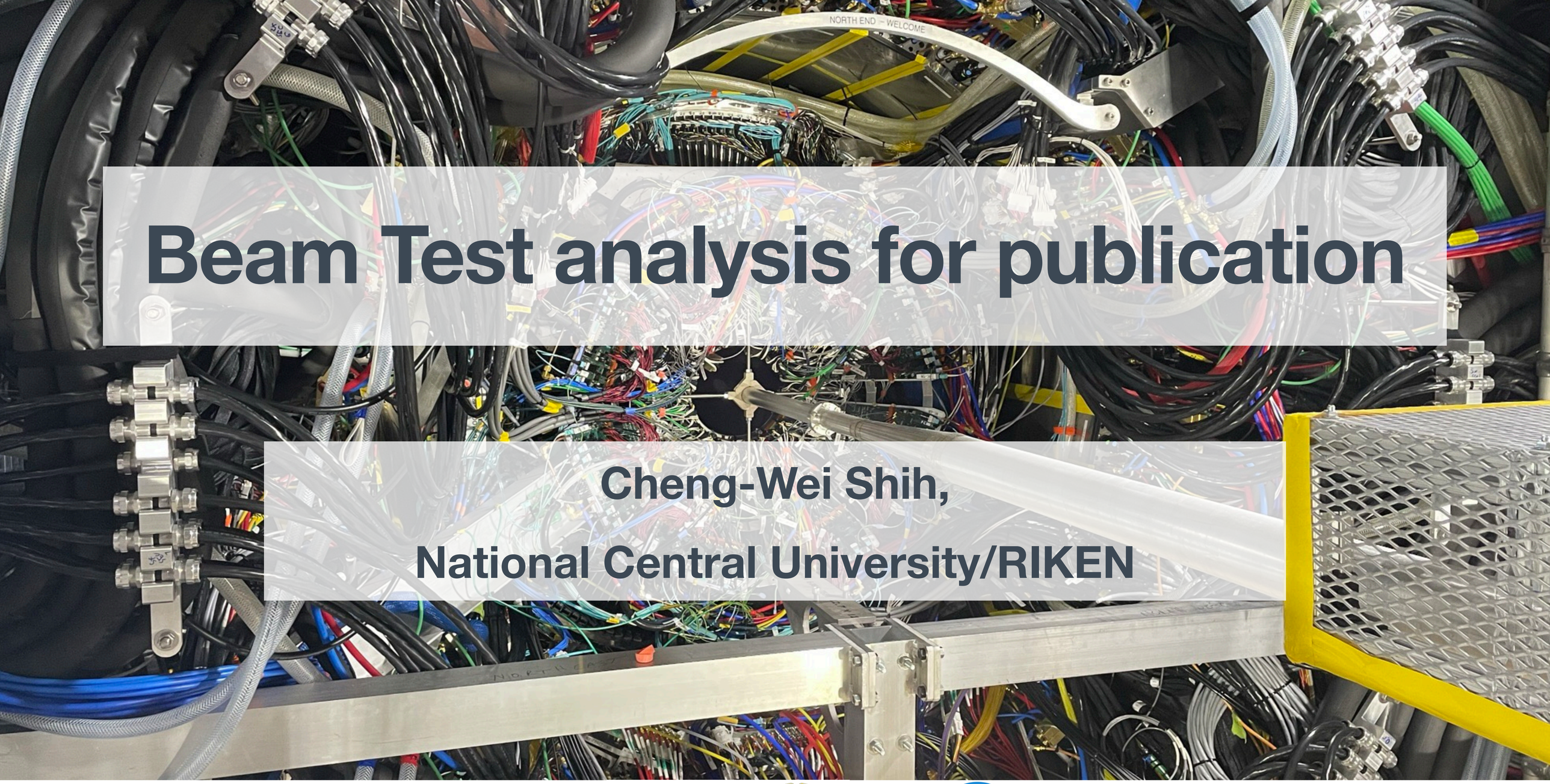


Beam Test analysis for publication

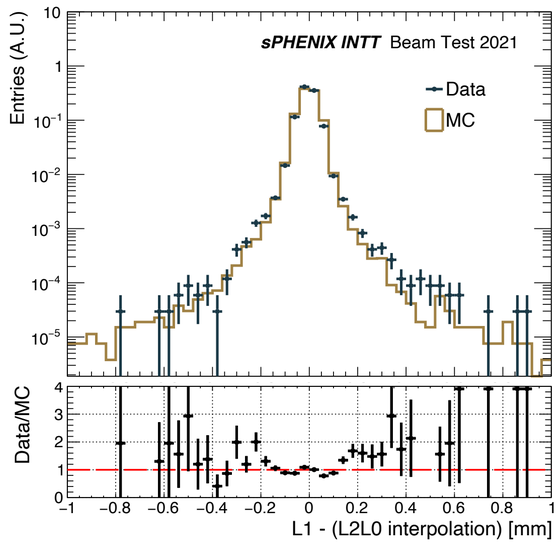
Cheng-Wei Shih,

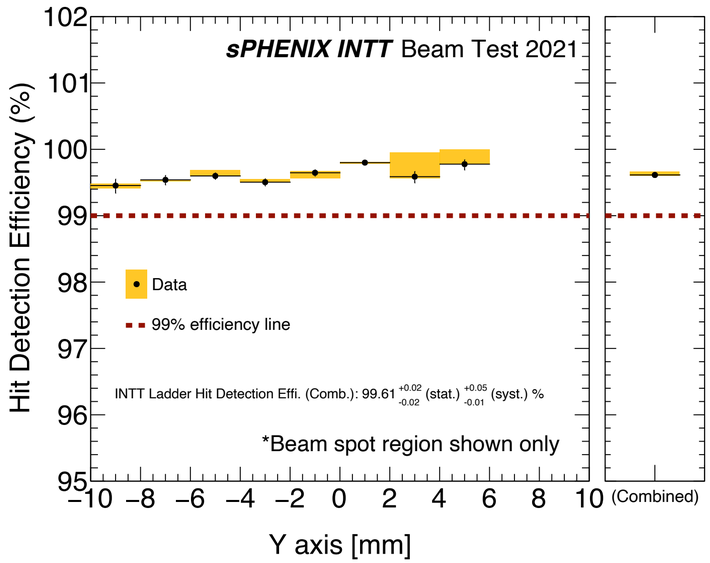
National Central University/RIKEN

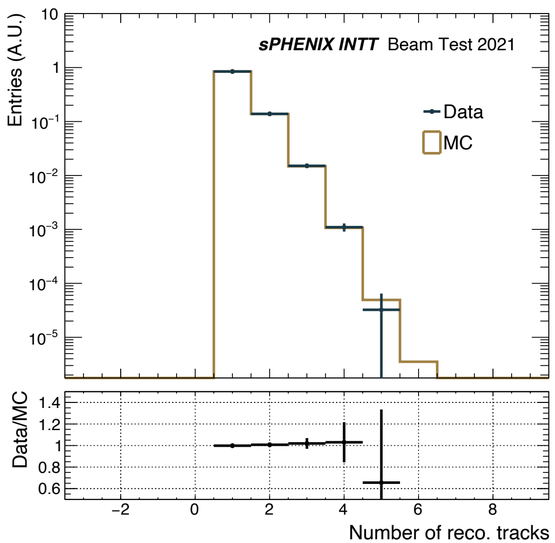
May 30th, 2025
INTT meeting

Current status

- Energy deposit distribution - Still need to converge on how to present the result
- Residual distribution - Done
- Hit detection efficiency - Done
- Number of reconstruction tracks - Done

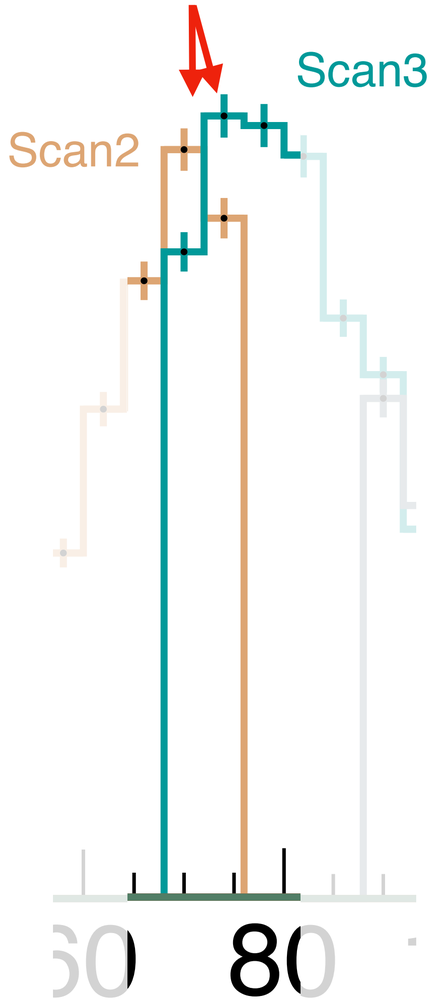


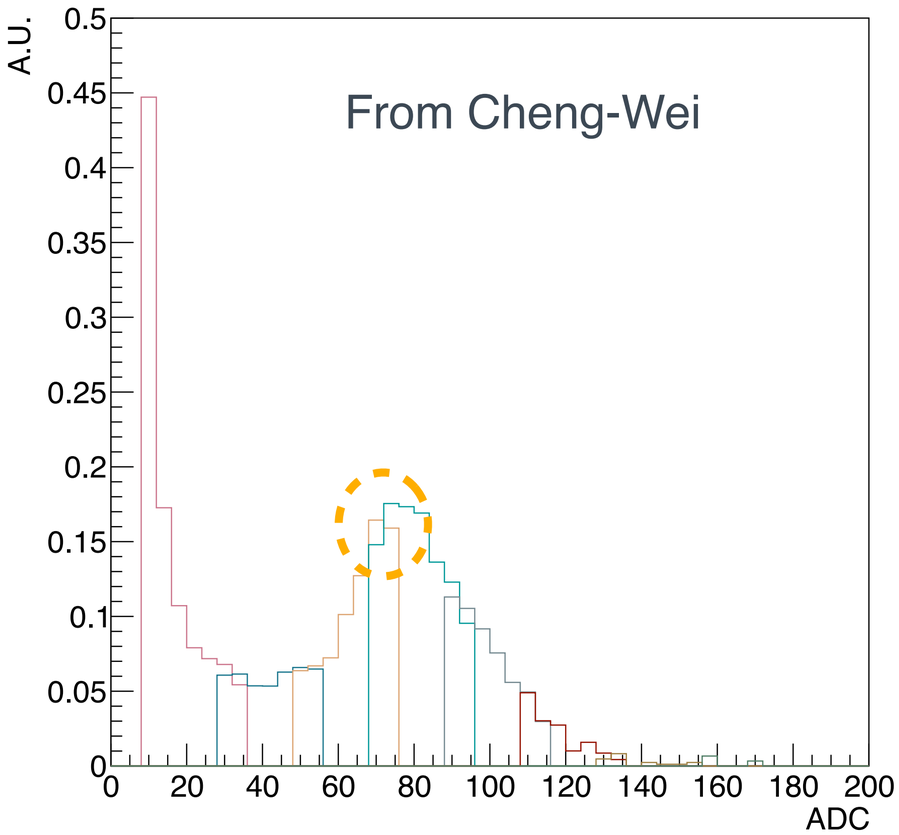


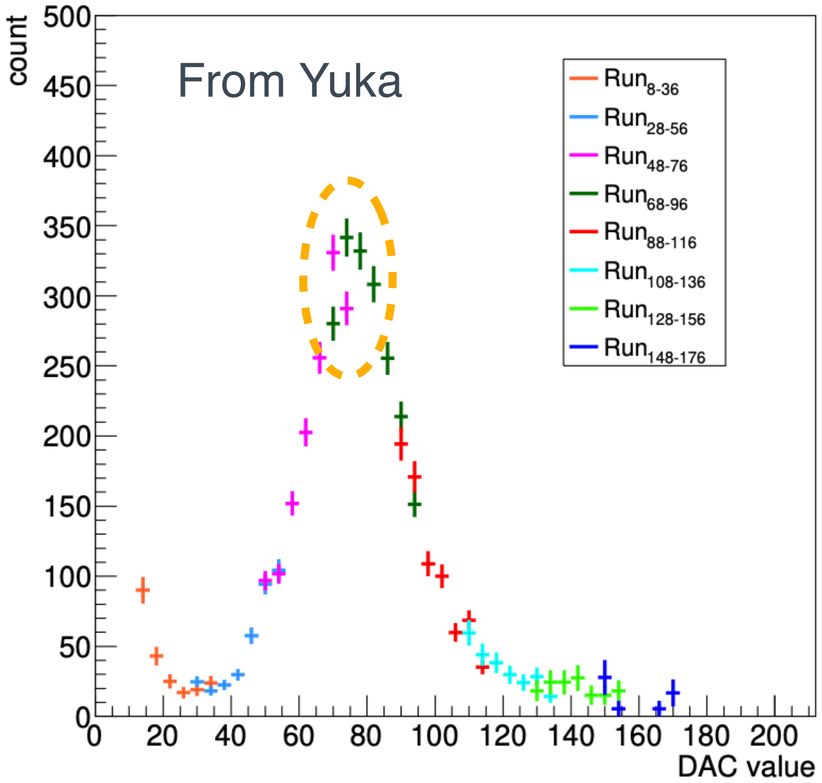


Reminder, DAC Scan - in combining bins

The disagreement in the overlap bins between Scan2 and Scan3, observed in the past already







Suggestions from Takashi, Genki and Itaru

1. Use 6th bin method as baseline

2. Check L1 distributions (10x more entries than L0 and L2) and Remove L1 from the study

3. Remove overflow-bin method

4. Diff. b/w 6th bin method and 6-7th bin method to be the syst. unc.
   - Diff. to be both upper and lower unc.
   - Variations between L0 and L2 to be the additional syst. unc. source

5. Fitting for extracting S/N and MPV, and their corresponding errors
   - Use Only Gaussian functions to model noise component
   - Write down the fit parameters of Gaussian functions
   - 3-time fitting (baseline, upper syst. err., down syst. err.)

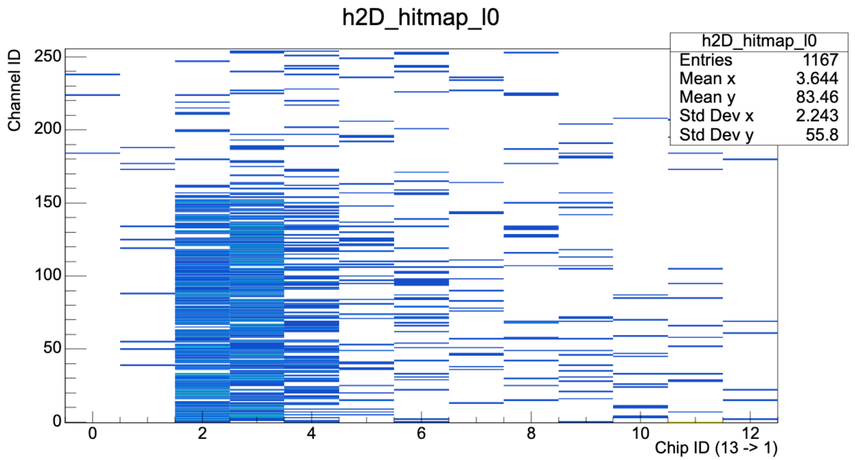
6. Within single-hit clusters, check the cluster ADC as a function hit position (From Itaru)

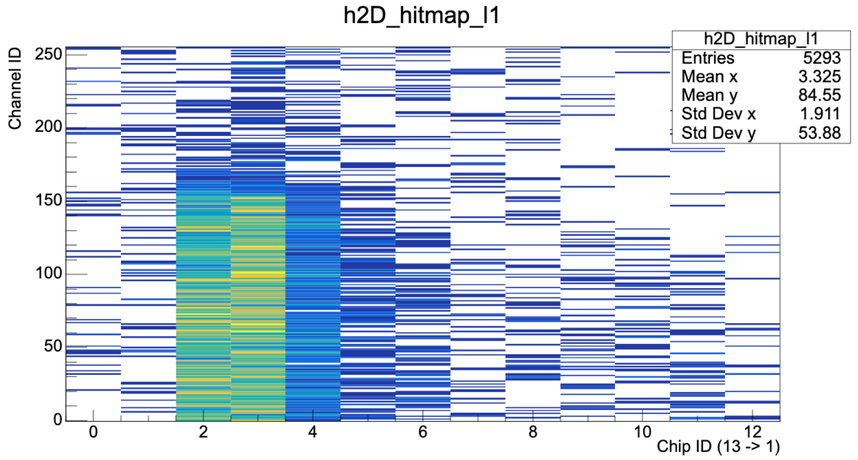
Replies

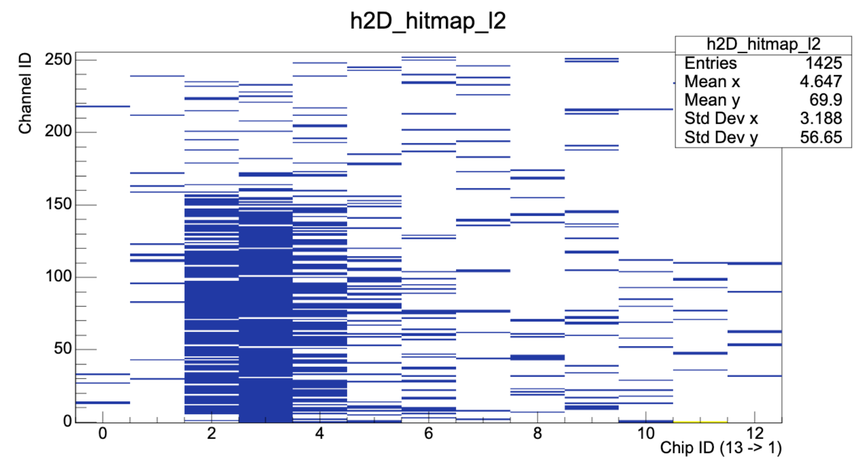
- Use 6th-bin method as baseline
  - Can do

- Check L1 distributions (10x more entries than L0 and L2) and Remove L1 from the study
  - Can do
  - I noticed and investigated this higher-entry issue of L1 in the past, and found no obvious problem (ADC distribution and hit map both look good). Therefore was still using it.

Run72 [threshold range: 108 - 136]





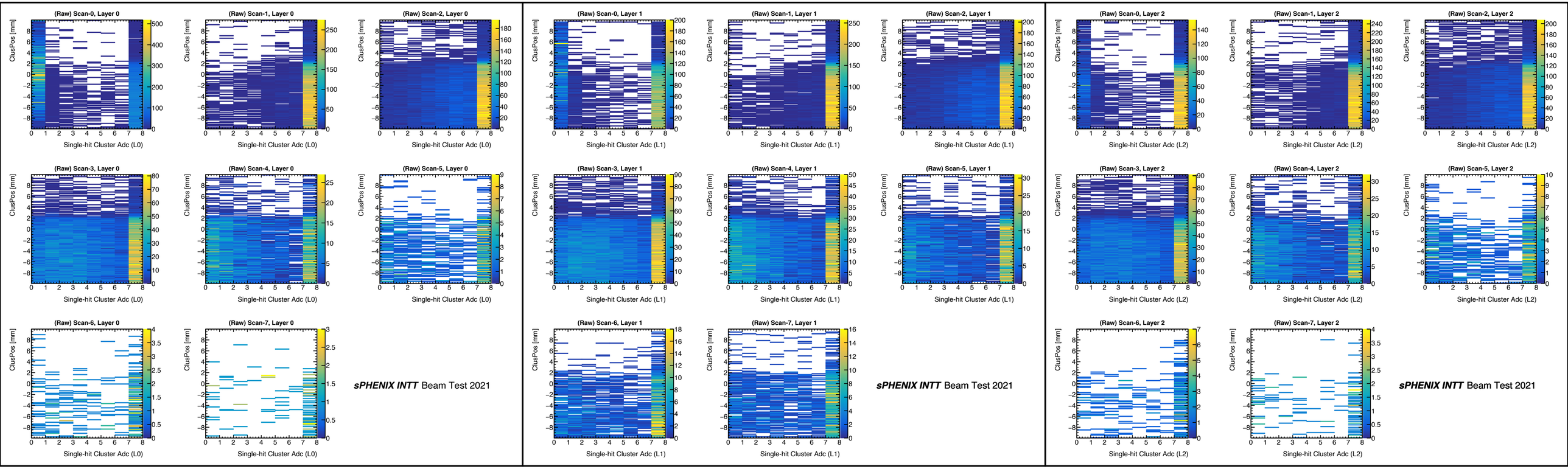


Replies

- Within single-hit clusters, check the cluster ADC as a function hit position (From Itaru)
  - Concerns: is the adc0 bin reliable? (Since it's the only bin used in the matching)

Cluster ADCs and positions of the single-hit clusters in Column 9, 10 and 11 are binned into histograms
In each subplot, X axis: cluster ADC, Y axis: Cluster position

L0 L1 L2



Distributions look reasonable. The single-hit clusters with adc0 seem to be reliable

Replies

- Remove overflow-bin method
  - Can do

- Diff. b/w 6th bin method and 6-7th bin method to be the syst. uncertainty. Difference to be both upper and lower unc. And variations between L0 and L2 to be the additional syst. uncertainty source
  - Can do, but
  - with a second thought, wondering what is the necessity of having the systematic uncertainty if the 6th-bin method is considered as the most reliable one?

Replies

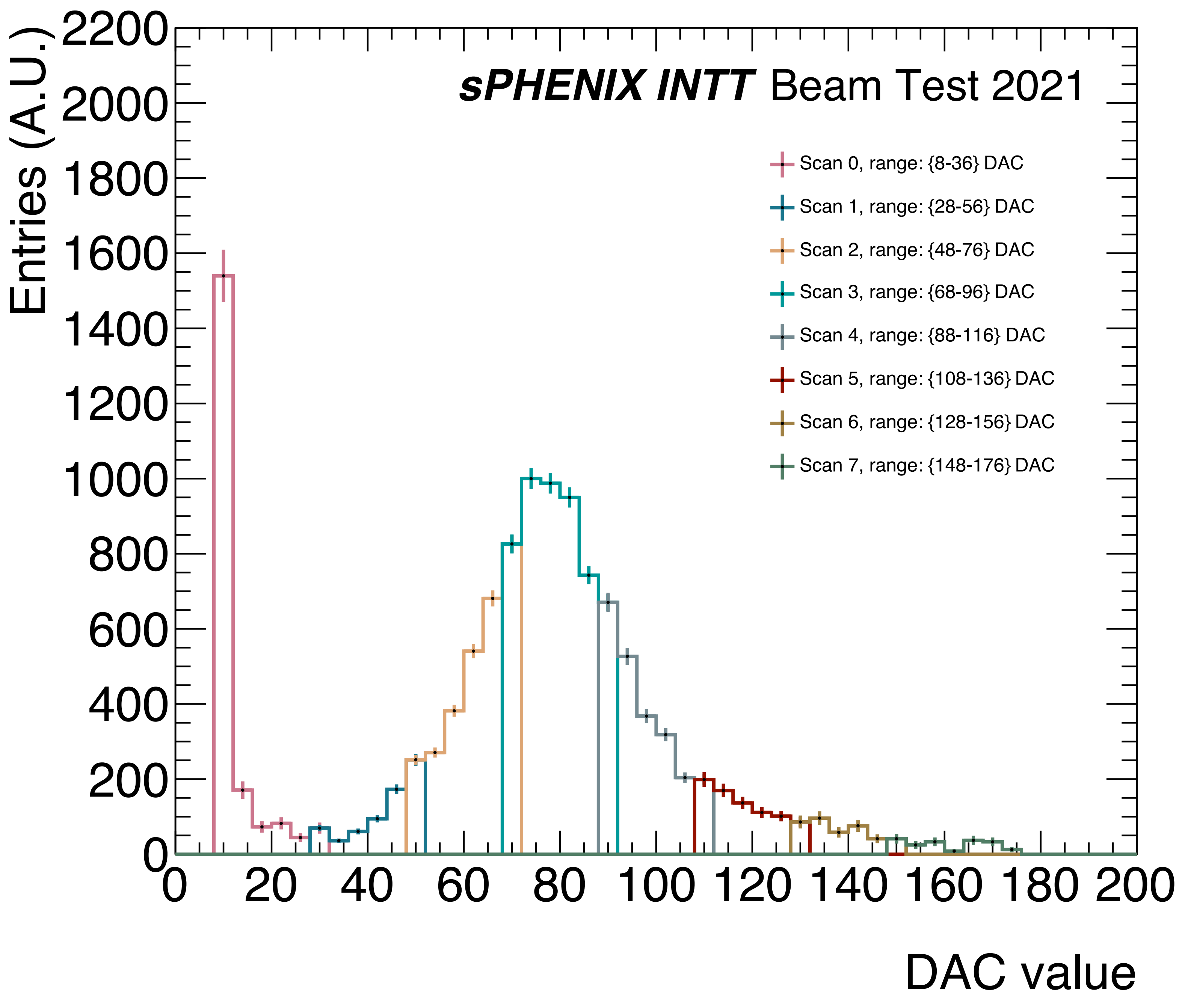
- Fitting for extracting S/N and MPV, and their corresponding errors
  - Use Only Gaussian functions to model noise component
  - Write down the fit parameters of Gaussian functions
  - 3-time fitting (baseline, upper syst. err., down syst. err.)

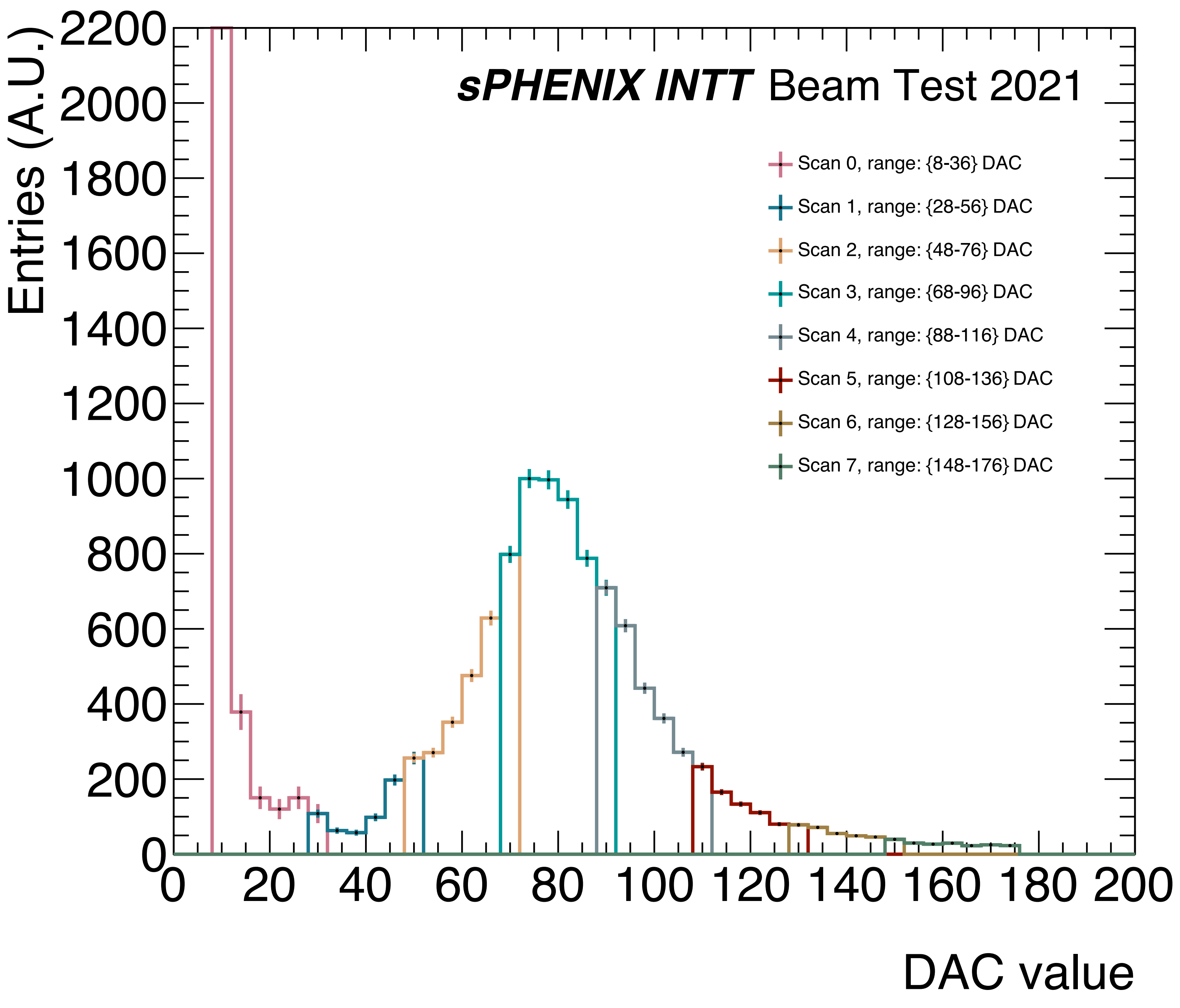
- Reply:
  - Can do, but
  - no reason to show S/N (maybe also the MPV)
  - S/N highly depending on event selections
    - The current event selections used in the DAC Scan study is very loose comparing to that of used in detection efficiency study
    - Reported range is in ELPH (adc > 40) does not correspond to the threshold setting (adc=15) for most of the runs
  - MPV would just be an one-time-shown value. It's not used throughout the whole beam test analysis as well as collision data analyses

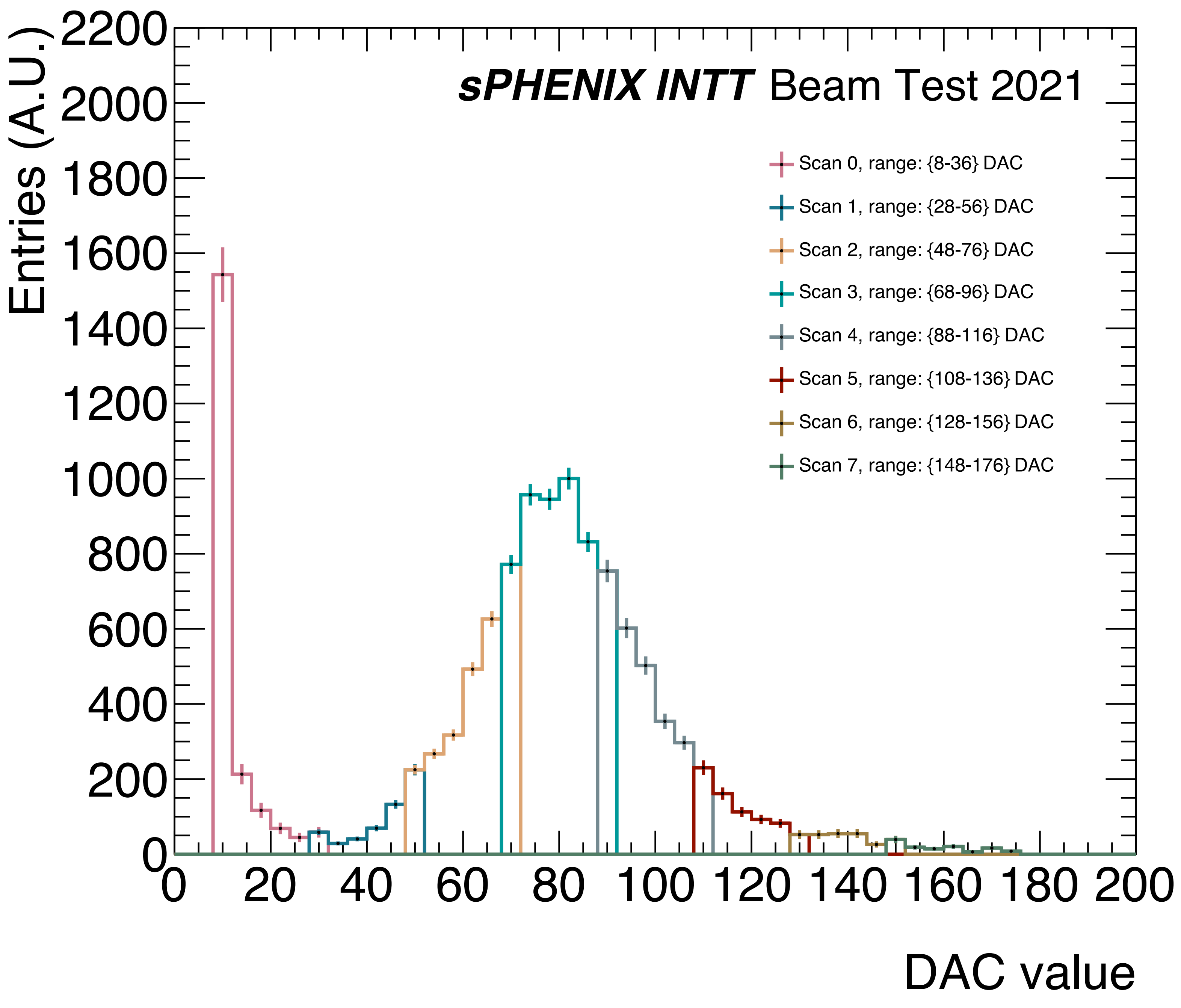
My proposal 1

- Just show the distributions matched by the 6th-bin method

- Clone-hit removal and clustering were performed in the first place. And only single-hit clusters are considered
- Event selection:
  - Requiring single cluster or no cluster in each layer (inclusive to location, and cluster size)
  - Columns within beam-spot region selected (Column9, 10, 11)
- Matching method: only use the 6th bin

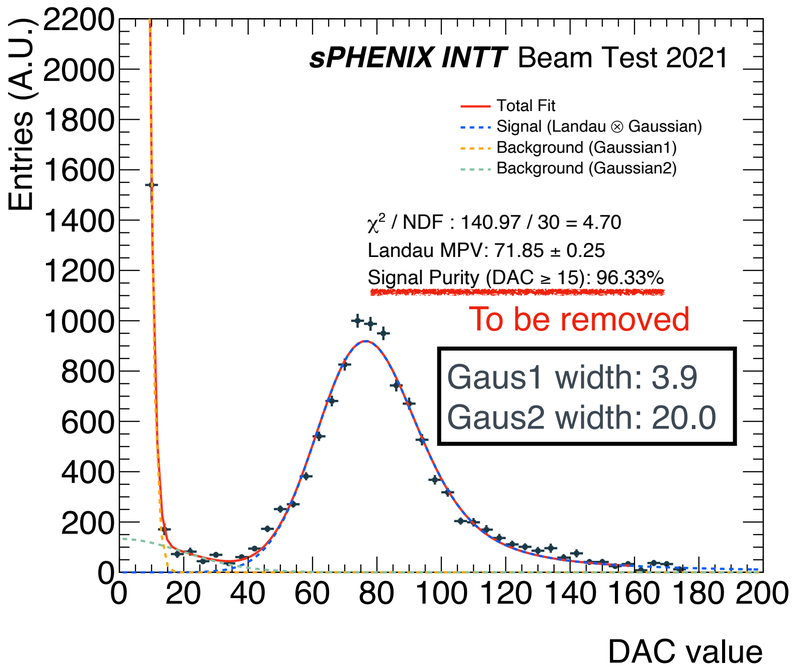


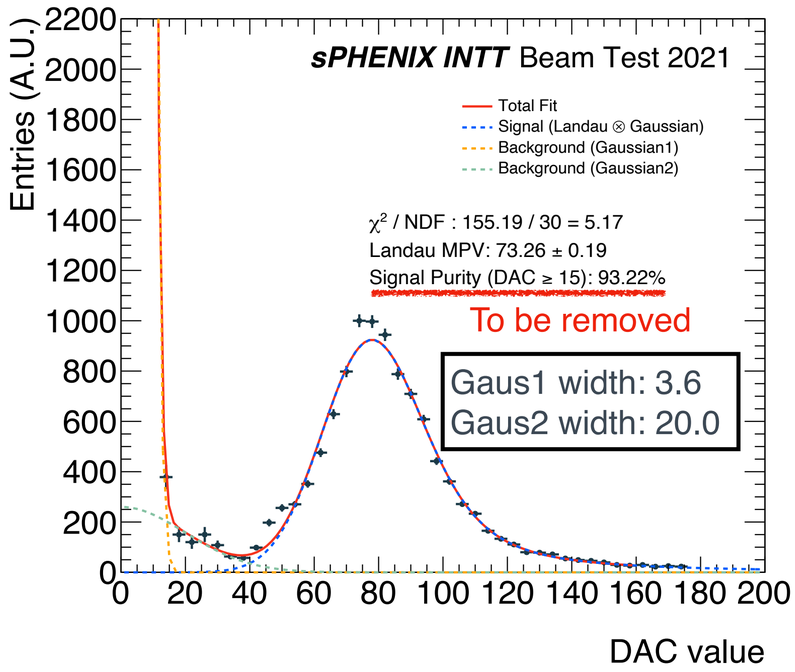


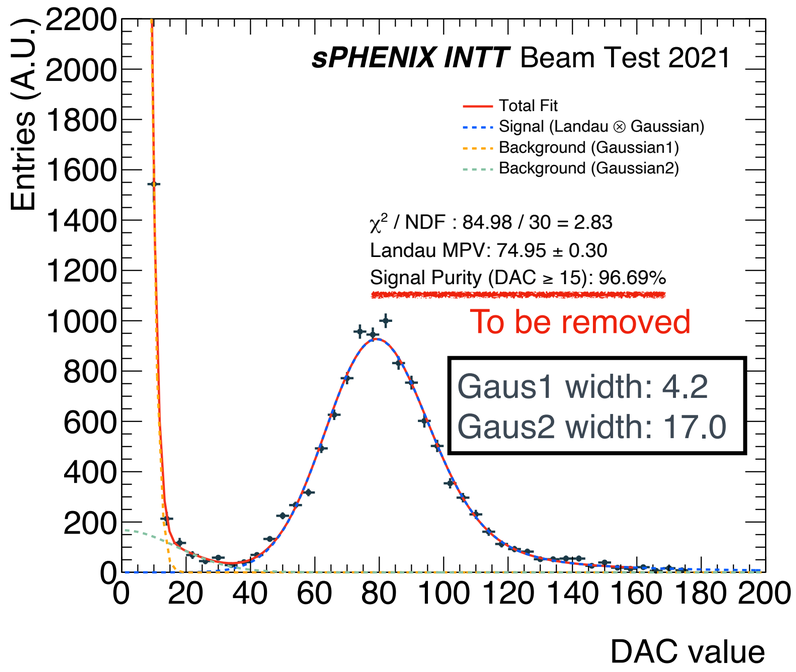


My proposal 1

- In combining overlapped bins
  - The overlapped bins are on the top of each other
  - Final statistic error: $(E_A+E_B)/2$
- Don't show the signal purity:
  - It's not relevant to hit detection efficiency (with the current event selections)
- Fitting: Fit range (8 to 160)
  - Exponential component is replaced by Gaussian1
  - Means of Gaussian1 and Gaussian2 are fixed at 0



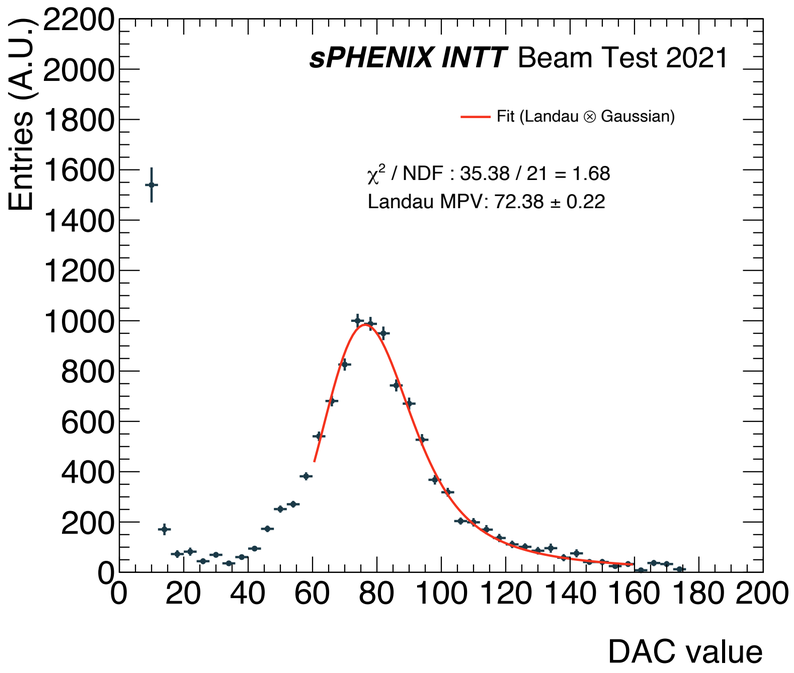


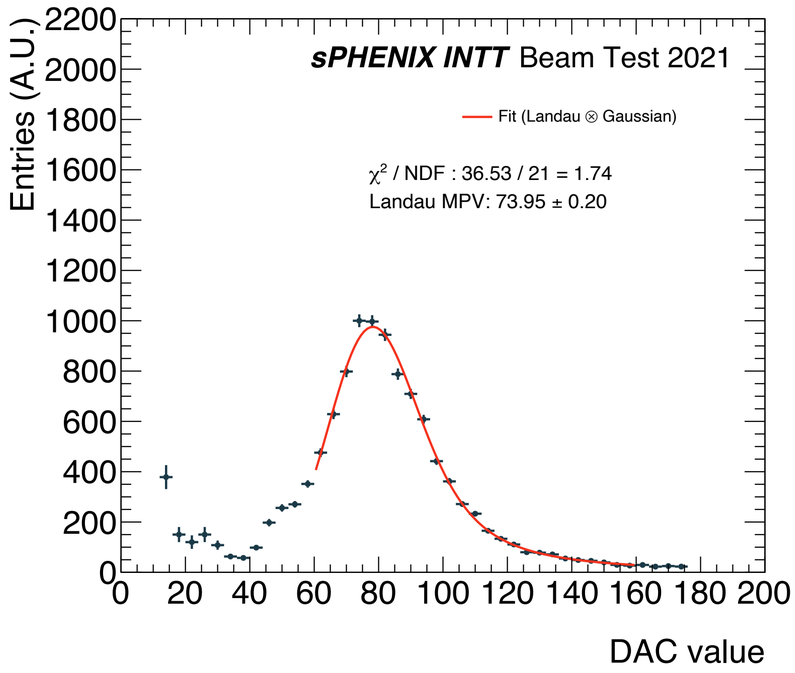


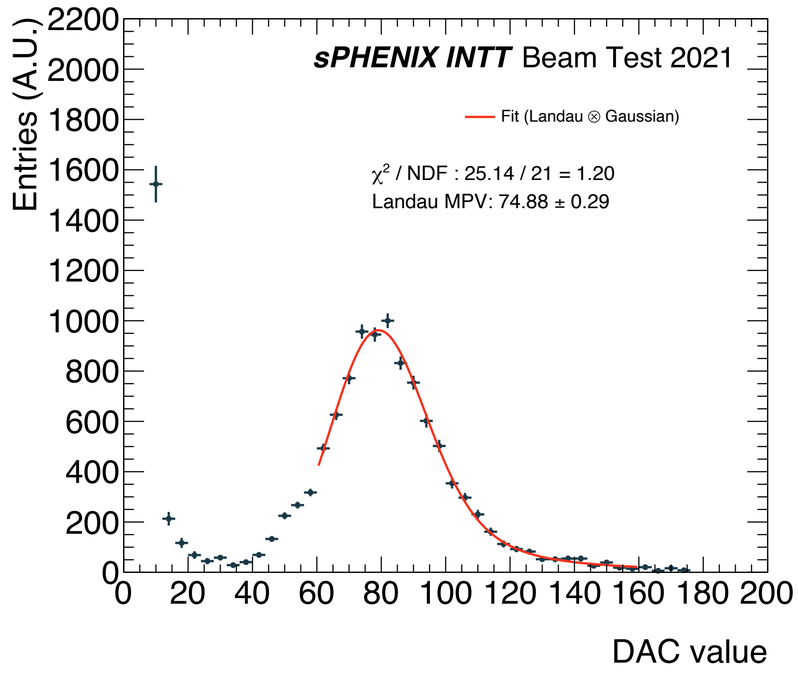
My proposal 1

- Fitting option2 (fit range: 60 to 160)
  - Just fit the signal regions to obtain MPVs

- IMHO: In terms of NIM report, the main physics message from this plot (with current event selection) is to show the clear signal component, and (maybe) to highlight MPVs

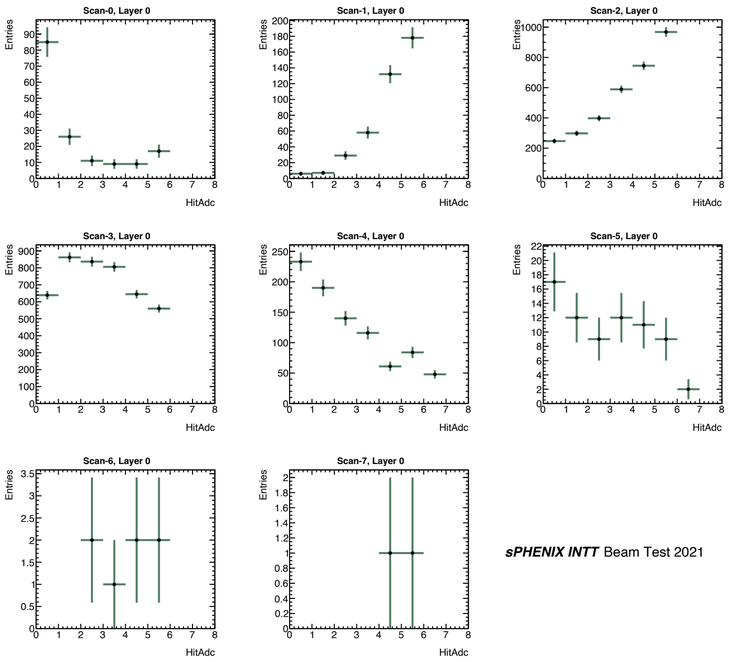


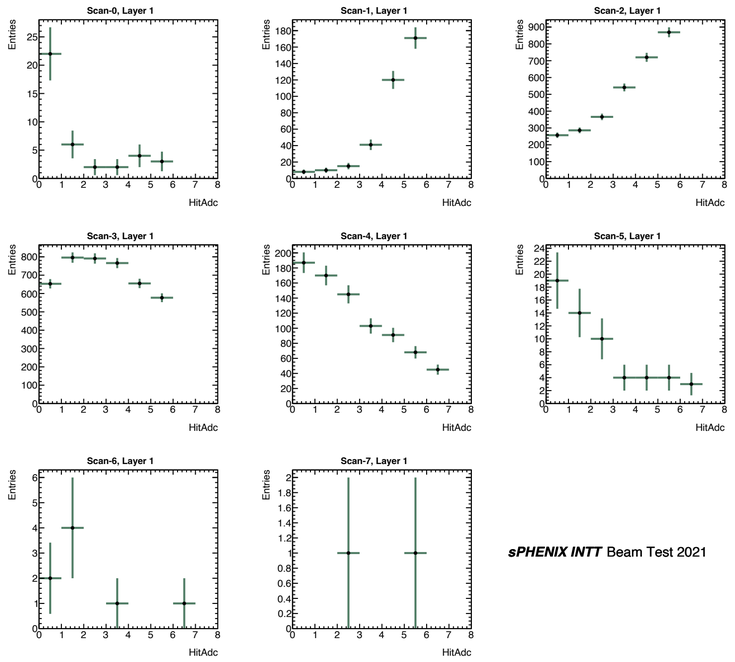


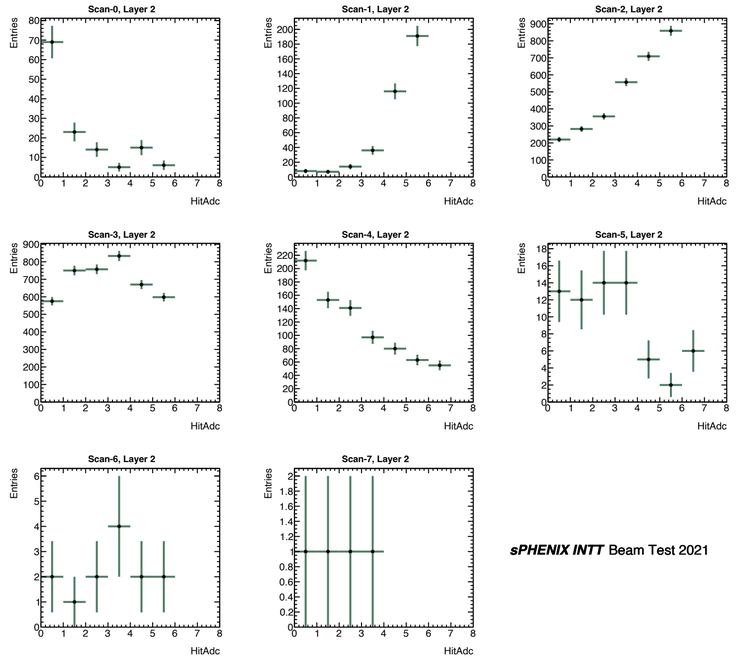


My proposal 2

- L0 and L2: perform tracking
  - Same selection as what used in detection effi. study except clusterAdc criterion
- L1: the cluster matched to the track the best
- If the clusters are single-hit clusters, bin to the histograms

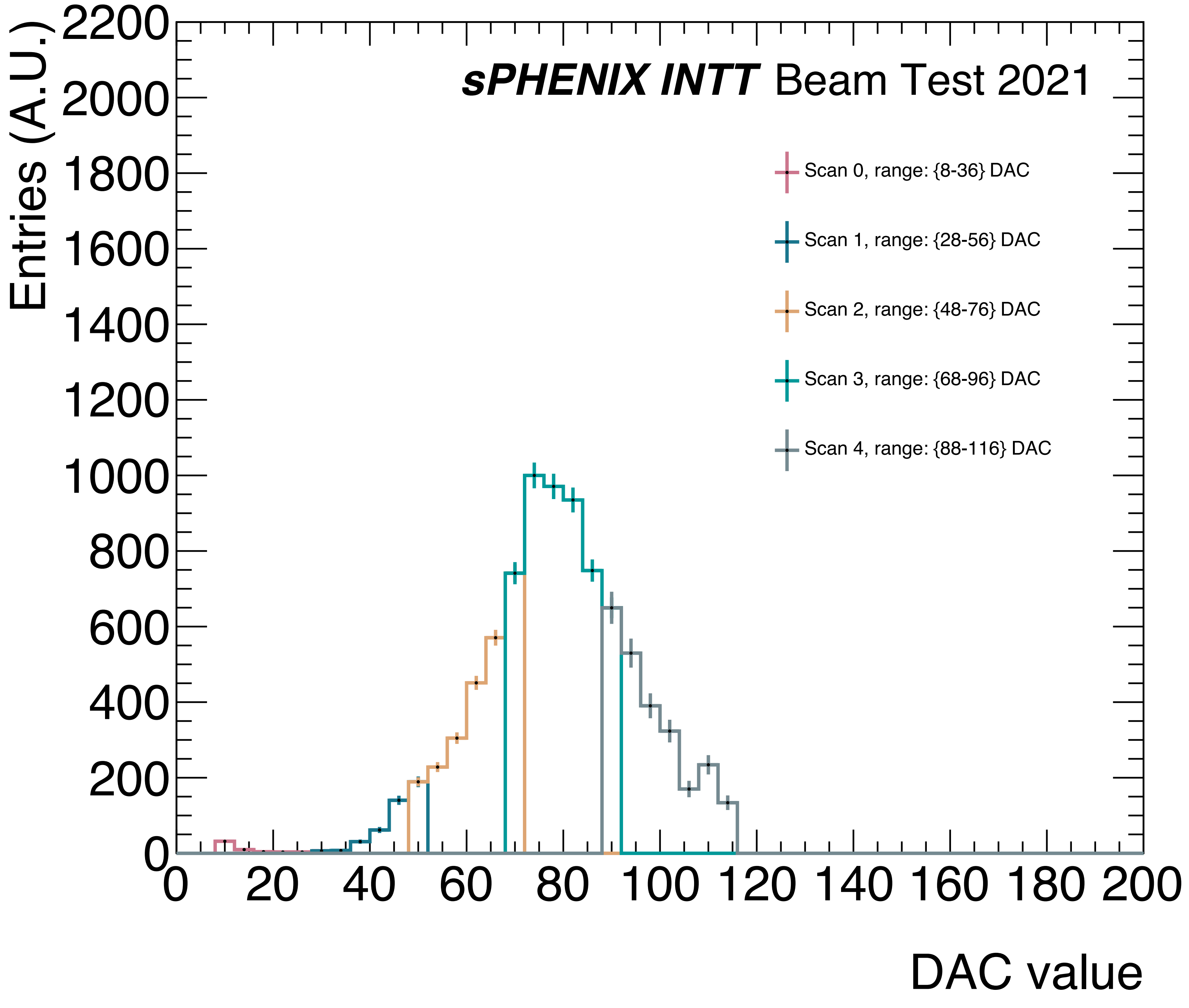


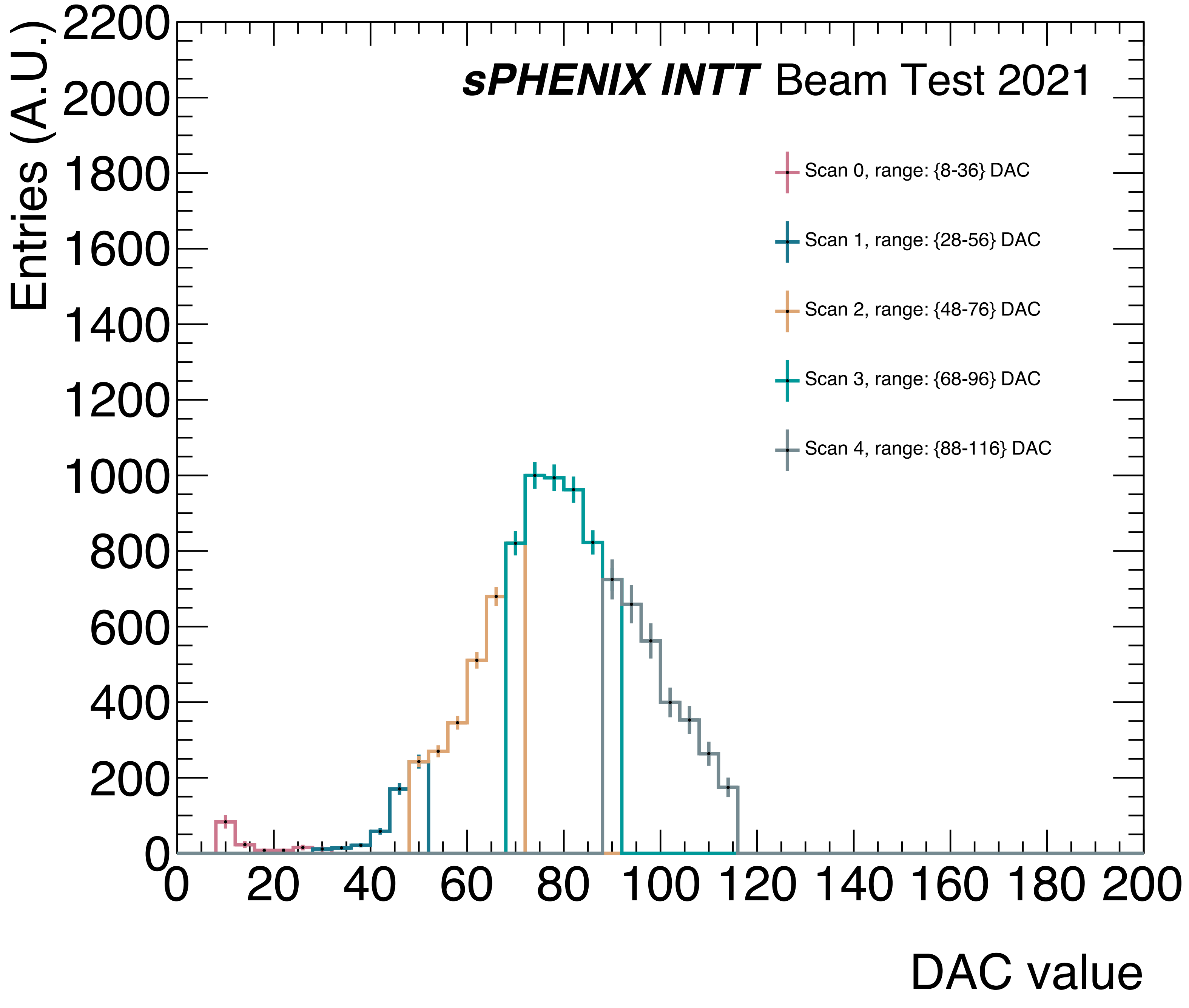


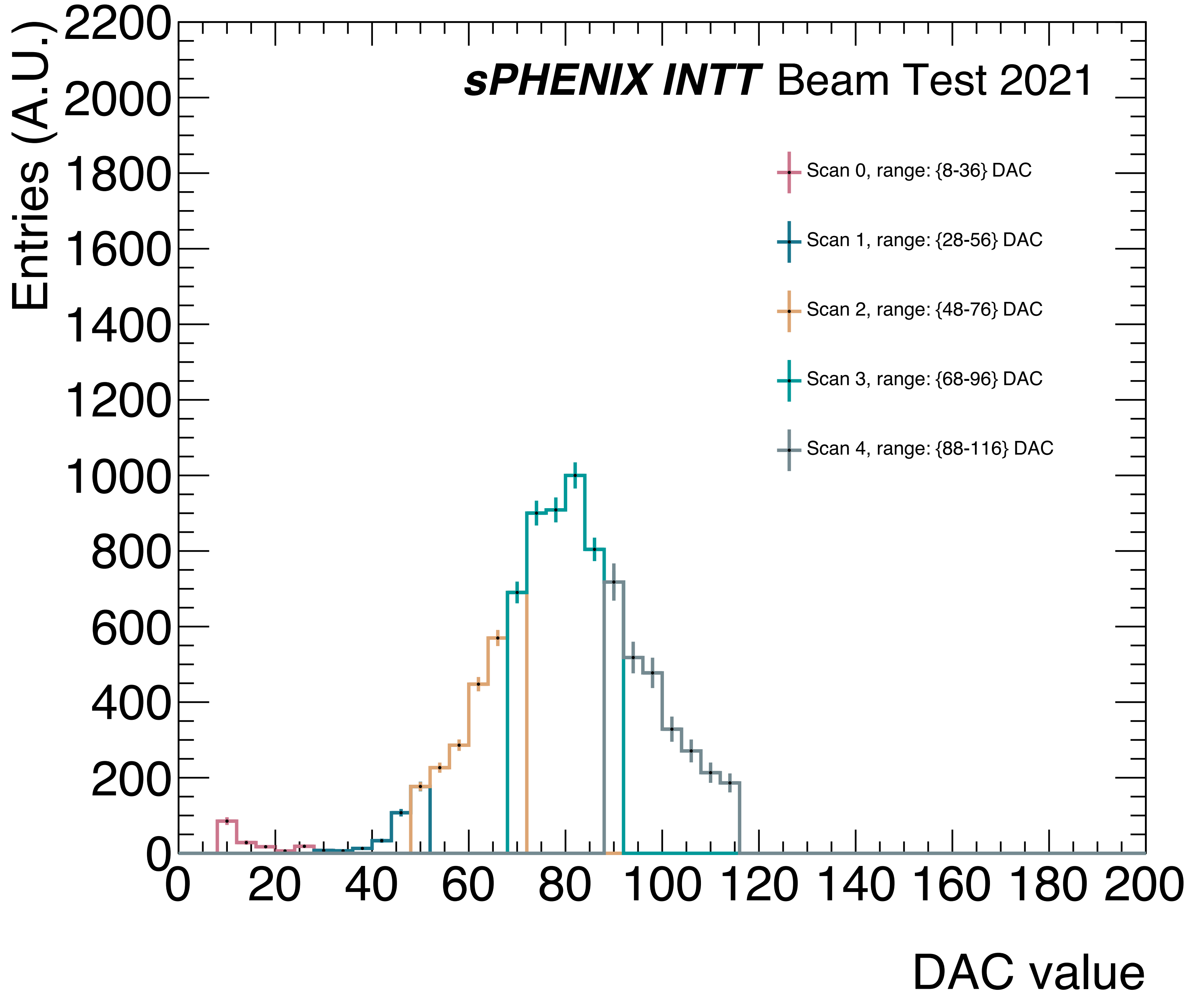


My proposal 2

- Just show the distributions matched by the <u>6th-bin method</u>
- Drop Scan5, 6, and 7 due to their too low statistics
  - Most useful DAC Scan dataset for the hit detection efficiency: changing the threshold settings of L1 while keeping L0 and L2 as the nominal setting (threshold=15)

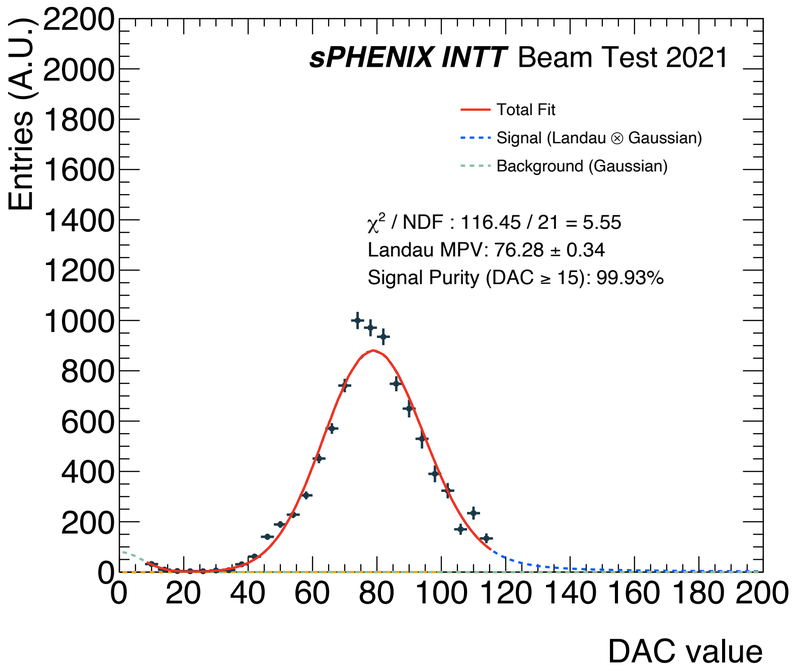


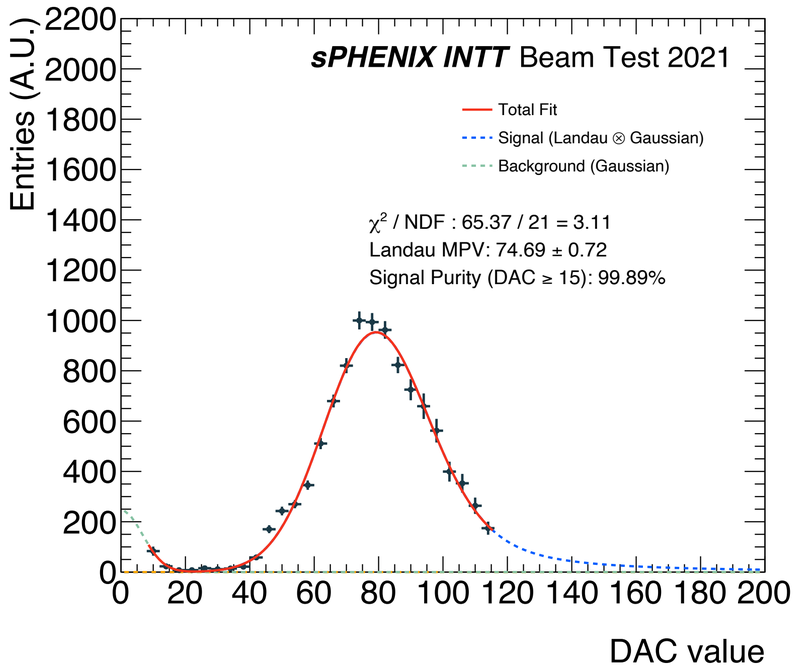


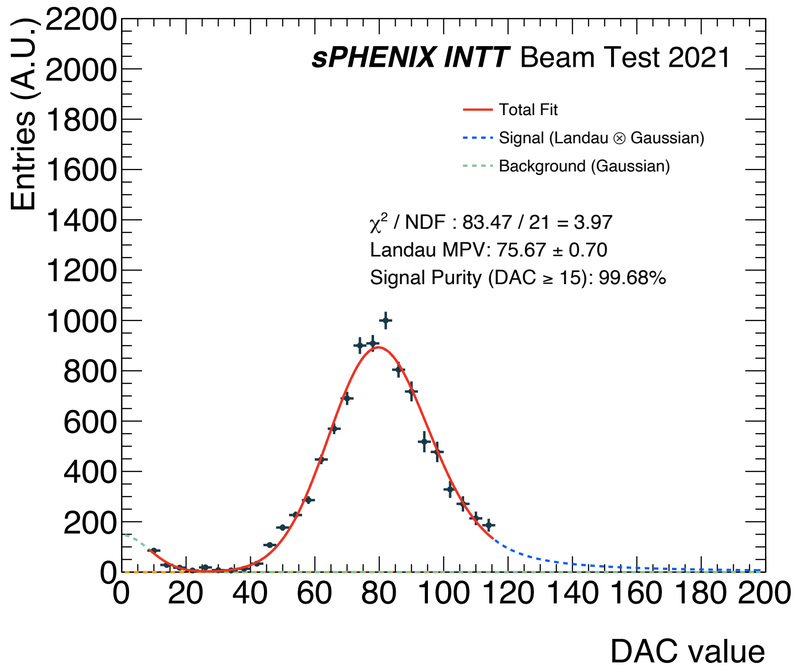


My proposal 2

- In combining overlapped bins
  - The overlapped bins are on the top of each other
  - Final statistic error: $(E_A+E_B)/2$
- Single purity can be mentioned
  - More relevant to the hit detection efficiency
- Fitting: Fit range (8 to 116)
  - Single Gaussian to describe noise component
  - Mean of Gaussian is fixed at 0







Any other thoughts?

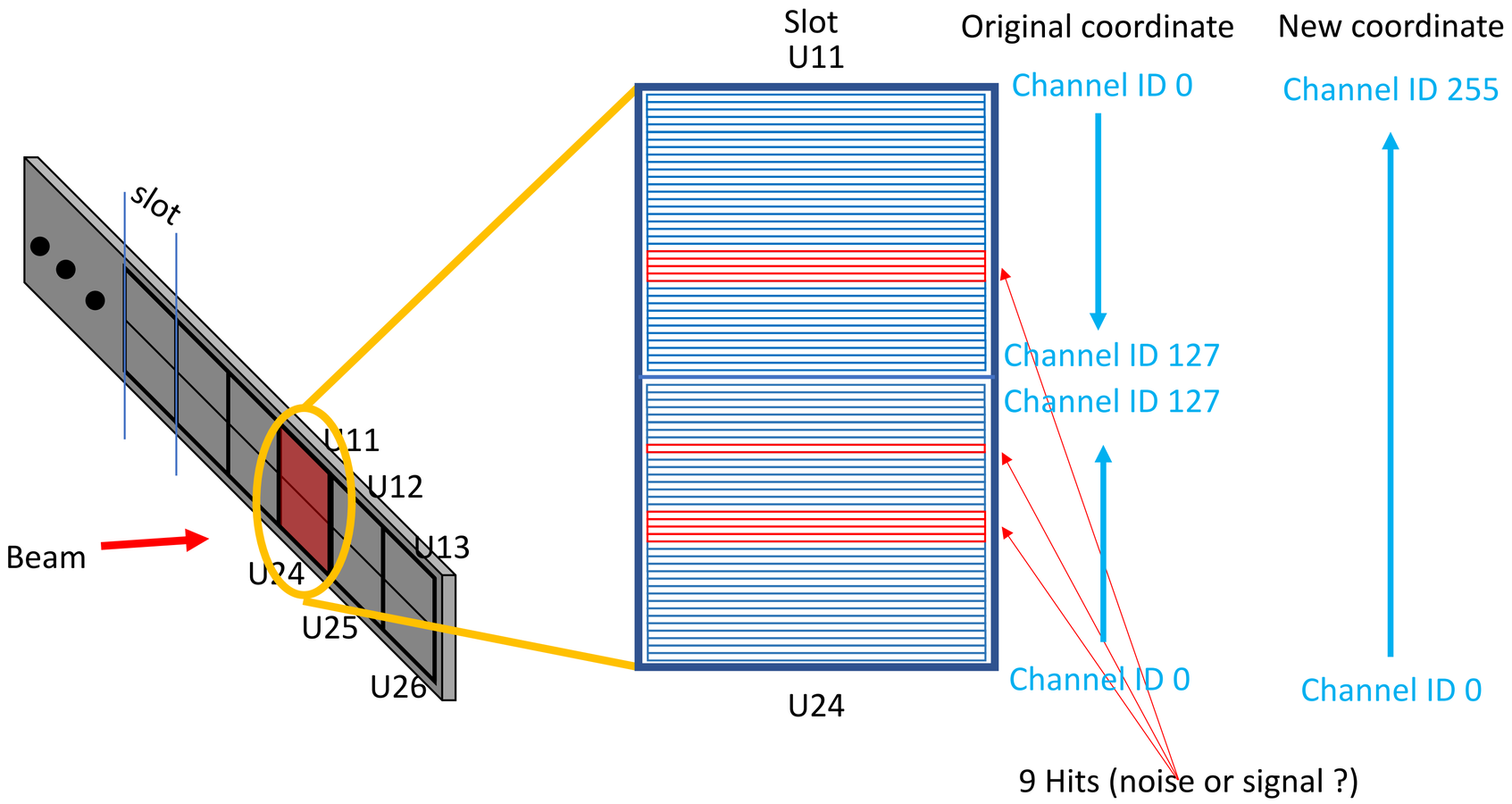
- Any other thoughts?

Back up

Clustering - 1

Clustering was performed column by column

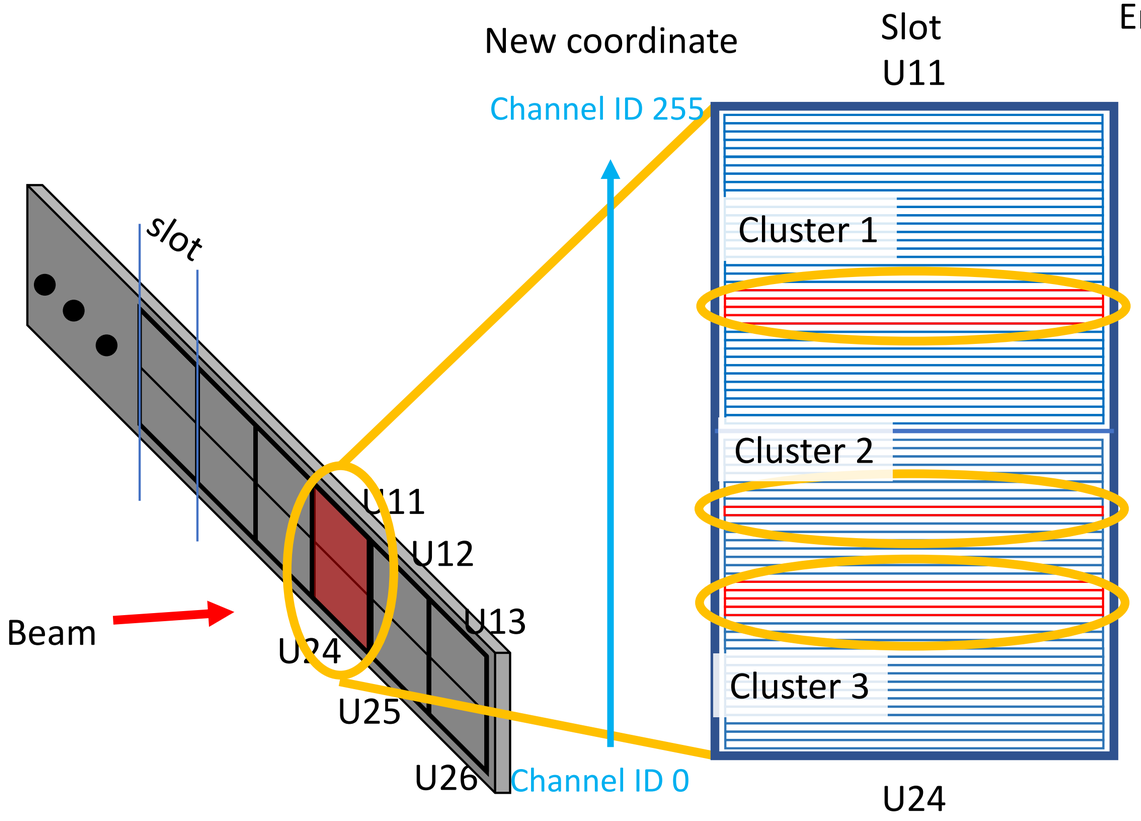
Tracking algorithm



Clustering - 2

Clustering was performed column by column

Tracking algorithm



Energy-weighted method is applied

$$P_j^l = \frac{\sum_n C_n E_n}{\sum_n E_n}$$

C_n : position (mm) in y-axis of channel n in cluster

E_n : energy deposit of channel n in cluster

P_j : final position in y-axis of cluster j

Cluster : the adjacent channels

	Cluster 1	Cluster 2
Chan_id :	3 4 5 6	8 9 10

reduce

9 fired-channels -> 3 positions

DAC Scan table

RunNumber	adc0	adc1	adc2	adc3	adc4	adc5	adc6	adc7
71	88	92	96	100	104	108	112	116
72	108	112	116	120	124	128	132	136
73	128	132	136	140	144	148	152	156
74	148	152	156	160	164	168	172	176
75	8	12	16	20	24	28	32	36
76	28	32	36	40	44	48	52	56
77	48	52	56	60	64	68	72	76
78	68	72	76	80	84	88	92	96

Table 1: The threshold settings used for the DCA-scan runs.