6th International Conference on
New Developments In Photodetection
NDIP2011
Lyon - France, July 4-8, 2011

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CENTRE NATIONAL D'ÉTUDES SPATIALES

HIGLIGHT of Poster Session IV

A. PENQUER (CNES/France)

Poster Session IV: overview

- 16 contributions
- very pleasant work with very interesting results
- various technologies addressed and also system & performances aspects
  - -FEE (8 contributions)
  - -MCP detectors (3 contributions)
  - -Gaseous detectors (2 contributions)
  - -System (2 contributions)
  - -Photo-performances (1 contribution)

=> Not attending this poster session would be a mistake!

Poster Session IV: overview

- Aim is to have a quick look on the presented work
- Not possible to have a detailed focus on each poster
- Need to group posters into specific topics
- Some poster presentations are shorter. **Shorter does not mean less interest!!**

FEE (Front End Electronics)

- Large range of detector applications : SiPM & PMT; X-Ray solid states; CMOS readout
- Analog and digital, design description/simulation/measurement results
- 3 different topics underlined:

  -ASIC for PMTs (5 posters) : multi-channels, high count rate event detection, digitalization on chip, large dynamic range, charge and arrival time measurement

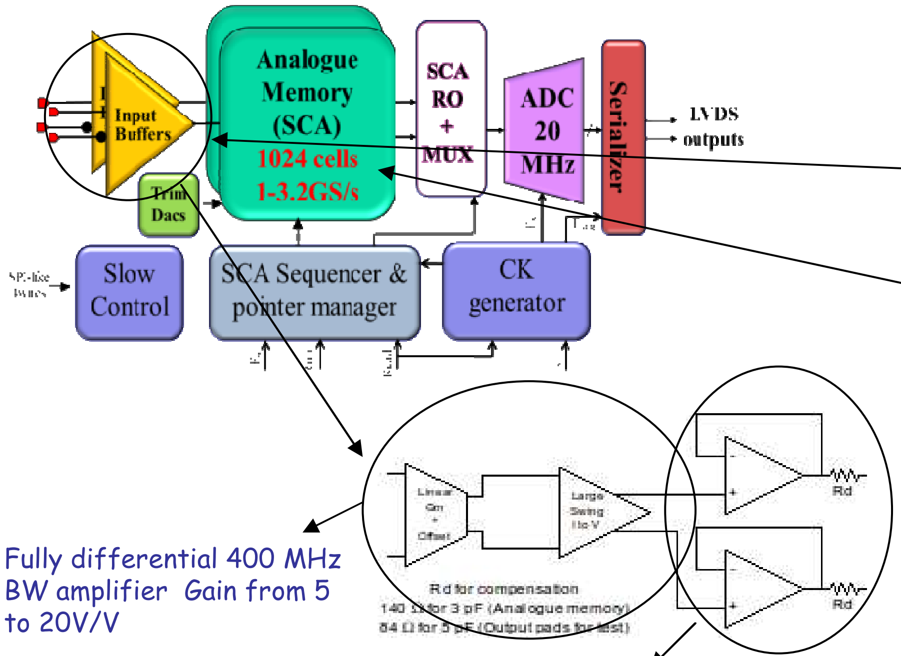
  -ASIC for X-Ray solid state (1 poster): lower count rate and dynamics, very low noise, spectroscopy with very high spectral resolution

  -Discrete electronics for SiPM and CMOS readout (2 posters)

FEE: ASIC for PMT

- 3 posters concerning NECTAr0 Chip

-**Wideband Pulse amplifiers for the Nectar chip**, A. Sanuy – P044
-**A MultiGiga Sample/s Digitizer ASIC for the Cherenkov Telescope Array**, E. DELAGNES – P100
-**Optimizing readout of the NECTAr front-end electronics**, S. Vorobiov – P087



Fully differential 400 MHz BW amplifier Gain from 5 to 20V/V

Class AB Miller operational amplifier for non-linear current boost (fast capacitive load up to 15pF)

New electronics for CTA

-2 differential channels

-input buffer: fast differential amplifier and class AB Miller AOP for non-linear current boost

-ultra fast analog memory followed by a fast ADC. 1024 analogue cells/channel

-sampling rate : 0.4-3GS/s range – 11.3 bits range

-low readout dead time (2μs)

-digitization of data of interest by a 20 MS/s pipeline ADC

-serialization of output data on a 240MBit/s link

-optimization in readout time and sample rate/analog BW ratio under final specification (impacts on total signal charge and arrival time reconstruction)

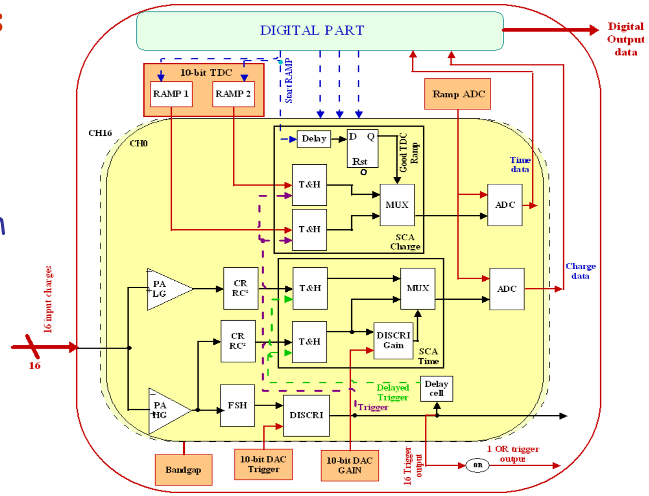
FEE: ASIC for PMT

▪2 other very interesting PMT readout ASIC contributions

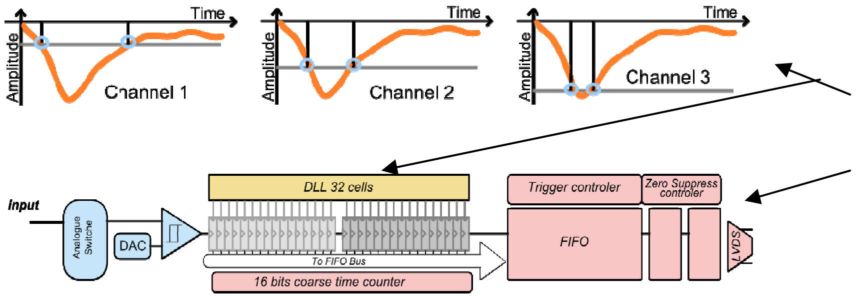
-PARISROC: an autonomous front-end ASIC for triggerless acquisition in next generation neutrino experiments, C. DI LORENZON – P020

-short description
Front-end chip for low cost and triggerless acquisition system
16 channel/2 adjustable gains

-Performances
1/3 photoelectron auto-trigger (50fC @ 10^6 PM gain)
charge measurement from 1 to 300 p.e.
time tagging better than 1 ns

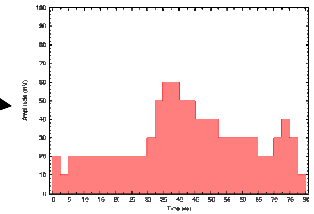


-A new concept of amplitude and time digitizer ASIC for photomultiplier tubes signal processing, F. Guilloux – P202



-short description
New concept of PMT data processing
Analog voltage compared with several thresholds (16 channels/10Bits DAC)
Fast sampling memory and zero supress data reduction

-Results
Tested with PMTs
250MHz BW
250mW power consumption
1.25ns sampler time step



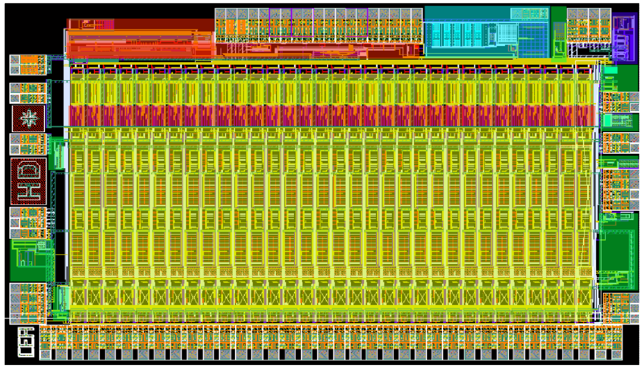
FEE: ASIC for X-Ray solid-state detector

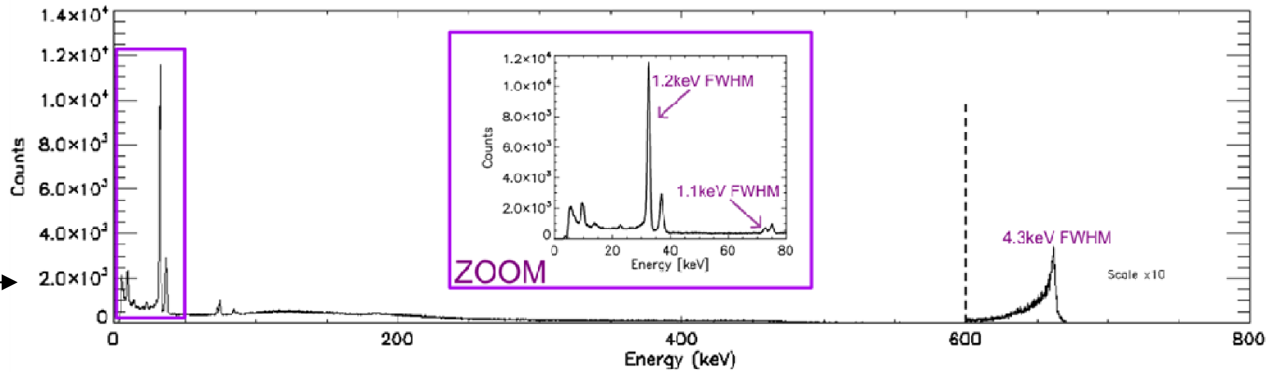
-Imaging X-Ray Detector Front-End with High Dynamic Range:
IDeF-X HD, A. MICHALOWSKA – P162

-**Motivation**
CdTe detector readout for high resolution spectro-imaging camera

-**Design**
CMOS AMS 0.35µm technology
High dynamic range (1MeV)
Tunable discrimination threshold
Peak time from 0.7 to 10.7µs
Temperature sensor on chip

-**Results**
Low power consumption (800µW/channel)
Very low noise (33 e-rms noise floor)
High spectroscopy resolution (1.01keV @ 14keV and 4.3keV @ 662keV)



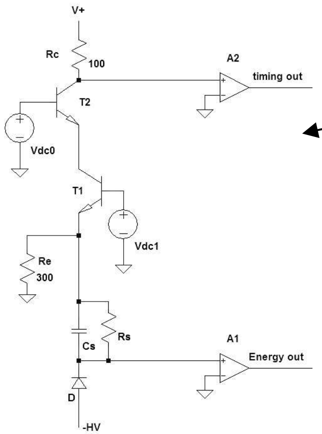


Single pixel CdTe Schottky,
Pixel size: 2x2mm^2, Detector thickness: 2mm,
Temperature: -10°C, Bias voltage: 1020V

FEE: discrete electronics

- 2 posters about discrete electronics developments

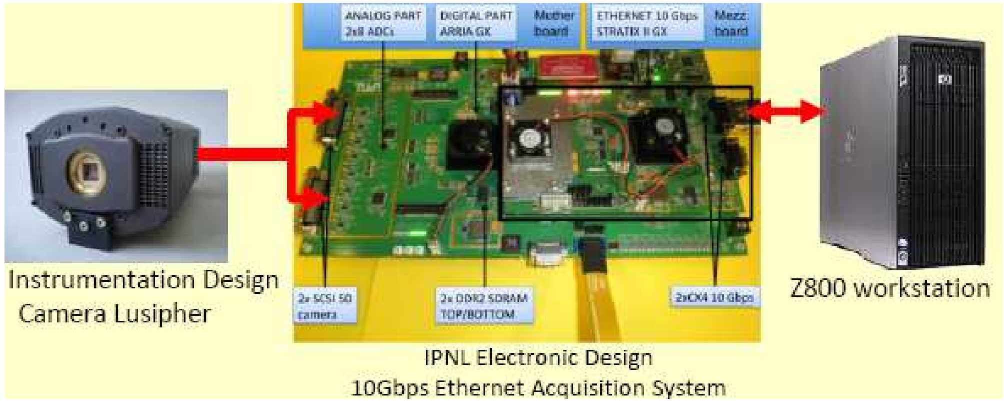
-A fast preamplifier concept for SiPM based time-of-flight PET detectors, J. HUIZENGA – P030



-**Short description**
Fast front-end to minimize loss of rise time in SiPM readout
Low input impedance common-base transimpedance amplifier
High speed, discrete transistors
Fast timing output & shaped energy output

-**Results** (Small LaBr:CE crystals measurements)
1ns rise time with light excitation
<300ps rise time with pulse excitation (SiPM attached)
100ps FWHM coincidence resolving time

-An acquisition system for CMOS imagers with a genuine 10 Gps bandwidth, C. GUERIN – P164



-**Motivation**
System to read 800x800 EBCMOS camera
Ultra fast frame rate needed (1000fps) with on board preprocessing

-**Design**
16 analog channels @ 40Msps 12Bits
Up to 21.3 Gbps memory BW on board
Digital part (FPGA, memory, connectivity, ethernet…)
Software features

MCP (Micro-Channel Plates) detectors

- Testing of existing MCP detectors & system performances modelling (2 posters)

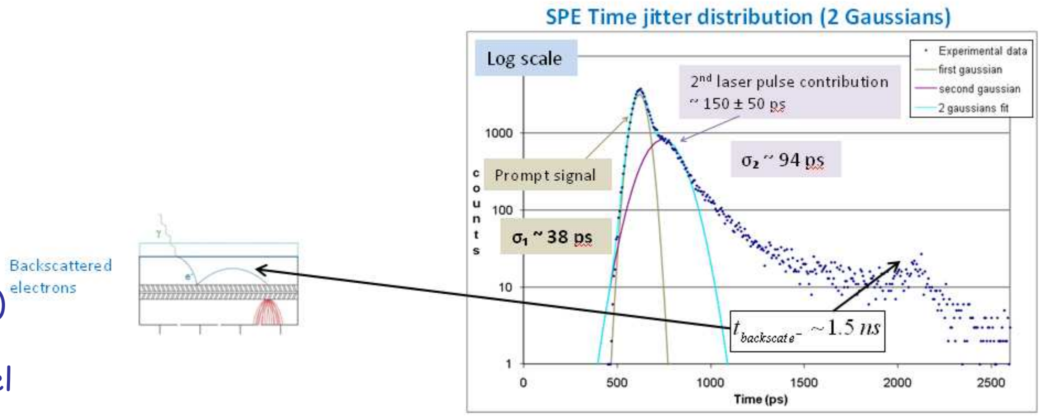
- New technique to optimize MCP-PMT performances (1 poster)

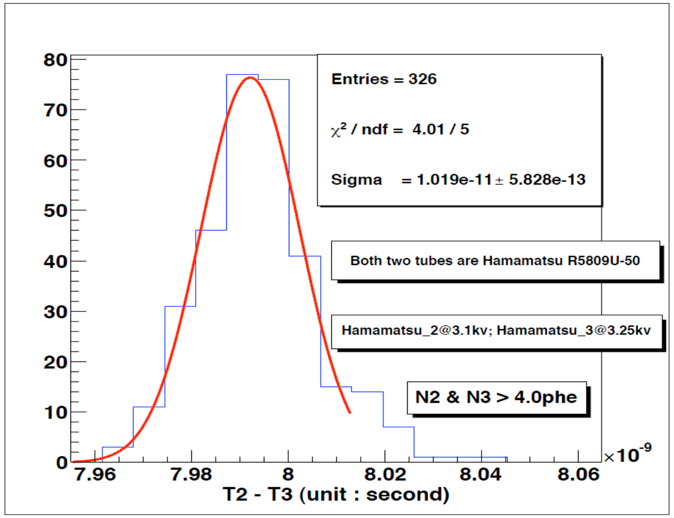
MCP: testing & modelling

-Testing Micro-channel plates timing performance for LHCb upgrade, L. CASTILLO GARCIA – P121

-**short description**
TORCH detector
Very fine anode segmentation detector for low time spread for single photon

-**Experiment/Results**
Commercial MCP detector-Moderate gain (7.10^5)
Excellent timing resolution (<40 ps) with estimated Ɛ of ~ 90% for single photons on pixel centre





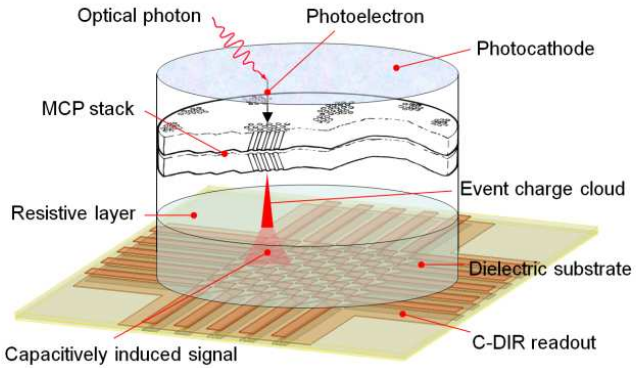
-GasTOF: Picosecond resolution timing detector using MCP-PMTs, J. LIAO – P019

-**Short description**
Development of a picosecond resolution Cherenkov detector using the fastest single anode MCP-PMT

-**Work**
Measurement (2 runs)
HAMAMATSU R5809 and Photek 210 tubes
Response modeling
Outlook for future development

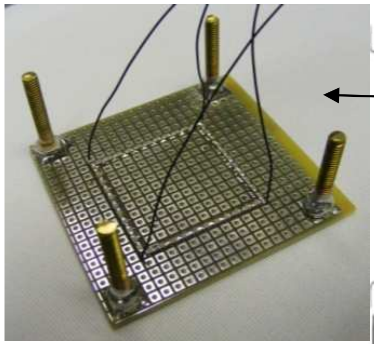
MCP: new technique

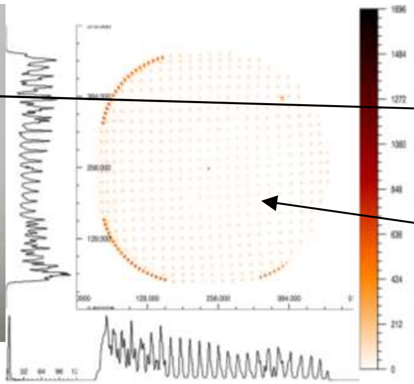
-High speed imaging using a capacitive division technique, J. LAPINGTON – P150



-**Approach**
Event charge localized on resistive layer
Transient signal induced through dielectric
C-DIR readout (array of capacitively coupled electrodes)

-**Advantages**
High speed and low noise
No geometric charge division
Excellent spatial resolution and high count rate
Simple operation (no vacuum)





-**Prototype and results**
Array of isolated vias, in contact with detector dielectric substrate
1mm pitch pinhole array
150 µm FWHM obtained without optimization at 10^6 gain

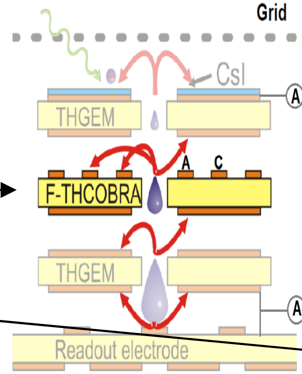
Gaseous detectors

- Study of parasitic and aging effects:
  - -Ion backflow reduction technique (1 poster)
  - -Effects of contamination and aging on gas scintillation (1 poster)

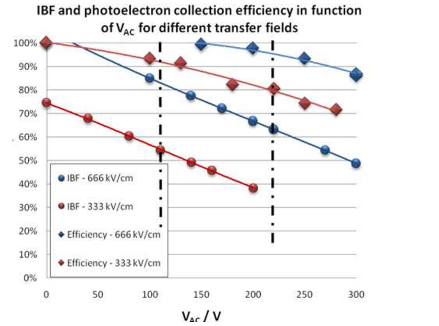
Gaseous detectors: parasitic and aging effects

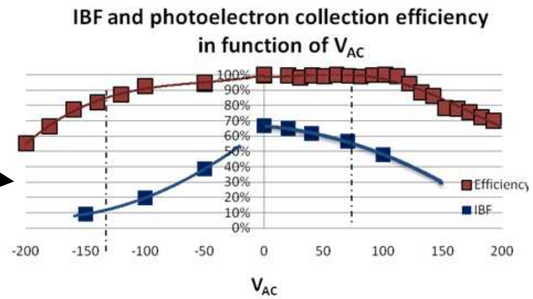
-THGEM based VUV photosensor incorporating the THCOBRA for Ion Back Flow reduction, C. SANTOS – P195

-Short description
Ion back flow reduction (feedback pulses, field distorsion and photocathode aging)
THGEM based photosensors for RICH + Thick-Cobra as ion trap device



-**Experimental results and simulations**
Ion back flow reduction below 20% with full collection efficiency and stable gain is possible





-Effect of the gas contamination on CF4 primary and secondary scintillation, L. MERGATO – P191

-**purpose**
Effect of gas aging and contamination on light emission properties of CF4 and CF4+He gas mixtures

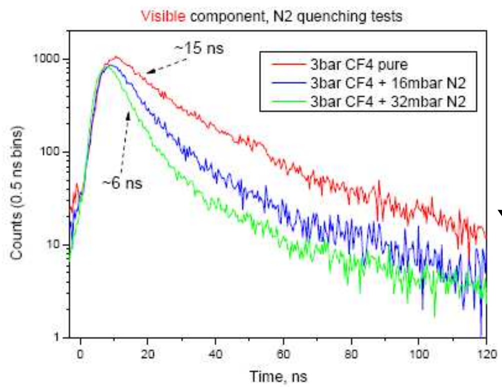


Figure 4 - Primary scintillation from CF4: time spectra of the visible emission (450– 800 nm) in 1bar CF4, 1bar CF4+16mbar N2 and 1bar CF4+32 mbar N2.

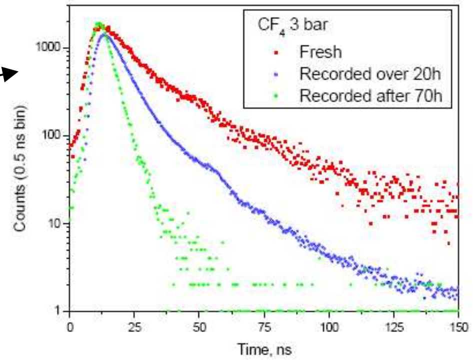


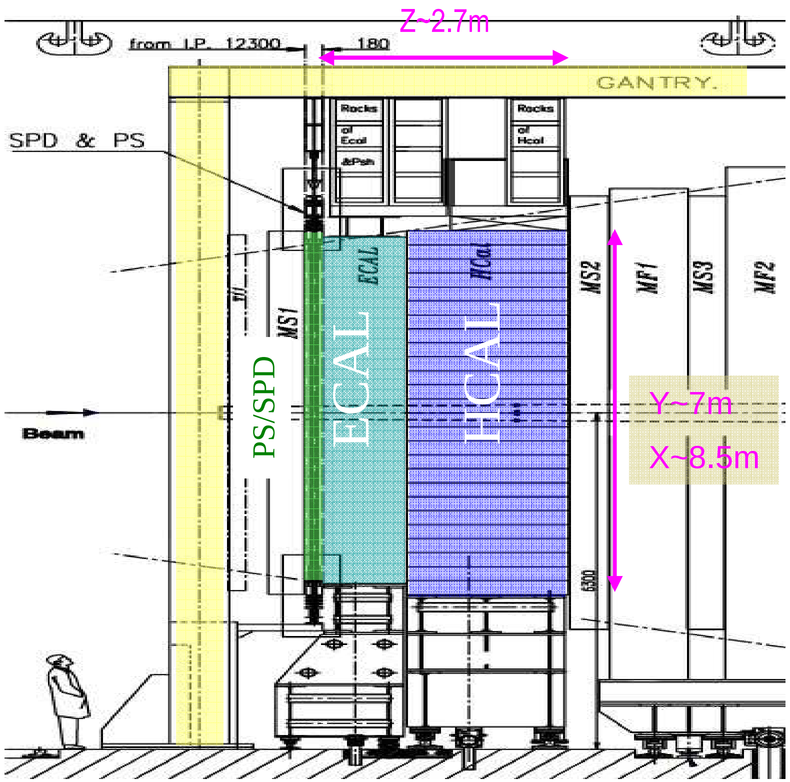
Figure 2 - Primary scintillation from CF4: time spectra of the visible emission (450– 800 nm) for fresh and aged gas conditions.

System (SiPM & PMT detectors)

- 1 contribution about system feedback: results and performances under exploitation

- 1 contribution about specific development and optimization for future system

-**First year of running for the LHCb calorimeter system**, Y. GUZ – P133



-Purpose
Precision measurement of CP violation and rare decays of B hadrons

-**System**
Area of ~7x8.5 m^2
Electromagnetic (ECAL) and hadronic (HCAL) calorimeters
Scintillator pad and preshower detectors: 12032 detection channels (light readout by 64 channels PMT)
Shashilk calorimeter technology for ECAL: 3312 modules 12x12 cm2 (PMTs)

-Performances
Since beginning, LHCb calorimeter system runs successfully and meets its design parameters

Photon and electron reconstruction performance

- Electron identification:
~4% misID rate at 90% efficiency

- π^0 peak width in modes with 0, 1, 2 converted ($\rightarrow e^+e^-$) photons:
  - $\pi^0 \rightarrow \gamma\gamma$: 7.2 MeV/c^2;
  - $\pi^0 \rightarrow \gamma(ee)\gamma$: 8.2 MeV/c^2;
  - $\pi^0 \rightarrow \gamma(ee)\gamma(ee)$: 9.5 MeV/c^2;

System: development for futur system

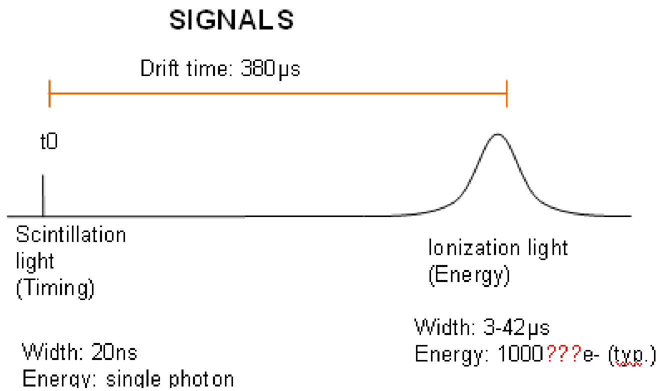
-Front-end for accurate energy measurement of double beta decays in the NEXT-1 TPC,
A. GIL ORTIZ – P147

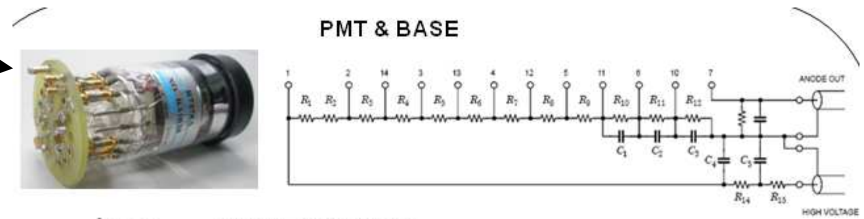
-Motivation
Search for double beta decays of 136Xe isotope in the frame of NEXT experiment

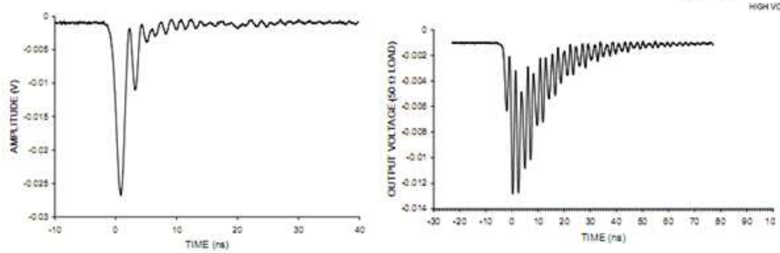
-**Challenge**
Excellent energy resolution (better than 1%)

-Solution & System design
Electroluminescent mode (two signals)
Detection by PMTs
PMT & base optimization
Front-end electronics with diff. amplifier and low pass filter
Set of DAQ cards

-**Results**
Stretching the signal=> excellent linearity and high efficiency
FEE design=> very low noise and high energy resolution
Measurements with test signals => energy resolution of 0.26% for events with electroluminescent charge of 600pC







Original PMT signal
Stretched PMT signal

Photo-performance

- Only 1 contribution: improvement of noble gases VUV emission detection

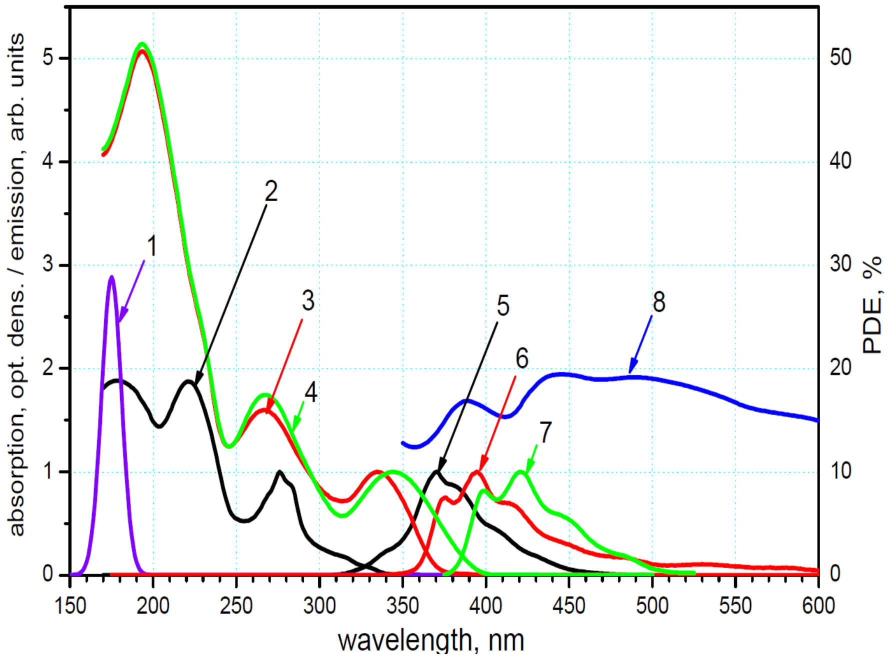
Photo-performance

-Development of VUV wavelength shifter for the use with a visible light photodetector in noble gas filled detectors, D. AKIMOV – P124

-**Motivation**
In noble gases, emission in VUV non detectable with SiPM
⇒re-emission toward visible range

-**Solutions**
1) use of of *p*-terphenyl encapsulated by poly-para-xylylene. Encapsulation is required because the *p*-terphenyl is volatile

2) use of Nanostructured Si-organic WLS (NSIWLS). Non volatile
Emission in longer wavelength for more efficient detection



1 – emission of LXe
2 – absorption of p-terphenyl
3 – absorption of NSIWLS-I
4 – absorption of NSIWLS-II
5 – emission of p-terphenyl
6 – emission of NSIWLS-I
7 – emission of NSIWLS-II
8 – photon detection efficiency (PDE) of the CPTA “blue-sensitive” photodetector, right axis.