Status on
ECL Trigger Calibration

TRG/DAQ Workshop
@ NTU, Taiwan

YoungJun Kim

KOREA UNIVERSITY 고려대학교 KOREA UNIVERSITY

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Hadron & Nuclear Physics Lab

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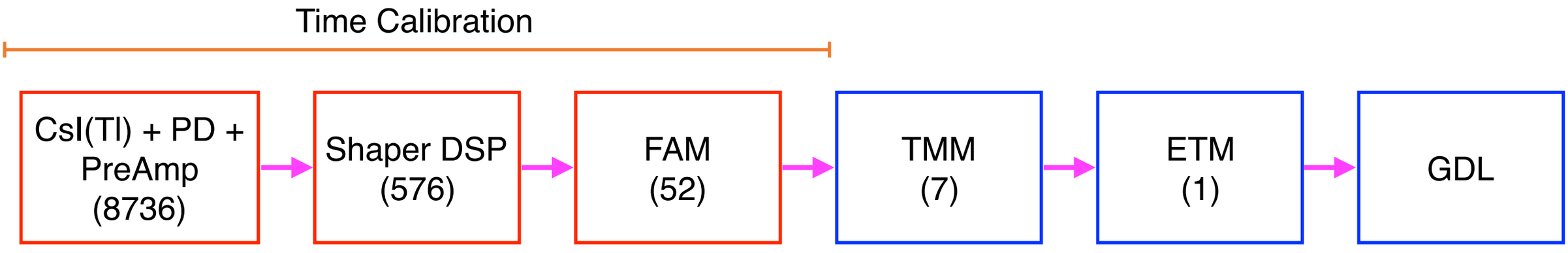
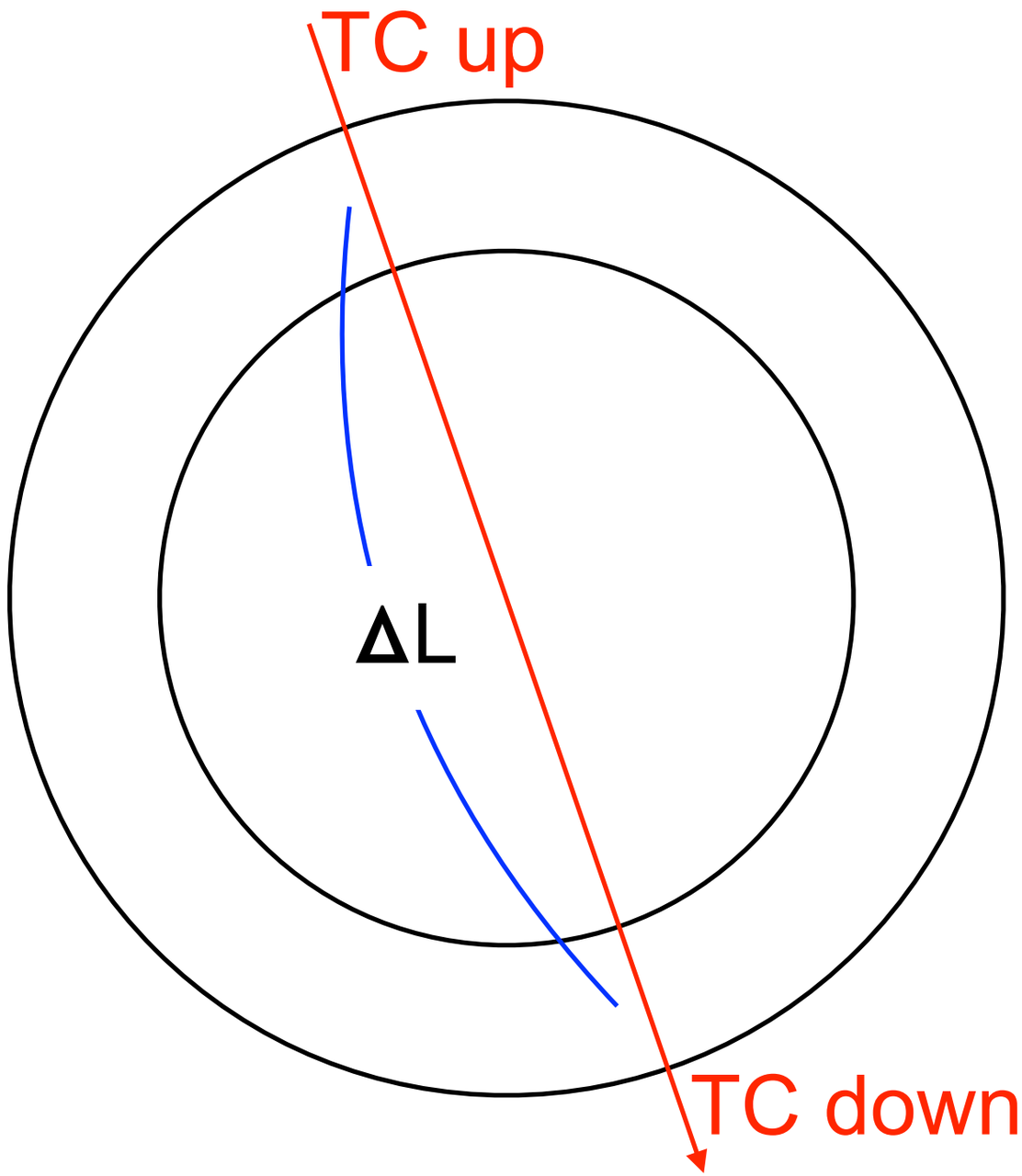
Time Calibration - Overview



- Due to some hardware condition, each channel has different time offset
- Goal is to make a whole TC time offset constants
- Calibration from crystal to FAM

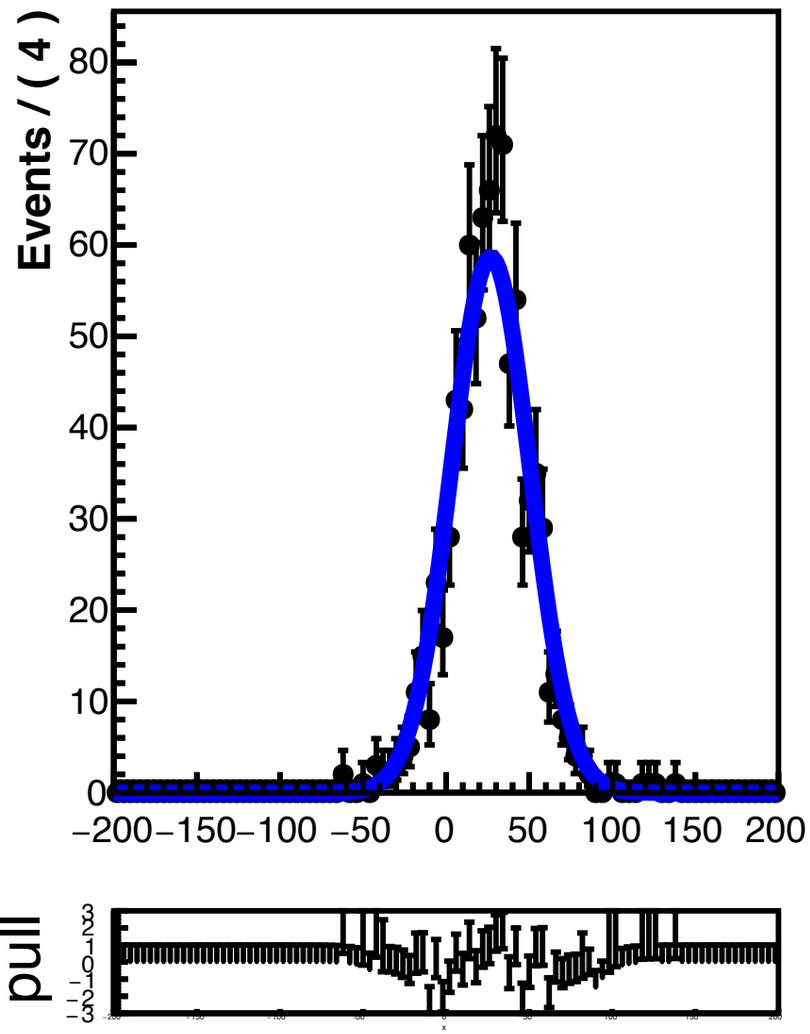
Time Calibration with cosmic ray

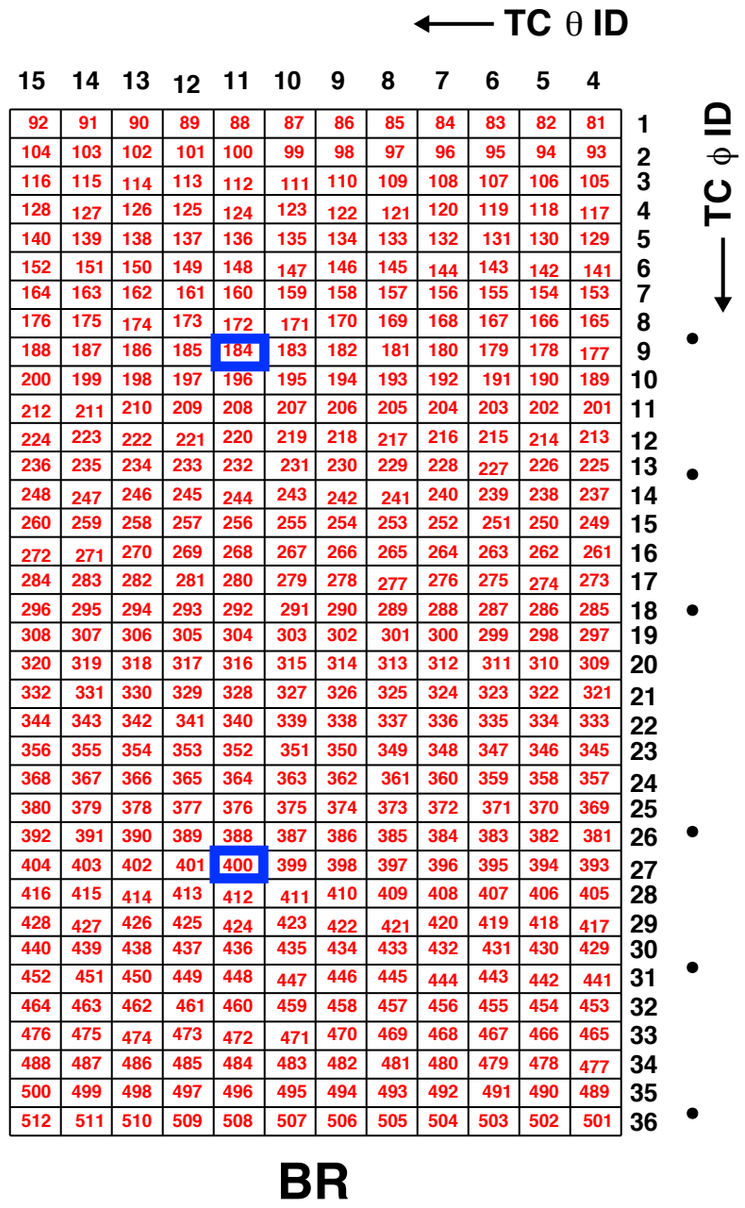


- 2 ≤ # of TC hit ≤ 10
- High energy cut
  - Energy < 300 ADC count (~1GeV)
  - MIP E_{dep} in 30cm CsI(Tl) ~ 170MeV
- TOF correction
  - $(Time_{TC\_down} - Time_{TC\_up}) - TOF$
  - $TOF = \Delta L / c$

※ MIP : Minimum Ionizing Particle
TOF : Time Of Flight

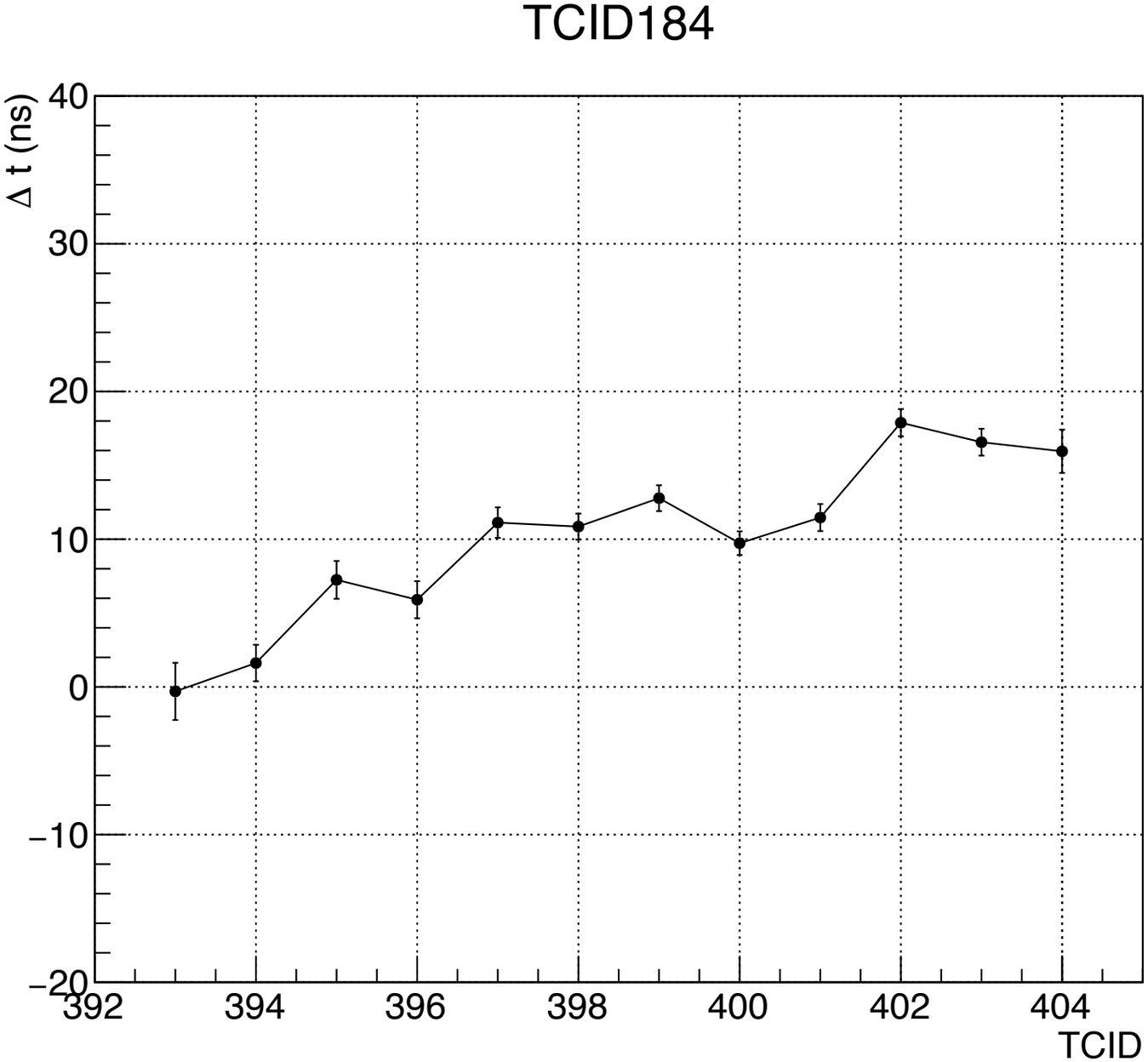
Estimation of the time offset

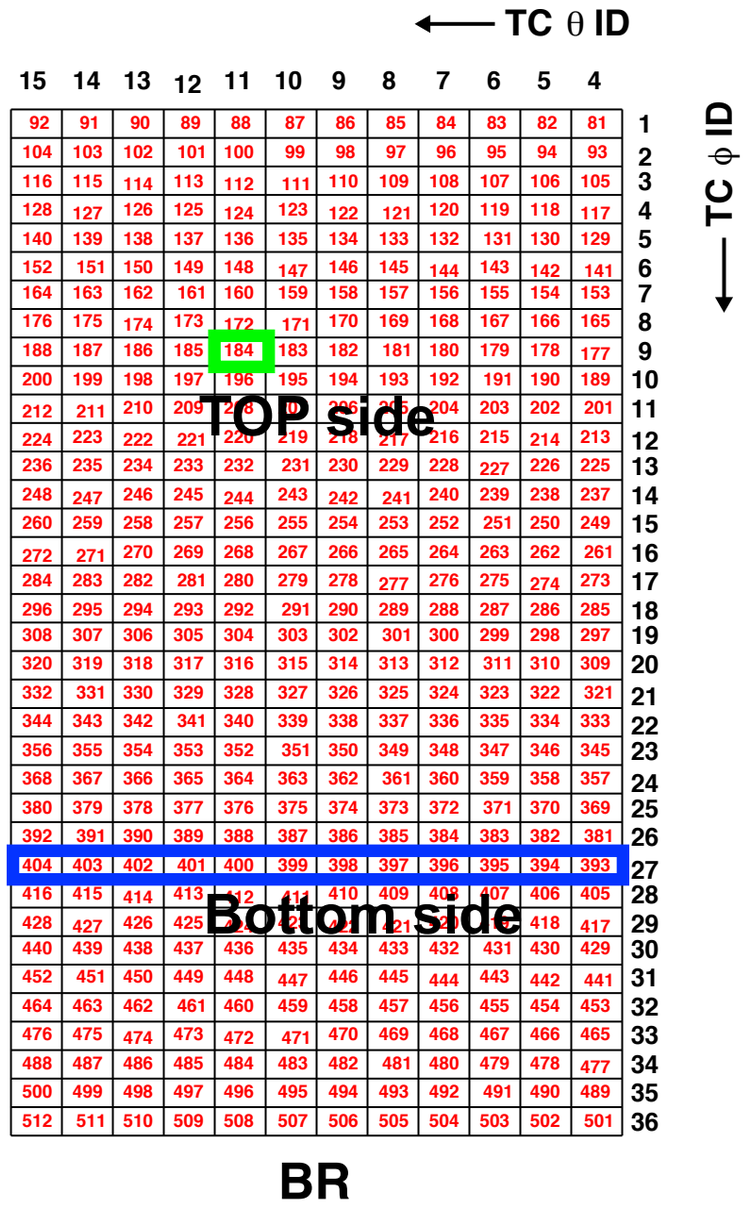




- Total 60M data sample
- An example TC 184-400
- Filling the histogram with $Time_{TC184}$ - ($Time_{TC400}$ - TOF)
- Gaussian Fitting
- Taking mean value & error
- $\Delta t \equiv$ mean value

Time offset - TC184 and ϕ 27





15	14	13	12	11	10	9	8	7	6	5	4	
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104	103	102	101	100	99	98	97	96	95	94	93	2
116	115	114	113	112	111	110	109	108	107	106	105	3
128	127	126	125	124	123	122	121	120	119	118	117	4
140	139	138	137	136	135	134	133	132	131	130	129	5
152	151	150	149	148	147	146	145	144	143	142	141	6
164	163	162	161	160	159	158	157	156	155	154	153	7
176	175	174	173	172	171	170	169	168	167	166	165	8
188	187	186	185	184	183	182	181	180	179	178	177	9
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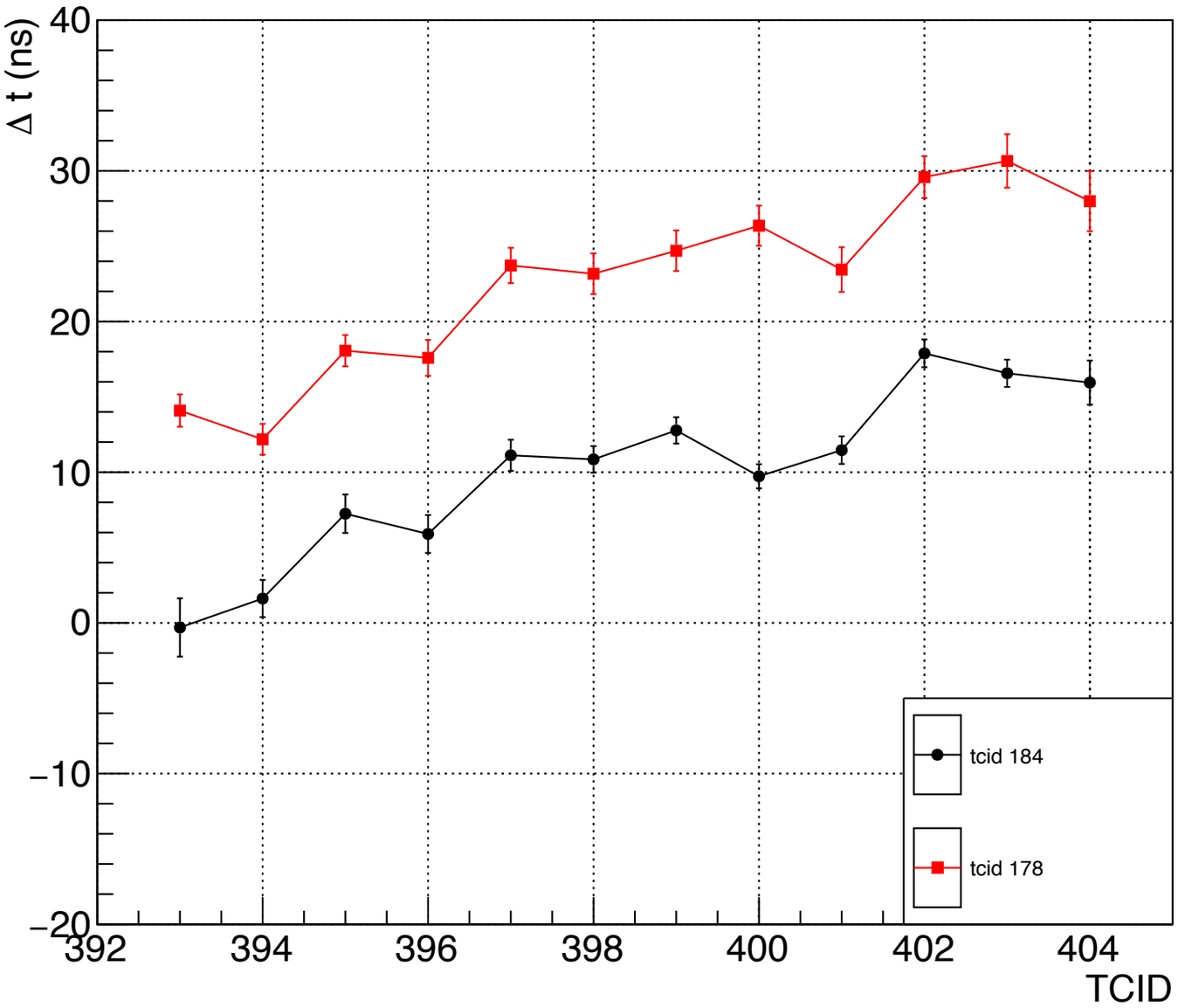
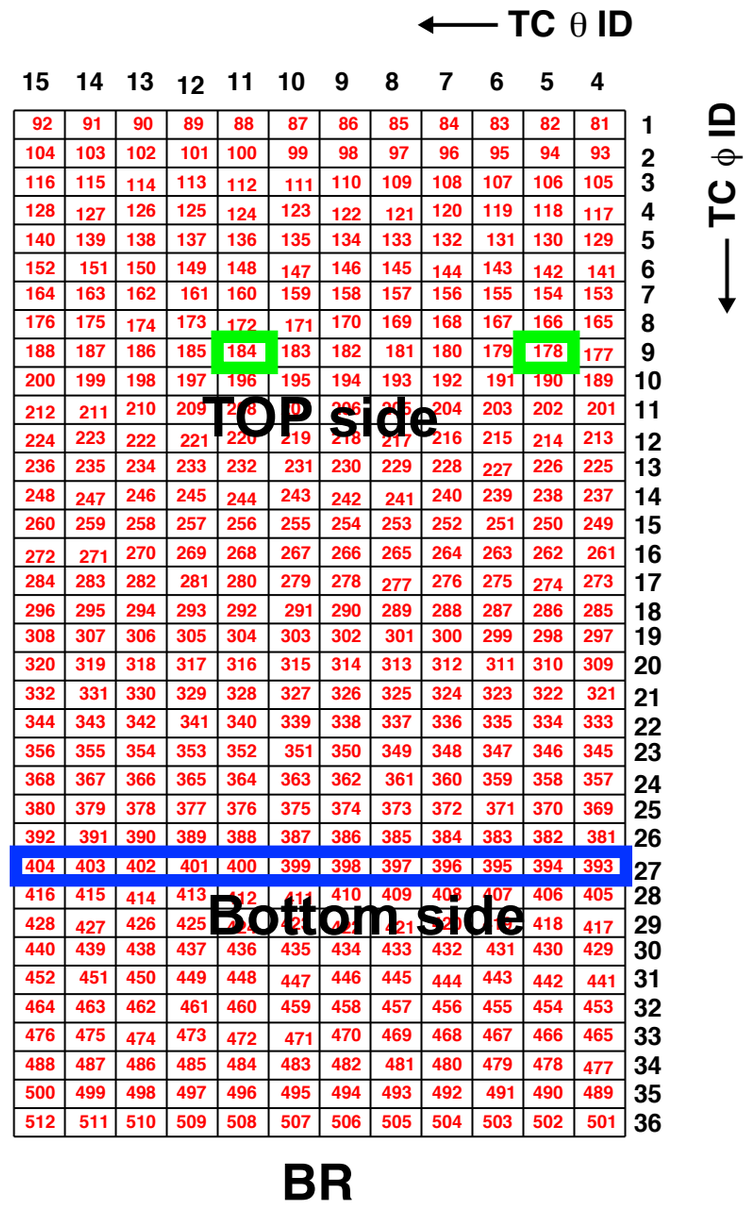
476	475	474	473	472	471	470	469	468	467	466	465	33
488	487	486	485	484	483	482	481	480	479	478	477	34
500	499	498	497	496	495	494	493	492	491	490	489	35
512	511	510	509	508	507	506	505	504	503	502	501	36

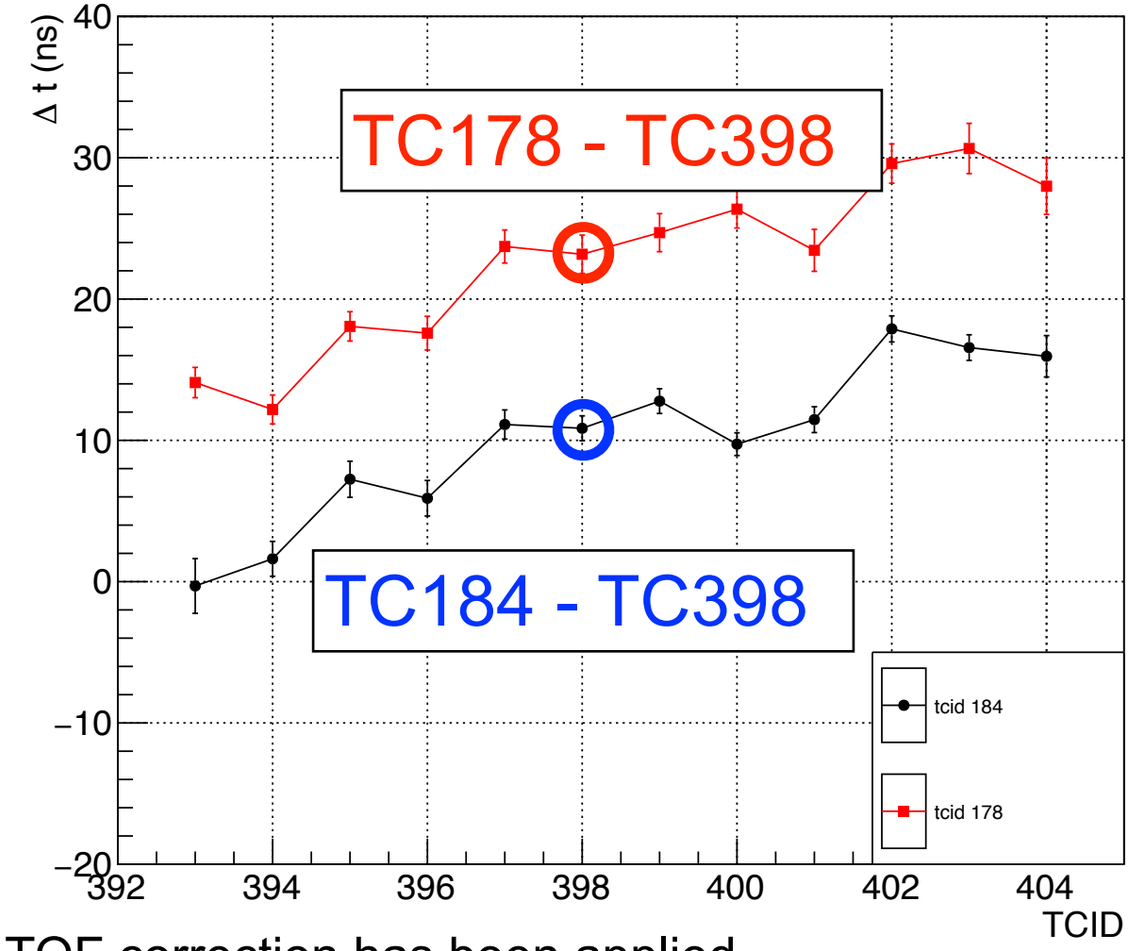
- Y value of each point means mean value of $time_{TC184}$ - $time_{TCID}$ with TOF correction

Time offset - TC178 and ϕ 27

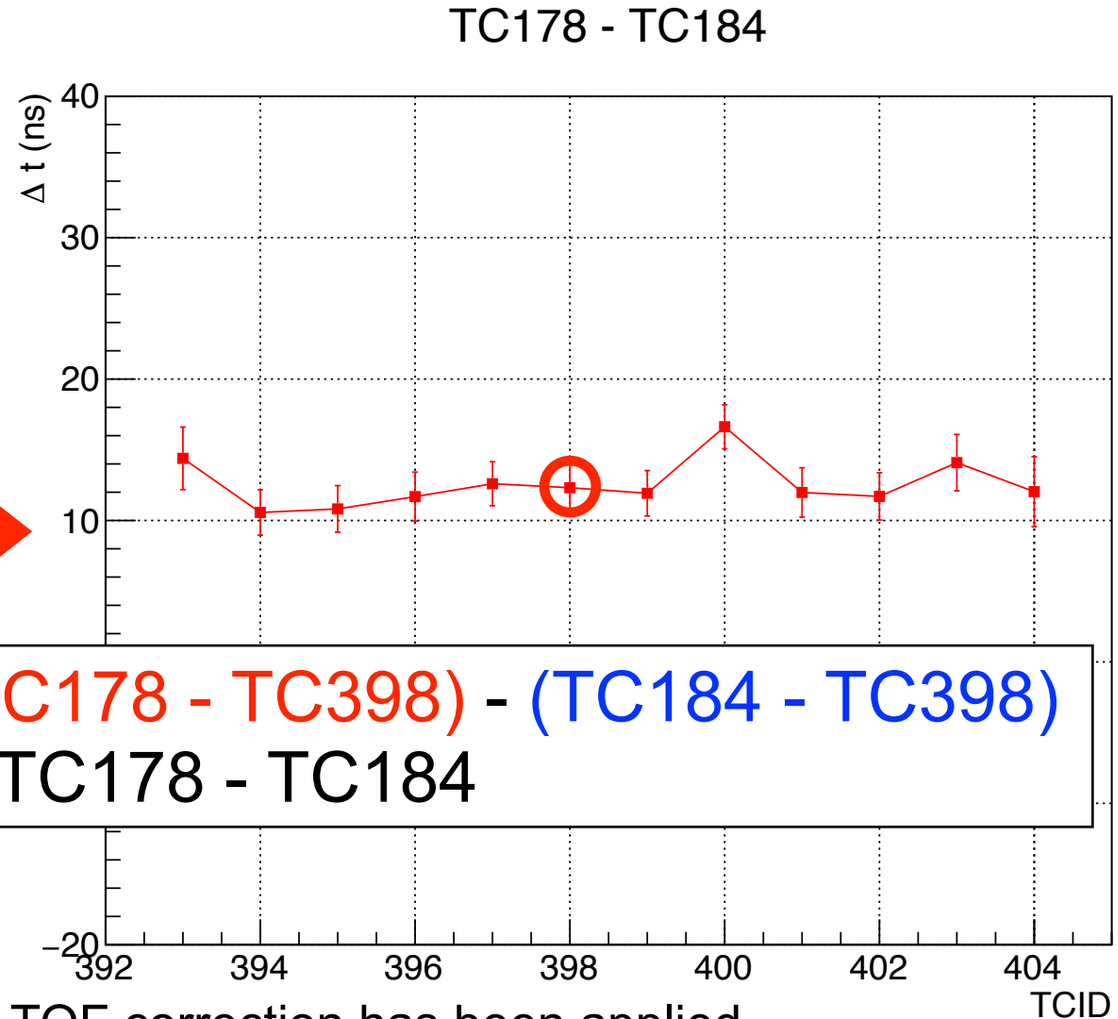




Relative time offset to TC184



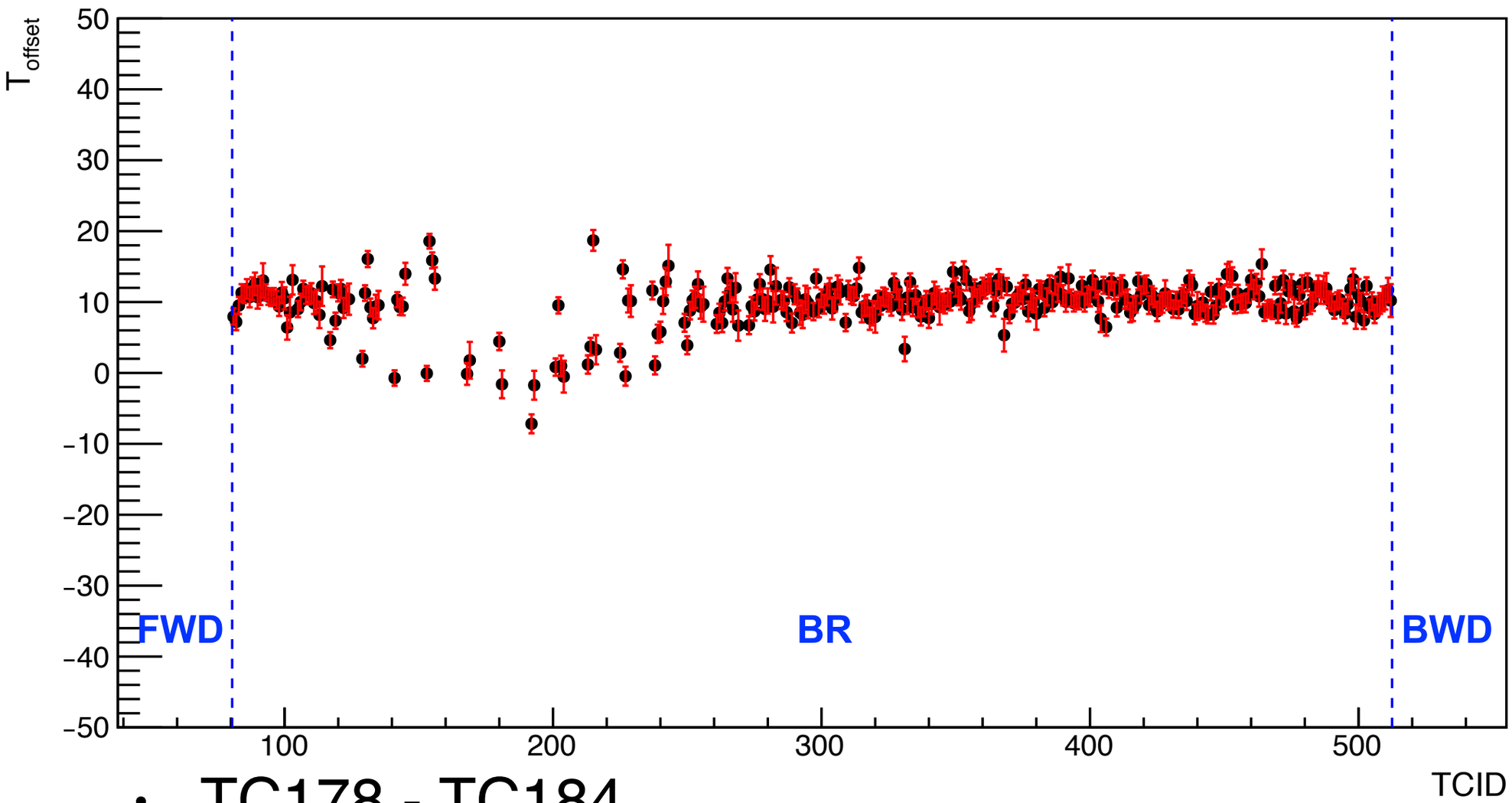
TOF correction has been applied



TOF correction has been applied

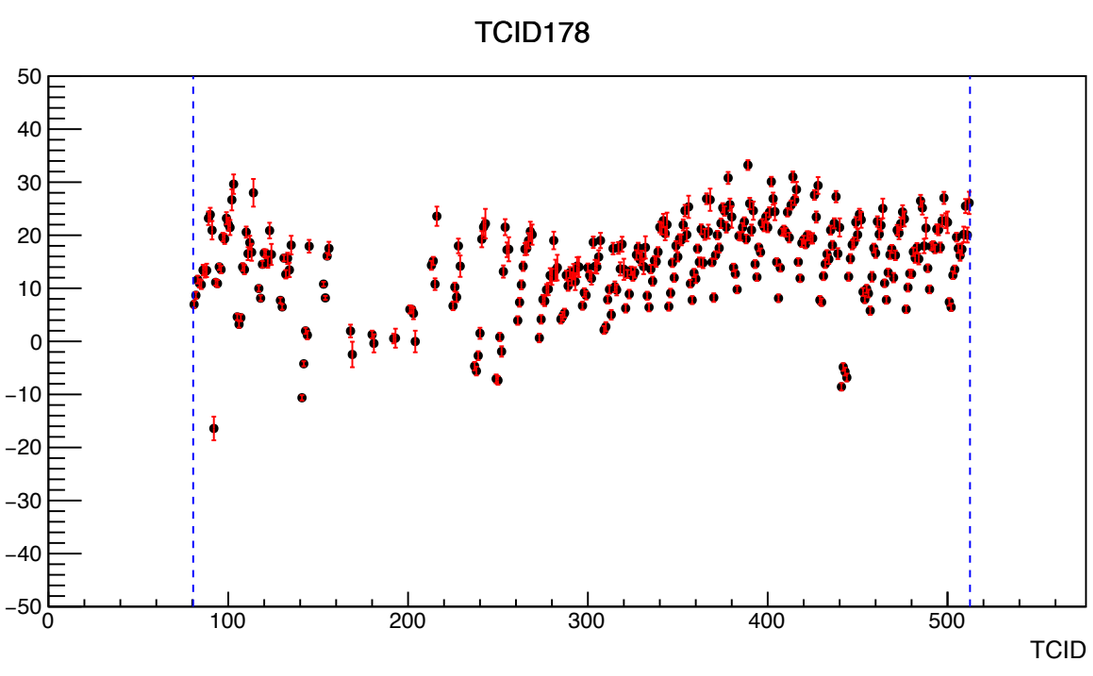
- Time offset relative to TC184
- For the ideal case, each point means TC178 - TC184

Time offset distribution

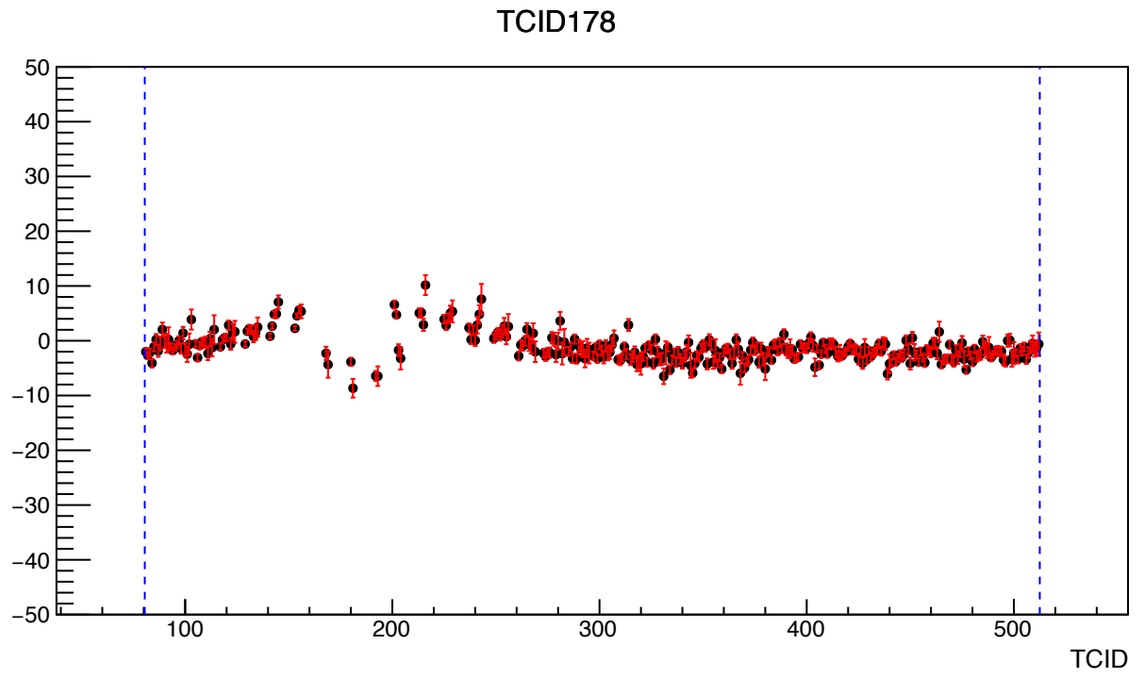


- TC178 - TC184
- # of event > 100 && excluding neighbor TC
- y = p[0], χ2 fitting
- p[0] → time constant of TC178
- Repeat for all TC in barrel side

Time offset with the time constant



Before apply time constant
Only TOF correction applied



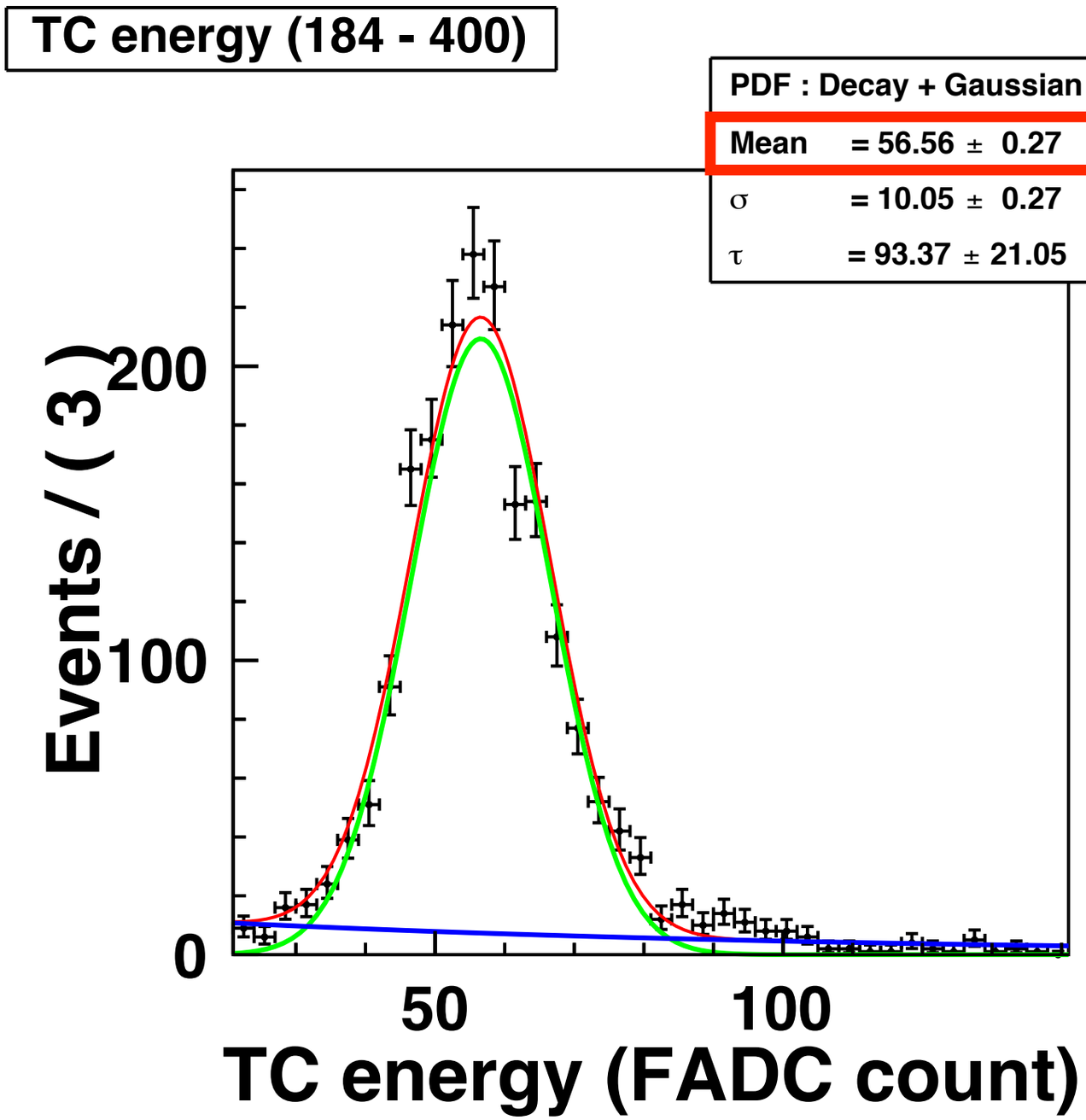
After apply time constant
TOF correction applied

- First version of the time constants is ready
- Left plot : TC178 - each TC
- Right plot : (TC178 - TC178 offset) - (each TC - each TC offset)

Energy Calibration

- Event identification in ETM needs energy information of TC
- We need TC energy deposition to ADC count of FAM conversion factor
- Rough energy calibration has been done, but we need more precise calibration

Rough calibration using cosmic ray



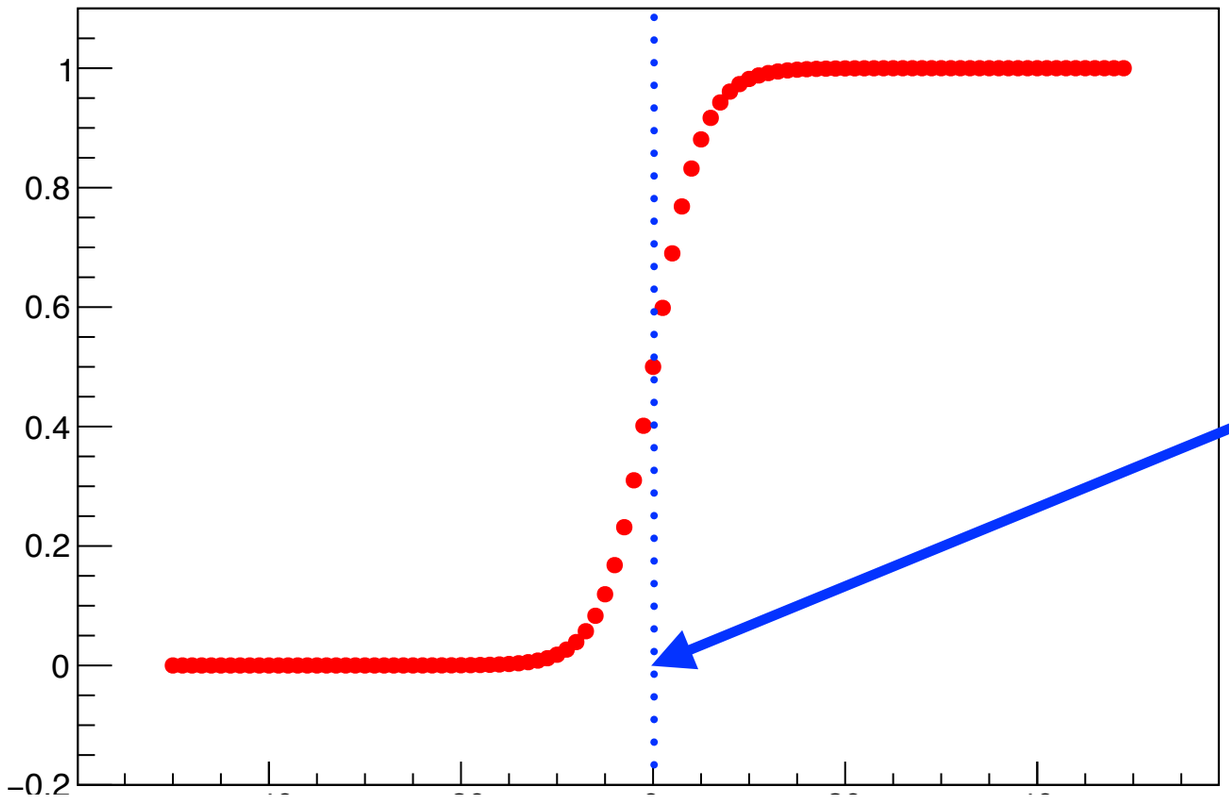
dE/dx for MIP × Crystal length

- **5.610 MeV/cm × 30 cm = 168.3 MeV is equal to Mean**

- We regarded cosmic ray as a MIP
- 1 ADC count corresponds to ~ 3MeV energy deposition

Calibration using ECL data

Expected ratio graph



- Threshold is unit of ADC count of the ECL Trigger
- We can regard the value of this point is same as threshold
- Then we can get Energy to ADC count conversion factor

ratio = # of ECLTRG data / # of ECL data

→ Energy > Threshold

Summary & Plan

- Time Calibration
  - Calibration using cosmic ray - First version of the time constants is ready
  - Applying ECL time calibration algorithm and compare with first version time constant
  - Event timing resolution check with CDC timing information

- Energy Calibration
  - Rough calibration using cosmic ray and future study method
  - Calibration using ECL data

Back up

TCID Map

TC θ ID →

15	14	13	12	11	10	9	8	7	6	5	4	
92	91	90	89	88	87	86	85	84	83	82	81	1
104	103	102	101	100	99	98	97	96	95	94	93	2
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500	499	498	497	496	495	494	493	492	491	490	489	35
512	511	510	509	508	507	506	505	504	503	502	501	36

BR

TC φ ID ↓

17	16	
516	515	1
513	514	2
520	519	3
517	518	4
524	523	5
521	522	6
528	527	7
525	526	8
532	531	9
529	530	10
536	535	11
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544	543	15
541	542	16
548	547	17
545	546	18
552	551	19
549	550	20
556	555	21
553	554	22
560	559	23
557	558	24
564	563	25
561	562	26
568	567	27
565	566	28
572	571	29
569	570	30
576	575	31
573	574	32

BE

θ →

φ ↓

	3	2	1	
1	3	2	1	1
2	4	5		
3	8	7	6	3
4	9	10		
5	13	12	11	5
6	14	15		
7	18	17	16	7
8	19	20		
9	23	22	21	9
10	24	25		
11	28	27	26	11
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18	44	45		
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22	54	55		
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24	59	60		
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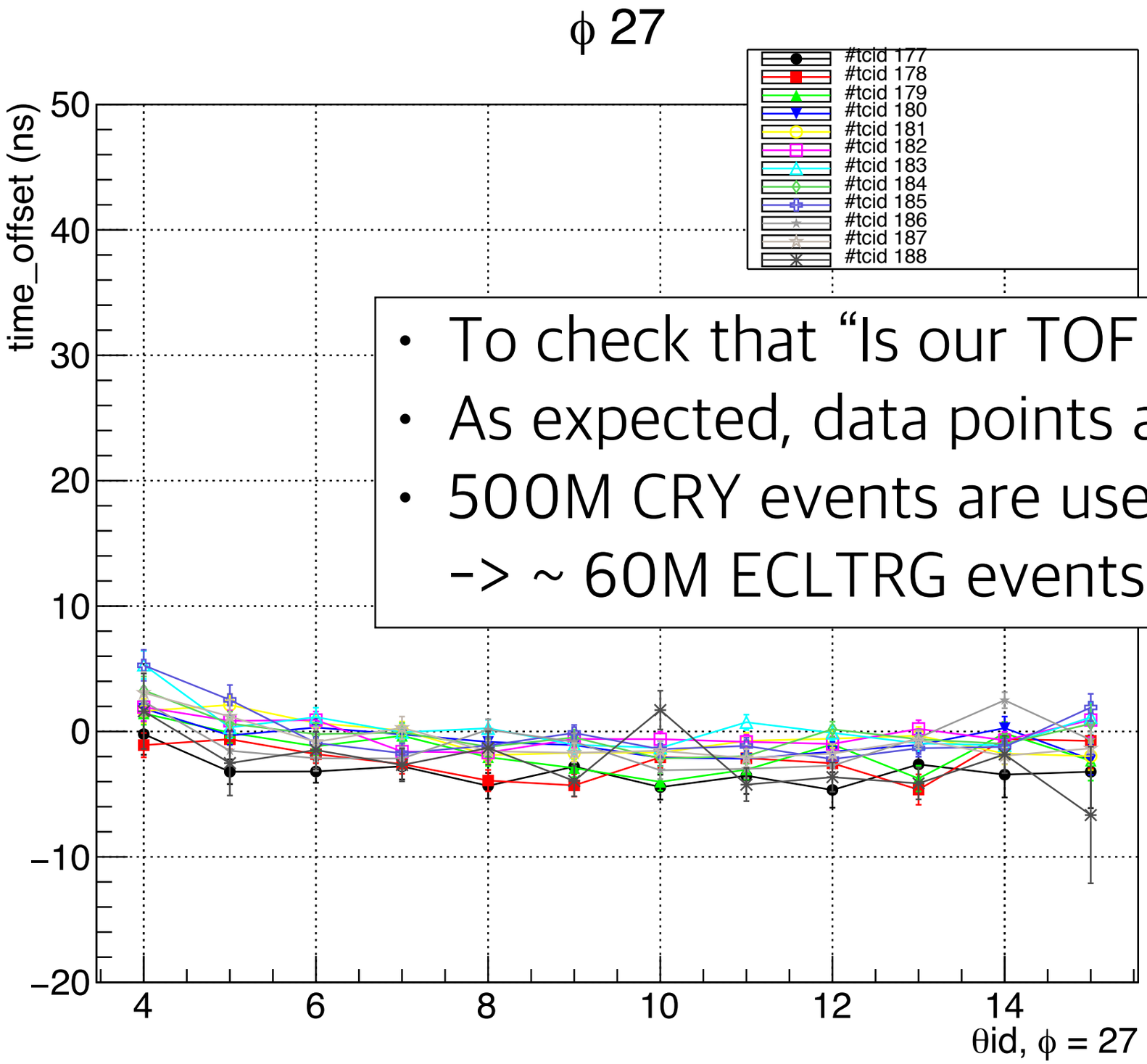
26	64	65		
27	68	67	66	27
28	69	70		
29	73	72	71	29
30	74	75		
31	78	77	76	31
32	79	80		

FE

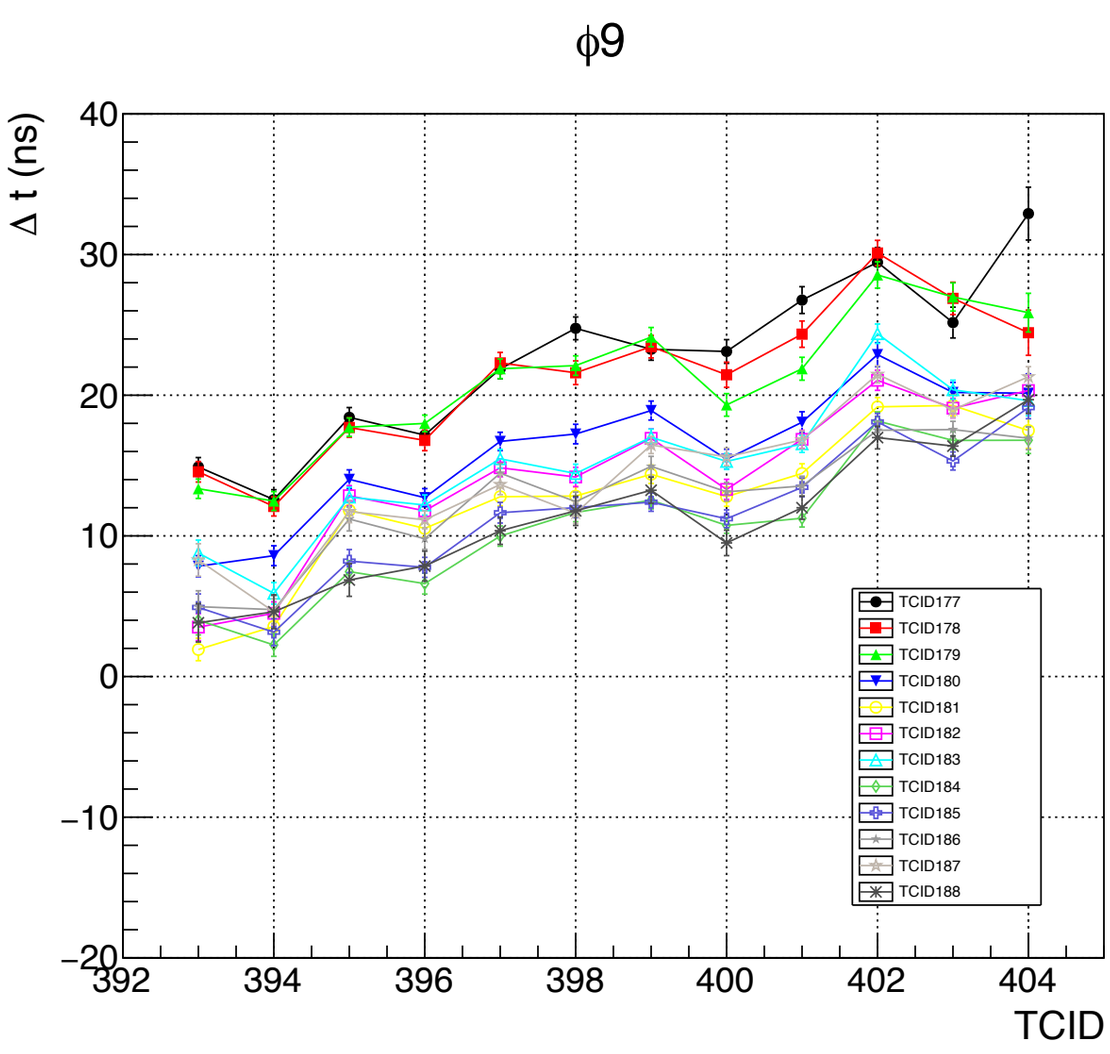
→ z(e^-)

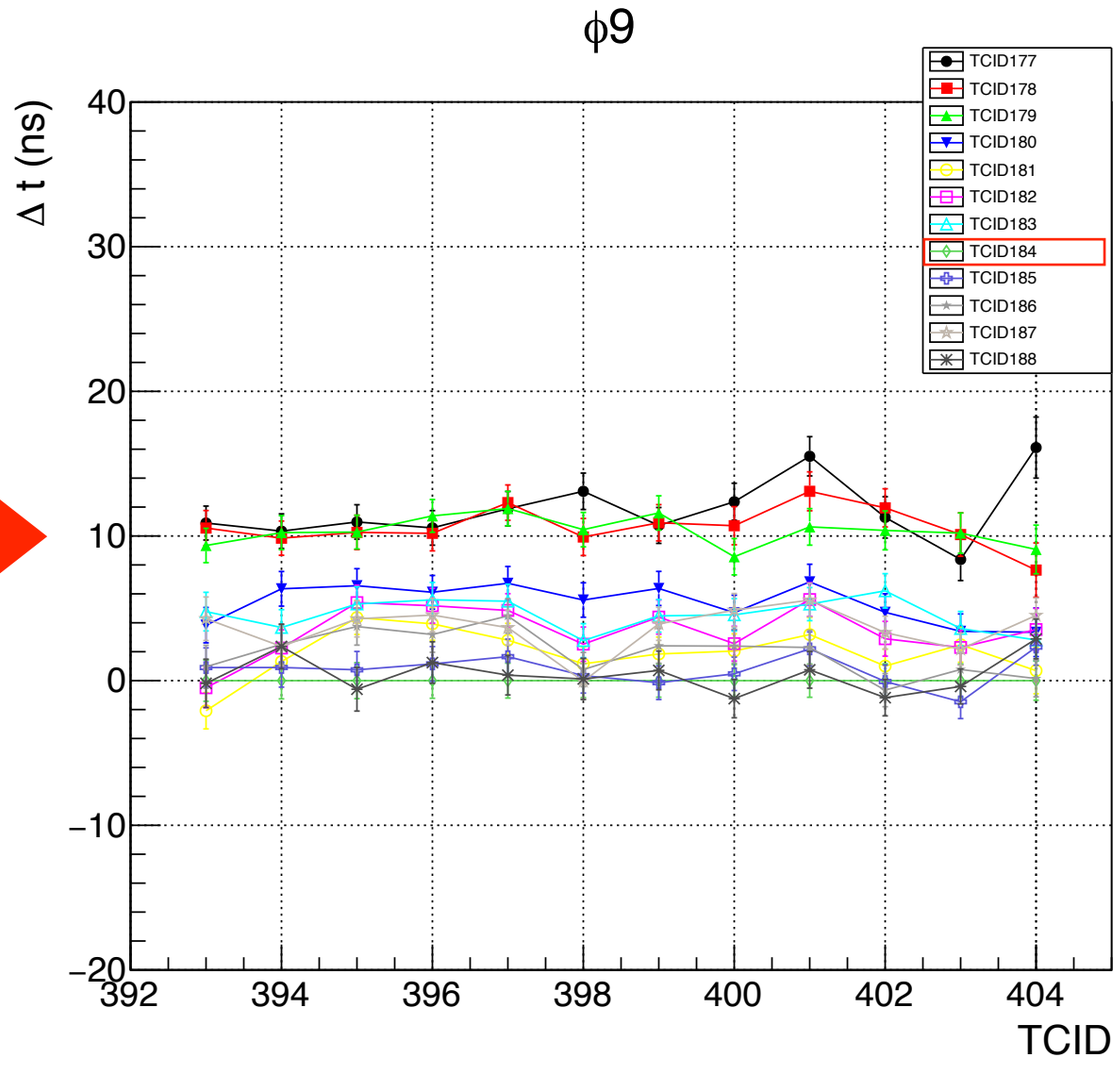
MC Time Offset ϕ 9 and ϕ 27



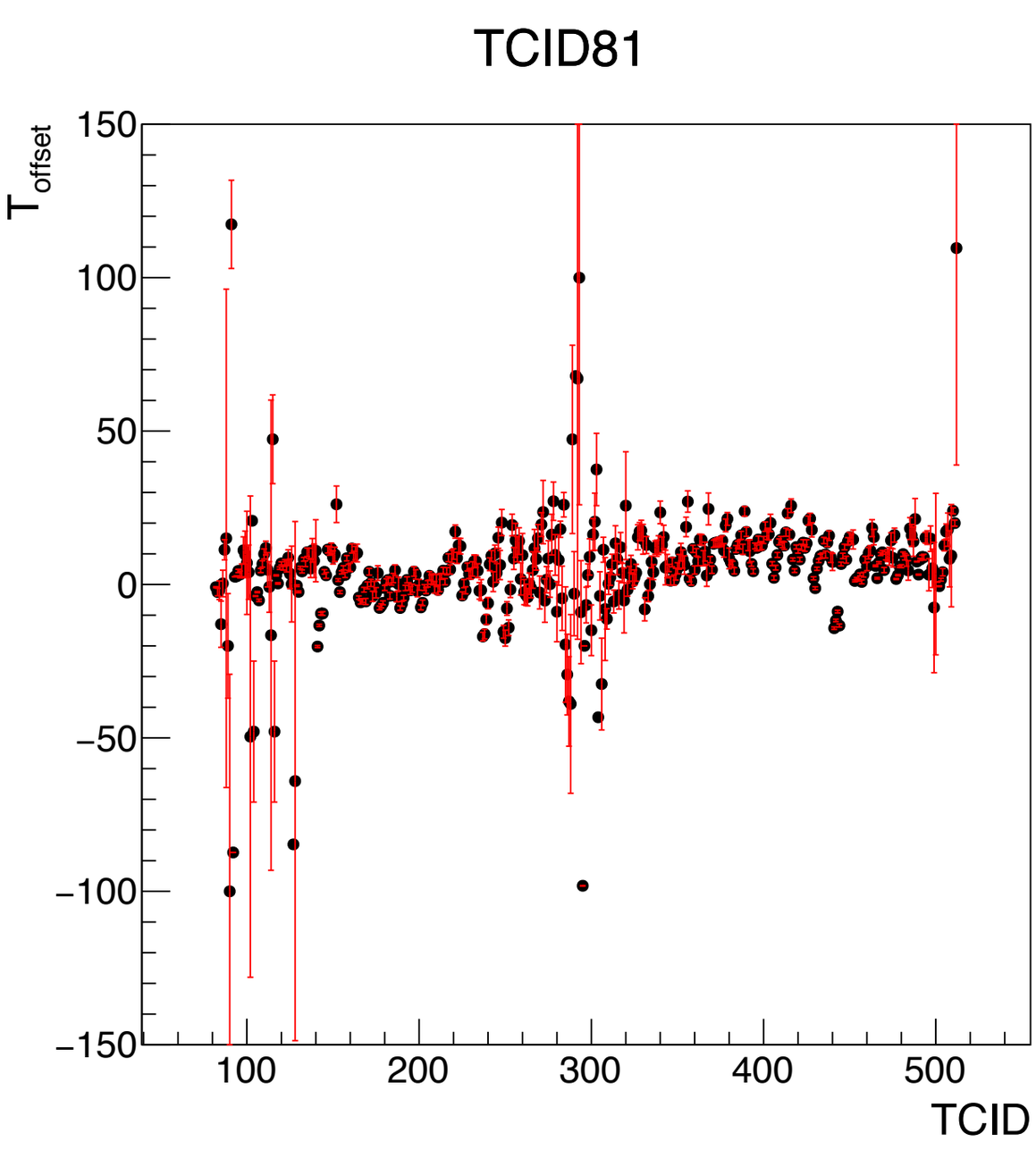
- To check that "Is our TOF correction reliable?"
- As expected, data points are around 0
- 500M CRY events are used.
  -> ~ 60M ECLTRG events

Relative Time offset - ϕ 9 and ϕ 27

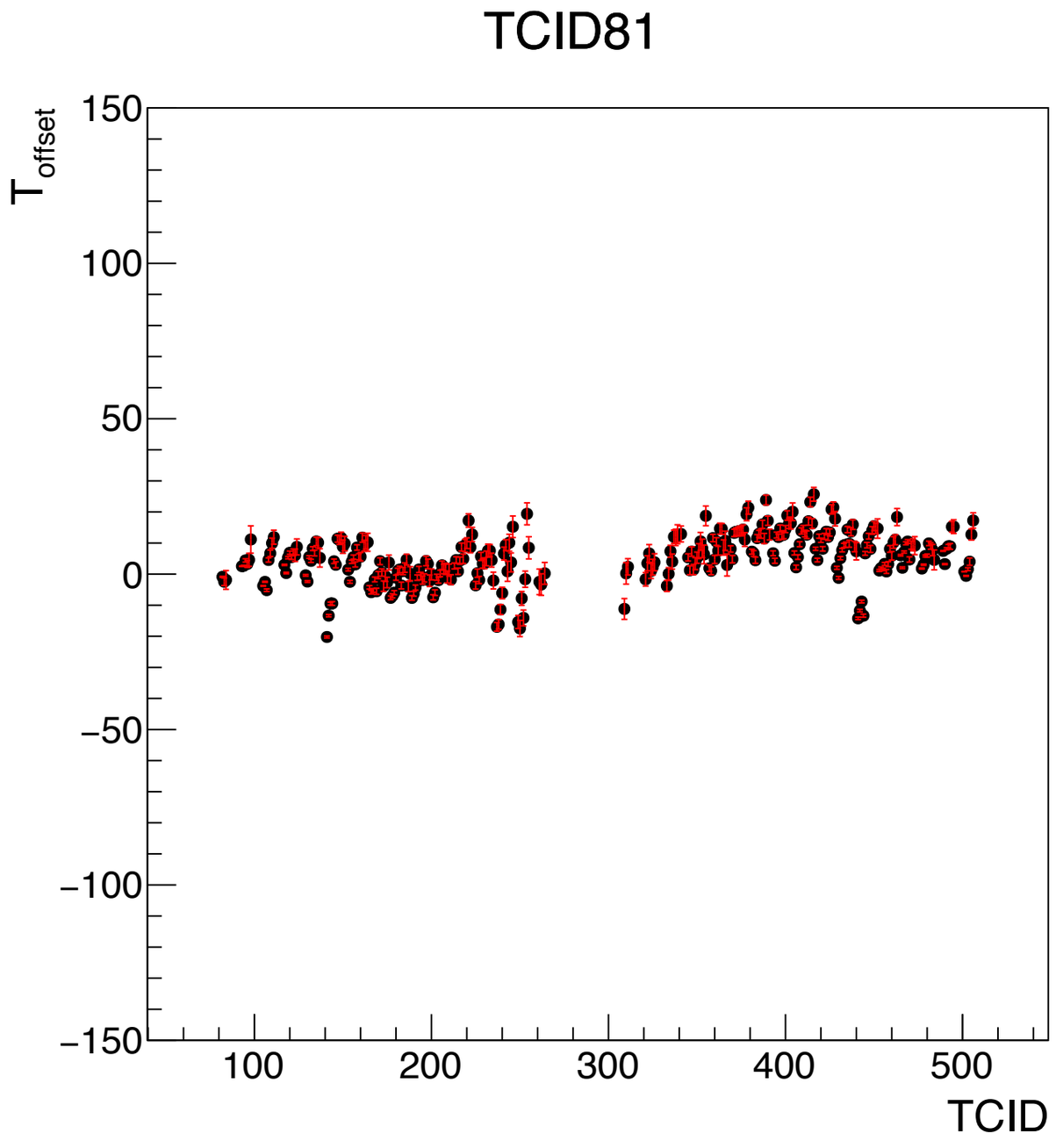




Relative Time offset - ϕ 9 and ϕ 27

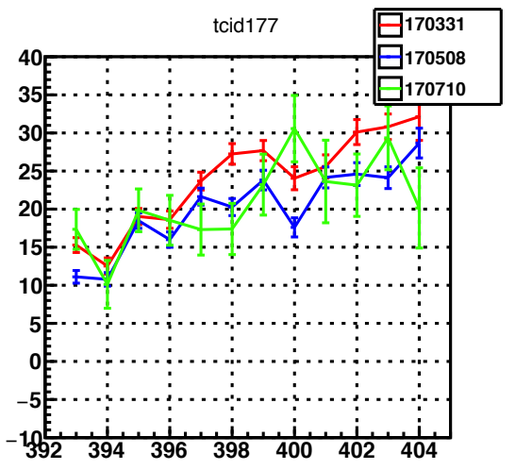


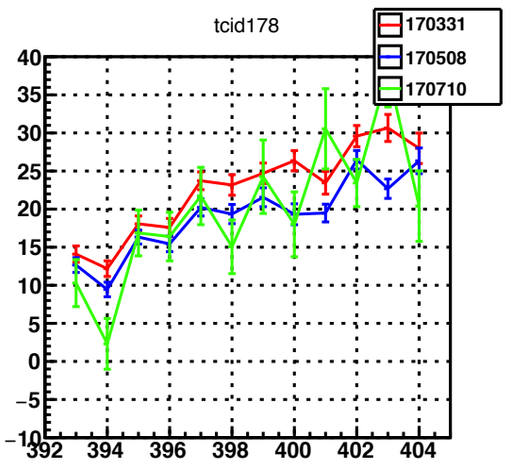
no event cut

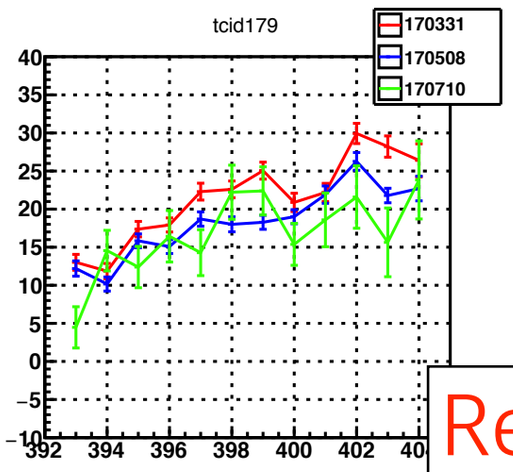


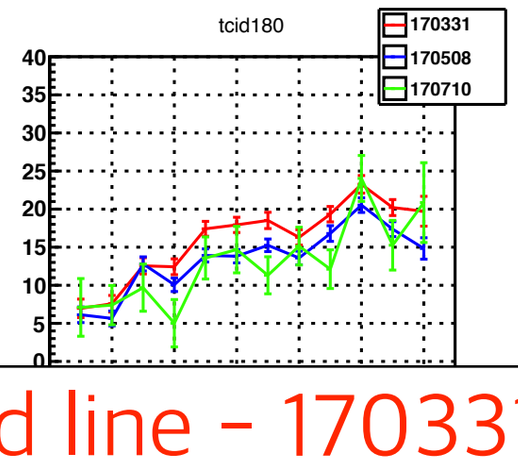
nevent > 50

Data set Comparison - ϕ 9 and ϕ 27





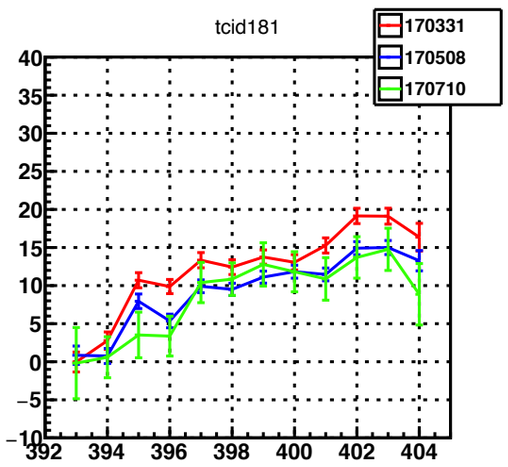


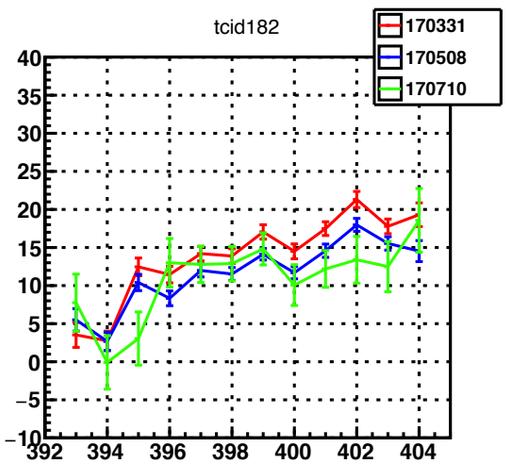


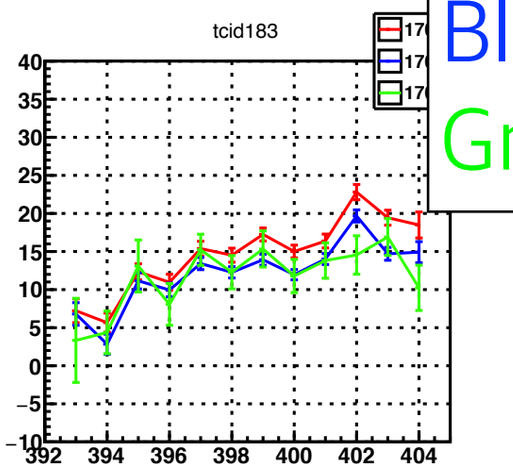
Red line – 170331 ~60M

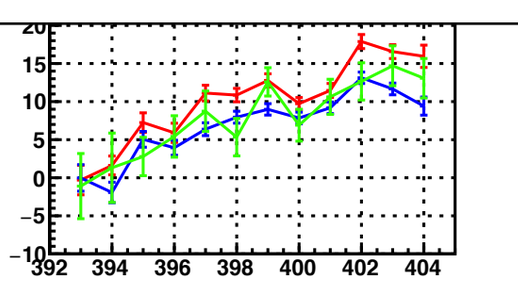
Blue line – 170508 ~80M

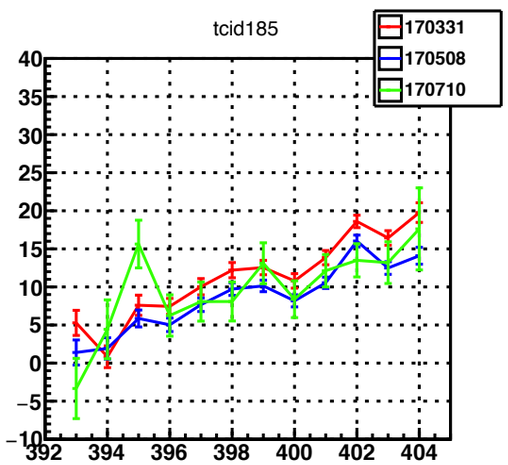
Green line – 170710 ~8M

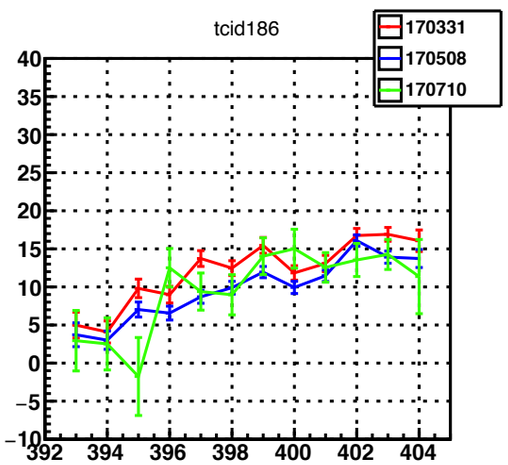


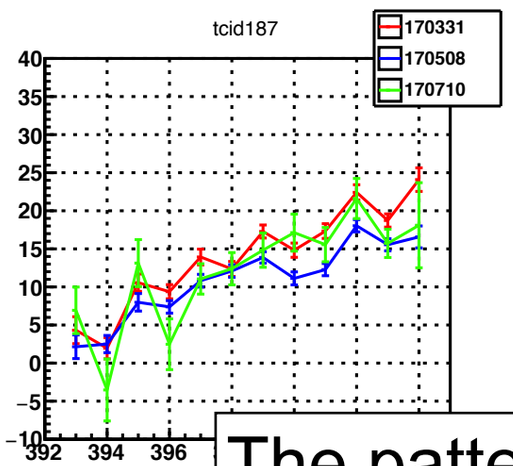


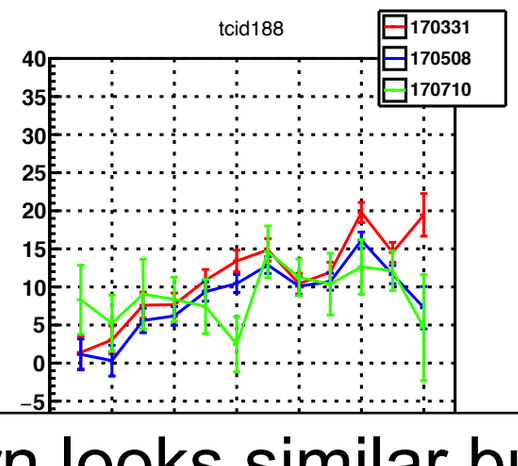












TOF correction has been applied

The pattern looks similar but the offset fluctuate depending on the date