

GL1 matching study(2)

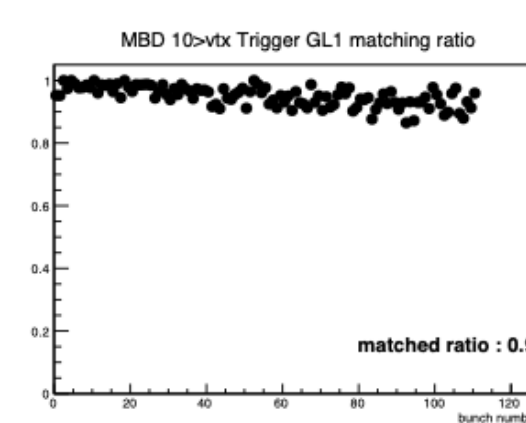
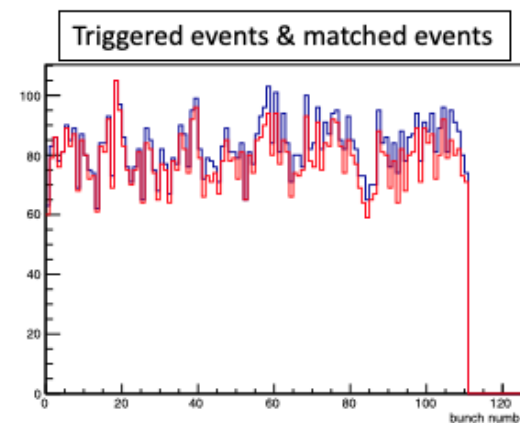
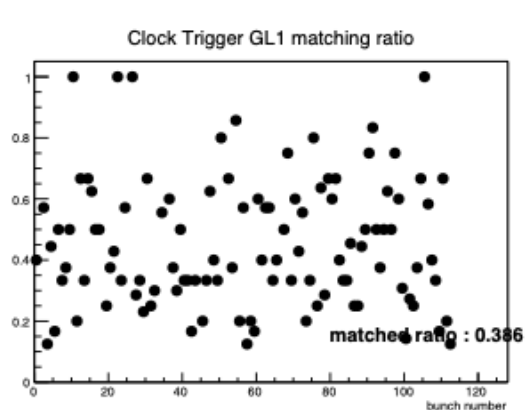
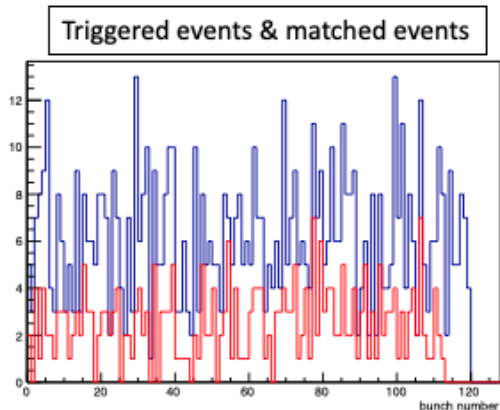
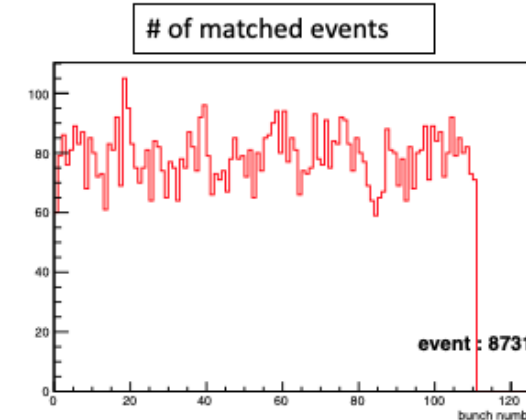
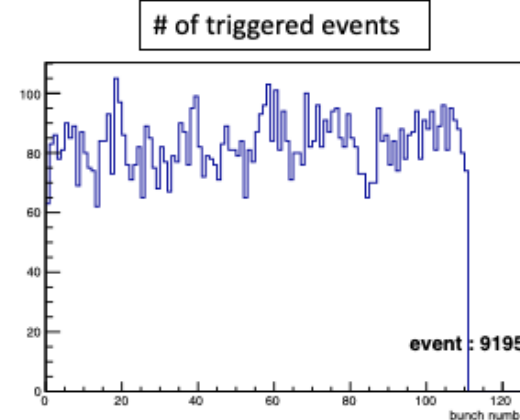
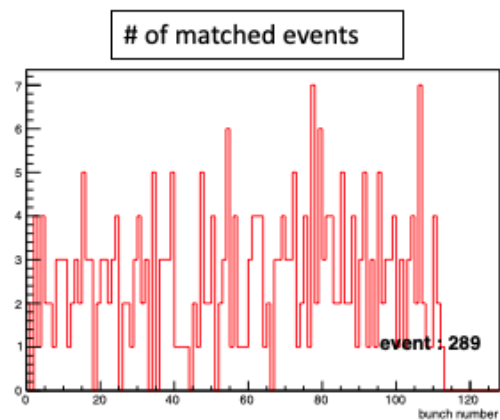
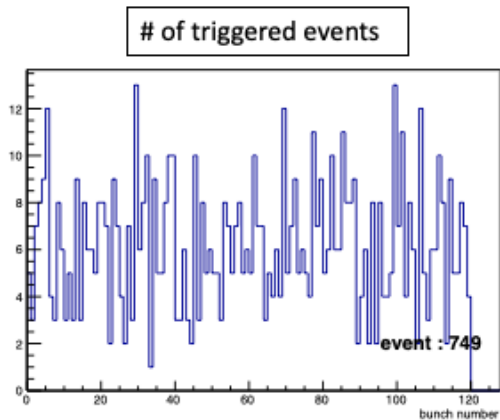
Jaein Hwang

2024/10/16



Motivation Review(1)

https://indico.bnl.gov/event/25091/contributions/97557/attachments/5778/2/99297/INTT_meeting_gl1_10_7.pdf



Trigger type	Total event	Matched event	Ratio(%)
All	50000	46365	92.7%
Clock	749	289	38.6%
MBD N&S	5454	5831	93.5%
MBD N&S 10>vtx	9195	8731	95.0%

- **GL1 study was performed for the cross-check purpose**
- **Could see trigger dependence**

Motivation Review(2)



Trigger type	Ratio-Jaein (%)	Ratio-Genki (%)
All	92.7%	82%
Clock	38.6%	43%
MBD N&S	93.5%	77%
MBD N&S 10>vtx	95.0%	82%

- GL1 finding ratio is much higher than Genki's previous result
https://indico.bnl.gov/event/24711/contributions/96287/attachments/57049/97903/20240904_streaming_timing.pdf
- Genki's result also indicates different trigger type would give us different matching ratio. But we have difference btw genki's result & jaein's result

@ From Genki

Bit	Name	#match	#all	Ratio
0	Clock	6	14	0.43
1	ZDC South	0	0	
2	ZDC North	6	14	0.43
3	ZDC N&S	24	43	0.56
4	HCAL Single	24	43	0.56
5	HCAL Coincidence	24	43	0.56
6		24	43	0.56
7		0	0	
8	MBD S>=1	16	31	0.52
9	MBD N>=1	4	7	0.57
10	MBD N&S>=1	100	130	0.77
11	MBD N&S>=2	26	34	0.76
12	MBD N&S>=1 vtx<10cm	216	265	0.82
13	MBD N&S>=1 vtx<30cm	57	73	0.78
14	MBD N&S>=1 vtx<60cm	190	244	0.78
15	HCAL, Singles+MBD NS>=1	32	41	0.78
16	Jet 6GeV+MBD NS>=1	177	224	0.79
17	Jet 8GeV+MBD NS>=1	141	168	0.84
18	Jet 10GeV+MBD NS>=1	242	300	0.81
19	Jet 12GeV+MBD NS>=1	12	21	0.57
20	Jet 6GeV	224	280	0.80
21	Jet 8GeV	320	390	0.82
22	Jet 10GeV	281	347	0.81
23	Jet 12GeV	215	259	0.83
24	Photon 2GeV+MBD NS>=1	52	73	0.71
25	Photon 2GeV+MBD NS>=2	75	98	0.77
26	Photon 2GeV+MBD NS>=3	310	381	0.81
27	Photon 2GeV+MBD NS>=4	82	91	0.90
28	Photon 2GeV	246	309	0.80
29	Photon 3GeV	134	163	0.82
30	Photon 4GeV	584	709	0.82
31	Photon 5GeV	213	254	0.84
all	all	638	778	0.82

Only 1k events were analyzed for each trigger.

Potential Divergences btw analyses



- # of events : Jaein : 50k / Genki : 1k
- Hot channel rejection : Produced by same algorithm
-> But potentially version can be different
- Date to produce DST file
-> intt_pool (decoder for evt to InttRawHit) or Combiner macro could be different version
- Jaein uses InttRawHit / Genki uses TRKR_HIT for scanning Gl1 associated hit

Potential Divergences (update)



Every analysis has been performed with same condition listed below

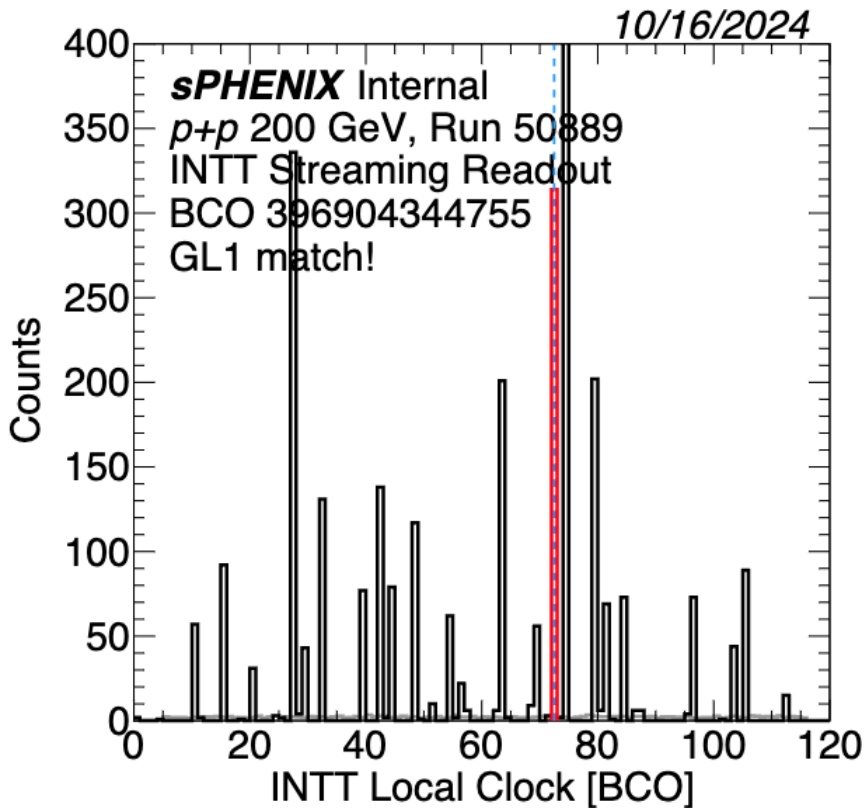
- # of events : Jaein : 50k / Genki : ~~1k~~ 50k
- Hot channel rejection : Produced by same algorithm
 - > ~~But potentially version can be different~~ Importing same hot channel map
- Date to produce DST file
 - > ~~intt_pool (decoder for evt to InttRawHit) or Combiner macro could be different version~~ DST file created by most recent version macro
- Jaein uses InttRawHit / Genki uses TRKR_HIT for scanning G11 associated hit
That is interesting to keep! Let's revisit if we see serious problem again

How to perform Genki's analysis? – Result(1)



https://github.com/sPHENIX-Collaboration/analysis/tree/master/INTT_preliminary/202409_performance/timing

- Code is available in GitHub already for preliminary procedure 😊
- Small modification was made (don't skip event which has 0 hit from INTT)



I can have similar plot for previous preliminary request!
Genki's code has been successfully performed 😊

How to perform Genki's analysis? – Result(2)



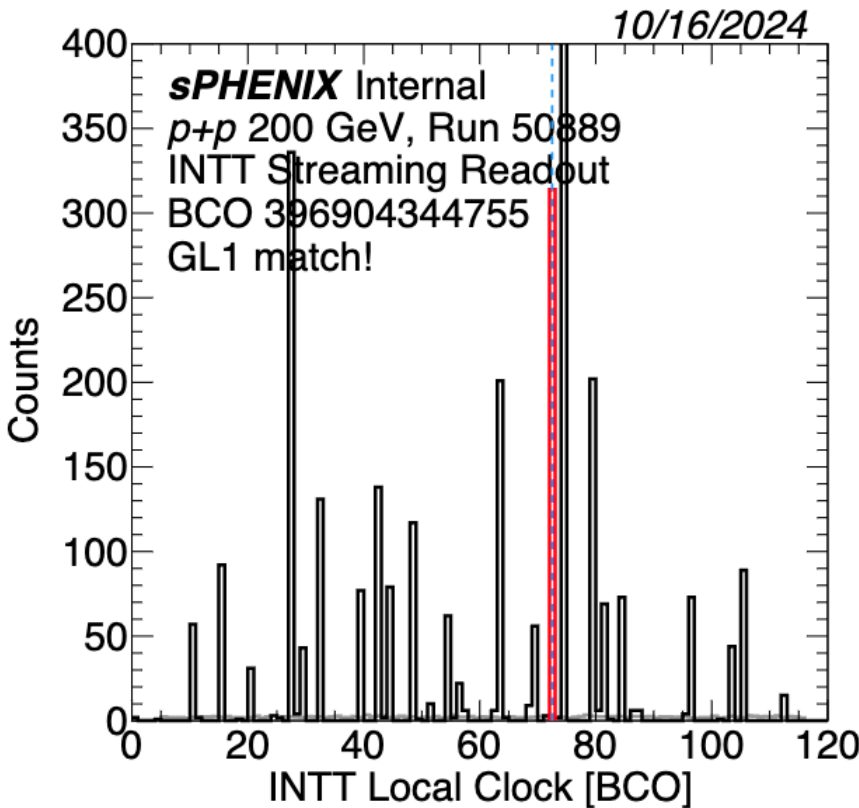
https://github.com/sPHENIX-Collaboration/analysis/tree/master/INTT_preliminary/202409_performance/timing

```
Info in <TCanvas::Print>: Current canvas address: 0x...
GL1 matching ratio: 46380 / 49999 = 0.927619
```

All trigger

```
Info in <TCanvas::Print>: Current canvas address: 0x...
GL1 matching ratio: 8733 / 9195 = 0.949755
```

MBD N&S 10>vtx



I can have similar plot for previous preliminary request!
Genki's code has been successfully performed 😊

Trigger type	Ratio-Jaein (%)	Ratio-Genki old(%)	Ratio-Genki new(%)
All	92.7%	82%	92.7%
Clock	38.6%	43%	-
MBD N&S	93.5%	77%	-
MBD N&S 10>vtx	95.0%	82%	95.0%

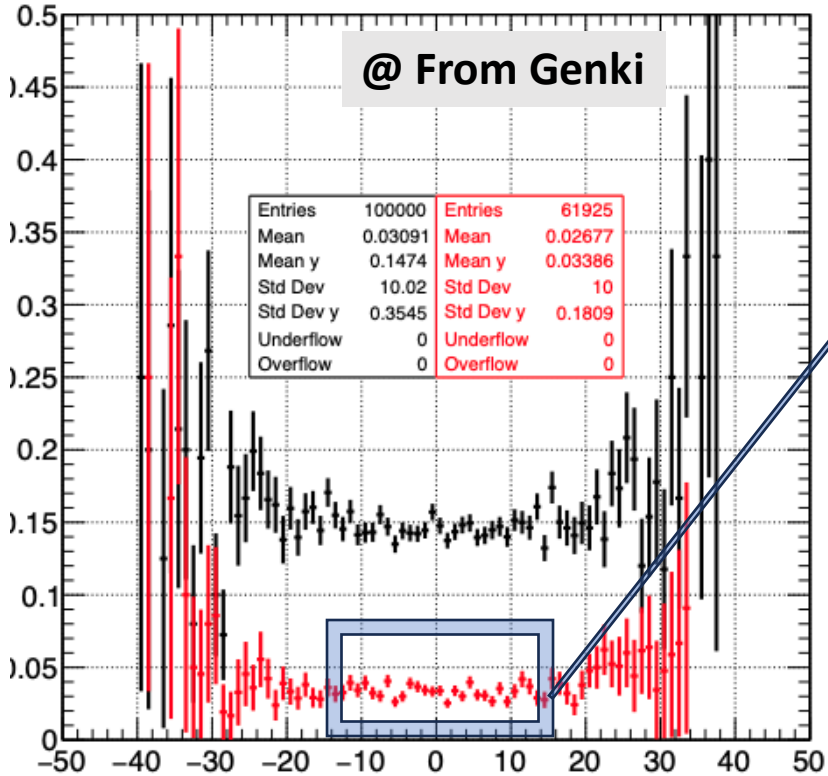
Very nice consensus achieved!
Should be less than >0.01% disagreement

Finding efficiency from MC study

From Genki's MBD simulation result(31 July weekly INTT meeting)

https://indico.bnl.gov/event/24367/contributions/94712/attachments/56271/96316/20240731_INTT_cluster.pdf

title



If MBD trigger $10 > z_{vtx}$ is required,
Suggested GL1 finding efficiency by MC is 96 – 97%
Now, we have 95%. Any possible reason?

Ratio of #INTT cluster/event = 0
as a function of truth z_{vtx}

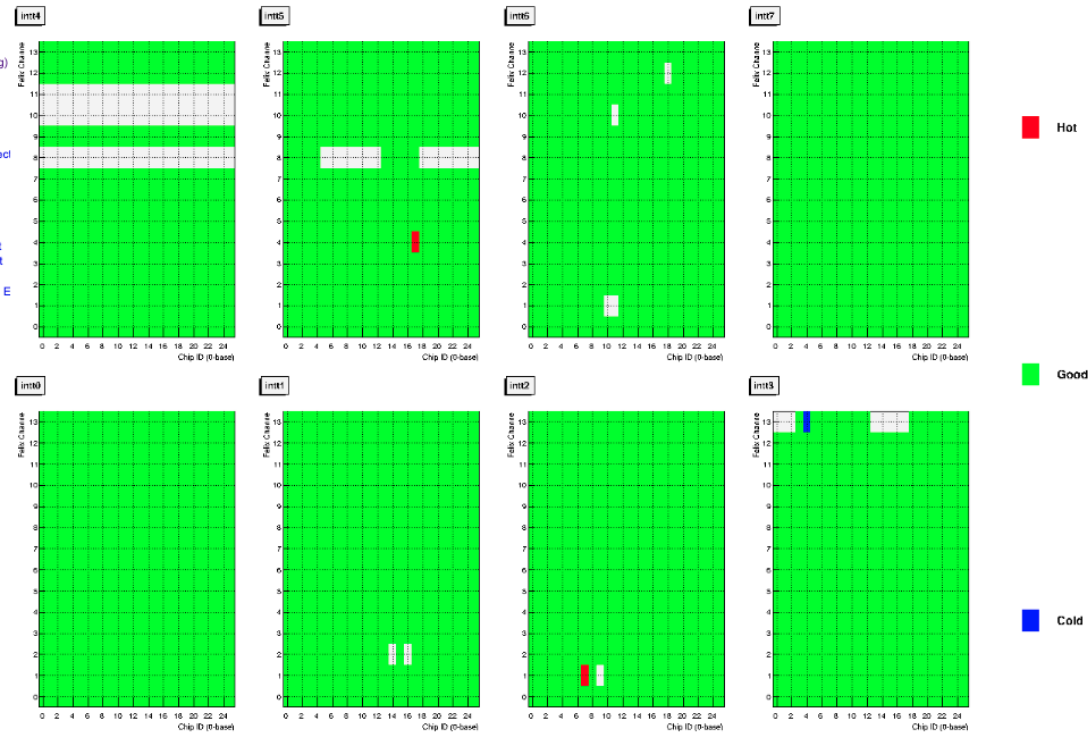
- No cut
- Simulated MBD trigger

Further Study(1)

From Genki's MBD simulation result(31 July weekly INTT meeting)

https://indico.bnl.gov/event/24367/contributions/94712/attachments/56271/96316/20240731_INTT_cluster.pdf

Intt Hit Map
Run 50889, Events: 9566416, Fri Aug 9 10:20:16 2024



If MBD trigger $10 > v_{tx}$ is required,
Suggested GL1 finding efficiency from MC 96 – 97%
Now, we have 95%. Any possible reason?

- **4 half ladders masked**
could be minor since INTT has 4 layers.

Further Study(2)

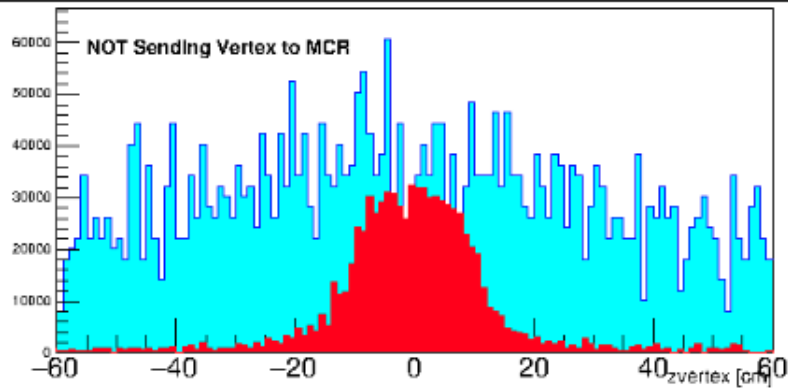
From Genki's MBD simulation result(31 July weekly INTT meeting)

https://indico.bnl.gov/event/24367/contributions/94712/attachments/56271/96316/20240731_INTT_cluster.pdf

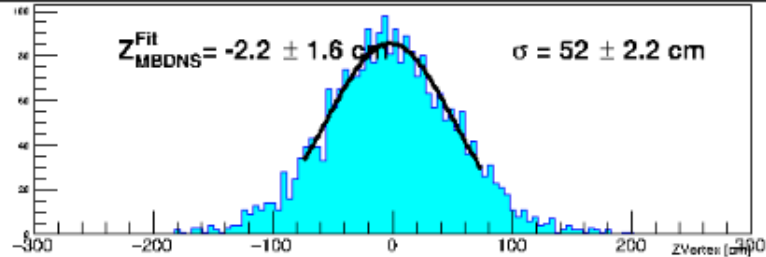
MBD ONLINE MONITOR

Run #50889 Events: 16942 Date: Fri Aug 9 10:20:15 2024

MBD zvertex



MBD ZVertex (south<->north)



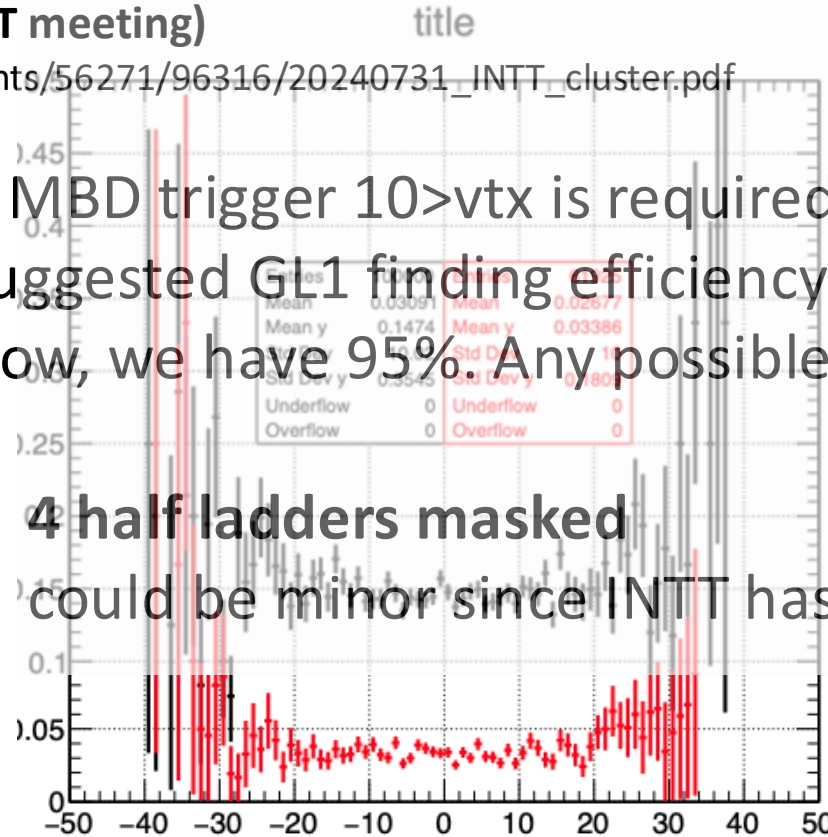
- 10 >vtx trigger fired events
- All events

2024-10-16

If MBD trigger 10>vtx is required, Suggested GL1 finding efficiency from MC 96 – 97% Now, we have 95%. Any possible reason?

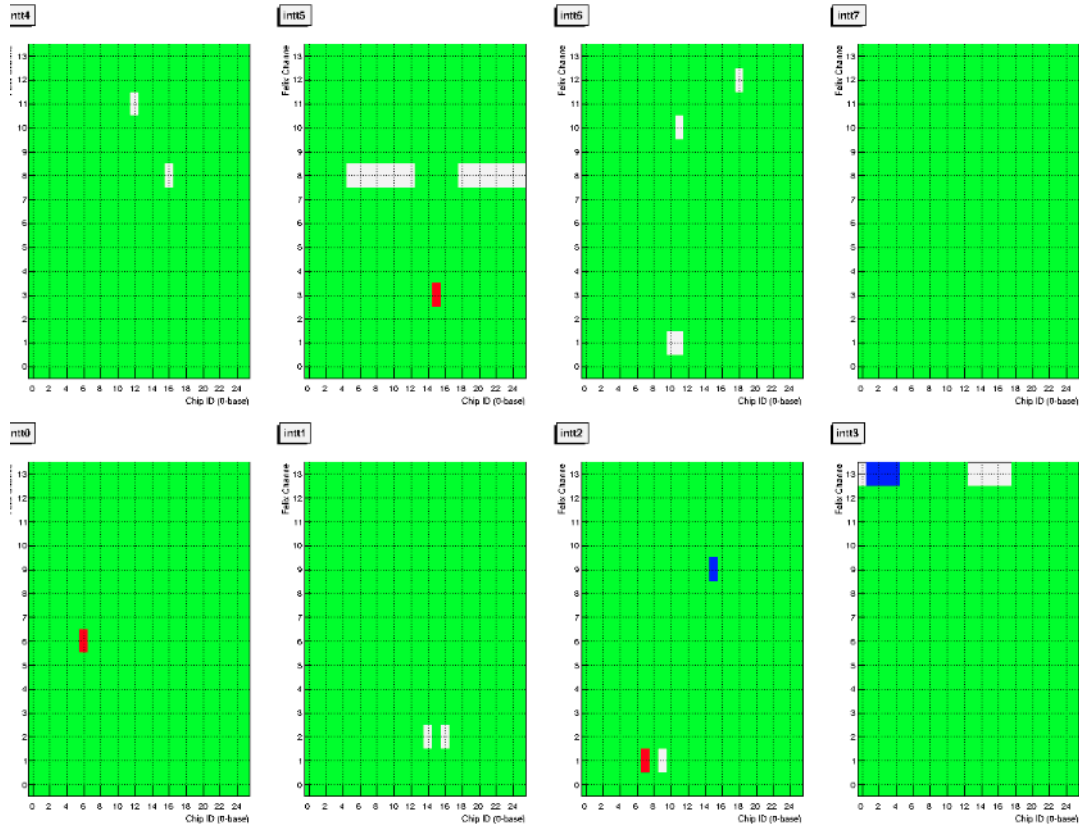
- **4 half ladders masked** could be minor since INTT has 4 layers.

- **Data taken in 0 X-ing angle**
MBD z-vertex trigger selection DO NOT CUT all collision out of 10 cm. (For sure, trigger selection can improve finding efficiency as we have seen)



Further Study with another run(53227)

Intt Hit Map
Run 53227, Events: 140822297, Sun Sep 15 10:31:02 2024



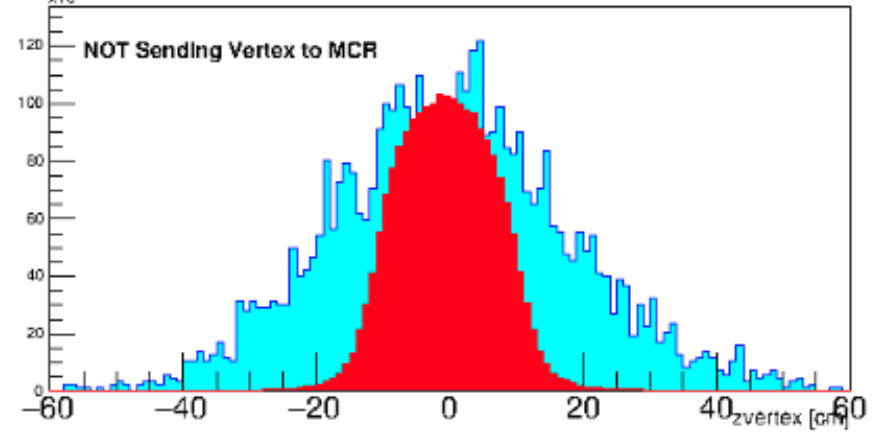
GOOD!

Only 1 half ladder (in total) masked due to no-bias
1.5 mrad X-ing angle - Much low probability having collision from $|z| > 10$ cm

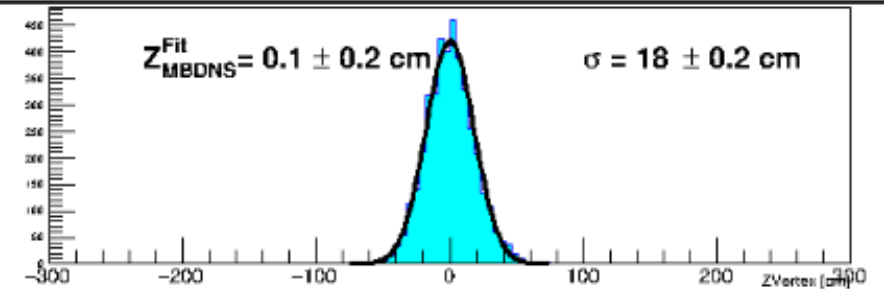
MBD ONLINE MONITOR

Run #53227 Events: 161115 Date:Sun Sep 15 10:30:25 2

MBD zvertex



MBD ZVertex (TRIG = MBDNS>=1)

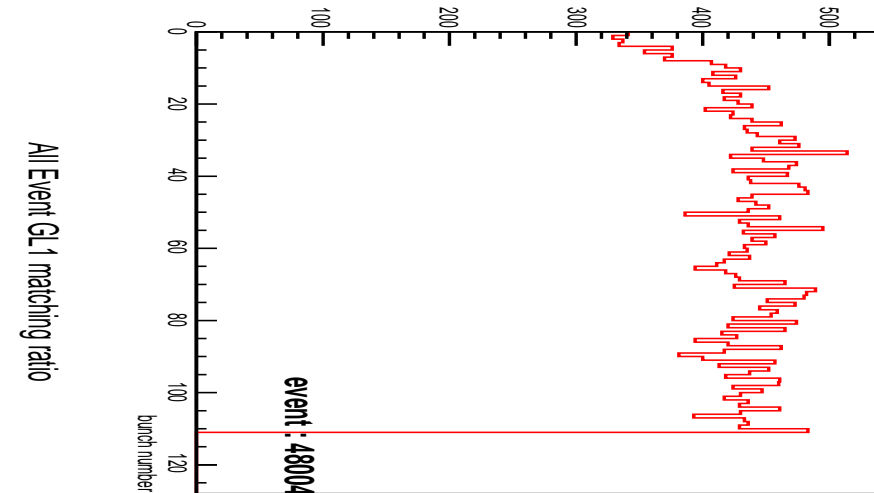
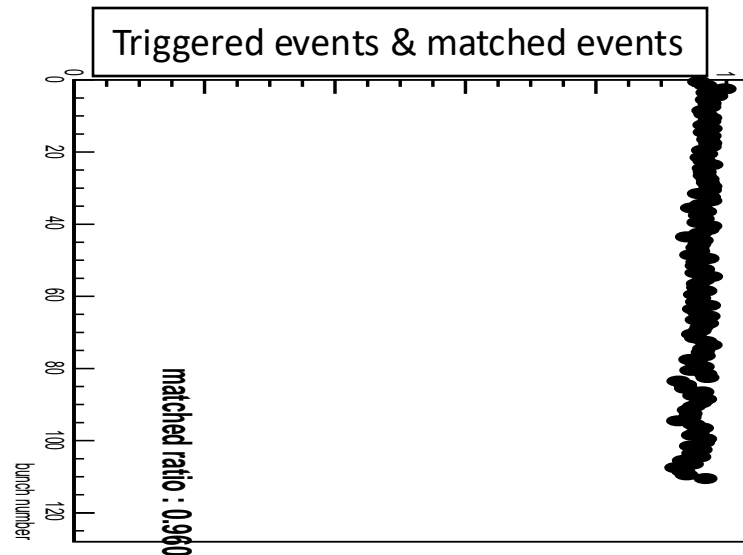
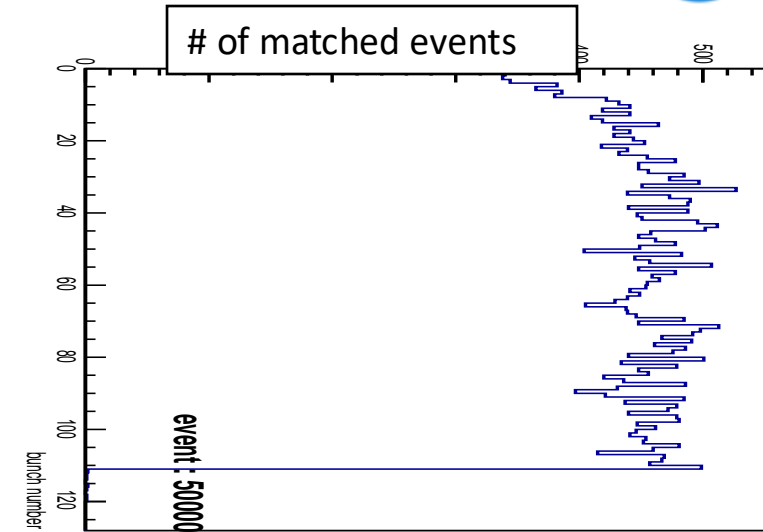
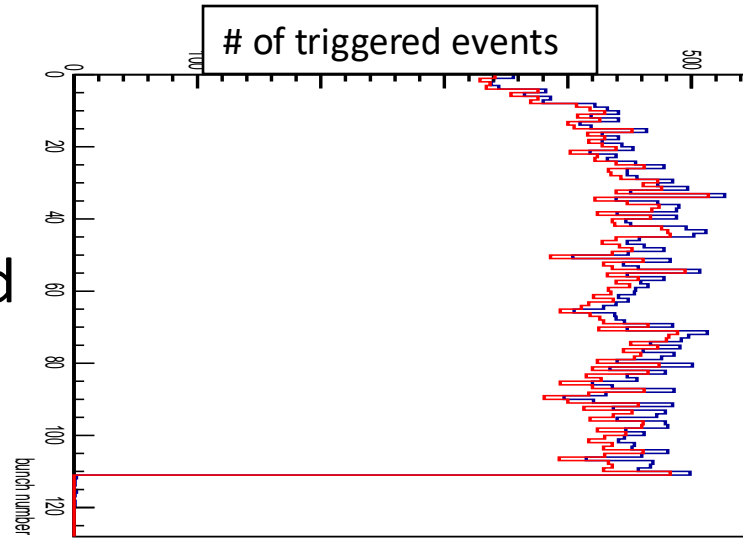


- 10 >vtx trigger fired events
- All events

Result(Run 53227 / All trigger used)



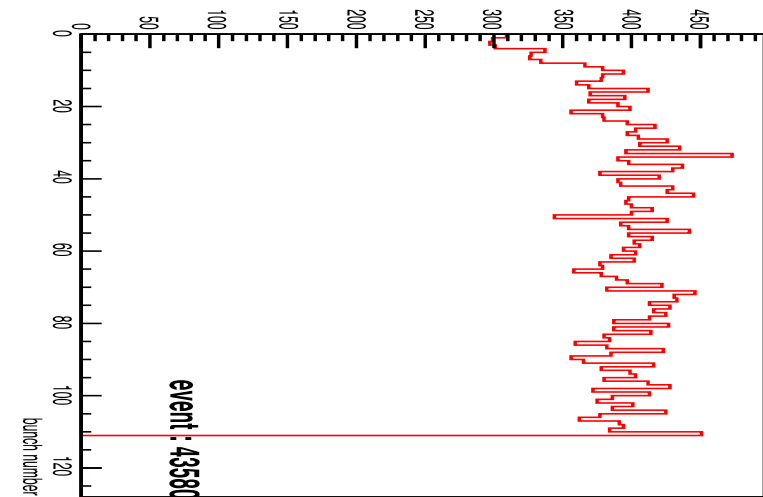
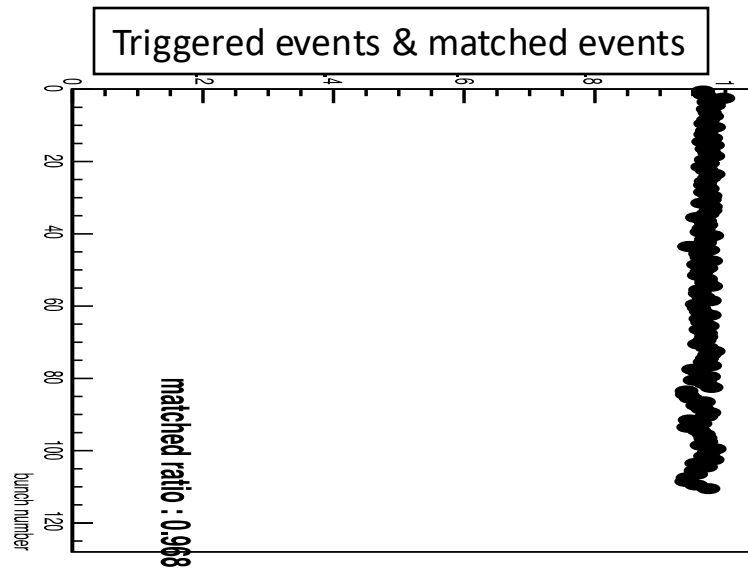
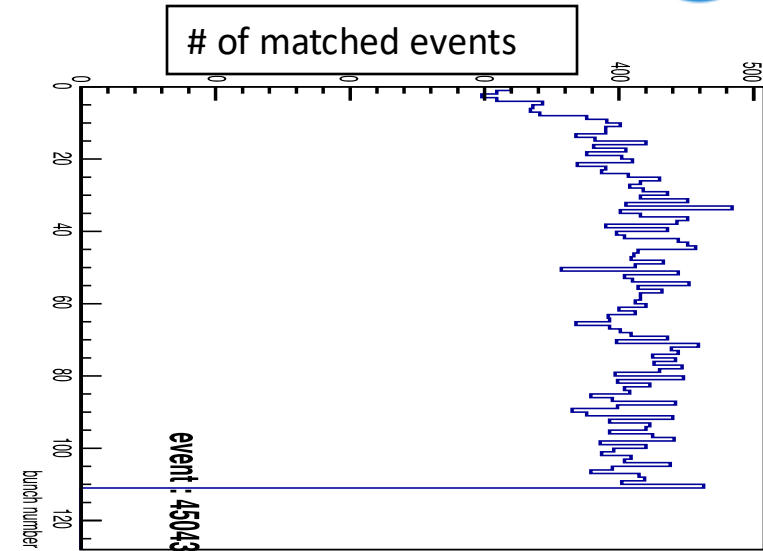
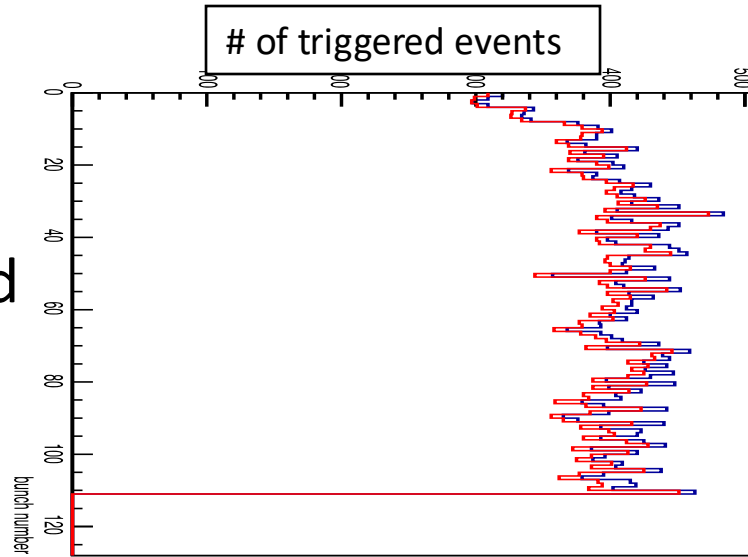
- Ratio : 48,004/50,000
~ 96.0%
- 1 half ladder in total masked during data taking
- 1.5 mrad X-ing angle
- # of events 50k
- Hot channel rejection
- DST file from latest macro



Result(Run 53227 / MBD vtx<10 used)



- Ratio : 43,580/45,043
~ 96.8%
- 1 half ladder in total masked during data taking
- 1.5 mrad X-ing angle
- # of events 50k
- Hot channel rejection
- DST file from latest macro



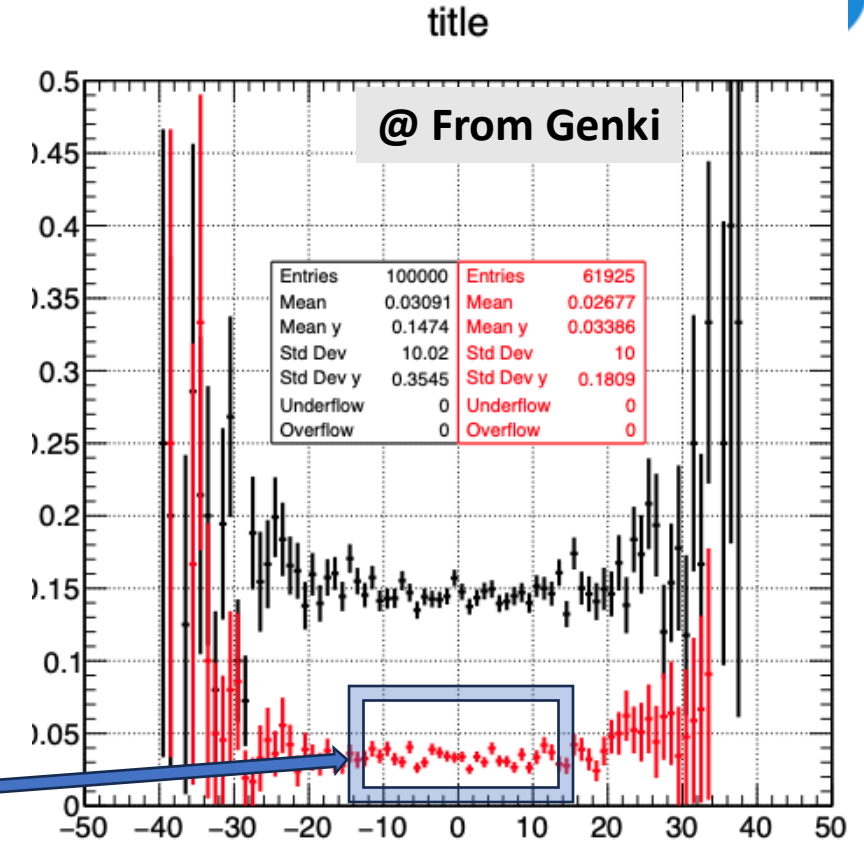
Summary result table

Trigger type	Ratio-Jaein (%)	Ratio-Genki old(%)	Ratio-Genki new(%)
All	92.7%	82%	92.7%
Clock	38.6%	43%	-
MBD N&S	93.5%	77%	-
MBD N&S 10>vtx	95.0%	82%	95.0%

Very nice consensus achieved!
Should be less than >0.01% disagreement

Note	Run 50889	Run 53227
All	92.7%	96.0%
MBD N&S 10>vtx	95.0%	96.7%
# of masked ch	4 half ladder+@	1 half ladder + @
X-ing angle	0 mrad	1.5 mrad

With 1.5 X-ing angle, we have nice agreement with MC in terms of the GL1 finding efficiency



Ratio of #INTT cluster/event = 0
as a function of truth z_{vtx}

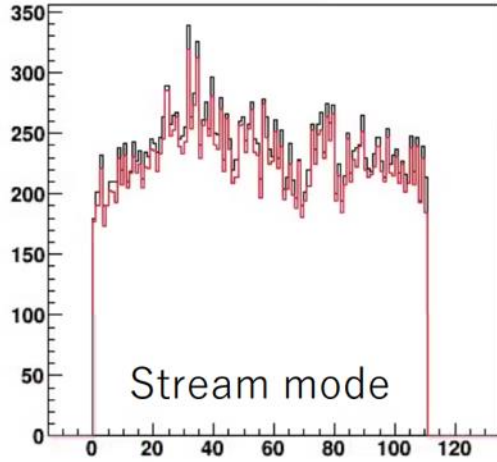
- No cut
- Simulated MBD trigger

Q) Why did Takashi see the difference between two streaming runs?

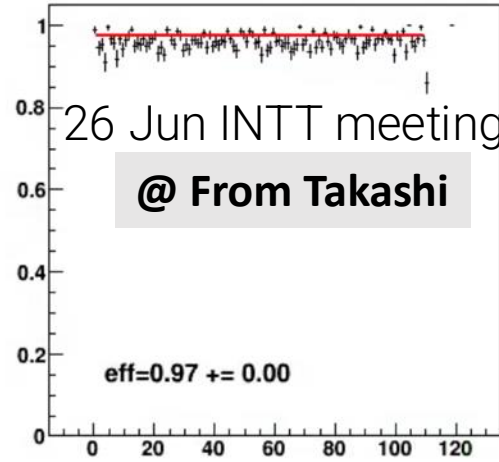
Streaming
Run 46099 (INTT LOCAL) **97%**
Run 46090 (Big Partition)

Streaming
Run 47977 (Big Partition) **94%**
Streaming (run47977)

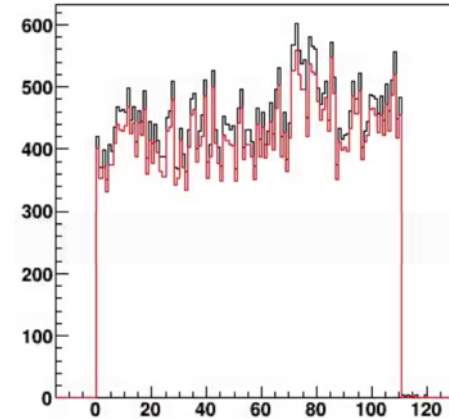
bunch @ gl1



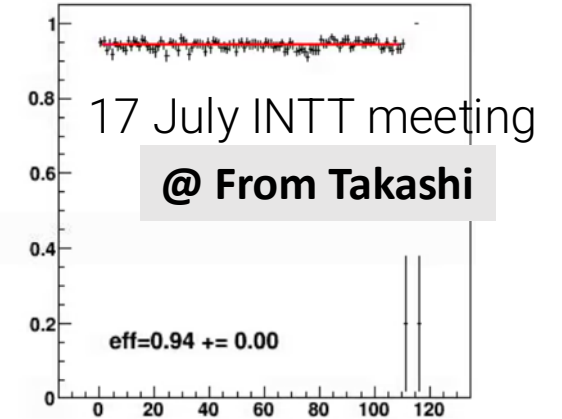
bunch @ evt all felix



bunch @ gl1



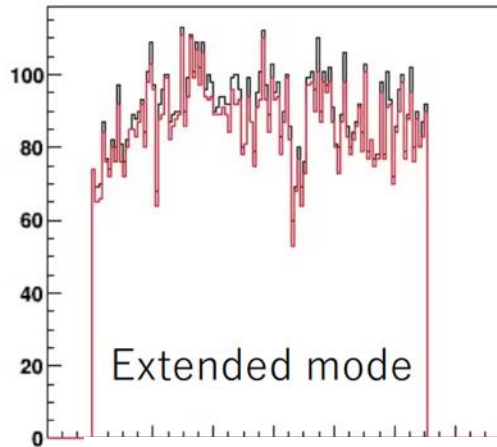
bunch @ evt all felix



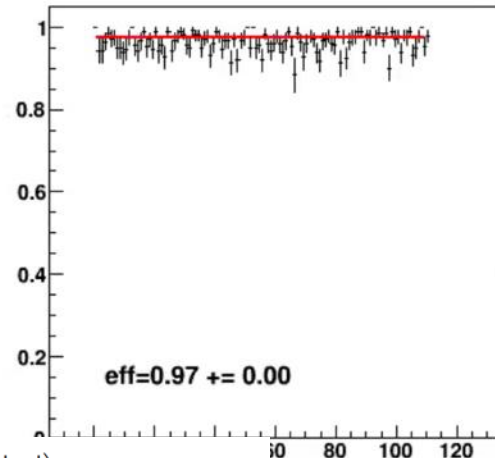
26 Jun INTT meeting
@ From Takashi

17 July INTT meeting
@ From Takashi

bunch @ gl1

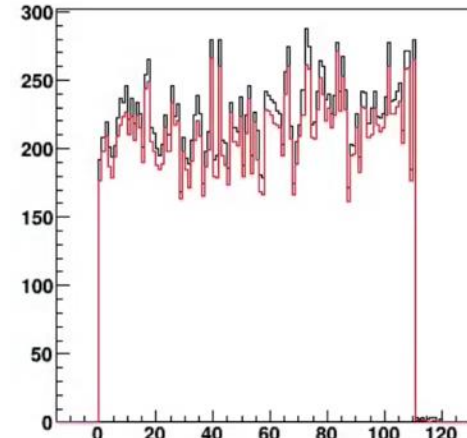


bunch @ evt all felix

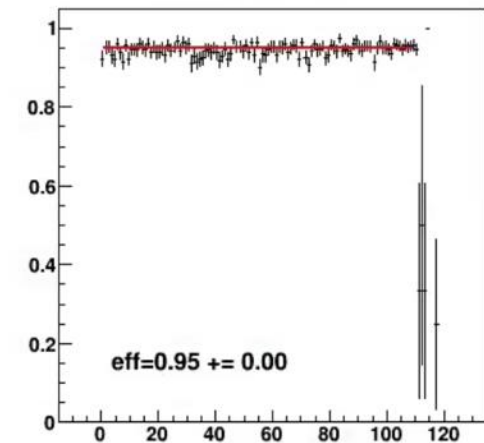


Triggered (run47982)

bunch @ gl1



bunch @ evt all felix



Run46090 (Big Partition : GL1 included)

Run46099 (INTT local)

Q) Why did Takashi see the difference between two streaming runs?



Streaming
Run 46099(INTT LOCAL) **97%**
Run 46090(Big Partition)

Streaming
Run 47977(Big Partition) **94%**

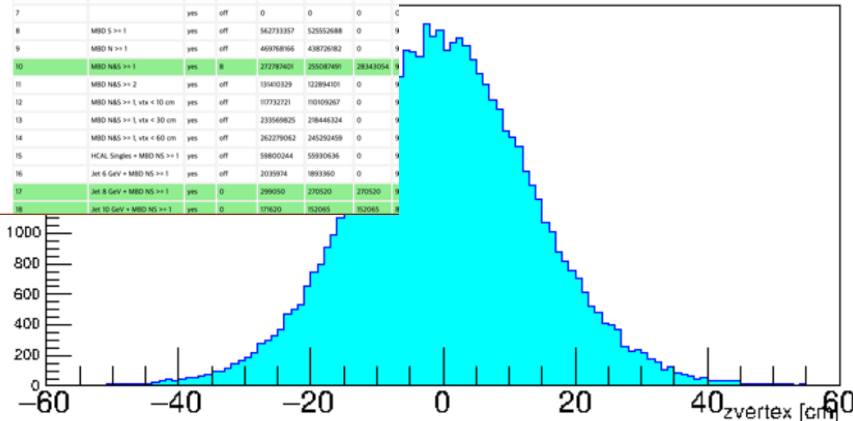
MRD ONLINE MONITOR

Run 46090 Trigger Configuration

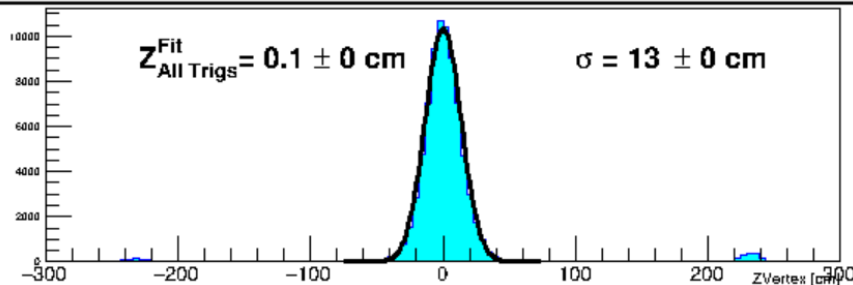
LL1 input channel	Triggerable	switchyard	Trigger input channel	Name	enabled	Scaledown	Raw	Live	Scaled
0	0	0	0	Clock	yes	off	3035169425	2837955071	0
1	0	0	1	ZDC South	yes	off	63563984	58450156	0
2	0	1	2	ZDC North	yes	off	56380443	52737364	0
3	5	2	3	ZDC Coincidence	yes	off	3626507	3625949	524355
4	5	3	4	HCAL Singles	yes	off	2090504	1953997	0
5	0	5	5	HCAL Coincidence	yes	off	3035169425	2837955071	0
6	0	6	6		yes	off	0	0	0
7	0	7	7		yes	off	0	0	0
8	5	8	8	MRD S >= 1	yes	off	56273357	525532688	0
9	5	9	9	MRD N >= 1	yes	off	46978166	43823682	0
10	5	10	10	MRD NS >= 1	yes	off	272787601	25087601	26343054
11	5	11	11	MRD NS >= 2	yes	off	15449329	12289400	0
12	5	12	12	MRD NS >= 1, vtx < 10 cm	yes	off	10733271	10105267	0
13	5	13	13	MRD NS >= 1, vtx < 30 cm	yes	off	23559825	21844324	0
14	5	14	14	MRD NS >= 1, vtx < 60 cm	yes	off	26227962	24529459	0
15	5	15	15	HCAL Singles + MRD NS >= 1	yes	off	5880244	55930636	0
16	5	8	16	Jet 8 GeV + MRD NS >= 1	yes	off	2039374	1893360	0
17	5	9	17	Jet 8 GeV + MRD NS >= 1	yes	off	266050	270520	0
18	1	18	18	Jet 10 GeV + MRD NS >= 1	yes	off	171620	152065	0

Date: Wed Jun 19 23:59:24 2024

x_ns, main trigger



MRD ZVertex (south<-->north)

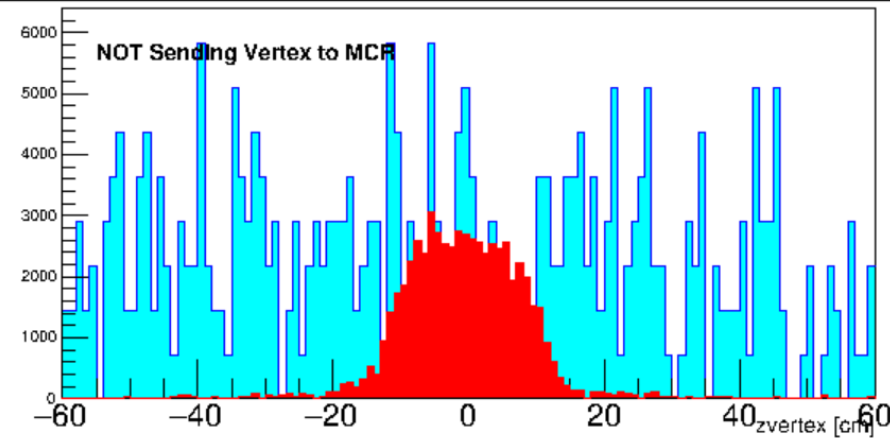


2 mrad X-ing angle

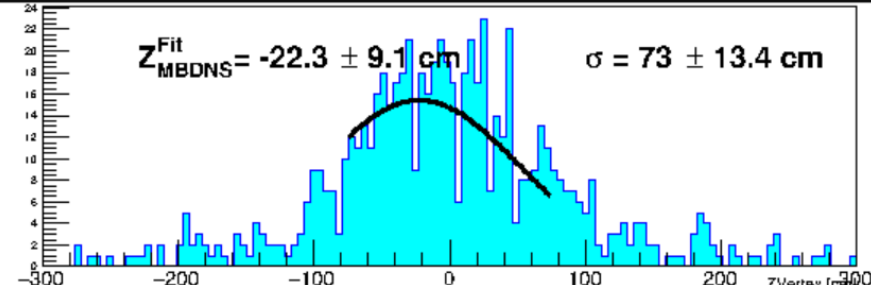
MRD ONLINE MONITOR

Run #47977 Events: 7269 Date: Thu Jul 11 02:46:05 2024

MRD zvertex



MRD ZVertex (south<-->north)



0 mrad X-ing angle

Q) Why did Takashi see the difference between two streaming runs?



Streaming
Run 46099(INTT LOCAL) **97%**
Run 46090(Big Partition)

Streaming
Run 47977(Big Partition) **94%**

Run 46090 Trigger Configuration

LL1 input channel	Triggerdelay	switchyard	Trigger input channel	Name	enabled	Scaledown	Raw	Live	Scaled	Live (%)
0	0	0	0	Clock	yes	off	30315169425	28379515071	0	9
1	0	0	1	ZDC South	yes	off	63563984	59450156	0	9
2	0	1	2	ZDC North	yes	off	56380443	52737364	0	9
3	5	2	3	ZDC Coincidence	yes	6	3926507	3670489	524355	9
4	5	3	4	HCAL Singles	yes	off	2090504	1953997	0	9
5	0	5	5	HCAL Coincidence	yes	off	30315169425	28379515071	0	9
6	0	6	6		yes	off	0	0	0	C
7	0	7	7		yes	off	0	0	0	C
8	5	8	8	MBD S >= 1	yes	off	562733357	525552688	0	9
9	5	9	9	MBD N >= 1	yes	off	469768166	438726182	0	9
10	5	10	10	MBD N&S >= 1	yes	8	272787401	255087491	28343054	9
11	5	11	11	MBD N&S >= 2	yes	off	131410329	122894101	0	9
12	5	12	12	MBD N&S >= 1, vtx < 10 cm	yes	off	117732721	110109267	0	9
13	5	13	13	MBD N&S >= 1, vtx < 30 cm	yes	off	233569825	218446324	0	9
14	5	14	14	MBD N&S >= 1, vtx < 60 cm	yes	off	262279062	245292459	0	9
15	5	15	15	HCAL Singles + MBD NS >= 1	yes	off	59800244	55930636	0	9
16	5	8	16	Jet 6 GeV + MBD NS >= 1	yes	off	2035974	1893360	0	9
17	5	9	17	Jet 8 GeV + MBD NS >= 1	yes	0	299050	270520	270520	9
18	1	18	18	Jet 10 GeV + MBD NS >= 1	yes	0	171620	152065	152065	8

Run 47977 Trigger Configuration

LL1 input channel	Triggerdelay	switchyard	Trigger input channel	Name	enabled	Scaledown	Raw	Live	Scaled	Live (%)
0	0	0	0	Clock	yes	93831	8798100995	7295288167	77748	82.9
1	0	0	1	ZDC South	yes	off	98056199	81370897	0	83.0
2	0	1	2	ZDC North	yes	off	88857939	73734297	0	83.0
3	5	2	3	ZDC Coincidence	yes	23	8612286	7143586	297649	82.9
4	5	3	4	HCAL Singles	yes	off	6059057	5030119	0	83.0
5	0	5	5	HCAL Coincidence	yes	off	8798100995	7295288167	0	82.9
6	0	6	6		yes	off	0	0	0	0
7	0	7	7		yes	off	0	0	0	0
8	4	8	8	MBD S >= 1	yes	off	1041513591	864292566	0	83.0
9	4	9	9	MBD N >= 1	yes	off	881932437	731578171	0	83.0
10	4	10	10	MBD N&S >= 1	yes	726	675707193	560570081	771073	83.0
11	4	11	11	MBD N&S >= 2	yes	off	465763187	386418080	0	83.0
12	4	12	12	MBD N&S >= 1, vtx < 10 cm	yes	20	91622735	76032910	3620614	83.0
13	4	13	13	MBD N&S >= 1, vtx < 30 cm	yes	off	246004240	204140857	0	83.0
14	4	14	14	MBD N&S >= 1, vtx < 60 cm	yes	off	483526505	401209777	0	83.0
15	4	15	15	HCAL Singles + MBD NS >= 1	yes	off	63978844	53095475	0	83.0
16	4	8	16	Jet 6 GeV + MBD NS >= 1	yes	off	3747509	3104690	0	82.8
17	4	9	17	Jet 8 GeV + MBD NS >= 1	yes	0	463729	382412	382412	82.5
18	1	18	18	Jet 10 GeV + MBD NS >= 1	yes	0	127180	104424	104424	82.1

Only Physics Trigger included (no clock)

2024-10-16

Clock trigger also included
Can decrease matching ratio

Understanding previous unsolved(?) issue

Let's try to answer previous issue!

Q1) Difference between two analysis results (Genki/Jaein)

A) needed to have apple to apple comparisons

- Confirmed by careful review of analysis procedure

Note	Run 50889	Run 53227
All	92.7%	96.0%
MBD N&S 10>vtx	95.0%	96.7%
# of masked ch	4 half ladder+@	1 half ladder + @
X-ing angle	0 mrad	1.5 mrad

Q2) Low Gl1 finding efficiency

A1) Trigger configuration – Confirmed by Trigger selection

ex) Clock trigger can clearly contaminate Gl1 finding efficiency

A2) MBD 10 cm > z-vtx trigger cannot cut every collision from z-vtx>10cm

- Confirmed by two different X-ing angle data set

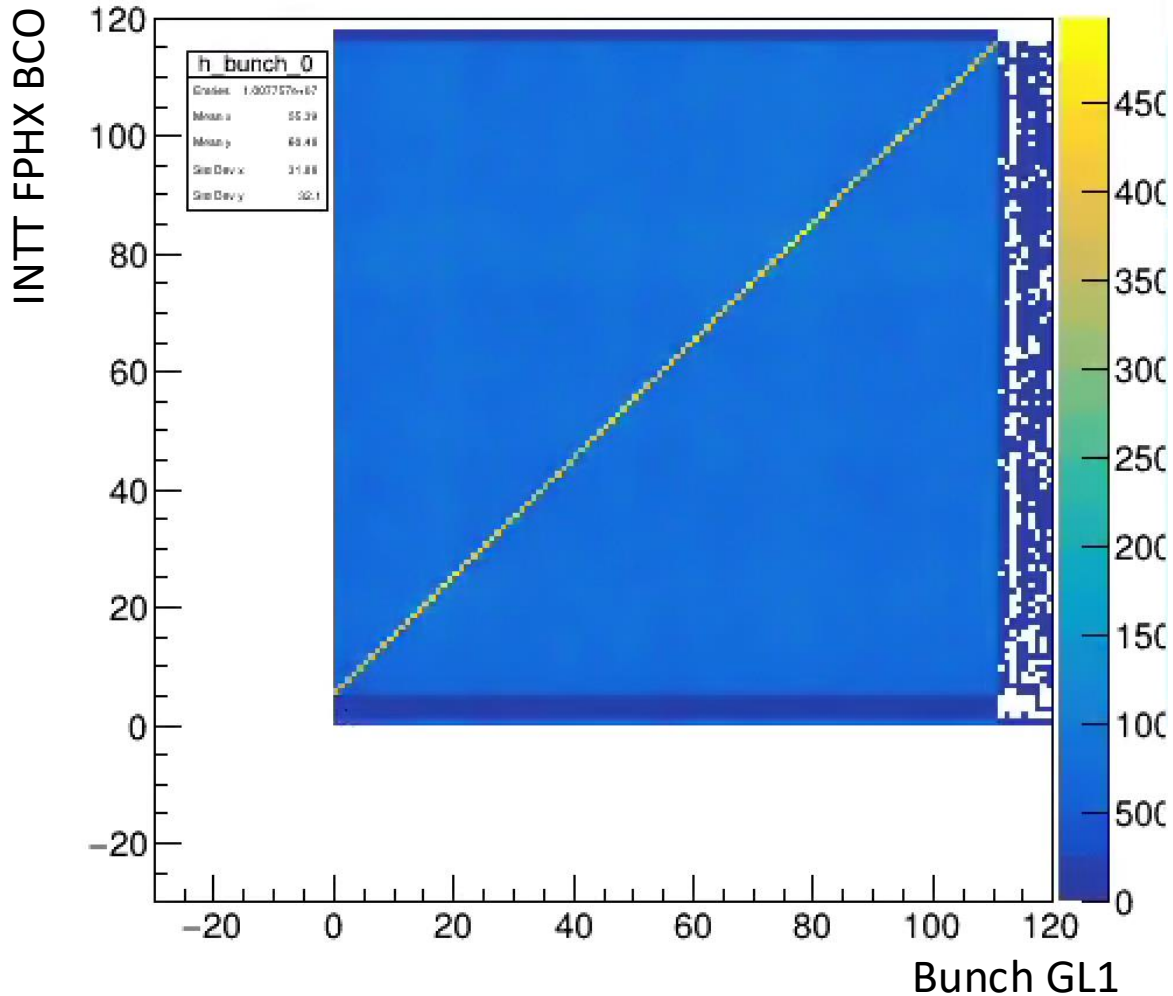
Q3) Why did Takashi see the difference between two streaming runs?

-> Answer is same as Q2).

backup

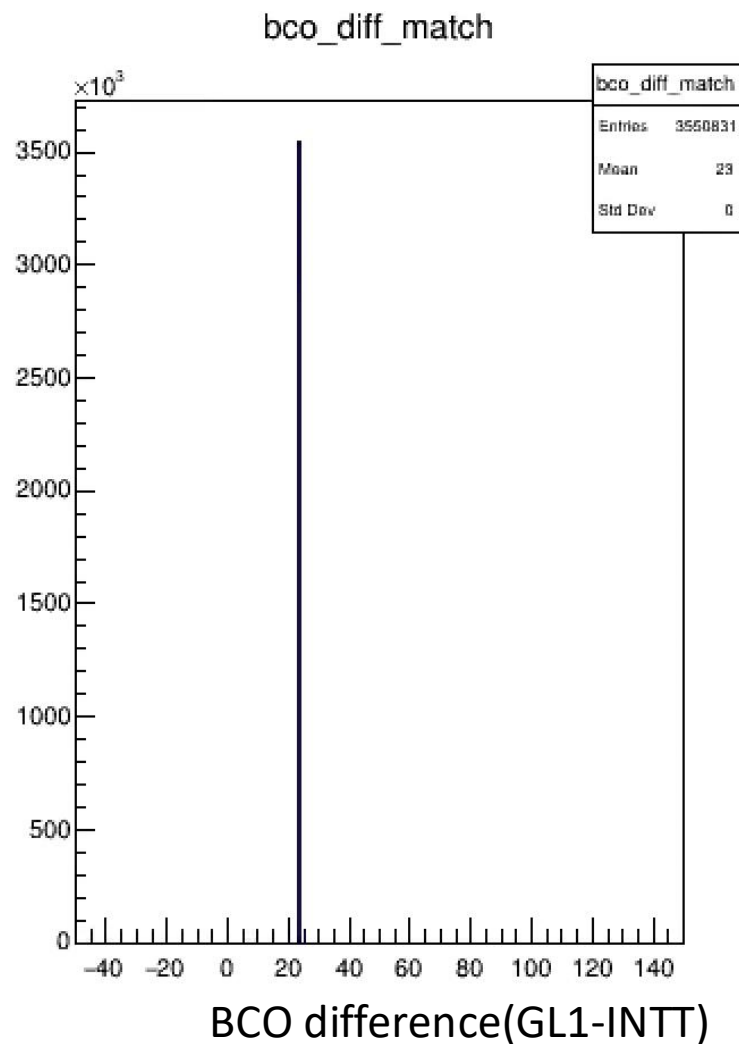
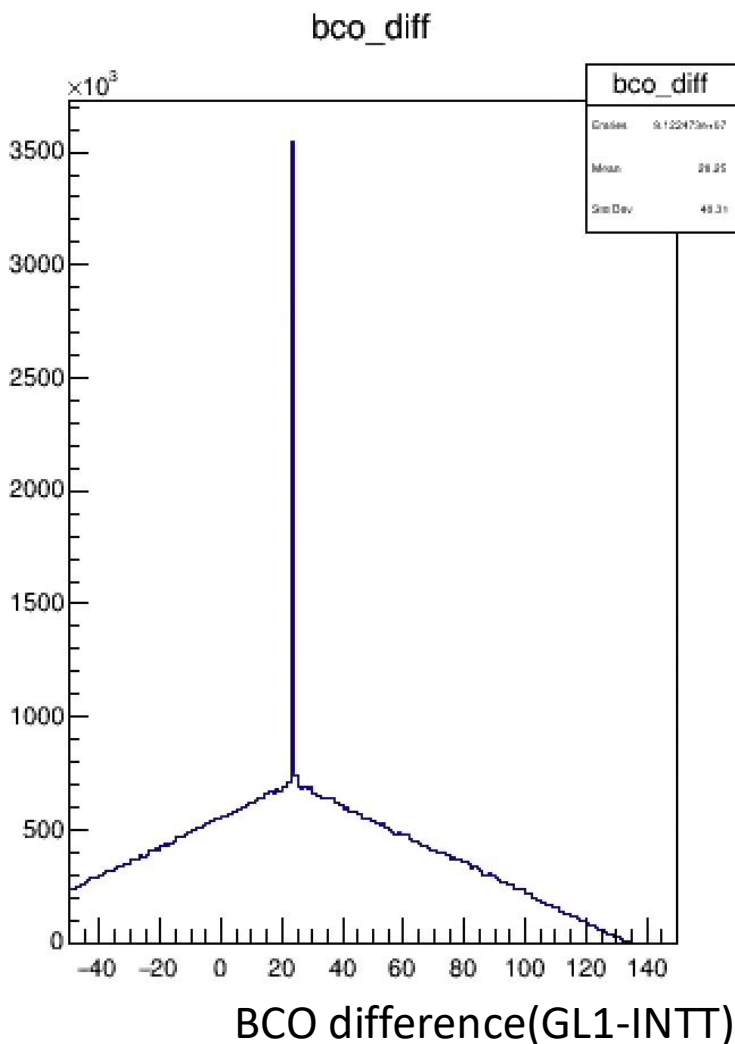
Some QA before GL1 matching ratio calculation

FPHX BCO(INTT) vs bunch #(GL1)



- Run 50889
- INTT 0 used
- 50,000 events used
- Hot channel rejected
- We can see clear correlation btw INTT and GL1

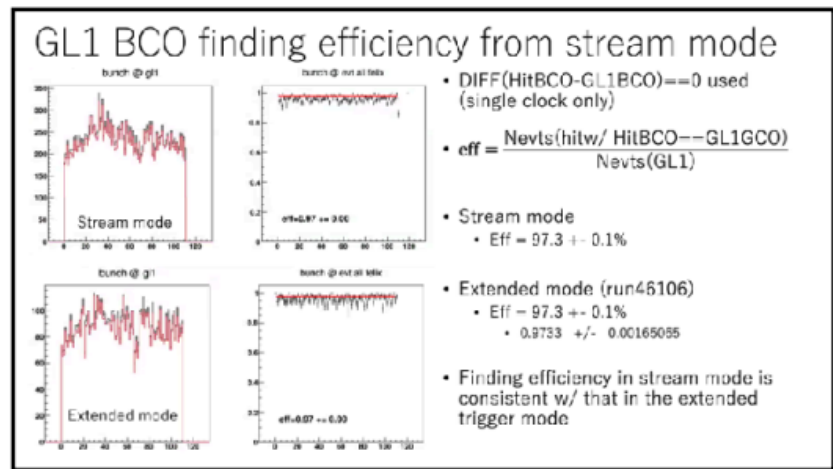
Some QA before GL1 matching ratio calculation



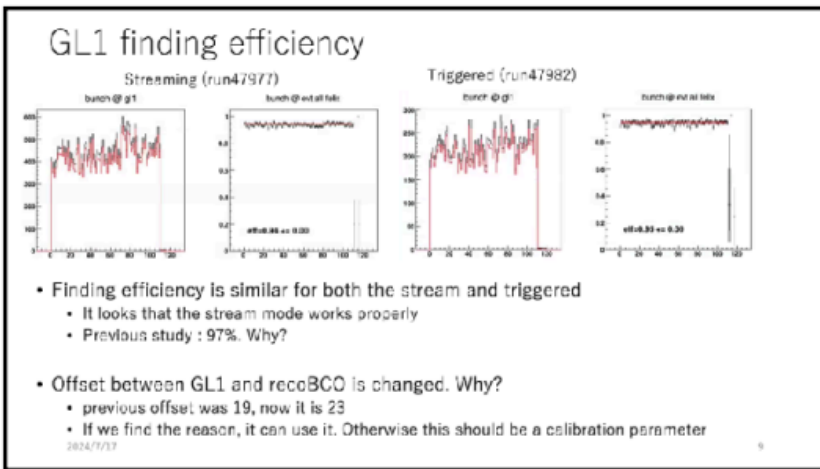
- Run 50889
- 50,000 events used
- Hot channel rejected

Hit from bco_diff match hit were used to count matched events

Summary



Takashi's first report

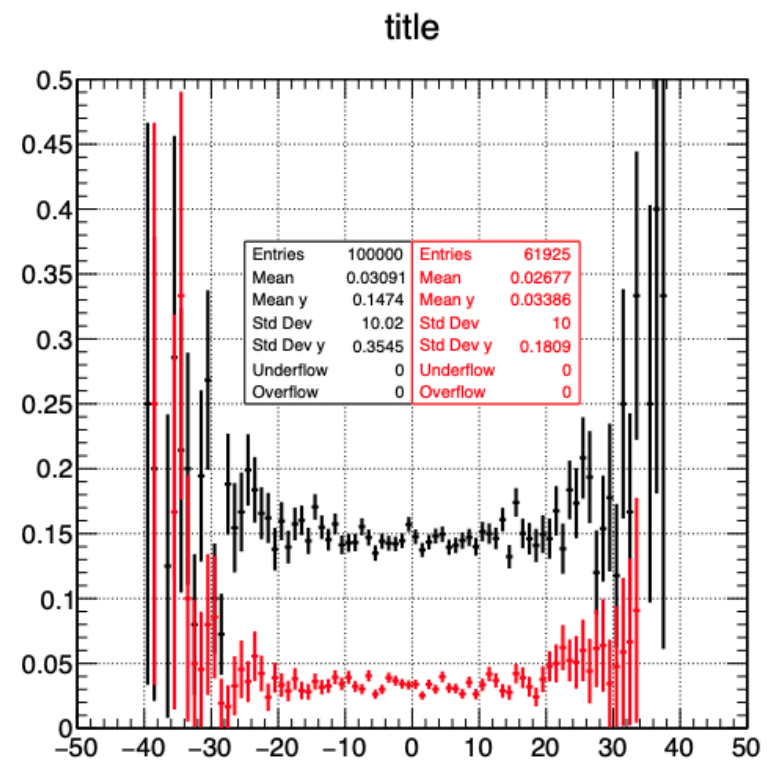


Takashi's latest report

GL1 finding efficiency

- Takashi's first report: 97.3%
- Takashi's latest: 94 — 95%
- Suggested efficiency from MC study: 96 — 97%

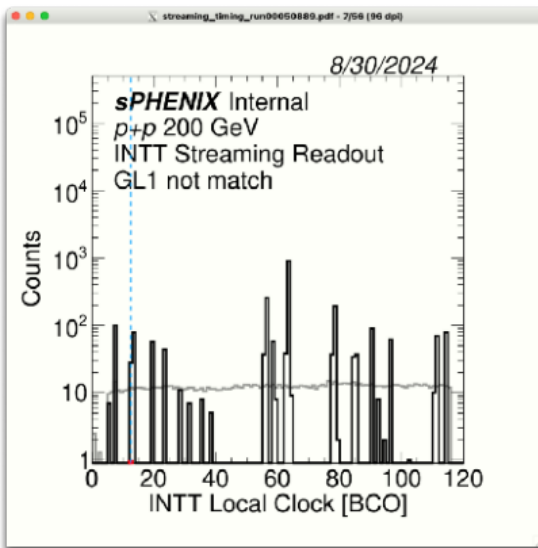
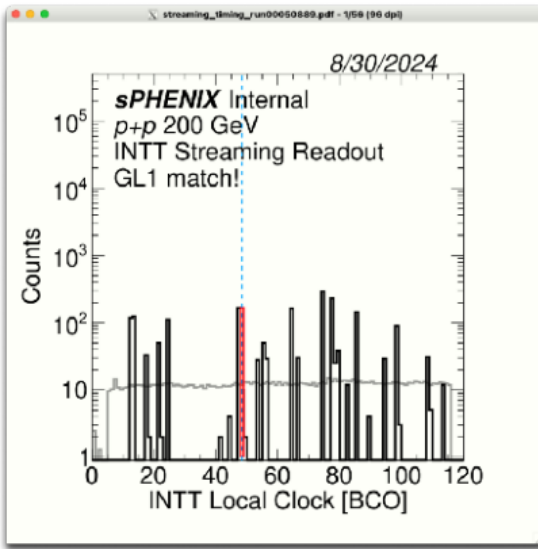
Note: MBD trigger mimic needs to be checked by the MBD group.



Ratio of #INTT cluster/event = 0 as a function of truth z_{vtx}

- No cut
- Simulated MBD trigger

What about GL1 matching?



Trigger type?:

The trigger type (clock, MBD N&1 >= 1, etc.) should affect to the GL1 matching ratio.
Thanks to Jaein, I could get information like:

```

153 std::vector< int > InttStreamingTiming::GetTriggerBits()
154 {
155
156     uint64_t trigger_vector = gl1->getScaledVector();
157
158     vector< int > rtn;
159     while( trigger_vector != 0 )
160     {
161         int this_bit = 0 ;
162         this_bit = trigger_vector & 1;
163         // cout << std::bitset<32>(trigger_vector) << " "
164         //         << this_bit << "\t";
165
166         trigger_vector = trigger_vector >> 1;
167
168         //cout << std::bitset<32>(trigger_vector) << endl;
169
170         rtn.push_back( this_bit );
171     }

```

~~I don't see trigger dependence.~~
The matching ratio is always too low.
I think I'm wrong.

Bit	Name	#match	#all	Ratio
0	Clock	6	14	0.43
1	ZDC South	0	0	
2	ZDC North	6	14	0.43
3	ZDC N&S	24	43	0.56
4	HCAL Single	24	43	0.56
5	HCAL Coincidence	24	43	0.56
6		24	43	0.56
7		0	0	
8	MBD S>=1	16	31	0.52
9	MBD N>=1	4	7	0.57
10	MBD N&S>=1	100	130	0.77
11	MBD N&S>=2	26	34	0.76
12	MBD N&S>=1 vtx<10cm	216	265	0.82
13	MBD N&S>=1 vtx<30cm	57	73	0.78
14	MBD N&S>=1 vtx<60cm	190	244	0.78
15	HCAL, Singles+MBD NS>=1	32	41	0.78
16	Jet 6GeV+MBD NS>=1	177	224	0.79
17	Jet 8GeV+MBD NS>=1	141	168	0.84
18	Jet 10GeV+MBD NS>=1	242	300	0.81
19	Jet 12GeV+MBD NS>=1	12	21	0.57
20	Jet 6GeV	224	280	0.80
21	Jet 8GeV	320	390	0.82
22	Jet 10GeV	281	347	0.81
23	Jet 12GeV	215	259	0.83
24	Photon 2GeV+MBD NS>=1	52	73	0.71
25	Photon 2GeV+MBD NS>=2	75	98	0.77
26	Photon 2GeV+MBD NS>=3	310	381	0.81
27	Photon 2GeV+MBD NS>=4	82	91	0.90
28	Photon 2GeV	246	309	0.80
29	Photon 3GeV	134	163	0.82
30	Photon 4GeV	584	709	0.82
31	Photon 5GeV	213	254	0.84
all	all	638	778	0.82

Only 1k events were analyzed for each trigger.