GRPC
for HCAL and muon detectors

I.Laktineh

OUTLINE

- Introduction
- Results
- Future

IPNL-Tsinghua-IHEP Collaboration

History of the collaboration :

2008 : First meeting during the IEEE-NSS Dresden

2009 : Tsinghua group joins CALICE

IPNL ILC and Tsinghua detectors groups join FCPPL

2010 : Construction of small GRPC with semi-resistive glass

Development of large GRPC for the SDHCAL

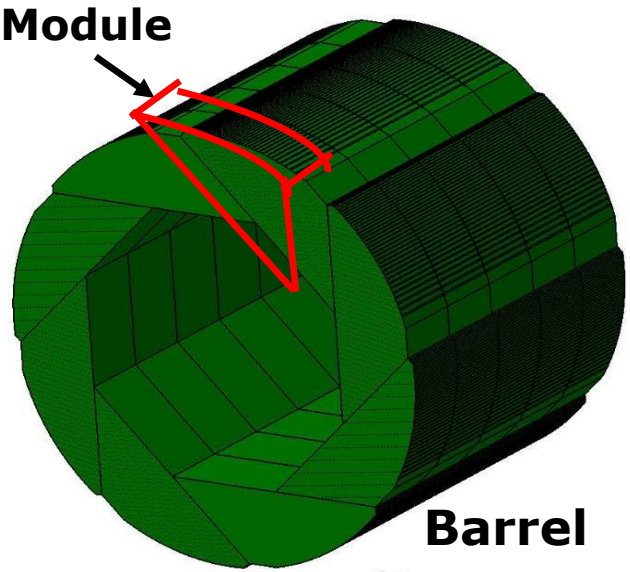
2011 : IHEP joined the efforts to build large RPC for SDHCAL

Construction of the SDHCAL prototype

Construction of medium high rate GRPC

2012 : Test of high rate GRPC at DESY

International Large Detector

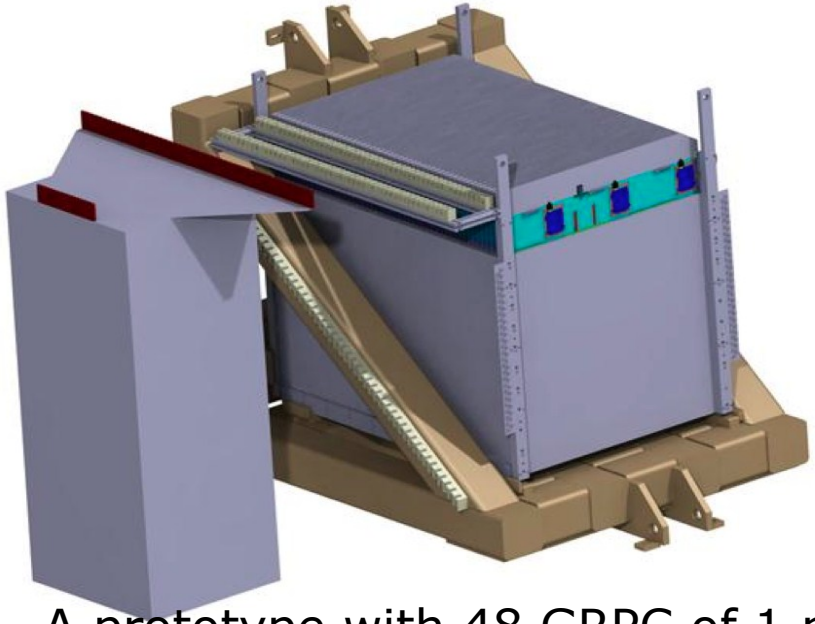


-The Semi-Digital HCAL is one of two options proposed in the ILD LOI. It aims at applying the PFA.
It uses gaseous detectors as sensitive medium embedded readout electronics providing 1cm2 lateral segmentation.
-A genuine mechanical structure is proposed for the SDHCAL.

GRPC was chosen as the baseline :
-Cost-effective
-High efficiency
-Adequate resolution

Challenges
-homogeneity for large surfaces
-Thickness of only few mms
-Services from one side
-Embedded electronics

(France, China, Belgium, Spain, Russia)



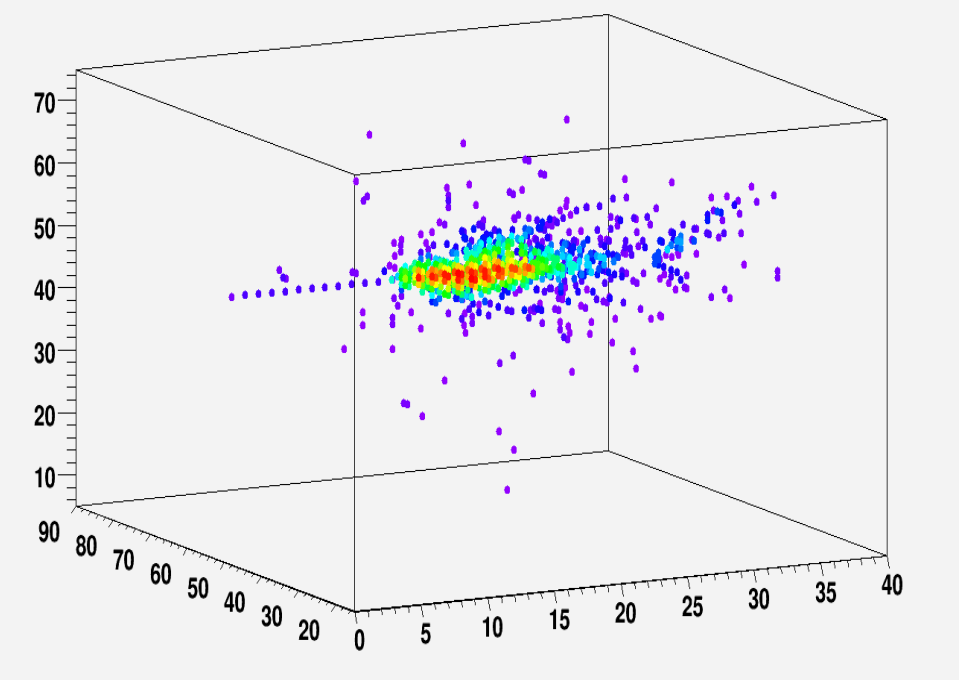
A prototype with 48 GRPC of 1 m2 was conceived as a demonstrator

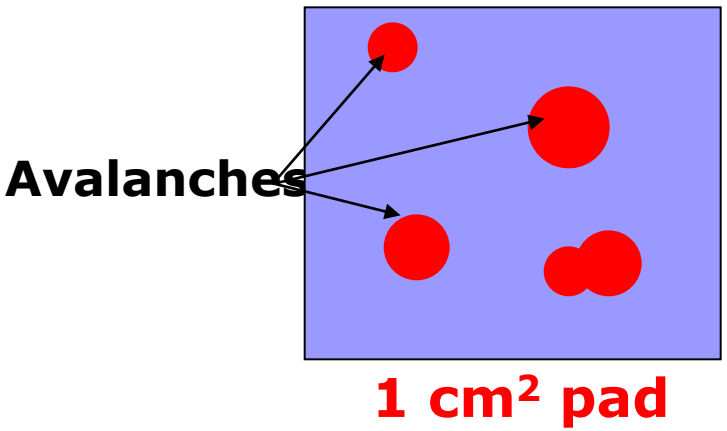
Motivation

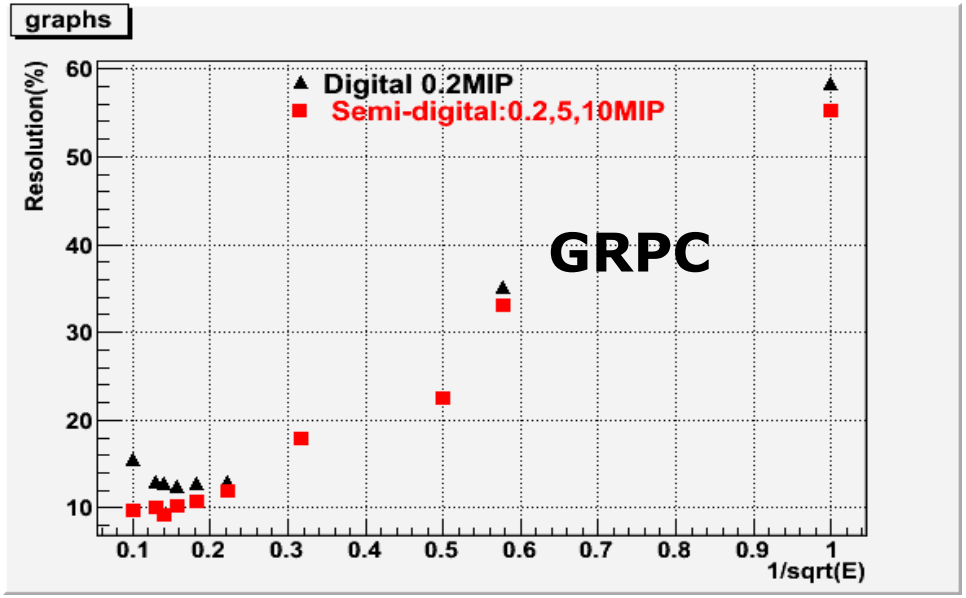
Electronics readout choice

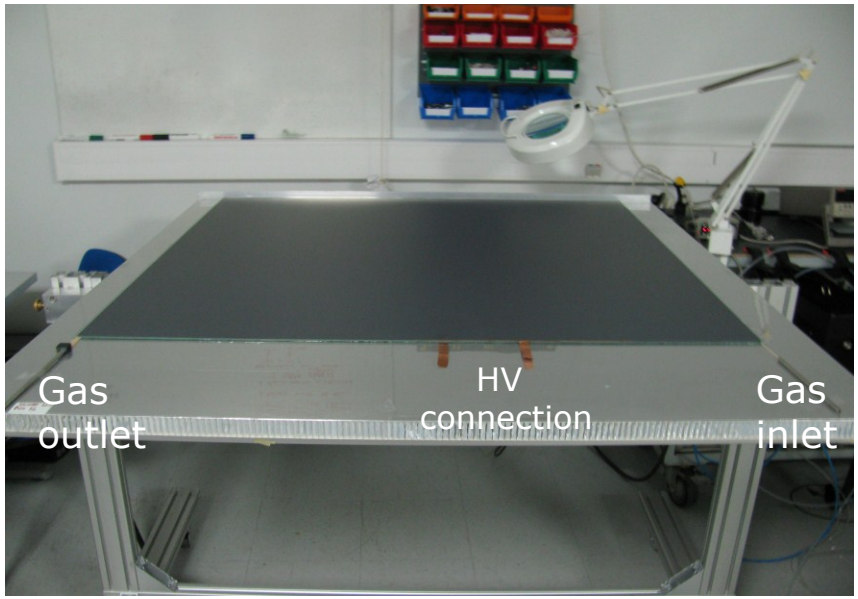
At high energy the shower core is very dense→ simple binary readout will suffer saturation effect

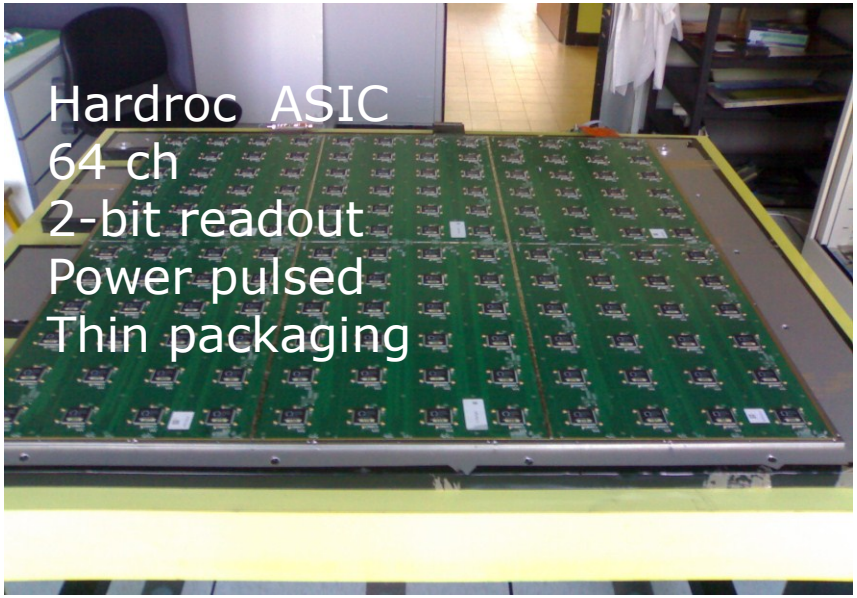
→ semi-digital readout (2-bit) can improve the energy resolution.



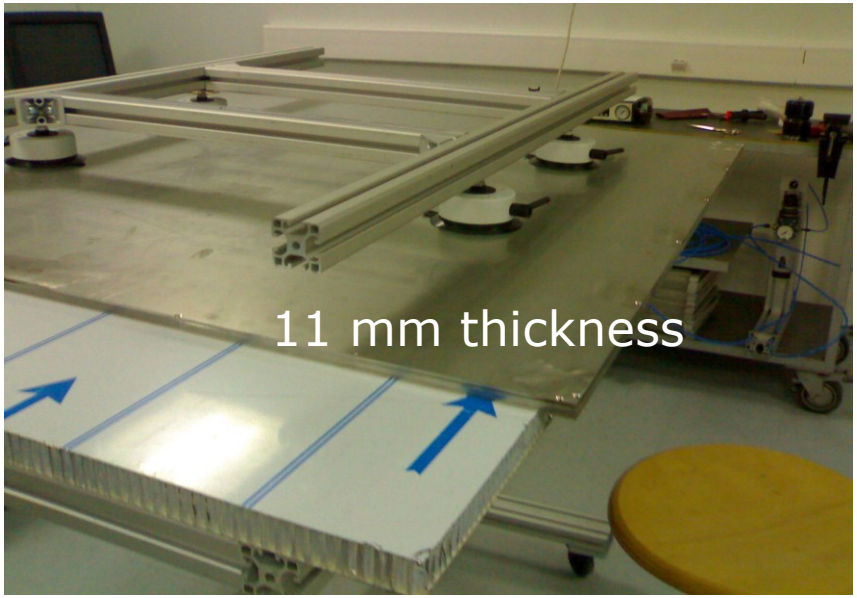





Gas
outlet
HV
connection
Gas
inlet

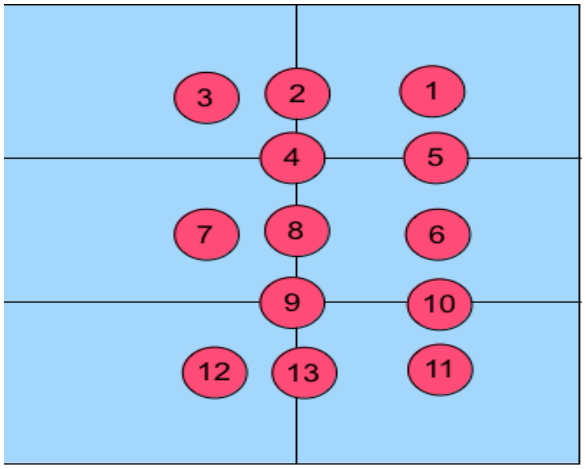

Hardroc ASIC
64 ch
2-bit readout
Power pulsed
Thin packaging

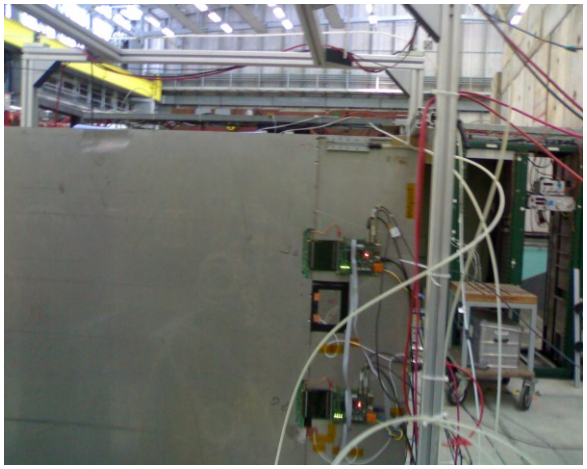

9216 ch/m2


11 mm thickness

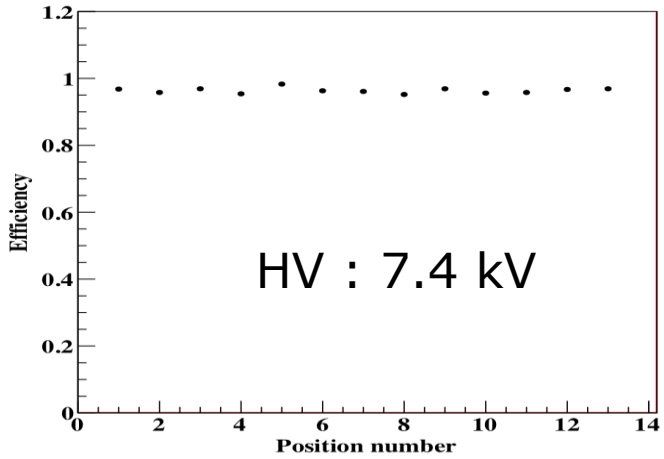
Validation

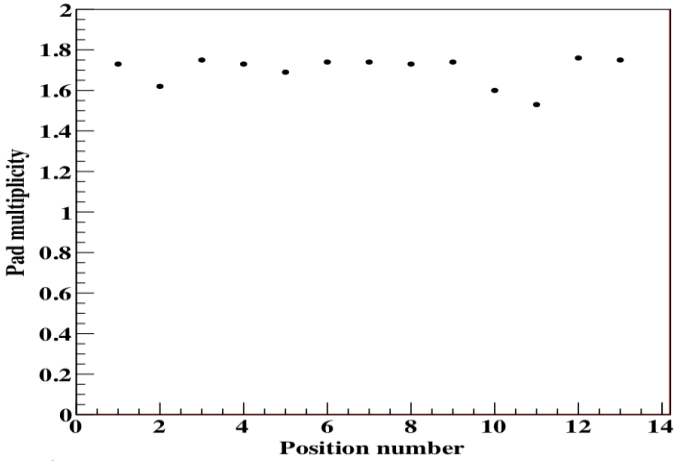
A full cassette was successfully tested at T9-PS May 2010
and H4-SPS in September 2010





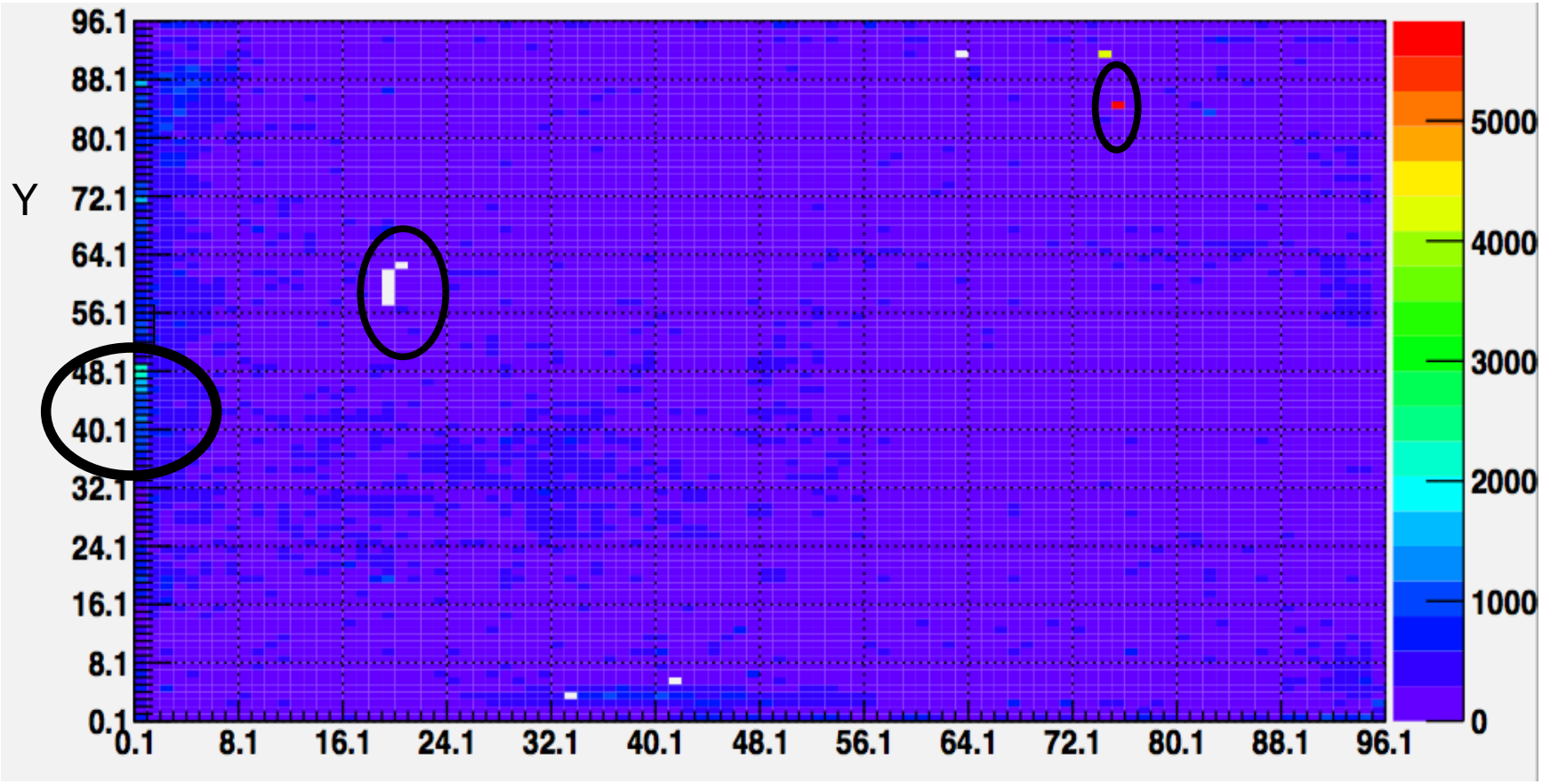
Gas mixture
TFE :94.5 %
Isobutane : 5 %
SF6 : 0.5 %





Validation

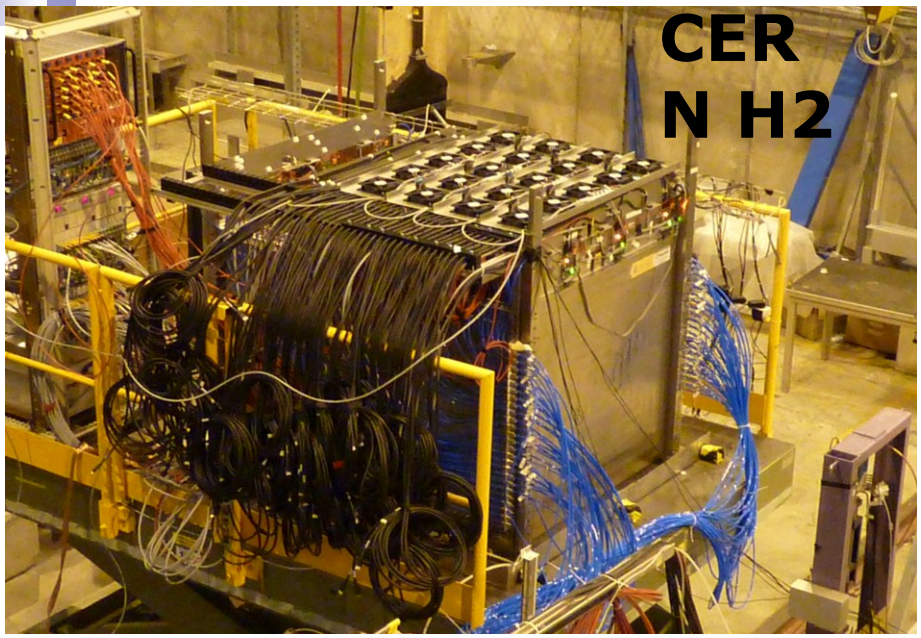
Noise was measured and found to be < 1 Hz/cm2 outside the channeling tubes and HV connection zones



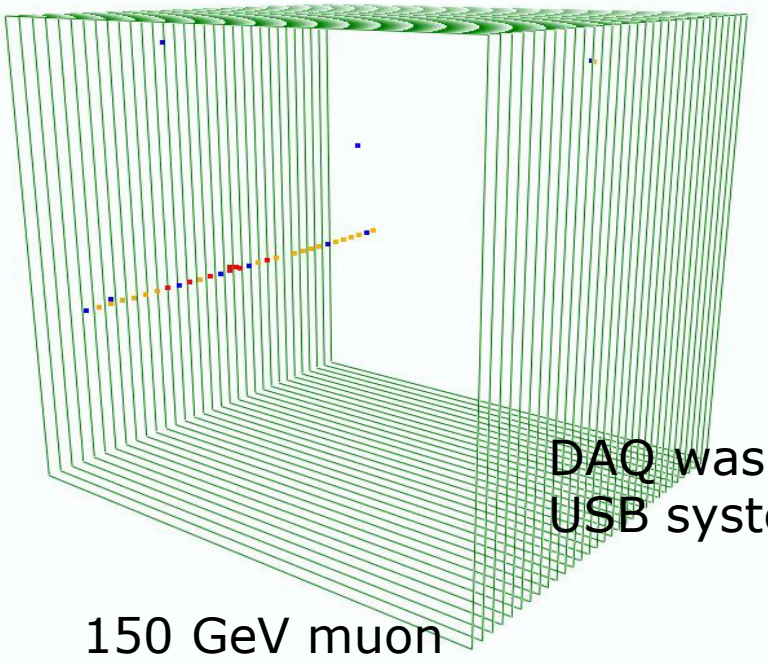
Noise Map

X

50 Chambers are built and will be used in the SDHCAL prototype in the coming days..

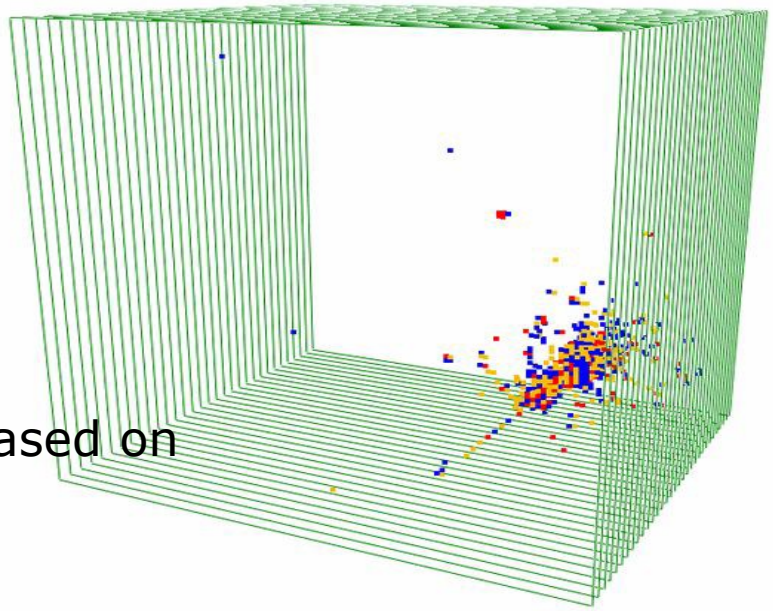


50 cassettes were produced
42 were inserted in a self-supporting mechanical Structure. Commissioning was performed at CERN.
Both IPNL and Tsinghua groups Participated to the commissioning CERN TB

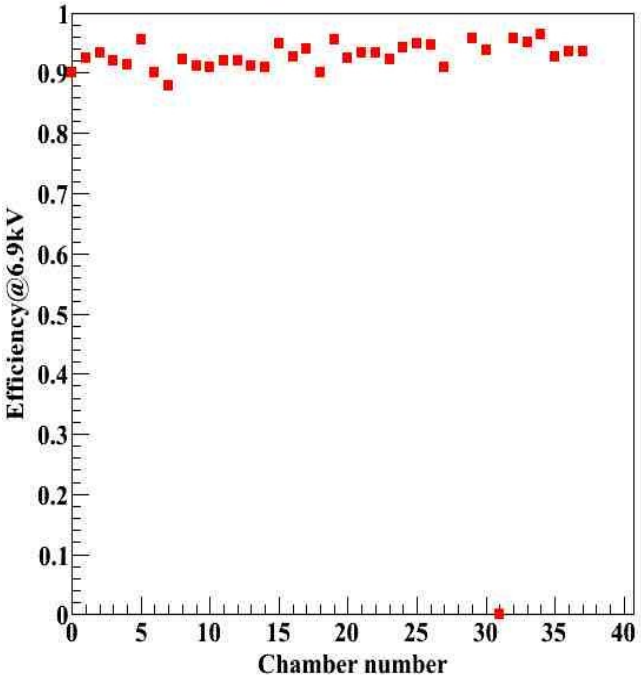


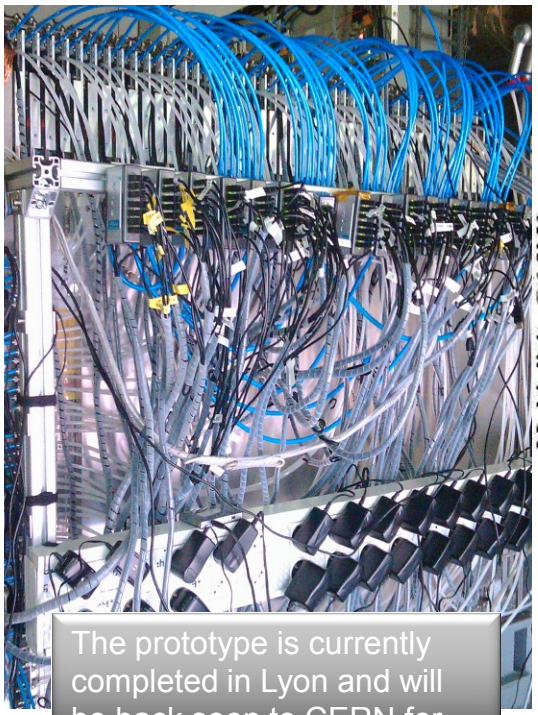
150 GeV muon

DAQ was based on USB system

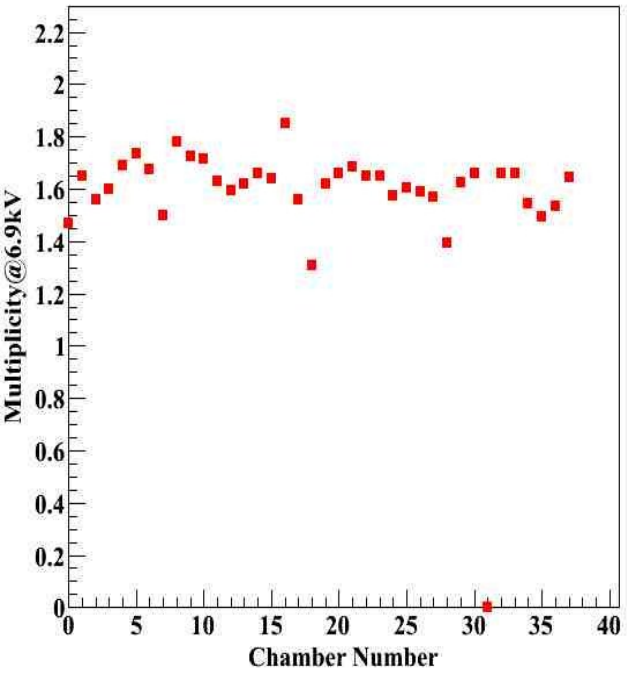


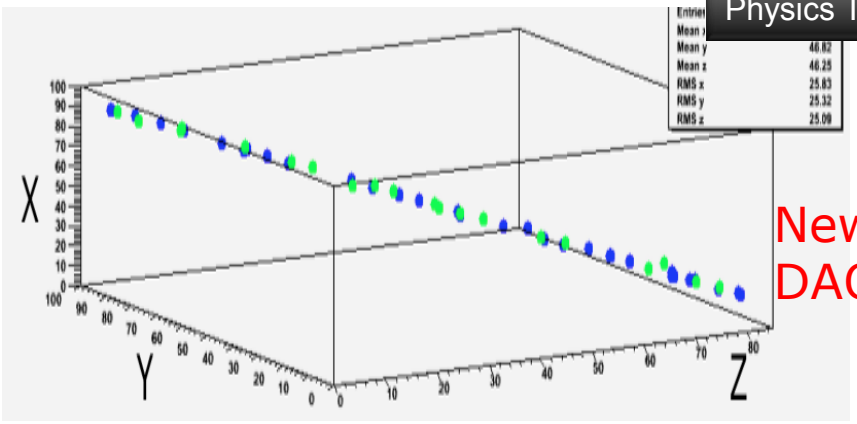
150 GeV pion



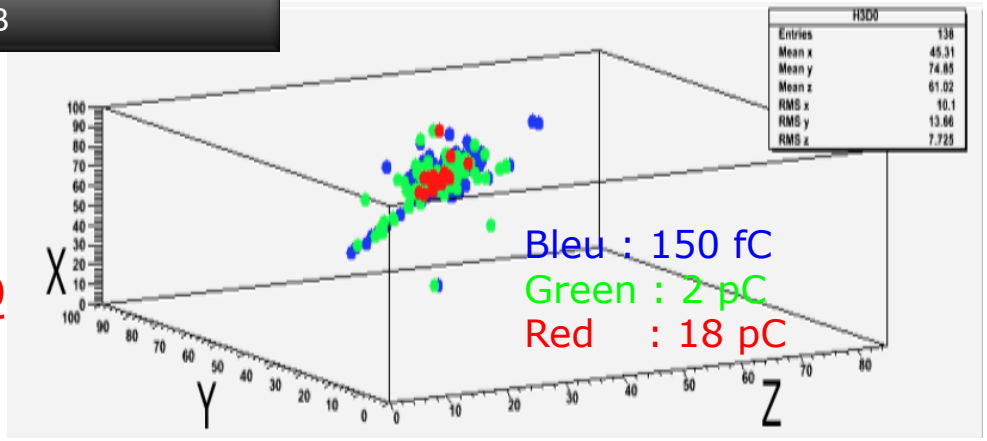


The prototype is currently completed in Lyon and will be back soon to CERN for Physics TB





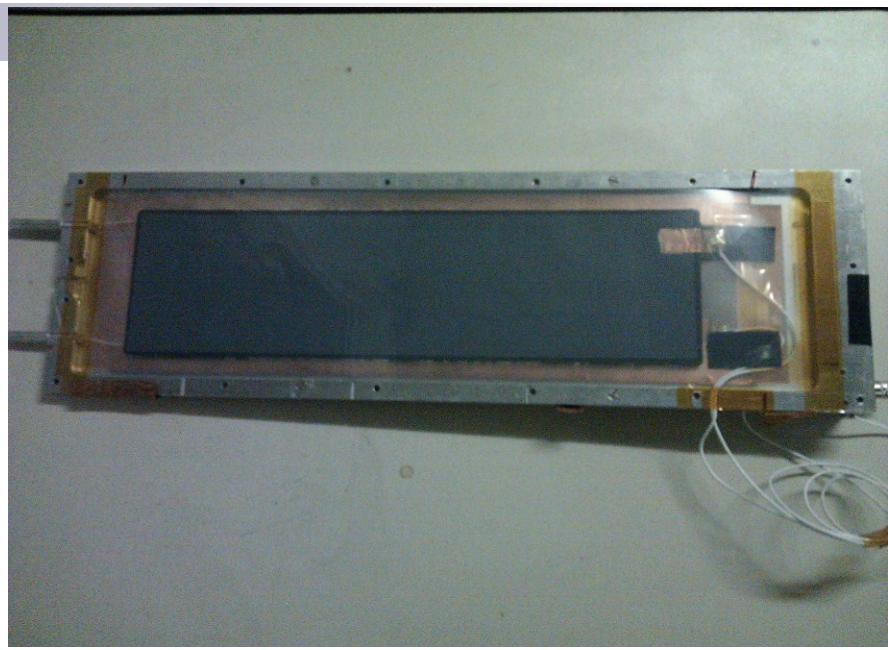
New DAQ

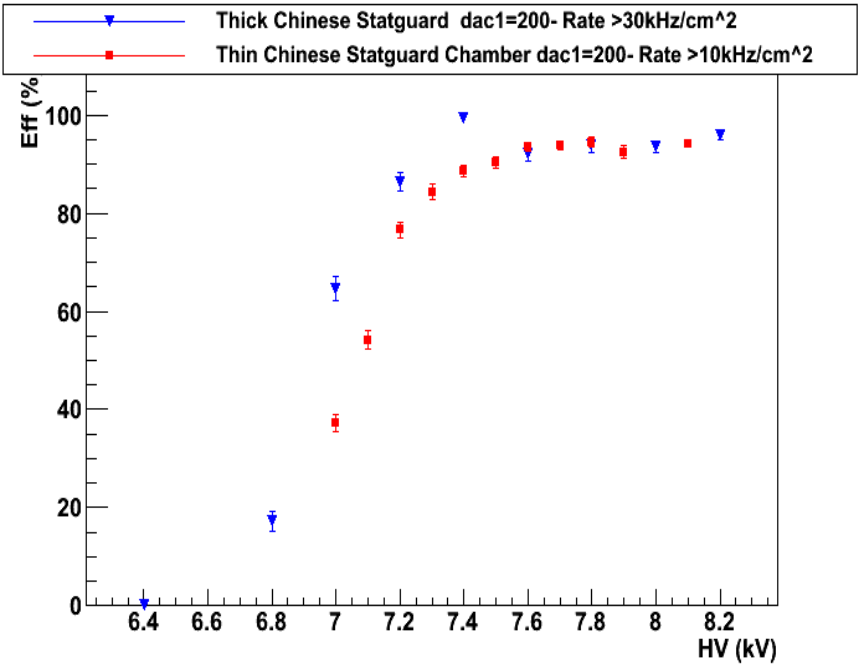


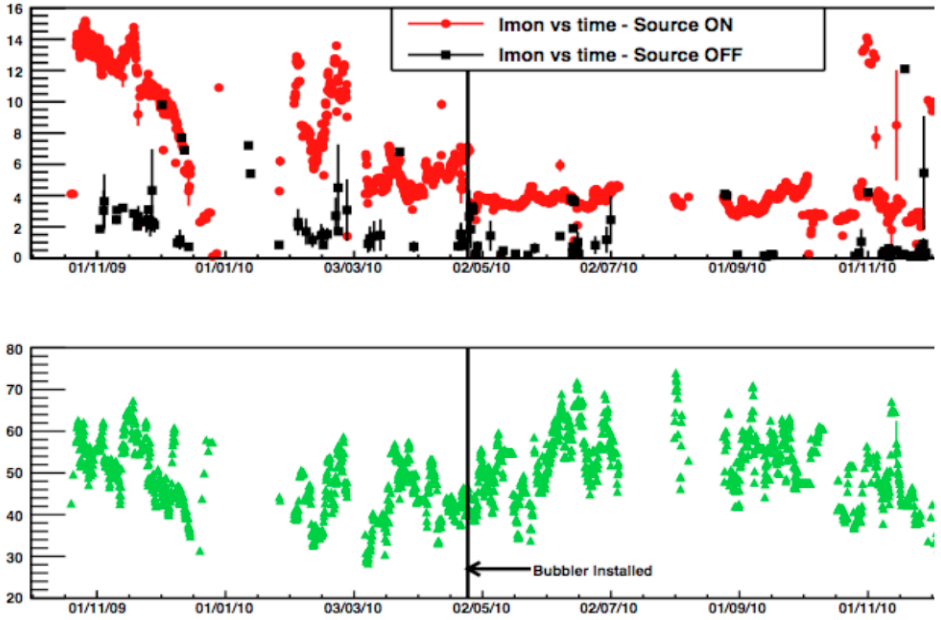
Cosmics are used to monitor the GRPCs

High Rate GRPC

GRPC are cheap, efficient and homogeneous detectors. However They have a limited detection rate (< 100 Hz/cm^2)
This may be not a limitation for future ILC but can be a problem for CLIC, …
Tsinghua has developed a new tech nique to make low resistivity glass 10^{10} Ω.cm which is irradiation hard
Few plates of 8X20 cm^2 were shiped to IPNL in 2009 and 2 small detectors were built.
They were tested at CERN-PS





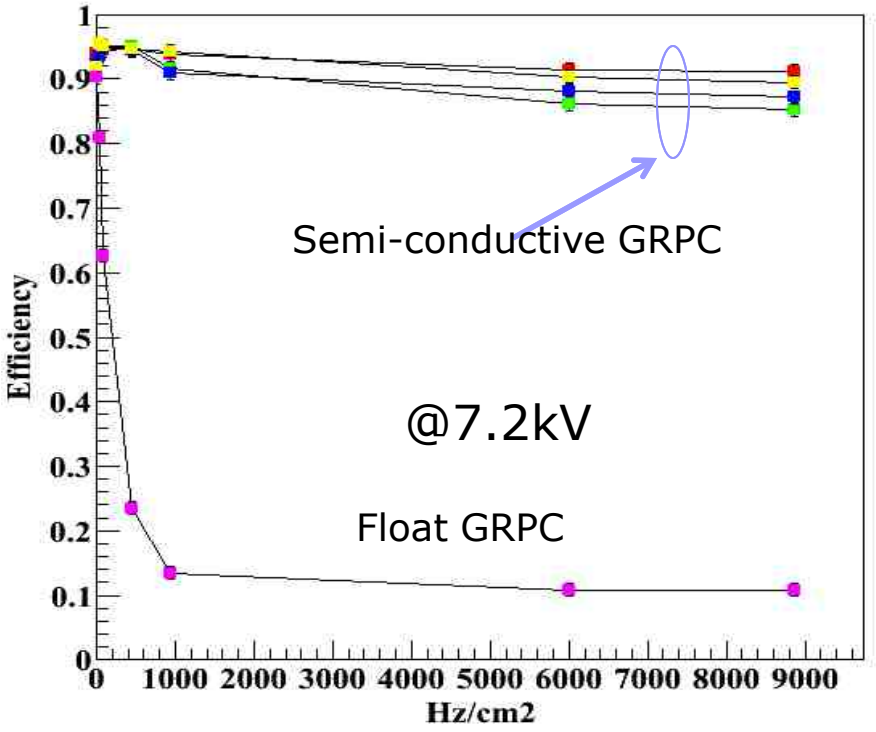


GIF@CERN : > 1000 Hz/cm^2

In 2011, larger GRPC plates(30X30 cm^2) were made. 9 of them were shiped to IPNL 4 GRPCs were buil using these plates

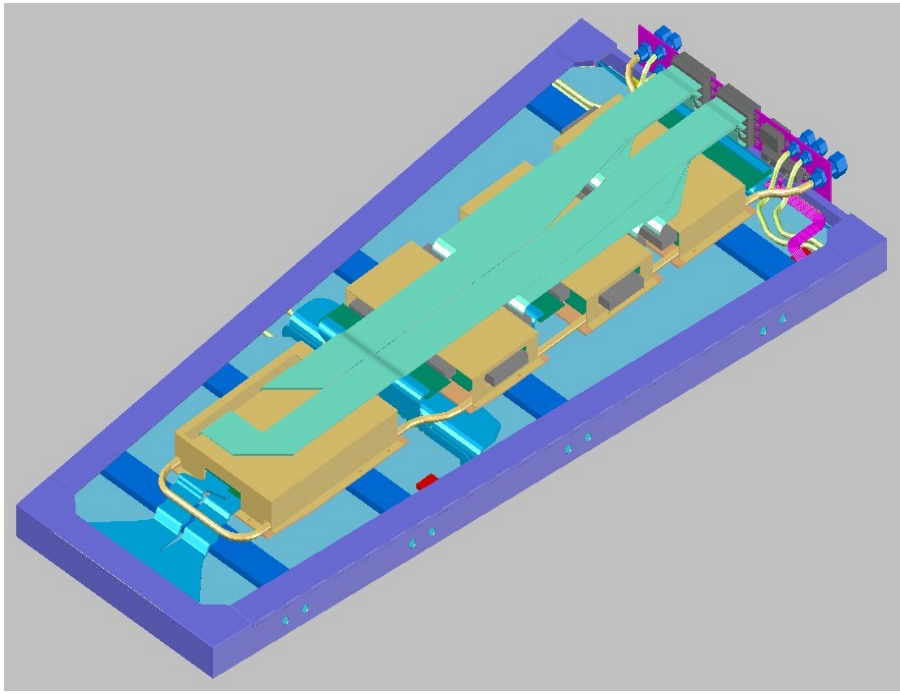
The 4 were exposed to DESY electron beam in order to validate the results of 2009

A GRPC chamber with float glass was also Exposed



High rate GRPC for CMS

The success of high rate GRPC makes of it a very good candidate to equip the high eta region of CMS with muon detectors (> 1000 Hz/cm 2, Currently not instrumented) and to replace the bakelite RPC in the the SLHC



The advantages of GRPC with respect to other proposed detectors (GEM,…etc)

1- Much Cheaper
2- Uses the same gas system
3- Time resolution < 100 ps (for multi-gap version)

IPNL and Tsinghua groups were asked by CMS muon detector community to make an official proposal. Belgian, Italian and Portuguese groups are eager to join. We are currently working on this proposal.

Future

-The collaboration between IPNL and Tsinghua for the hadronic calorimeter of the future linear colliders experiments is very fruitful.

-The collaboration on high rate GRPC allows the two teams to play an important role in the LHC upgrade of muon detectors

-Collaboration with IHEP on large Bakelite RPC should become stronger this year after the busy period of Daya Bay RPCs construction and commissioning.