

2022/12/8
INTT meeting

sPHENIX INTT - Beam Test 2021

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Ladder detection efficiency

Distance between the first ladder and the last one : 59.104 mm

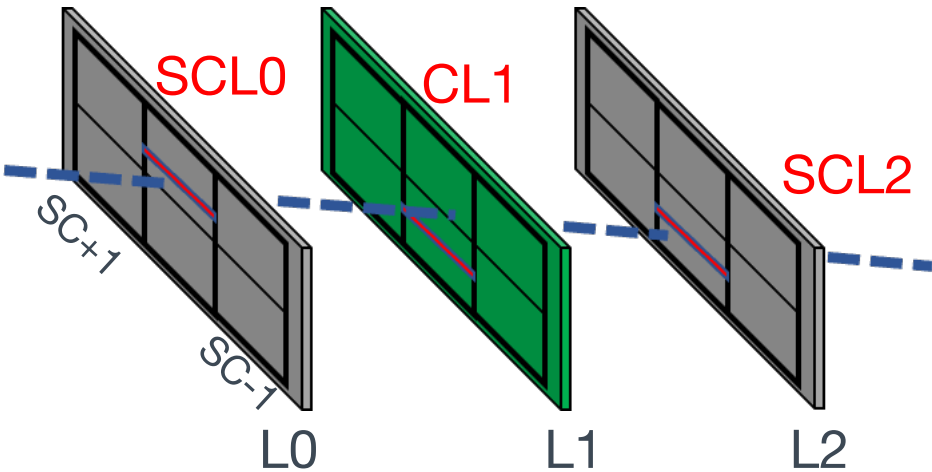
Event cut

Camac related

1	TDC	$400 < \text{Camac_tdc}[3] < 1200$	
2	ADC	run 52	$-1 < \text{Camac_adc}[0] < 400$
		run 89	$75 < \text{Camac_adc}[0] < 300$
3		$250 < \text{Camac_adc}[2] < 500$	
4		$250 < \text{Camac_adc}[2] < 500$	
5		$\text{INTT_event} == 1$	
6		No double saving hits (no clone hits)	
7		Single Cluster in selected chip (SC) of L0 (abbr. SCL0) and L2 (abbr. SCL2) required	
8		No cluster in adjacent chips (SC-1 & SC+1) required	
9	Edge exclusion	(ladder bottom edge + 5 ch) < Y-pos of SCL0 and SCL2 < (ladder top edge - 5 ch)	
10	Cluster ADC	Sum of ADC of SCL0 > adc0 && Sum of ADC of SCL2 > adc0	
11	Cluster size Two options	Cluster size of SCL0 > 1 && Cluster size of SCL2 > 1 → Not used now	
		Sum of cluster size of SCL0 and cluster size of SCL2 > 2 (or 1) → Currently used	
12	Slope cut	$\text{fabs}(\text{slope of SCL2} - \text{SCL0}) < 0.01$	
13	Residual	$\text{fabs}(\text{CL1} - \text{the extrapolation position}) < 3 \text{ strips } (0.234 \text{ mm}, \text{ currently used})$	

Correction

Alignment correction	run 52, L1 (U8 only)	-0.2908 mm
	run 89, L1 (U10, only)	-0.2850 mm
Slope correction	run 52	0.002725
	run 89	0.005269



// Procedures - run52, for example

(Run52, for example, focus on column 8 “U8+U21”)

1. Original files

- BeamData_20211210-0302_0.dat

2. Remove clone event (done by Genki)

- Run52_no_clone.root

3. Separate the BCO events and check the clone hits

- run52_no_clone_filter_all_int_1000.root
 - # of BCO event : 182933

4. Do the clustering

- cluster_information_offset-0.2908_adcinfo_NoCamac.root
 - # of the events that have more than one hit and no clone hit : 172560

5. All layers, no cluster in column 9 and column 7 : 70452

6. Single cluster in column 8 of layer 0 and layer 2 : 49300

7. Cluster_adc > adc0 (I0 and I2) : 48684

8. (Edge exclusion) bottom edge + 5 ch < Cluster_pos of I0 < upper edge - 5 ch : 48646

9. (Edge exclusion) bottom edge + 5 ch < Cluster_pos of I2 < upper edge - 5 ch : 48584

10. |slope (slope = (I2-I0)/distance)| < 0.01 : 45847

No cluster in the middle layer : 121

Has the cluster in the middle layer : 45726

- |Residual| < requirement (3 ch) : 45530
- |Residual| > requirement (3 ch) : 196

$$\text{Detection efficiency} : \frac{45530}{45530 + 121 + 196} = 99.30857$$

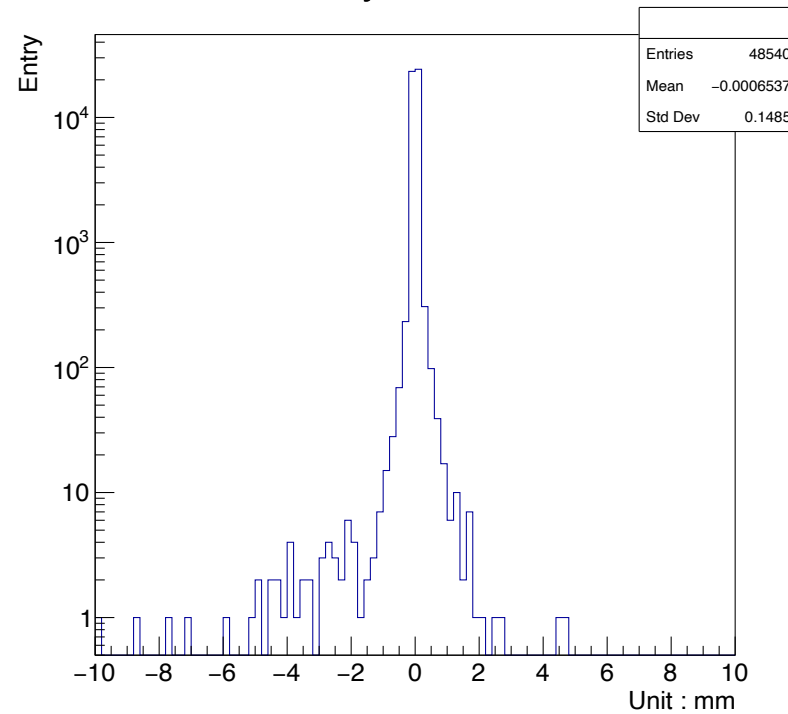
Residual distribution

Without :

1. slope cut
2. edge exclusion

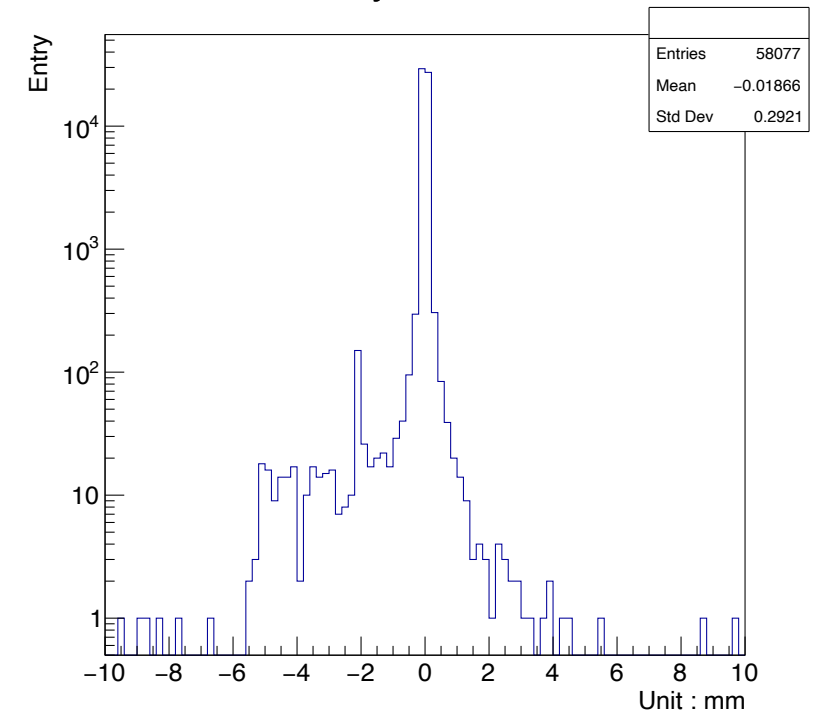
Run52, U8

DUT layer 1 residual

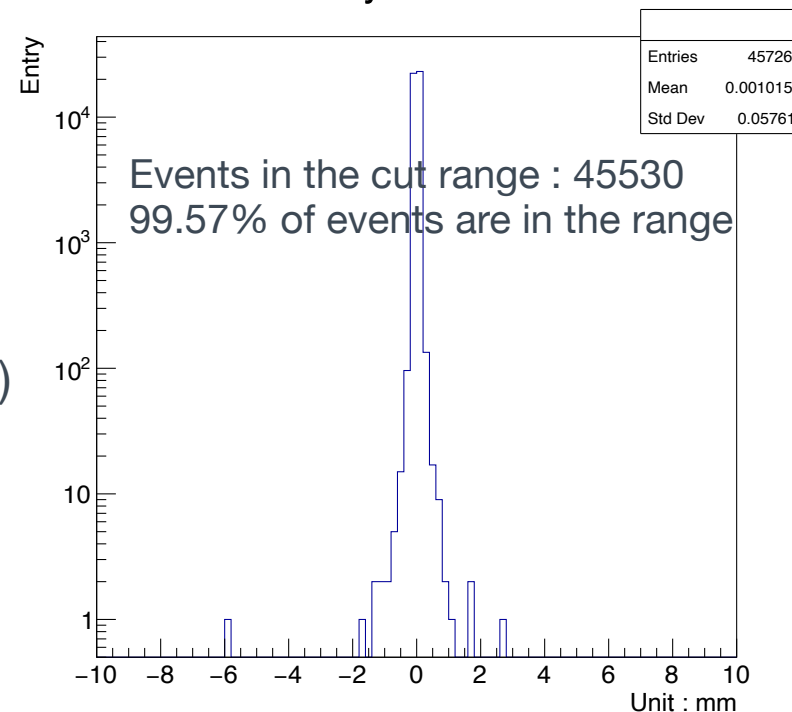


Run89, U10

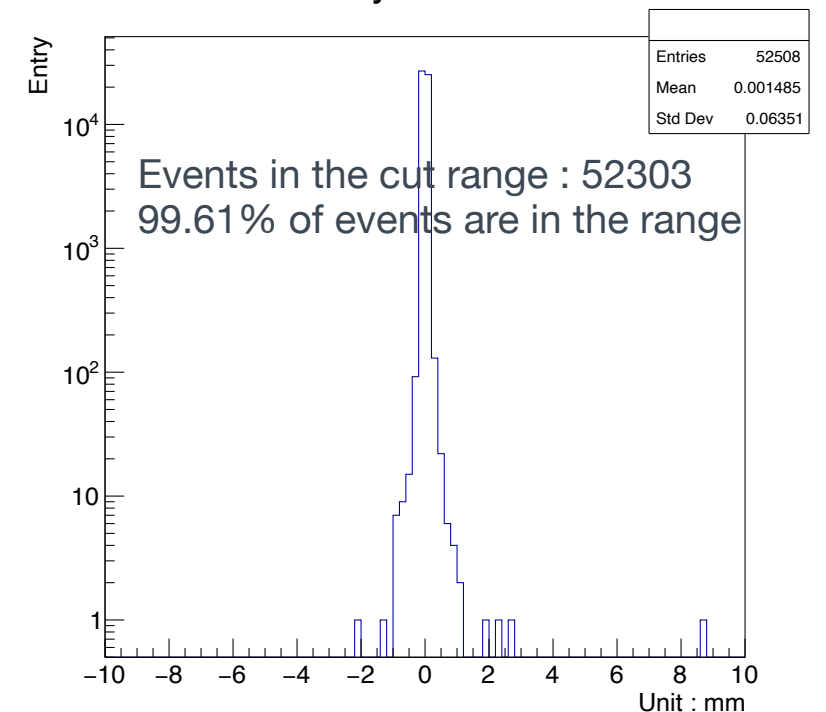
DUT layer 1 residual



DUT layer 1 residual



DUT layer 1 residual



With the slope cut and edge exclusion
(only the residual cut hasn't been applied)



Ladder detection efficiency

- Without the cuts of
 - Camac_tdc[3]
 - Camac_adc[1,2,3]
 - INTT_event == 1

There is almost no correlation between the CAMAC parameters and the INTT hits

Detection efficiency of I1 : $99.31^{+0.04}_{-0.04}$

Run52, U8

```
# of 111 : 45530
# of 101 : 317
Efficiency : 0.993086
Efficiency by TEfficiency
99.30857      +0.03869      -0.04091
```

Detection efficiency of I1 : $99.18^{+0.04}_{-0.04}$

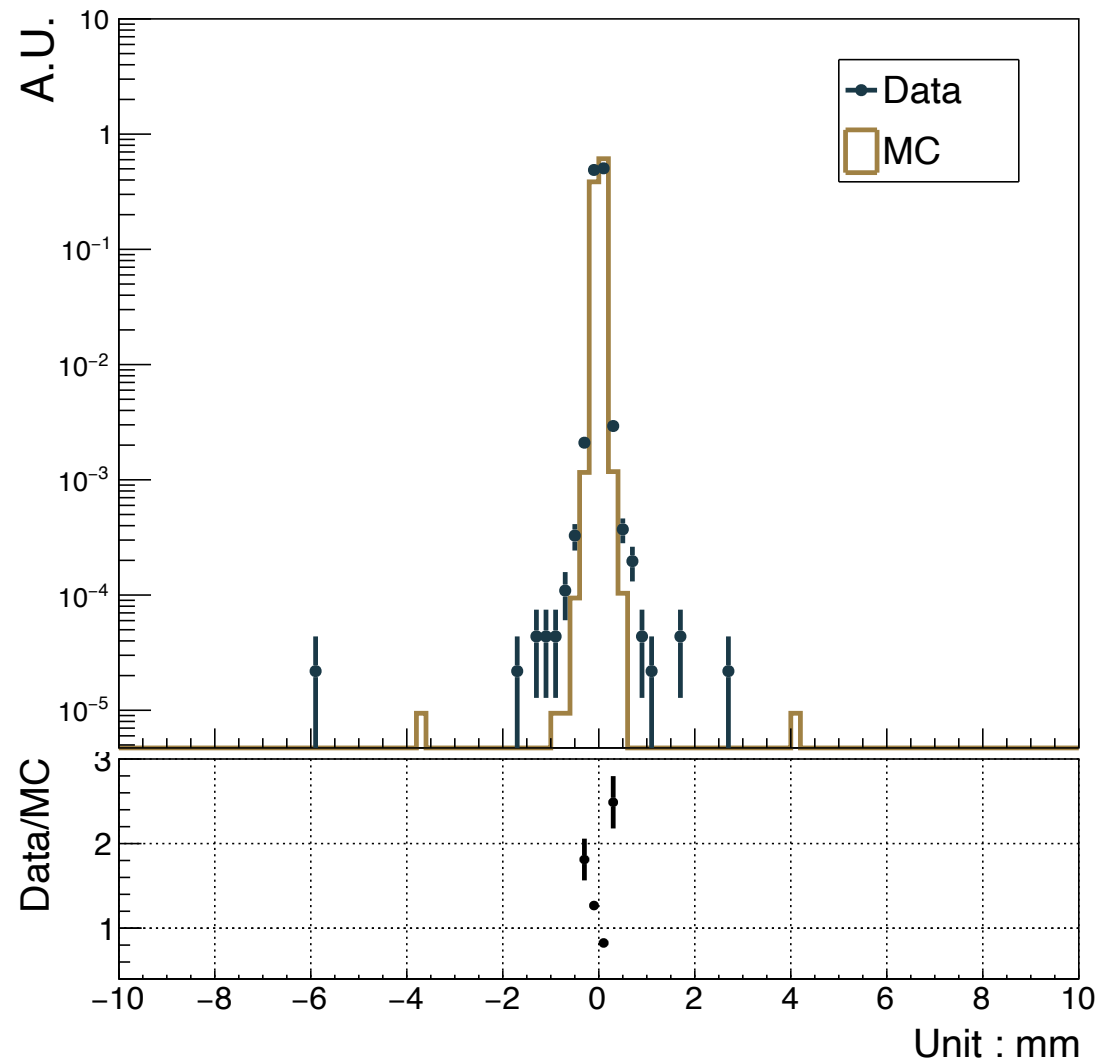
Run89, U10

```
# of 111 : 52303
# of 101 : 428
Efficiency : 0.991883
Efficiency by TEfficiency
99.18833      +0.03907      -0.04098
```

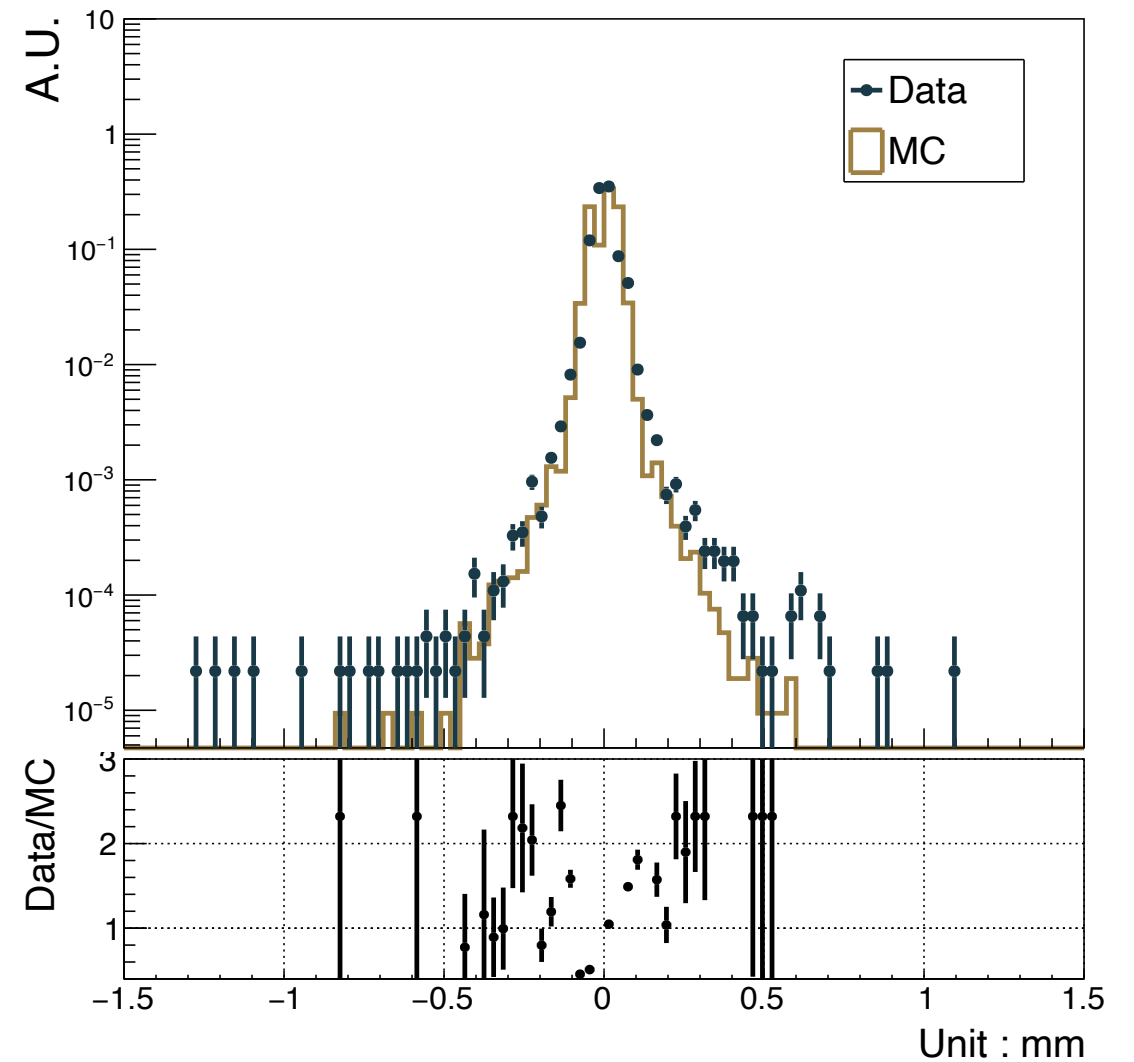


Residual comparison, data and MC

Run52, full range



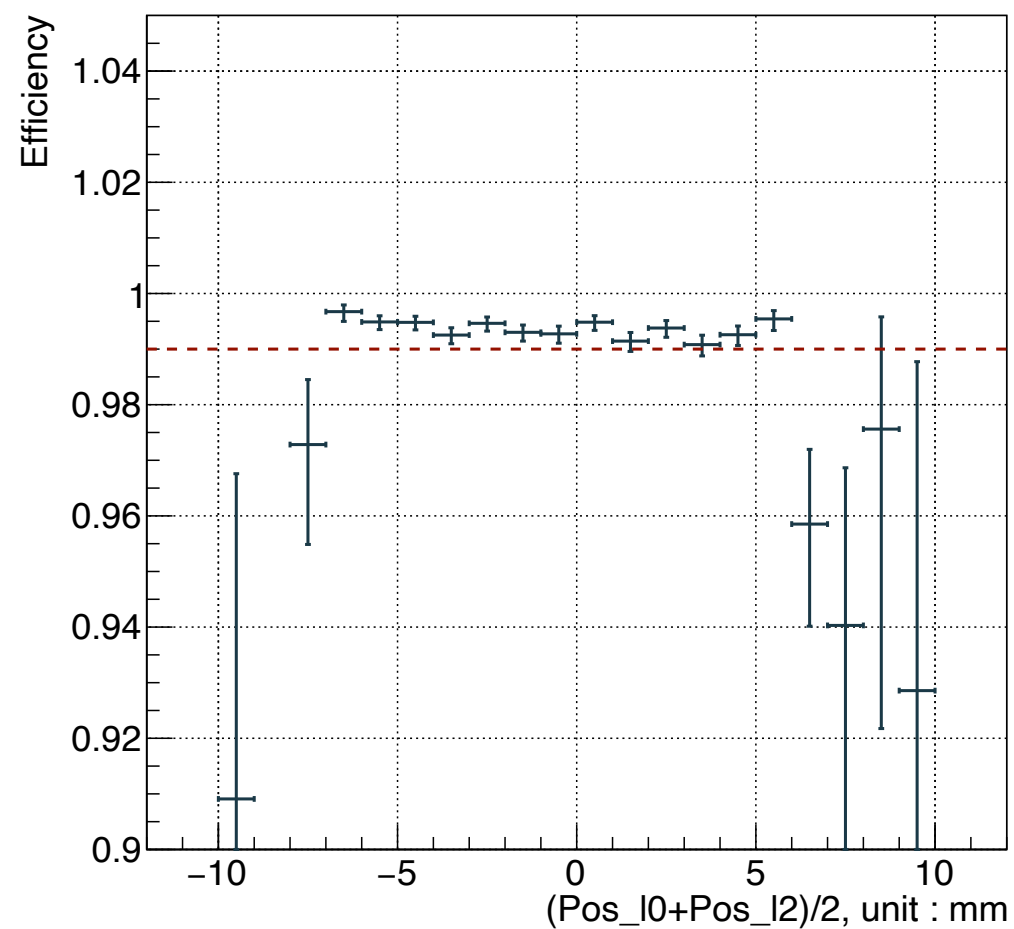
Run52, narrow



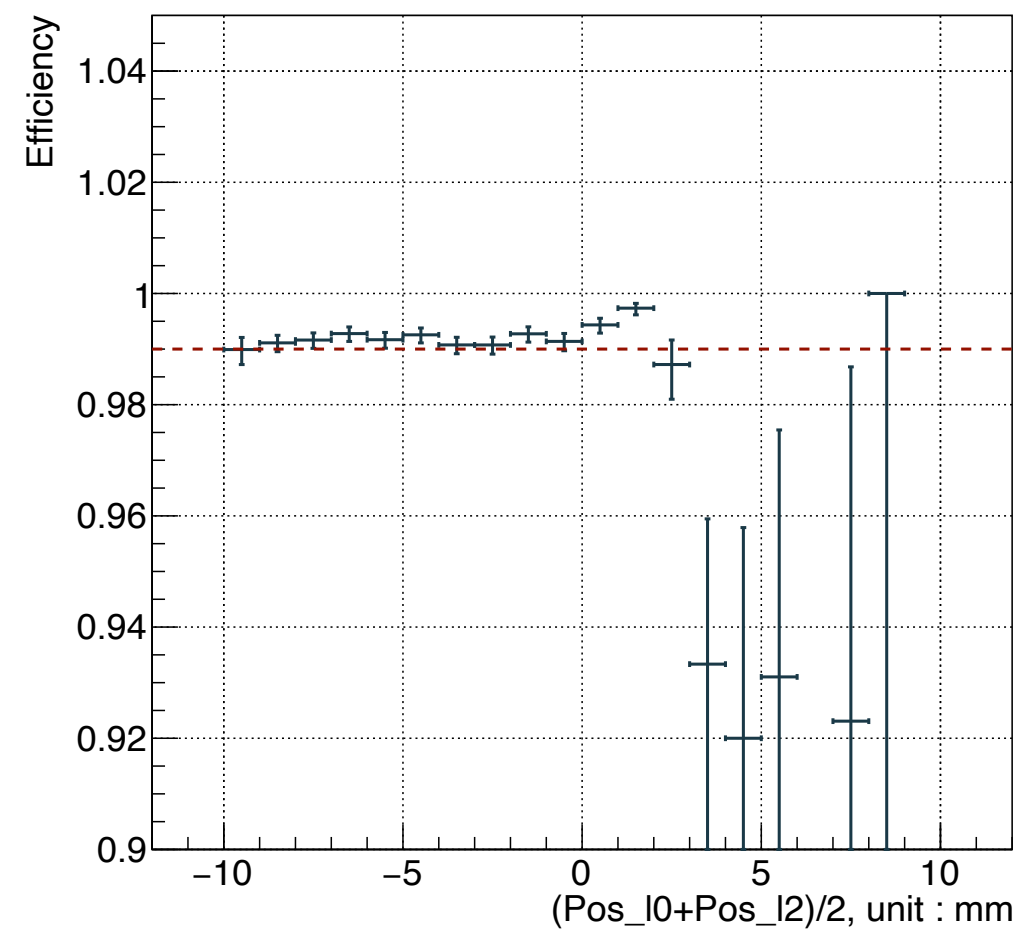


Detection efficiency as function of position

Run 52, U8

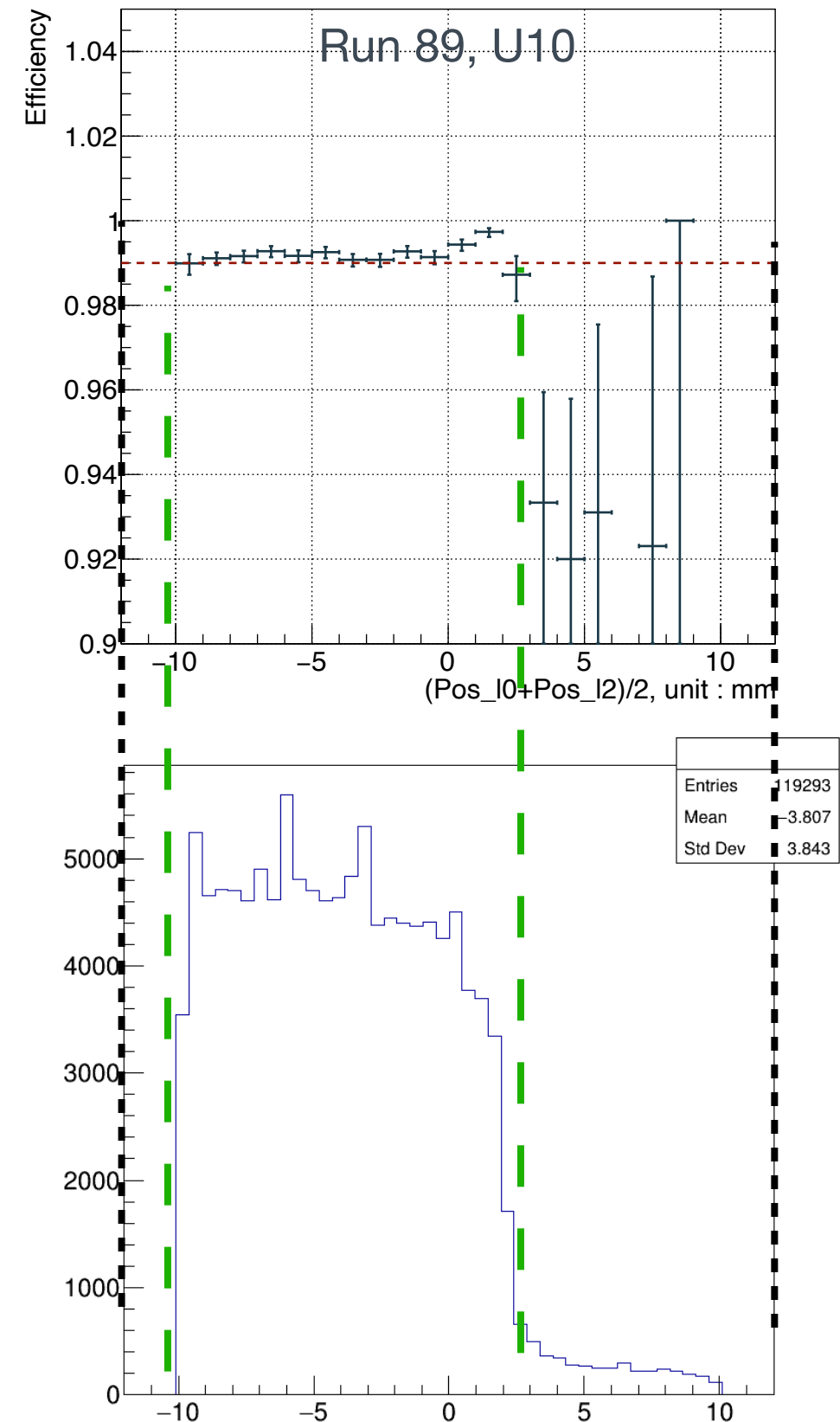
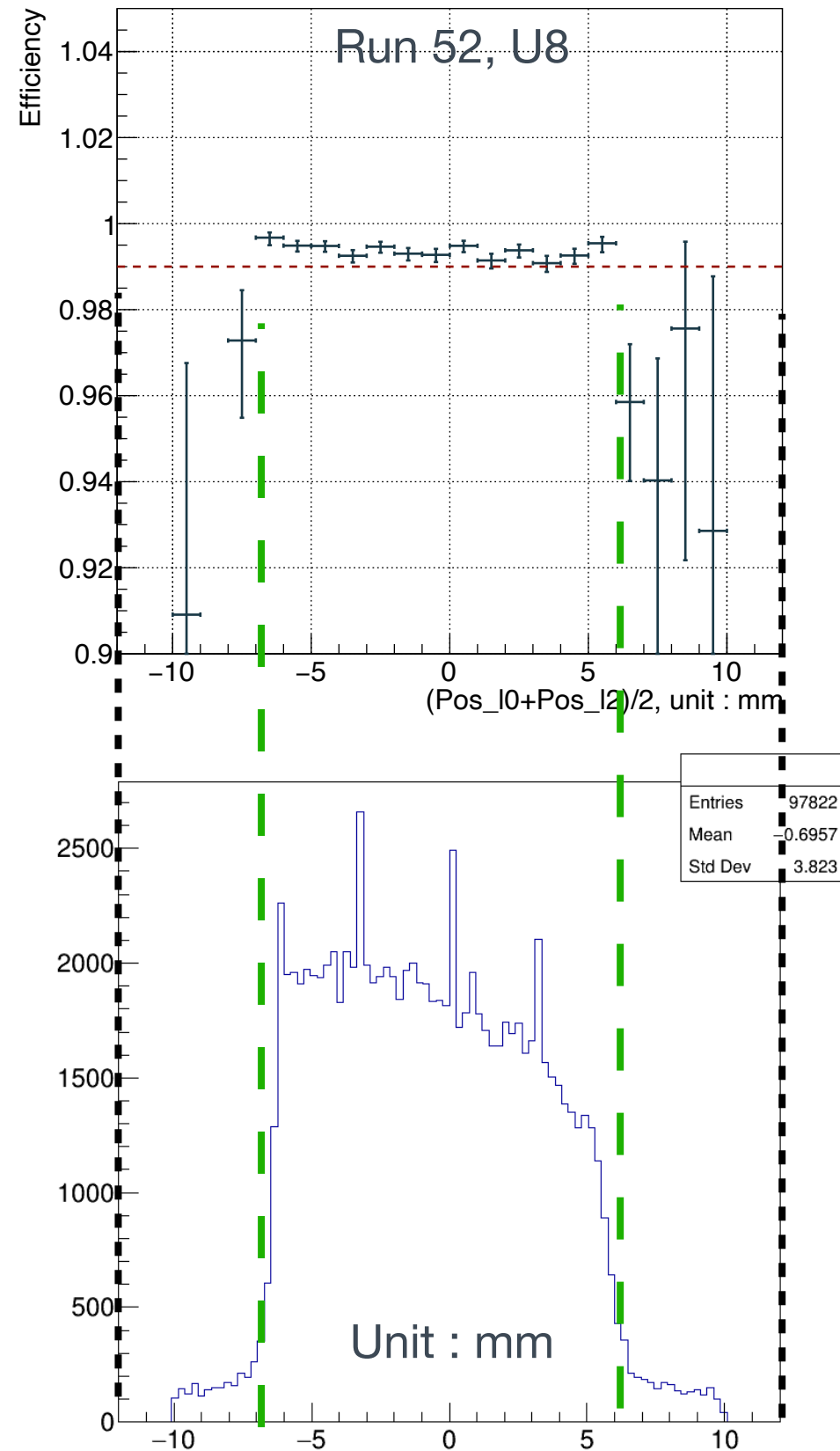


Run 89, U10





Comparing with hit map, run52





Systematic uncertainty trail, run52

- A. Residual cut (currently, 0.234 mm)
- B. Slope cut (currently, 0.01) No a scientific method to determine the cut values
- C. Edge exclusion (currently, 5)

- Procedures to estimate the systematic uncertainty (SU) :

1. Fix B and C, scan A (range : 0.164 ~ 0.304)
→ Average of variation : -0.00054
2. Fix A and C, scan B (range : 0.0088 ~ 0.0112)
→ Average of variation : 6E-5
3. Fix A and B, scan C (range : 0 ~ 10)
→ Average of variation : -6E-6
4. Total SU : $\sqrt{(-0.00054)^2 + (6e-5)^2 + (-6e-6)^2} = 0.00055$

Run52 column 8, final : $99.31^{+0.04}_{-0.04}$ (*stat*) $^{+0.06}_{-0.06}$ (*syst*) %



Conclusion

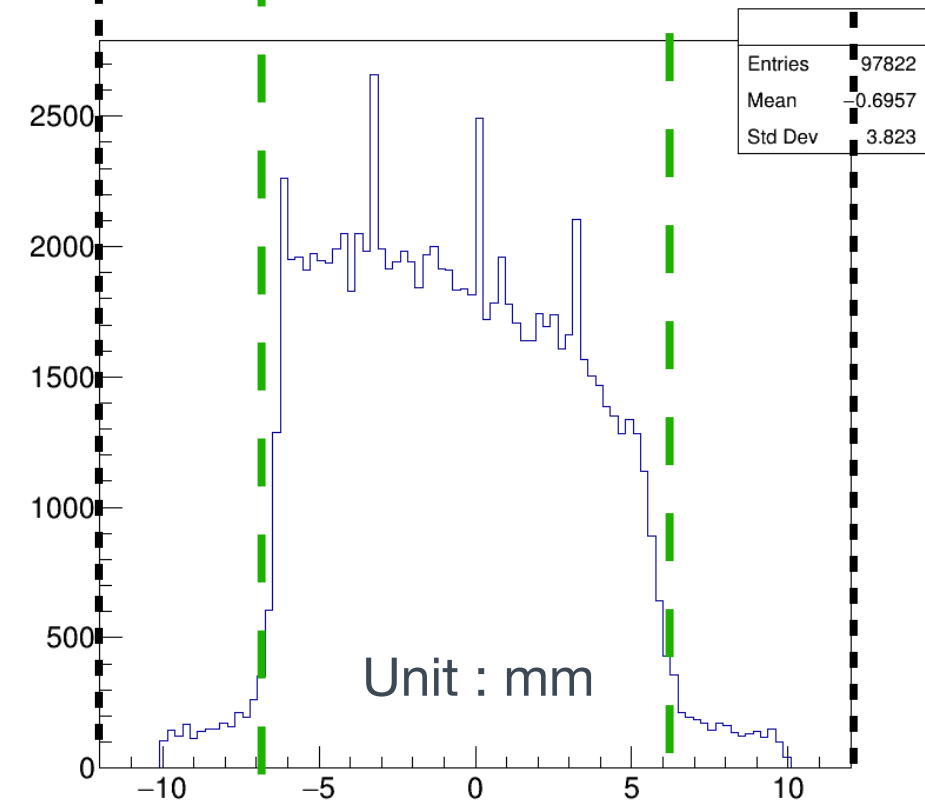
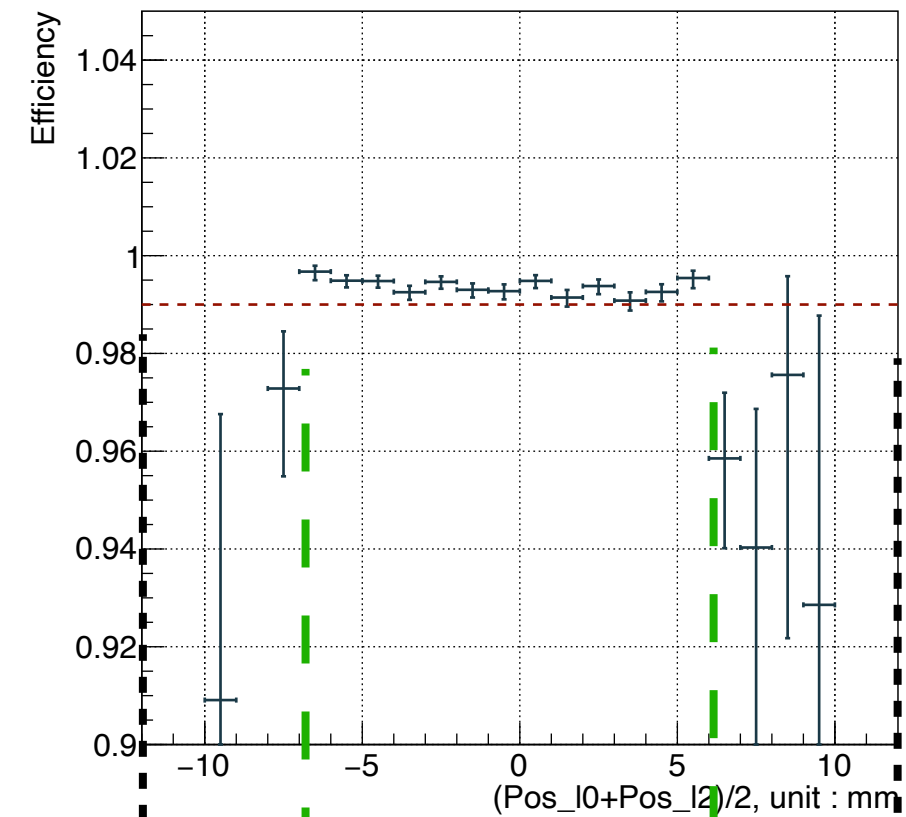
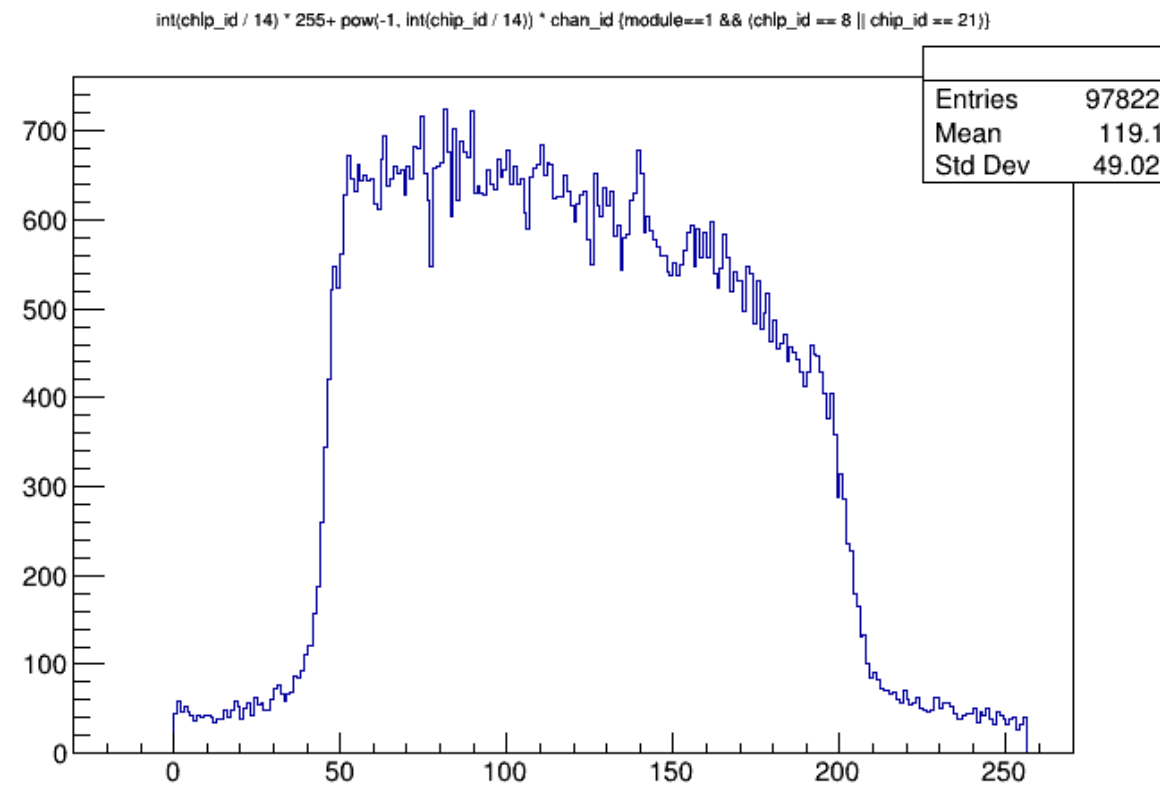
- The CAMAC-module related cuts are removed as there is almost no correlation between the INTT hits and the CAMAC parameters.
- The comparison of the residual distribution between data and MC were performed. The distribution of data is wider which is reasonable.
- The efficiency is independent to the sensor position.
- The systematic uncertainty of the efficiency study is expected to be originated from the determinations of three cut values.
 - The systematic uncertainty was calculated. Currently the final results (run52) : $99.31^{+0.04}_{-0.04} (stat) {}^{+0.06}_{-0.06} (syst) \%$

Back up



Comparing with hit map, run52

Unit : channel



// Hit map, run89, layer 0

