Poster Overview for PID and Photo-Detector Session

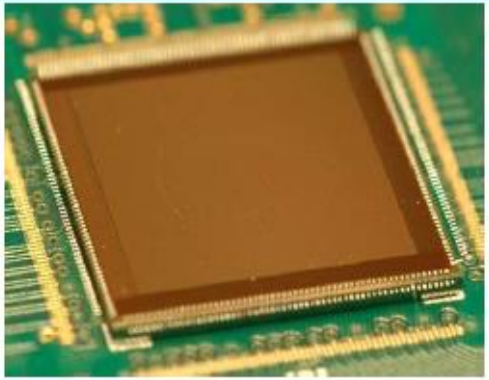
Karen Byrum
Argonne National Laboratory

Poster Overview

ID=6; Picosecond Cherenkov detectors for heavy ion experiments at LHEP/JINR
ID=13; Optimization of Statistical Methods for HpGe Gamma-ray Spectrometer Used in Wide Count rate Ranges
ID=23; Fast timing Detector R&D for the HL-LHC era
ID=25; On the operation of silicon photomultipliers at temperatures of 1-4 kelvin
ID=33; Development of solar blind UV extended APD for readout of Barium Floride crystals
ID=38; The Charged ANTIcounter for the NA62 experiment at CERN SPS
ID=47; The kaon identification system in the NA62 experiment at CERN SPS
ID=58; A new method improving multiplication factor in micro-pixel avalanche photodiodes with high pixel density
ID=62; A new detector concept for silicon photomultipliers
ID=102; The VSiPMT – A new generation of photodetectors
ID=108; The Development Of The DSSC Camera For The European XFEL
ID=142; High granularity scintillating fiber trackers based on Silicon Photomultiplier
ID=149; The Performance Test of the 20 inch PMTs for JUNO
ID=169; SPAD Array Chips with Cluster Reconstruction and Fast Full Frame Readout
ID=171; Exploring the limits of hybrid pixel detectors with MONCH
ID=176; Results on diamond timing detector for the TOTEM experiment
ID=185; Electron source uniformly distributed in the plane for MCP electron scrubbing and testing
ID=188; The Simulation of MCP and 20 inch MCP-PMT
ID=196; Dev and Char. of a Schottky CdTe Medipix3RX hybrid photon counting det w/ spatial & energy resolving cap.
ID=244; Impact of polishing on the light scattering on aerogel surface
ID=248; Characterization of SiPMs for cryogenic applications
ID=264; Radiation hardness study of the Philips Digital Photon Counter with 800 MeV/c protons
ID=286; Development of a low-cost fast-timing MCP photodetector
ID=307; Characterization of first prototype of high-density NUV-HD SiPMs for near-UV light detection
ID=319; Silicon photomultipliers for DM searches with liquid argon detectors
ID=324; Gain Compensation Technique by Bias Correction in Arrays of Si PMTs Using Fully Differential Fast Shaper
ID=335; Light induced tunnel effect in CNT-Si photodiode
ID=361; Large size SiPM matriax form Imaging Cherenkov Telescopes applications
ID=366; Parameters of the preproduction series SiPMs for the CMS HCAL Phase I Upgrade
ID=368; Effects of very high radiation on SiPMs
ID=378; Behaviour of multi-anode PMTs in magnetic fields for the LHCb RICH upgrade
ID=380; Barrel time-of-flight detector for PANDA experiment at FAIR
ID=403; Test and characterization of SiPMs intended as detector for the MEG high resolution timing counter

Exploring the limits of hybrid pixel detectors with MÖNCH

Slide by Roberto Dinapoli



MÖNCH03 Hybrid silicon pixel detector (readout chip)

- Targets high-res, low flux X-ray applications (e.g.XRCT[1])
- Charge integration with analog readout
- Active area:10x10 mm^2, 160k pixels at 25 µm pitch
  - → *World smallest pitch for hybrid pixel detectors*
  - → *goal: 2x3cm^2 chip size, 1M pixel/chip*
- Bump-bonding yield: 99.99% (on 4x4mm^2)
- Noise: <35 e$^-$rms
  - → *World lowest noise for hybrid pixel detectors*
- The charge sharing effect between pixels can be exploited to interpolate the hit position
  - → *spatial resolution with interpolation < 2 µm*

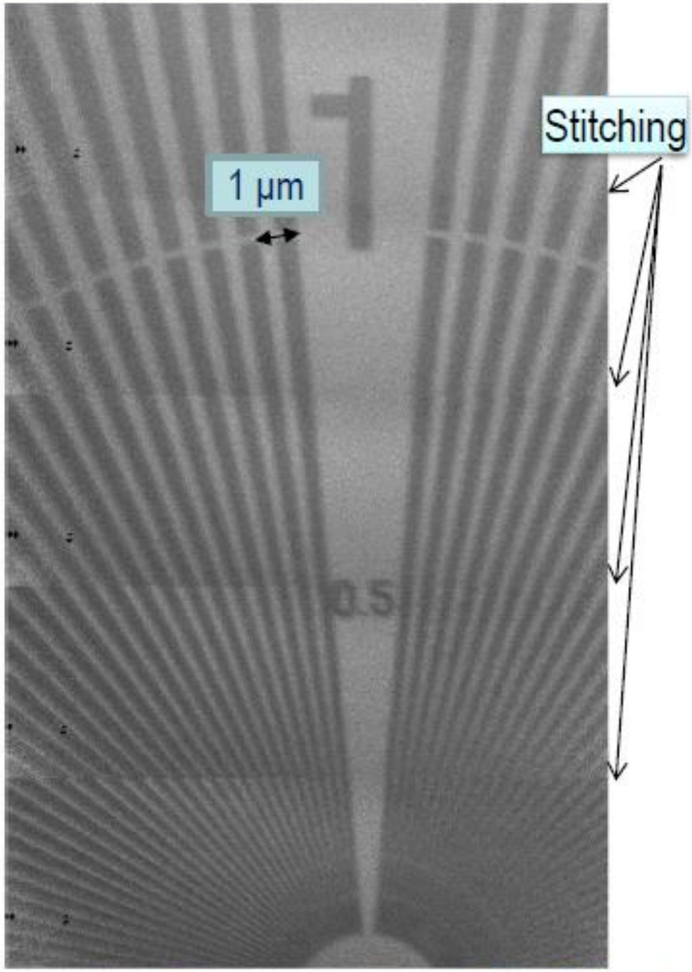


Image of a Siemens star with Mönch

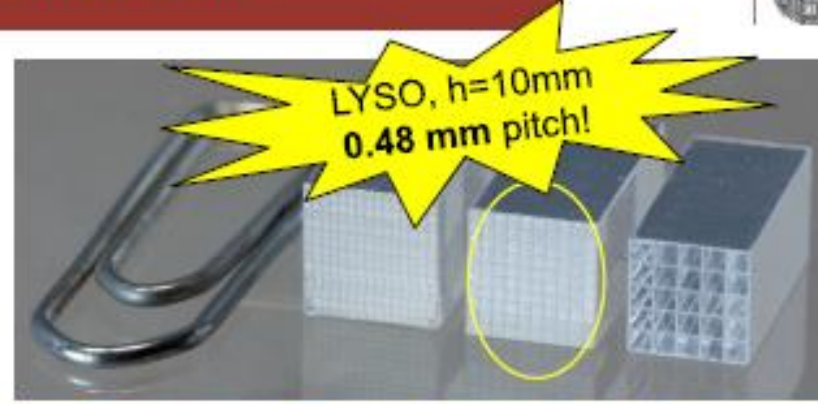
25µm pixel, with stitching and interpolation, not cooled. The setup (nanoscope) provides a magnification of 80x.

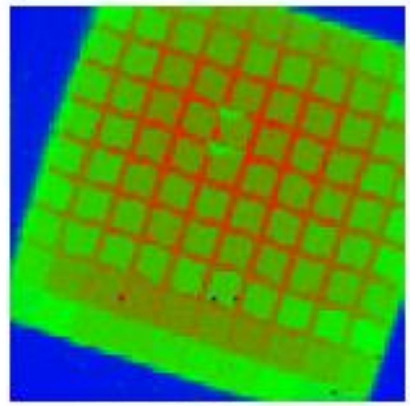
Field of view: 5x4 mm^2

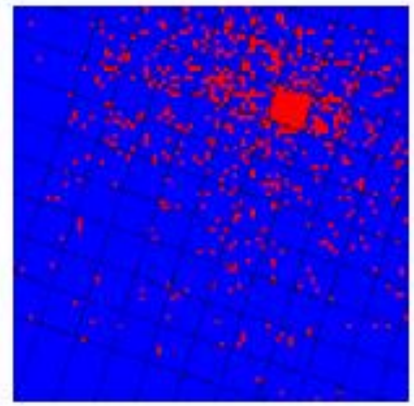
[1] X-Ray computed tomography

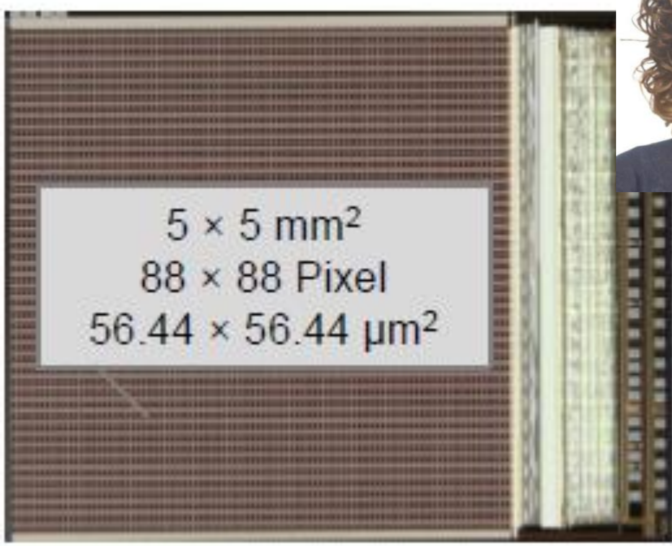
SPAD Array Chips with Full Frame Readout

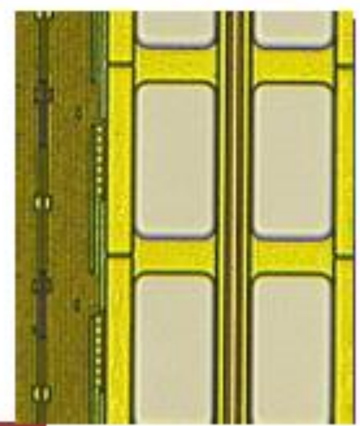
- SPAD Array Chips in CMOS Techno.
- 5 × 5 mm^2 sensitive area, 88 × 88 pixels
- SPAD fill factor 38% / 55% (1st / 2nd chip)
- Double buffering in pixel
- 400.000 full frames / second (design val.)
- Dark Count Rate <100 kcps/mm^2
- Crosstalk <~5% between adjacent pixels
- Dark Trigger rate ~Hz for Mult≥4

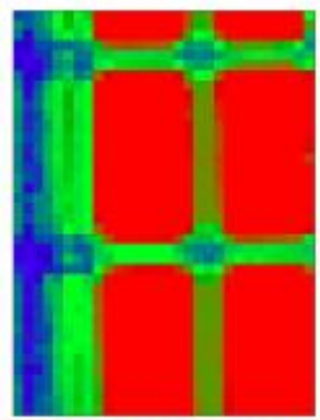










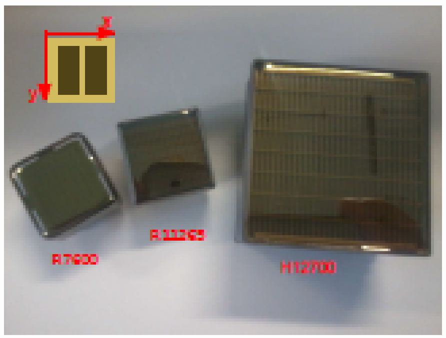


Behaviour of Multi-anode Photomultipliers in Magnetic Fields for the LHCb RICH Upgrade

Silvia Gambetta oh behalf of the LHCb RICH collaboration

The LHCb upgrade will take place in 2018: higher luminosity $2 \times 10^{33}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$

New photon detectors to be installed, different candidates tested

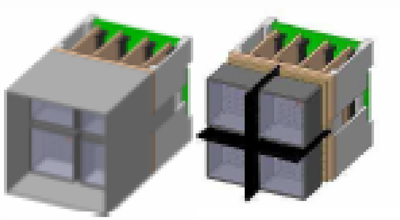


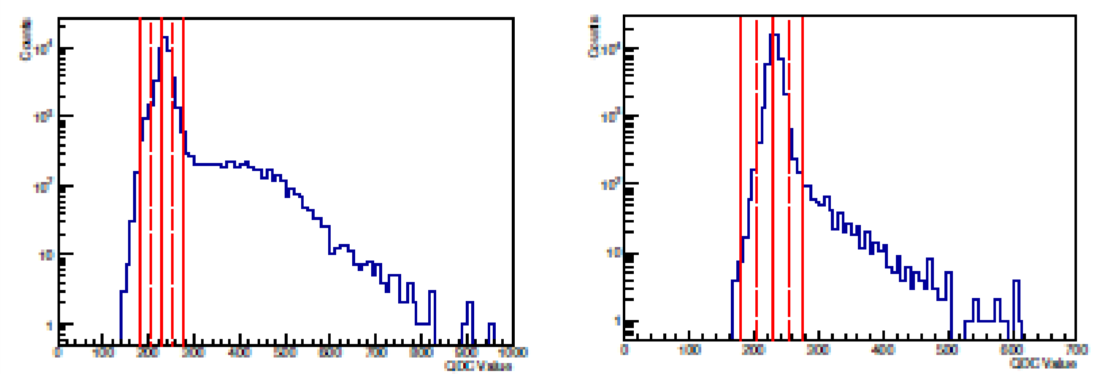
R11265 (Hamamatsu 1" MaPMT 64-channels): baseline for RICH1 and central part of RICH2

H12700 (Hamamatsu 2" MaPMT 64-channels): candidate for peripheral region of RICH2

Magnetic fields can cause loss of gain and photo-detection efficiency

Two designs of μ-metal shields have been tested:





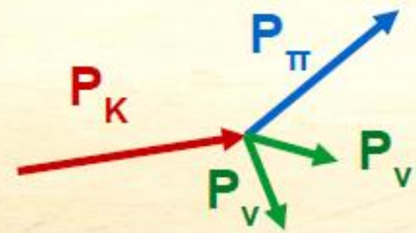
Results

- longitudinal field: similar performance, efficiency$\geq$ 90%
- transverse field: slightly better performance of full shield, efficiency$\geq$ 95%

The CHANTI for the NA62 experiment at CERN

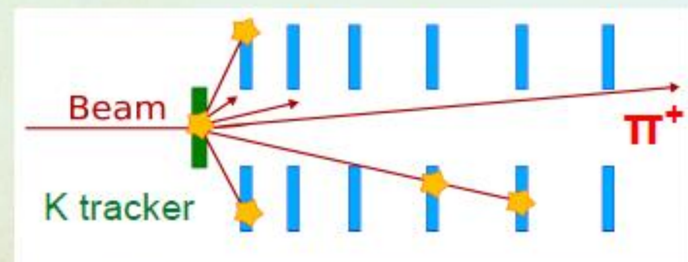
Marco Mirra on behalf of CHANTI working group of INFN - Naples

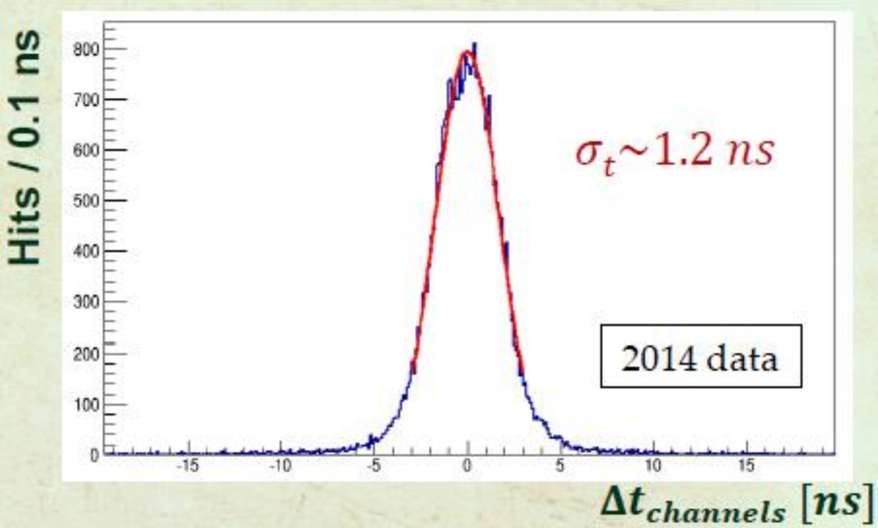
NA62 Goal : measure BR($K^+ \rightarrow \pi^+ \nu\nu$) with O(10%) precision
- collect ~100 SM (BR($K^+ \rightarrow \pi^+ \nu\nu$)~$10^{-10}$) events
- high intensity kaon beam (75GeV/c hadron beam w/ ~6% kaons)
- large background rejection + redundancy
- momentum measurement of K^+ and π^+ + PID + veto



The purpose of the CHANTI is to identify inelastic interactions occurring in the kaon tracker

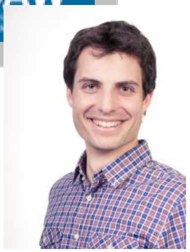
- 6 stations made by triangular scintillator bars (both X and Y view)
- Readout: WLS and SiPM (288 channels)
- ~1 ns time resolution
- ~2 mm spatial resolution





Barrel time-of-flight detector for the PANDA experiment at FAIR

L. Gruber for the PANDA Collaboration

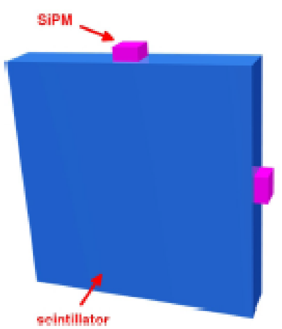


PANDA:

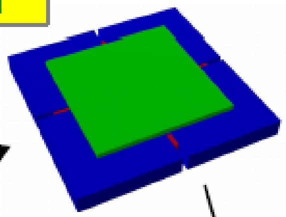
- One of the major experiments at the Facility for Antiproton and Ion Research (FAIR)
- PANDA stands for Antiproton Annihilations in Darmstadt
- It will study interactions between $\bar{p}$ (1.5 – 15 GeV/c) and fixed target protons and nuclei

Barrel TOF detector:

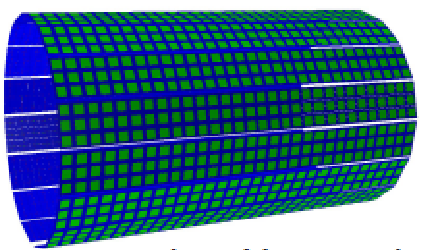
- Requirements:
  - Minimum material (2 cm radial thickness)
  - Good time resolution (σ ~ 100 ps)
- Layout:
  - Small plastic scintillator tiles (~ 30 x 30 x 5 mm³)
  - Silicon Photomultipliers (SiPMs) as photodetectors
  - In total 5760 tiles → 5.2 m²



Single tile



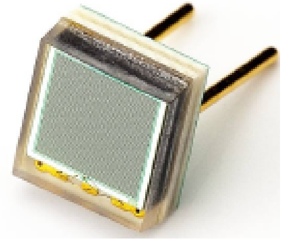
Quad-module (4 tiles)



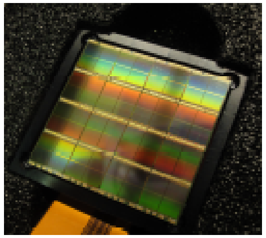
TOF barrel (r ~ 50 cm)

Silicon Photomultipliers:

- We consider analog as well as digital SiPMs
- One of the first studies to apply the Digital Photon Counter for a large scale experiment in HEP



KETEK SiPM



Philips Digital Photon Counter (DPC)

Detector optimization:

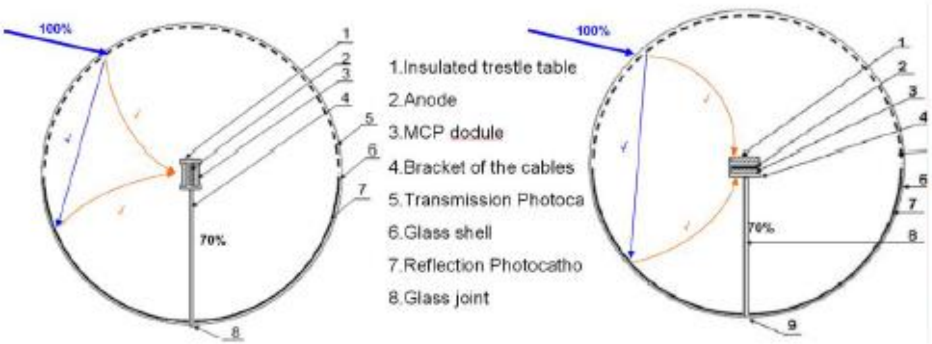
- Massive R&D work has been done to optimize the detector design: scintillator, SiPMs, electronics
- Latest results from test beam experiment using 2.7 GeV/c protons:
  - σ = 82 ps with analog SiPMs
  - σ = 32 ps with digital SiPMs

Time resolution well below 100 ps (sigma) could be achieved with an optimized detector fulfilling the PANDA requirements.

Frontier Detectors for Frontier Physics 13th Pisa Meeting on Advanced Detectors
24–30 May 2015 ● La Biodola, Isola d'Elba (Italy)

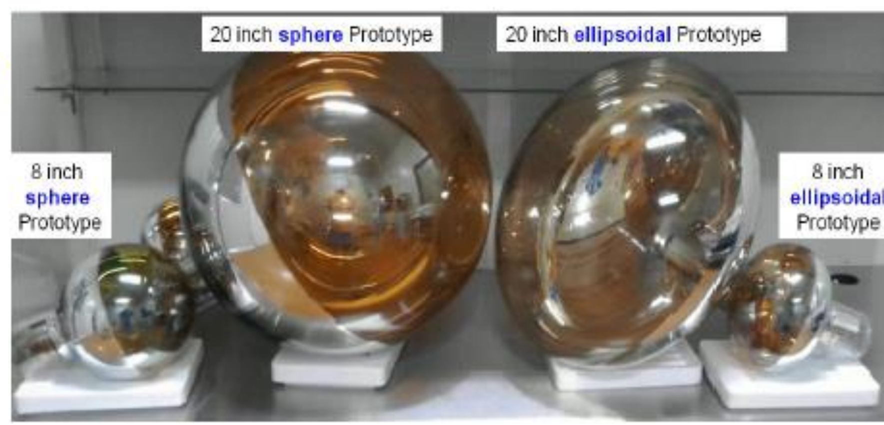
The R&D of Large Area MCP-PMT in IHEP

The researchers（Microchannel-Plate-Based Large Area Photomultiplier Collaboration **(MLAPC)**）in IHEP designed a new type of MCP-PMT for **JUNO** (Jiangmen Underground Neutrino Observatory）



The small MCP unit instead of the large Dynode, the transmission and reflection photocathode were assembled in the same glass shell to form nearly 4π photocathode effective area to enhance the efficiency of the photoelectron detecting.

- MCP-PMT prototype technical issues mostly resolved;
- Successful 8” and 20”prototypes with normal performance;
- Three types of 8” prototypes;
- QE ~ 25%@410nm; CE ~ 60%; P/V of SPE > 2.0;
- Two types of 20” prototypes;
- QE ~ 22%@410nm; CE ~ 60%; P/V of SPE > 2.0;
- The better performance Prototype should be produced!;
- QE ~ 35%@410nm; CE ~ 80%;

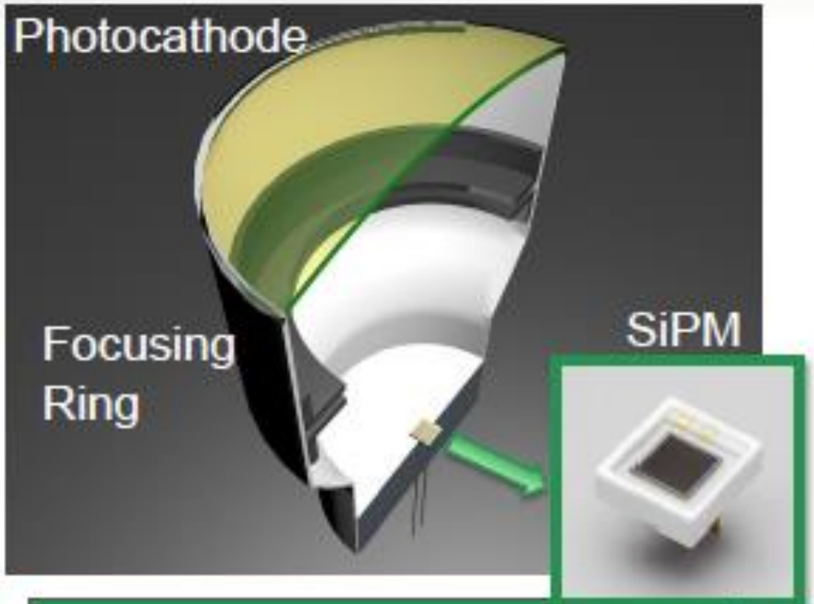


@ Dr. Sen Qian , On Behalf of the Workgroup， qians@ihep.ac.cn
Institute of High energy Physics, Chinese Academy of Science Beijing.100049；

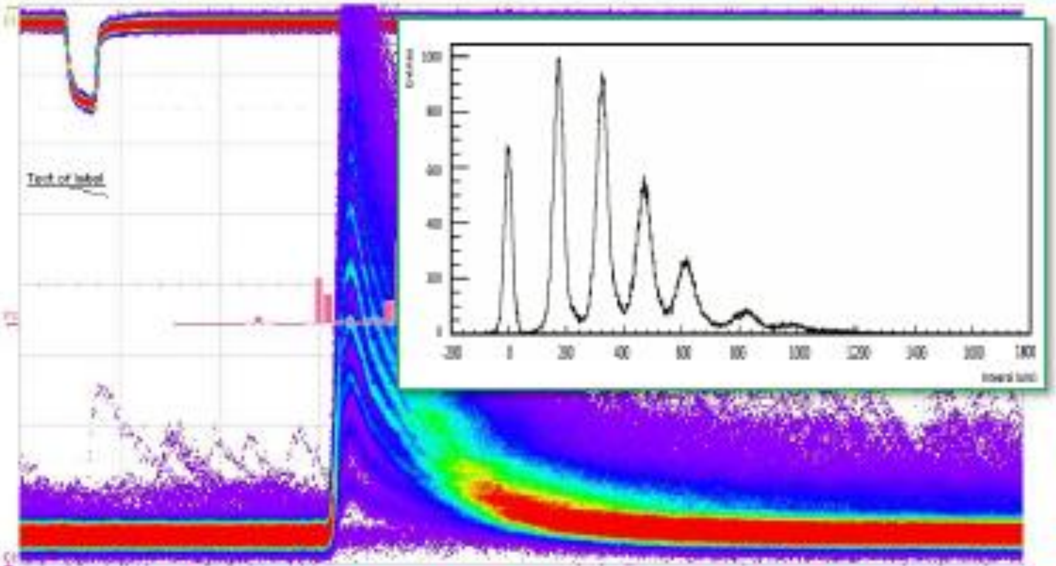
The VSiPMT

A new generation photodetector

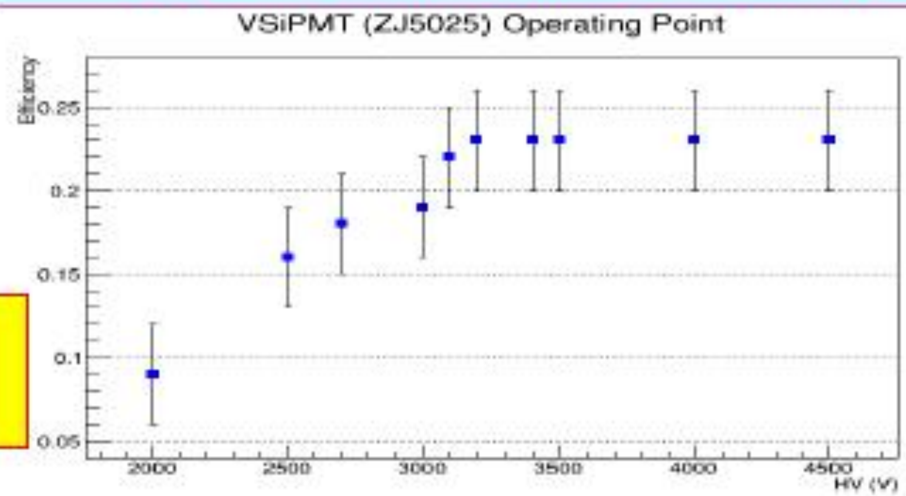
Riccardo de Asmundis



The classical dynode chain of a PMT is replaced with a special no-windowed SiPM, acting as an electron multiplying detector.



Excellent photon counting capability



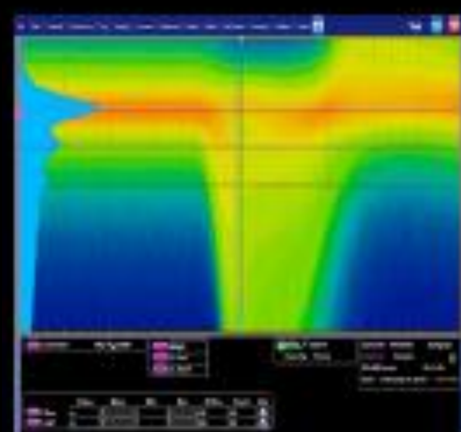
Efficiency is highly stable over 3200 V. No need for high voltage stabilization.

Large size SiPM matrix for Imaging Atmospheric Cherenkov Telescopes applications

Mose' Mariotti

The goal of this research is to develop a silicon-based prototype for an IACT pixel, the "basic element" of a Cherenkov Telescope focal plane camera. This will be the solid-state equivalent of a PMT, having a few square centimeters of sensitive area (~1 inch pixel in diameter: 0.1° @17m focal length in the case of MAGIC), high photon detection efficiency, good single-photon sensitivity, and time response around 2-3 ns

As a demonstrator we built and characterized a 16 3x3mm^2 sensor, on a structure designed to be compatible with the pixel size of the MAGIC telescope. The performance of this sensor is compatible with the operational requirements: single-phe resolution (S/N ratio ~3), ~3mV/phe output signal, 2-3 ns peak width, linearity up to ~100 phe. The power consumption of the adder stage is ~360mW (SiPM power consumption not included).



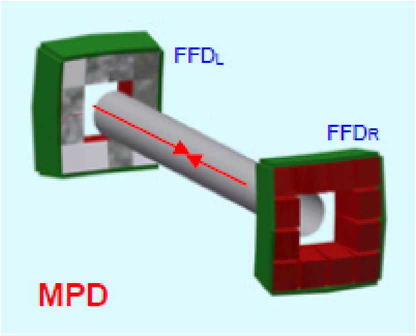
Picosecond Cherenkov detectors for heavy ion experiments at LHEP/JINR

Vladimir Yurevich[a] and Oleg Batenkov[b]

a Joint Institute for Nuclear Research, Dubna, Russia
b V.G. Khlopin Radium Institute, St. Petersburg, Russia

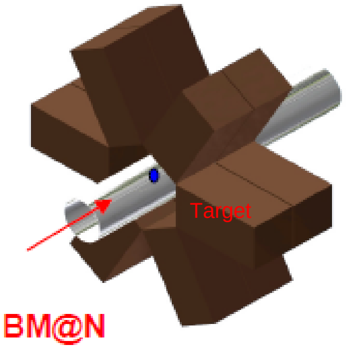
The modular Cherenkov detectors with picosecond time resolution are developed as main start and L0 trigger detectors for Au + Au collisions in future experiments MPD at NICA collider and BM@N at Nuclotron in Dubna for study of highly-excited and dense baryon matter.

Fast Forward Detector



2 arrays, 2×12 modules, 2×48 channels

T0 detector



Array with 12 modules, 48 channels

Detector module

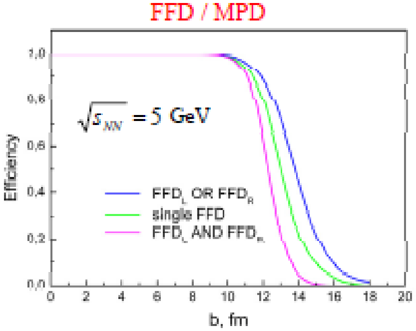
10-mm Pb converter,
4 units of 15-mm quartz bars,
MCP-PMT XP85012/A1-Q,
FEE board, HV divider

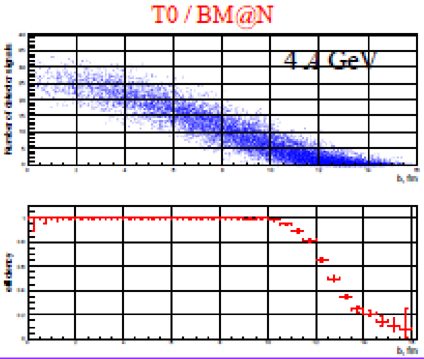
Efficiency of photon detection

50 MeV – 32%
100 MeV – 52%
200 MeV – 67%
500 MeV – 74%

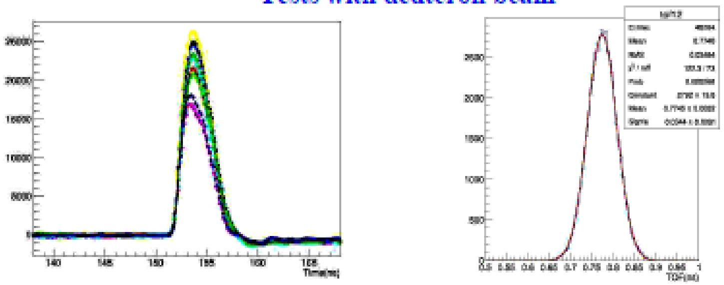
Efficiency to trigger Au+Au collisions as a function of centrality

(QGSM + GEANT4 simulation)





Tests with deuteron beam



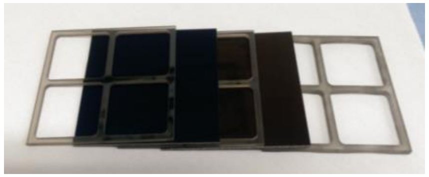
Pulse form and TOF peak measured with modules and DRS4 digitizer

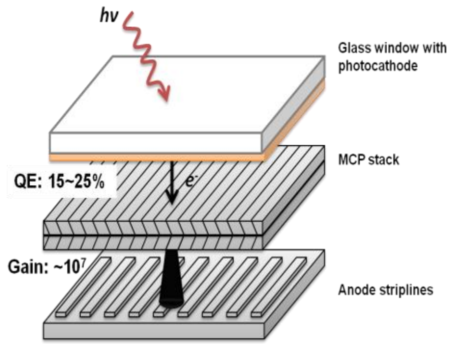
Time resolution of detector module obtained with two different readout (sigma)

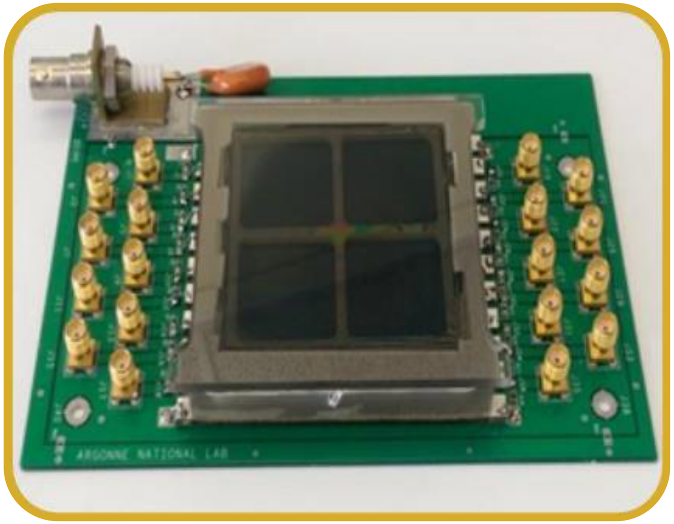
Analog pulses and DRS4 digitizer	24 ps
LVDS pulses and TDC (TDC32VL)	37 ps

Development of a low-cost fast-timing MCP photodetector - Excellent timing characteristics

Junqi Xie, Karen Byrum

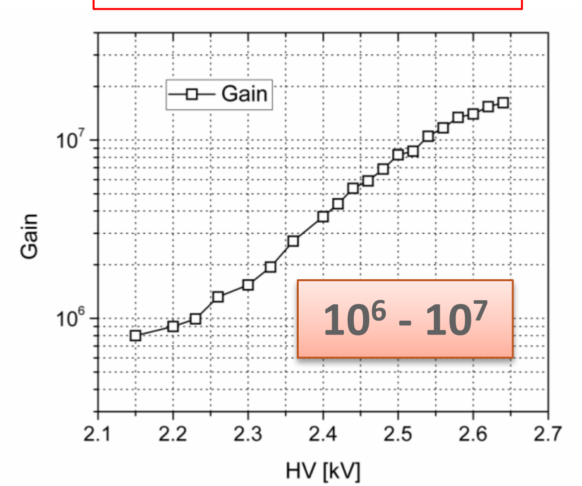




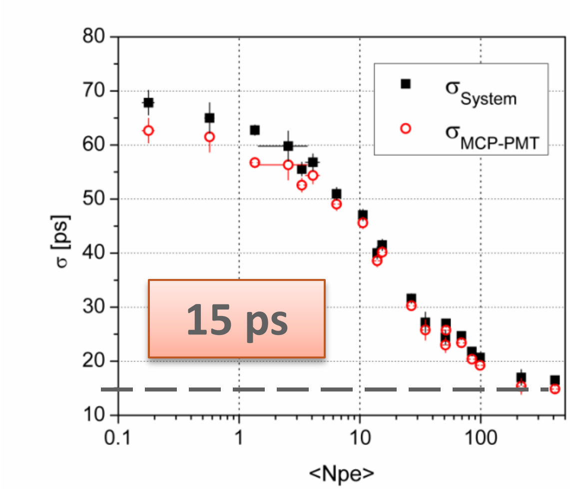


- ✓ Successfully fabricated compact MCP photodetector
- ✓ Gain over 10^7
- ✓ Time resolution ~ 15ps
- ✓ Position resolution ~ 0.7mm

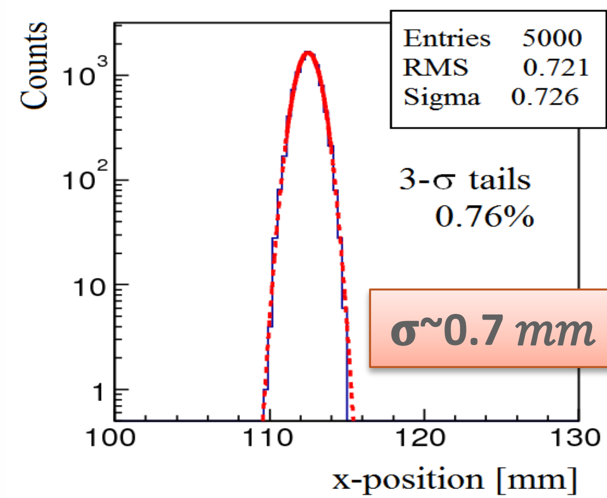
Gain vs. Voltage



Time resolution σ vs. N_{pe}



Position resolution

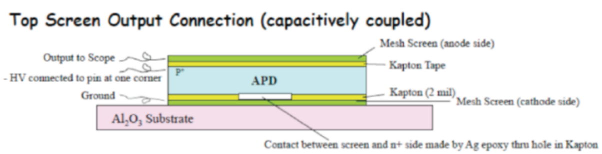


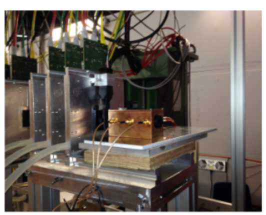
Development of Hyperfast Sensors for the HL-LHC Era

Sebastian White, CERN/Princeton

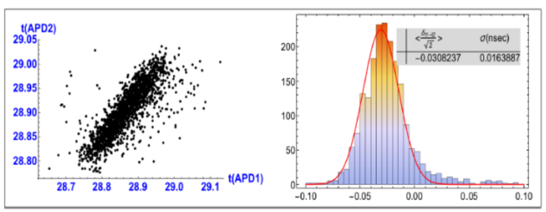
- Physics backgrounds due to jet mis-association in processes such as Vector Boson Fusion and also vertex merging could be significantly reduced by tagging physics objects with the "time of occurrence".
- Fully complimentary to z-vertex tag currently used to mitigate in-time pileup.

Hyperfast Silicon:





Typical beam setup
(DESY electron beam)



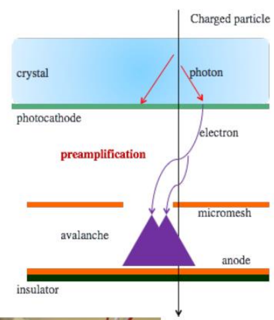
Laser@1MIP
->16 picosecond rms!!

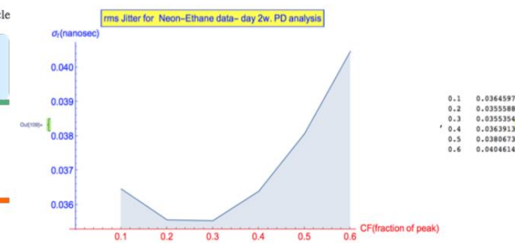
See also:
SAMPIC talk by D. Breton

MicroMegas based:

(initial tests March/April 2015)

Ne-Ethane(10%)-200 micron drift+50micron Micro Bulk





36 picosecond rms on first try!!

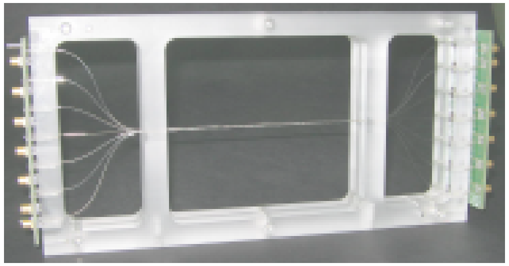
Saclay
Chamber
<-

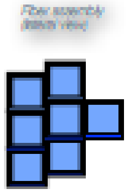
Also discussed infrastructure for hyperfast sensors: Signal processing, FEE, clock distribution and characterization

Scintillating fibres coupled to silicon photomultiplier prototypes for fast beam monitoring and thin timing detectors

F. Barchetti[1], S. Corrodi[2], D. Grigoriev[3,4], P. Kettle[1], A. Papa[1], E. Ripiccini[5], S. Ritt[1], G. Rutar[1,2], Y. Yudin[3]

3 layers of square 250 x 250 μm² fibers
- length/fiber ~ 25 cm
- Saint-Gobain multi-clad BFC12 fibers
- 100 nm of Al coating around fibers
- 2 SiPM/fiber
- SiPM: Hamamatsu S12825-050C 1.3x1.3 mm²





Result 1: The prototype performances...

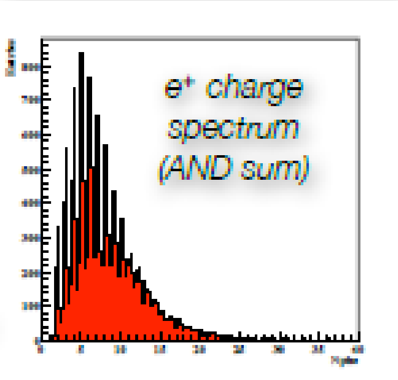
Collected light (m.i.p.): 8.5 Nphe/fiber (AND)

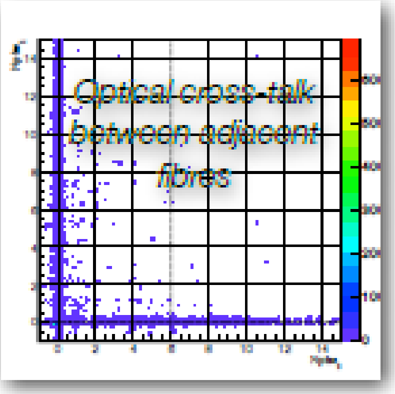
Detection efficiency:
single fiber: ε (AND)~74% ε (OR)~92%
single layer: ε (AND)~79% ε (OR)~96%
double layer: ε (OR) > 99.9%

Fiber optical cross-talk < 1%

Result 2: ...as Beam monitoring:

The high detector segmentation combined with the fast detector response allows to work at the highest continuous muon beam intensity in the world (2×10^8 μ/s)



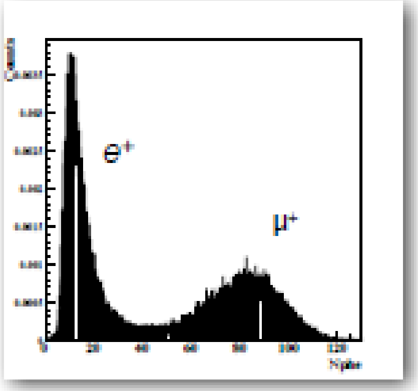


Result 3: ...as Timing detector:

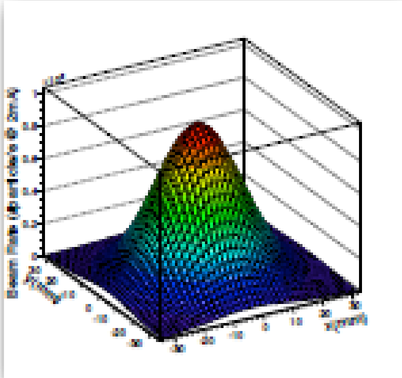
Timing resolutions of the order of 500 ps already achieved with a single layer (250 um thick) prototype detecting m.i.p.

Thin standalone timing detector either Scintillating fiber trackers and scintillating fiber timing detector complementing trackers made either by wire chambers or by silicon wafers are straightforward applications of this technology

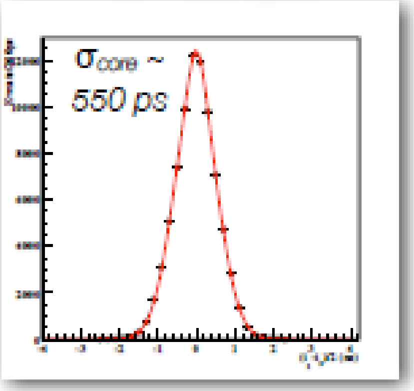
Particle ID: clear separation between e⁺ and μ⁺



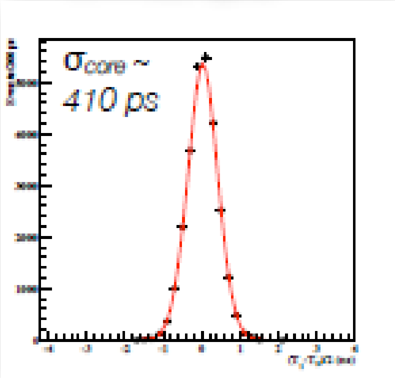
μ⁺ beam profile : 3D view



Single hit: timing resolution thr > 0.5 Nphe



Double hit: timing resolution thr > 0.5 Nphe

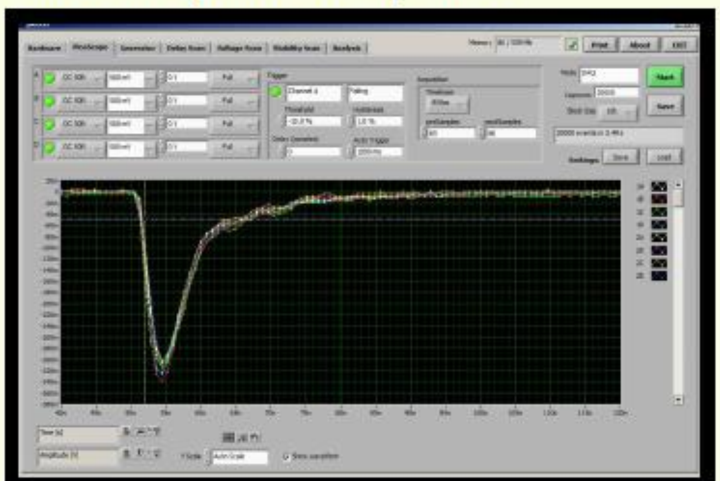


Parameters of the Preproduction SiPMs for CMS Phase I upgrade

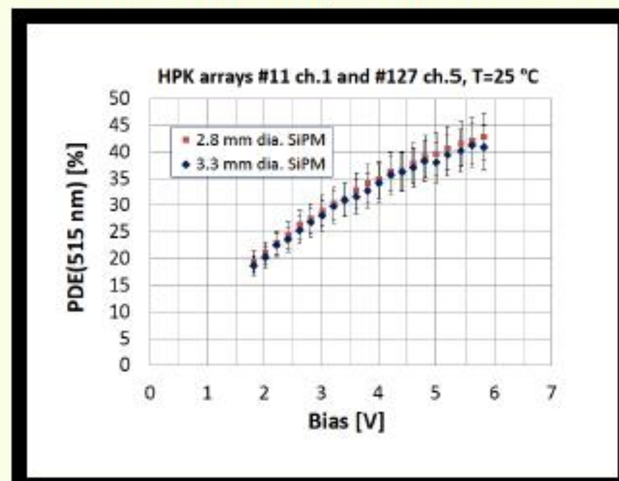
We developed a custom SiPM array (HPK and KETEK)
for CMS HCAL Scintillator sampling detector
The detector will need ~1000 * 8 channels arrays

We present:
Results of the PreProduction Series of 175 arrays

Very fast recovery time (8ns)
Custom Optimized Rq and Rs



Very good PDE with 15 micron cells
with use of transparent metal film resistor

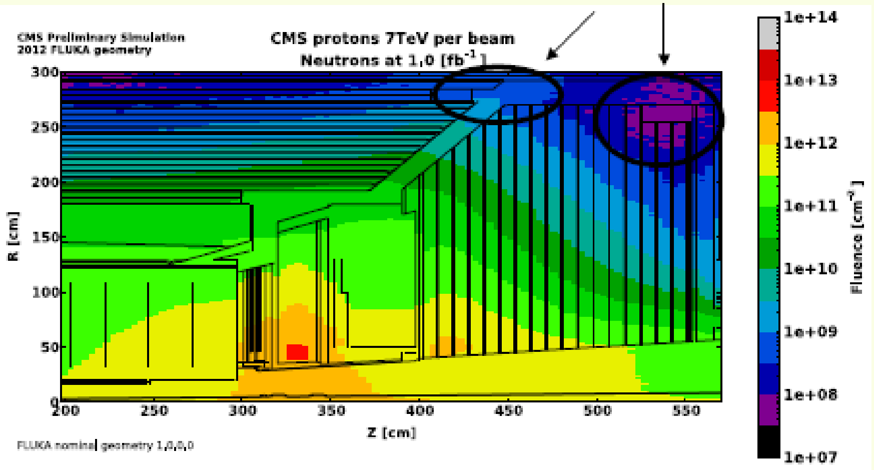


Effects of Very High radiation on SiPMs

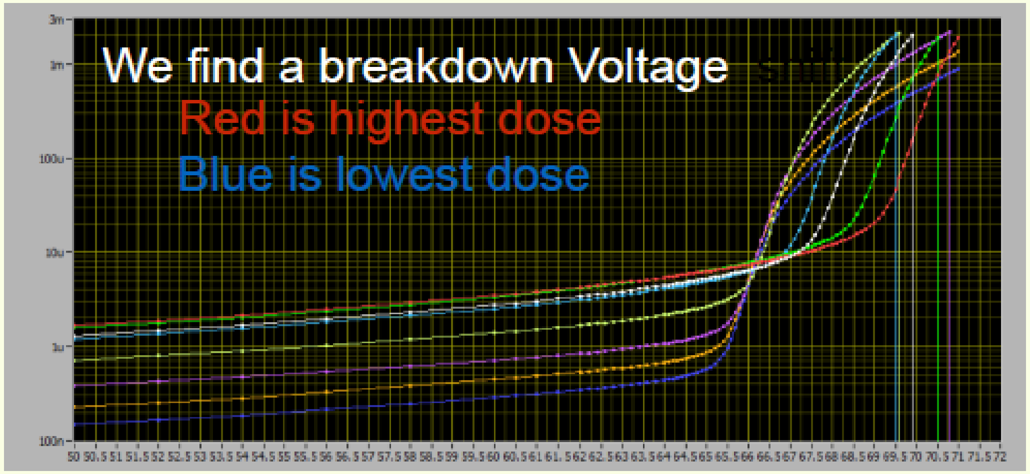
In the last 5 years we have developed SiPMs for installation in the outer regions of the CMS detector (dose 10^{12} n/cm^2) by the development of small cell (10 micron) devices

To evaluate the possibility of using the SiPMs in the wider CMS environment we have exposed them to 10^{13} to 10^{14} n/cm^2

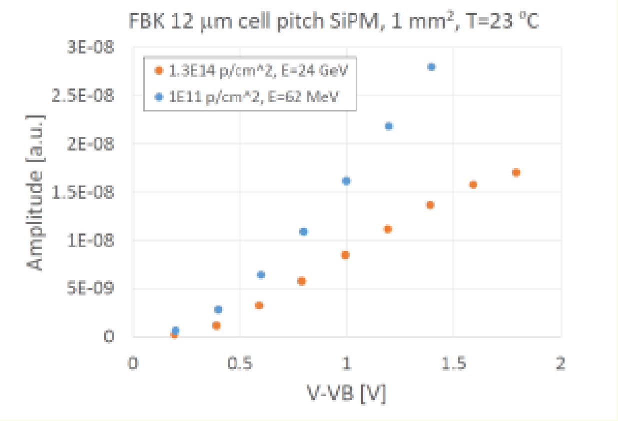
Currently Approved SiPM installation for max 10^{12} n/cm^2 for 3000 fb^{-1}



HPK 10 micron cell radiated with doses between 10^{13} to 10^{14}



LED signal of FBK 12 micron cell SiPM
We see also Loss of gain at room temperature



Results on diamond timing detector for the TOTEM experiment

Edoardo Bossini on Behalf of the TOTEM Collaboration

Email: edoardo.bossini@pi.infn.it

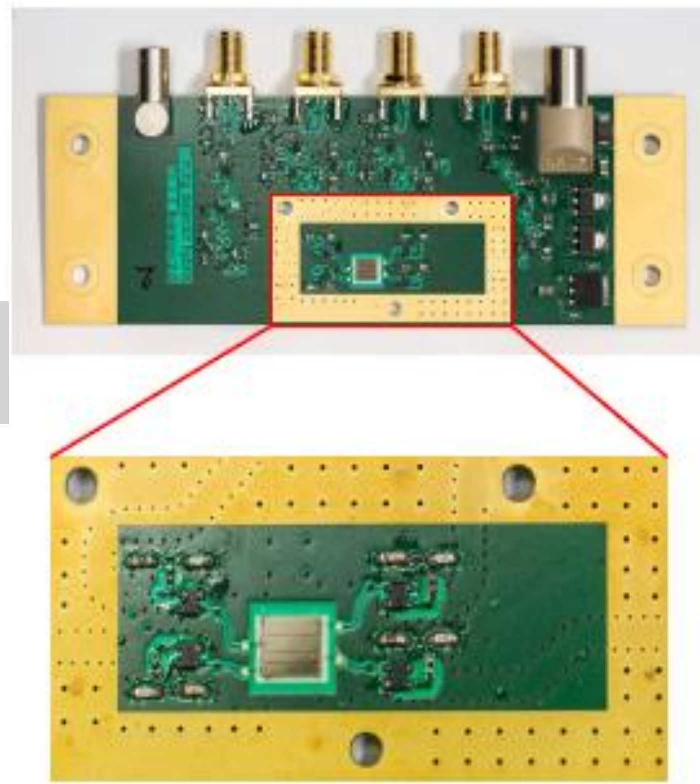
TOTEM experiment will extend his physics program during LHC Run II. To disentangle pile-up events development of TOF detector with timing resolution <100 ps is needed. Diamond detectors has been choosen and tested.

The poster will present the results obtained with commercial solutions , which showed unsatisfactory performances.

A new hybrid board board has thus been developed:

First Results at SPS (CERN) and confirmed at DESY TB

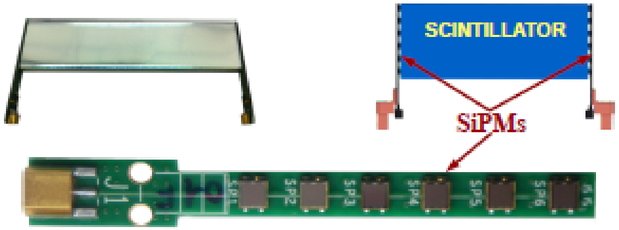
- 4 independent channel
- Full amplification chain integrated
- Can host 1 Diamond metallized with up to 4 pixel/strip
- Pre-amplifier at ~1 cm from the diamond
- Core area can be shielded with special aluminum boxes

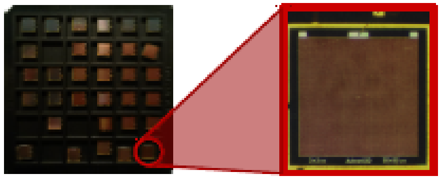


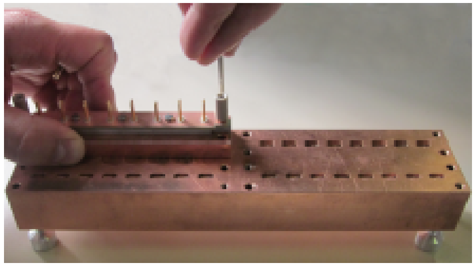
Board prototype

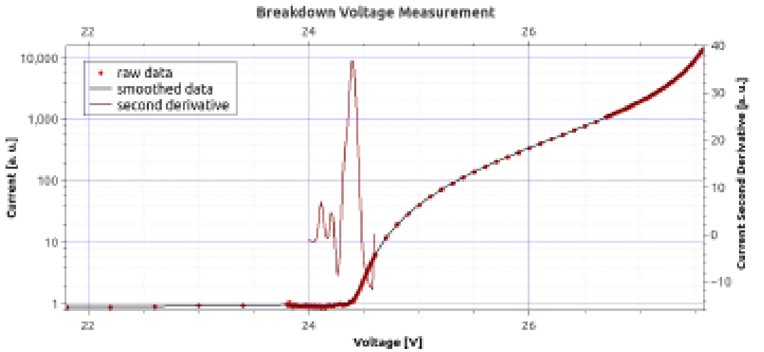
Test and characterisation of SiPMs for the MEG high resolution timing counter

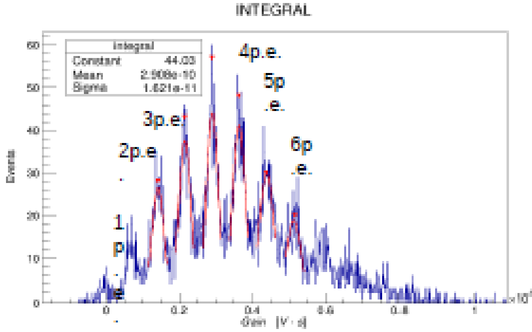
- $\mu^+ \rightarrow e^+\gamma$ is a forbidden decay in the Standard Model (SM): its discovery would open a door to new physics beyond the SM. It is predicted by supersymmetric theories
- The MEG Timing Counter (TC) will measure the positron time of arrival with a resolution of 30 ps, thus improving by 1 order of magnitude the existing limit
- Each TC's pixel is made of a plastic scintillator and of 6 SiPMs attached at both sides
- Over 4000 SiPMs have been tested and their breakdown voltage and gain have been measured









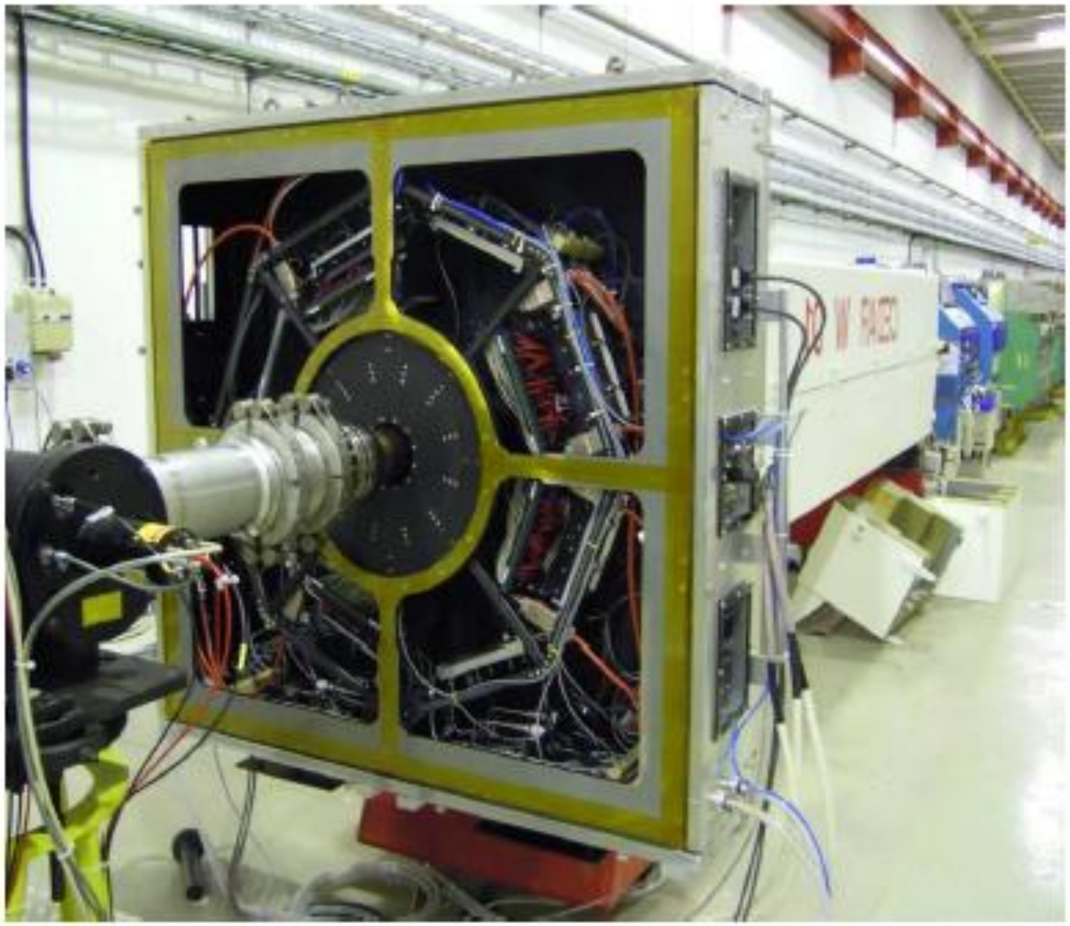


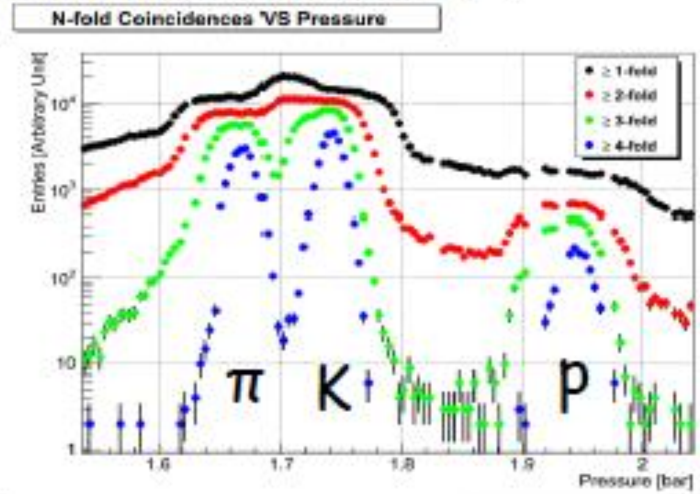
Marcello Simonetta

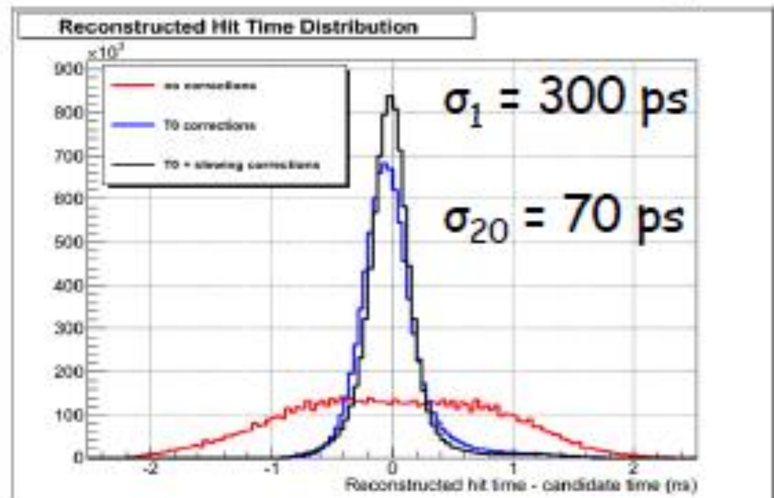
K^+ Identification in CERN experiment NA62

John Fry (Liverpool)

KTAG tags and timestamps the 6% K^+ in the 800 MHz unseparated charged-particle beam. It detects K^+ with >95% efficiency, has a time resolution of <100 ps, and particle misidentification of $< 10^{-4}$.

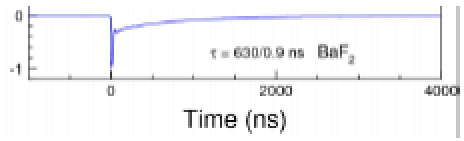


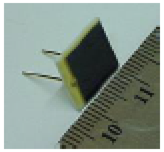


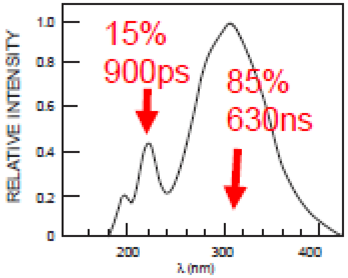


An APD for the detection of the fast scintillation component of BaF_2

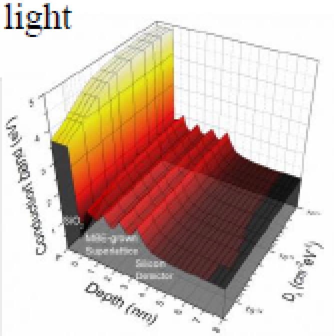
- The baseline design for the Mu2e electromagnetic calorimeter uses BaF_2 crystals
  - BaF_2 has the fastest decay time of any inorganic scintillator: τ~900ps at 220nm
  - This is accompanied by a much larger slow component: τ~630ns at 300nm

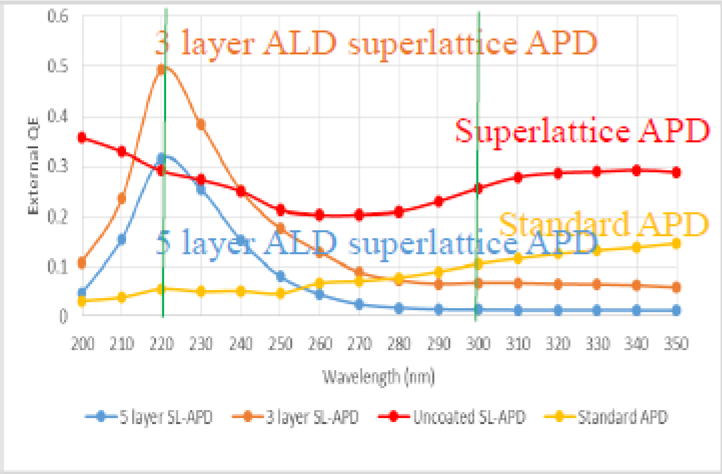




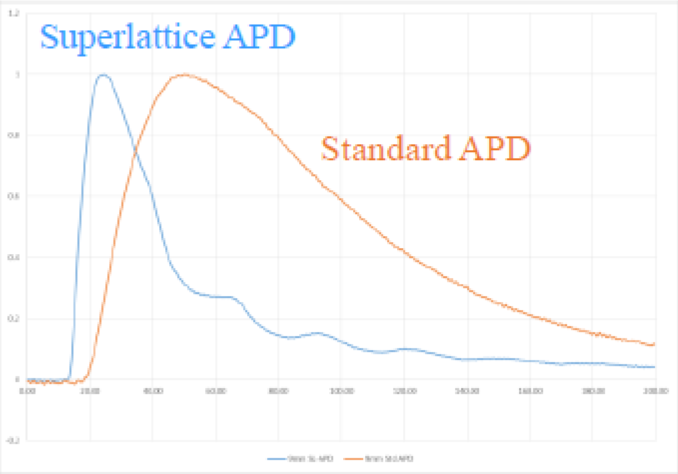


- A Caltech/JPL/RMD collaboration has developed a 9x9mm APD suitable for BaF_2 readout
  - Employs superlattice doping to improve QE in the UV and improve timing
  - Uses an atomic layer deposition interference filter to detect 220 nm and reject 300 nm light

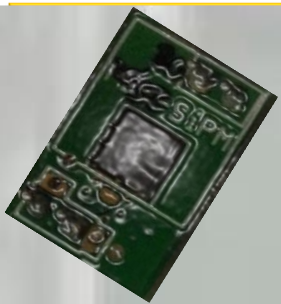




ALD+superlattice filter performance



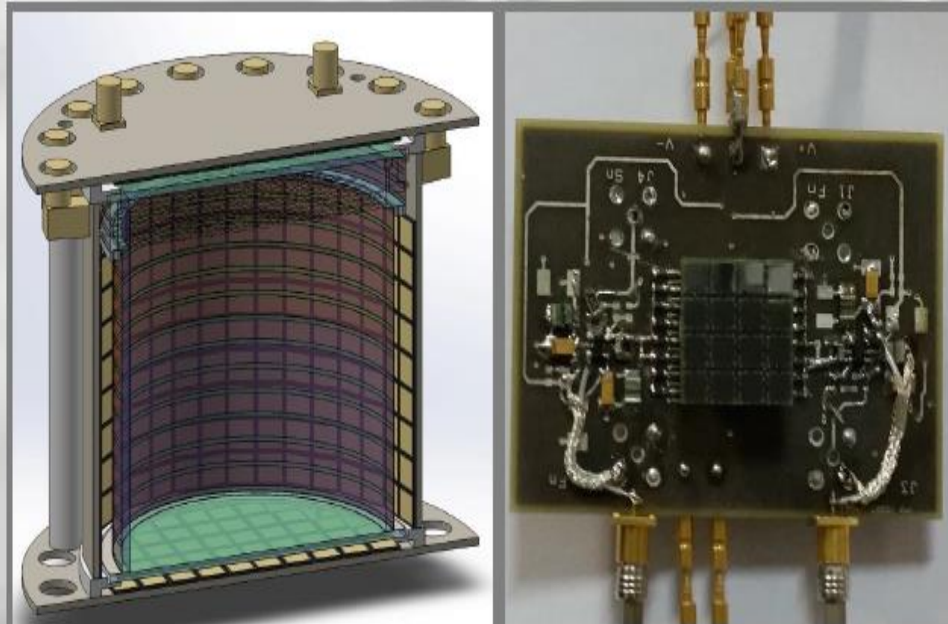
Superlattice APD rise/decay time



Silicon Photomultipliers for DM Searches with Liquid Argon Detectors

G. Fiorillo, B. Rossi, S. Walker
Universita di Napoli Federico II
M. D'Incecco, G. Korga, A. Razetto, D. Sablone
LNGS INFN

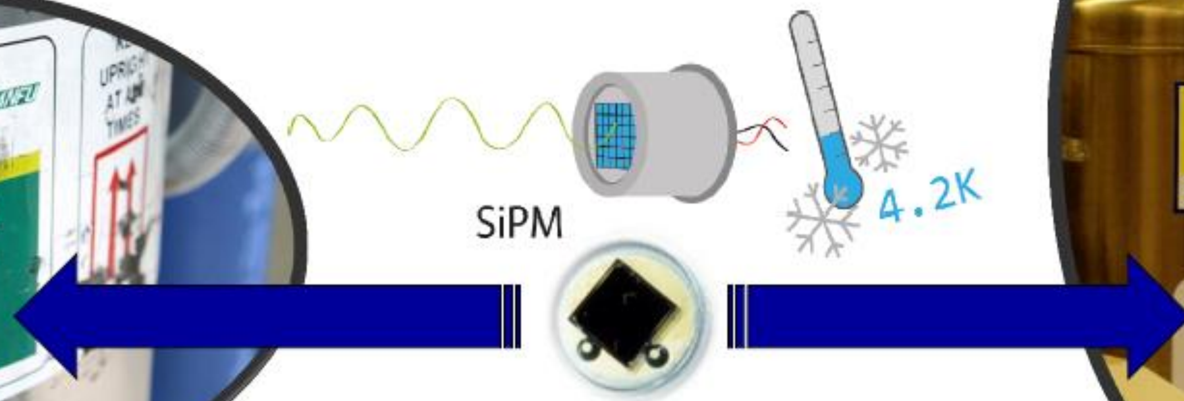
- Next generation multi-ton scale noble liquid experiments have the unique opportunity to discover dark matter particles at the TeV scale
- Requirements for next-gen experiment photosensors:
    - Negligible levels of radioactivity
    - High quantum efficiency
    - High gain
    - High single photon resolution
    - Fast response
    - Large sensitive areas
    - Low radioactivity
    - Low power consumption
    - Low price
- SiPM arrays are an attractive solution, with low intrinsic radioactive background and small mass in addition to unrivalled performances in single photon detection.
- SiPMs have been proven to perform adequately in cryogenic conditions, and their behavior has been fully characterized.



a) An illustration of a GAP-TPC utilizing SiPMs for 4π coverage of the TPC
b) SensL-30035-16P SiPM array

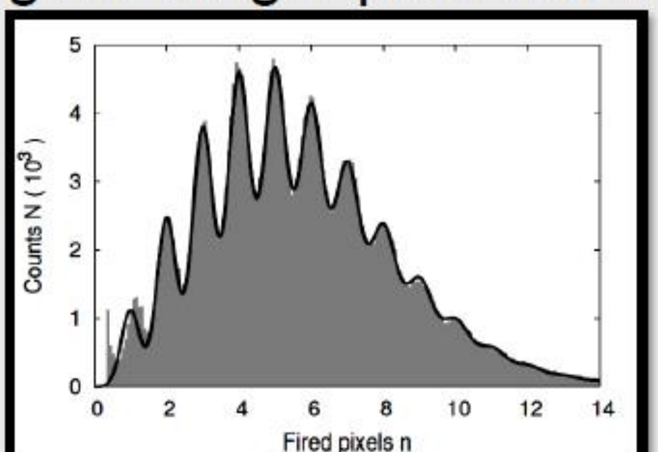
Operation of SiPM at Temperatures of 1-4 Kelvin

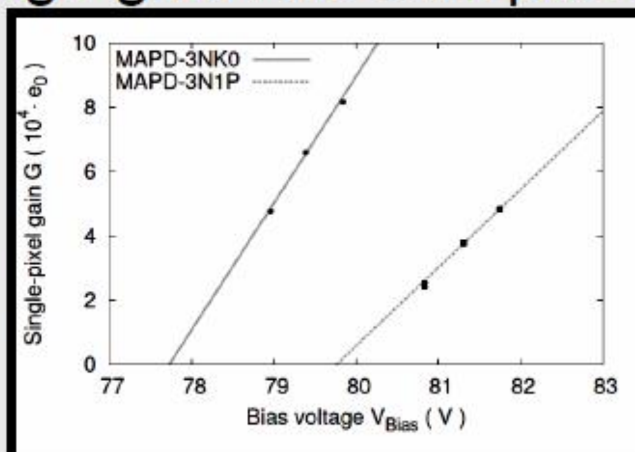
P. Achenbach, M. Biroth, E. Downie, A. Thomas



Zecotek's SiPM perform well at cryogenic temperatures!

- good single-pixel resolution
- high gain / no afterpulses



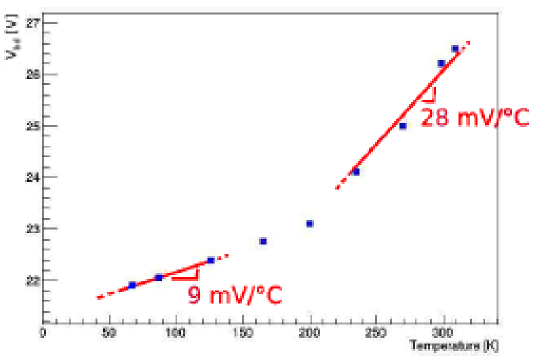


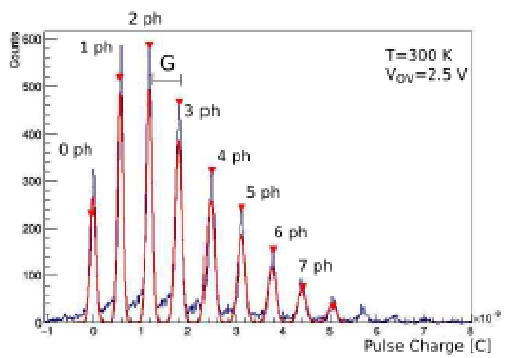
Characterization of SiPM for cryogenic application

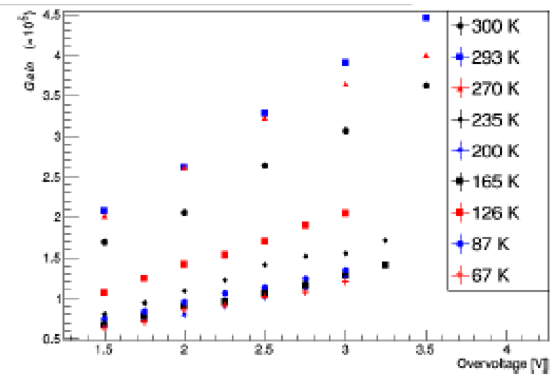
M. Bonesini, T. Cervi, A. Falcone, A. Menegolli, G.L. Raselli, M. Rossella, M. Simonetta, M. Torti

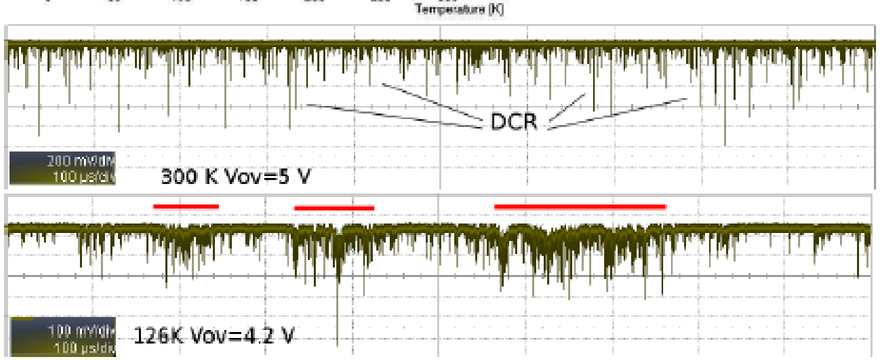
We present a comparison of the performance of a SiPM model at various temperatures in view of a possible application as a trigger and timing detector in LAr-TPCs or LXe-TPCs.

We have measured breakdown voltage and gain at various temperatures from 60 K to 300 K. Moreover, we evaluated the noise at cryogenic temperature compared to the noise at room temperature.



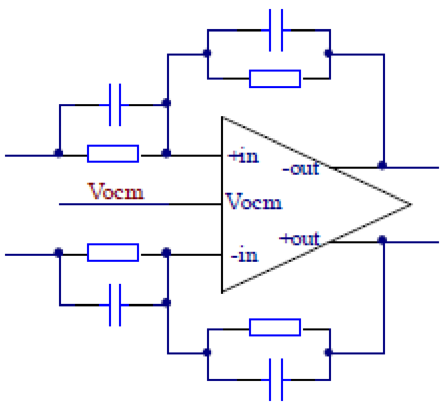






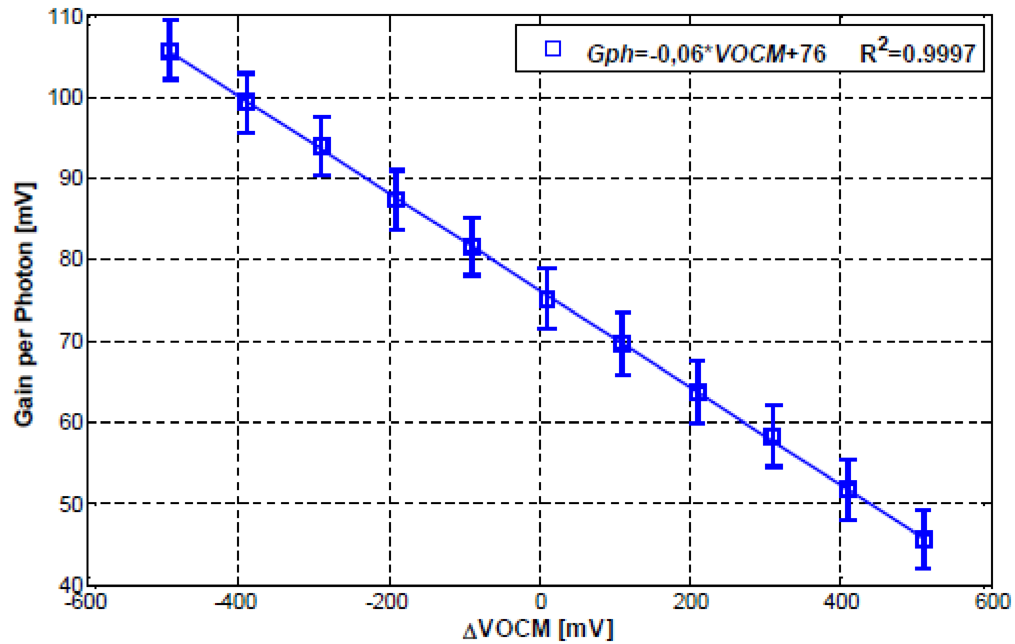
Mateusz Baszcz

Gain Compensation Technique by Bias Correction in Arrays of Silicon Photomultipliers Using Fully Differential Fast Shaper



Proposed algorithm compensates the gain by changing the bias voltage of Silicon Photomultipliers. The bias is adjusted individually in each channel indirectly by tuning the output common mode voltage (VOCM) of fully differential fast shaper.

The advantage of the algorithm is the possibility to set the bias of each SiPM in the array independently so they all could operate in similar conditions (have similar gain and dark count rate). It allows to compensate temperature. The measurement system requires only one high voltage power supply. The relationship between VOCM and gain per one photon is linear.

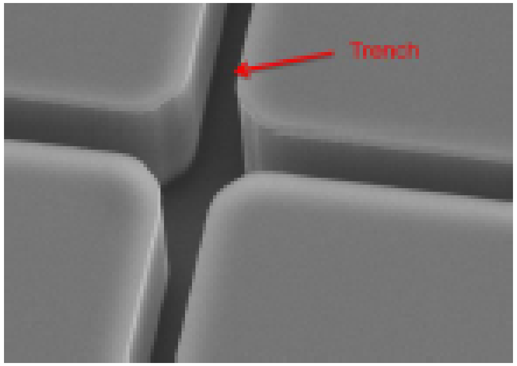


Characterization of first prototype of high-density NUV-HD SiPMs for near-UV light detection

G. Paternoster, F. Acerbi, A. Ferri, A. Gola, G. Zappalà, N. Zorzi , C. Piemonte

High cell Density (HD-SiPM) technology

New narrow cell border region, implementig trench for both electrical and optical cell isolation

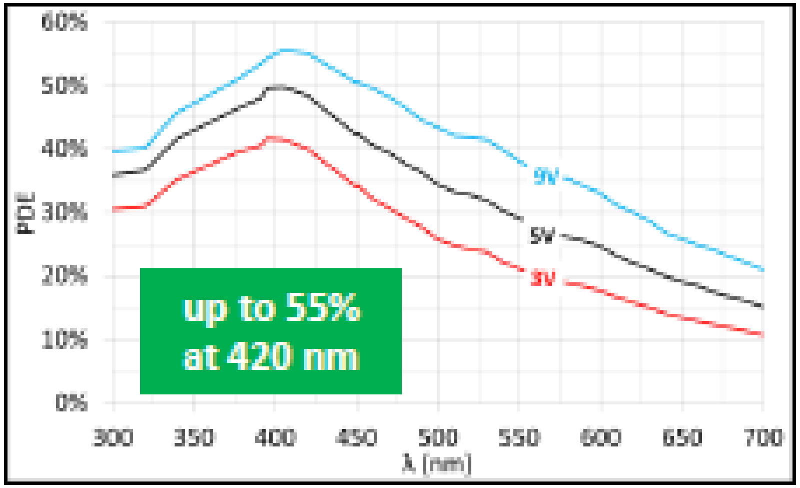


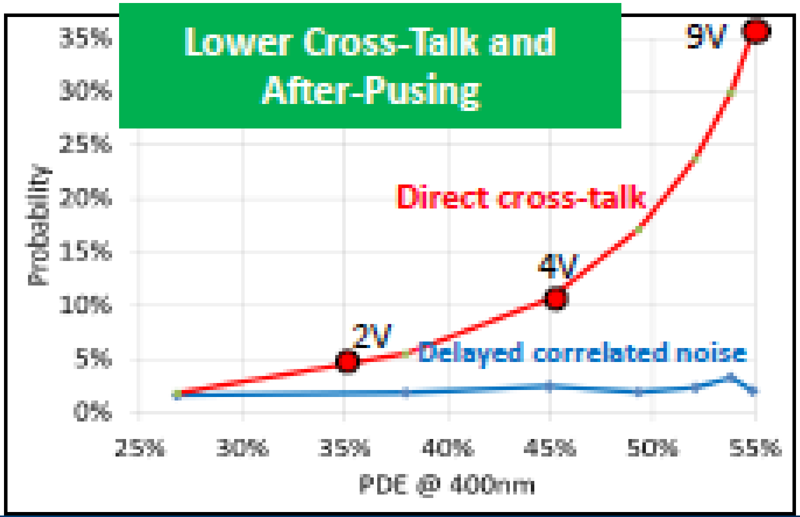
Small Cell Pitch and High Fill Factor

Cell Pitch	Fill Factor	Cell Density
12×12 μm²	52 %	7056 cells/mm²
15×15 μm²	62 %	4624 cells/mm²
20×20 μm²	66 %	2500 cells/mm²
25×25 μm²	72 %	1600 cells/mm²
30×30 μm²	78 %	1156 cells/mm²

The HD technology allows to produce devices with small cell pitch (from 30um down to 12um) with a considerably high Fill Factor (78% for 30um cell pitch)

High Photodetection Efficiency



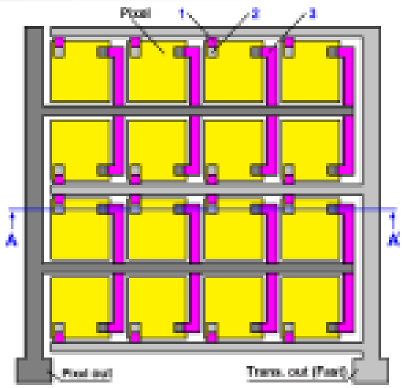


A NEW DETECTOR CONCEPT FOR SILICON PHOTOMULTIPLIERS

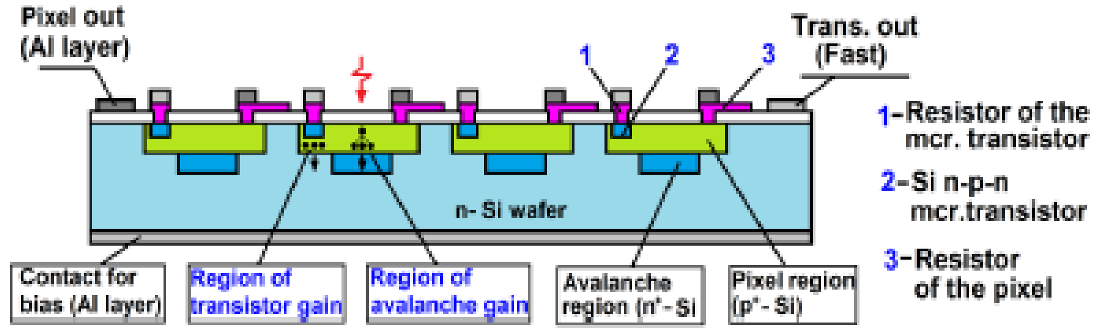
A. Sadigov[1], F. Ahmadov[1], A. Ariffin[2], S. Khorev[2], Z. Sadygov[1, 3], S. Suleymanov[1], F. Zerrouk[2]

1- National Nuclear Research Center, Baku, Azerbaijan;
2- Zecotek Photonics Inc.;
3- Joint Institute for Nuclear Research, Dubna, Russia

The silicon photomultiplier (SiPM), also named as the micro-pixel avalanche photodiode (MAPD) was invented in 1996 year (Z. Sadygov….., Russian patent №2102820, priority from 10.10.1996) . The device comprises an array of small p-n - junctions (pixels) with individual quenching resistors. However, this design has a high specific capacitance (about 30 pF/mm^2), which limits the sensitive area of the MAPD. Here we present a new SiPM on basis of a Micro-pixel Avalanche Photo-Transistor (MAPT).



Face view of the MAPT



Cross-section A–A'

Main advantages of the new device.

- Fast photo response due to individual micro-transistors working in digital mode.
- Very low (about 50 times less) capacitance of devices.
- MAPT will increase the working area of the device in comparison with analogs.
- Capable for use in TOF detectors due to fast photo response.
- Capable for use in astrophysics detectors due to low capacitance.

I. DESIGN OF THE MAPT

The MAPT Comprises an array of micro phototransistors with individual ballast resistors Rt, the base electrodes of which are connected to the pixels with quenching resistors Rp (Z. Sadygov and A. Sadigov. Russian patent №2528107, a priority from 04.16.2013).

Each pixel the MAPT consists of two parts: an avalanche region and a micro-transistor region . Area of the micro-transistor region is about 3μ×3μ which is about 1÷5% of the pixel area. Therefore, the MAPT device has 30 ÷ 50 times lower capacitance than known SiPMs.

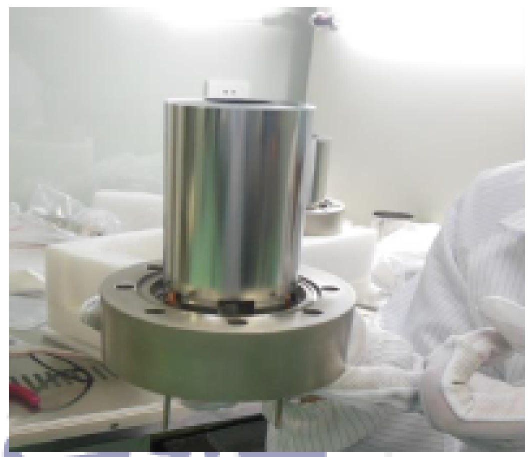
Electron source uniformly distributed in the plane for MCP electron scrubbing and testing

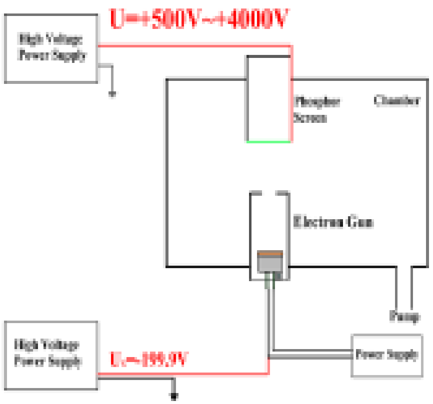
Shulin LIU, Baojun YAN，Yuzhen YANG.，et al

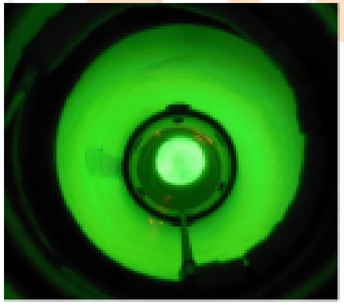
From Institute of High Energy Physics, CAS, Beijing, China

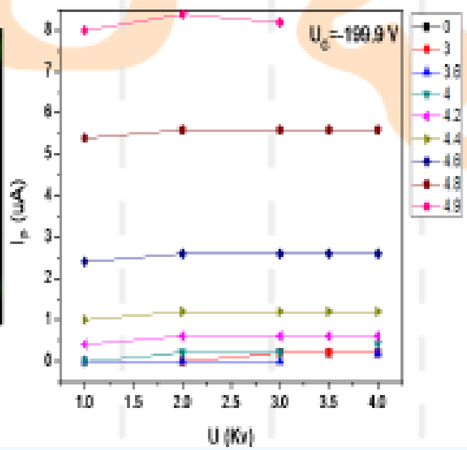
In order to realize electron scrubbing degassing treatment and subsequent testing for Microchannel Plate (MCP)， we developed several electron sources uniformly distributed in the plane. Three ways to produce uniformly electron sources are described in this study.

- **Tray shaped filament + metal mesh + the shield metal cylinder**









Two other MCP electron scrubbing methods are studied and tested:

- **Deep ultraviolet light incident to the MCP input surface coated Au film**
- **Deep ultraviolet excitation gold photocathode to produce electron source uniformly distributed.**