CALICE Collaboration meeting
Arlington University - September 2016

MRPCs for SDHCAL

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The Idea:

A SDHCAL module using Multi-gap Resistive Plate Chamber

- Effective area : 1m x 1m
- signal pad segmentation : 1cm x 1cm
- electrodes : 96 x 96 square pads
- time resolution : better than 100ps
- counting rate : better than 1,000Hz/cm^2

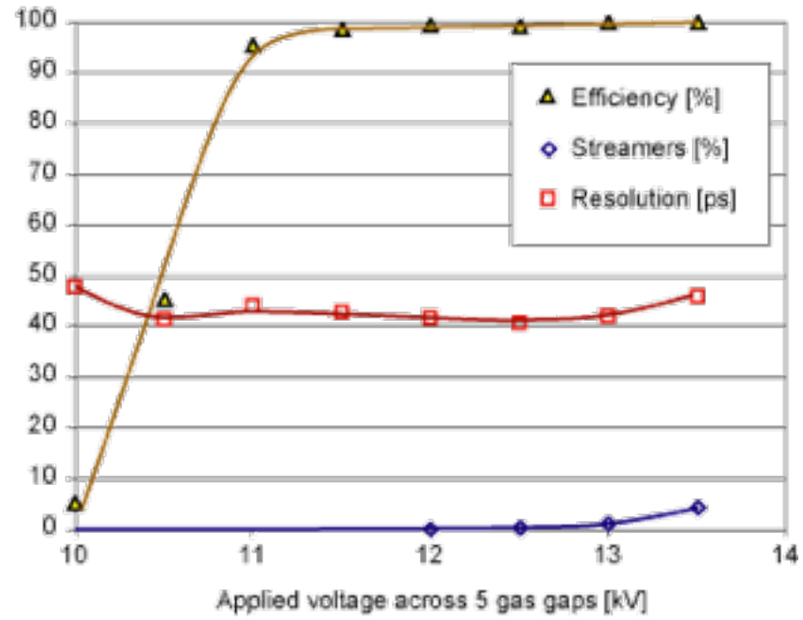
IPNL - GWNU collaboration
within AIDA-2020

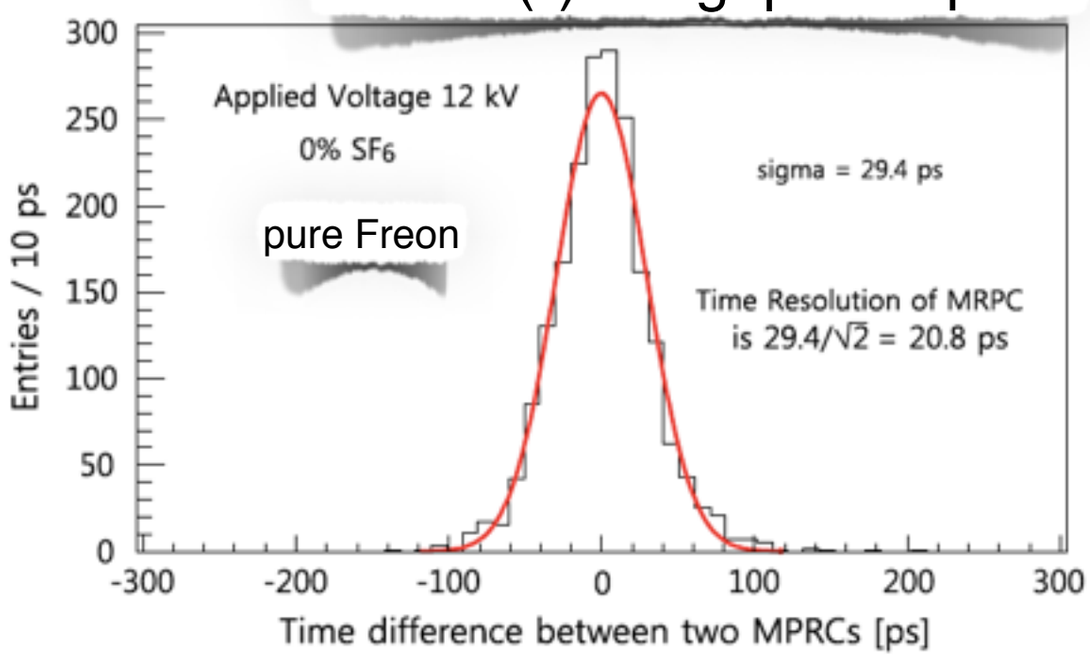
Outline:

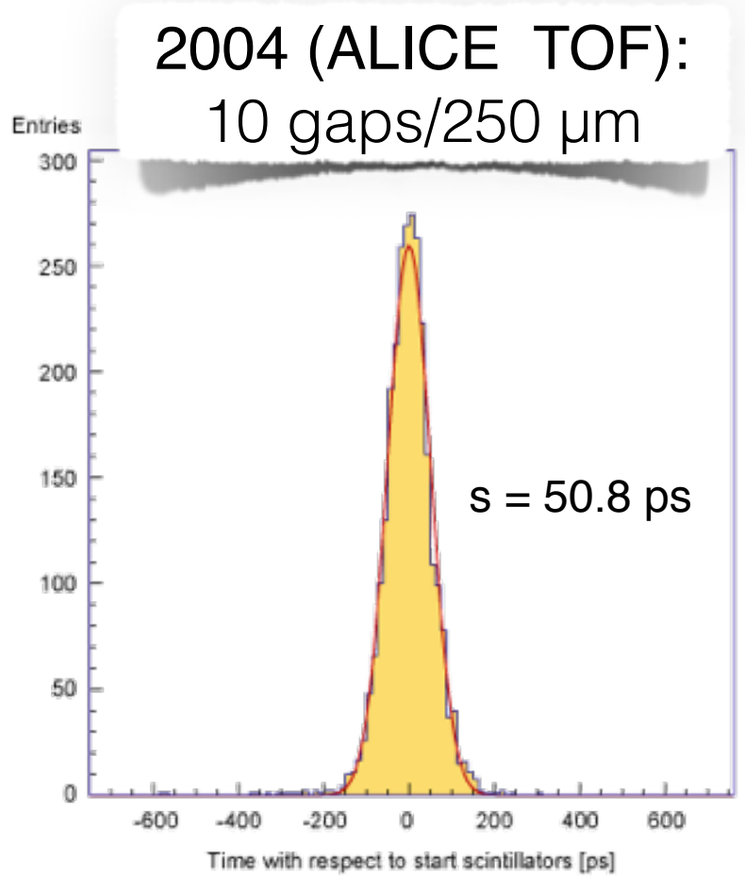
- Second prototype
- Performance
  - Test beam
- Electronics
- Current & planned activities

Why MRPC?

- High precision time measurements
- **Large efficiency plateau** with no streamers
- **Reasonable cost** even for large areas
  - 16k channels of MRPC produced for ALICE-TOF (INFN Bologna, Salerno, **GWNU**, ITEP)

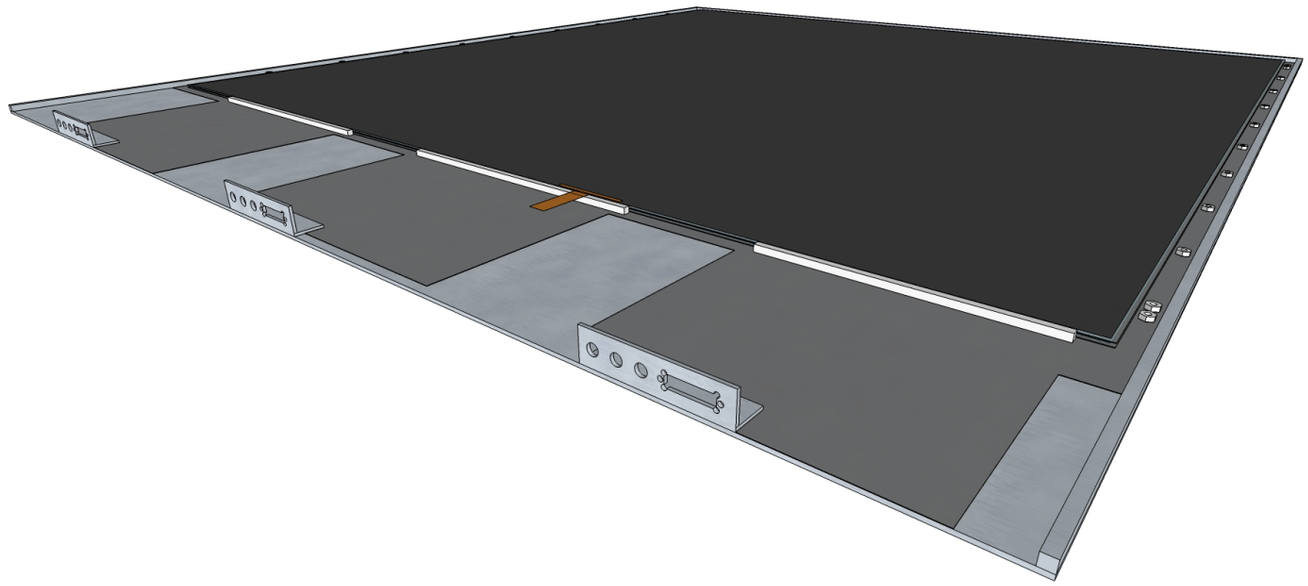






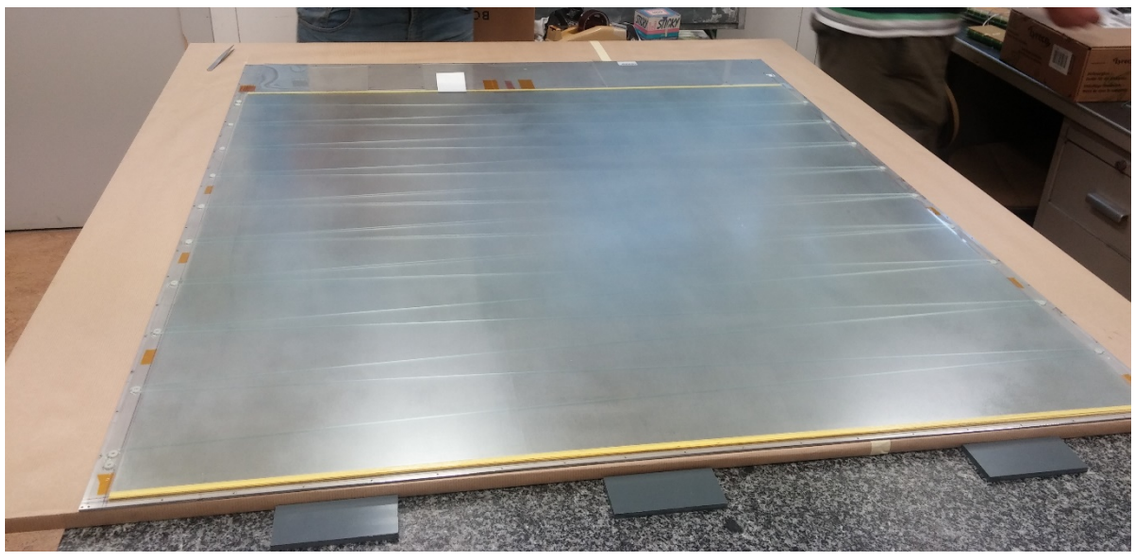
(*) Nuclear Instruments and Methods in Physics Research A 594 (2008) 39– 43
Nuclear Instruments and Methods in Physics Research A 629 (2011) 106–110

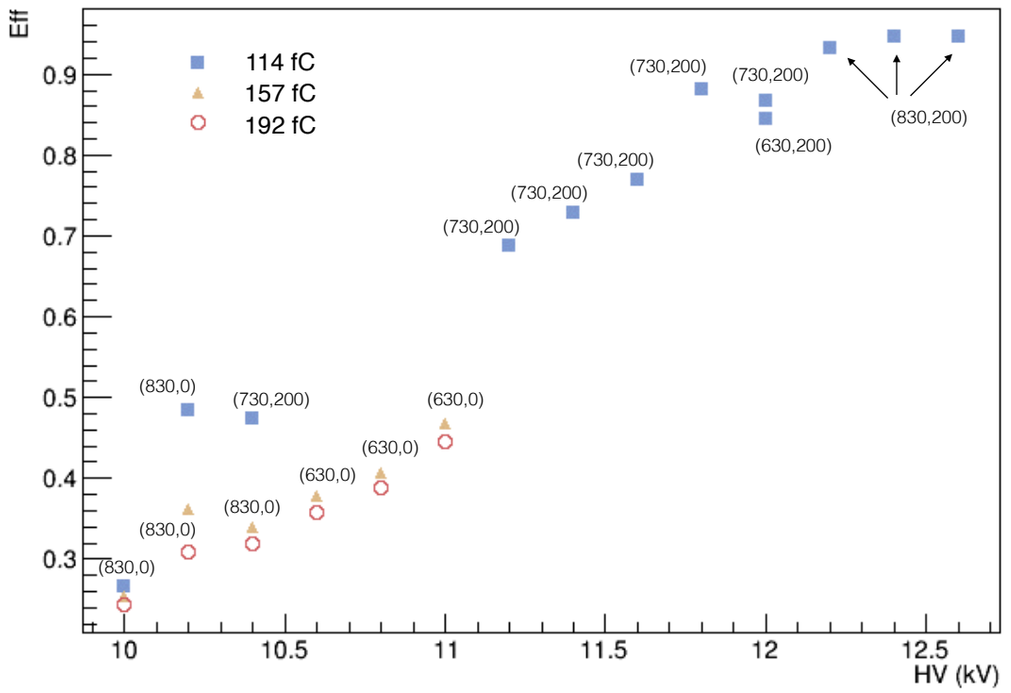
First prototype



- 1m x1m chamber
  - 5 glasses, 400μm /280 μm
  - 4 gaps, 300μm
- Isolation via mylar layers
- Fishing lines and double sided tape + mylar as spacers
- 4 GeV protons test beam + cosmics
  - 98% TFE + 2% SF_6 @ ~0.3 l/h

Good efficiency but very high dark current (~10 μA @10 kV)

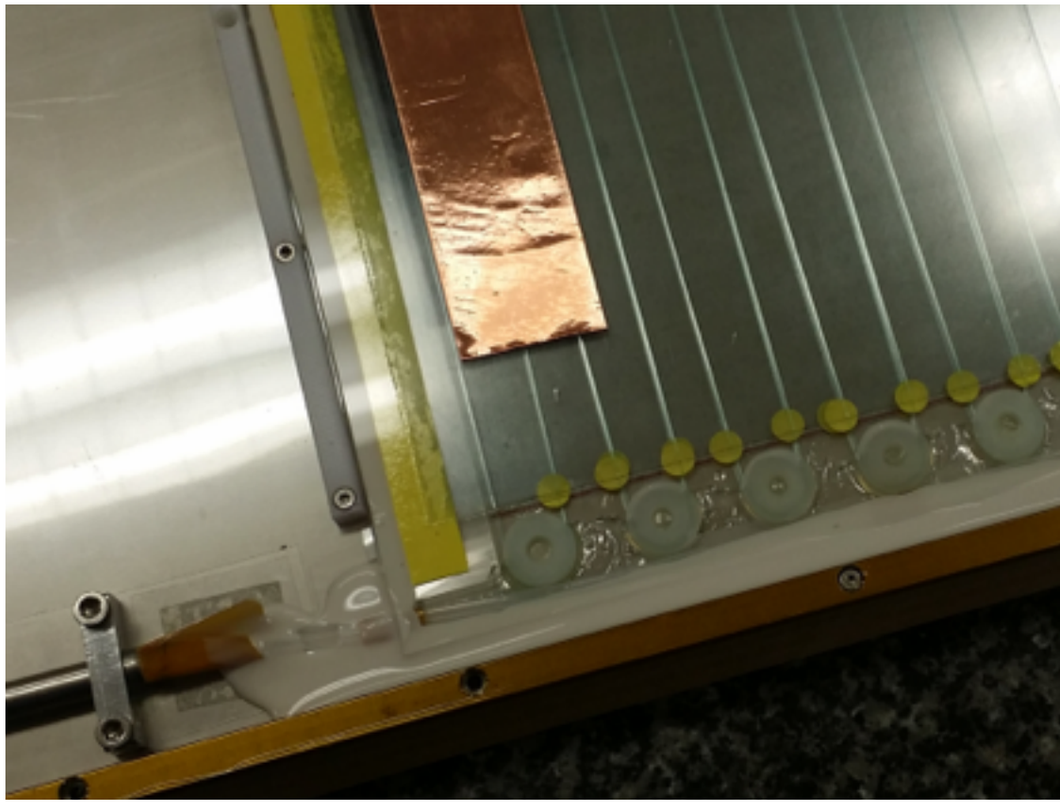


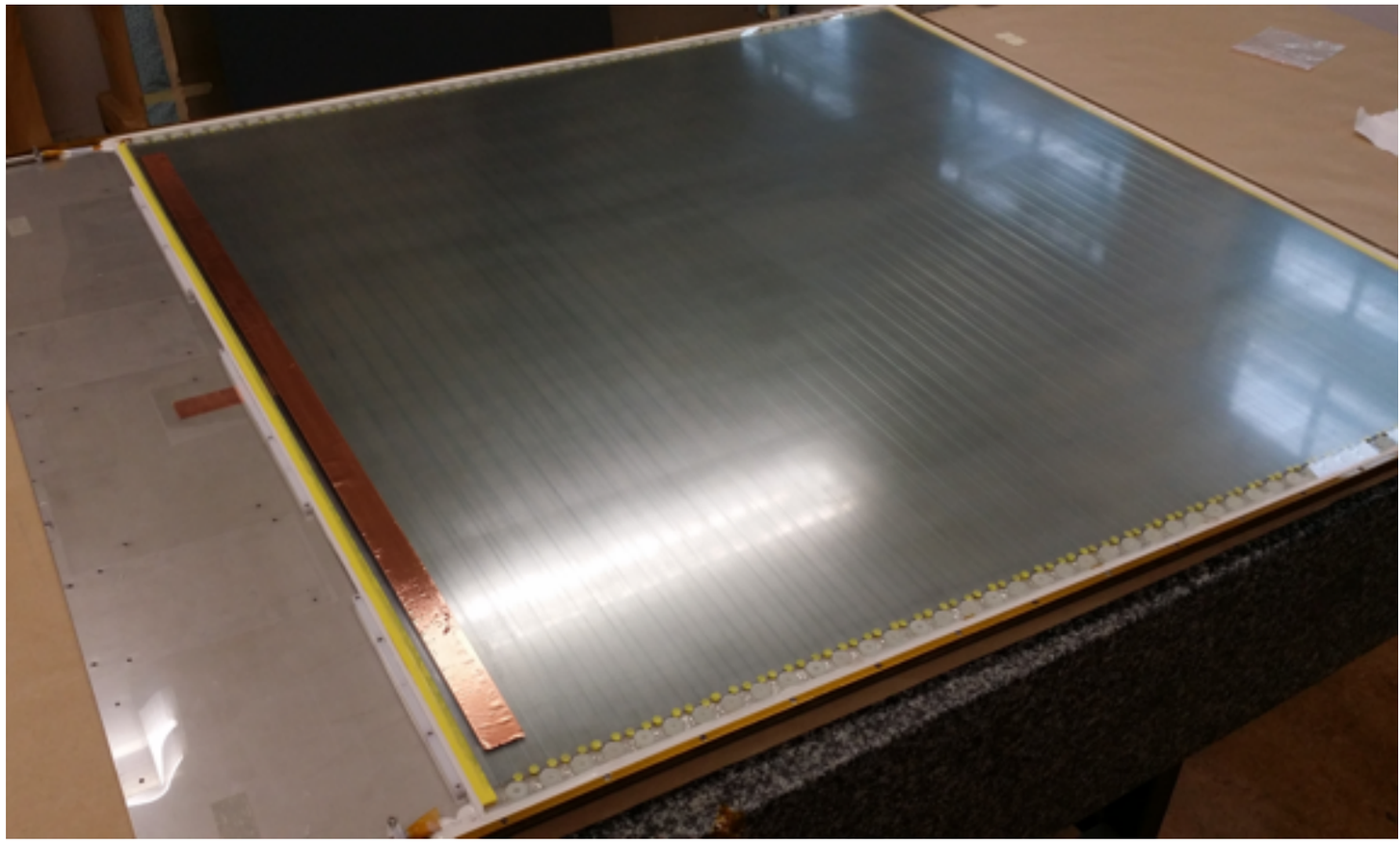


Second prototype

Layout

- 5 1mx1m glasses
  - 2 external 400μm thick glasses
  - 3 internal 280μm thick
- 4 gaps, 300μm wide
- Isolation via mylar layers
  - Top: 50 μm thick
  - Bottom: 295 μm thick
- Spacers
  - Fishing lines + teflon supports (nuts)
  - Double sided tape + mylar

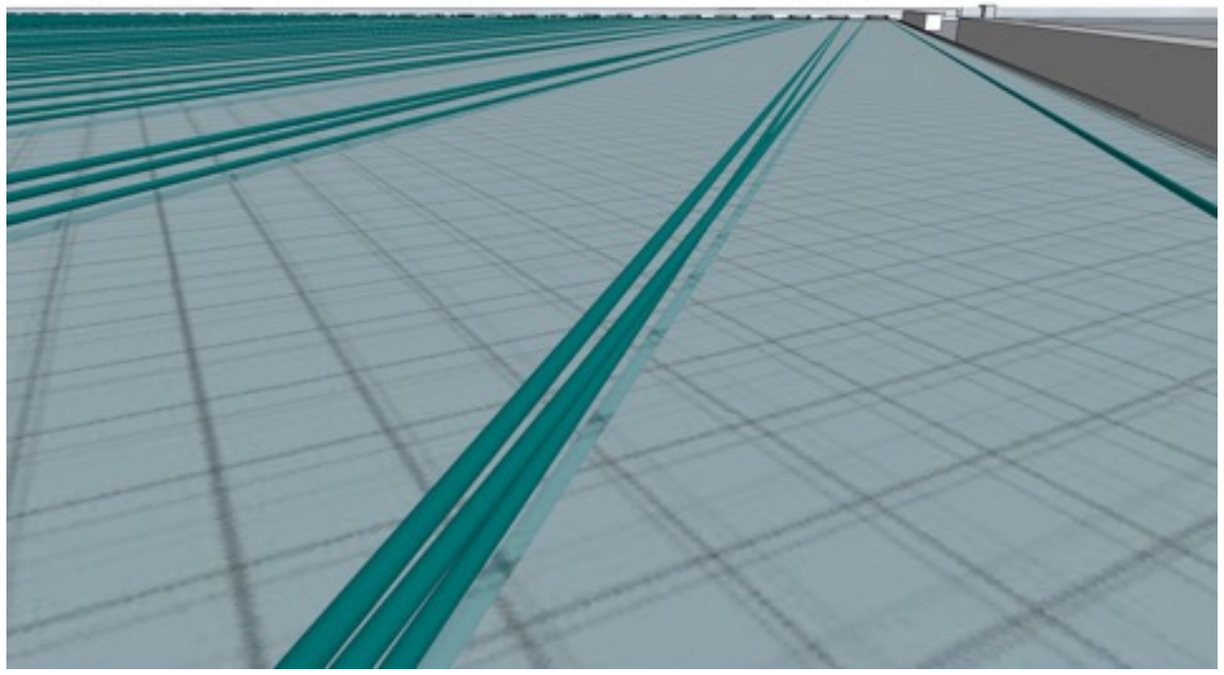


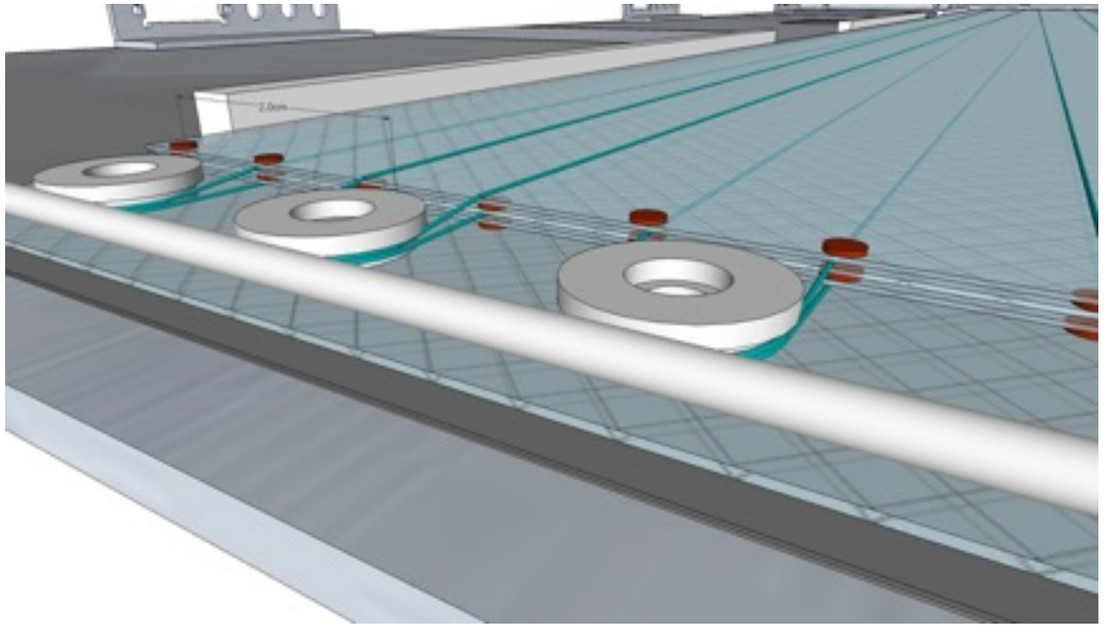


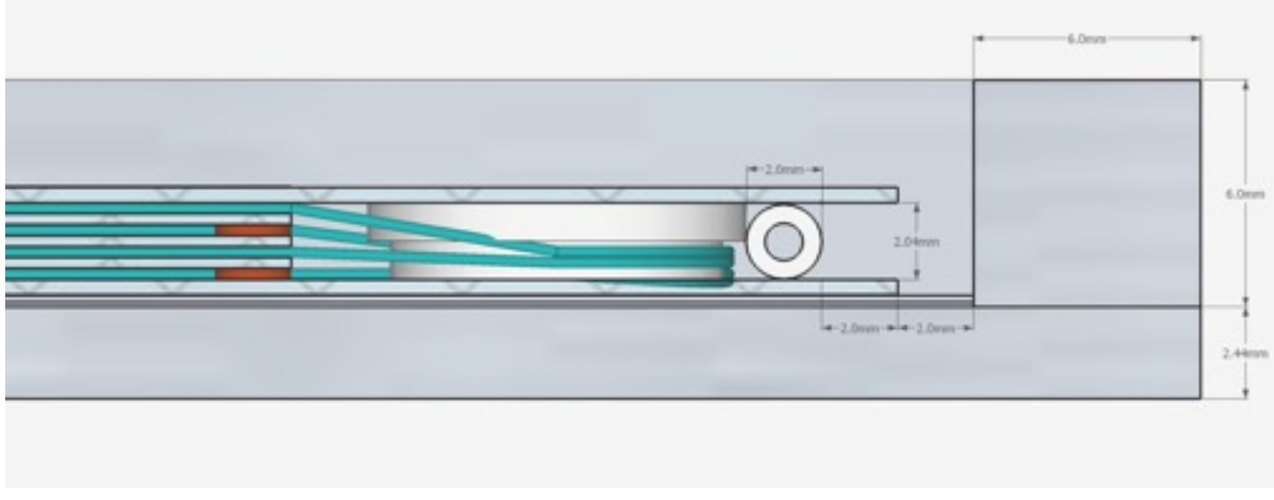
Second prototype

Main differences wrt first prototype

- Changed fishing lines structure
- Glue nuts to external glass (no longer on the metal box)
- Uncoated edge on external glasses is larger (1-2 cm) to reduce DC



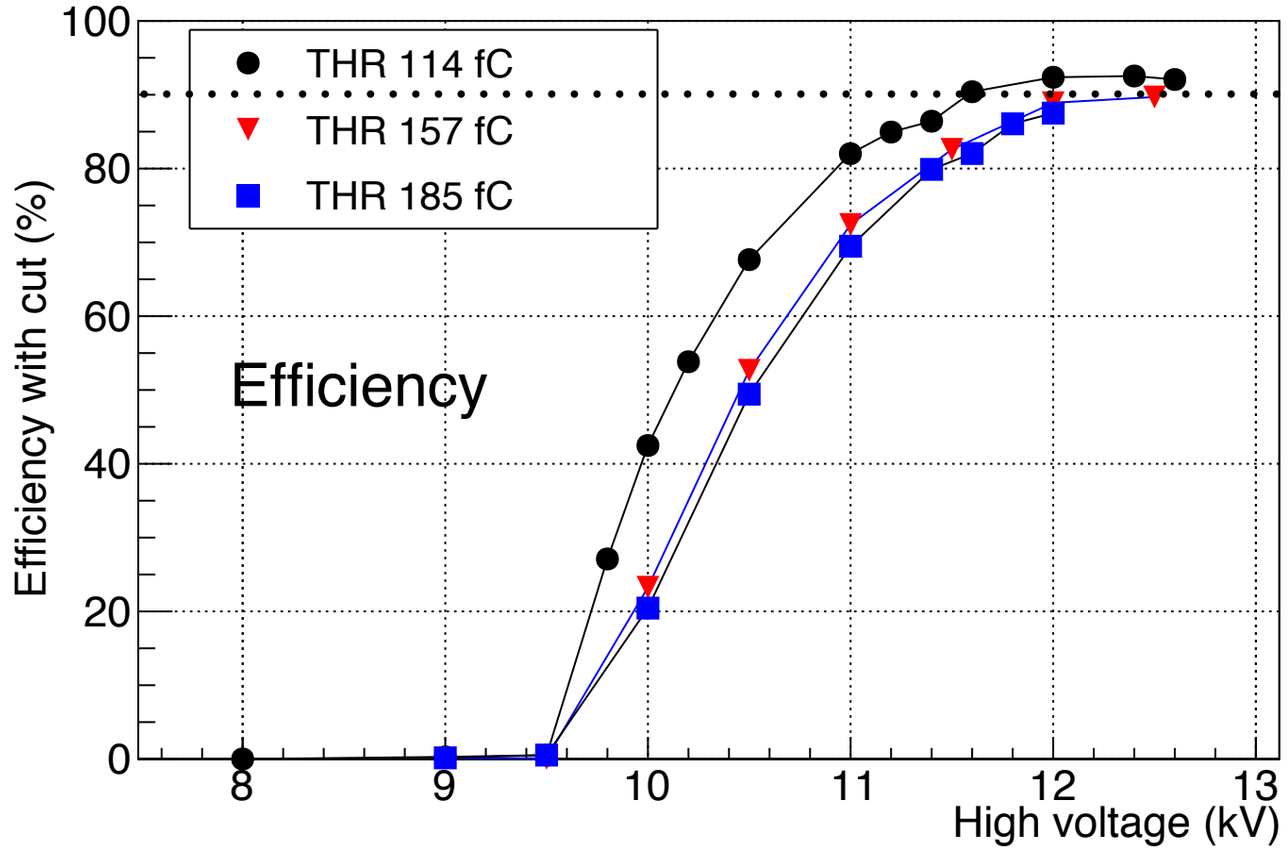


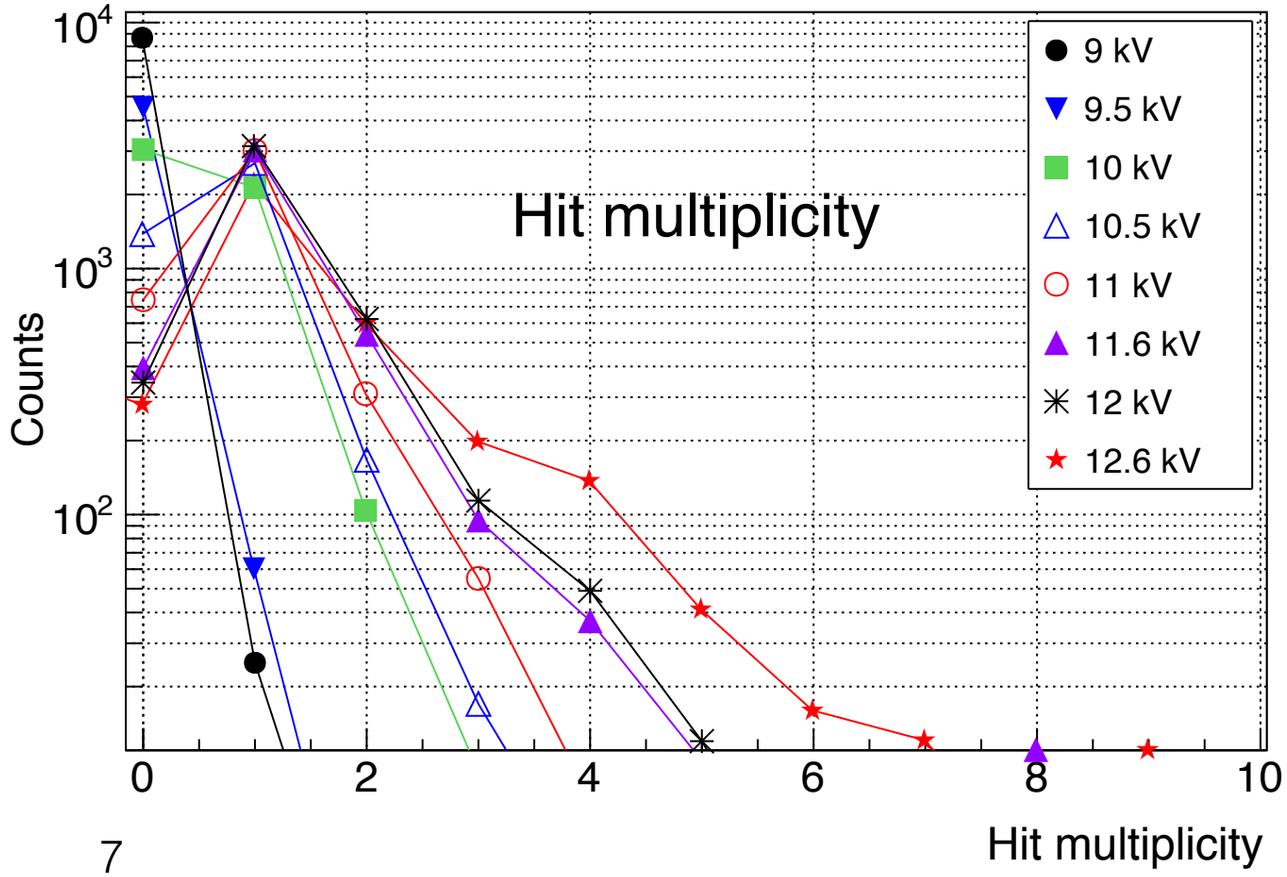


Performance

Test beam results

- 2 weeks during May 2016 at T10 in the PS East Area
- 4 Gev protons
- **Trigger** using coincidence of 2 scint+PMT
- **GAS**: 98% TFE (Tetrafluorethane + freon 134a) + 2% SF_6 @ ~5 l/h
- 90% efficiency at 11.6kV for the lowest threshold

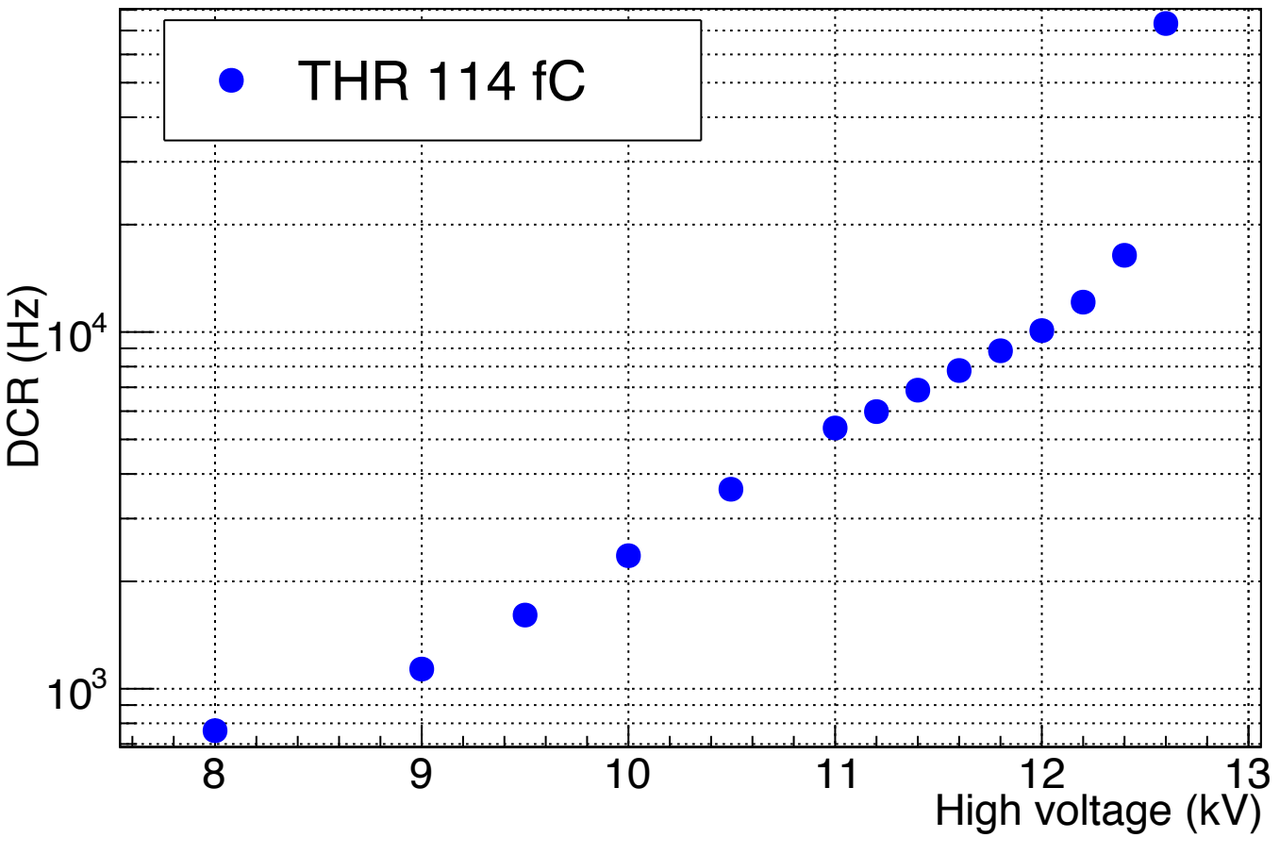


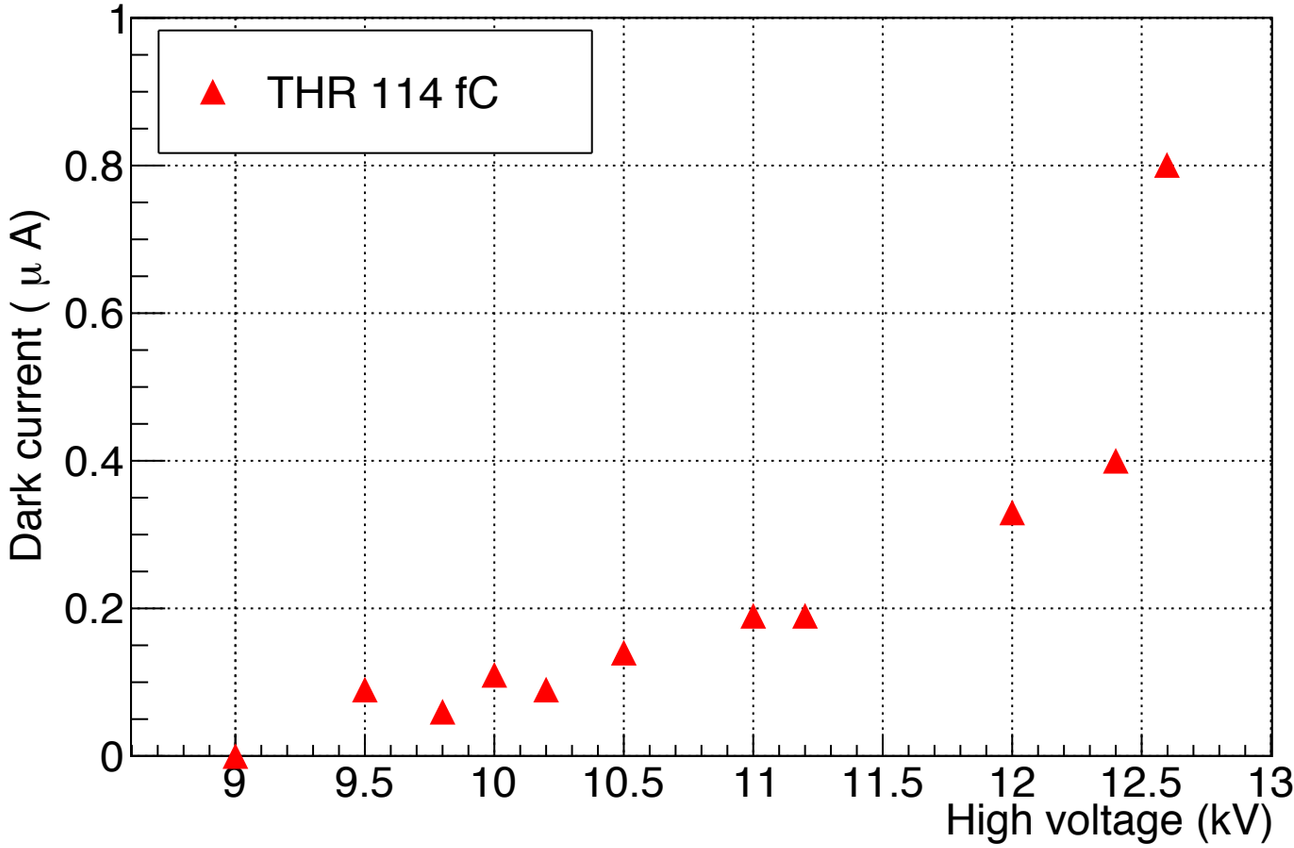


Performance

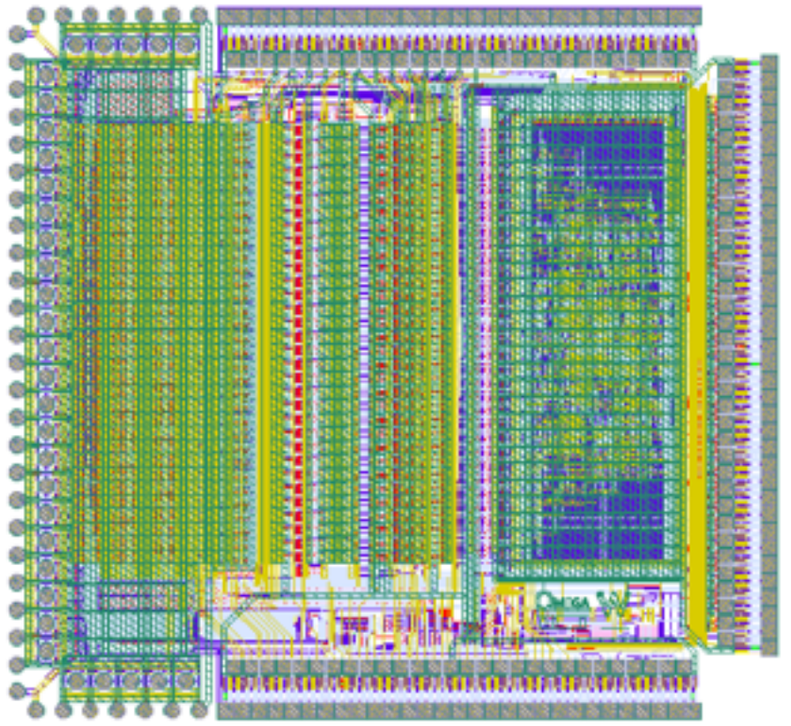
Noise and dark current

Factor >50 below what we had in the previous prototype

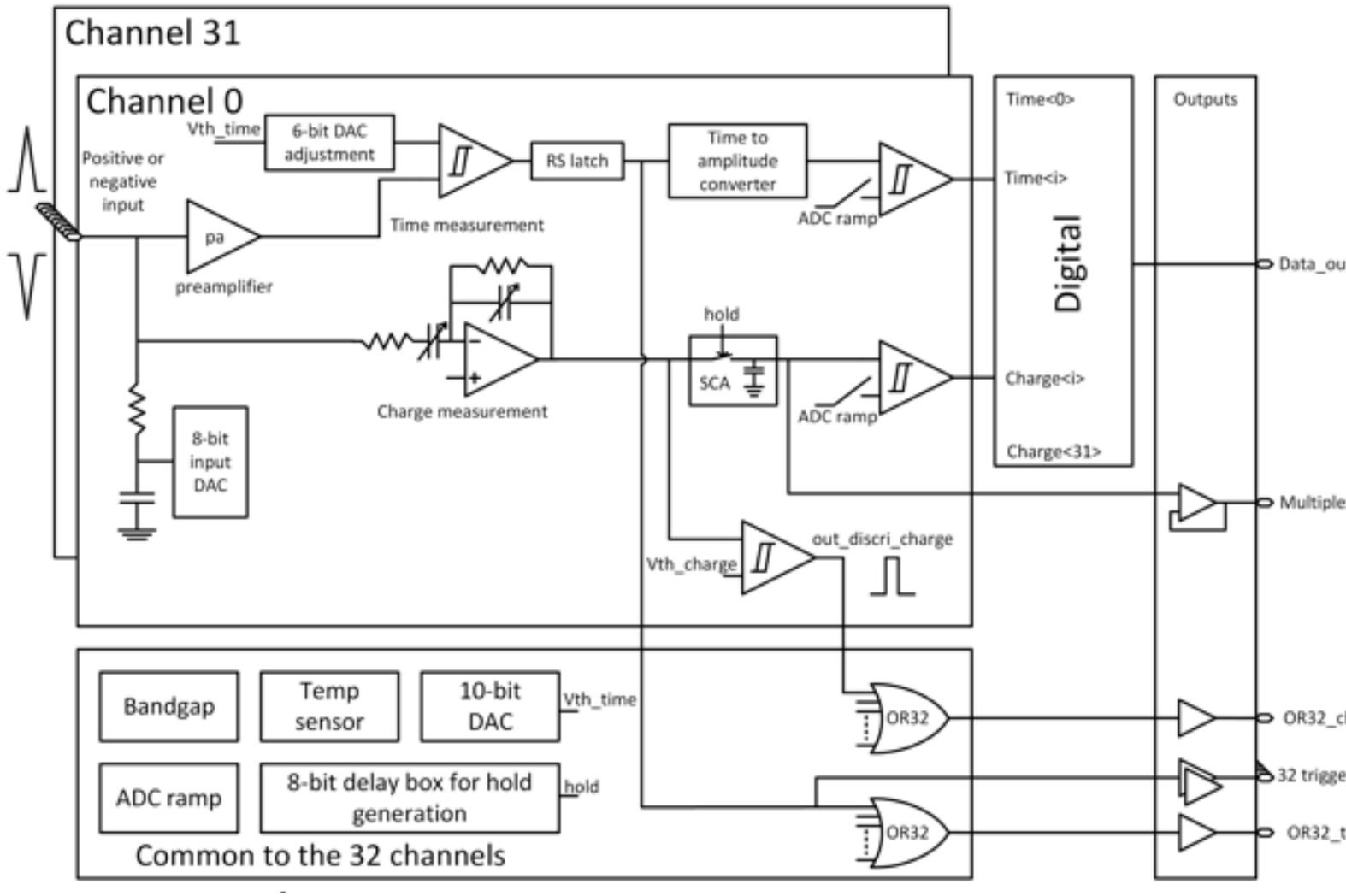




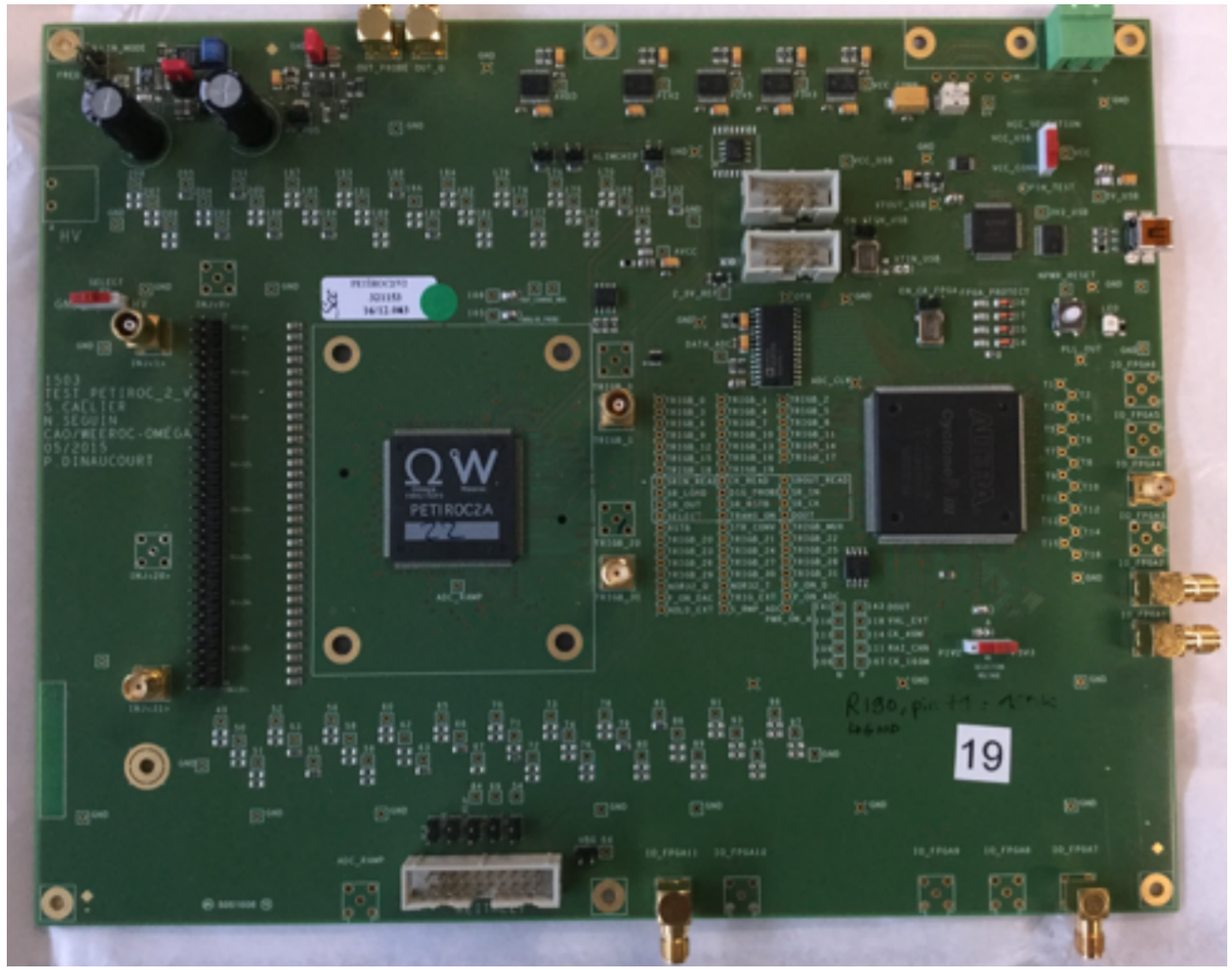
Electronics



- Started a collaboration with Omega group of the Ecole Polytechnique in Palaiseau to use the PETIROC2 chip
  - 32-channels front-end ASIC (positive and negative signal polarity)
  - Fast and low-jitter trigger (on first photo-electron)
  - Accurate charge and time (<40ps) independent measurements.
  - Times are digitized internally with a Time to Amplitude Converter and 10 bit ADC.
- First tests using a 1 chip board

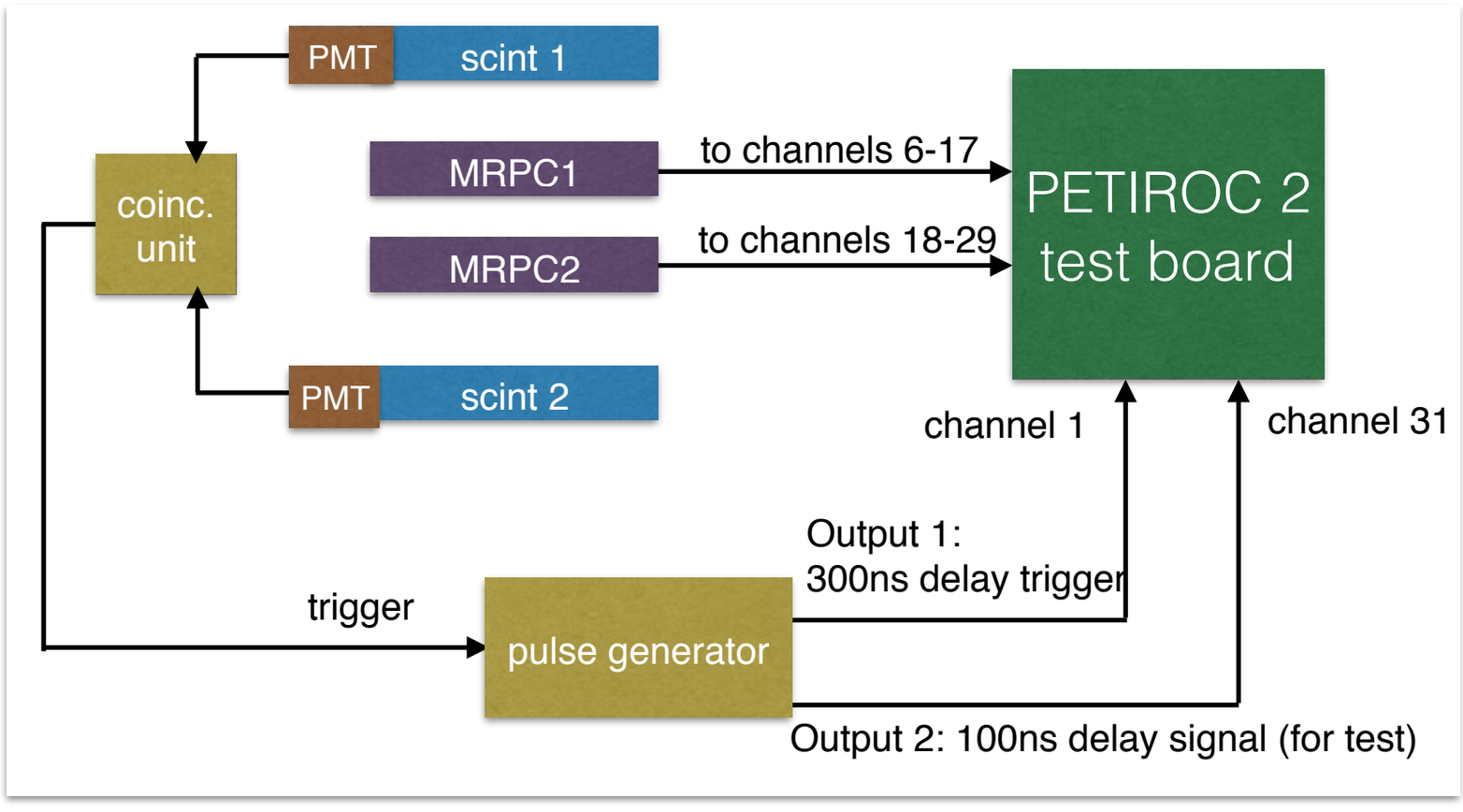


PETIROC-2 tests

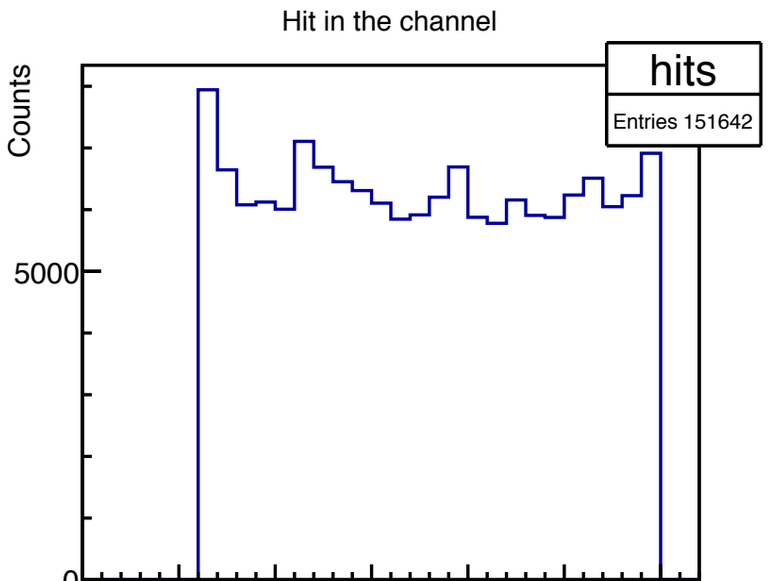


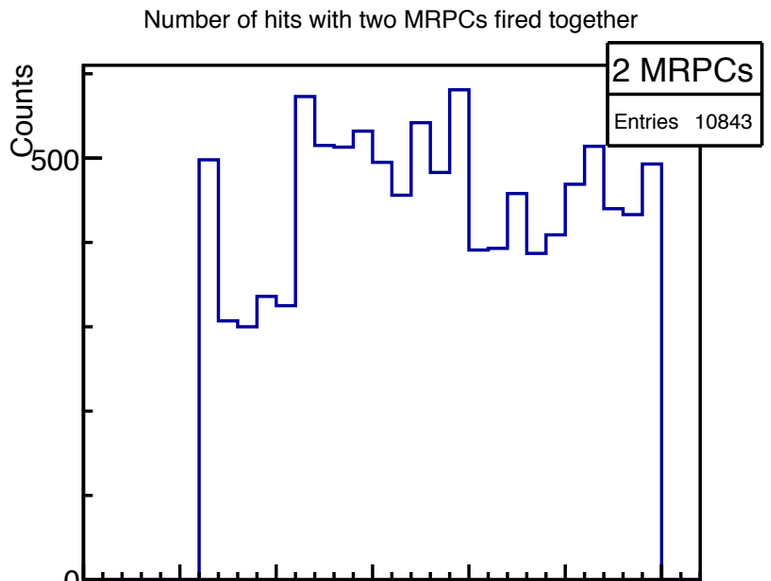
Cosmic rays setup

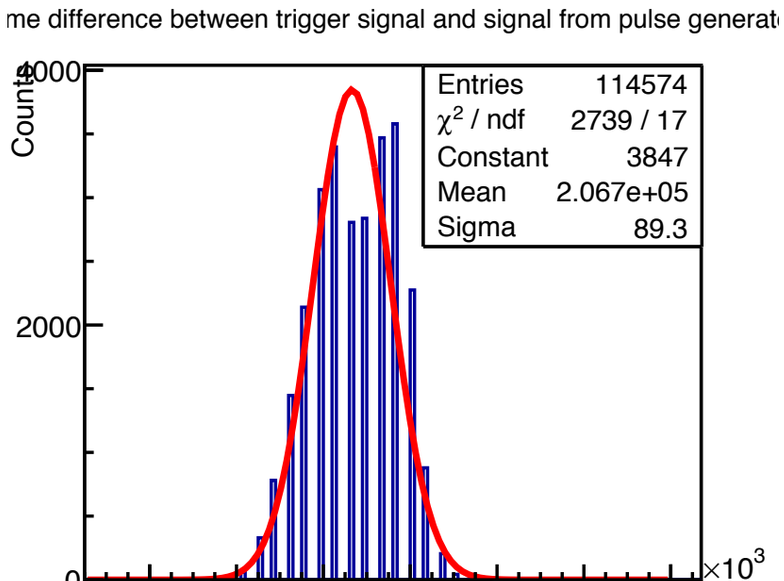
- PMTs + scintillators triggers
- Signal from two“small” MRPC chambers (~20x20cm)
- 2000s FPGA acquisition frame
- PETIROC2 chip is reset every 50 µs to reduce noise

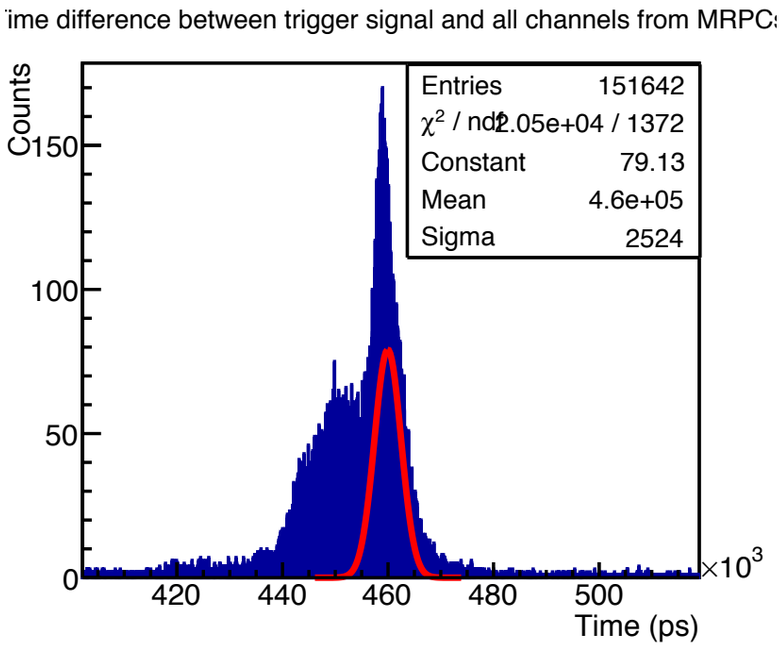


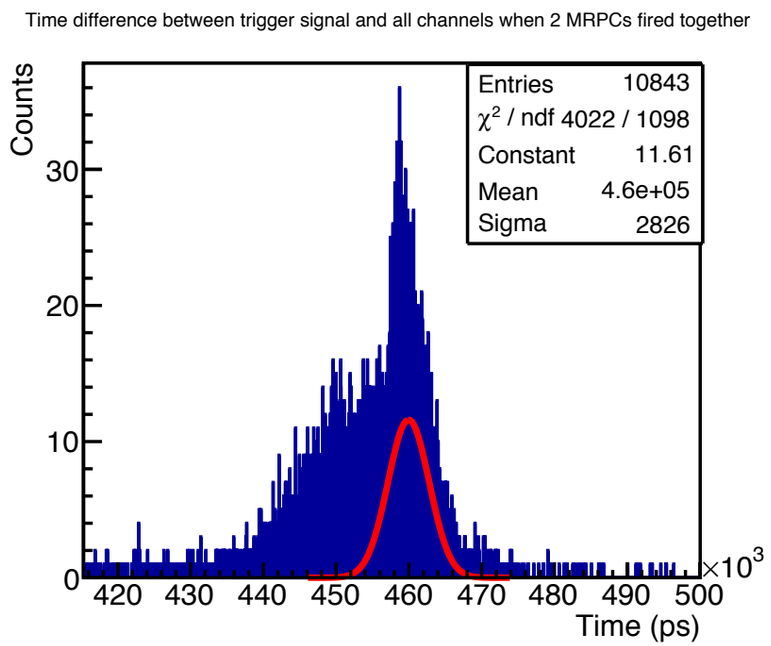
PETIROC2 tests

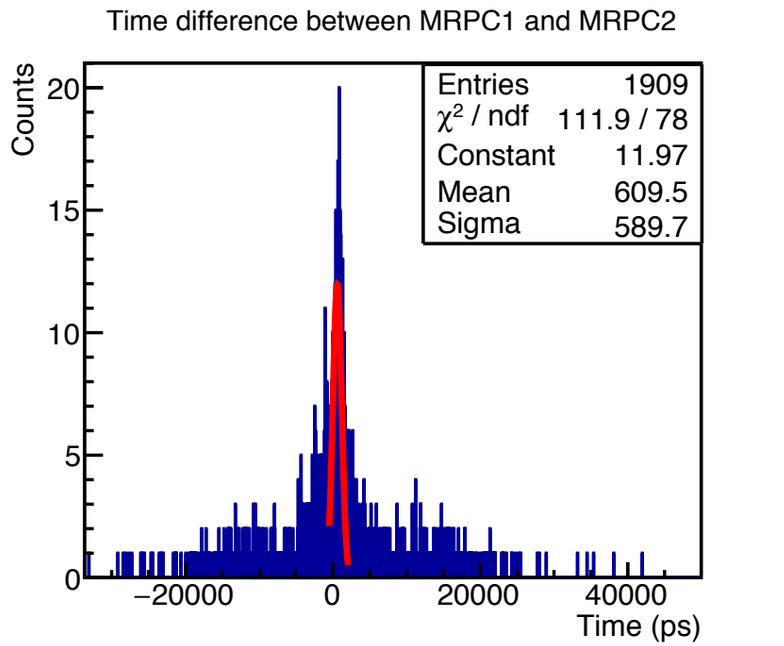












On-going work & Plans

- Test different painted glasses
- Test different gas mixtures
- New 1mx1m chamber with 5 narrower gaps (~220 μm)
- Electronics:
  - Building a new board with 2 PETIROC-2 chips and then 48 chips
- Next scheduled test beam in October

Thank you!