Event Mixup

2024/02/02

INTTJP

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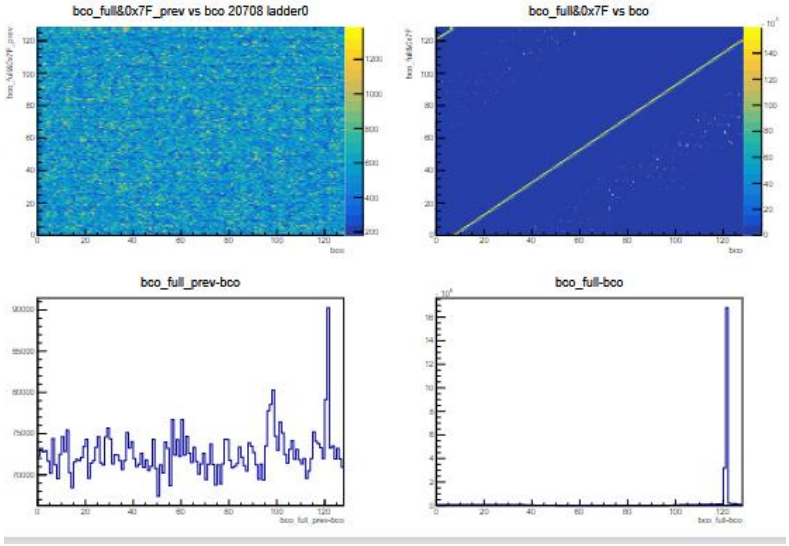
やったこと

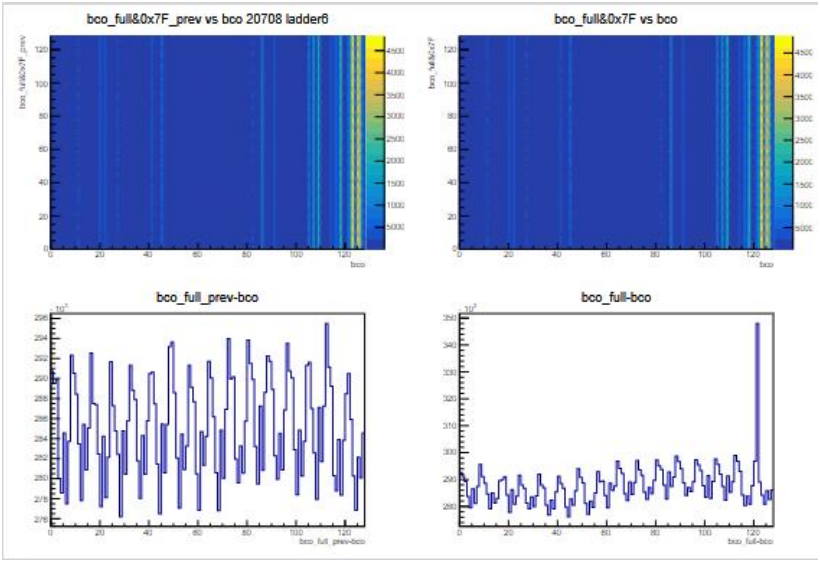
- Ladderごとに調べる
- Mixupのコピーヒットが前のイベントにあるかどうか

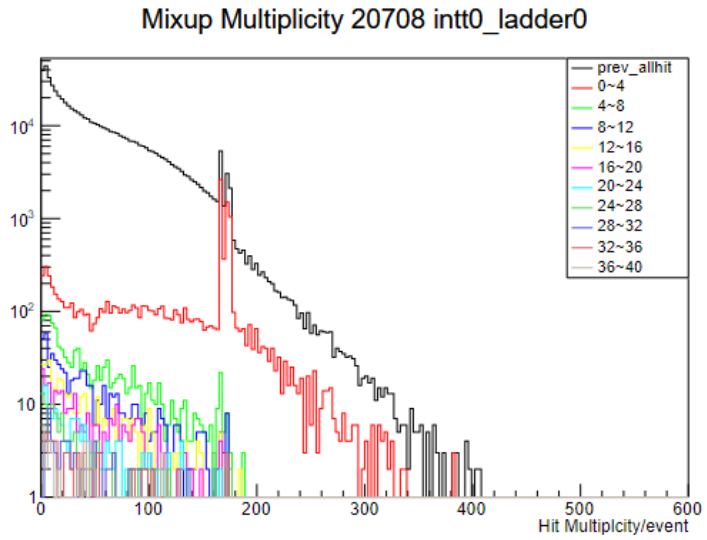
- 使ったデータ：Run20708 2023/07/04 DAC0=15 L1Delay=25
  open time=35 n_collision=127 Modebit= 79:0x35

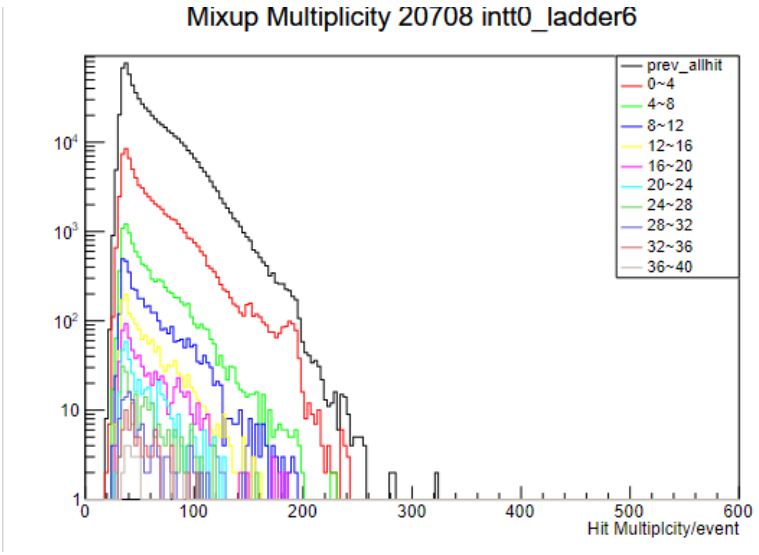
ladder by ladder

- I have examined the mixup ladder by ladder.
- I found different plots in some ladders. But I do not think it has anything with mixup.
- Because the BCO_Full-BCO plots for the same event are different. This is a different state of collision data.
- Except for these error ladders, almost all ladders have the same results, so I don't think it changes from ladder by ladder.









Most ladders state

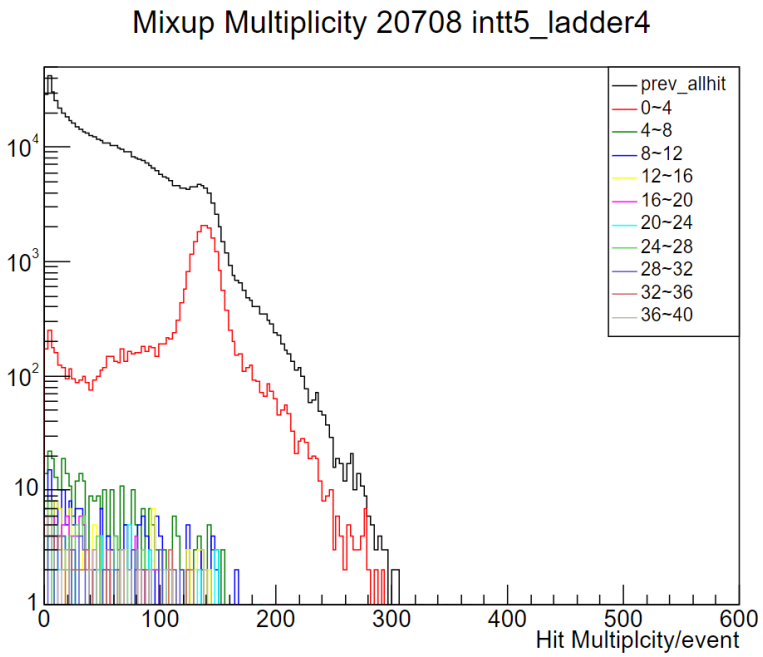
Some ladders

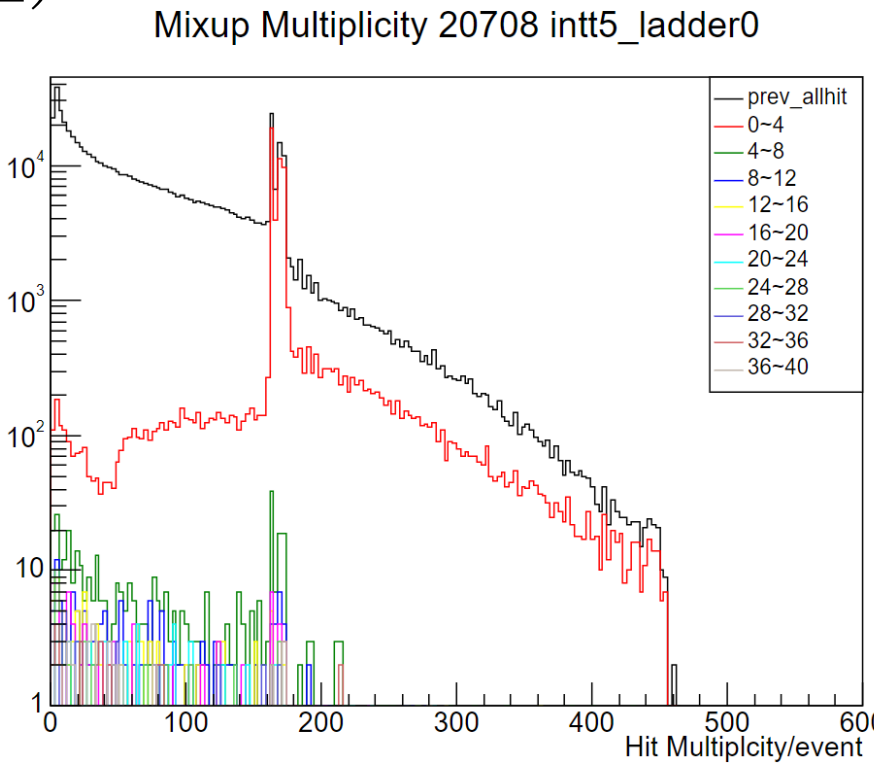
Ladder by ladder

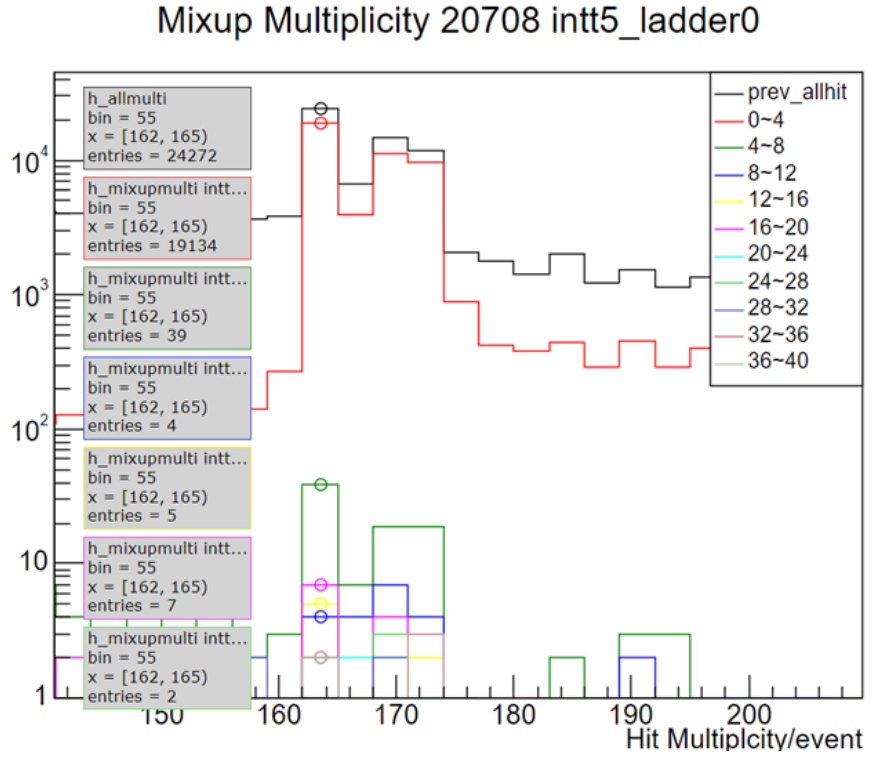
- ハーフラダー2~13でMixupの数が1~4のピークが緩やかになっていた。
- しかし全Felixのラダー０がピークが鋭くなっていた。ピークのBinの値はほとんど一緒（x=162）
- 他のデータでも

  同じかどうか

  調べているところ







Clone event

- ビームテストのデータから別のイベントにBCOを除いたヒット情報が全て同じコピーヒットがあることが確認された。
- Mixupとの関係が疑われるので調べた。

Clone event (not clone hit)

File: BeamData_20211210-0302_0.root (run52)

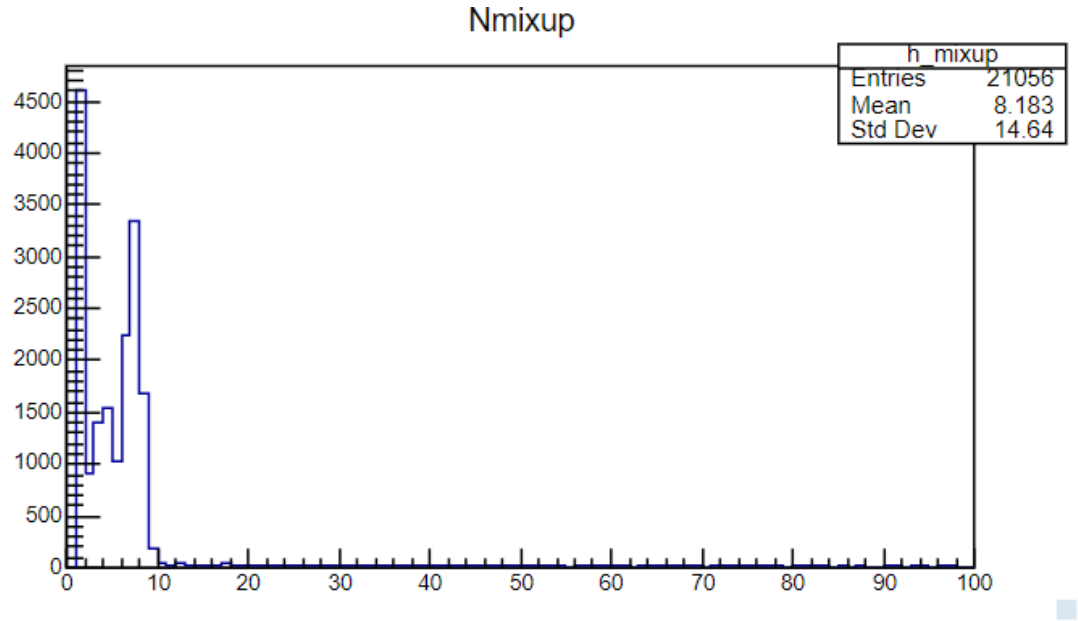
Row	Instance	camac_adc	camac_tdc	INTT_even	adc	ampl	chip_id	fpga_id	module	chan_id	fem_id	bco	bco_full	event
17	48	*	*	1	3	0	21	0	1	103	1	67	65475	-1
17	49	*	*	1	1	0	21	0	5	101	8	67	65475	-1
17	50	*	*	1	0	0	21	0	5	100	8	67	65475	-1
17	51	*	*	1	3	0	21	0	6	98	8	67	65475	-1
17	52	*	*	1	3	0	21	0	1	103	1	68	65476	-1
17	53	*	*	1	1	0	21	0	5	101	8	68	65476	-1
17	54	*	*	1	0	0	21	0	5	100	8	68	65476	-1
17	55	*	*	1	3	0	21	0	6	98	8	68	65476	-1

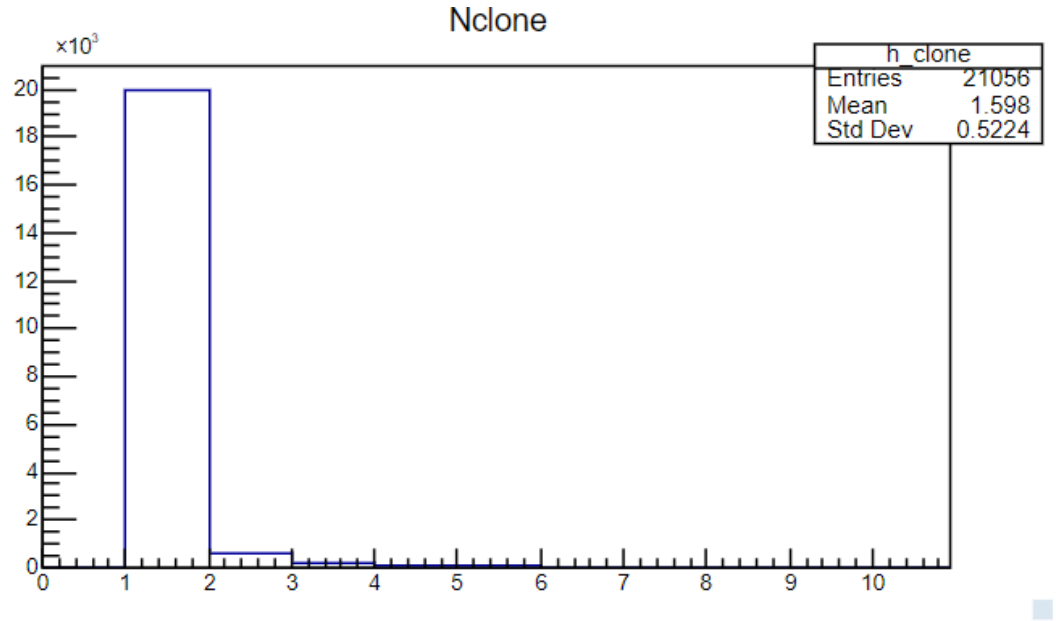
The pairs are identical! only the timing information is different!

- They are in the same “trigger event”
- The two groups have identical content except the bco and bco_full
  - Are they clone event ? or just coincidence ?

Clone event

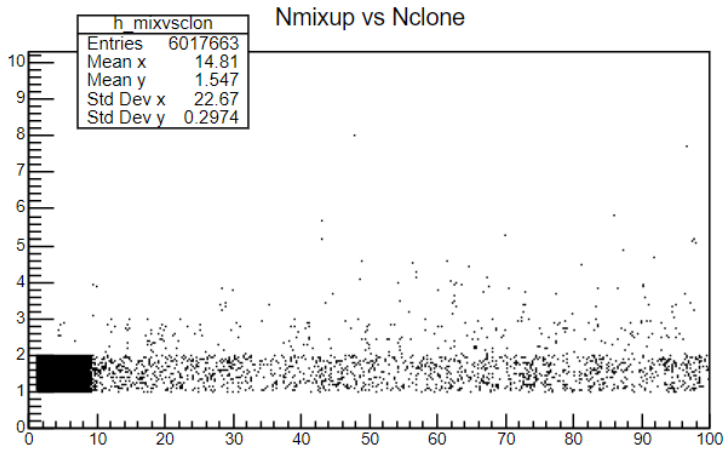
Mixupのヒットがあったとき、そのヒット情報（module,chip_id,chan_id,adc,bco）が全く同じコピーヒットが前のイベント内にあるかどうかを調べ、数を数えた。左図が１イベントあたりのMixupの数、右図がコピーヒットの数の分布。Mixupに比べ少ない。

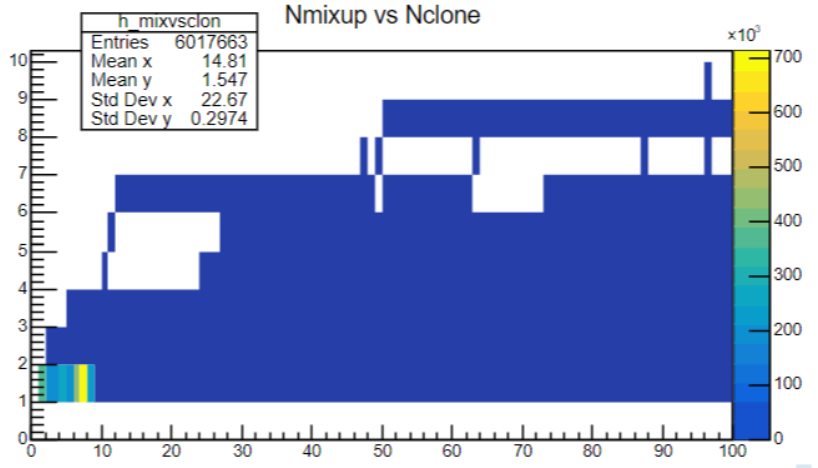


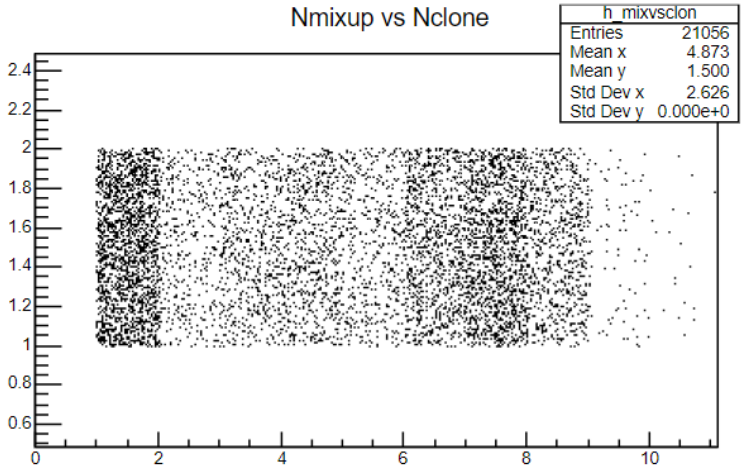


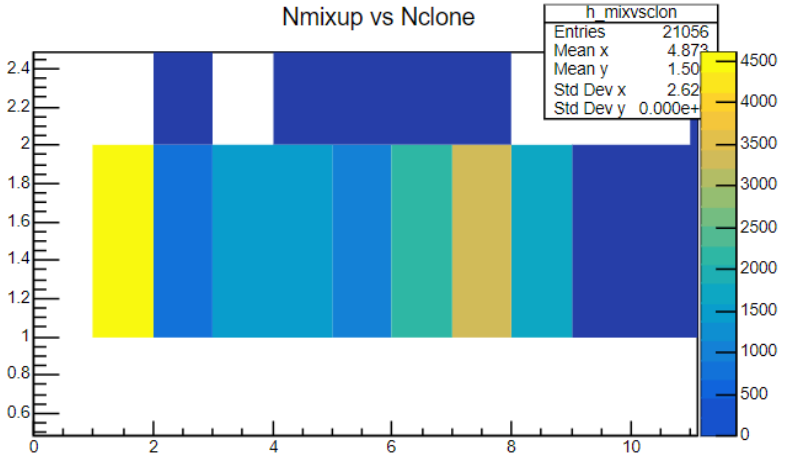
Clone event

- 次に横軸Mixup の数、縦軸コピーヒットの数の2次元分布を確認したところ前の分布からもコピーヒットが1個、Mixupが1～10個の範囲に多くエントリーがあった。
- この結果からはNmixup=1の時はNcopy=1、Nmixup=2の時Ncopy=1 or 2となっていることが分かる。



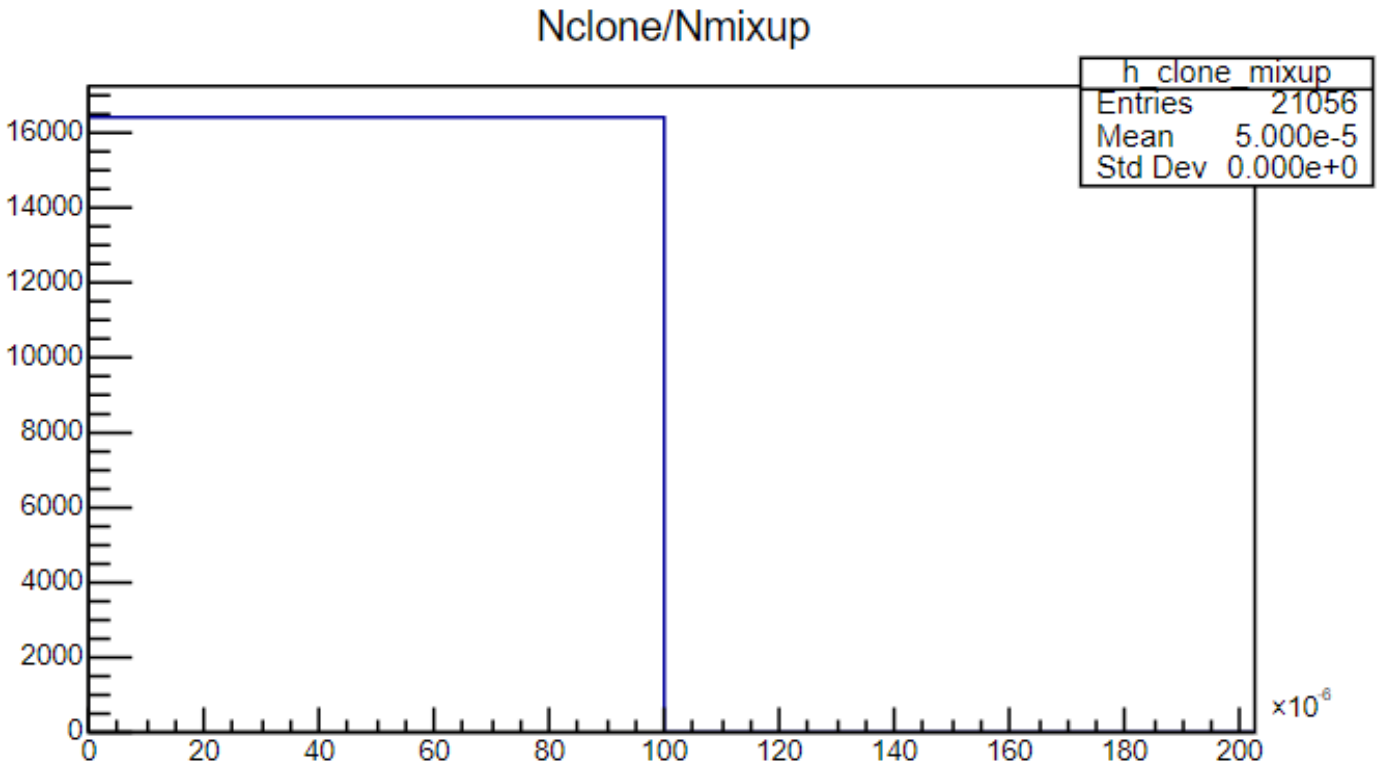






Clone event

- 1イベント辺りのMixupのヒットのうちコピーヒットがある割合を調べたところ（Nmixup>0 && Ncopy>0）0 -100*10^-6にエントリーがあった。
- Binの設定が悪いのでこれ以上は細かく見れてはいないが、ほとんど0に近い割合になっている。Mixupのヒットの中でコピーヒットがあったヒットはとても少ないと考えられる。

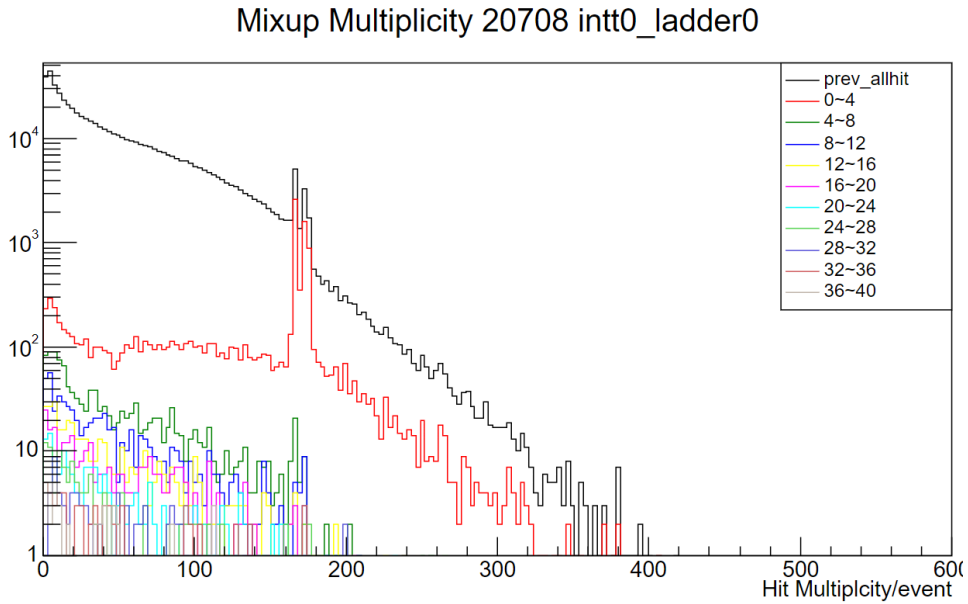


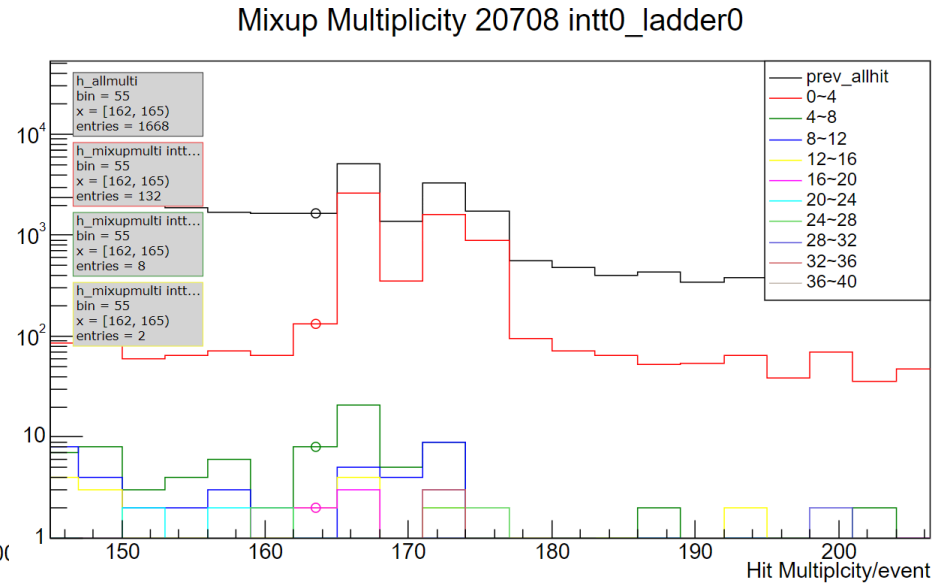
My next step

- Check with the latest data of beam
- Closer examination of the peaks in the ladder-by-ladder plot
- Examine chip by chip
- Correlation between clone events and Mixup
- Correlation Hot channel between Mixup
- Mixup with cosmic ray data

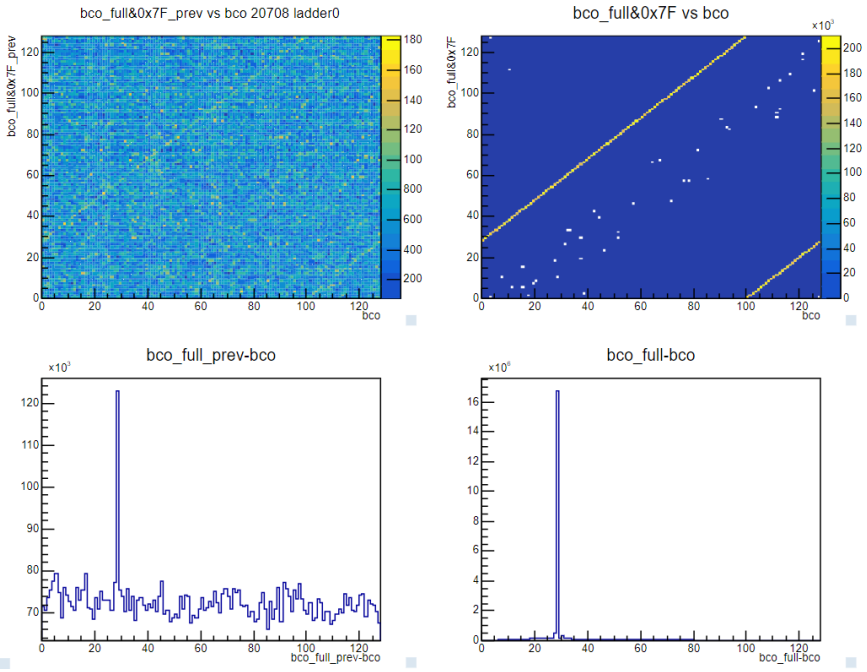
Back up

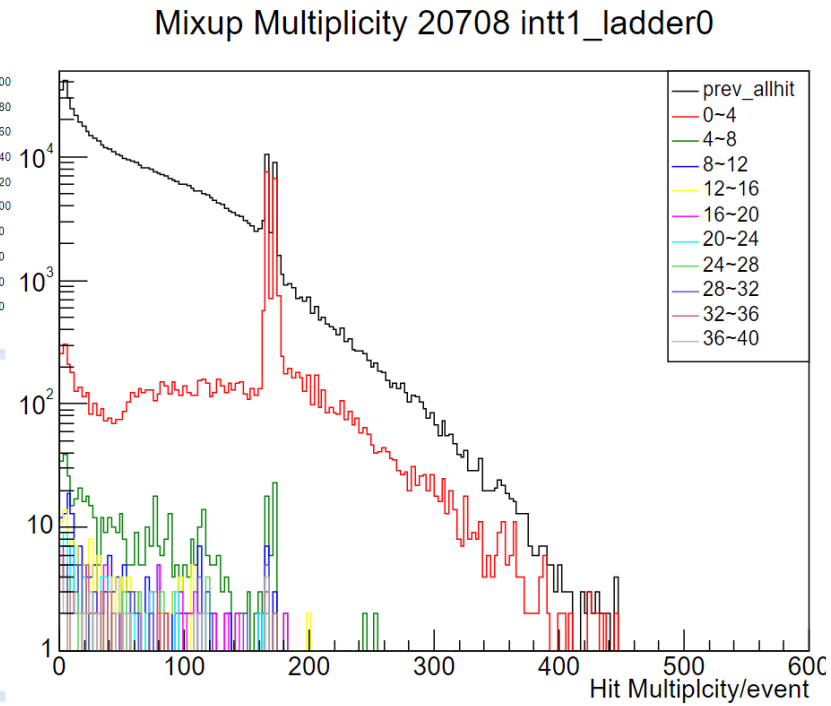
Run20708 intt0 ladder0

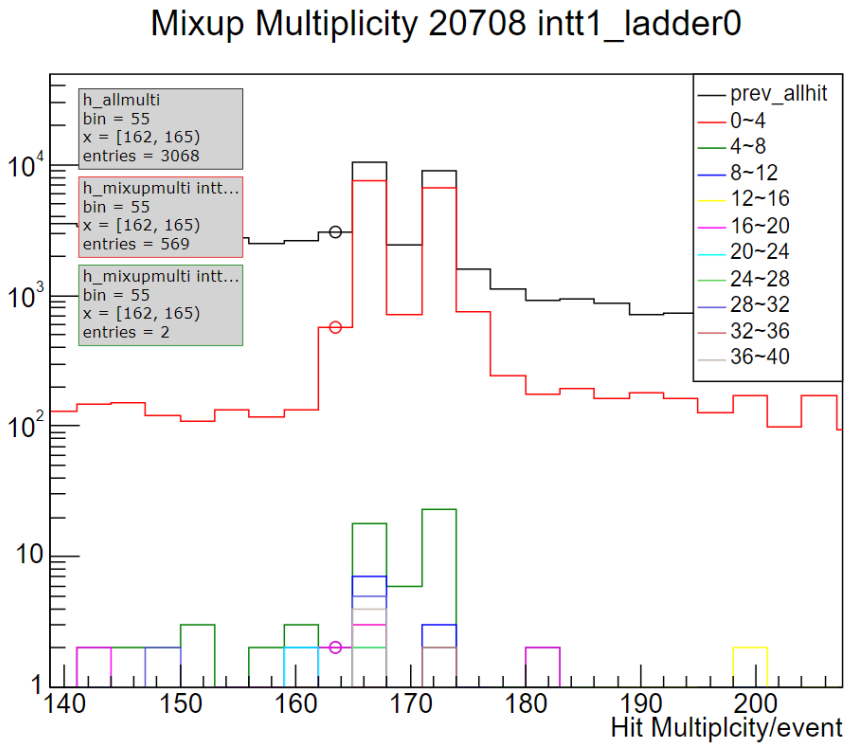




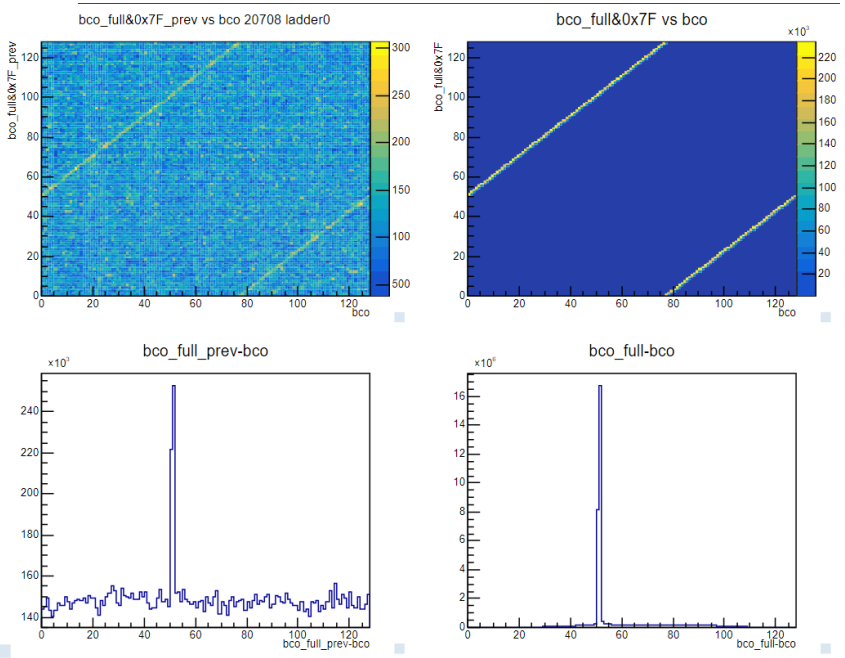
Run20708 intt1 ladder0

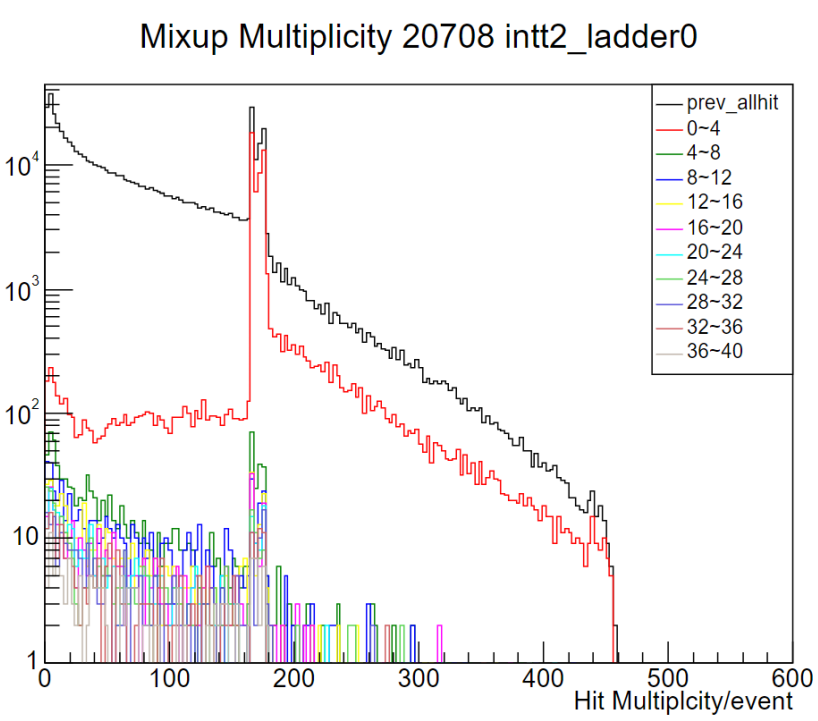


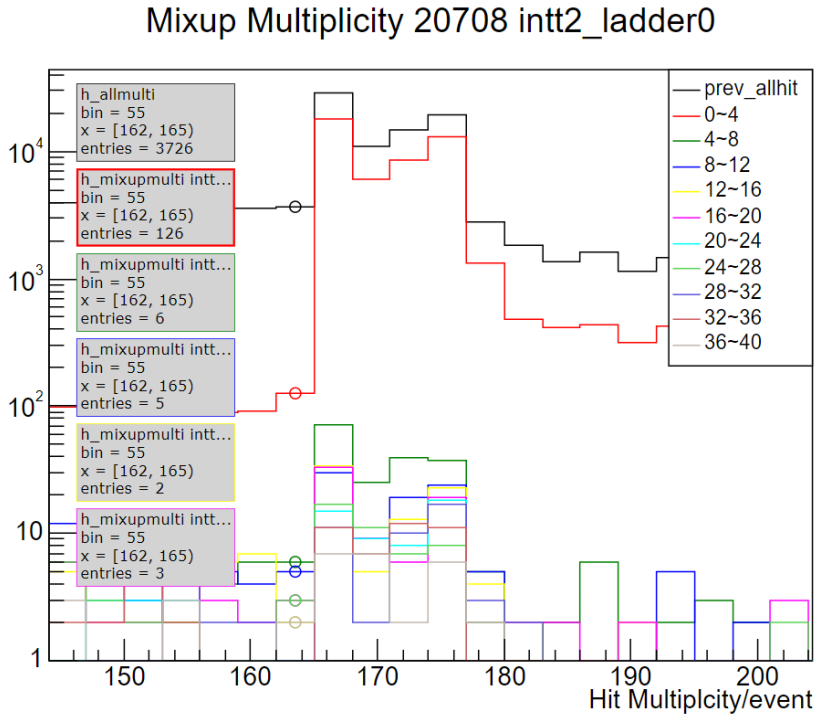




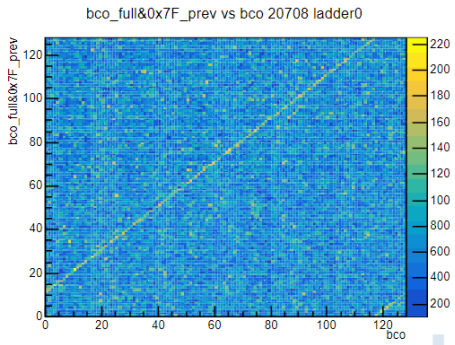
Run20708 intt2 ladder0

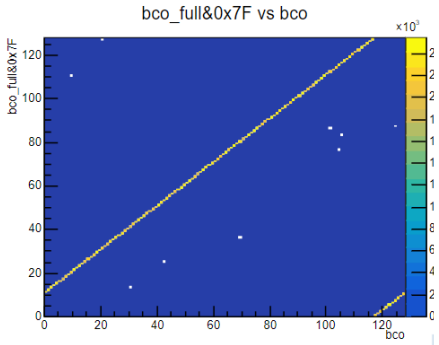


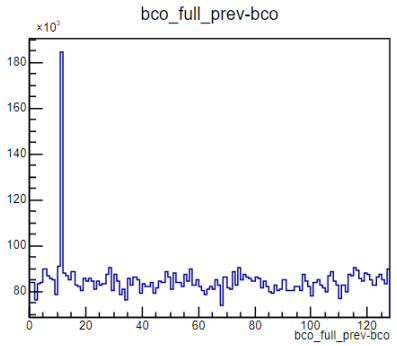


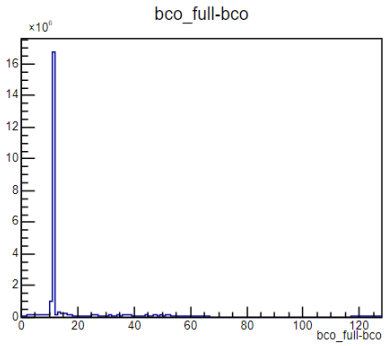


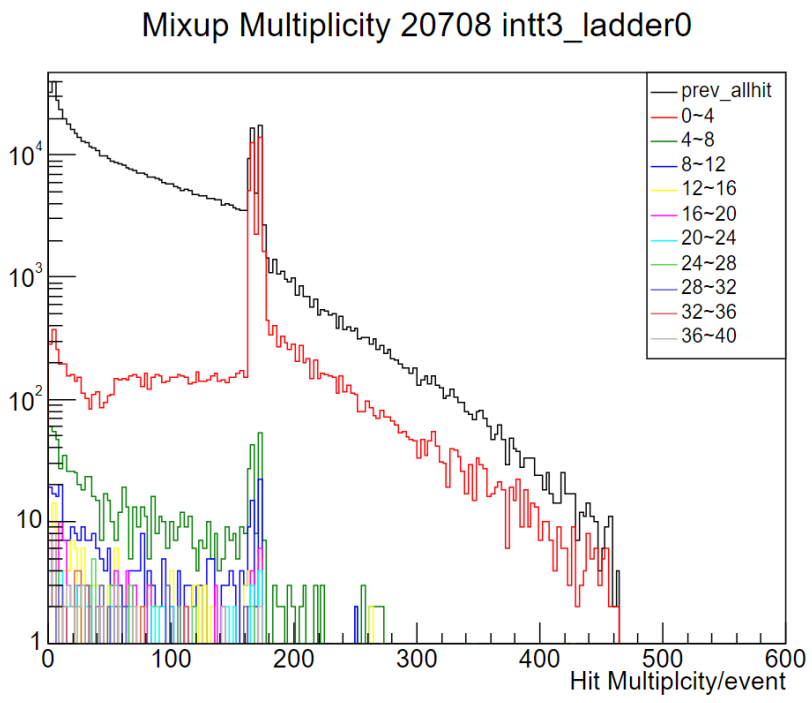
Run20708 intt3 ladder0

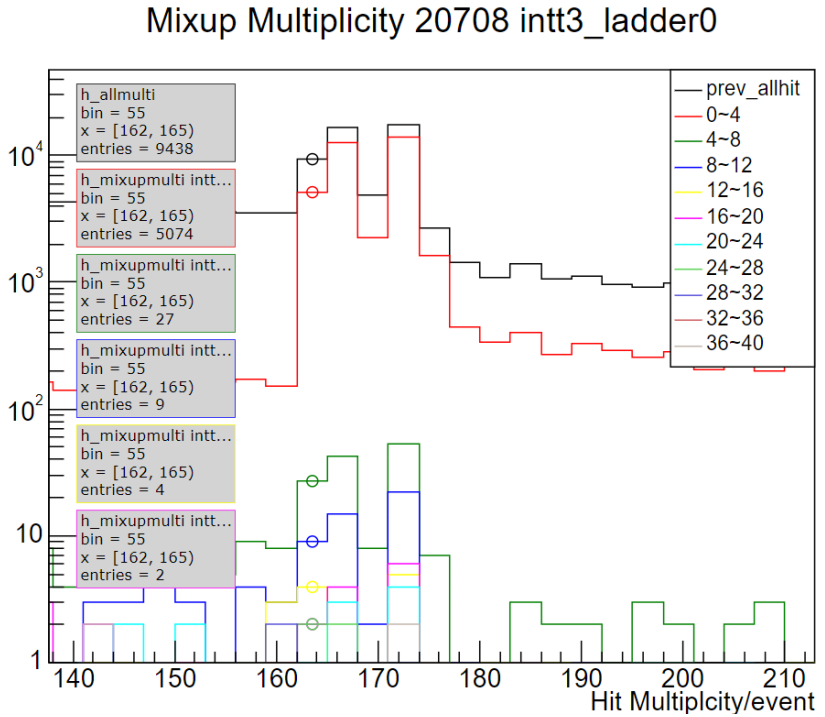




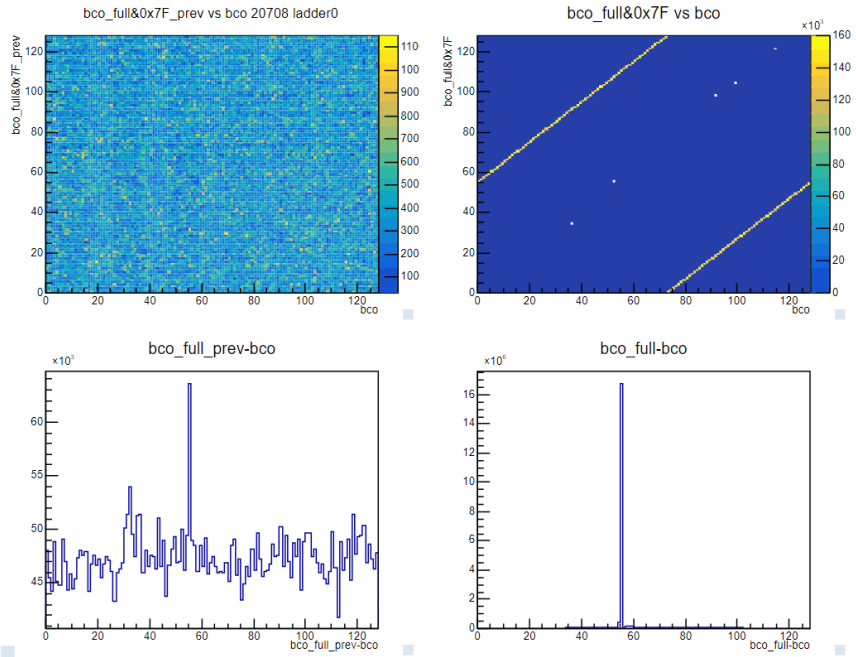


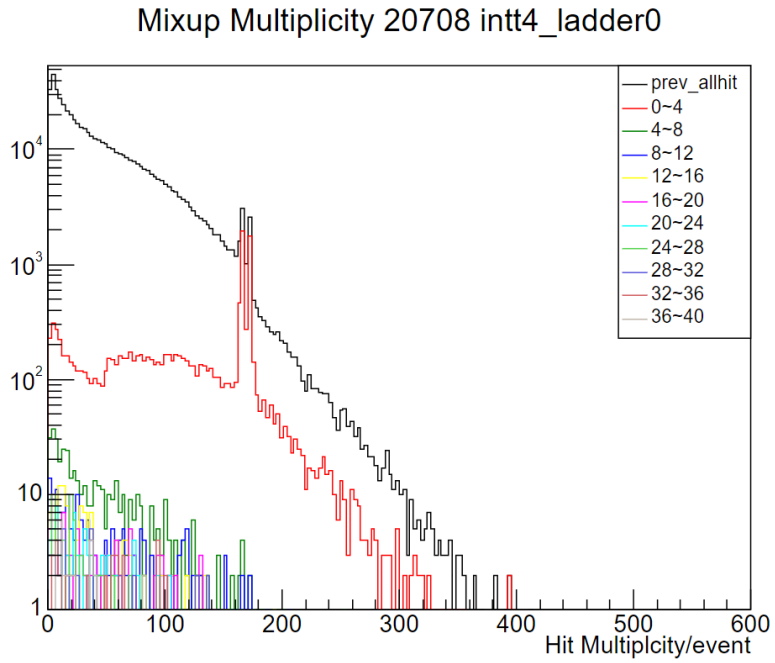


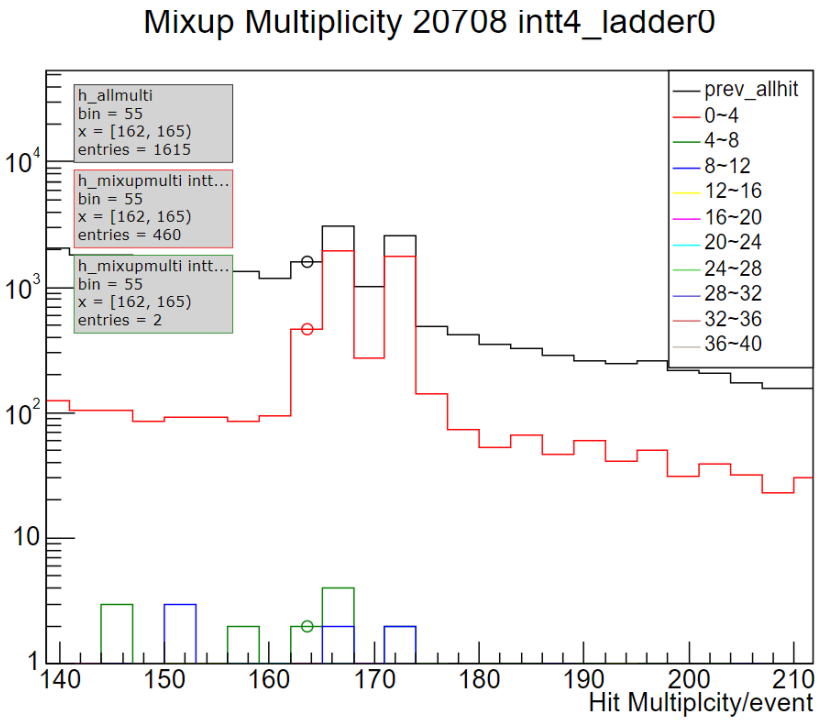




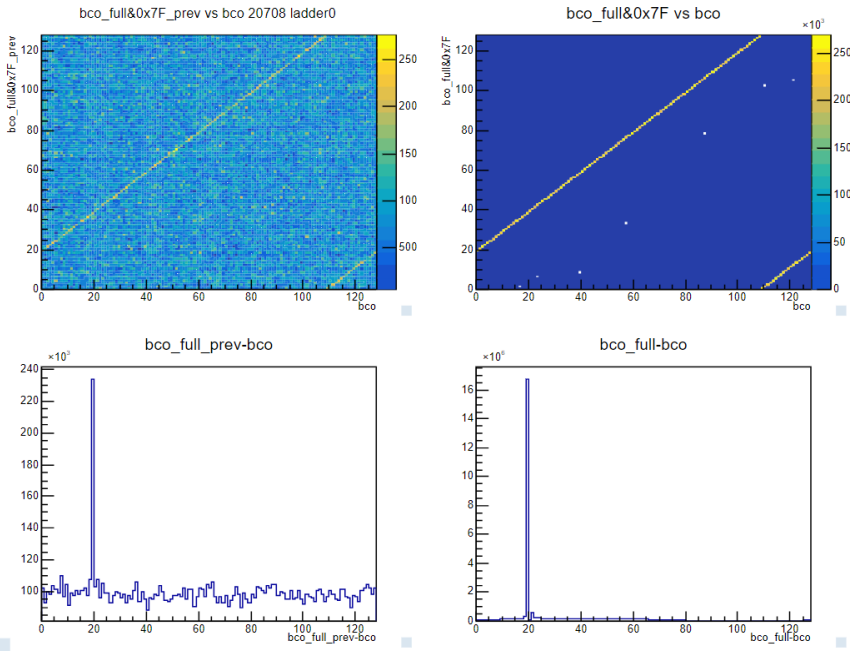
Run20708 intt4 ladder0

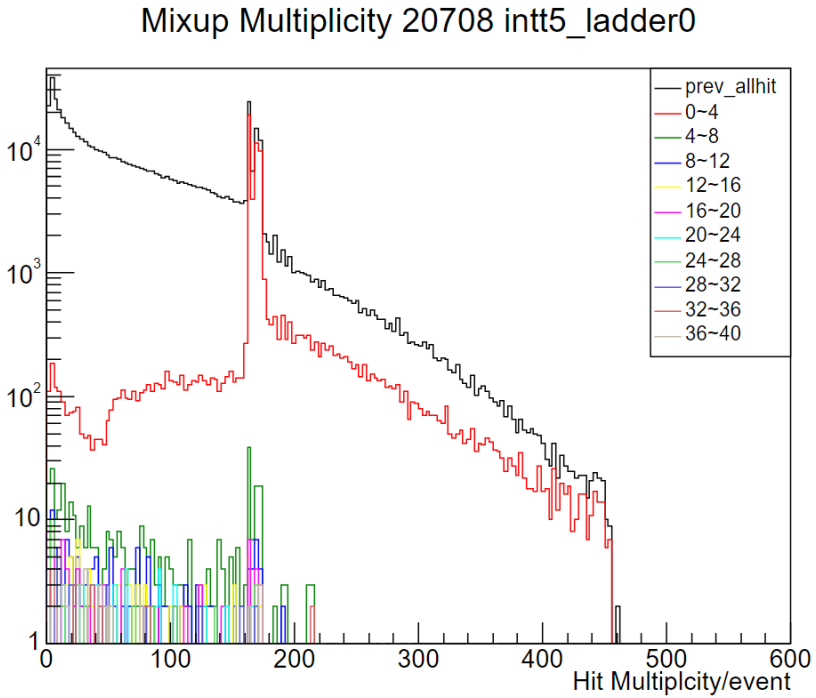


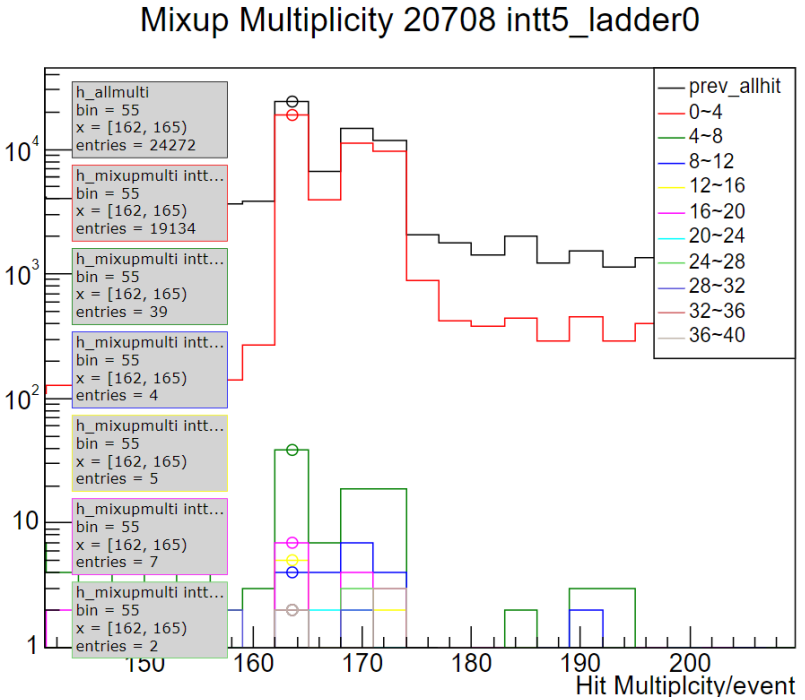




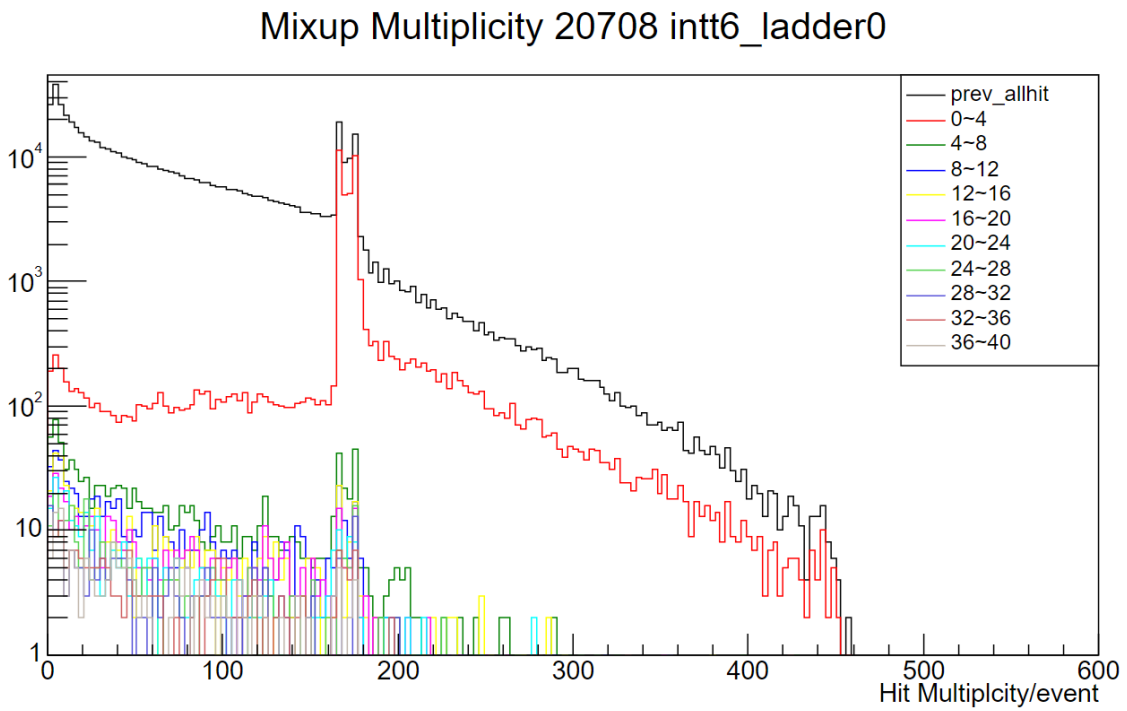
Run20708 intt5 ladder0

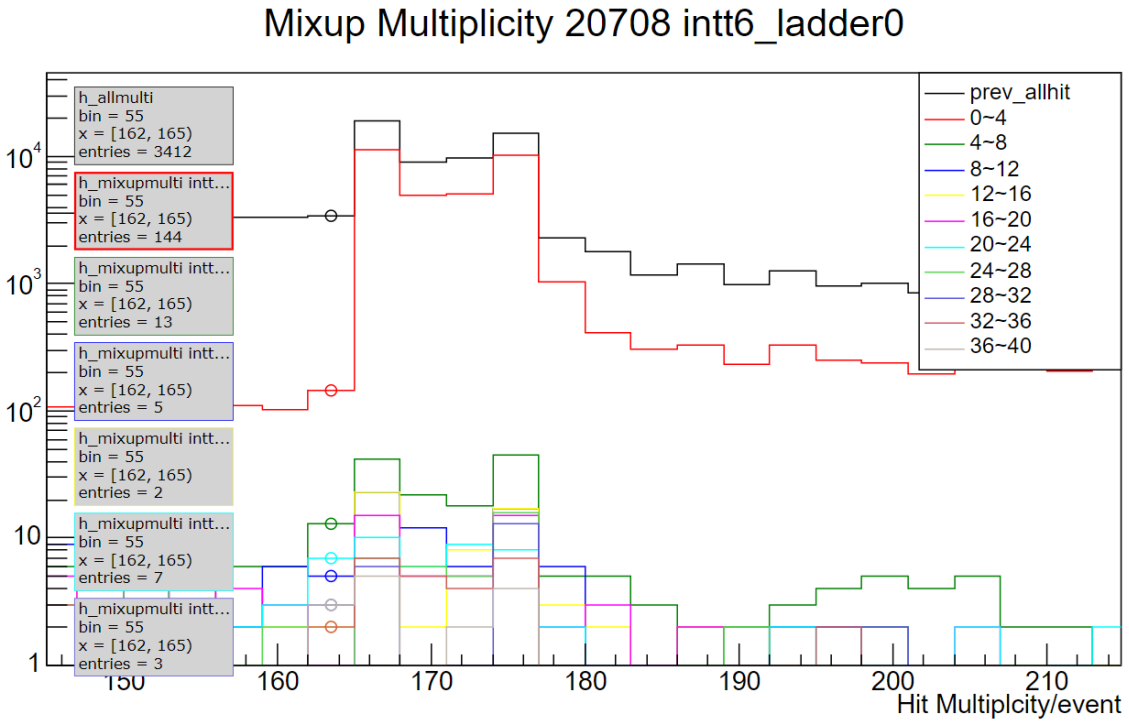






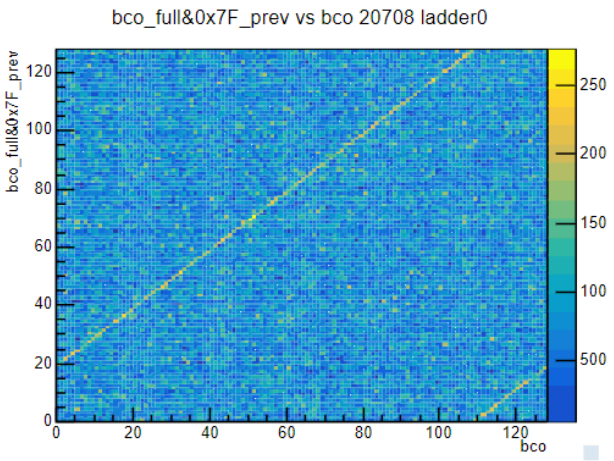
Run20708 intt6 ladder0

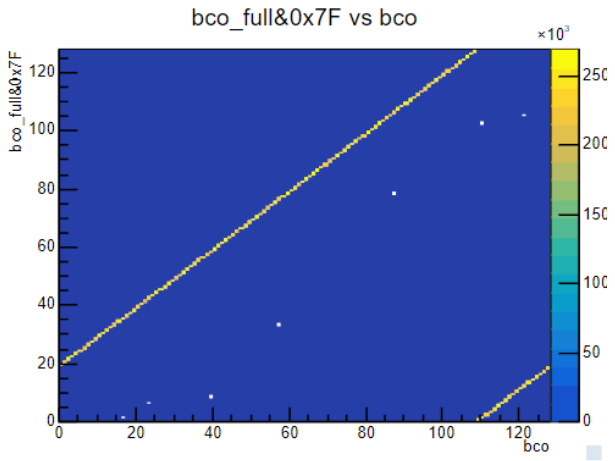


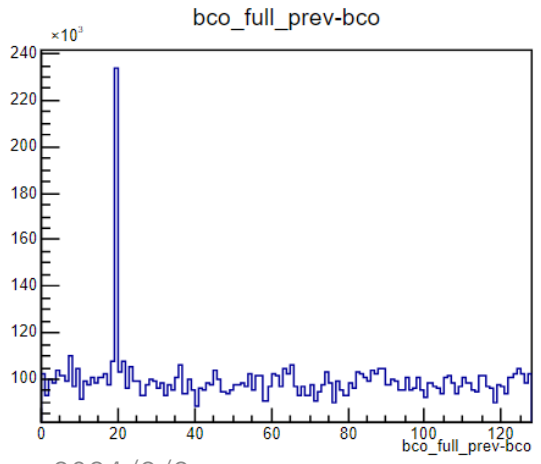


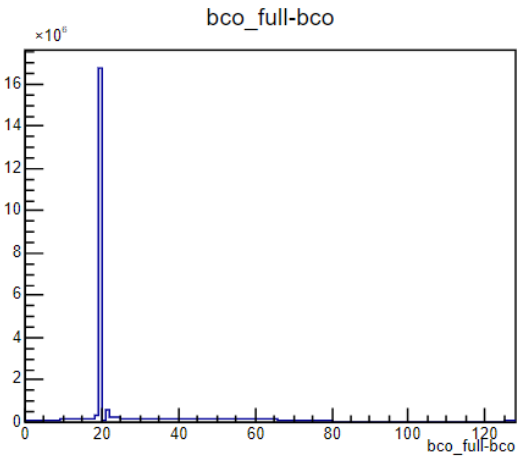
Run20708 intt2 ladder0

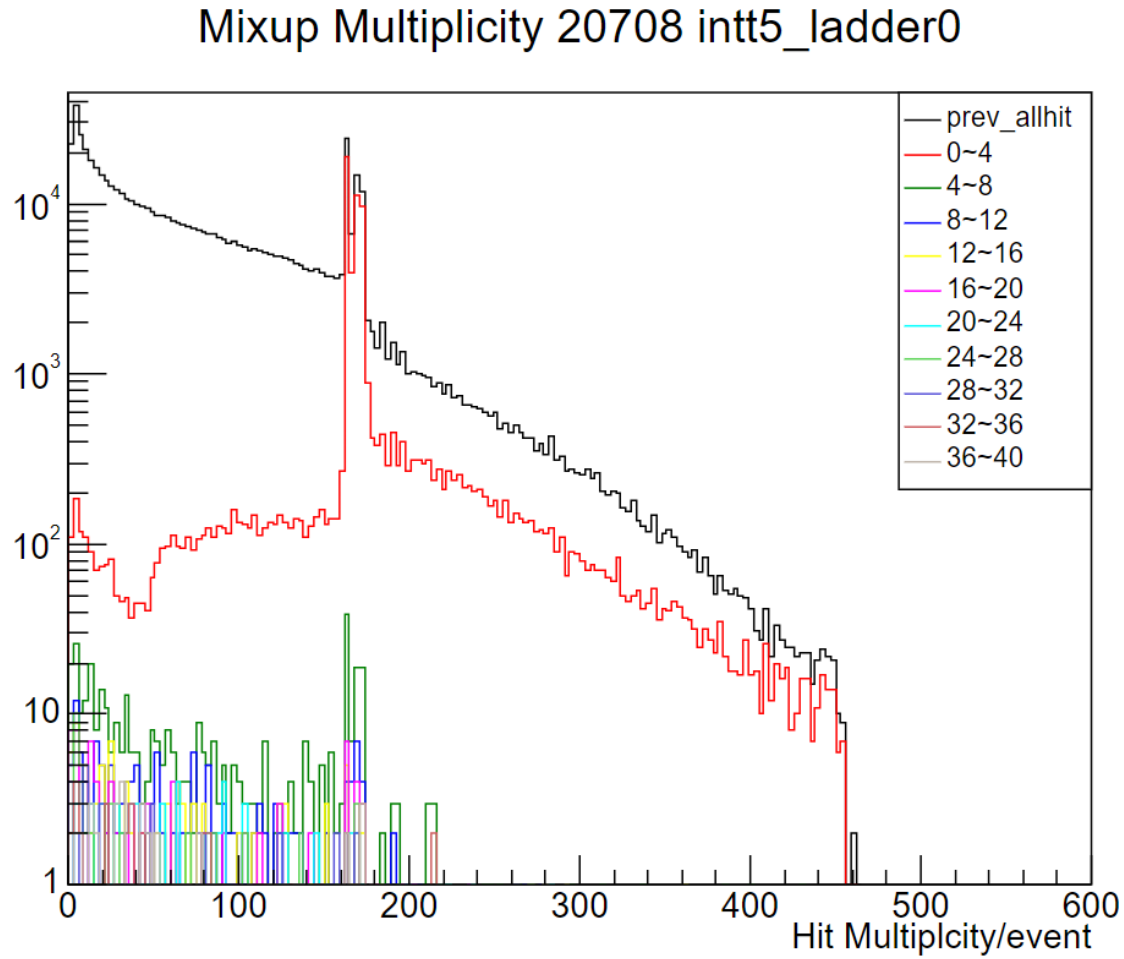
Run20708 intt5 ladder0



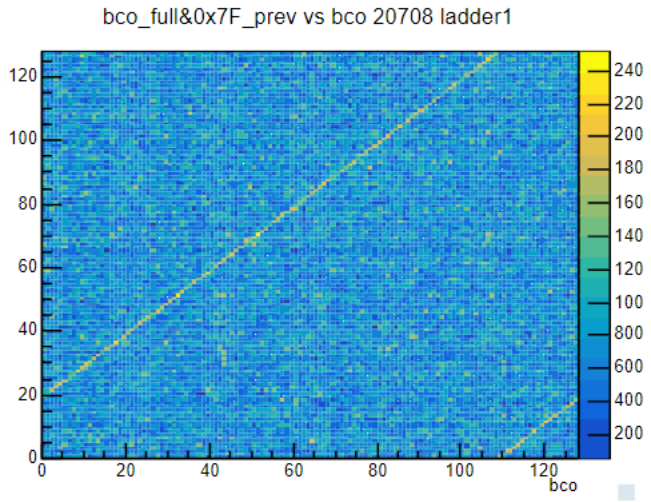


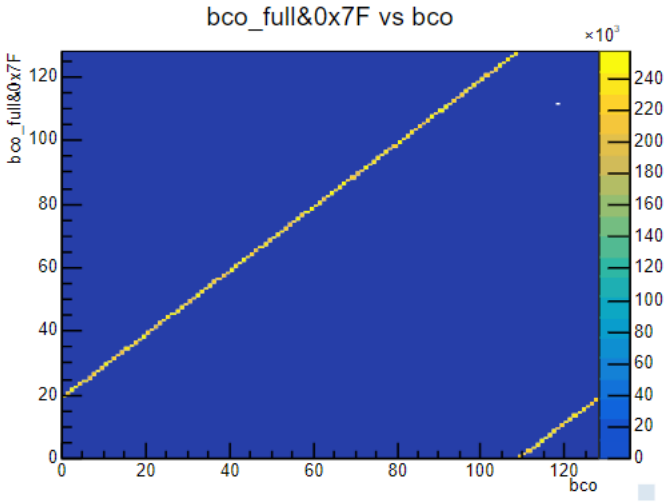


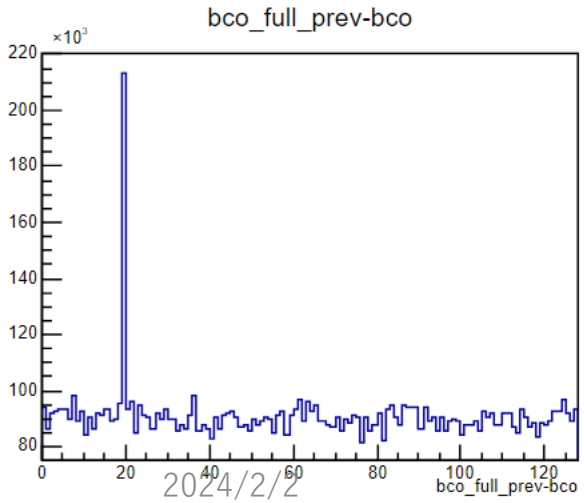


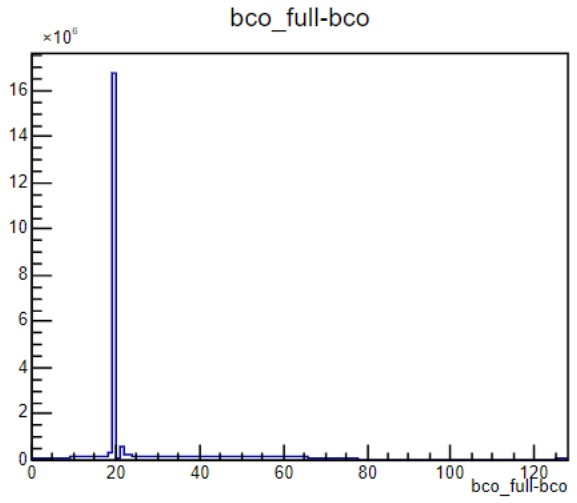


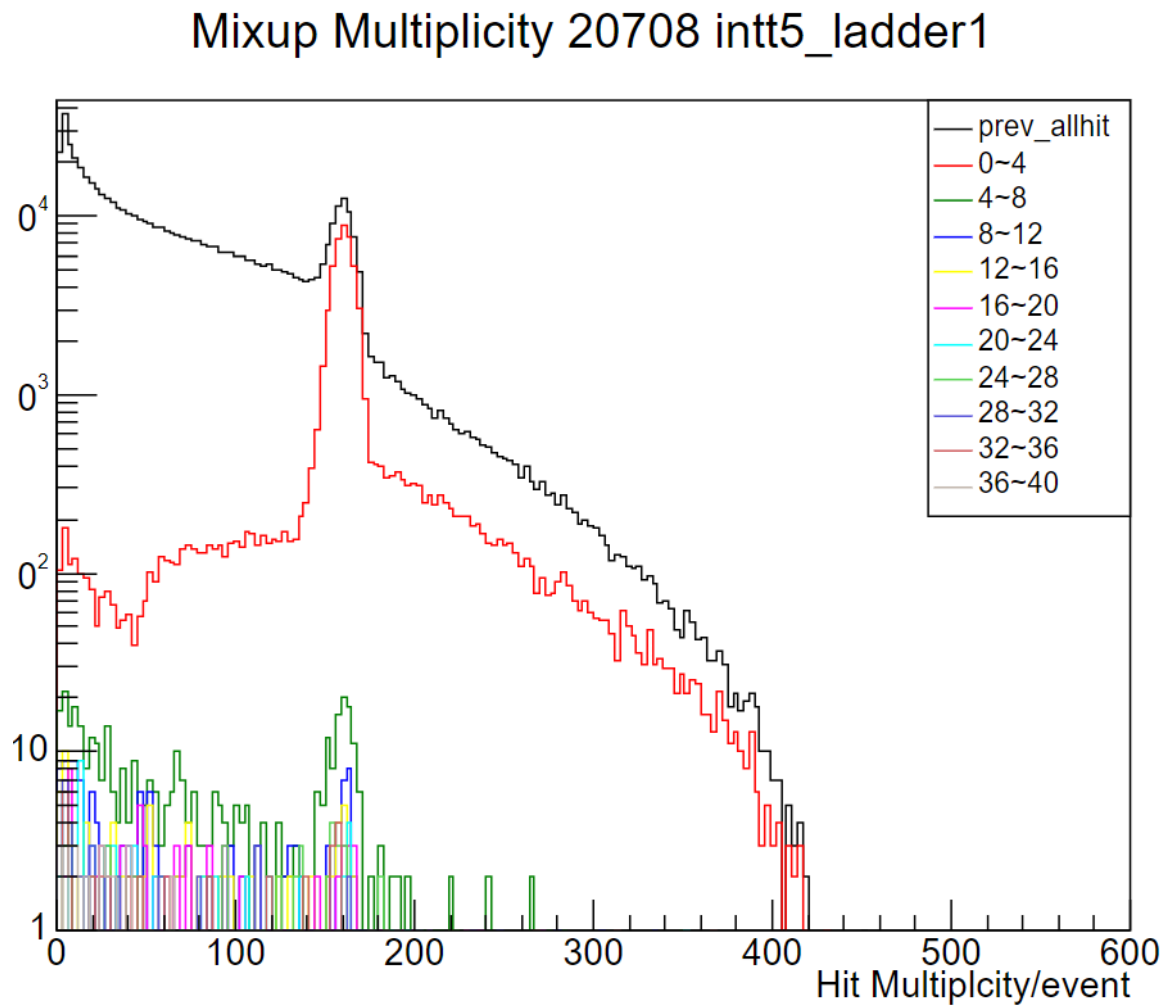
Run20708 intt5 ladder1



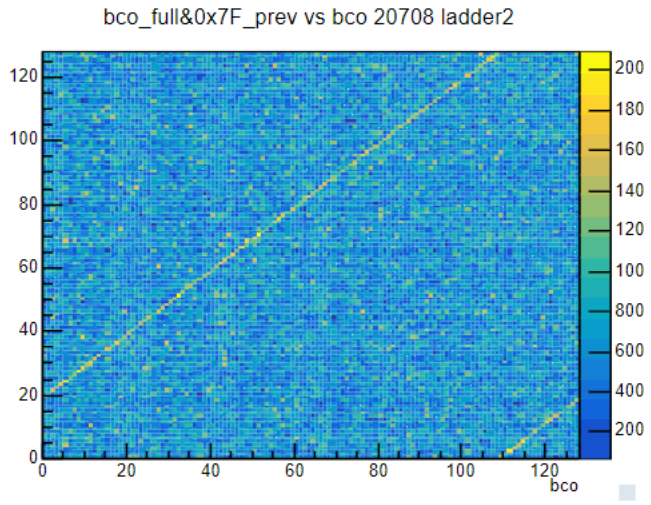


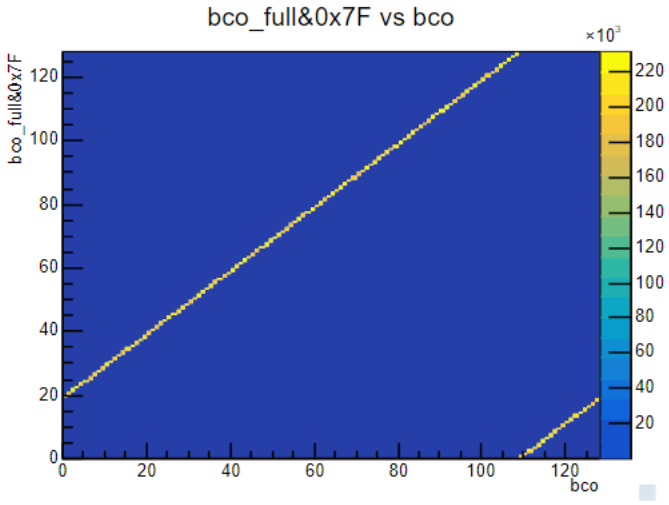


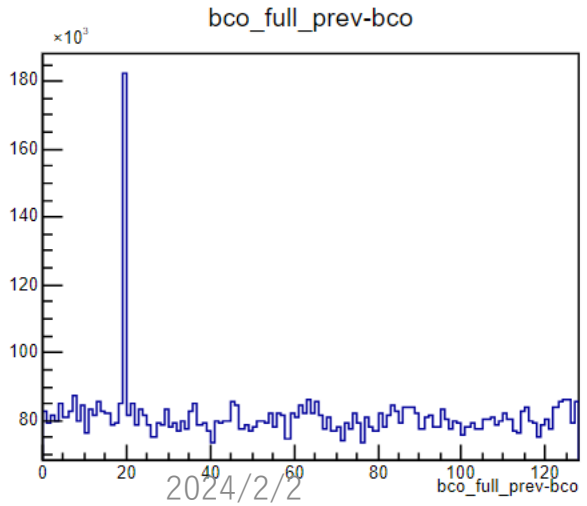


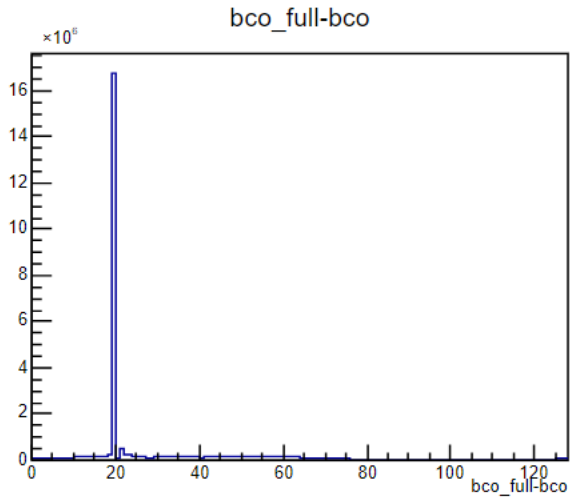


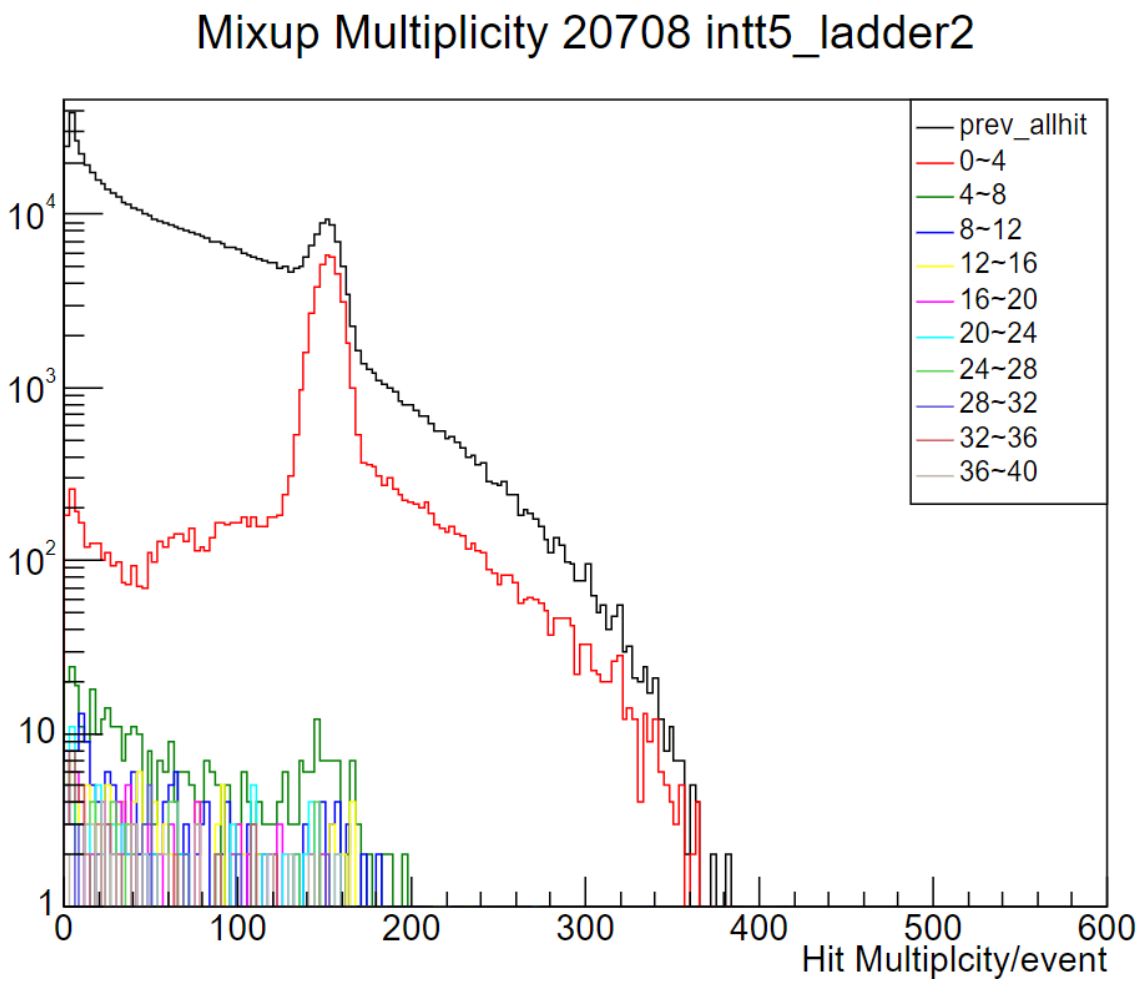
Run20708 intt5 ladder2



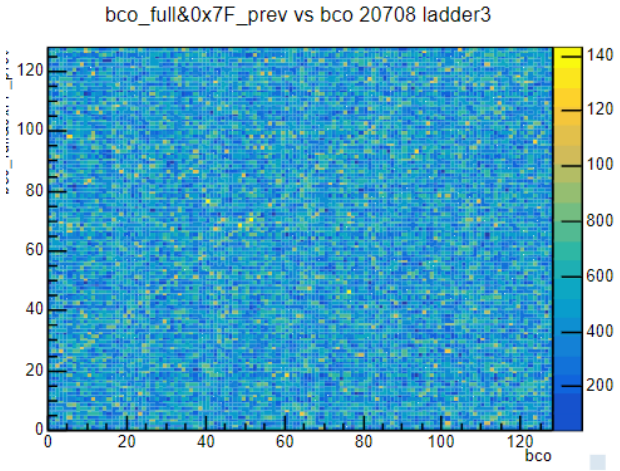


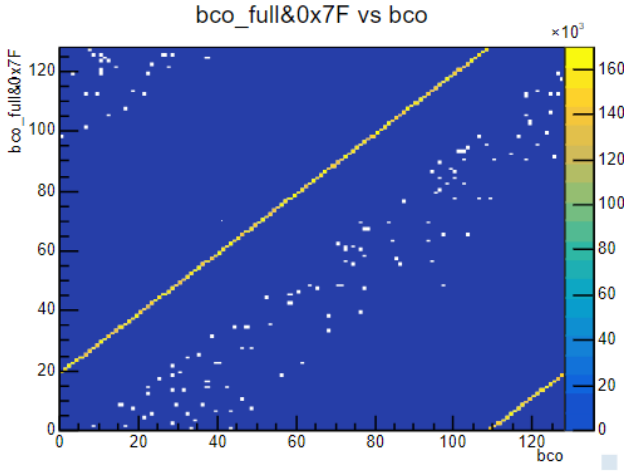


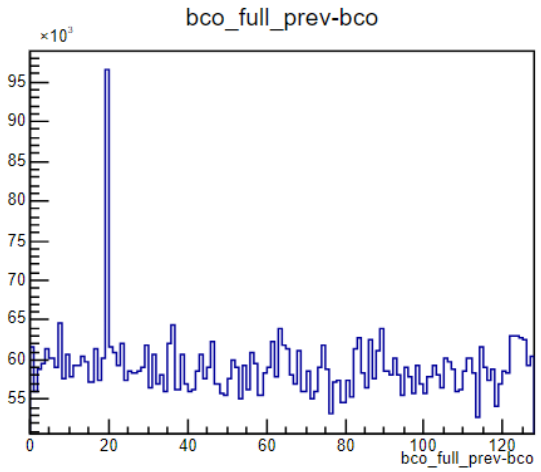


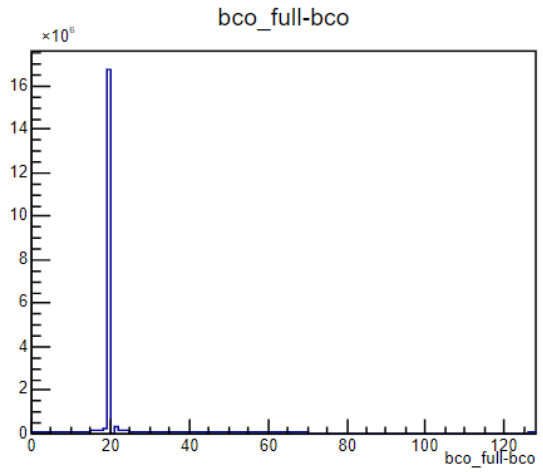


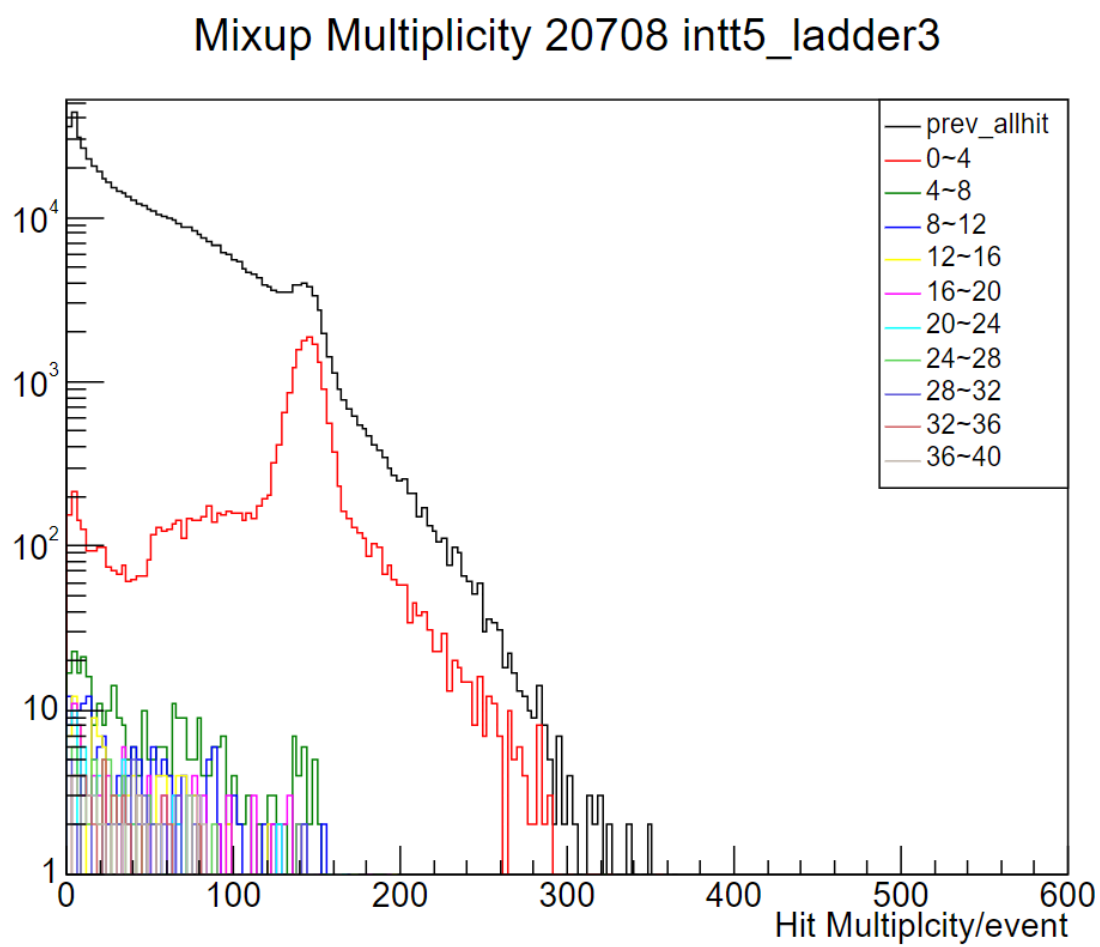
Run20708 intt5 ladder3



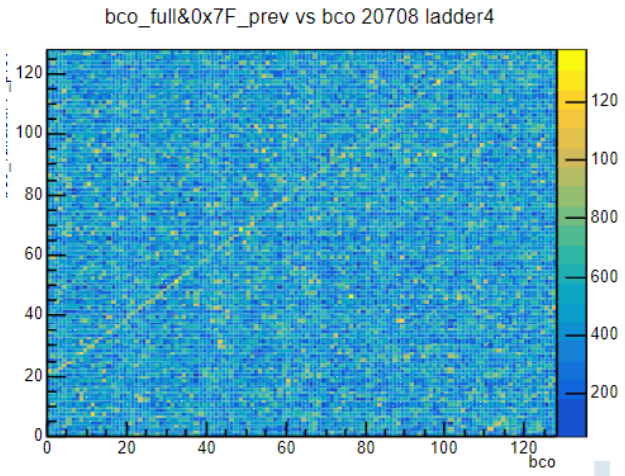


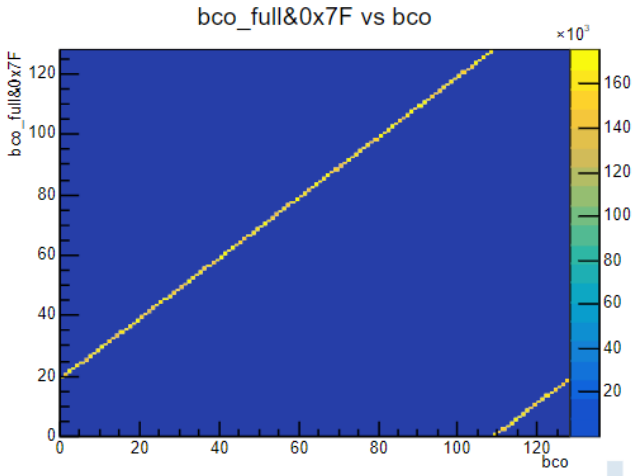


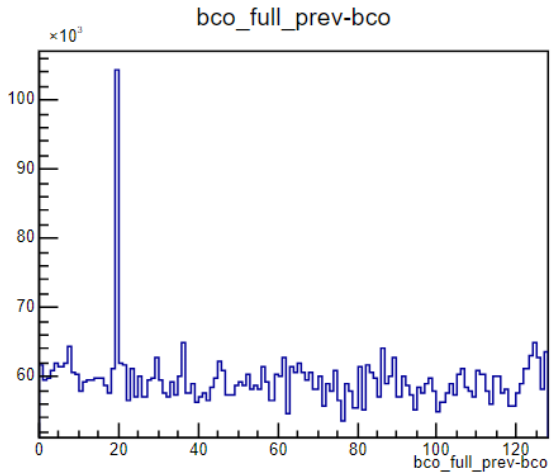


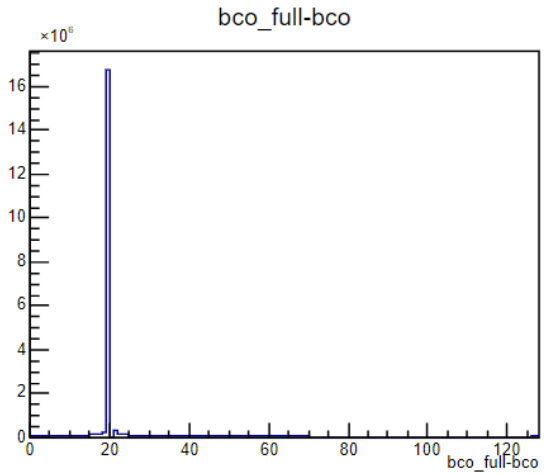


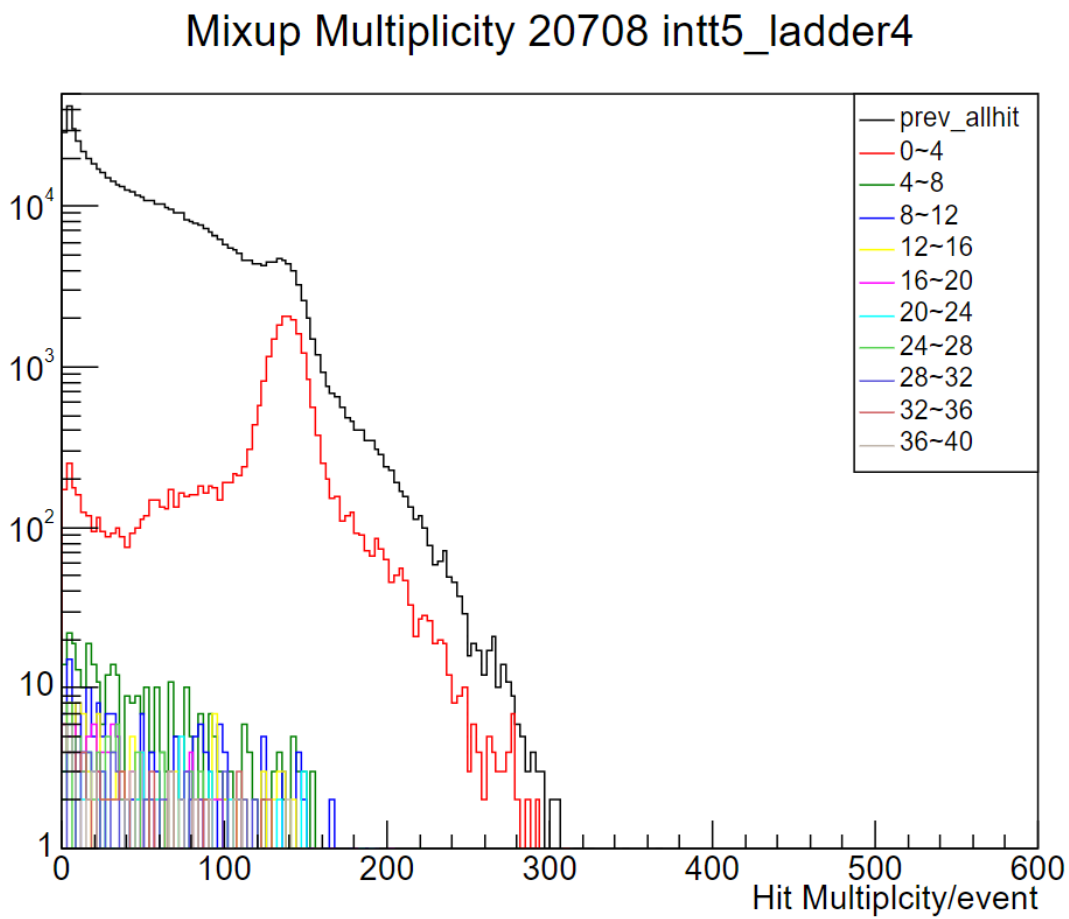
Run20708 intt5 ladder4



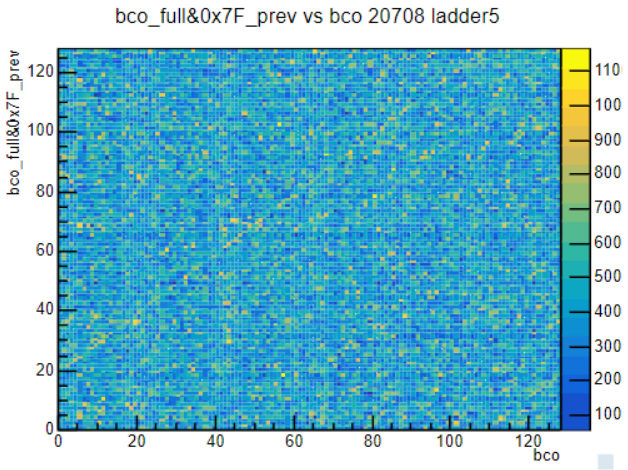


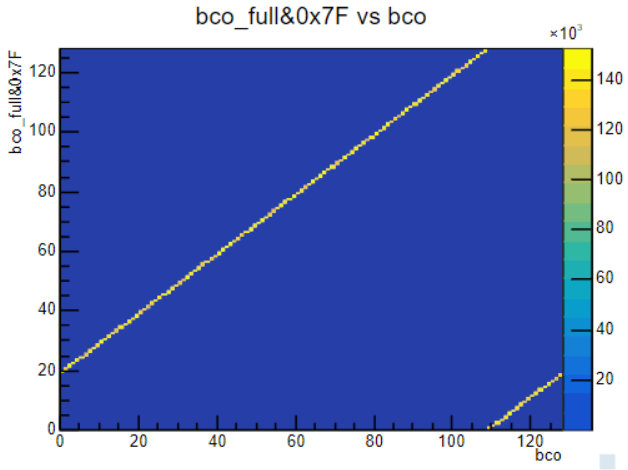


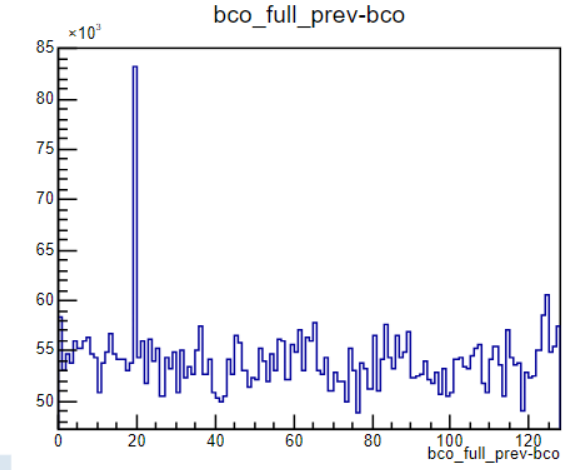


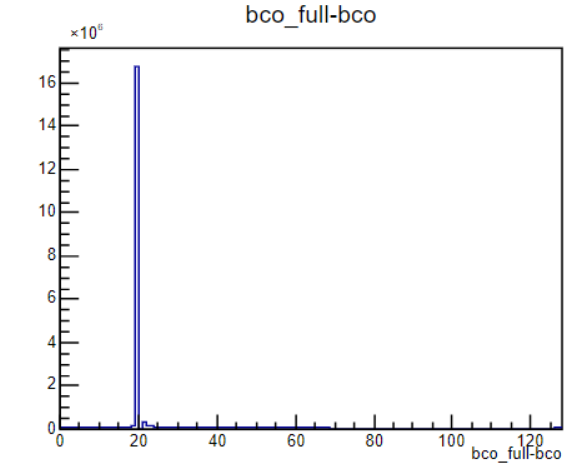


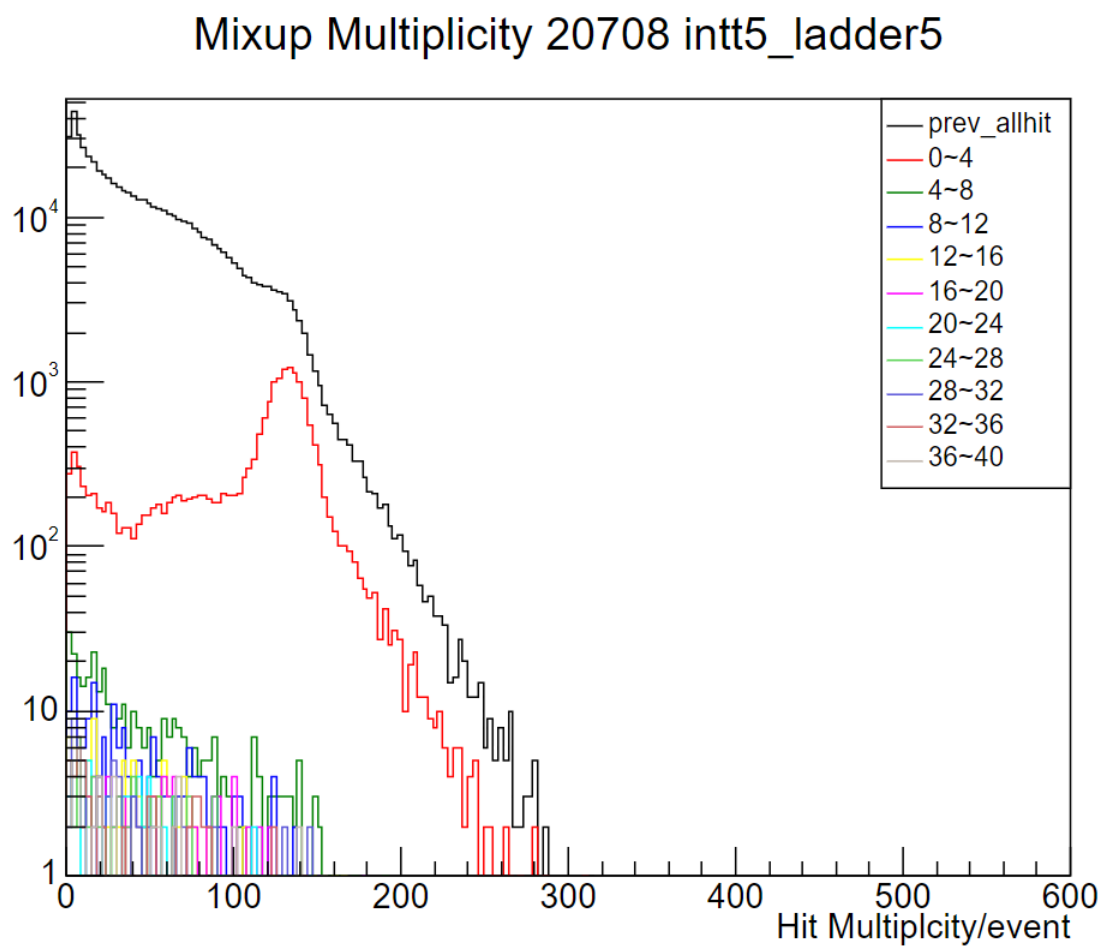
Run20708 intt5 ladder5



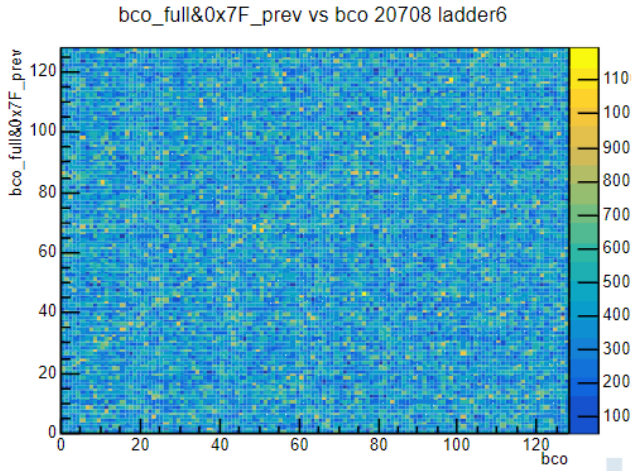


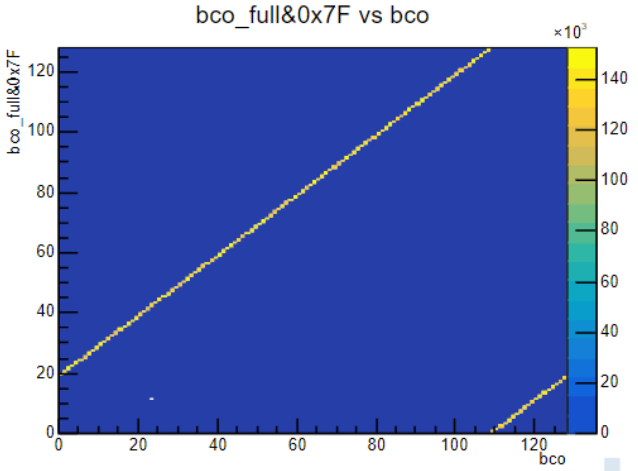


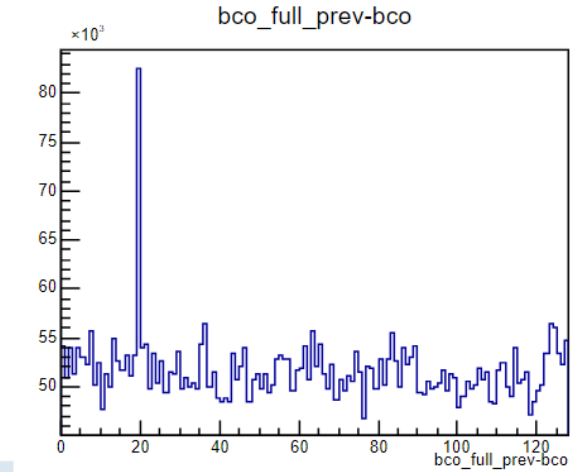


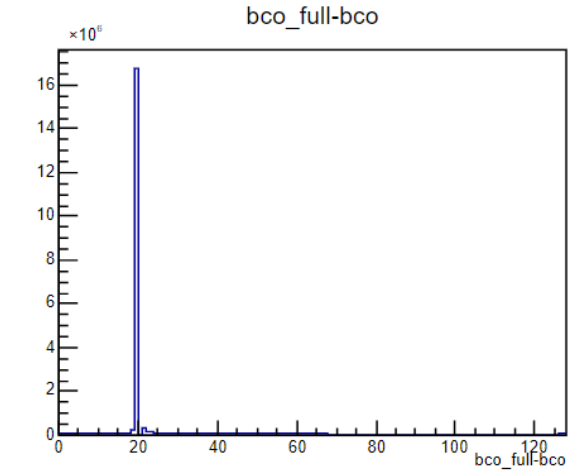


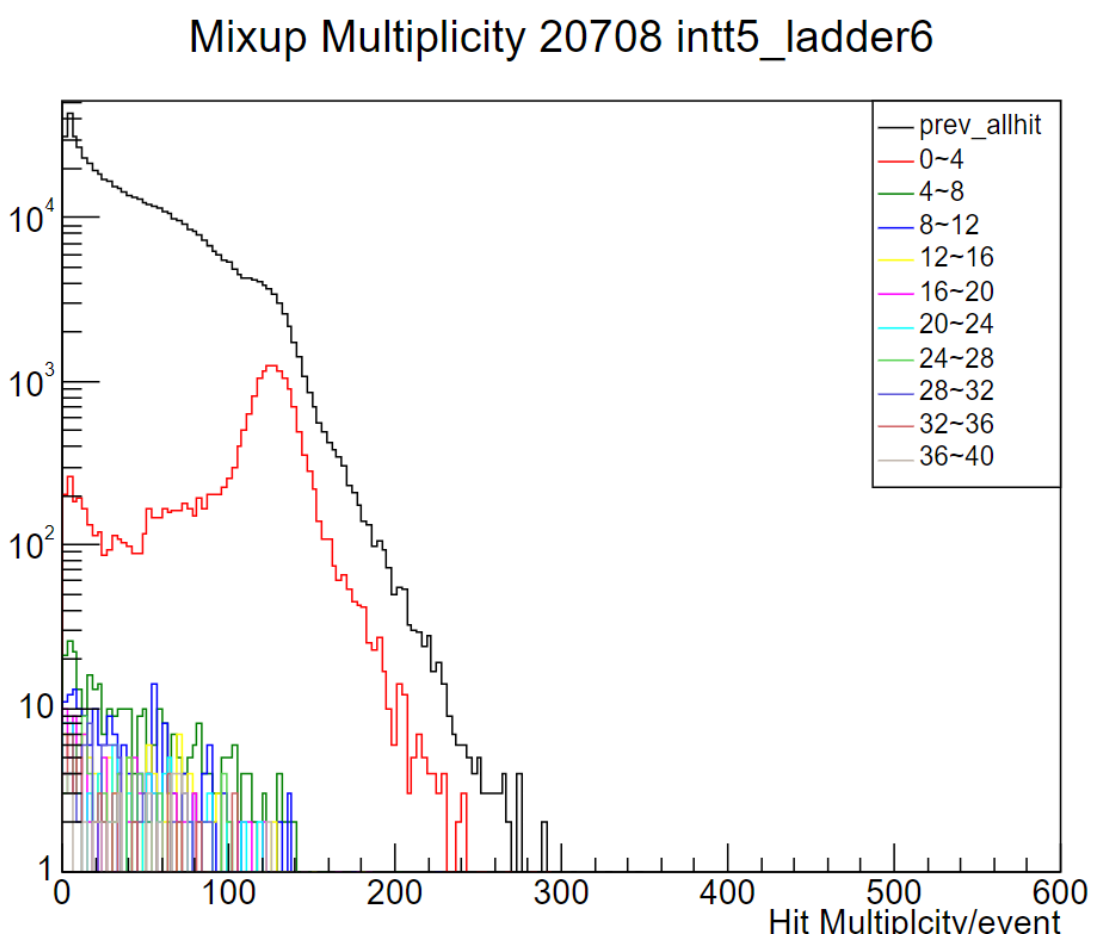
Run20708 intt5 ladder6



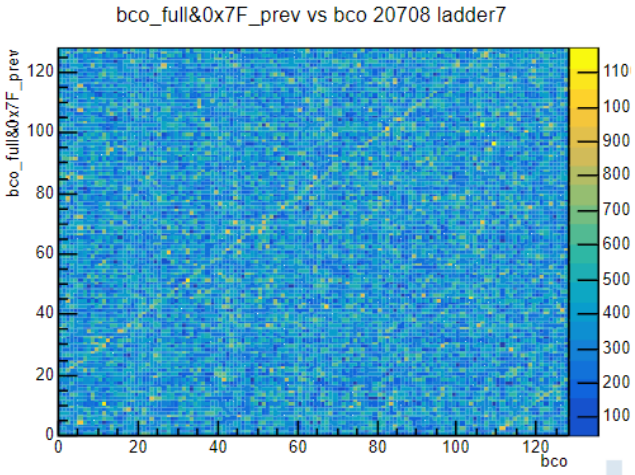


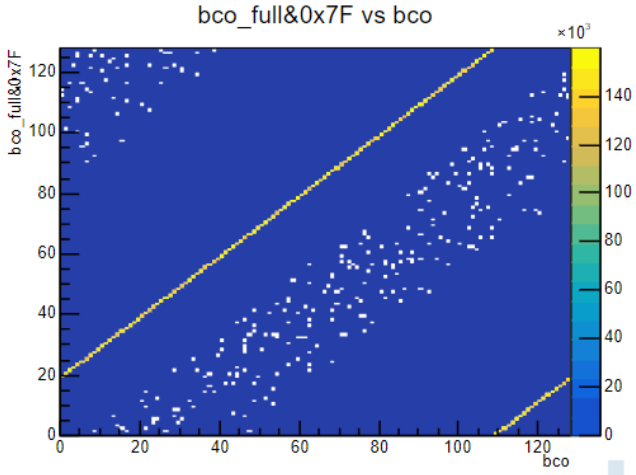


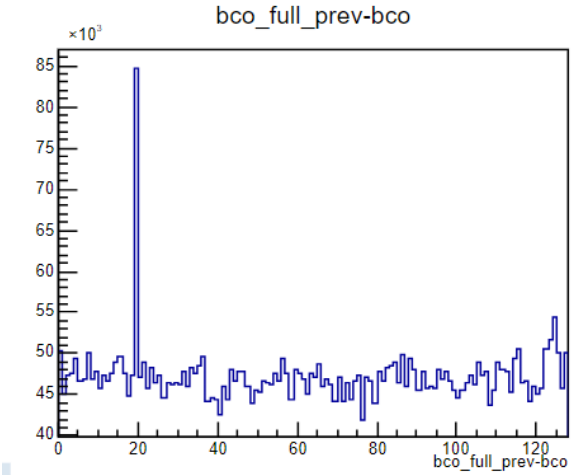


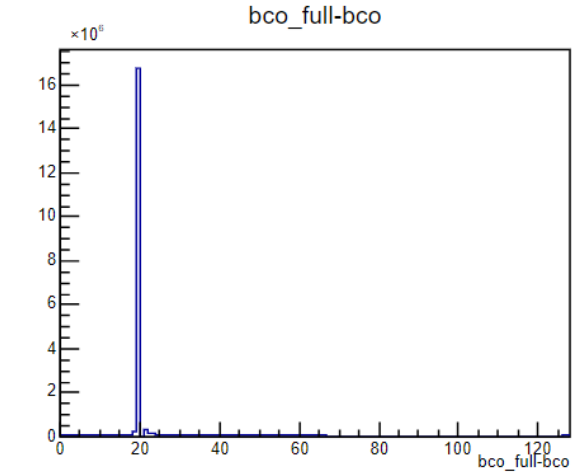


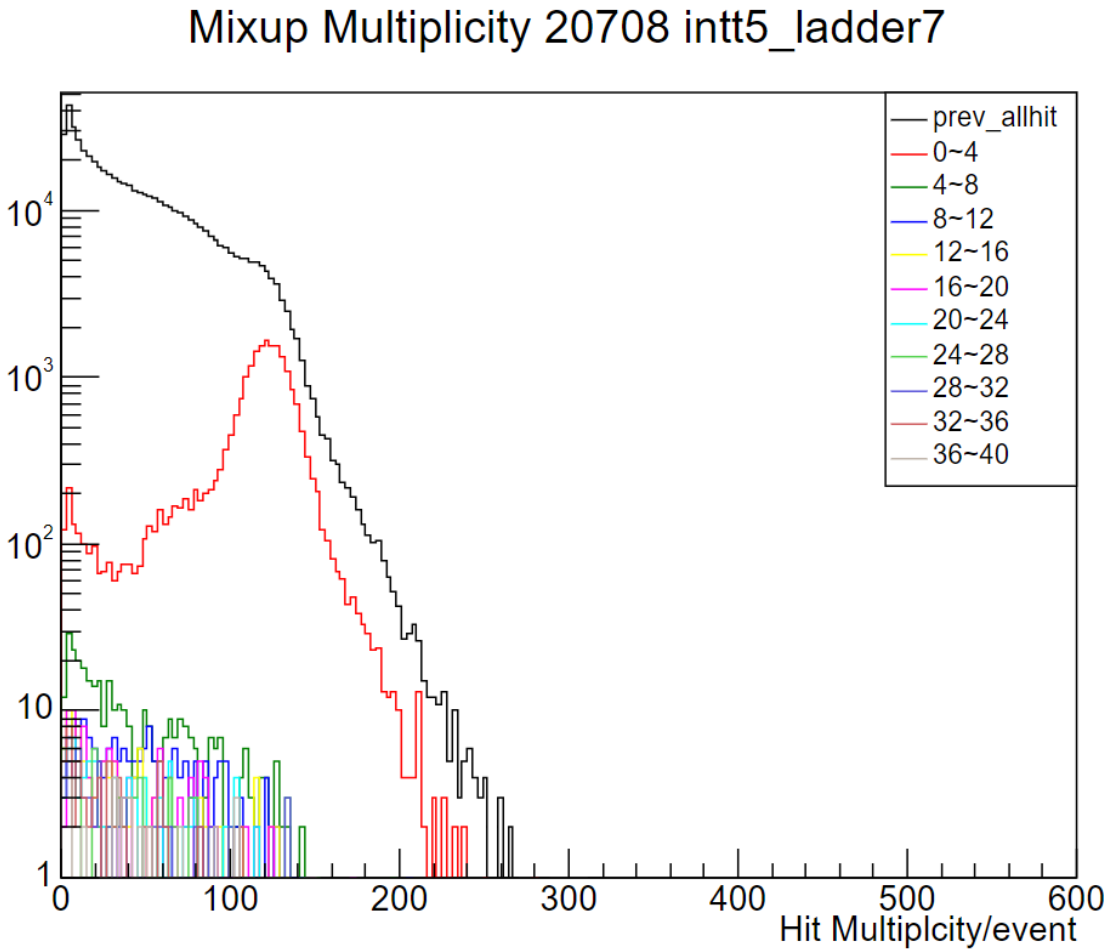
Run20708 intt5 ladder7



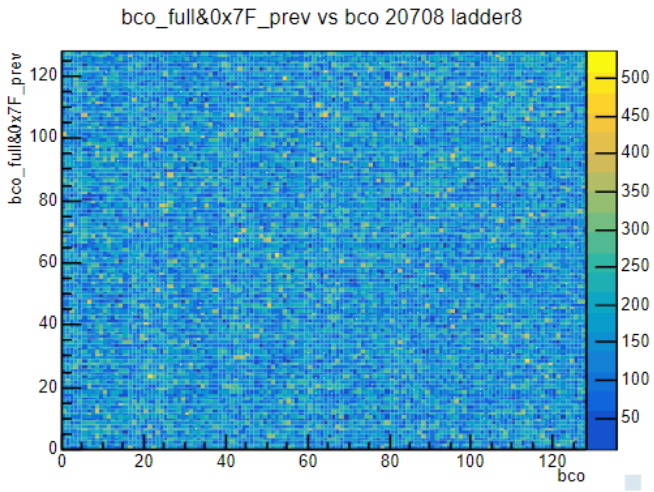


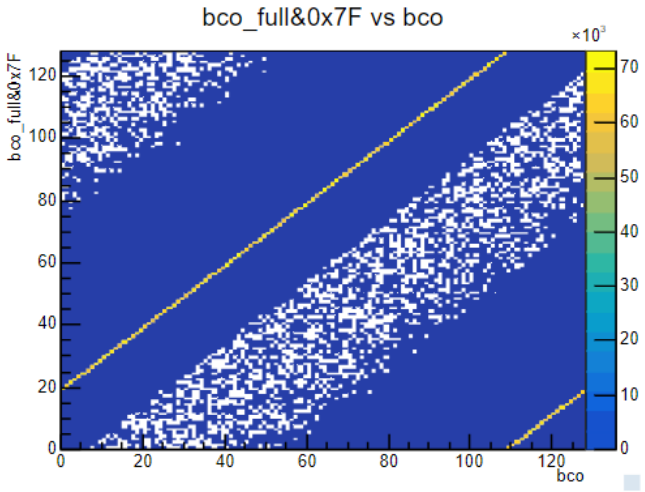


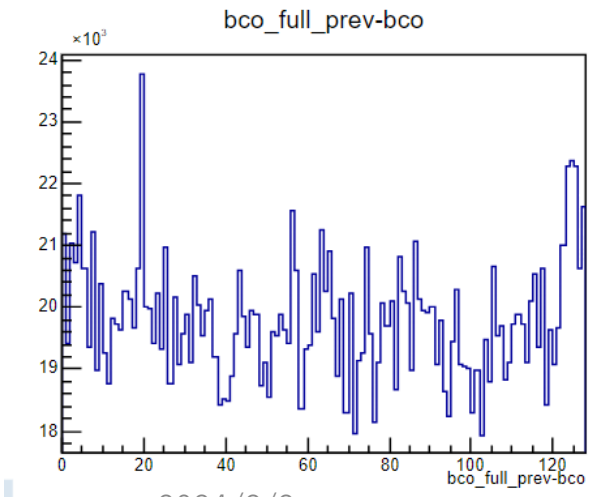


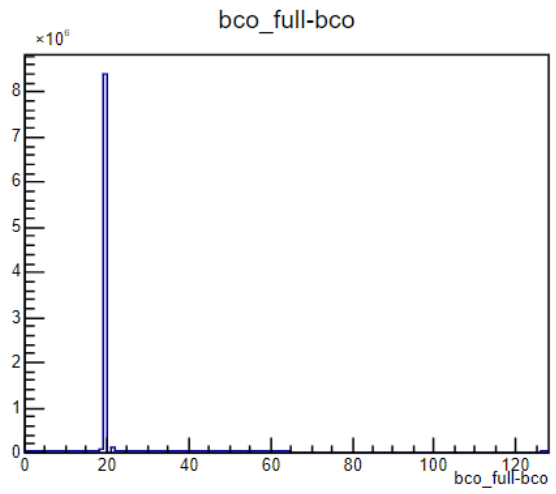


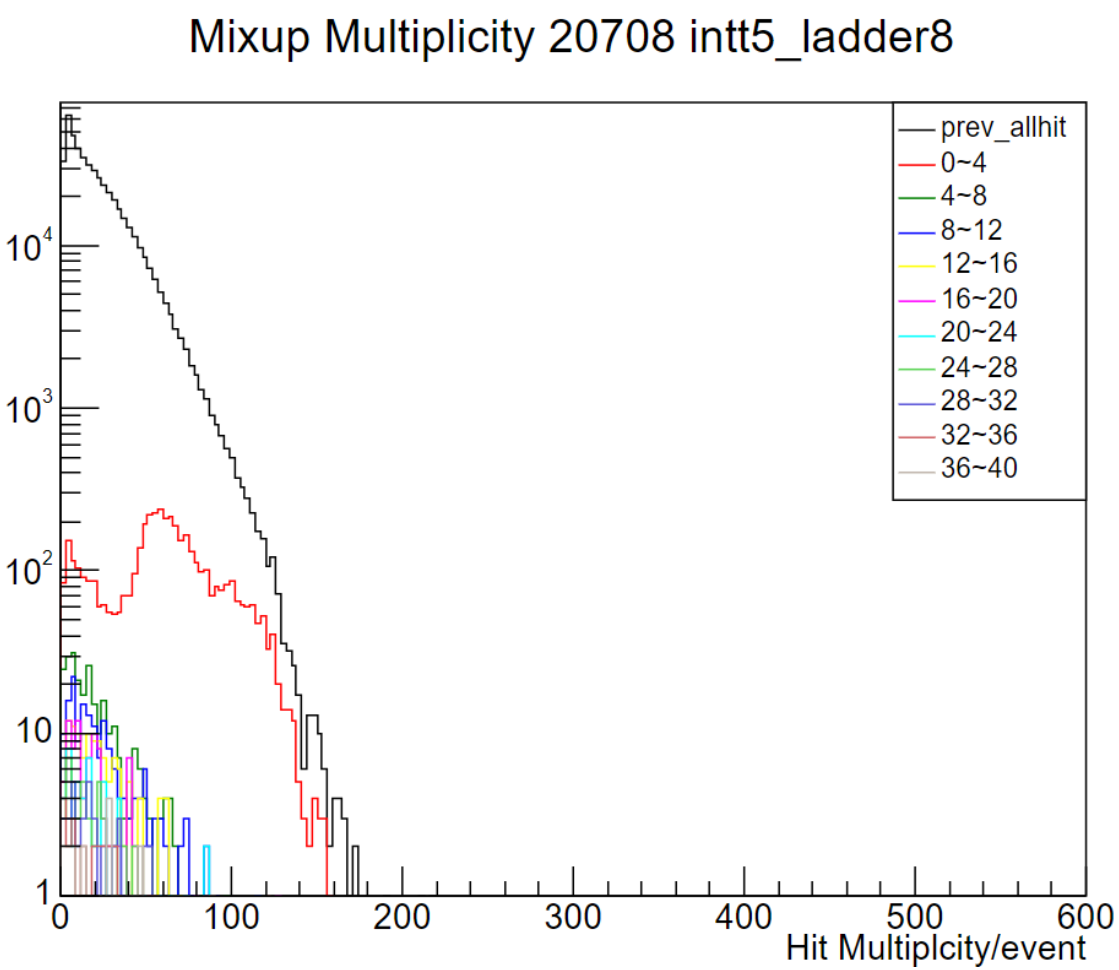
Run20708 intt5 ladder8



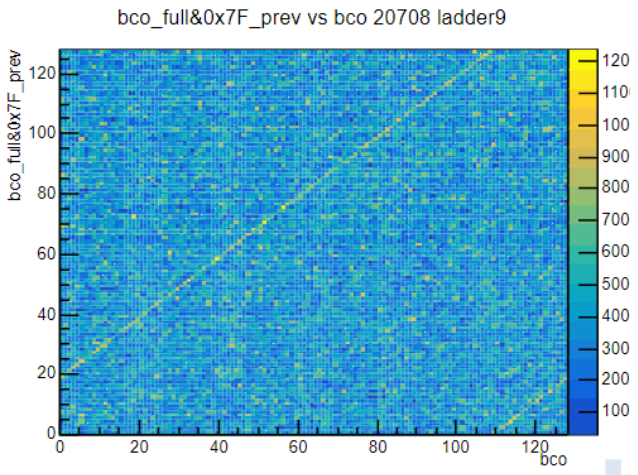


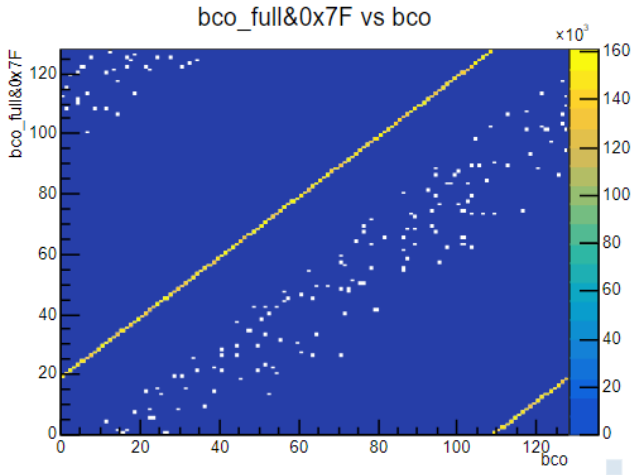


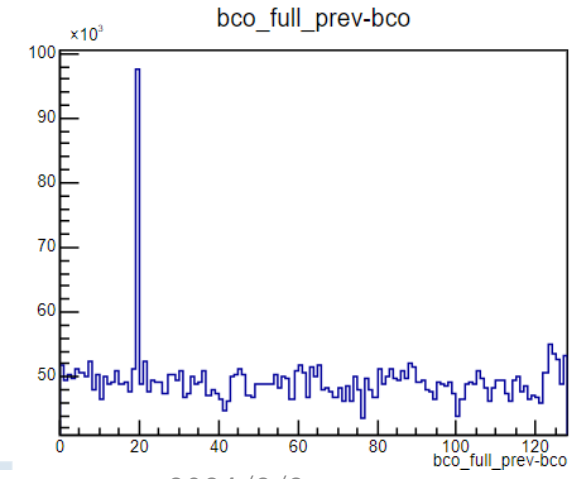


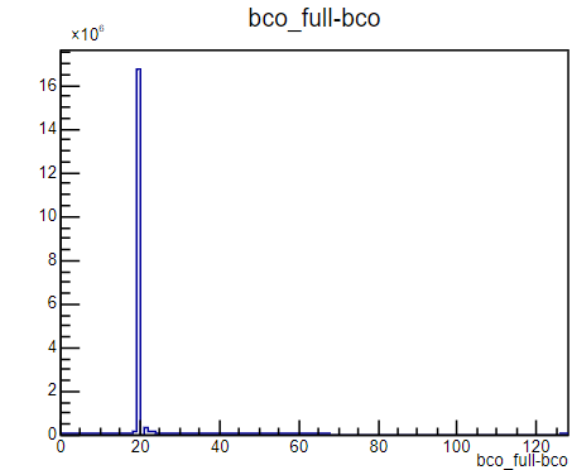


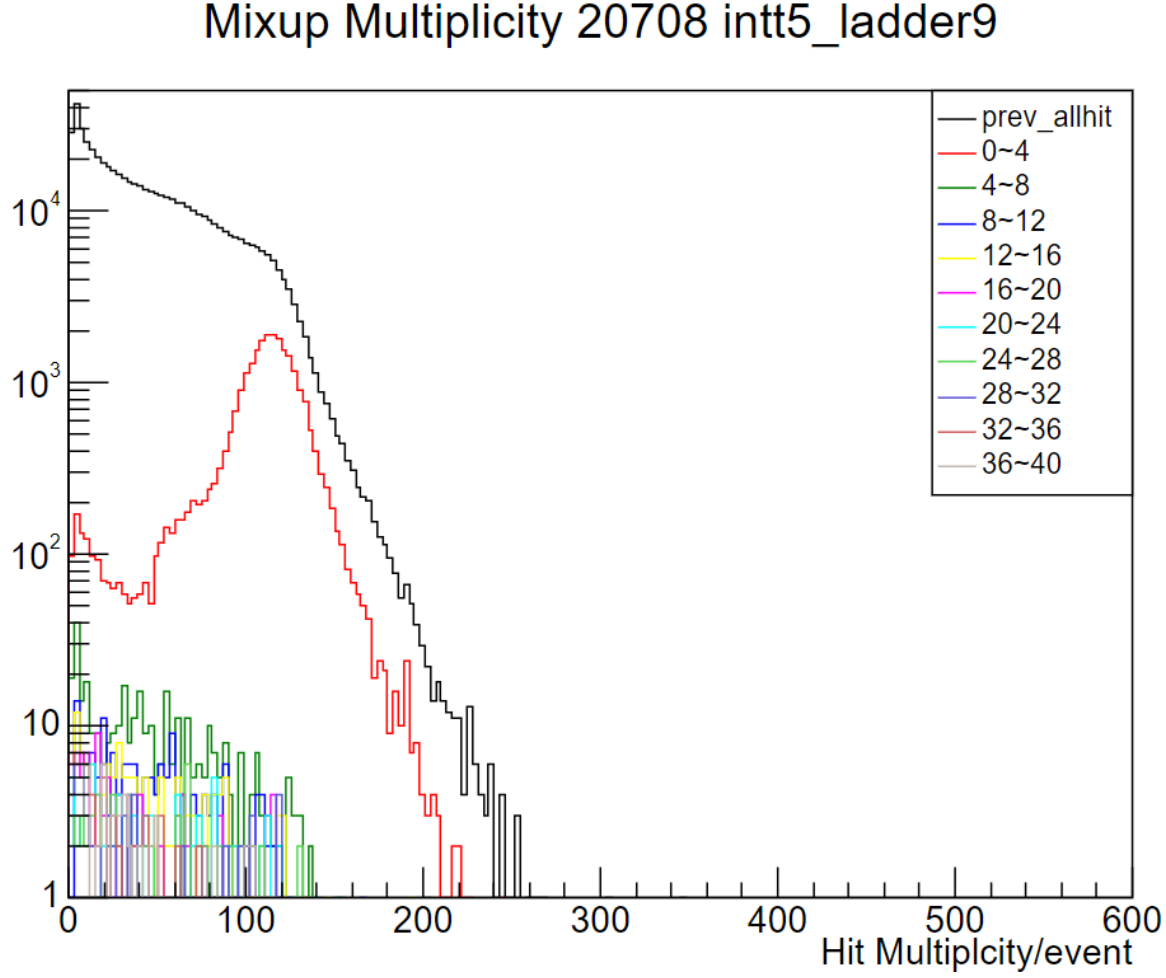
Run20708 intt5 ladder9



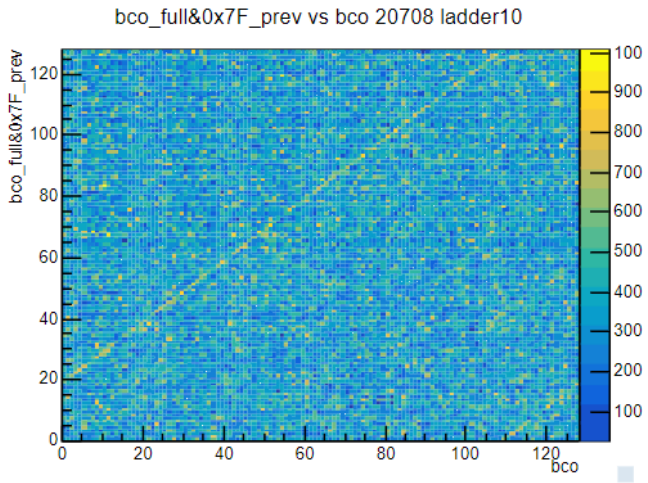


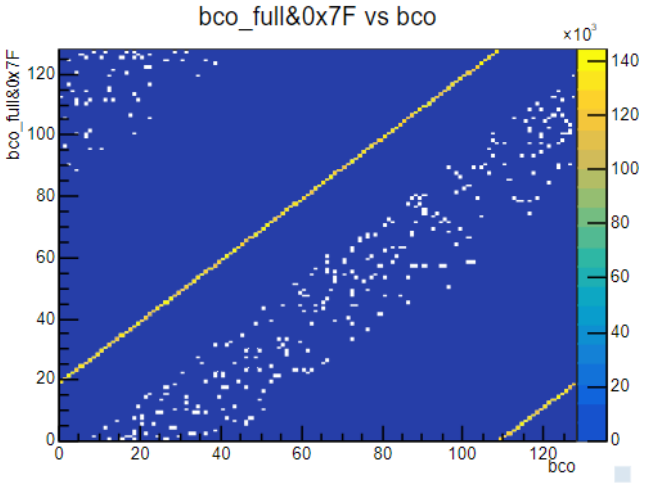


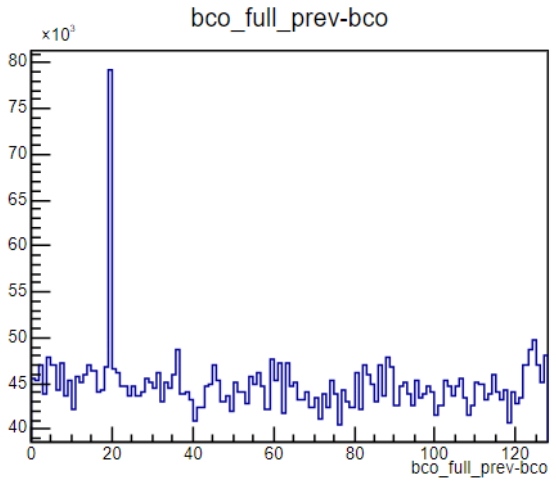


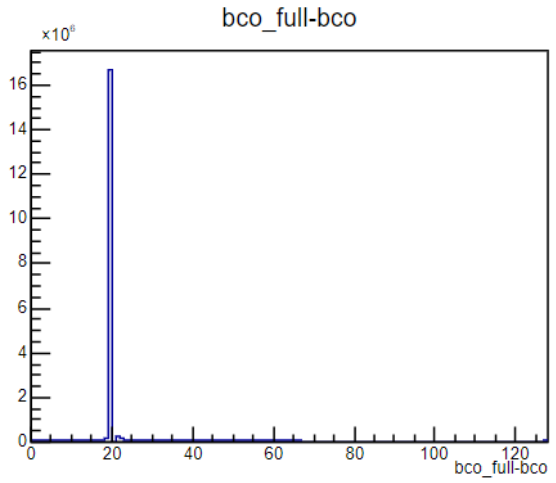


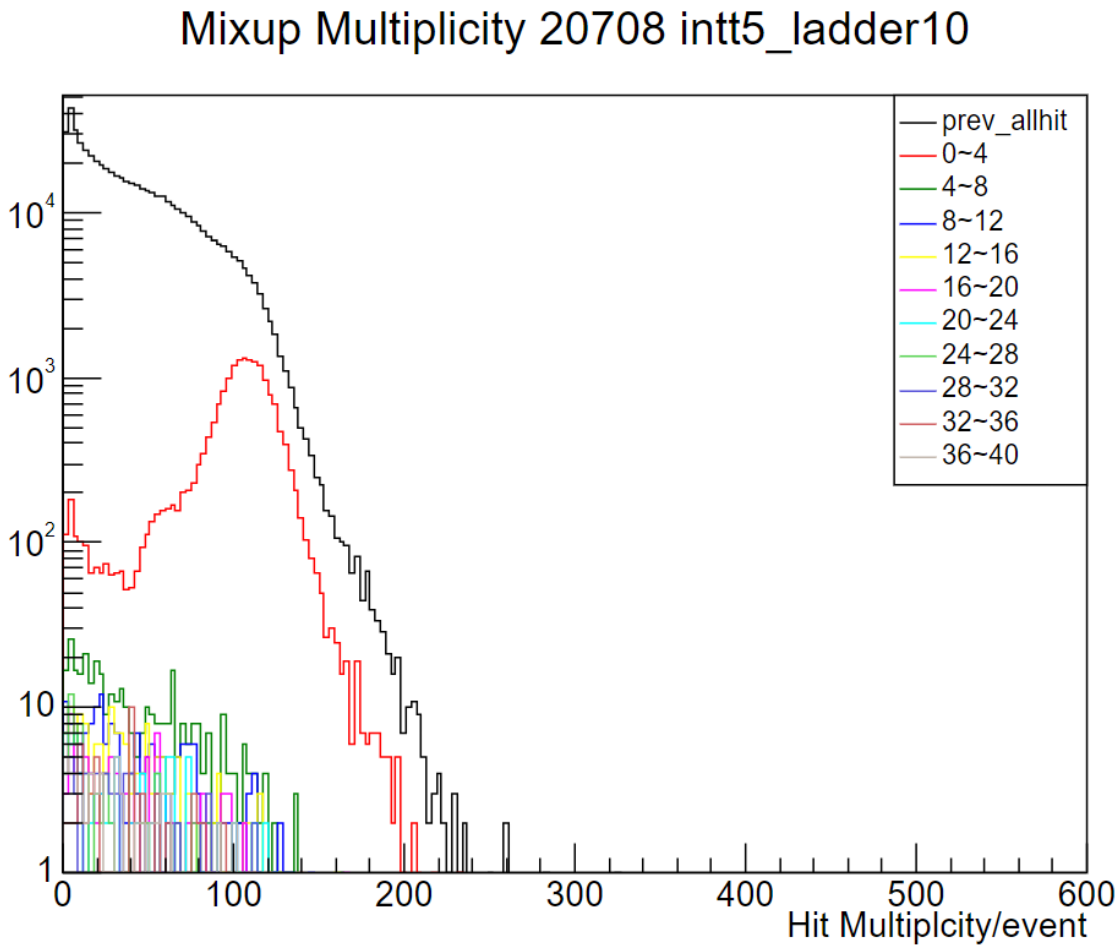
Run20708 intt5 ladder10



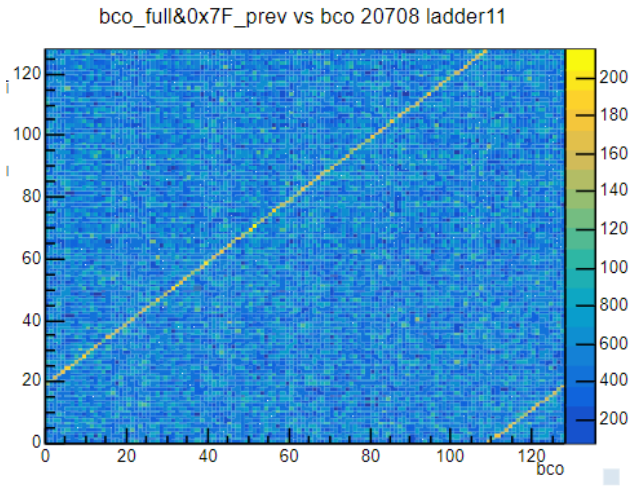


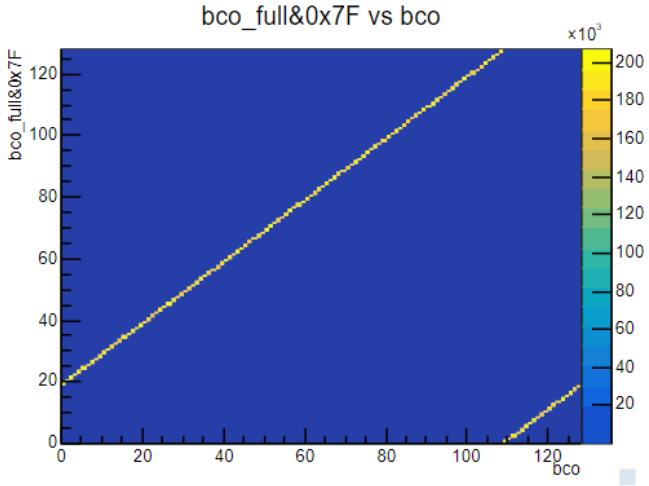


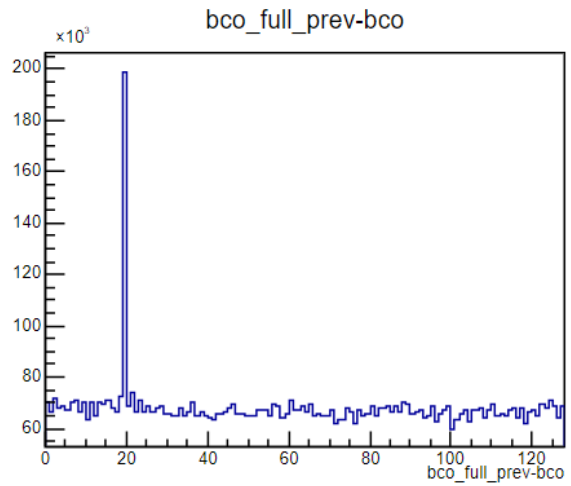


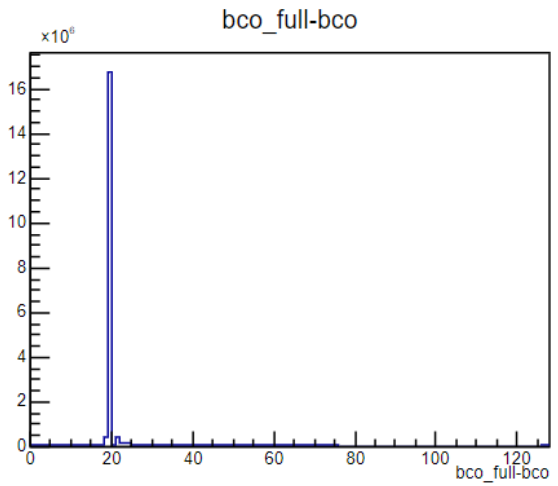


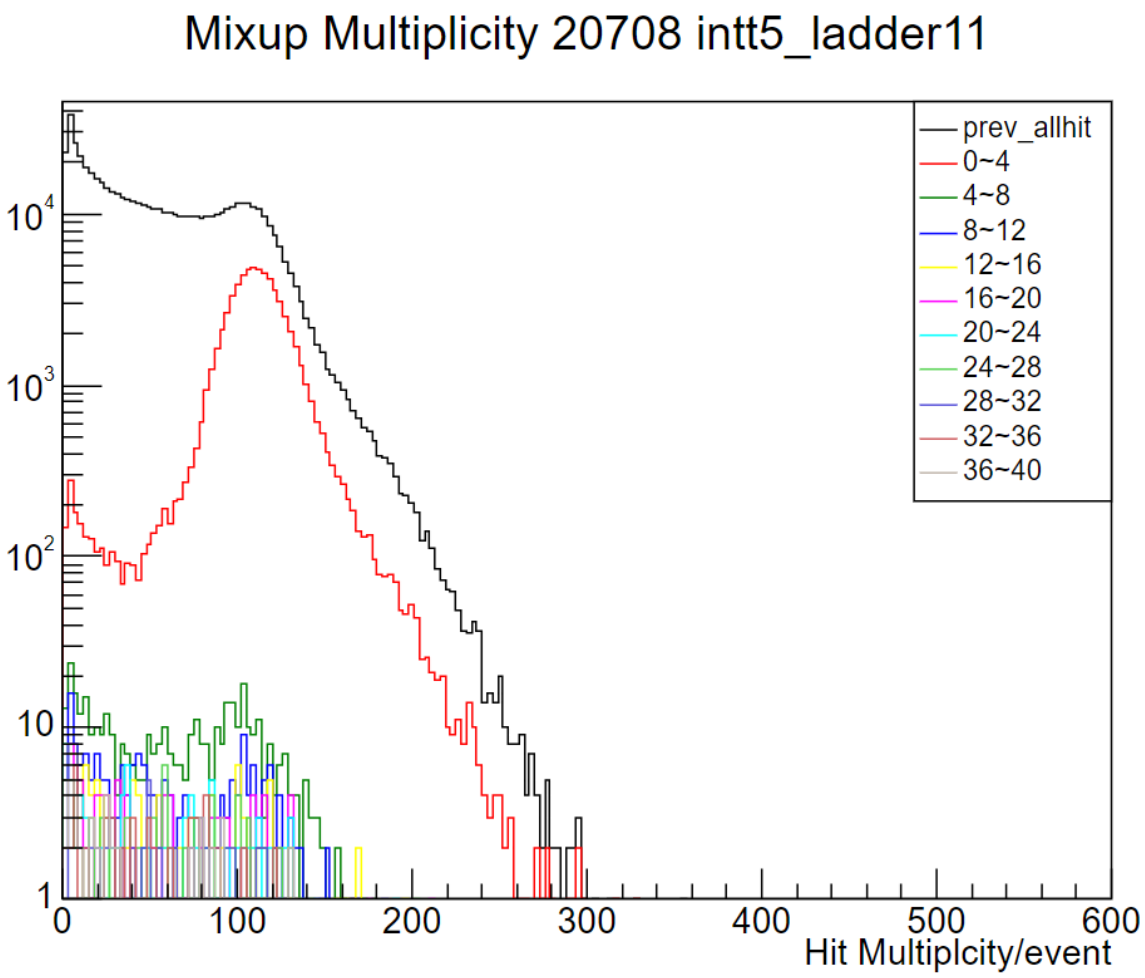
Run20708 intt5 ladder11



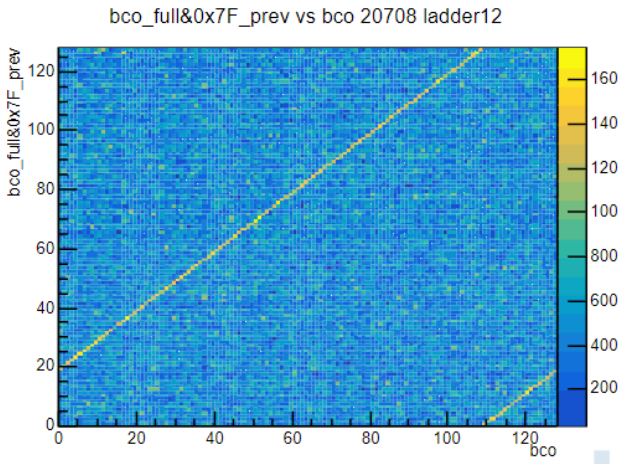


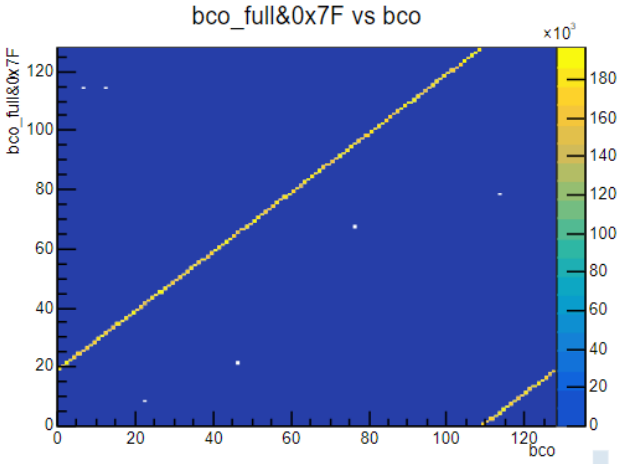


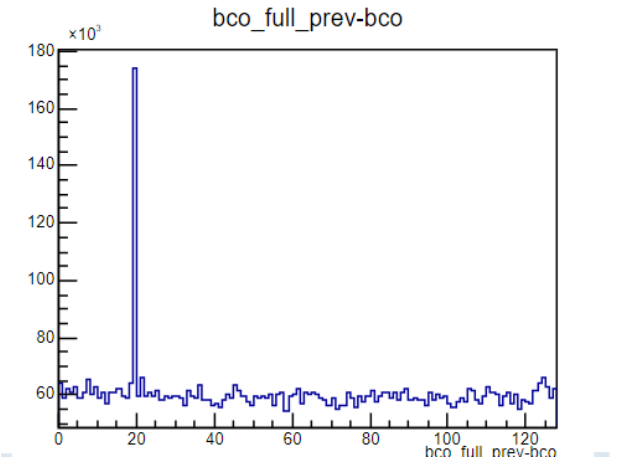


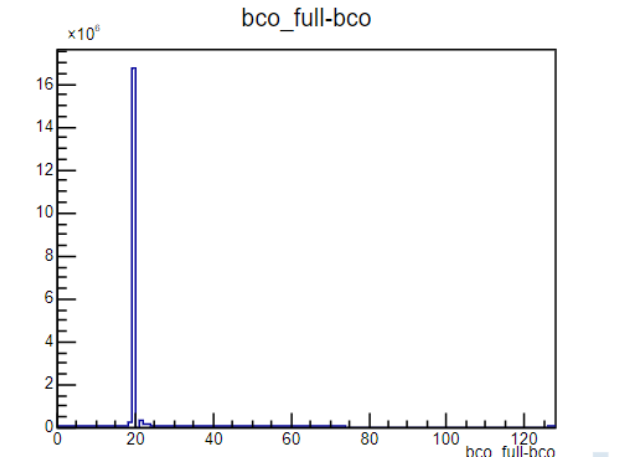


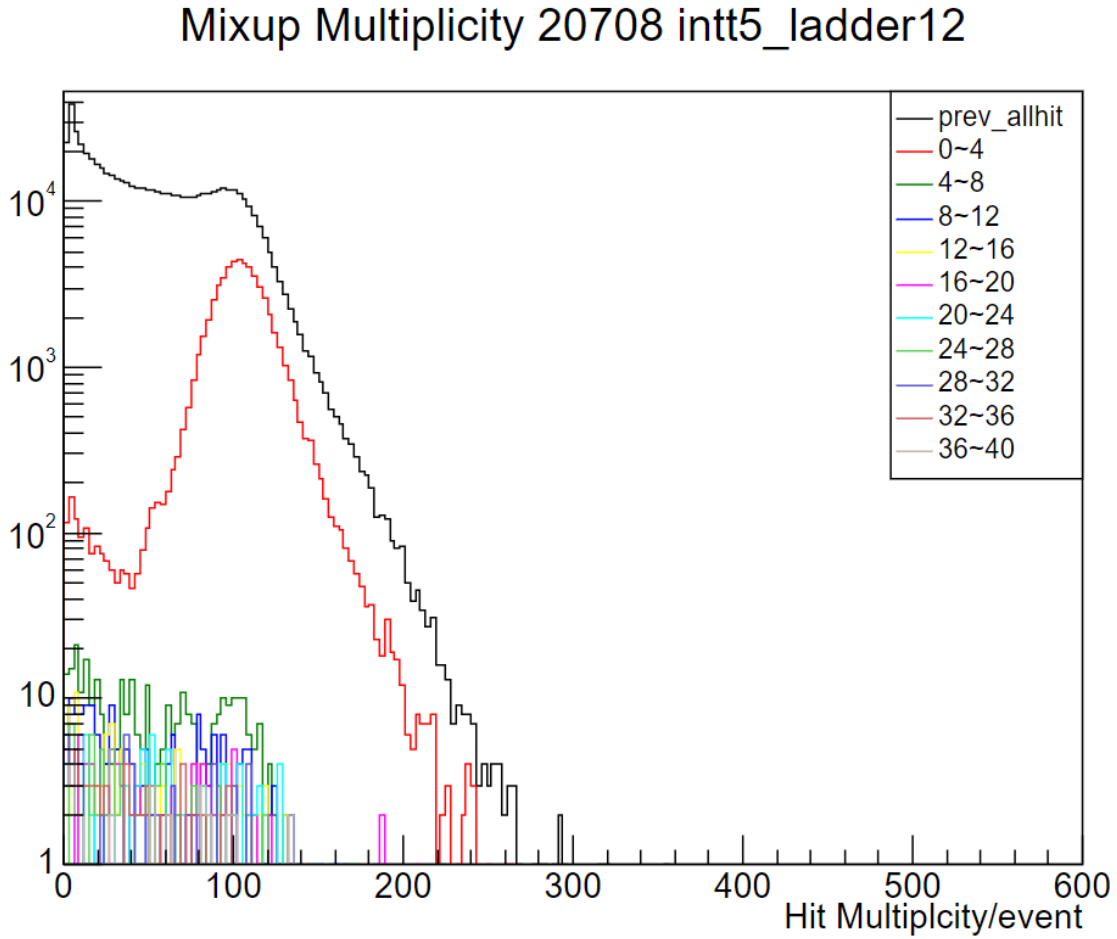
Run20708 intt5 ladder12



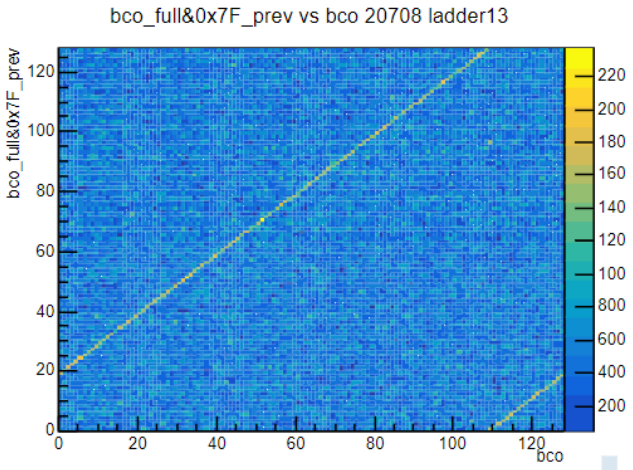


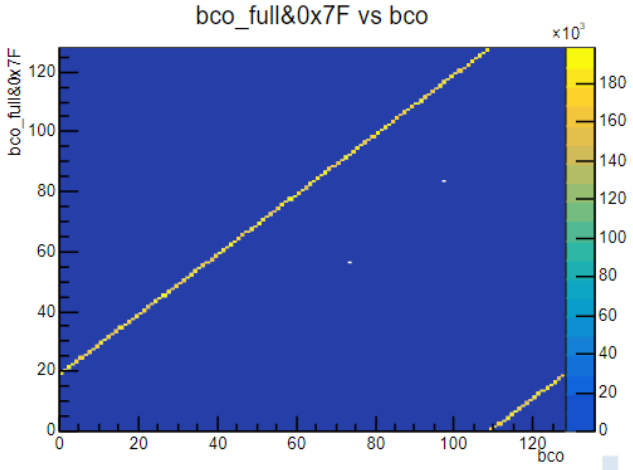


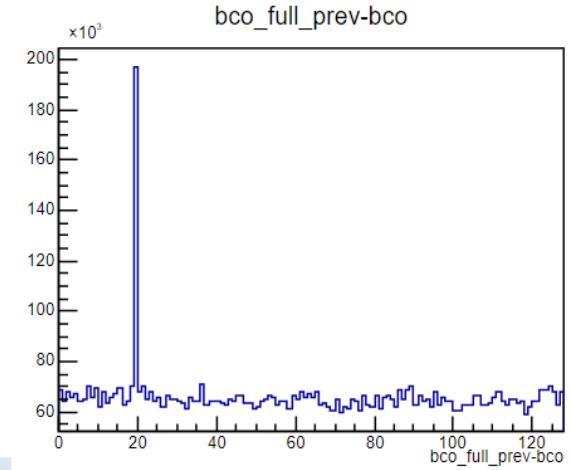


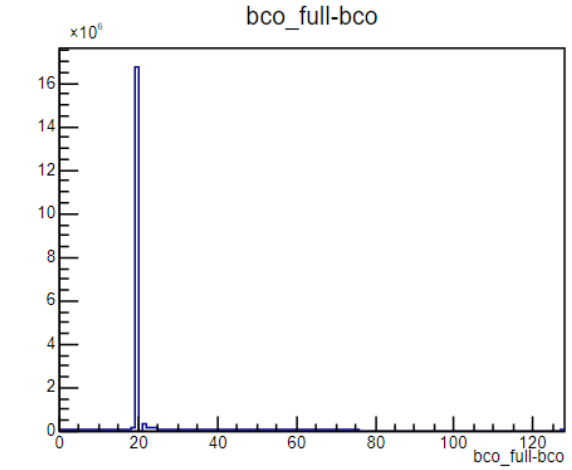


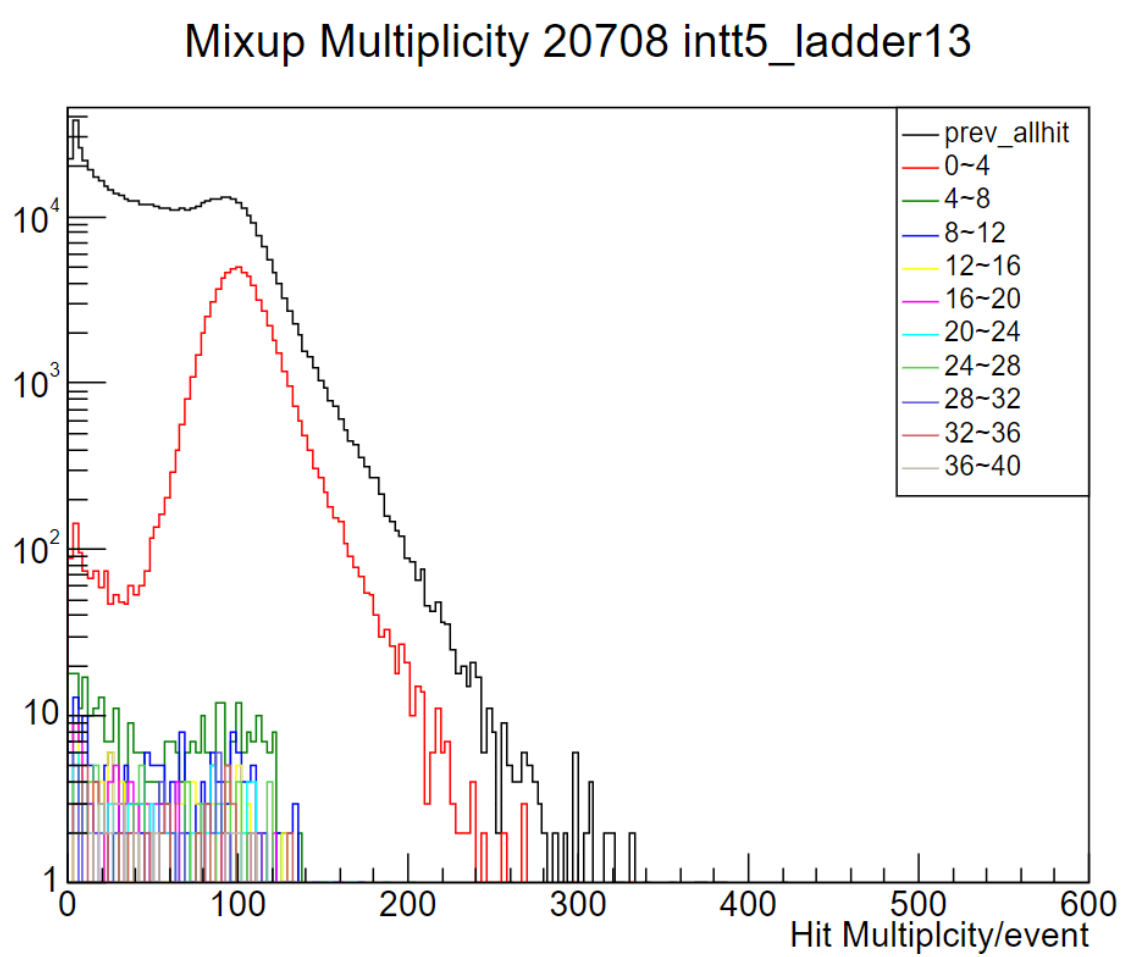
Run20708 intt5 ladder13







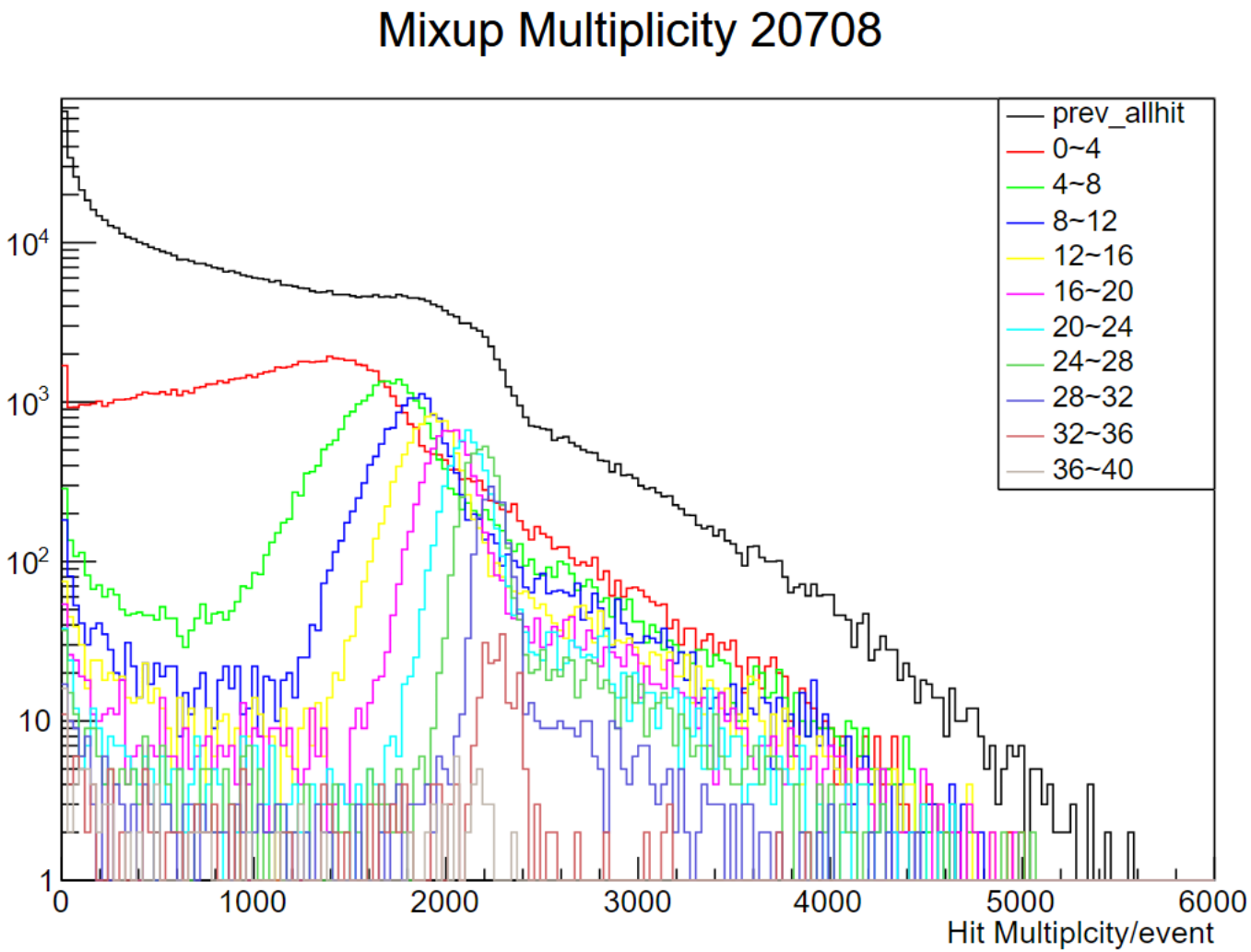




What we know about Event Mixup

- Event Mixup is in the form that hit information from the previous event is mixed up with the next event.
- Most of the time the degree of Mixup is low.
- Event mixups have been observed on some runs.
- There is correlation between Multiplicity of previous event and the number of Mixup hits.

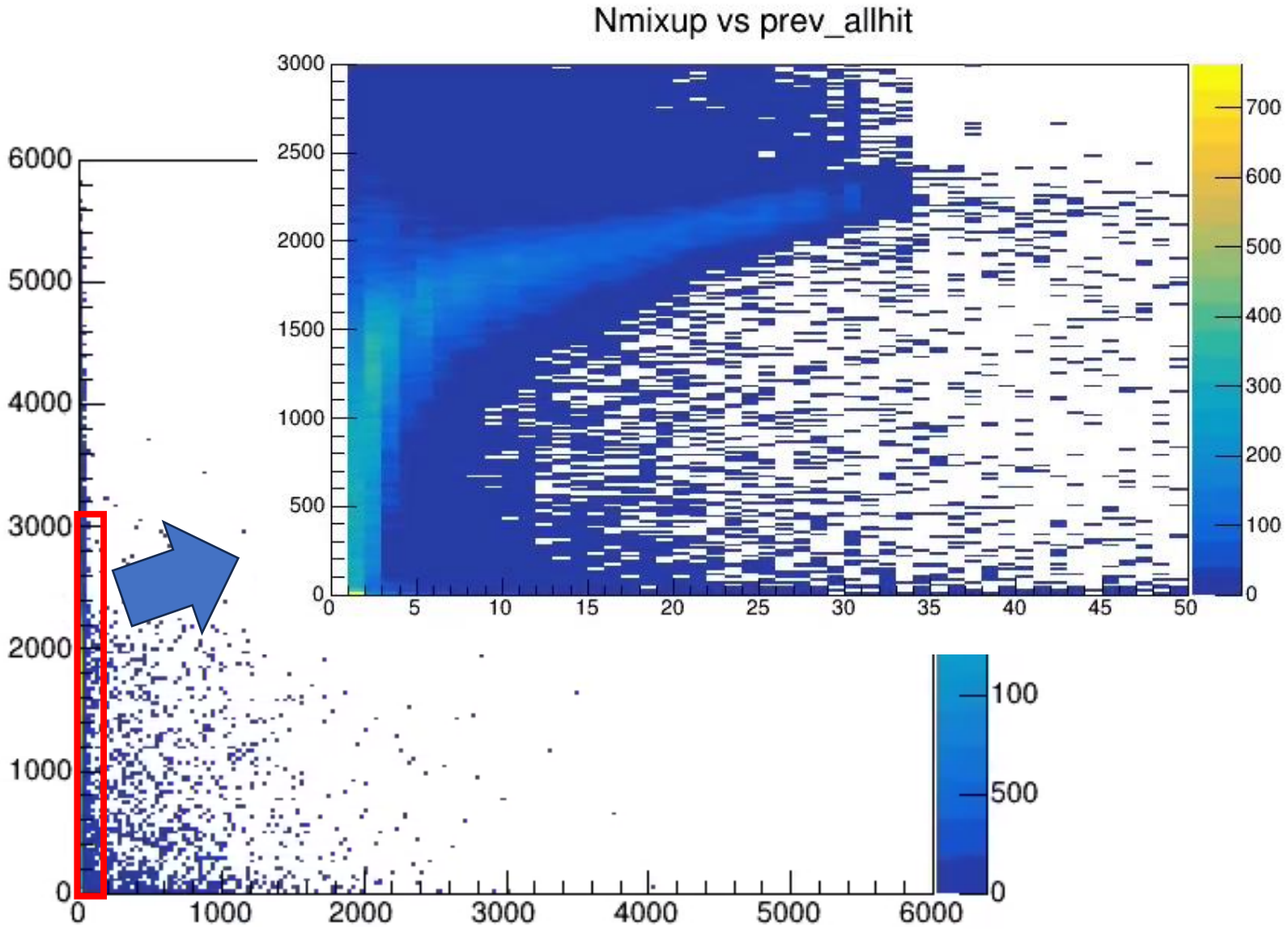
Hit Multiplicity (separated by number of Mixup)



- I examined the number of mixup from 1 to 40.
- The results confirm that as the number of mixup increases, the peak moves in the direction of increasing multiplicity.

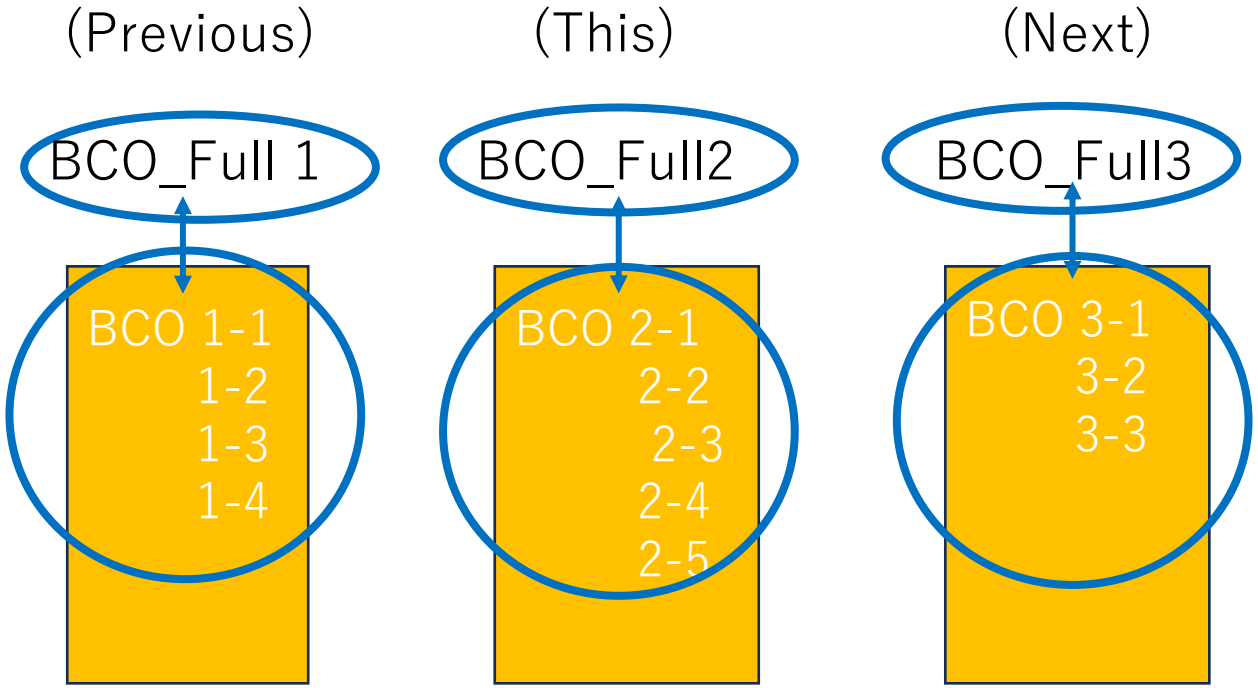
→There may be a correlation between the number of Mixup and multiplicity.

Number of Mixup vs previous event Multiplicity



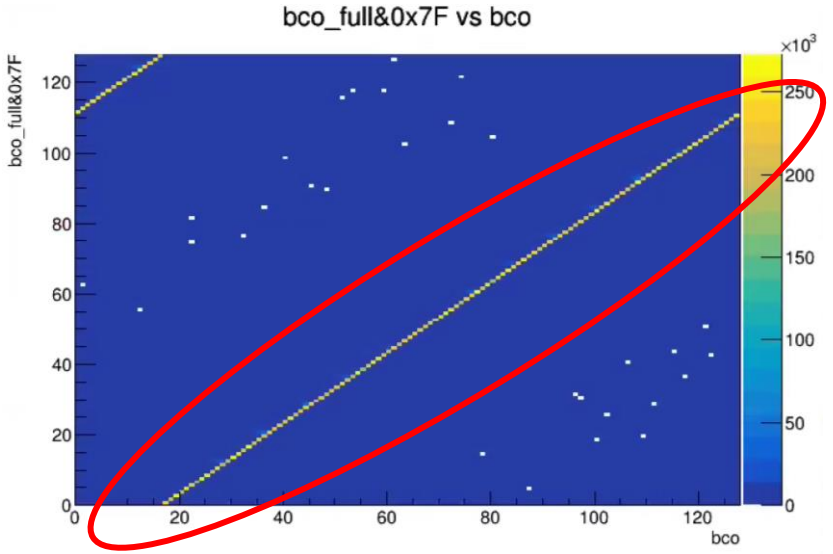
- From the results obtained from the Multiplicity distribution, a range of 0~50 on the x-axis and 0~3000 on the y-axis was chosen for the plot.
- The results confirmed the correlation shown in the figure, within the range of 1 to roughly 30 Mix up hits, the number of mix up hits are increasing with larger previous event multiplicity.

BCO Correlation in for NO mix-up



Run23648 intt5

Same event BCO_Full &0x7F vs BCO



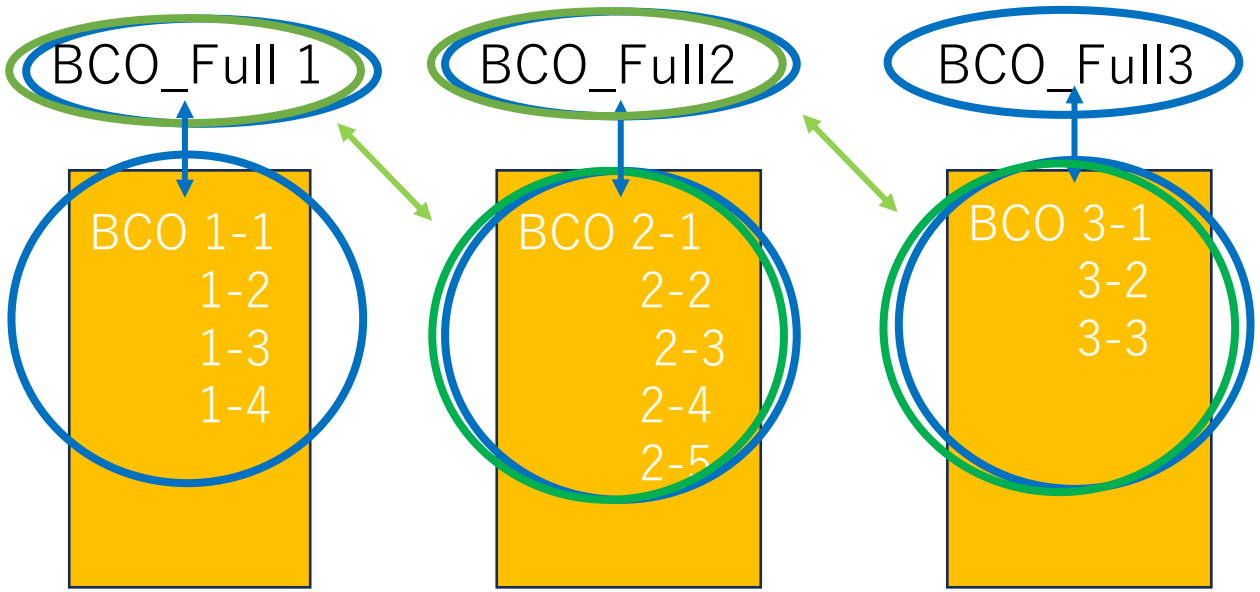
Perfect correlation observed as expected

For example, suppose that when normal and no mixup is occurring, the above figure is shown.
The figure on the right shows the correlation between BCO(x-axis) and the lower 7 bits of BCO_Full(y-axis).

BCO_Full and BCO in the same event are correlated (hit from collision).

BCO Correlation in for NO mix-up

(Previous) (This) (Next)

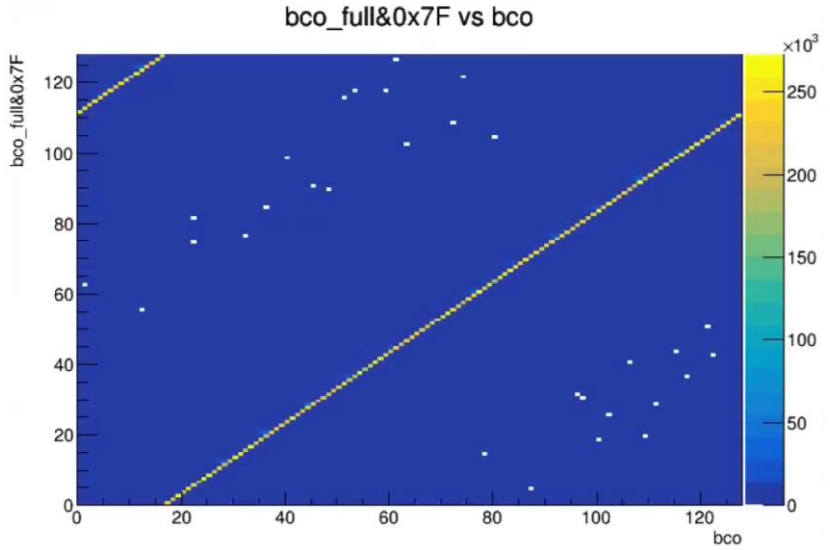


For example, suppose that when normal and no mixup is occurring, the above figure is shown.
The figure on the right shows the correlation between BCO(x-axis) and the lower 7 bits of BCO_Full(y-axis).

If we look at the plot of BCO of one event and BCO_Full of the previous event here, we don't see the correlation as we except.

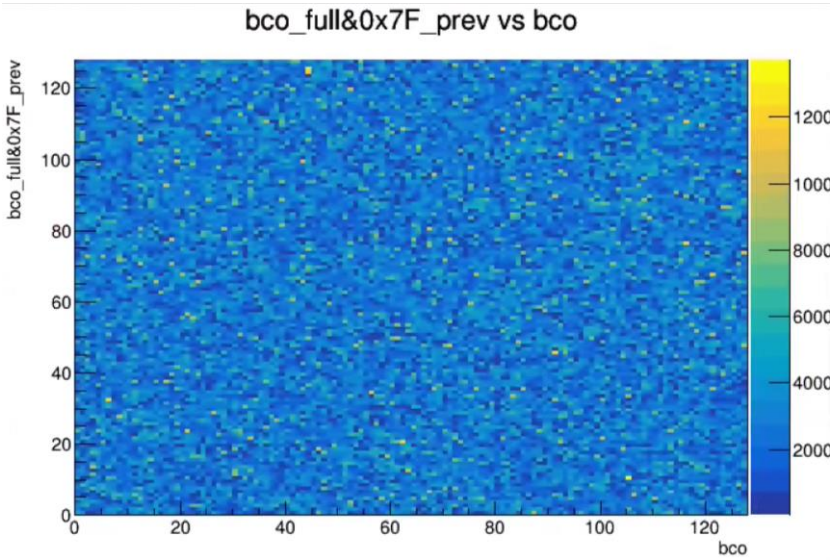
Run23648 intt5

Same event BCO_Full &0x7F vs BCO



Run23648 intt5

Previous event BCO_Full &0x7F vs BCO

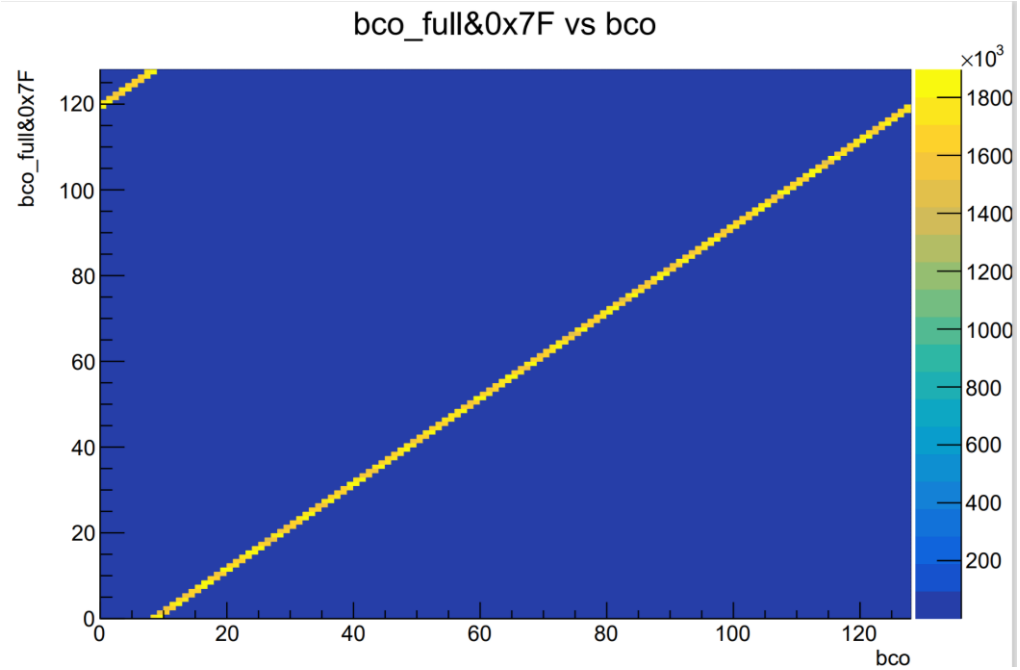


BCO Correlation in for mix-up

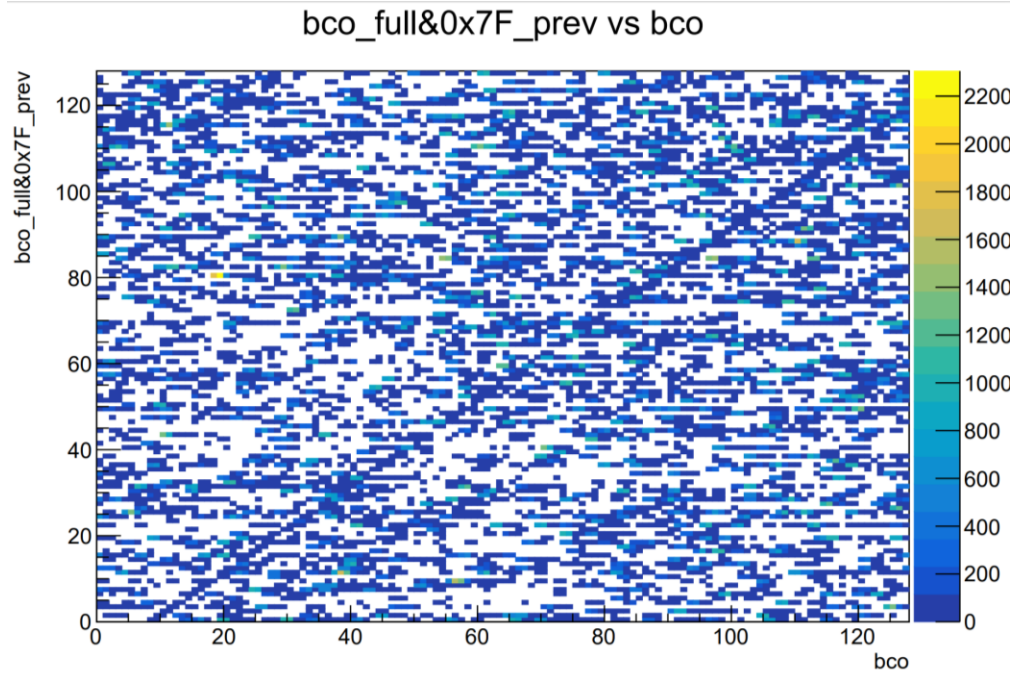
Run20444 intt5

However, the plot of BCO_Full vs BCO showed that there is a correlation in the results of some runs.

Same event BCO_Full &0x7F vs BCO



Previous event BCO_Full &0x7F vs BCO



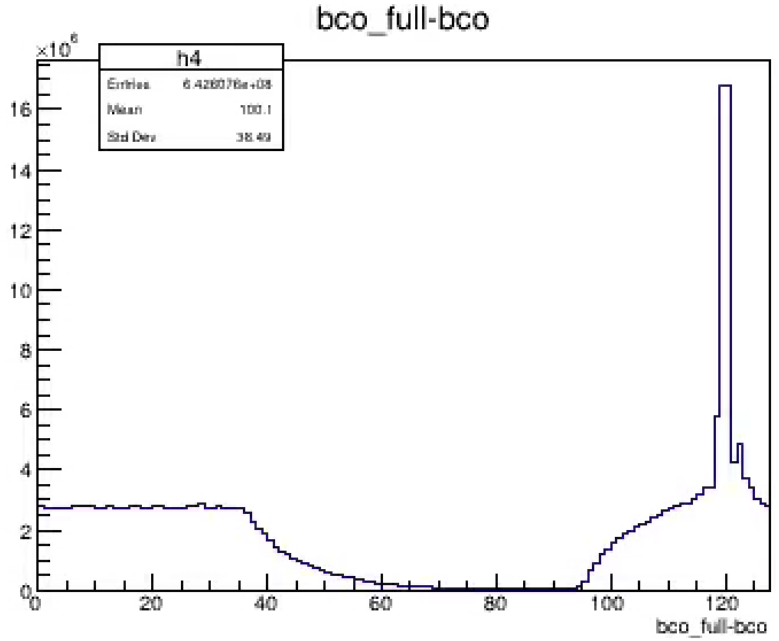
There should be no correlation between the BCO_Full of the previous event and the BCO of this event, but the correlation as shown on the right figure suggests that the data from the collision of the previous event has been mixed up with this event. →**Event Mixup is occurring.**

BCO_Full_prev-bco Mixup

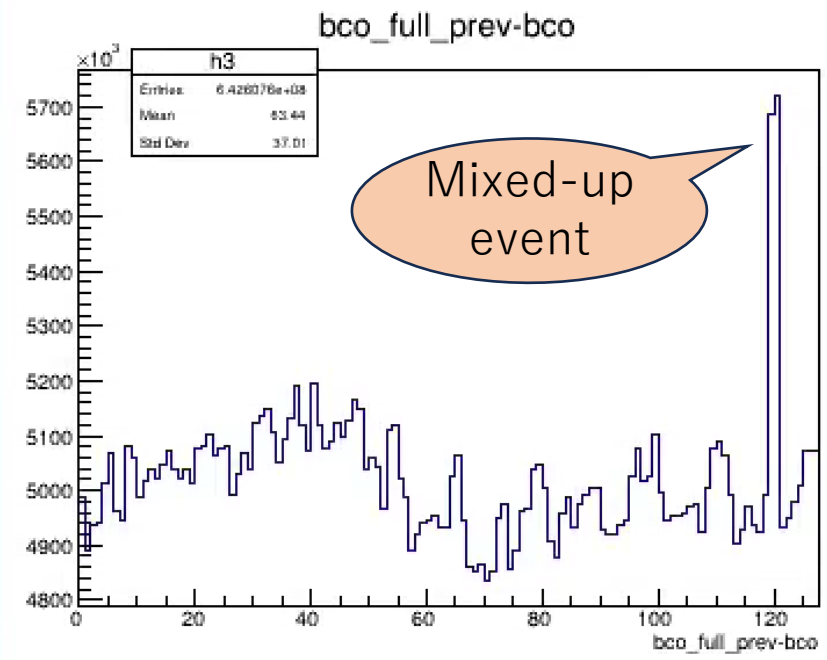
Run20444 intt5
This Run was measured with n_collision=127

- Also, when looking at the BCO_Full of the previous event -BCO at the Run where the Mixup is believed to have occurred, I could see the peak standing in the same position as the BCO_Full-BCO of the same event

Same event BCO_Full &0x7F - BCO



Previous event BCO_Full &0x7F - BCO

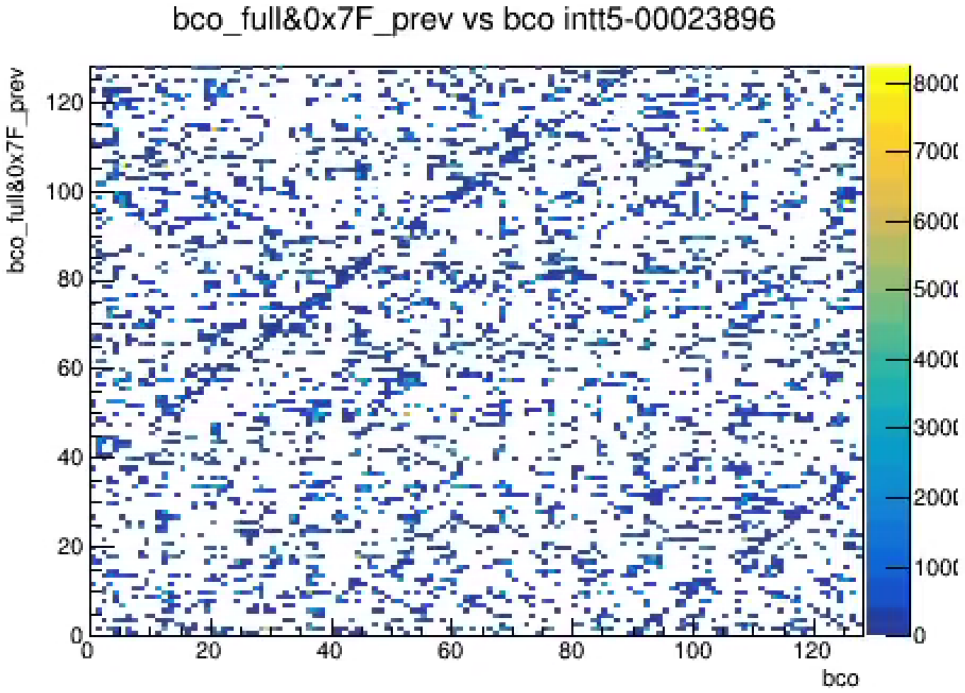


From this result, I think that the data from the collision of the previous event has been mixed up.

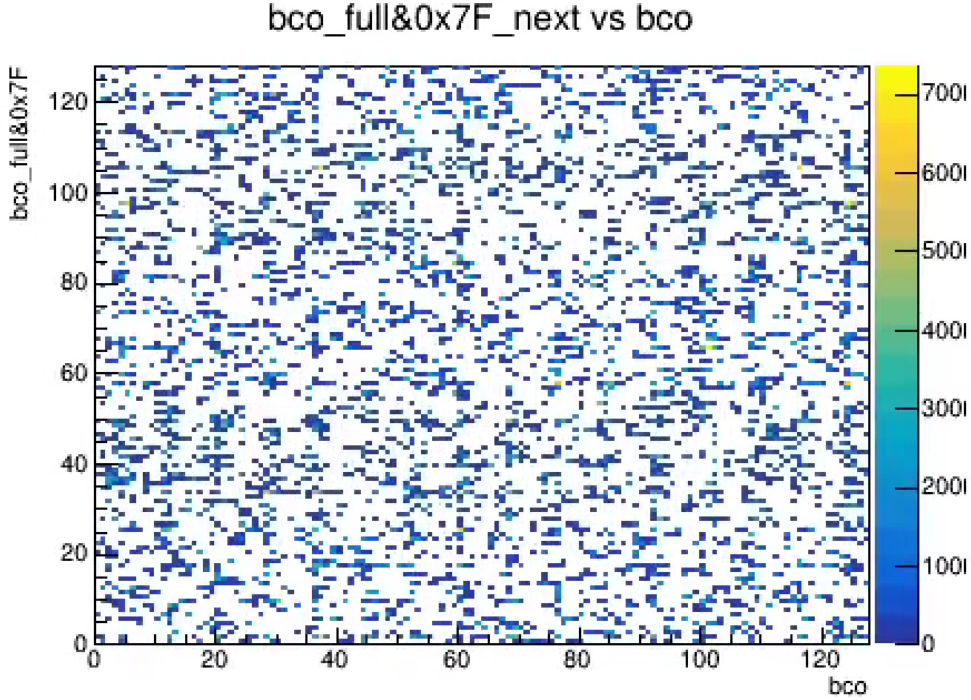
How about the correlation between “This” and “Next” events?

Run23896 intt5
This Run is what I think the Mixup is occurring

BCO vs previous event BCO_Full

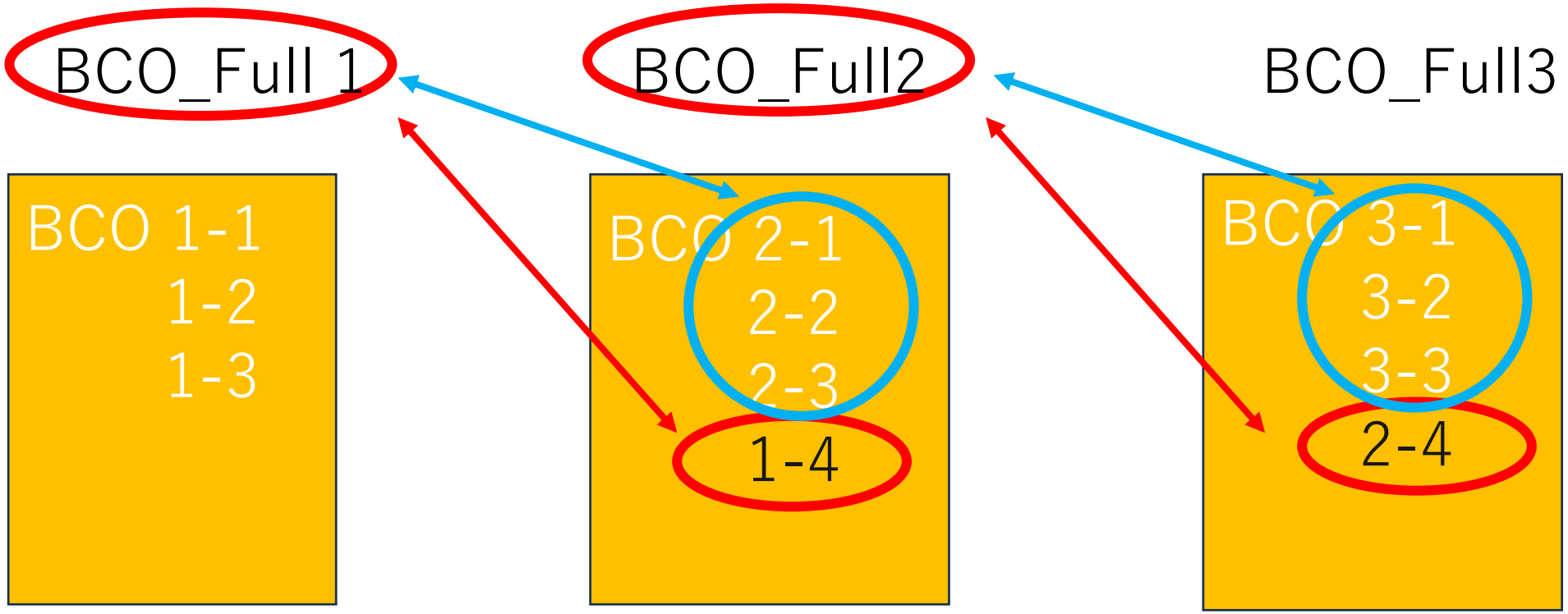


BCO vs next event BCO_Full



Next I looked at BCO_Full for the next event vs BCO and the correlation that was there when looking at BCO_Full for the previous event disappeared.

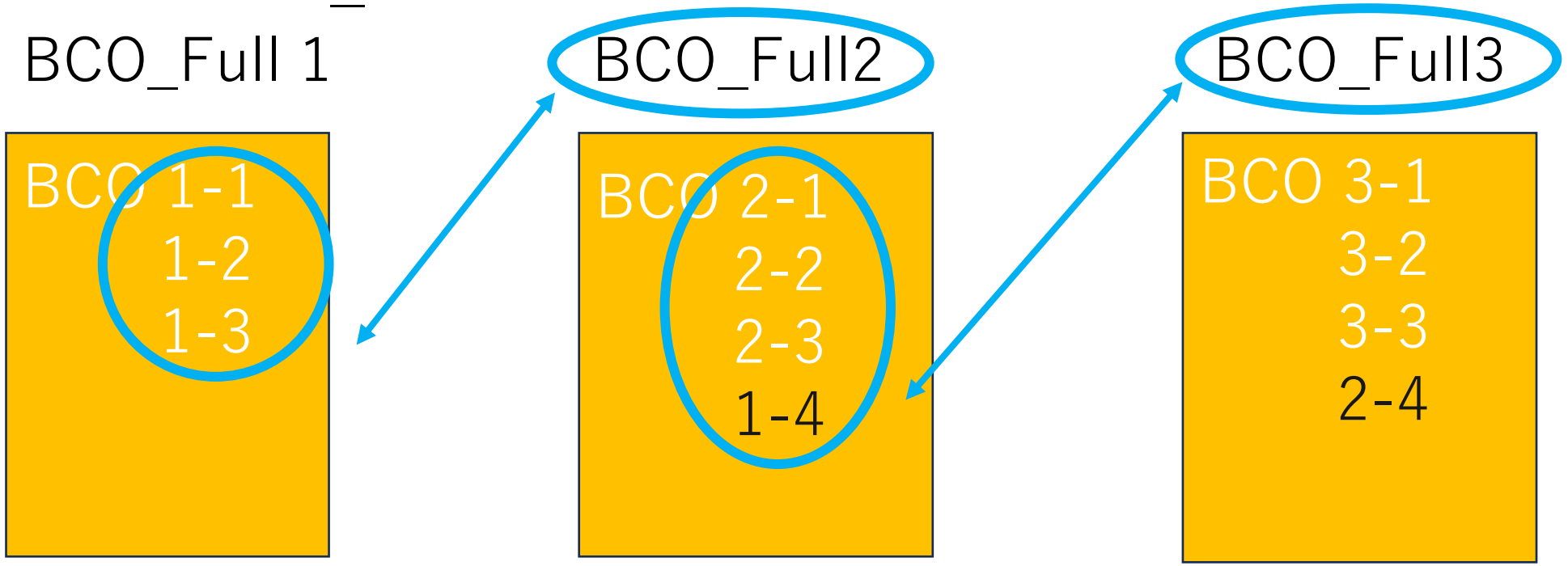
Why this event BCO vs prev event BCO_Full have correlation



The red circled areas are correlated because the information is from the same collision.

The blue circled area do not match, so there is no correlation.

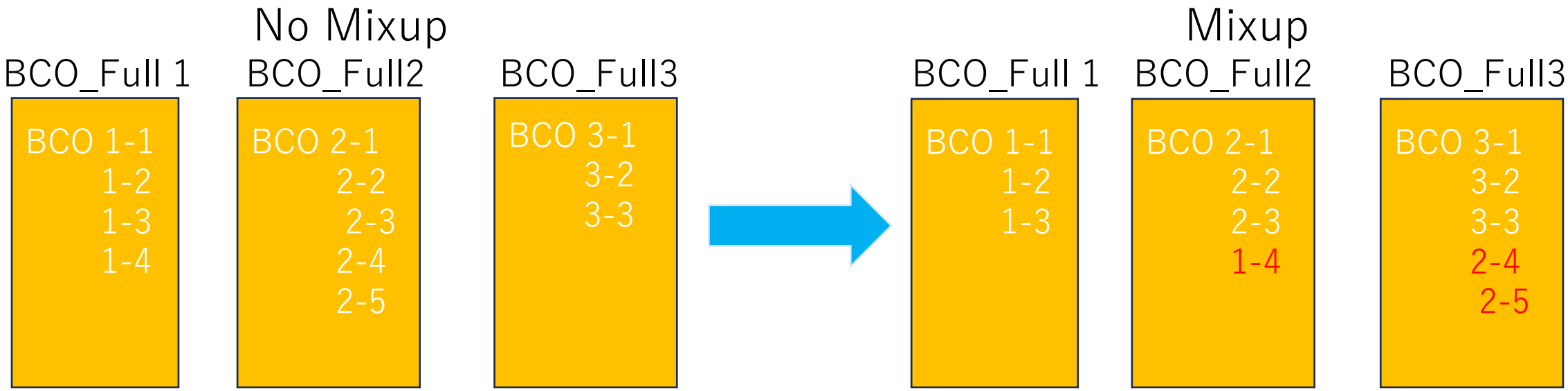
Why we don't observe the correlation in this event BCO vs next event BCO_Full



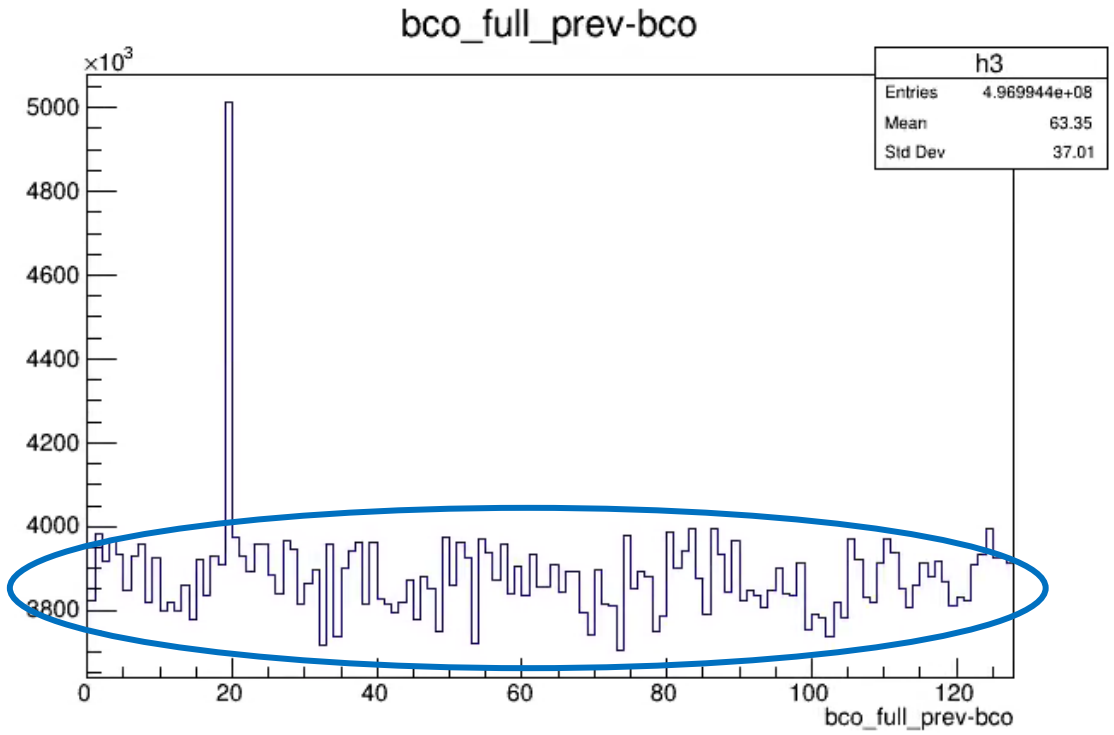
There is any combination of data for the same collision and there is no correlation because the labels do not match, as shown in the blue circles.

What's happening in the case of Event Mix-up?

- From the results so far, Event Mixup is in the form that hit information from the previous event is mixed up with the next event, as shown in the following figure.
- I know that there are Runs where this is happening and Runs where this is not happening, I suspect high multiplicity event causes the event mixup.



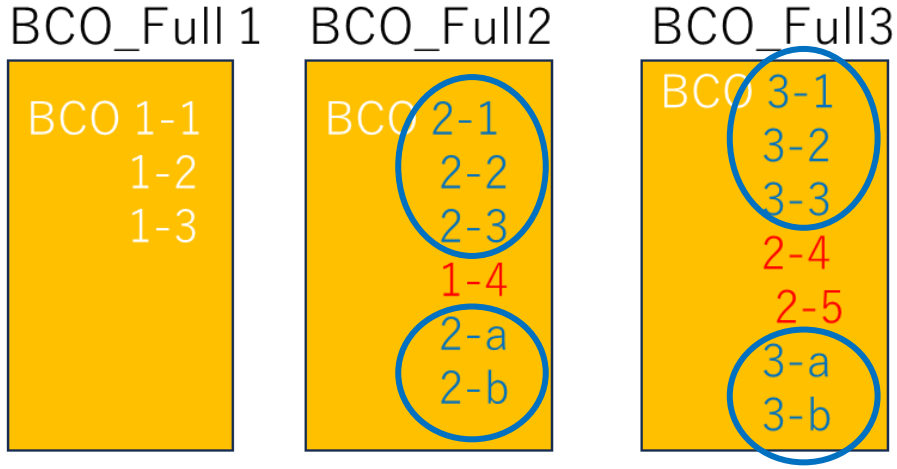
Re-thinking how to determine Mixup.



Possible non-peak inclusions:

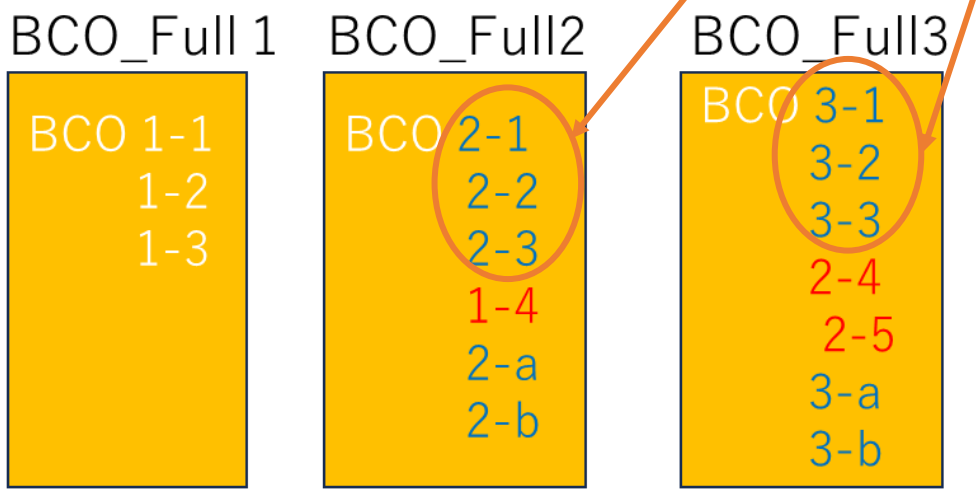
- collision hits of this event(2-1~3,3-1~3)
- just noise hits(2-a,2-b,3-a,3-b)

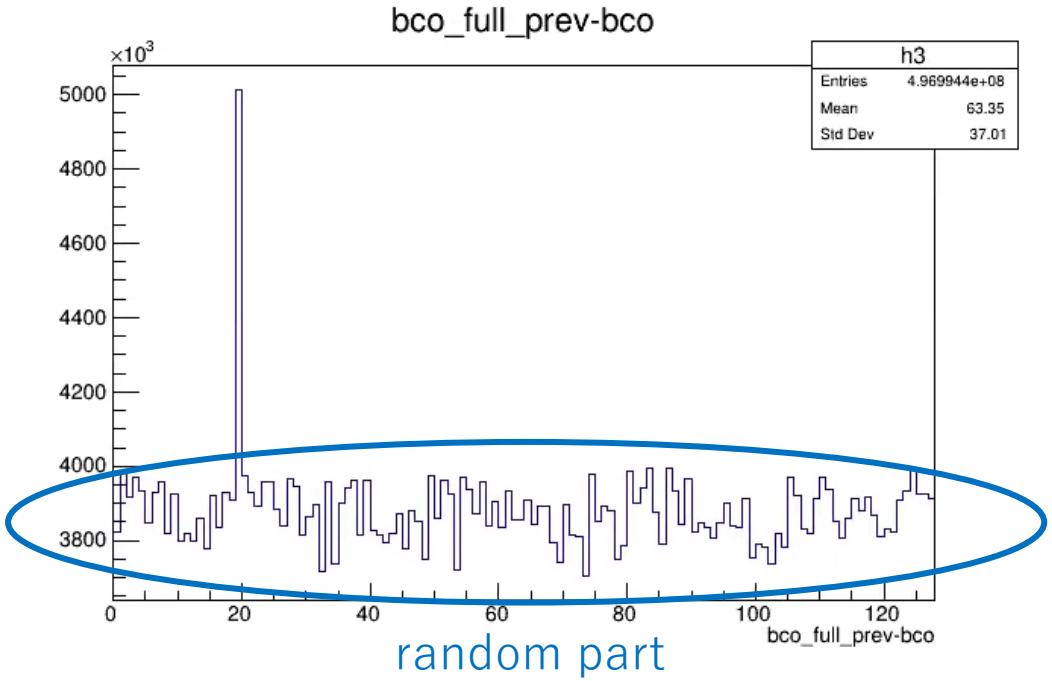
- I had determined that all hits that peaked in BCO_Full_prev-BCO were mixups.(For example, this run peaks at BCO_Full_pre-BCO=19. If a hit takes this value, the hit is considered a mixup.)
- However, hits that were not mixup were also determined to be mixup.(Random hits circled in blue)
- I am trying to get rid of the random hits and correctly select only the mixup hits but have not yet completed it.
- I've learned a few things in the course of my research to accomplish this, and I'll report them on the next pages.



Cut to determine mixup hit

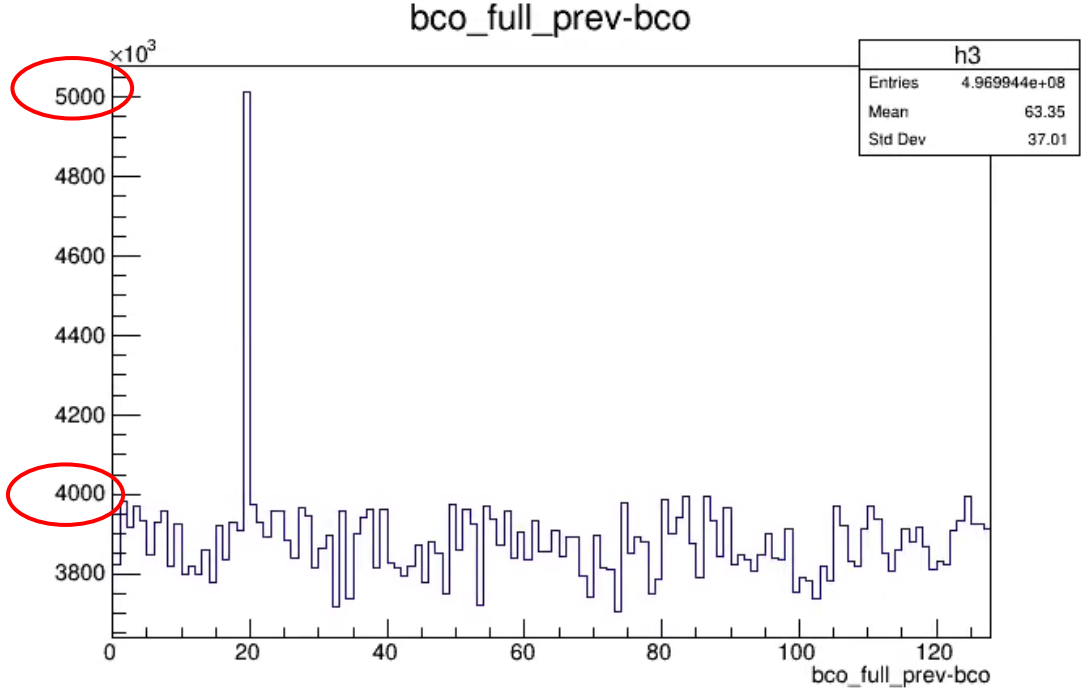
- So far, I wanted to use the Mixup degree to determine if it was a Mixup, so I have explained the results of my research on that.
- Next I will explain I cut **the collision hits of this event** to reduce the random part.



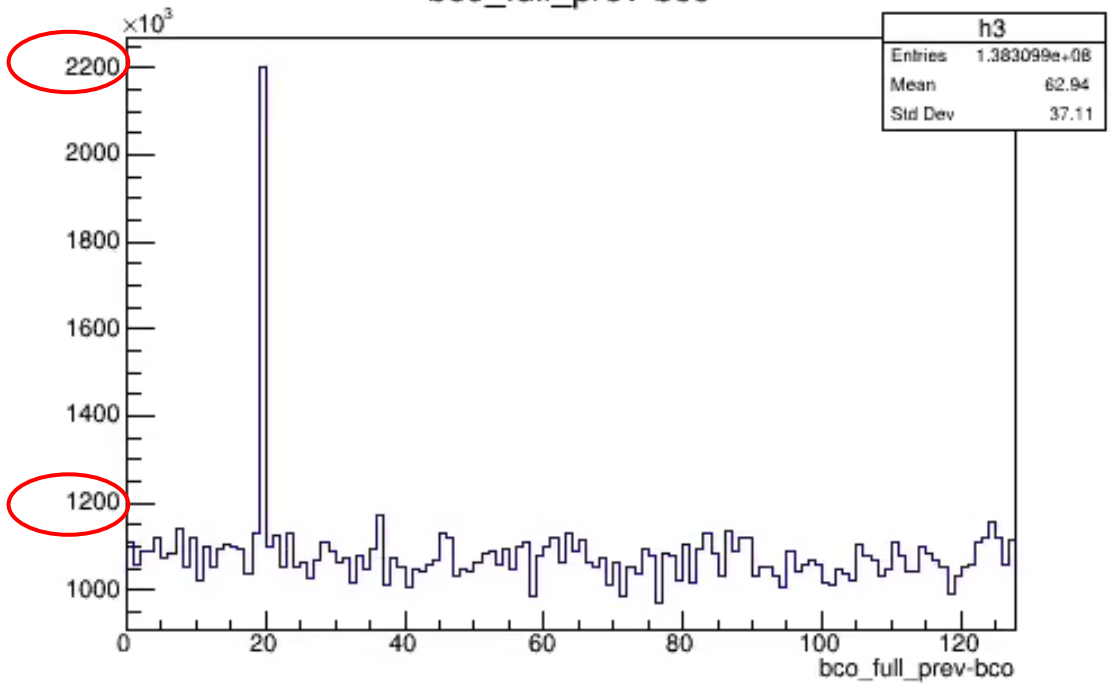


Collision hit of this event cut

Before



After



- Cutting the collision hits for this event and plotting BCO_Full_prev-BCO, the random portion of the hits decreased, as can be seen value of the vertical axis.
- I didn't get rid of all the non-mixup hits, but I did succeed in reducing them.
- So I reflected that in the plot I showed you before.