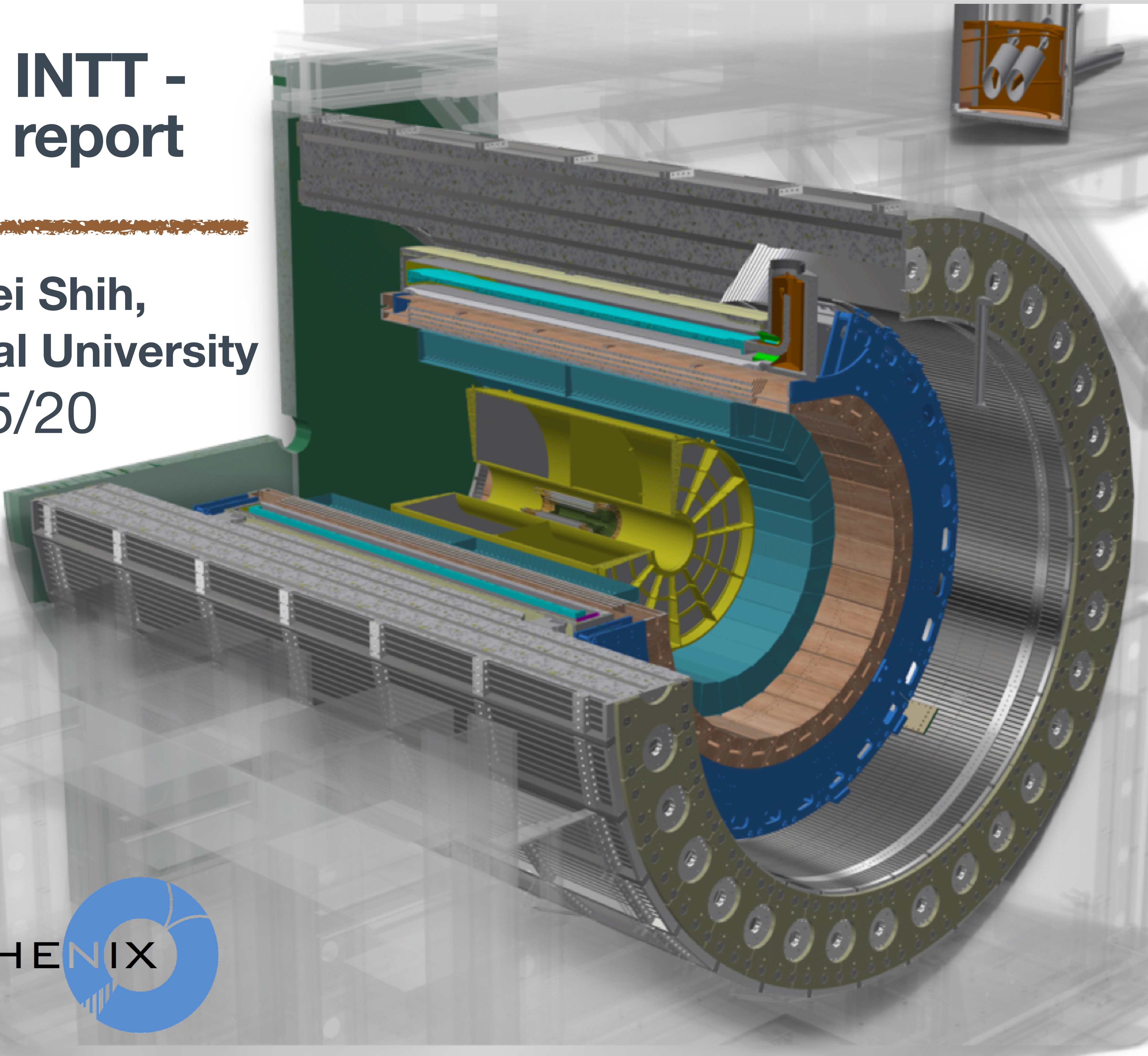
sPHENIX INTT - progress report

Cheng-Wei Shih,
National Central University

2022/5/20



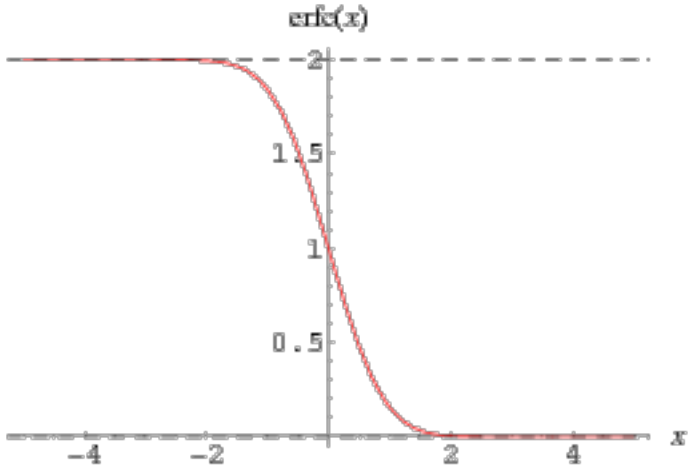
Capacitance - bias voltage

174 sets of sensors are included, file title : 190528_S…datasheet + 211130_S…datasheet
sensor ID : 1011 ~ 1159 + 1161 ~ 1185

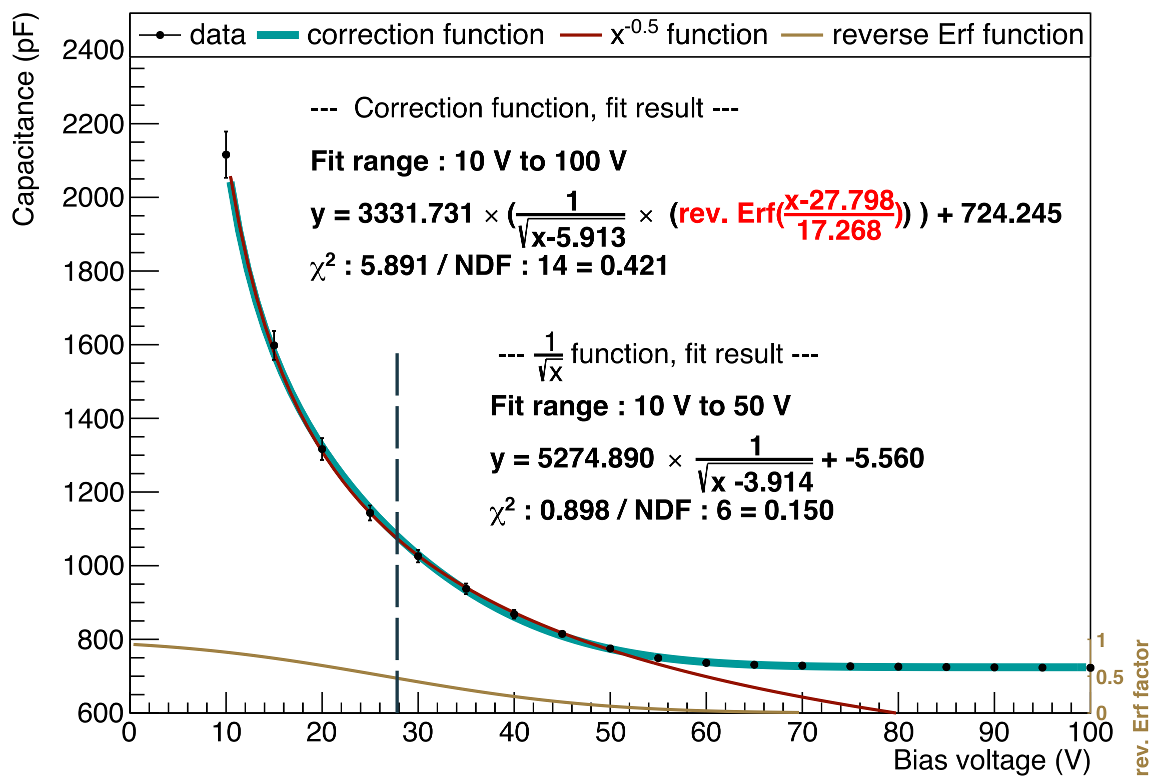
Based on the theory :

$$C \propto \frac{1}{d} \propto \frac{1}{\sqrt{V}} \propto \frac{1}{signal}$$

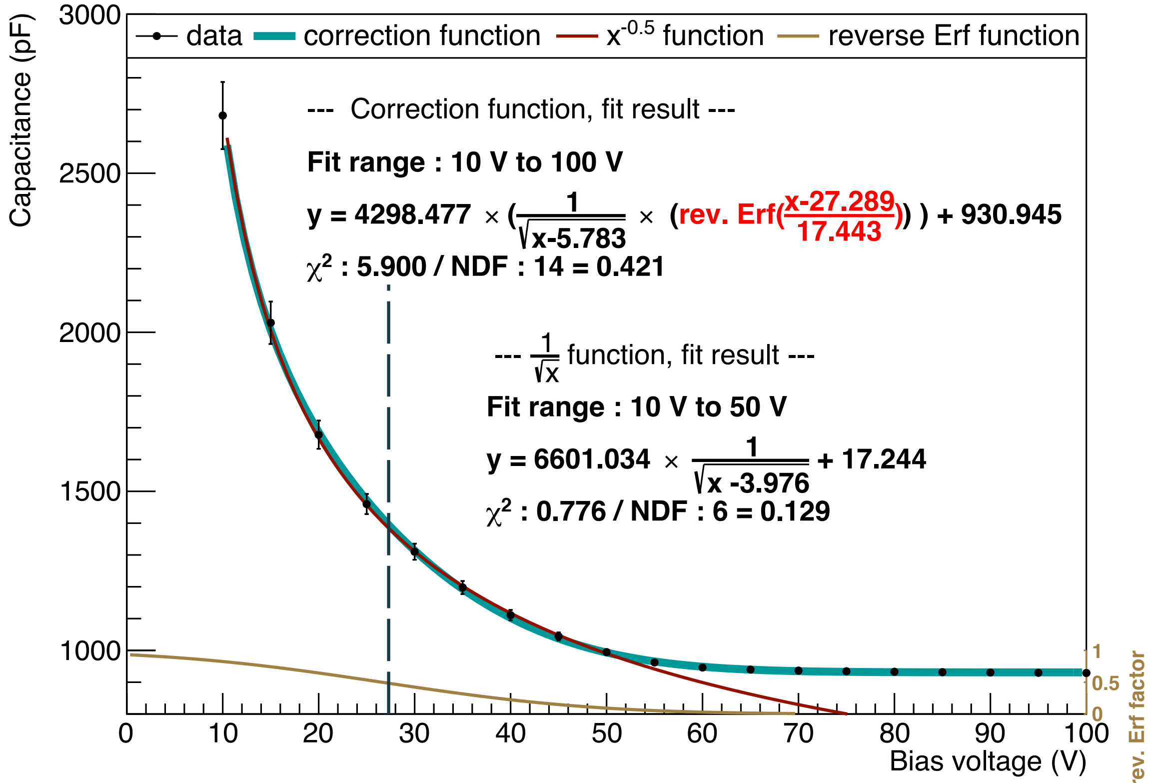
Complementary error function as a factor



Capacitance - Bias voltage (Type-B)



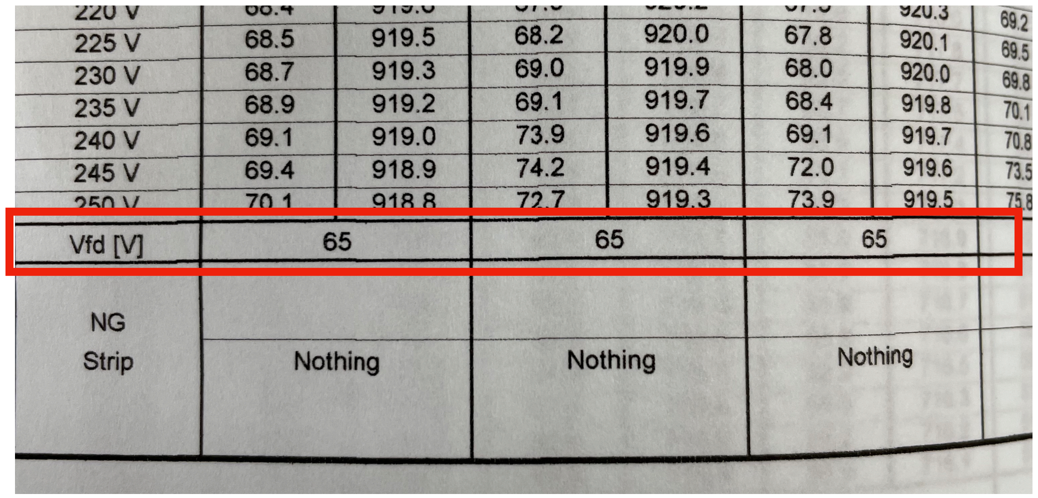
Capacitance - Bias voltage (Type-A)



INTT sensor, full depletion voltage

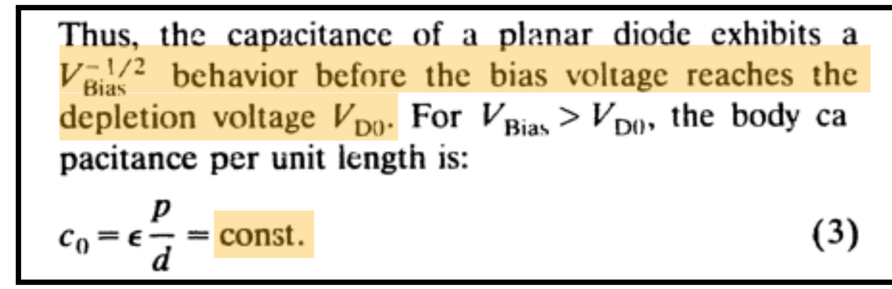
174 sets of sensors are included, file title : 190528_S…datasheet + 211130_S…datasheet
sensor ID : 1011 ~ 1159 + 1161 ~ 1185

Measurements from Hamamatsu



225 V	68.5	919.5	68.2	920.0	67.8	920.1	69.5
230 V	68.7	919.3	69.0	919.9	68.0	920.0	69.8
235 V	68.9	919.2	69.1	919.7	68.4	919.8	70.1
240 V	69.1	919.0	73.9	919.6	69.1	919.7	70.8
245 V	69.4	918.9	74.2	919.4	72.0	919.6	73.5
250 V	70.1	918.8	72.7	919.3	73.9	919.5	75.8
Vfd [V]	65		65		65		
NG Strip	Nothing		Nothing		Nothing		

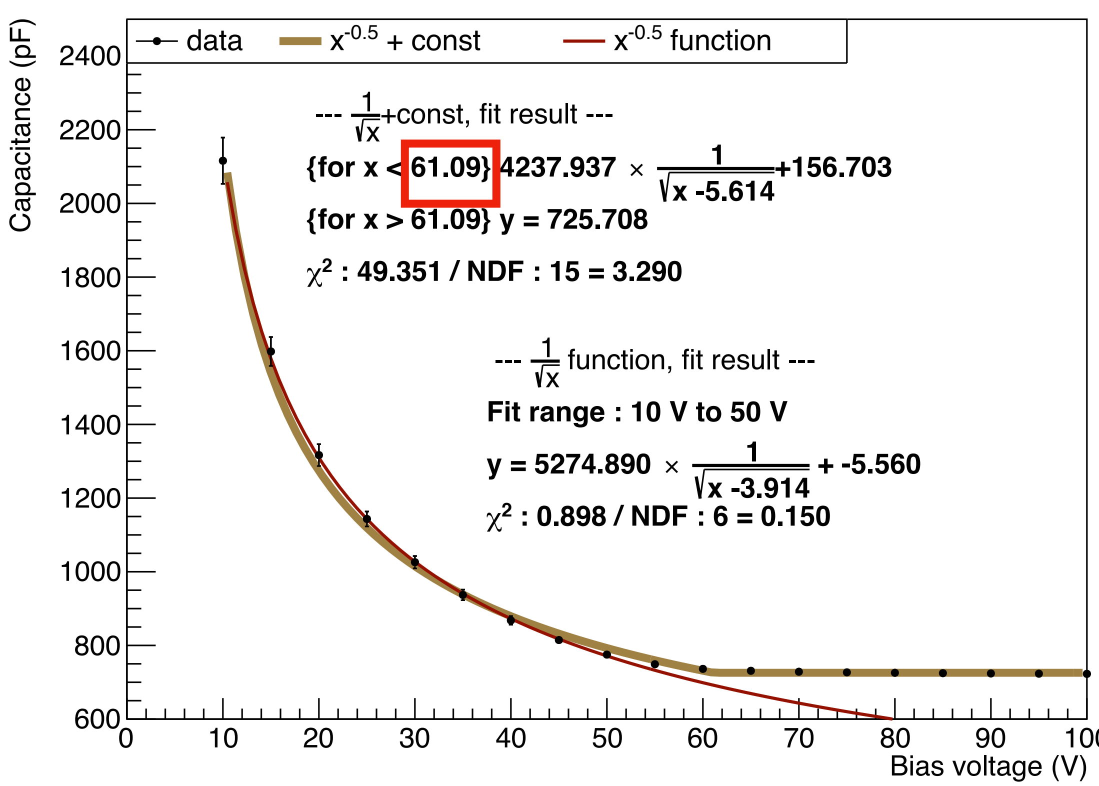
Paper link



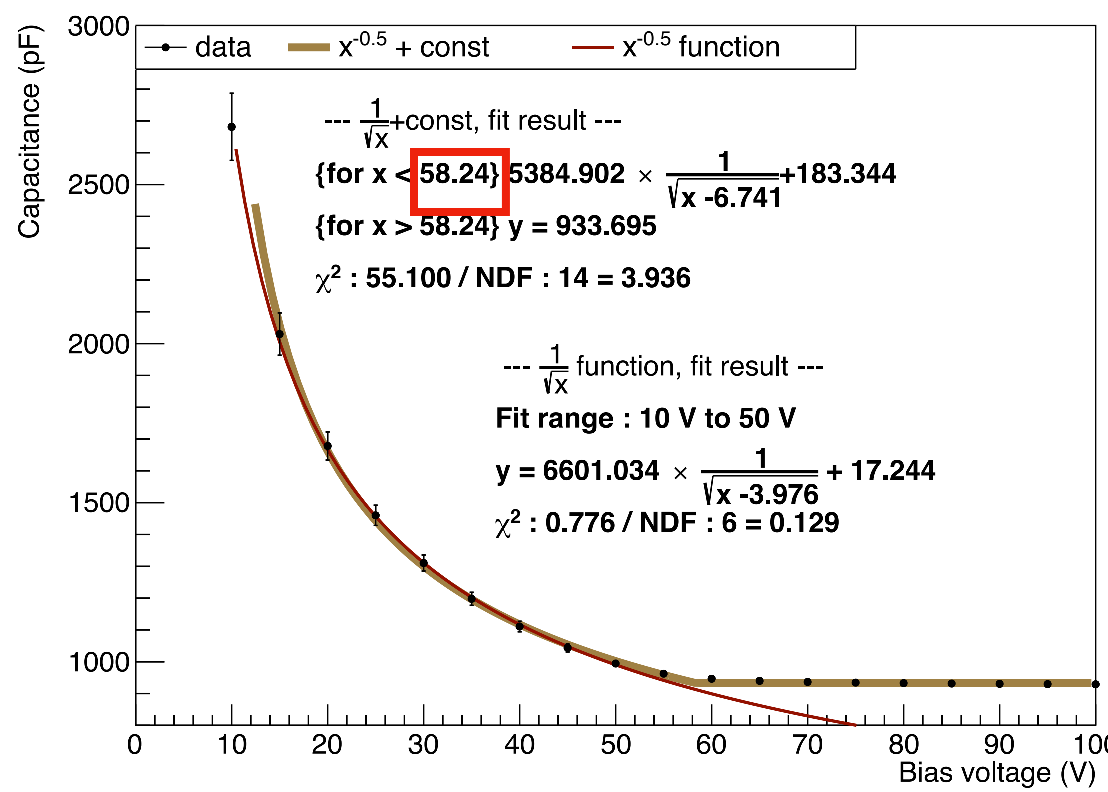
Thus, the capacitance of a planar diode exhibits a $V_{\mathrm{Bias}}^{-1/2}$ behavior before the bias voltage reaches the depletion voltage V_{D0}. For $V_{\mathrm{Bias}} > V_{D0}$, the body capacitance per unit length is:

$$c_0 = \epsilon \frac{p}{d} = \mathrm{const.} \quad (3)$$

Capacitance - Bias voltage (Type-B)



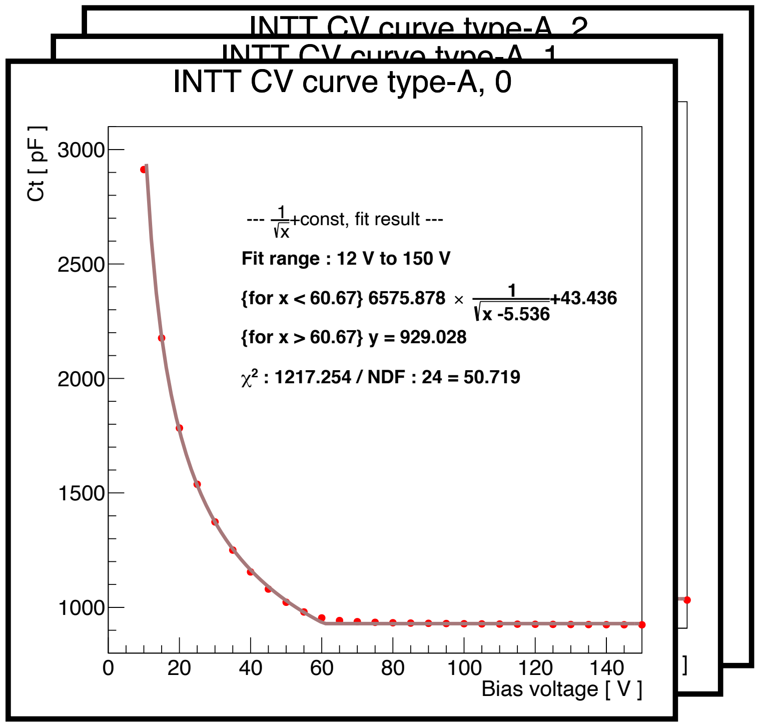
Capacitance - Bias voltage (Type-A)



INTT sensor, full depletion voltage

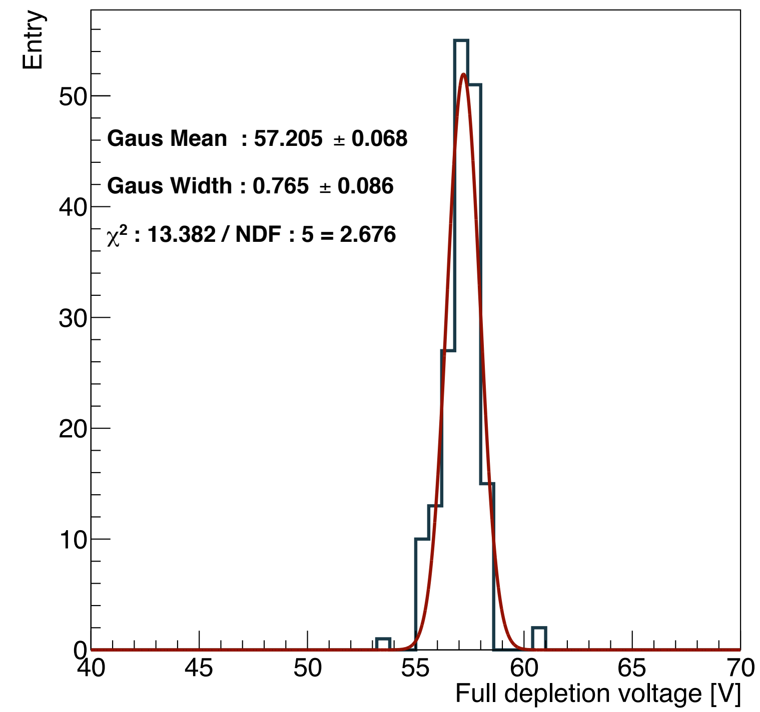
174 sets of sensors are included, file title : 190528_S…datasheet + 211130_S…datasheet

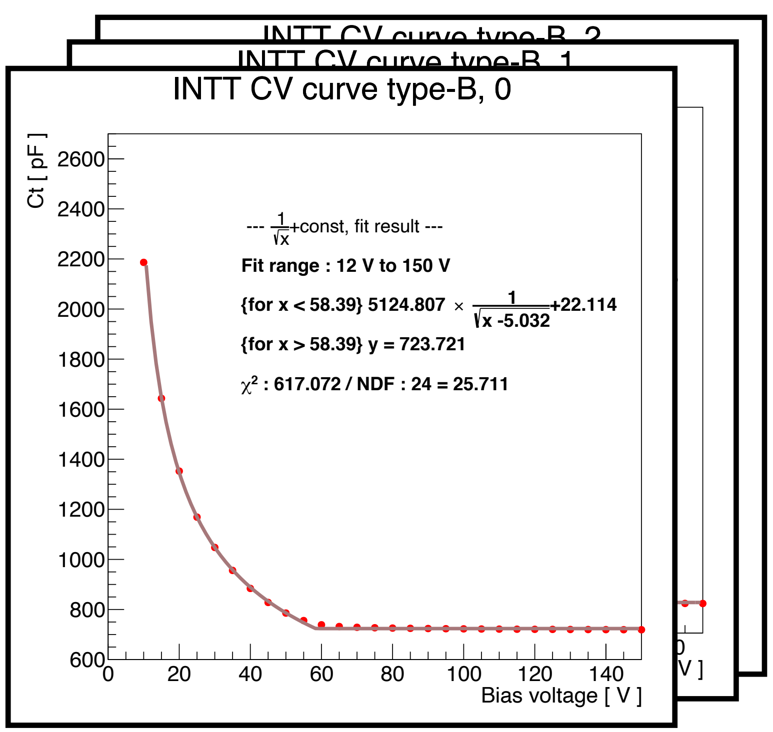
sensor ID : 1011 ~ 1159 + 1161 ~ 1185



X 174

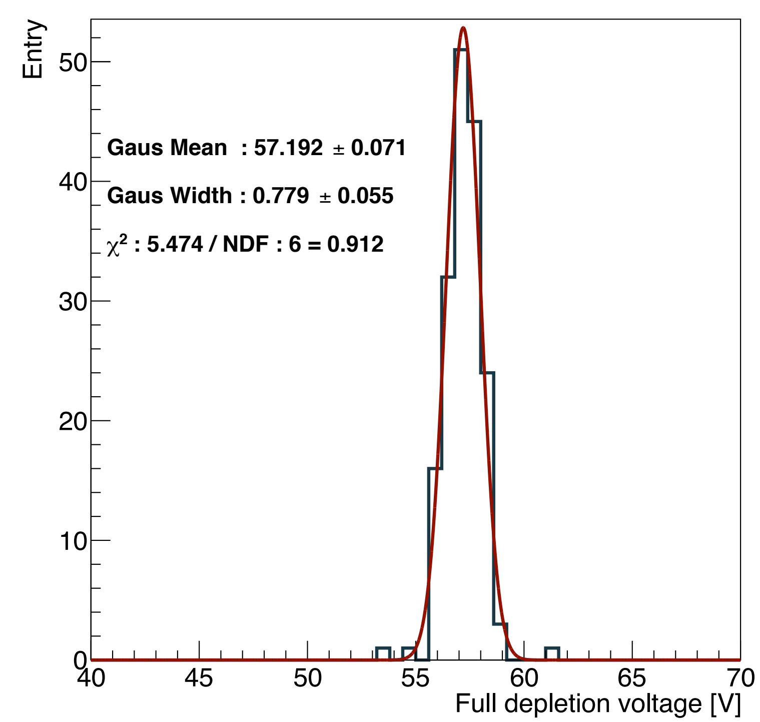
Type-A, full depletion voltage





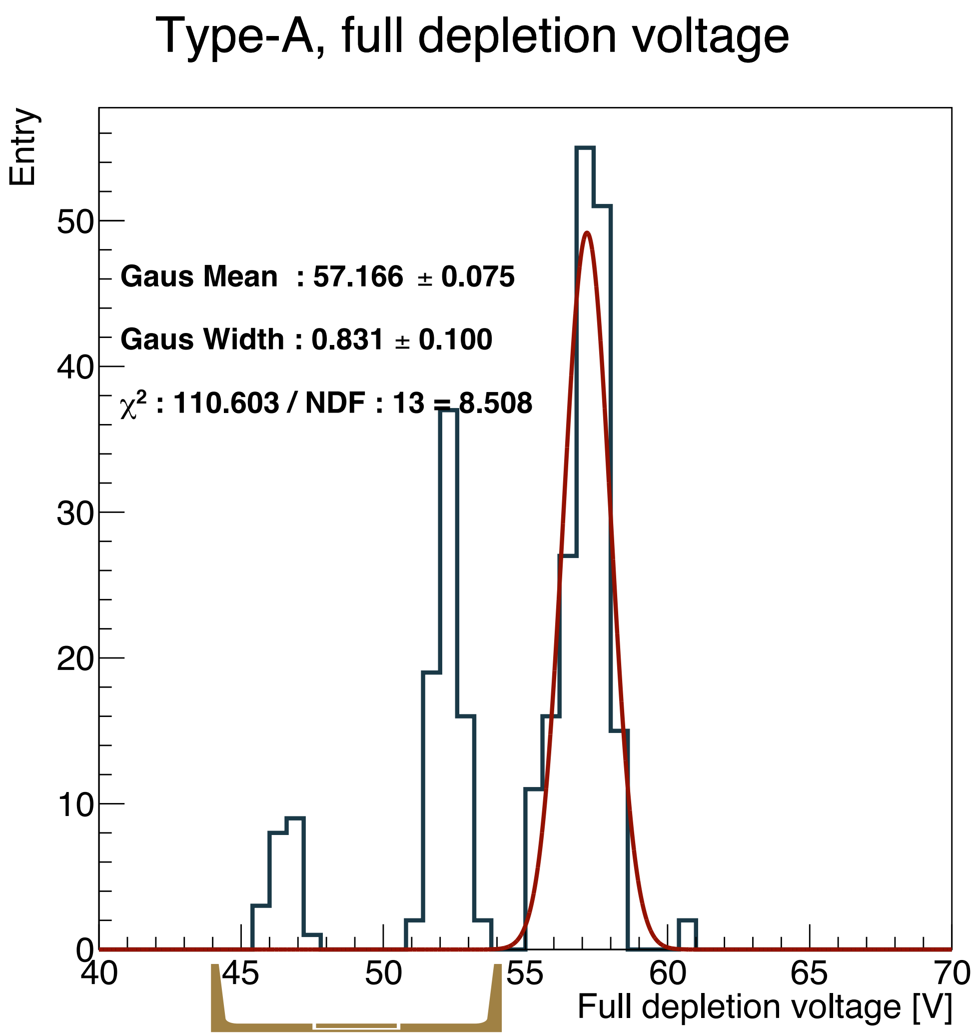
X 174

Type-B, full depletion voltage

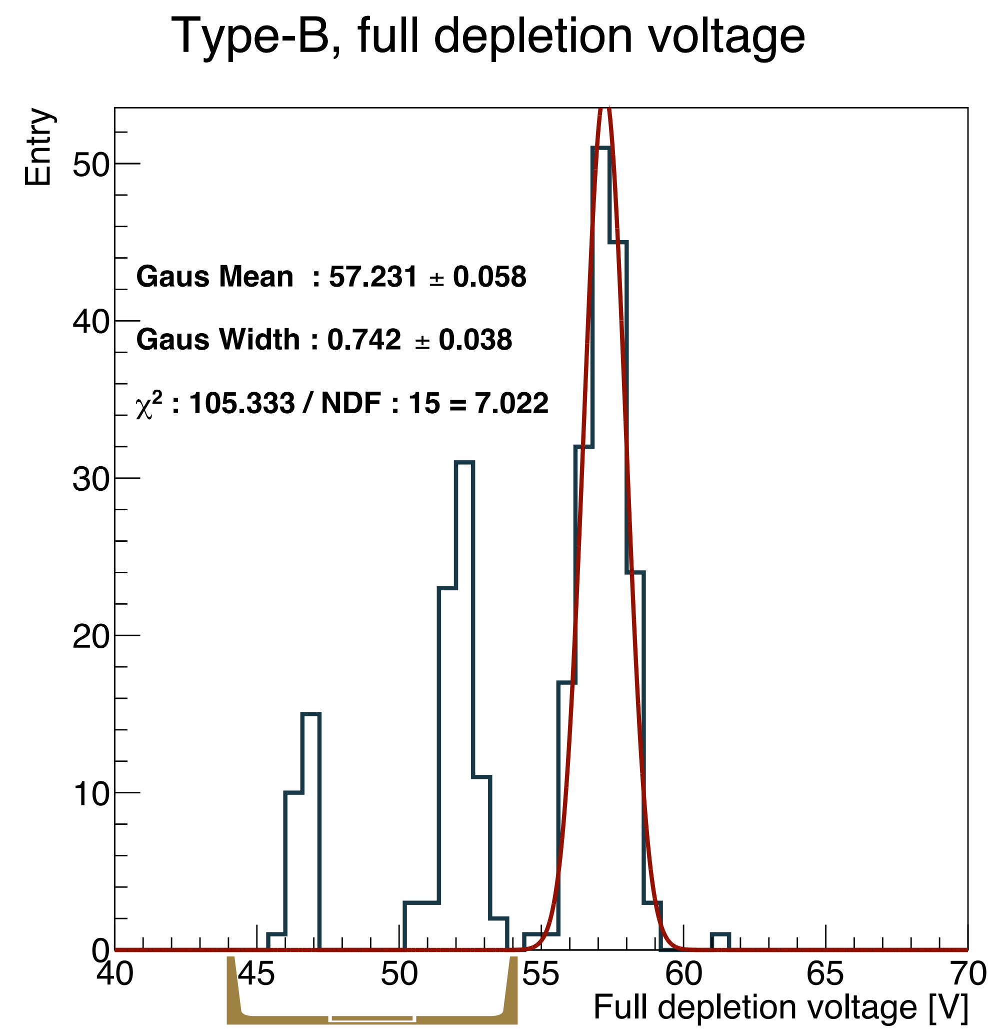


INTT sensor, full depletion voltage

274 sets of sensors are included,
file title : 190528_S…datasheet + 211130_S…datasheet + 200519_S…datasheet (100 sets)
sensor ID (A & B) : 1011 ~ 1159 + 1161 ~ 1185
1231 ~ 1330 (A) & 1223 ~ 1322 (B)



200519_S…datasheet

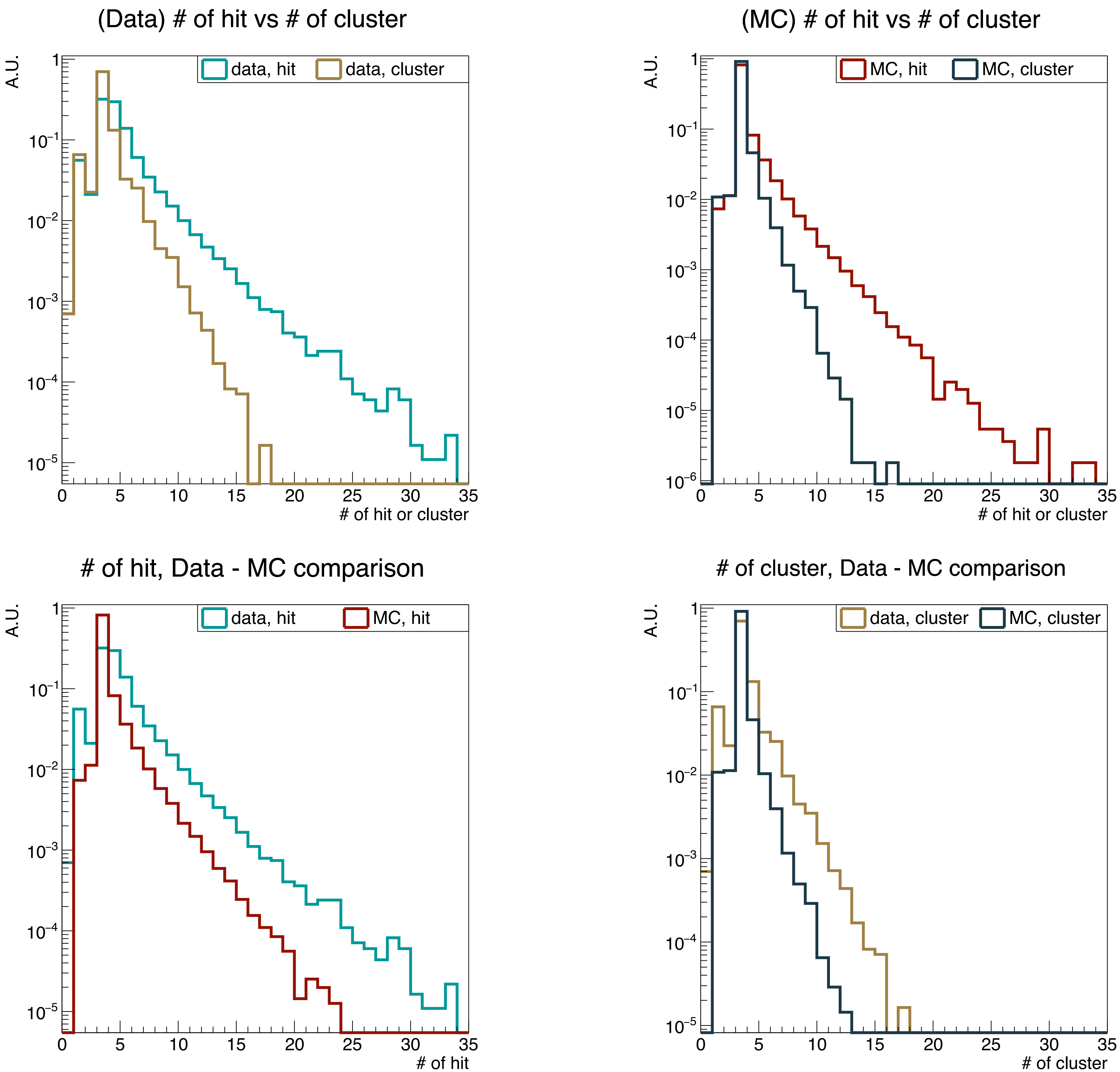


200519_S…datasheet

of hit (cluster) comparison

Goal :
explain the discrepancy between data and MC by introducing the noise hit in MC ?

Run 52 is used for the comparison
log scale

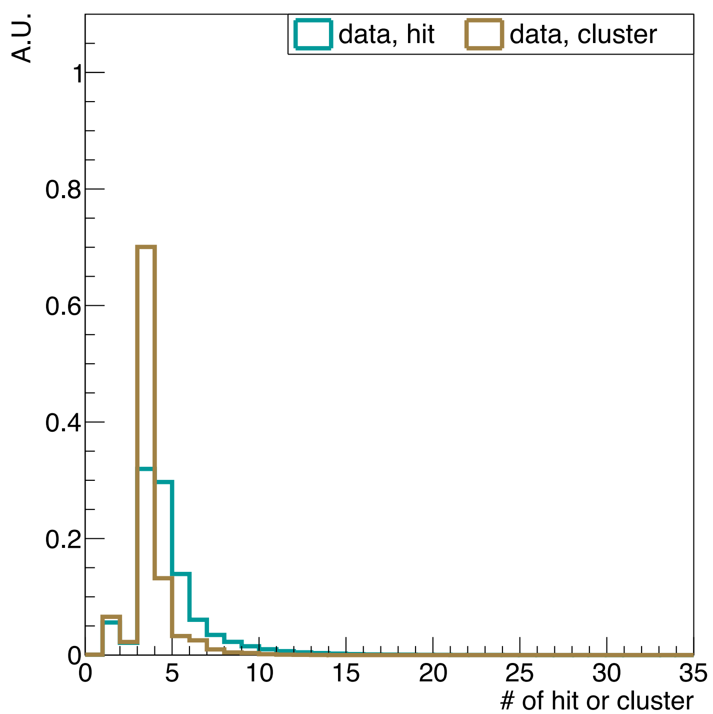


of hit (cluster) comparison

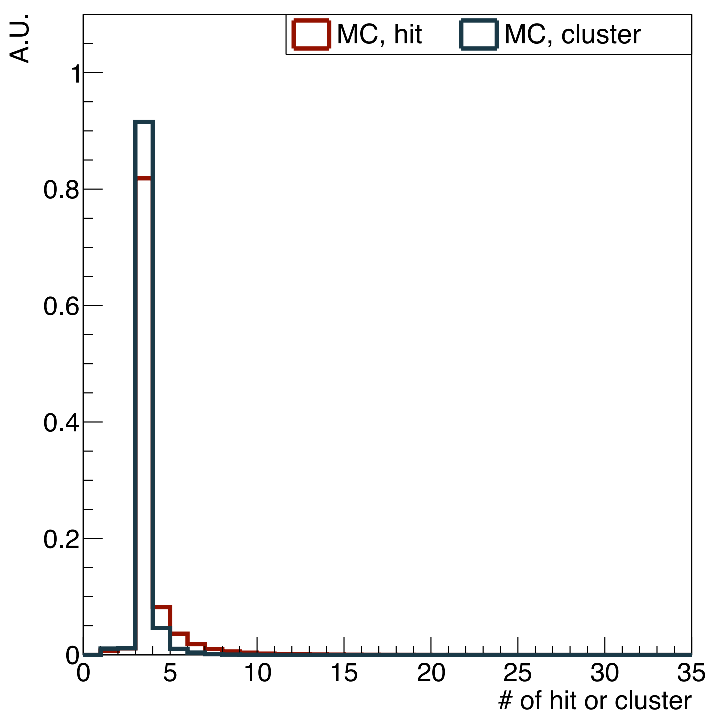
Goal :
explain the discrepancy between data and MC by introducing the noise hit in MC ?

Run 52 is used for the comparison

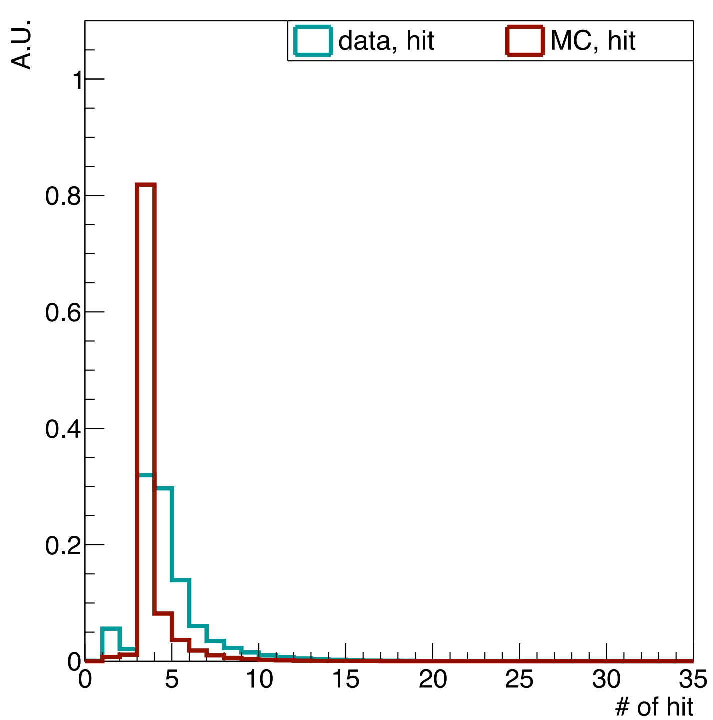
(Data) # of hit vs # of cluster



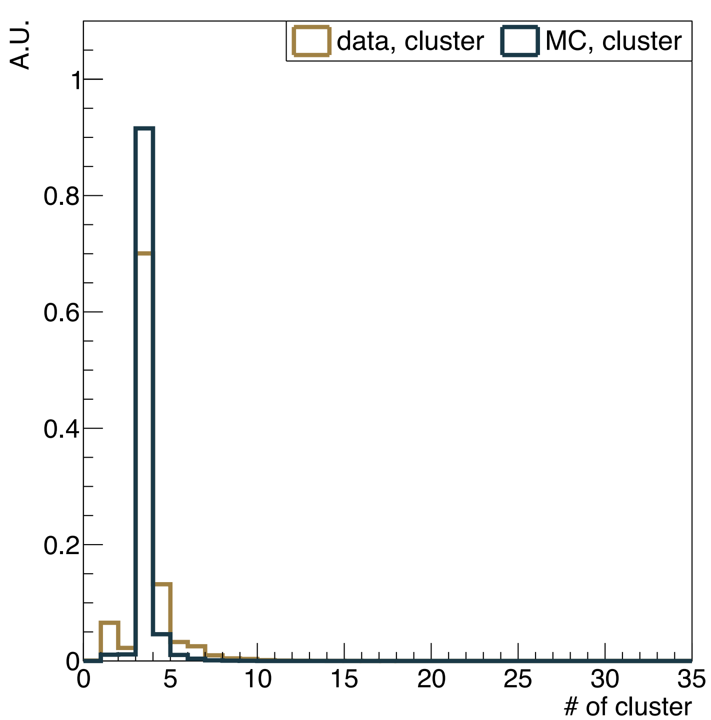
(MC) # of hit vs # of cluster



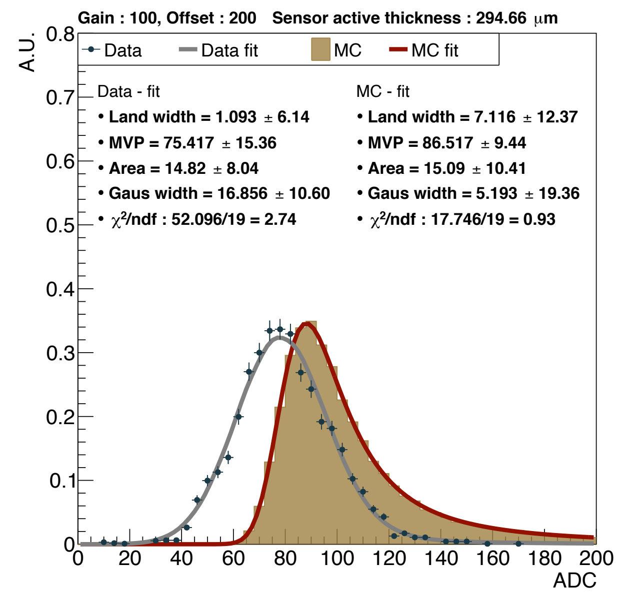
# of hit, Data - MC comparison

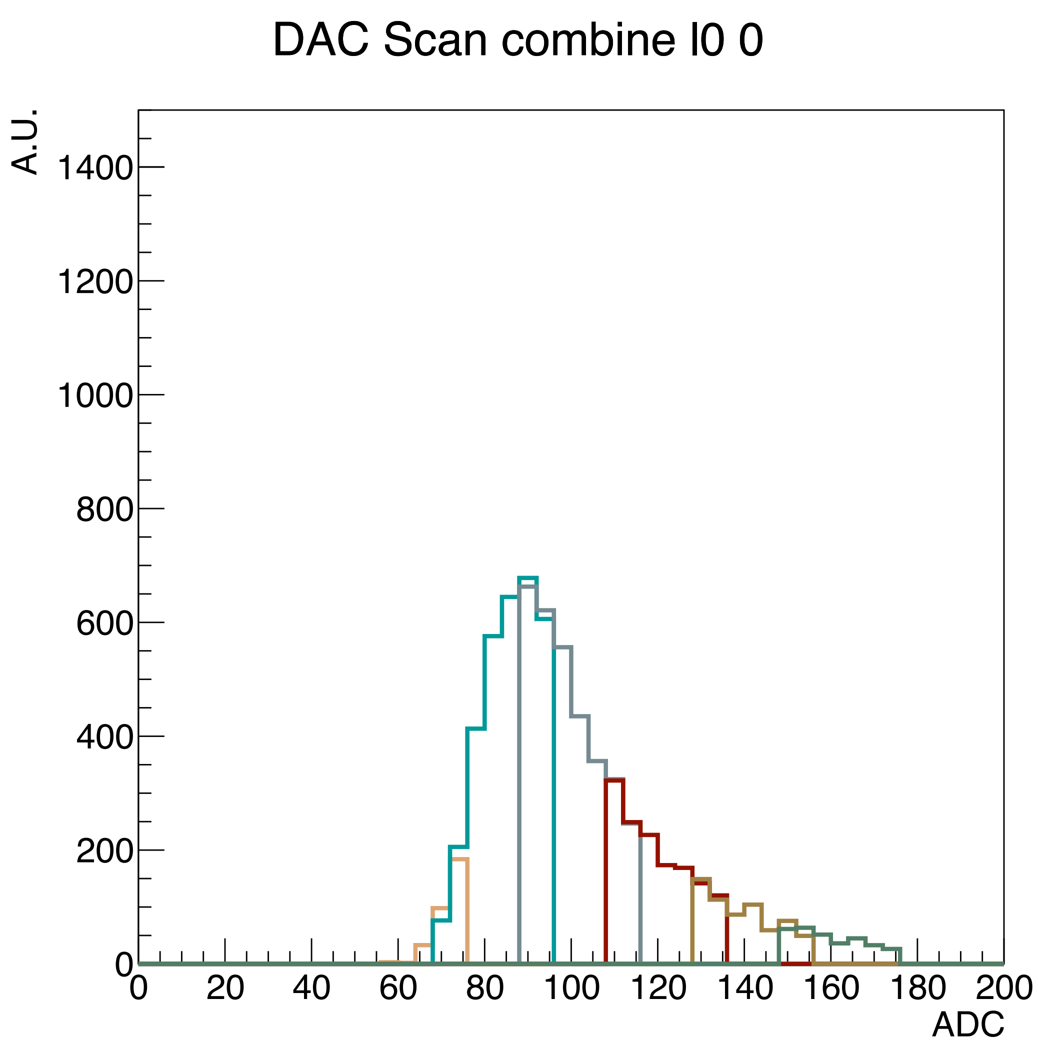


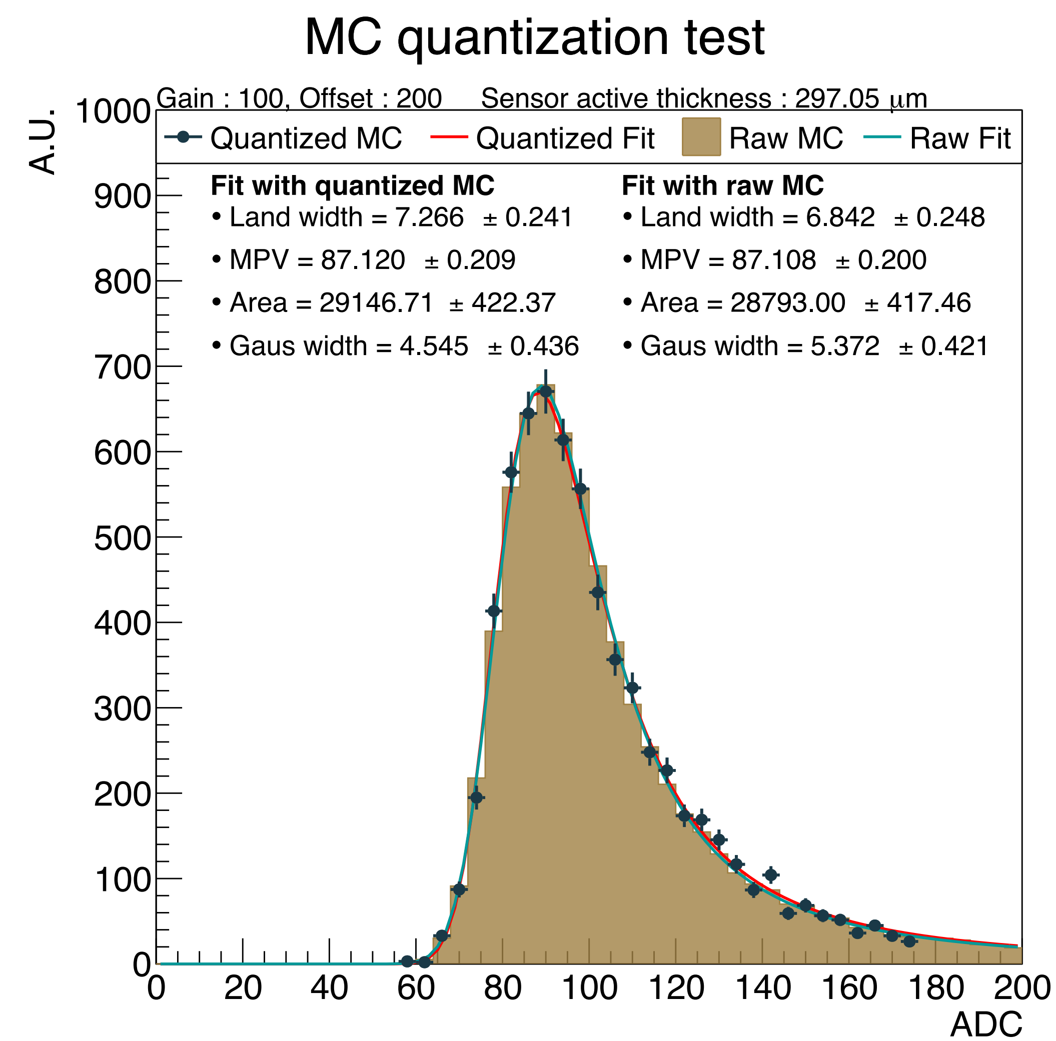
# of cluster, Data - MC comparison



MC, DAC Scan quantization





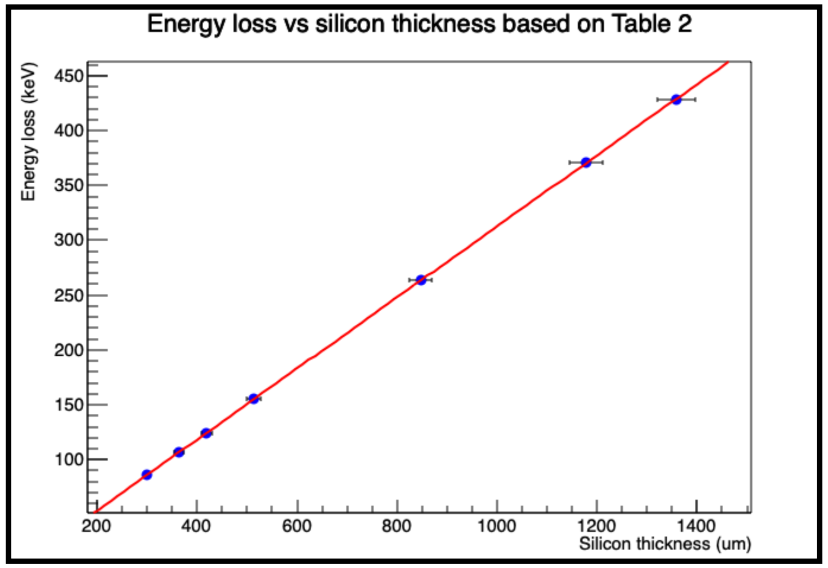


Info. found from papers

	Beam	Beam energy	silicon thickness (um)	edep (keV)	Paper link	note
1	Proton	1 GeV	300 um	130.8 ± 3.8 keV	link1	
2	Proton	115 GeV	300 um	85.5 ± 2.8 keV	link1	
3	Proton	50 GeV	300 um	85.79 keV	link2	
4	Proton	50 GeV	320 um	92.4389 keV	link2	interpolation from link2, Table 2
5	Proton	12 GeV	320 um	90.158 keV	link3	Extrapolation from link3, Figure 11
6	Proton	120 GeV	320 um	111.697 keV		Testbeam2019, Gain 100, Offset 200
7	Proton	120 GeV	320 um	93.297 keV		Testbeam2019, Gain 100, Offset 280

Info. found from papers

link 2 plot



Fit : Y = 3.23932e-01*X -1.12194e+01

link 3 plot

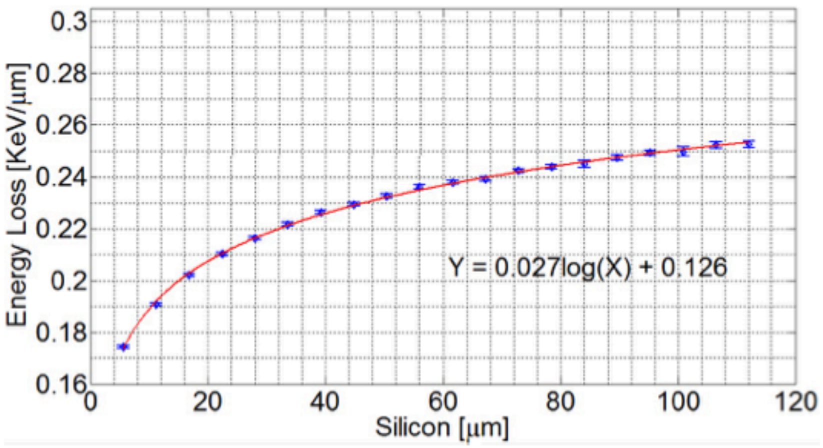
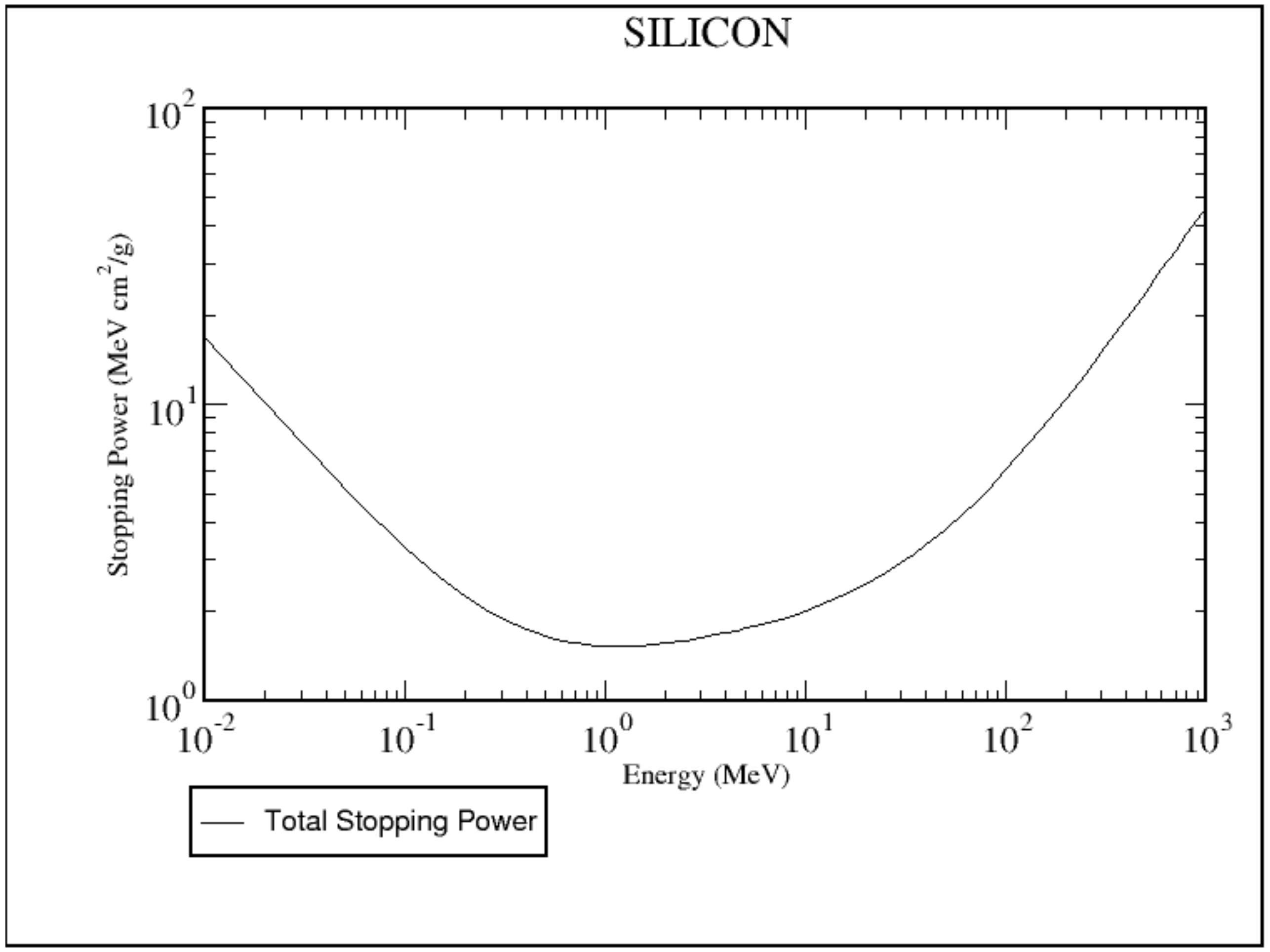


Figure 11. Energy loss for 12GeV protons passing through several silicon thickness.

Theoretical stopping power in silicon

Electron



@ 1 MeV : 1.531 $MeV\ cm^2/g$

@ 1GeV : 46.69 $MeV\ cm^2/g$???

Proton

@ 10 GeV : 1.830 $MeV\ cm^2/g$

Calculation based on the web

Summary

- The Batch-1, Batch-2 and Batch-3 sensors, 274 sets of sensors are included in the study. The $1/\sqrt{V} + const$ function is fit sensor by sensor as well.
- The sensors of batch “200519_S…datasheet” have lower $V_{fd.}$ 65 V is a safe value of full depletion voltage for all sensors.
- The hit (cluster) distribution is compared, the data has wider distribution for both cases.
- The DAC scan quantization test is performed and results in the consistent distribution comparing with the raw distribution.
- For testbeam2019, the peak with a setting of gain 100 and offset 280 can be consistent with other experiments.

Back up