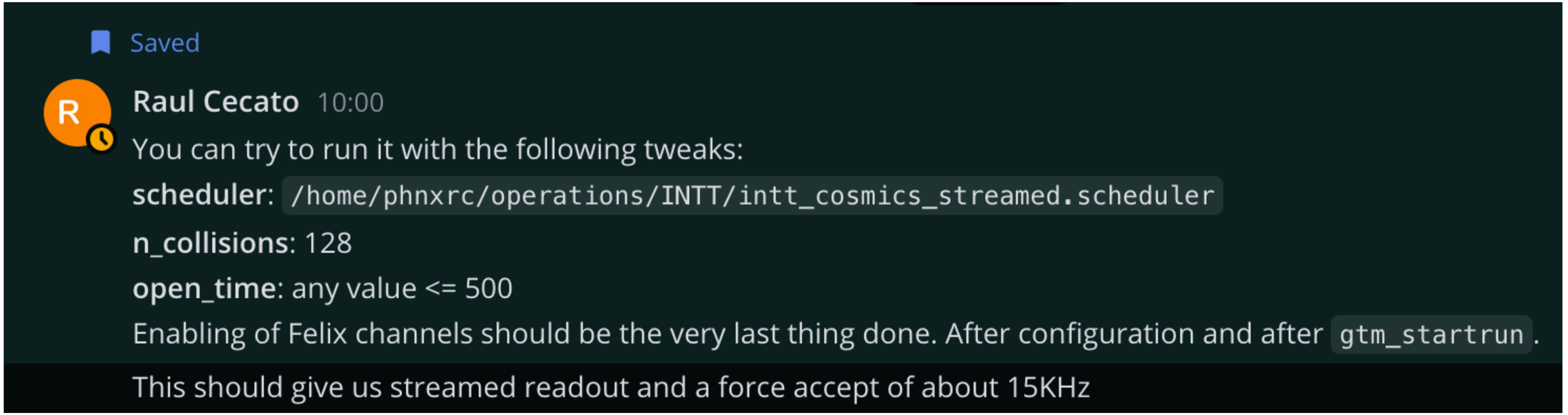
Tests for the streaming readout mode

Genki, Cheng-Wei, Jaein, Misaki, Hinako, Ryota, Tomoya, Raul.

Moving to the streaming readout mode

- Our experience with the streaming readout was not so good. When we tested it last time, we used Raul's Python DAQ, and it hung in a few seconds due to too large data(?).
- Another experience of ours is that RCDAQ never hung.
- It's worth testing the streaming readout with RCDAQ now.
- Raul gave us an instruction to operate INTT in the streaming readout mode:



Measurements

- Date: Aug/14/2023
- Run: 25563 - 25570
- No magnetic field
- Some runs at the beginning are for the study of noise conditions. We made a new list of noisy channels to mask them. Streaming readout tests were conducted with the new masks.
- We also tried measurements with DAC0 = 15 or 25.
- After confirming cosmic tracks, we performed a long run (only for 10 min) with the new masks and DAC0 = 25.
- At the end of the measurements, we took data in BigPartition global mode together with MVTX (run).

433	Mon Aug 14 19:46:44 2023	Genki Nukazuka	Testing the streaming readout mode at 75 kHz

Tests of the streaming readout mode at 75 kHz.

The configuration for the streaming readout mode at 75 kHz: /home/phnxrc/operations/INTT/intt_cosmics_streamed_75KHz.scheduler

Time	Run	Run Length (min)dsa	n_collisions	modebits	DAC0	Rate (kHz)	Comment
19:54	25571	30sec~1 min	8	95	25	75	by mistake
20:03	25572	1 min	128	95	25	75	
20:18	25573	1 min	128	95	25	15	for comparison

432	Mon Aug 14 14:55:06 2023	Misaki Hata	Measurement by self trigger

8/14 streaming readout mode

default : n_coll =128 . mode bit= 95. opentime =35 . DAC0=15 .

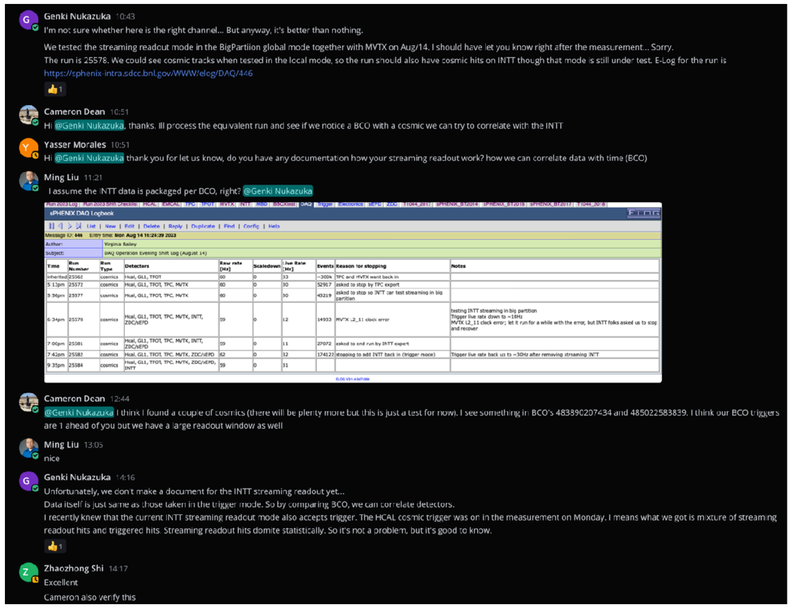
conclusion :

run 25566 : DAC0=25

run 25568 : We tried to mask the chip for some hot channels which cannot be masked by channel level.
But, we could not mask even we used chip mask.

Time	Run	Run Length (min)	Event(intt0s packet)	setting	trigger	porpose
14:57	25563		1766219(roughly)			
16:02	25564		4890121			test the chip mask command
16:37	25565	2	13G			update masking list & rate cut 0.4 from run 25564
16:45	25566	2	6462729			threshold is changed
17:14	25567	2	6662387			update masking list & rate cut 0.2 from run 25564
17:49	25568		647587			short run & test the chip masking for some hot channels
18:04	25570	10	20422893			long run

https://sphenix-intra.sdcc.bnl.gov/WWW/elog/INTT/432



I let the MVTX group know about the run together with MVTX.

https://chat.sdcc.bnl.gov/sphenix/pl/noxeecdddbfnpdjmwq7sd1frze

Measurements

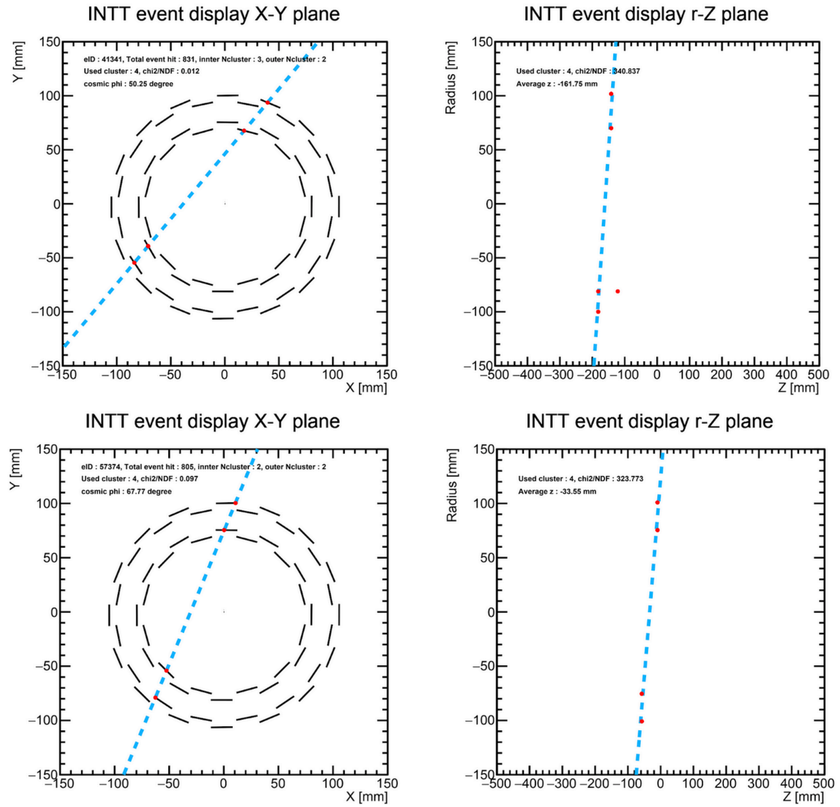
- We could find some cosmic tracks in the online analysis by Cheng-Wei. The results were reported at the shift change meeting the next day.
- We need to have a look at the data. Who can do it?

- When streaming INTT joins to the global mode, the trigger rate of the HCAL cosmic dropped from 25 Hz to 10 Hz.

6:34pm	25578	cosmics	Hcal, GL1, TPOT, TPC, MVTX, INTT, ZDC/sEPD	59	0	12	14933	MVTX L2_11 clock error	testing INTT streaming in big partition Trigger live rate down to ~10Hz MVTX L2_11 clock error; let it run for a while with the error, but INTT folks asked us to stop and recover

INTT (Cheng-Wei/Genki)

- The test of the streaming readout mode were performed yesterday, and we could find some cosmic tracks. The tests were done in the local mode mainly. We also took a run (#25578) in the global mode together with MVTX.



- We were back to the BigPartition global mode and operating the detector in the trigger mode. We keep this condition for 1-2 days to have some statistics without magnetic field.

The report in the shift change meeting.

I expect a detailed explanation
by Cheng-Wei or someone someday…

Another measurement

- Run: 25572 - 25573
- BigPartition local mode
- The streaming readout mode was tested at 15 kHz operation frequency. The frequency can be changed in the INTT scheduler.
- I quickly tested at 15 kHz and 75 kHz
- Raul suggested checking 2 parameters:
  - event counter
  - hit BCO difference

```
phnxrc@opc0:~/operations/INTT$ cat intt_cosmics_streamed_15KHz.scheduler
# modegrp repeat jump target modebitfile
# modebit default value is 0:0x36;95:0x35; (9 August 2023)
  0          0    0    0
  1          0    0    0     0:0x36;95:0x35;
  2          0    0    0     0:0x100
  3          3    1    2
```

INTT scheduler for 15 kHz.

```
phnxrc@opc0:~/operations/INTT$ cat intt_cosmics_streamed_75KHz.scheduler
# modegrp repeat jump target modebitfile
# modebit default value is 0:0x36;95:0x35; (9 August 2023)
  0          0    0    0
  1          0    0    0     0:0x36;95:0x35;
  2          0    1    2     0:0x100
```

INTT scheduler for 75 kHz.

https://sphenix-intra.sdcc.bnl.gov/WWW/elog/INTT/433

Another measurement

Event counter

- It has to be incremented exactly by 1.
- By looping over all events (even if no hit was recorded), I took the difference between the event counter of an event and the previous event. The analysis was done for each FELIX server.
- The runs were for 1min. Roughly speaking, we can expect 900k and 4500k events for 15 and 75 kHz operations.

$$\Delta_i \equiv (\text{EVT CTR})_i - (\text{EVT CTR})_{i-1}$$

Run 25573 (15 kHz)

FELIX	#event	$\Delta_i \neq 1$
INTT0	1025873	0
INTT1	1019280	0
INTT2	1013291	0
INTT3	1006497	0
INTT4	1000492	0
INTT5	994438	0
INTT6	987454	0
INTT7	981093	0

Run 25572 (75 kHz)

FELIX	#event	$\Delta_i \neq 1$
INTT0	1284176	0
INTT1	1275794	3
INTT2	1268080	3
INTT3	1260420	3
INTT4	1252024	2
INTT5	1245172	3
INTT6	1237429	3
INTT7	1229716	2

#event should vary over the FELIX servers since
the timing of enabling reading out data was different.

EVT CTR for the first 7 events in INTT3 from Run25572 (75 kHz)

Event Index	EVT CTR	Previous EVT CTR	Δ
0	1556630	1556629	1
1	-1	1556630	-1556631
2	1007545949	-1	1007545950
3	277707	1007545949	-1007268242
4	277708	277707	1
5	277709	277708	1
6	277710	277709	1

The streaming readout at 15 kHz works well.
The streaming readout at 75 kHz is mostly OK but not perfect.
The strange event counter values may not be on the FELIX side.

Another measurement

It has to be
an unsigned integer.
— Raul —

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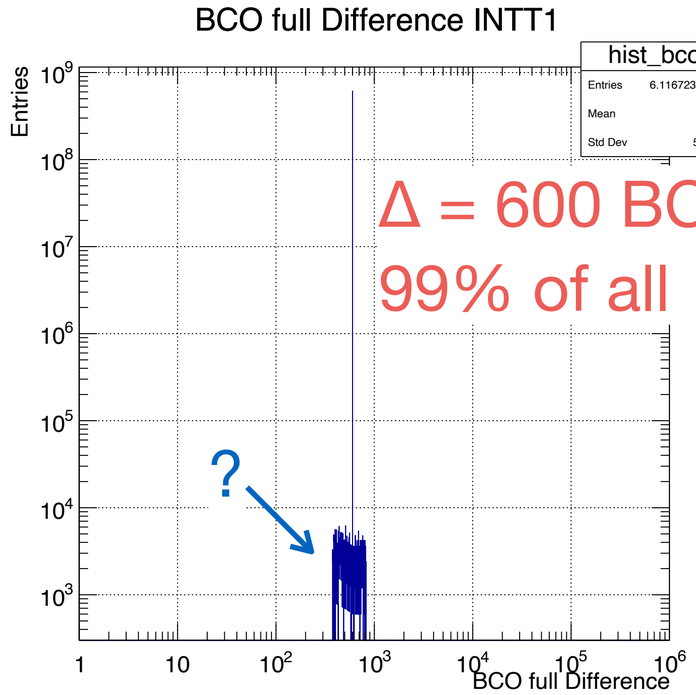
Another measurement

Difference between BCO full of hits from an event to the next event

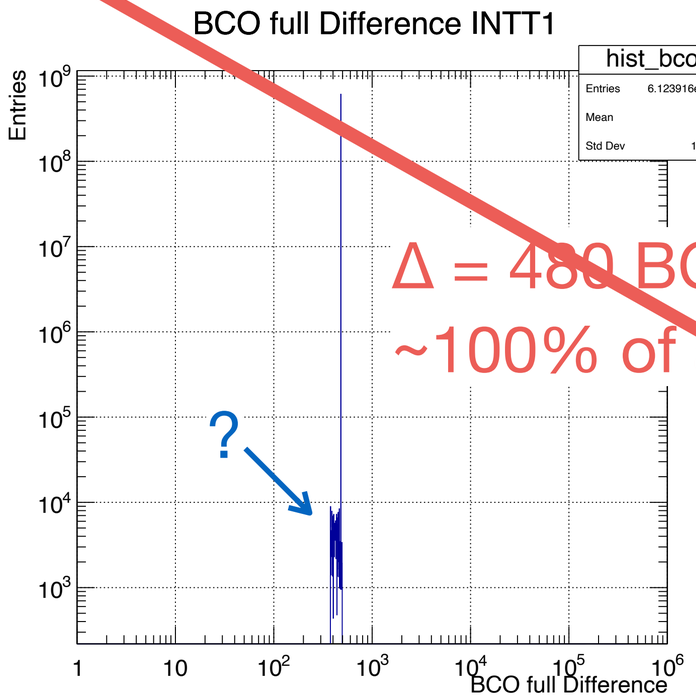
- The difference has to be f^{-1} / 106. It means
  - 630 BCOs at 15 kHz
  - 125 BCOs at 75 kHz.
- I confirmed that all hits in the same event have the same BCO full value.

Run 25573 (15 kHz), INTT1



The peak is expected to be at 630 BCO.
→The measurement more or less agrees.

Run 25572 (75 kHz), INTT1



The peak is expected to be at 125 BCO.
→The measurement doesn't agree.
Raul thinks why 🤔

The streaming readout actually accepts the trigger input. What we measured was the mixture of streaming readout hits and trigger hits. The ratio of the operation frequency of the streaming readout and the cosmic trigger rate is about
- 15k: 25 = 600:1 or
- 75k: 25 = 3000:1.

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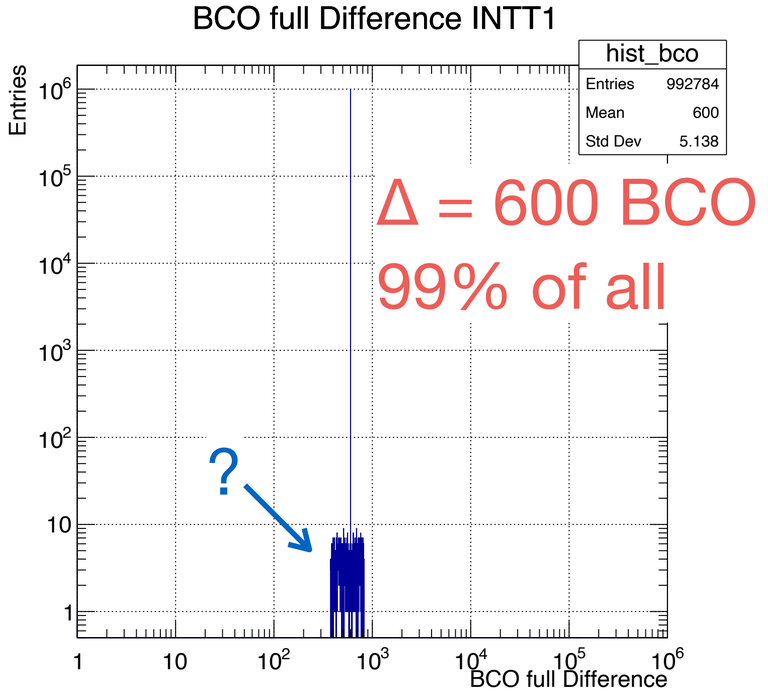

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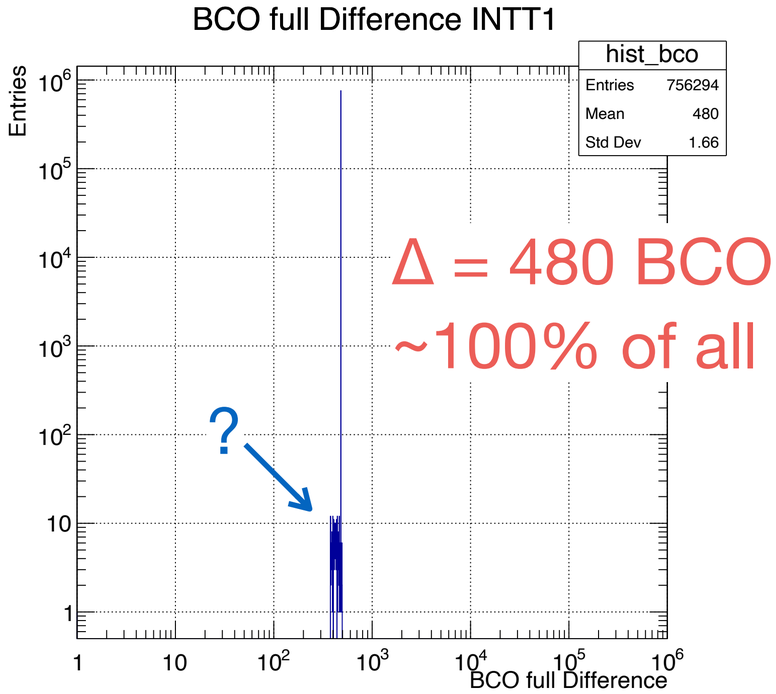
Run 25572 (75 kHz), INTT1



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Another measurement

Difference between BCO full of hits from an event to the next event

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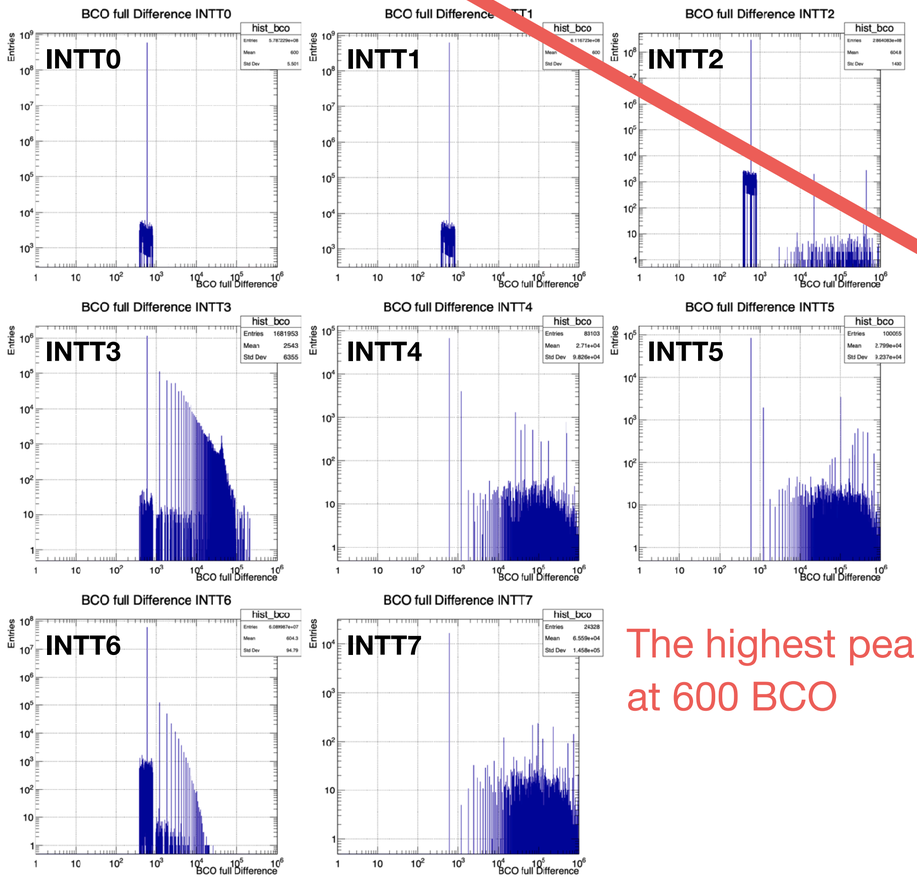
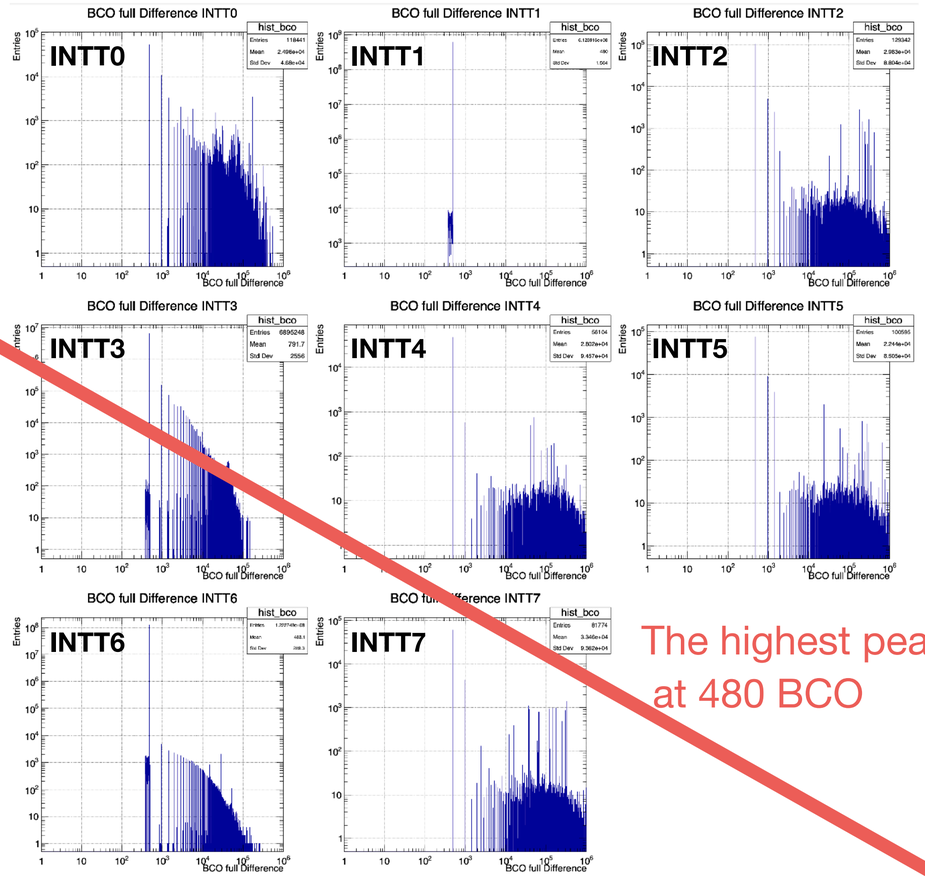


The highest peaks are at 600 BCO

Run 25573 (15 kHz)



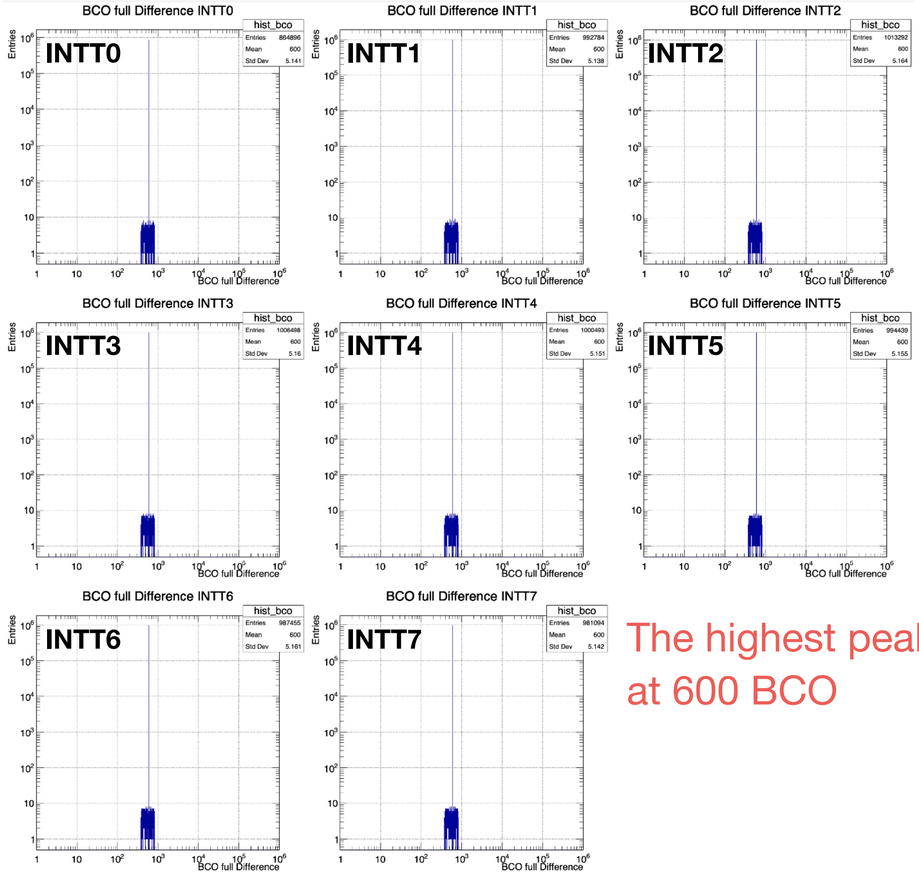
The highest peaks are at 480 BCO

Run 25572 (75 kHz)

Another measurement

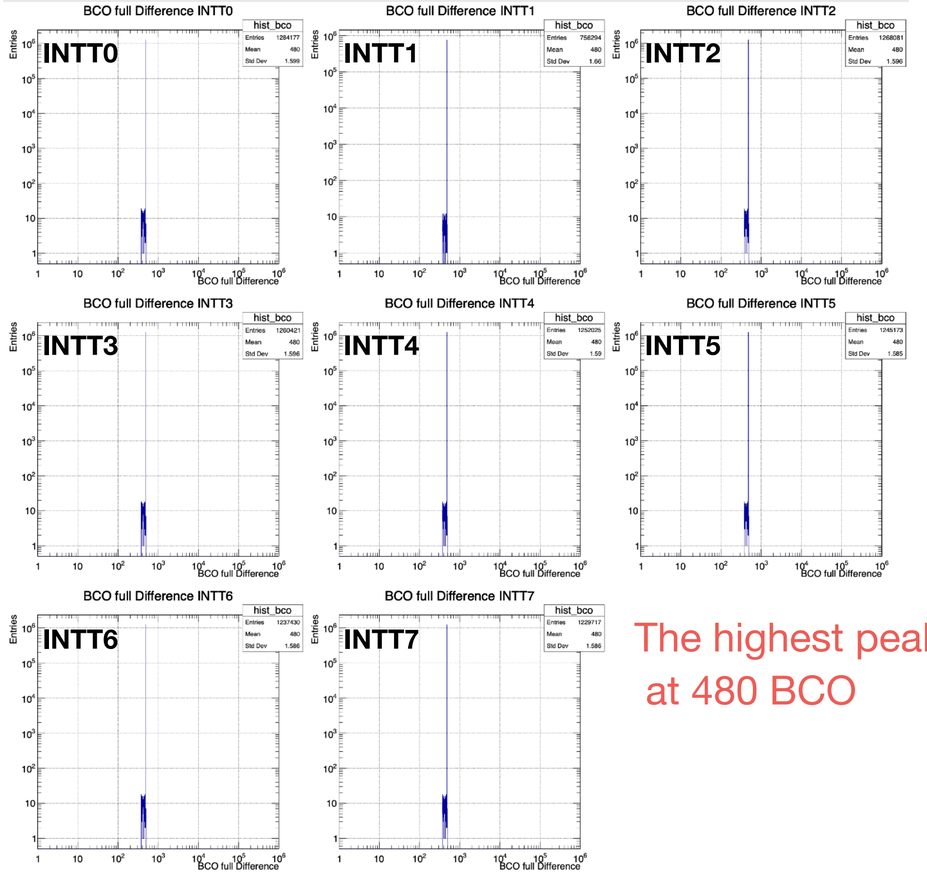
Difference between BCO full of hits from an event to the next event

- The difference has to be f^{-1} / 106, i.e. 630 and 125 BCOs for 15 and 75 kHz, respectively.
- I confirmed that all hits in the same event have the same BCO full value.



The highest peaks are at 600 BCO

Run 25573 (15 kHz)



The highest peaks are at 480 BCO

Run 25572 (75 kHz)

Next

I made a next plan after discussing the results with Raul

- Measurements without the trigger inputs
- Repeating the same measurements several times to see whether these conditions are reproduced.