MOLLER Counting DAQ 💜

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JLab

Outline

- Very brief summary of MOLLER counting DAQ setups at JLab prior to installation in Hall A

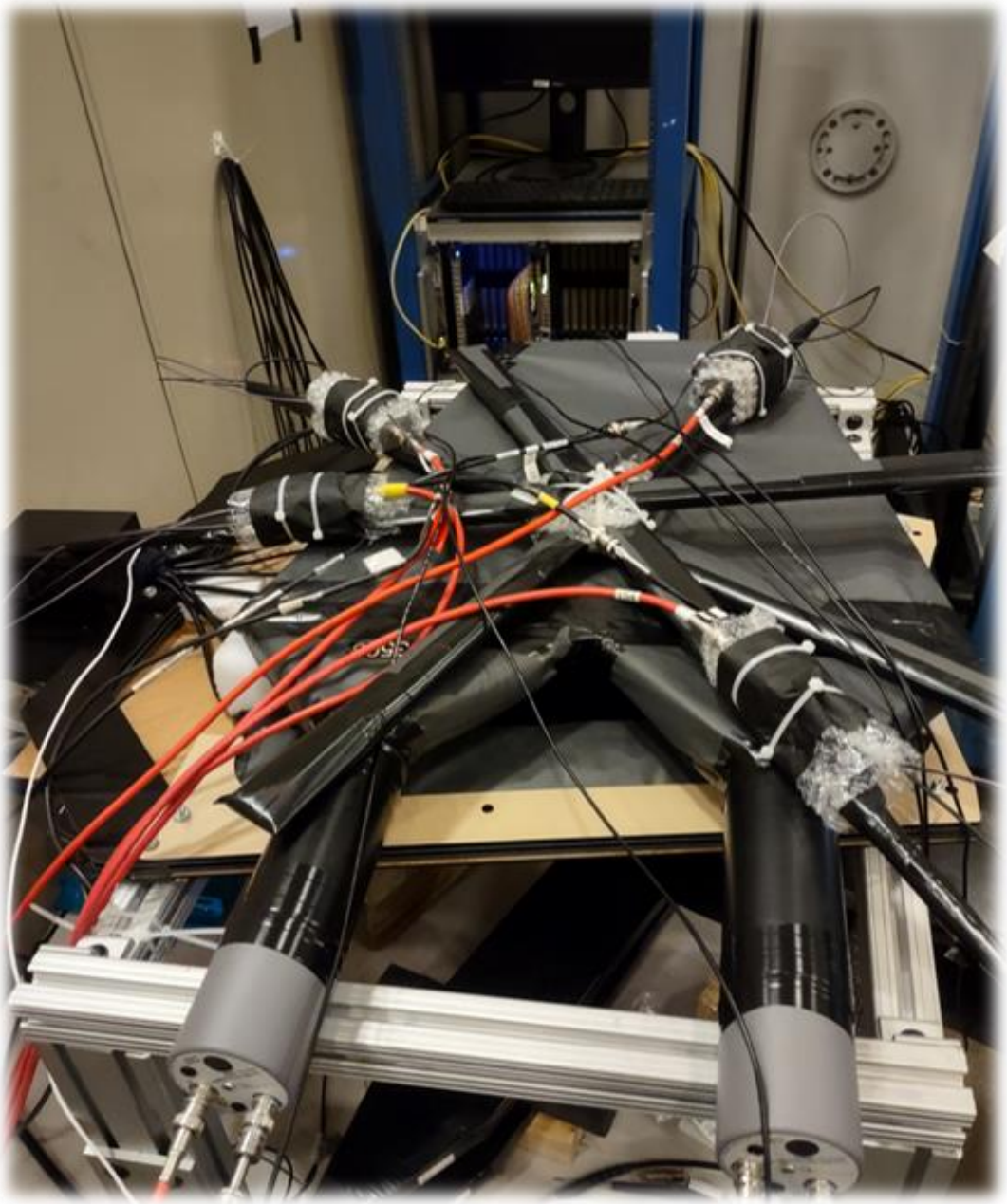
  → counting DAQ for MOLLER Pion Detector and scintillator tests in TestLab
  → counting DAQ for MOLLER in the ESB to deliver project milestones before installation in Hall A

- MOLLER counting DAQ installation in Hall A: status

  → Hardware installation
  → Setting up computer environment for CPUs, VTPs
  → Readout lists and CODA configuration
  → Pulser data

- MOLLER counting DAQ: to-do list

MOLLER Counting DAQ in TestLab: MOLLER scintillator tests



- Single crate CODA configuration with two ROCs: CPU and VTP

VTP-based trigger with 3 trigger types:

```
#########################################
## Trigger Bit 0: FADC multiplicity ##
#########################################
VTP_TRIG_PRESCALE        0   1
VTP_TRIG_DELAY           0   0
VTP_MOLLERCNT_MULTMIN    2

#########################################
## Trigger Bit 1: FADC or              ##
#########################################
VTP_TRIG_PRESCALE        1   0
VTP_TRIG_DELAY           1   0

#########################################
## Trigger Bit 2: SPE Trigger          ##
#########################################
VTP_TRIG_PRESCALE        2   0
VTP_TRIG_DELAY           2   0
VTP_MOLLERCNT_TRG_CH     0
VTP_MOLLERCNT_TRG_PULSE  4
```

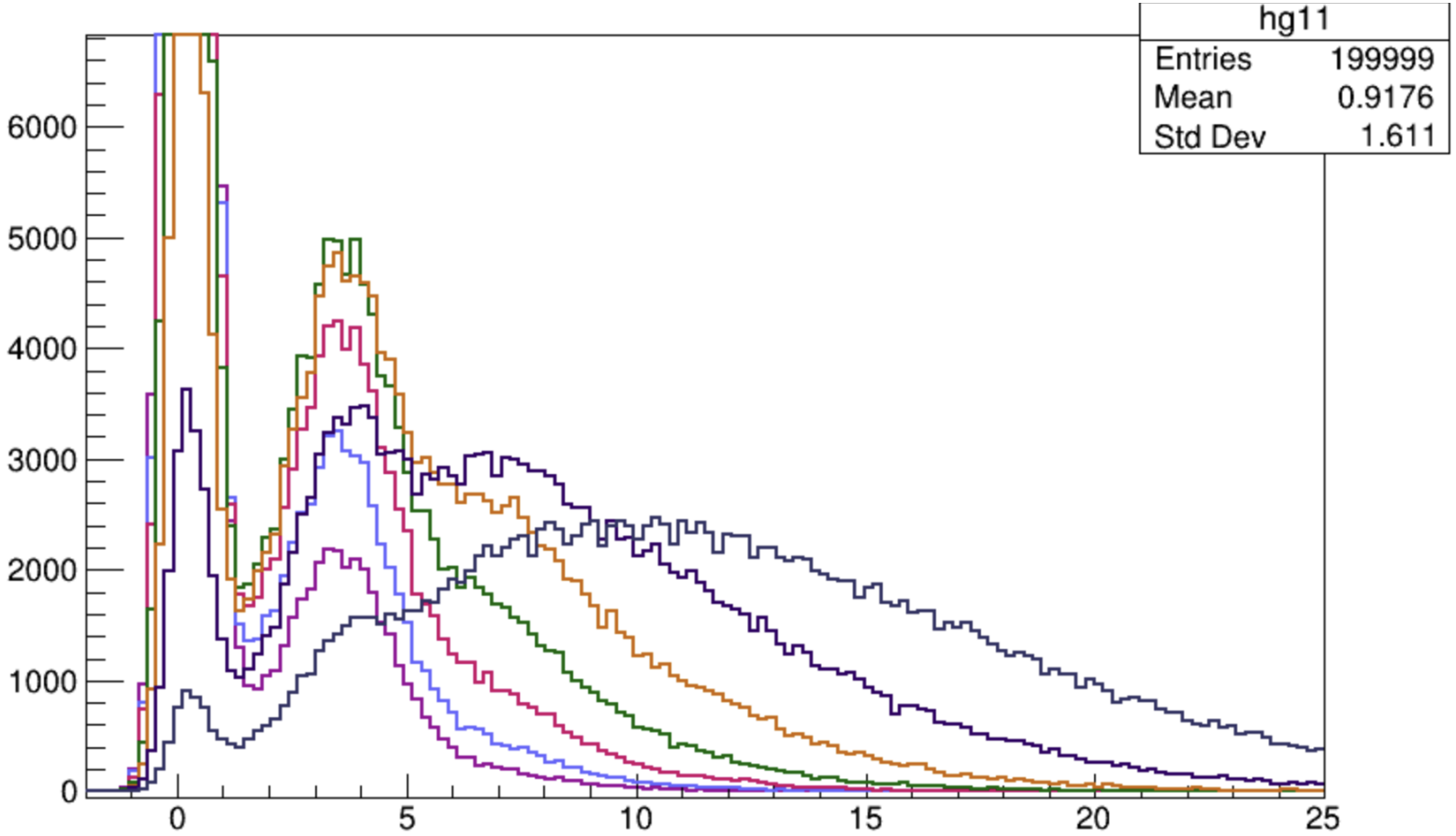
COIN

OR

Single Photoelectron detection (SPE)

MOLLER Counting DAQ in TestLab: MOLLER scintillator tests

- Data with the VTP SPE trigger



Distribution are obtained from runs with the same number of triggers per run but different yield of LED photons making it to the PMT photocathode so as to vary the probability of SPE production

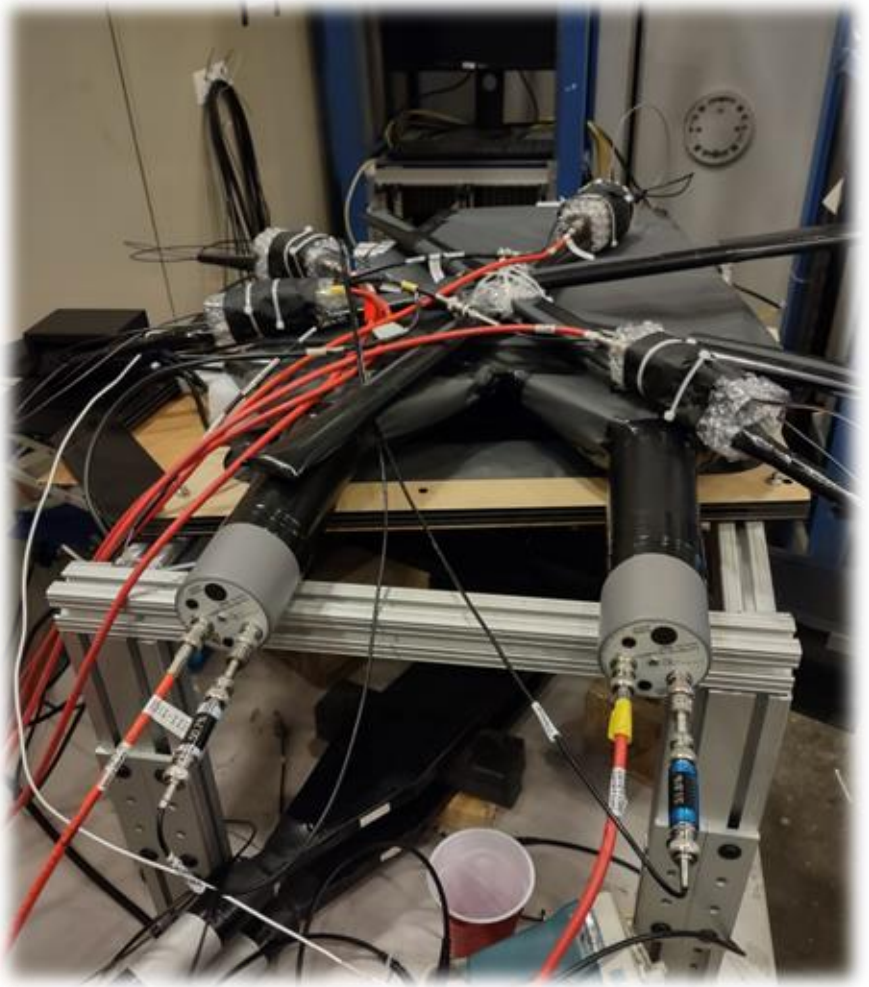
The VTP looks for trigger formation at a FADC channel that contains the pulser's pulse that also drives the LED

MOLLER Counting DAQ in TestLab: MOLLER scintillator tests

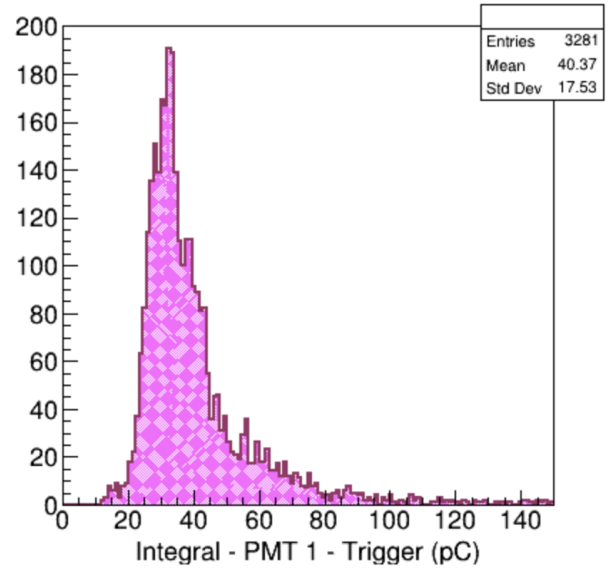
- Data with the VTP COIN trigger

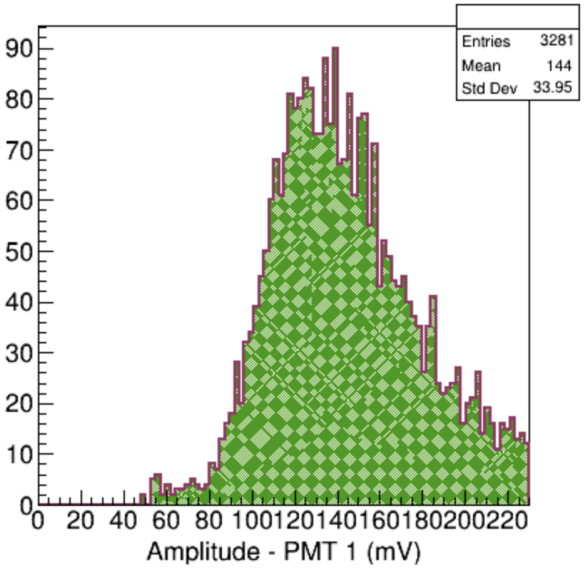
Two MOLLER scintillator prototypes tested at the same time with a VTP trigger coming from an coin between 4 external finger scin paddles

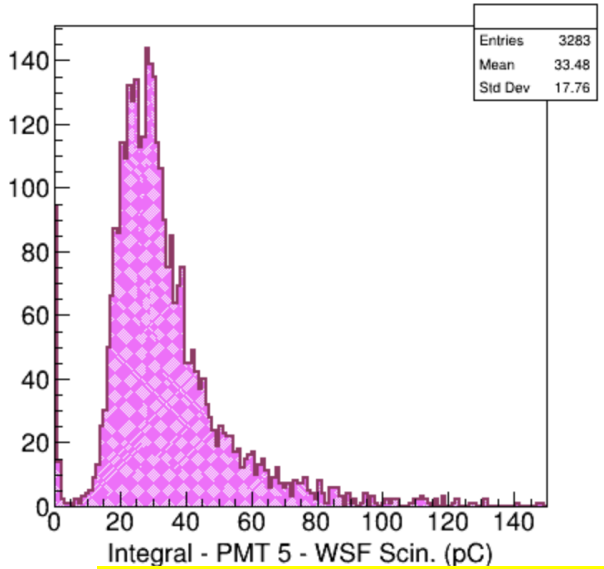
FADC ch 0: empty
FADC ch 1: Trigger finger scintillator PMT (1 V dynamical range)
FADC ch 2: Trigger finger scintillator PMT (1 V dynamical range)
FADC ch 3: Trigger finger scintillator PMT (1 V dynamical range)
FADC ch 4: Trigger finger scintillator PMT (1 V dynamical range)
FADC ch 5: Wavelength shifting fiber scintillator with PMT at 900 V (1 V dynamical range)
FADC ch 6: linear fan copy of Eljen scintillator PMT signal at 1375 V (2 V dynamical range)
FADC ch 7: linear fan copy of Eljen scintillator PMT signal at 1430 V (2 V dynamical range)
FADC ch 8: discriminated copy of Eljen scintillator PMT signal (2 V dynamical range)
FADC ch 9: discriminated copy of Eljen scintillator PMT signal (2 V dynamical range)
FADC ch 10: discriminated copy of Eljen scintillator PMT signal (1 V dynamical range)
FADC ch 11: discriminated copy of Eljen scintillator PMT signal (1 V dynamical range)

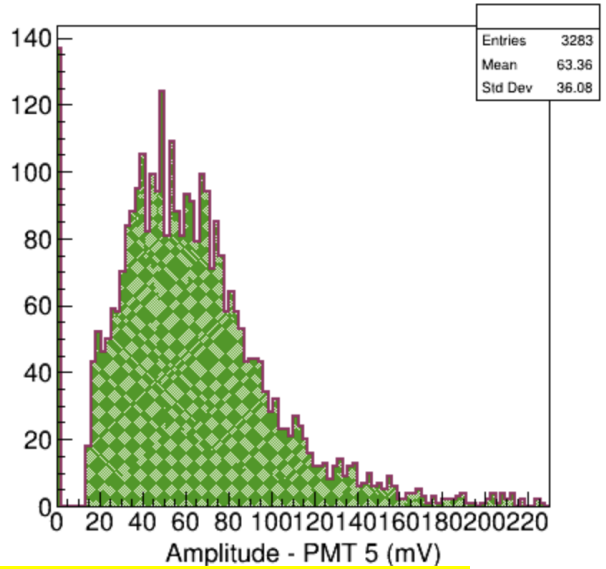


MOLLER Counting DAQ in TestLab: MOLLER scintillator tests

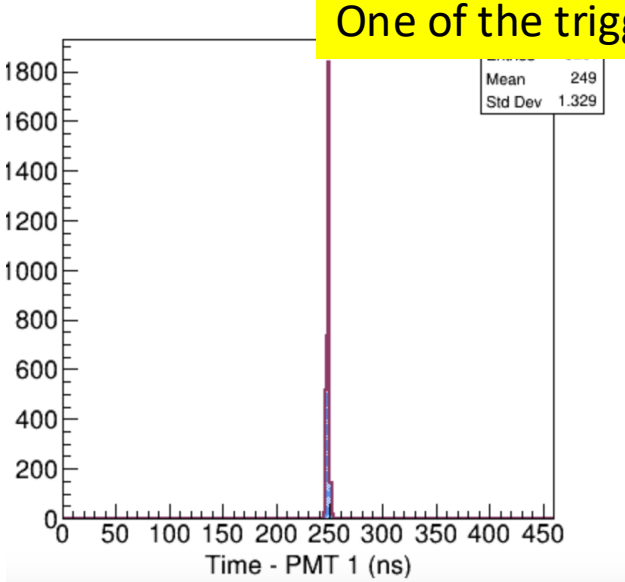


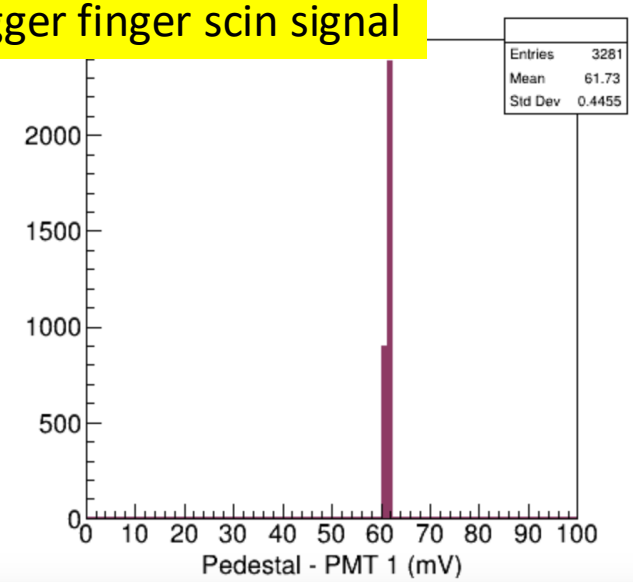




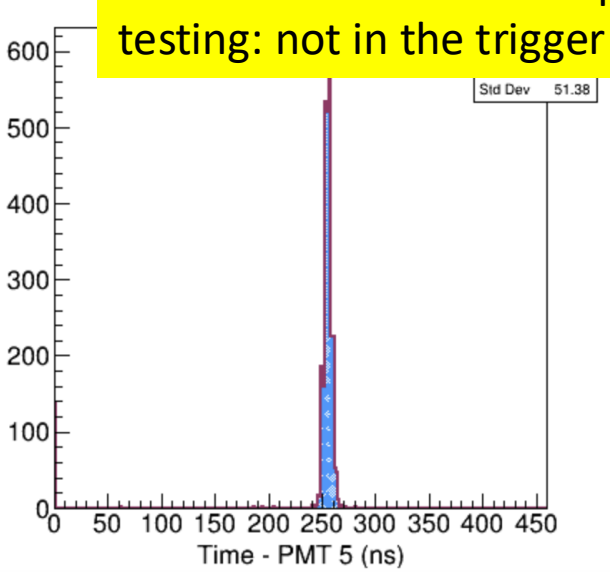


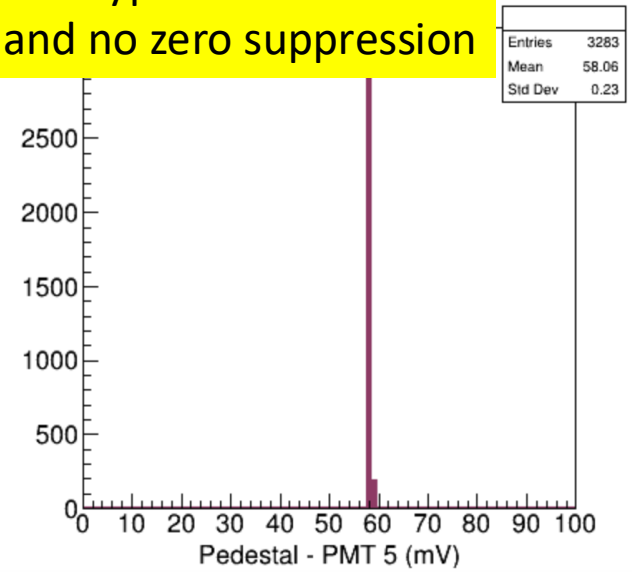
One of the trigger finger scin signal



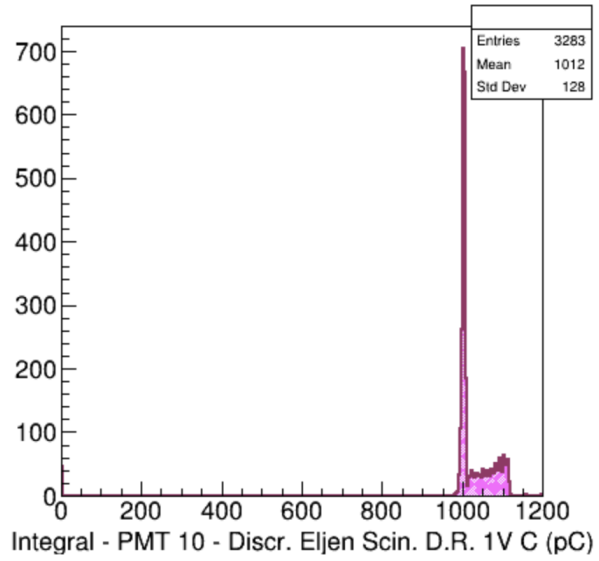


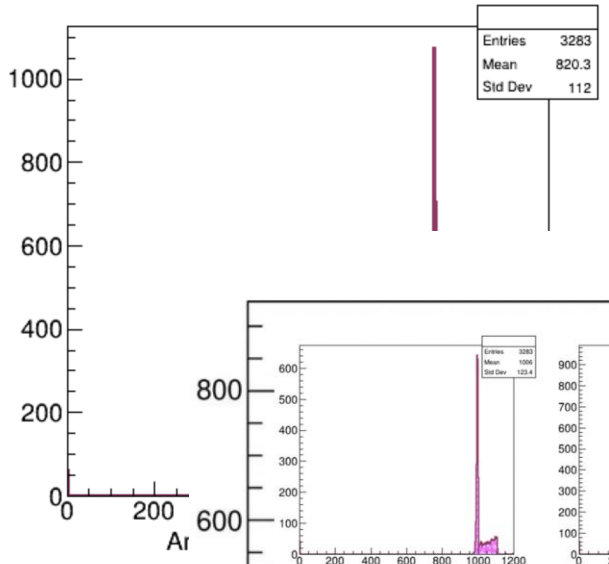
One of the MOLLER scin prototypes under testing: not in the trigger and no zero suppression

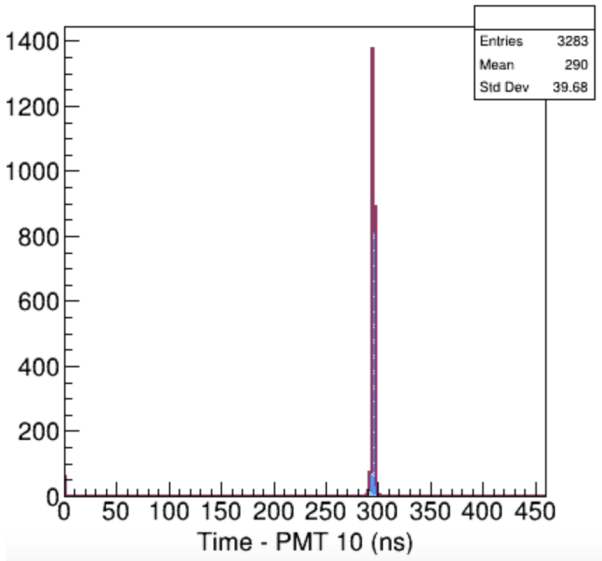


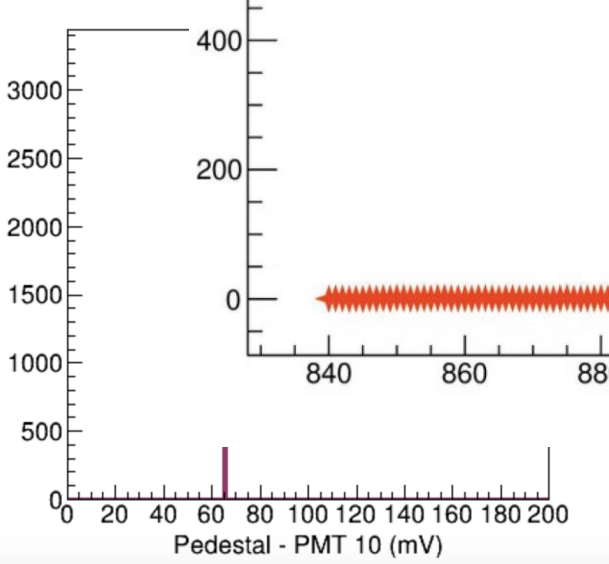


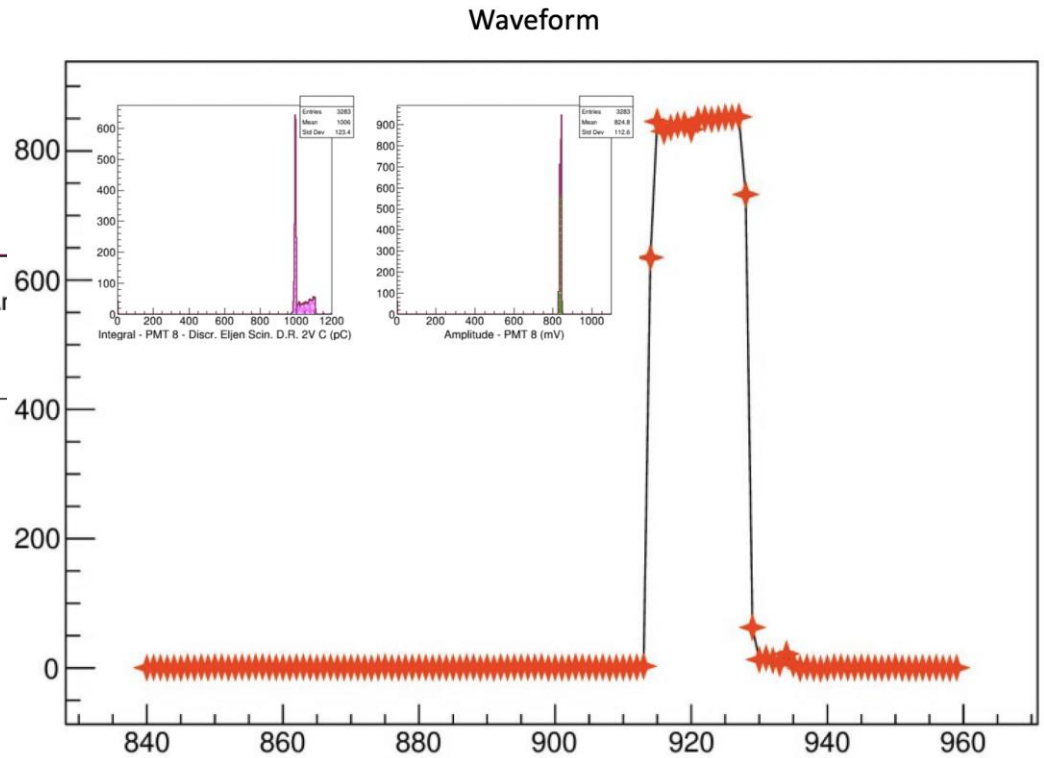
MOLLER Counting DAQ in TestLab: MOLLER scintillator tests











- Sanity checks: looking at the witness channels

Back-of-the-envelope calculation of charge integral:

→ V ~ 824 mV
→ Width ~ 64 ns

$$\int Idt = Q \rightarrow \int \frac{V}{R} dt = Q \rightarrow \frac{1}{R} \int Vdt = Q$$

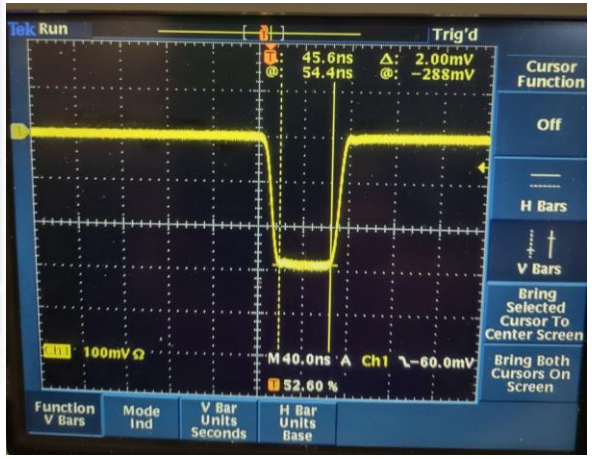
Integral meaning area under the pulse waveform

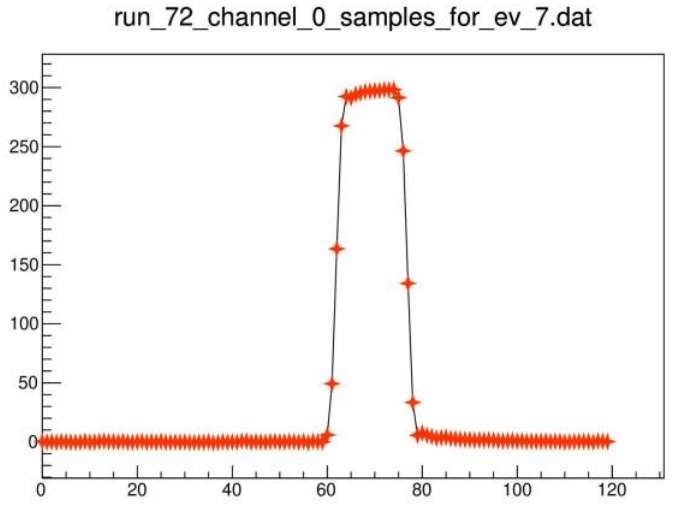
Charge integral =
(824*10^-3V*64*10^-9s)/50 ohm
= 1066*10^-12 C = 1054 pC

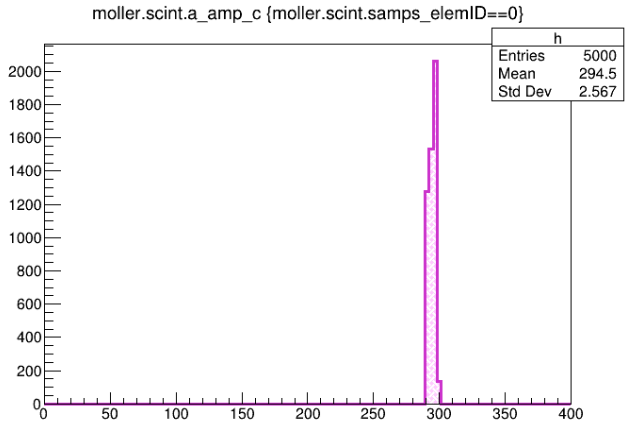
MOLLER Counting DAQ in the ESB

2-crate MOLLER counting DAQ setup in the ESB

- scope picture shows the input pulses into FADCs (2 pulses per FADC: 2 in the VXS master crate and 2 in the slave crate)
- VTP 2-fold coin per crate: the "master" VTP trigger goes to TI master TS 1 and the "slave" VTP trigger goes to the TI master TS 2
- accepting both triggers





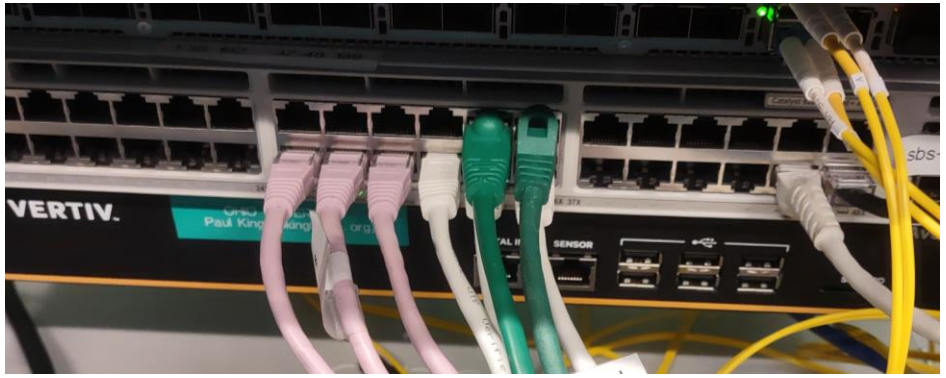


MOLLER Counting DAQ in Hall A

moller-counting-cpuTS (previously **sbsts1 129.57.192.138**)
moller-counting-cpu1 (previously **sbsecal5 129.57.192.107**)
moller-counting-cpu2 (previously **sbsecal6 129.57.192.164**)
moller-counting-cpu3

moller-counting-vtp1 (previously **sbsecal5vtp 129.57.192.178**)
moller-counting-vtp2 (previously **sbseval6vtp 129.57.192.124**)
moller-counting-vtp3

moller-counting-vxsTS (previously **sbstsvxs 129.57.192.116**)
moller-counting-vxs1 (previously **sbsecal5vxs 129.57.188.112**)
moller-counting-vxs2 (previously **sbsecal6vxs 129.57.188.111**)
moller-counting-vxs3



MOLLER Counting DAQ in Hall A

- Portserver (sbsgemts) connection established

  → moller-counting-cpu1: port 2
  → moller-counting-vtp1: port 4
  → moller-counting-cpu2: port 3
  → moller-counting-vtp2: port 5

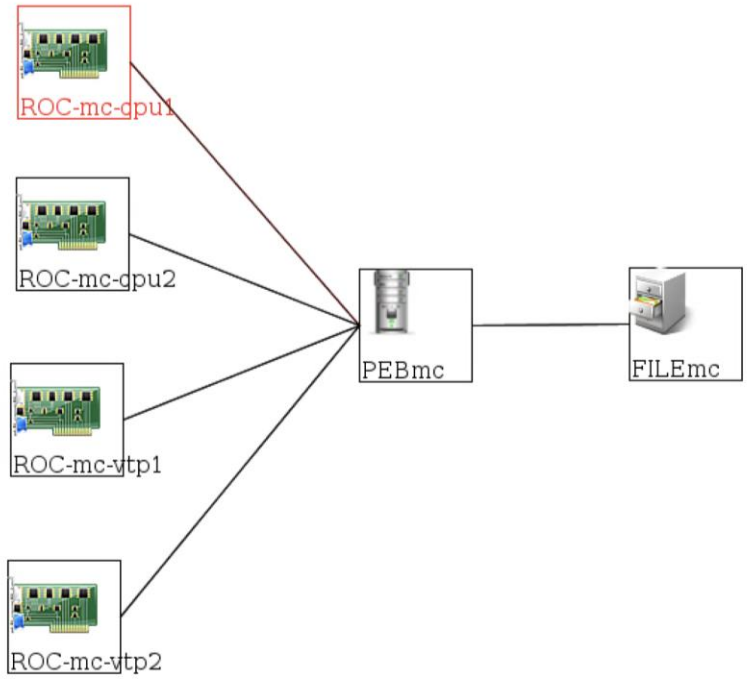

```
moller-onl@adaq1:~/integrating$ telnet sbsgemts
Trying 129.57.188.33...
Connected to sbsgemts.
Escape character is '^]'.

login: root
password:
#> set line range=2

tty  baud  csize parity stopb  break      error inpck istrip onlcr otab

  2 115200    8     N     1   ignore     ignore   off   off   off   off

#> set line range=3

tty  baud  csize parity stopb  break      error inpck istrip onlcr otab

  3 115200    8     N     1   ignore     ignore   off   off   off   off

#> set line range=4

tty  baud  csize parity stopb  break      error inpck istrip onlcr otab

  4 115200    8     N     1   ignore     ignore   off   off   off   off

#> set line range=45
Bad range

#> set line range=5

tty  baud  csize parity stopb  break      error inpck istrip onlcr otab

  5 115200    8     N     1   ignore     ignore   off   off   off   off

#>
```

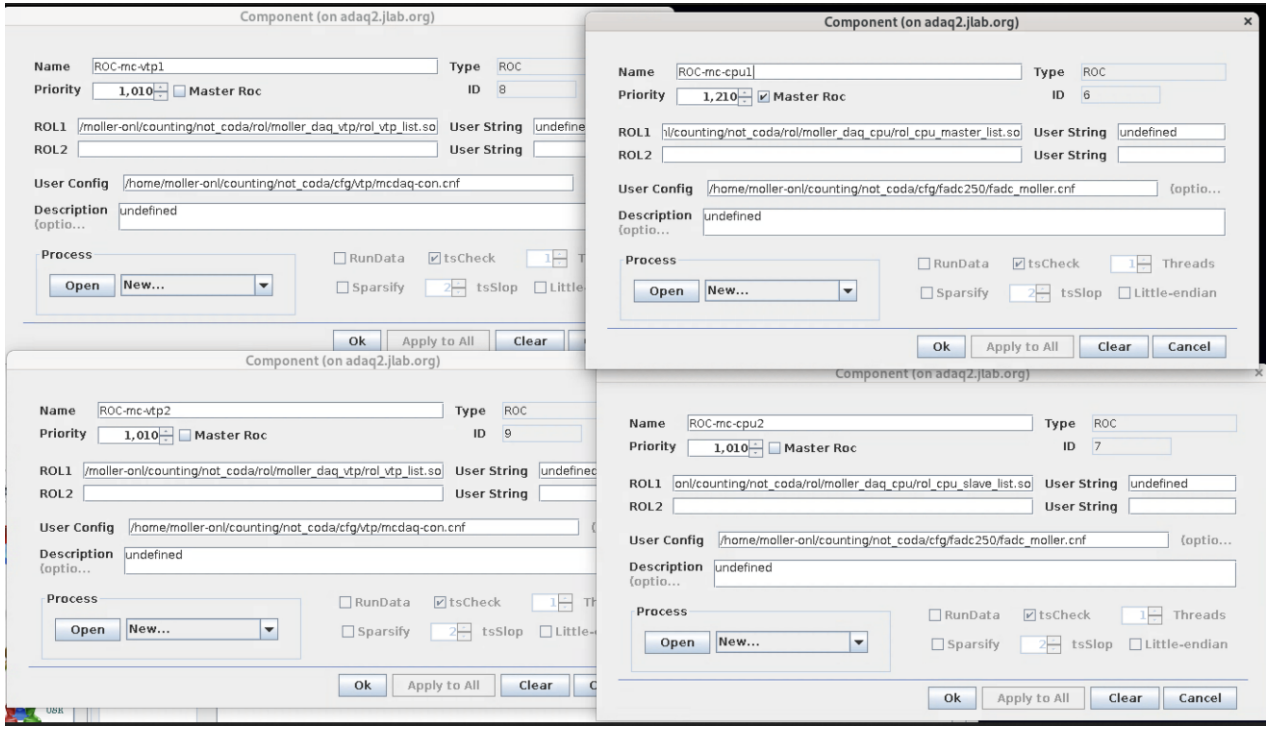
```
moller-onl@adaq1:~/integrating$ telnet sbsgemts
Trying 129.57.188.33...
Connected to sbsgemts.
Escape character is '^]'.

login: root
password:
#> connect 4
Set escape char to ^[
Connected to port 4

Xilinx First Stage Boot Loader
Release 2015.4  Jan 30 2017-11:51:58
Reset reason register 0x00000040
   [SWDT_RST]  = 0, System Watchdog timer
   [AWDT0_RST] = 0, CPU 0 Watch Timer
   [AWDT1_RST] = 0, CPU 1 Watch Timer
   [SLC_RST]   = 0, Write to soft reset bit
   [DBG_RST]   = 0, Debug command DAP controller
   [SRST_B]    = 0, PS_SRST_B reset signal
   [POR]       = 1, PS_POR_B reset signal
   reserved    = 0, reserved
Devcfg driver initialized
Silicon Version 3.1
Boot mode is SD
SD: rc= 0
SD Init Done
Flash Base Address: 0xE0100000
Reboot status register: 0x60400000
Multiboot Register: 0x0000C000
Image Start Address: 0x00000000
Partition Header Offset:0x00000C80
Partition Count: 2
Partition Number: 1
Header Dump
Image Word Len: 0x00015D85
```

```
[  OK  ] Started Authorization Manager.
[  OK  ] Started Network Manager.
         Starting Network Manager Wait Online...
         Starting Hostname Service...
[  OK  ] Started Hostname Service.
         Starting Network Manager Script Dispatcher Service...
[  OK  ] Started Network Manager Script Dispatcher Service.
[  OK  ] Started Network Manager Wait Online.
         Starting LSB: Bring up/down networking...
[  OK  ] Started LSB: Bring up/down networking.
[  OK  ] Reached target Network.
         Starting Dynamic System Tuning Daemon...
[  OK  ] Reached target Network is Online.
         Starting NIS/YP (Network Informatio... Clients to NIS Domain Binder...
         Starting Notify NFS peers of a restart...
         Starting NFS status monitor for NFSv2/3 locking....
         Starting System Logging Service...
[  OK  ] Started Notify NFS peers of a restart.
[  OK  ] Started System Logging Service.
[  OK  ] Started NFS status monitor for NFSv2/3 locking..
[  OK  ] Started NIS/YP (Network Information...e) Clients to NIS Domain Binder.
         Starting OpenSSH server daemon...
[  OK  ] Reached target User and Group Name Lookups.
         Starting Login Service...
         Starting Permit User Sessions...
         Starting Automounts filesystems on demand...
[  OK  ] Started Permit User Sessions.
         Starting Wait for Plymouth Boot Screen to Quit...
[  OK  ] Started Command Scheduler.
         Starting Terminate Plymouth Boot Screen...
[  OK  ] Started Login Service.

CentOS Linux 7 (AltArch)
Kernel 4.4.0-xilinx-00004-g8d932ab526ab on an armv7l

moller-counting-vtp1 login:
```

MOLLER Counting DAQ in Hall A

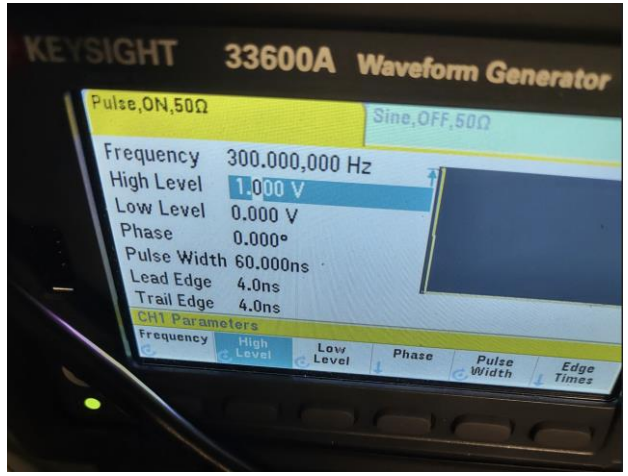
- ssh moller-onl@adaq2 will run the proper daq_setup sh for setting up environment for the MOLLER counting DAQ
- I created the CODA session and configuration and in coda_scripts directory I created the coda config file
- Looked up which fadc firmware the fadc driver expects and uploaded that firmware version onto the FADCs in the VXS crate
- Checked with journalctl as root on the VTPs where the firmware bin files should be stored for the VTPs to see them and copied over the simple MOLLER VTP trigger firmware version (the one I used for the pion detector/scintillator DAQ and in the ESB)
- Updated the VTP and FADC config files

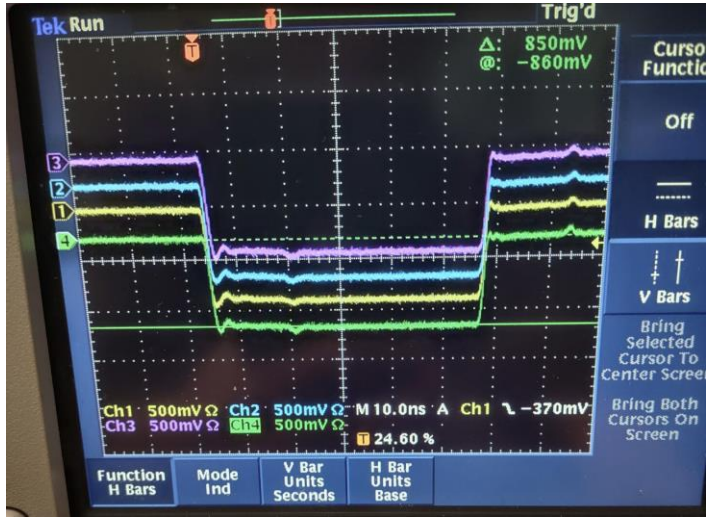


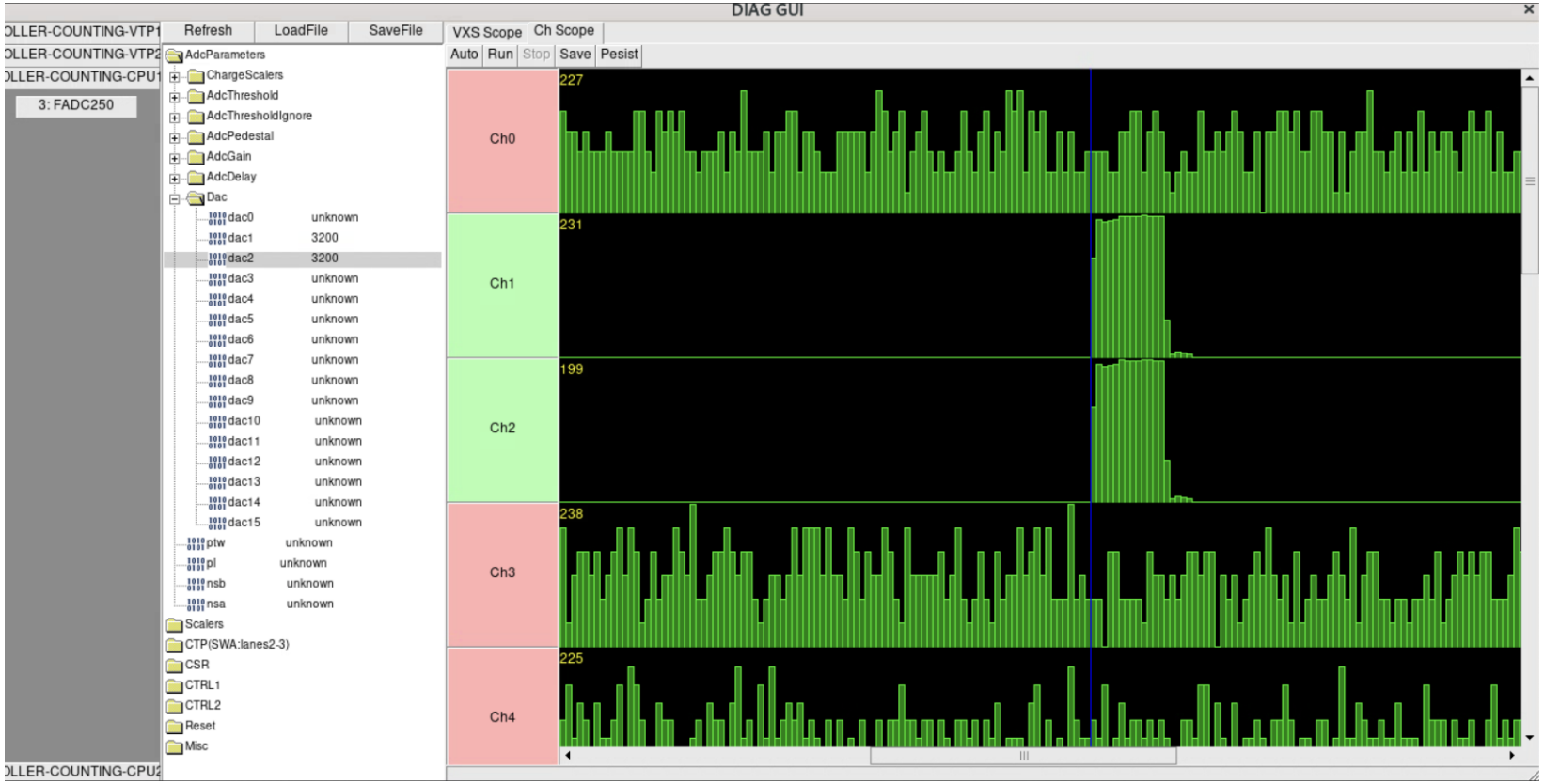


MOLLER Counting DAQ in Hall A

Set up a pulser to send 2 NIM level pulses per FADC in the 2 VXS MOLLER counting DAQ crates: channels 1,2 in both FADC

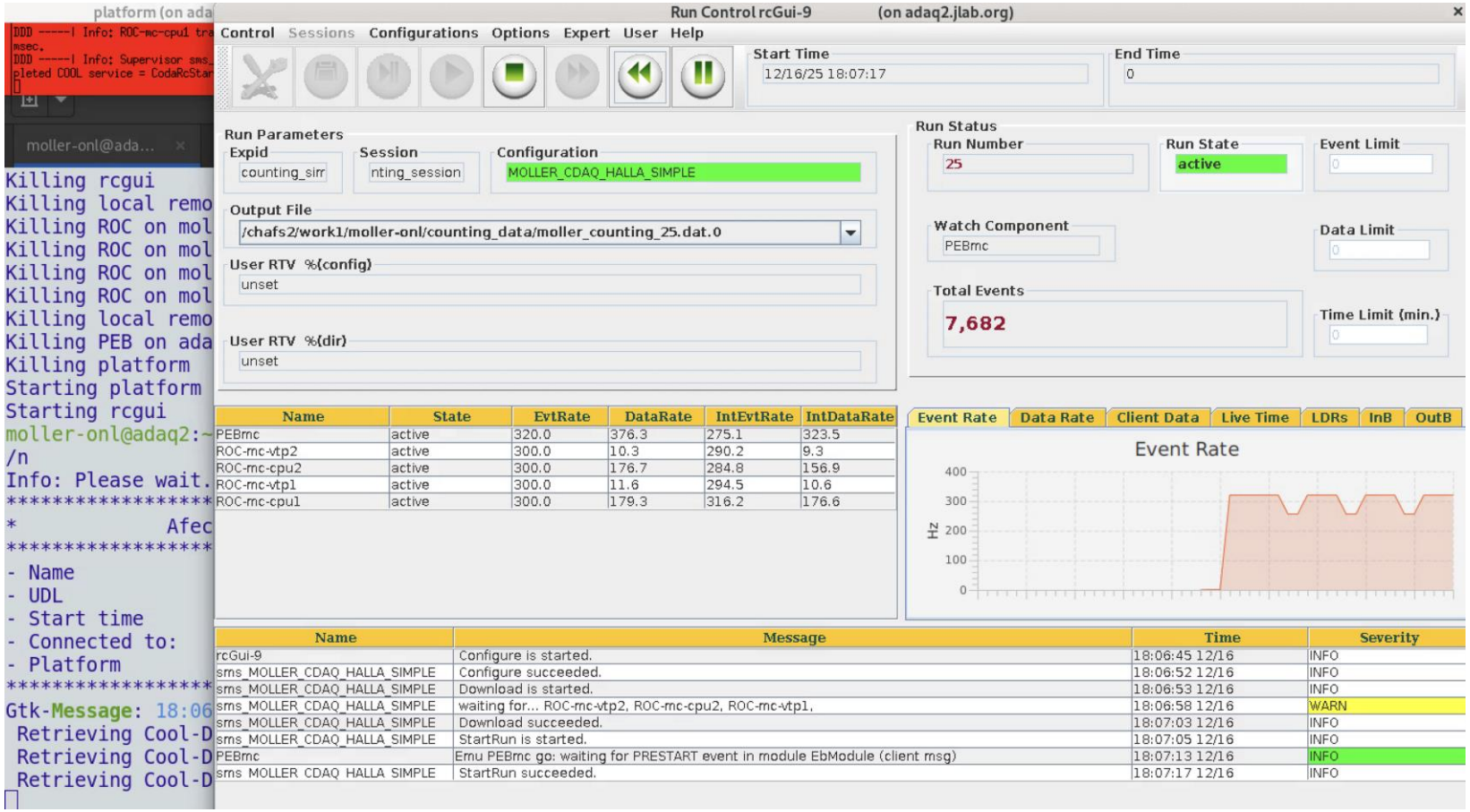






MOLLER Counting DAQ in Hall A

Took a run with pulser at 300 Hz, MOLLER counting DAQ simple VTP trigger (COIN), data look good



<uint32 data_type="0x1" tag="250" padding="0" num=
0xf800fafa 0x80c40101 0x90c00001 0x98000036
0x00e8742d 0xa0800078 0x00e700e7 0x00e500e8
0x00e700e5 0x00e800e7 0x00e700e7 0x00e400e6
0x00e700e6 0x00e800e8 0x00e700e5 0x00e600e5
0x00e800e6 0x00e700e8 0x00e700e7 0x00e500e5
0x00e800e7 0x00e800e6 0x00e700e7 0x00e600e6
0x00eb00e6 0x00e800e8 0x00e700e6 0x00e400e7
0x00e700e6 0x00e800e6 0x00e700e7 0x00e700e7
0x00e500e5 0x00e800e7 0x00e800e5 0x00e900e7
0x00e800e5 0x00e600e4 0x00e90695 0x0e560e30
0x0e480e26 0x0ec80eca 0x0ecd0ec8 0x0ecc0ece
0x0ecf0ec9 0x06710143 0x0181016c 0x016000ea
0x00ed00e9 0x00f000e3 0x00e400e5 0x00e600e5
0x00e500e5 0x00e600e5 0x00e600e6 0x00e900e5
0x00e600e4 0x00e400e7 0x00e500e6 0x00e700e7
0x00e500e7 0x00e700e8 0x00e500e6 0x00e900e7
0x00e700e8 0x00e700e8 0xa1000078 0x00c800c9
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0x00ca00ca 0x00c800c9 0x00c900c8 0x00c800c7
0x00cb00c8 0x00ca00ca 0x00ca00c9 0x00c900c7
0x00c800c9 0x00c900cb 0x00c700c8 0x00ca00c9
0x00c900ca 0x00cb00c8 0x00cb00c9 0x00ca00c7
0x00c800c9 0x00c900c8 0x00c800c8 0x00c805f7
0x0e550e31 0x0e420e2d 0x0ec90ecd 0x0ed10ecf
0x0ed10ed3 0x0ed00ed1 0x06dd0125 0x016b0155
0x014700cb 0x00cc00cb 0x00d100c6 0x00c700c7
0x00c600c5 0x00c900c8 0x00c600c7 0x00c800c8

MOLLER Counting DAQ in Hall A: To Do (As Tracked by MOLLER Project)

1. Prepare safety documentation – done
2. hardware install VXS trigger crate 1 and crate 2 - done
3. hardware install the GEM readout VTP/QSFT VXS crate - done
4. configure computing environment for trigger VXS crates 1 and 2 Nov 3-19 - done
5. write rols for CPUs and VTPs for trigger VXS crates 1 and 2 – start Nov 20-21 - done
6. write rols for CPUs and VTPs for trigger VXS crates 1 and 2 – debug Nov 24 - Dec 10 done
7. write rols for CPUs and VTPs for trigger VXS crates 1 and 2 – finish Dec 11-19
8. take pulser data with the 2-crate system (simple VTP trigger setup) Jan 5-9 done
9. characterize simple VTP trigger performance (no GEM crate readout) Jan 12 - Jan 23
10. finalize the MOLLER VTP trigger code – start Jan 26-29
11. finalize the MOLLER VTP trigger code – debug Jan 30-Feb 13
12. finalize the MOLLER VTP trigger code – finish Feb 16-27
13. compare v2 to v3 FADC VTP trigger Feb 23 – Mar 3
14. characterize MOLLER VTP trigger performance (dead time) (no GEM crate readout) Mar 23 -Apr 10
15. configure computing environment for GEM readout VXS crates – Apr 13-17
16. write/debug rols for CPUs and VTPs for GEM readout VXS crate -start Apr 20 – May 1
17. write/debug rols for CPUs and VTPs for GEM readout VXS crate -finish May 4-8
18. characterize full MOLLER counting DAQ performance – May 11 – 29

DEAD ZONE: NO POWER TO THE HALL A BUNKER → Mar 3-19 ??