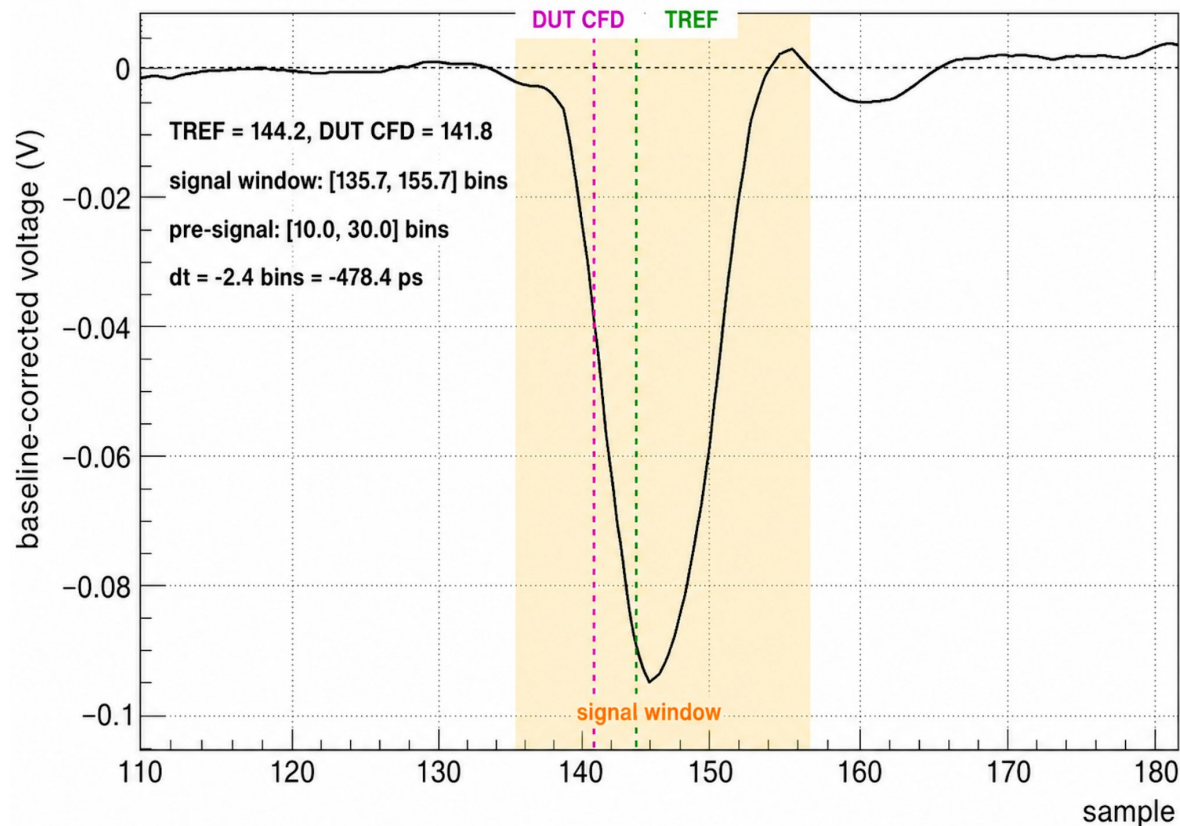
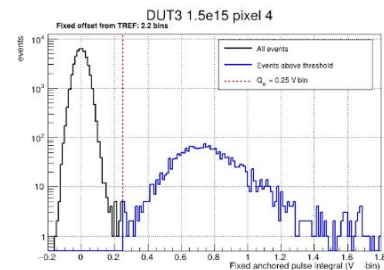
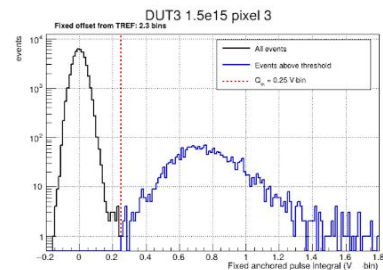
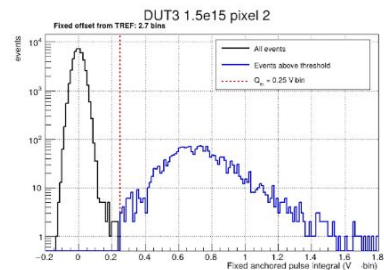
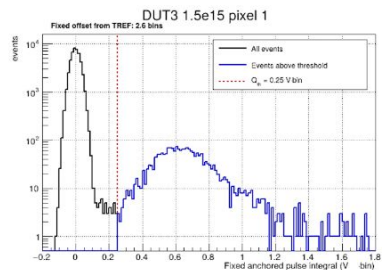
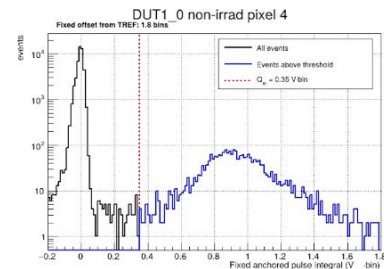
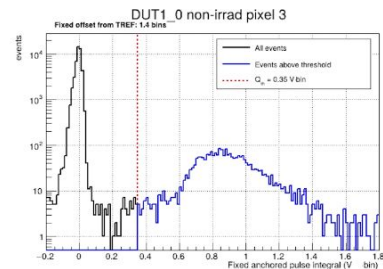
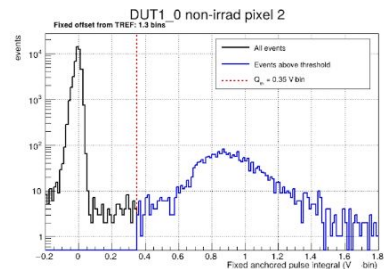
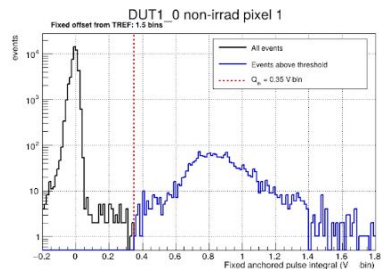


Fixed-anchor signal extraction and timing definition

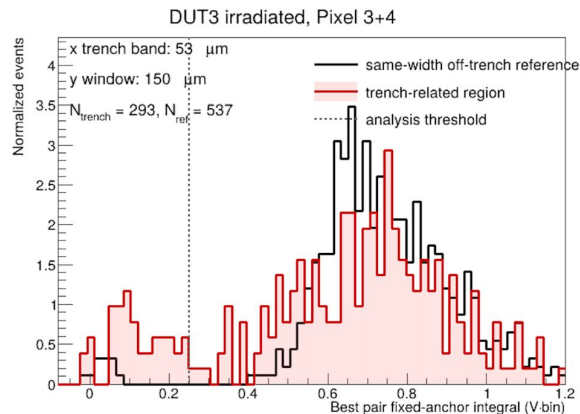
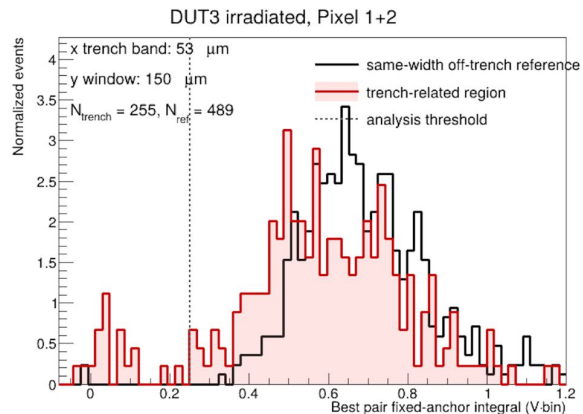
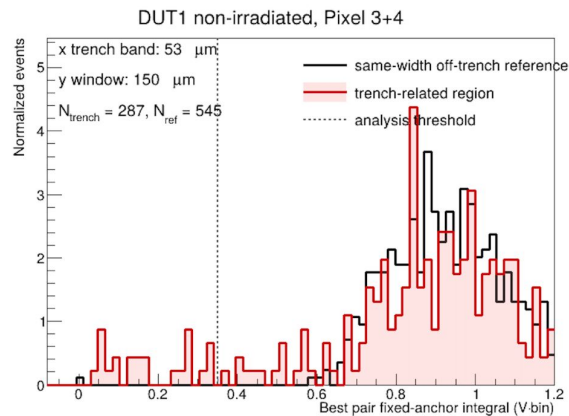
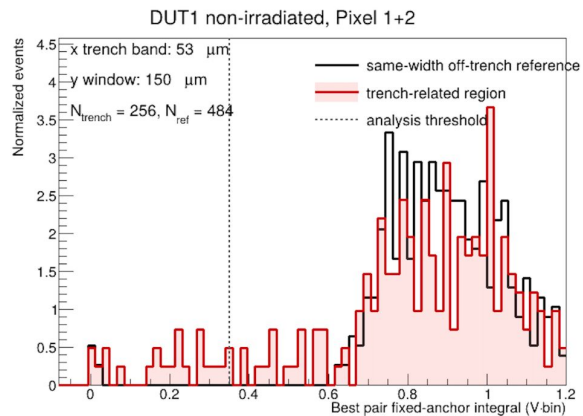


- TREF CFDA defines the event time anchor
- Same-length pre-signal window used for baseline reference
- $dt = t_{\text{DUT}} - t_{\text{REF}}$
- The DUT charge is integrated in a fixed 20-bin window placed relative to the TREF CFDA anchor, to avoid the pedestal bias of peak-centering while retaining the main part of the DUT pulse for the selected events in this run

TI LGAD structure: V2-TR1-TW2/TW3



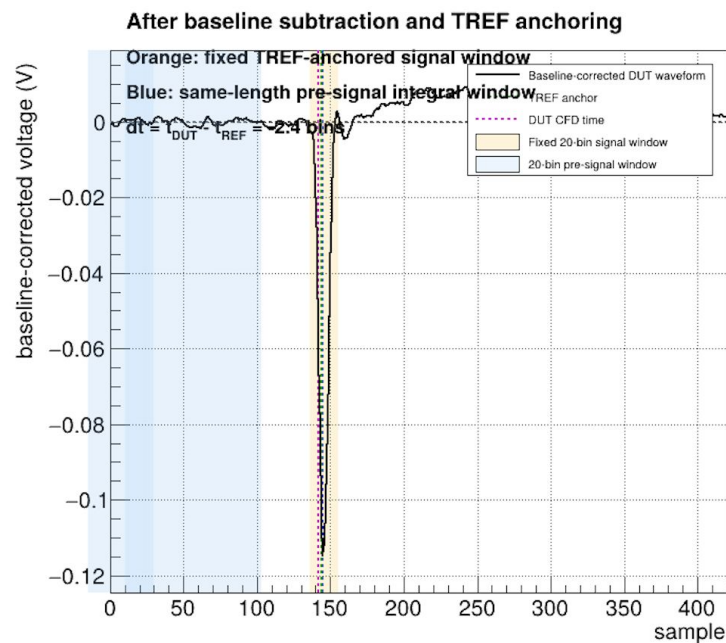
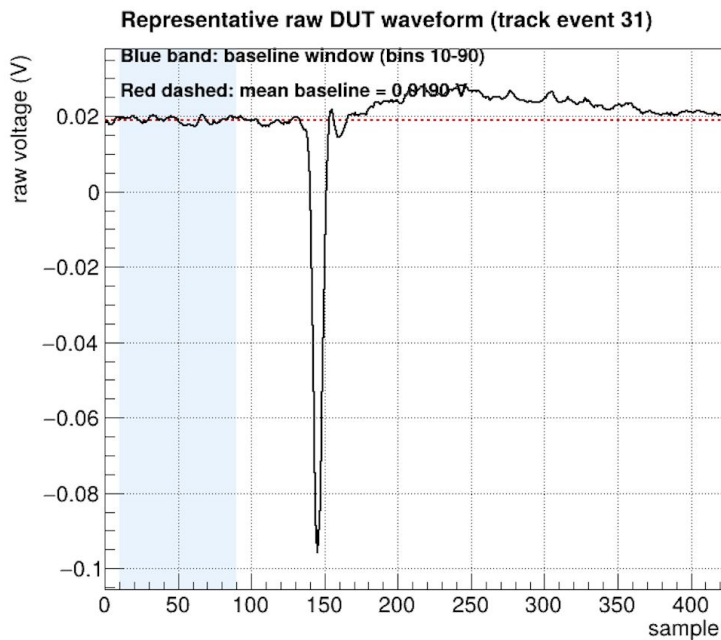
How does the trench-region signal spectrum compare to a nearby non-trench region?



The trench-related region shows a lower-charge population than the off-trench reference region, which is consistent with the local efficiency loss.

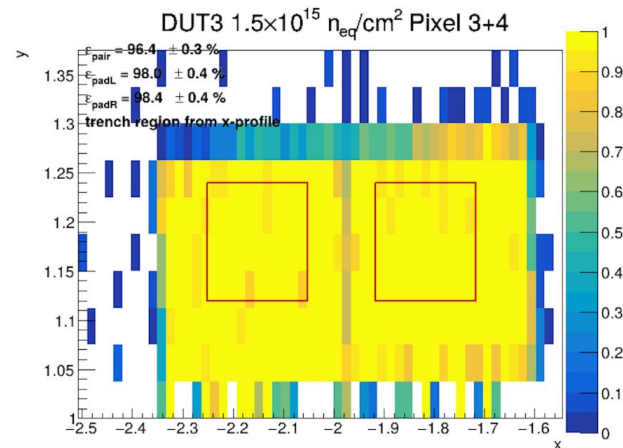
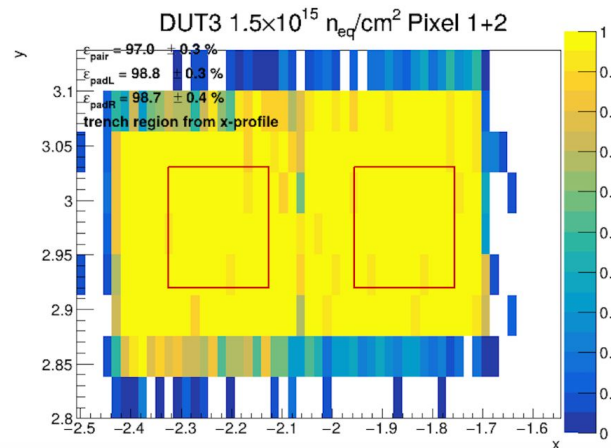
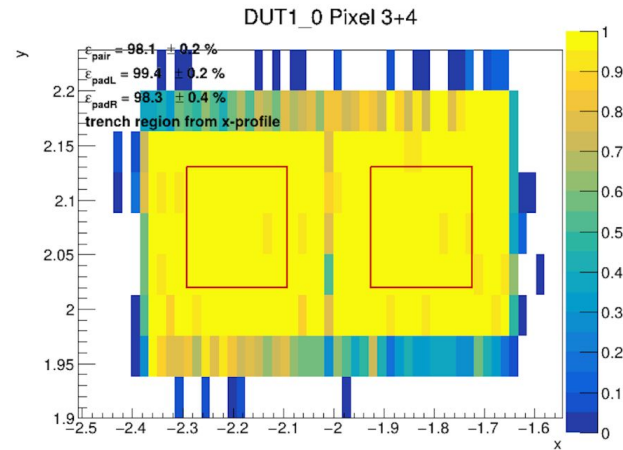
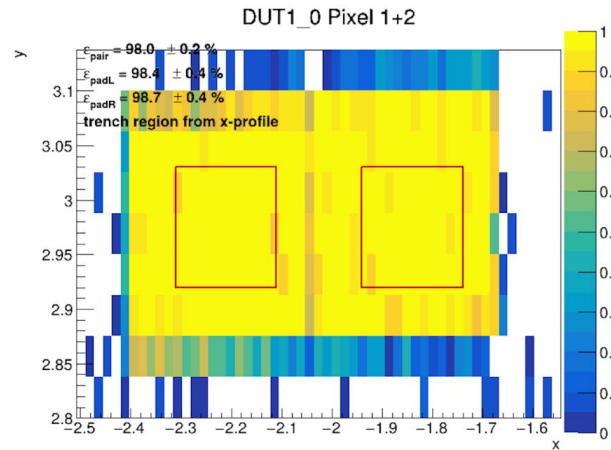
Example event showing the fixed TREF-anchored signal definition

- REF waveform defines the time anchor.
- DUT signal is integrated in a fixed 20-bin window relative to that anchor.
- A same-length pre-signal window is used for the baseline reference.
- dt is the time difference between DUT and reference.



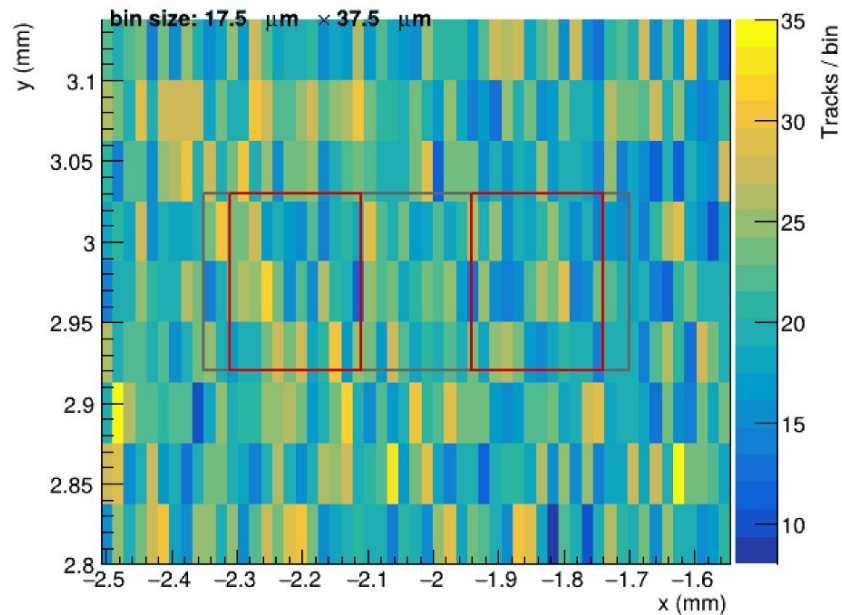
Efficiencies

Binning: $17.5\ \mu\text{m} \times 37.5\ \mu\text{m}$

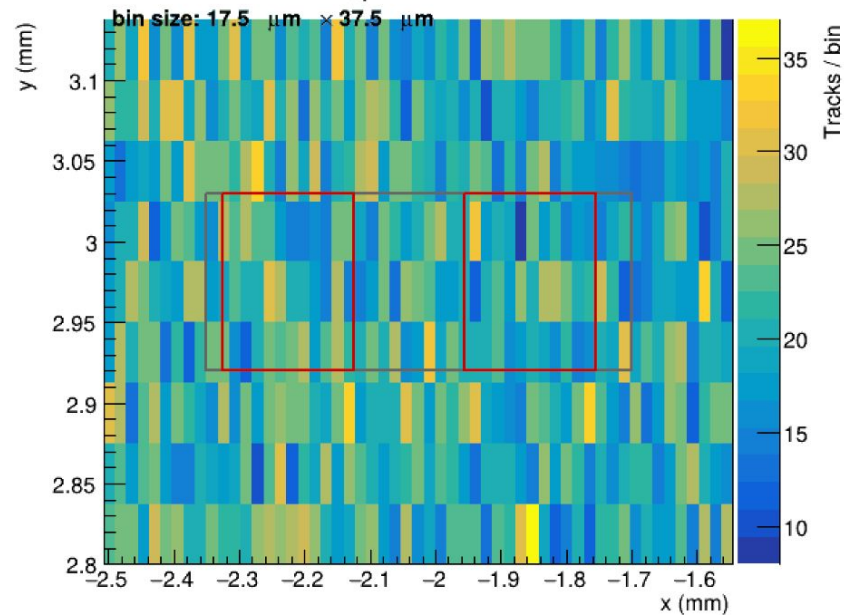


- Pad-only ROIs exclude the trench
- Left and right pad efficiencies quoted separately
- Pair inefficiency is partly driven by the trench region

DUT1_0 Pixel 1+2 track statistics



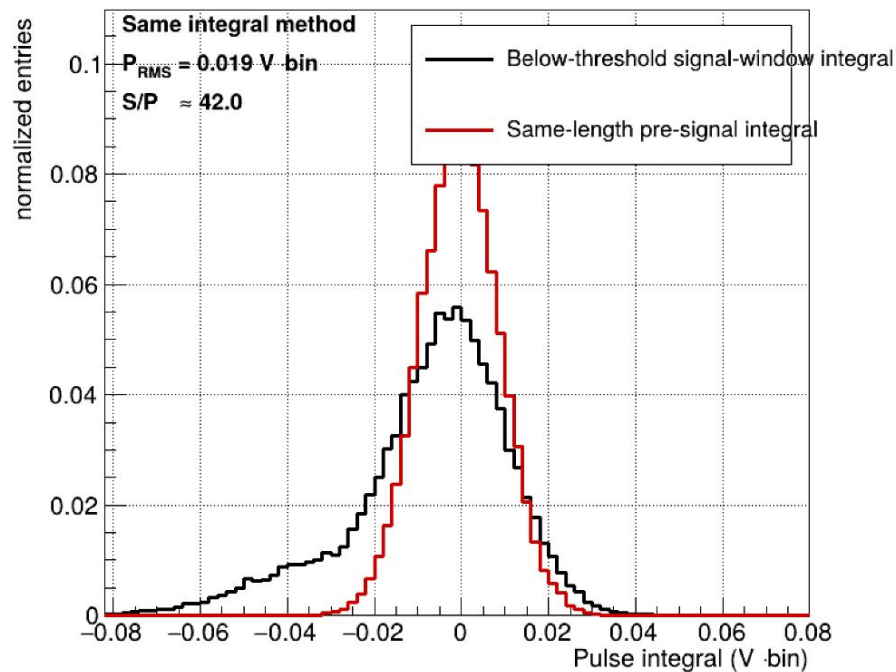
DUT3 $1.5 \times 10^{15} n_{\text{eq}}/\text{cm}^2$ Pixel 1+2 track statistics



- Track-statistics map shown to indicate local entries per bin-> Typical local statistics: about 17 tracks/bin

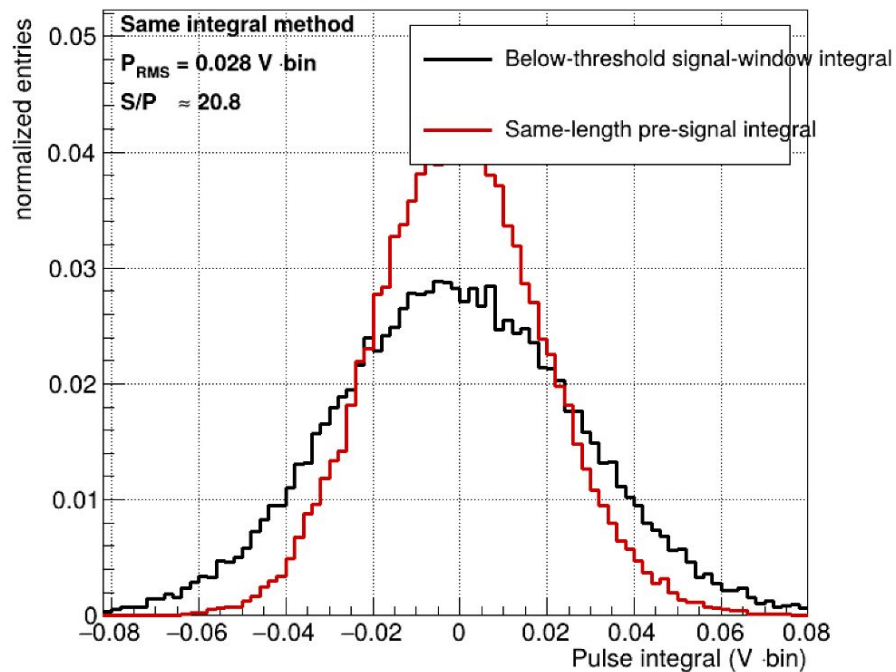
DUT1_0 non-irrad pixel 1

Pedestal-focused comparison

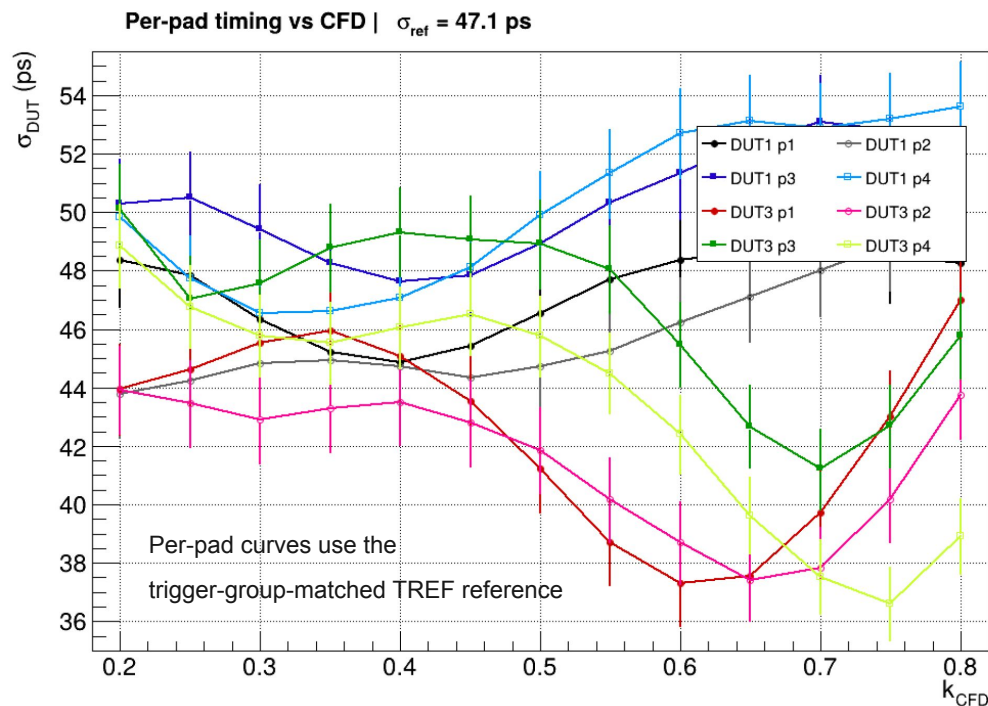


DUT3 1.5e15 pixel 1

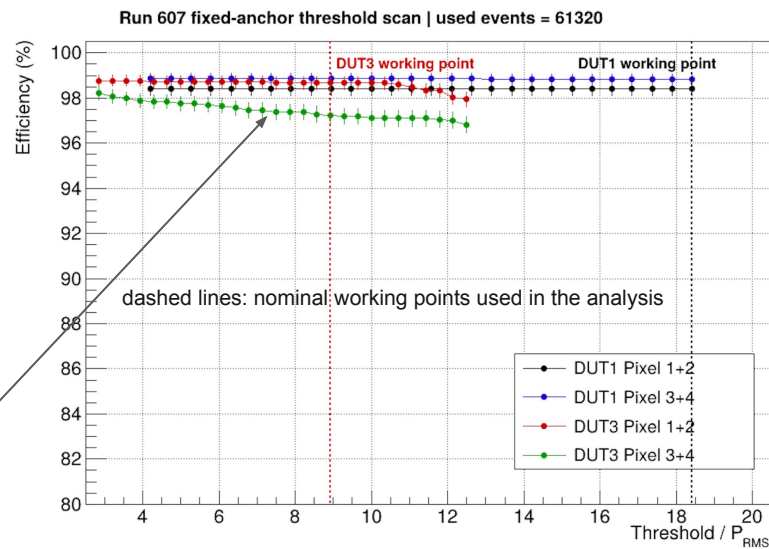
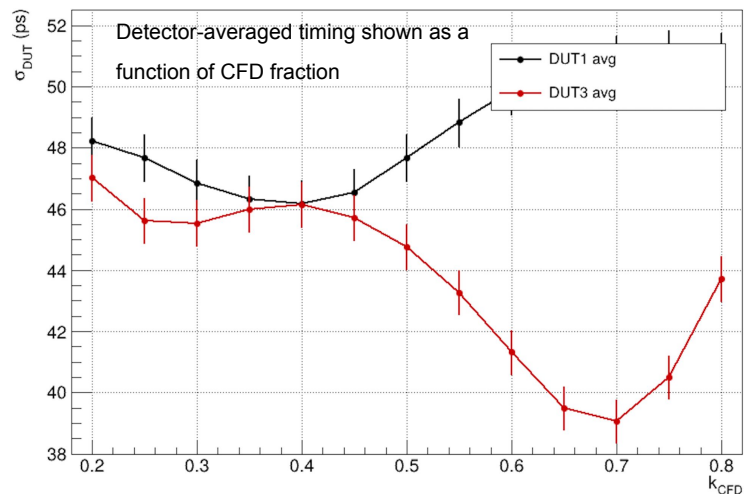
Pedestal-focused comparison

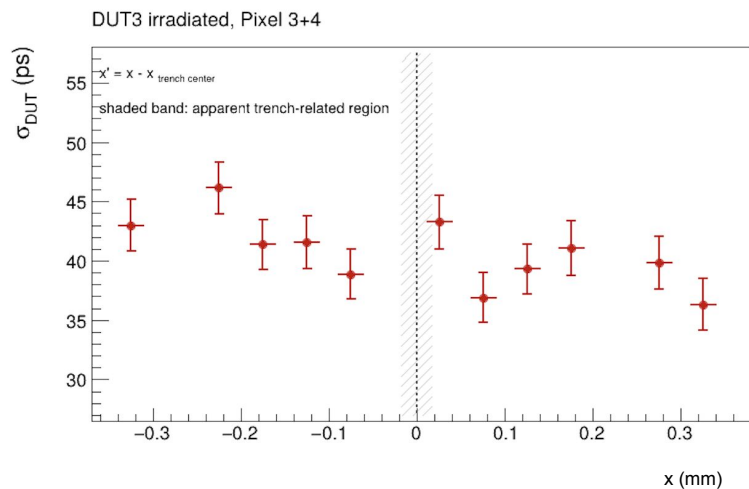
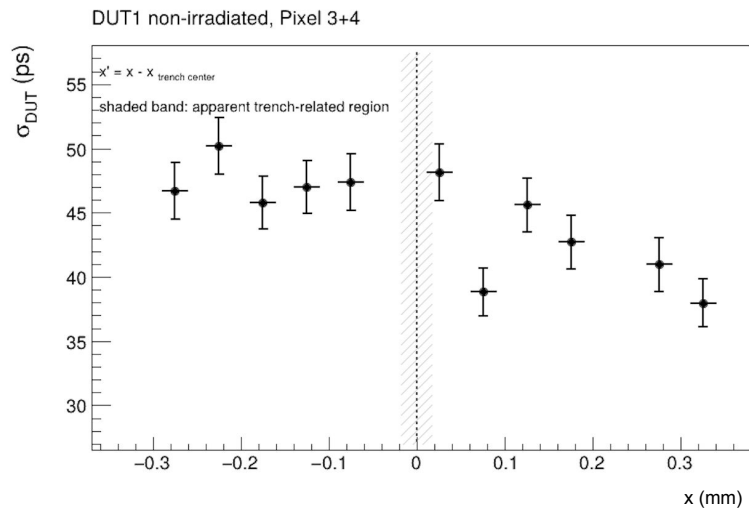


Threshold and CFD scans with track-based fixed-anchor selection



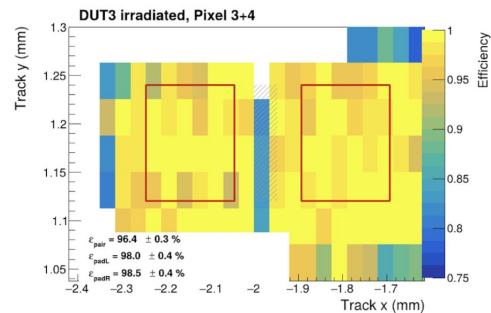
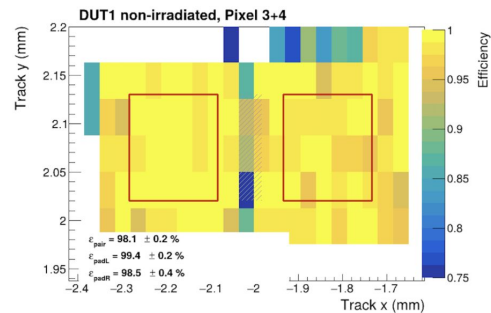
Threshold choice is much more critical for DUT3 than for DUT1





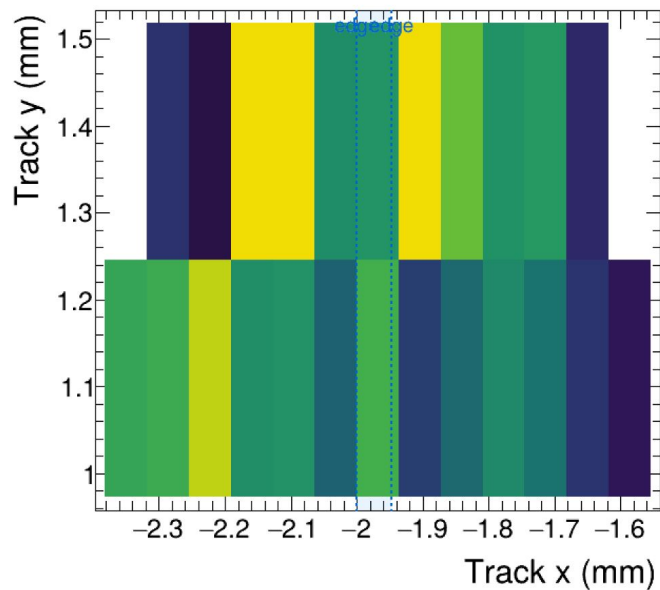
Trench-centered timing x-projection plots

- Timing projected in x after aligning each pair to its own trench center
- Grey band: apparent trench-related region from the efficiency x-profile
- No strong universal timing degradation is observed

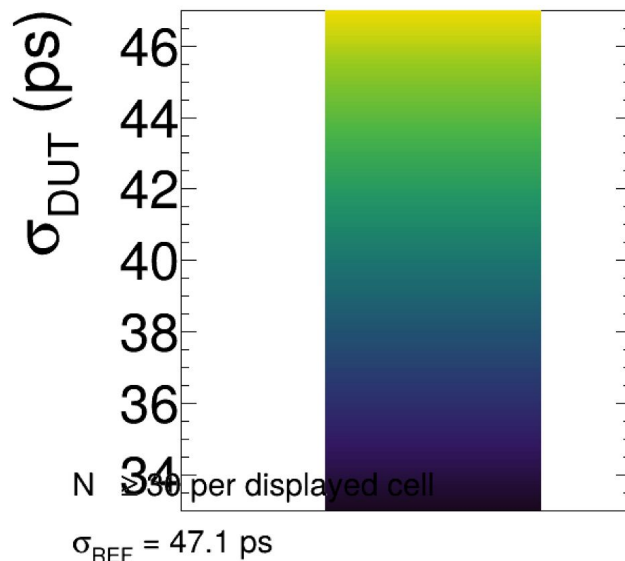


2D local timing map

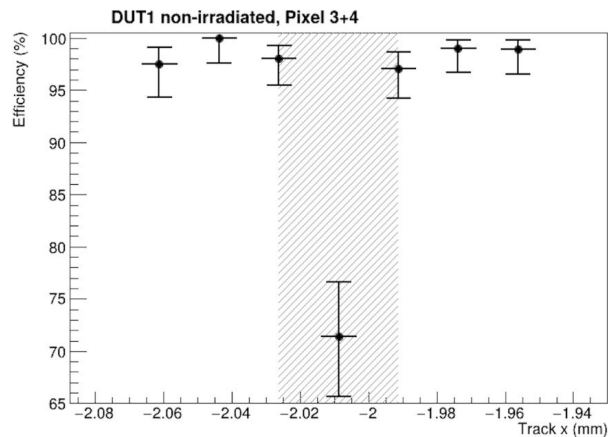
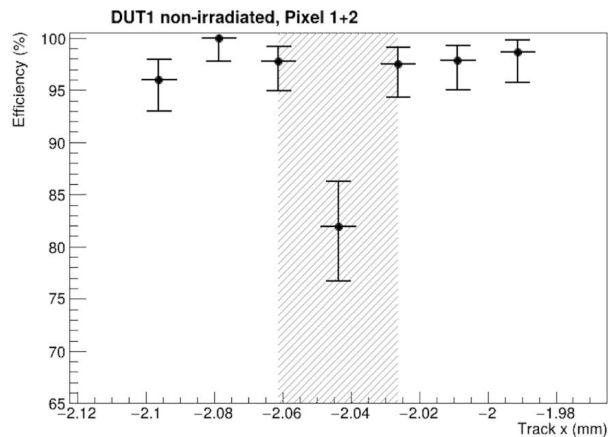
DUT3 irradiated, Pixel 3+4



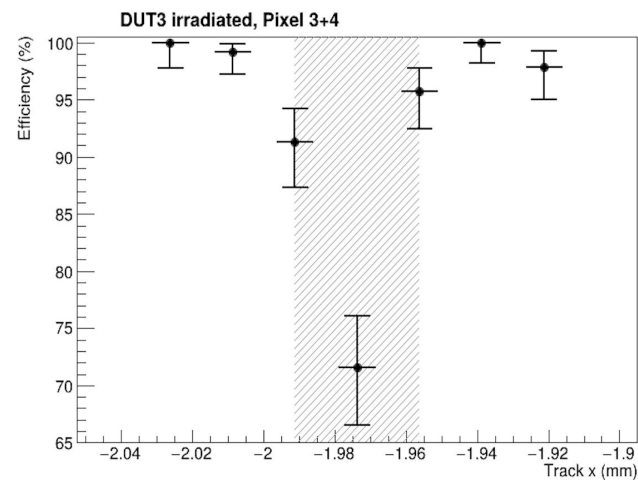
Direct local ΔToA RMS



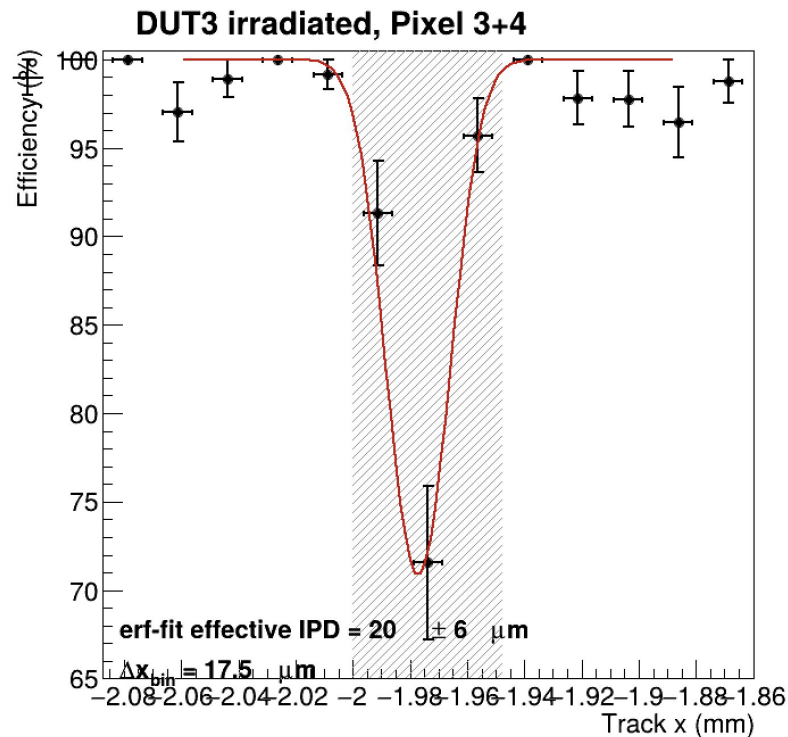
- Direct local ΔToA RMS map
- DUT3 irradiated, Pixel 3+4
- Blue dashed lines: trench edges from efficiency x-profile
- Only cells with $N \geq 30$ timing entries shown



- Efficiency projected in x for the full pair ROI
- Error bars: Clopper–Pearson 68.3% confidence intervals
- Grey band: apparent trench-related region from the efficiency x-profile
- DUT3 shows a clear localized efficiency dip in the apparent trench-related region



Effective IPD estimate from the efficiency dip



- Summed x projection for DUT3 irradiated, with an error-function fit to the trench-related efficiency dip

$$\varepsilon(x) = p - (A/2) * [\text{erf}((x - xL)/\sigma) - \text{erf}((x - xR)/\sigma)]$$

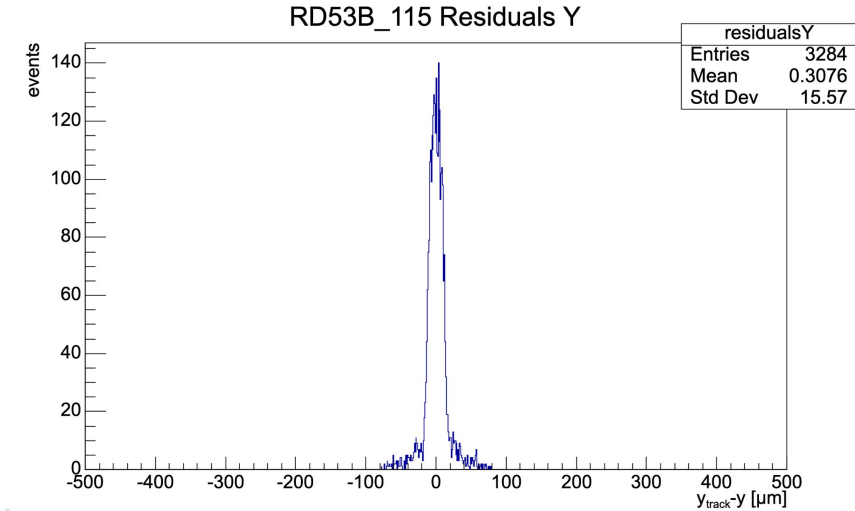
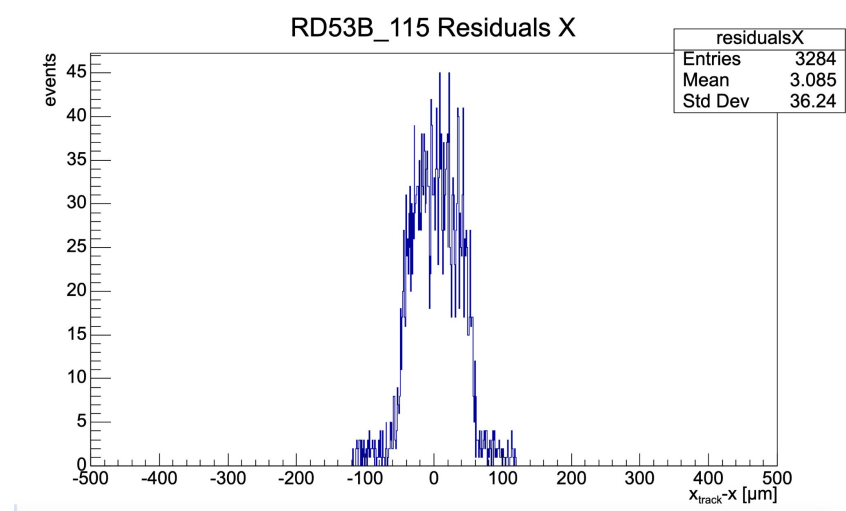
with parameters:

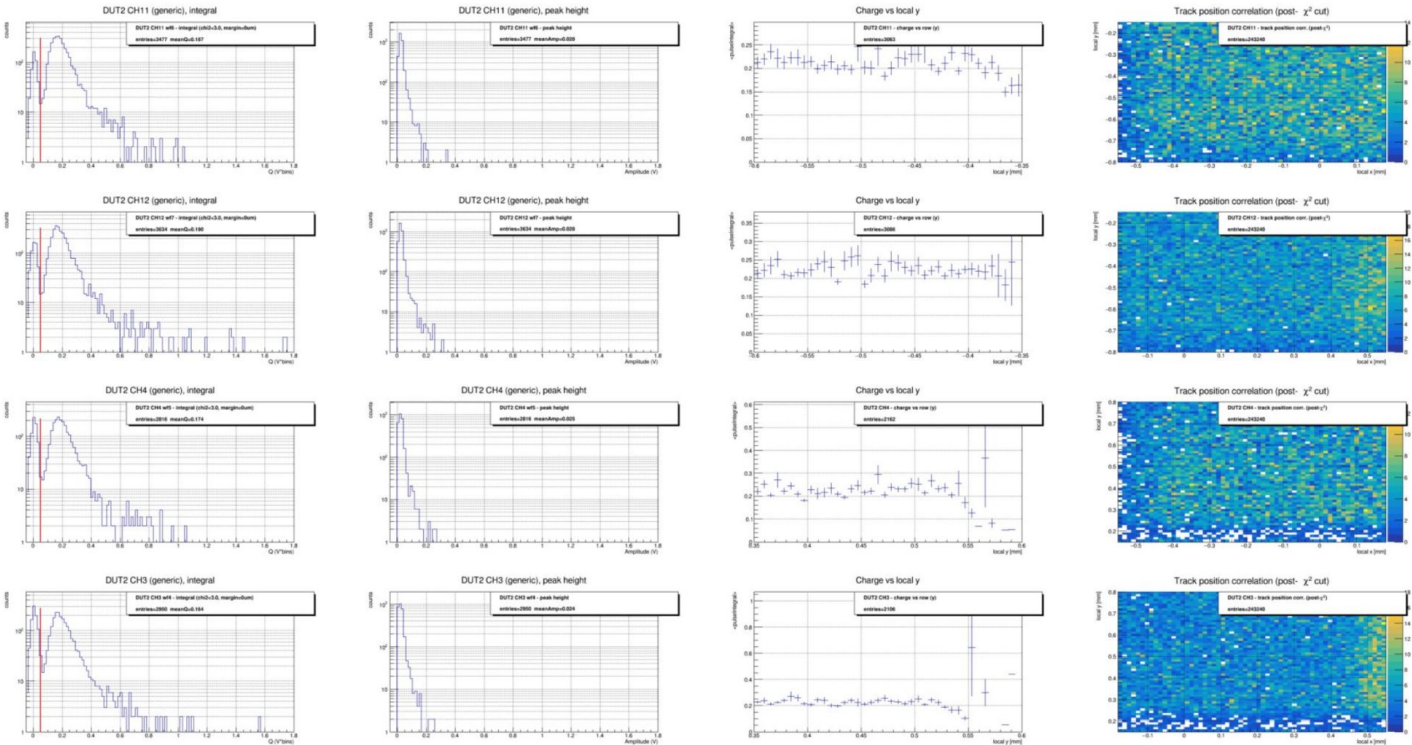
- p : plateau efficiency
 - A : dip amplitude
 - xL, xR : effective dip edges
 - σ : edge-smearing scale
- Larger dip-region errors reflect lower local track statistics
 - Grey band: data-driven apparent trench-related region from the efficiency x-profile
 - Effective IPD: model-dependent response width of the dip, not physical trench width

Ongoing analysis: Batch 1 -> March TB 2026; 100 um x 25 um CROC

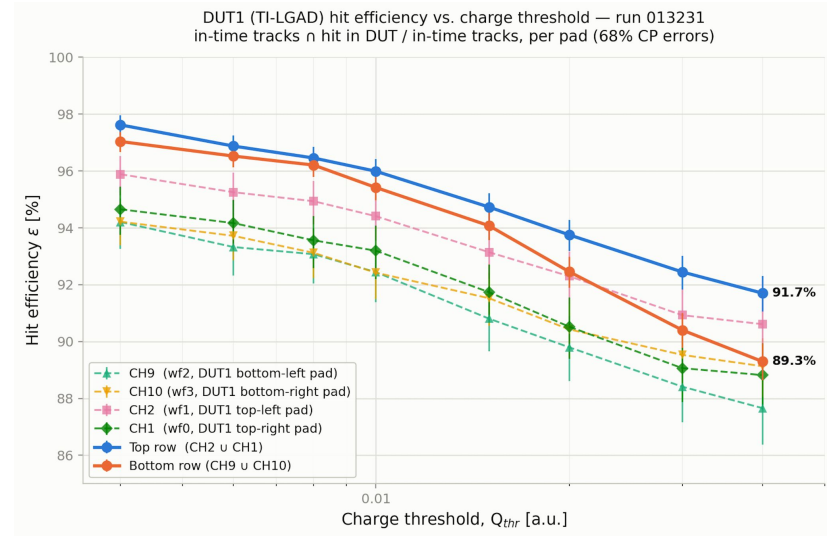
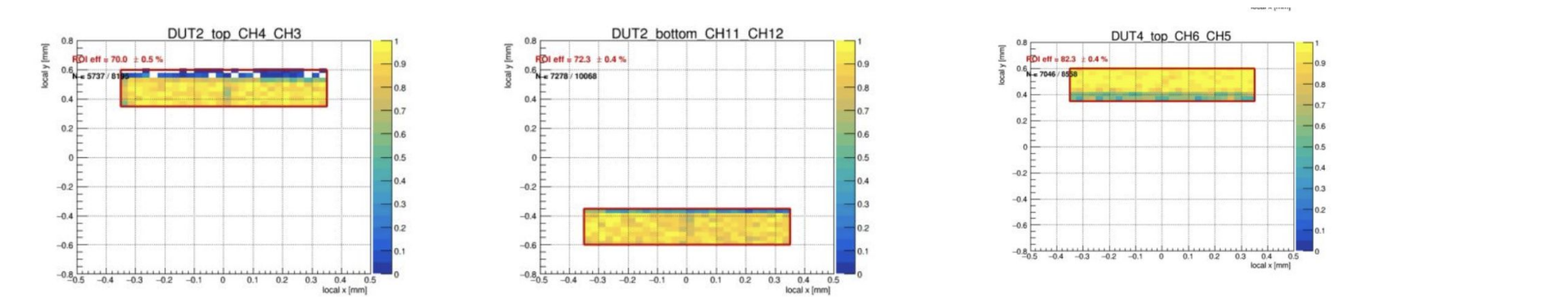
Batch 1						
Wafer	Version	Trench parameter	Fluence	# daughterboard	Chubut CH1,2	Chubut CH3,4
W5	V2	TW1-2			V2TW1	V2TW2
W5	V2	TW1-2			V2TW1	V2TW2
W5	V1-V2	TW5			V1TW5	V2TW5
W5	V1-V2	TW5			V1TW5	V2TW5

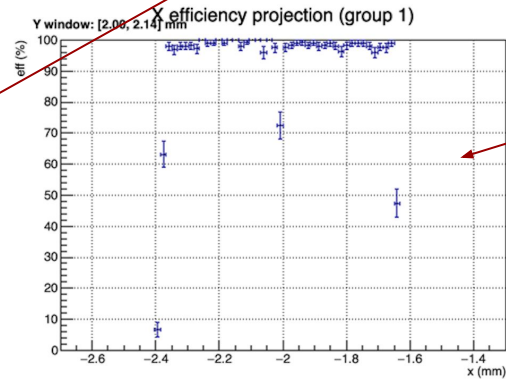
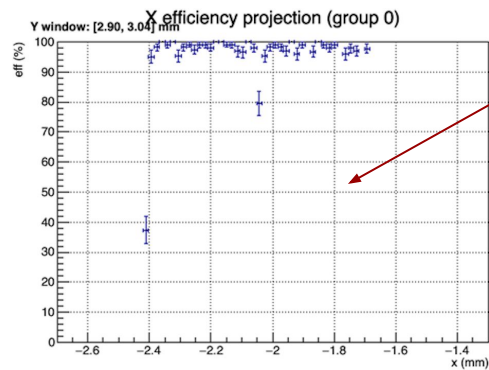
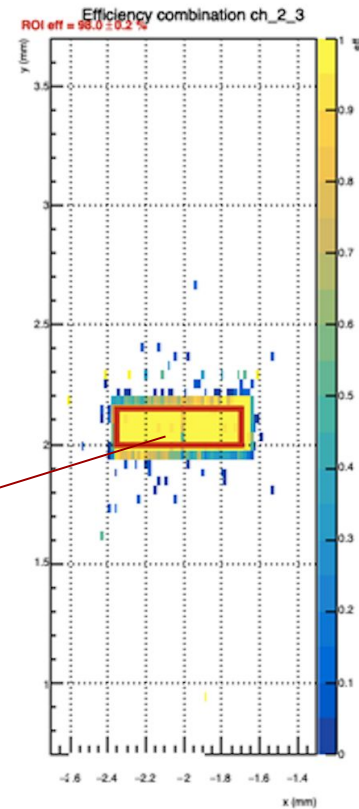
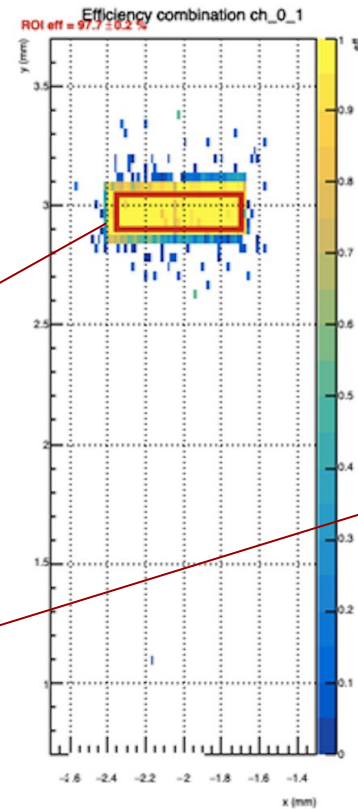
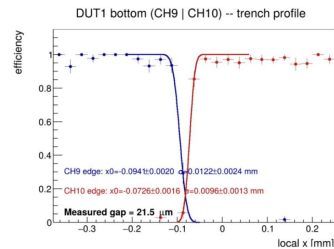
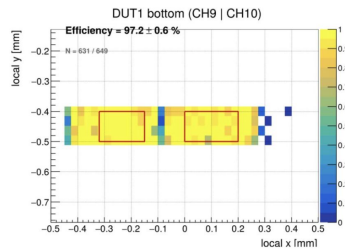
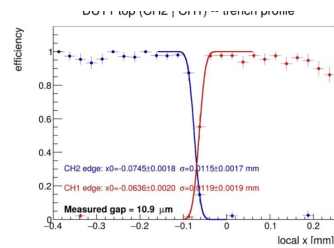
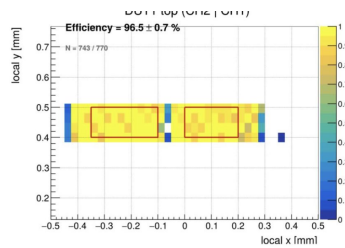
HV plane 1 (V) TREF1 - Genova	HV plane 2 (V) DUT1 - UZH	HV plane 3 (V) DUT2 - UZH	HV plane 4 (V) DUT3 - UZH	HV plane 5 (V) DUT4 - UZH
200V; 0.07uA	240V; 11.3uA	240V; 12.9uA	200V; 13.2uA	200V 20.0uA





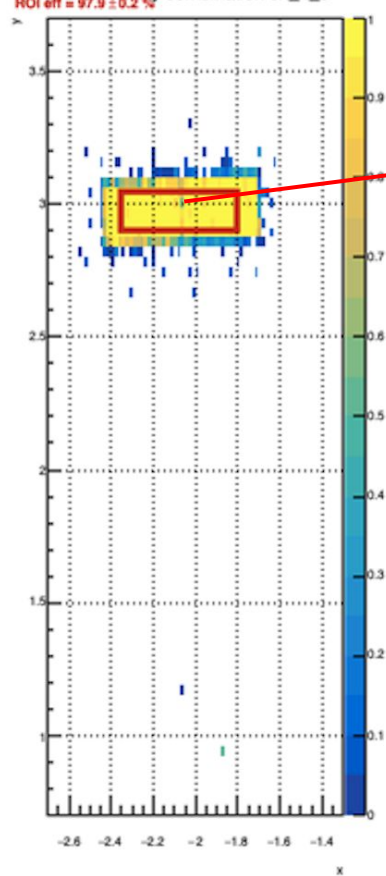
W5 V2 TW23 25e14 ; W5_V2TW4_15e14



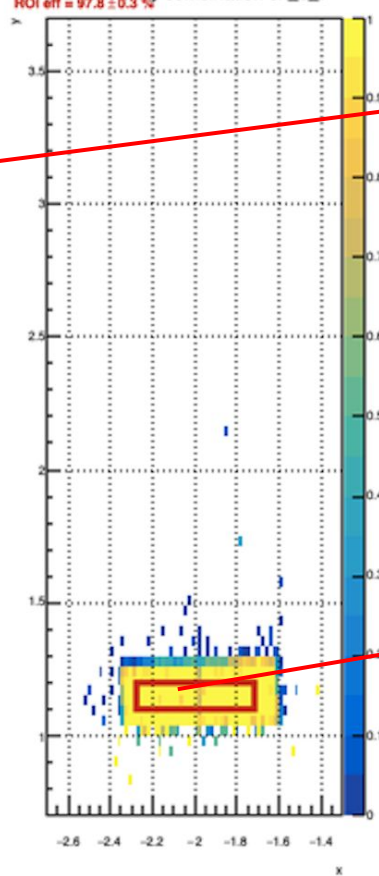


Irradiated structure to $1.5\text{E}15 \text{ neq/cm}^2$ -> efficiencies

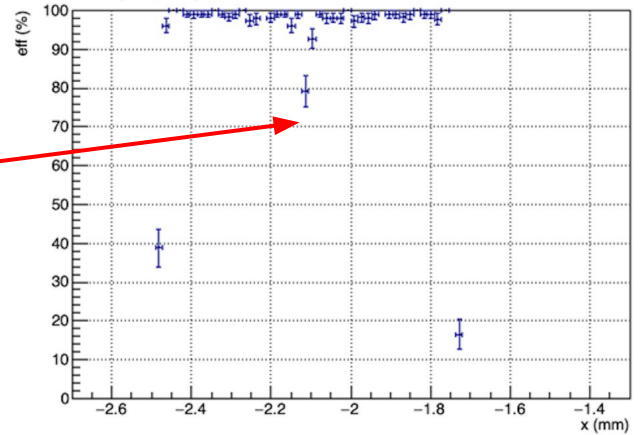
Efficiency combination ch_4_5



Efficiency combination ch_6_7



X efficiency projection (group 2)



X efficiency projection (group 3)

