

Strange ToT decreasing investigation

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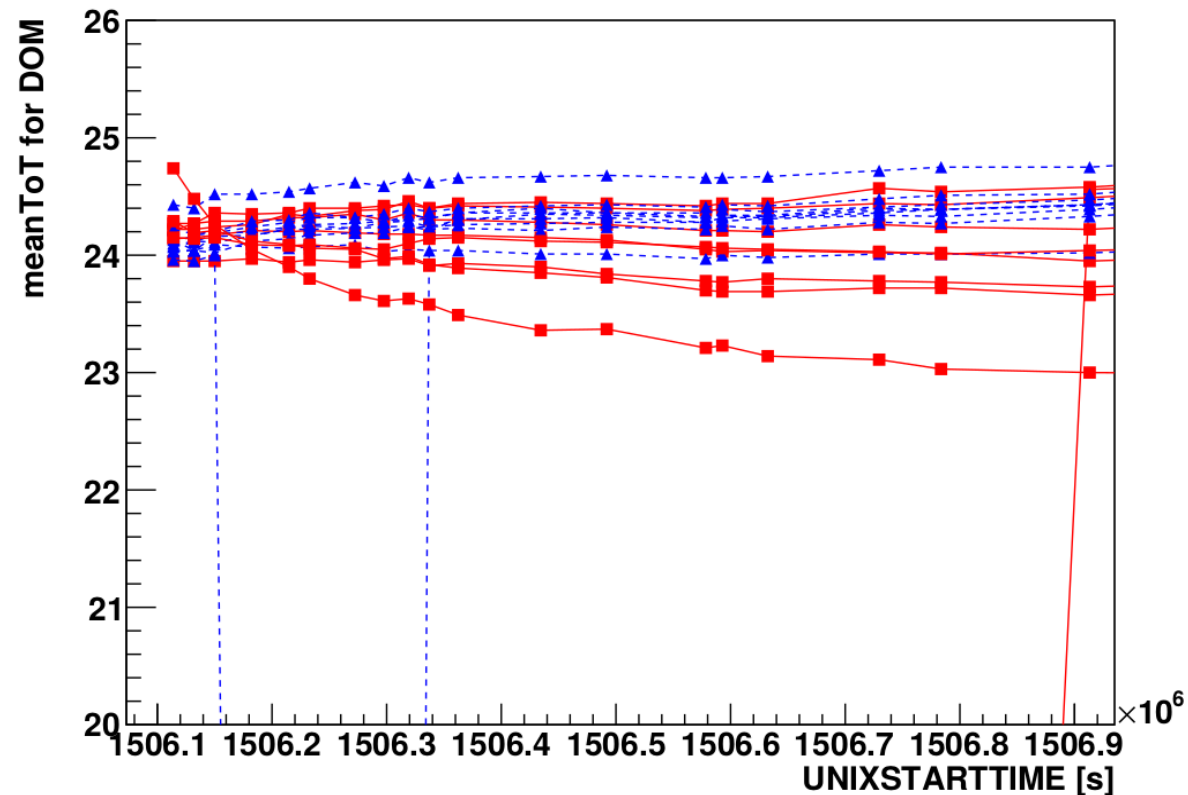
Workshop on PMT handling, storage, calibration and analysis, Napoli, 16th January 2017



Istituto Nazionale di Fisica Nucleare

Introduction

- Strange behavior of the ToT. It seems to decrease over time.
- Decrease rate differences between the DOMs of Catania and those of Napoli.
- Decrease rate differences between “old” and “new” DOMs.

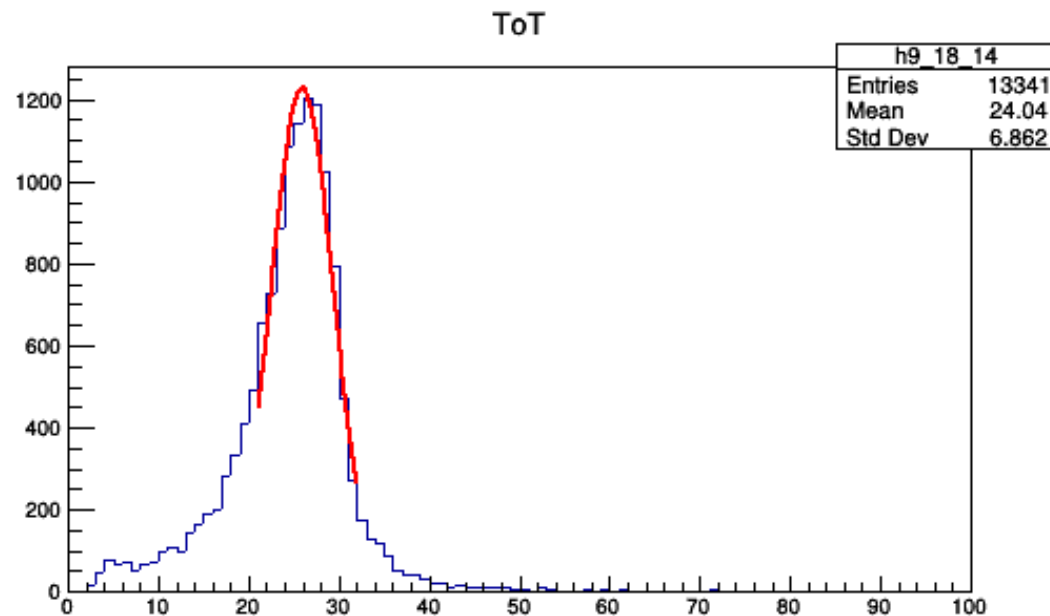


Method

Run analyzed:

2318,2323,2339,2351,2357,2365,2370,2382,2400,2423,2427,2440,2445,2460,2493,2525,2558 .
From data 2318 to data 2558

ToT distribution for each PMT of each DOM and RUN



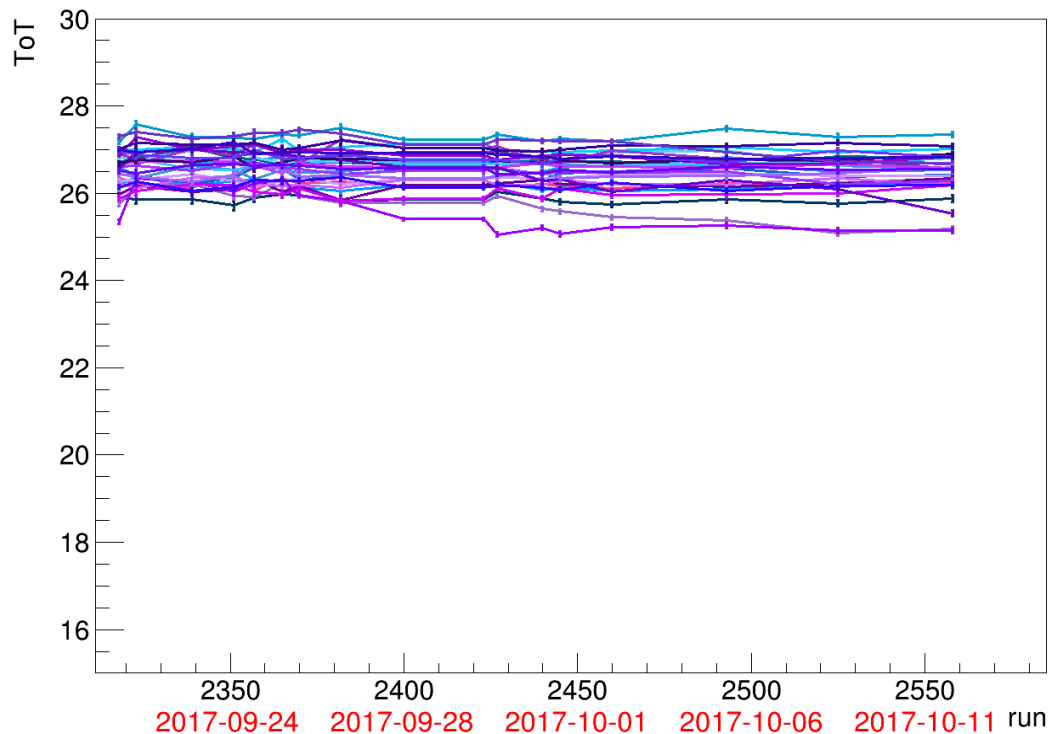
Research of the max position

Gaussian fit around the peak (maxbin-3, maxbin+3)

- ➡ Estimation of ToT mean for each PMT of each DOM and RUN
- ➡ Analysis for each DOM and PMT

DOM 1

808972698



3 Orange PMT:
PMT20,PMT23,PMT26

2 Red PMT:
PMT13 and PMT18

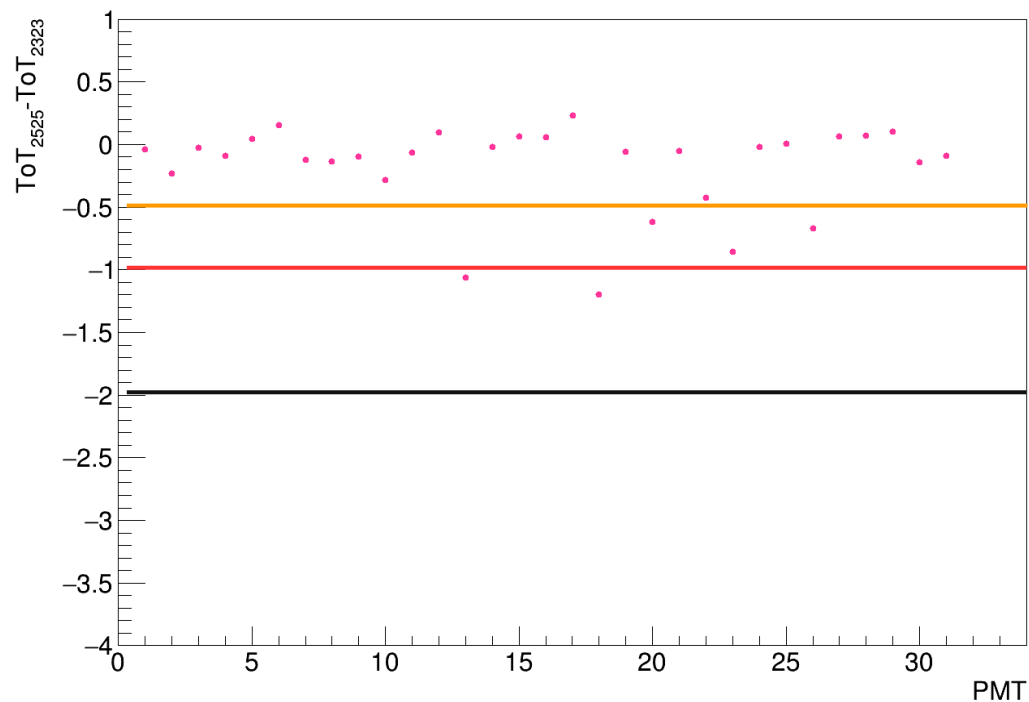
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

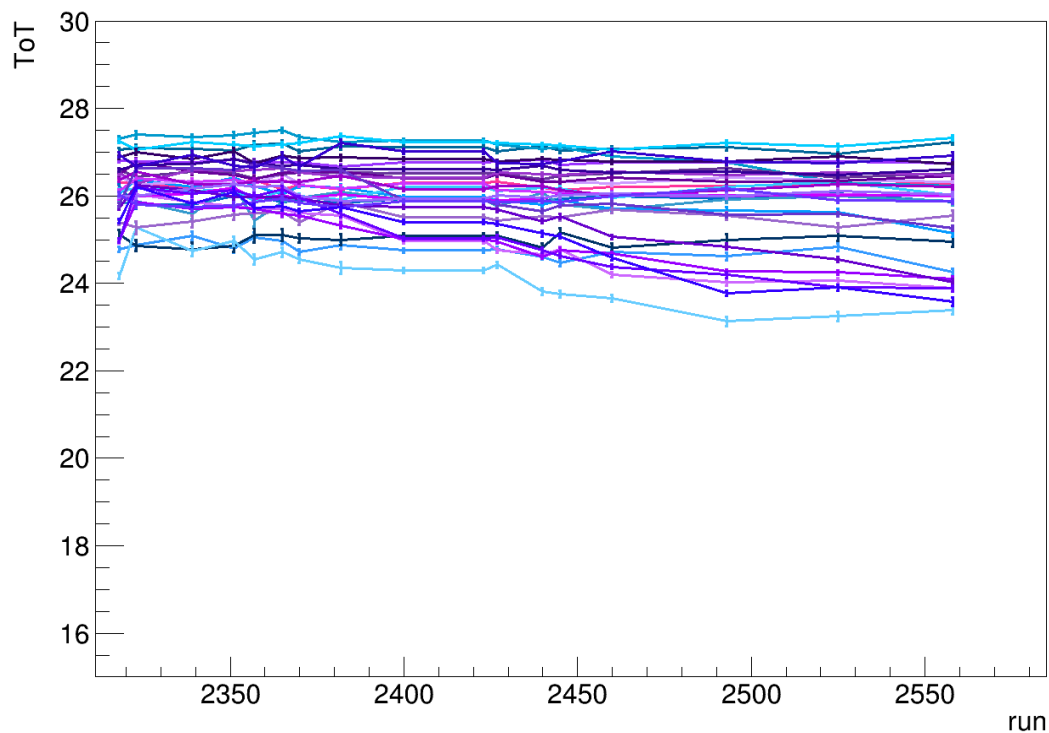
Black PMT: $\Delta\text{ToT} \leq -2$

808972698



DOM 2

808982077



1 Orange PMT:
PMT8,

5 Red PMT:
PMT10 , PMT17,PMT18,
PMT23,PMT26

3 Black PMT:
PMT7 , PMT28,PMT31,

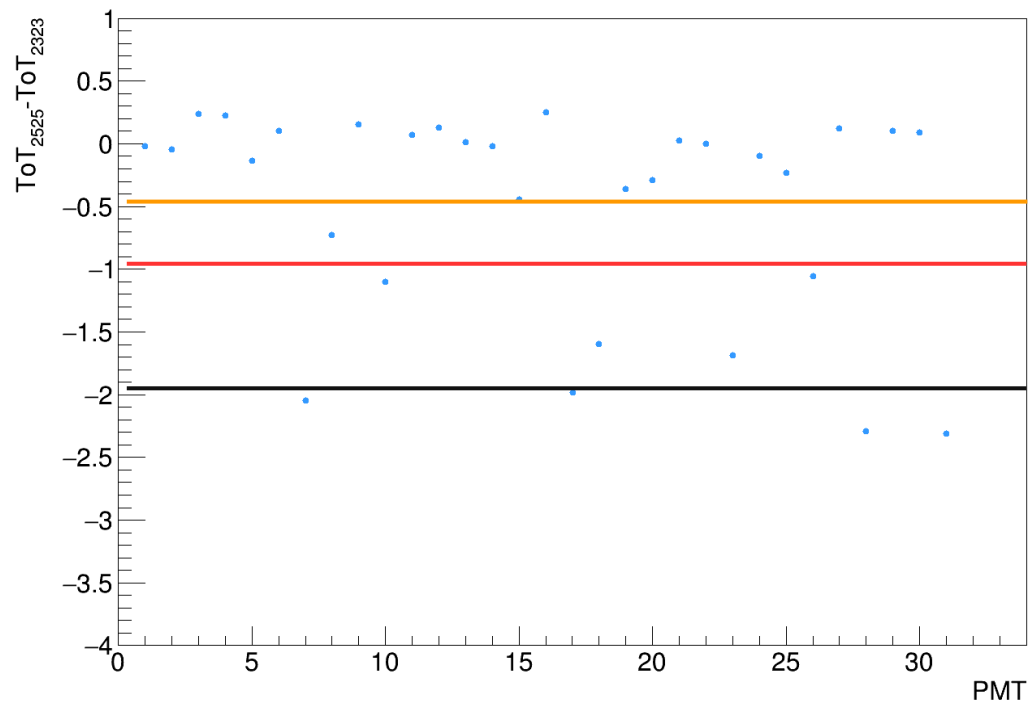
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

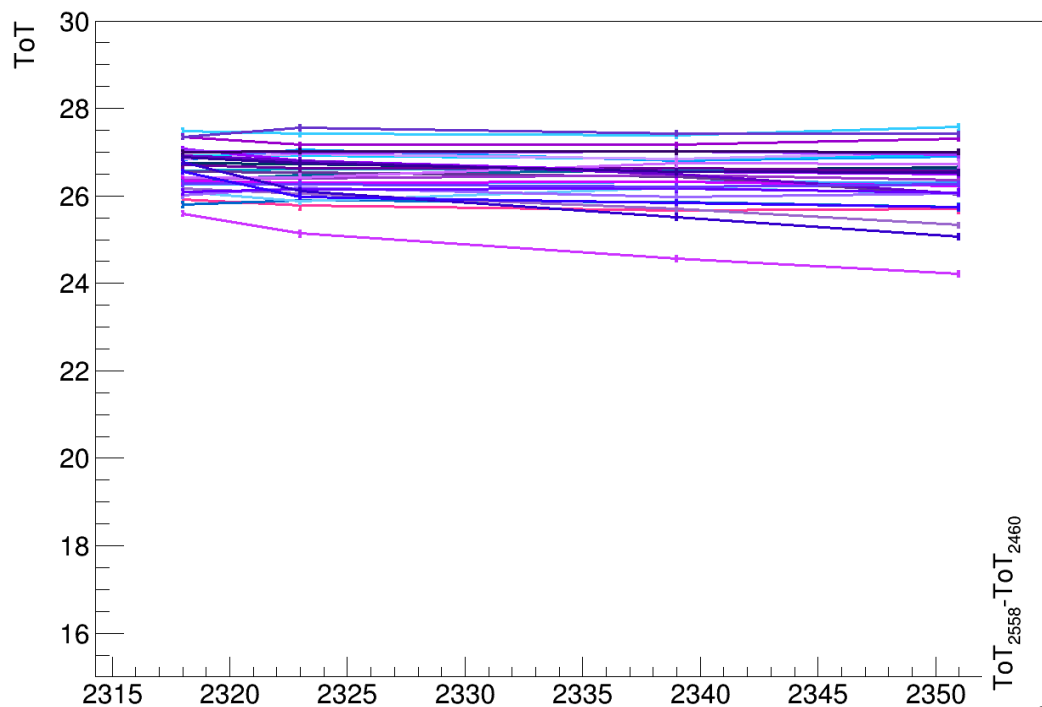
Black PMT: $\Delta\text{ToT} \leq -2$

808982077



DOM 3

808969848



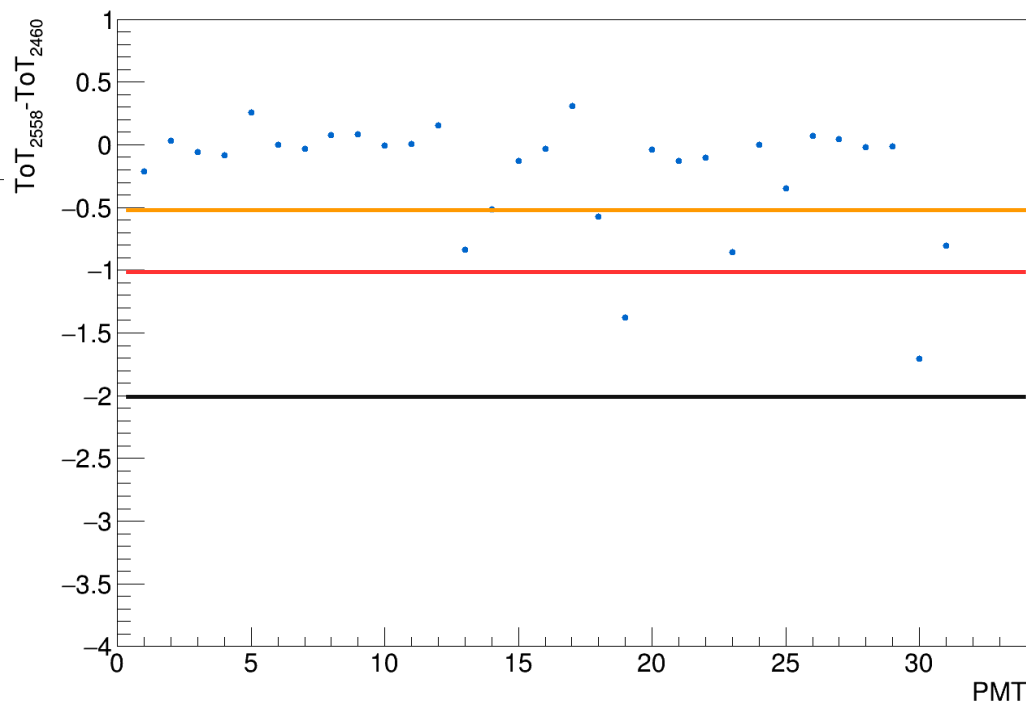
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

Black PMT: $\Delta\text{ToT} \leq -2$

808969848

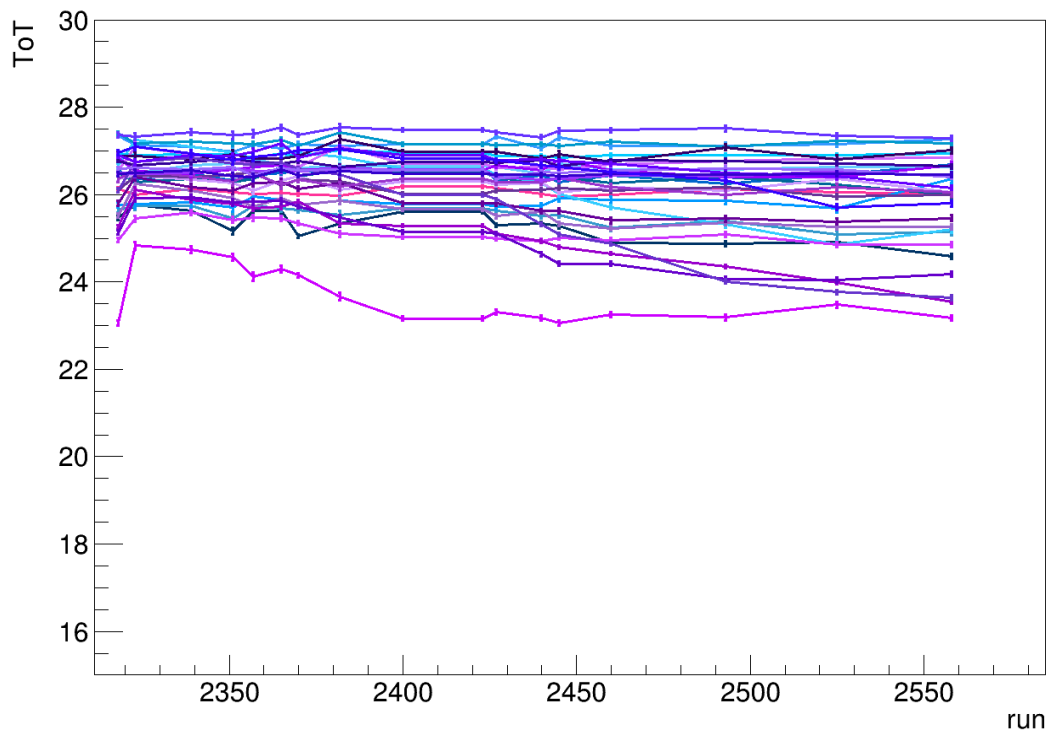


5 Orange PMT:
PMT13, PMT14, PMT18,
PMT23, PMT31

2 Red PMT:
PMT19, PMT30

DOM 4

808974773



- 4 Orange PMT:
PMT4,PMT6,PMT13,
PMT19
- 4 Red PMT:
PMT15,PMT21,PMT23,
PMT31
- 3 Black PMT:
PMT9,PMT20,PMT26

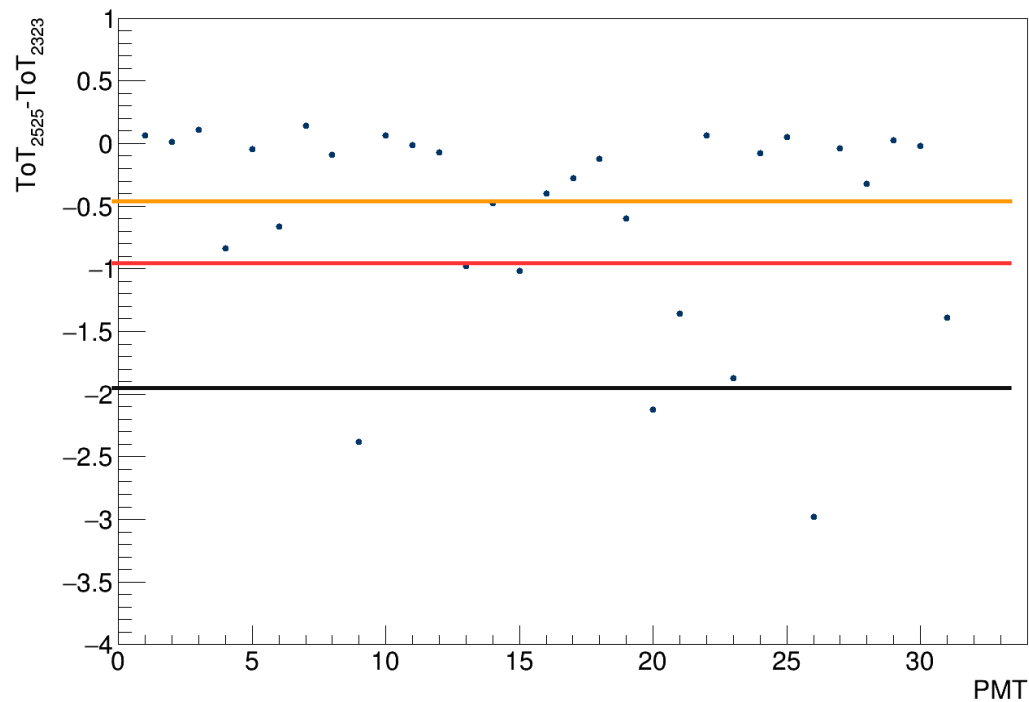
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{toT} \leq -1$

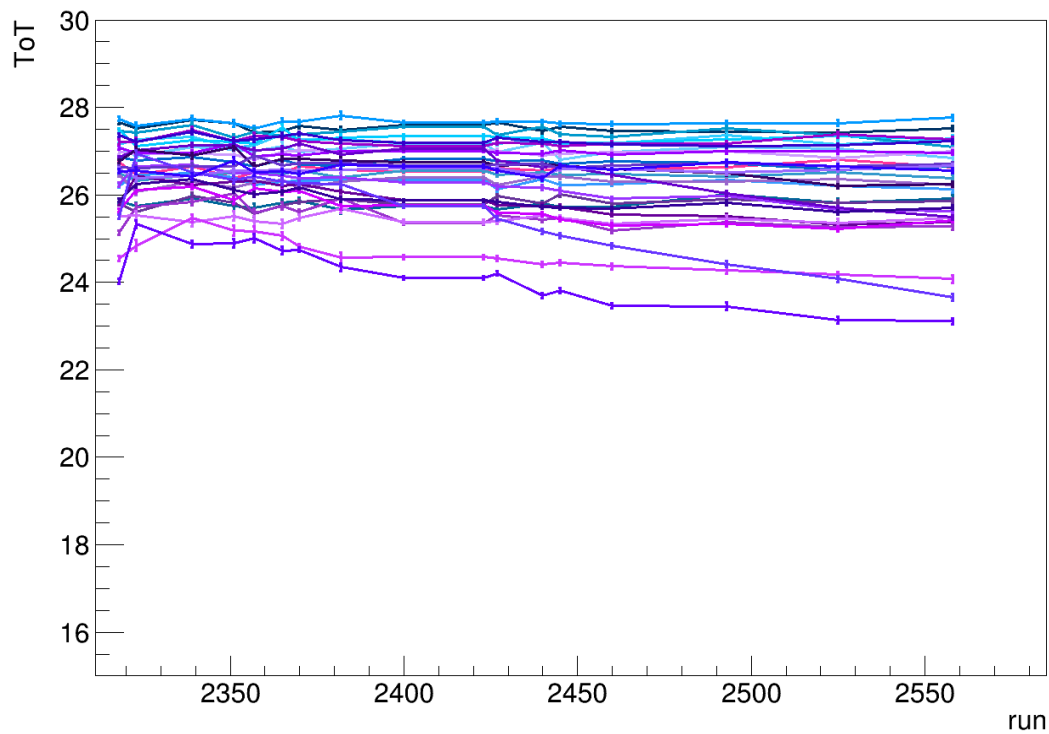
Black PMT: $\Delta\text{toT} \leq -2$

808974773



DOM 5

808979567



- 5 Orange PMT:
PMT19,PMT21,PMT22,
PMT24,PMT24,
- 2 Red PMT:
PMT15,PMT23,
- 2 Black PMT:
PMT28,PMT29

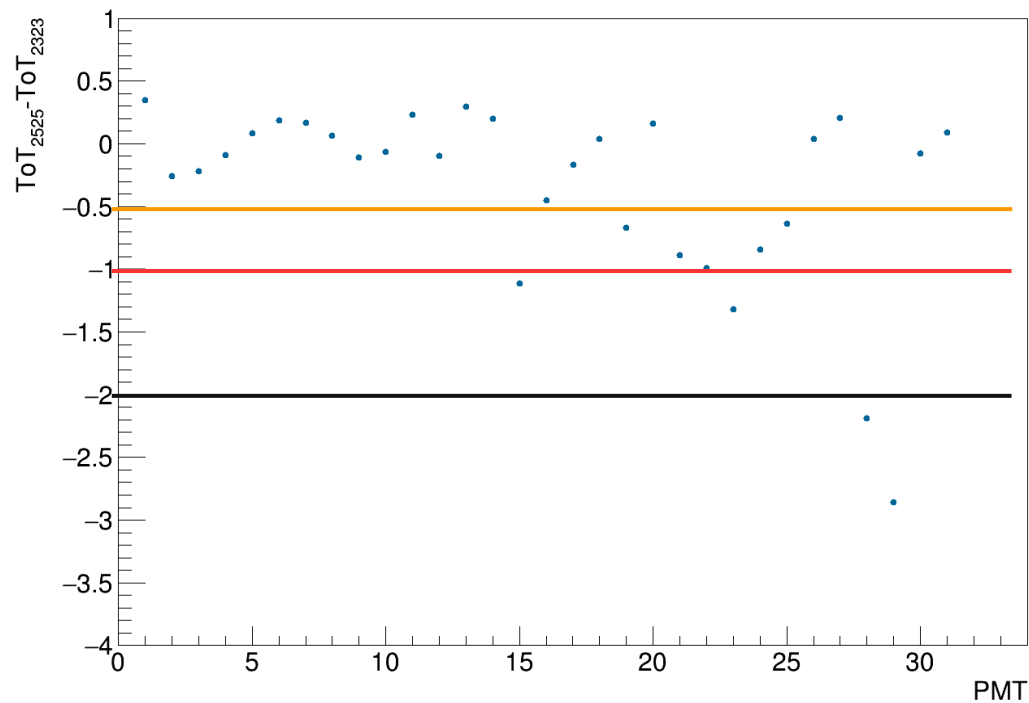
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

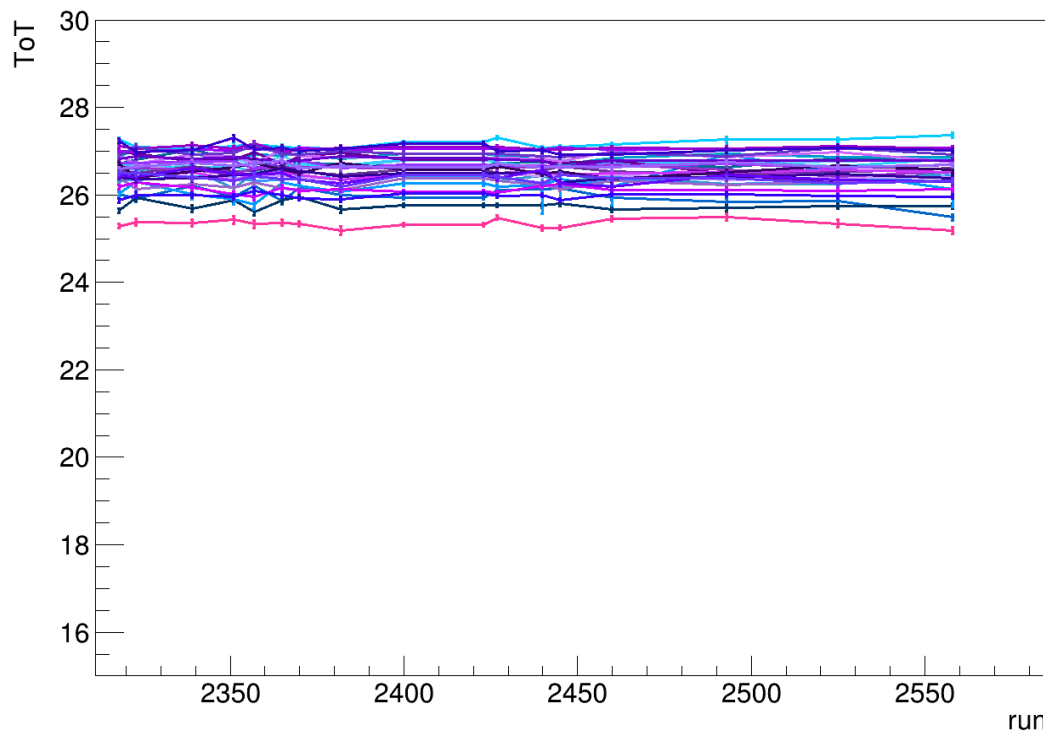
Black PMT: $\Delta\text{ToT} \leq -2$

808979567



DOM 6

809544061



1 Orange PMT:
PMT15

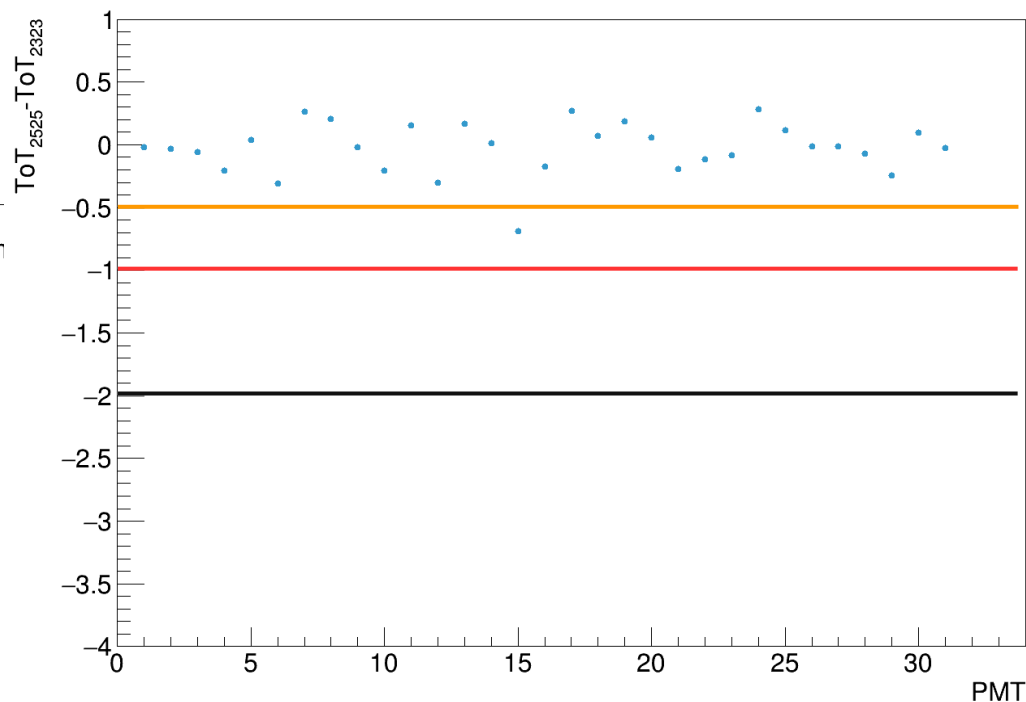
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

Black PMT: $\Delta\text{ToT} \leq -2$

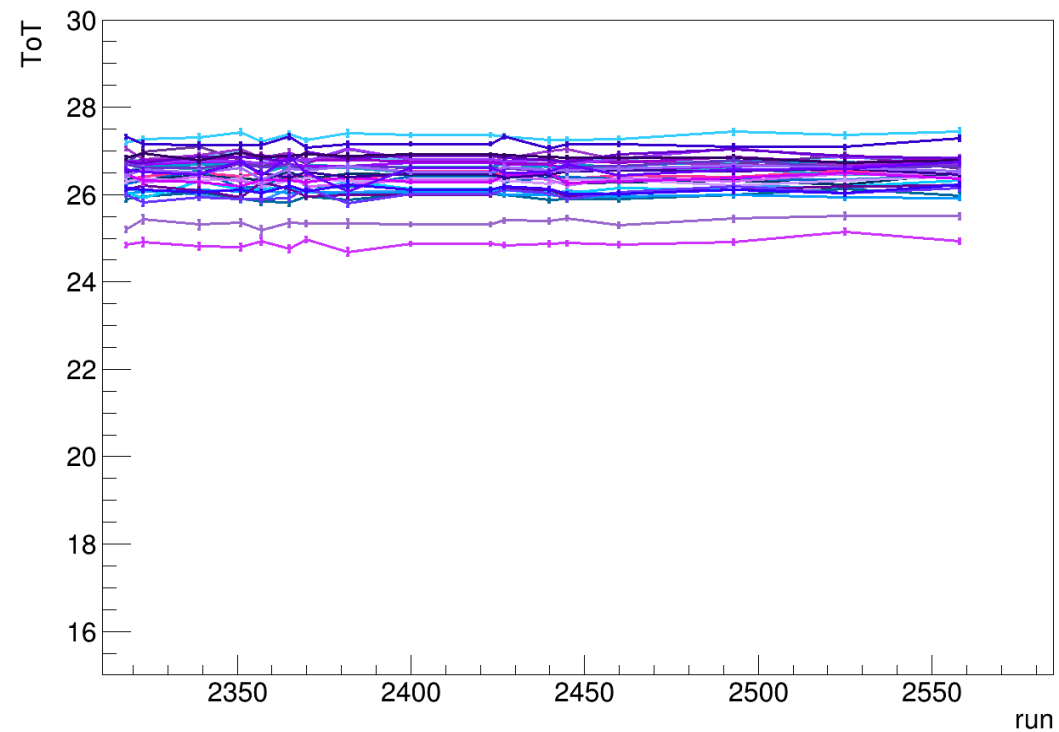
809544061



PMT

DOM 7

808488990



Green PMT: $\Delta\text{toT} \geq -0.5$

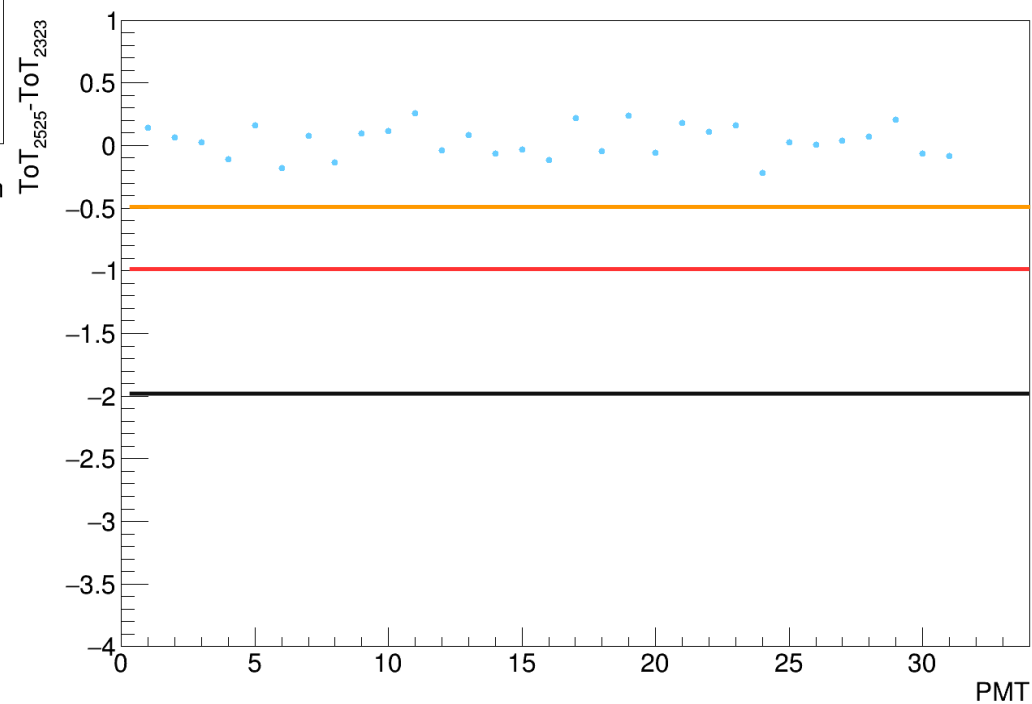
Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

Black PMT: $\Delta\text{ToT} \leq -2$

ALL GREEN

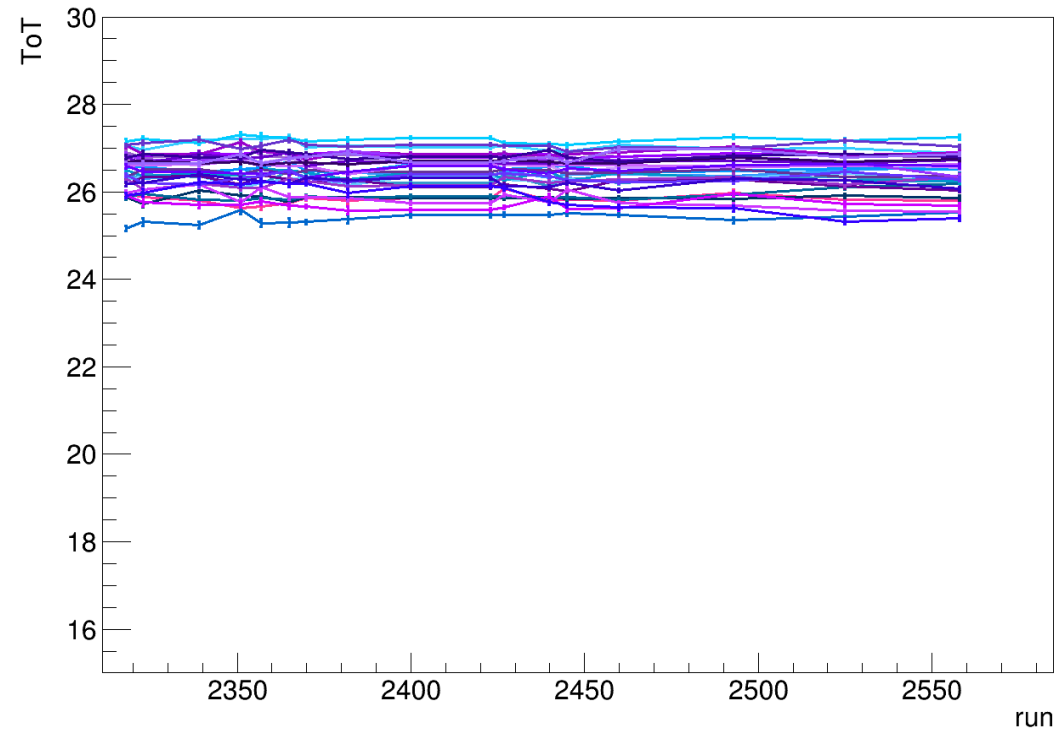
808488990



PMT

DOM 8

808964815



1 Orange PMT:
PMT31

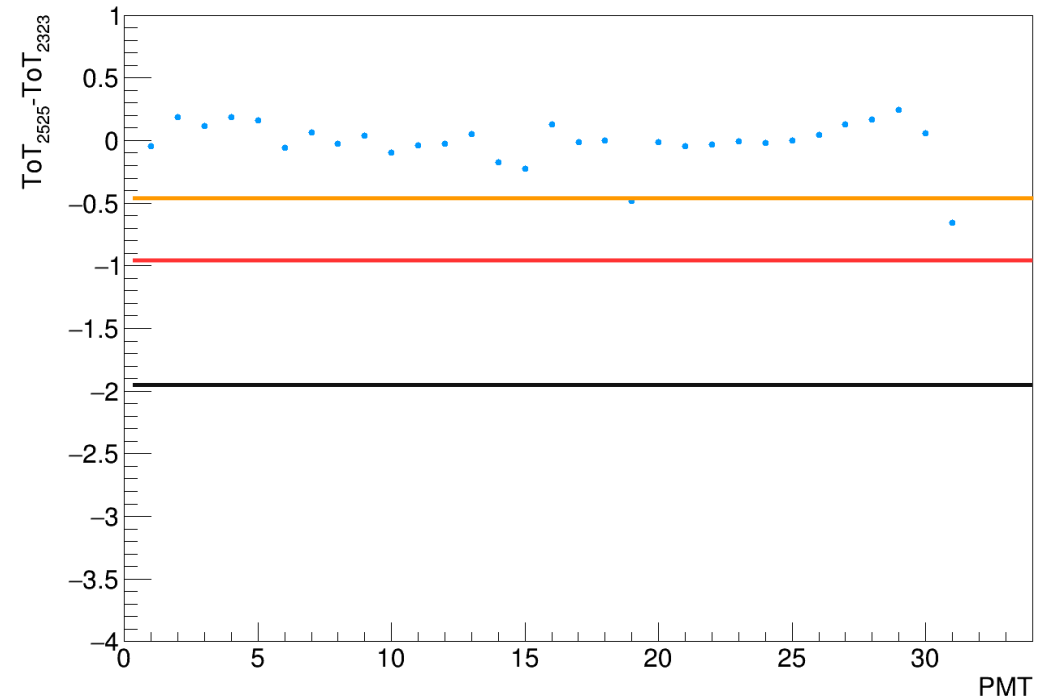
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{toT} \leq -1$

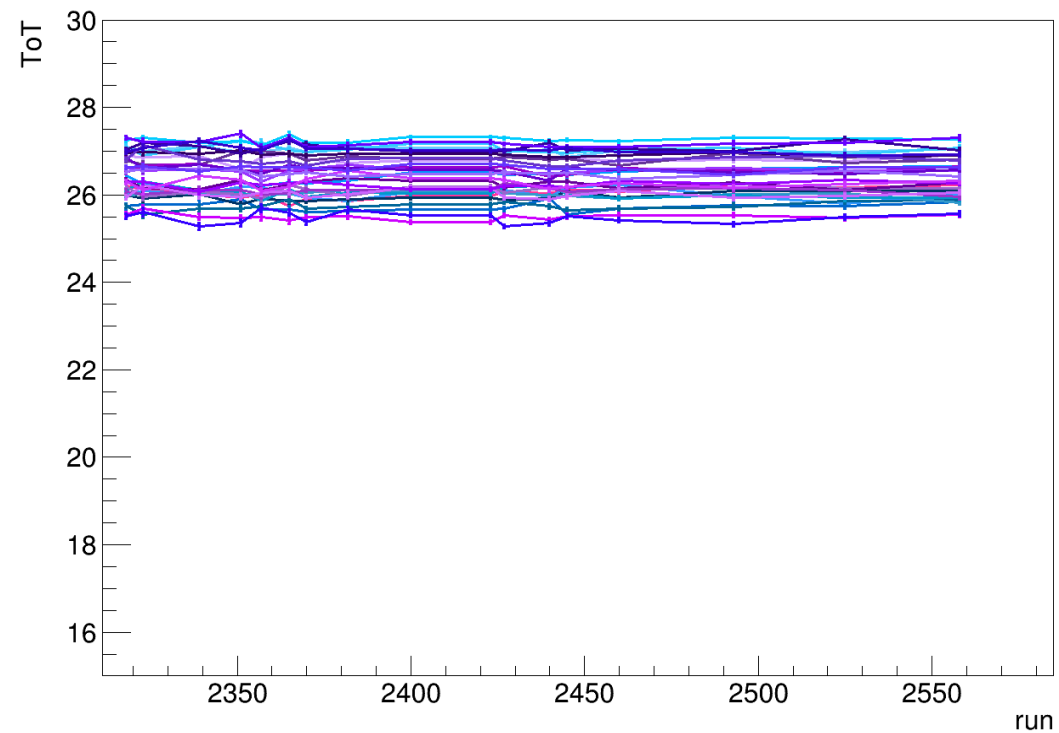
Black PMT: $\Delta\text{toT} \leq -2$

808964815



DOM 9

808982018



ALL GREEN

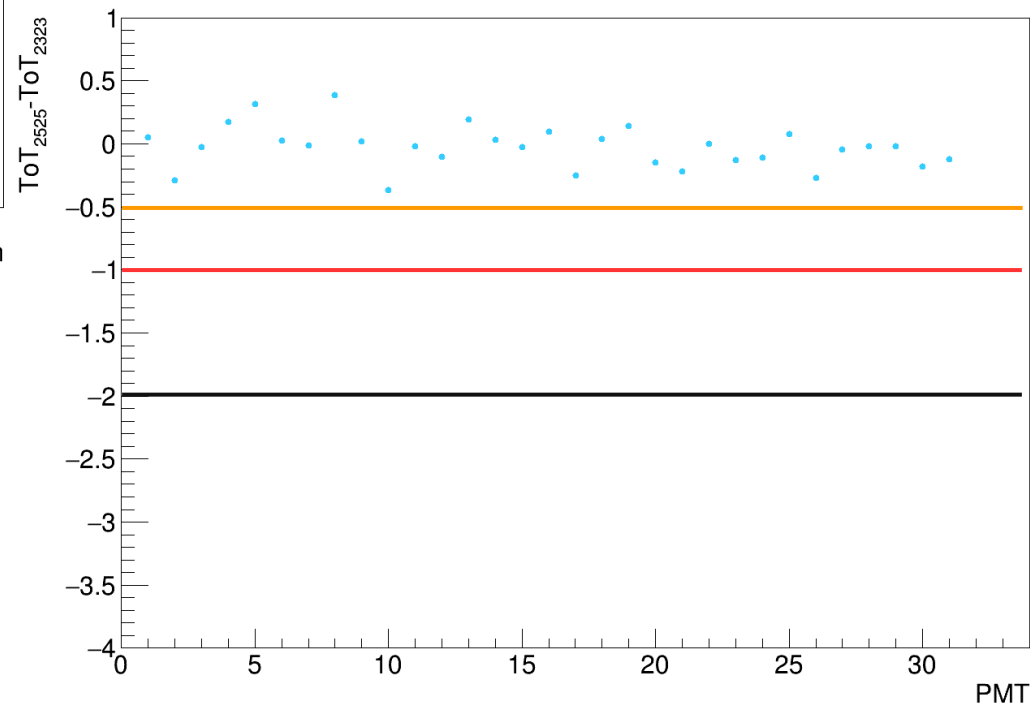
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{toT} \leq -1$

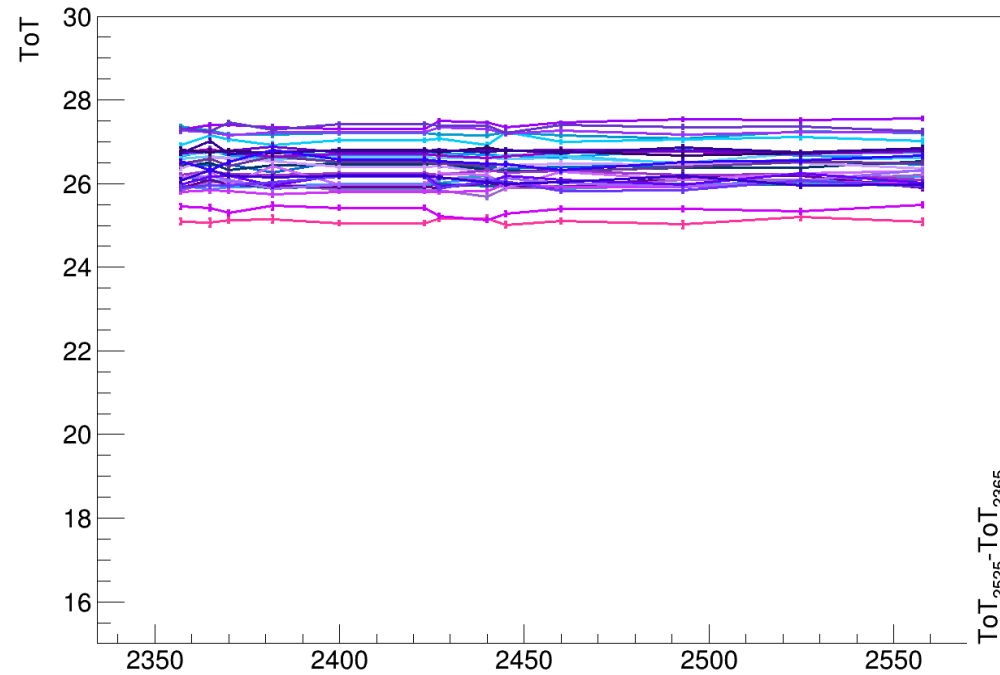
Black PMT: $\Delta\text{toT} \leq -2$

808982018



DOM 10

808979721



Green PMT: $\Delta\text{toT} \geq -0.5$

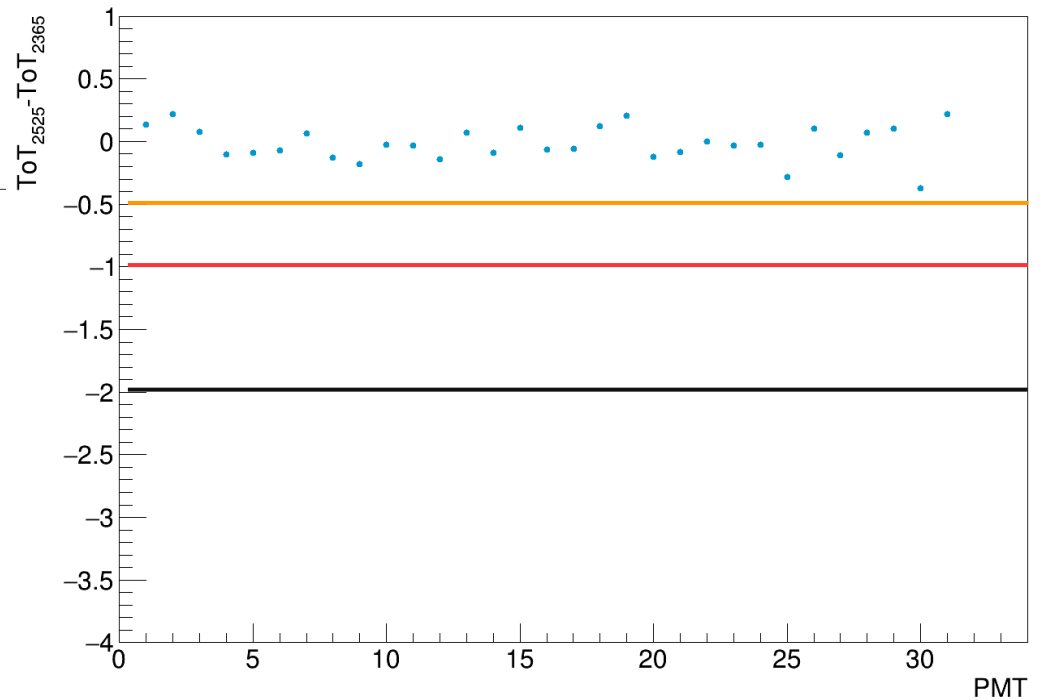
Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{toT} \leq -1$

Black PMT: $\Delta\text{toT} \leq -2$

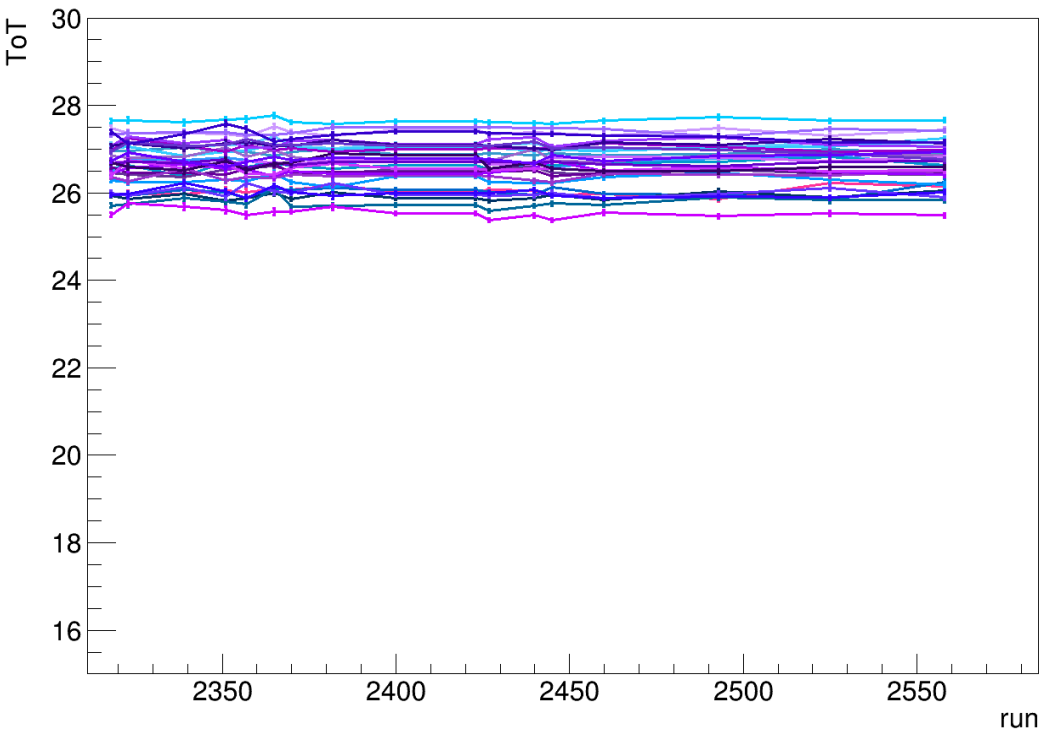
ALL GREEN

808979721



DOM 11

809007627



ALL GREEN

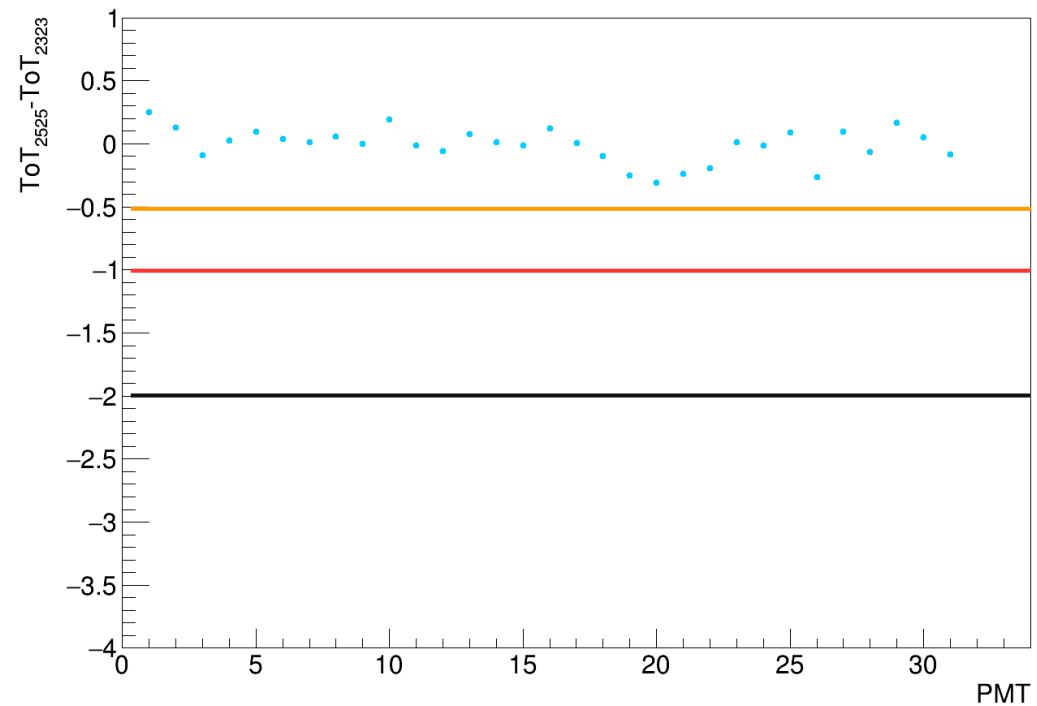
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

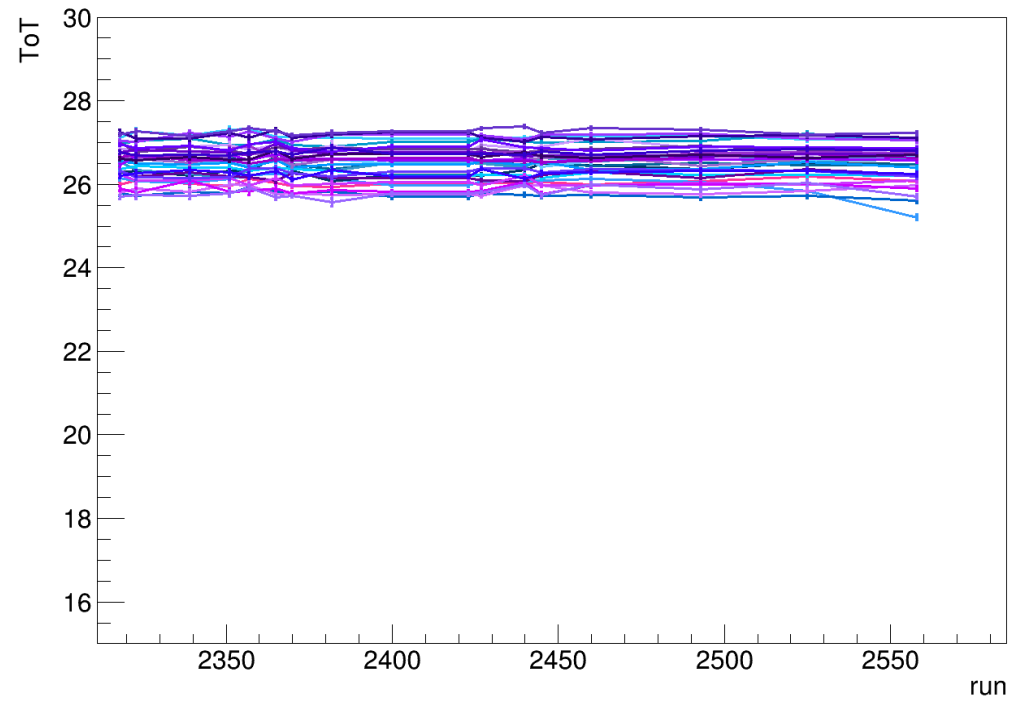
Black PMT: $\Delta\text{ToT} \leq -2$

809007627



DOM 12

809503416



ALL GREEN

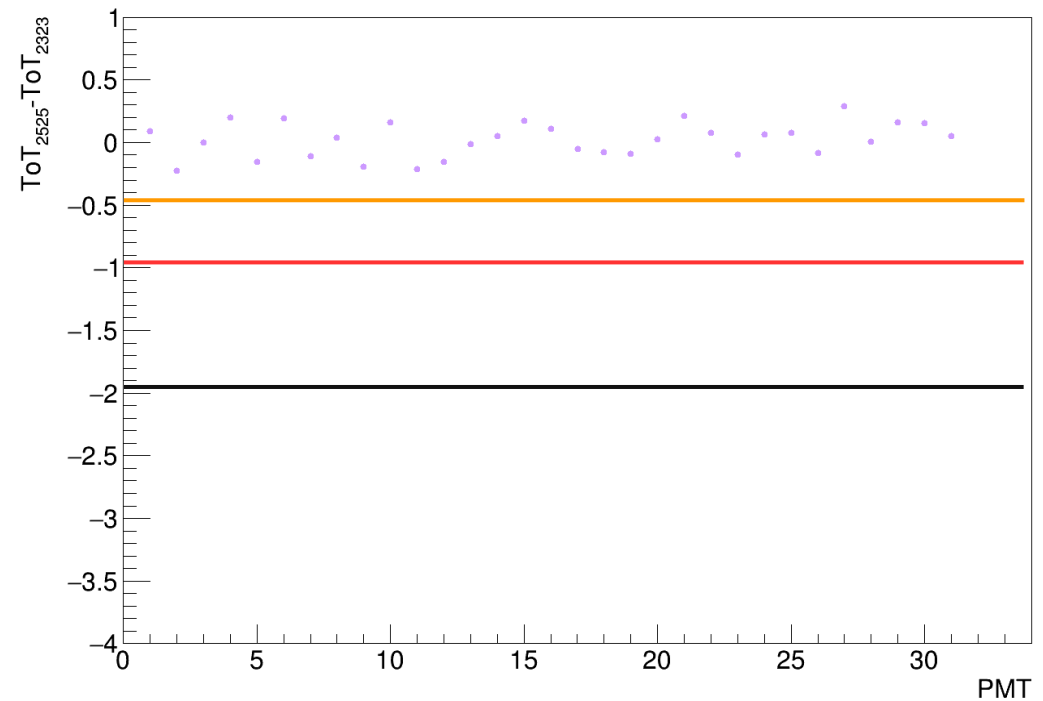
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

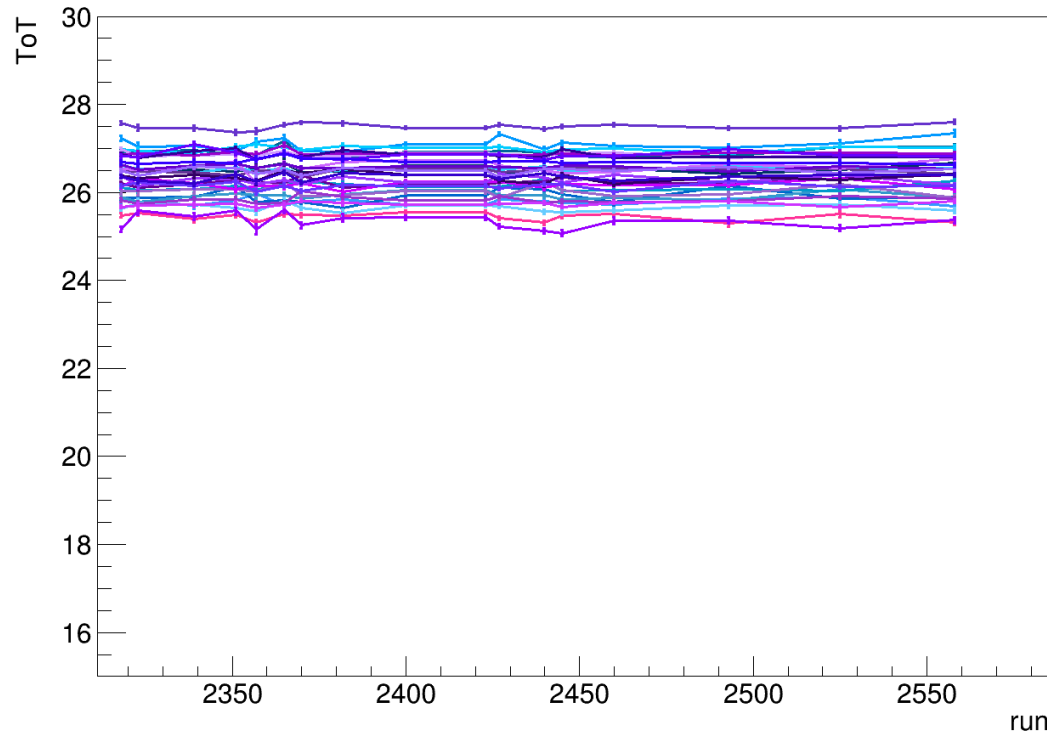
Black PMT: $\Delta\text{ToT} \leq -2$

809503416



DOM 13

808489014



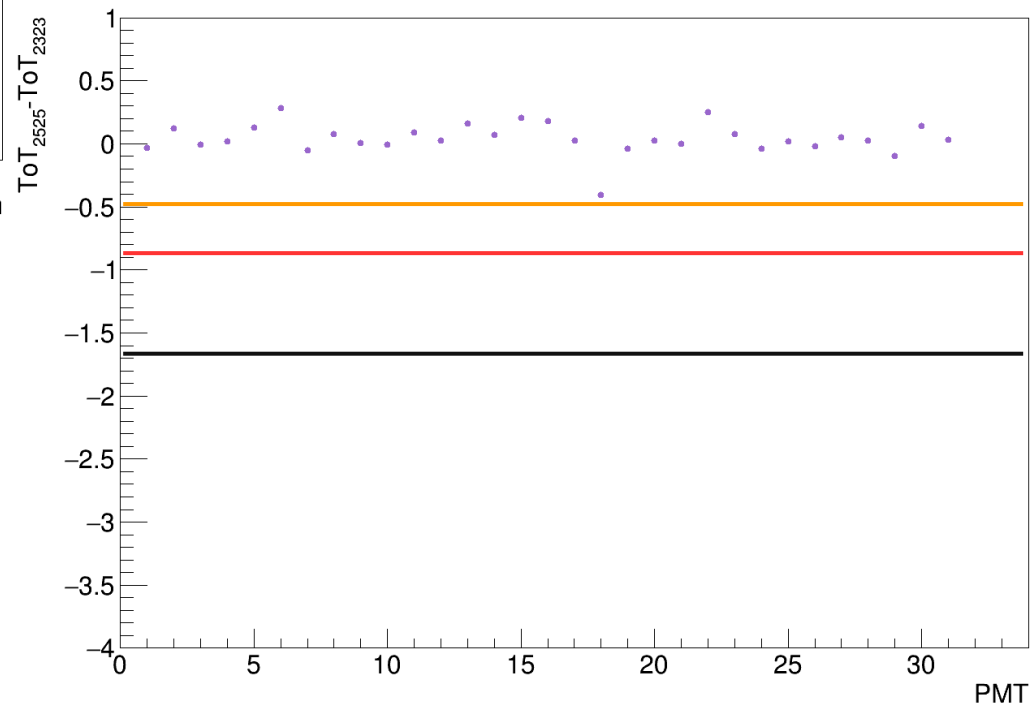
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

Black PMT: $\Delta\text{ToT} \leq -2$

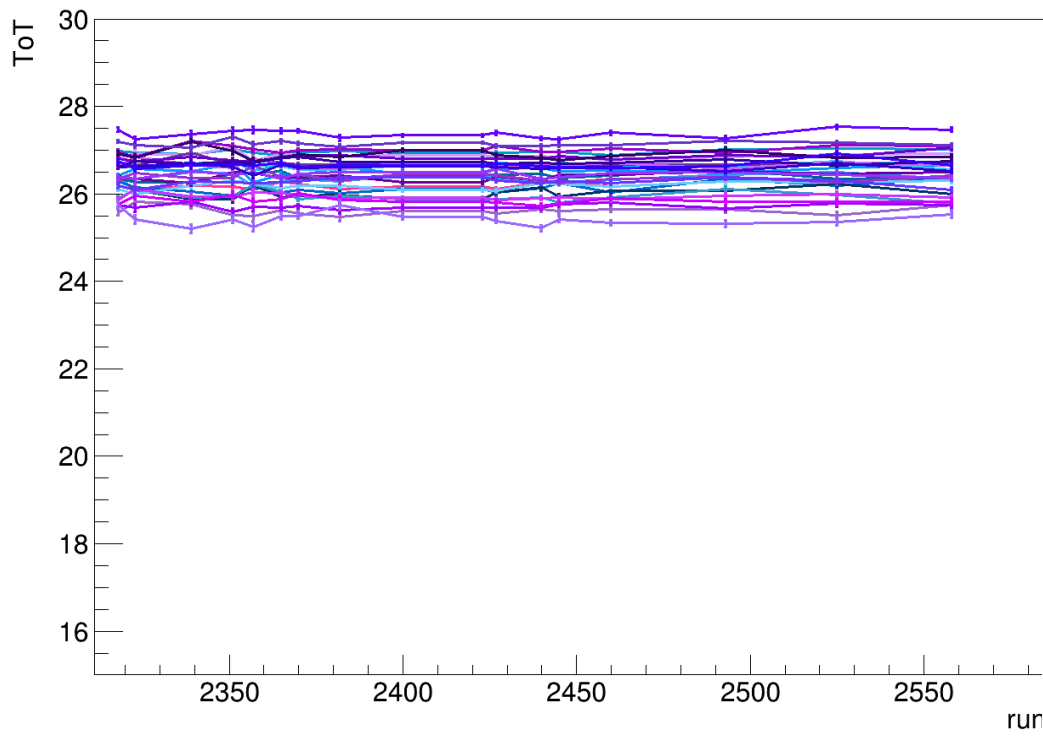
808489014



ALL GREEN

DOM 14

808997793



Green PMT: $\Delta\text{toT} \geq -0.5$

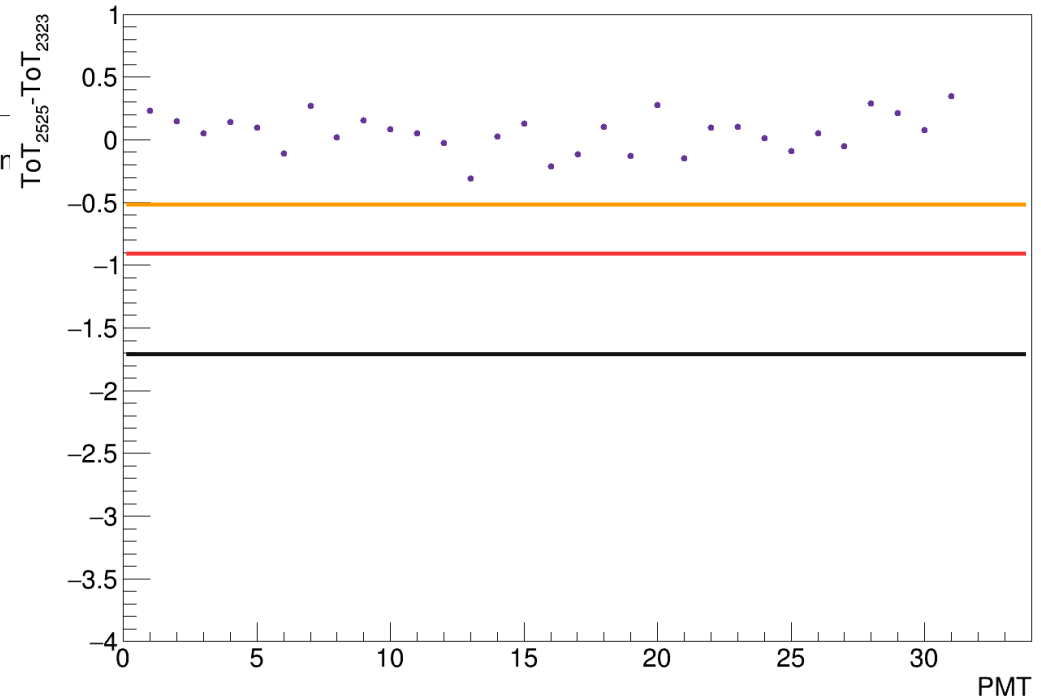
Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

Black PMT: $\Delta\text{ToT} \leq -2$

ALL GREEN

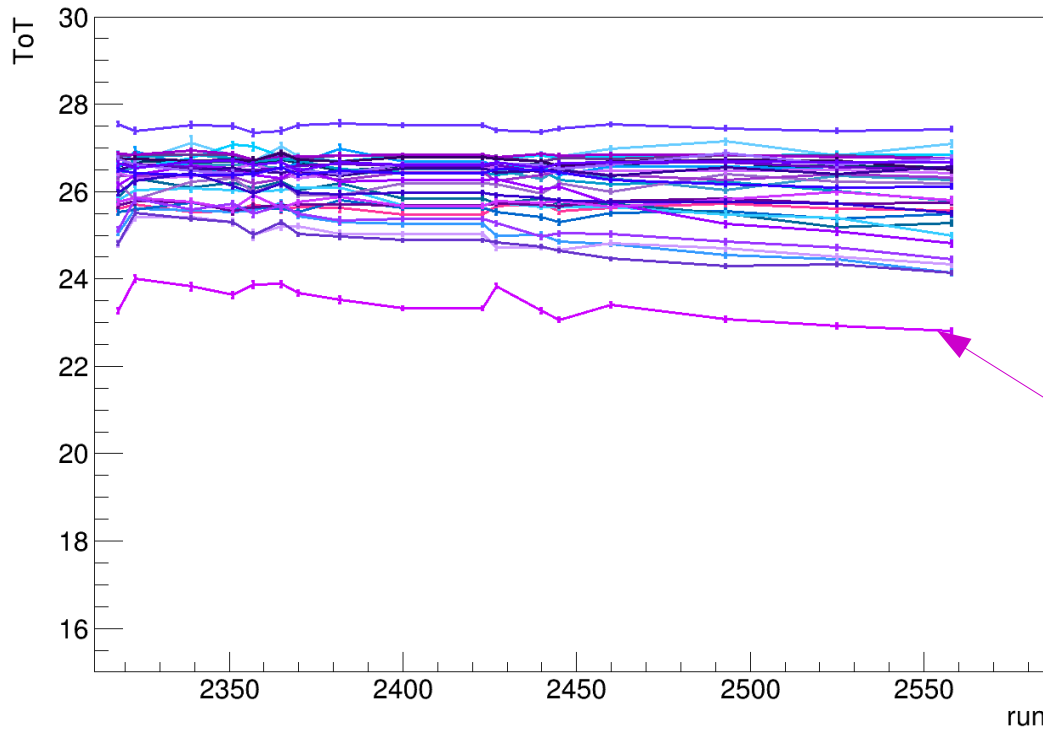
808997793



PMT

DOM 15

808992657



Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

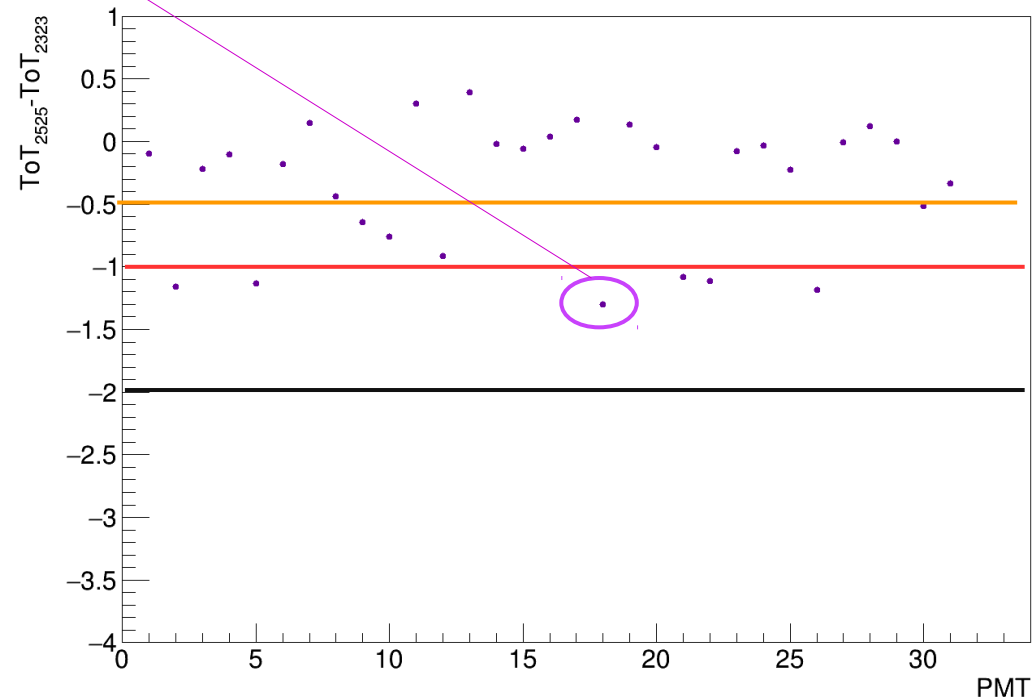
Red PMT: $-2 < \Delta\text{ToT} \leq -1$

Black PMT: $\Delta\text{ToT} \leq -2$

4 Orange PMT:
PMT9, PMT10, PMT12,
PMT30

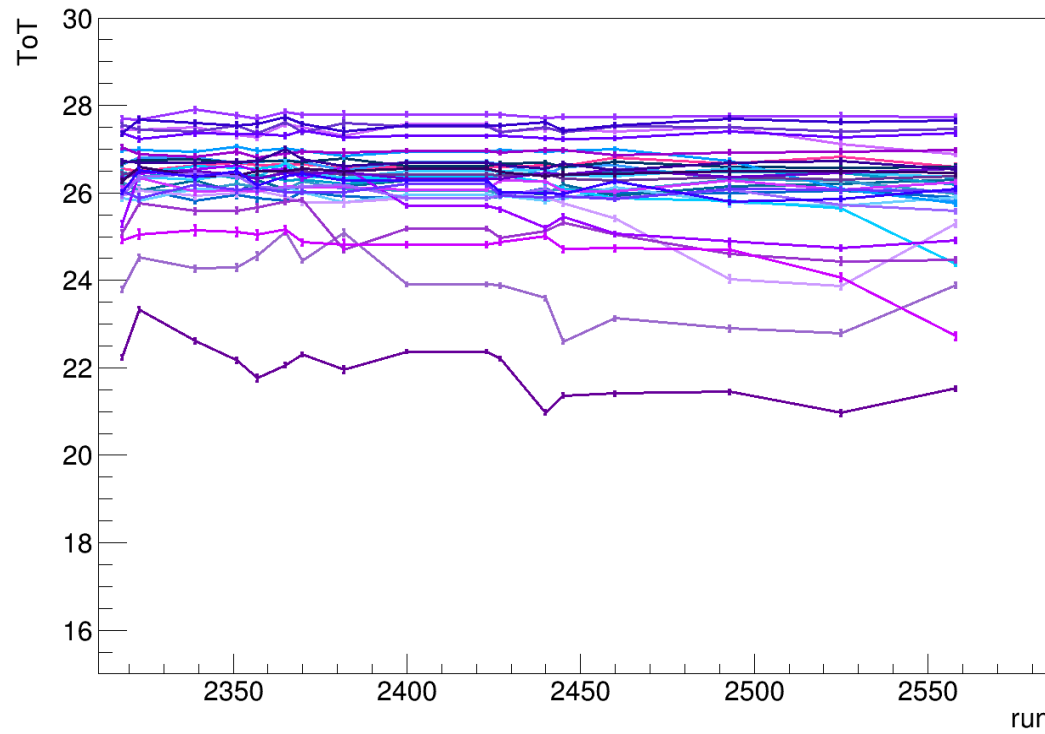
6 Red PMT:
PMT2, PMT5, PMT18,
PMT21, PMT22, PMT26

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DOM 16

808488997



2 Red PMT:
PMT12,PMT15,PMT26

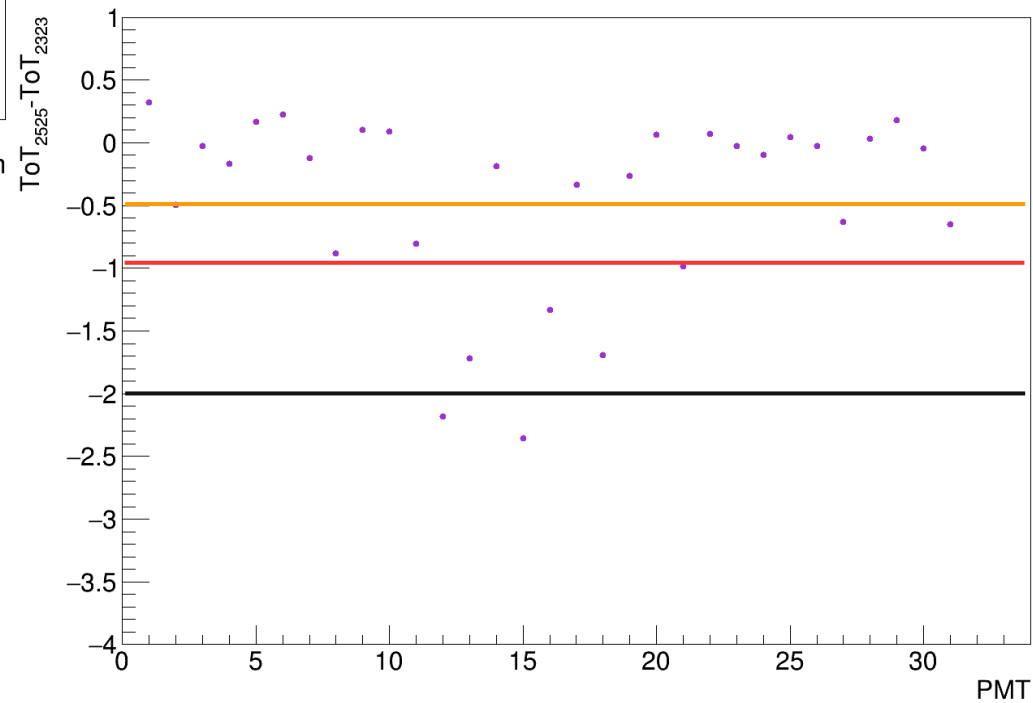
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{toT} \leq -1$

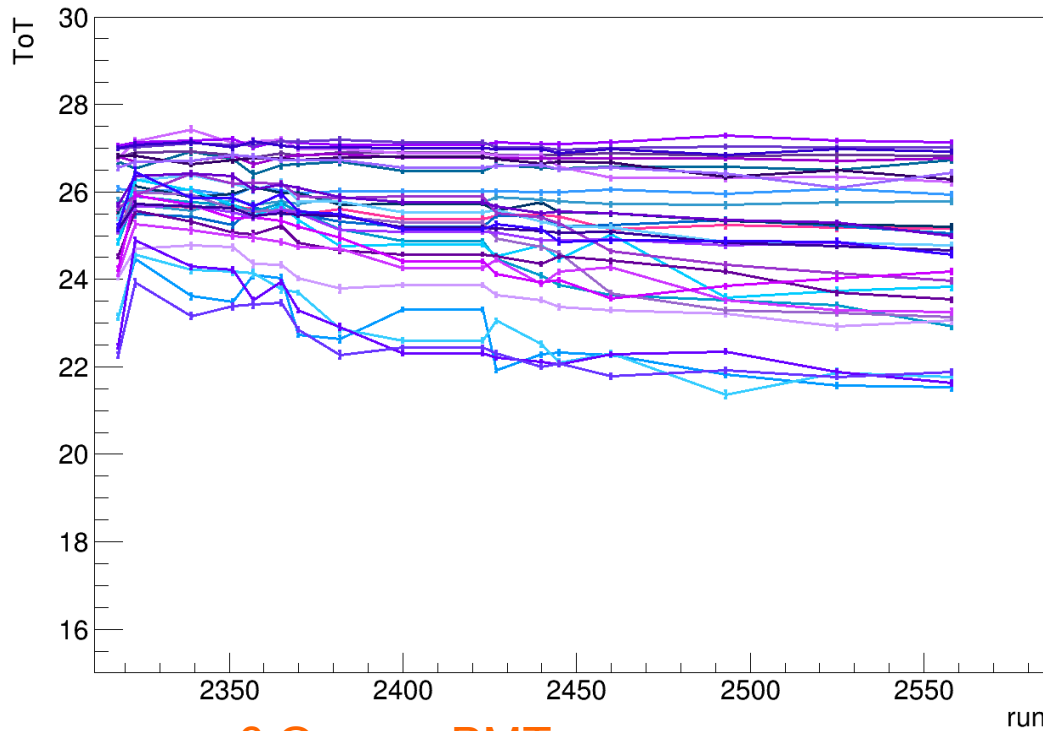
Black PMT: $\Delta\text{toT} \leq -2$

808488997



DOM 17

809526097



Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

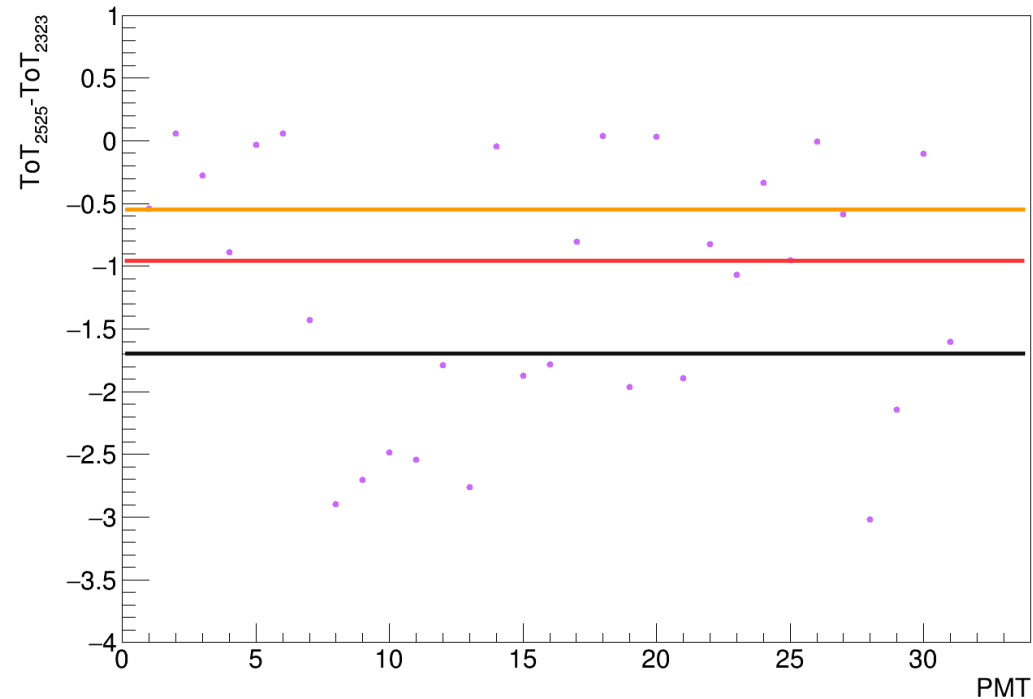
Black PMT: $\Delta\text{ToT} \leq -2$

6 Orange PMT:
PMT1, PMT4, PMT17,
PMT22, PMT25, PMT27

8 Red PMT:
PMT7, PMT12, PMT15,
PMT16, PMT19, PMT21,
PMT23, PMT31

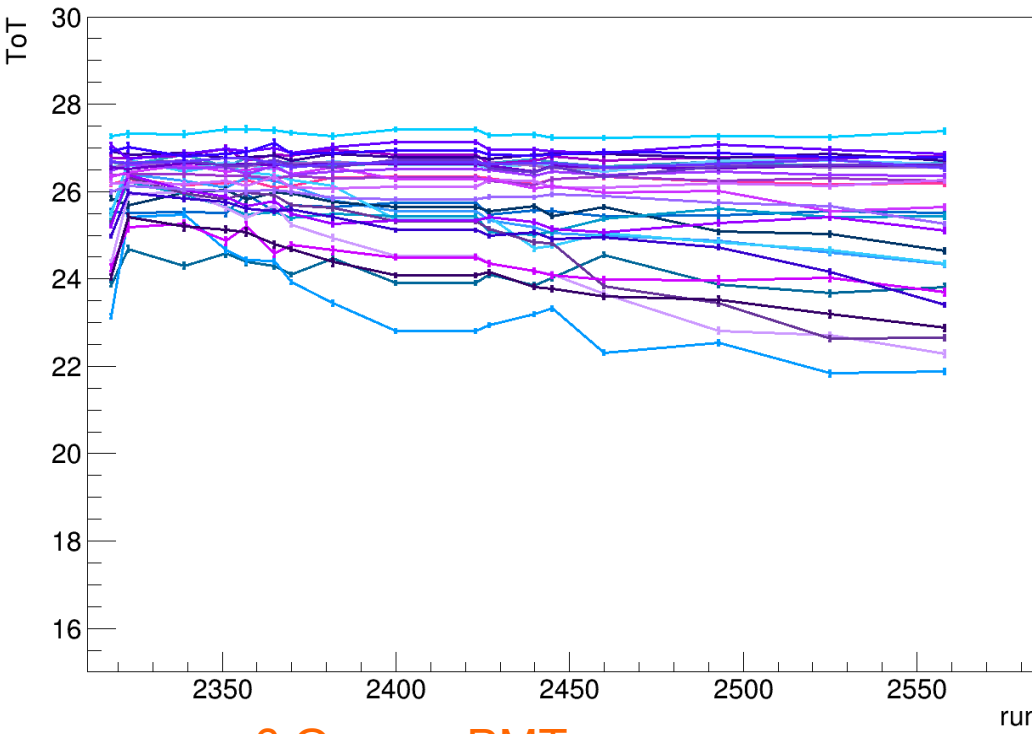
7 Black PMT:
PMT8, PMT9, PMT10, PMT11,
PMT13, PMT28, PMT29

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DOM 18

808432835



Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

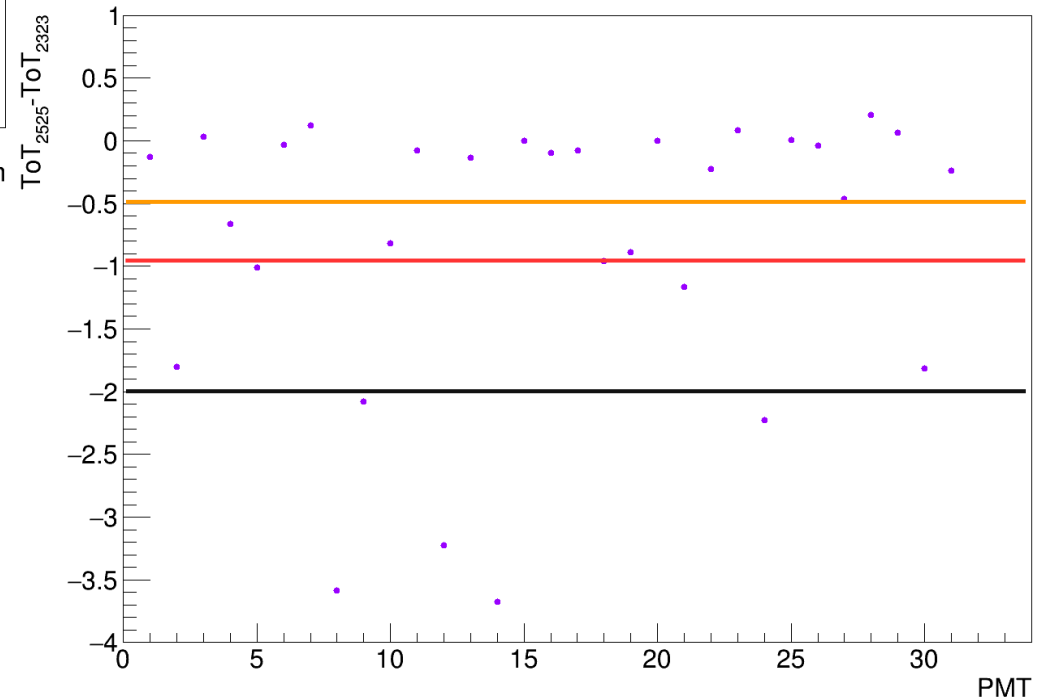
Black PMT: $\Delta\text{ToT} \leq -2$

6 Orange PMT:
PMT1, PMT4, PMT17,
PMT22, PMT25, PMT27

8 Red PMT:
PMT7, PMT12, PMT15,
PMT16, PMT19, PMT21,
PMT23, PMT31

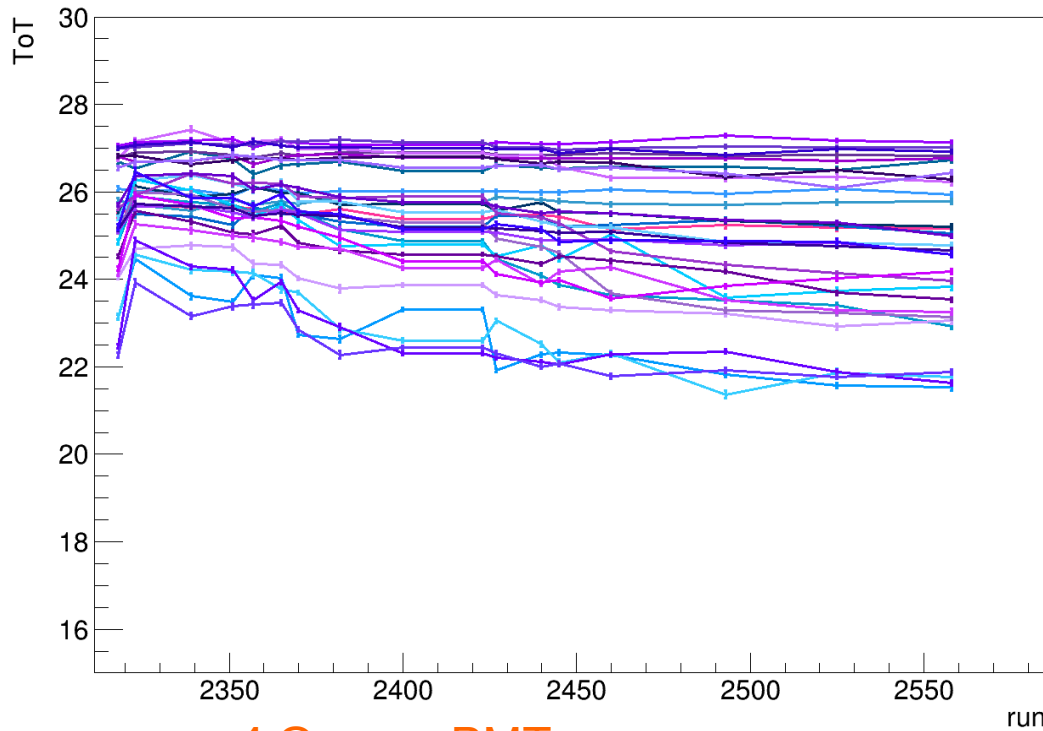
7 Black PMT:
PMT8, PMT9, PMT10, PMT11,
PMT13, PMT28, PMT29

808432835



DOM 17

809526097



4 Orange PMT:
PMT4,PMT10,PMT18,
PMT19

4 Red PMT:
PMT2,PMT5,PMT20,
PMT30

5 Black PMT:
PMT8,PMT9,PMT12,
PMT14,PMT24

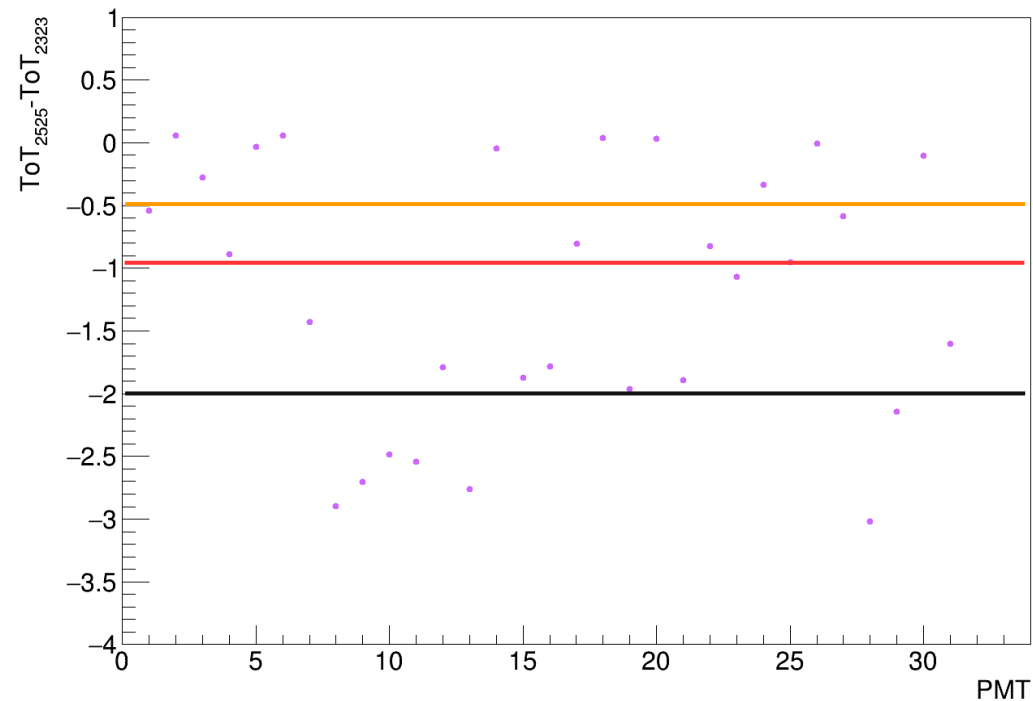
Green PMT: $\Delta\text{toT} \geq -0.5$

Orange PMT: $-1 < \Delta\text{toT} \leq -0.5$

Red PMT: $-2 < \Delta\text{ToT} \leq -1$

Black PMT: $\Delta\text{ToT} \leq -2$

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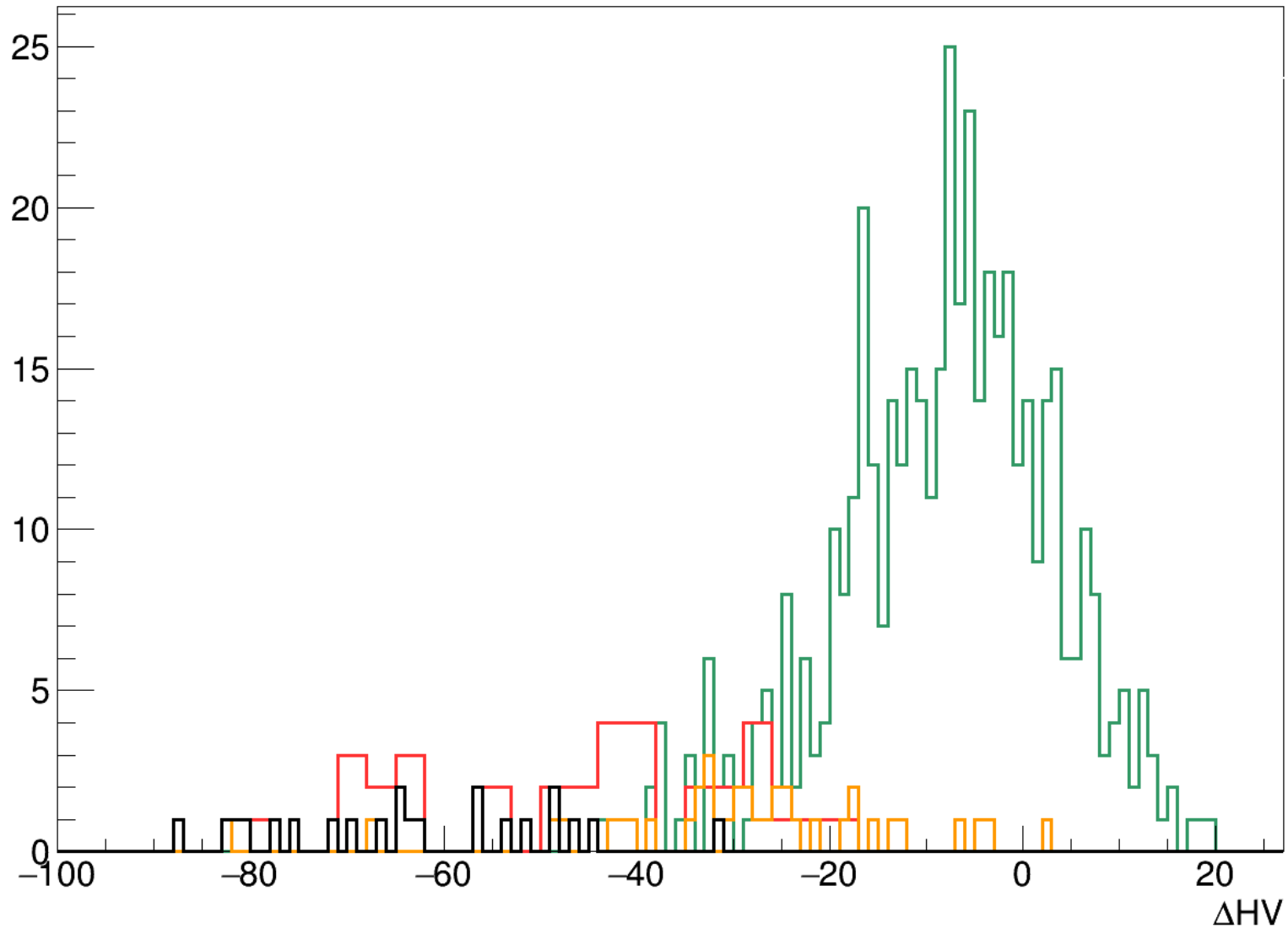


Results

DOM	Orange	Red	Black	Green	
1	3	2	0	26	Catania "New"
2	1	5	3	22	
3	5	2	0	24	
4	4	4	3	20	
5	5	2	2	22	
6	1	0	0	30	
7	0	0	0	31	Napoli "New"
8	1	0	0	30	
9	0	0	0	31	
10	0	0	0	31	
11	0	0	0	31	
12	0	0	0	31	
13	0	0	0	31	Napoli "Old"
14	0	0	0	31	
15	4	6	0	21	
16	5	3	2	21	Catania "Old"
17	6	8	7	10	
18	4	4	5	18	

Results: $HV_{\text{tuned}} - HV_{\text{seateduned}}$

ΔHV



Conclusions

- Decrease rate confirmed
-->Especially in “old PMT”

Green PMT: $\Delta t_o T \geq -0.5$

Orange PMT: $-1 < \Delta t_o T \leq -0.5$

Red PMT: $-2 < \Delta T_o T \leq -1$
































Black PMT: $\Delta T_o T \leq -2$

- Decrease rate different in Catania DOM and Napoli DOM.

- Decrease maybe correleted with the $HV_{\text{tuned}} - HV_{\text{seaturated}}$

Backup Slides

PMT Color Legend

	PMT 1
	PMT 2
	PMT 3
	PMT 4
	PMT 5
	PMT 6
	PMT 7
	PMT 8
	PMT 9
	PMT 10
	PMT 11
	PMT 12
	PMT 13
	PMT 14
	PMT 15
	PMT 16
	PMT 17
	PMT 18
	PMT 19
	PMT 20
	PMT 21
	PMT 22
	PMT 23
	PMT 24
	PMT 25
	PMT 26
	PMT 27
	PMT 28
	PMT 29
	PMT 30
	PMT 31

Means ToT per DOM

