Happy Lunar New Year! 新年快樂！

Remaining tasks for INTT

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Context

- Now, the sPHENIX operation has come to an end. The sPHENIX should now transition to the full-analysis phase

- We should start to review the progress we have made, which is, of course, huge!
  - But also the remaining tasks for INTT that we need to resolve/accomplish

- I prepared a wiki page aiming to summarize/monitor the tasks
  - https://wiki.sphenix.bnl.gov/index.php?title=INTT_Remaining_task

The remaining tasks

- **High Priority**
  - INTT DAC setting implementation
  - Offline QA, good run list for INTT
  - Carried-over-hit issue
  - The duplicate hits in Run25 AuAu due to too large open_time
  - INTT data-MC edep discrepancy (ClusAdc, ClusPhiSize)
  - INTT timing reliability, fraction of the hits to the next bco bin

- **Low Priority**
  - INTT geometry distorted by the alignment parameters
  - Cluster
    - splitting
    - merger
  - Timing instability

Feel free to edit the web page if you come up with some new tasks, or if you have some updates for the task

INTT DAC setting implementation

- The module, InttDacMap.cpp, is for assigning the INTT hit DAC values
  - From adc0 - adc7 to thresholds we set to the FPHX comparators
- We kept the adc settings for all (most) of the runs in the sPHENIX PSQL DB (intt_setting)
- Currently, the InttDacMap.cpp module reads the table from the CDB file, but the CDB is outdated
  - There are only three DAC maps in the sPHENIX CDB file system
- We need to come up with a way to have the correct DAC values assigned to the INTT hits
  - We need to link runnumber to the corresponding threshold setting
  - We either update the CDB files or we load the values from the PSQL database

In the sPHENIX CDB file system

```
[ecie9969@sphnxuser08 cdb]$ ls INTT_DACMAP/*/*/*
INTT_DACMAP/05/2b/052bc59ac86636e7ee2310c636a0218e_CDBTTree_INTT_DACMAP_2024.root
INTT_DACMAP/fb/c5/fbc57b510a51212c46c98b6cef0219f8_CDBTTree_INTT_DACMAP.root
INTT_DACMAP/fd/55/fd551e8101598bcecdb3b305c19379f1_cdb_intt_dac_35_45_60_90_120_150_180_210_streaming.root
```

The variation of the threshold settings in INTT lifetime

			adc0
Run24	pp	triggered	30
		streaming	35
	AuAu	triggered	35
Run25	AuAu	triggered	30/25 (35?)
	pp	triggered	30?
		streaming	35
	OO	triggered	30
		streaming	35

```cpp
class InttDacMap
{
 public:
  InttDacMap();
  virtual ~InttDacMap() {}

  virtual int LoadFromCDB(std::string const& calibname);
  virtual int LoadFromFile(std::string const& filename);
  virtual int WriteToFile(std::string const& filename);
```

Issue in the intt_setting table

Somehow, the physics run 80125 is not listed in the INTT database

Message ID: **1656**	Entry time: **Tue Dec 23 20:54:50 2025**
Author:	Hanpu Jiang
Subject:	12/23 evening shift
Run:	

Run Number	Run Type	Reason for Stop	Duration [min]	Notes
80118	Cosmic	Reach 1 hour	60 min	
80119	Cosmic	Reach 1 hour	59 min	
80120	Cosmic	Beam injection	45 min	
80123	Physics	To include TPC	11 min	
80125	Physics	SEB05 busy	31 min	
80126	Physics	Reach 1 hour	60 min	
80127	Physics	Handle to owl shift		

and then you would get

```
  missing_physics_runs
 ----------------------
                   697
(1 row)
```

Similar command to check the number of physics runs in `run` table.

```
1    select count(*) as aaa from run where runnumber > 20000 and runtype = 'physics';
```

then you get

```
  aaa
 -------
  10936
(1 row)
```

697 / 10936 = 6.37%

Jaein Hwang 2 weeks ago
Does this method also include some runs when INTT was not in big partition?(I bet it's quite rare but we have some)
🖉 Edited

```
[daq=> select * from intt_setting where runnumber > 80000;
 runnumber | n_collisions | open_time | readout_mode | dac0 | dac1 | dac2 | dac3 | dac4 | dac5 | dac6 | dac7
-----------+--------------+-----------+--------------+------+------+------+------+------+------+------+------
     80001 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80002 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80003 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80004 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80005 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80006 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80007 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80008 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80009 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80010 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80011 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80012 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80013 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80014 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80015 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80016 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80017 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80119 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80120 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80122 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80123 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80124 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80126 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
     80127 |          127 |        59 | streaming    |   35 |   45 |   60 |   90 |  120 |  150 |  180 |  210
```

It seems that few hundred physics runs are missing in the INTT DB

Offline QA, the good run list

- The sPHENIX run QA: https://sphenix-intra.sdcc.bnl.gov/WWW/scripts/runqa/all.py?page_size=50&page=2
  - In total, we have Run24 pp, Run24 AuAu, Run25 AuAu, Run25 pp, and Run25 OO
  - As far as I know, sPHENIX aims to centralize the good run list
  - Is this the official one?

Large acceptance losses? Really? Or is it just hot channels biasing the scale?

There are runs where the INTT is labeled as "Bad". Is it really "bad"?

| Run #	Begin Run Time	QA Links	Previews	Run Type	MVTX	INTT	TPC	TPOT	EMCAL	IHCAL	OHCAL	MBD	ZDC	sEPD	Tracking QA Ready	Calo QA Ready	Shifter Checked
82425	2026-02-01 21:57:09	Mon / Online / Mon		physics	Good	Good	Good	Good	Quest. bit shifted hot tower	Good	Good	Good	Good	Good	QA ready	QA ready	Open
82424	2026-02-01 21:35:30	Offline / Mon / Online / Mon		physics	Bad	Bad	Bad	Bad	Bad	Bad	Bad	Bad	Bad	Bad	QA ready	QA ready	Open
82423	2026-02-01 20:44:38	Offline / Mon / Online / Mon		physics	Good	Good	Good	Good	Quest. bit shifted hot tower	Good	Good	Good	Good	Good	QA ready	QA ready	Open
82422	2026-02-01 20:20:57	Offline / Mon / Online / Mon		physics	Good	Good	Good	Good	Quest. bit shifted hot tower	Good	Good	Good	Good	Good	QA ready	QA ready	Open
82421	2026-02-01 19:19:04	Offline / Mon / Online / Mon		physics	Bad	Bad	Bad	Bad	Quest. bit shifted hot tower	Good	Good	Good	Good	Good	QA Not ready	QA ready	Open
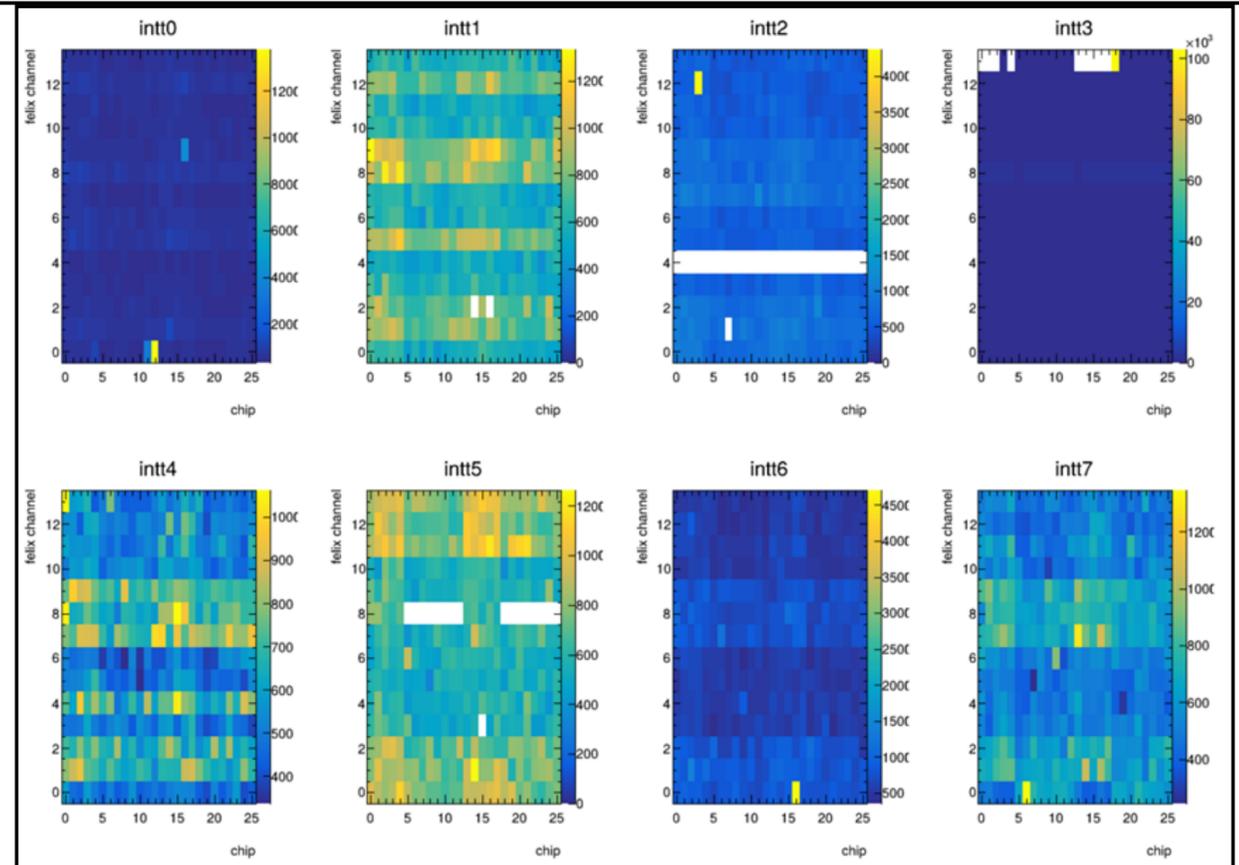
Jaein has put a lot of effort into the INTT good run classification. Now we need to take over and synchronize/update our good run list to the sPHENIX official table

Xin Hu 3:08 AM
Hi INTT experts, runs #82526, 82508, INTT Hitmaps There are large acceptance losses. Runs were marked as QUESTIONABLE for INTT. Hi MVTX experts, runs #82526, 82523, chi2/ndf are bad. Runs were marked as QUESTIONABLE for MVTX.

February 06

图片.png PNG 265KB
图片.png PNG 259KB
图片.png PNG 211KB
图片.png PNG 210KB

Carried-over-hit issue

- Caiired-over-hit issue happens in triggered and streaming modes, but behaves differently
  - Now we have <u>Ryotaro</u> trying to implement some functions in the decoder step for the <u>triggered mode</u>, which is very nice
  - We should also look into the issue in streaming mode (see backup)
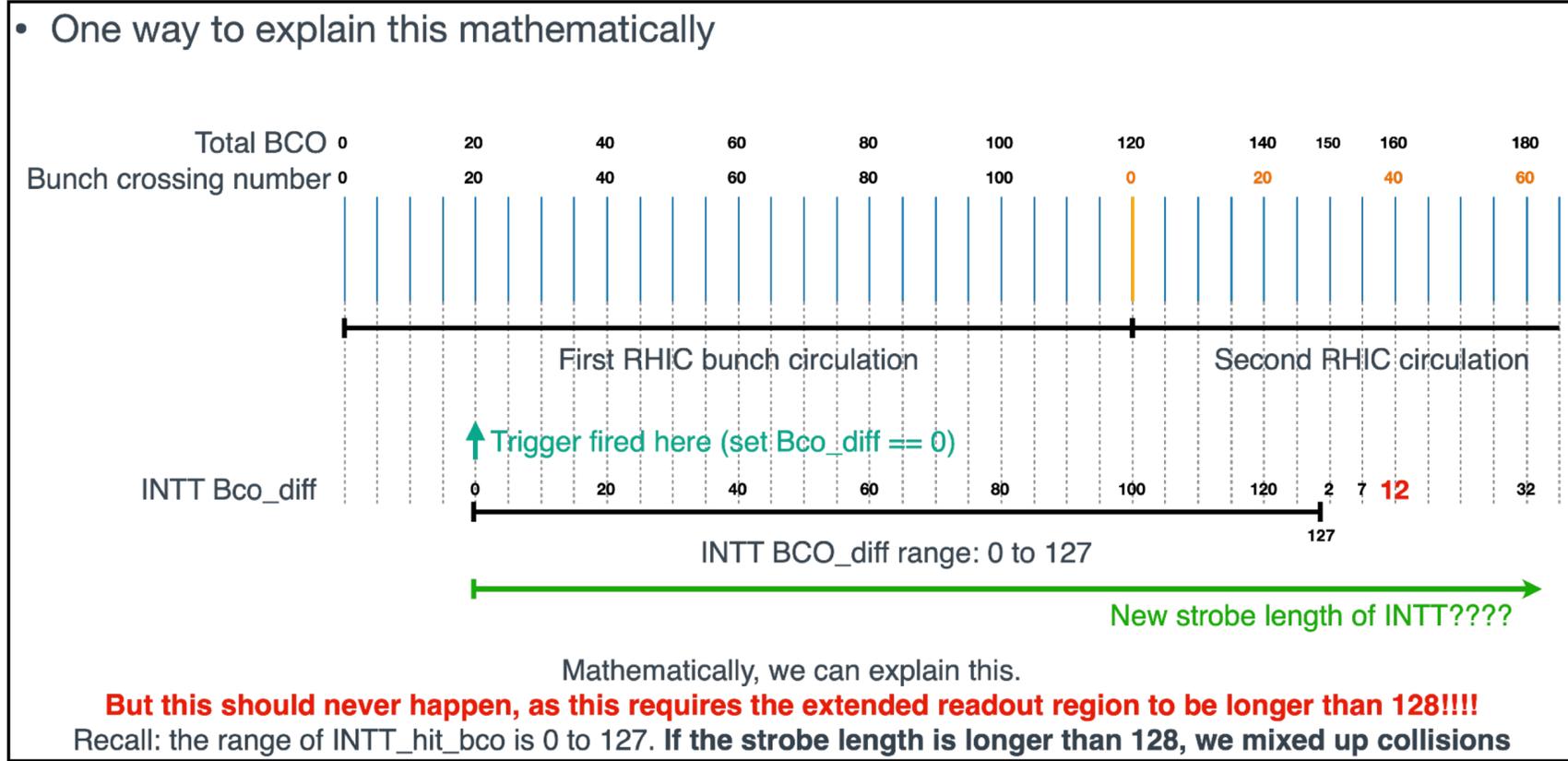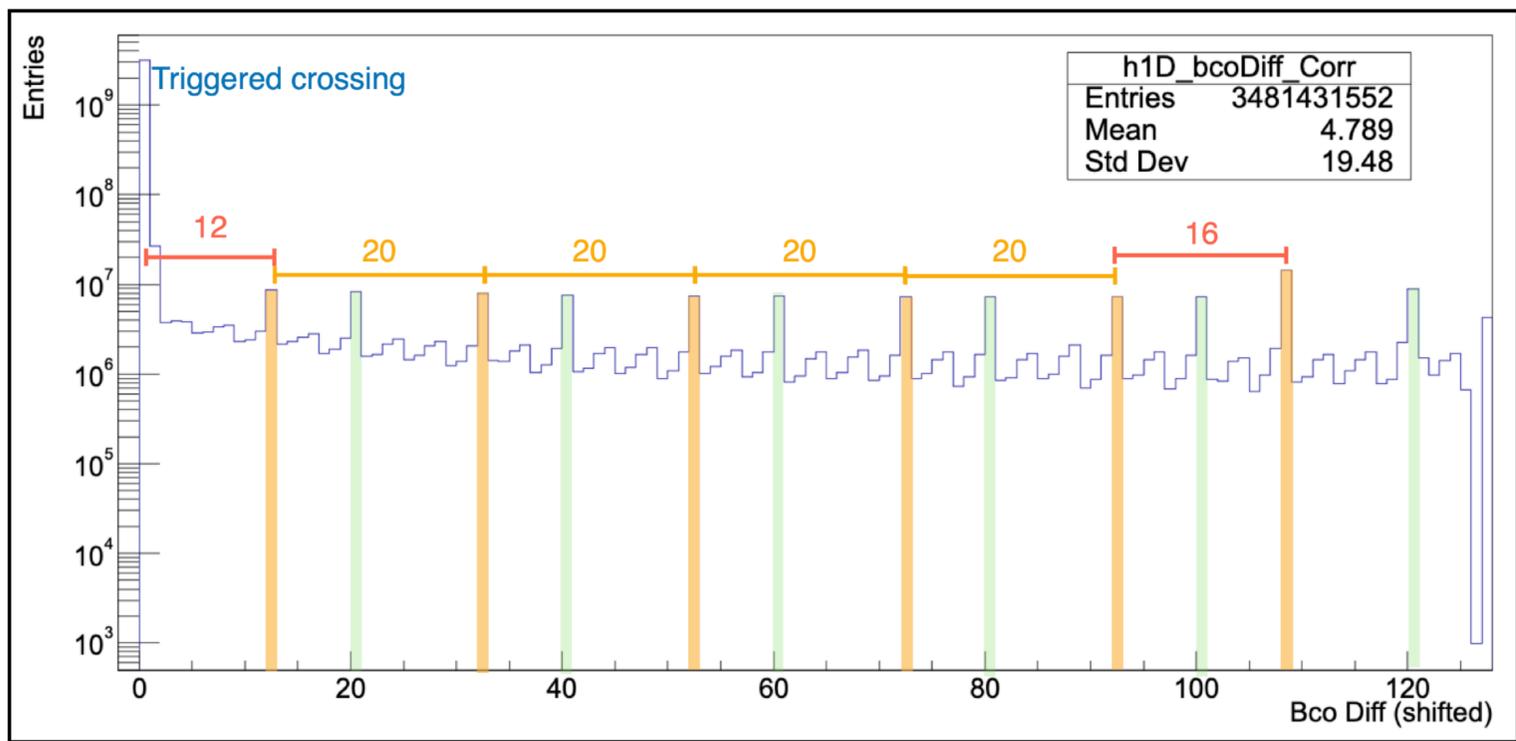
In triggered
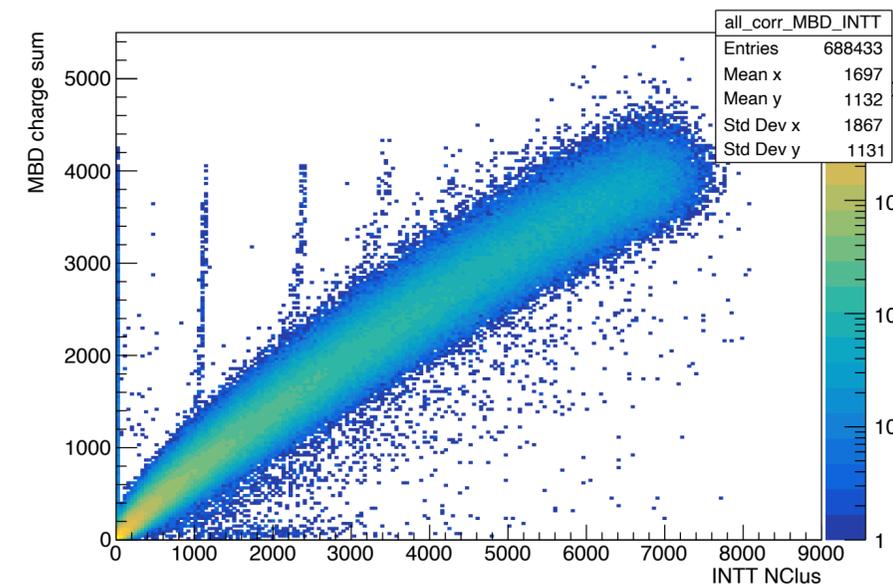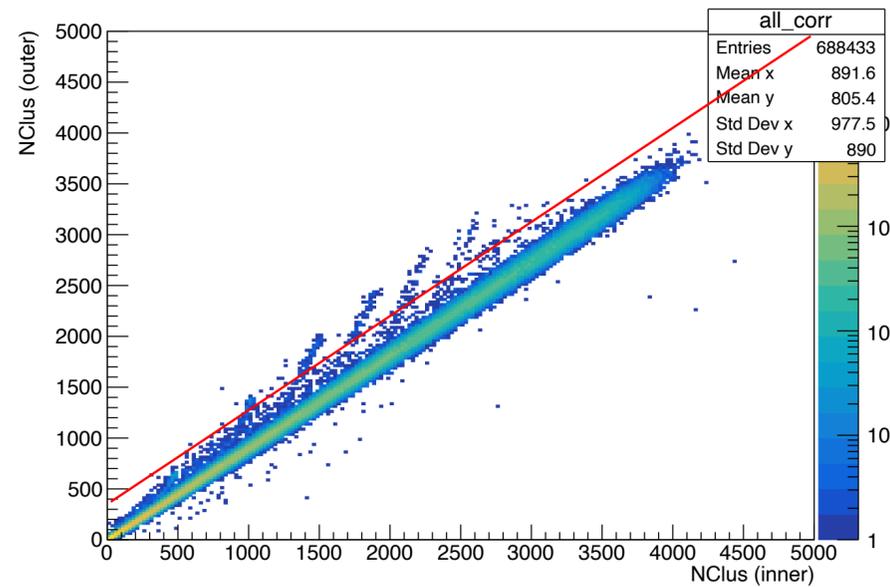
In streaming
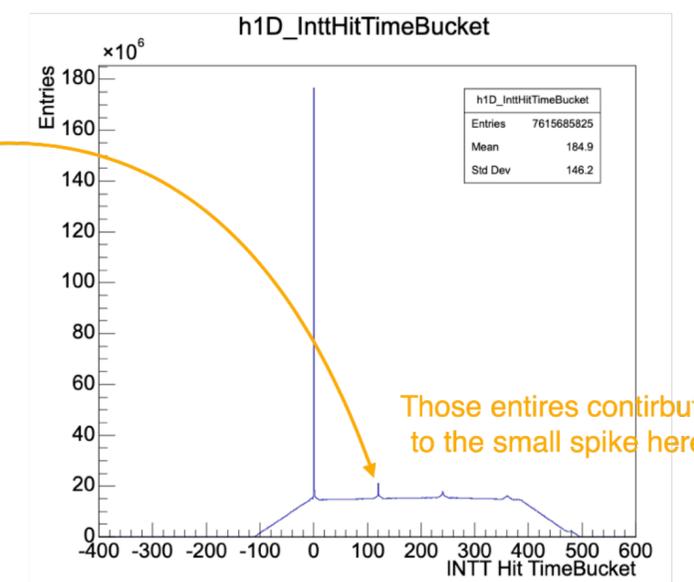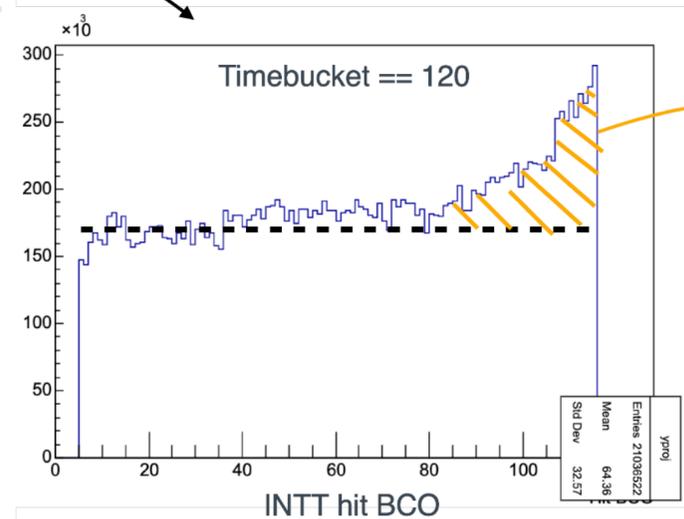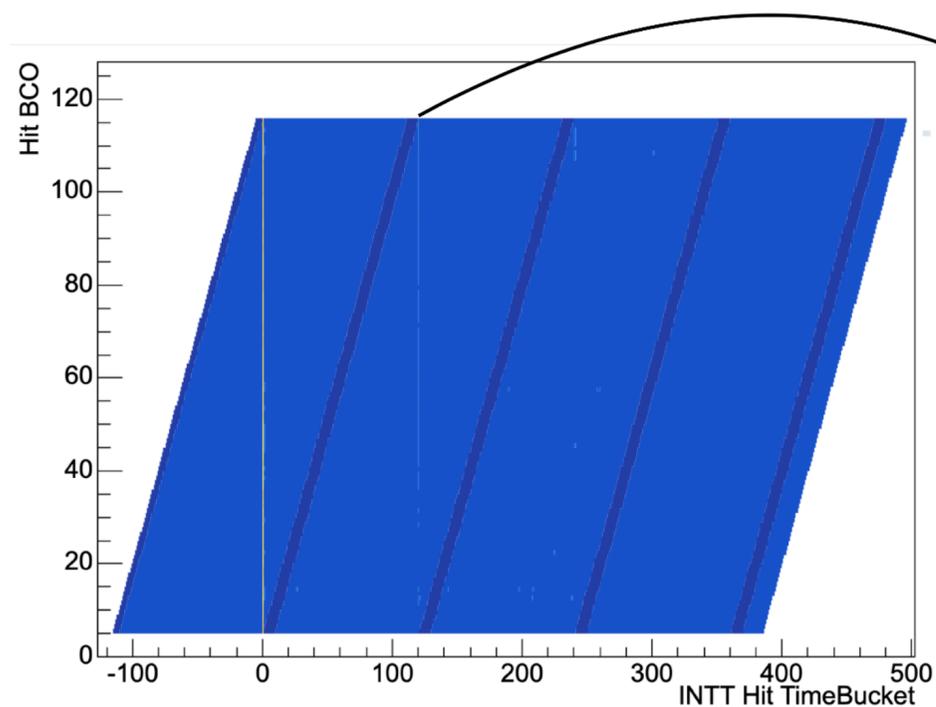
Those entires contirbute to the small spike here

- Context:
  - I was checking a 6x6 run and found that there are more than 6 spikes in the INTT data
  - Those additional spikes are very likely to be due to too long open_time we set
  - The reason for extending the open_time was to try to resolve the chip-saturation issue

Several Run25 AuAu runs are affected. We need to resolve this (If one wishes to use the extended readout region)

INTT data-MC edep discrepancy

- We know that the current MC can not fully describe the INTT data, and there are some things we can improve in the INTT simulation

- The major issues in the MC can be found below
  - `siinactive_volume` is called by `si_glue_box`
  - Very small clearance in INTT Geant4 geometry, resulting in triggering the overlapping error when updating the geometry
  - Incorrect ZID assignment
  - Hard-coded threshold setting
  - No hit rejection if the hit_adc is below the threshold
  - non-optimized diffusion radius model and parameters
    - edep distribution discrepancy b/w data and MC
   - cluster phi size discrepancy

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Another input to the tracking group?

1 bin = 1 BCO (~100 ns) = bunch crossing

sPHENIX Preliminary
Run-24 p+p 200 GeV
Run 50379
INTT Triggered mode

Clusters fired the trigger

Clusters taken in the extended time

~10 μs

Crossing relative to GTM [BCO]

readout here

time axis

9/12/2024

sPHENIX Internal
Run-24 p+p 200 GeV, Run 50889
INTT Streaming Readout
BCO 396904292675

—#INTT hits (100k strobes average)
—#INTT hits (single strobe)
—#INTT hits (Matching trigger timing)

INTT Local Clock [BCO]

The timing resolution of INTT is limited by the performance FPHX chip
What important here is to understand the fraction of the hits moved to the next
bco due to the imperfect coarse/fine delay settings

Or say, the question could be, shall we try to find a way to evaluate how good the INTT timing is?

INTT geometry distortion

w/ the latest alignment parameter file
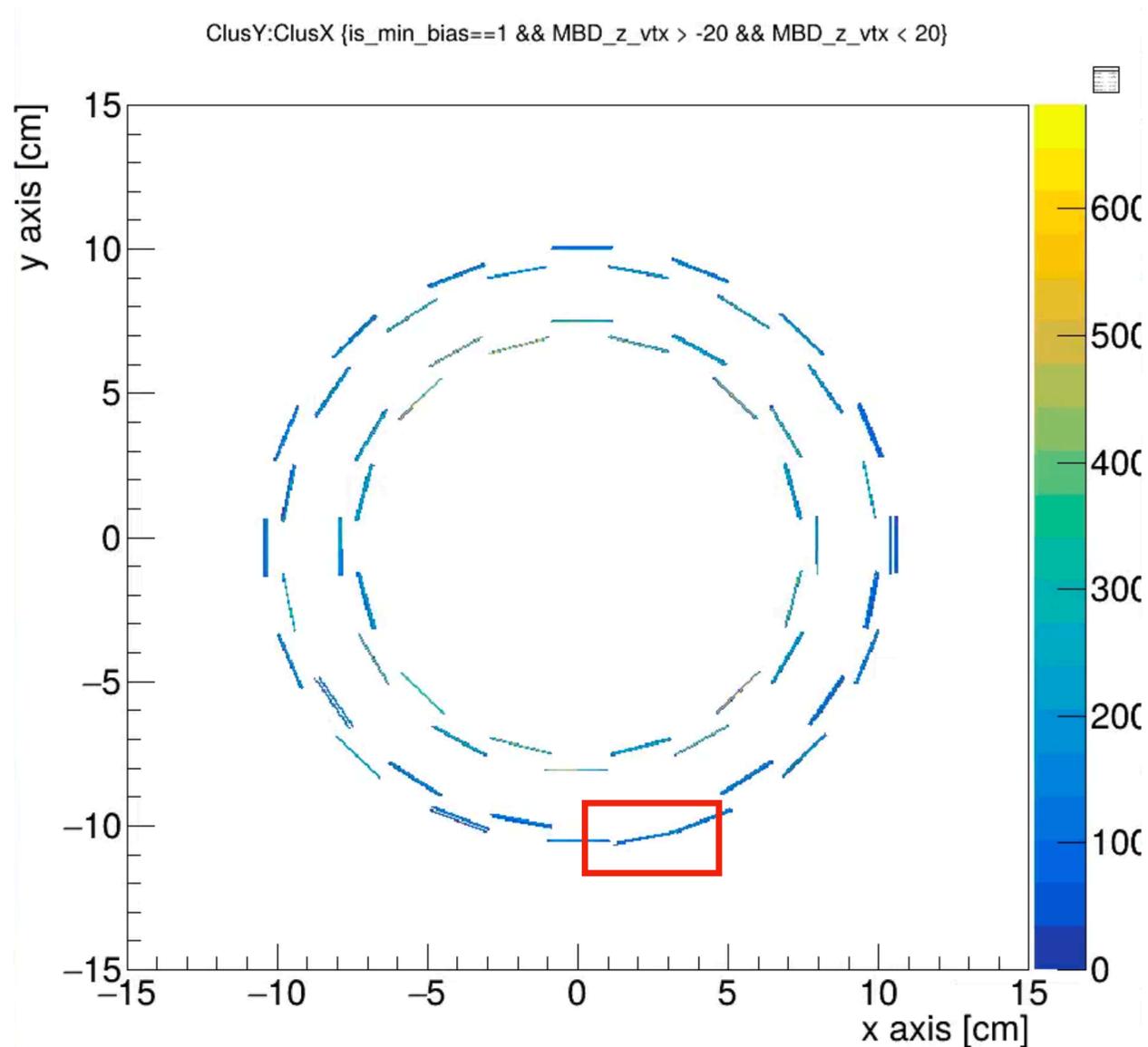
NO alignment correction
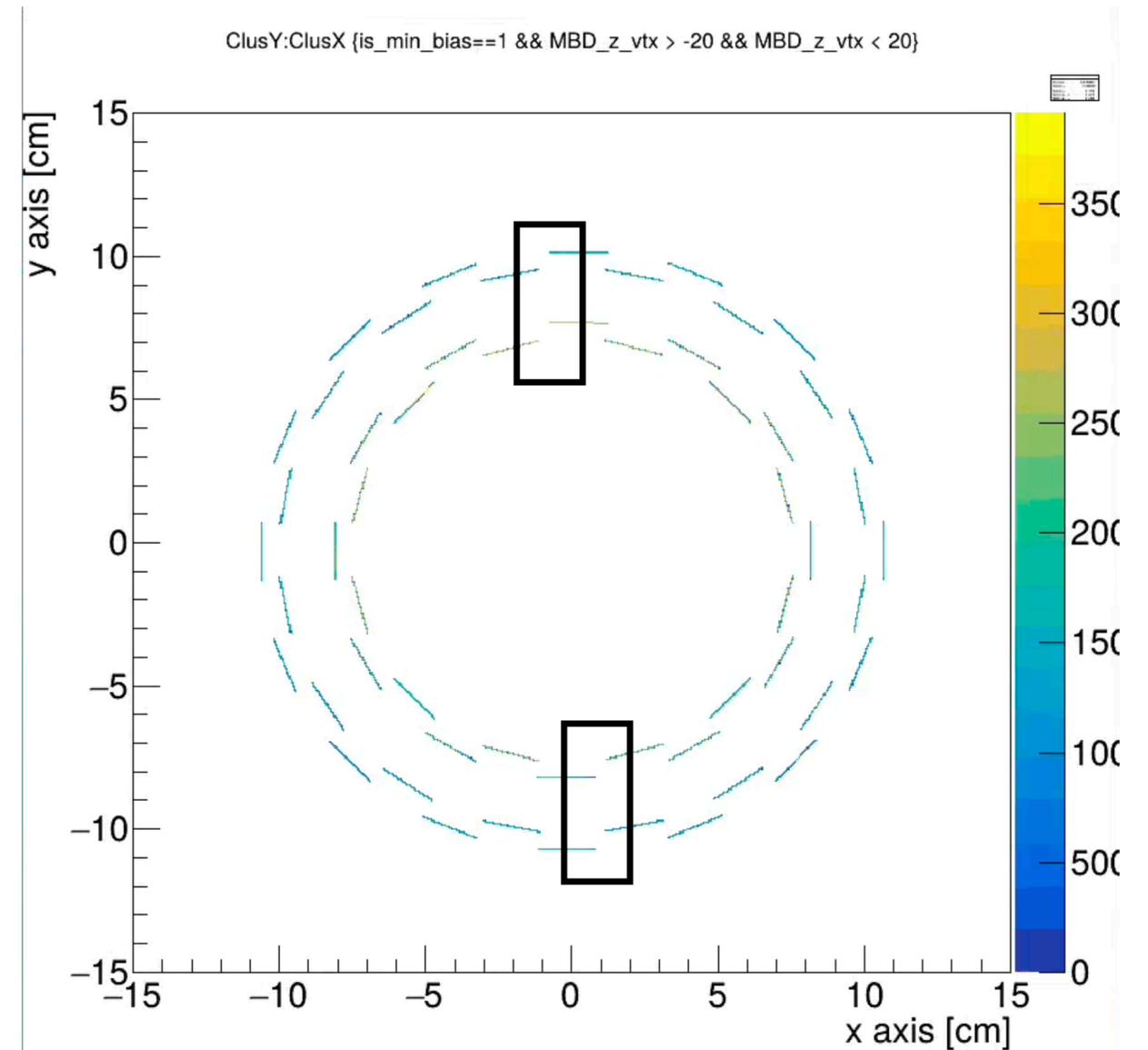
Current alignment correction works quite well for the phi-relevant calculations, but it has no radial constraints
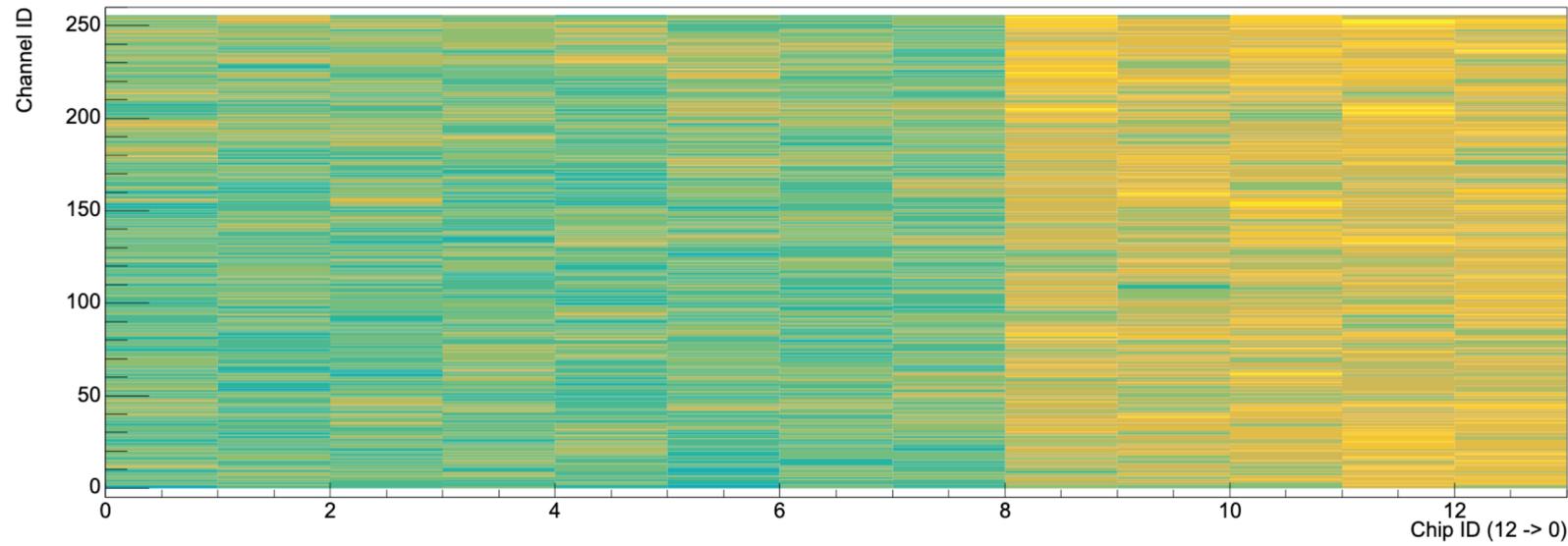
INTT timing instability

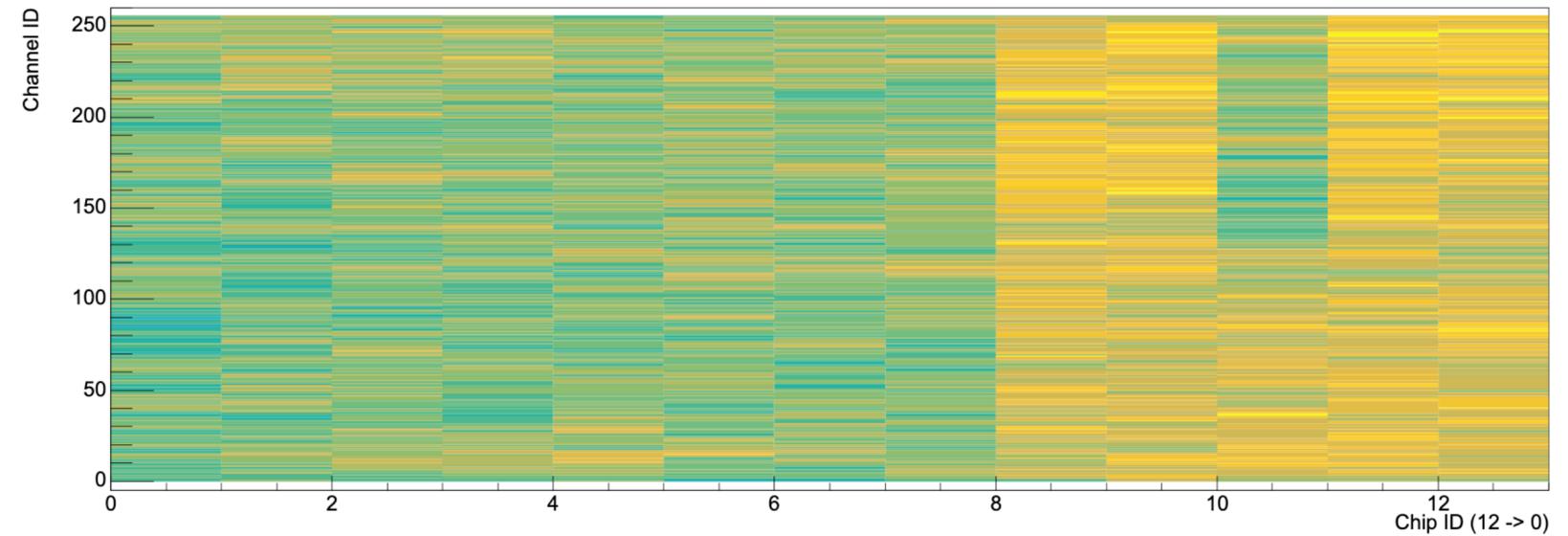Run 54280 HitMap of Server_2, FelixCh 9, **post hot channel mask**, **bco_diff cut**, **hitQA**, **clone hit removal**
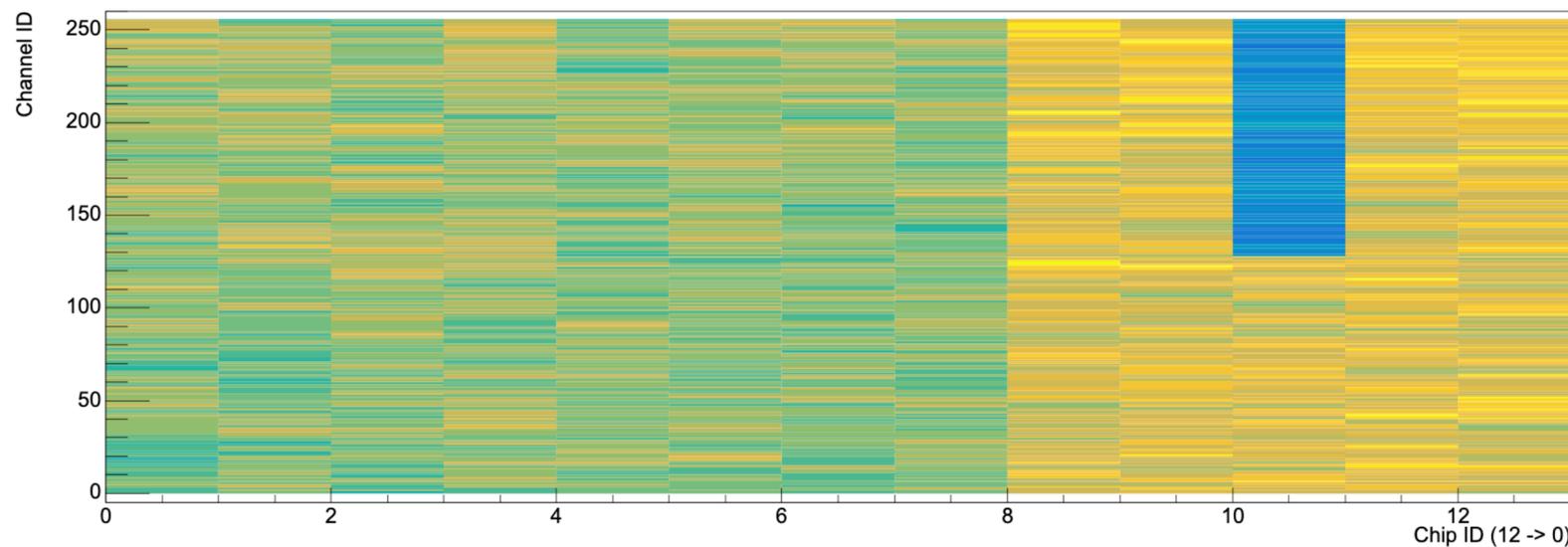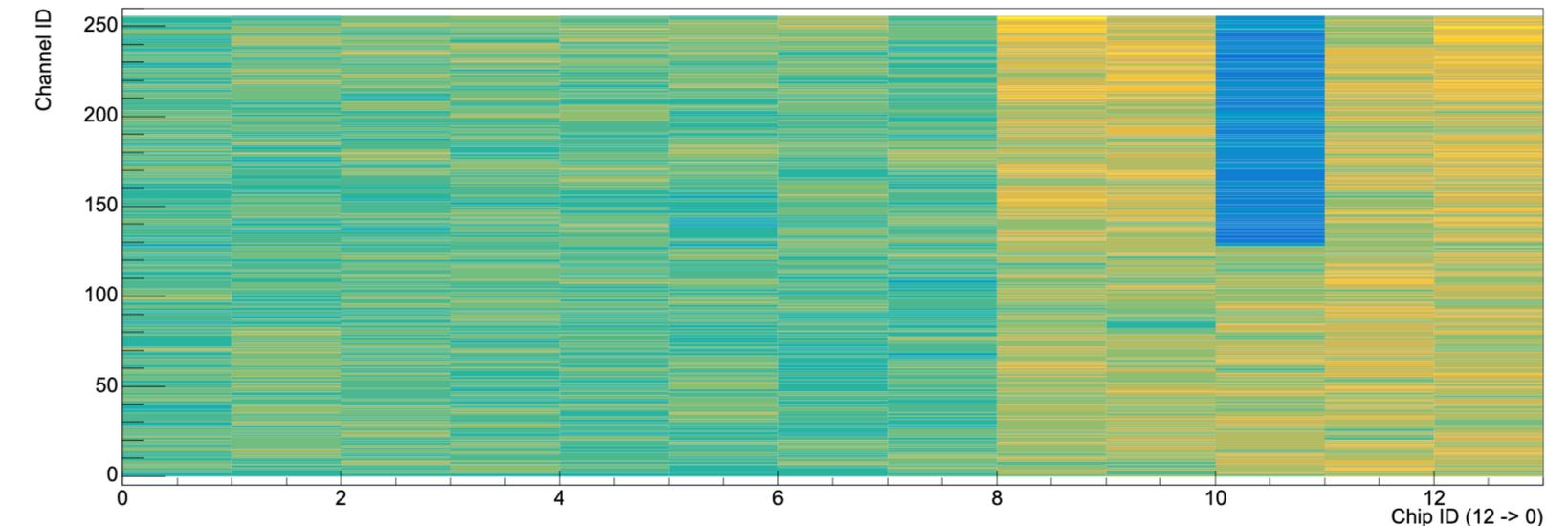
It's possible that the INTT timing varied during the data taking

Cheng-Wei Shih (NCU, Taiwan)

Cluster

- I think it may be good to look into cluster
  - splitting (one cluster showed up in multiple following BCOs)
  - merger (hits from multiple particles being considered as one cluster)

Backup

For carried-over-hit issue in streaming

- Perhaps we don't have to solve the issue. The get-around solution could be (for the full-track reconstruction only):
    1. In reconstructing silicon seeds, we keep seeds with INTT cluster BCOs different by 120.
    2. And when matching to TPC seeds, we take the smaller INTT BCO for assigning the TPC z. This is the quickest get-around solution I can think of, and this should largely correct the issue. (study needed for sure)

- Quantify the impact of hit carry-over in streaming O+O (and p+p)
    - I think this can be quantified by
        1. counting the number of silicon seeds with two INTT clusters (MVTX triplet + INTT doublet, and requiring the BCO difference of the two INTT clusters to be within \pm 1 BCO, and no INTT duplicates, e.g. one INTT cluster can only associate with 1 seed).
        2. We prepare the seed counts as a function of INTT BCO segments to see the correlation.

The remaining tasks

- **High Priority**
  - INTT DAC setting implementation
    - CDB is now outdated
    - We need to establish a way to link the run number with the corresponding DAC setting configuration. INTT_setting PSQL DB could be a good approach.
    - Some runs are missing in INTT_setting PSQL DB
  - offline QA, good run list for INTT
    - Run24 pp, Run25 AuAu, Run 25 pp, and Run 25 OO
    - We need to synchronize with the official good run list table
  - Carried-over-hit issue
    - In triggered mode (Au+Au, pp)
    - In_streaming_mode (pp and OO)
  - The duplicate hits in Run25 AuAu due to too large open_time
  - INTT data-MC edep discrepancy (ClusAdc, ClusPhiSize)
  - Fraction of the hits to the next bco bin
  - INTT timing reliability

- **Low Priority**
  - INTT geometry distorted by the alignment parameters
  - Cluster
    - splitting (one cluster showed up in multiple adjacent BCOs)
    - merger (hits from multiple particles being considered as one cluster)
  - Timing instability