Flush Report 2

2023/11/16

Mai Kano

INTT Analysis Workshop

My To Do List (New)

- **Re-examine Multiplicity dependence after rethinking how to determine Mixup.**

 （Because, when selecting the event that caused the mixup, the random hit was also determined to be a mixup.）

- Checking collision interval dependence

- Checking open time scan dependence

- Checking N-2,N-3,N+2,N+3

- Checking Multiplicity ladder by ladder

- Checking others Felix

Mixup/prev allhit +Mixup Run20708
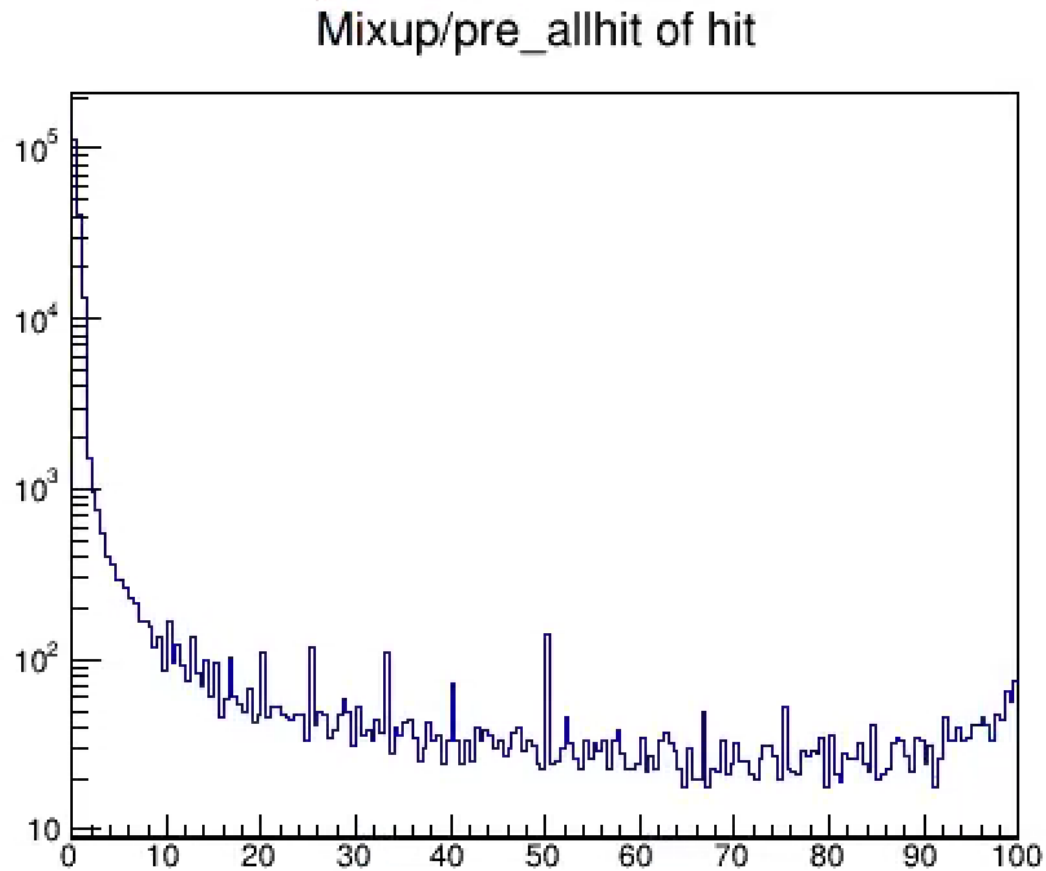
Mixup/pre_allhit of hit

- First, to quantify how much of a Mixup event it is(degree of Mixup),

  I plotted the number of Mixup hits/number of previous event hits + number of Mixup hits.

- I counted hits with prev_BCO_Full-this_BCO=19 as Mixup hits.

- Results indicate that 0-10% is the most common. we found that the degree of Mixup was low.

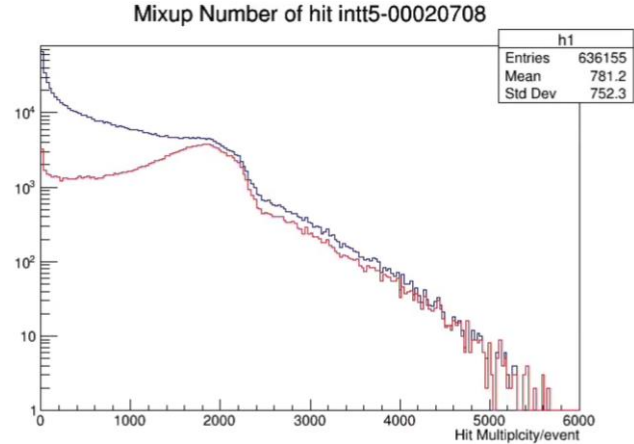# Mixup/prev allhit +Mixup Run20444
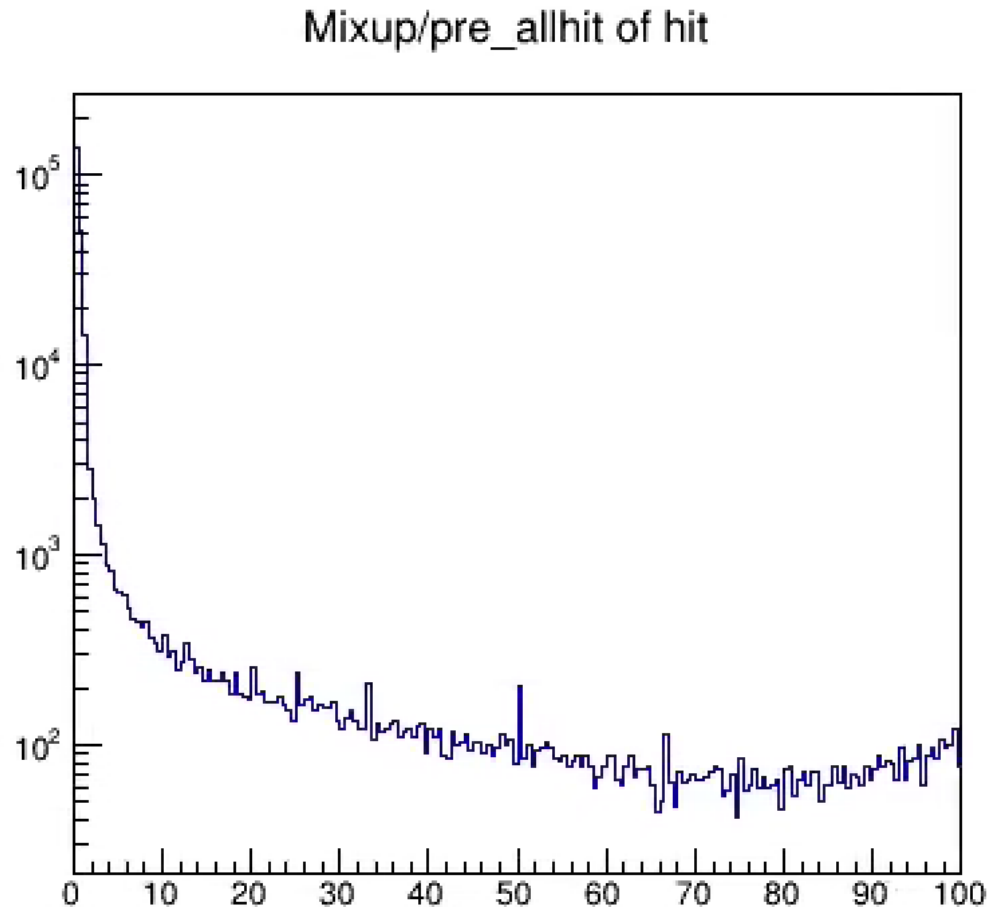
Mixup/pre_allhit of hit

- First, to quantify how much of a Mixup event it is(degree of Mixup),

  I plotted the number of Mixup hits/number of previous event hits + number of Mixup hits.

- I counted hits with prev_BCO_Full-this_BCO=119,120 as Mixup hits.

- Results indicate that 0-10% is the most common. we found that the degree of Mixup was low.

Multiplicity(with Nmixup/(pre_allhit+Nmixup))

Mixup Multiplicity intt5-00020708

- Multiplicity was plotted separately by Mixup degree.
- Since we knew from the previous plot that 0-10% was the most common, it was predictable and correct that 0-10% in this plot would be the closest to the shape of the plot that was not divided by degree.
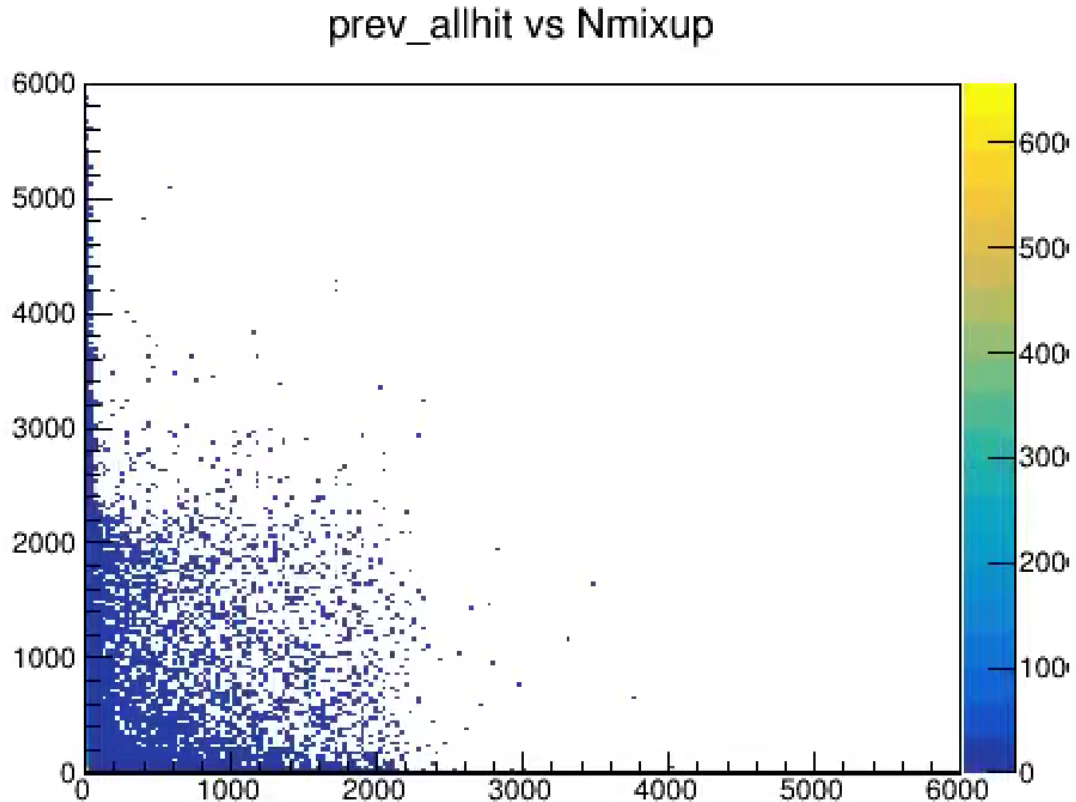
Mixup Number of hit intt5-00020708

Multiplicity(Nmixup/(pre_allhit+Nmixup)*100)

Mixup Multiplicity intt5-00020444
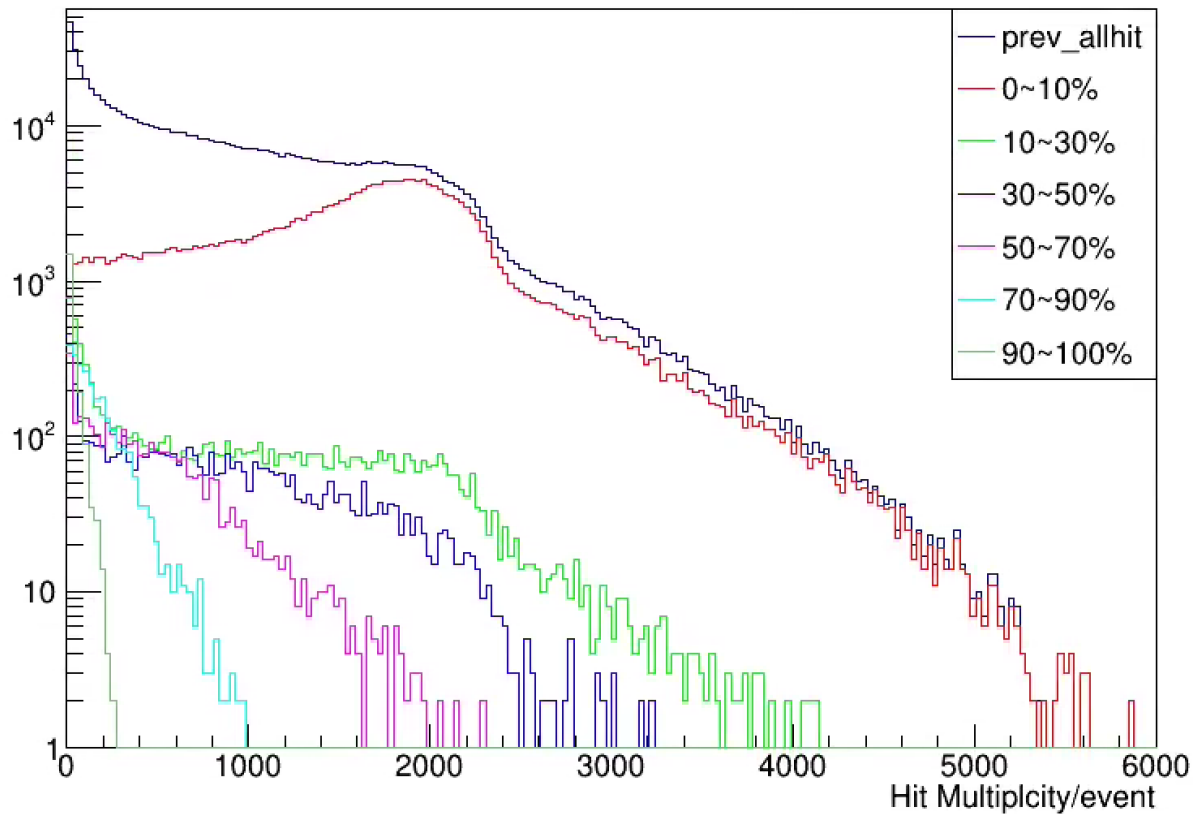
- However, I found that entry was lower at degrees above 10%, but Multiplicity became lower with each increase in degree.

Number of Mixup hit vs prev_allhit Run20708

prev_allhit vs Nmixup

- This plot has Number of Mixup hits on the horizontal axis and Number of previous event hits on the vertical axis.
- The results show that Number of previous events hit is not proportional to the number of mixups.

Number of Mixup vs prev_allhit Run20444
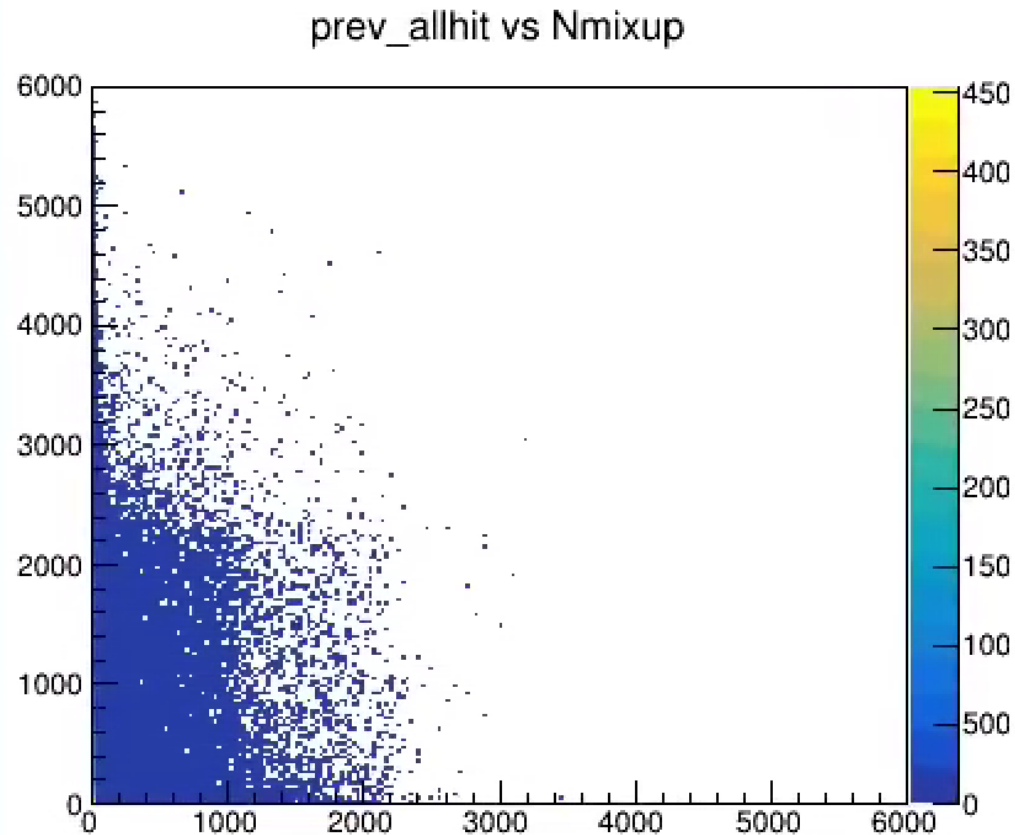
- This plot has Number of Mixup hits on the horizontal axis and Number of previous event hits on the vertical axis.
- The results show that Number of previous events hit is not proportional to the number of mixups.

Summary

- When Mixup was defined only for prev_bco_full-this_bco, it was found that many of the events with Mixup had a low Mixup degree.

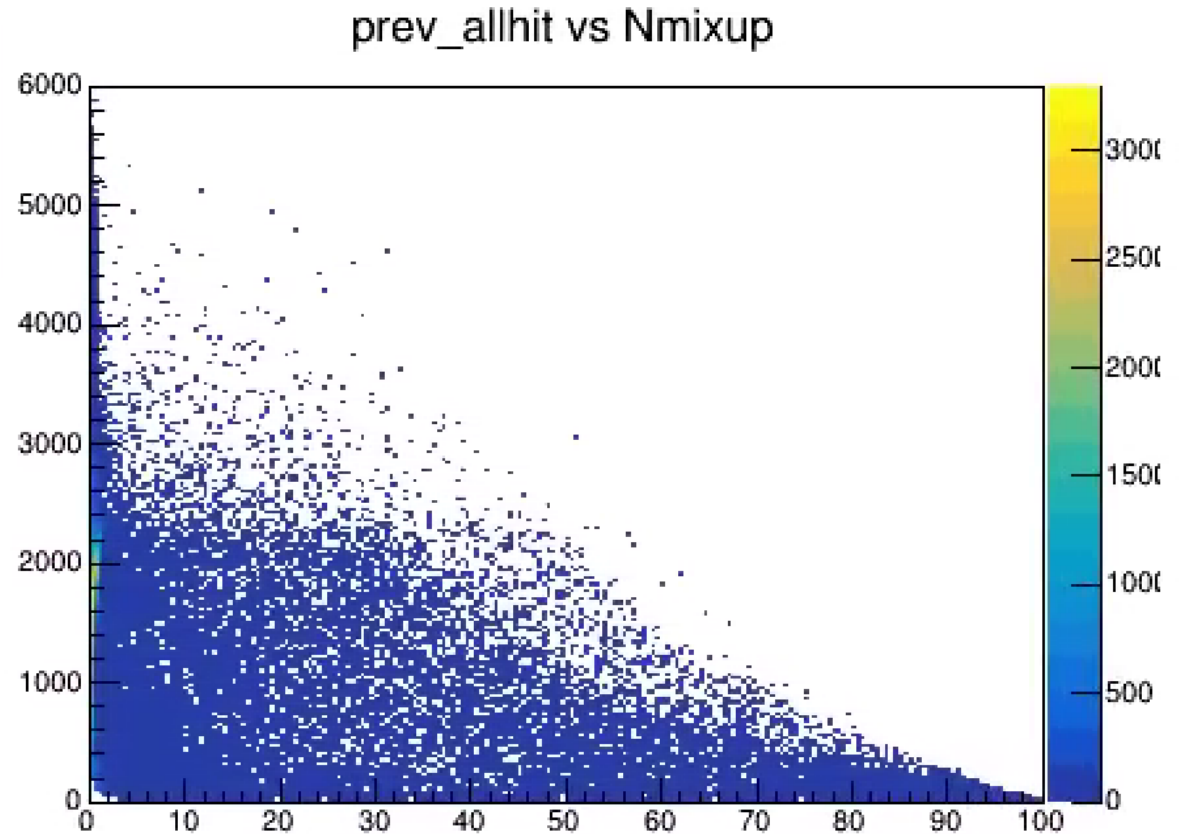- Number of previous events hit is not proportional to the number of mixups.

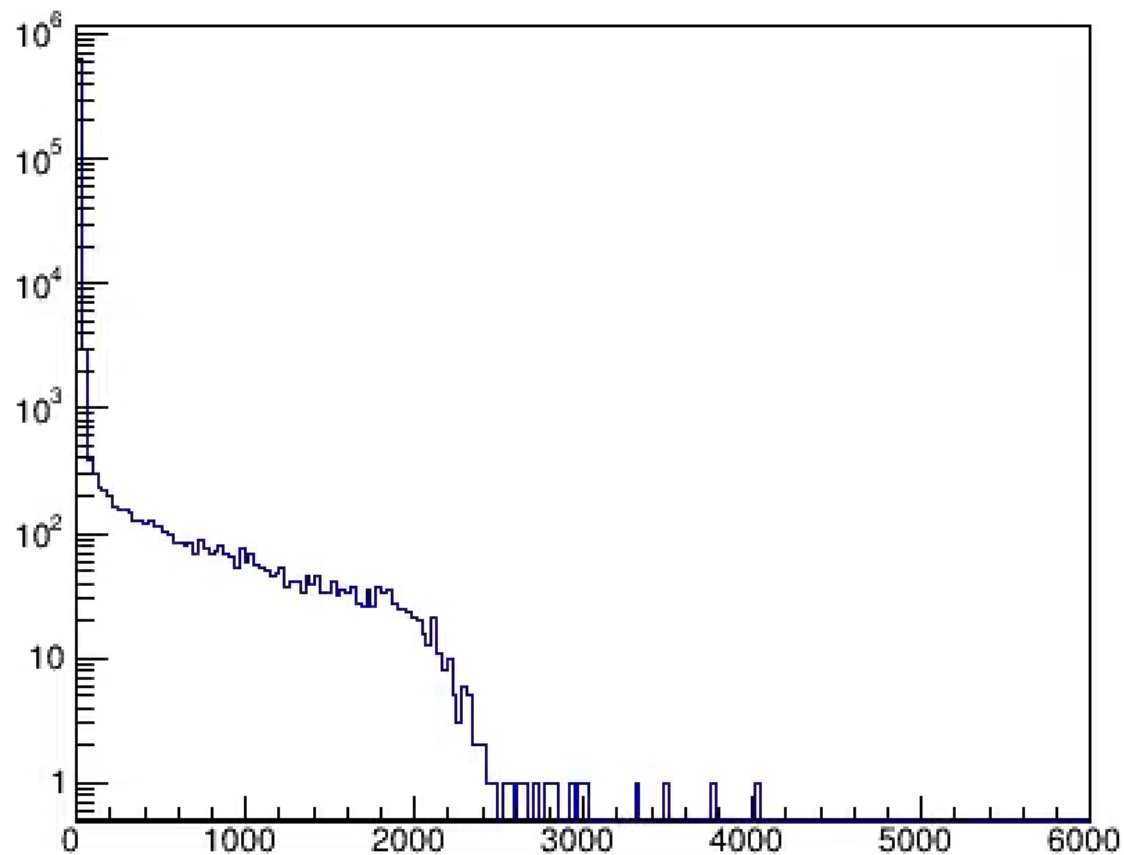# Back up

Run20708

- Mixup degree vs prev_allhit

prev_allhit vs Nmixup
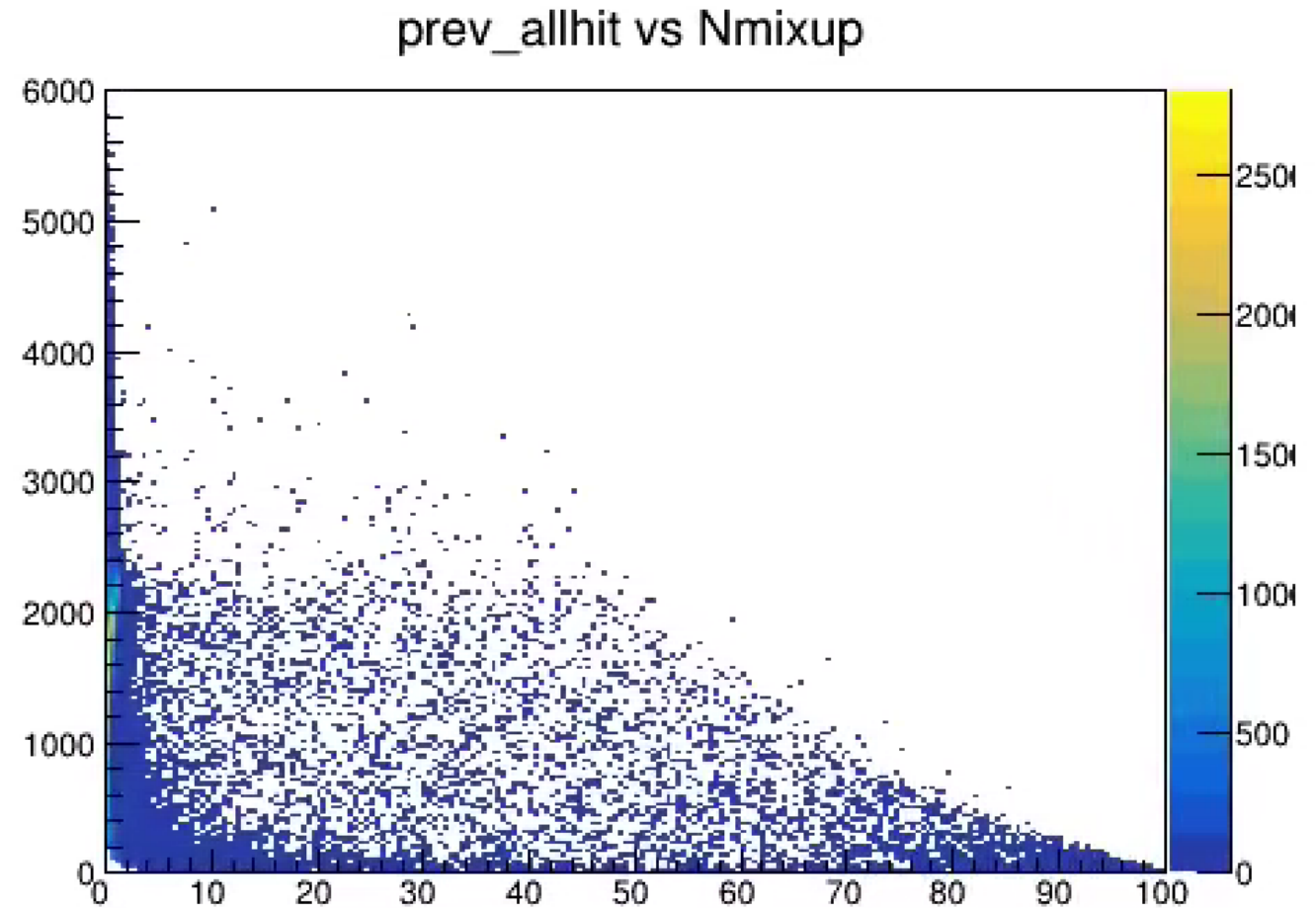
Run20444

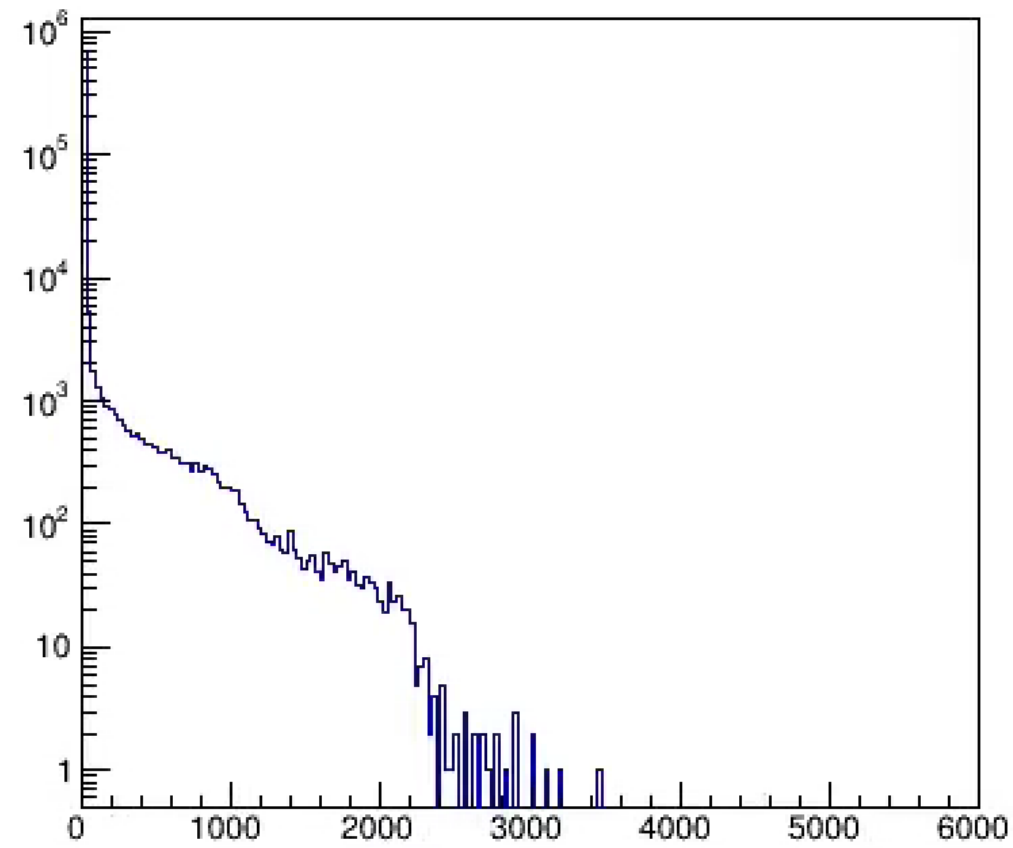- Mixup degree vs prev_allhit

prev_allhit vs Nmixup

Number of Mixup hit
Run20708　Run20444

Event Mixup

Mai Kano
（NWU）

**Mix-up hits from previous event and this event.**

**Goal in this workshop**: Examining the incidence of Event Mixup.

My To-Do List

- Checking collision interval dependence

  - Making plot of BCO_Full_previous – BCO_Full_this　others run

  - Making plot of interval vs Mixup Multiplicity

- Checking open time scan dependence

- ~~Examining multiplicity dependent quantitatively~~

- Cutting out the non-mixed hits when taking a mix-up event

- ~~Creating a document about of Event Mixup to inform Raul~~

- Checking N-2,N-3,N+2,N+3

- Checking Multiplicity Ladder by ladder

- Checking others Felix

Multiplicity dependence Mixup event Nhit / All event Nhit （ratio) Run20708
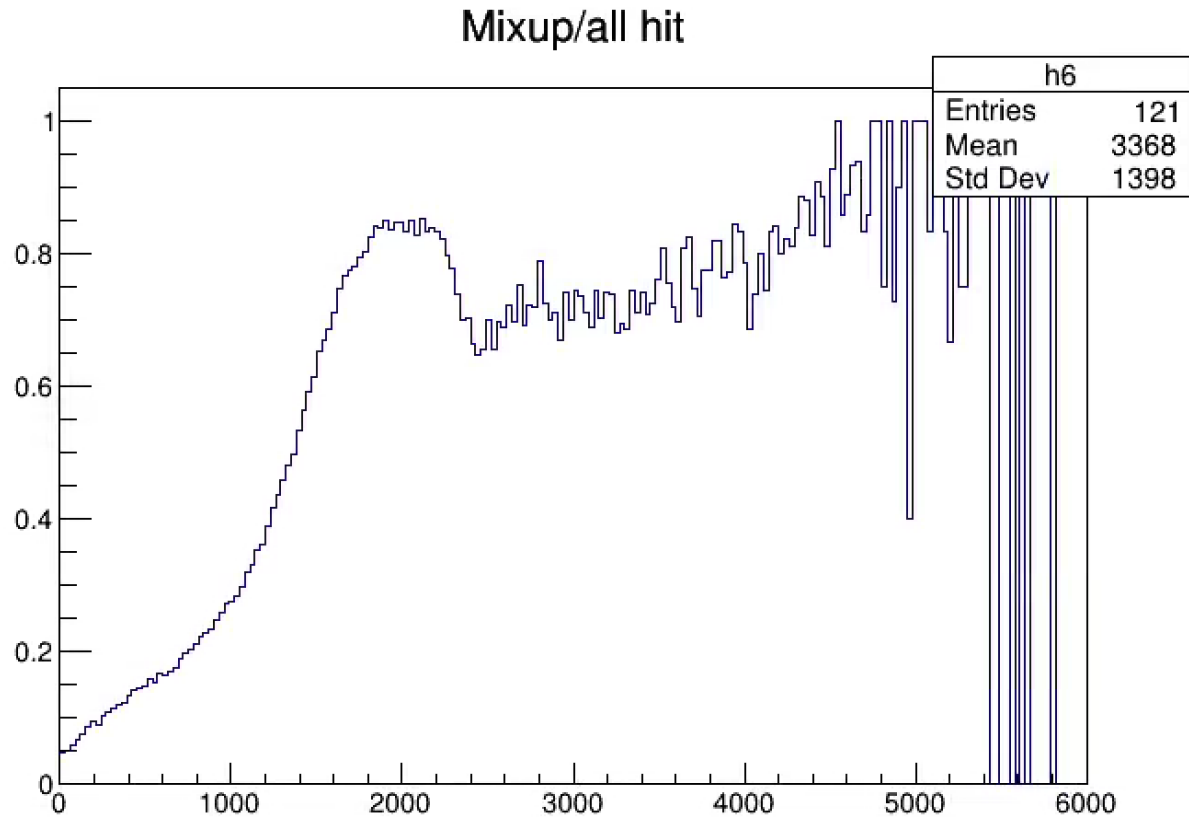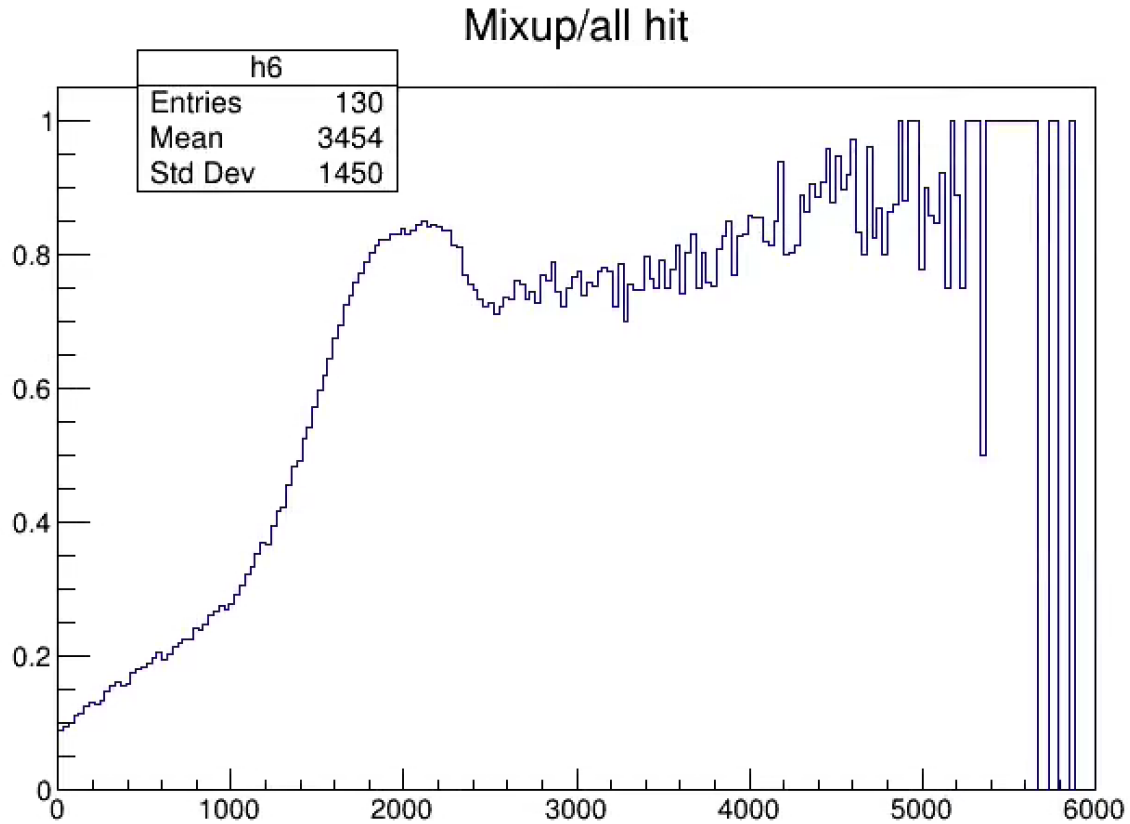

The left figure shows the distribution obtained by dividing the red and black lines of the Multiplicity distribution in the lower right.

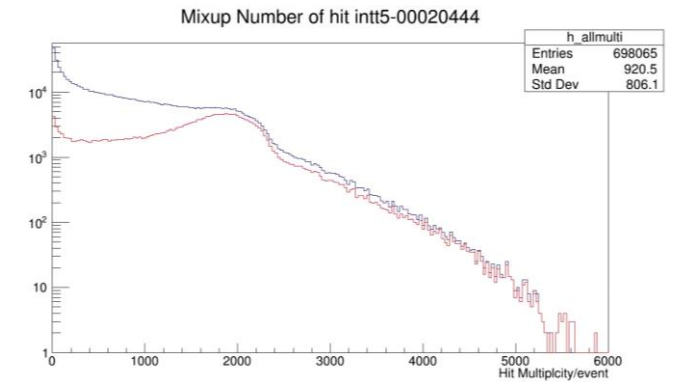I still don't understand why ratio shape.
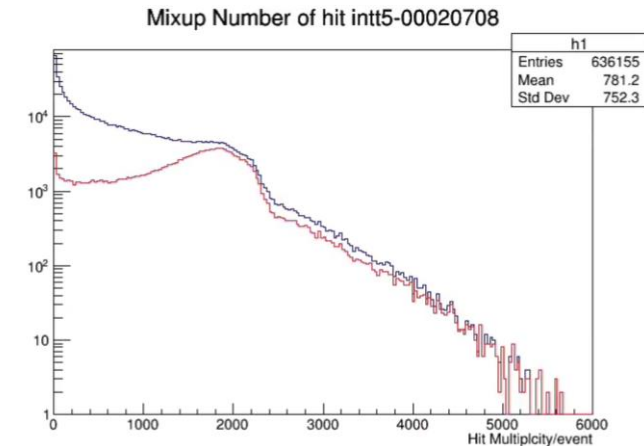
Multiplicity dependence can be quantitatively determined.

Multiplicity dependence Mixup event Nhit / All event Nhit （ratio) Run20444

The left figure shows the distribution obtained by dividing the red and black lines of the Multiplicity distribution in the lower right.
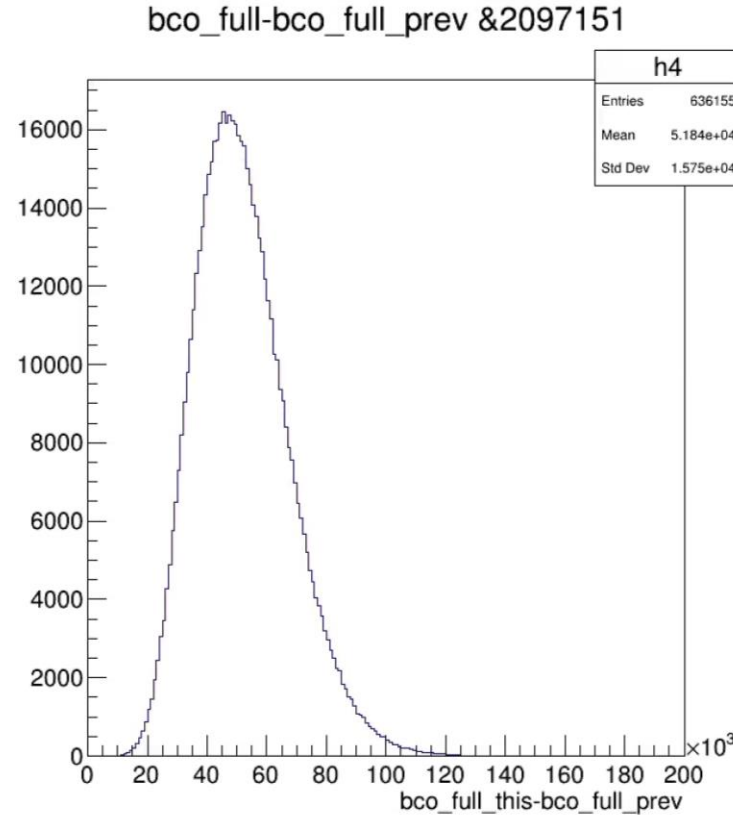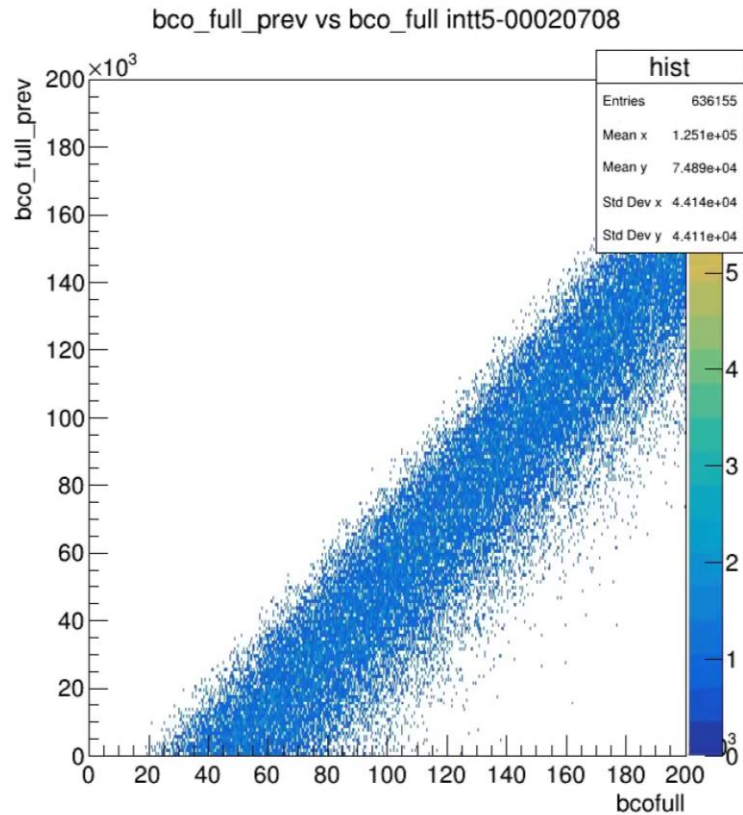
I

Multiplicity dependence can be quantitatively determined.

Collision interval dependence

- BCO_Full_this-BCO_Full_prev &0x1FFFF (Lower 21 bits)Run20708

bco_full_prev vs bco_full intt5-00020708

bco_full-bco_full_prev &2097151

To examine collision interval dependence, I first made a plot of BCO_Full_this-BCO_Full_prev(Lower 21bits). This result shows that this run has a collision interval of about 50×10^3 Beam clocks.

Collision interval dependence

- BCO_Full_this-BCO_Full_prev &0x1FFFF (Lower 21 bits) Run20444 INTT trigger rate 450Hz
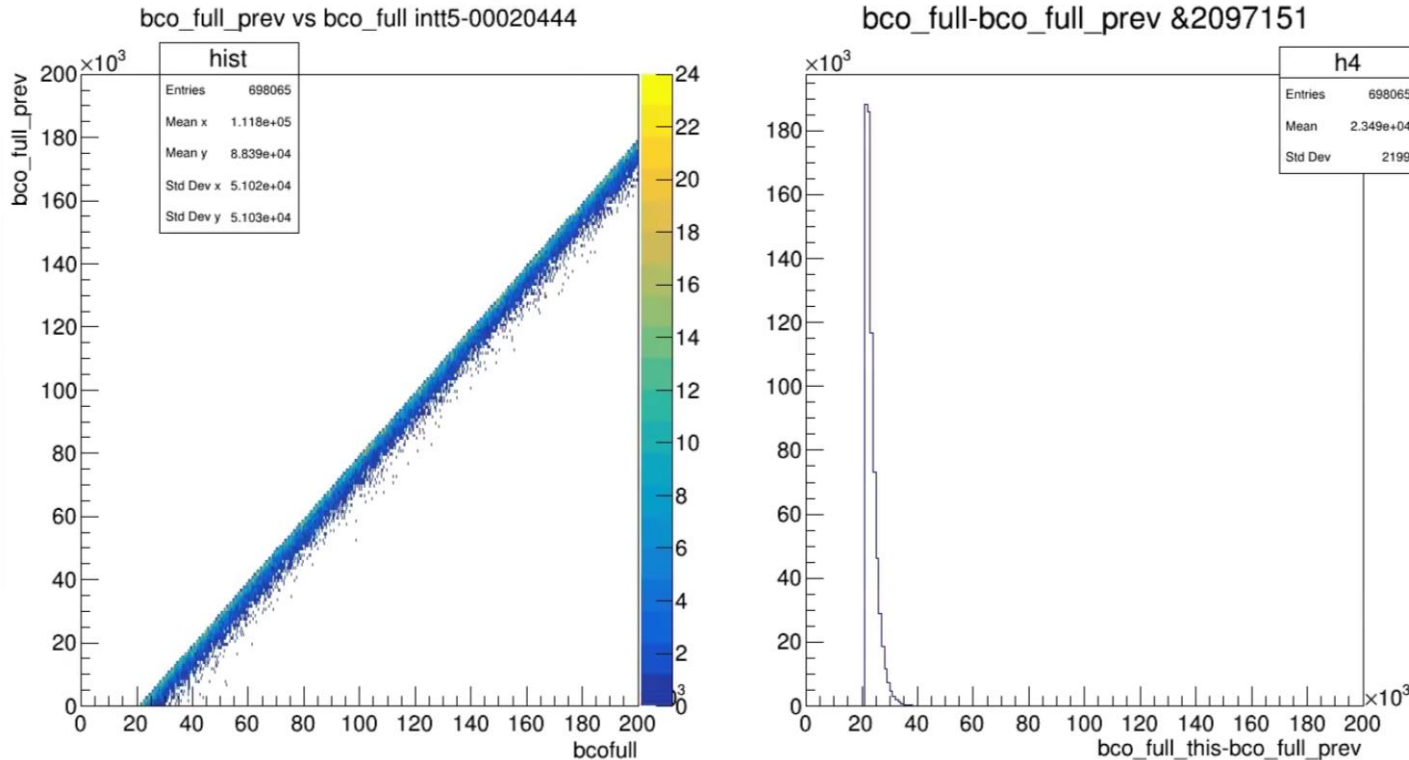
This result shows that this run has a collision interval of about 20×10^3 Beam clocks.

The difference in shape from the previous plot is likely due to the different trigger rates.

My next step is to find out the collision interval and the incidence of mixup.
→I will make a plot of BCO_Full_this-BCO_Full_prev vs Mixup Multiplicity
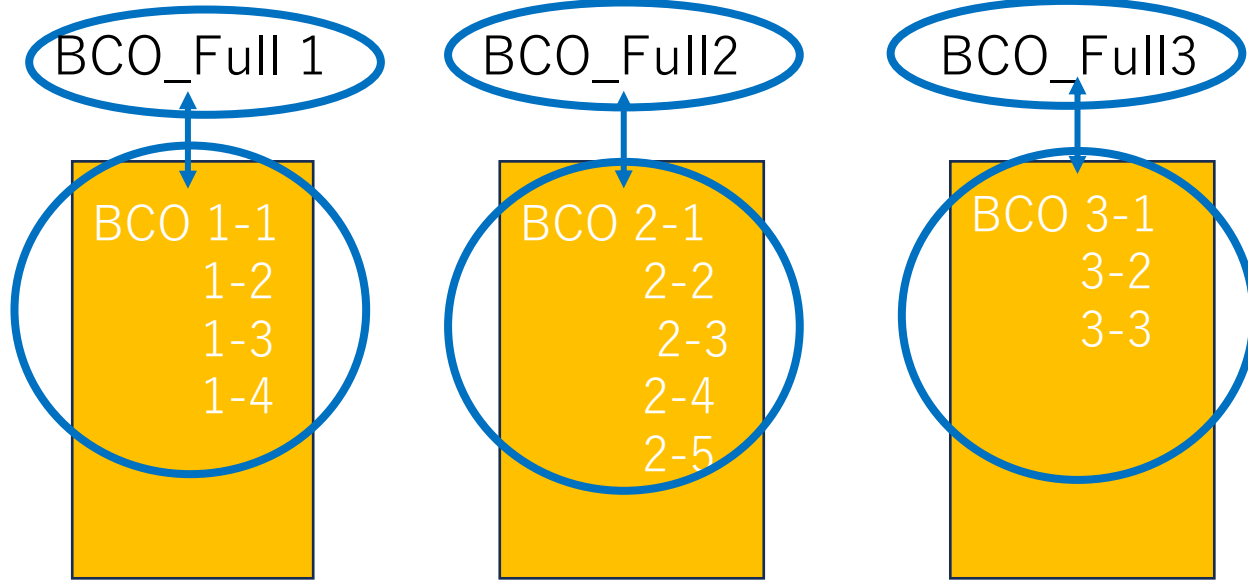
What is Event Mixup?

- The definition of the Event is the group of hits comes from the same collision.

- We observe some suspicious events which are likely to be mix-up hits from previous event and this event. We call them "Mixed-up Events" hereafter.

- The mix-up event will screw up track reconstruction of INTT in offline analysis and has to be fixed ASAP.

BCO Correlation in for NO mix-up

(Previous)   (This)   (Next)

Same event BCO_Full &0x7F vs BCO

BCO_Full 1   BCO_Full2   BCO_Full3

BCO 1-1   BCO 2-1   BCO 3-1
    1-2   2-2   3-2
    1-3   2-3   3-3
    1-4   2-4
                    2-5
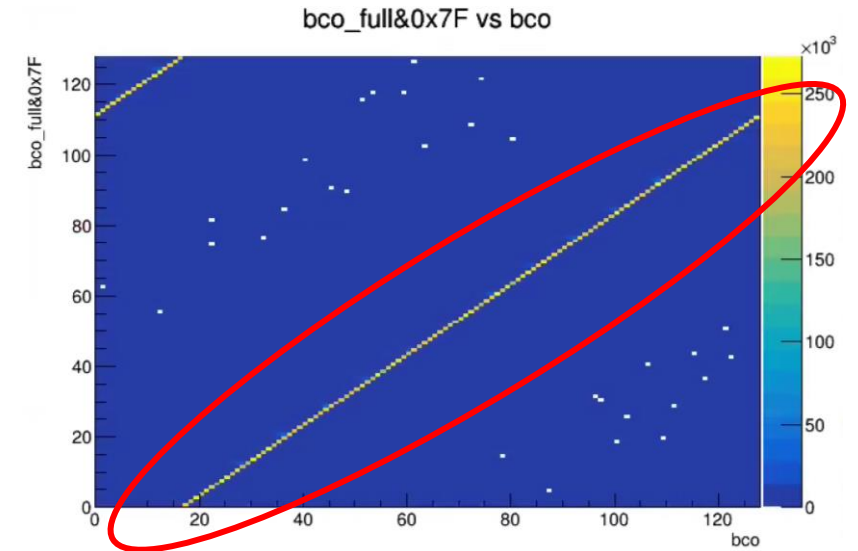
Perfect correlation observed as expected
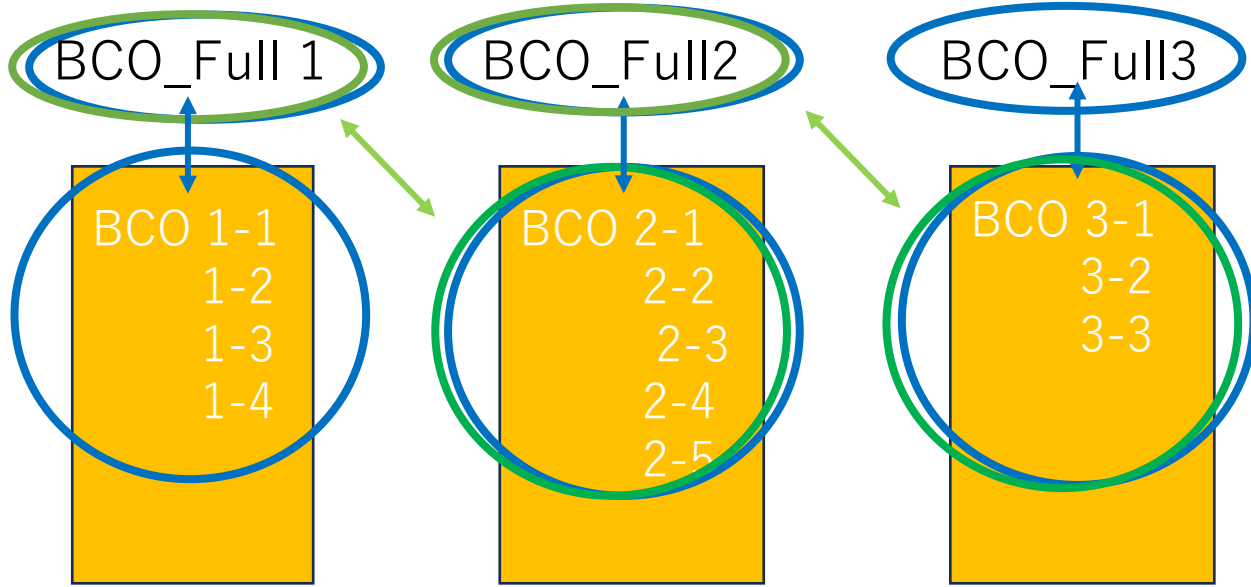
For example, suppose that when normal and no mixup is occurring,
the above figure is shown.
The figure on the right shows the correlation between BCO(x-axis)
and the lower 7 bits of BCO_Full(y-axis).

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

BCO Correlation in for NO mix-up

(Previous)   (This)   (Next)

BCO_Full 1   BCO_Full2   BCO_Full3

BCO 1-1   BCO 2-1   BCO 3-1
    1-2   2-2   3-2
    1-3   2-3   3-3
    1-4   2-4
                     2-5

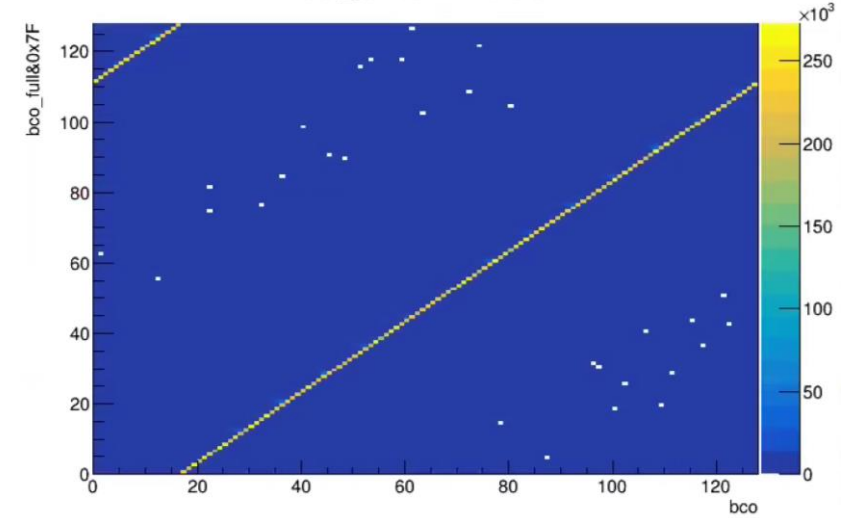For example, suppose that when normal and no mixup is occurring, the above figure is shown.
The figure on the right shows the correlation between BCO(x-axis) and the lower 7 bits of BCO_Full(y-axis).

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.
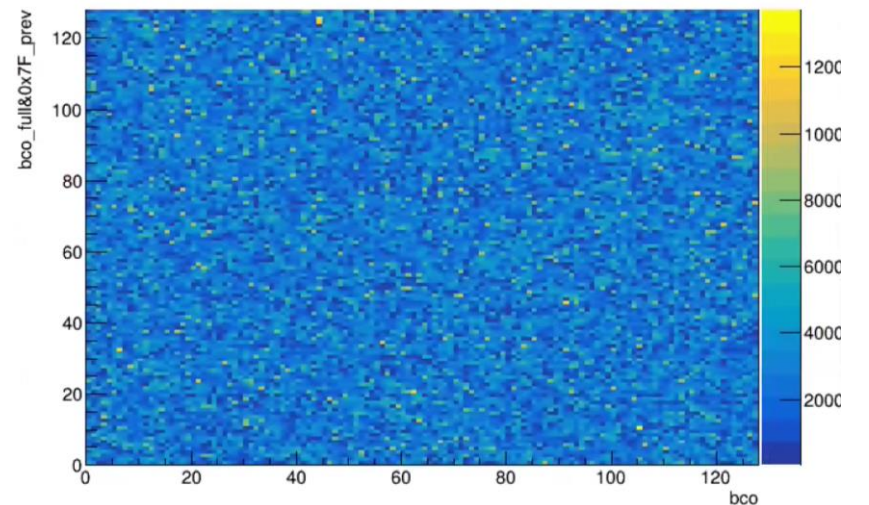
Run23648 intt5
Same event BCO_Full &0x7F vs BCO

Run23648 intt5
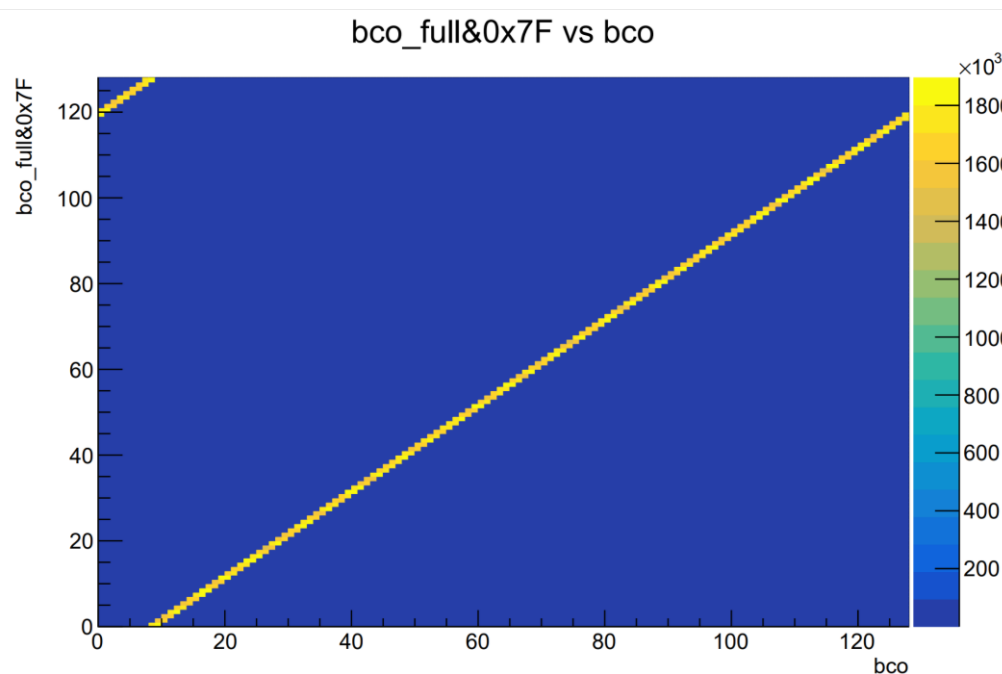Previous event BCO_Full &0x7F vs BCO
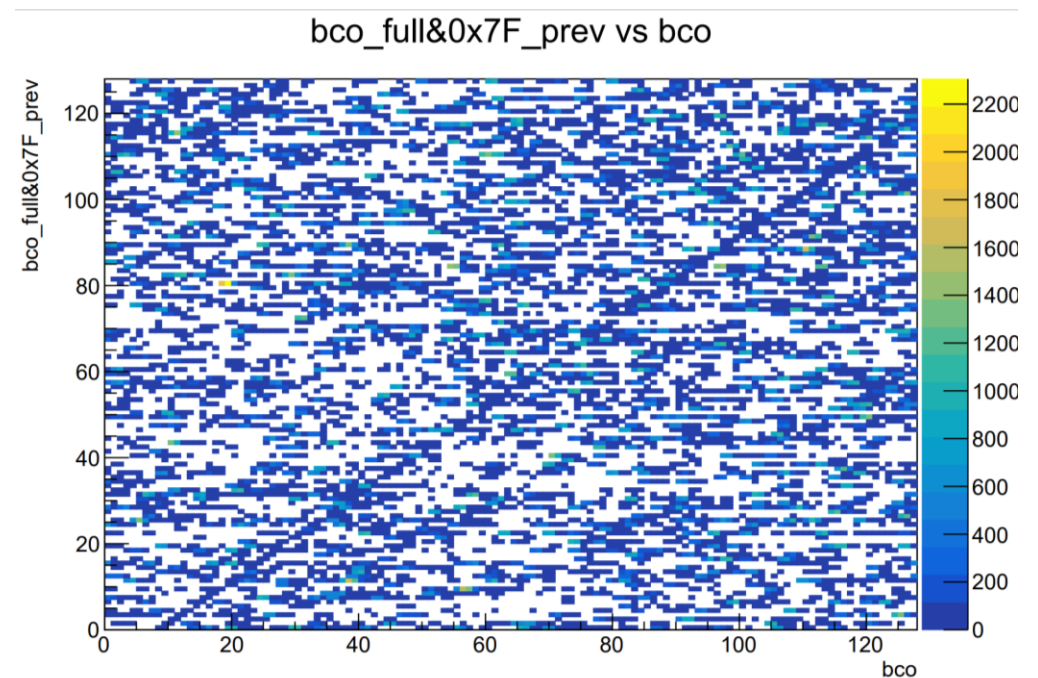

2023/11/16

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.**
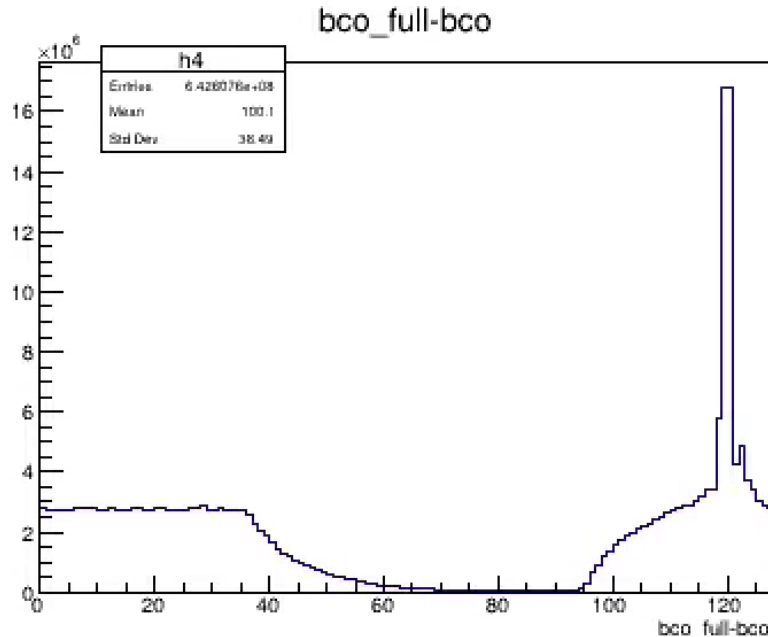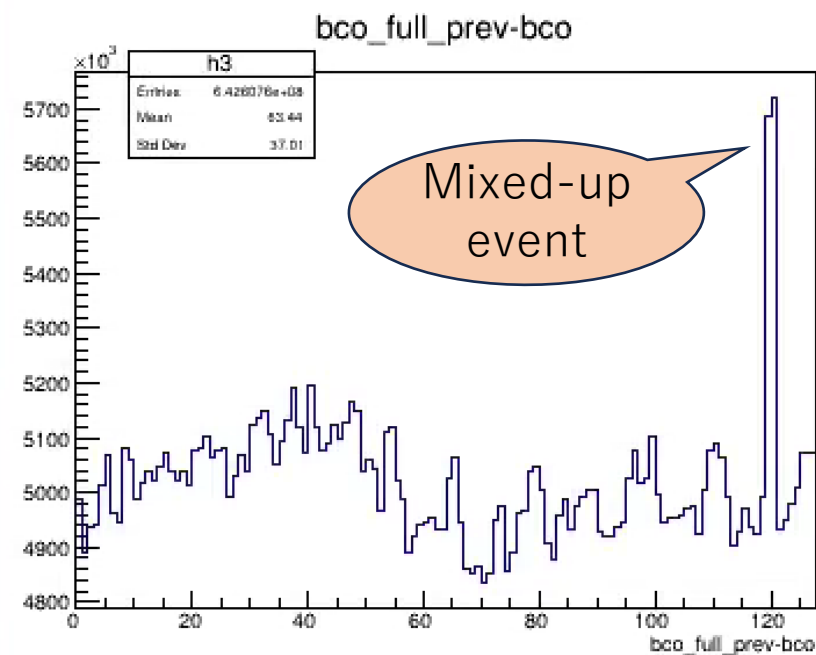
BCO_Full_prev-bco Mixup

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.
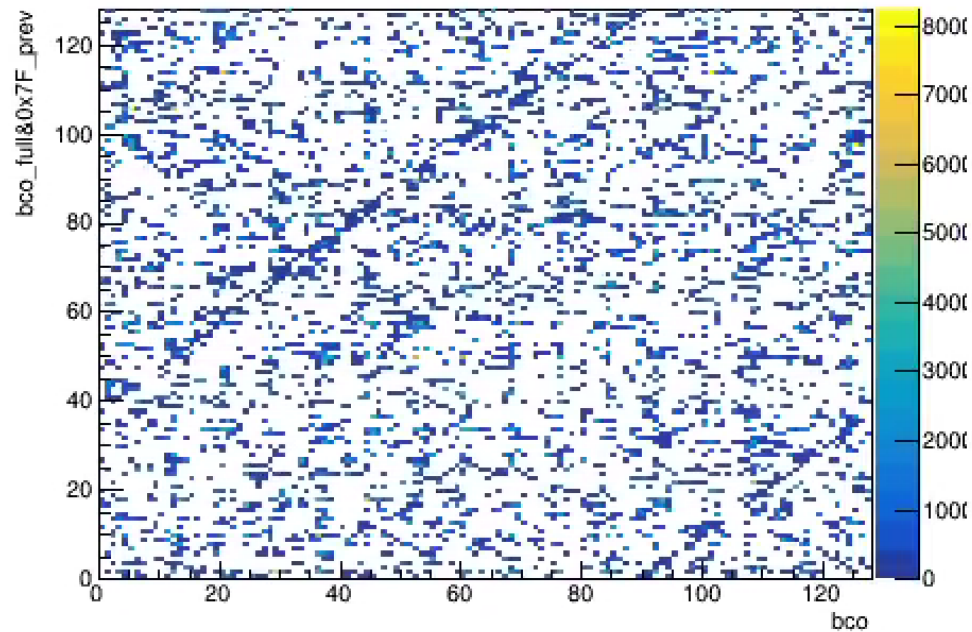
How about the correlation between "This" and "Next" events?

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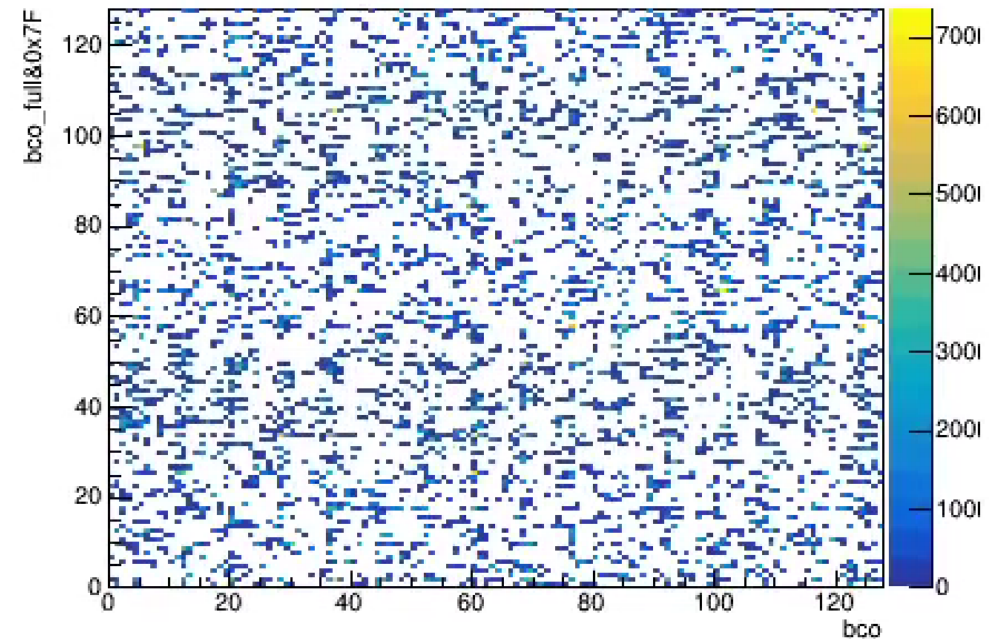This Run is what I think the Mixup is occurring

BCO vs previous event BCO_Full

BCO vs next event BCO_Full
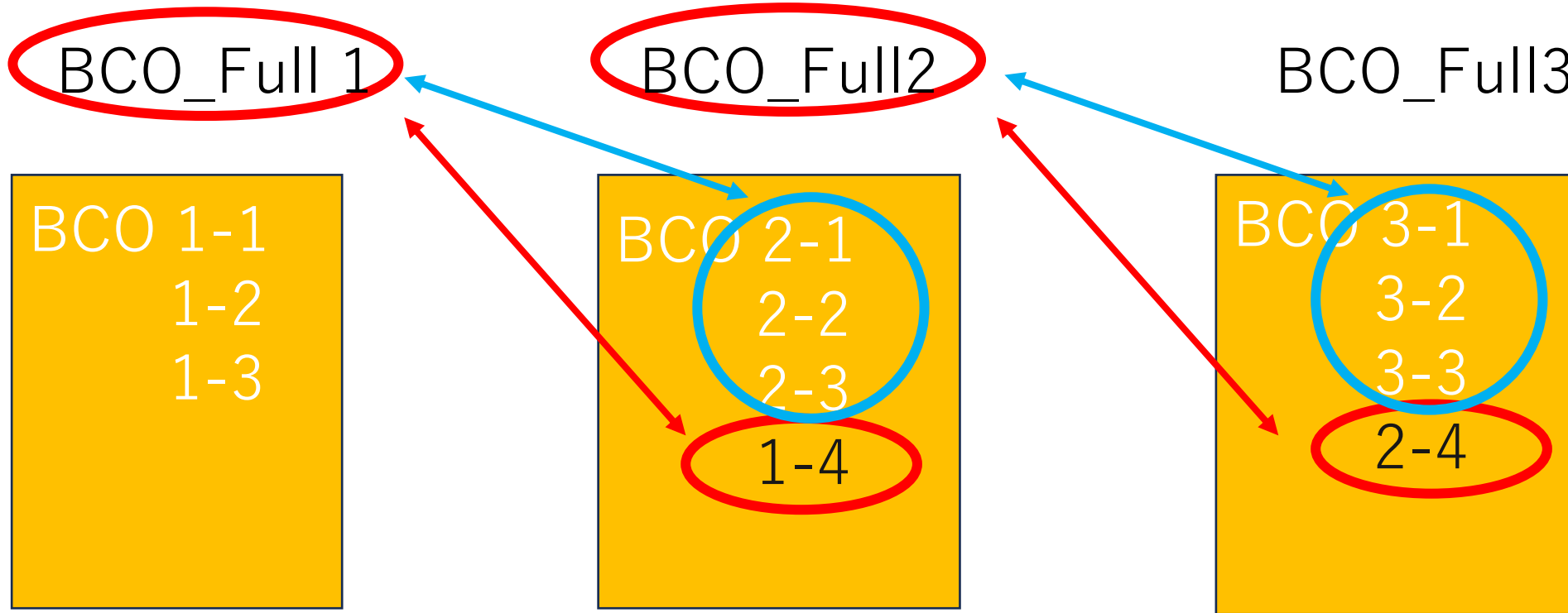

Next I looked at BCO_Full for the next event vs BCO and the correlation that was there when looking at BCO_Full for the previous event disappeared.

Why this event BCO vs prev event BCO_Full have correlation

BCO_Full 1

BCO_Full2

BCO_Full3

BCO 1-1
1-2
1-3

BCO 2-1
2-2
2-3

1-4

BCO 3-1
3-2
3-3

2-4

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

BCO_Full 1 **BCO_Full2** **BCO_Full3**

BCO 1-1
1-2
1-3

BCO 2-1
2-2
2-3
1-4

BCO 3-1
3-2
3-3
2-4
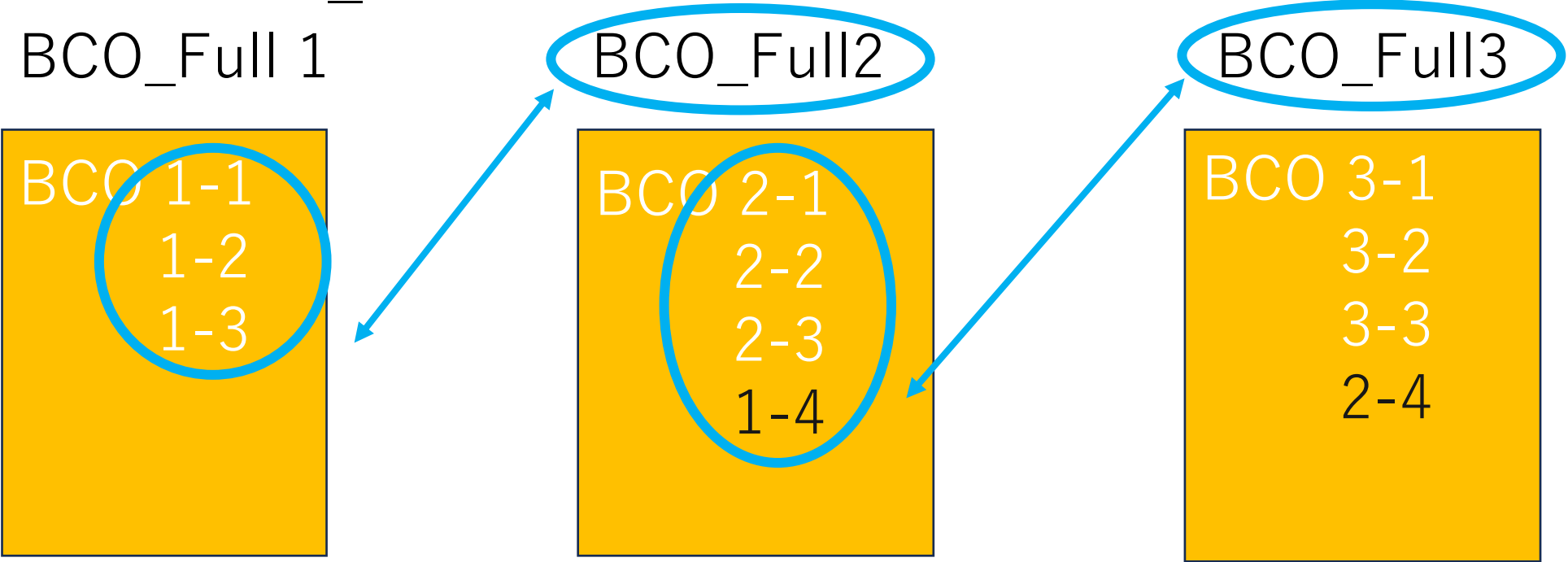
There is any combination of data for the same collision and there is no correlation because the labels do not match, as shown in the blue circles.

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.
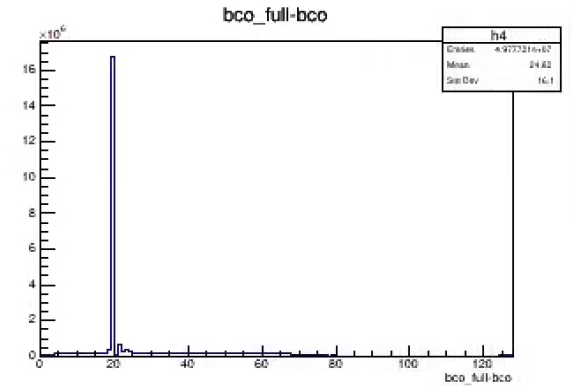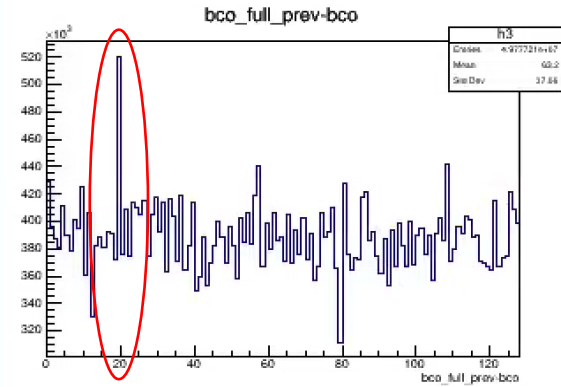

No Mixup

BCO_Full 1	BCO_Full2	BCO_Full3
BCO 1-1 1-2 1-3 1-4	BCO 2-1 2-2 2-3 2-4 2-5	BCO 3-1 3-2 3-3

Mixup

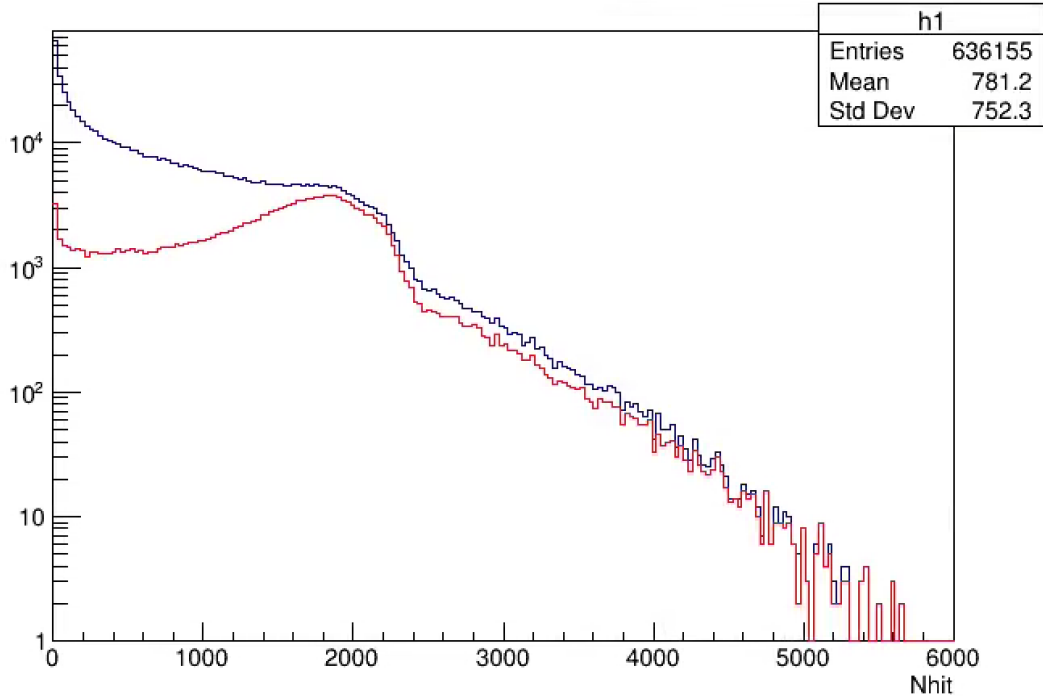| BCO_Full 1	BCO_Full2	BCO_Full3
BCO 1-1 1-2 1-3	BCO 2-1 2-2 2-3 1-4	BCO 3-1 3-2 3-3 2-4 2-5
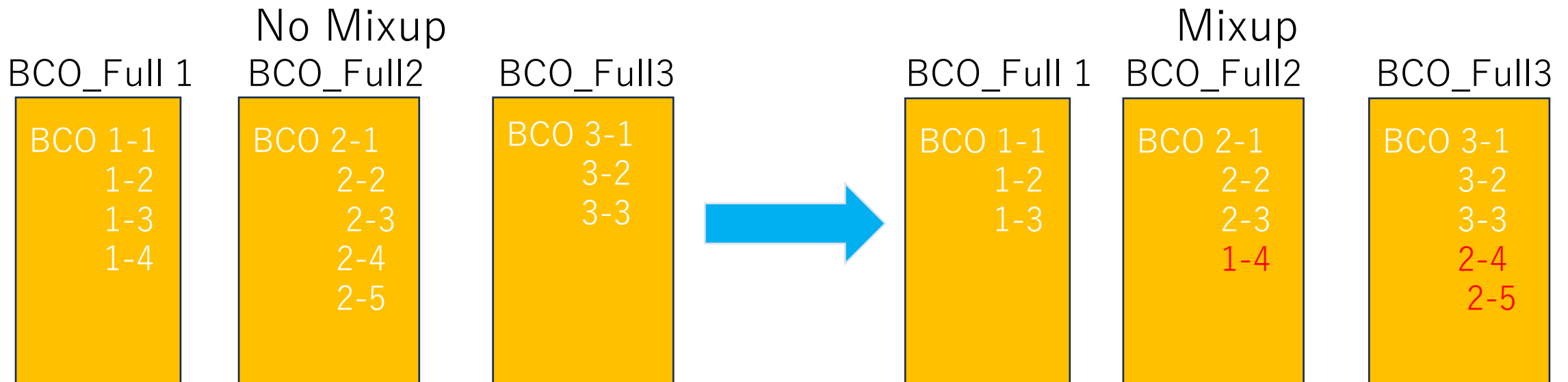
Multiplicity dependence Run20708 intt5

Black: All events   Red: Mixup events

Mixup Number of hit intt5-00020708

h1	
Entries	636155
Mean	781.2
Std Dev	752.3

- Number of hit are plotted in black for all events and in red only for events where mixup are occurring.
- I had selected BCO_Full_prev-BCO=19 events for Mixup.

- Left plot shows that **there is multiplicity dependence in the mixup.**
- Many mixup is occuring where Multiplicity is high.