UNIVERSITÀ DEGLI STUDI DI PADOVA

Istituto Nazionale di Fisica Nucleare

Commissioning the LPMT readout electronics at Legnaro

Arsenii Gavrikov on behalf of Padova group

Legnaro setup overview

- **17 L** of LAB-based scintillator
- **16 GCUs**, **48 2” PMTs**
- **3 plastic scintillators** for muons
- **BEC** used as **trigger** (external or based on multiplicity)

Main activities:

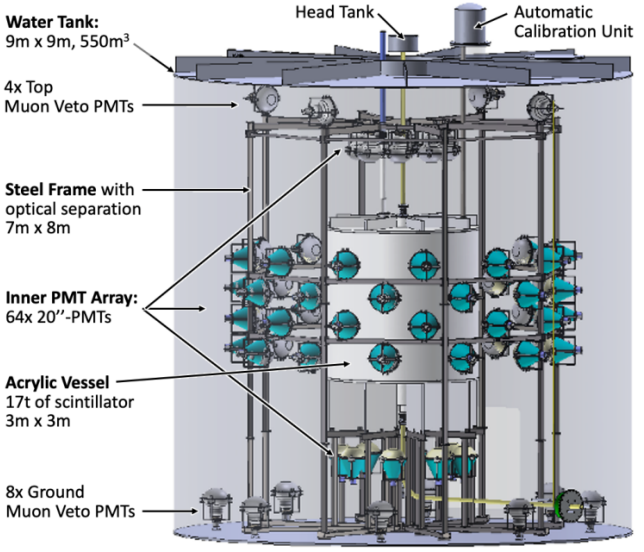
- BEC firmware development
- Setup energy calibration
- OSIRIS DAQ tests
- Coincidence analysis of BiPo events

BEC firmware developments

Firmware based on Filippo Marini’s work for TTIM v2

- **porting to TTIM v3** complete (Andrea Triossi)
- **BEC-based** multiplicity trigger **implemented**
- **Prescaler** on the trigger validation **implemented**
- Periodic trigger **implemented**

OSIRIS DAQ tests

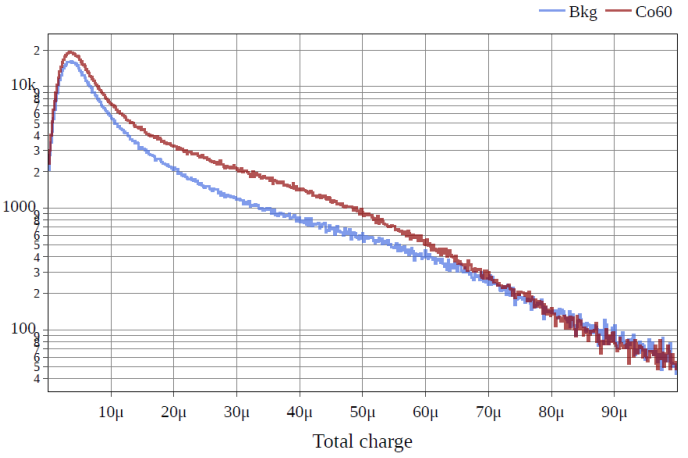


The first **OSIRIS DAQ tests** are successfully **finished**:

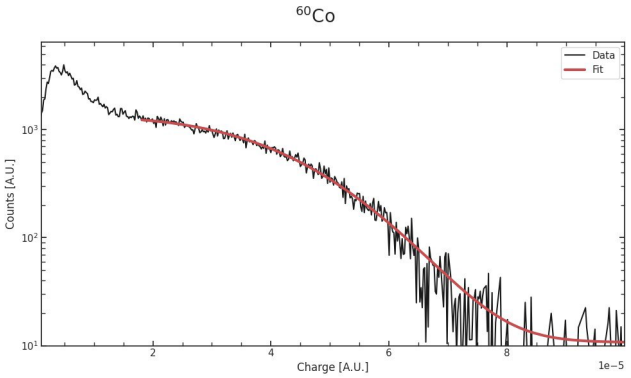
- **The OSIRIS group** with help of **Andrea Serafini**
- The DAQ **software** has been **intalled** at LNL
- **DAQ-GCUs communication** already **tested**
- **Event building** and **storage** of events **tested**
- DAQ online event building **tested**

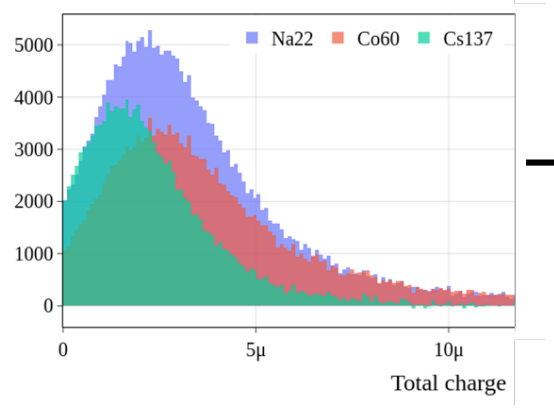
Setup energy calibration

- Calibration with 22Na, 60Co, 137Cs

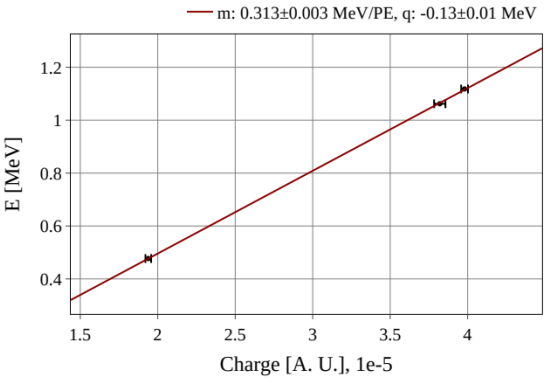


- Fit of Compton edge



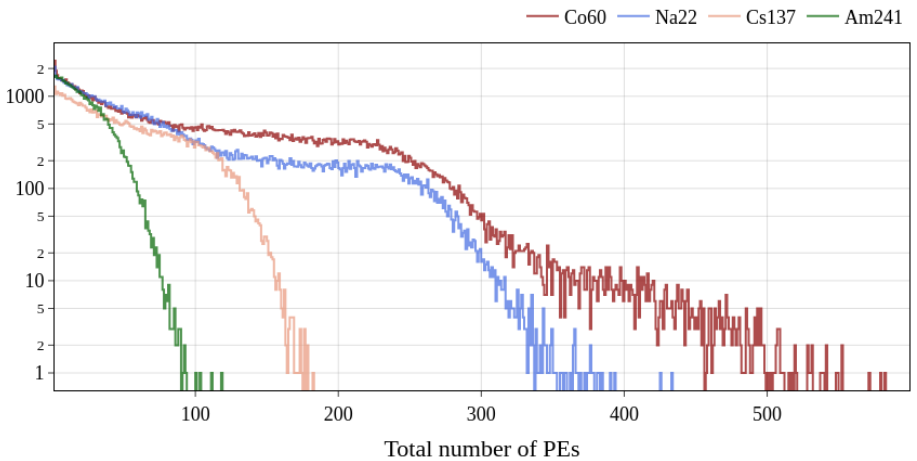


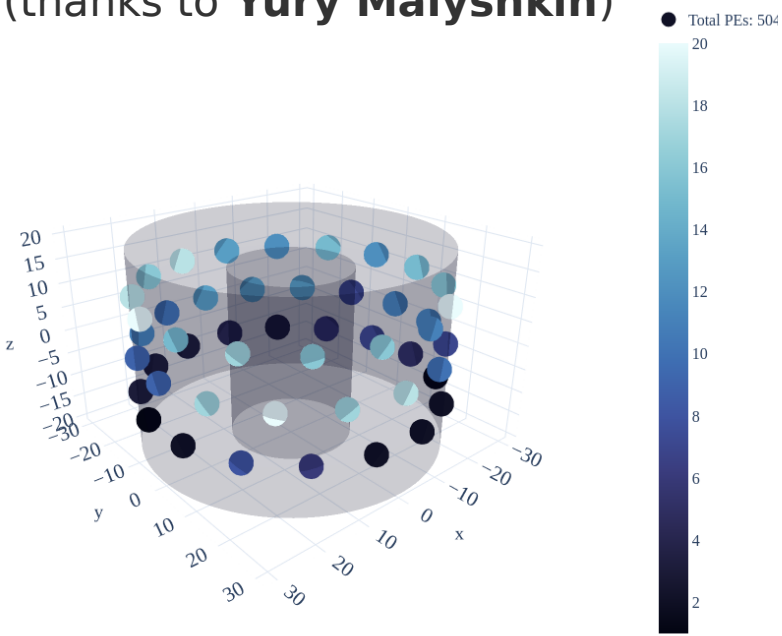
- Energy scale calibration



LSMC: MC modeling software

- **LSMC**: **Geant4-based** Monte Carlo modeling for **liquid scintillator detectors**
- **Adapted** the software to our detector (thanks to **Katharina von Sturm**)
- **Fixed a bug** with incorrect hit values on a PMT (thanks to **Yury Malyshkin**)



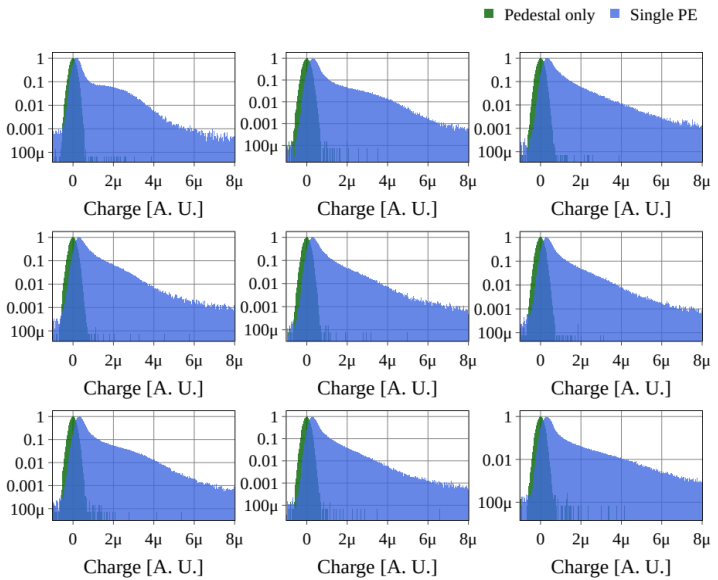


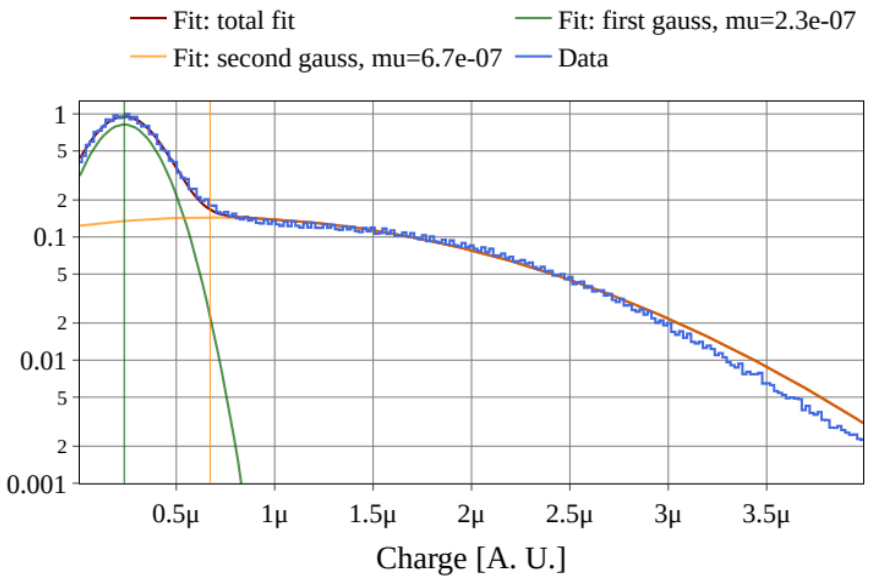
Correction procedure

- We need to match **nPEs** in *MC data* with **charge** in *real data*:

  1) **Charge → nPEs** in *real data* with a single PE calibration

  => 1 PE = 6.7e-7 charge [A.U.]

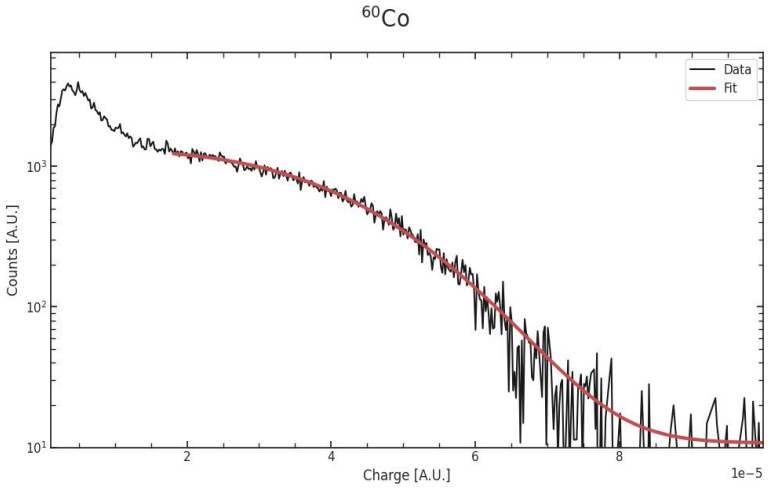




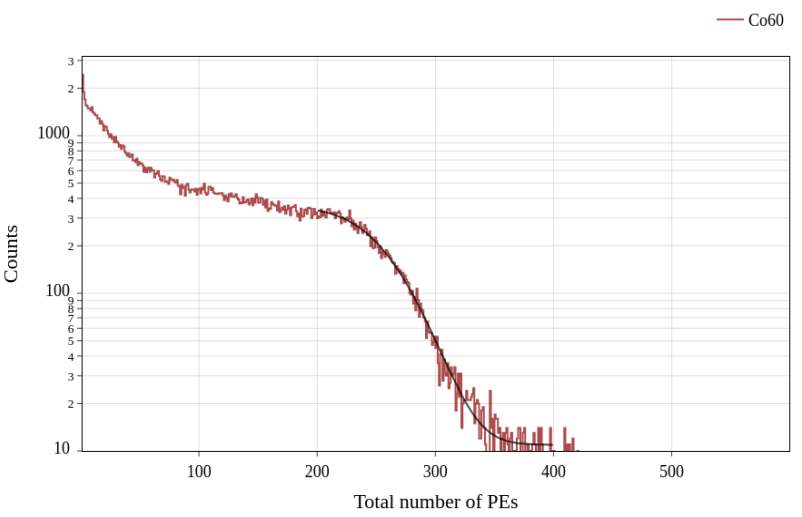
Correction procedure

2) Use Co60's Compton edge as reference to calculate the correction factor

Real data



MC data



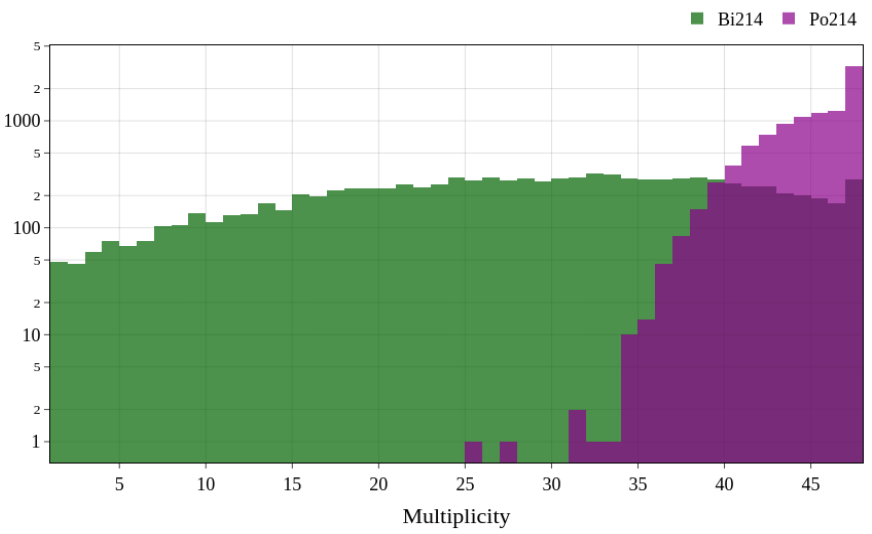
3.98e-5 / 6.7e-7 ≈ **59 PEs** at Compton edge

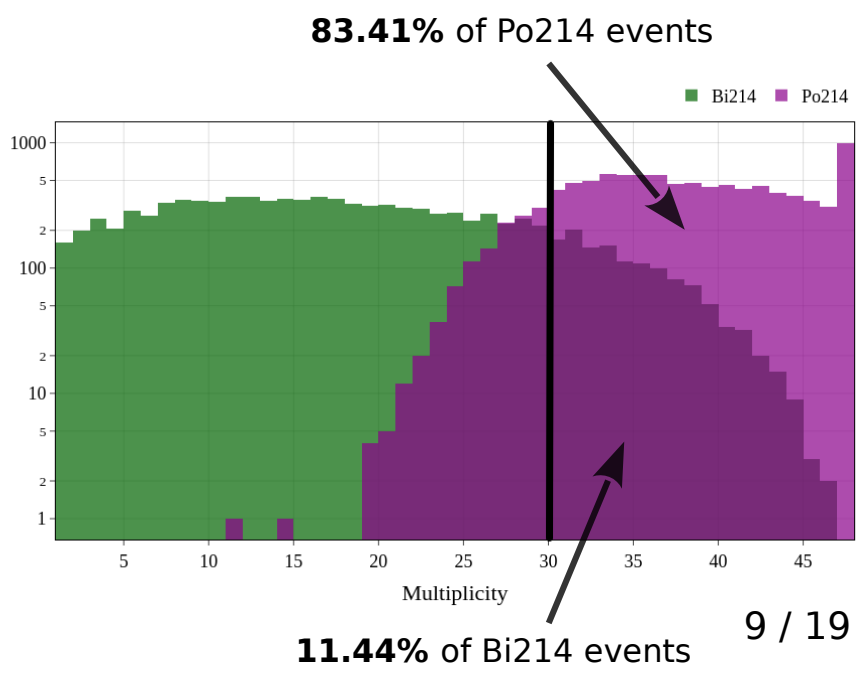
257 PEs at Compton edge

=> correction factor is 59 / 257

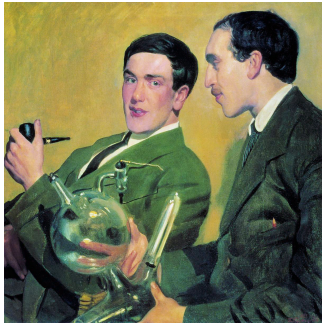
Coincidence analysis of BiPo events

- We need to choose **the optimal multiplicity**
- “Optimal” means: still could **see BiPo**, the **lowest background**
- **MC generated data** with **the correction** to find the optimal multiplicity
- **The multiplicity of 30** was chosen





No BiPo...

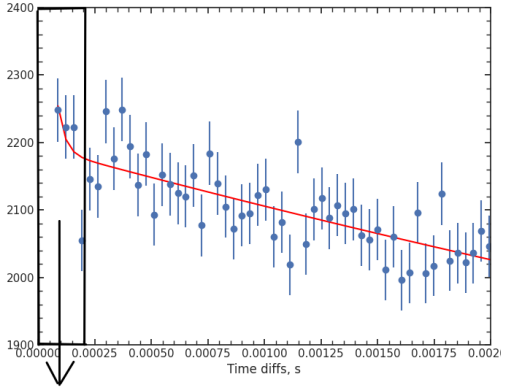


Real data

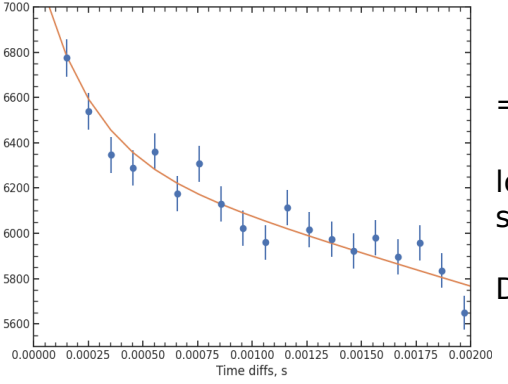
7 hours of exposure

Fit with sum of two exponents

Toy MC
(Andrea Serafini)



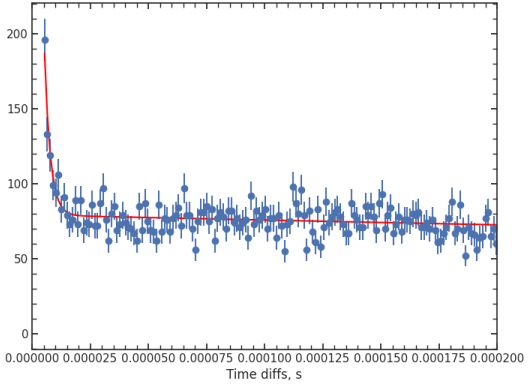
Need to add more contaminants



=> τ_2 = (240 +- 50) µs

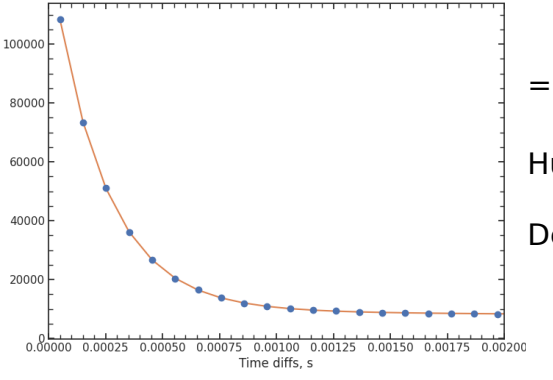
lowest contamination to see BiPo with the toy MC

Decay rate: ~0.08 Hz



=> τ_2 = (2.52 +- 0.34) µs

Something, but **no BiPo**



=> τ_2 = (236.6 +- 0.7) µs

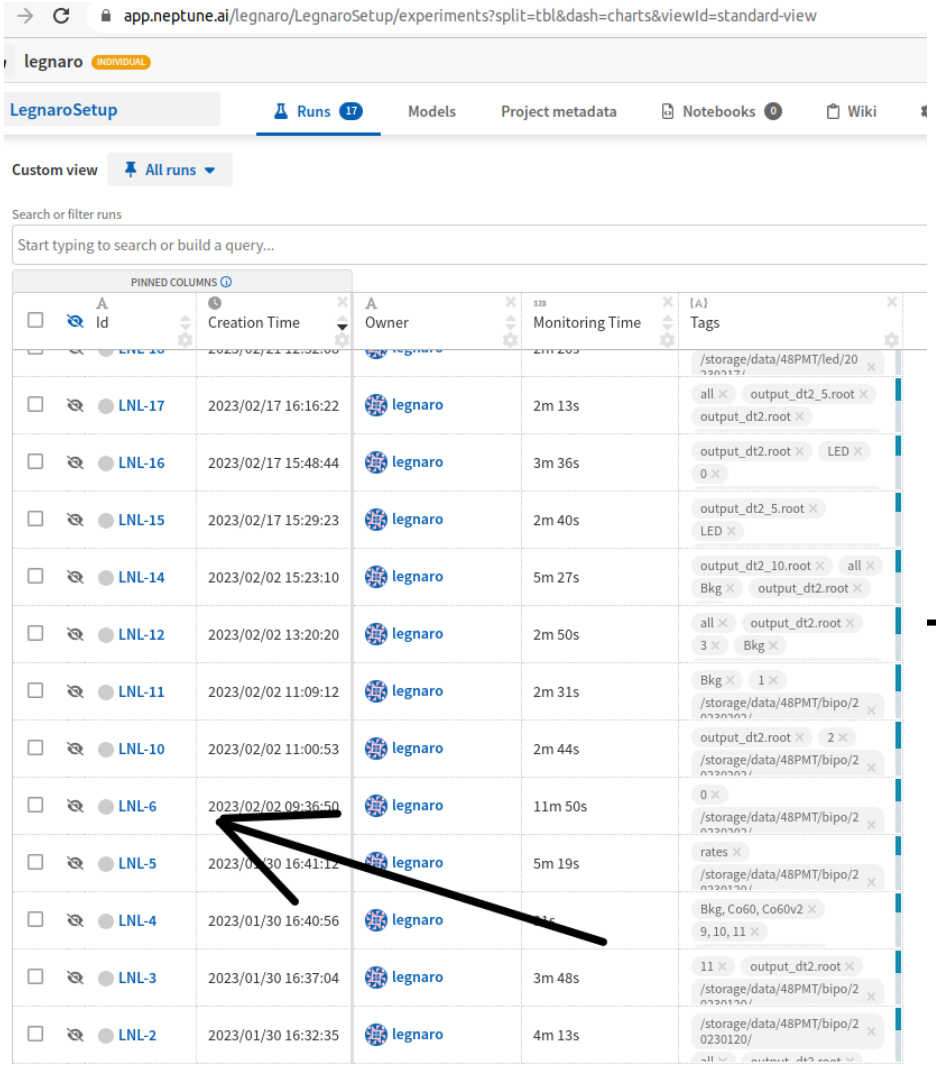
Huge contamination

Decay rate: 11 Hz

Data analysis and monitoring tool

The tool for data monitoring:

- Taking the processed GCU data
- Interactive visualization of the data:
    - Waveforms
    - Rates
    - Timestamps
    - Multiplicity
    - etc
- Store a metadata of a run
- All the output is available by link on Neptune.ai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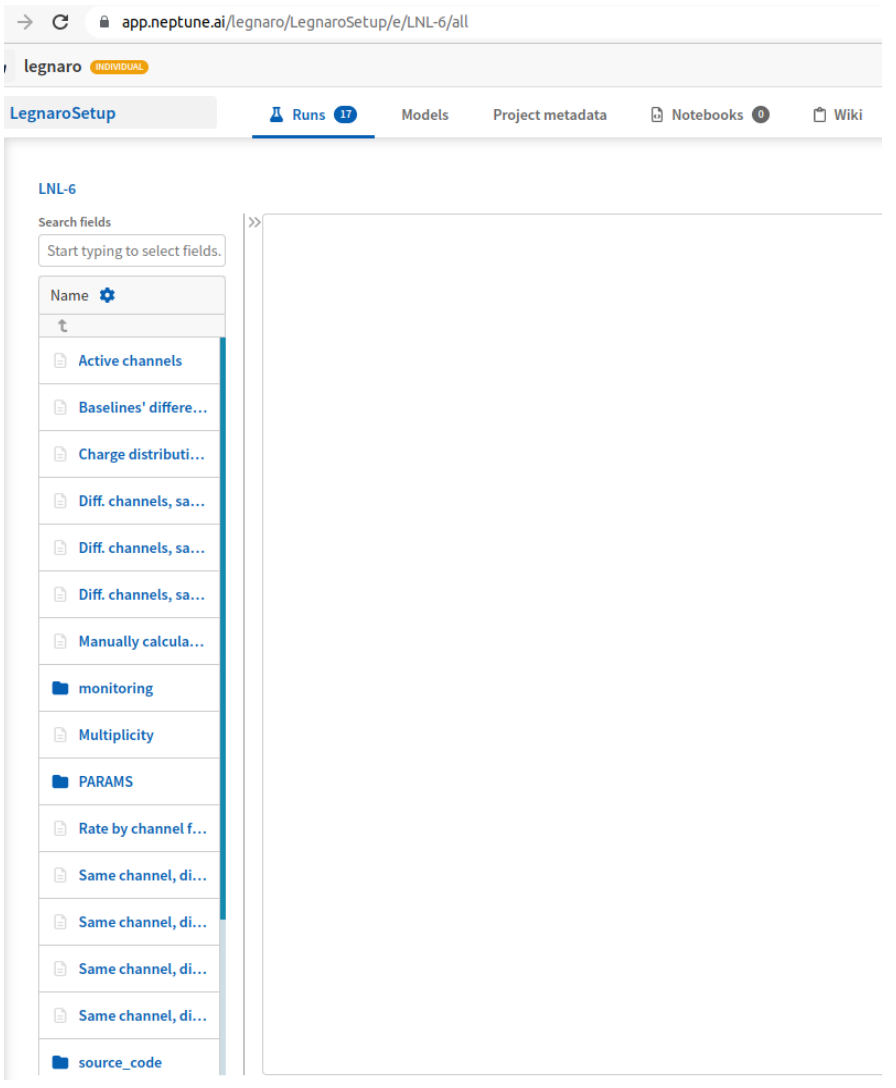
legnaro INDIVIDUAL
LegnaroSetup
Runs 17
Models
Project metadata
Notebooks 0
Wiki
Custom view
All runs
Search or filter runs
Start typing to search or build a query...
PINNED COLUMNS
Id
Creation Time
Owner
Monitoring Time
Tags
LNL-17 2023/02/17 16:16:22 legnaro 2m 13s all output_dt2_5.root output_dt2.root
LNL-16 2023/02/17 15:48:44 legnaro 3m 36s output_dt2.root LED 0
LNL-15 2023/02/17 15:29:23 legnaro 2m 40s output_dt2_5.root LED
LNL-14 2023/02/02 15:23:10 legnaro 5m 27s output_dt2_10.root all Bkg output_dt2.root
LNL-12 2023/02/02 13:20:20 legnaro 2m 50s all output_dt2.root 3 Bkg
LNL-11 2023/02/02 11:09:12 legnaro 2m 31s Bkg 1
LNL-10 2023/02/02 11:00:53 legnaro 2m 44s output_dt2.root 2
LNL-6 2023/02/02 09:36:50 legnaro 11m 50s 0
LNL-5 legnaro 5m 19s rates
LNL-4 2023/01/30 16:40:56 legnaro Bkg, Co60, Co60v2 9, 10, 11
LNL-3 2023/01/30 16:37:04 legnaro 3m 48s 11 output_dt2.root
LNL-2 2023/01/30 16:32:35 legnaro 4m 13s /storage/data/48PMT/bipo/20230120/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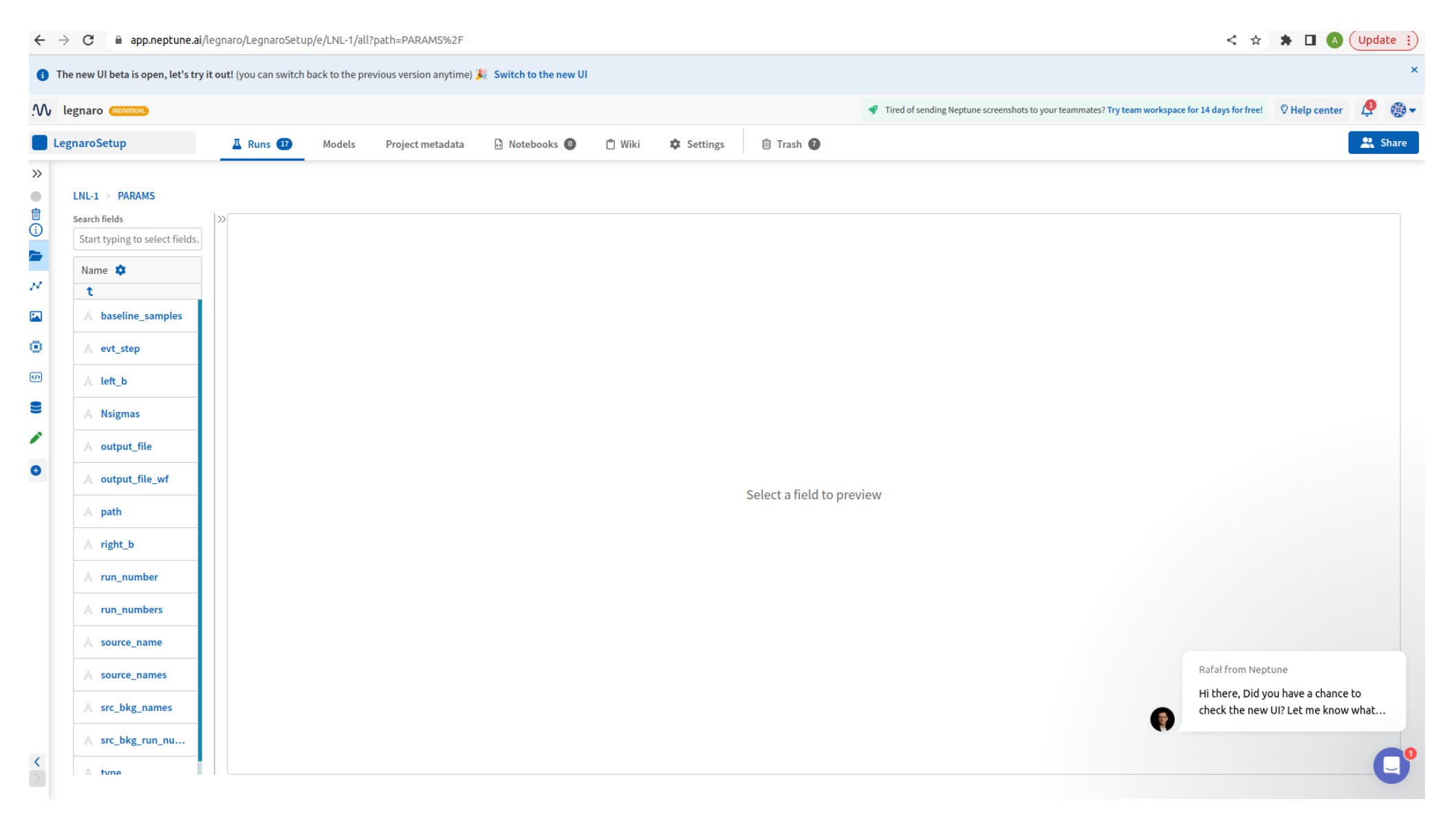
legnaro INDIVIDUAL
LegnaroSetup
Runs 17
Models
Project metadata
Notebooks 0
Wiki
LNL-6
Search fields
Start typing to select fields.
Name
Active channels
Baselines' differe...
Charge distributi...
Diff. channels, sa...
Diff. channels, sa...
Diff. channels, sa...
Manually calcula...
monitoring
Multiplicity
PARAMS
Rate by channel f...
Same channel, di...
Same channel, di...
Same channel, di...
Same channel, di...
source_code


app.neptune.ai/legnaro/LegnaroSetup/e/LNL-1/all?path=PARAMS%2F
Update
The new UI beta is open, let's try it out! (you can switch back to the previous version anytime) Switch to the new UI
legnaro INDIVIDUAL
Tired of sending Neptune screenshots to your teammates? Try team workspace for 14 days for free!
Help center
LegnaroSetup
Runs 17
Models
Project metadata
Notebooks 0
Wiki
Settings
Trash 7
Share
LNL-1 > PARAMS
Search fields
Start typing to select fields.
Name
baseline_samples
evt_step
left_b
Nsigmas
output_file
output_file_wf
path
right_b
run_number
run_numbers
source_name
source_names
src_bkg_names
src_bkg_run_nu...
type
Select a field to preview
Rafał from Neptune
Hi there, Did you have a chance to check the new UI? Let me know what...

LNL-2

Search fields

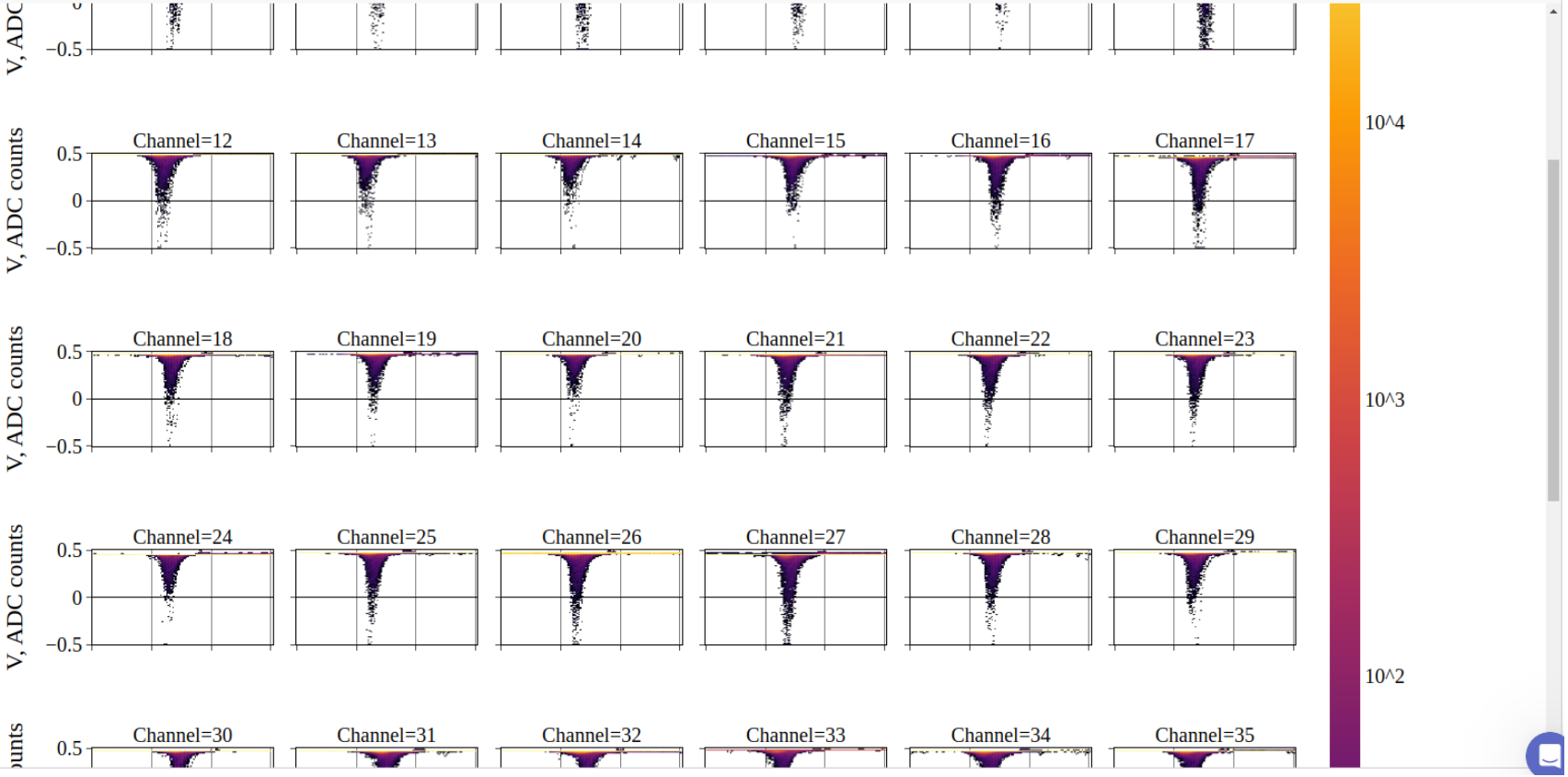
Start typing to select fields.

Name

- Diff. channels, sa…
- Diff. channels, sa…
- Manually calcula…
- monitoring
- Multiplicity
- PARAMS
- Rate by channel f…
- Same channel, di…
- Same channel, di…
- Same channel, di…
- Same channel, di…
- source_code
- sys
- Timestamps
- Total charge for 1…
- wfs 2d hist by ch…

wfs 2d hist by channel

7.59MB



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legnaro INDIVIDUAL

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Help center

Update

LegnaroSetup

Runs 17 | Models | Project metadata | Notebooks 0 | Wiki | Settings | Trash 7

Share

LNL-2

Search fields

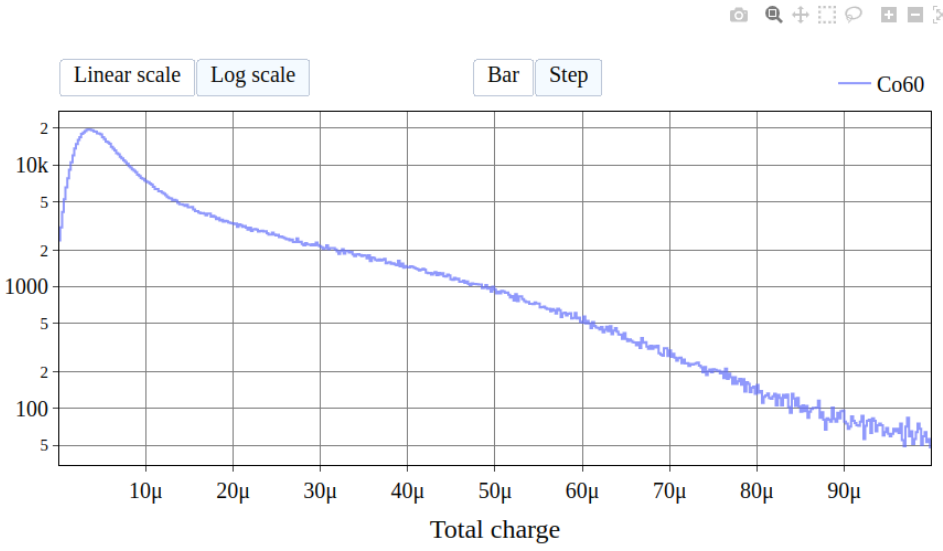
Start typing to select fields.

Name

- Diff. channels, sa…
- Diff. channels, sa…
- Manually calcula…
- monitoring
- Multiplicity
- PARAMS
- Rate by channel f…
- Same channel, di…
- Same channel, di…
- Same channel, di…
- Same channel, di…
- source_code
- sys
- Timestamps
- Total charge for 1…
- wfs 2d hist by ch…

Total charge for 10 run

3.44MB



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LegnaroSetup

Runs 17 | Models | Project metadata | Notebooks 0 | Wiki | Settings | Trash 7

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LNL-2

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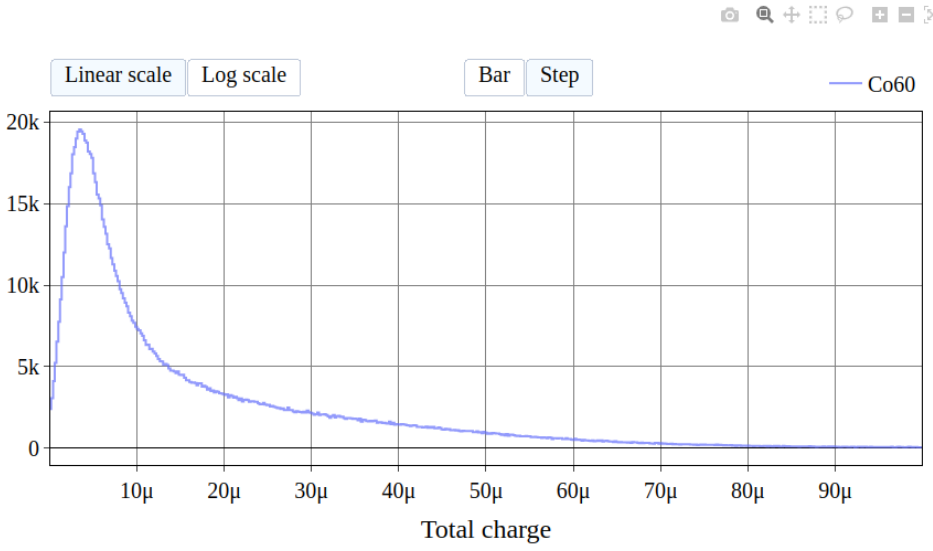
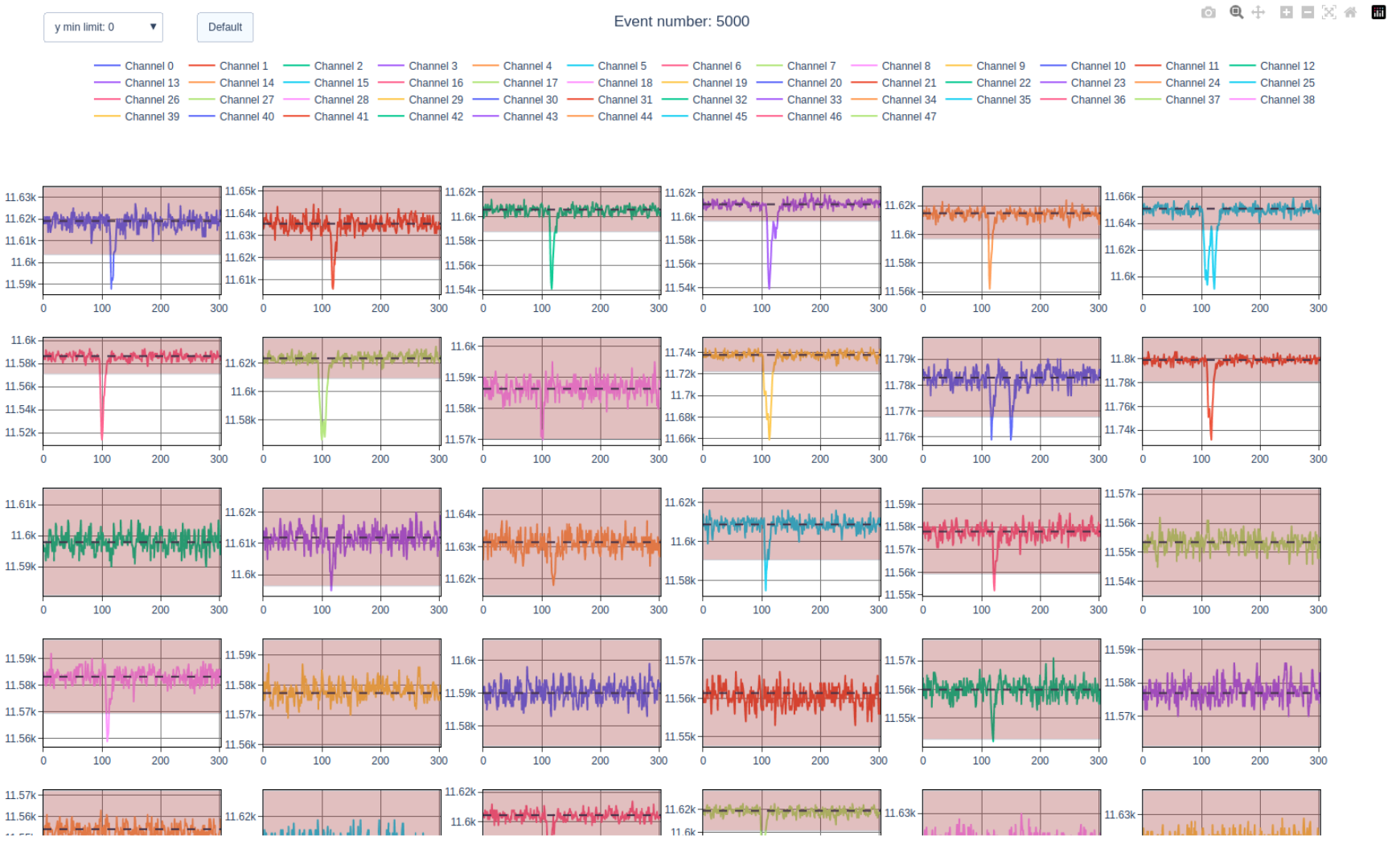
- Diff. channels, sa…
- Manually calcula…
- monitoring
- Multiplicity
- PARAMS
- Rate by channel f…
- Same channel, di…
- Same channel, di…
- Same channel, di…
- Same channel, di…
- source_code
- sys
- Timestamps
- Total charge for 1…
- wfs 2d hist by ch…

Total charge for 10 run

3.44MB




y min limit: 0
Default
Event number: 5000
Channel 0
Channel 1
Channel 2
Channel 3
Channel 4
Channel 5
Channel 6
Channel 7
Channel 8
Channel 9
Channel 10
Channel 11
Channel 12
Channel 13
Channel 14
Channel 15
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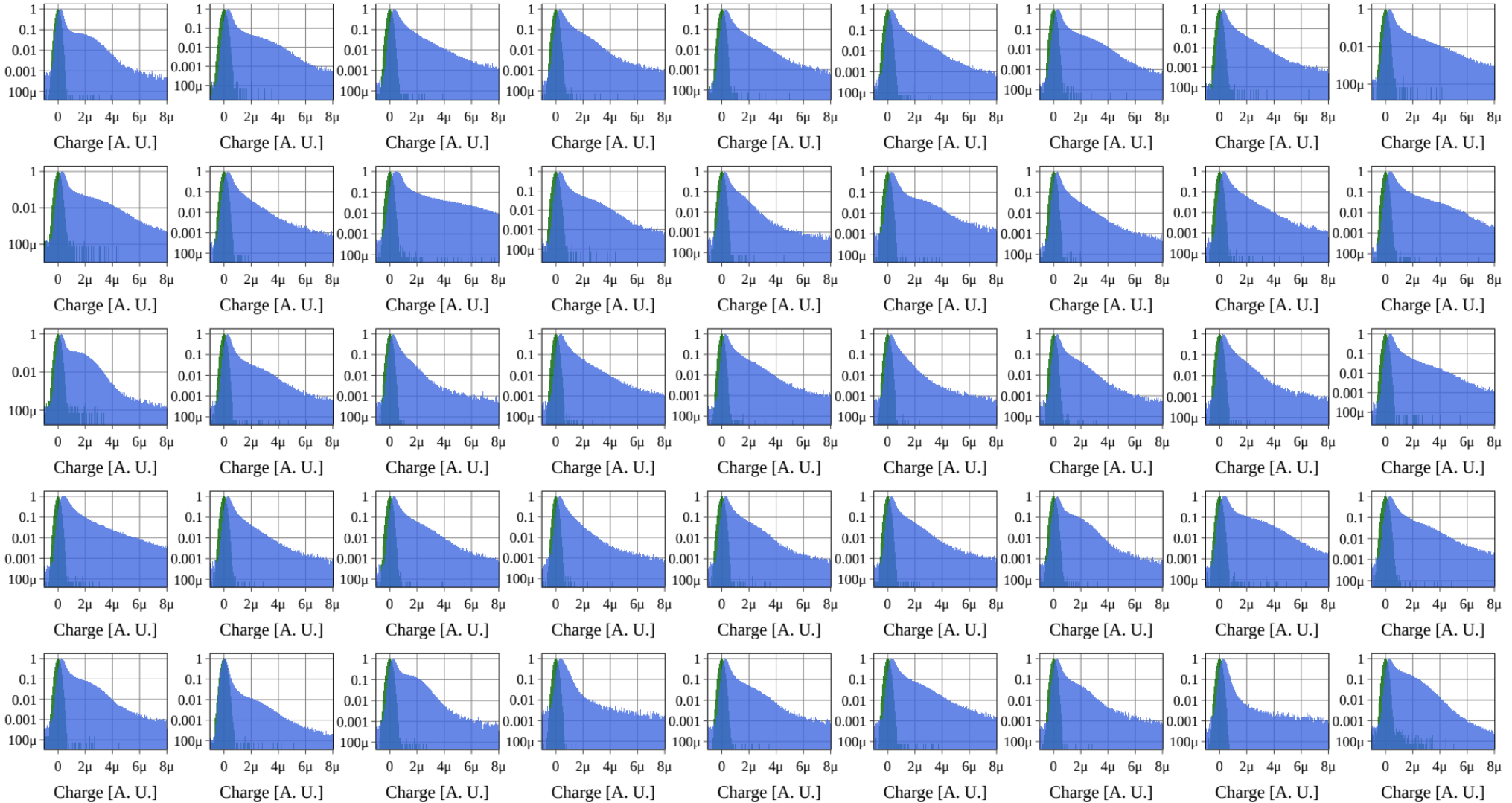
Channel 46
Channel 47

BACKUP


1
0.1
0.01
0.001
100μ
0
2μ
4μ
6μ
8μ
Charge [A. U.]