

RADIATION AND TEMPERATURE EFFECTS ON CHARGE COLLECTION IP REGION OF TRENCHED LGAD UNDER HIGH INTENSITY INJECTION : WORK UNDER PROGRESS

Gordana Lastovicka-Medin¹, Jovana Doknic¹, Ivona Bozovic¹,
Vanja Backovic¹ Gregor Kramberger², Mateusz Rebarz³

¹University of Montenegro, ²Jozef Stefan Institute,

³ELI Beamlines, ELI ERIC

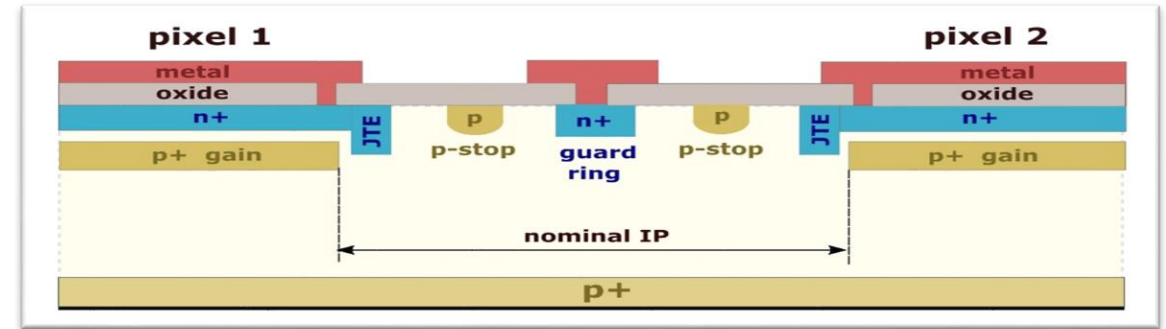
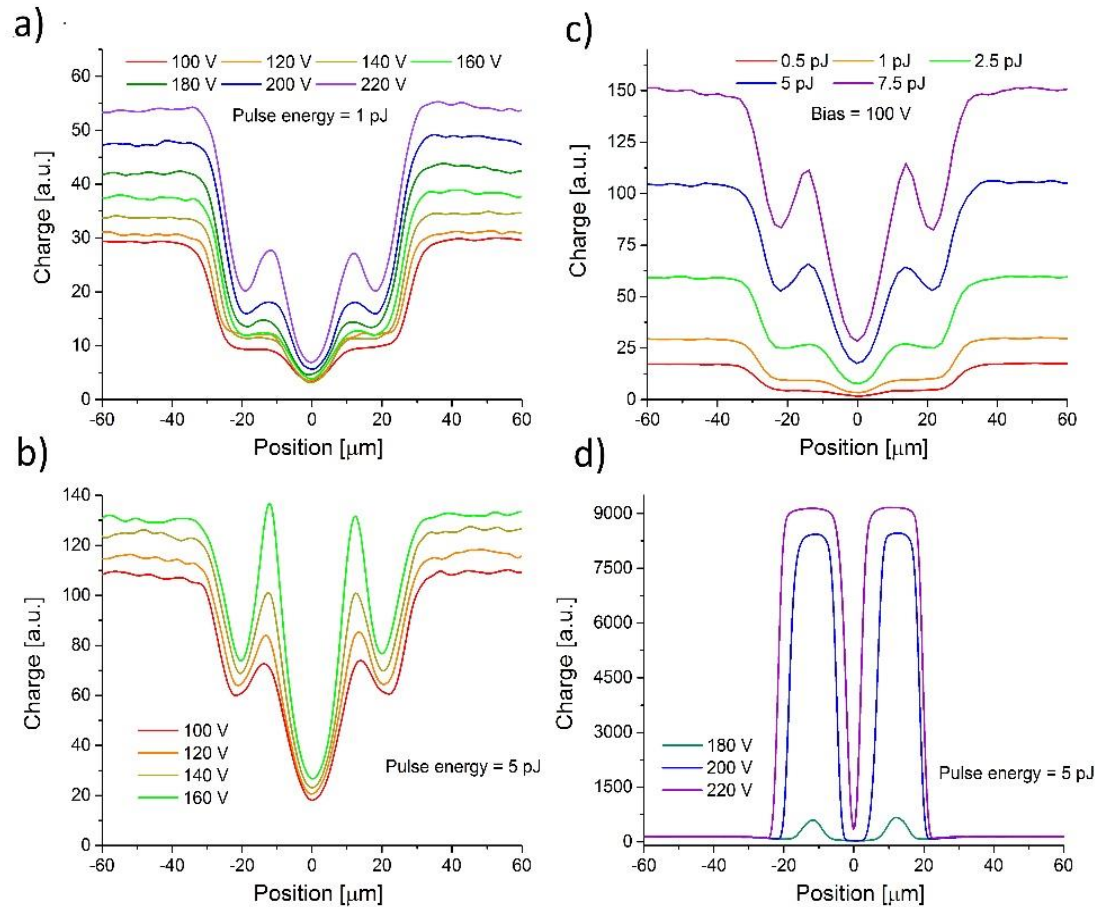
Motivation

- Effect of irradiation on the spikes observed in ip in LGAD
- We repeated procedure on trench LGAD
- We checked effect of irradiation damage on that.

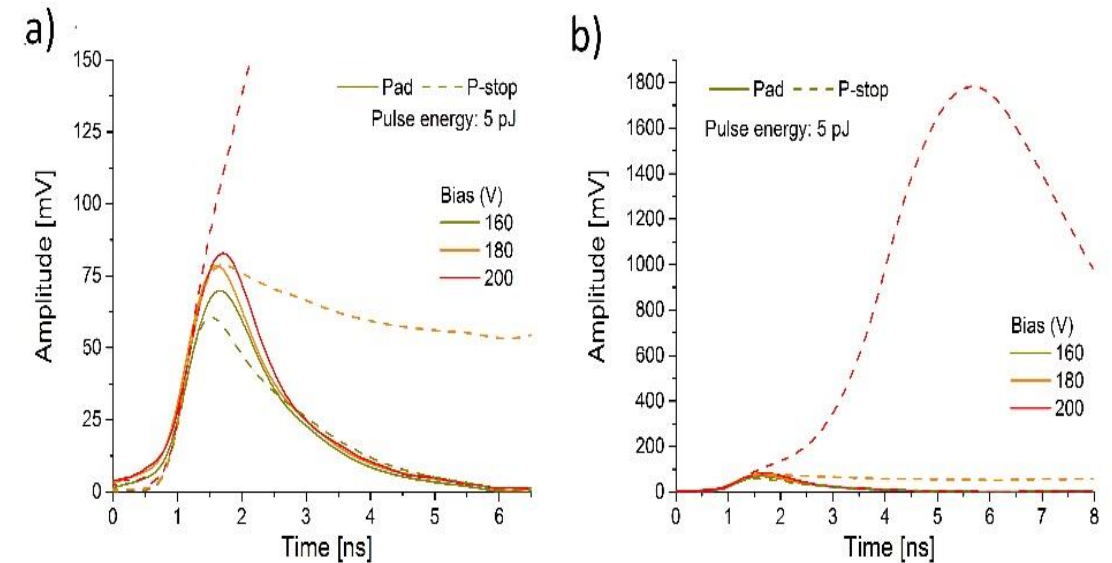
Reminder:
Non typical “UFSD” with 2 p-stops +bias; IP = 49mm

X-profile

Reference UFSD type 10 from TI-
LGAD run production



Waveforms



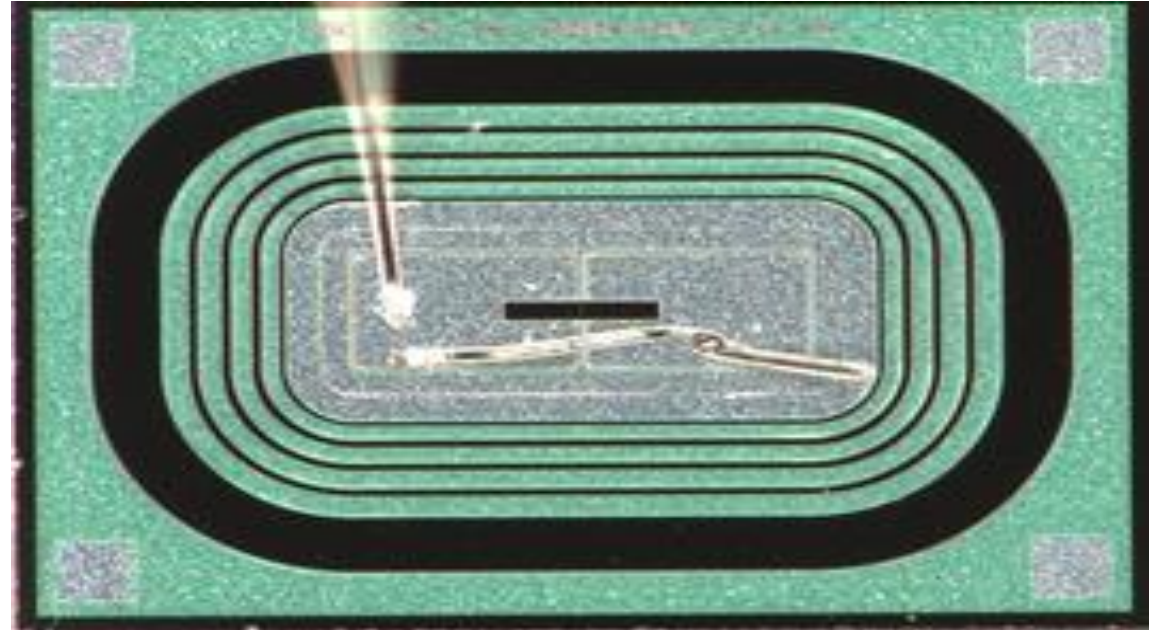
Trenched LGAD W11, 2Tr, C1, V2

W: Type of Wafer

C: Contact Type (Contact between metallization and n++)

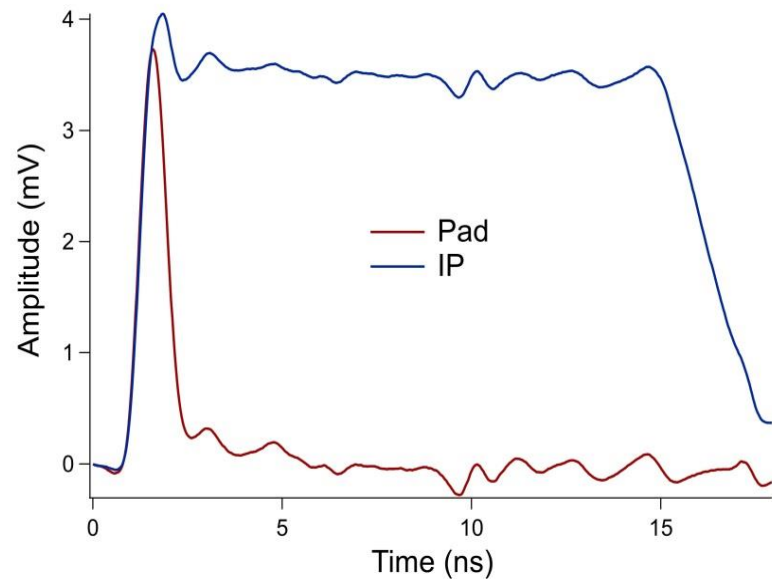
V: depth of trenches

$$V1' < V2 < V3$$

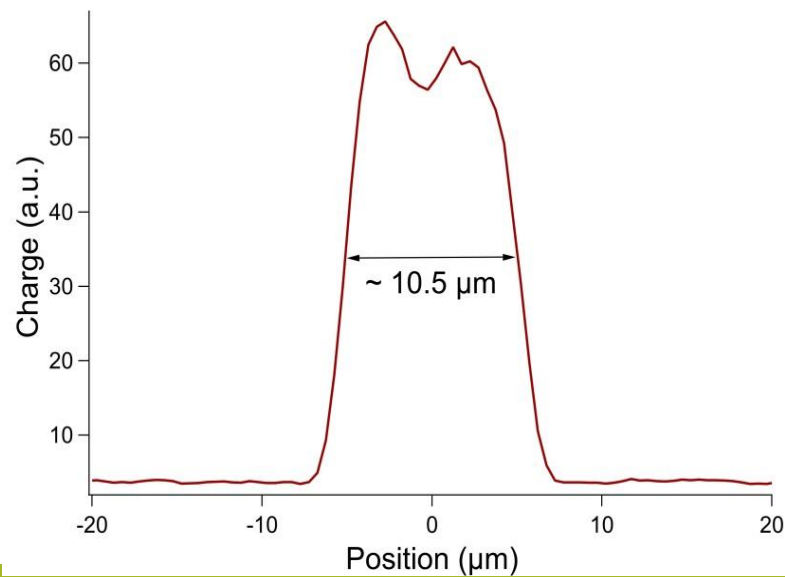


Experimental results

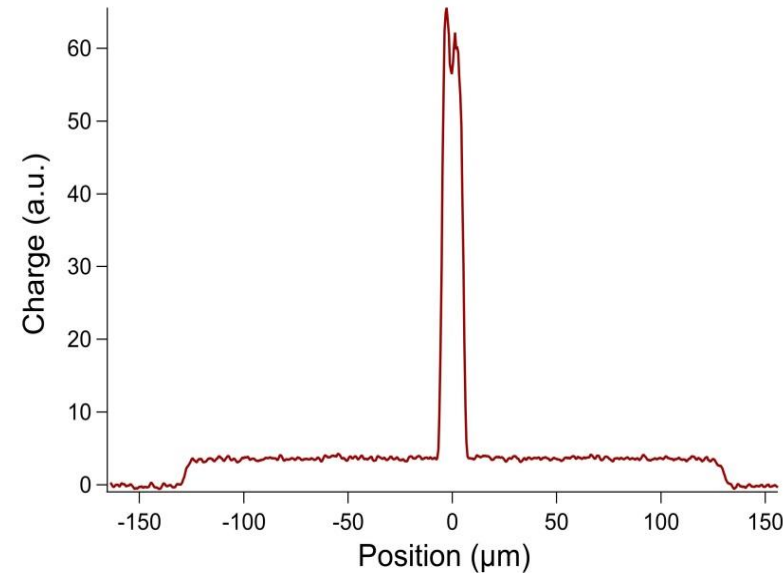
X-profiles & Waveforms at 0.2 pJ and 100 V



Waveforms in the center of pad and in the center of IP region



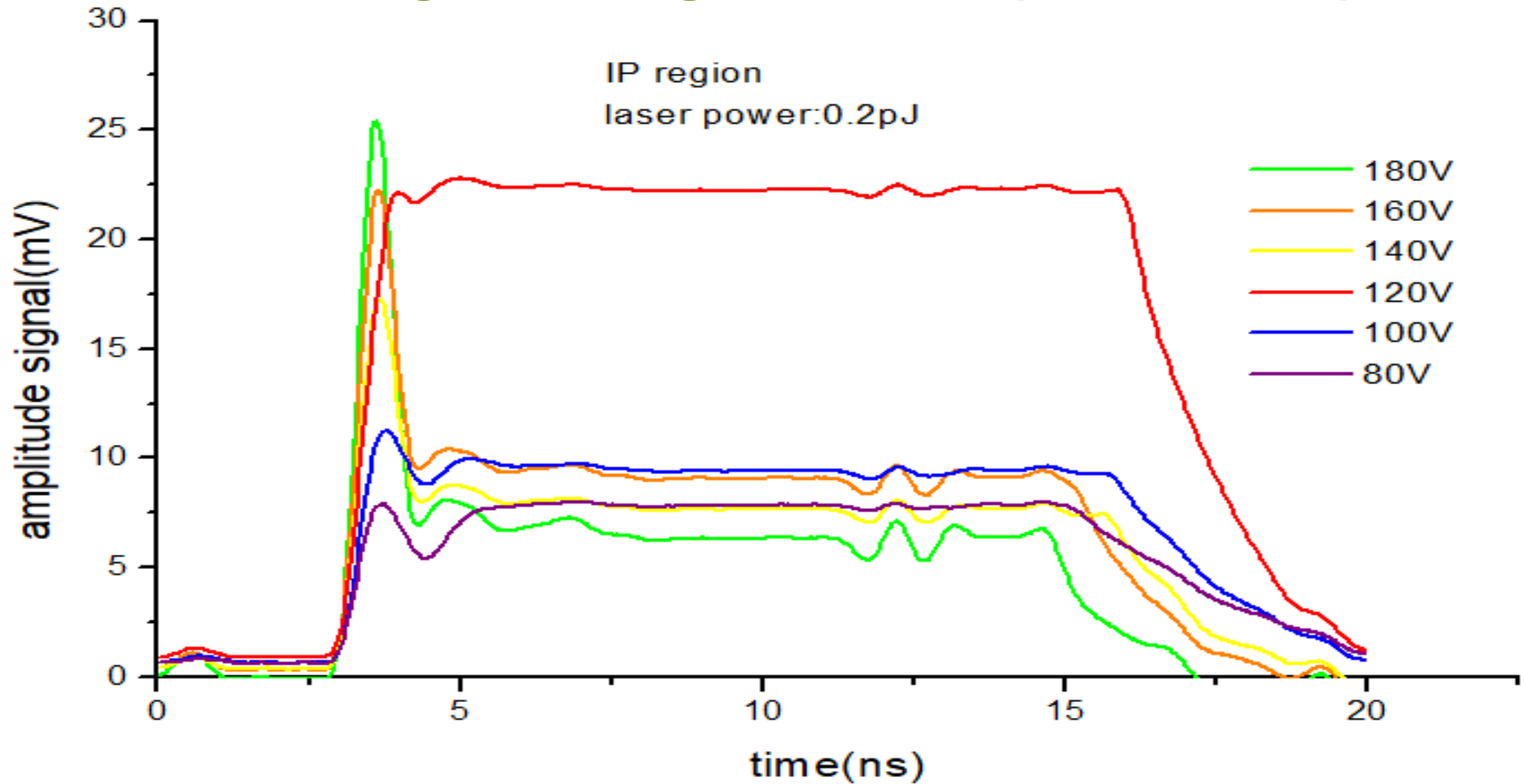
X-profile:
it's hard to say if this is double trench resolved structure because the signal is quite jumpy in IP.



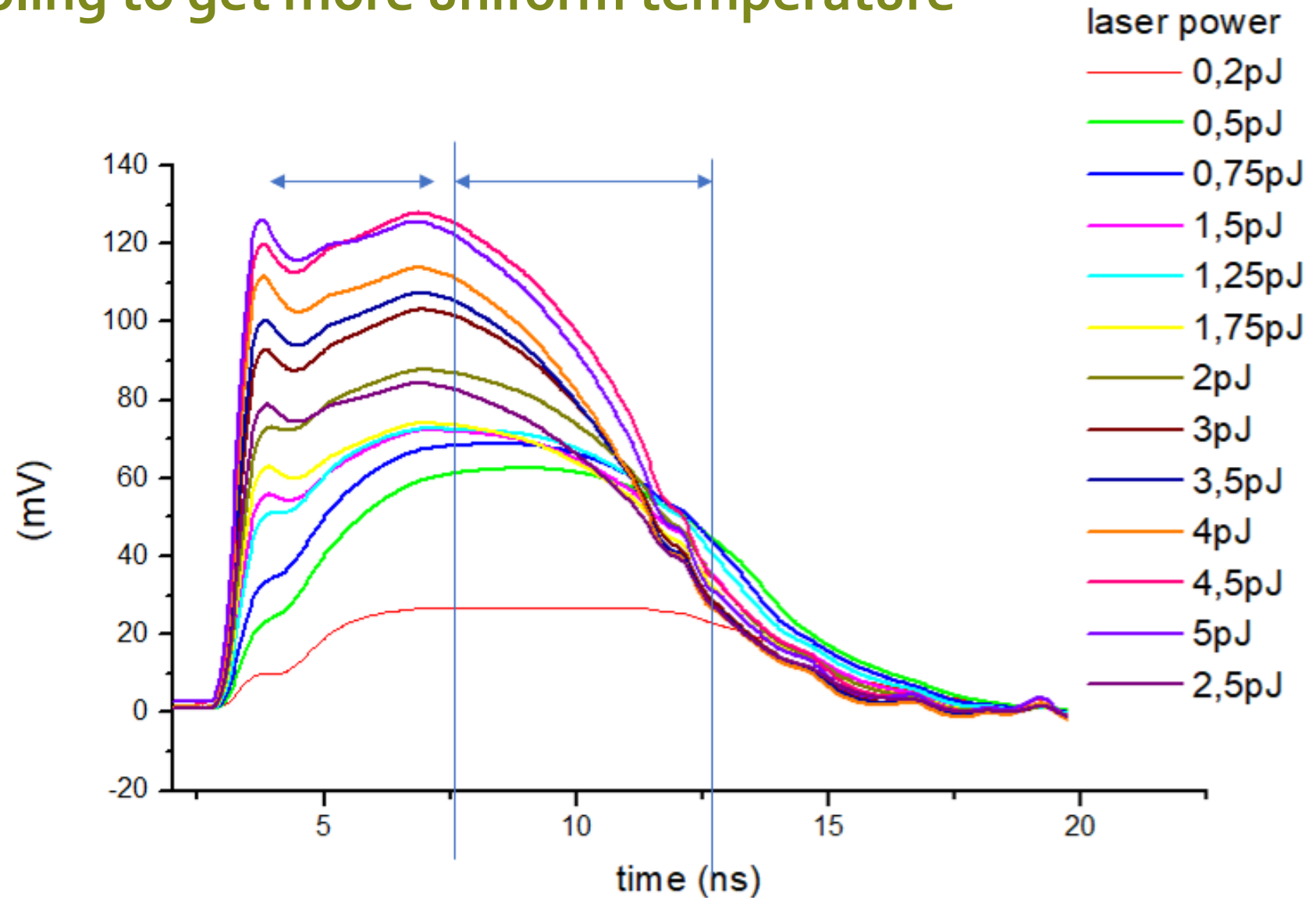
When we integrate the waveforms to get the charge X-profile this broadening results in strong increase in IP region.

X-profile – vertical zoom

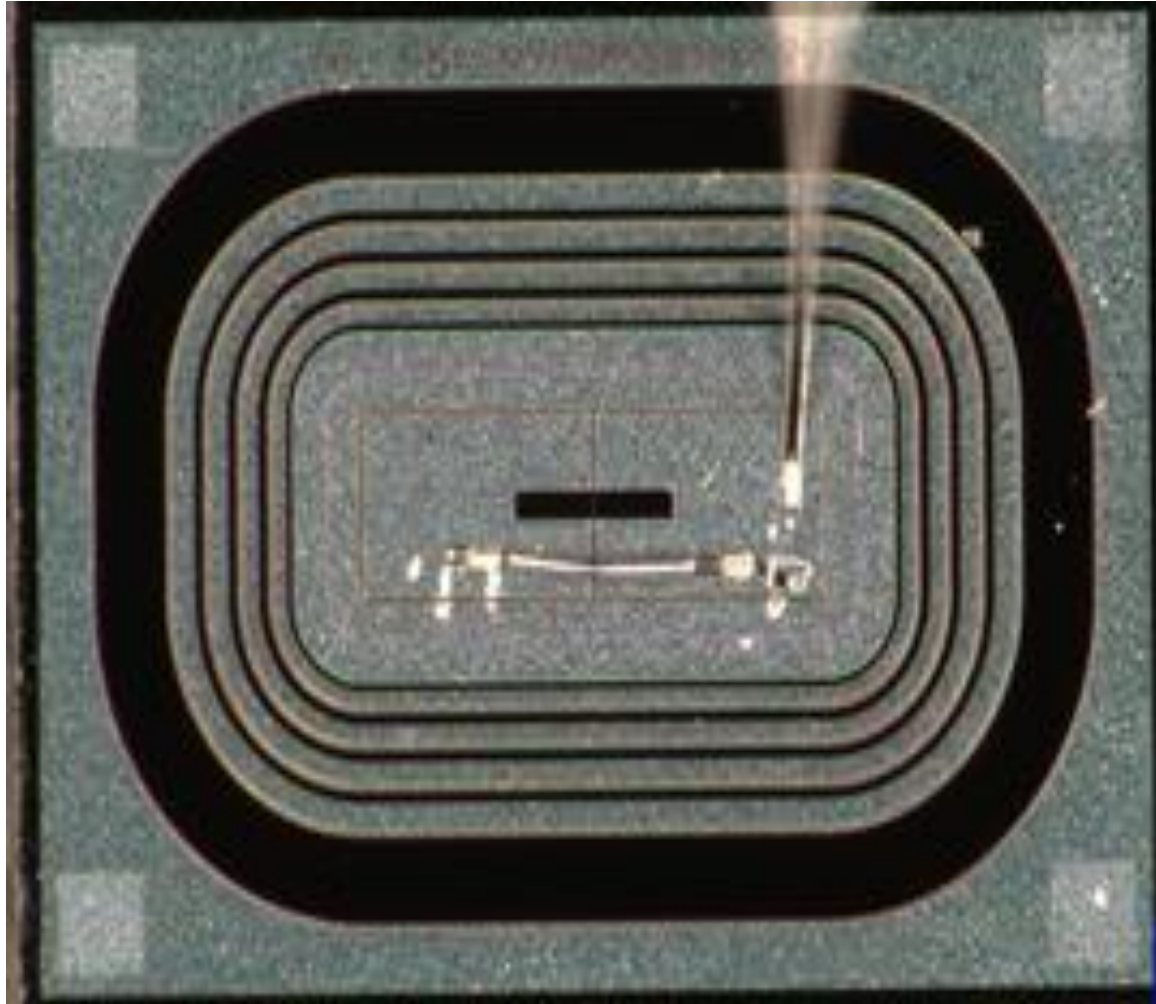
Bias voltage scanning at the laser power of 0.2 pJ



Overnight cooling to get more uniform temperature inside LGAD

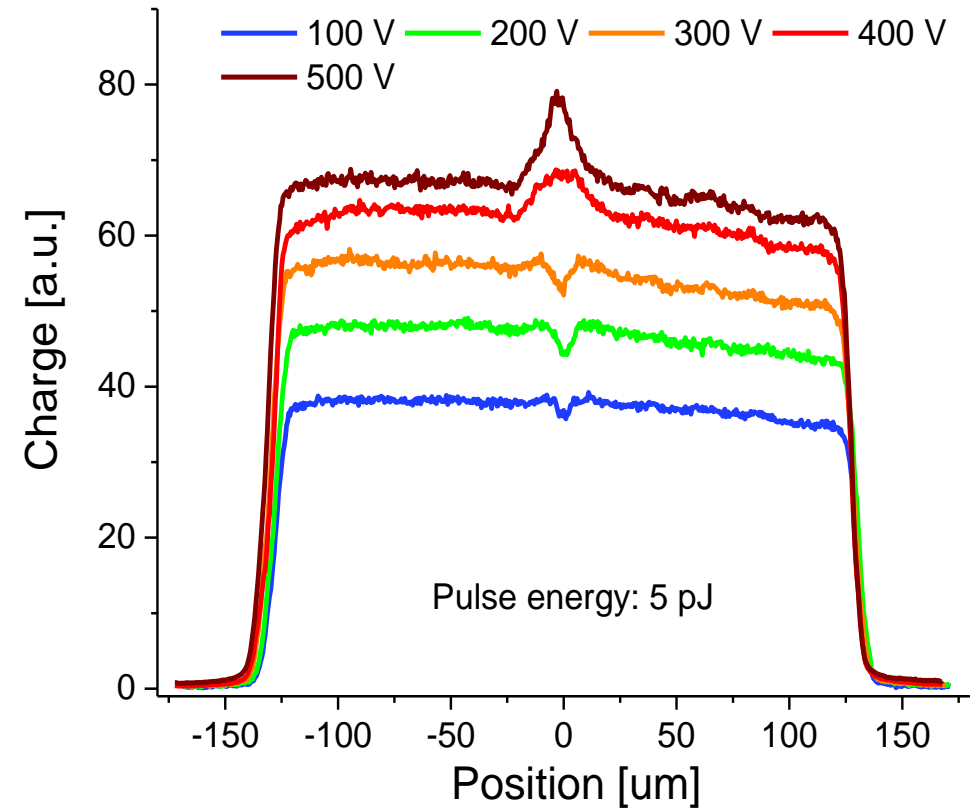
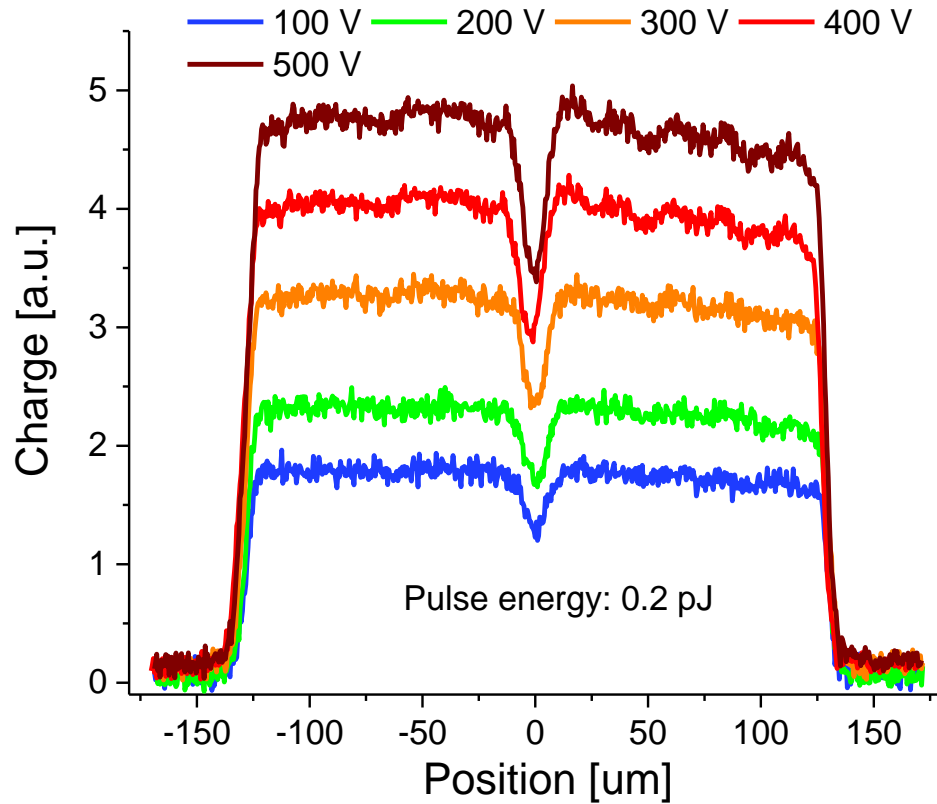


IRRADIATED



Standard SPA experiment at 800 nm
Temperature: -20 C, No amplifier
Bias range: 100-500 V

X-profiles at 0.2 pJ and 5 pJ vs bias



in contrast to non-irradiated one here the enhancement of the signal is much smaller and it's present only for high power (5 pJ) and high bias (500 V). Since 500 V is very close to burnout limit we didn't go higher to avoid SEB.

Conclusion



- ✓ Study was motivated by observation of spikes of Type 10 LGAD .
- ✓ We repeated our procedure on Ti-LGAD 2 trench prototype and observed much broaden spikes; hollow shape in X-profile was not observed since there is no bias ring and that proved that this method can be used to distinguish if there are trenches or 2 p stops as isolation structures in IP region..
- ✓ Looking at the shape and changes in the waveforms that correspond to the broaden spike in x profile for 2 trenches LGAD we found a few interesting things.
 - ✓ Electric field must be so high in ip region so that high charged density is causing charge almost not to move.
 - ✓ There must be some correlation of high charge density in LGAD with gain layer depletion, so it could be that there is also some transient region between region of space charge and non-depleted region causing prolonged charge collection time,.
 - ✓ PREPARATION FOR THE COOLING REQUIRES THE TIME,SO THE QUESTION IS WHEN UNIFORM COOLING OF SENSOR IS REACHED. Some effect of duration of cooling on shape of waveforms is seen.
- ✓ Another thing we investigated is the effect of radiation defects; we found that large spike in IP region in trenched LGAD disappear after sensor was irradiated .