IPN LYON Meeting

15 – 16 October 2008

ESI and ABC Laboratory

(ABC= Archamps Biomedical Centre)

TOF Developments

Goal :

•Use ultra-fast detectors like MCP to obtain TOF measurement at a level of a few tens picoseconds

• For Medical imaging : Better images (reject background…)
Lower patient dose

• The purpose of the ABC Lab is to progree on this may.

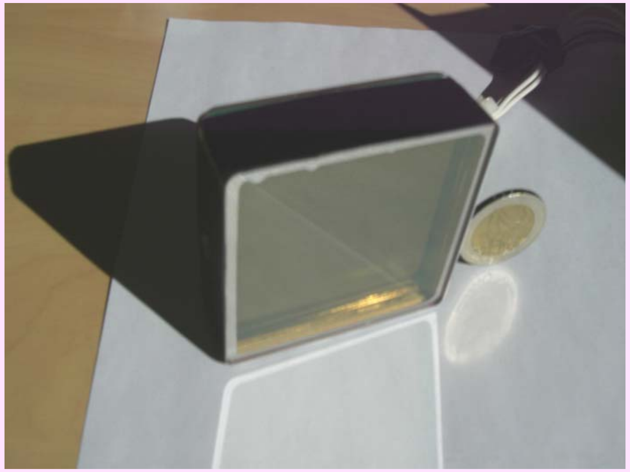
•Our study programme :

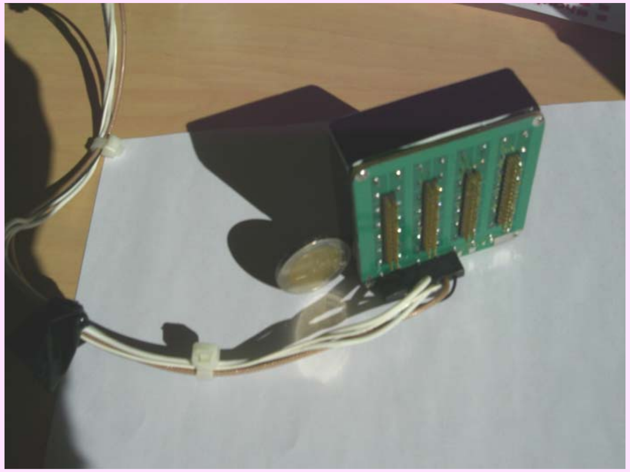
• Work in a first step with charged particle (Cerenkov effect in PbF2 crystals). Then measure TOF limit in a CERN beam (to 10 to 50 psec.

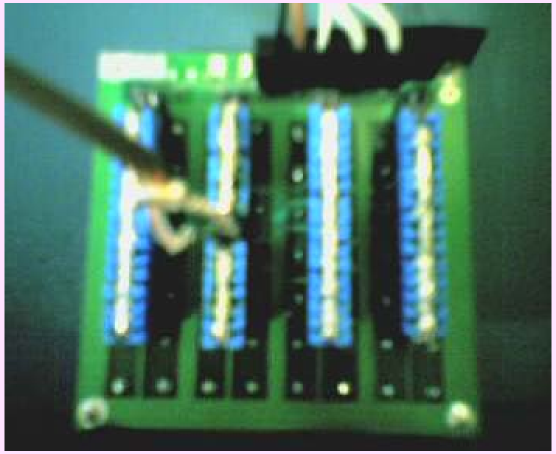
• In a second step try with photons (TEP). Need a simulation of photons trajectories in crystals, for instance with LITRANI programme from Saclay .

Perspectives TOF

J. LOLLIEROU, Y. LEMOIGNE







64 Anodes MCP

Pico-Second Timing Workshop

University of Chicago
Argonne National Laboratory
Commissariat a l'Energie Atomique
European Scientific Institute, Archamps
Consulat de France à Chicago, Attaché Scientifique

University of Chicago, March 27 & 28, 2008

TOF Developments

Front-End Readout Electronics for Micro-Channel Plate (MCP)

Julien Lollierou, ESI
Pier PaoloTrapani, INFN
& CERN, Geneva, Switzerland

Goal:

A fully parallel prototype readout system that allows digitization and acquisition of 64 anode signals from a micro-channel plate photomultiplier tubes (MCP-PMTs) was developed for gamma camera. First and foremost, our goal is to build an efficient and economical front-end card for the readout conditioning of 64 analog signals.
Then, four 16-channels analog-to-digital conversion (ADC) CAMAC modules were used to digitize individual outputs signals.

TOF Developments

J.Lollierou / PP.Trapani

Introduction

Due to high signal-to-noise ratio, MCP-PMTs are used like photodetectors in many imaging applications particularly in PET scanners. The non-uniform spatial response and gain variation of MCP-PMT significantly degrades performance unless individual anode correction is applied.
The main advantage of independent channel readout is that it allows digital correction of gain variation, cross-talk and non-uniformity within the readout channels providing accurate position estimation and image quality.

View of detector

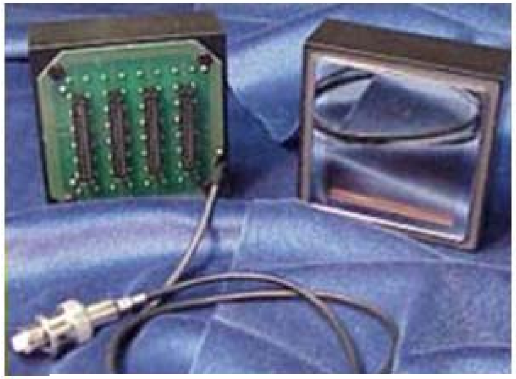


Figure 1: The 85013-501 PLANACON™ assembly is based on a new photomultiplier tube that utilizes microchannel plates (MCP) for electron multiplication

TOF Developments

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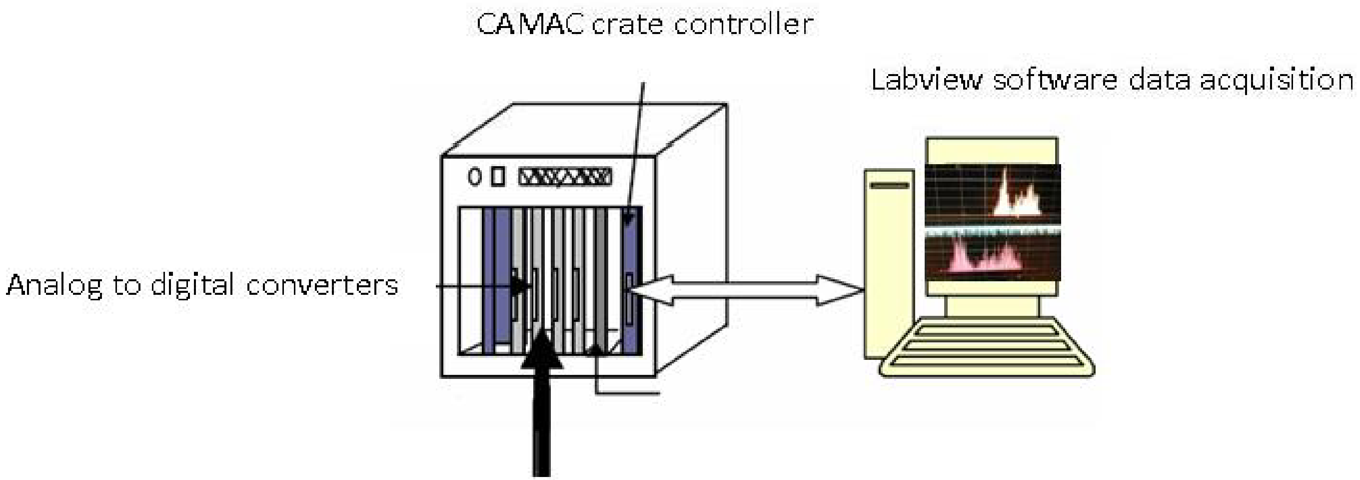
Readout System description

Our gamma camera is based on the detector equipped with 64 (8 x 8) anode pixels in a 50 mm square active detector area. This detector will be coupled to a LYSO block scintillation crystal optimized for photon detection sensitivity and resolution . The signal output from each anode is read out individually using four front-end cards and CAMAC Crate Controller with USB2 interface aided by Labview software data acquisition system as depicted in Figure 2.



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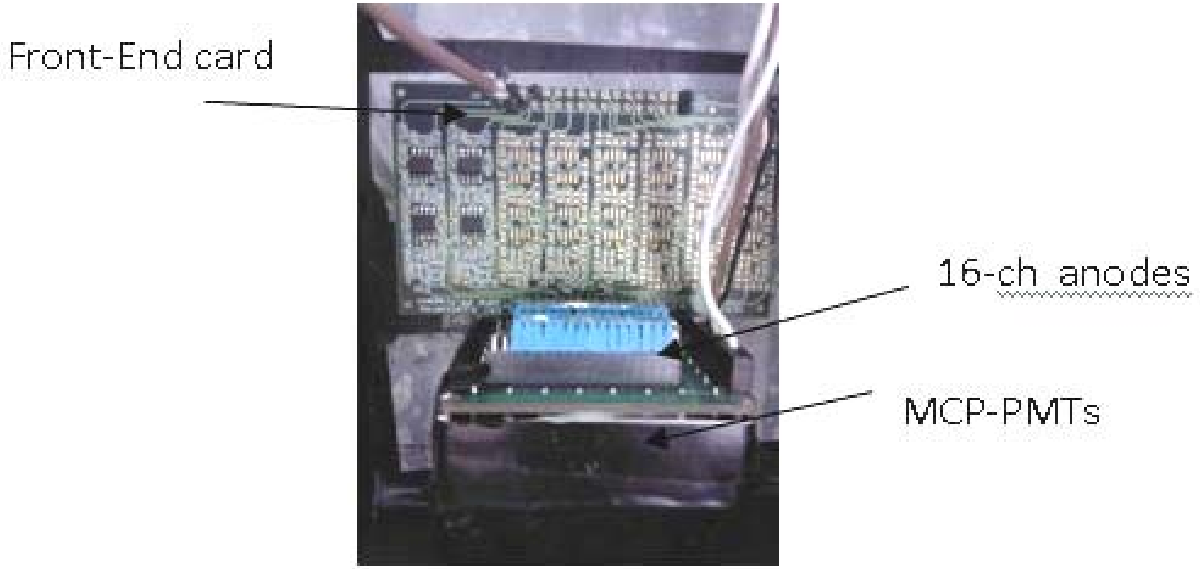

Figure 2: Experimental Setup of CAMAC based fully parallel readout and acquisition system

TOF Developments

View of one front-end card tested

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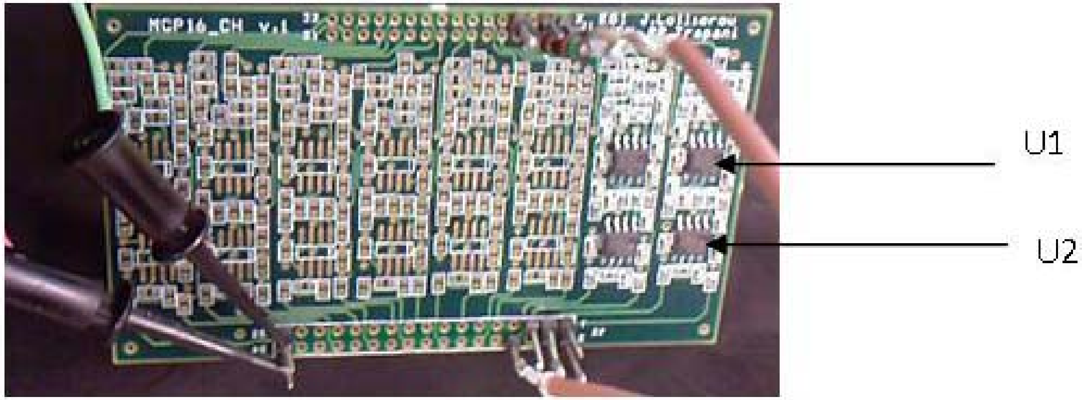
PP.Trapani

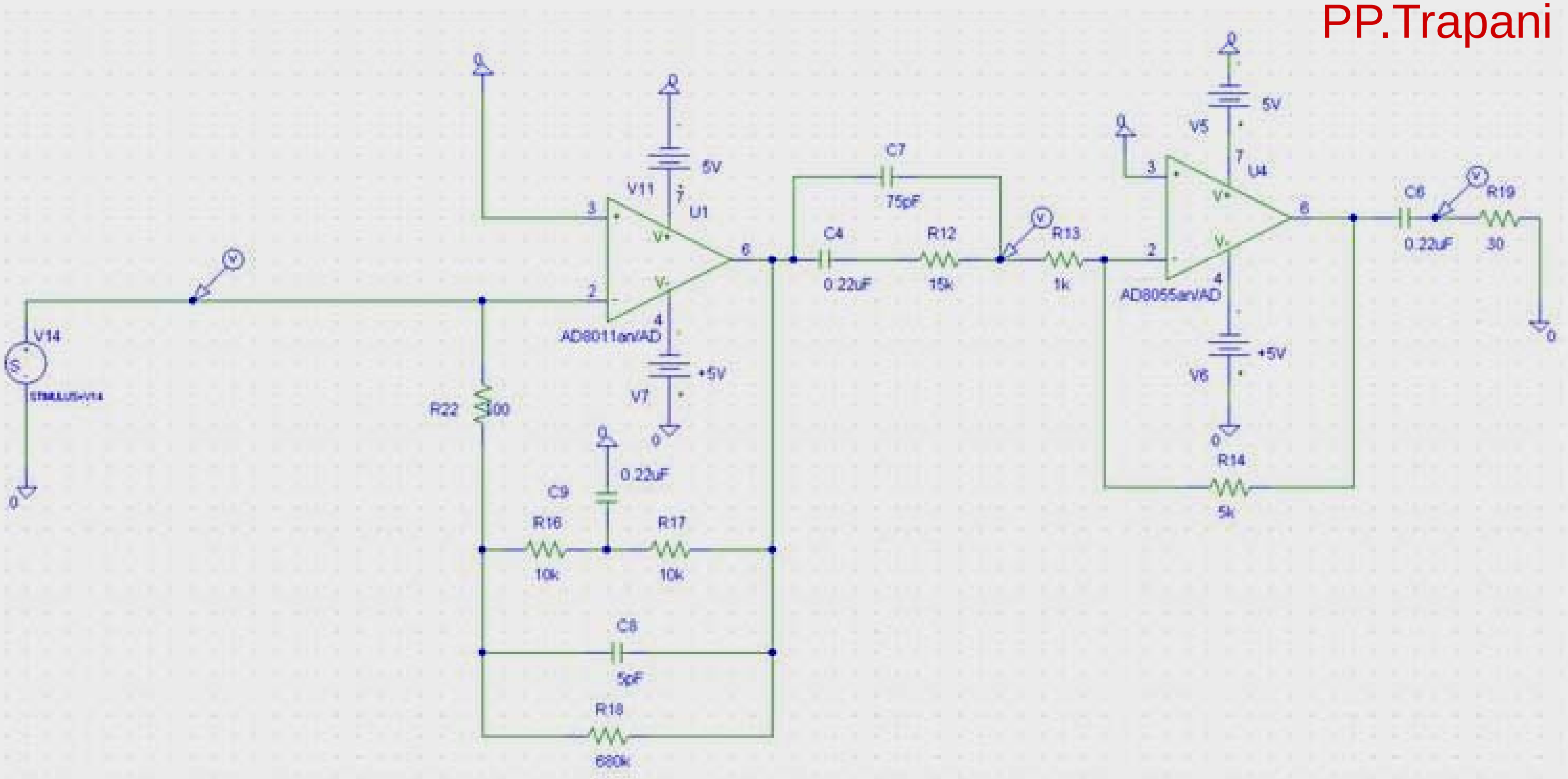


Each analog front-end card including a 16-ch simultaneous permits multichannel parallel signal conditioning of analog data. Front-end amplifiers (made of AD8012 and AD8056 fast low noise OP amp. by Analog Devices, U1 & U2) are used to provide signal amplification and proper pulse shaping. The resistors are made of equal 1%-accurate SMD resistors of 0603 size which are placed on one PCB and directly attached to the MCP outputs to minimize possible parasitic crosstalk and noise.

The fifth board collects all 64 signals and send them to ADC, it permits also to consolidate mechanically the structure.

Schematic and pspice simulation

J.Lollierou / PP.Trapani



This schematic represents one of 64 analog channels with its charge collecting termination amplifier including pole/zero cancellation circuit and output buffer-inverter. The amplifiers front-end circuit operates as a charge sensitive amplifier with a 5pF feedback capacitor. A simple and efficient pole/zero cancellation circuit shape the output pulse.

TOF Developments

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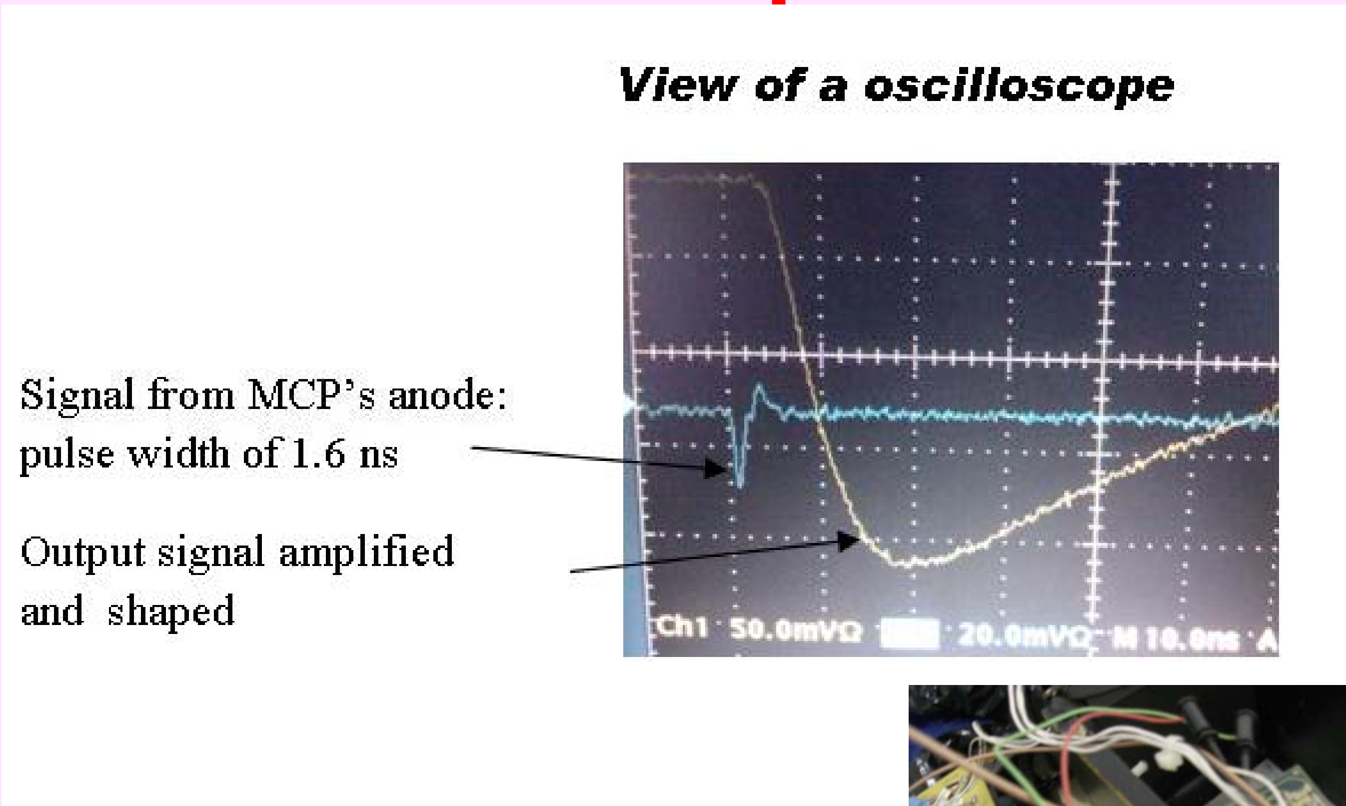
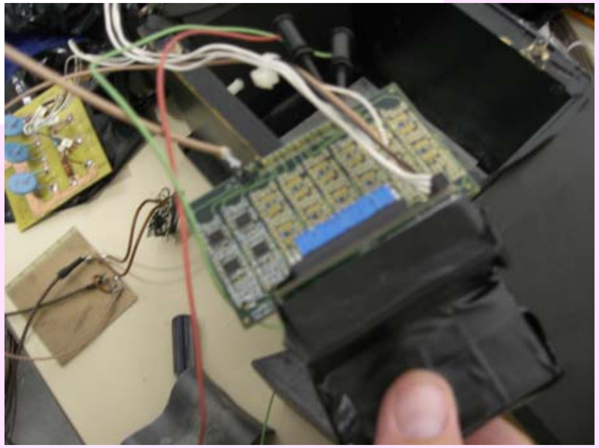


MCP + LYSO Crystal (Na22 source)



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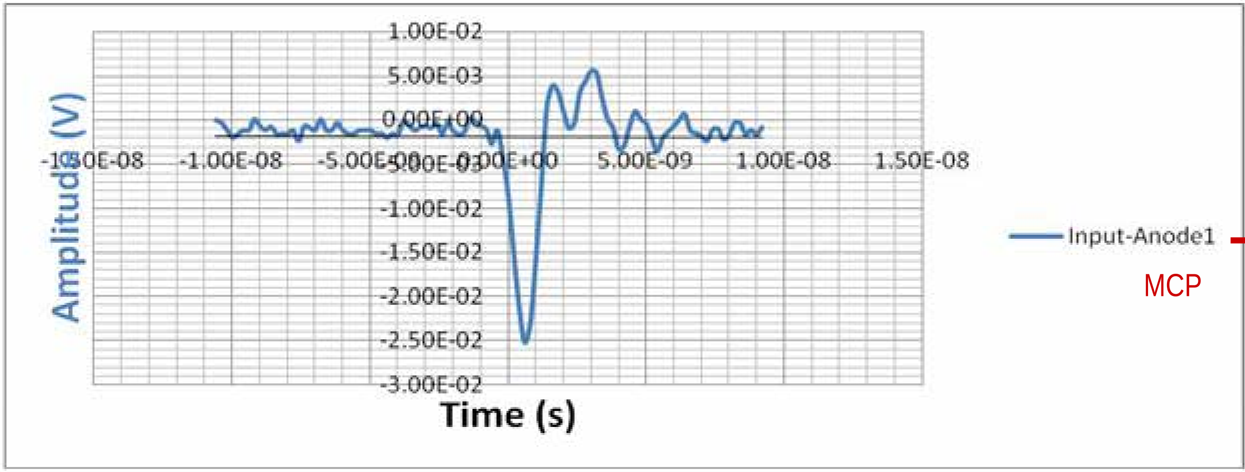
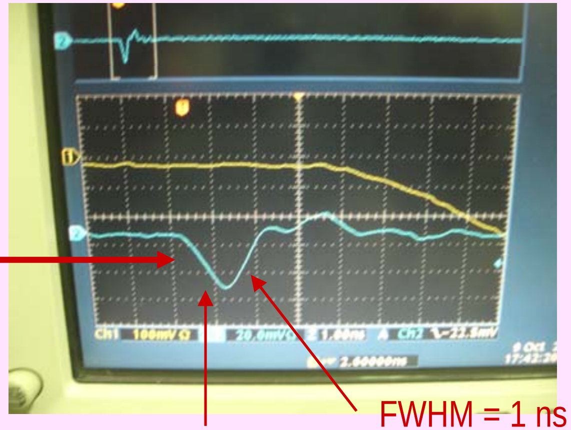
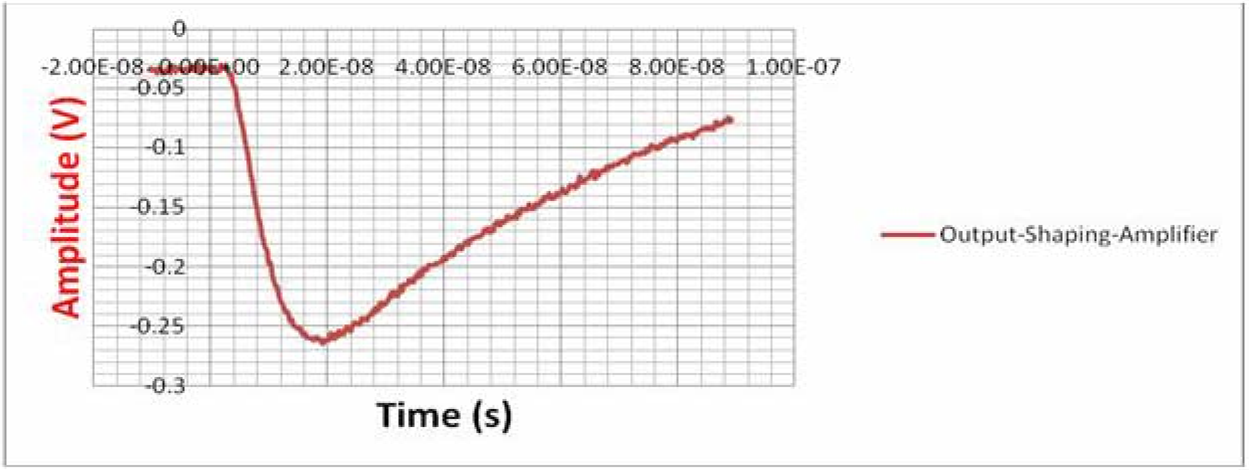


MCP

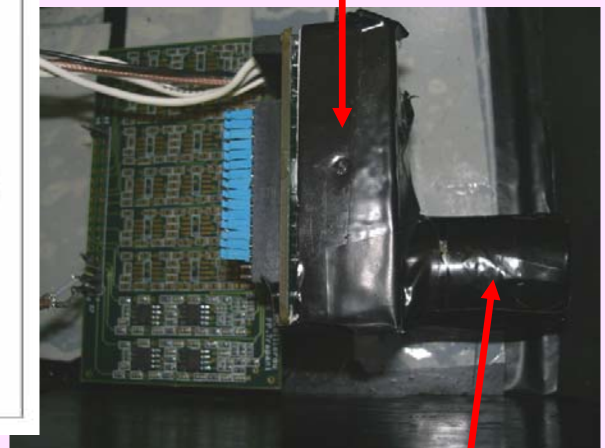


Rise time= 600 ps

FWHM = 1 ns



MCP



Cerenkov in plastic

TOF Developments

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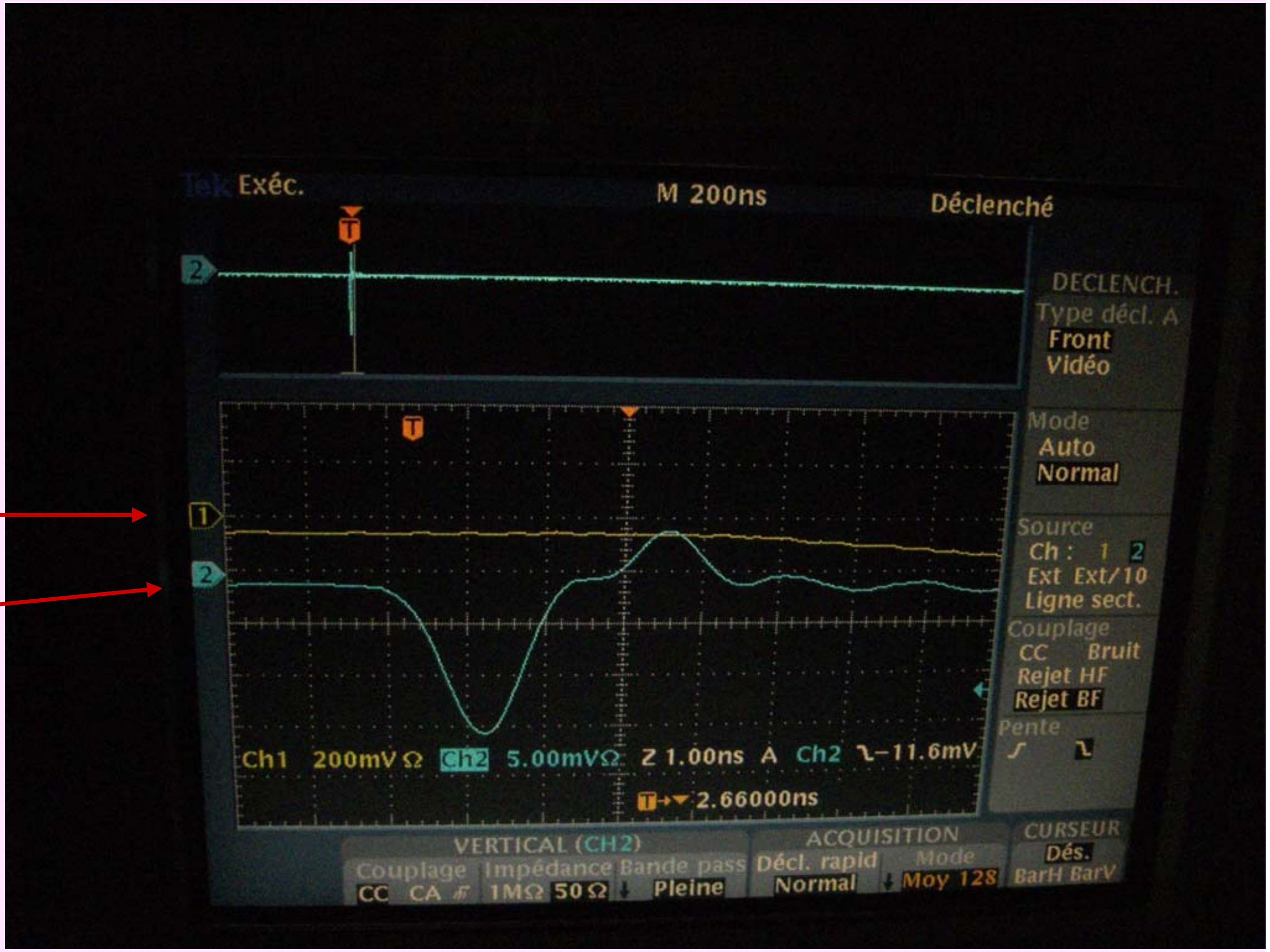
With quartz crystal

Zoom 1 ns/div

Output-shaping amplifier

MCP anode (input ampli)



CONCLUSION

- Our first tentative for a « cheap » front-end for MCP
- Improvement possible (suggestions welcome)
- Cerenkov pulses measured last week
- Jitter to be mesured carefully

Thanks a lot for the gentle attention!