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Some constrains and cautions when testing fast DUT using EUDET telescope

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Fast DUT definition: shaping time (integration time) < 100 µs (M26 integration time).

For applications other then ILC, $t_{shaping}$ is usually << 100 µs

This discussion was triggered by the Mimosa25 beam tests using Mimosa18 telescope (TAPI). Integration time of M25 is 80 µs, integration time of M18 is 4 ms…

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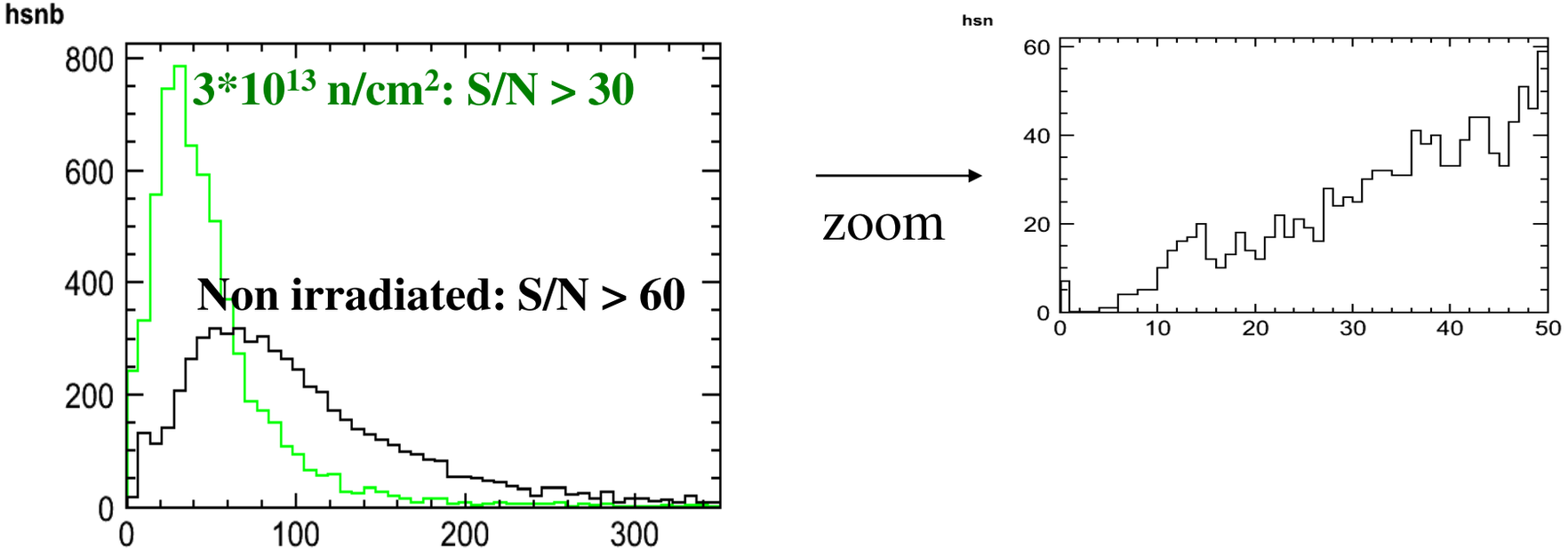
Mimosa25 : our first MAPS using high-resistivity epi layer

- excellent S/N ratio for MIP detection



- but poor efficiency (~90 %) when using telescope reconstructed tracks as a reference… Impossible to be real!

Missing data from M25 or extra tracks from the telescope???

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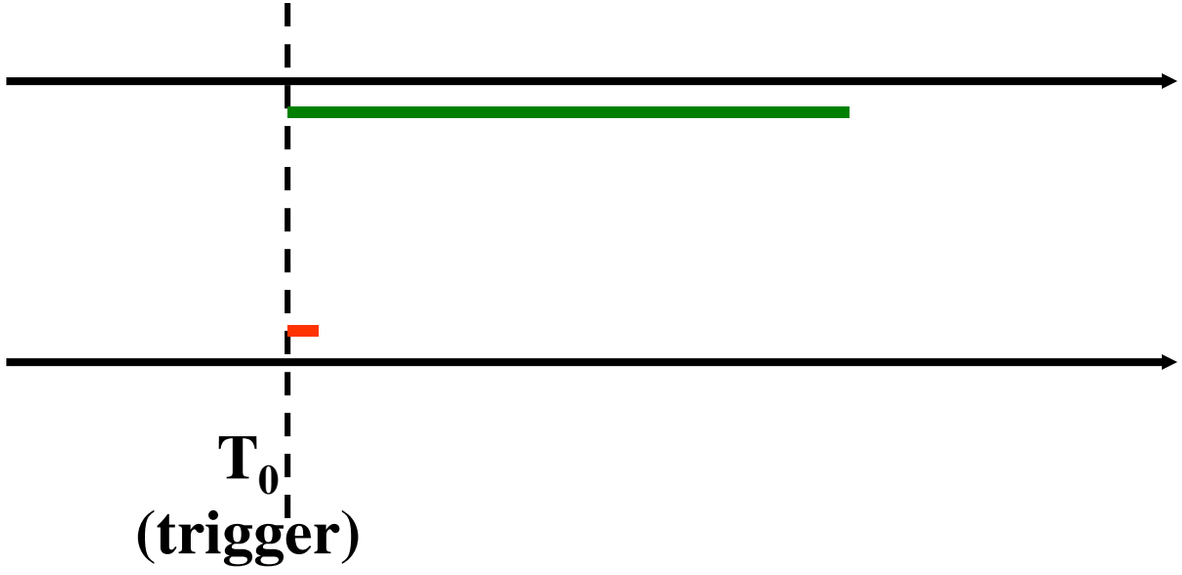
The way to record data, using sparsifying TNT-DAQ Similar scheme will be implemented by EUDET for M26…

- all M18 hits from 4ms window following the trigger

- all M25 hits from 80 µs window following the trigger



In addition, to avoid multiple tracks, no another trigger during 4 ms following T_0.

No trigger means no second signal from the scintillator (not result of VETO)!

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Are this precautions sufficient to prevent unwanted real spurious tracks? No, for two reasons:

- scintillator system is NOT 100% efficient

- track reconstruction procedure is also not 100% efficient. May be even far from this, sometime for good reasons (for example badly scattered track, but still being source of the trigger).

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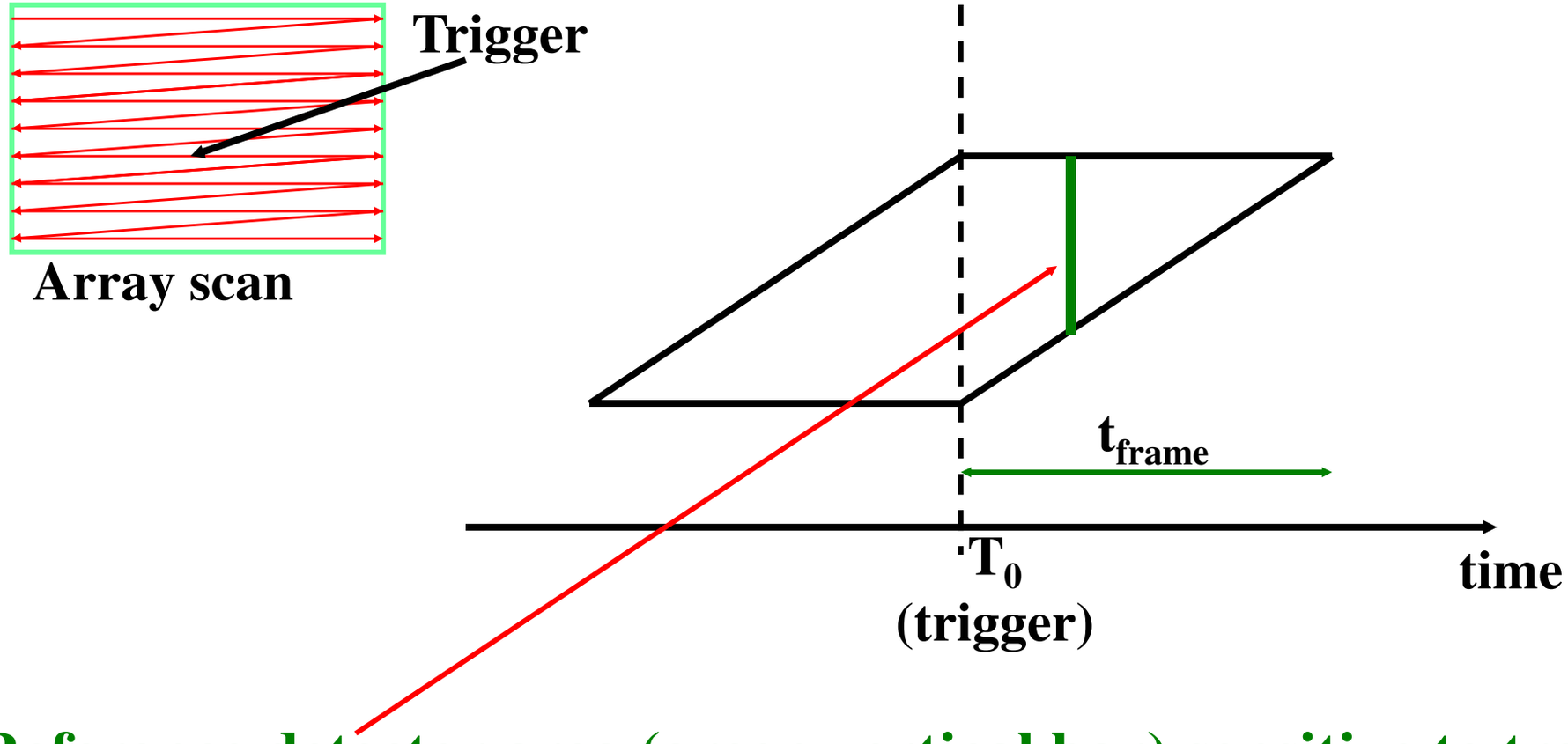
In fact, the situation is even worse, because of memory time of "rolling shutter type" readout. Because of this, even tracks from ahead of the trigger may still be recorded!



Reference detector area (green vertical bar) sensitive to tracks as a function of track timing versus trigger

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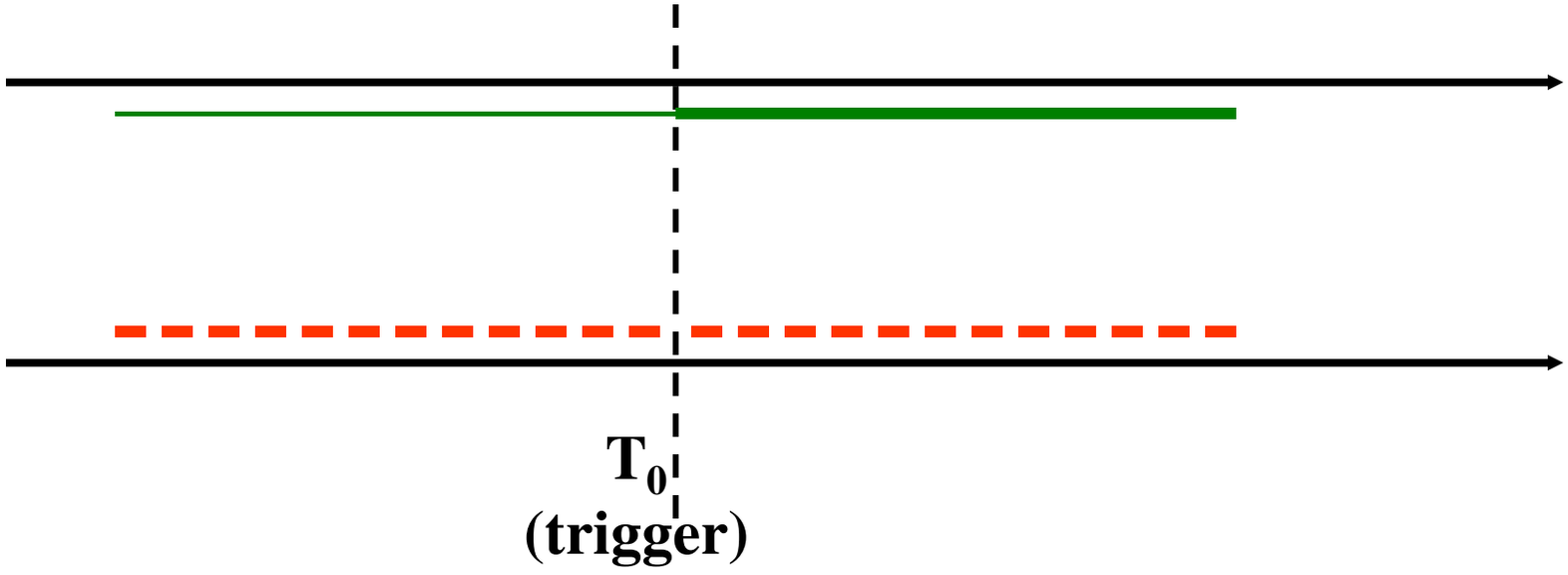
Is there any easy way of measuring absolute efficiency of fast detector using slower, integrating one? Unfortunately not the general solution…



For M25 as a DUT, we may propose multiple readout after an before the trigger, in order to have the same sensitivity time. This is possible, because TNT-DAQ readout has no dead time!

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Conclusions and recommendations to limit spurious tracks effect.

-Be aware of your trigger efficiency

- Be aware of you track reconstruction efficiency

- Set-up your beam rate low (order of magnitude less?) with respect to the reference system frame rate. It may be not very practical for tests requiring high statistics…

- However, the general solution to this problem exists: reference system based on self-triggering trackers, like the one (Stripset) we are developing within 3D Electronics Collaboration…