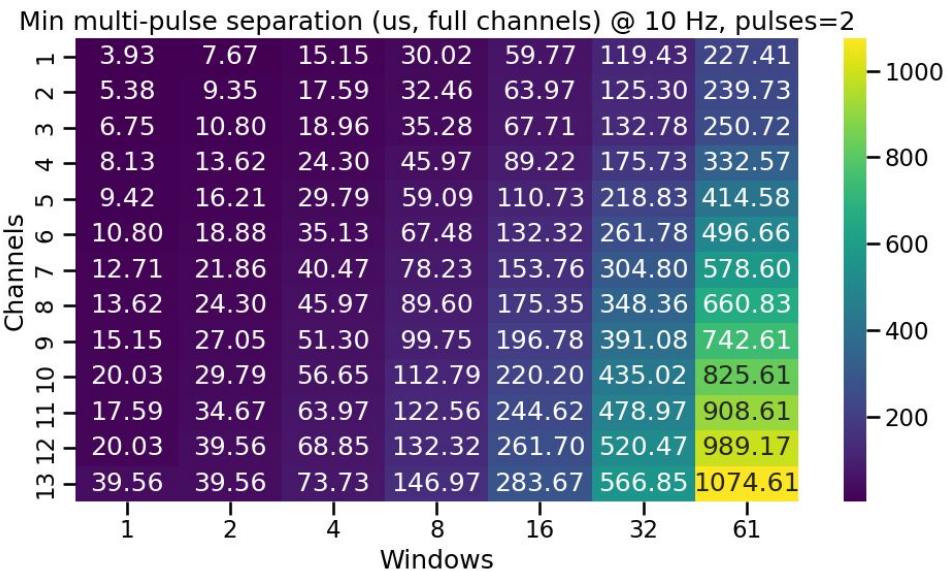
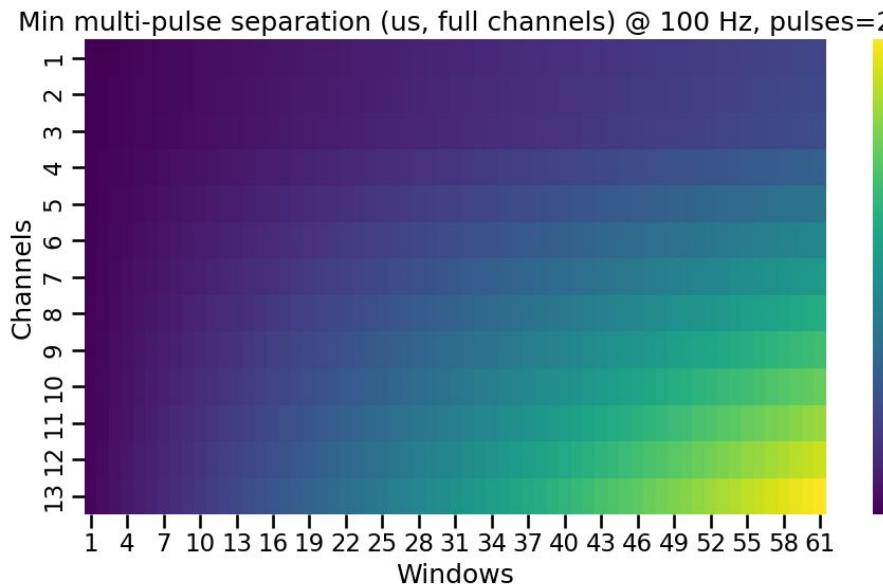
Channels = [1,2,...,13]

Windows = [1,2,3,...61]

Parameter Space (91 combinations):

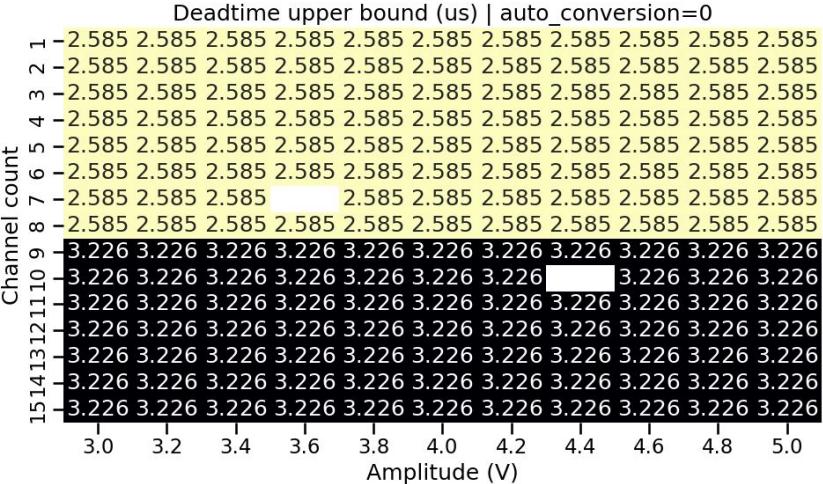
Channels = [1,2,...,13]

Windows = [1,2,4,8,16,32,61]



SAMPiC Deadtime Scan (Results)

- Some runs failed (likely a communication error), the scan was programmed to move on in this case
- There's some scaling between Lecroy input voltage and SAMPic read voltage (ex. 5V lecroy input digitizes as ~0.5V pulse on SAMPic)



Parameter Space (330 combinations):
Channels = [1,2,...,13,14,15]
Amplitude = [3.0,3.2, ... 5.0]
Auto_conversion = [False, True]

