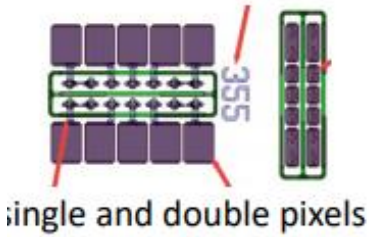
Trench vs Column 3D simulations and comparison

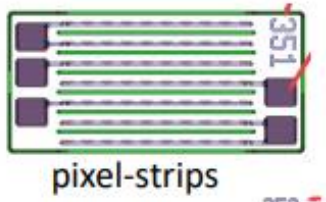
G. KRAMBERGER

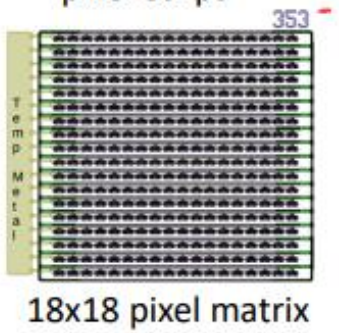
Trench - 3D detectors

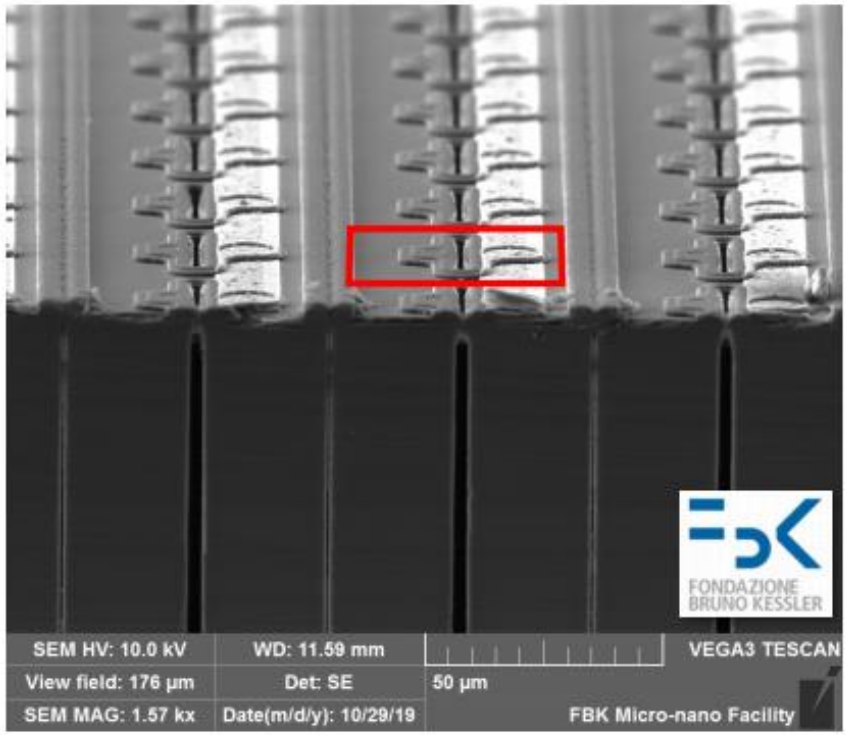
- **55x55 µm²** pixels
- **150 µm** active thickness
- Collection electrode **135 µm** deep

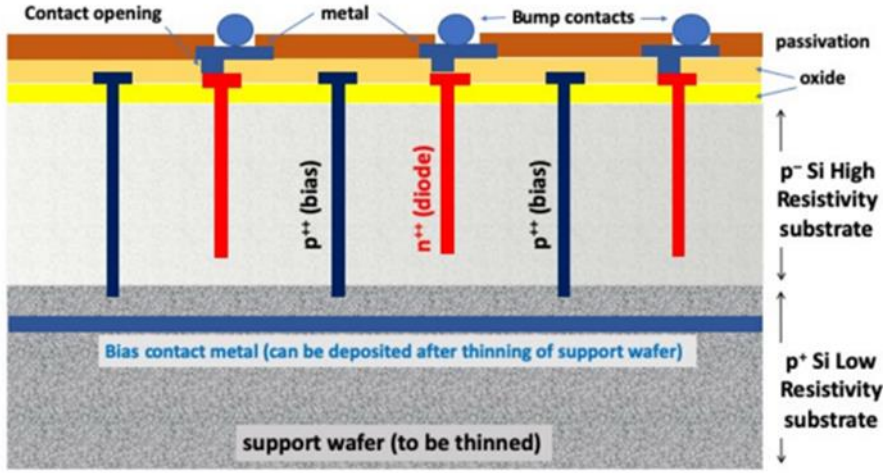
A. Lampis, 16th TRENTO workshop, 2021
M. Garau, 16th TRENTO workshop, 2021
web.infn.it/timespot/

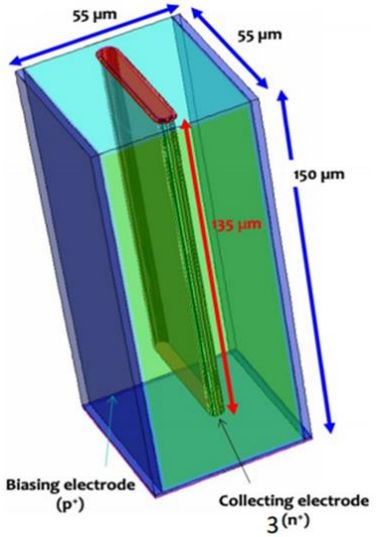




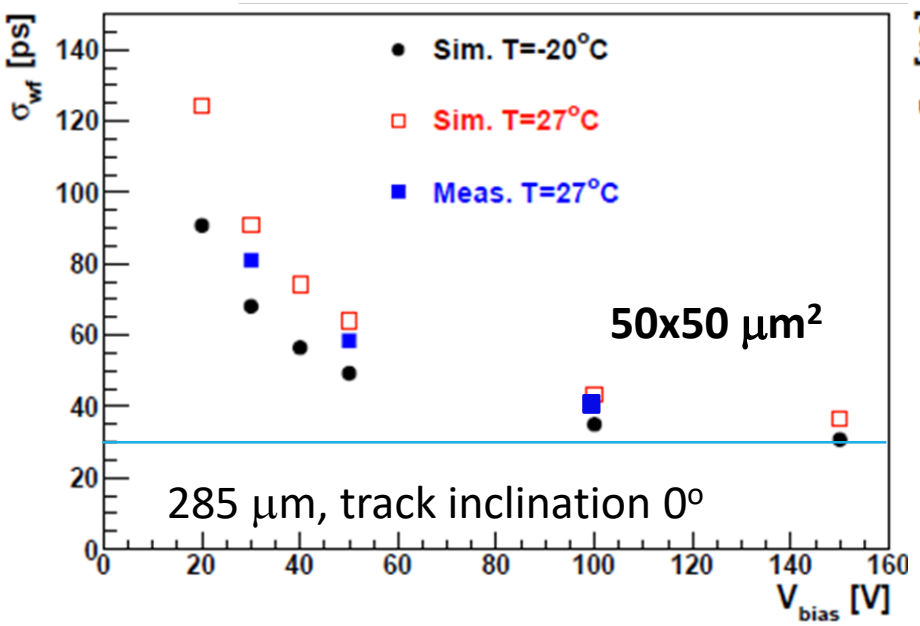


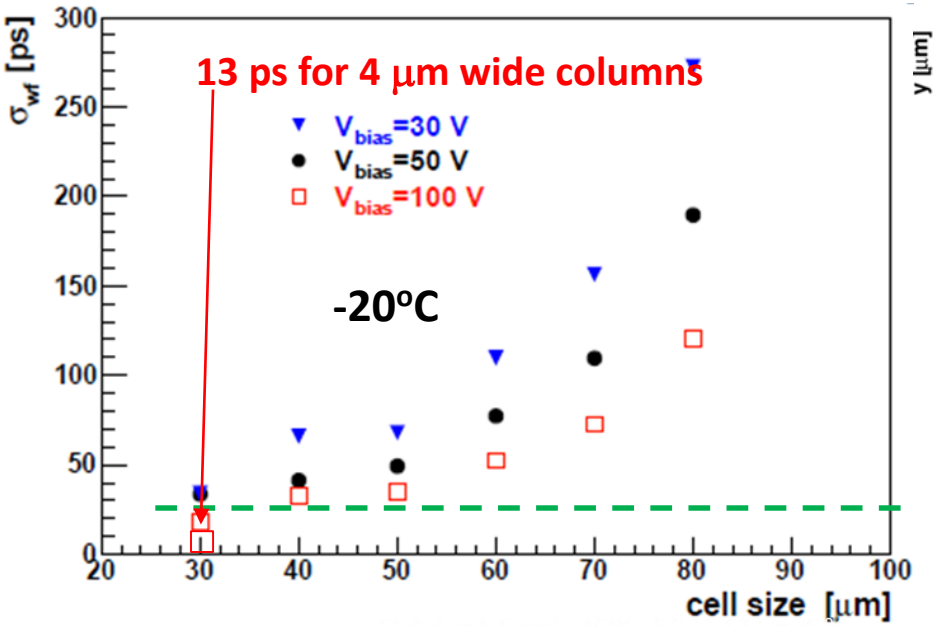


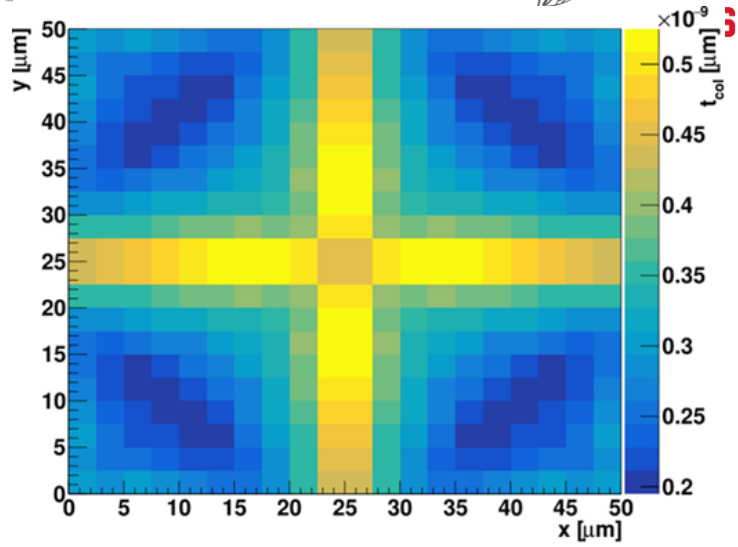




Column 3D - Measurements and simulations





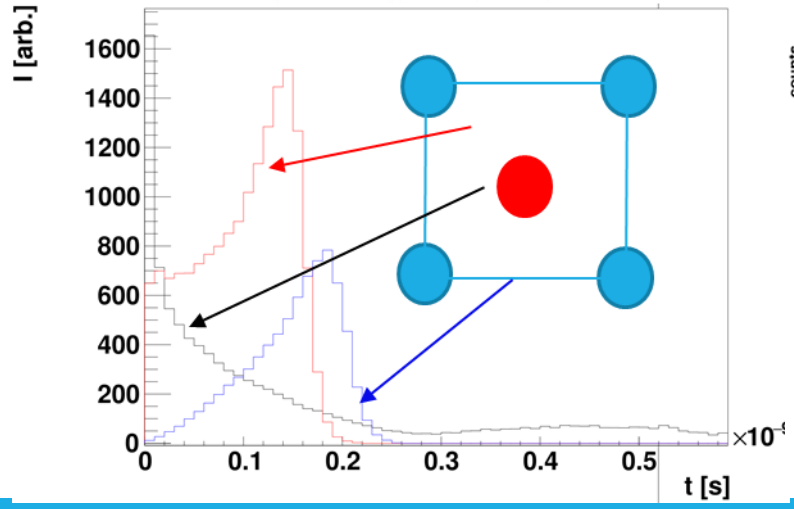


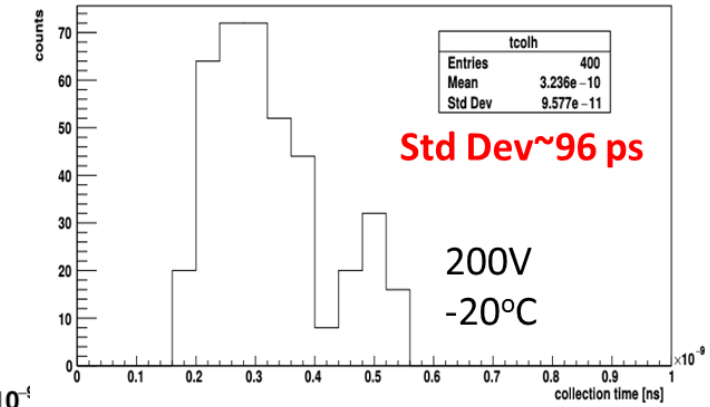
Single square cell readout σ_{wf} at -20°C and 100V

- **25x25 μm -> ~13 ps**
- **50x50 μm -> ~32 ps**

for multiple cell connected together and inclined tracks even better time resolution can be achieved

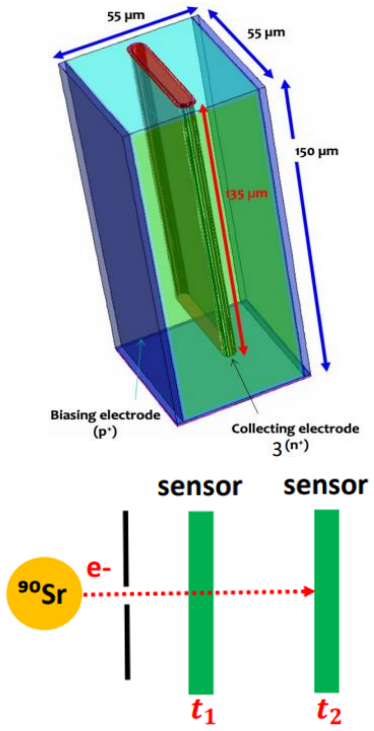
- around 20-25 ps for 50x50 μm² cell

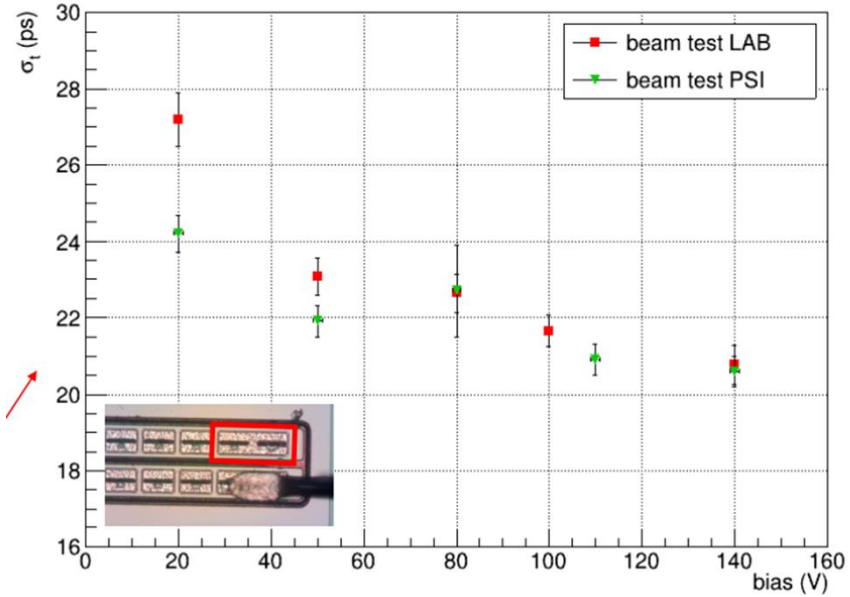


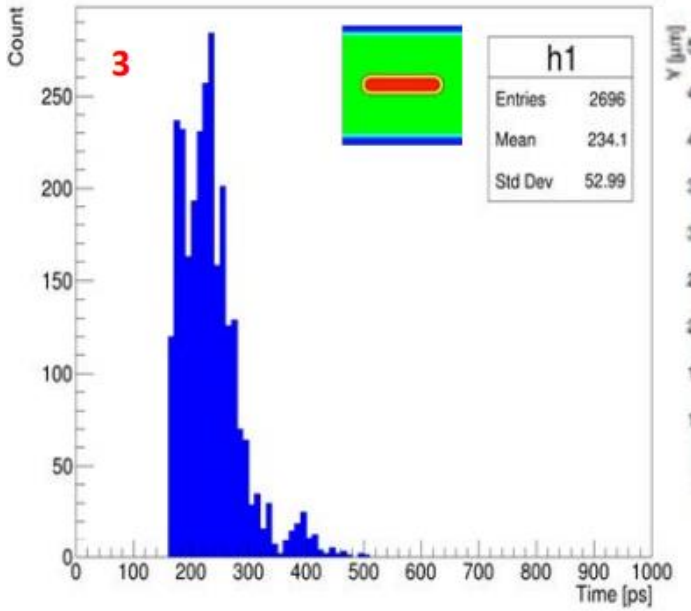


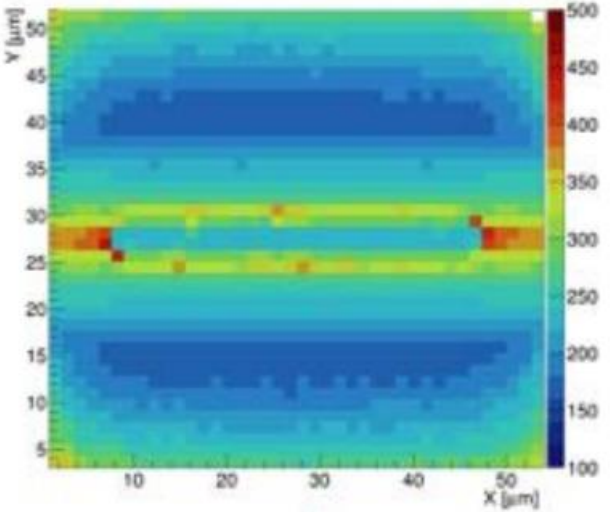
Trench - 3D detectors

A. Lampis, 16th TRENTO workshop, 2021
M. Garau, 16th TRENTO workshop, 2021









The time resolution was found to be dominated by FE electronics σ_j ~18 ps

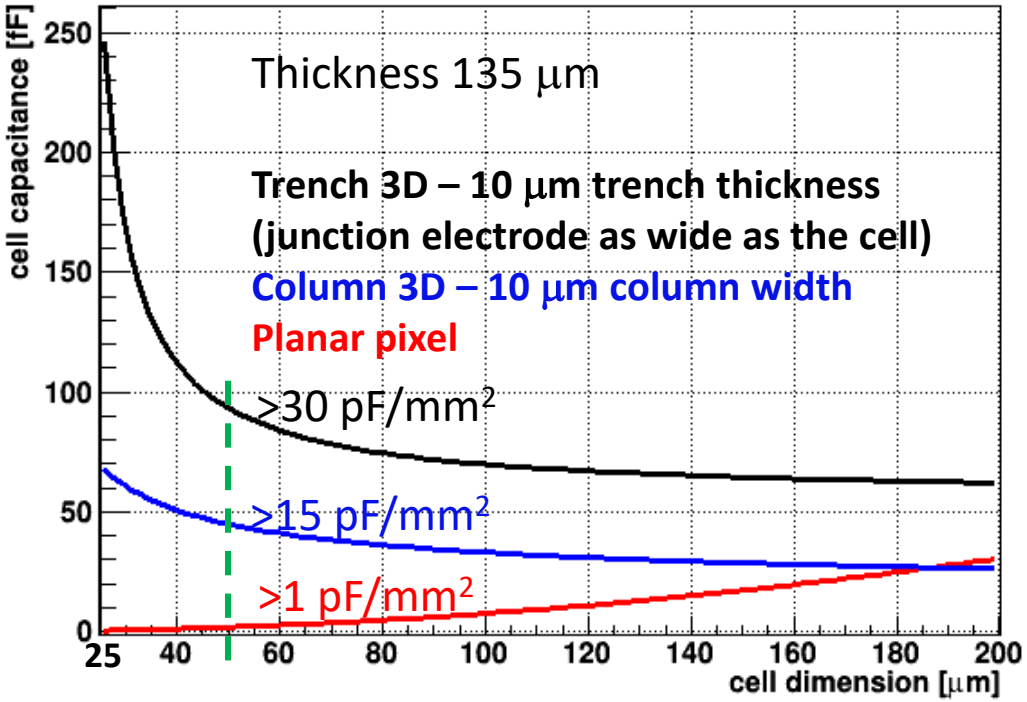
The σ_{wf} (intrinsic time resolution) of was found to be ~14-15 ps with accurate analysis **~10 ps.**

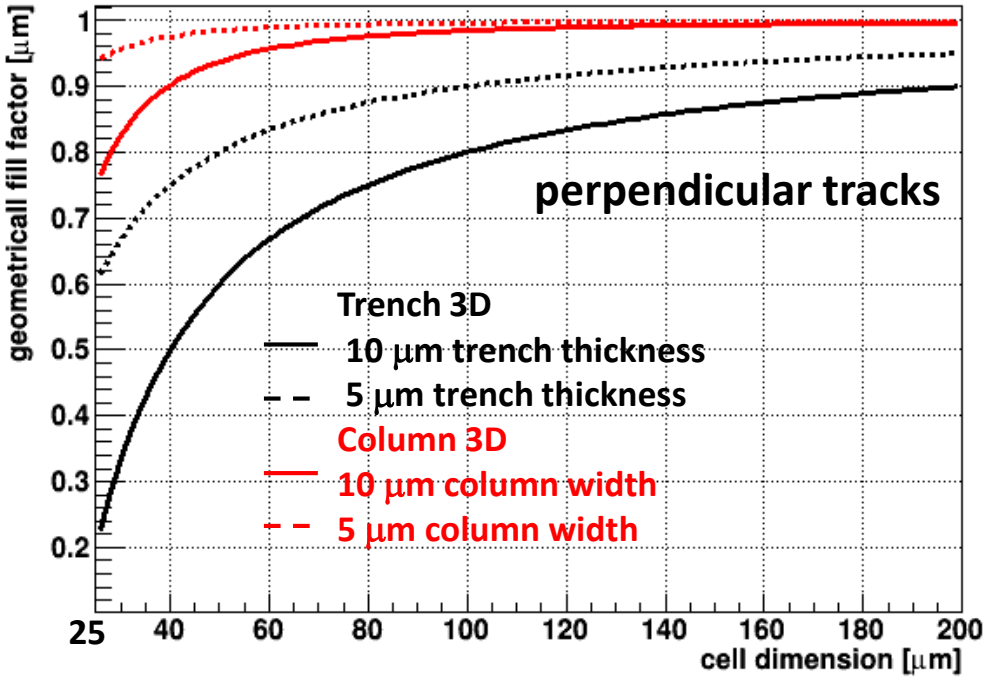
The tails in distribution due to low field regions in the space between the pads.

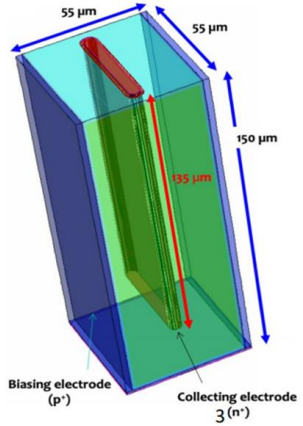
The reduction cell size may not improve the time resolution σ_t as the σ_{wf} may not be the limiting factor to the total time resolution.

around 15 ps better time resolution than for similar cell size with 3D-columns.

Drawbacks of 3D (Capacitance and fill factor)

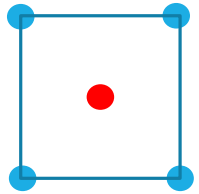






- Much larger capacitance of the trench design wrt. to column and planar (ASIC is crucial)
- At small cell sizes needed for superior timing resolution the fill factor can become a major issue:
  - For column like the direction of the inclined tracks is not very important
  - **For trench detectors the direction of tracks is crucial (detector design should be tailored to the application)**

not fully efficient for all φ at $\theta \neq 0$



fully efficient at $\theta \neq 0$