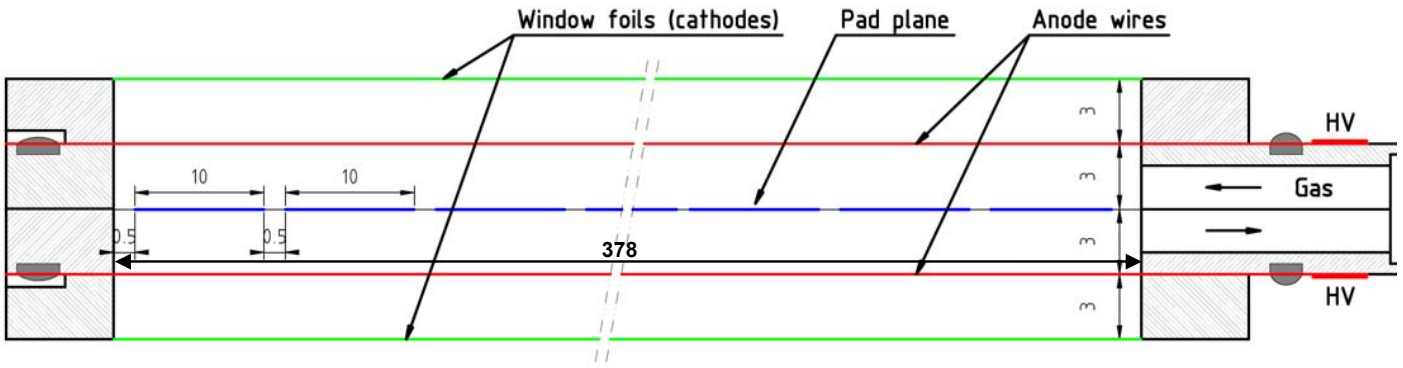
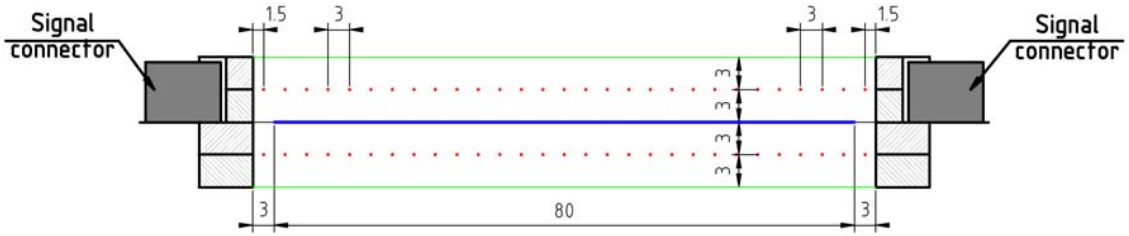
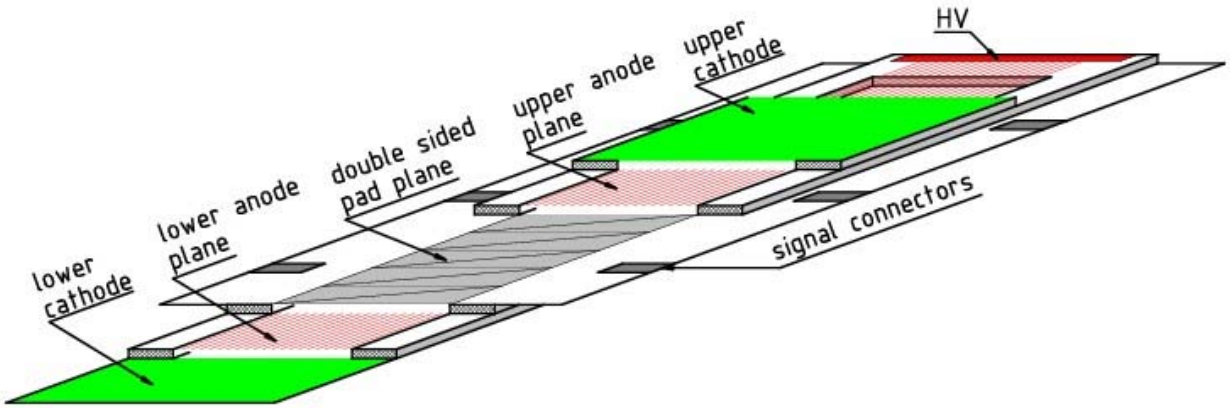
Status of two - dimensions position sensitive TRD prototypes

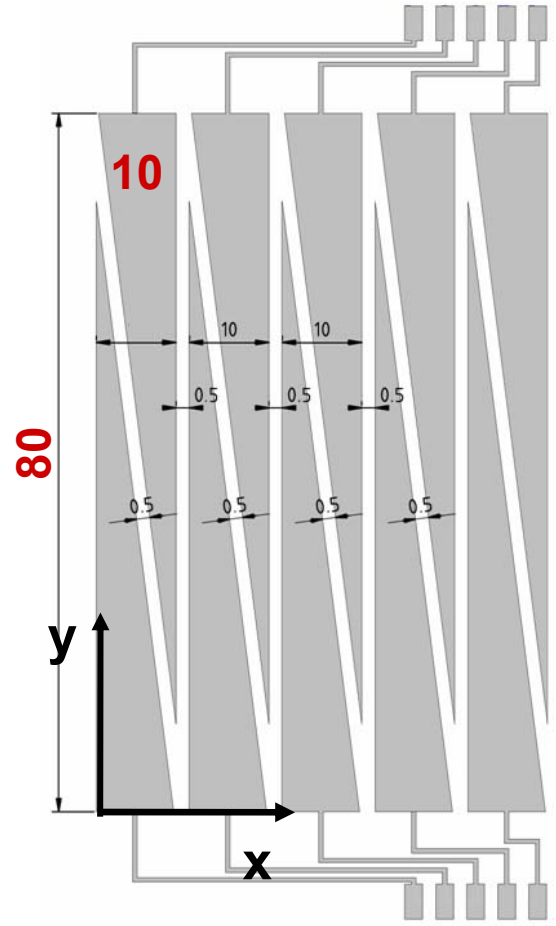
- Double-sided pad readout electrode TRD prototypes
- ^{55}Fe energy resolution
  - Anode signal – Charge Sensitive Preamplifier
  - Pad signal - Fast Analog Signal Processor (FASP-V0)
    - Flat - top output
    - Semi – Gaussian fast - output
- Position reconstruction using ^{238}Pu X-ray source
- Single-sided pad readout electrode TRD prototypes
- ^{55}Fe energy resolution
  - Anode signal – Charge Sensitive Preamplifier
  - Pad signal - Fast Analog Signal Processor (FASP-V0)
    - Flat - top output
    - Semi – Gaussian fast - output
- Summary and outlook

Double-sided two-dimension position sensitive prototype

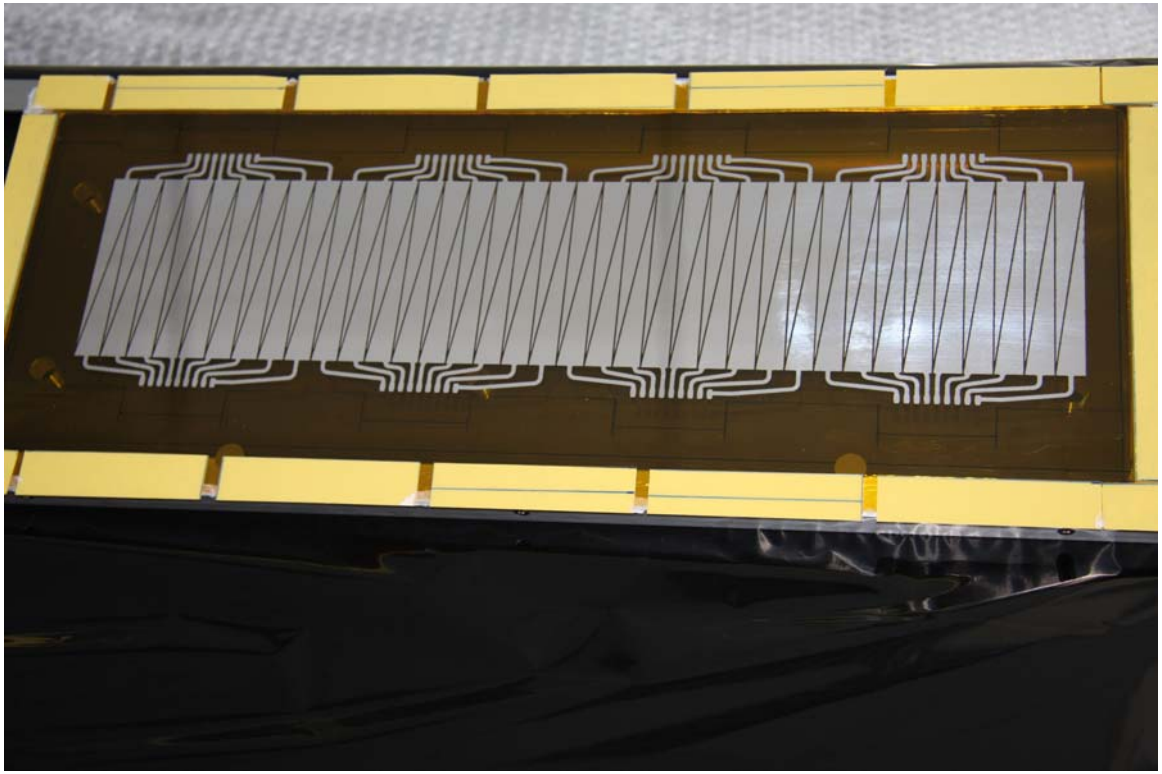








Double -sided 3 mm anode-cathode distance prototype version



Readout electrode

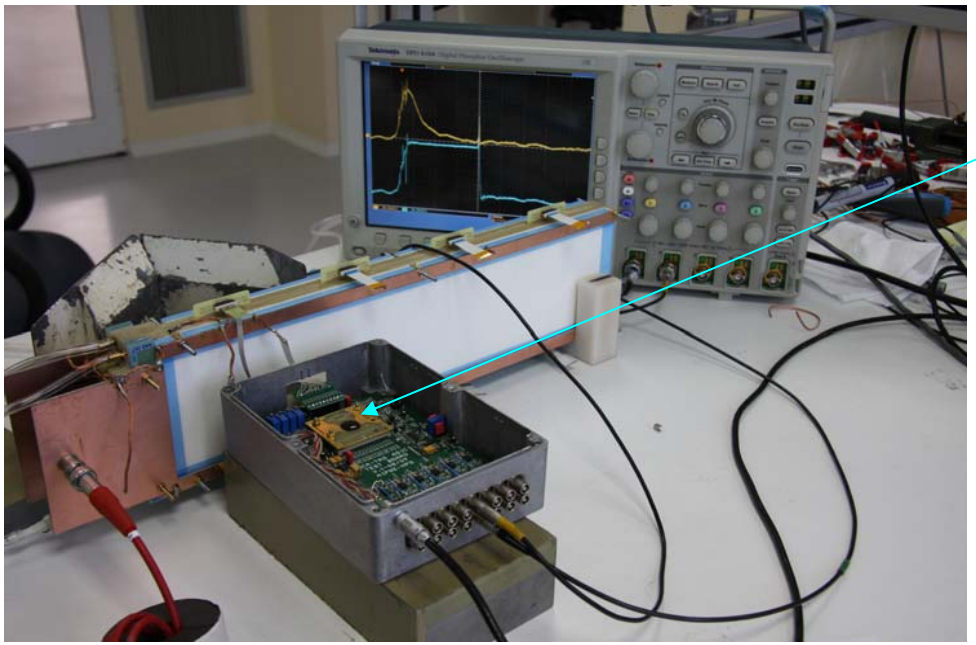
Cr(20 nm)/Al(200nm)

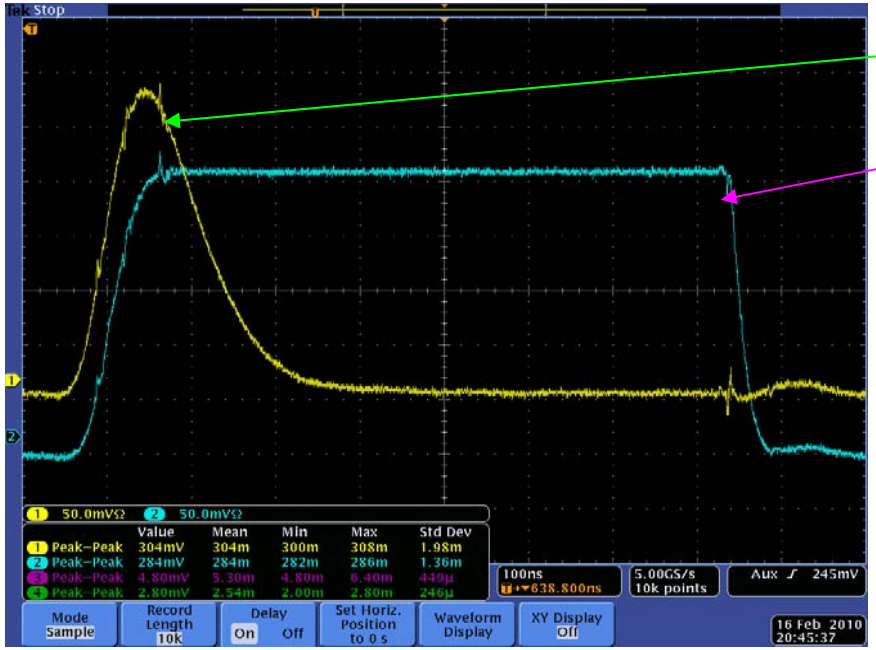
on 25 μm kapton foil

3 mm anode-cathode distance

3 mm anode wire pitch

First version of ***Fast Analog Signal Processor FASP-VO***





V. Catanescu: Analog Chip for High Counting Rate Transition Radiation Detector; 14th CBM Meeting, October 6 -9, Split, Croatia

8 input/output channels

Gain: 6.1 mV/fC

Analog channel outputs:

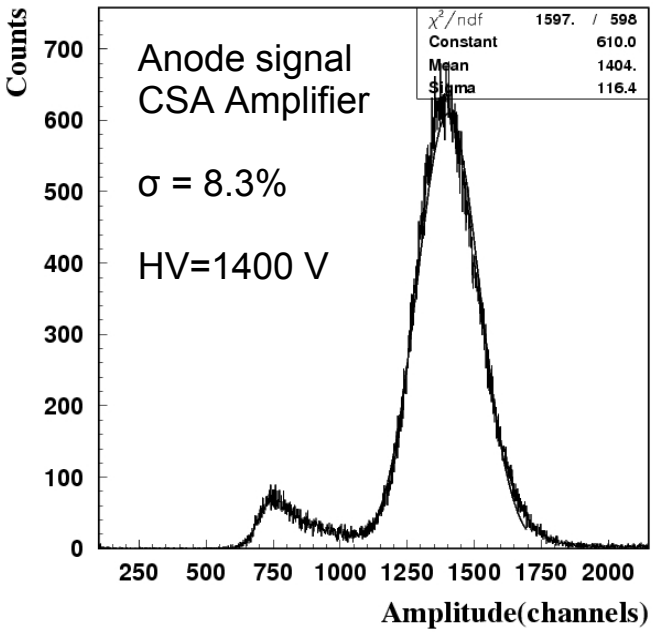
a) fast semi-Gaussian output signal

b) peak sense output signal

A. Caragheorgheopol, D. Bartos, V. Catanescu

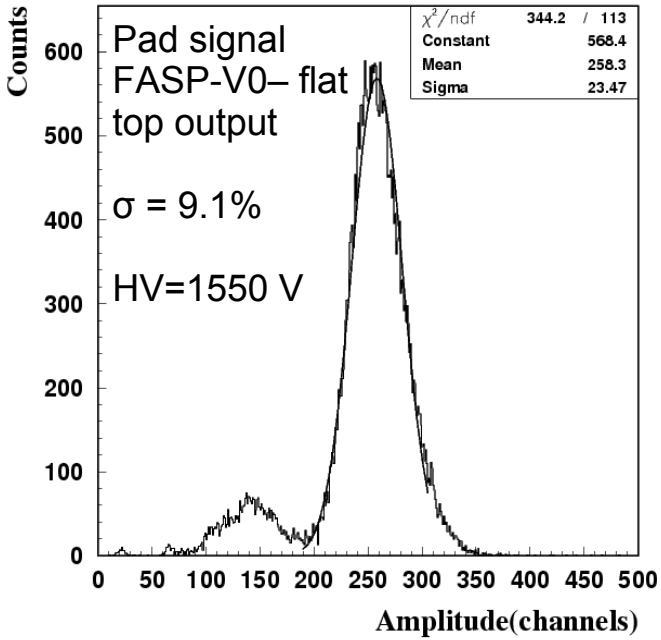
CBM FEE / DAQ Workshop, Feb.22nd-23rd 2010, GSI

3 mm A-K distance TRD Prototype

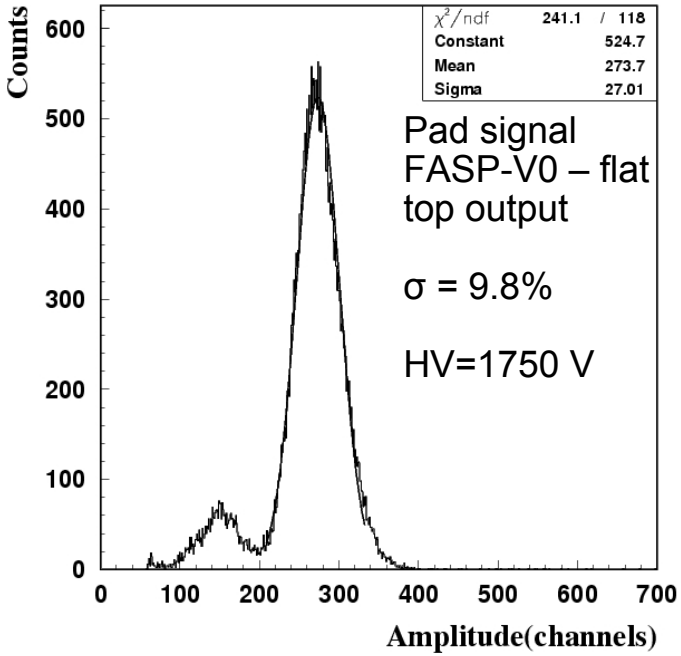


^{55}Fe source tests

80%Ar+20%CO_2

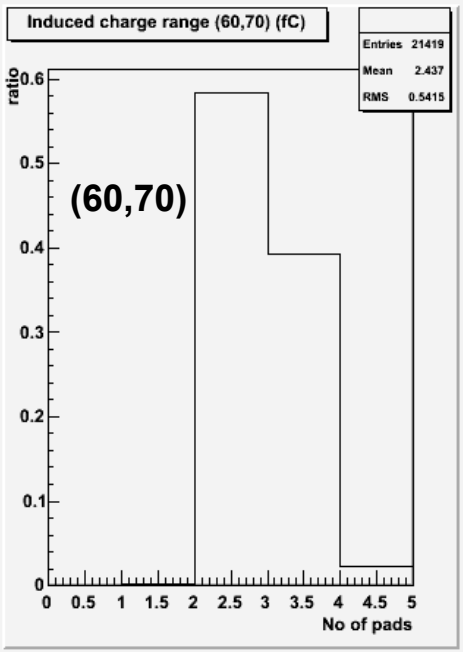


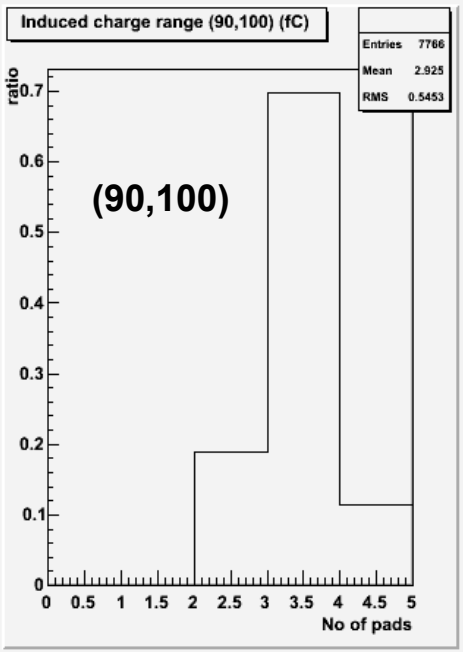
70%Ar+30%CO

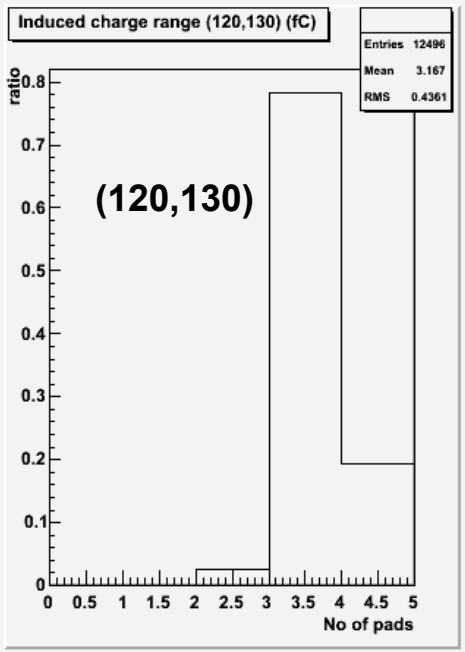


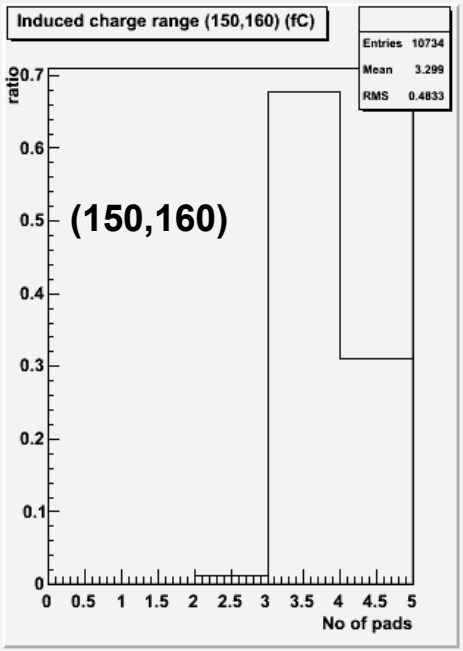
Trigger: the event signal of FASP-V0

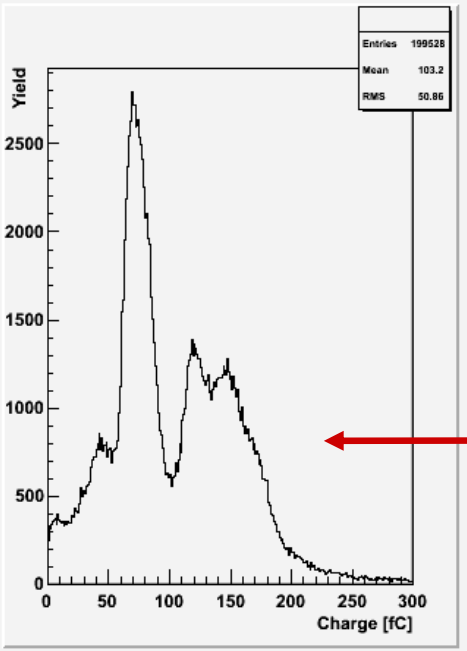
Fired rectangular pads as a function of induced charge











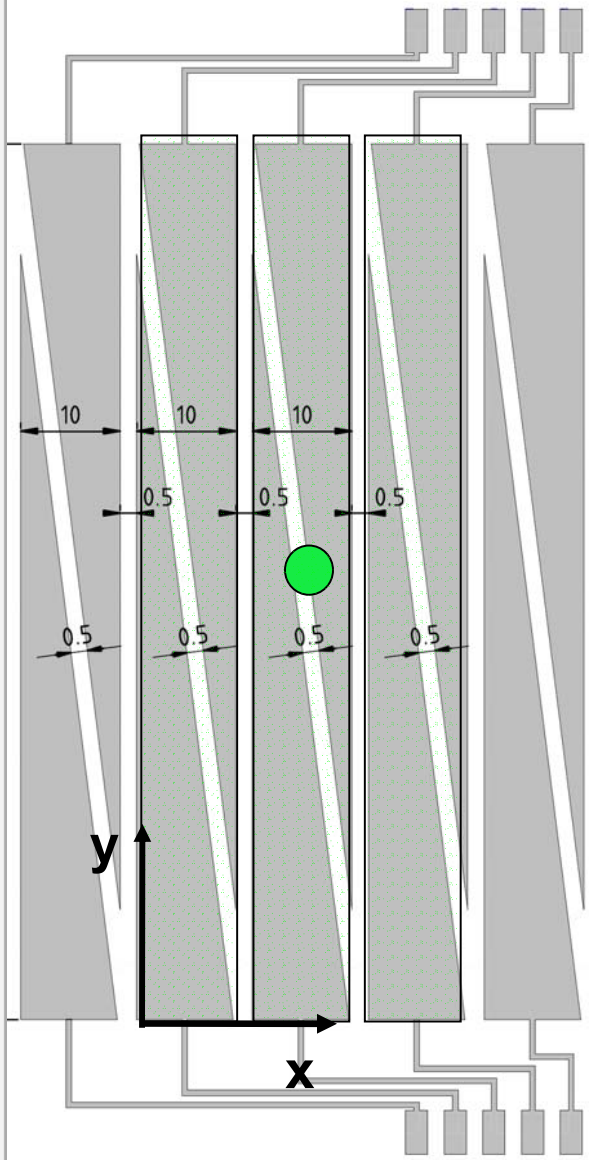
^{238}Pu

X – ray source

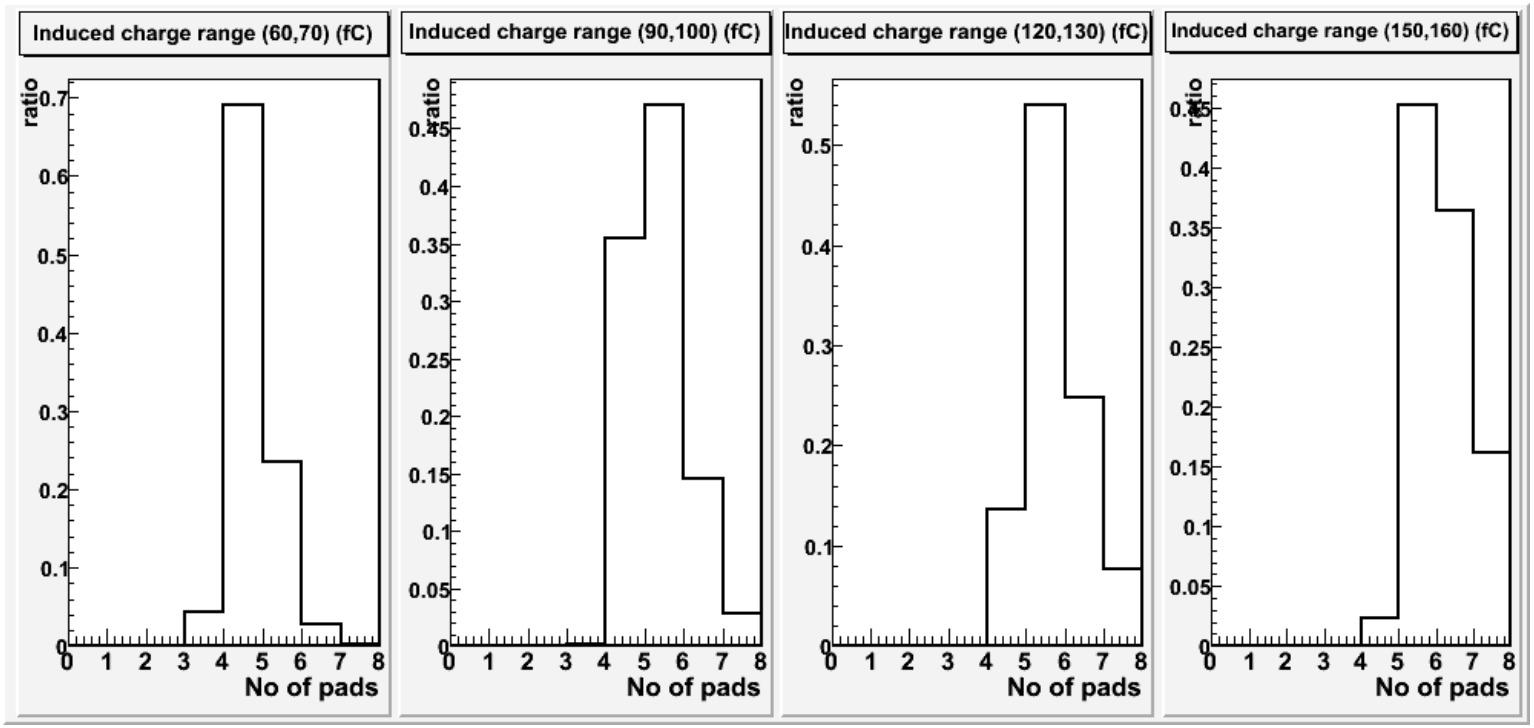
U_a = *1800 V*

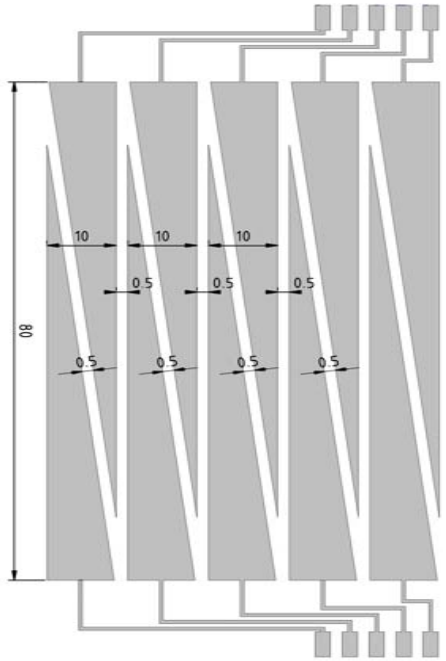
70%Ar+30%CO_2

Calibrated induced charge spectrum



Fired triangular pads as a function of induced charge

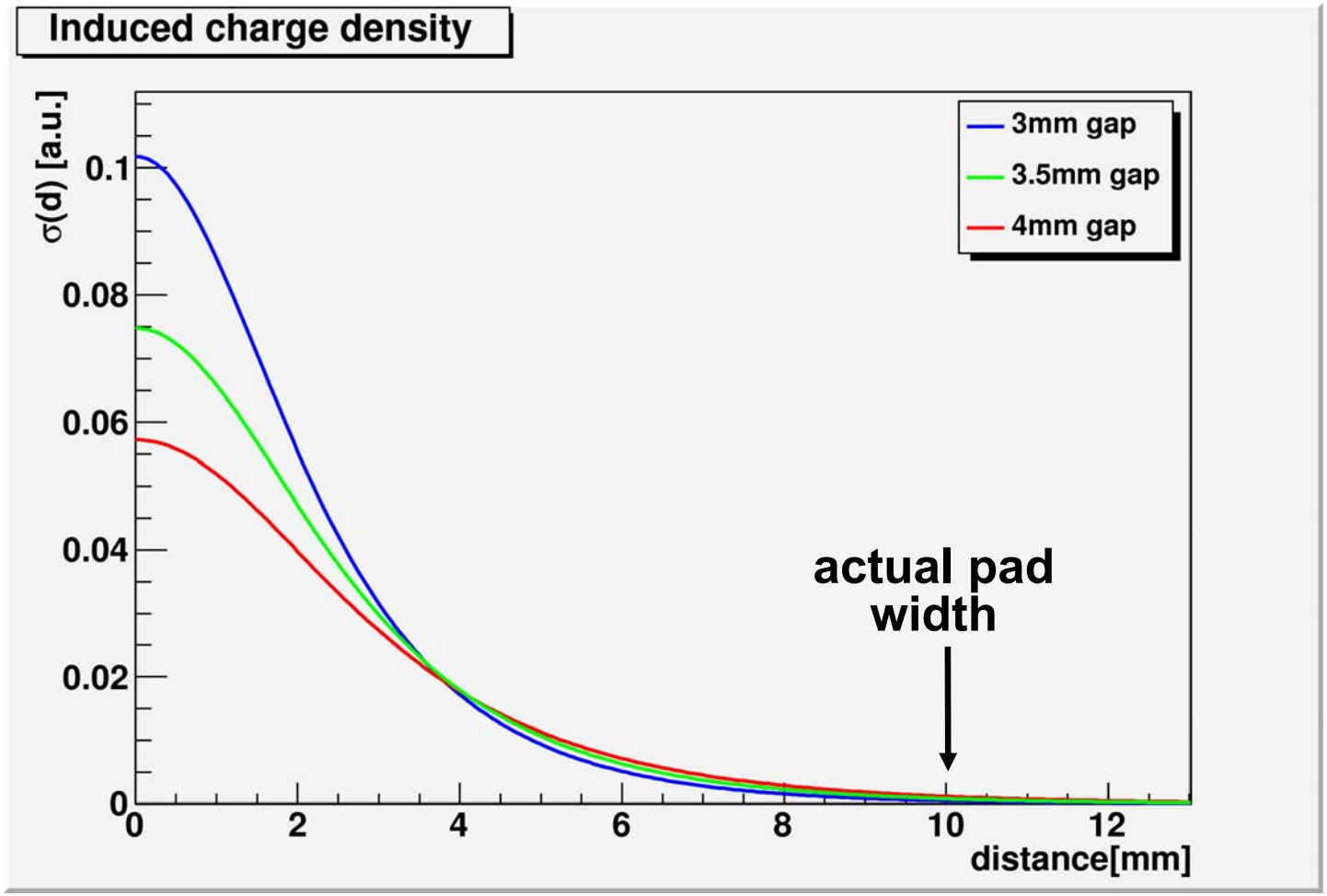




HV = 1800V

Next step

- *Geometry modification based on charge density plots for different gap sizes*



Double -sided 4 mm anode-cathode distance prototype version

Readout electrode

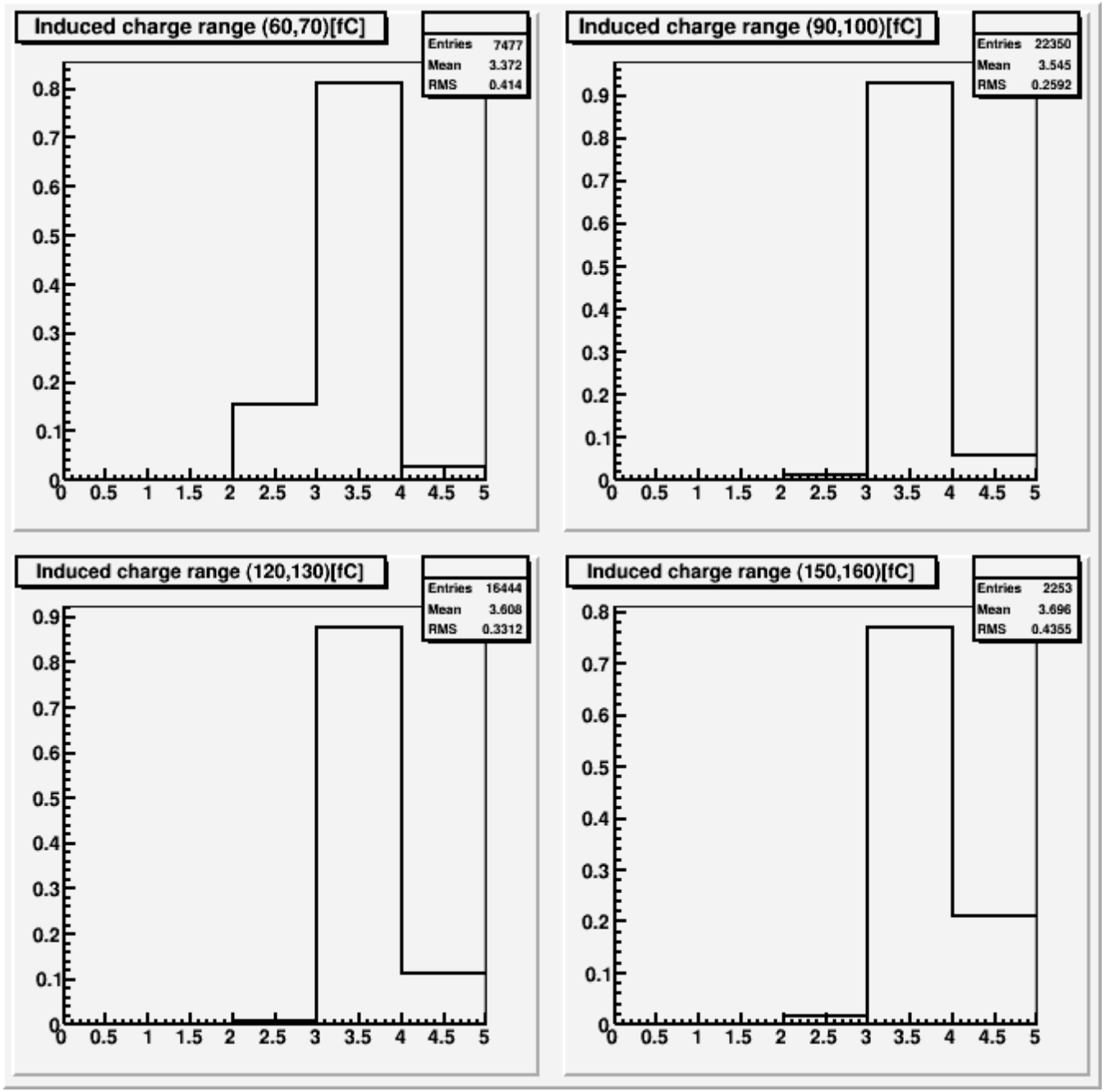
Cr(20 nm)/Al(200nm)

on 25 μm kapton foil

4 mm anode-cathode distance

3 mm anode wire pitch

Fired rectangular pads as a function of induced charge

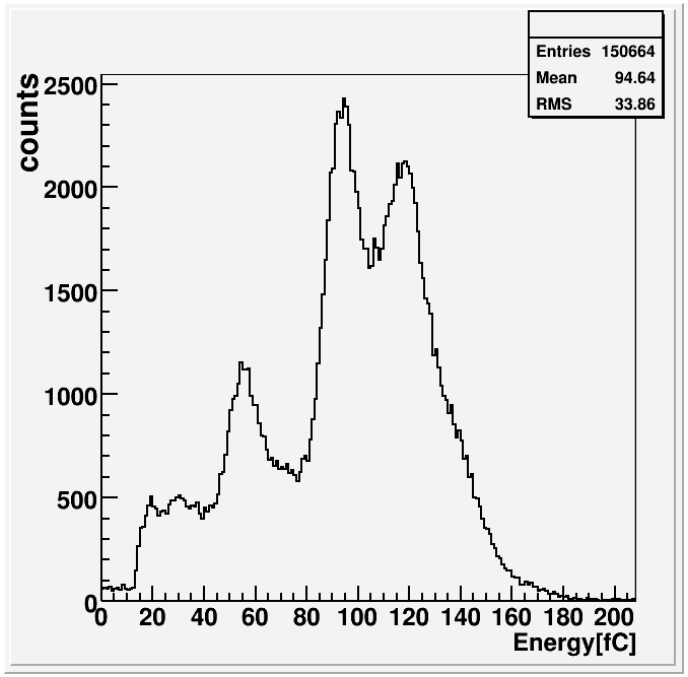


^{238}Pu X – ray source

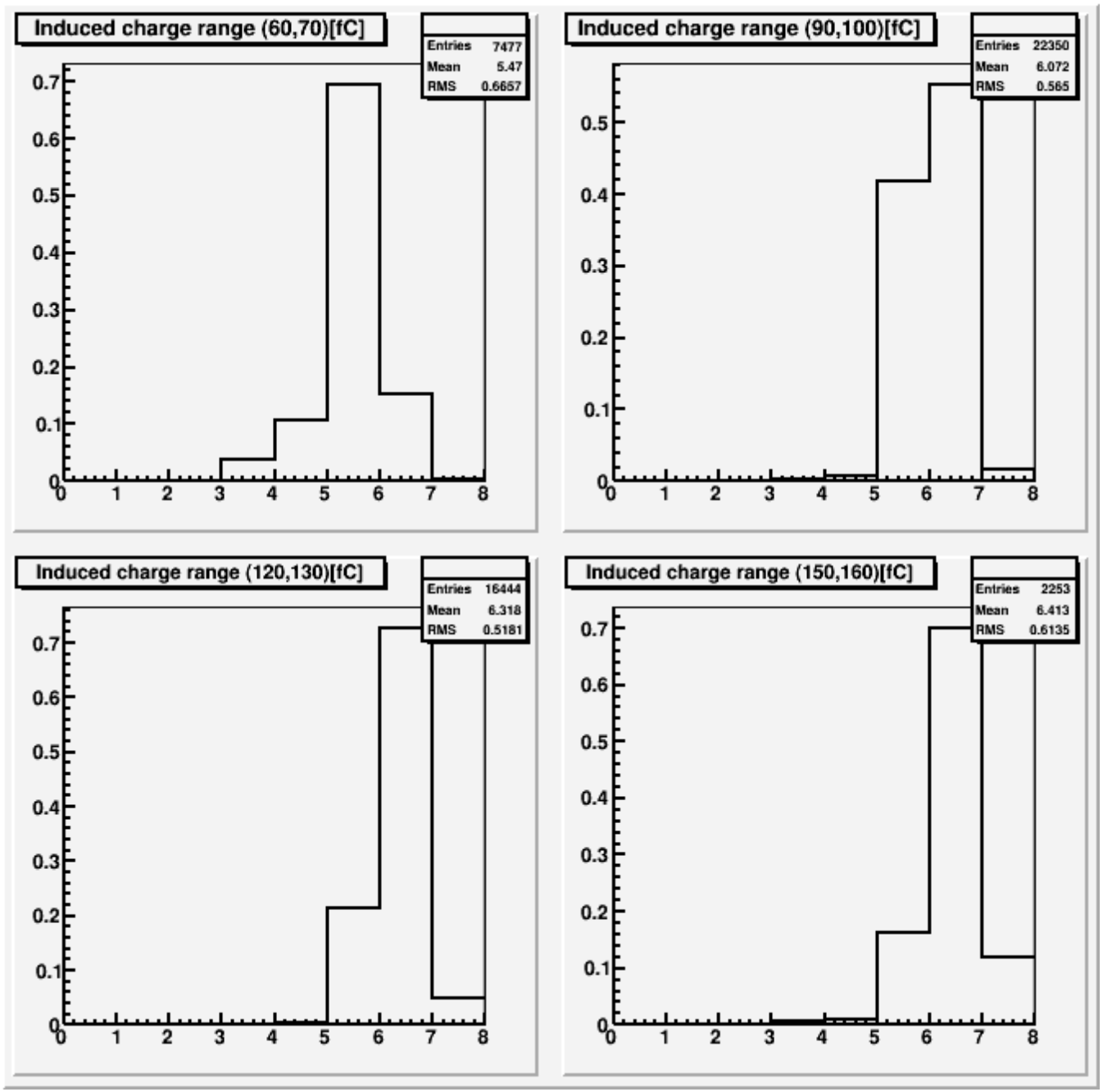
U_a = 1750 V

80%Ar + 20%CO_2

Calibrated induced charge spectrum

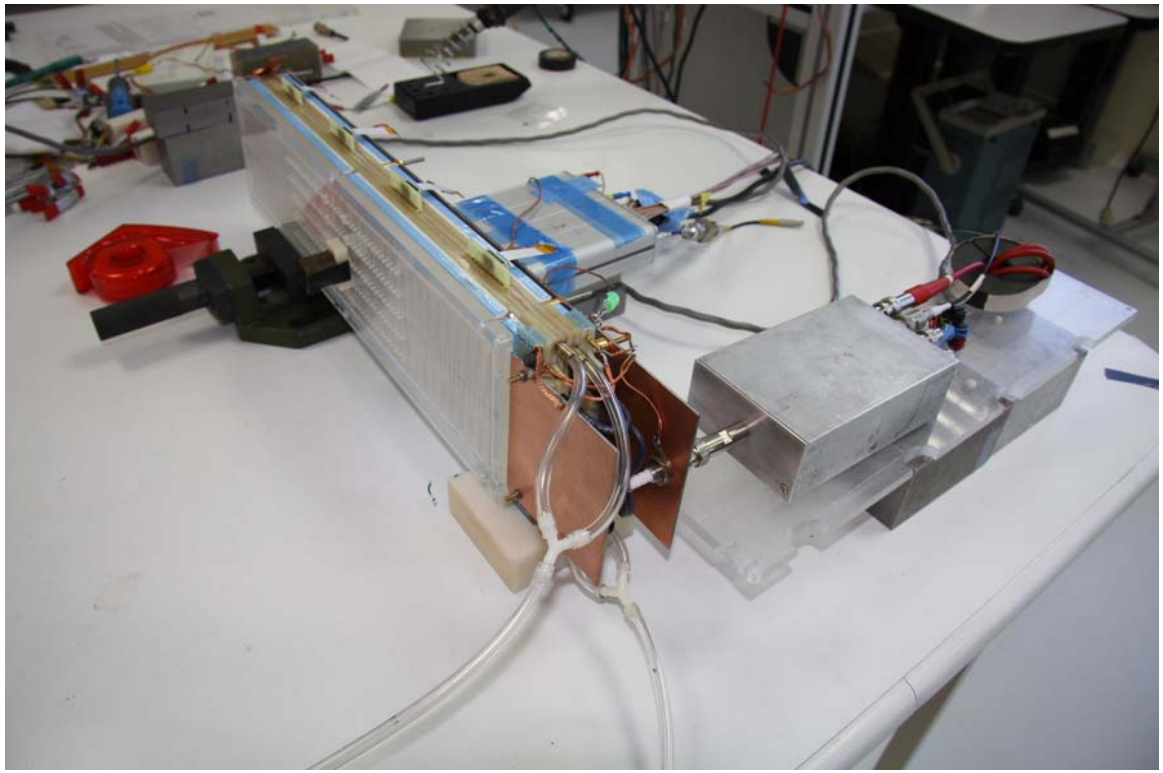


Fired triangular pads as a function of induced charge

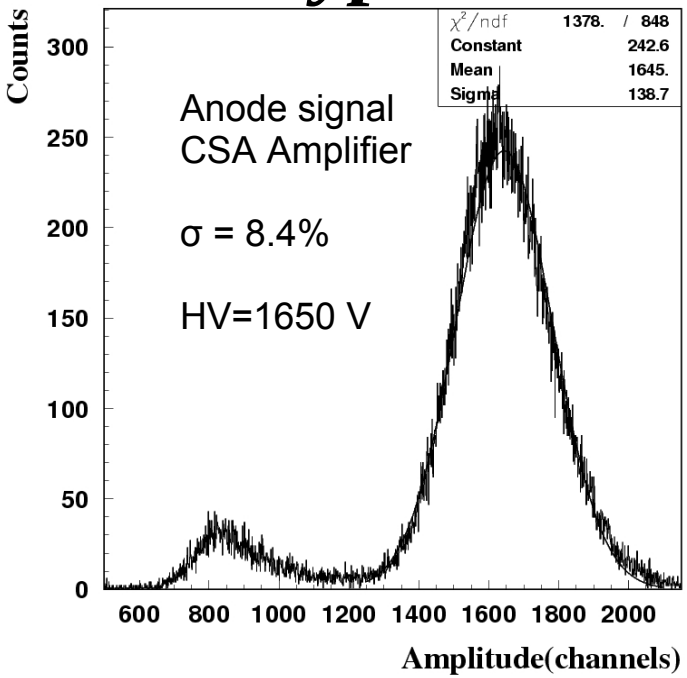


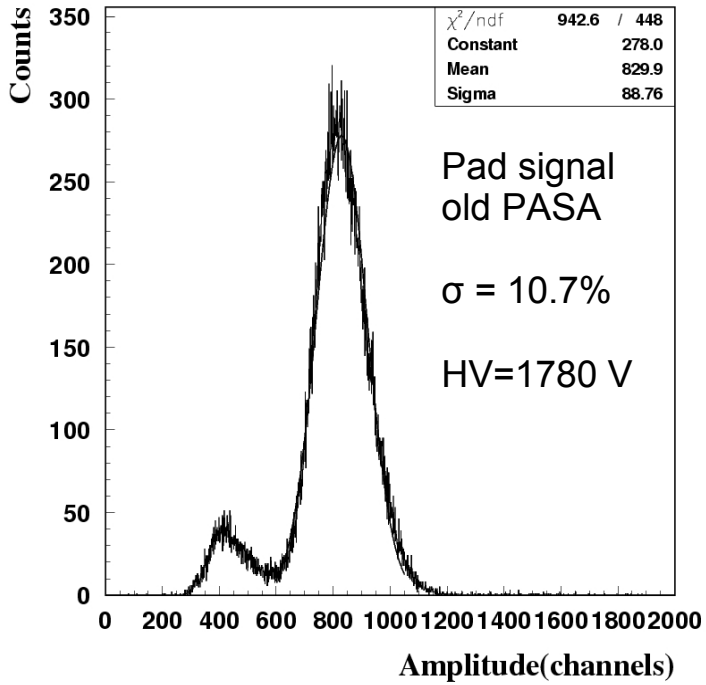
4 mm A-K distance TRD Prototype

^{55}Fe source tests



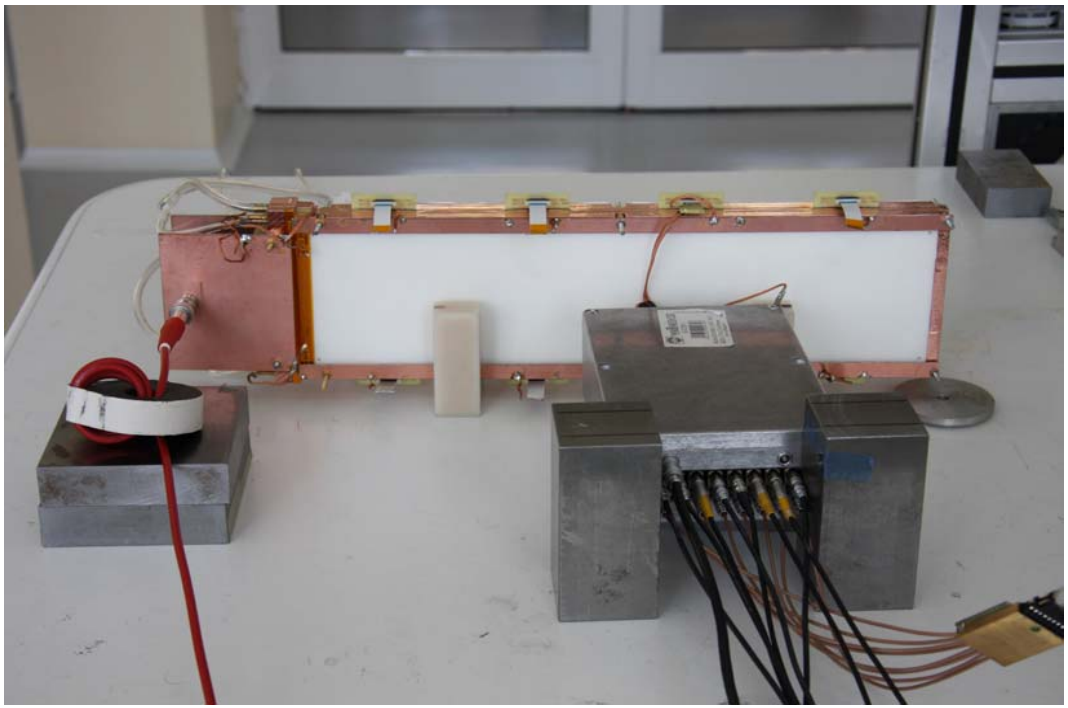
80%Ar + 20%CO_2



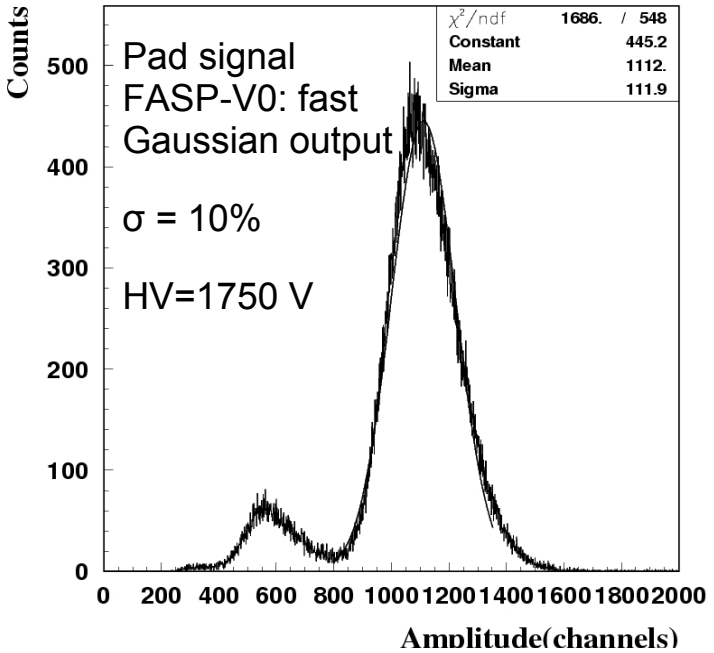


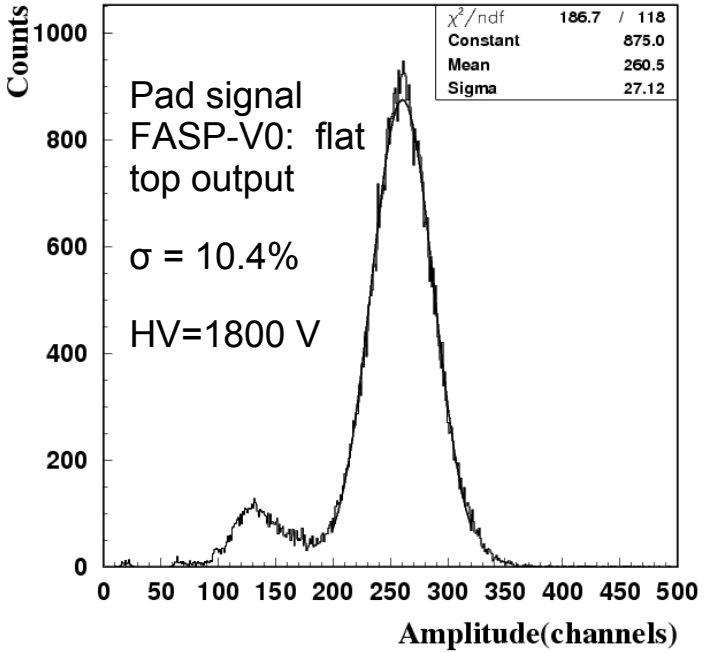
4 mm A-K distance TRD Prototype

^{55}Fe source tests using FASP-V0



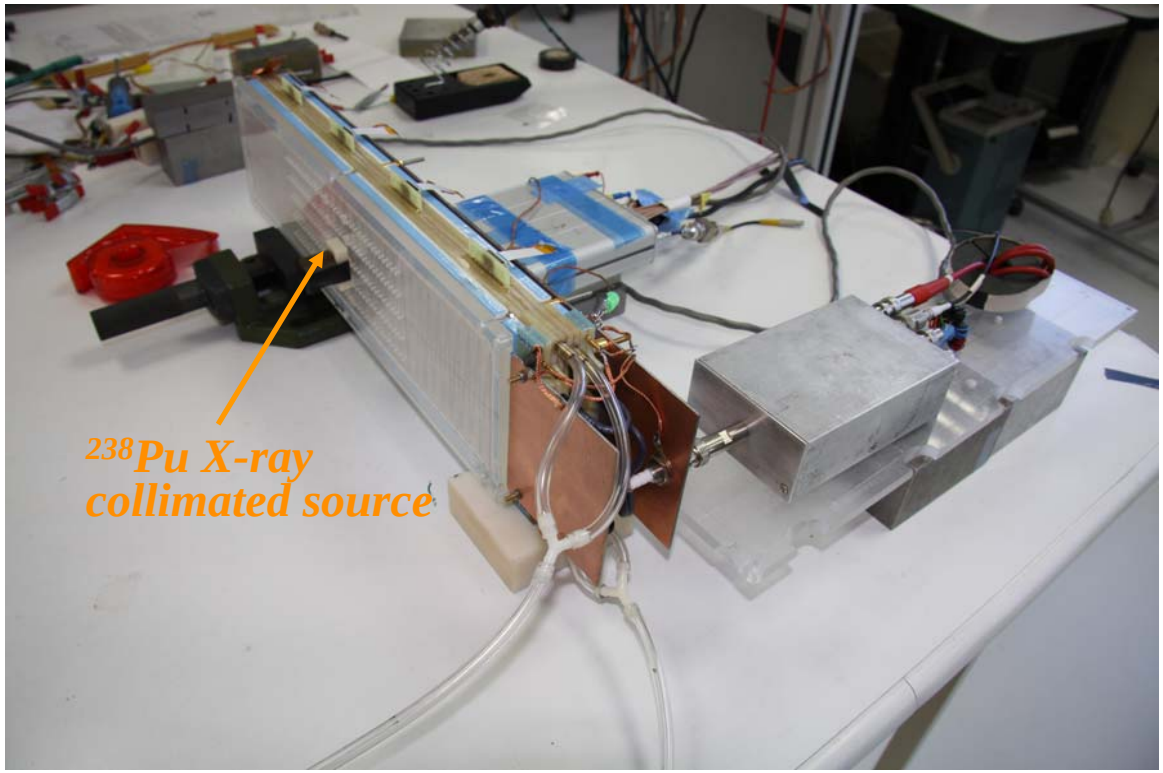
80%Ar+20%CO_2

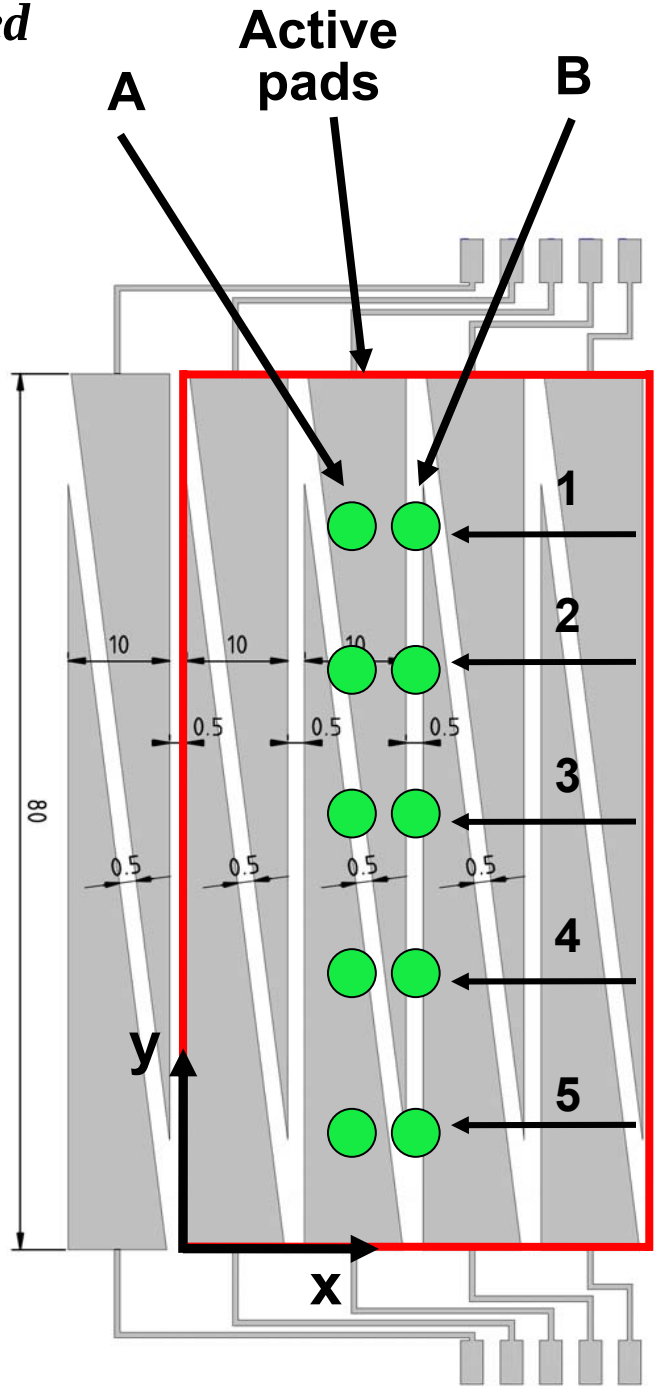




Position reconstruction

for events with at least three pads fired





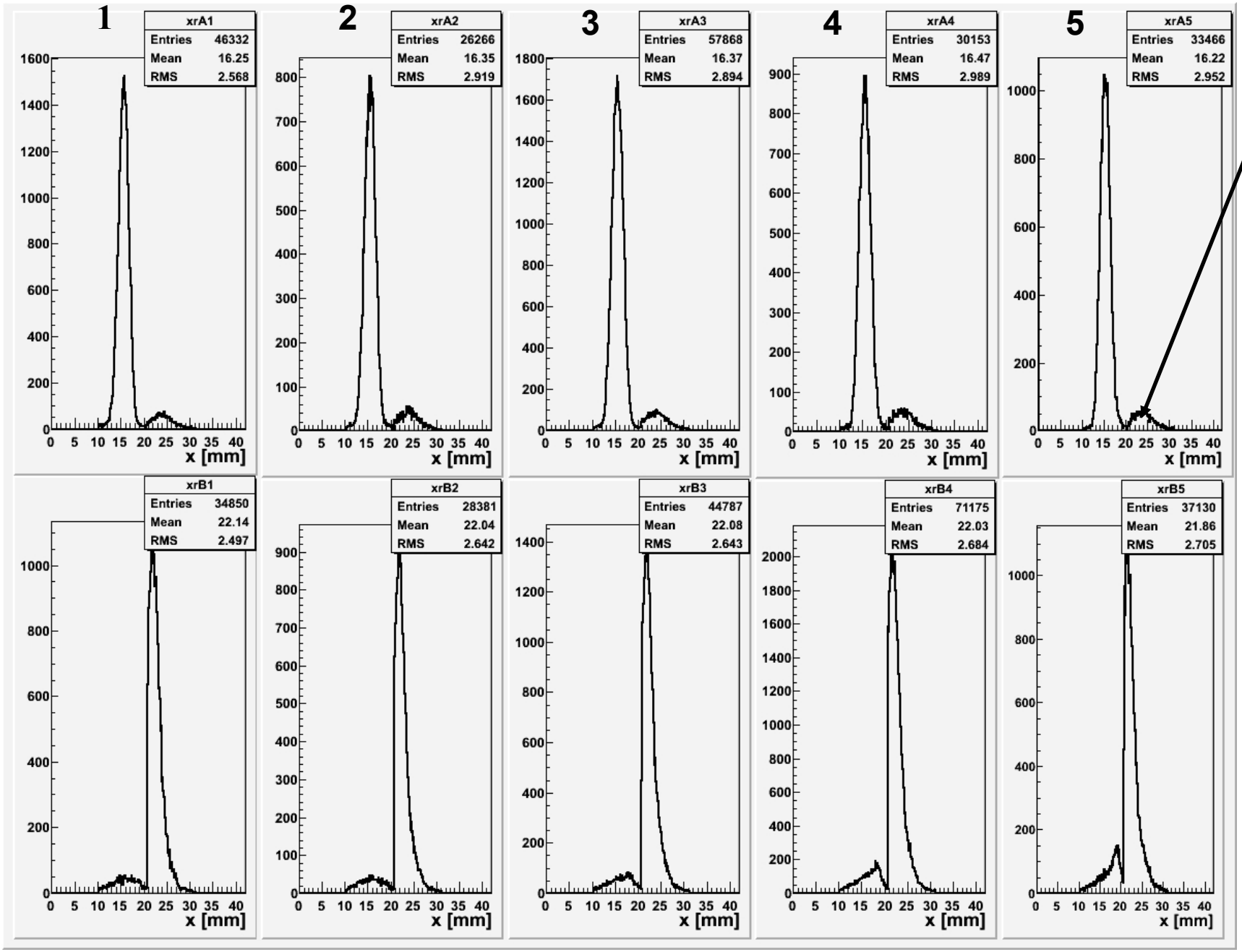
Collimator positions @ y=10, 25, 40, 55, 70 mm & x=15.5 (A), 20.75 (B) mm

$\Phi_{collimator}$*=2 mm*

Trigger: all measured pads

Position reconstruction – 3 mm anode-cathode distance

x coordinate



non-perfect collimation

A

(middle of a rectangular pad)

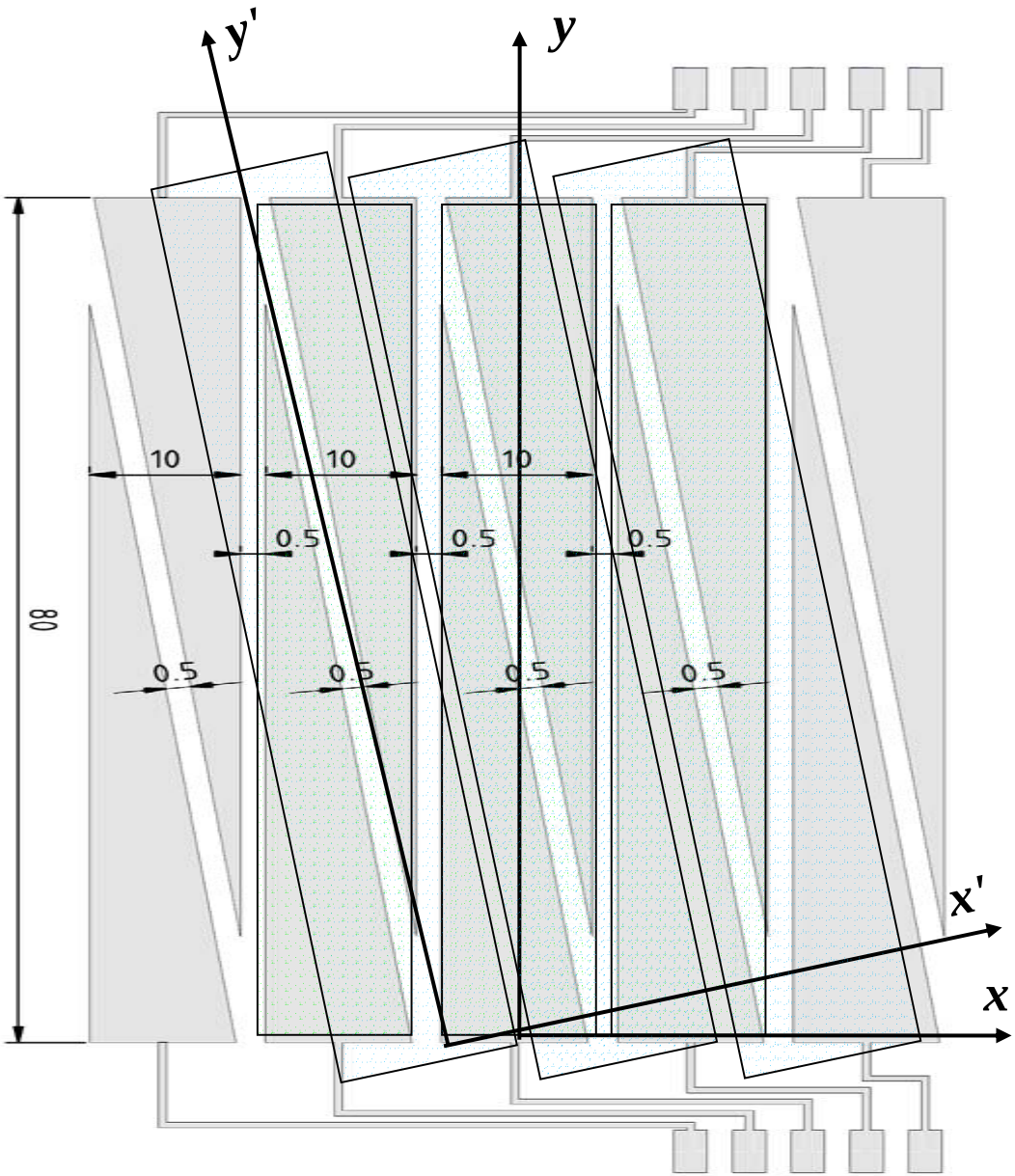
$\sigma_{fit} \approx 1.34$ mm

B

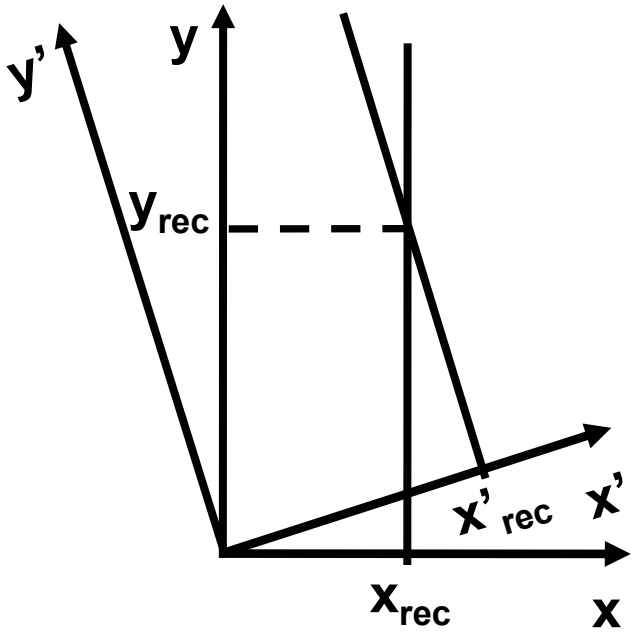
(border between rectangular pads)

Position reconstruction

y coordinate

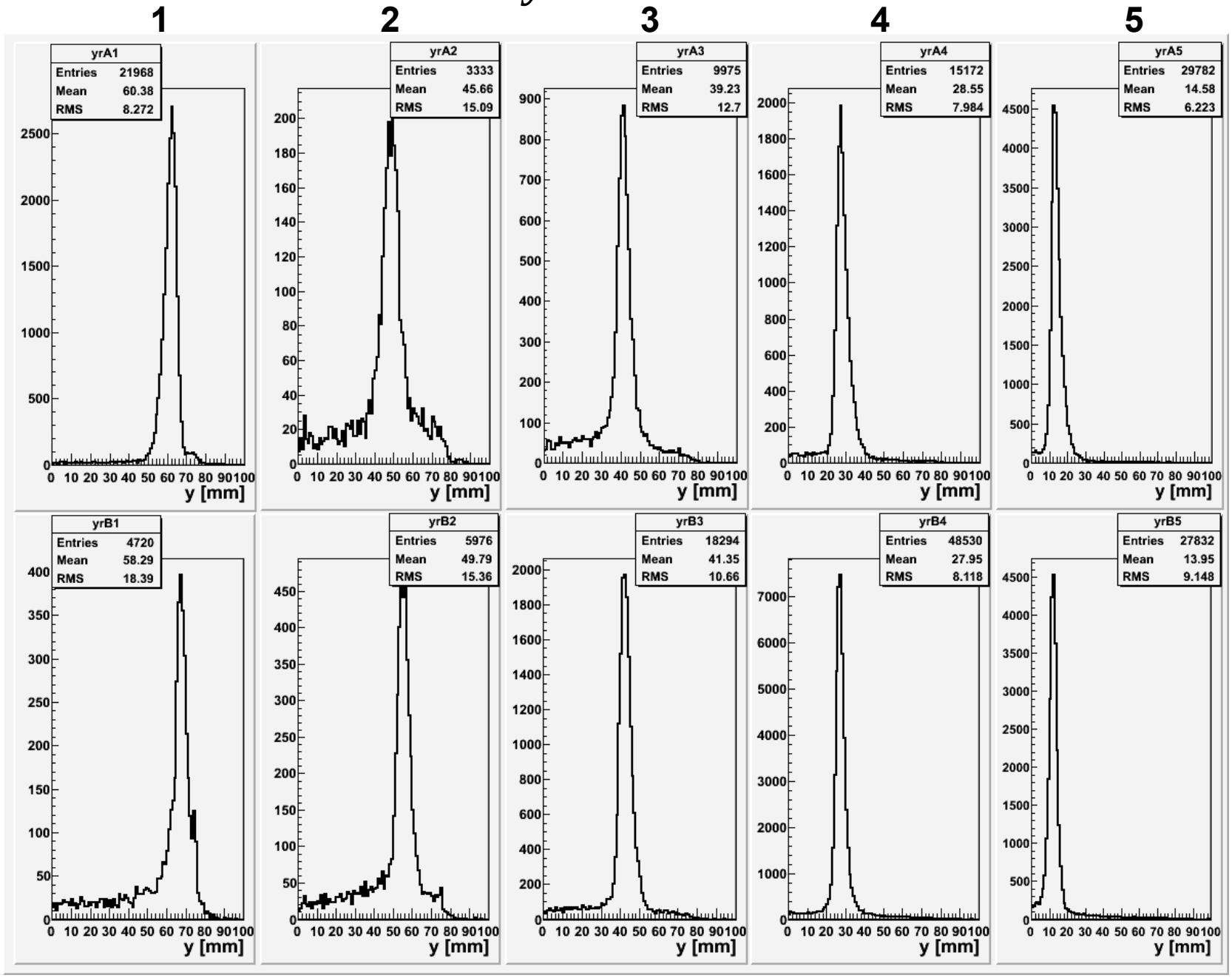


Algorithm graphic description:



Position reconstruction

y coordinate



A

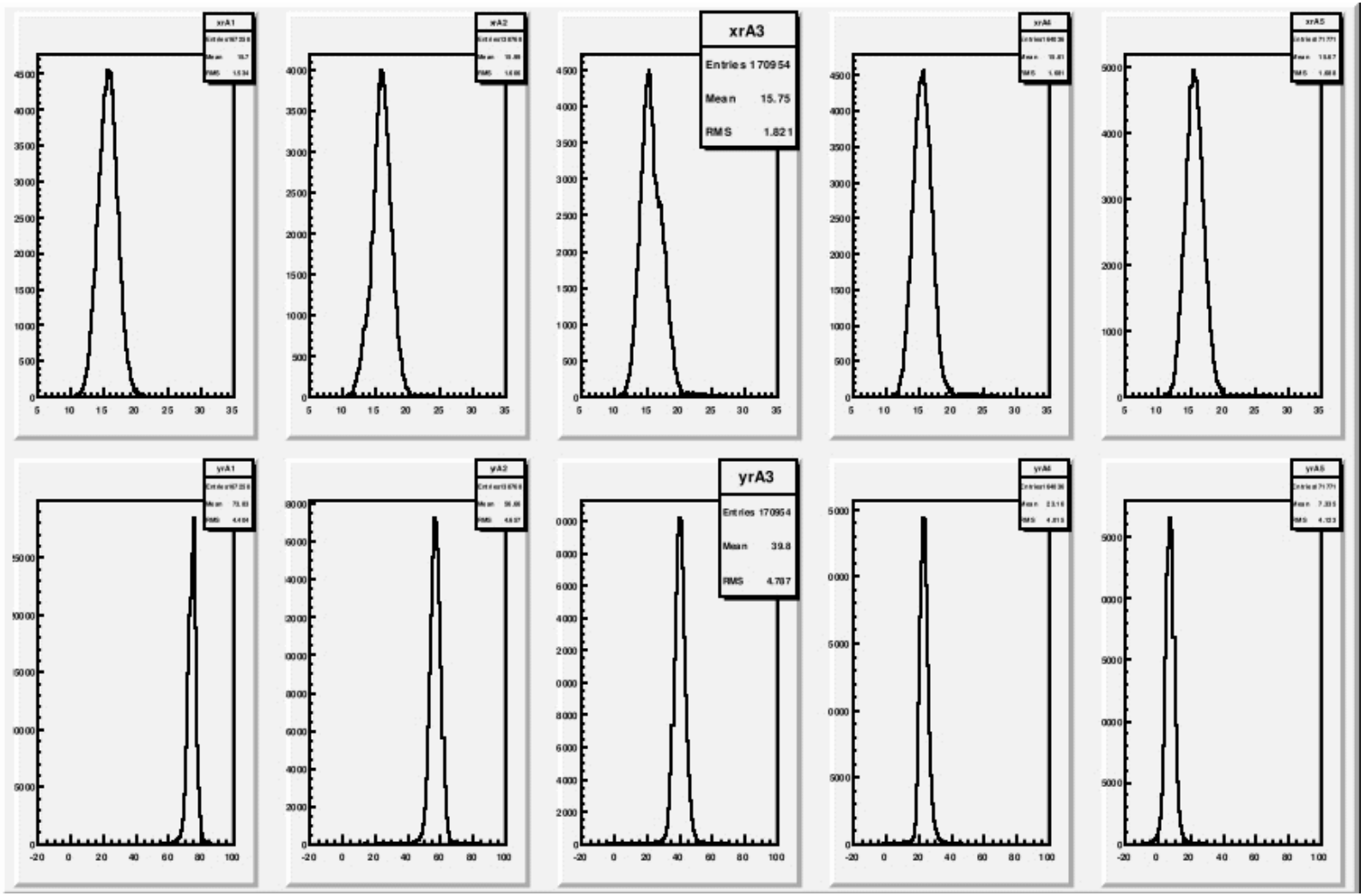
(middle of a rectangular pad)

$\sigma_{fit} \approx 2.5$mm

B

(border between rectangular pads)

Position reconstruction - 4 mm anode-cathode distance



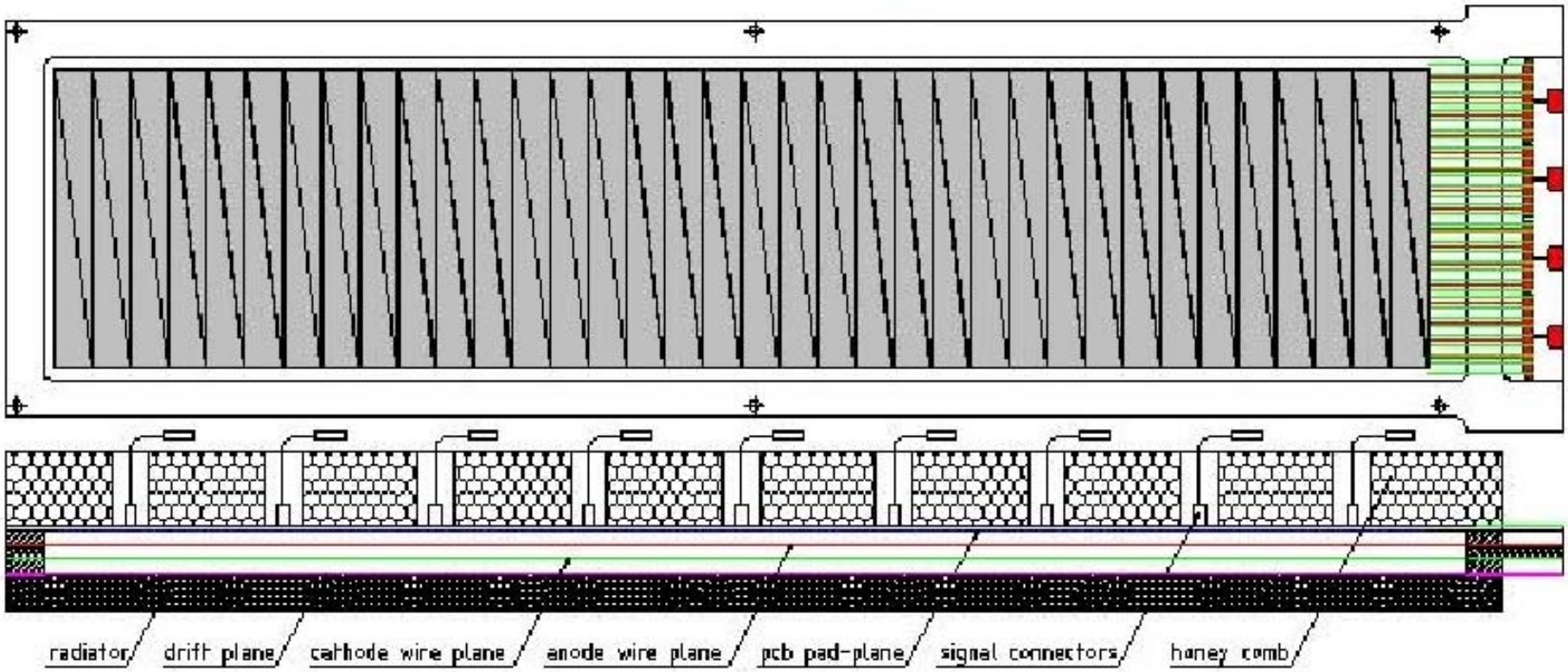
x coordinate

$\sigma_{fit} \approx 1.4$ mm

y coordinate

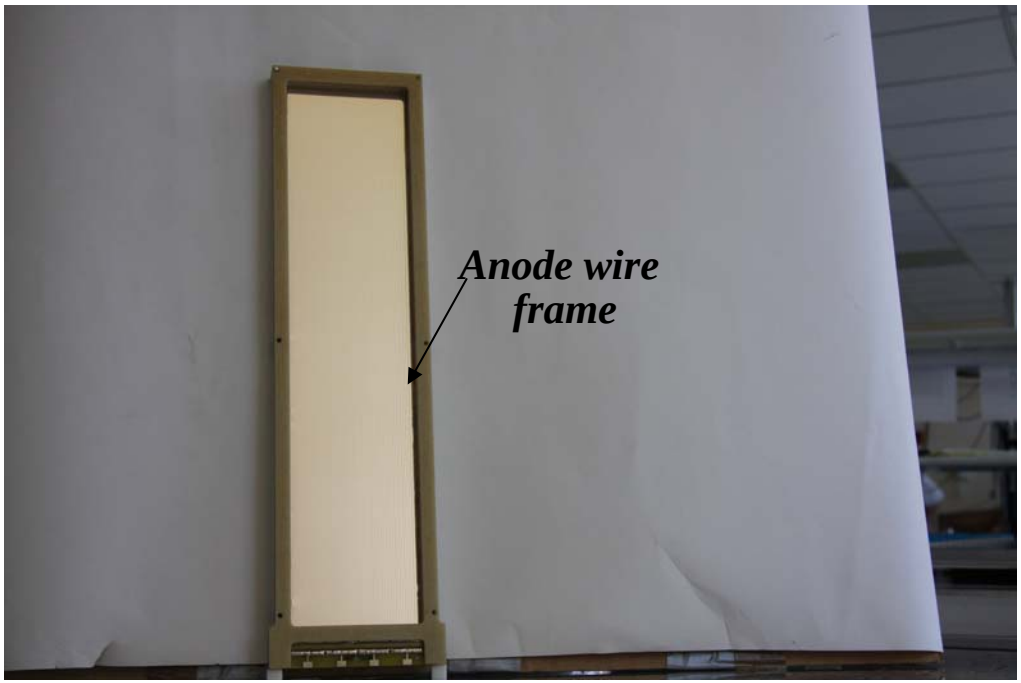
$\sigma_{fit} \approx 2.7$ mm

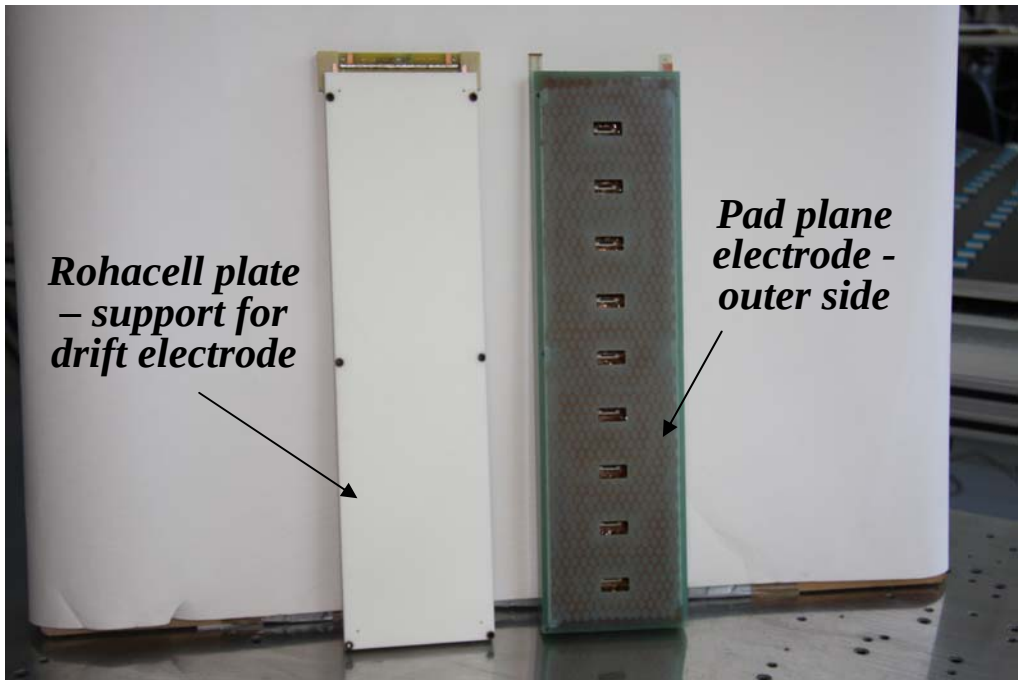
Single-sided two-dimension position sensitive prototype

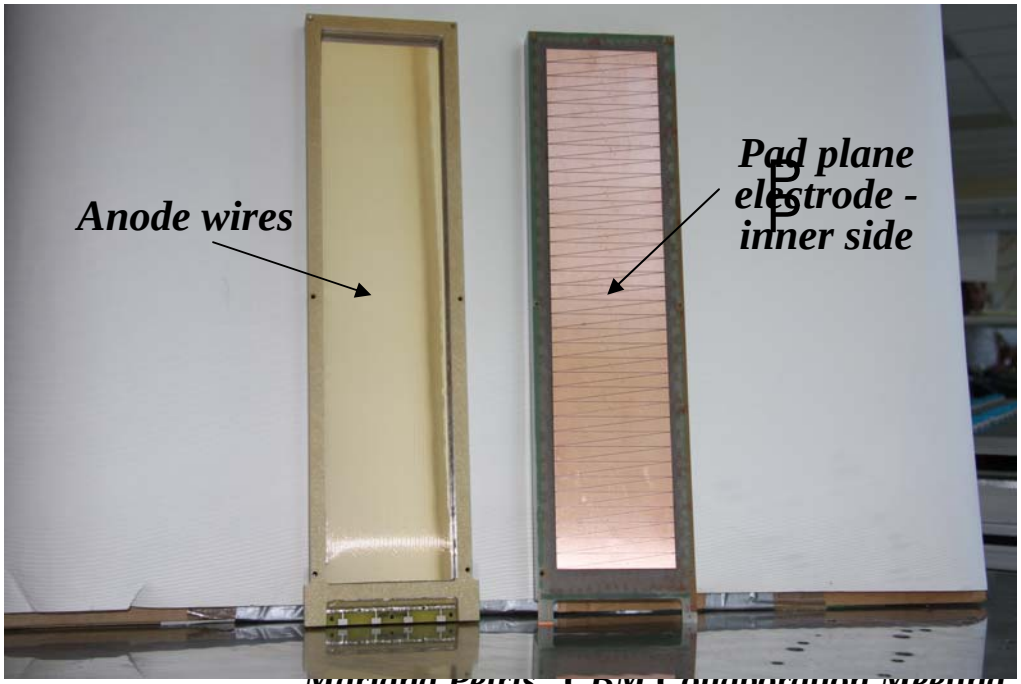


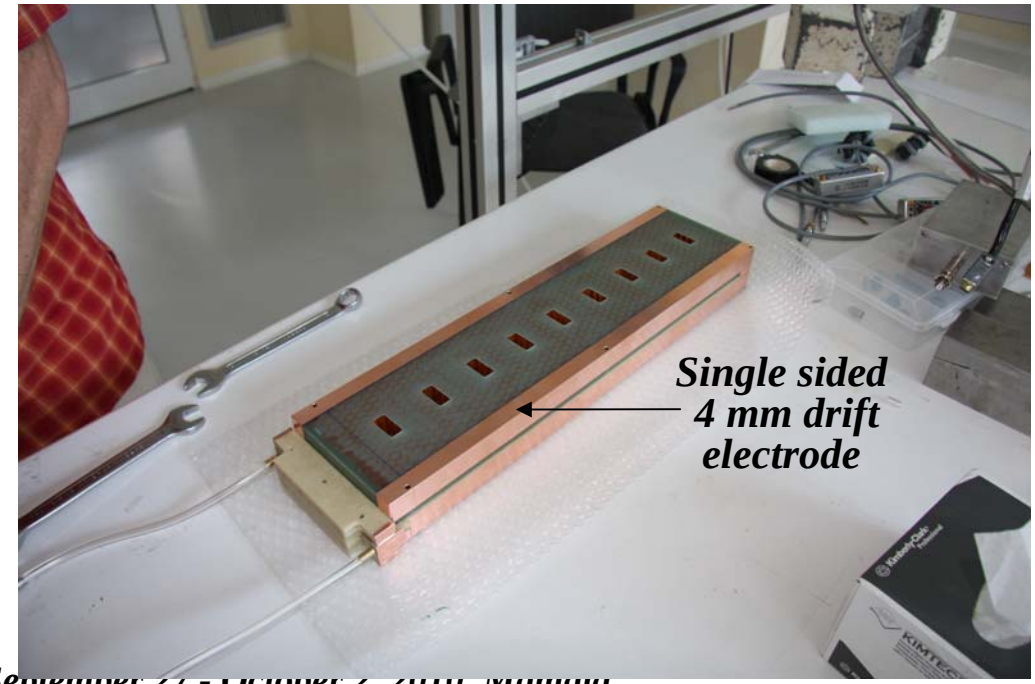
- ***Readout electrode: PCB, 300 μm thickness***
- ***4 mm anode-cathode distance***
- ***4 mm drift distance***
- ***3 mm anode wire pitch***
- ***1.5 mm cathode wire pitch***

Construction Details



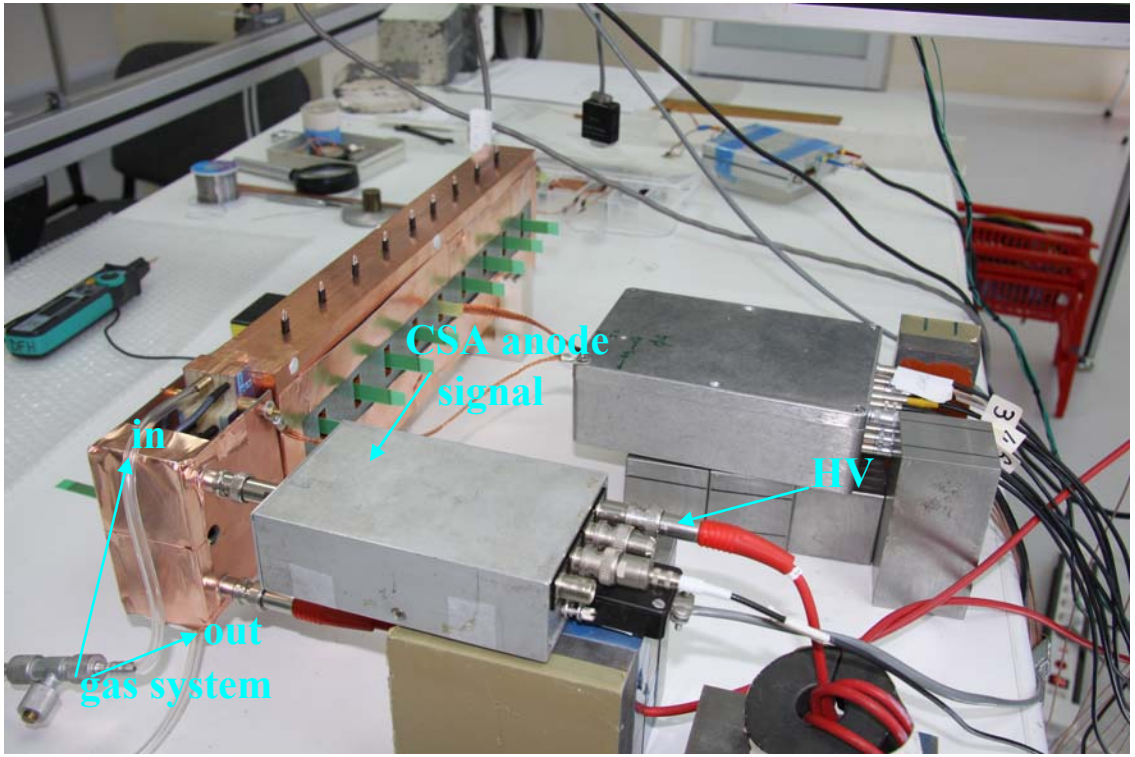


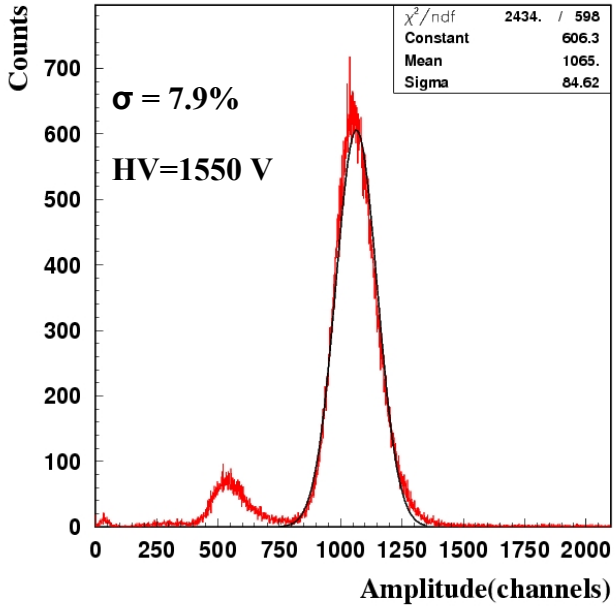


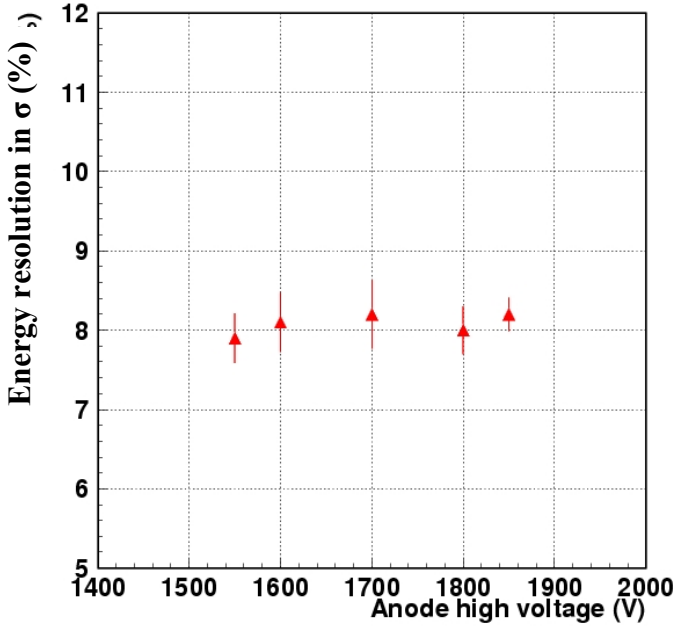


^{55}Fe source energy resolution tests
Anode - signal

Gas mixture: 80%Ar + 20%CO_2



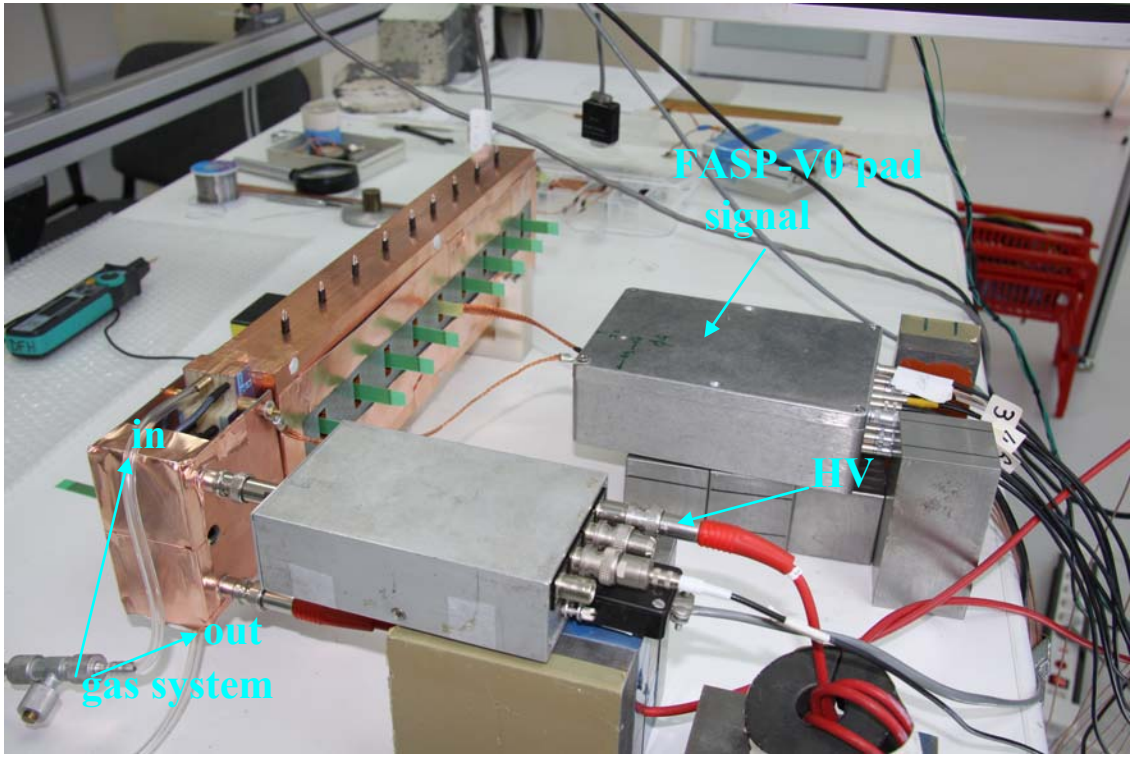




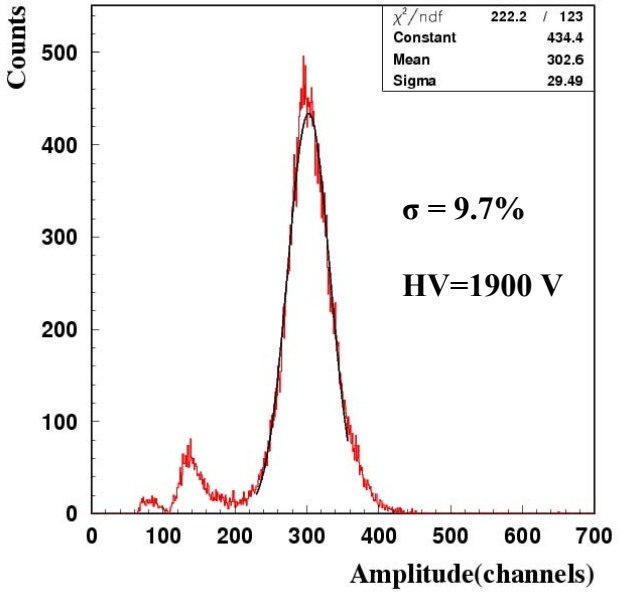
Energy resolution in σ (%), using anode signal, as a function of high voltage

^{55}Fe source energy resolution tests
Pad signal

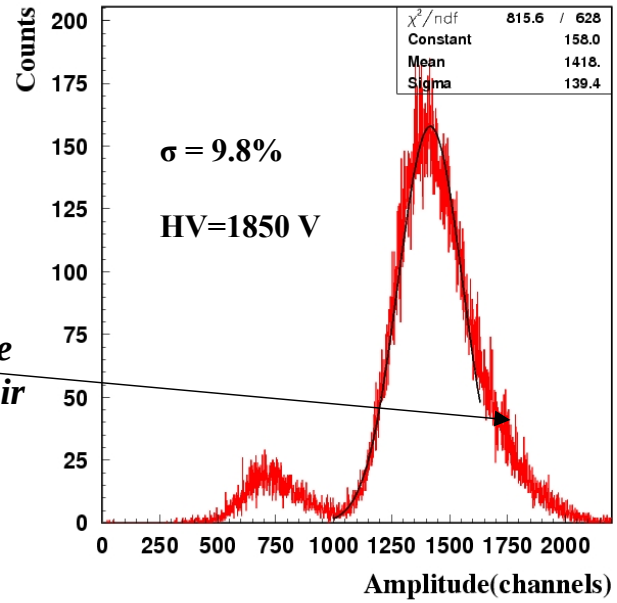
Gas mixture: 80%Ar + 20%CO_2



Pad signal - FASP-V0, flat top output



Pad signal - FASP-V0, fast output



The tail is supposed to be a consequence of the difference between the DC levels of the different channels of the two main amplifiers and their shaping time – will be investigated.

Summary and Outlook

- ***Two version of the TRD prototype based on a two - dimension position sensitive, double sided pad read-out electrode were designed, built and tested with radioactive sources***

  - ***The obtained energy resolution @ ^{55}Fe source for each of them was very good. The position reconstruction in both x and y direction using ^{238}Pu X-ray source was demonstrated.***

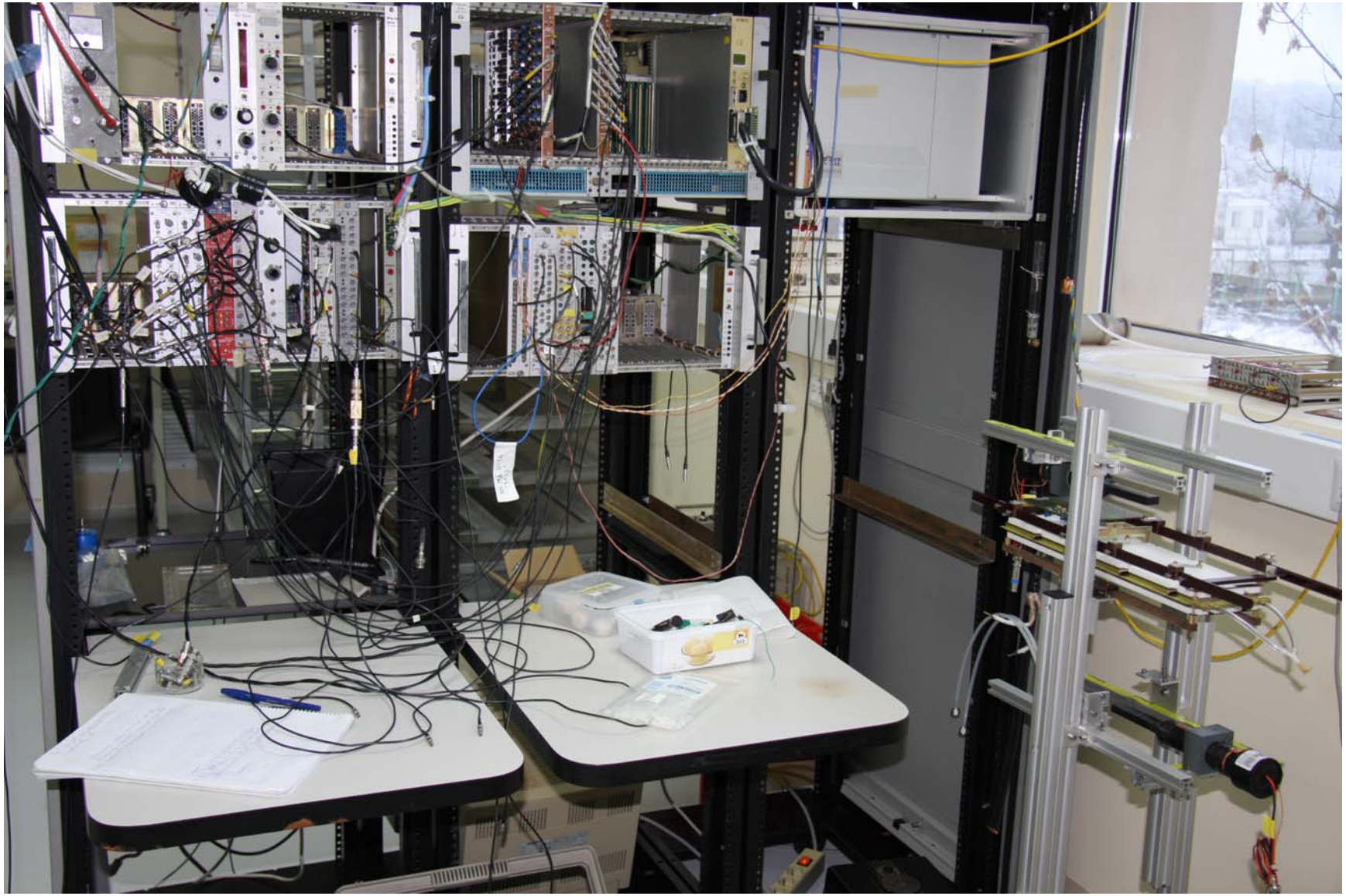
- ***The performance of the new FEE electronics developed in our group - the first version of the Fast Analog Signal Processor (FASP-V0) - was demonstrated by the energy resolution results obtained in the performed tests using both possibilities:***
  a) fast semi-Gaussian output
  b) peak sense output

- ***A single sided prototype with 4 mm A-K distance and 4 mm drift distance and two-dimension position sensitive was designed built and tested with radioactive source.***

  - ***The obtained results of the performed tests showed o very good energy resolution for this prototype using the ^{55}Fe source for both anode and pad signal.***

- ***We are planning detailed cosmic tests using the prototypes presented above and a cosmic trigger.***

Experimental set-up for cosmic ray tests



- mechanics, electronics and DAQ in preparation

In-beam tests, November @ PS-CERN

15 – 22 November

Double sided pad-readout electrode two – dimension position sensitive TRD prototypes

- *3 mm anode – cathode distance*
- *4 mm anode -cathode distance*

Single sided pad-readout electrode two – dimension position sensitive TRD prototype

- *4 mm anode -cathode distance + 4 mm drift distance*

FEE – Fast Analog Signal Processor - FASPV0

MBS - DAQ

NIPNE – Bucharest

V. Aprodu

D. Bartos

G. Caragheorgheopol

V. Catanescu

A. Herghelegiu

M. Petris

M. Petrovici

L. Prodan

A. Radu

V. Simion

University of Münster

C. Bergmann

M. Klein-Bösing

J.P. Wessels