# DL DAQ/SlowCtrl/Rates

Jan C. Bernauer

DL CM, Vancouver, May/June 2023


RBRC
RIKEN BNL Research Center

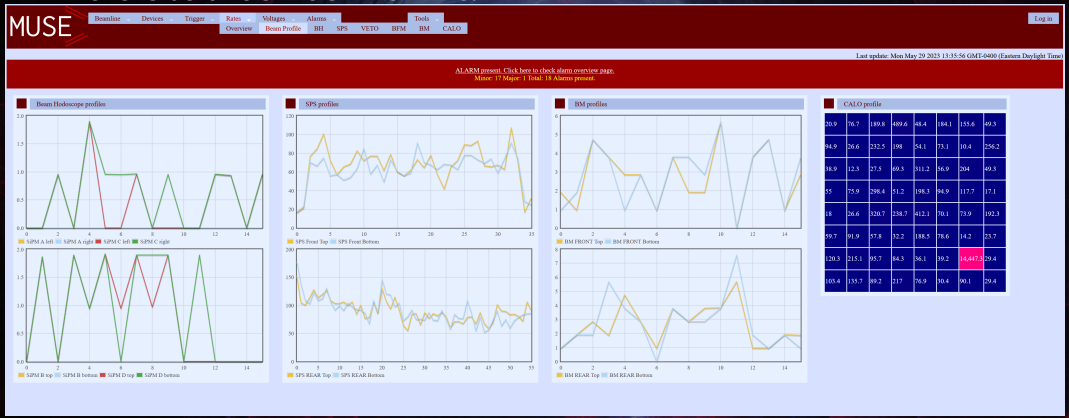
Stony Brook
University

TwoDr. Bernauer is supported by NSF grant PHY 2012114

# Slow Ctrl

Suggestion: Use system we employed in OLYMPUS and MUSE

- » EPICS based
- » PSQL database + python datapump + flask web gui
- » Data also streamed into DAQ



# GEM DAQ

- Components: 8+5=13 APV cards per plane.
- MPD4 digitizer: up to 15 APV cards per MPD
- Standard readout via VME
- Can do 1, 3 or 6 frames
  - 3 frames gives us time resolution, probably good to reduce multi-hit confusion

# Data rates / speeds

- At MUSE: 120 $\mu s$ for 4 APV 6 frames = 12kByte/Event$\longrightarrow$ 100 MByte/s (2x data reduction with firmware upgrade possible)
- Time dominated by VME transfer.
- Assume: 1 MPD / plane, 3 frames, all channels
  - 78 kByte per event.
  - 100% dead at 1250 Hz if read out via one crate (but larger data block might improve speed)
  - 2.5kHz with better packing
- We expect 200 Hz for 13@31, 700Hz for 17@55.
  - Not crazy bad, but not ideal.
  - This assumes trigger-level single bunch resolution, no additional background!

# Alternative readouts

Alternative readout options:

- Split into multiple MPD4 (-> 5kHz @2, 10kHz@4, but need more VME CPUs)
- Use Fiber interface
  - Aurora protocol (implemented, need VTP?, 2.5Gbit/s per MPD) 31kHz, need special electronics
  - Direct ethernet (not implemented, 1 GBit/s or maybe 2.5 GBit/s?) 12.5kHz/31kHz, only need ethernet cards

# Disk requirements

We will save about

- 7.6 MByte/s for 13@31 ( 26 TB for 1000h. Small raid?)
- 26 MByte/s for 17@55
- 38 MByte/s for 1kHz (130TB for 1000h. Biggish raid)

This is for uncompressed but word-packed data.

# Busy / synchronization

Need to distribute trigger to MPD4

- Must have fixed latency<4 $\mu s$

Fully locked or free running?

- Free running:
  - MPD4 can raise busy flag if FIFO is above threshold
  - Generate MIDAS event for each fully read event
- Fully locked
  - Not sure if we can use the busy. Threshold=1?
  - Need trigger to set busy until MPD4 can set busy. Wait for busy or fixed time.

# Software

- Will use MIDAS for DAQ
- Strongly suggest to use COOKER framework for analysis:
  - Used in OLYMPUS, MUSE, J-PARK, and DL
  - Can read MIDAS files (even compressed with xz), map to root file
  - Break down analysis into independent plugins – decouple development of different aspects
  - Thin framework on top of root

# What we already have for cooker

- Analysis configuration via XML based init file
- Run database (postgresql)
- Can chain plugins, can split to run in parallel, compatible with clusters
- Command line and GUI versions. Can visualize event per event.
- Handling of MC weights etc.
- Have code for
  - Mapping
  - GEM analysis
  - MC integration, generators
  - Slow Ctrl
  - many more