GEM Progress from USTC

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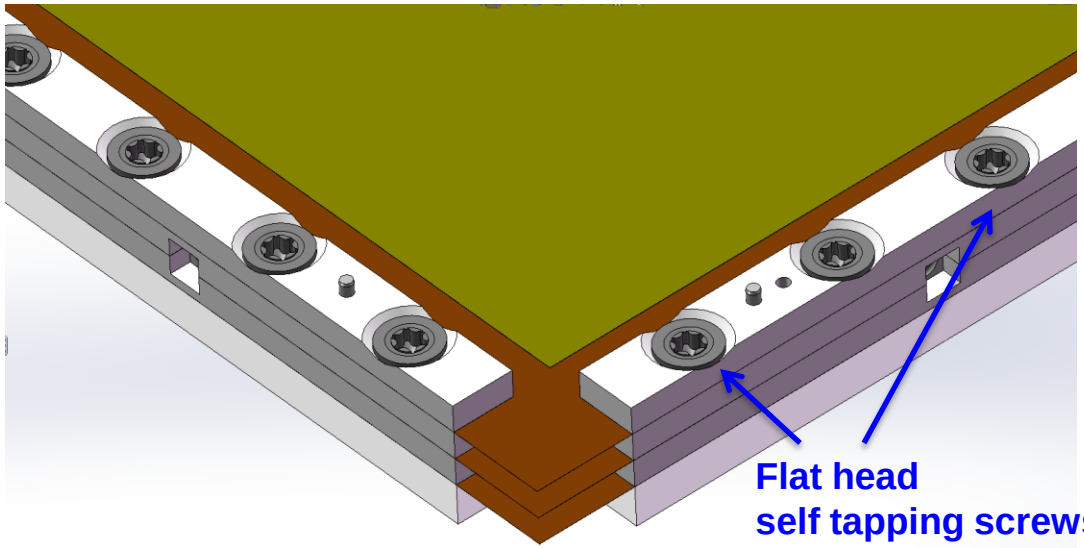
July-23-2014

Outline

- **Progress of the 30cm×30cm GEM**
  1. Assembly of the 1st detector
  2. Assembly of the 2nd detector
  3. Gain measurement
  4. Position resolution measurement
- **Design of the 100cm×50cm GEM**
  1. Design of the 100cmX50cm GEM detector
  2. Design of the tension measurement platform
- **The 30cm×30cm THGEM for STAR TRD**

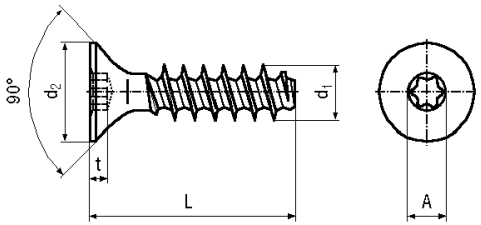
Detector assembly (V1)

Assembly of the 3 GEM foils



BN 11308

PT®-Flat countersunk head screws
Torx plus® / Autosert®
heat treated

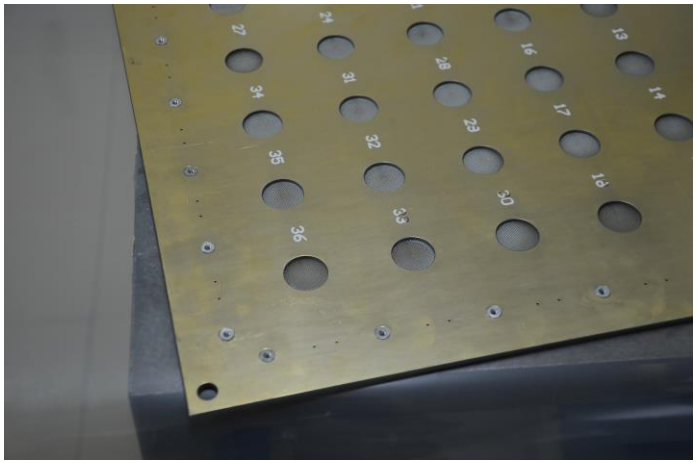


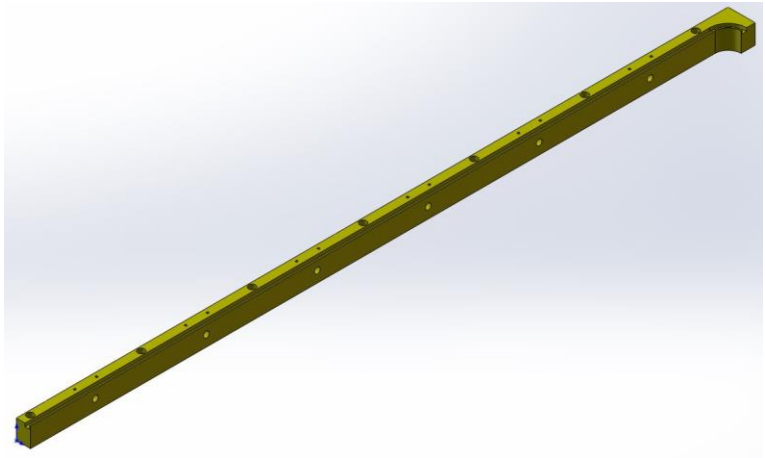
Trade mark	PT®	Surface	zinc plated blue
Type	WN 1423	Tensile strength	1000 N/mm2
Material	Steel	Hardness	320-390 HV

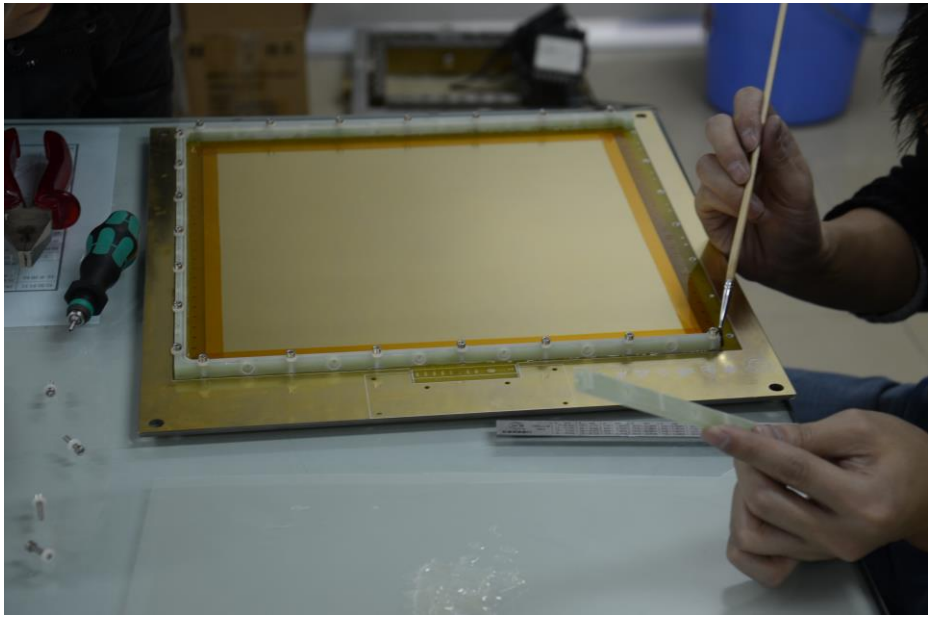
Article No. - 3060095	
ø nominal	K25
d_1	2,5
L	10
d_2	4,7
Torx plus®/Autosert®	8 IP
A~	2,4
t min.	0,7
t max.	0,9

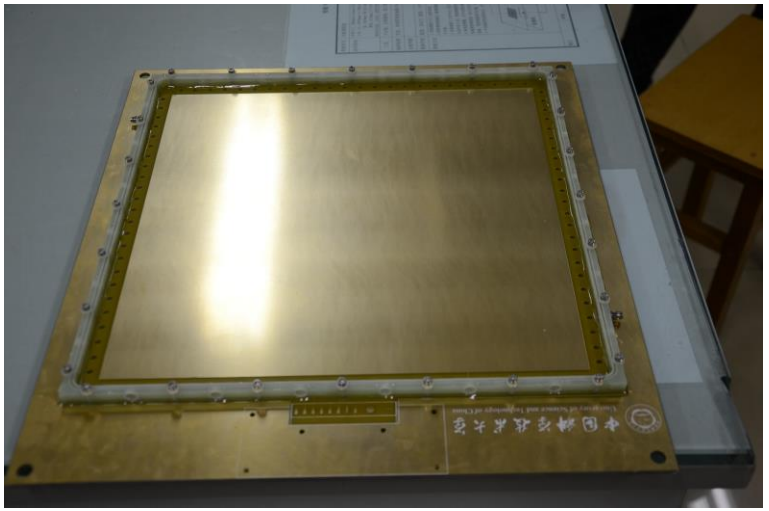
Detector assembly (V1)

Assembly of the main frames



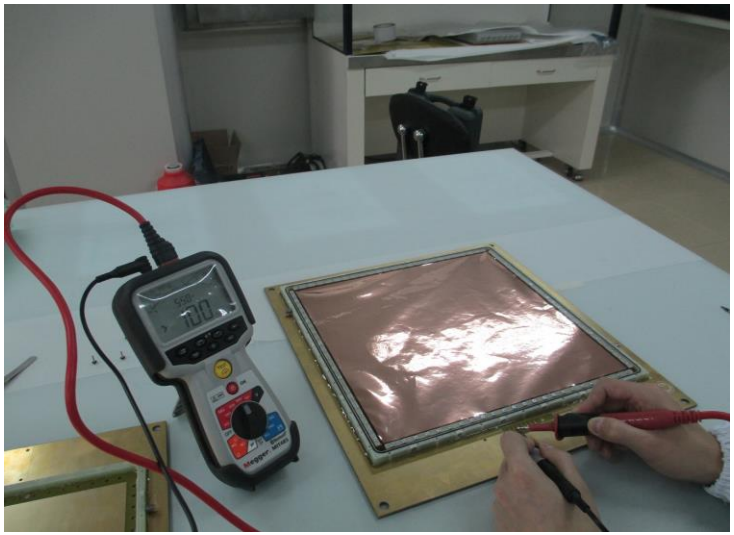


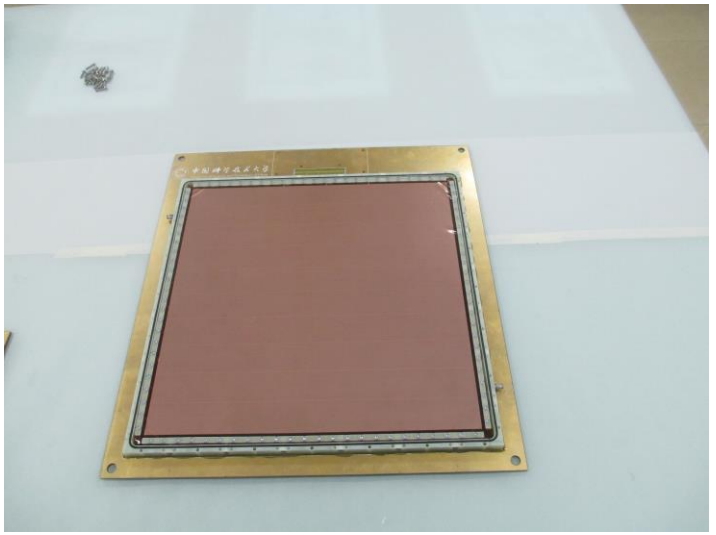


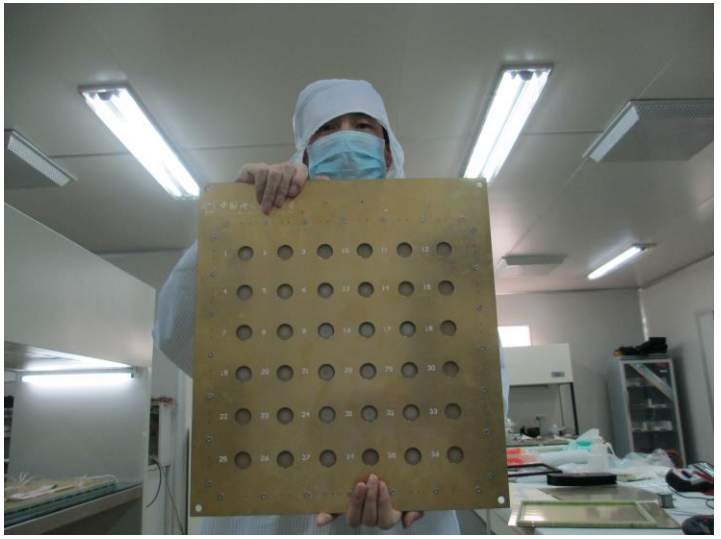


Detector assembly (V1)

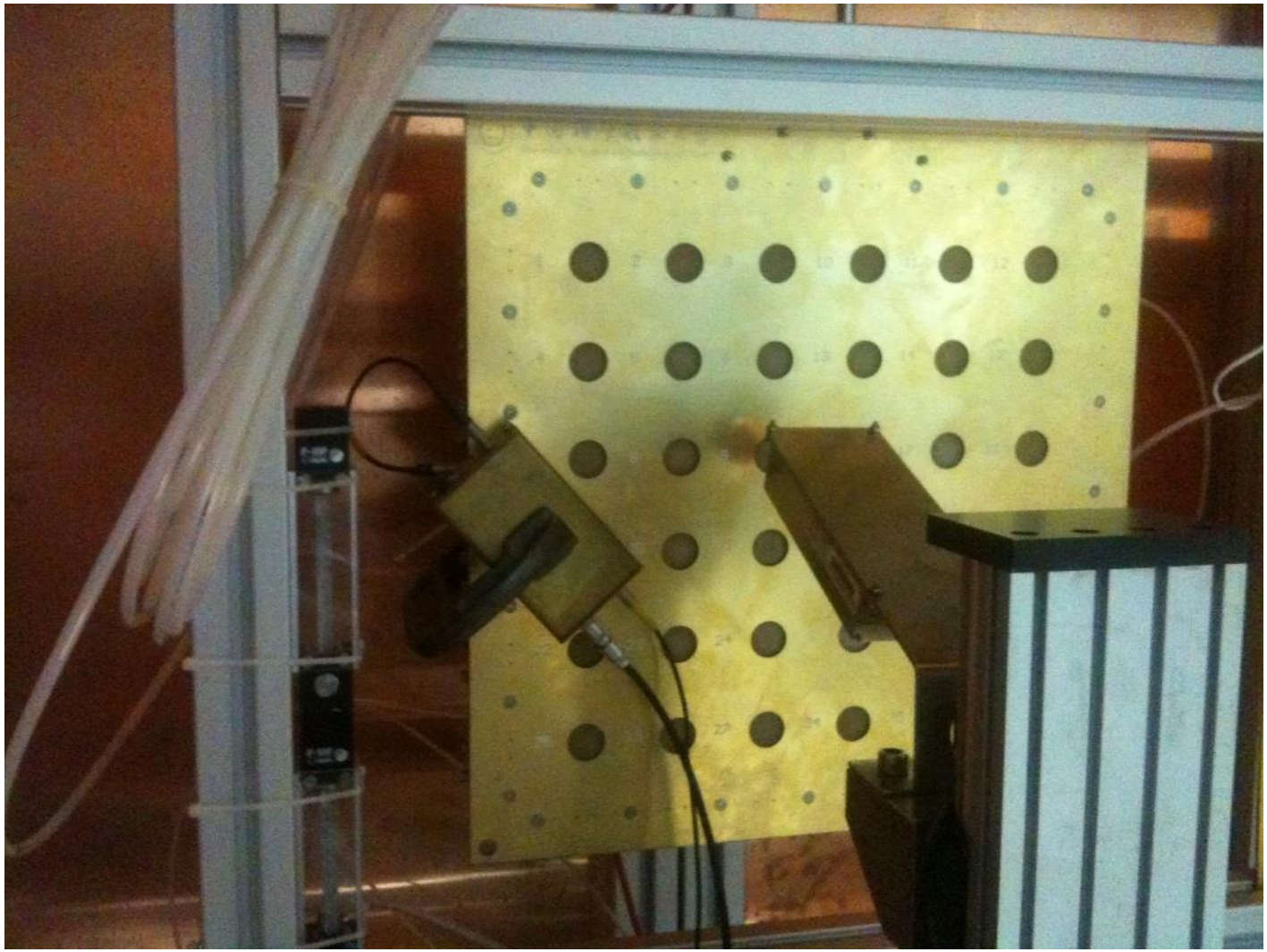
Assembly of the detector



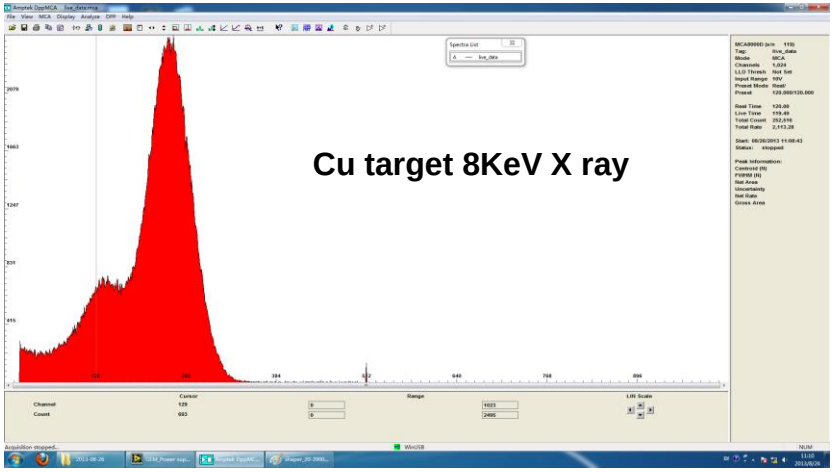




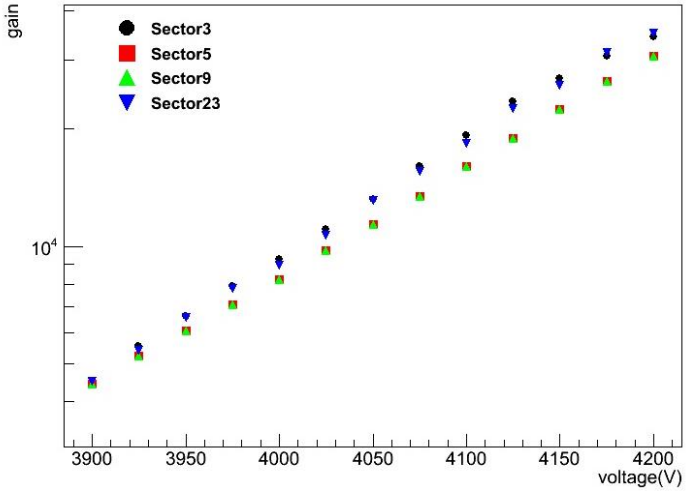
Gain measurement system (V1)



Results of the gain (V1)

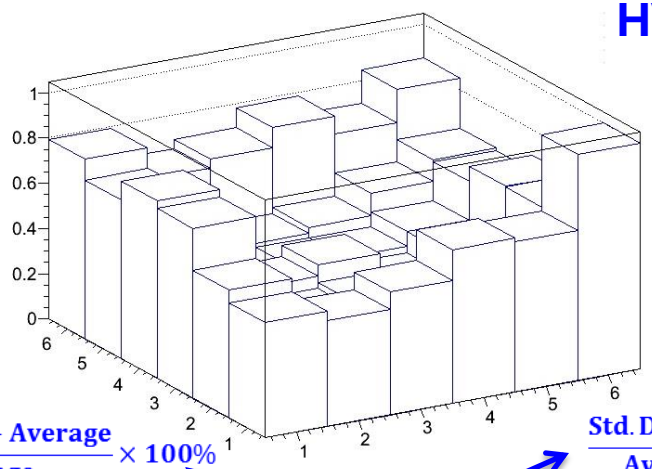


Gain Uniformity



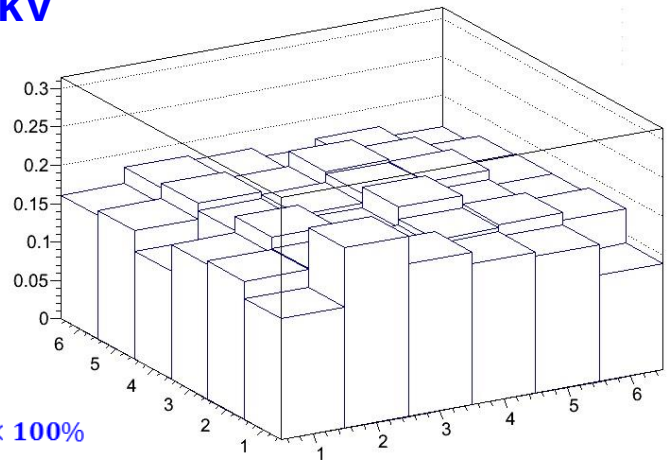
energy resolution

HV=3.9kV



$$\frac{\text{Max(Min)} - \text{Average}}{\text{Average}} \times 100\%$$

Max : 71.5%; Min: -36.0%; σ= 27.8%



$$\frac{\text{Std. Deviation}}{\text{Average}} \times 100\%$$

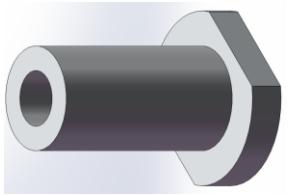
Max: 26.3%; Min: -25.3%; σ= 9.7%

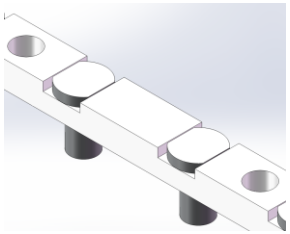
Disadvantages of the design (V1)

- The head of self tapping screws has an angle of 90°, the screws will produce the horizontal force onto the frames and make the frames be distorted
- The Epoxy frames for GEM foils are not hard enough, the screw threads on the frames are very easy to be destroyed by the self tapping screws
- The assembling process of the GEM foils produces epoxy dusts and metal dusts, these dusts may drop into the GEM foils and cause problems
- The nuts for main frame were smashed into the PCB, it is able to cause the distortion of the drift PCB
- The bad mechanical tolerance of the main frame results in the distortion of the PCBs and makes the gain uniformity be worse
- The main frames are glued onto the drift PCB, the gluing and drying process takes about 2 hours. Both of the main frame and the drift PCB are not replaceable

Detector assembly (V2)

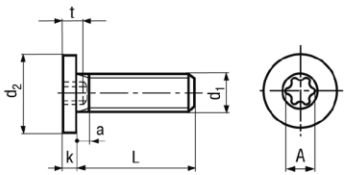
Assembly of the 3 GEM foils





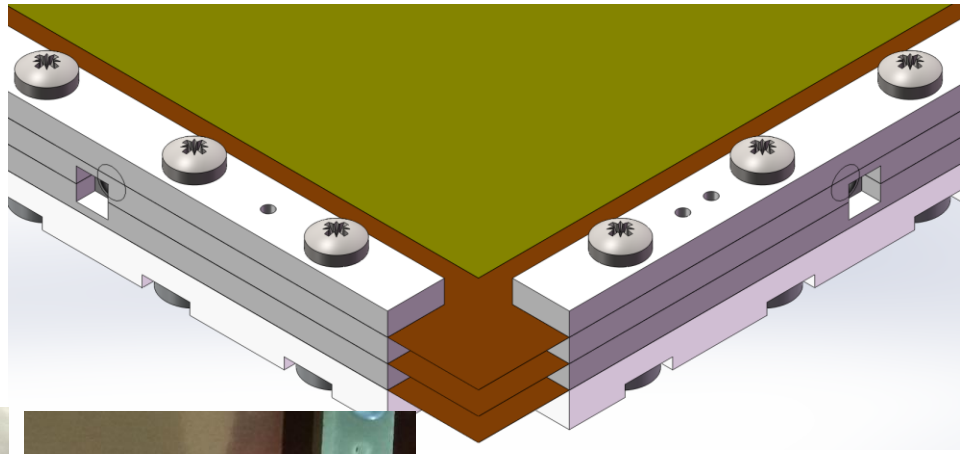
BN 9524

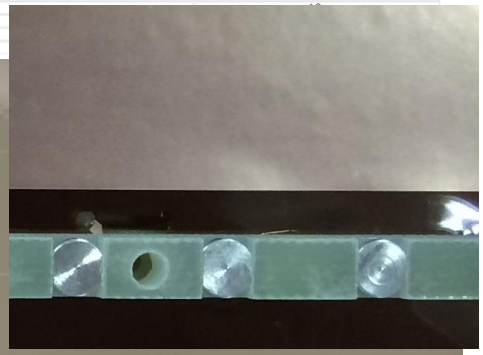
Hexalobular (6 Lobe) socket flat head screws
with special low head, fully threaded



Material	Steel	Quality	~08.8
Surface	zinc plated blue		

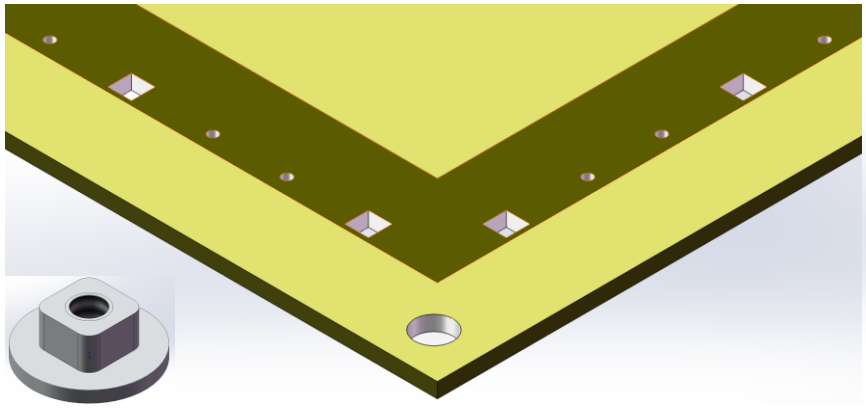
Article No. - 3555993	
d_1	M2
L	10
d_2	4
k max.	1,27
a min.	0,5

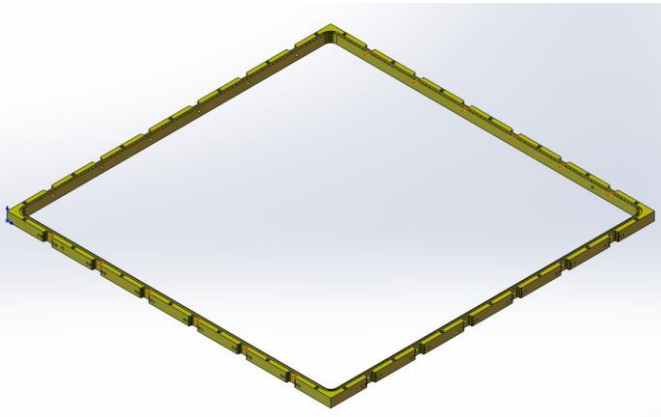


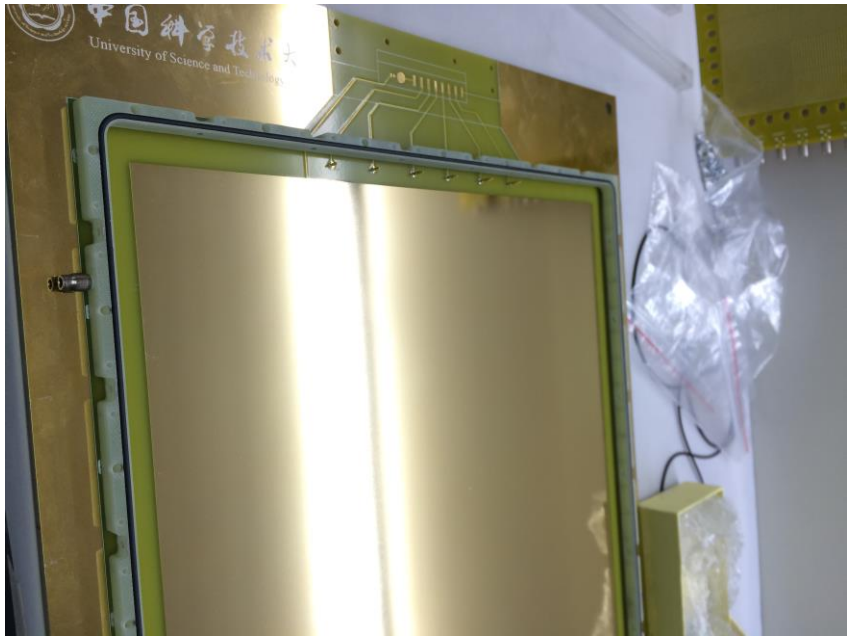


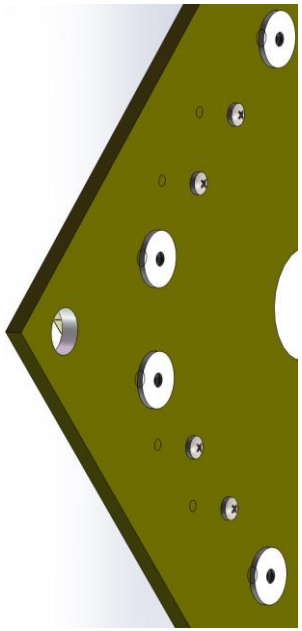
Detector assembly (V2)

Assembly of the main frames





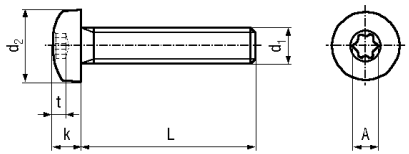




BN 20005 - ISO 14583

Hexalobular (6 Lobe) socket pan head screws fully threaded

ISO 14583

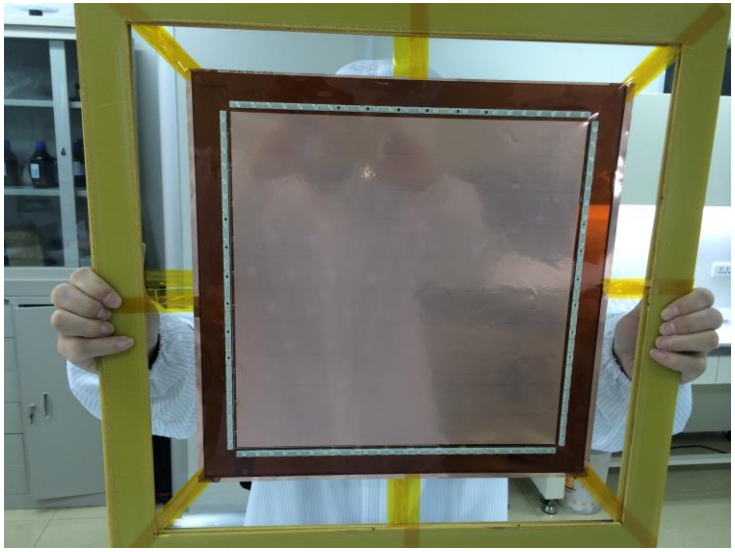


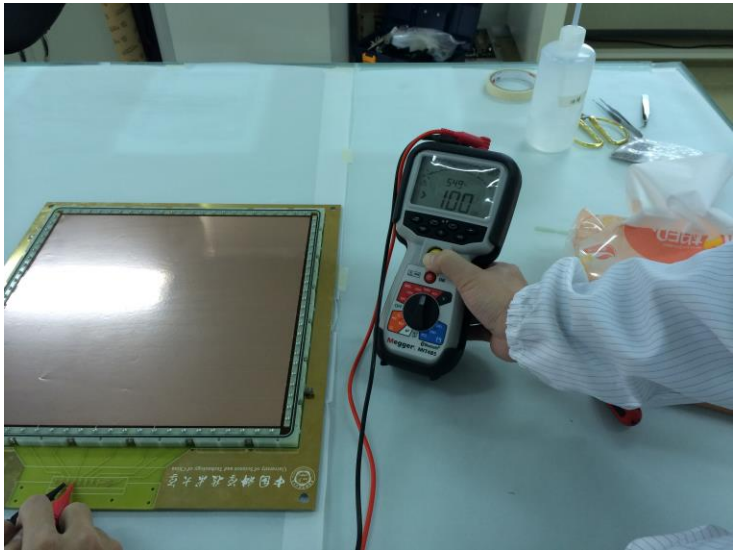
Material	Steel	Quality	08.8 / 8.8
Surface	zinc plated blue		

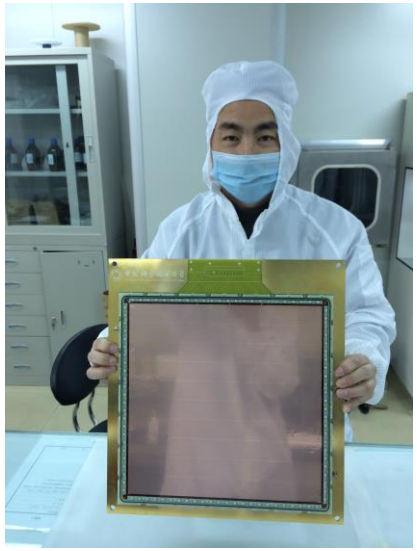
Article No. - 3148249	
d_1	M2
L	8
d_2 max.	4
k max.	1,6
c	X6
t max.	0,77
A~	1,75

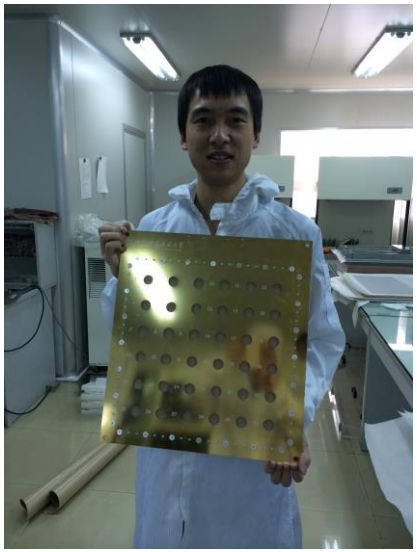
Detector assembly (V2)

Assembly of the detector



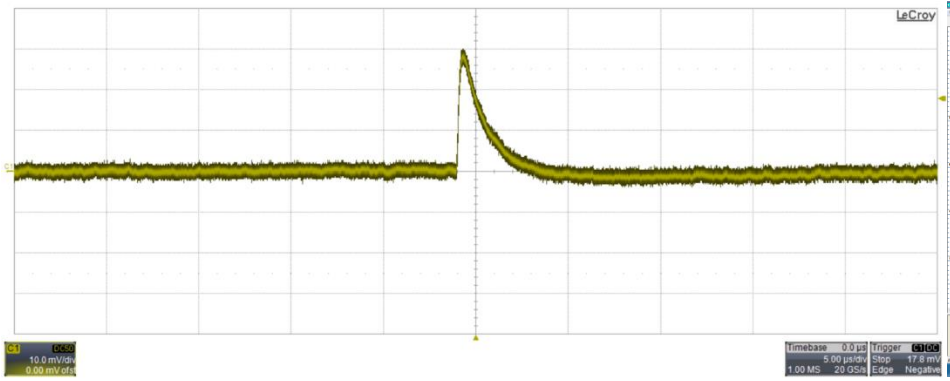


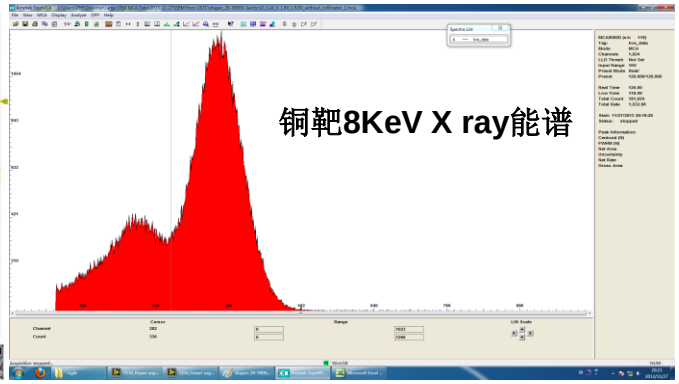




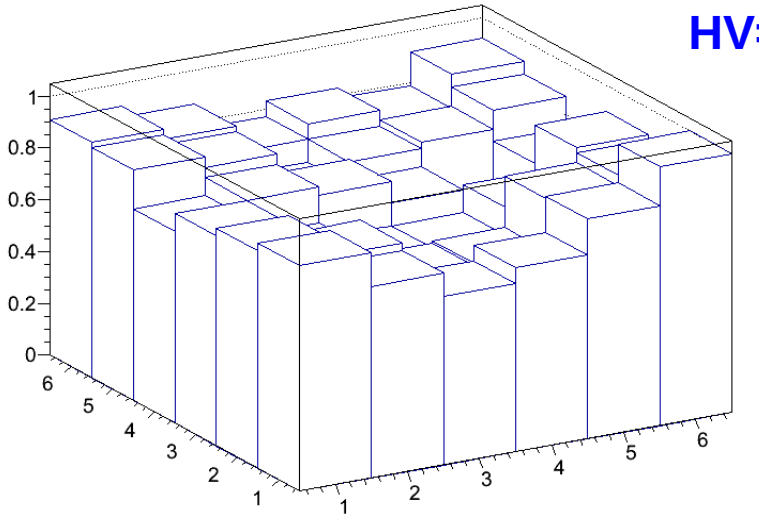
Results of the gain (V2)

Tested after assembly



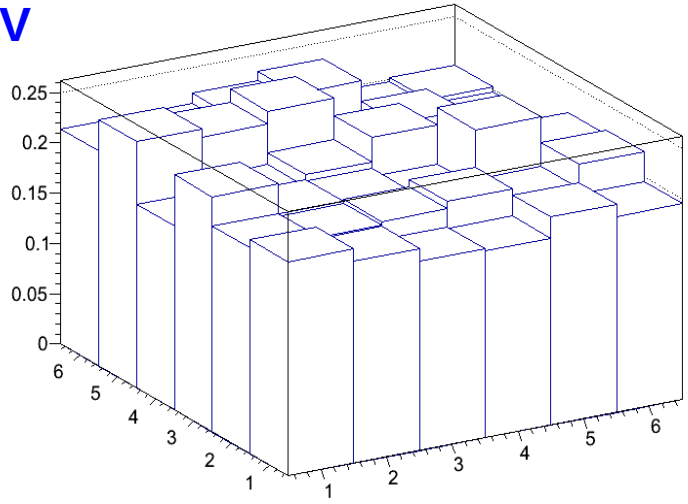


Gain uniformity



HV=4kV

Energy resolution



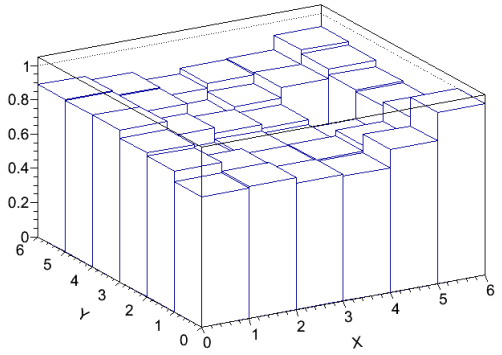
Max: 27.6%; Min: -22.7%; σ = 12.3%

Max: 23.2%; Min: -13.3%; σ = 8.8%

Gain uniformity VS HV

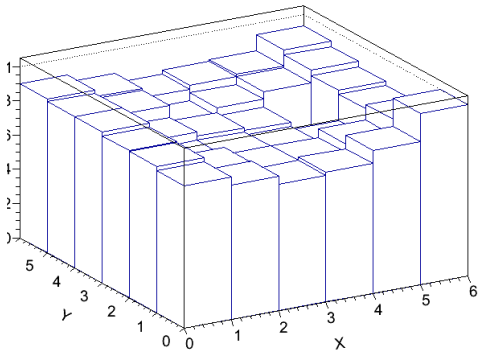
Tested after a long time of radiation

Gain Uniformity 3900V



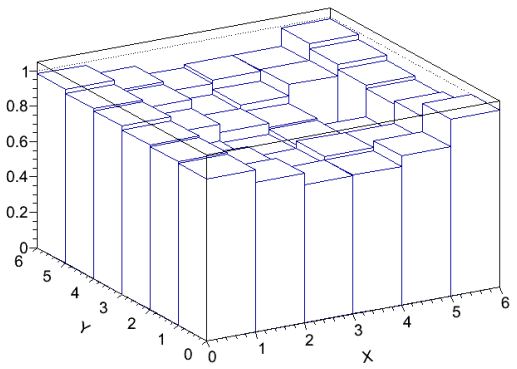
Max: 23.6%; Min: -13.8%; σ = 8.8%

Gain Uniformity 3950V



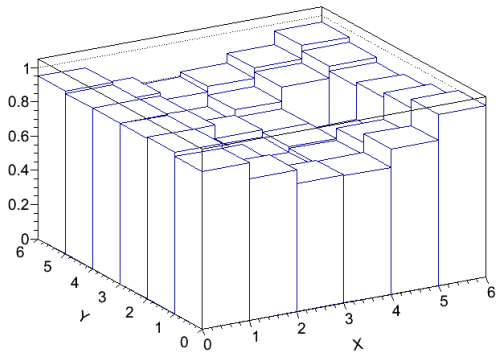
Max: 23.0%; Min: -14.5%; σ = 8.6%

Gain Uniformity 4000V



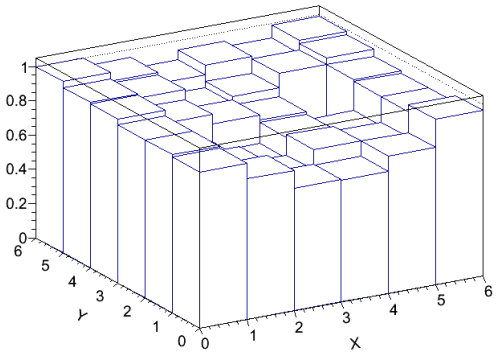
Max: 15.5%; Min: -13.5%; σ = 8.6%

Gain Uniformity 4050V



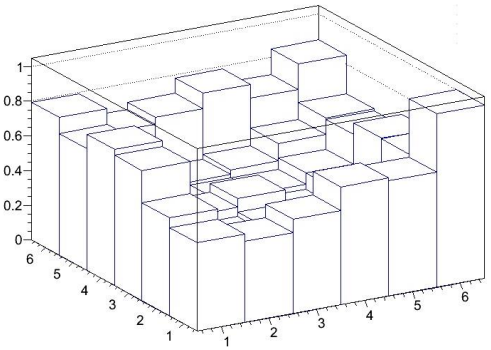
Max: 20.0%; Min: -15.5%; σ = 10.8%

Gain Uniformity 4100V



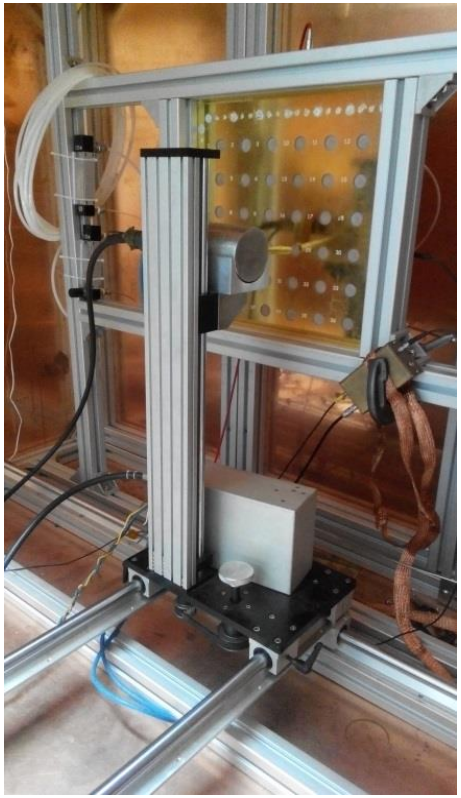
Max: 16.1%; Min: -23.11%; σ = 11.0%

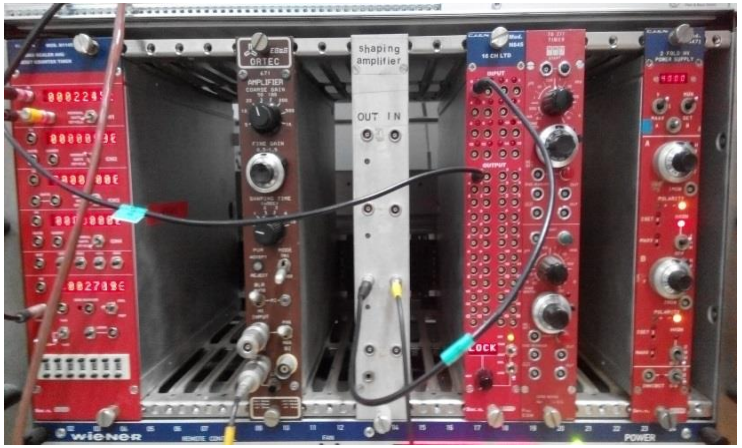
Gain Uniformity(V1) 3900V



Max : 71.5%; Min: -36.0%; σ= 27.8%

Test of the effective gas gain





HV

X-Ray → GEM → Pico-ammeter

Pre-Amplifier

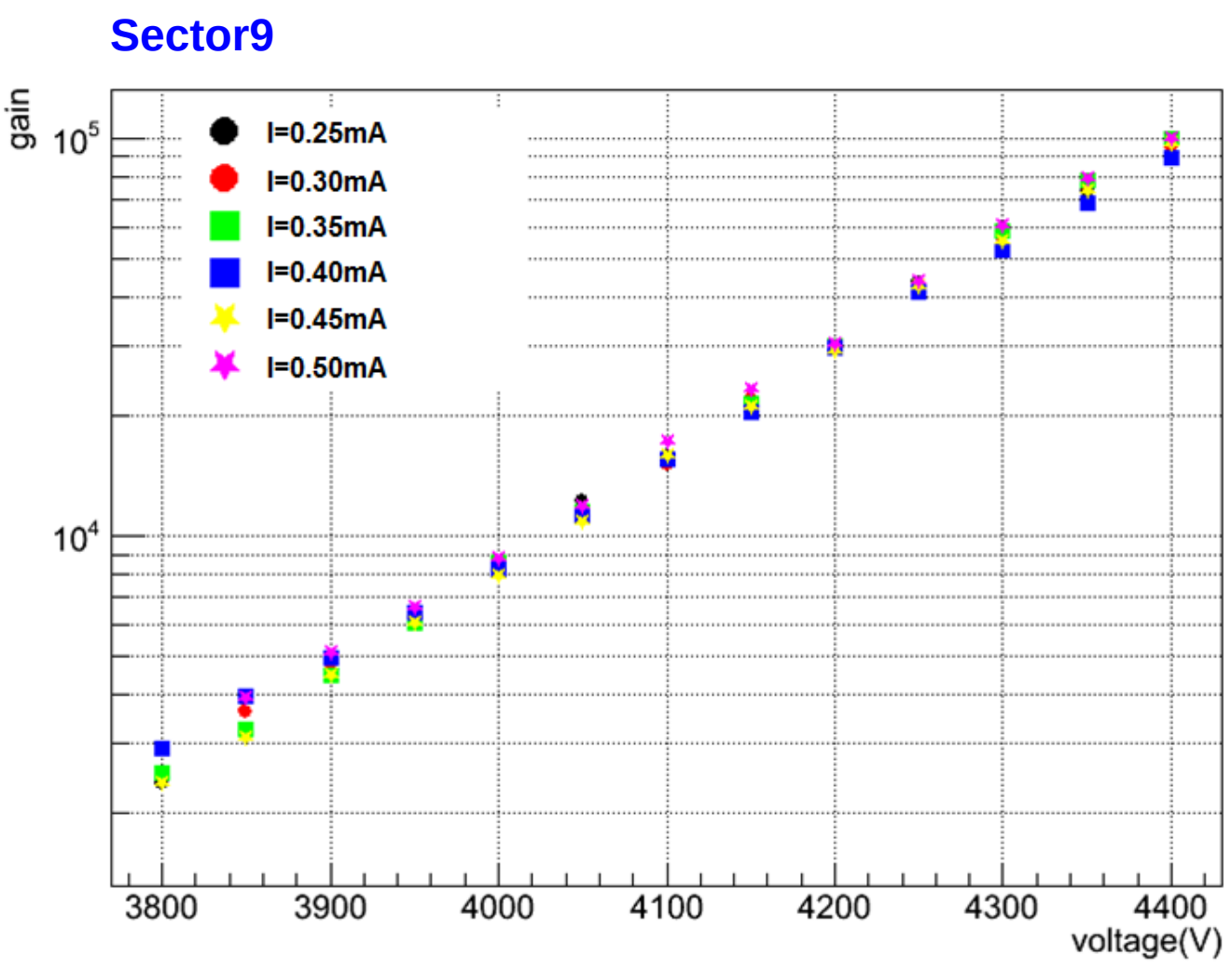
Shaper → MCA

Disc.

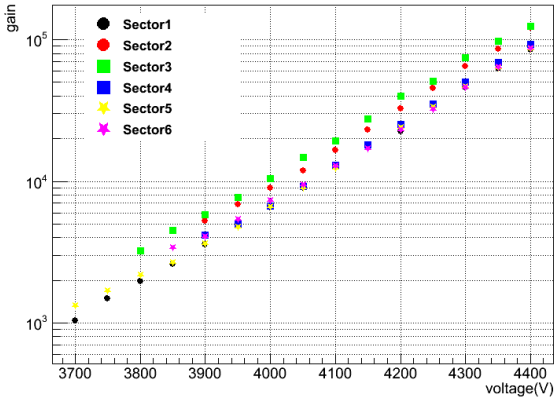
Scalar

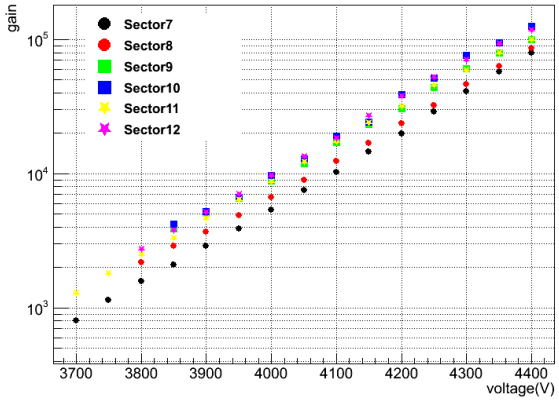
$$G = \frac{I}{R \times e \times \frac{8keV}{26.4eV}}$$

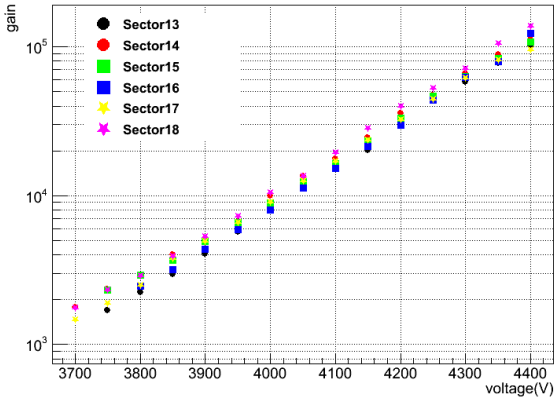
Effective gas gain VS rate

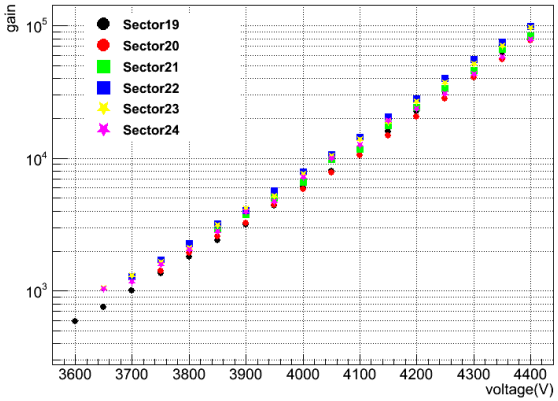


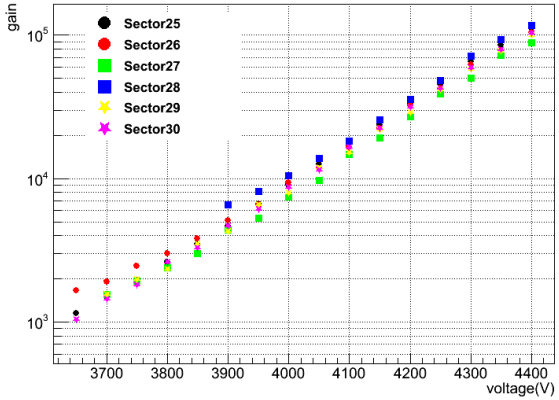
Effective gas gain VS HV

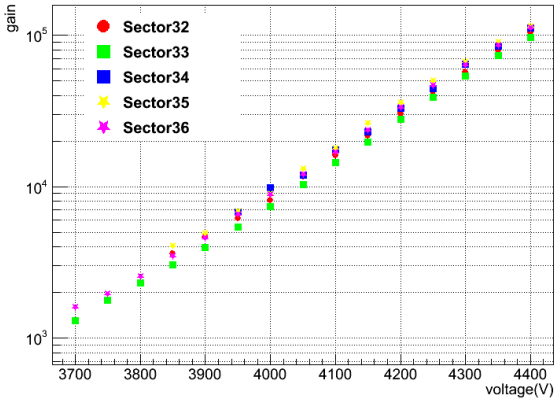






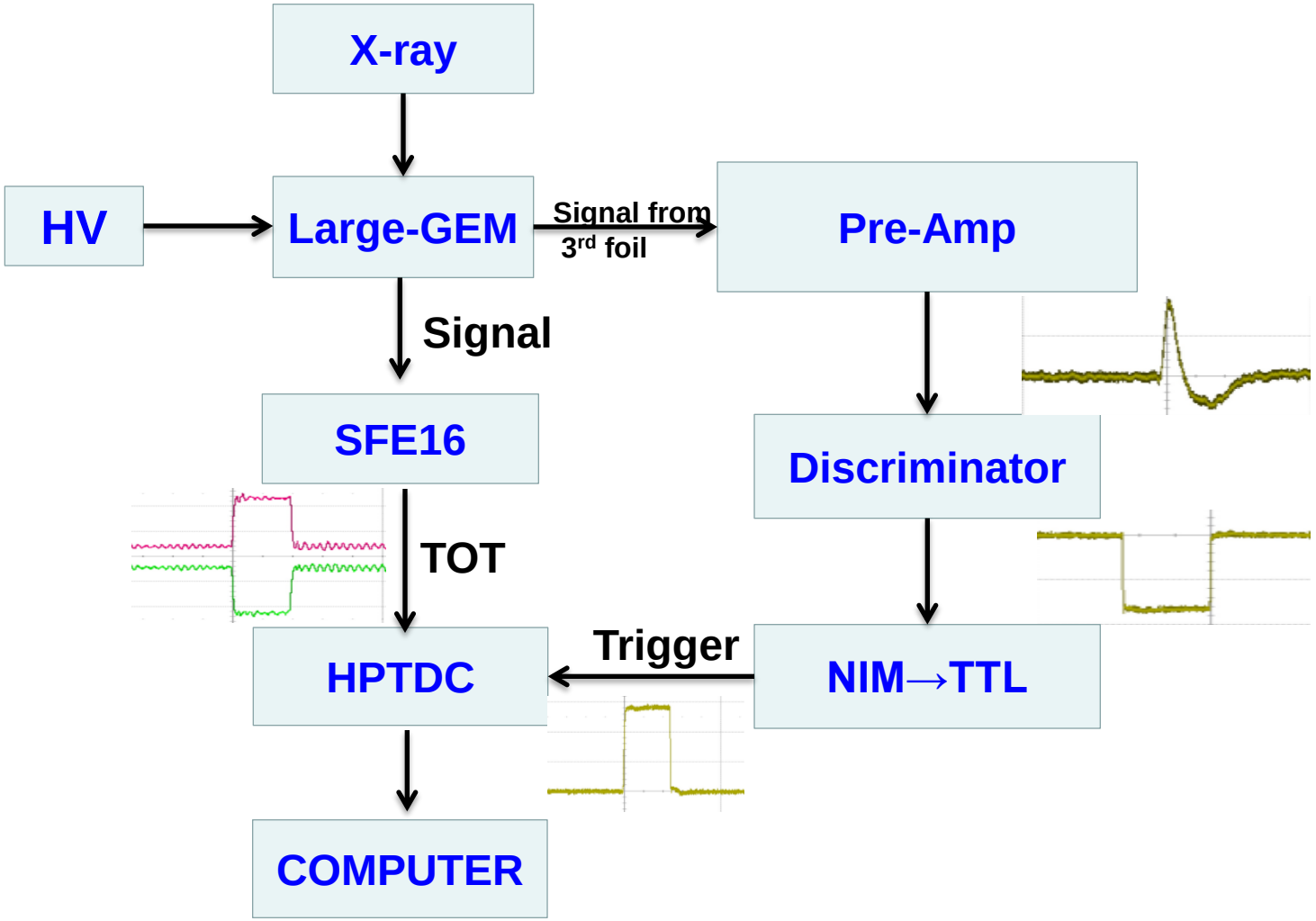






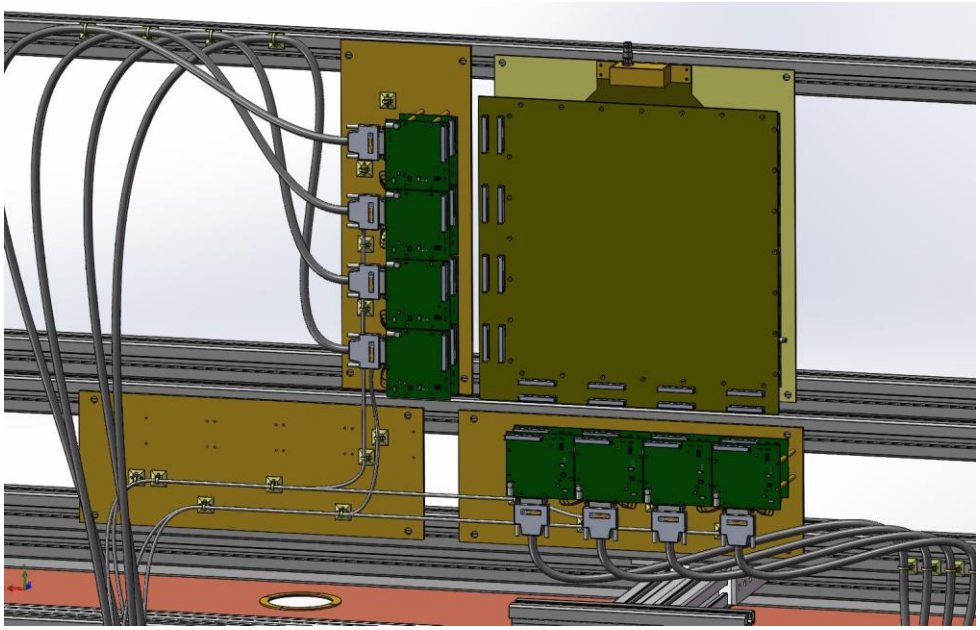
Position resolution measurement

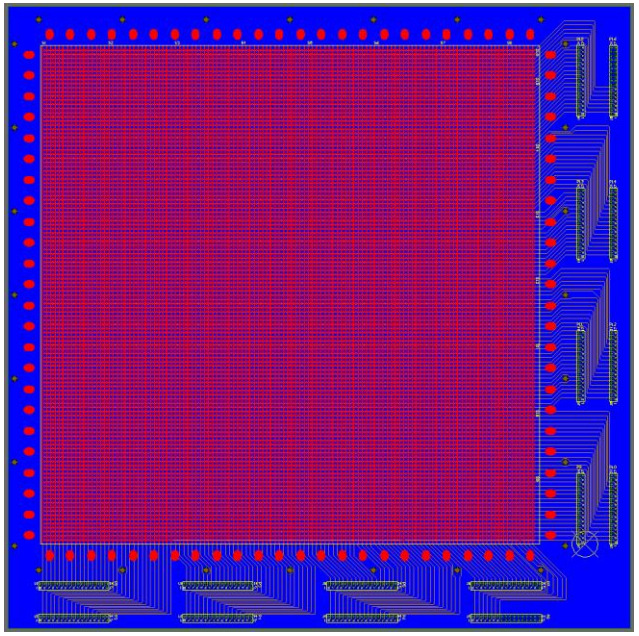
Flow chart



Position resolution measurement

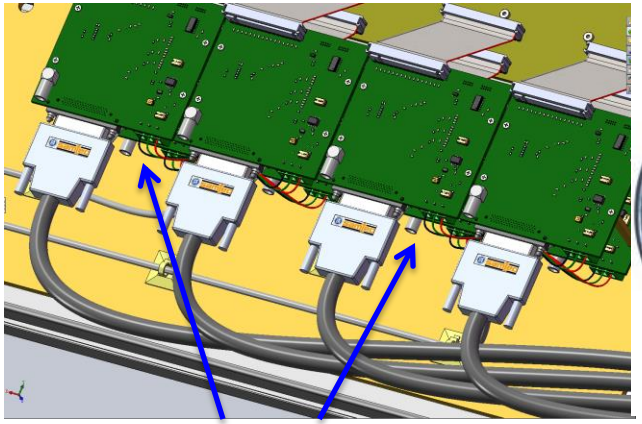
Design of the test system



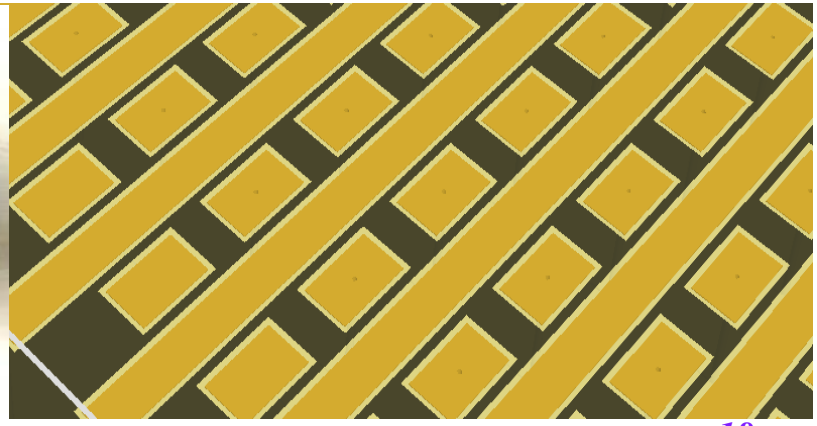


Width:
1.0mm(x)
1.5mm(y)

Pitch:
2.54mm

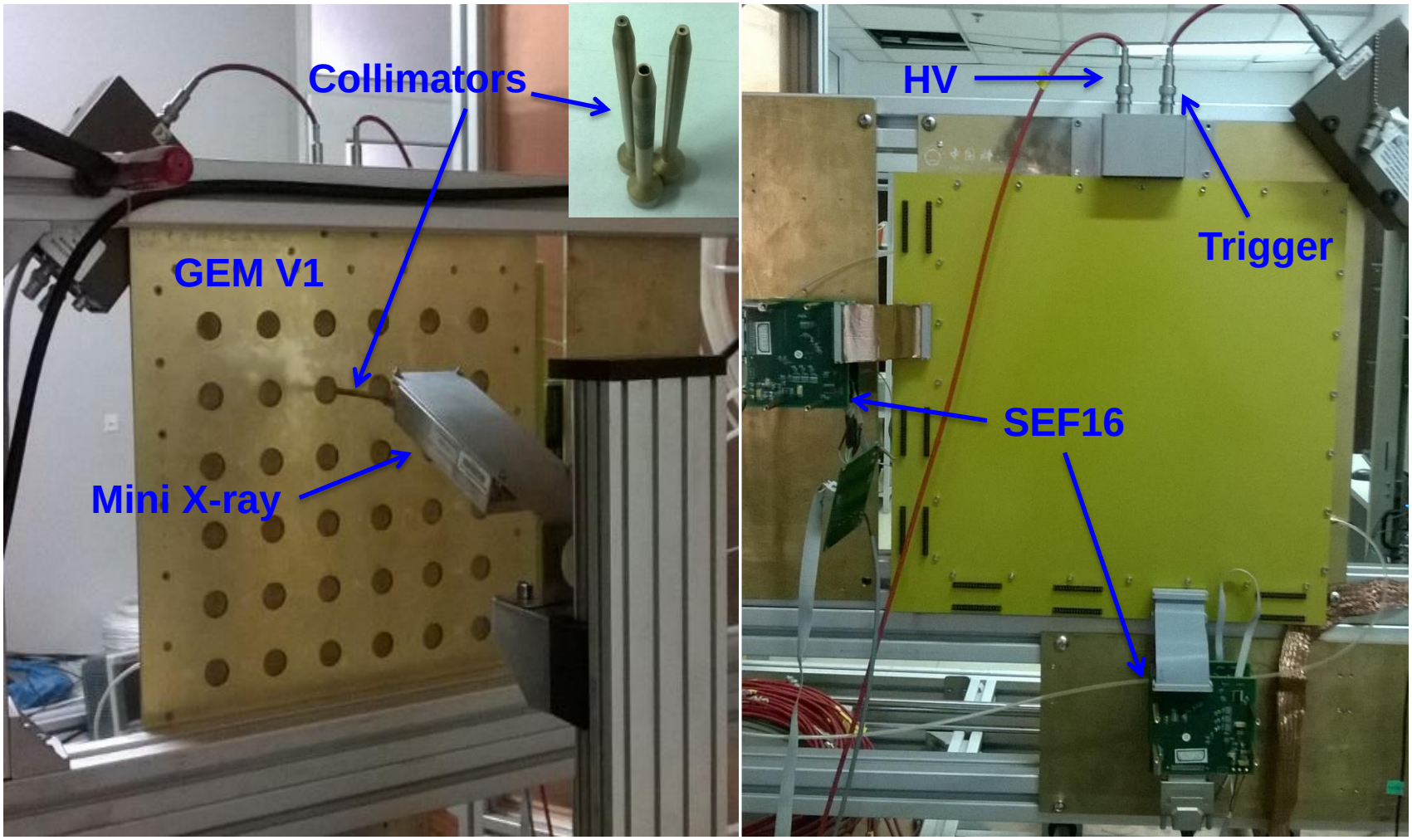


SFE16



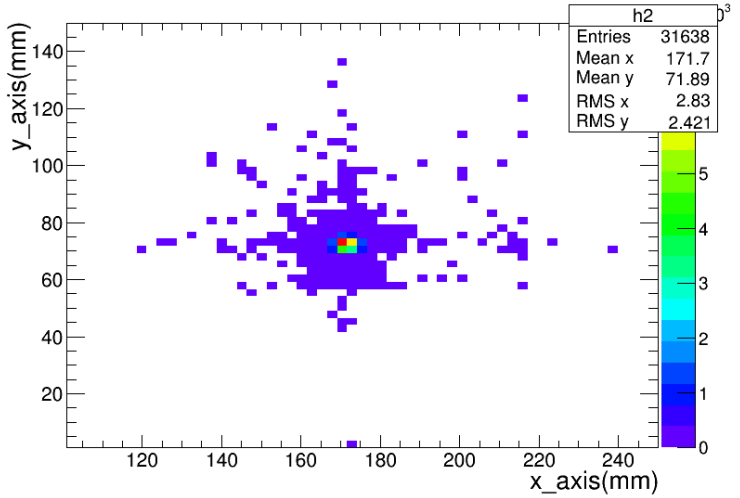
Position resolution measurement

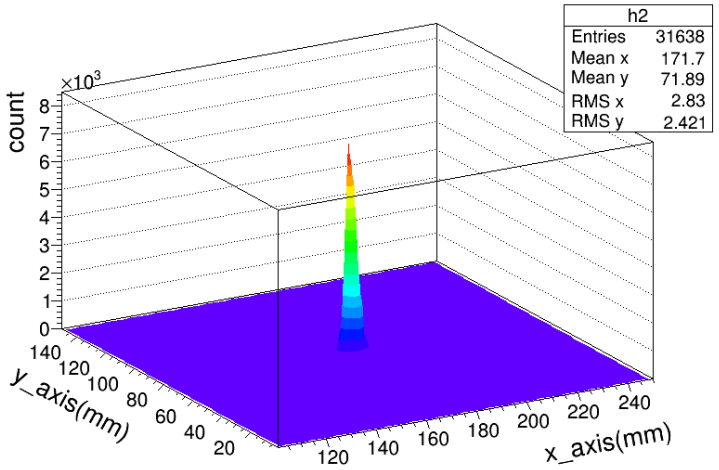
The 1st experiment setup for FEE debugging

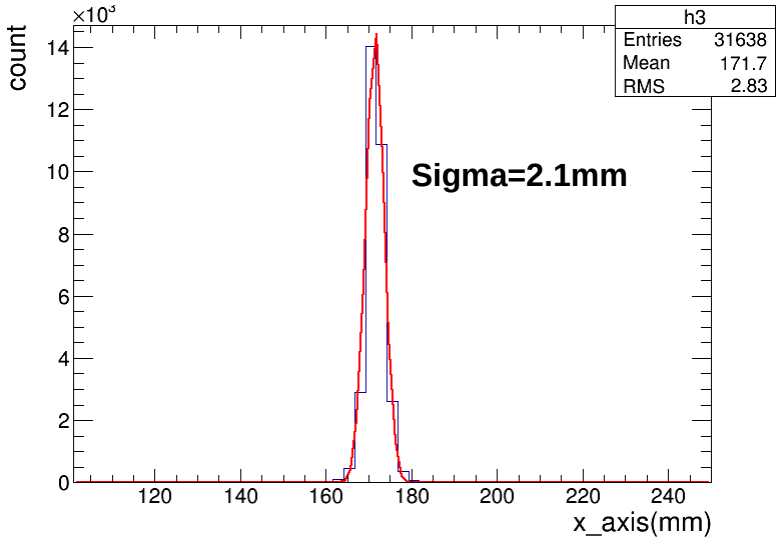


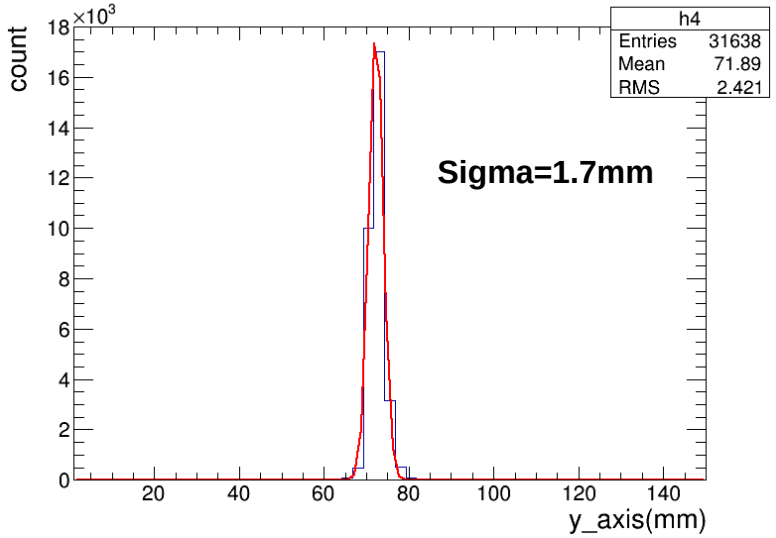
Position resolution

The 1st result (not accurate!!!)





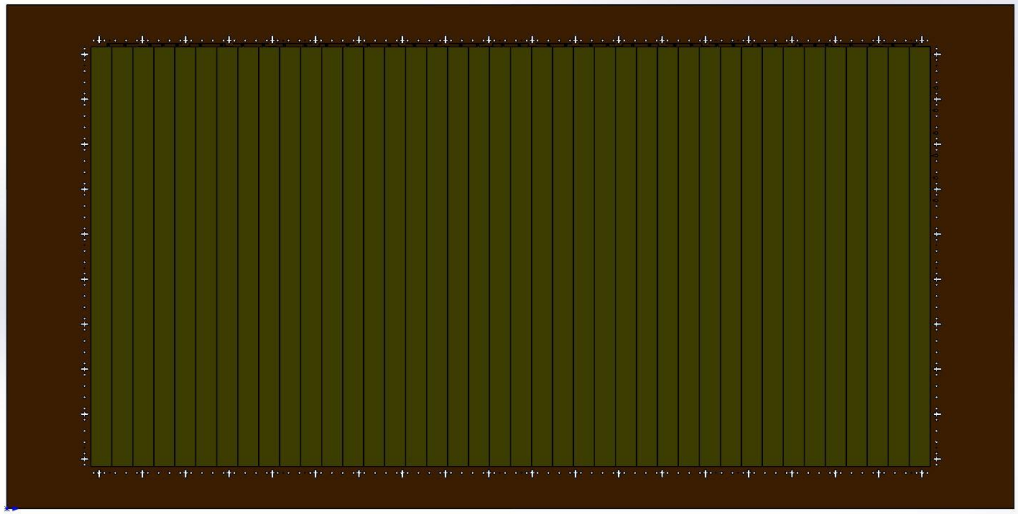


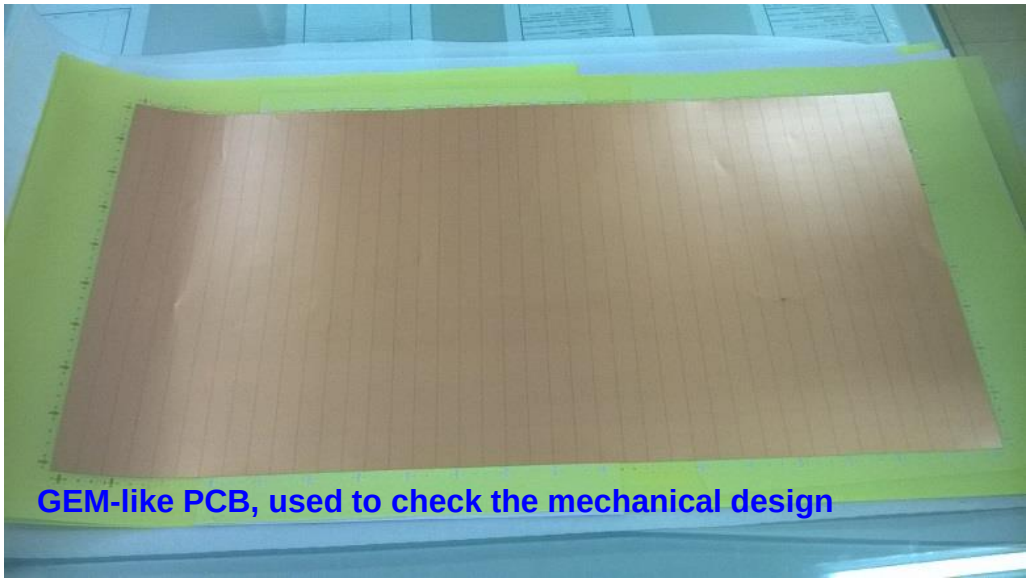


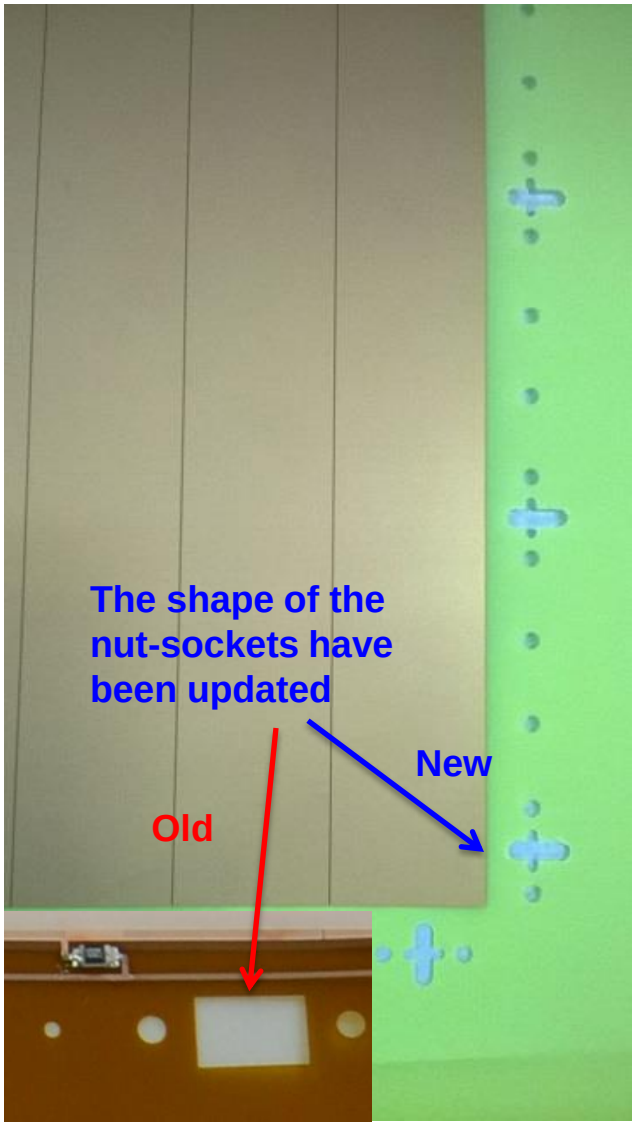
The SFE16 should be calibrated, this work will be done soon.

Design of 100cm×50cm GEM

Design of the 100cm×50cm GEM foil

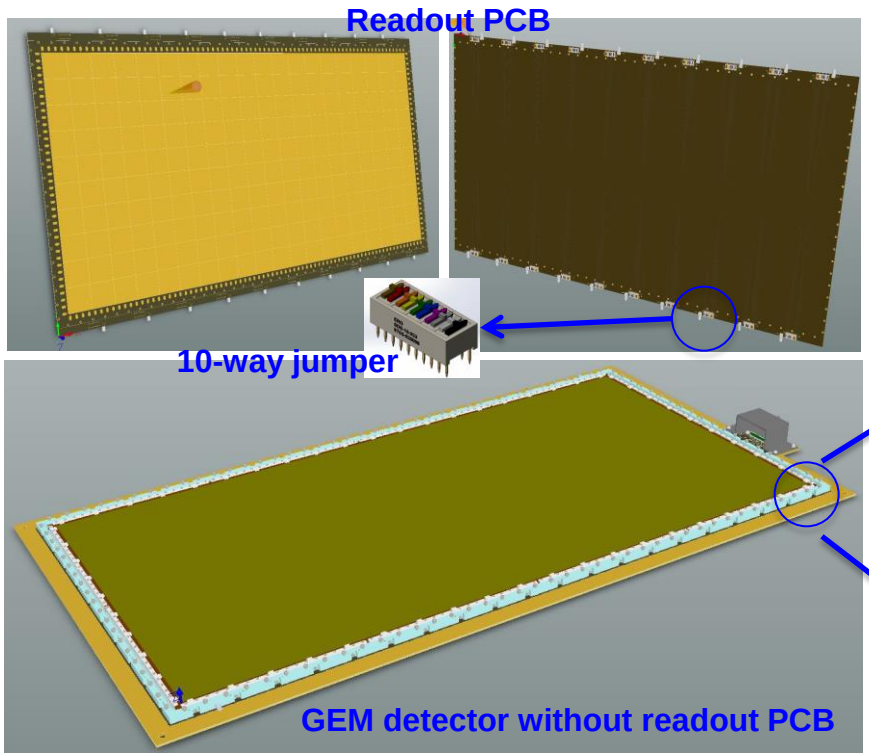


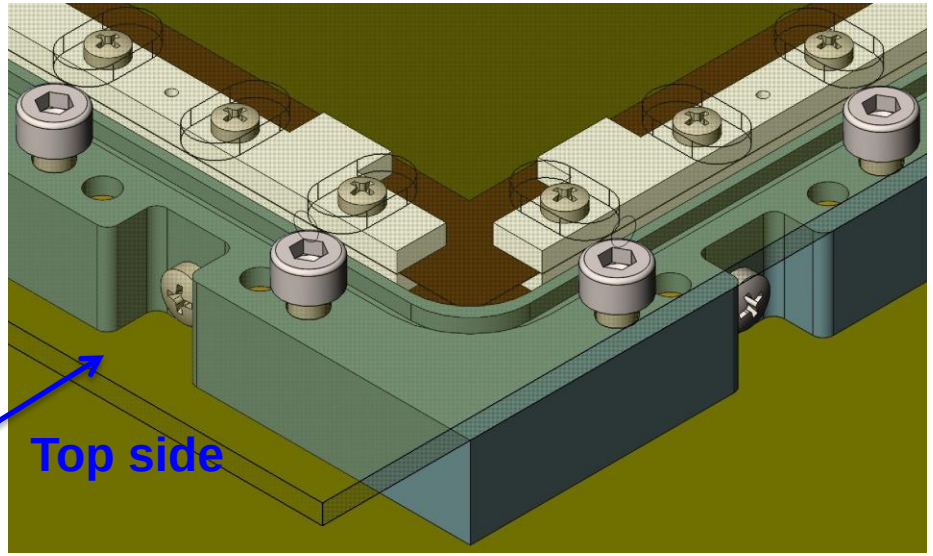


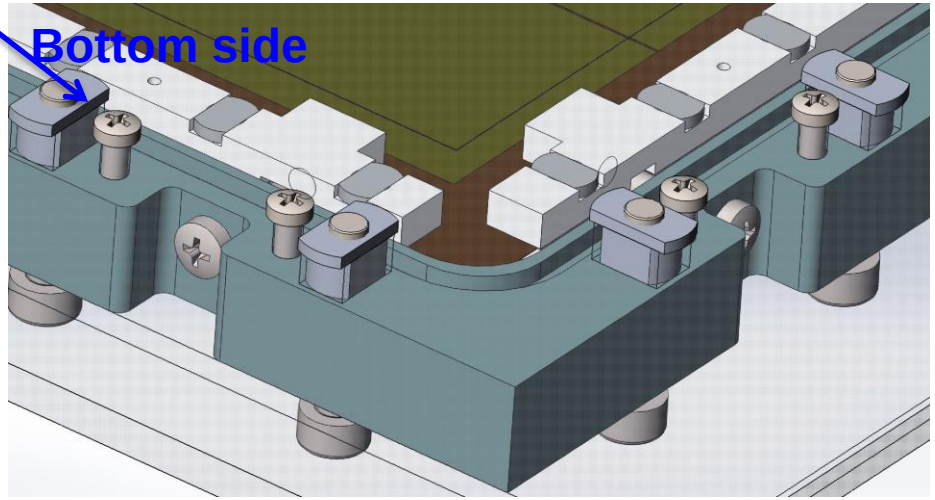


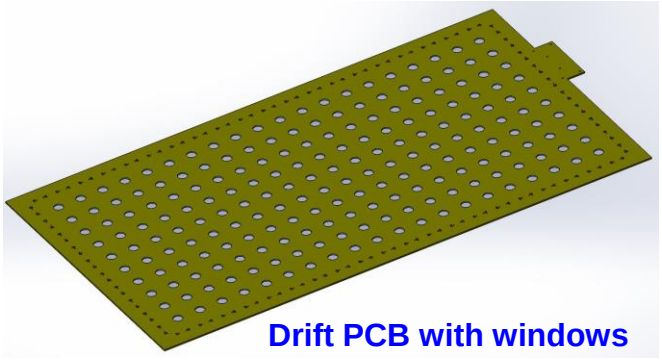
Design of 100cm×50cm GEM

3D model of the 100cm×50cm GEM detector



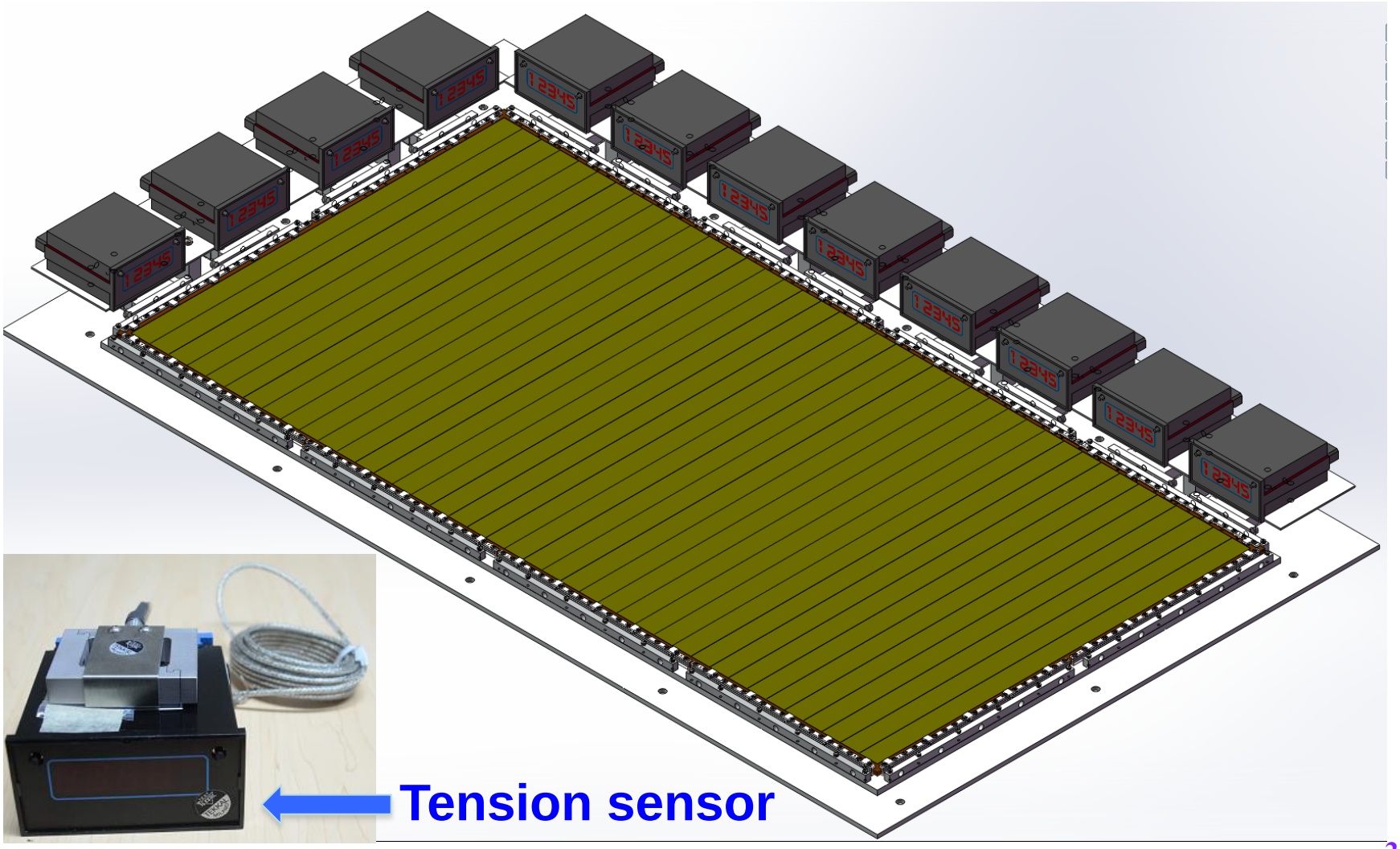






Design of 100cm×50cm GEM

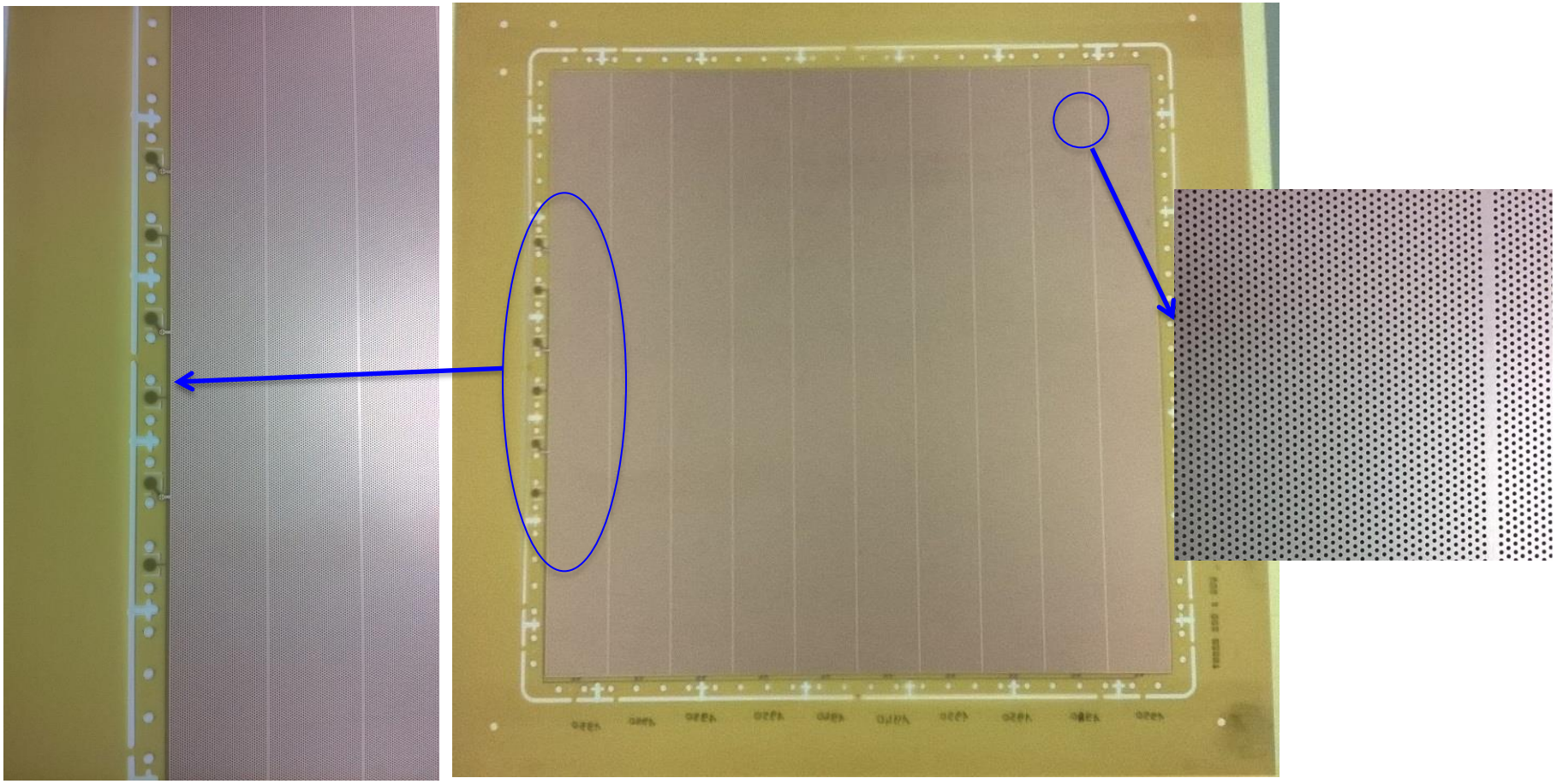
Tension measurement platform



Tension sensor

THGEM R&D for STAR TRD

Size: 30cm×30cm; Thickness: 0.4mm; Hole: 0.4mm; Pitch: 0.8mm



TRD requires that the detector should have a 4cm drift gap.
All the frames and HV transfer route will be designed in near future.

Summary & near future work

1. We have built two 30cm×30cm GEM detectors, the 2nd detector has a good gain performance. The NS2 technique has been updated during the R&D period. Using the new NS2 technique, the assembling process is more convenient and safer.

2. The FEE system based on SFE16 now works well, the calibration of all the SFE16 chips will be done soon. The readout PCB will be replaced by a new one which has small strip width and pitch. The position resolution measurement based on SFE16 system will be finished before the end of September, and the measurement based on APV25 system will be started in October.

3. The design of the 100cm×50cm GEM detector system is finished, some parts have already been in production. We will start the detector construction at the end of 2014.

4. A 30cm×30cm THGEM with a "3-2-2-2" structure will be built soon, this detector will be used to check the foil performance. The design of "40-x-x-x" THGEM will be finished before the end of 2014.