



A proposal to equip the high eta muon stations with High Rate GRPC

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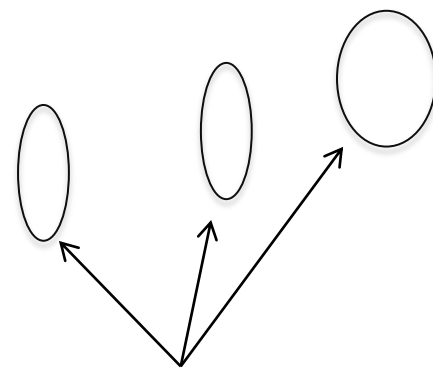
OUTLINE

- Proposal goals
- R&D activities
- R&D strategy
- Conclusion

GRPC R&D goals

The aim of this R&D is to show that we can build a GRPC detector satisfying the Physics requirement of CMS.

If successful this R&D could lead to a proposal of equipping the REX/1 stations with other detectors (CSC, GEM)



High η (1.6–2.2)

GRPC R&D goals

- Build few GRPC with the same shape foreseen for the RE X/1 RPC with single-gap and multigap detectors.
- Adapt one of the ROC family ASIC readout electronics so it include a TDC with time resolution better than 100 ps.
- Compare strips and pad readout scenarios, analog and digital readout possibilities
- Use/develop CMS DAQ board
- Study the impact of GRPC on the physics performance :
time resolution importance for $H \rightarrow ZZ, WW, \tau\tau$.

R&D activities:

Semi-conductive glass is produced with a special procedure →
Size limitation (30x32 cm²)

To build large detector we need to assemble few glass pieces.

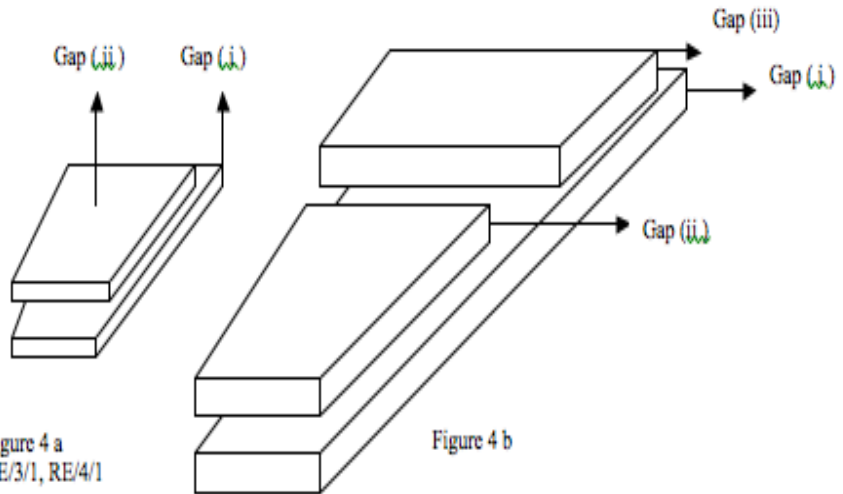
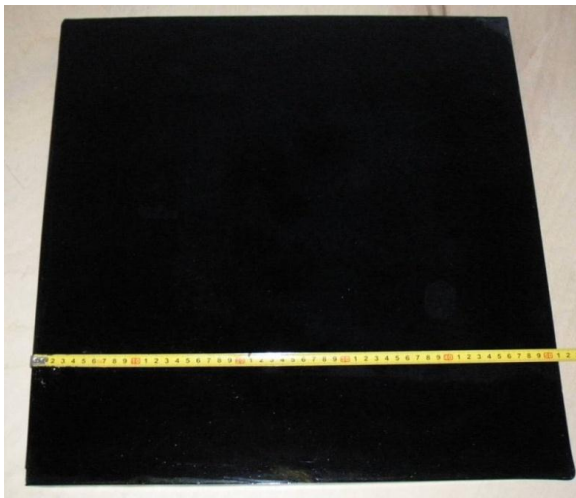
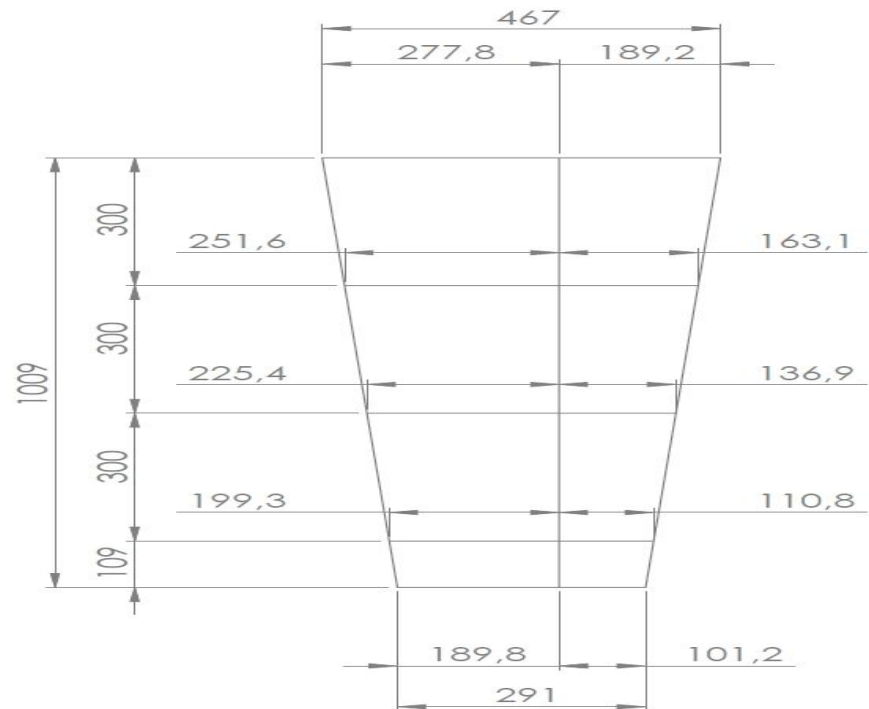


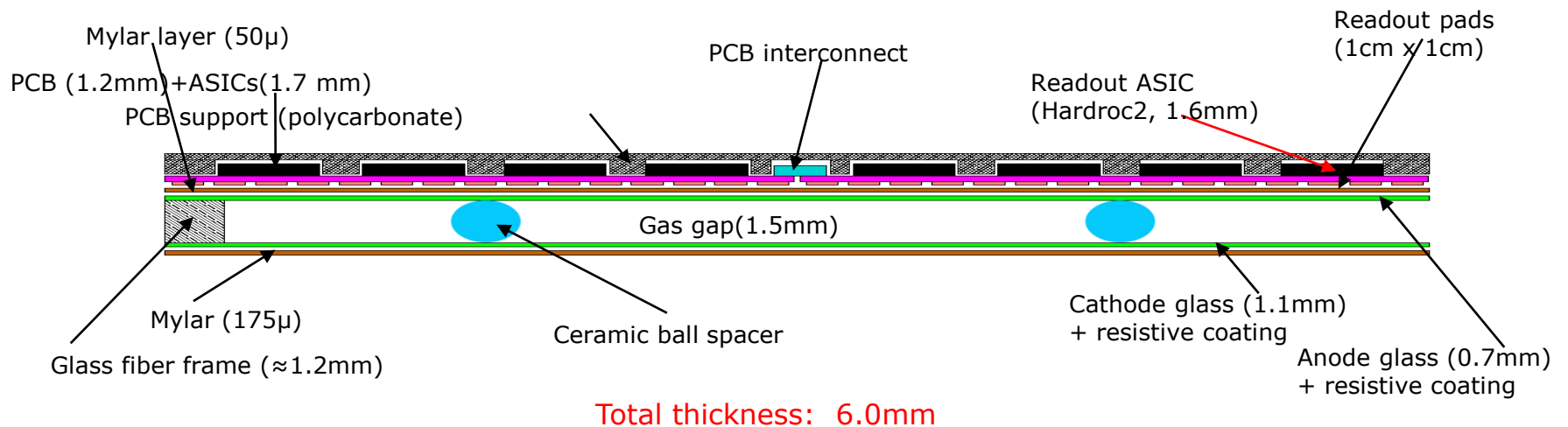
Figure 4 a
RE/3/1, RE/4/1

Figure 4 b

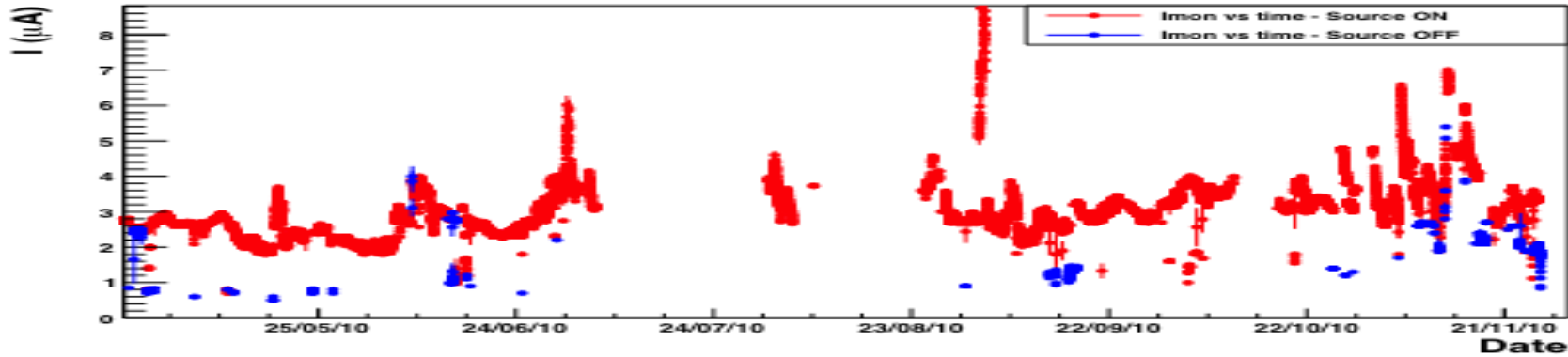


8 small pieces were assembled together using a special glue already used successfully by HARP

We will build few GRPCs using the semi-conductive with single and 6-gap schemes



Irradiation tests



A small LR-GRPC was exposed with the CMS, ATLAS RPC to the GIF source for more than one year

We would like to expose HR-GRPC to a dose of at least the equivalent of 10 years of CMS accumulated charge and monitor not only the GRPC HV current but also the efficiency using cosmic rays. Dedicated exposure of the new electronics can also envisaged



Electronics readout

ASICs : HARDROC2

64 channels

Trigger less mode

Memory depth : 127 events

3 thresholds

Range: 10 fC-15 pC

Gain correction → uniformity

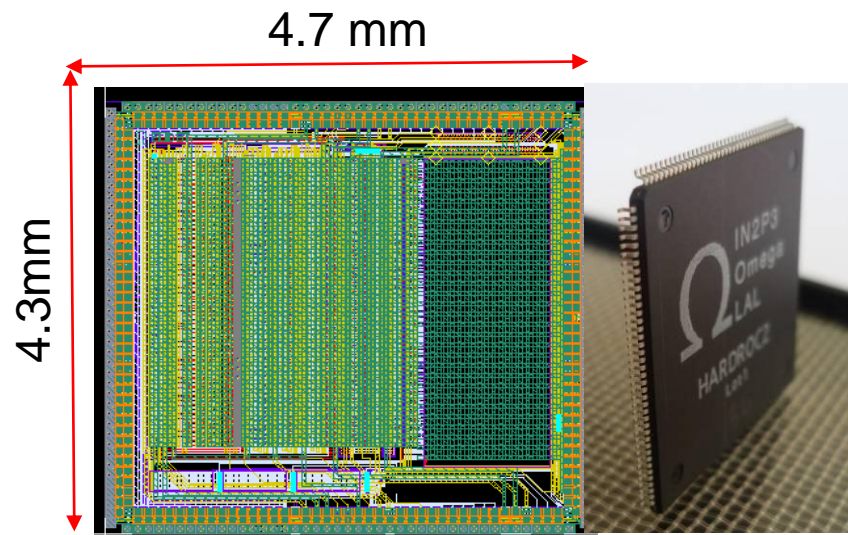
The discriminator resolution is better than 100 ps

We started working on adding time measurement

1- using an FPGA

2- to incorporate a TDC for each of the ASIC channel

It is possible to use/develop other ASICs.





Groups interested in this R&D

France : IPNL, LLR, OMEGA

Belgium : Ghent

Italy : Bari, Bologna, Pavia

Romania: NIPNE-Horia-Hulubei

China : Tsinghua, North China Electric Power University

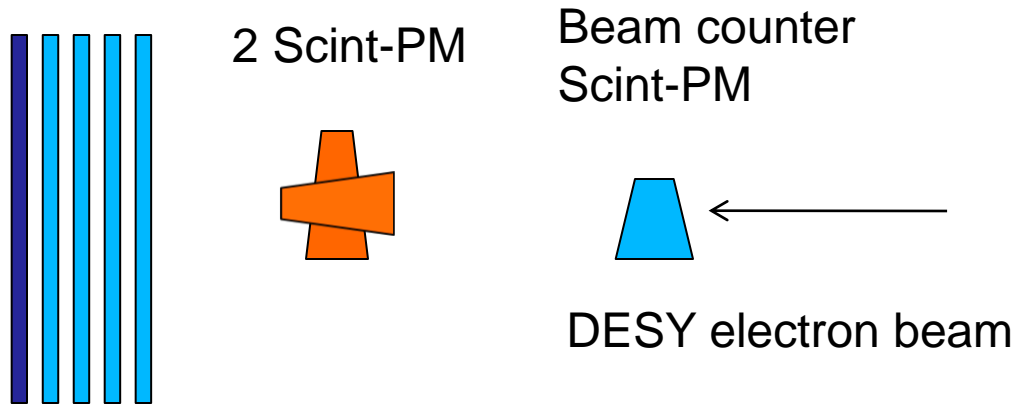
Tunisia : Tunis university.

But you are welcome to join this R&D.

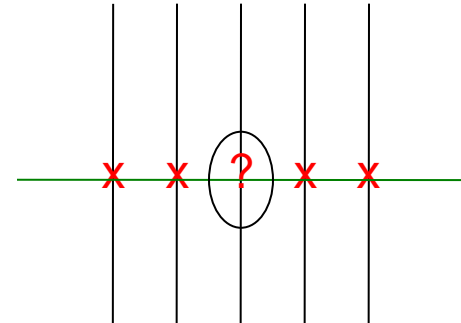


Backup

Beam test setup



GRPC running conditions :
Gas flow : 2 l/h
Gas mixture:
93% R134A, 5% CO₂, 2% SF₆



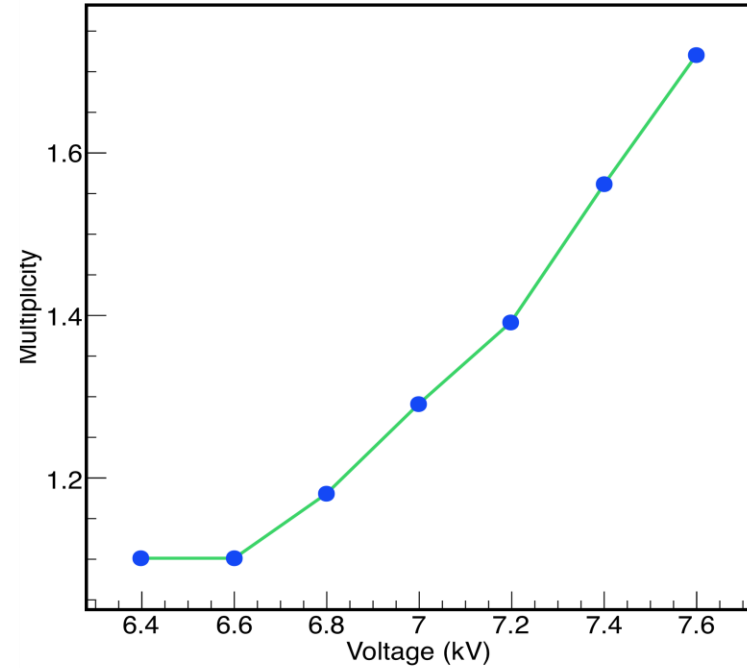
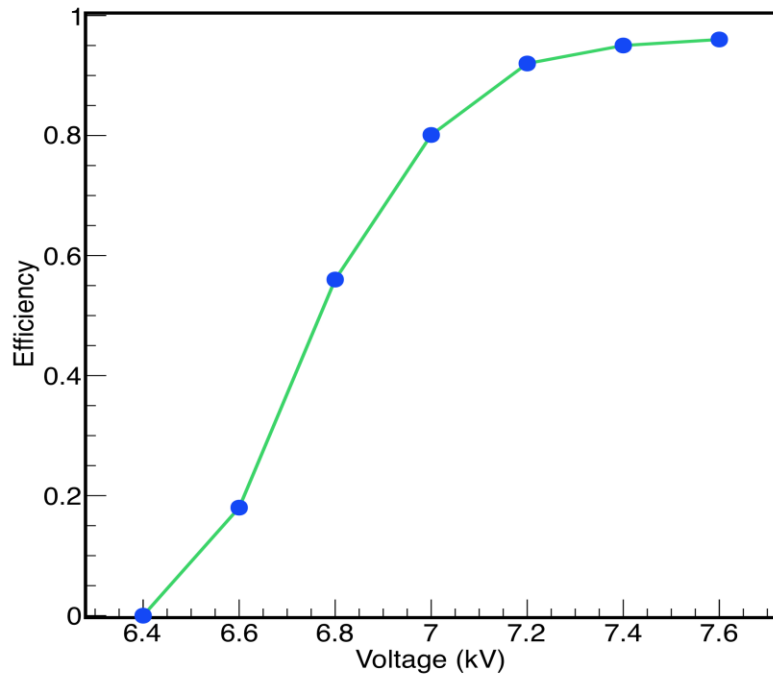
1 float GRPC+ 4 S-C GRPC

Measurements :

Efficiency of one chamber is estimated using tracks built from clusters of at least 3 other RPCs. Only one cluster per RPC is allowed for this study

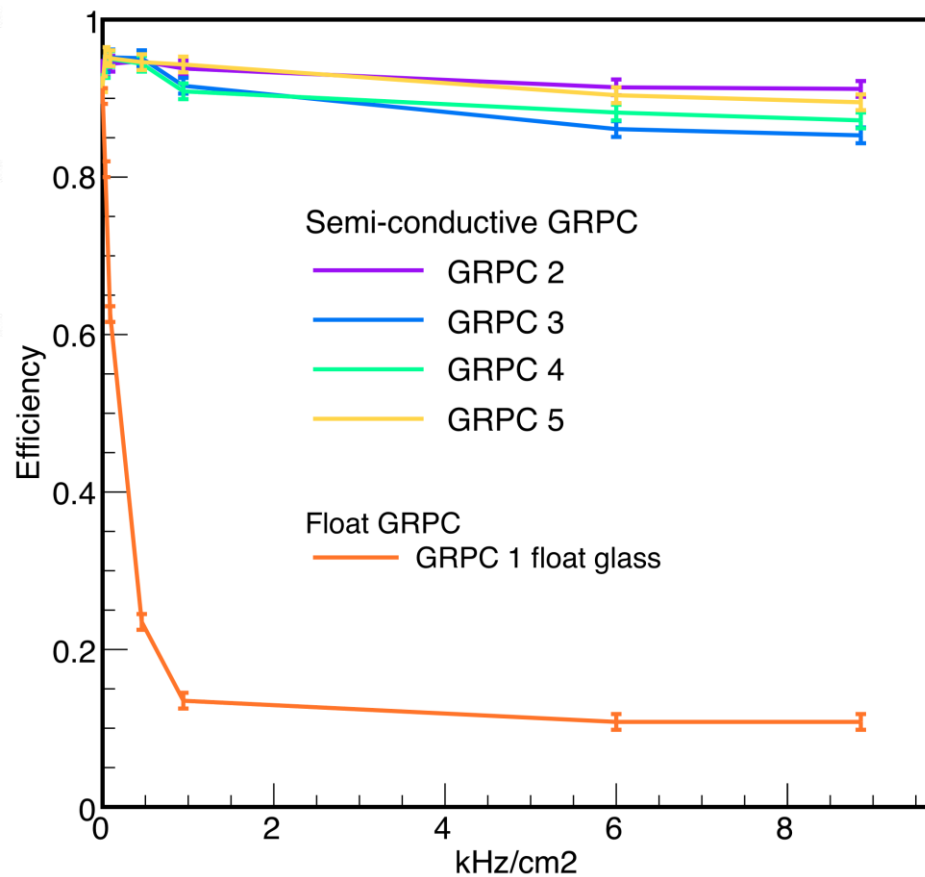
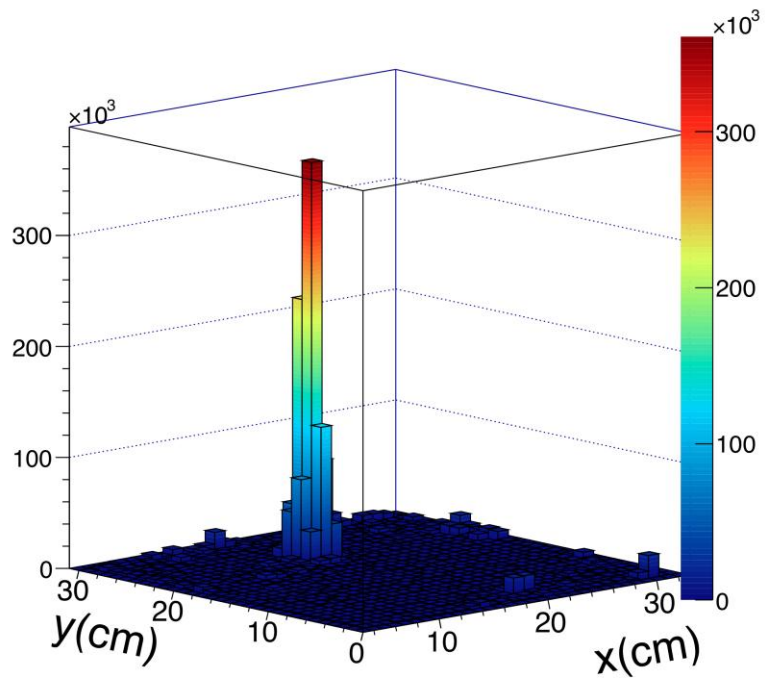
Multiplicity : Number of pads associated to the track in the given chamber

Semi-Conductive GRPC performance

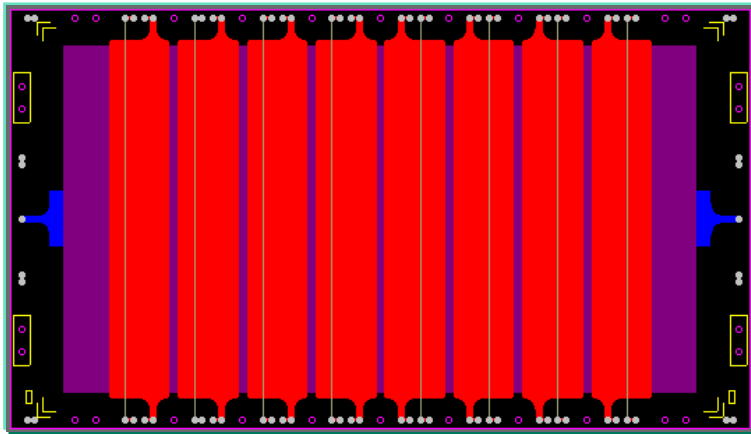
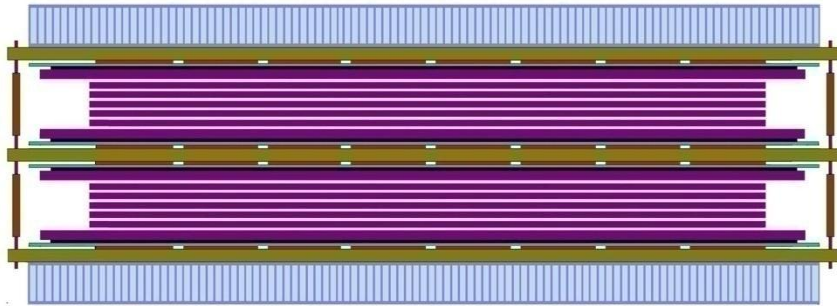


Threshold@130fC
Rate : few Hz/cm²

Semi-Conductive GRPC performance at high rate



Multi-gap GRPC



: $10^{10} \Omega\text{cm}$
 Read out: 3 strips
 Strip size: 12.5cm * 2.2cm
 Strip pitch: 2.5cm
 Gas gap: **0.25 mm**
 Active area: 12.5cm * 7.5cm

