Data analysis for the detection efficiency

IV

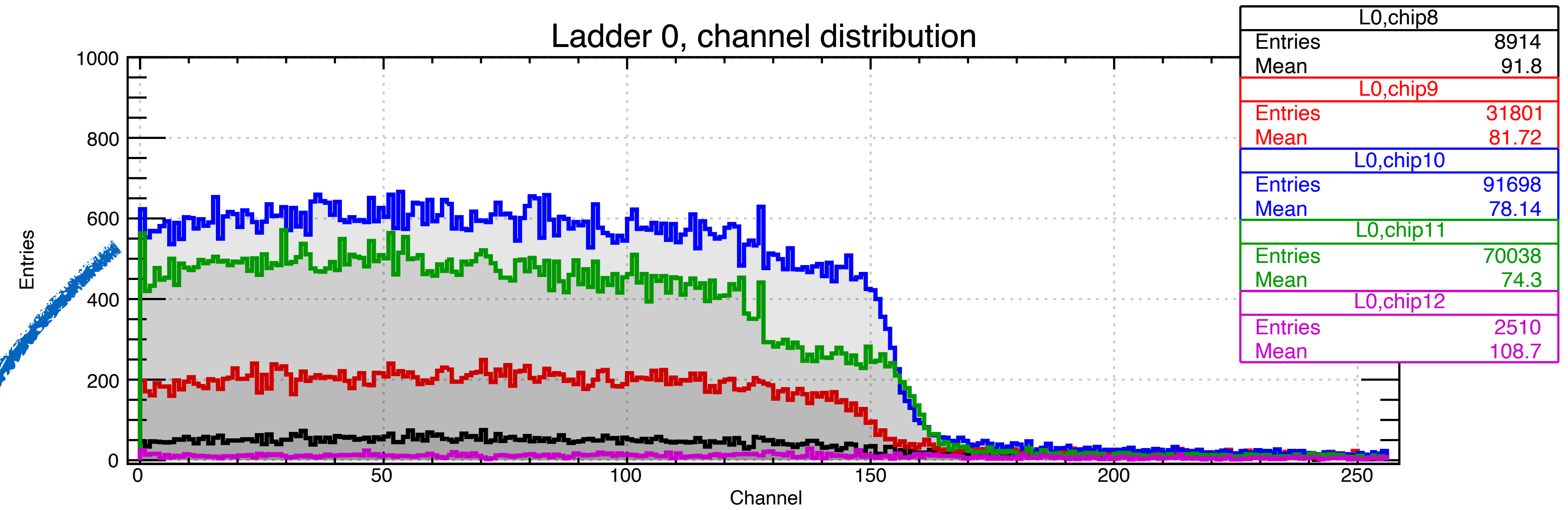
G. Nukazuka (RBRC)

Past reports:

I. Jan/27/2022 (clone hits)
II. Feb/24/2022 (BCO grouping, clustering)
III. Mar/17/2022 (alignment)

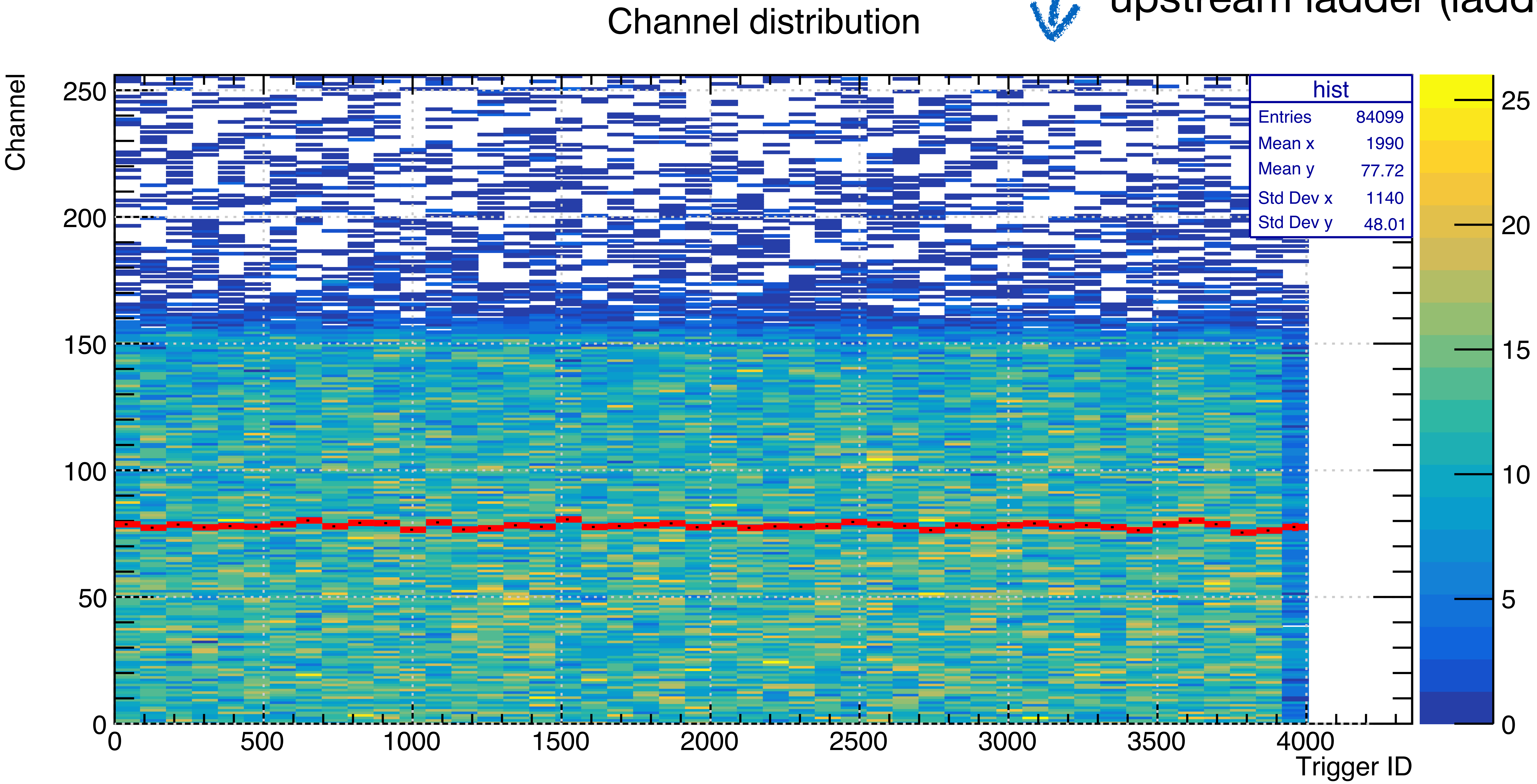
Homework: Beam stability

Run89, channel distributions,
The hottest chip (chip10 for run89)
after clustering

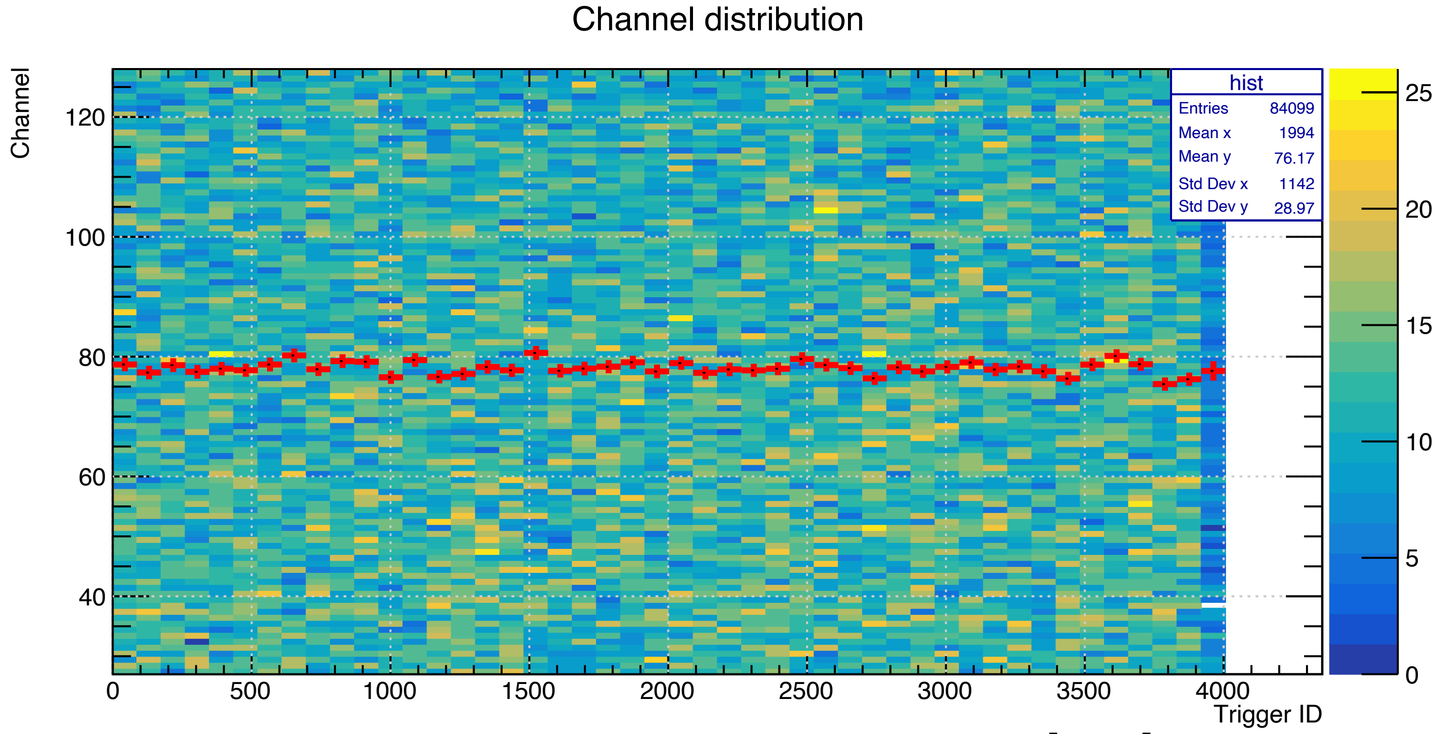


Hits only on the hottest chip of the upstream ladder (ladder0) are used.

Channel of the chip column 10 (chip10&23)



x-axis: trigger ID ~ time
since data was written to a file chronologically.

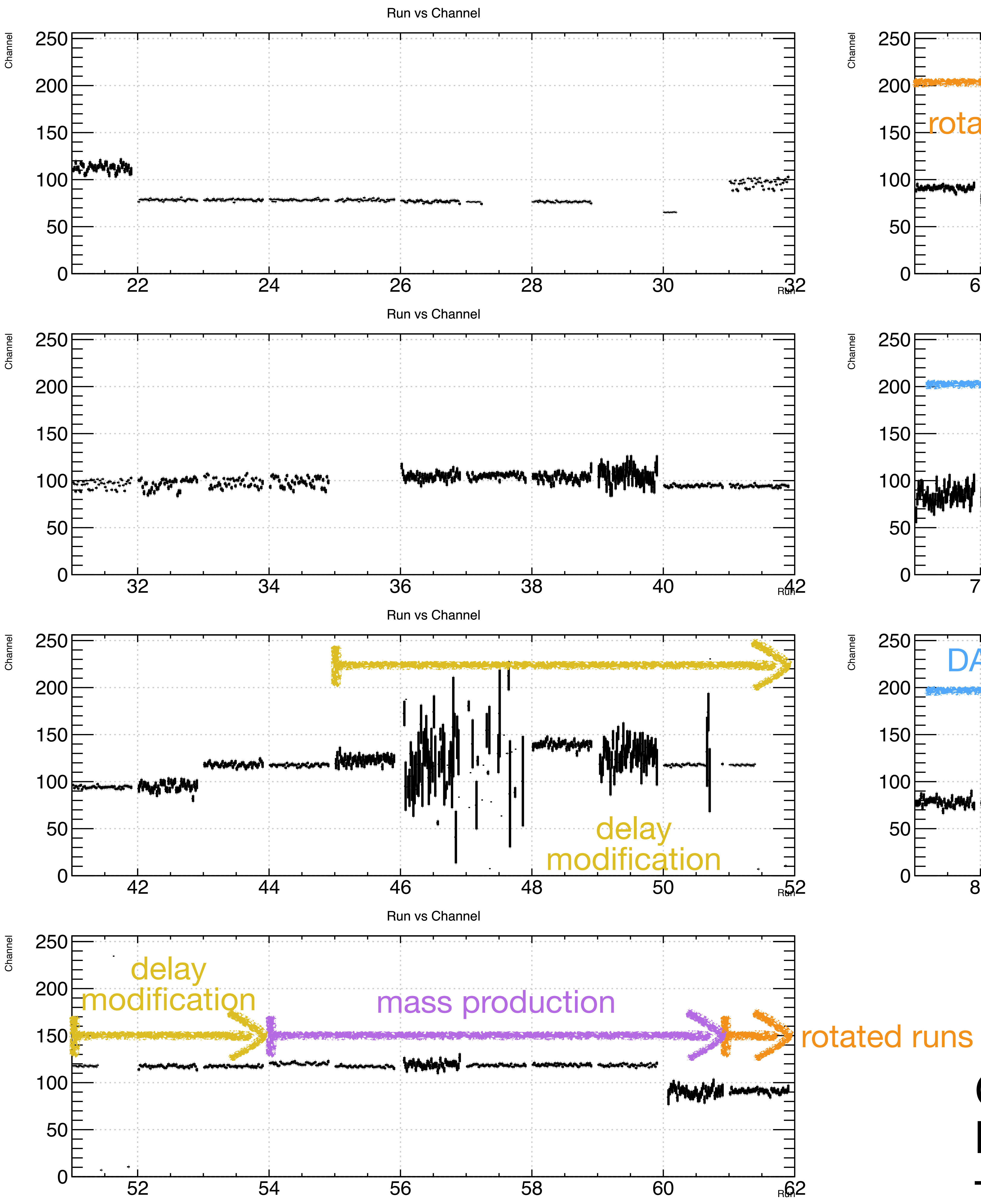


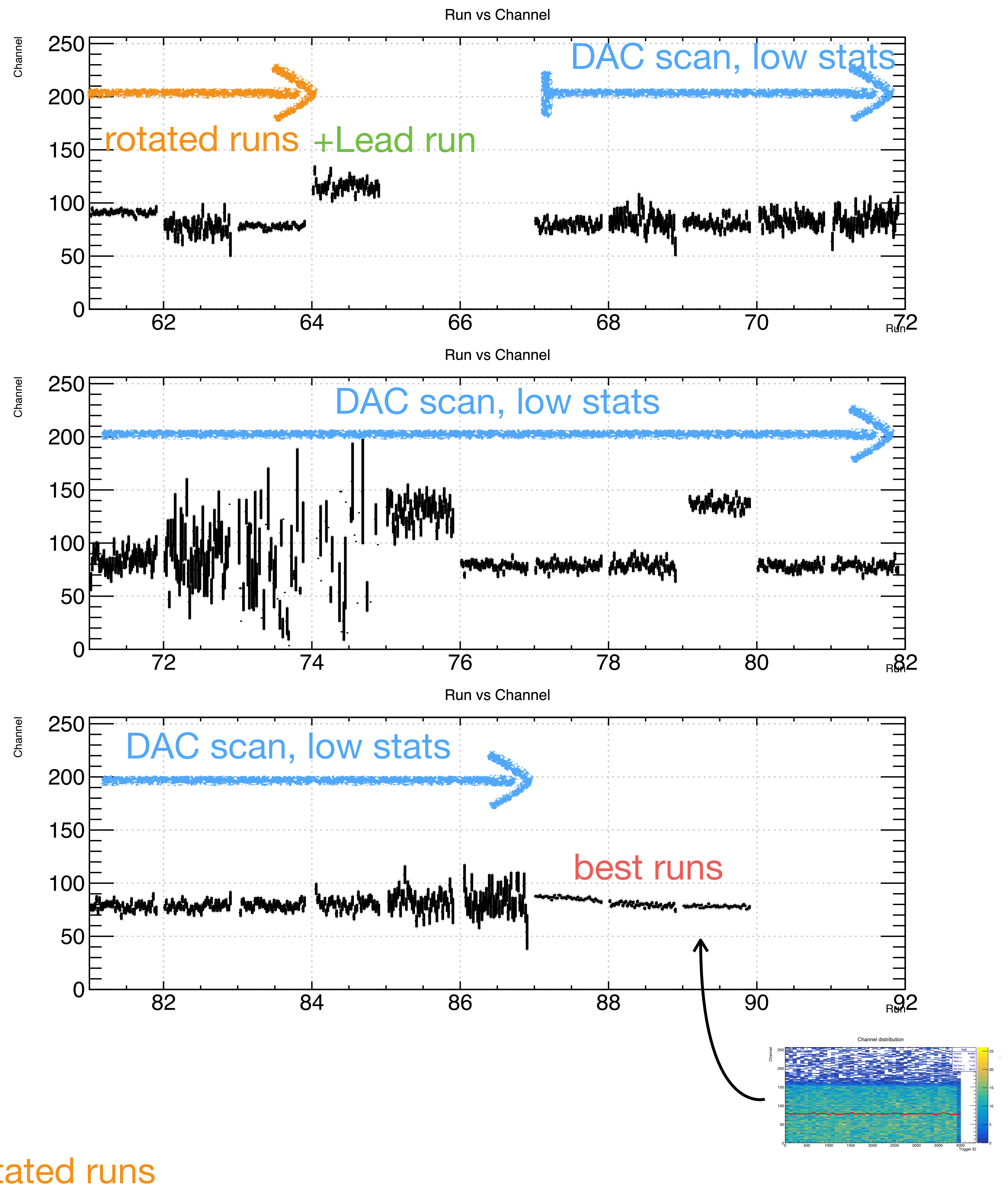
zoomed view

Time dependence of the beam profile in a run is negligible.

Homework: Beam stability

x-axis: #run + trigger ID
y-axis: channel dists. of the hottest chip column

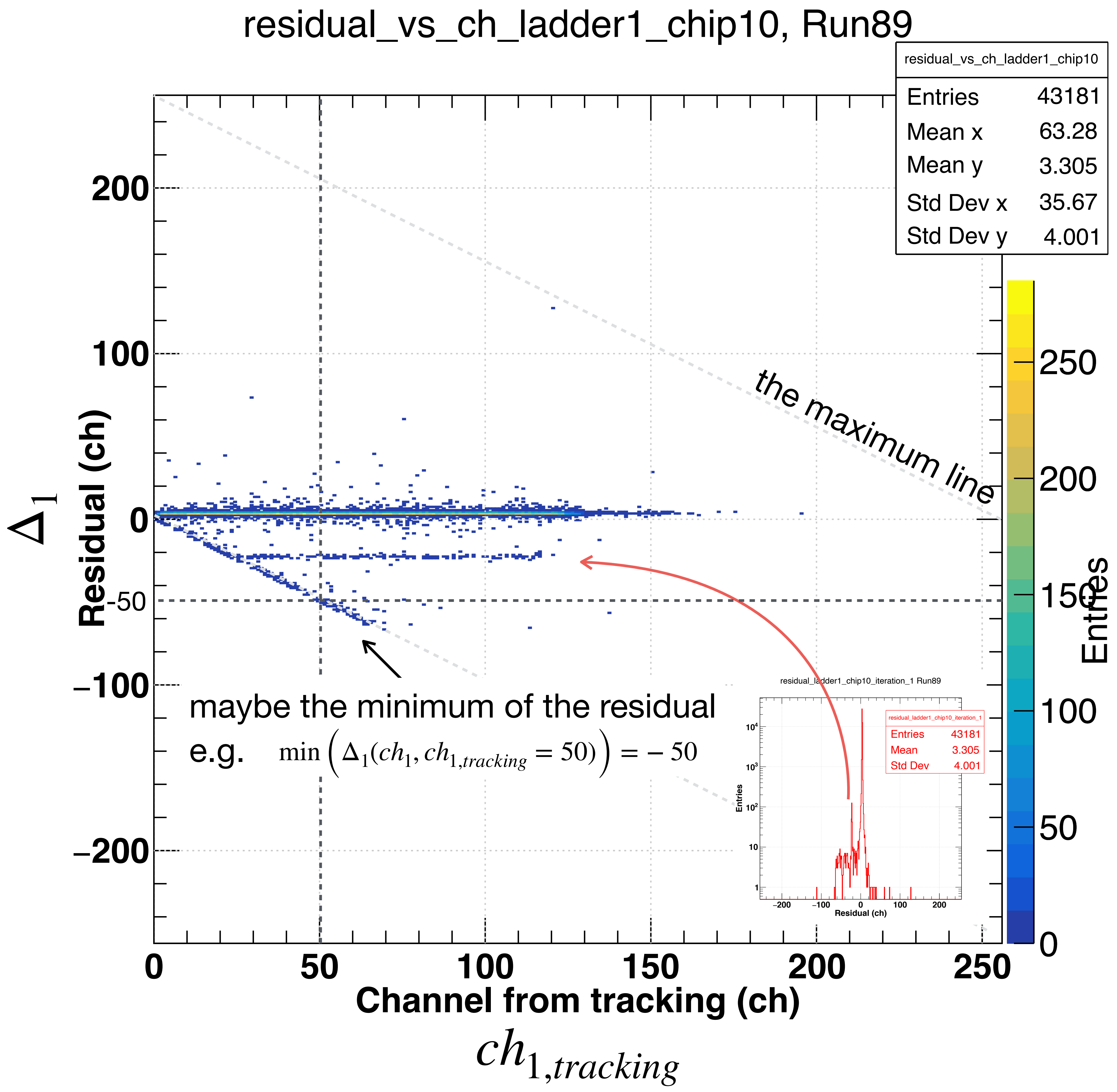




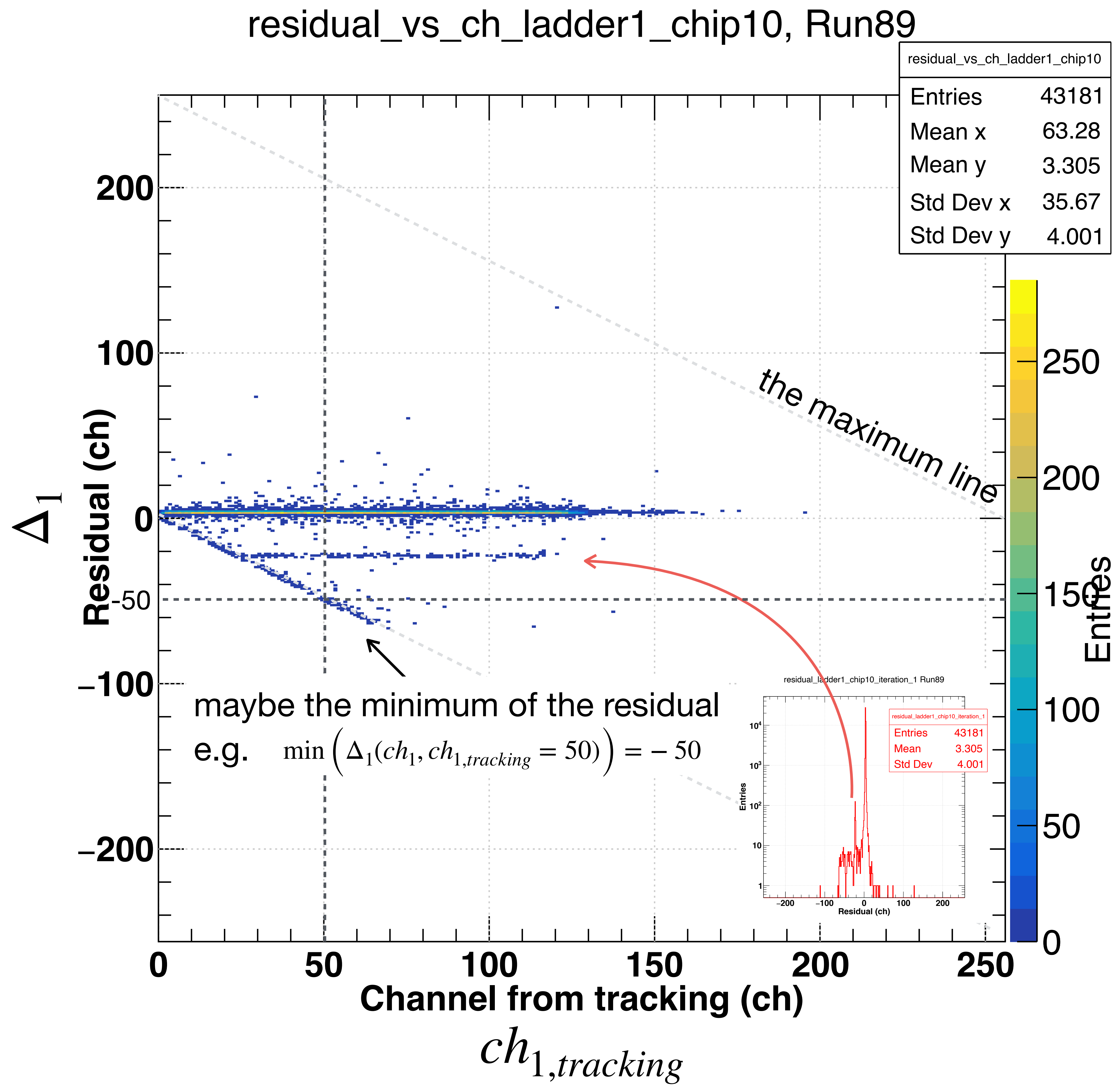
Channel distribution was affected by our activity.

The beam was more or less stable.

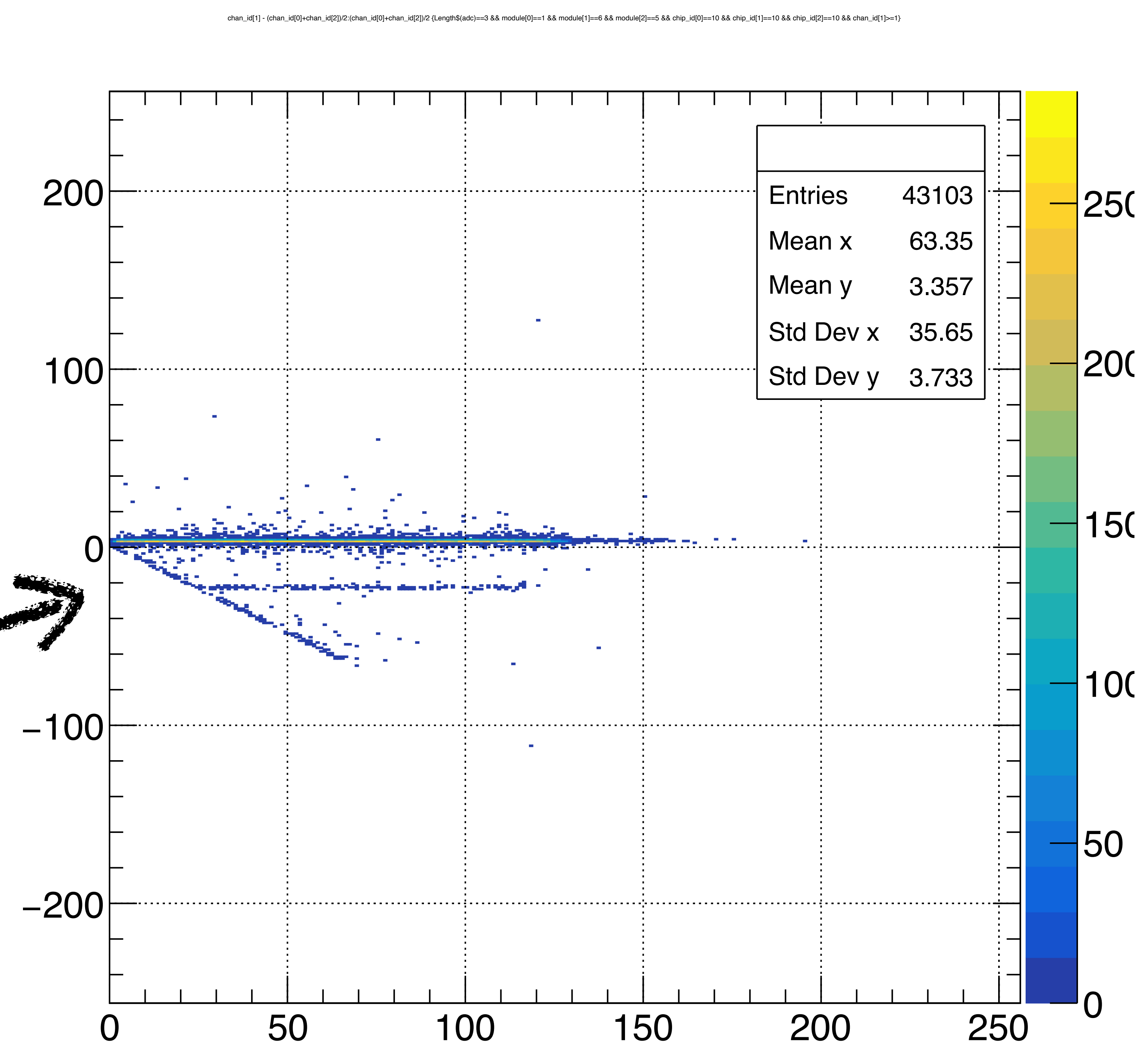
Homework: Can I remove the lines ?



Homework: Can I remove the lines ?

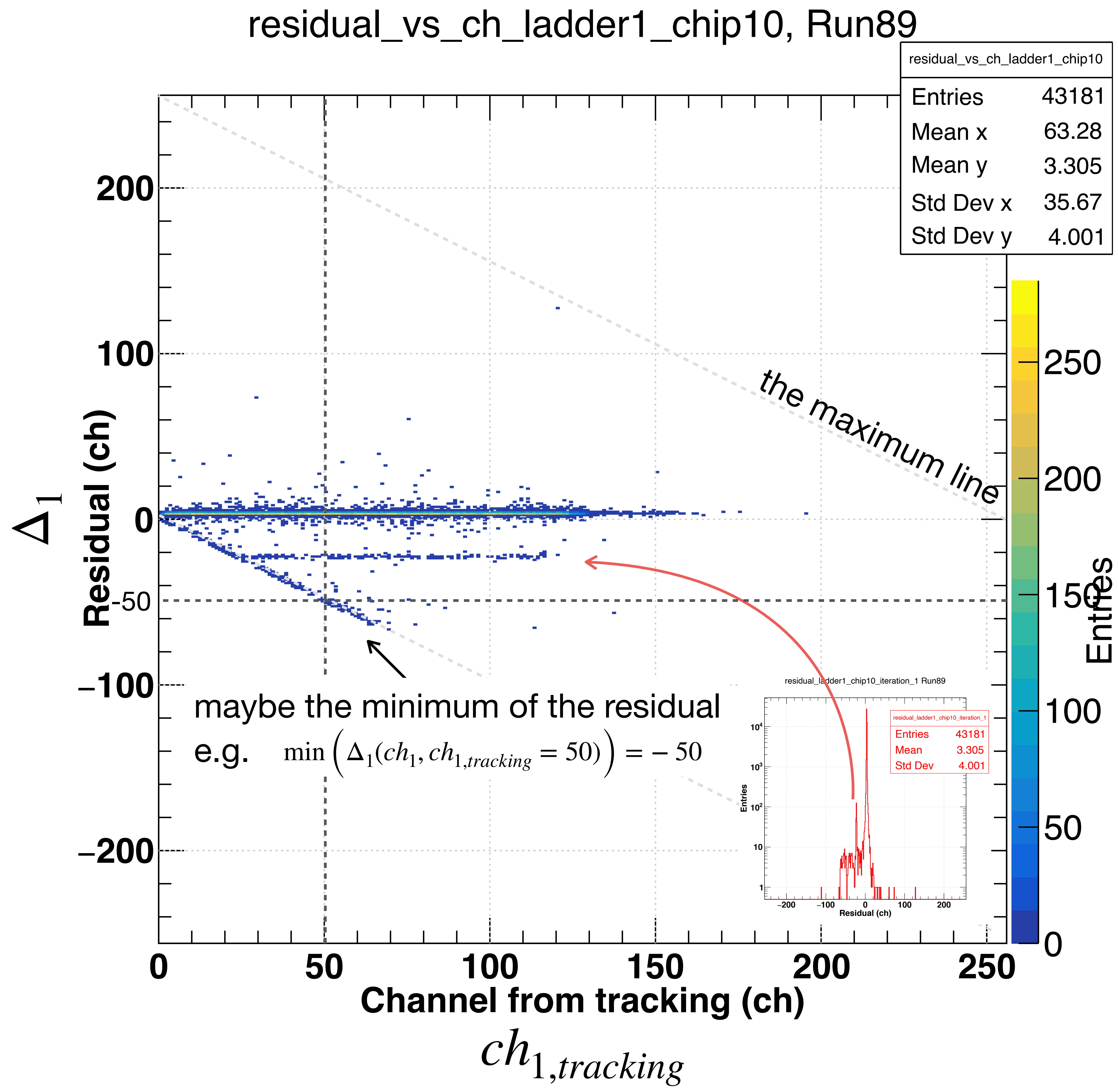


masking ch0 of the ladder1 (1≦ ch_1)

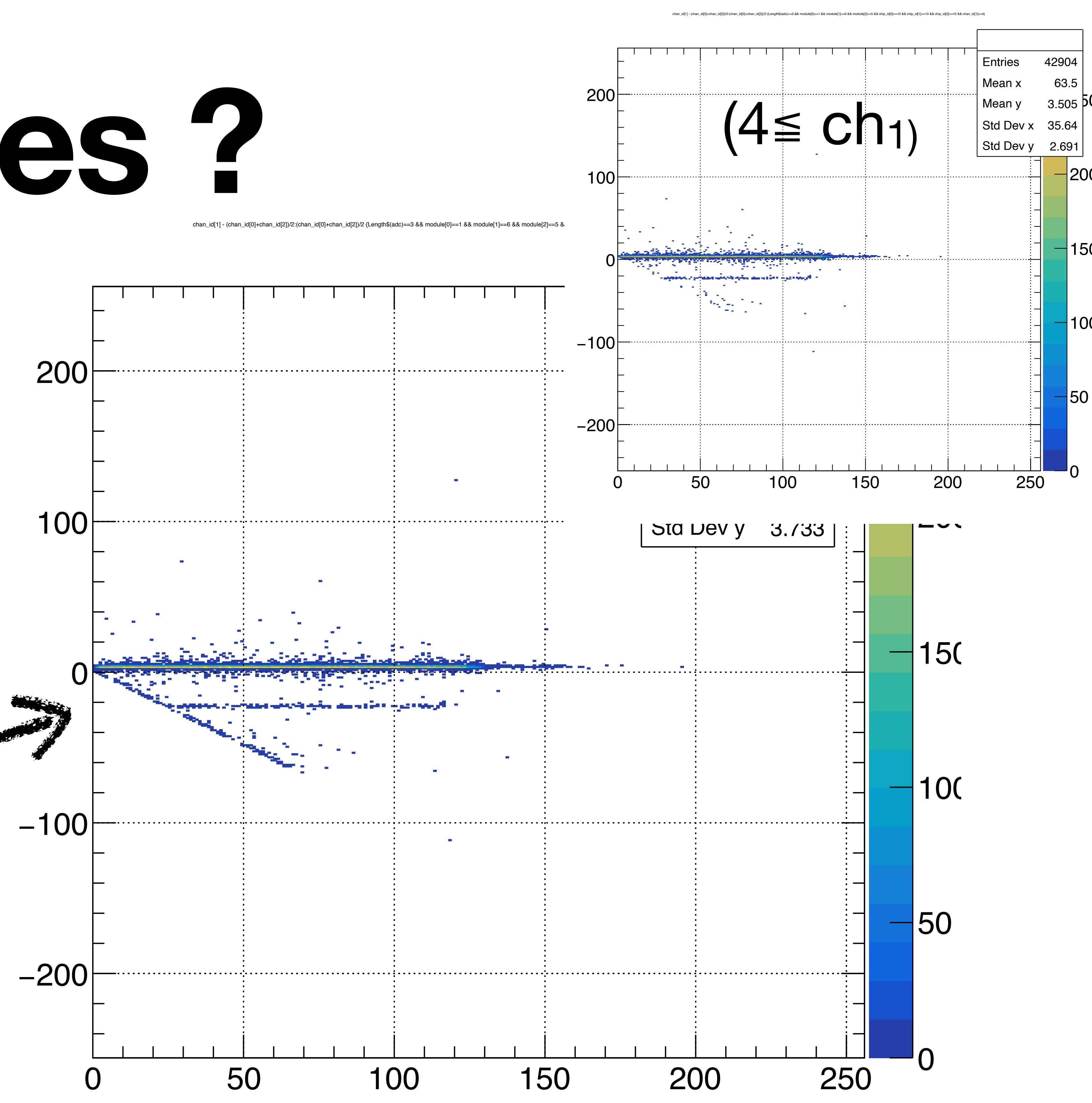


The minimum line gets slightly narrower but exists clearly.

Homework: Can I remove the lines ?



masking ch0 of the ladder1 ($1 \leqq ch_1$)



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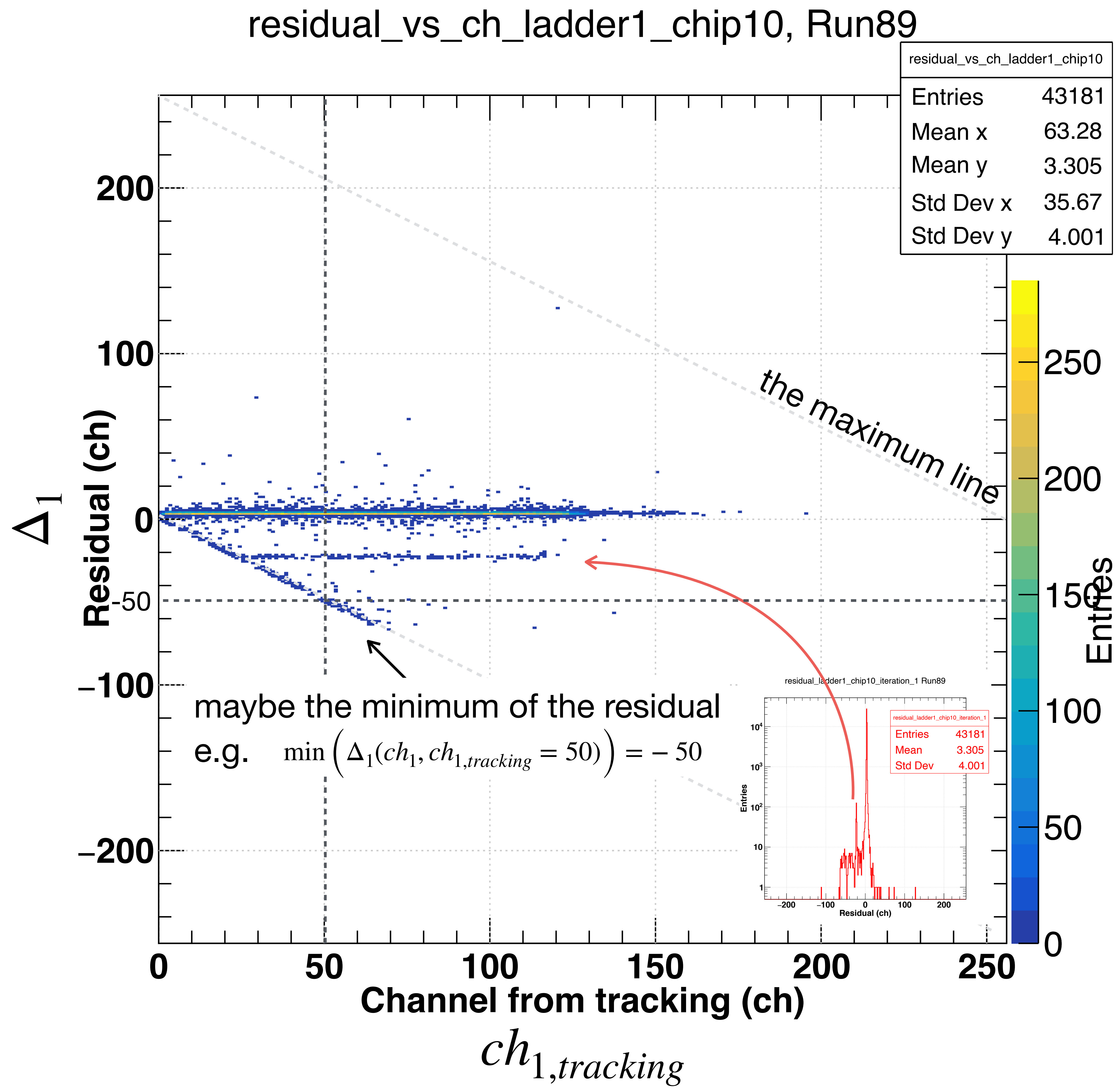
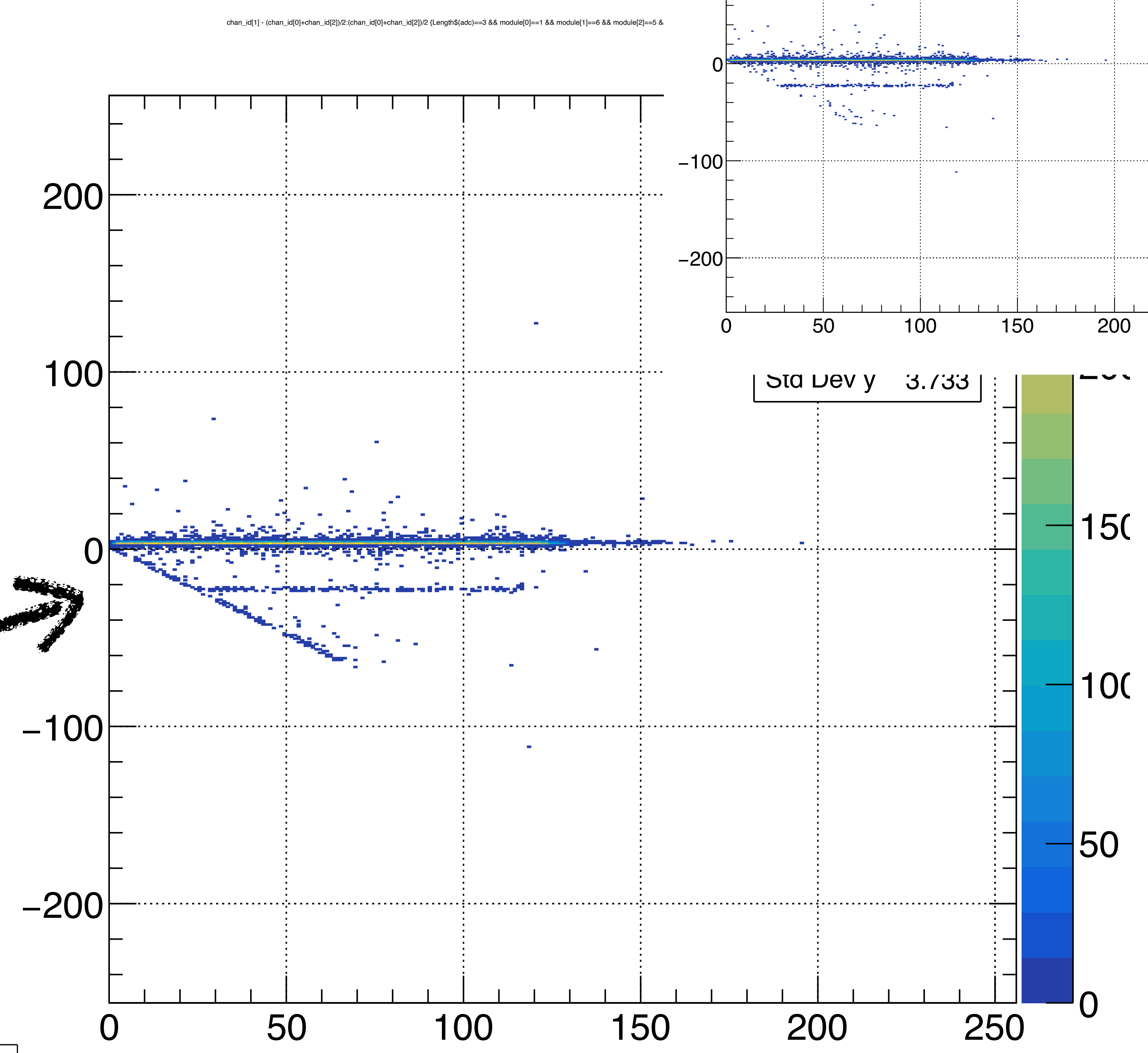
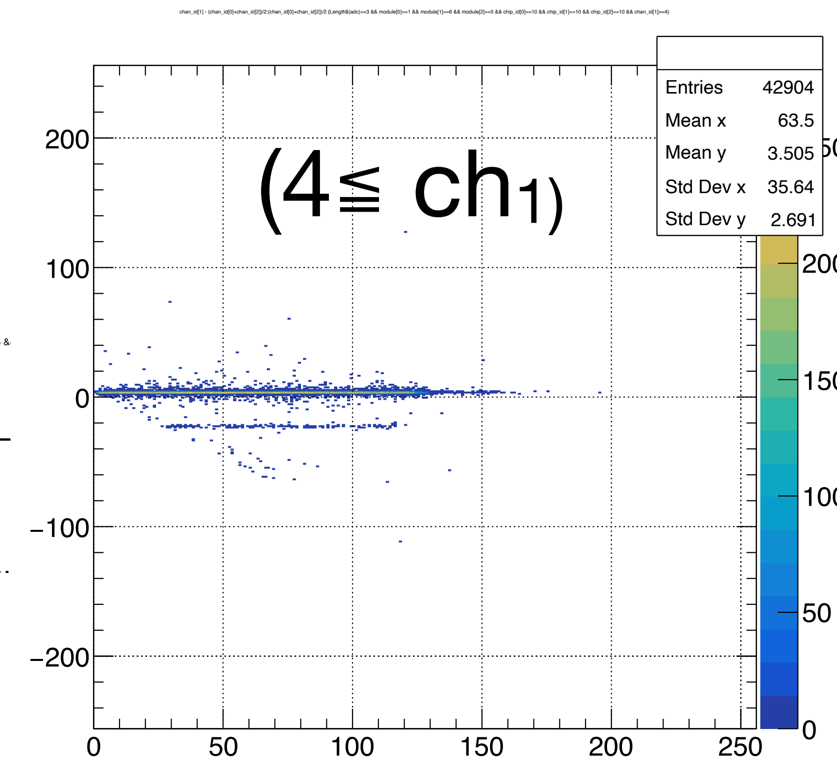
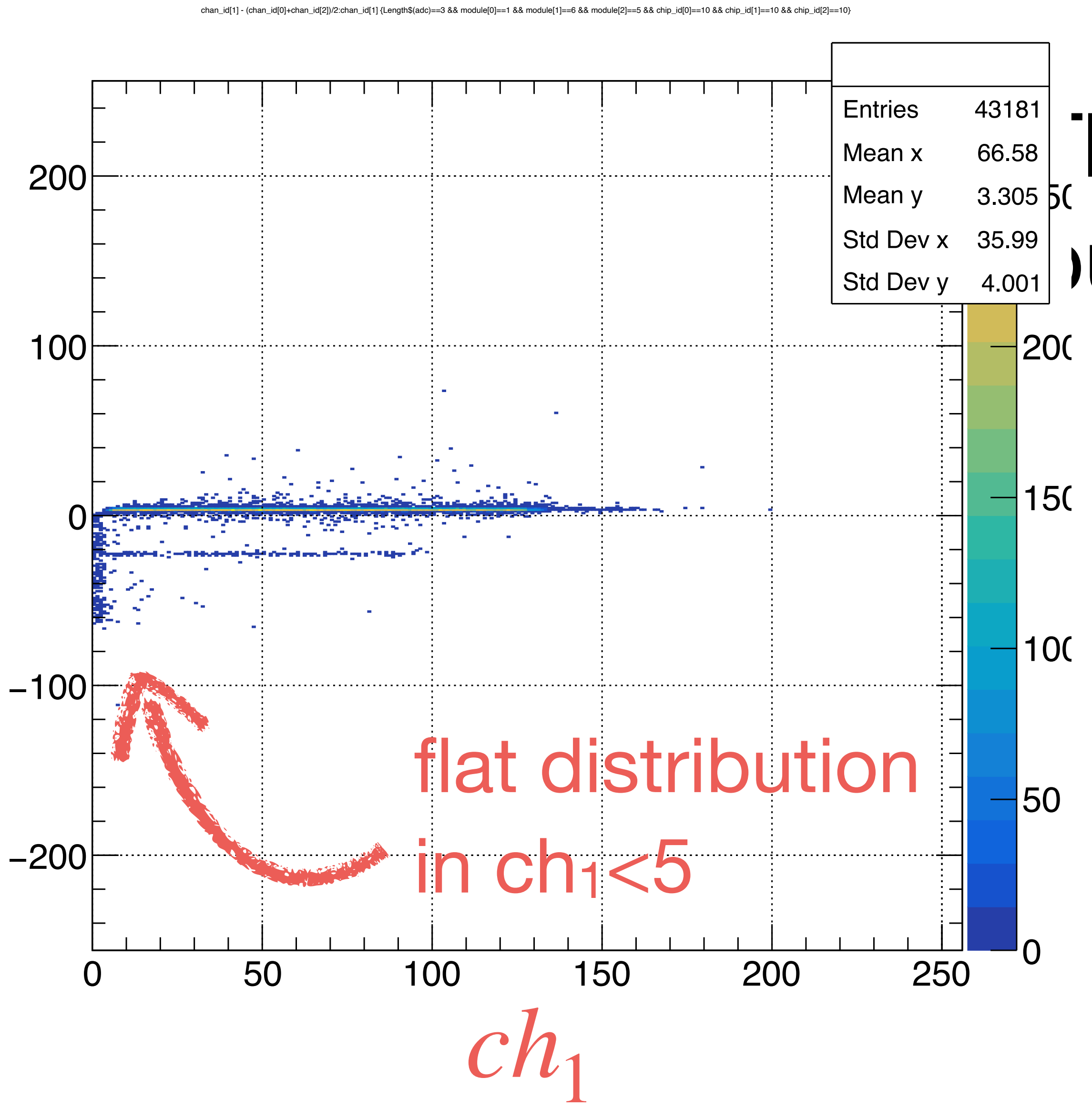


masking ch0 of the ladder1
(1≦ ch_1)



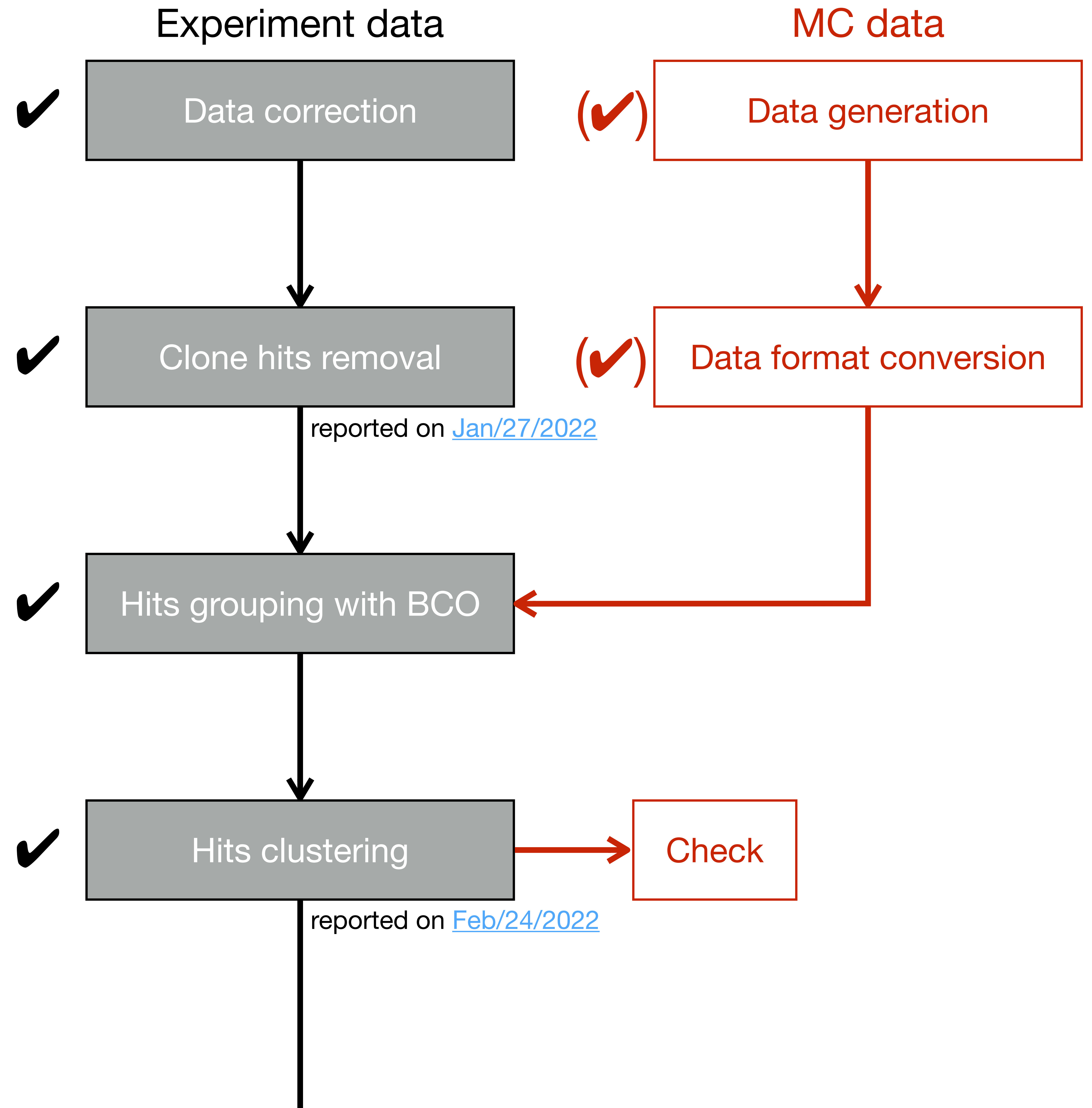


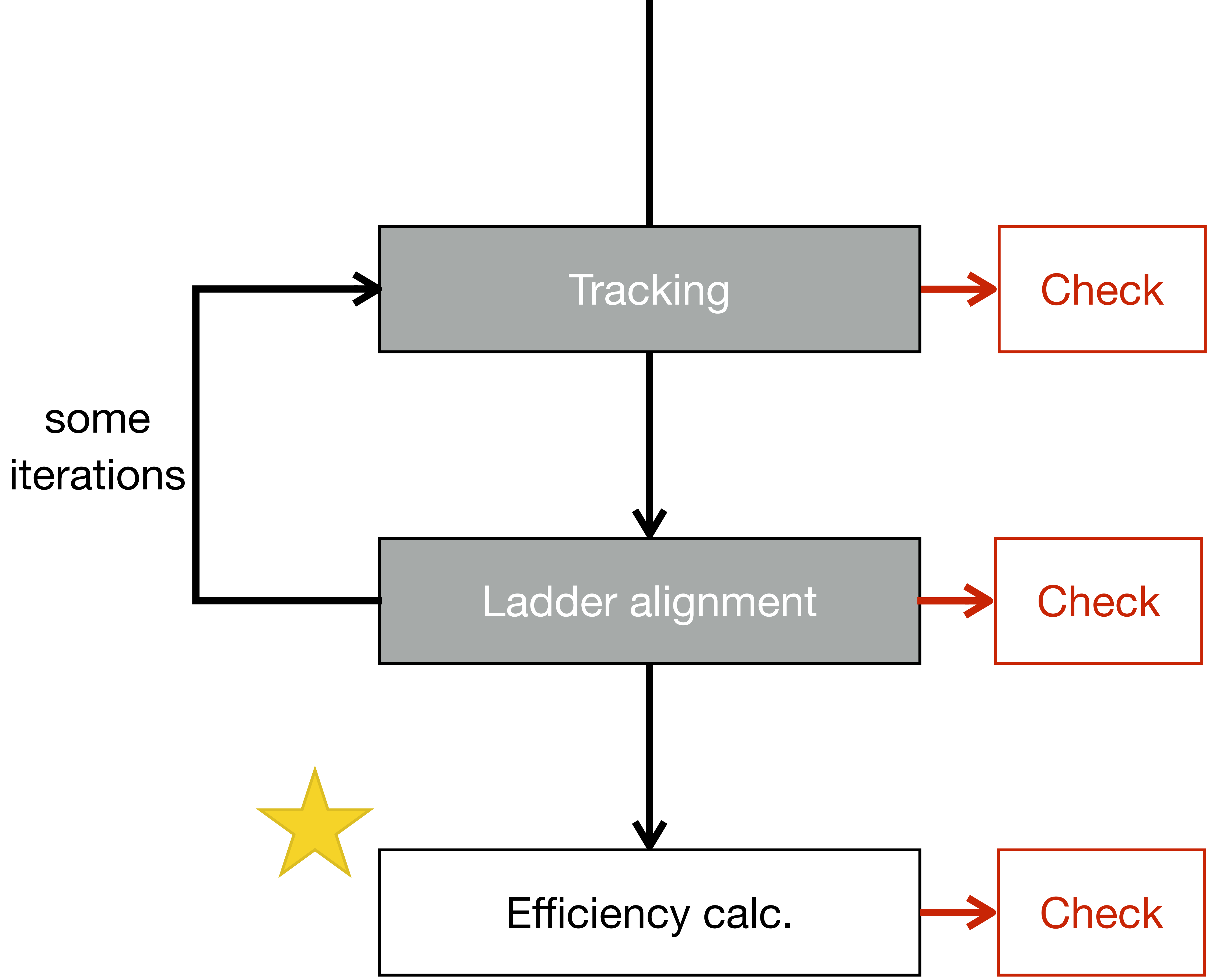
The minimum line gets slightly narrower but exists clearly.

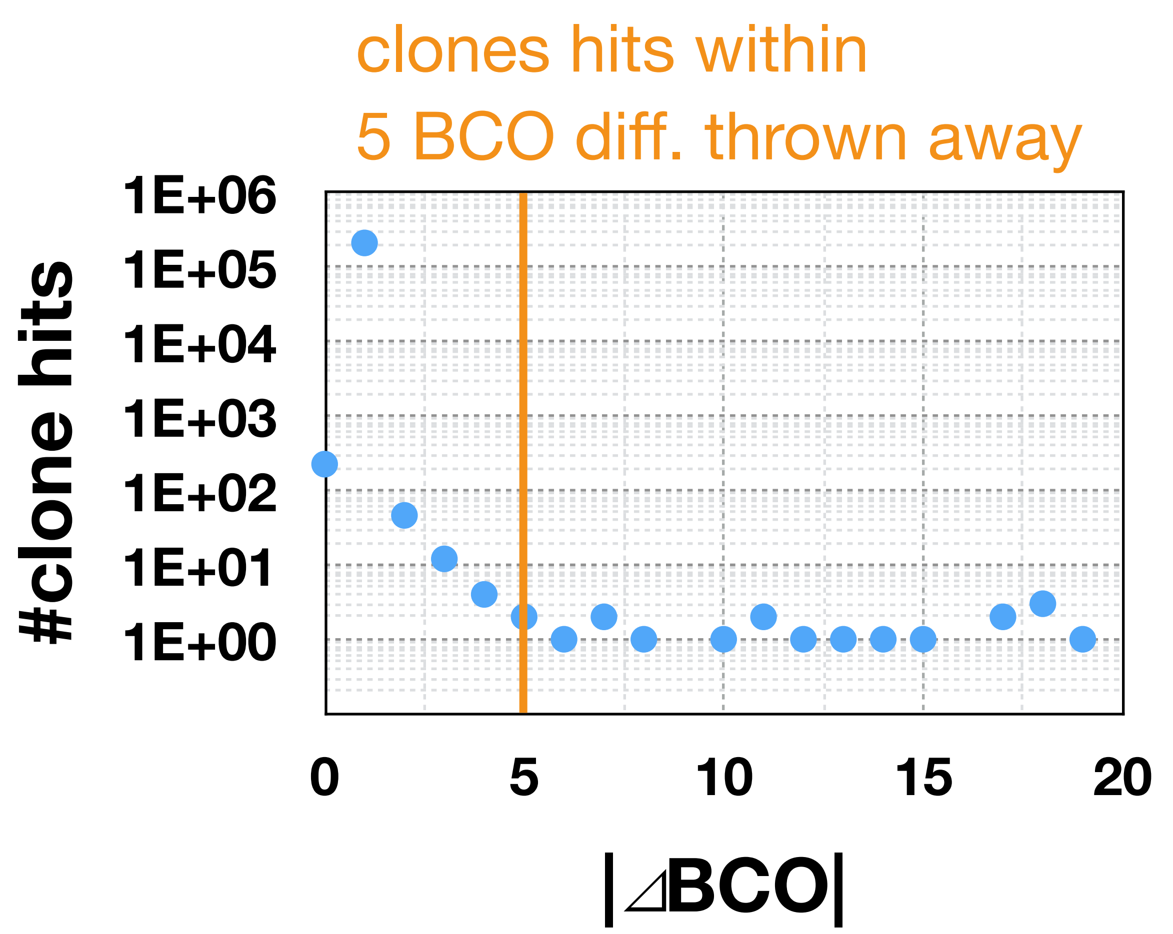


The origin of the flat distribution found in the residual distributions are not clear…

Plan to get the efficiency







Eff. can be as a function of：

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

Detection efficiency, Beam track definition

More selections are possible:

- single/multiple hit cluster
- DAC value
- Hit channel(s)
- the predicted hit position
- #ADC0, 1,… in the clusters
- the slope and/or the intercept of the beam track

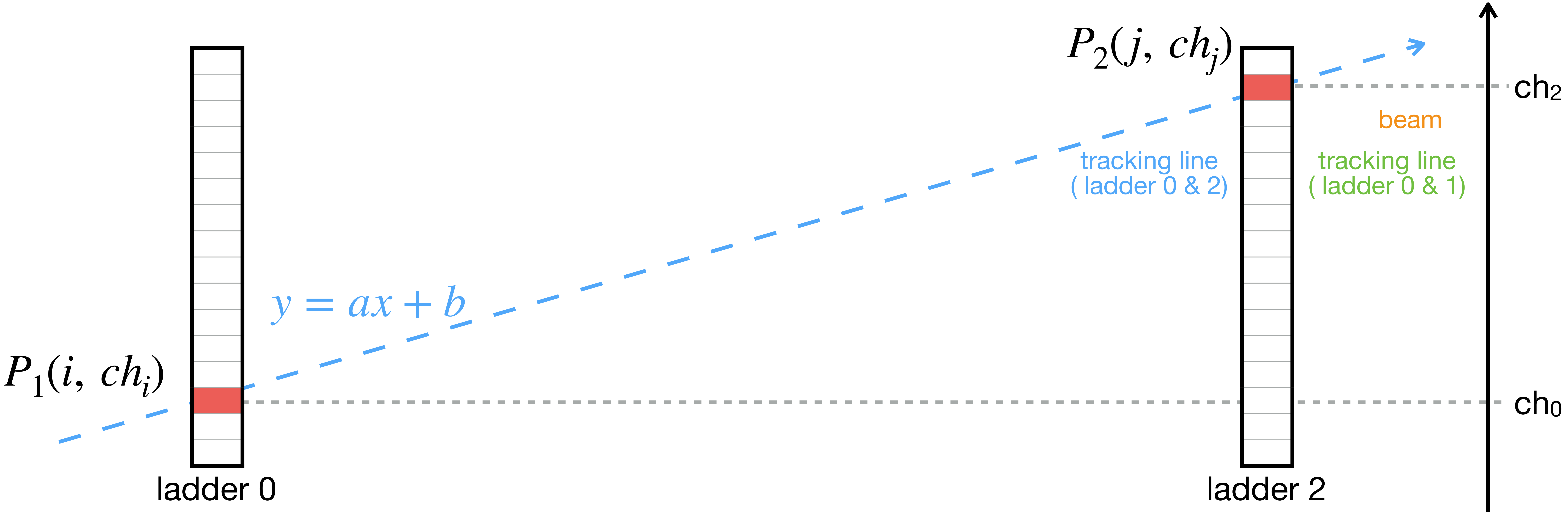
For example:

The tested ladder: ladder1 (middle)

The testing ladders: ladder0 and ladder2

Beam track definition

Data selection: The testing ladders can only have **a cluster on the testing chip column**.



Detection efficiency, Hit search and distance to the predicted point

For example:

The tested ladder: ladder1 (middle)

The testing ladders: ladder0 and ladder2

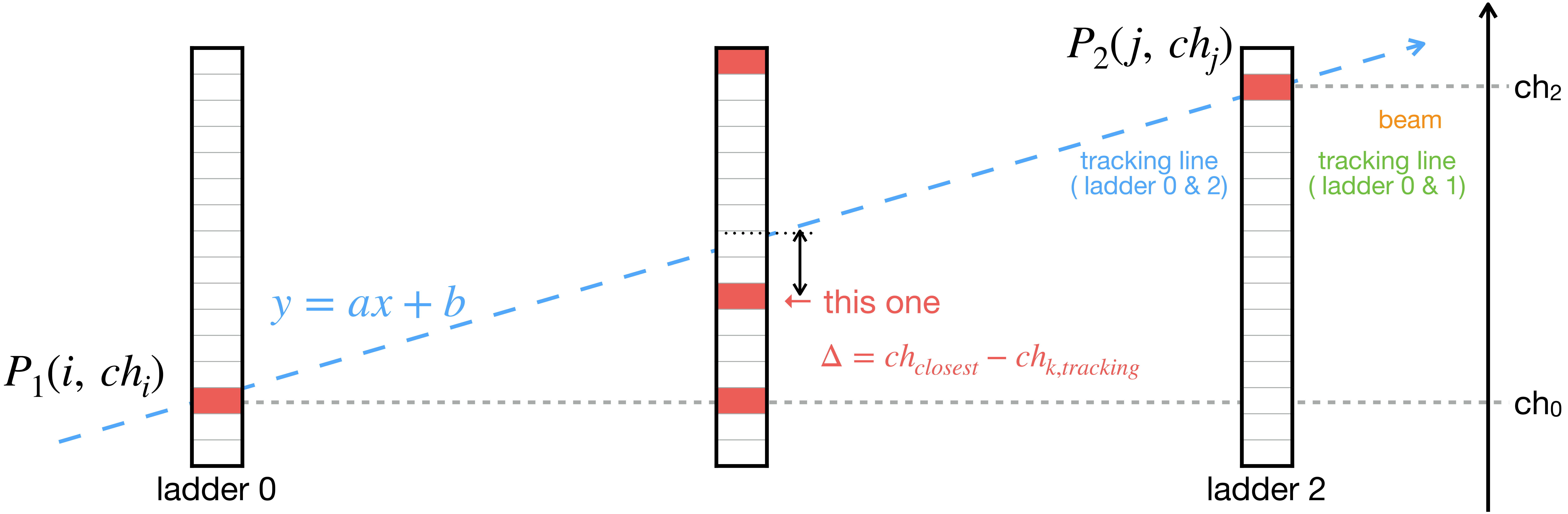
Beam track definition

Data selection: The testing ladders can only have **a cluster on the testing chip column**.

Hit search

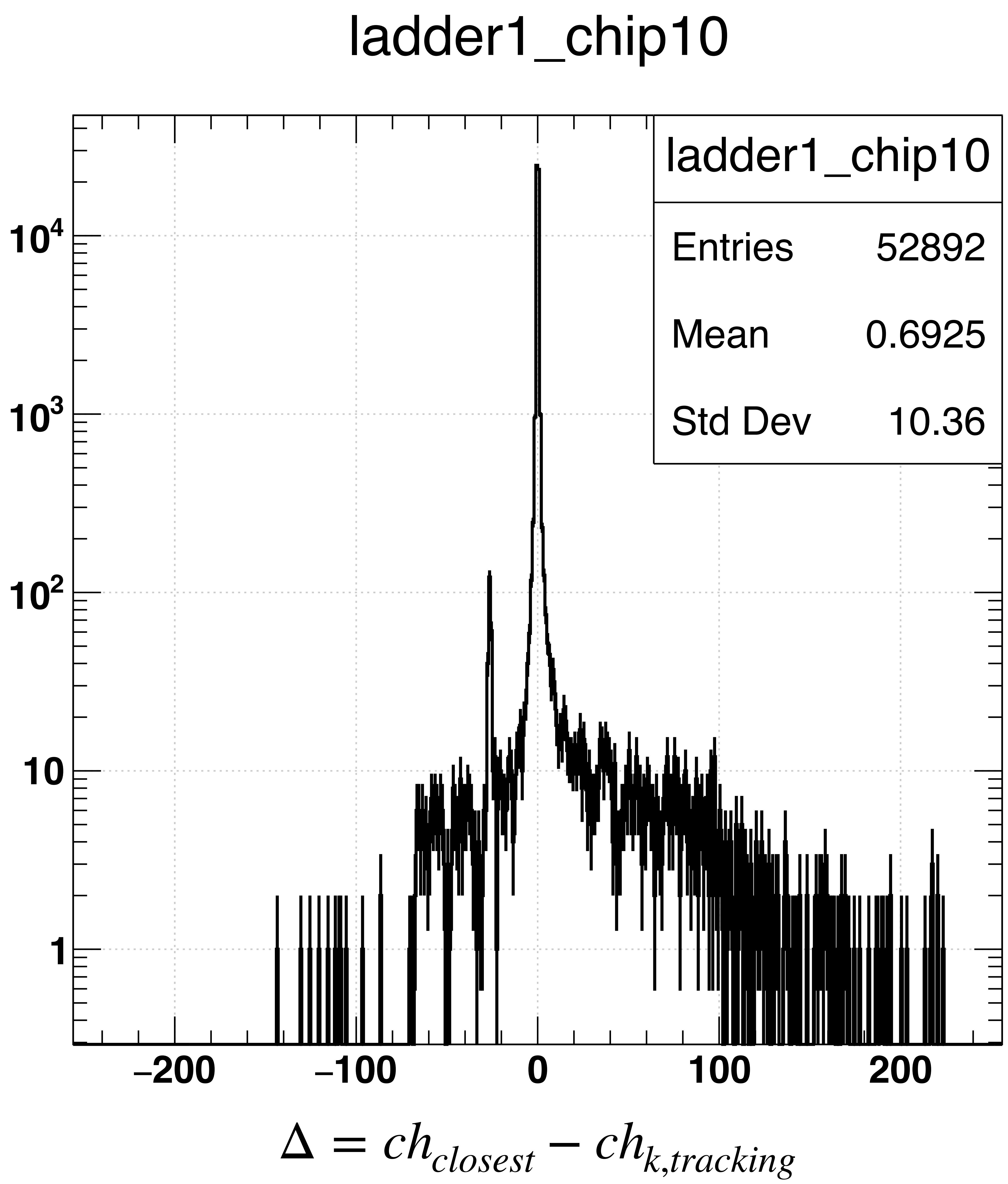
Data selection: The tested ladder can only have clusters on the tested chip column otherwise this test is skipped.

The closest hit to the predicted position is hired.



Detection efficiency, Run89 ladder1 chip10

$$\varepsilon \equiv \frac{N(h_i \cap h_j \cap h_k)}{N(h_i \cap h_j)}, (i \neq j \neq k)$$



Numerator

#successful tracking = 53235

Difference of the closest hit and the predicted hit position

53235 - 52892 = 343 cases: Hit was not found on ladder 1 chip col. 10

! no additional cut applied !

Detection efficiency, Run89 ladder1 chip10

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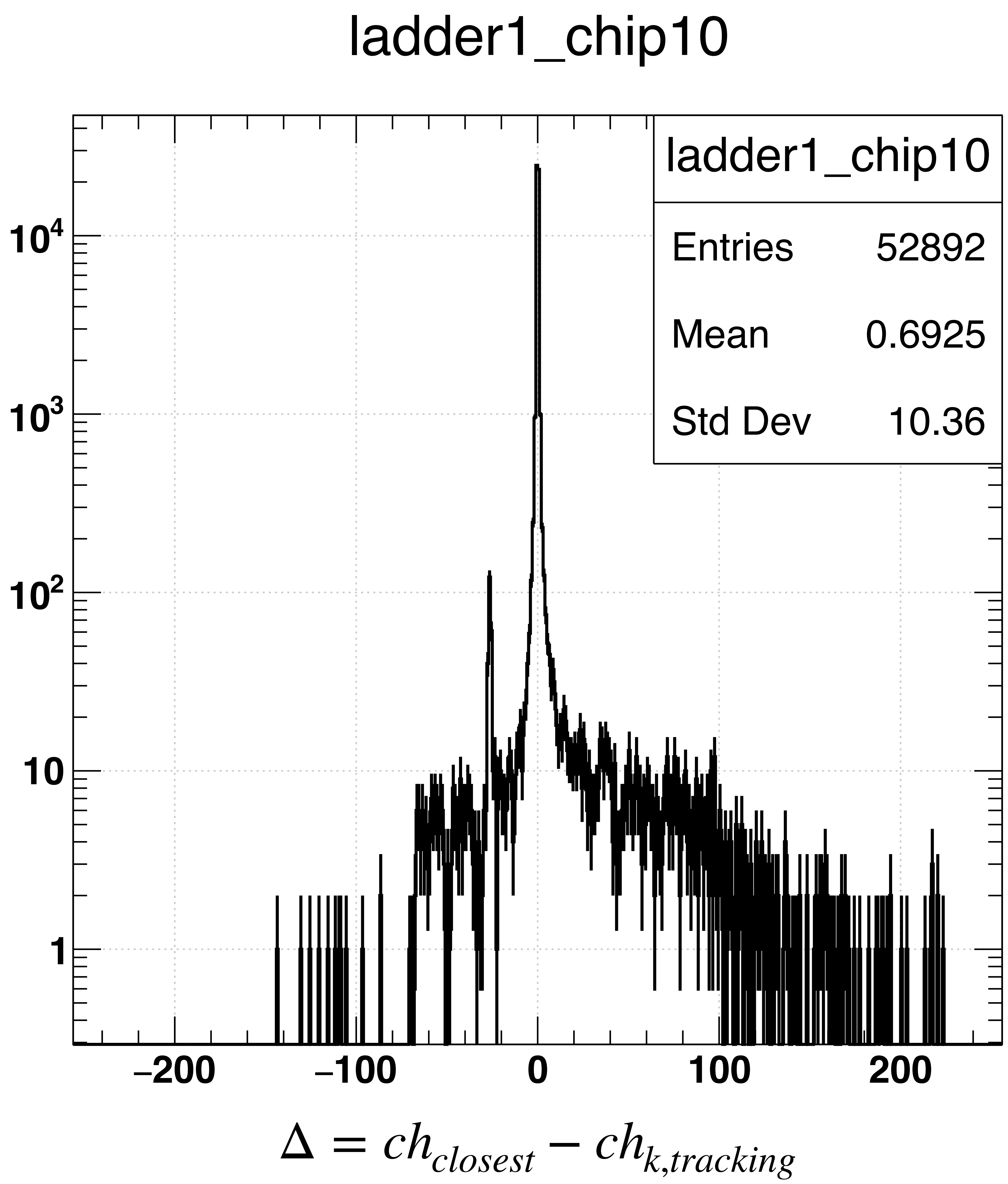

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Mean and std dev are estimated by fitting with 2 gaussians (need to be done in better way)

Denominator

```
If all accepted: 52892 → 0.994
```

! no additional cut applied !

Detection efficiency, Run89 ladder1 chip10

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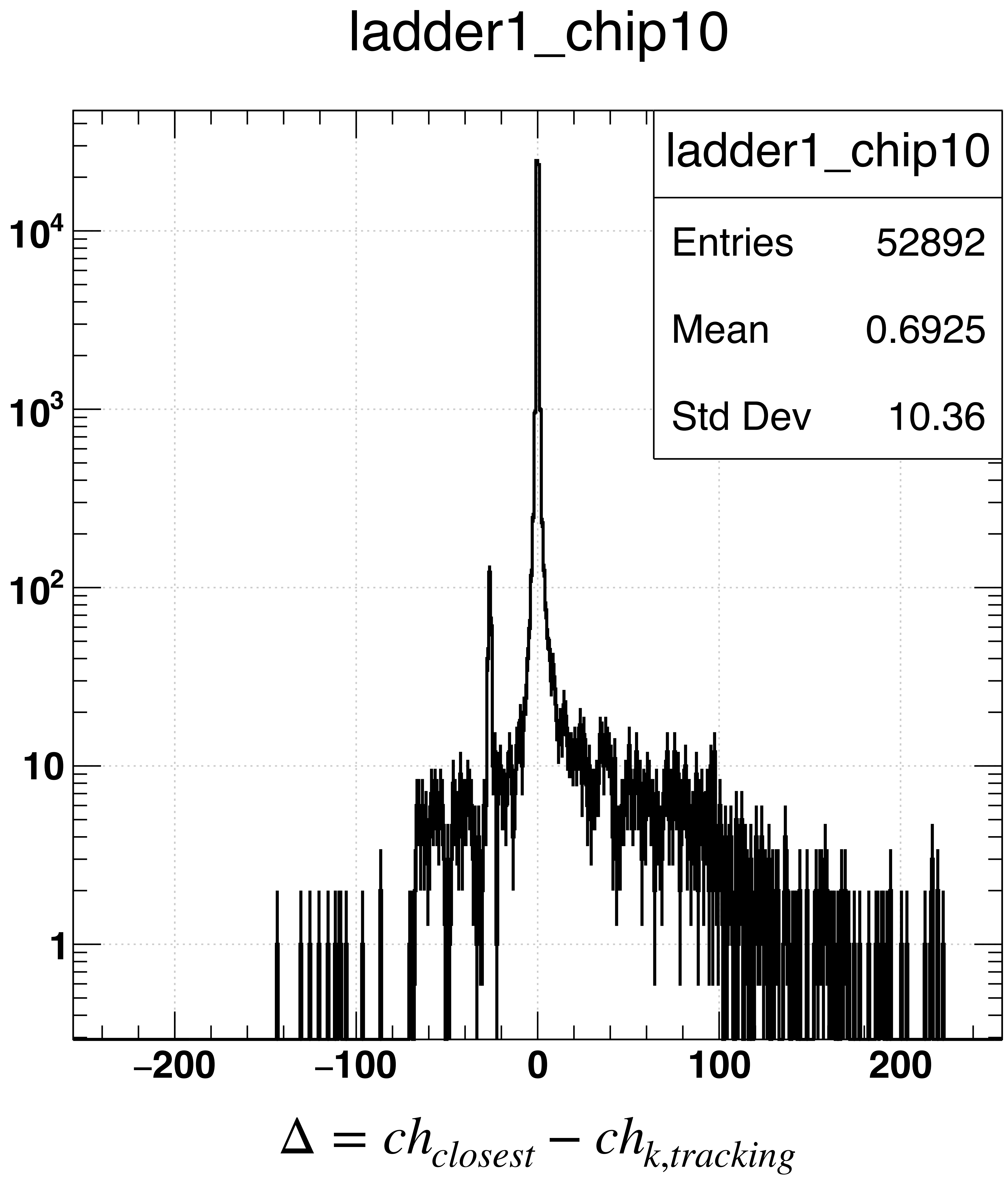

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- #successful tracking = 53235

Difference of the closest hit and the predicted hit position

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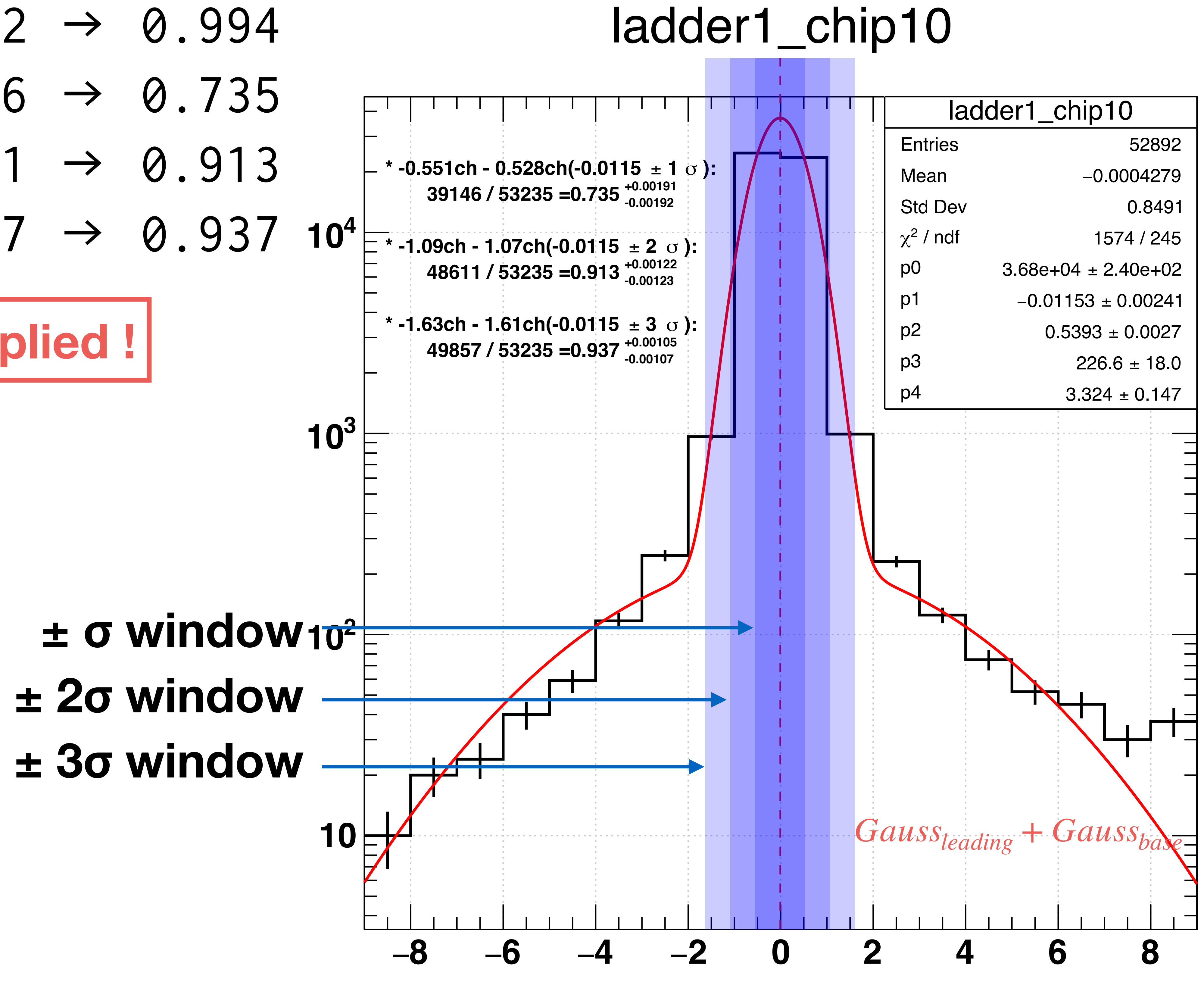
- Mean and std dev are estimated by fitting with 2 gaussians (need to be done in better way)

Denominator

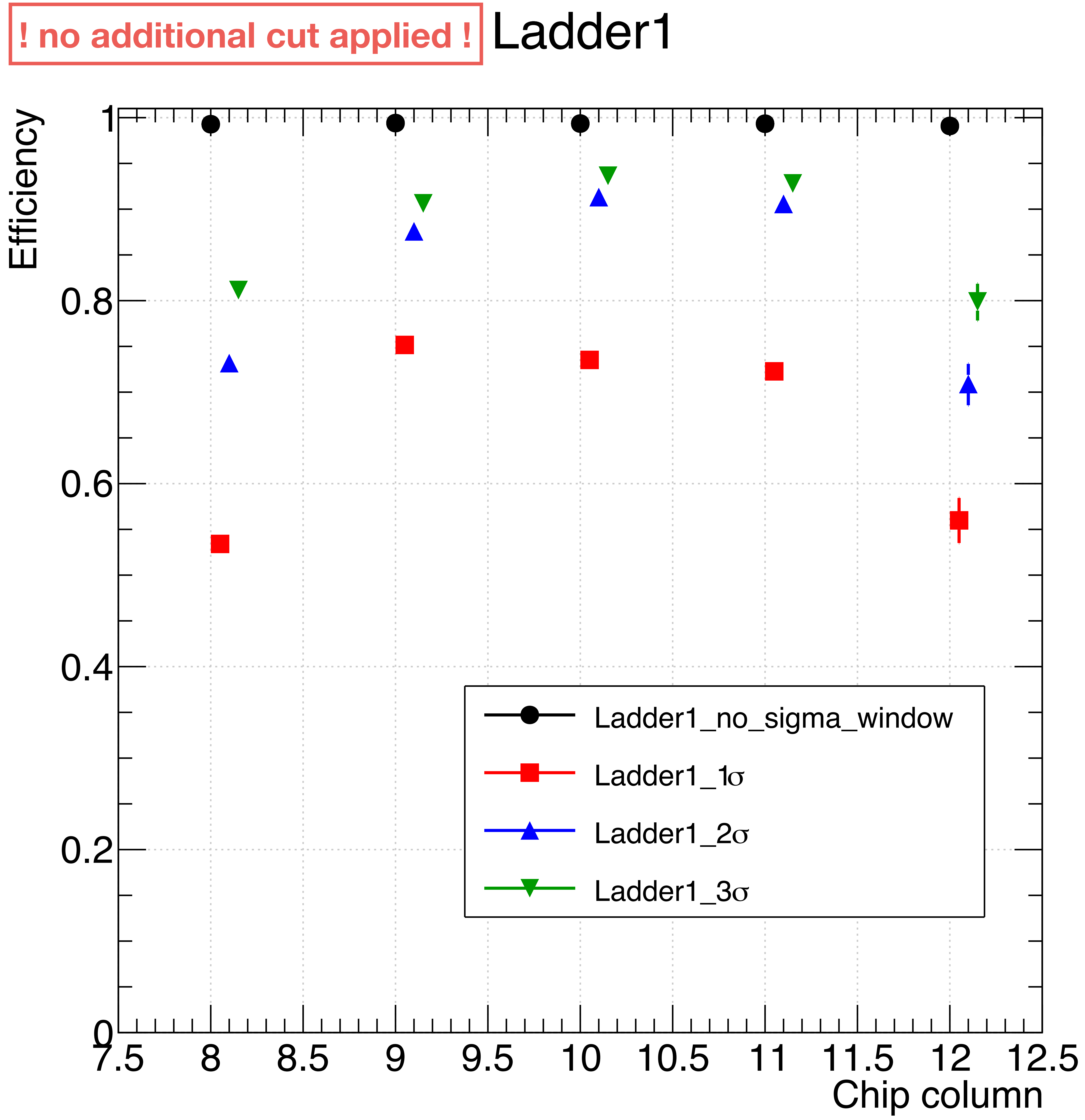
```
If all accepted: 52892 → 0.994
Mean ± σ       : 39146 → 0.735
Mean ± 2σ      : 48611 → 0.913
Mean ± 3σ      : 49857 → 0.937
```

! no additional cut applied !



Detection efficiency, Run89 ladder1 chip8, 9, 10, 11, 12

! no additional cut applied !



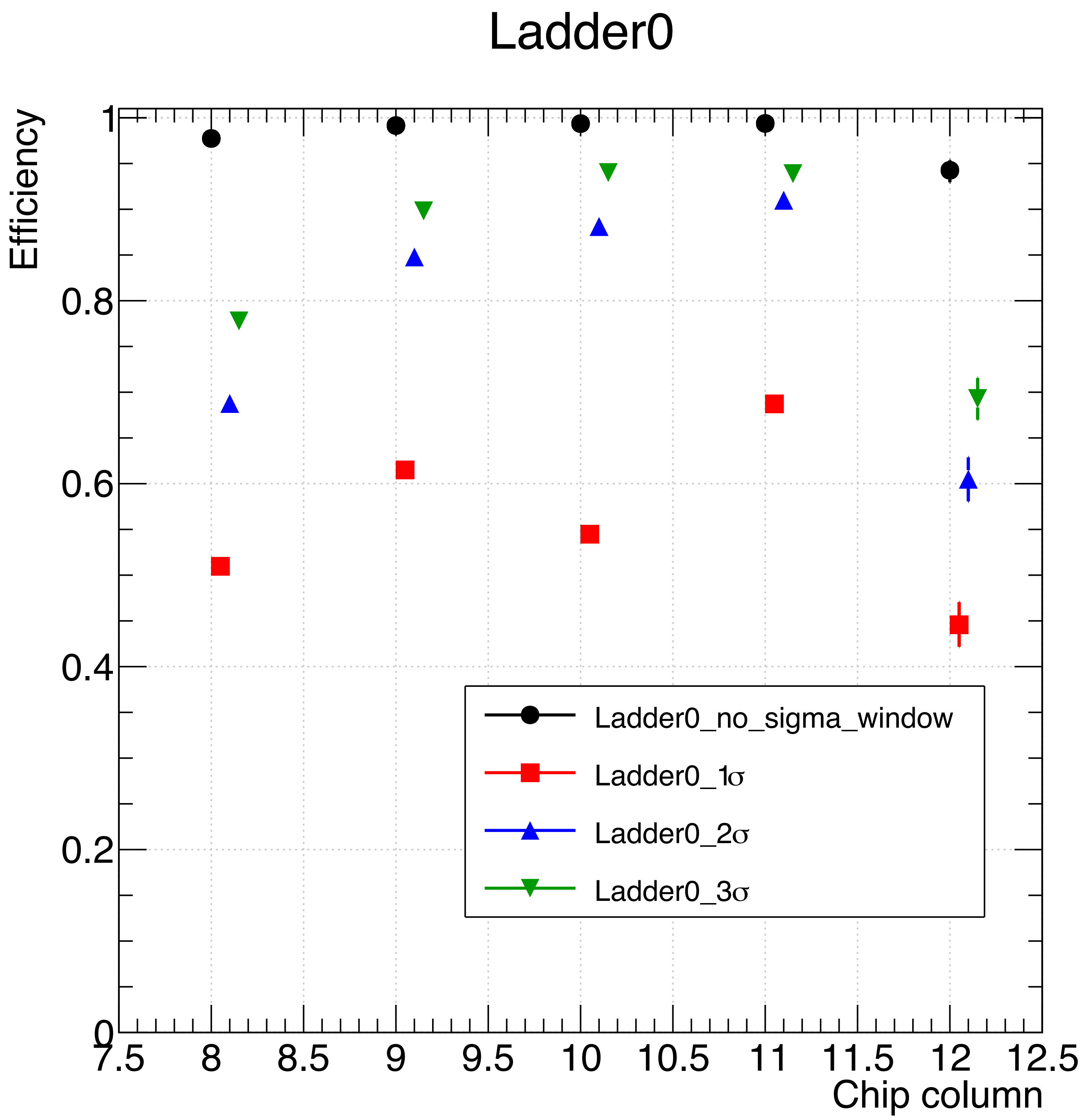
n.b. The same alignment correction obtained from chip col. 10 was applied.

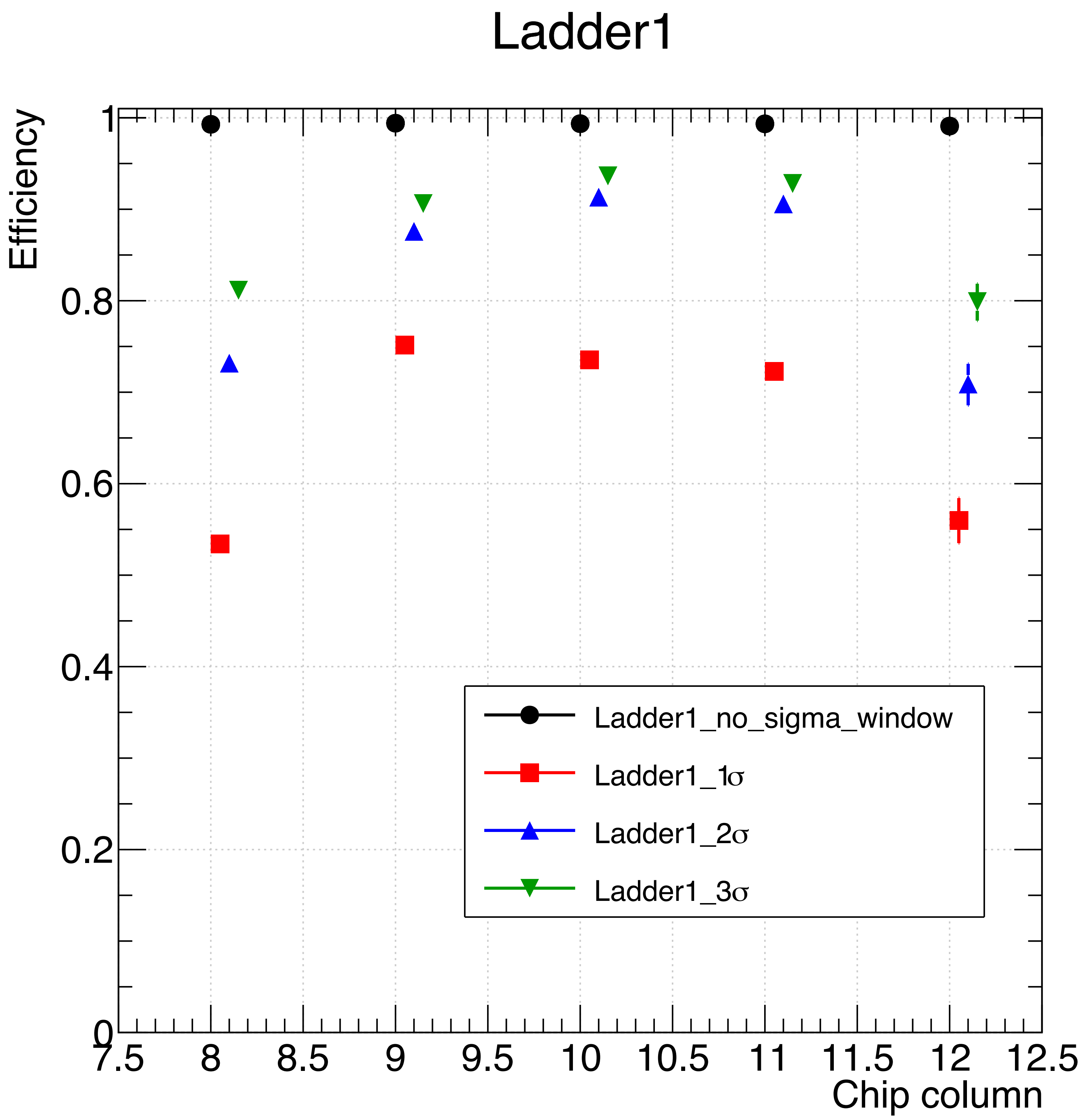
chip	σ	denominator	numerator	ε	error
8	**-1**	**3056**	**3078**	**0.993**	**2E-03**
8	1	1644	3078	0.534	9E-03
8	2	2252	3078	0.732	8E-03
8	**3**	**2498**	**3078**	**0.812**	**7E-03**
9	**-1**	**16781**	**16881**	**0.994**	**6E-04**
9	1	12686	16881	0.751	3E-03
9	2	14783	16881	0.876	3E-03
9	**3**	**15300**	**16881**	**0.906**	**2E-03**
10	**-1**	**52892**	**53235**	**0.994**	**4E-04**
10	1	39146	53235	0.735	2E-03
10	2	48611	53235	0.913	1E-03
10	**3**	**49857**	**53235**	**0.937**	**1E-03**
11	**-1**	**39111**	**39371**	**0.993**	**4E-04**
11	1	28453	39371	0.723	2E-03
11	2	35659	39371	0.906	1E-03
11	**3**	**36544**	**39371**	**0.928**	**1E-03**
12	**-1**	**439**	**443**	**0.991**	**6E-03**
12	1	248	443	0.560	2E-02
12	2	314	443	0.709	2E-02
12	**3**	**354**	**443**	**0.799**	**2E-02**

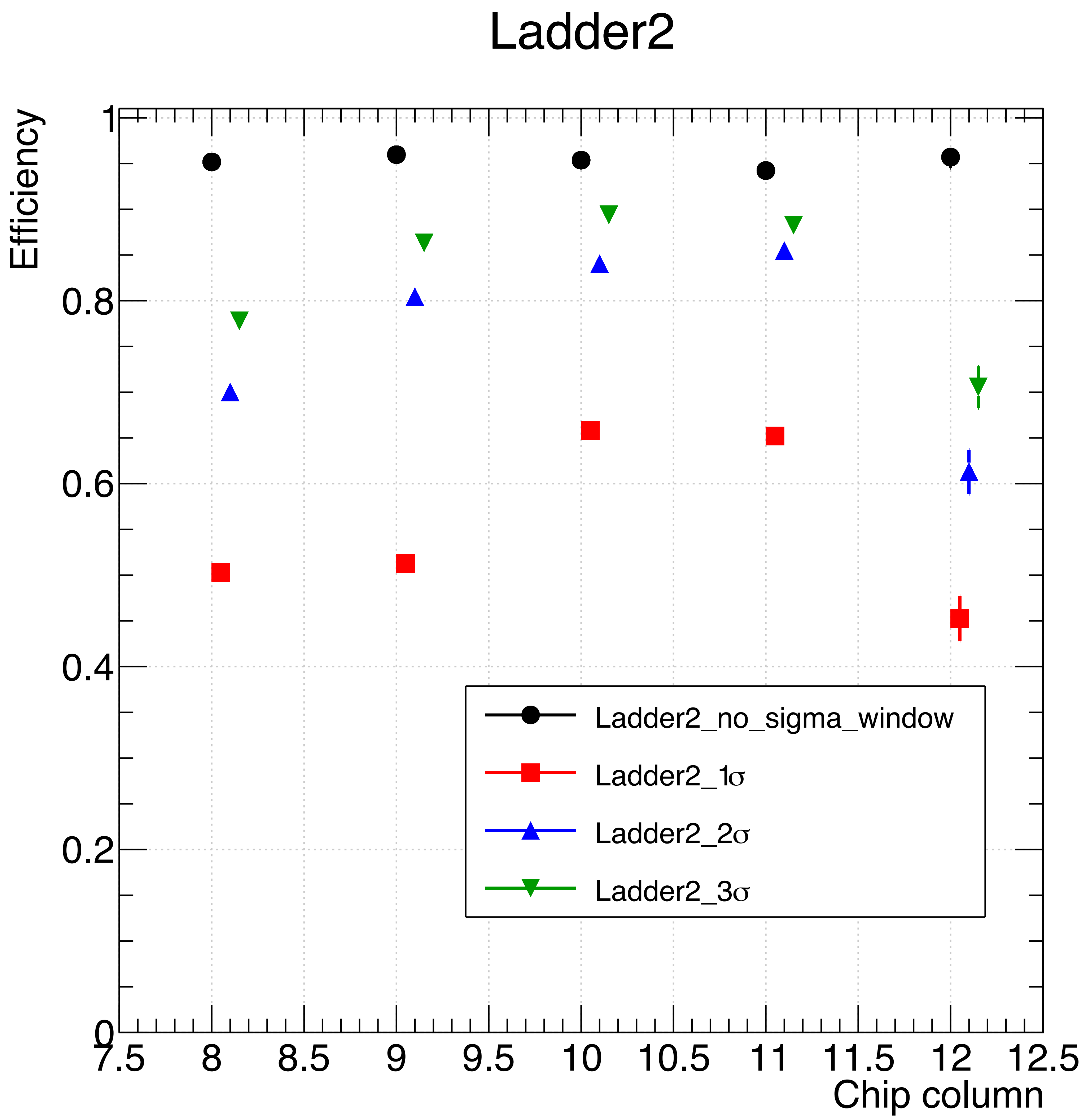
If a sigma window is not required, the efficiency reaches to 0.994.
± σ, 2σ windows are too narrow

Detection efficiency, Run89 ladder0, 1 2, chip8, 9, 10, 11, 12

! no additional cut applied !







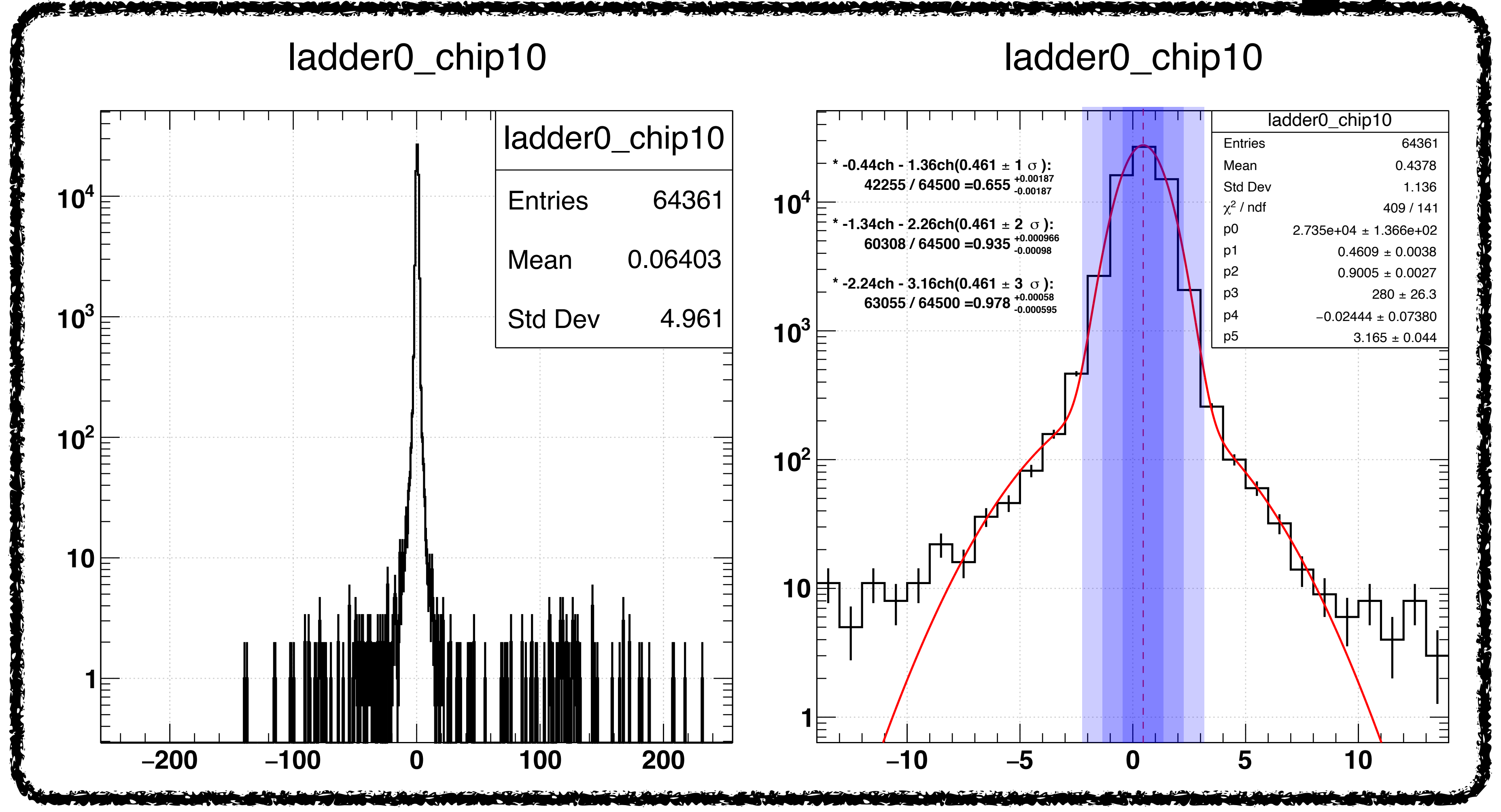
no sigma:0.977, 0.992, 0.994, 0.994, 0.943
3 σ :0.778, 0.898, 0.940, 0.939, 0.693

no sigma:0.993, 0.994, 0.994, 0.993, 0.991
3 σ :0.812, 0.906, 0.937, 0.928, 0.799

no sigma:0.952, 0.960, 0.954, 0.942, 0.957
3 σ :0.778, 0.863, 0.894, 0.883, 0.706

Detection efficiency, MC for Run89

! no additional cut applied !



The same analysis was performed to MC data (latest version).

Alignment correction was not applied because it's not needed.

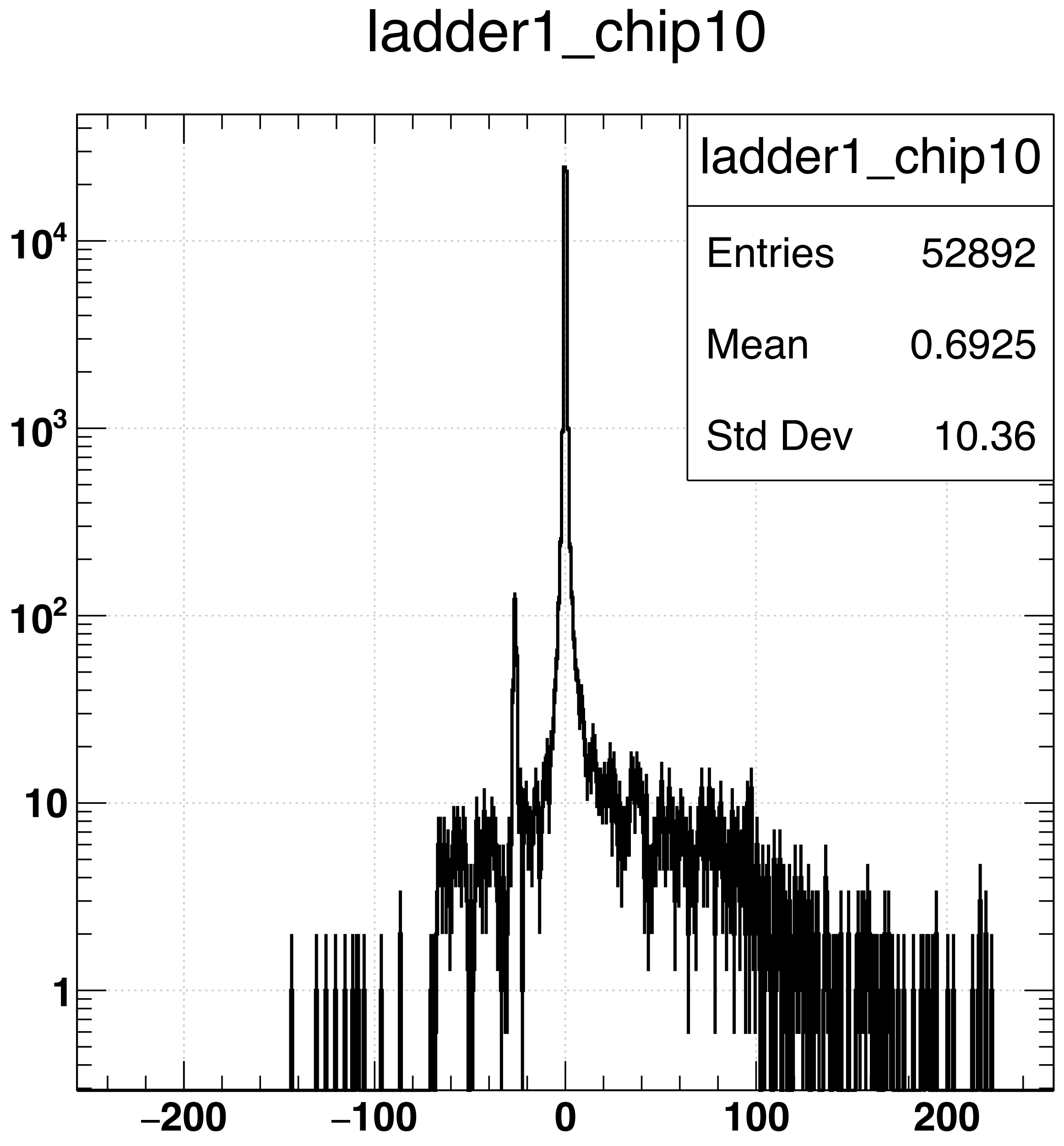
Contribution of largely scattered beam is clearly seen in the ⊿ distribution.

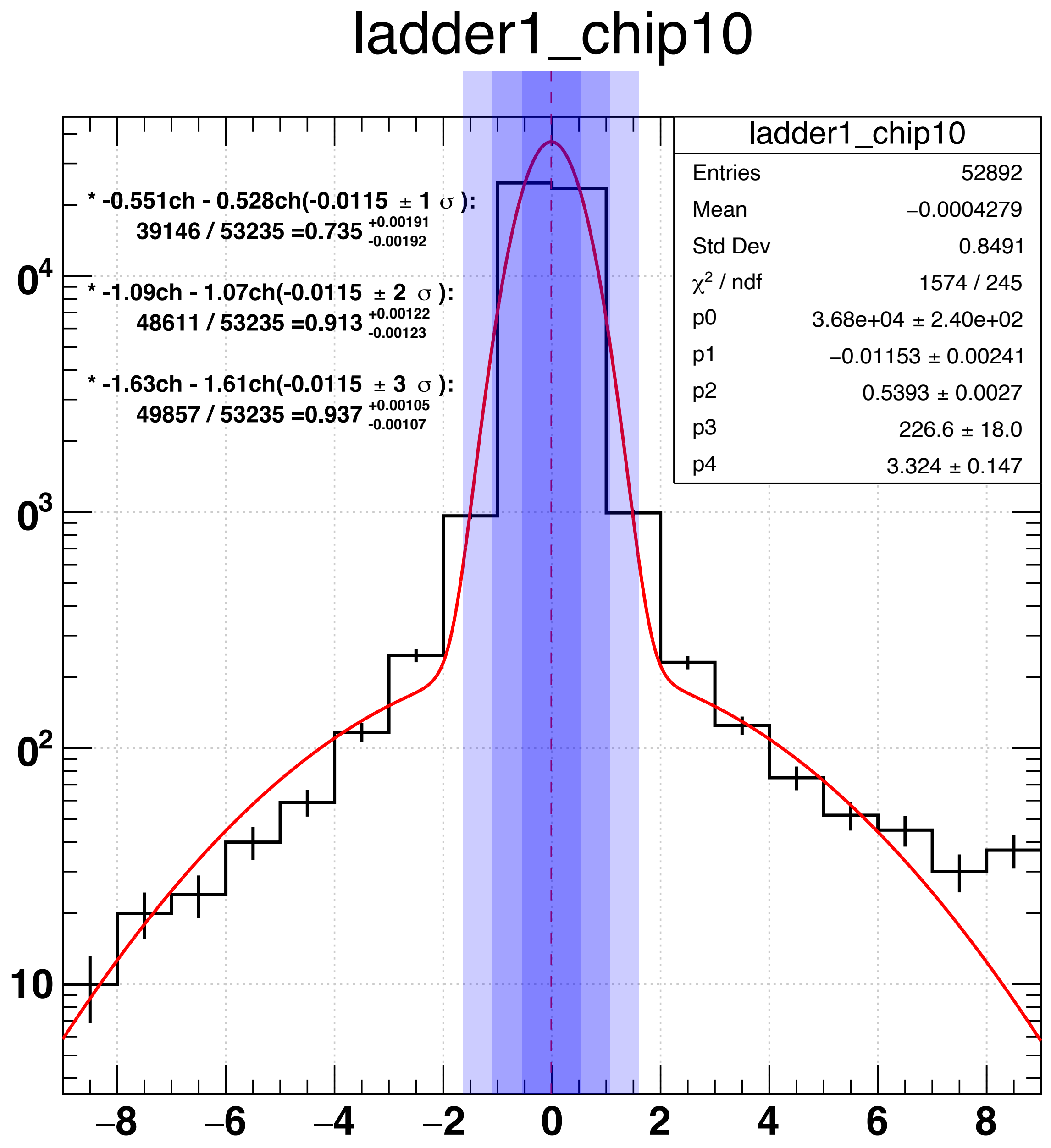
→ Even 3 σ window may be too narrow if gaussian width is used.

Detection efficiency, MC for Run89

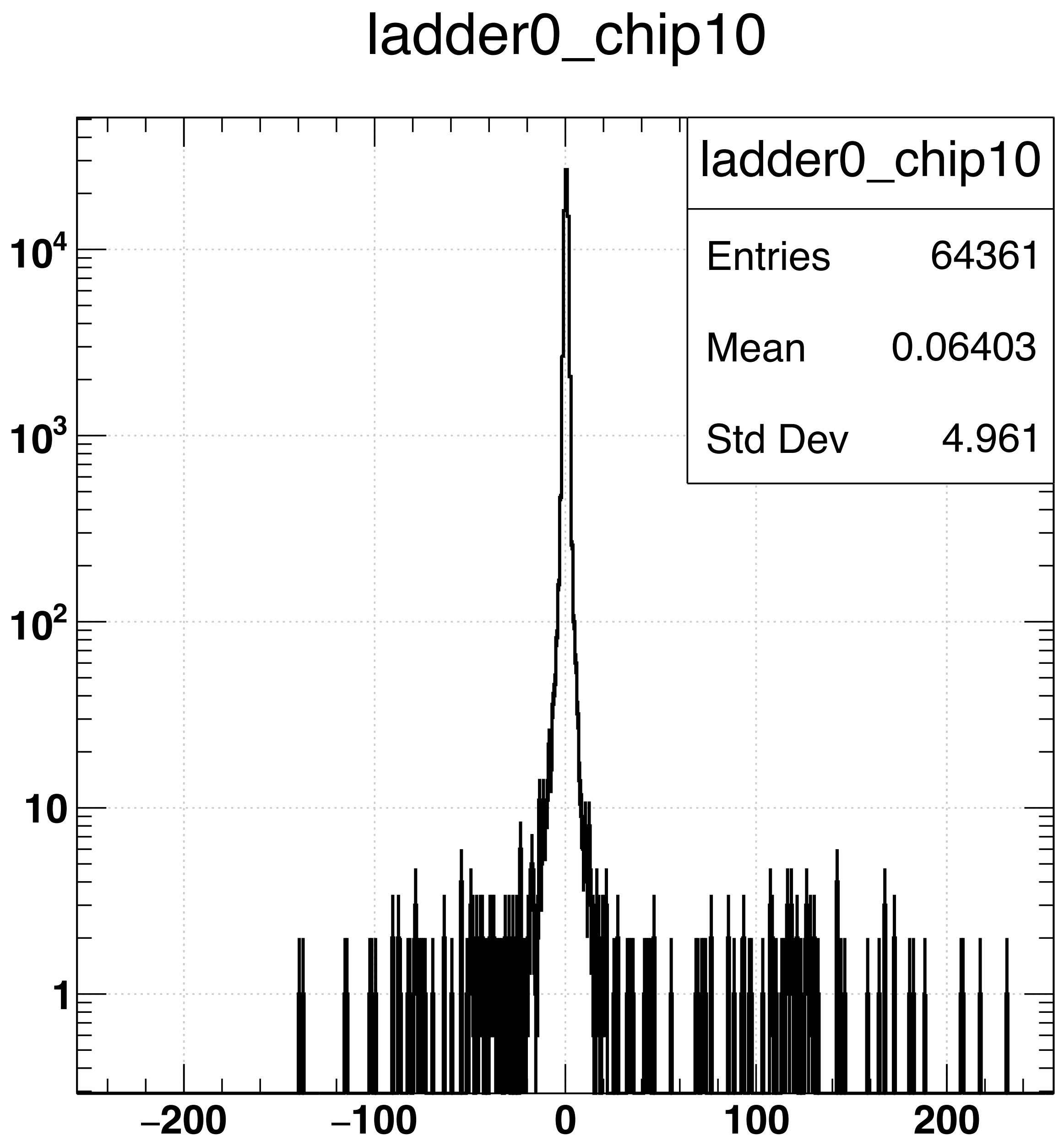
! no additional cut applied !

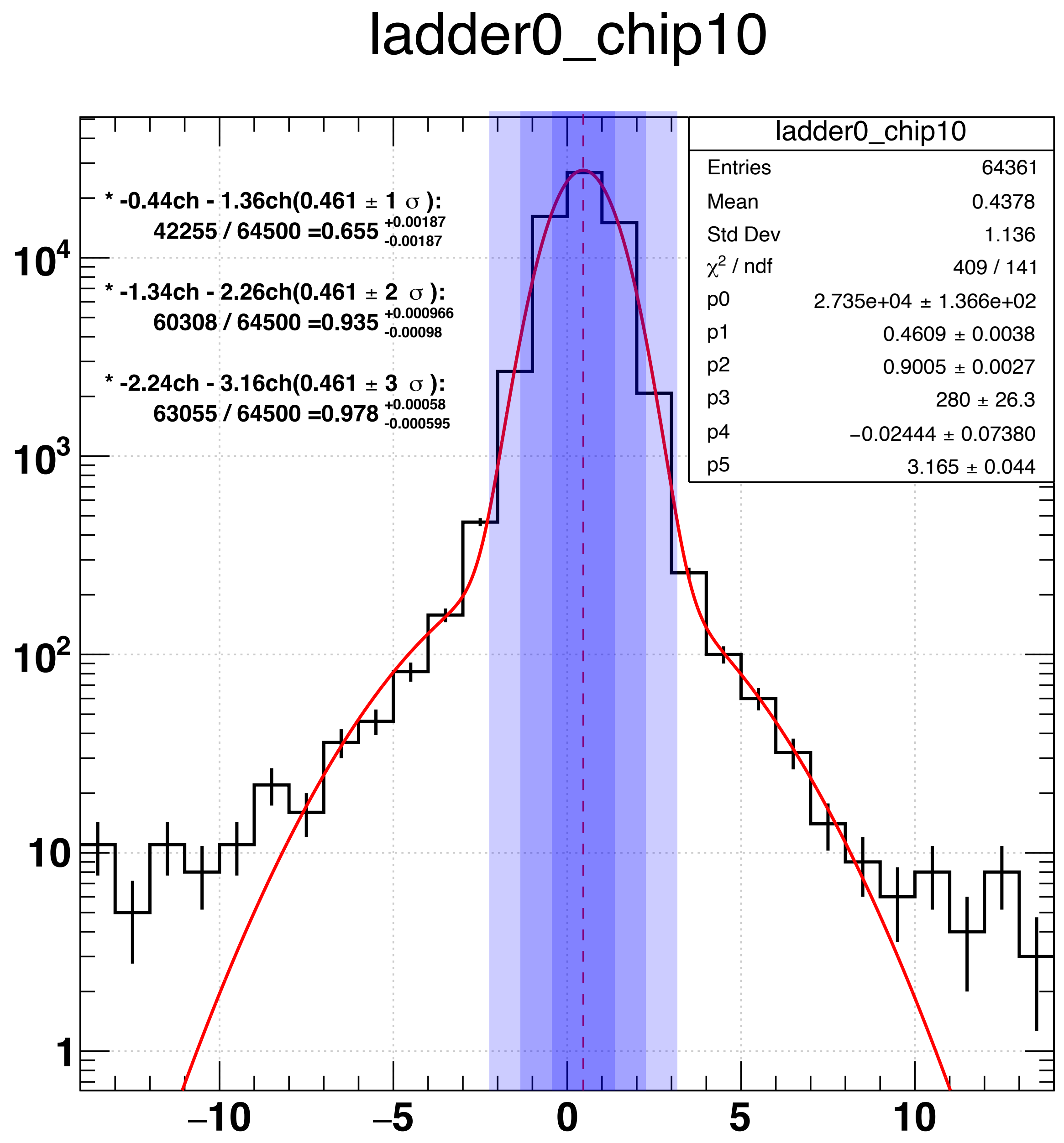
real data





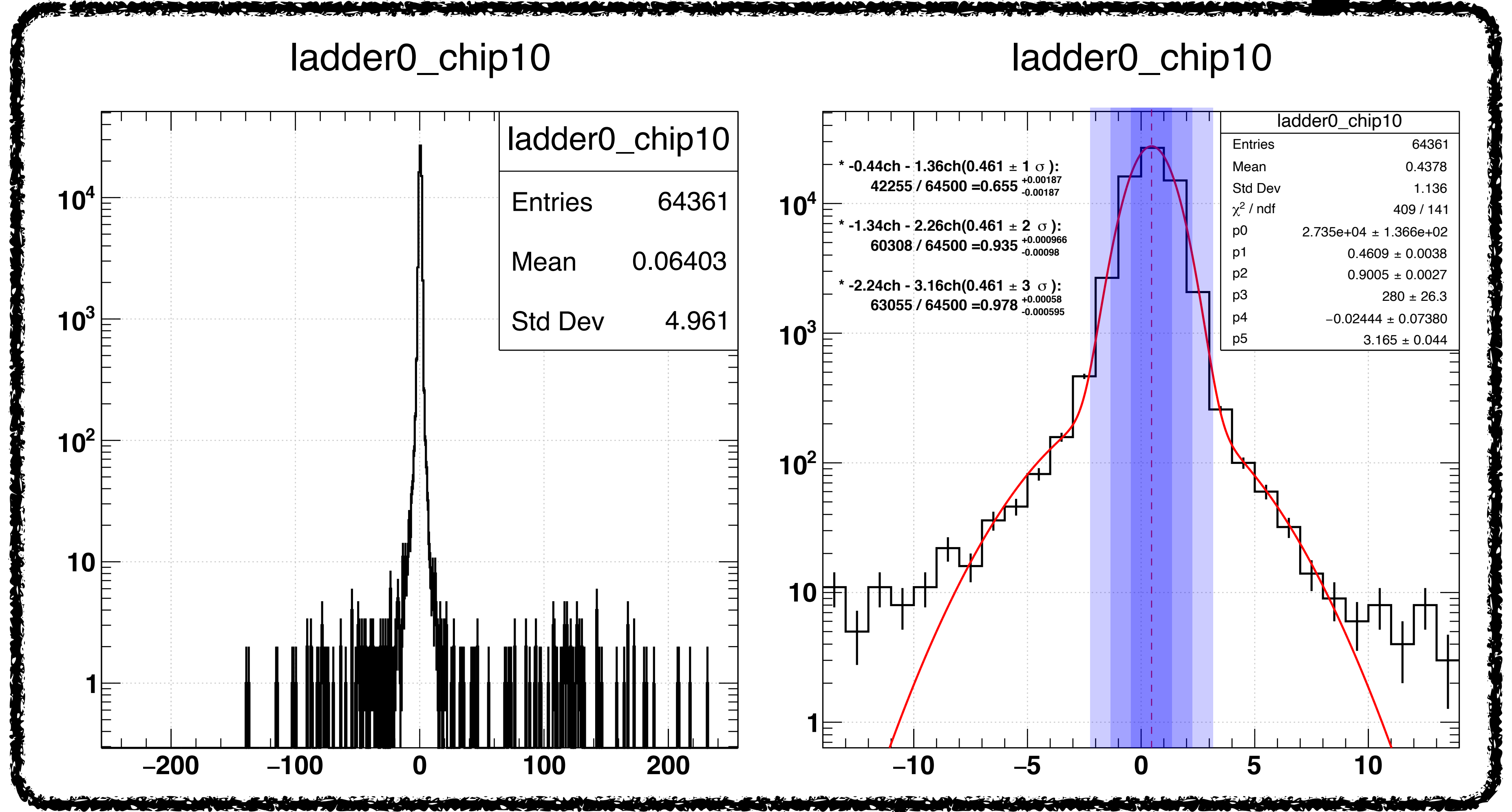
MC data





Detection efficiency, MC for Run89

! no additional cut applied !



The same analysis was performed to MC data (latest version).

Alignment correction was not applied because it’s not needed.

Contribution of largely scattered beam is clearly seen in the ⊿ distribution.

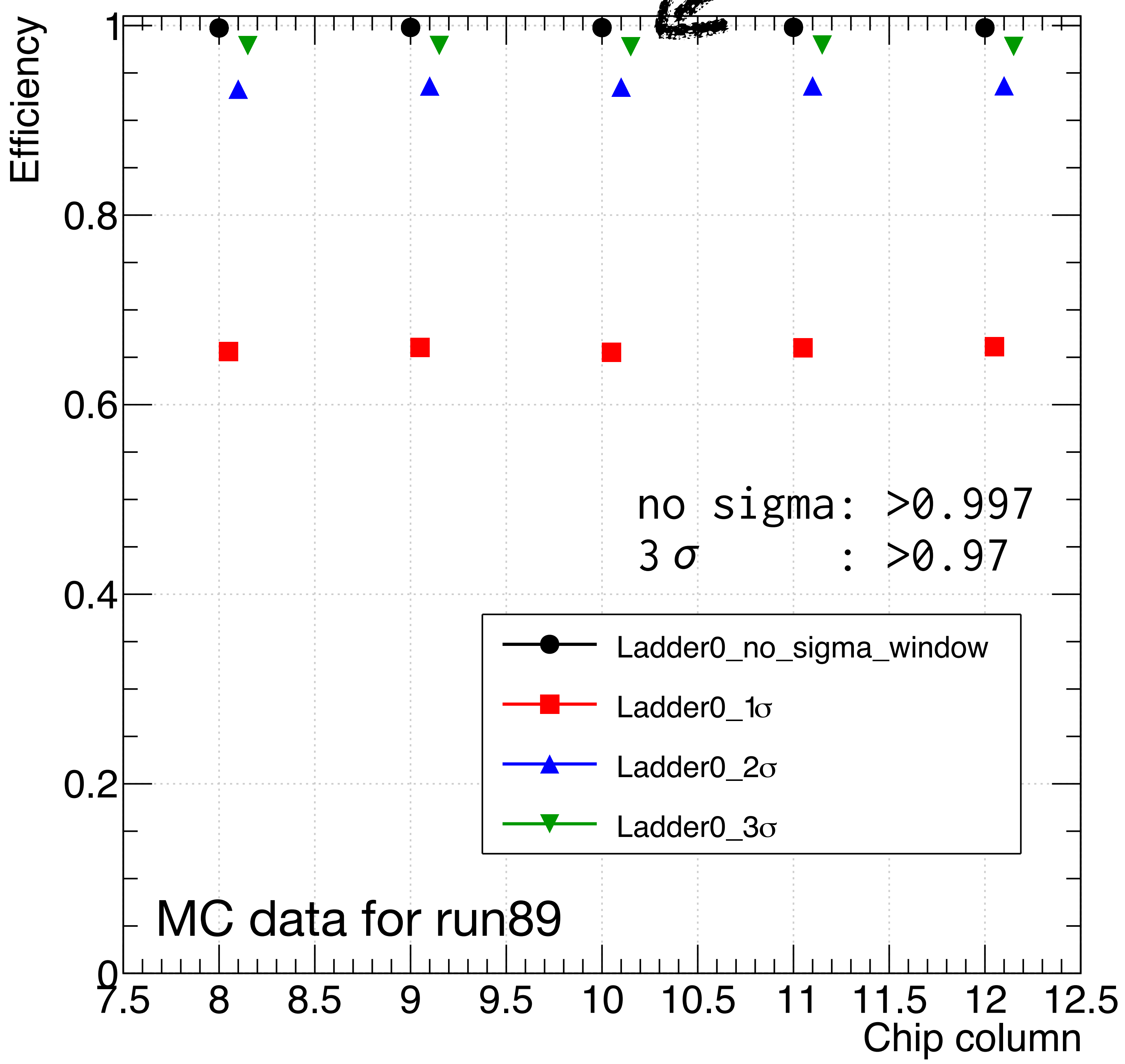
→ Even 3 σ window may be too narrow if gaussian width is used.

Detection efficiency without the sigma window is ~99.7%.

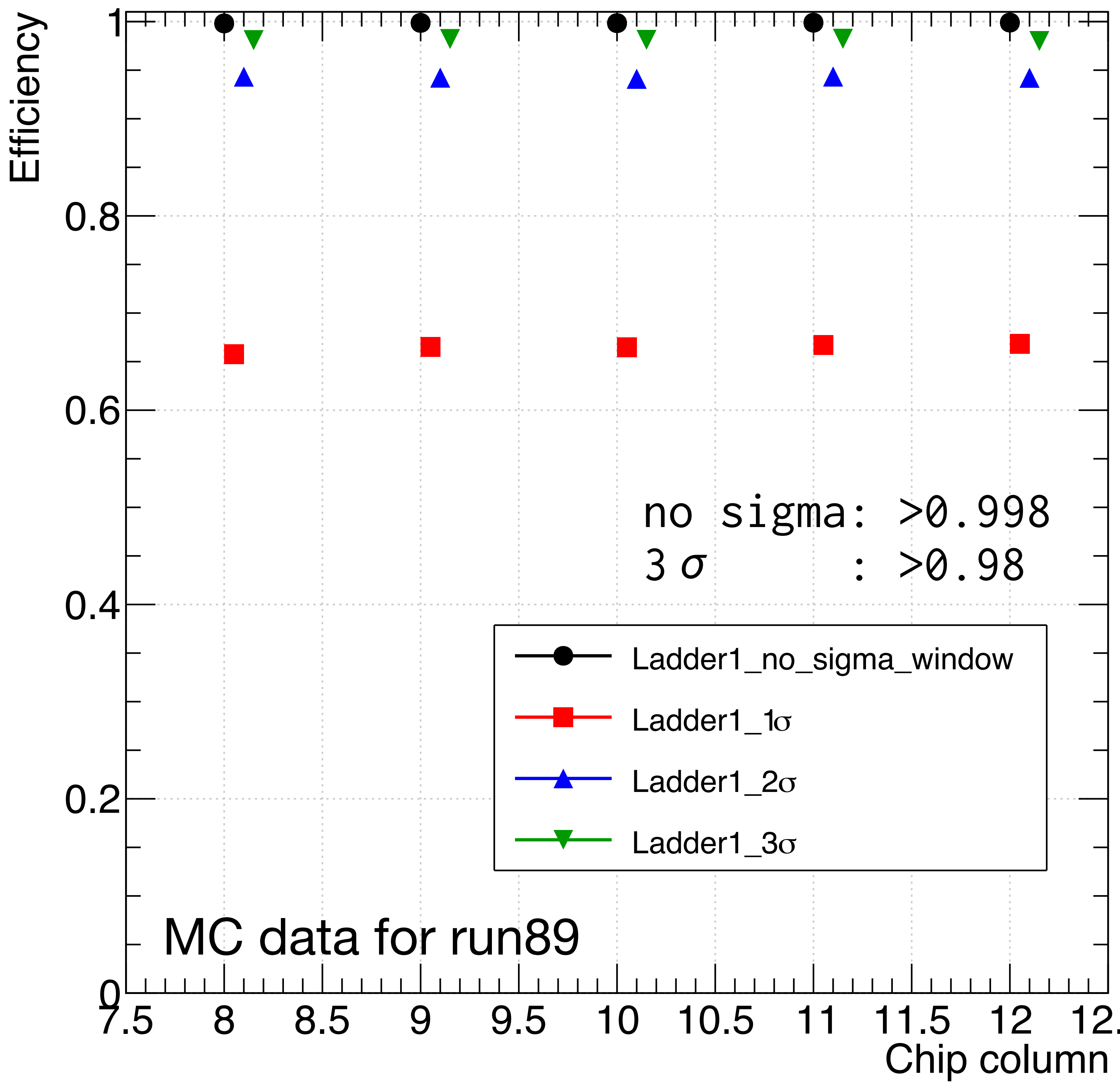
Detection efficiency without 3 σ window is ~97%.

No chip dependence was found, of course.

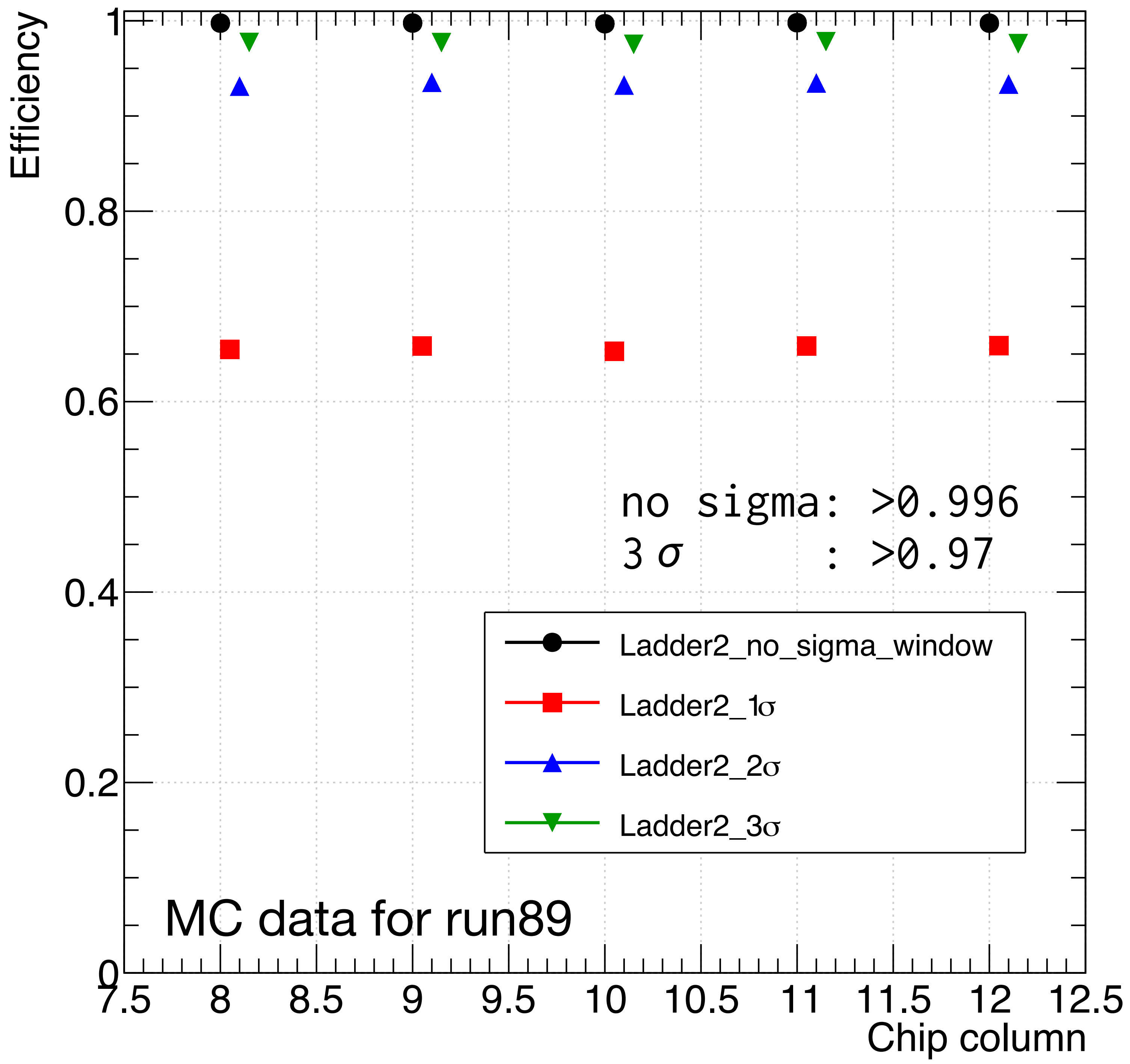
Ladder0



Ladder1



Ladder2



Detection efficiency, additional cut(s) for Run89 ladder1 chip10

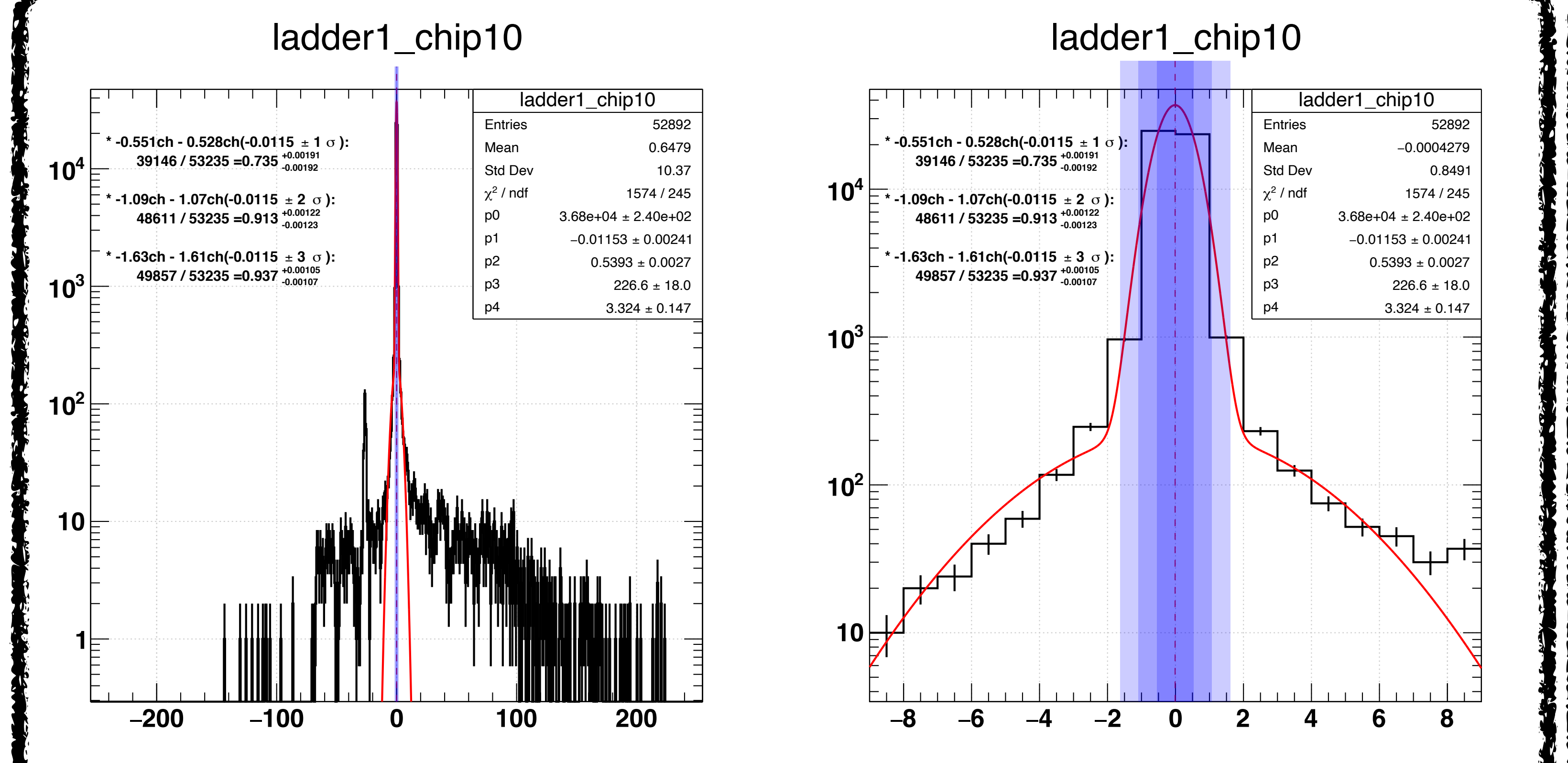
No sigma window cut

	chip	σ	denominator	numerator	ε	error (upper)	error (lower)
no additional cut	10	-1	52892	53235	0.994	0.000	0.000
only single hit clusters	10	-1	31511	31749	0.993	0.000	0.001
multi hit clusters	10	-1	2711	2723	0.996	0.001	0.002
central area	10	-1	33658	33918	0.992	0.000	0.001
no ADC0	10	-1	39630	39821	0.995	0.000	0.000
straight beam track	10	-1	14731	14816	0.994	0.001	0.001

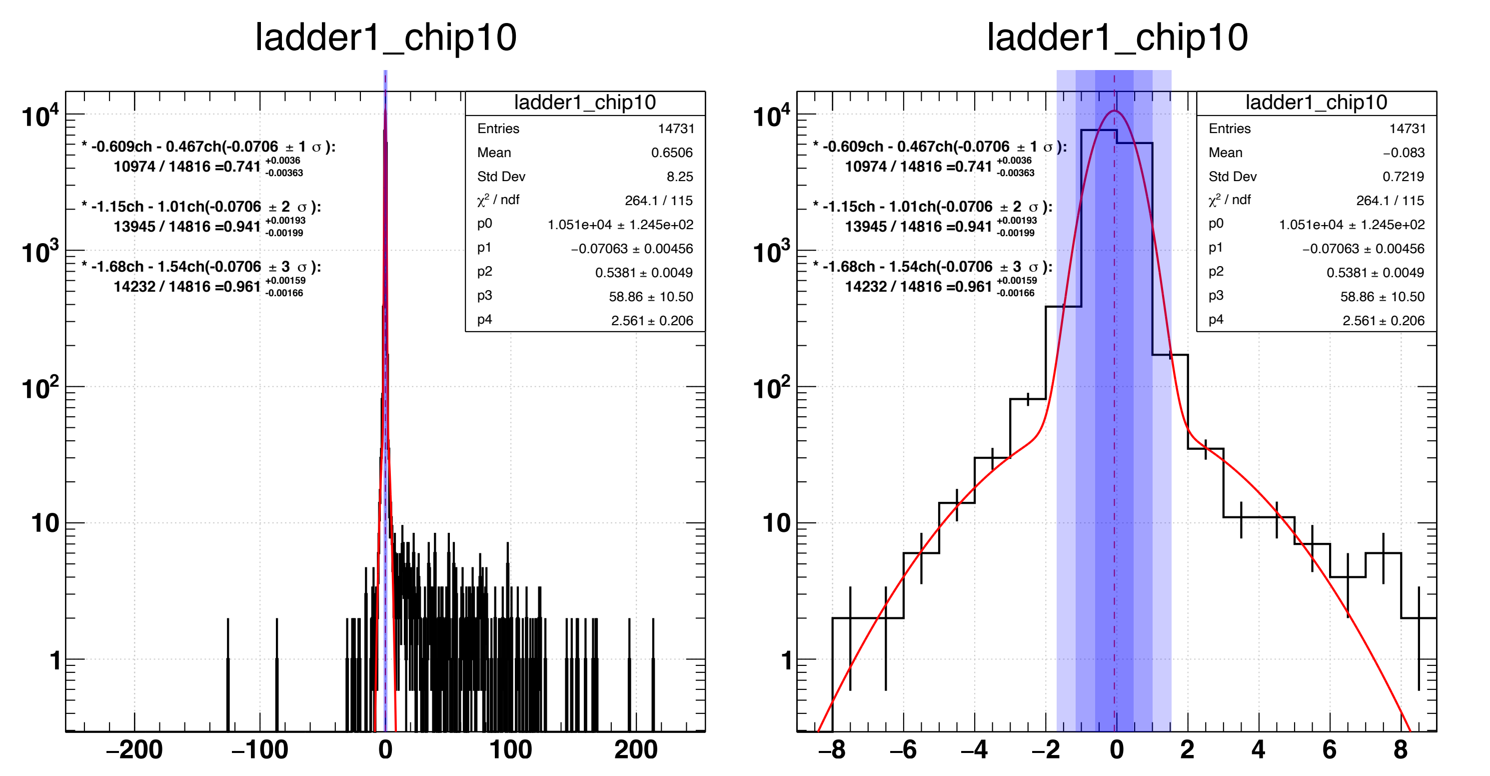
3 σ window

chip	σ	denominator	numerator	ε	error (upper)	error (lower)
10	3	49857	53235	0.937	0.001	0.001
10	3	29822	31749	0.939	0.001	0.001
10	-1		2723			
10	3	32016	33918	0.944	0.001	0.001
10	3	37479	39821	0.941	0.001	0.001
10	3	14232	14816	0.961	0.002	0.002

- **central area**: $20 < ch_{testing} < 120$, $20 < ch_{tracking} < 120$
- **no ADC0**: clusters don't have a hit with ADC0 on the testing ladders
- **straight beam track**: $|ch_{testing,1} - ch_{testing,2}| < 3$ ch



no additional cut



straight beam track

Cuts increase efficiency a little bit.

Correlation of parameters to ⊿ need to be checked.

Detection efficiency, comparison

Analsis	Run	ε (%) Ladder 0	ε (%) Ladder 1	ε (%) Ladder 2
Cheng-Wei	89	$99.3^{+0.2}_{-0.2}$	$99.5^{+0.1}_{-0.2}$	$97.1^{+0.3}_{-0.4}$
Miu	87 88 89	99.53 ±0.02	99.39 ±0.03	99.56 ±0.02
FNAL in 2019	96.0±0.5			
Cosmic ray by Genki	$98.2^{+1.2}_{-2.4}$			

No sigma window cut

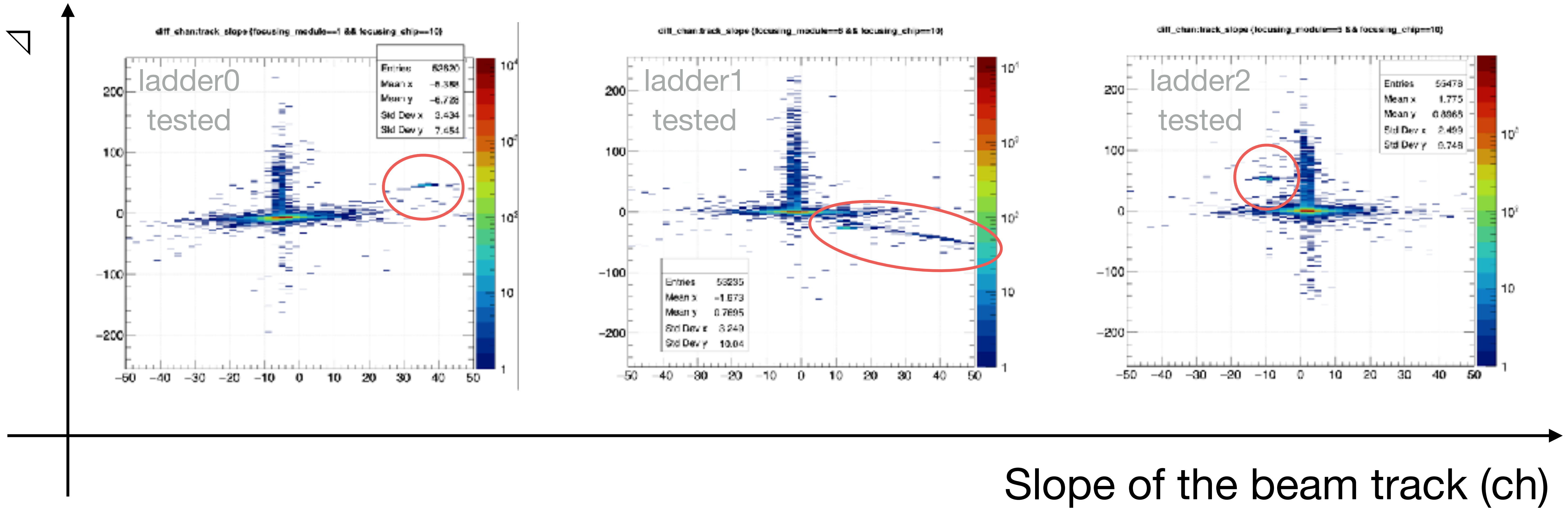
	chip	σ	ε Ladder 0	ε Ladder 1	ε Ladder 2
Genki, no additional cut	10	-1	0.994	0.994	0.954
Genki, straight beam track	10	-1	0.981	0.994	0.963

3 σ window

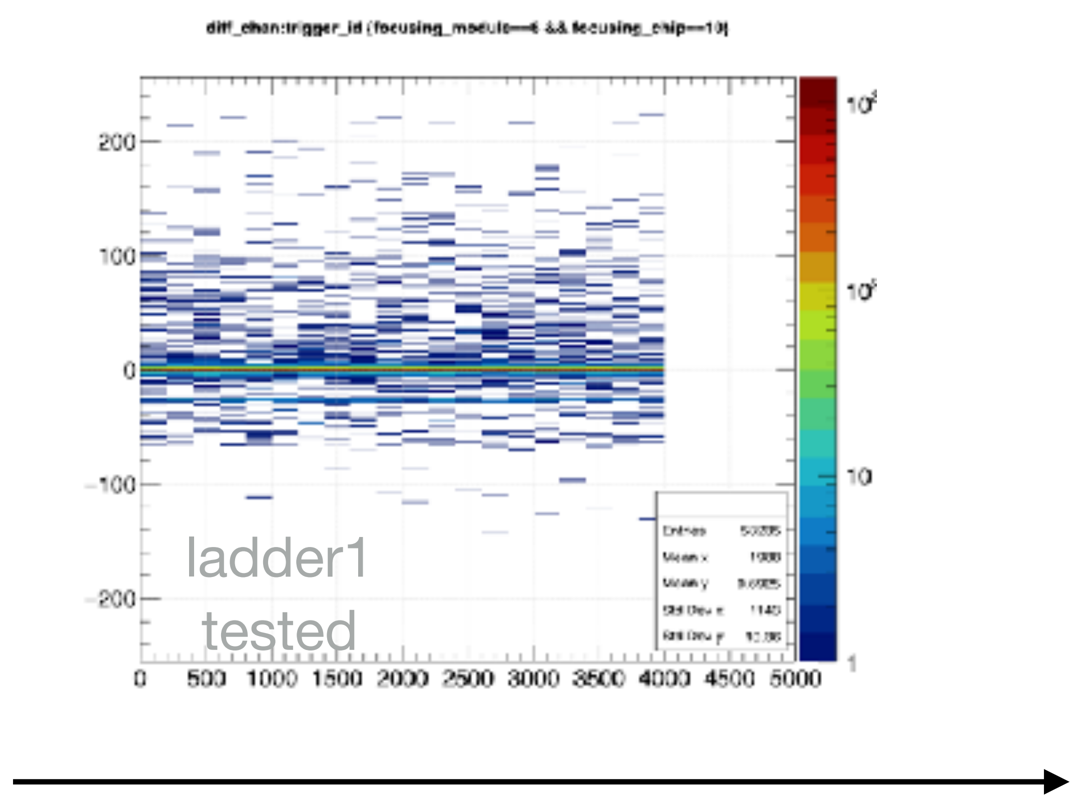
chip	σ	ε Ladder 0	ε Ladder 1	ε Ladder 2
10	3	0.940	0.937	0.894
10	3	0.883	0.961	0.921

I have to do something more…

Detection efficiency, for better results…



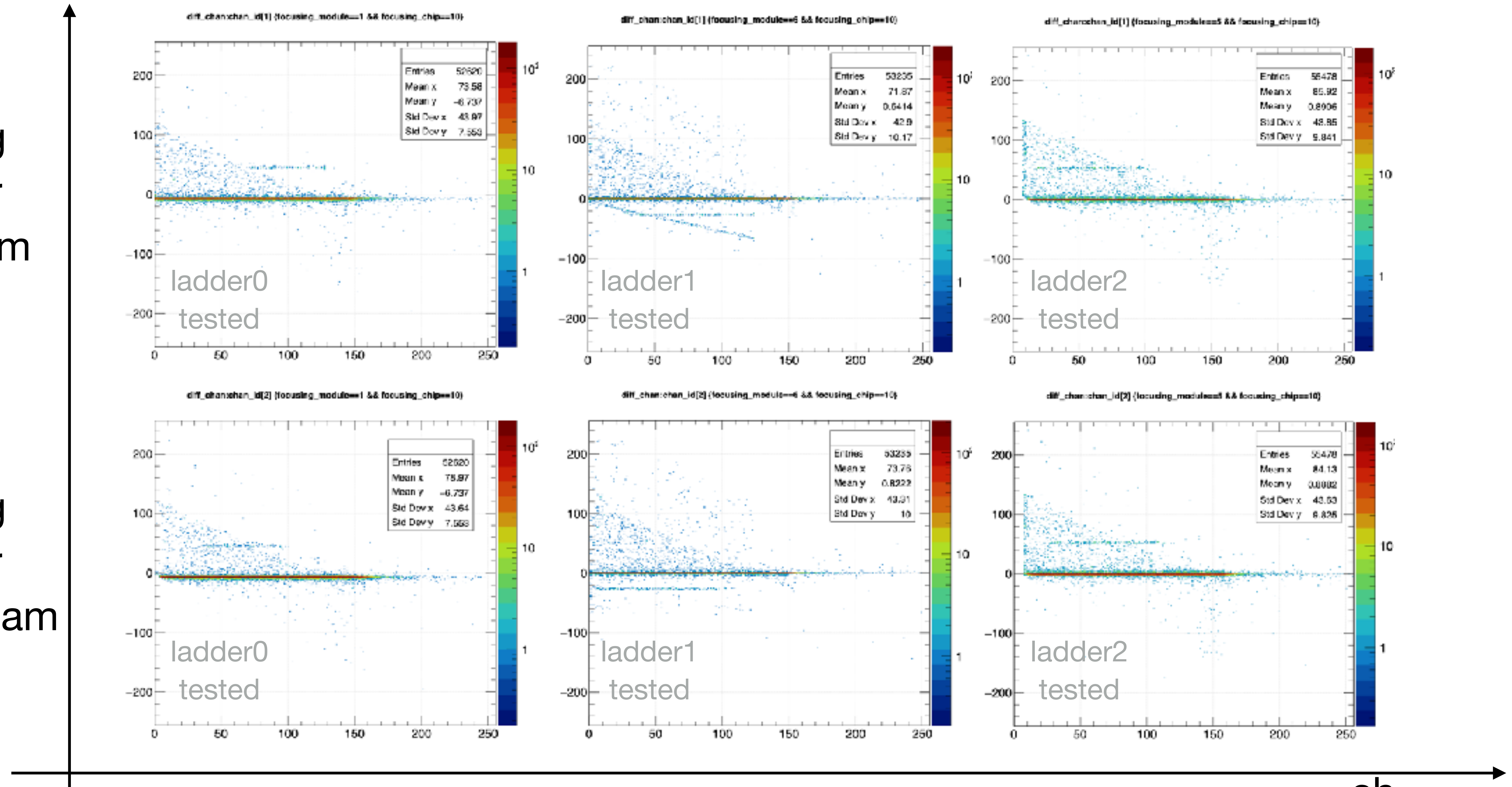
Slope of the beam track (ch)



trigger ID ~ time

testing ladder upstream

testing ladder downstream



$ch_{testing}$

Correlation of ⊿ to…

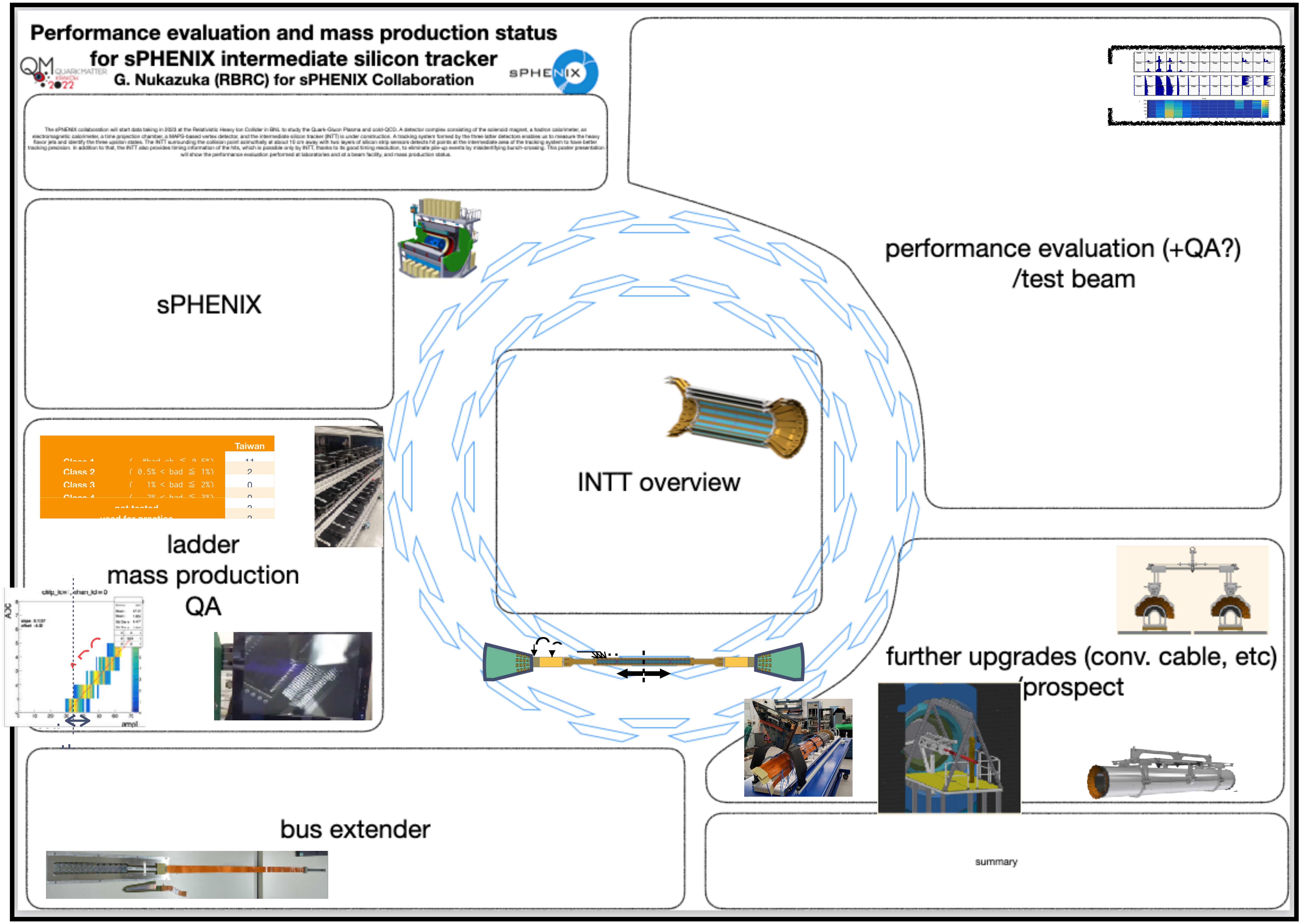
beam track slope: small islands found

time: no

ch of the testing ladders: yes

Plan for QuarkMatter2022

Plan for QuarkMatter2022, current status



HOW TO JOIN THE ONLINE PLATFORM OF THE QUARK MATTER 2022 CONFERENCE ?

The virtual conference will take place on the Zoom Events platform. The registered and confirmed attendees will receive an invitation from the platform (on March 29,2022). **After receiving an invitation follow the instruction, which is available for download at the link below.** After signing in, you will get access to all conference sessions.

Important:

- If you do have a *Zoom account*, please check whether your *Zoom username* matches the email address used for the conference registration. If not, please make a new Zoom registration with that email address.
- If you do not have a *Zoom account*, please register now using your email address (the one in the conference database) as the Zoom username.

Instructions on how to access the online conference can be found here >>

On 30, 31 March and 1 April between 14.00 and 16.00 CET, the zoom events platform will be open to presenters and attendees, where you will receive technical support and be able to practice your presentations live. In case of further problems, please contact technical support under qm2022@symposium.pl

POSTER SESSIONS

It is planned to have three one-hour long Poster Sessions: two on Wednesday (April 6) and one on Friday (April 8) , They will be all organised in an online mode. Each poster session will be divided into 12 poster topical subsessions (rooms) that will be further divided into (up to) 15 breakout rooms. So each poster session will host about 180 separate poster presentations. The detailed (still preliminary) organization of poster sessions is displayed on indico
https://indico.cern.ch/event/895086/timetable/#20220406
https://indico.cern.ch/event/895086/timetable/#20220408

Note that the indico list of poster presentations in a given room is divided into 4-minute slots, which serves only to arrange the presentations into a vertical list. In reality, each poster presentation is planned for one hour.

For poster presenters: It is required that the poster presentations are uploaded to the indico in advance, by Tuesday (April 5) afternoon at the latest. It will allow the interested participants to view the posters earlier. The recommended presentation format is similar to that of a standard oral presentation, with the main difference that the number of pages for a poster should be up to 5. The poster presenter should join first the topical subsession and then the breakout room assigned to a given poster. To do so, use the button to the right of the "share screen" button (marked as 4 white squares) and join the room assigned to your poster. Use "share screen" to present your poster (as well as some additional materials). Wait for participants who are interested in your presentation.

For those who are going to view the posters: Since the poster sessions will be organised online, it is recommended for the onsite participants to return to their hotels or other places with a good internet connection to take part in the poster sessions. We are also going to arrange some places in the conference lobby for this purpose. The first step is to select the topical subsession of your interest and join this track. Once there, you go to the breakout room where the poster you want to see is presented. To do so, use the button to the right of the "share screen" button (one marked as 4 white squares) and choose a poster. You can then switch from poster to poster by leaving one breakout room and joining the other one within this topical subsession. You can also leave this topical subsession and join another one of your further interest.

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