Muon System Status

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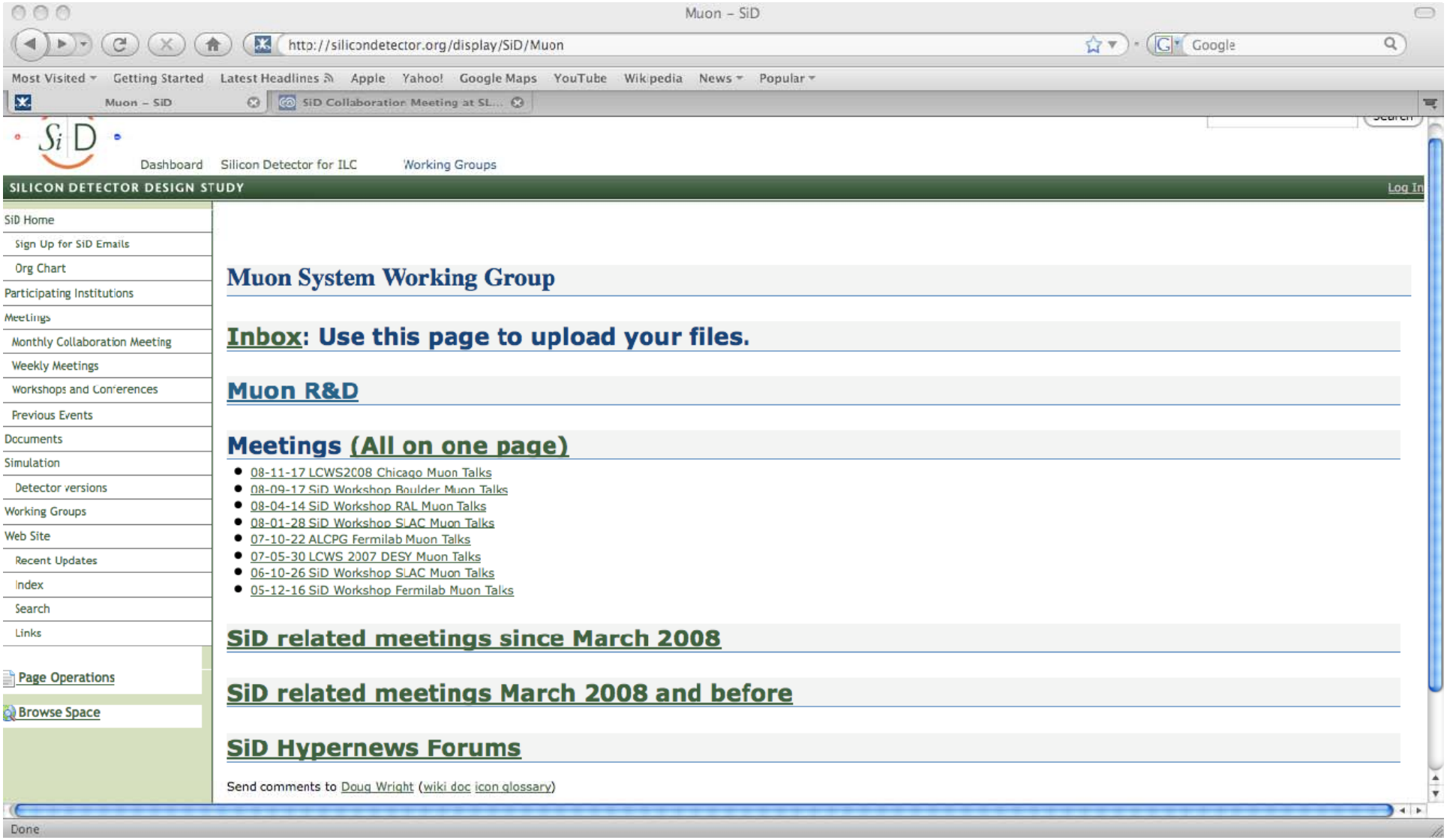
Outline

- *LOI Status*
  - *Good shape*
  - *Minor edits required*
  - *Move scintillation option to appendix?*
- *R&D proposals*
  - *Mostly focused on electronics/DAQ*
  - *Applicable to HCAL*
- *RPC*
  - *Princeton -Aging*
  - *U. Of Wisconsin - KPiX/IHEP RPCs*
- *Scintillators/SiPMs*
  - *Wayne State, Indiana, N.I.U. , Notre Dame*
  - *Fermilab*
  - *INFN(Trieste)/Udine*

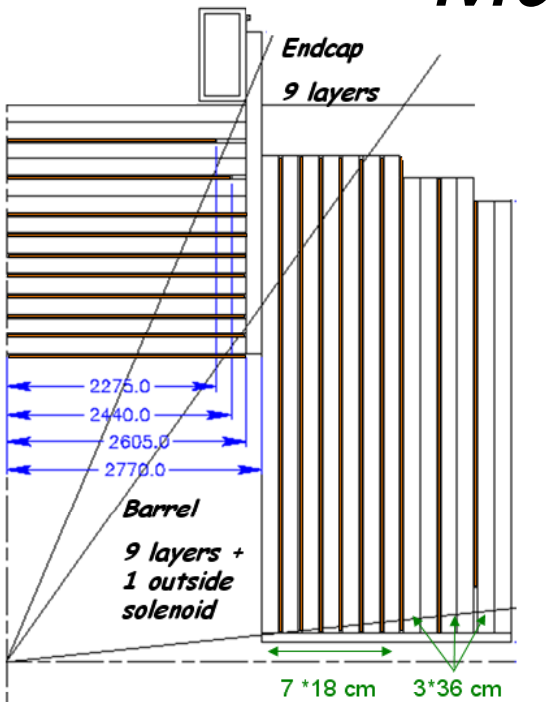
New Web Page – Doug Wright LLNL



Muon LOI

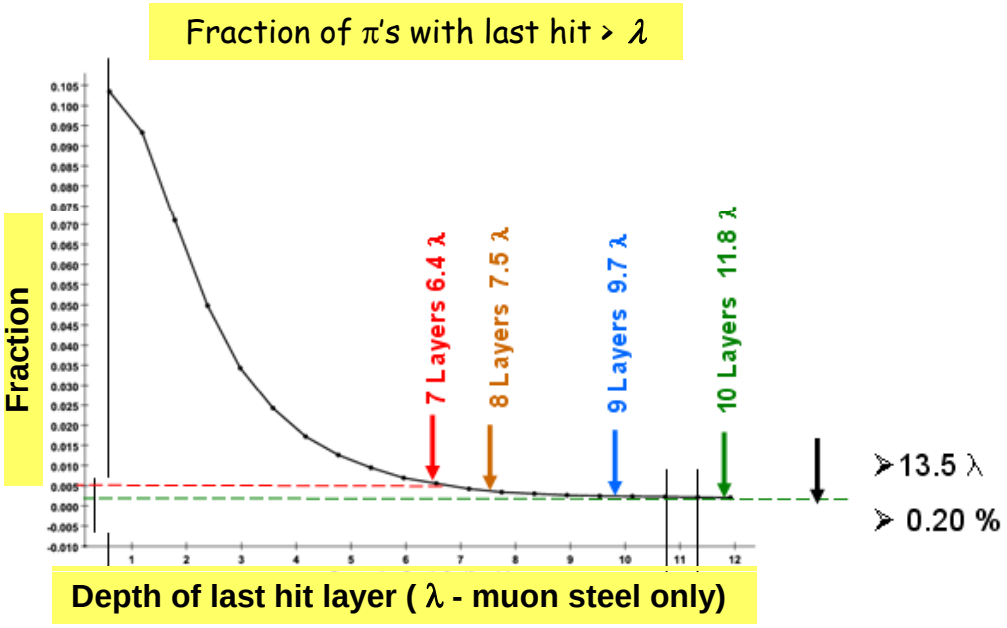
- *LOI baseline is double gap RPCs operating in avalanche mode*
- *Alternate technology is scintillating strips read by SiPMs*
- *LOI section is 11 pages, > ½ on R&D*
  - *1 page of references*
  - *1 page R&D table*
- *10-11 layers not yet optimized*
  - *~1 cm resolution*
  - *4500 m^2*
- *Backgrounds*
  - *3 $10^{-3}/cm^2$- train from beam halo induced muons*
  - **10 at small radii (30cm) from 2γ hadrons & μ's*

Muon /Flux Return



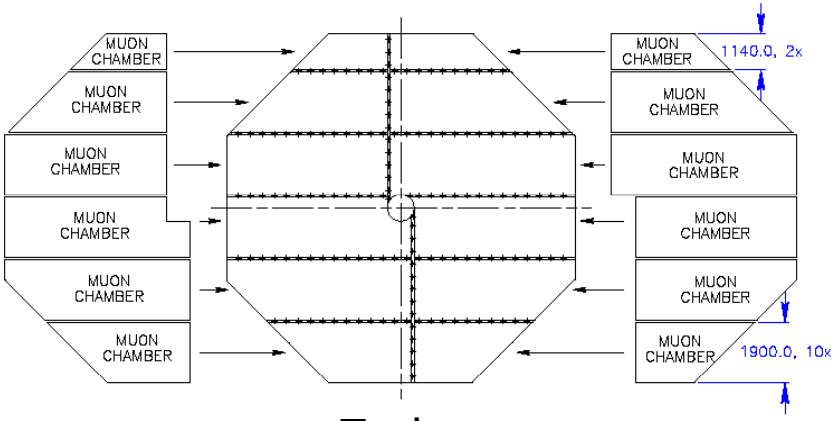
- ***10-11 layers***
- ***ECAL + HCAL + Solenoid = 6 λ***
- ***Muon = 14 λ***
- ***Study of pion misidentification vs cut on penetration depth in steel flux return, 10<p<50 GeV/c - flat distribution***

- ***Steel thickness determined by flux return requirements***
- ***Modest detector resolution needs can be meet by scintillator strips or RPCs***



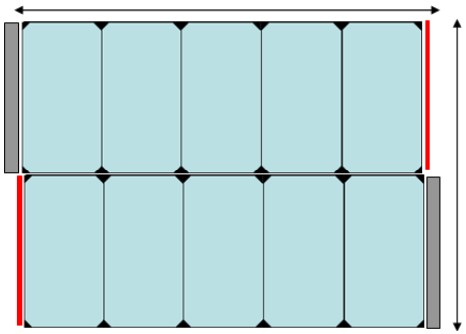
RPC Baseline

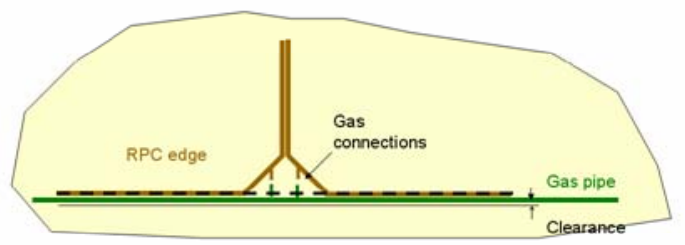
- *Double gap RPCs operated in avalanche mode*
- *RPC and steel boundaries staggered to minimize geometric inefficiencies*
- *> 93% eff. per layer*
- *Digitized by KPIX64*



Endcap

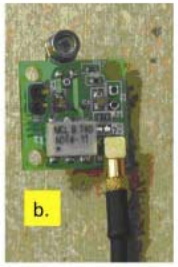
Barrel

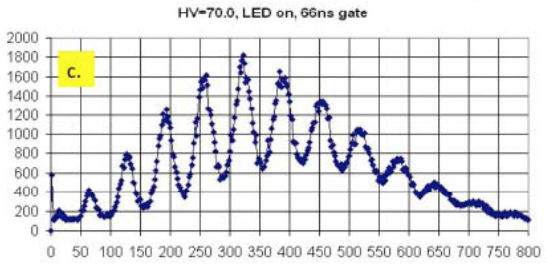


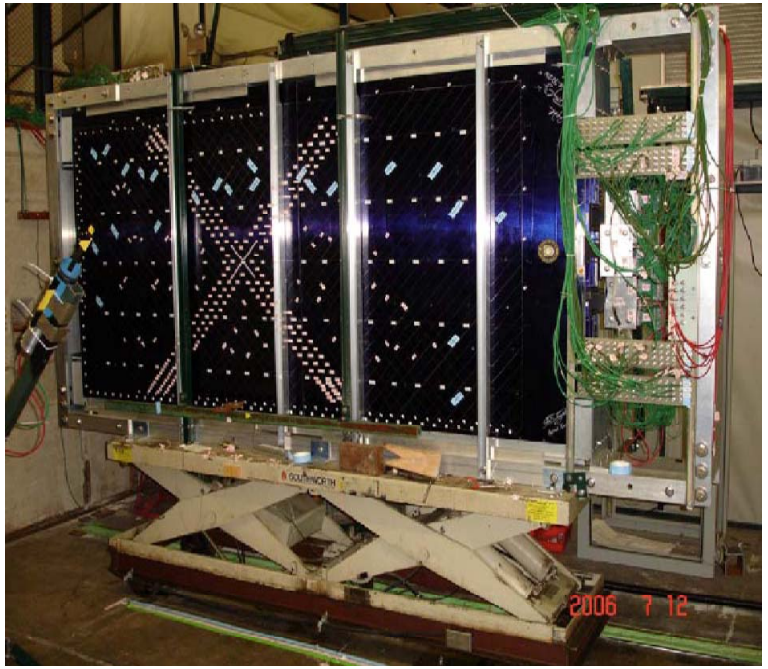


Scintillating Strip – Alternate Technology

- *Double layer of extruded "Minos" style scintillating strips - 4 cm by 1 cm by 2-6 meters long*
- 



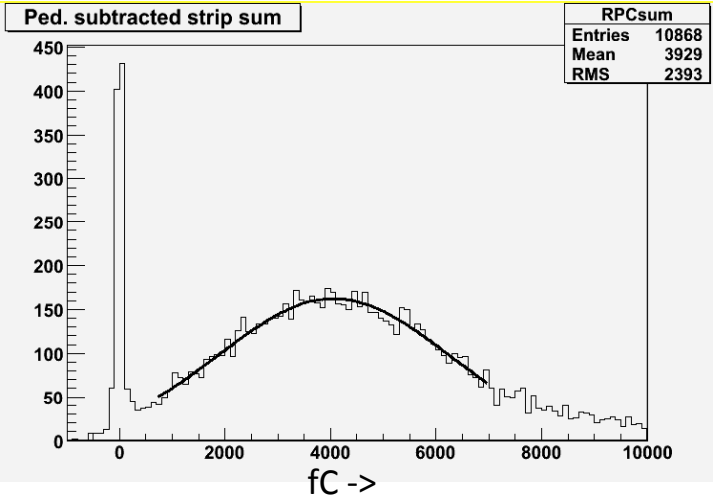


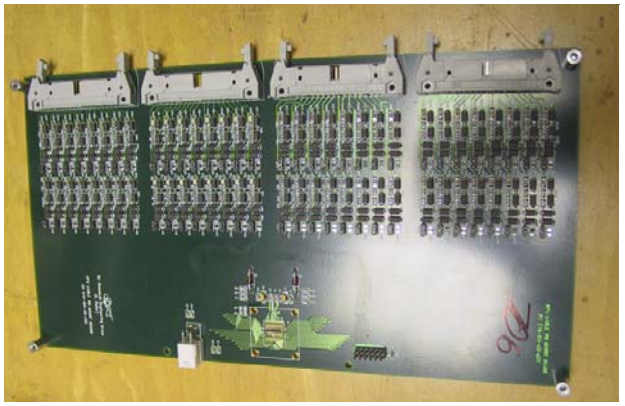


- *Single ended readout*
- *Need to measure photo-electron yields with SiPMs*

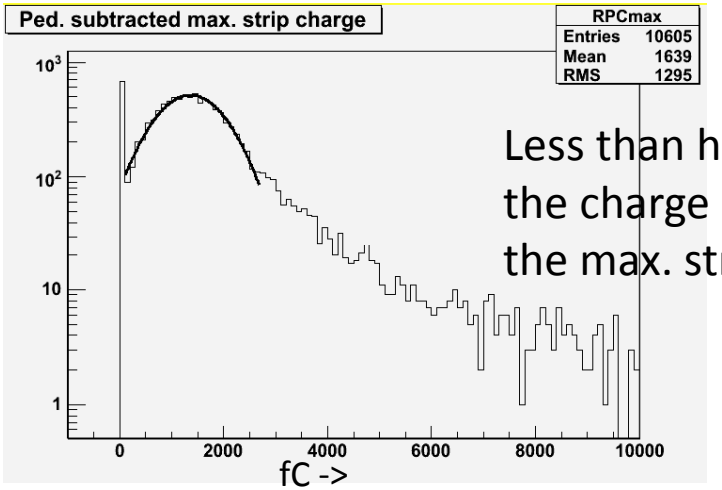
RPC R&D – Wisconsin - H. Band

- ***RPC/KPiX Studies***
  - ***Continuation of LCRD grant to study use of KPiX chip to digitize avalanche mode RPC signals***
  - ***In collaboration with SLAC KPiX group Herbst, Freytag***
- ***Progress to date***
  - ***"Proof of concept"***



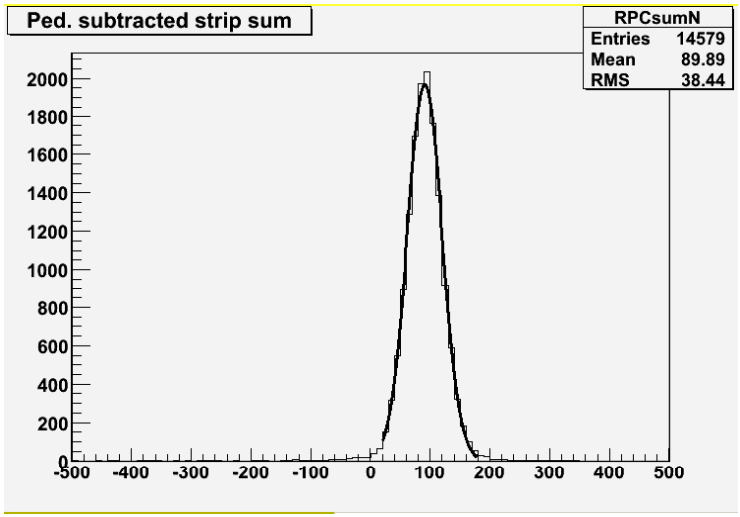


RPC R&D – Wisconsin (2)



- *FY2009 Milestones*
  - *Relocate test-stand*
  - *Make current, rate, and efficiency measurements of IHEP test RPCs operating in avalanche mode.*
  - *Readout multiple RPCs with 1 KPiX(v. 7) chip*
  - *Readout negative RPC signals with KPiX(v. 7)*
  - *Test KPiX (v. 7 & v. 8) trigger and reset operating modes.*
  - *Optimize RPC/KPiX interface board design to maximize efficiency and minimize strip multiplicity.*

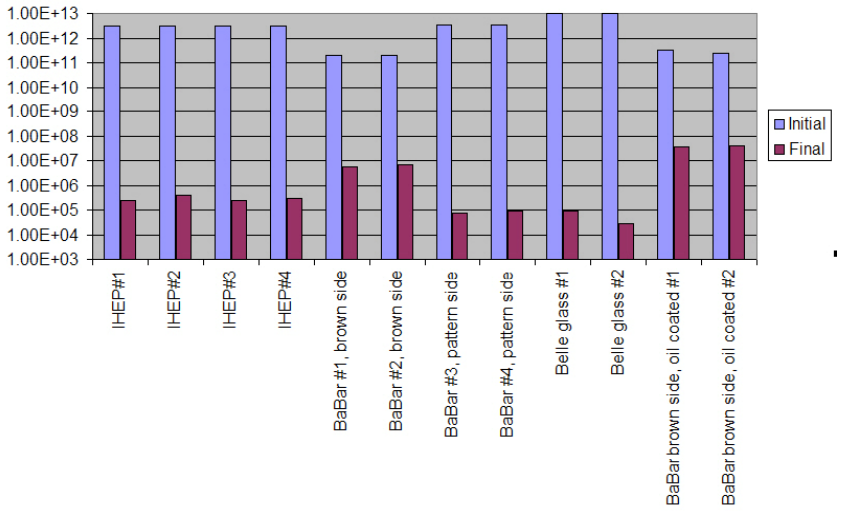
RPC R&D – Wisconsin (3)

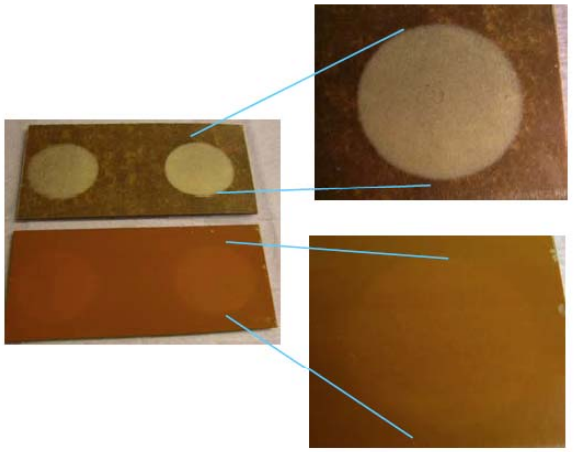


- *FY2010 & FY2011 Milestones:*
  - *Readout multiple KPiX chips*
  - *Use position and charge information from multiple RPC/KPiX devices to make fitted cosmic ray tracks*
  - *Study position resolution of RPC/KPiX tracks,*
  - *Test HCAL prototypes in teststand*
  - *Study response on IHEP RPCs to HF.*
  - *Begin IHEP RPC aging studies*

RPC R&D - Princeton

- ***Aging Study for SiD Hcal and Muon System RPCs***
- ***Progress to date***





Marble side of BaBar Bakelite plate, the marble-pattern is completely disappeared, also discolored.

Brown side of Bakelite plate shows slightly discolored mark.

Figure4. HF vapor corrosive action on BaBar Bakelite surface.

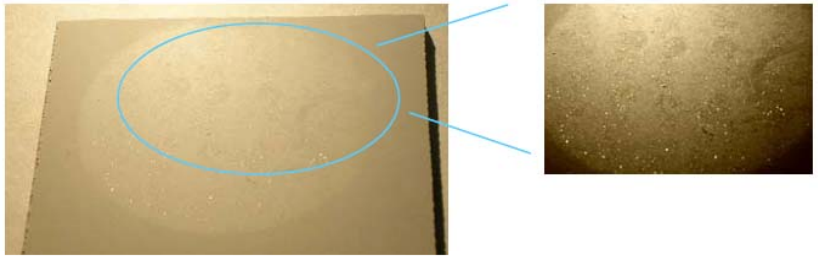


Figure 5. HF corrosive action on BES III bakelite surface.

RPC R&D – Princeton (2)

- *FY2009 Milestones*
  - *Purchase optical microscope, open the previously aged RPC and survey the inner surface*
  - *Set up expanded cosmic-ray-trigger counter array*
  - *Prepare 5 new BESIII-type test RPCs*
  - *Start a new round of aging tests.*
- *Beyond FY2009*
  - *Collaborate with IHEP and Gaonengkedi to try out various new Bakelite electrodes*
  - *Bench top test robustness to HF*
  - *General performance test for new Bakelite electrode*
  - *Aging test for the new RPC.*

Scint-SiPM Muon/Tail-catcher R&D

Feb 17, 2009

G. Fisk, A. Para, P. Rubinov - Fermilab,
D. Cauz, A. Driutta, G. Pauletta - IRST/INFN-Udine,
R. Van Kooten, P. Smith - Indiana Univ.,
A. Dychkant, D. Hedin, V. Zutshi – No. Ill. Univ.,
M. McKenna, M. Wayne - Univ. of Notre Dame
A. Gutierrez, P. Karchin, C. Milstene - Wayne State
H. Band – Univ. Of Wisconsin

* Non-funded collaborators

Scintillator/SiPM

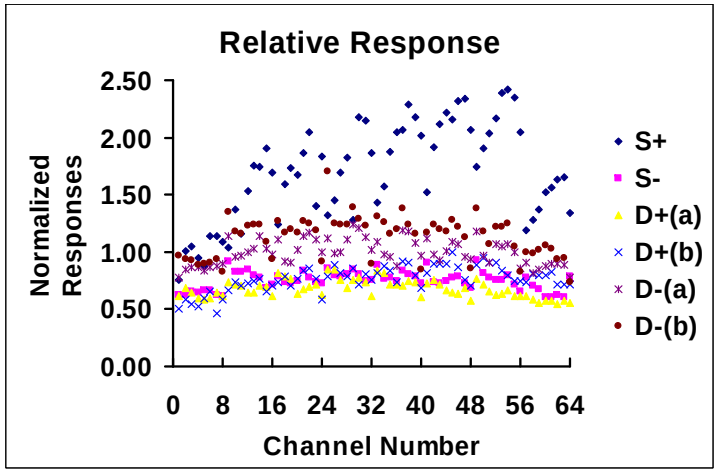
Priority	R&D Item	Institutions	Personnel
1	Silicon PMs from HPK and IRST - Bench Tests Current vs Bias Voltage to establish operating Voltage, gain, noise rate as a function of temperature, threshold, etc. Have 150 devices from IRST (Italy) & HPK (Japan) LED pulser development.	Fermilab Indiana INFN Udine NIU Notre Dame Wayne State	Si Detector Facility: Para, Rubinov Van Kooten & students G. Pauletta & collaborators Hedin, Chakraborty, Dychkant, Zutshi Wayne, Baumbaugh, McKenna Karchin, Gutierrez, students
1	Strip and Fiber Mechanical R&D. Geometry of strip ends + SiPM FE miniature circuit. Preparation of ~30 scint. Strips w/WLS fiber. QC checks. Light pulser tests. Instrumentation.	 Notre Dame Fermilab INFN Udine	 McKenna, Wayne Rubinov, Fisk Pauletta
1	MTest device studies: both strips and instrumentation. Calibration measurements: 1, 2, 3, 4, n,.. p.e.s obsv'd. Signal/noise vs. transverse & longitudinal position. CAMAC and Minerva electronics.	INFN Udine Fermilab Notre Dame Wayne State	Pauletta et al Rubinov, Fisk Baumbaugh Gutierrez, students
2	FE electronics development: AC vs. DC coupling; Design of ASIC with temperature compensated gain; Strip signal transport, collection and digitization. Multiplexing digitized signal scheme and design.	Fermilab Indiana Wayne State INFN Udine	Rubinov Van Kooten Karchin Pauletta
2	Tail catcher with CALICE; Beam tests results vs. number of pixels; Gain issues	NIU	Chakaraborty, Zutshi
3	Fast timing measurements	NIU	Hedin
3	Simulations. Testbeam software. Analysis software.	Rochester INFN Udine All	Manly Pauletta, et al
4	Co-extrusion of scintillator and WLS fiber	Fermilab Notre Dame	Fisk Ruchti, Wayne, McKenna

What R&D have we done?

Previous Studies

Hamamatsu H7546B

64 channel MAPMTs calibrated using a 5mCi Sr^{90} in contact w/plastic scintillator and WLS fiber to each MAPMT pixel.

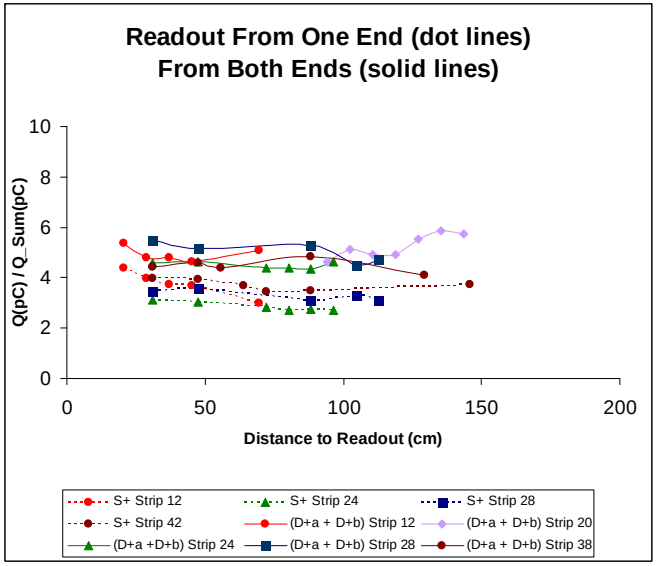


Measured both single ended (S) and dual (D) readout.

3 pC for (S), 5 pC for (D)

~50% more light with (D)

Nominal gain ~ 2X10⁶ @ 960 V



FY09 Activities

- *Northern Illinois University – procurement of new SiPM devices, comparison of LN2 and room temperature operation of SiPMs, CALICE-TCMT operation and analysis*
- *University of Notre Dame – gain and noise of SiPMs versus temperature at room temperatures, comparison of commercial and specialized front-end amplifiers, strip and fiber mechanical R&D*
- *Indiana University – design of bias voltage and temperature control system, test-beam support*
- *Wayne State University – comparison of SiPMs from different manufacturers, test beam support*

Very preliminary results

- *IRST SiPM typical plots*

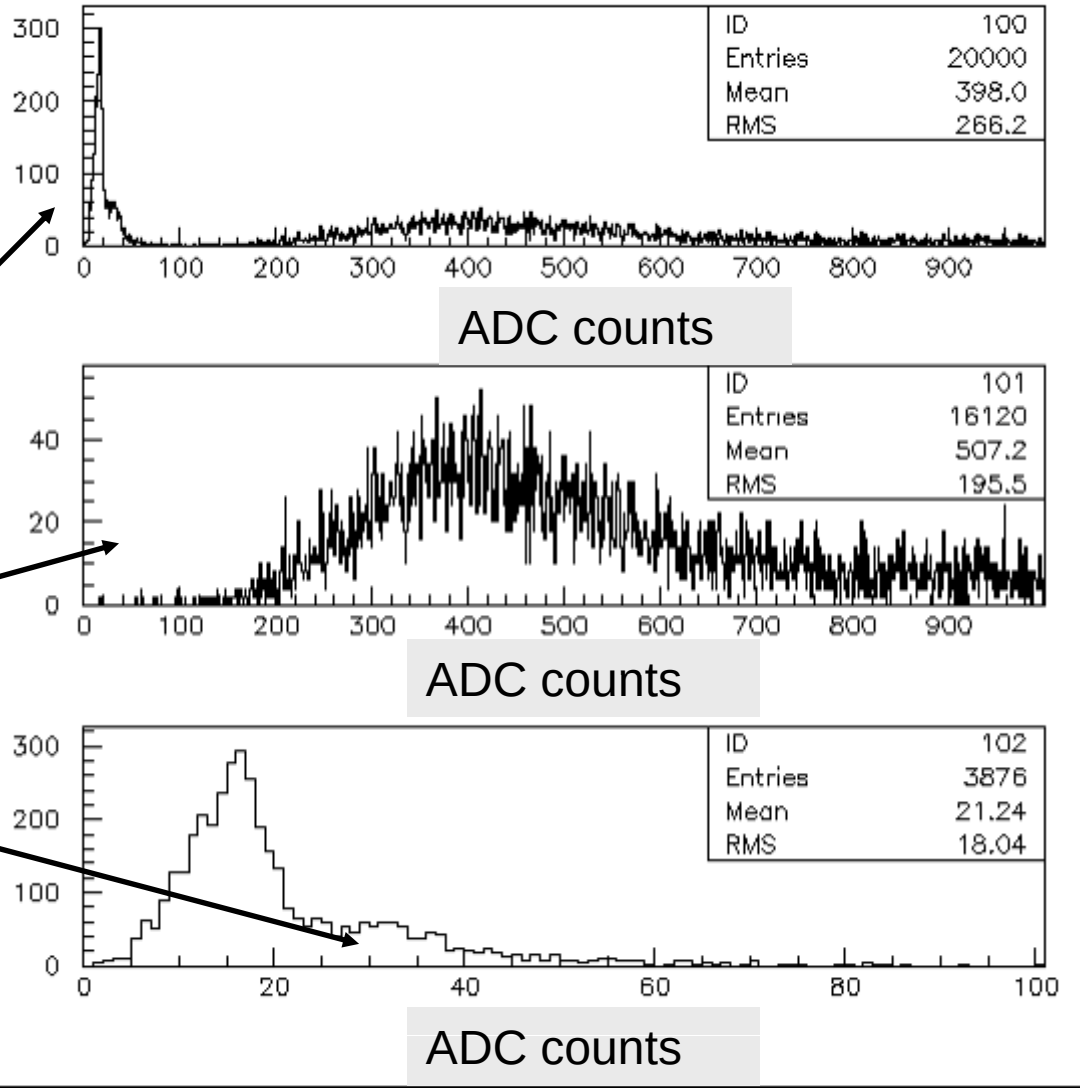
Our strategy is:

Take data with loose trigger to enable us to see pedestal.

Use other counters to select MIPs.

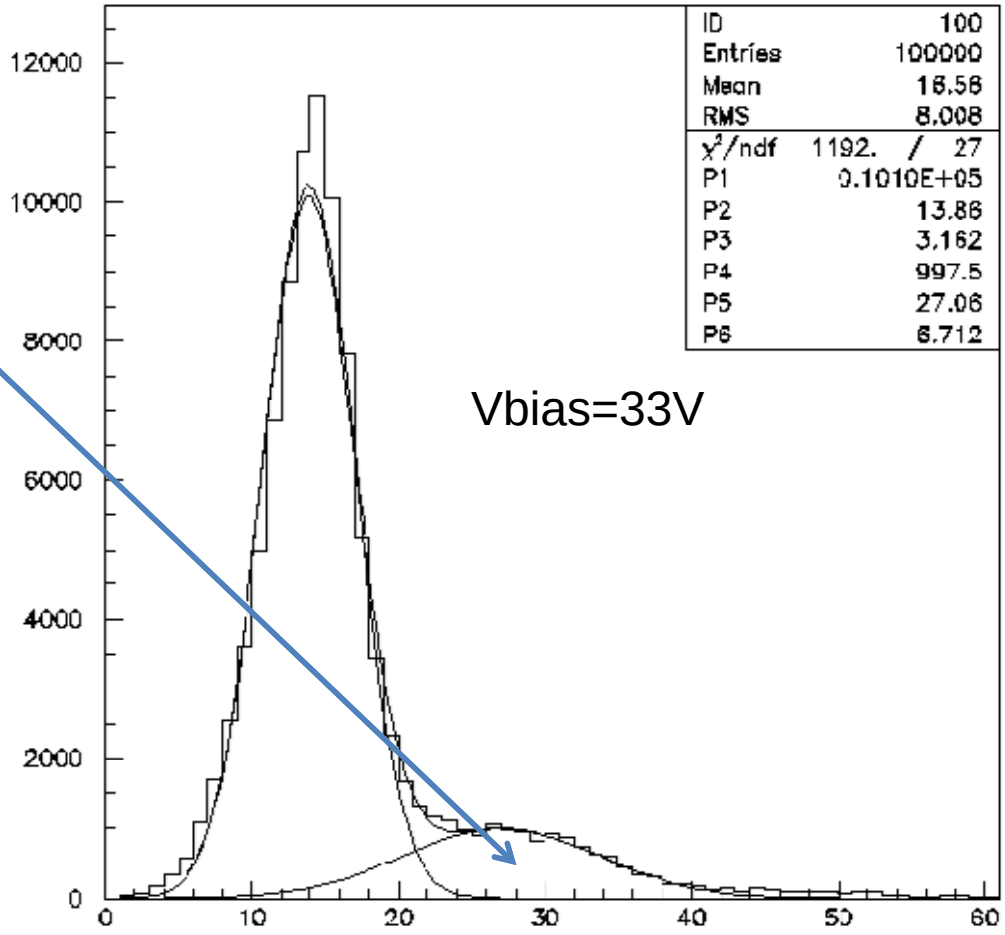
Extract 1pe peak from pedestal.

Peak at 400 counts is ~ 25 photo-electrons.



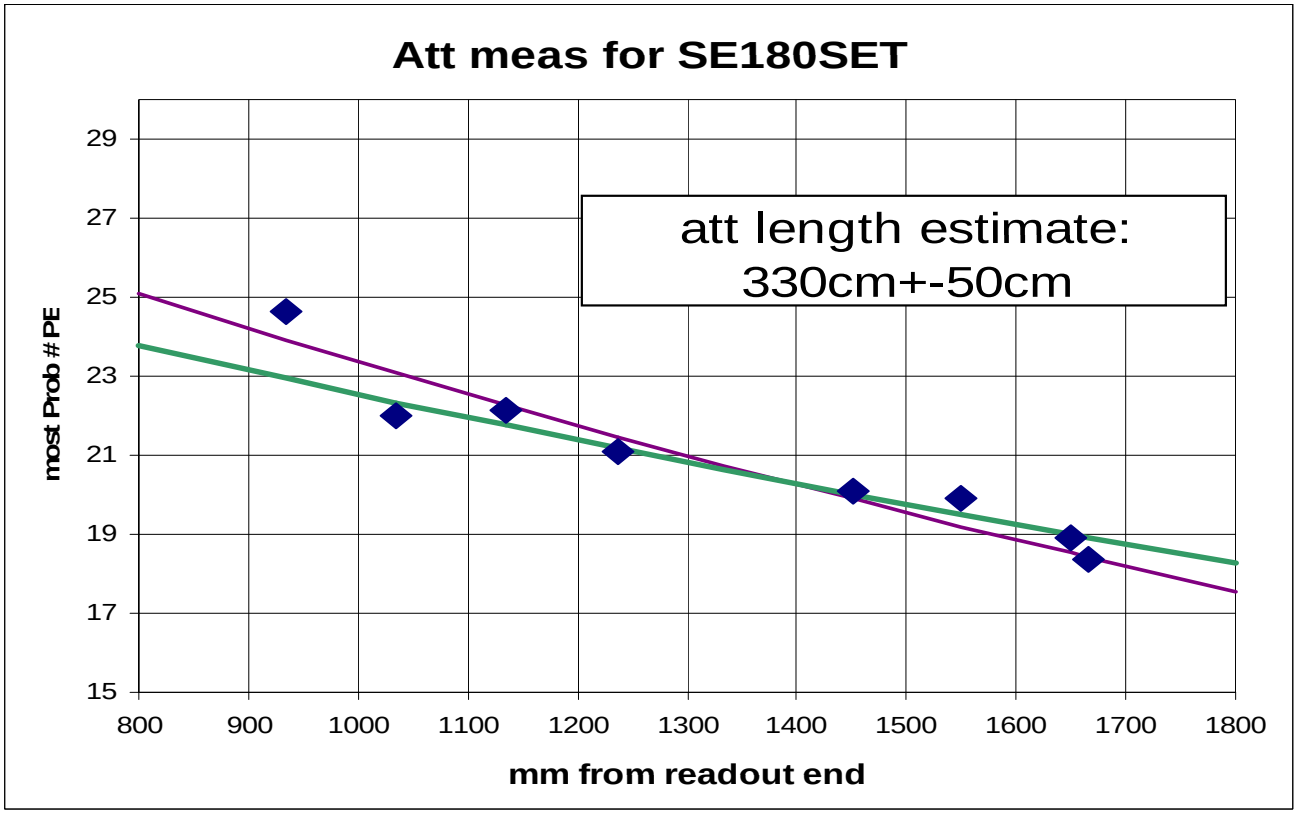
Very preliminary results(2)

- *Plan is to pull single p.e. peak from noise data.*
- *This makes the detector self-calibrating*



Very preliminary results(3)

- *A scan of the 1.8m bar across the beam gives an estimate of the attenuation length*



Summary

- *Muon LOI section requires minor edits*
- *3 Detector R&D proposals submitted - 6 institutions + Fermilab, SLAC, IHEP, INFN*
- *R&D details in Tuesday parallel session*