

Development of Silicon Photo Multiplier, Associated Electronics and its Applications

Shashikant R. Dugad

For SiPM Group

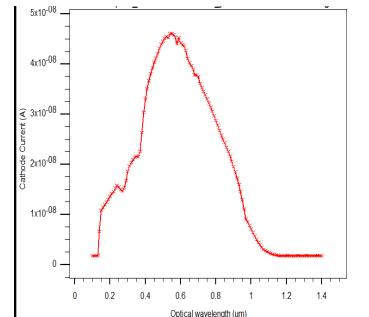
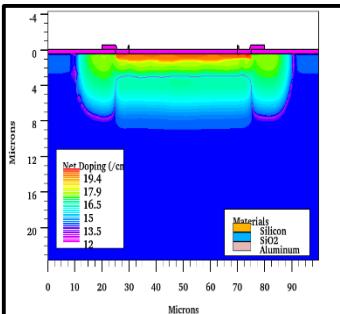
**(V.G. Achanta, S.R. Dugad, S. Duttagupta, C.S. Garde,
S.K. Gupta, S.S. Prabhu, R.A. Shukla)**

DHEP Annual Meeting

08 May 2018

Simulation, Fabrication and Characterization of SiPM

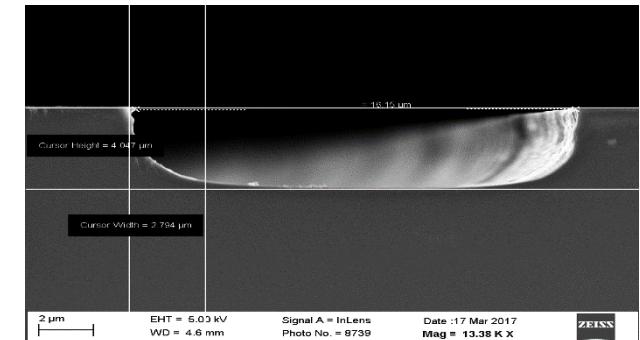
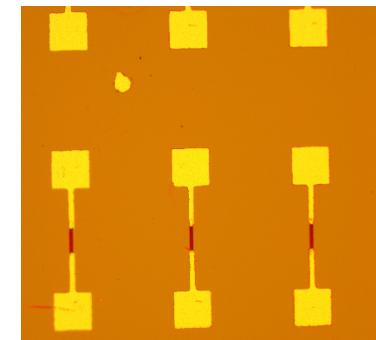
Design and Simulation of an SiPM



- Extensive simulation to design the optimized SiPM
- Process level simulations with foundry inputs
- Fabrication will start soon

Presented at ICEE 2016, IIT Bombay

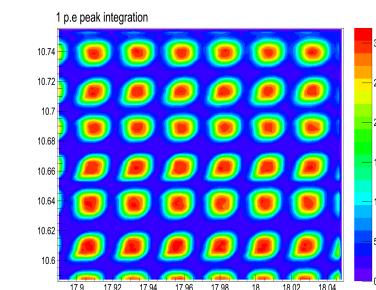
Fabrication Activities: Micro-resistors and Deep Trenches



- High-precision micro resistors required for avalanche quenching in SiPM
- Trenches required for proper isolation between pixels.

Presented at ICEE 2016, IIT Bombay

Development of Micron Resolution Optical Scanner

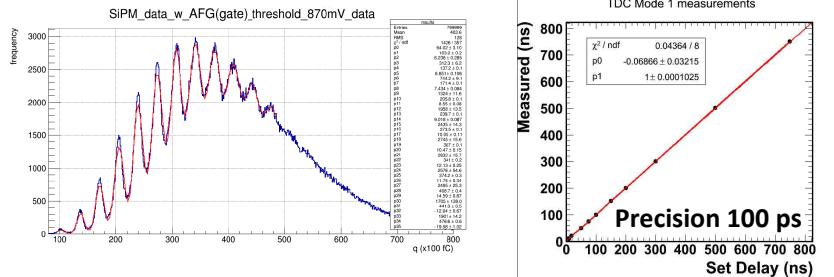


- Enabling optical scanning of Silicon sensors at microscopic level
- Complete surface of SiPM is scanned with tightly focused Laser beam (2 μm)

Review of Scientific Instruments 85, 023301 (2014); doi: 10.1063/1.4863880

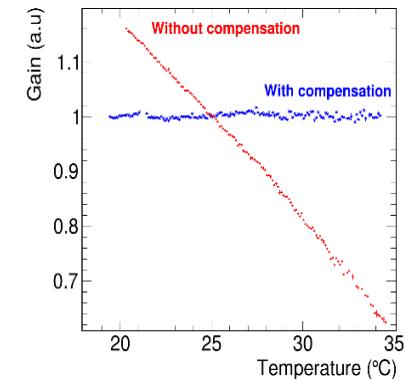
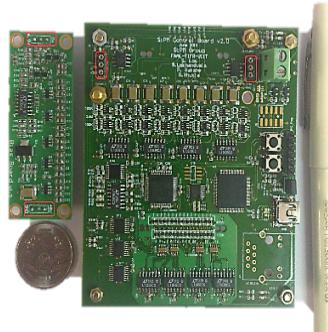


Development of High Speed Amplifier, Discriminator and TDC



- Compact, high speed amplifier discriminator module
- TDC: High precision (100 ps) timing measurement achieved at high event rate.
- Complete Vertical Slice for SiPM readout developed !

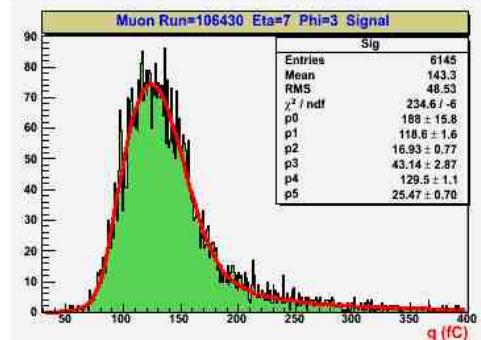
Temperature Compensated Programmable Power Supply for SiPM



- ✓ Negates SiPMs large temperature dependence on Gain.
- ✓ Gain stabilized to ~0.5% over 15°C

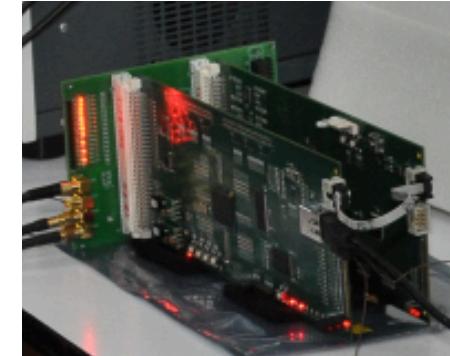
Review of Scientific Instruments 87, 015114, 2016

HO Upgrade with SiPM for CMS Experiment



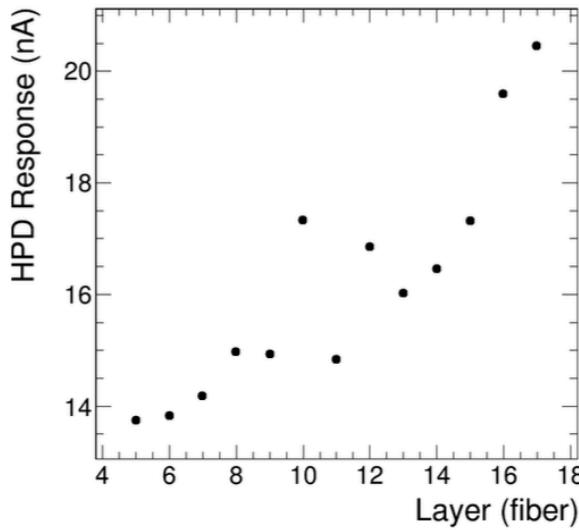
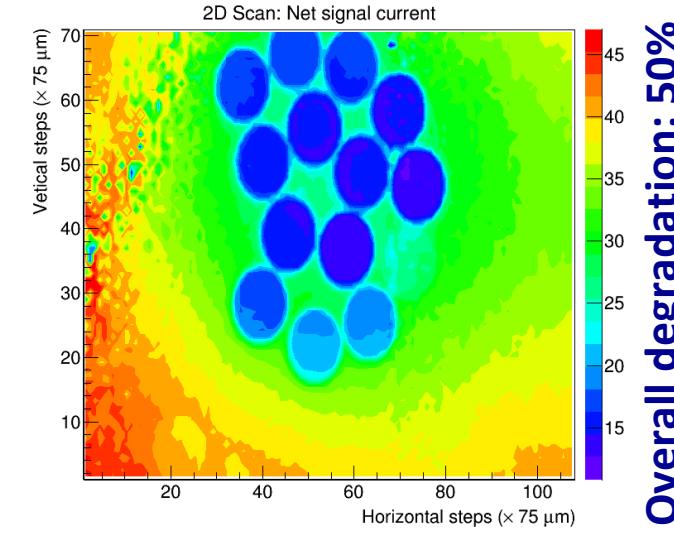
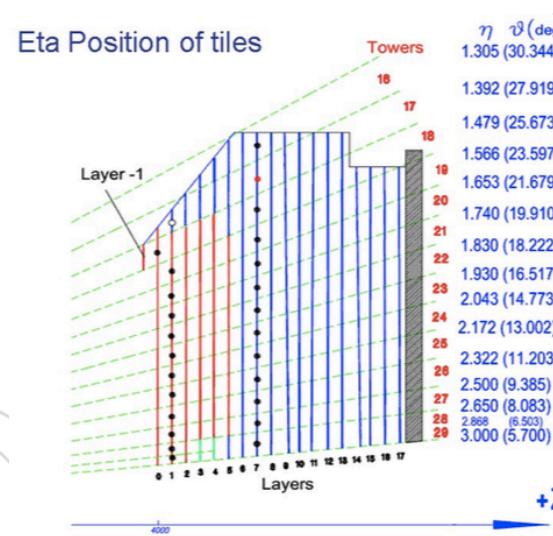
- Validation of SiPM for CMS environment, Installation and Commissioning
- Fabrication of 160 SiPM Control Boards in India
- Quality Control of Control Boards and SiPM Boards (160+160) at India

Development of HFRADMON System for CMS Experiment



- ✓ Long term monitoring of the absorbed dose and neutron flux
- ✓ State of the art, high speed FPGA design with Ethernet communication
- ✓ Complete in-house design, fabrication and testing
- ✓ Successful first prototype: Installed at CERN P5, operational 24x7

Fine Scan of HPD using MROS



Pixel	Fibers (layers)	Tower	Eta	% Damage
2	5	24f	2.172	22
16	5	26f	2.5	50
14	13	28r	2.868	54
6	3	28f	2.868	56
15	3	29f	3	60

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DHEP, Annual Meeting

The Compact Muon Solenoid Experiment
Detector Note



The content of this note is intended for CMS internal use and distribution only

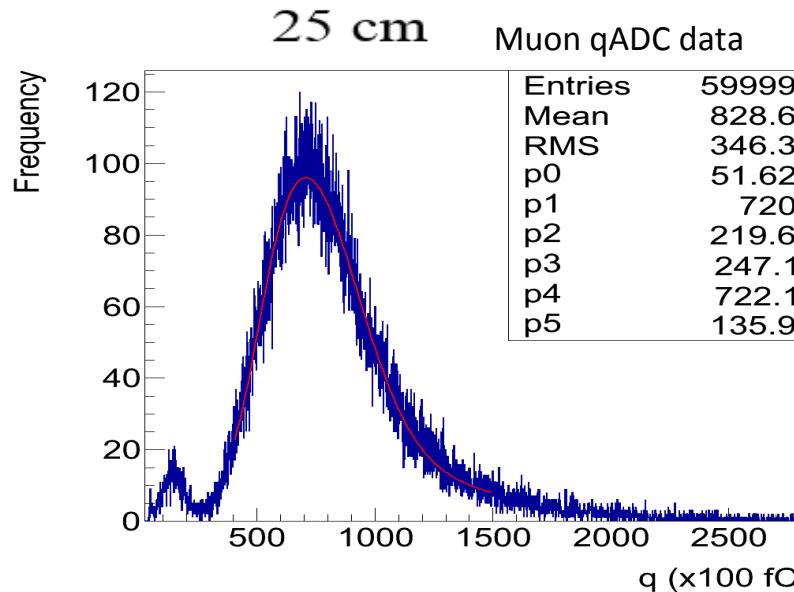
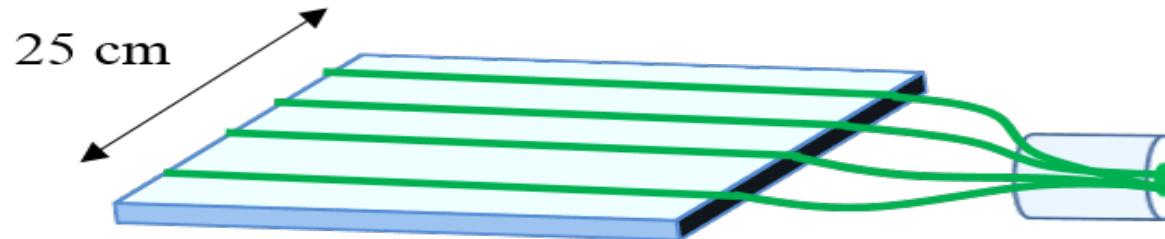


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Ultra Fine Characterization of Hybrid Photo Detectors
decommissioned from End-cap (HE) and outer hadron
(HO) calorimeter using Microscopic Resolution Optical
Scanner

Results presented in LHCC Review Meeting

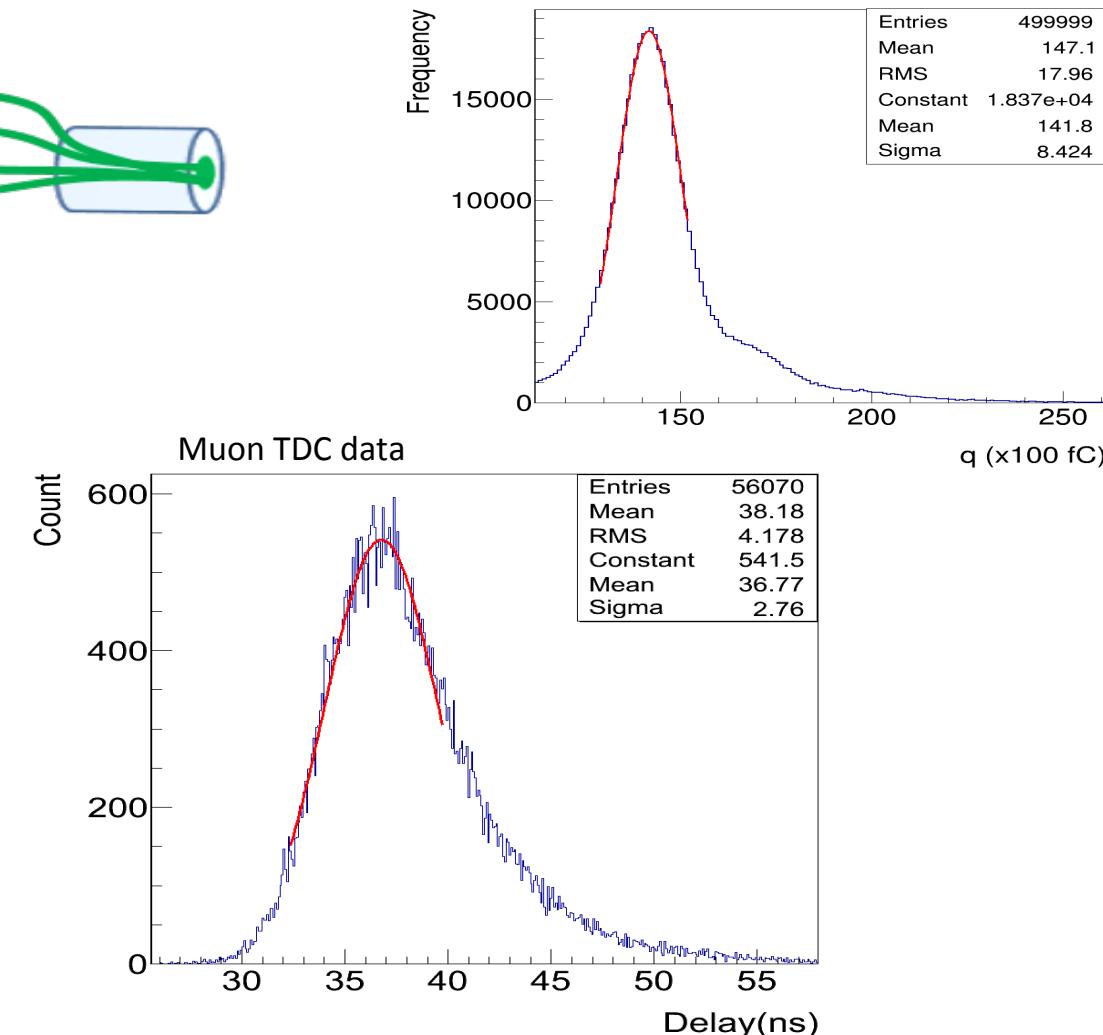
Muon Detection with in-house amplifier, discriminator and TDC



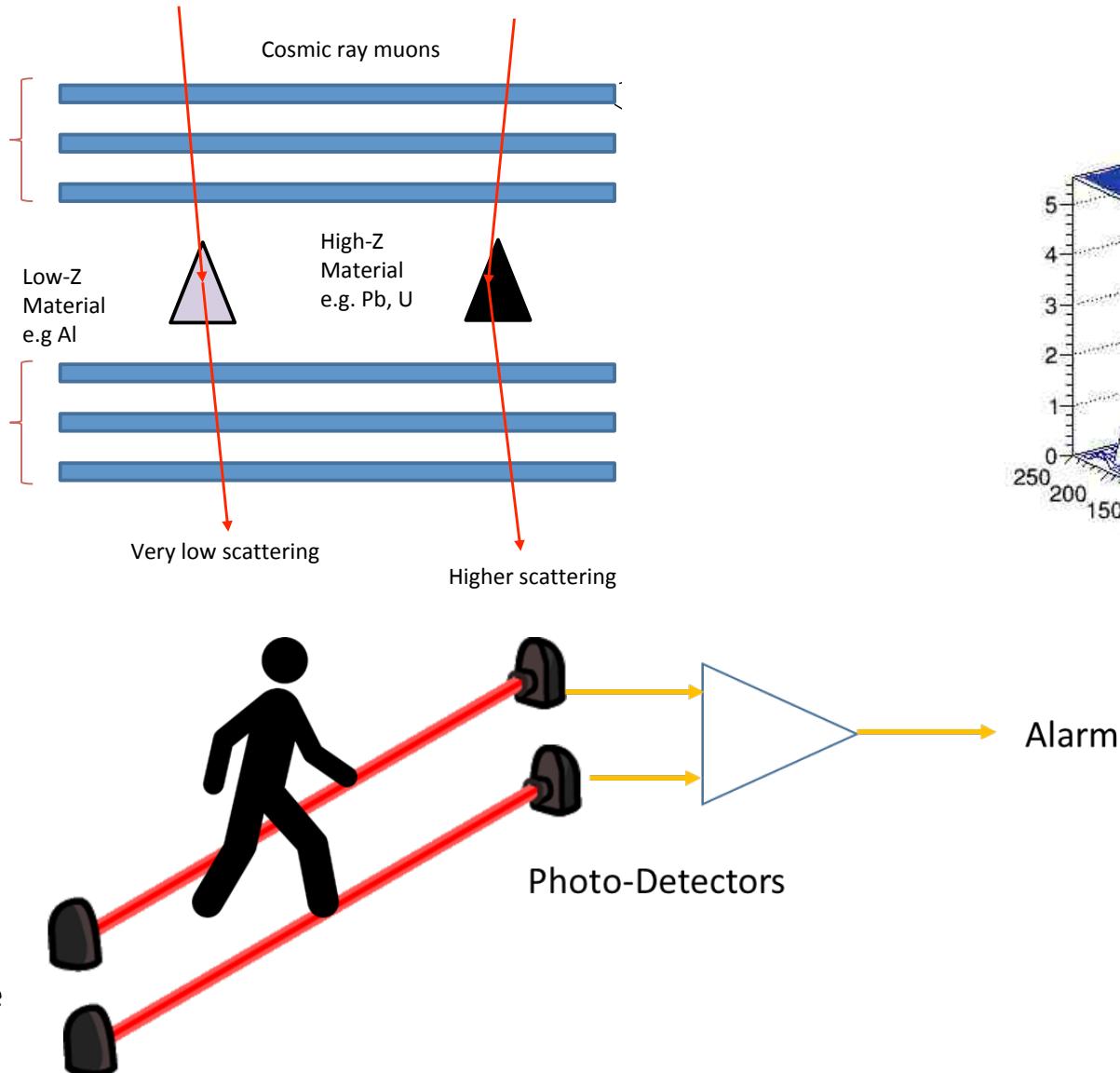
No of p.e = $580/28 \sim 20$

S/B ~ 70

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Muon Tomography Simulation



Application of the SiPM

