

2022/12/2
INTT meeting

sPHENIX INTT - Beam Test 2021

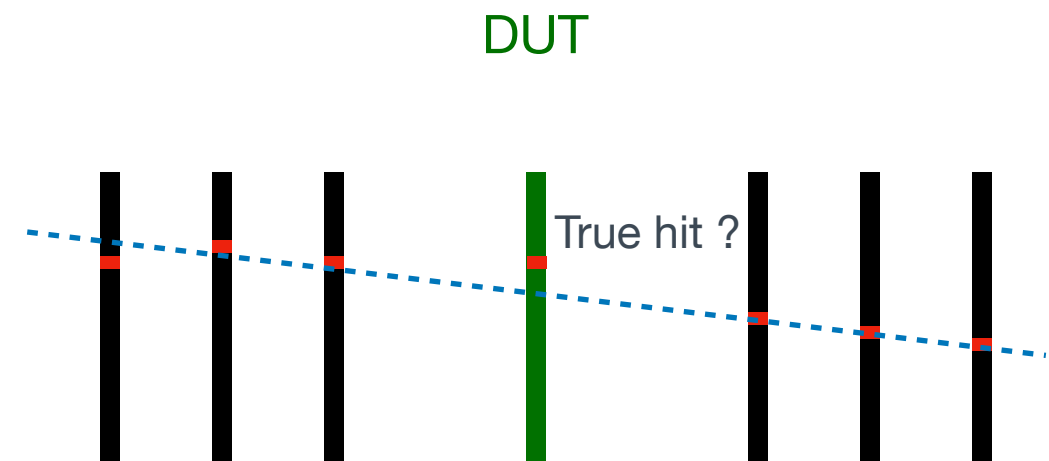
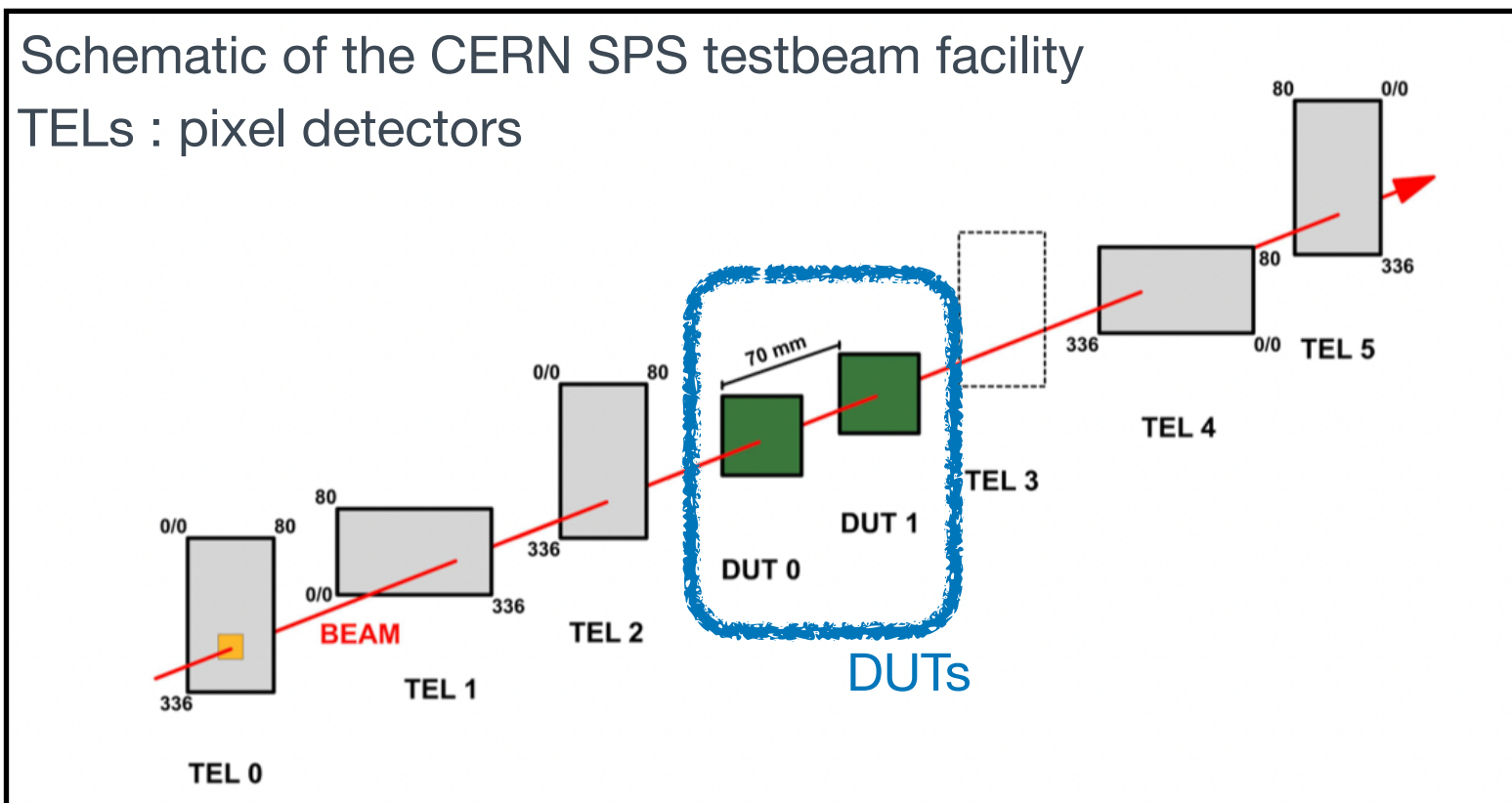
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Ladder detection efficiency

- Original : fitting method
- New method : Detector Under Test (Geometry method), standard



Procedures :

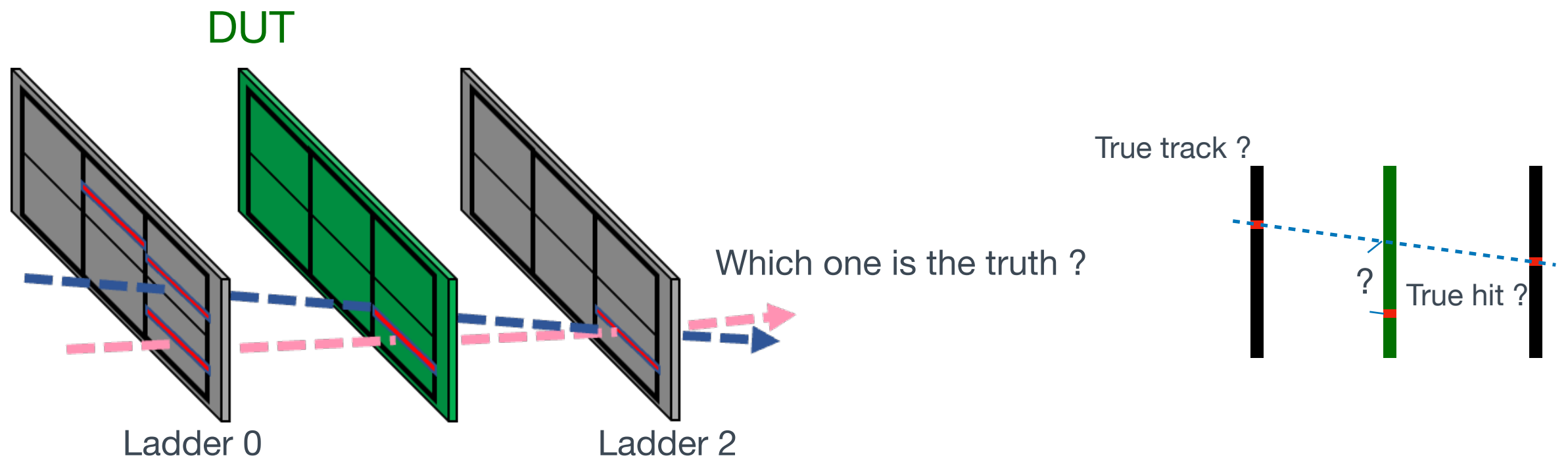
1. find the track by the detector units (TELs in this facility)
2. once the candidate is confirmed to be a really track, check the clusters of DUTs
3. if the residual of the interpolation of the track and the clusters of DUTs $<$ requirement
→ good



Ladder detection efficiency

- INTT : stripe silicon tracker
- Beam test 2021
 - 3 layers
 - standalone
 - Not easy to define a good track by two hits, challenge !

$$\text{Efficiency calculation : } \frac{l0 \cap l1 \cap l2}{l0 \cap l2}$$





Ladder detection efficiency

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

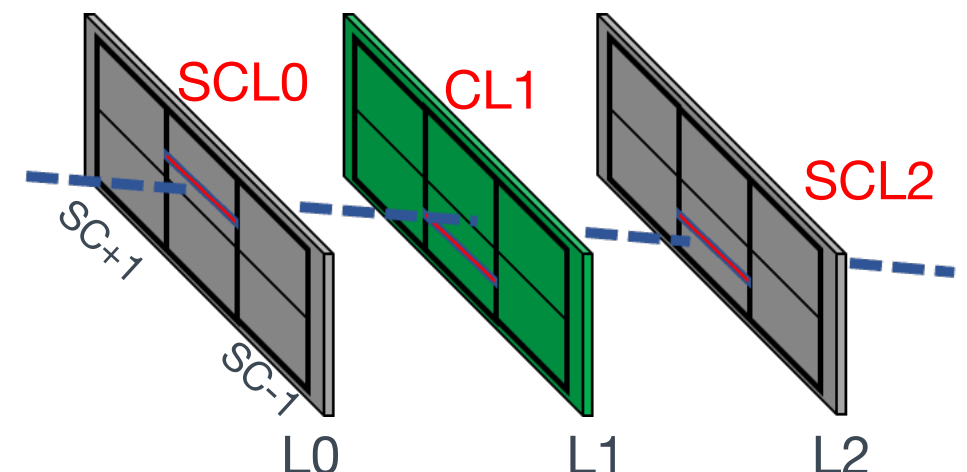
Event cut

Camac related

1	TDC	$400 < \text{Camac_tdc}[3] < 1200$			
2	ADC	run 52	$-1 < \text{Camac_adc}[0] < 50$	$200 < \text{Camac_adc}[1] < 400$	$250 < \text{Camac_adc}[2] < 500$
		run 89	$75 < \text{Camac_adc}[0] < 300$	$100 < \text{Camac_adc}[1] < 350$	$250 < \text{Camac_adc}[2] < 500$
3	$\text{INTT_event} == 1$				
4	No double saving hits (no clone hits)				
5	Single Cluster in selected chip (SC) of L0 (abbr. SCL0) and L2 (abbr. SCL2) required				
6	No cluster in adjacent chips (SC-1 & SC+1) required				
7	Edge exclusion	$(\text{ladder bottom edge} + 5 \text{ ch}) < \text{Y-pos of SCL0 and SCL2} < (\text{ladder top edge} - 5 \text{ ch})$			
8	Cluster ADC	Sum of ADC of SCL0 $> \text{adc0}$ && Sum of ADC of SCL2 $> \text{adc0}$			
9	Cluster size Two options	Cluster size of SCL0 > 1 && Cluster size of SCL2 $> 1 \rightarrow$ Not used now			
		Sum of cluster size of SCL0 and cluster size of SCL2 > 2 (or 1) $\rightarrow$ Currently used			
10	Slope cut	$\text{fabs}(\text{slope of SCL2} - \text{SCL0}) < 0.01$			
11	Residual	$\text{fabs}(\text{CL1} - \text{the extrapolation position}) < 3 \text{ strips}$ (0.234 mm, 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





Ladder detection efficiency, run52 MC U11

Sum of cluster size of SCL0 and SCL2 > 1

```
# of 111 : 105951
# of 101 : 182
Efficiency : 0.998285
Efficiency by TEfficiency
99.82852          +0.01269          -0.01366
```

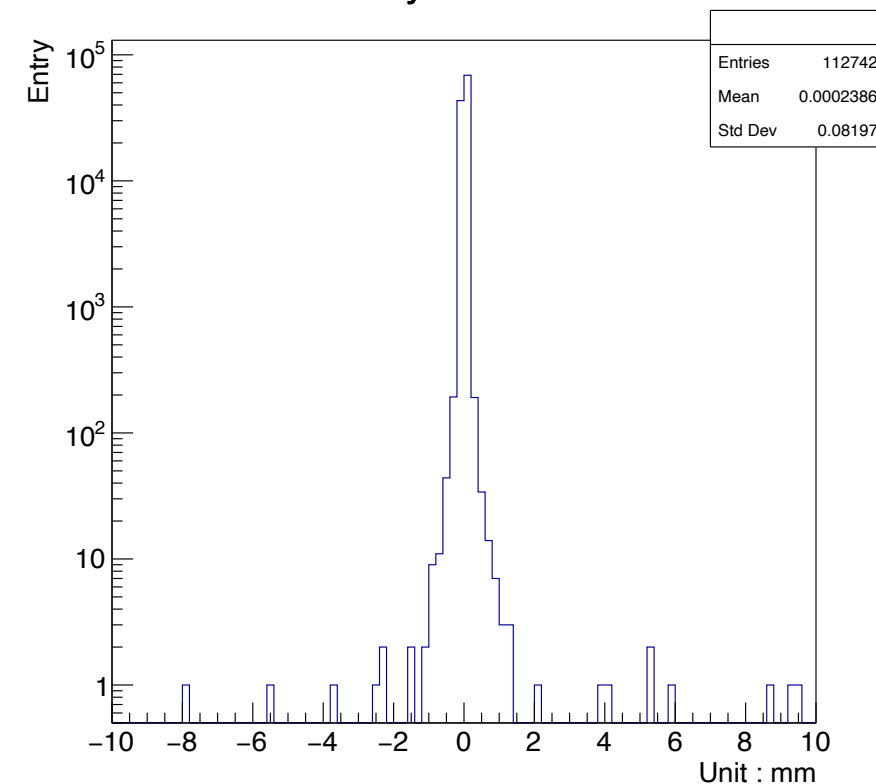
Detection efficiency of I1 : $99.82^{+0.01}_{-0.01}$

Sum of cluster size of SCL0 and SCL2 > 2

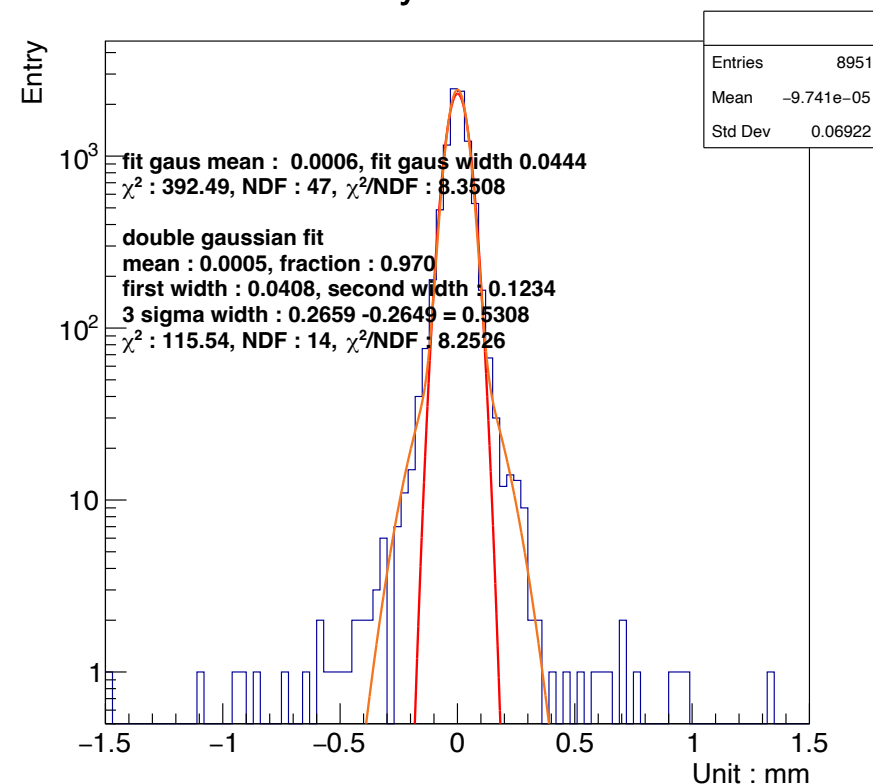
```
# of 111 : 8204
# of 101 : 32
Efficiency : 0.996115
Efficiency by TEfficiency
99.61146          +0.06823          -0.08135
```

Detection efficiency of I1 : $99.61^{+0.07}_{-0.08}$

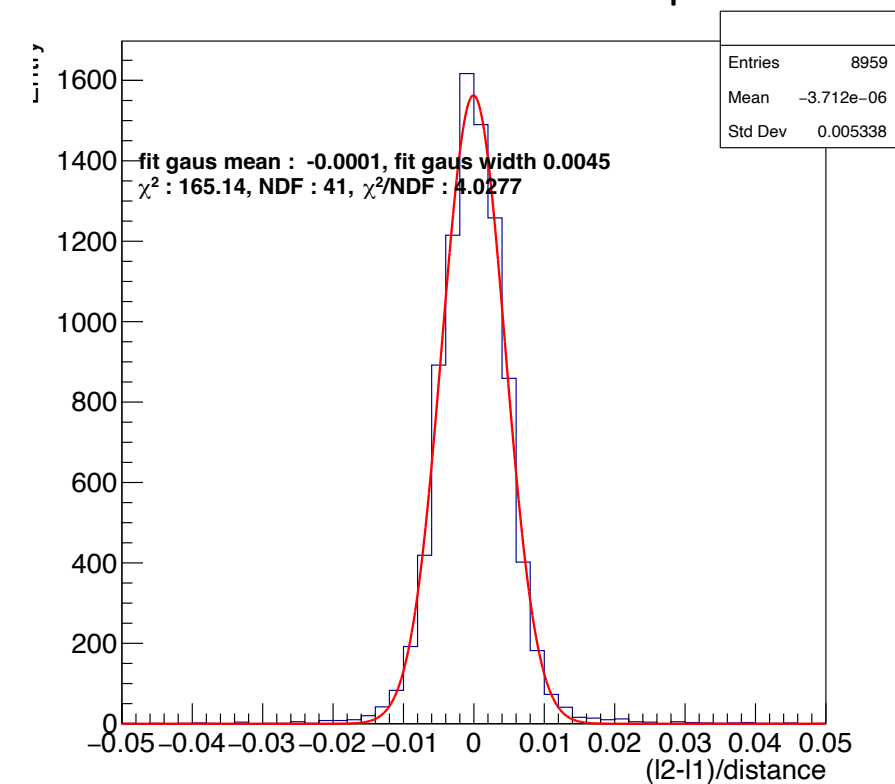
DUT layer 1 residual



DUT layer 1 residual



DUT candidate track slope





Ladder detection efficiency, run52 U8

Sum of cluster size of SCL0 and SCL2 > 1

```
# of 111 : 45116
# of 101 : 315
Efficiency : 0.993066
Efficiency by TEfficiency
99.30664      +0.03892      -0.04116
```

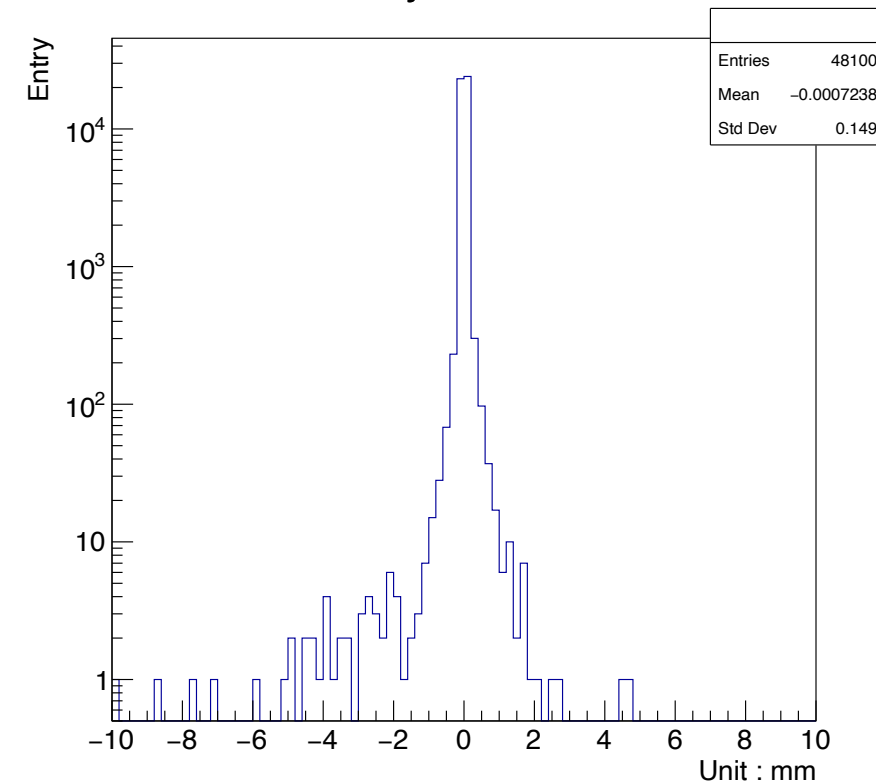
Detection efficiency of I1 : $99.31^{+0.04}_{-0.04}$

Sum of cluster size of SCL0 and SCL2 > 2

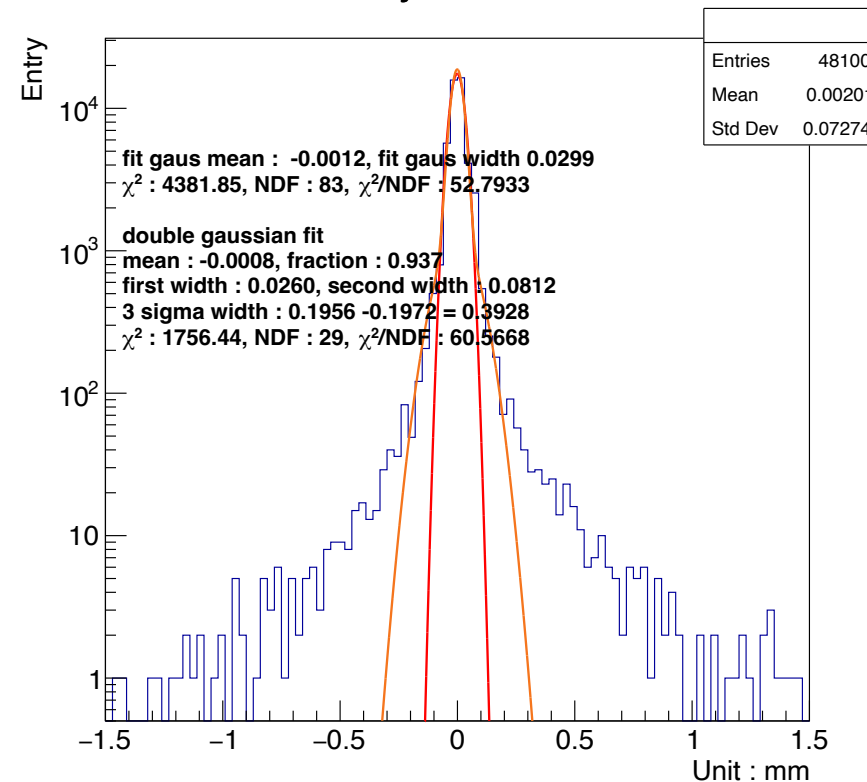
```
# of 111 : 18493
# of 101 : 132
Efficiency : 0.992913
Efficiency by TEfficiency
99.29128      +0.06143      -0.06695
```

Detection efficiency of I1 : $99.29^{+0.06}_{-0.07}$

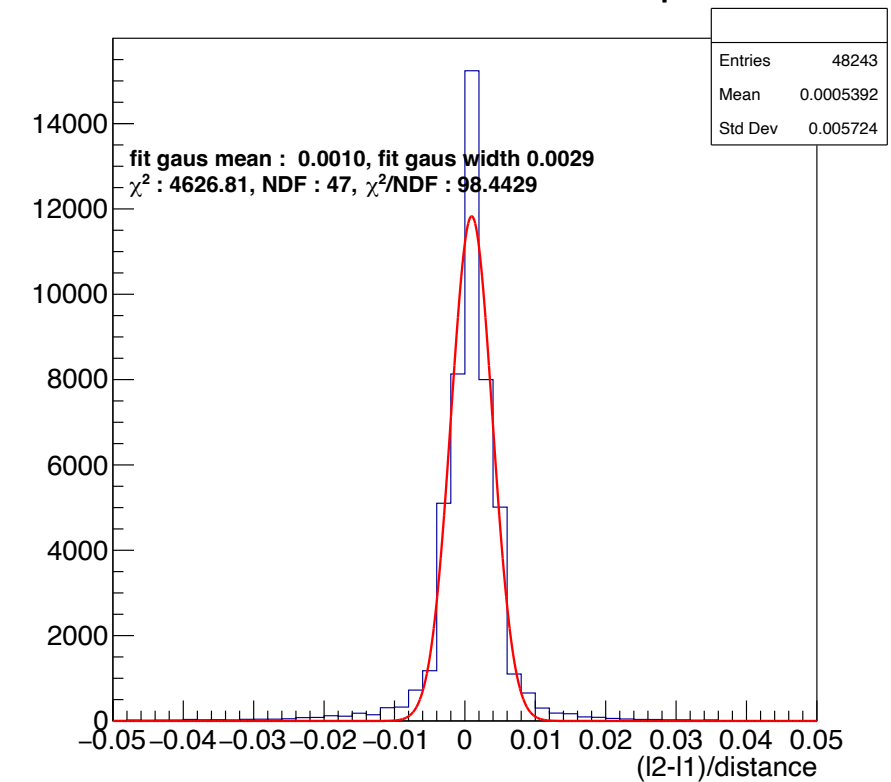
DUT layer 1 residual



DUT layer 1 residual



DUT candidate track slope





Ladder detection efficiency, run89 U10

Sum of cluster size of SCL0 and SCL2 > 1

```
# of 111 : 51765
# of 101 : 424
Efficiency : 0.991876
Efficiency by TEfficiency
99.18757          +0.03929          -0.04123
```

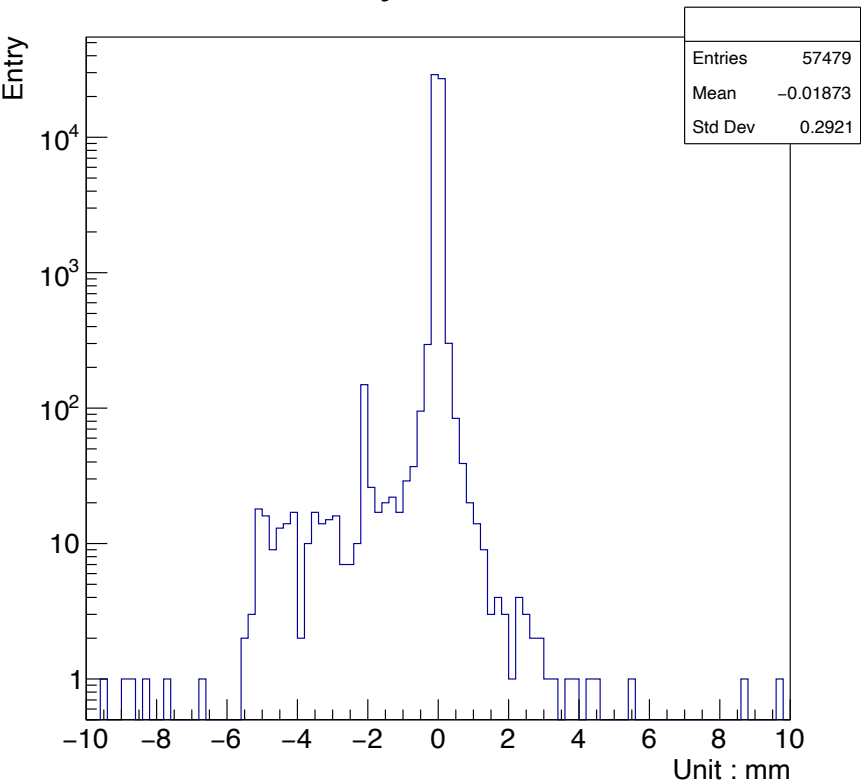
Detection efficiency of I1 : $99.19^{+0.04}_{-0.04}$

Sum of cluster size of SCL0 and SCL2 > 2

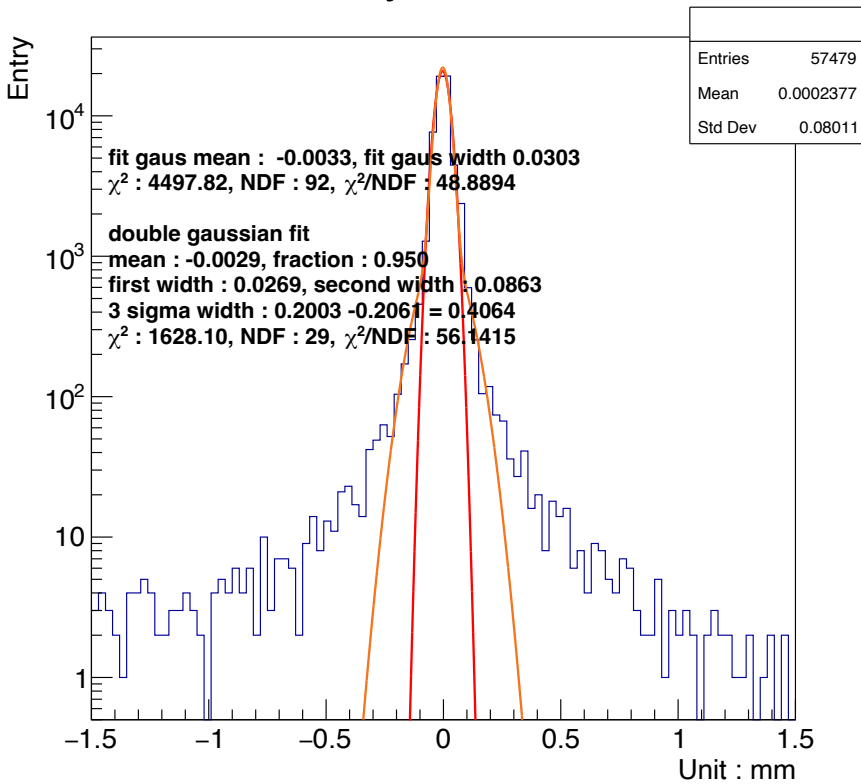
```
# of 111 : 21076
# of 101 : 159
Efficiency : 0.992512
Efficiency by TEfficiency
99.25124          +0.05913          -0.06395
```

Detection efficiency of I1 : $99.25^{+0.06}_{-0.06}$

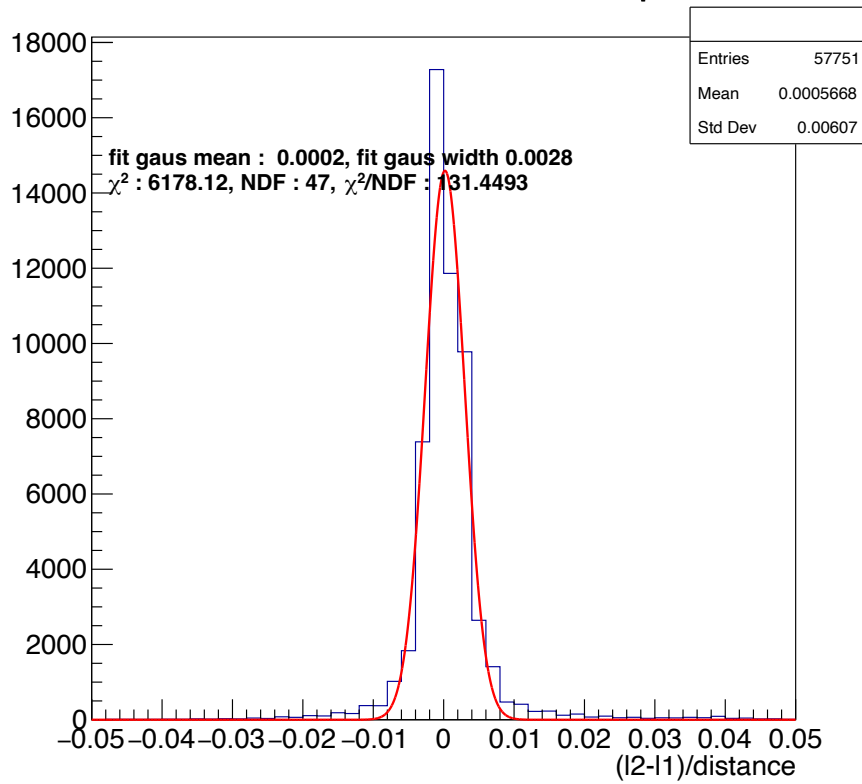
DUT layer 1 residual



DUT layer 1 residual



DUT candidate track slope





Detection efficiency - comparison

Sum of cluster size of SCL0 and SCL2 > 1

Run52 U8

of 111 : 45116
of 101 : 315
Efficiency : 0.993066
Efficiency by TEfficiency
99.30664 +0.03892 -0.04116

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

Sum of cluster size of SCL0 and SCL2 > 2

of 111 : 18493
of 101 : 132
Efficiency : 0.992913
Efficiency by TEfficiency
99.29128 +0.06143 -0.06695

Detection efficiency of I1 : 99.29^{+0.06}_{-0.07}

Run89 U10

of 111 : 51765
of 101 : 424
Efficiency : 0.991876
Efficiency by TEfficiency
99.18757 +0.03929 -0.04123

Detection efficiency of I1 : 99.19^{+0.04}_{-0.04}

of 111 : 21076
of 101 : 159
Efficiency : 0.992512
Efficiency by TEfficiency
99.25124 +0.05913 -0.06395

Detection efficiency of I1 : 99.25^{+0.06}_{-0.06}

Comparing to the original method

Run ID	effi. L0 (%)	effi. L1 (%)	effi. L2 (%)
52	99.73 ^{+0.02} _{-0.02}	99.60 ^{+0.03} _{-0.03}	99.00 ^{+0.04} _{-0.04}
53	99.75 ^{+0.02} _{-0.02}	99.65 ^{+0.02} _{-0.02}	99.12 ^{+0.04} _{-0.04}
54	99.78 ^{+0.02} _{-0.02}	99.61 ^{+0.02} _{-0.02}	99.16 ^{+0.03} _{-0.04}
55	99.75 ^{+0.02} _{-0.02}	99.58 ^{+0.02} _{-0.03}	99.14 ^{+0.03} _{-0.04}
57	99.21 ^{+0.03} _{-0.04}	99.60 ^{+0.02} _{-0.03}	99.25 ^{+0.03} _{-0.04}
58	94.63 ^{+0.09} _{-0.09}	99.59 ^{+0.03} _{-0.03}	99.18 ^{+0.04} _{-0.04}
88	99.27 ^{+0.04} _{-0.05}	99.73 ^{+0.03} _{-0.03}	99.16 ^{+0.05} _{-0.05}
89	99.62 ^{+0.02} _{-0.03}	99.78 ^{+0.02} _{-0.02}	99.16 ^{+0.04} _{-0.04}



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
```



Macro test

- Run52 MC, reduce the effi. of all three layers down to 95%

U11

```
# of 111 : 91010
# of 101 : 4875
Efficiency : 0.949158
Efficiency by TEfficiency
94.91578      +0.07099      -0.07194
```

- Run52 MC, reduce the effi. of all three layers down to 92%

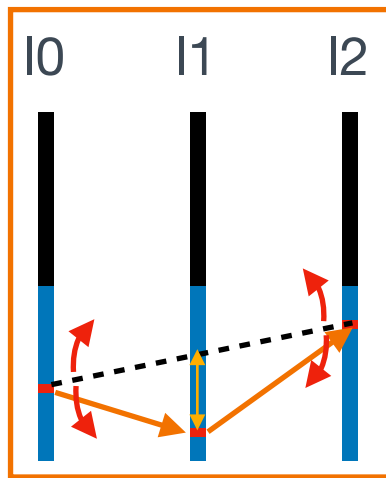
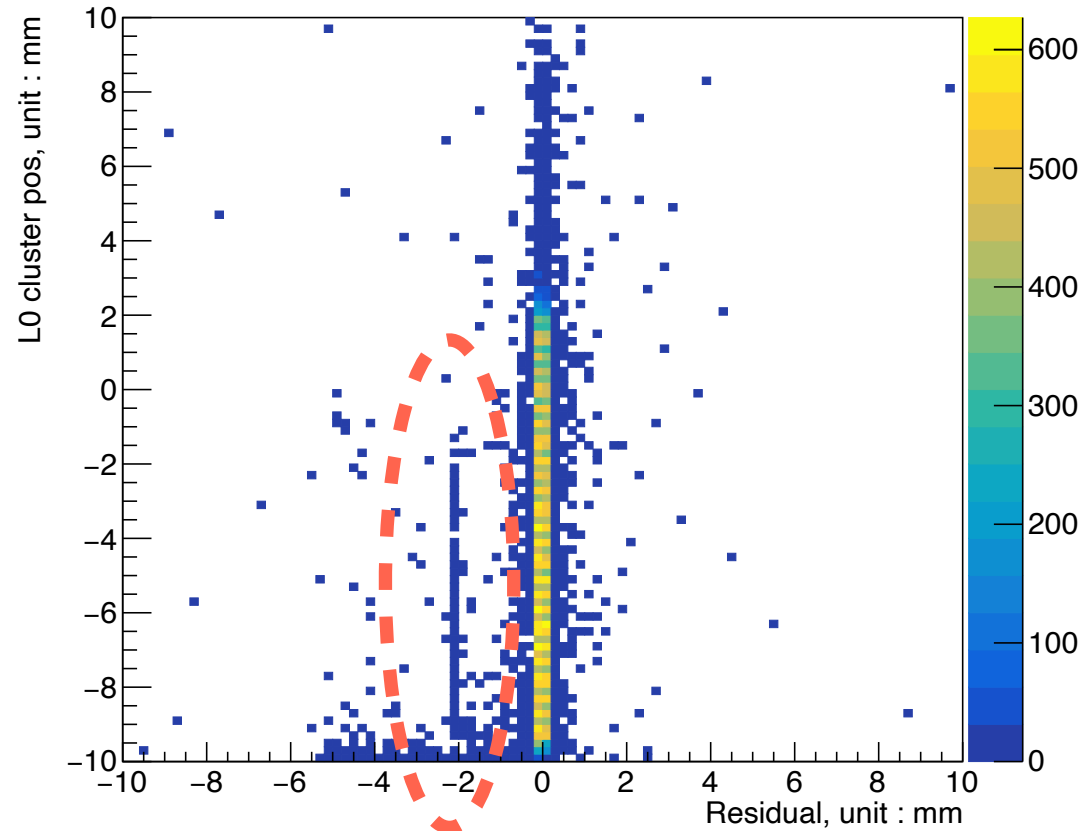
U11

```
# of 111 : 82823
# of 101 : 7175
Efficiency : 0.920276
Efficiency by TEfficiency
92.02760      +0.09038      -0.09132
```

Run 89, two behaviors

Satellite peak, seesaw behavior

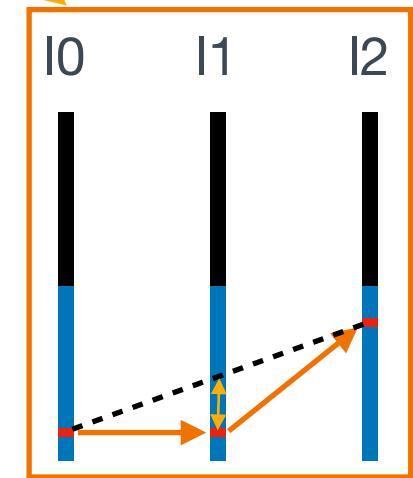
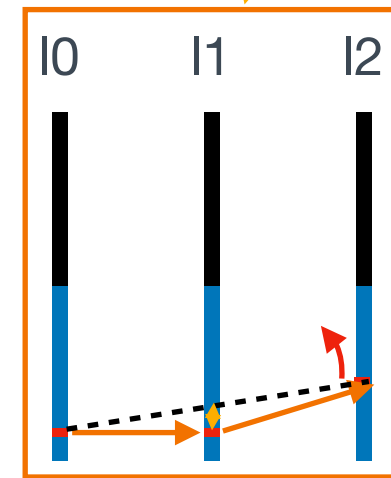
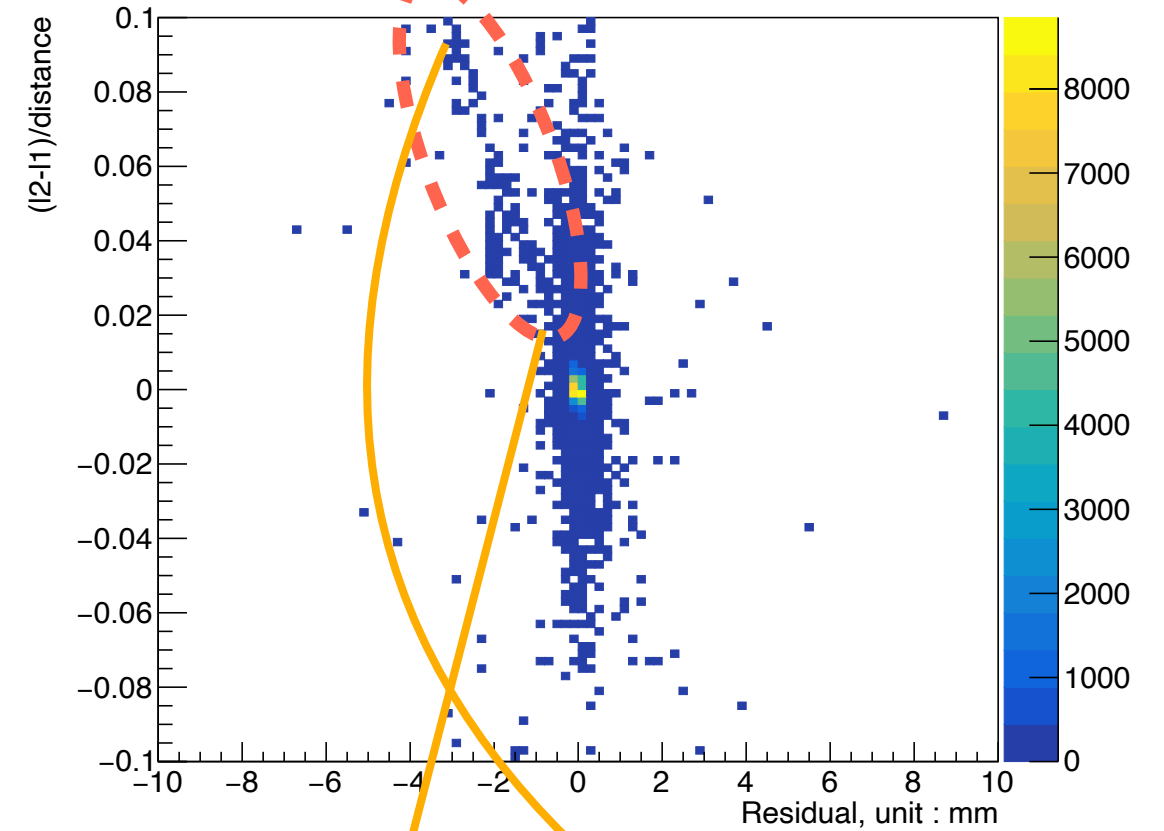
Correlation of residual and I0 position



Seesaw !

Behavior 2 : slope big $\rightarrow$ middle-layer residual big

Correlation of residual and slope



Only I2 cluster moves



Summary

- The preliminary results show that the detection efficiency of the middle layer can be up to 99% by using the DUT method (Geometry method)
- The MC was checked as well to test the algorithm. Based on current test results, the algorithm is capable to reflect the true efficiency
- The satellite peak region of run89 seems to be made of two behaviors. Further check is required

Back up