OLD DOMINION UNIVERSITY

Analysis of calibration timelines and QA timeline results For RG-F

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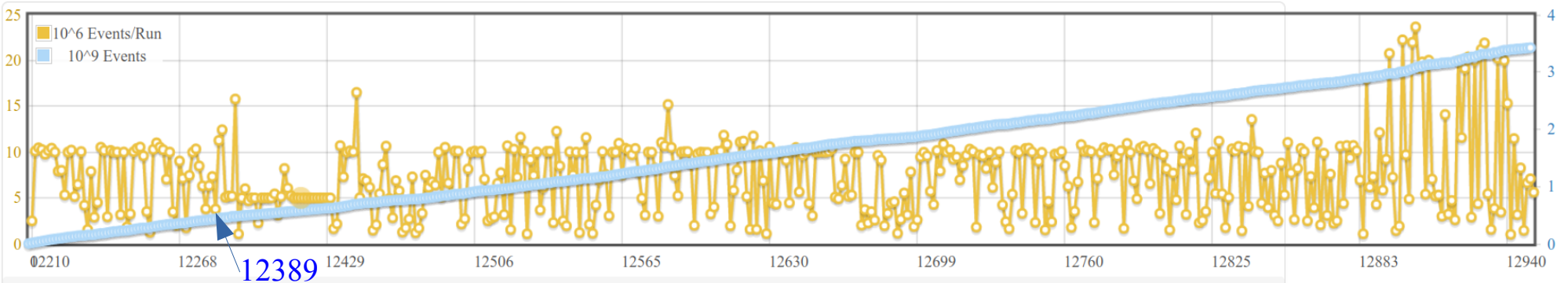
Pass1 Review, April 14th, 2021, JLab

Data Scope



Data Range (RTPC3 Data):

- **Spring run**:
  12210 – 12282 (In-bending 5 pass)
- **Summer run**:
  12389 – 12434 (Out-bending 1 pass)
  12435 – 12443 (In-bending 1pass)
  12447 – 12951 (In-bending 5 pass)

Beam Energy	Target	Spring 2020	Summer 2020
1 Pass Data	H2		185M
	D2		45M
	4He		44M
	Empty		22M
5 Pass Data	H2	9M	266M
	D2	400M	2355M
	4He	9M	51M
	Empty	22M	45M
		420M	**3013M**

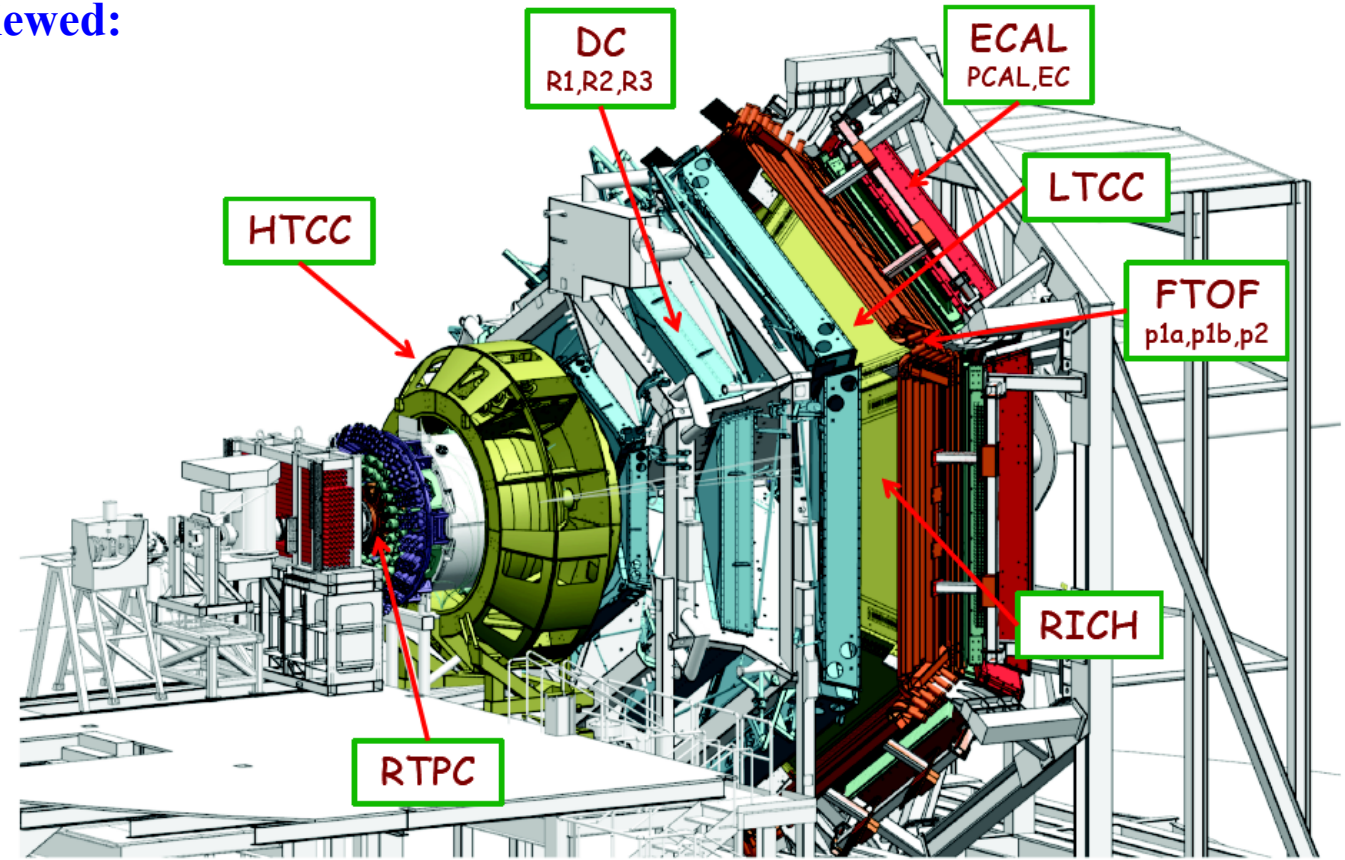
Calibration Scope

*** Detectors calibration to be reviewed:**

- RTPC
- HTCC
- DC
- LTCC
- RICH
- FTOF
- EC

*** Detectors to be later calibrated (pass2):**

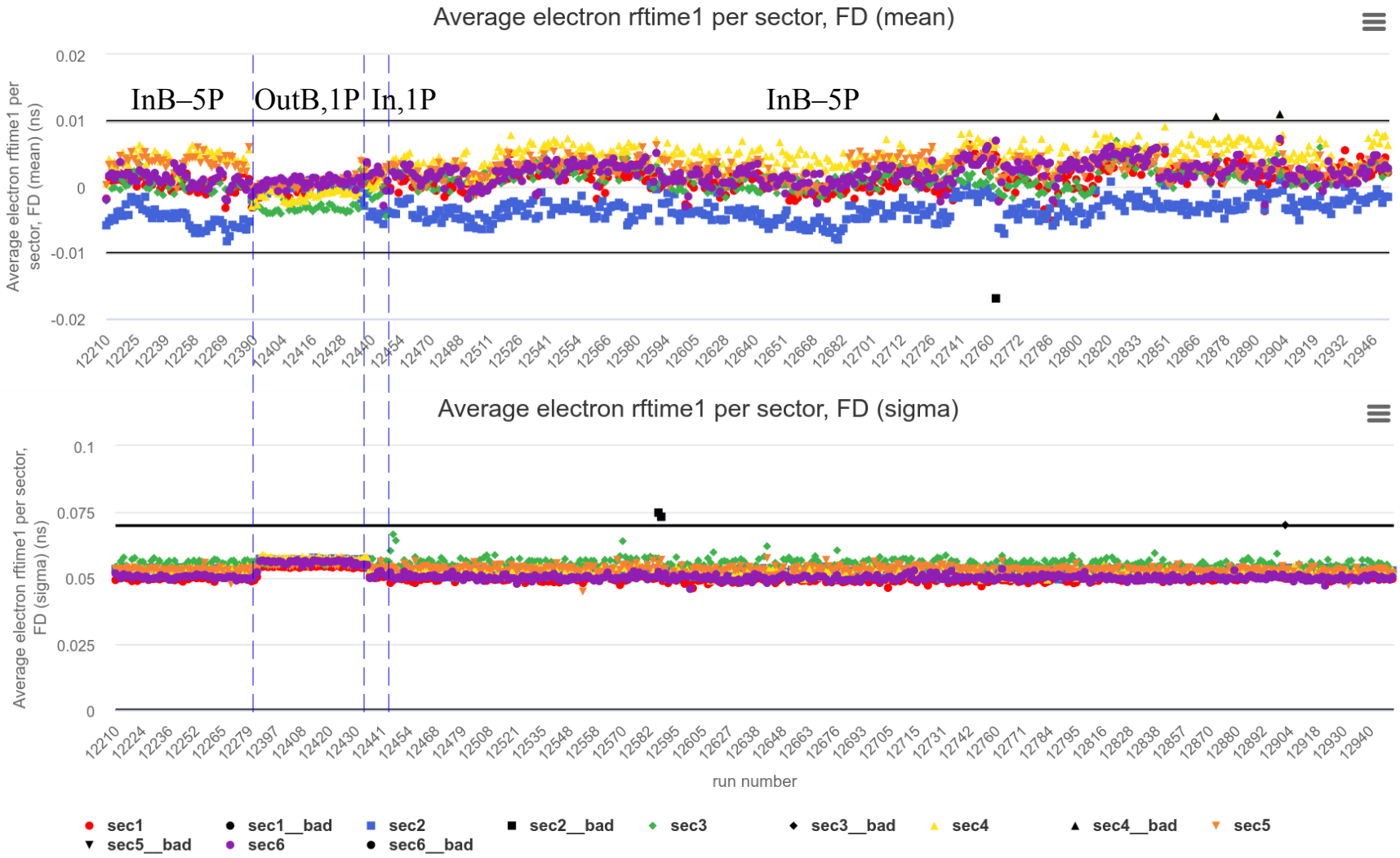
- FMT (3 layers)
- CND + CTOF



Sub-Systems Standard Quality Constraints

Subsystem	Timeline	Constraint
RF	rftime electron FD mean	< ±10 ps
	rftime electron FD sigma	< 70 ps
LTCC	ltcc elec nphe sec	5-20
HTCC	htcc nphe sec	10-13
FTOF	ftof edep p1a midangles	9.25-10.5 MeV
	ftof edep p1b midangles	11.25-12.25 MeV
	ftof edep p2	9.2-10.2 MeV
	ftof time p1a mean	< ±25 ps
	ftof time p1a sigma	< 125 ps
	ftof time p1b mean	< ±15 ps
	ftof time p1b sigma	< 70 ps
	ftof time p2 mean	< ±50 ps
	ftof time p2 sigma	< 325 ps
ECAL	ec Sampling	0.22-0.25
	ec gg m mean	128-142 MeV
	ec gg m sigma	< 15 MeV
DC	dc residuals sec mean	<-0.03 - 0.01 cm
	dc residuals sec sl sigma	<450 mm
RICH	rich time fwhm max	< 1 ns

RF

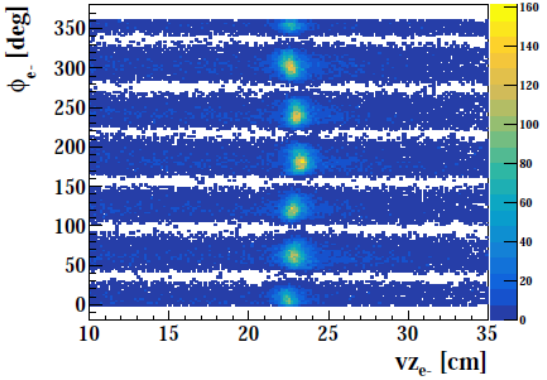

Average electron rftime1 per sector, FD (mean)
Average electron rftime1 per sector, FD (mean) (ns)
InB–5P
OutB,1P
In,1P
InB–5P
Average electron rftime1 per sector, FD (sigma)
Average electron rftime1 per sector, FD (sigma) (ns)
run number
sec1
sec1__bad
sec2
sec2__bad
sec3
sec3__bad
sec4
sec4__bad
sec5
sec5__bad
sec6
sec6__bad

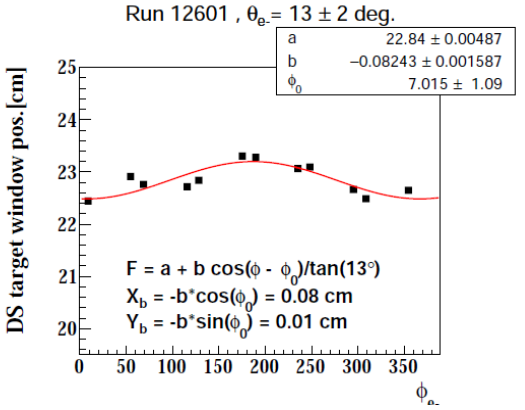
< ±10 ps

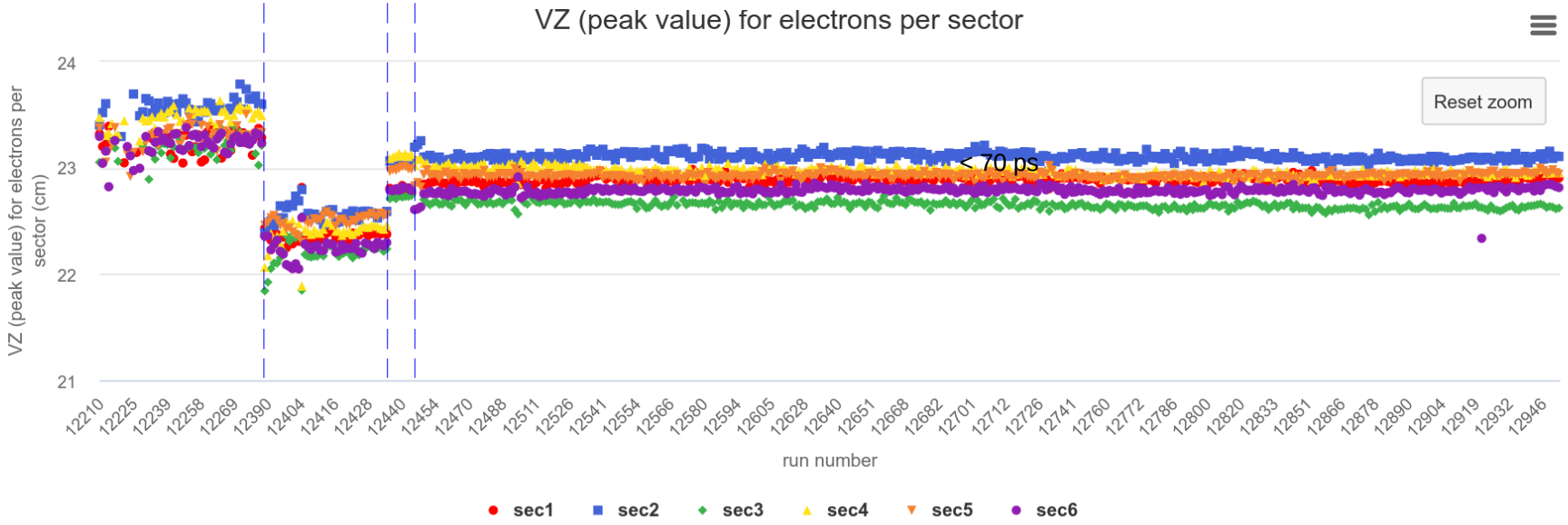
< 70 ps

Beam XY Offsets

- Using the DS target Al window.
- Empty targets.
- Reduced the phi-modulation
  from >1 cm to 0.5cm.

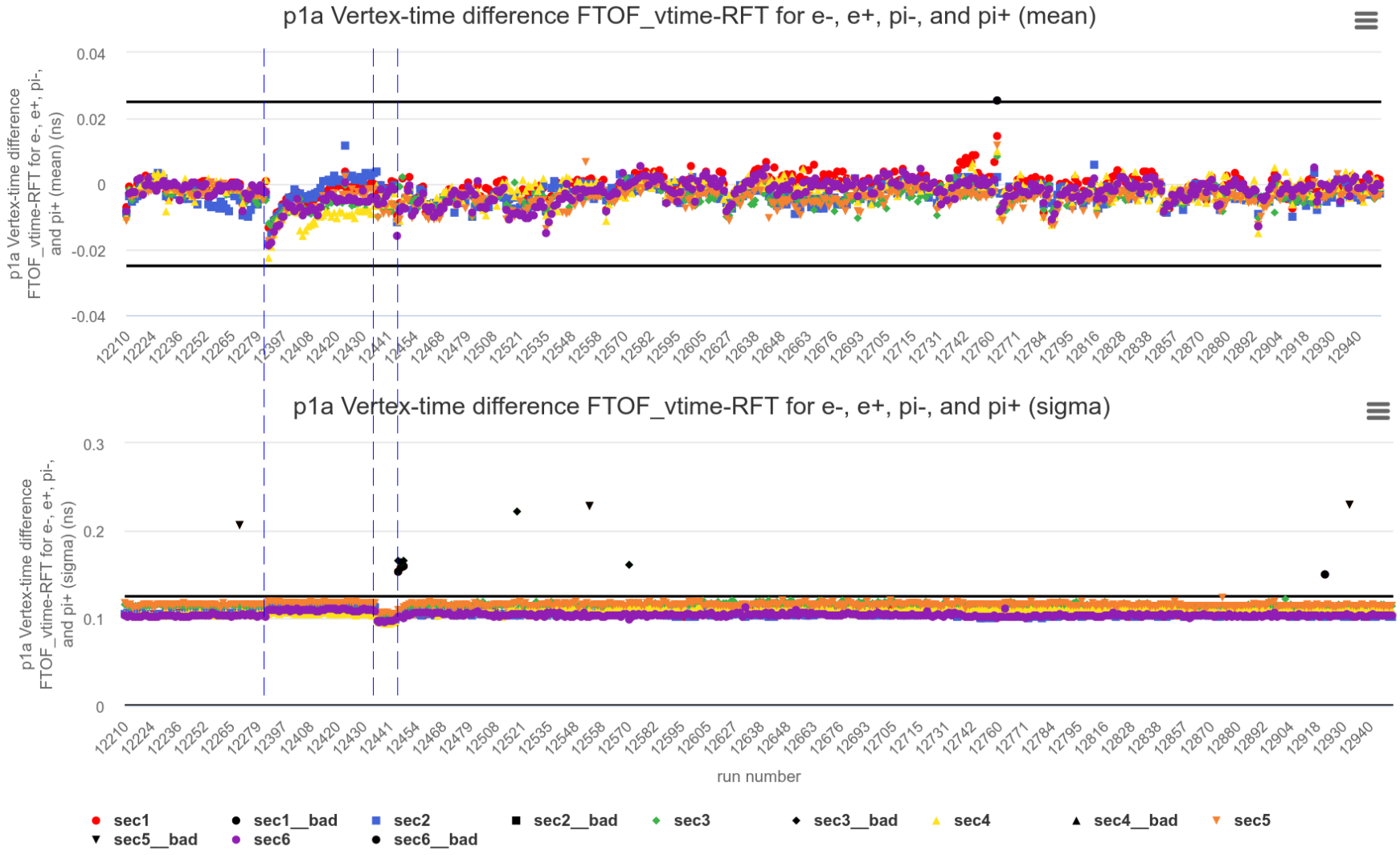






< 7 mm

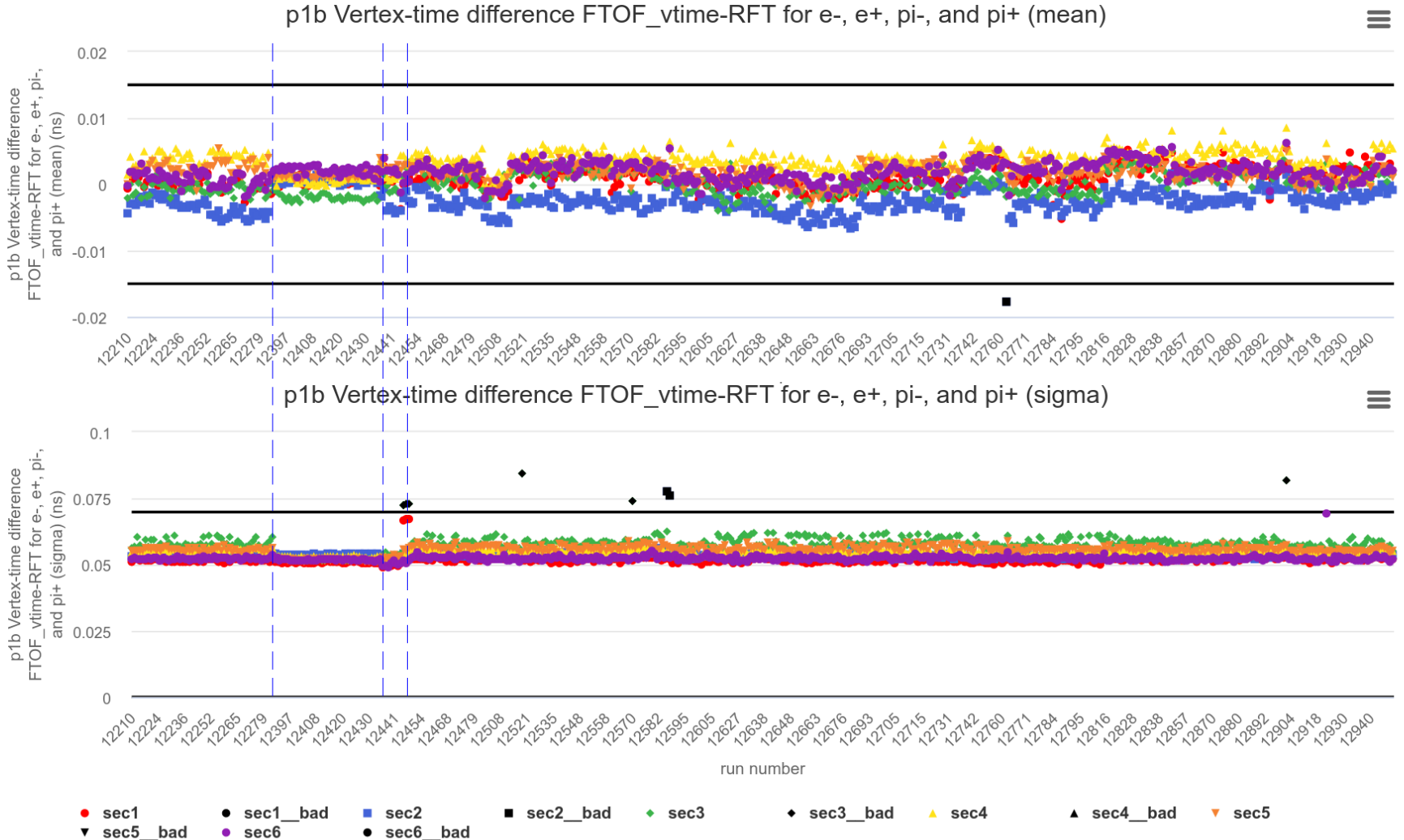
FTOF – p1a (Timing Calib.)



< ±25 ps

< 125 ps

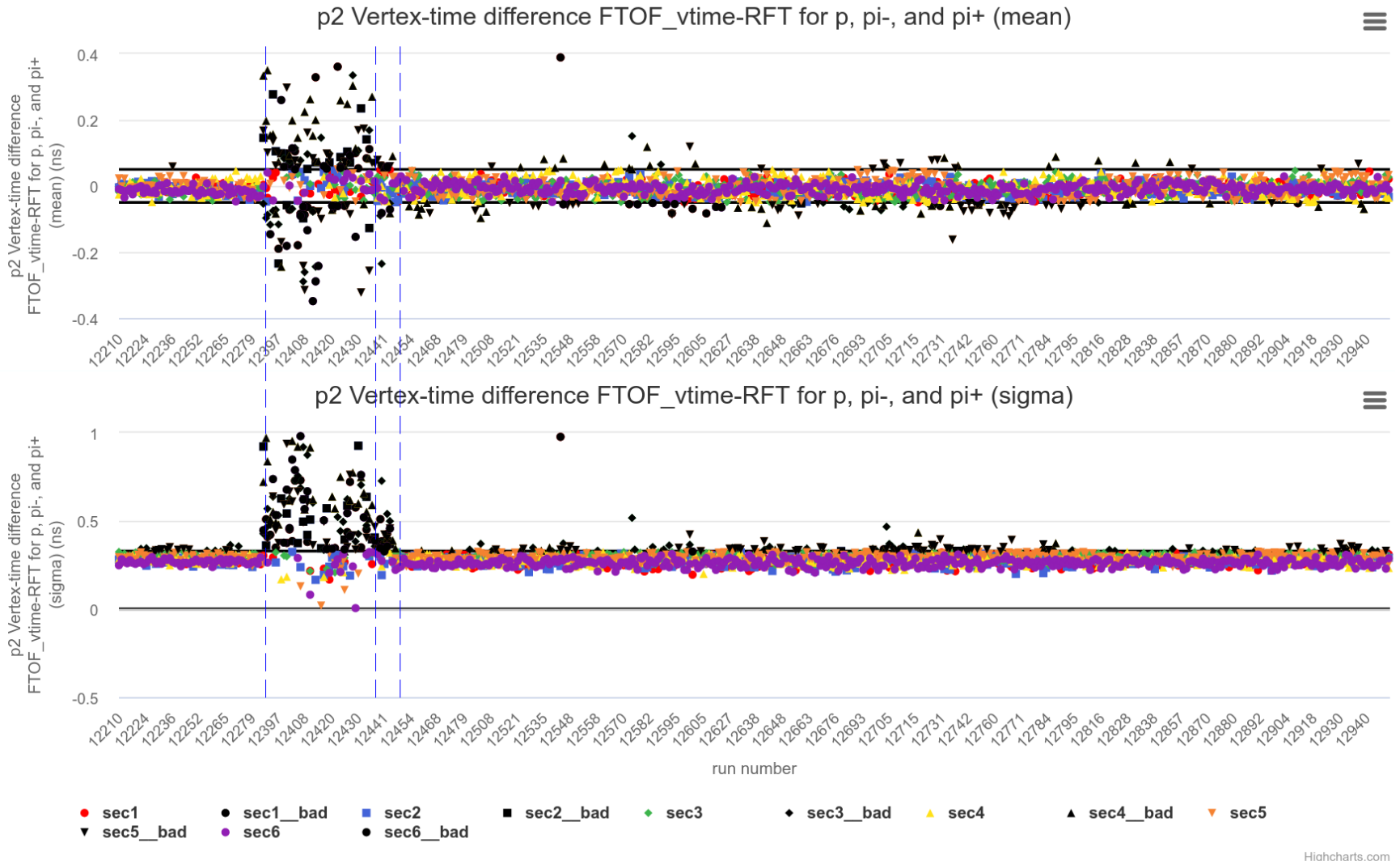
FTOF – p1b (Timing Calib.)



< ±15 ps

< 70 ps

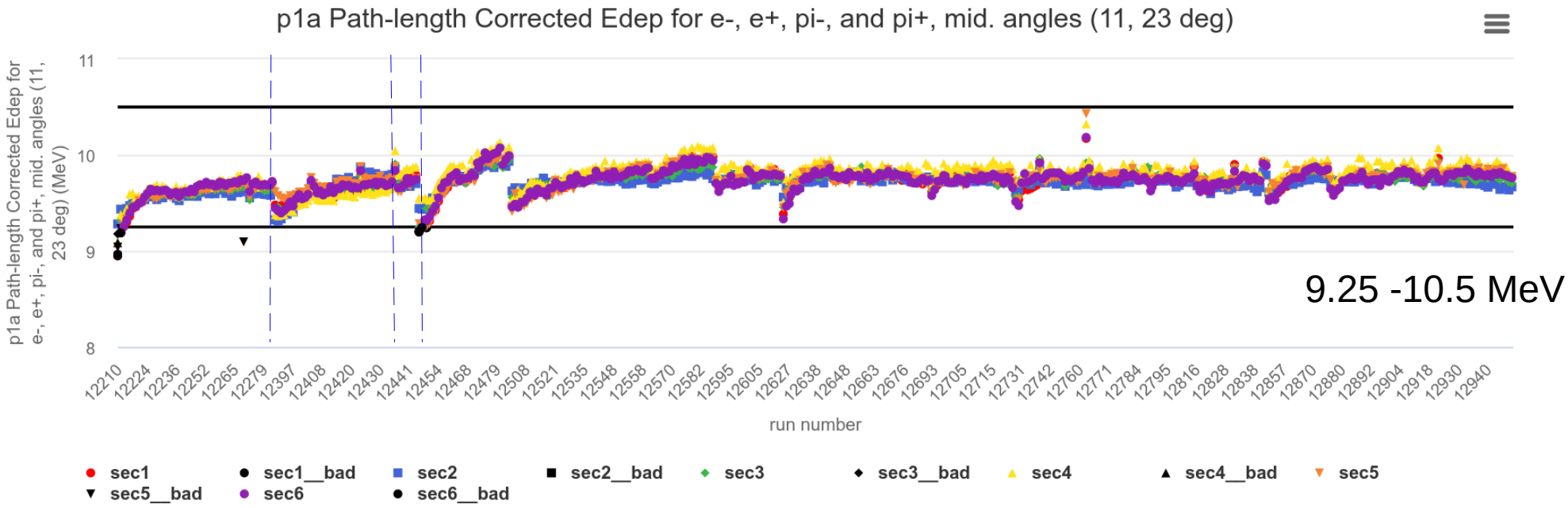
FTOF – p2 (Timing Calib.)



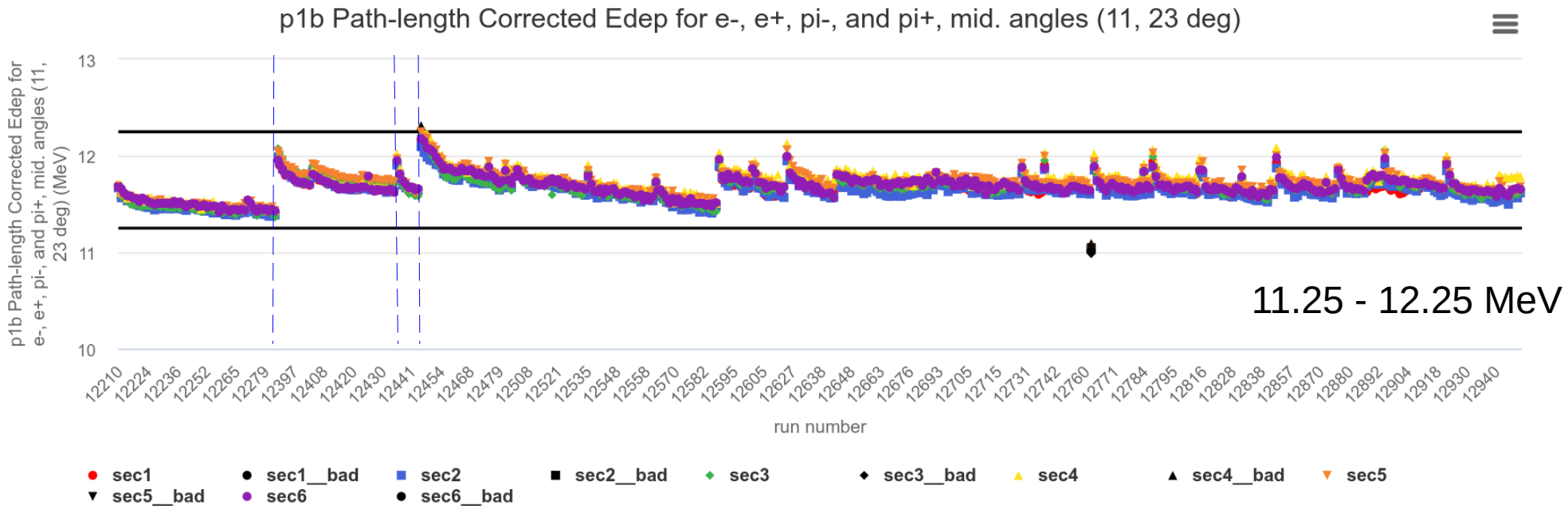
< ±50 ps

< 325 ps

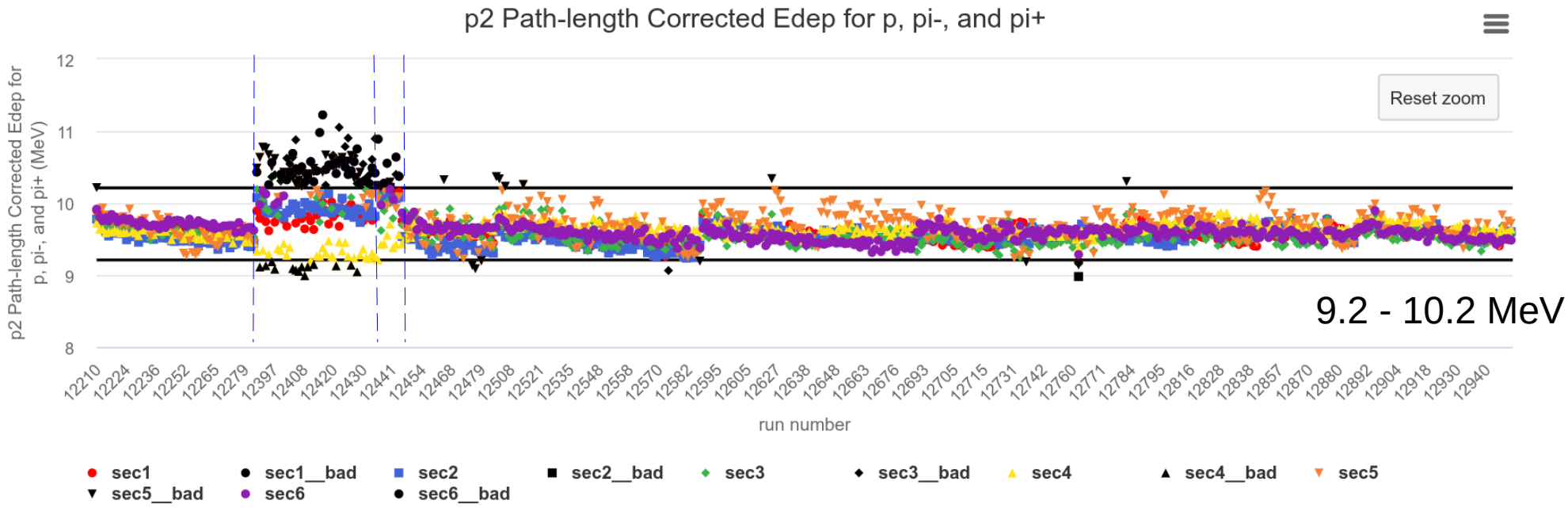
FTOF – p1a (Energy Calib.)



FTOF – p1b (Energy Calib.)

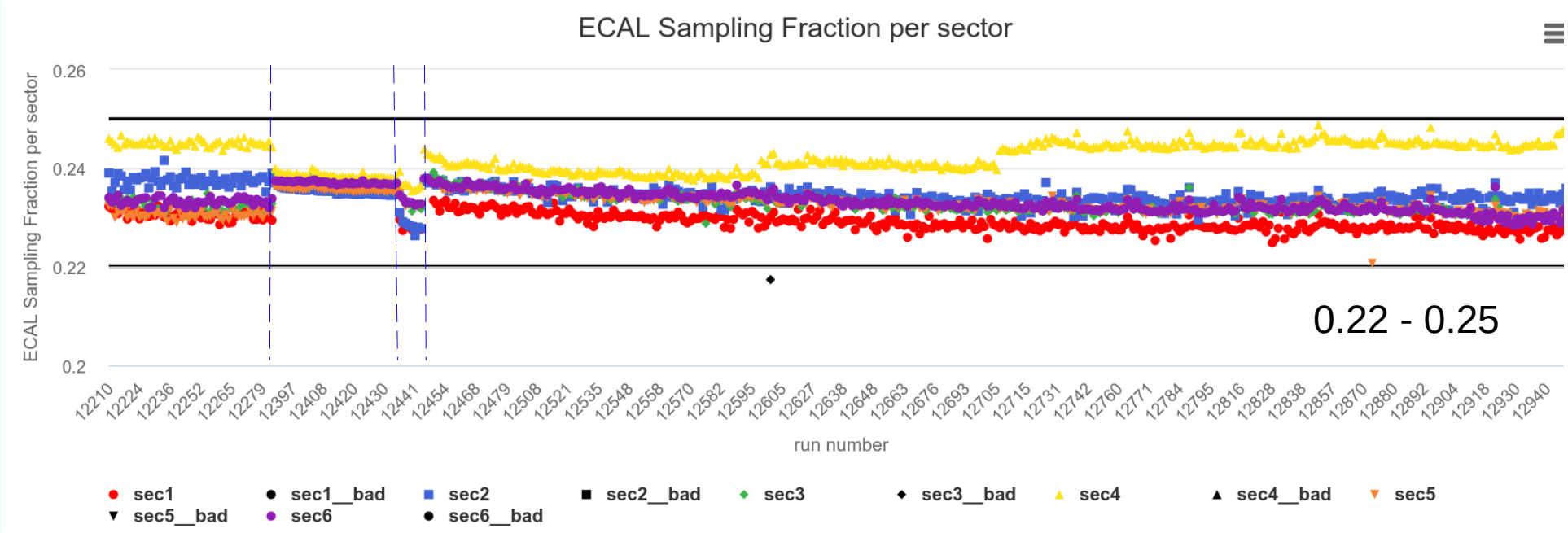


FTOF – p2 (Energy Calib.)

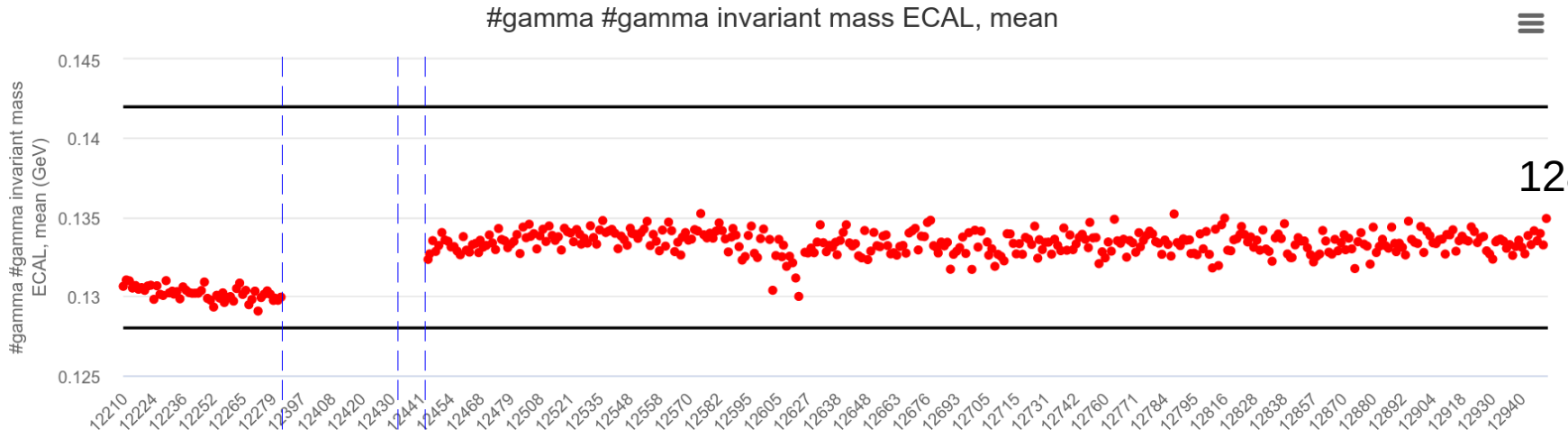


9.2 - 10.2 MeV

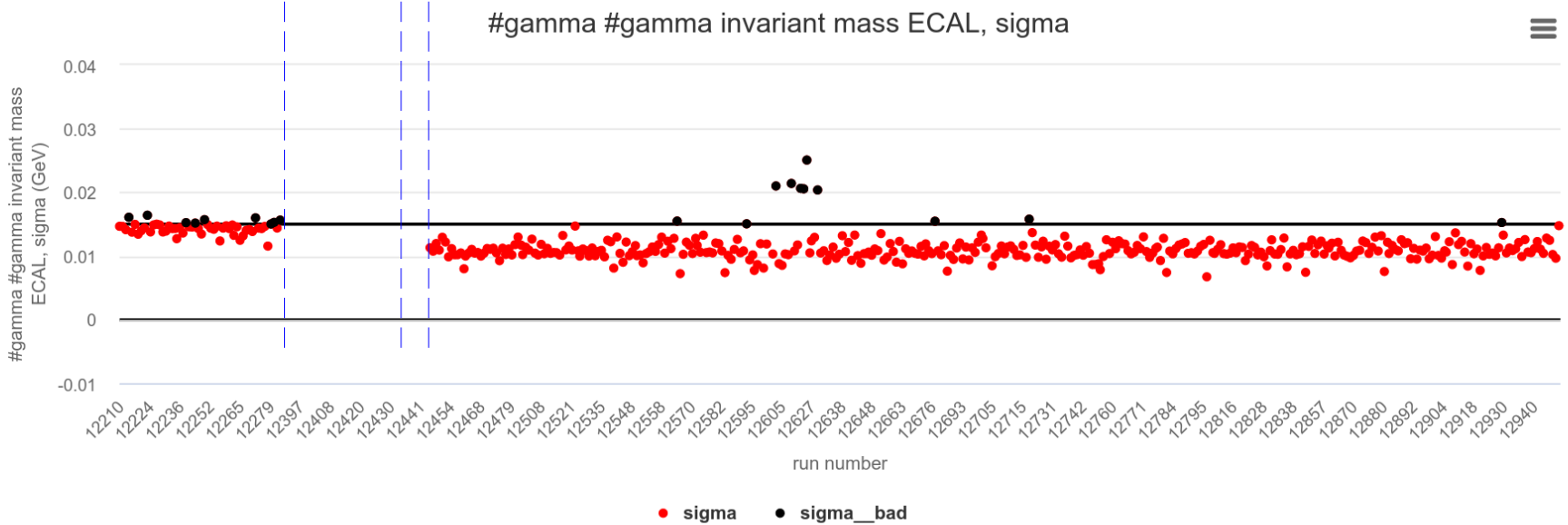
ECAL - SF


ECAL Sampling Fraction per sector
ECAL Sampling Fraction per sector
0.26
0.24
0.22
0.2
0.22 - 0.25
12210 12224 12236 12252 12265 12279 12397 12408 12420 12430 12441 12454 12468 12479 12508 12521 12535 12548 12558 12570 12582 12595 12605 12627 12638 12648 12663 12676 12693 12705 12715 12731 12742 12760 12771 12784 12795 12816 12828 12838 12857 12870 12880 12892 12904 12918 12930 12940
run number
sec1
sec1__bad
sec2
sec2__bad
sec3
sec3__bad
sec4
sec4__bad
sec5
sec5__bad
sec6
sec6__bad

ECAL - π^0

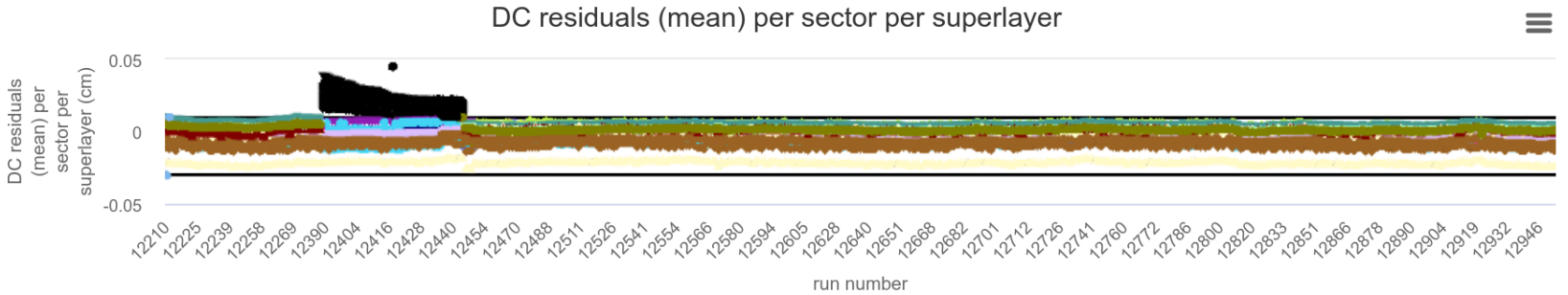


128 -142 MeV

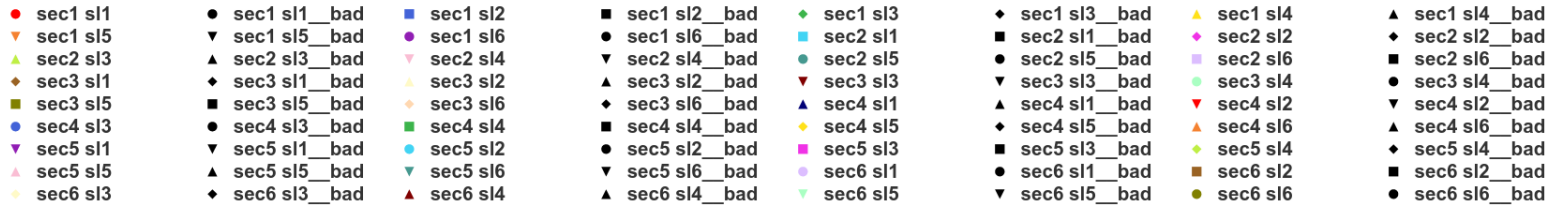


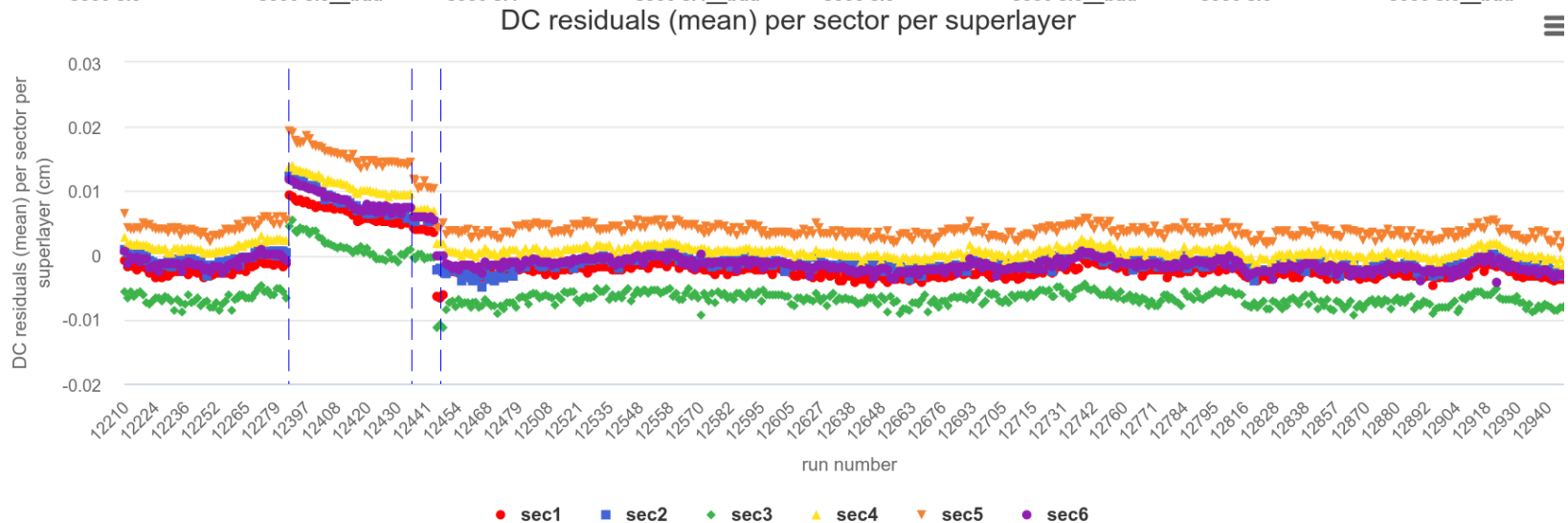
<15 MeV

DC – Residuals

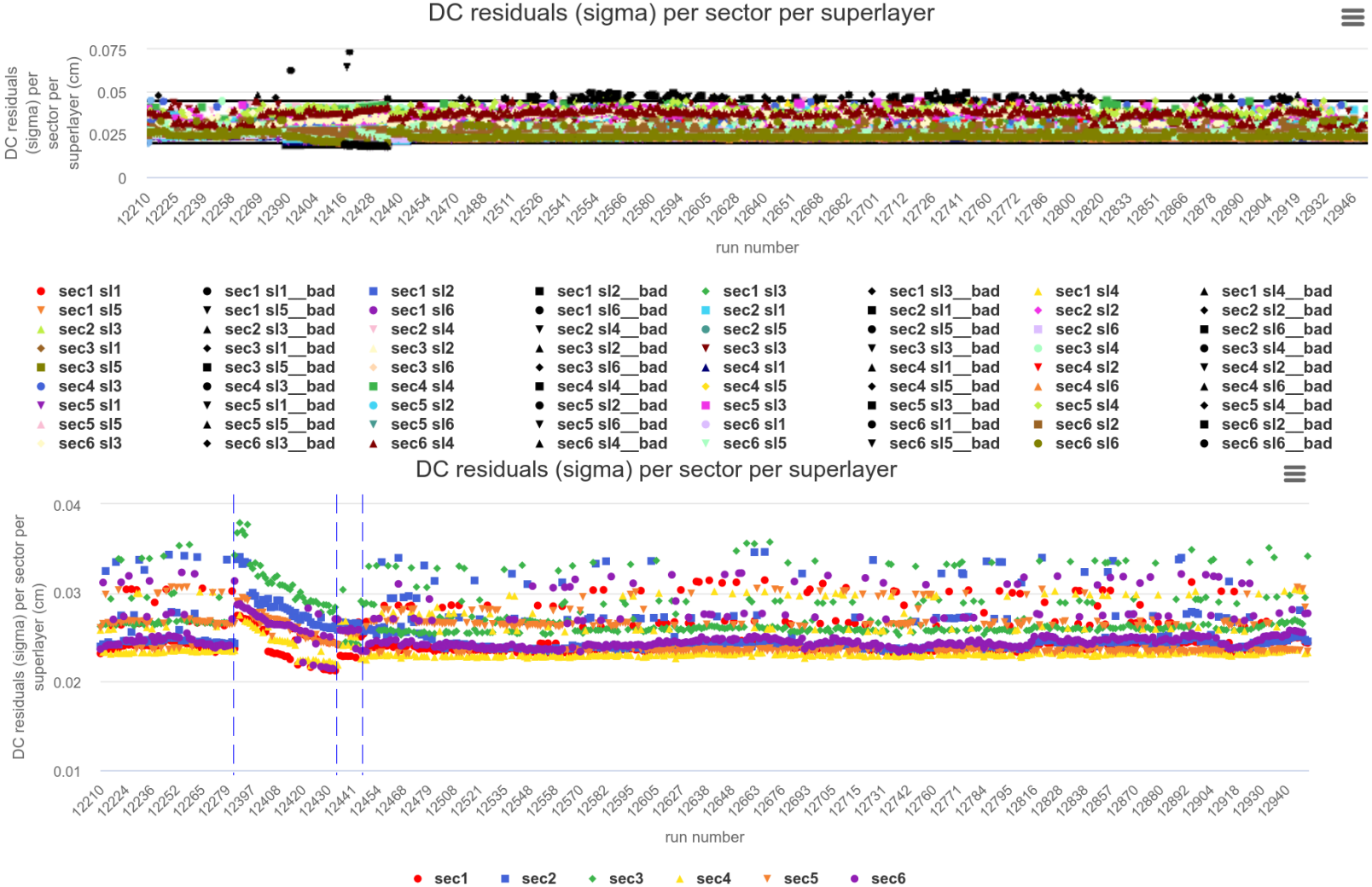


-0.03 - 0.01



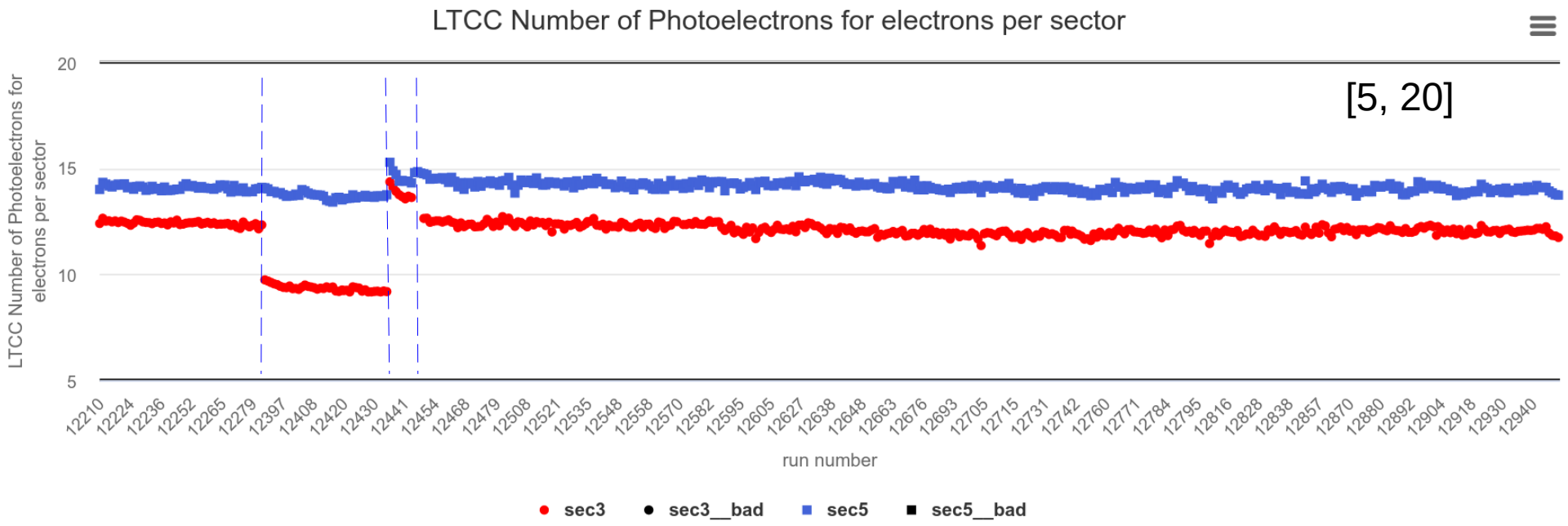


DC – Residuals

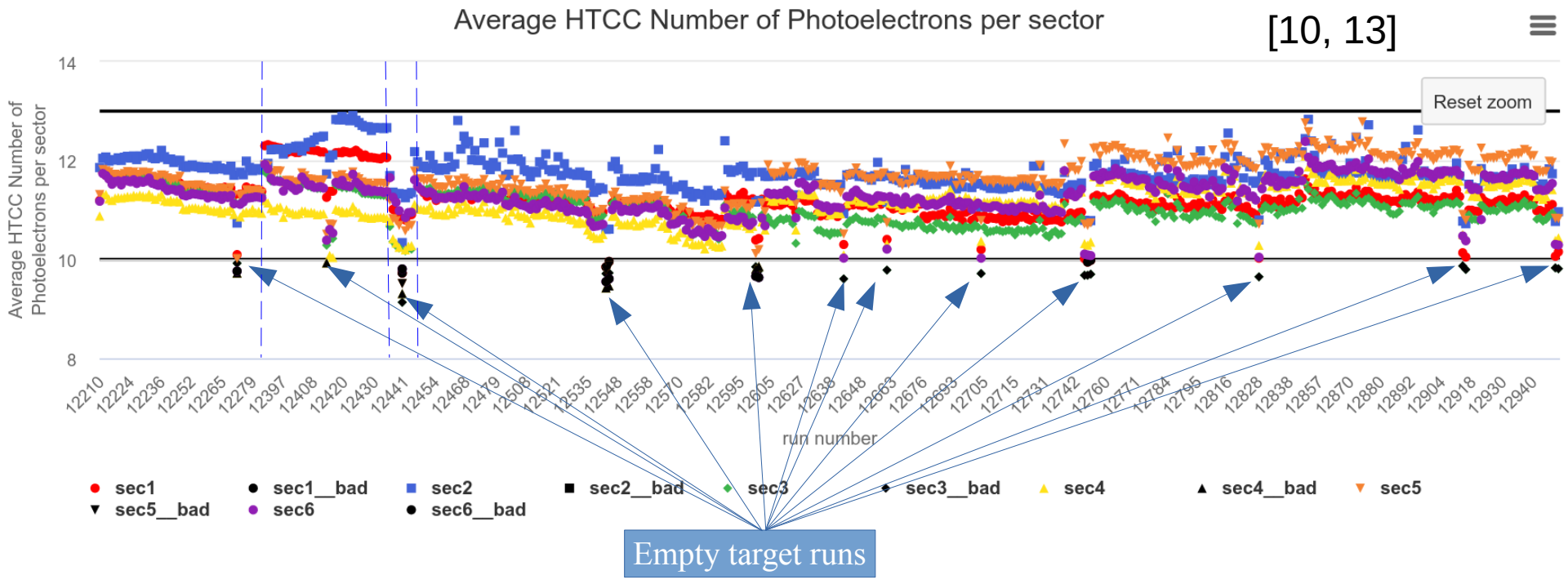


0.02 - 0.045

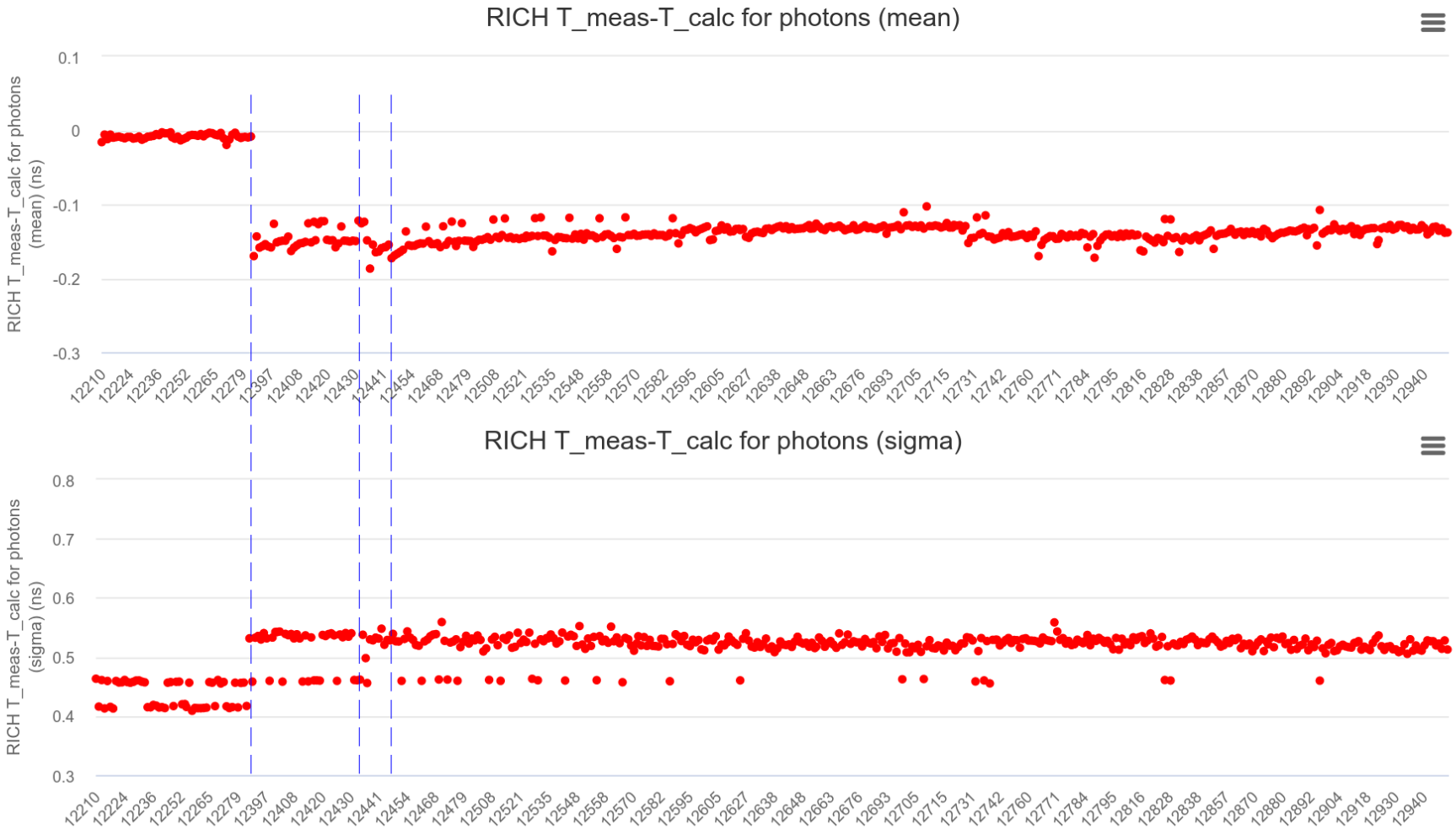
LTCC


LTCC Number of Photoelectrons for electrons per sector
[5, 20]
LTCC Number of Photoelectrons for electrons per sector
20
15
10
5
12210 12224 12236 12252 12265 12279 12397 12408 12420 12430 12441 12454 12468 12479 12508 12521 12535 12548 12558 12570 12582 12595 12605 12627 12638 12648 12663 12676 12693 12705 12715 12731 12742 12760 12771 12784 12795 12816 12828 12838 12857 12870 12880 12892 12904 12918 12930 12940
run number
sec3
sec3__bad
sec5
sec5__bad

HTCC

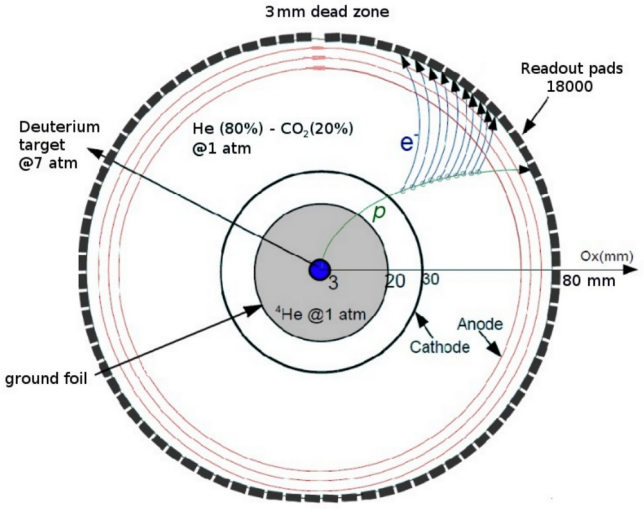

Average HTCC Number of Photoelectrons per sector
[10, 13]
Reset zoom
Average HTCC Number of Photoelectrons per sector
14
12
10
8
12210 12224 12236 12252 12265 12279 12397 12408 12420 12430 12441 12454 12468 12479 12508 12521 12535 12548 12558 12570 12582 12595 12605 12627 12638 12648 12663 12676 12693 12705 12715 12731 12742 12760 12771 12784 12795 12816 12828 12838 12857 12870 12880 12892 12904 12918 12930 12940
run number
sec1
sec1__bad
sec2
sec2__bad
sec3
sec3__bad
sec4
sec4__bad
sec5
sec5__bad
sec6
sec6__bad
Empty target runs

RICH

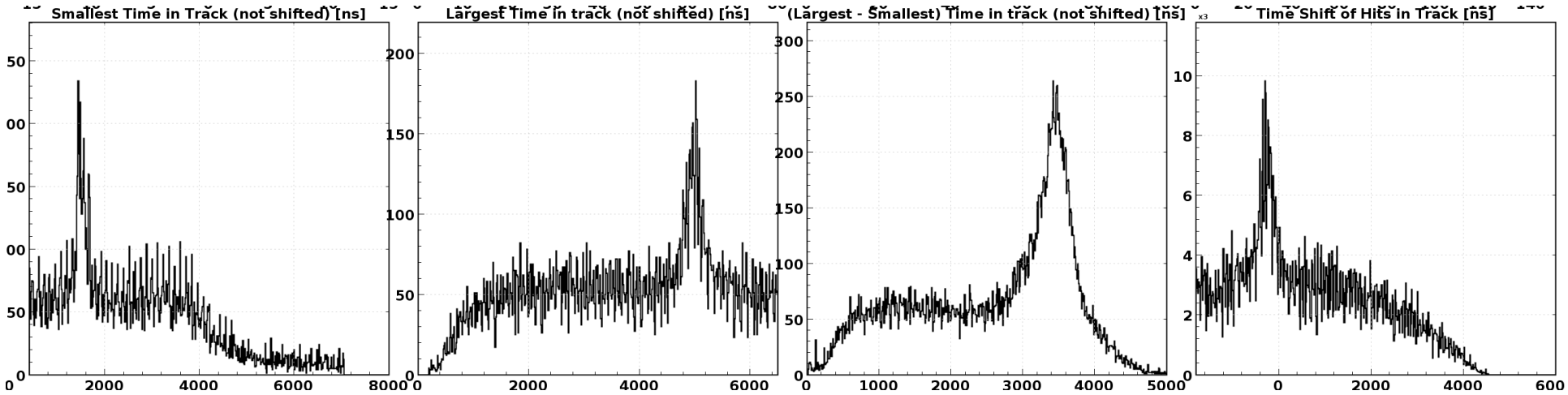

RICH T_meas-T_calc for photons (mean)
RICH T_meas-T_calc for photons (mean) (ns)
0.1
0
-0.1
-0.2
-0.3
RICH T_meas-T_calc for photons (sigma)
RICH T_meas-T_calc for photons (sigma) (ns)
0.8
0.7
0.6
0.5
0.4
0.3
12210 12224 12236 12252 12265 12279 12397 12408 12420 12430 12441 12454 12468 12479 12508 12521 12535 12548 12558 12570 12582 12595 12605 12627 12638 12648 12663 12676 12693 12705 12715 12731 12742 12760 12771 12784 12795 12816 12828 12838 12857 12870 12880 12892 12904 12918 12930 12940

< 1ns

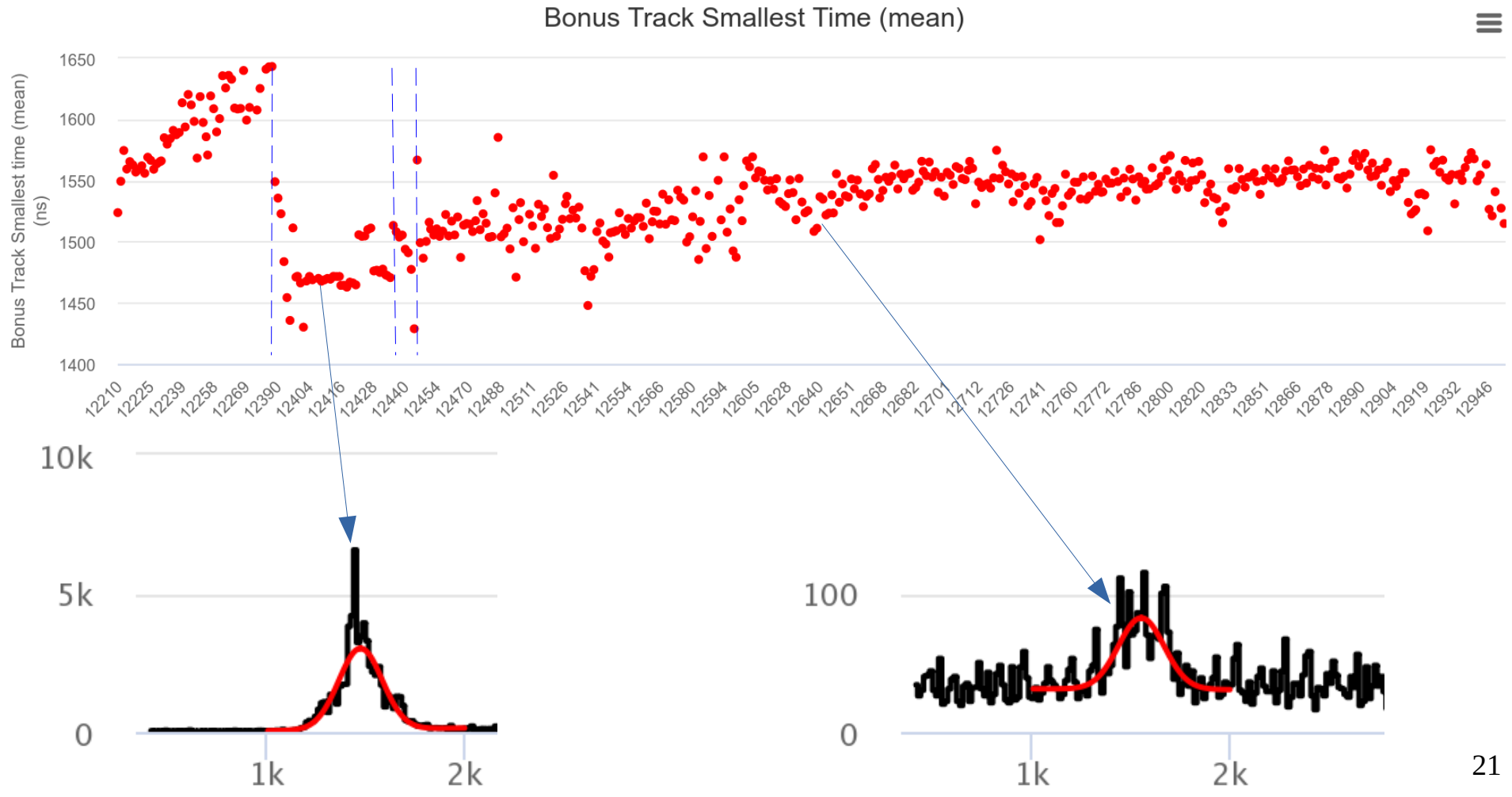
BONuS - Timing



- Smallest time → Timing offsets between the trigger and the RTPC.
- Largest time → To extract the nominal maximum drift time.
- Diff time → A measure to the time length of a track
- Time shit → Time shift of track's chain of hits



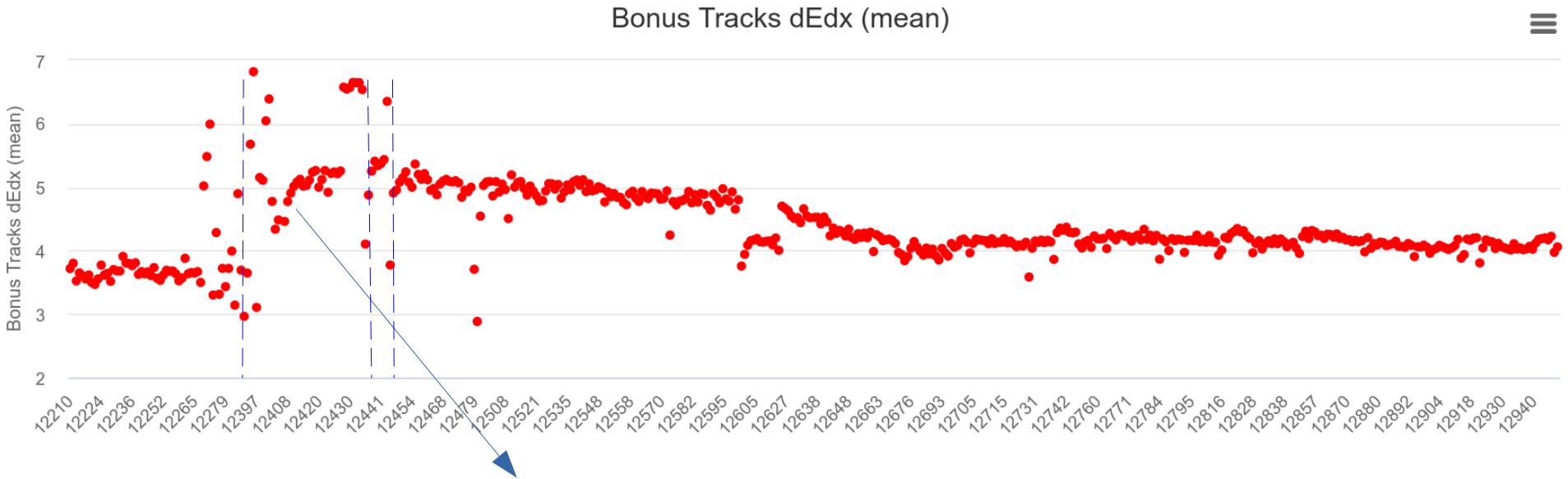
BONuS - Timing

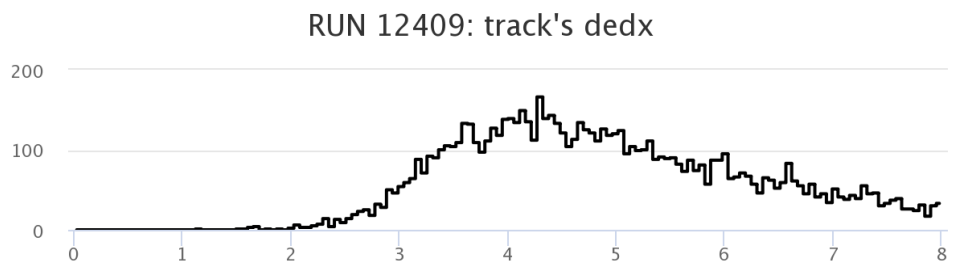


BONuS - Gain

Signal height → Pads' gains (G_i)

$$\left\langle \frac{dE}{dX} \right\rangle = \frac{\sum_i \frac{ADC_i}{Gi}}{vtl}$$





Summary

Subsystem	Timeline	Constraint (RG-B)	Constraint (RG-F)
RF	rftime electron FD mean	< ±10 ps	< ±10 ps
	rftime electron FD sigma	< 70 ps	< 70 ps
LTCC	ltcc elec nphe sec	12-14	5-20
HTCC	htcc nphe sec	11-13	10-13
FTOF	ftof edep p1a midangles	9.25-10.5 MeV	9.25-10.5 MeV
	ftof edep p1b midangles	11.25-12.25 MeV	11.25-12.25 MeV
	ftof edep p2	9.2-10.2 MeV	9.2-10.2 MeV
	ftof time p1a mean	< ±25 ps	< ±25 ps
	ftof time p1a sigma	< 125 ps	< 125 ps
	ftof time p1b mean	< ±15 ps	< ±15 ps
	ftof time p1b sigma	< 70 ps	< 70 ps
	ftof time p2 mean	< ±50 ps	< ±50 ps
	ftof time p2 sigma	< 325 ps	< 325 ps
ECAL	ec Sampling	0.24-0.26	0.22-0.25
	ec gg m mean	131-134 MeV	128 -142 MeV
	ec gg m sigma	< 15 MeV	< 15MeV
DC	dc residuals sec mean	< ±0.005 cm	< [-0.03,0.01] cm
	dc residuals sec sl sigma	R1,R3 < 300 mm, R2 < 400 mm	< 450 mm
RICH	rich time fwhm max	< 1 ns	<1ns

LTCC Check (Inbending vs. Outbending)