Updates on C-V measurements

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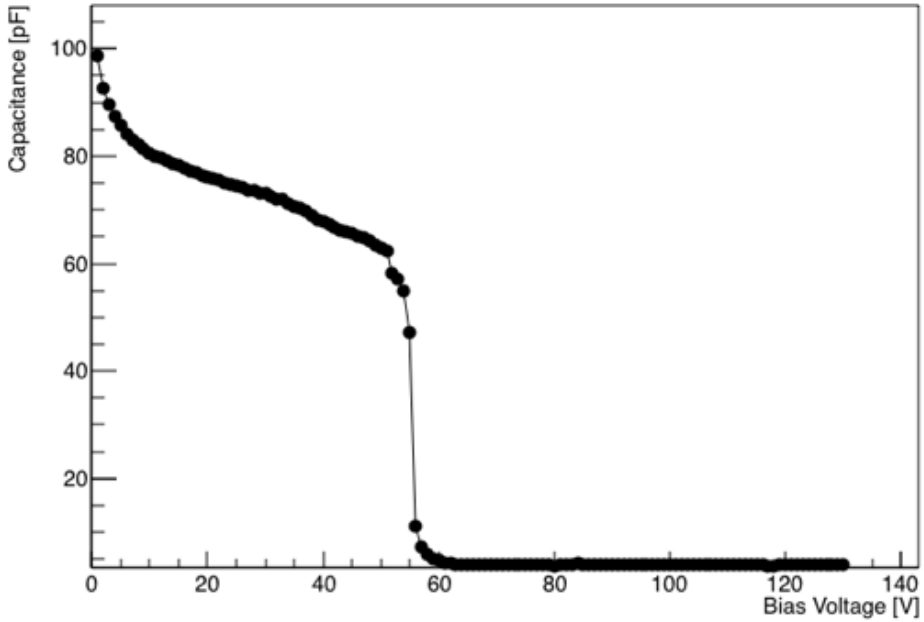
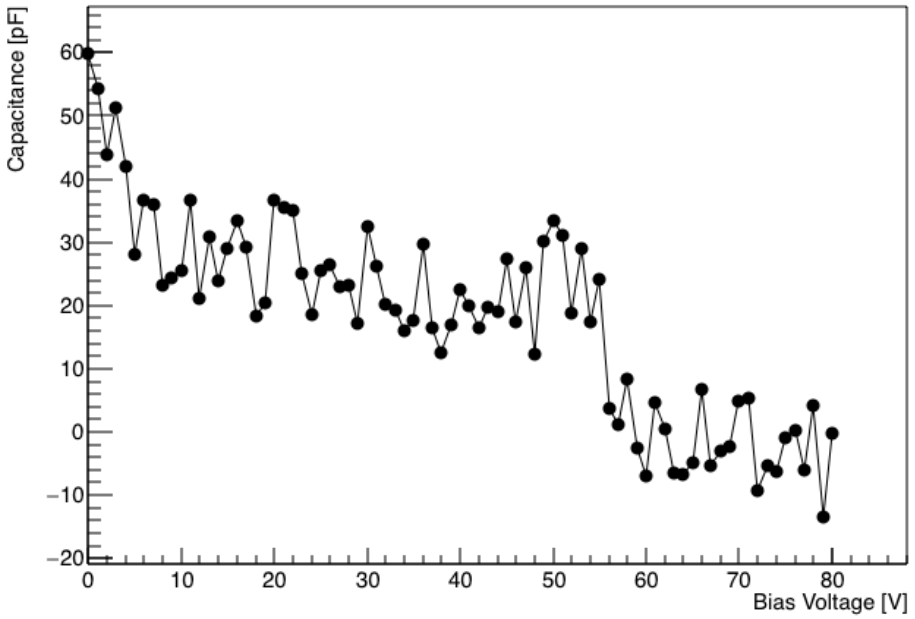
Jan. 24, 2019

Comparison of C-V obtained from two probe stations

Probe station of electronic group



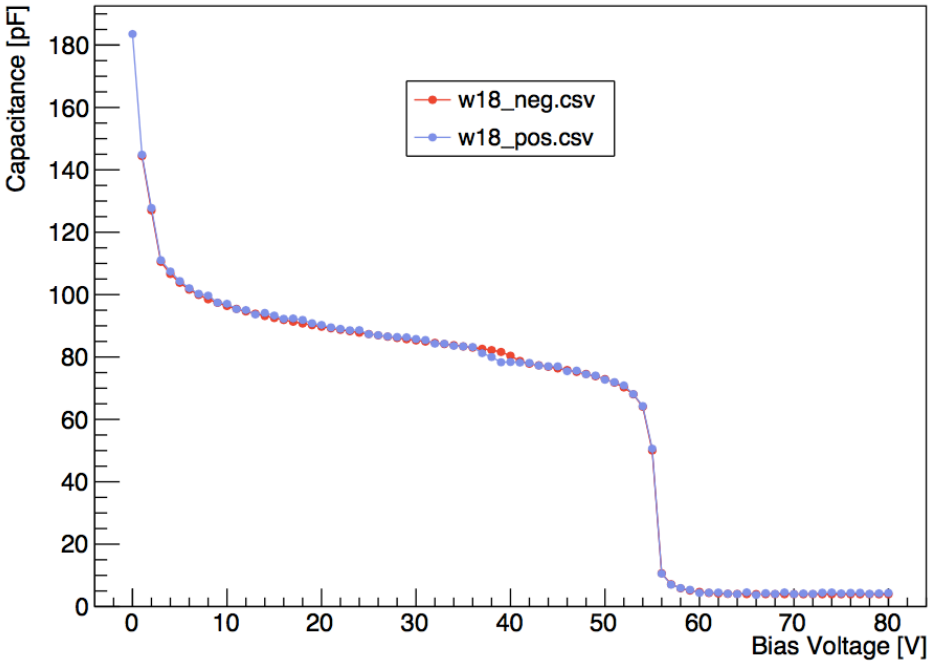
New probe station in B106



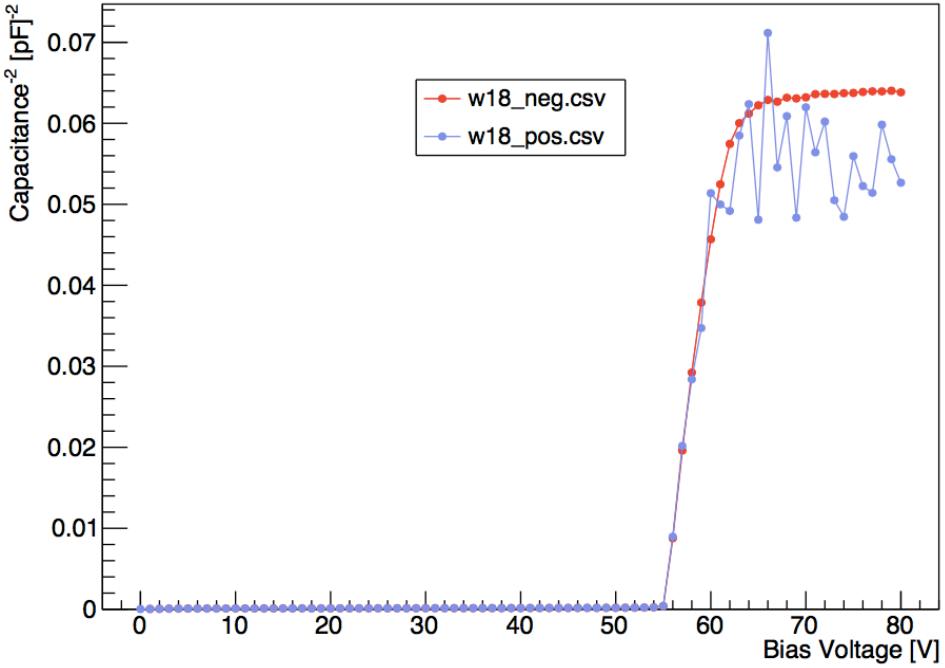
- C-V scans performed on the same sensor from HPK Wafer 18.
- Full depletion at ~60V is visible in both probe station.
- Very noisy ($\pm$10pF) in the new probe station.
  - Noise seems to appear when chunk is connected into the circuit.
  - One message we got from the company is that chunk is not isolated from the thermal control circuit and it shouldn't be applied HV.
- I cannot resolve this problem after several days investigation. Need technical support.

Comparison of positive/negative HV

C



$1/C^2$



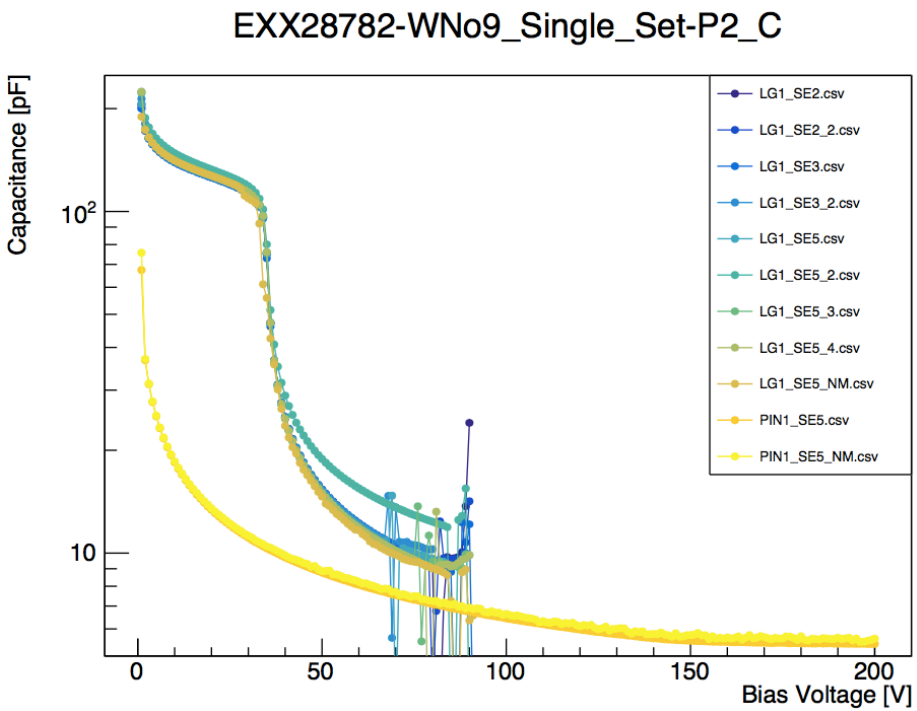
- Results are consistent.
- Larger noise when applying HV to the top of the sensors.
- Prefer applying negative HV to the back of the sensors.

C-V test settings

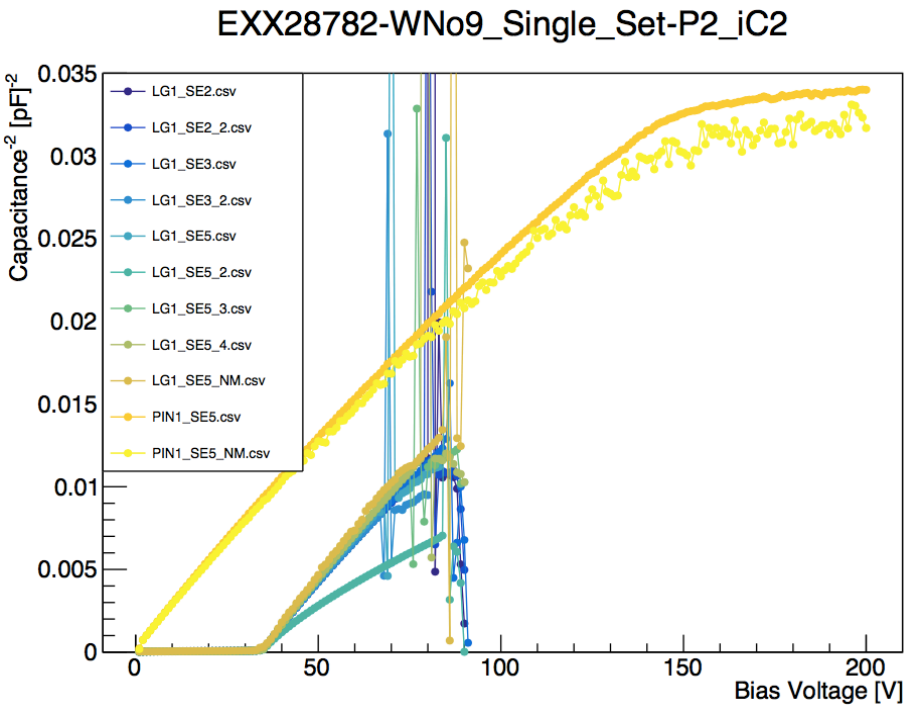
- Negative HV applied to back of the sensor
- LCR measuring Cp-Rp
- f = 10kHz
- Ramping speed 0.1V/100ms
- Recording step: 1V

C-V results: HPK-SMPL-1-W9_Single_Set-P2

C



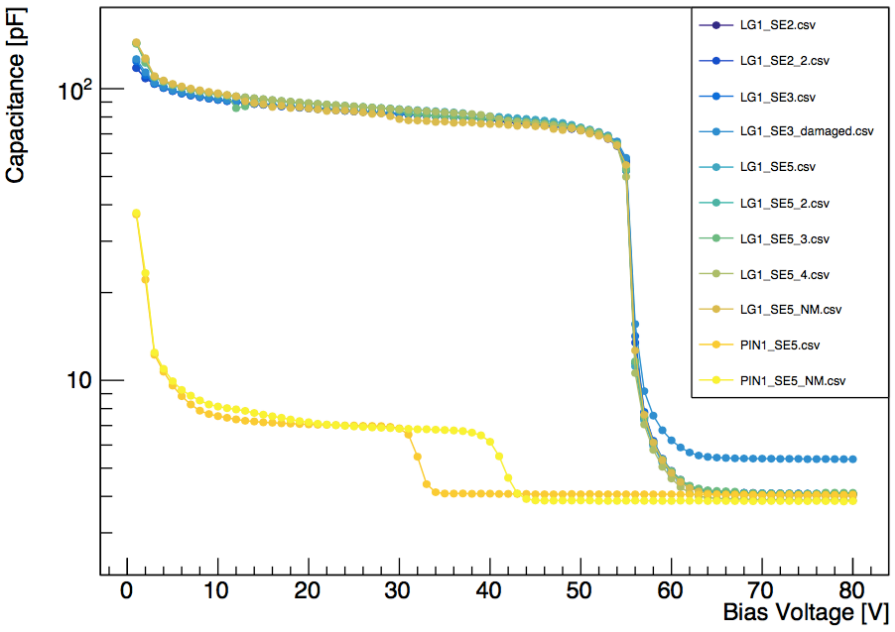
$1/C^2$



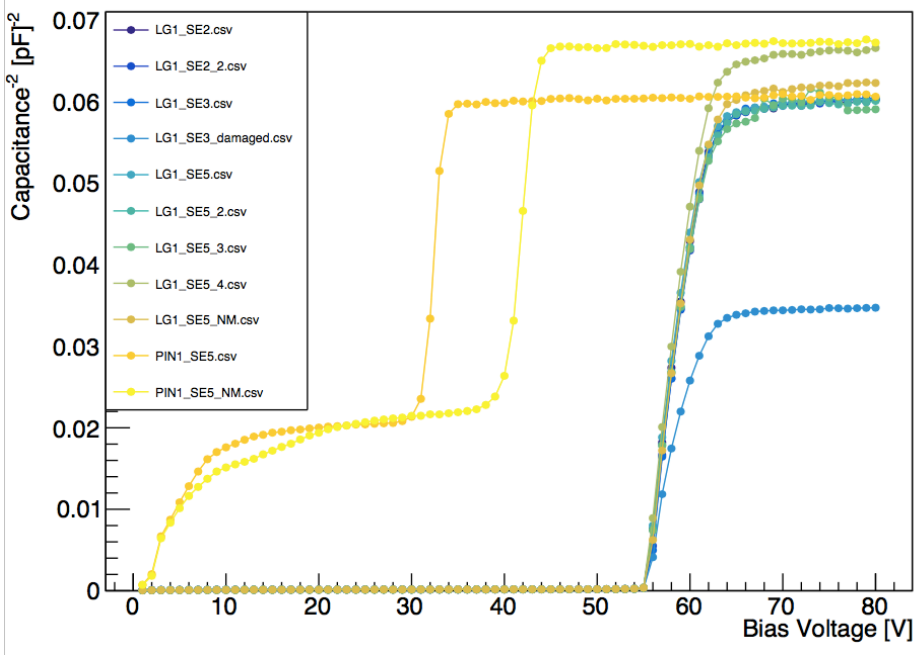
- LGADs breakdown (~80V) before full depletion.
- PINs depleted at ~150V.

C-V results: HPK-SMPL-3.2-W18_Single_Set-P6

C



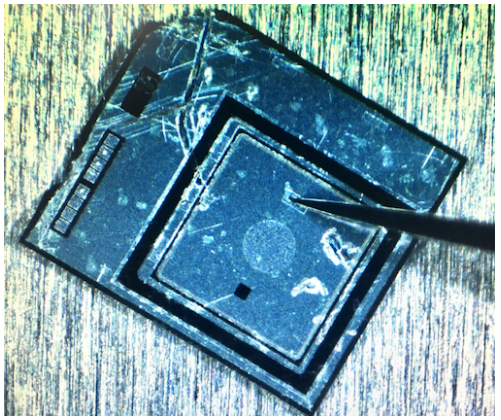
$1/C^2$



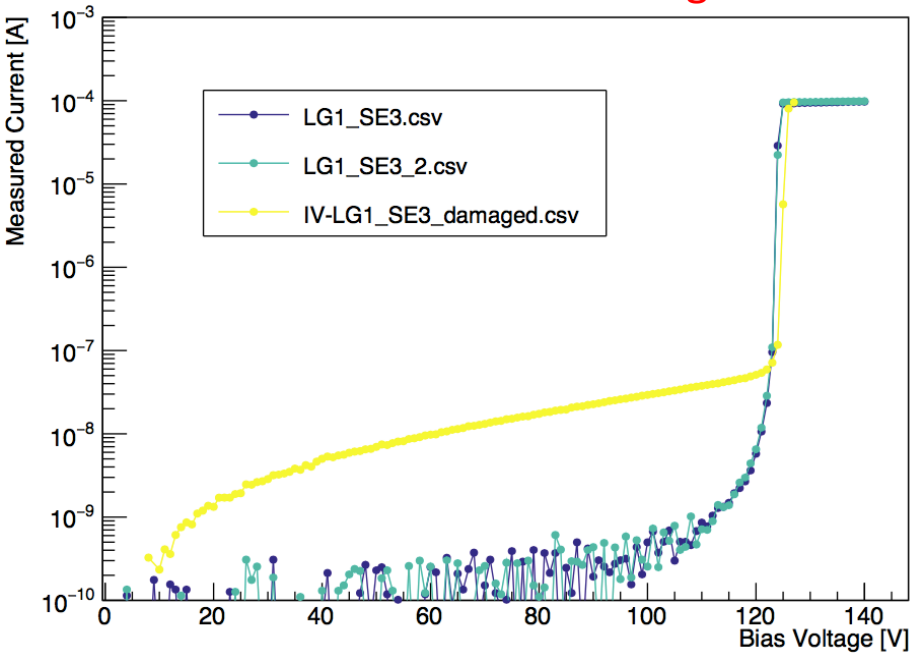
- Full depletion ~60V for LGADs. PINs depleted before LGADs.
- Capacitance at full depletion: 4.0µF
- One of the LG1_SE3 sensors is damaged, showing higher capacitance (5.4µF) after full depletion.

Look deeper into the damaged sensor

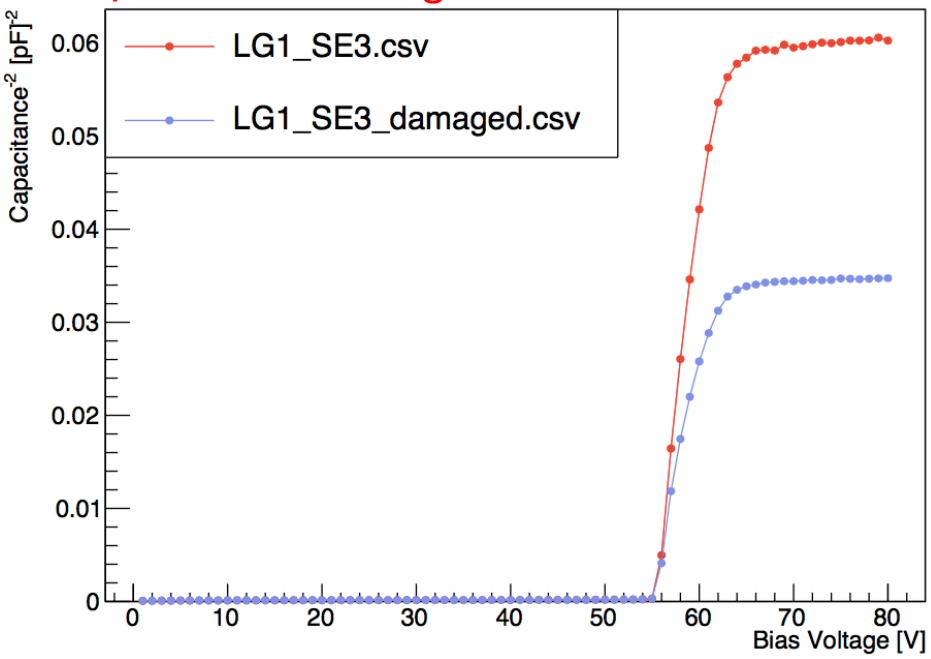
- An LG1_SE3 sensor was damaged after I-V test in December due to improper handling.
- After the damage:
  - Higher leakage current.
  - Breakdown voltage is the same.
  - Higher capacitance after full depletion.
  - Full depletion voltage is the same.



I-V before and after damage

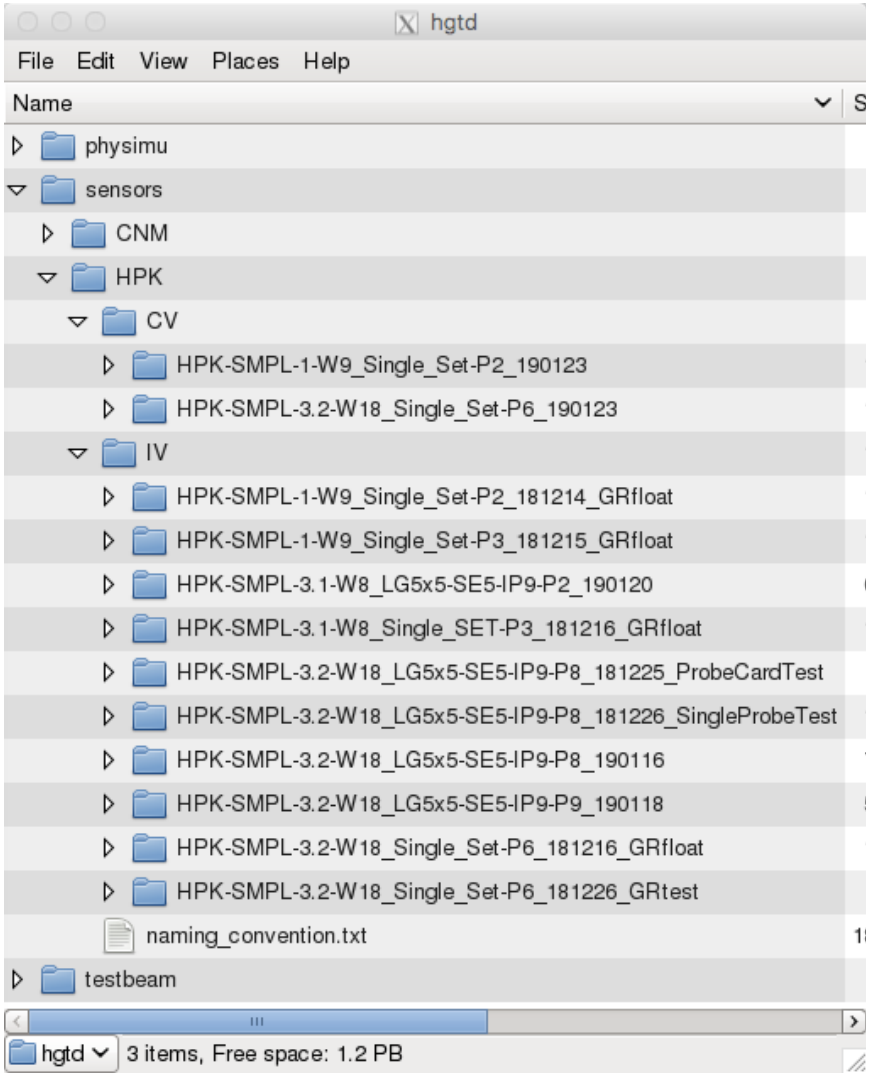


$1/C^2$ of the damaged and a normal sensor



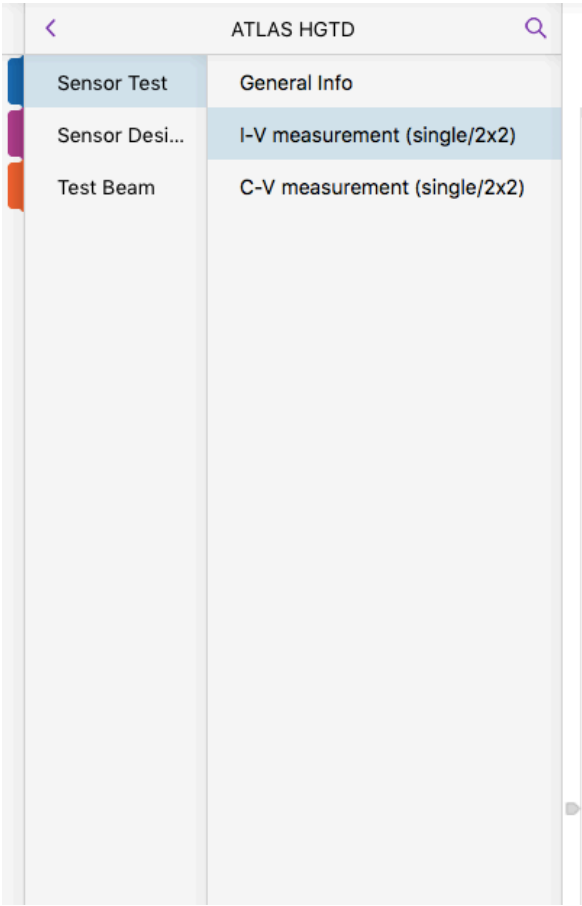
Raw data storage for test results

- Raw data are stored as .csv files on the IHEP server at /publicfs/atlas/atlasnew/hgtd/sensors (Many Thanks Lianyou's help !)
- A note.txt file in each folder is a record of some basic information and issues during data-taking.
- After uploading data, I use command > chmod g+w -R folder_name to give write permission to users in the atlas group.



Data summary for test results

- A summary of the test results is filld in the OneNote ATLAS HGTD notebook.
- I-V summary has been filled. C-V summary will be filled soon.



I-V measurement (single/2x2)

Monday, 7 January 2019 16:44

########################## HPK sensors ##########################

Current compliance: 100µA

HPK W8 (Lot No. EXX28995-WNo8)

	Tag	Status	Date	Typ. Current (if available)	B.D. Vol. (if available)	Comment (if any)
Single Set-P3	"LG SE2"	ok	12/16/2018		259V	
	"LG SE2"	ok	12/16/2018		258V	
	"LG SE3"	ok	12/01/2018 12/16/2018		244V 261V	
	"LG SE3"	ok	12/16/2018		257V	
	"LG SE5"	ok	12/16/2018		258V	
	"LG SE5"	ok	12/16/2018		258V	
	"LG SE5"	ok	12/16/2018		261V	
	"LG SE5"	ok	12/16/2018		264V	
	"LG SE5 NM"	ok	12/16/2018		263V	
	"PIN SE5"	ok	12/16/2018		448V	
	"PIN SE5 NM"	ok	12/16/2018		463V	

* Please contact Xin with your Microsoft ID if you want to see this notebook.

Summary and plan

- Single pad sensor list:
  - HPK
    - Type 1 (35µm) Wafer 9 Set-P2 (tested)
    - Type 1 (35µm) Wafer 9 Set-P3 (not tested yet)
    - Type 3.1 (50µm) Wafer 8 Set-P3 (not tested yet, high priority)
    - Type 3.2 (50µm) Wafer 18 Set-P6 (tested)
  - CNM:
    - 12 LGADs (not tested yet)
    - 4 PINs (not tested yet)

- Plan:
  - HPK Wafer 8 will be tested with highest priority.
  - May also check the CNM sensors.