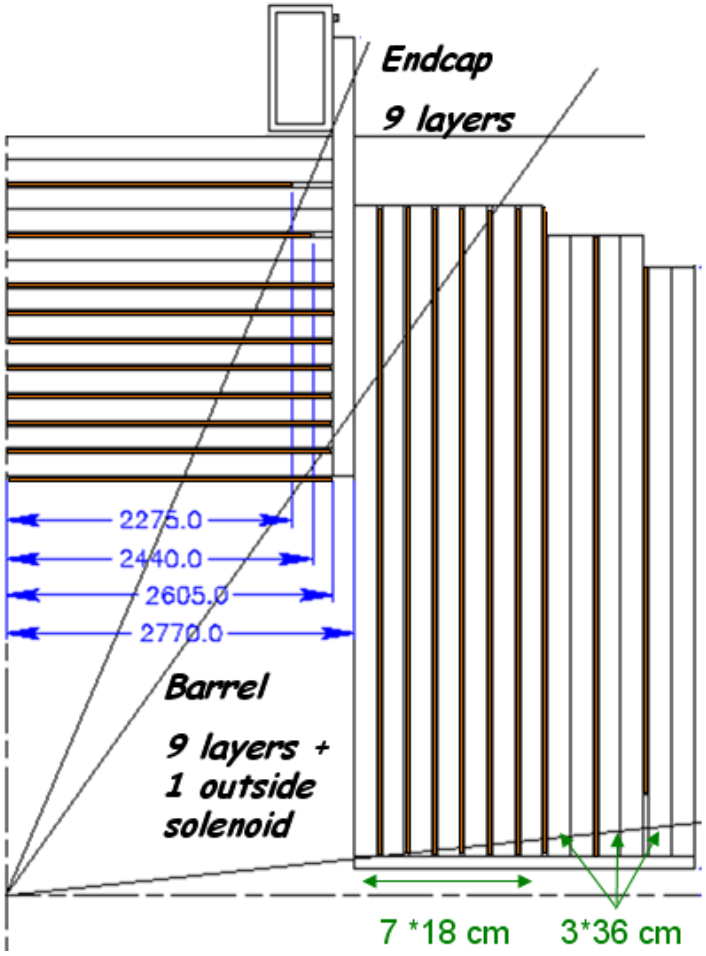
SiD Muon R&D

H. Band
University of Wisconsin

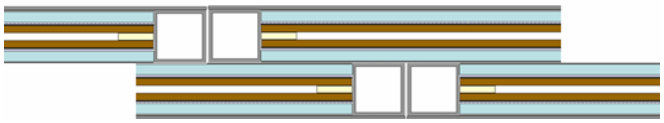
SiD Muon

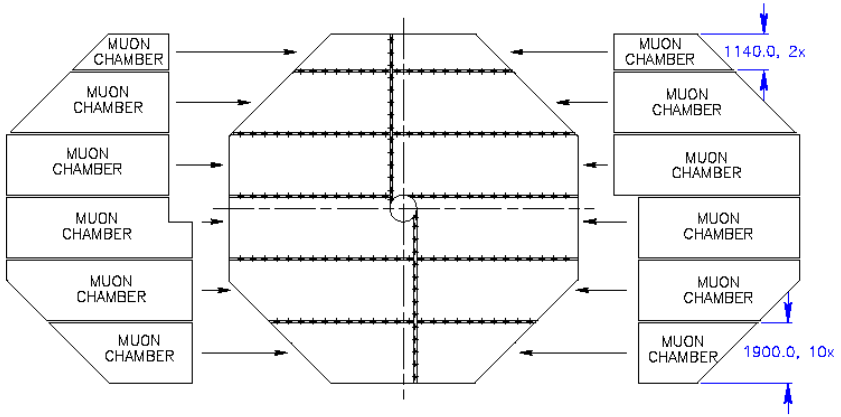
- Expected Backgrounds
  - Barrel -Beam halo induced muons
    - 3 10^{-3}/cm^2- pulse train
  - Endcap -2 γ hadrons & μ
    - 4 10^{-2} /cm^2- pulse train
- Detector design
  - Modest resolution ~ cm
  - 9-10 layers interspersed in steel flux return (8 λ)
  - X and Y coordinate readout ~ 3-4 cm pitch



SiD Muon Detector

- *Baseline choice*
  - *Double gap RPCs operating in avalanche mode are expected to have lowest cost and have adequate reliability*
  - *RPC and steel boundaries staggered to minimize geometric inefficiencies*
  - *> 93% eff. per layer*
  - *Digitized by KPIX(64or128)*

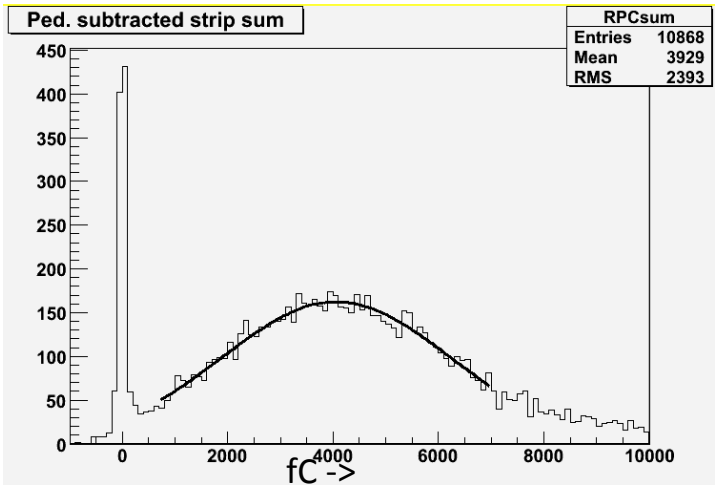




- *Detector Option*
  - *MINOS style scintillating strips with SiPM readout being pursued to understand cost and performance of SiPM readout – reliable backup*

RPC/ KPiX Studies

- RPC readout with KPiX chip previously reported at LCWS08 and ALCPG09
- 64 channel interface board with KPiX7
- First tests
  - Optimize Ω & capacitor values
  - Protection circuits
  - KPIX readout modes



- Good efficiency but 3.1 strips/track
- Next steps
  - Reduce noise
  - Reduce multiplicity

RPC Studies

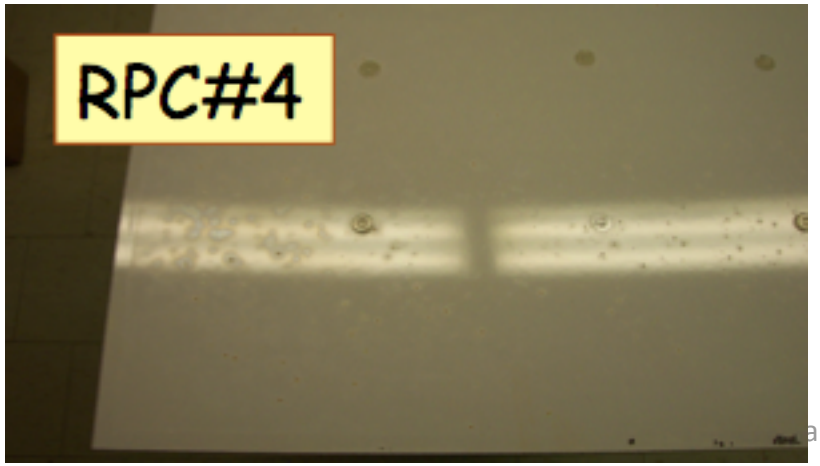
Ongoing programs at Princeton and Wisconsin to understand RPC aging (Bakelite/melamine)

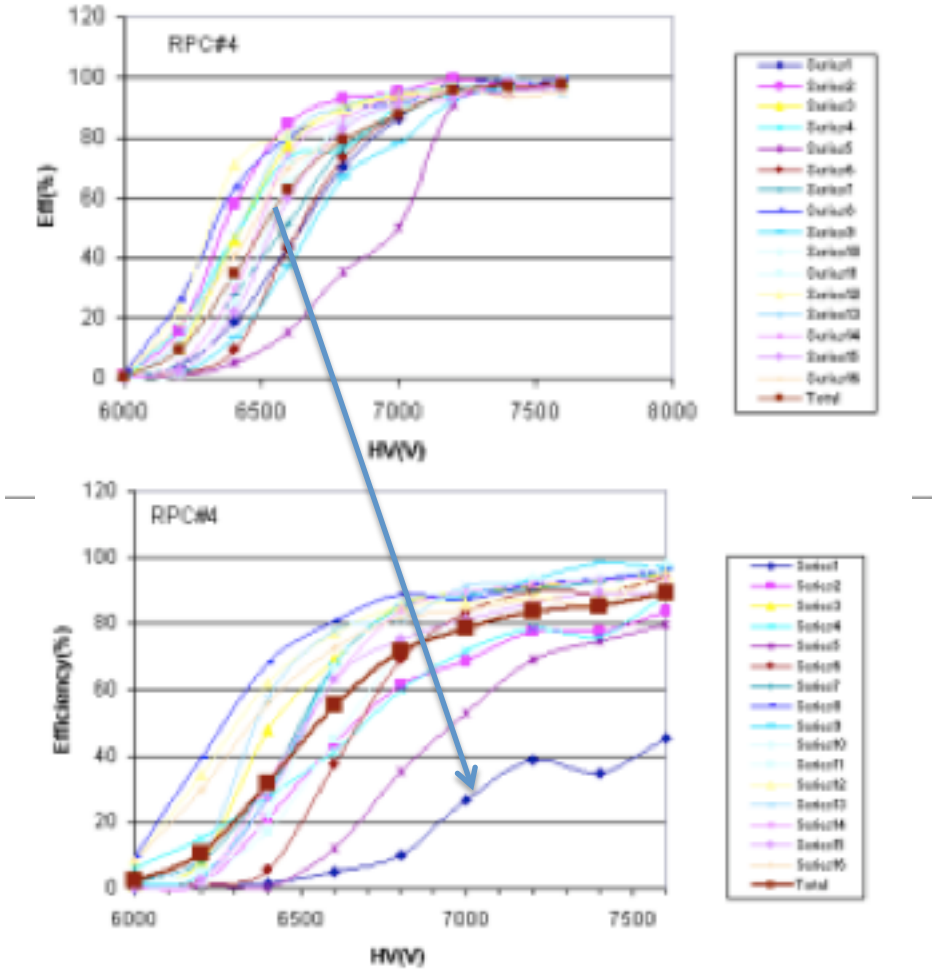
- Princeton – C. Lu
  - IHEP RPCs
    - Bakelite/melamine from Chinese industry
    - No linseed oil design
    - Used in BESIII& DayaBay,
    - Proposed for SiD
  - Surface quality studies
  - Accelerated aging studies
  - Development of new materials
- Wisconsin – H. Band
  - BaBaR forward RPCs
    - Construction similar to ATLAS/CMS RPCs
    - 6 years of data
    - Large range of background & signal rates
  - Analysis of trends & correlations
  - Autopsy of aged RPCs

C. Lu
Princeton

IHEP RPCs

- *Accelerated aging studies with Co_{60} equivalent to 7.6 years of cosmic ray rate*
  - *Sizable eff. losses*
  - *HV surfaces are vulnerable to HF produced in gas*



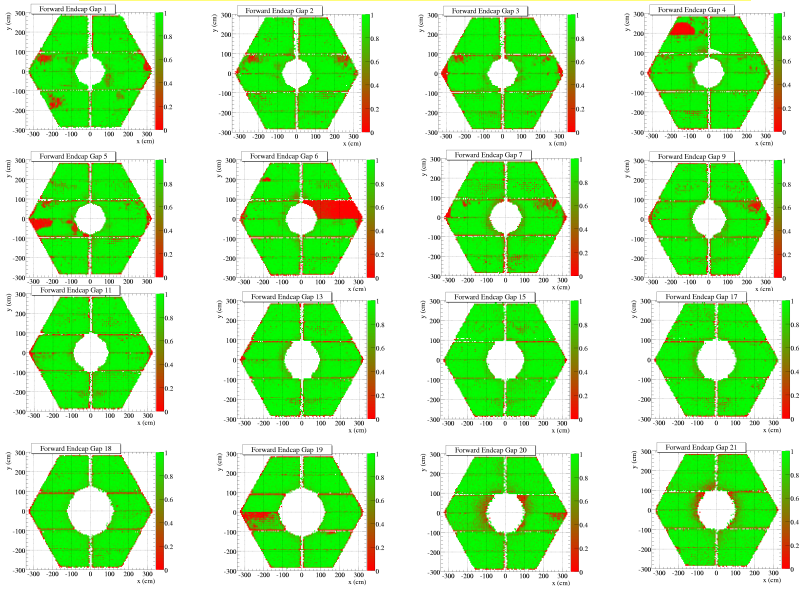


H. Band
UW

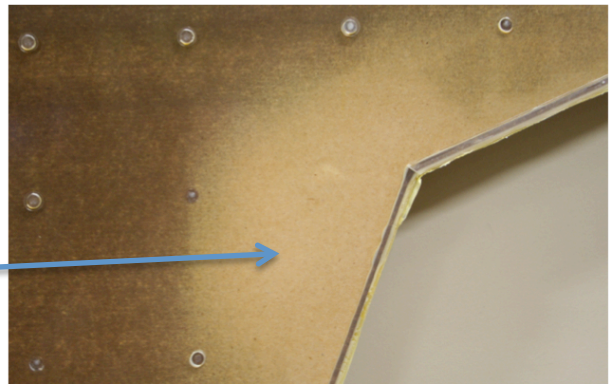
BaBar RPCs

- Verify 2nd generation
- Clear Aging
  - Noise rate 400 Hz → 3 kHz
  - Current < 1 μA → 12 μA
- However
  - Graphite Ω unchanged
  - Linseed oil OK
  - Bakelite Ω ~unchanged
  - High rate regions show discoloration

μ pairs with beam

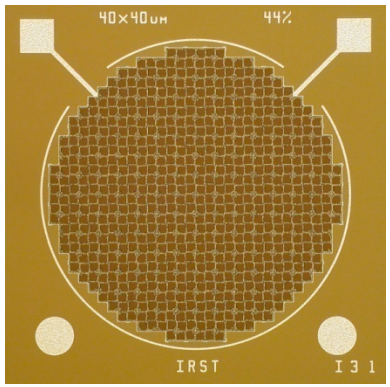


"Bleached Area"



Scintillating Strip with SiPM R&D

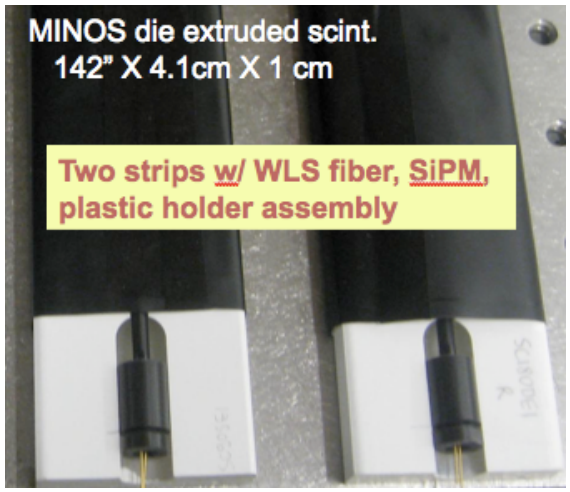
- Fermilab beam test in progress
- Uses 1.2 mm round ISRT SiPM ~ 650 pixels
- 3.6 m X2 strips

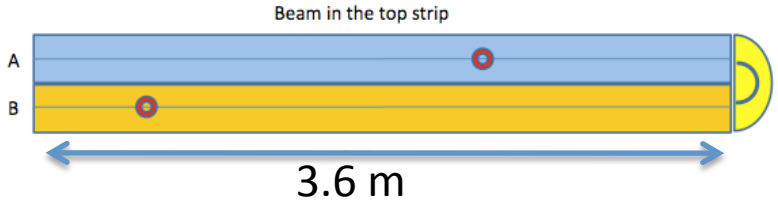


Giovanni Pauletta
INFN/UDINE

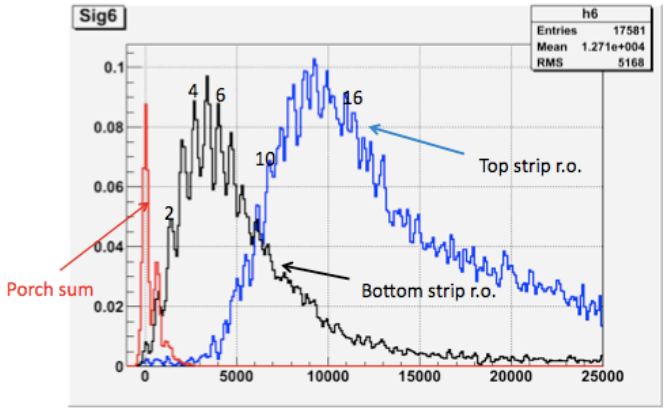
- T-995 Muon Detector/Tail Catcher R&D Using Strip-scintillator and Pixelated Photon Detectors

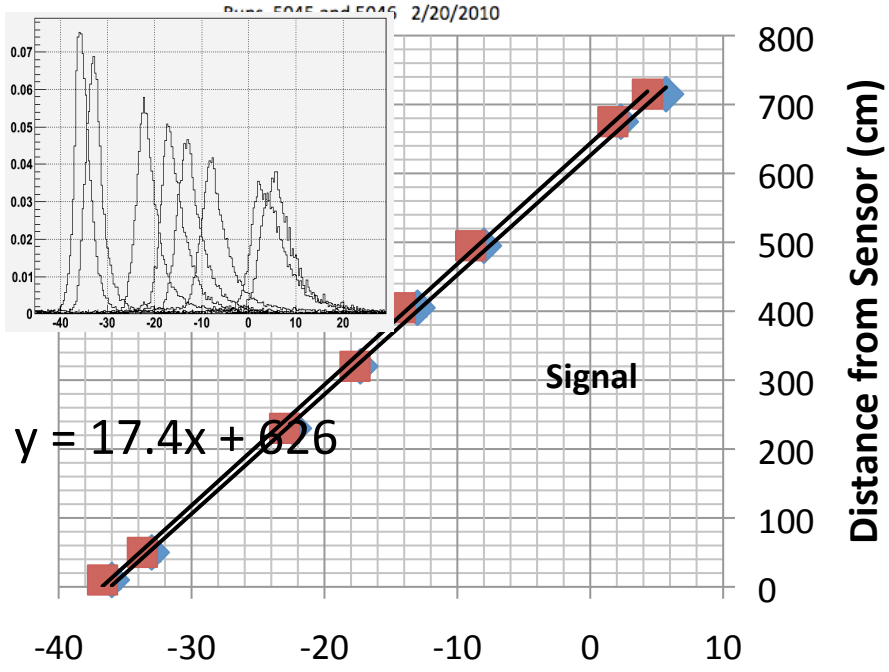
H.E. Fisk, A. Meyhoefer, A. Para,
E. Ramberg, & P. M. Rubinov
Fermilab
M. Wayne, M. McKenna
University of Notre Dame
D. Cauz, M Ouri, G. Pauletta,
INFN: Roma I and Trieste/Udine
J. Blazey, S. Cole, I. Viti, D. Hedin, R. Shea,
Northern Illinois University,
P. Karchin, A. Gutierrez
Wayne State University





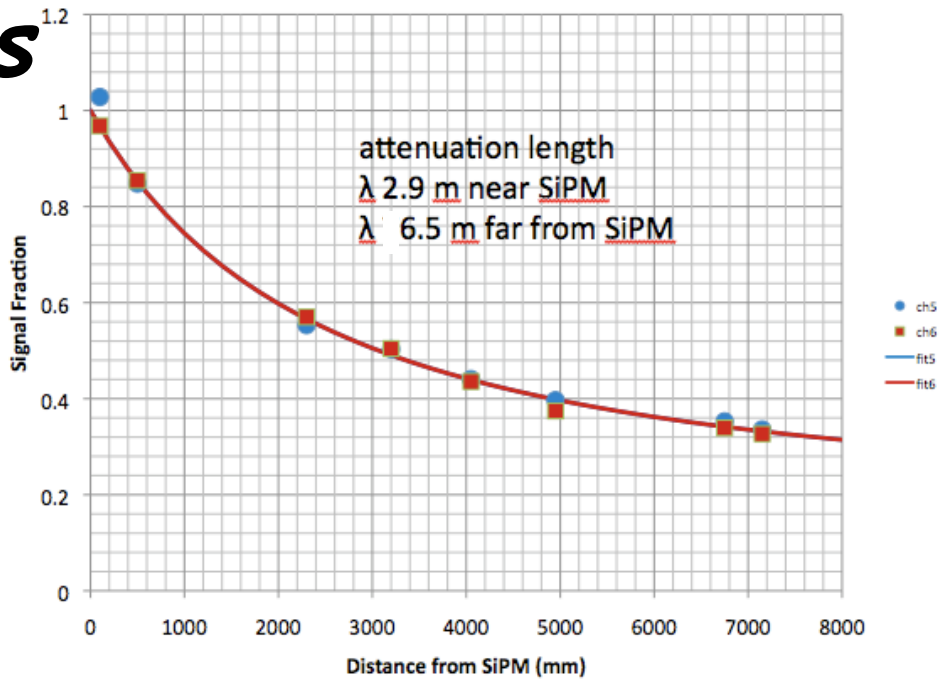
Beam in the top strip 10 cm from readout end.

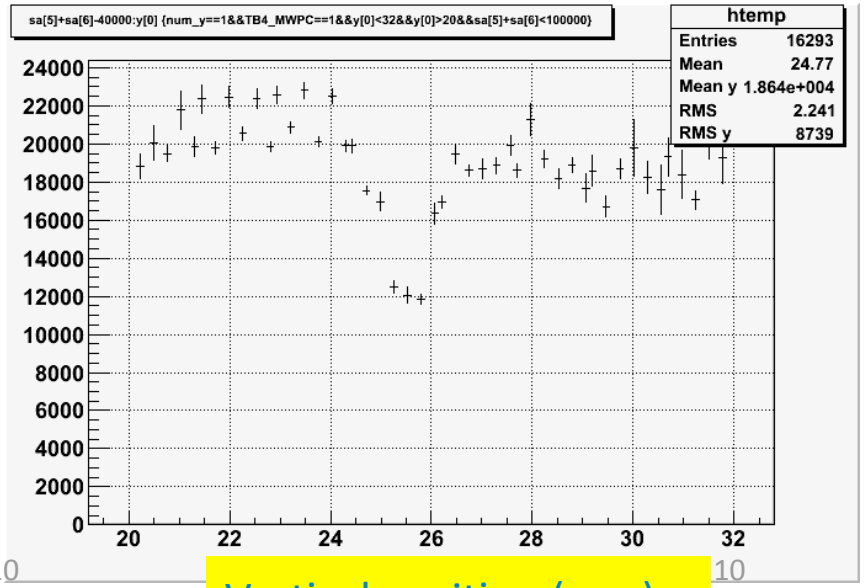




Preliminary Results

- Attenuation measured as a function of distance from SiPM
  - Data not fitted by single exponential
- Vertical Scan of Inter-strip Crack
  - Region ~1mm wide with efficiency ~55%.





Summary

- KPiX readout of RPCs looks promising
- RPC aging studies - More details emerging
  - Graphite, linseed oil problems seem fixed
  - Aging in streamer mode, associated with rates > 2 Hz/cm^2 or bad gas
  - RPCs without linseed oil are more sensitive
- Scintillation strips/SiPMs
  - Beam test data validating design with SiPMs
- Both efforts are low on manpower and would welcome interested groups