

Update on Scintillator System Production

- Production Status Overview
- Module quality summary
- M16 intrapixel gain uniformity
- M16 testing at Athens
- M64 testing at Oxford
- Light Injection System
- Anomalous singles rates
- M64 Paper and LI Paper

Doug Michael

Jan. 5, 2002

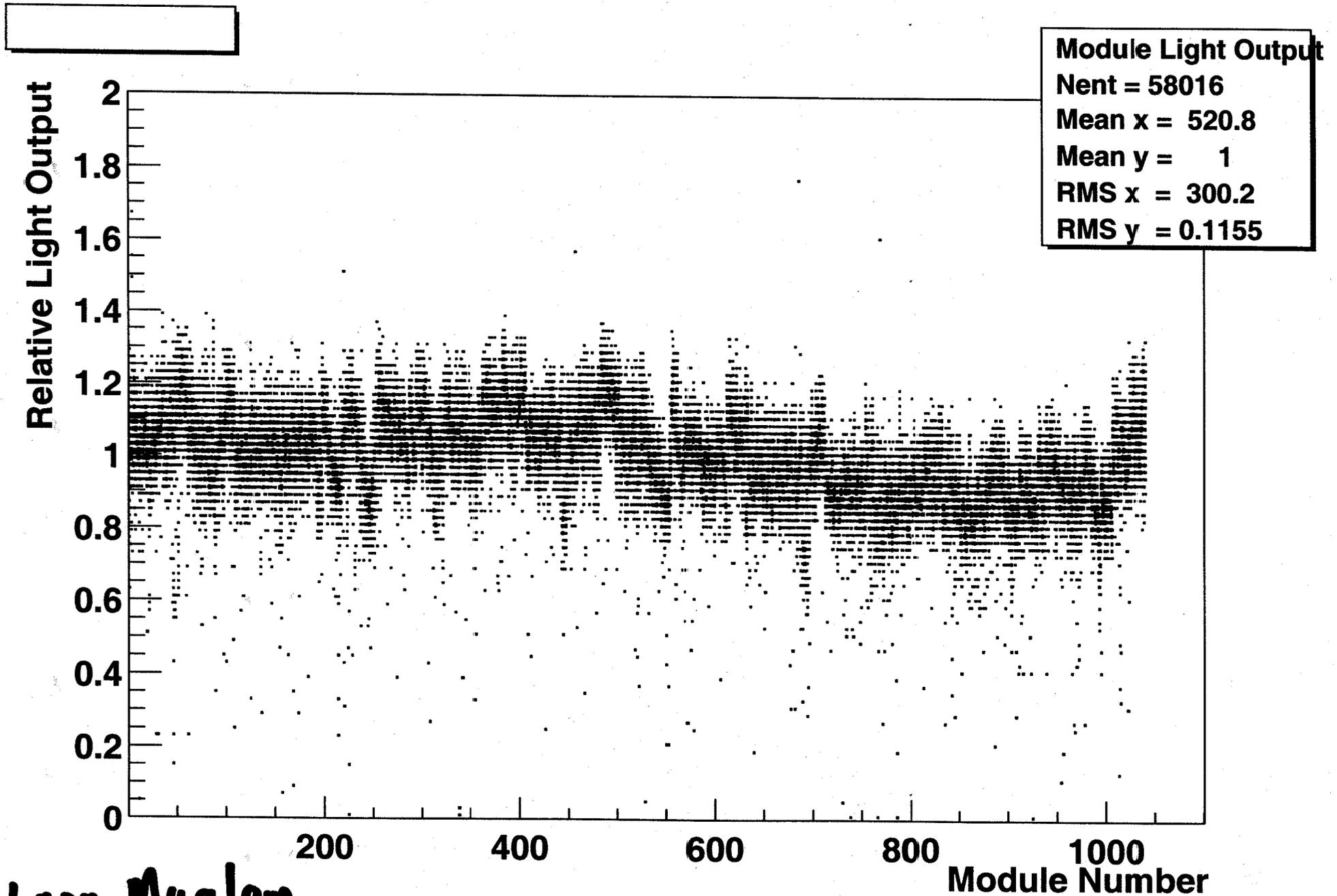
Summary of Production

- Scintillator Strip production 53%
- WLS+Clear Fiber purchase 65%
- Completed Modules
 - Far Detector 50%
 - Near Detector 48%
- Completed Fiber Cables (FD) 53%
- Completed PMT Boxes (FD) 45%
- M16 PMTs
 - Delivered 62%
 - Tested 52%
 - Accepted/ready to use 45%
- Light Injection System
 - Pulsers 15%
 - Fibers 20%
- Near Detector
 - M64 PMTs 32%
 - PMT Boxes Acquisition in preparation
 - Clear cables Acquisition in preparation

“Issues”

- Near Spectrometer MUXing details (base construction and light routing vs physics)
- Scintillator module assembly trays (few \$10k?)
- Keeping light injection system production ahead of installation (almost solved?)
- Keeping PMT testing (and therefore completed PMT boxes) ahead of installation (almost solved?... Athens test stand now fully operational and testing tubes at 20/week rate)
- Near detector readout acquisition (UK budget)?
- Anomalous singles rates
- Near detector module map strip normalizations
- Light tightness of modules (solved?)
- Many others “below threshold”

Light Output for all strips for Minnesota Modules

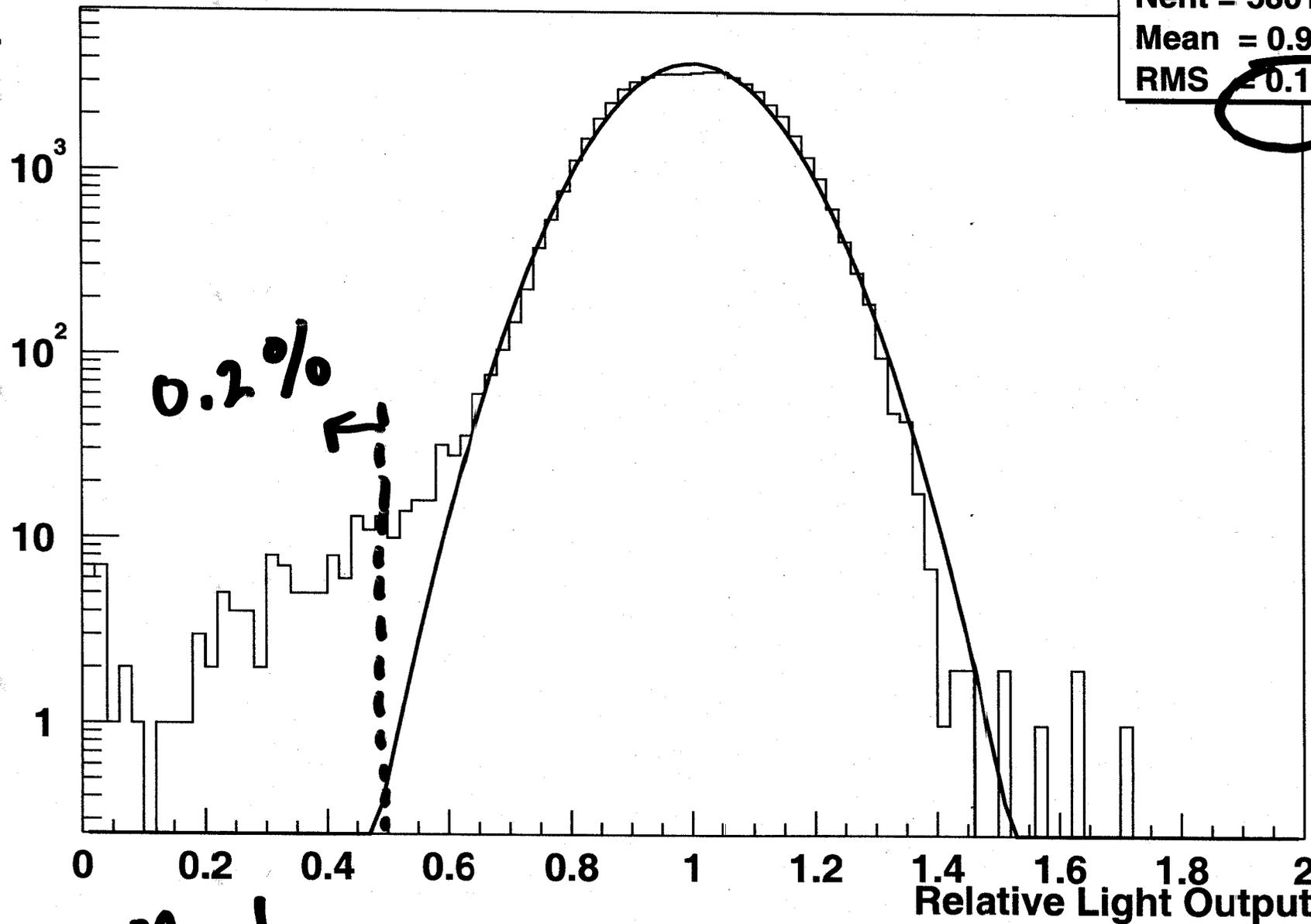


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Relative Light Distribution

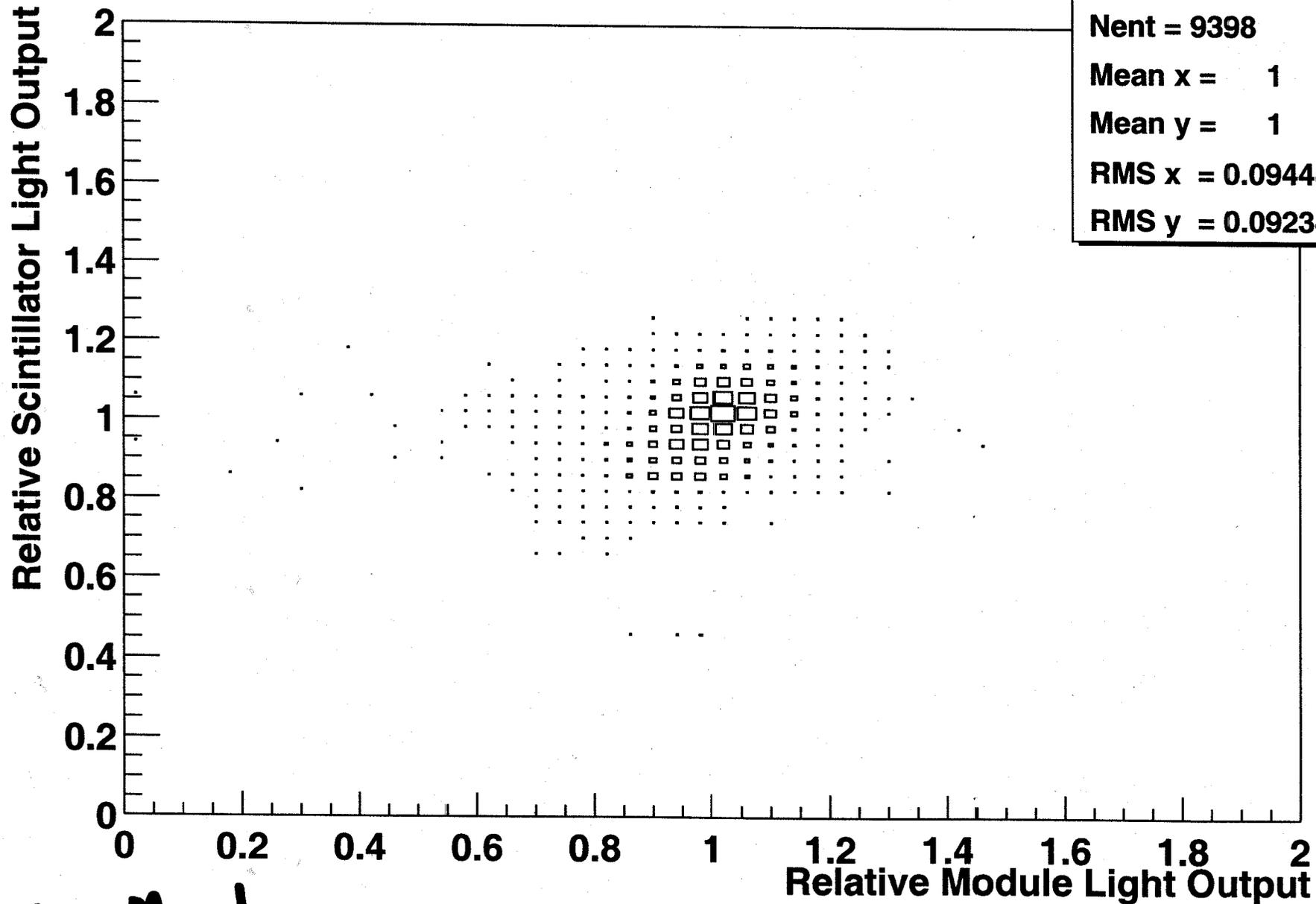
Number of Strips

Light Distribution
Nent = 58016
Mean = 0.9996
RMS = 0.1248



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Scint LO vs Module LO

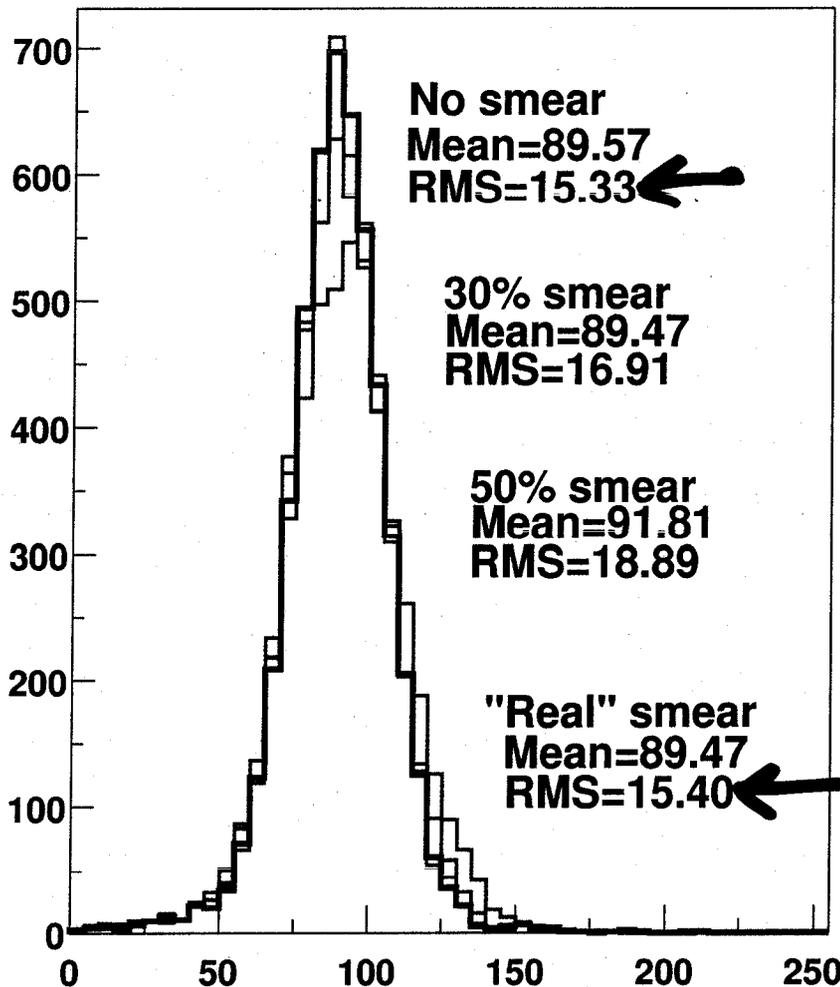


Scint LO vs Module LO
Nent = 9398
Mean x = 1
Mean y = 1
RMS x = 0.09448
RMS y = 0.09234

Leon Mualen

Impact of MIB Intra-pixel Gain Variations

totmips



Smeared
Actual
Data
From CALdet

conclude
that 60%
non-uniformity
is OK as long
as dist. stays
about the same.

Vahle + Texas Group

Figure 3: Total MIP Distributions. Non smeared data in black, blue shows 30% smearing, red shows 50% smearing, while magenta shows smearing by the measured non-uniformity.

Resolution vs. $1/\sqrt{p}$

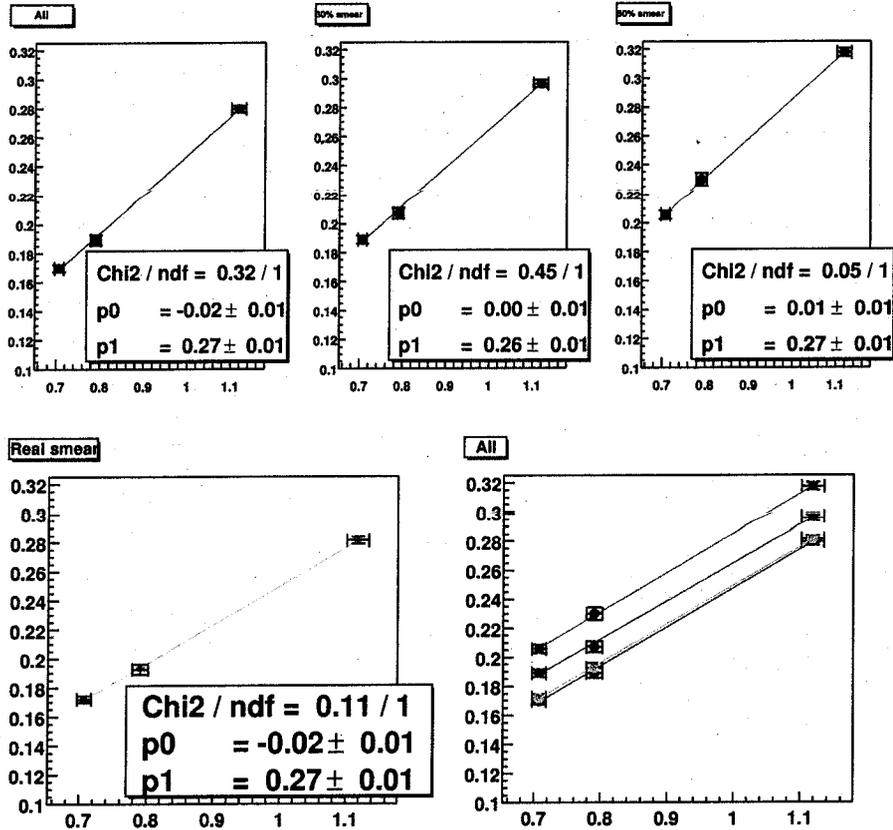


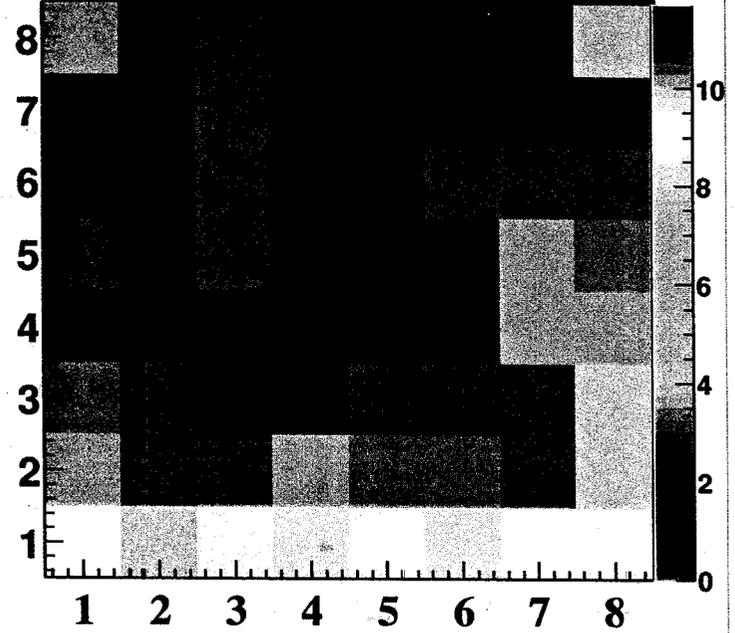
Figure 4: Resolution vs. inverse square root of beam momentum. Top left plot shows no smearing, top middle 30%, top right 50%. Bottom left shows smearing with measured non-uniformity. The bottom right shows the previous graphs superimposed.

M16 Testing at Athens

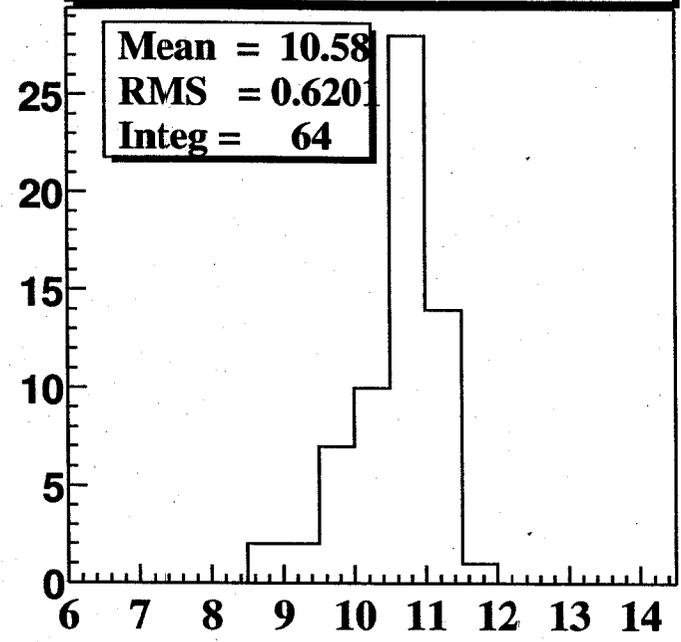
- Some issues resulting from shipping of the test stand and general commissioning have now been completely solved.
- Testing of tubes is underway
 - 60 tubes tested
 - 10 tubes tested that were also tested at Texas with identical results within measurement errors.
 - First shipment of 52 tubes being shipped to Indiana now.
 - Expected throughput of 20 tubes per week for duration of testing.

M64
Testing
at Oxford

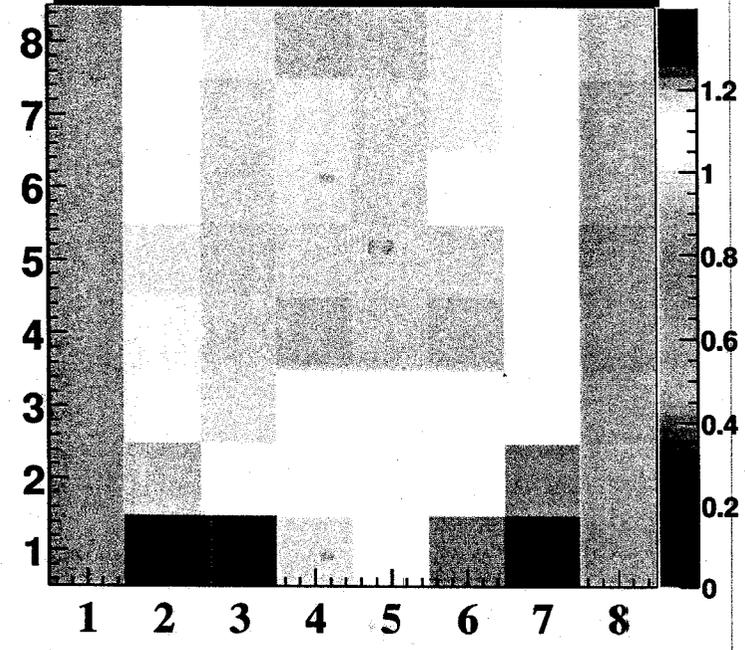
Npe, GA0332-P3, FW#6, 805V



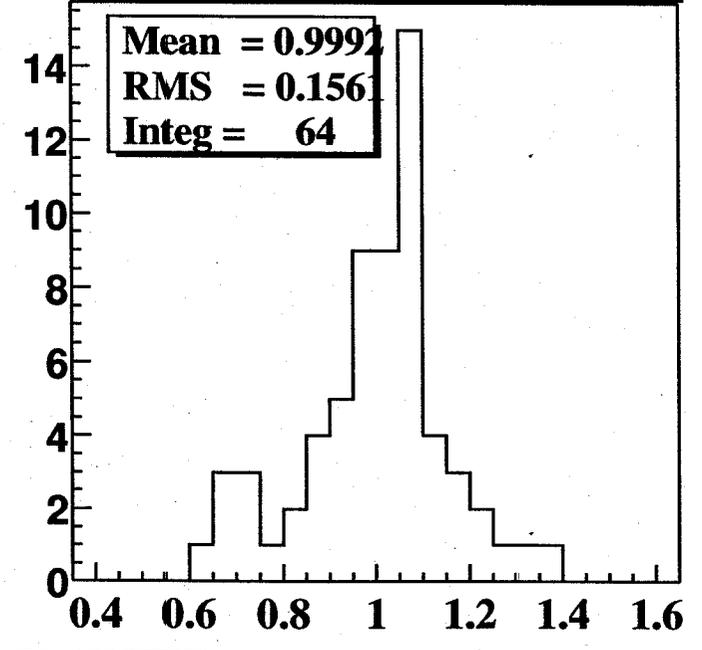
Npe, GA0332-P3, FW#6, 805V



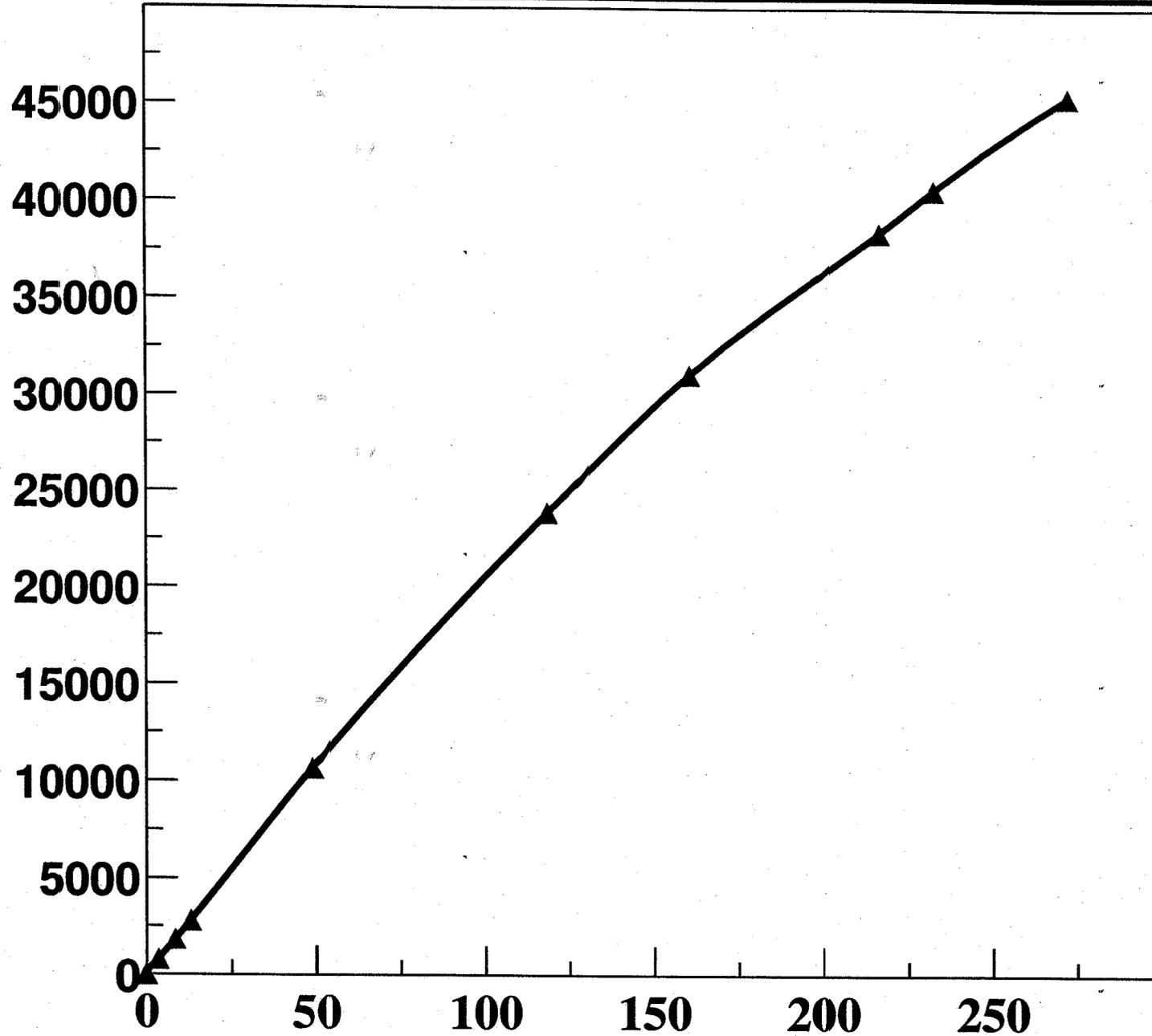
Gain, GA0332-P3, FW#6, 805V



Gain, GA0332-P3, FW#6, 805V



Charge vs. Npe



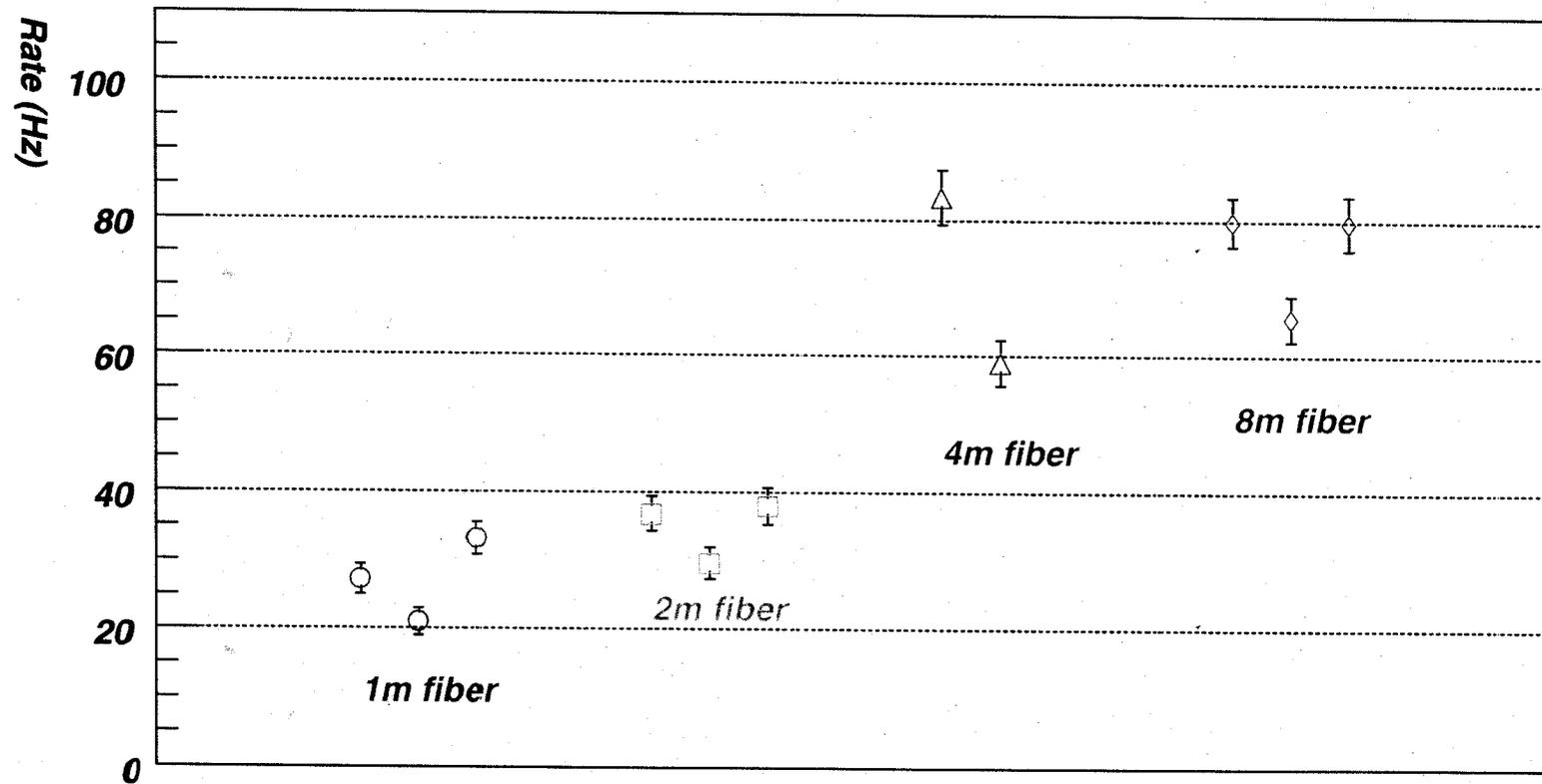
M64
Testing
at Oxford

Rates at Soudan

- Count rates are based on discrimination levels $\sim 1/4$ of a pe.
- Rates for horizontal planes assembled on the steel in the MINOS cavern are ~ 50 kHz/side.
- Rates for vertical planes, once shielded by several planes of steel are ~ 10 kHz/side... This is the source of the problem. It is $\sim 6-8$ times higher than expected, and high enough to cause problems for the electronics.
- The rate is dominated by single photo-electrons. There is negligible electronic noise and >1 pe is only about 10% of single pe.
- What is the source of the anomalous rate?
- We do not believe it will be possible to reduce these rates significantly with any action we can take. Rather, we believe that we must learn to live with it.

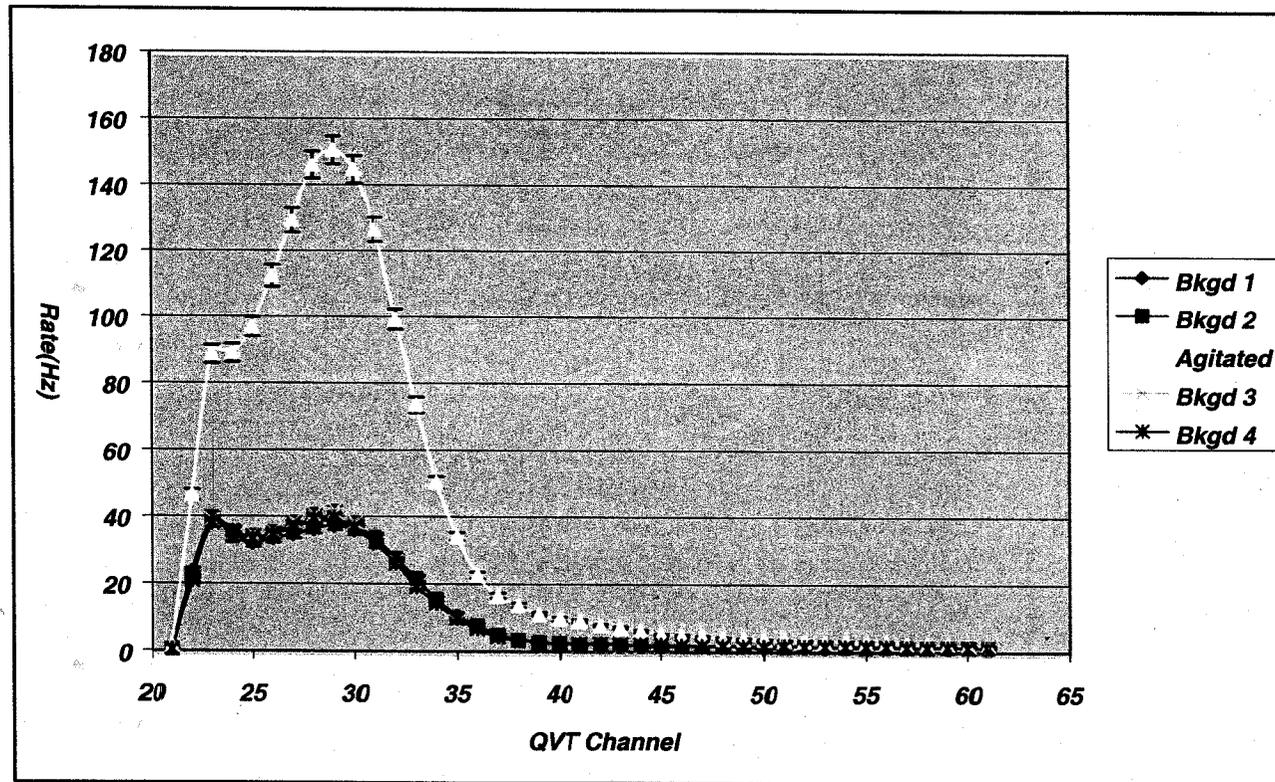
Rate as function of Length

Rates for >0.66 pe in Test Module 2 for various bare fiber lengths



Oct 20, 2001 Mualem

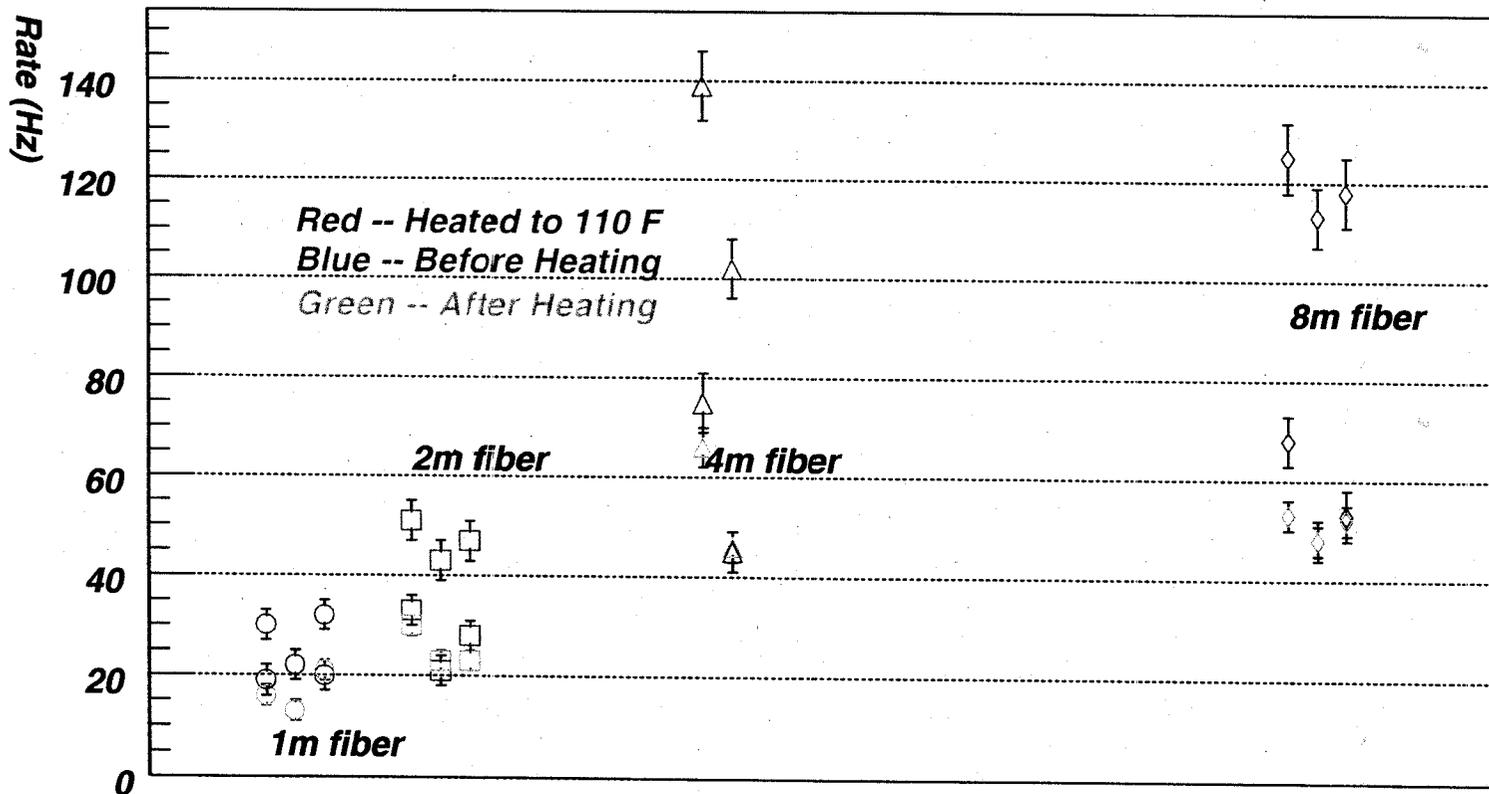
Agitated Fiber Test



Oct 20, 2001 Mualem

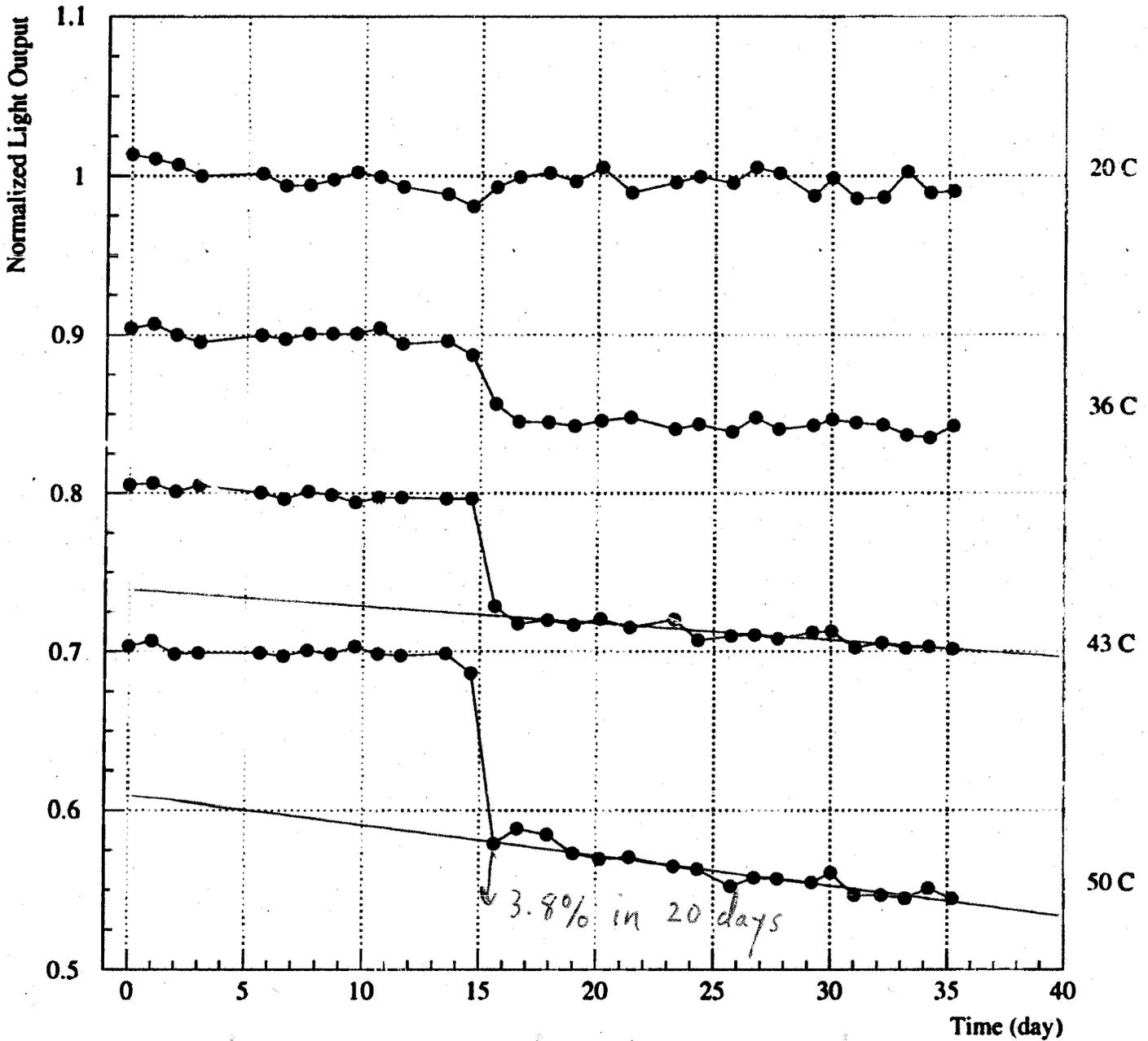
Heated Fiber

Rates for >0.66 pe in Test Module 2 for various bare fiber lengths



Oct 20, 2001 Mualem

Aging Results

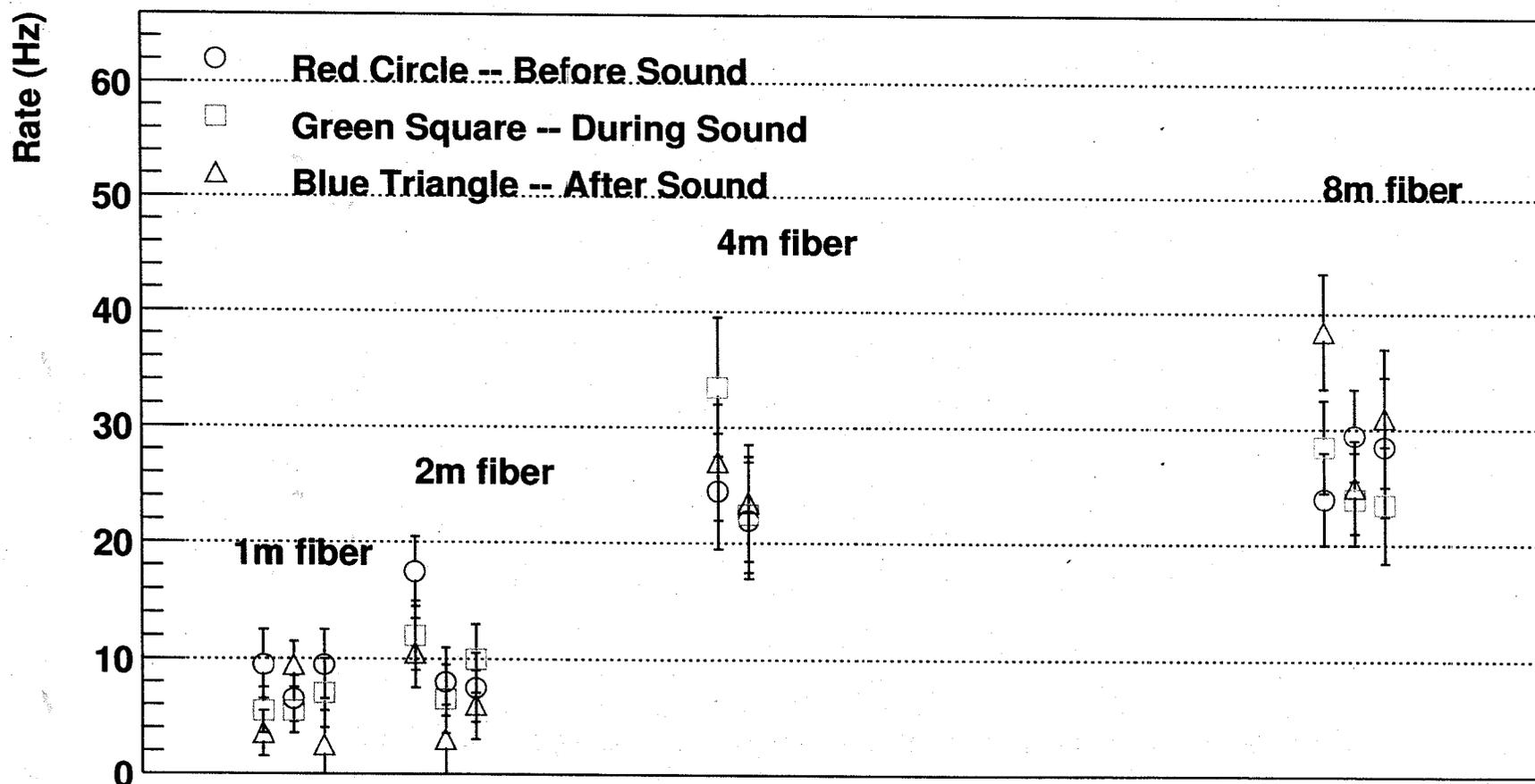


Acceleration $\frac{50^\circ}{20^\circ} \sim 8.3$ months

Slope $\sim \times 2$ for every 7°C

Hwi Kim (old result)

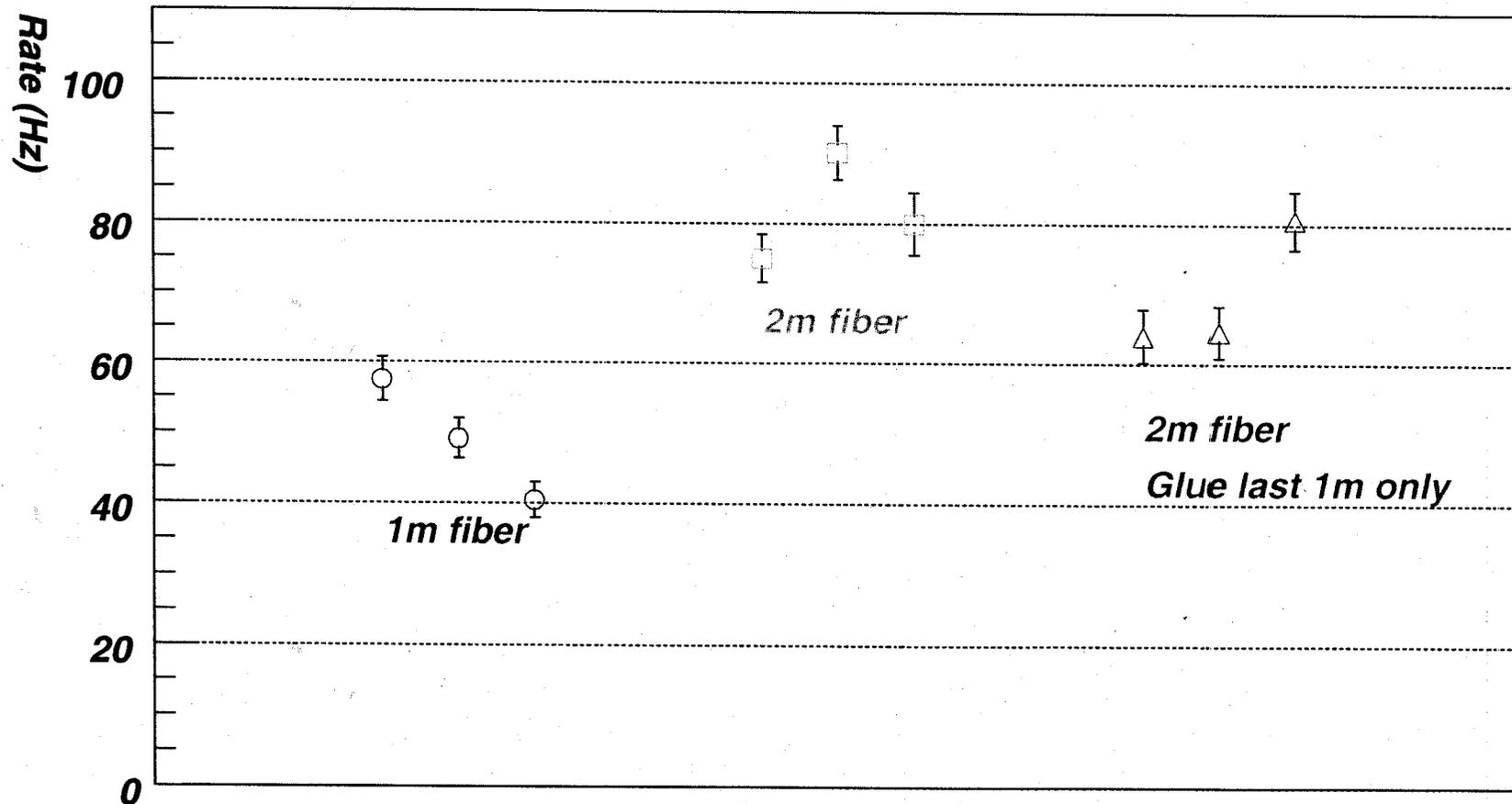
Rates Test Module 2 run Nov 19, 2001



Mualem

Rate for various lengths in Epon

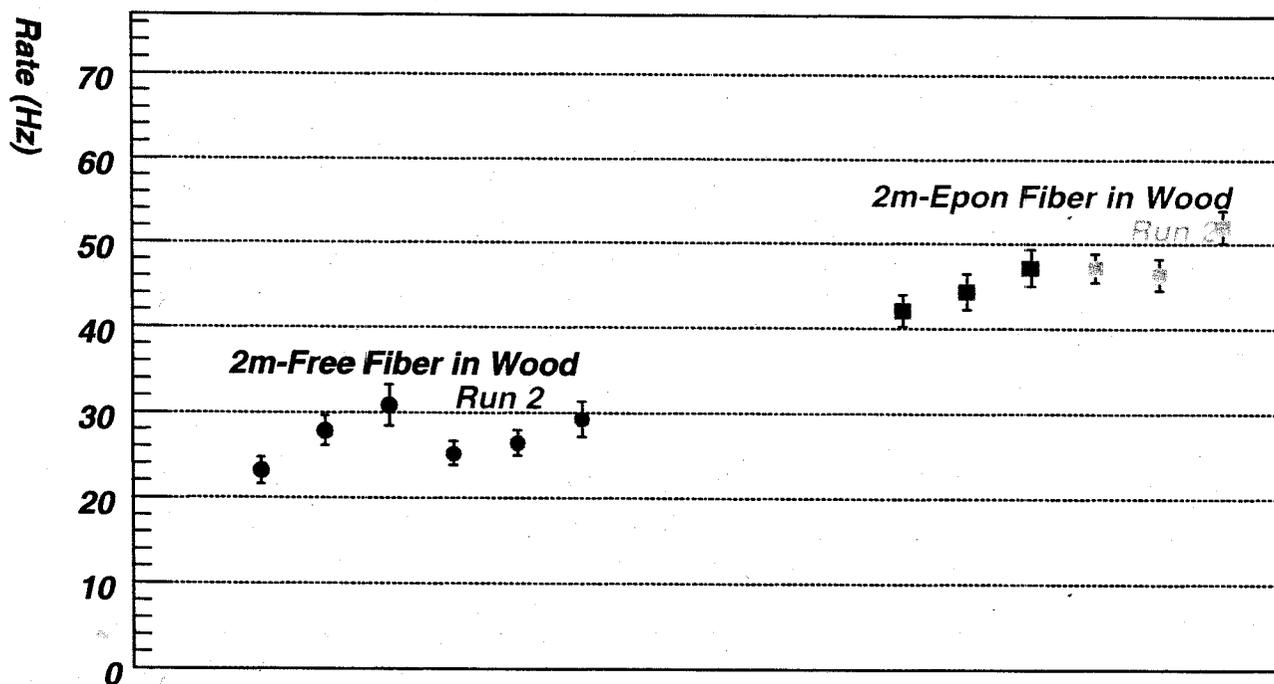
Rates for >0.66 pe in Test Module 2 for various fiber lengths in EPON



Oct 20, 2001 Mualem

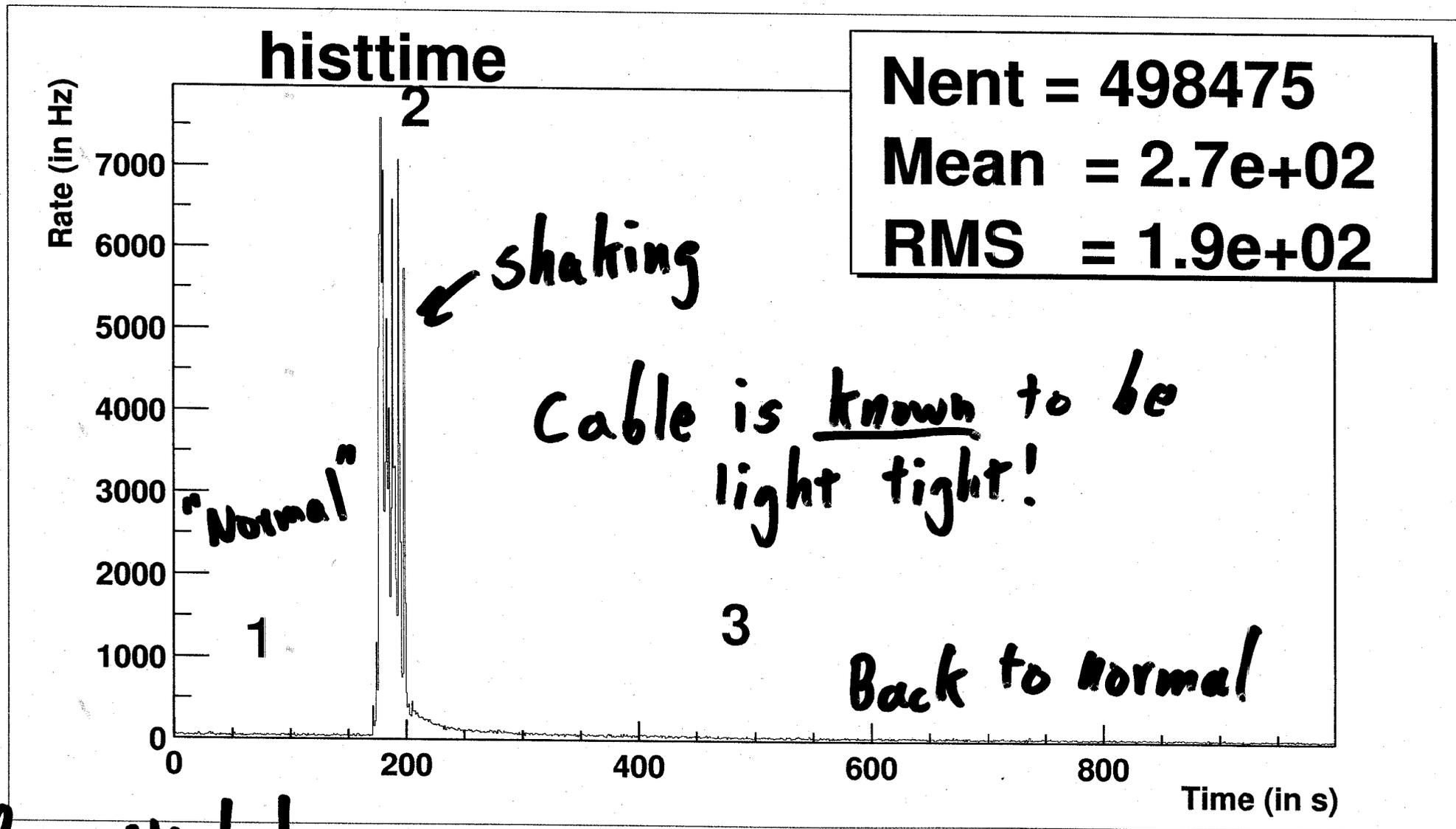
Fiber Mounted in Wood

Rates for >0.66 pe in WOOD, not scintillator

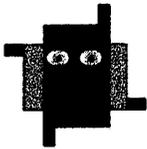


Oct 20, 2001 Mualem

4m WLS Fiber readout cable for Caldet

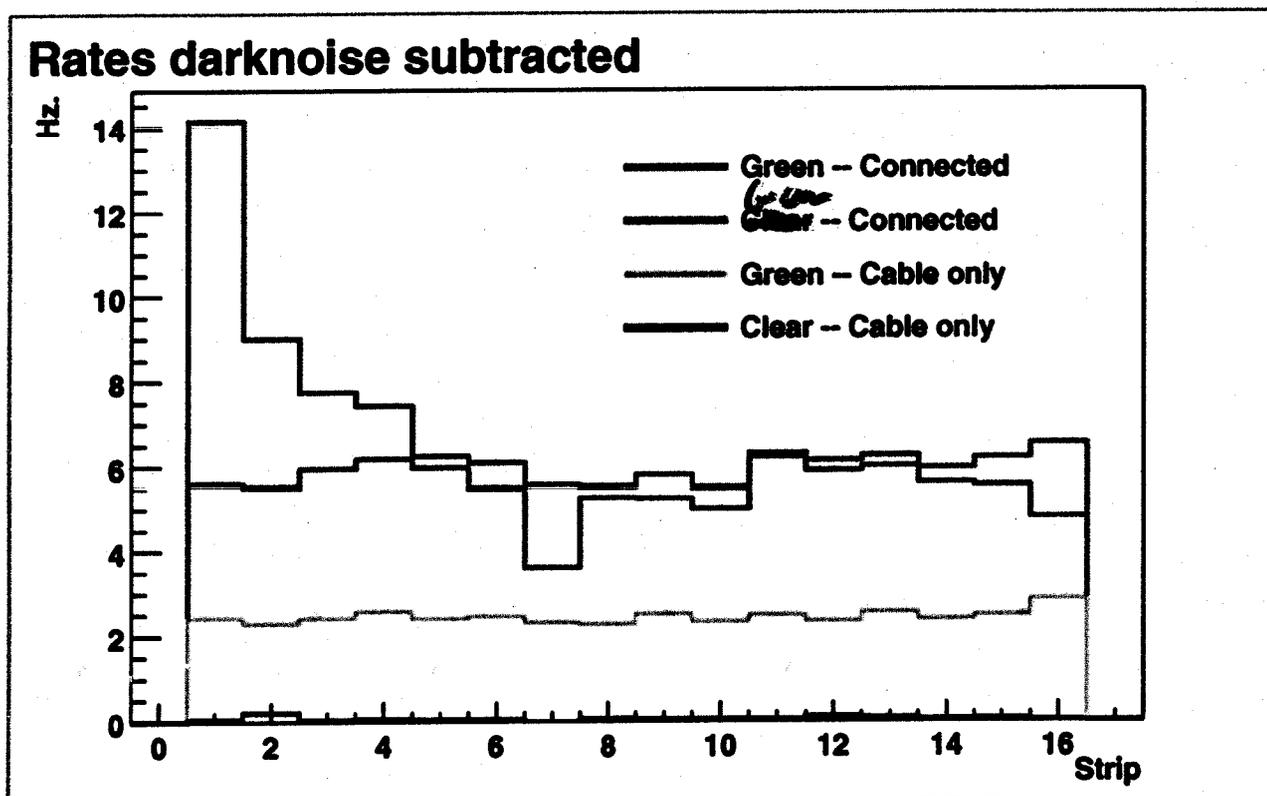


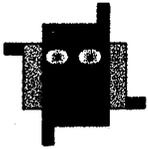
Ryan Nichol



Light from green fibre!

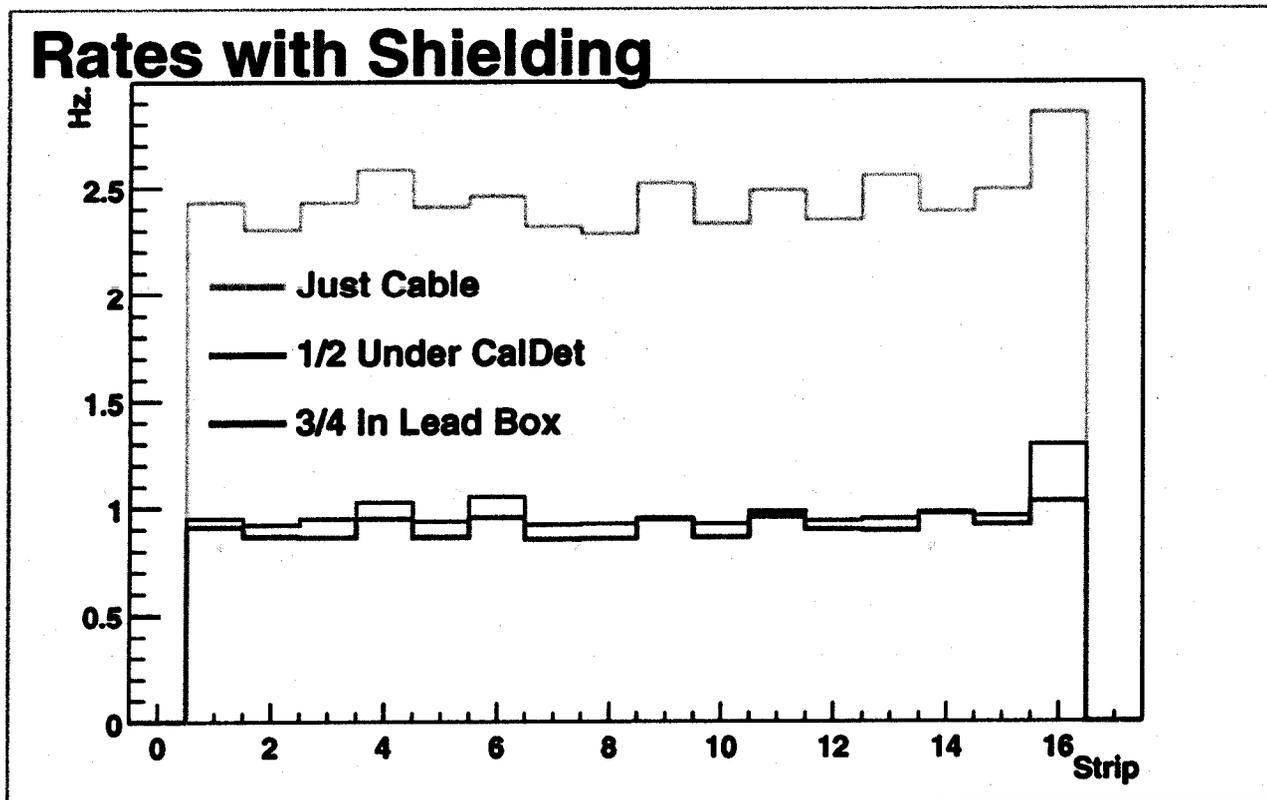
- To investigate further:
 - Plugged spare green and clear cables into mux box.
 - The other end was not attached to the detector.
 - Then compared the dark noise subtracted rate in each cable.
- And find clear cable rate is comparable with dark noise.
- But find a rate of 2Hz. per strip in the green fibre.





Scintillation

- The rate that we see in the green cable is 20 times lower than the rate that Leon measured.
- We tried to shield the green fibre using:
 - The detector (steel above and below the cable).
 - Lead (on all sides of the cable).
- And see a reduced rate in both situations.
- Therefore hypothesise that this rate comes from scintillation in the green fibre due to background radiation.



Rates at Soudan

- We do not yet understand the nature of the anomalous rates:
 - Have we made the right assumptions about the relative effectiveness of WLS fiber as a scintillator compared to fiber glued into the extruded scintillator strips?
 - Could fiber glued into strips be the true culprit, not just fiber on its own?
- We need additional measurements:
 - Tests on other green cables at Minneapolis (accidentally didn't happen with the holidays)
 - New set of tests being done at Texas.
 - Continuing contribution as seems useful/appropriate from various sources... but not one of the highest priority issues.