Silicon detector test updates

2021.09.16

Kang Liu for tracker lab

上海交通大學
SHANGHAI JIAO TONG UNIVERSITY

目录 Contents

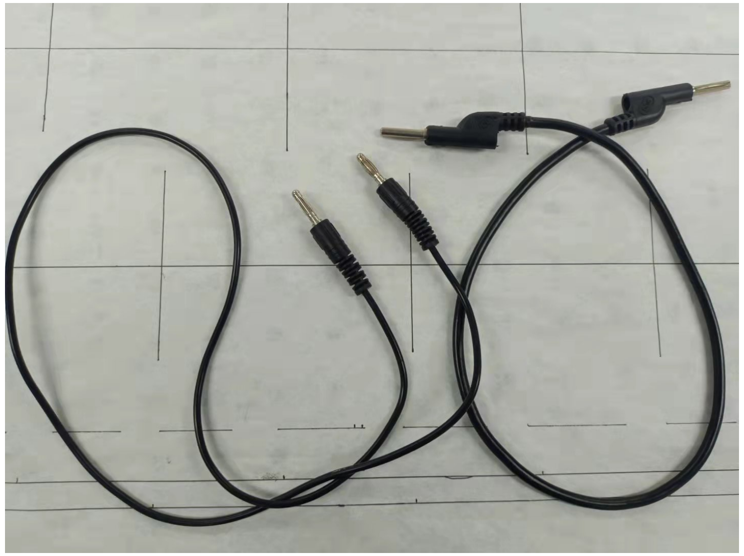
Improvement of experimental setup

Replaced the banana jumper that was connected to the negative electrode of the ammeter with poor contact.

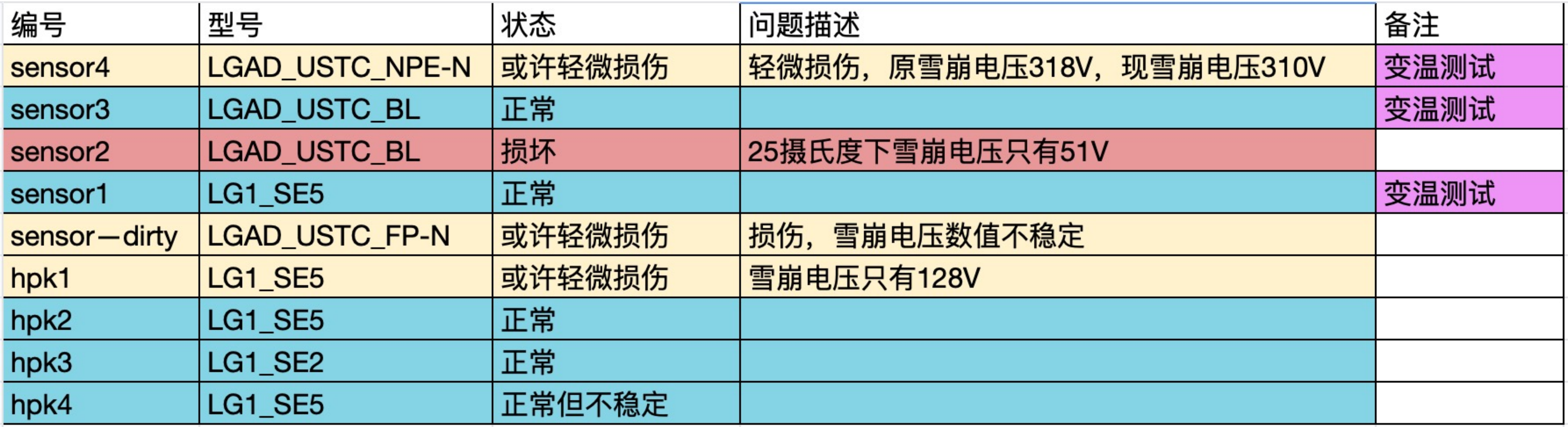
Replaced the thin banana jumper connected to the negative pole of the power supply.

There is a difference of about tens to 100 pA before and after replacement.

It is necessary to ensure that each jumper is in good contact and has uniform specifications.



Device damage condition test by IV



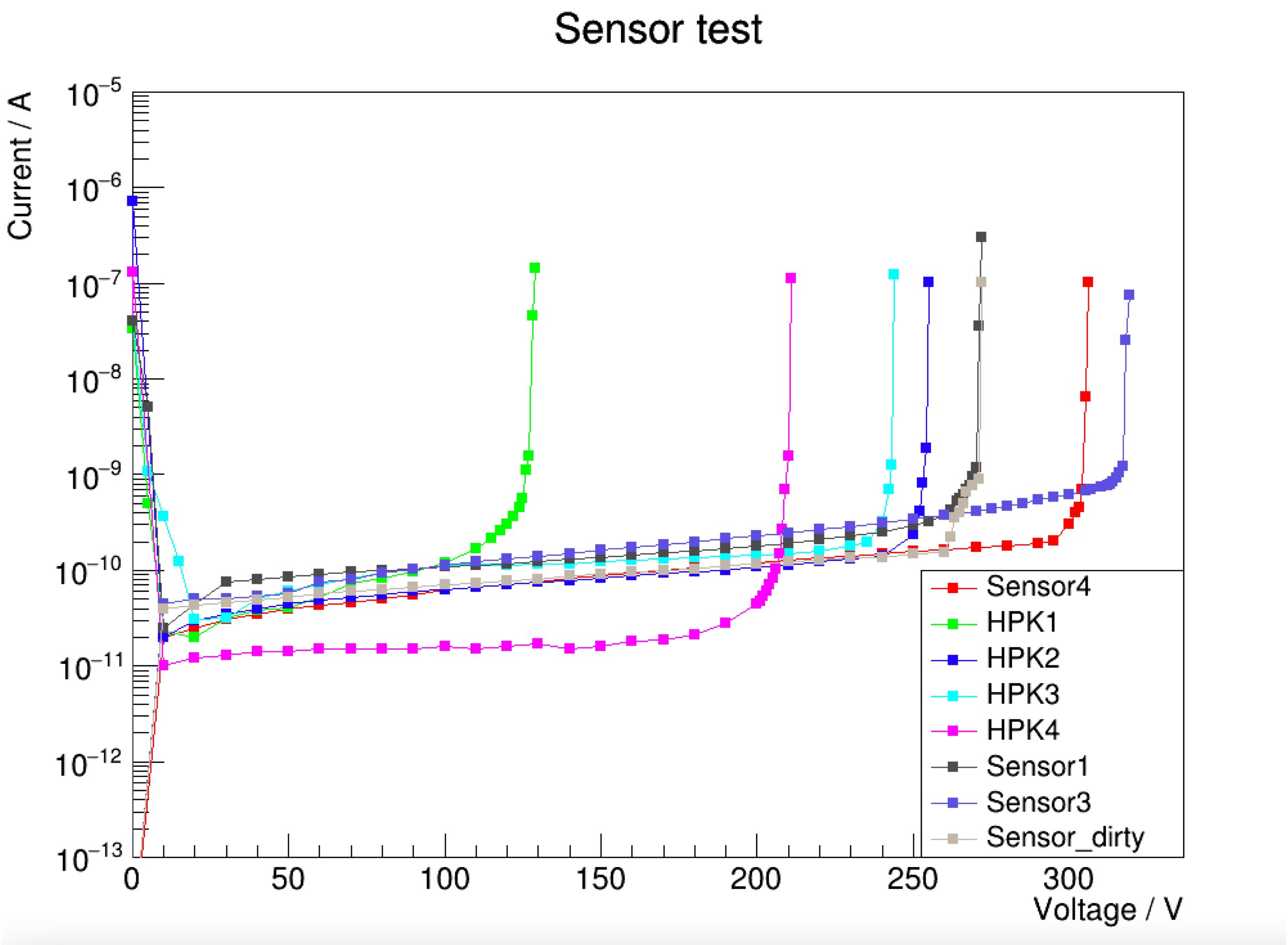
编号	型号	状态	问题描述	备注
sensor4	LGAD_USTC_NPE-N	或许轻微损伤	轻微损伤，原雪崩电压318V，现雪崩电压310V	变温测试
sensor3	LGAD_USTC_BL	正常		变温测试
sensor2	LGAD_USTC_BL	损坏	25摄氏度下雪崩电压只有51V	
sensor1	LG1_SE5	正常		变温测试
sensor—dirty	LGAD_USTC_FP-N	或许轻微损伤	损伤，雪崩电压数值不稳定	
hpk1	LG1_SE5	或许轻微损伤	雪崩电压只有128V	
hpk2	LG1_SE5	正常		
hpk3	LG1_SE2	正常		
hpk4	LG1_SE5	正常但不稳定		

We have a total of 9 devices, of which 5 are normal, 3 are suspected to be damaged, and 1 is damaged.

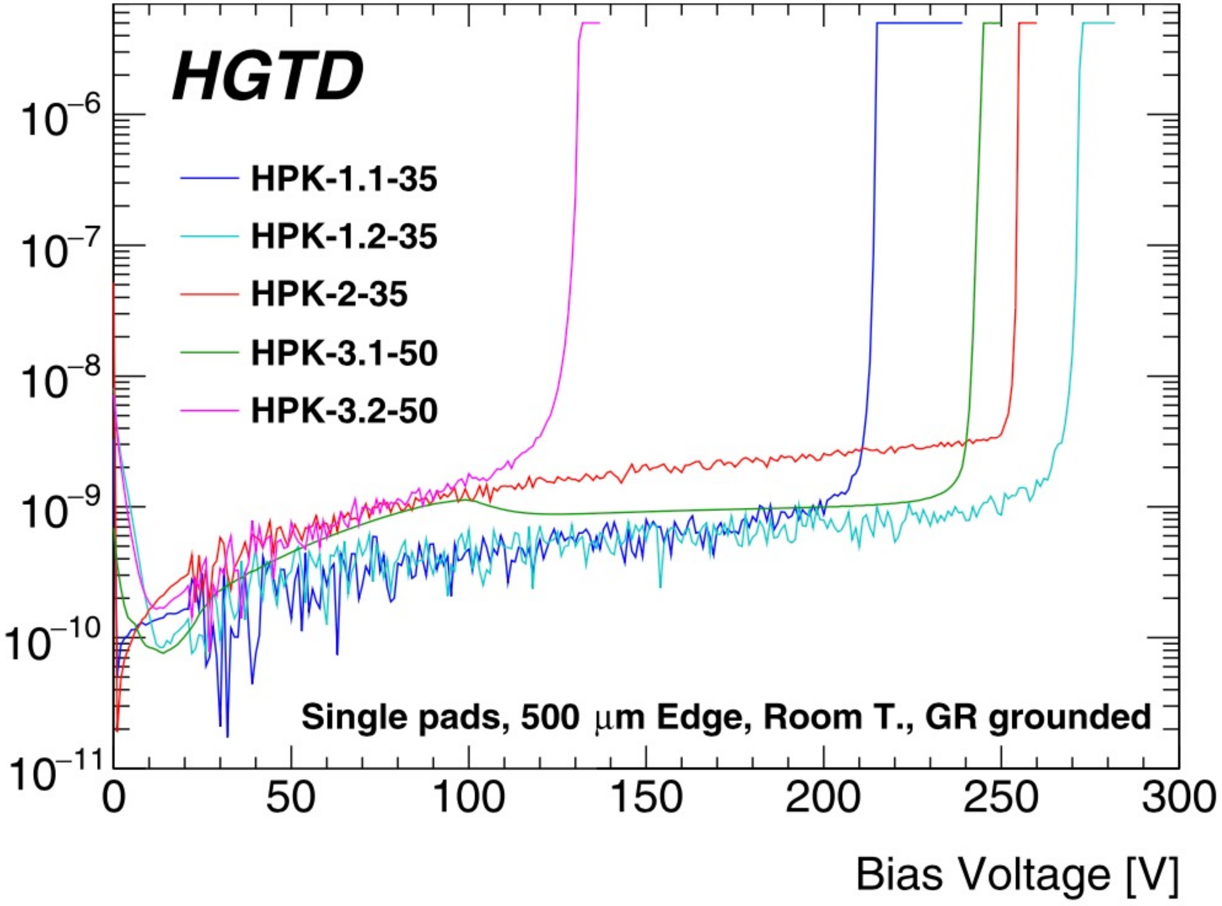
A temperature-dependent IV test was done on sensor1 and sensor3.

Sensor1 is the same as hpk.

IV Testing result

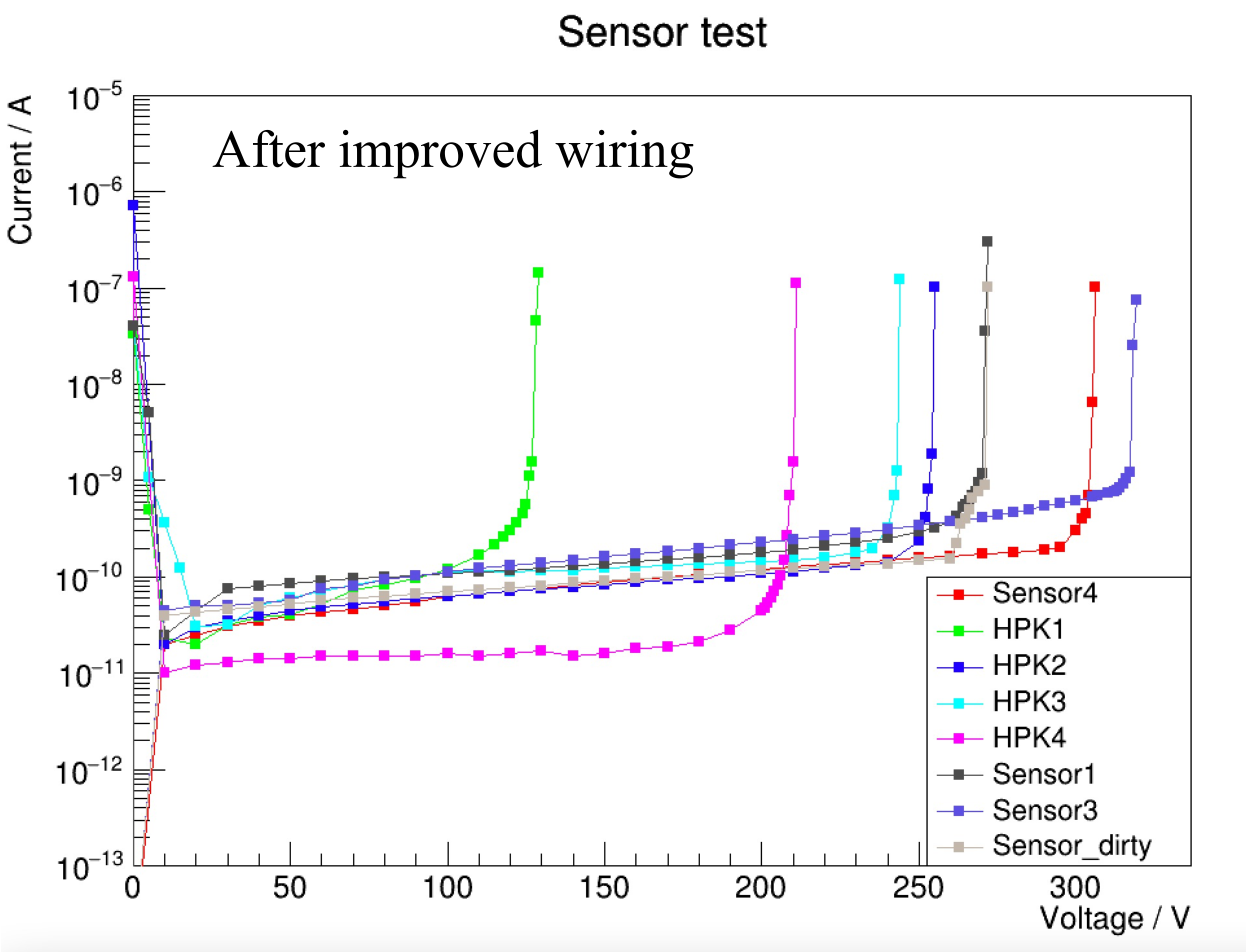


The latest test



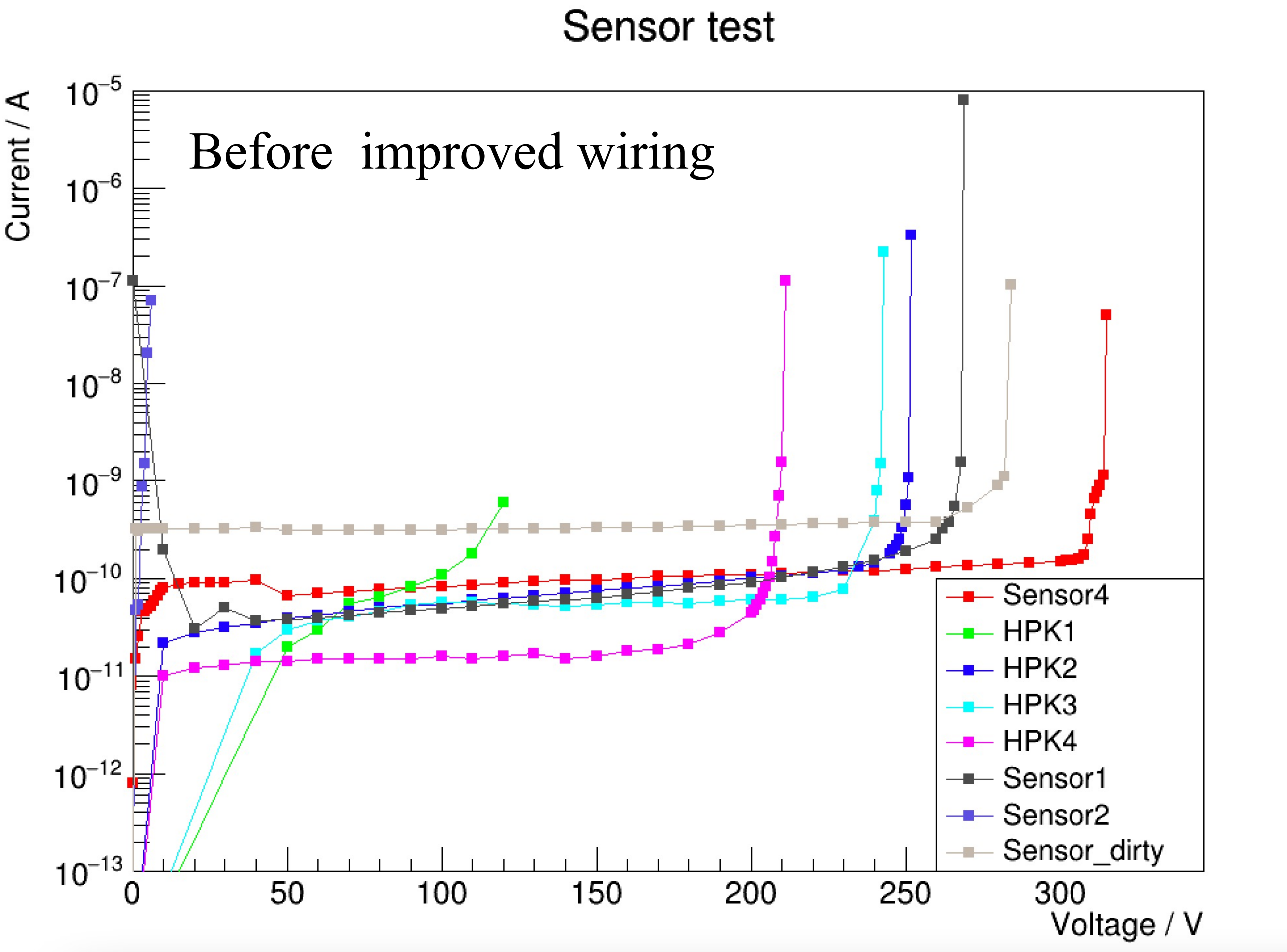
Nuclear Inst. and Methods in Physics Research,
A 980 (2020) 164379

IV Testing result



Sensor test

After improved wiring

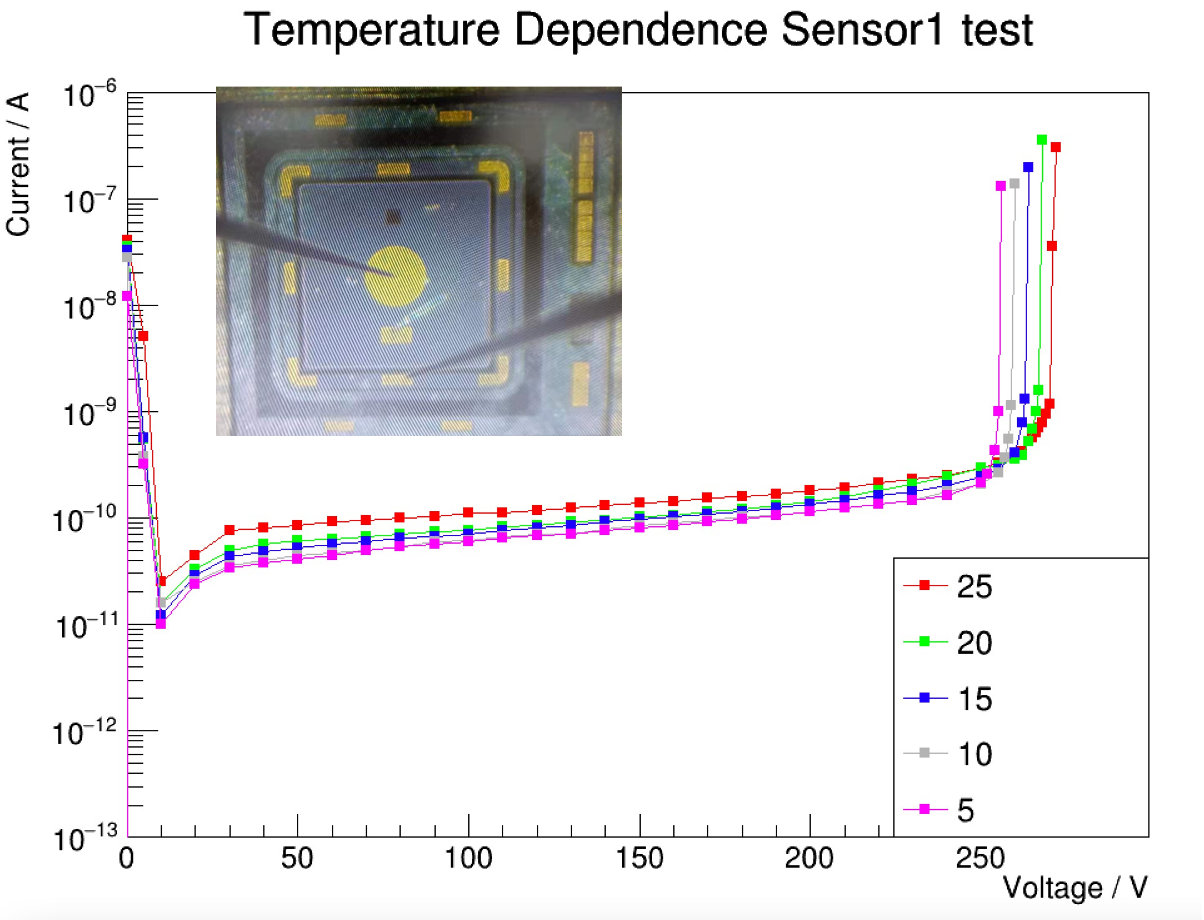


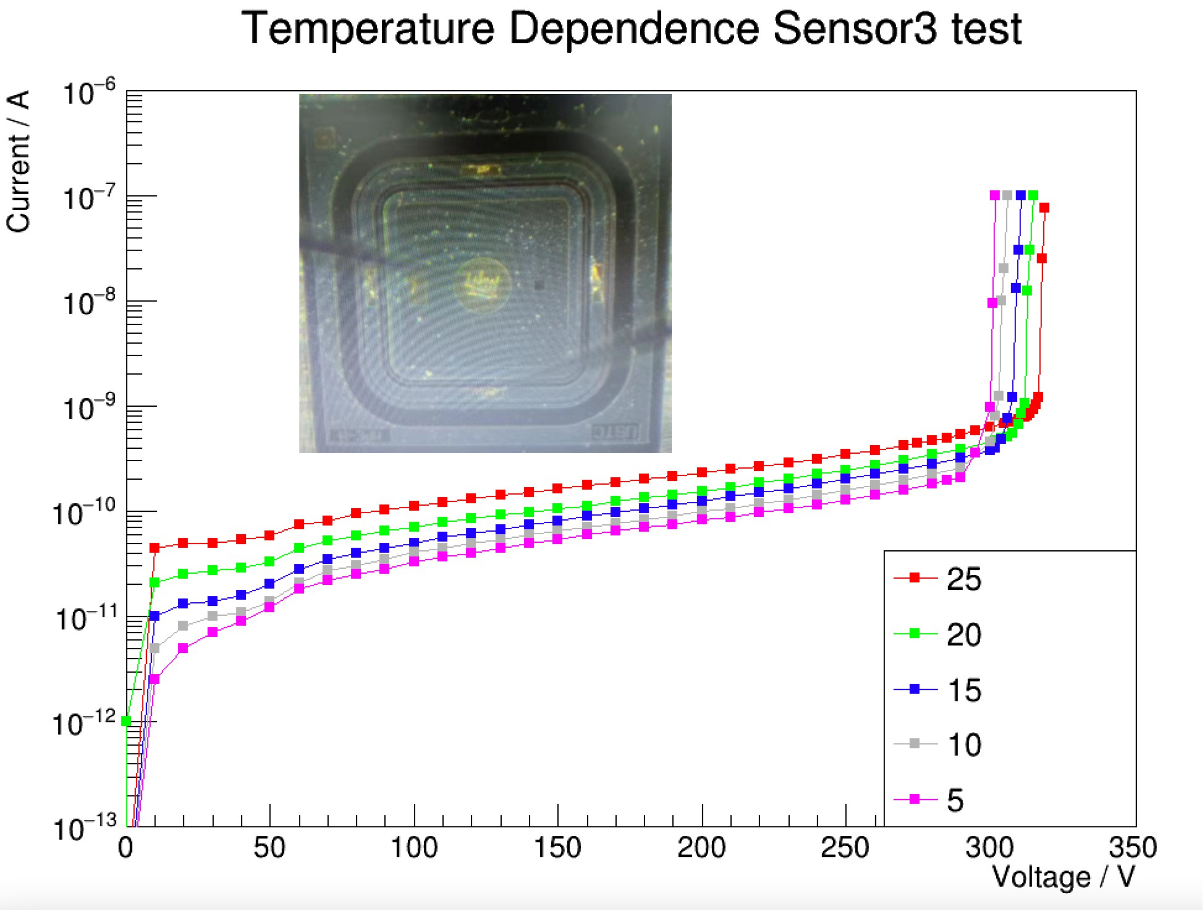
Sensor test

Before improved wiring

The IV curve after the improved wiring looks more normal.

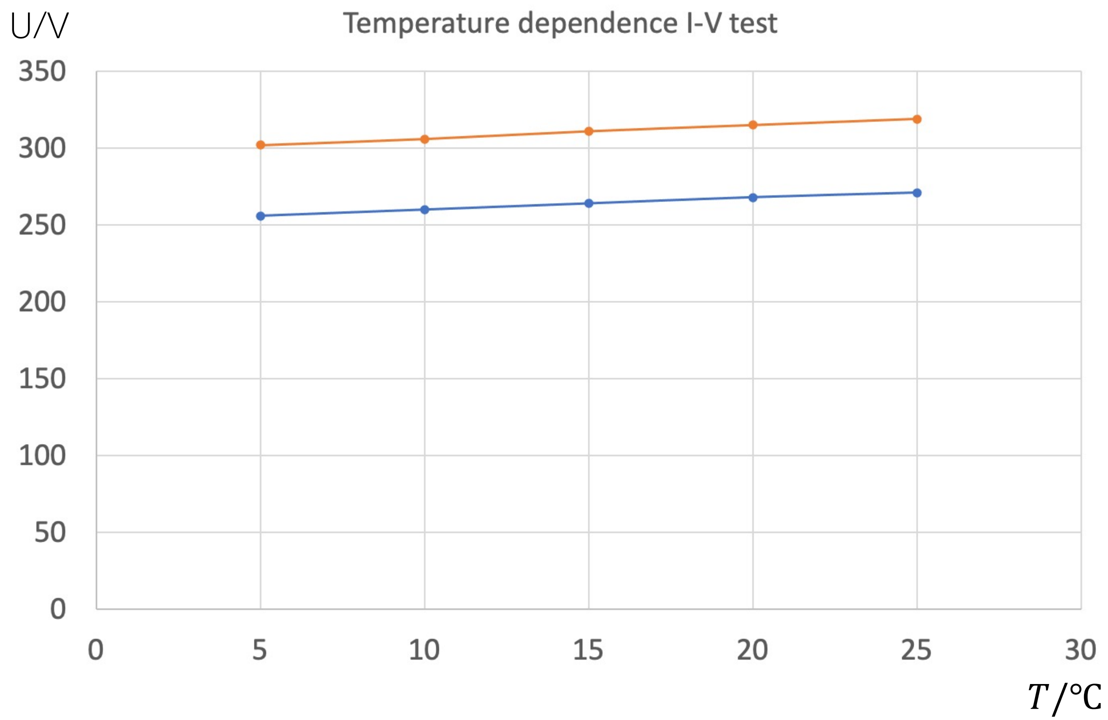
Temperature dependence I-V test





Temperature dependence I-V test

T/D/U **℃ V**	**5**	**10**	**15**	**20**	**25**
Sensor1	256	260	264	268	271
Sensor3	302	306	311	315	319

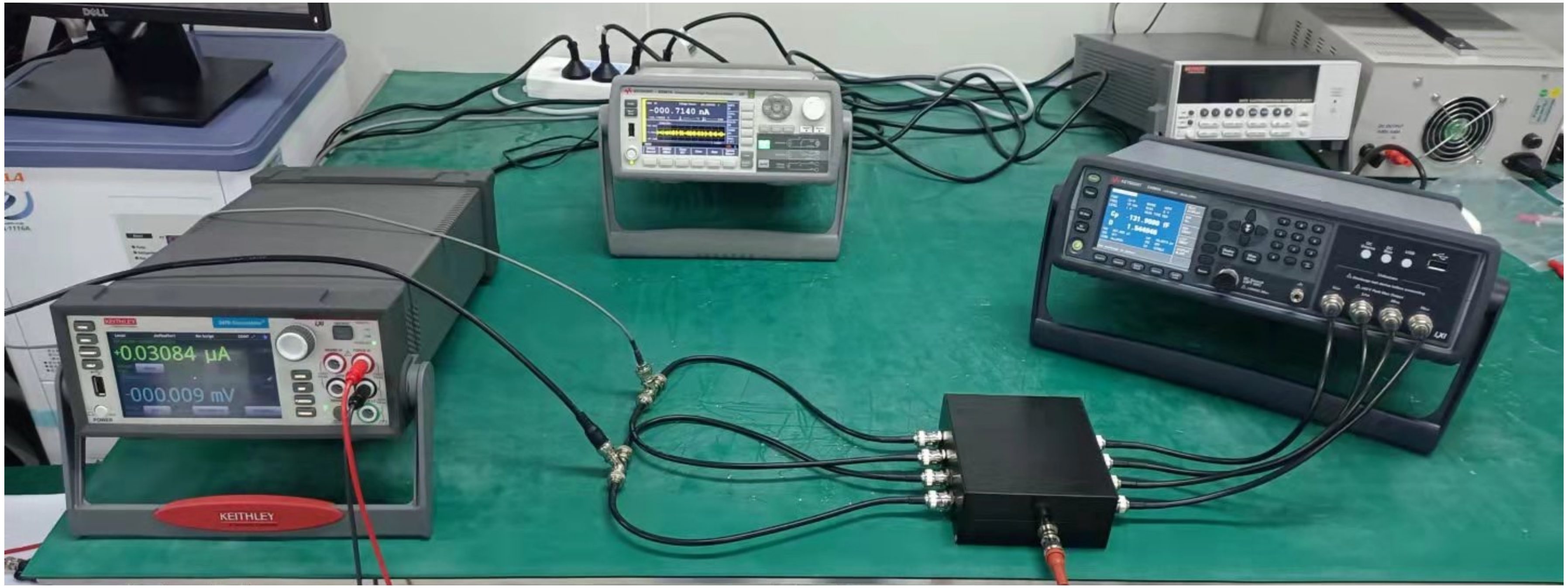


The avalanche voltage increases by 0.8V for every degree of temperature increase.

C-V test setup

Replace the 1 m long BNC cables with 30 cm long cables.

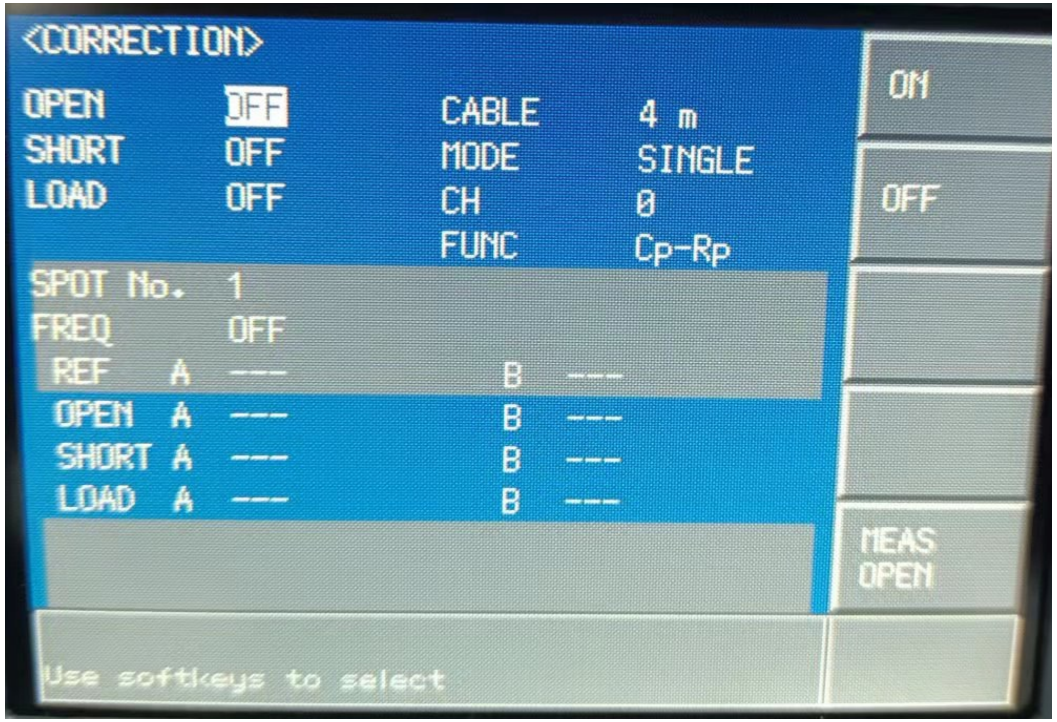
The cheap BNC one-turn two-turn T-head was replaced with a pure copper T-head.



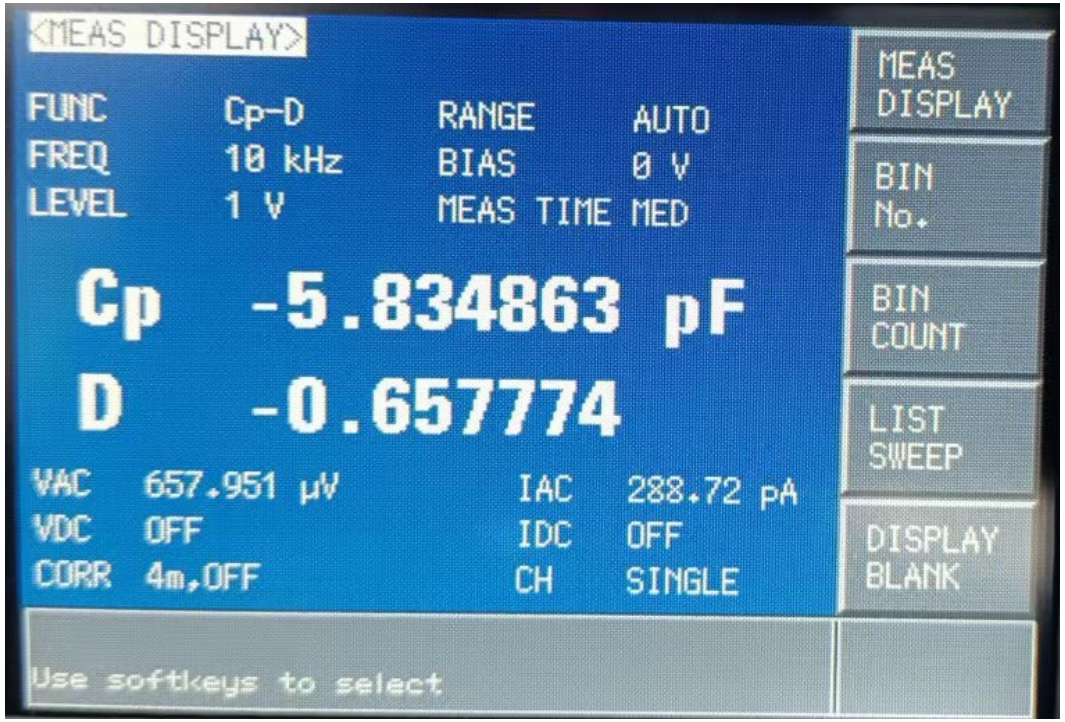
C-V test setup

It is best to OFF the OPEN and SHORT after LCR meter correction. (But I’m not sure.)

There is still a problem here is that the corrected capacitance reading is still negative, but it is more stable than before.

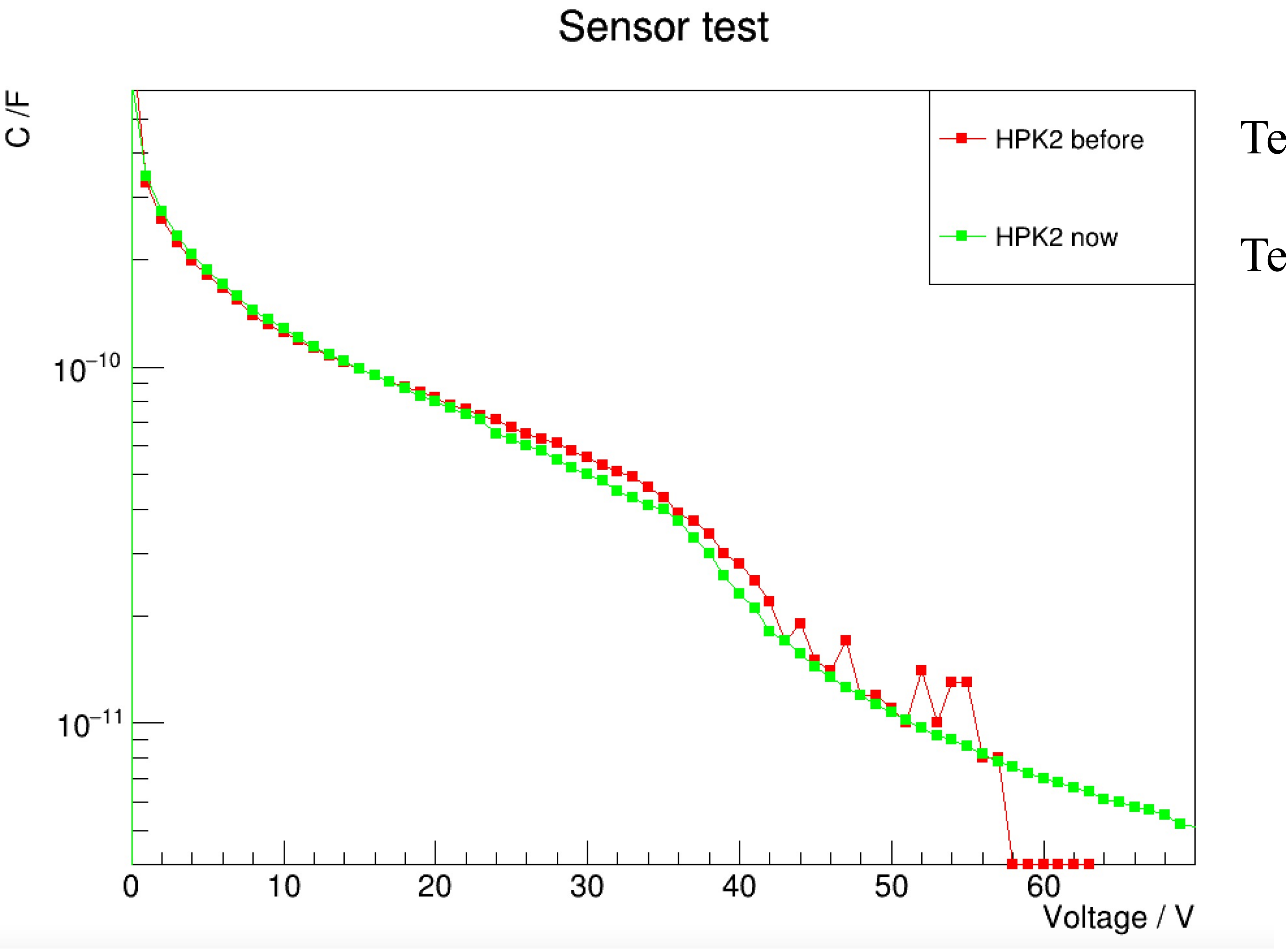


```
<CORRECTION>
OPEN       OFF          CABLE      4 m
SHORT      OFF          MODE       SINGLE
LOAD       OFF          CH         0
                        FUNC       Cp-Rp
SPOT No.   1
FREQ       OFF
 REF    A  ---               B  ---
 OPEN   A  ---               B  ---
 SHORT  A  ---               B  ---
 LOAD   A  ---               B  ---

Use softkeys to select
```



```
<MEAS DISPLAY>
FUNC      Cp-D        RANGE      AUTO
FREQ      10 kHz      BIAS       0 V
LEVEL     1 V         MEAS TIME  MED

 Cp     -5.834863 pF

 D      -0.657774

VAC   657.951 µV            IAC   288.72 pA
VDC   OFF                   IDC   OFF
CORR  4m,OFF                CH    SINGLE

Use softkeys to select
```

Comparison of previous and current tests

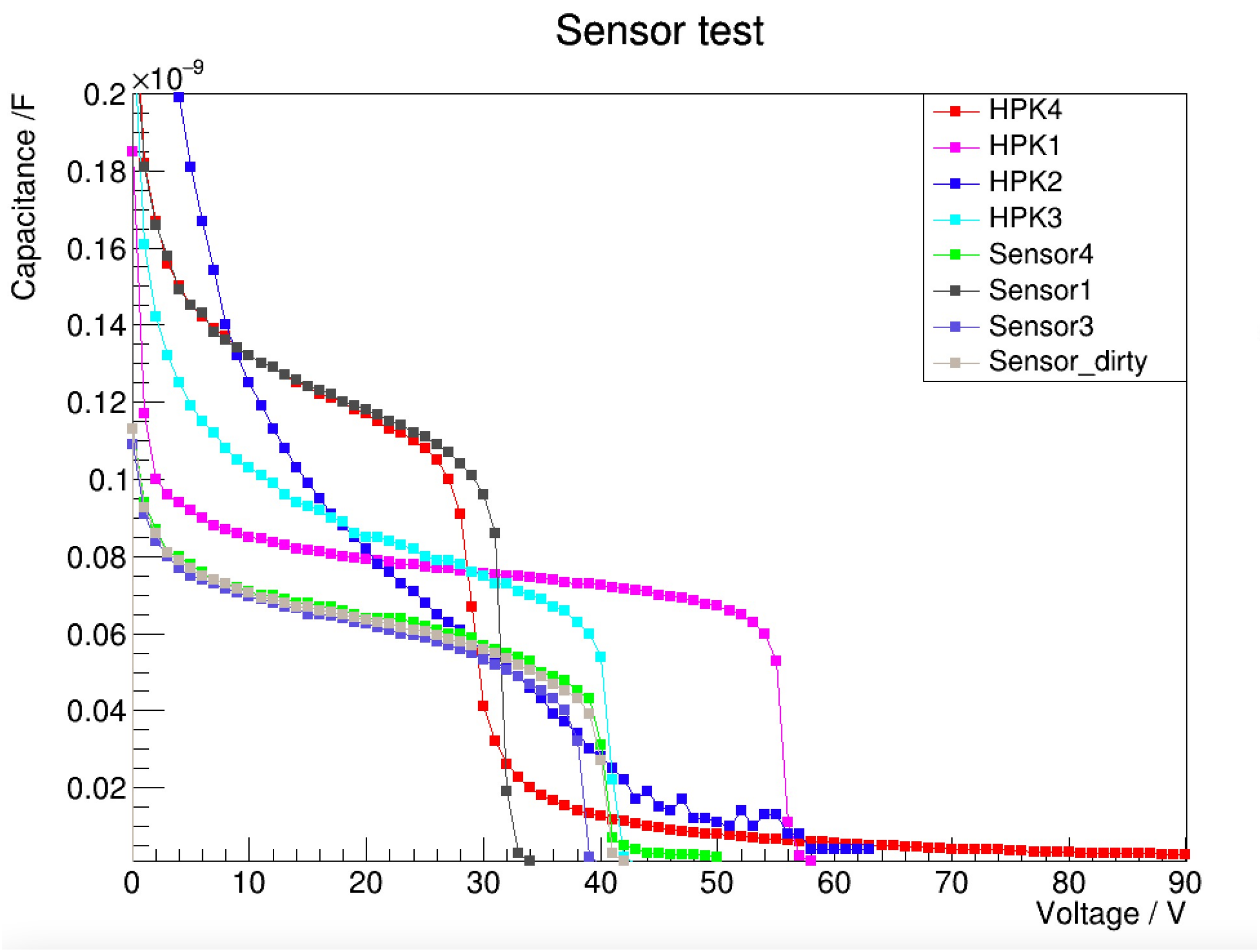


Temperature 21 ℃

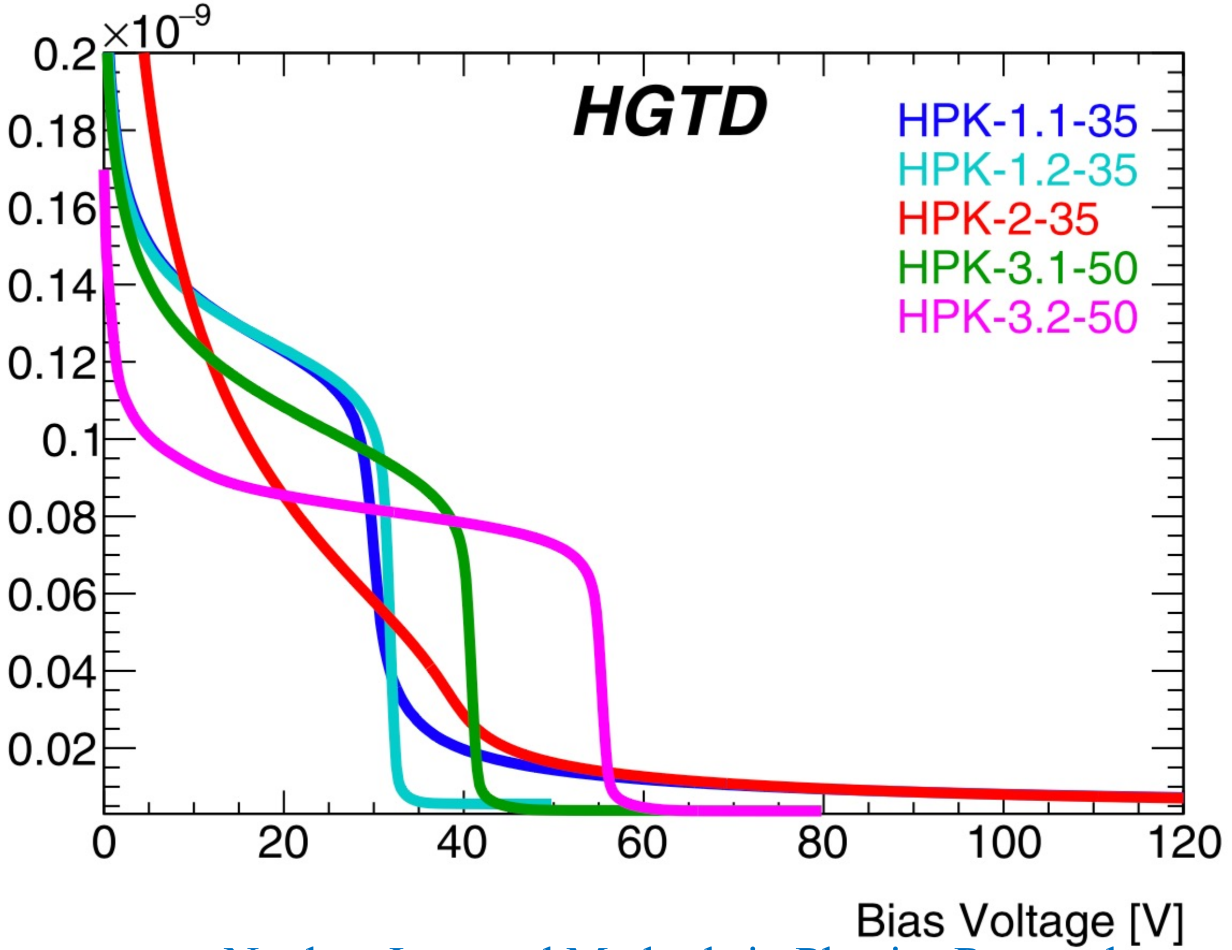
Temperature 20 ℃

The results appear to be consistent.

C-V test results

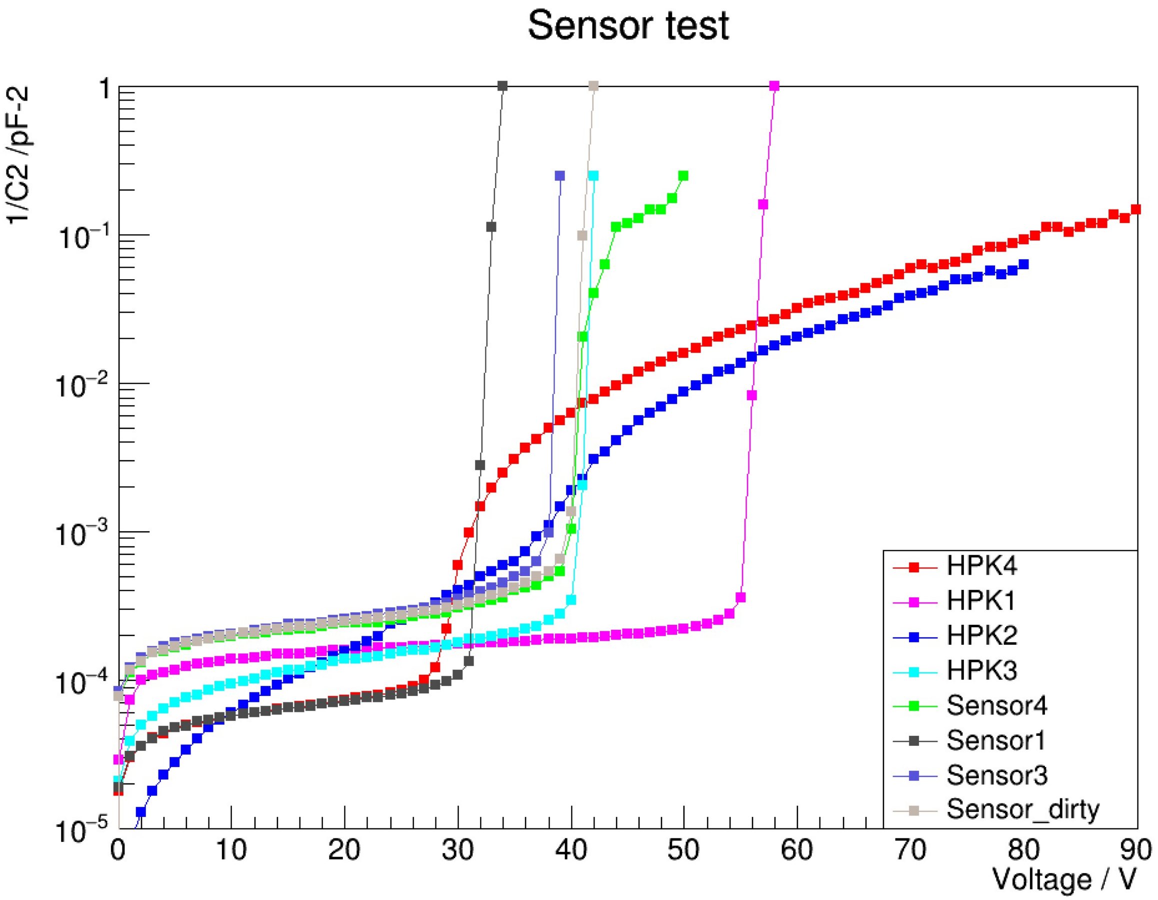


The latest test

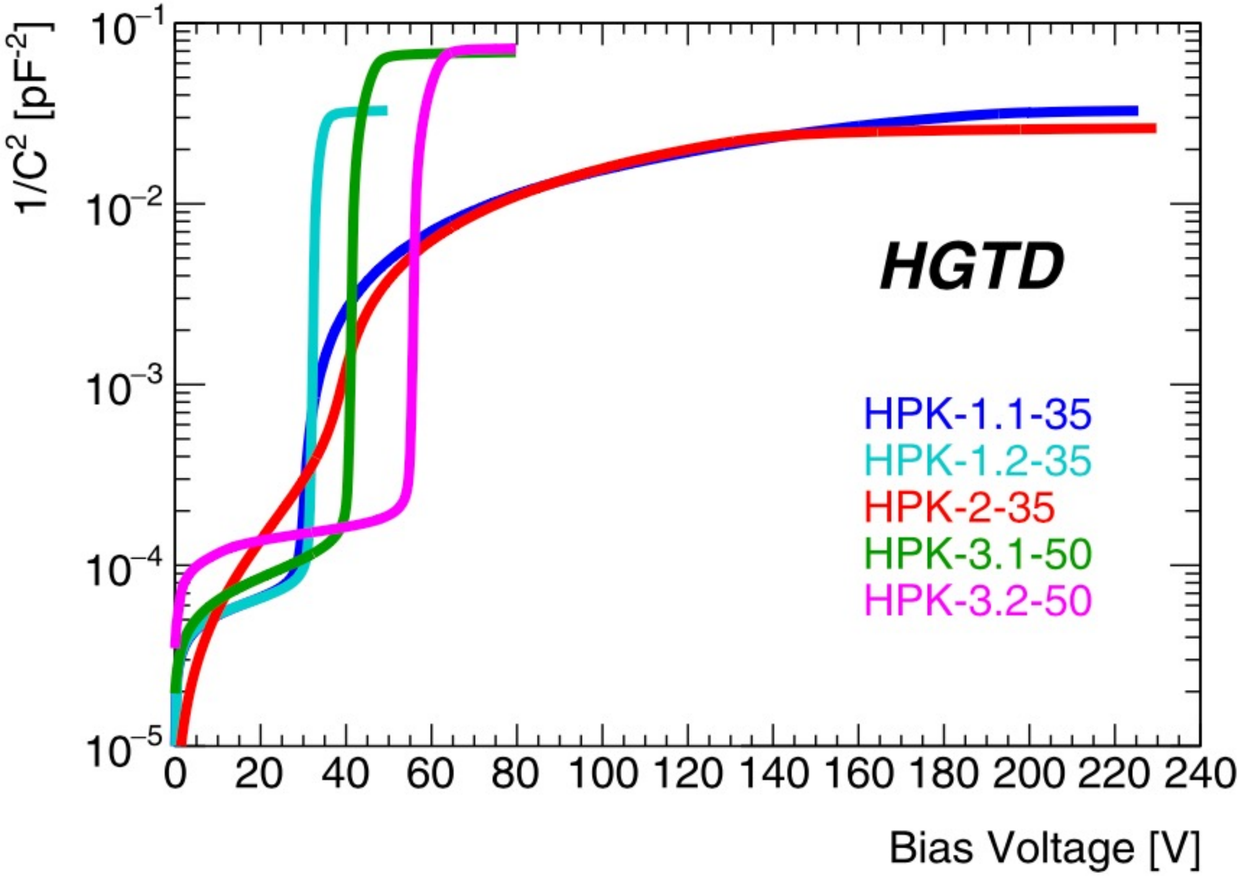


Nuclear Inst. and Methods in Physics Research, A 980 (2020) 164379

$1/C^2$-V



The latest test



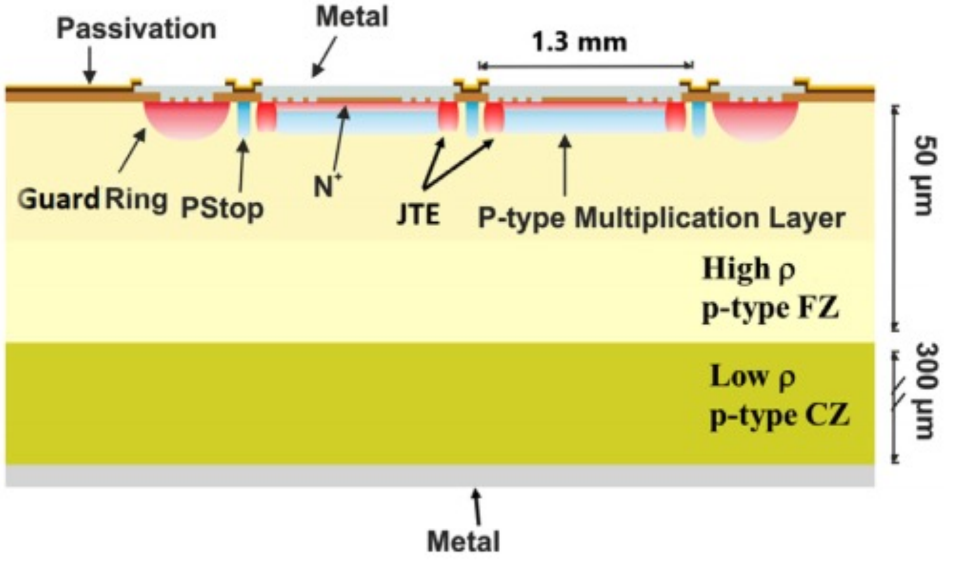
Nuclear Inst. and Methods in Physics Research, A 980 (2020) 164379

Conclusion and next to do

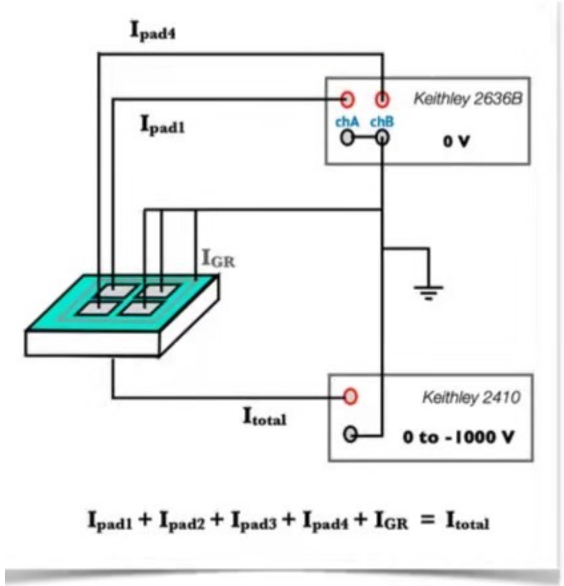
- The testing system has been set up for both I-V and C-V tests.
- The default I-V and C-V test has finished, and the results look reasonable.
- Temperature dependence I-V test has been completed.
- Develop semi-automated testing.
- Charge collection ability test.
- Seek more detector measurement work.

Backup

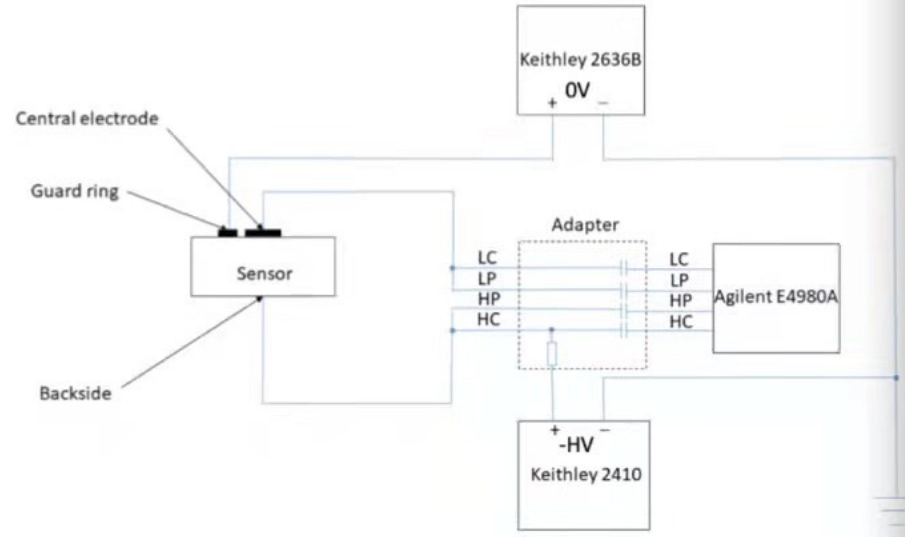
Setup of I-V and C-V measurement



HPK 2*2 sensor layout

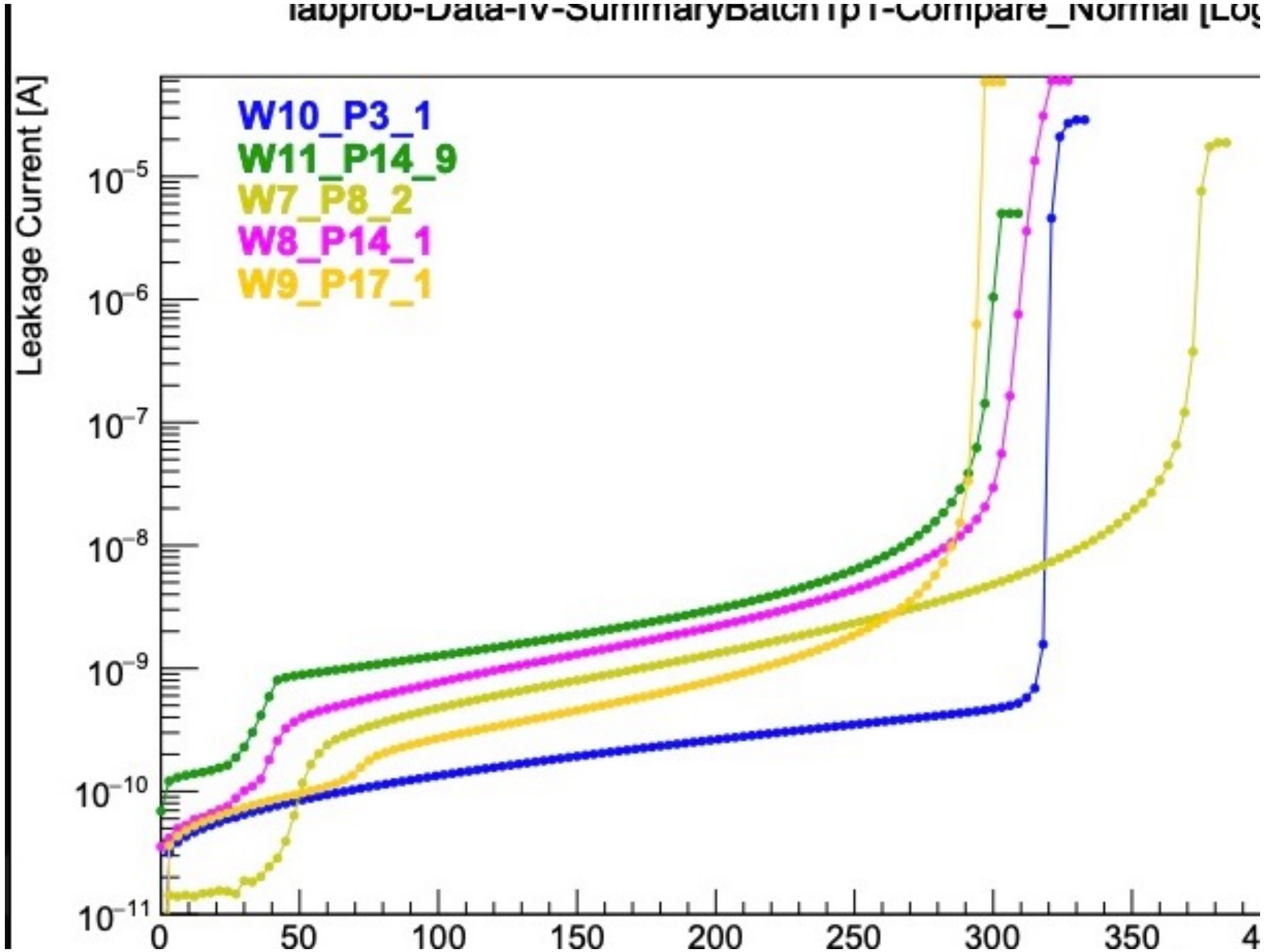


Setup of I-V measurements



Setup of C-V measurements

Backup


labprob-Data-IV-SummaryBatch1p1-Compare_Normal [Lo
Leakage Current [A]
W10_P3_1
W11_P14_9
W7_P8_2
W8_P14_1
W9_P17_1
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
0
50
100
150
200
250
300
350
4

Thanks！