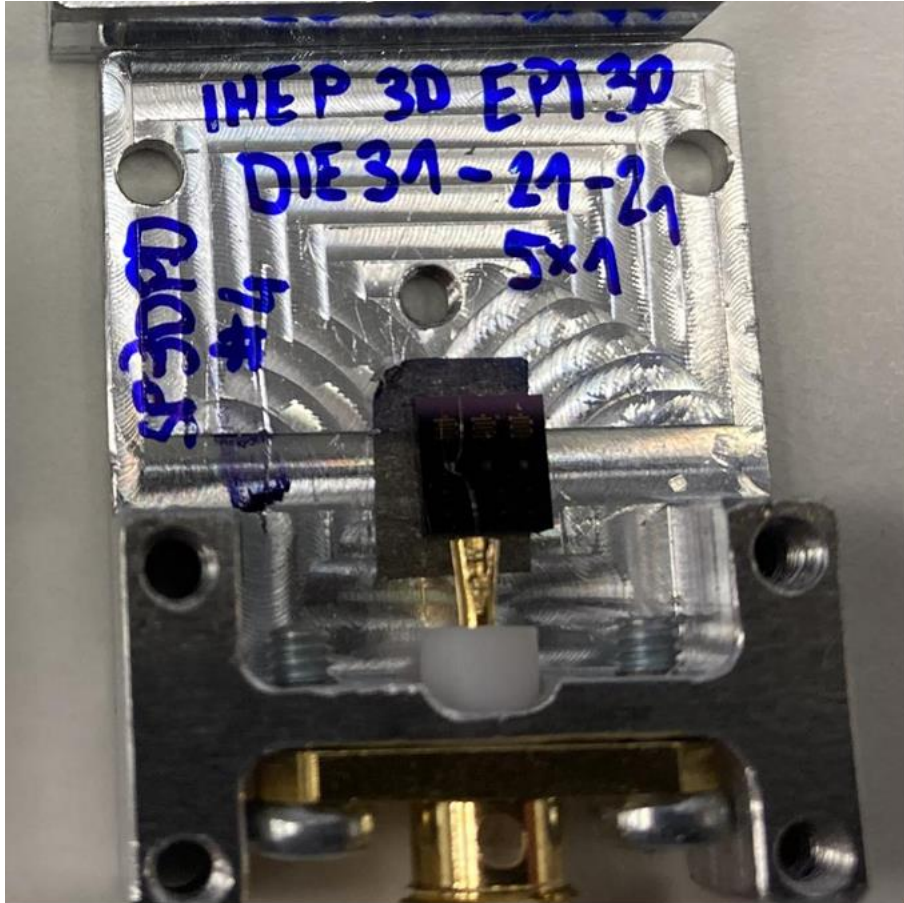


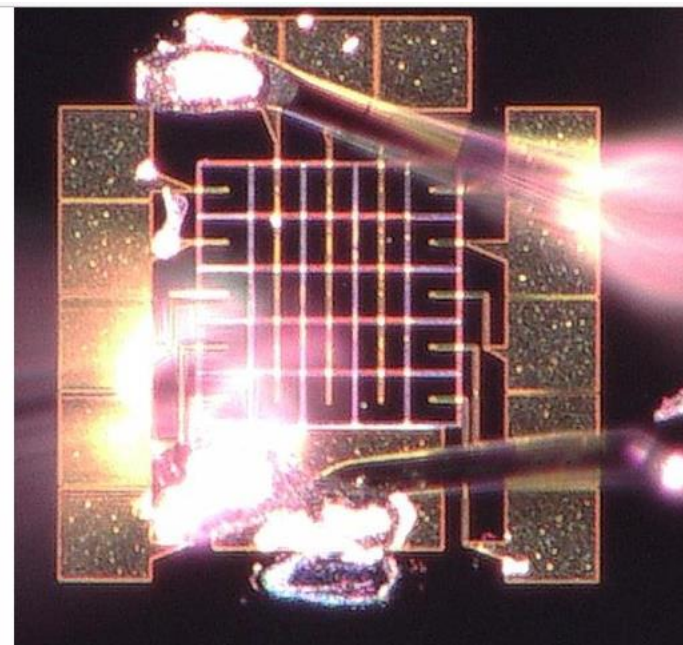
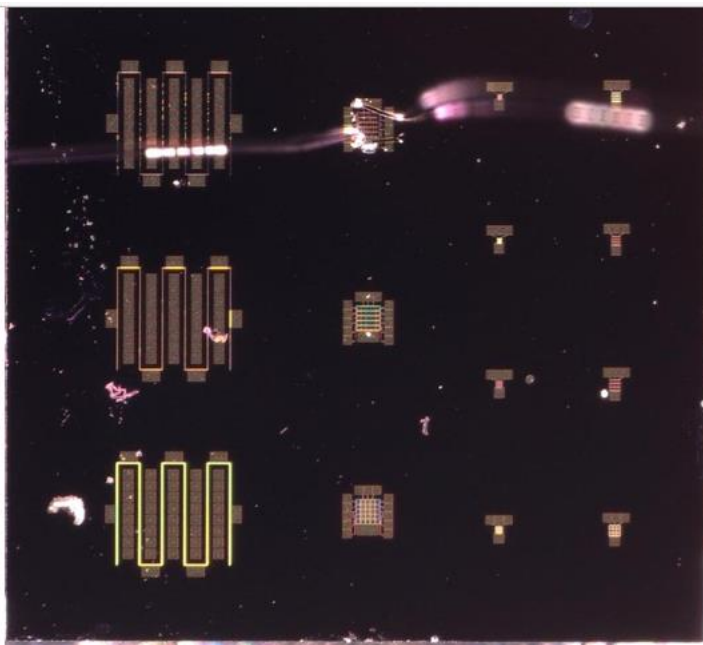
4th DRD3 Week, CERN, 10-15 Nov 2025

**Measurements on 3D-Trench IMECAS
Sensors
at ELI ERIC, ELI Beamlines with 2PA-TCT**

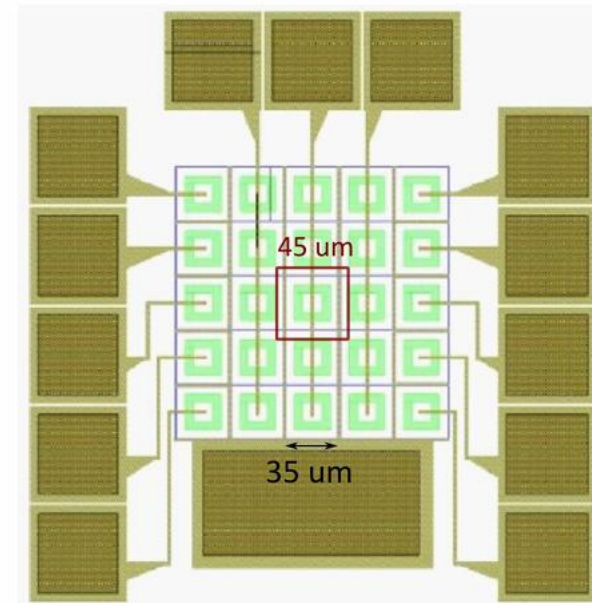
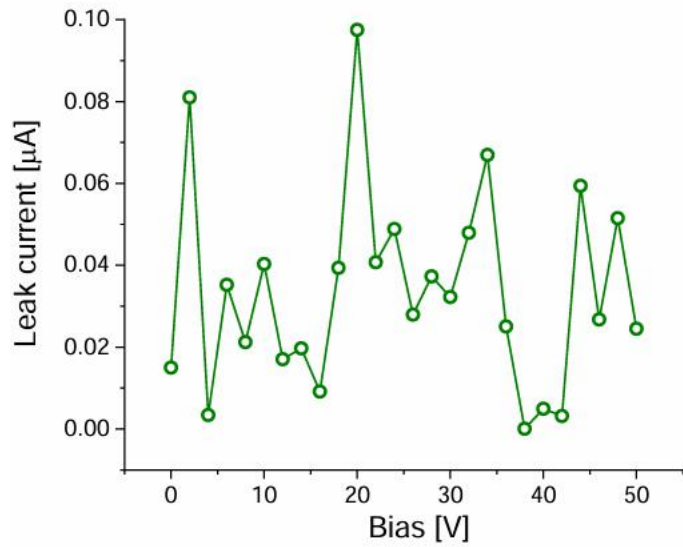
Gordana Lastovicka-Medin, UCG
Vuk Baletic, Danijela Mrkic, UCG
Bojan Hiti, Gregor Kramberger, JSI,
Zheng Li, Xin Shim, Yanwen Liu, Manwen Liu, Huimin Ji, IMECAS
Mateusz Rebarz, ELI



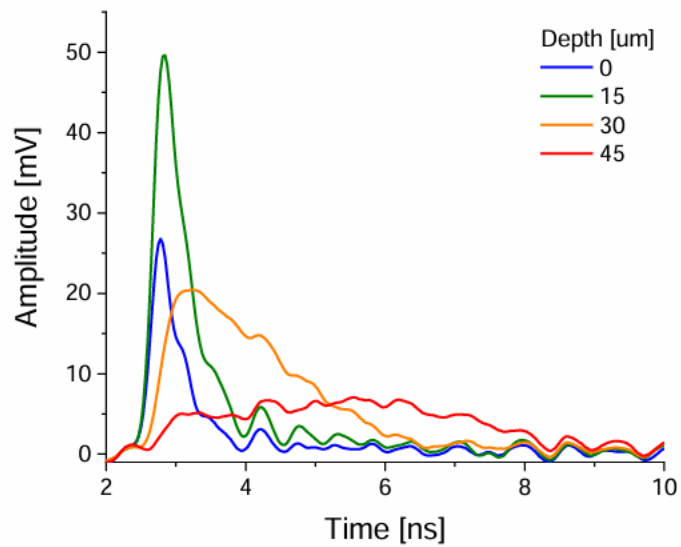
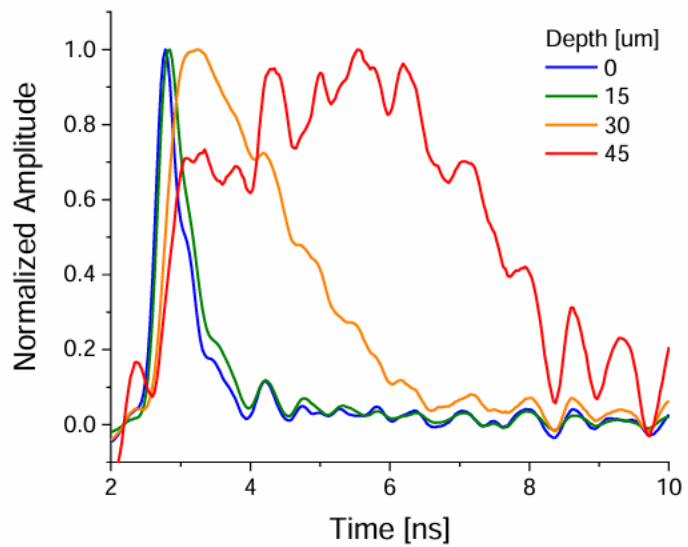
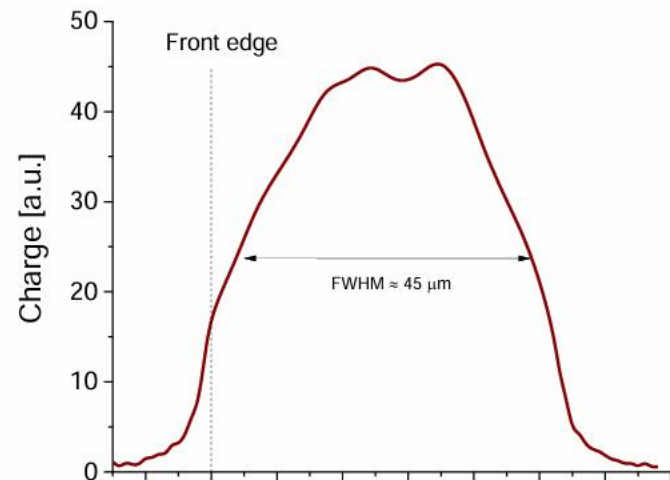
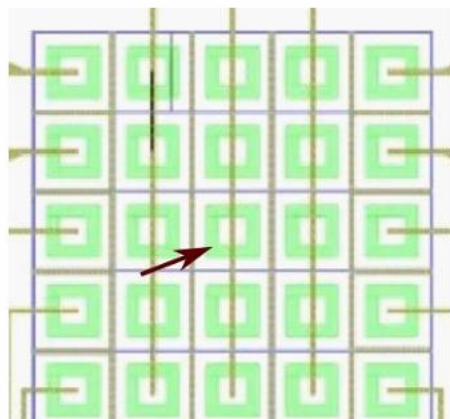
TPA: 1550 nm
Bias: 0-50 V
Power: 40 pJ
Amplifier: 35 dB
Temperature: RT



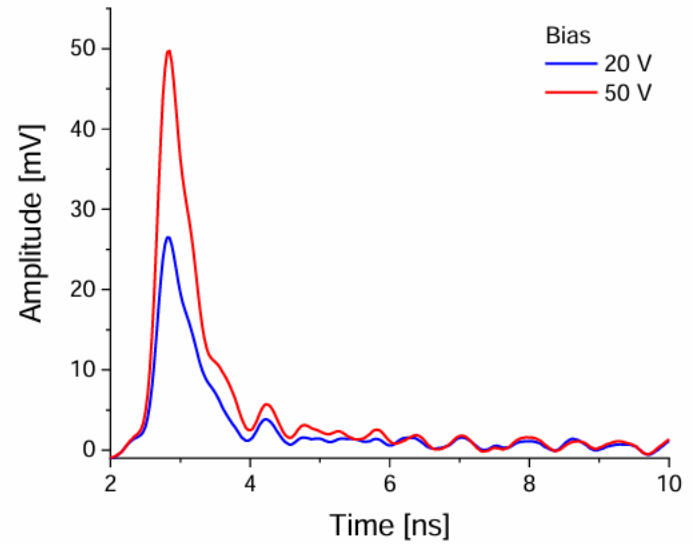
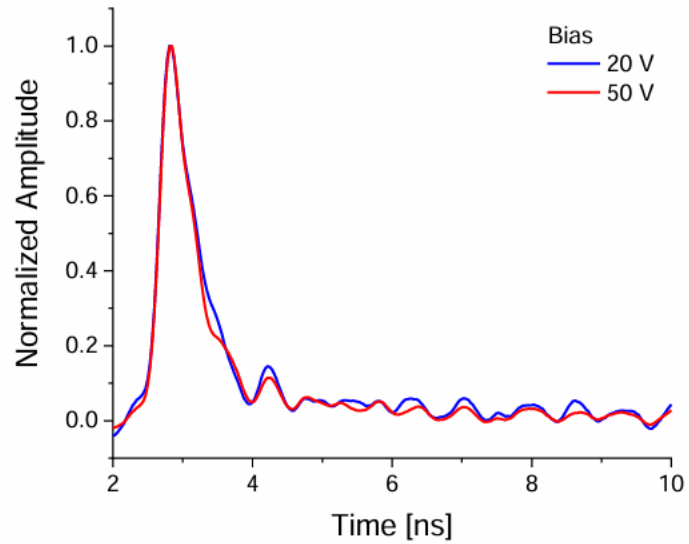
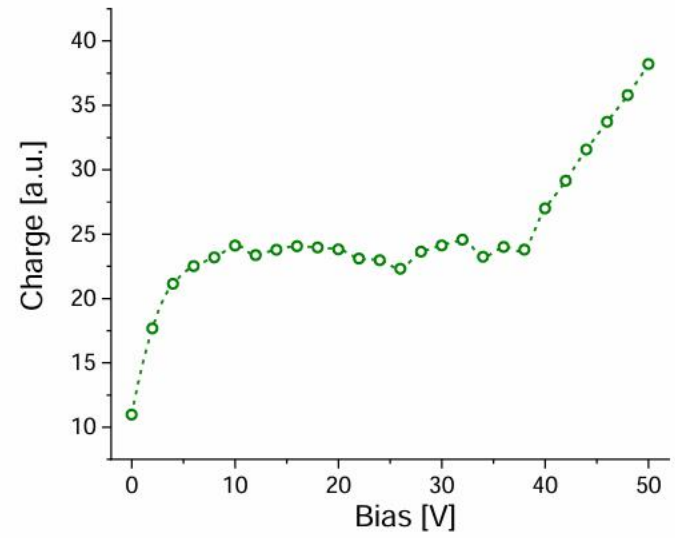
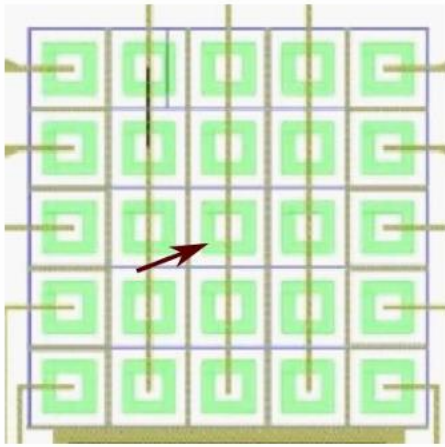
Leak current is very low up to 50 V
(I didn't try higher bias)



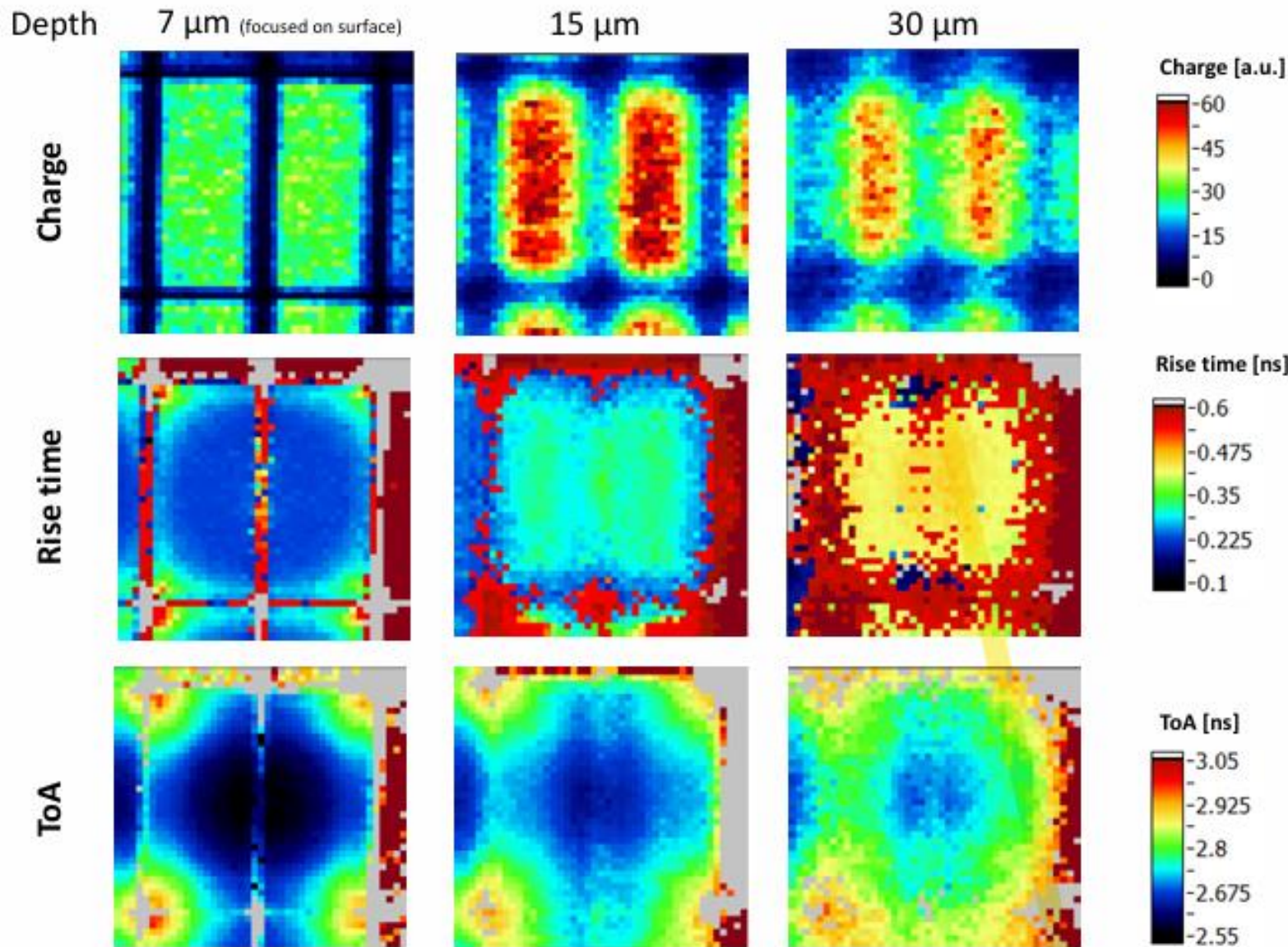
Z-scan (40 pJ, 50 V)



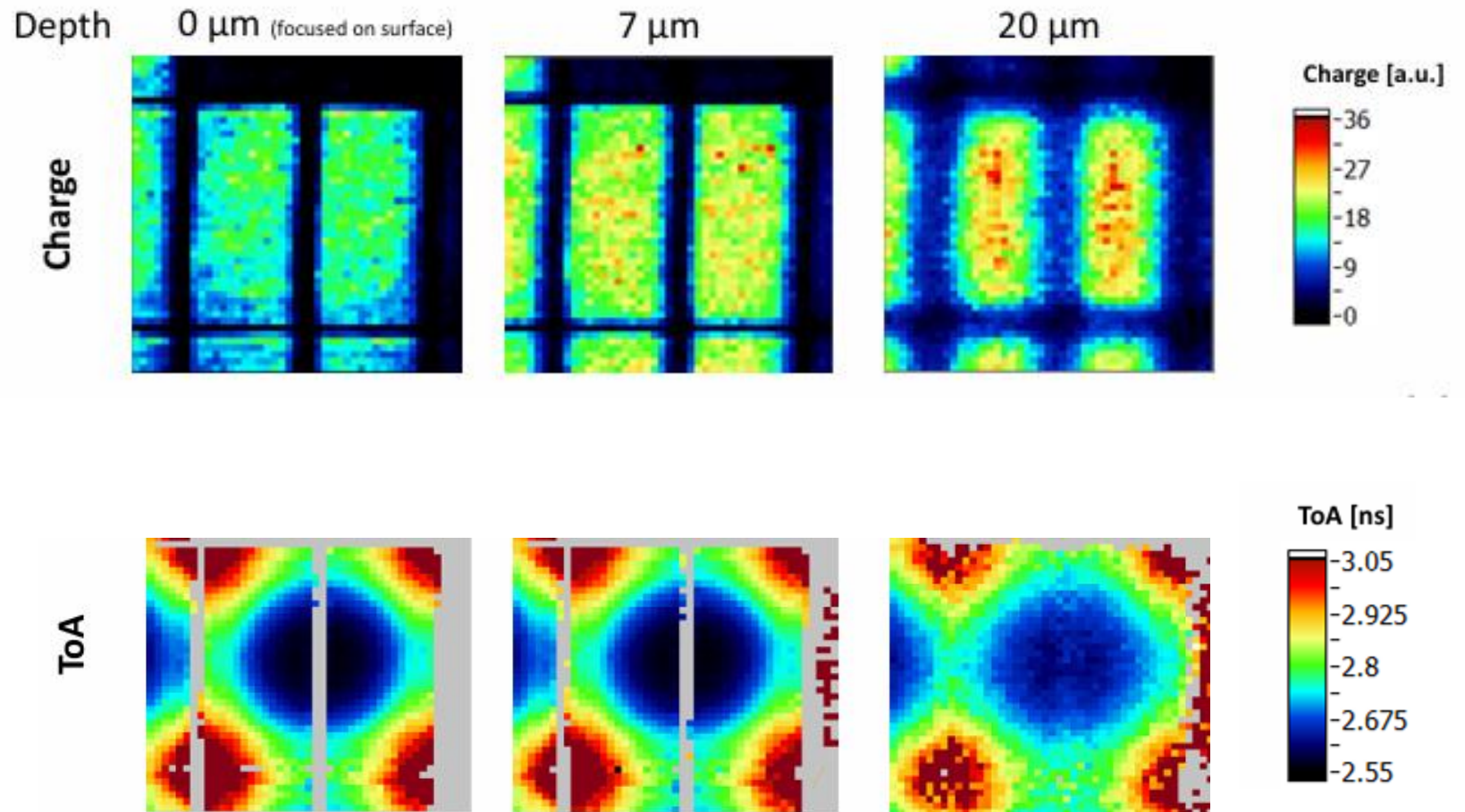
Bias-scan (40 pJ, depth 15 μm)



2D maps: 50 V, 40 pJ

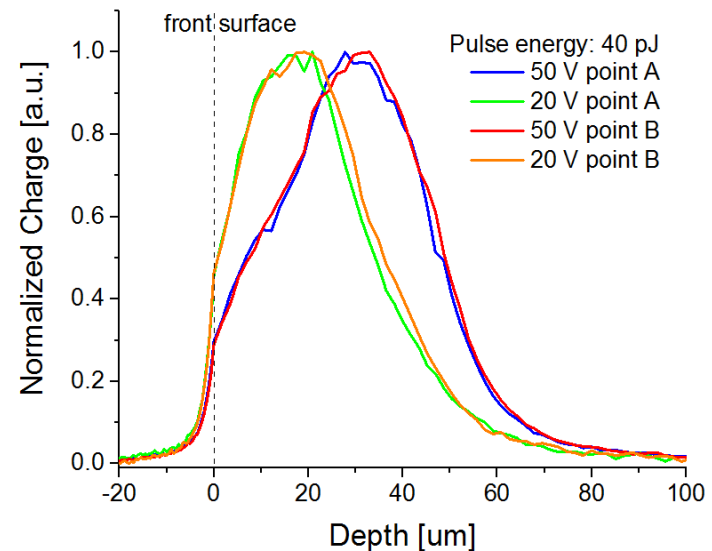
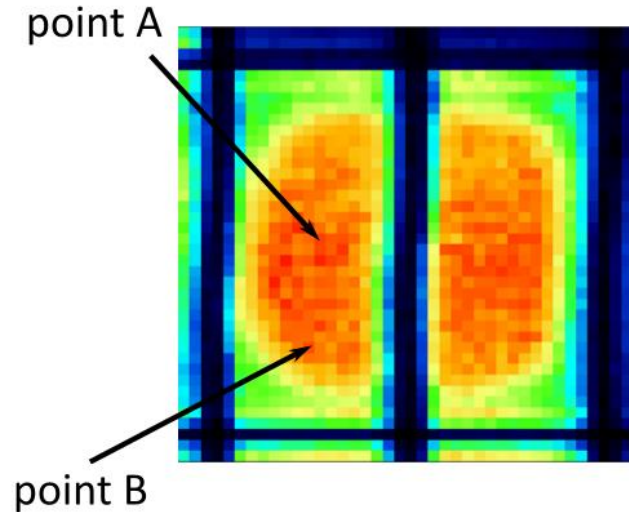
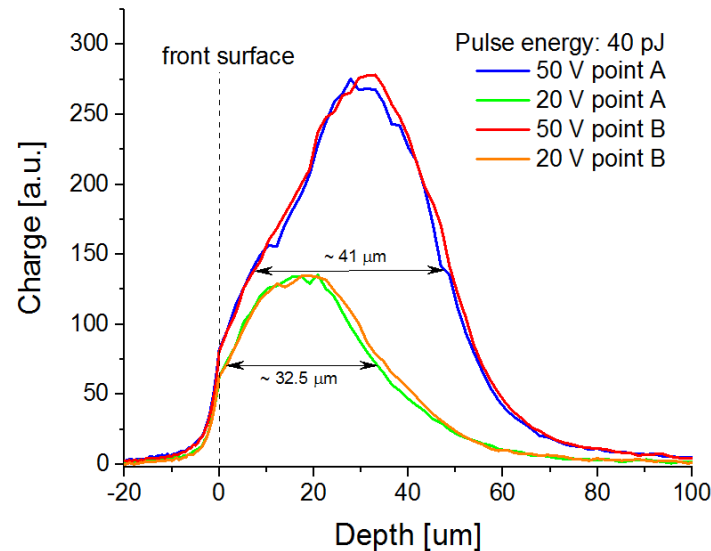


2D maps: 20 V, 40 pJ



Z-scans at 20V and 50V

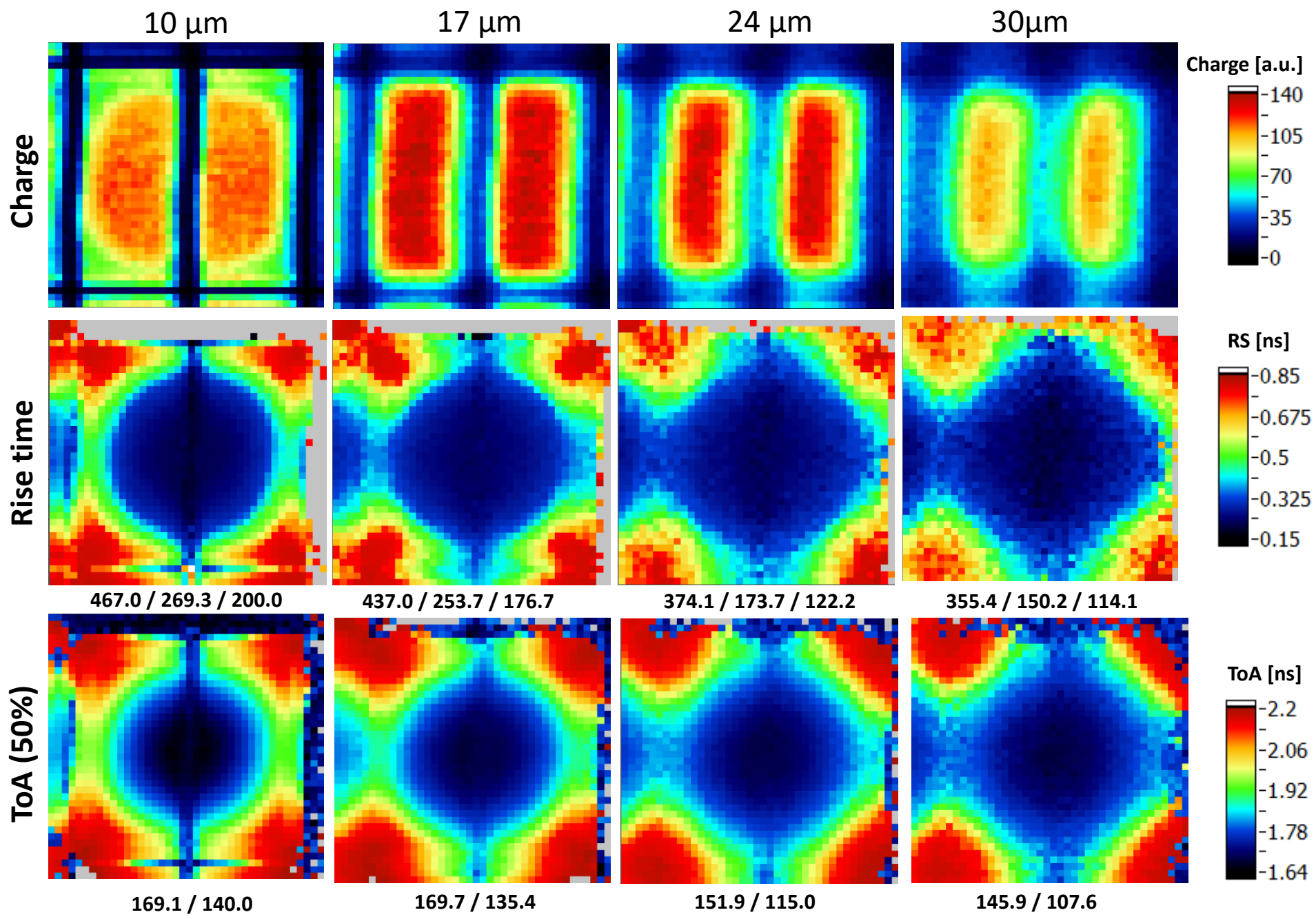
Z-scans were performed for two different bias through two testing points (A and B) Profile at 20 V (no gain) gives width close to nominal thickness value (35 μm) but profile for 50 V (gain) is significantly wider



2D maps were measured at two different bias for scanning central cell same as in preliminary data. Here, we have the same corresponding depths for both bias values. Timing parameters were determined for the scanned cell. TPA 1550 nm, pulse energy 50 pJ, amplifier 35 dB, room temperature

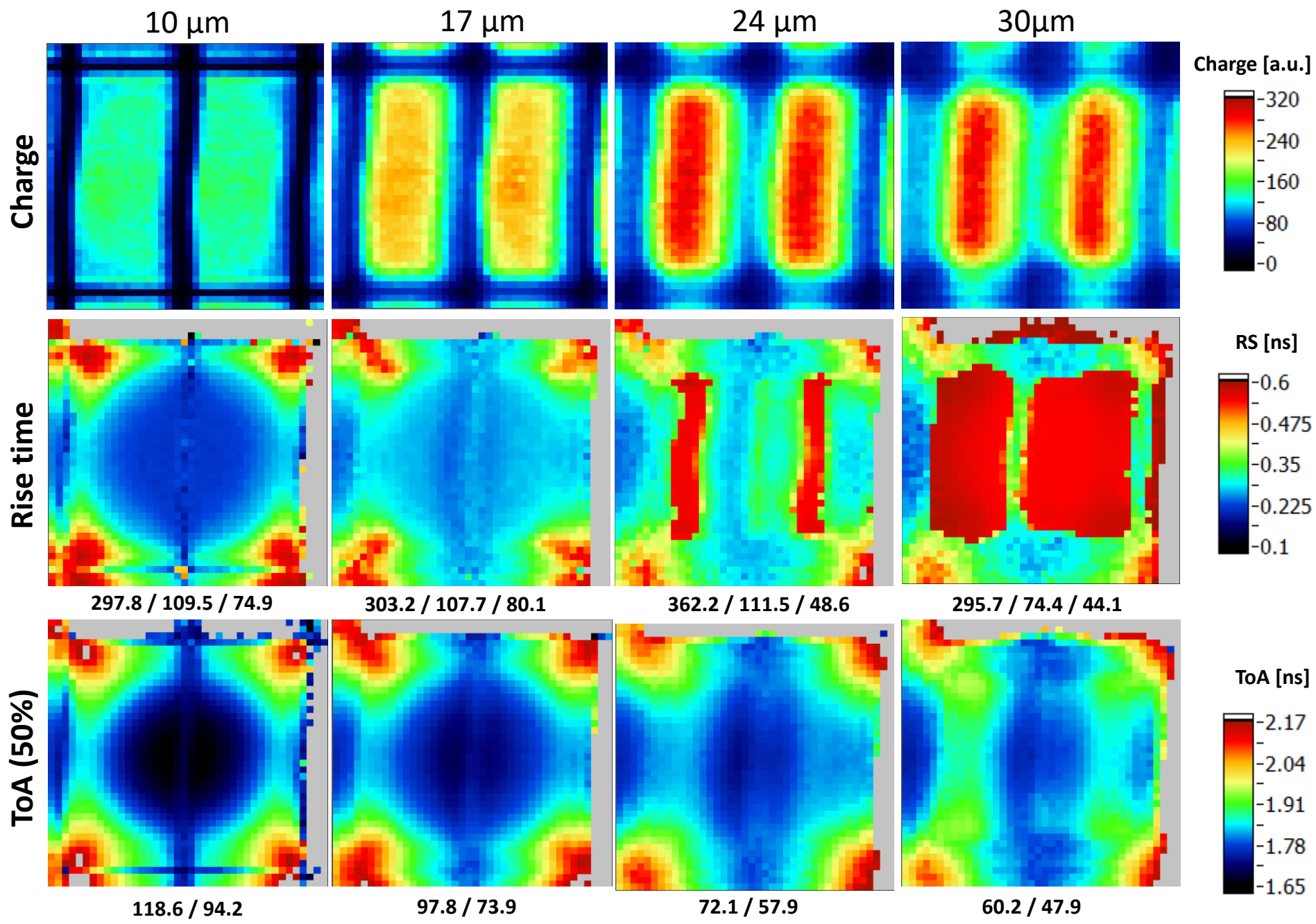
20 V

Maps Vs Depth



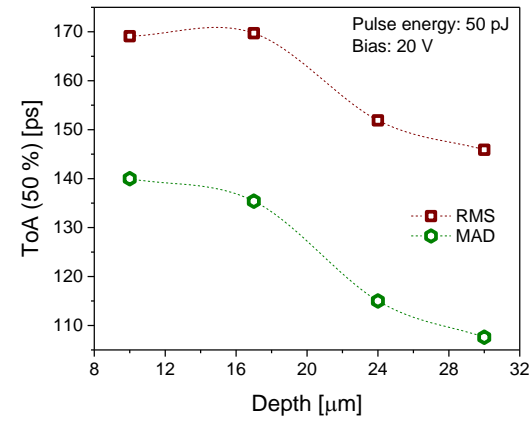
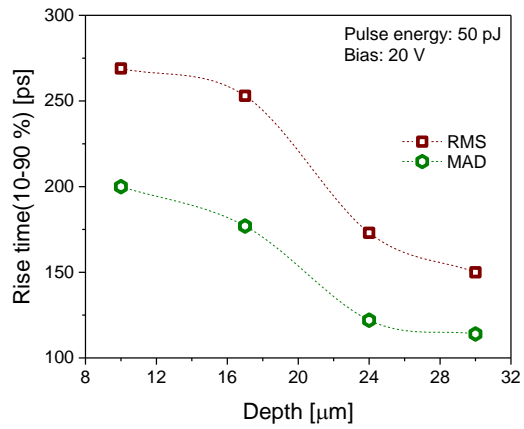
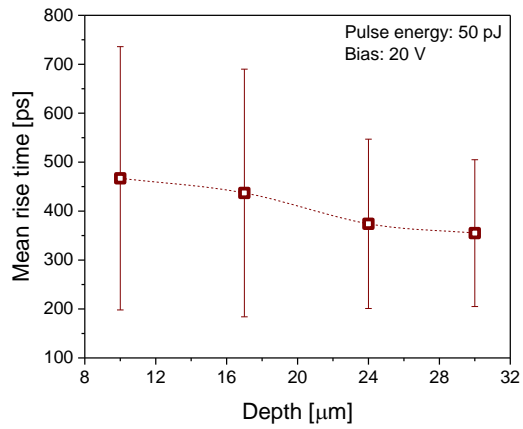
50 V

Maps Vs Depth

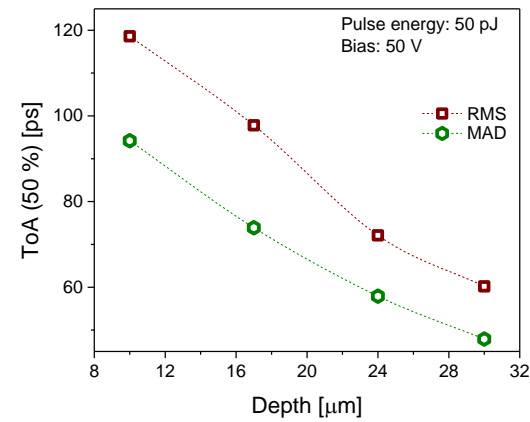
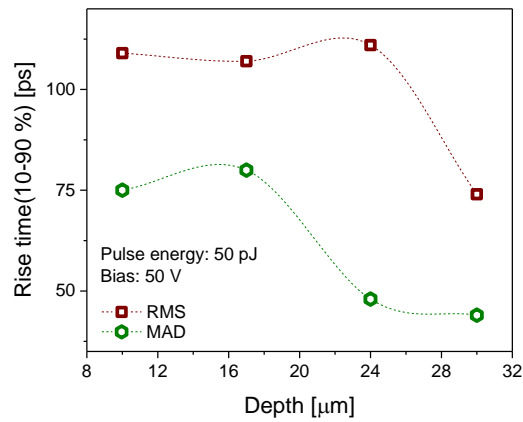
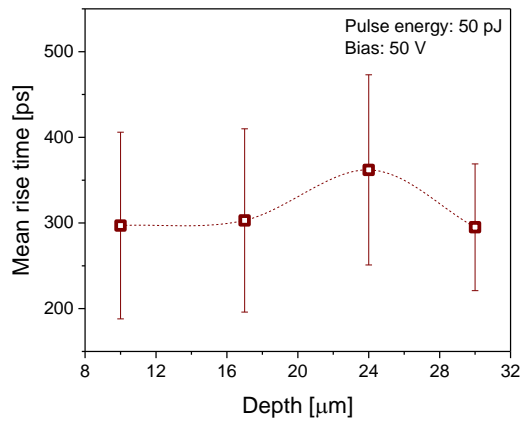


20 V

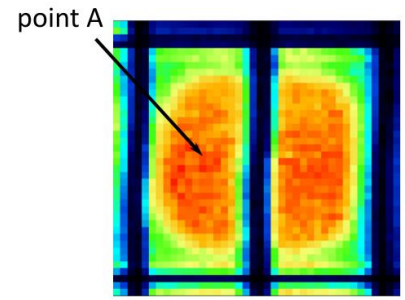
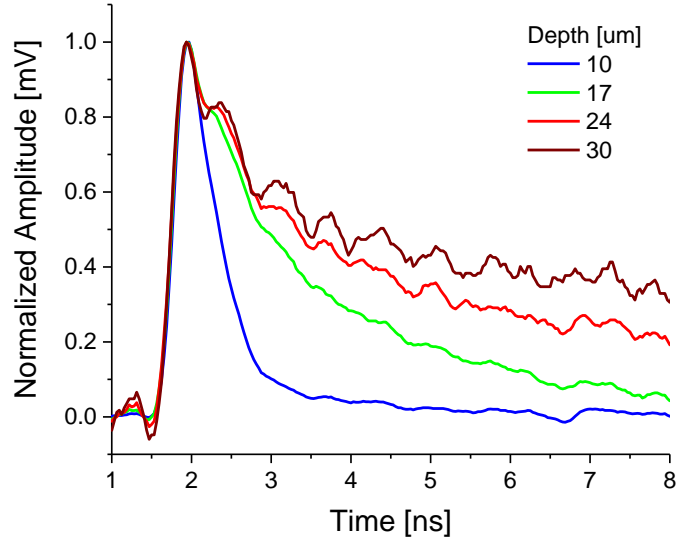
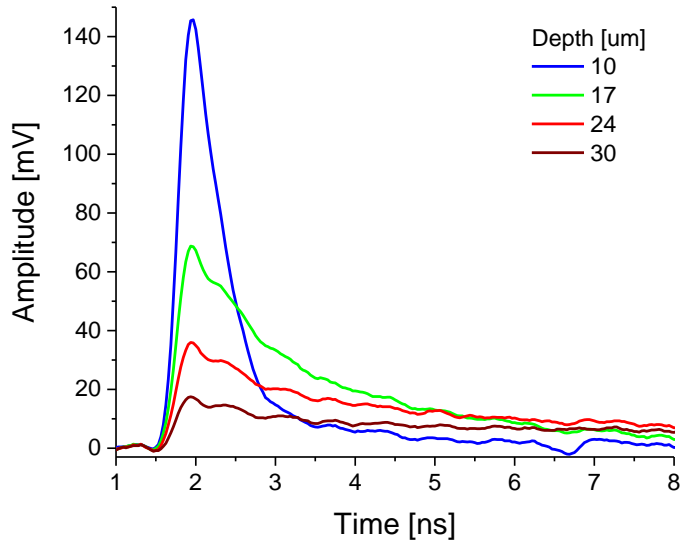
Timing parameters Vs Depth



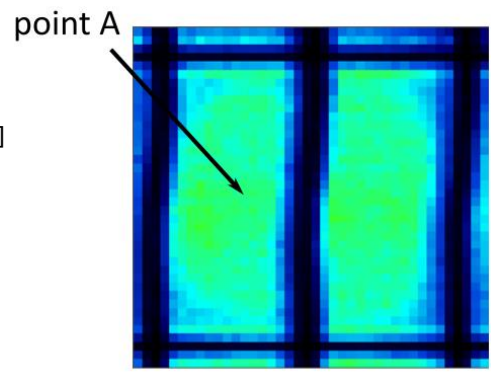
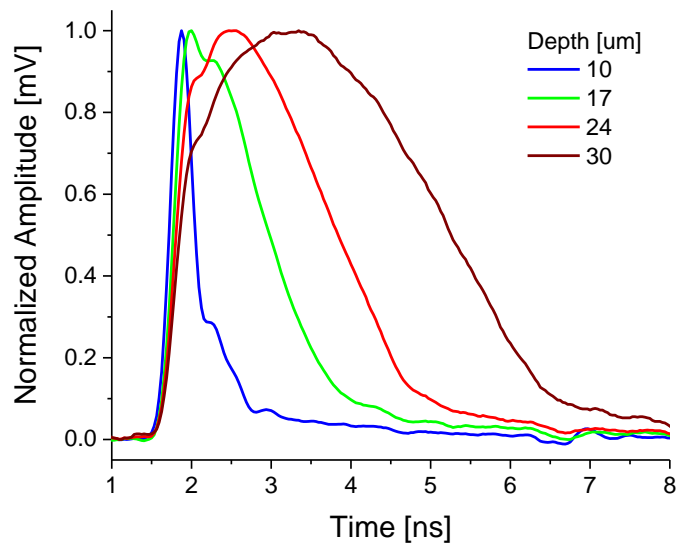
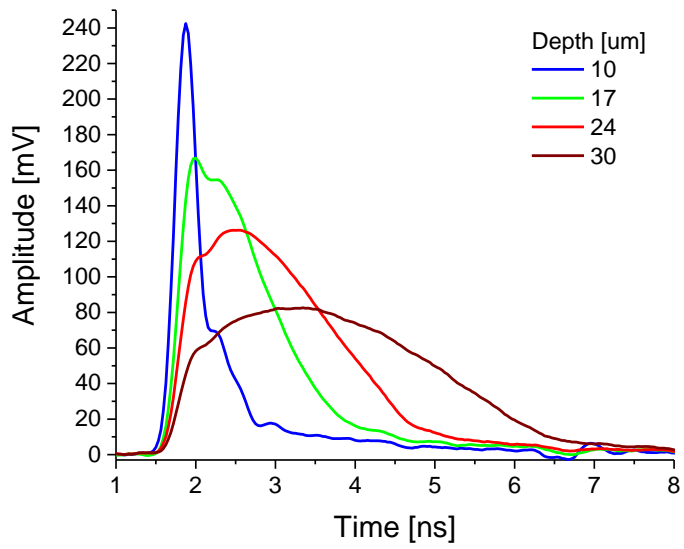
50 V

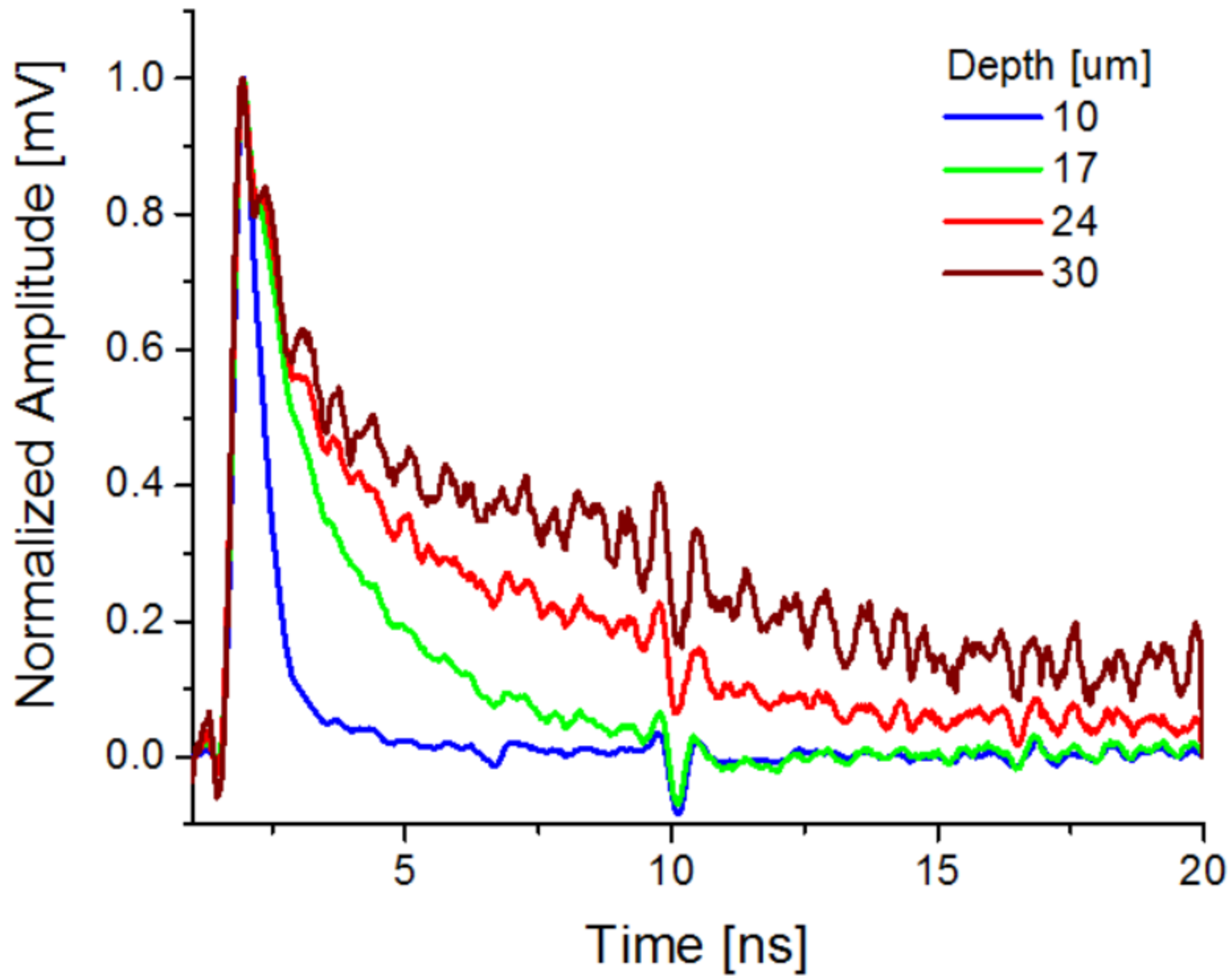


20 V Example waveforms from testing point A



50 V Example waveforms from testing point A





Comparison to 3D CNM

Waveforms vs depth from selected point (same for every depth)

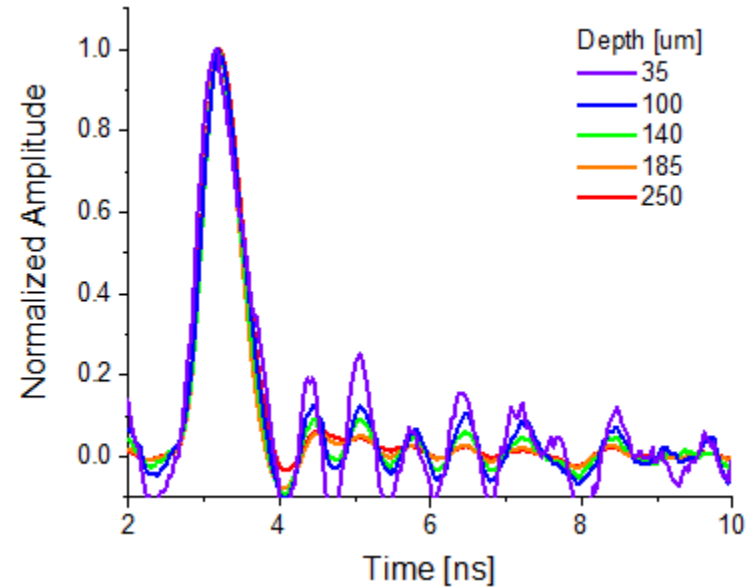
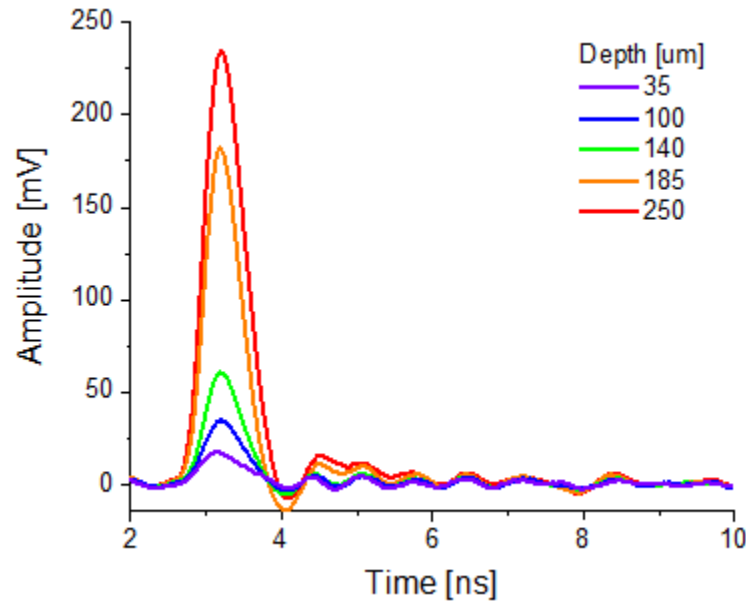
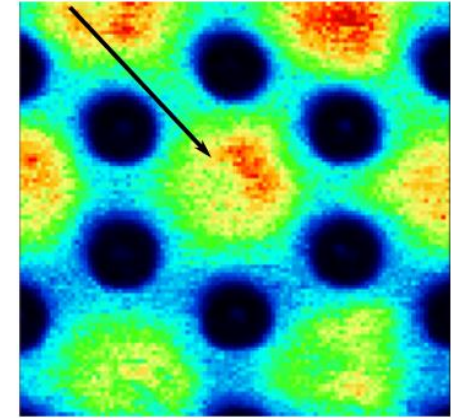
3D CNM Multi-cell HEX (4-X) – non-irradiated

TPA: 1550 nm, 650 pJ, 40 V

Backside illumination

Depth calculated from top surface

testing point



No widening effect (in contrast to IMECAS) vs depth. Amplitude decrease is mostly due to clipping (for backside illumination going up total power decreases). Width of signal is the same across entire depth.

Comparison to 3D CNM

Example Waveforms 3PA vs TPA

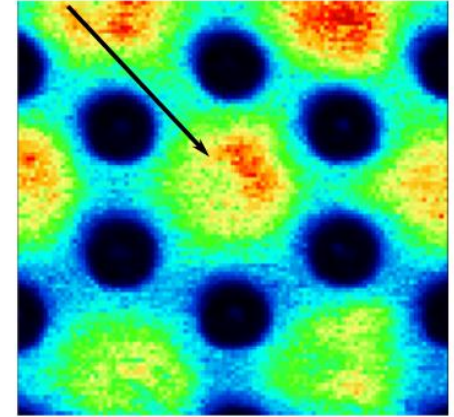
3D CNM Multi-cell HEX (4-X)

TPA: 1550 nm, 650 pJ, depth 185 μm

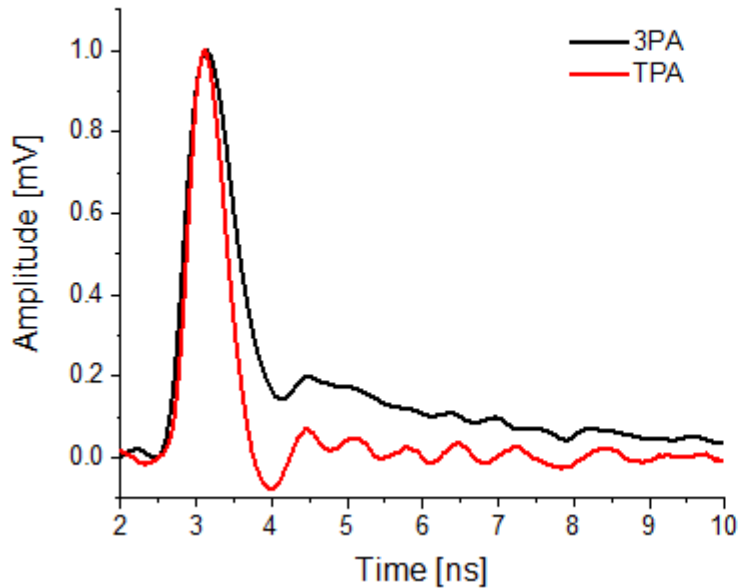
3PA: 2500 nm, 235 nJ, depth 185 μm

Backside illumination

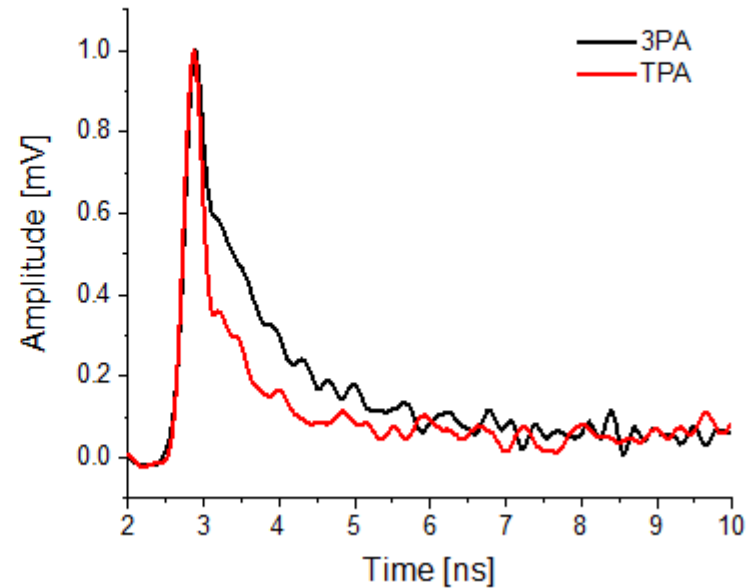
testing point



non-irradiated (40 V)



Irradiated (200 V)



What is done and what the future steps are

Done (on non-irradiate samples):

- ✓ Our first results are shown
- ✓ Results are now under careful investigation and systematic checks

On non-irradiated samples:

- 3PA technique will be performed on 3D trench devices are the results will be compared with 2PA; we will also performs SPA-TCT with different wavelengths probing this way different depth of device.
- More devices to be tested and compared (uniformity of ToA, rising time, charge collection time)

Future plan:

On irradiated samples

- 3PA – TCT was successfully applied on irradiated 3D CNM sensors (this will be shown at 4th DRD3 week)
- We will also apply 3PA methodology and technique on the 3D Trench IMECAS devices (we are looking forward to receiving set of irradiated samples from Igor and Gregor in nearby future)