

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 - SiD

http://silicondetector.org/display/SiD/Muon

Most Visited Getting Started Latest Headlines Apple Yahoo! Google Maps YouTube Wikipedia News Popular

Muon - SiD SID Collaboration Meeting at SL...

SiD Dashboard Silicon Detector for ILC Working Groups

SILICON DETECTOR DESIGN STUDY [Log In](#)

SID Home

- Sign Up for SiD Emails
- Org Chart

Participating Institutions

Meetings

- Monthly Collaboration Meeting
- Weekly Meetings
- Workshops and Conferences
- Previous Events

Documents

Simulation

- Detector versions

Working Groups

Web Site

- Recent Updates
- Index
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- Links

Page Operations

Browse Space

Muon System Working Group

Inbox: Use this page to upload your files.

Muon R&D

Meetings (All on one page)

- [08-11-17 LCWS2008 Chicago Muon Talks](#)
- [08-09-17 SiD Workshop Boulder Muon Talks](#)
- [08-04-14 SiD Workshop RAL Muon Talks](#)
- [08-01-28 SiD Workshop SLAC Muon Talks](#)
- [07-10-22 ALCPG Fermilab Muon Talks](#)
- [07-05-30 LCWS 2007 DESY Muon Talks](#)
- [06-10-26 SiD Workshop SLAC Muon Talks](#)
- [05-12-16 SiD Workshop Fermilab Muon Talks](#)

SiD related meetings since March 2008

SiD related meetings March 2008 and before

SiD Hypernews Forums

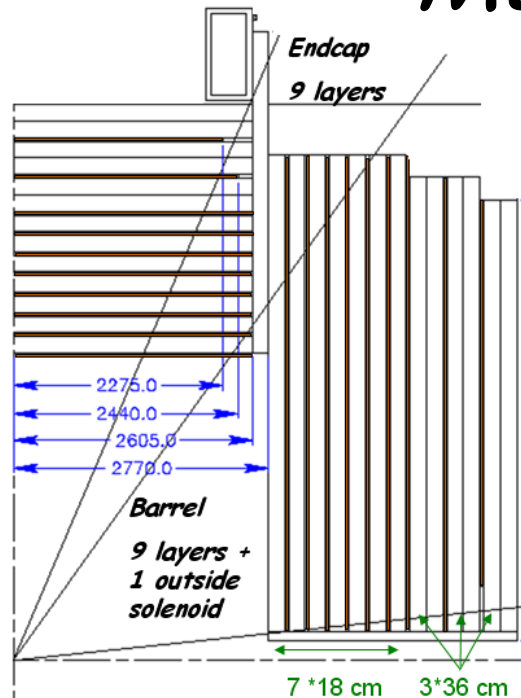
Send comments to [Doug Wright](#) ([wiki](#) [doc](#) [icon](#) [glossary](#))

Done

Muon LOI

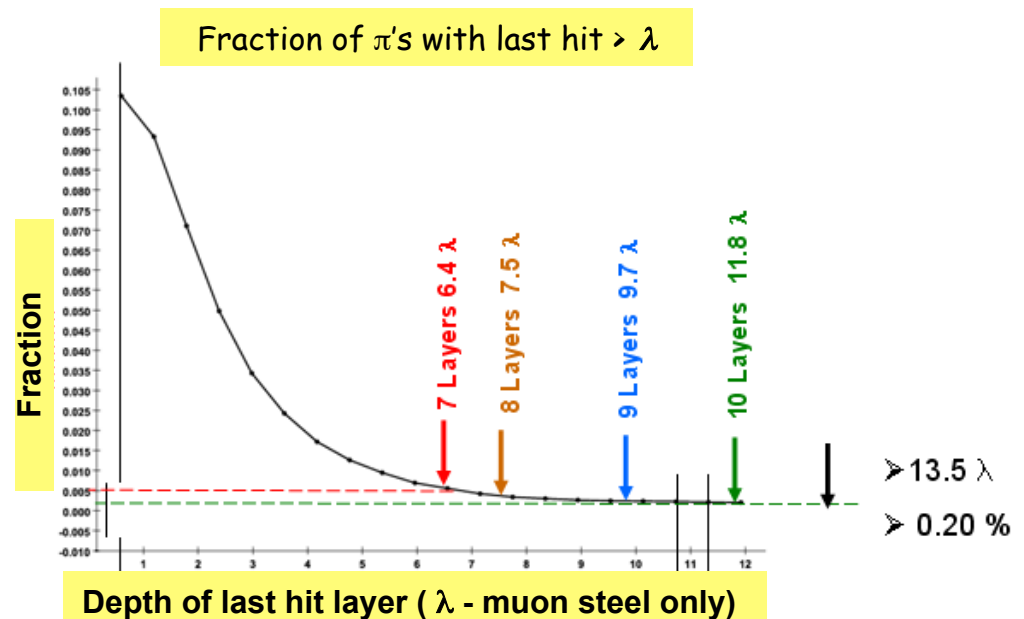
- *LOI baseline is double gap RPCs operating in avalanche mode*
- *Alternate technology is scintillating strips read by SiPMs*
- *LOI section is 11 pages, > $\frac{1}{2}$ on R&D*
 - *1 page of references*
 - *1 page R&D table*
- *10-11 layers not yet optimized*
 - *~1 cm resolution*
 - *4500 m²*
- *Backgrounds*
 - *$3 \cdot 10^{-3}/\text{cm}^2$ - train from beam halo induced muons*
 - **10 at small radii (30cm) from 2 γ hadrons & μ 's*

Muon / Flux Return



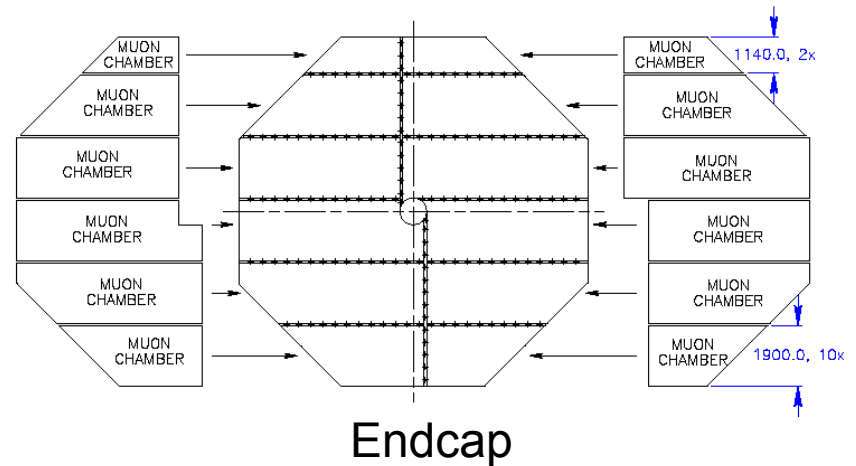
- 10-11 layers
- ECAL + HCAL + Solenoid = 6λ
- Muon = 14λ
- Study of pion misidentification vs cut on penetration depth in steel flux return, $10 < p < 50 \text{ GeV}/c$ - flat distribution

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

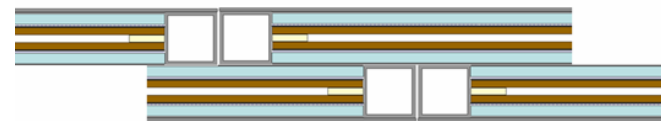
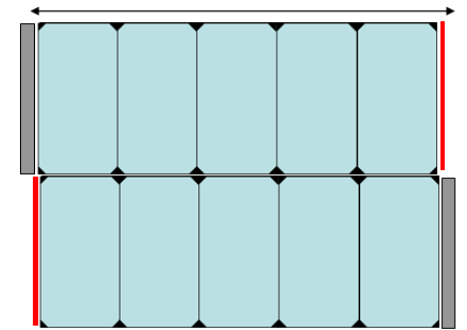


RPC Baseline

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

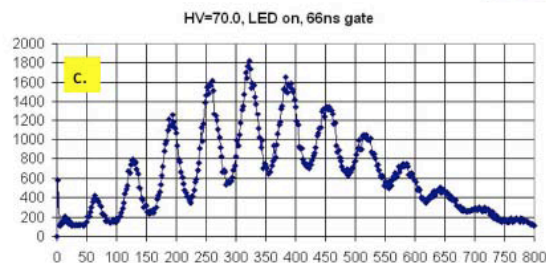
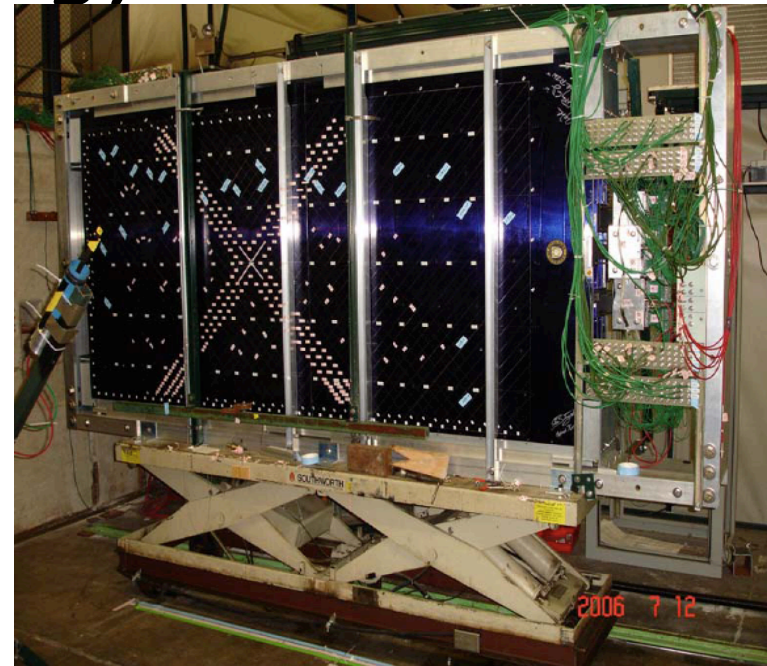


Barrel
5.7 m



Scintillating Strip - Alternate Technology

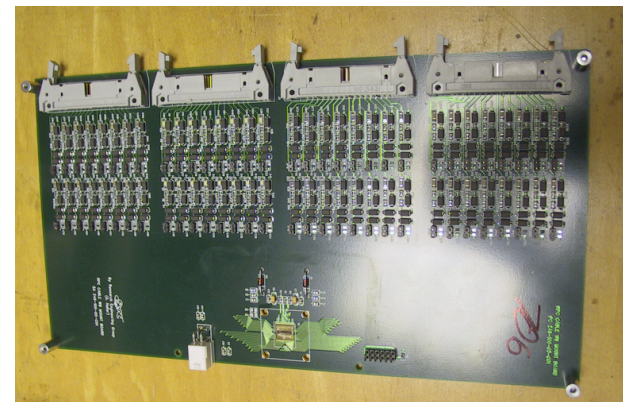
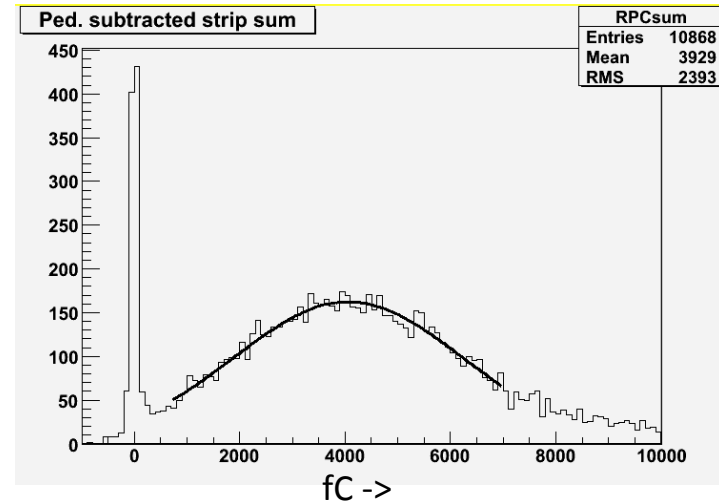
- Double layer of extruded "Minos" style scintillating strips - 4 cm by 1 cm by 2-6 meters



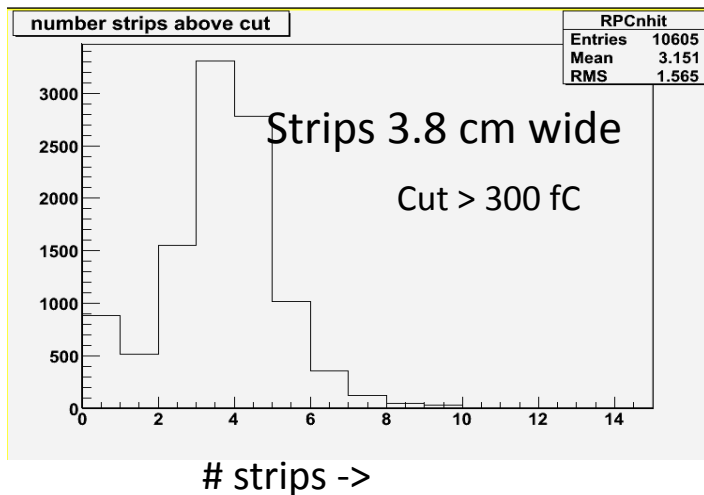
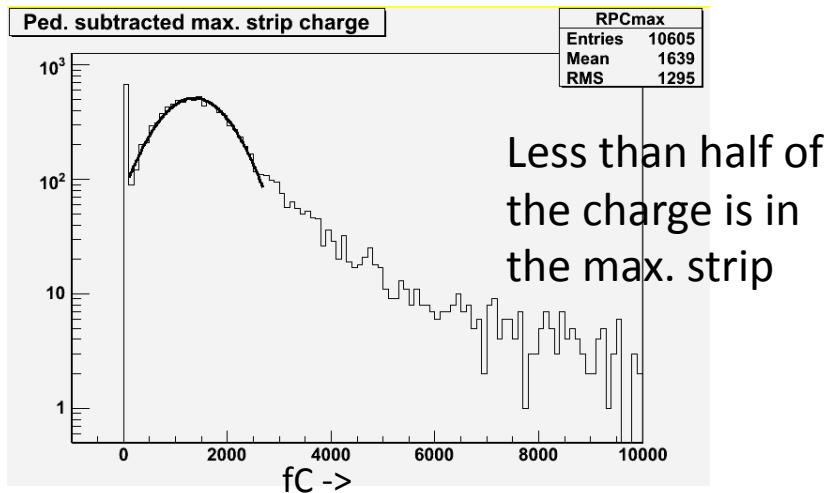
- Single ended readout
- Need to measure photo-electron yields with SiPMs

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"



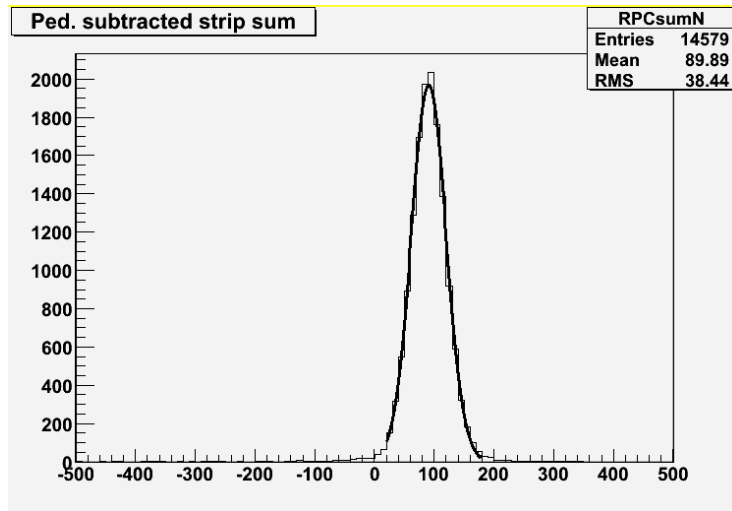
RPC R&D - Wisconsin (2)



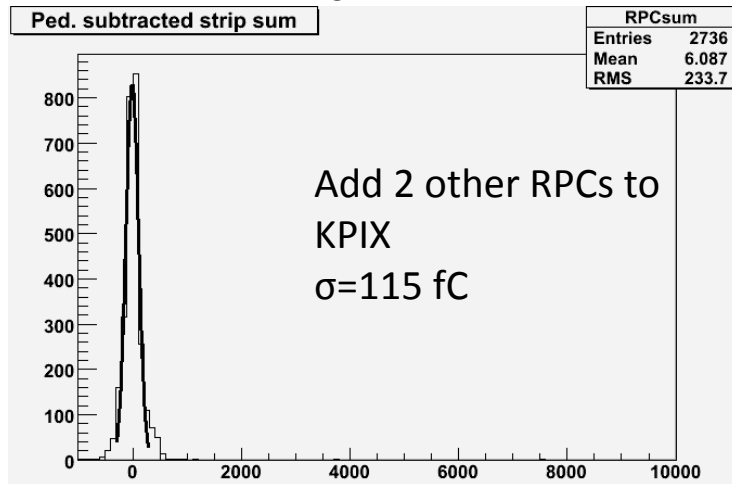
• FY2009 Milestones

- 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)



fC ->



fC ->

- *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*

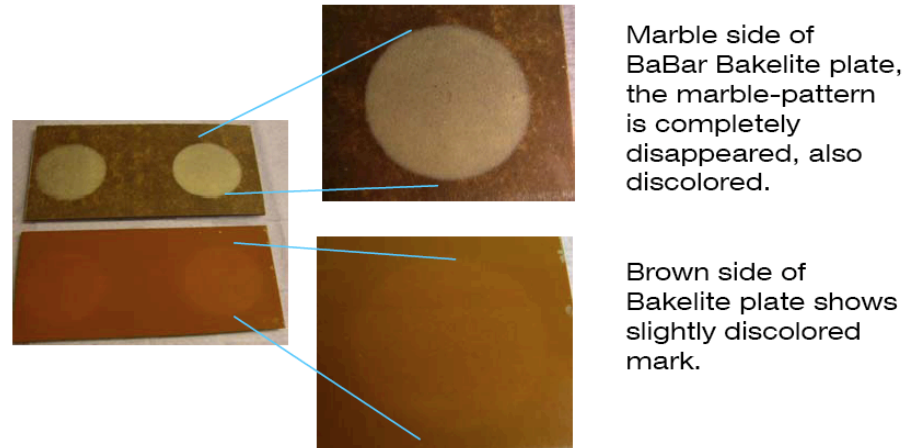
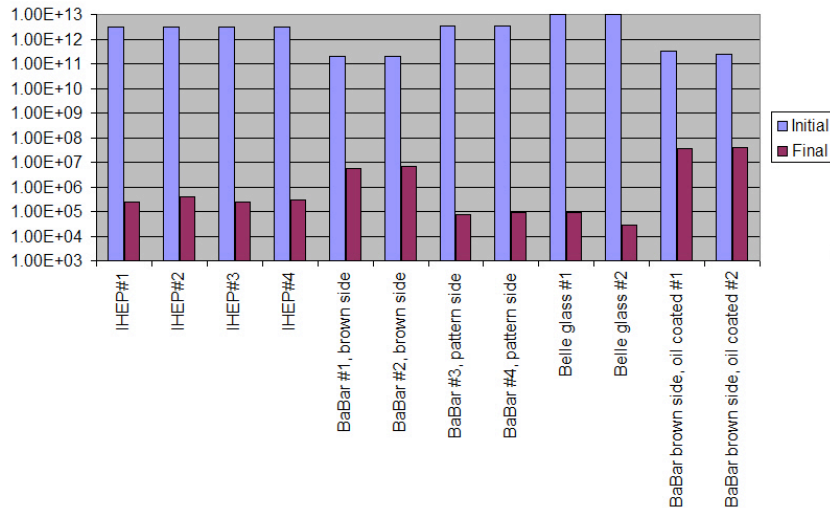


Figure4. HF vapor corrosive action on BaBar Bakelite surface.

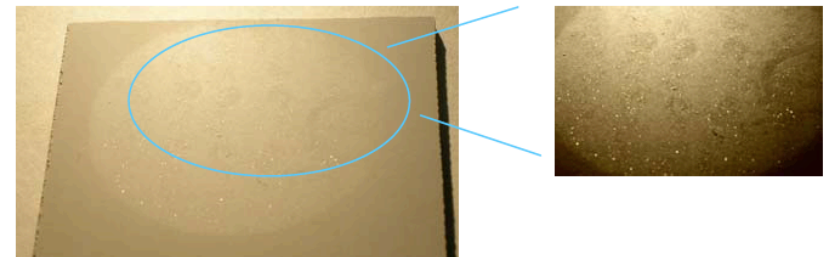


Figure 5. HF corrosive action on BES III bakelite surface.

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 Gaonengke 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

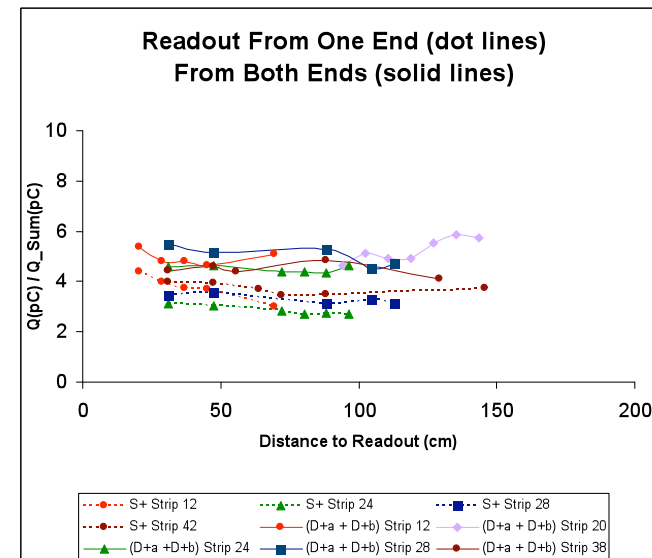
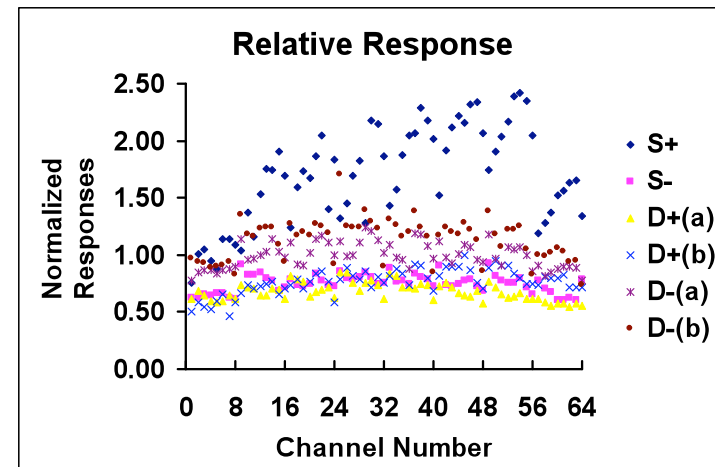
Hamamatsu H7546B

64 channel MAPMTs
calibrated using a 5mCi Sr⁹⁰
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 $\sim 2 \times 10^6$ @ 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*

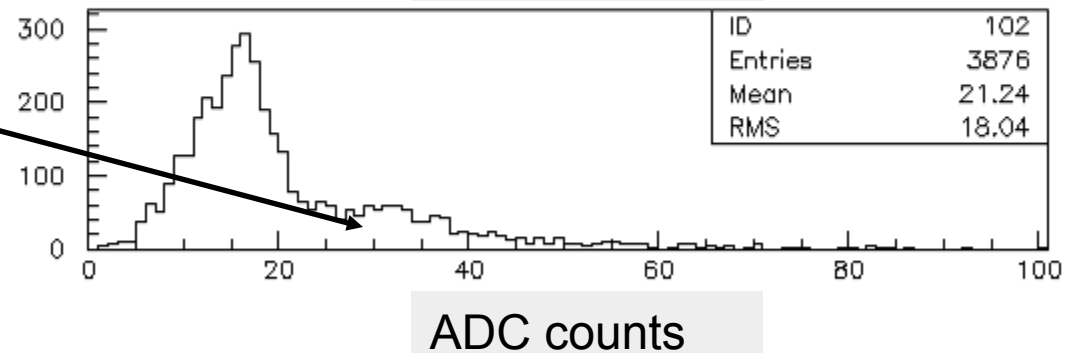
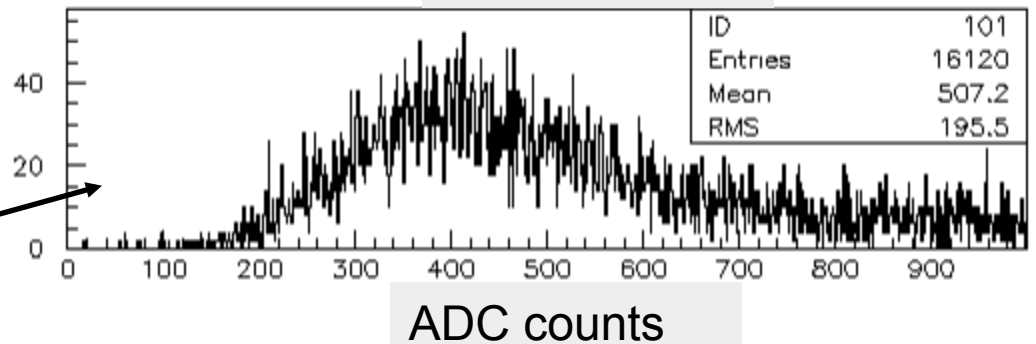
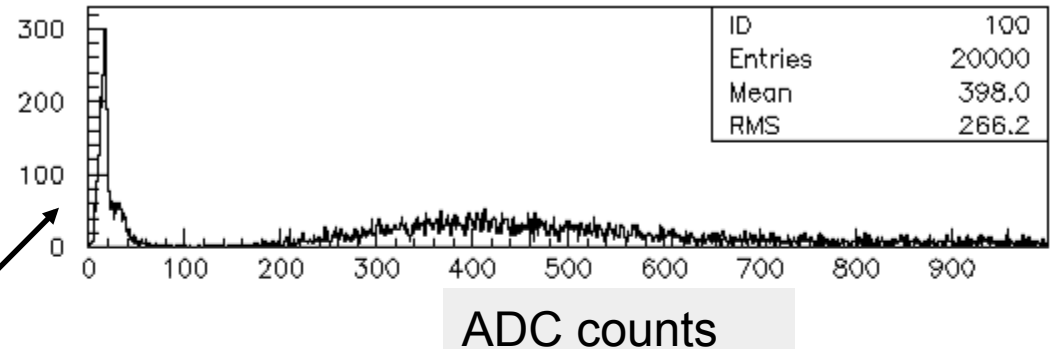
Our strategy is:

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

Use other counters to select MIPs.

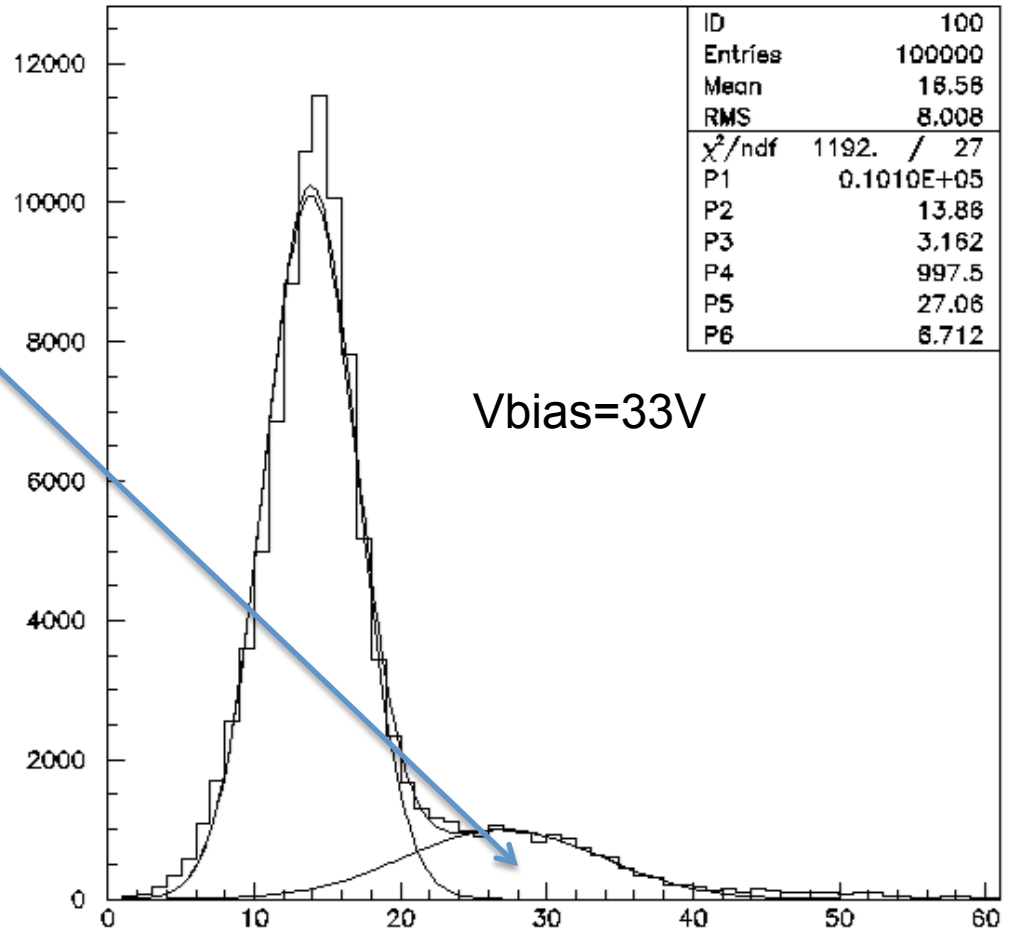
Extract 1pe peak from pedestal.

Peak at 400 counts is ~ 25 photo-electrons.



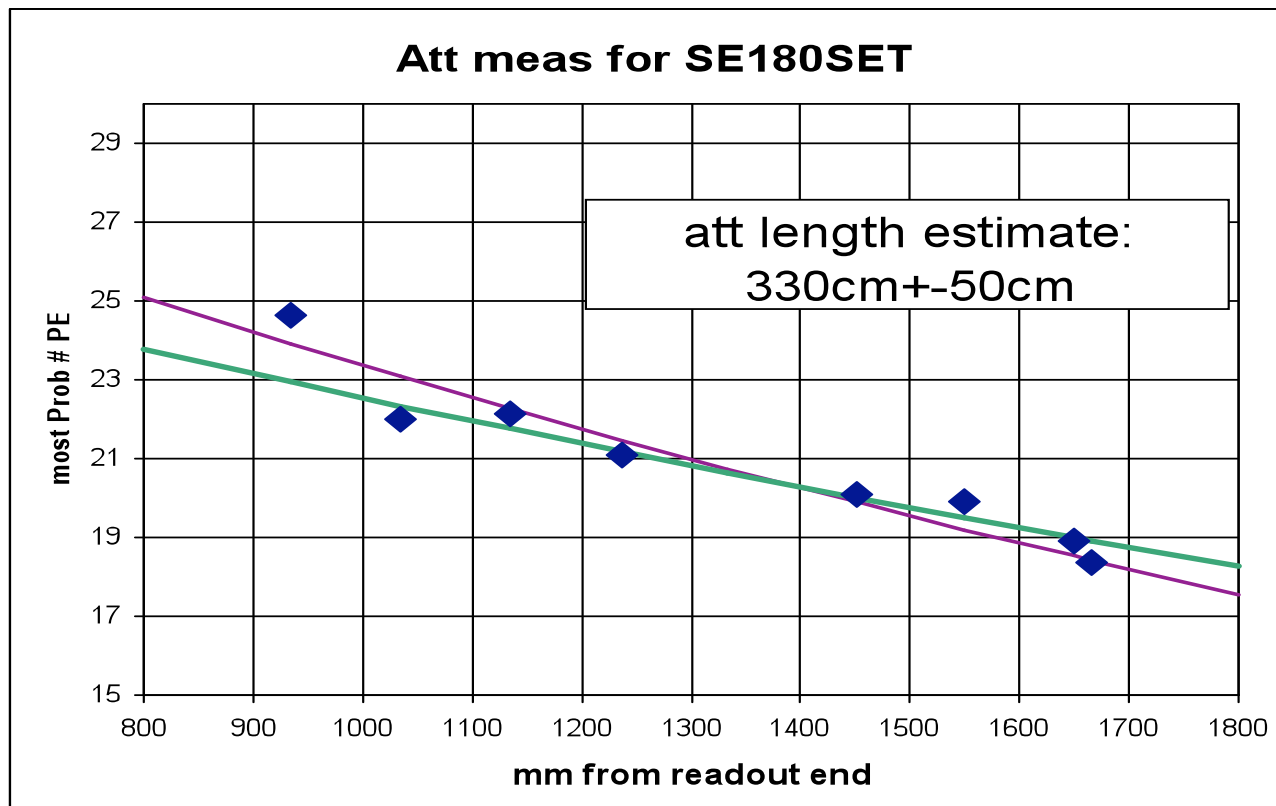
Very preliminary results(2)

- *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*