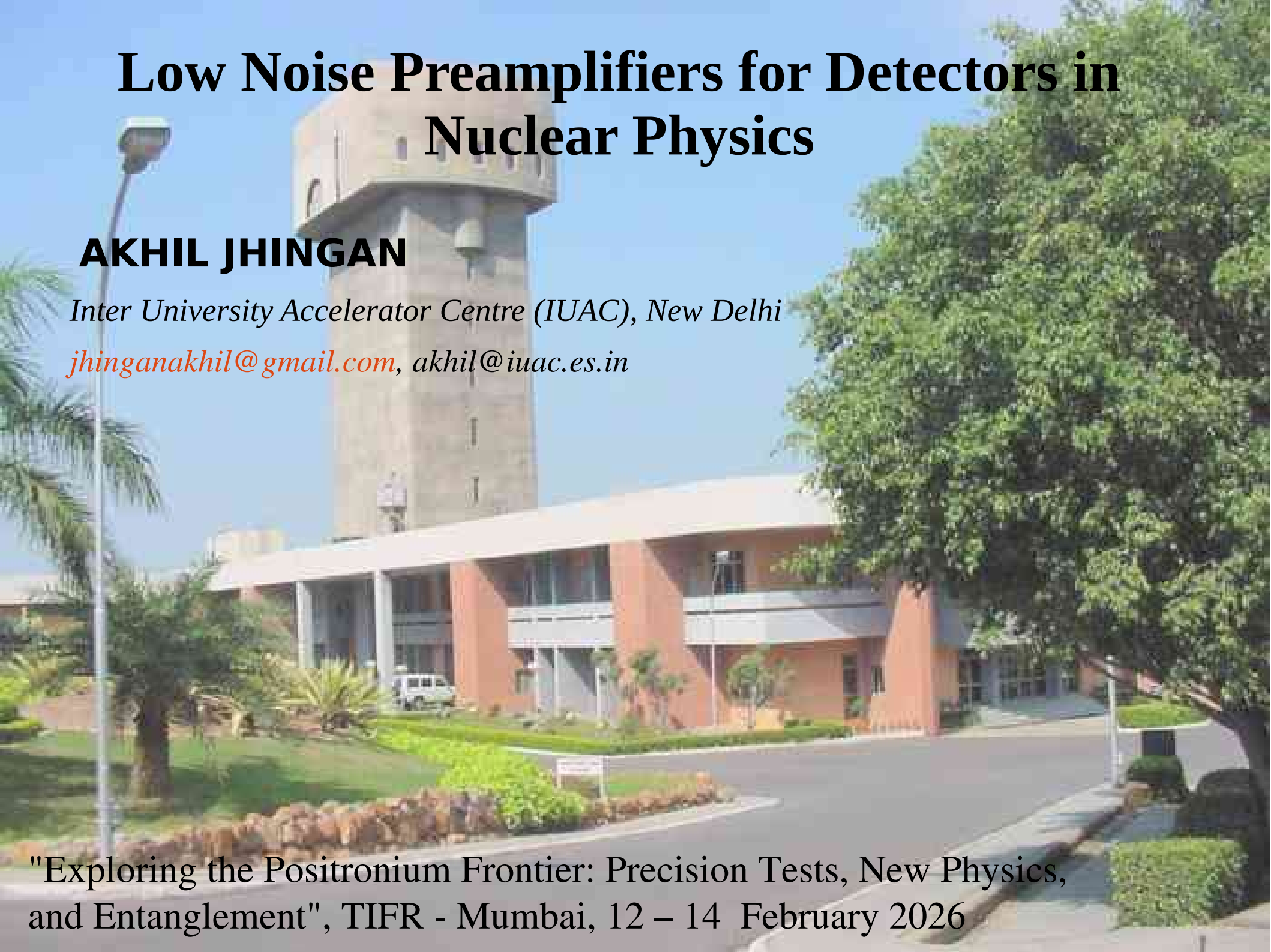
# Low Noise Preamplifiers for Detectors in Nuclear Physics



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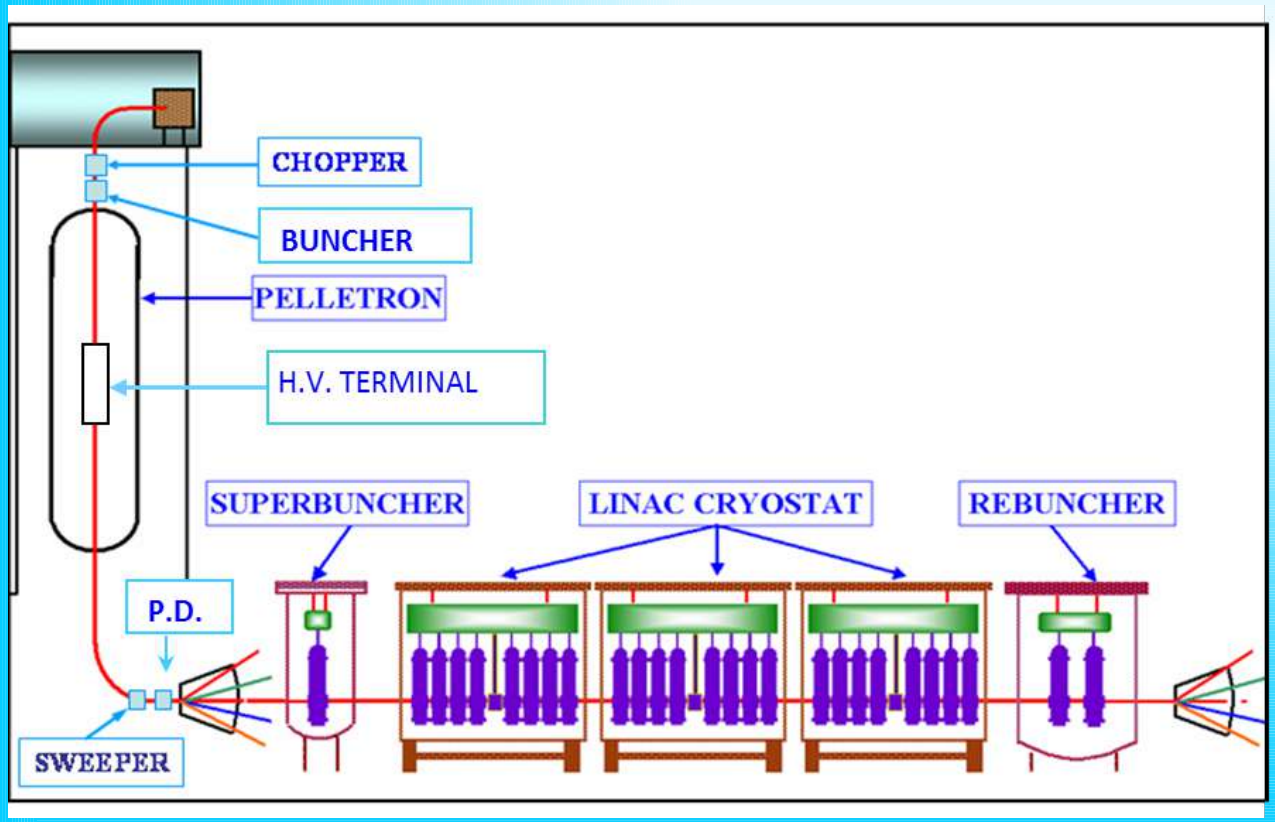
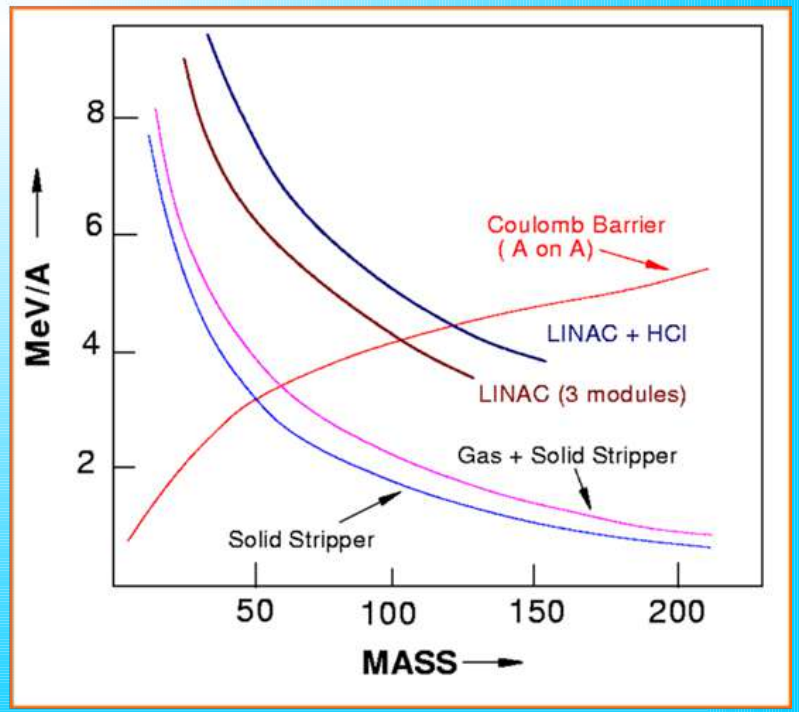
"Exploring the Positronium Frontier: Precision Tests, New Physics, and Entanglement", TIFR - Mumbai, 12 – 14 February 2026

# Accelerator

- IUAC is equipped with a 15 UD Pelletron accelerator
- Delivers beams from H-Pb with energies from tens to hundreds of MeV (wide velocity range)
- With Pelletron energy, coulomb barrier for symmetric system can be achieved up to mass ~50
- Decided to boost up the energy so that the energy to exceed Coul. Bar. will be extended up to ~Ag (107) and that demands to double the energy obtained from Pelletron.



## Experiments

***Fusion***

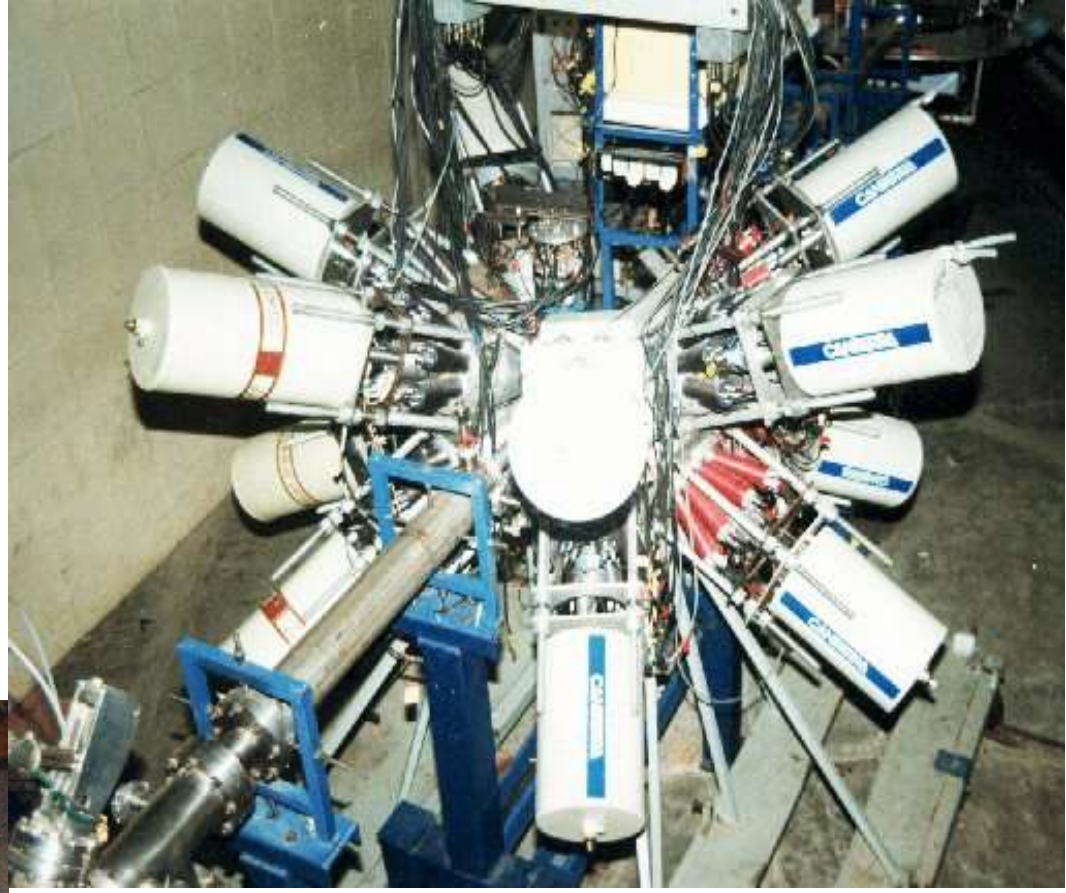
***Quasi-elastic scattering, MNT***

***Fission***

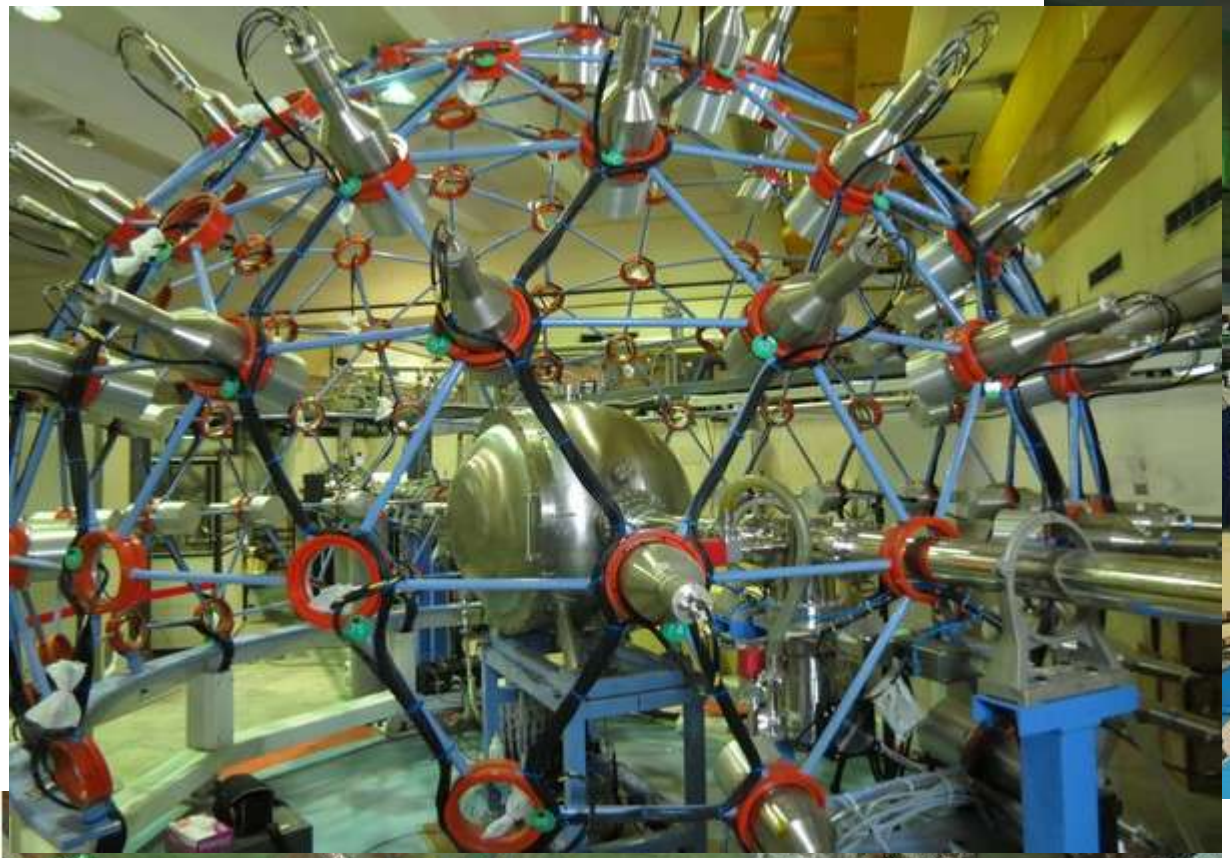
Mass distributions, Angular Distributions,
Mass gated Neutron multiplicity, Charge Particle Multiplicity

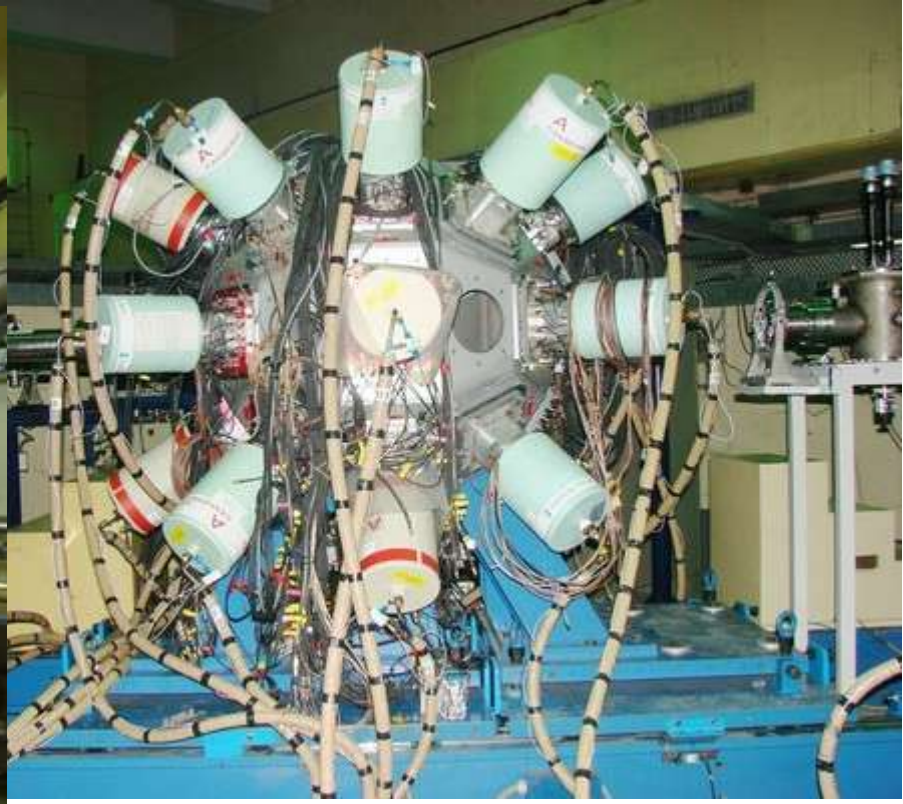
***Coulomb Excitation***

***Gamma spectroscopy***




Beam Hall I facility





Beam Hall II Facilities

## Nuclear physics facilities and experiments

***Nuclear reaction and structure studies using experimental facilities at Inter-University Accelerator Centre (IUAC)***

***Eur. Phys. J. A (2022) 58:250***
https://doi.org/10.1140/epja/s10050-022-00855-y

***Detectors and front-end electronics for nuclear physics research at IUAC***

***Eur. Phys. J. A (2025) 61:64***
https://doi.org/10.1140/epja/s10050-025-01526-4

# Detector Development for  Nuclear Physics experiments

Gas Detectors
Multi Wire Proportional Counters (MWPC)
Gas ionization Chambers for particle identification

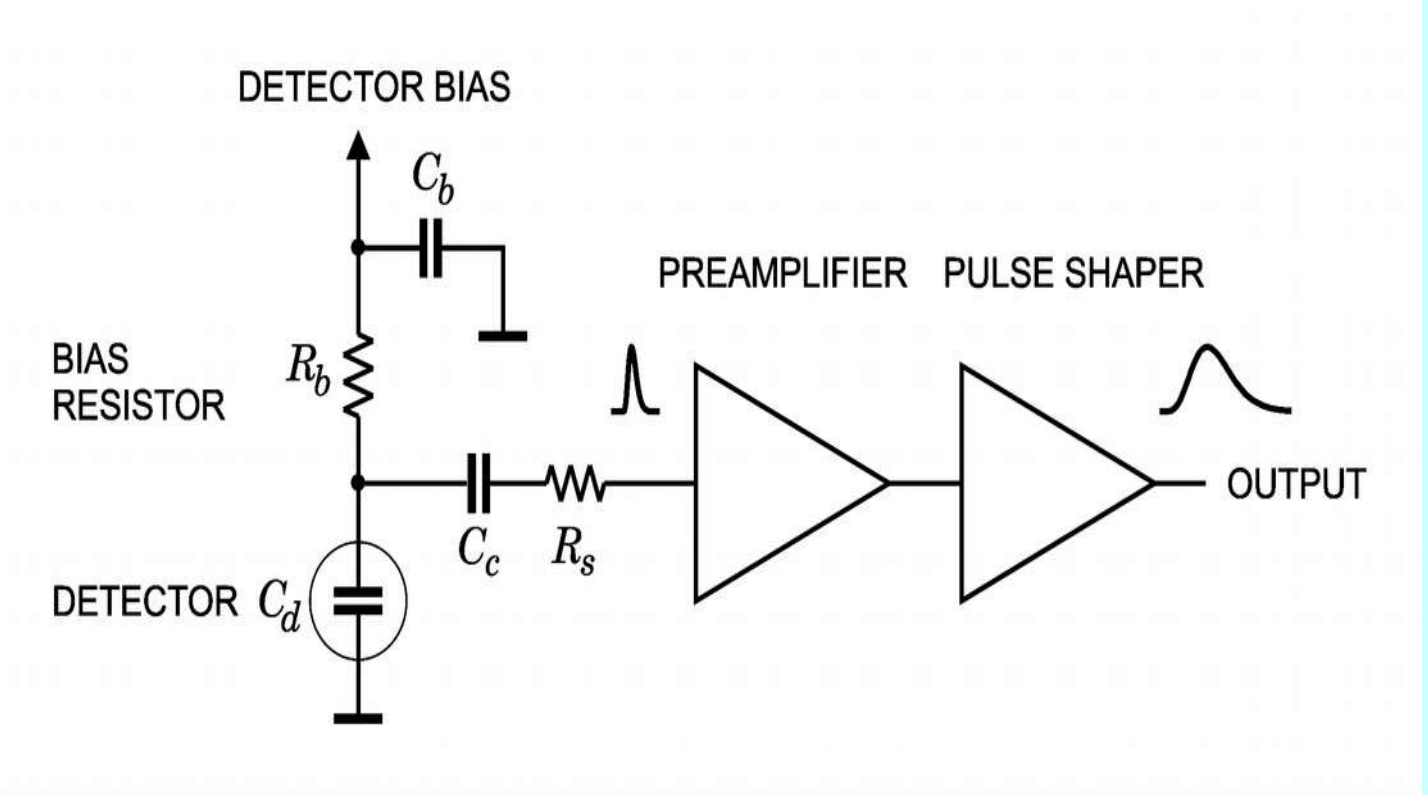
Silicon detector systems
Position sensitive silicon detectors
Gas – Silicon Hybrid telescopes for particle identification

Scintillators
CsI coupled to photo-diode
Liquid Scintillators (BC 501) for Neutron detection

## Preamplifiers for these detectors

Charge sensitive Preamplifiers for energy measurement
Current sensitive for Timing measurements

# *DETECTOR FRONT END*




- Detector output : high impedance, affected by detector capacitance
- To transport the signal, a 'PREAMPLIFIER' of low output impedance is inserted between detector and pulse shaper
- Detector mounted directly on the preamplifier or through a short cable to minimize capacitance

# Preamplifiers for detectors

## Charge Sensitive Pre-Amplifiers or CSPA (Low Noise preferred)

Provides Energy Information or net charge or light output (converted into charge by PMT or photo-diode) generated by the detector by processing or integrating the entire pulse area.

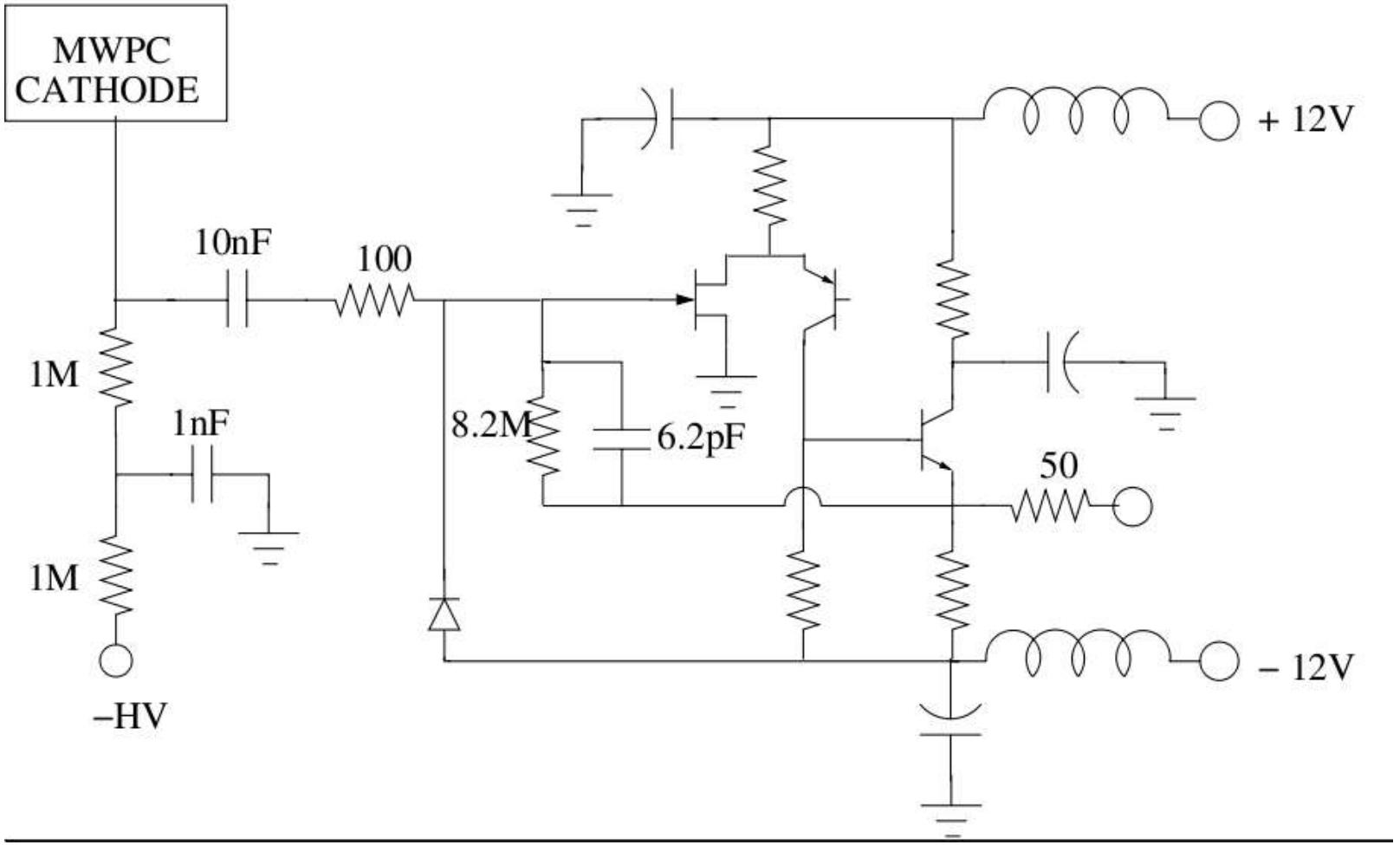
Amplitude contains energy information, Rising edge can provide TOF and Particle identity : Bandwidth & Detector dependent

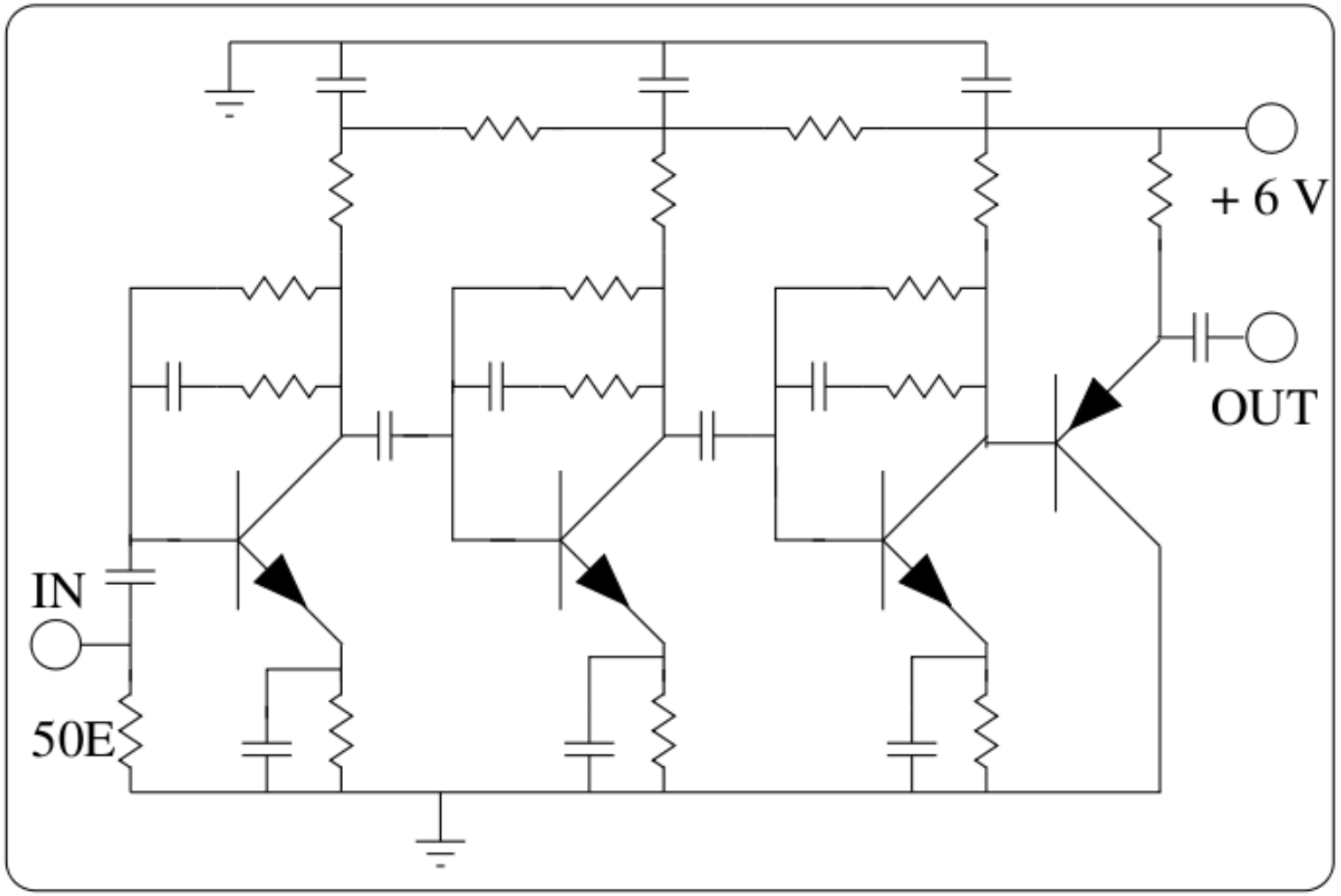
Useful for all kind of detectors (Gas, Semiconductors, Scintillators etc.)

## Current Sensitive Amplifiers or FTA (Low Noise preferred

Processes generally the rising edge or leading edge for Timing/TOF.
Falling or trailing edge may provide identity of the particle type

Useful for fast detectors only (< 5 ns rise times)
Proportional Counters, MCP, Fast Scintillators


MWPC
CATHODE
10nF
100
1M
1nF
8.2M
6.2pF
50
1M
–HV
+ 12V
– 12V




Schematic of FTA based on Beeskow's circuit [1]

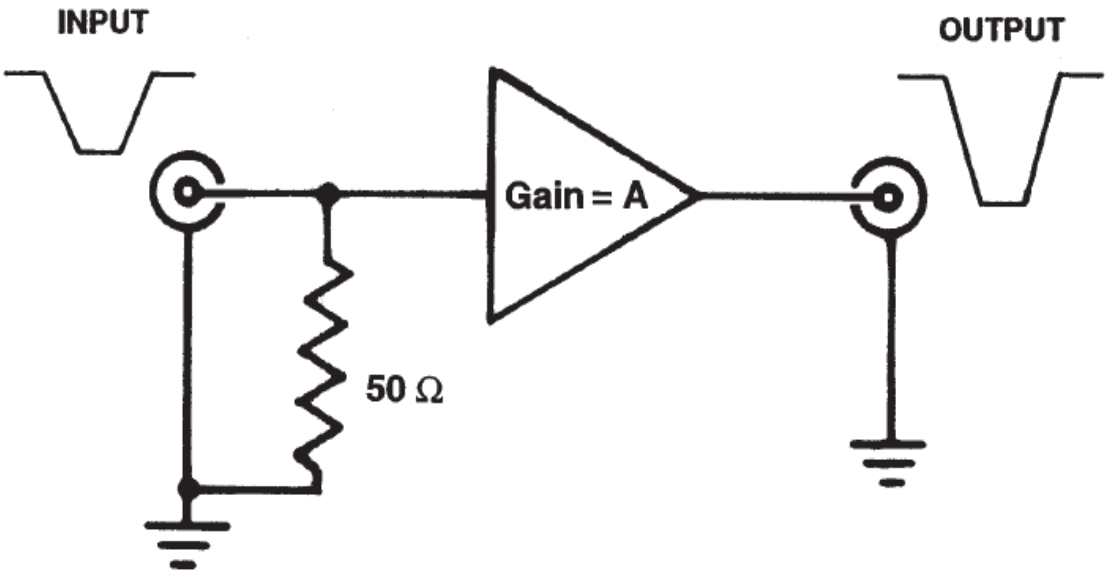
[1] U. Lynen, H. Stelzer, NIM 162 (1979) 657
GSI Internal report



Charge sensitive preamplifier



Photo-multiplier-tube base

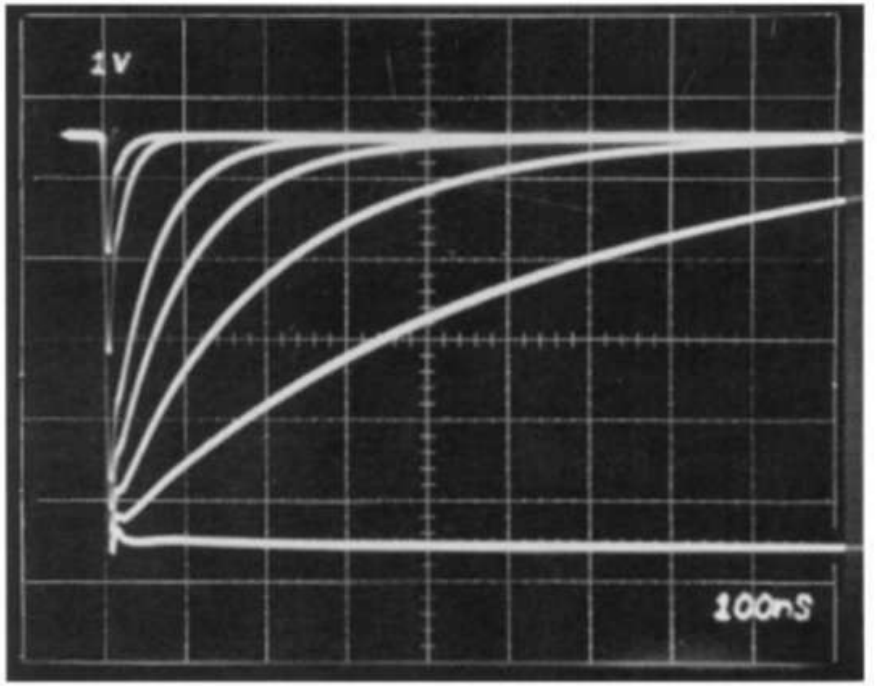
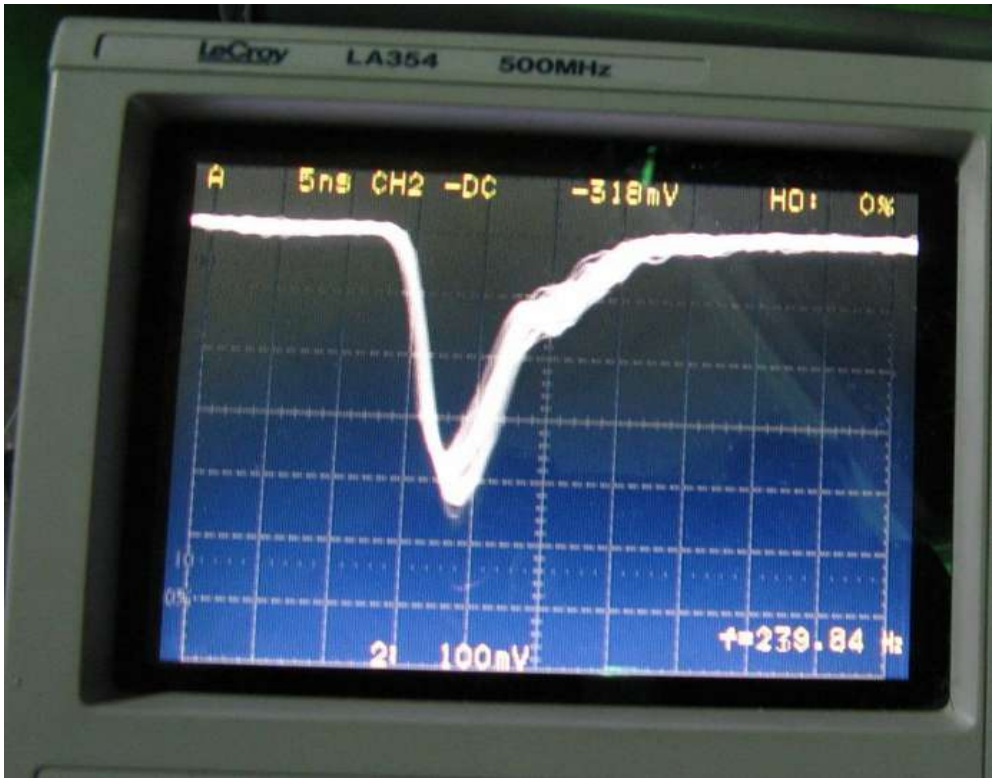
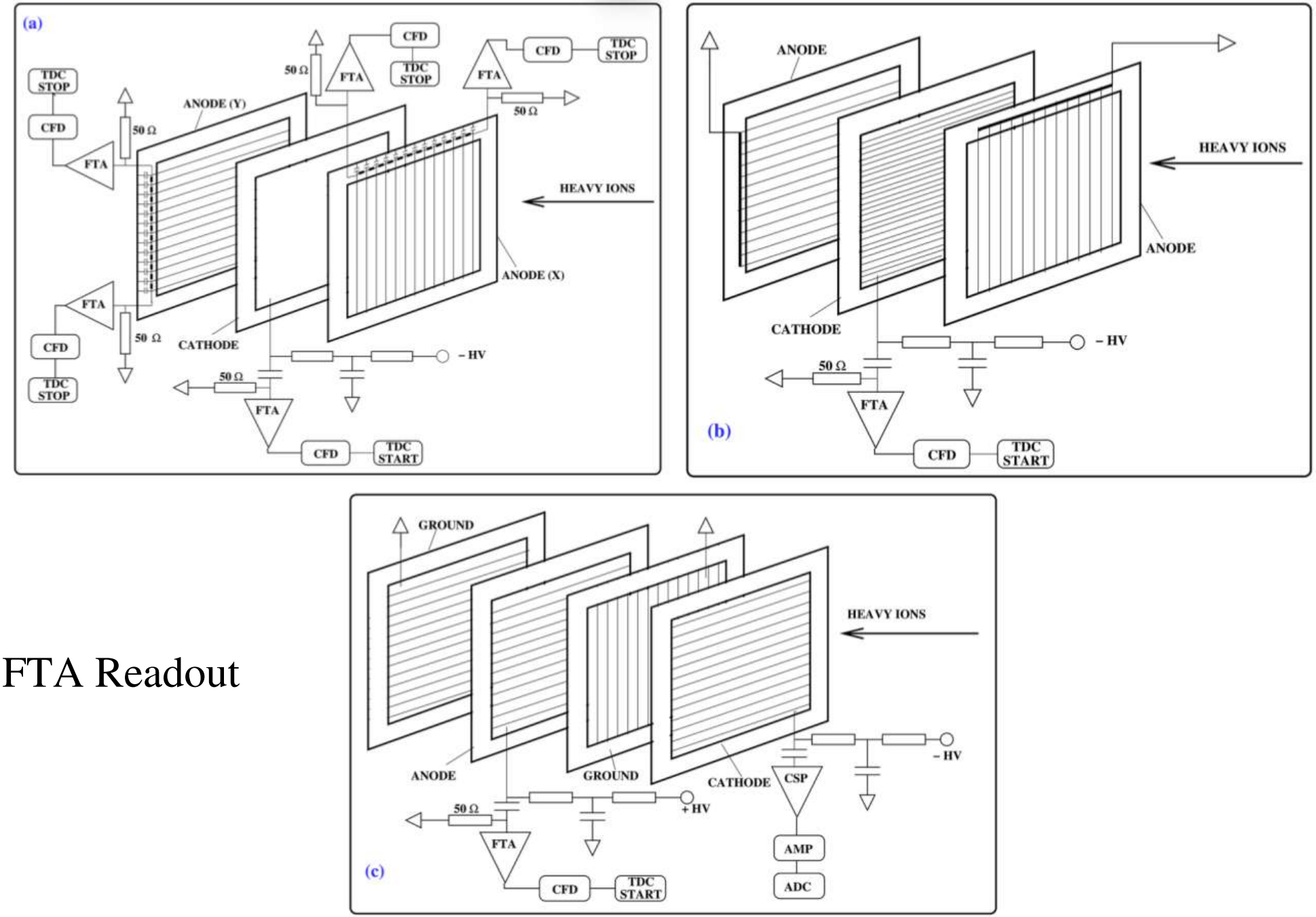




Fig. 4. Model 579 Output Signals for $\tau_i$ = Out and $\tau_D$ = Out, 10, 20, 50, 100, 200, and 500 ns.

Use of fast current sensitive preamplifier
And
Time filter amplifiers

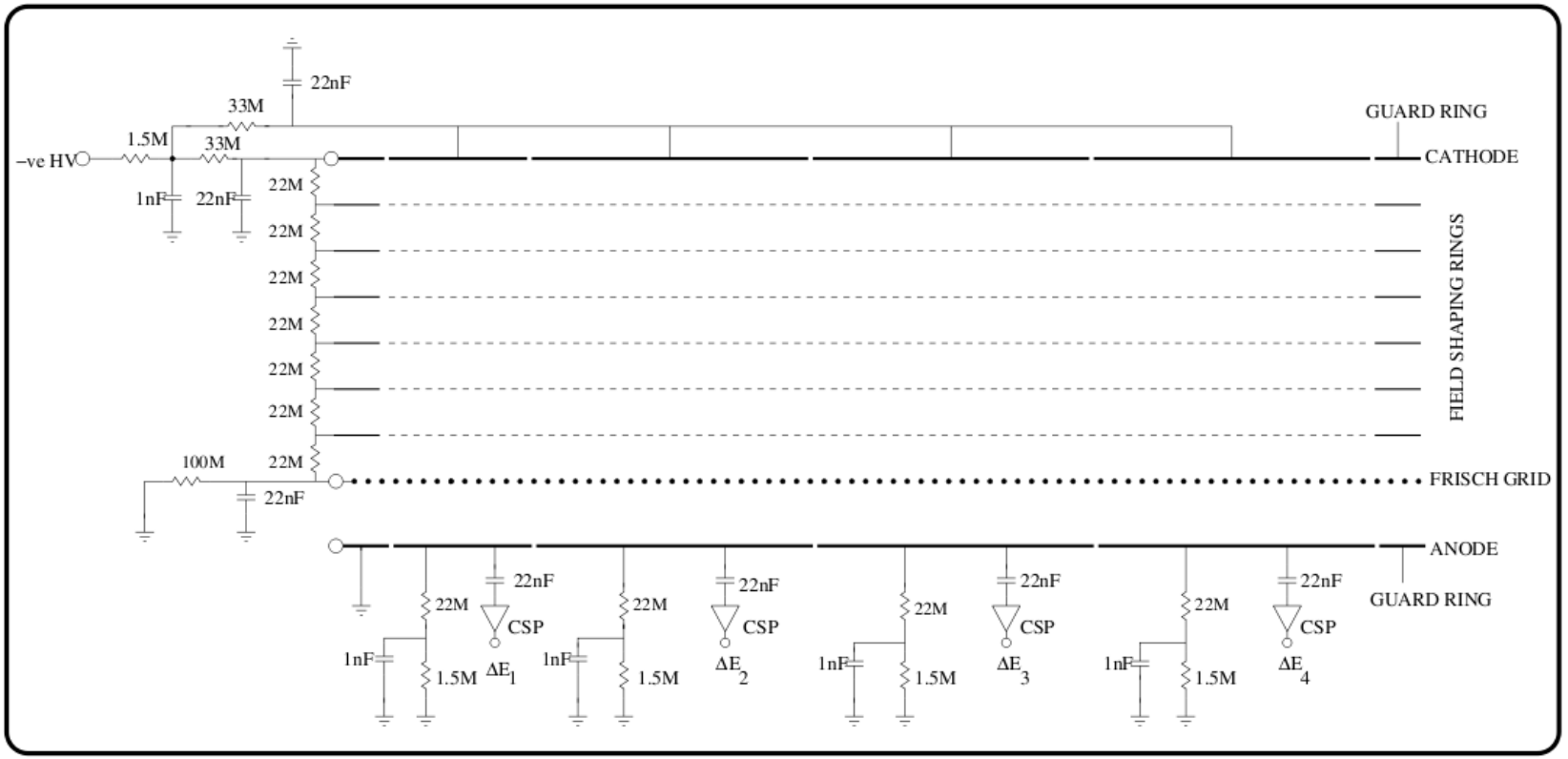


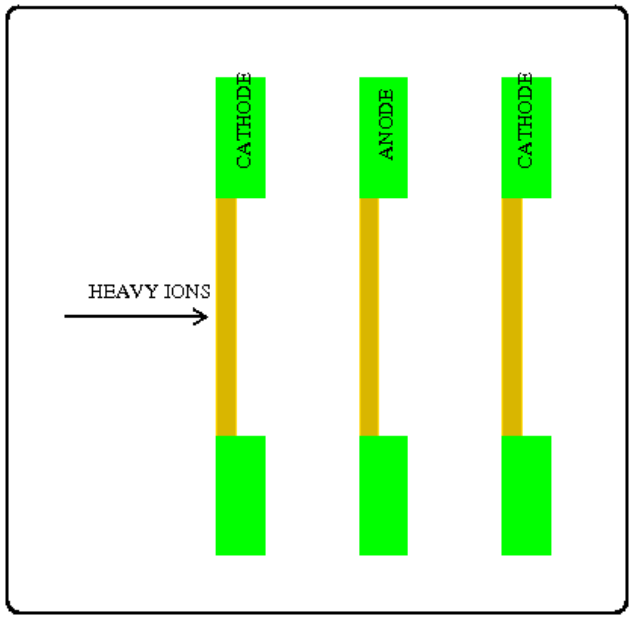

FTA Readout

**FIG. 1.** (a) Schematic layout of the three electrode MWPC with the readout scheme having a central cathode (aluminized mylar) sandwiched between two anode wire frames. For position sensitive MWPC, wires are interconnected by a delay line (as shown here). For the start detector, these wires are shorted and electrically grounded. (b) Schematic layout of the start detector with a wire frame cathode. (c) Schematic layout of the multi-step counter with all wire frame electrodes.

A. Jhingan et. al, Rev. Sci. Instrum. 92, 033309 (2021)

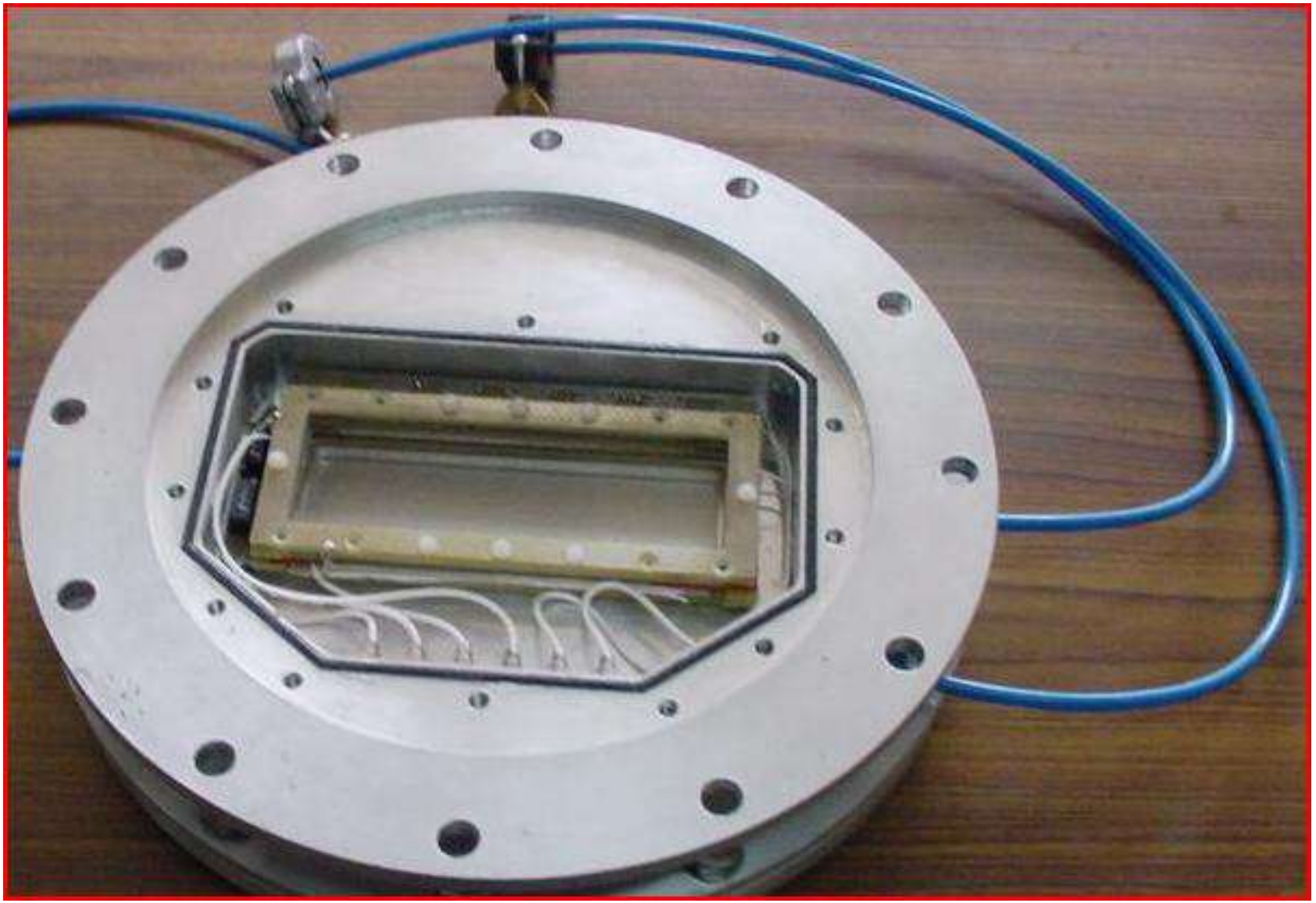
Transverse field IC with segmented anodes, Frsisch grid and cathode



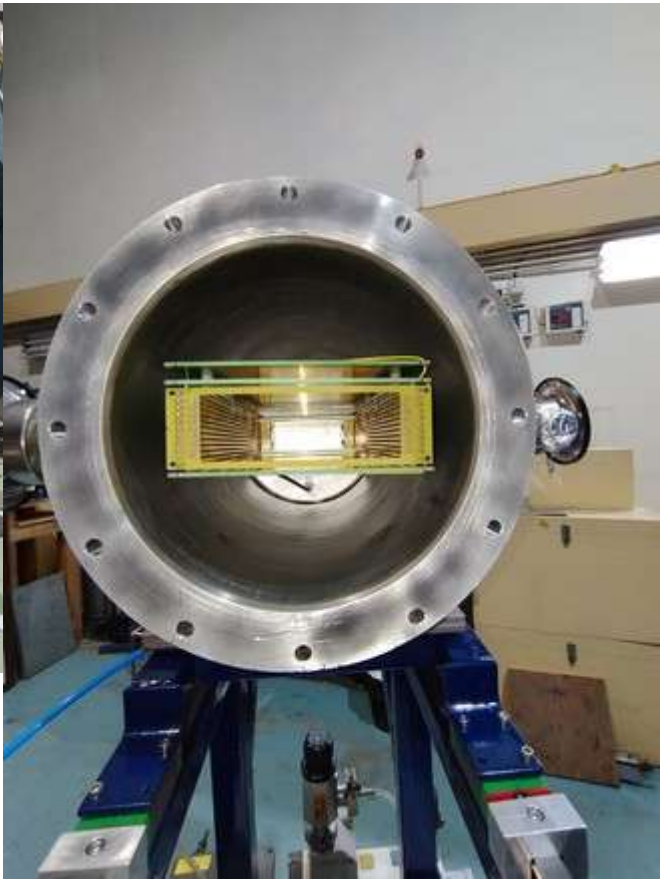

Axial field IC with anode sandwiched between two cathodes

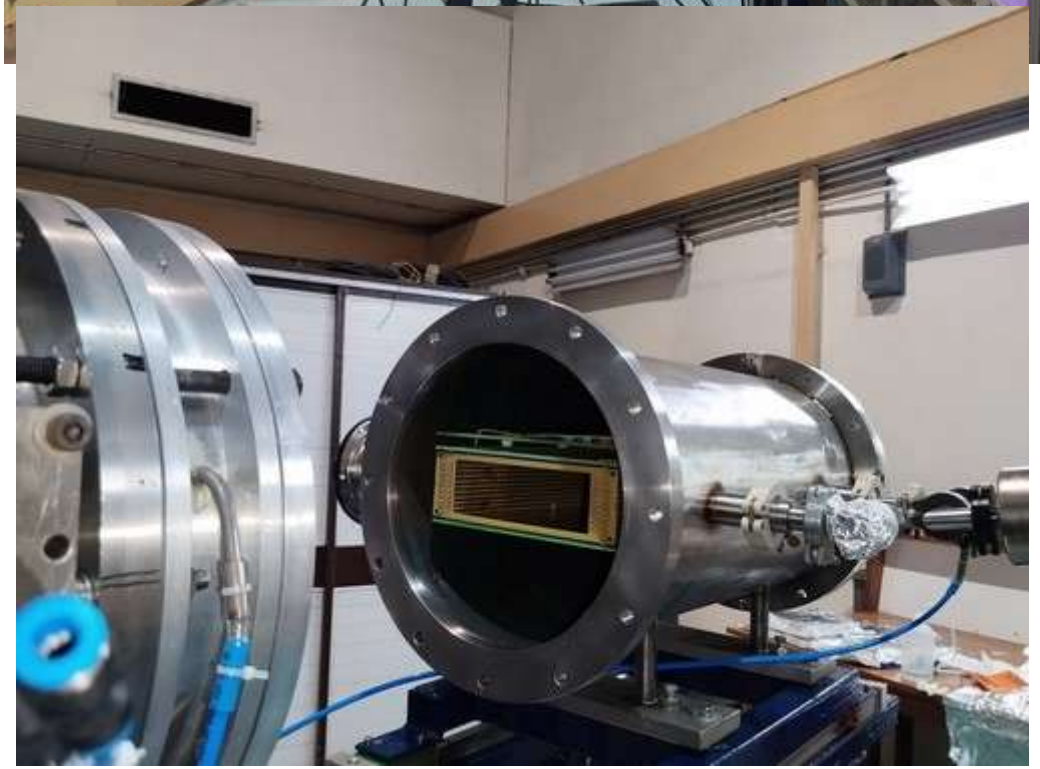
CSPA Readout



5 electrode MWPC (6" x 2", 1.27 mm wire pitch) at HIRA focal plane

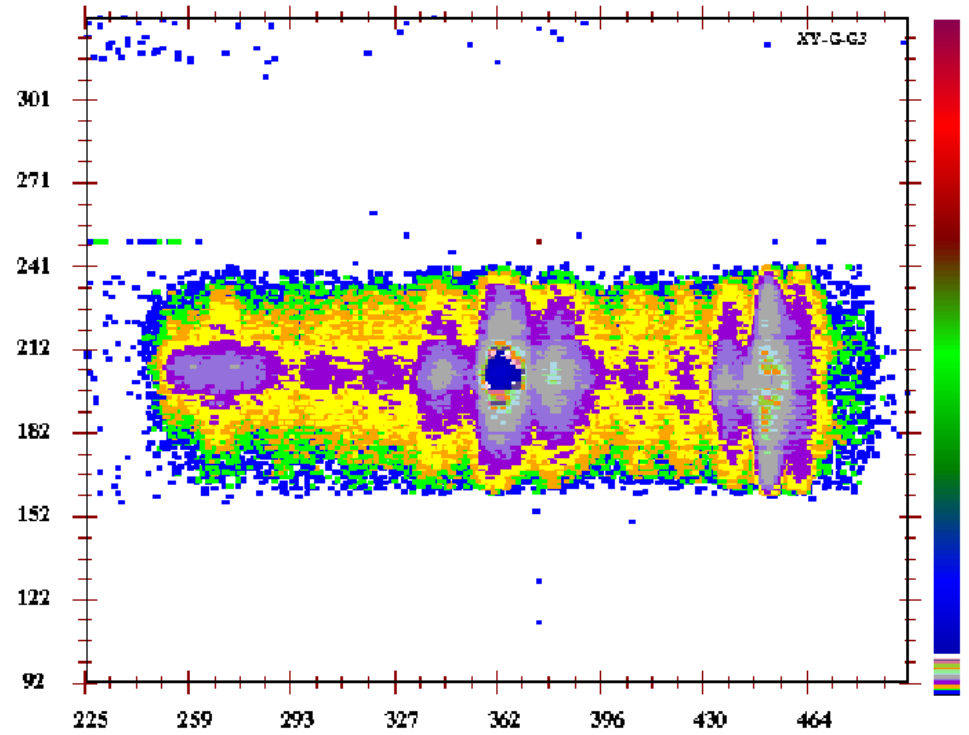
A. Jhingan et al., Proc. DAE-BRNS Symp. Nuc. Phys. 52(2007)585

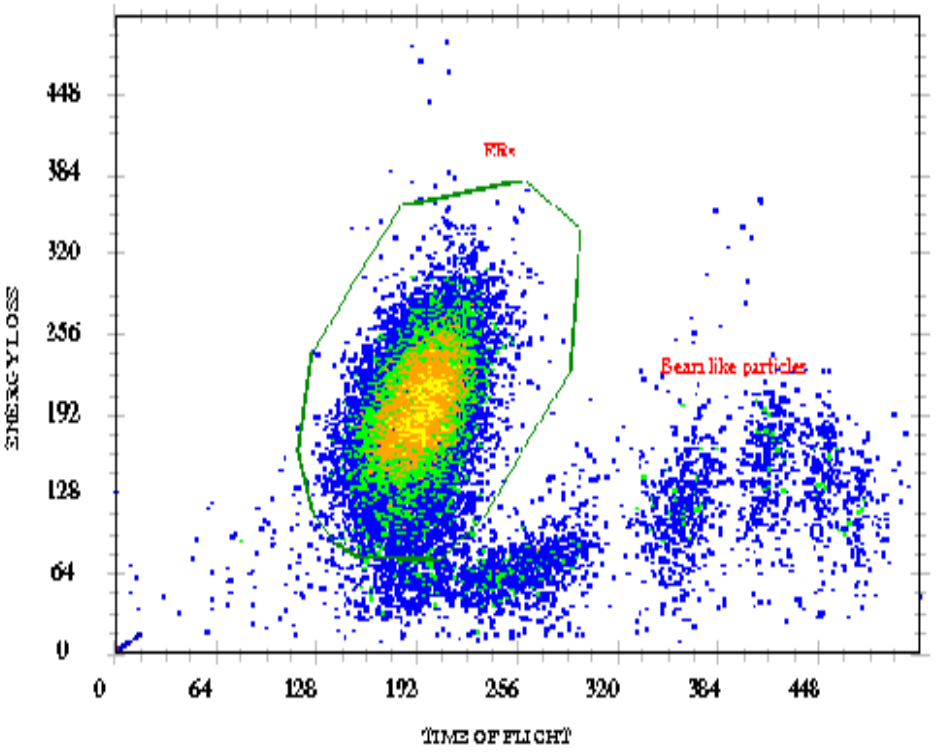


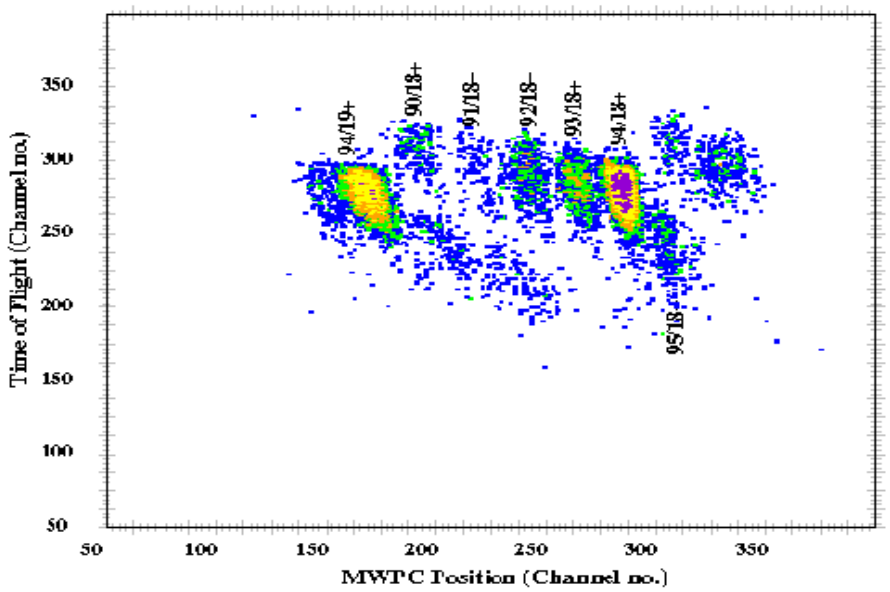


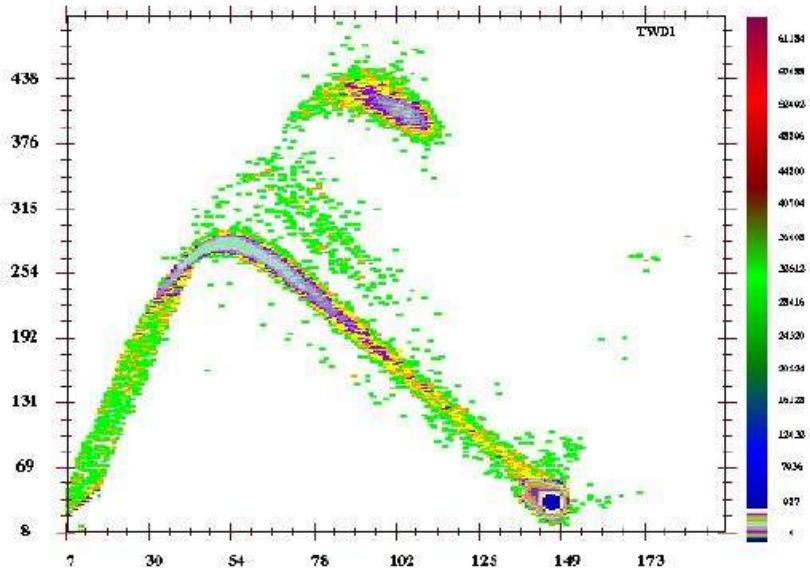
Large Area IC at HIRA focal llane
(behind MWPC)
Active Area 15 x 5 $cm^2$, Depth~ 40 cm

J. Gehlot et al., Proc. DAE-BRNS Symp. Nuc. Phys. 68 (2024)

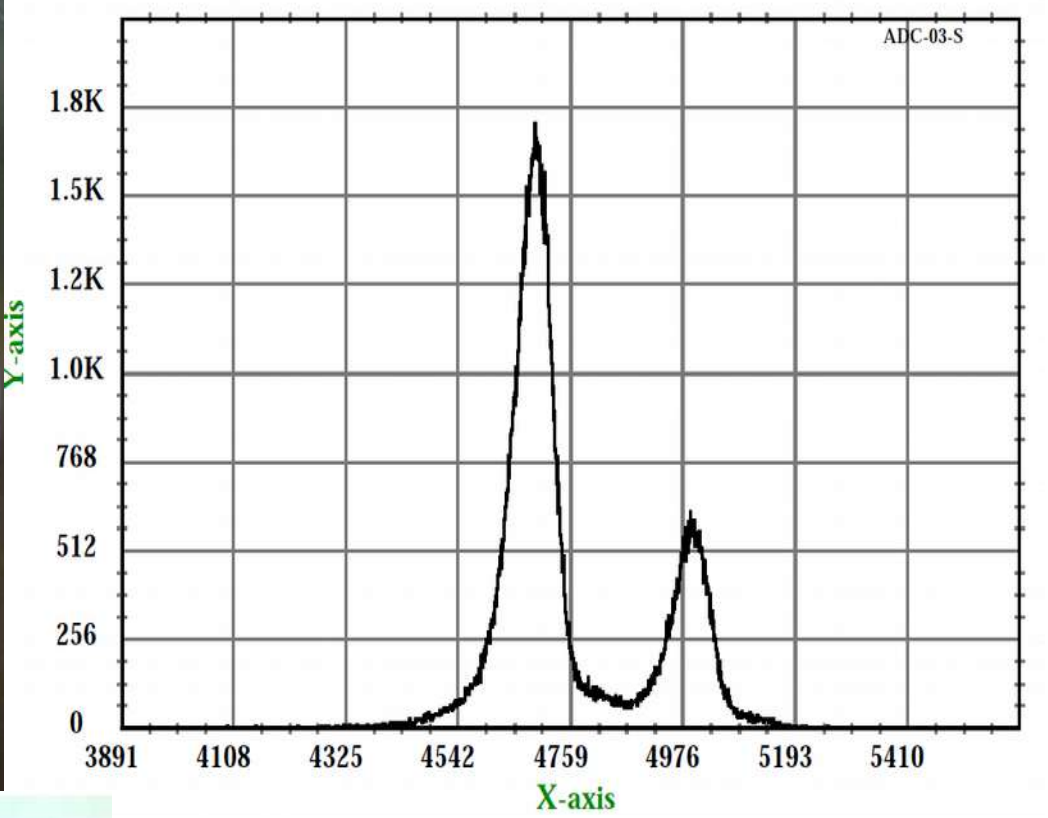


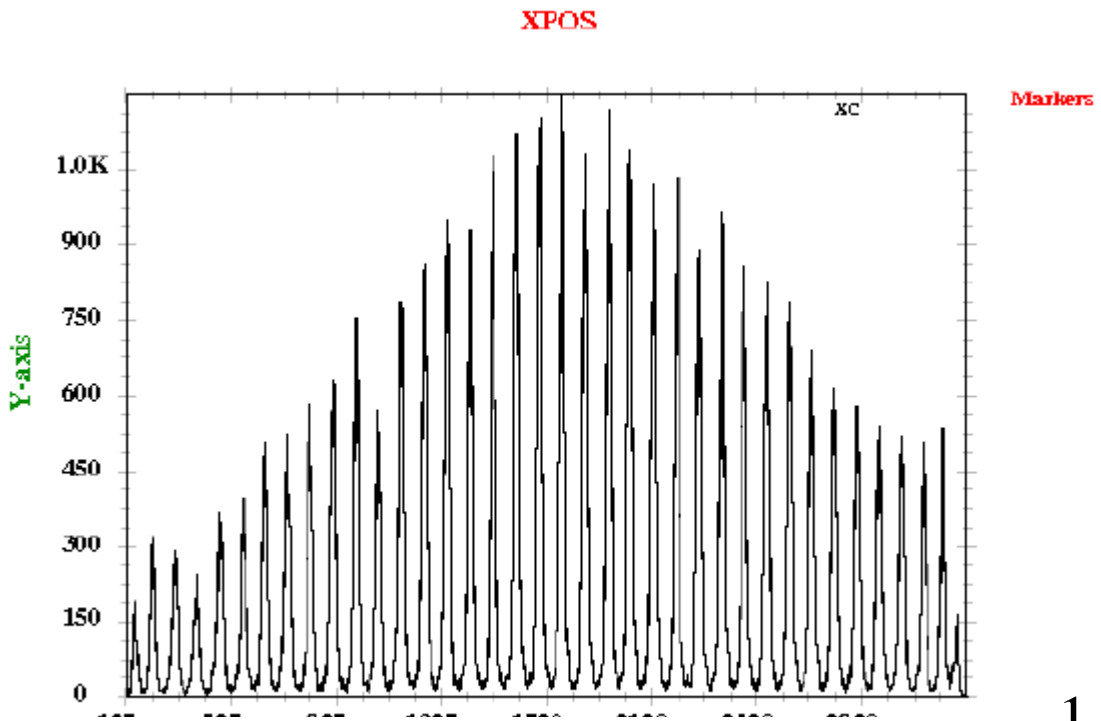



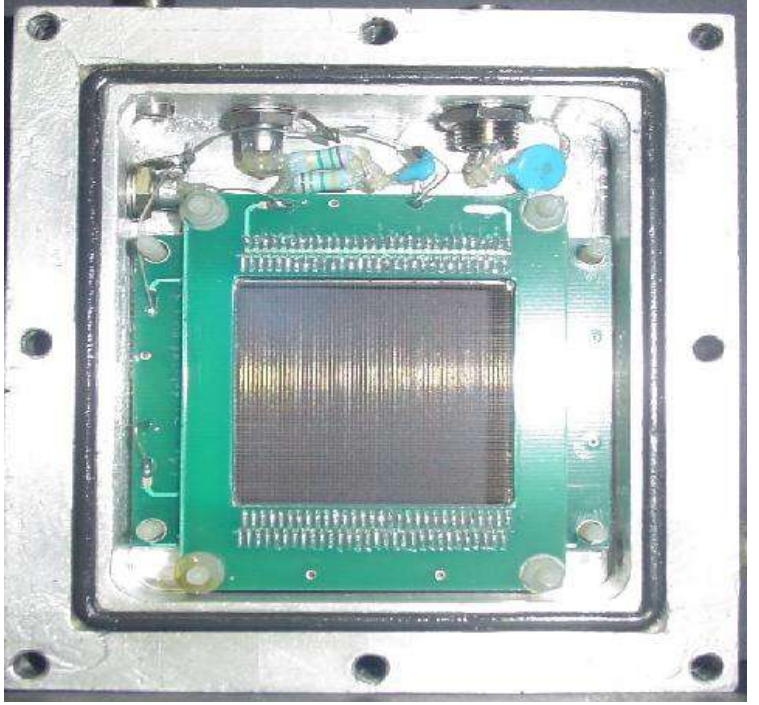

S. Kalkal et al, Phys. Rev. C 81, 044610 (2010)
S. Kalkal et al, Phys. Rev. C 83, 054607 (2011)



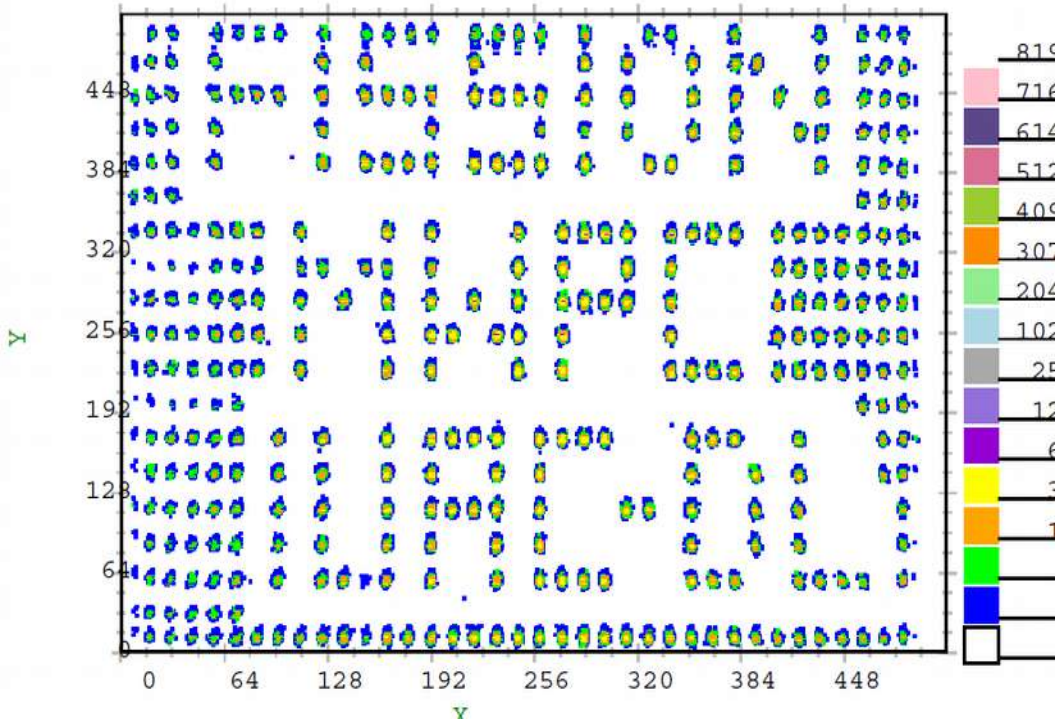

Tested with Pu-Am source

Resolution ~ 75 keV @5.48 MeV



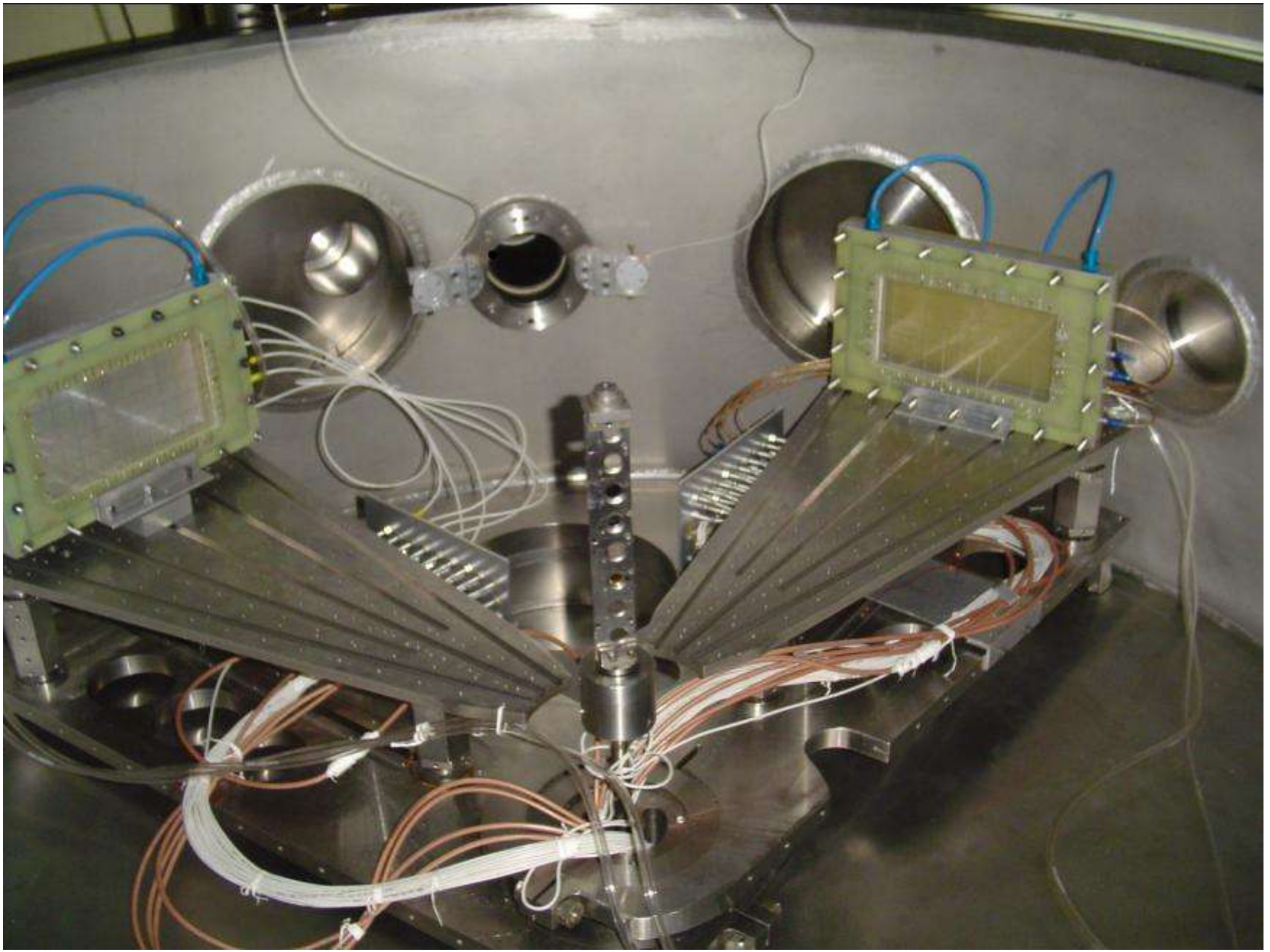



1.5" x 1.5", 0.63 mm pitch, 4 electrode

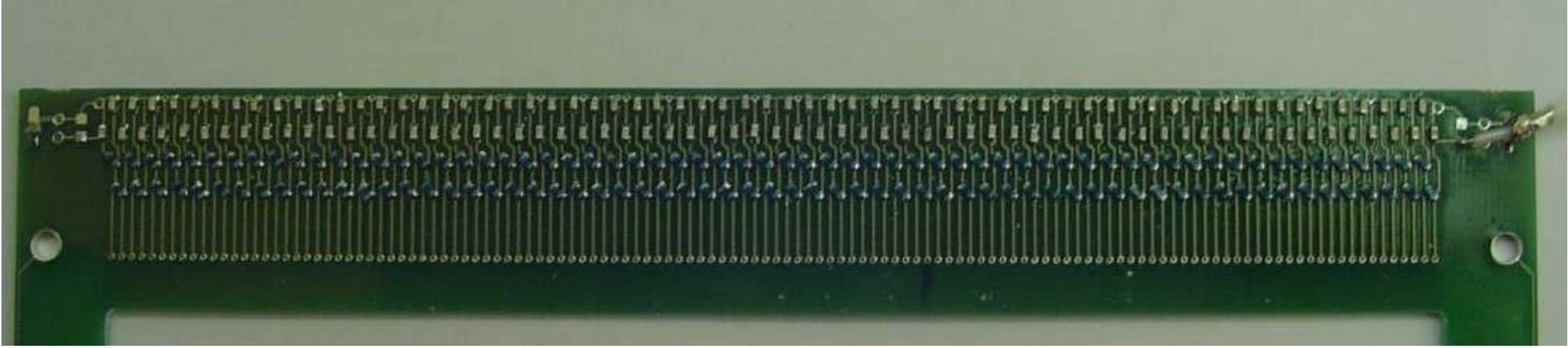



5 electrode, 8"x4", 1.27 mm for GPSC

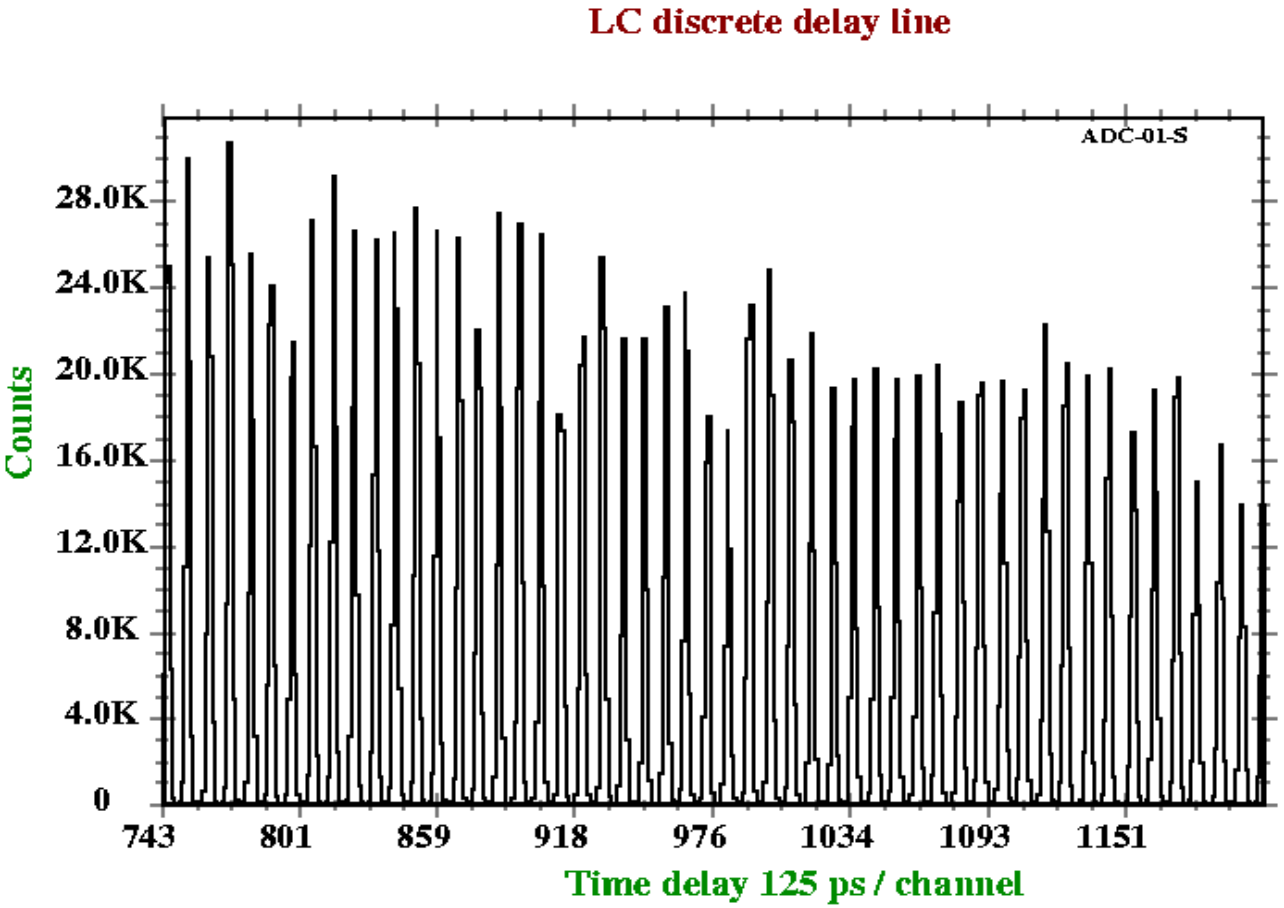
Akhil Jhingan et al RSI 80(2009)123502



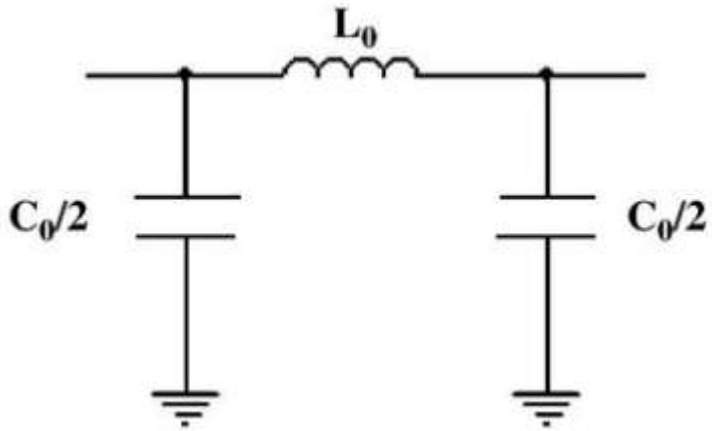
MWPC set up in GPSC for fission experiments



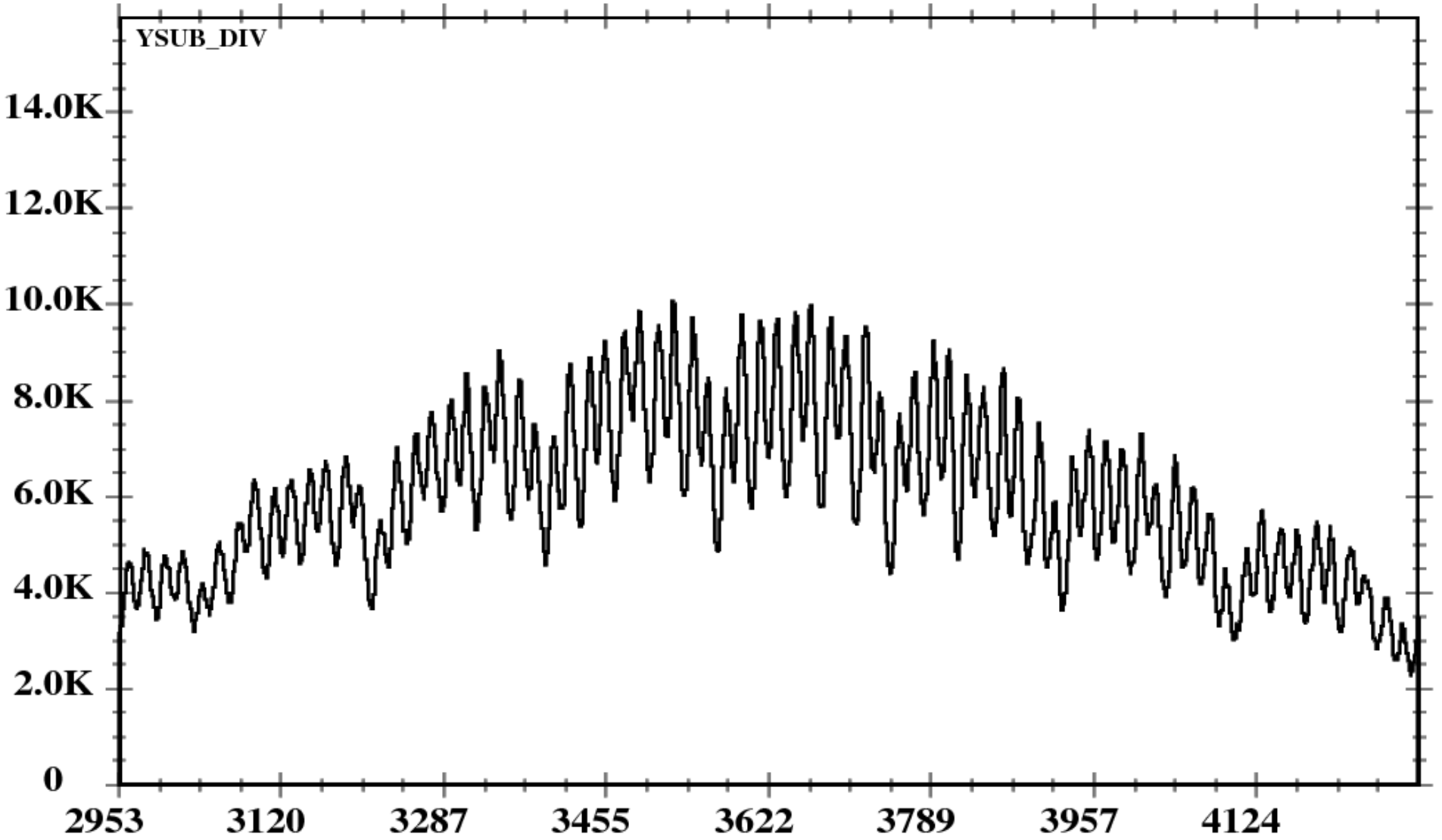
X-position wire frame delay line




Phillips 7120 charge time calibrator

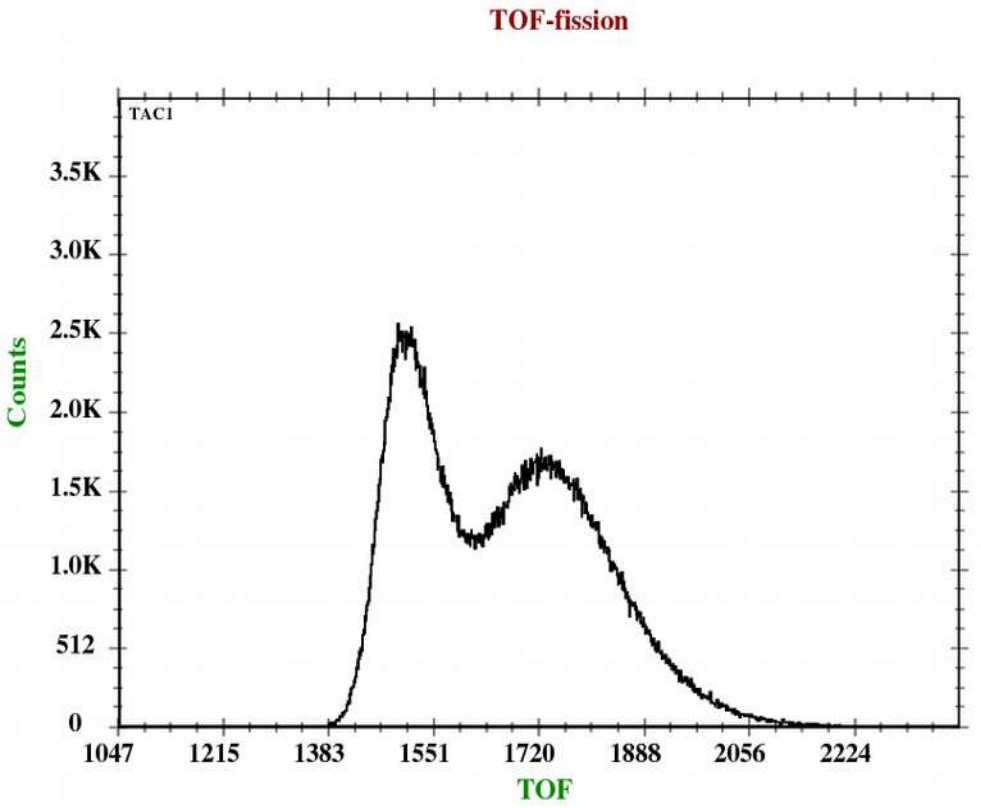



Electrical scheme of a
Single delay line cell

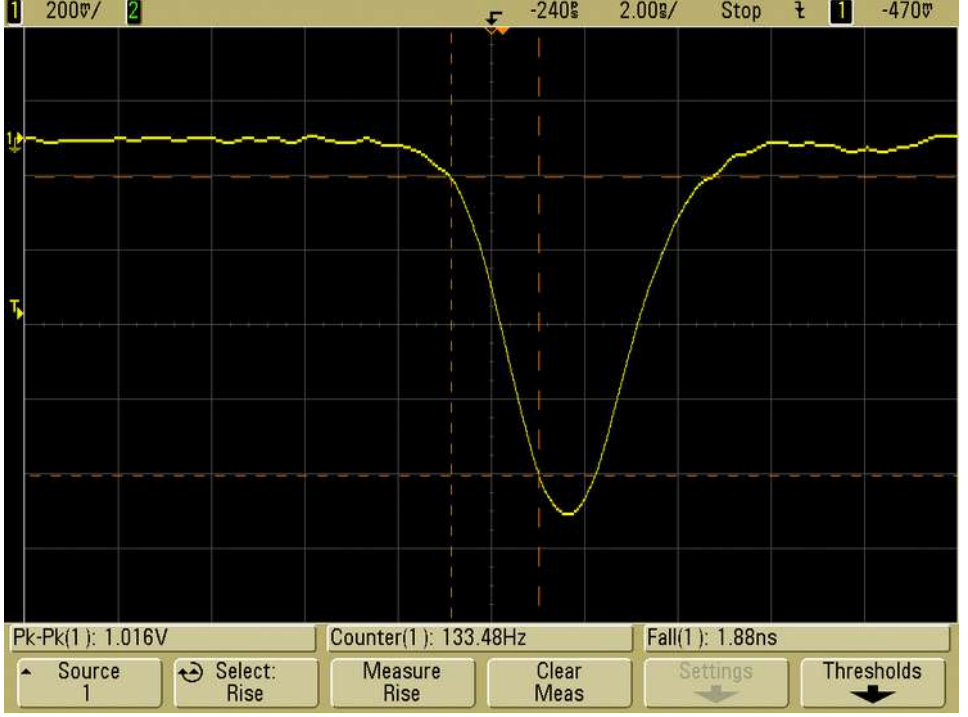



X-position spectra with 241Am alphas
FWHM of each peak ~ 500 ps


Double Arm fission TOF set up at GPSC-IUAC



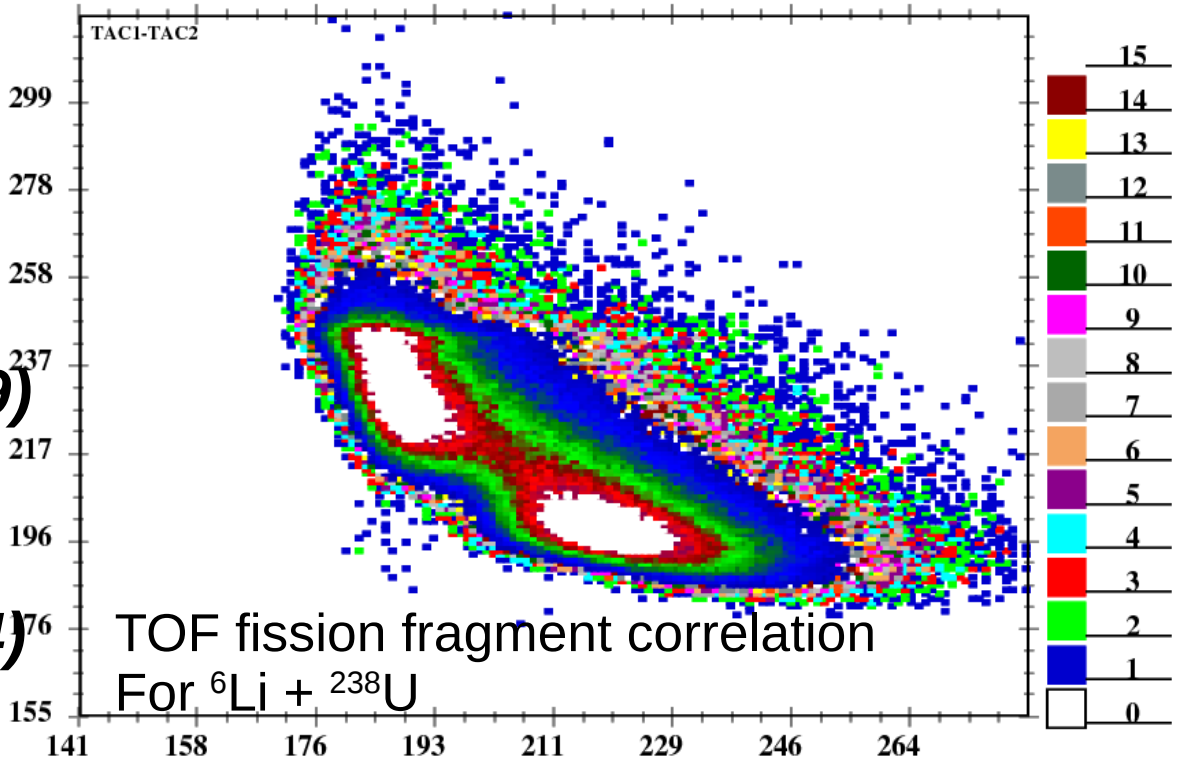

TOF spectra




MWPC Pulse ~ 2 ns rise time

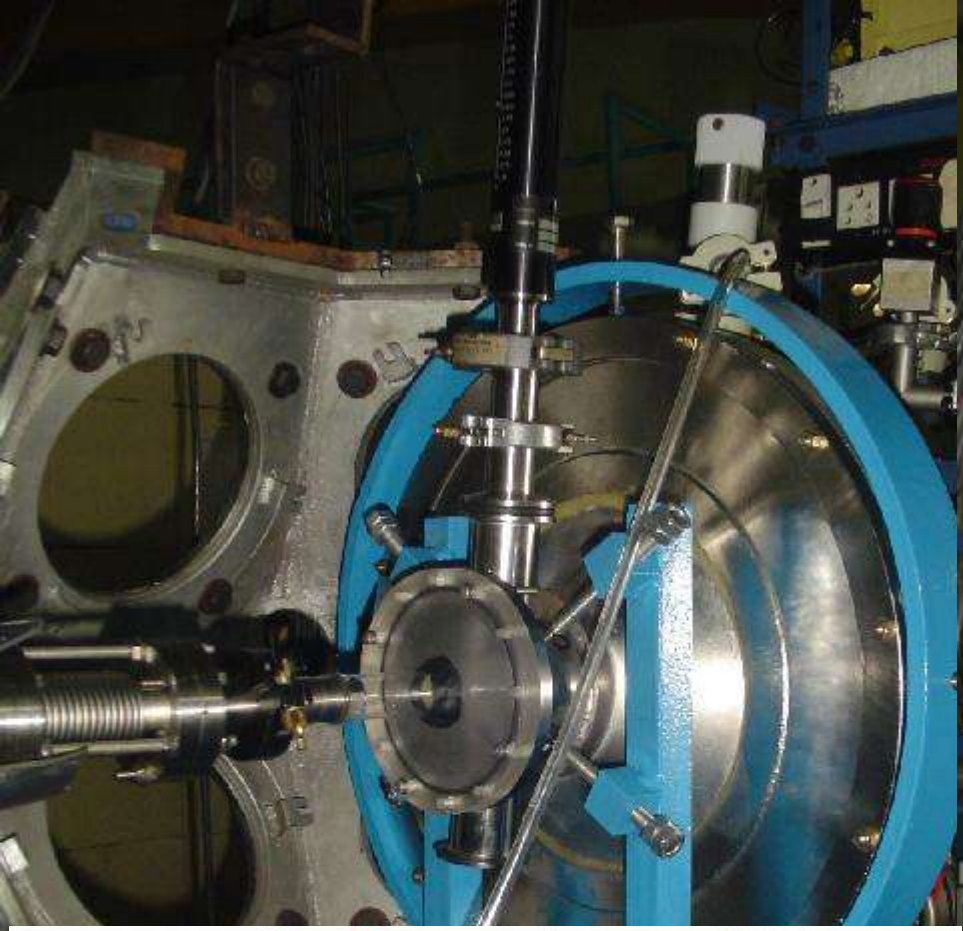
***A. Pal, S. Santra et al.,***
***Phys. Rev. C 99, 024620 (2019)***

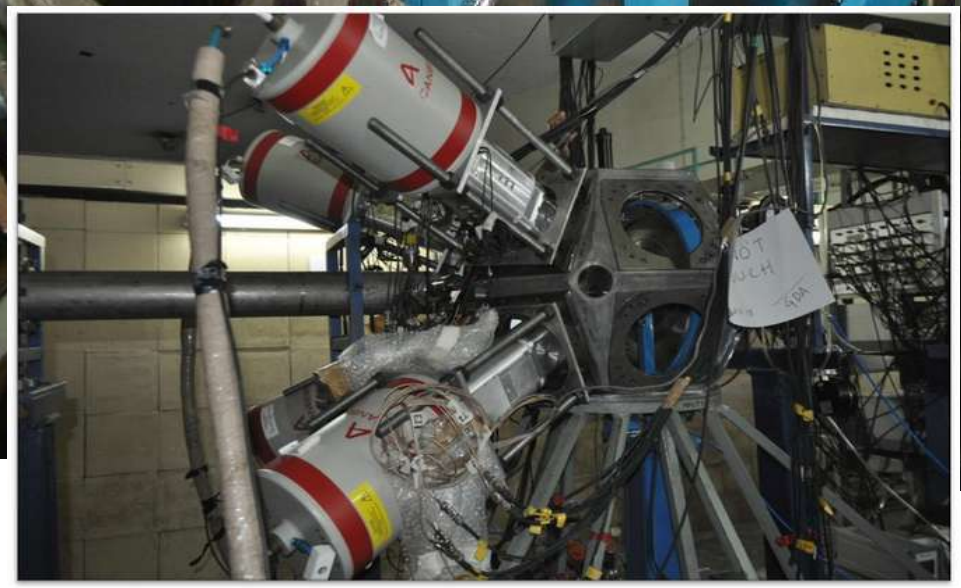
***S. Santra et al.,***
***Phys. Rev. C 90, 064620 (2014)***



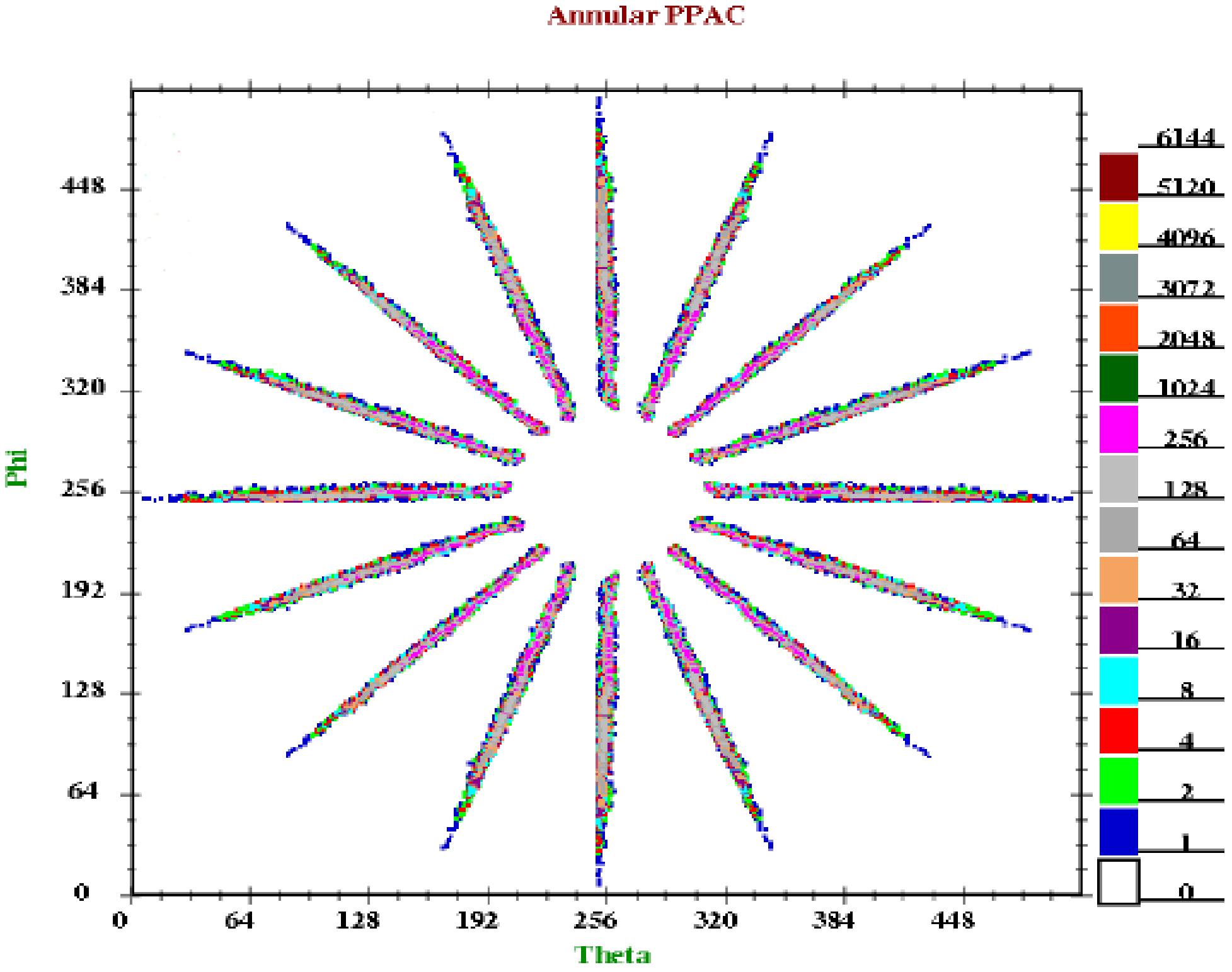

TOF fission fragment correlation
For $^{6}Li + ^{238}U$


BIAS - U

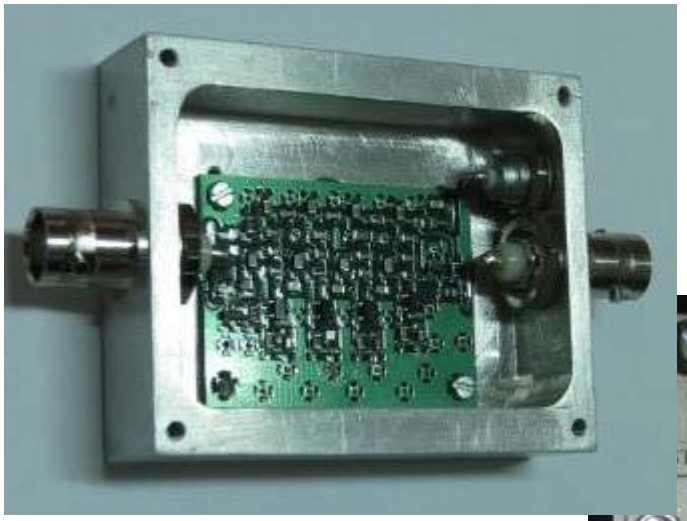


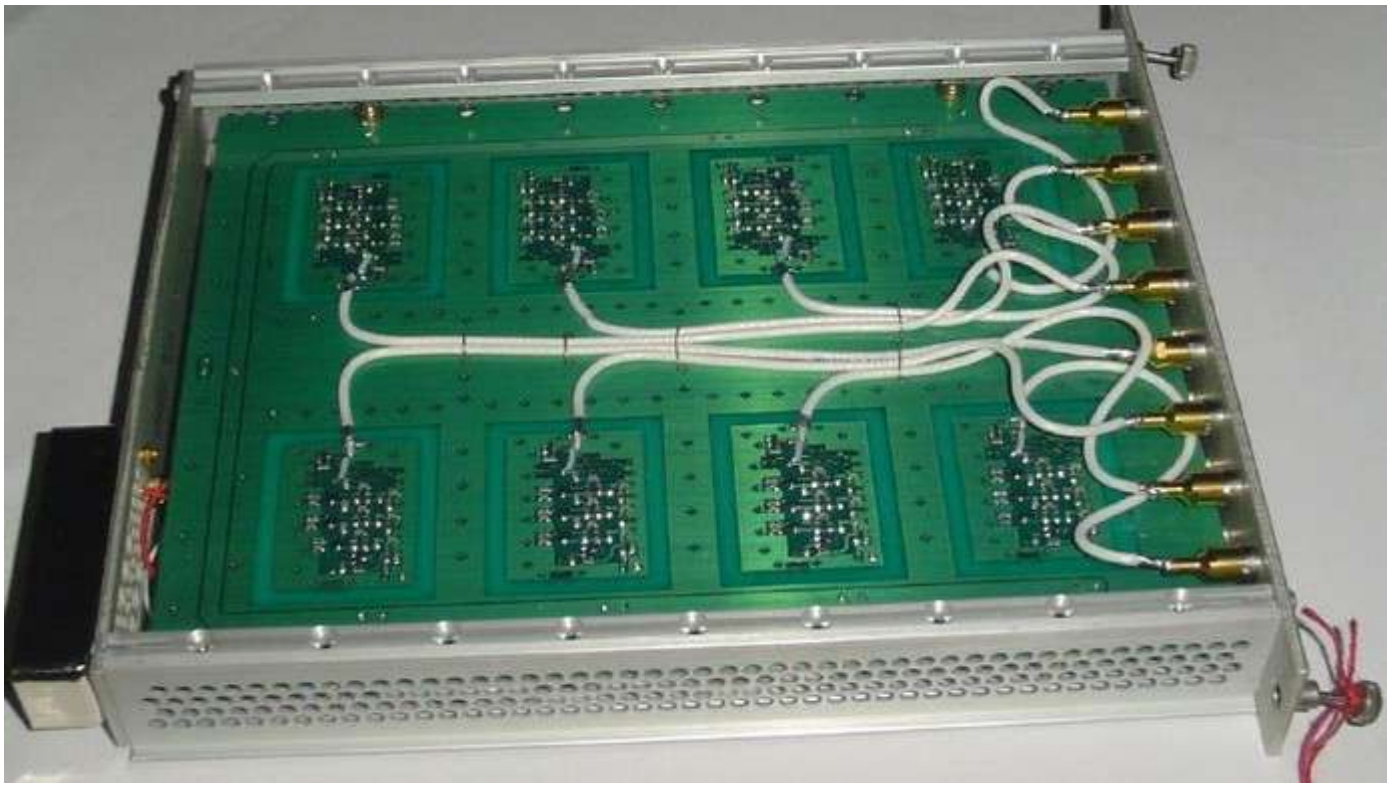


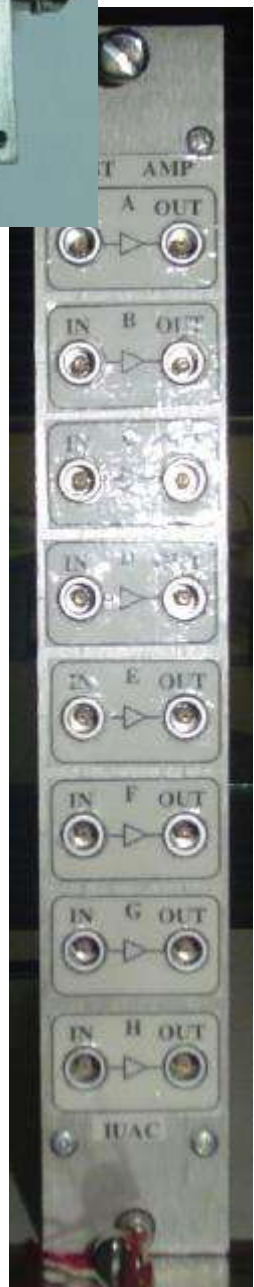
Coulex set up at GDA, IUAC

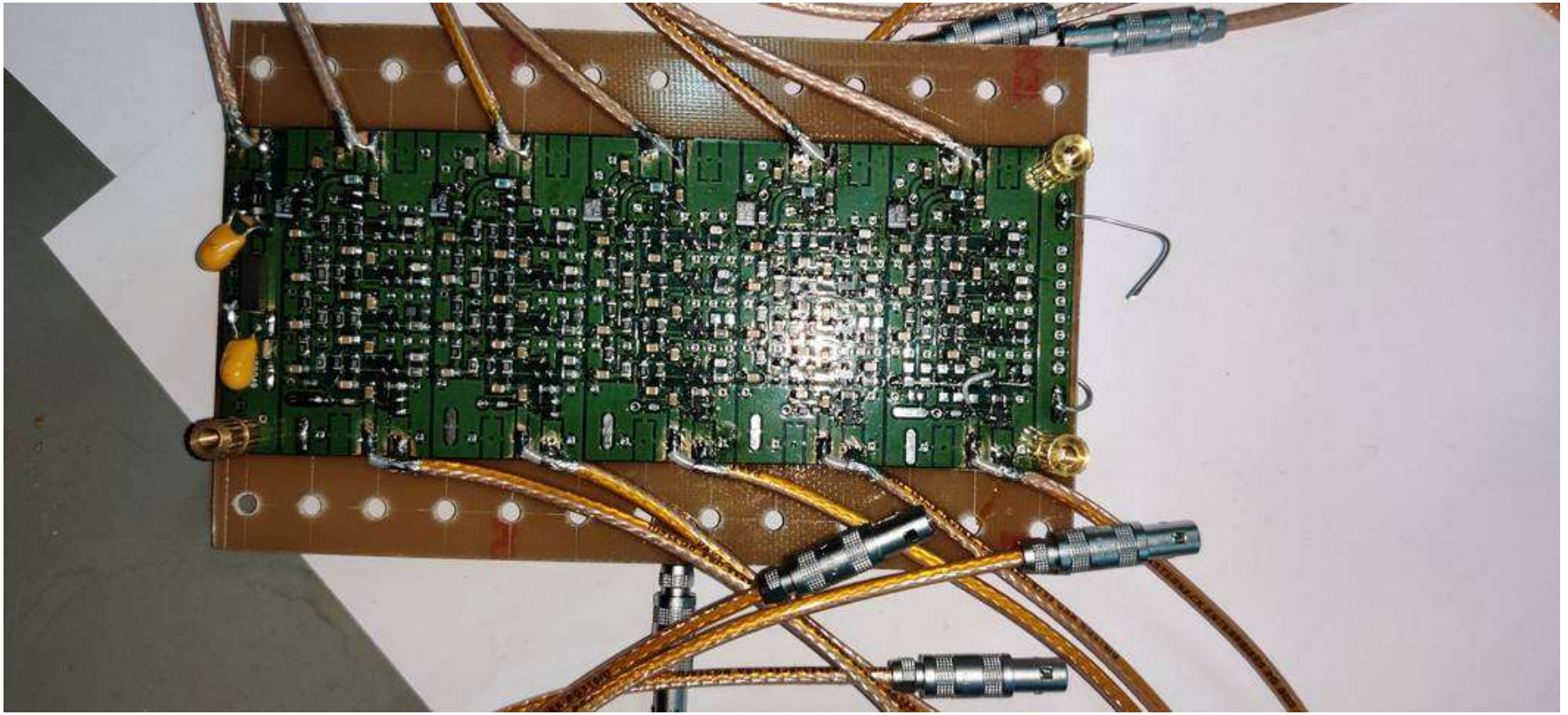

Annular PPAC
Phi
Theta
0
64
128
192
256
320
384
448
6144
5120
4096
3072
2048
1024
256
128
64
32
16
8
4
2
1
0

# Fast timing preamplifiers of PPAC readout

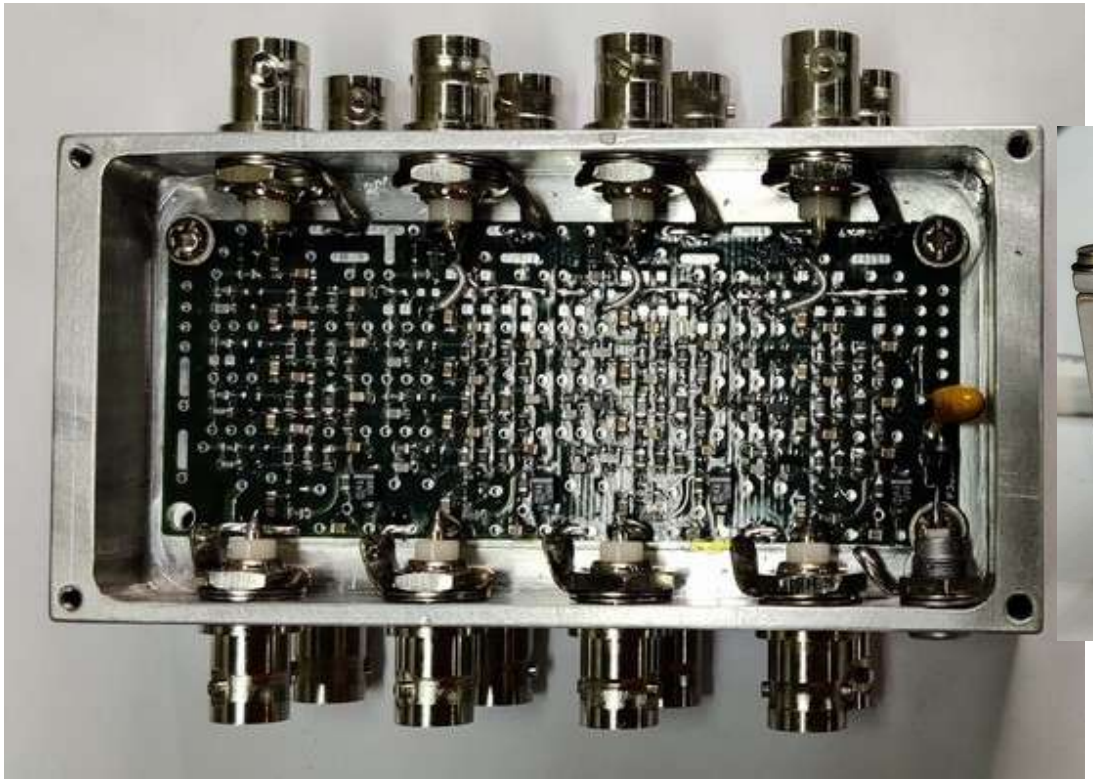








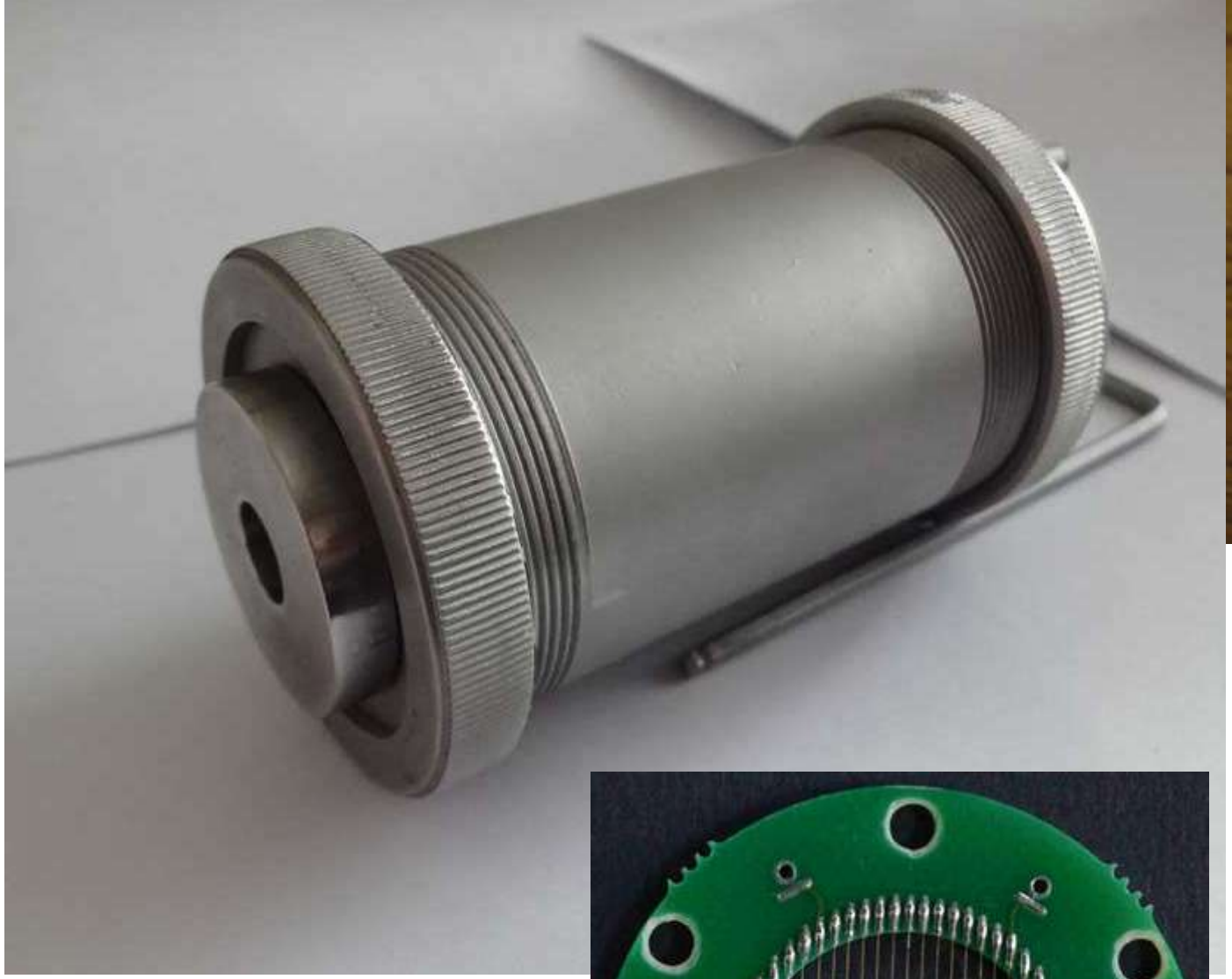
Fabrication of two units of 5-channel timing amplifiers.
Light weight with no metal frame and in-vacuum operation.
Assembled on copper clad FR4 board.
Replaced the older units (10 year old)

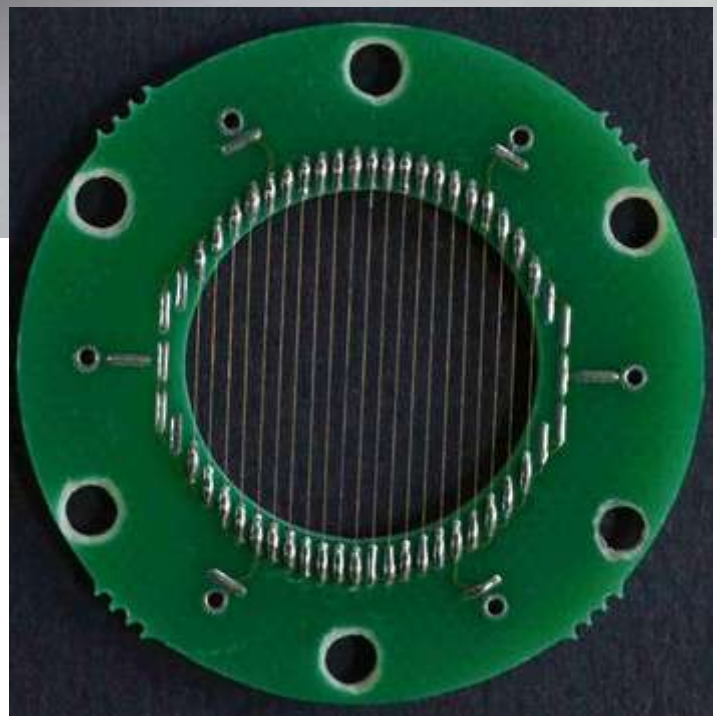


## LEIBF Molecular Physics

***Development of 8 channel fast timing amplifier for HEX-anode MCP***
A. Jhingan, M. Kumar, C. P. Safvan, Pragya, Mech. Workshop IUAC

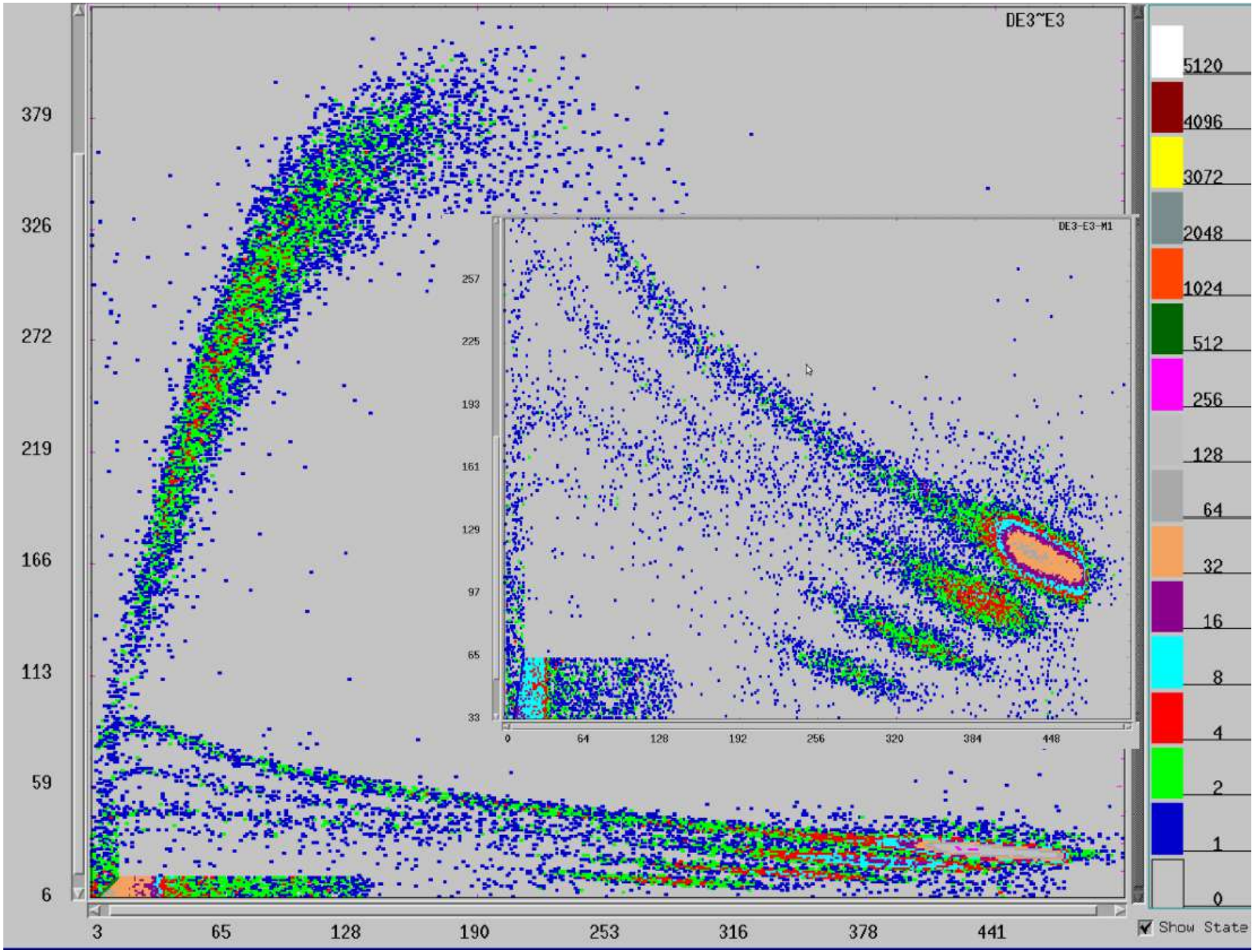
8 channel (4 x 2) FTA developed. 6 inverting and 2 non-inverting channel.
Final assembly to proceed.



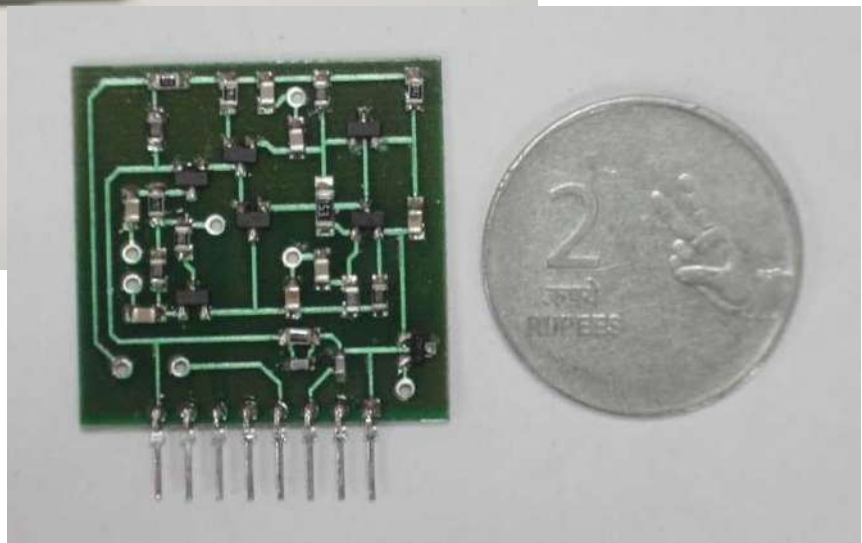


Various parts of
Hybrid telescope

Setup for quasi-elastic scattering and angular/barrier distribution 2014


DE3~E3
DE3-E3-M1
379
326
272
219
166
113
59
6
3
65
128
190
253
316
378
441
257
225
193
161
129
97
65
33
0
64
128
192
256
320
384
448
5120
4096
3072
2048
1024
512
256
128
64
32
16
8
4
2
1
0
Show State

***19F + 194Pt***




Charge Sensitive Preamplifiers

**Detector system for Multi-nucleon Transfer (MNT) Reactions in GPSC**

Absolute *TOF* measurements using start stop MWPC

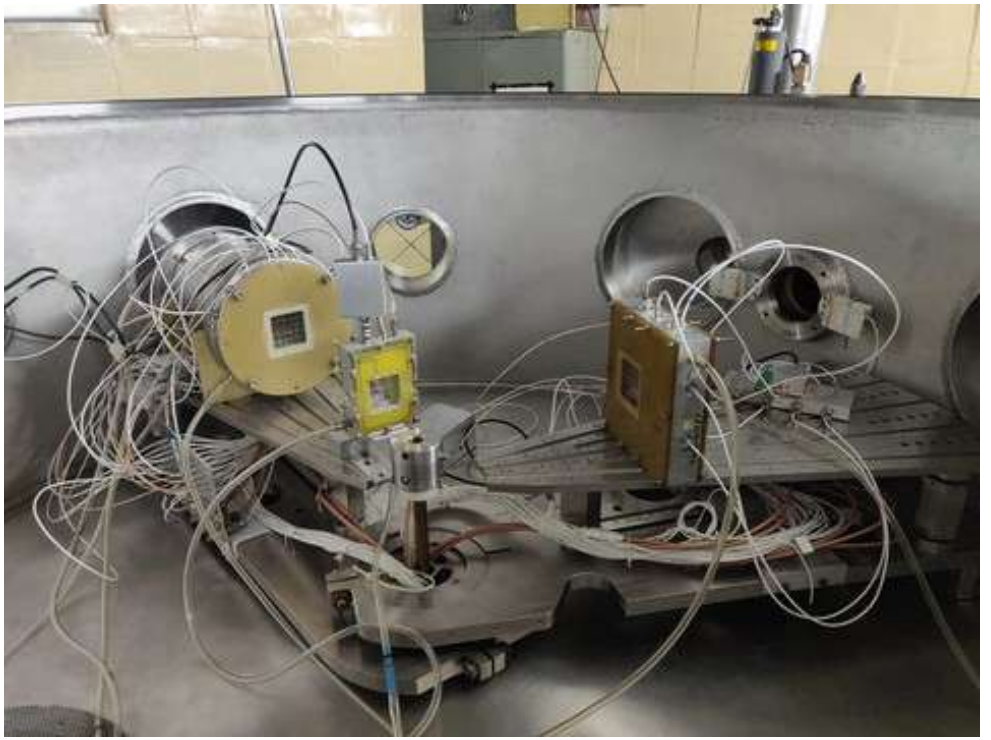
Ionization chambers (IC) for Δ*E-E* measurements to identify *Z* (projectile-like)

MWPC prepared with 0.3 *mm* wire pitch for faster timing.

Angular distribution, velocity, energy and total energy, along with kinematic

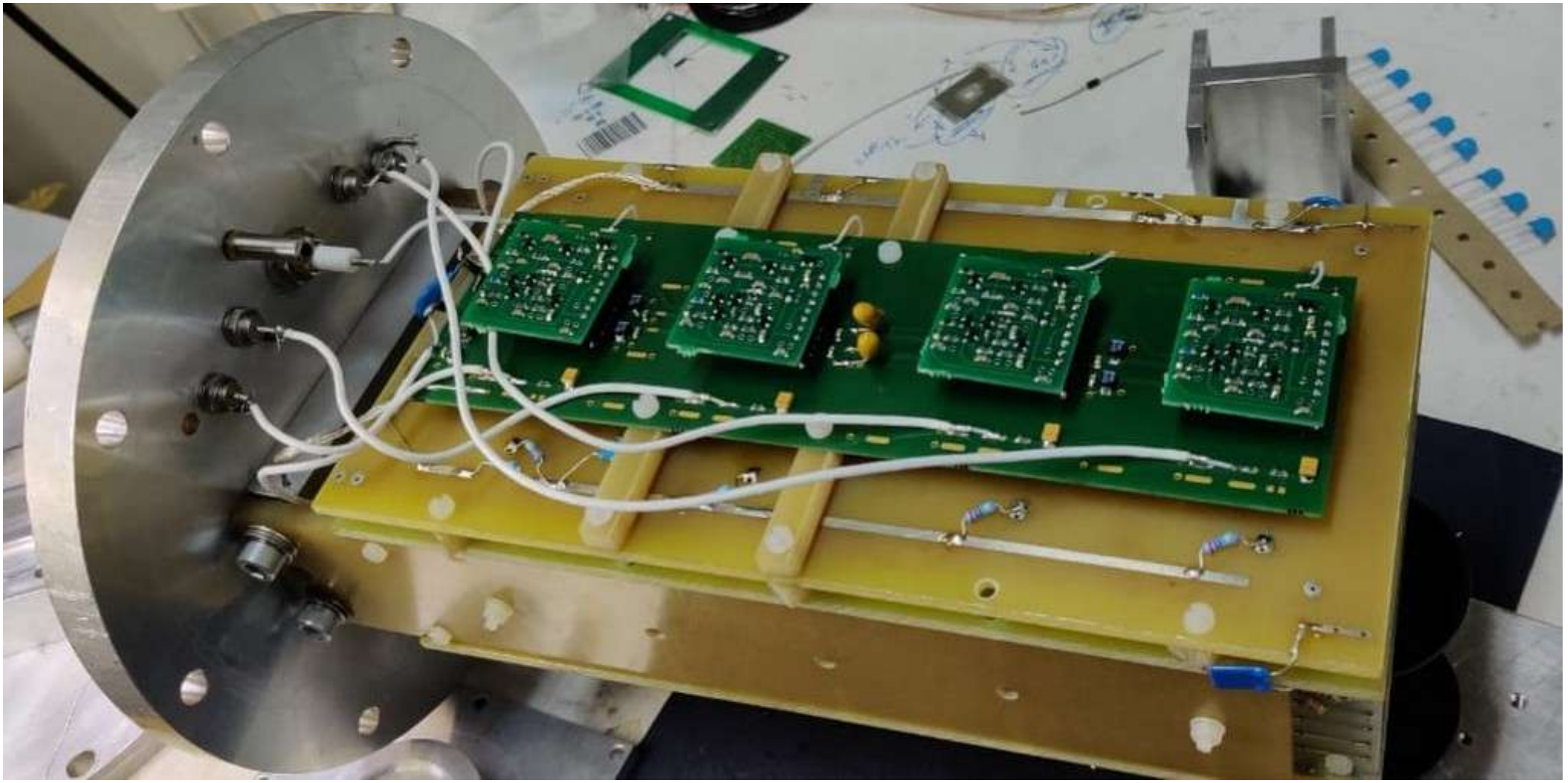
Coincidence between projectile and target like particles

MNT setup for below barrier

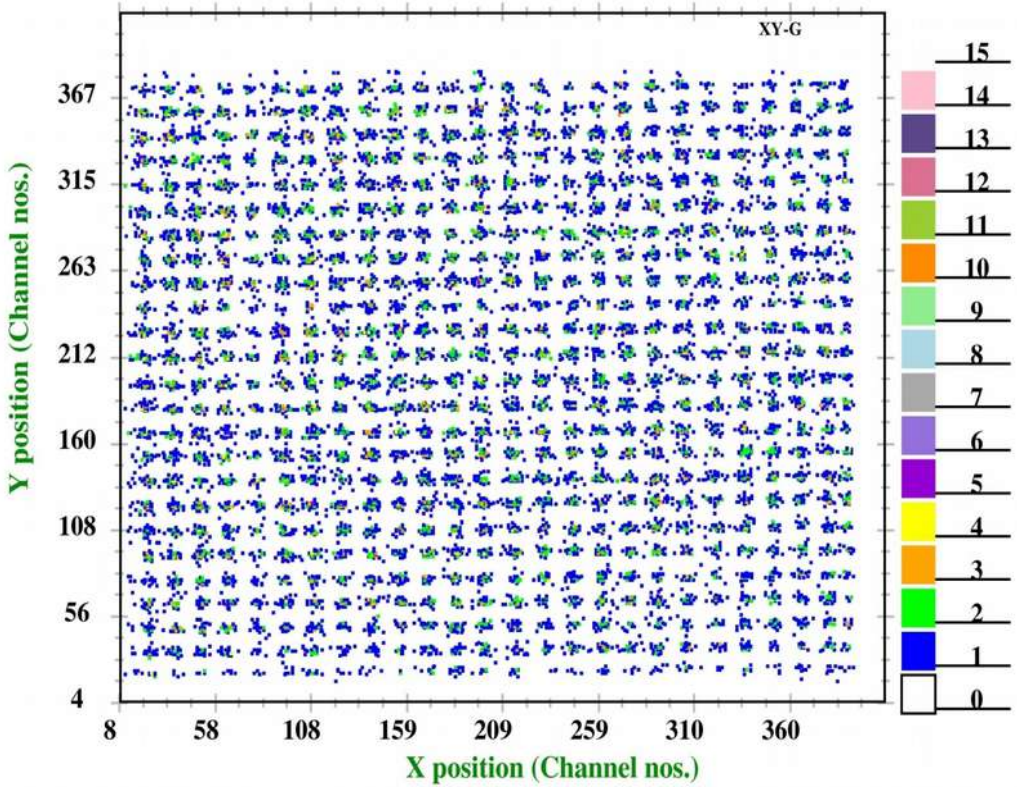


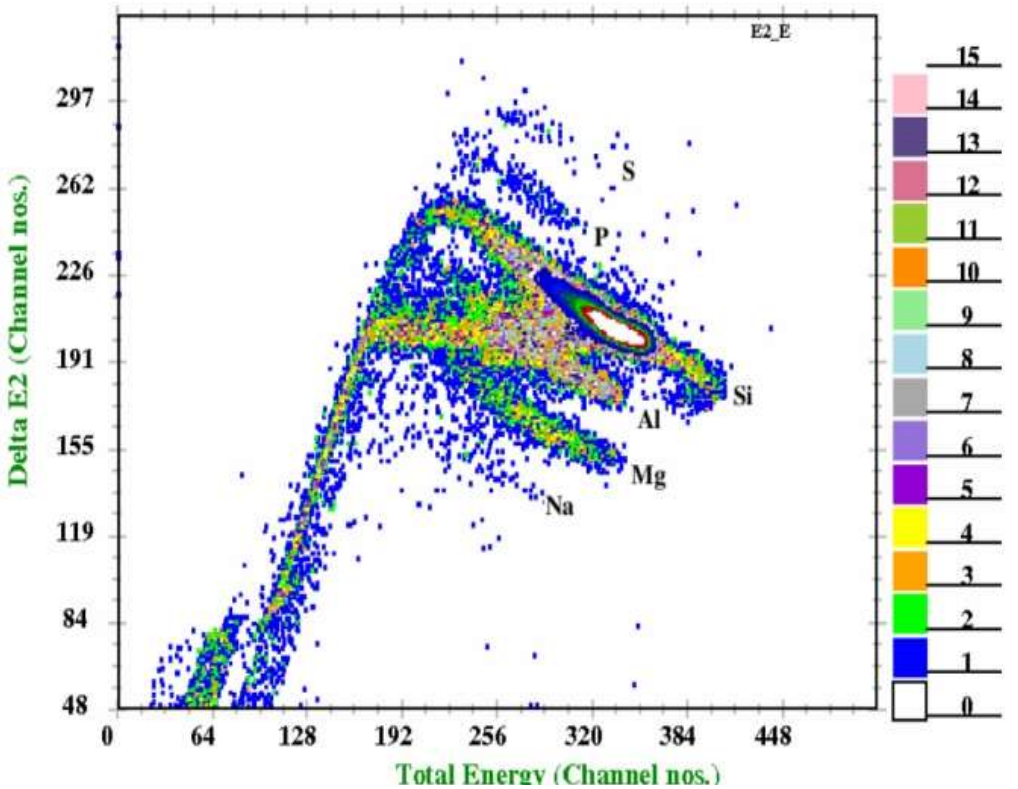
MNT setup for above barrier

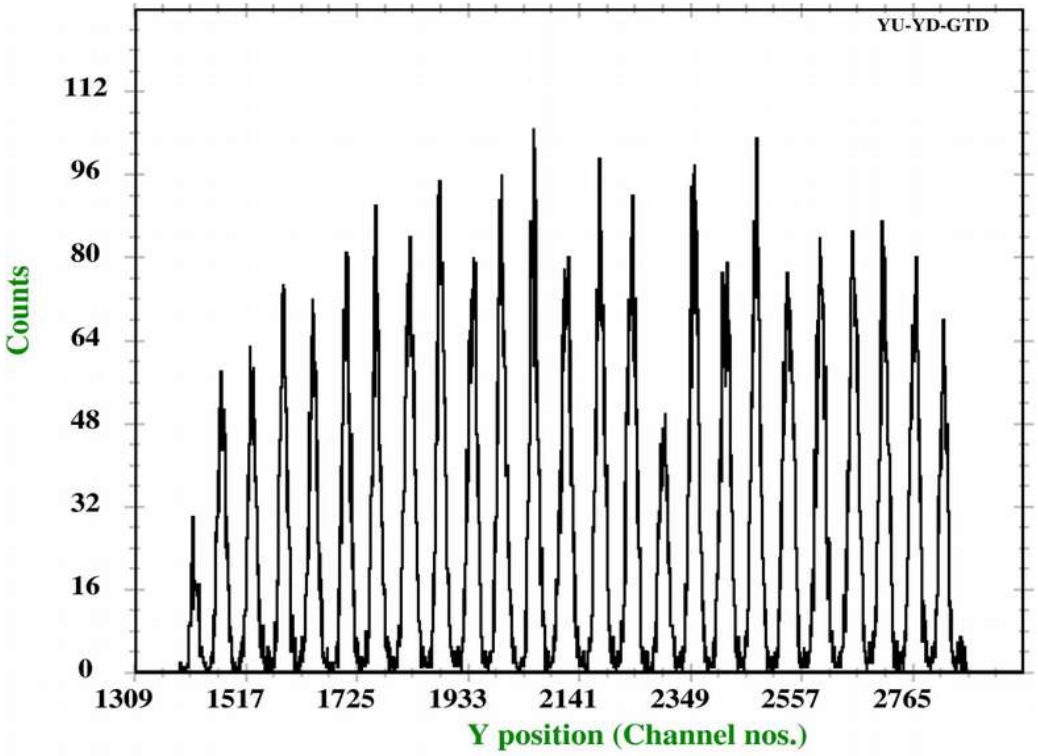
# Testing of CSPA units in gas volume with transverse field IC

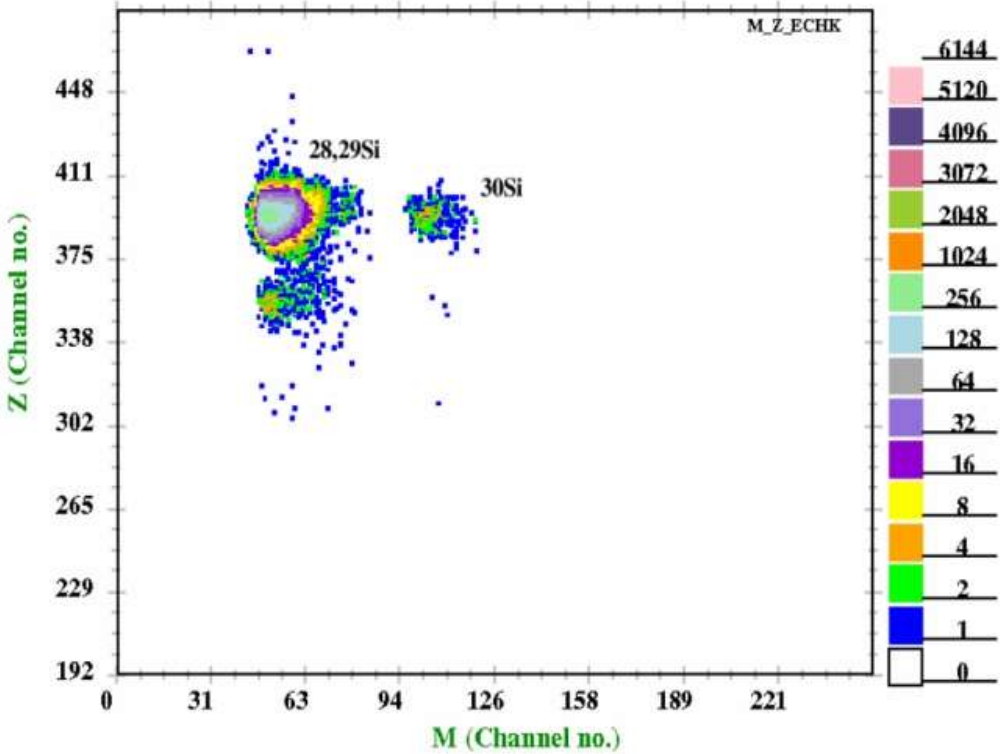


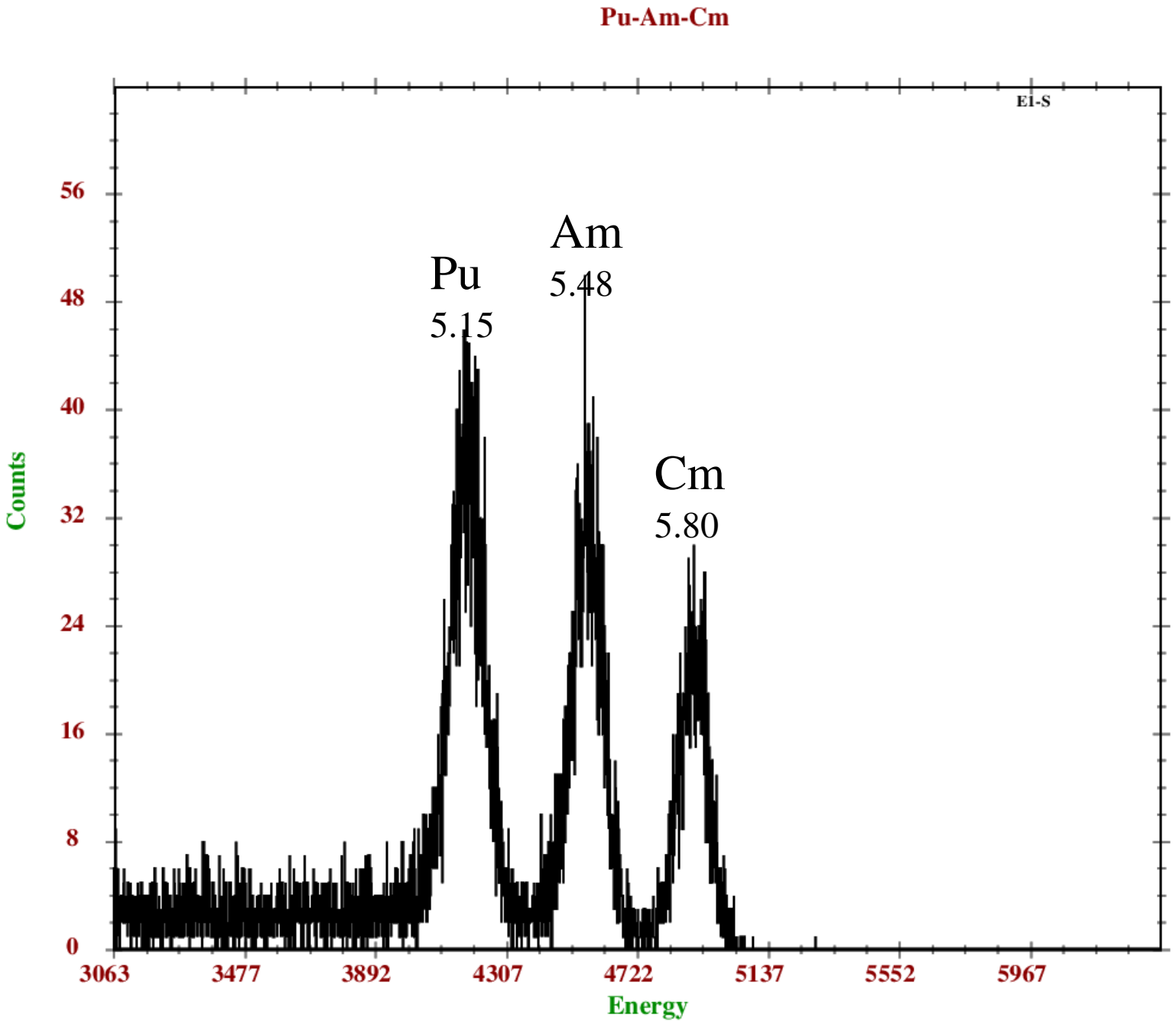
Transverse field segmented anode IC with integrated CSPA
4 segments: 3,6,6,6 *cm*
Detector operated with iso-butane @ 90 – 125 *mbar*


XY-G
Y position (Channel nos.)
X position (Channel nos.)
4
56
108
160
212
263
315
367
8
58
108
159
209
259
310
360
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0


E2_E
Delta E2 (Channel nos.)
Total Energy (Channel nos.)
48
84
119
155
191
226
262
297
0
64
128
192
256
320
384
448
S
P
Si
Al
Mg
Na
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0

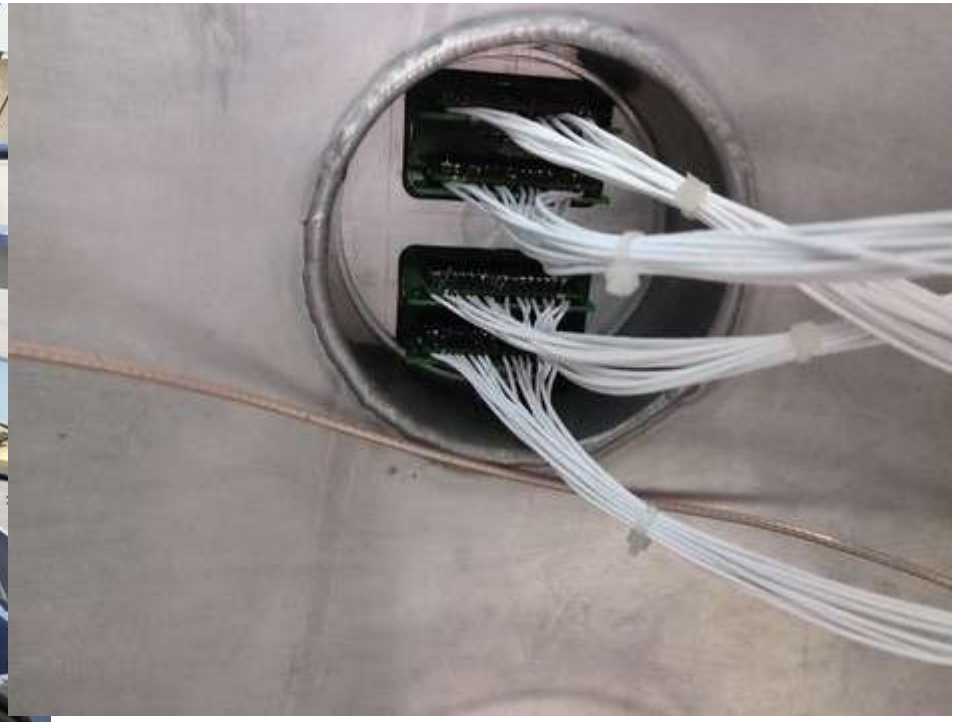

YU-YD-GTD
Counts
Y position (Channel nos.)
0
16
32
48
64
80
96
112
1309
1517
1725
1933
2141
2349
2557
2765

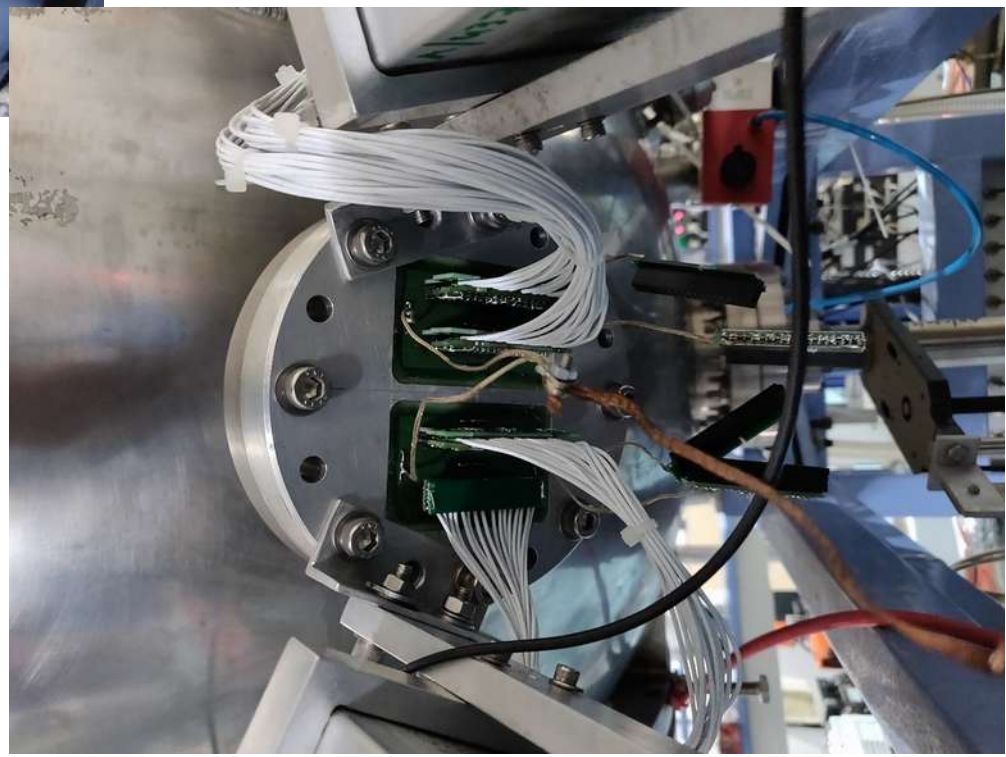

M_Z_ECHK
Z (Channel no.)
M (Channel no.)
192
229
265
302
338
375
411
448
0
31
63
94
126
158
189
221
28,29Si
30Si
6144
5120
4096
3072
2048
1024
256
128
64
32
16
8
4
2
1
0




Energy Resolution: 2% (108 keV) for 5.48 MeV $^{241}$Am, 90 mbar iso-butane
Improvement by a factor of ~ 20 % in comparison with external CSPA units

Experimental setup for Transfer Induced Fission

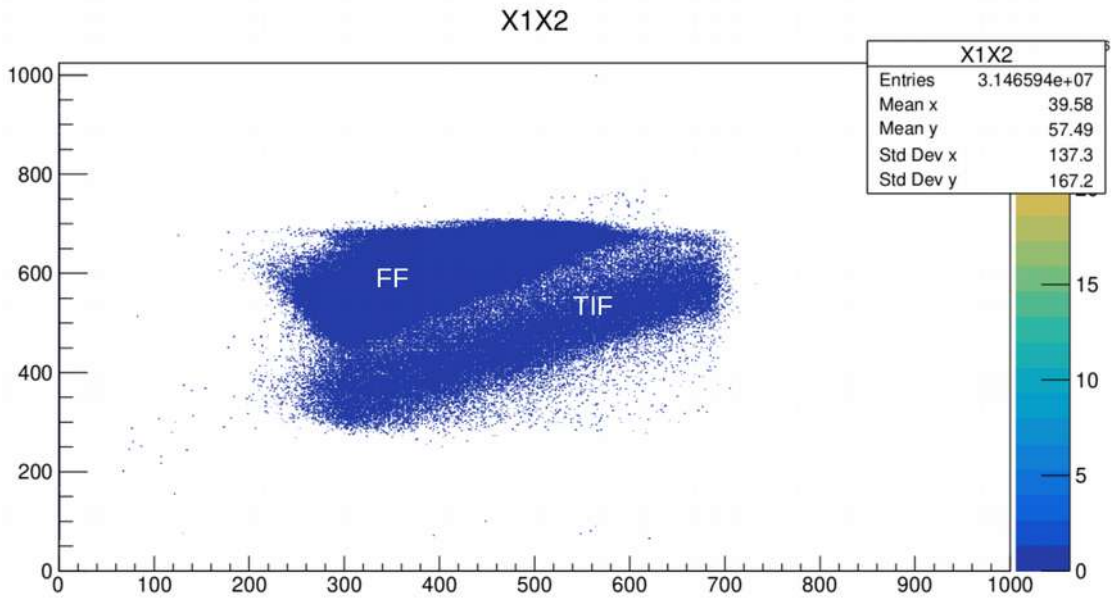





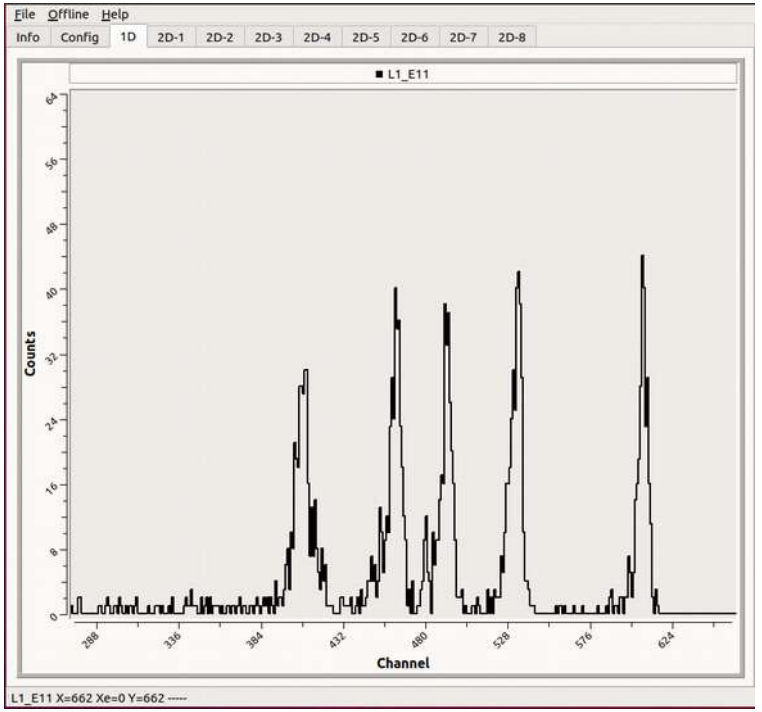
Preamplifier System, Feehthru flange
and signal cabling system.

*Acknowledgement:*
Mechanical Workshop IUAC

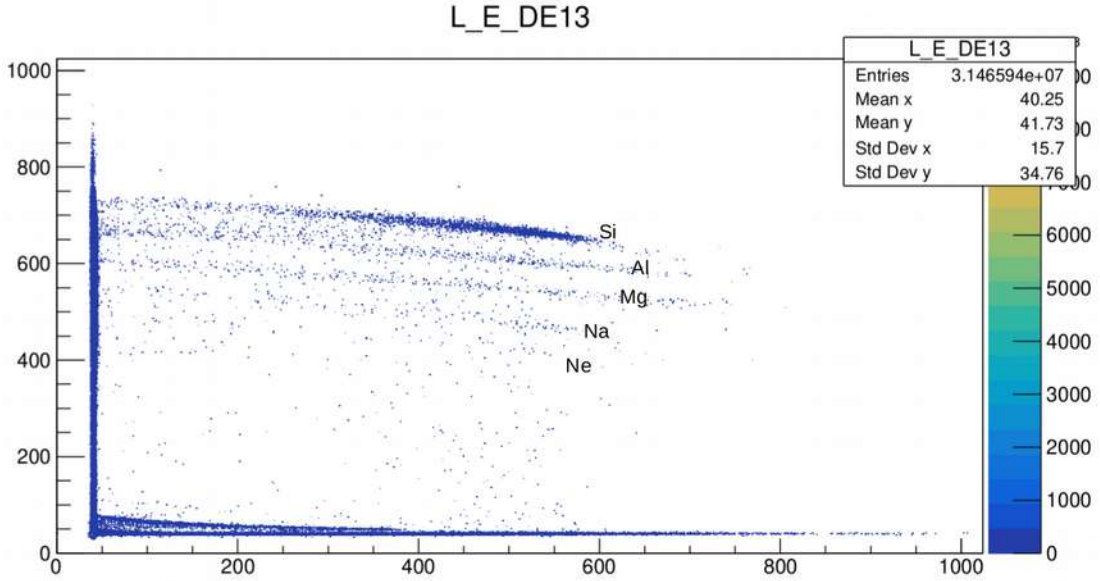
Fission fragment folding angle correlation




FF: Fusion-Fission, TIF: Transfer Induced Fission



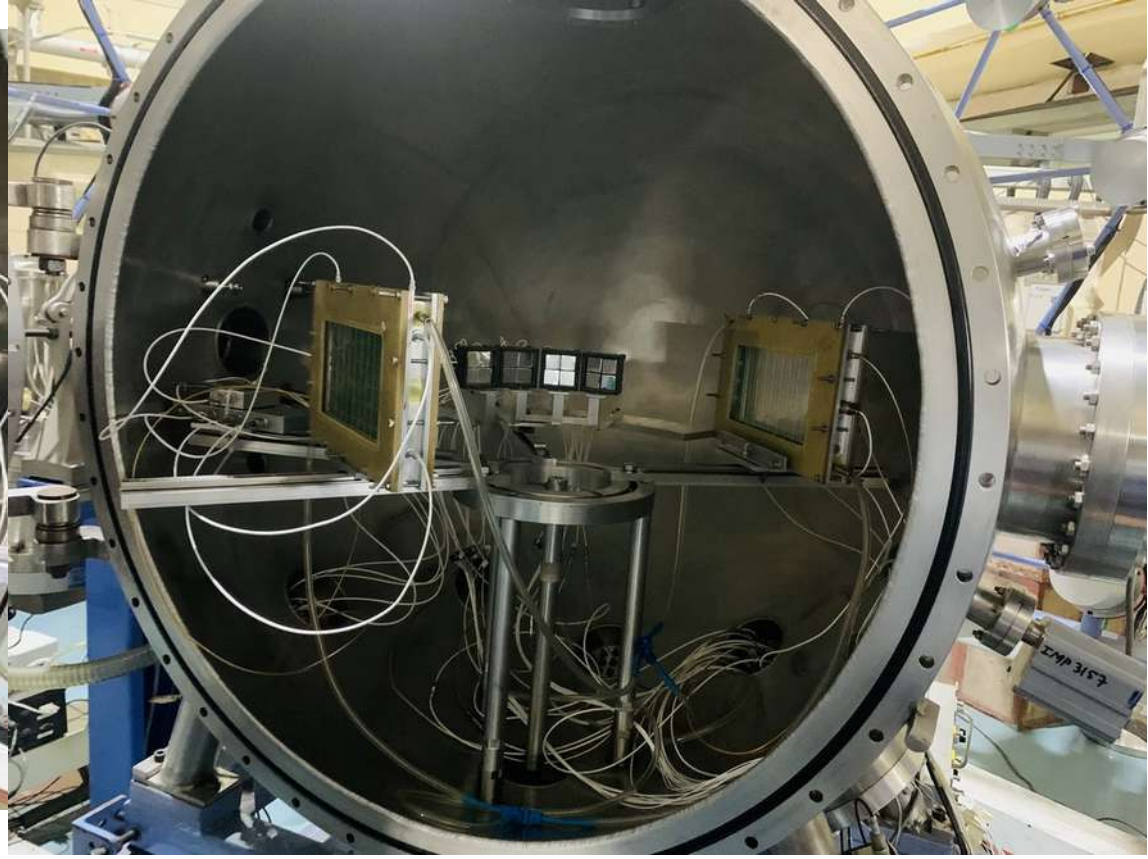

α- spectrum with $^{229}$Th



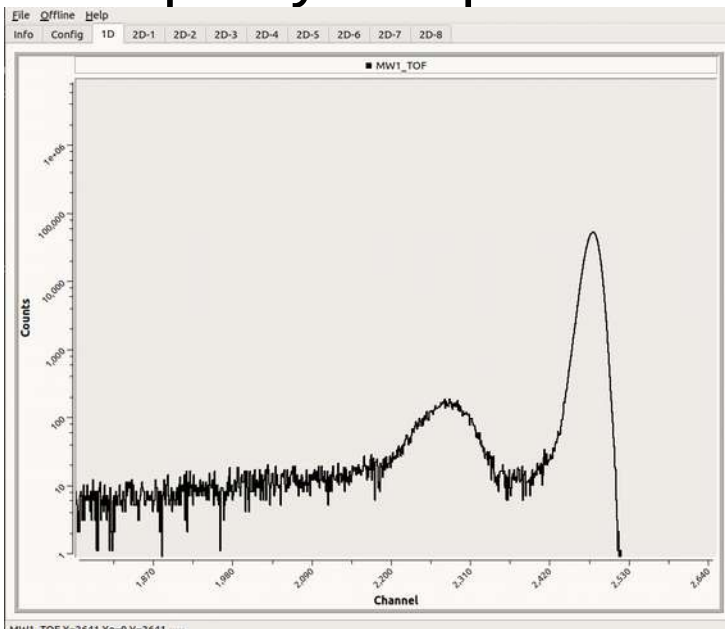

ΔE-E plot for one pixel of strip detector (16x16) telescope
Transfer channels for projectile (28Si) like particles

Data from $^{28}$Si + $^{232}$Th

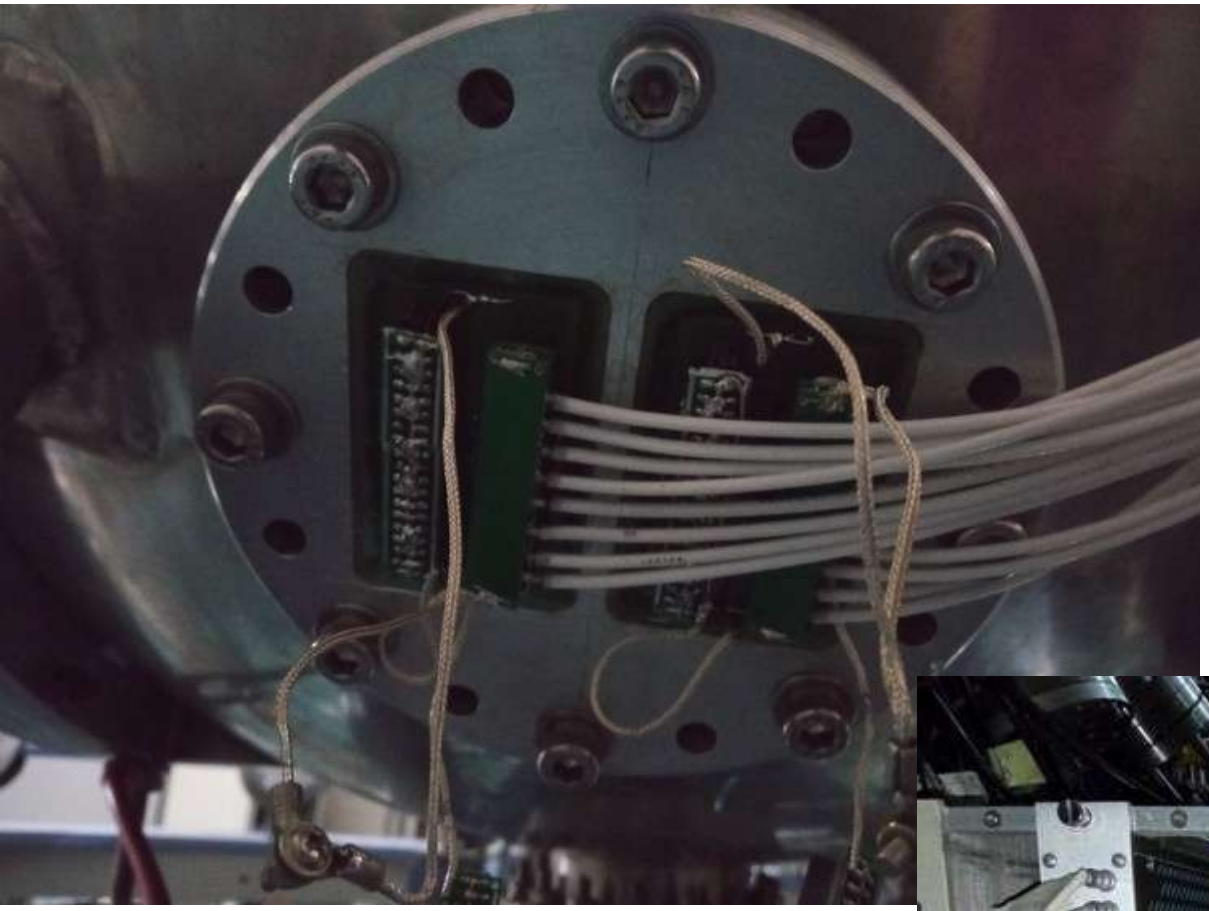
ER gated light charge particle multiplicity setup.



Fission gated light charge particle multiplicity setup.

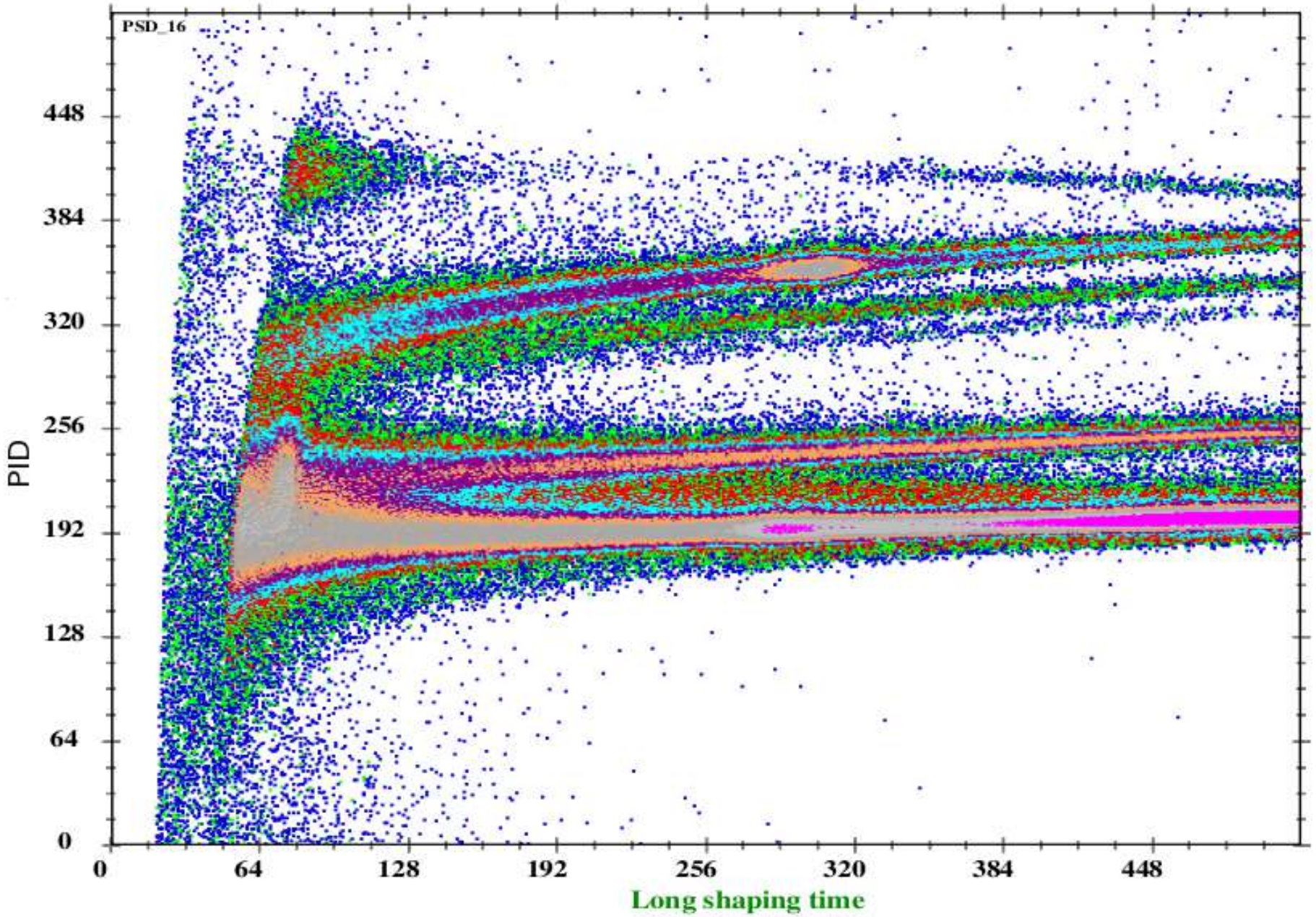


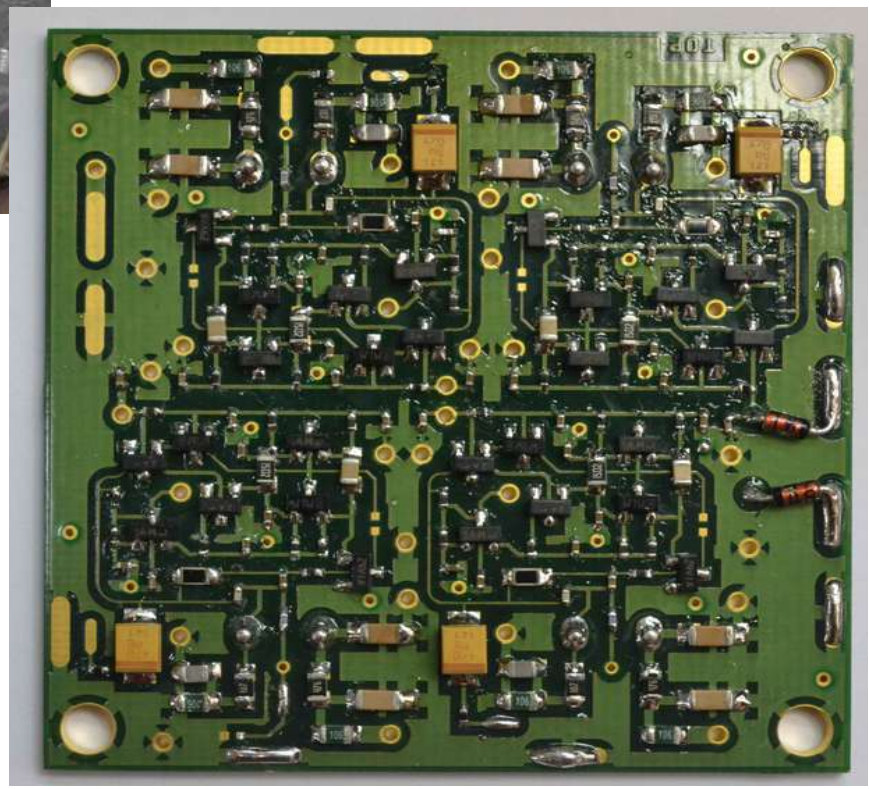

TOF spectrum at ~ 100k count rates



Signal extraction: CsI detectors

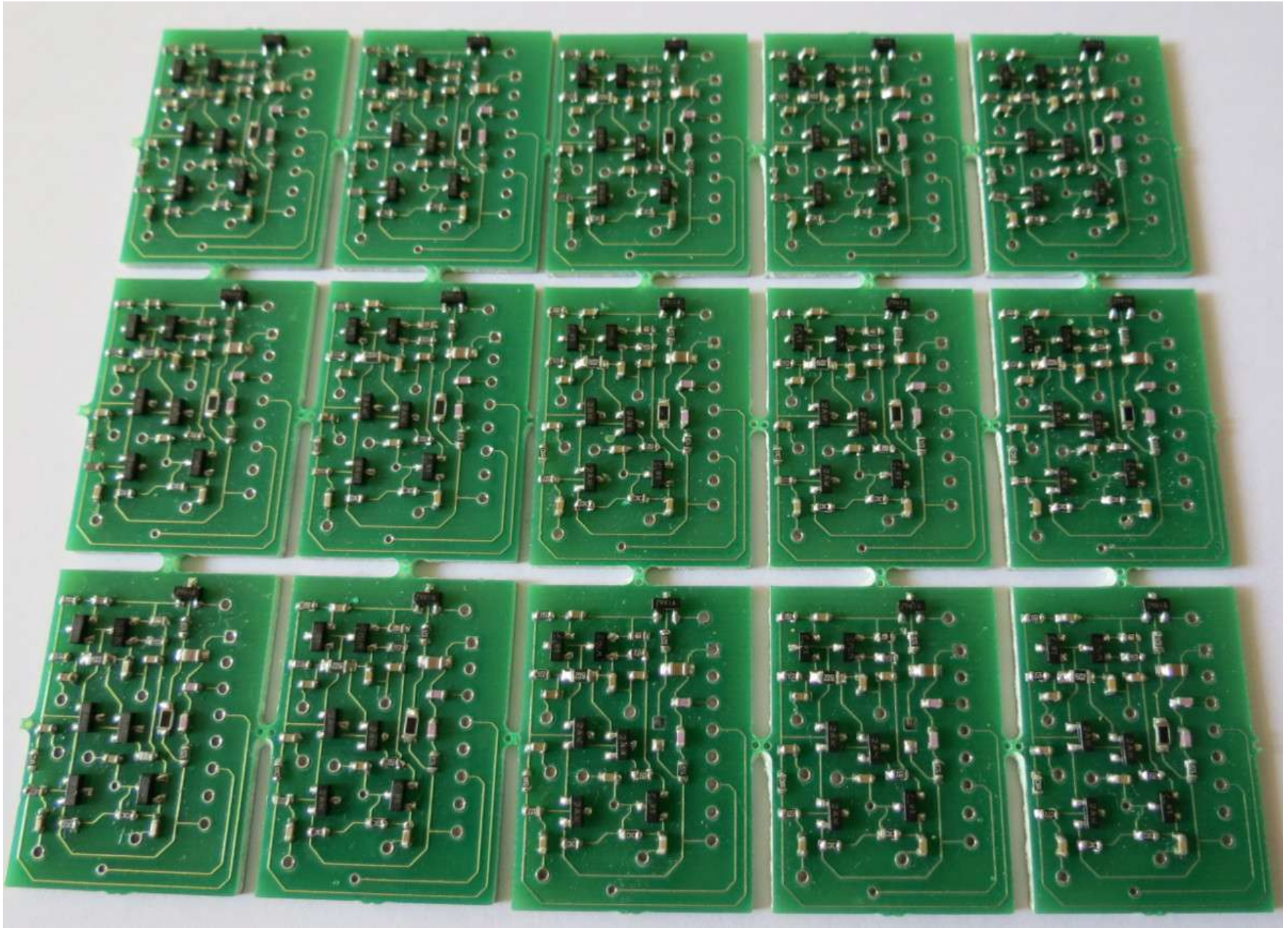
Signal processing


PSD_16
448
384
320
256
192
128
64
0
PID
0
64
128
192
256
320
384
448
Long shaping time

CSPA for CsI-photo-diode detectors
4 channels with bias ckt., test inputs
Area 5.5 x 5.5 cm2
Fabricated using 0402 Resistor/Capacitor

Detector target distance 15 cm



## CPDA for INGA

For light charged particle gated gamma spectroscopy

Currently 32 detectors in the array mounted in Rhombicuboctahedron geometry
20 mm x 20 mm x 3 mm CsI coupled to 10 x 10 $mm^2$

16 detectors in front hemisphere and 16 in back hemisphere

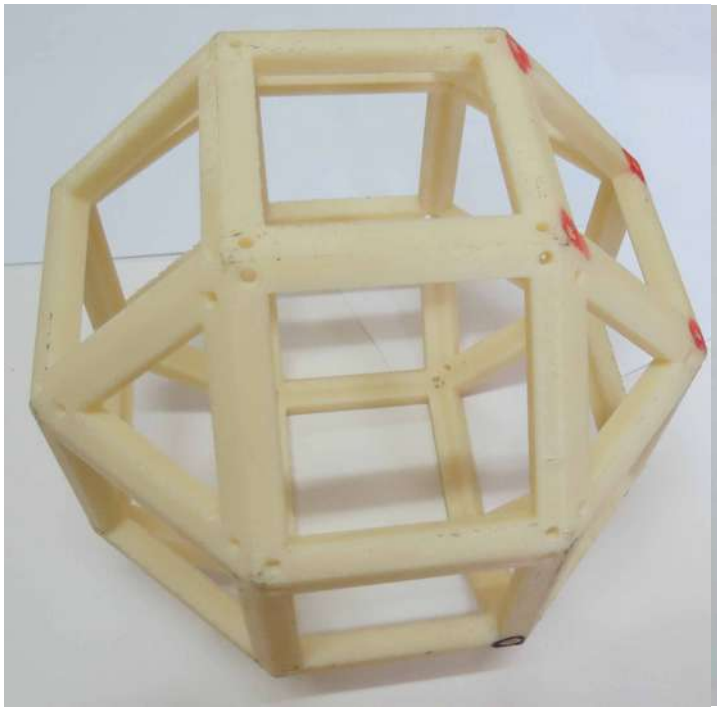
In-house developed low power charge senistive preamplifier (CSPA) units

Low noise CSPA units (~ 30 mW/unit) operated inside vacuum

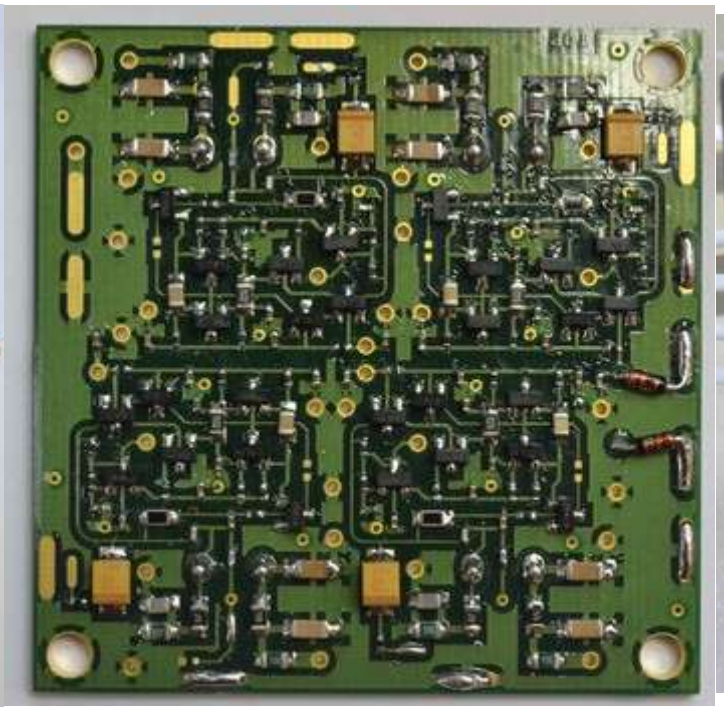
Particle identification performed using ballistic deficit technique using
Long (3 us) and Short (0.5 us) shaping times.

Differential driver units developed for driving signals.

Array used in experiments recently

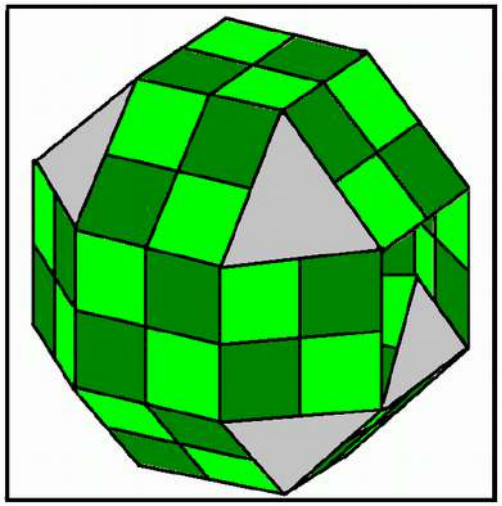


Rhombicuboctahedron
Plastic mounting



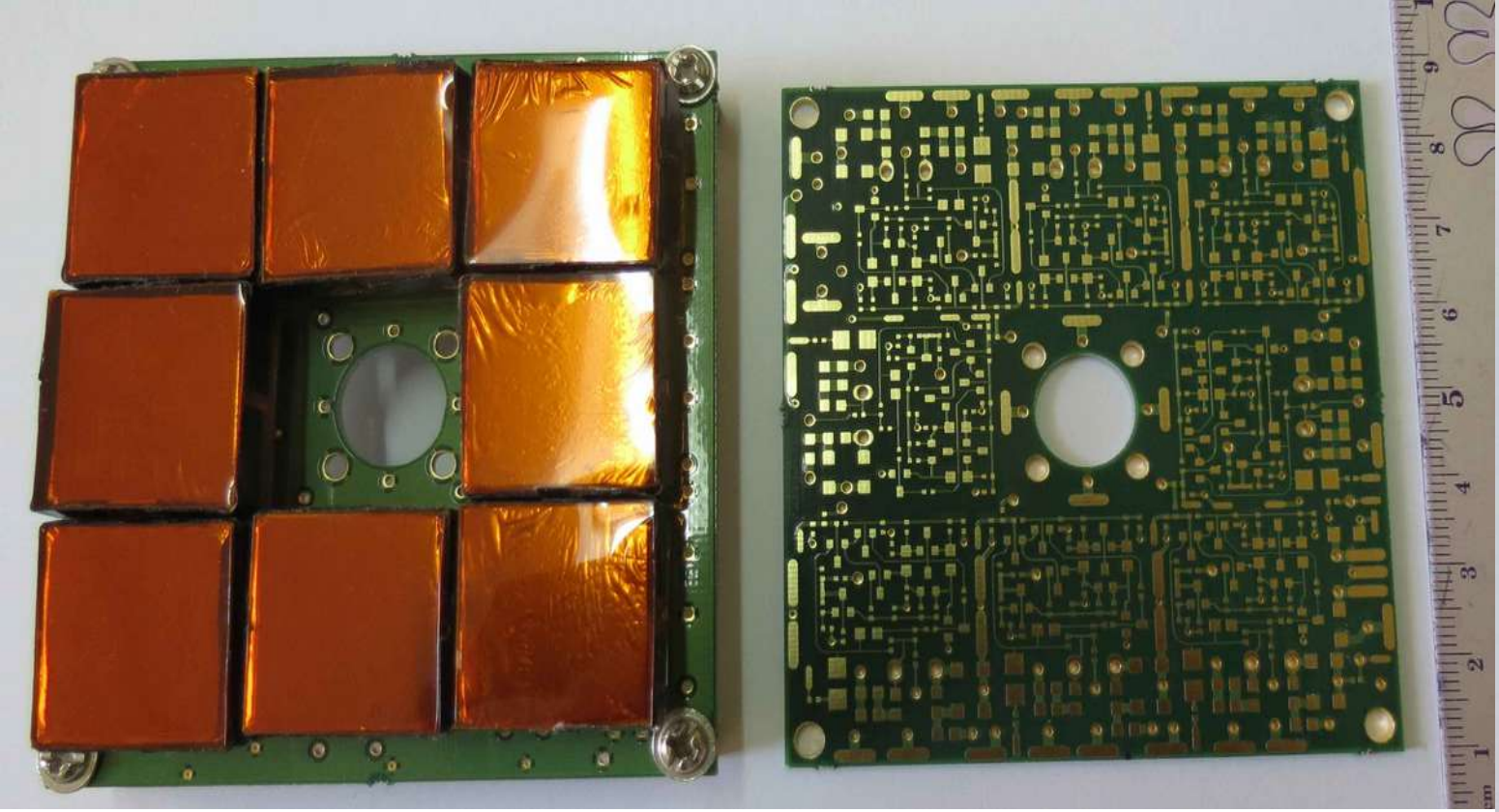
4-channel preamplifier
Card. CsI detectors
Plugged on the other side

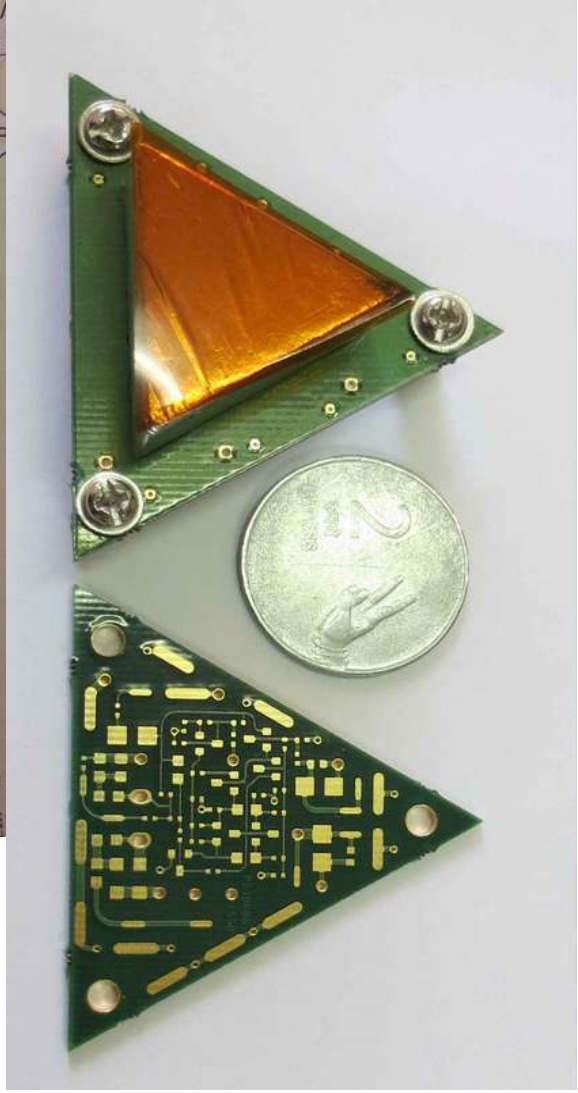
4 CsI detectors plugged
on the CSPA board.

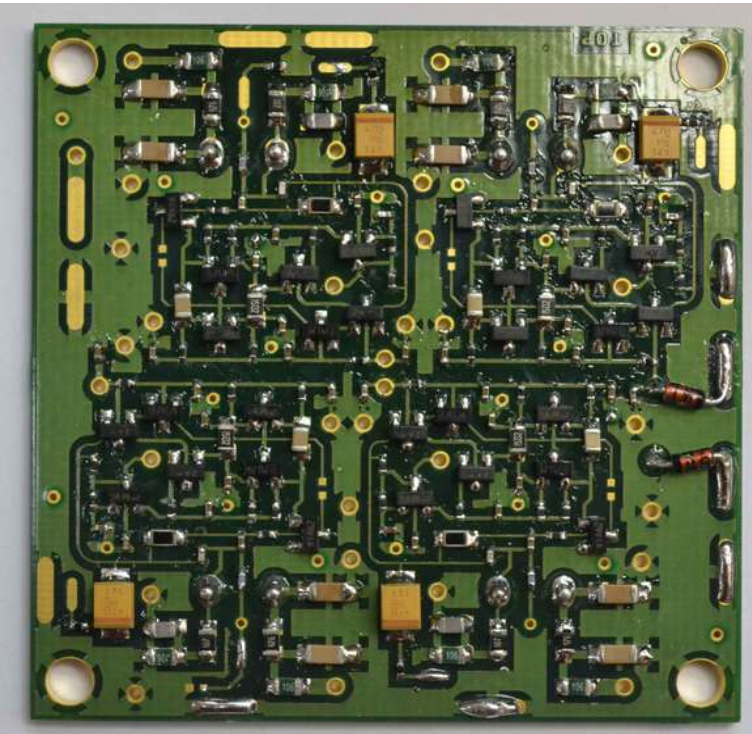


Mounting scheme of CsI Detectors
4 detectors on each face of rhombicuboctahedron structure

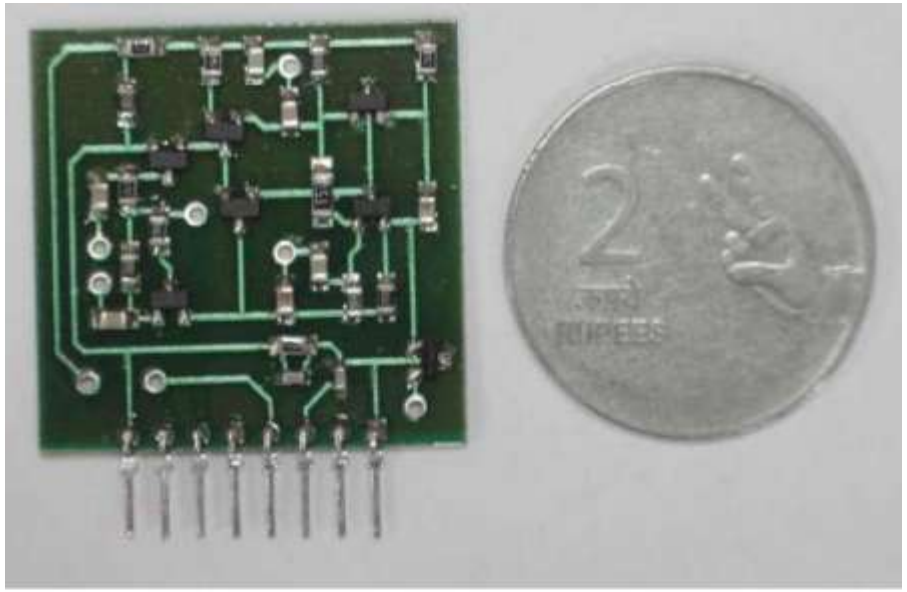

Rhombicubeoctahedron structure for CsI

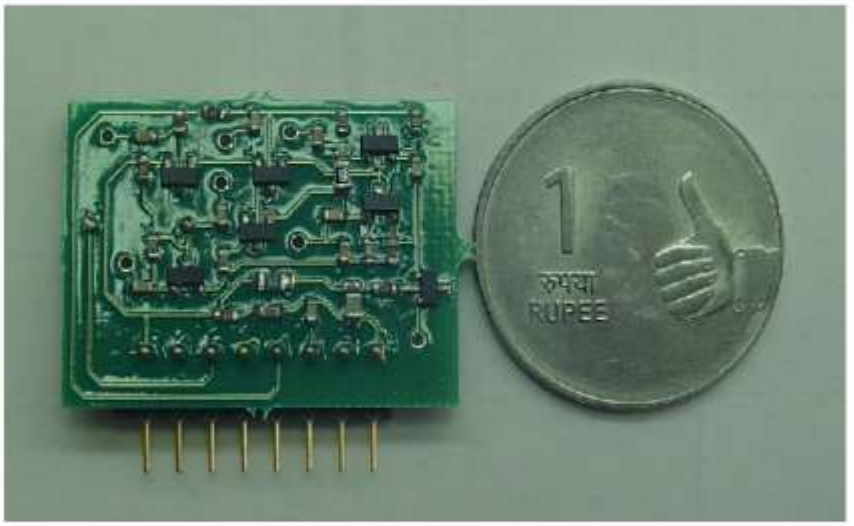


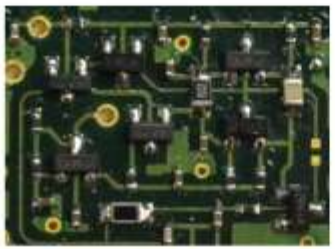




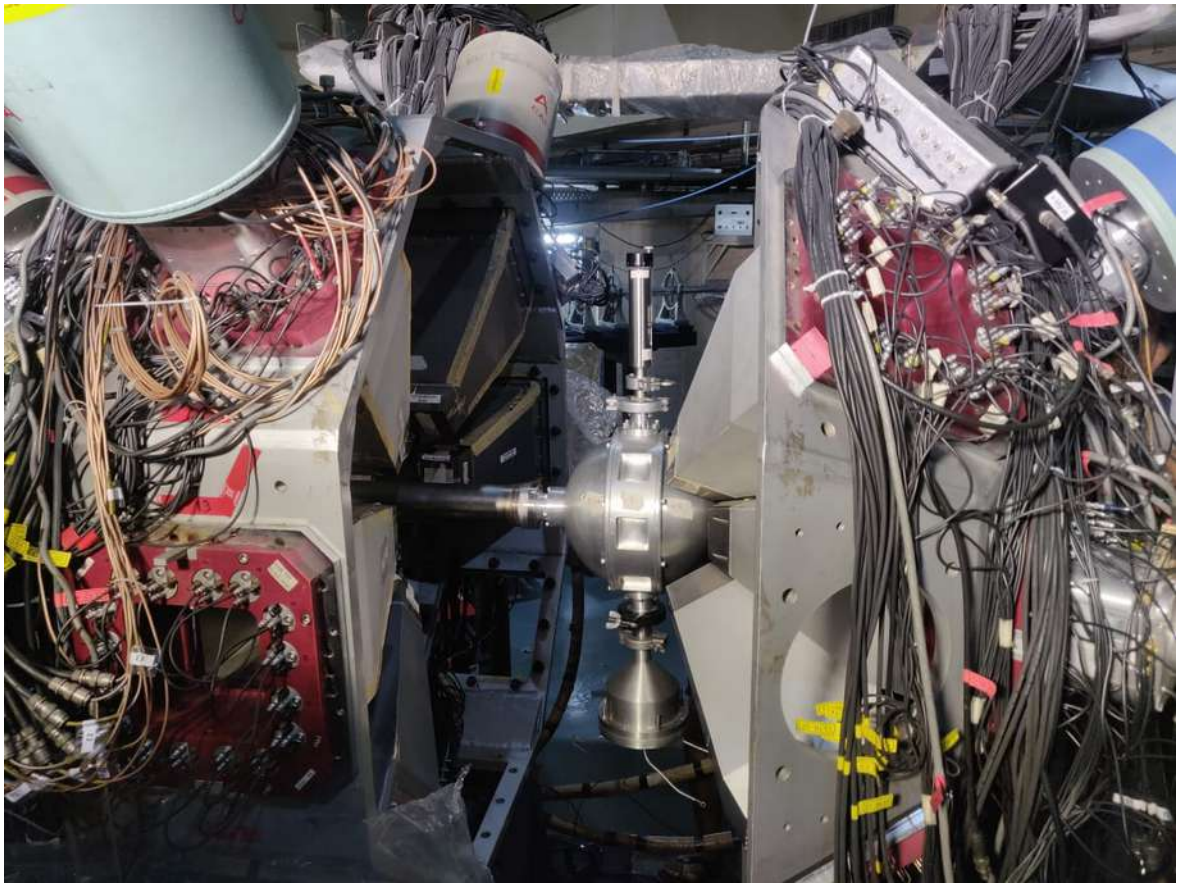
Assembly Config. of CsI coupled to Photo diode



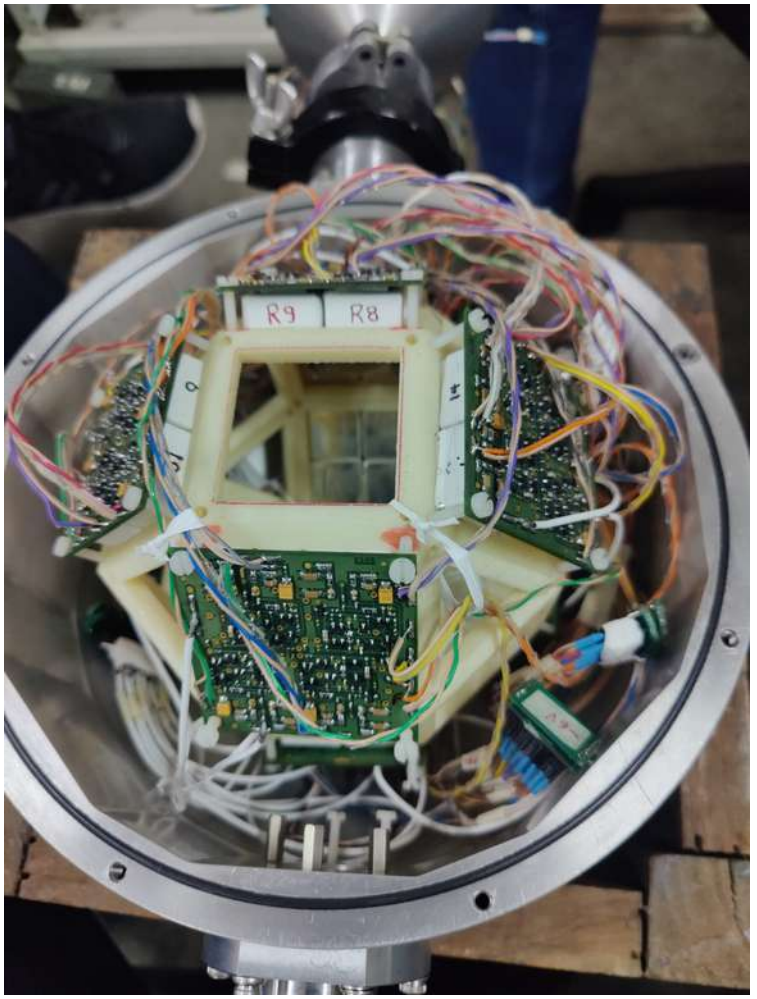



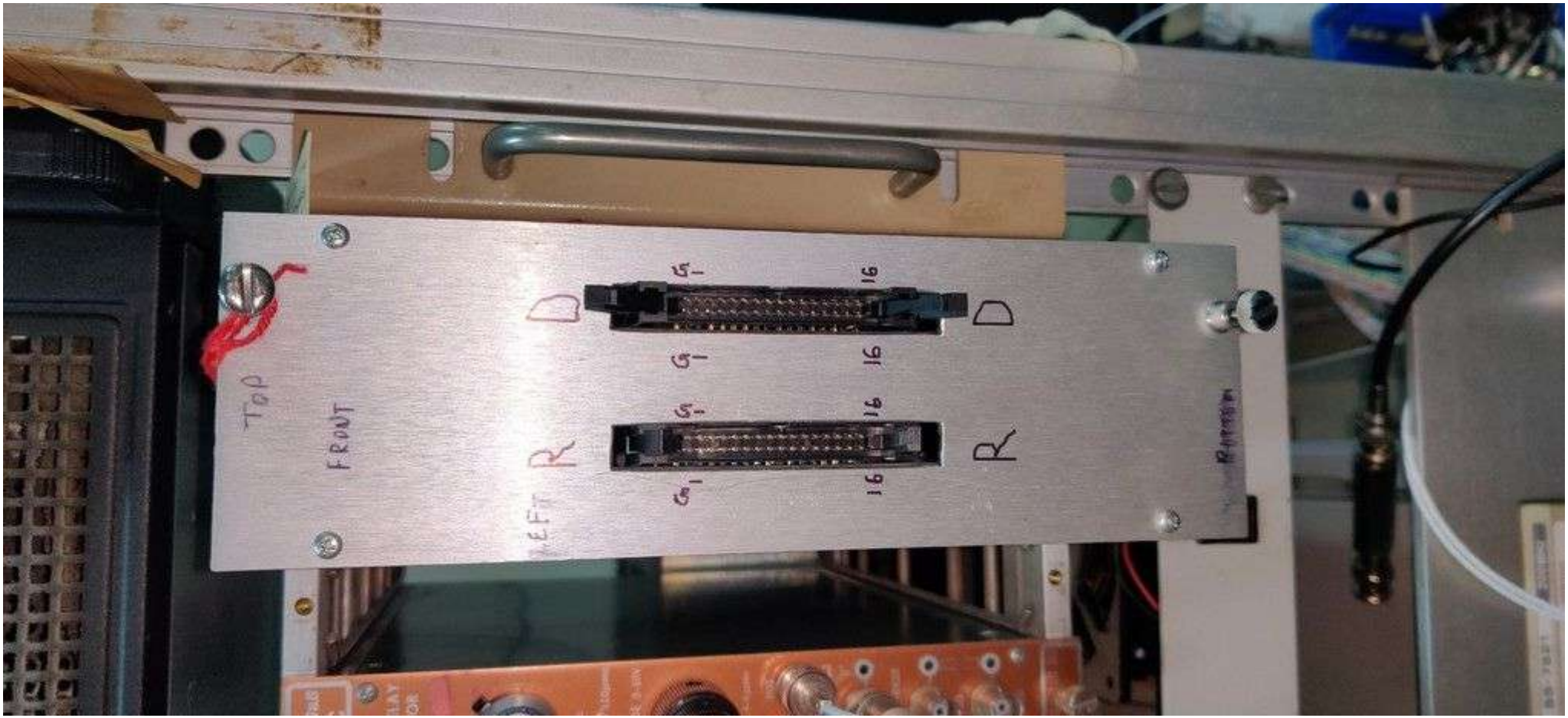
CSPA Hybrids



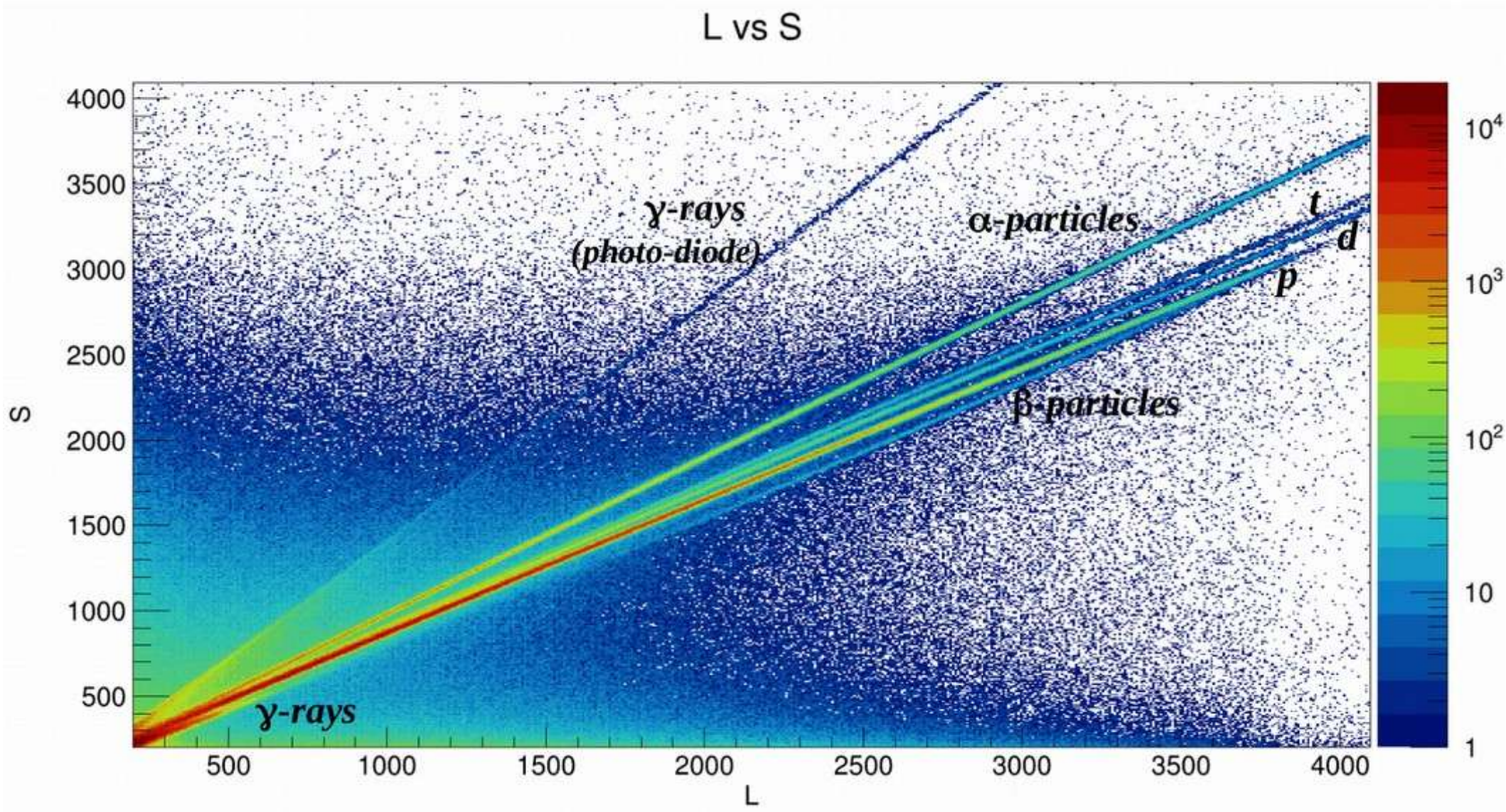
Speherical CPDA target chamber
Mounted inside INGA



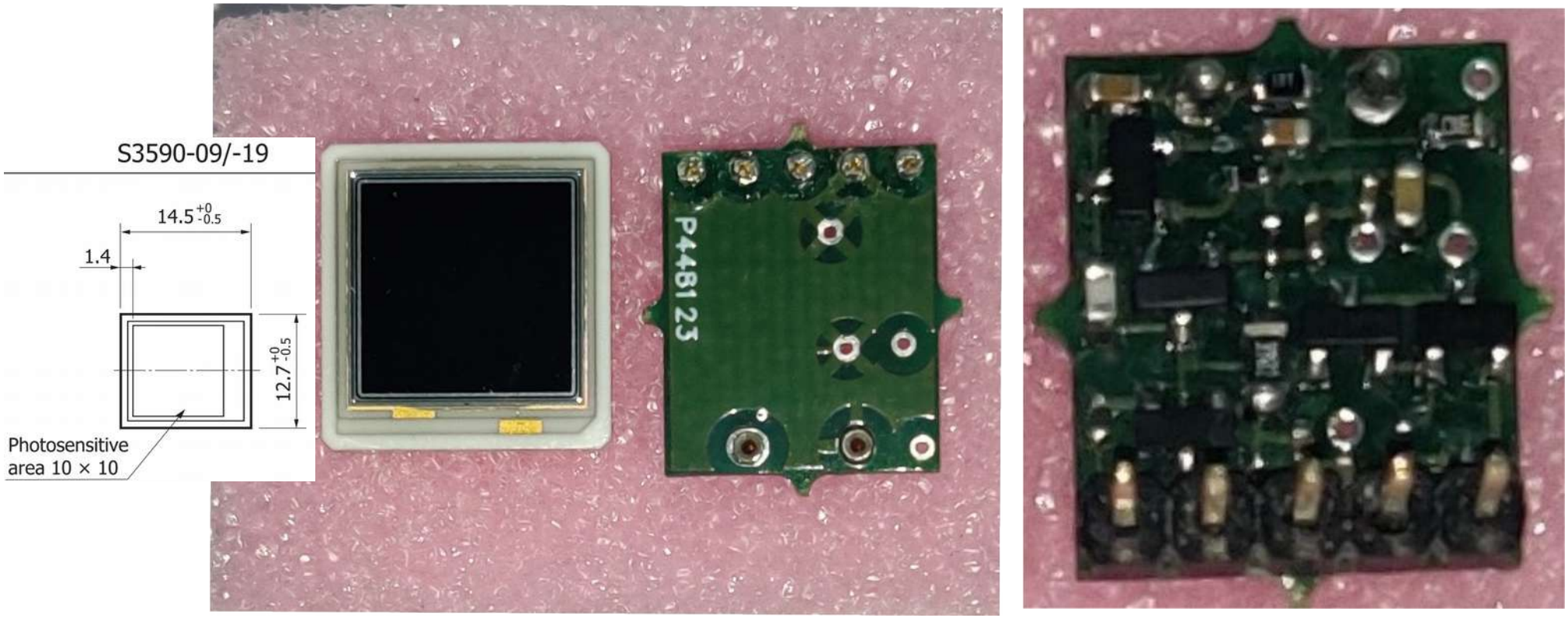

Detectors along with
preamplifiers mounted
Inside target chamber




Differential receiver-driver unit for twisted pair cable signals.




Plot between long and Short shaping time for particle identification using ballistic Deficit technique.




**Miniaturized CSPA units**

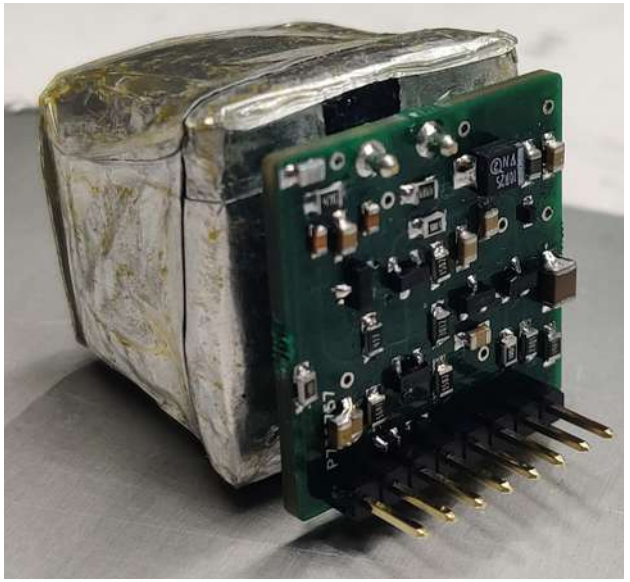
Area 13 x16 *mm*$^2$, Power consumption 20 *mW*

Compatible with plug in type PIN diodes (S-3590) from Hamamatsu

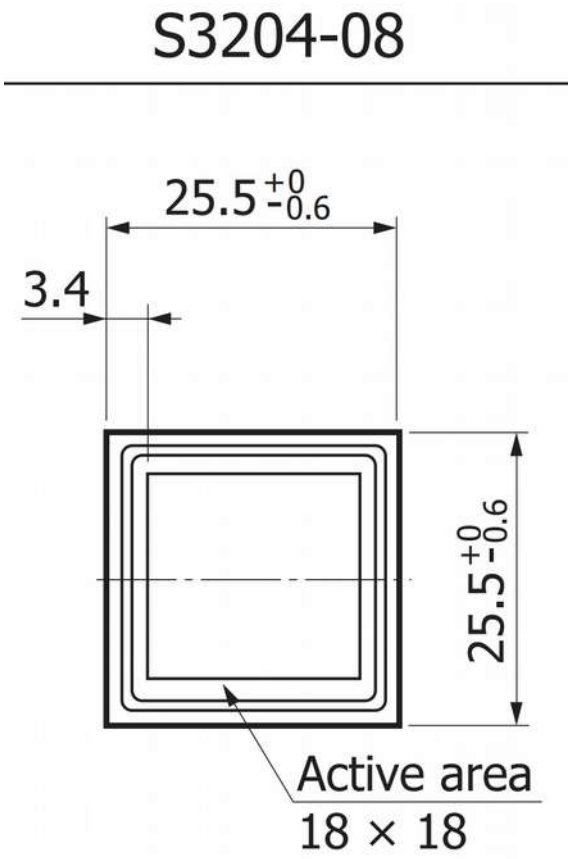
Tested with radioactive sources, good performance observed

In-beam experiments to be performed

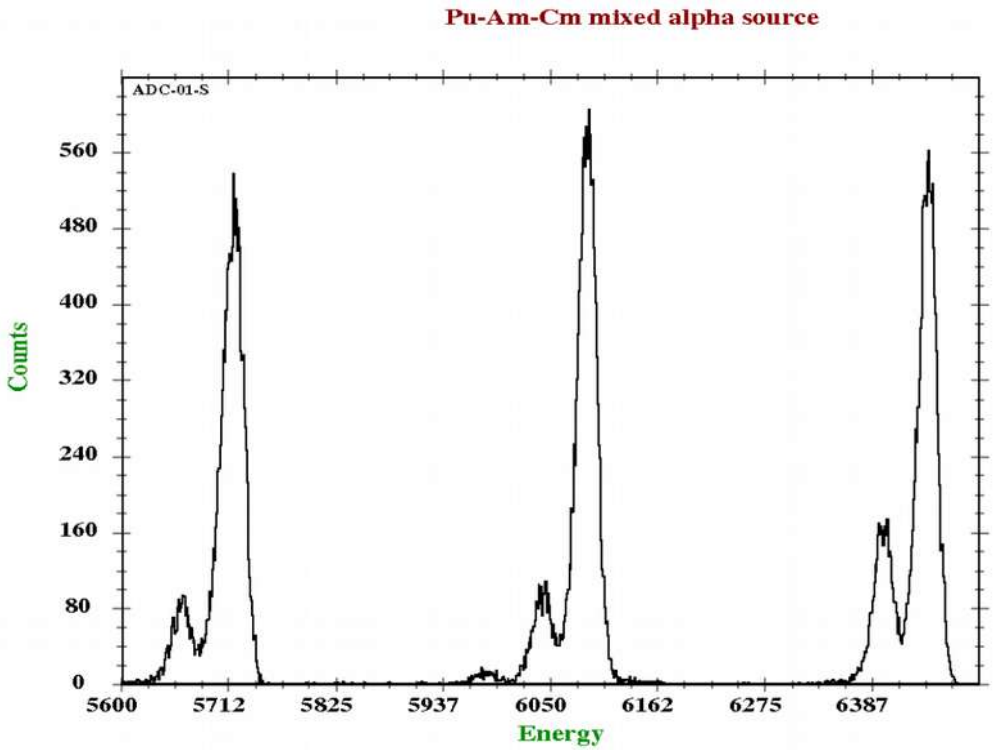
Useful for array of PIN diode and photo-diodes coupled to scintillator



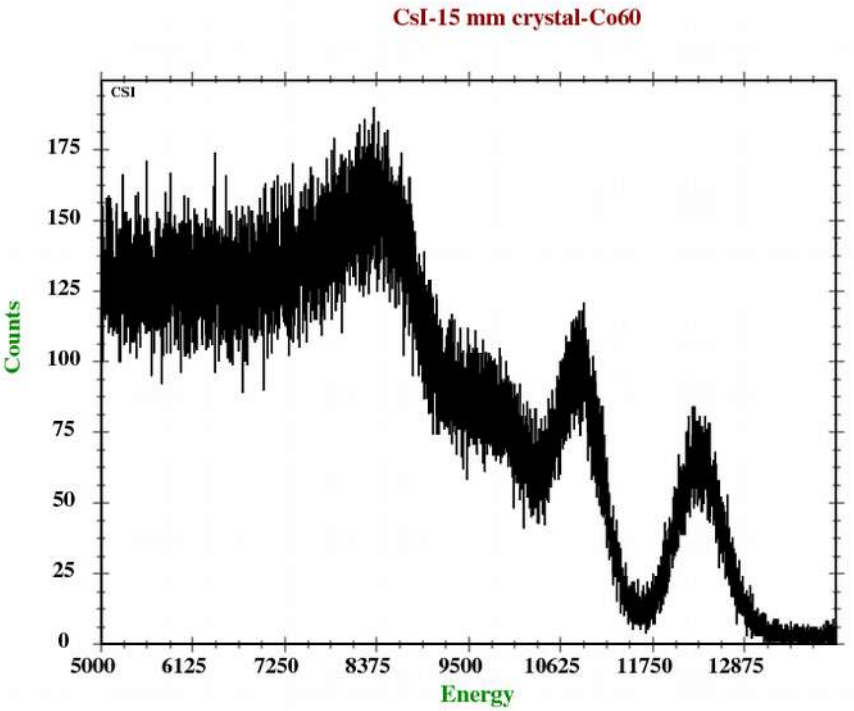
Power consumption 140 mW



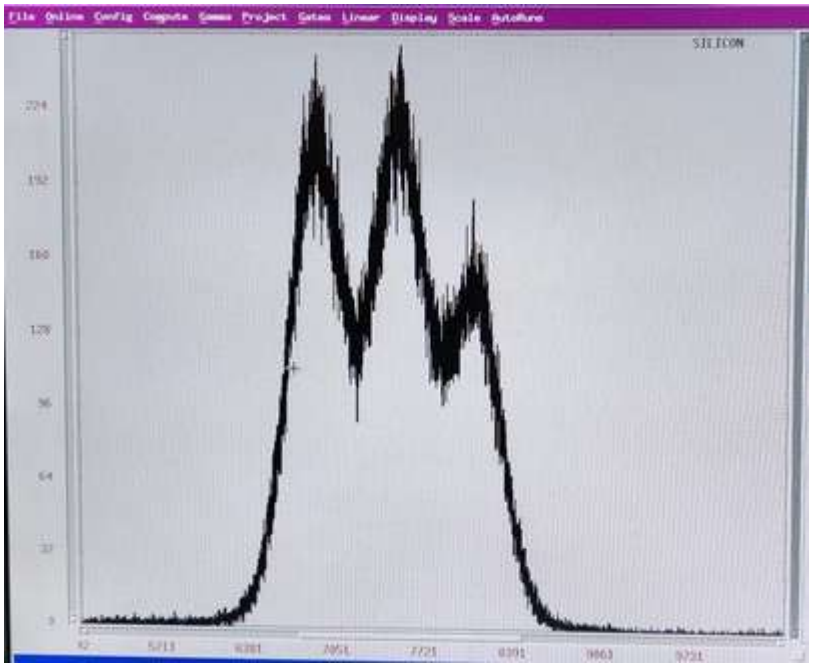

*CsI – photo-diode with integrated CSPA*




α-*particle* spectrum with PIN diode




γ-*ray* spectrum with 15 x 15 mm CsI
Coupled to 10 x 10 mm PIN diode




α-*particle* spectra with CsI-PIN diode
20x20 mm diode with 20x20 mm CsI

## Future

Use of APDs and SiPM as replacememt for PMT

APD and SiPM: efficently used with NaI, CsI, plastic scintillators etc.

Close packed arrays possible near the target within vacuum in large scattering chambers.

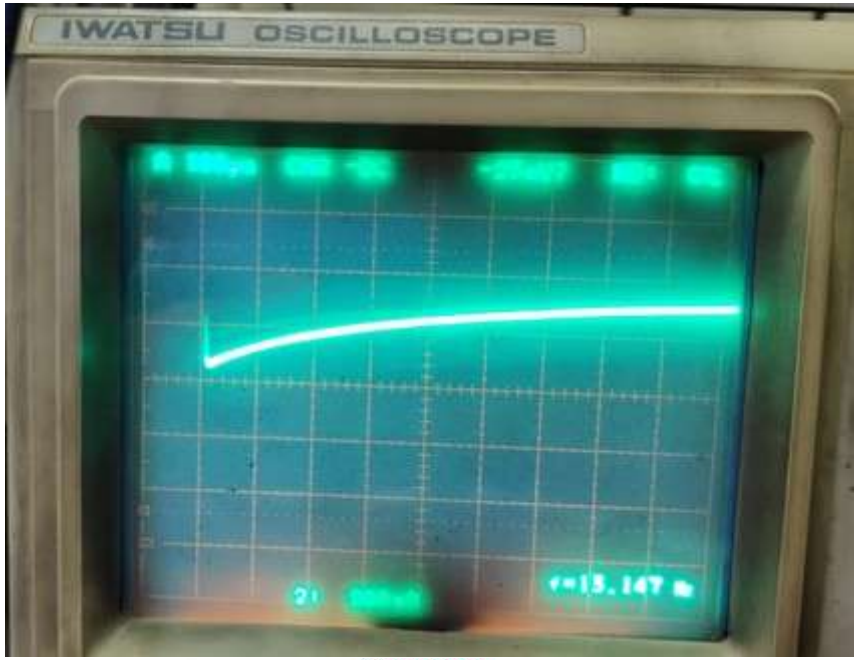
Segmented SiPM provides position sensitivity in small area crystals

Energy resolution compatible with PMT

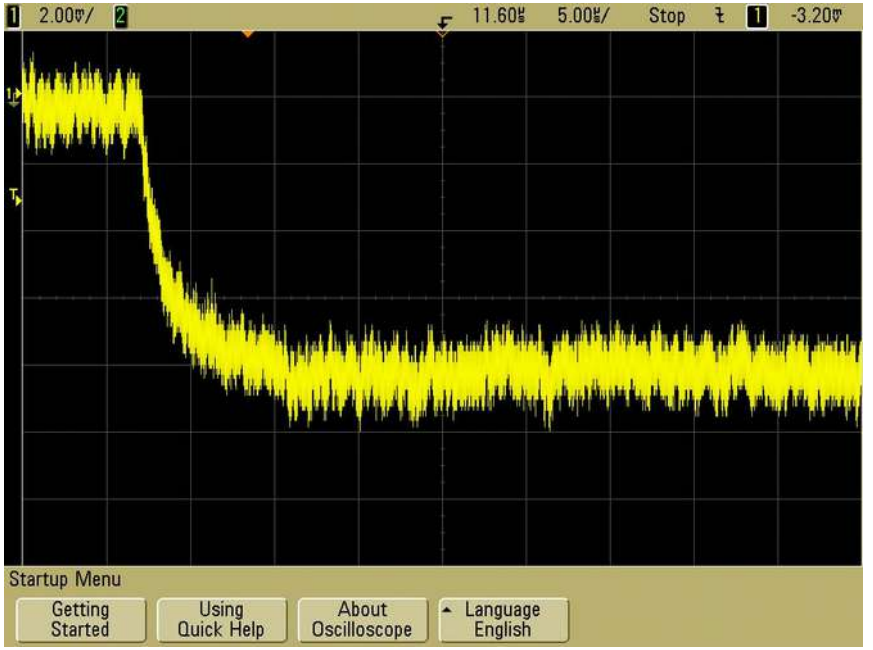
Possible to go to lower energy thresholds (~ 50 keV) with CsI-APD

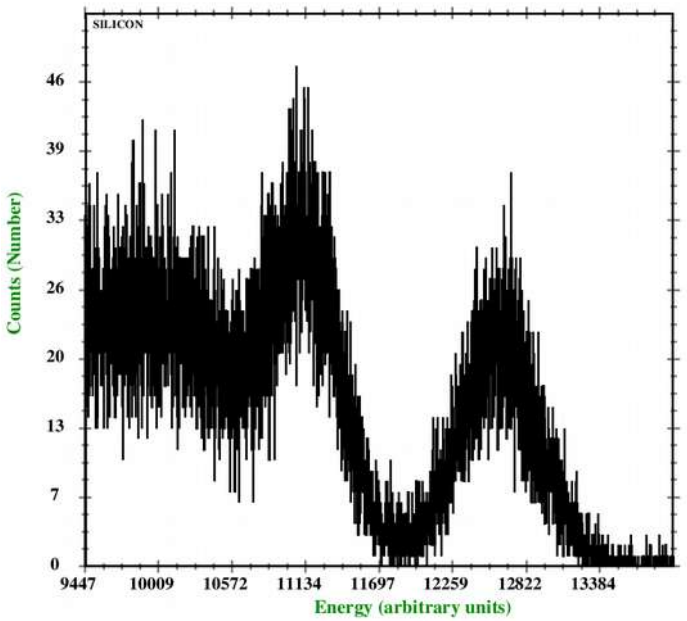
Timing resolutions inferior w.r.t. PMT

# Testing of CsI with APD (IUAC + TIFR)

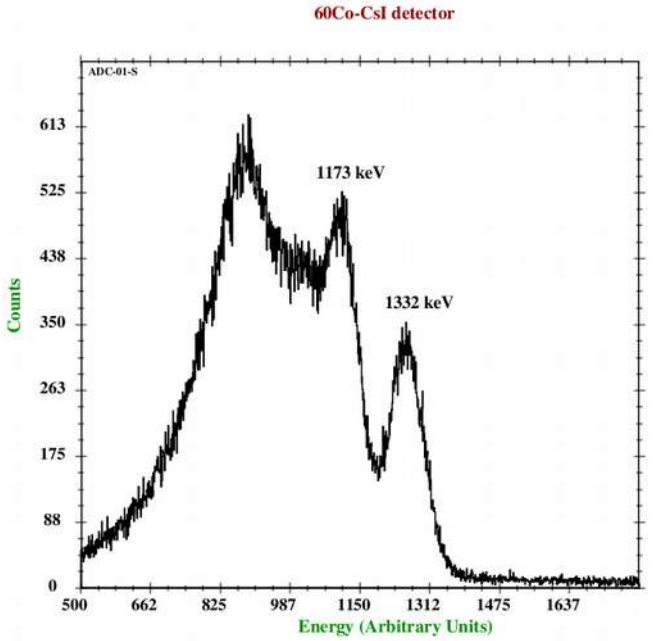



60Co-APD-CsI

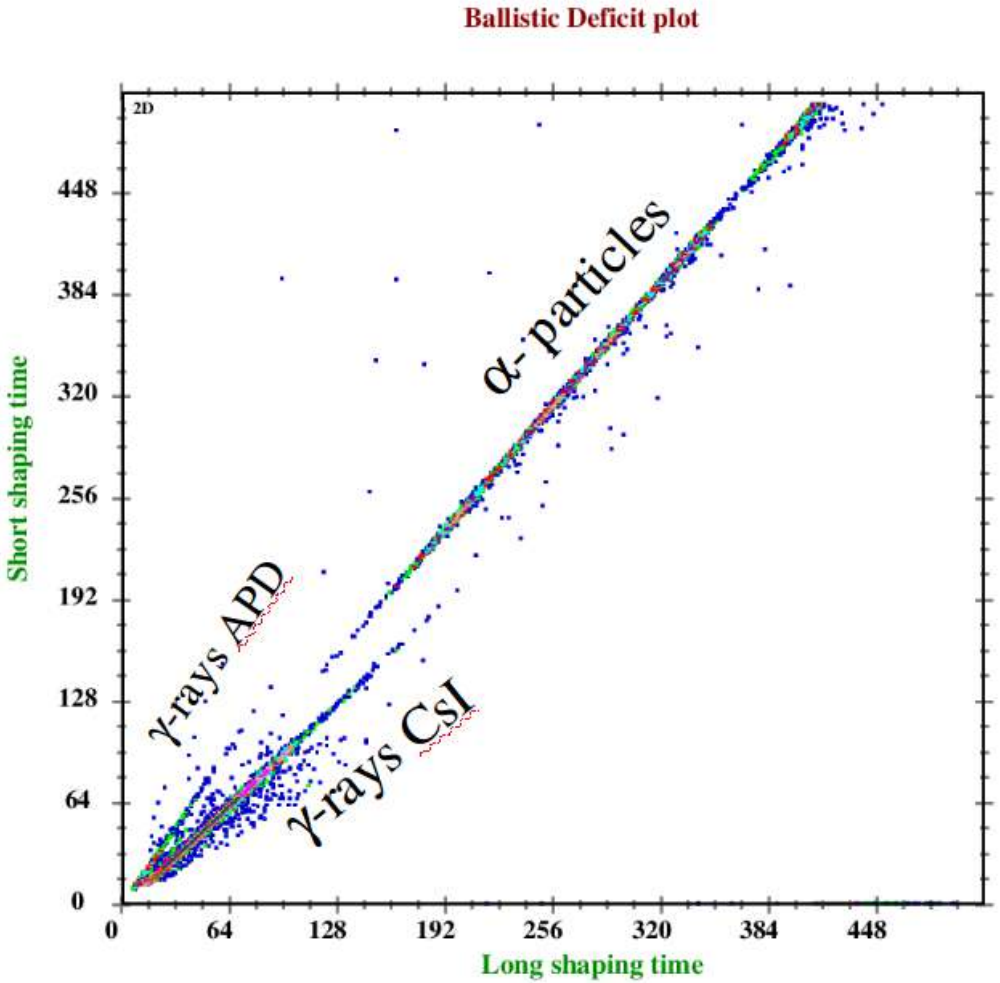


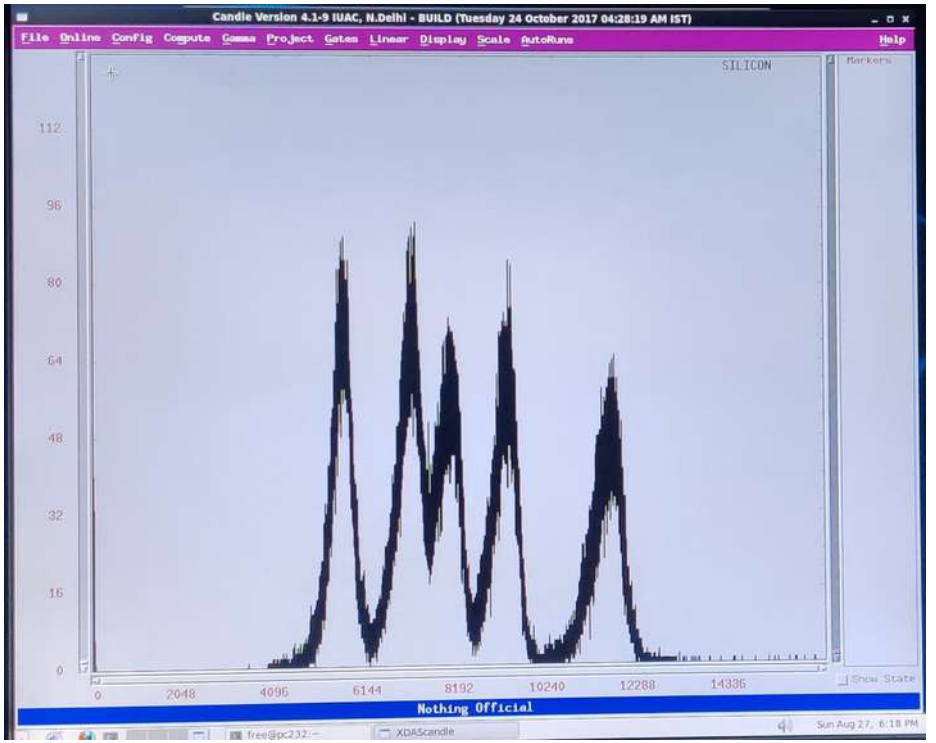

APD + CsI




APD + photo-diode




PID plot with α-*particles*
& γ-*rays*




α-*particles*Energy spectrum with $^{229}$Th

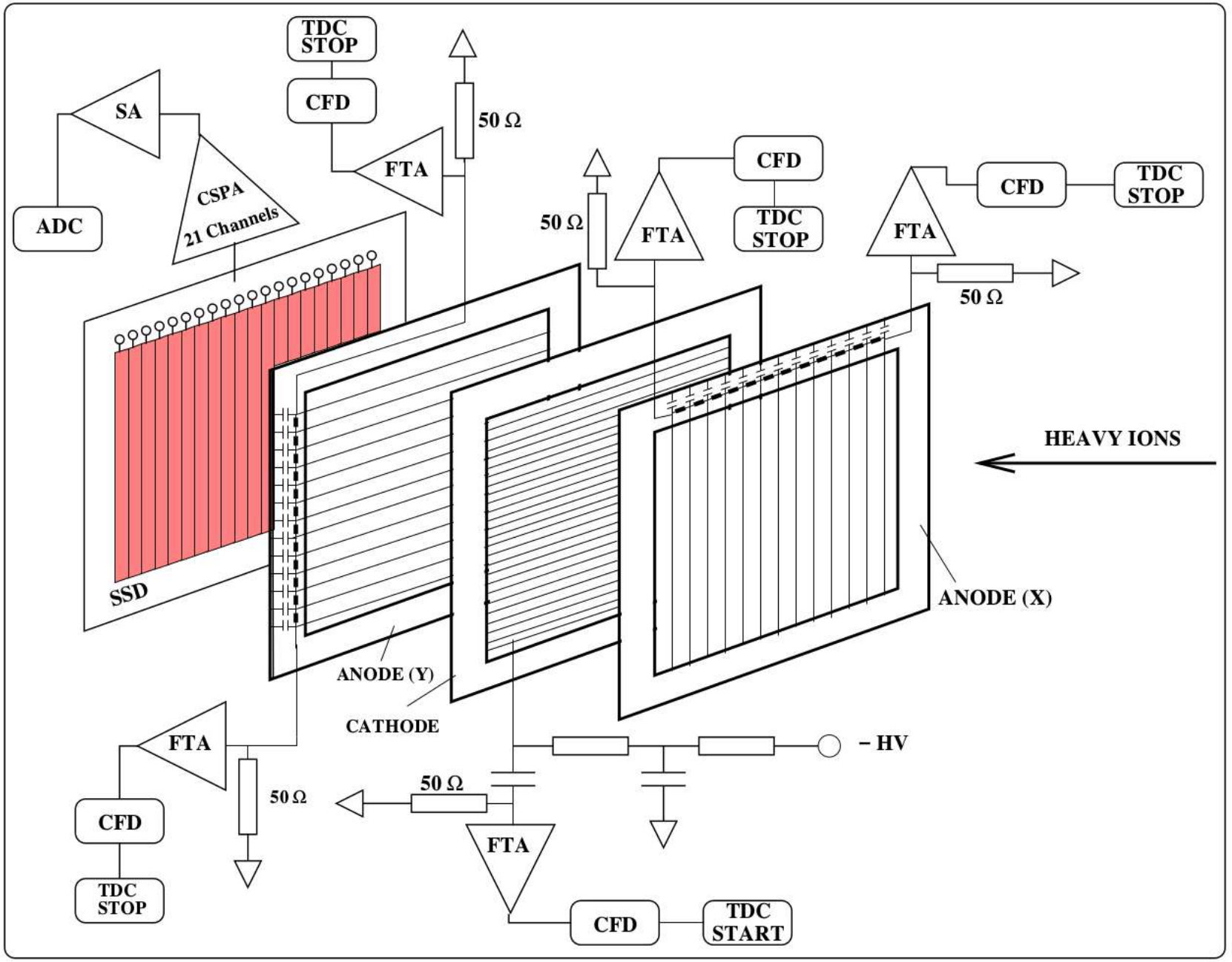
## Integrated MWPC-Silicon detectors (2v-2E)

Detectors developed in collaboration with GANIL

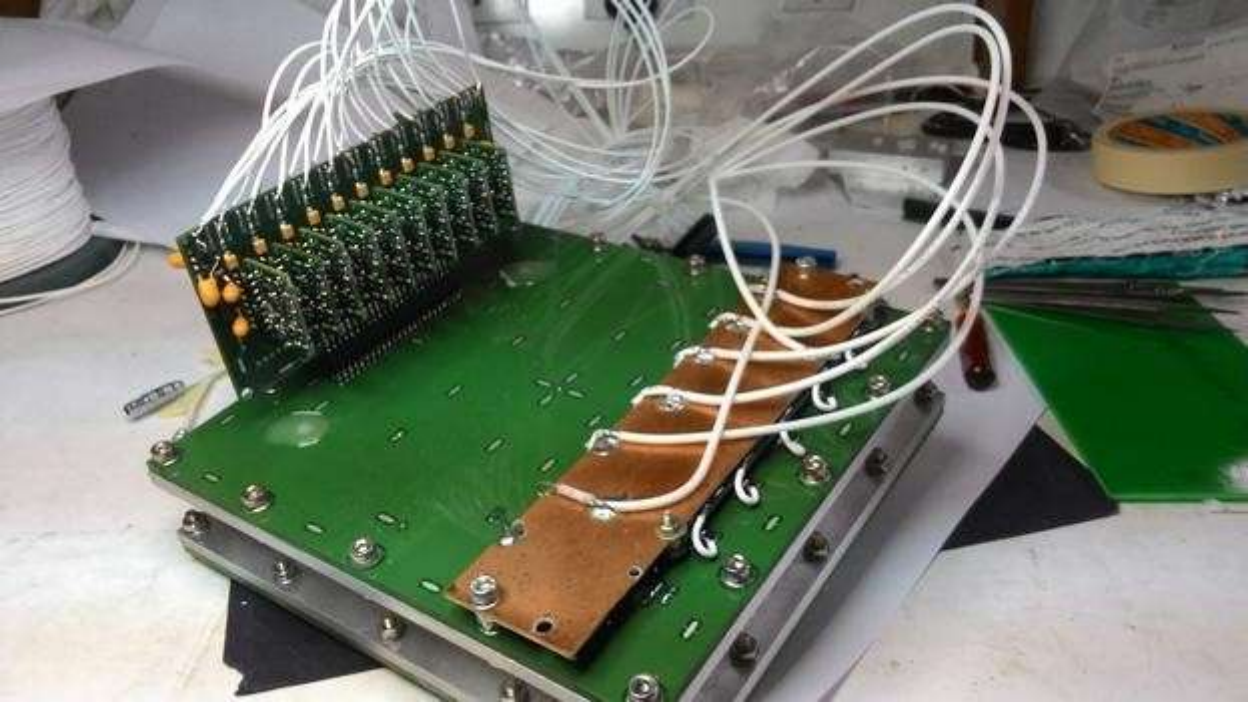
MCP/MWPC as start detector or Pulsed beam

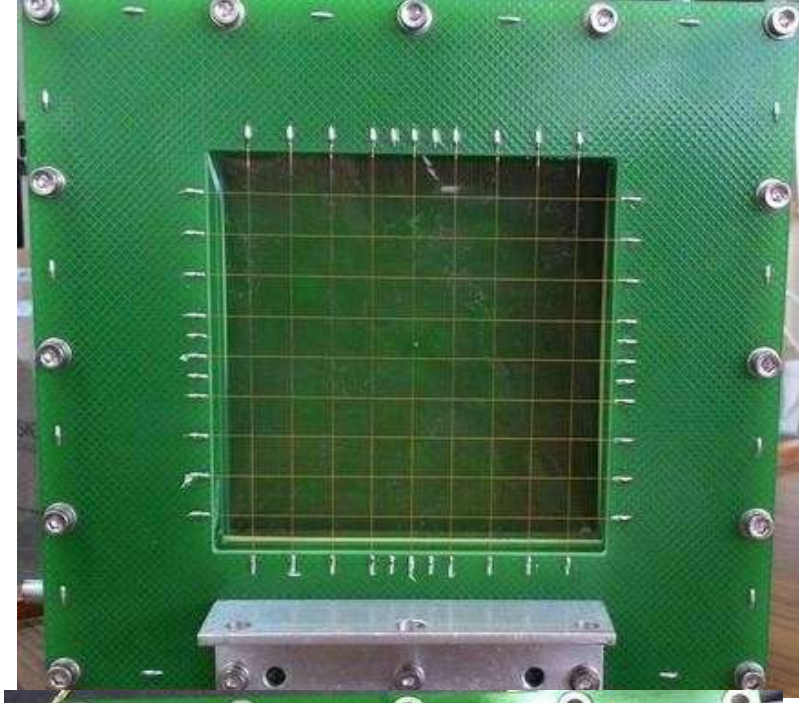
Stop detector MWPC followed by SSD (thin dead layer)

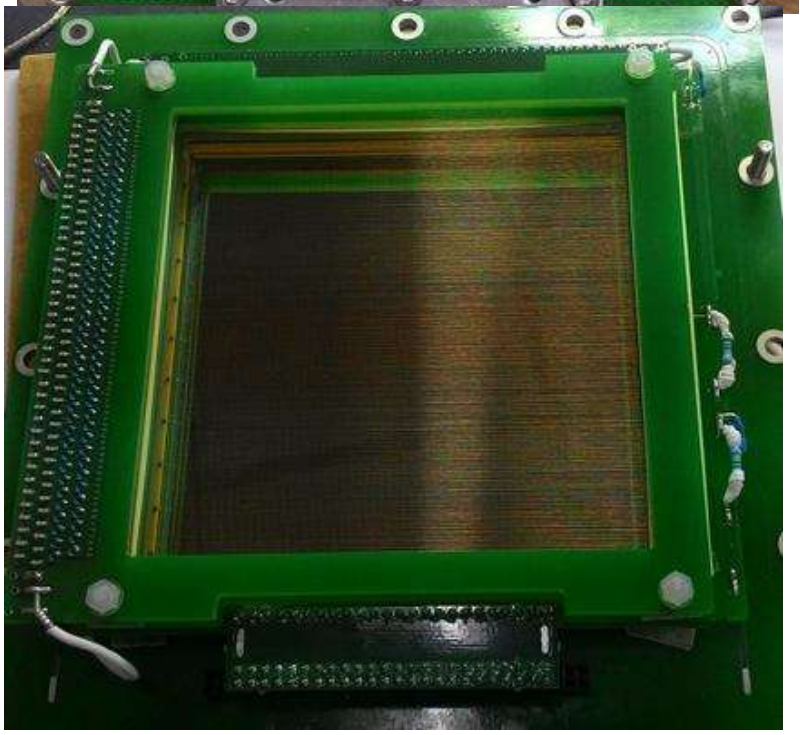
Integrated SSD in MWPC chamber to avoid exit foil



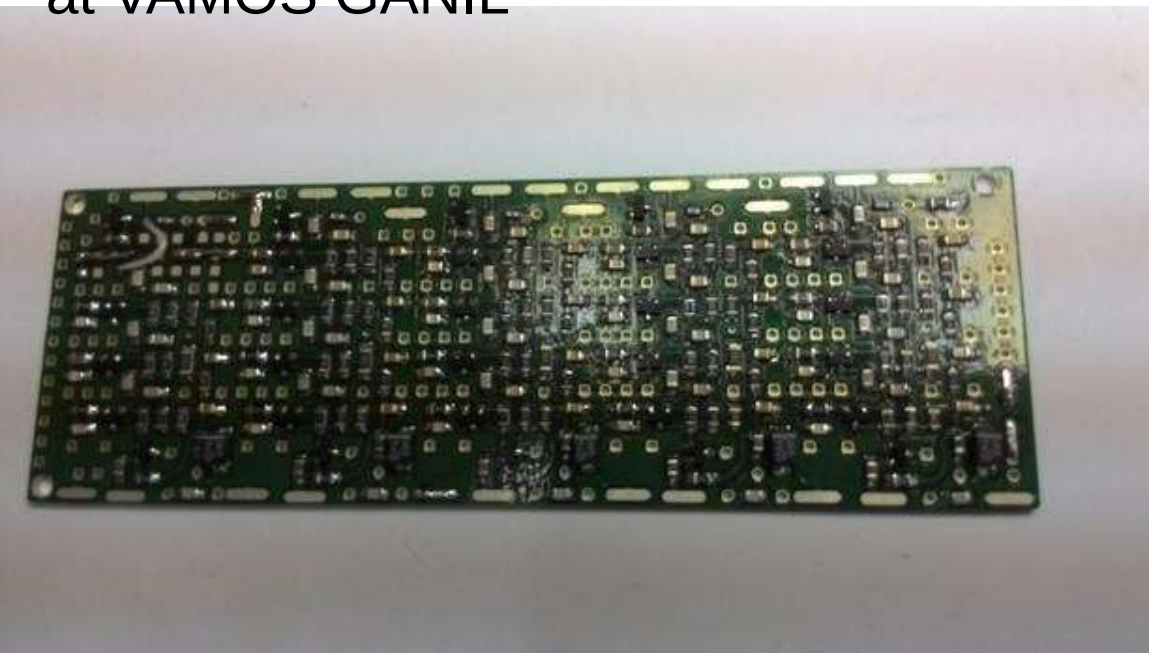

Schematic of 3 electrode start detector with central
Timing electrode made from wire frame of 0.3 mm pitch







Mass distribution : 124Xe + 54Fe → 178Hg
at VAMOS GANIL



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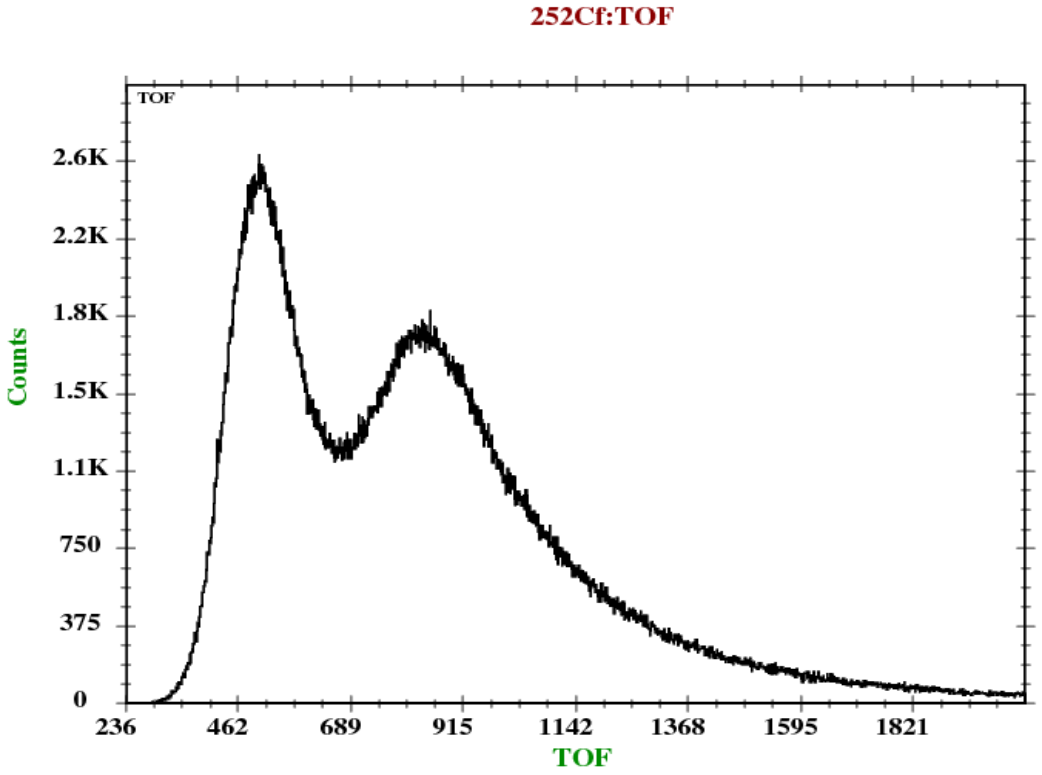
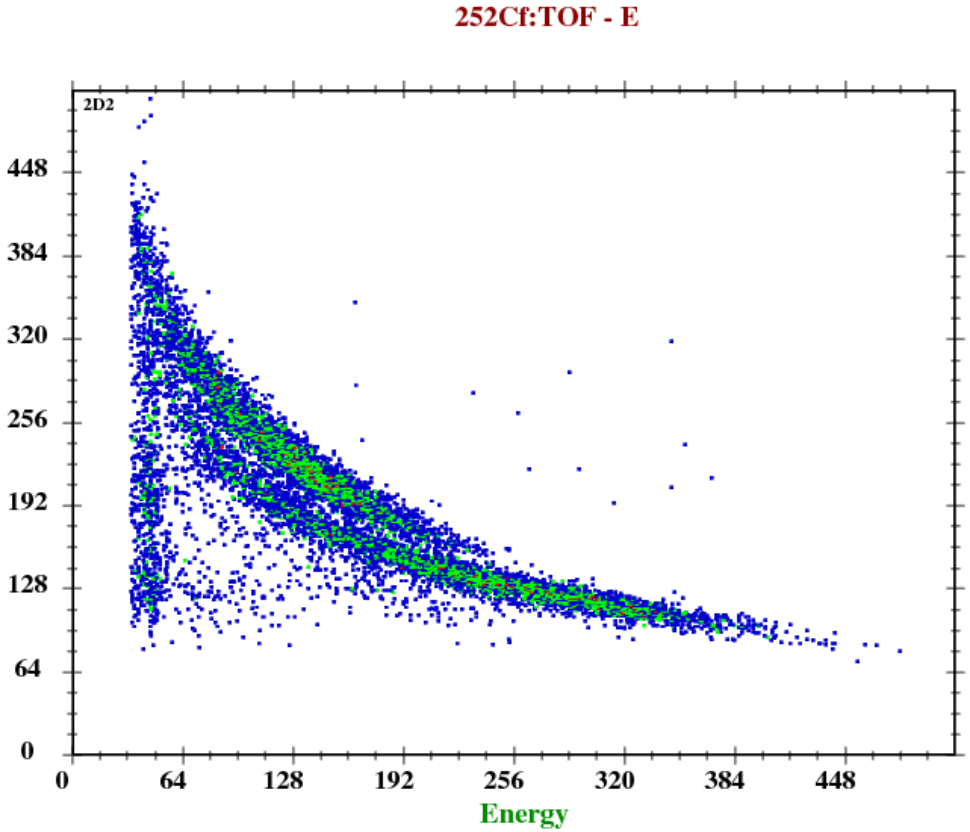
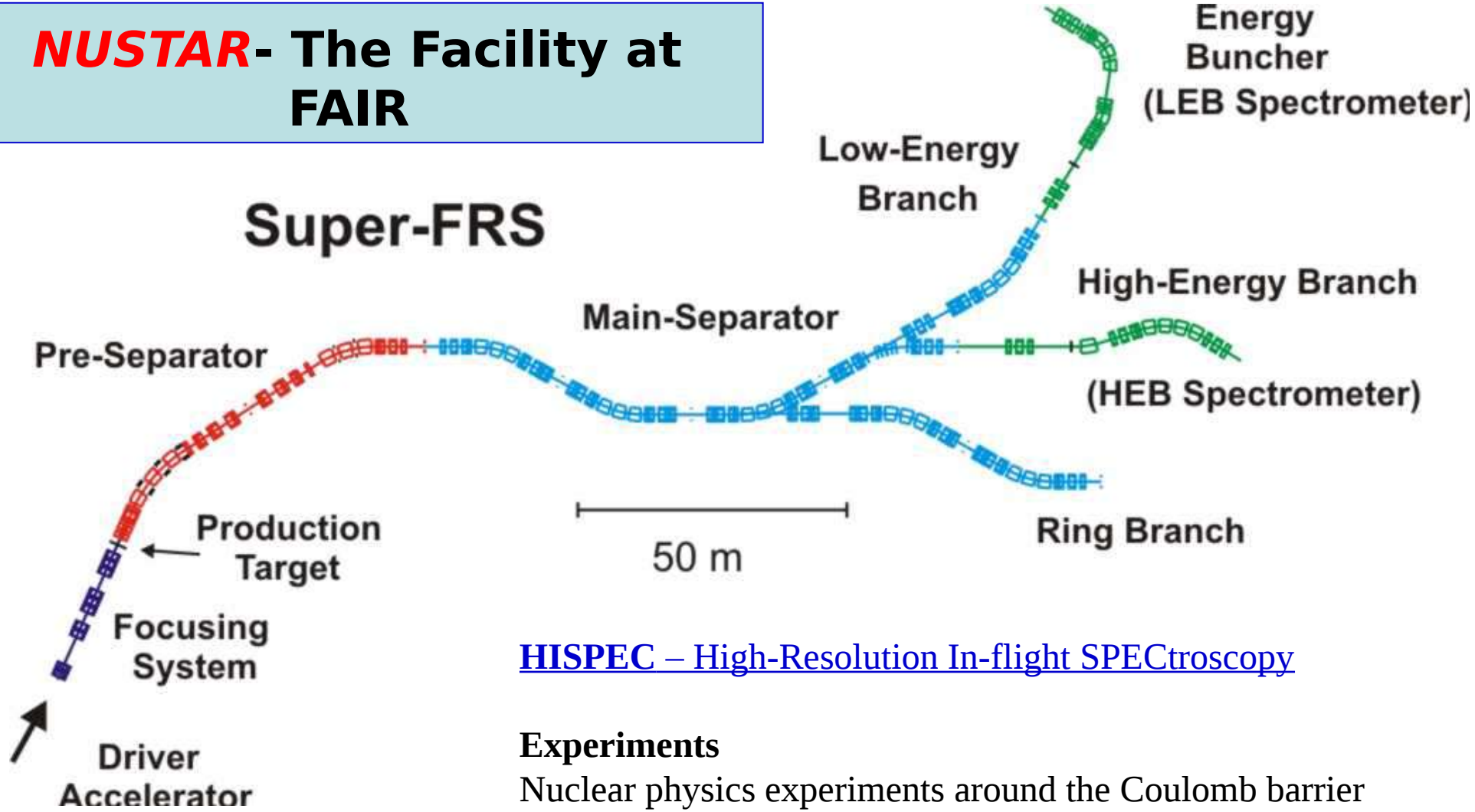



TOF between two MWPC, 5 cm flight path
Estimated resolution ~ 100 ps



# *NUSTAR*- The Facility at FAIR




**HISPEC** – High-Resolution In-flight SPECtroscopy

**Experiments**

Nuclear physics experiments around the Coulomb barrier using slowed down beams (poor beam quality)

**Type of experiments planned:**

- Multi-Nucleon Transfer
- Deep-Inelastic Scattering
- Coulomb Excitation

# Tilted Electrode Gas Ionization Chamber (TEGIC)

Electrodes tilted at an angle *w.r.t.* normal to the beam trajectory

Allows different trajectory for charge carriers and beam particles

Reduced drift length for charge carriers with same active length

Faster induced charge

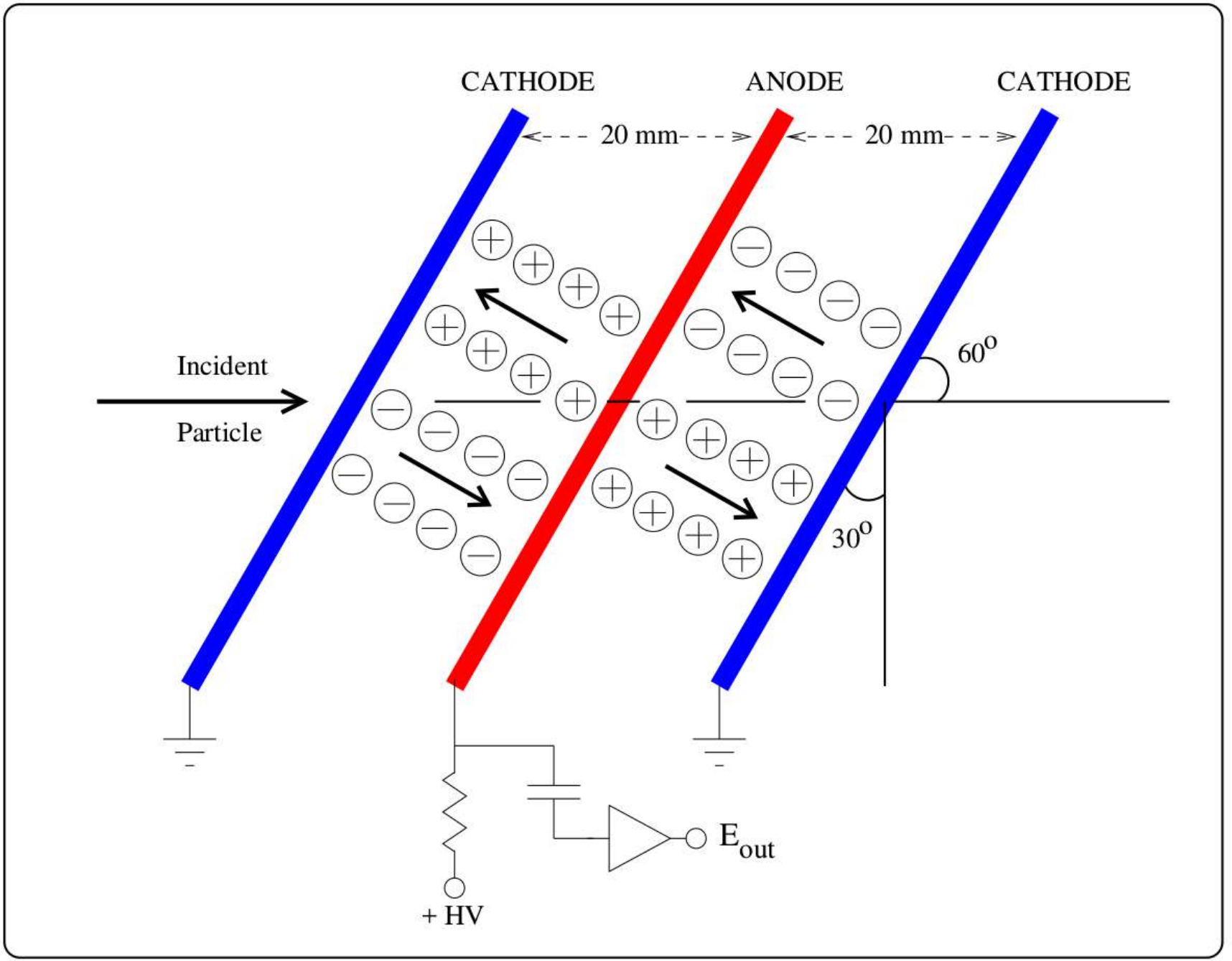
Count rates ~ $10^6$ pps

Reduced probability of recombination/loss of charge carriers

Reduced space charge electric field distortion effects

Improved energy and $\Delta Z$ resolutions

***Design established at BIG-RIPS (RIKEN) and ORNL***




Schematic of TEGIC electrode config. with movement of charge carriers.

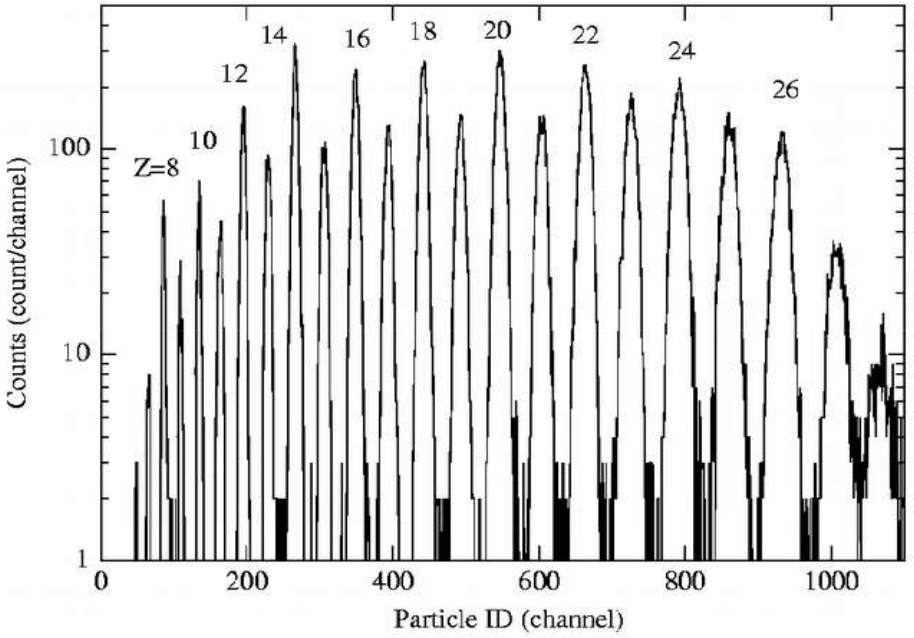
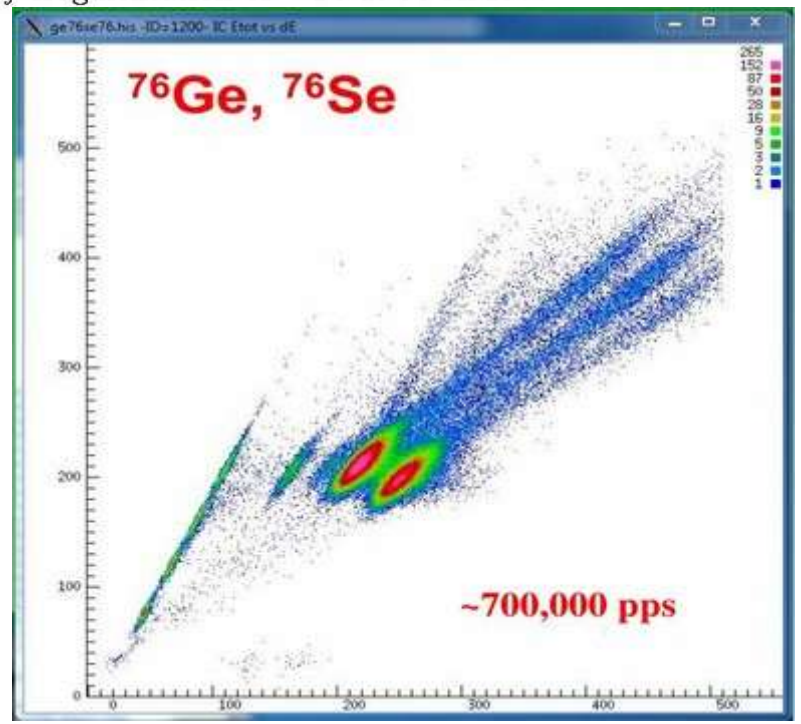



Fig. 4. Particle identification spectrum for $A/Z$=2 nuclides produced by fragmentation of $^{56}$Fe at 90 AMeV.




Chae et al, NIM A 751(2014)6

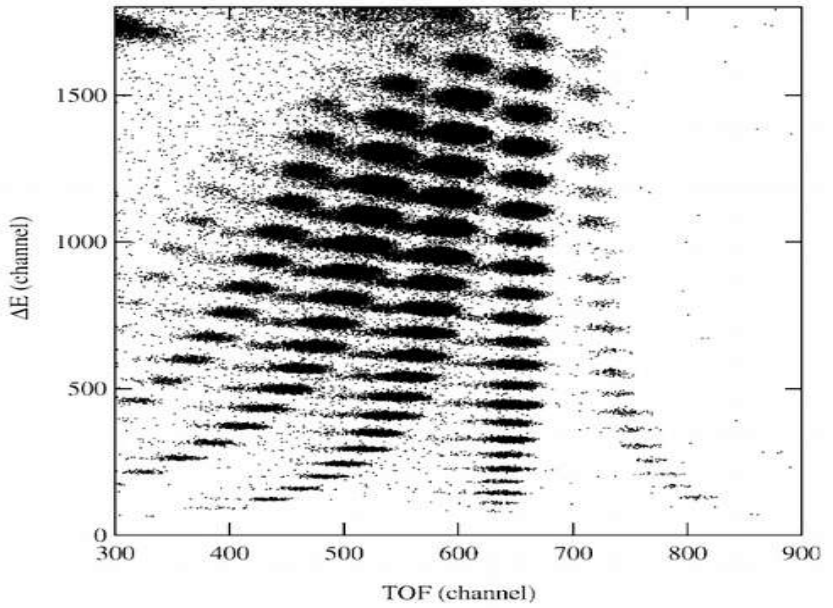



Fig. 2. Two-dimensional scatter plot of $\Delta E$ vs. TOF for the secondary beam produced by nuclear fragmentation of $^{56}$Fe at 90 A MeV.

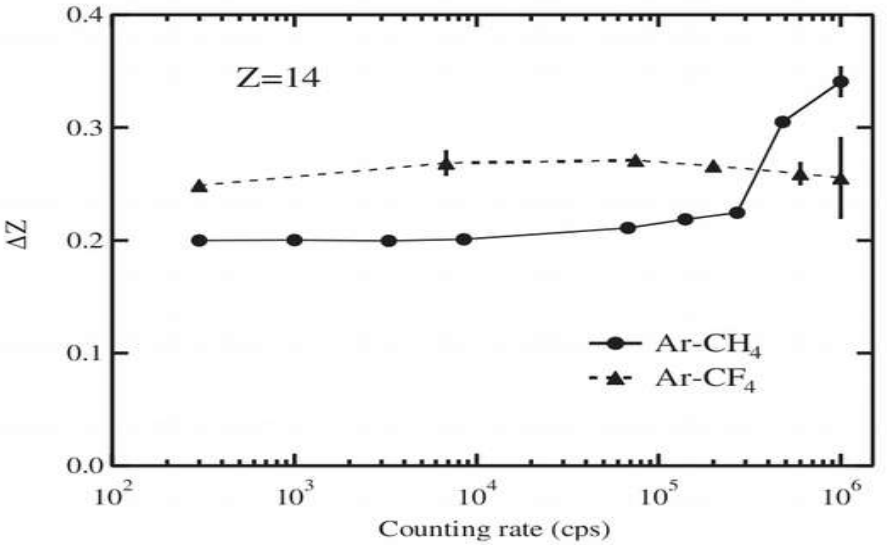



Fig. 8. Dependence of $Z$-resolutions on the intensities of the secondary beam produced by nuclear fragmentation of $^{40}$Ar at 95 A MeV. Performances of two kinds of counter gas, Ar–$CH_4$ (90%, 10%) and Ar–$CF_4$ (90%, 10%), are compared.

Kimura et al, NIM A 538(2005)608

## Design Features TEGIC (IUAC - GSI)

21 electrodes: 10 ***anodes*** and 11 ***cathodes***

Electrodes: 3 $\mu m$ mylar (aluminized on both sides)
stretched and pasted on FR frames.

Active area of frame: 25 x 12 $cm^2$.

Inter-electrode separation: 2 *cm*

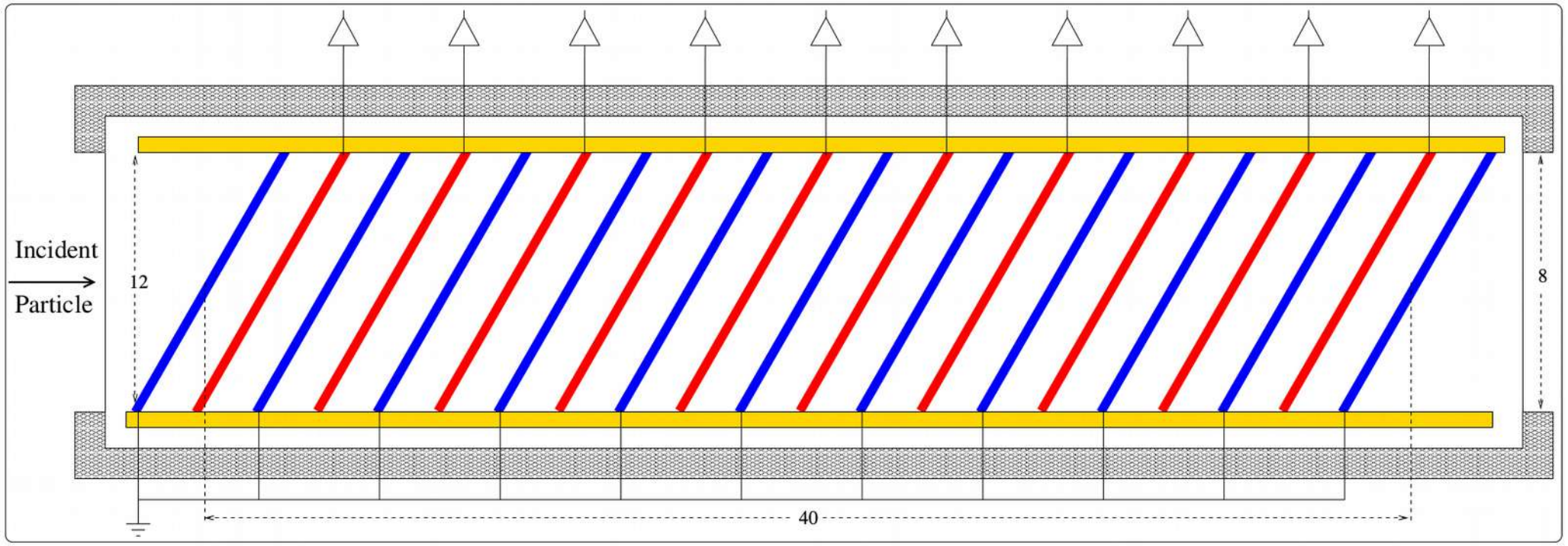
Active Length: 40 *cm*

Housed in aluminium cuboid chamber: 60 x 38 x 24 $cm^3$

Gas Medium: CF4 or P-10 at 1 *atm.*

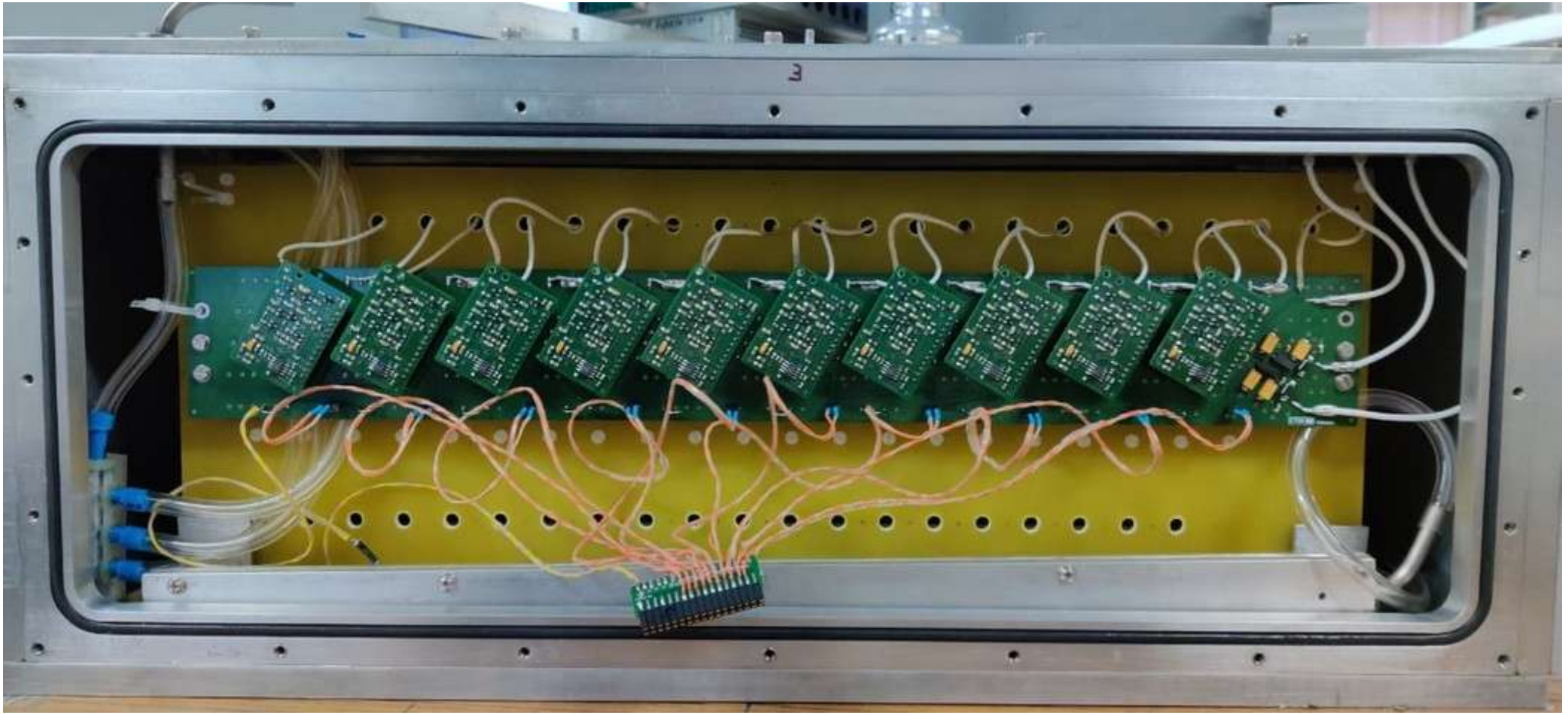
Detector to be operated at reduced field of 0.25 – 1 *V/cm/mbar*

# Schematic layout of the TEGIC with 21 stacked electrodes



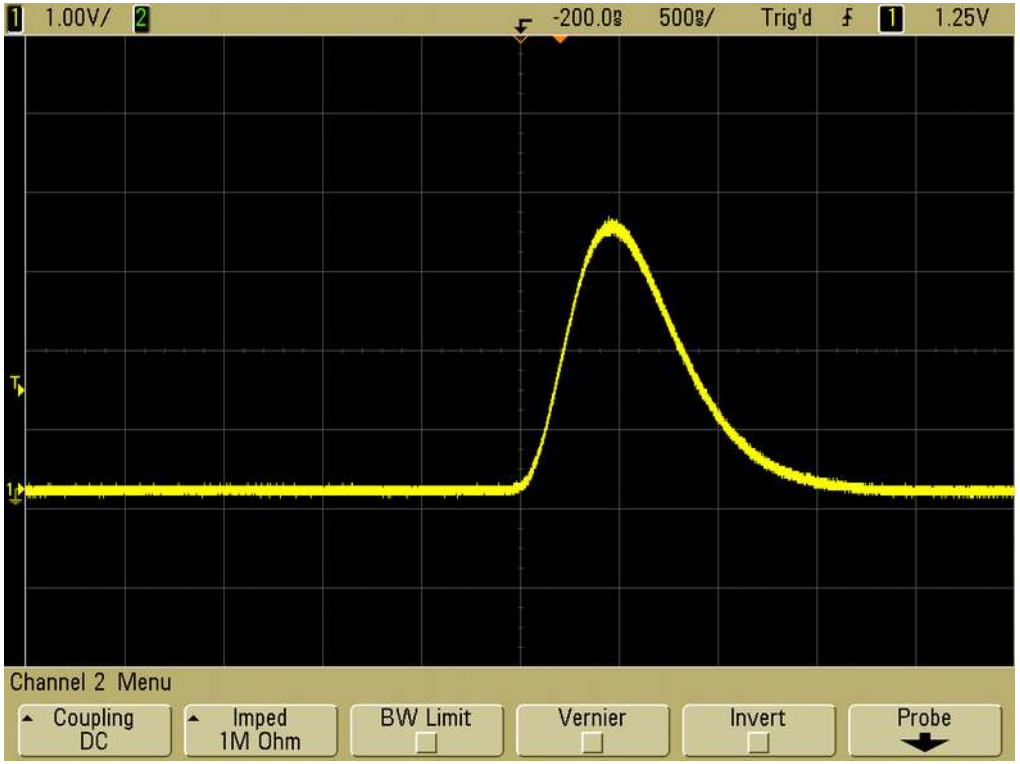

10 ***Anodes*** : Red colored

11 grounded ***Cathodes*** : Blue colored



TEGIC with integrated CSPA units having differential outputs

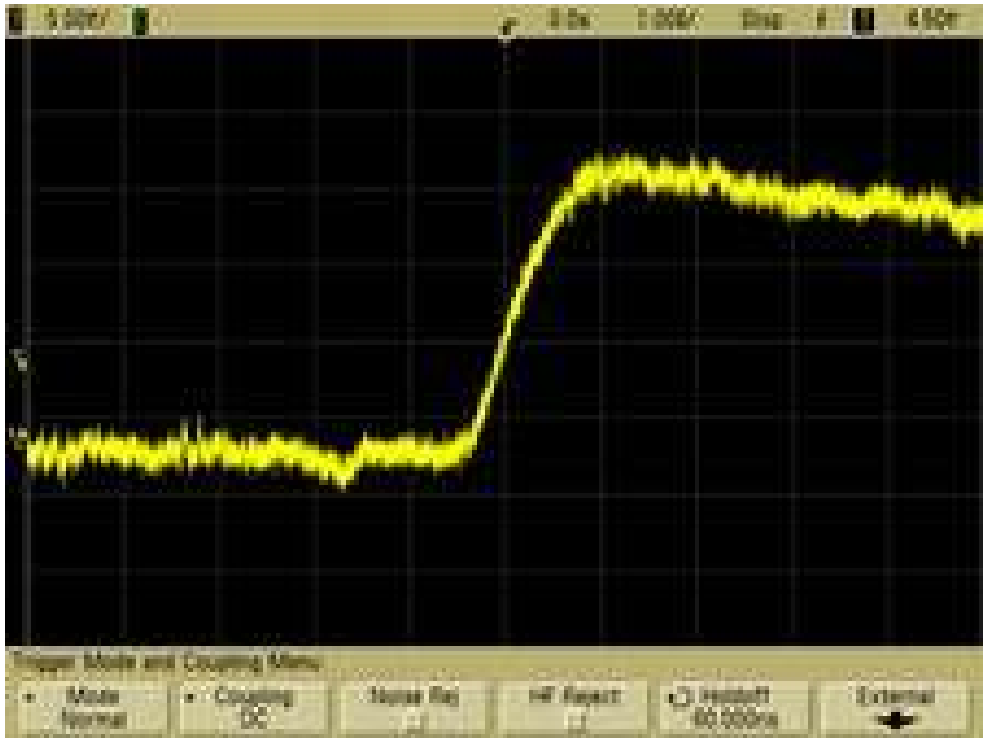

CSPA ouput with 5.48 *MeV* alpha
using silicon PIPS detector (CANBERRA)



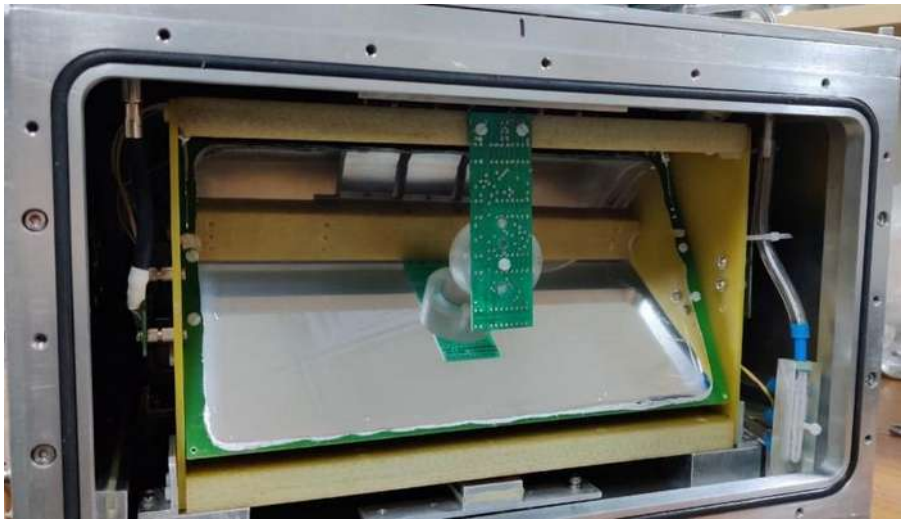

Spectroscopy Amplifier output
Shaping time: 0.25 µ*s*

# Testing of TEGIC detector with alpha source

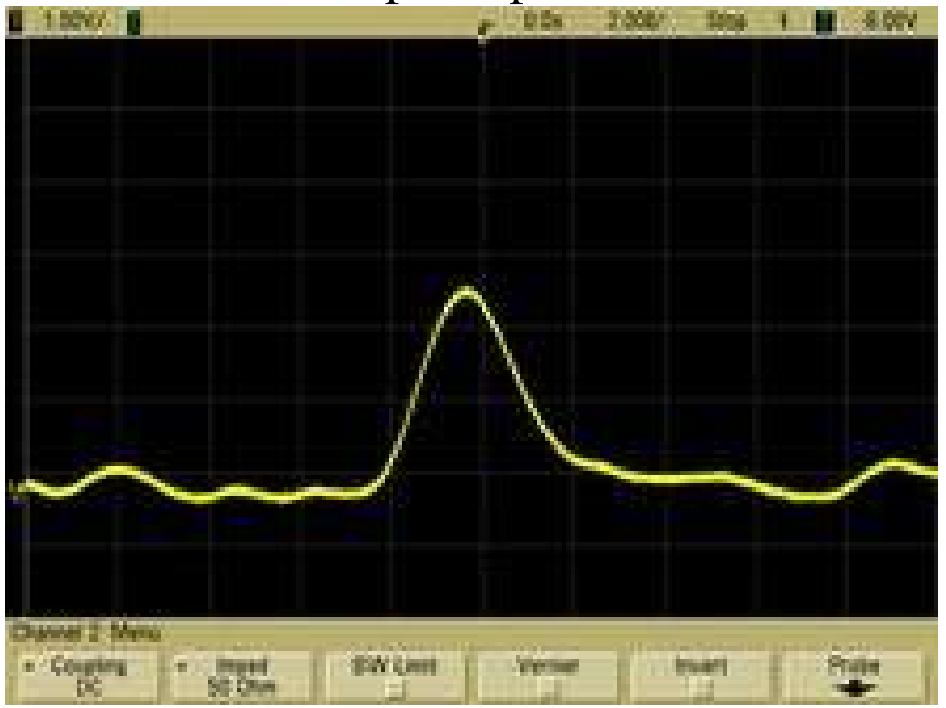
TEGIC mounted inside Scattering chamber for off-line alpha particle test
Tests performed with iso-butane gas at 50 – 300 mbar



CSPA output-alpha



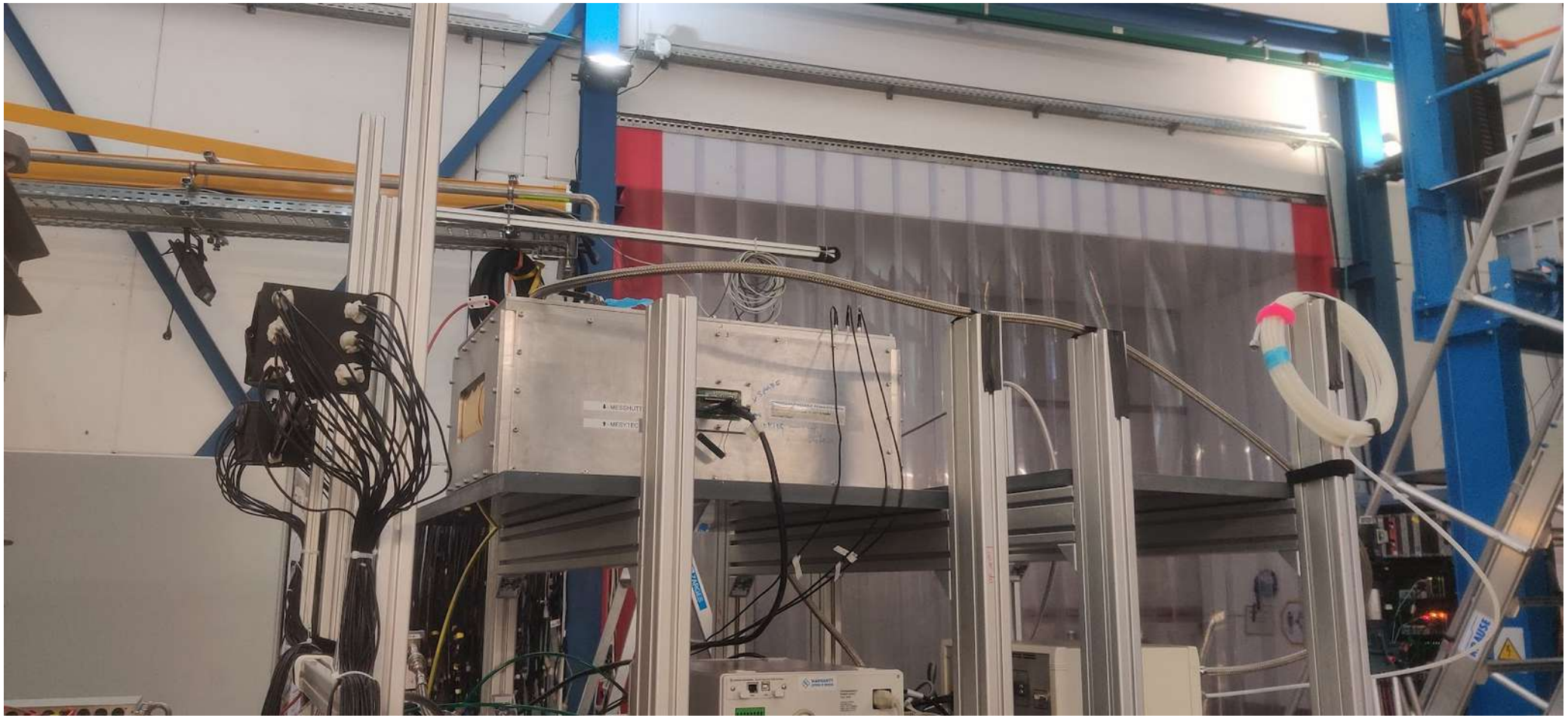
TEGIC with α-*particle* source



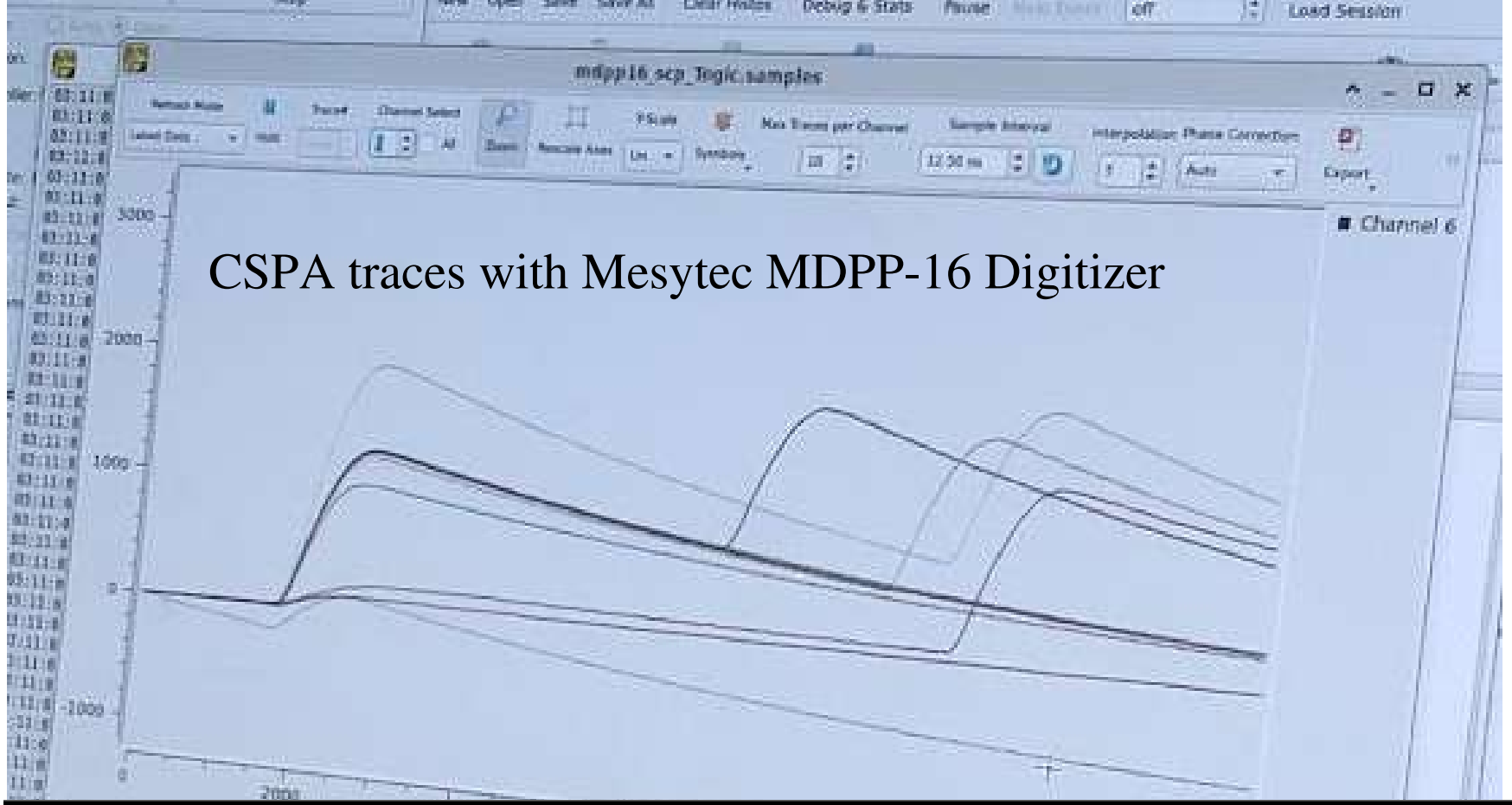
SA: 0.4 μ*s*

SA: 0.25 μ*s*

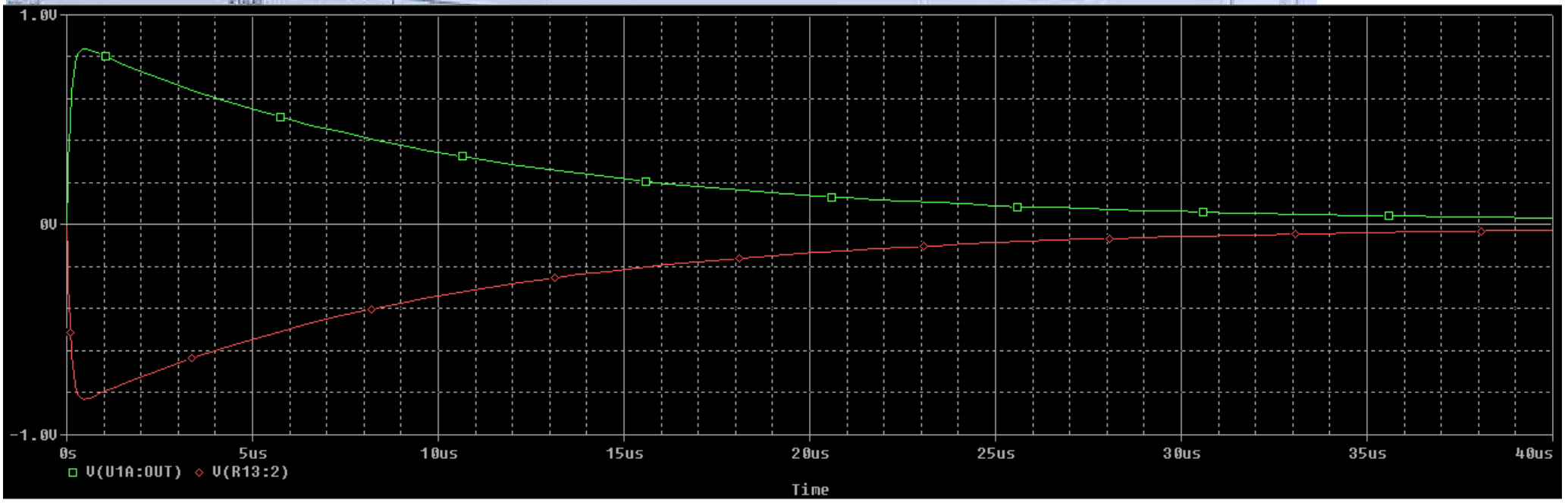
# TEGIC Mounted in CAVE ‘C’ at GSI with UNILAC-SIS18 Accelerator Facility

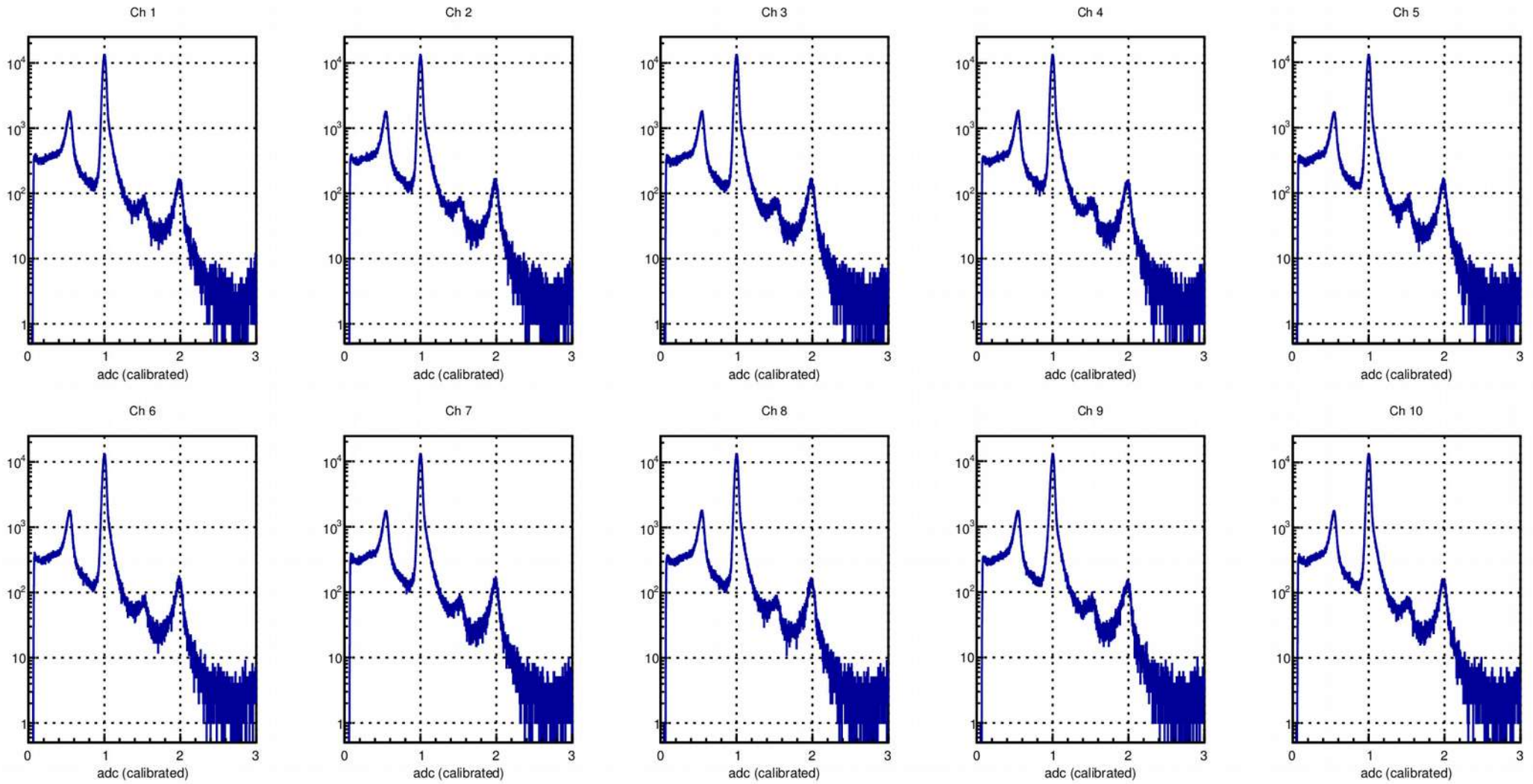


Measurements performed with 238U beam @ 300 MeV/A – 1 GeV/A




CSPA traces with Mesytec MDPP-16 Digitizer






Calibrated differential energy loss spectra from 10 segments of TEGIC

## Development of 16 channel fast timing amplifier (FTA) for SSD

FTA realized as a hybrid fabricated using SMD components.

0402 package R and C used.

Inverting three stage CE amplification

16 channels assembled on 4 layer PCB ( 8 x 5 $cm^2$)

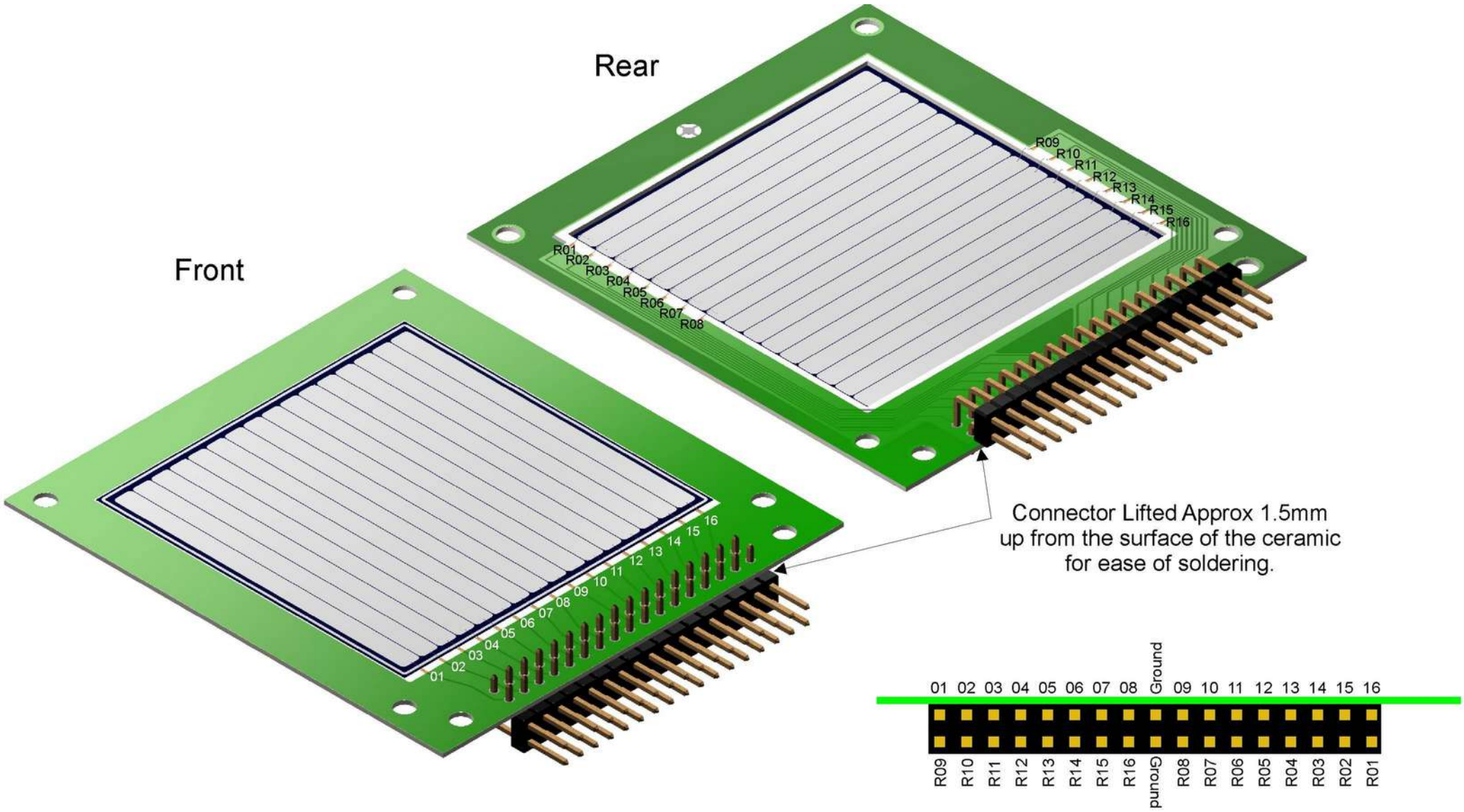
8 channels each on top and bottom layer ( 3 cm x 1 cm for each channel)

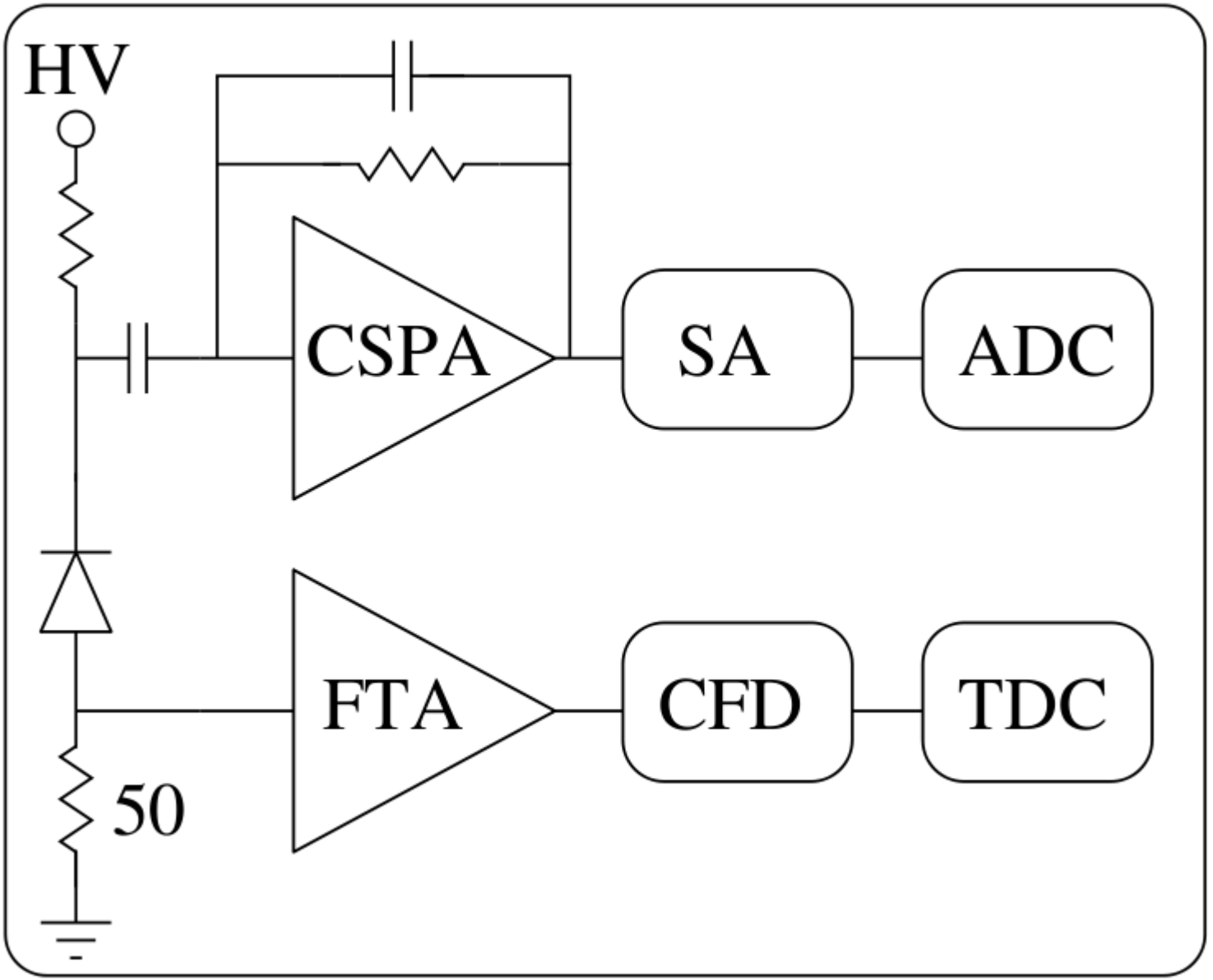
Gain ~ 50, Input impedance 50 Ω
Sensitivity : ~ 3 - 5 mV/MeV (Detector capacitance dependent)

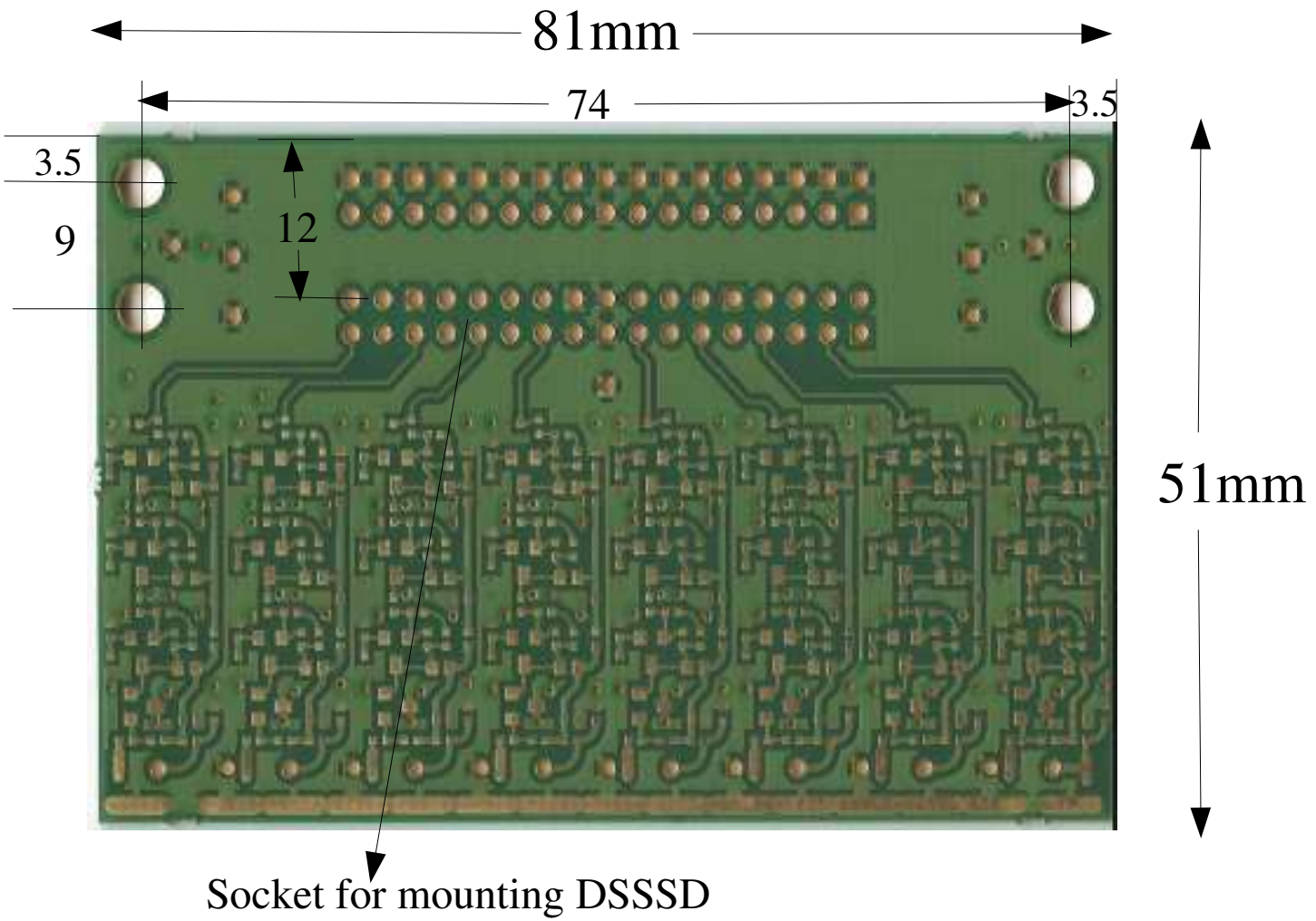
Power consumption : 1.6 W (100 mW/channel) @ + 6V supply.

Designed for SSD design W from Micron Semiconductors, UK

FRC 34 pin socket as input connector


Rear
Front
R09
R10
R11
R12
R13
R14
R15
R16
R01
R02
R03
R04
R05
R06
R07
R08
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
Connector Lifted Approx 1.5mm
up from the surface of the ceramic
for ease of soldering.
01 02 03 04 05 06 07 08 Ground 09 10 11 12 13 14 15 16
R09 R10 R11 R12 R13 R14 R15 R16 Ground R08 R07 R06 R05 R04 R03 R02 R01

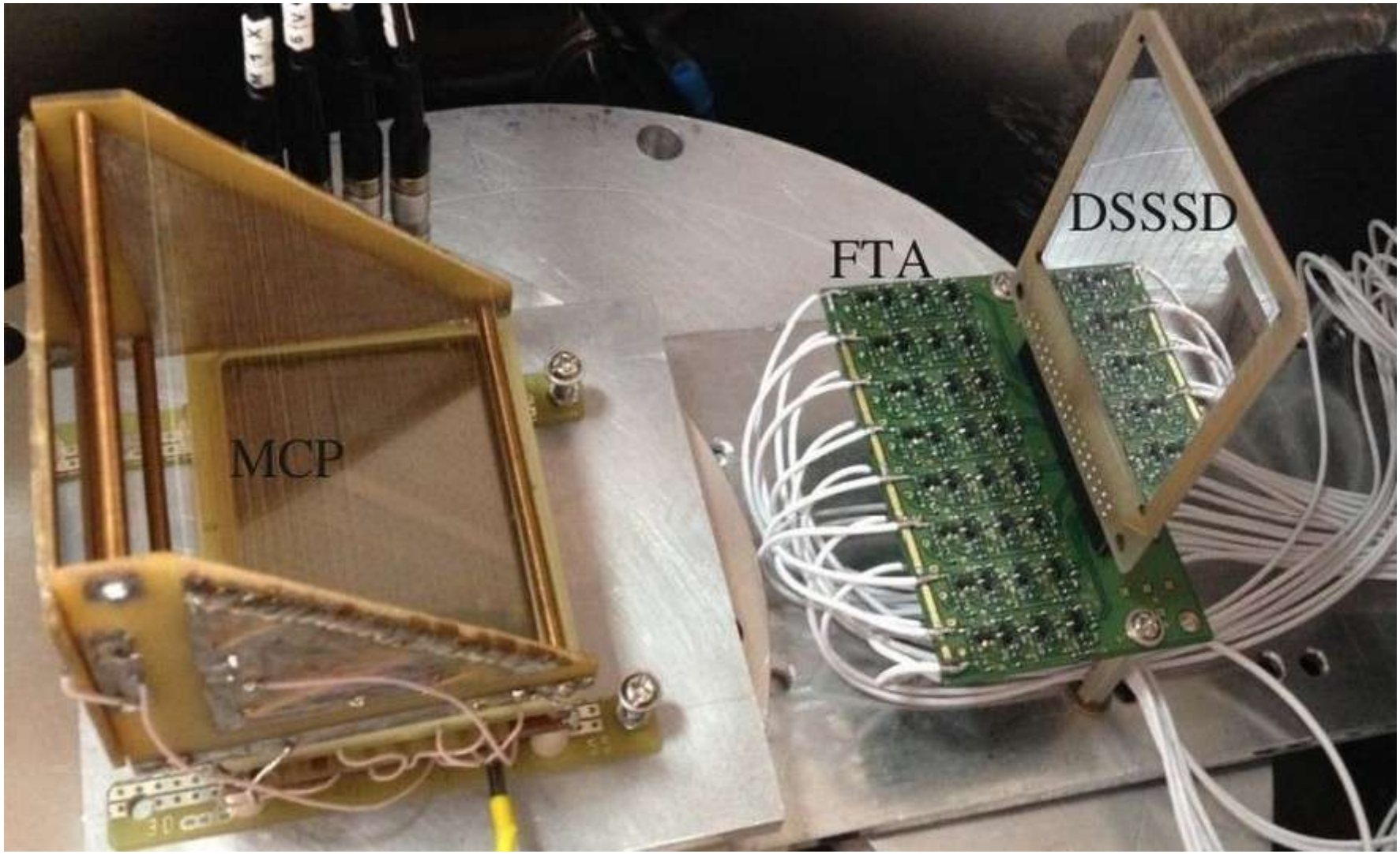

HV
CSPA
SA
ADC
FTA
CFD
TDC
50



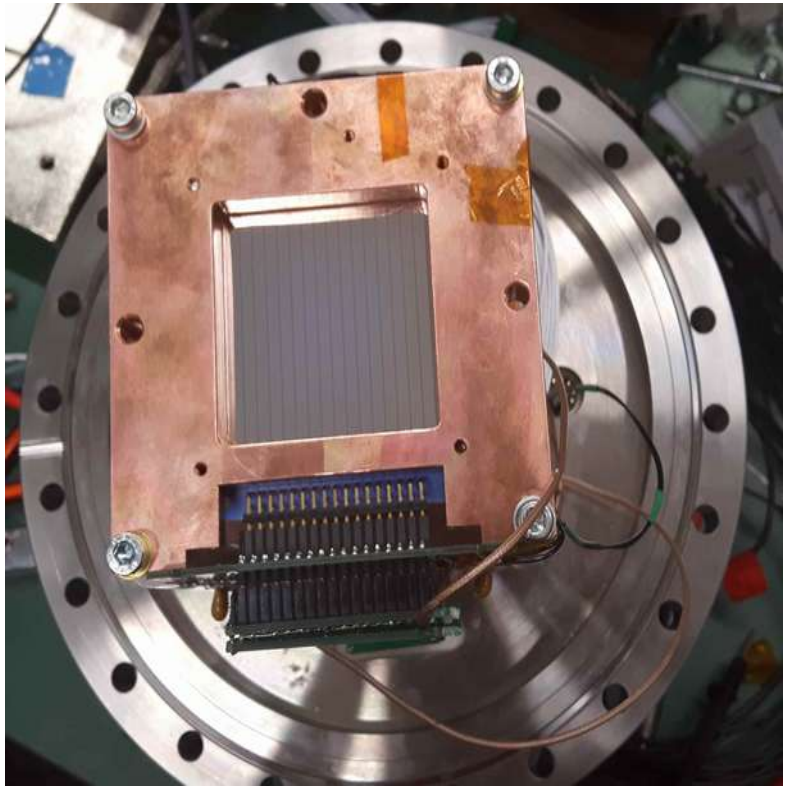

PCB layout of the 16 channel FTA

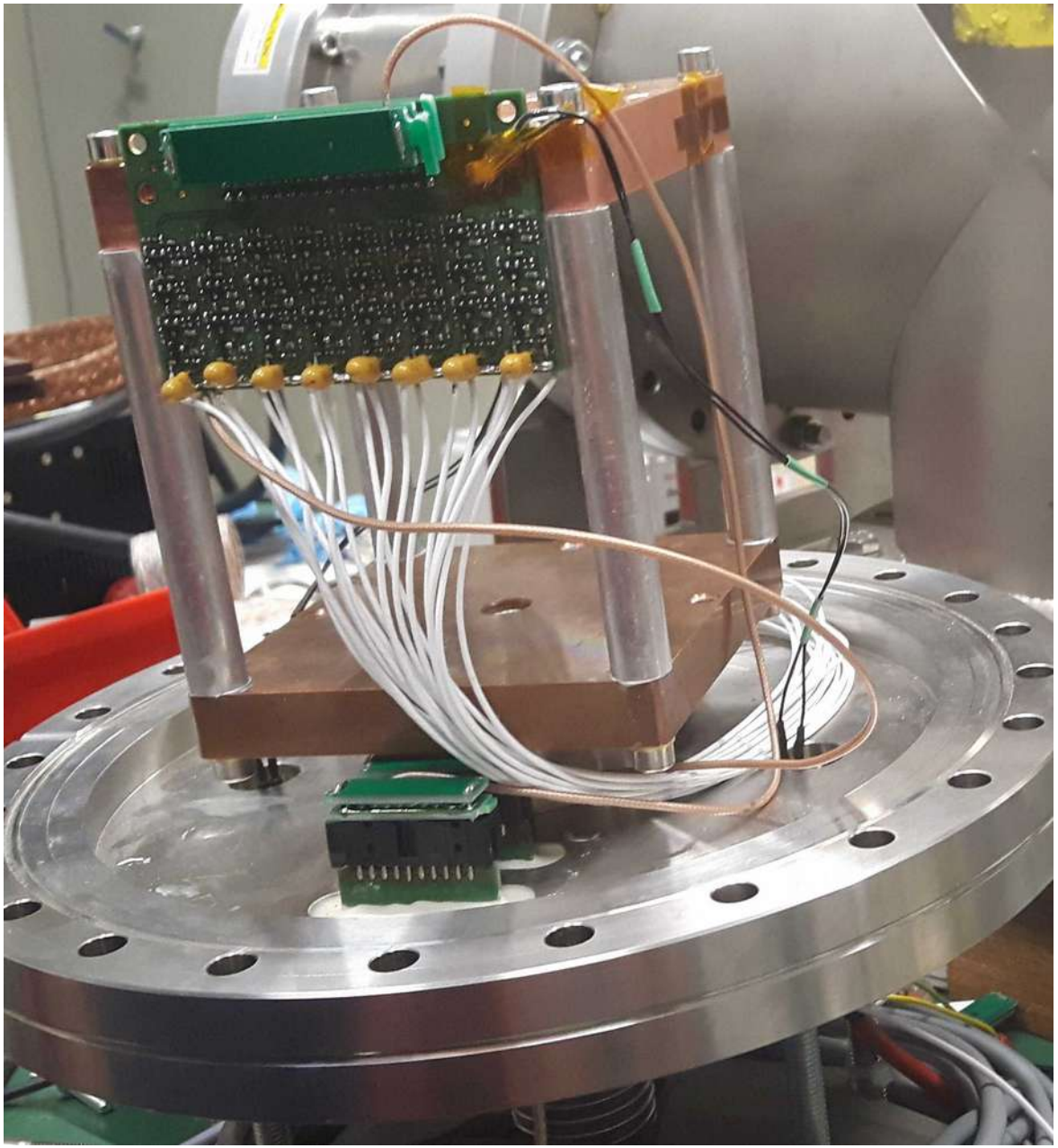
**Table 1 :** FTA specifications

| | |
|---|---|
| No. of channels | 16 |
| Input signal polarity | Positive |
| Input impedance | 50 Ω |
| Gain | 50 |
| Max. output voltage | - 1 V (50 Ω load) |
| Rise times | ~2 ns (without detector) |
| Power requirement | 1.6 W (100 mW/ch.) |

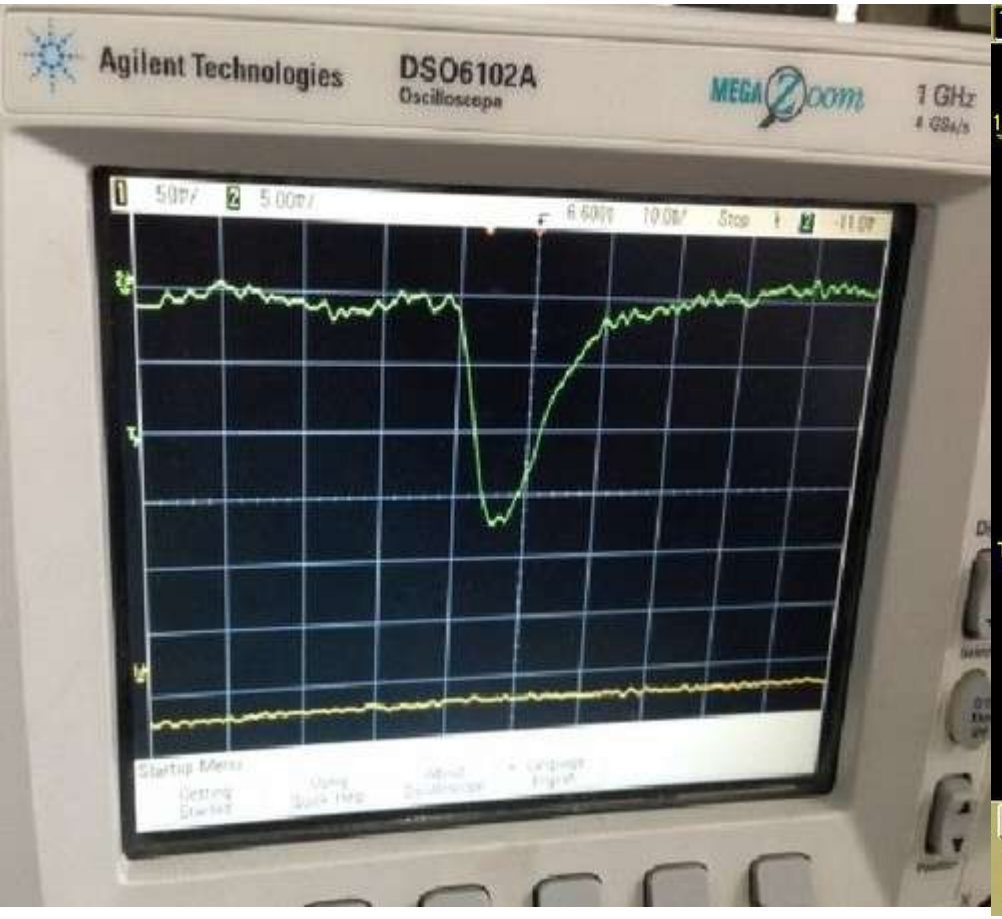



TOF set up with alpha source

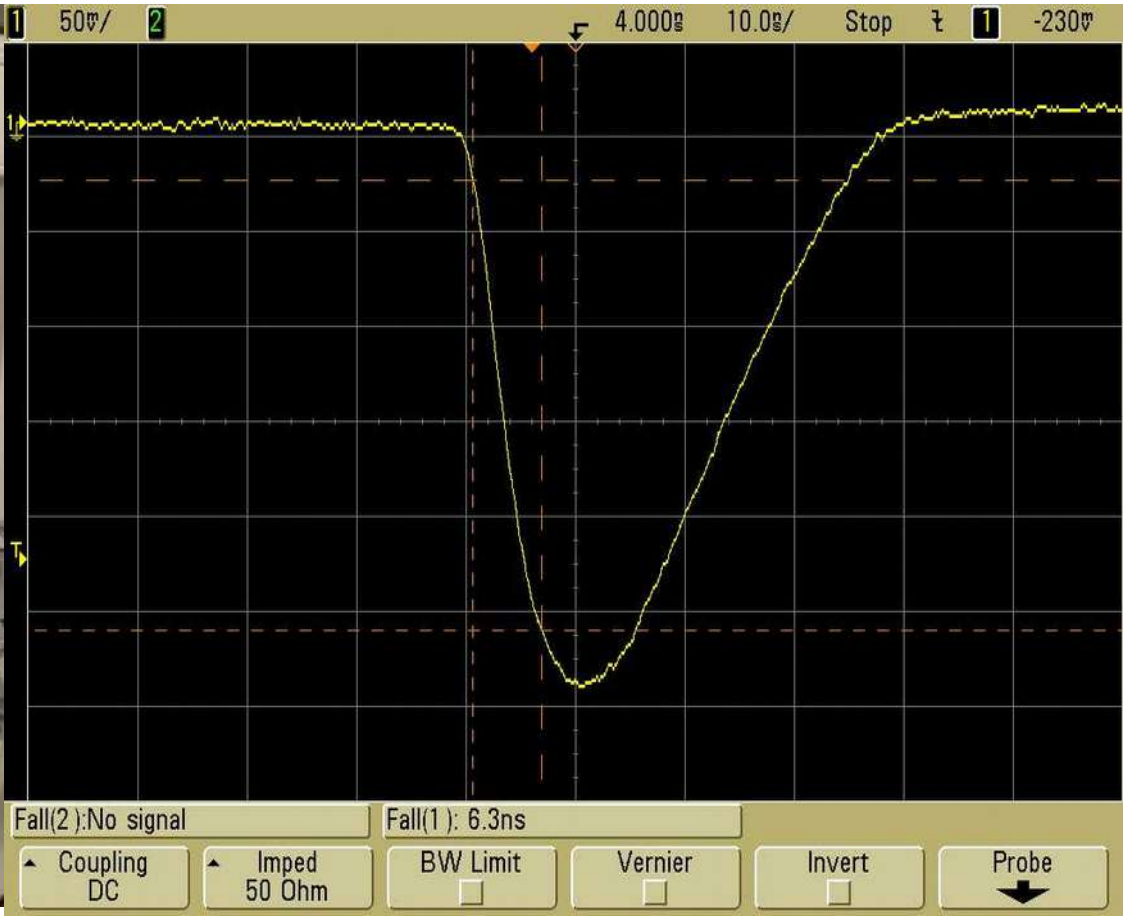




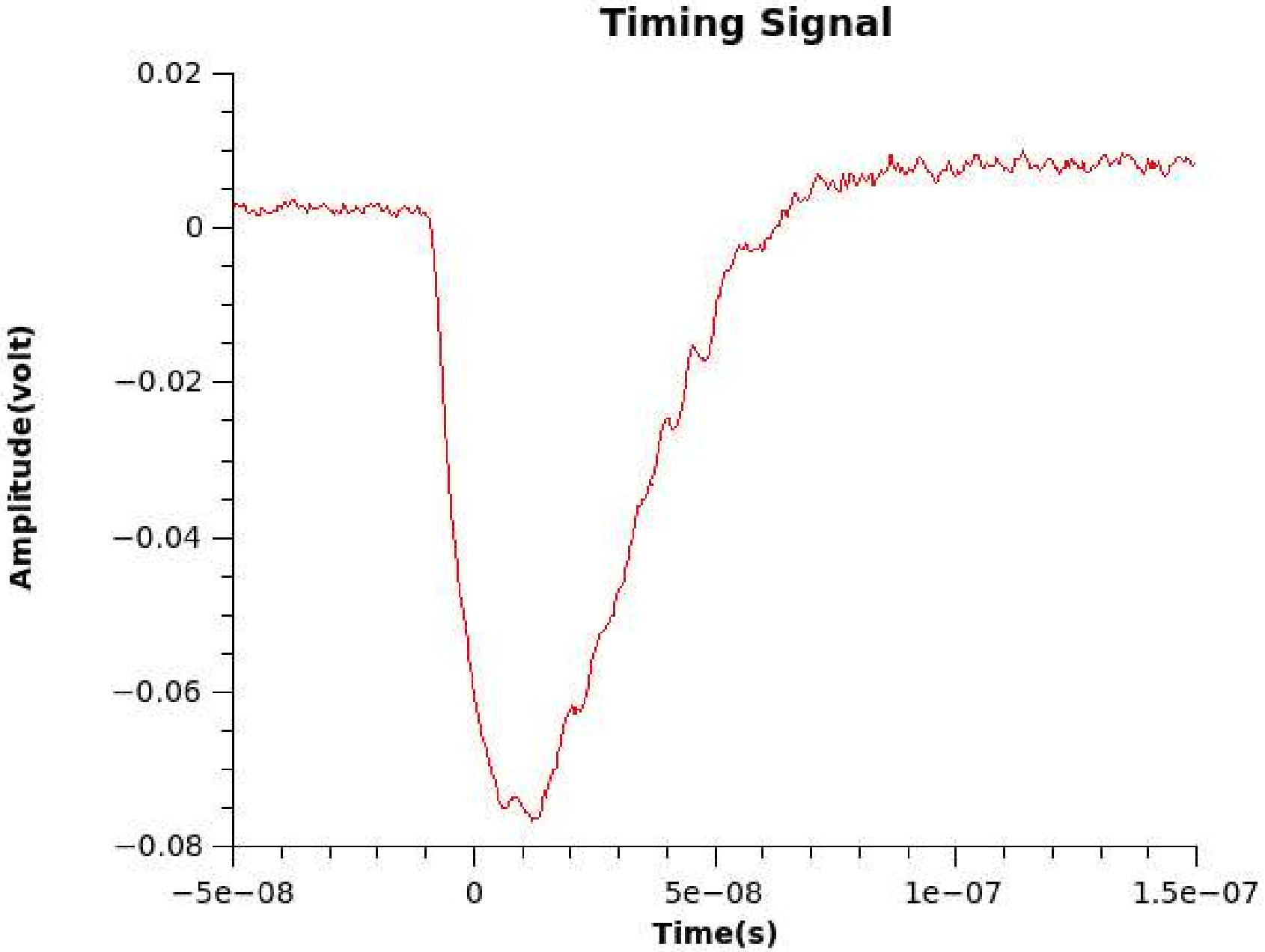
20 um SSSD with cooling arrangement




Alpha particles

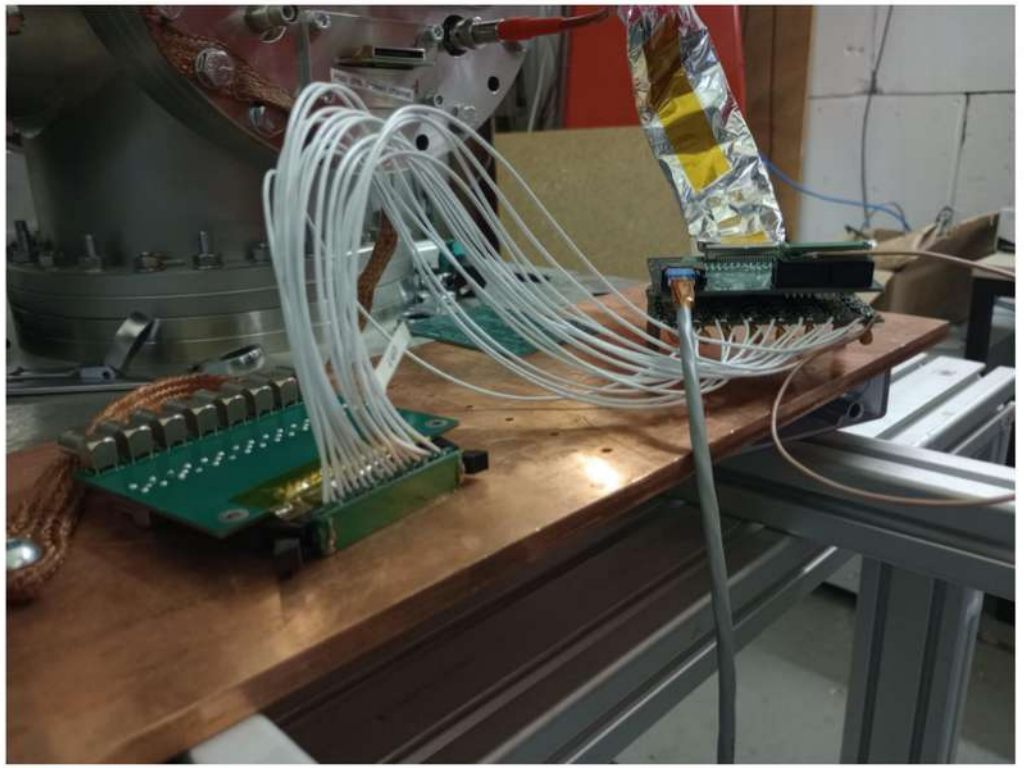



Silicon Beam




Timing signal from 124Xe beam with 20um SSSD

# Electronics



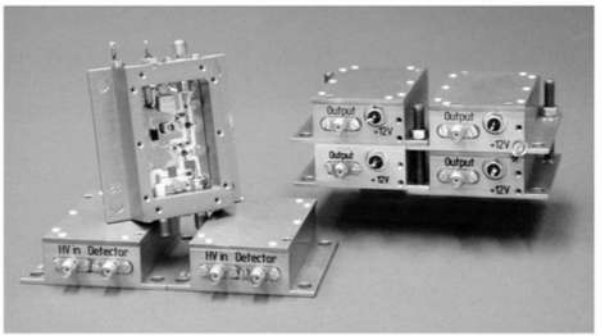
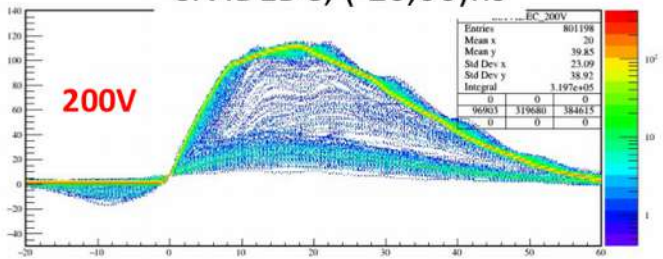



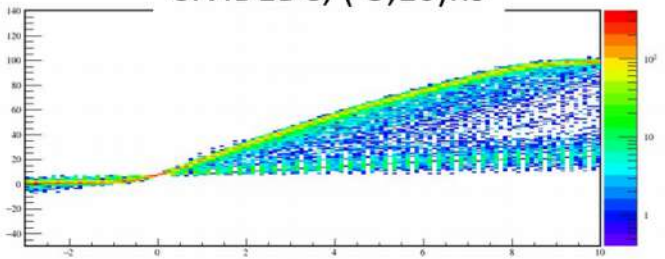

Fig. 1. Photograph of GSI DBA-II amplifiers.

# Results

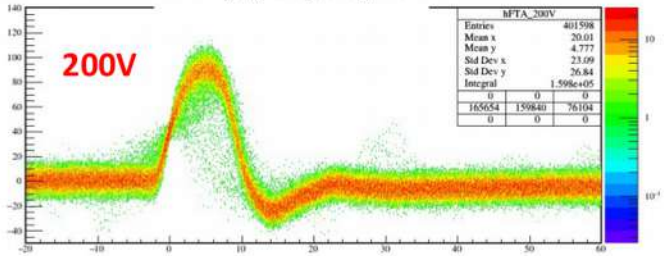
CIVIDEDC; (-20,60)ns



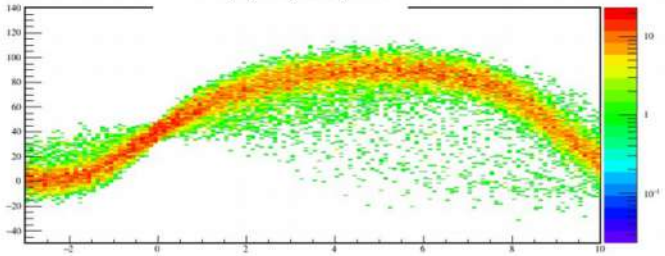

CIVIDEDC; (-3,10)ns



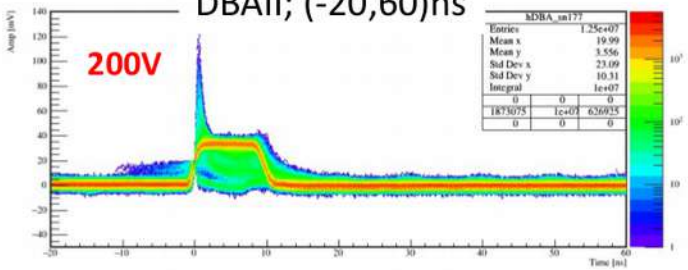
FTA; (-20,60)ns



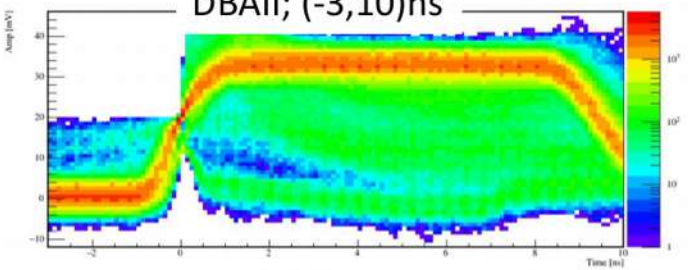

FTA; (-3,10)ns



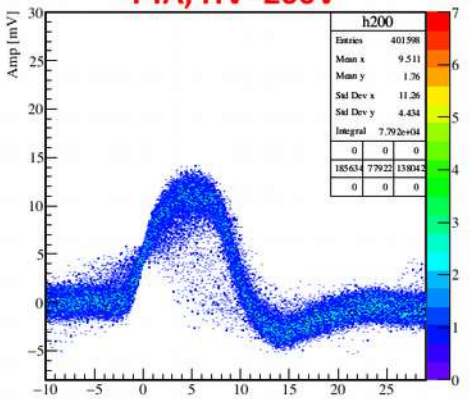
DBAII; (-20,60)ns



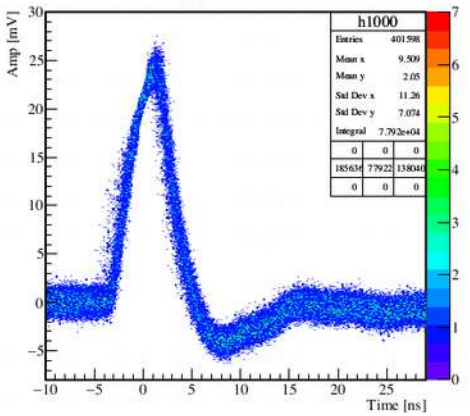

DBAII; (-3,10)ns

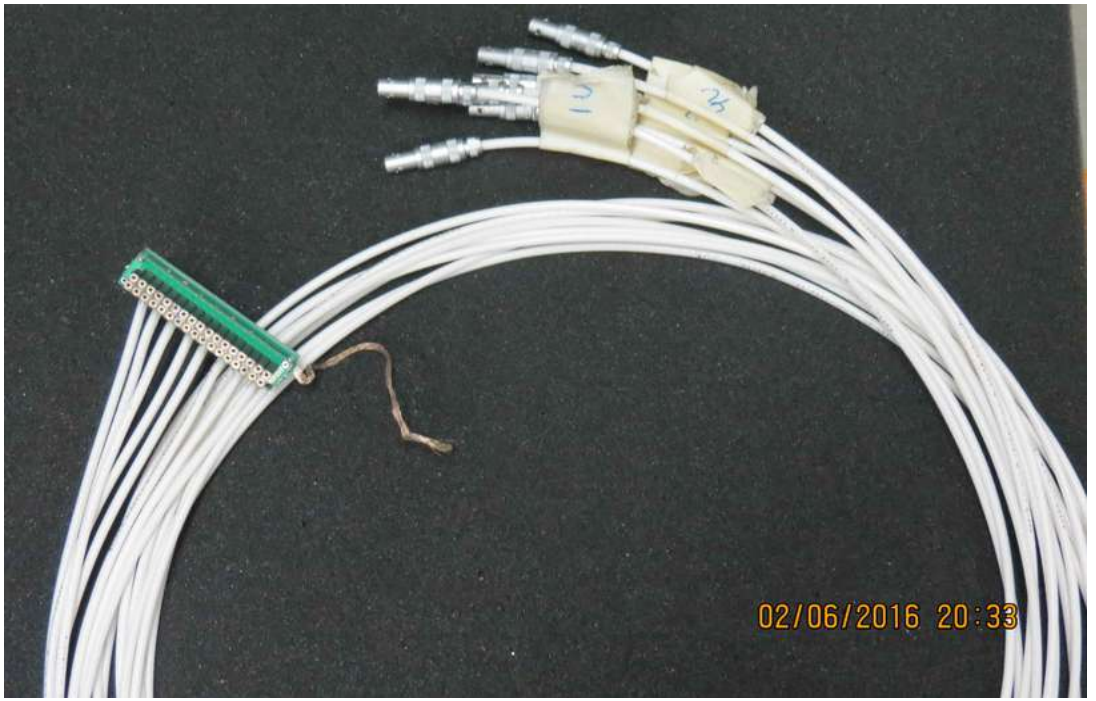


FTA; HV=200V



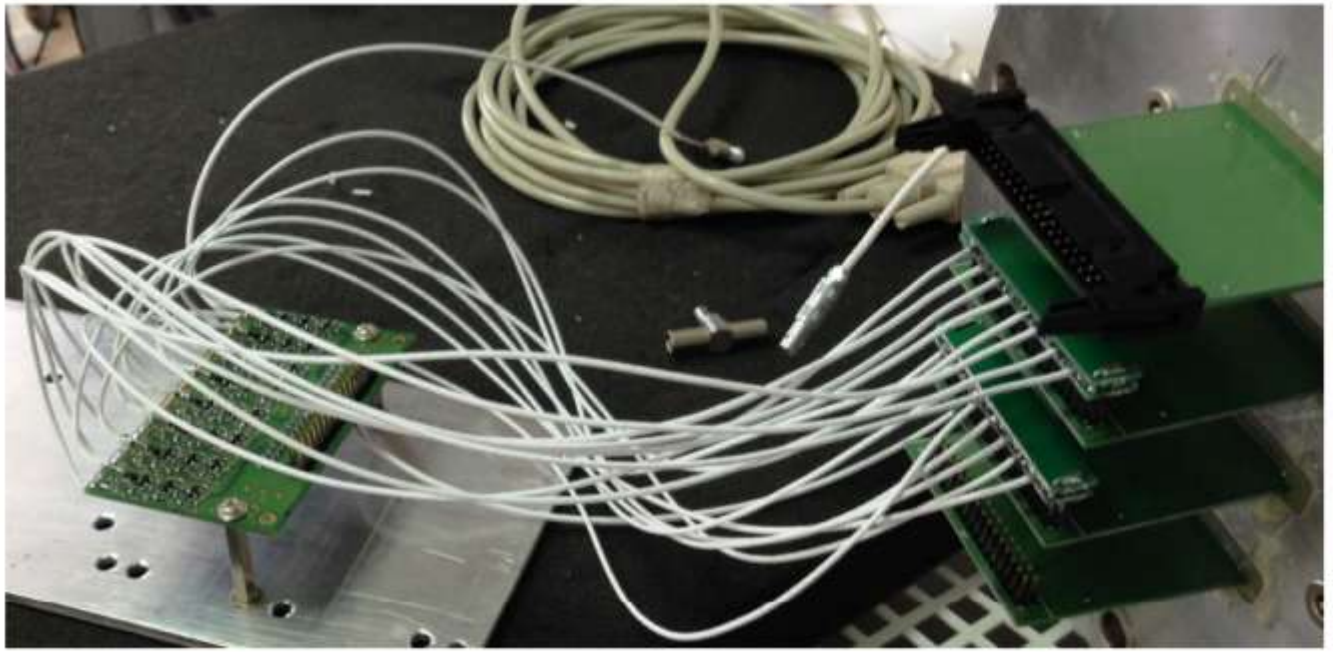

FTA; HV=1kV

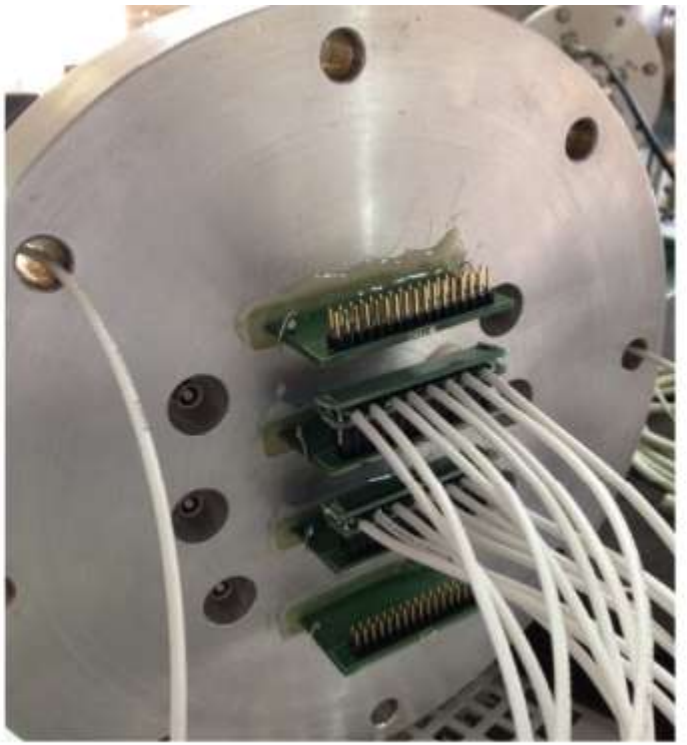


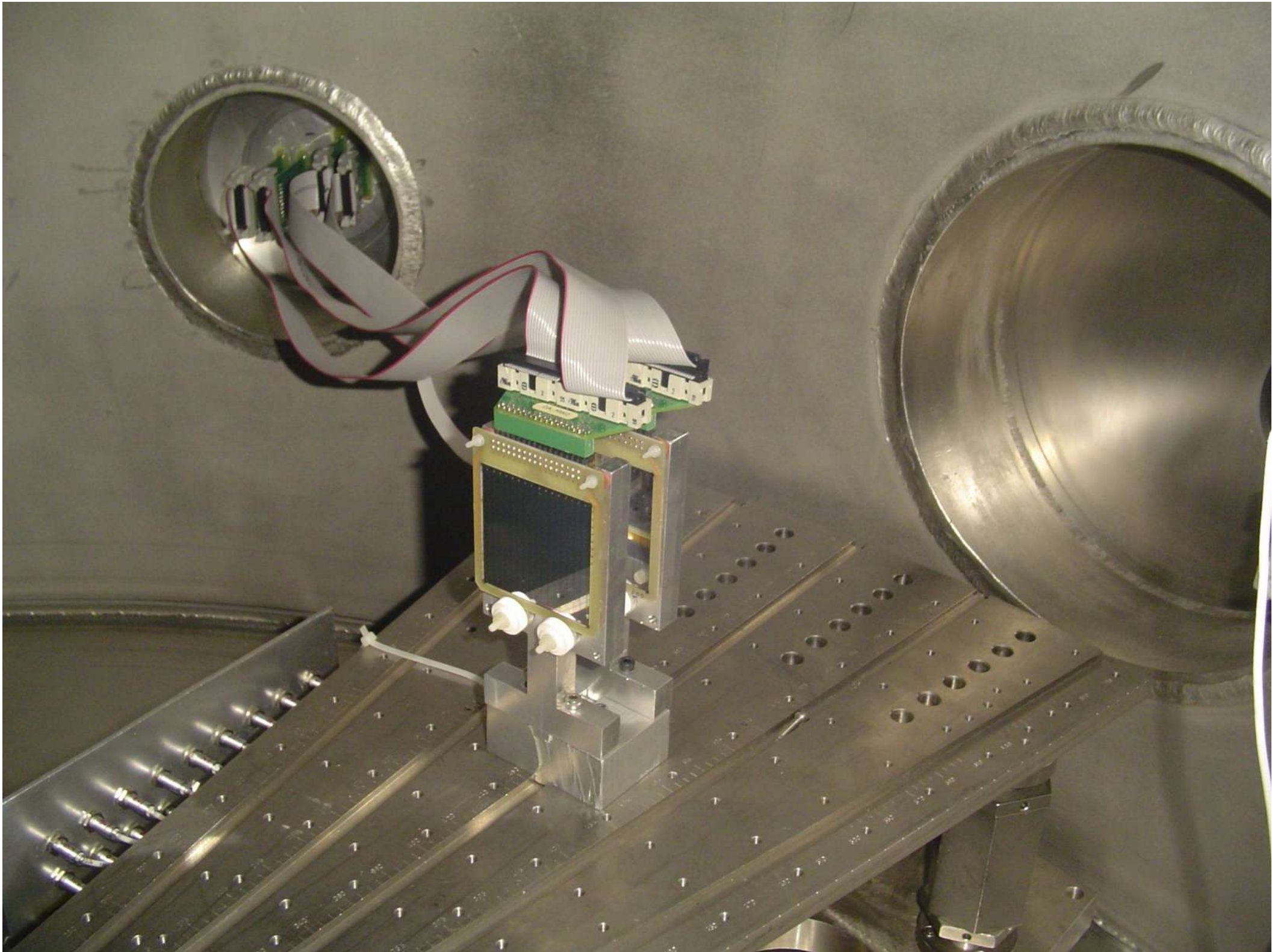

Cable set for signal transmission

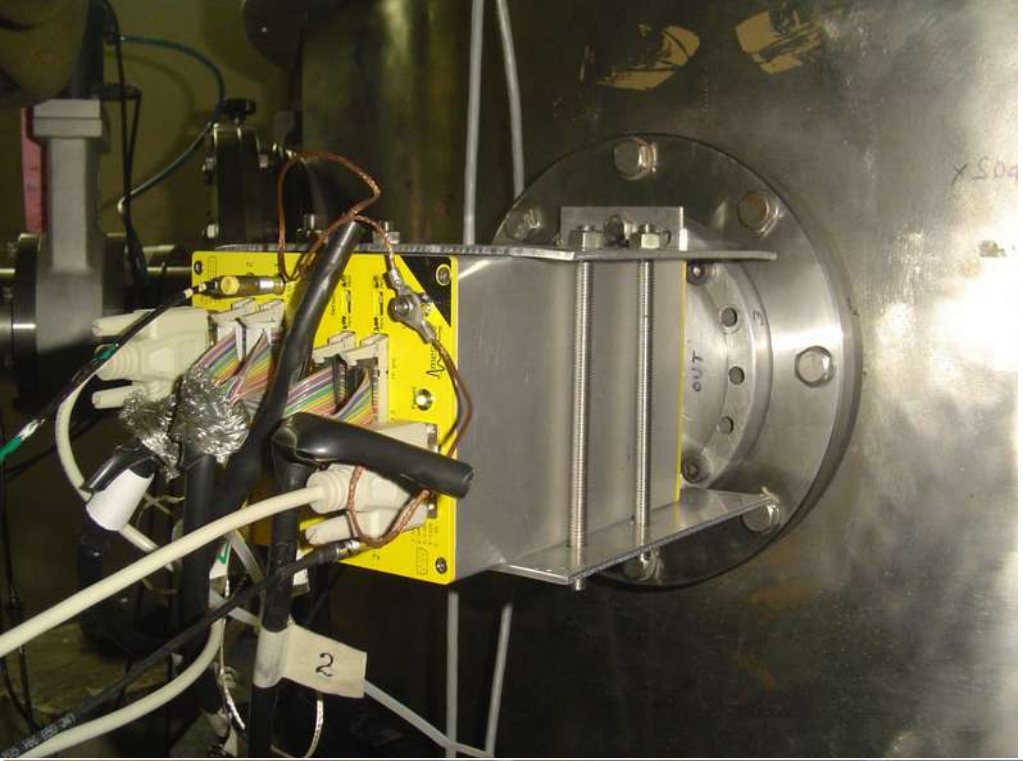
25 pin D-con to 34 pin FRC (16 channel)
34 pin FRC to 34 pin FRC (16-channel)
FRC to LEMO (8 channel)

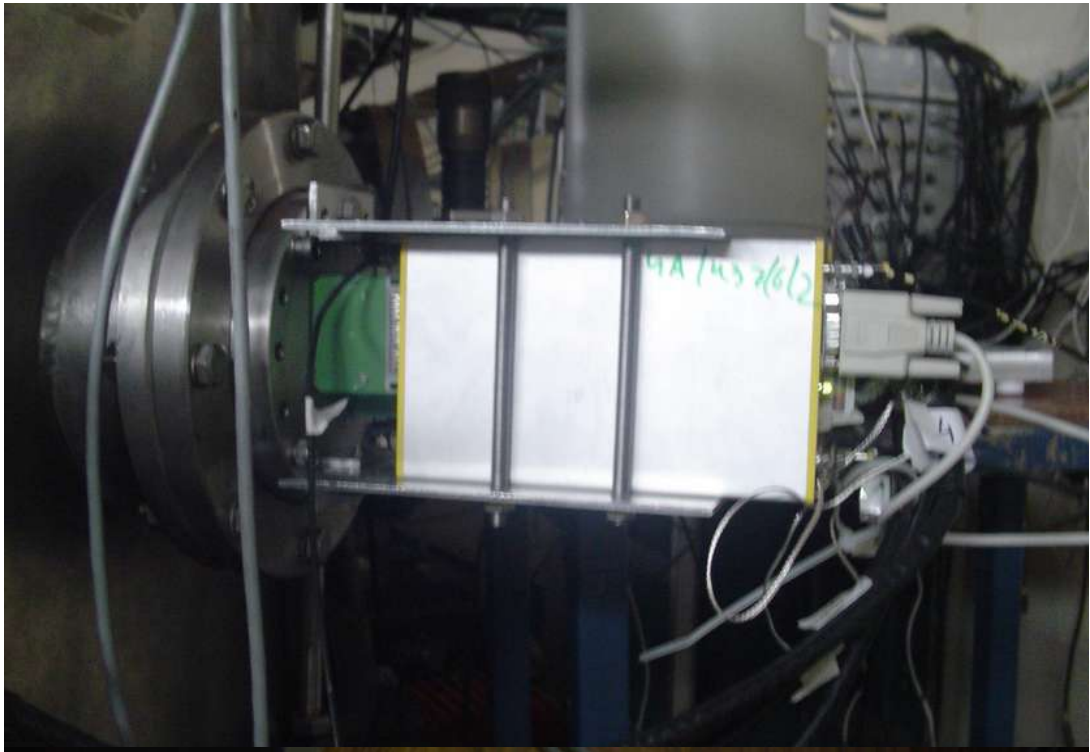


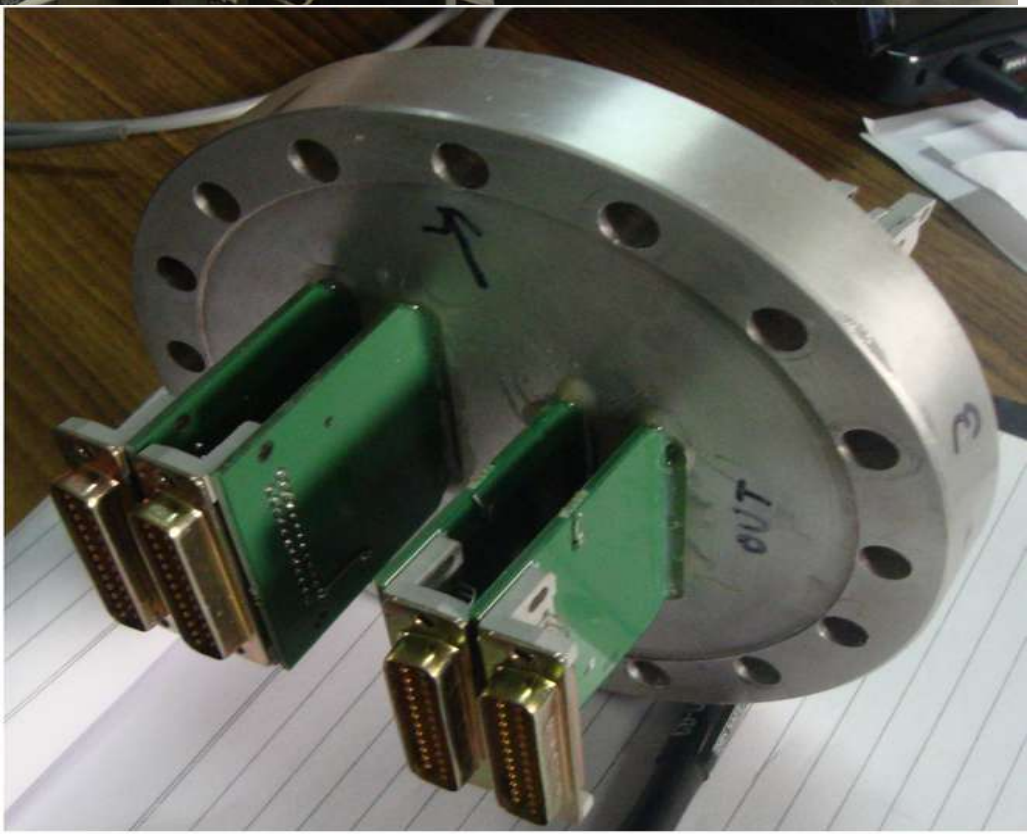


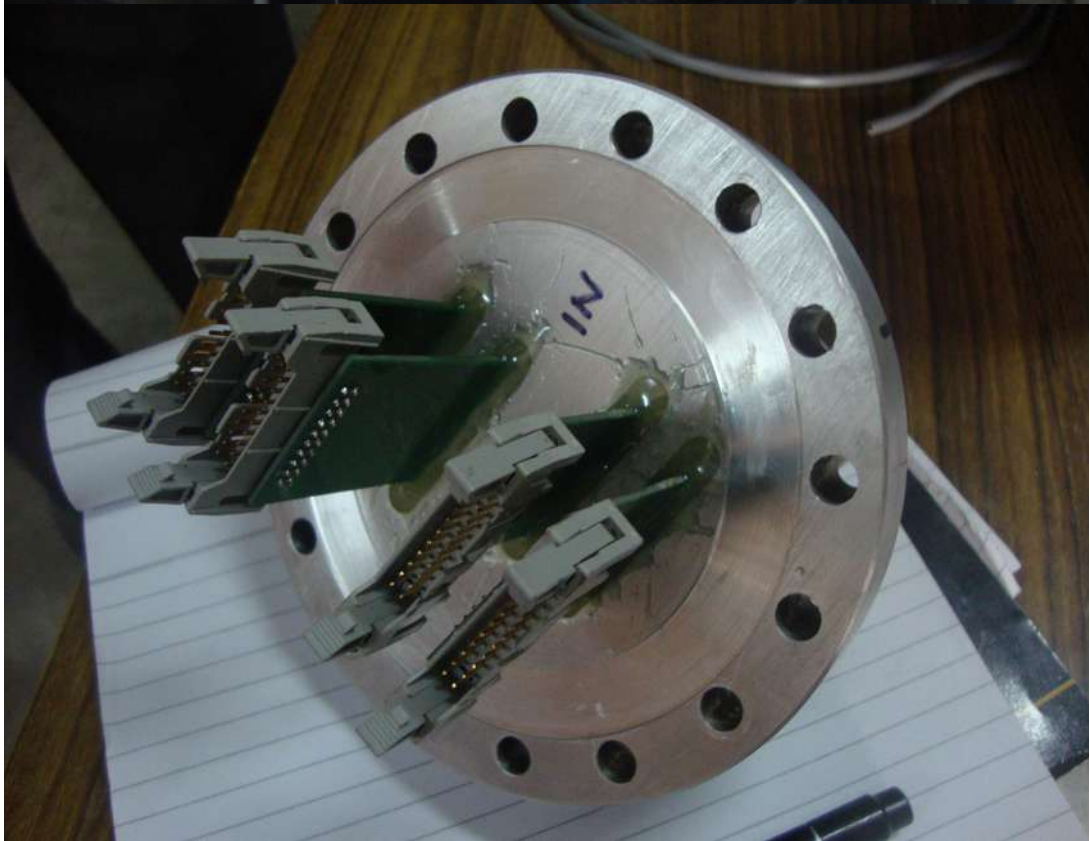
Feedthrough Flange

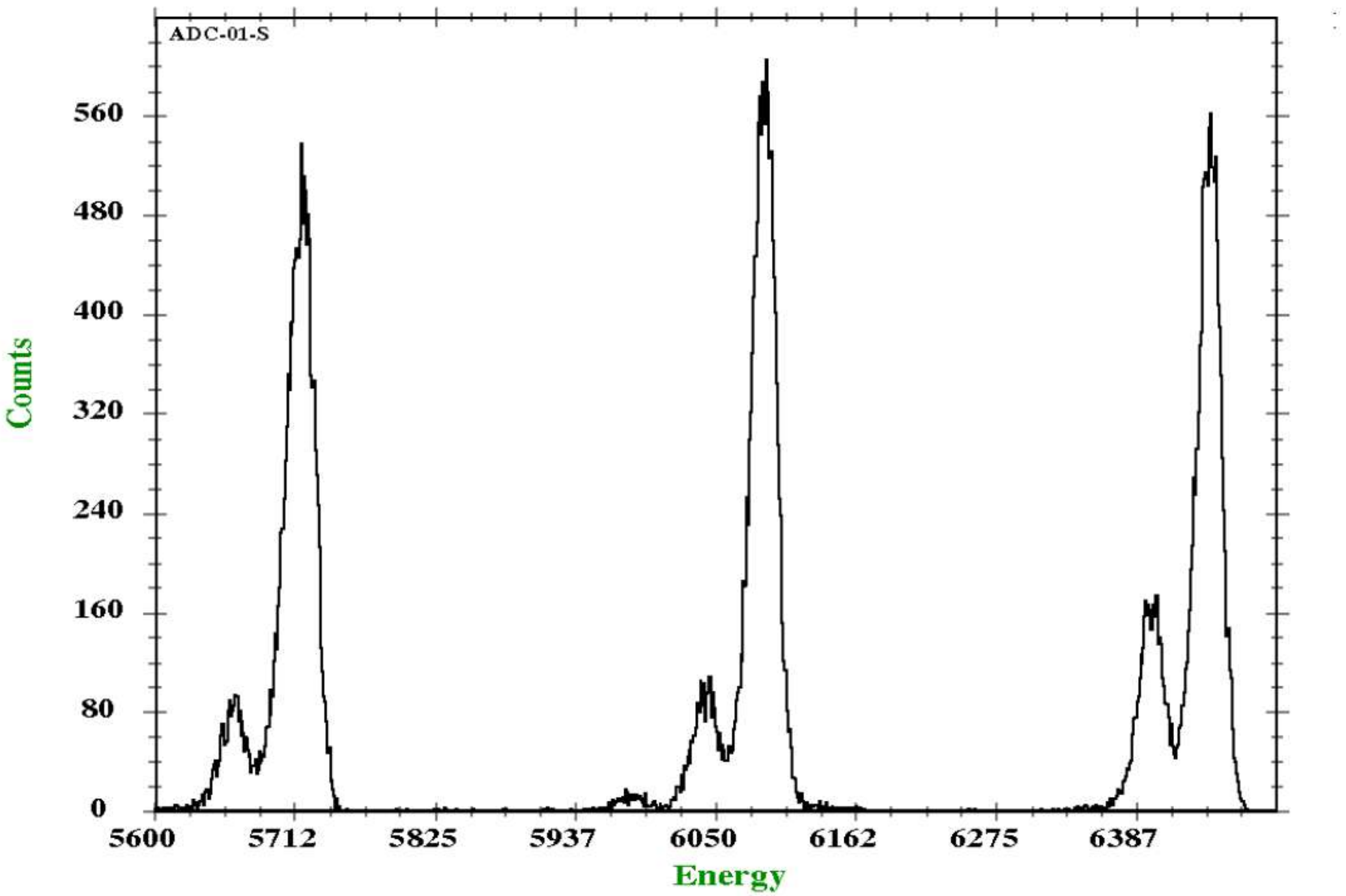


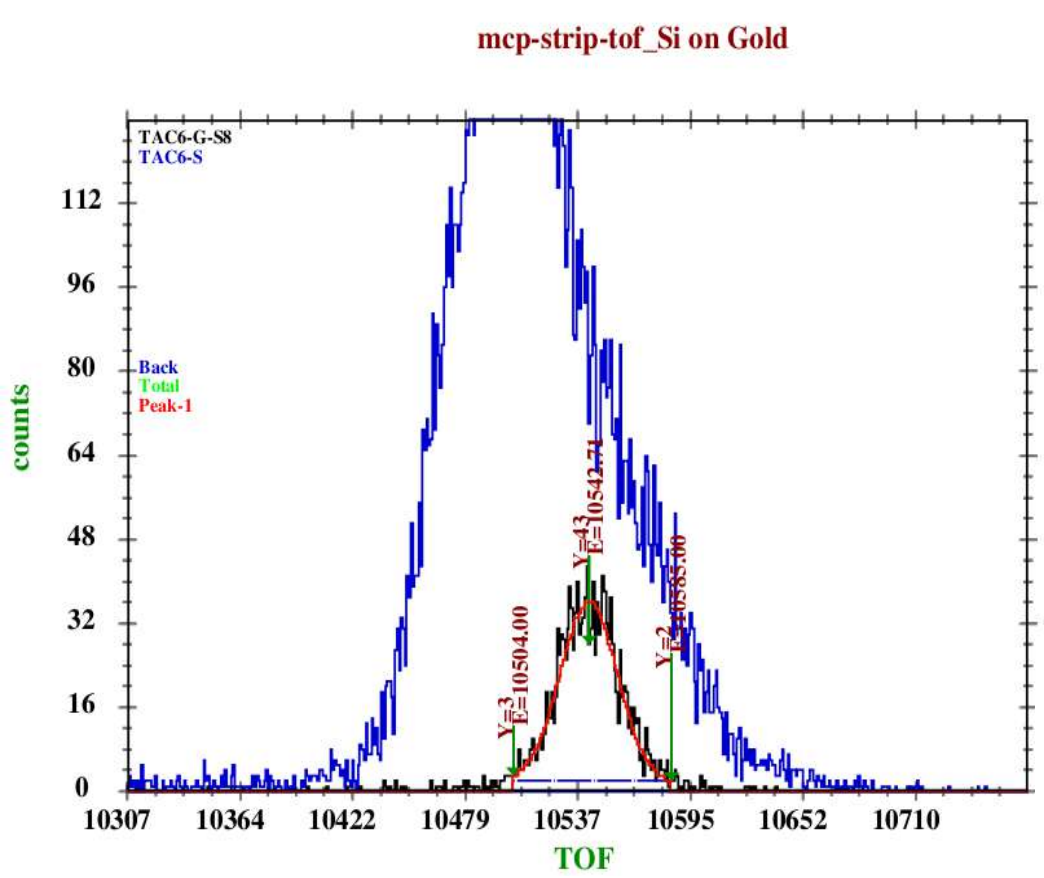

OUT
2




OUT

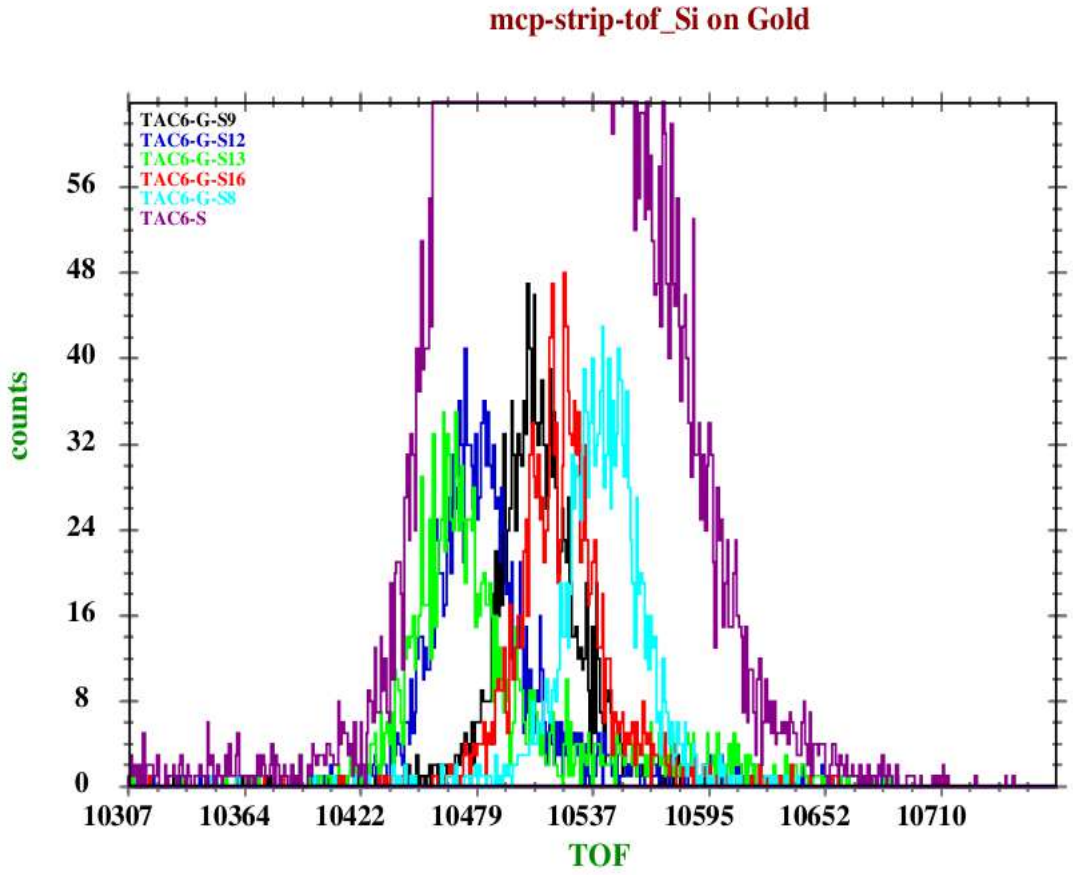

IN


Pu-Am-Cm mixed alpha source
ADC-01-S
Counts
560
480
400
320
240
160
80
0
5600
5712
5825
5937
6050
6162
6275
6387
Energy




122 MeV 28Si on 197Au
Flight path 15 cm

Propagation delay from
Pixel to pixel observed




TOF res. for 1 pixel ~ 210 ps (fwhm)
MCP res. : 140 ps (fwhm)
Pixel res. : ~ 170 ps (fwhm)

**Electronics for $LaBr_3$ detectors**

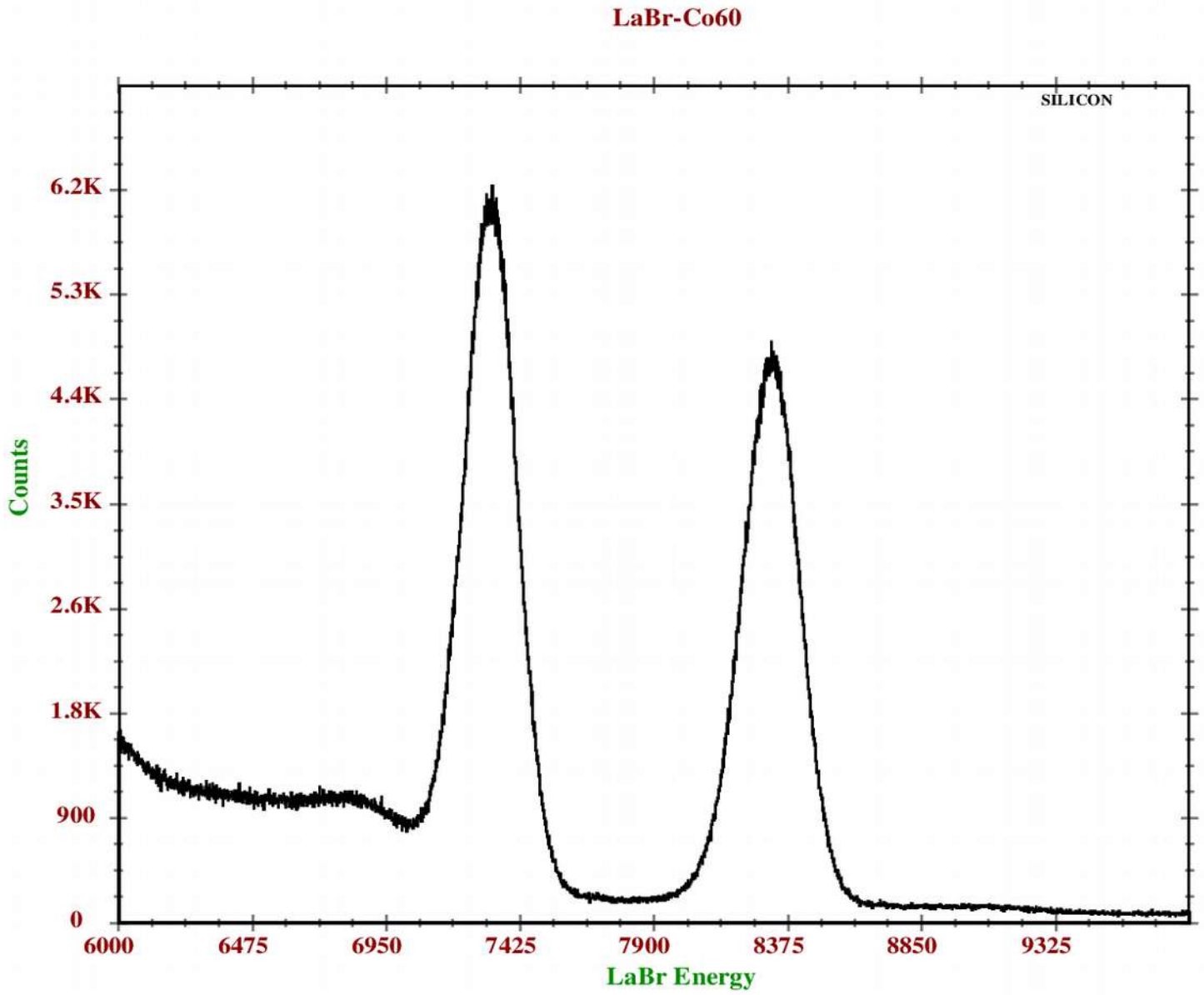
Low gain CSPA developed for extracting Energy information : PMT Dynode

Sensitivity 4.5 *mV/pC* (*Si* equi.), Dynamic range 20 *MeV* @ 1 *kV* bias
CSPA output fed to Spectroscopy amplifier-ADC or Digitzers

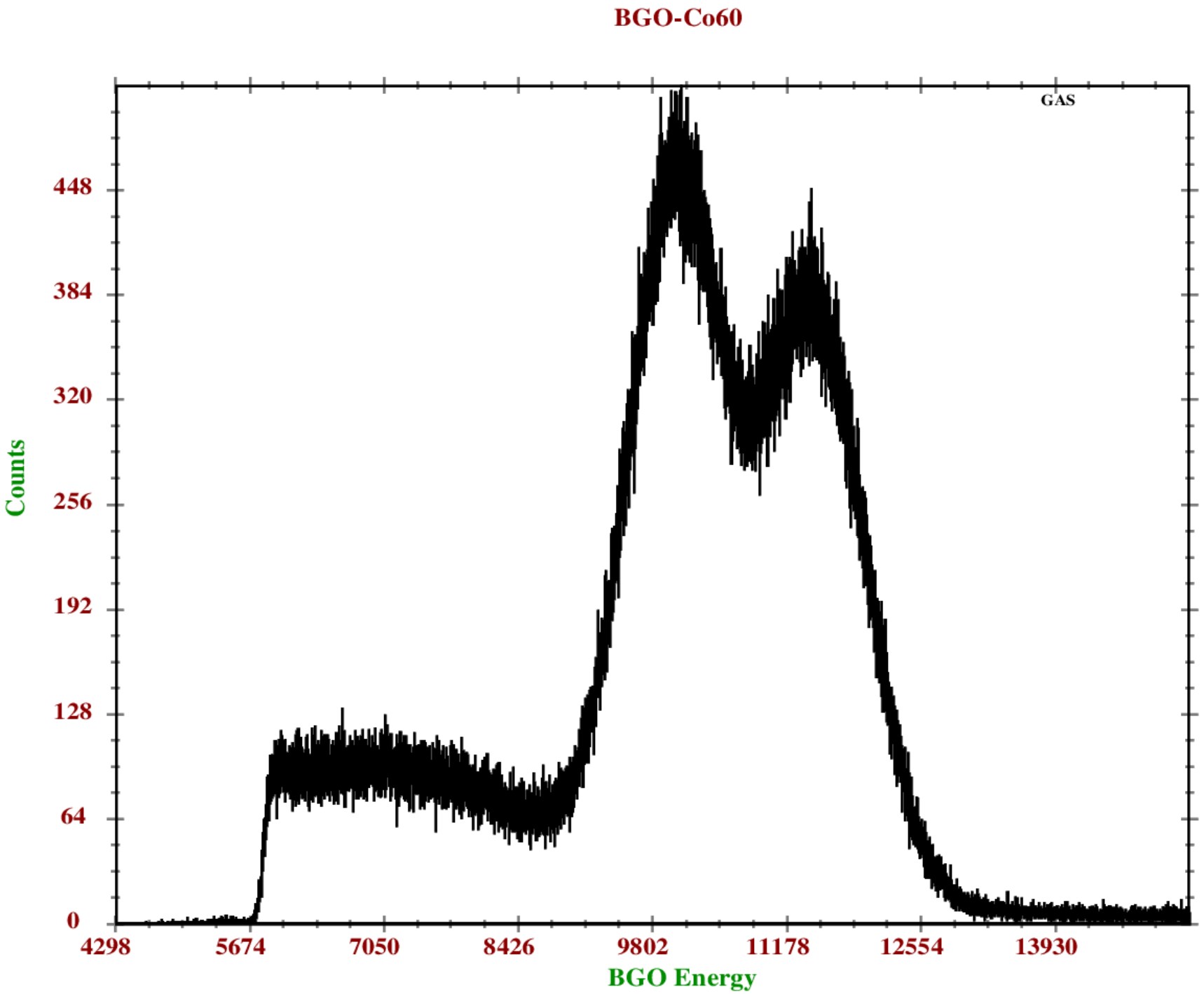
Low gain FTA for extracting timing information : PMT Anode
Gain ~ 5, Dynamic range 10 *MeV @ 1 kV* bias.
Output fed to CFD

Performance : Energy Resolution 2.5 % @ 1.33 *MeV γ-ray*
Timing Resolution 300 *ps* @ 1.33 *MeV* γ-ray

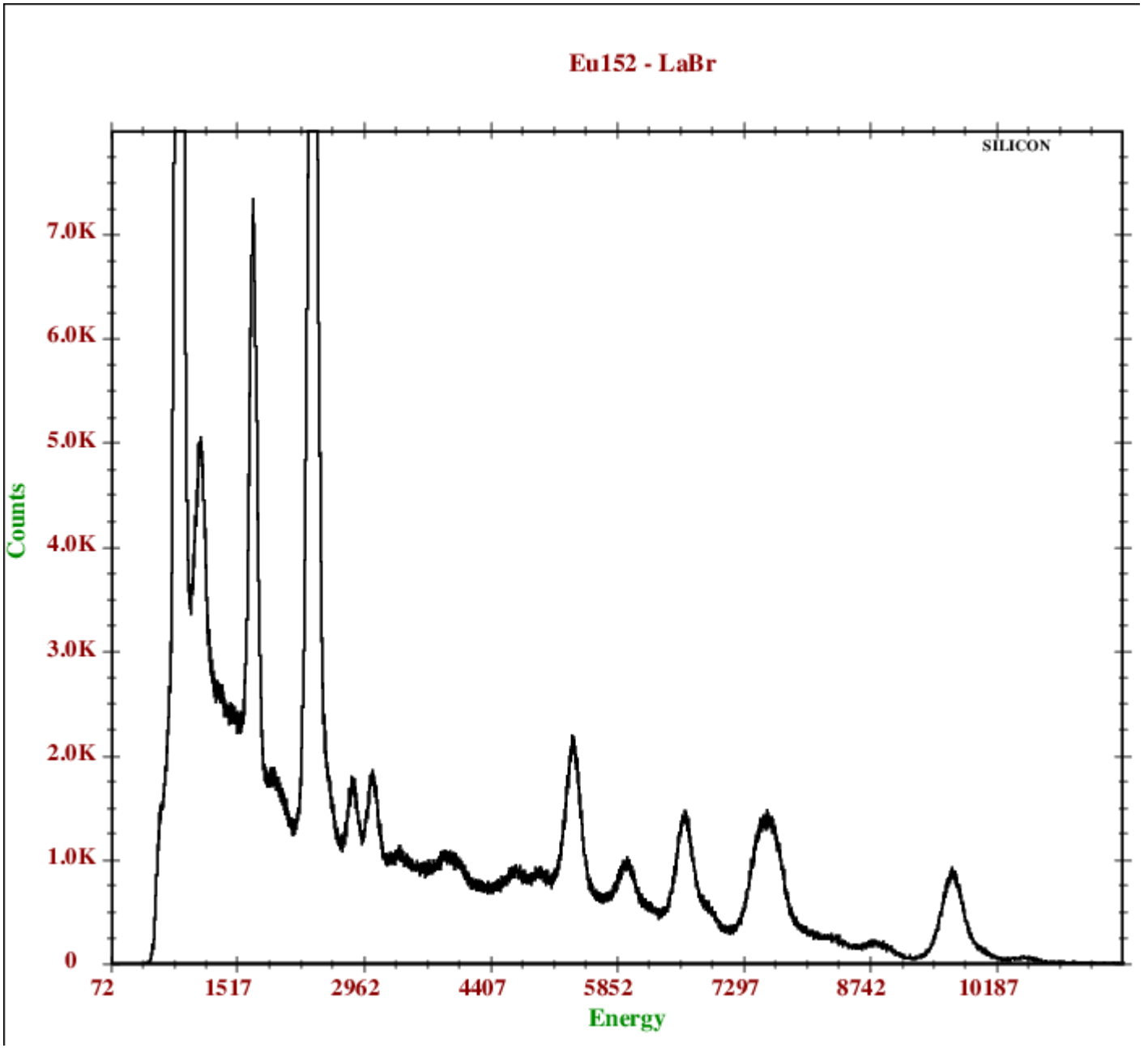
CSPA and FTA improves the dynamic range and linearity, low PMT voltage operation, drives the signal through long cables (15 – 20 m) improving signal to noise ratio.



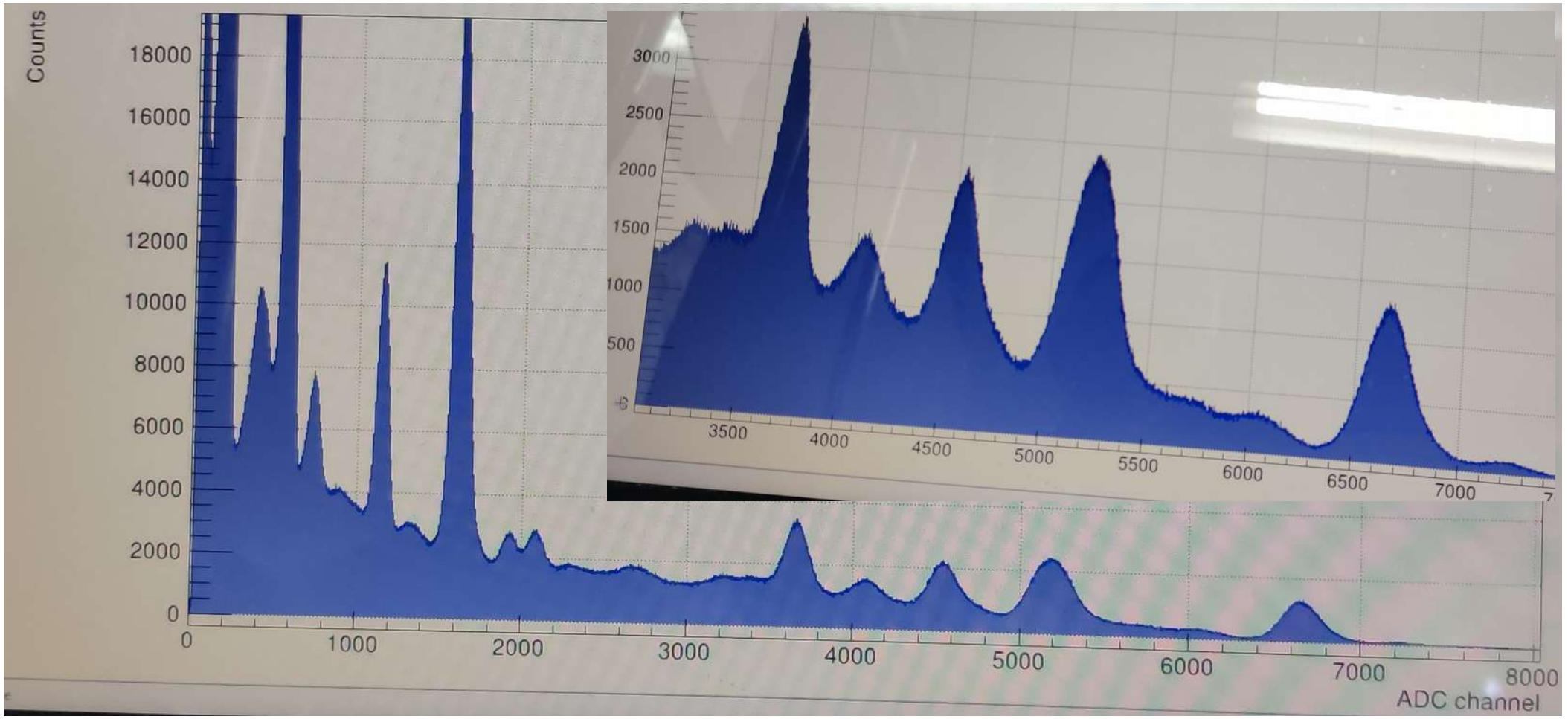

LaBr Energy spectrum with Co60 source



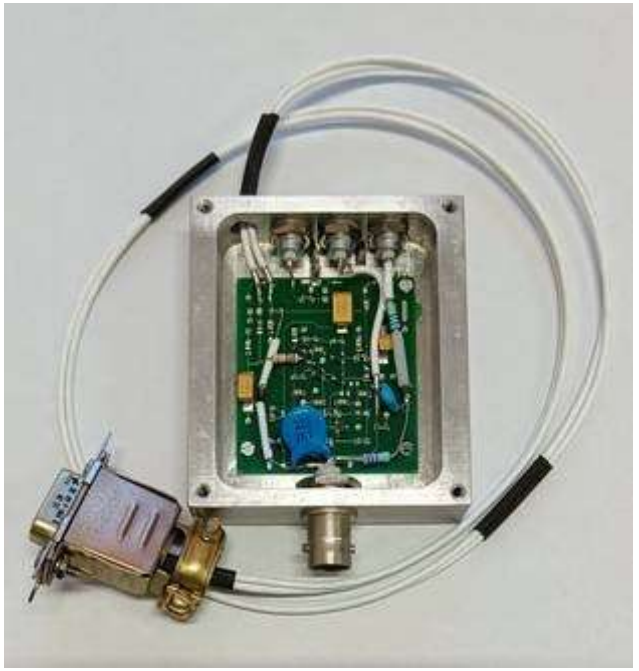

BGO Energy plot with Co60




$LaBr_3$-$Eu^{152}$ Energy Plot with conventional Analog Signal Processing Electronics

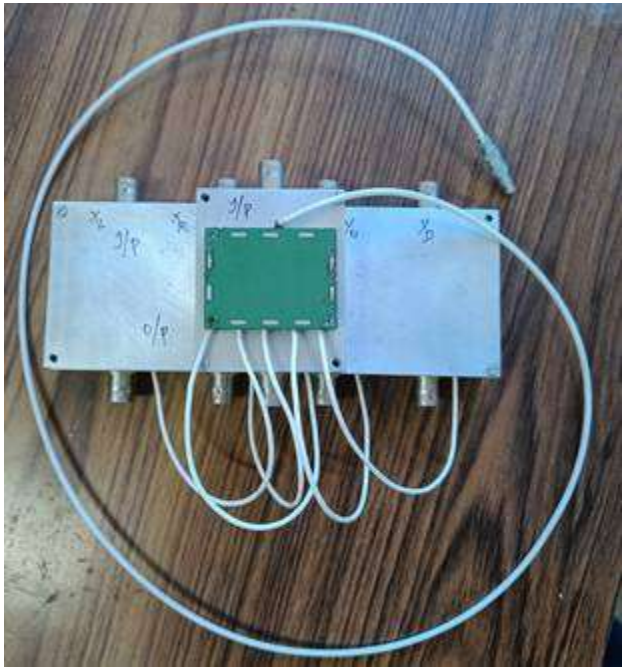



$LaBr_3$-$Eu^{152}$ Energy Plot with CAEN Digitizer PHA



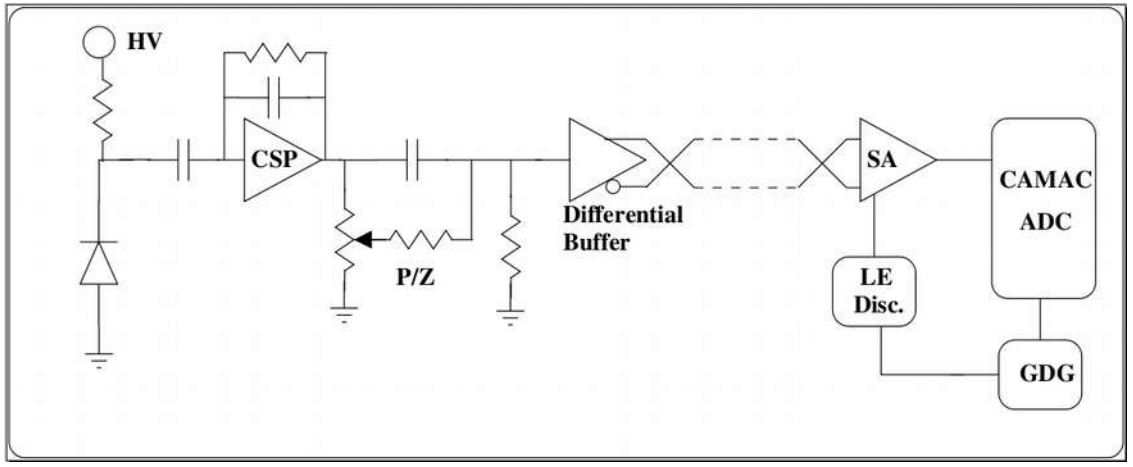
CSPA

FTA



5 ch. FTA

# Preamplifier units prepared for processing LaBr signals




**Signal Processing Block diagram**

## Development of RESET CSPA

Strong flashes of γ-*rays*, X-*rays* or even energetic heavy ions etc. can often lead to saturation of pulses in g-ray detectors such as germanium, $LaBr_3$ etc.

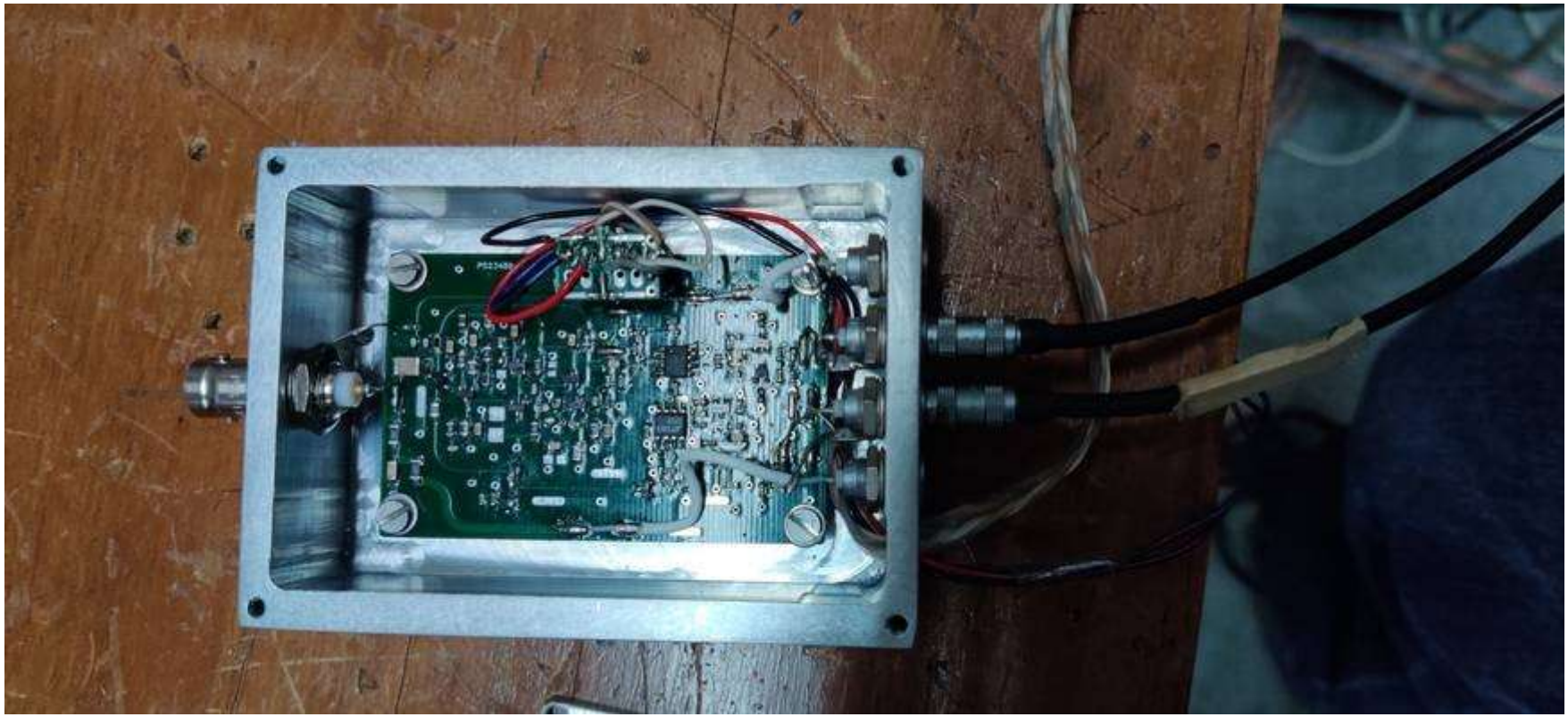
Saturation inhibits CSPA counting for several milliseconds sometimes

Digitizers have limited dynamic range +/- 1 V

***Result:*** Reduced efficiency of the system

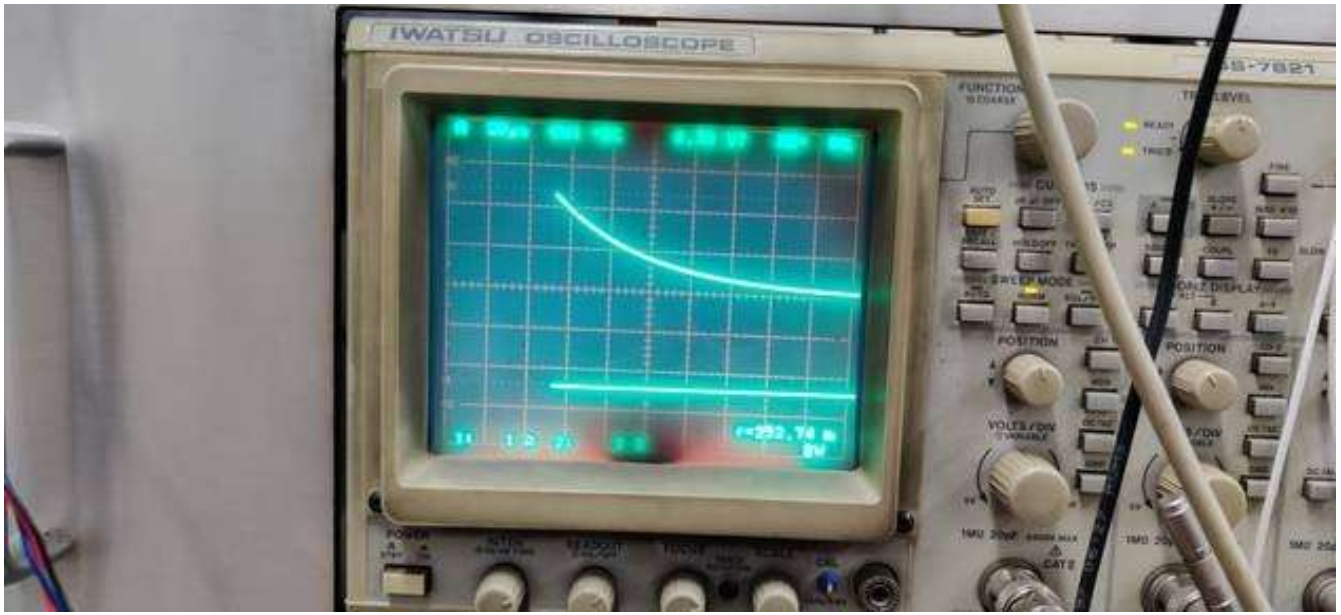
**Remedy:** Use of RESET charge sensitive pre-amplifiers or CSPA

Assembled charge sensitive preamplifier with reset

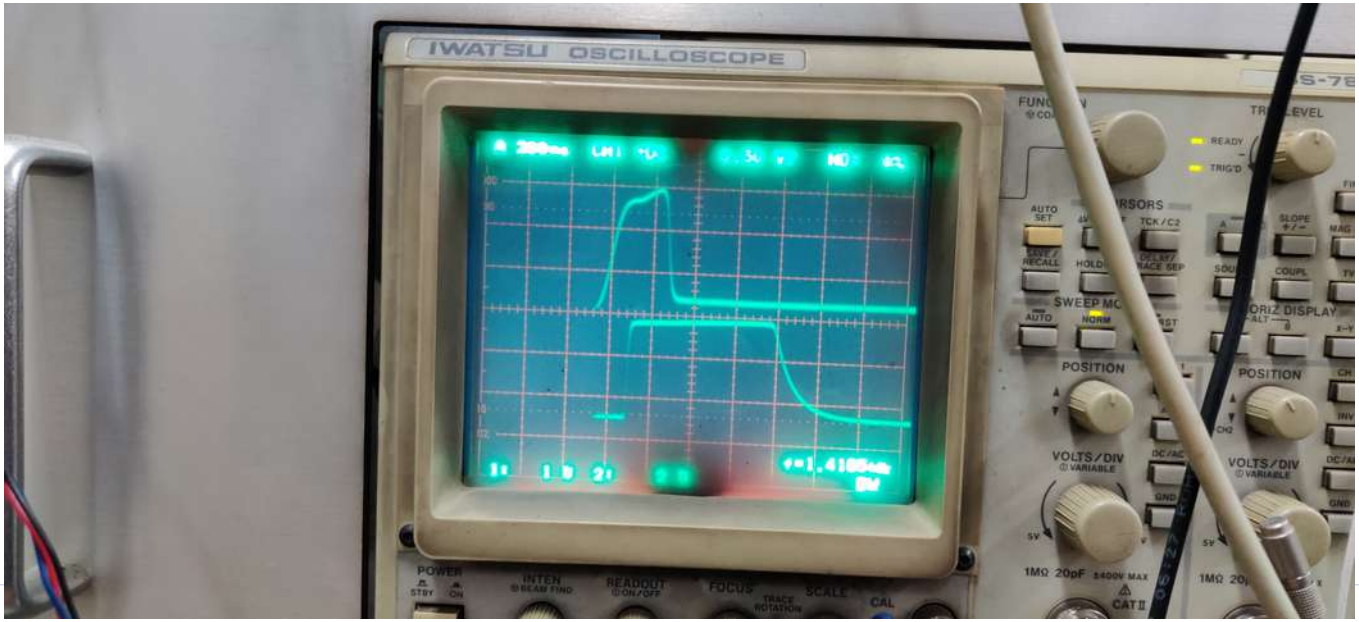


Assembled CSPA designed for n-side readout and reset at input stage. Gain 44 mV/MeV (Si equiv.). Decay time 500 μs for CSPA stage, differentiated to 50 μs followed by a buffer amplifier feeding voltage comparator and output driver (for 50 ohm loads).

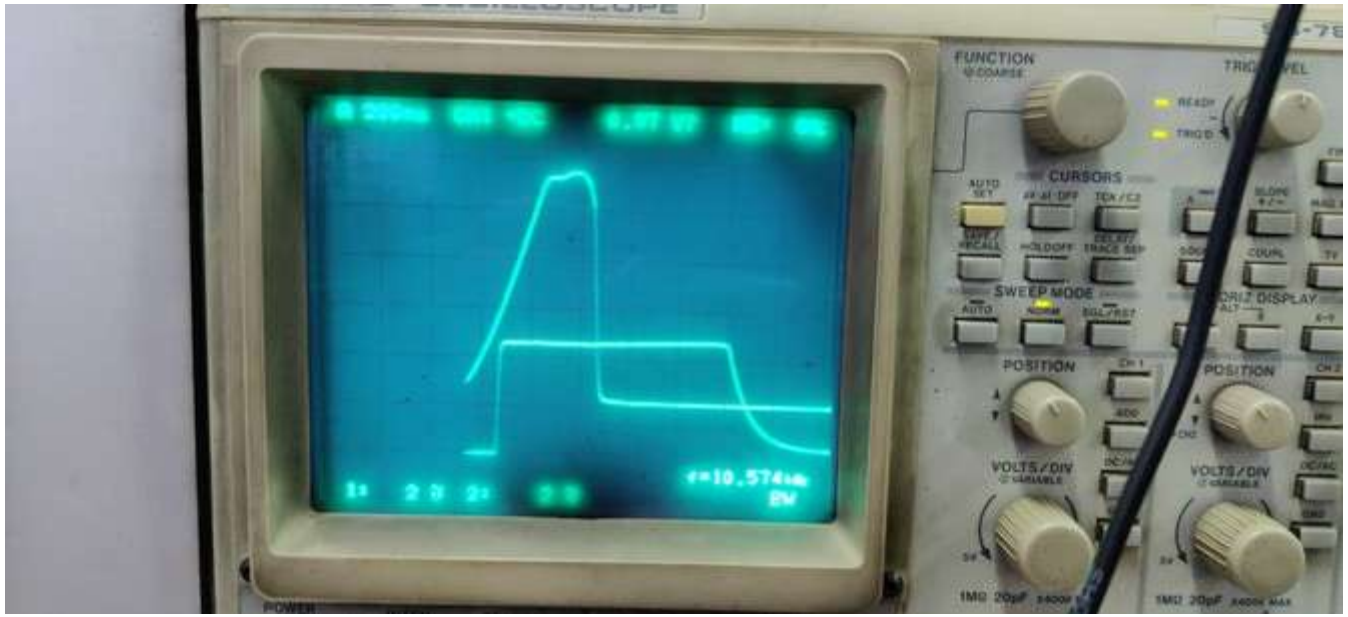
Note: This will work only for *n*-side readout.



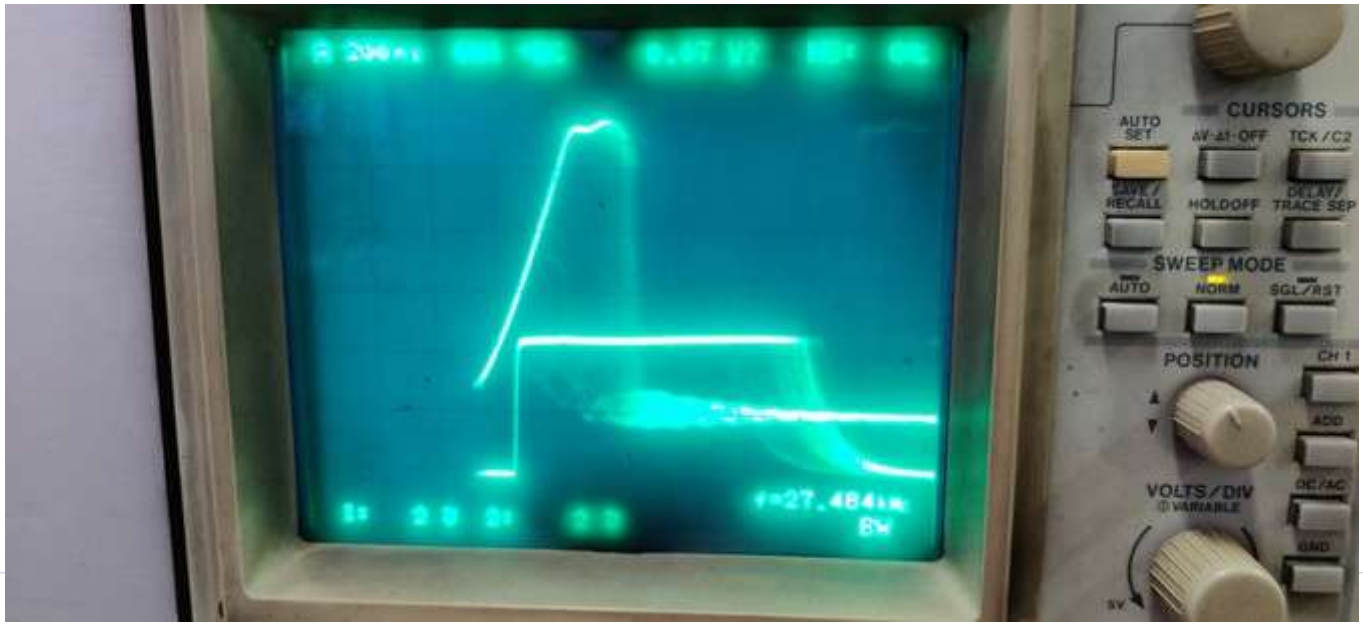

CSPA normal output with pulser without reset (below threshold)



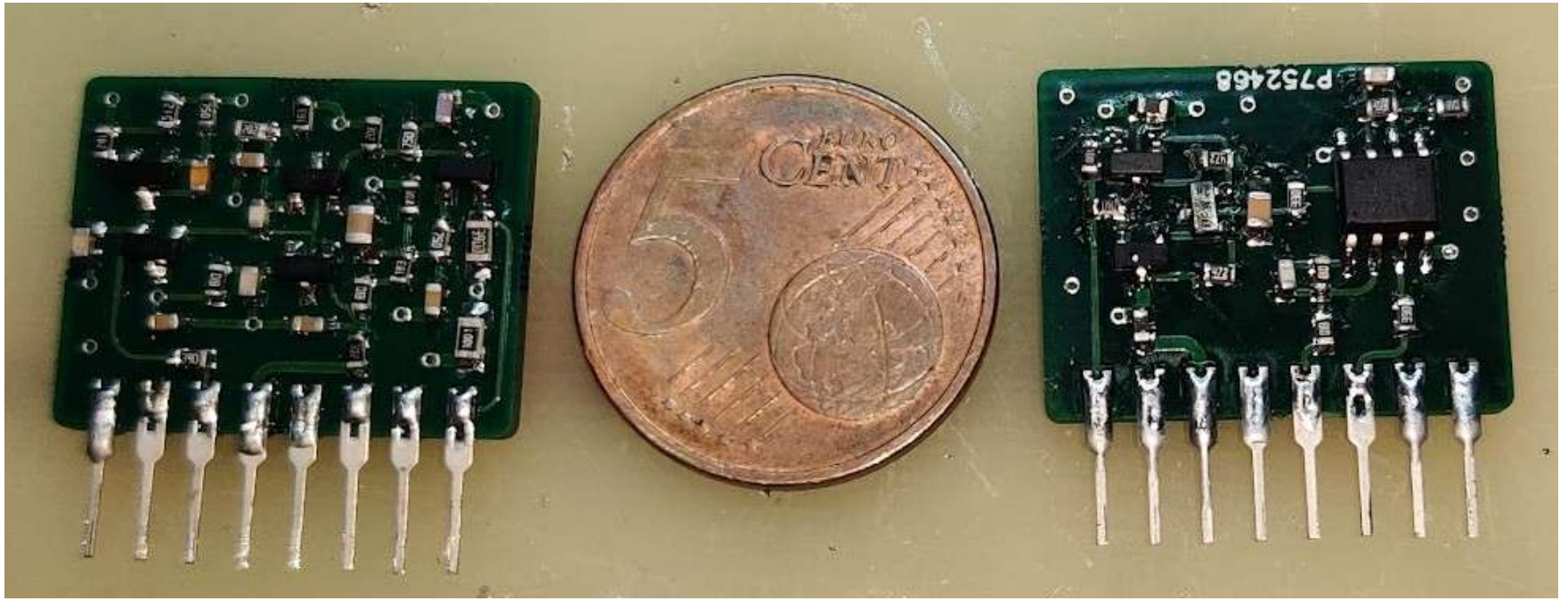

CSPA reset output with pulser (top pulse) with TTL output (bottom)

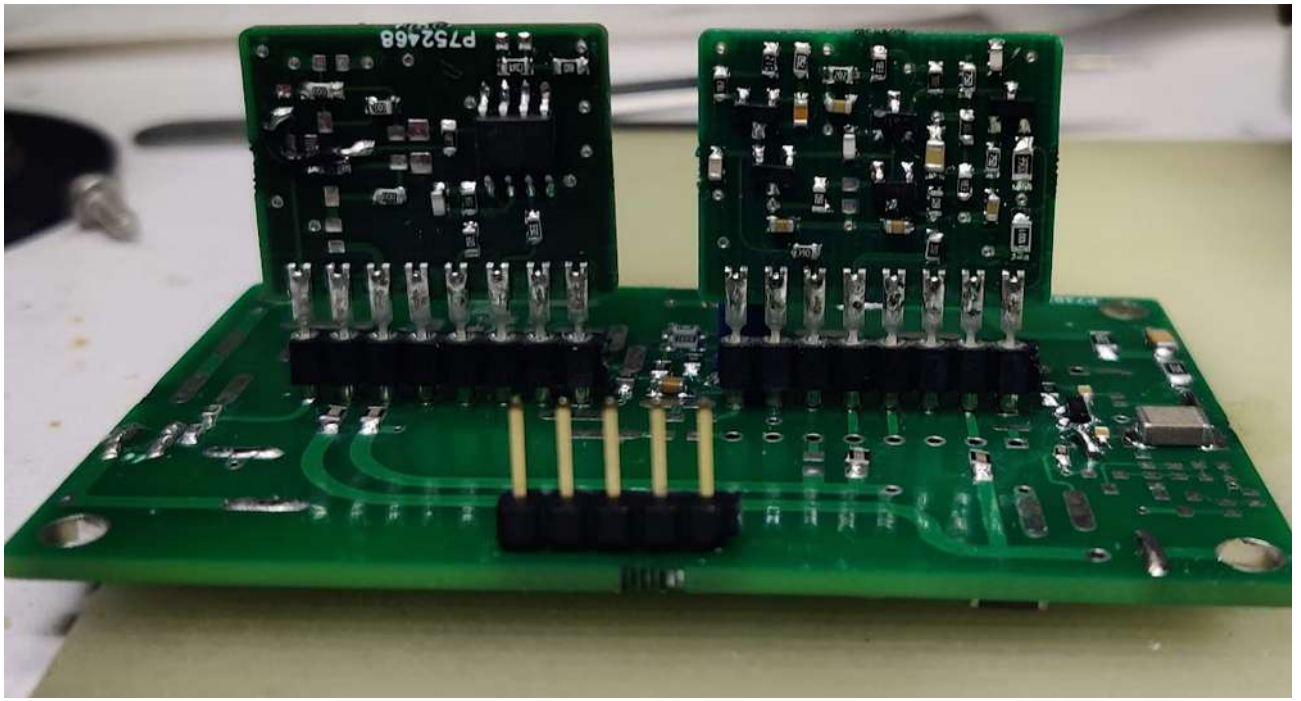



CSPA output using Phillips 7120 charge-time calibrator with 600 pC charge input. No undershoot.




CSPA reset output with BC501 liquid scintillator & $^{60}$*Co source*. Charge input ~ 2 – 3 nC. Reset time ~ 300 ns with no undershoot.


P752468
EURO
CENT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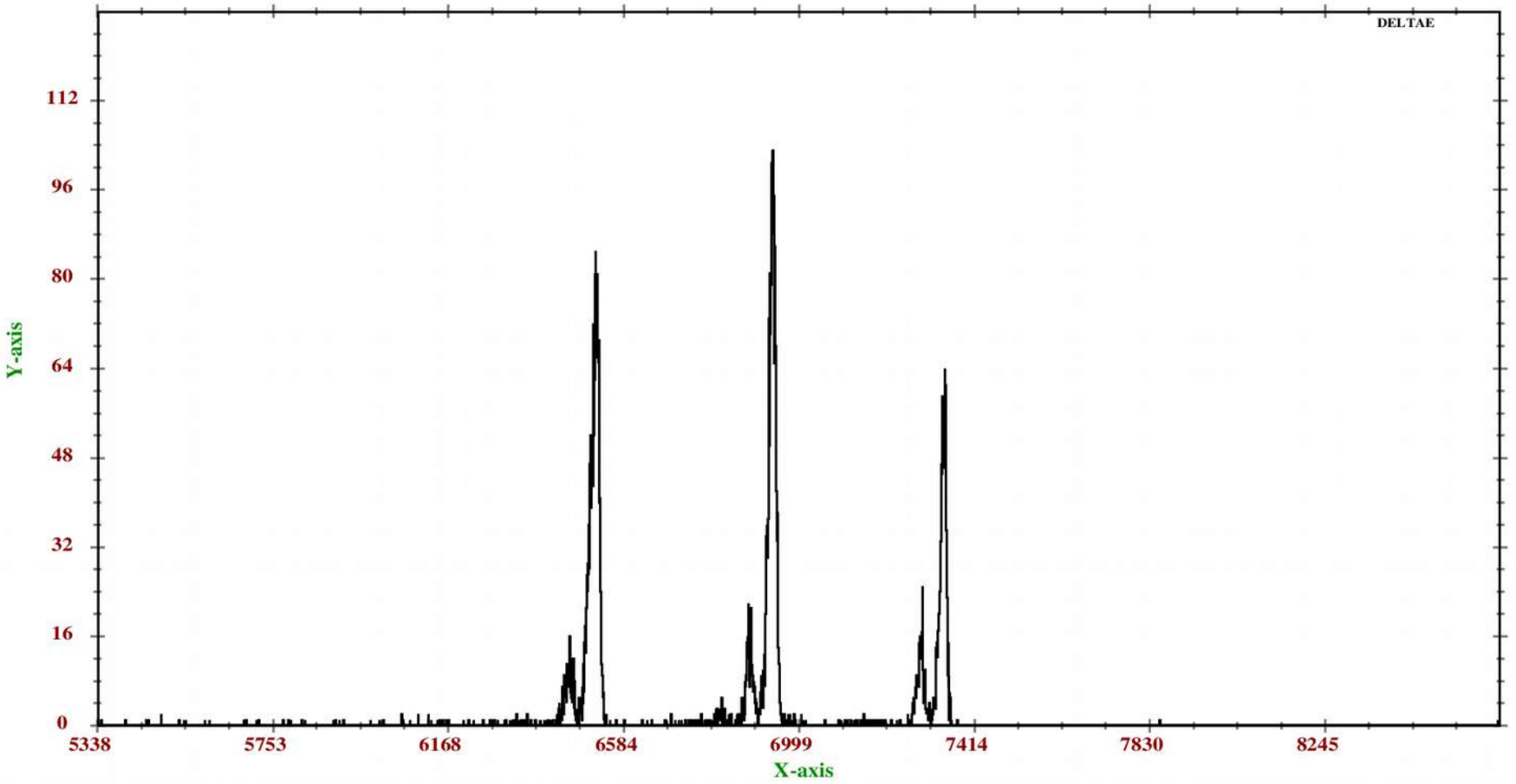
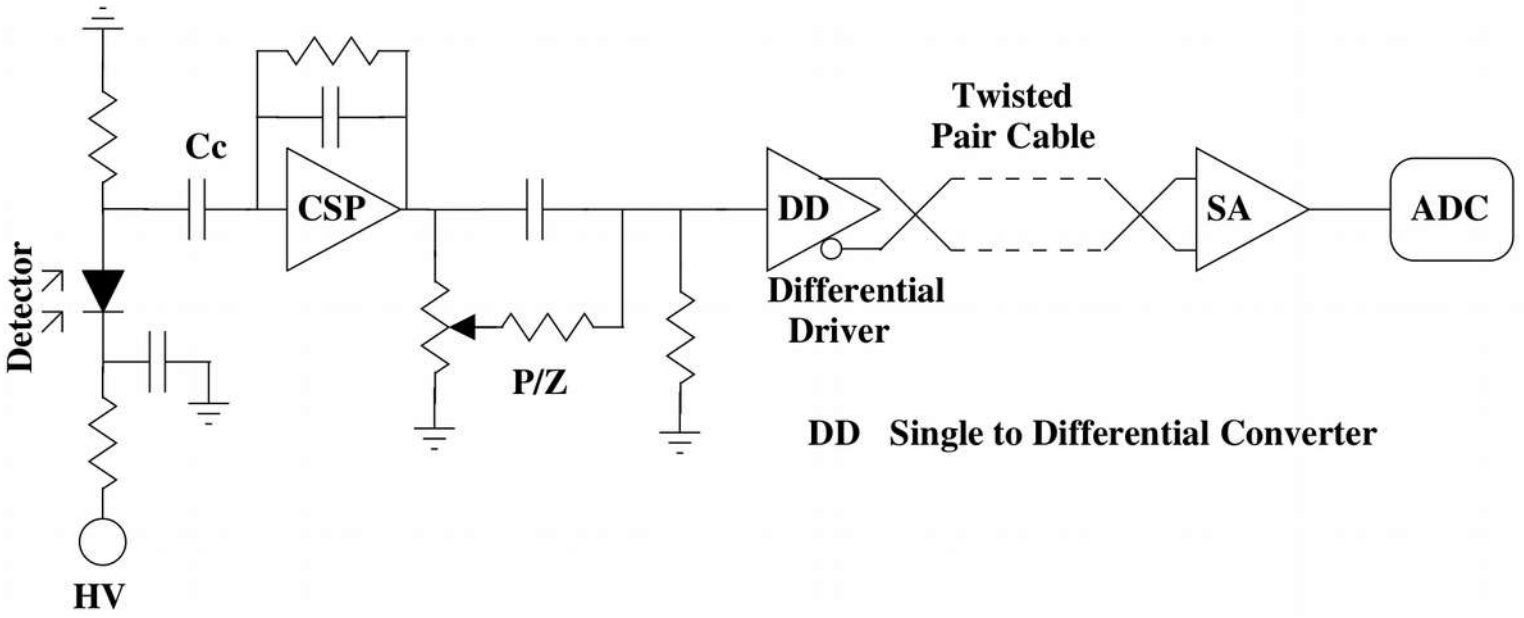
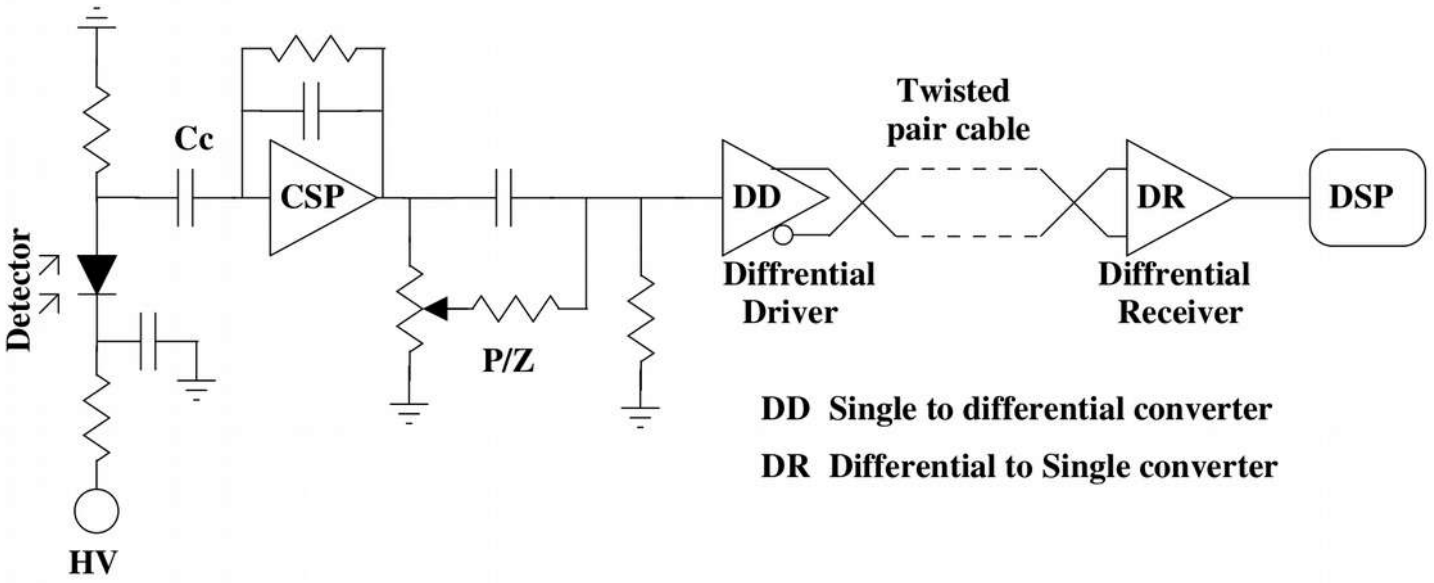



*Silicon detector +Pu-Am-Cu*

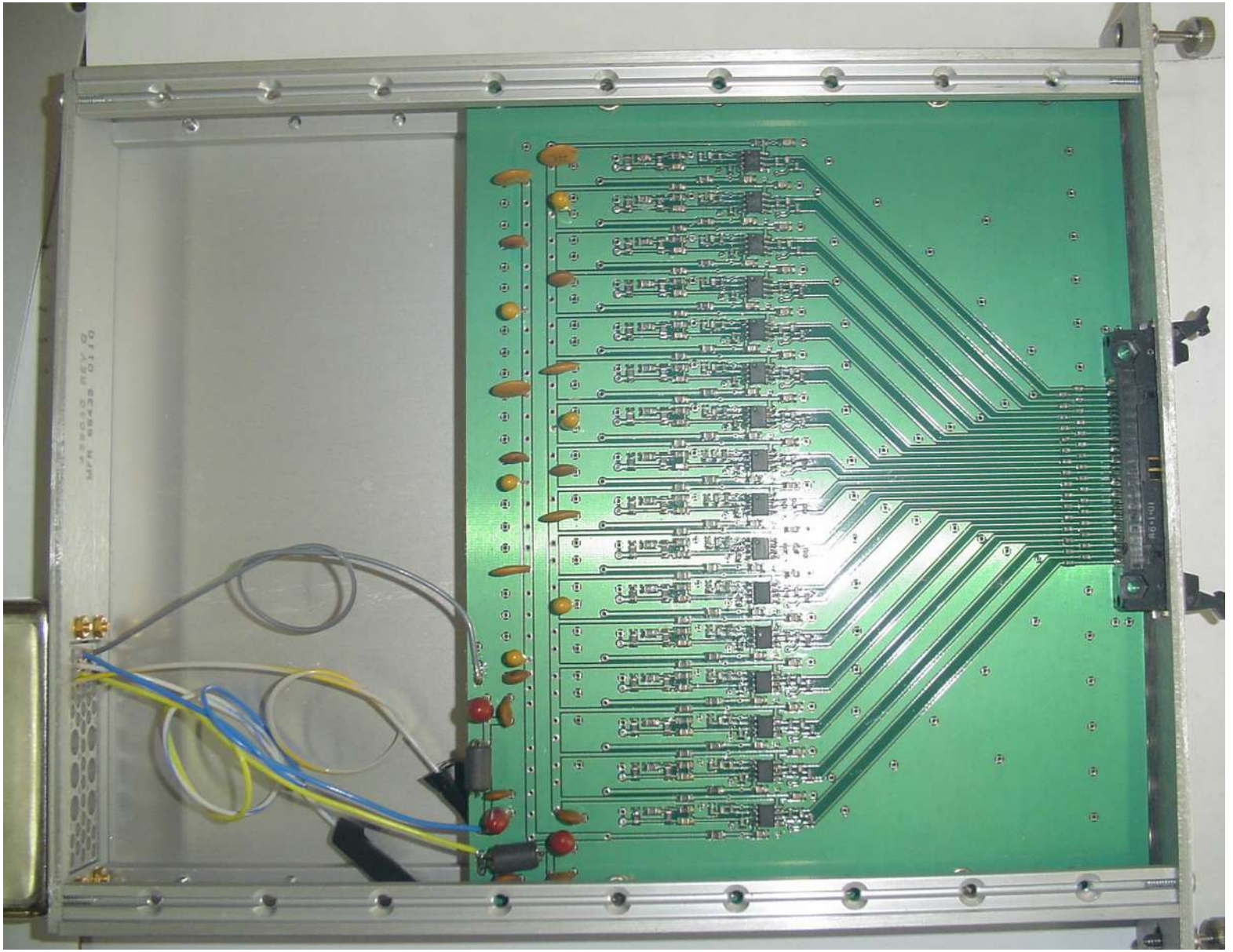


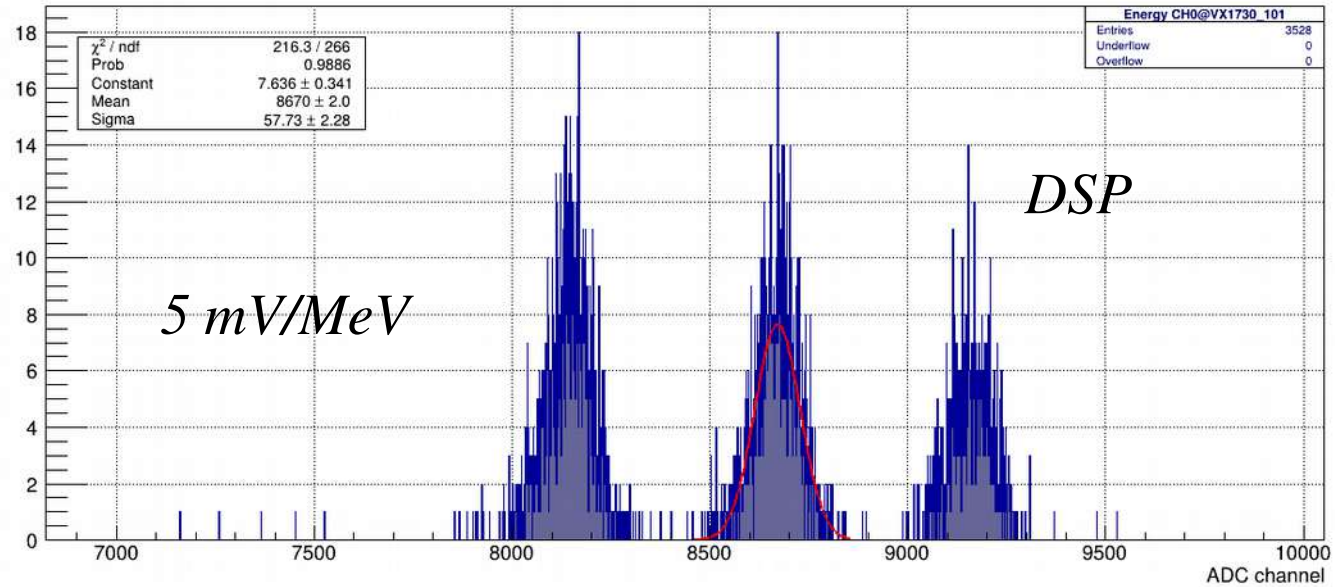





Digital Readout Schematic for multi-channel CSPA with Differential output

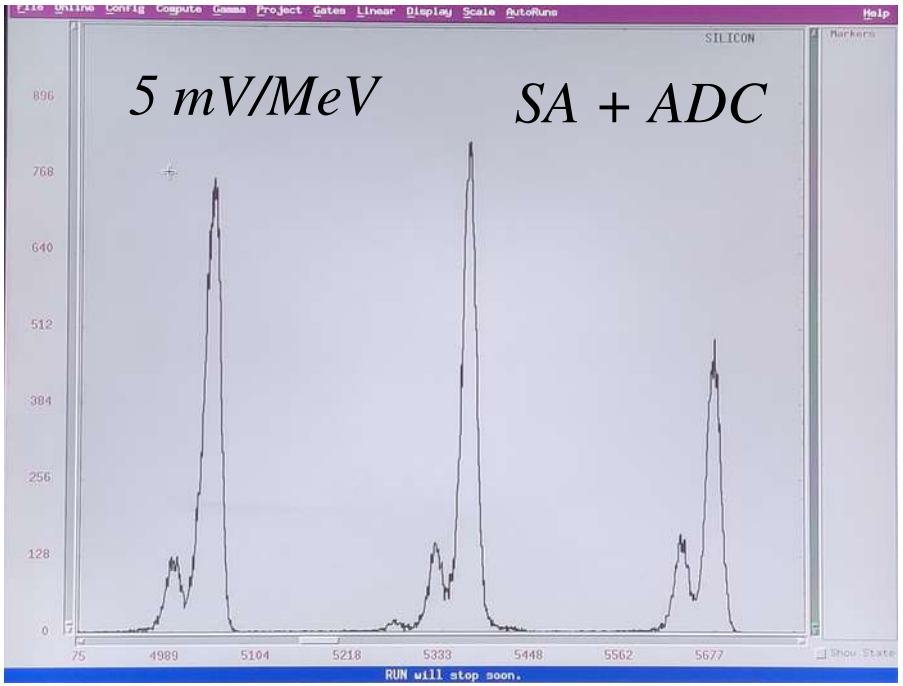
# Differential Driver/receiver module – 16 channels

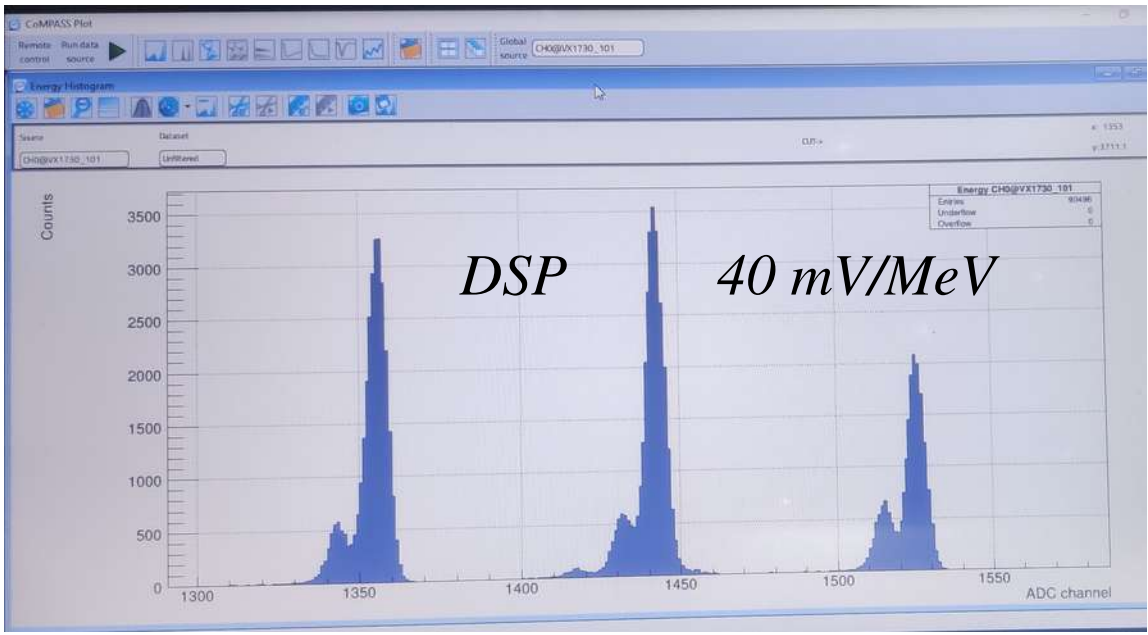






*Mesytec + DR + DSP*
*Silicon detector +Pu-Am-Cu*



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**Thank You**