

Event Mixup

20240828

INTTMT

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Contents

- I will talk about Event Mixup to report on the current status of INTT data readouts in Run24 at JPS meeting.
- At this point, I would like to reiterate the current status of the Event Mixup at Run24
- I have not been able to change to the sPHENIX style yet.

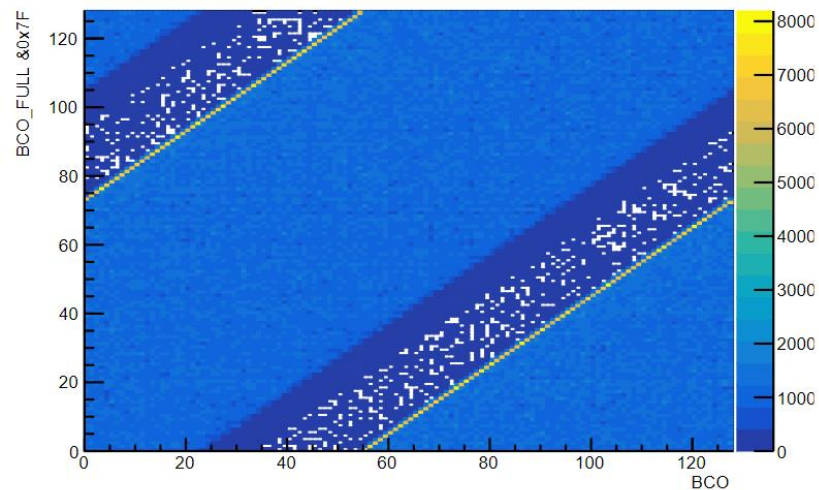
And I was going to show you a plot to show at JPS, but some of the results are not yet complete, so I will send them to the mailing list as soon as they are completed.

I also plan to present some results from streaming mode data, but we are still discussing this and will report back as soon as it is decided.

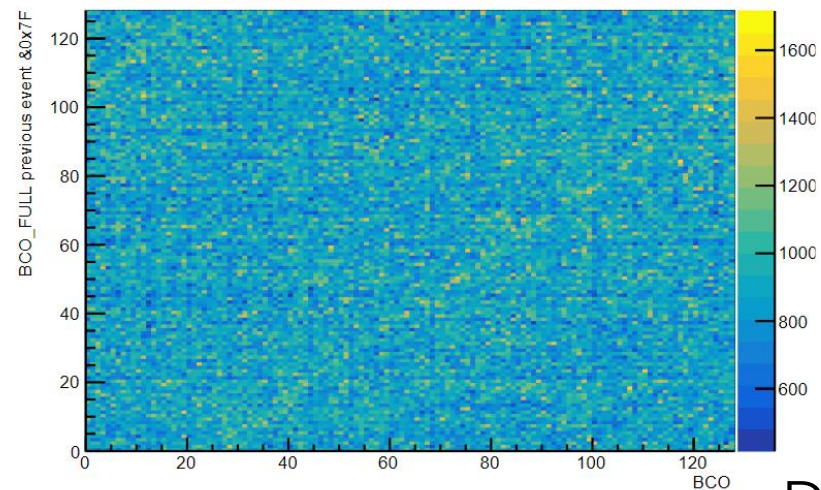
Run24

Run47892(7/9) inttt0

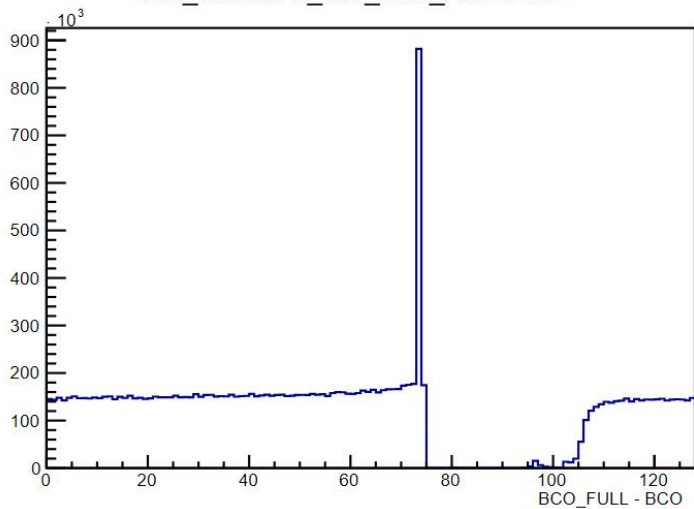
bco_full&0x7F_vs_bco_intt0_Run47892



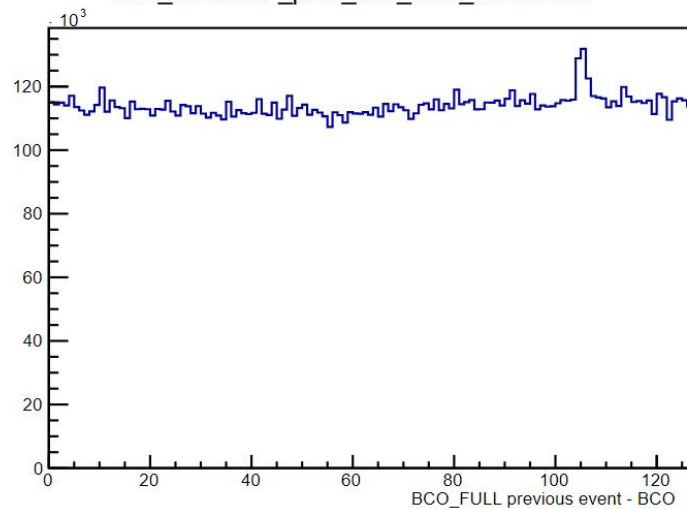
bco_full&0x7F_prev_vs_bco_intt0_Run47892



bco_full&0x7F_bco_intt0_Run47892



bco_full&0x7F_prev_bco_intt0_Run47892



Different peaks from Mixup were identified in the plots of Previous event BCO_Full - BCO peak

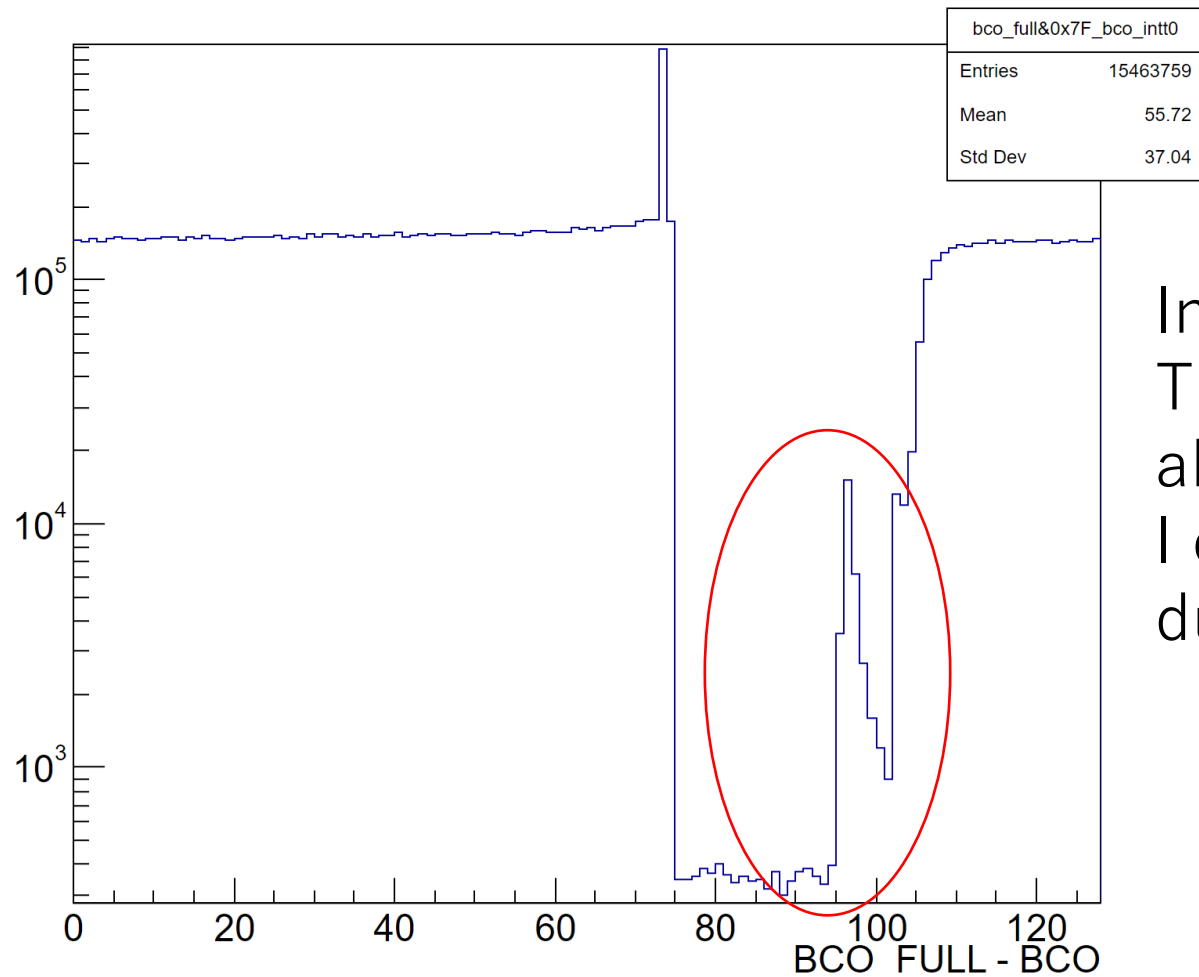
$\text{BCO_Full} - \text{BCO} = 73$

$\text{pre_BCO_Full} - \text{BCO} = 105$

Run24

Run47892(7/9) inttt0

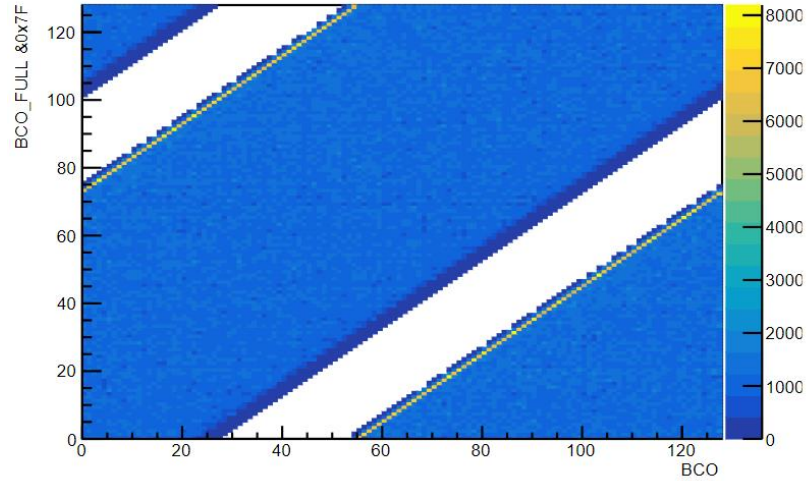
bco_full&0x7F_bco_inttt0_Run47892



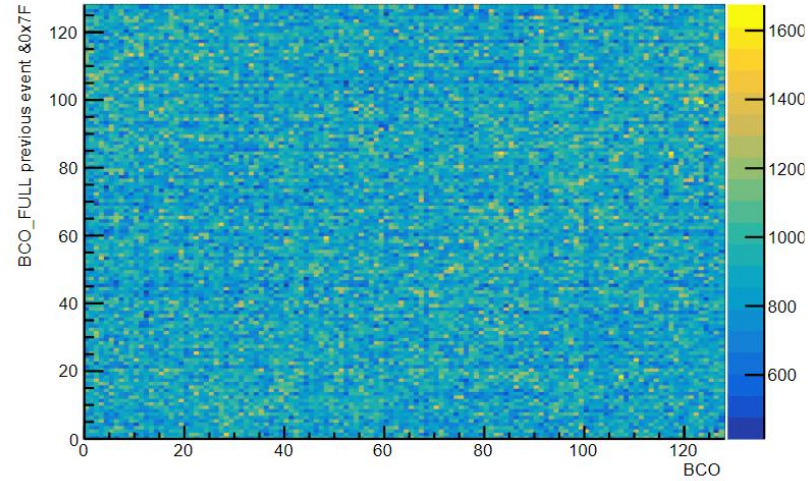
In the same event BCO_Full-BCO
There is an entry between 75~101 in the
abort gap.
I checked the peak (previous page) was
due to this

Run24 Run47892(7/9) intt0

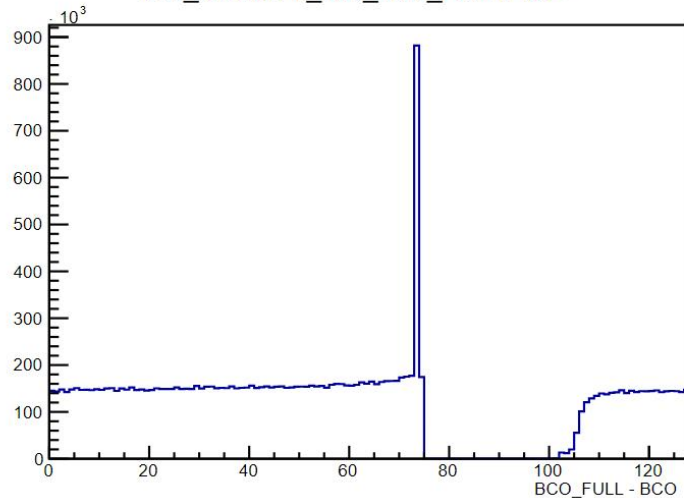
bco_full&0x7F_vs_bco_intt0_Run47892



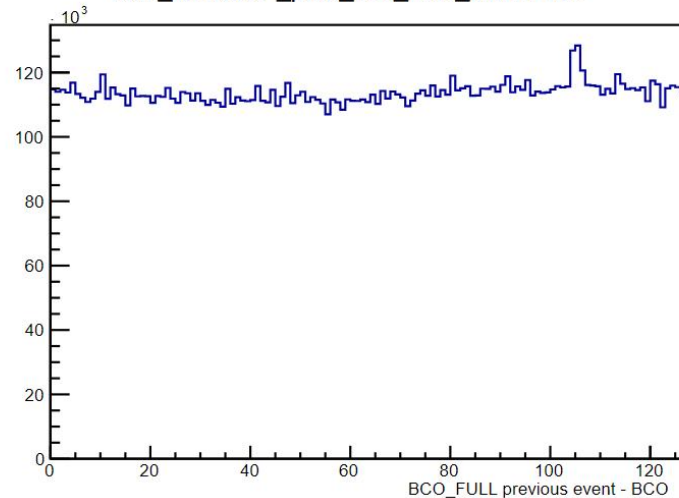
bco_full&0x7F_prev_vs_bco_intt0_Run47892



bco_full&0x7F_bco_intt0_Run47892



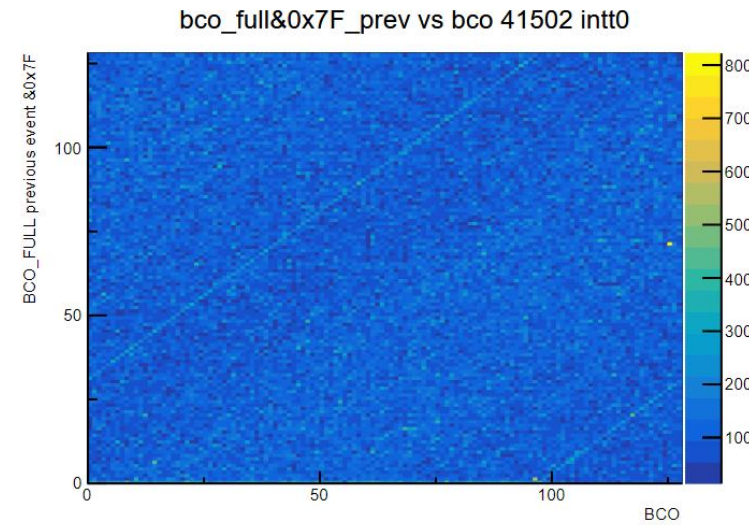
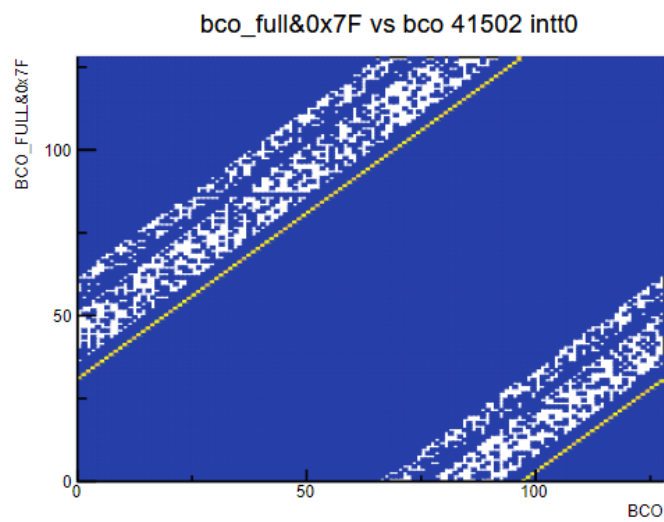
bco_full&0x7F_prev_bco_intt0_Run47892



Hit-cut results of
 $75 < \text{BCO_Full} - \text{BCO} < 101$
Unknown peak did not
disappear

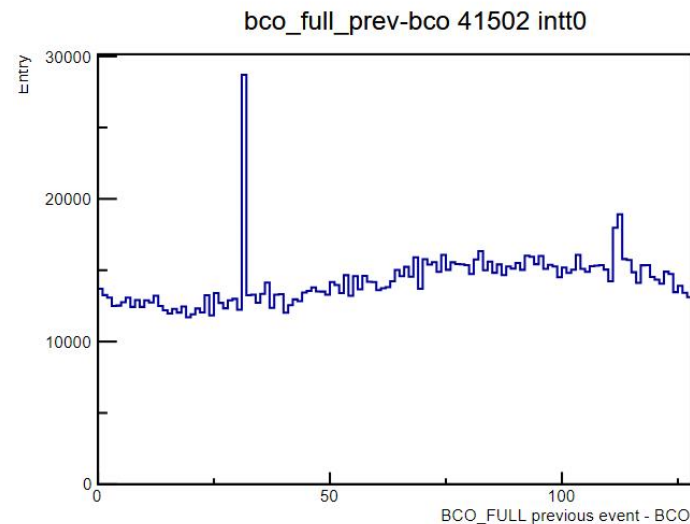
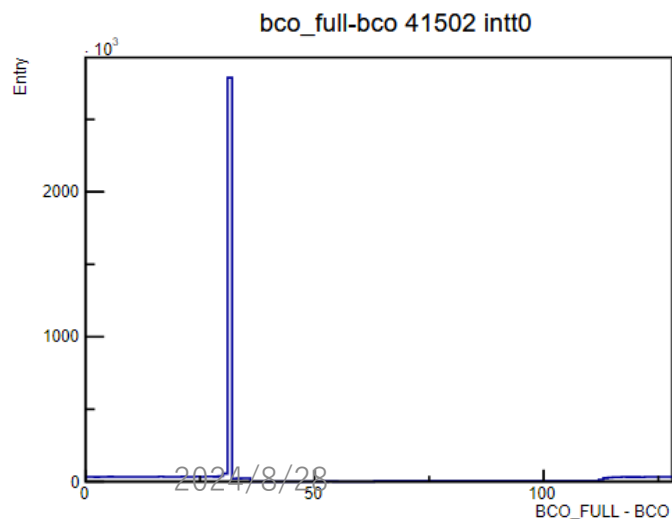
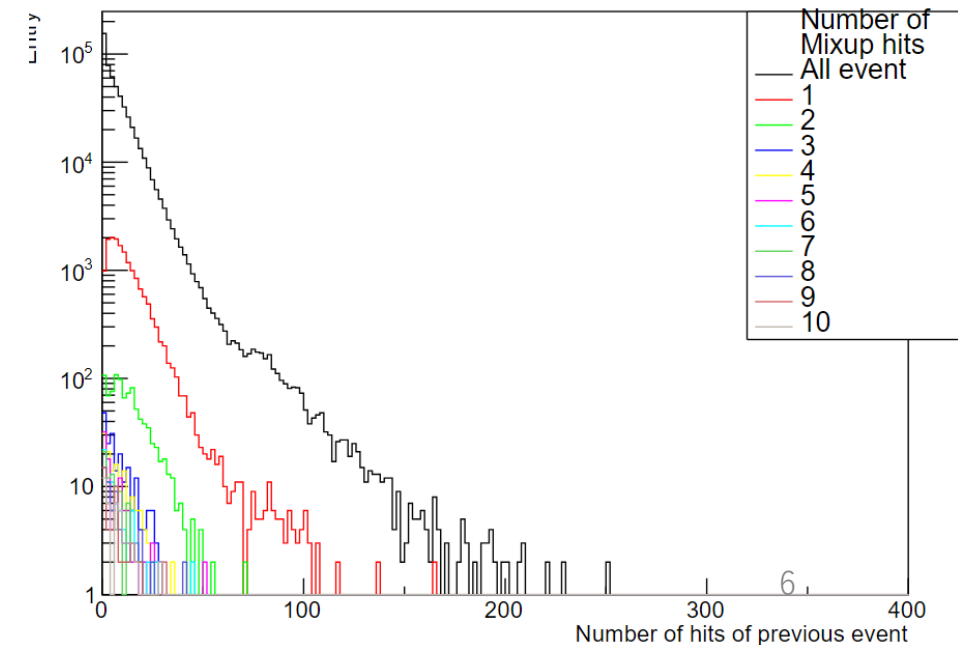
Run24 p-p

Run41502(5/2) open time=35 n_collision=100 intt0

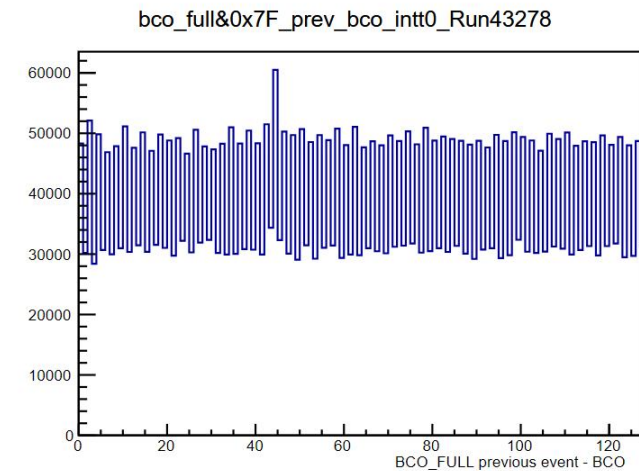
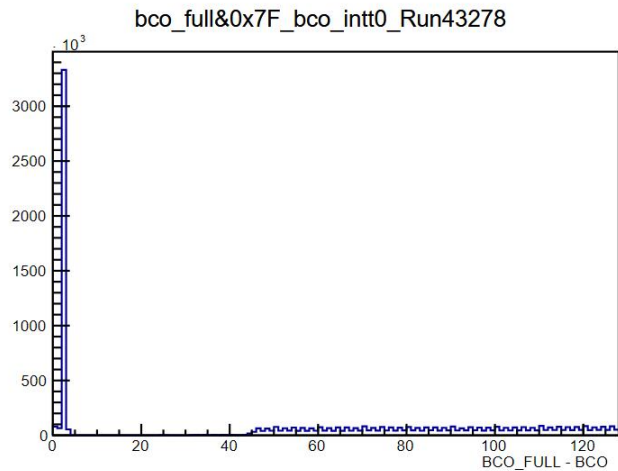
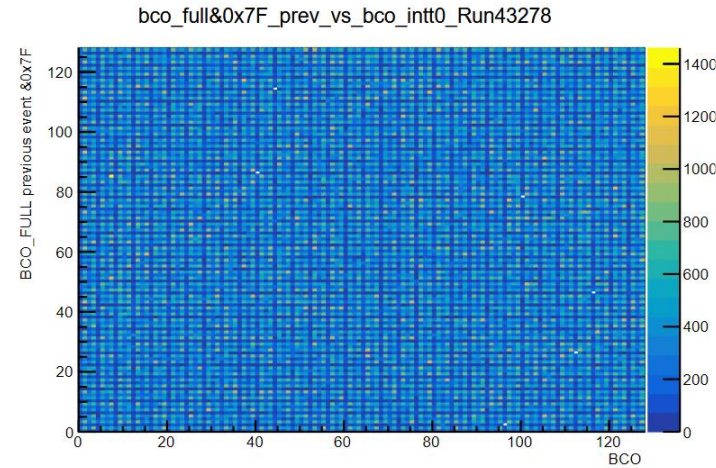
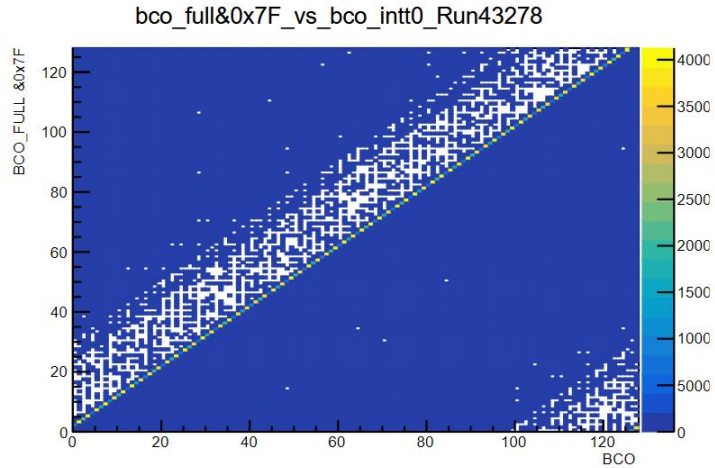


The other Felix are in the same state. These results indicate that Event Mixup occur even in p-p collisions with low multiplicity.

Mixup Multiplicity 41502 intt0

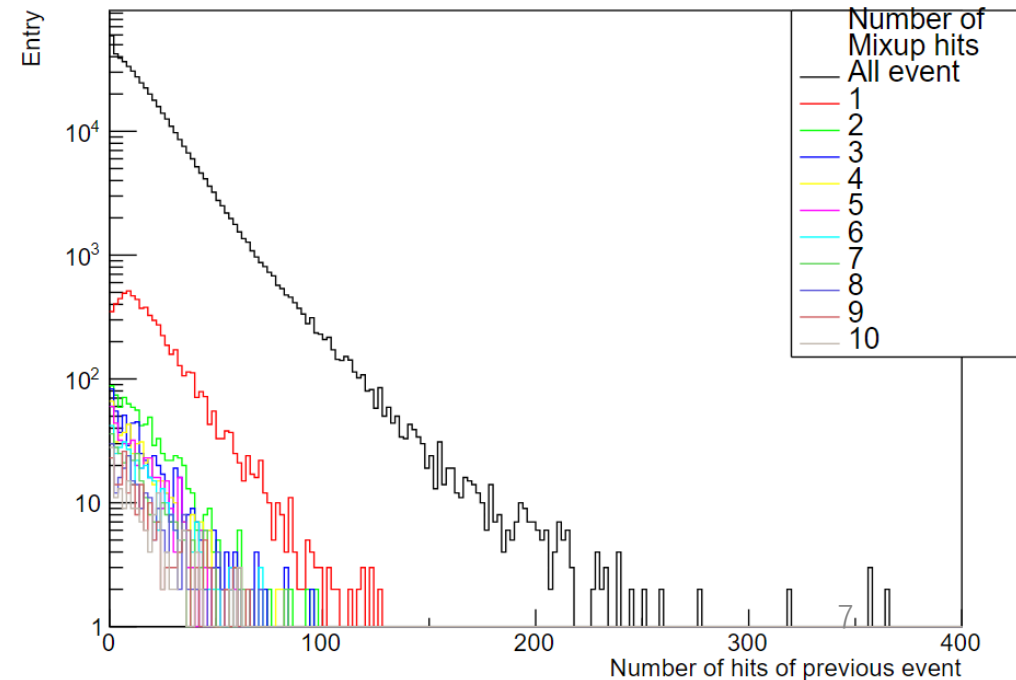


Run24 p-p Run43278(5/20) open time=55 n_collision=100 intt0



The other Felix are in the same state. These results indicate that Event Mixup occur even in p-p collisions with low multiplicity.

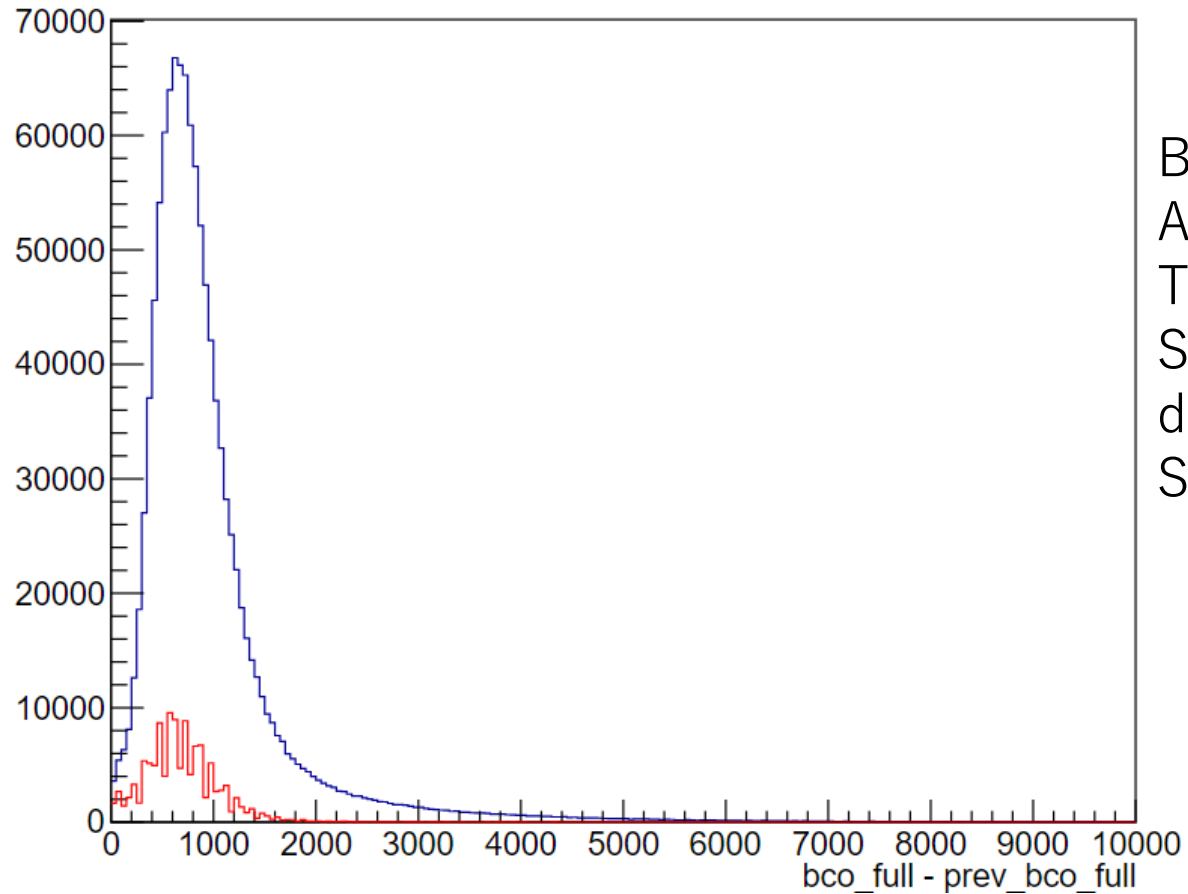
Mixup Multiplicity 43278 intt0



Collision interval

bco_full - prev_bco_full_Run43278

Run43278 open time = 55 n_collision=100



BCO_Full – previous BCO_Full

All event (black) Mixup event (red)

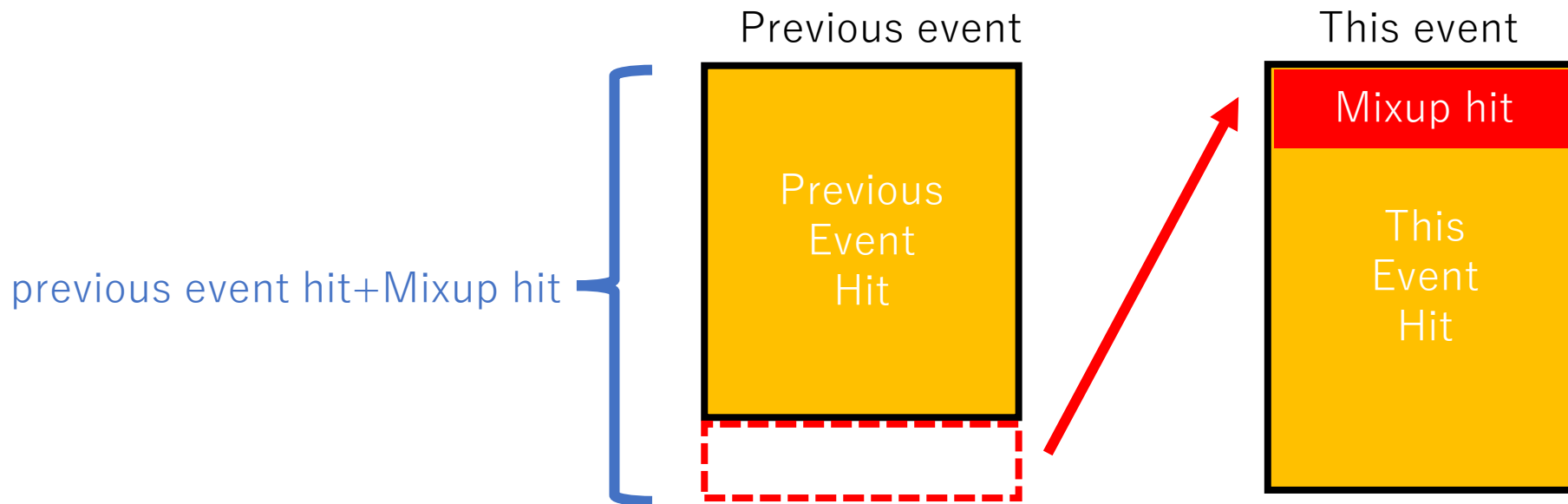
The peaks do not appear to be significantly misaligned.
So I think Mixup don't have collision interval dependence.

Similar results were obtained for other Runs.

Mixup event · hit fraction

$$\text{Mixup Event fraction} = \frac{\text{Mixup Event}}{\text{All Event}} \times 100 [\%]$$

$$\text{Mixup Hit fraction} = \frac{\text{Mixup Hit}}{\text{Previous Event Hit} + \text{Mixup Hit}} \times 100 [\%] \quad \text{Average} = \frac{\text{Mixup Hit fraction}}{\text{Mixup Event}}$$

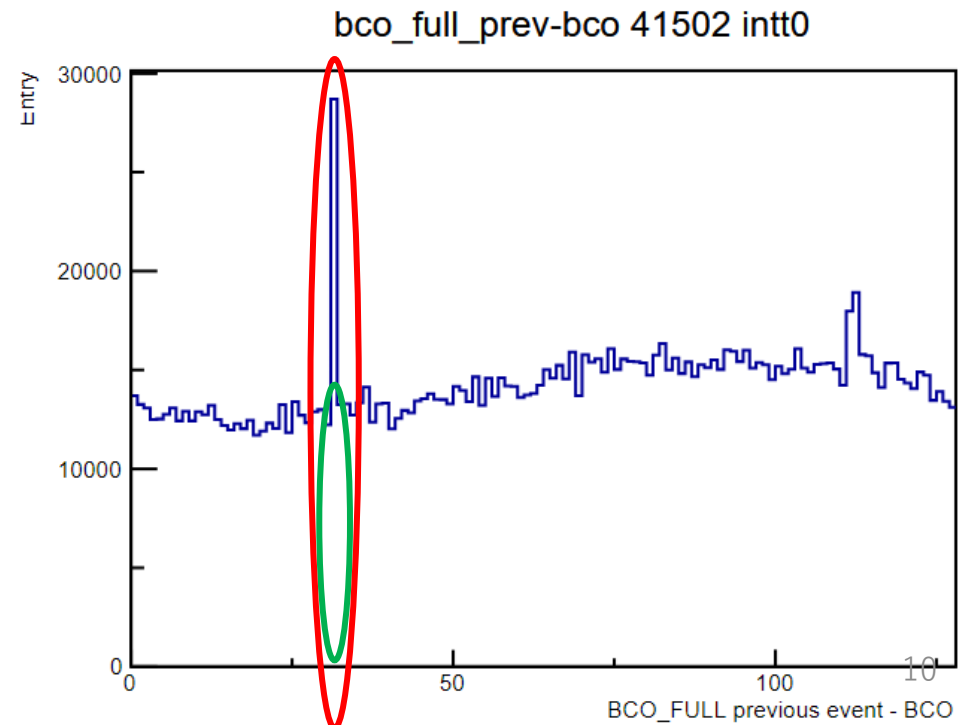


To be able to see how many mixups are occurring, I calculated the fraction of events where mixup are occurring and the fraction of mixup hits. Both are multiplied by 100 and changed to percent.

How to calculate

- **Mixup Hit fraction** – **Random Hit fraction** = **True Mixup hit fraction**

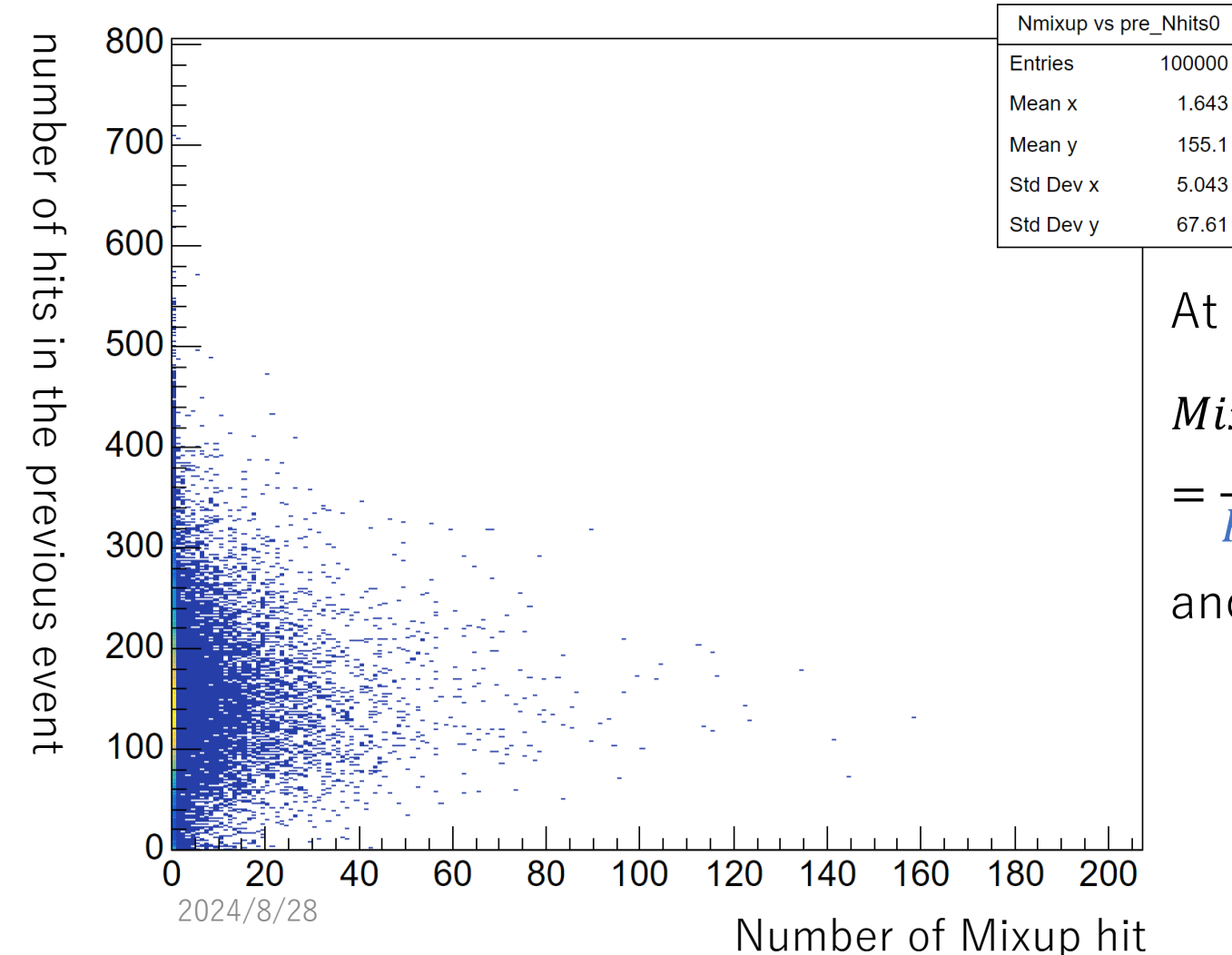
Random hit rate is calculated from the average of ± 2 bin around the peak of mixup hits.



Mixup fraction

Nmixup vs pre_Nhits0_Run47892

First, as shown in the left figure
Horizontal axis : number of mixup hits
Vertical axis: number of hits in the previous event



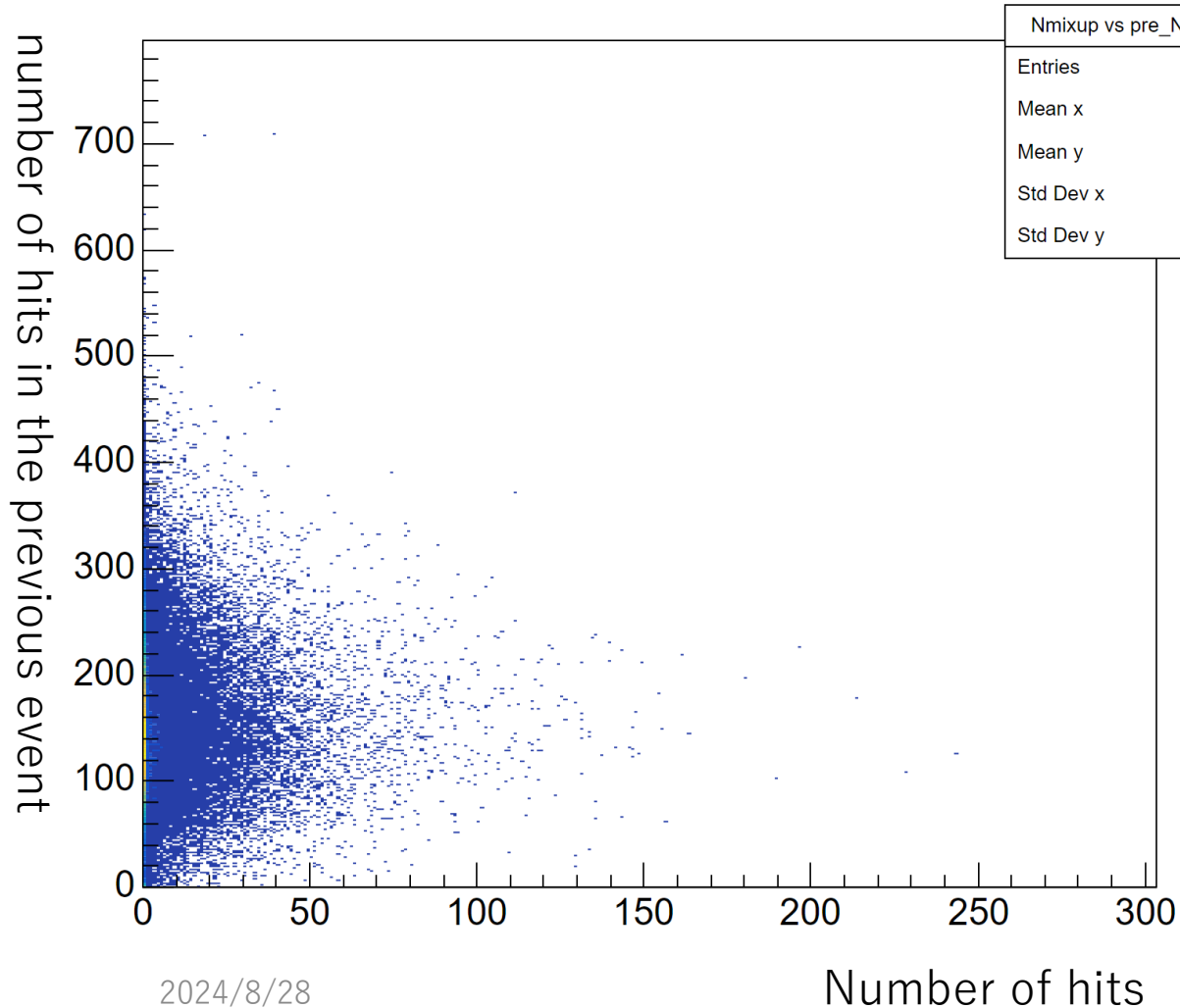
At each point in the plot, calculate

$$\text{Mixup Hit fraction} = \frac{\text{Mixup Hit}(x)}{\text{Previous Event Hit}(y) + \text{Mixup Hit}(x)} \times \text{Entries}$$

and averaged over all entries

Mixup fraction

Nmixup vs pre_Nhits others 4bin0_Run47892



Next, a similar distribution of Mixup's peak ± 2 bins
Horizontal axis : number of hits

Vertical axis: number of hits in the previous event

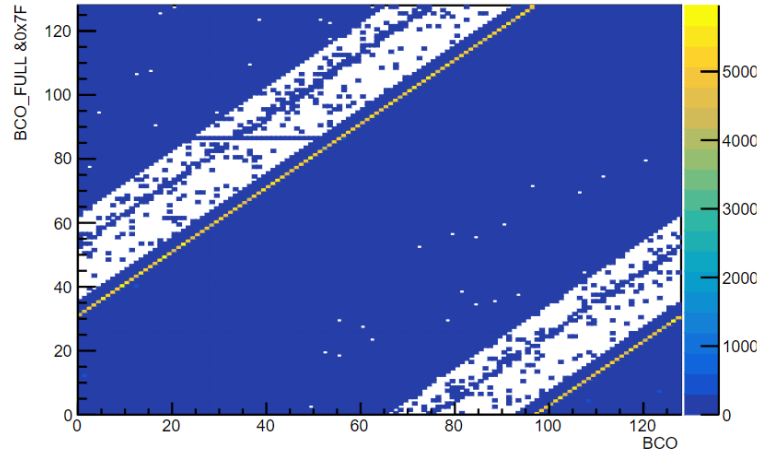
Around ± 2 bin *Hit fraction*
 ± 2 bin *Hit(x)*

$$= \frac{\pm 2 \text{bin Hit}(x)}{\text{Previous Event Hit}(y) + \pm 2 \text{bin Hit}(x)} \times \text{Entries}$$

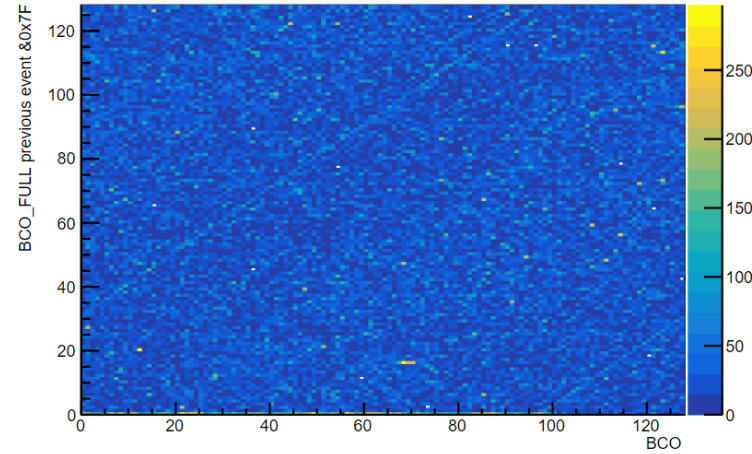
Calculate the random hit fraction and divide by 4bins to obtain the average random hit fraction per bin

Run41502 inttt0

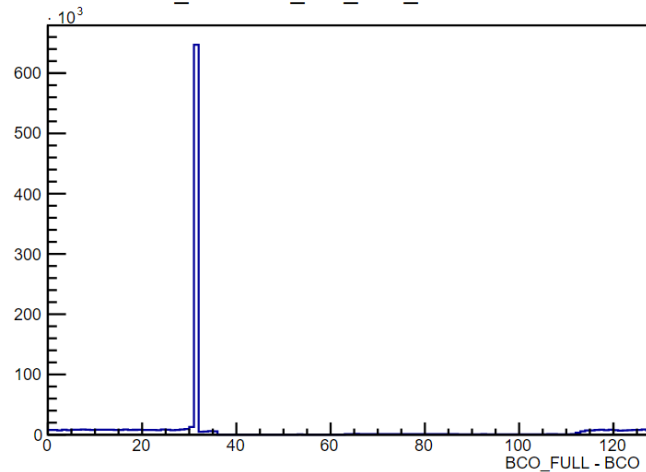
bco_full&0x7F_vs_bco_inttt0_Run41502



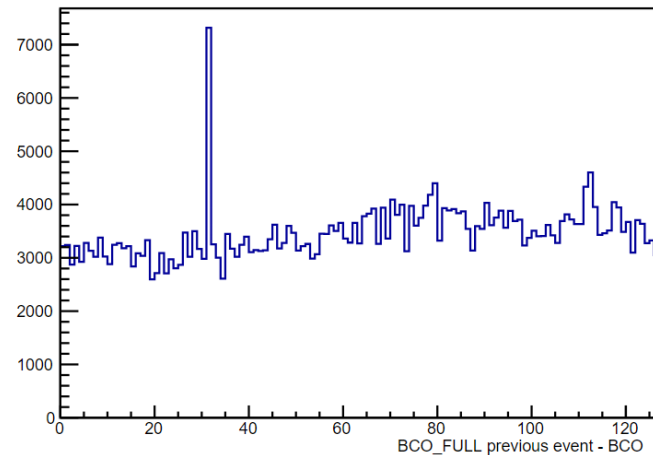
bco_full&0x7F_prev_vs_bco_inttt0_Run41502



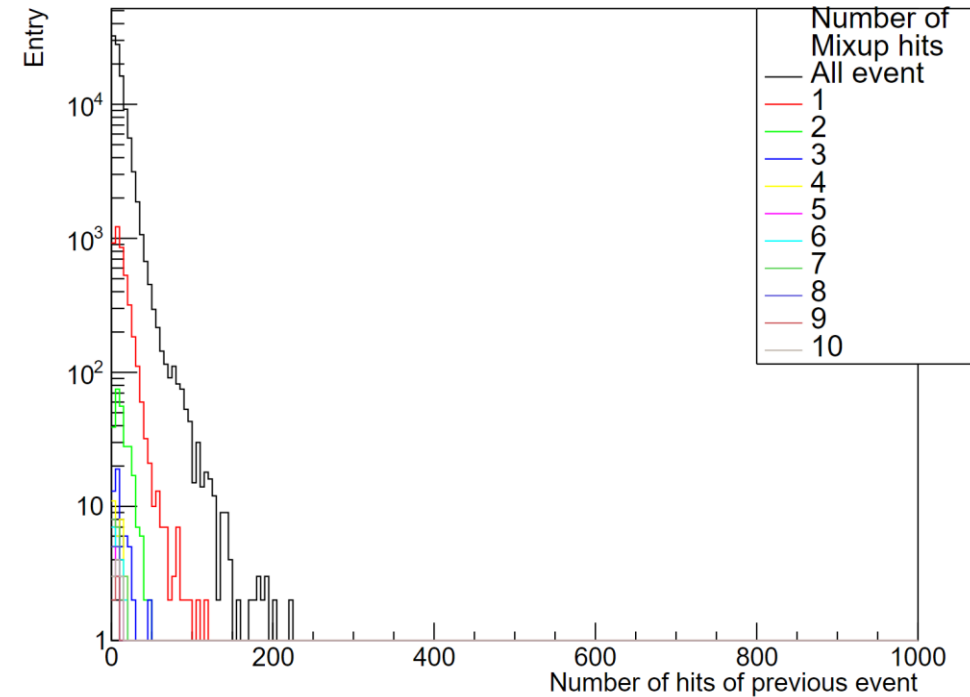
bco_full&0x7F_bco_inttt0_Run41502



bco_full&0x7F_prev_bco_inttt0_Run41502



allmulti_inttt0_Run41502: with clone cut

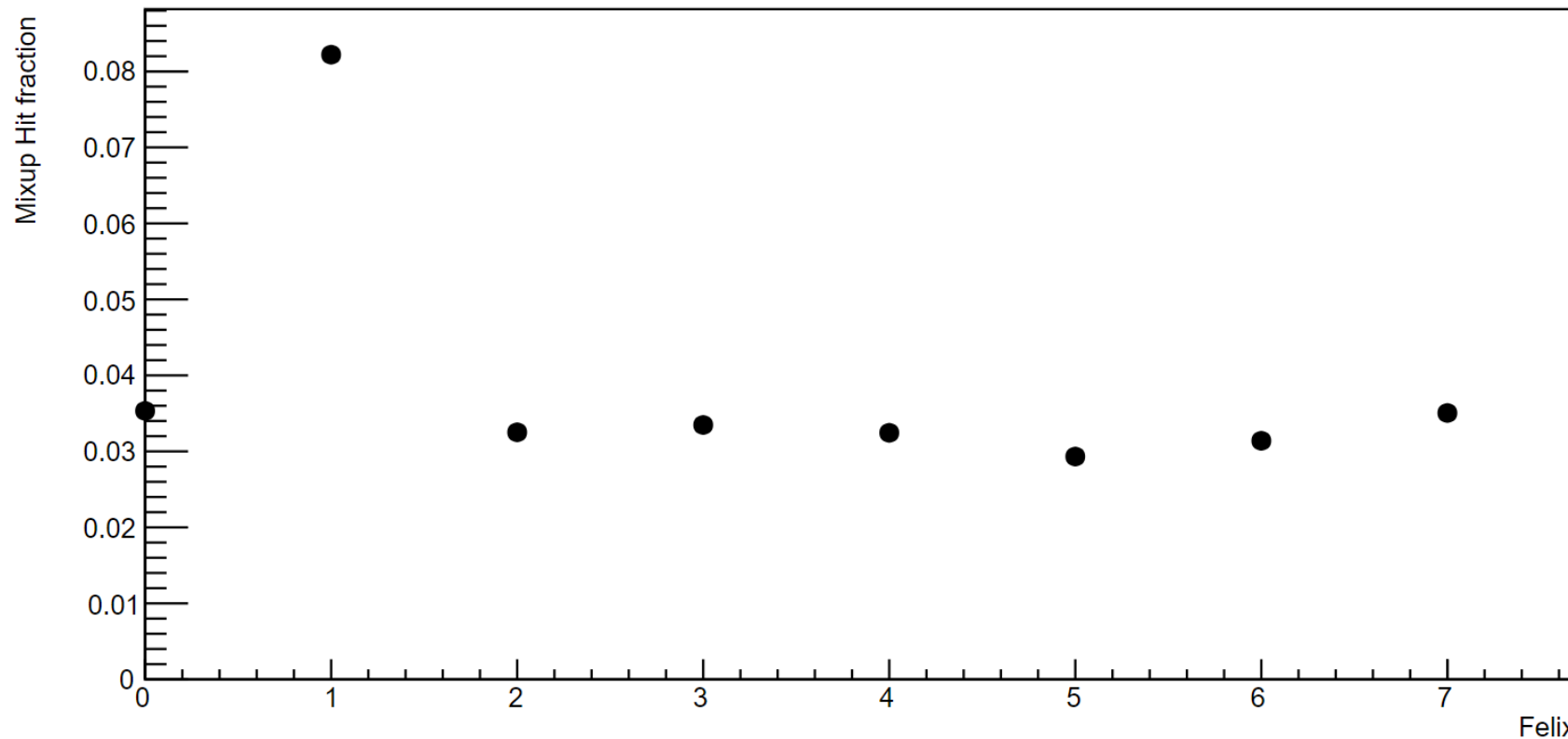


Run41502

$$\text{Mixup Hit fraction} = \frac{\text{Mixup Hit}(x)}{\text{Previous Event Hit}(y) + \text{Mixup Hit}(x)}$$

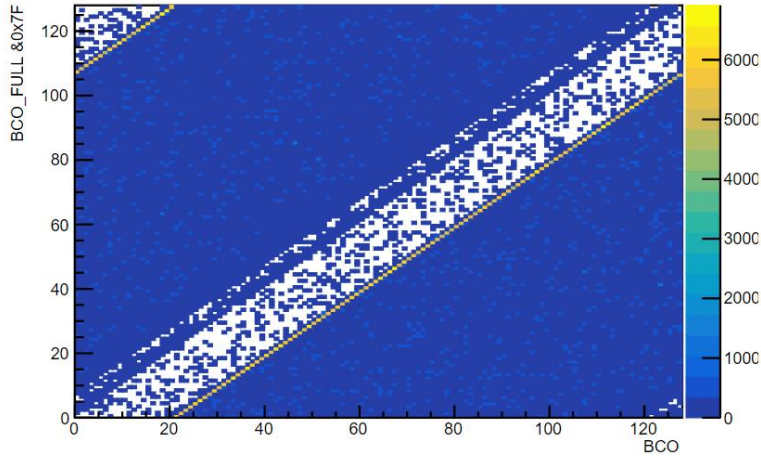
In Runs where Event Mixups are considered to be occurring Mixup hit fraction was approximately 3-4%.

Mixup Hit fraction Run41502

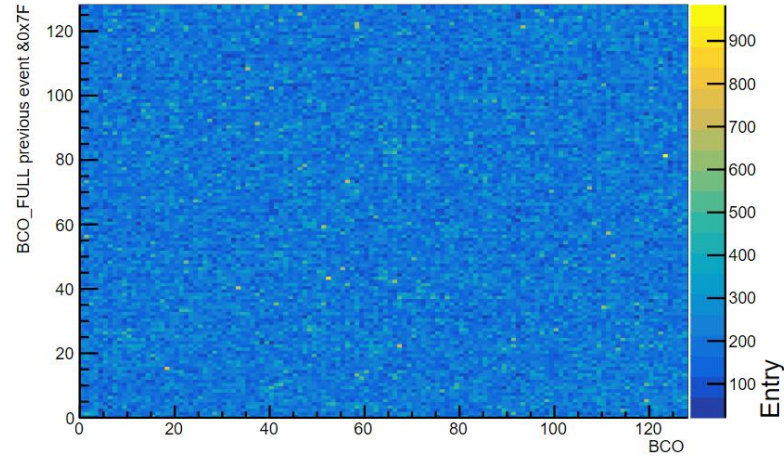


Run49737 inttt0

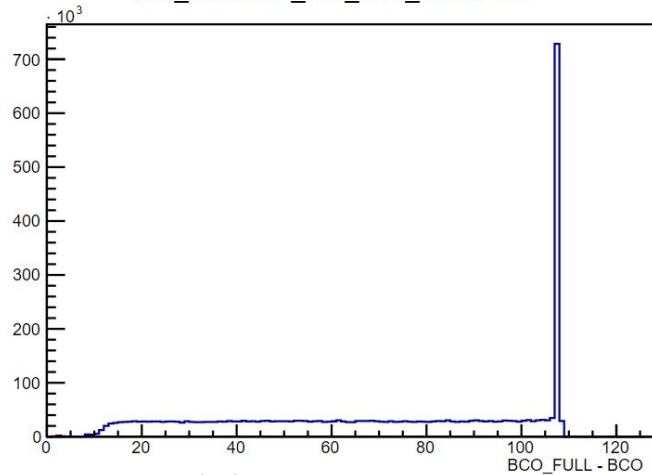
bco_full&0x7F_vs_bco_intt0_Run49737



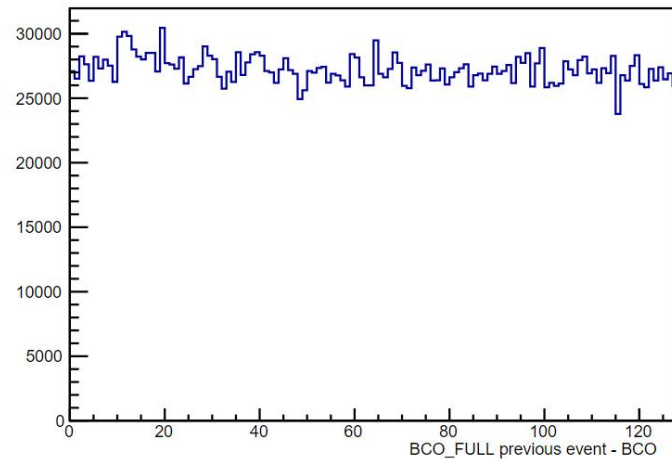
bco_full&0x7F_prev_vs_bco_intt0_Run49737



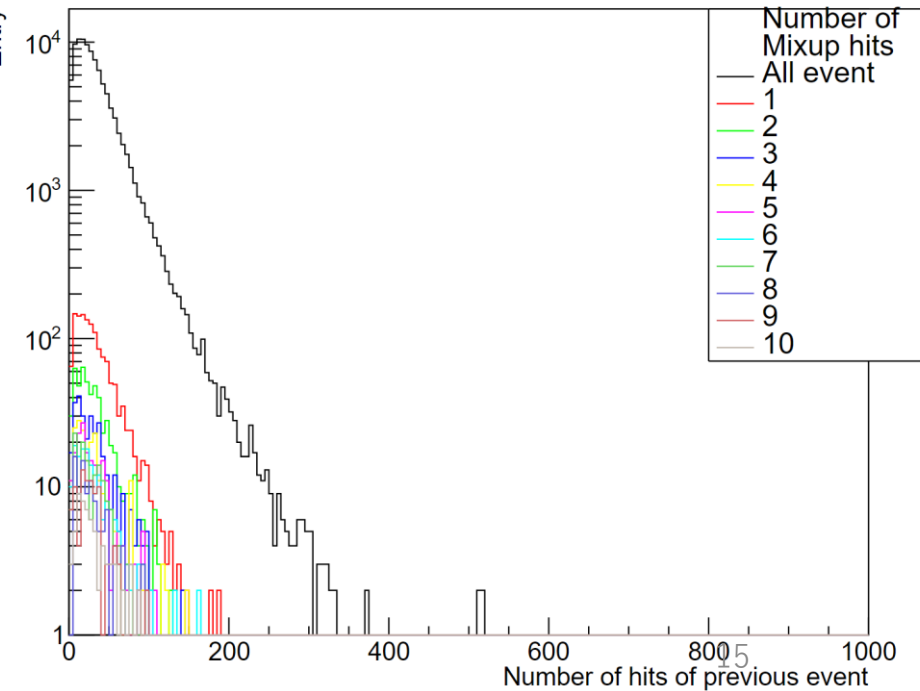
bco_full&0x7F_bco_intt0_Run49737



bco_full&0x7F_prev_bco_intt0_Run49737



allmulti_intt0_Run49737: with clone cut

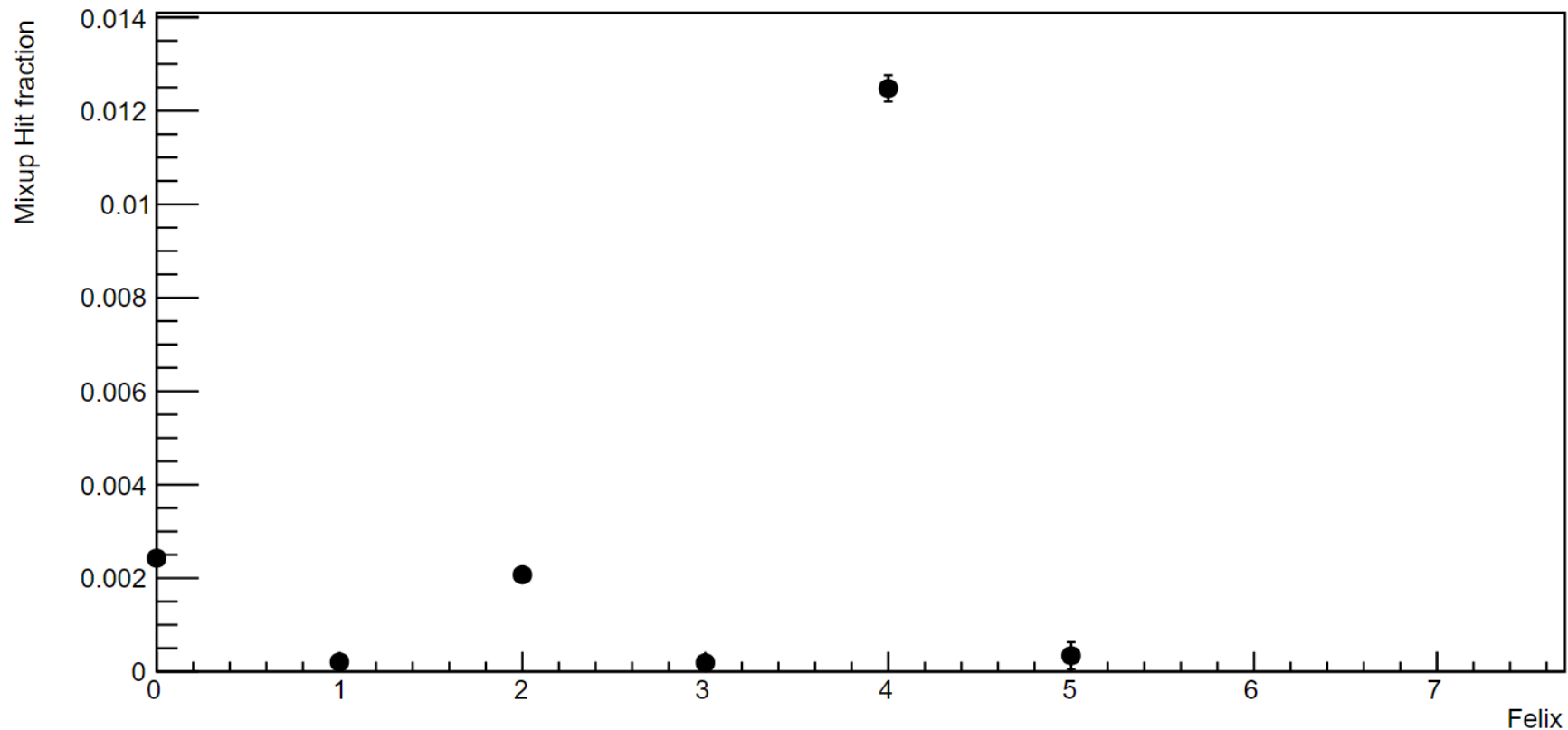


Run49737

$$\text{Mixup Hit fraction} = \frac{\text{Mixup Hit}(x)}{\text{Previous Event Hit}(y) + \text{Mixup Hit}(x)}$$

In Runs where no Event Mixups were considered to have occurred Mixup hit fraction was approximately 0~0.4%.

Mixup Hit fraction Run49737



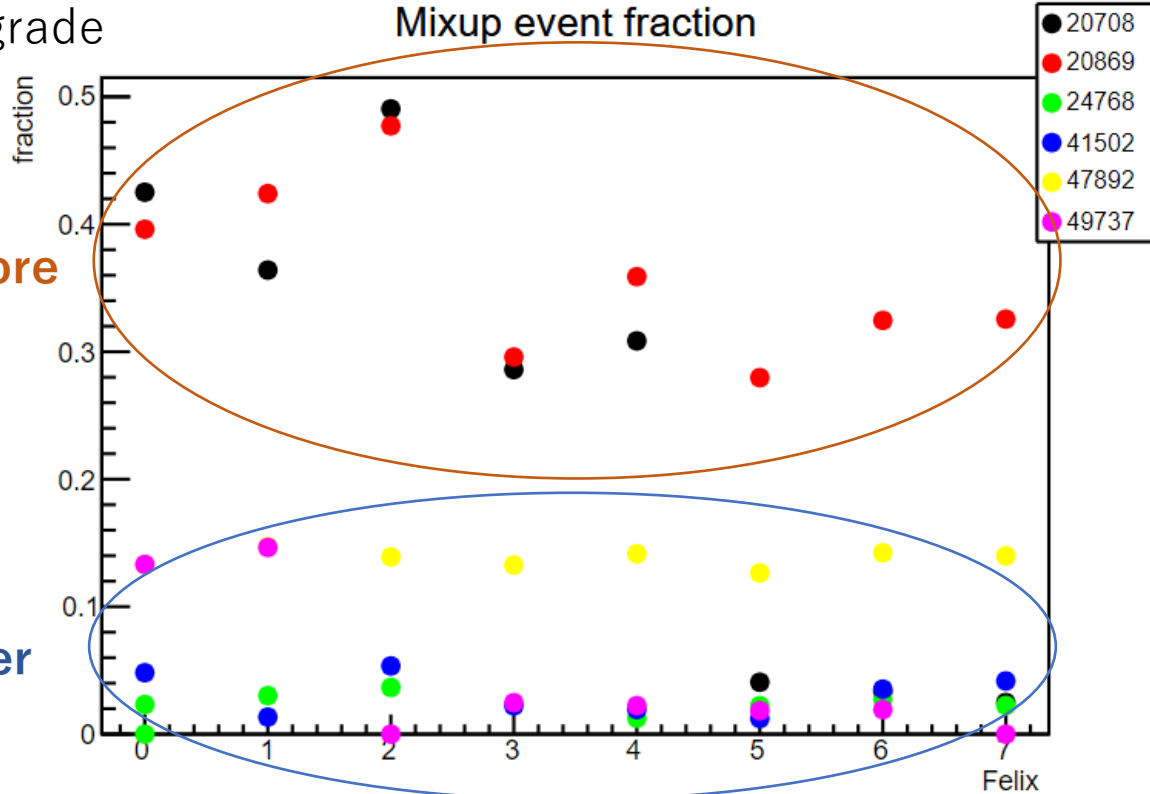
Run23&24 Mixup fraction

Felix
Firmware
upgrade

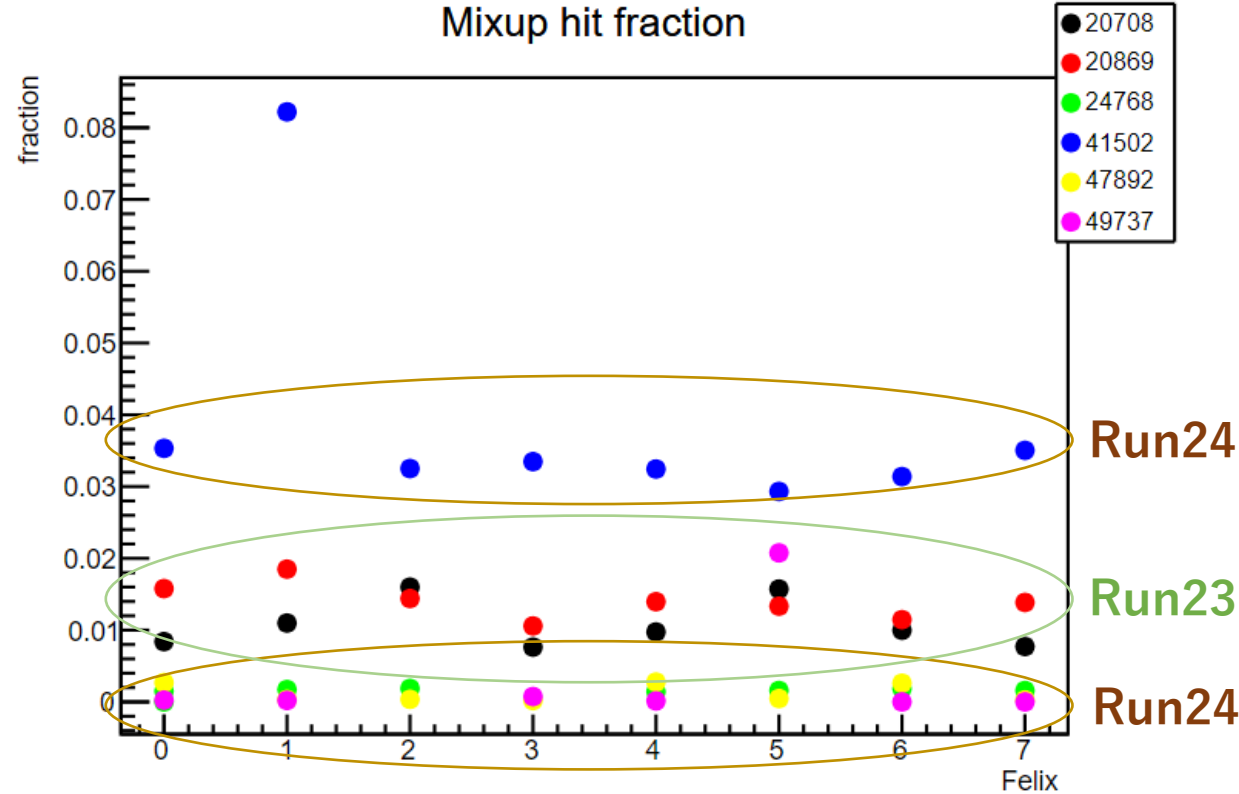
Before

After

Mixup event fraction



Mixup hit fraction



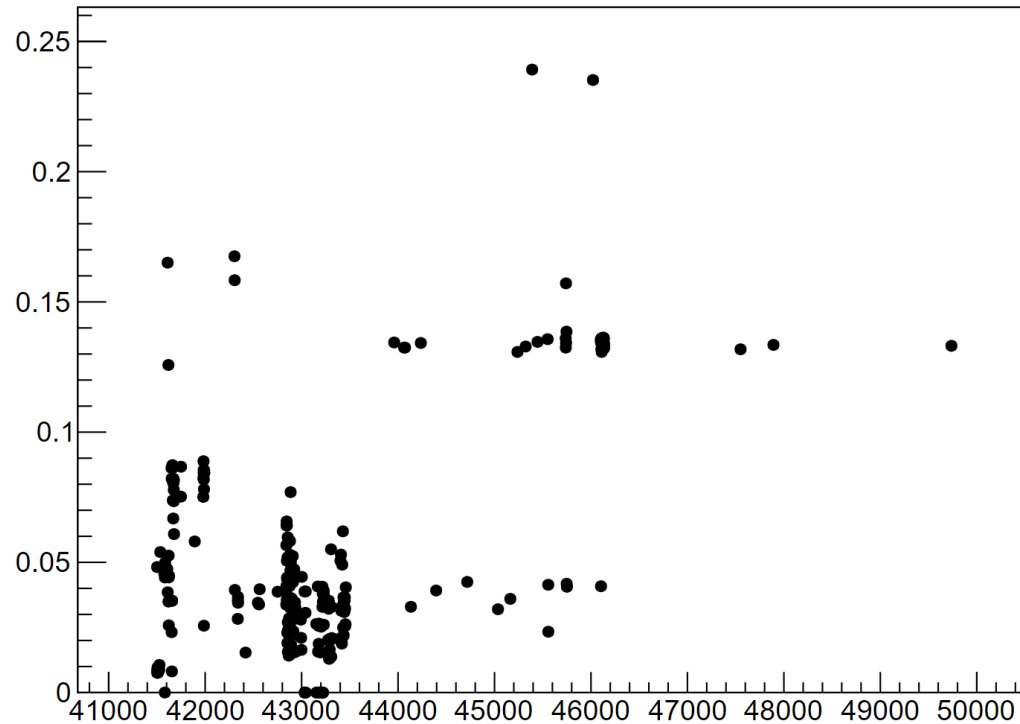
- Similar to the results shown earlier for the event fraction, the fraction was lower after the firmware upgrade, suggesting that mixups were less likely to occur in Run24 also.
- For the Hit fraction, subtracting the random hit fraction resulted in a lower Run24 Mixup for runs that were not considered to have occurred, and a slightly higher but lower than previous results for Runs that did appear to have occurred.

Run24 Mixup fraction

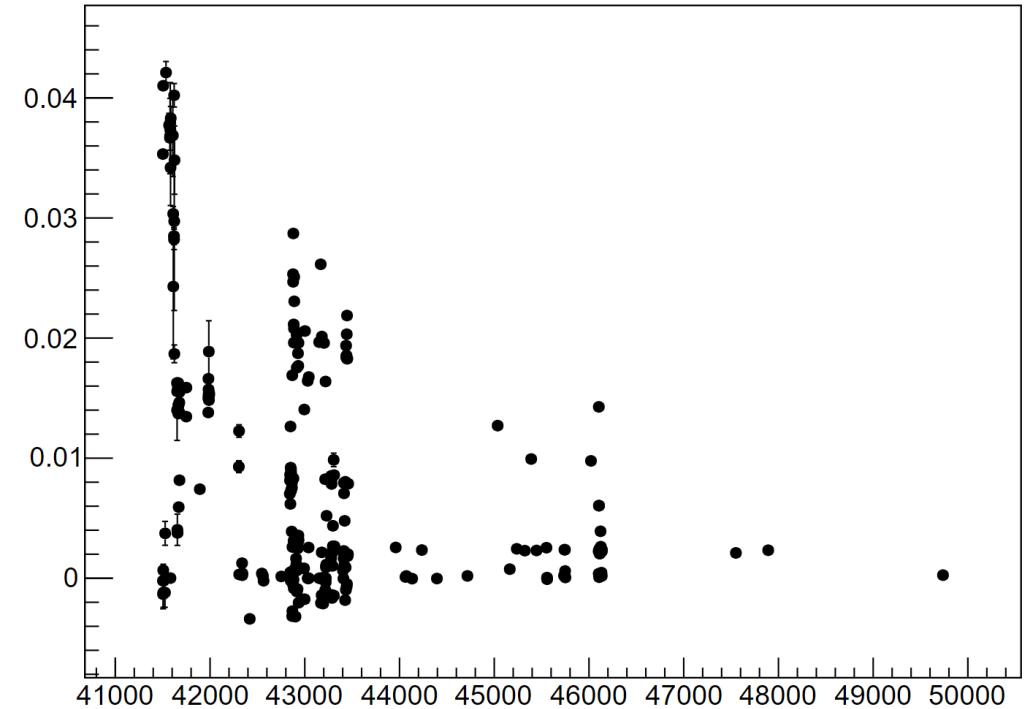
- Run 41502~49737 for each Felix (some runs not seen)
Mixup event fraction and mixup hit fraction were calculated and graphed.
- Here, fraction is calculated after collision hit, clone hit, and hot channel cut to determine mixup hit.

Run24 Mixup fraction intt0 Noisy Run cut

Mixup event fraction for Felix = 0



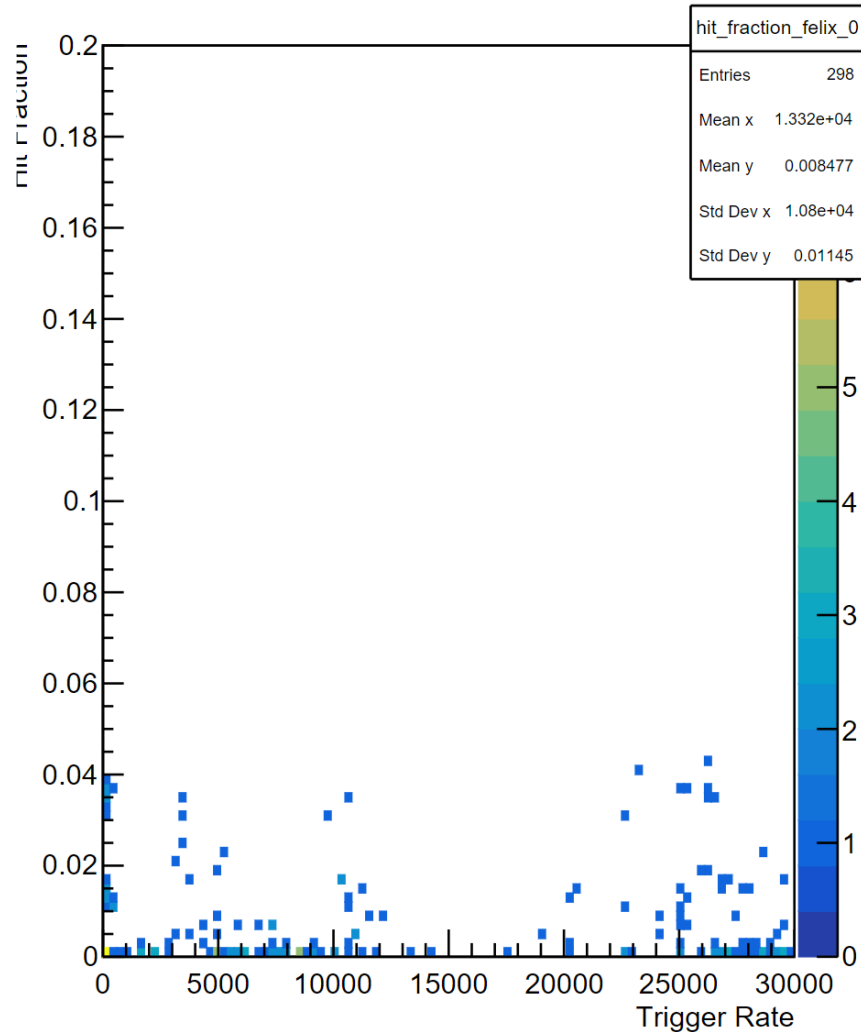
Mixup hit fraction for Felix = 0



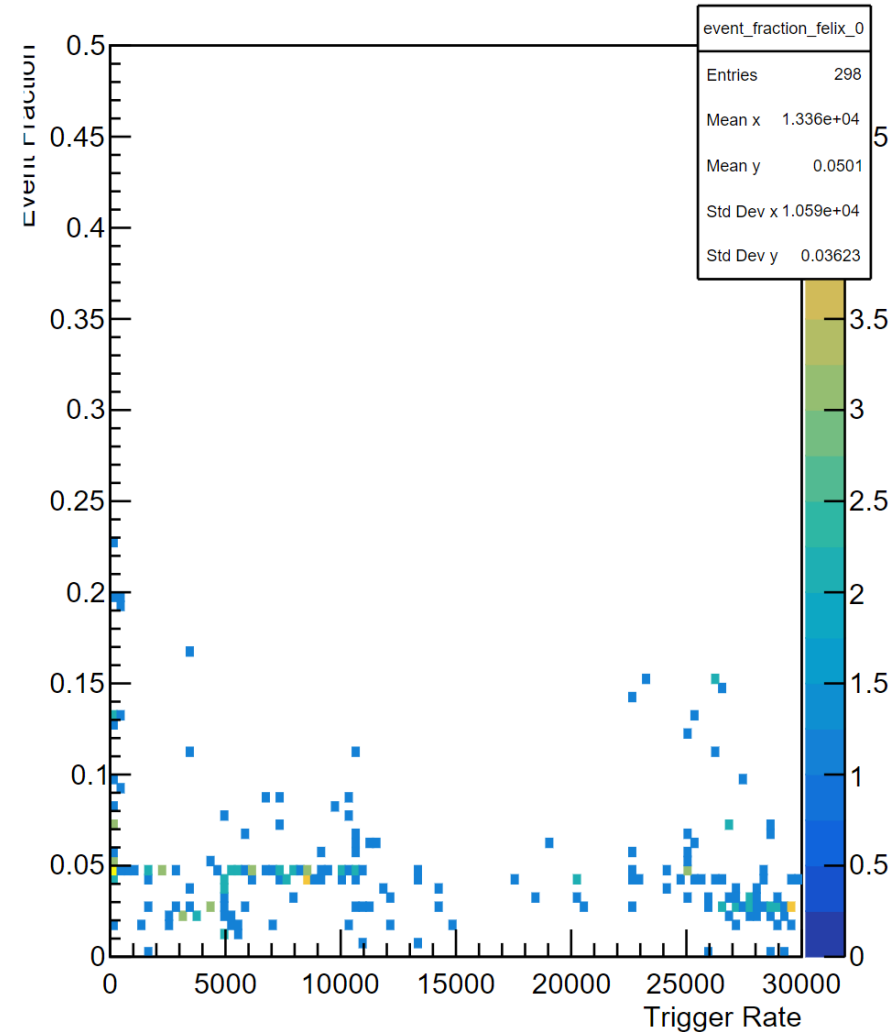
- This plot cuts off runs that have high fractions but no mixups, as shown on the previous page.
- Hit fractions appear to decrease as the Run number increases, suggesting that mixups are unlikely to have occurred in recent runs.
- Other Felix are in Back up

Mixup fraction vs trigger rate inttt0

Hit Fraction vs Trigger Rate for Felix 0



Event Fraction vs Trigger Rate for Felix 0

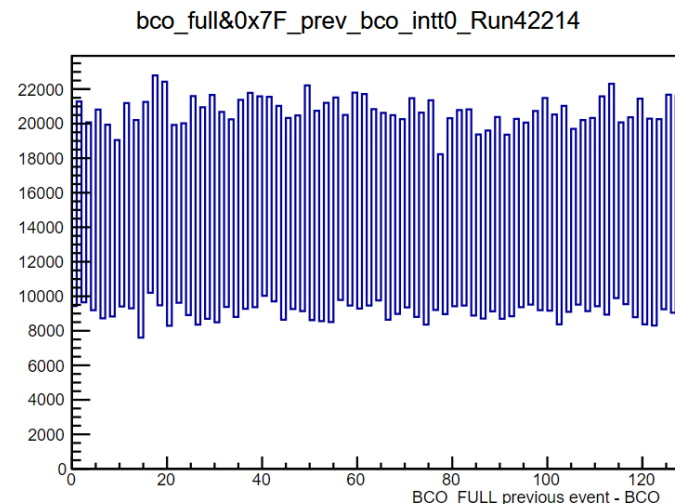
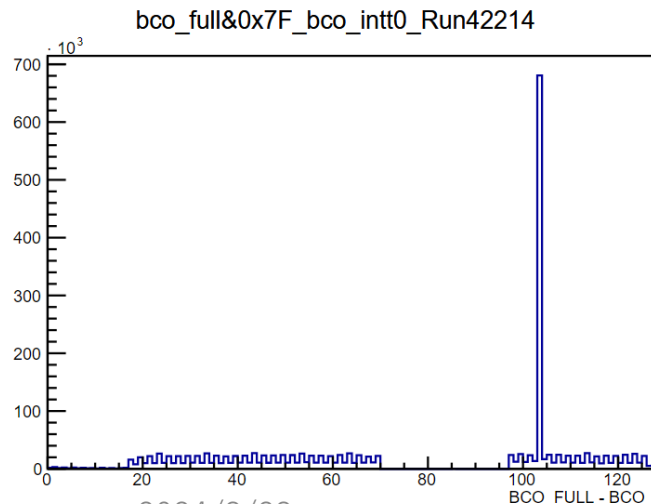
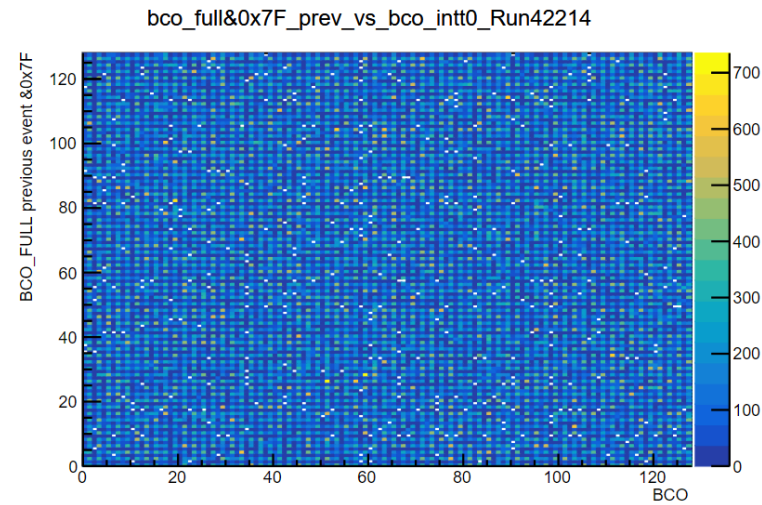
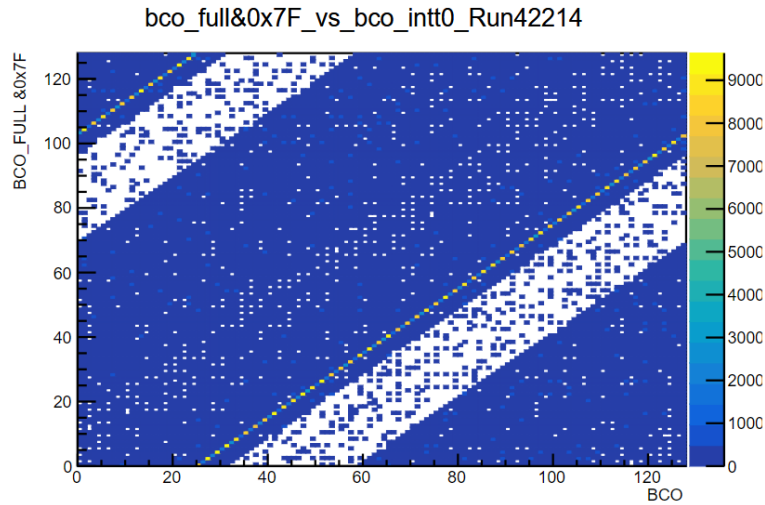


Back up

Next to do

- Determination of plots to show in JPS and creation of approval plots, preparation of Analysis Notes.
- Confirmation of mixup in streaming data.

Run42214 (high fraction)



However, when I examined the state of the Run that was producing high fraction values, Mixup did not seem to be happening.

It is thought that the random hit fraction is not calculated correctly because the selected 4 bins contain both high and low hit count bins.

At this point, a high fraction value does not necessarily mean that a Mixup is occurring.

Run24 pp

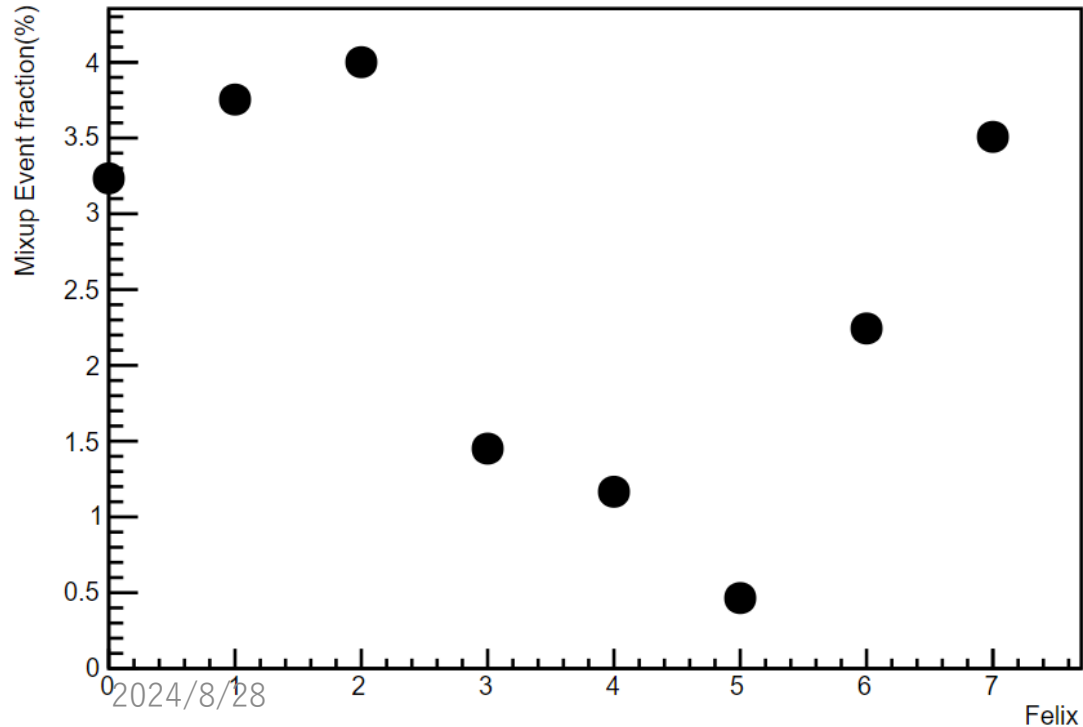
Run41502(5/2) open time=35 n_collision=100

$$\text{Mixup Event fraction} = \frac{\text{Mixup Event}}{\text{All Event}} \times 100$$

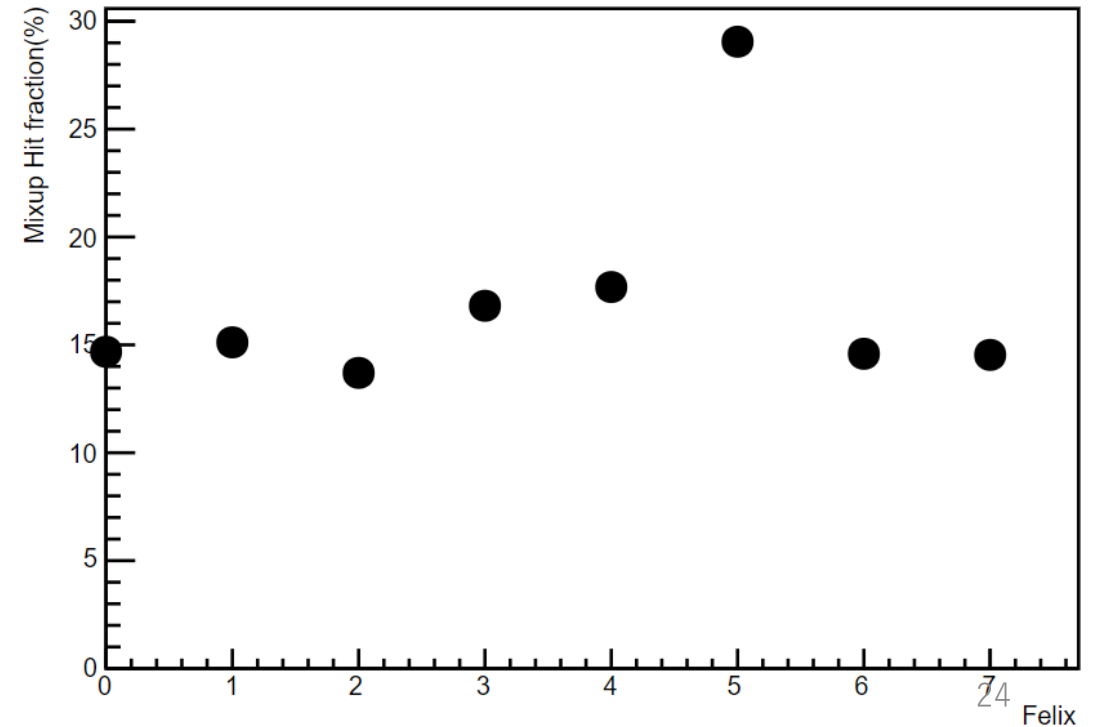
$$\text{Mixup Hit fraction} = \frac{\text{Mixup Hit}}{\text{Previous Event Hit} + \text{Mixup Hit}} \times 100$$

$$\text{Average} = \frac{\text{Mixup Hit fraction}}{\text{Mixup Event}}$$

Mixup event fraction



Mixup Hit fraction



Run24 p-p

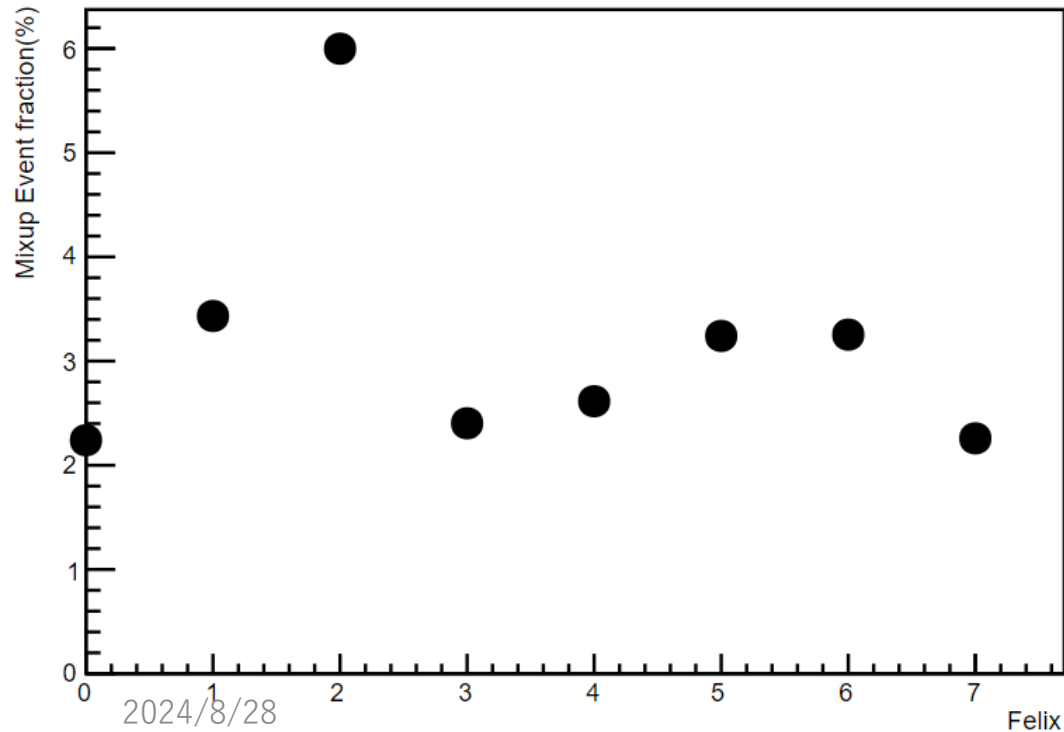
Run43278(5/20) open time=55 n_collision=100

$$\text{Mixup Event fraction} = \frac{\text{Mixup Event}}{\text{All Event}} \times 100$$

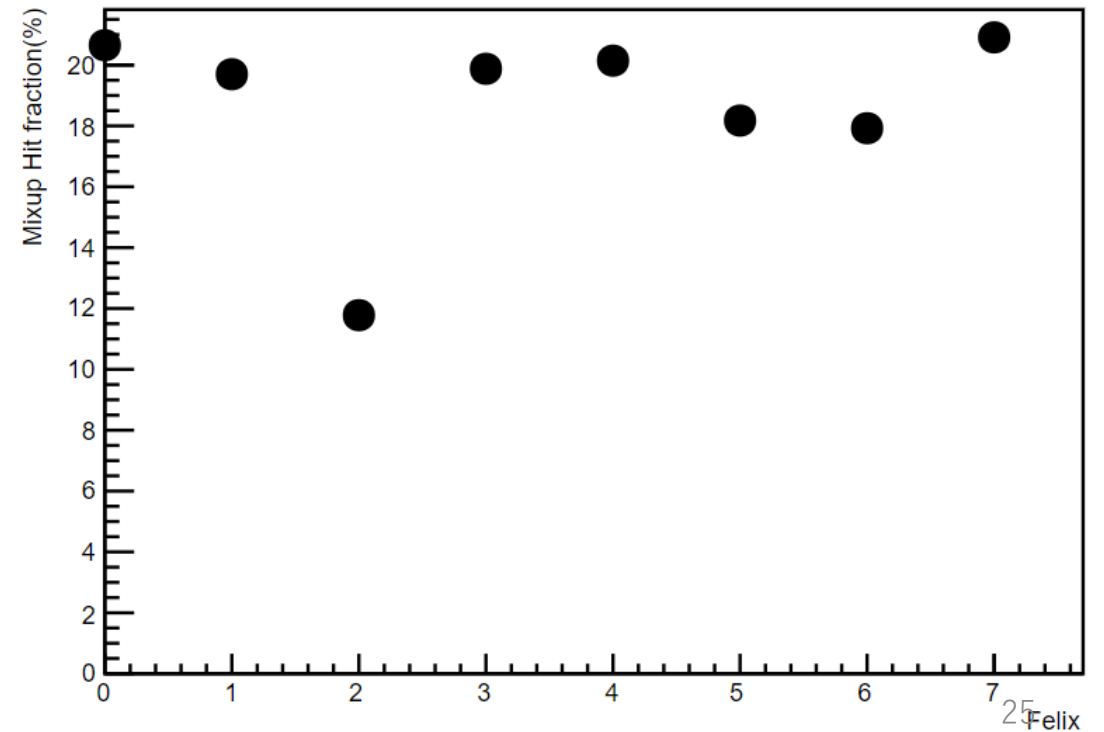
$$\text{Mixup Hit fraction} = \frac{\text{Mixup Hit}}{\text{Previous Event Hit} + \text{Mixup Hit}} \times 100$$

$$\text{Average} = \frac{\text{Mixup Hit fraction}}{\text{Mixup Event}}$$

Mixup event fraction



Mixup Hit fraction



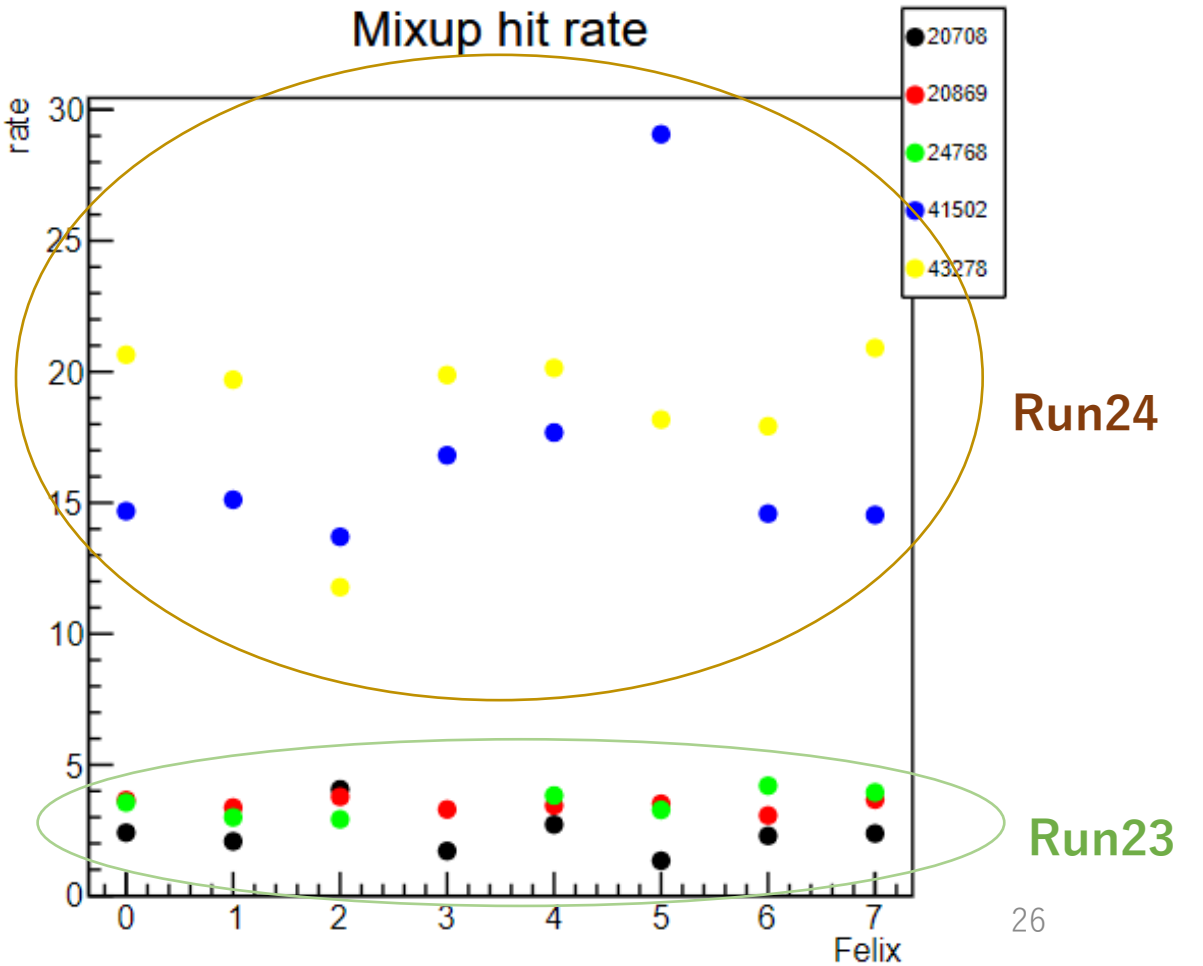
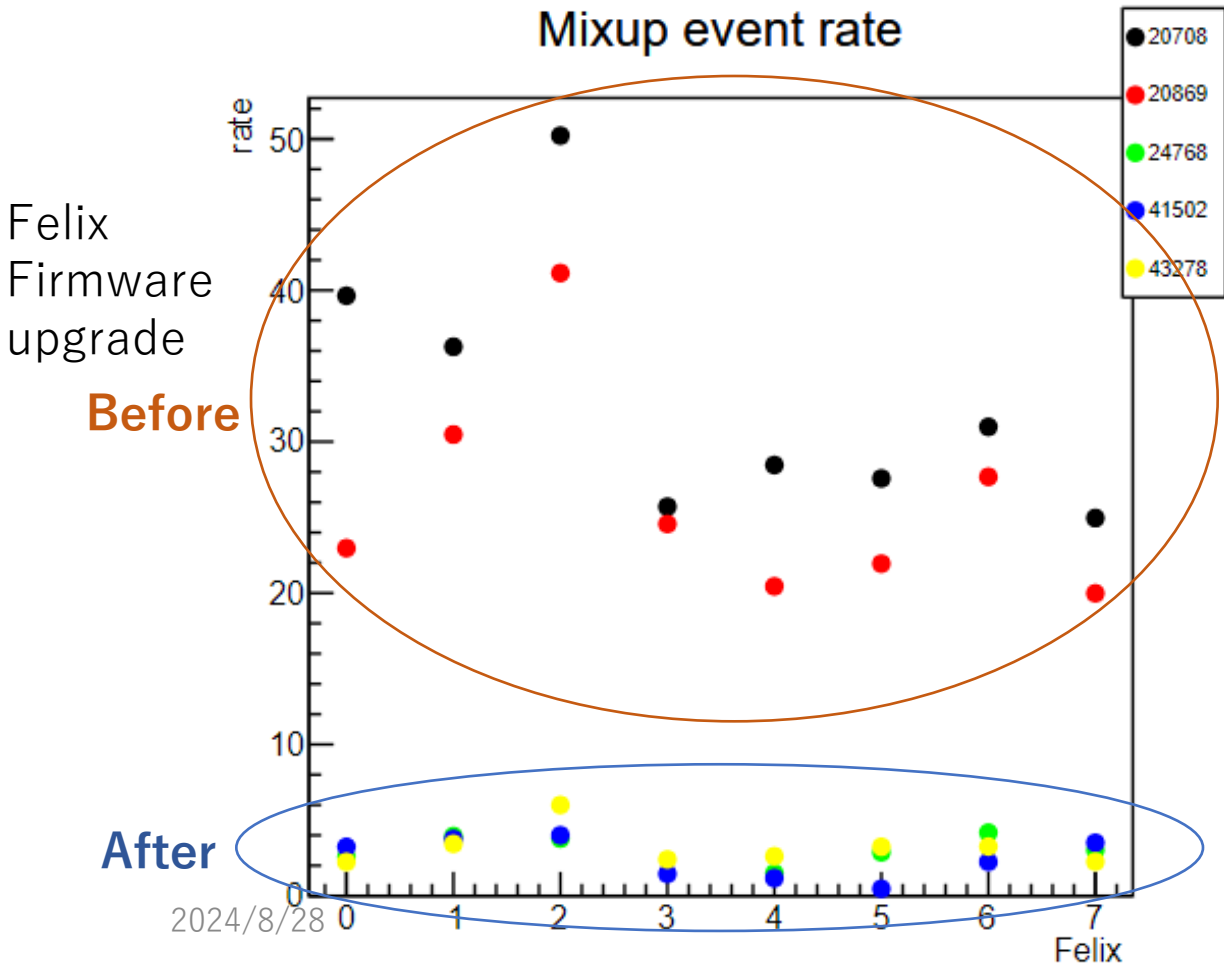
Run23 · Run24 fraction

$$\text{Mixup event fraction}[\%] = (\text{Mixup Event}) / (\text{Entries}) \times 100$$

$$\text{Mixup hit fraction}[\%] = (\text{Mixup hit}) / (\text{Previous event hit} + \text{Mixup hit}) \times 100$$

$$\text{Average (Mixup hit fraction)} / (\text{Mixup Event})$$

- Event fraction results show that the Mixup Event fraction was lower after the firmware upgrade. This suggests that mixups are less likely to occur than before.
- Run24 had higher fractions than Run23 in the Mixup hit fraction.

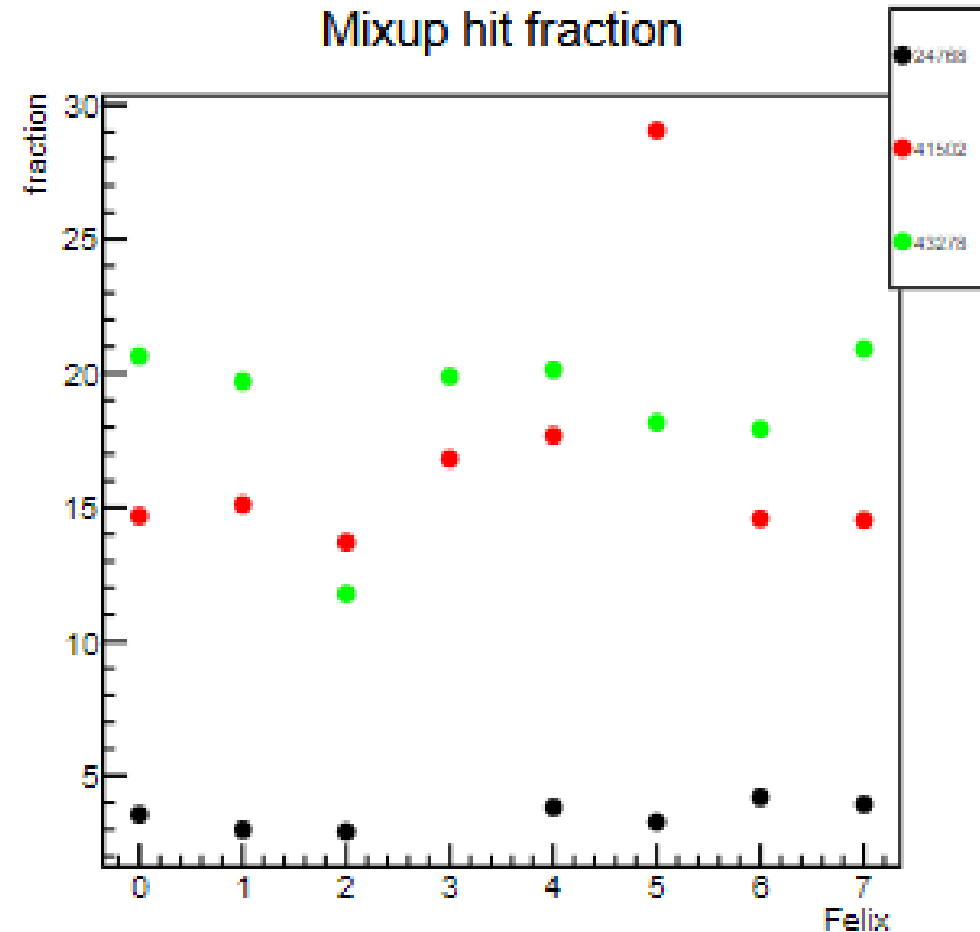
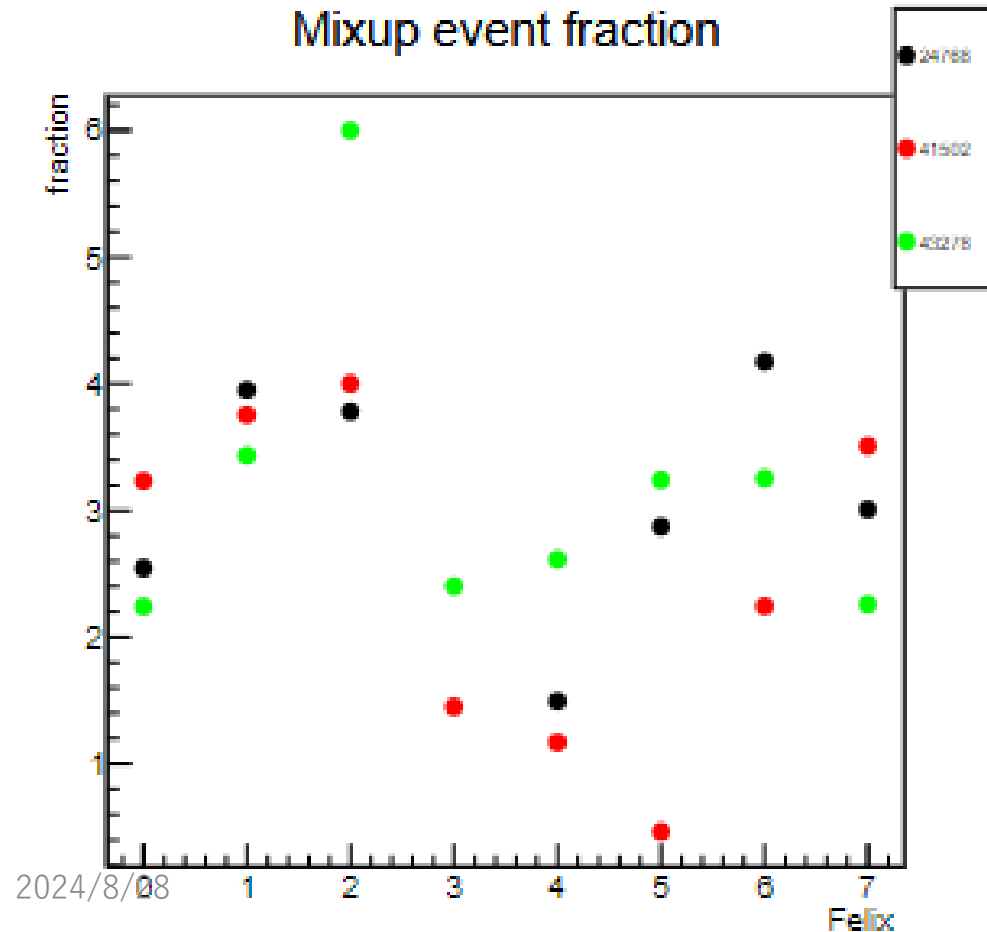


Fraction after firmware upgrade Run23,24

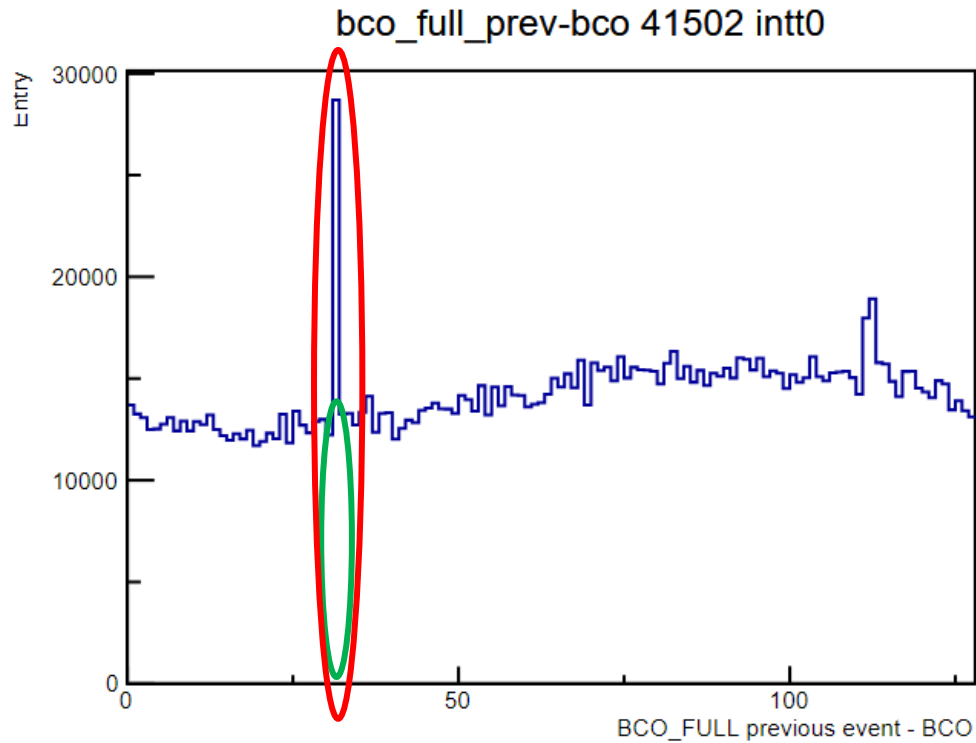
Mixup event fraction[%]=(Mixup Event)/(Entries) × 100

Mixup hit fraction[%]=(Mixup hit)/(Previous event hit + Mixup hit) × 100

Average (Mixup hit fraction)/(Mixup Event)



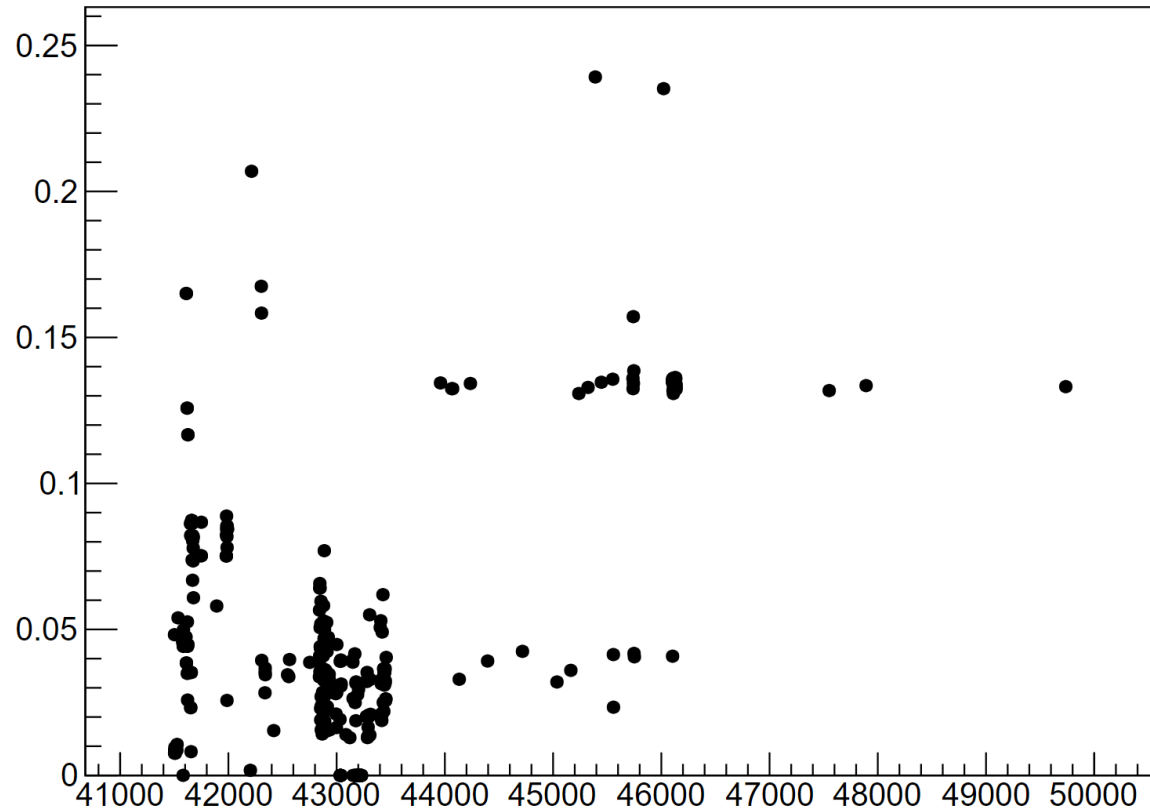
Hit fraction Run24



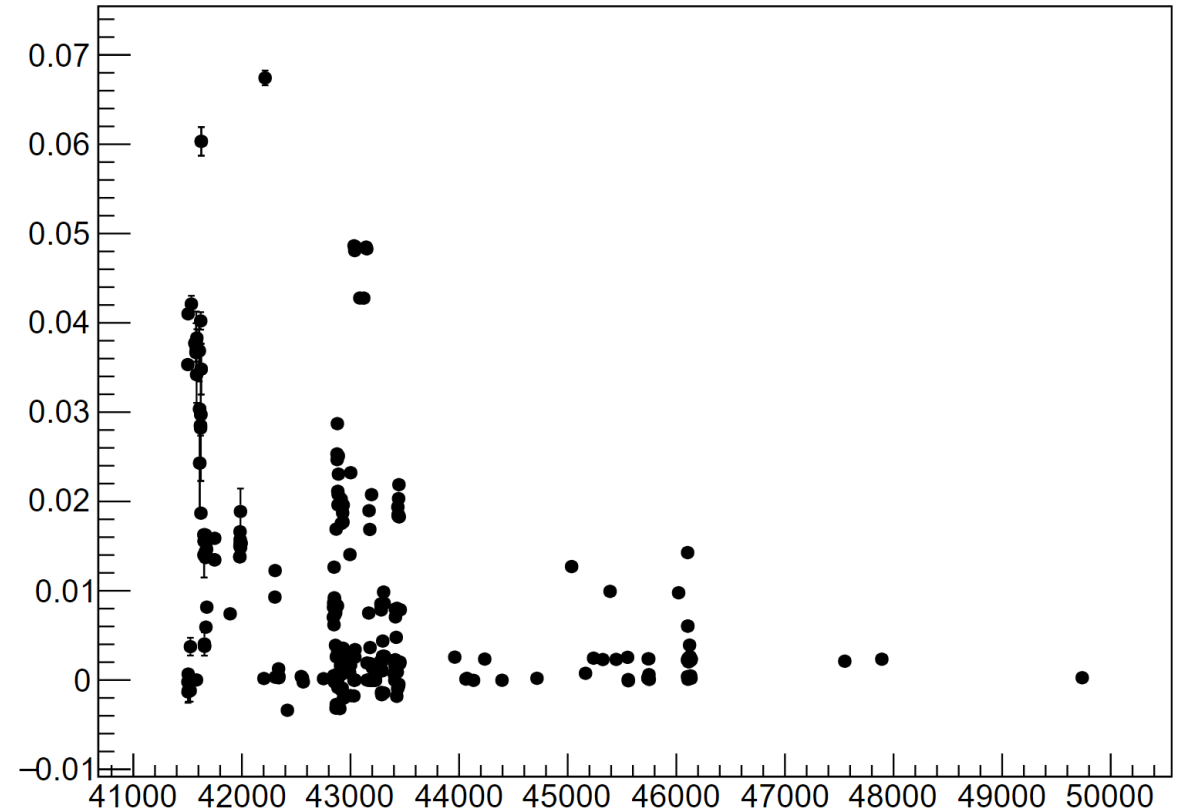
The baseline level of p+p is much higher than that of Au+Au, and I think that the p+p contains a large amount of background that is mistakenly judged as a mixup hit, resulting in a high hit fraction. I plan to calculate the hit fractions after subtracting the baseline in the mixup hit counts.

Run24 Mixup fraction intt0

Mixup event fraction for Felix = 0

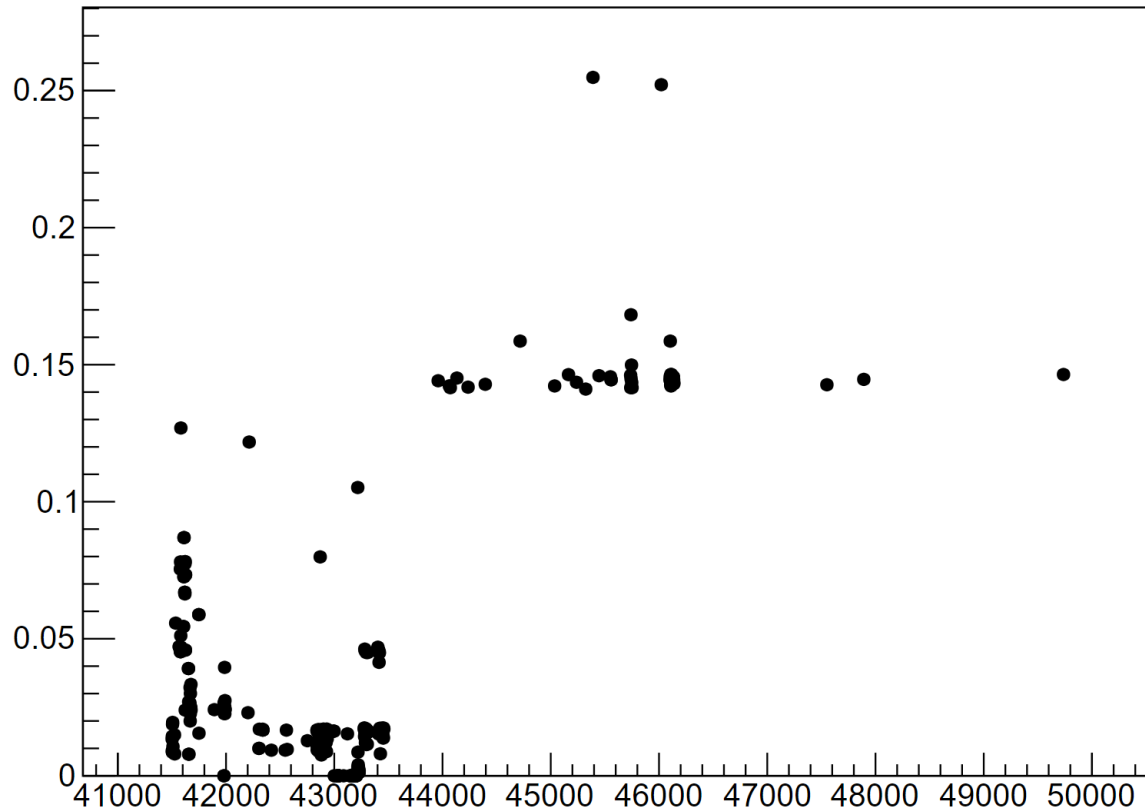


Mixup hit fraction for Felix = 0

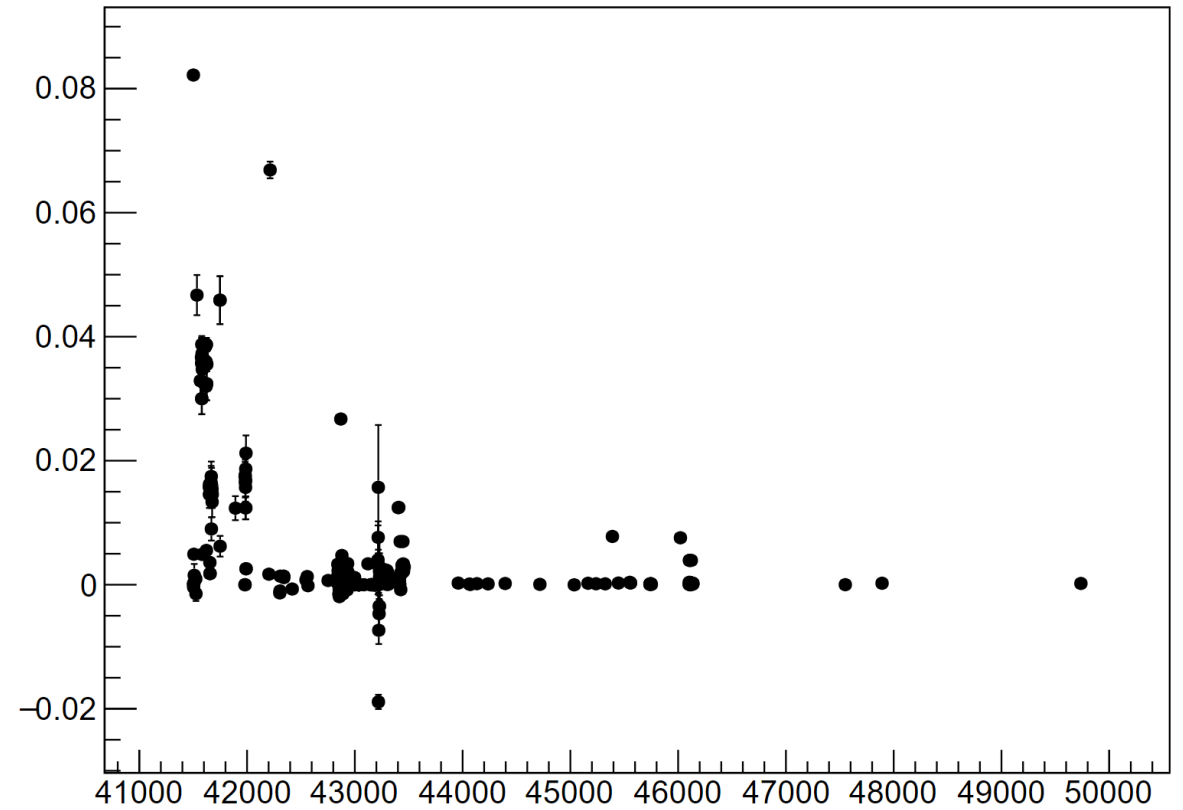


Run24 Mixup fraction intt1

Mixup event fraction for Felix = 1

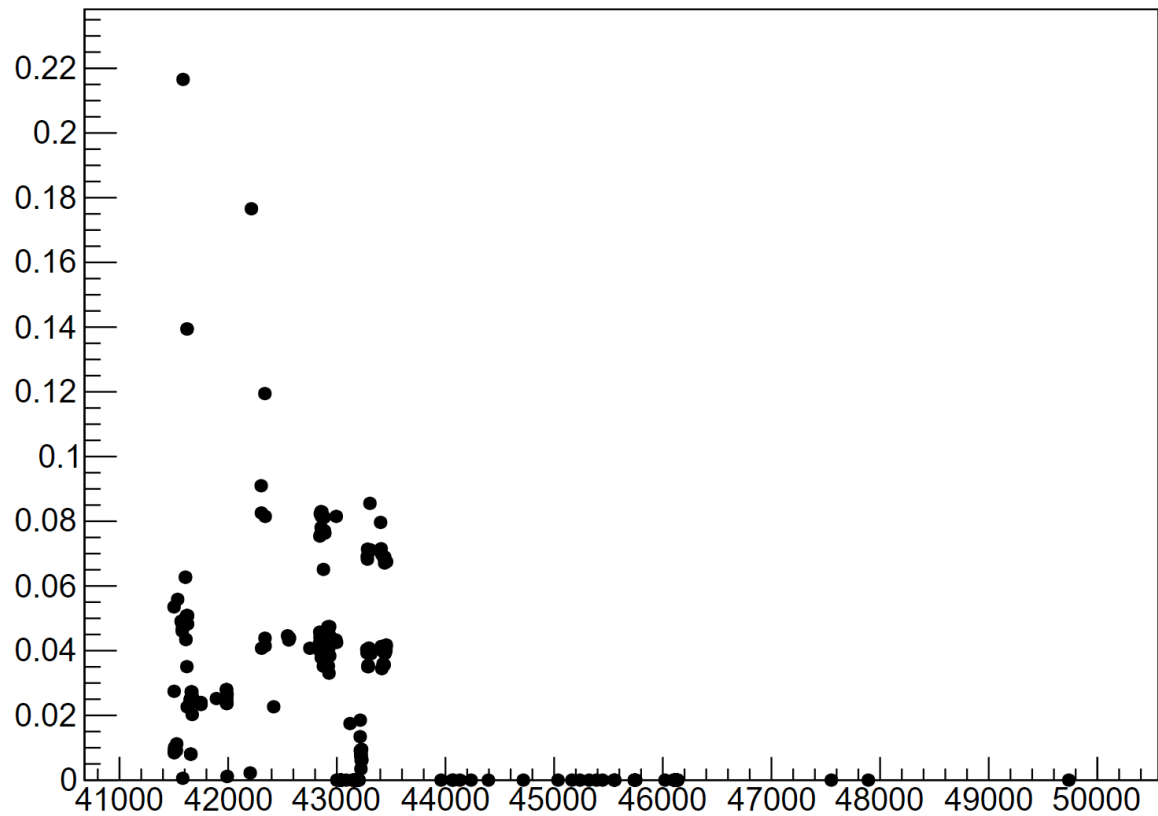


Mixup hit fraction for Felix = 1

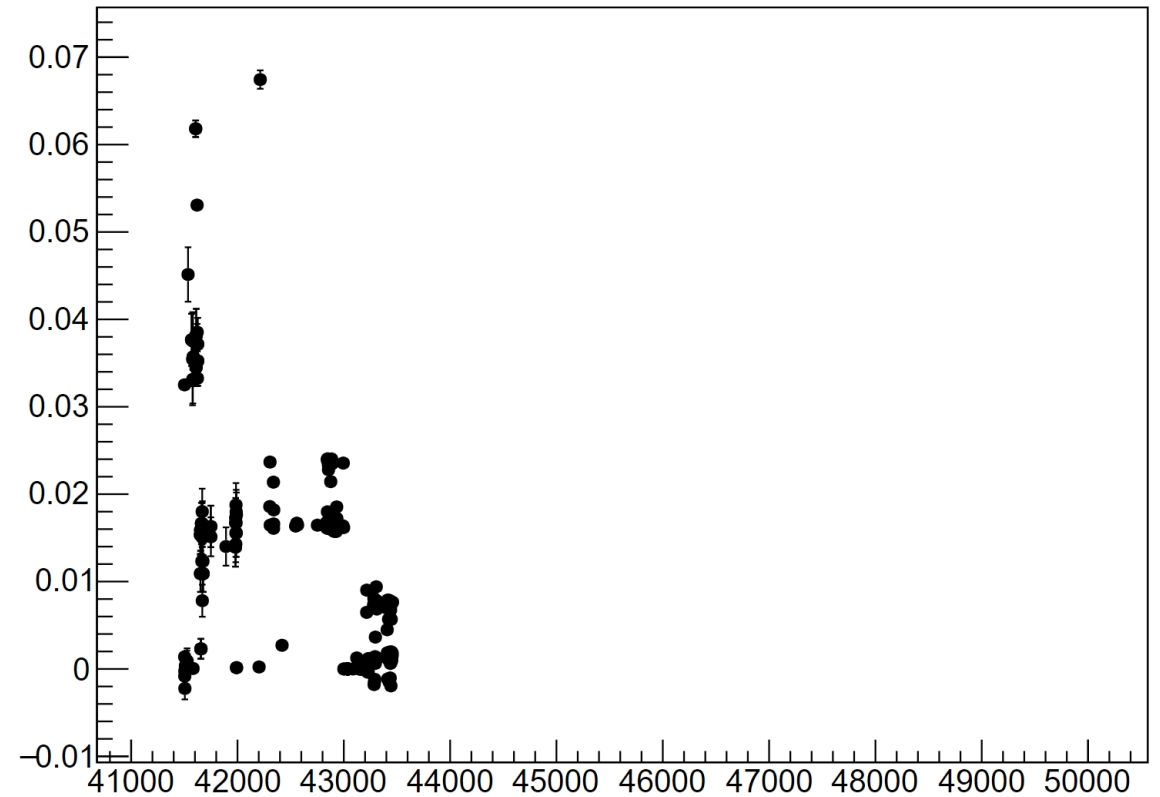


Run24 Mixup fraction intt2

Mixup event fraction for Felix = 2

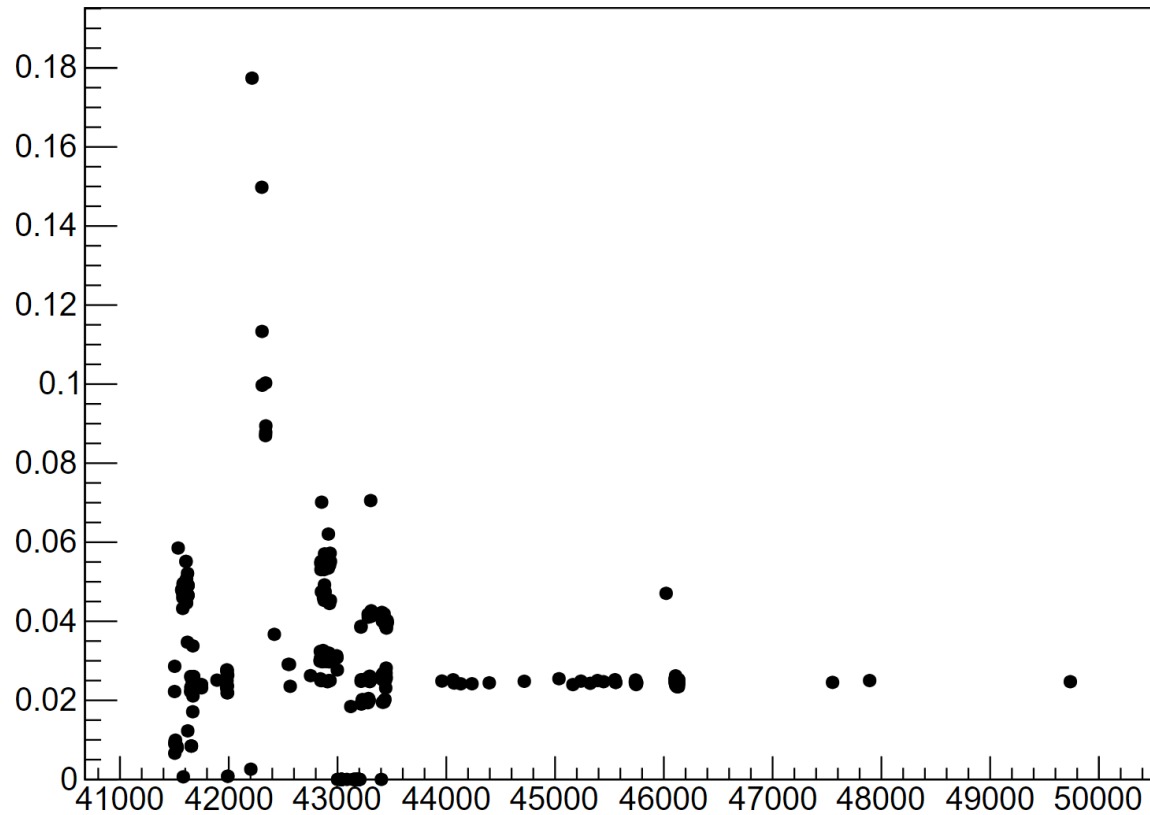


Mixup hit fraction for Felix = 2

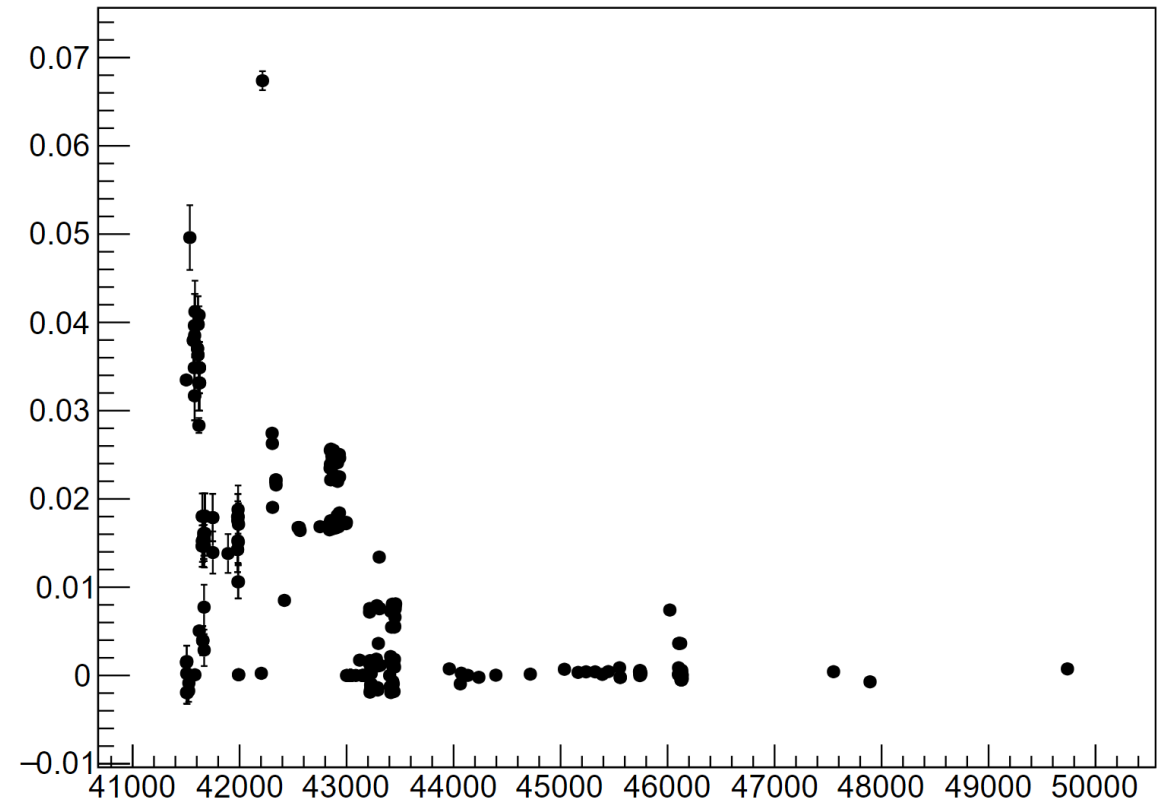


Run24 Mixup fraction intt3

Mixup event fraction for Felix = 3

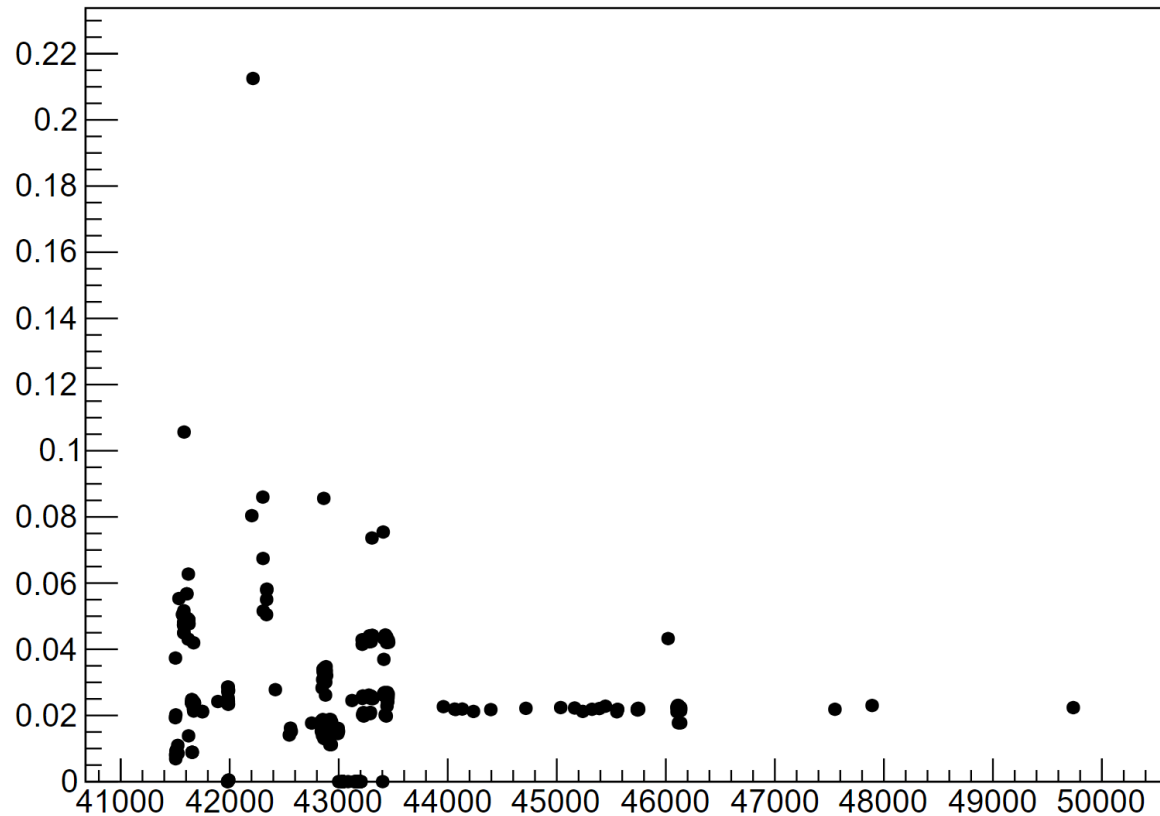


Mixup hit fraction for Felix = 3

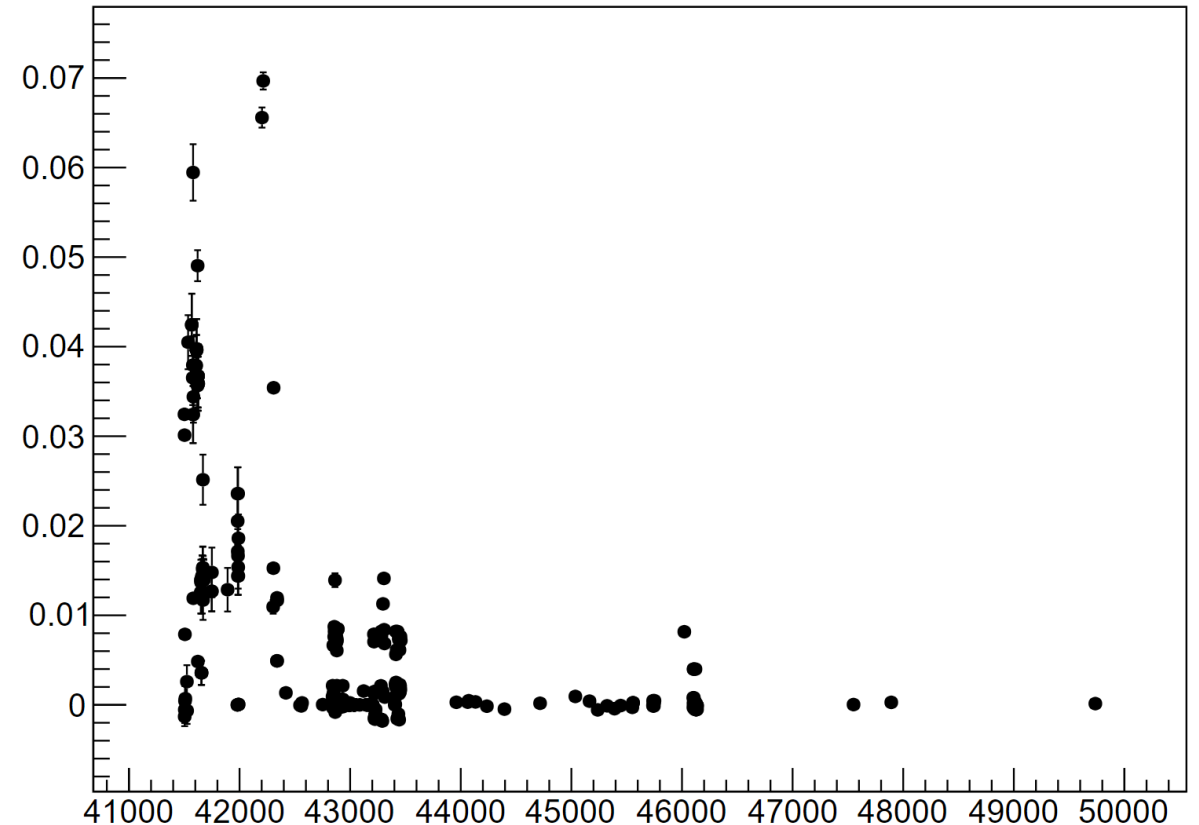


Run24 Mixup fraction intt4

Mixup event fraction for Felix = 4

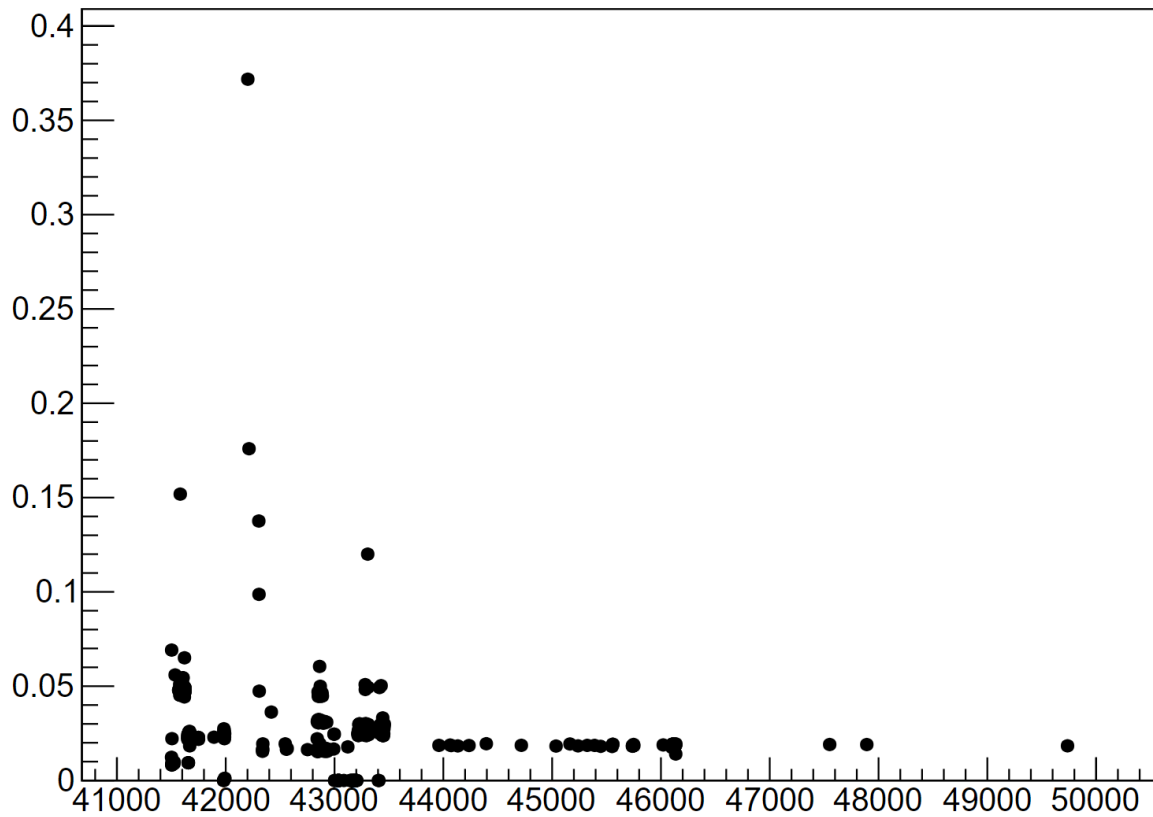


Mixup hit fraction for Felix = 4

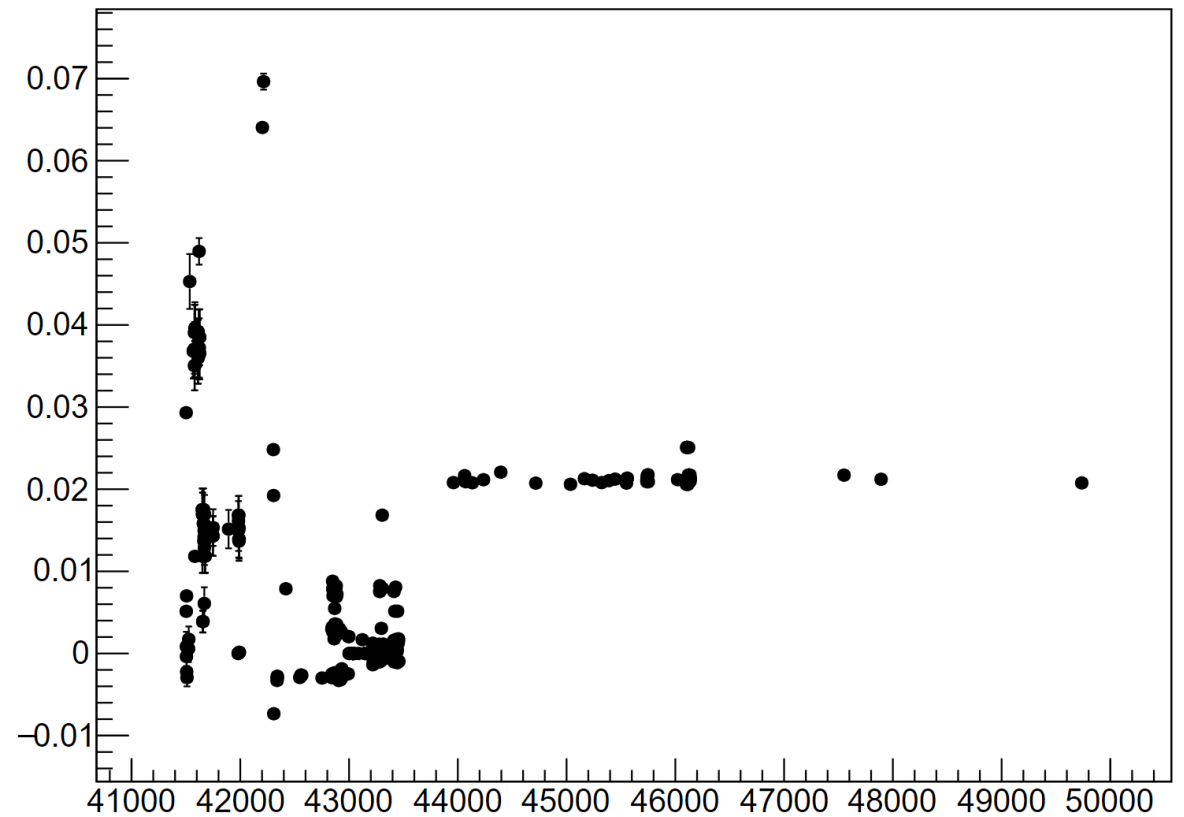


Run24 Mixup fraction intt5

Mixup event fraction for Felix = 5

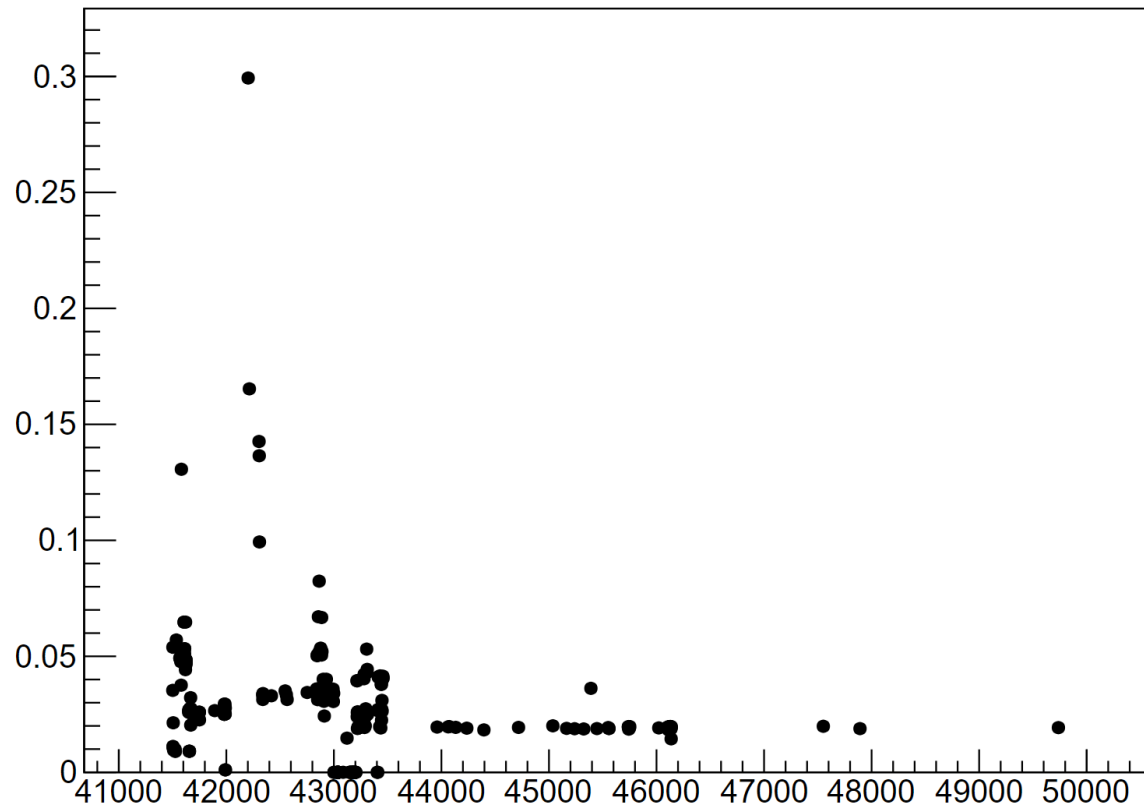


Mixup hit fraction for Felix = 5

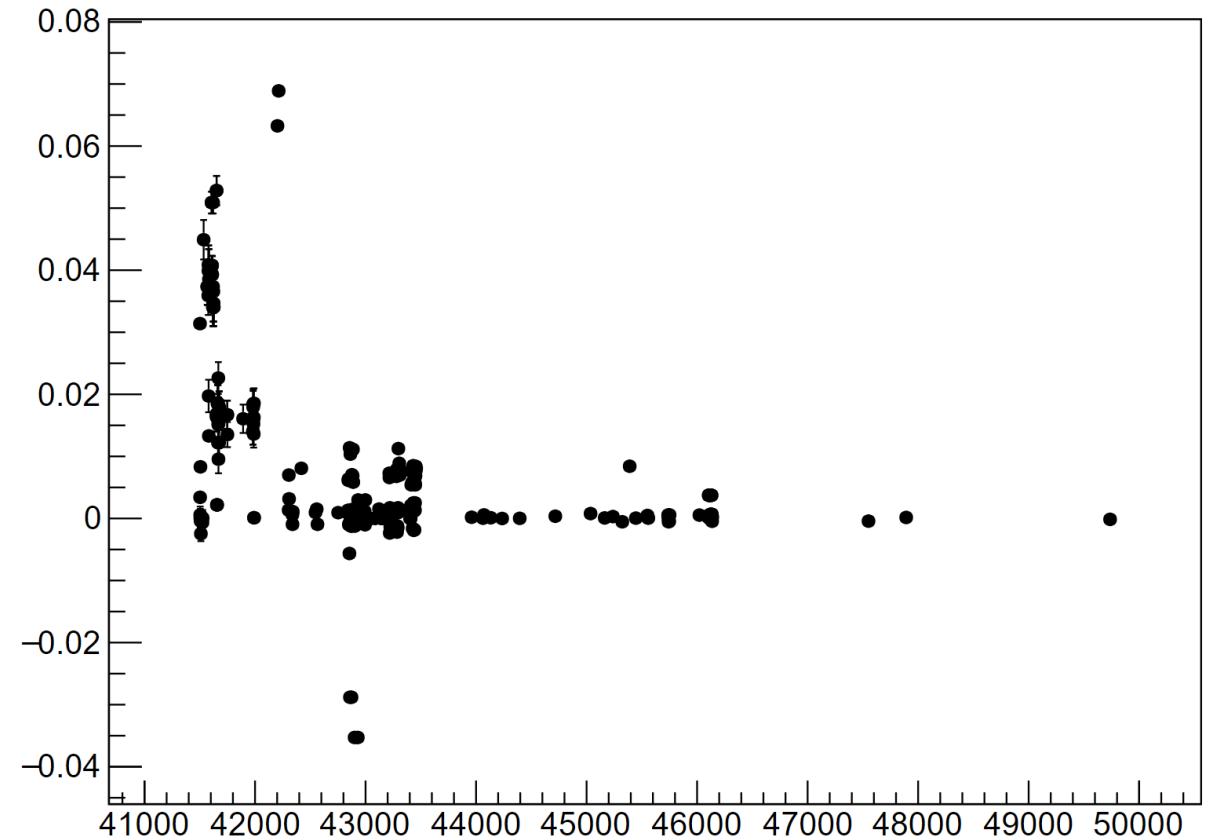


Run24 Mixup fraction intt6

Mixup event fraction for Felix = 6

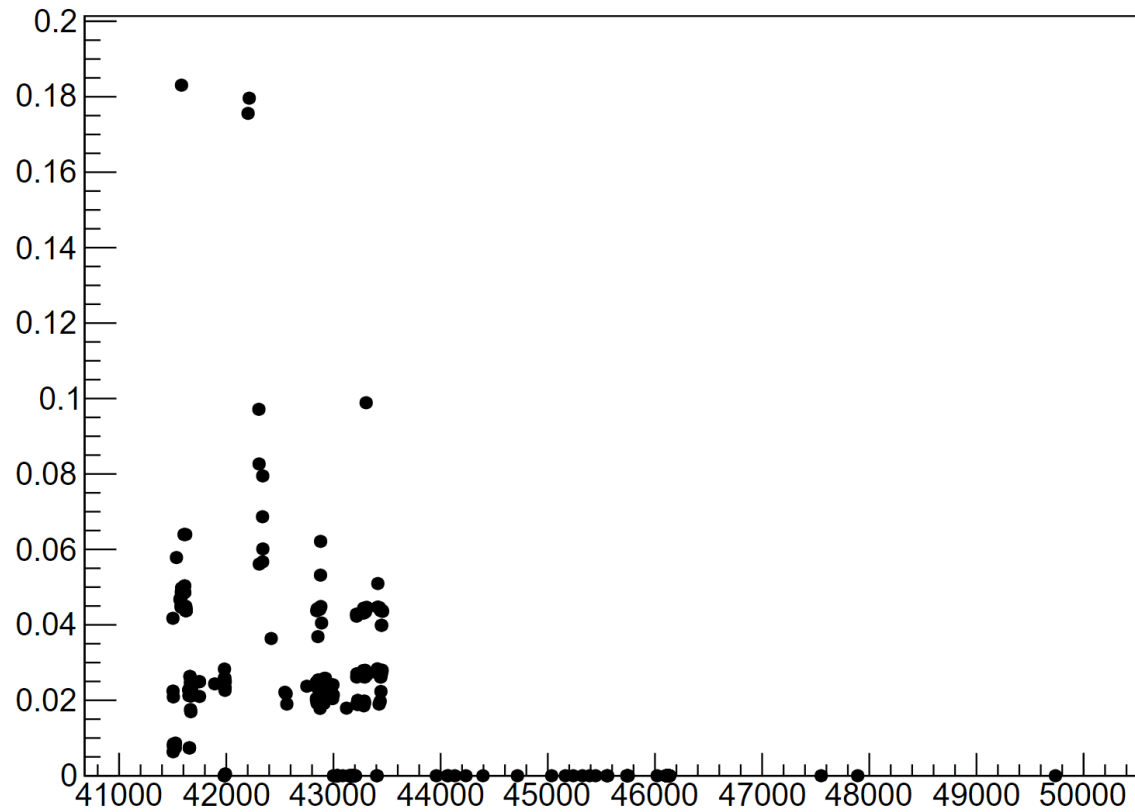


Mixup hit fraction for Felix = 6



Run24 Mixup fraction intt7

Mixup event fraction for Felix = 7



Mixup hit fraction for Felix = 7

