

Proton Irradiated Sensors -reasonable fluences

IV, CV, and TCT Data

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8/27/26

Overview of Sensors and test structures

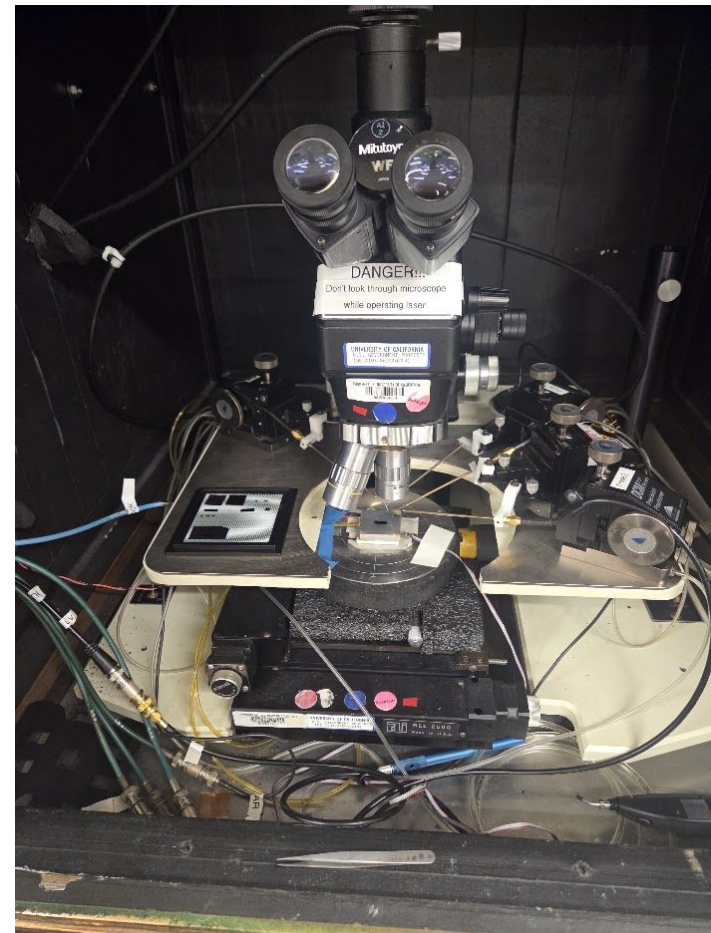
- Proton irradiated sensors (FNAL ITA)
- 4 different fluences
 - $(1e13, 1e14, 5e14, 1e15) n_{eq}/cm^2$
- 16 wafers, all $30\mu m$ thick
- Geometry of strips are half size multipitch
- Geometry of pixels are $100\mu m$ width



Experimental Setup

- Current versus Voltage measurements (IVs)
- Capacitance versus Voltage measurements (CVs)
- All taken at room temperature $\sim 25^\circ\text{C}$
- HV is supplied to the chuck and a tungsten needle
- For CVs the voltage had to be corrected

- $V_{\text{diode}} = V_{\text{Bias}} - 100\text{k}\Omega * I$



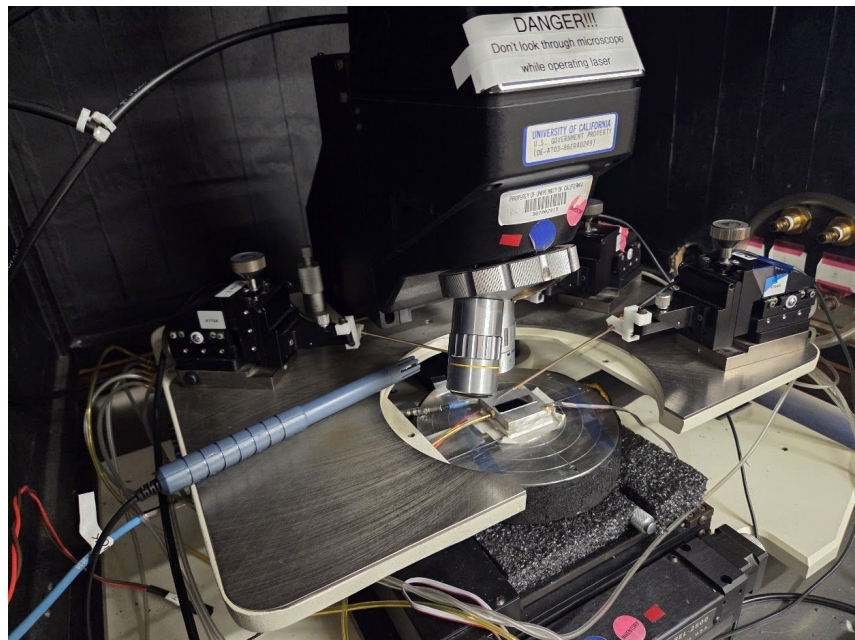
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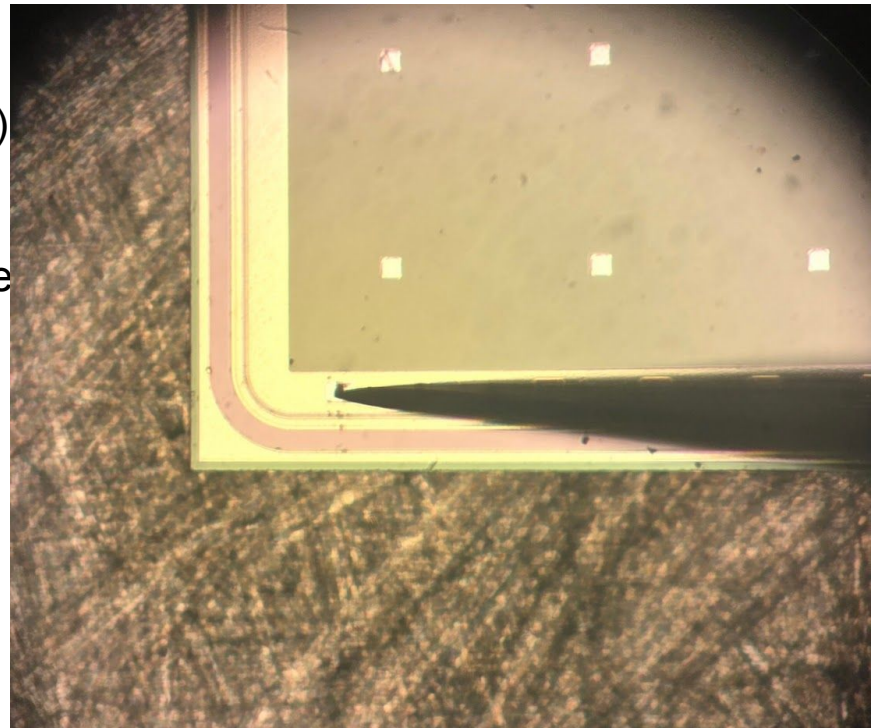
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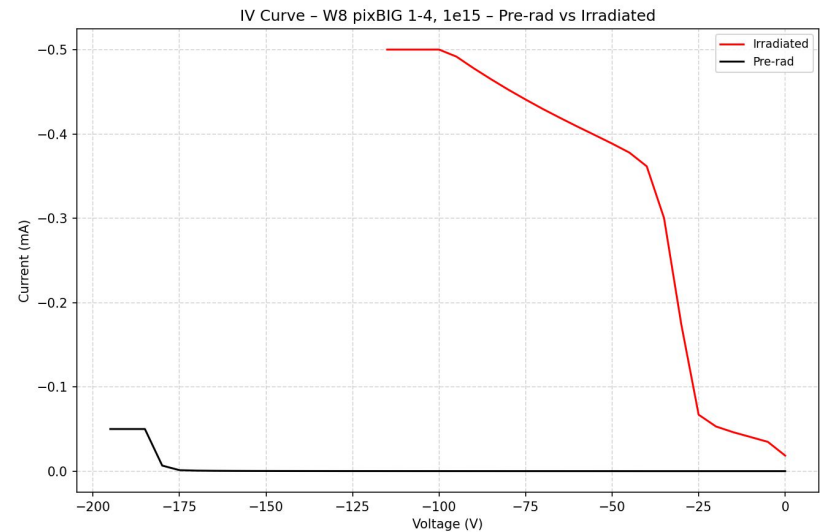
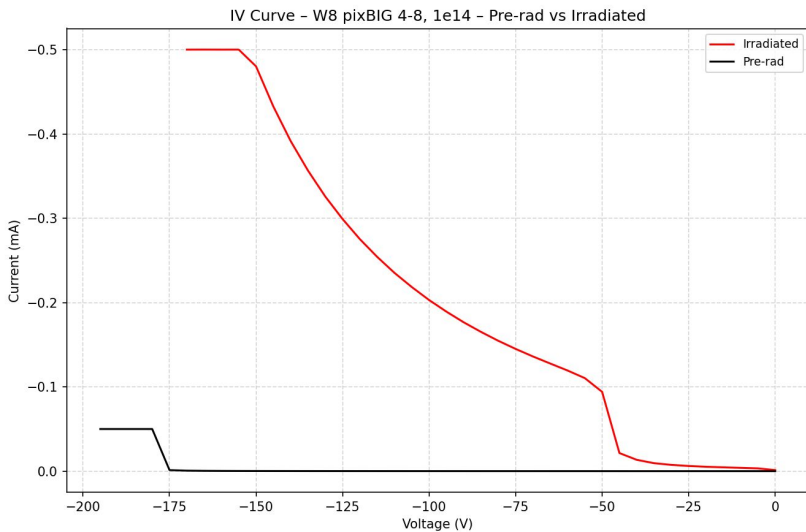
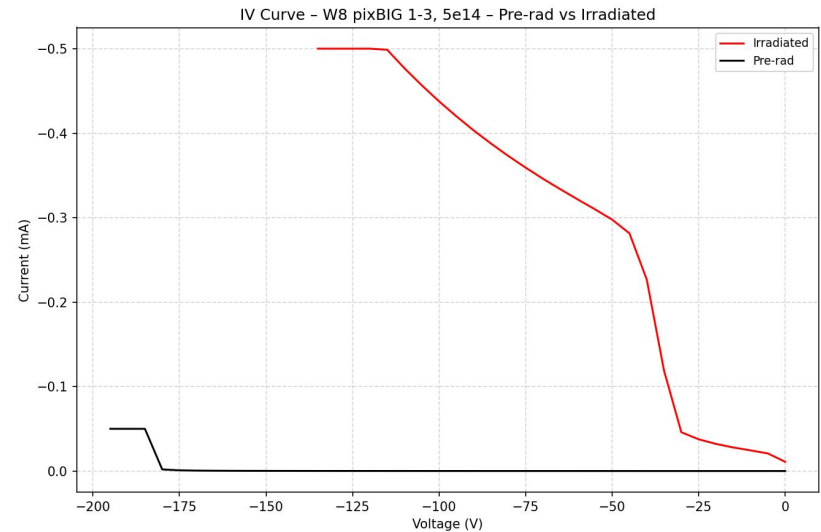
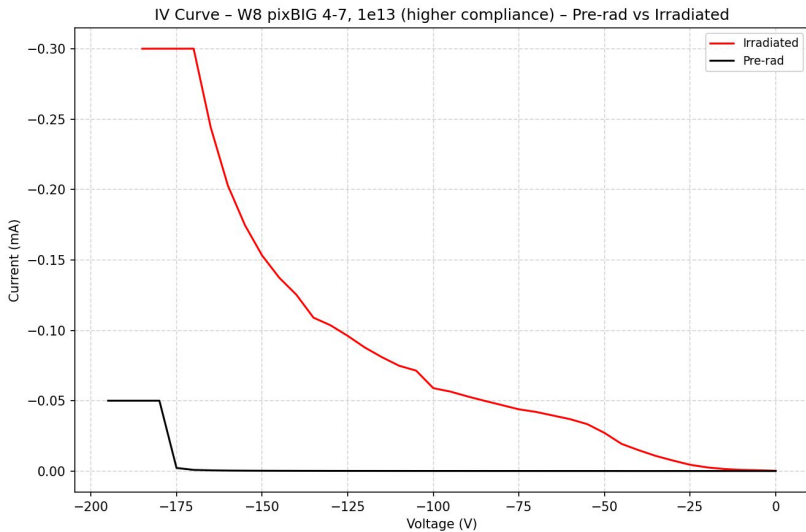


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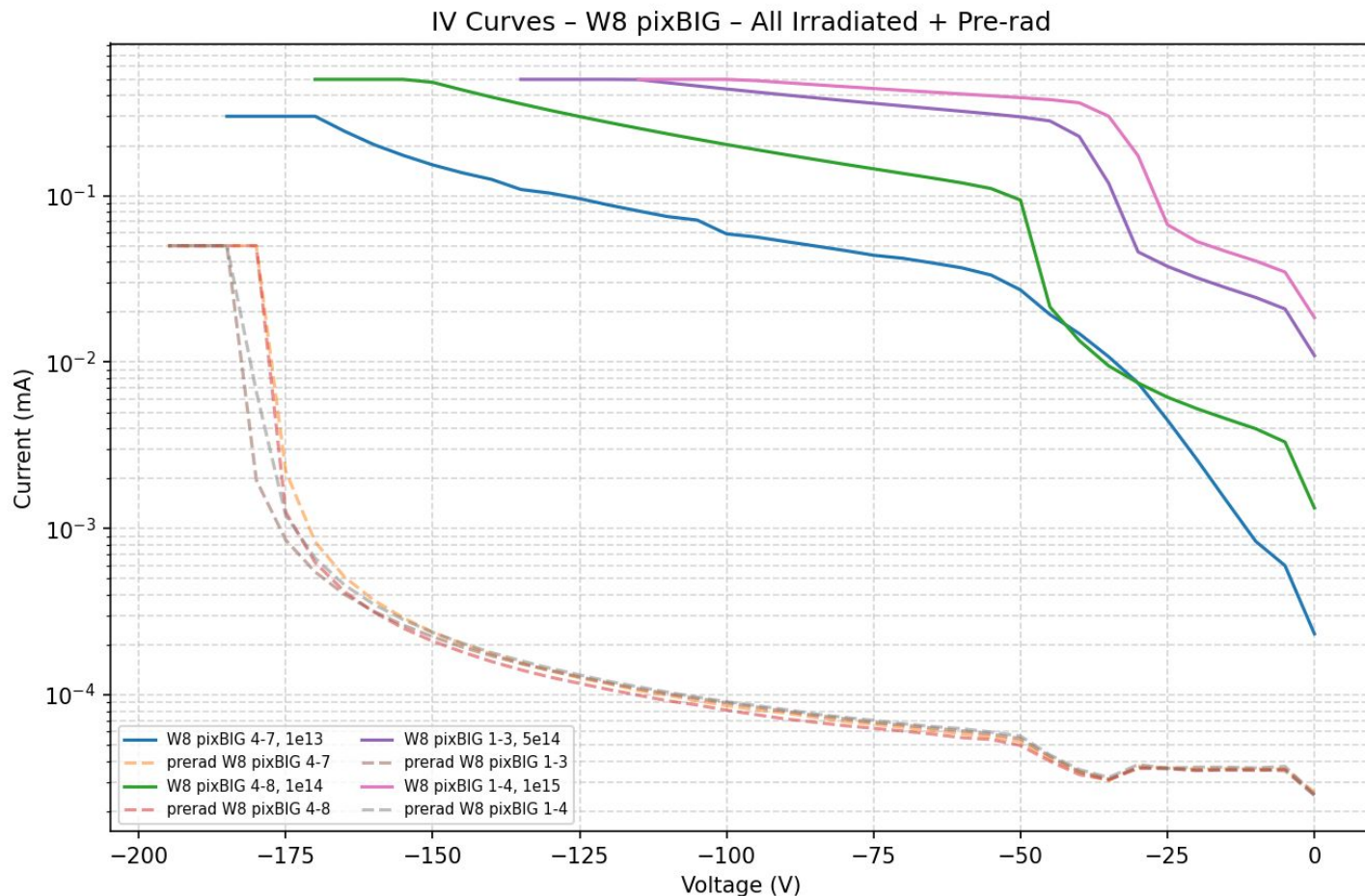


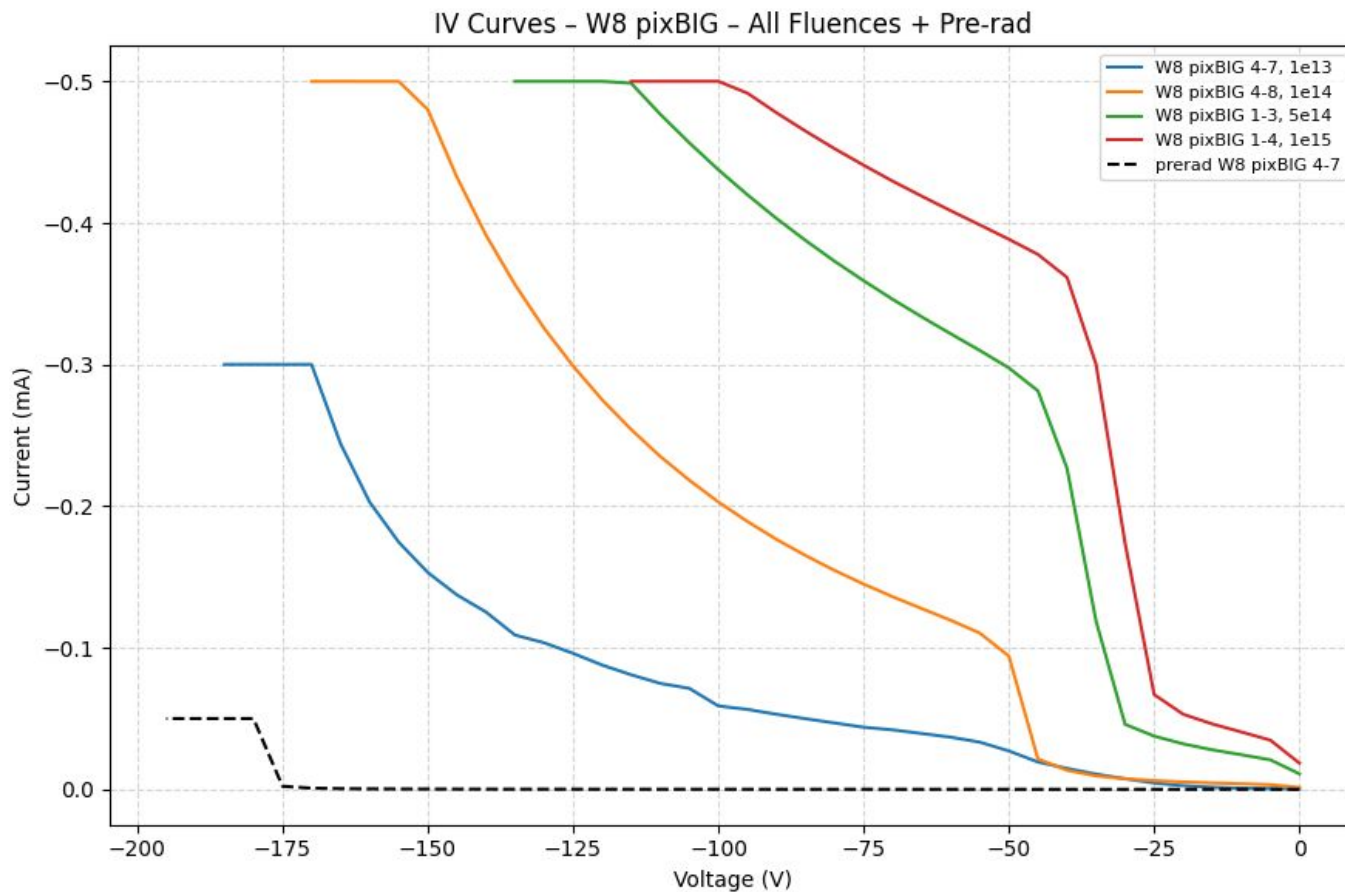
IVs

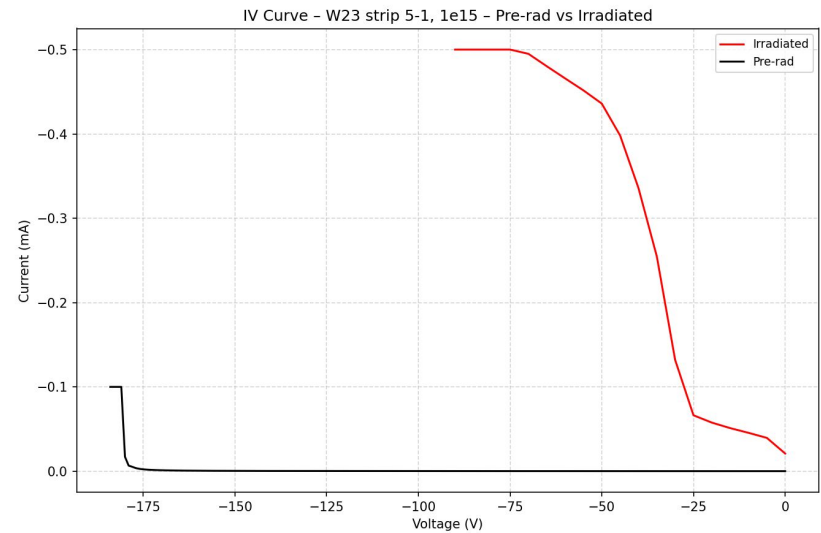
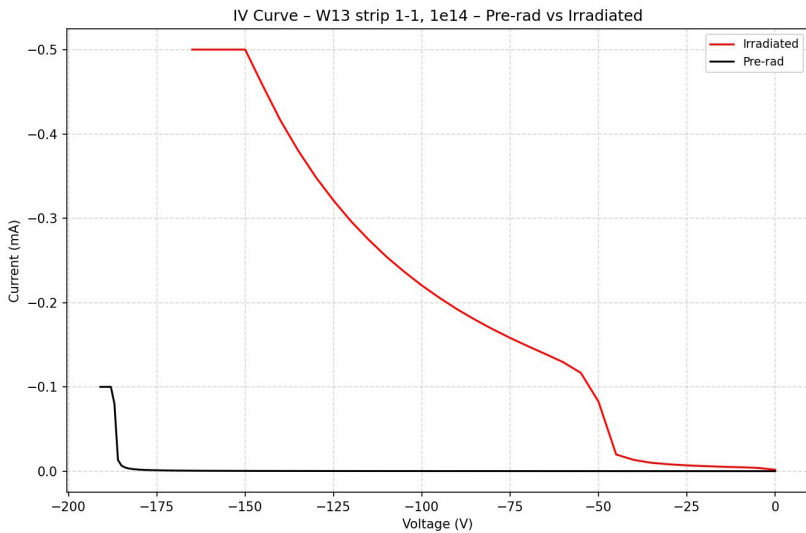
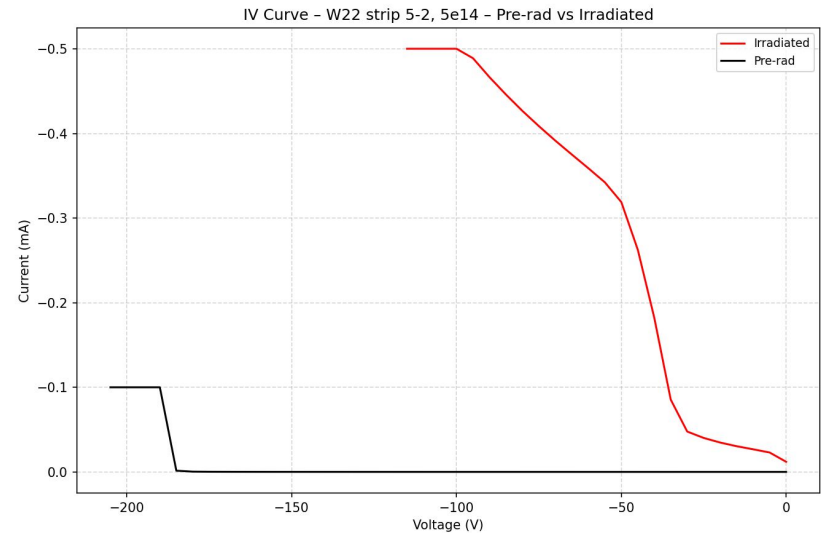
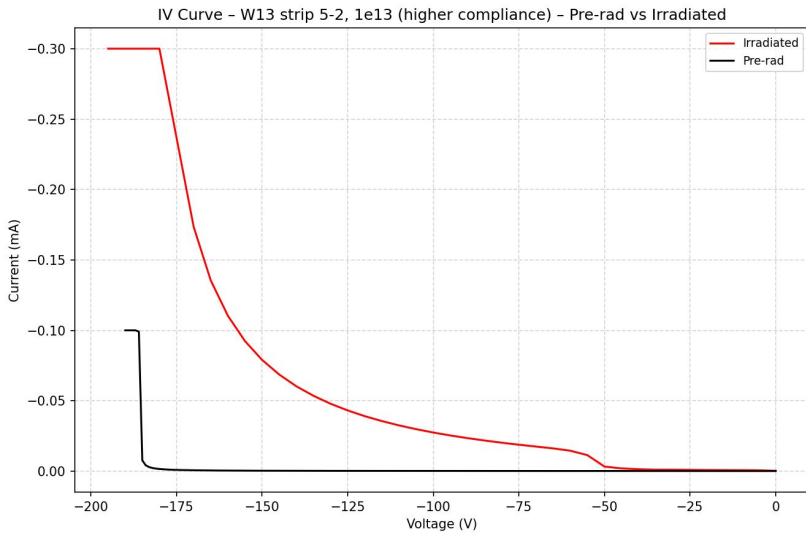


Meeting Name

- IVs are done to find the breakdown
- The $1e13$ n_{eq}/cm^2 pixel sensor lacks a leg

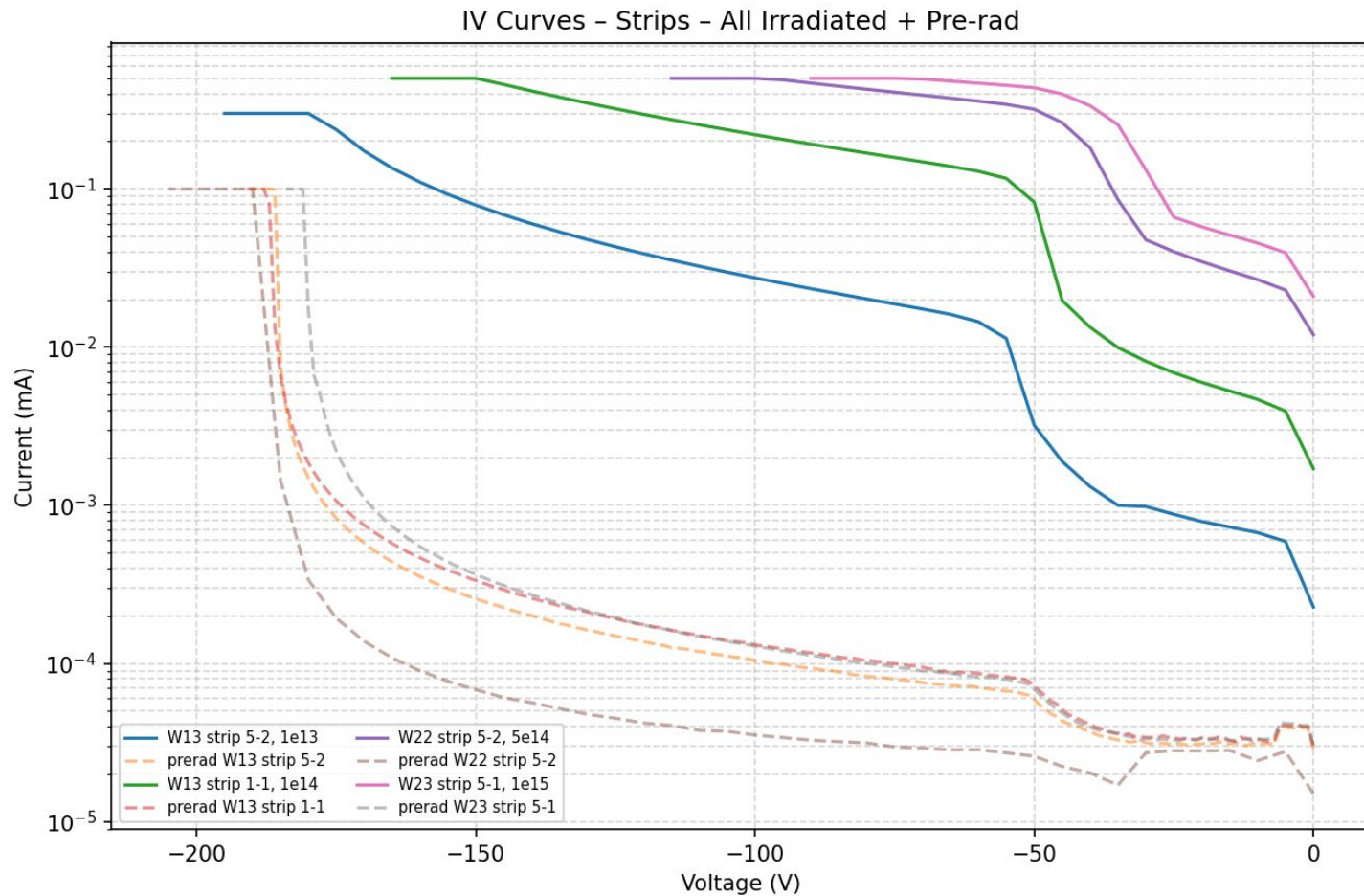


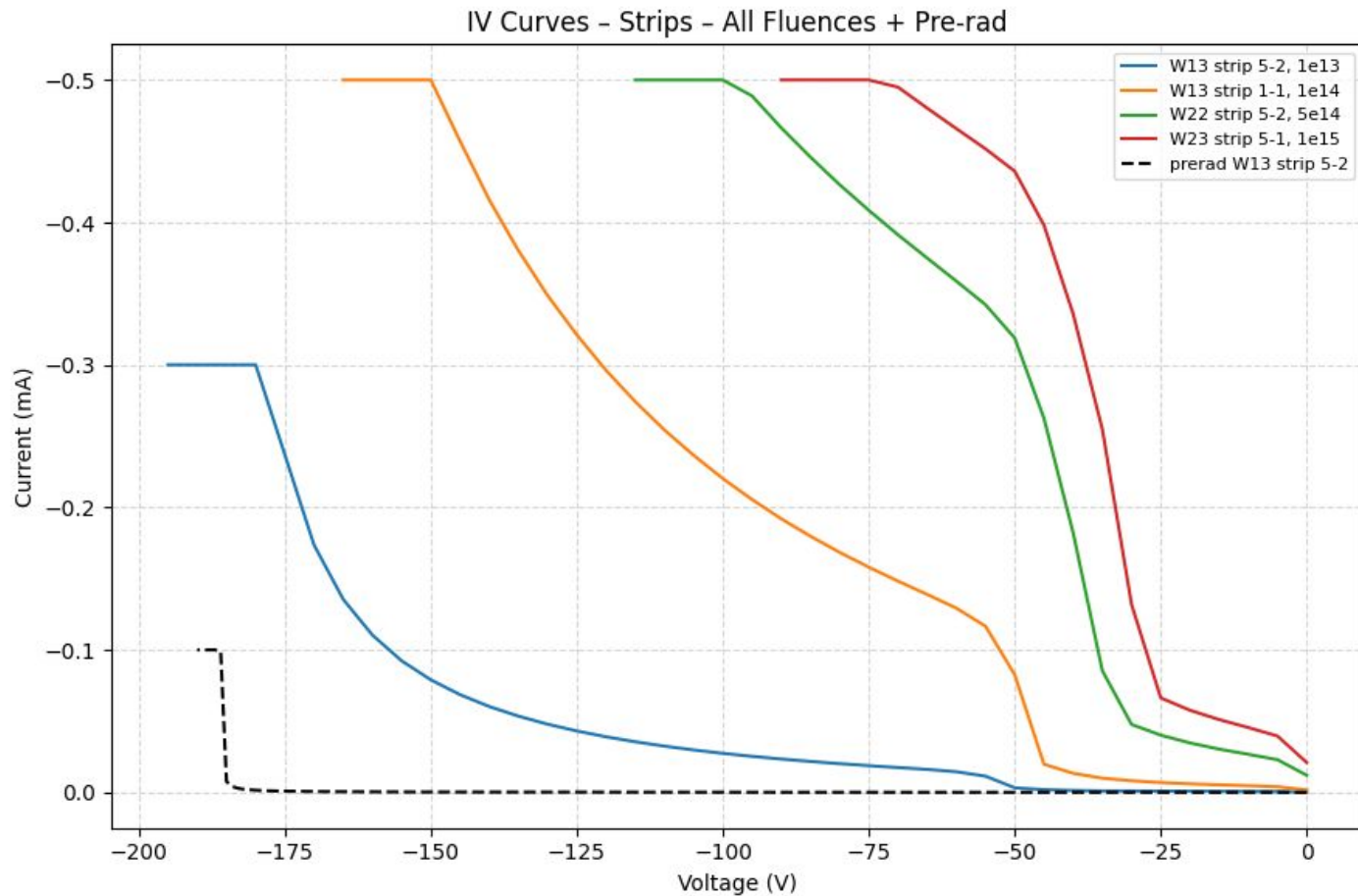




Meeting Name

- We do not see the lack of a leg



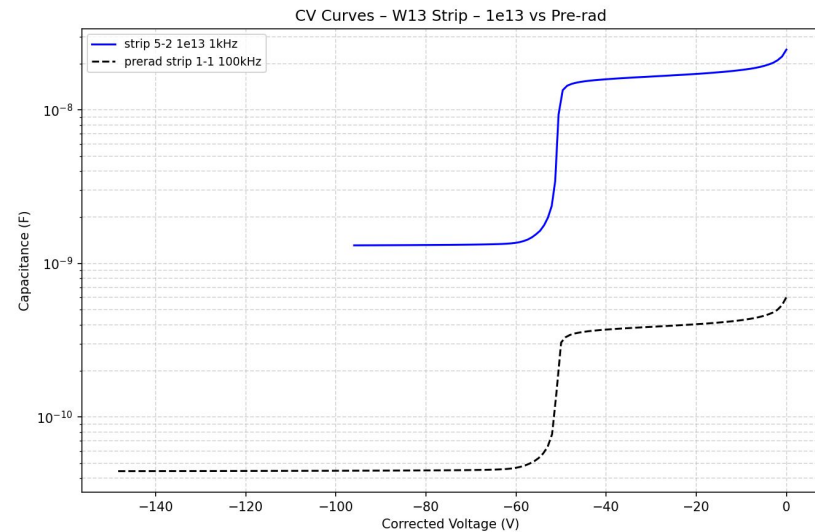
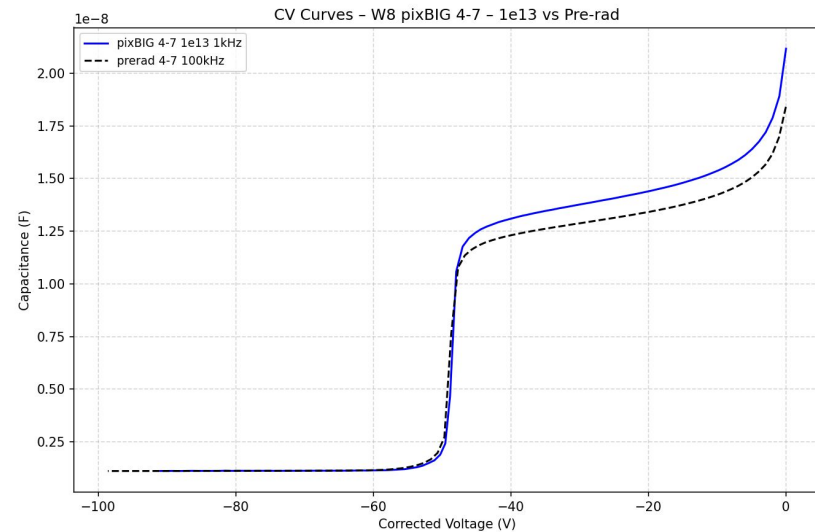


CVs

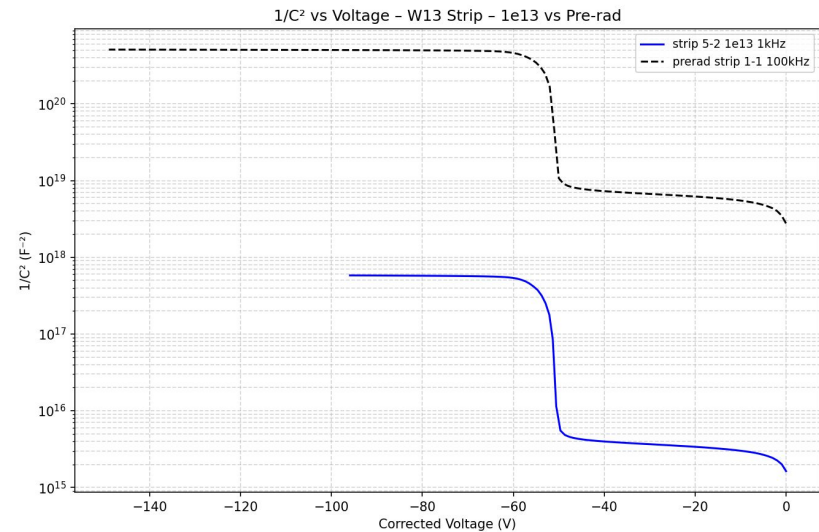
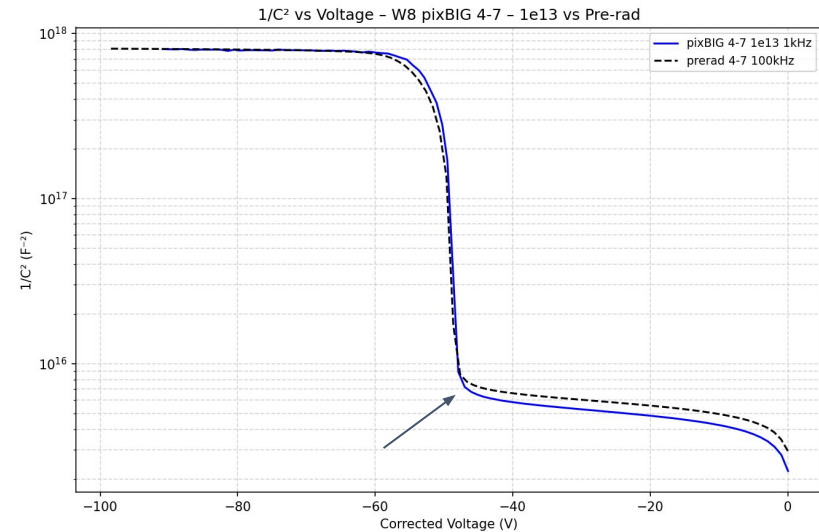
- CV box had a measured resistance of 100K Ohms
- $V_{\text{diode}} = V_{\text{Bias}} - 100\text{k}\Omega * I$



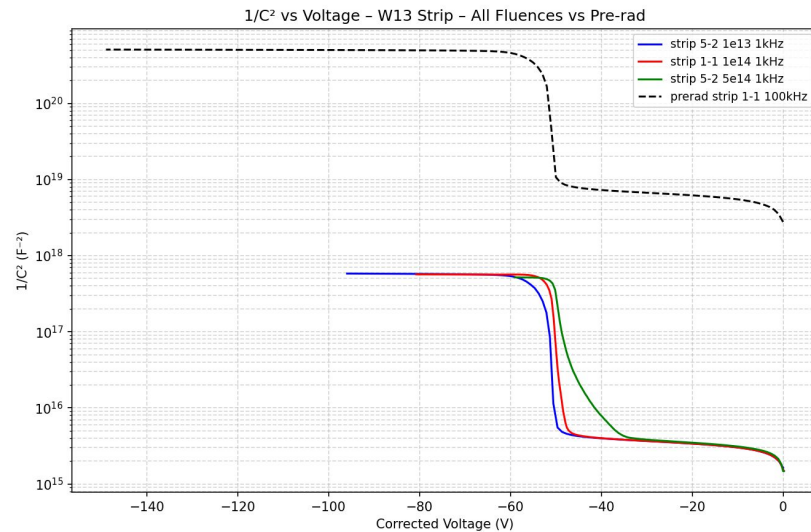
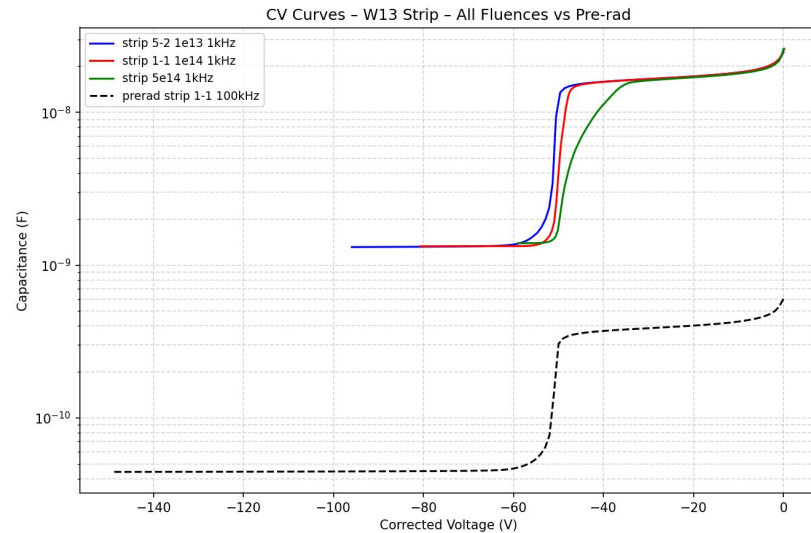
- The depletion voltage from pre-rad to $1e13$ n_{eq}/cm^2 is unchanged



- A more appropriate of seeing the depletion voltage V_{GL} is looking at the $(1 / C^2)$ curves

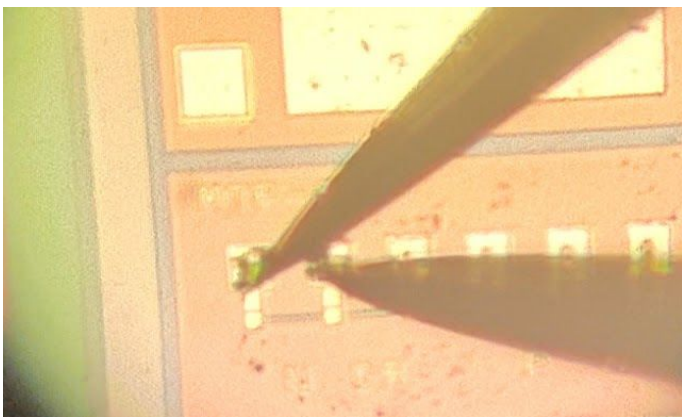


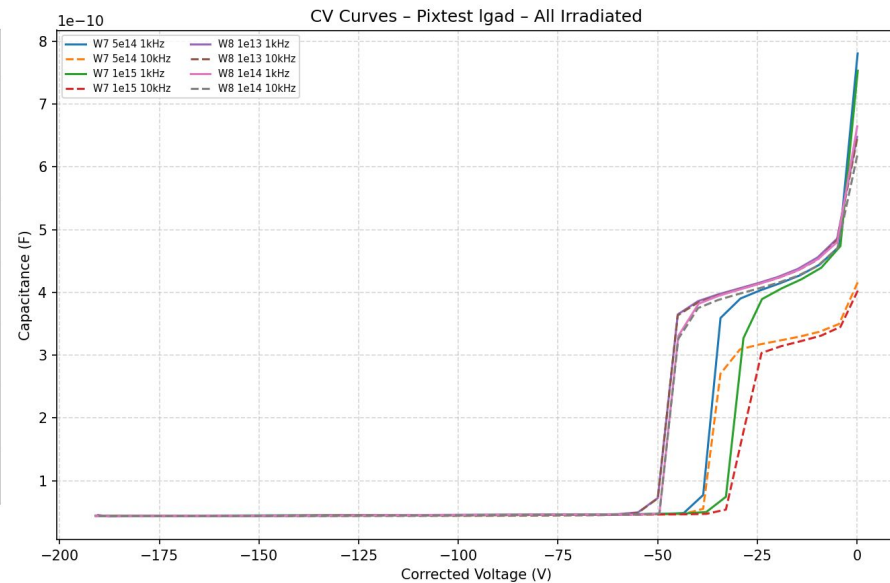
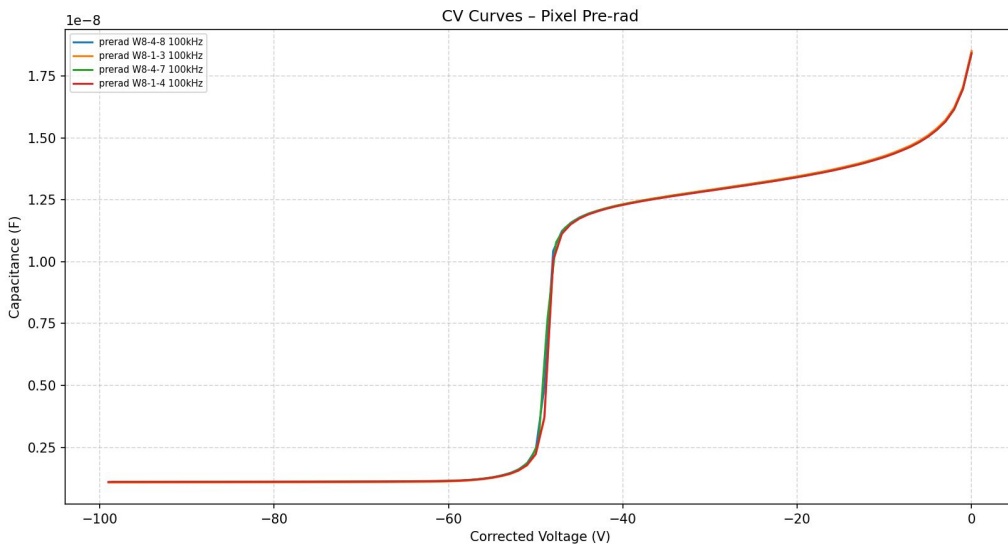
- There is a decrease in the depletion voltage V_{GL} with an increase of the fluence



Conclusion (Future Plans)

- IVs below room temperature
 - 15°C, 10°C ...
- TCT scans in our laser station
- IVs of the N⁺ layer
 - We expect to not see a change for the 1e13 and 1e14 n_{eq}/cm²



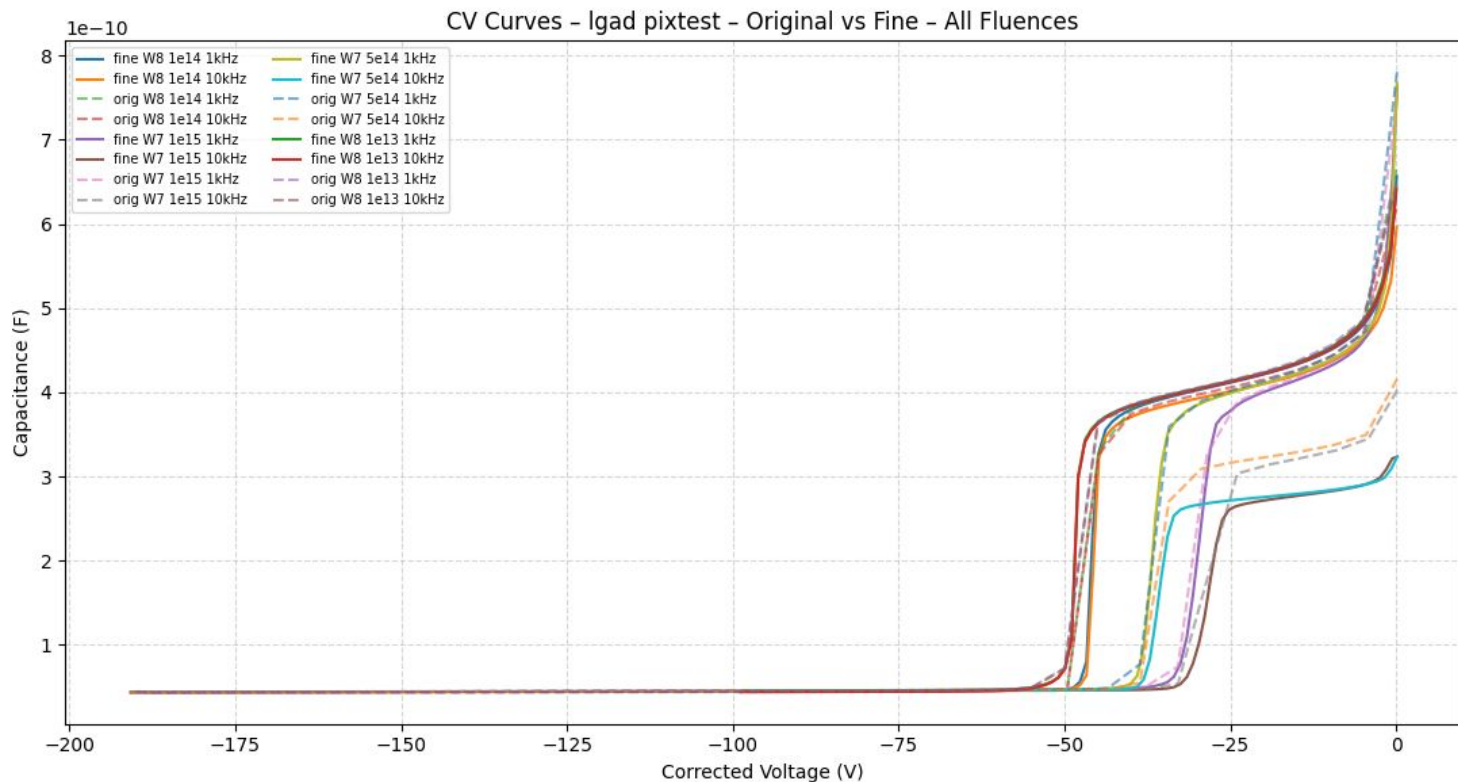


Sensor	Final Cap 100kHz (F)
prerad W8-4-8	1.09e-09
prerad W8-1-3	1.08e-09
prerad W8-4-7	1.11e-09
prerad W8-1-4	1.10e-09

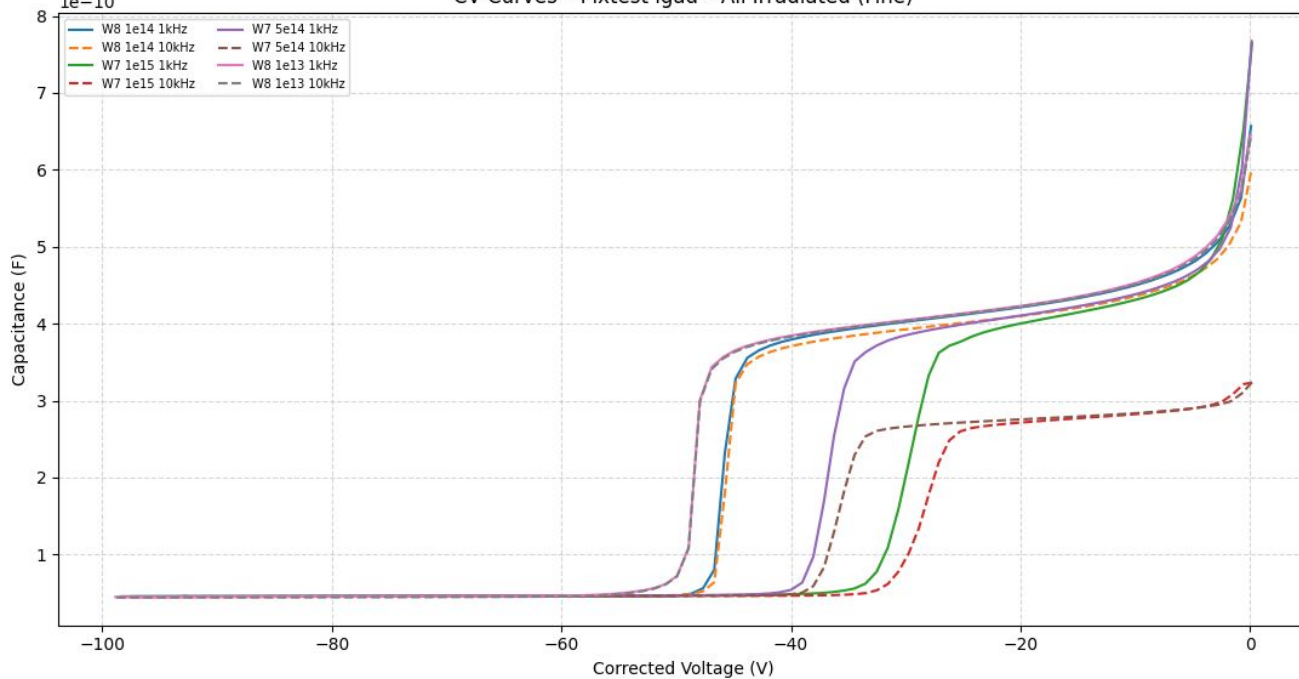
Sensor	Final Cap 1kHz (F)	Final Cap 10kHz (F)
W7 5e14	4.42e-11	4.37e-11
W7 1e15	4.42e-11	4.36e-11
W8 1e13	4.53e-11	4.41e-11
W8 1e14	4.37e-11	4.35e-11

-original are the CVs with -5V size steps

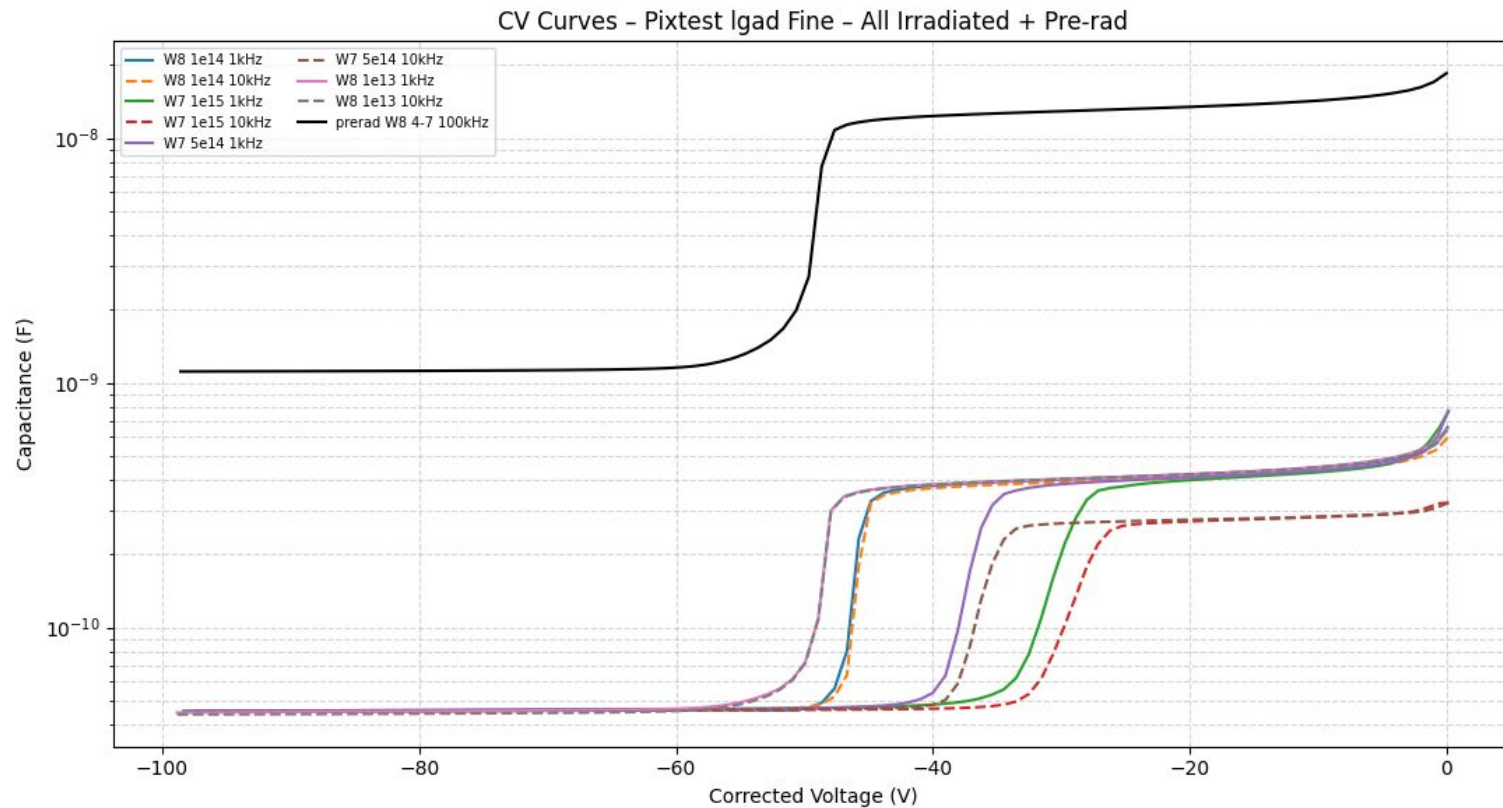
-fine are CVs with -1V size steps

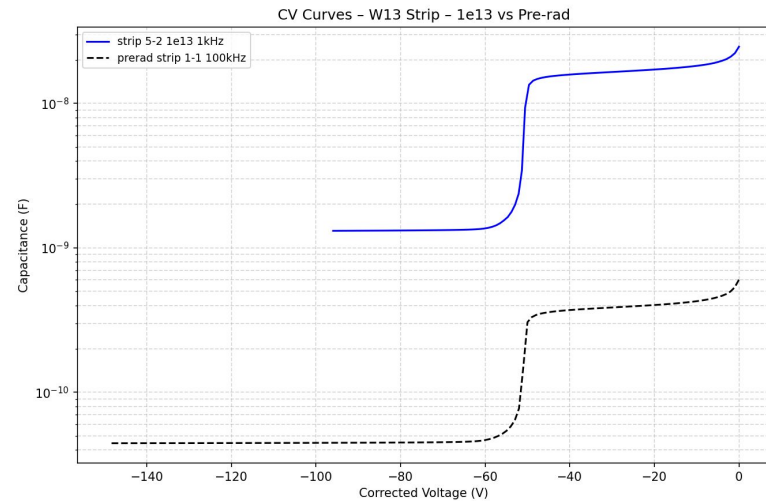
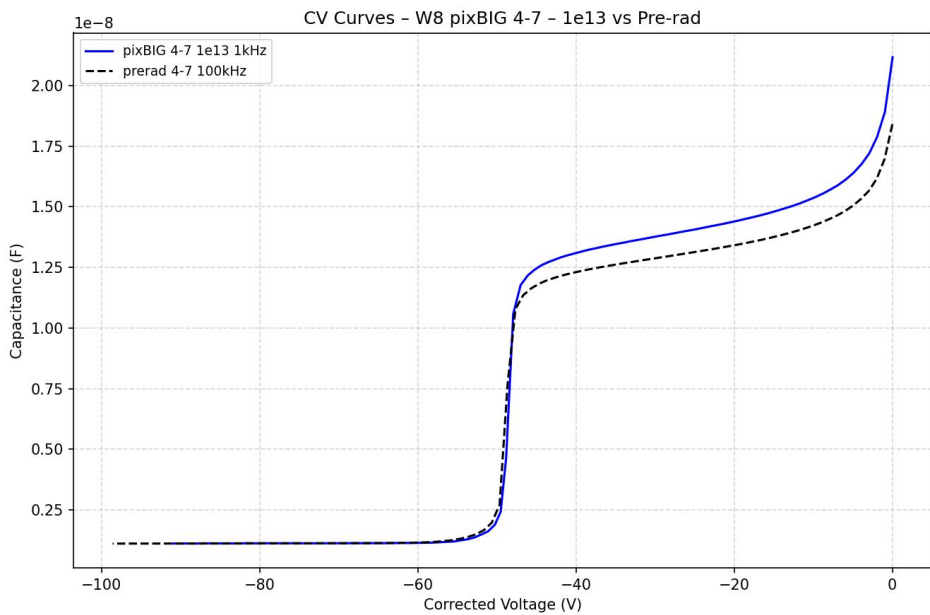


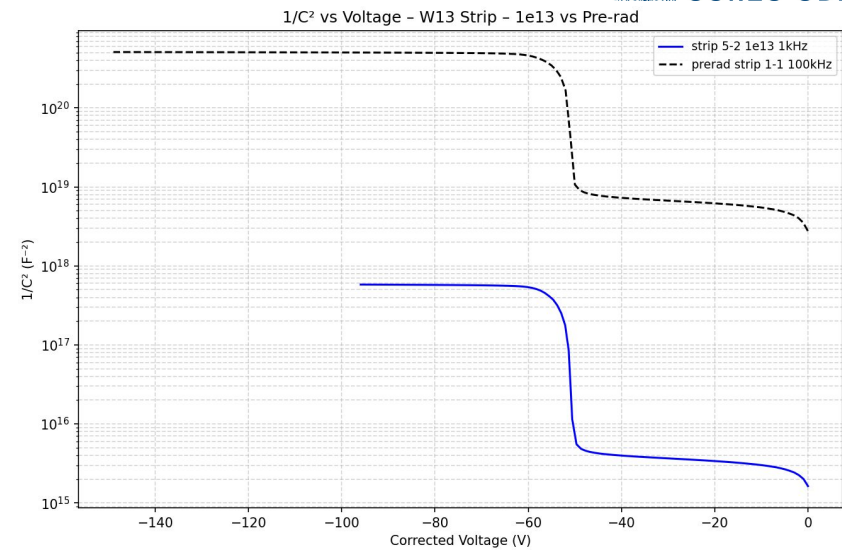
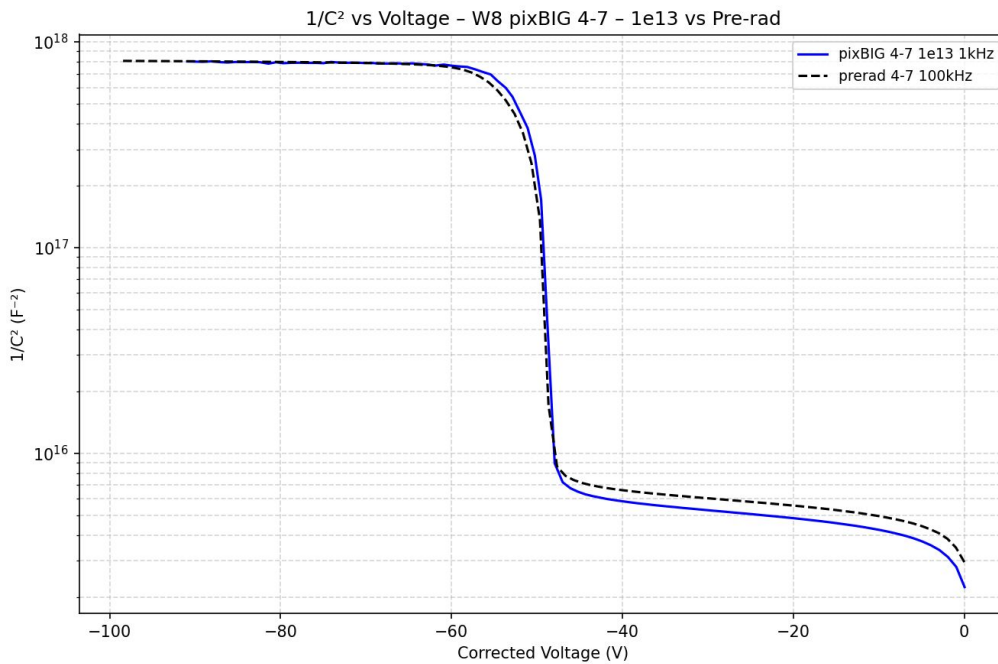
CV Curves - Pixtest Igad - All Irradiated (Fine)



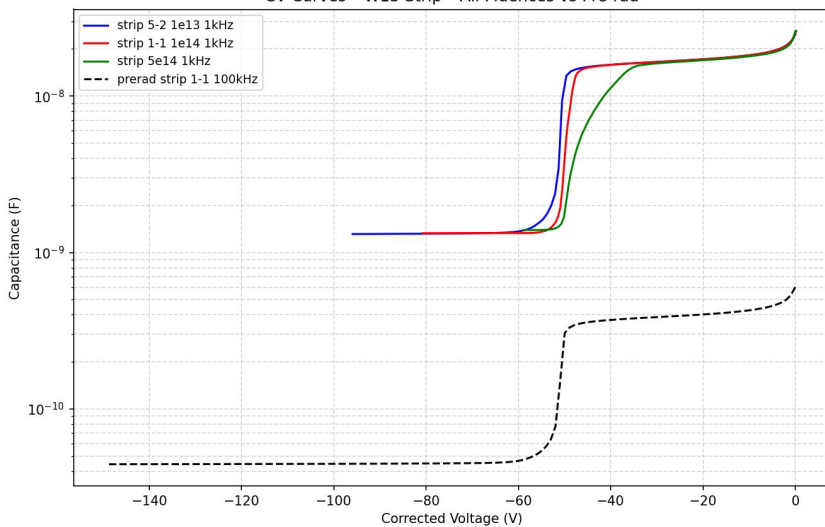
Sensor	Final C 1kHz (F)	Final C 10kHz (F)	Final Voltage (V)
W8 1e14	4.56e-11	4.48e-11	-98.3
W7 1e15	4.54e-11	4.52e-11	-97.1
W7 5e14	4.55e-11	4.52e-11	-97.6
W8 1e13	4.49e-11	4.41e-11	-98.8



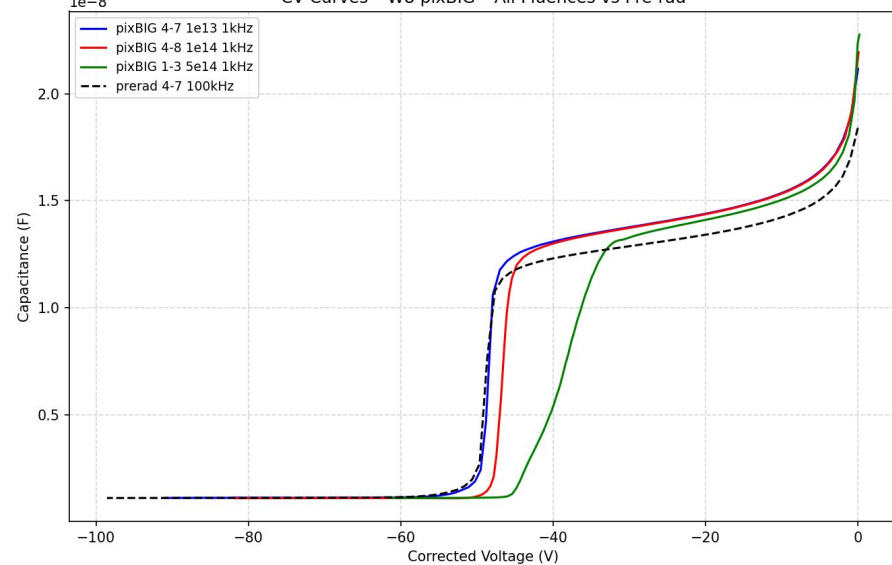
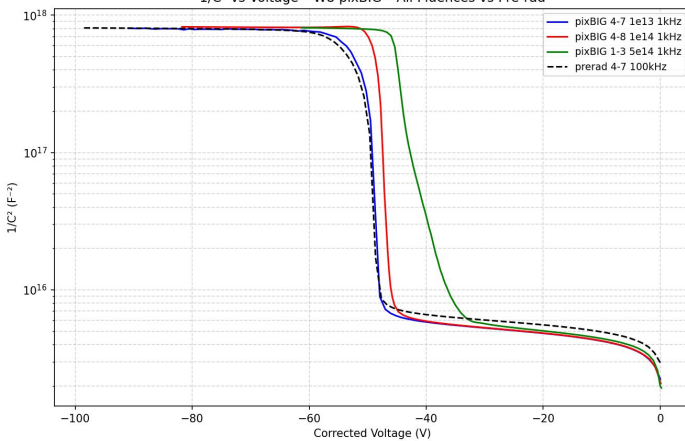
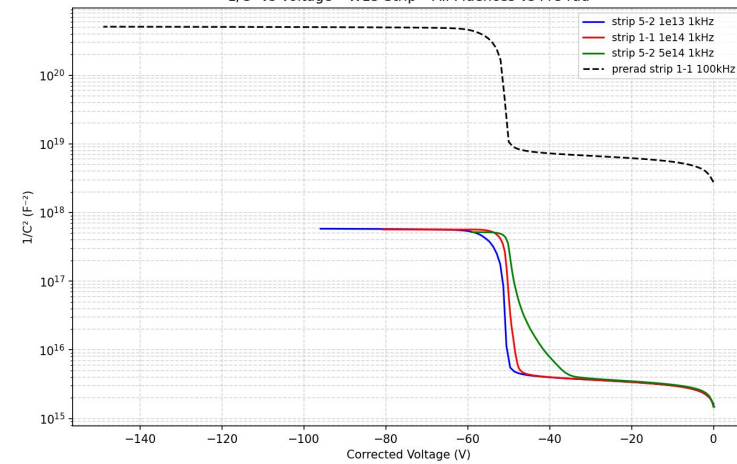




CV Curves - W13 Strip - All Fluences vs Pre-rad



CV Curves - W8 pixBIG - All Fluences vs Pre-rad

1/C² vs Voltage - W8 pixBIG - All Fluences vs Pre-rad1/C² vs Voltage - W13 Strip - All Fluences vs Pre-rad

CV Curves - Striptest Igad Fine - All Irradiated + Pre-rad

