Digital Control test in 1008

08/10/2024 Takahiro Kikuchi

Overview

- Test to change digital control.
- Checked each chip’s hit rate and took the ratio run by run.
- Counting the number of clone hit chip by chip.

Overview

- I couldn’t figure out the difference of hit rate ratio caused by the changing of digital control.
- Now I doubt that sending digital control doesn’t work well.

- And chips which seem to be half entry still have clone hits.
- That’s so mysterious.

6 runs with different digital control status

- We took 2 sets of noise data with 3 types of digital control.

The function of digital control

- Digital control is a part of slow control with 4 bits.
- Bit 0 and 3 are changed in this test, since 1 and 2 have nothing to do with taking noise data.

Digital control : Bit 0

- Bit 0 is related with 2 output line from FPHX chip to ROC.
- Normally, it means set bit 0=1, FPHX chip sends data to ROC with 2 output line.

- When we set digital control bit 0=0, the way of sending data is changed.

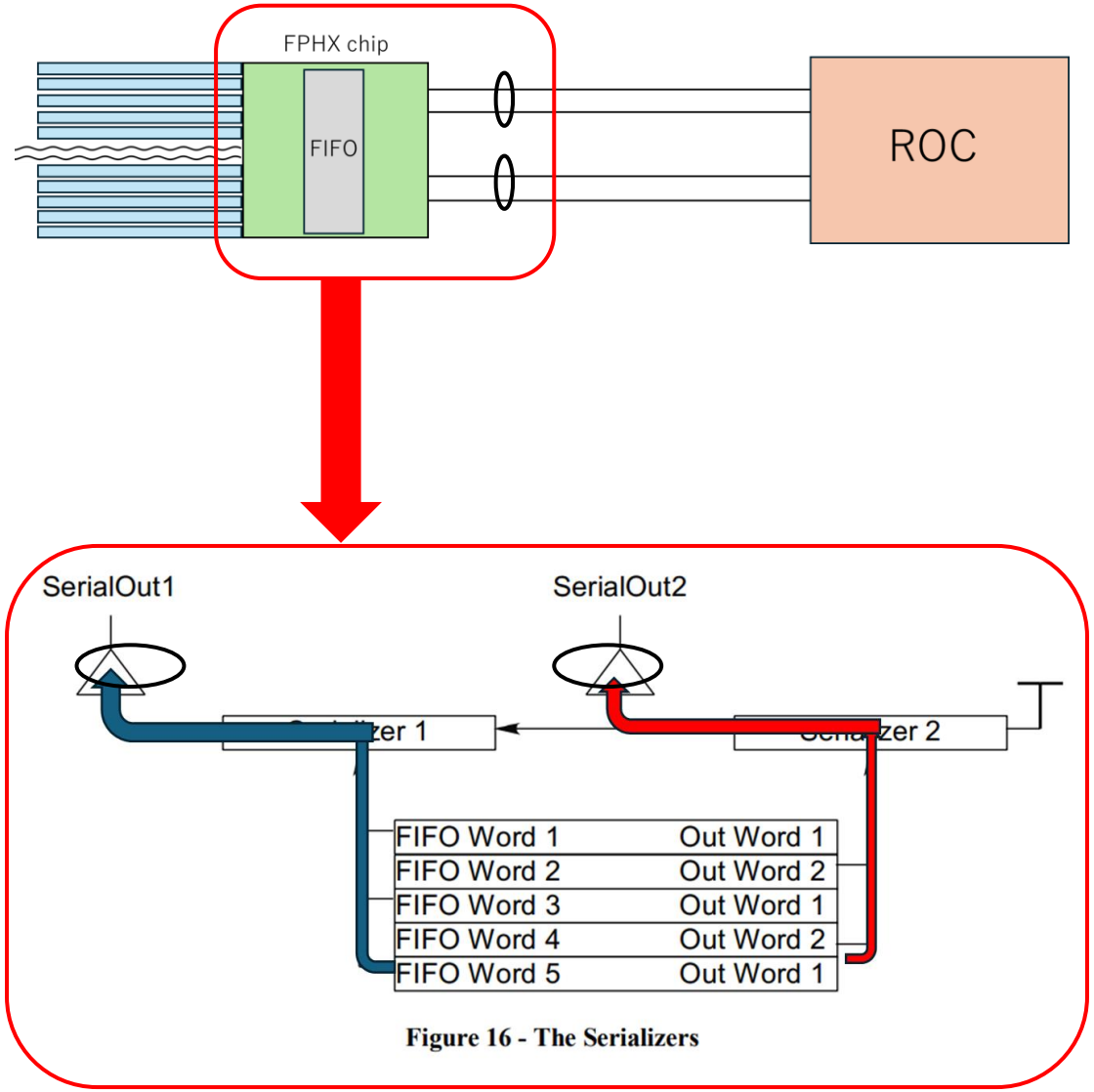


Figure 16 - The Serializers

Digital control : Bit 0

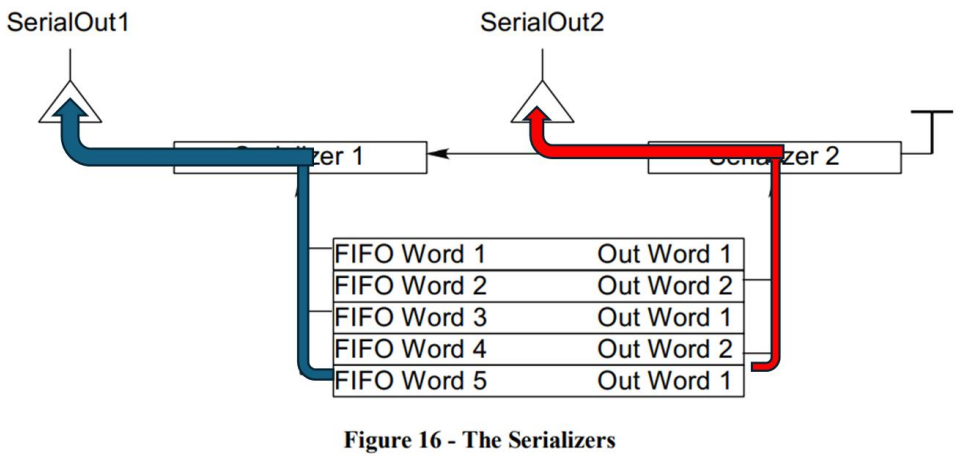


Figure 16 - The Serializers

- The flow of data is changed like that.
- One of two data is sent to both of output line.
- So, the half of signals are duplicated.

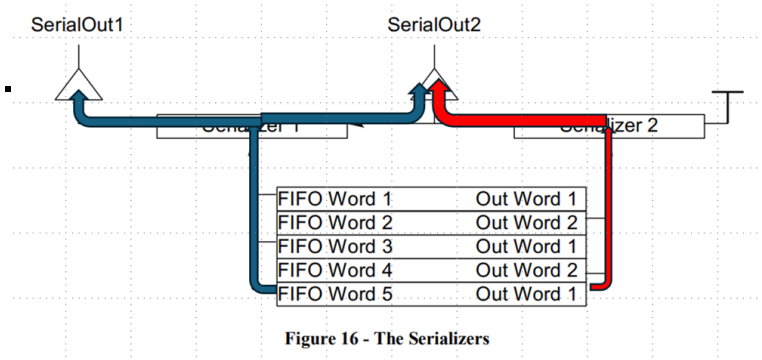


Figure 16 - The Serializers

Or

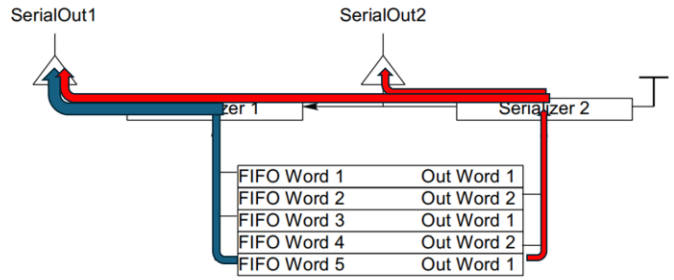
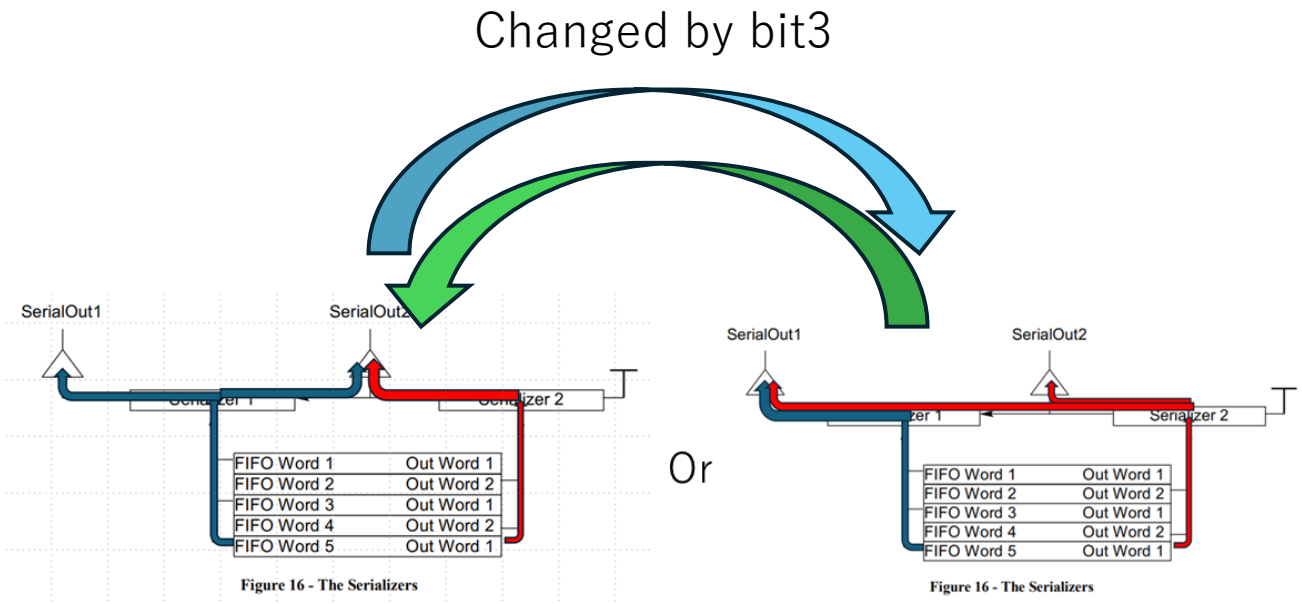


Figure 16 - The Serializers

Digital control : Bit 3

- Bit 3 is related to bit0=0.
- When bit0=0, one of two data is sent to both of output line.
- Then, bit3 can change which data to send other output line.

- But at present, we don't know which line is correspond to bit3=0 and bit3=1.



Half entry and digital control

- Half entry seems to be caused by the disconnection of one output line.
- If we set digital control bit0=0, one line starts to send both of two output lines data.
- It will recover the half entry chip.

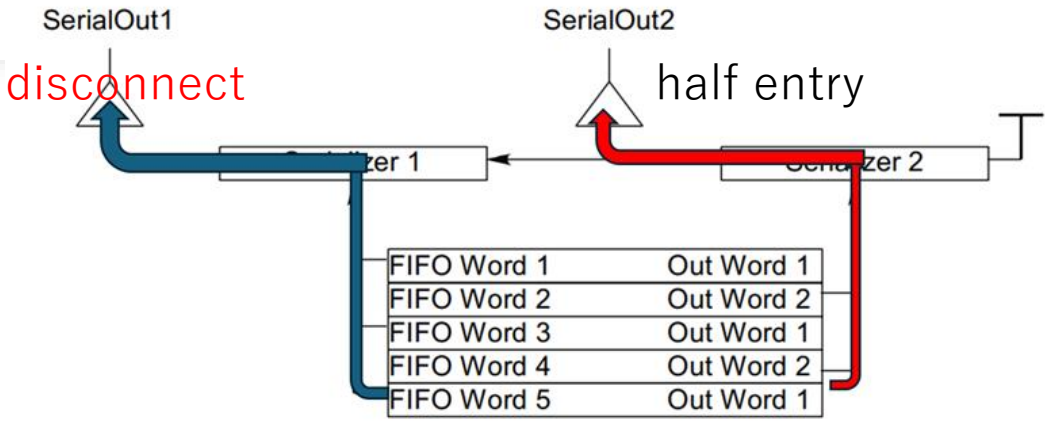


Figure 16 - The Serializers

Changing digital control

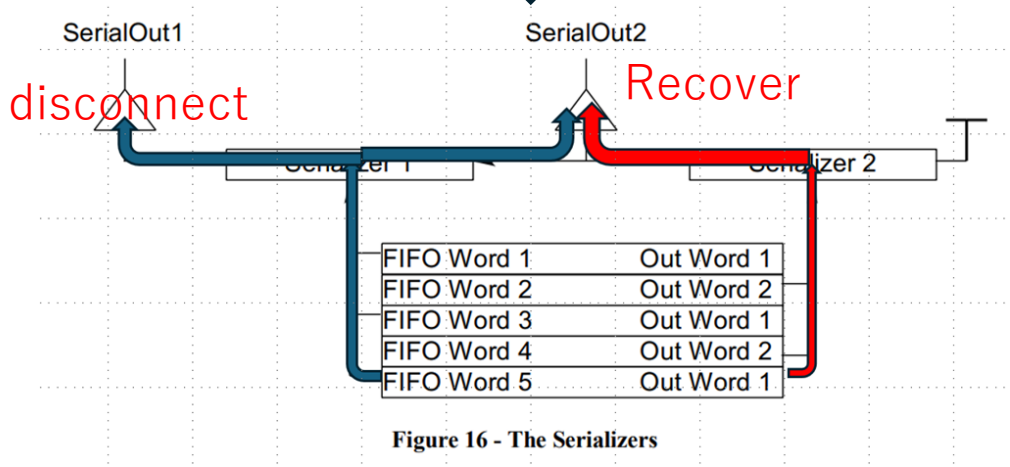


Figure 16 - The Serializers

The purpose of this test

- To recover half entry chip, we should know which bit0 and bit3 pair will work for each chip.
- Then, took noise data with 3 types of bit0 and bit3 pair.
- (bit3, bit2, bit1, bit0)=(0, 0, 0, 0), (0, 0, 0, 1), (1, 0, 0, 0)

- After this slide, I express (0, 0, 0, 0) as digcon=0, (0, 0, 0, 1) as digcon=1, (1, 0, 0, 0) as digcon=8.

What to check with each run

- Calculating hit rate chip by chip.
- Then, taking a ratio of them.

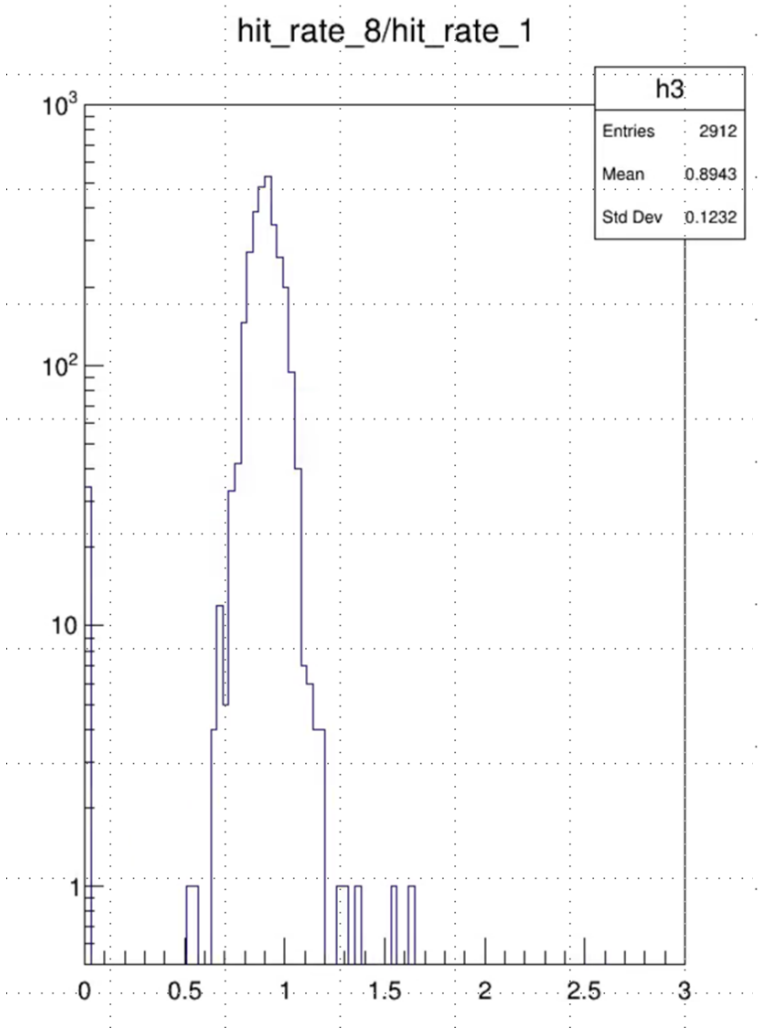
→ $\frac{\text{hitrate(digcon=0)}}{\text{hitrate(digcon=1)}}$, $\frac{\text{hitrate(digcon=8)}}{\text{hitrate(digcon=1)}}$

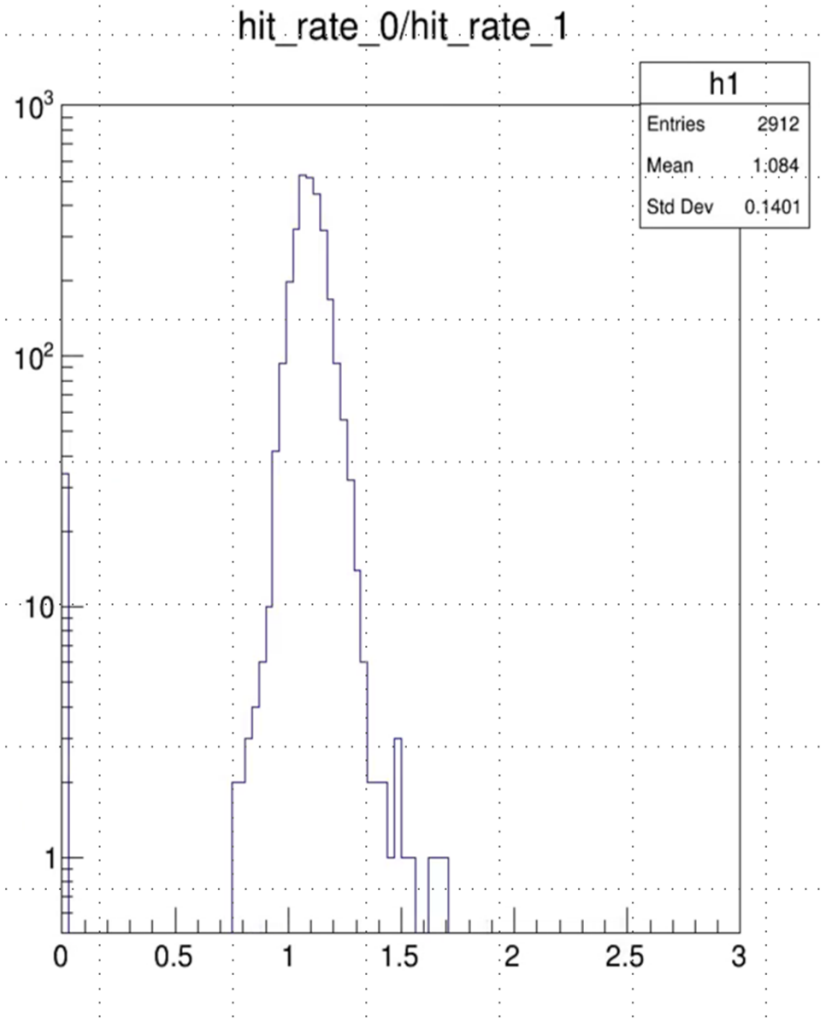
- And also, counting clone hit chip by chip.

Hit rate ratio

- Hitrate(digcon=0, 8) divided by hitrate(digcon=1) will have peaks depends on chip's status.
- If the chip is normal, changing digcon=1 to =0, 8 will increase hit ratio to $\frac{\text{hitrate(digcon=0, 8)}}{\text{hitrate(digcon=1)}} = 1.5$, since it duplicate one of two output line.
- If the chip is half entry, the ratio will be $\frac{\text{hitrate(digcon=0 or 8)}}{\text{hitrate(digcon=1)}}$=1.0 or 2.0
- We don't know which 0 or 8 recover half entry.

Results



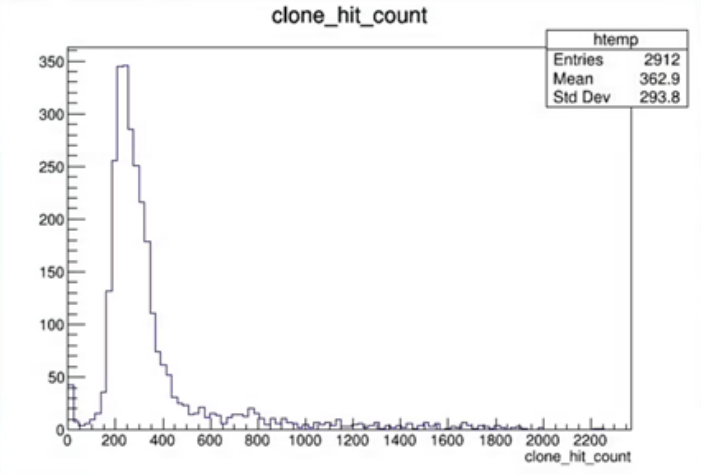


- These are the histogram : x axis is the hit rate ratio and y axis is the number of chips.
- We can see that these don't have a peak at 1.5.
- Having a peak at 1.0 means almost every chips are half entry, that's untrue.

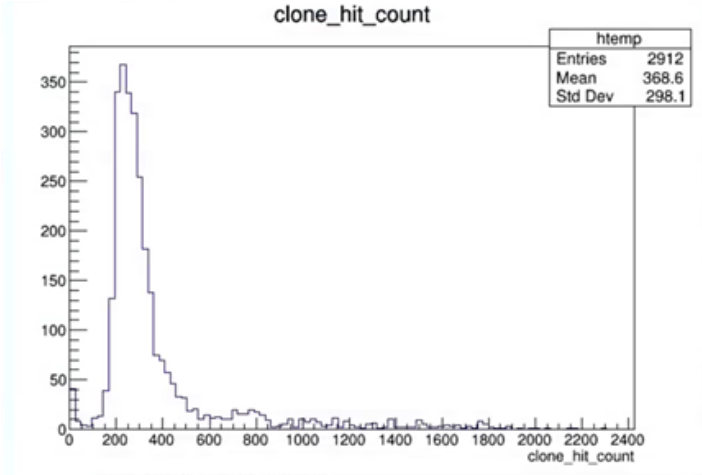
Counting clone hit

- According to our hypothesis, changing digital control will increase clone hits on normal (not half entry) chip.
- All chips, except for masked chips, have almost same amount of clone hits.

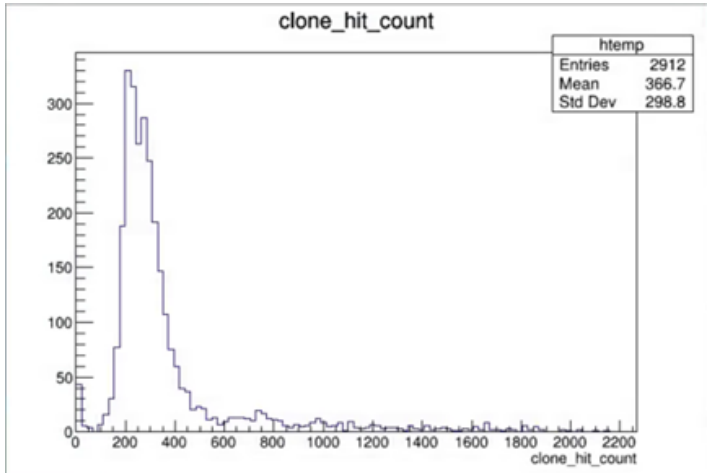
- It’s so mysterious why chips which seems to be half entry still contain clone hits.



Digcon=1



Digcon=0



Digcon=8

Results

- The measurement time is almost same, so the count is also the rate of clone hit.
- We cannot see any increasing of clone hit.

Results

- I also calculated the clone hit ratio $\frac{\textbf{total clone hit}}{\textbf{total hit}}$, but there're also no difference.

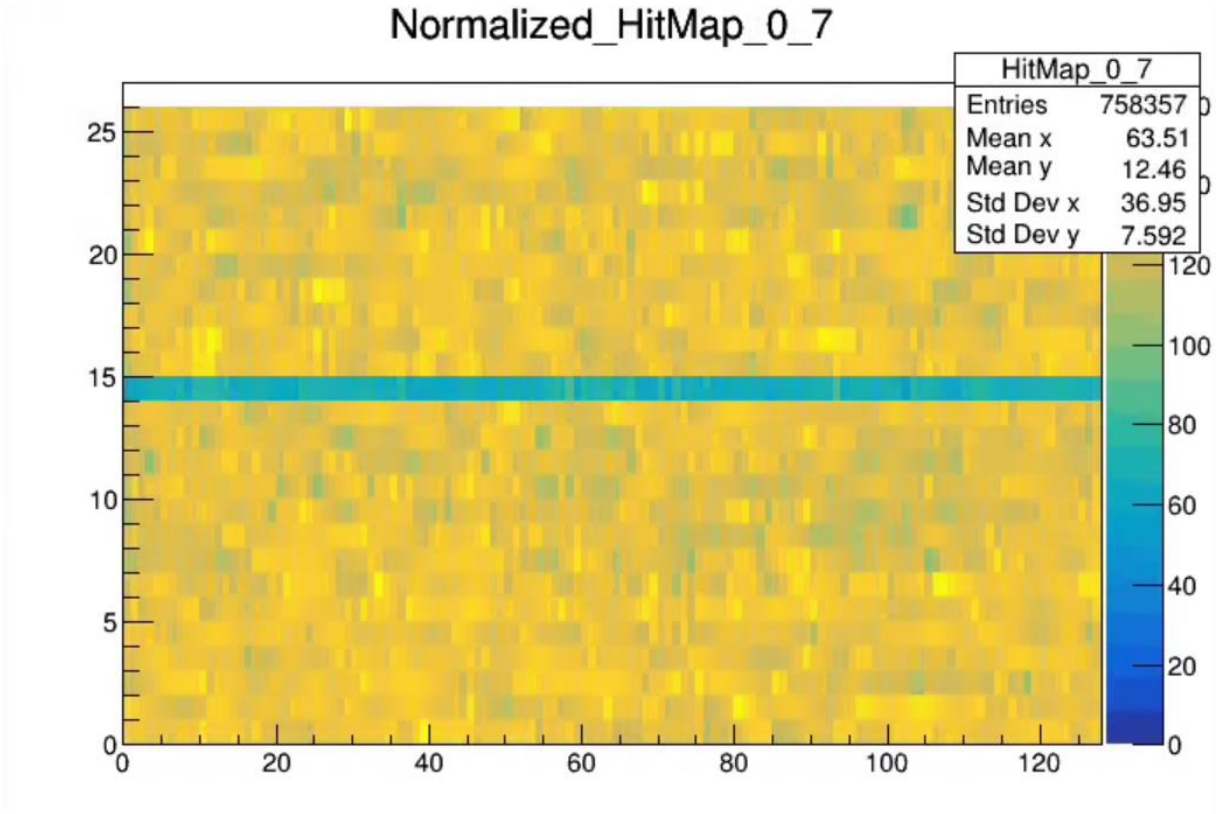
Conclusion

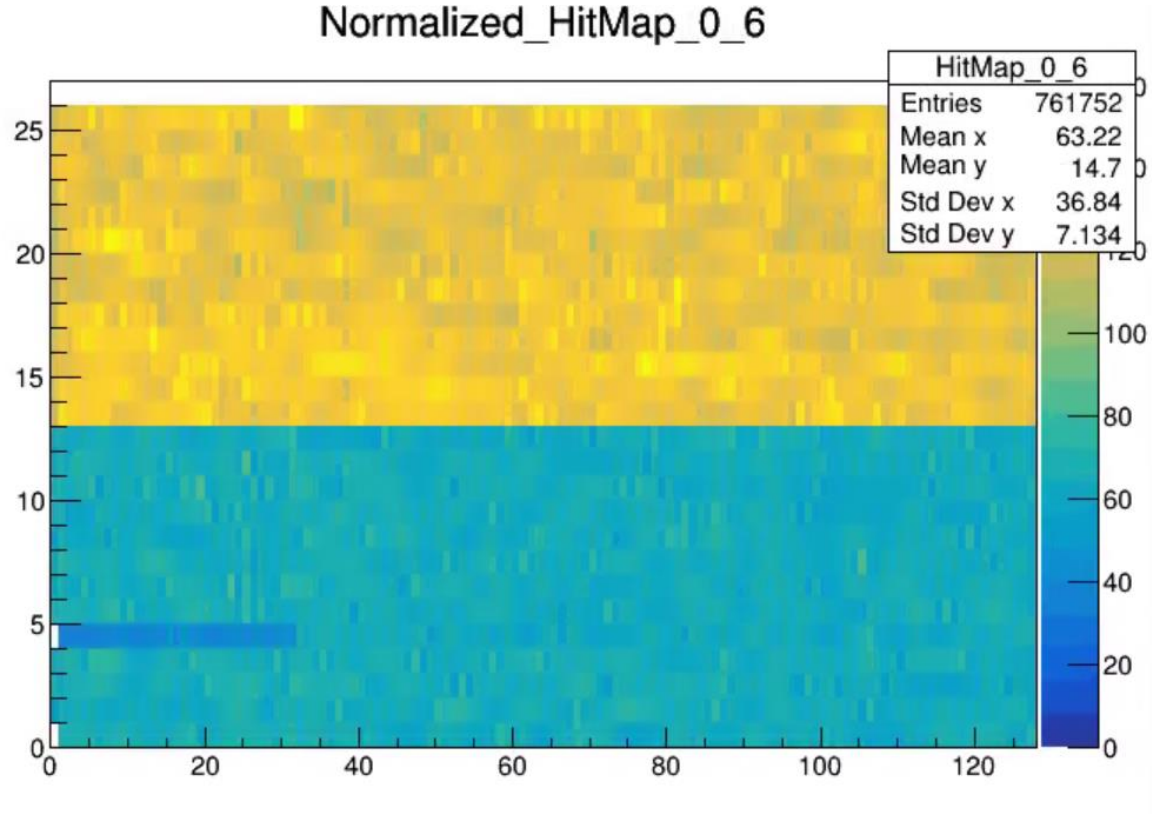
- We took noise data with changing digital control, but I hardly see the difference in both hit rate and clone hit count.
- Furthermore, chips which seems to be half entry also contain clone hit.

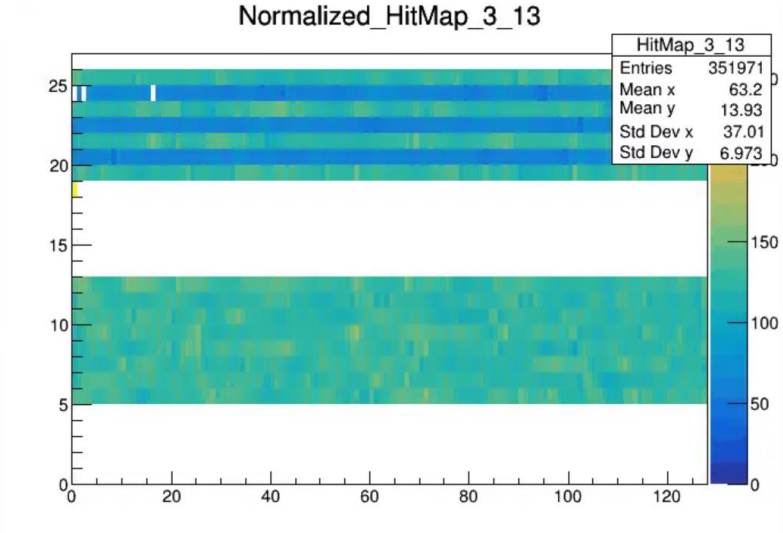
- My questions are

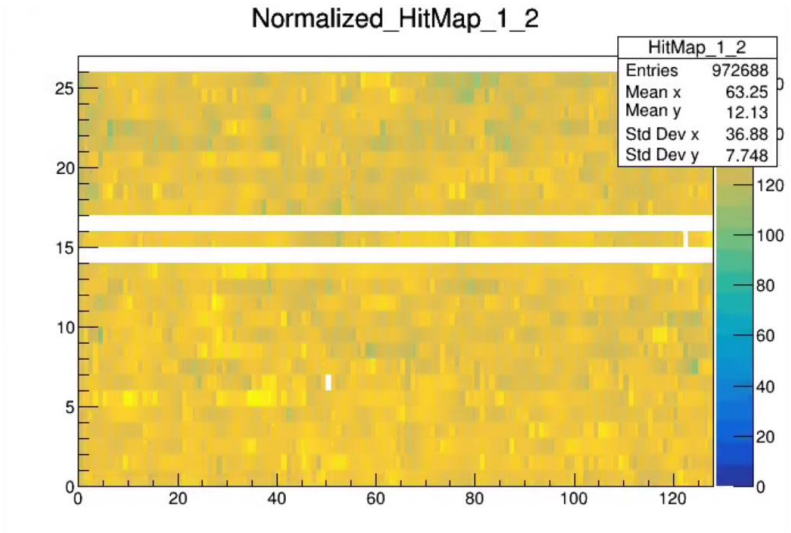
Does digital control really work?

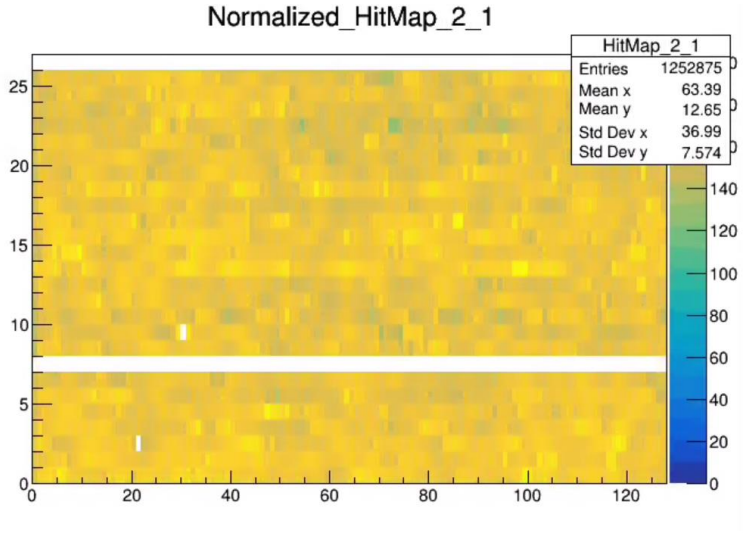
Are they half entry chips same as tested in RIKEN testbench (It means they’re just poor efficiency chips, not half output line dead)?

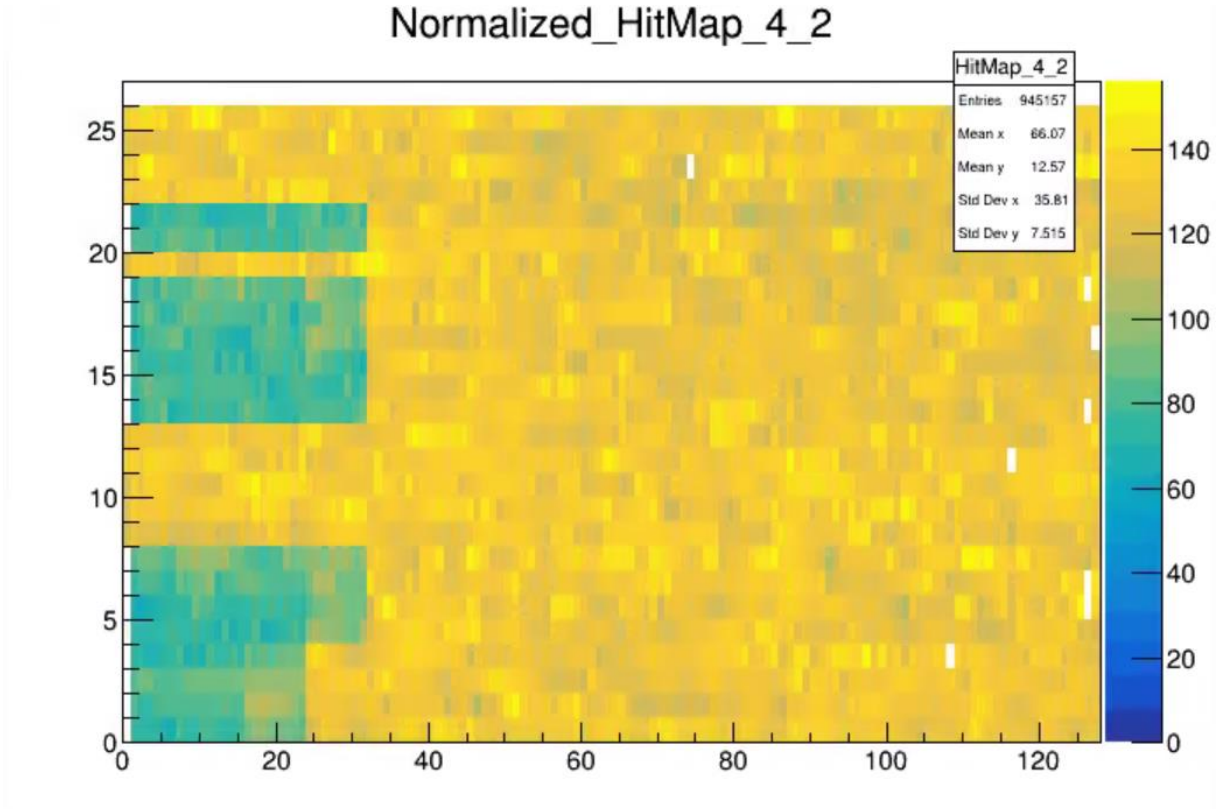

Normalized_HitMap_0_7
HitMap_0_7
Entries 758357
Mean x 63.51
Mean y 12.46
Std Dev x 36.95
Std Dev y 7.592
0 5 10 15 20 25
0 20 40 60 80 100 120
0 20 40 60 80 100 120

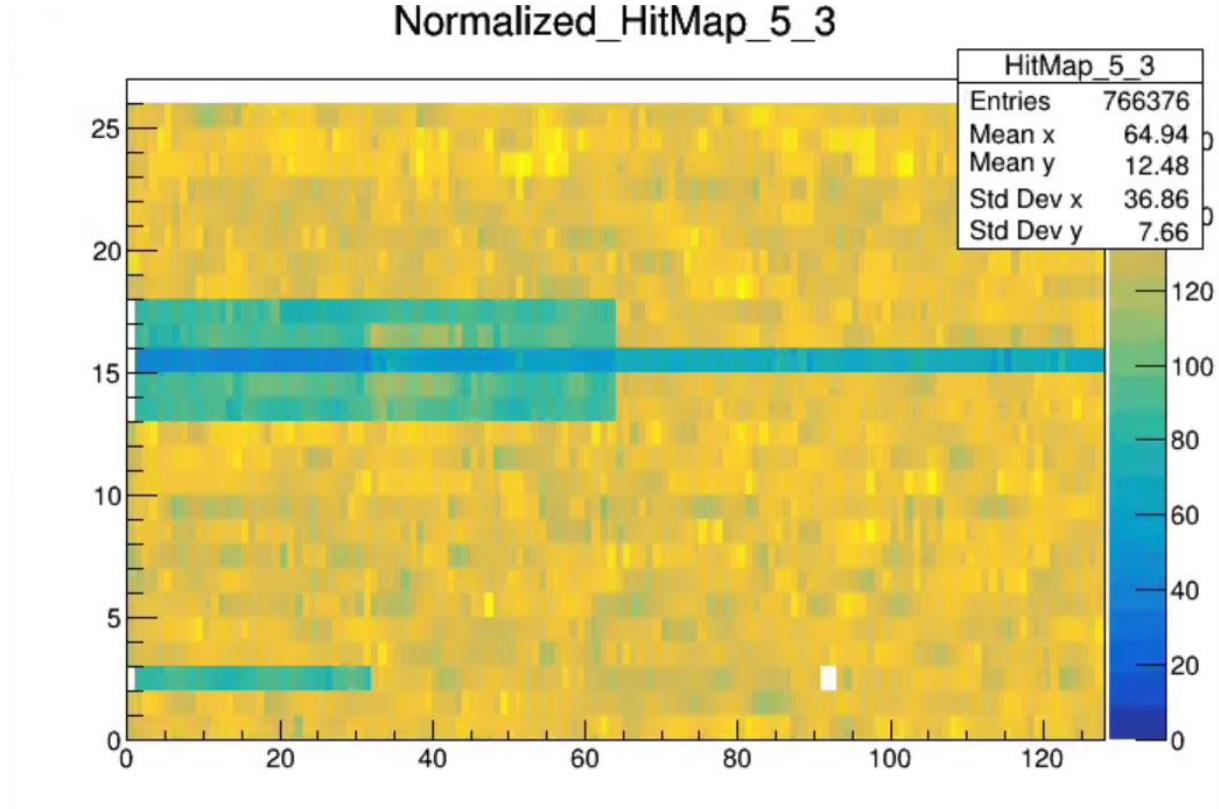

Normalized_HitMap_0_6
HitMap_0_6
Entries 761752
Mean x 63.22
Mean y 14.7
Std Dev x 36.84
Std Dev y 7.134
0 5 10 15 20 25
0 20 40 60 80 100 120
0 20 40 60 80 100 120

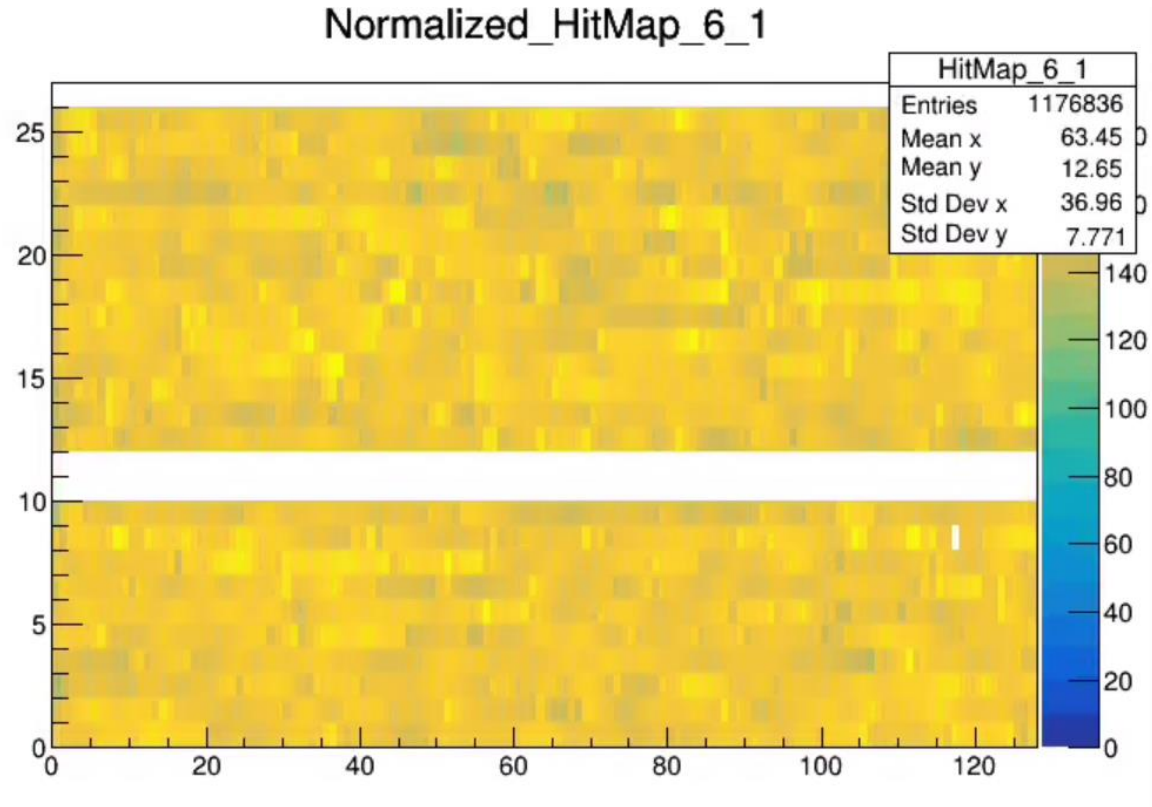

Normalized_HitMap_3_13
HitMap_3_13
Entries 351971
Mean x 63.2
Mean y 13.93
Std Dev x 37.01
Std Dev y 6.973

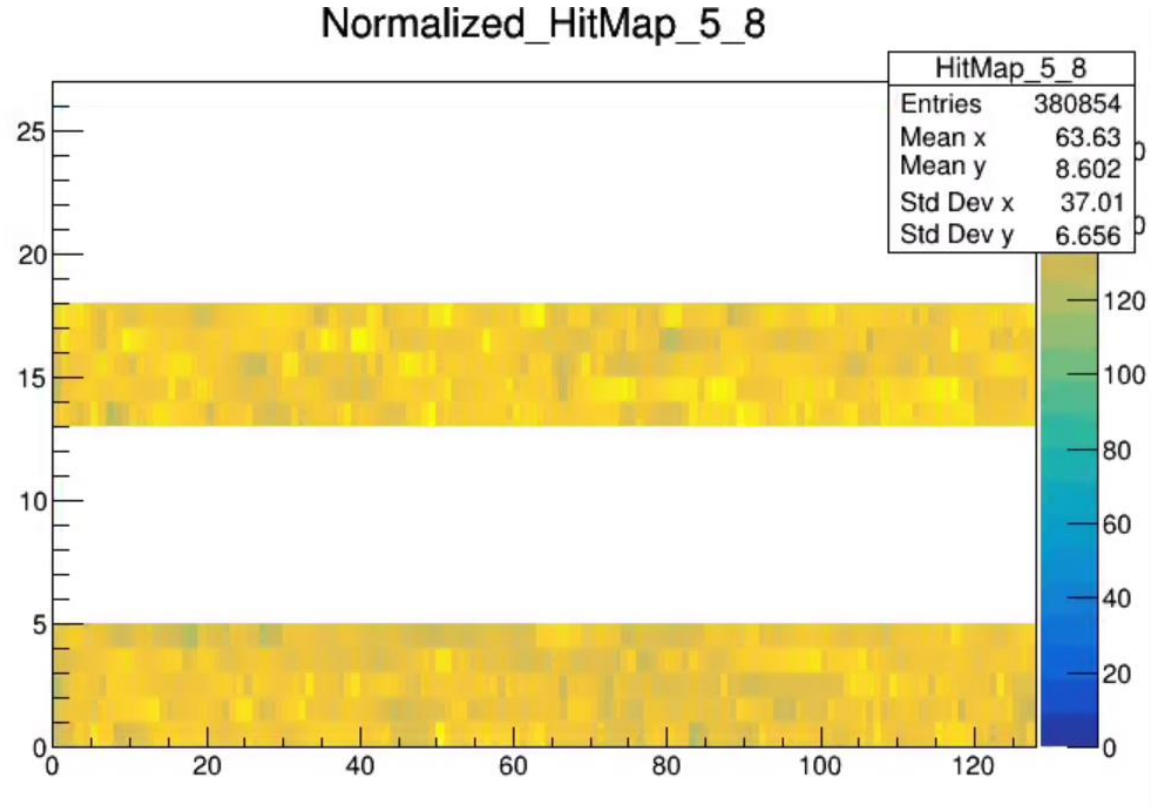

Normalized_HitMap_1_2
HitMap_1_2
Entries 972688
Mean x 63.25
Mean y 12.13
Std Dev x 36.88
Std Dev y 7.748

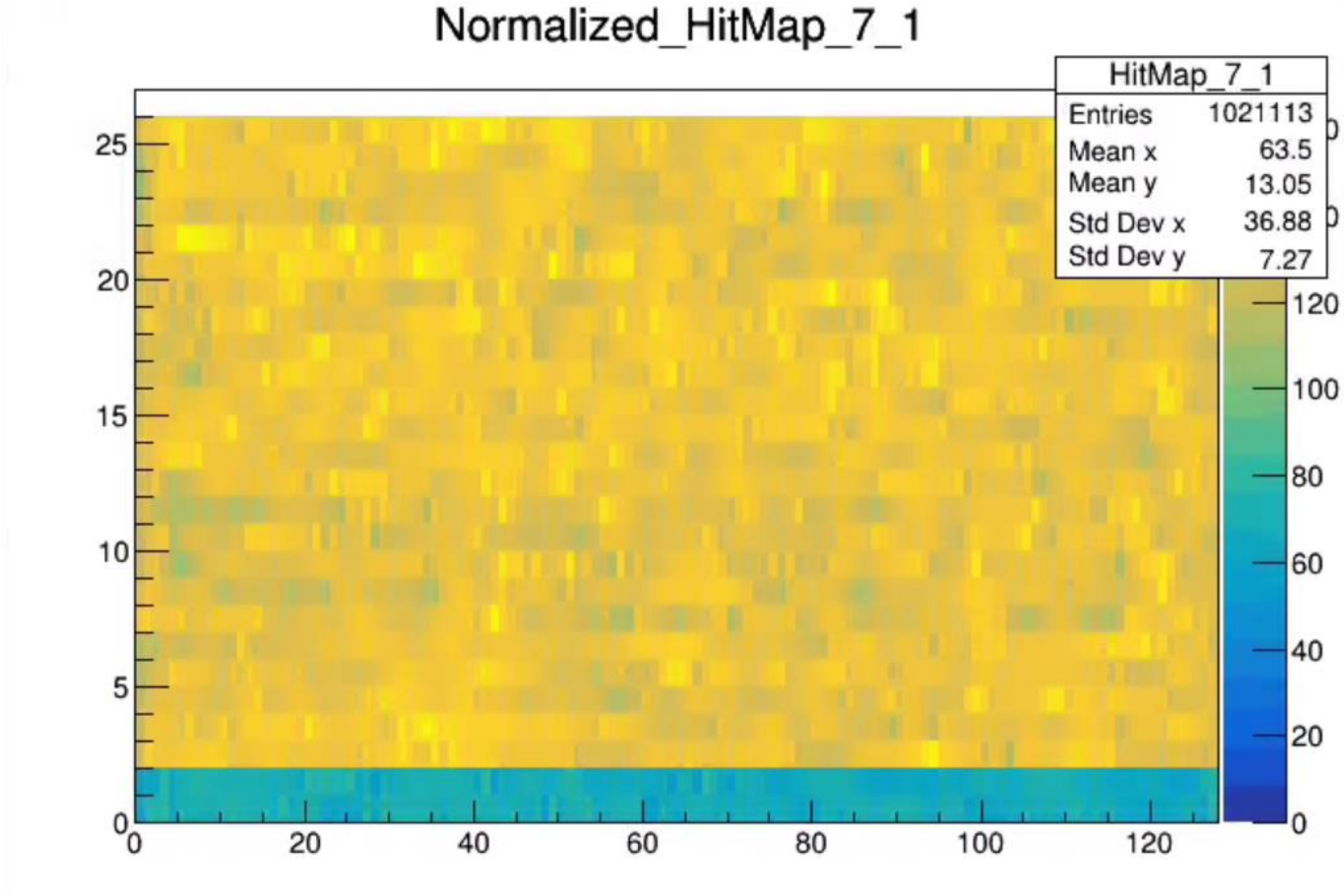

Normalized_HitMap_2_1
HitMap_2_1
Entries 1252875
Mean x 63.39
Mean y 12.65
Std Dev x 36.99
Std Dev y 7.574


Normalized_HitMap_4_2
HitMap_4_2
Entries 945157
Mean x 66.07
Mean y 12.57
Std Dev x 35.81
Std Dev y 7.515
0
5
10
15
20
25
0
20
40
60
80
100
120
0
20
40
60
80
100
120
140


Normalized_HitMap_5_3
HitMap_5_3
Entries 766376
Mean x 64.94
Mean y 12.48
Std Dev x 36.86
Std Dev y 7.66
0
5
10
15
20
25
0
20
40
60
80
100
120
0
20
40
60
80
100
120


Normalized_HitMap_6_1
HitMap_6_1
Entries 1176836
Mean x 63.45
Mean y 12.65
Std Dev x 36.96
Std Dev y 7.771
0 5 10 15 20 25
0 20 40 60 80 100 120
0 20 40 60 80 100 120 140


Normalized_HitMap_5_8
HitMap_5_8
Entries 380854
Mean x 63.63
Mean y 8.602
Std Dev x 37.01
Std Dev y 6.656
0 5 10 15 20 25
0 20 40 60 80 100 120
0 20 40 60 80 100 120


Normalized_HitMap_7_1
HitMap_7_1
Entries 1021113
Mean x 63.5
Mean y 13.05
Std Dev x 36.88
Std Dev y 7.27
0
5
10
15
20
25
0
20
40
60
80
100
120
0
20
40
60
80
100
120