Data analysis for the detection efficiency

G. Nukazuka (RBRC)

Plan to get the efficiency

Experiment data

- ✔ Data correction
- ✔ Clone hits removal

reported on [Jan/27/2022]

MC data

- (✔) Data generation
- (✔) Data format conversion

Hits grouping with BCO

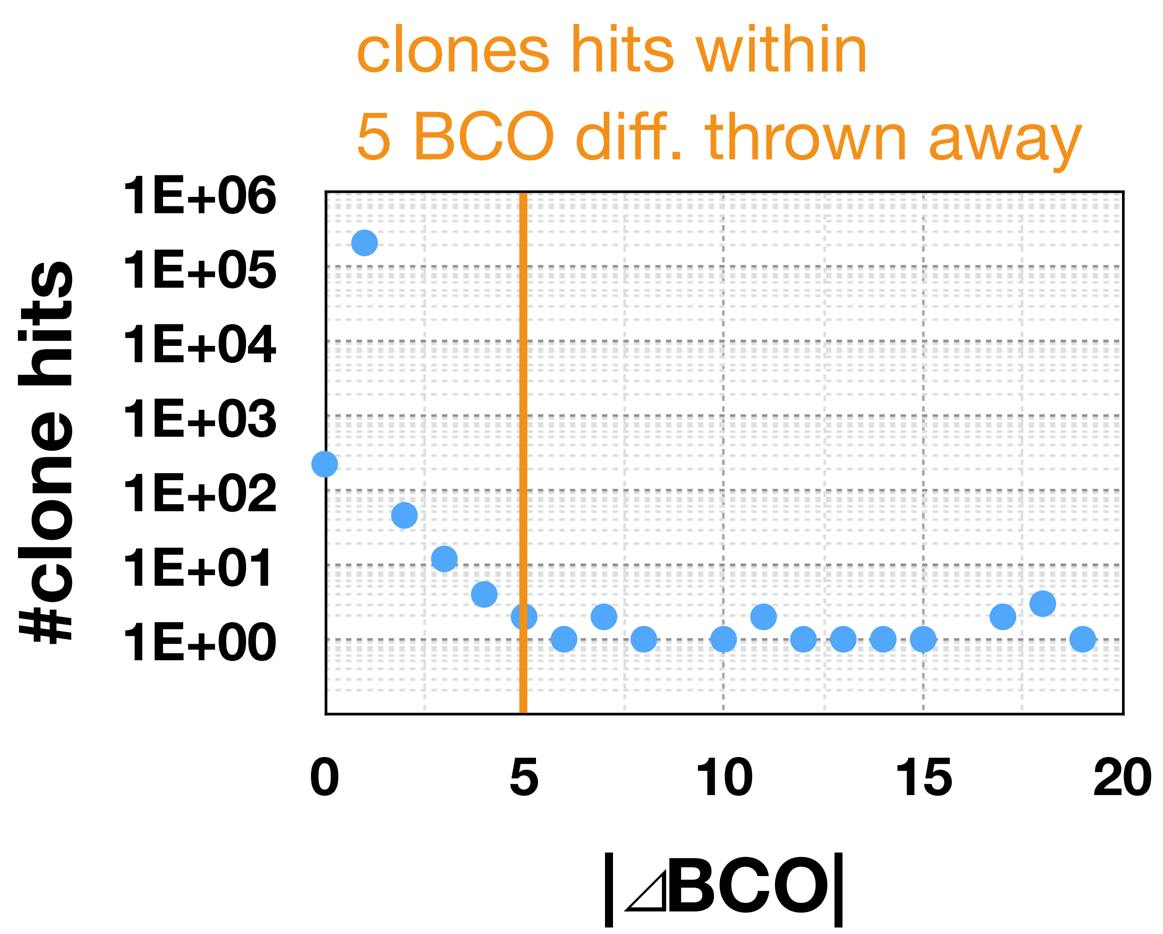
Hits clustering → Check

Tracking → Check

some iterations

Ladder alignment → Check

Efficiency calc. → Check



Eff. can be as a function of：

- run
- module
- chip
- ch
- BCO phase
- #BCO group
- RD or MC

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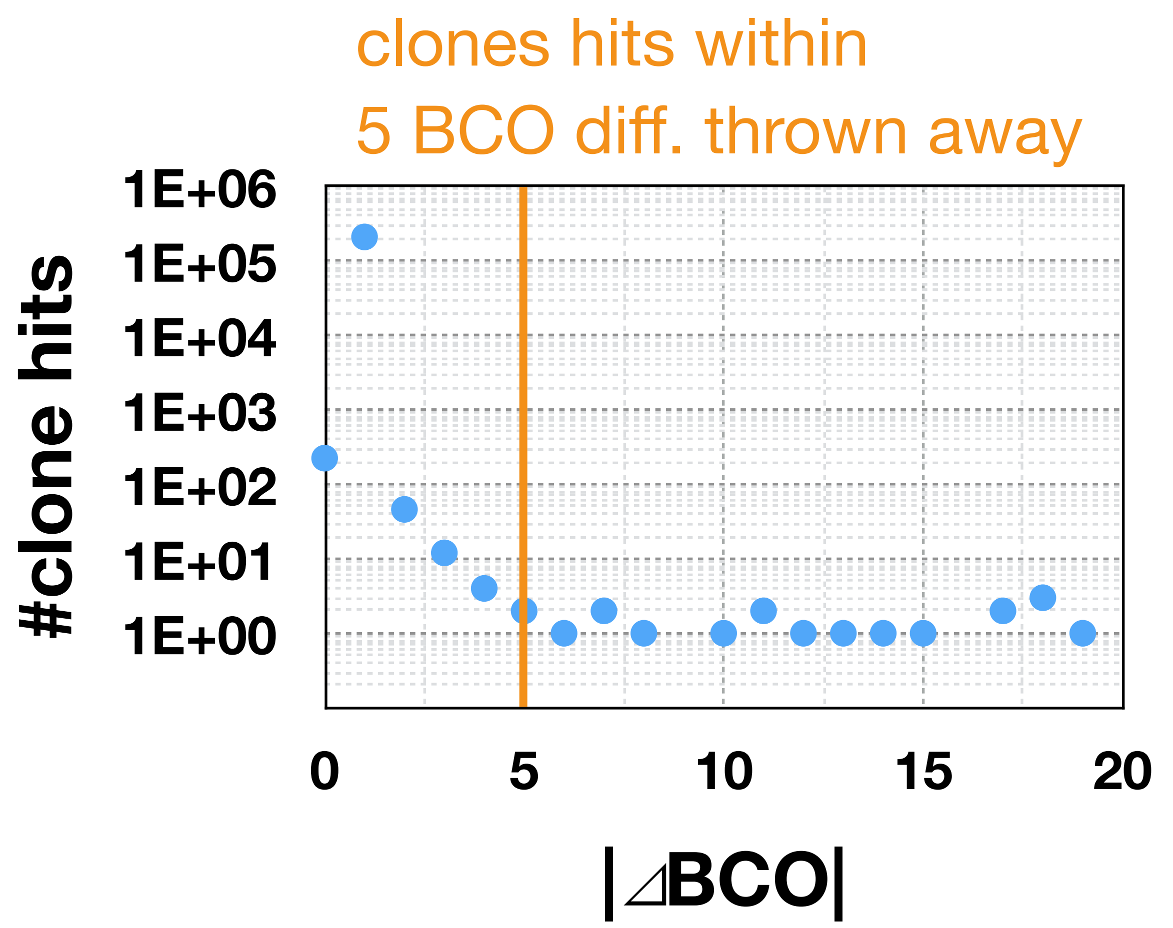

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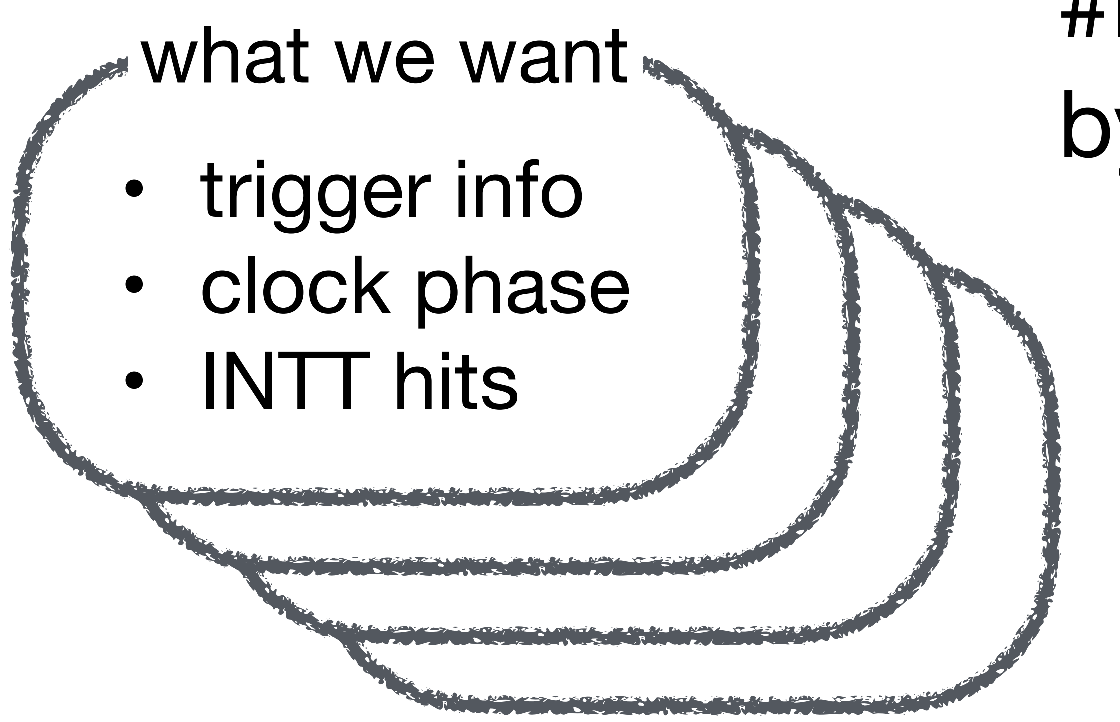
Hits grouping with BCO (full)

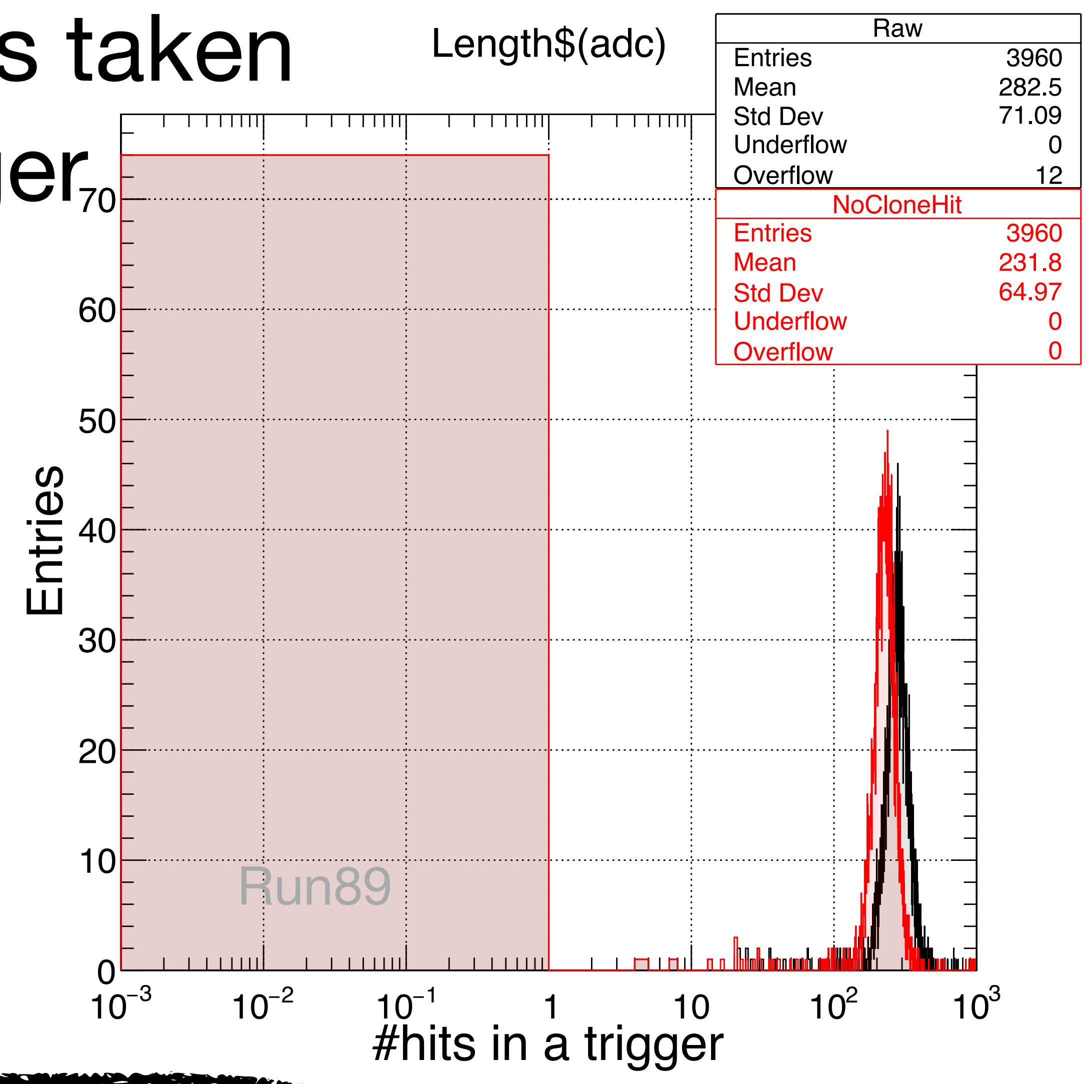
what we want

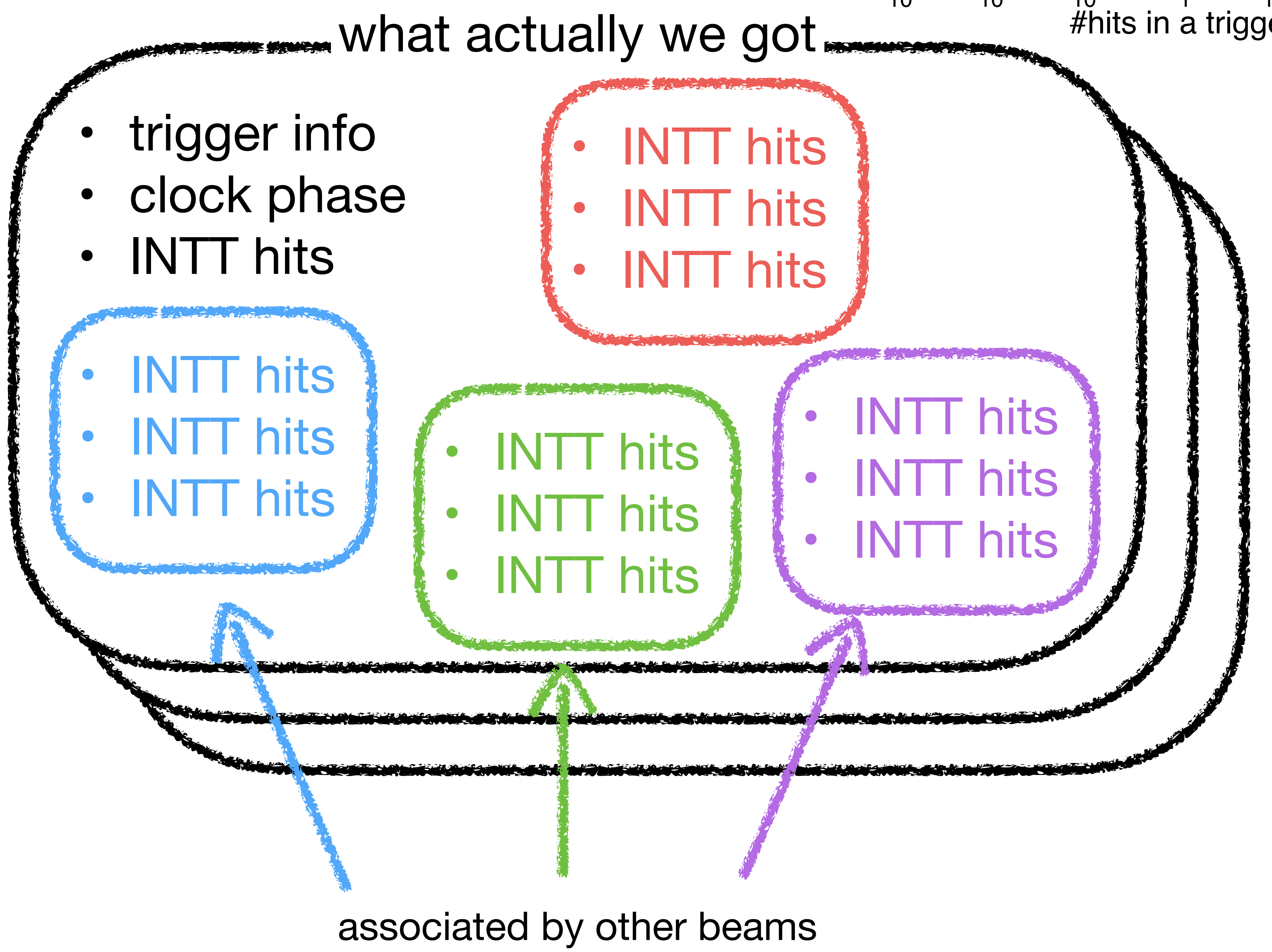
- trigger info
- clock phase
- INTT hits

Hits grouping with BCO (full)



#INTT hits taken by a trigger





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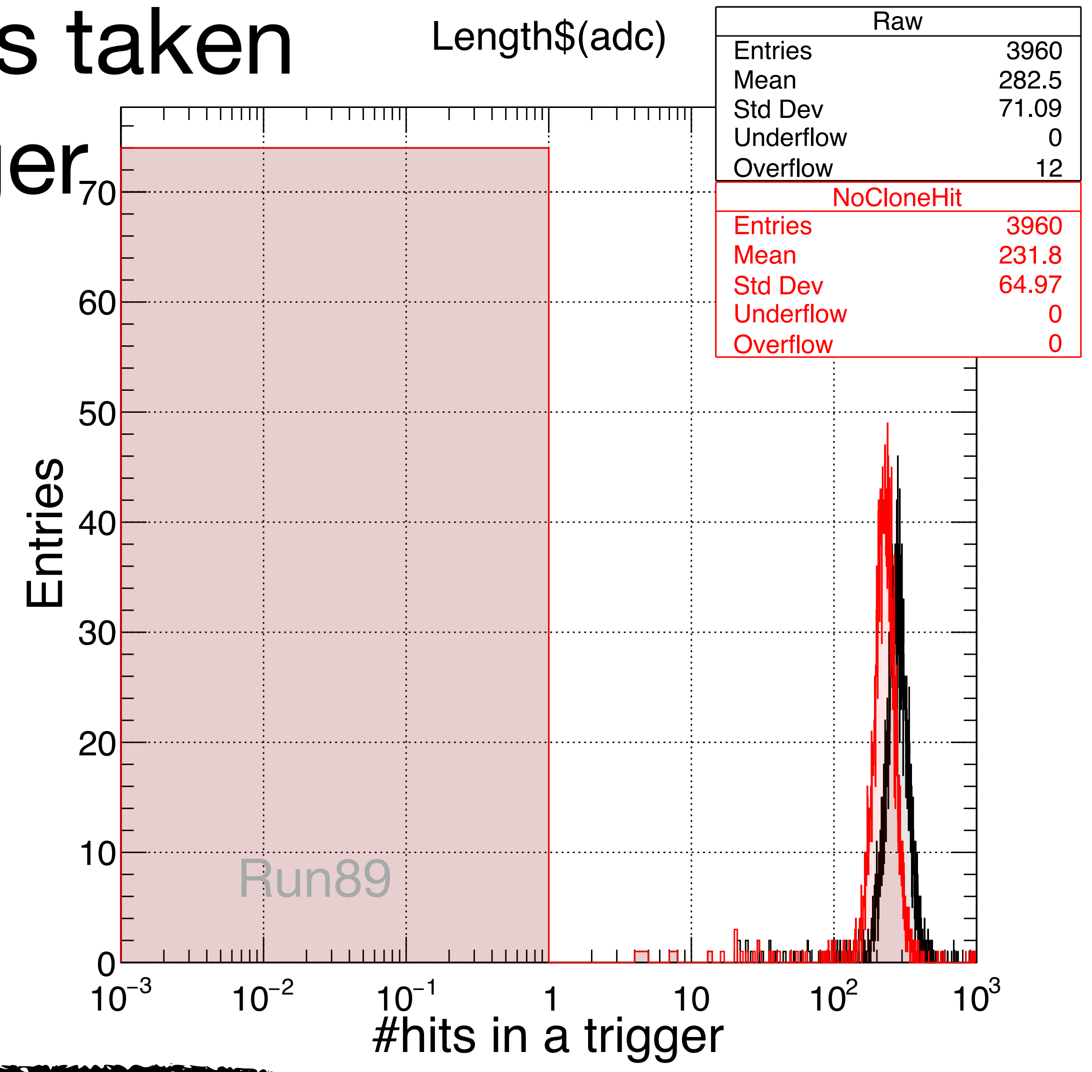

what actually we got

- trigger info
- clock phase
- INTT hits

- INTT hits
- INTT hits
- INTT hits

- INTT hits
- INTT hits
- INTT hits

- INTT hits
- INTT hits
- INTT hits

- INTT hits
- INTT hits
- INTT hits

associated by other beams

BCO group

- trigger info
- clock phase

+ group ID

- INTT hits
- INTT hits
- INTT hits

BCO group

- trigger info
- clock phase

+ group ID

- INTT hits
- INTT hits
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BCO group

- trigger info
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BCO group

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BCO group

- trigger info
- clock phase

+ group ID

- INTT hits
- INTT hits
- INTT hits

....

⋮

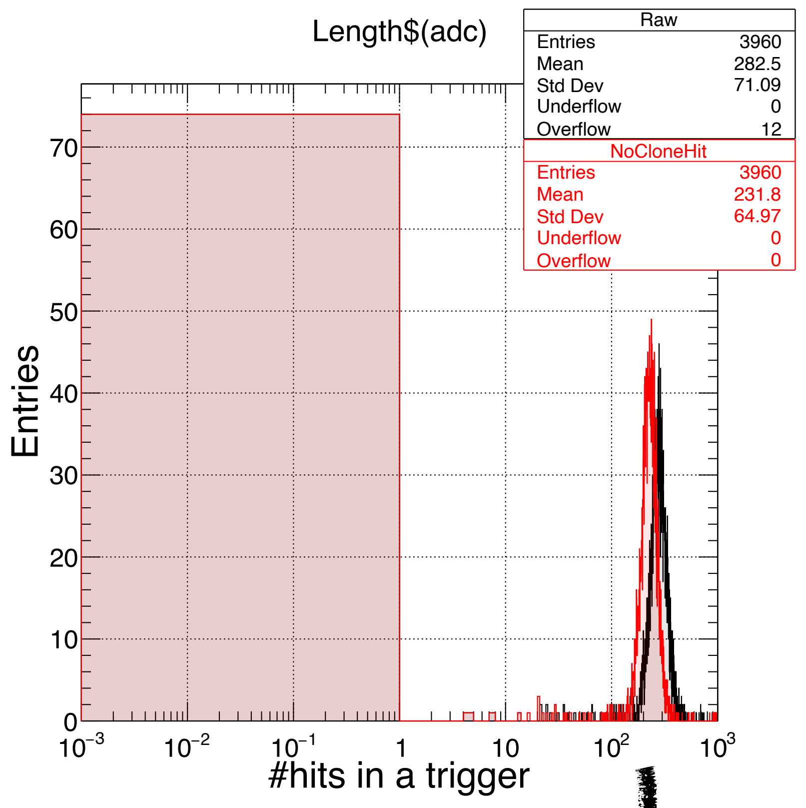
Hits grouping with BCO full

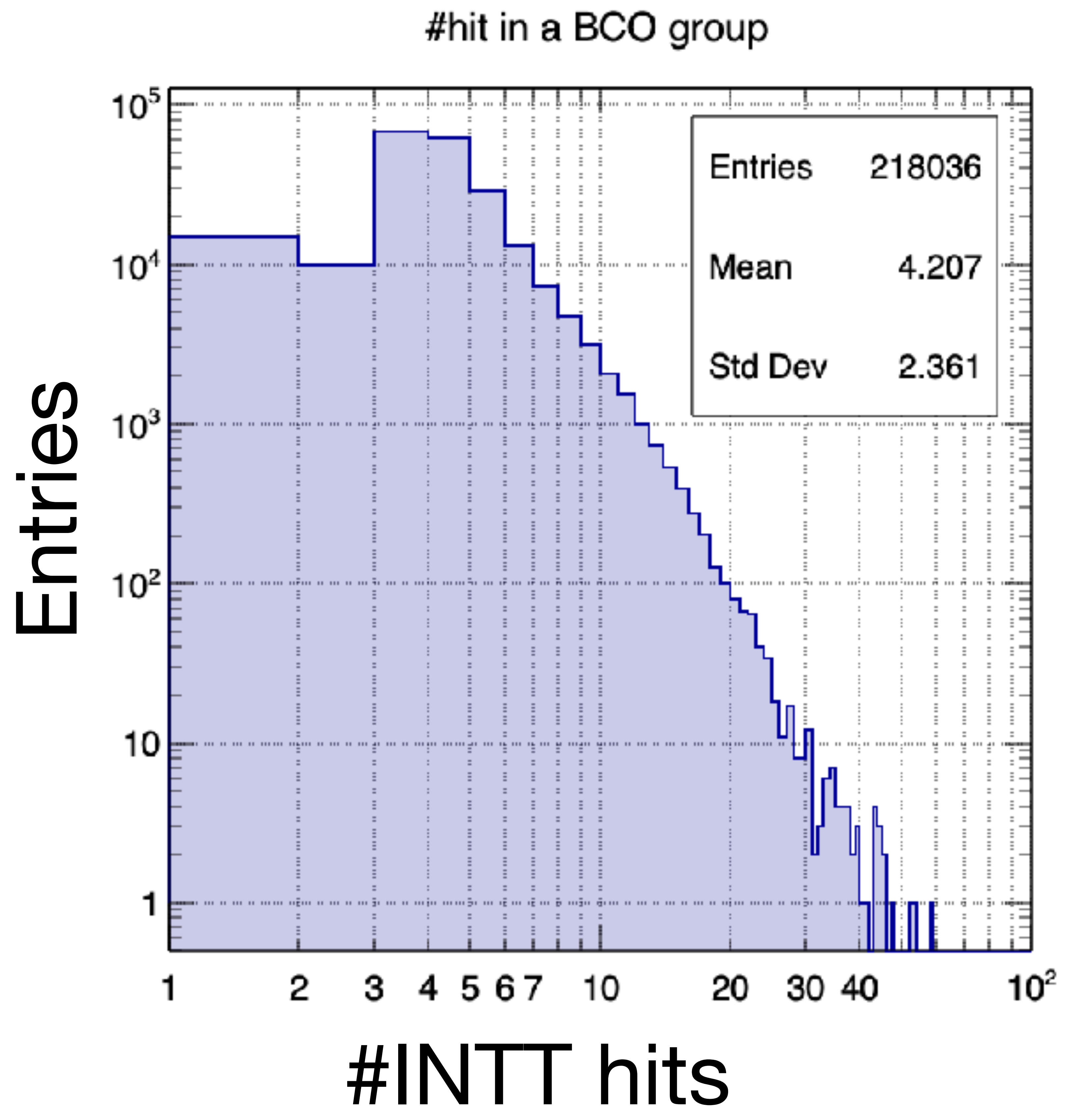
Run89（after clone hits removal）

- #trigger：3960
- #INTT hits：918241

→ after BCO grouping

- #BCO groups：218036





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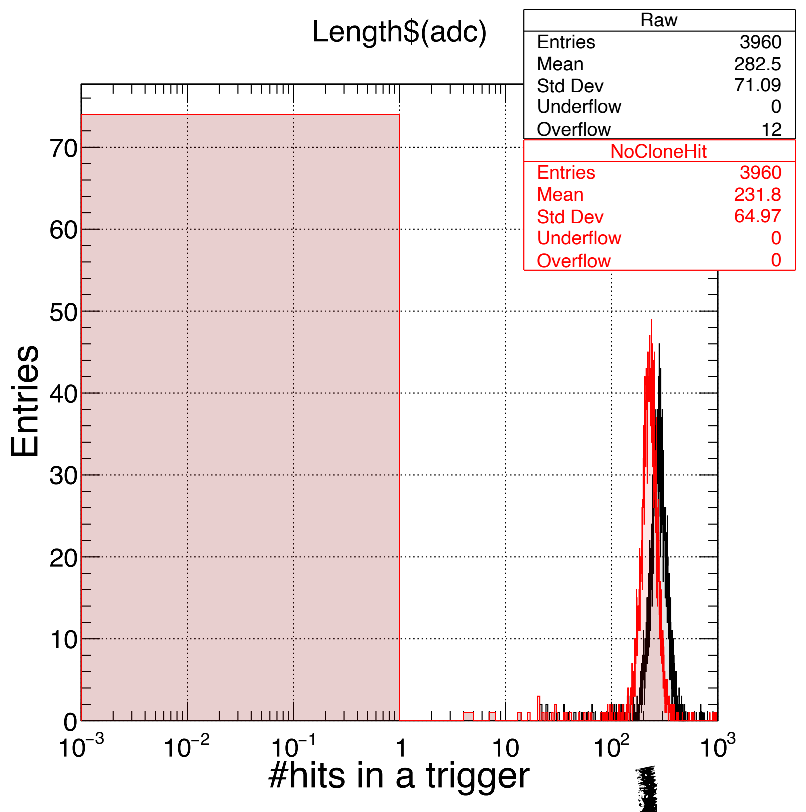

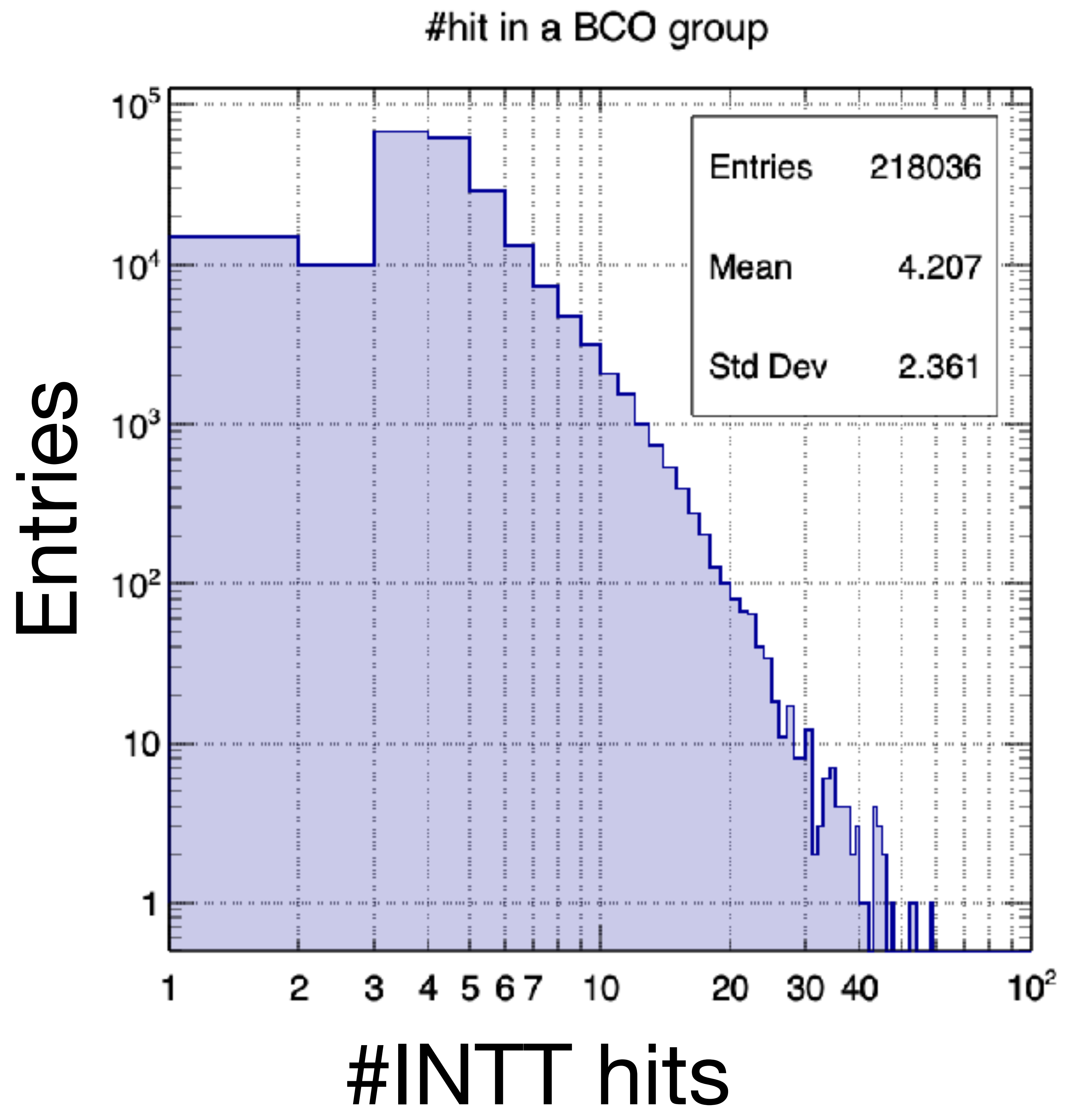

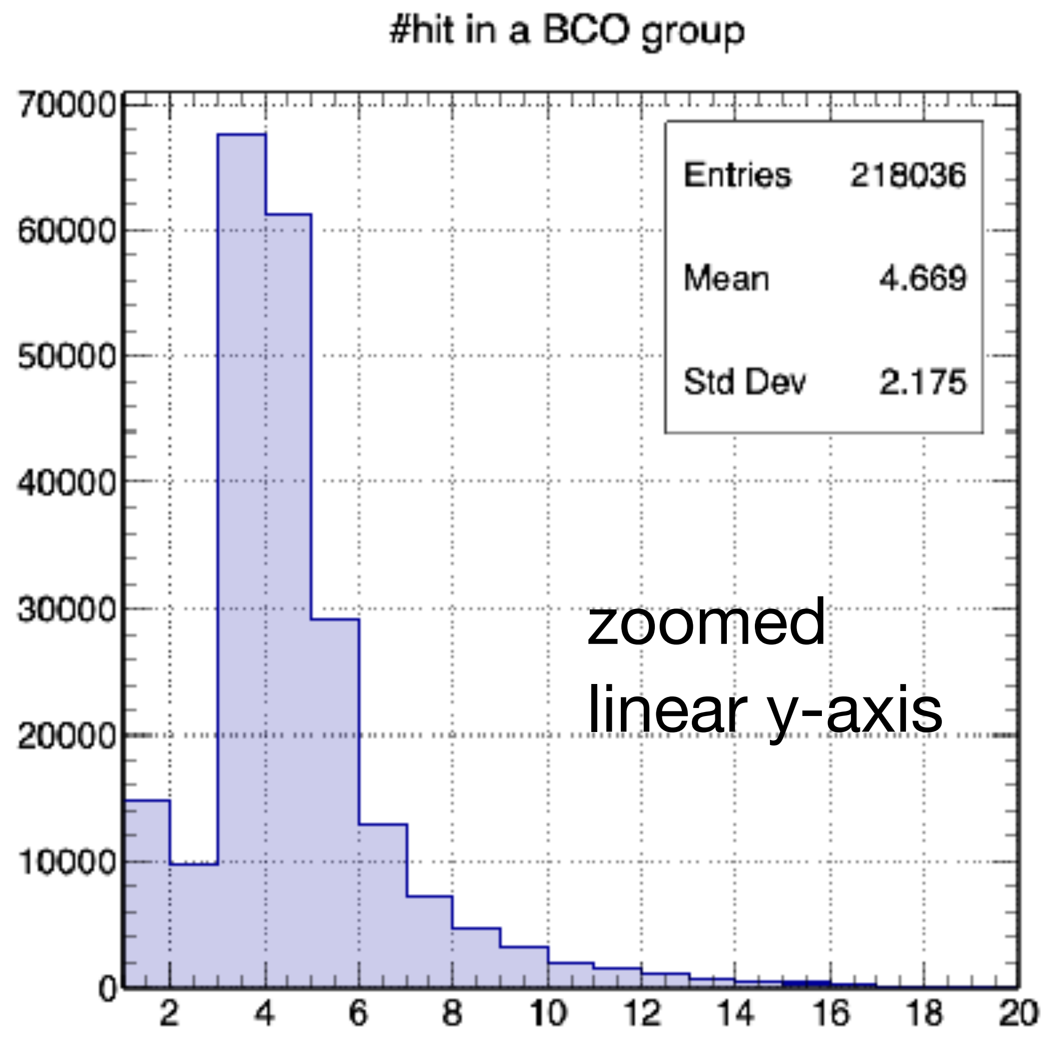

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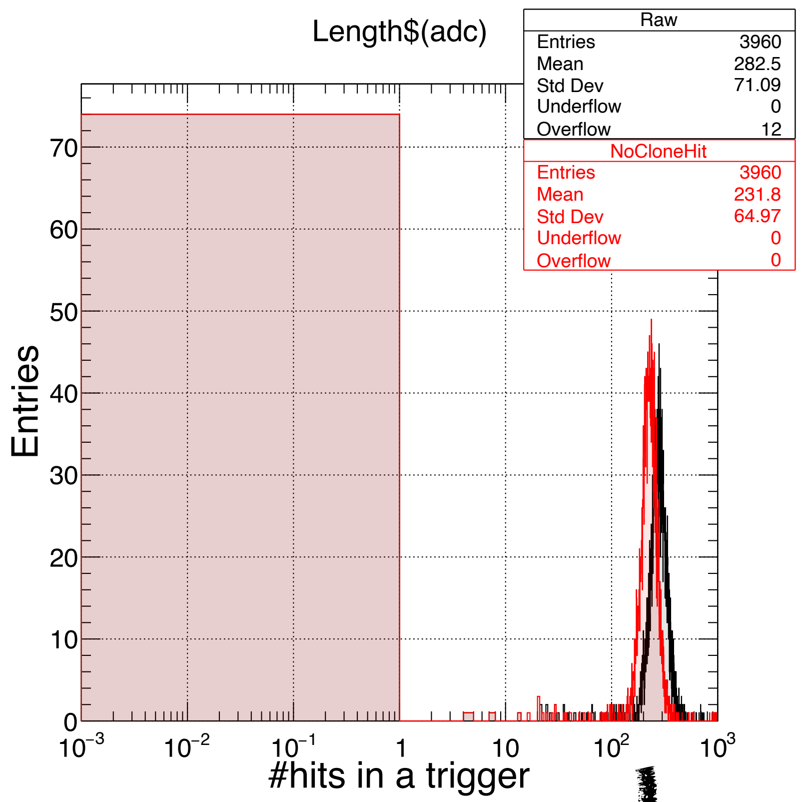

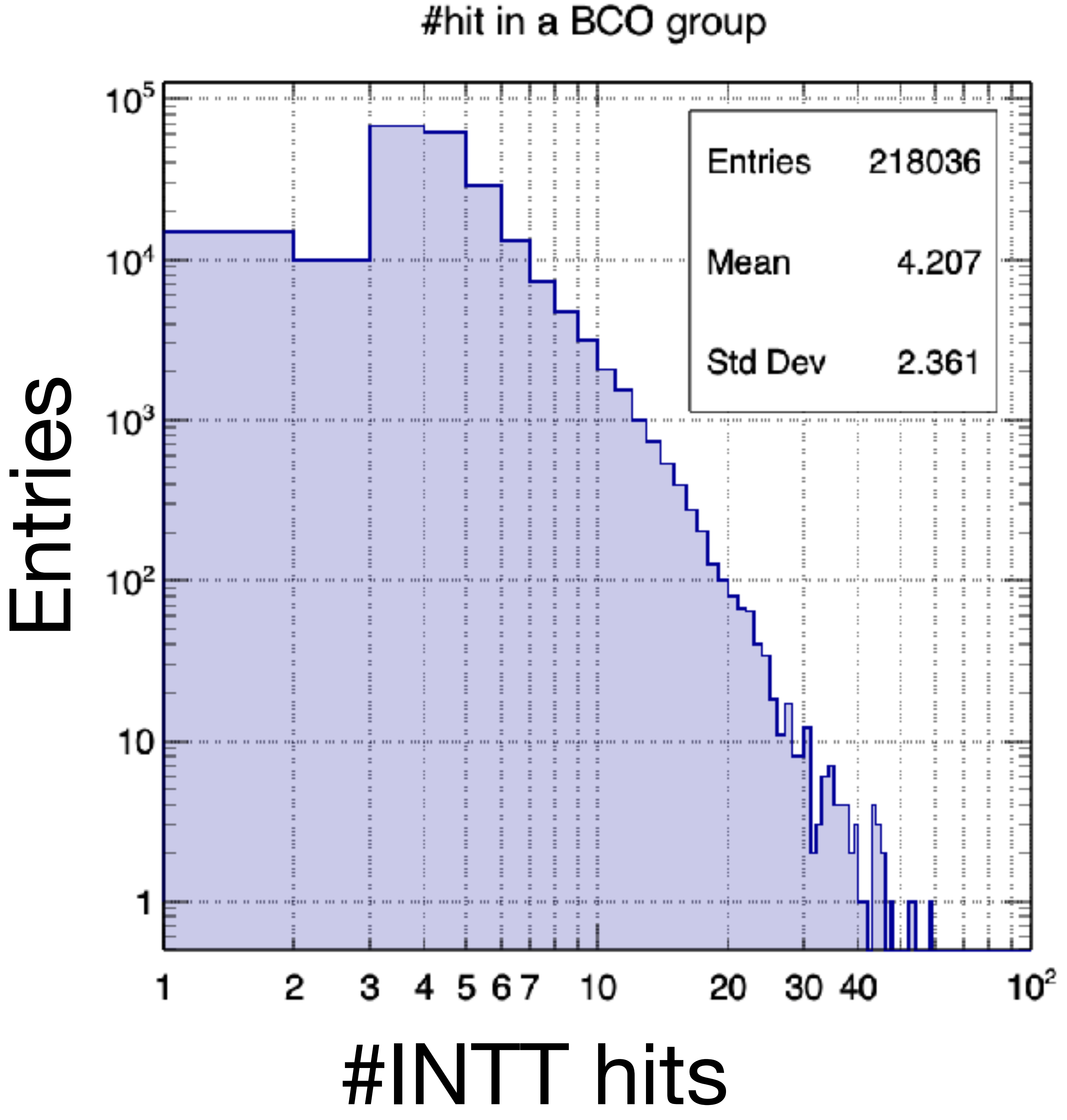

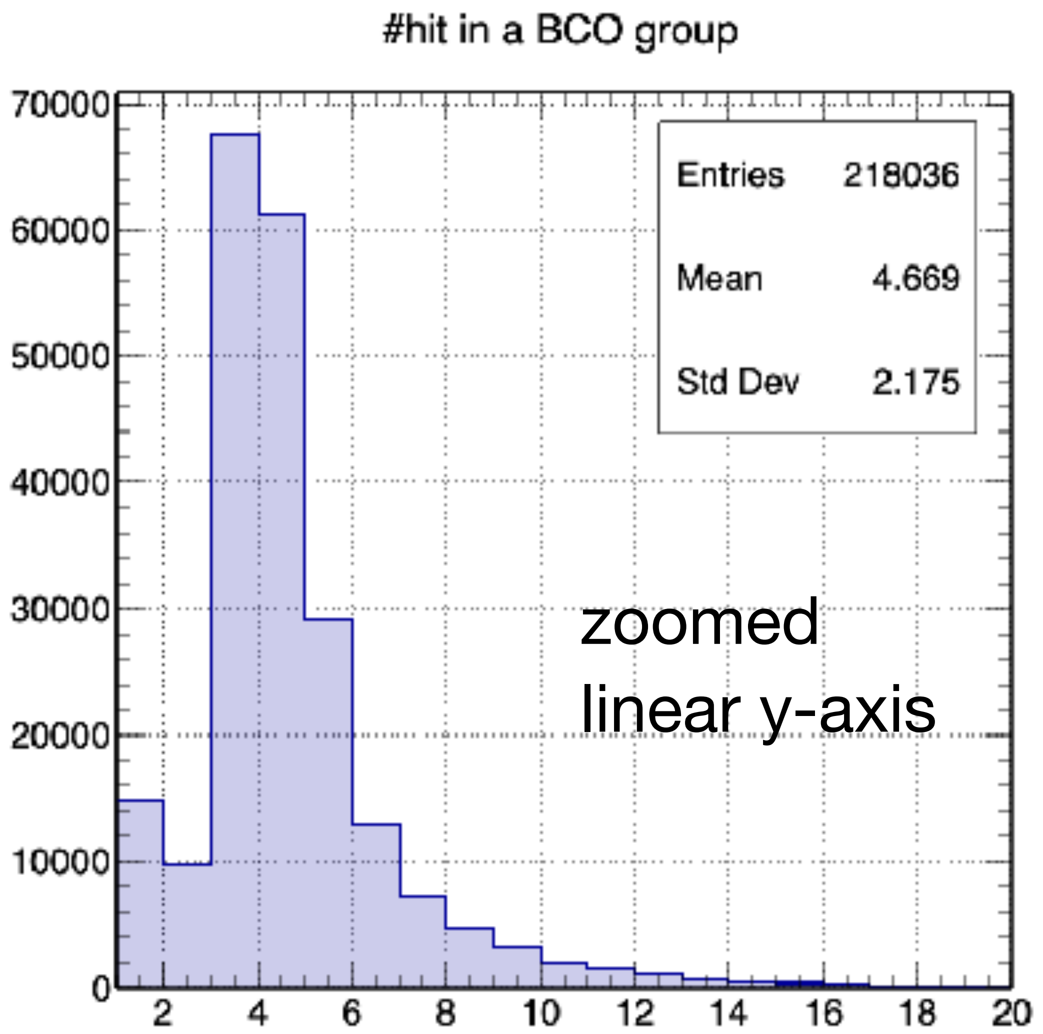

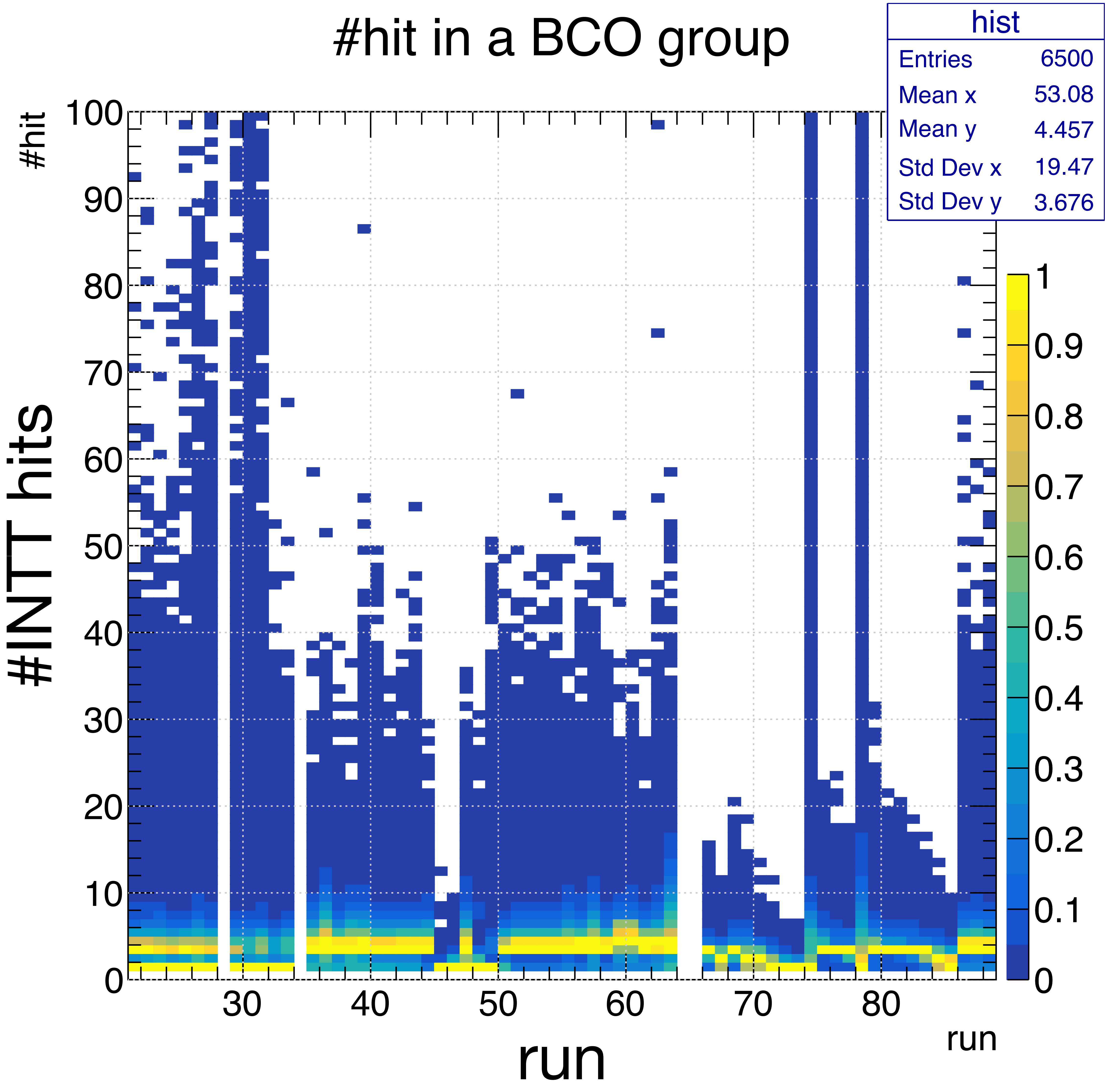

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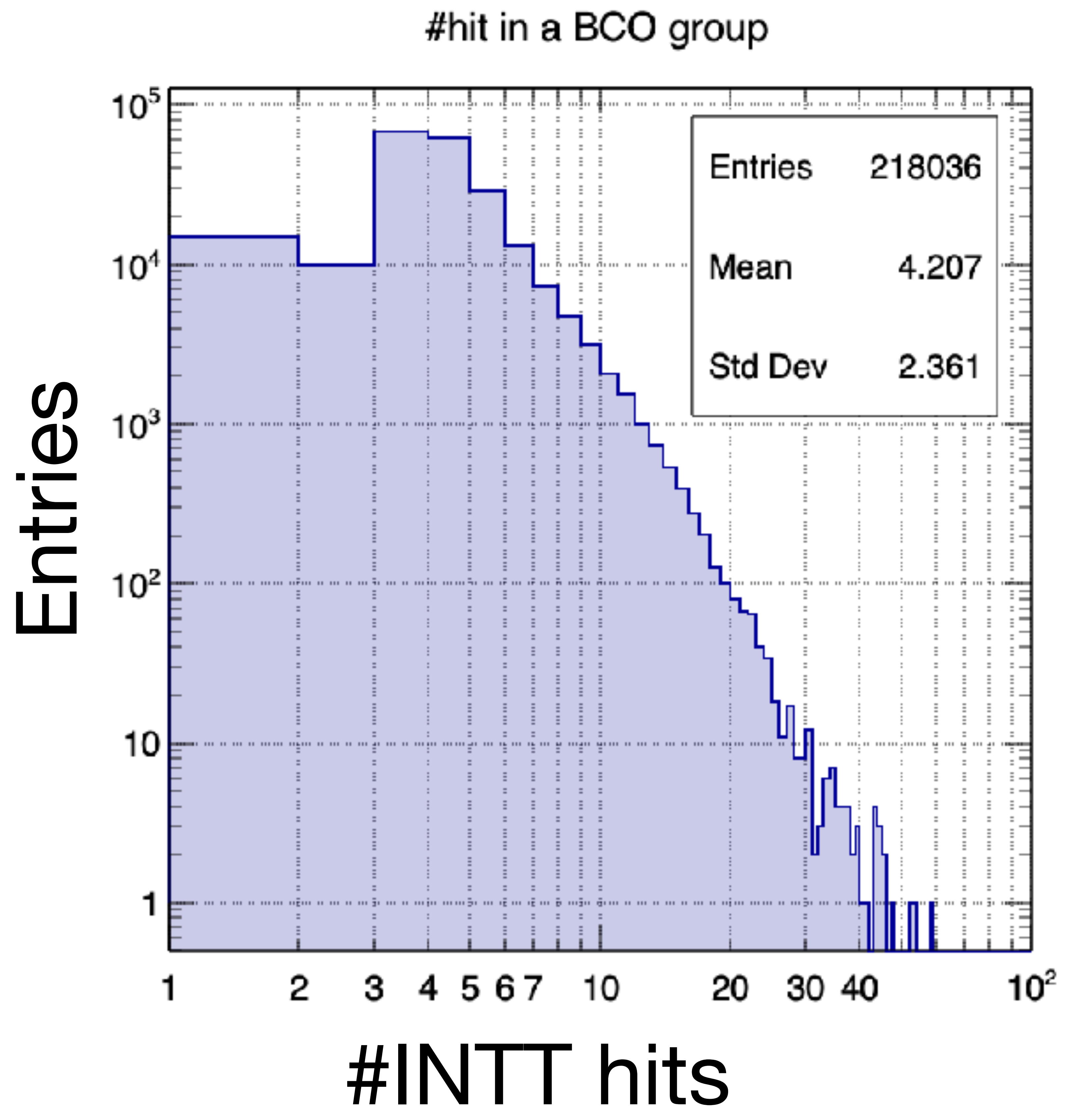
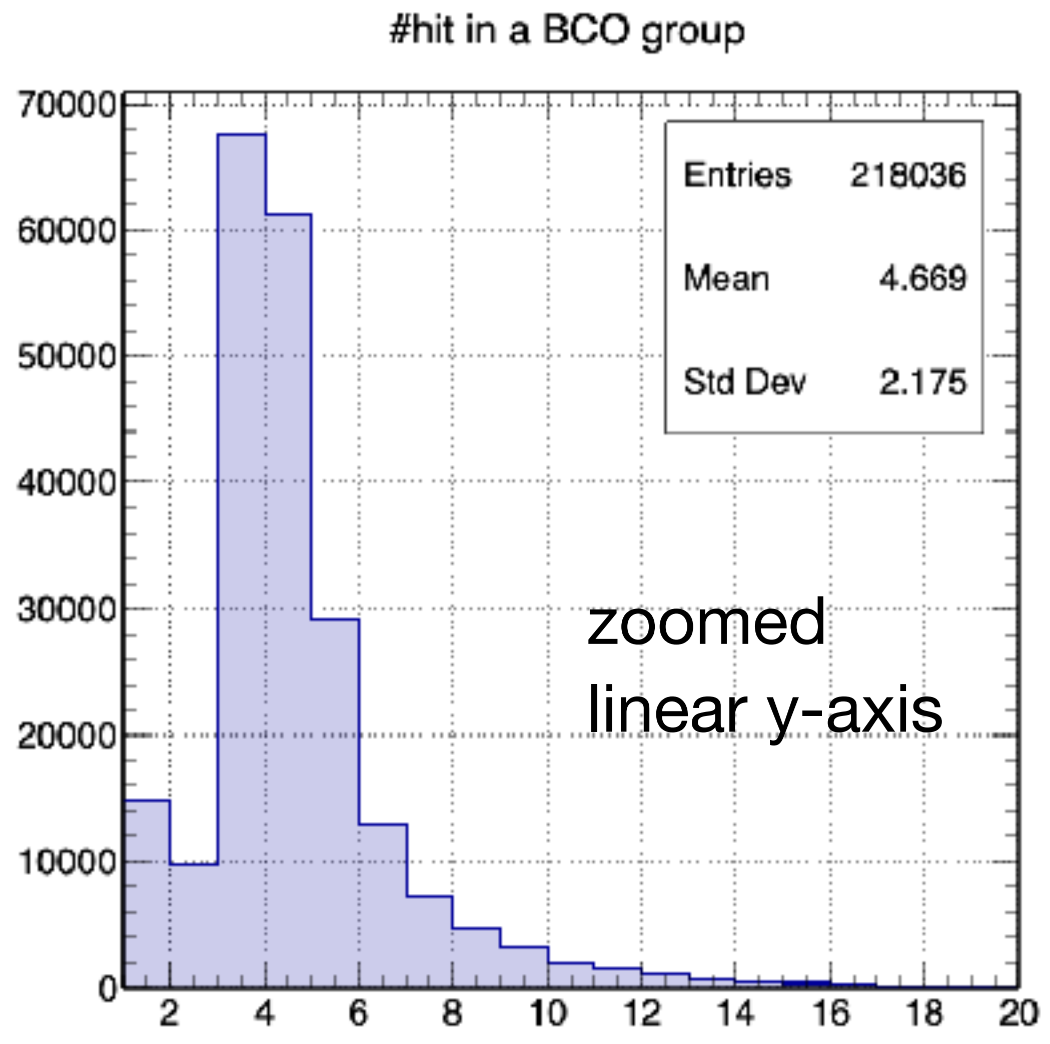
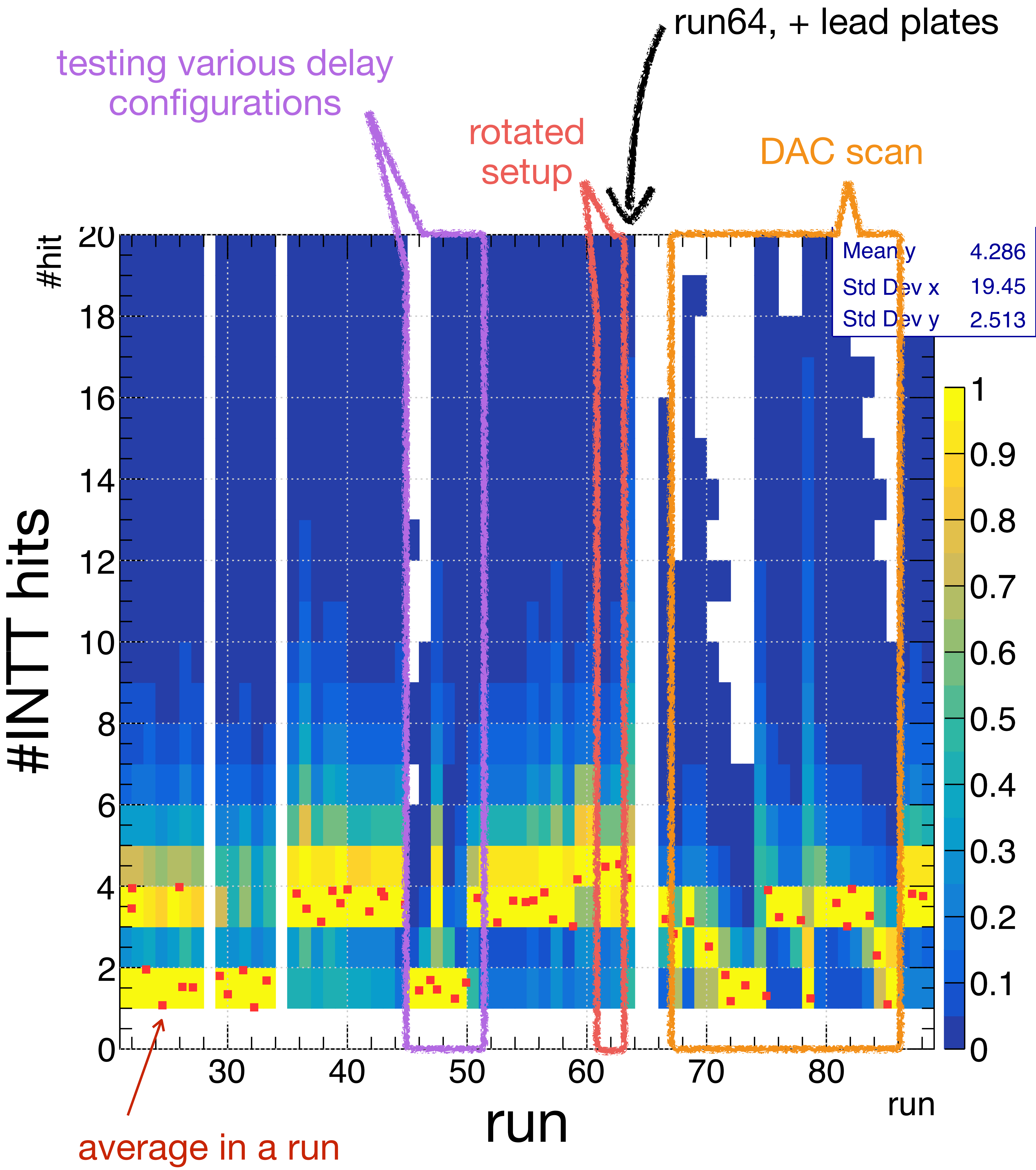


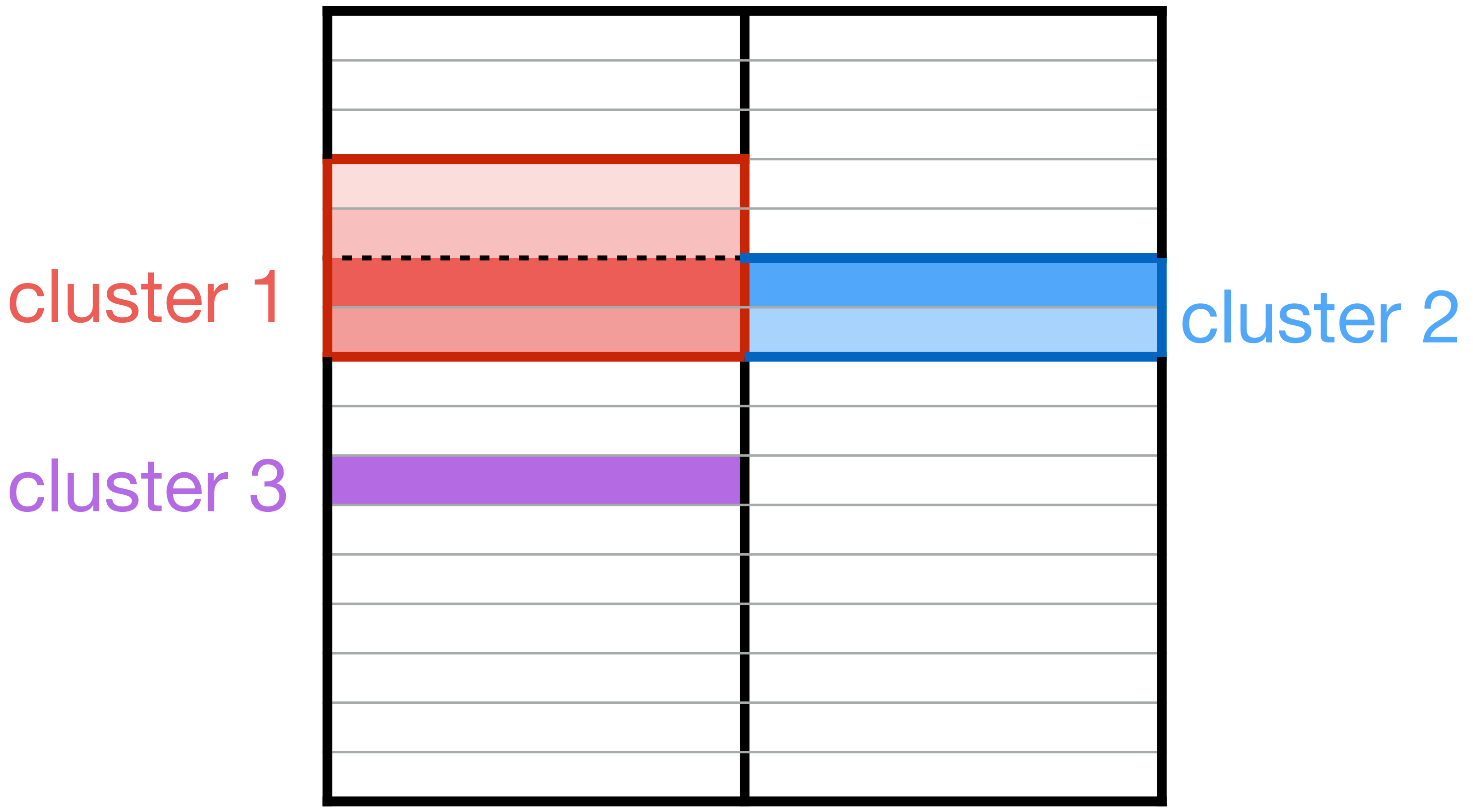


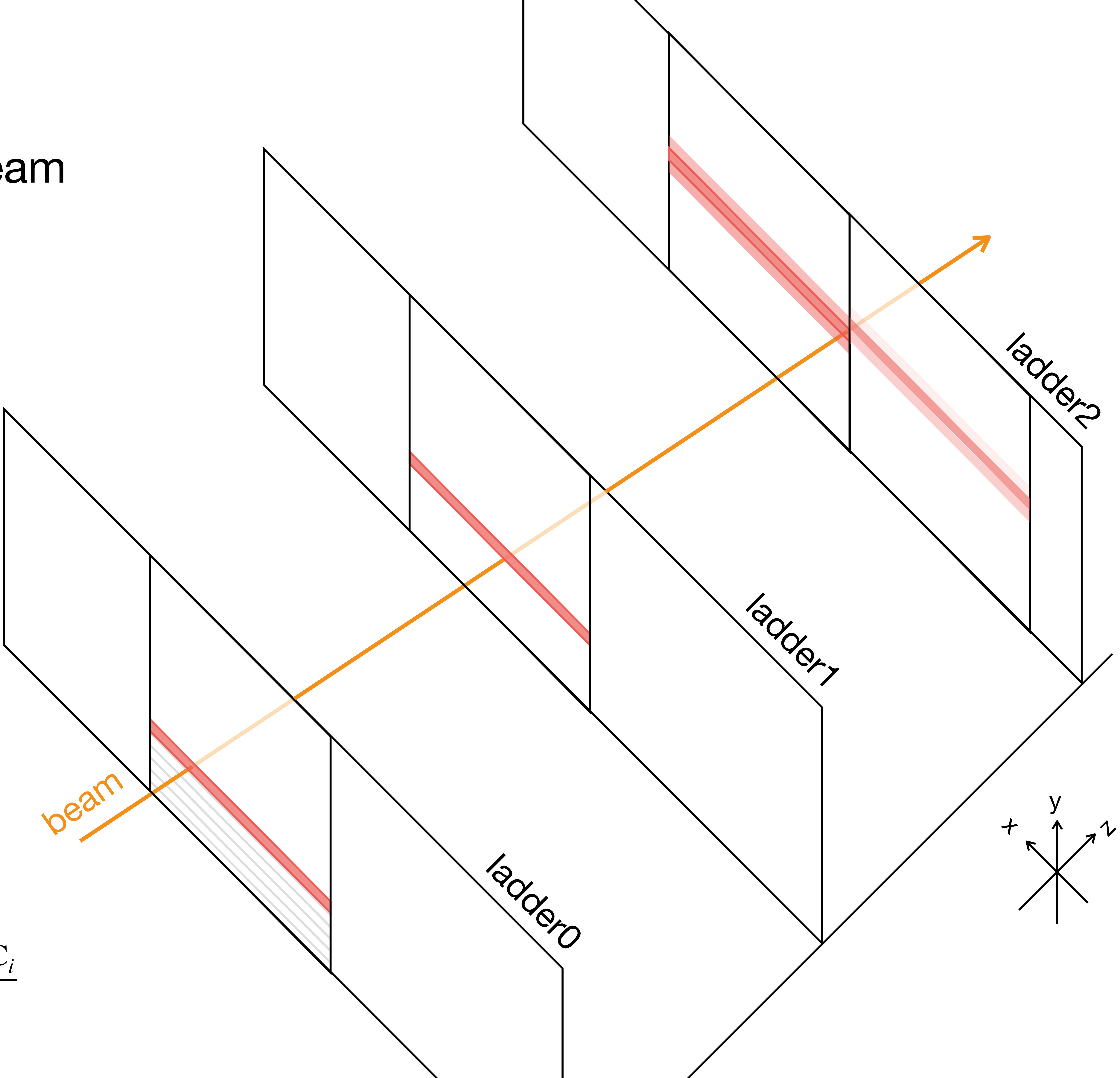


Hits clustering

Hits over some strips by a single beam track are merged into a hit cluster.

Example of a hitmap





I don’t attempt clustering over chip columns for the moment.

ADC of hits are converted to DAC ch and summed: $\mathrm{DAC}_{clst} = \sum \mathrm{DAC}_i$

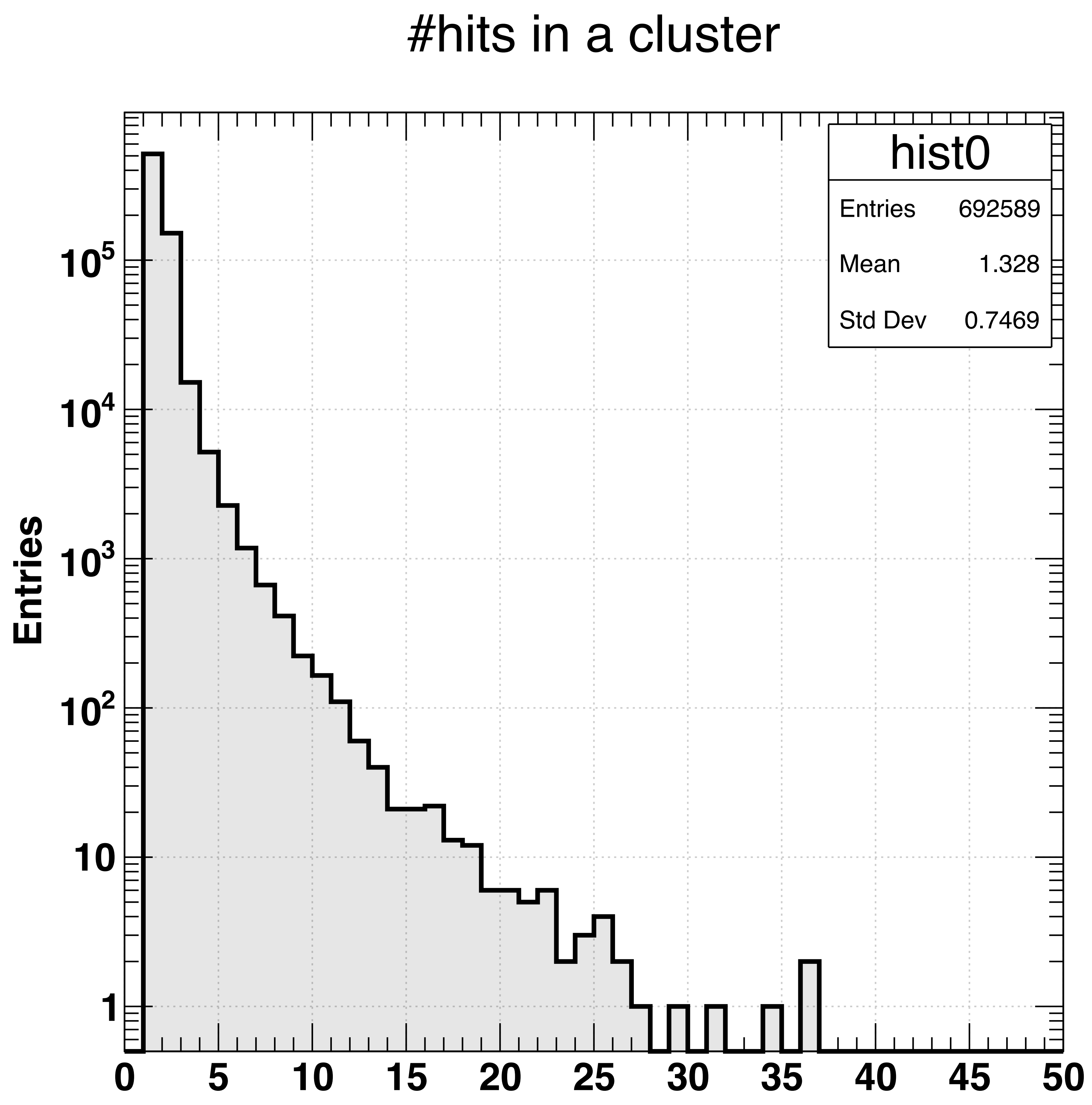
Strip position of a cluster: $\mathrm{ch}_{clst} \equiv \dfrac{\sum \mathrm{ch}_i \times \mathrm{DAC}_i}{\sum \mathrm{DAC}_i}$

Hits clustering

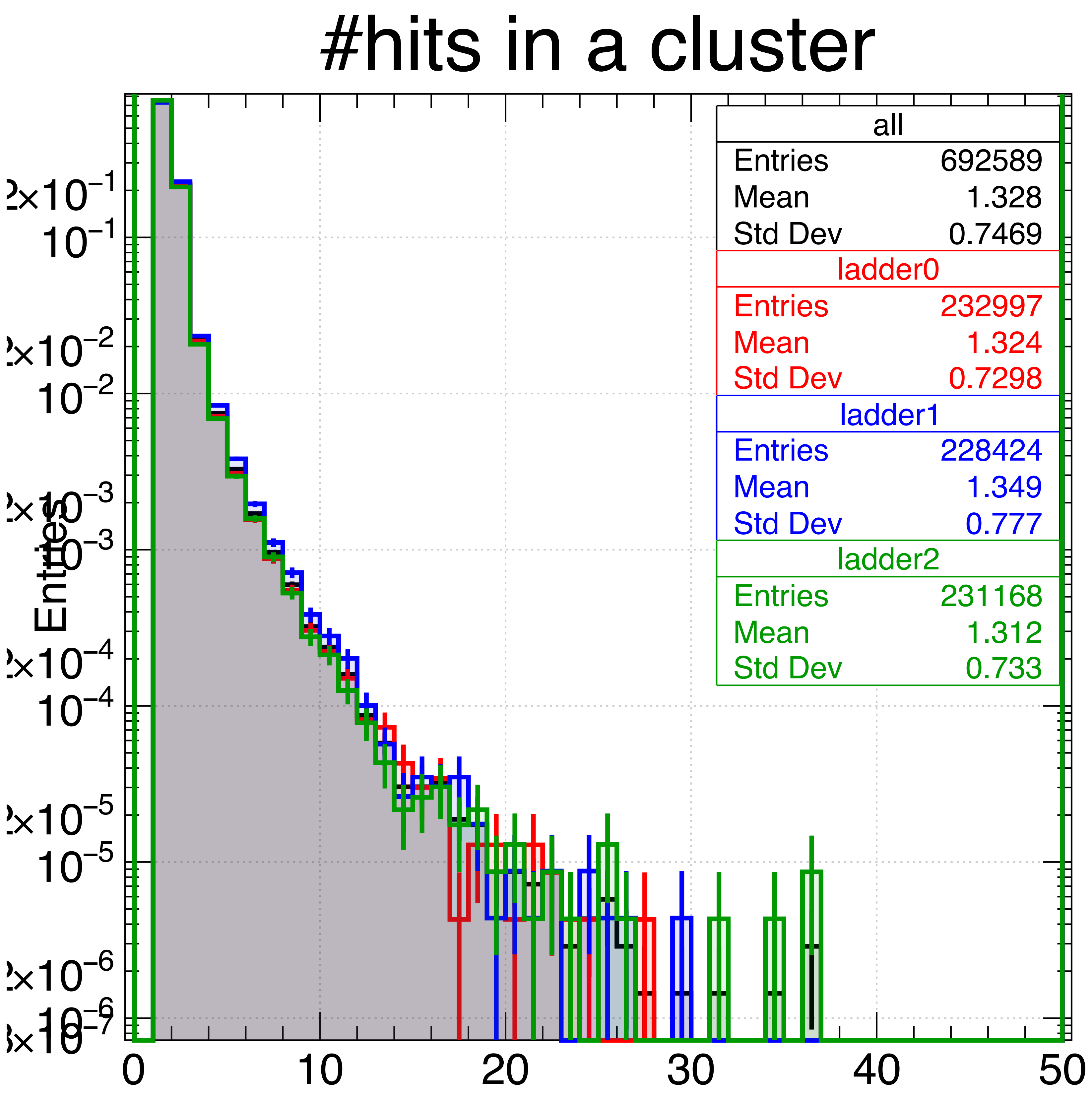
Run89

#hits after clone hits removal: 918241

#clusters: 693552 (76%)



Distribution of #hits in a cluster



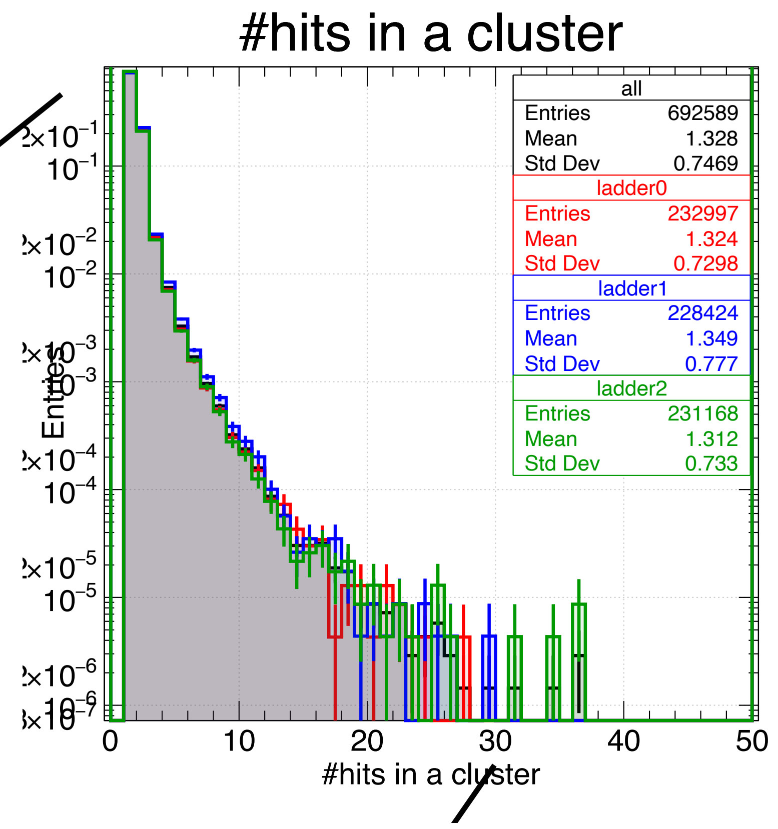
#hits in a cluster by ladders

Hits clustering

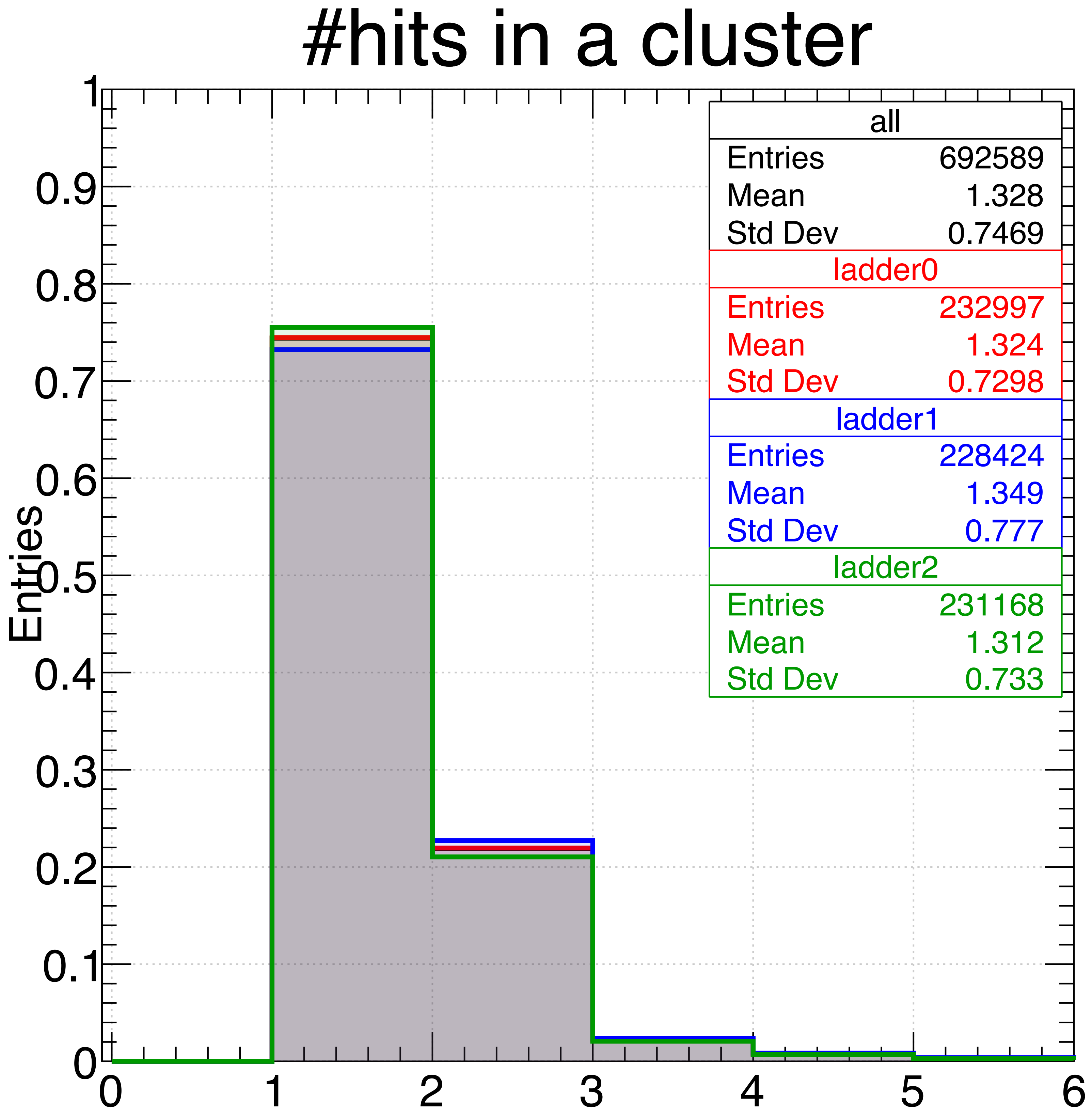
Run89

#hits after clone hits removal: 918241

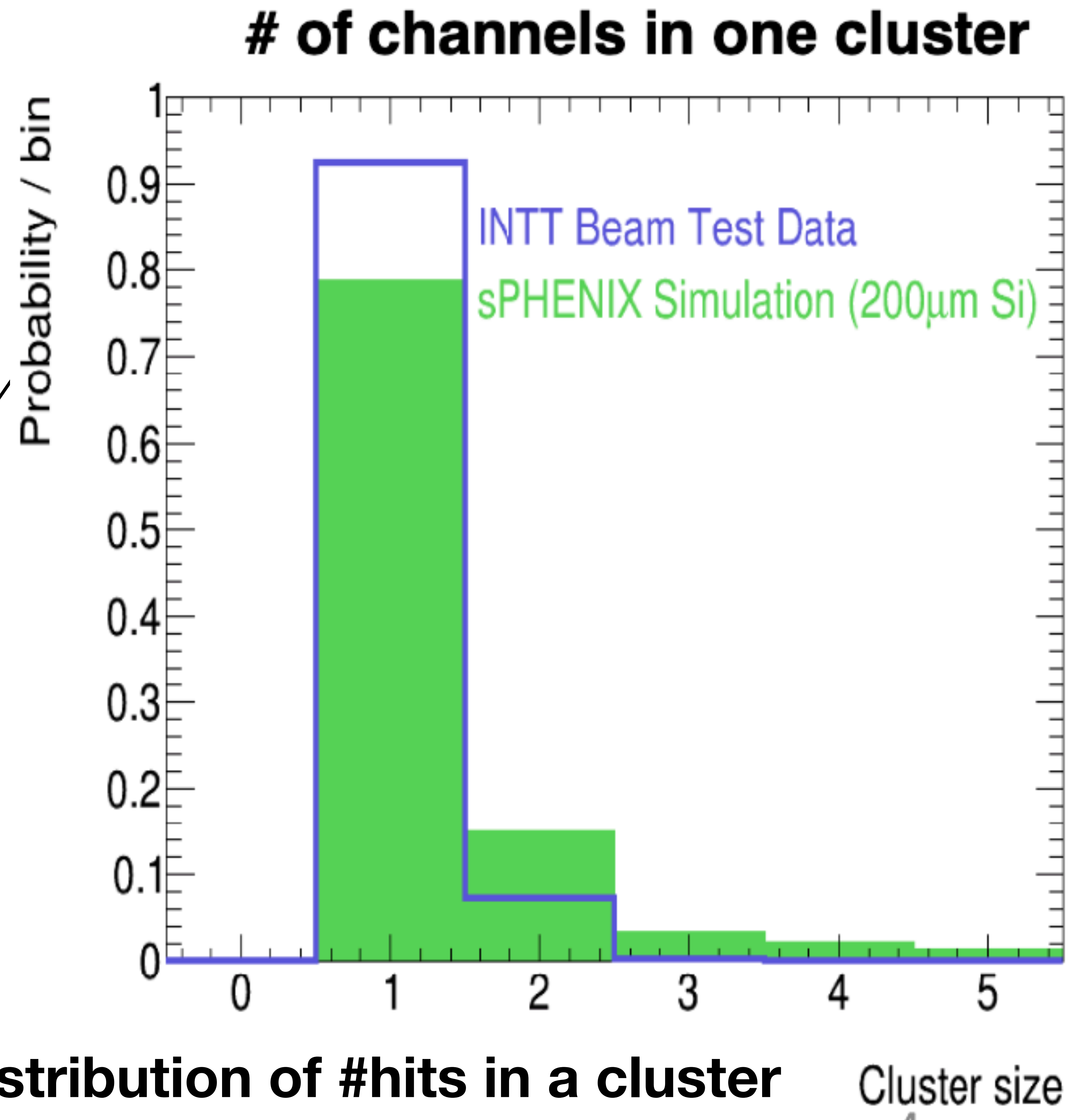
#clusters: 693552 (76%)



zoomed



Distribution of #hits in a cluster



Distribution of #hits in a cluster from FNAL2019

Hits clustering

Run89

#hits after clone hits removal: 918241

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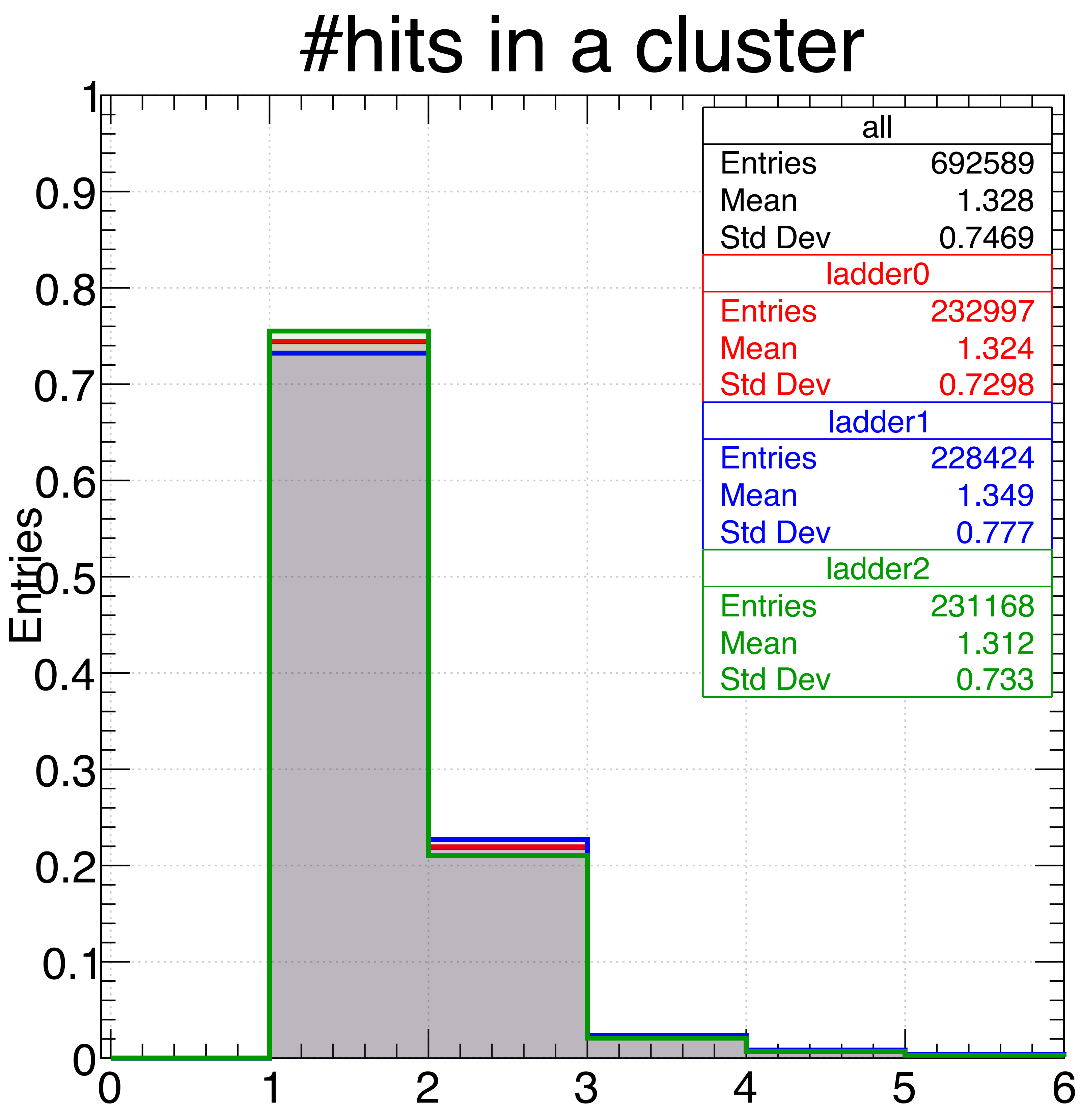
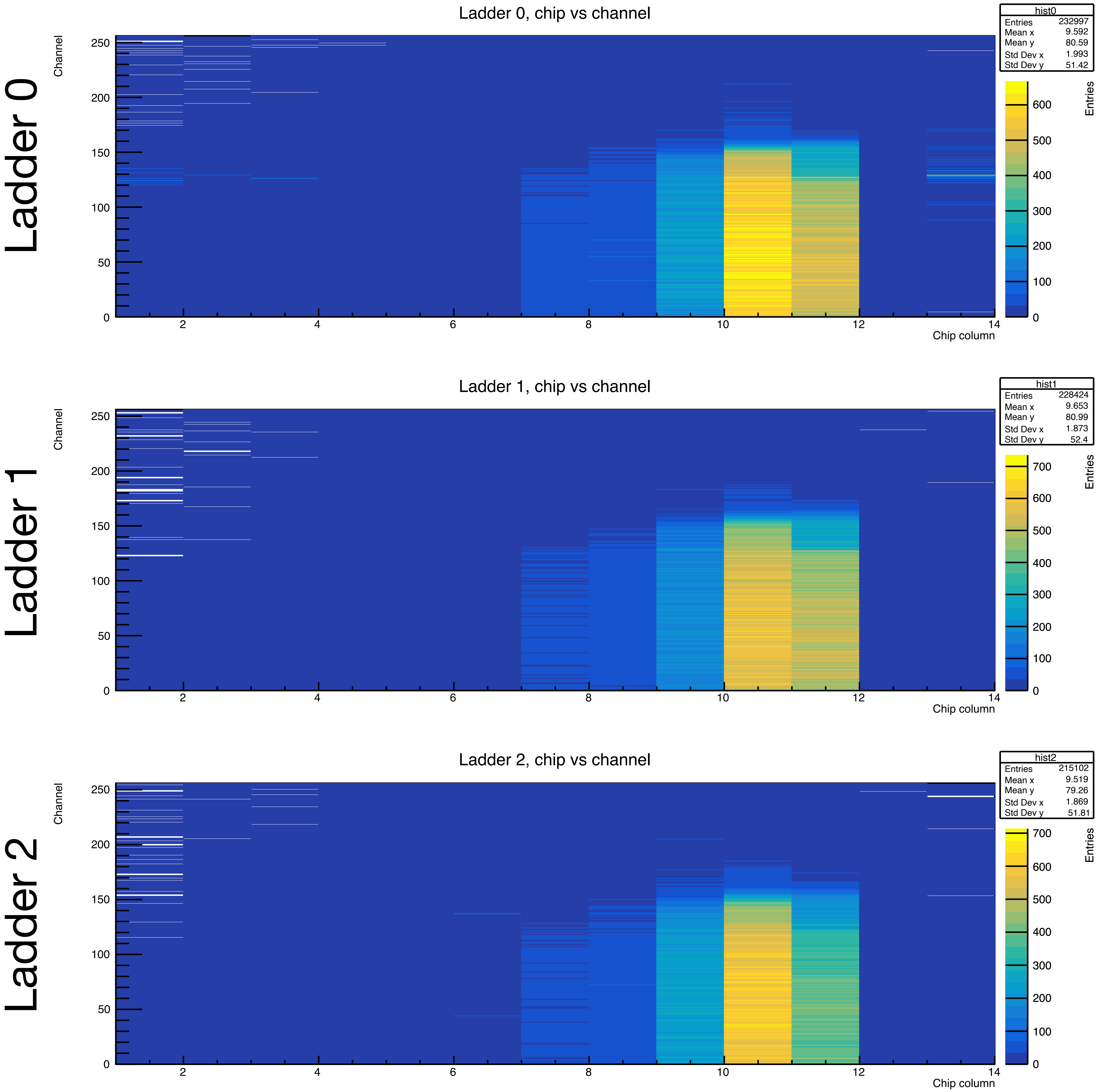


Distribution of #hits in a cluster

Hitmaps



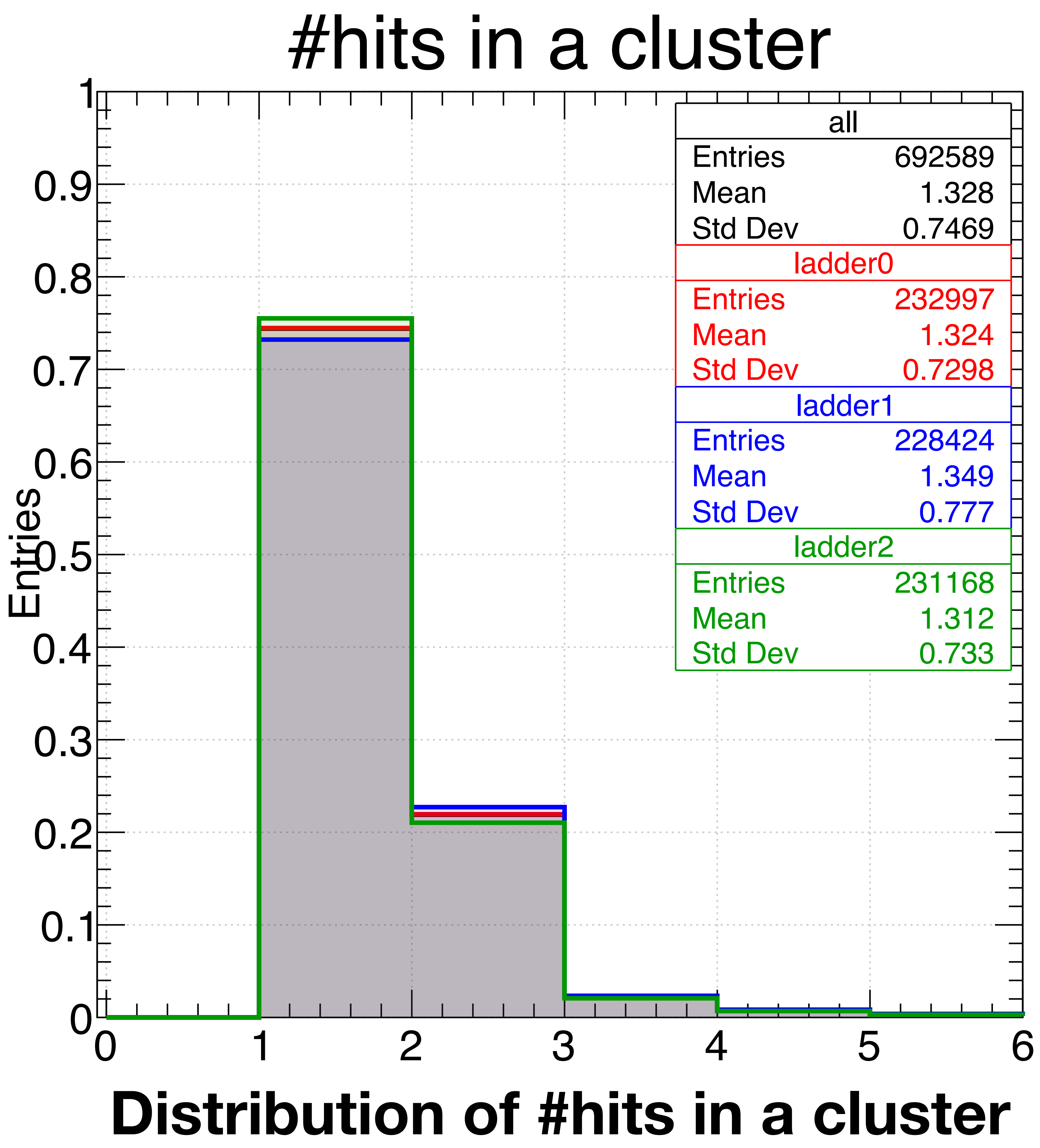
noisy channel: ladder 2 (module5) chip 6 ch 136

Hits clustering

Run89

#hits after clone hits removal: 918241

#clusters: 693552 (76%)



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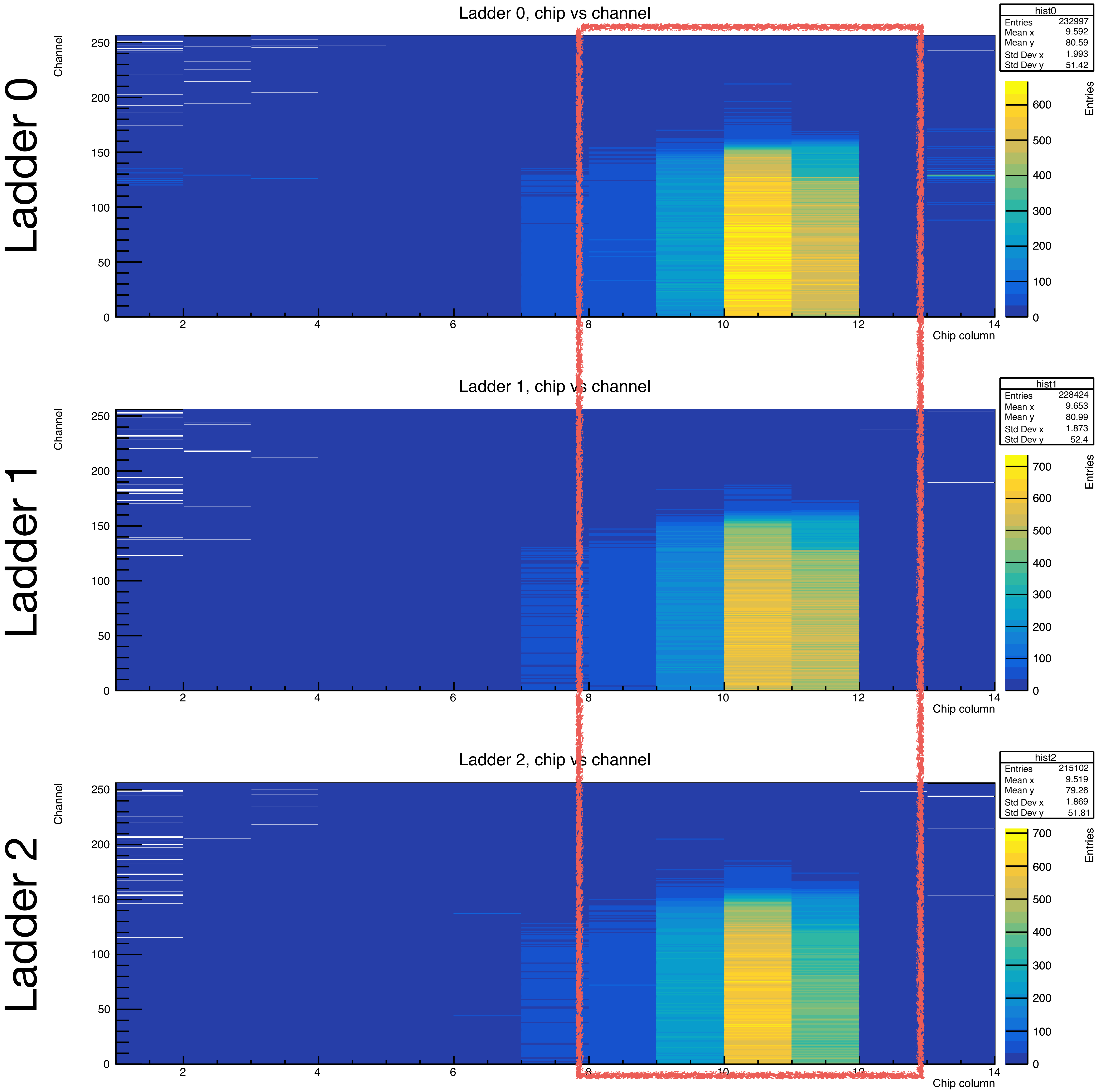

noisy channel: ladder 2 (module5) chip 6 ch 136

Hits clustering

- chip column 8
- chip column 9
- chip column 10
- chip column 11
- chip column 12

Run89

#hits after clone hits removal: 918241

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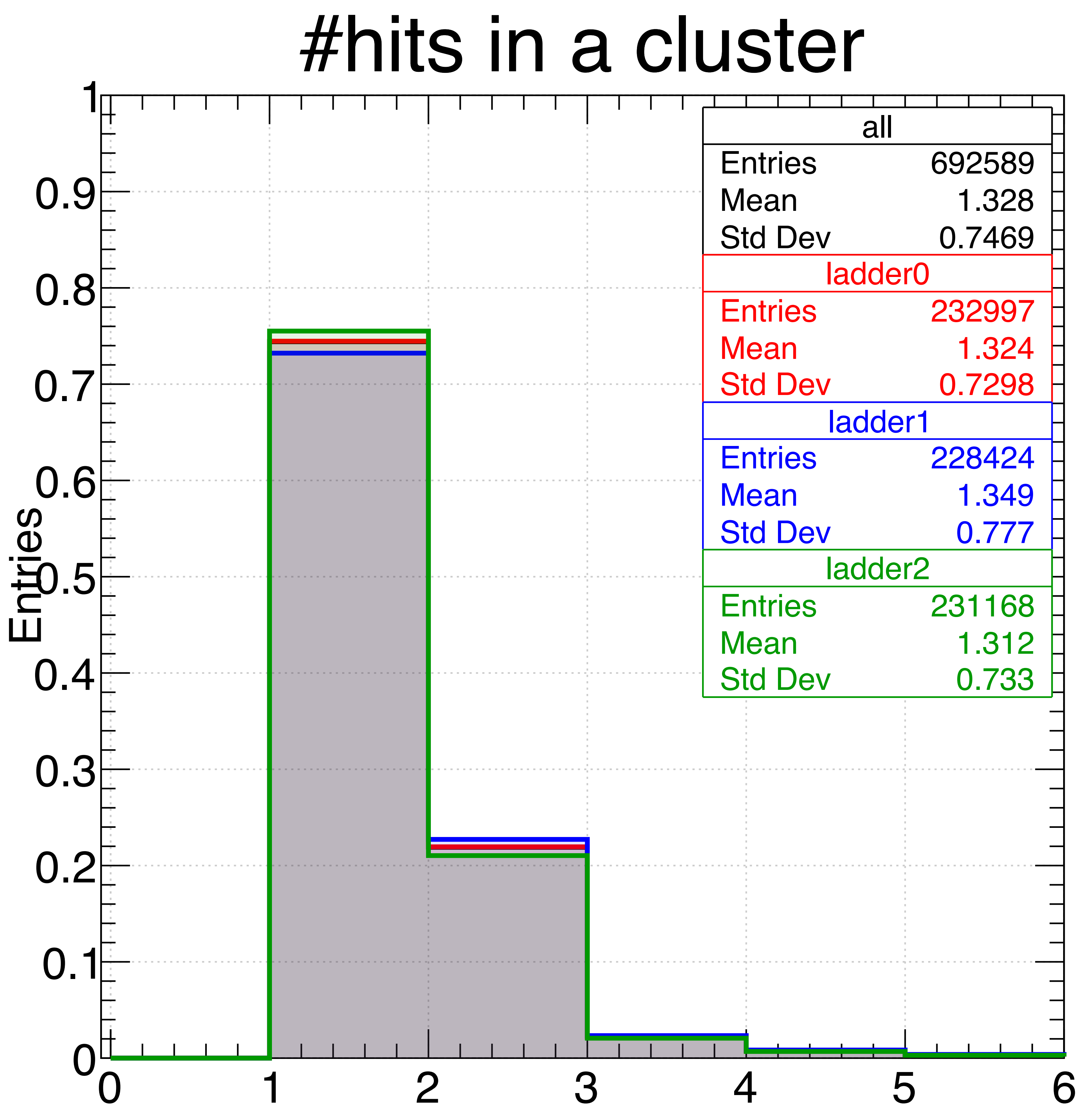
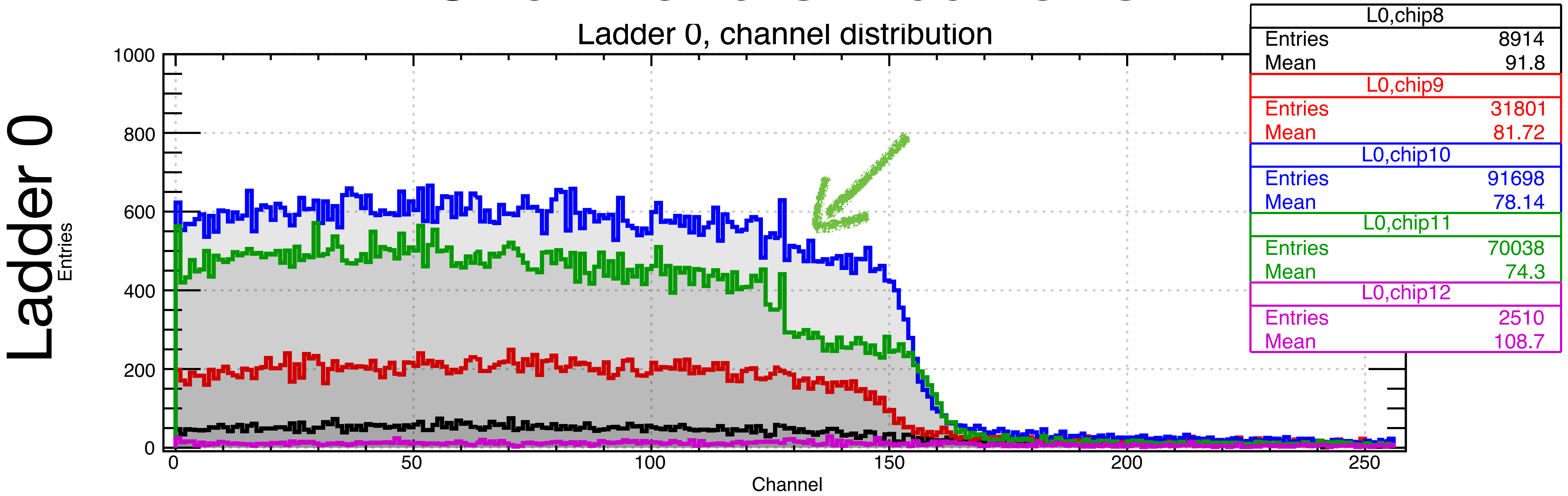
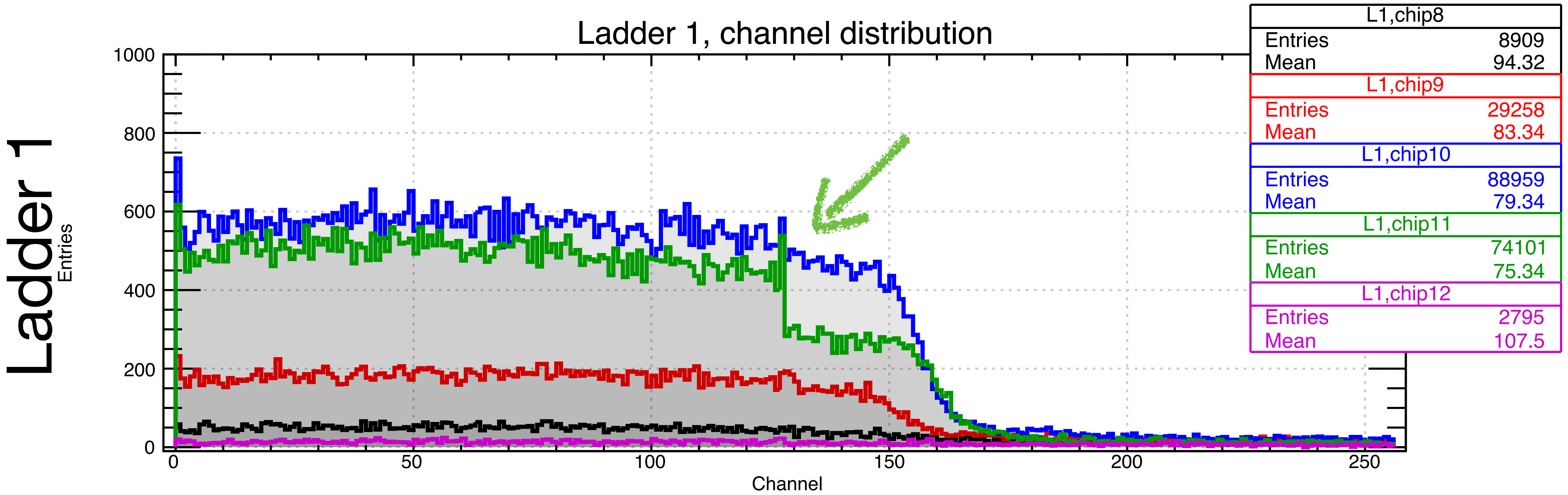
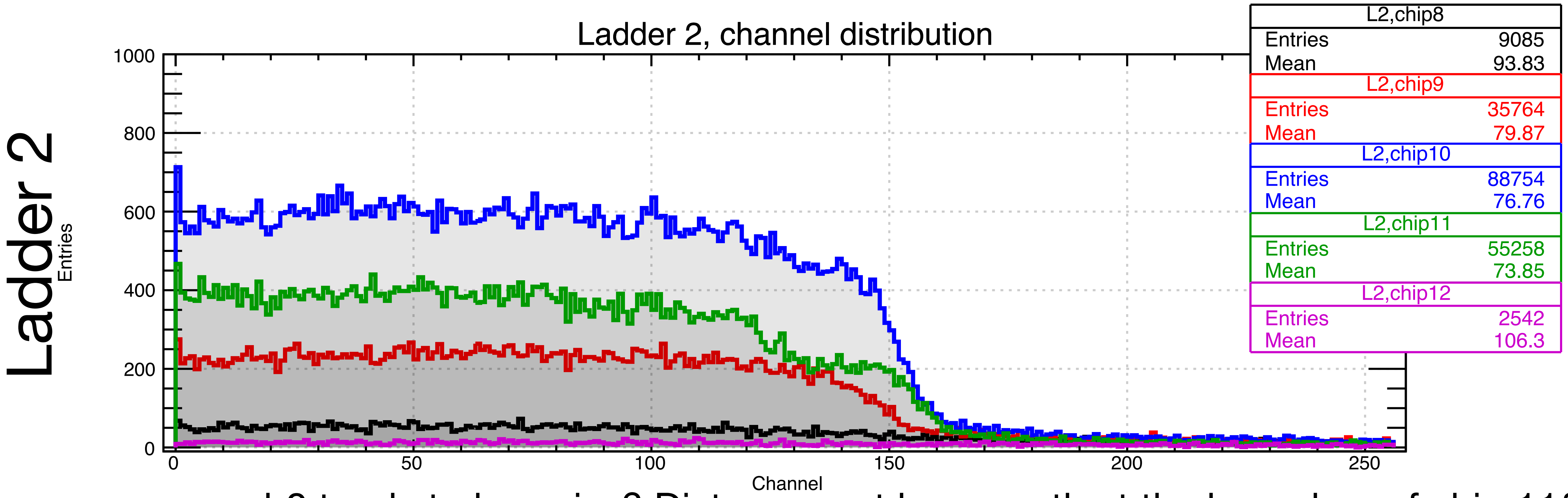


Distribution of #hits in a cluster

Channel distributions







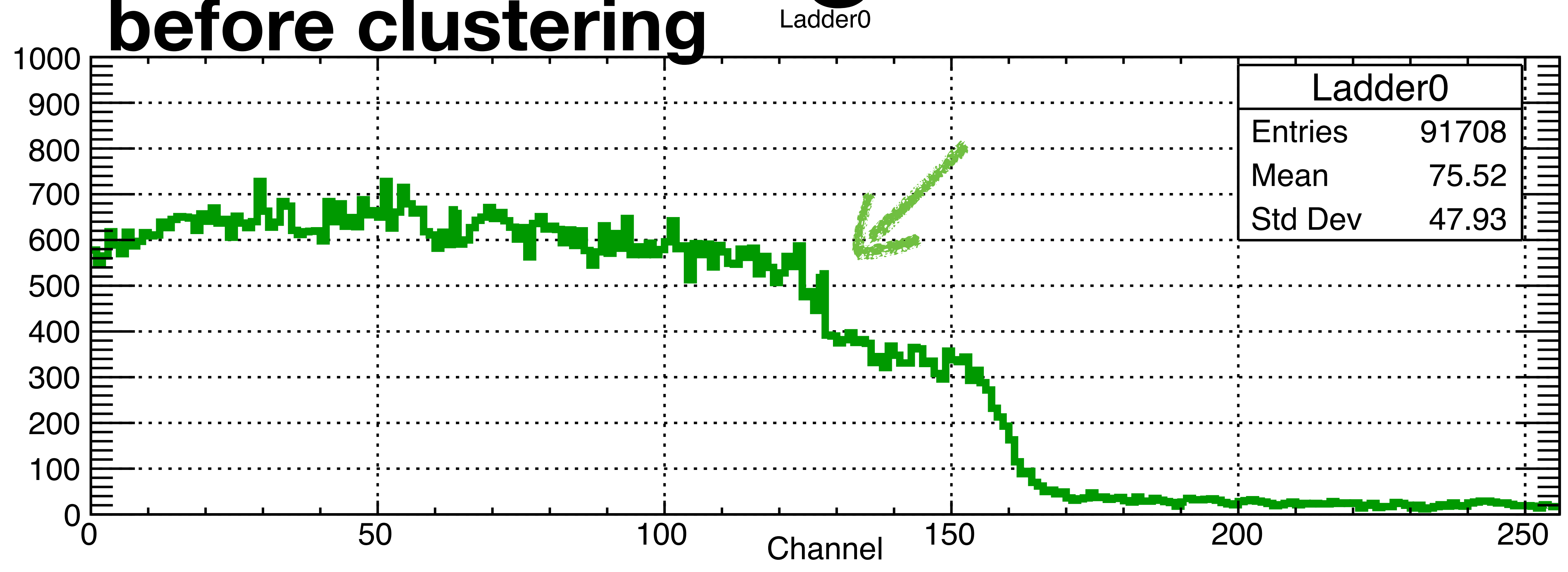
ch0 tends to be noisy? Dist. may not be smooth at the boundary of chip 11&24?

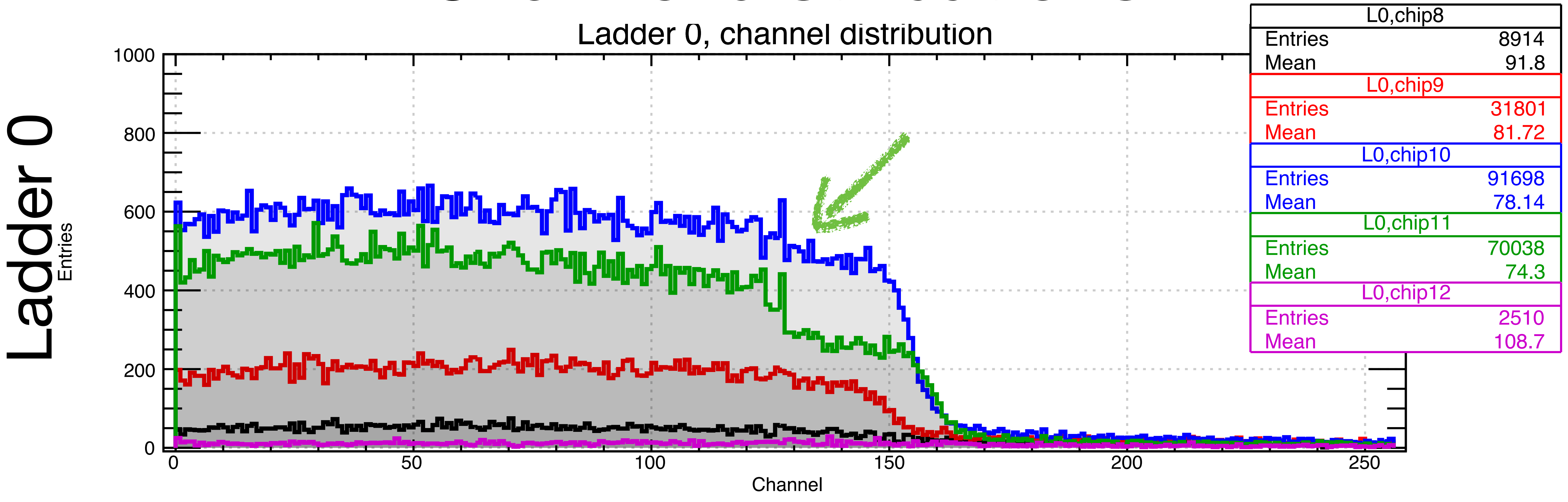
Hits clustering

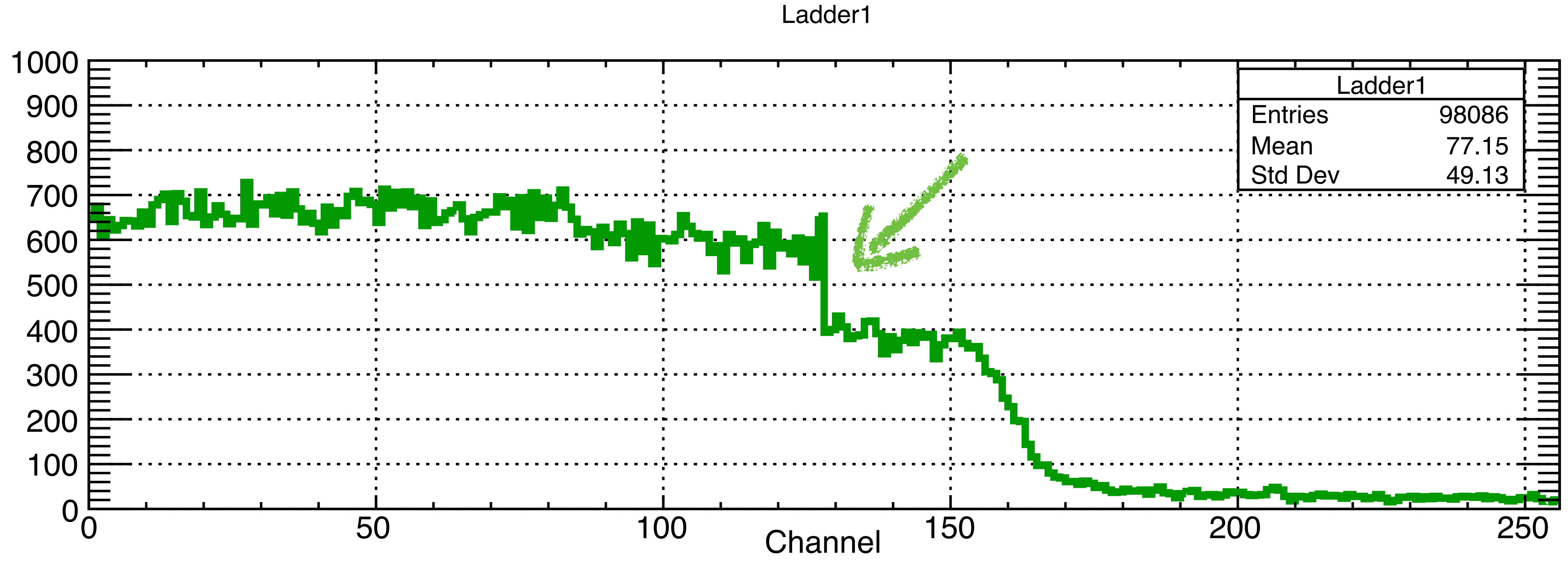
- chip column 8 - 9 - 10 - 11 - 12

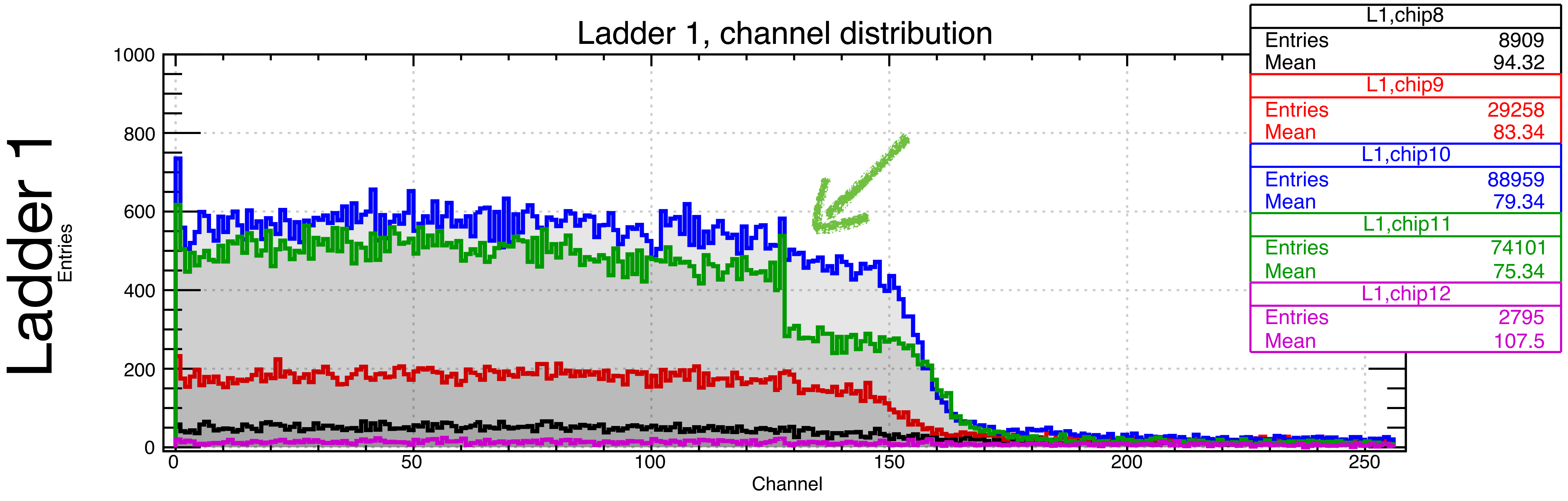
Channel distributions

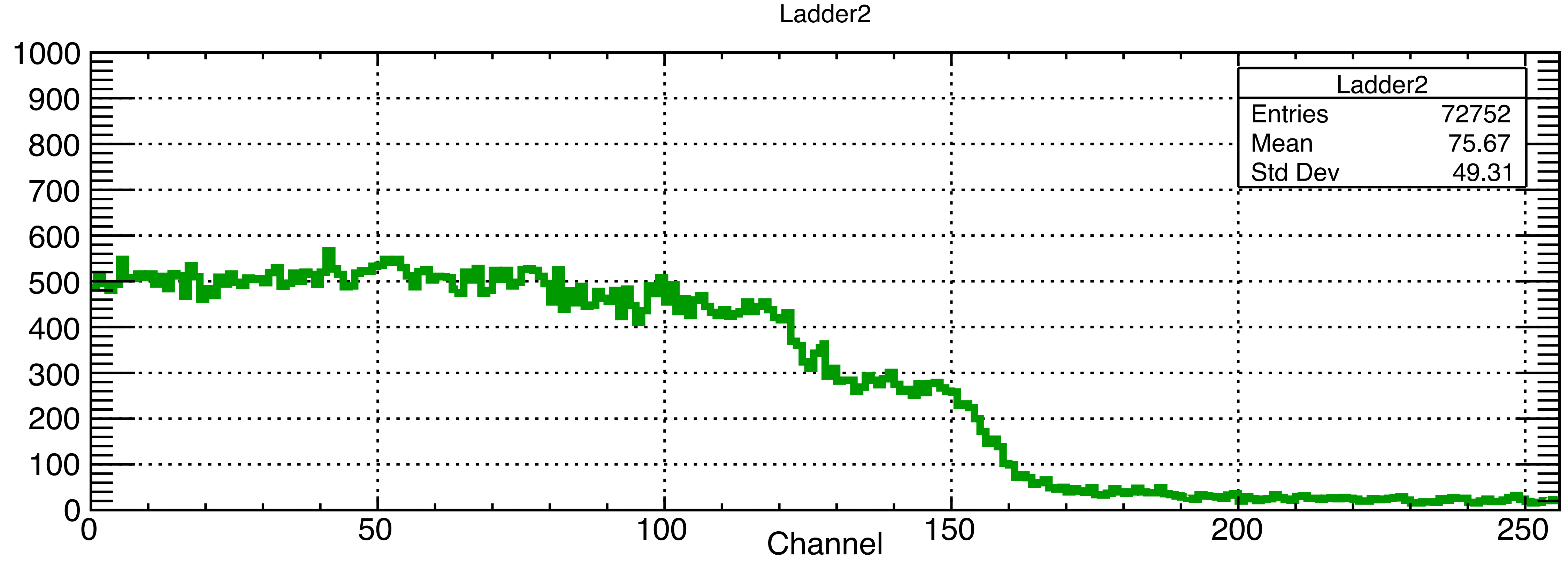
before clustering

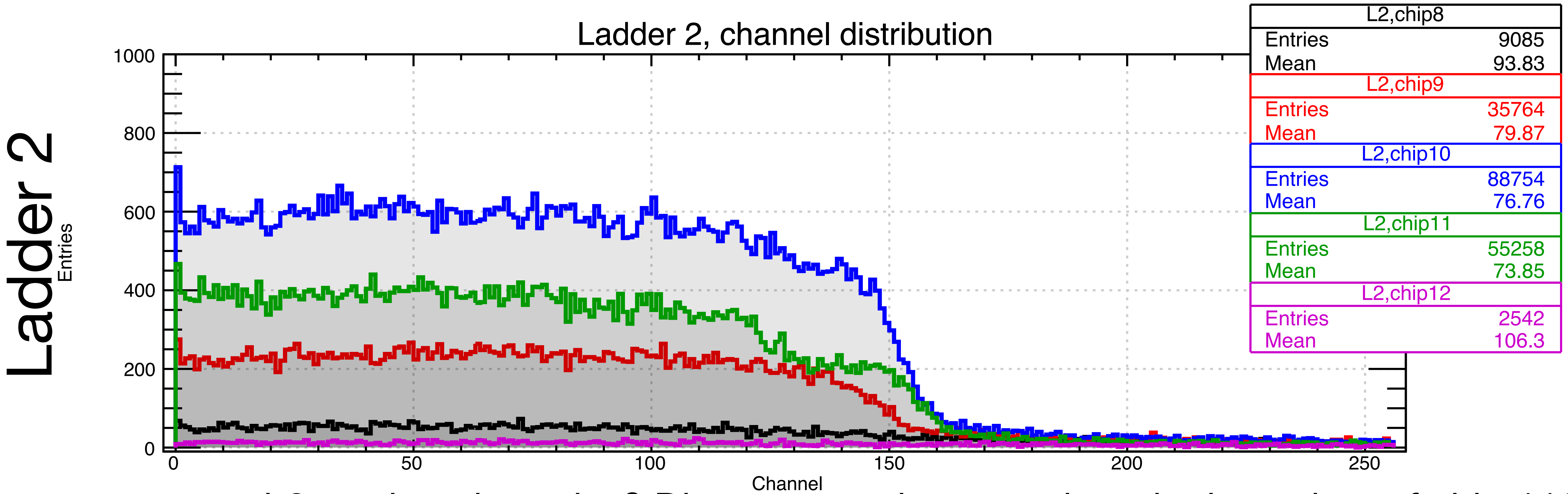












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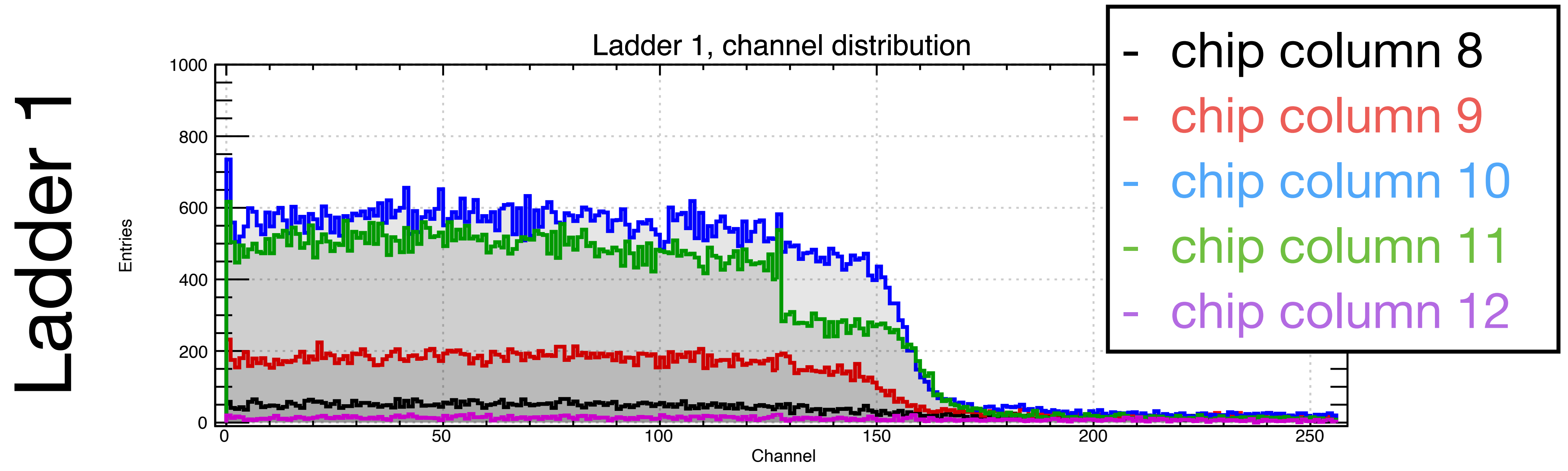
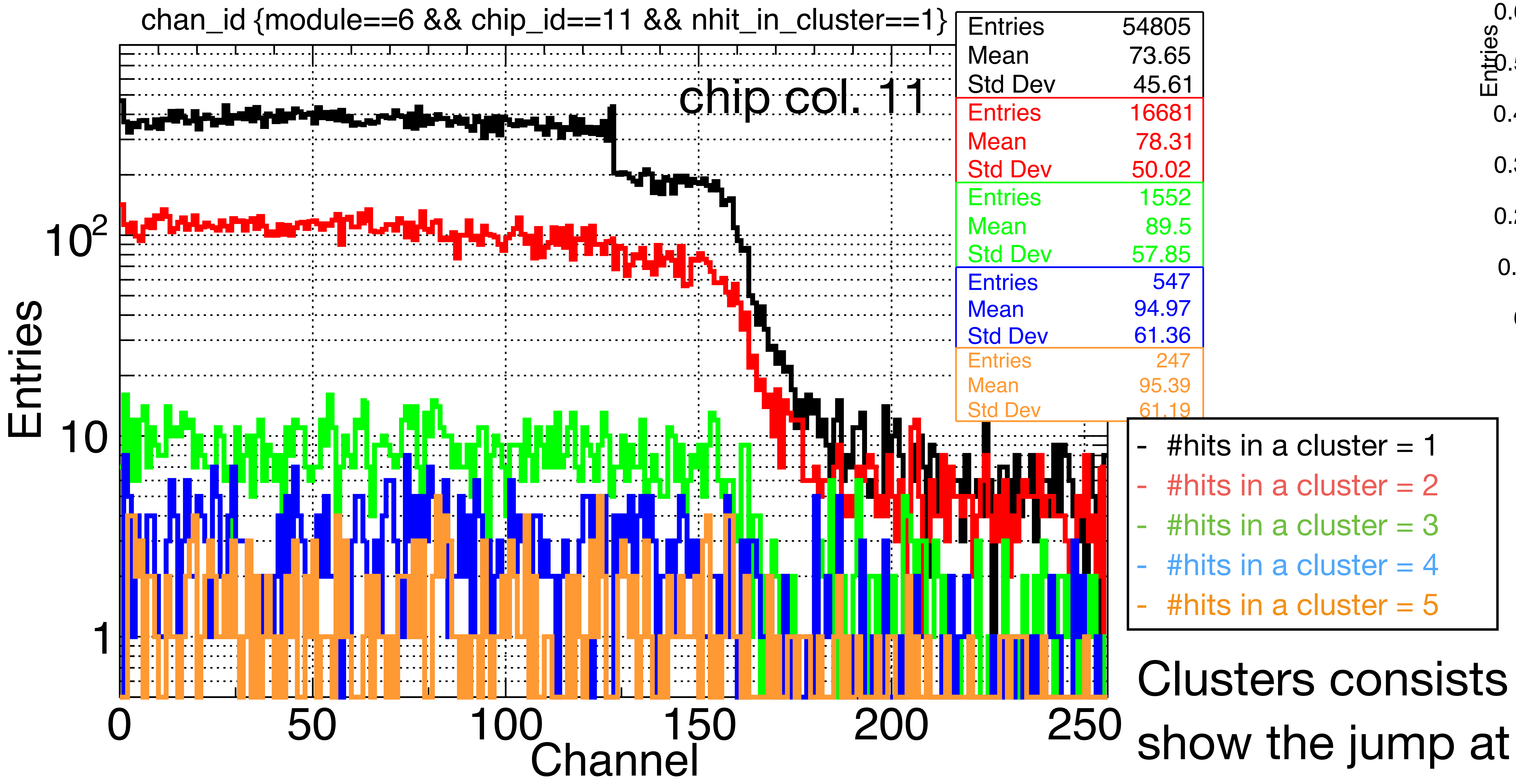
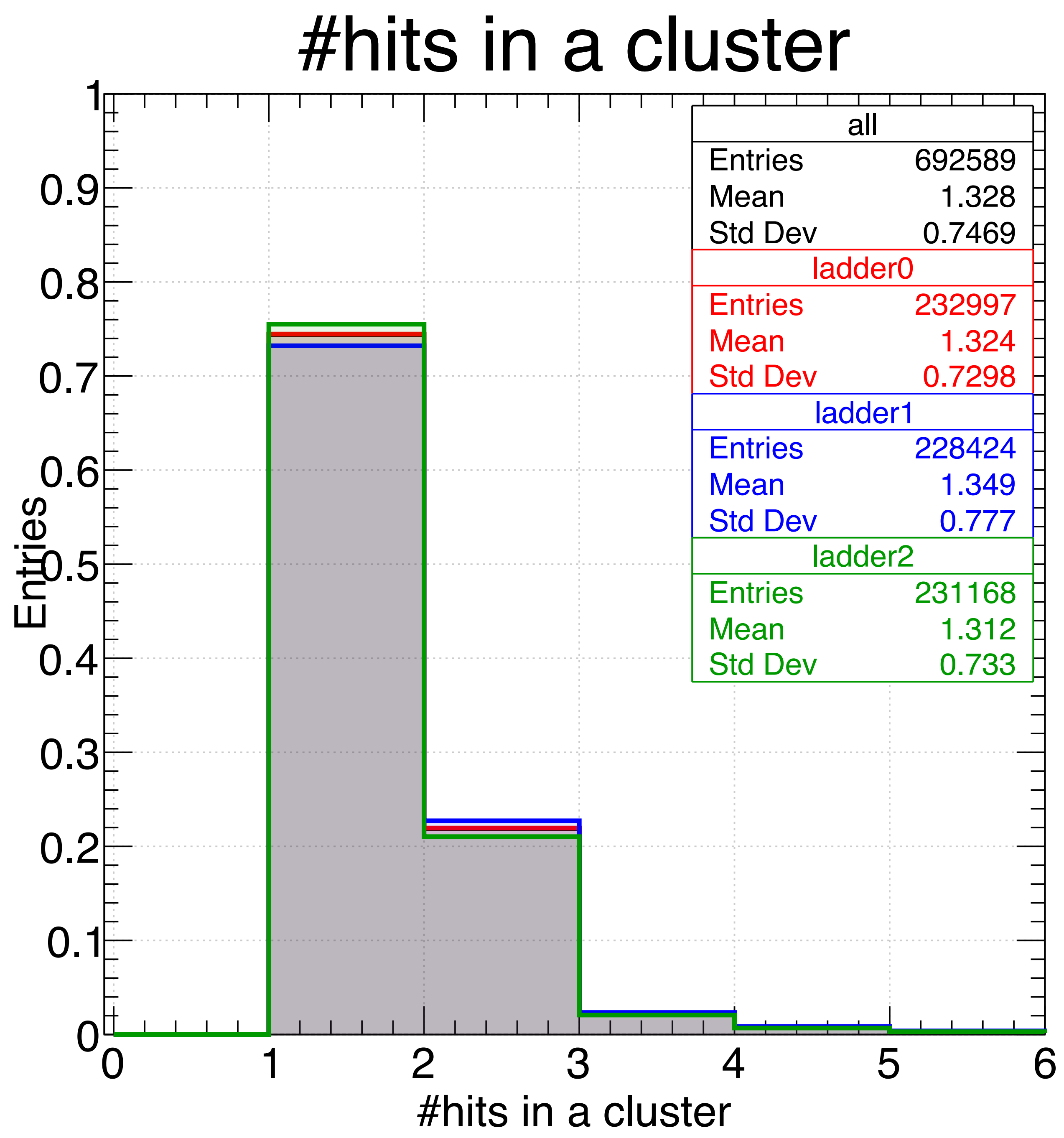
Hits clustering



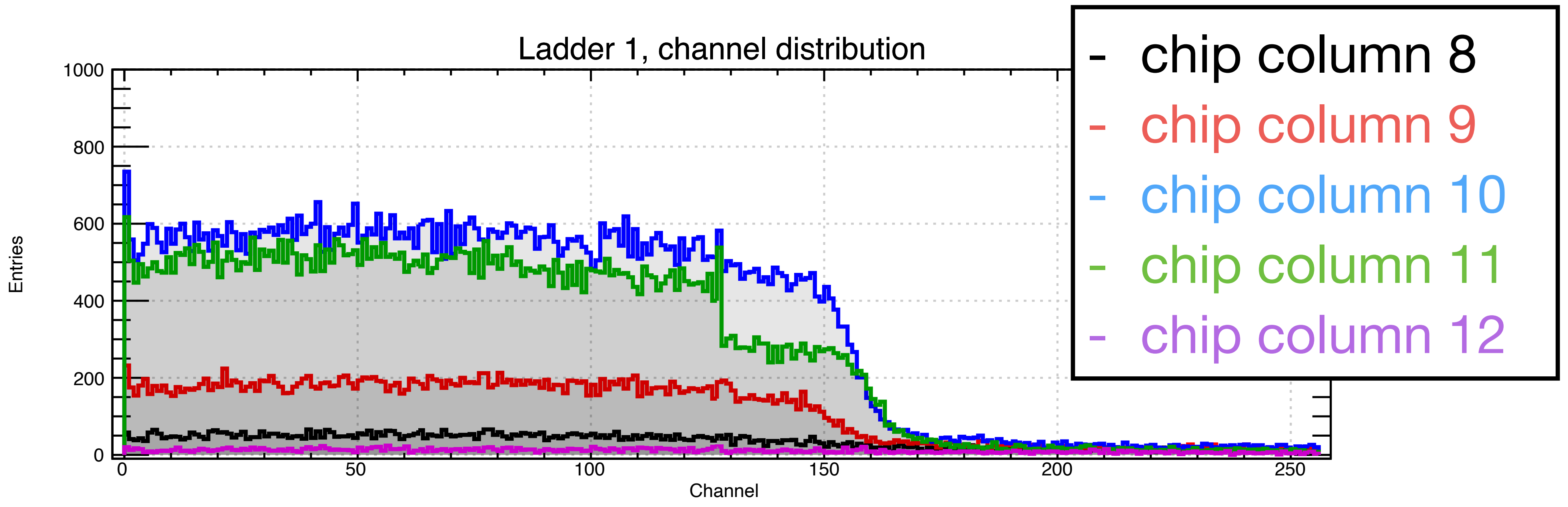




Clusters consists of a single hit show the jump at the chip boundary.

Hits clustering

Ladder 1



1

BCO group

- trigger info
- clock phase

+ group ID

- INTT hits
- INTT hits
- INTT hits

2

BCO group

- trigger info
- clock phase

+ group ID

- INTT hits
- INTT hits
- INTT hits

3

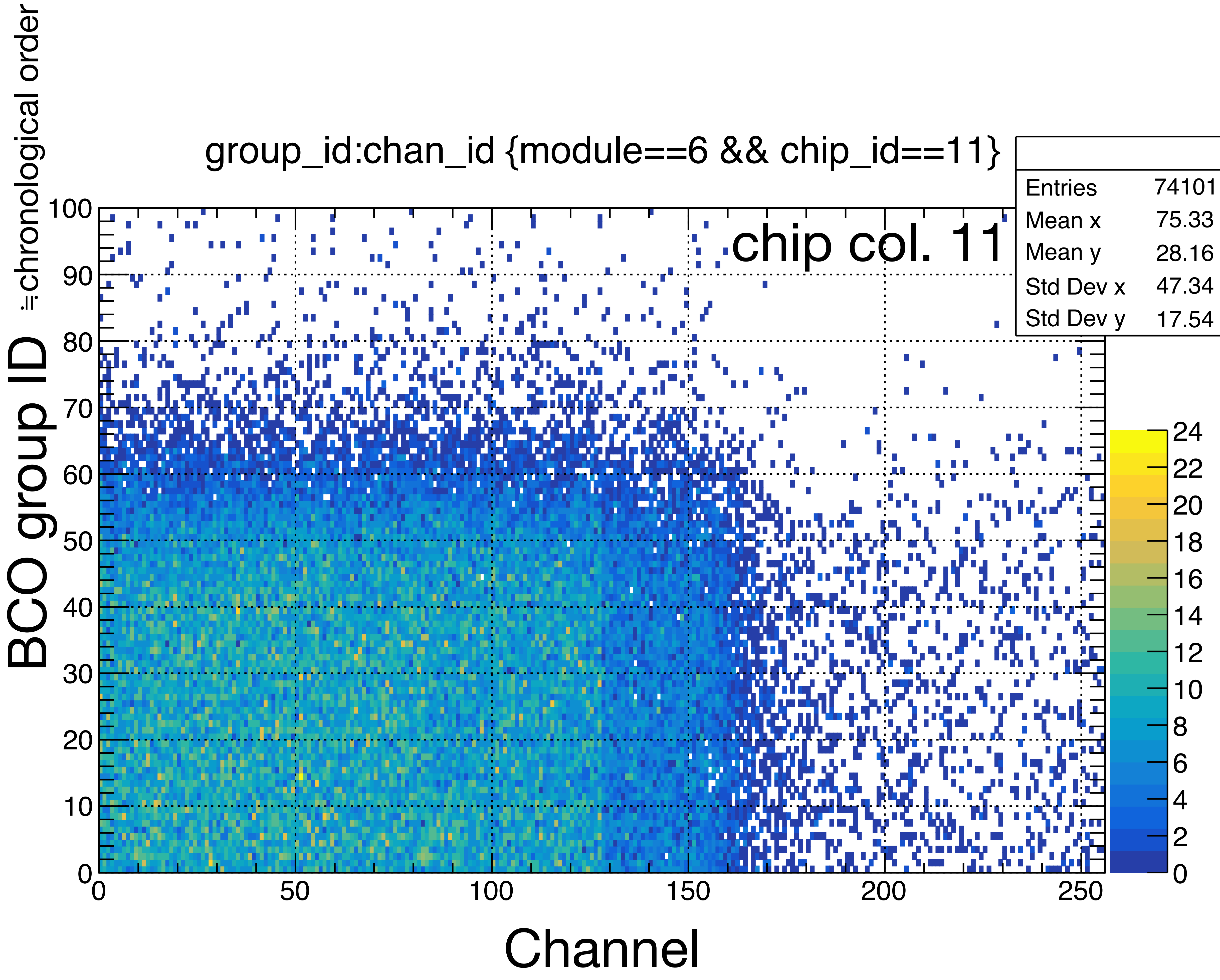
BCO group

- trigger info
- clock phase

+ group ID

- INTT hits
- INTT hits
- INTT hits

・・・・・



No dependency of the jump on the BCO group ID

Hits clustering

Run89 x = +3 cm

Run25 x = +3 cm

Ladder 0

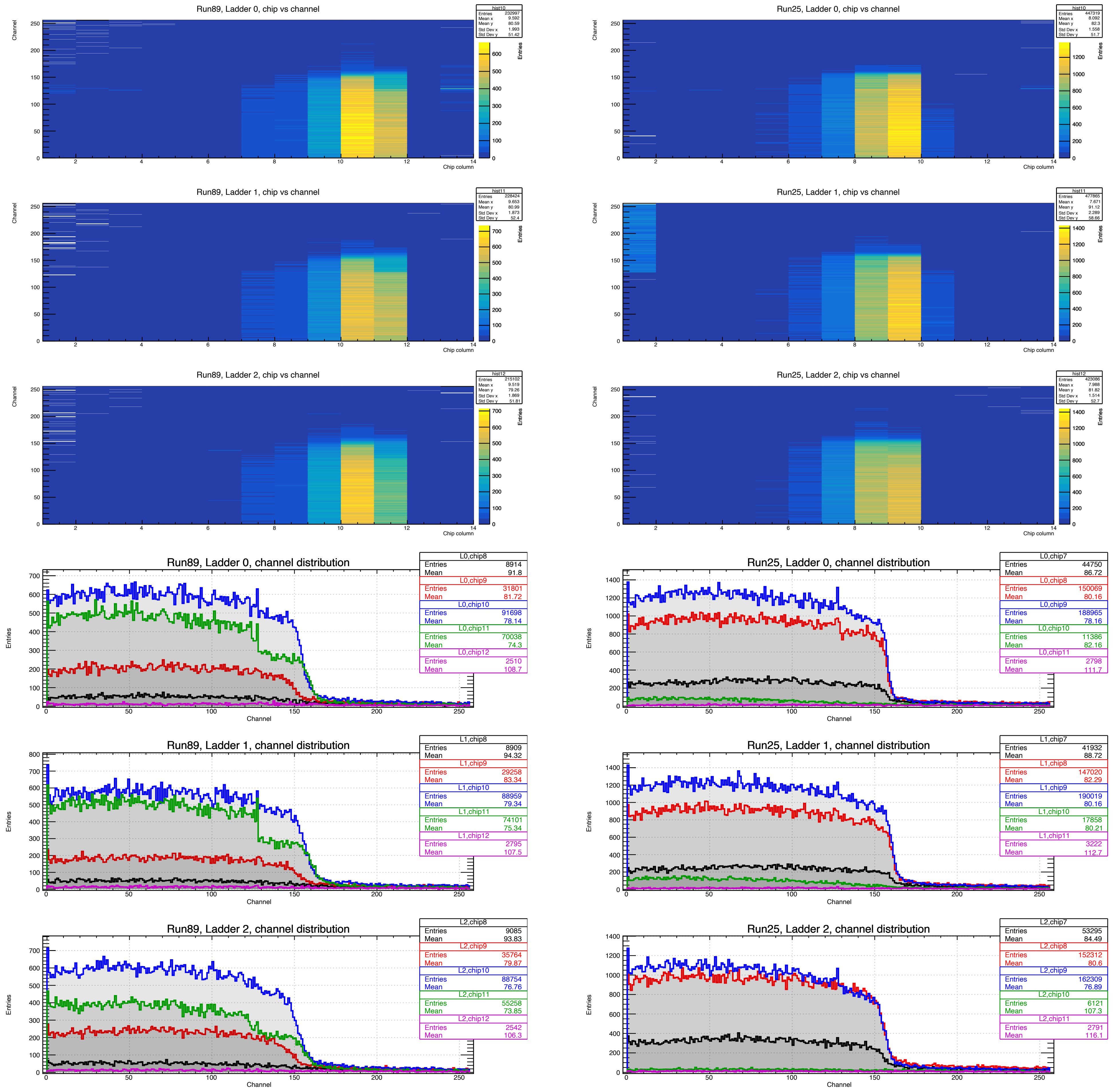
ladder 1

Ladder2

Ladder0

ladder 1

Ladder 2

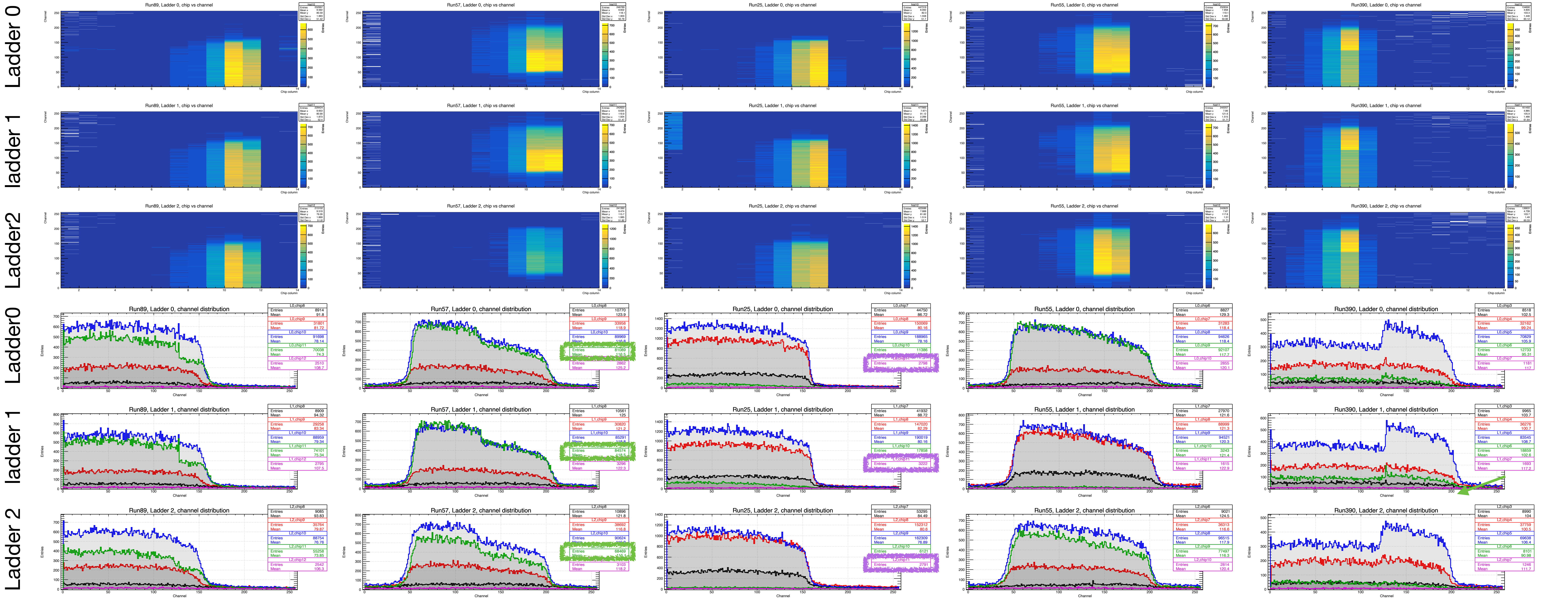


- hot chip column - 2
- hot chip column - 1
- hot chip column
- hot chip column + 1
- hot chip column + 2

Hits clustering

run 36, 37: W 200 μm
run 38, 39: Au 20 μm

Run89	Run57	Run25	Run55	Run36~39
x = +3 cm	x = 0 cm	x = +3 cm	x = +6 cm	x = +9 cm



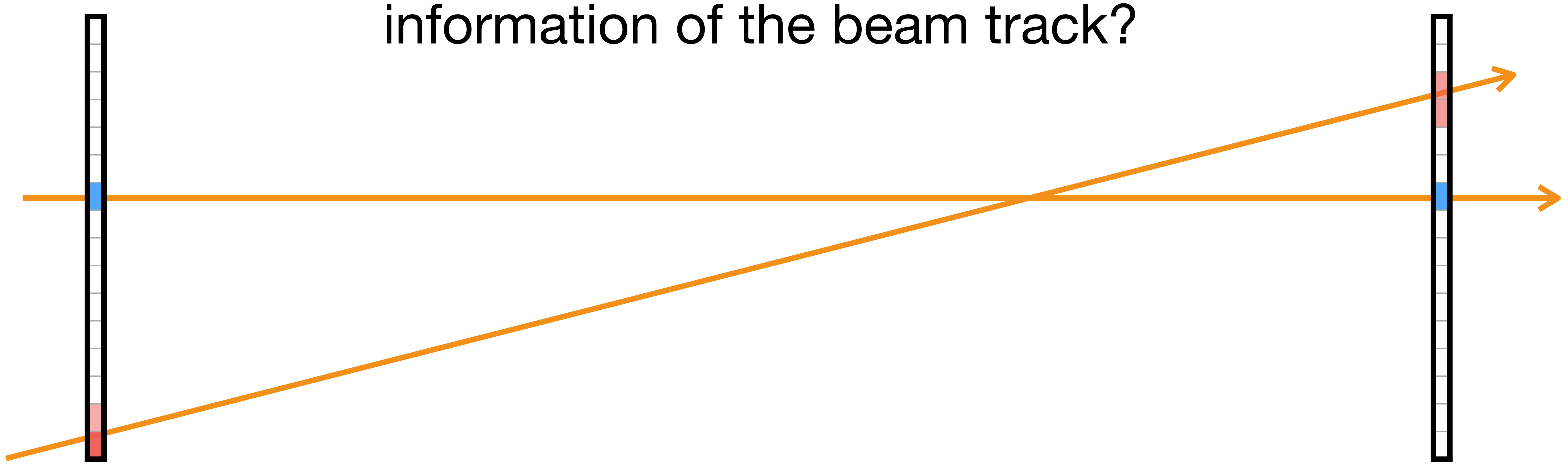
the jump	ladder0, chip11 ladder1, chip11	none	none	none	none

At least, other chips have no jumping structure.
The jump in chip col.11 can be due to noise hits

- hot chip column - 2
- hot chip column - 1
- hot chip column
- hot chip column + 1
- hot chip column + 2

Hits clustering

Does #hits in a cluster have angular information of the beam track?



Beams enter to the silicon with larger angle should across more strips if the scattering angle is enough small wrt the incident angle.

→Larger clusters may be created by beams with larger incident angle.

→→Beams make a larger cluster in a ladder tend to make a larger cluster in the next ladder???

Hits clustering

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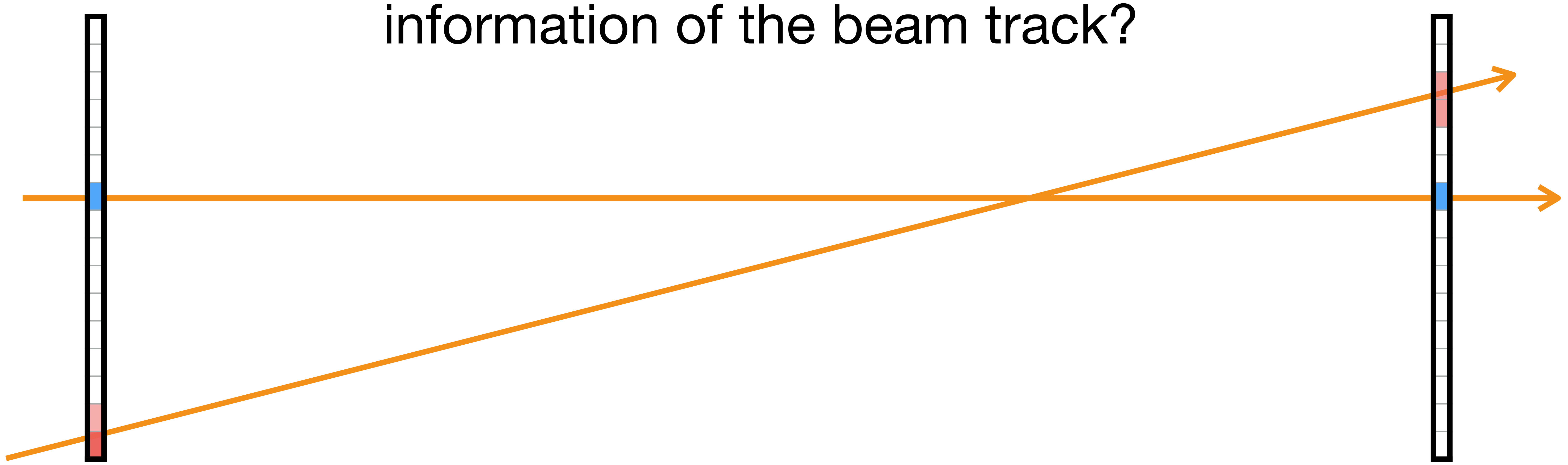

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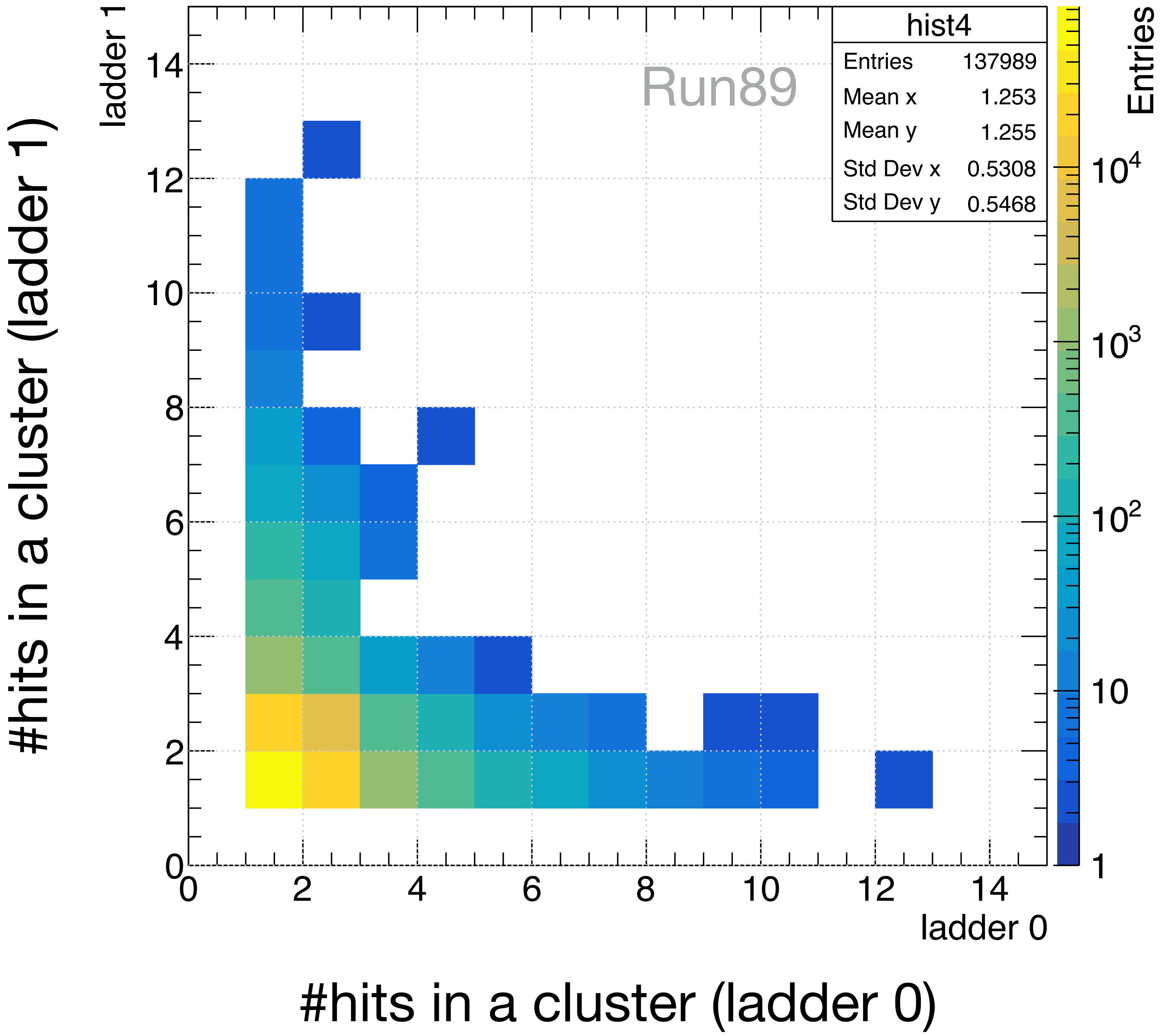

Cuts:

- only 1 cluster for each ladder
- only clusters in chip col. 10

no positive correlation can be seen

Hits clustering

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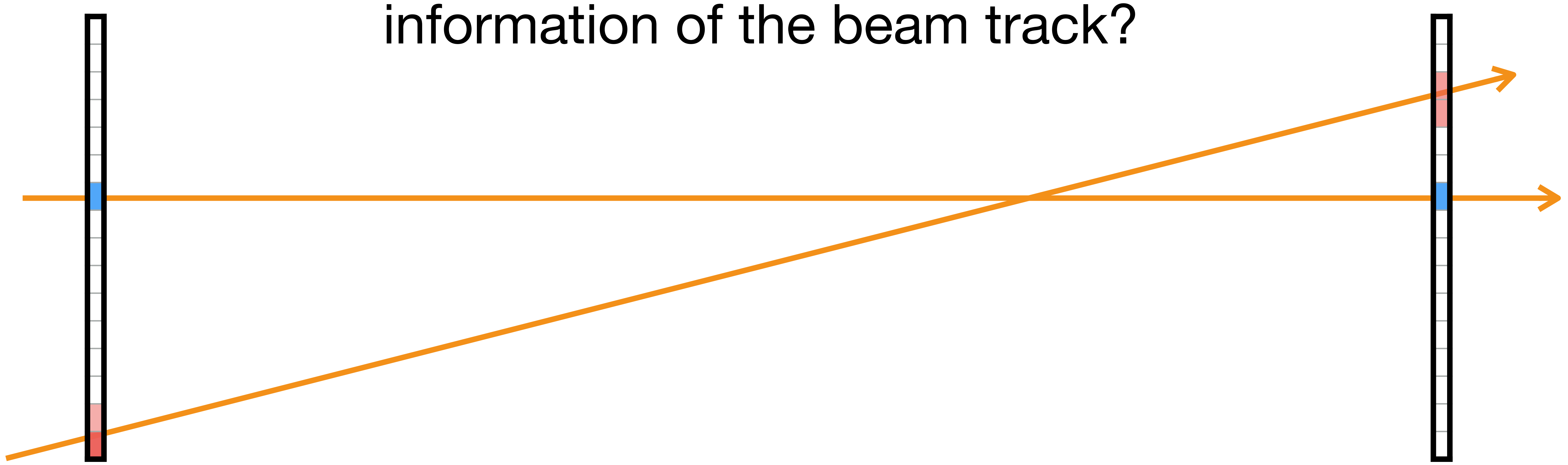

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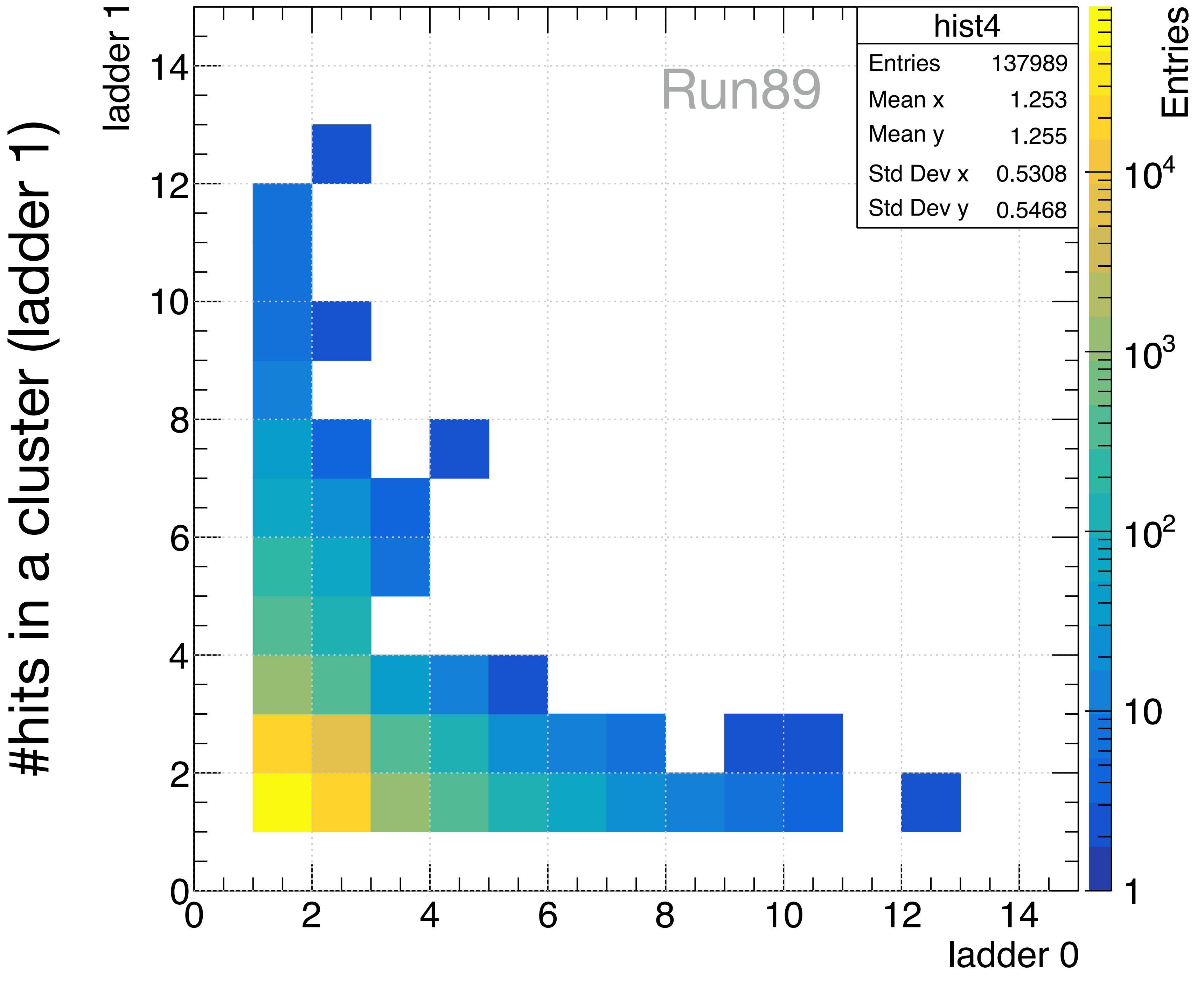

#hits in a cluster (ladder 0)

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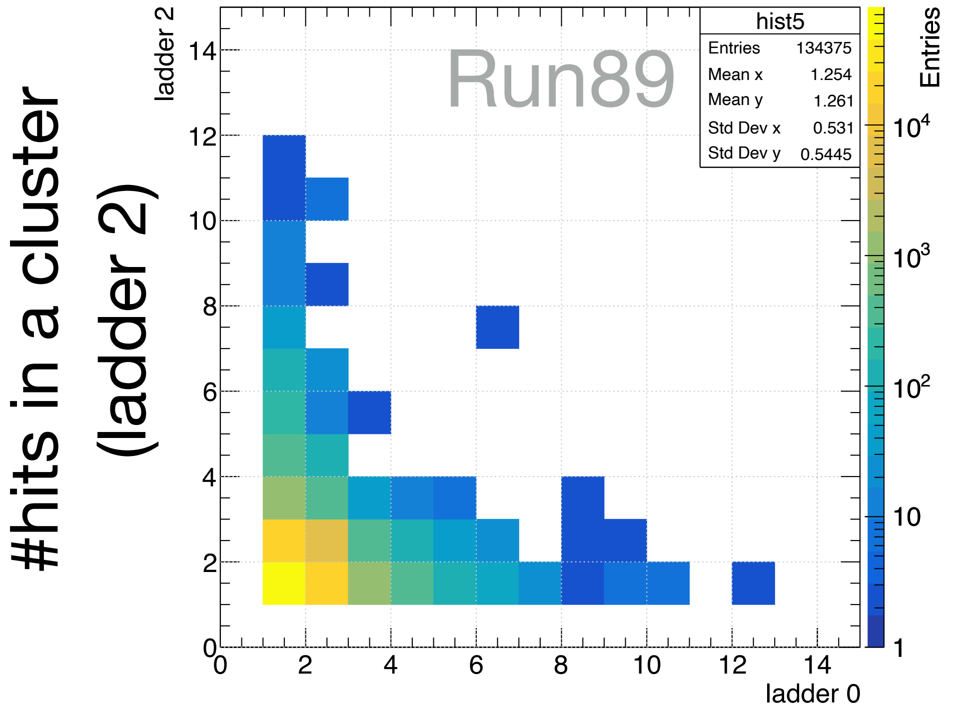

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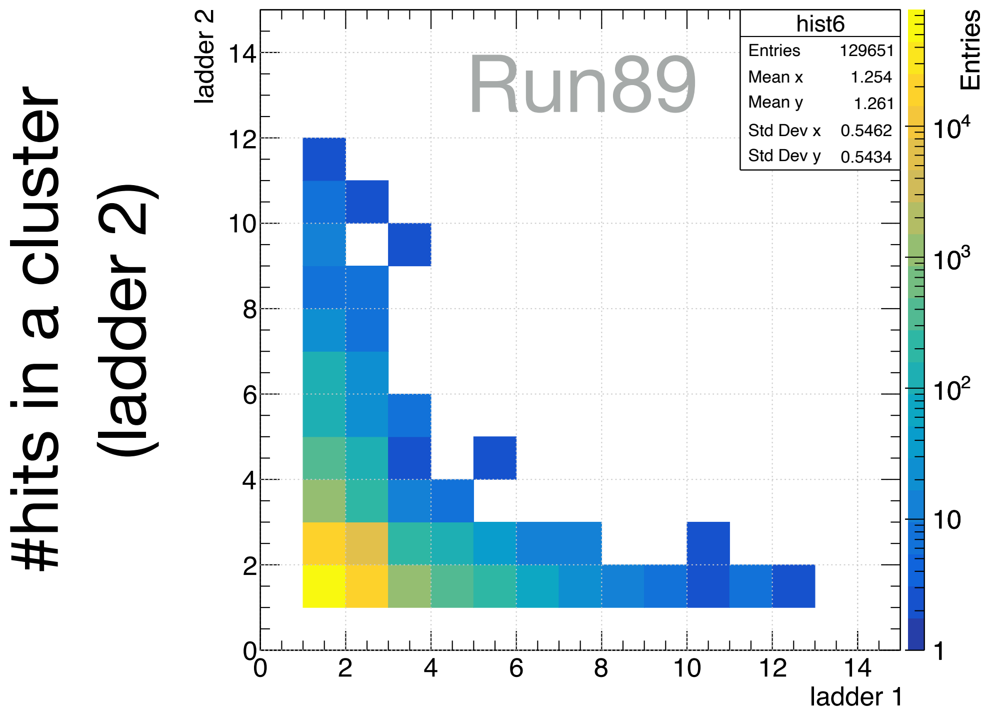
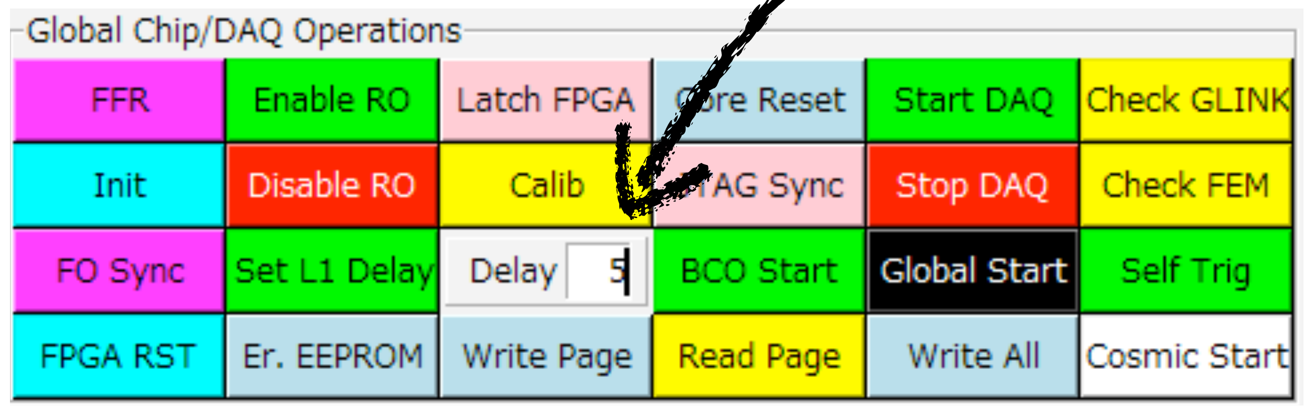


#hits in a cluster (ladder 1)

no positive correlation can be seen

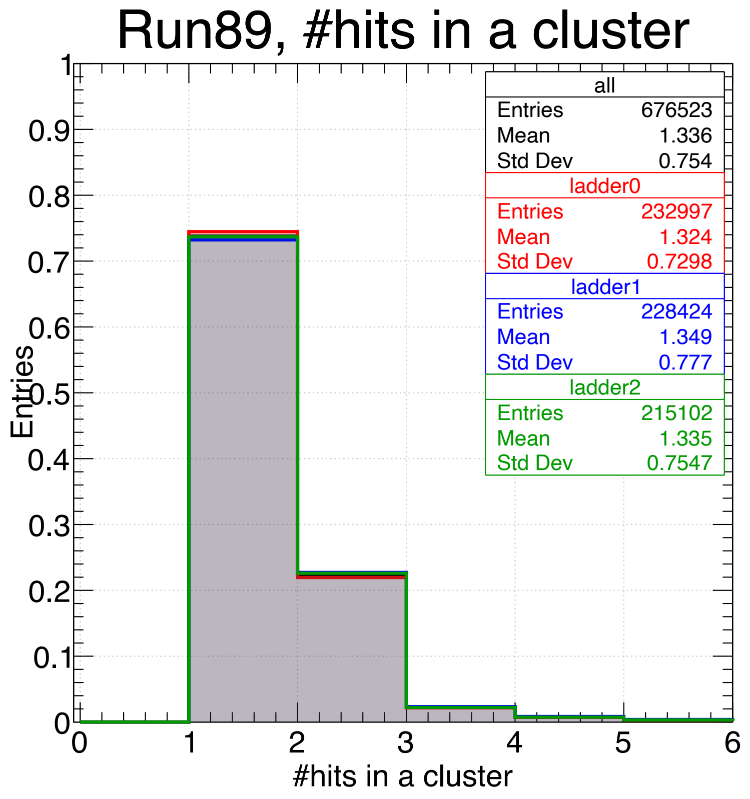
Hits clustering



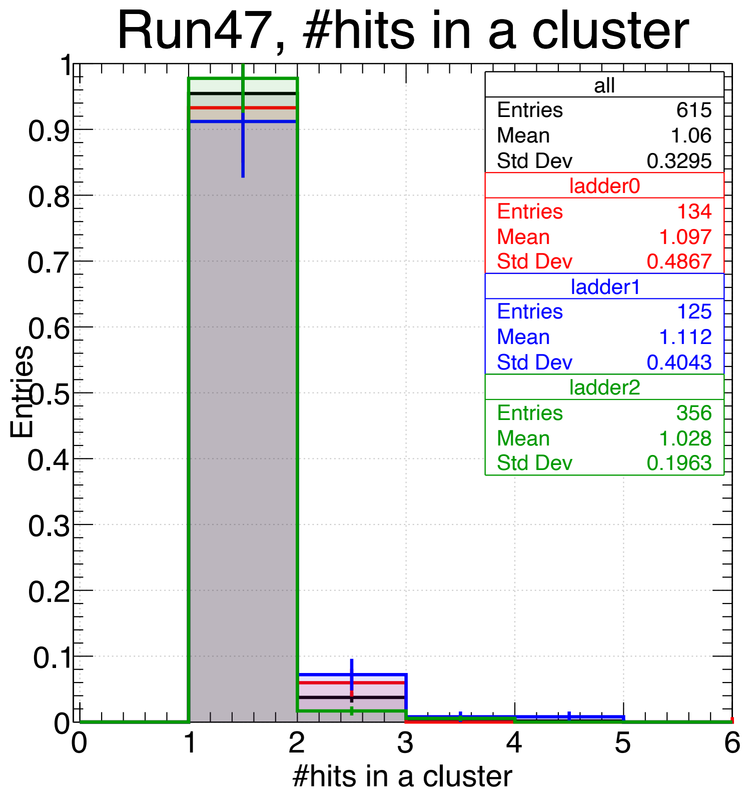
The delay configuration affects to the ladders differently.

- all data
- ladder 0
- ladder 1
- ladder 2

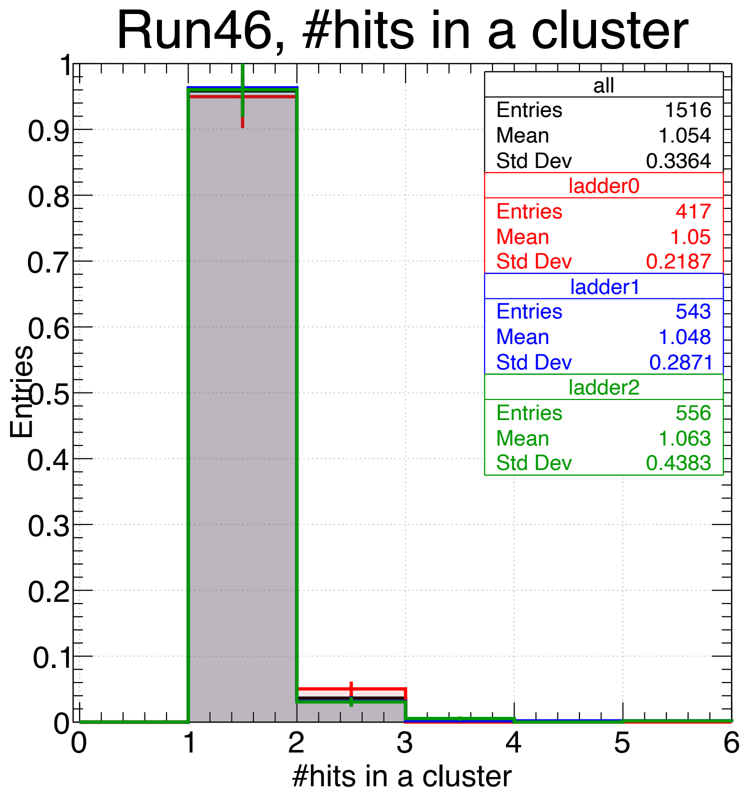
Run89 delay ?



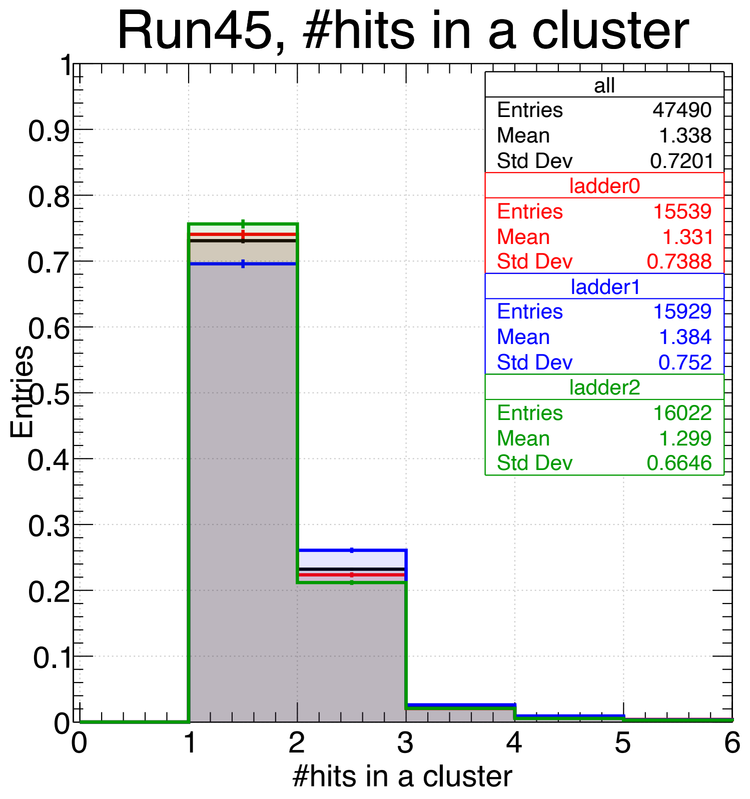
Run47 delay 57



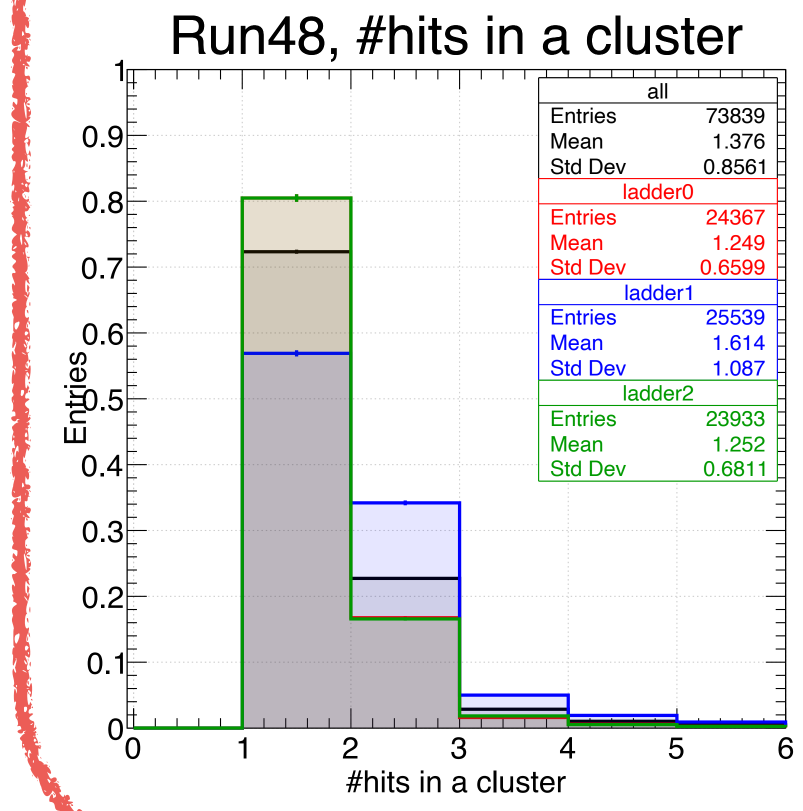
Run46 delay 58



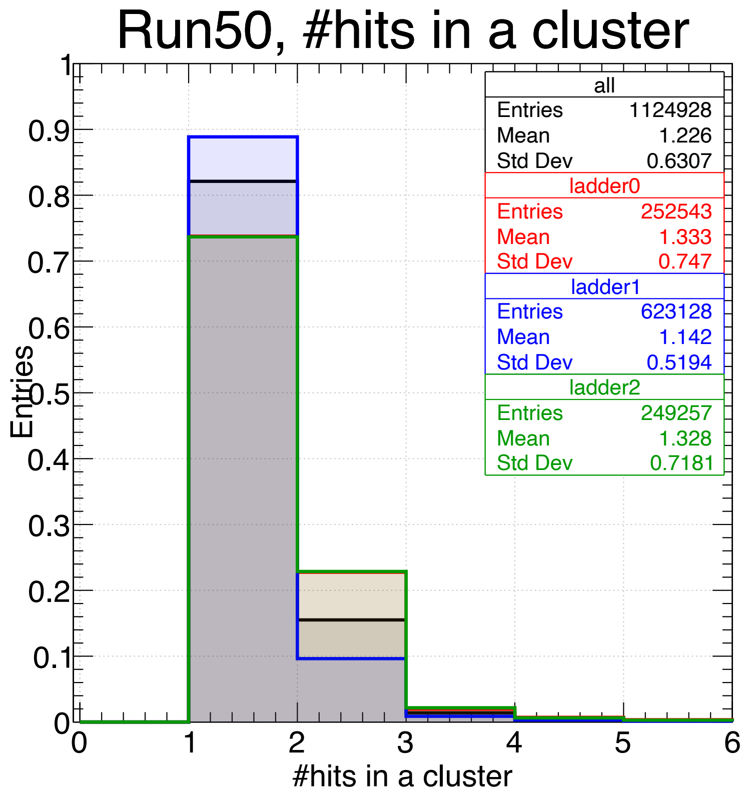
Run45 delay 60



Run48 delay 61



Run50 62



#hits in a cluster

Hits are not retrieved properly if the configuration is too bad.