

Depth measurements in the SmartPET planar germanium detector

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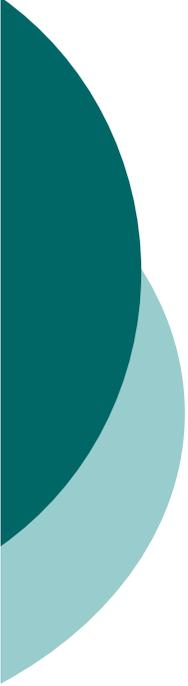
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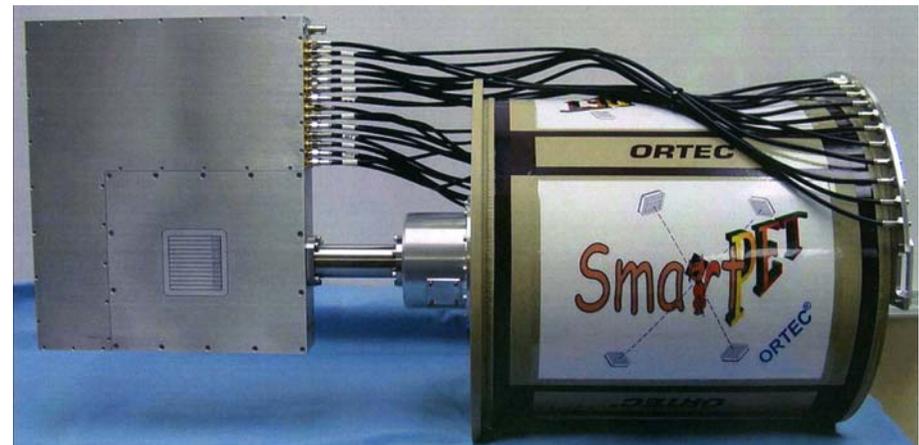


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First SmartPET Planar detector

- 60 x 60 x 20 mm active area HPGe crystal
- 5 mm orthogonal strip segmentation
- Interstrip distance:
 - AC: 180 μm
 - DC: 300 μm
- Operating voltage: -1800 V
- Energy resolution (FWHM): ~ 1.5 keV @ 122 keV
- AIM:
 - Position resolution:
 $\sim 1\text{mm}^3$

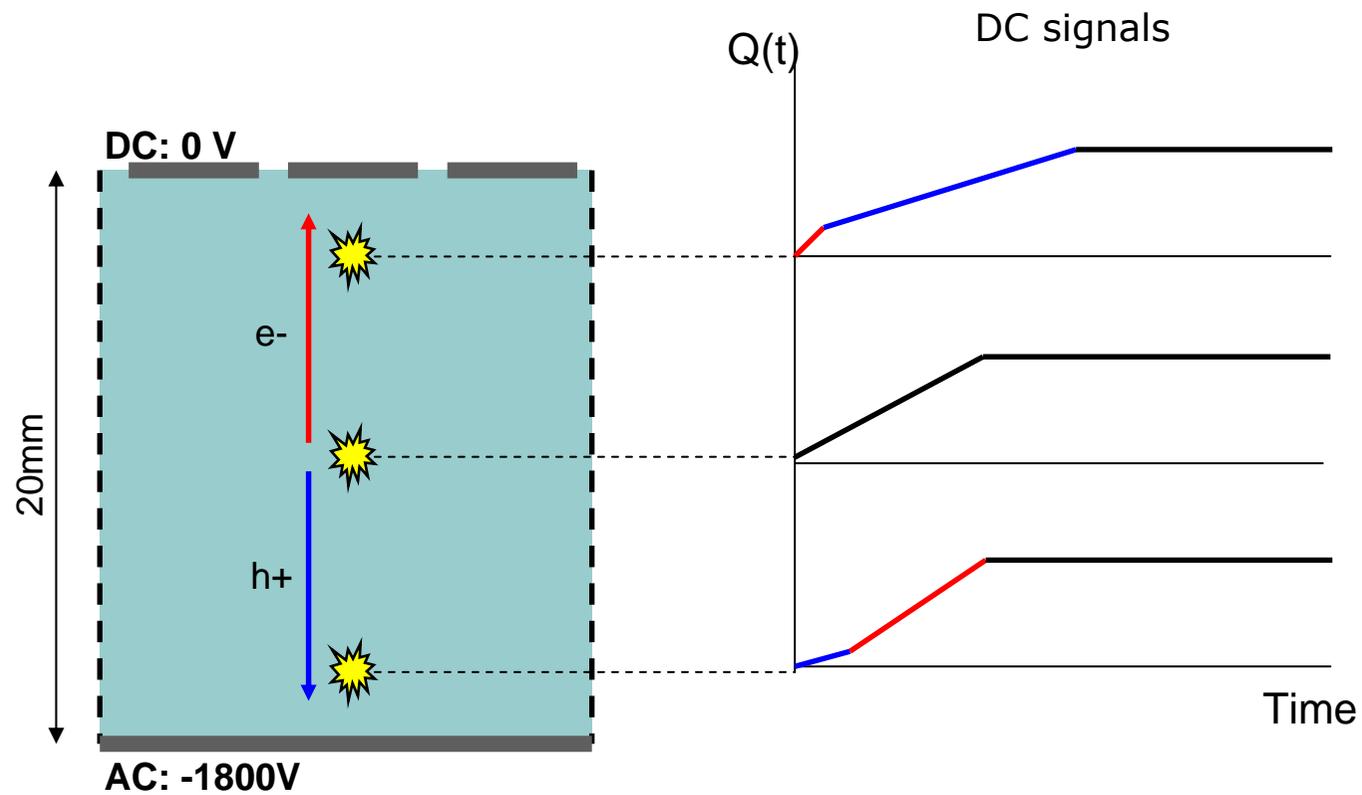


Digital Acquisition System

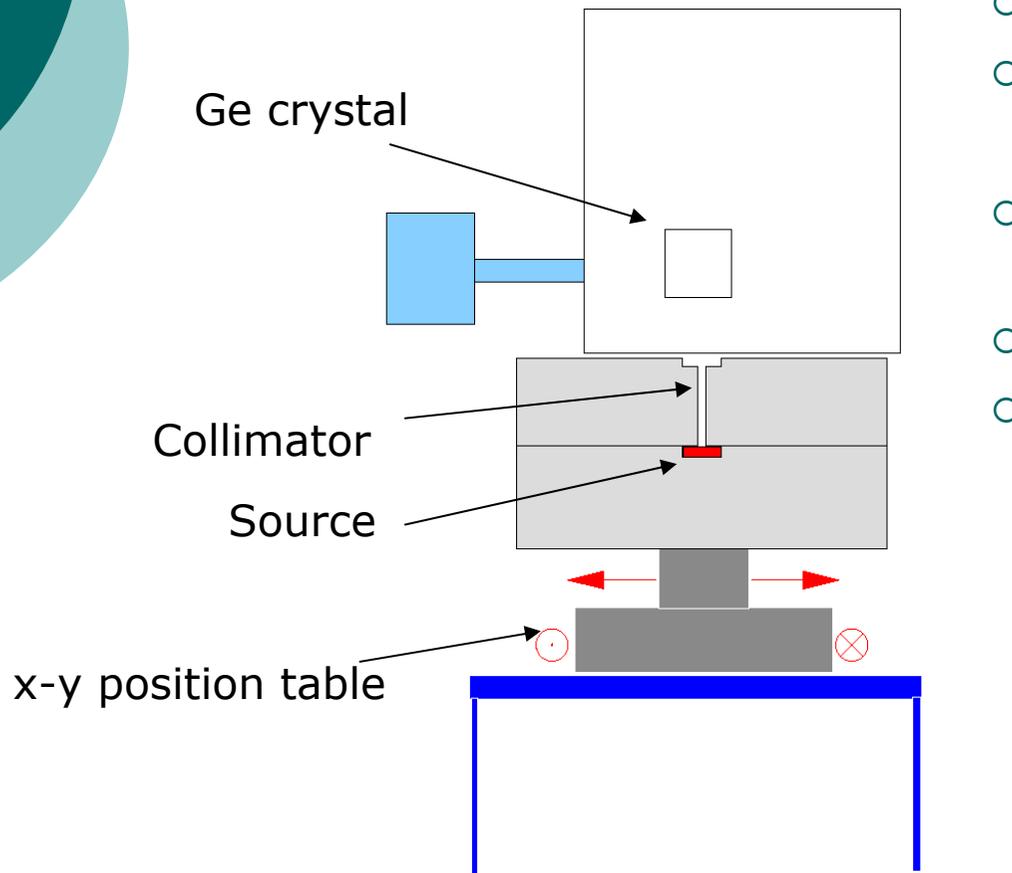
- GRT4 DAQ system made by CCLRC Daresbury Laboratory
- 24 channels 14 bit 80 MHz electronics
- Each channel has a FADC → FPGA which can be programmed to provide:
 - Energy
 - Time
 - Position (x,y,z)



Signal generation from depth



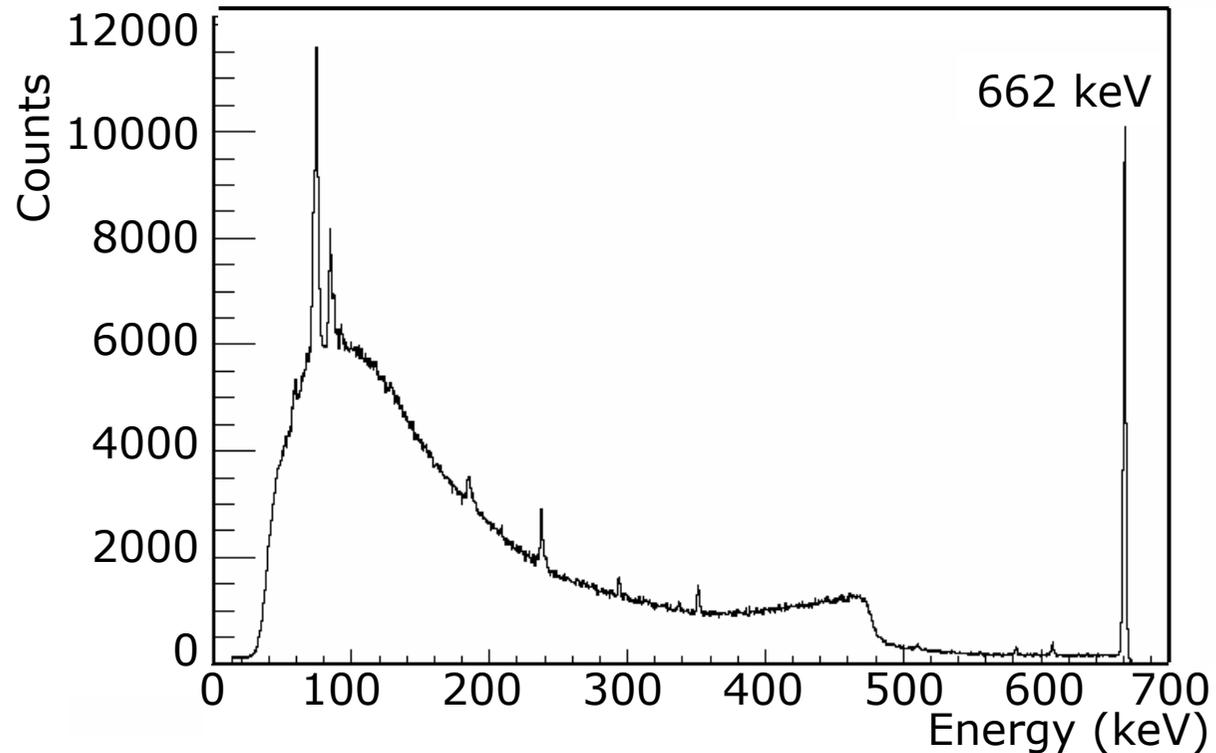
Scanning apparatus



- 662 keV of ^{137}Cs
- 1 mm Tungsten collimator (eff. 1.2 mm)
- 17 cm lead shielding between detector and source
- 2 minutes per position @ 70 cps
- 64 x 25 mm scan
1 mm steps

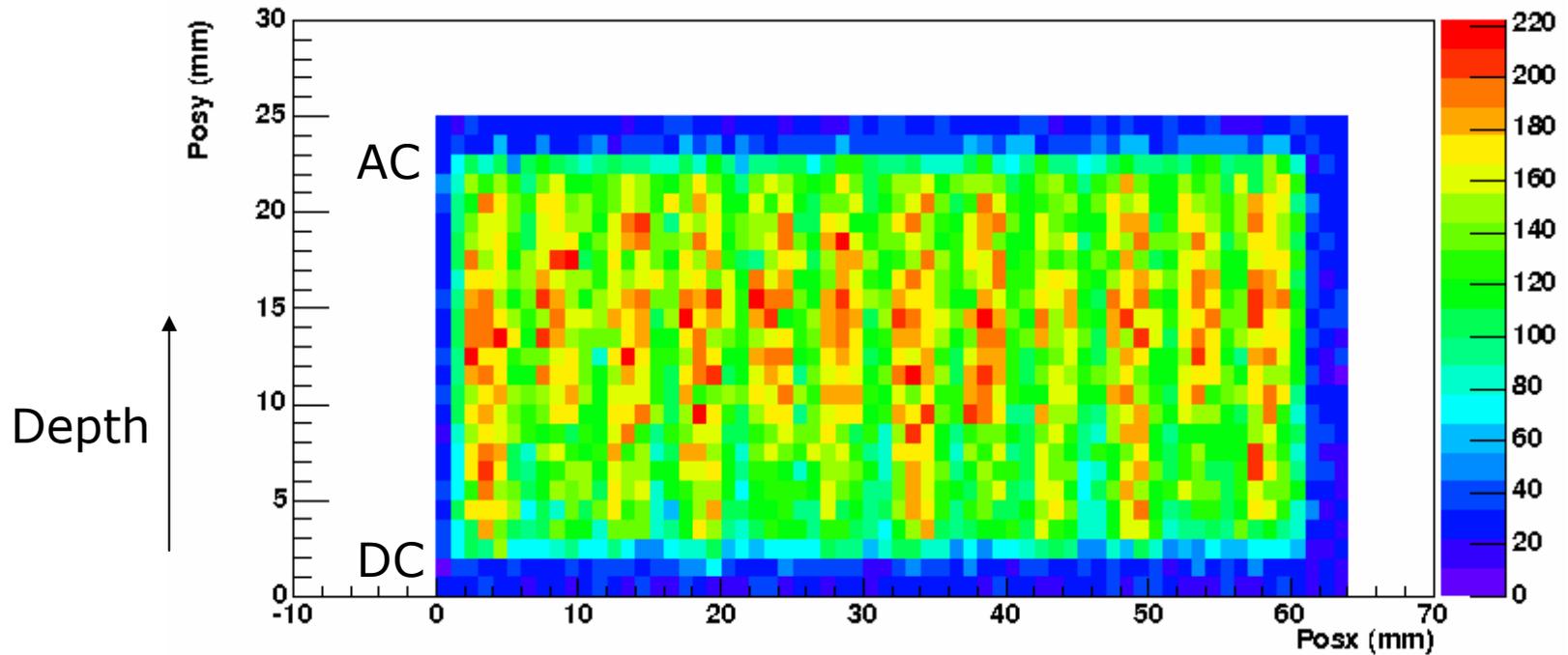
Data of interest

- 1 interaction on the AC side
 - 1 interaction on the DC side
- } $5 \times 5 \times 20$ mm pixel



- 662 keV full energy interactions ($\sim 2\%$ P/T)

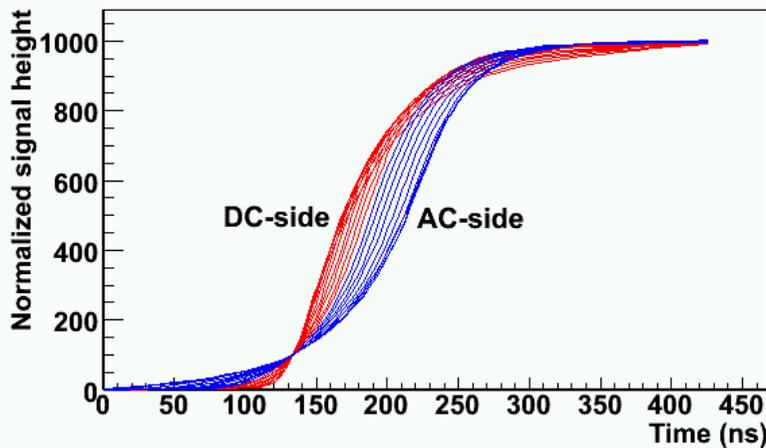
Intensity map



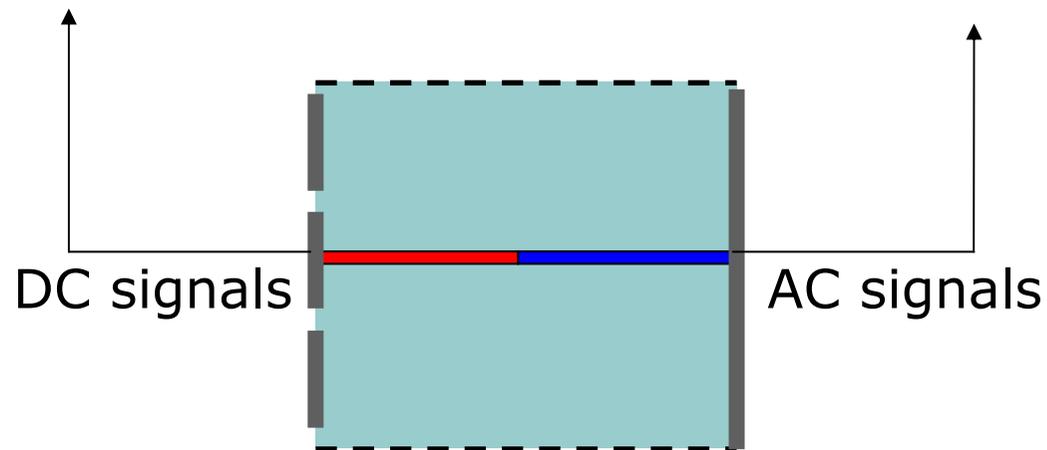
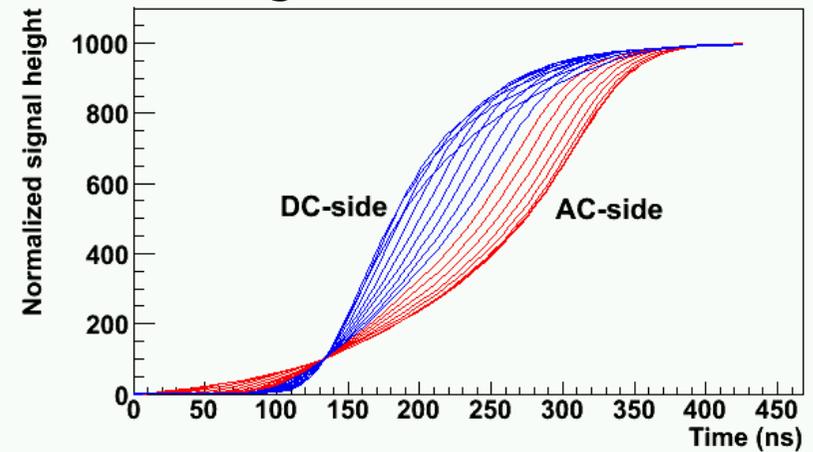
- The 12 AC strips are clearly visible
- Because of the complicated electric field in the edge strips they are excluded from the analysis

Average pulse shapes

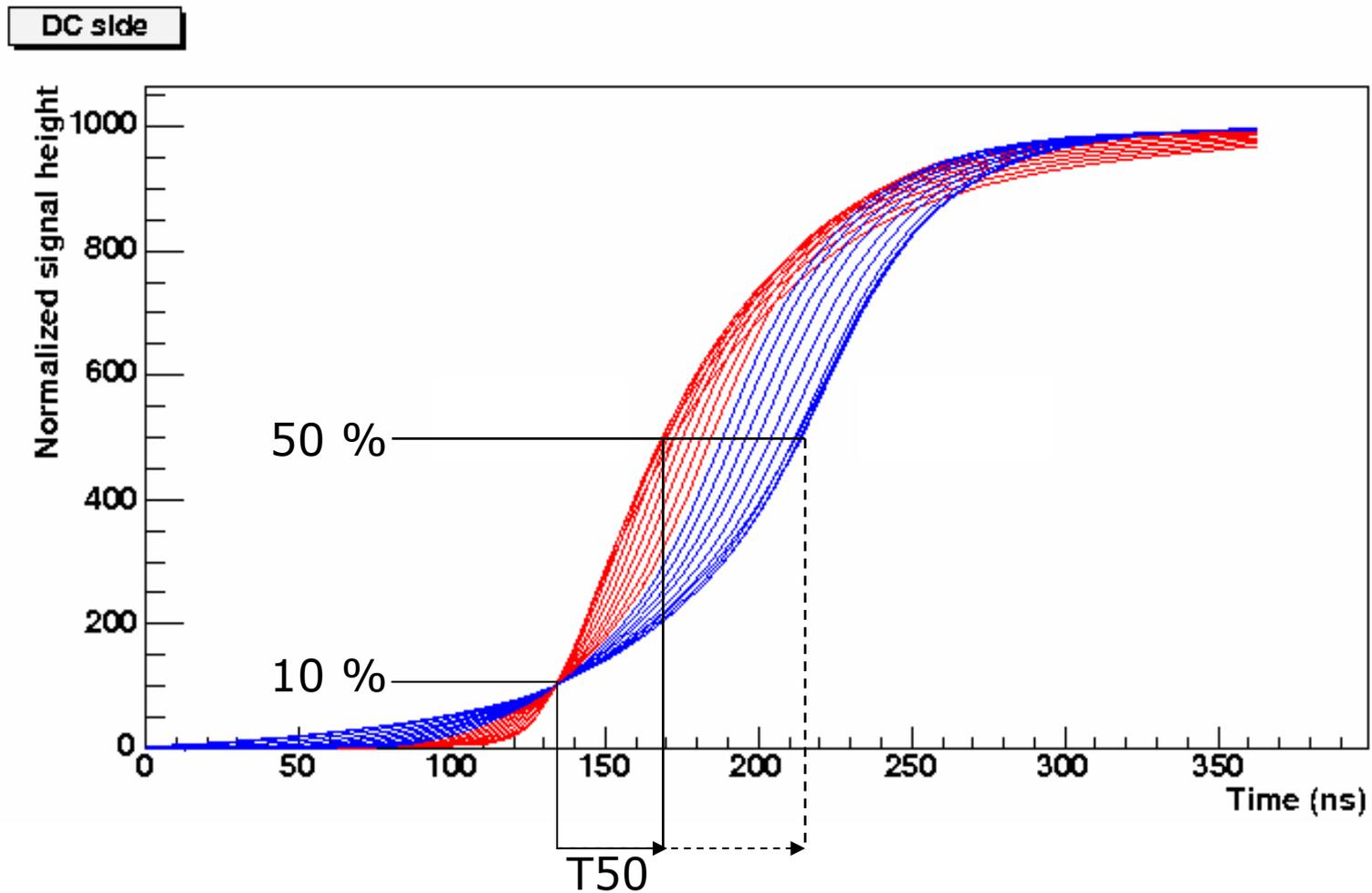
DC signals



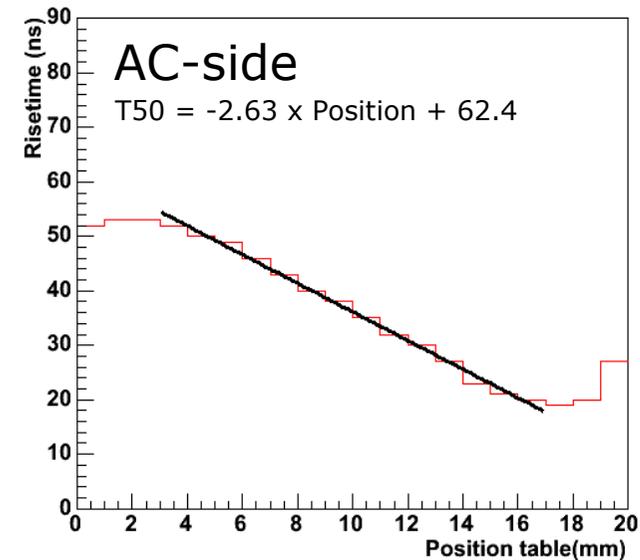
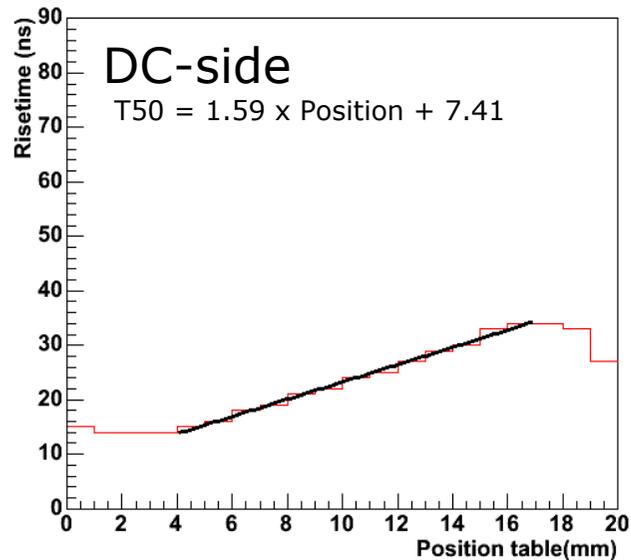
AC signals



Average pulse shapes

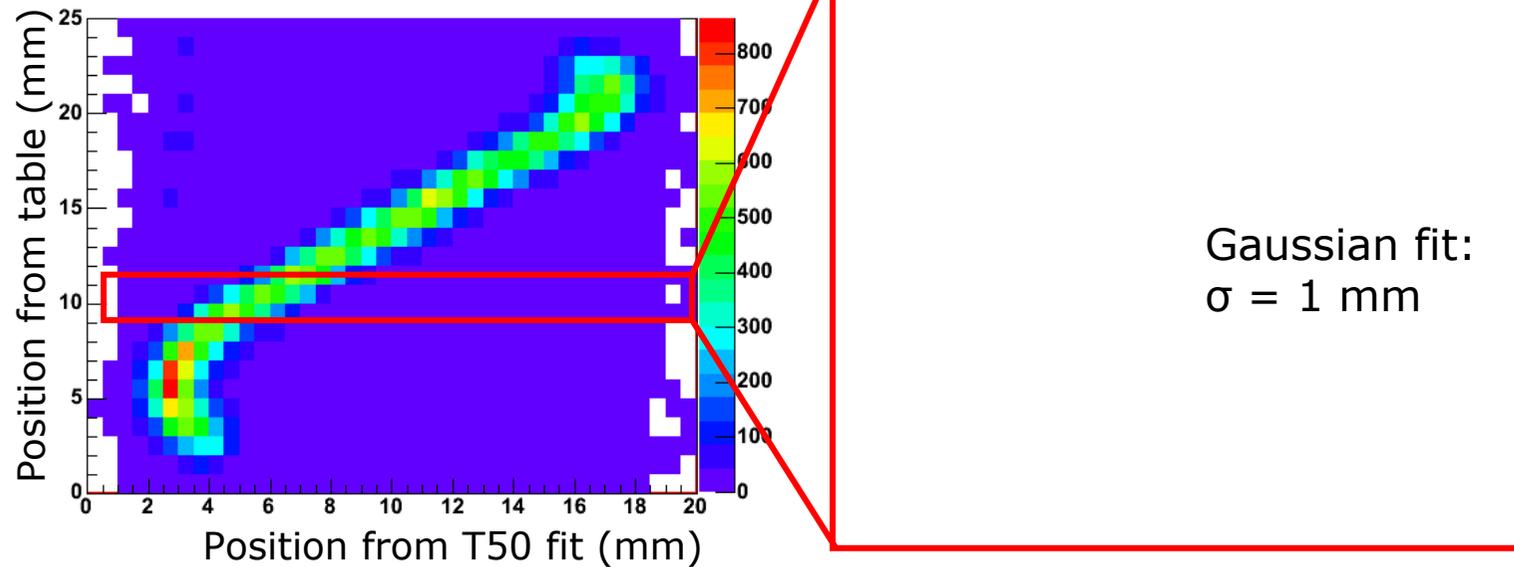


T50 Risetime value



- The DC and the AC are both useful to extract the position information from the data

Recalculation of the position



- T50 is a good measure to evaluate the depth of interaction inside the major part of the detector



Conclusion

- A first attempt has been made to get the depth information by using the rise time information
- The T50 rise time method is proven to work well in the middle of the detector



Future work

- A further investigation into the area close to the contact should be carried out:
 - Multiple scatters inside a pixel
 - Weighting field effect near the contacts