sPHENIX INTT - sensor summary

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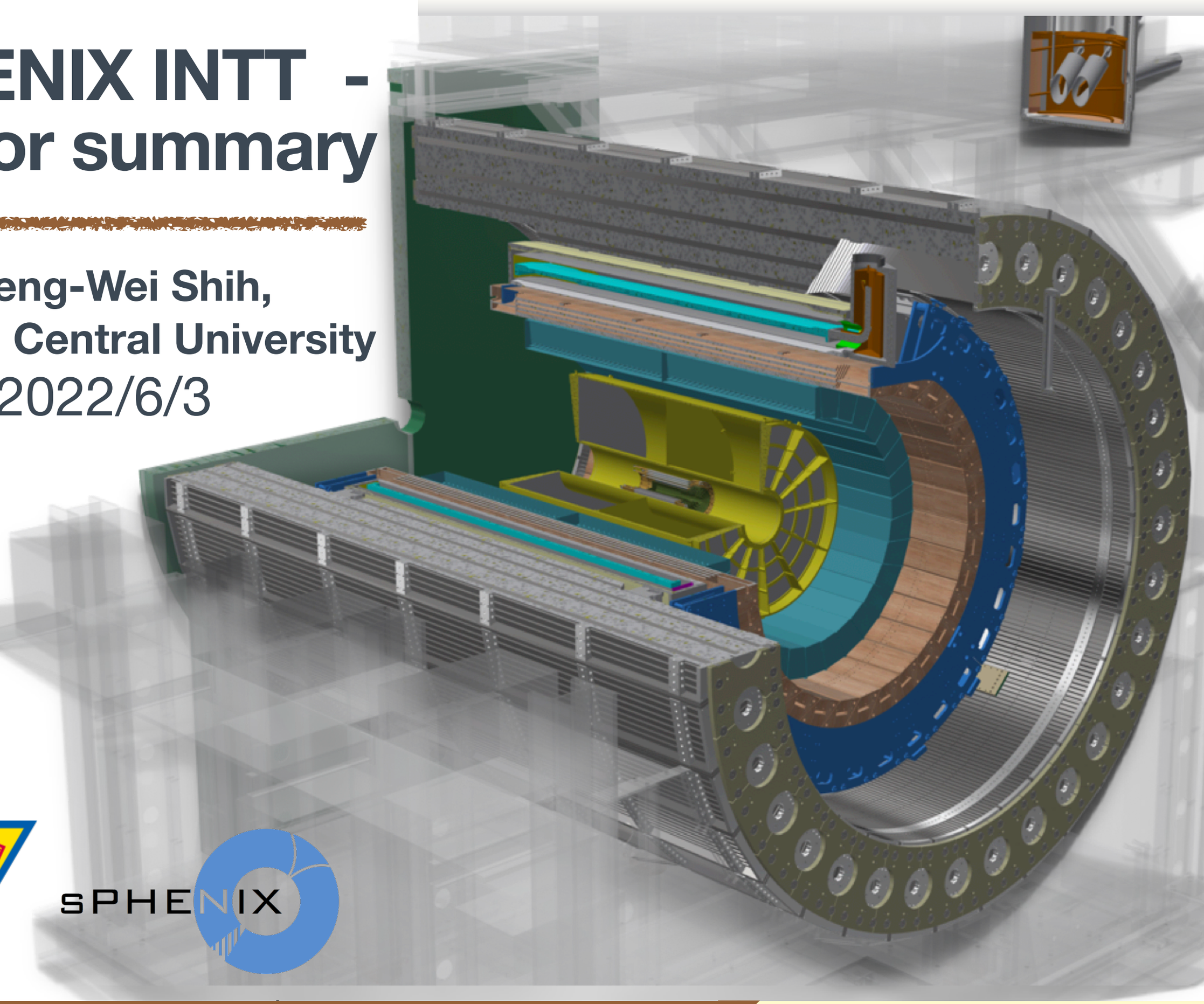


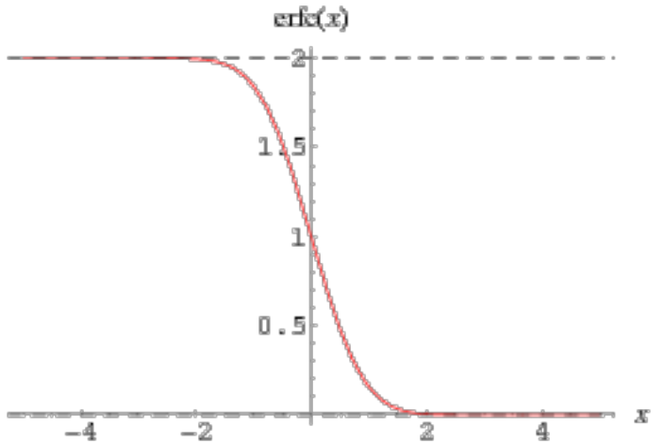
Capacitance - bias voltage

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

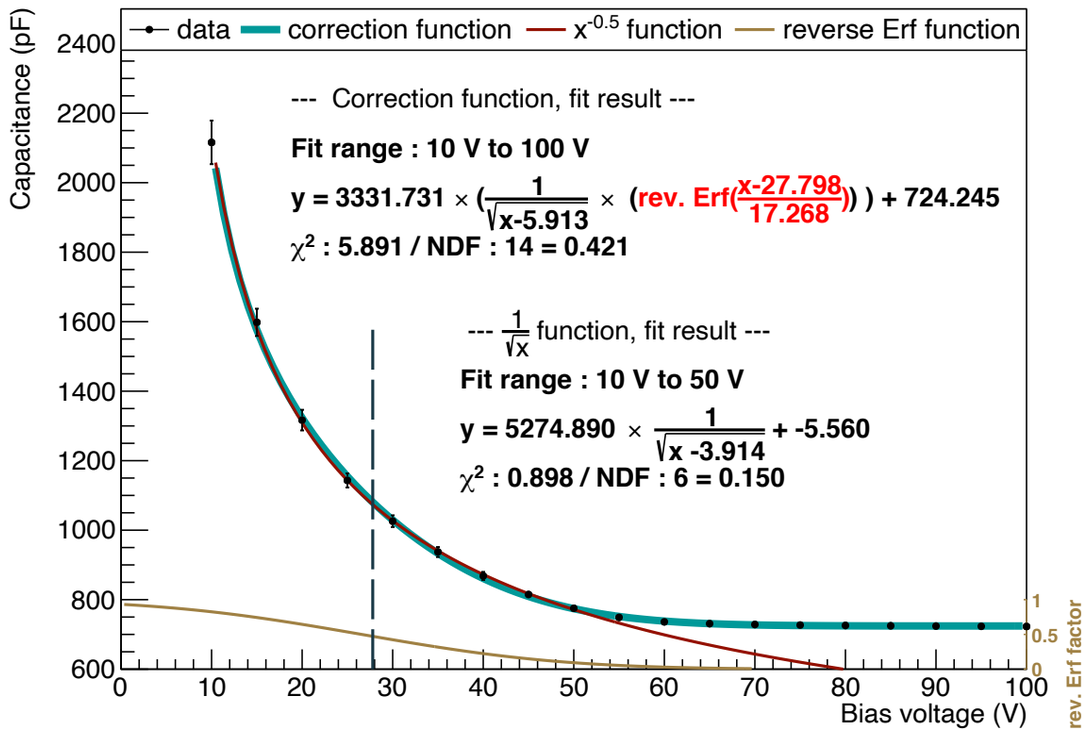
Based on the theory :

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

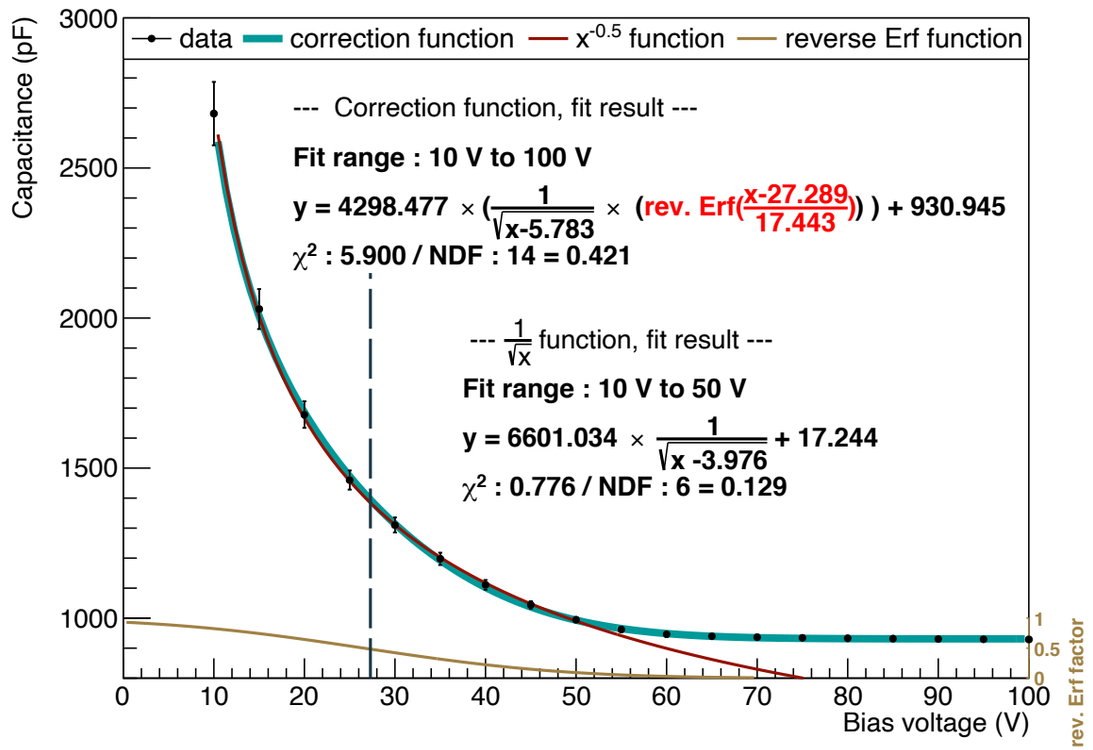
Complementary error function as a factor



Capacitance - Bias voltage (Type-B)



Capacitance - Bias voltage (Type-A)



INTT sensor, full depletion voltage

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Measurements from Hamamatsu

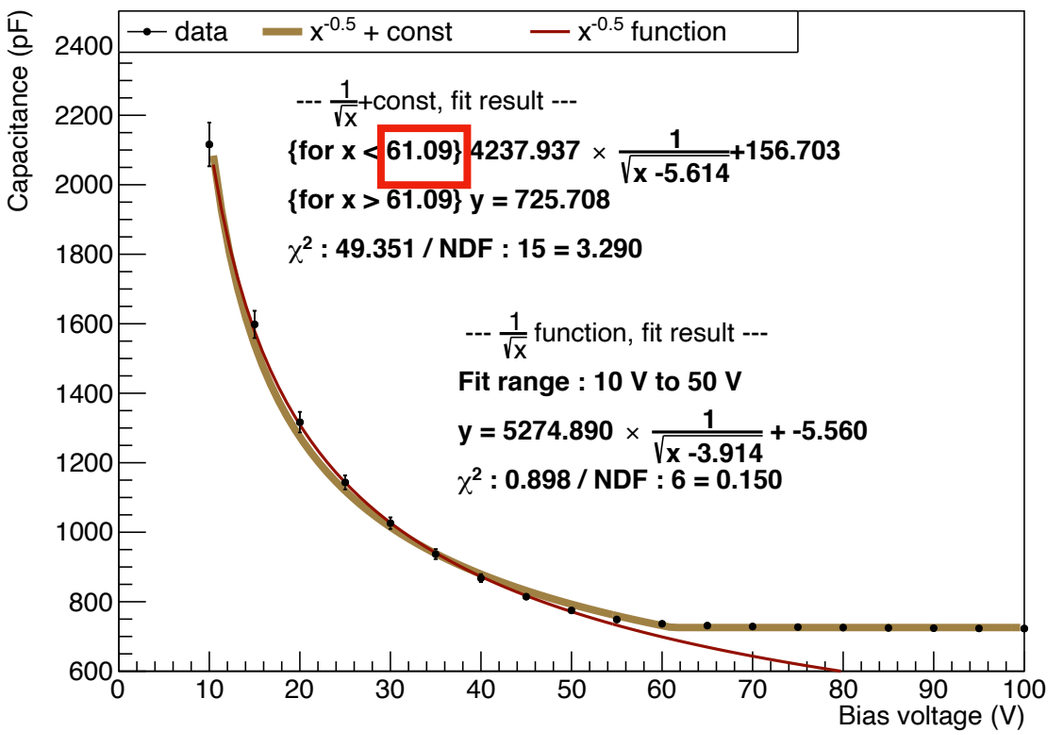
220 V	68.4	919.6	67.6	920.2	67.5	920.3	69.2
225 V	68.5	919.5	68.2	920.0	67.8	920.1	69.5
230 V	68.7	919.3	69.0	919.9	68.0	920.0	69.8
235 V	68.9	919.2	69.1	919.7	68.4	919.8	70.1
240 V	69.1	919.0	73.9	919.6	69.1	919.7	70.8
245 V	69.4	918.9	74.2	919.4	72.0	919.6	73.5
250 V	70.1	918.8	72.7	919.3	73.9	919.5	75.8
Vfd [V]	65		65		65		
NG Strip	Nothing		Nothing		Nothing		

Paper link

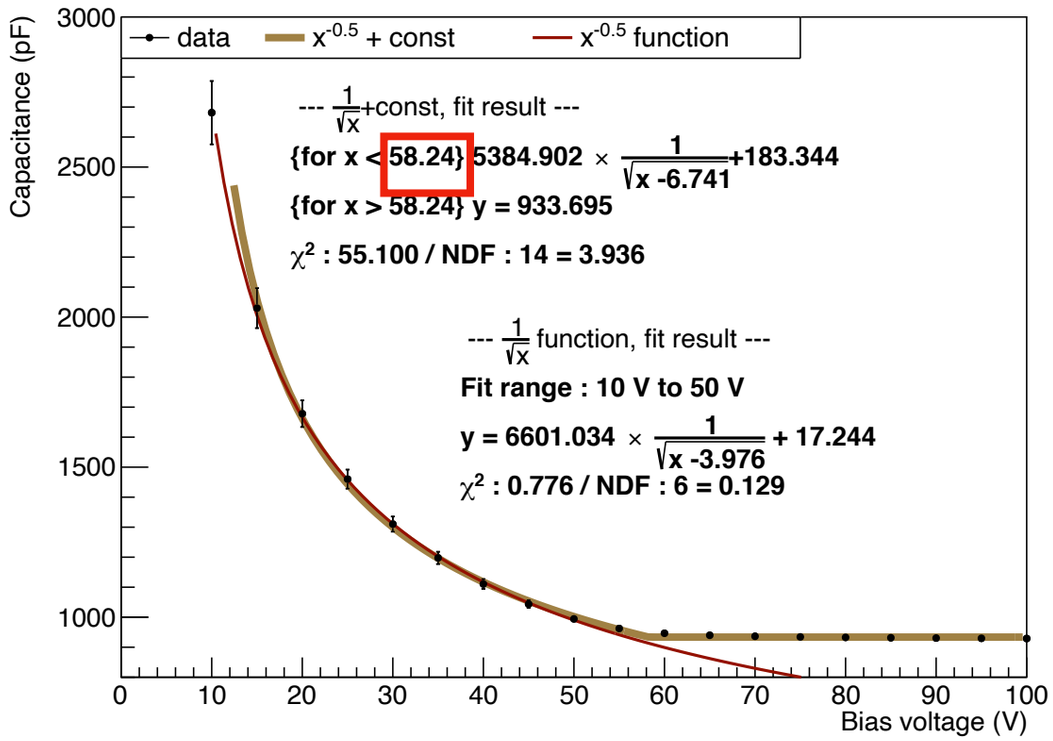
Thus, the capacitance of a planar diode exhibits a $V_{\mathrm{Bias}}^{-1/2}$ behavior before the bias voltage reaches the depletion voltage V_{D0}. For $V_{\mathrm{Bias}} > V_{\mathrm{D0}}$, the body capacitance per unit length is:

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

Capacitance - Bias voltage (Type-B)



Capacitance - Bias voltage (Type-A)



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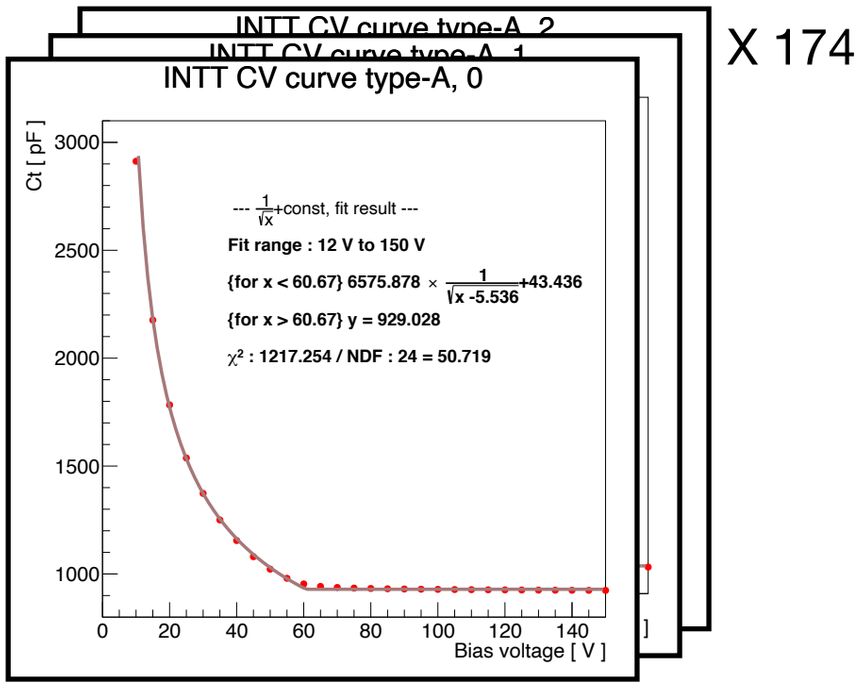
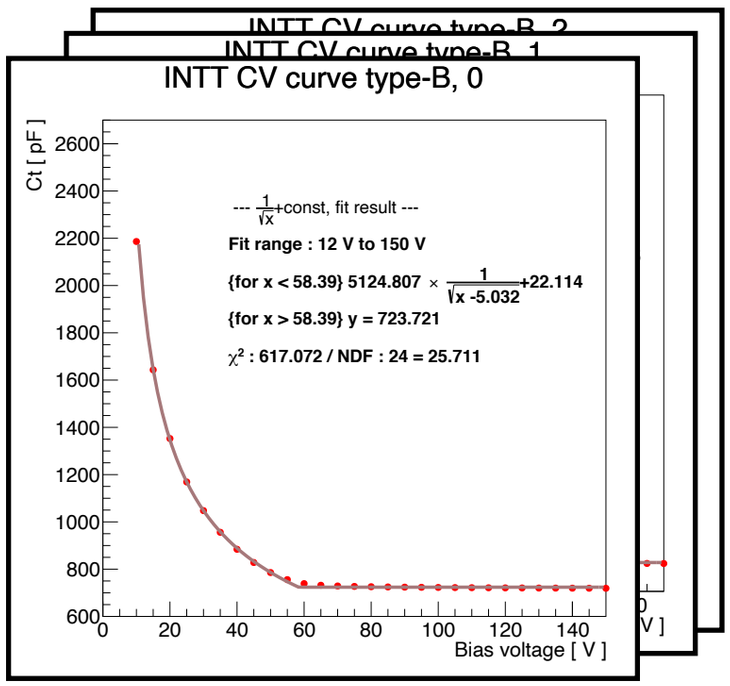
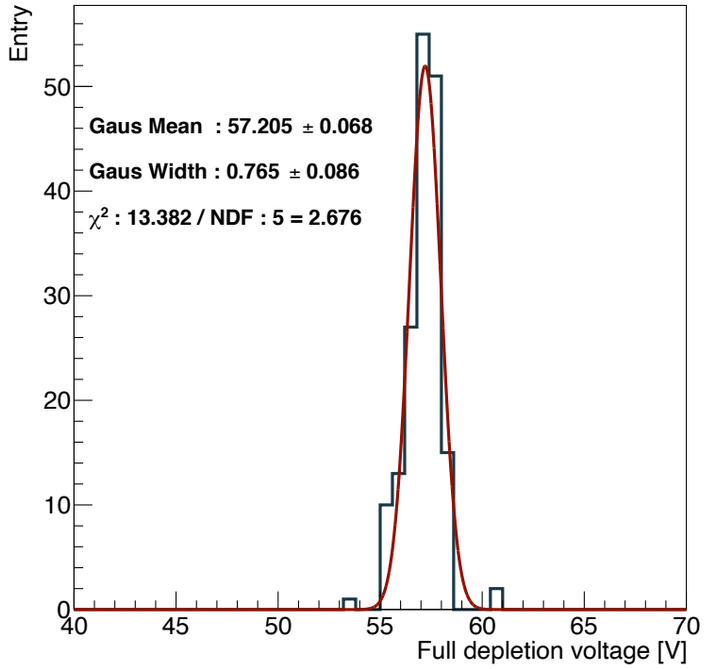


X 174

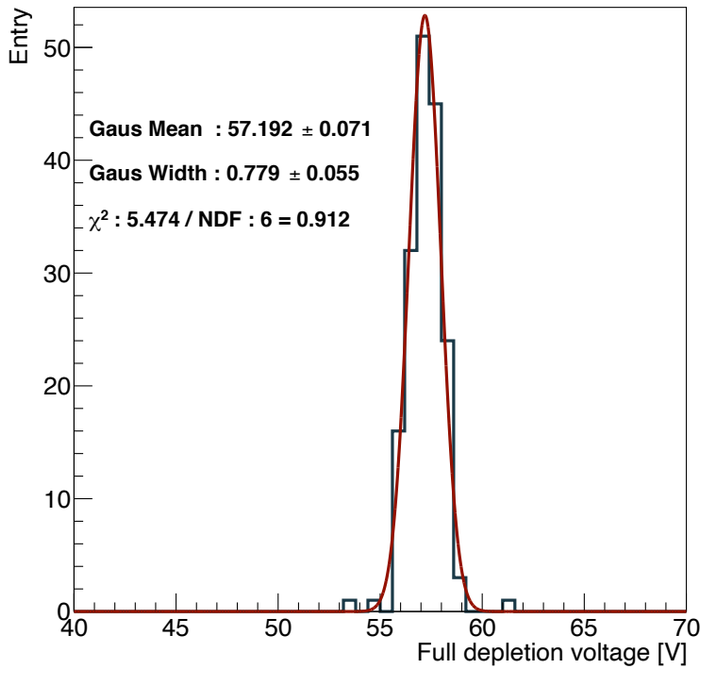


X 174

Type-A, full depletion voltage



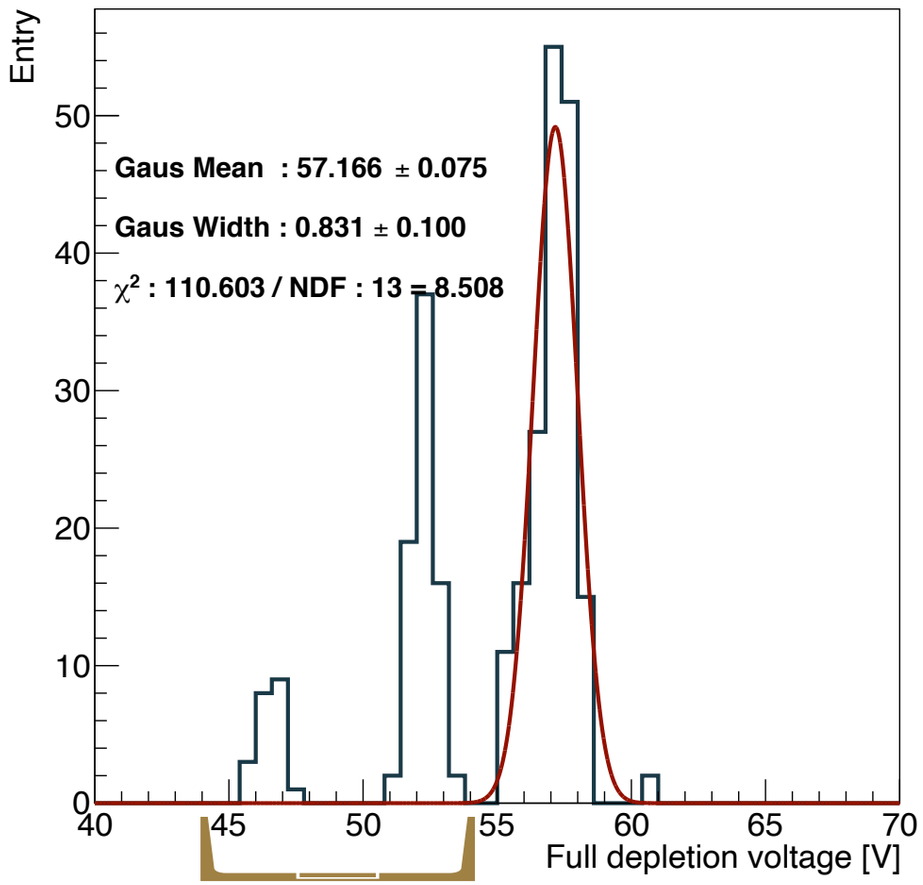
Type-B, full depletion voltage



INTT sensor, full depletion voltage

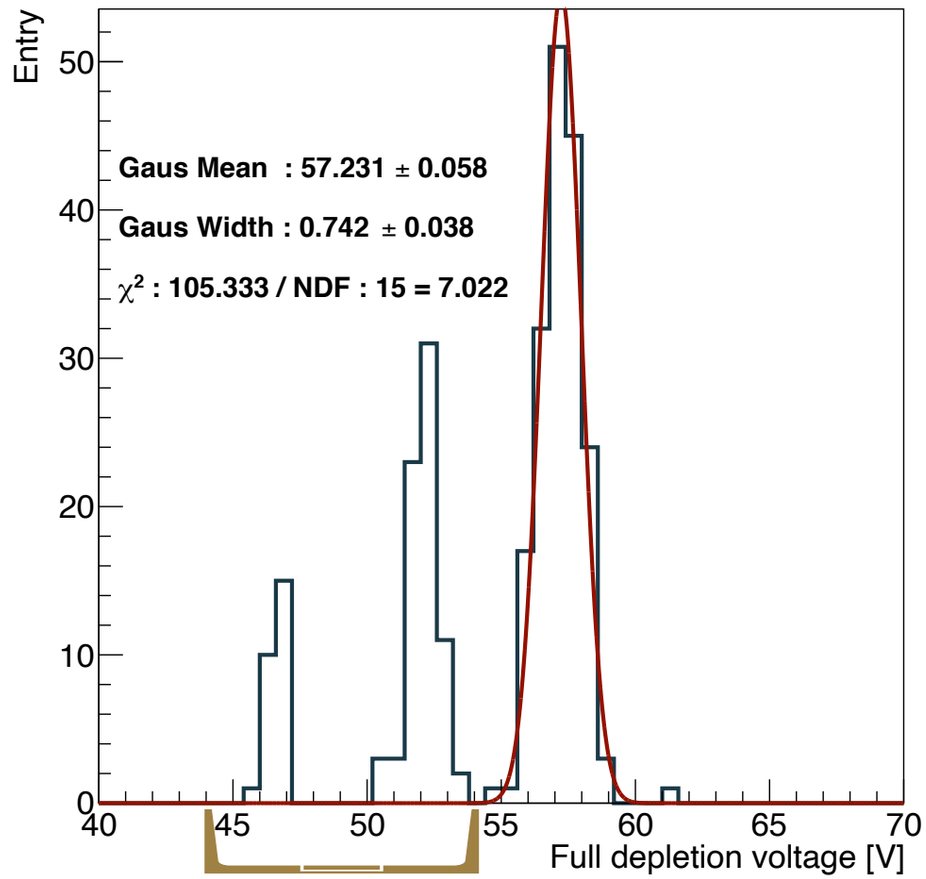
274 sets of sensors are included,
file title : 190528_S…datasheet (149 sets) + 211130_S…datasheet (25 sets) + 200519_S…datasheet (100 sets)
sensor ID (A & B) : 1011 ~ 1159 + 1161 ~ 1185
1231 ~ 1330 (A) & 1223 ~ 1322 (B)

Type-A, full depletion voltage



200519_S…datasheet

Type-B, full depletion voltage



200519_S…datasheet

INTT sensor, leakage current

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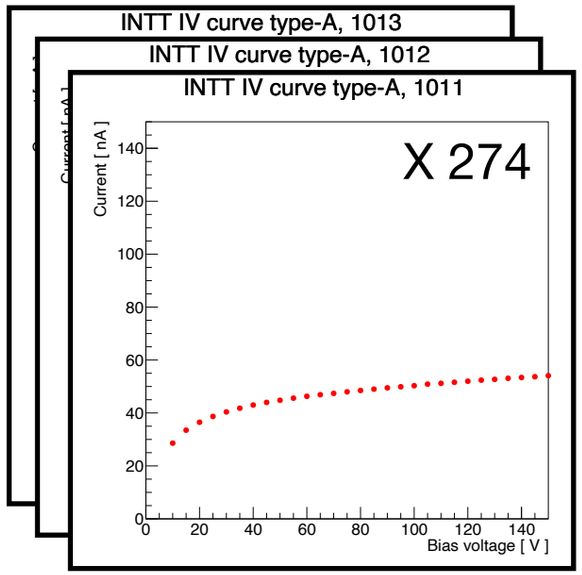
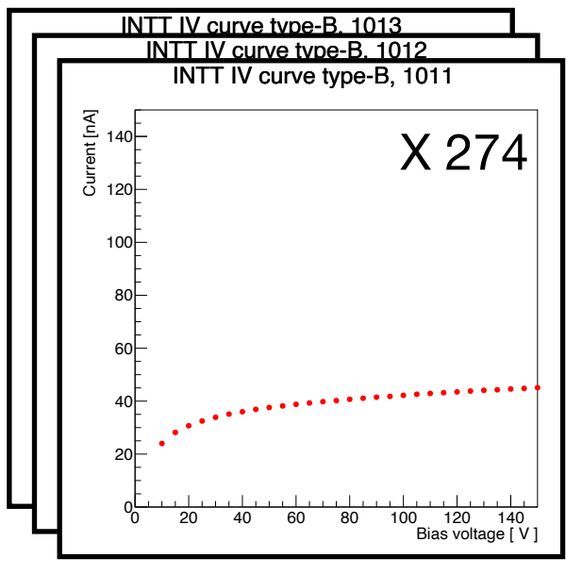
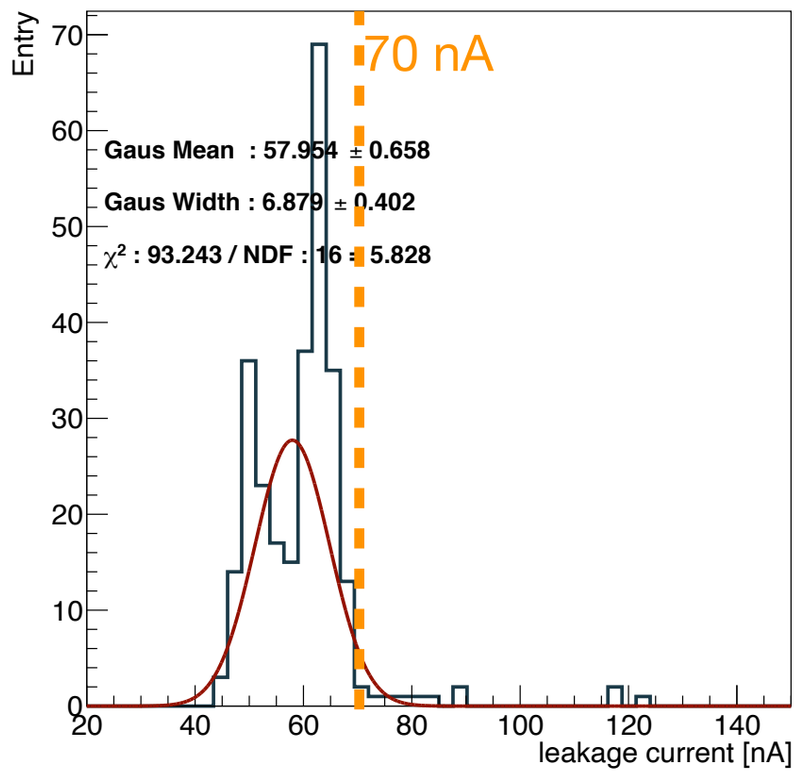
Type A



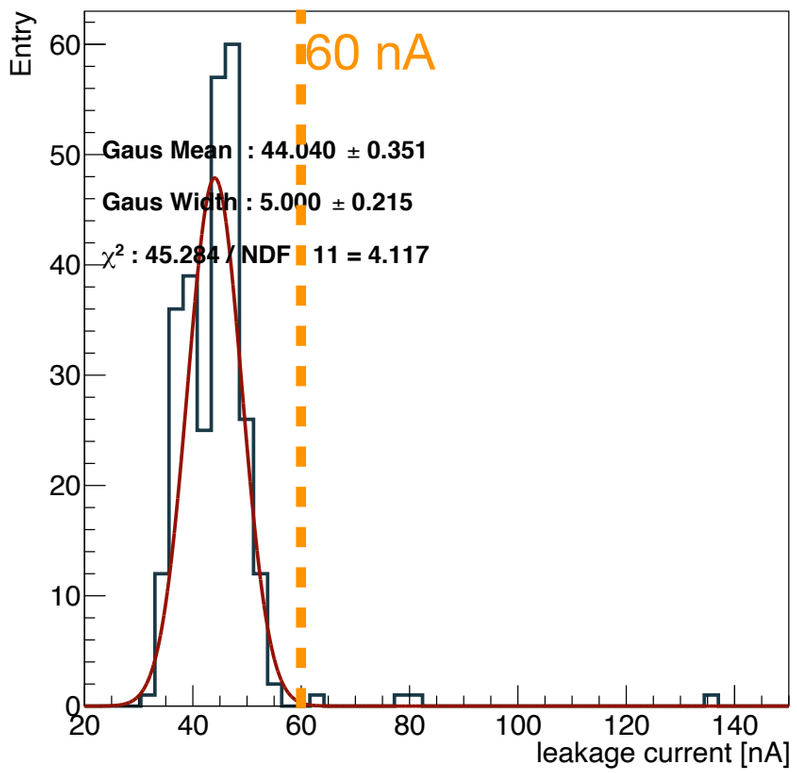
Type B



Type-A, leakage current at 100 V



Type-B, leakage current at 100 V



INTT sensor, leakage current

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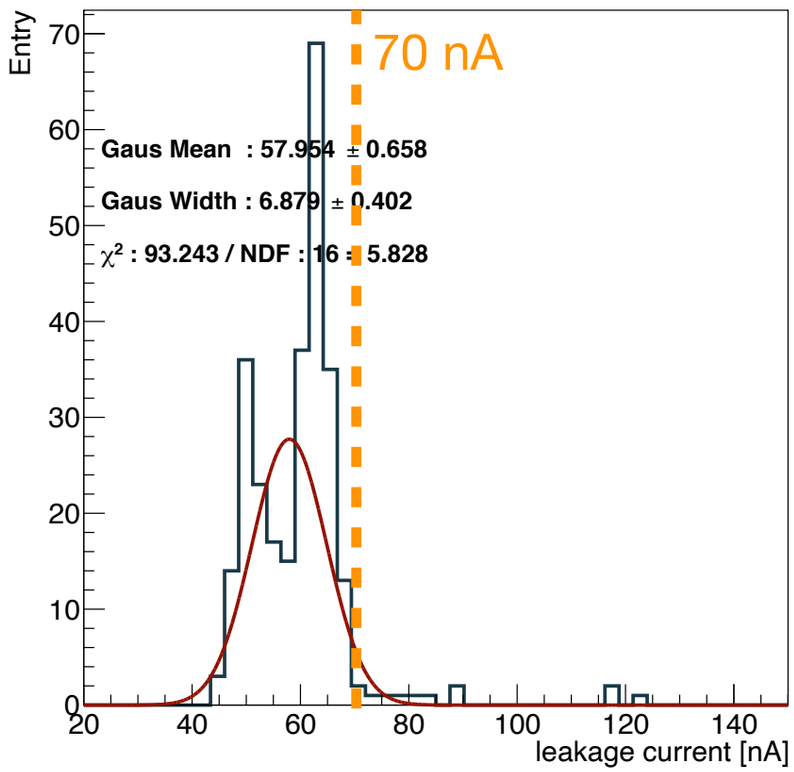
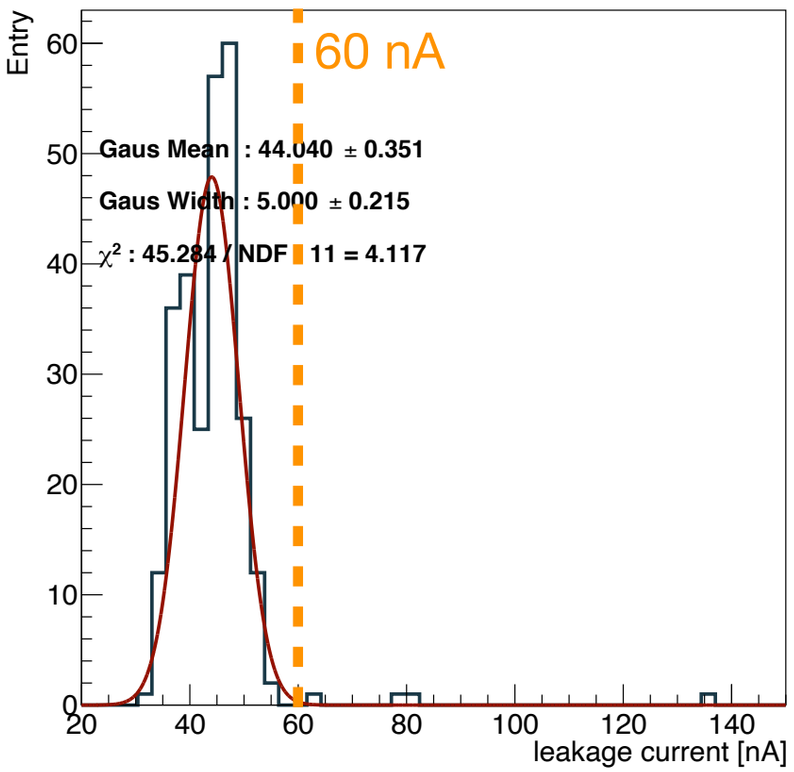
HC : High Current (current > cut)
“<—“ : current > 80 nA

```
type A, HC : 118.2,     ID : 1047 <---
type A, HC : 79.5,      ID : 1048
type A, HC : 116.4,     ID : 1116 <---
type A, HC : 88.8,      ID : 1117 <---
type A, HC : 121.5,     ID : 1118 <---
type A, HC : 80.1,      ID : 1119 <---
type A, HC : 70.5,      ID : 1127
type A, HC : 89.9,      ID : 1244 <---
type A, HC : 73.7,      ID : 1257
type A, HC : 75.2,      ID : 1279
type A, HC : 84.3,      ID : 1291 <---
type A, HC : 70.8,      ID : 1301
=====================================
type B, HC : 79.2,      ID : 1045
type B, HC : 136.4,     ID : 1118 <---
type B, HC : 62.4,      ID : 1119
type B, HC : 81.2,      ID : 1120 <---
```

Type-A, leakage current at 100 V



Type-B, leakage current at 100 V



Summary

- The Batch-1, Batch-2 and Batch-3 sensors, 247 sets of sensors are included in the study.

- CV study :

  - The combined results are shown, 2 functions are introduced to describe the data (for the case of 174 sets)

    - 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 depletion voltage for all sensors.

- IV study :
  - The leakage current of all INTT sensors are checked. The leakage current of some sensors are a little bit higher.

Back up