Milagro Collaboration Meeting

Los Alamos, New Mexico

February 10-11, 2002

1 Meeting Schedule - February 11

1.1 Calibration Issues (chair Peter Nemethy)

Calibration Overview - Andy Smith
Timing Calibrations - Liz Hays
PE Calibrations with ADC - David Noyes

1.2 Outriggers (chair Brenda Dingus)

Outrigger Overview (Current Status, Coming Schedule) - Tony Shoup
Zap Box Test Results - Don Coyne / Michael Schneider
Outrigger Software Reconstruction - Led by B. Dingus

1.3 Milagro Upgrades (chair Ben Shen)

Data Storage Options - Andy Smith / Frank Samuelson
VME Trigger Card - Erik Blaufuss
Muon Trigger Cards - Greg Sullivan
New DAQ Sytem - Erik Blaufuss
New DAQ Sytem - Frank Samuelson
The Myths of Sysiphus: of Lasers, Glass, and Water - Don Coyne

1.4 Milagro Analysis (chair Allen Mincer)

Galactic Plane Update - Roman Fleysher
Sun Shadow and Wimp Analysis - Lazar Fleysher
Search for Active Galaxies - Wysten Benbow

2 Meeting Schedule - February 12

2.1 Milagro Analysis (chair Allen Mincer)

GRB Analyses - Julie McEnery
The Moon - Frank Samuelson

2.2 Gamma Hadron Rejection (chair Gaurang Yodh)

Neural Networks - Ty DeYoung
Top Down Rejection - Frank Samuelson
Neural Networks - Xian-Wu Xu
Gamma Hadron Separation - Roman Fleysher

2.3 Online Analysis (chair Jordan Goodman)

Summary of Pre-Meeting - Magdalena Gonzalez
Very Short Burst Search - Andy Smith
Mid-Term Burst Search - Miguel Morales
Long-Term Burst Search - Liz Hays

2.4 Papers in Progress (chair Cy Hoffman)

GRB 970417a Energy Analysis - Julie McEnery
Milagrito Upper Limits from GRBs - Gaurang Yodh
Moon Paper - Cy Hoffman

2.5 Various Topics (chair David Williams)

WACT Update - Frank Samuelson
Simulations (Air/No Air) - Julie McEnery
Water on the Cover - Peter Nemethy
PMT Deaths - Cy Hoffman
PMT Repair Plans (Fix'em All?) - Cy Hoffman

3 Calibration Overview - Andy Smith

Calibration Update

Outline:

1) TOT−PE Occupancy Update (me)

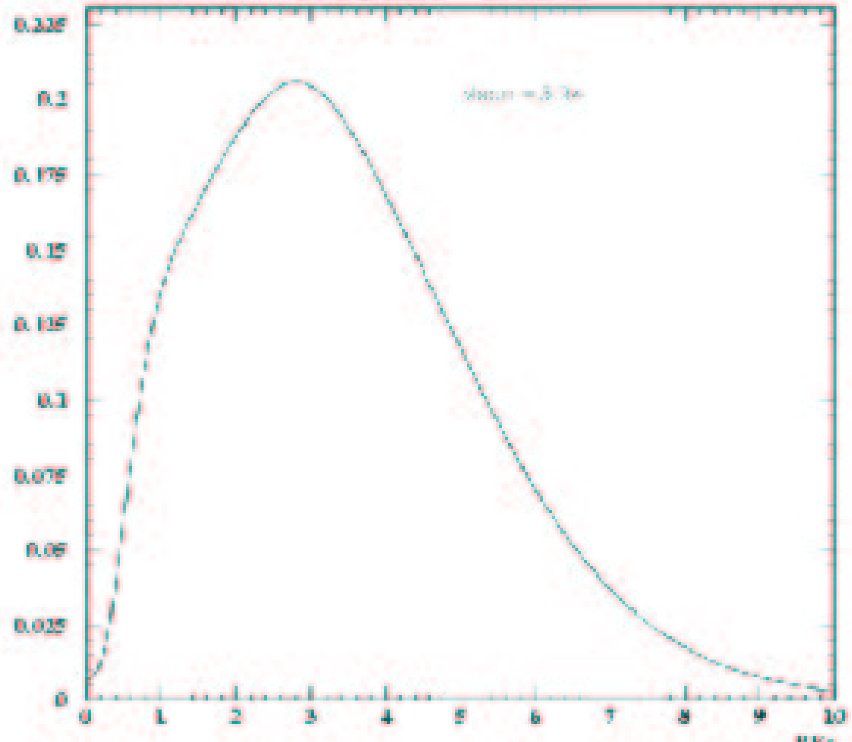
2) Laser timing. (Liz)

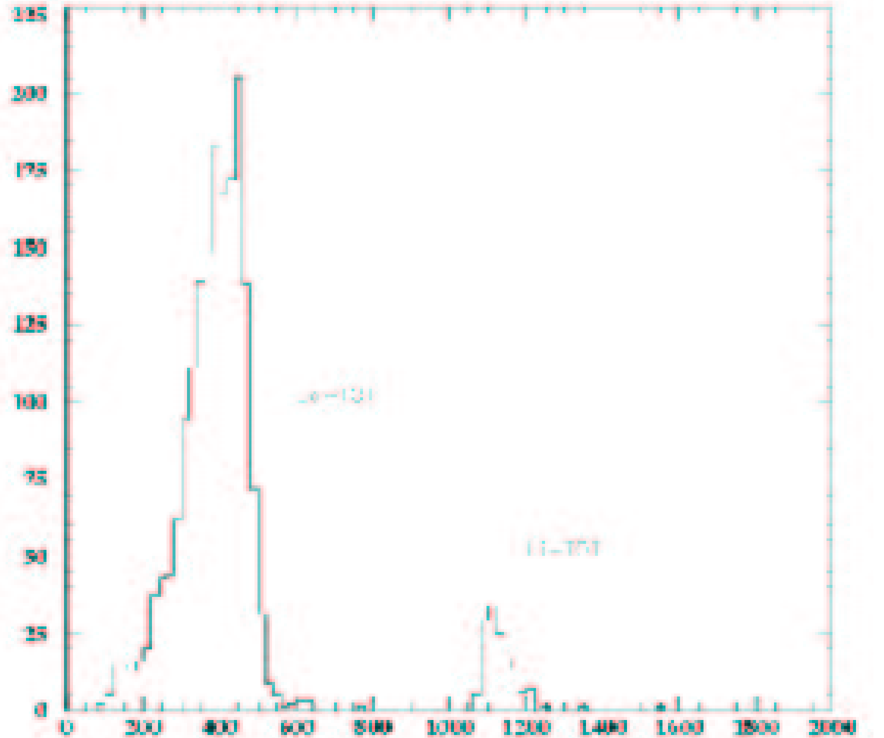
3) TOT−PE with the ADC (David N.)

TOT to PE Estimation

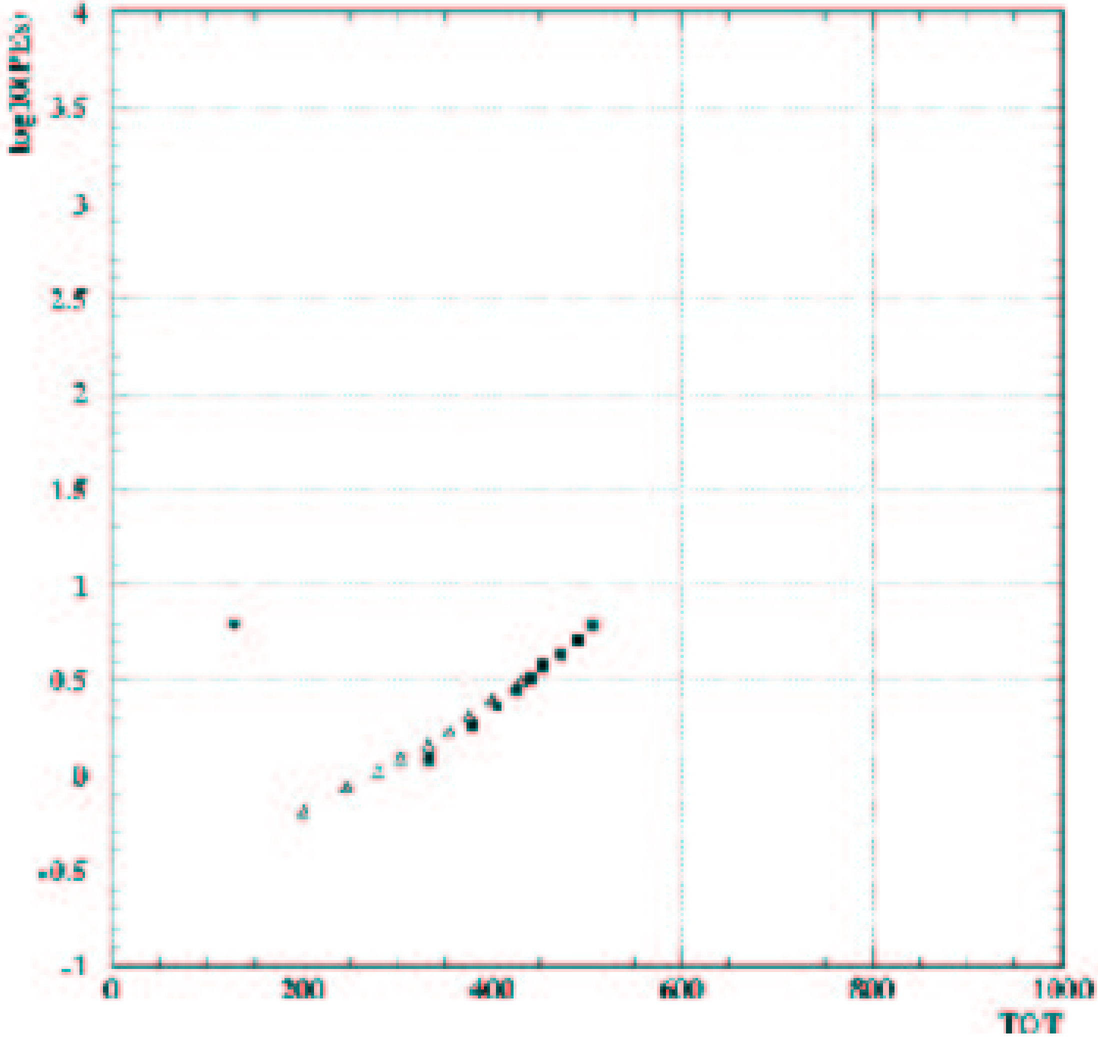
- Previously, the peak TOT value was associated with the PE value derived from occupancy plus filter wheel conversion.
- Now, we simulate the PE spectrum for the known average PE level and associate 9 percentile points (10%,20%...,90%) in the PE spectrur with the measured PE spectrum.
- Spectrum simulated with Poisson distribution plus 40% single PE erro

Mean=3.35





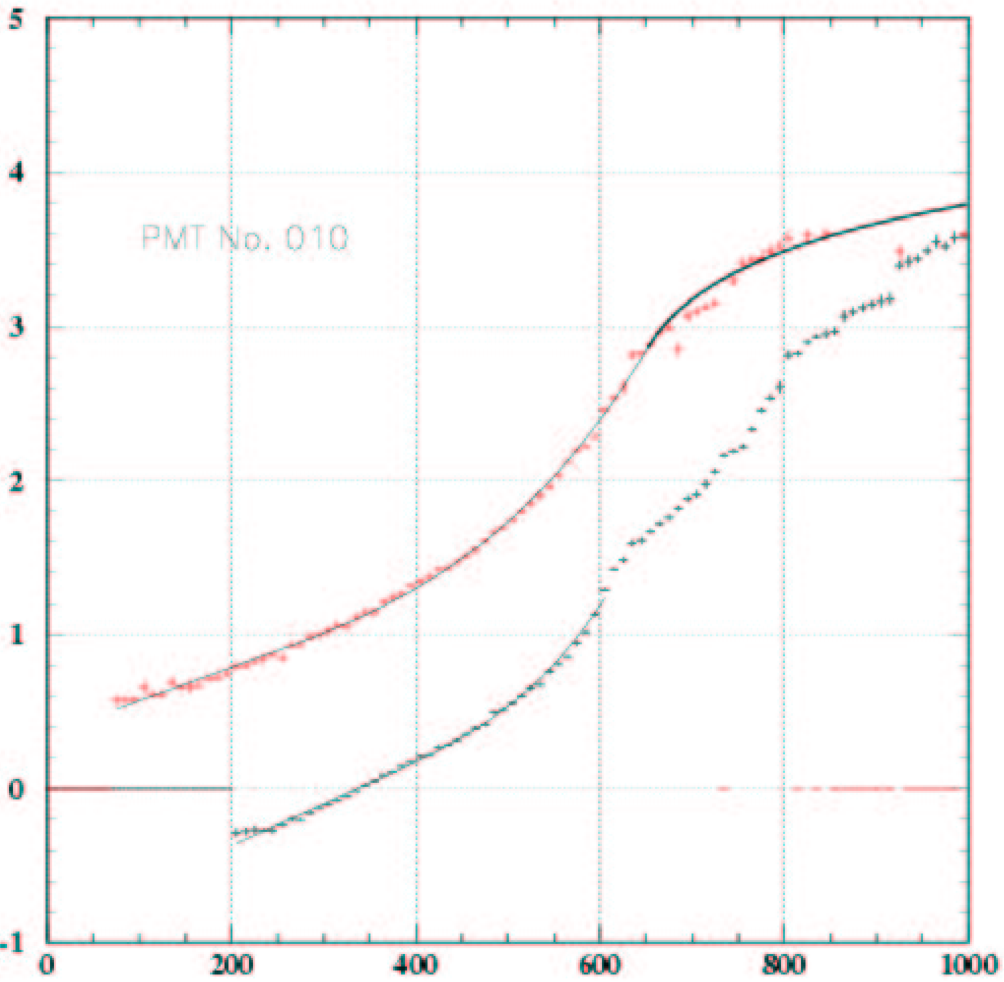
Calibration Example



- Calibrate using all balls with all PMTs.

- Instead of 10–15 points included in the fit, hundre of data points are included.

New Fit Function



For small TOT values:

PE = A + B*TOT

For middle TOT values: (TOT >C)

PE = D + E exp((TOT−C)/F)

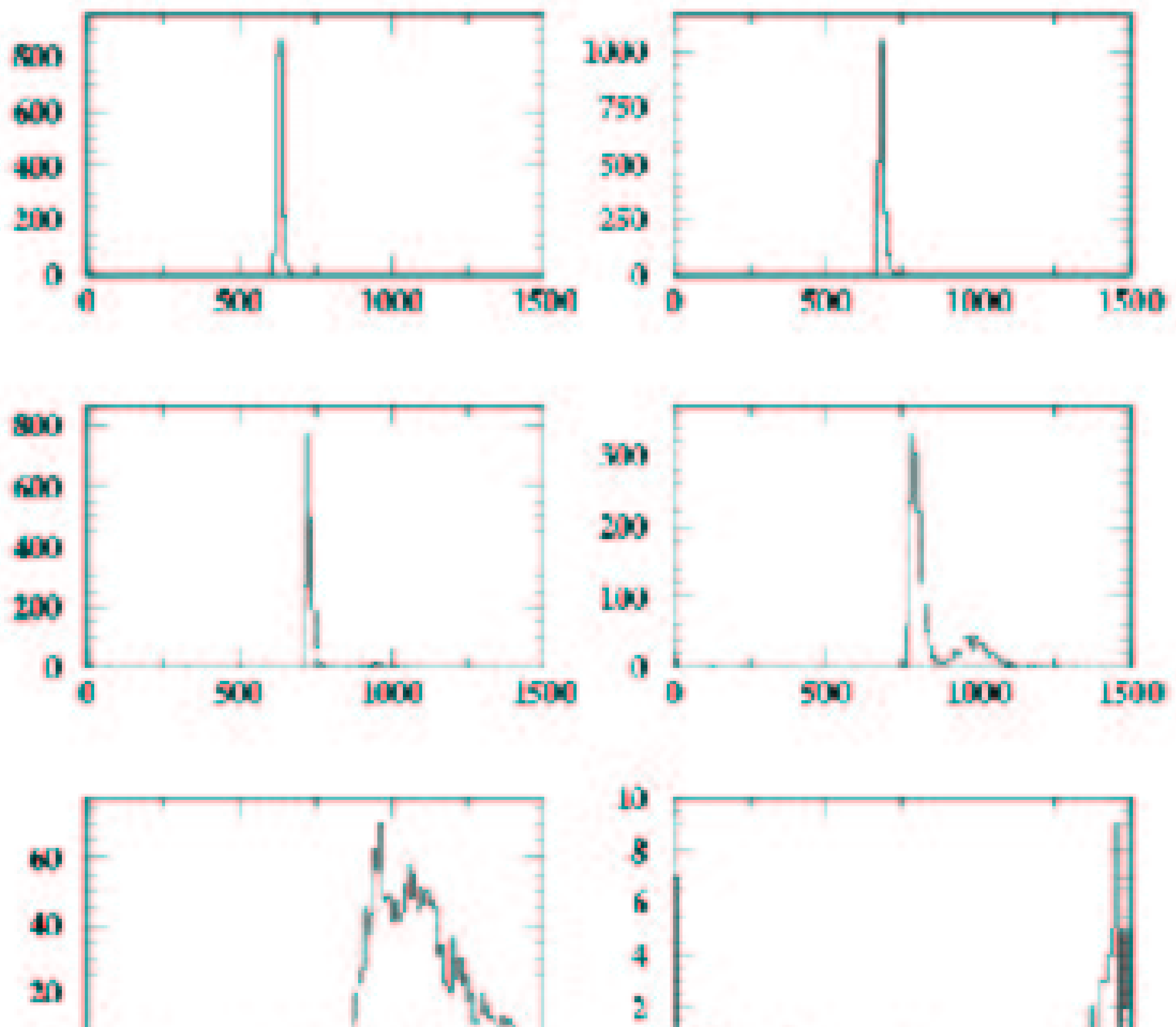
D and E are chosen to match value and derivative.

Hi fit range: 75−650
Lo fit range: 200−600

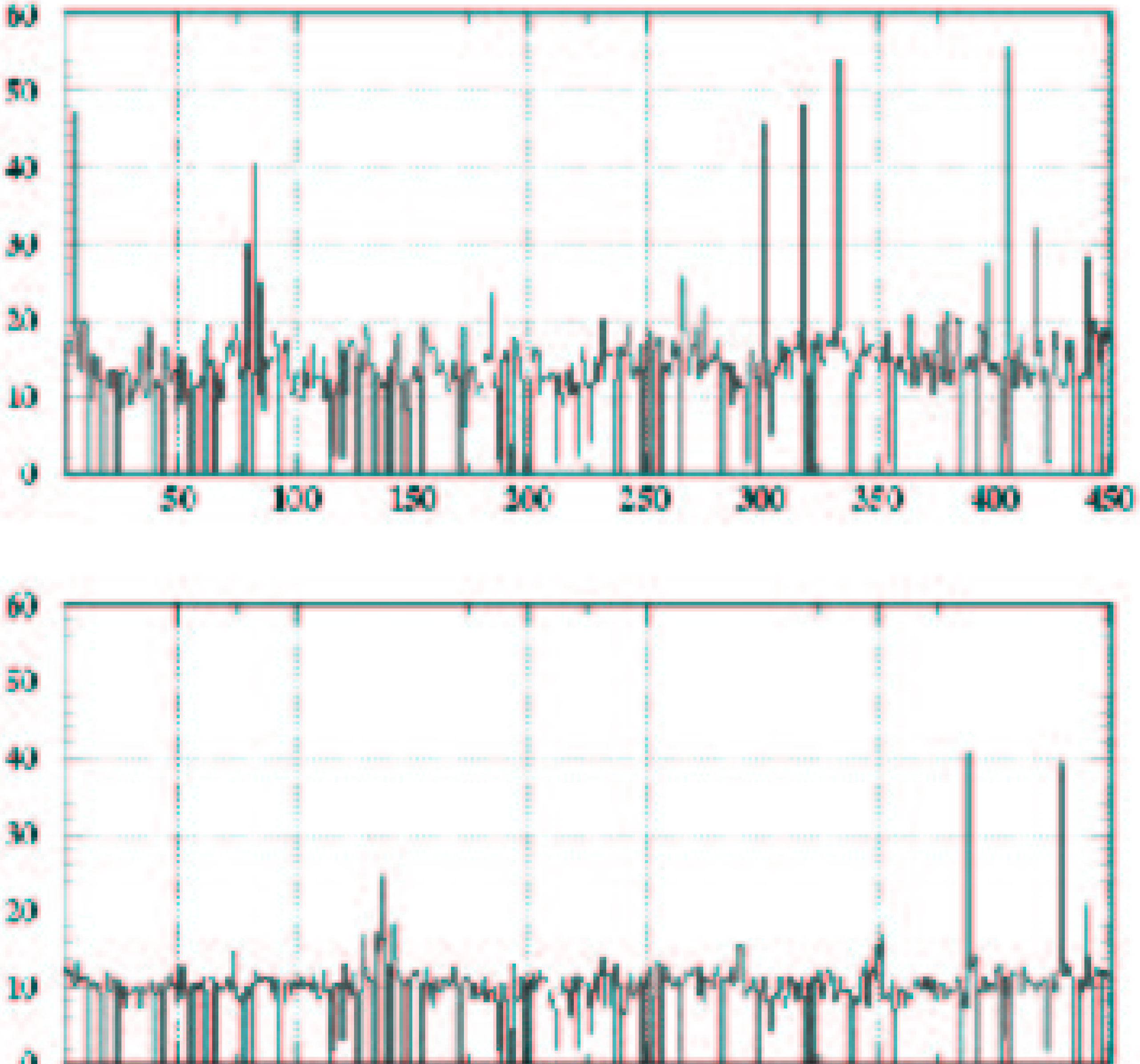
At high end, function is
A+B*log(1+(TOT−650)/C)

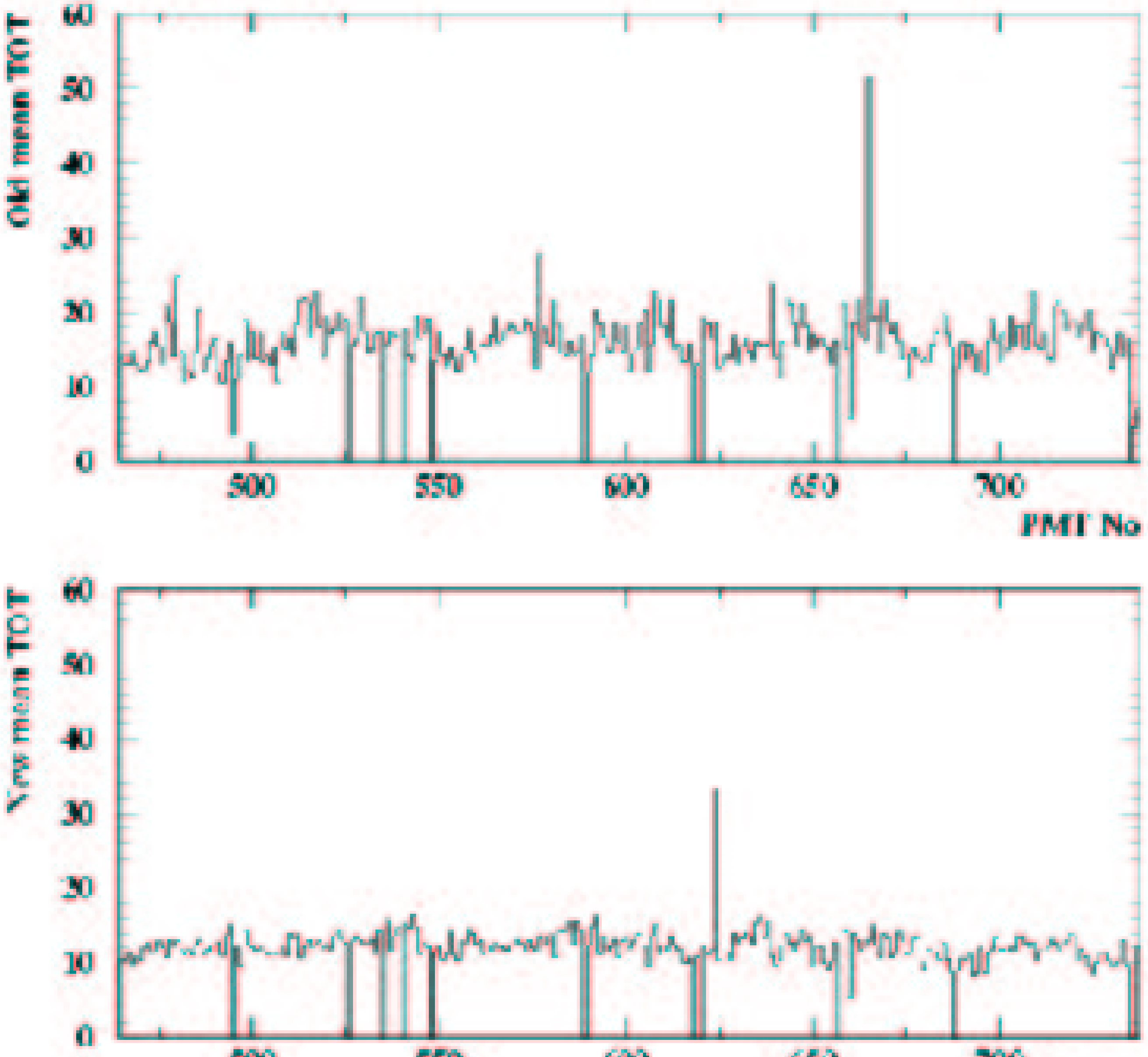
A,B,C selected to match fit region with function fixed at 3.8 for HiTOT=1000.

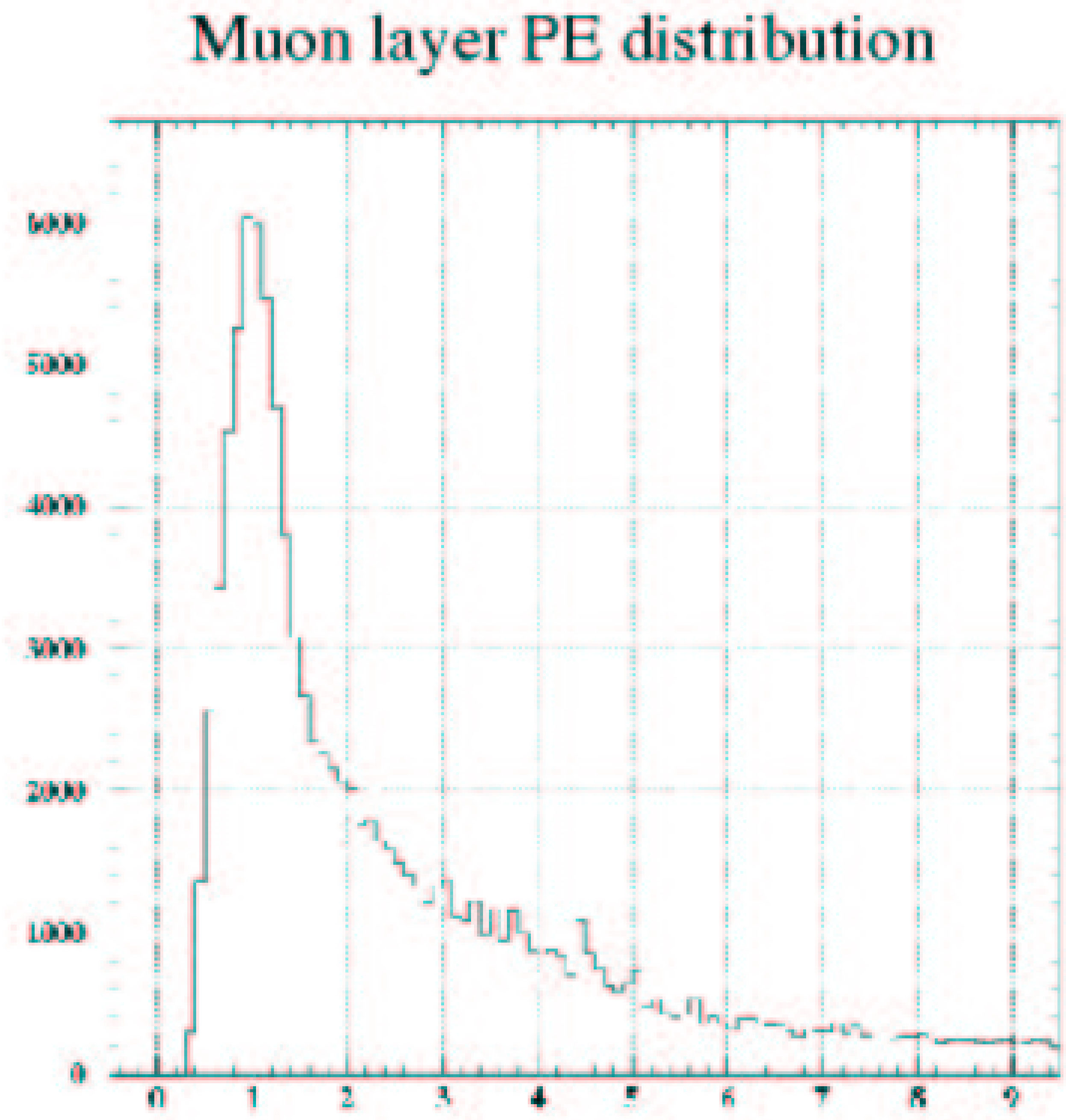
Hi TOT Breakdown

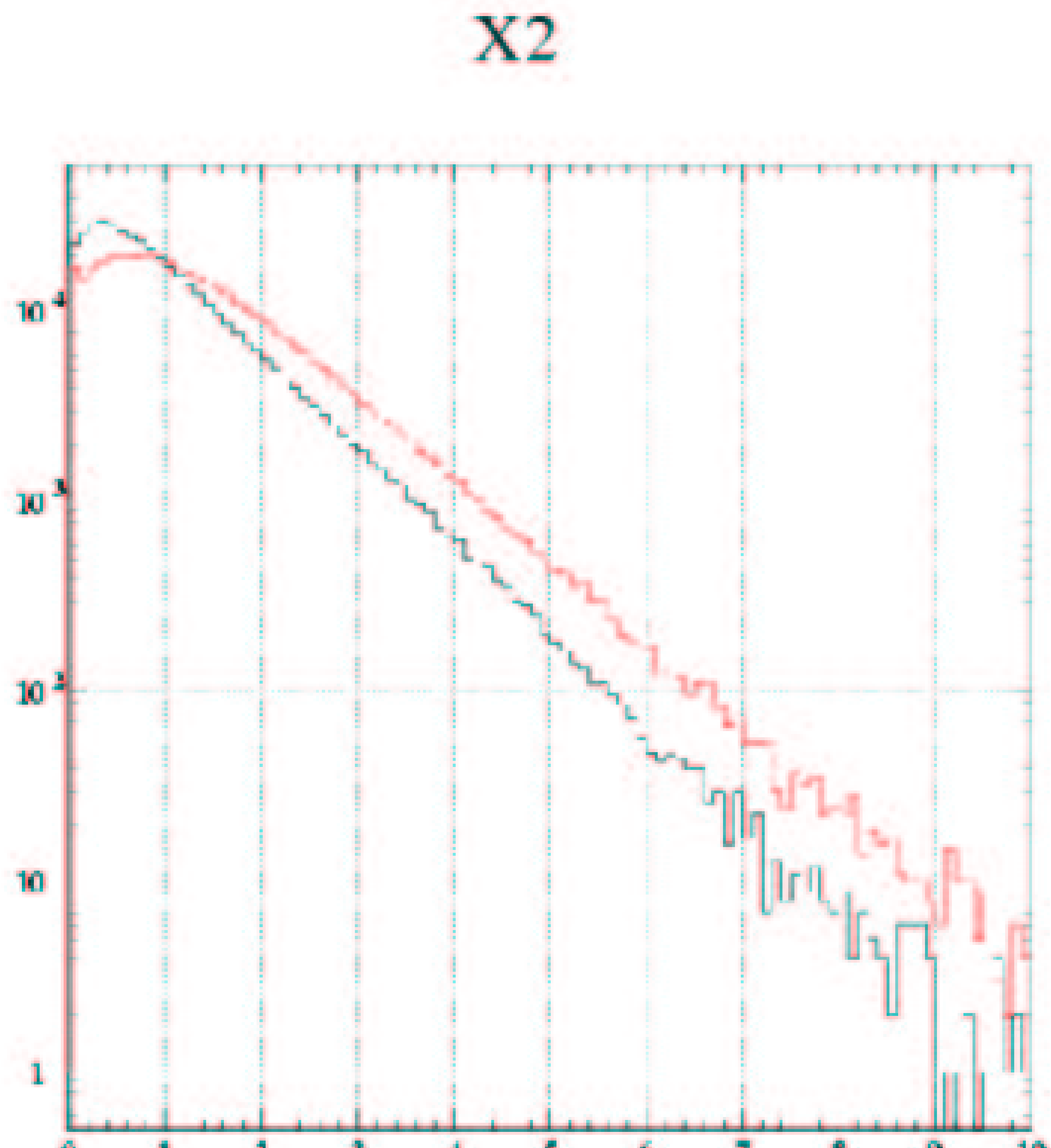


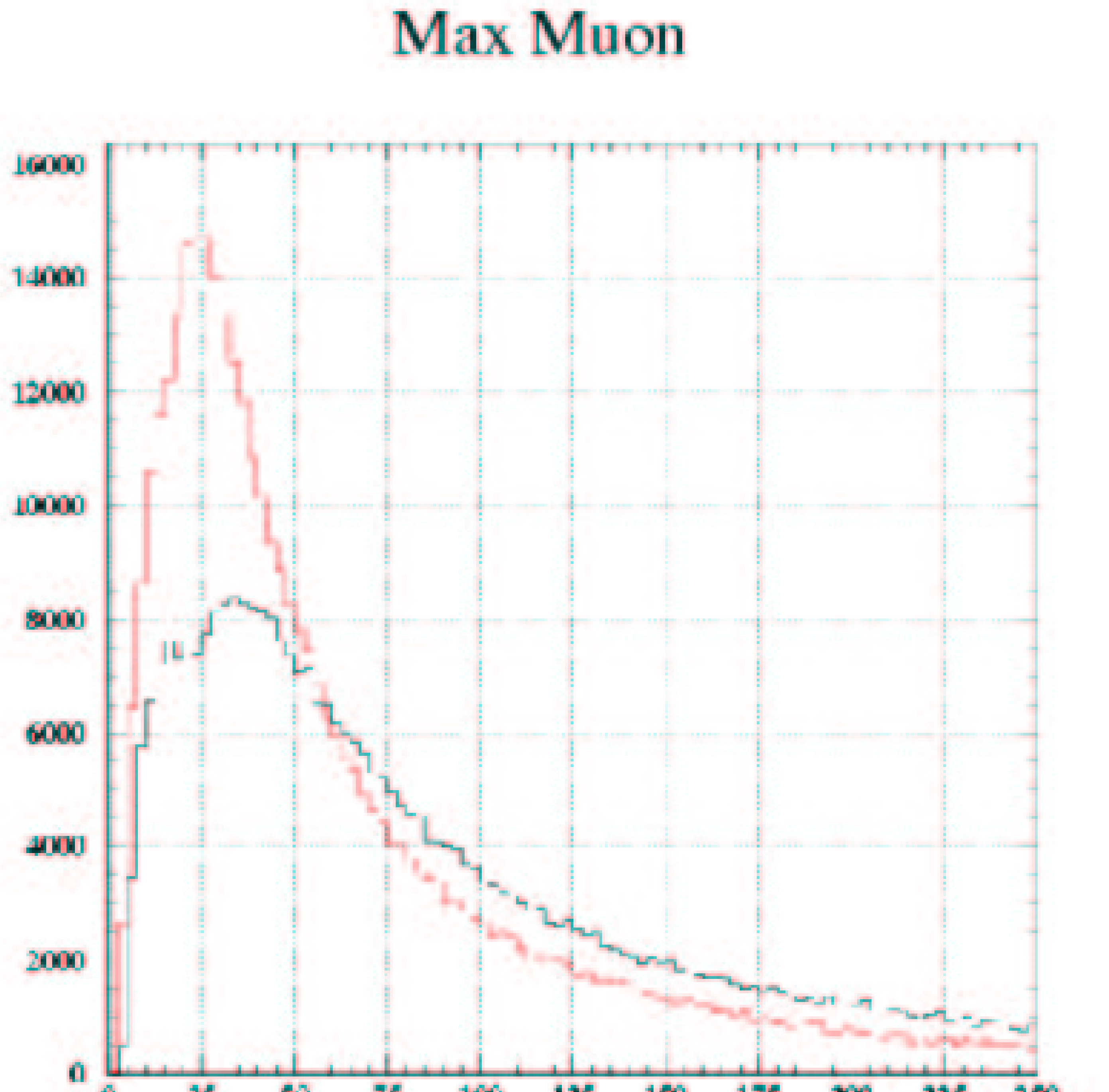
AS layer ave PE distribution




Old mean TOT
0
10
20
30
40
50
60
500
550
600
650
700
PMT No
New mean TOT
0
10
20
30
40
50
60


Muon layer PE distribution
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
9


X2
10^4
10^3
10^2
10
1


Max Muon
16000
14000
12000
10000
8000
6000
4000
2000
0

Current Status

Nov 2001 laser calibrations complete:

- a) Cross check against ADC
- b) Look for PMTs with irregular spectra in data.
- c) Check filter wheel calibration with ADC.
- d) Use spectrum calibration to fill in the gaps.

1999 and 2000 Calibrations:

- a) 2000 calibration nearly complete.
- b) 1999 calibration still needs to be done.

Outrigger Calibrations:

- a) We have calibrations for all outriggers with the exception of 801−816.
- b) About two thirds the calibrations are from the laser data.
- c) The remaining channels were calibrated by matching their spectra with a model outrigger spectrum from well calibrated outriggers.

Current Status (cont.)

Timing Calibrations:

a) Nov 2001 laser timing calibrations nearly complete (Liz)
b) Outrigger slewing complete.
c) Need T−PEDs for outrigger. Will get from paddle data.

Need to rewrite CalibrateRaw() to automatically load correct calibration files for a given run.

Plan to have frequent calibration revisions to address changes in the detector and irregularities in the data. We will need improved revisions control.

a) Unlink calibration versions and software versions.
b) Add calibration version info to subrun header.

Current Status (cont.)

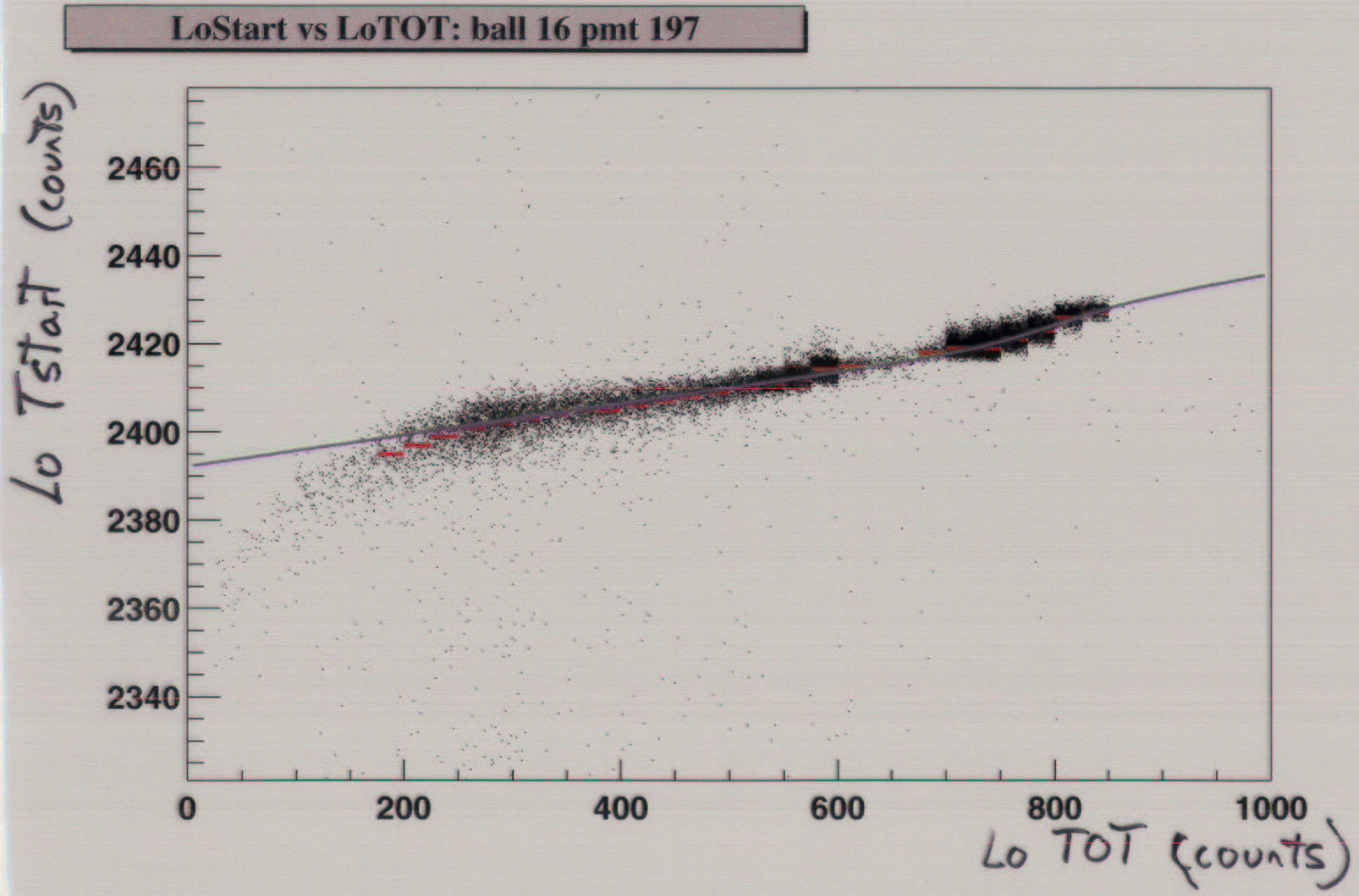
The laser needs love:

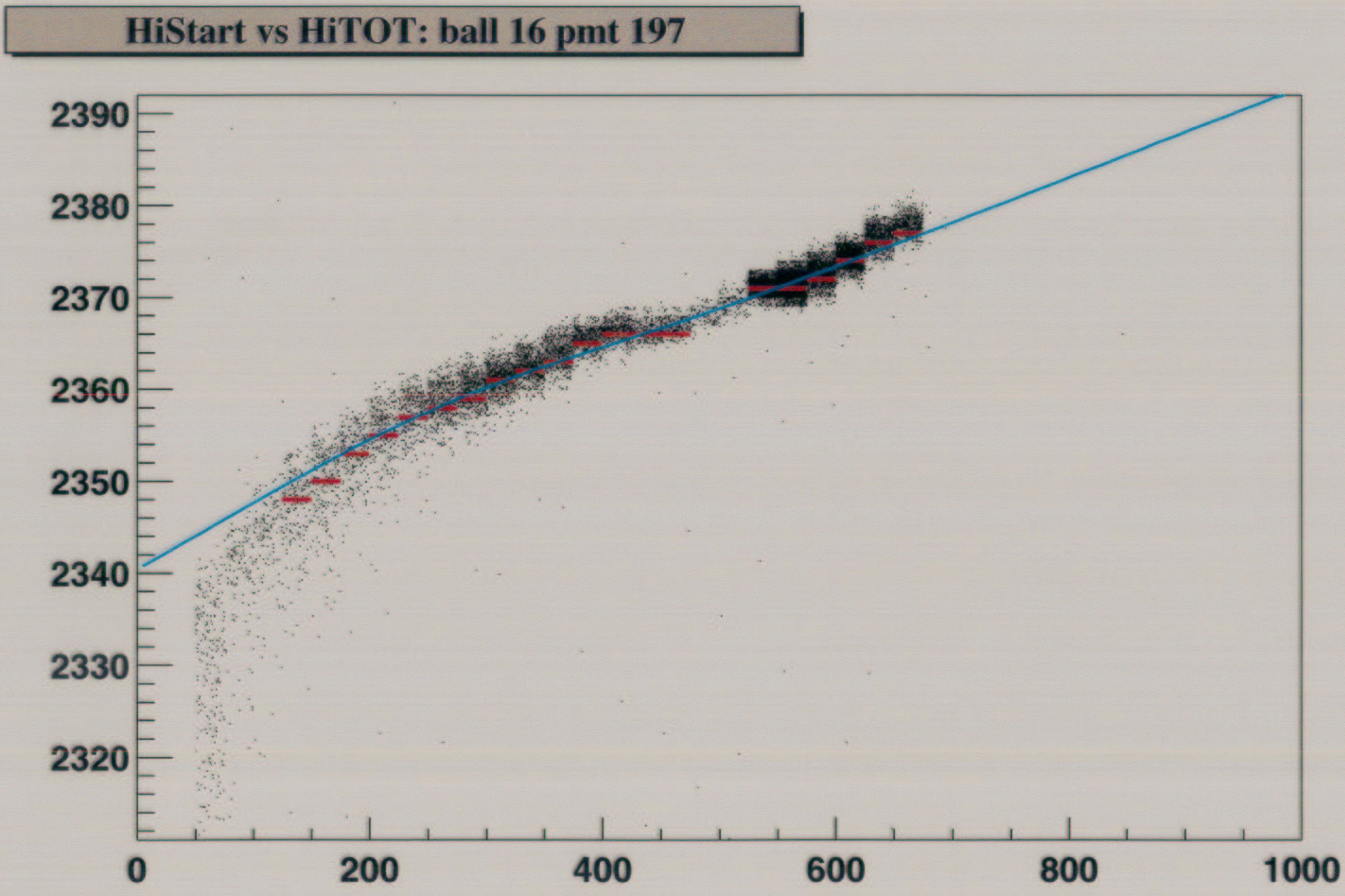
- a) Monitor pulses!
- b) Automatic zeroing of filter wheel.
- c) More automation/stability.
- d) Real time data quality monitoring ==> Real time calibrations
- e) Track calibration trigger time shifts.

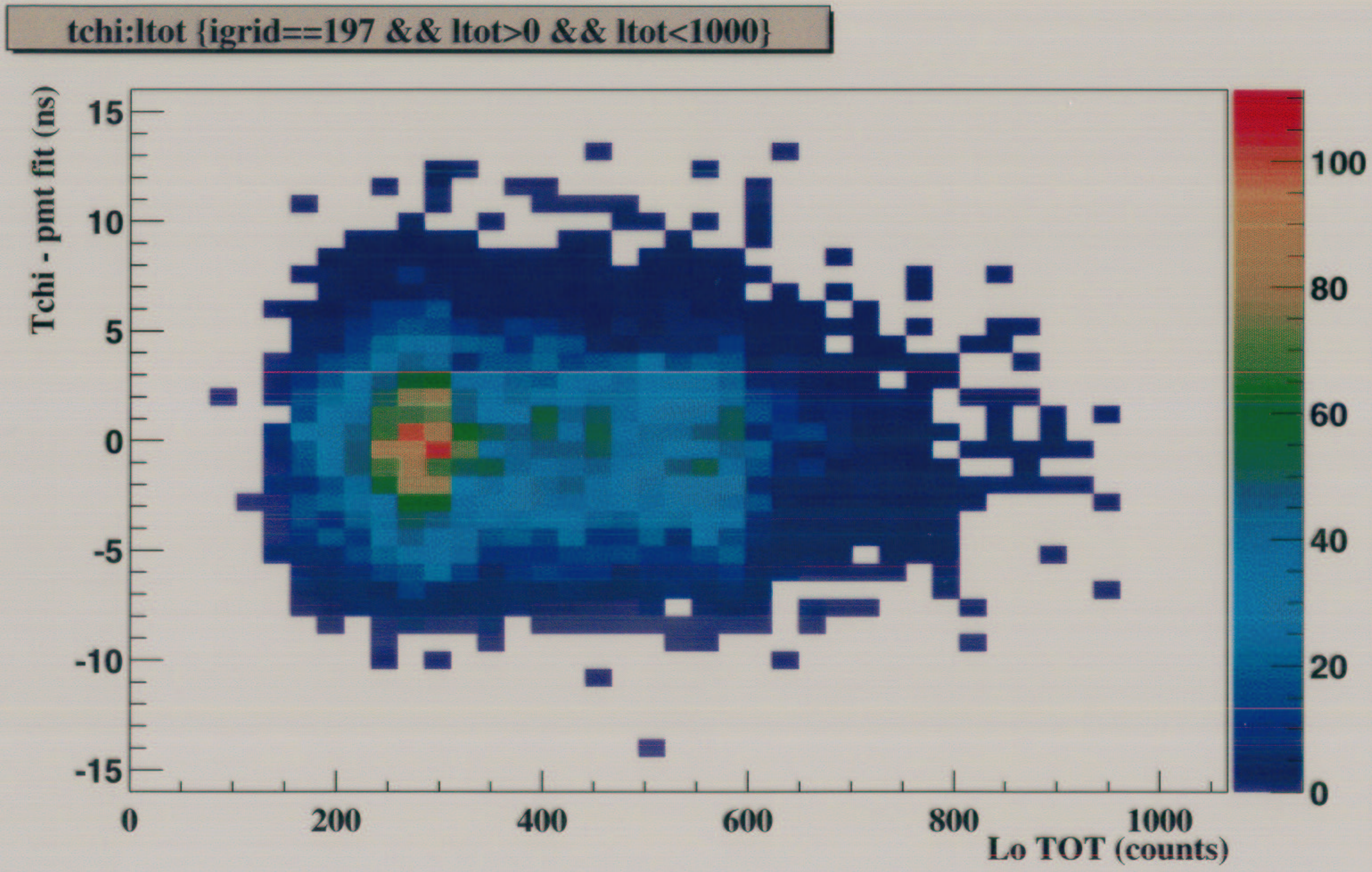
4 Timing Calibrations - Liz Hays

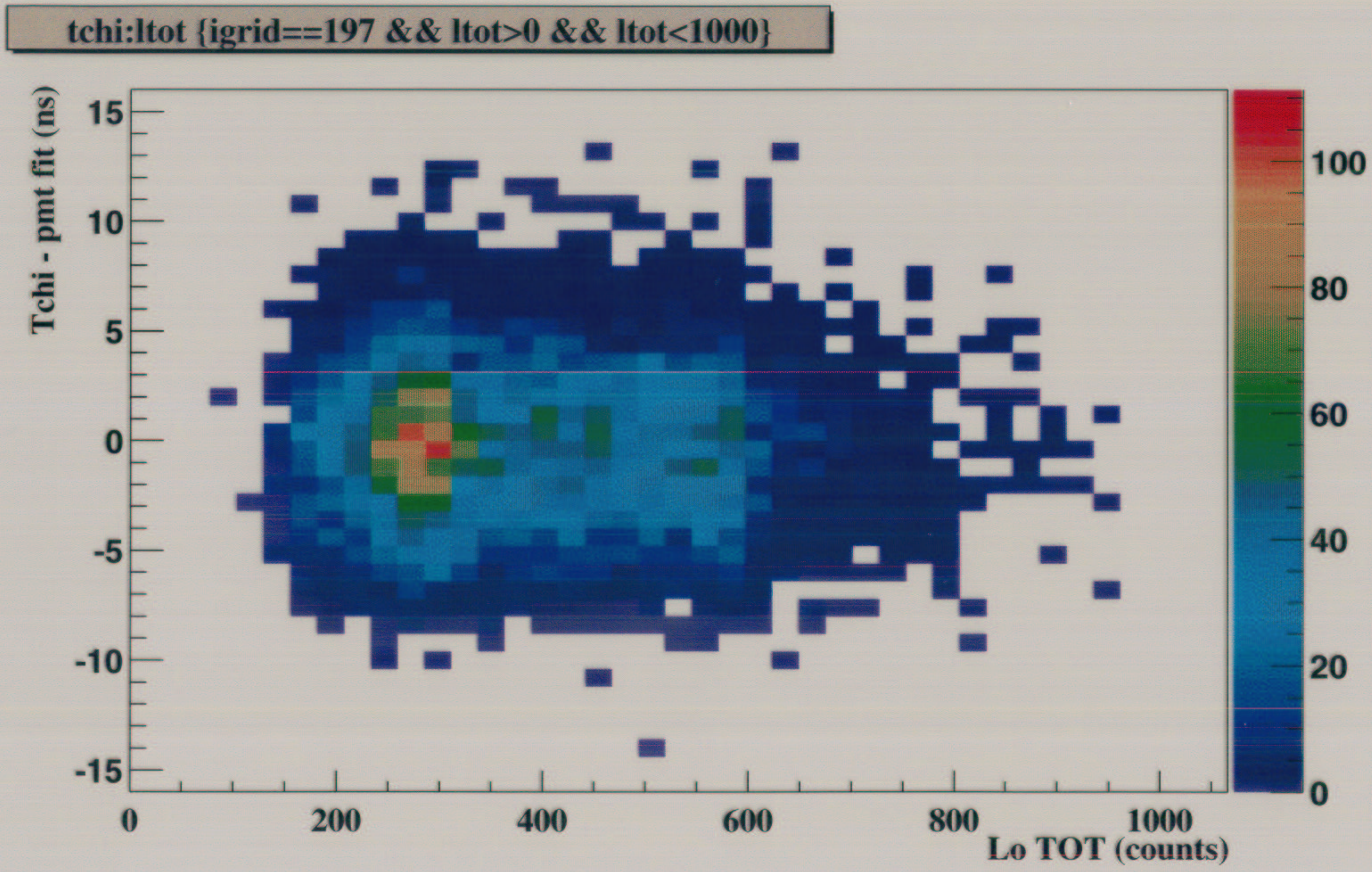
Timing Calibrations

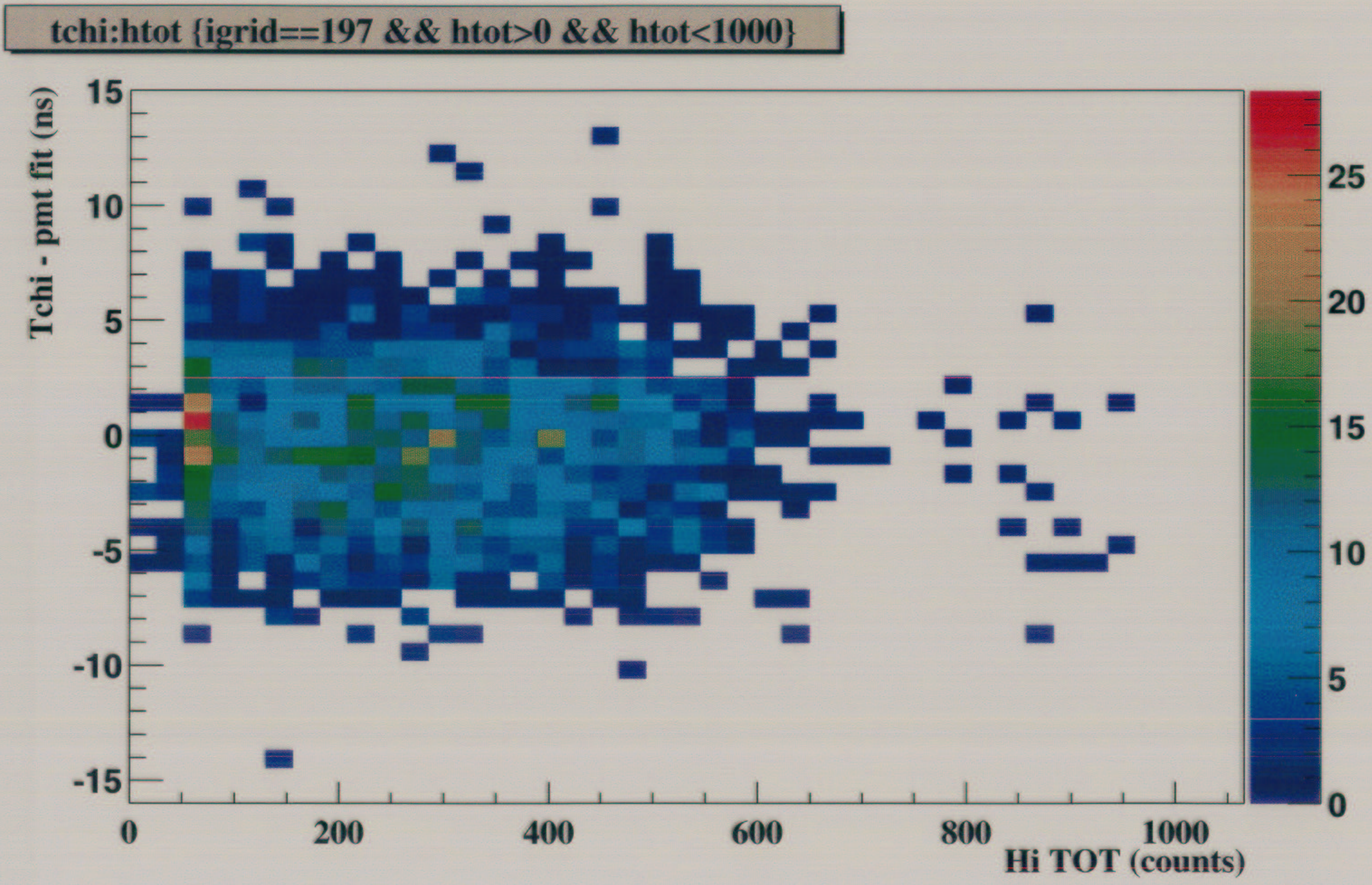
Status, Results, and evidence for the laser being as flaky as we always thought it was.

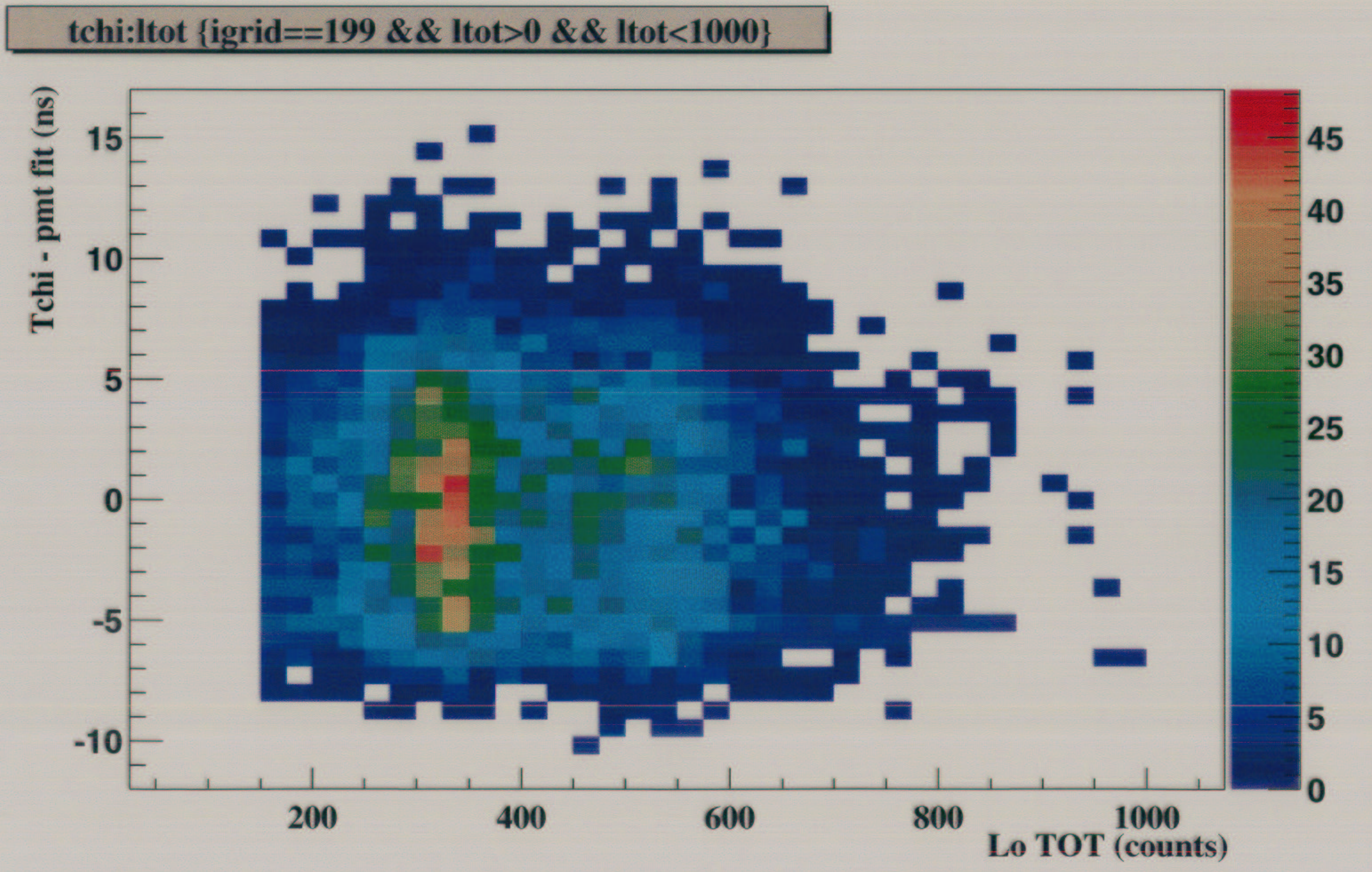

LoStart vs LoTOT: ball 16 pmt 197
Lo Tstart (counts)
2460
2440
2420
2400
2380
2360
2340
0
200
400
600
800
1000
Lo TOT (counts)

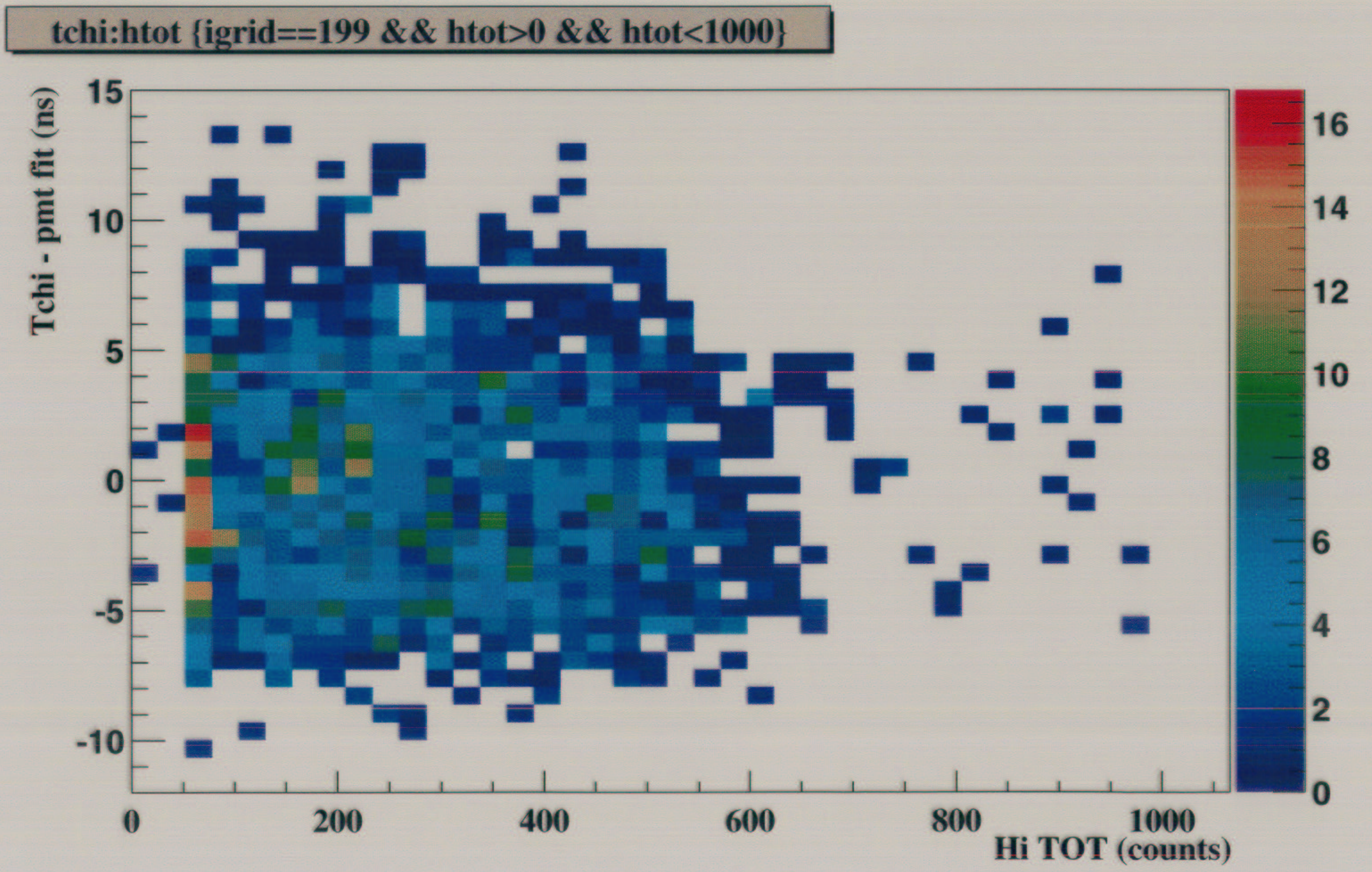

HiStart vs HiTOT: ball 16 pmt 197
2390
2380
2370
2360
2350
2340
2330
2320
0
200
400
600
800
1000


tchi:ltot {igrid==197 && ltot>0 && ltot<1000}
Tchi - pmt fit (ns)
15
10
5
0
-5
-10
-15
0
200
400
600
800
1000
Lo TOT (counts)
100
80
60
40
20
0

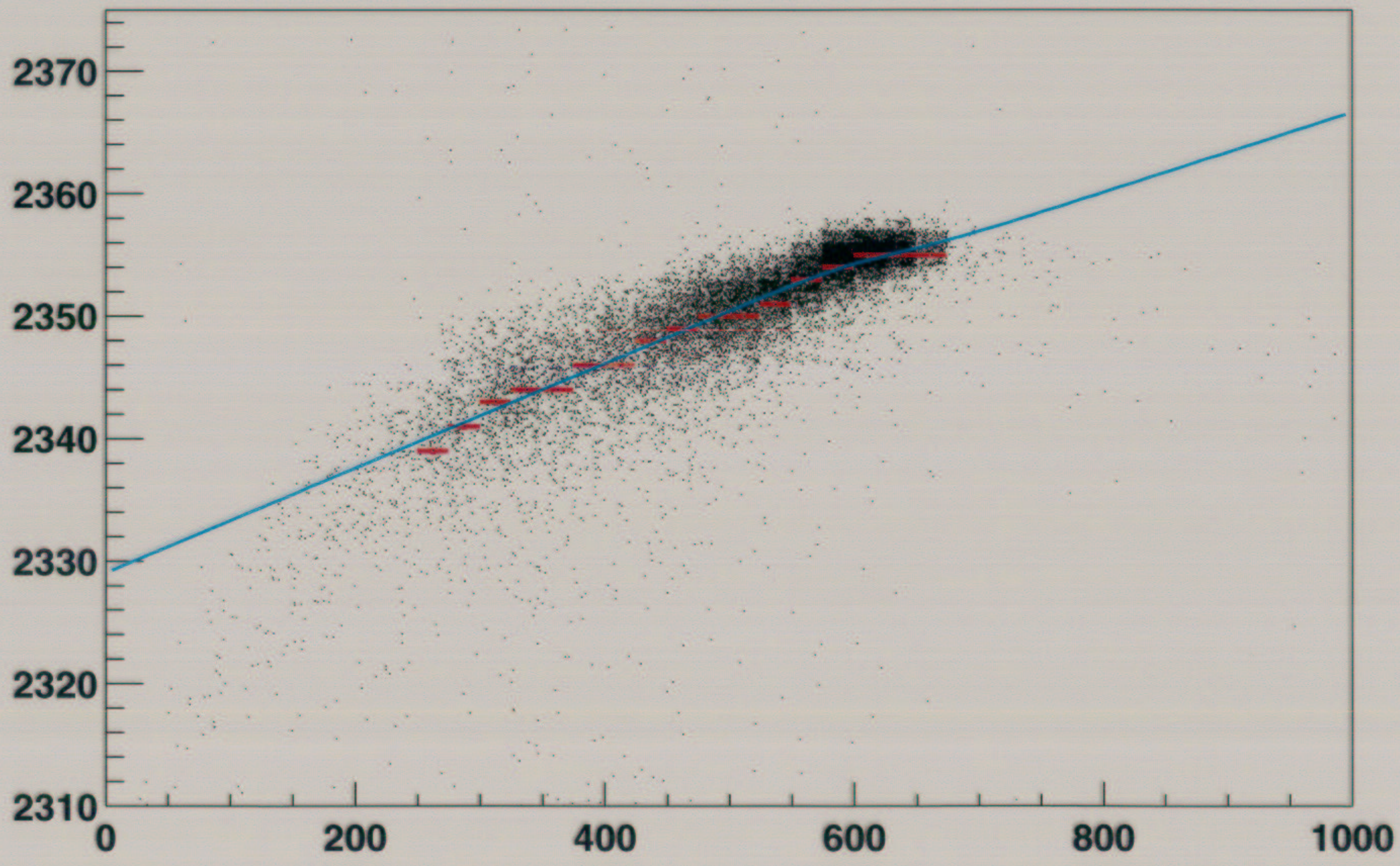

tchi:ltot {igrid==197 && ltot>0 && ltot<1000}
Tchi - pmt fit (ns)
15
10
5
0
-5
-10
-15
0
200
400
600
800
1000
Lo TOT (counts)
100
80
60
40
20
0

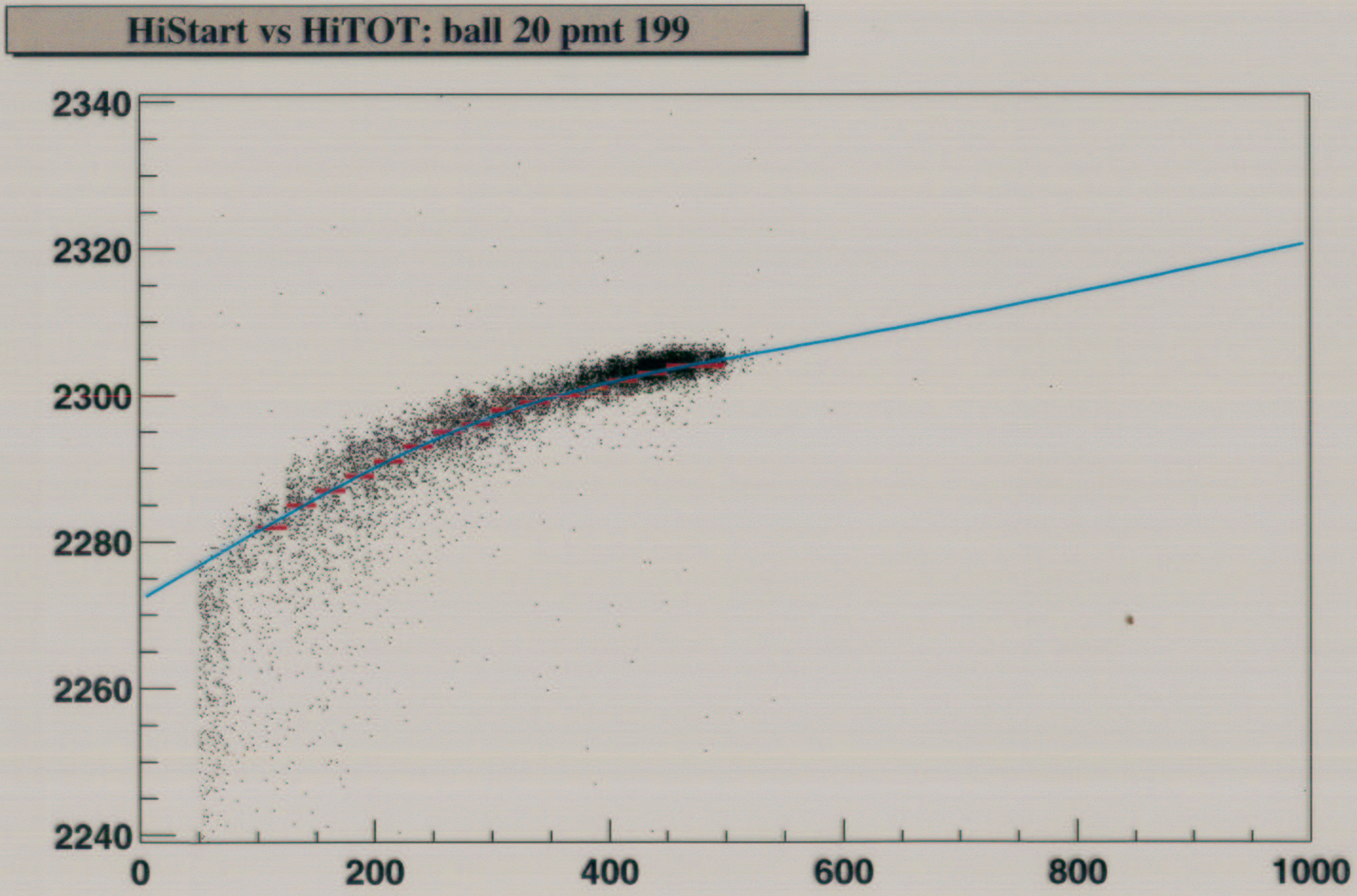

tchi:htot {igrid==197 && htot>0 && htot<1000}
Tchi - pmt fit (ns)
15
10
5
0
-5
-10
-15
0
200
400
600
800
1000
Hi TOT (counts)
0
5
10
15
20
25

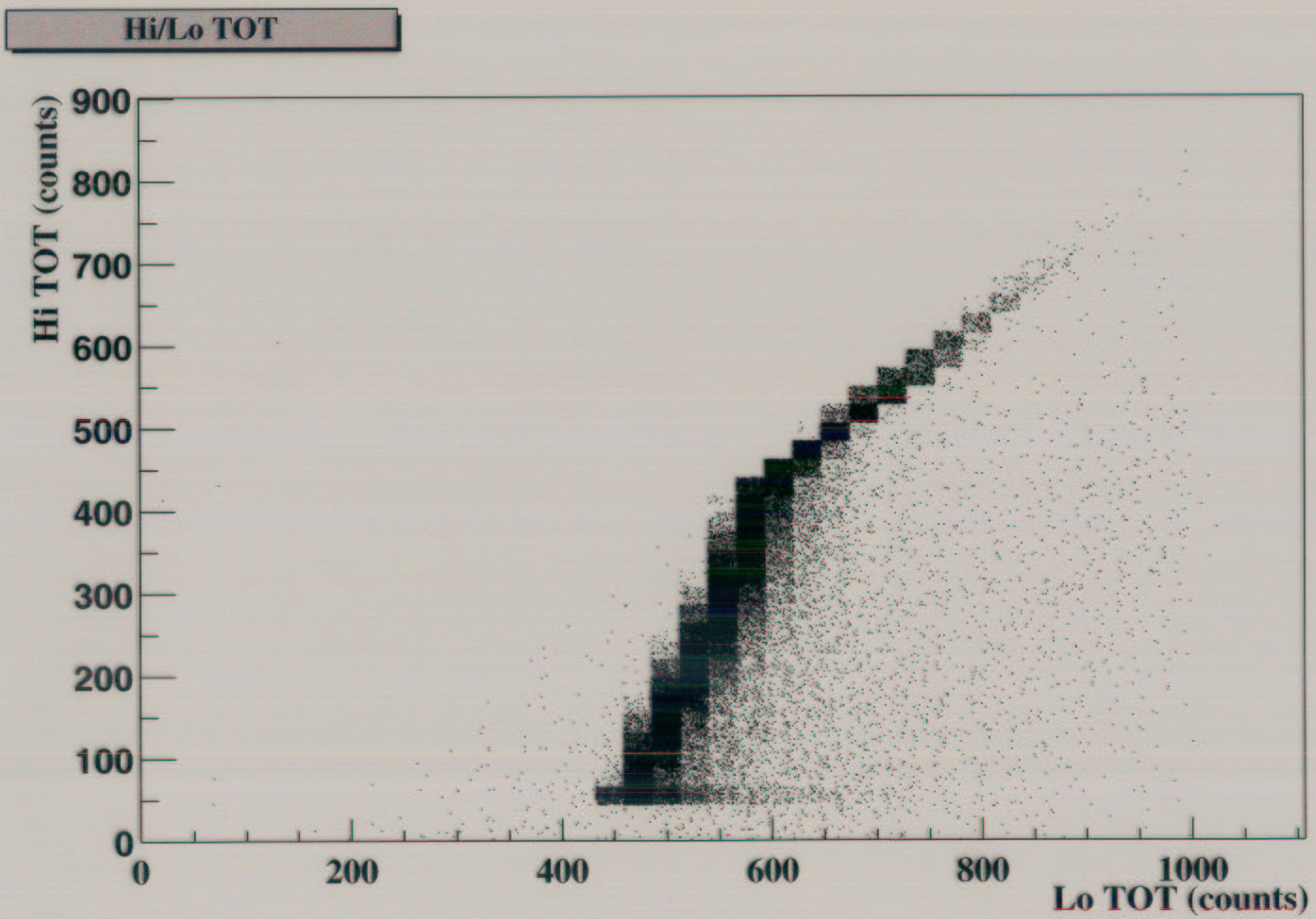

tchi:ltot {igrid==199 && ltot>0 && ltot<1000}
Tchi - pmt fit (ns)
15
10
5
0
-5
-10
200
400
600
800
1000
Lo TOT (counts)
45
40
35
30
25
20
15
10
5
0

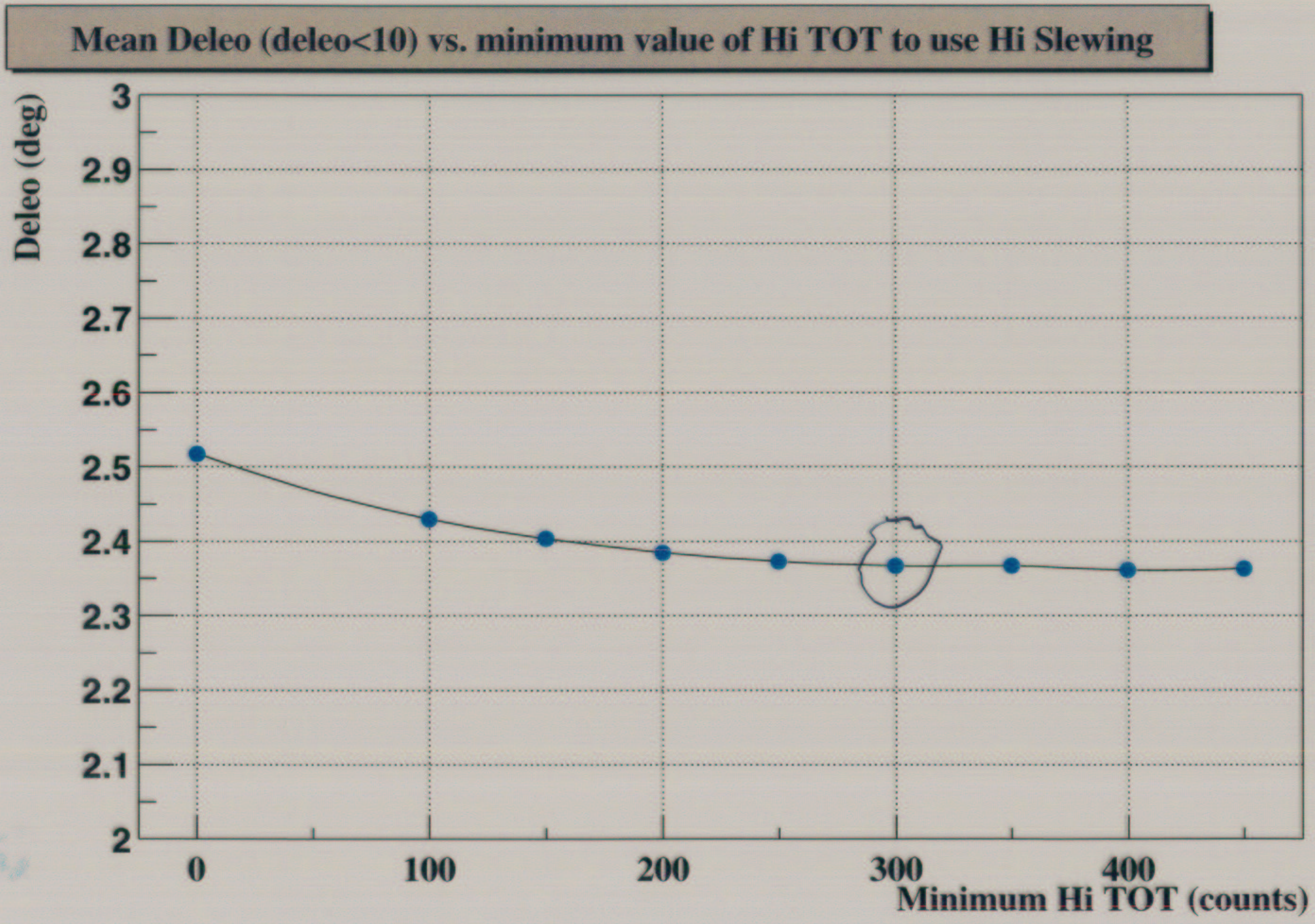

tchi:htot {igrid==199 && htot>0 && htot<1000}
Tchi - pmt fit (ns)
15
10
5
0
-5
-10
0
200
400
600
800
1000
Hi TOT (counts)
16
14
12
10
8
6
4
2
0

LoStart vs LoTOT: ball 20 pmt 199

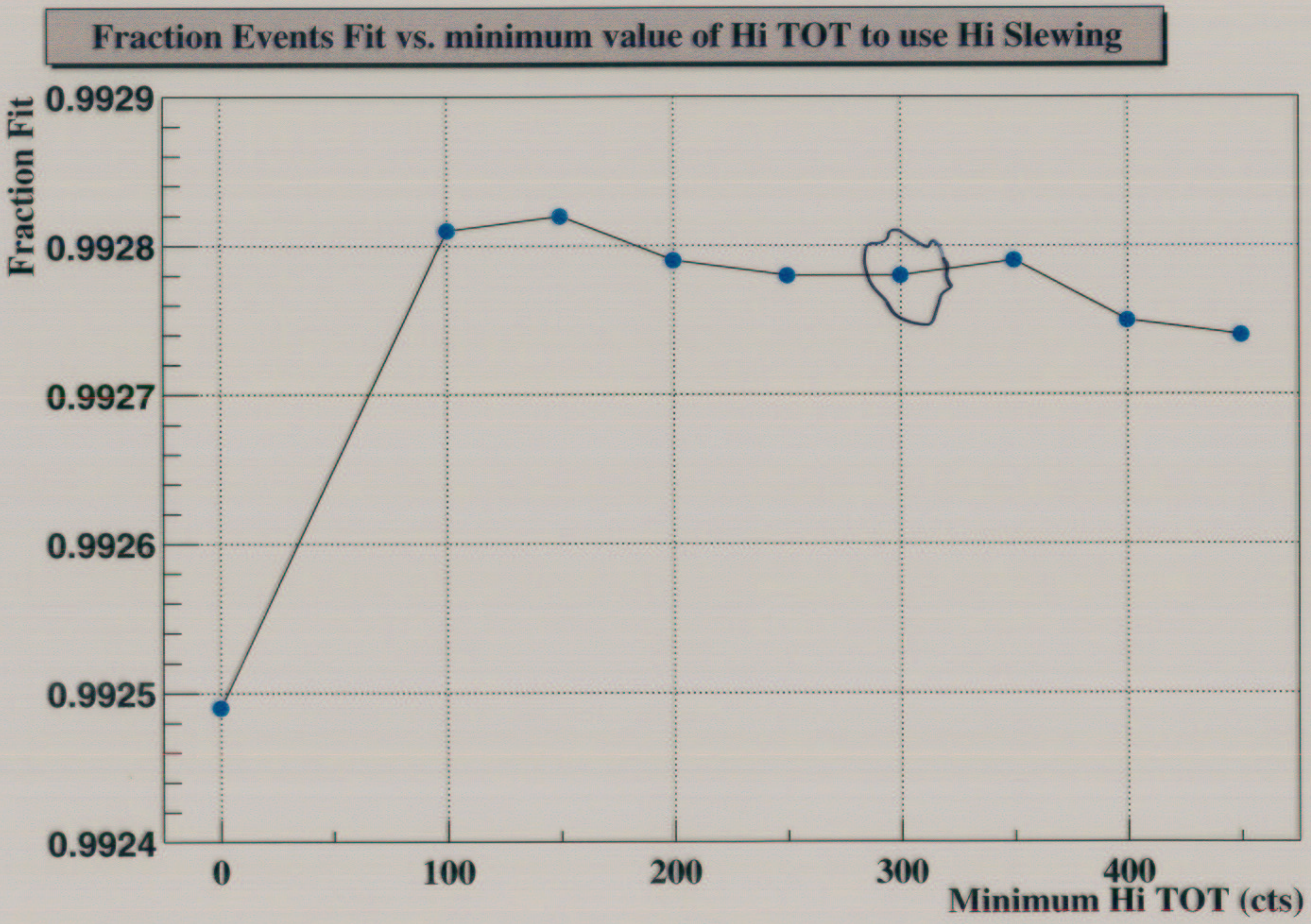


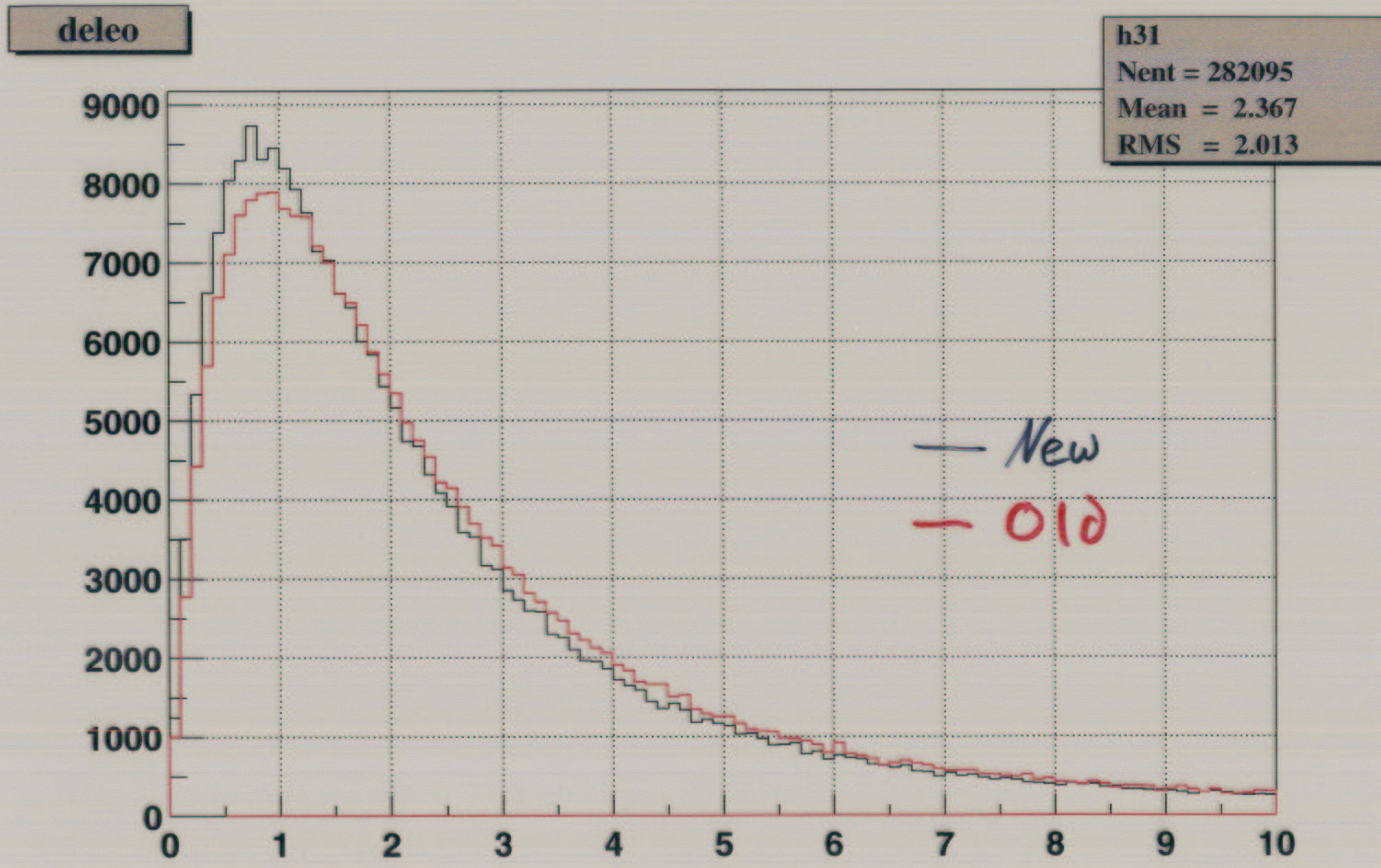

HiStart vs HiTOT: ball 20 pmt 199
2340
2320
2300
2280
2260
2240
0
200
400
600
800
1000

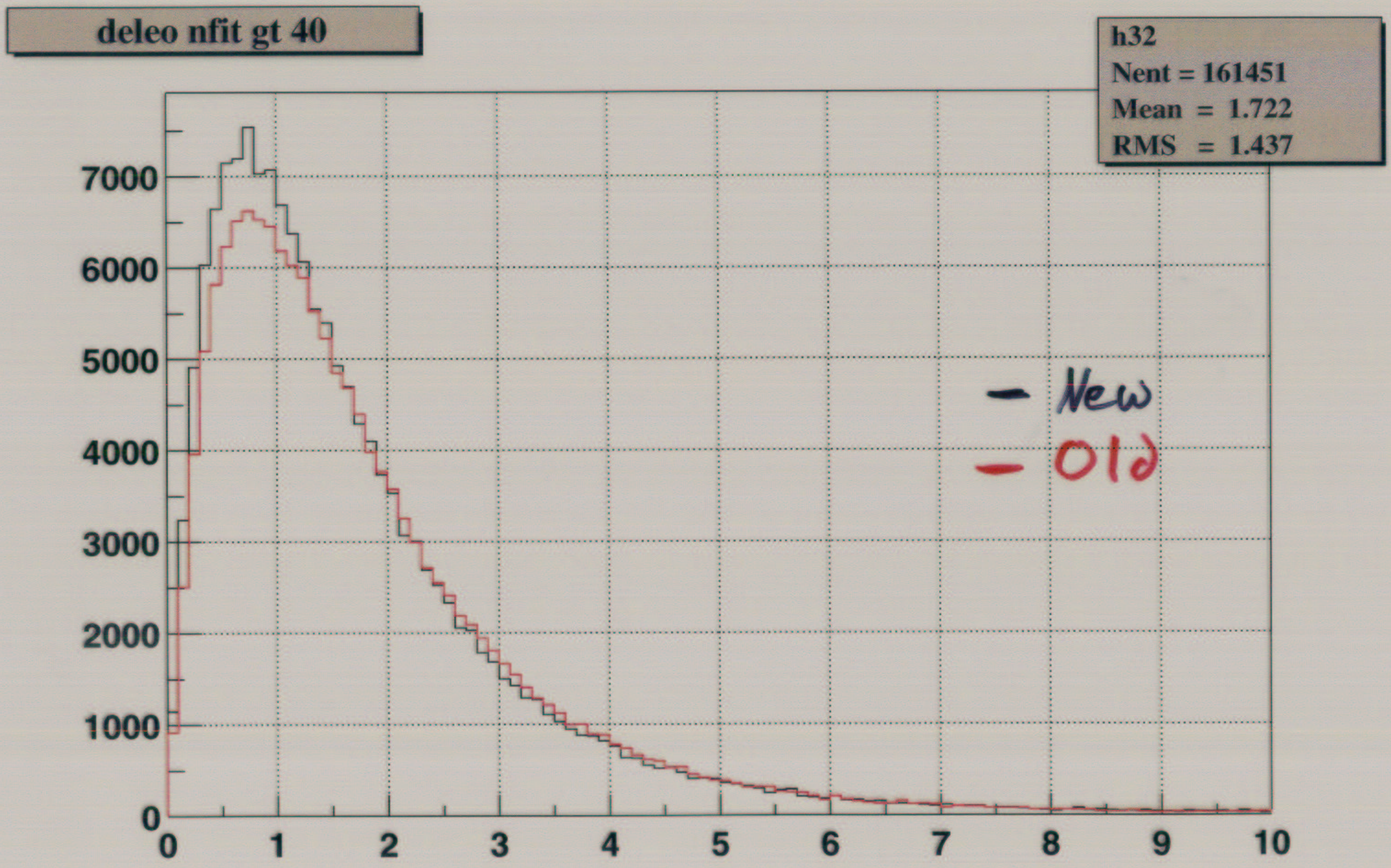

Hi/Lo TOT
Hi TOT (counts)
900
800
700
600
500
400
300
200
100
0
0
200
400
600
800
1000
Lo TOT (counts)

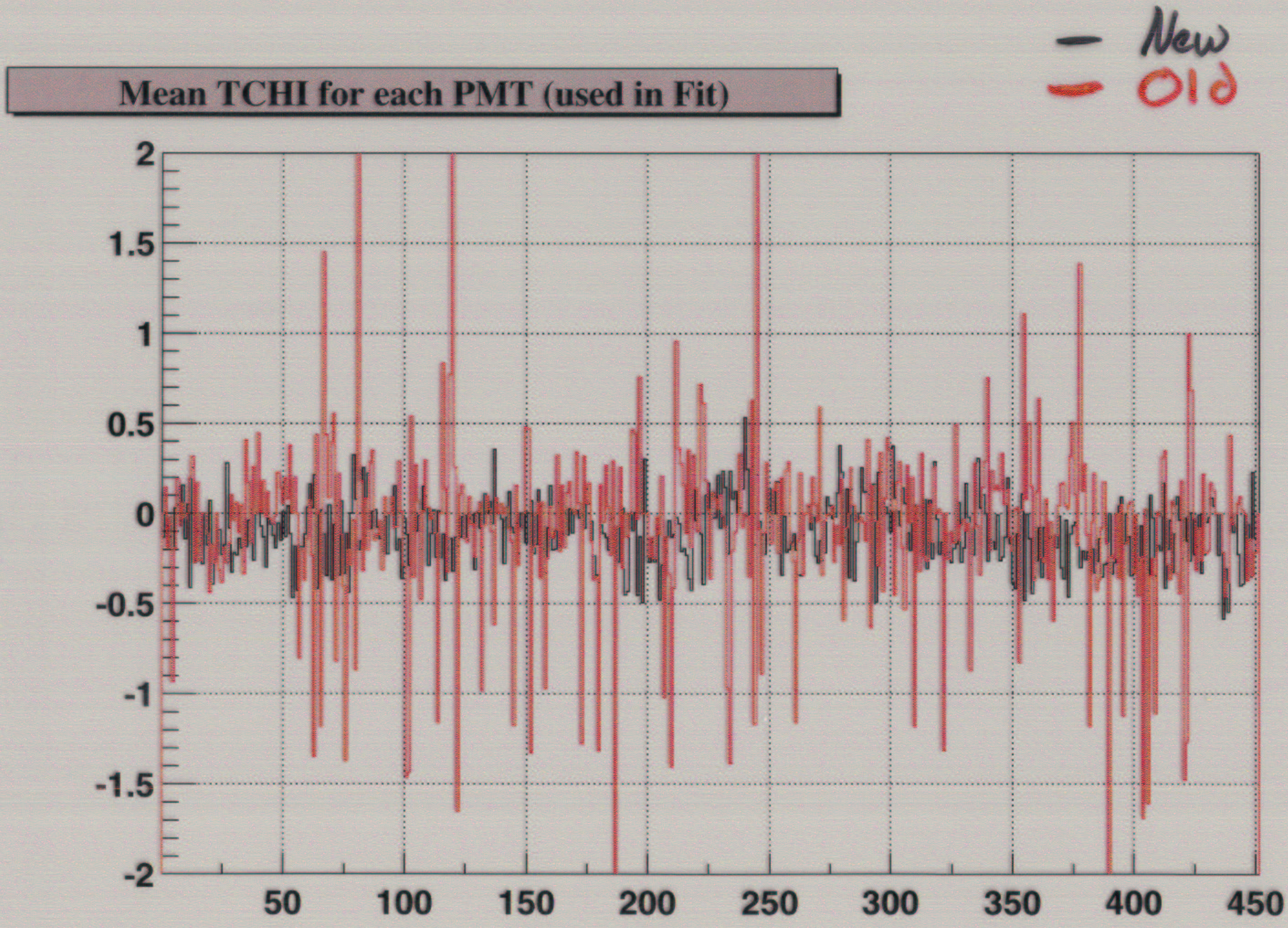


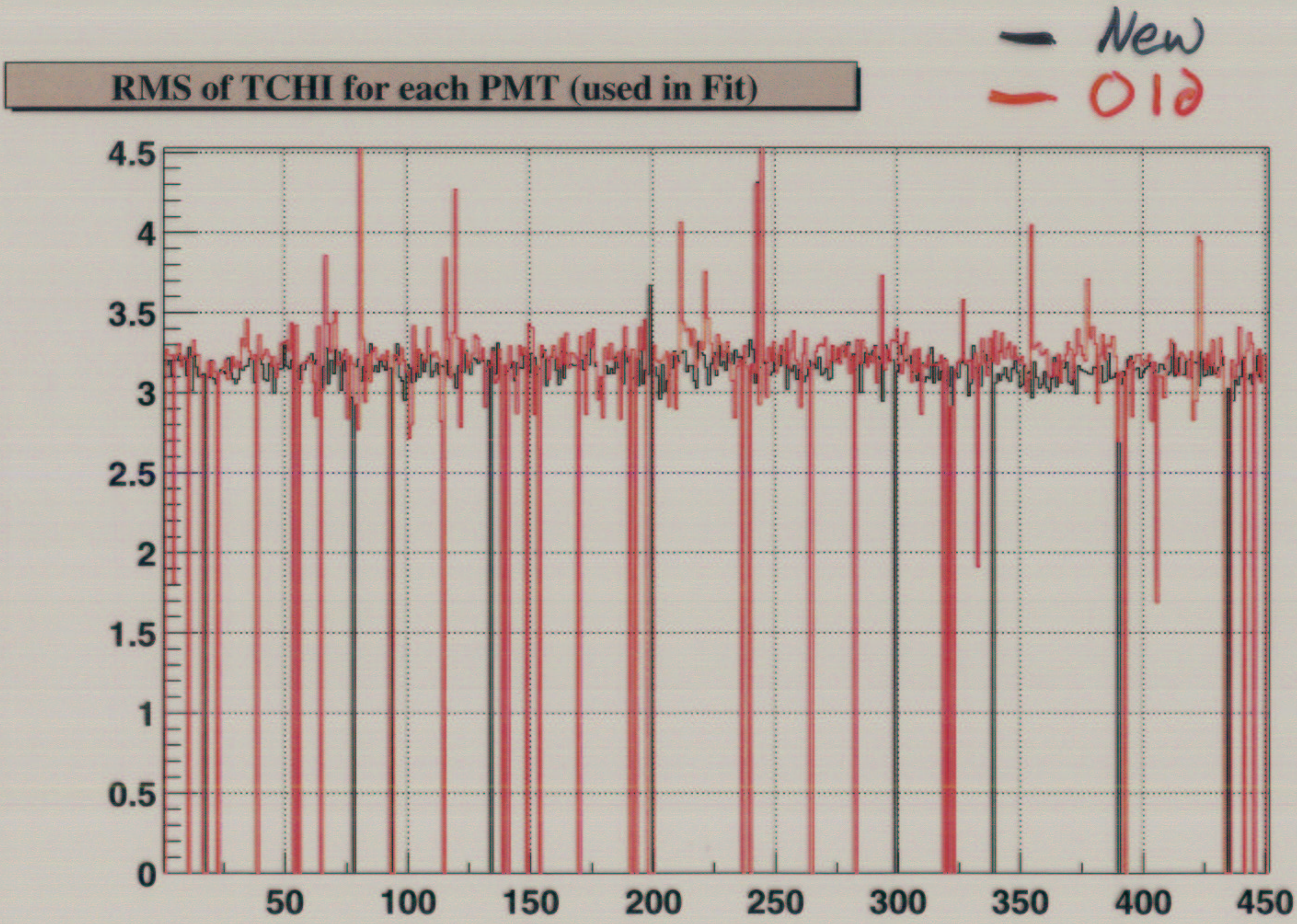
Mean Deleo (deleo<10) vs. minimum value of Hi TOT to use Hi Slewing

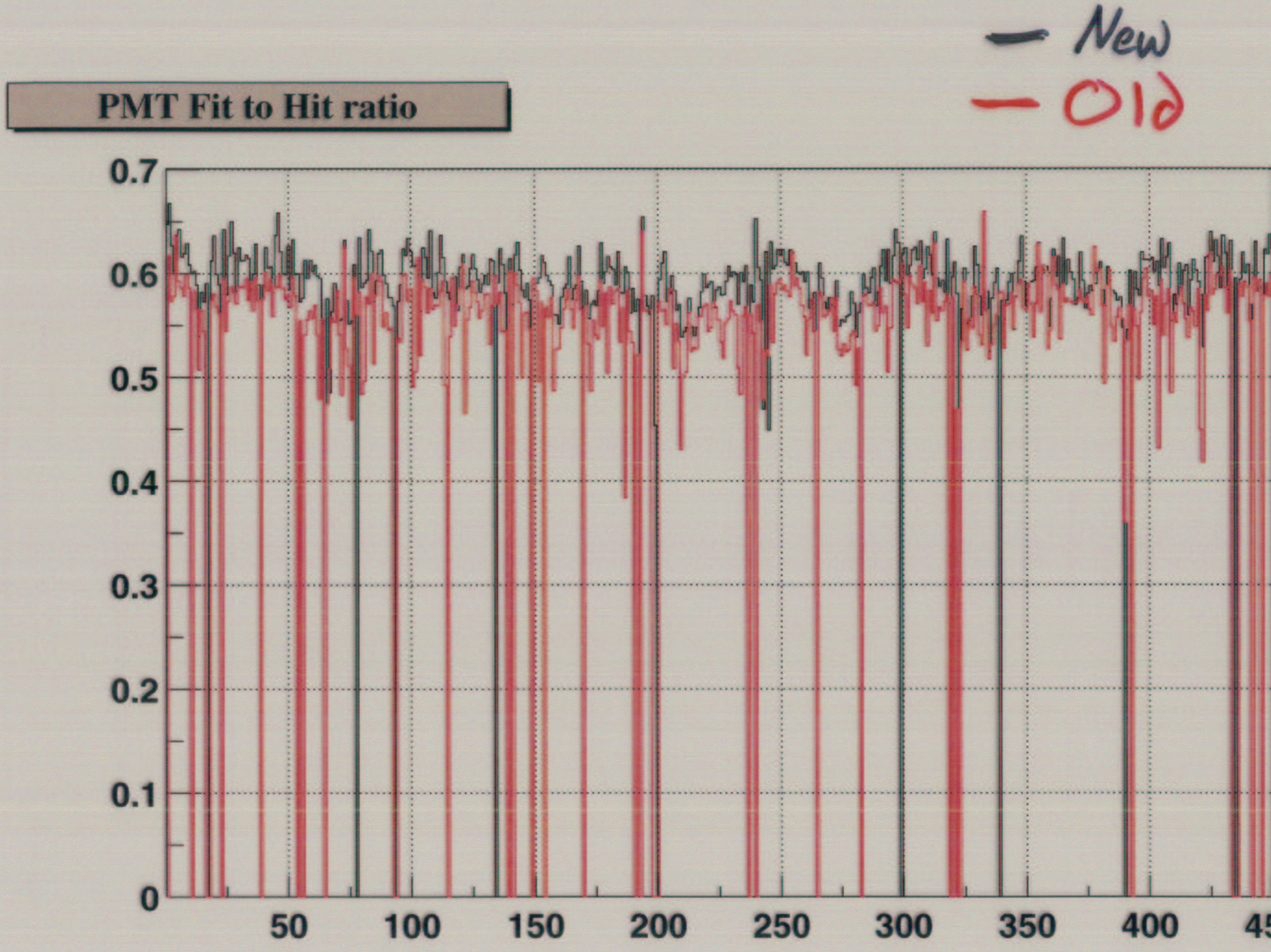

Fraction Events Fit vs. minimum value of Hi TOT to use Hi Slewing
Fraction Fit
0.9929
0.9928
0.9927
0.9926
0.9925
0.9924
0
100
200
300
400
Minimum Hi TOT (cts)

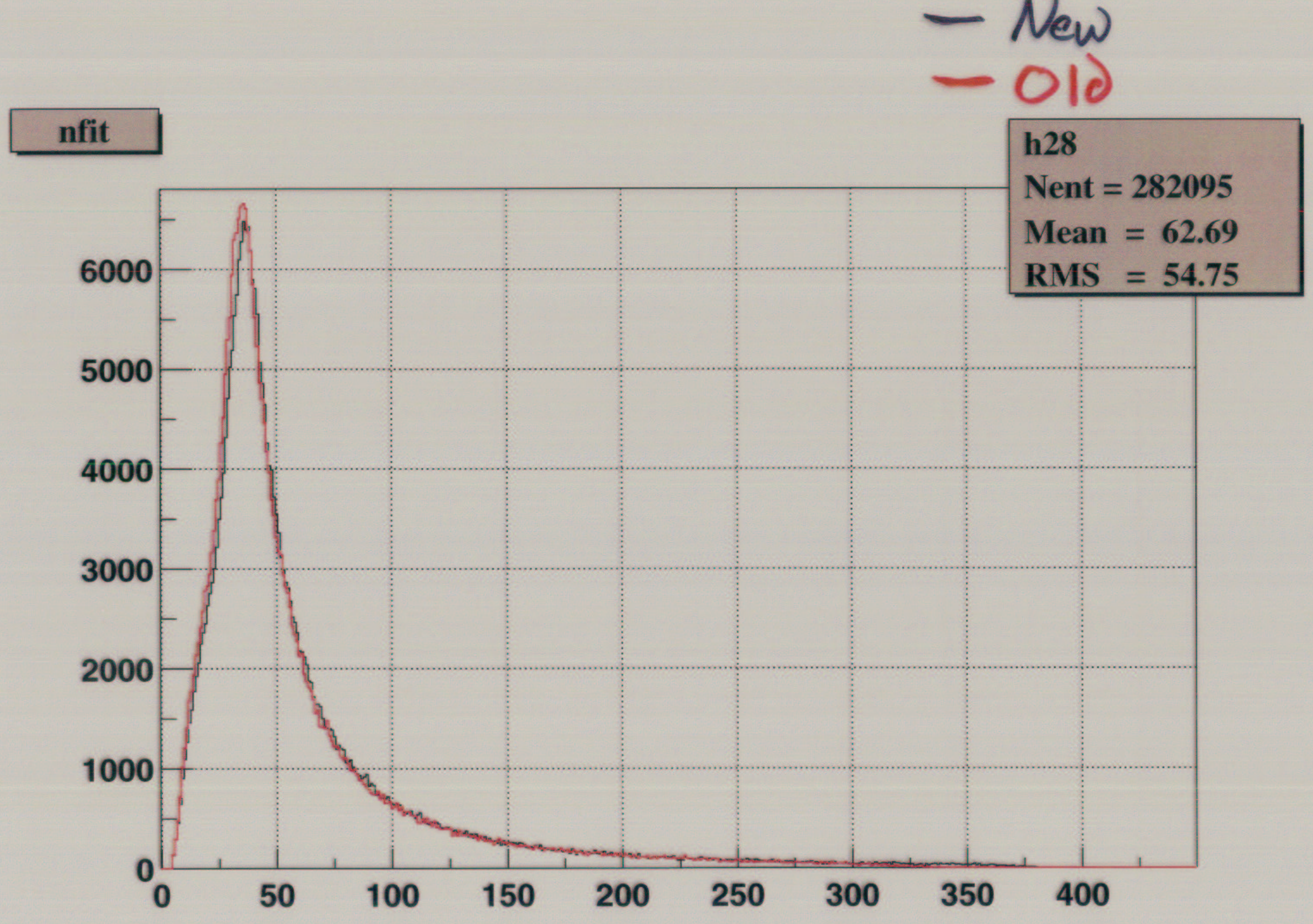

deleo
h31
Nent = 282095
Mean = 2.367
RMS = 2.013
— New
— Old
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
9
10


deleo nfit gt 40
h32
Nent = 161451
Mean = 1.722
RMS = 1.437
7000
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
9
10
- New
- Old

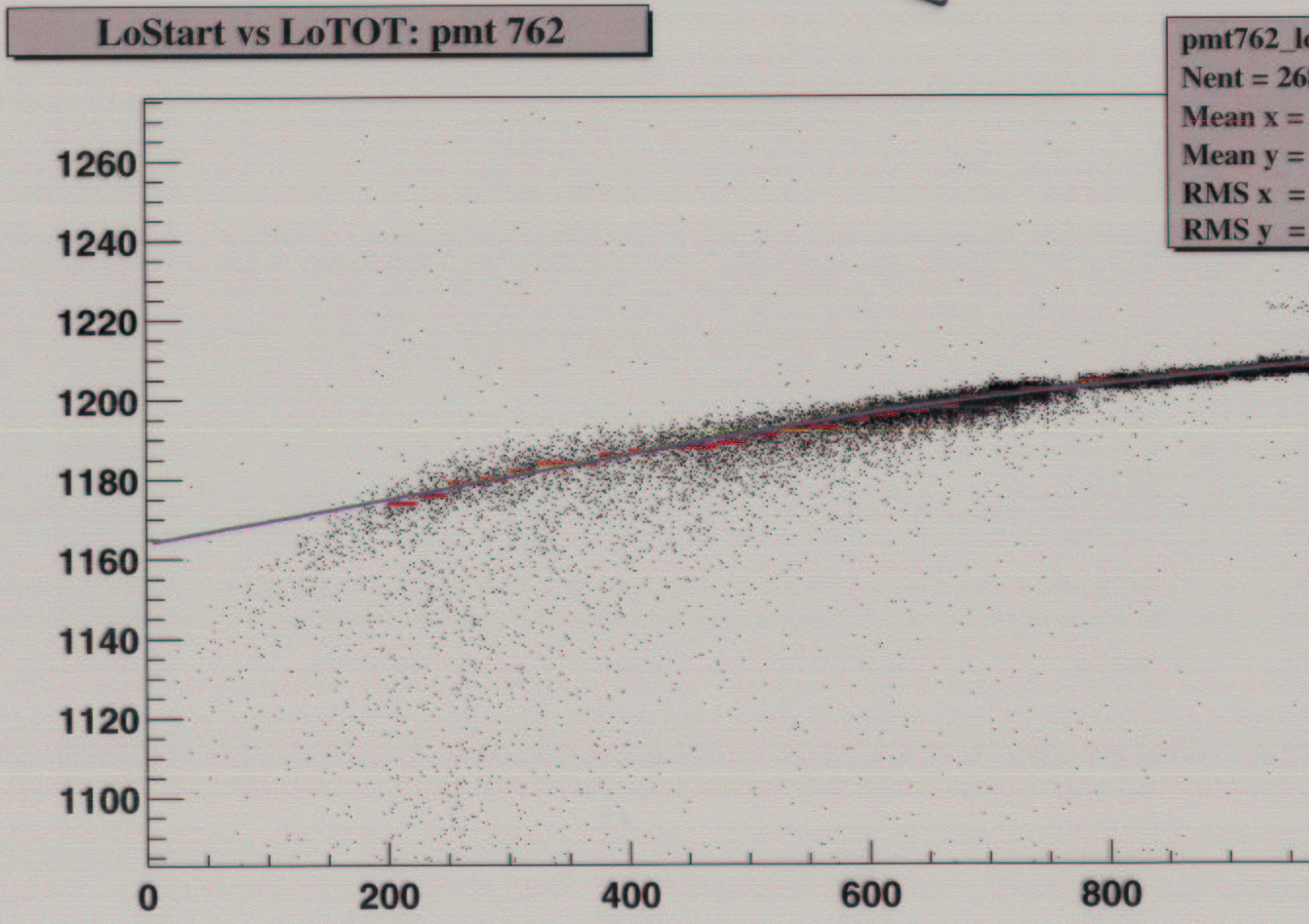

Mean TCHI for each PMT (used in Fit)
— New
— Old
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
50
100
150
200
250
300
350
400
450

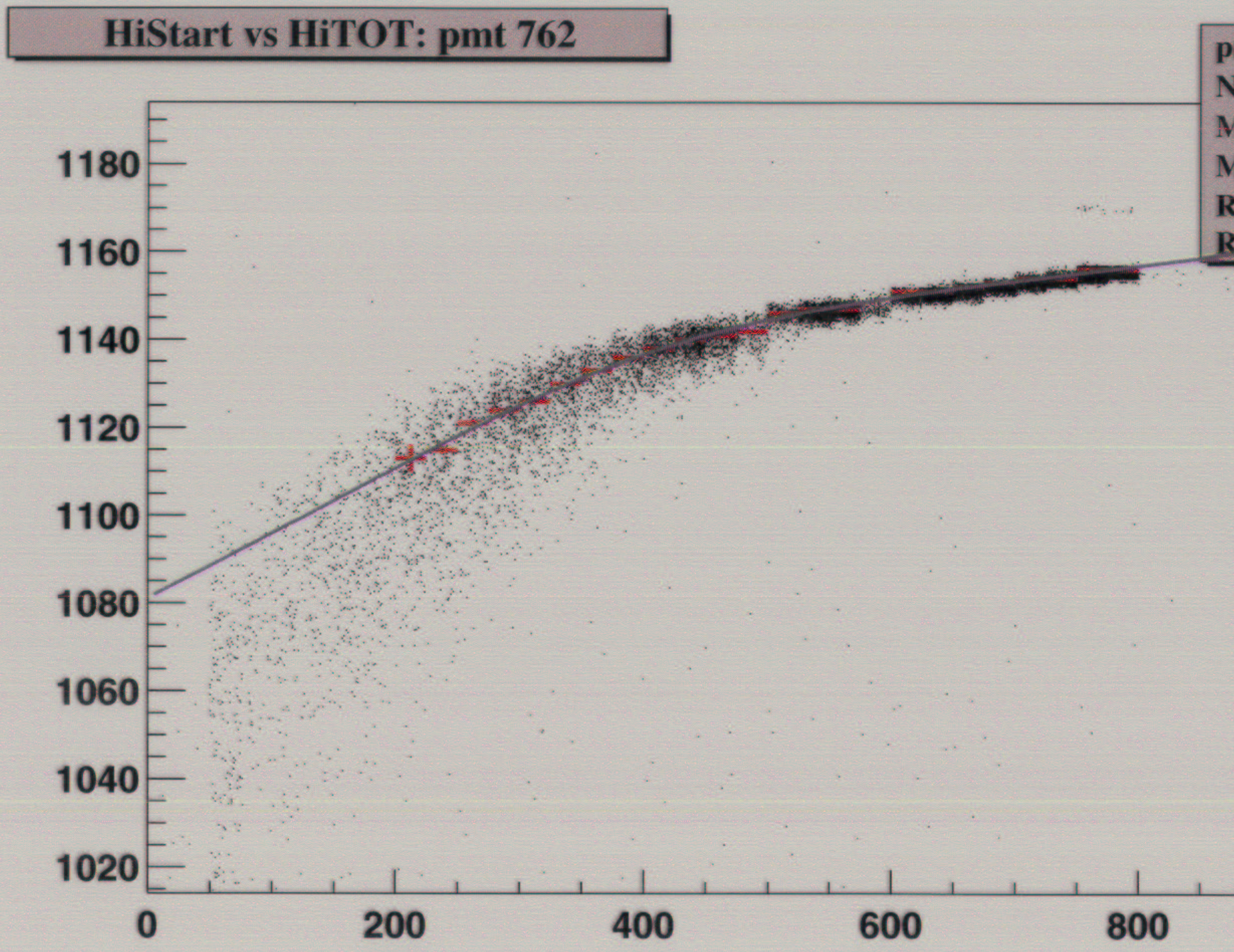

RMS of TCHI for each PMT (used in Fit)
New
Old
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
50
100
150
200
250
300
350
400
450


PMT Fit to Hit ratio
— New
— Old
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
300
350
400
45


— New
— Old
nfit
h28
Nent = 282095
Mean = 62.69
RMS = 54.75
0
1000
2000
3000
4000
5000
6000
0
50
100
150
200
250
300
350
400

Outrigger Slewing




HiStart vs HiTOT: pmt 762

Problems with laser data

1. OR 801-816 No data

   Solution: Turned over cable to TDC

2. Ball 18 has relocated

   Solution: Calculate new position from data for now.

3. Laser trigger has some timing instability - warm up issue?

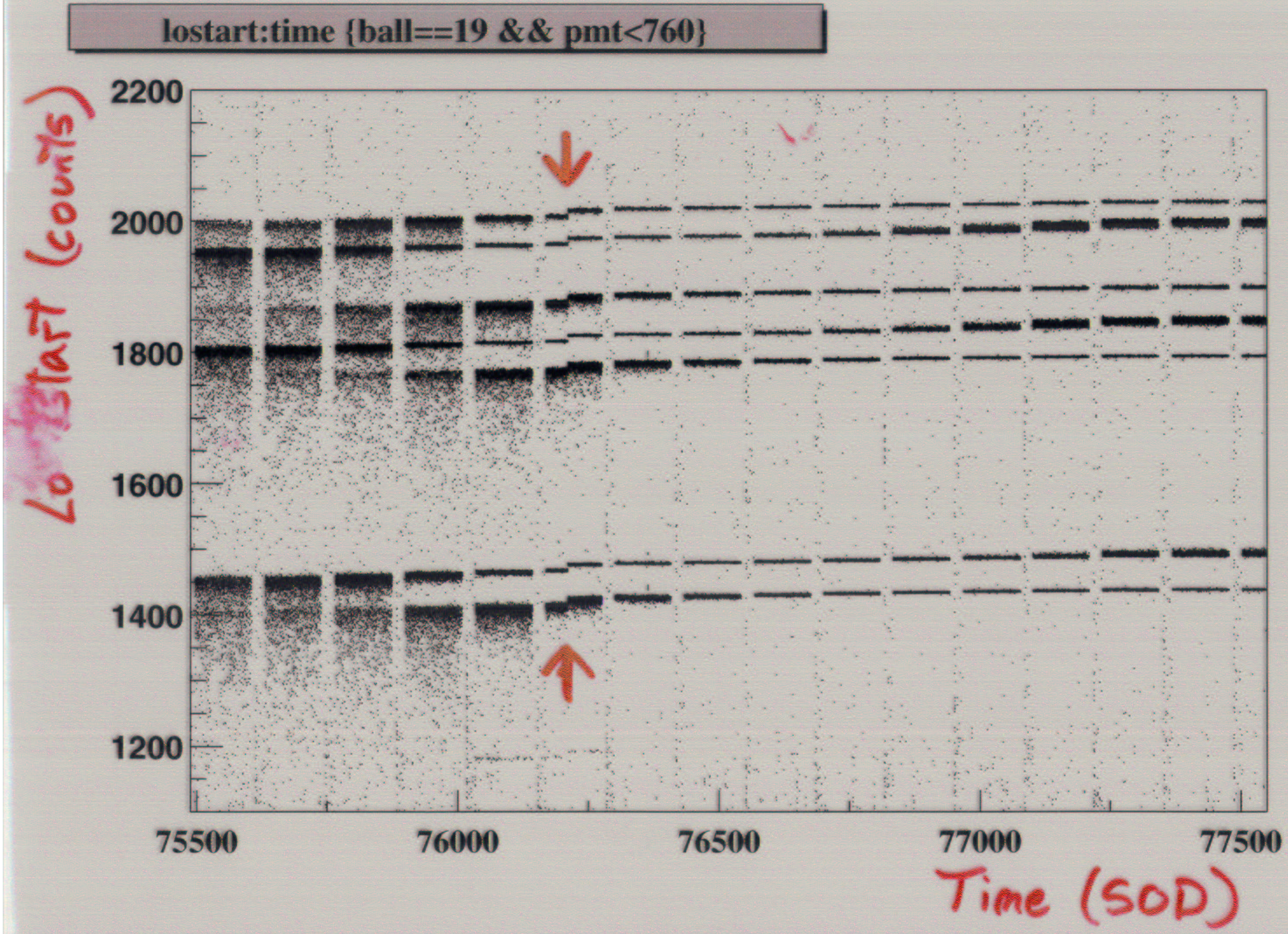
   Solution: Data can be corrected

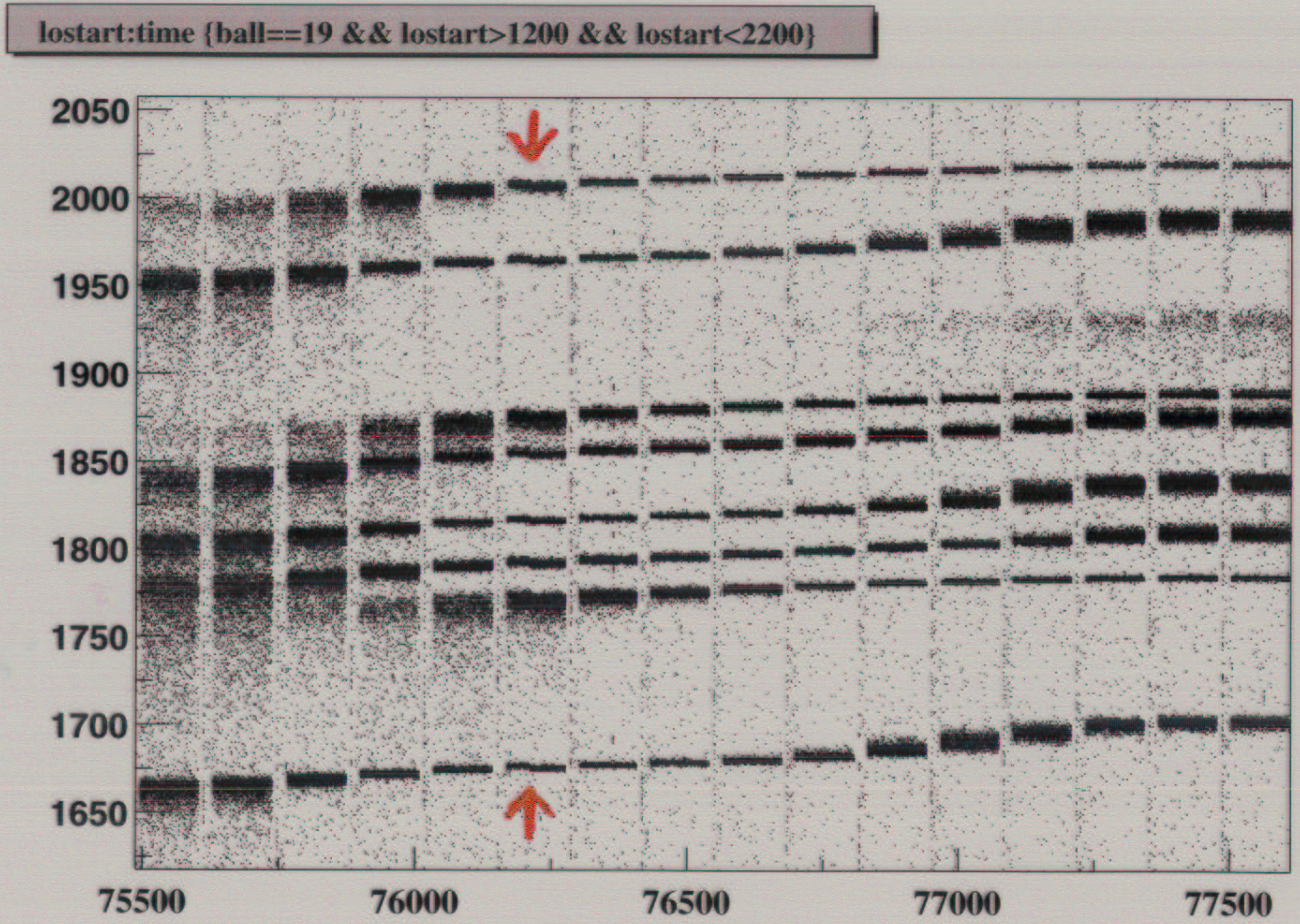
4. Outriggers have a large range in tstart in laser data. Some are late enough to be cut off by common stop.

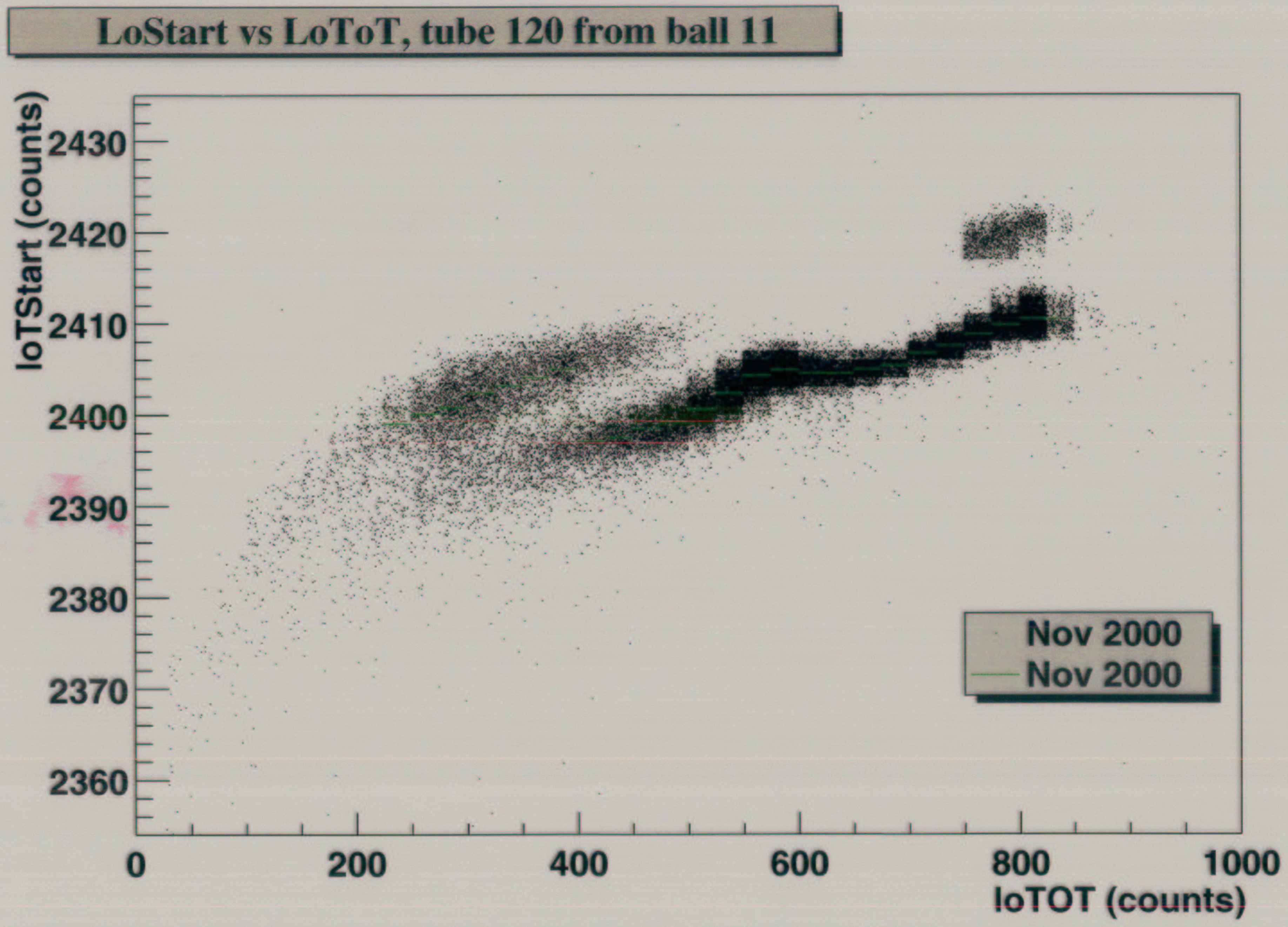
   Solution: Add delay to laser trigger

5. Still no data for fiber 15.

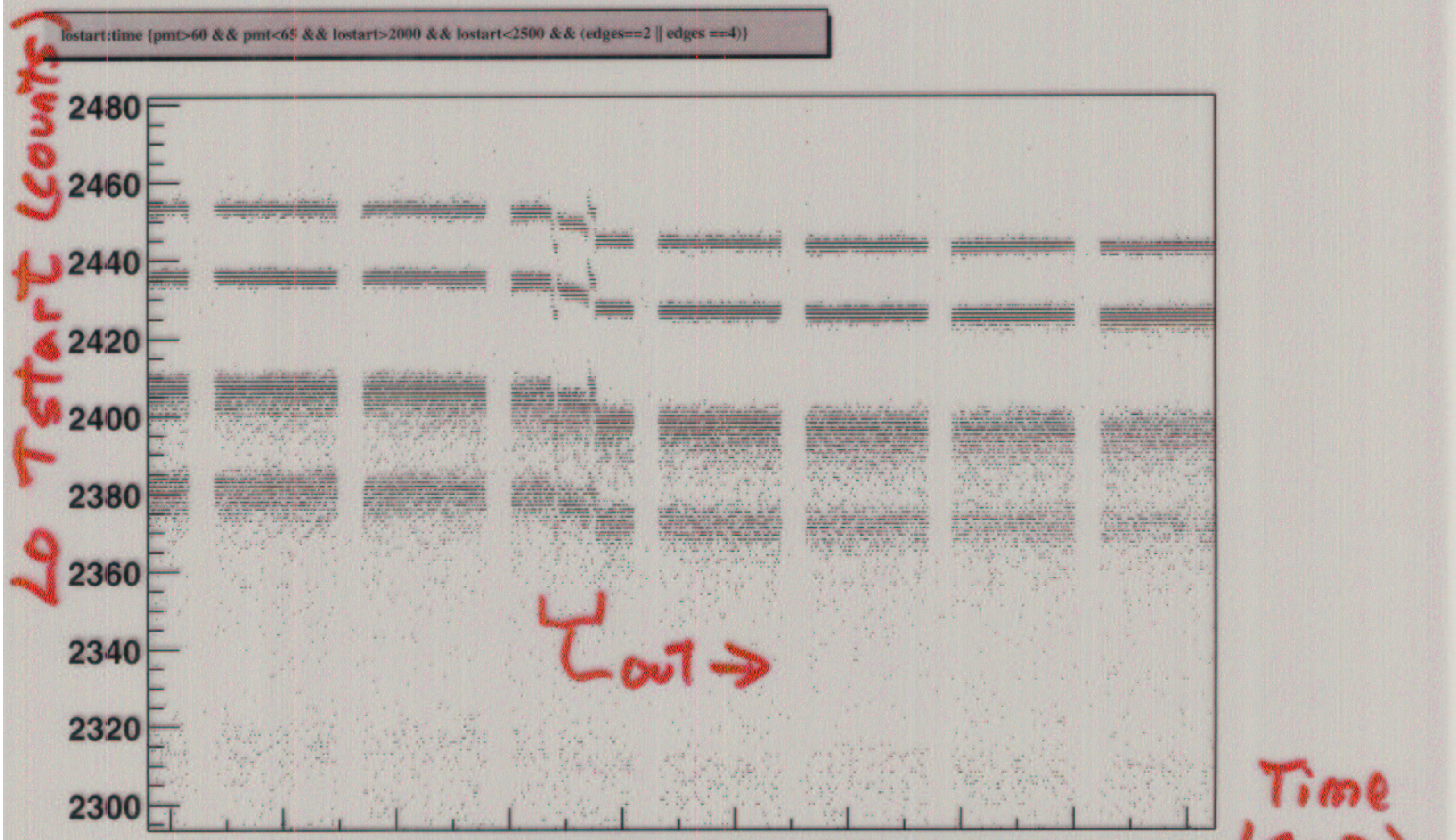
   Possible solution: bad connector in laser shack?

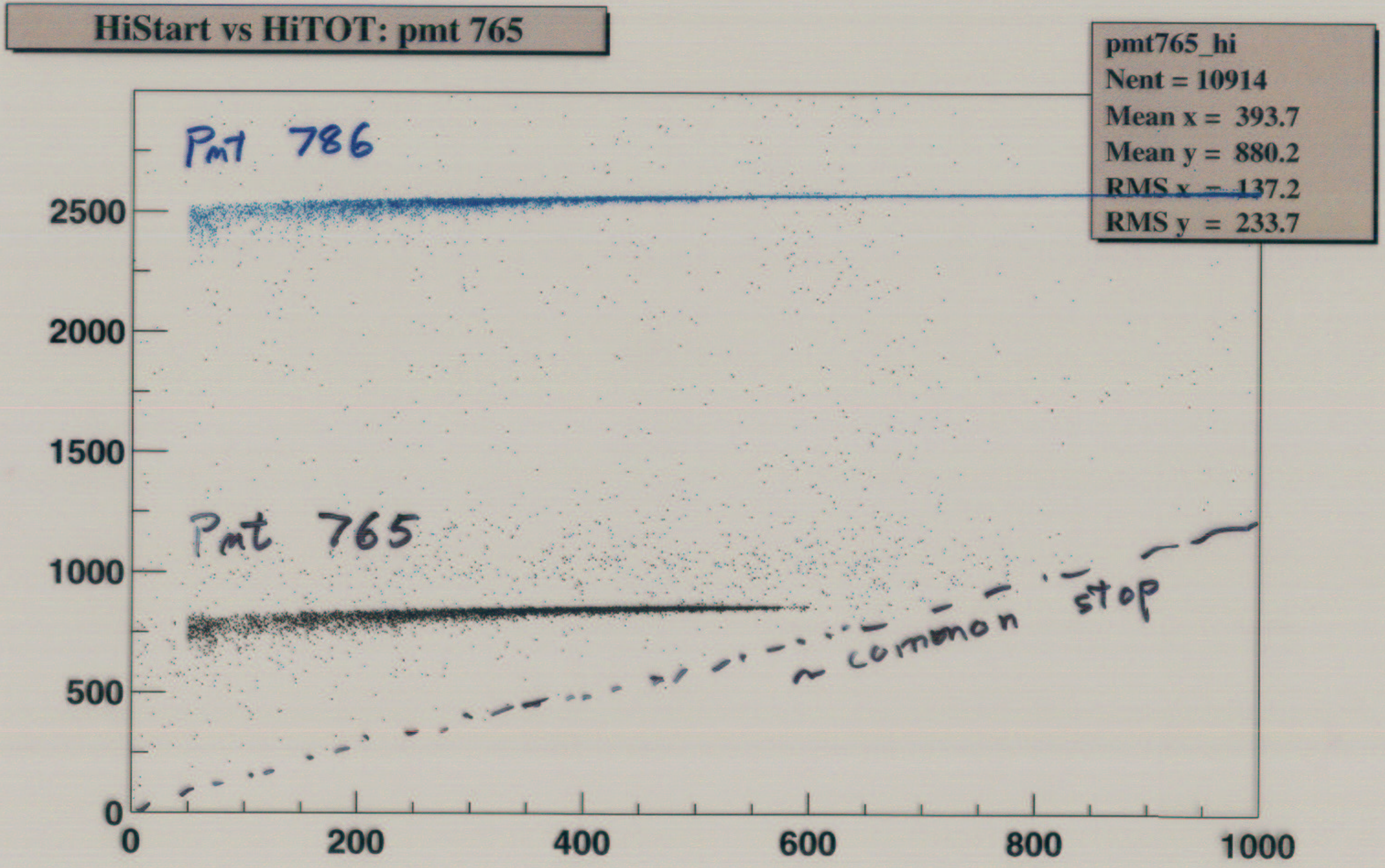

lostart:time {ball==19 && pmt<760}
Lo start (counts)
2200
2000
1800
1600
1400
1200
75500
76000
76500
77000
77500
Time (SOD)


lostart:time {ball==19 && lostart>1200 && lostart<2200}
2050
2000
1950
1900
1850
1800
1750
1700
1650
75500
76000
76500
77000
77500


LoStart vs LoToT, tube 120 from ball 11
loTStart (counts)
2430
2420
2410
2400
2390
2380
2370
2360
0
200
400
600
800
1000
loTOT (counts)
Nov 2000
Nov 2000

Nov 2000 Laser Ball 7



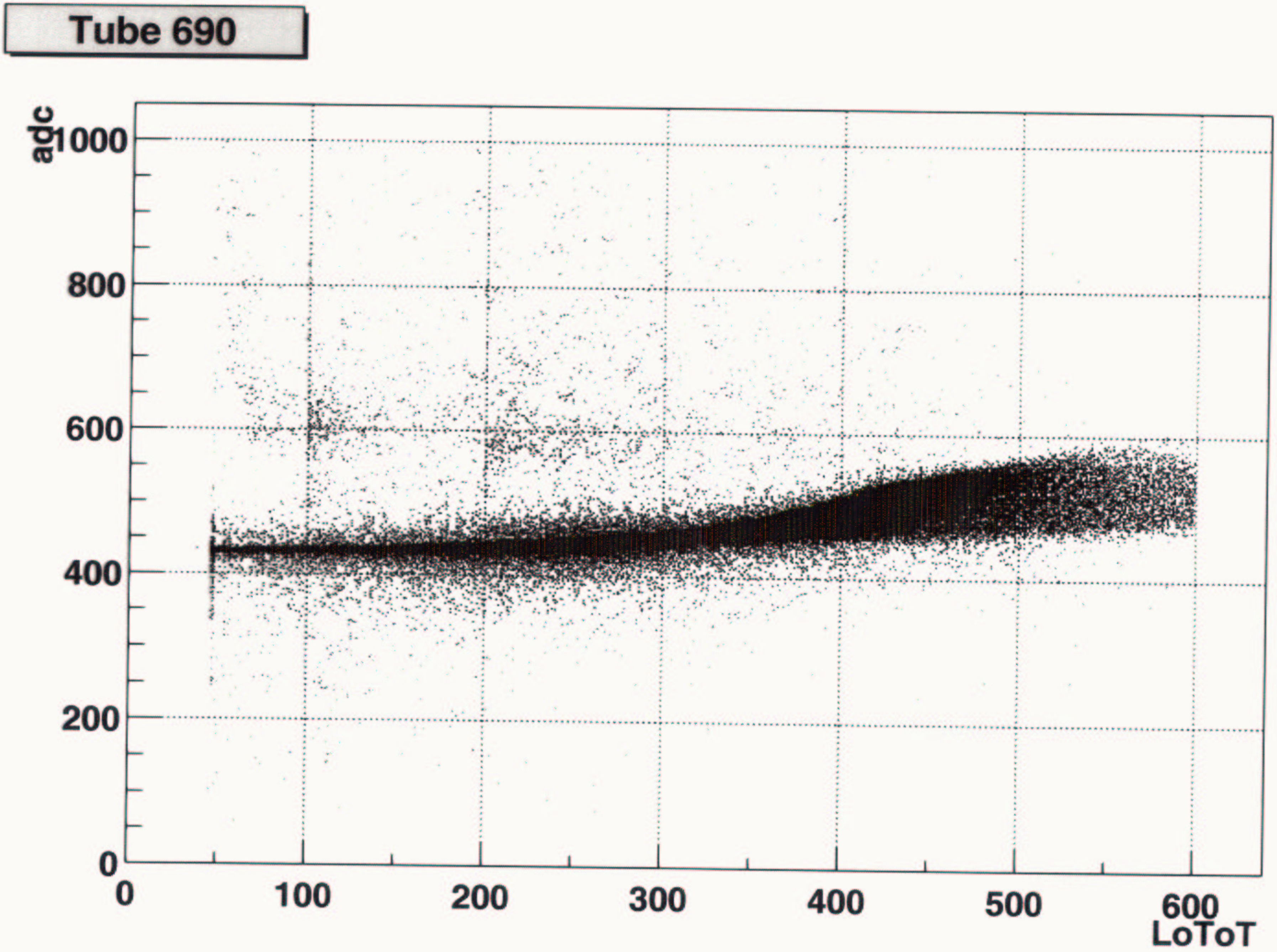

HiStart vs HiTOT: pmt 765
pmt765_hi
Nent = 10914
Mean x = 393.7
Mean y = 880.2
RMS x = 137.2
RMS y = 233.7
Pmt 786
Pmt 765
~ common stop
0
500
1000
1500
2000
2500
0
200
400
600
800
1000

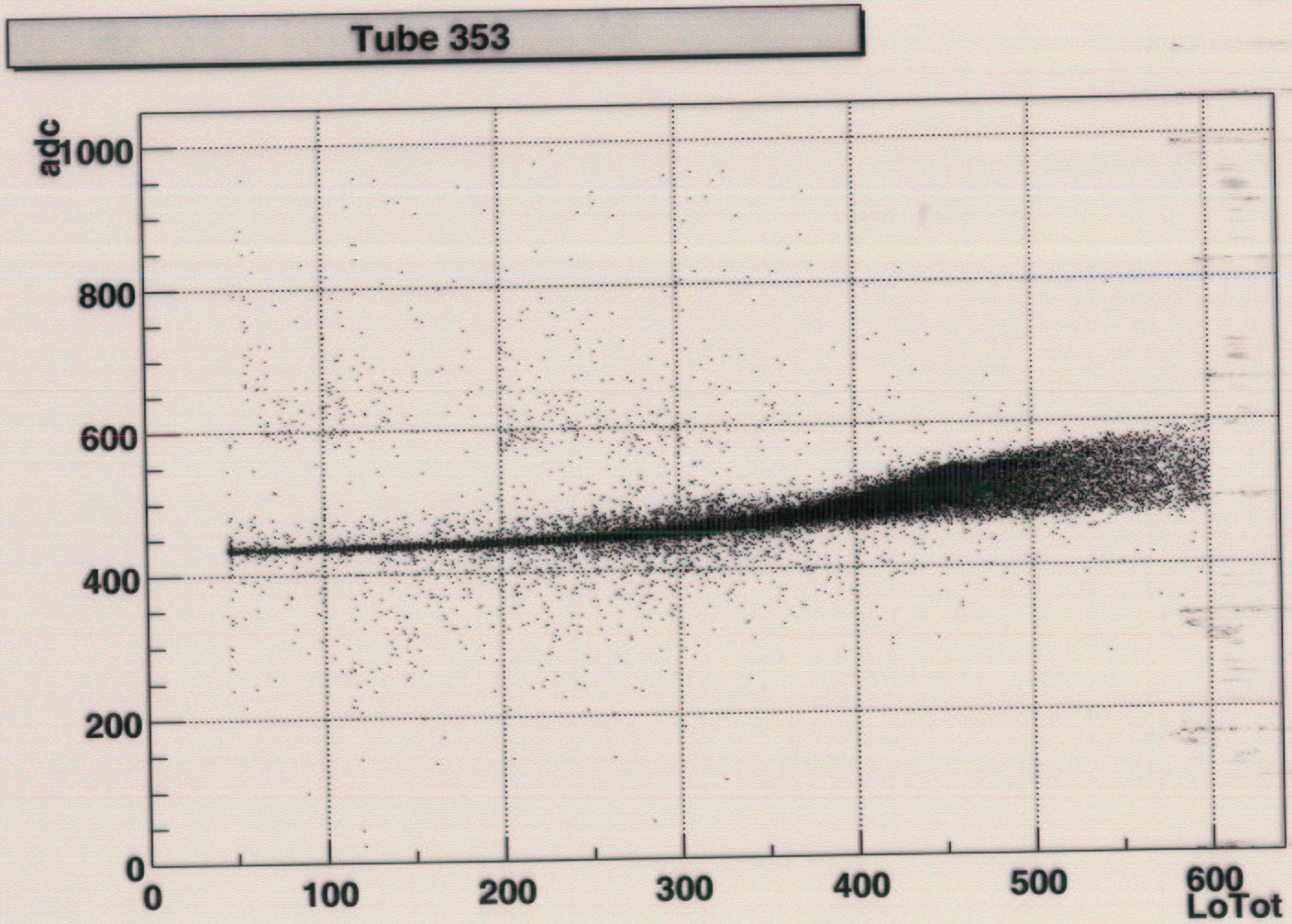
5 PE Calibrations with ADC - David Noyes

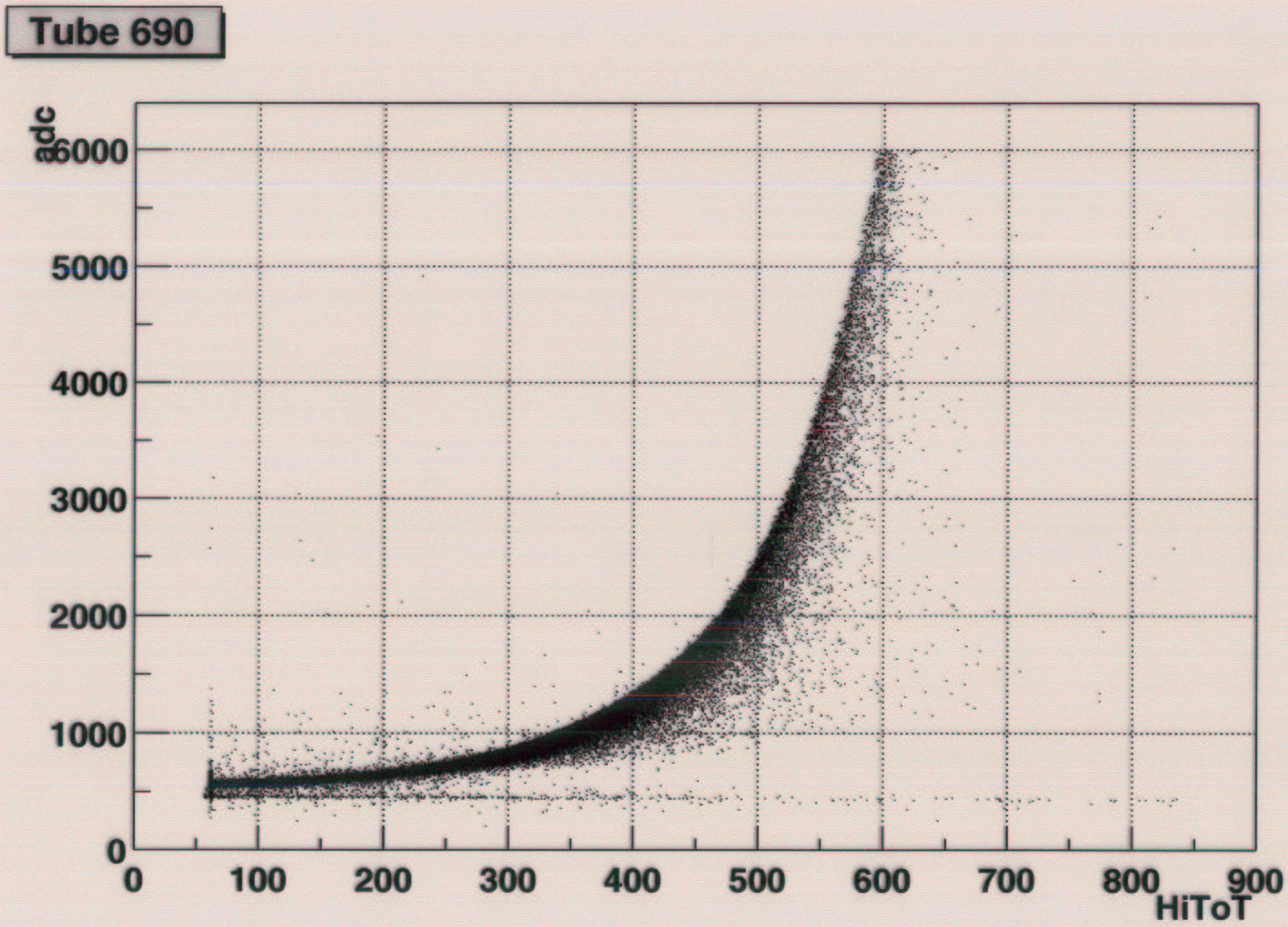
ADC
Calibration

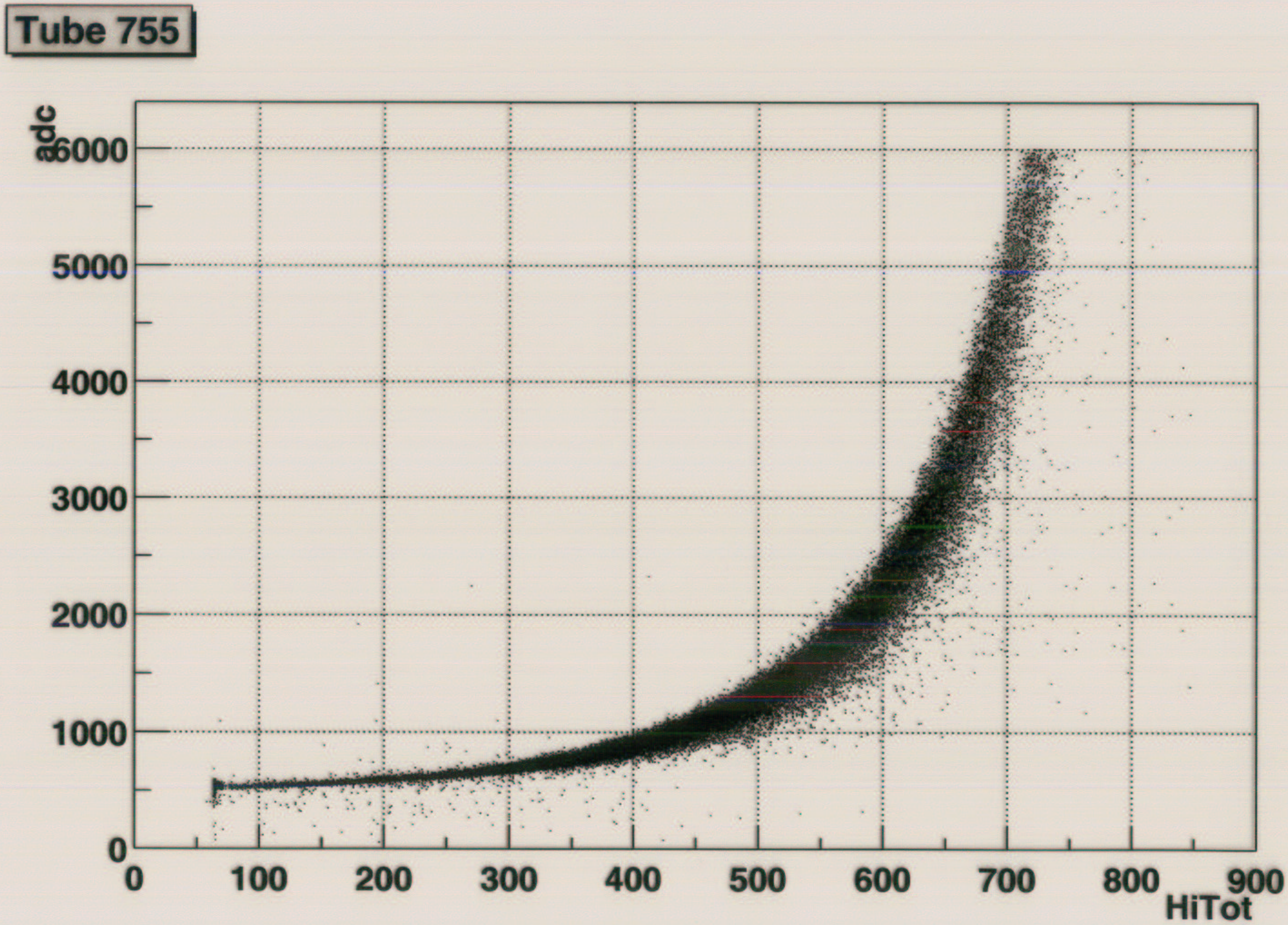
* ADC data taken for entire pond & outriggers.

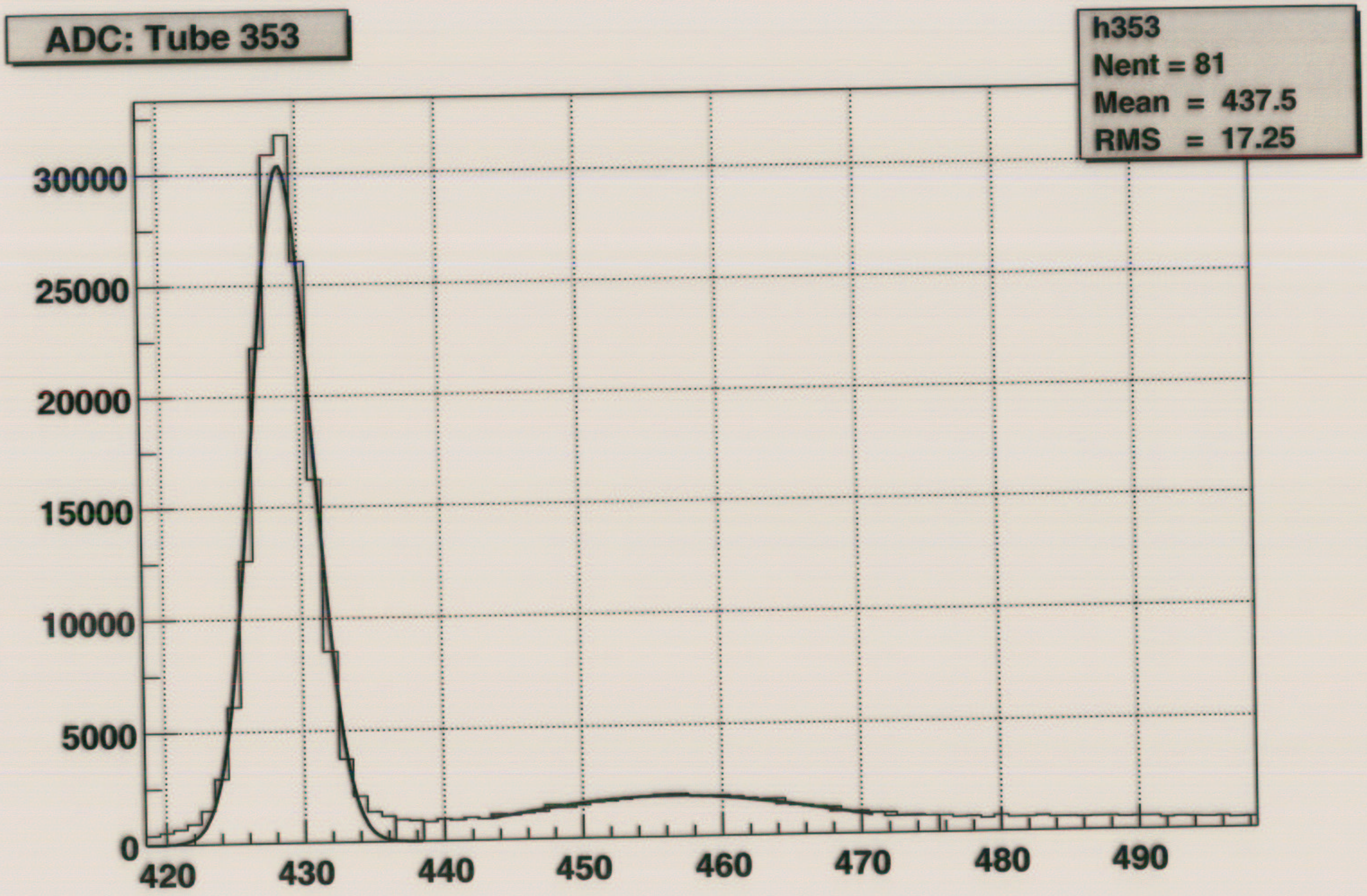
* Use ADC calibration as a check on/improve laser pe calibration

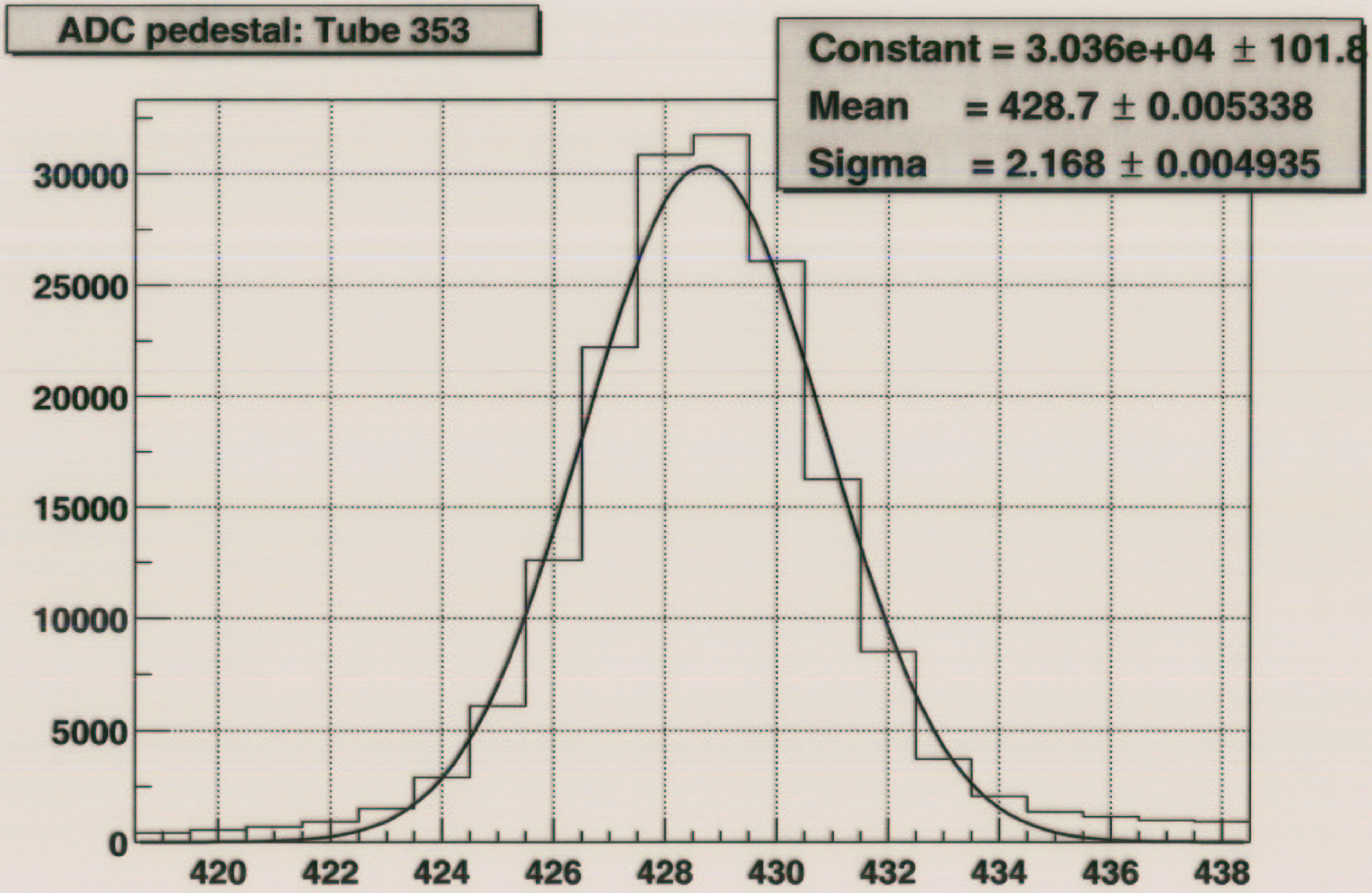

Tube 690
adc
1000
800
600
400
200
0
0
100
200
300
400
500
600
LoToT

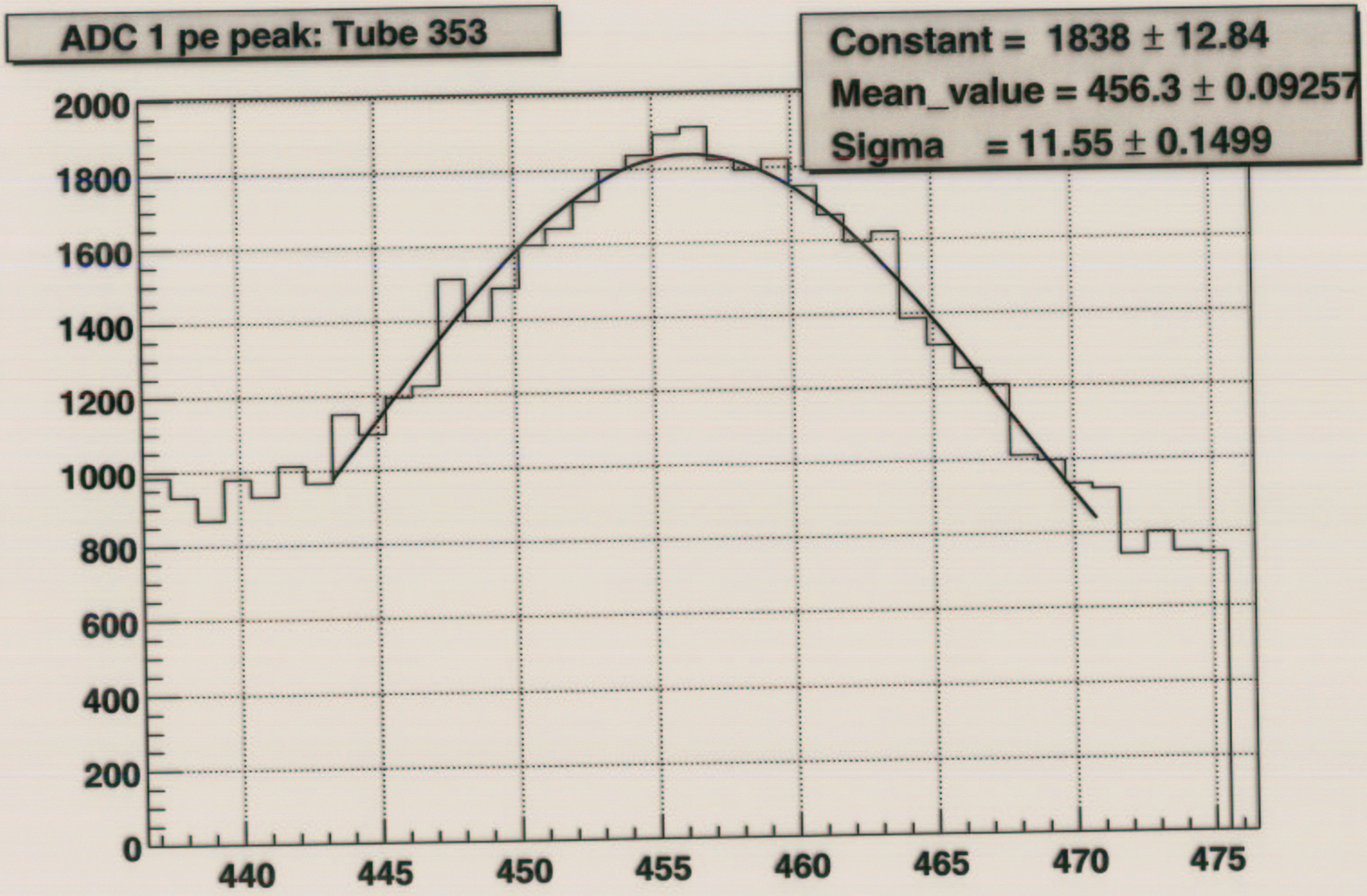

Tube 353
adc
1000
800
600
400
200
0
0
100
200
300
400
500
600
LoTot

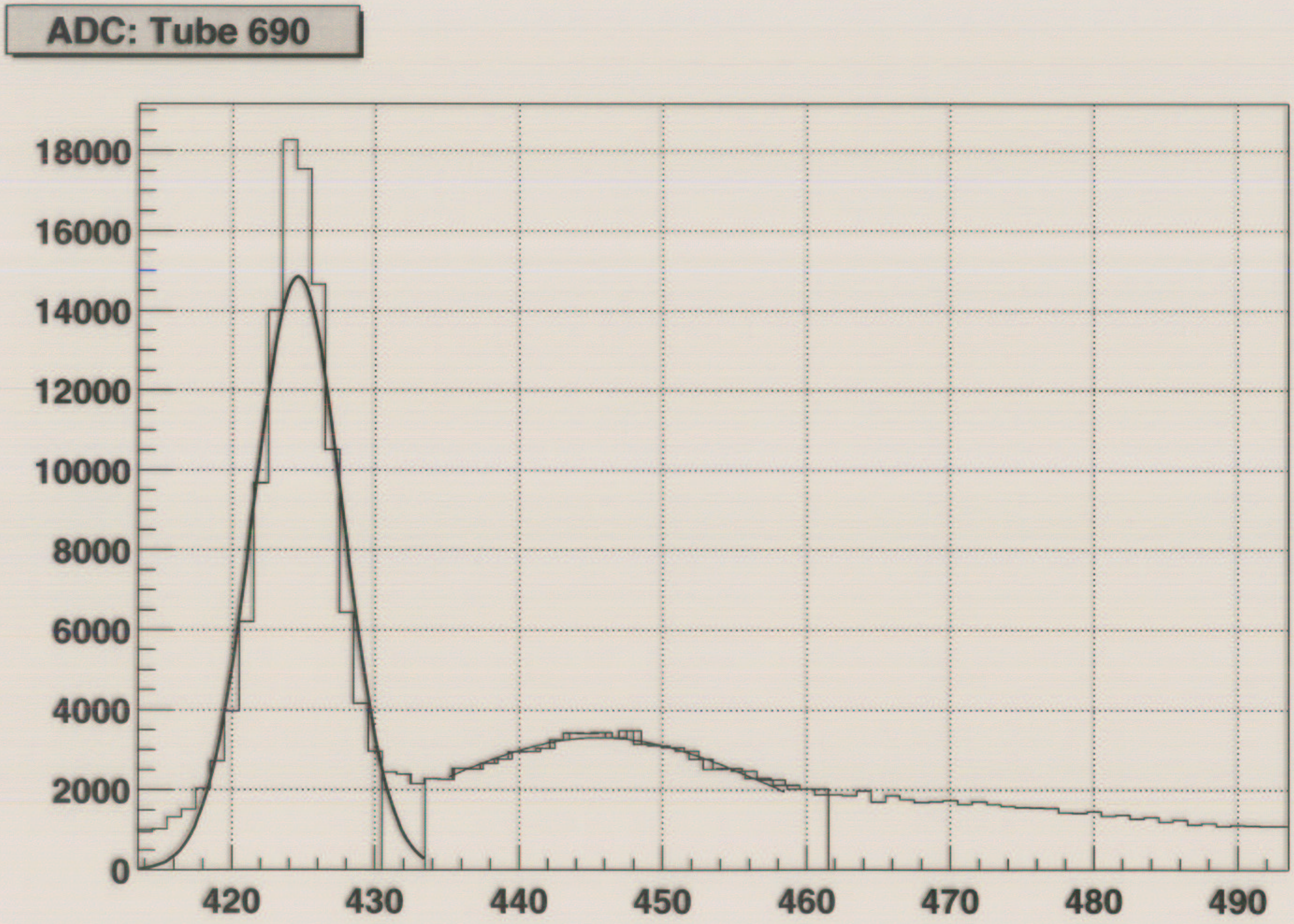

Tube 690
adc
6000
5000
4000
3000
2000
1000
0
0
100
200
300
400
500
600
700
800
900
HiToT

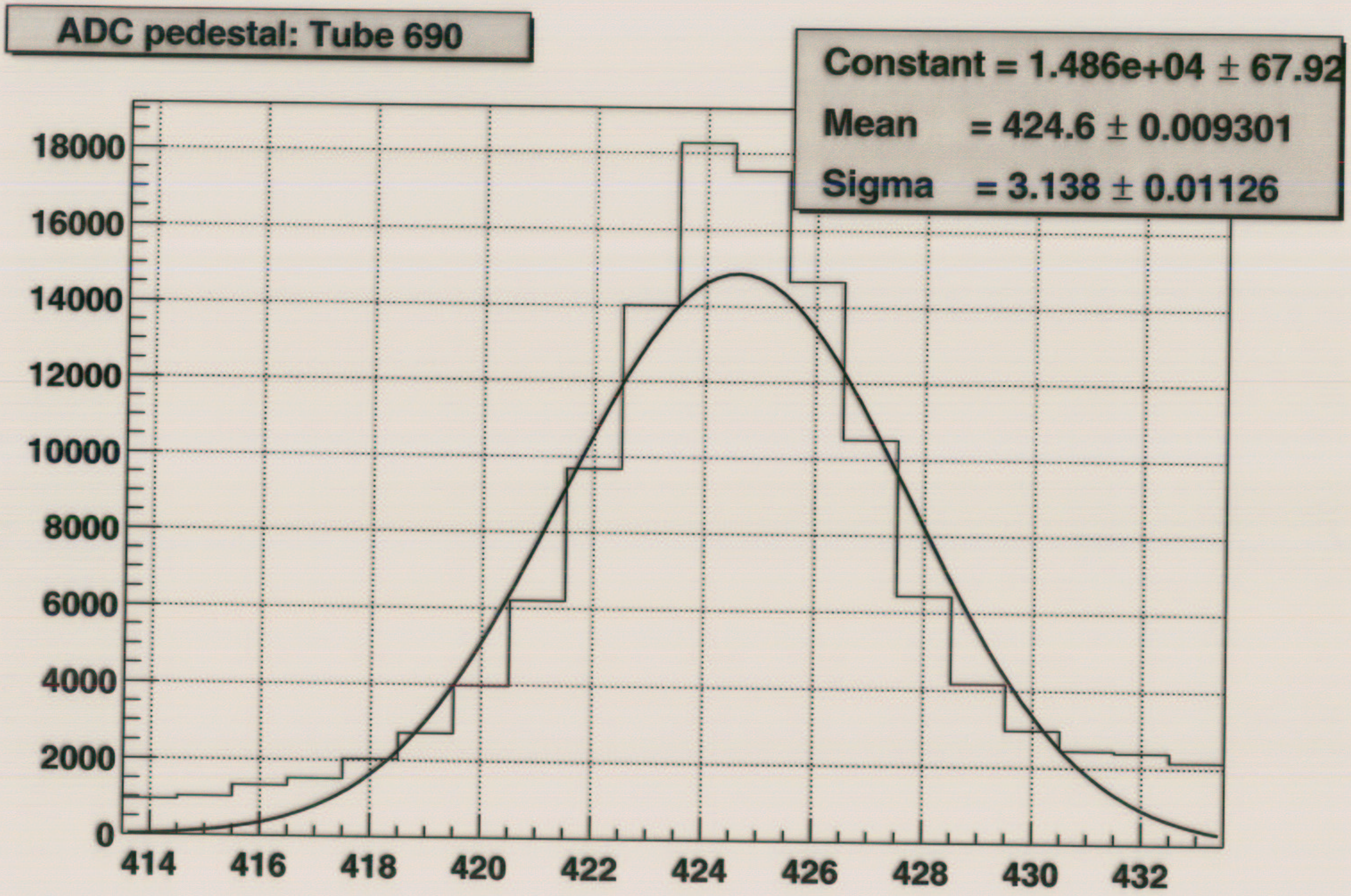

Tube 755
adc
6000
5000
4000
3000
2000
1000
0
0
100
200
300
400
500
600
700
800
900
HiTot

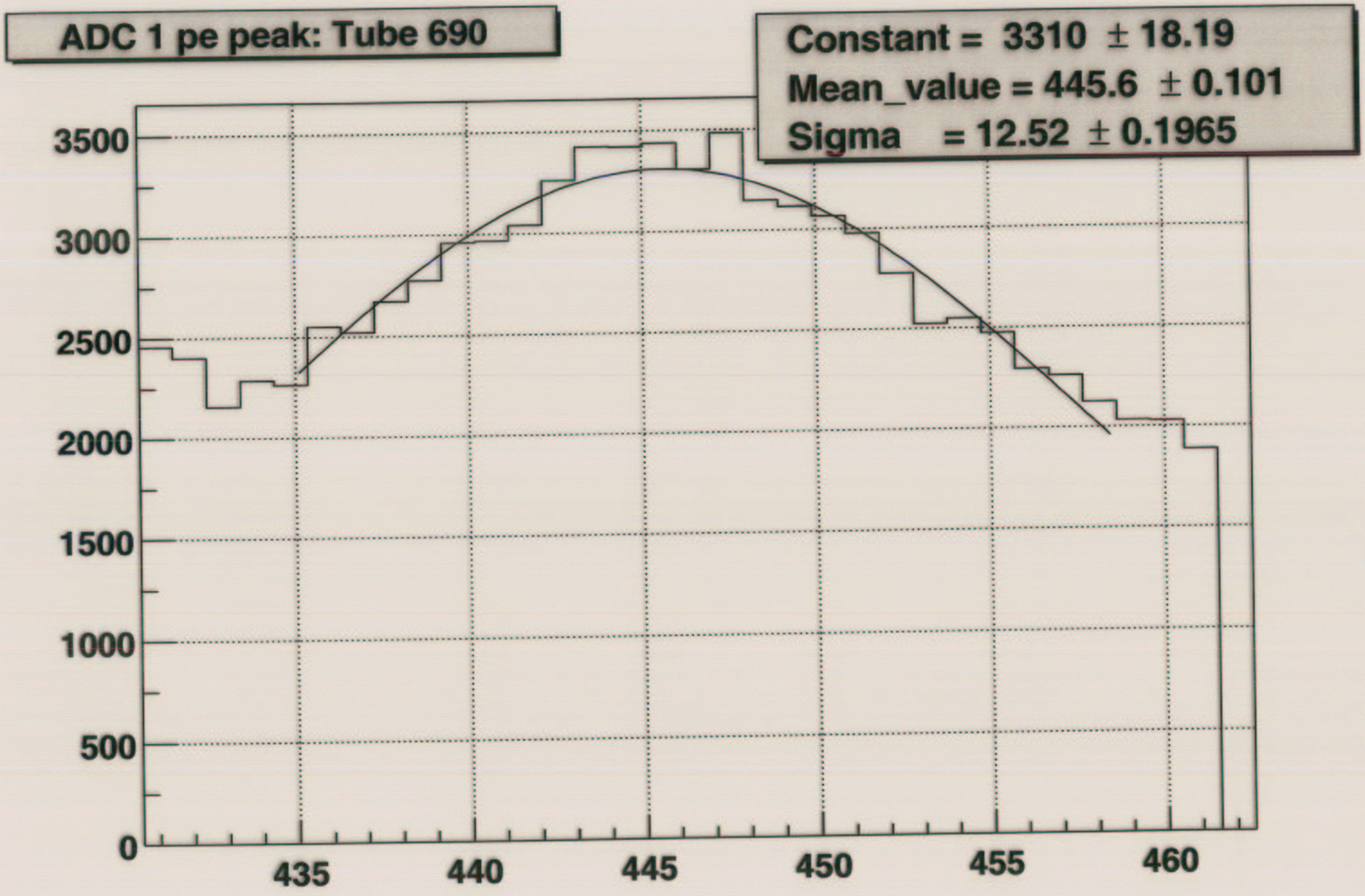

ADC: Tube 353
h353
Nent = 81
Mean = 437.5
RMS = 17.25
30000
25000
20000
15000
10000
5000
0
420
430
440
450
460
470
480
490

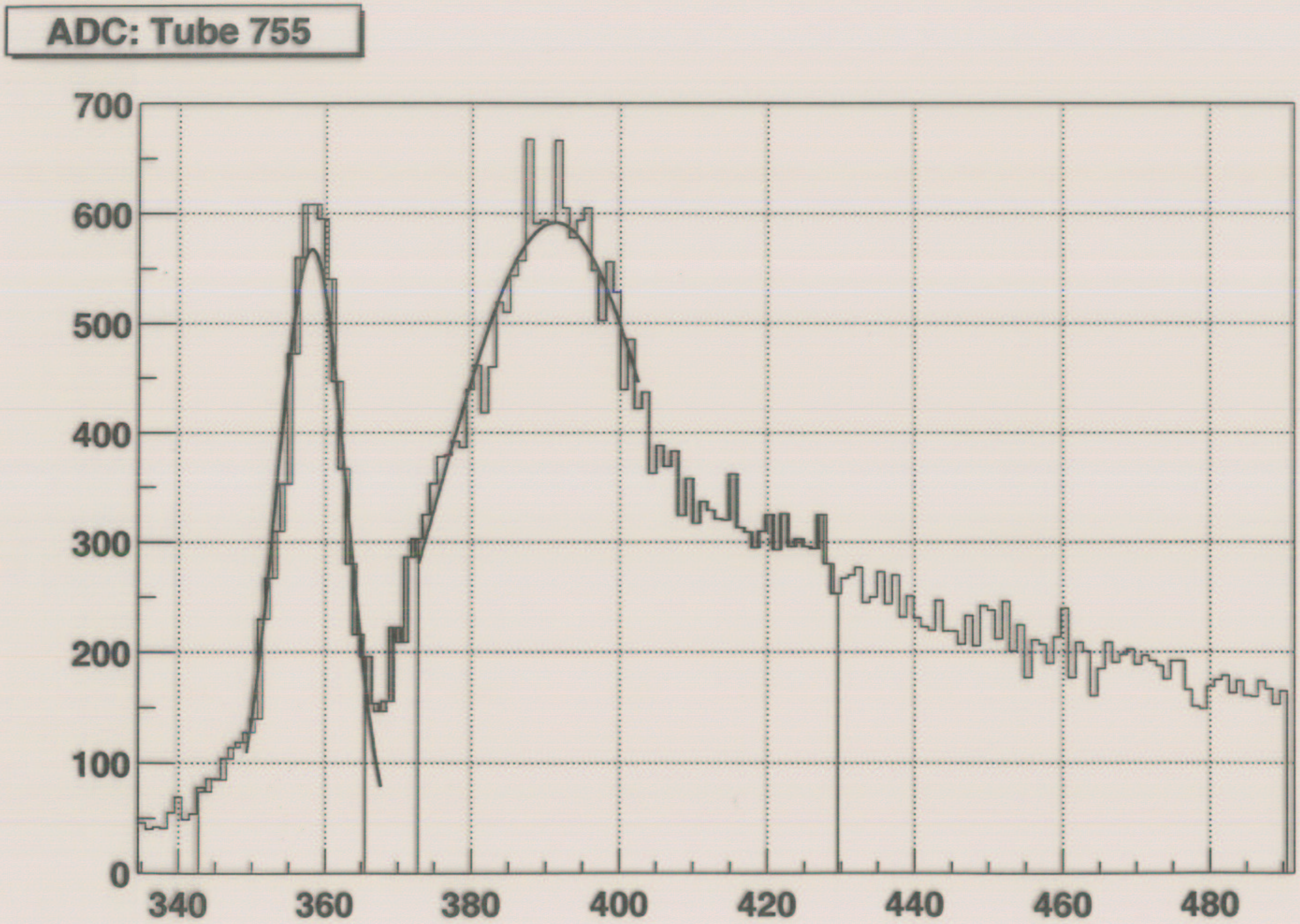

ADC pedestal: Tube 353
Constant = 3.036e+04 ± 101.8
Mean = 428.7 ± 0.005338
Sigma = 2.168 ± 0.004935
30000
25000
20000
15000
10000
5000
0
420
422
424
426
428
430
432
434
436
438

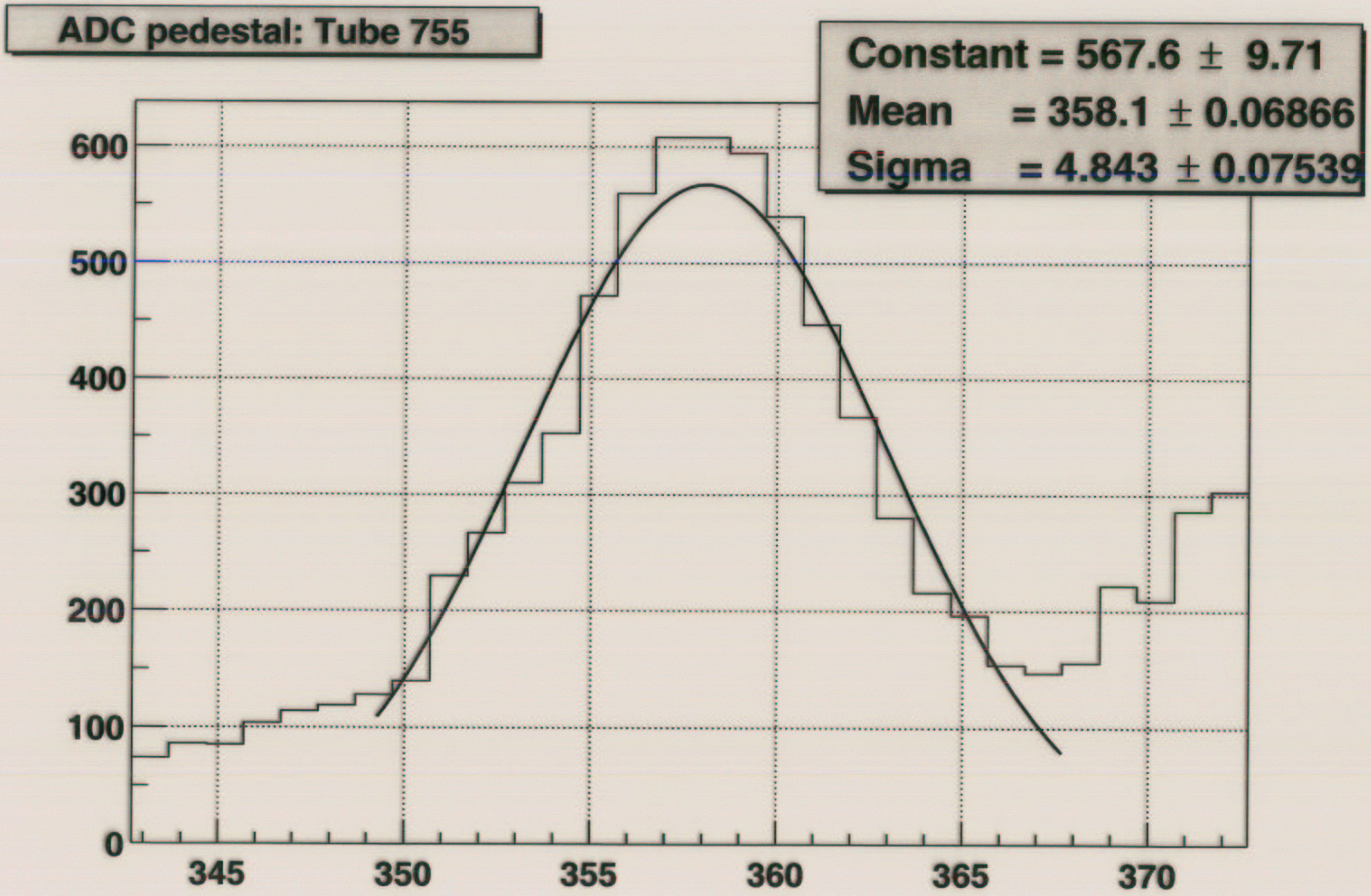

ADC 1 pe peak: Tube 353
Constant = 1838 ± 12.84
Mean_value = 456.3 ± 0.09257
Sigma = 11.55 ± 0.1499
2000
1800
1600
1400
1200
1000
800
600
400
200
0
440
445
450
455
460
465
470
475

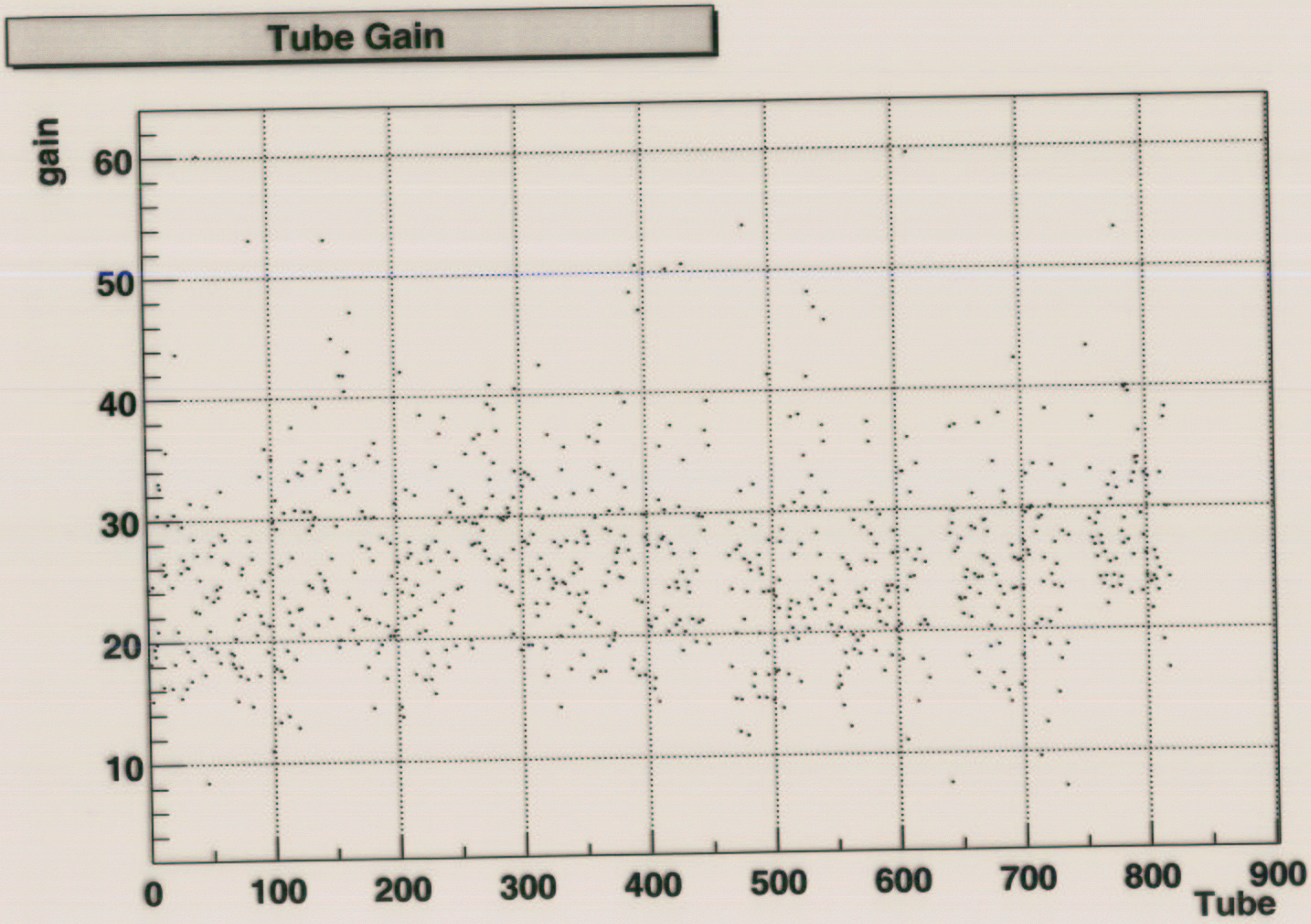

ADC: Tube 690
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
420
430
440
450
460
470
480
490

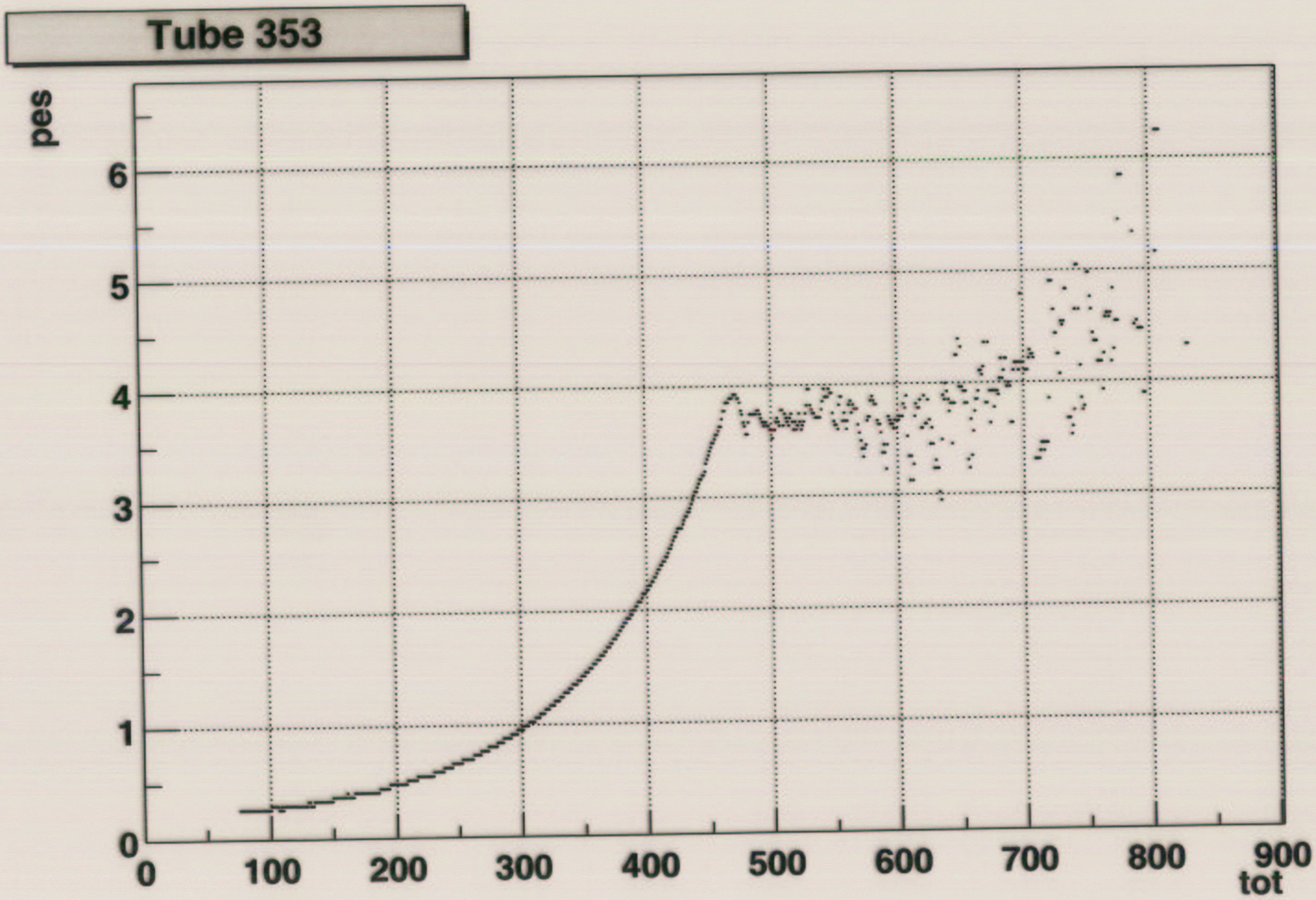

ADC pedestal: Tube 690
Constant = 1.486e+04 ± 67.92
Mean = 424.6 ± 0.009301
Sigma = 3.138 ± 0.01126
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
414
416
418
420
422
424
426
428
430
432

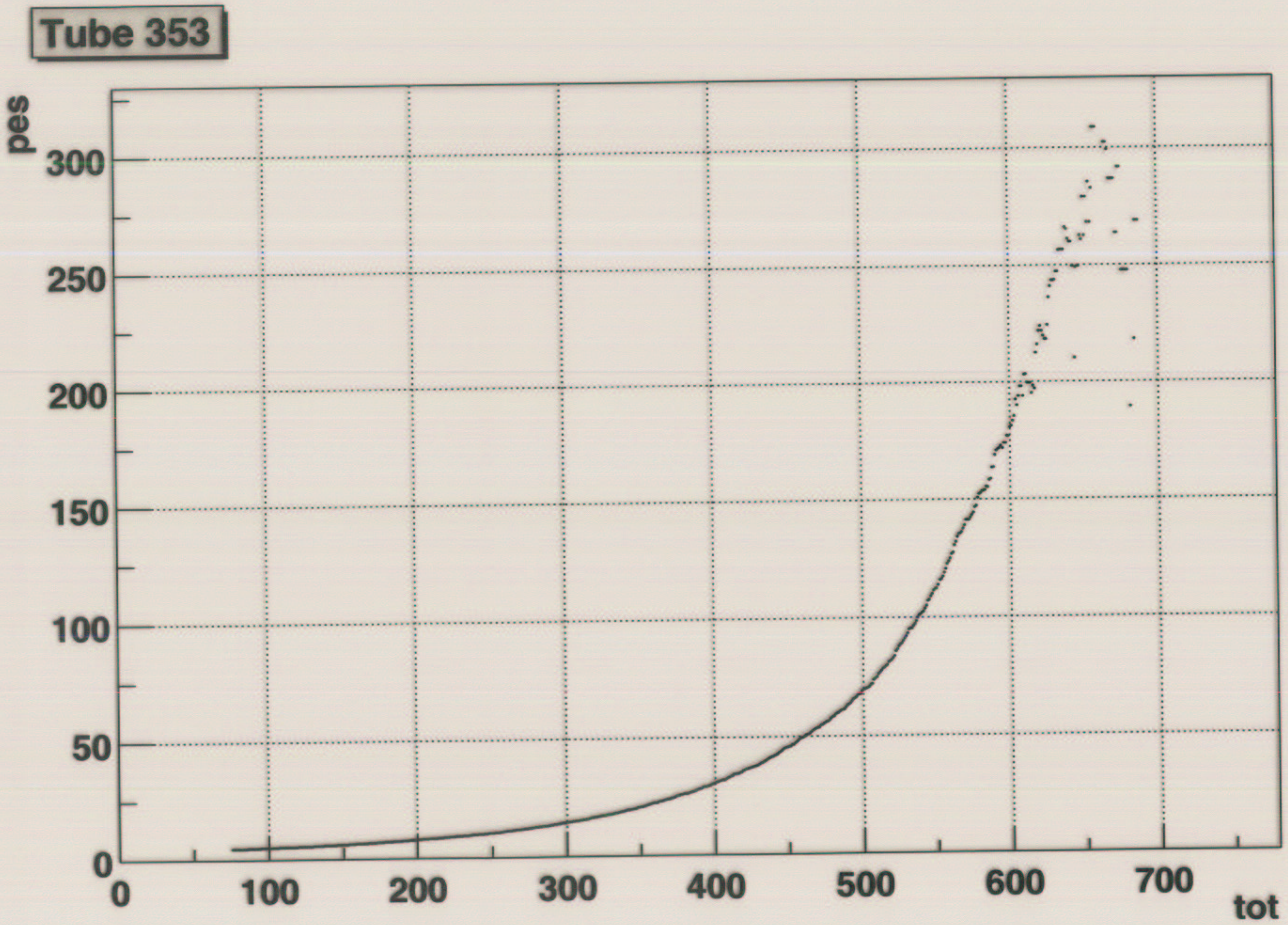

ADC 1 pe peak: Tube 690
Constant = 3310 ± 18.19
Mean_value = 445.6 ± 0.101
Sigma = 12.52 ± 0.1965
3500
3000
2500
2000
1500
1000
500
0
435
440
445
450
455
460

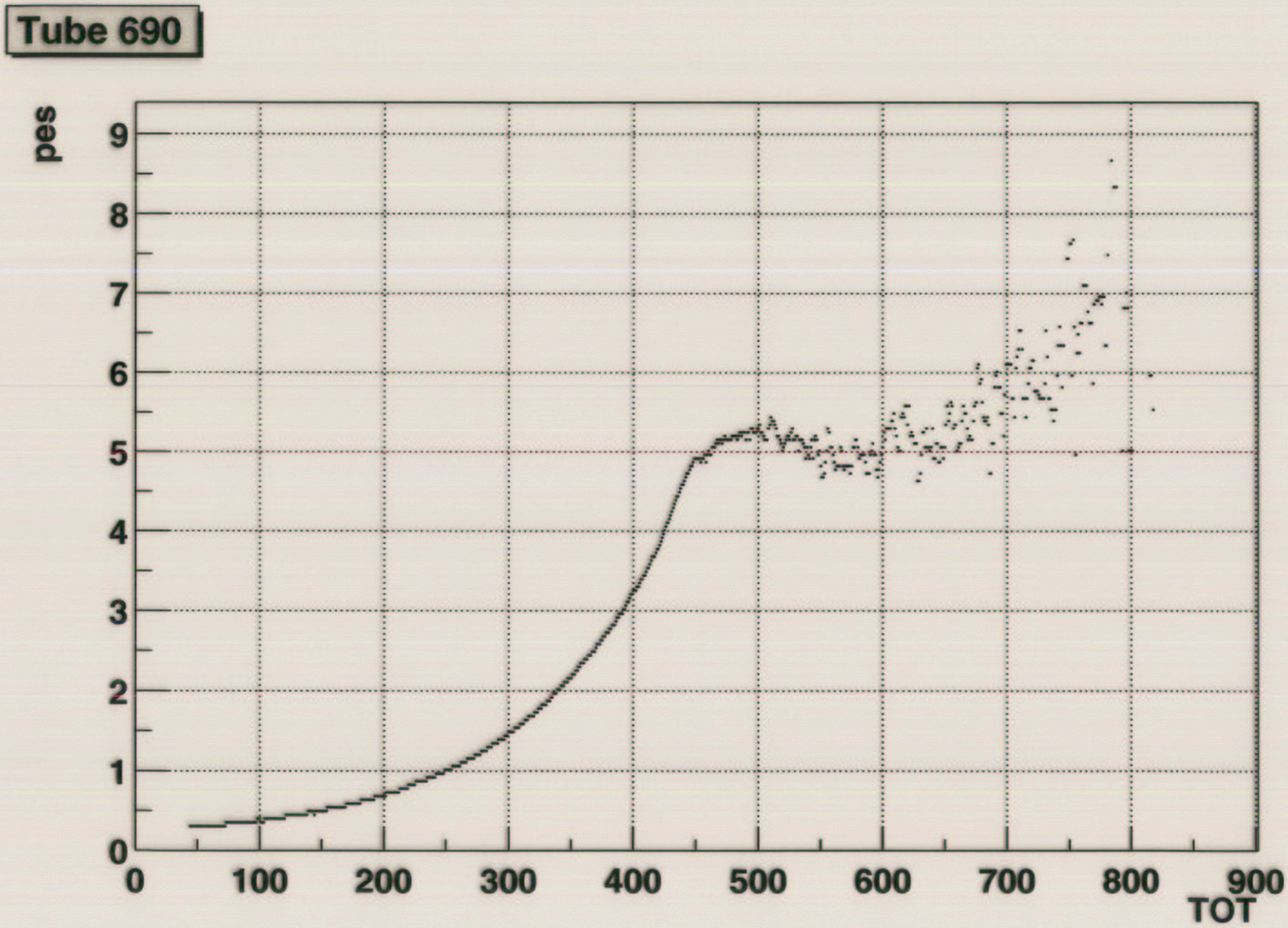

ADC: Tube 755
700
600
500
400
300
200
100
0
340
360
380
400
420
440
460
480

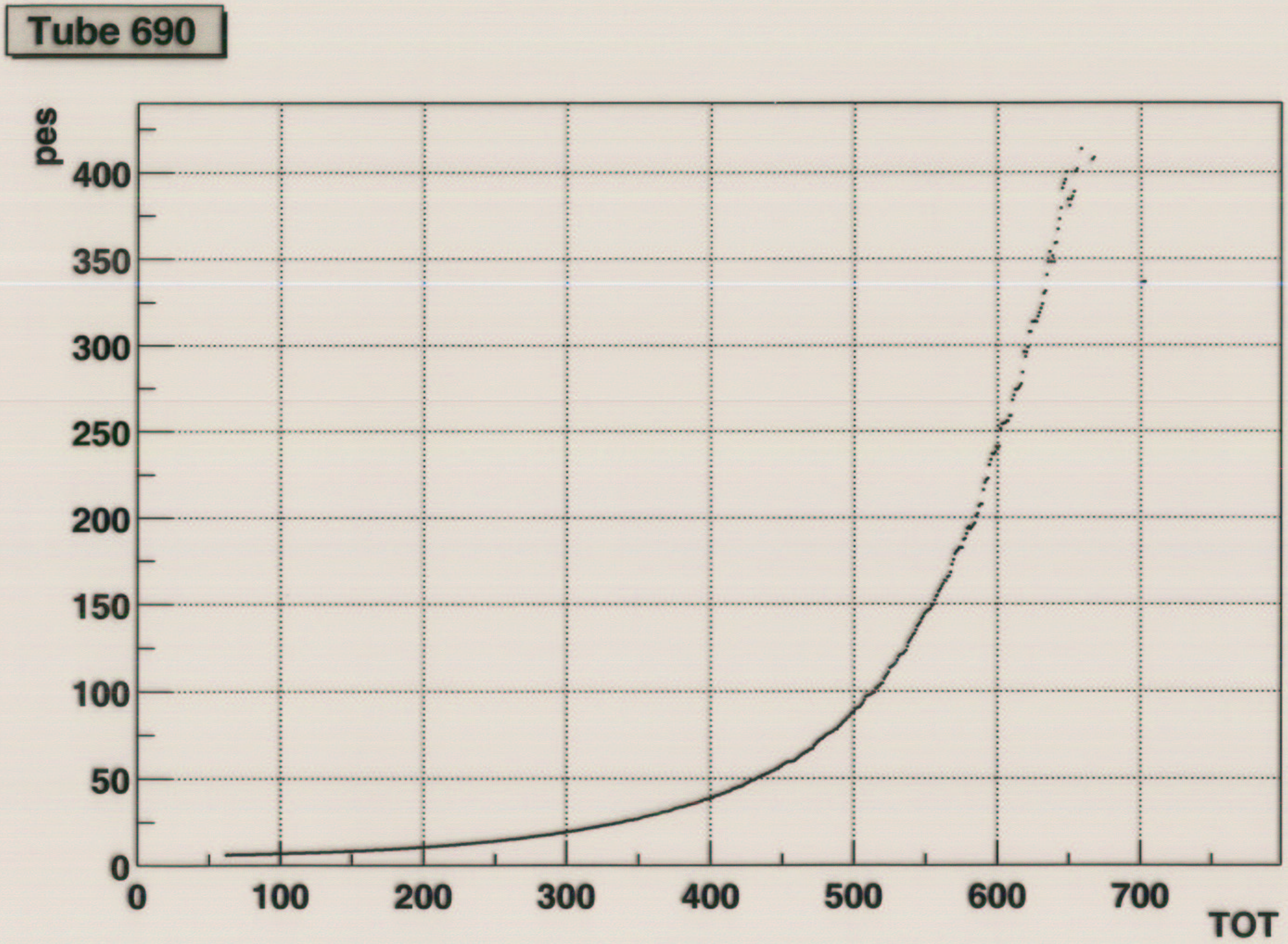

ADC pedestal: Tube 755
Constant = 567.6 ± 9.71
Mean = 358.1 ± 0.06866
Sigma = 4.843 ± 0.07539
0
100
200
300
400
500
600
345
350
355
360
365
370

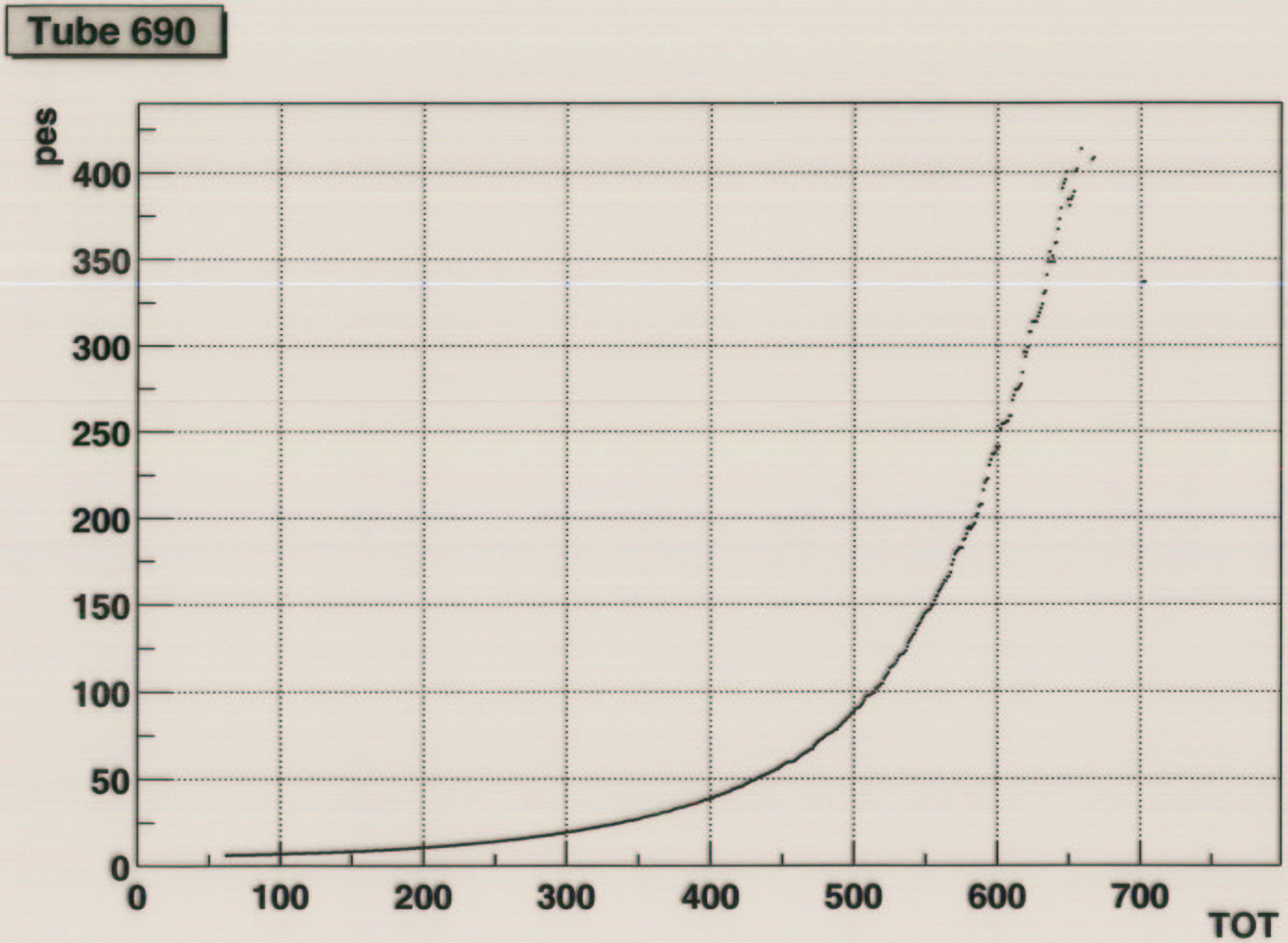

Tube Gain
gain
60
50
40
30
20
10
0
100
200
300
400
500
600
700
800
900
Tube

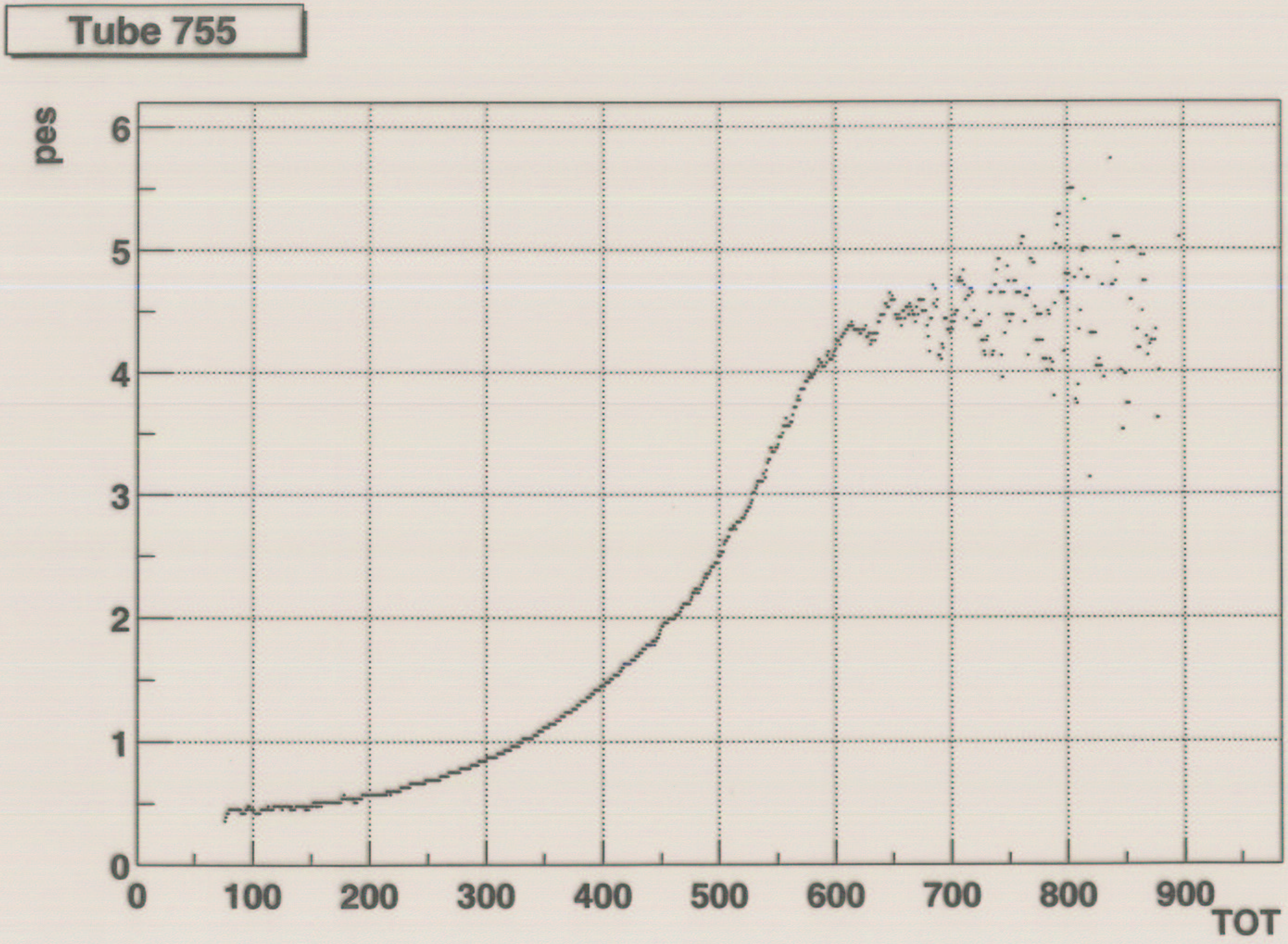

Tube 353
pes
0
1
2
3
4
5
6
0
100
200
300
400
500
600
700
800
900
tot

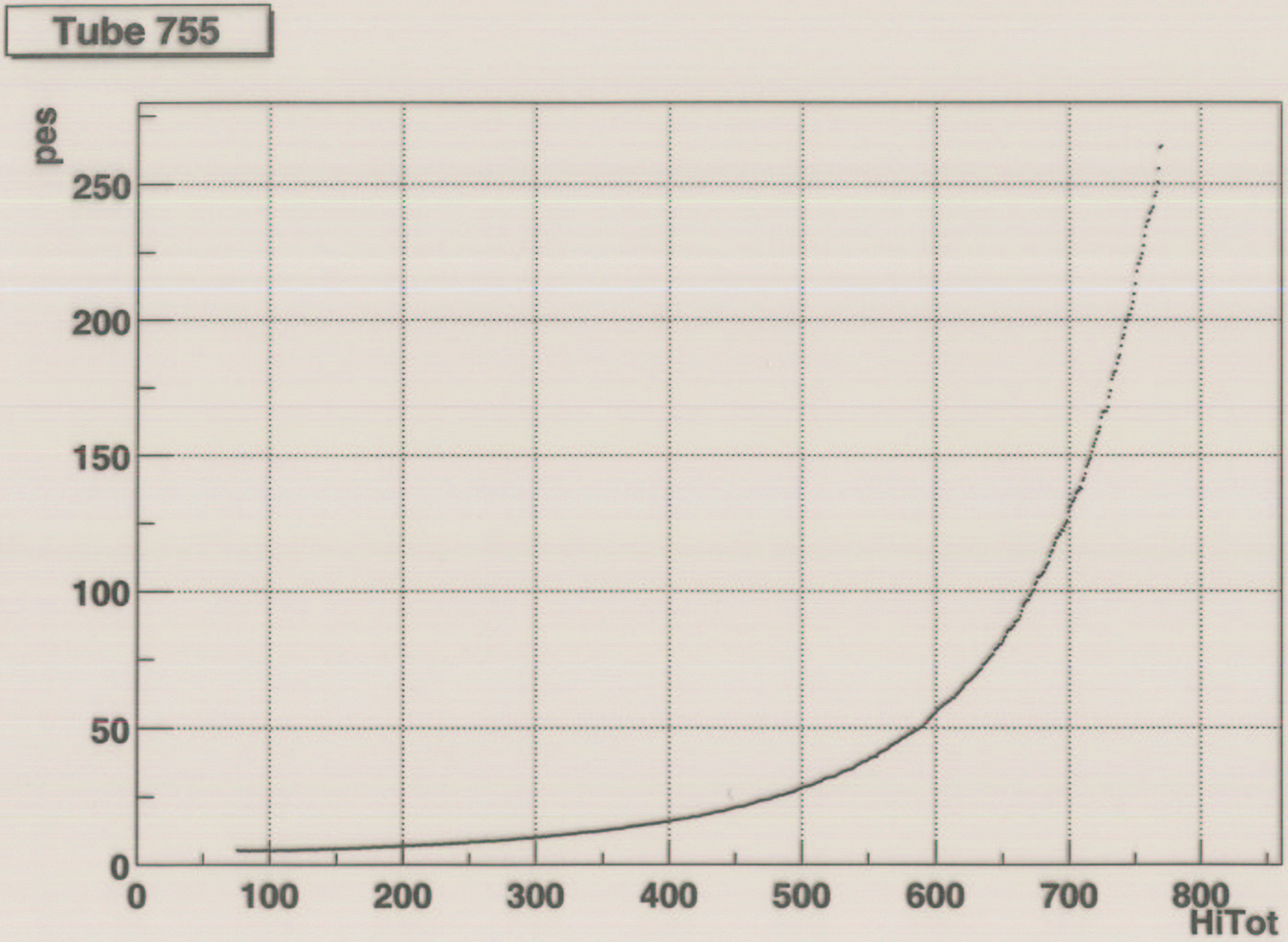

Tube 353
pes
0
50
100
150
200
250
300
0
100
200
300
400
500
600
700
tot

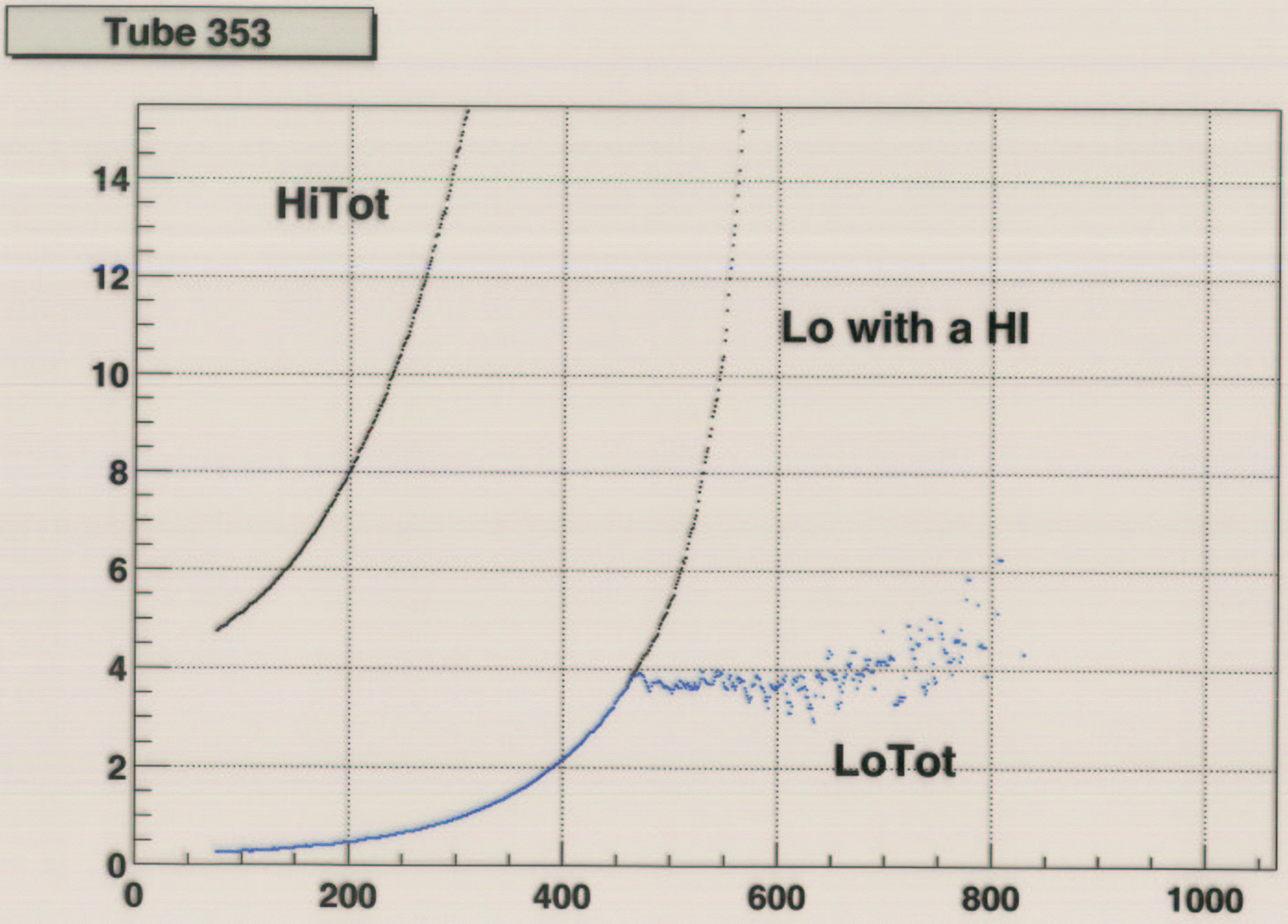

Tube 690
pes
0
1
2
3
4
5
6
7
8
9
0
100
200
300
400
500
600
700
800
900
TOT

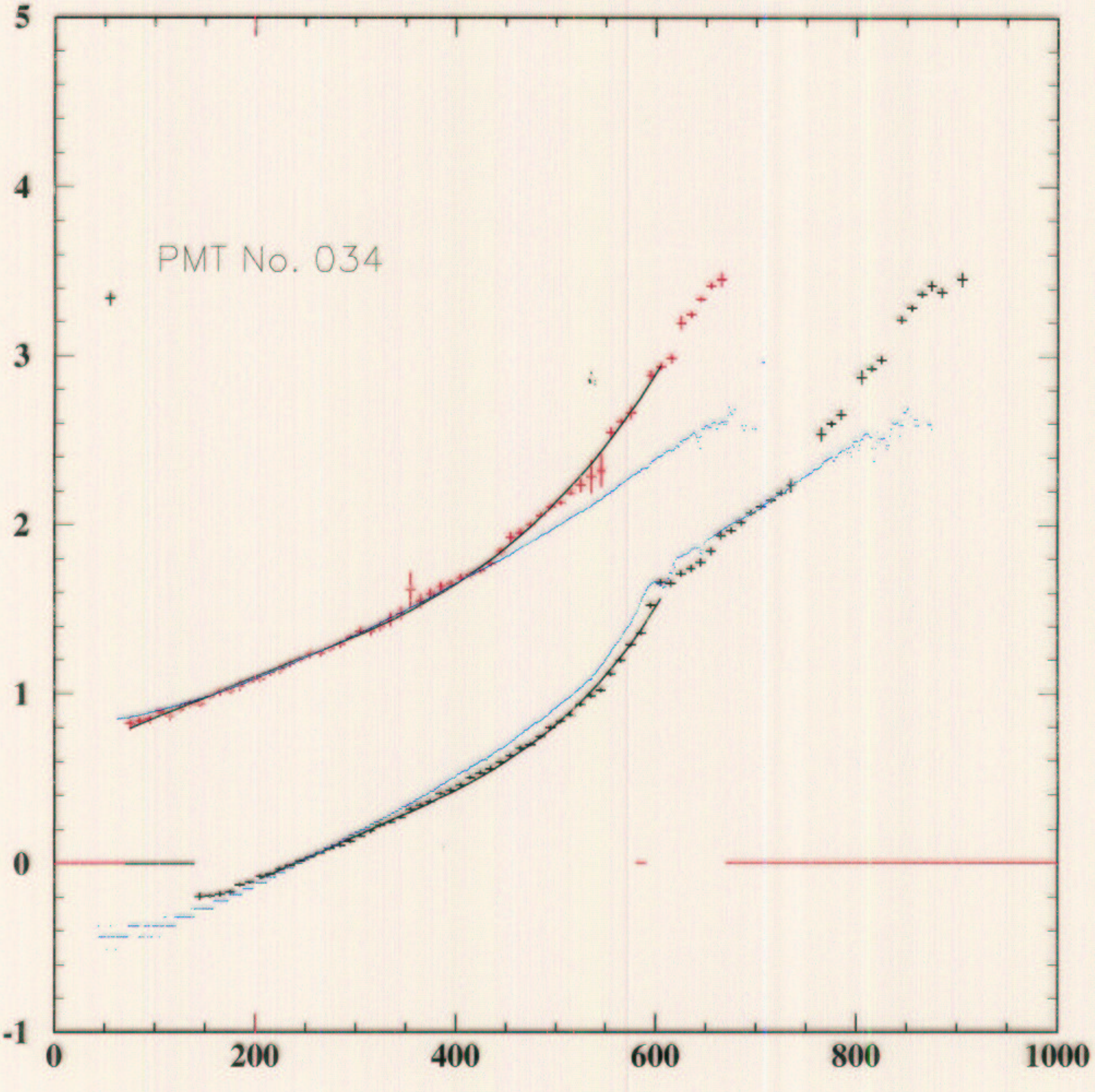

Tube 690
pes
0
50
100
150
200
250
300
350
400
0
100
200
300
400
500
600
700
TOT

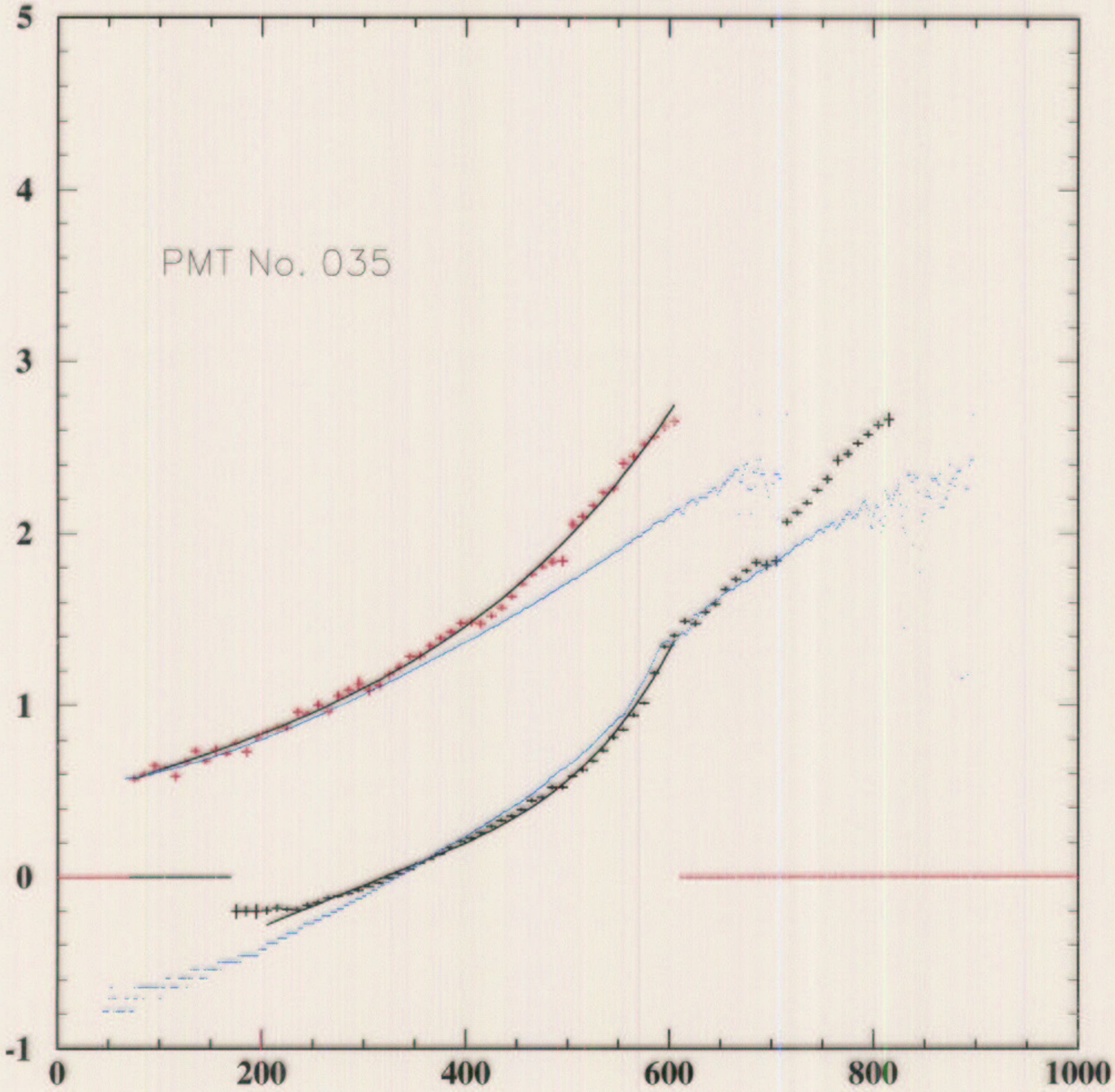

Tube 690
pes
400
350
300
250
200
150
100
50
0
0
100
200
300
400
500
600
700
TOT

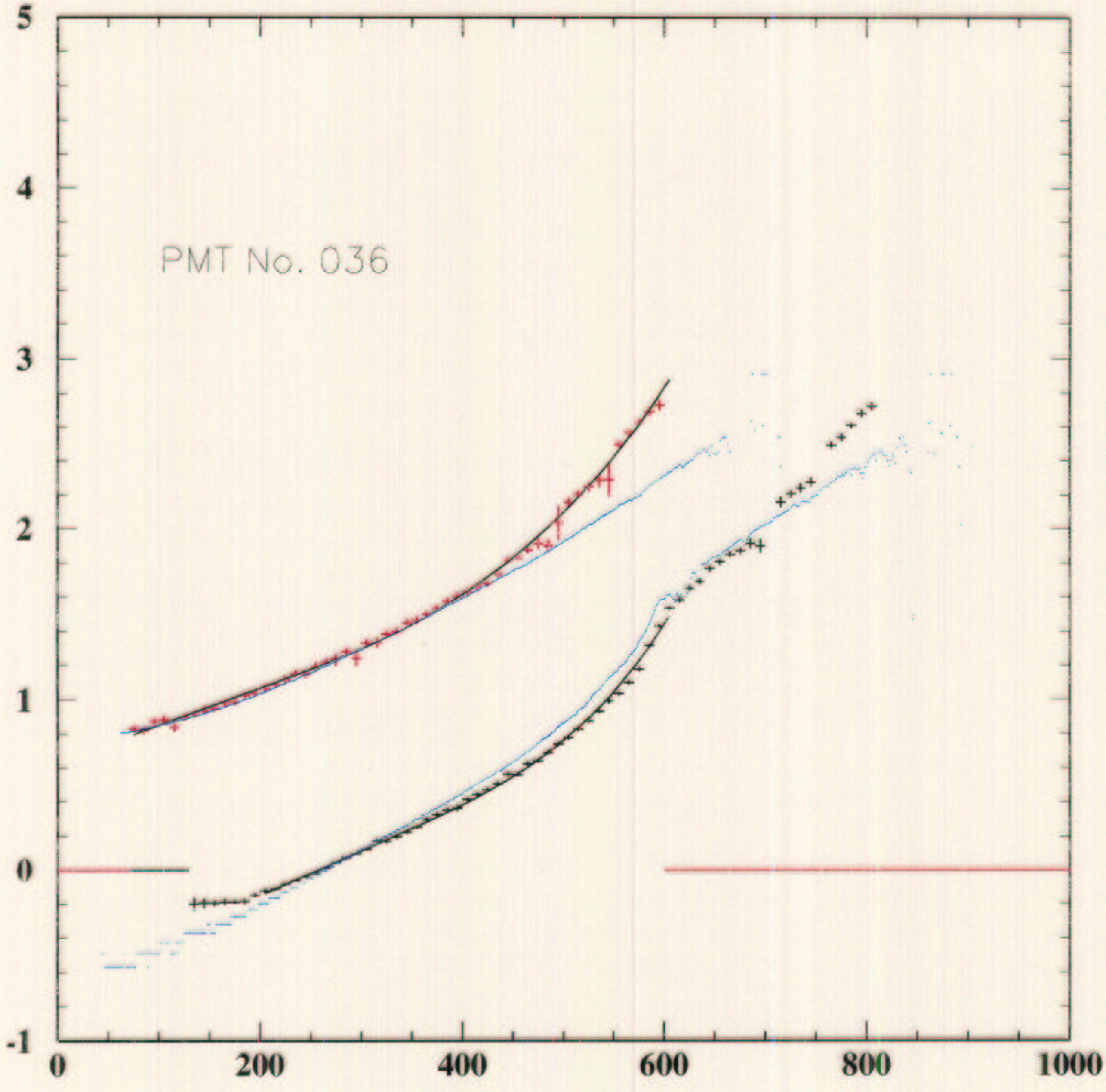

Tube 755
pes
0
1
2
3
4
5
6
0
100
200
300
400
500
600
700
800
900
TOT

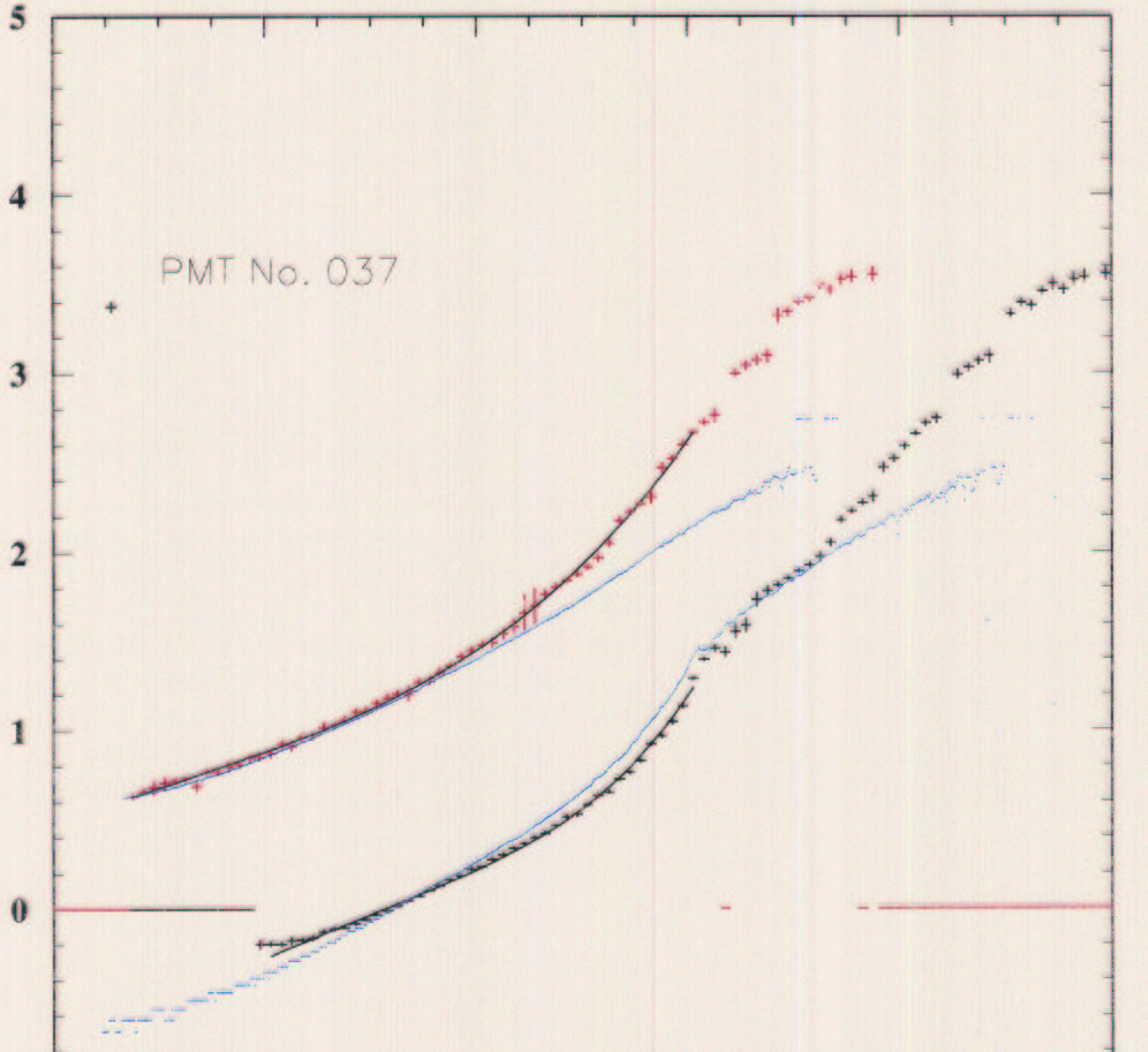

Tube 755
pes
0
50
100
150
200
250
0
100
200
300
400
500
600
700
800
HiTot


Tube 353
HiTot
Lo with a HI
LoTot
0
2
4
6
8
10
12
14
0
200
400
600
800
1000


PMT No. 034
5
4
3
2
1
0
-1
0
200
400
600
800
1000


PMT No. 035
5
4
3
2
1
0
-1
0
200
400
600
800
1000


PMT No. 036
5
4
3
2
1
0
-1
0
200
400
600
800
1000


PMT No. 037
5
4
3
2
1
0
-1
0
200
400
600
800
1000

6 Outrigger Overview (Current Status, Coming Schedule) - Tony Shoup

Status & Schedule for Outrigger Construction

What’s been done to date?

- The inner array (66 tanks) completed
  - Installed, filled, light sealed, surveyed
  - All working well, including fibers
- Progress on outer array (105 + 5)
  - HV cables run to each outrigger
  - Optical fibers run to each outrigger
  - Received all 105 tanks
  - Assembled and delivered 54 Tyvek sets
  - All pmts have been modified with PVC fittings

Status & Schedule for Outrigger Construction

What needs to be done for completion?

- Finish another 60 Tyvek sets & deliver to Fenton Hill
- Solder pigtails on UCI pmts
- Deliver pmts and support materials to Fenton Hill
- Deploy the tanks
  - Place tank at site
  - Install Tyvek
  - Install pmt (includes assembly of pmt/structure)
  - Fill with water
  - Seal and cover
  - Terminate fiber
- Insert into data stream
- Survey and calibrate

Status & Schedule for Outrigger Construction

Labor needs for completion?

- At UCI: **(total 160 hours)**
  - Finish Tyvek sets − 120 hours
  - Attach pmt pigtails − 20 hours
  - Process pmt support materials − 20 hours

- At Fenton Hill:
  - Tank Deployment: **(total: 2.0 * 110 = 220 hours)**
    - Tank placement and cleaning − 0.5 hour
    - Install Tyvek − 0.25 hour
    - Install pmt − 0.33 hour
    - Water Fill − 0.25 hour
    - Fiber termination − 0.25 hour
    - Cover − 0.25 hour

} ~2.0 hours

Status & Schedule for Outrigger Construction

Labor needs for completion? (continued)

- At Fenton Hill (continued):
  - Insert into data stream
    - Spark gap installation – ??.? hours?
    - Install connectors at spark gaps and in counting house – 55 hours
    - Connection to data stream – 1 Day?
  - Survey tank positions – 3 Days?
  - Calibrations (laser & paddle?) – ??.? Days?

Status & Schedule for Outrigger Construction

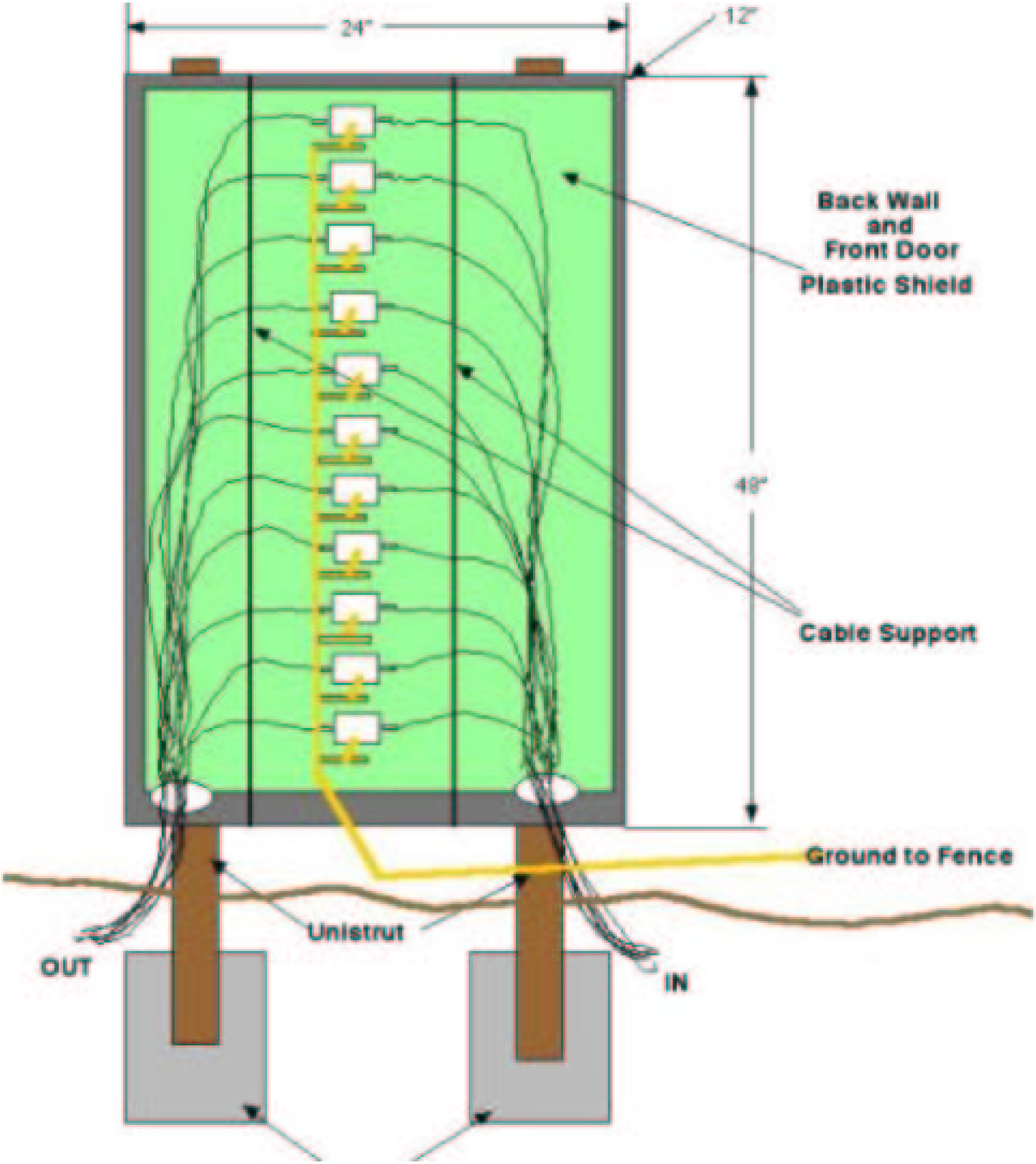
Schedule?

- At UCI:
  - 160 hours − Should be complete by 4/15/02
- At Fenton Hill
  - 275 + ?? hours
  - Depends on **available labor** and **weather**
  - Fiber and PMT installation requires tech. work
  - I plan to be at site 1 week in April, May, & June
- **Bottom line − should have outer array completed before end of summer!**

7 Zap Box Test Results - Don Coyne / Michael Schneider

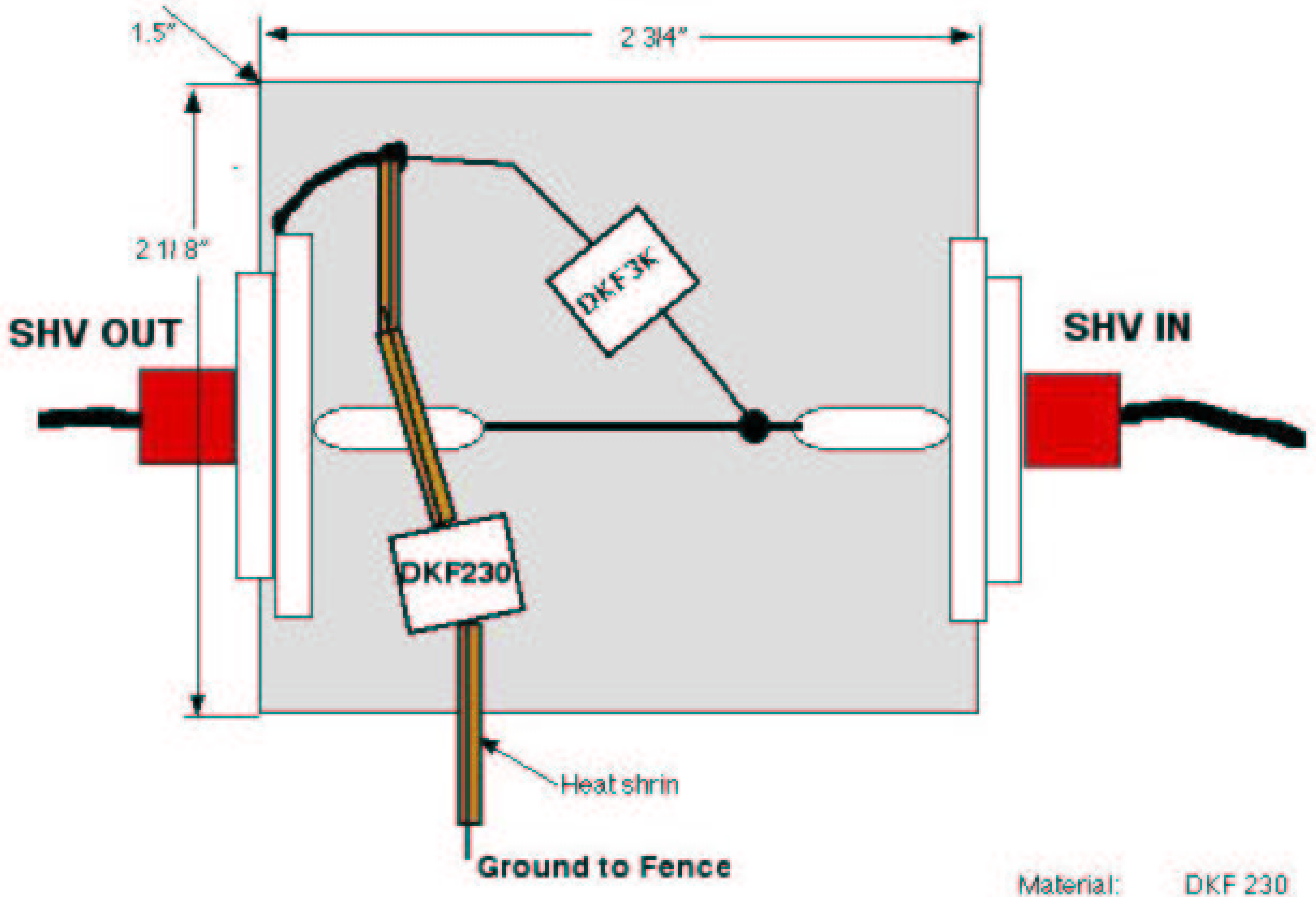
Milagro Meeting Feb.2002

Spark Boxes Test and Status

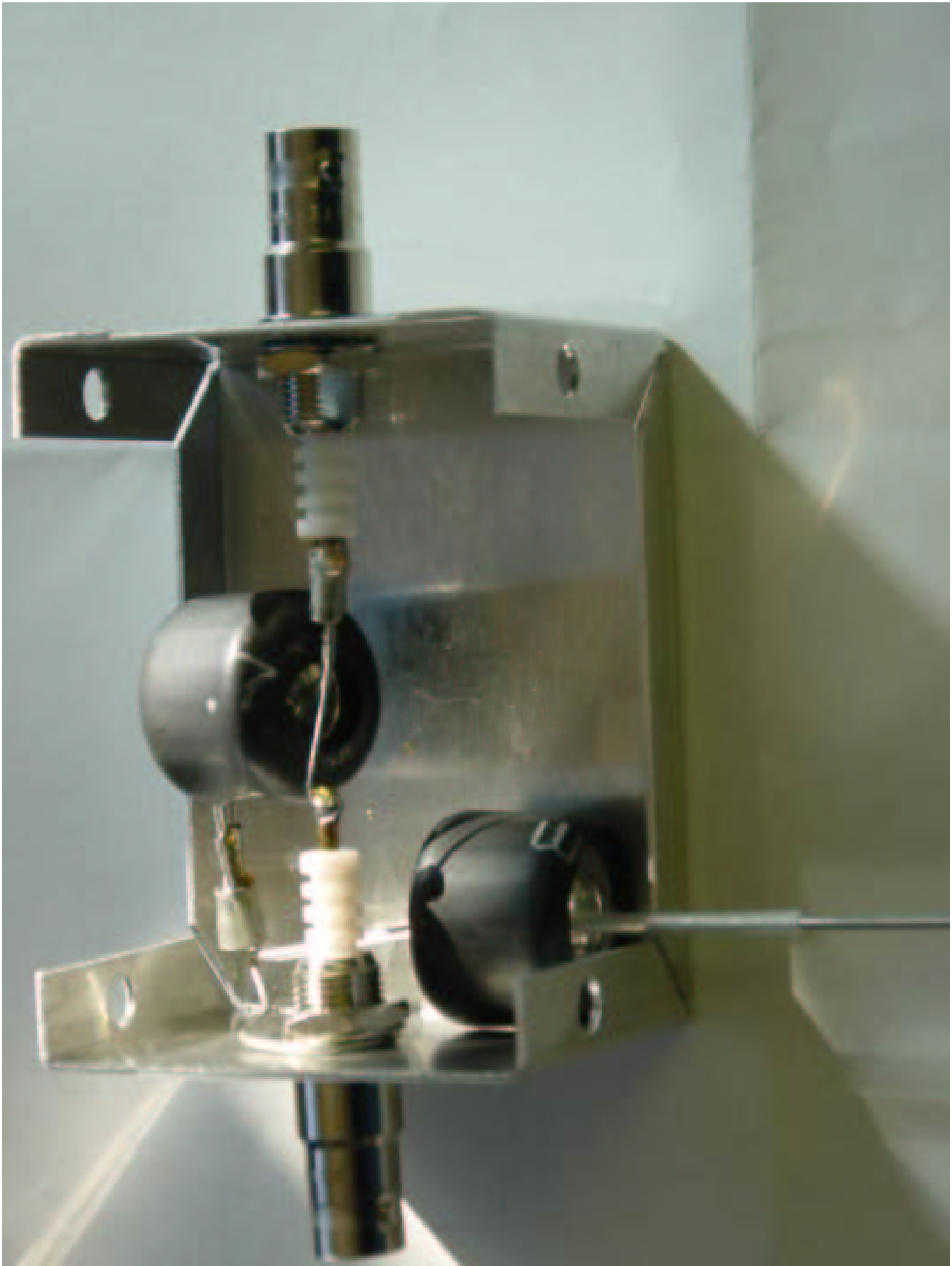
24"
12"
Back Wall
and
Front Door
Plastic Shield
49"
Cable Support
Ground to Fence
Unistrut
OUT
IN

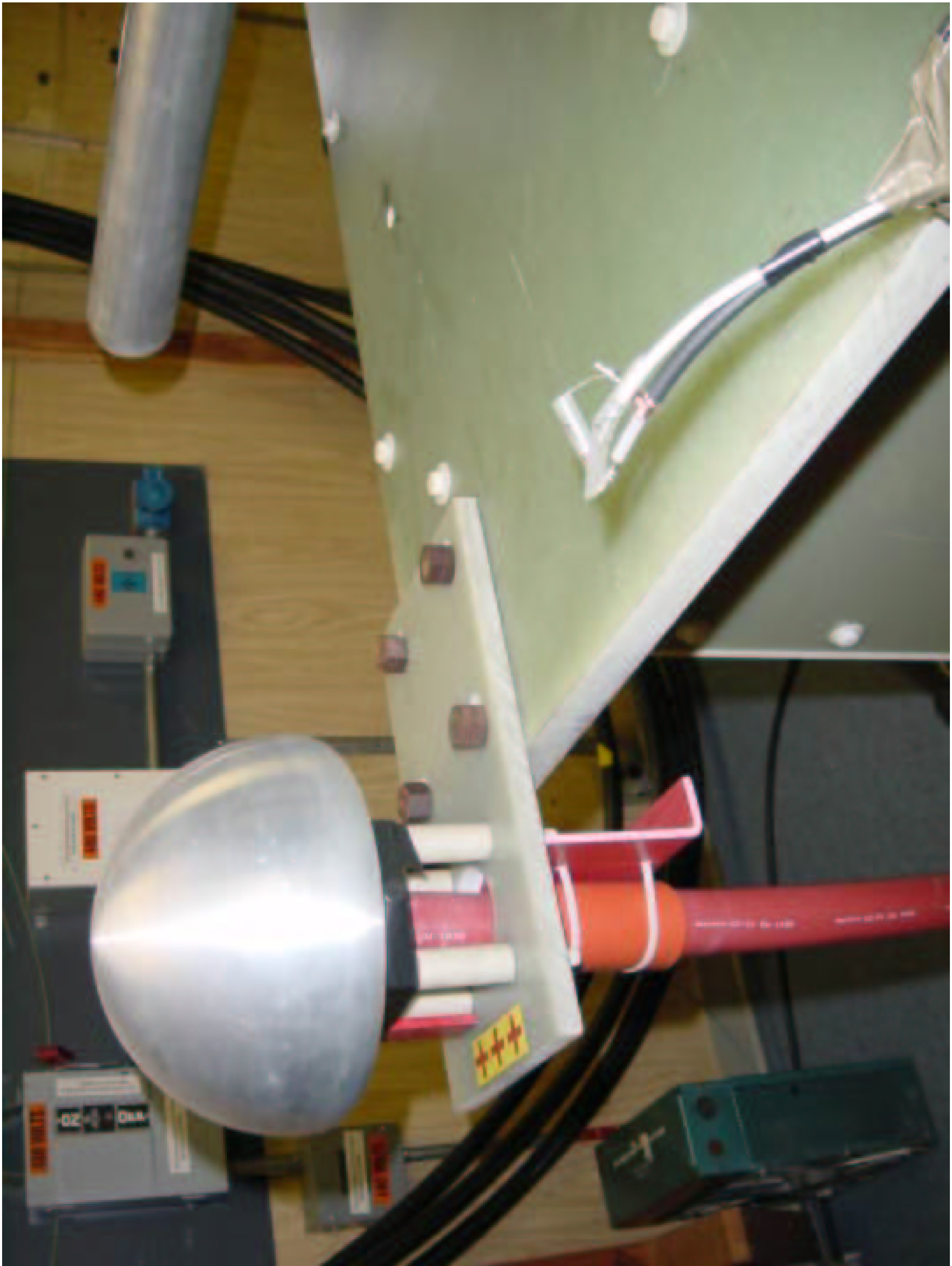
MS 02/01

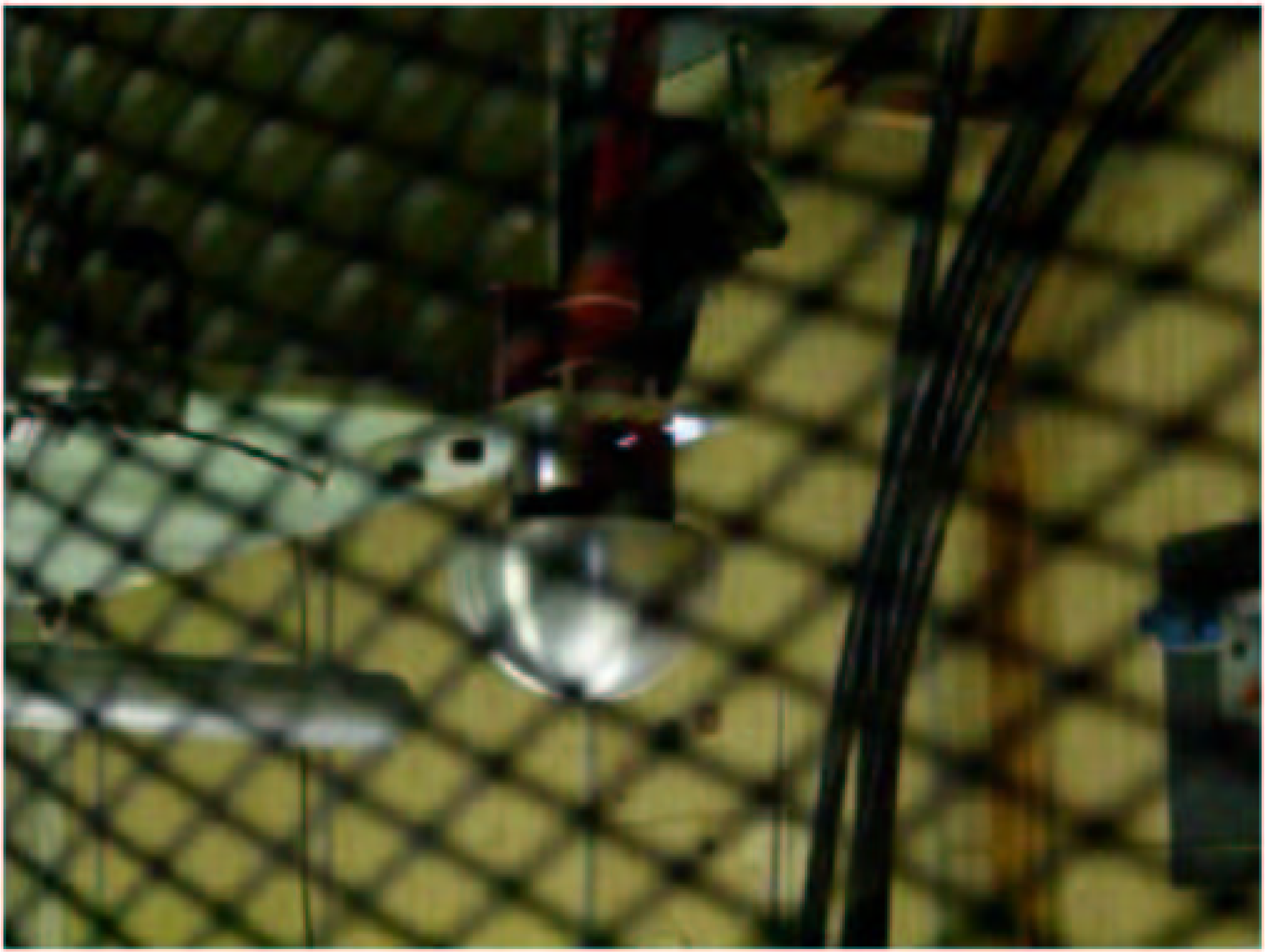
Single Sparkgap Housing



Material:		DKF 230	$40
		DKF 3k	$40
	2x	SHV	$ 40
		Box	$ 5
		Fire House per chan.	
$20			







Milagro Baffle upgrade

Changes are in 2 dimensions

The top diameter stays the same.(21”)

The height goes to 4”

The bottom diameter will be 6.6”

8 Outrigger Software Reconstruction - Led by Brenda Dingus

Outrigger Software Reconstruction Discussion
02/11/02

At SAGENAP we claimed that with 170 outriggers, we'd be able to detect the Crab at 5 σ in 3 months.

Simulation: Julie

- Outriggers at fixed z are included
- Single muons in outriggers are good test of MC
- GEANT4 will be used to get different z Elect. sim

Calibration: laser, μ paddle

Core Fitter: Ty

- Fast online algorithm Tony
- Better algorithms for source files?

Angle Fitter: Tony

- Curvature correction ?
- Separate ~~or combined~~ with the pond Andy
- Nfit vs Nhit criteria (chi cuts) Erik

Energy Fitter: Gaurang

- Background Rejection for distant sources
- Determining Highest Observed Energy
- Determining Spectral Index

Outrigger data exists for GRB010921

- z = 0.45 so E < 150-200 GeV
- Outriggers useful for long duration upper limit?

γ- hadron

Gus
Ty

9 Data Storage Options - Andy Smith/Frank Samuelson

Answer:

They are all dead.

Milagro Data Rates

Total RAW compressed rate for all data = ~260GB/day

Data written to tape:

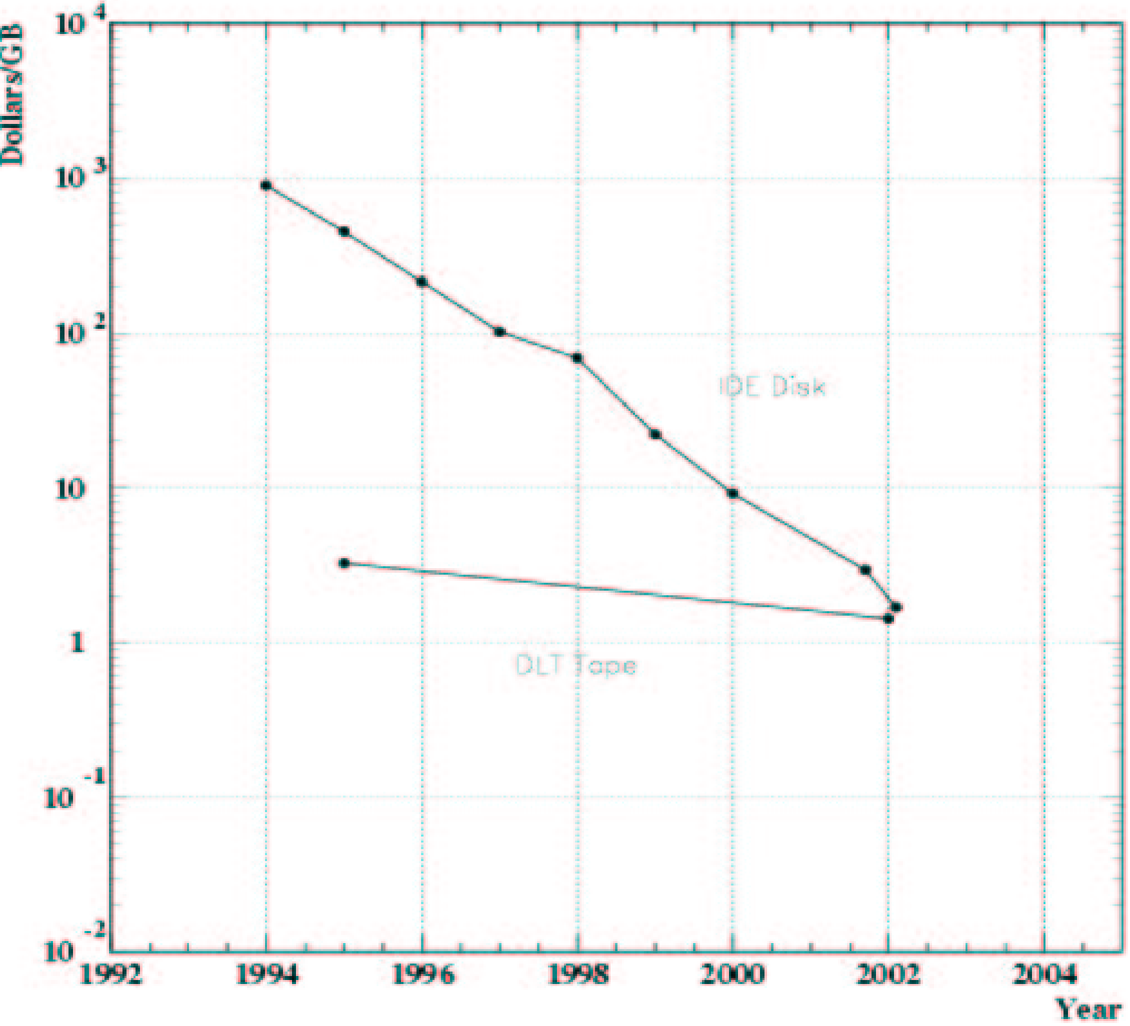
SAVE	50	GB/day
Crab	15	GB/day
Mrk421	17	GB/day
Mrk501	17	GB/day
Moon	10	GB/day
Sun	10	GB/day
REC	3	GB/day
Single Hadron	1	GB/day
GRB	3	GB/day

----

126 GB/day = 3.6 Tapes/day

But I heard that disk is really really expensive?

Answer: It was, but no longer.



Today’s Prices:

DLT \$51/35GB = <u>1.46 $/GB</u>

Maxtor 160GB IDE HD:
\$270/160GB = <u>1.68 $/GB</u>

If the trend of the last 8 years continues, the price of disk will drop by 2.22 times per year, while the price of tape will remain almost unchanged.

Plan for a Disk Archiving System

Build semi−portable disk arrays:

9 x 160GB disks
RAID 5 (8+1) to maintain data integrity
Use low cost firewire disks for portability
Linux software RAID5

COST:

Disks	9x$270	$2430
Firewire interface	9x(35−80)	$315−$720
Case and Cables	1x$150	$150

−−−−−−−−

$2900−$3300 or 2.3−2.6 $/GB

Capacity: 1280GB (~10 days or 37 tapes)
Access speed: 15−45MB/s

Transportation of the Data from the Milagro Site

Construct a large (>~4TB) data buffer for the Milagro site.

Data will be copied to the data buffer and a 1.3TB disk array.

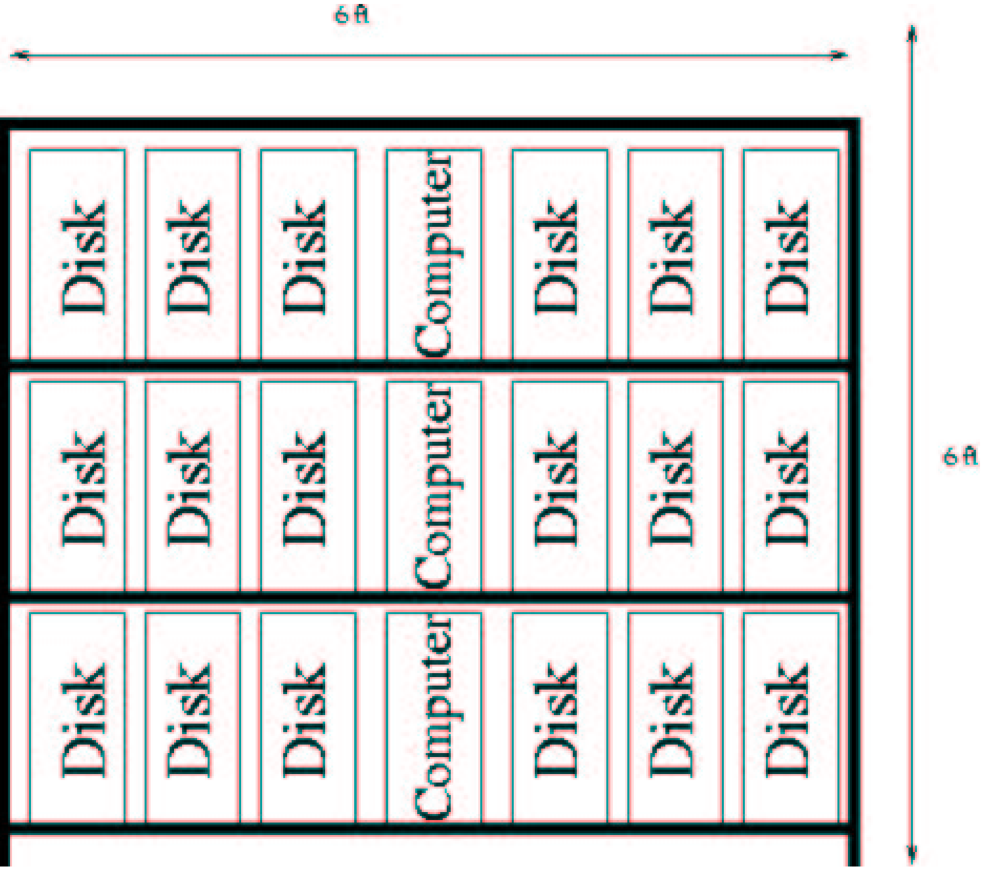
When the disk array is full, it is transported to the lab and attached to a computer.

The integrity of the data is then verified.

The the data is then removed from the buffer at the site.

Disk arrays will be changed about once every 10 days.

Data Storage



Attach 6 disk arrays to each computer.

One rack can hold 18 arrays.

About 1.5 to 2 racks are needed to store a year of data.

Similar space requirements to tape storage.

But I heard that disks are not an "Archival" medium

You heard wrong.

Tape are much less reliable than disks.
Their magnetic surfaces are exposed to
the atmosphere and subject to deterioration.

Disks continuously verify their contents.

Disk arrays are redundant.

High speed access allows us to easily copy
the data to a new media in the future.

MaxSafe uses idle time to read data from the disk and ensure that it is error free. If an error is found, the on-board ECC is used to correct the data. The data is then re-written to a different spot on the disk.

What Could Go Wrong?

Disks are much much much much much more reliable than tapes for data storage. However there are several failure modes unique to disks.

What if a disk fails:

The RAID5 array can survive a single disk failure. In the event of a failure, the contents of the array can be written to a "hot spare" disk array.

Correlated failure modes:

1) Power spikes, Lightening: protect disks with the high quality UPS's.
2) Mechanical damage: Don't tip over the shelf!

A Final Point on the Cost

Tapes are defined by UMD purchasing as supplies and are subject to a 26% overhead charge:

DLT Media cost: $1.46/GB −−−> $1.84/GB

Disk arrays and computers are overhead free.

Cost of disk Media: $1.68/GB

Cost of a firewire disk system: 2.3−2.6 $/GB

10 VME Trigger Card - Erik Blaufuss

VME Trigger Card

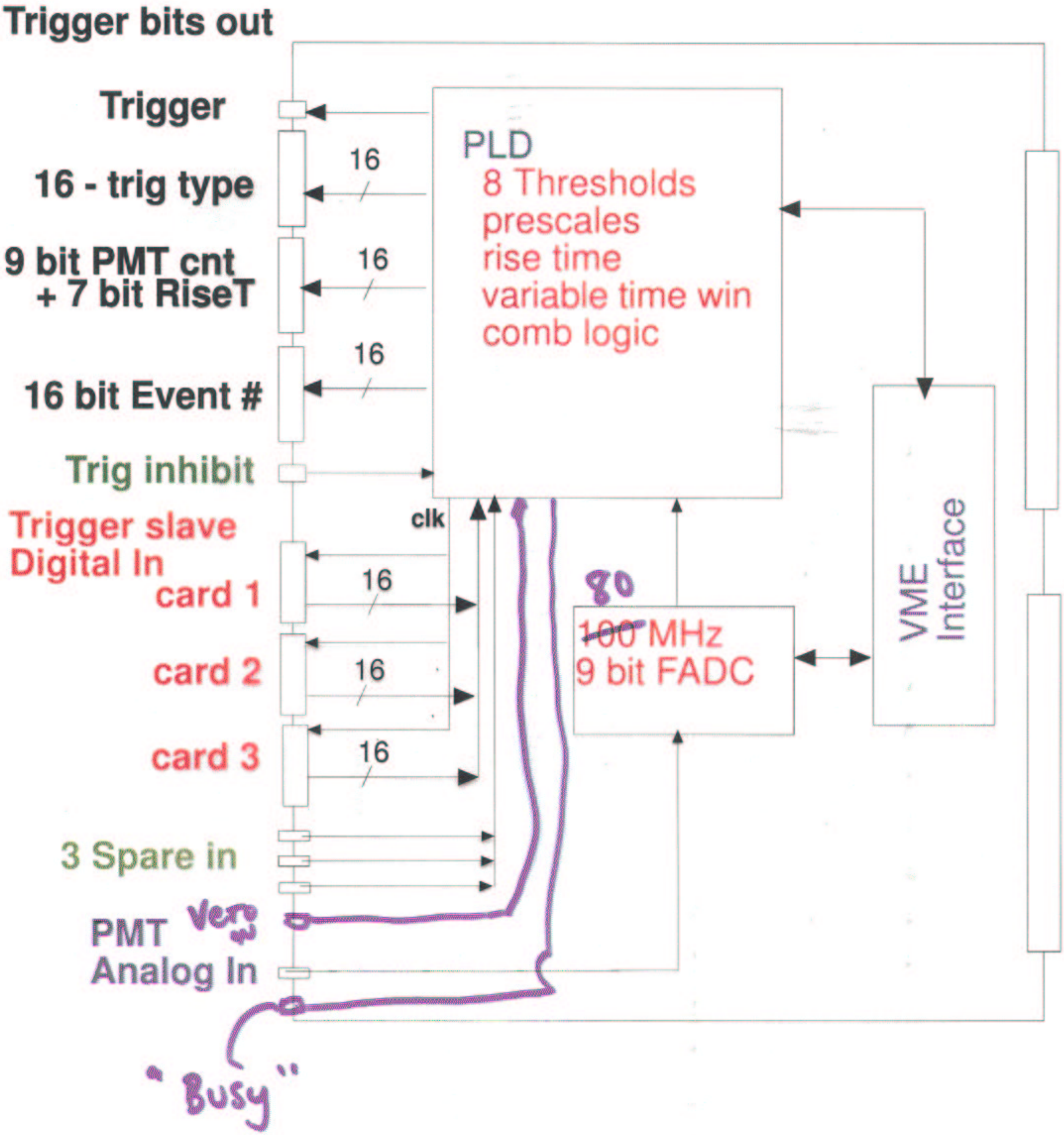
Erik Blaufuss
University of Maryland

- Operational overview
  - New Features added
- Card is running
  - Current trigger levels
- Hardware settings and issues
  - Pretrigger level
  - Capacitive coupling of analog sum
- A look at the new "low" nhit data collected
- What about the "regular" trigger (>52 tubes)?
- The new muon layer veto
- Recommendations for settings
- Things still to be done

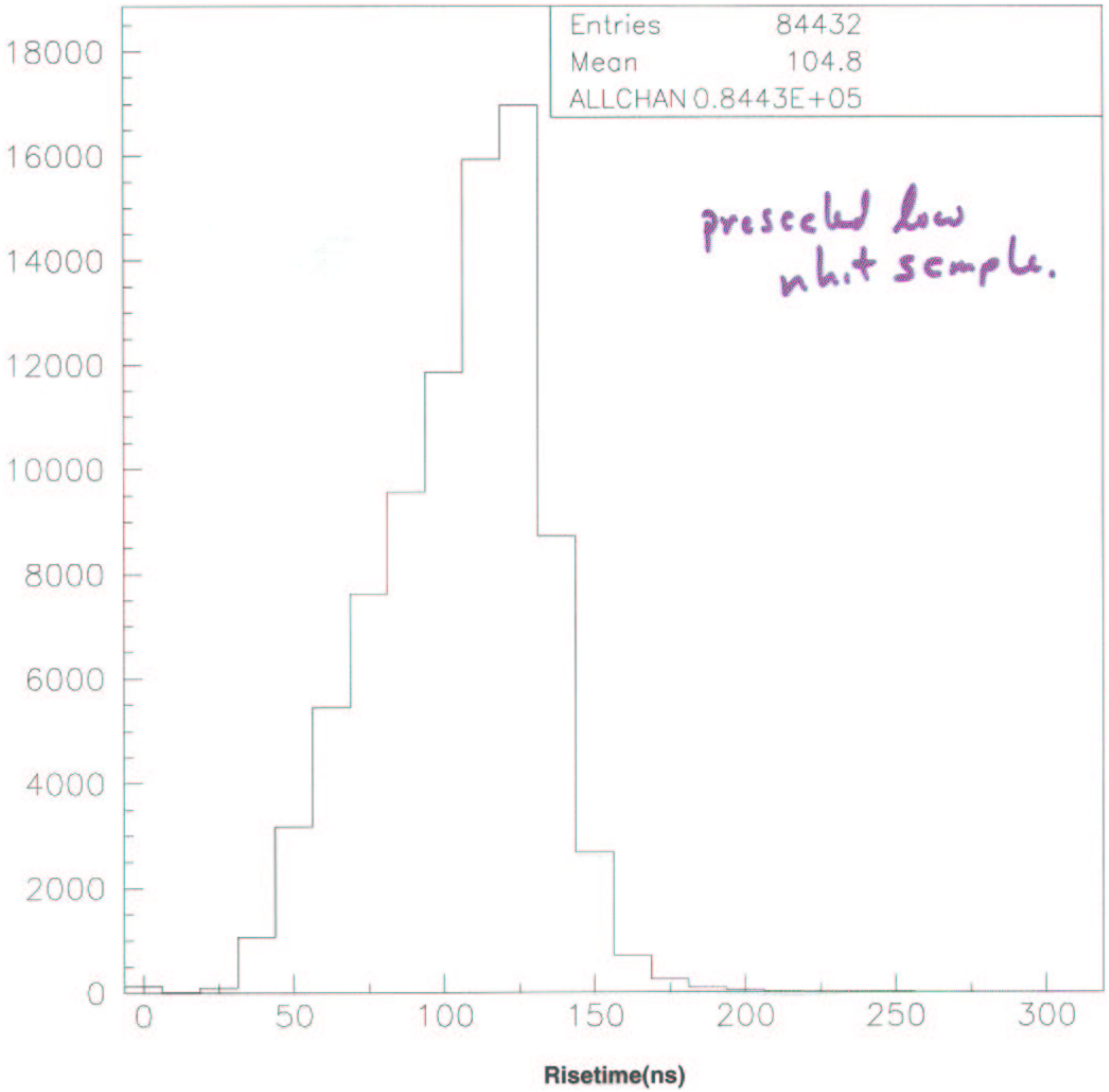
Operation of card

- VME trigger card looks at the analog sum and finds:
  - Peak value analog sum pulse (number of 5mV tubes)
  - Risetime of analog sum pulse (in 12.5 ns counts)
  - Can prescale any of up to 16 programmable triggers.
- The card will then issue a trigger to the DAQ based on these measurements and the programmed settings.
- New since the last meeting:
  - Ability to measure total deadtime (DAQ and card)
  - Front panel veto input (e.g. Gus’s muon layer veto)

6U VME CARD

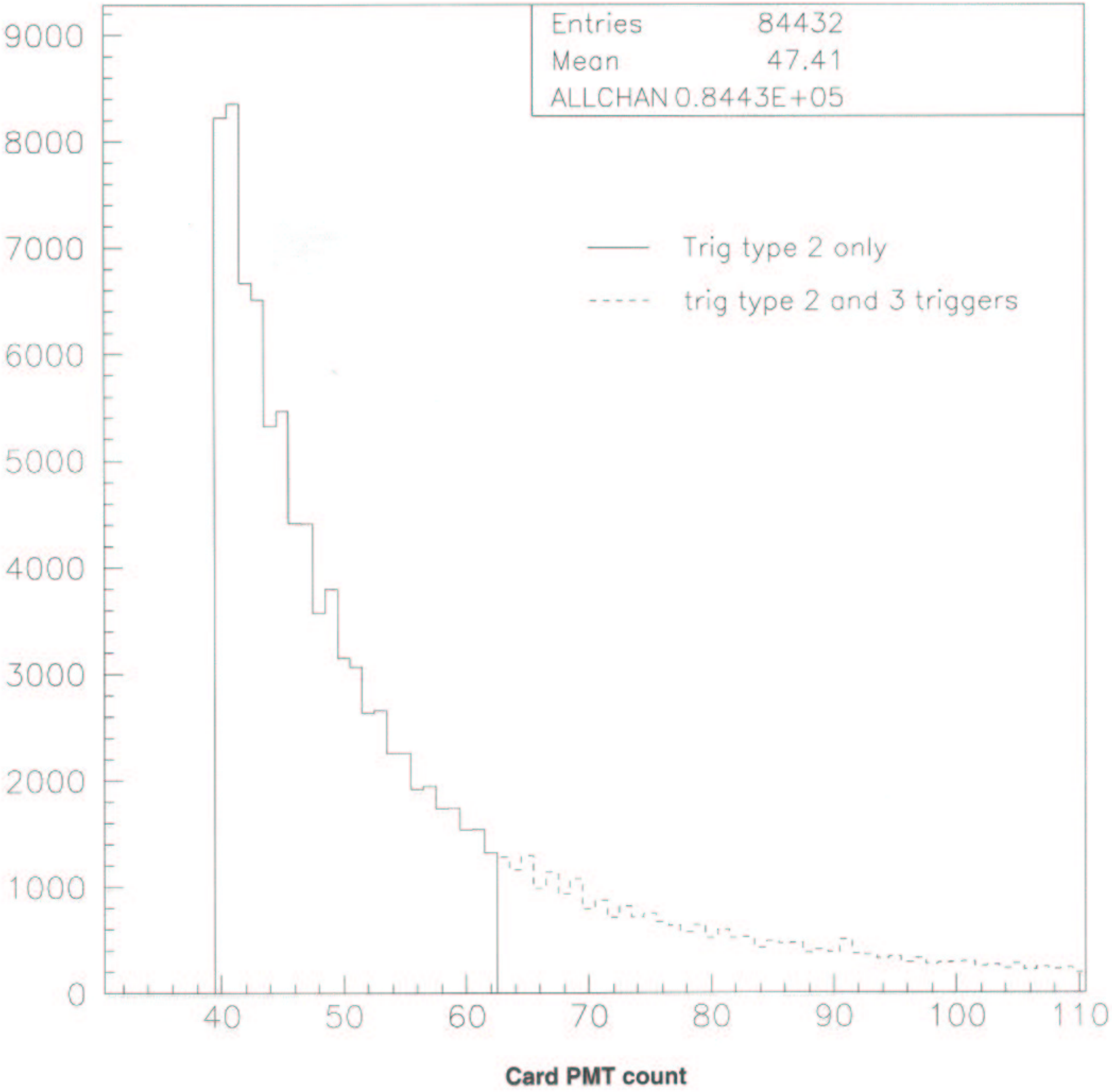

Trigger bits out
Trigger
16 - trig type
9 bit PMT cnt
+ 7 bit RiseT
16 bit Event #
Trig inhibit
Trigger slave
Digital In
card 1
card 2
card 3
3 Spare in
PMT
Veto in
Analog In
"Busy"
16
16
16
16
16
16
clk
PLD
8 Thresholds
prescales
rise time
variable time win
comb logic
80
~~100~~ MHz
9 bit FADC
VME
Interface

2002/02/11 08.09



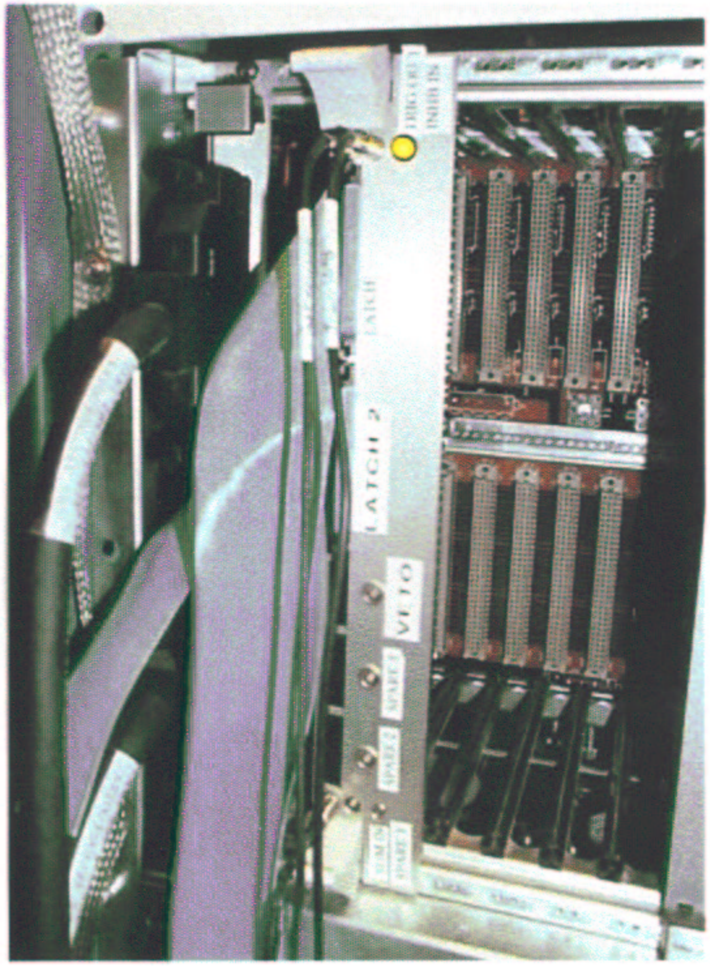
prescaled low nhit sample.

2002/02/10 11.58



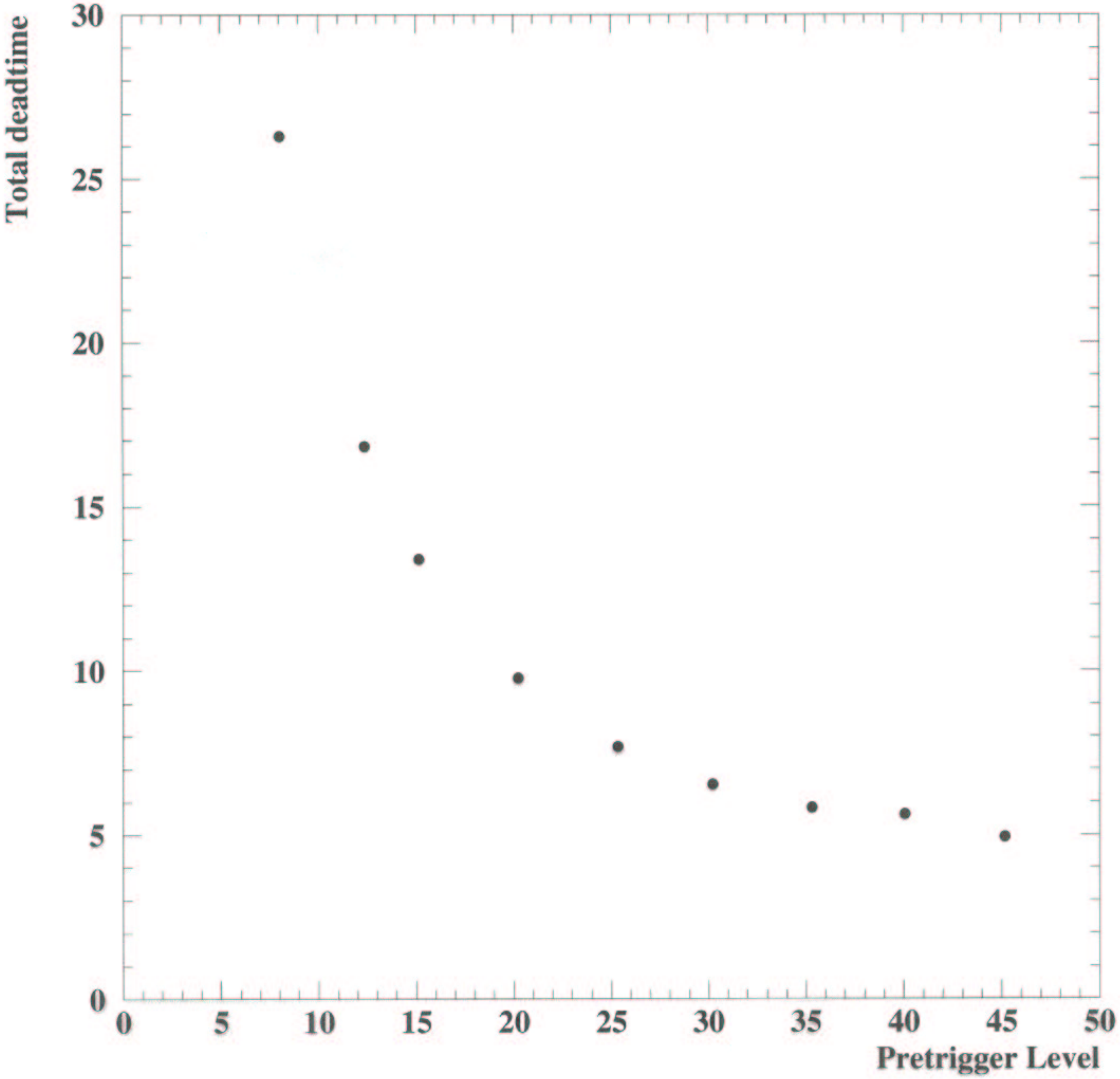
Card is in place...

- Card was installed in late January and has been issuing triggers since then.
- Automatically programmed with correct settings at run start time.
- Still a few EMS page updates are needed.
  - Use the VME Trigger deadtime



Hardware settings and issues

- The pretrigger level must be lower than any trigger level, even prescaled triggers.
  - Each pretrigger will generate ~1.5 us of deadtime.
  - Measurements made of deadtime and pretrigger.
- Capacitive coupling of analog sum (reduces rate variations) is slightly shifting the measured risetimes (~10 ns shorter with 0.1 uF cap.)
- Current triggers:
  - Trig 1: PMT> 315 mV, no risetime cut, no prescale, no veto
  - Trig 2: PMT> 200 mV, no risetime cut, 1/50 (low), no veto
  - Trig 3: PMT> 240 mV, no risetime cut, no prescale, veto ON
    - Veto event if 2 or more tubes in mu layer have HITOT hits

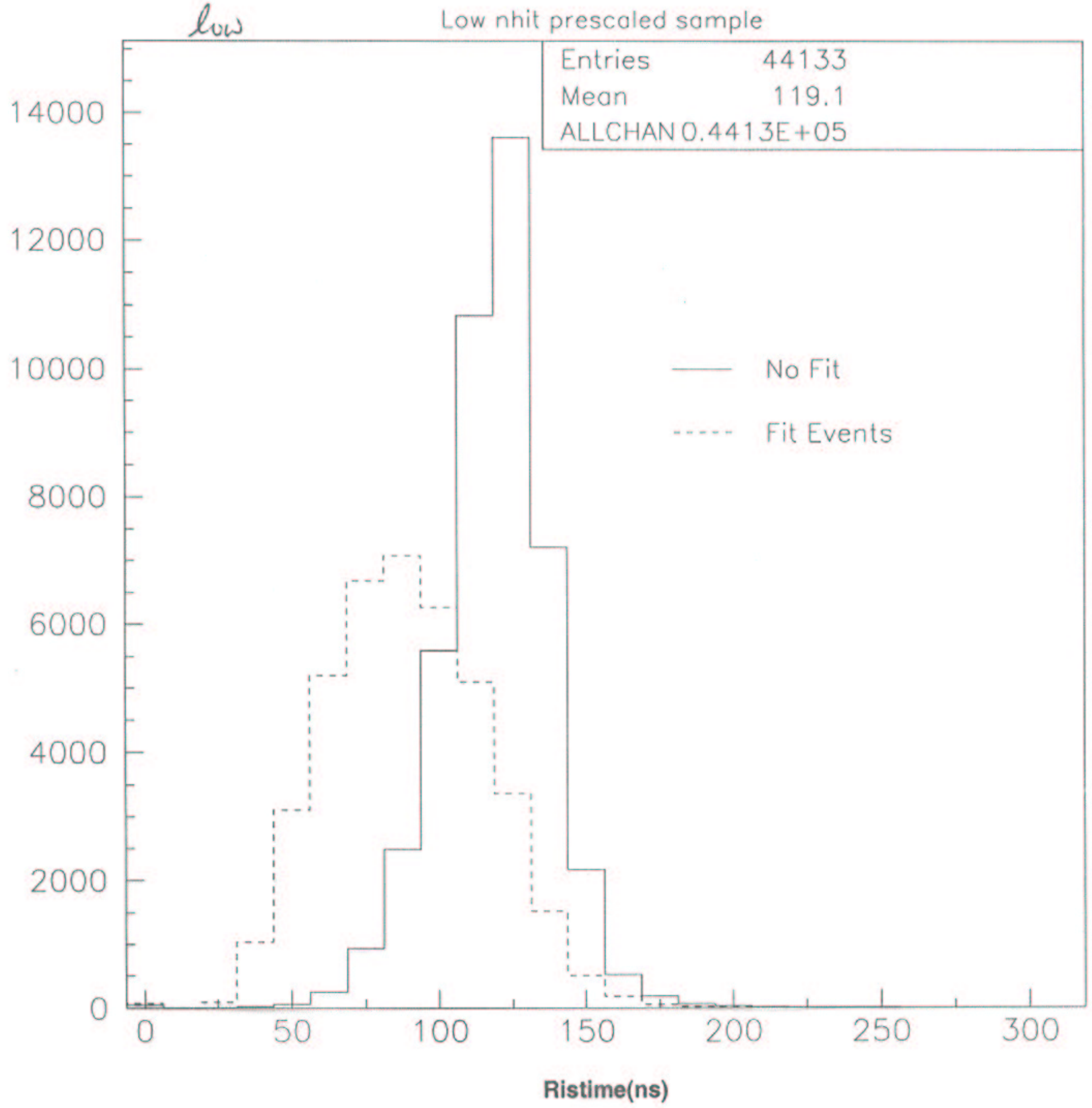

Total deadtime
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35
40
45
50
Pretrigger Level

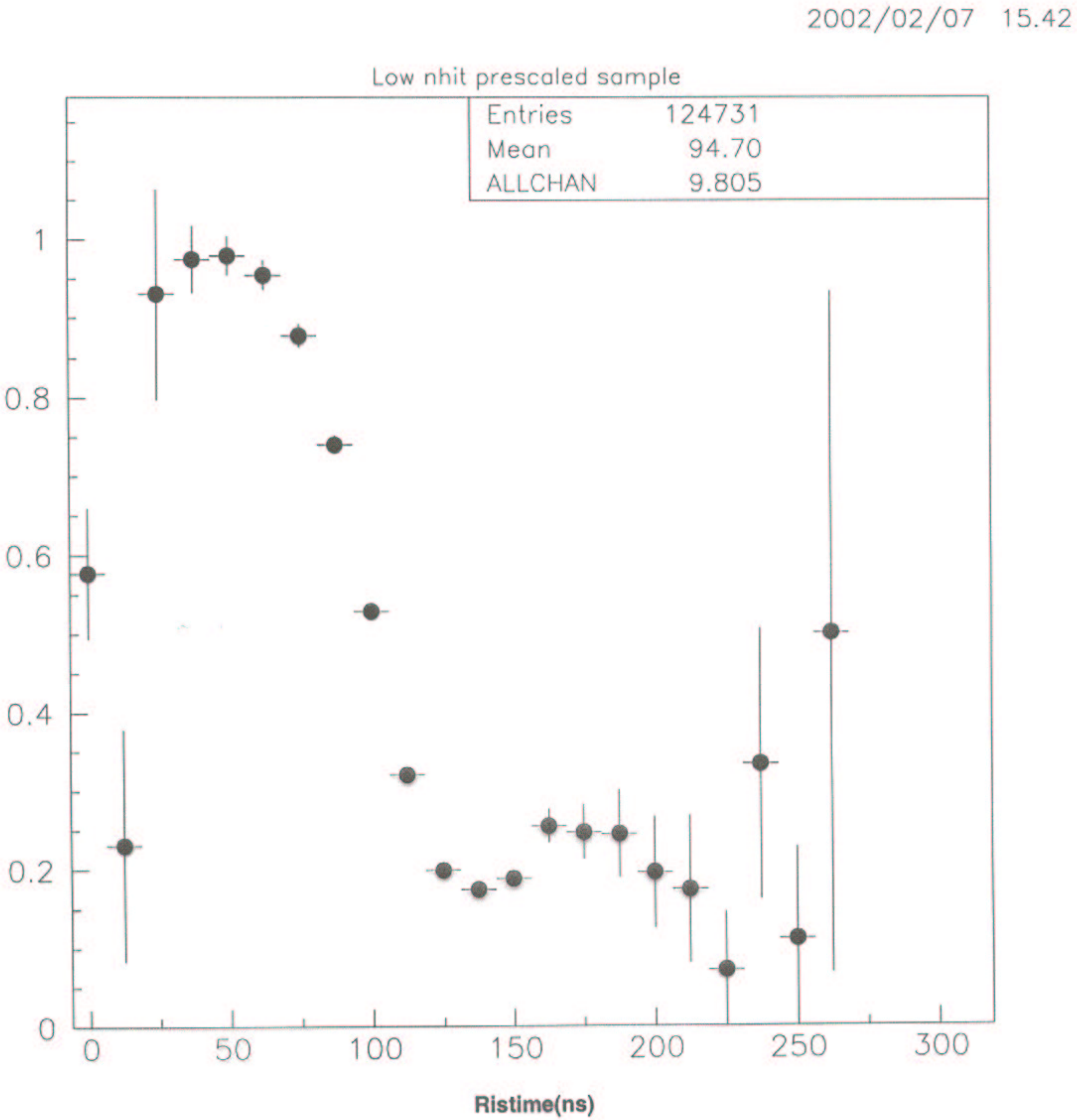
A look at the prescaled low nhit data

- Looked at the correlation between the measured risetime, and things like fit fraction, zenith angle, and event rates.
  - Risetime for fit and unfit events
  - Deleo of fit events, look at deleo less than 10 deg.
  - Zenith angle distributions for fit events
    - Also with increasing risetime cuts.
  - Events rates and fraction of events kept after cut

2002/02/07 15.41

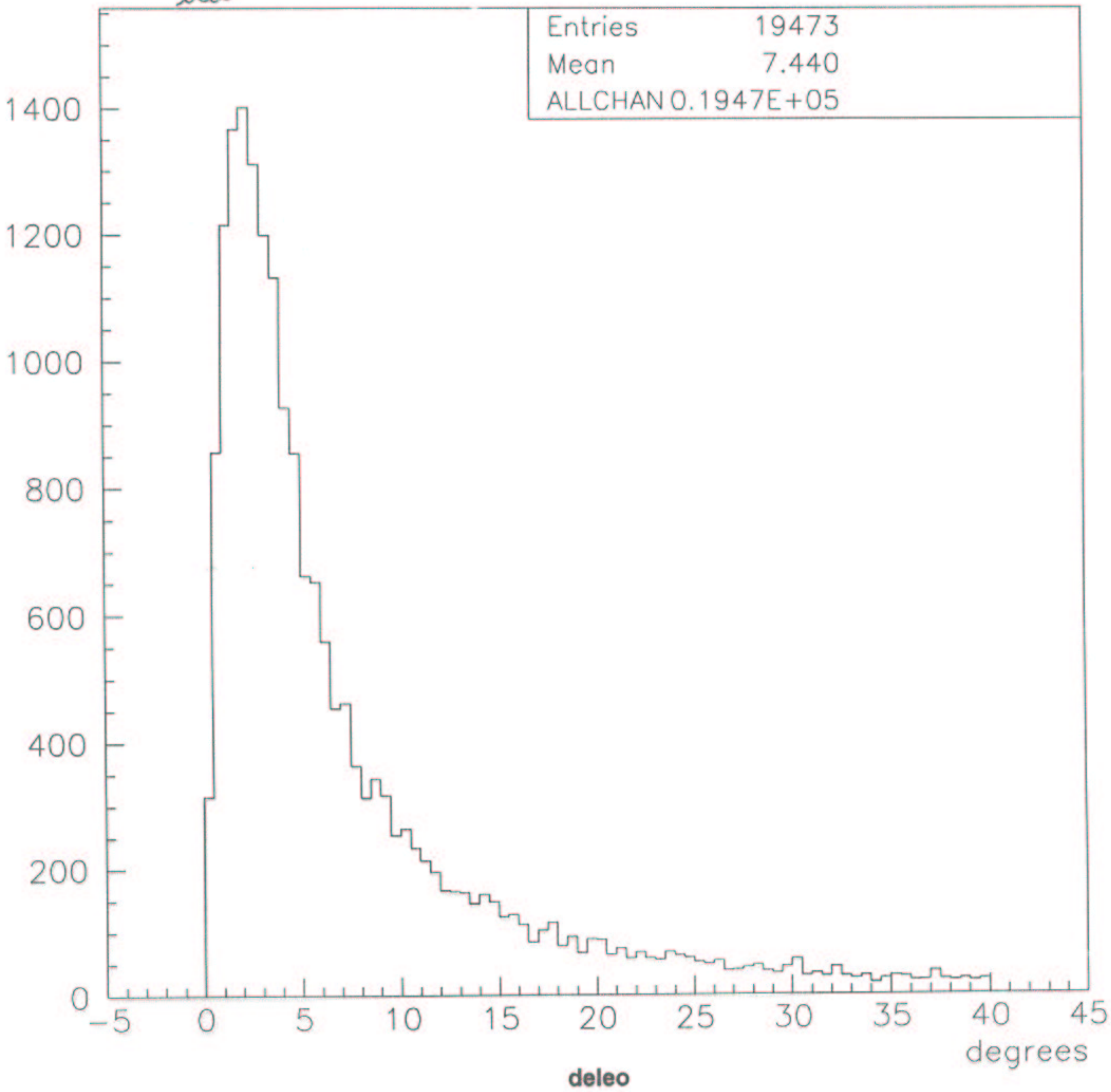
low




2002/02/07 15.42
Low nhit prescaled sample
Entries 124731
Mean 94.70
ALLCHAN 9.805
1
0.8
0.6
0.4
0.2
0
0
50
100
150
200
250
300
Ristime(ns)

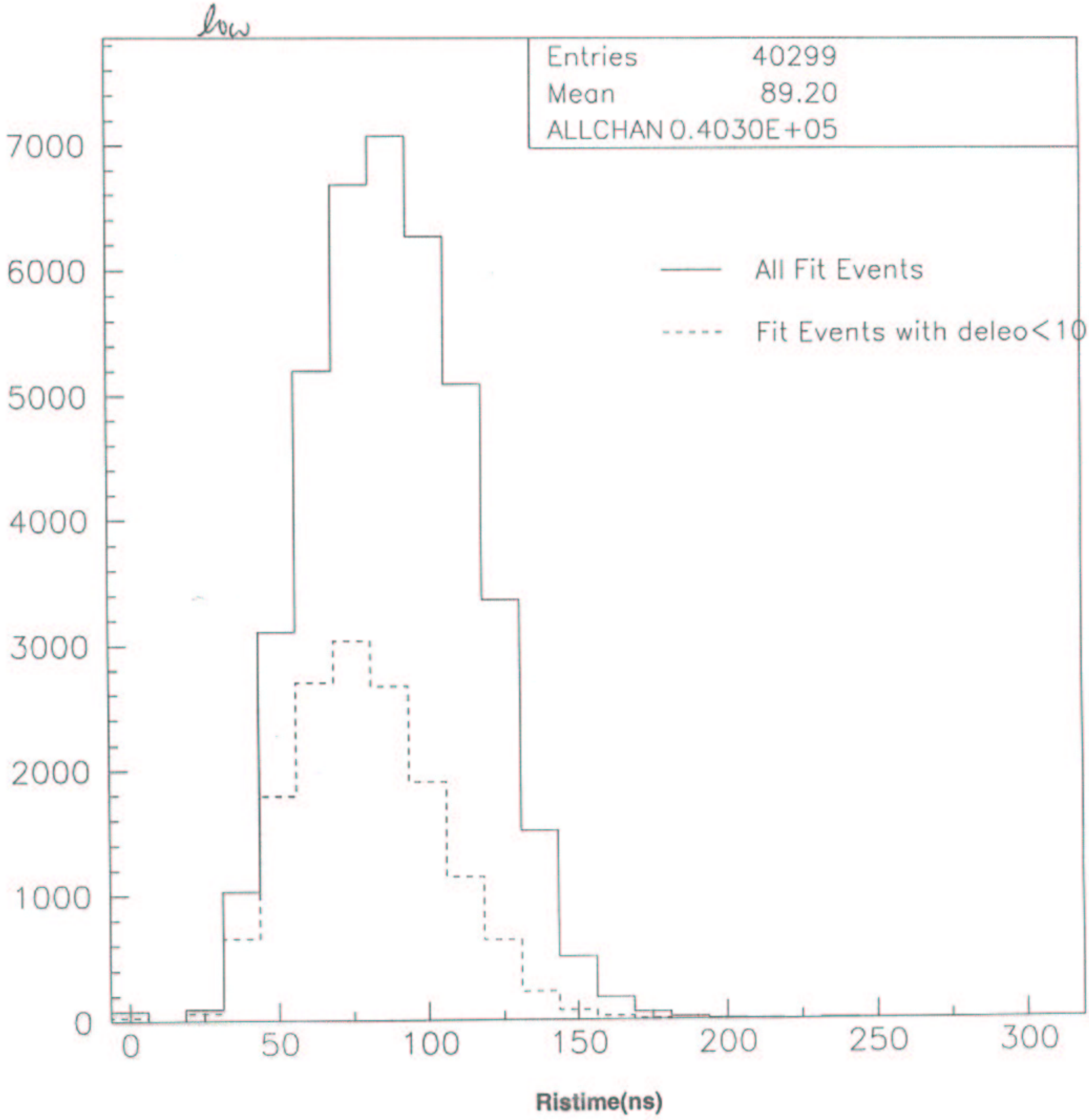
2002/02/08 13.01

law

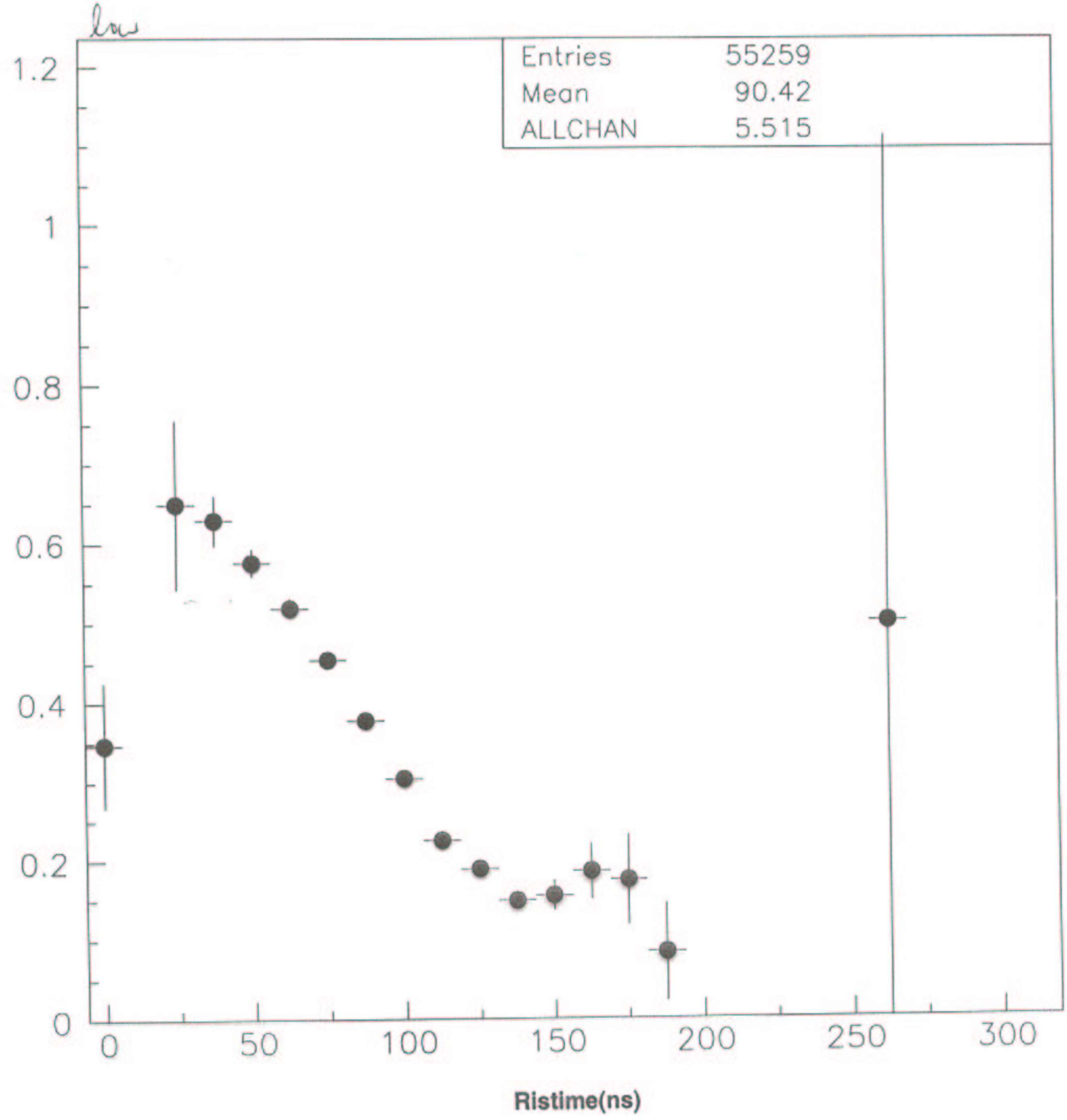


2002/02/07 20.22

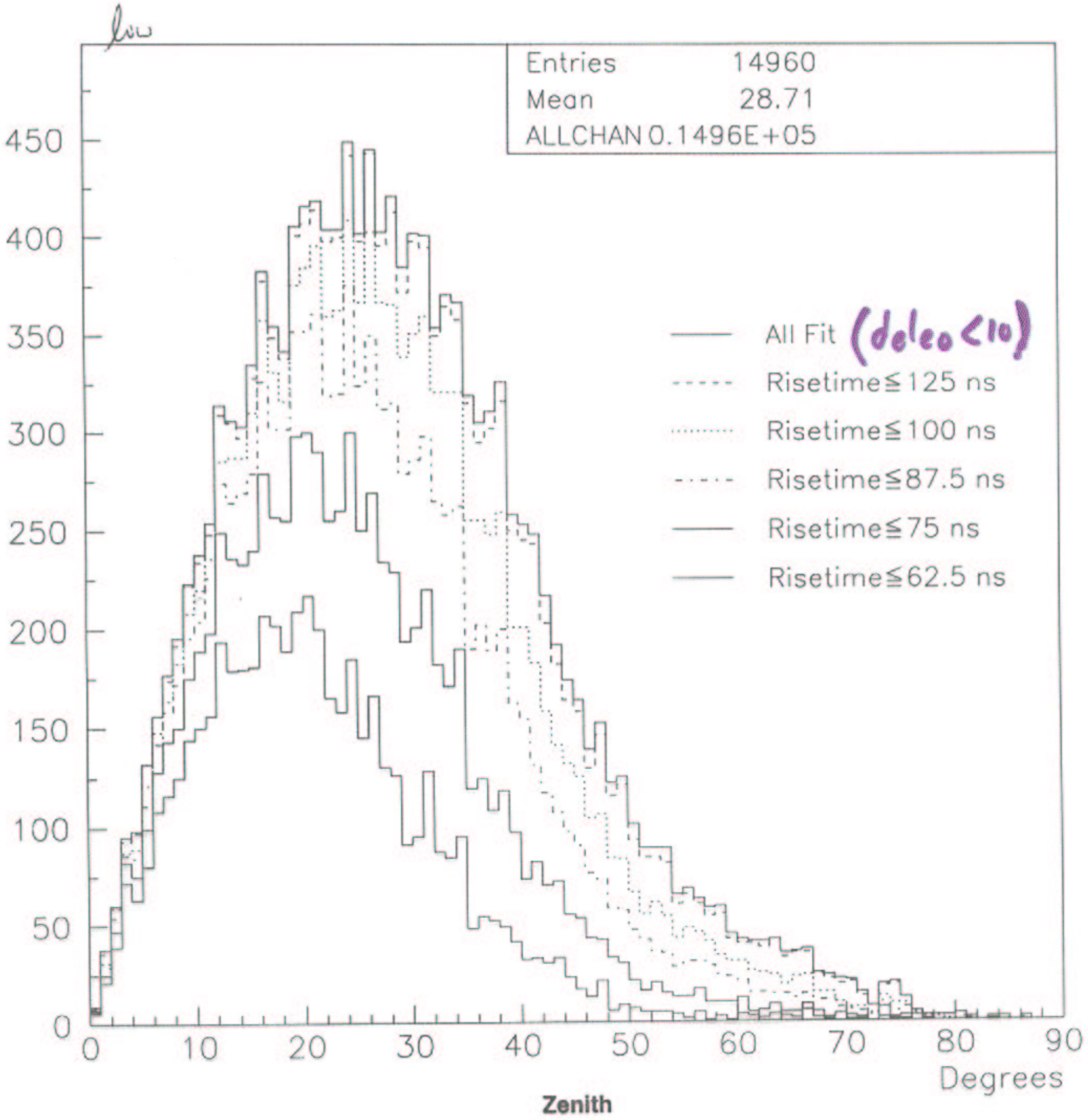
low

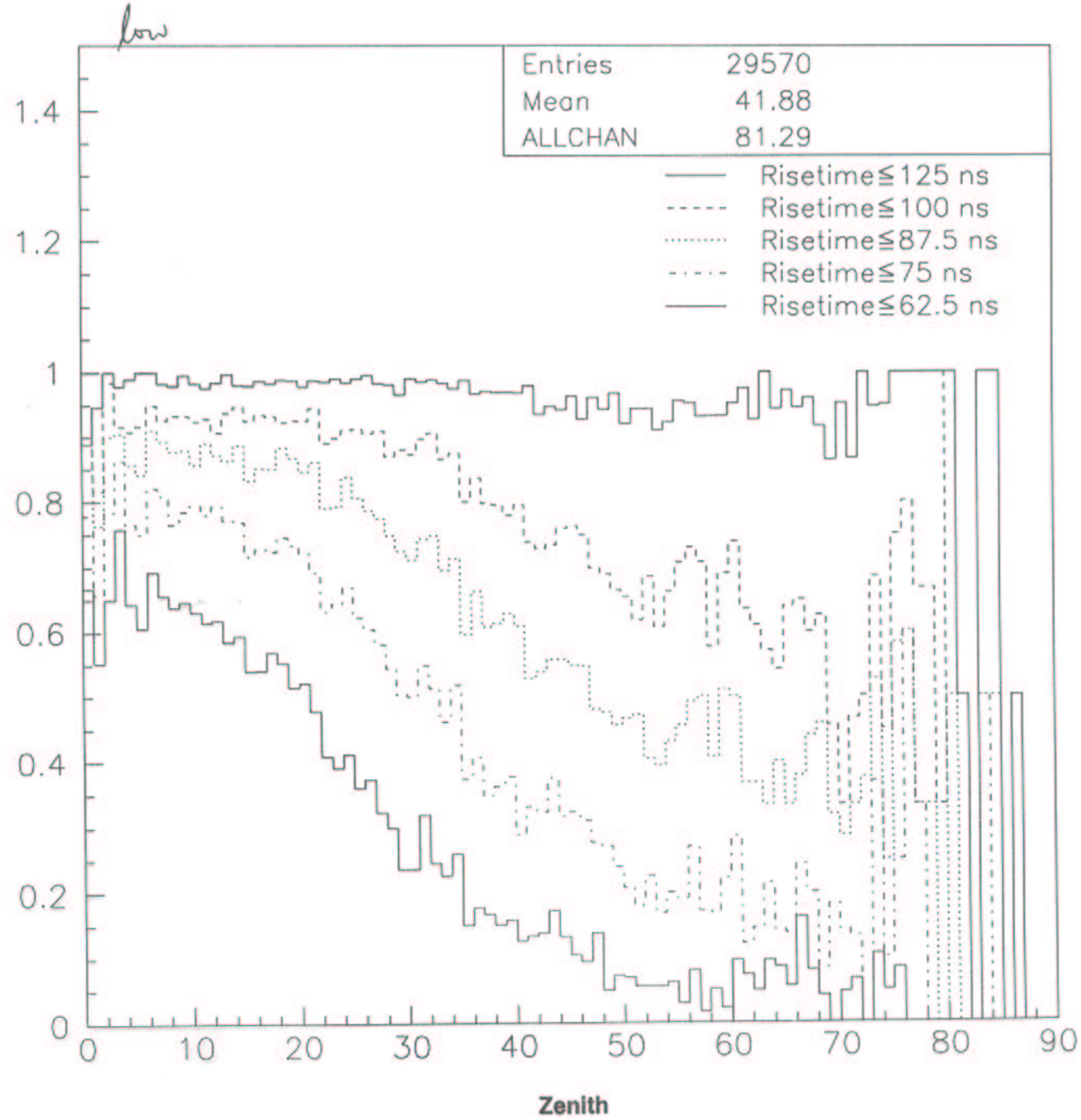


2002/02/07 20.24


low

2002/02/08 14.01



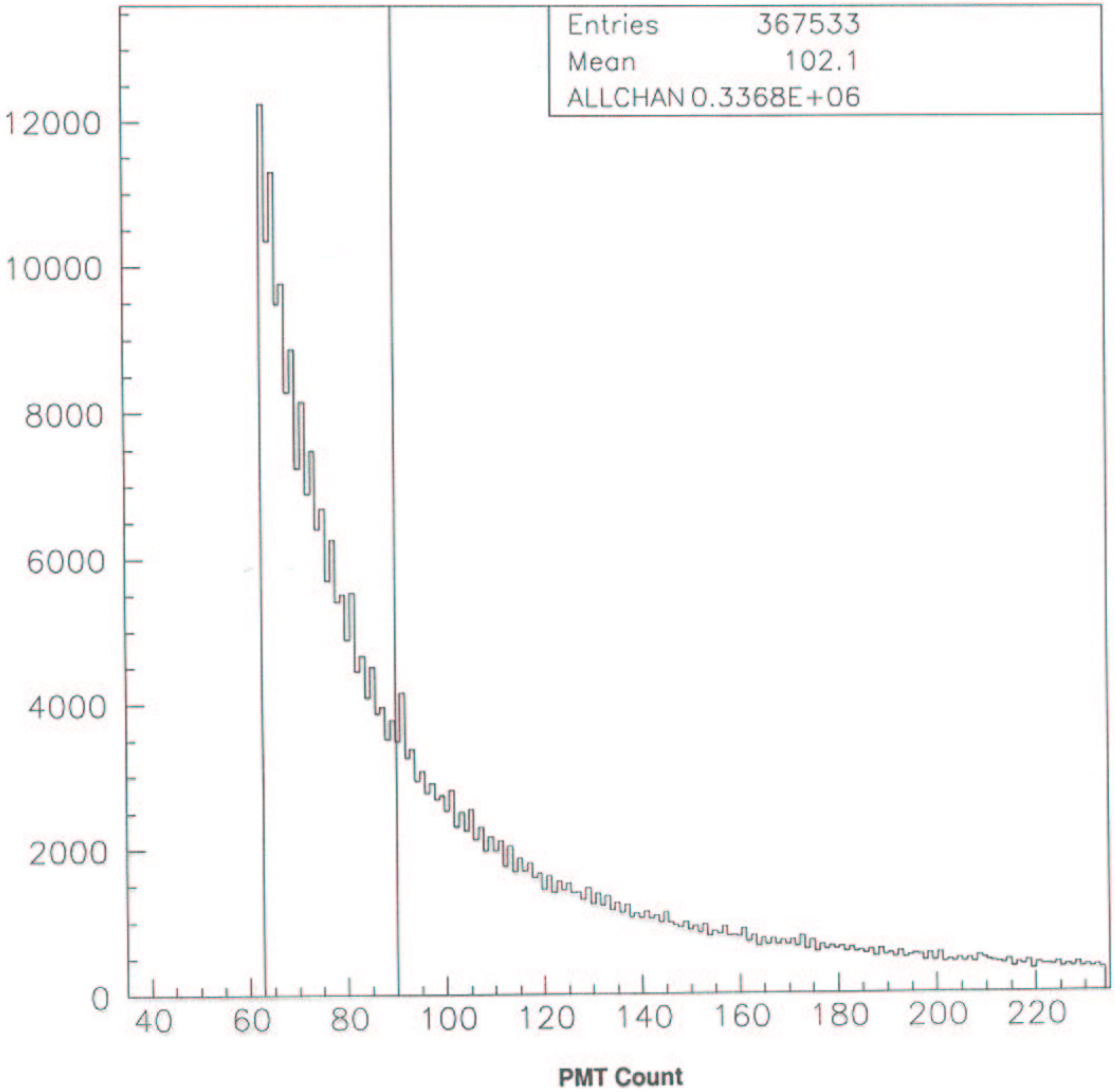


2002/02/08 14.03

What about the "regular" trigger?

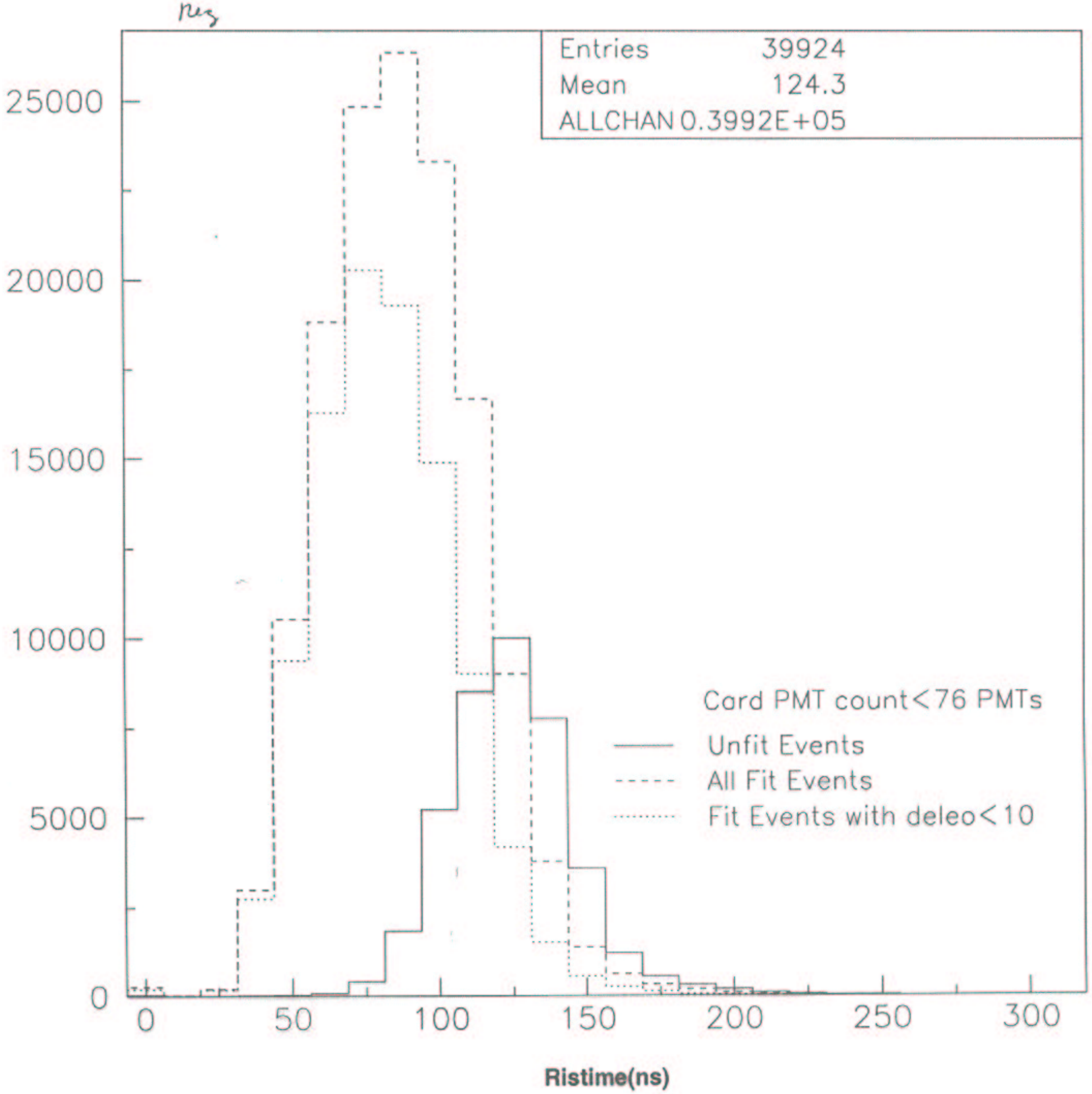
- Is it possible to use a risetime cut to increase the fraction of fittable events kept while reducing the current trigger rate?
    - Would make room in the DAQ for other trigger types
  - ~50% of triggers come from analog sum total in the 53–76 tube range.
    - Risetime distribution for fit and unfit events.
      - Seems to be 2 classes of events
    - Zenith angle distributions after a risetime cut

2002/02/08 16.32

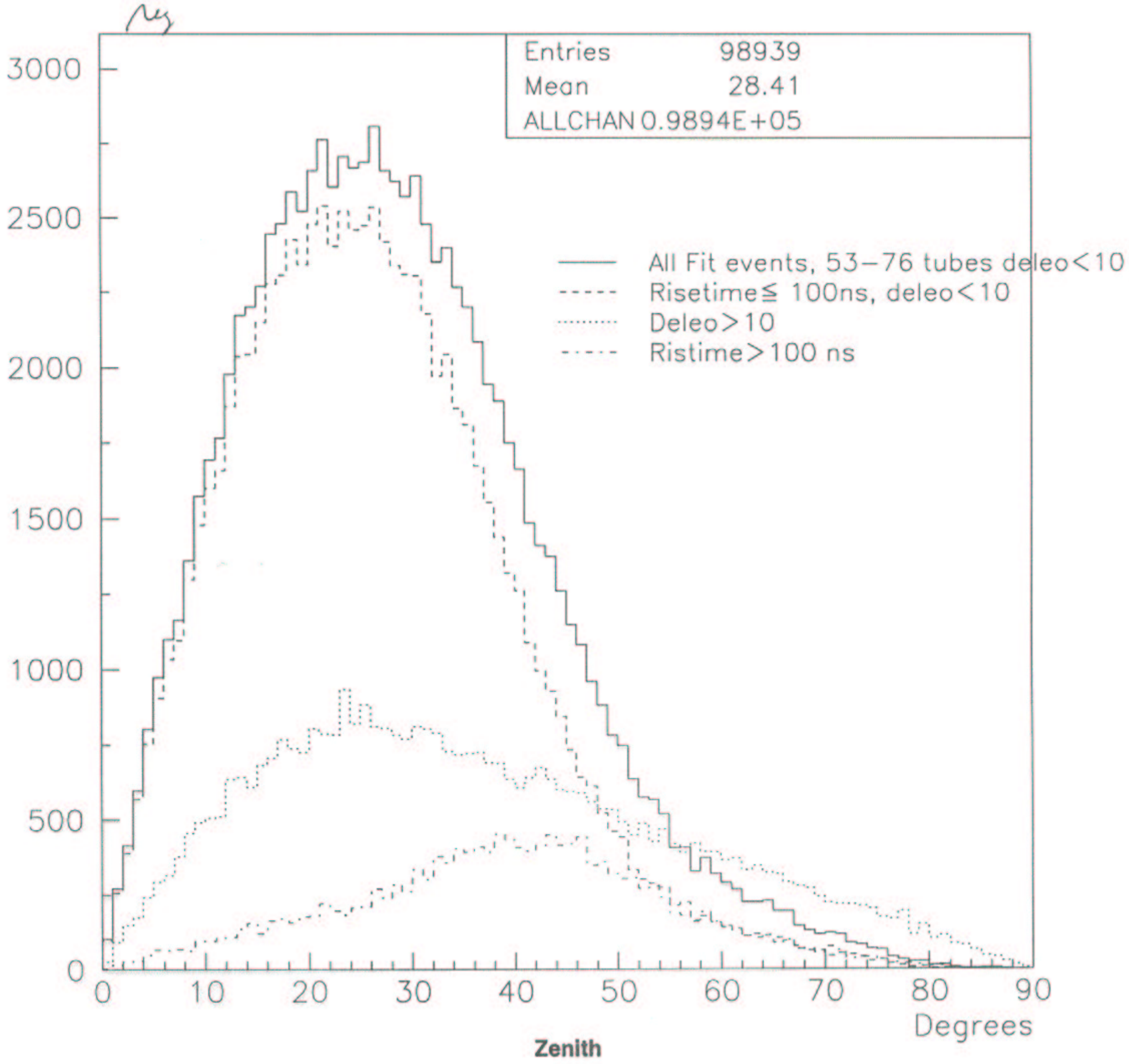


2002/02/08 14.38

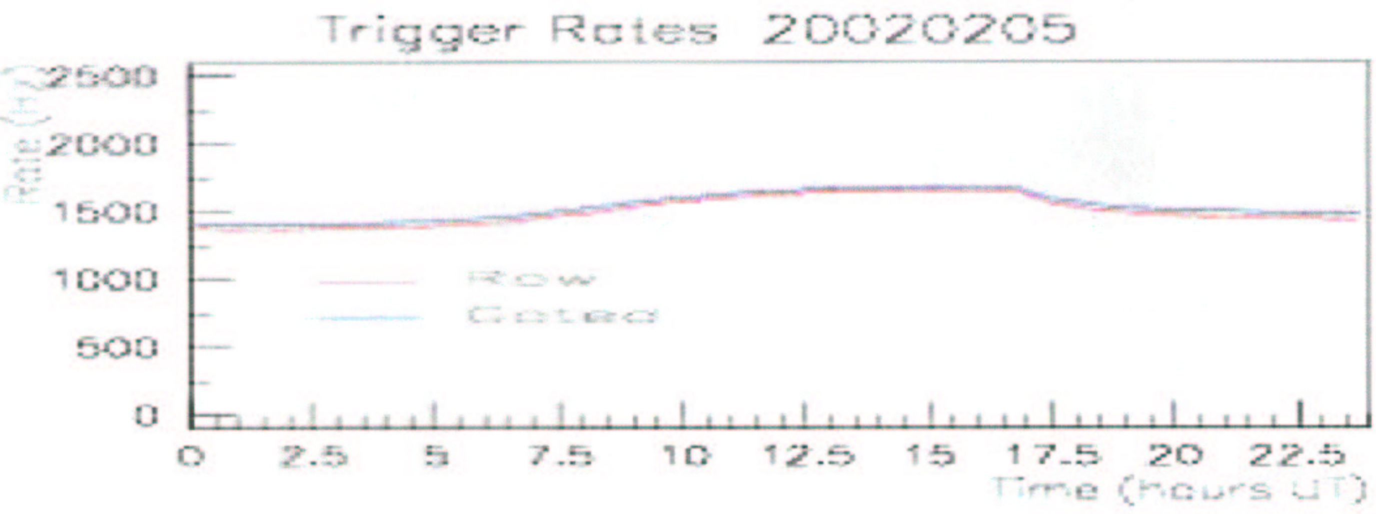
neg



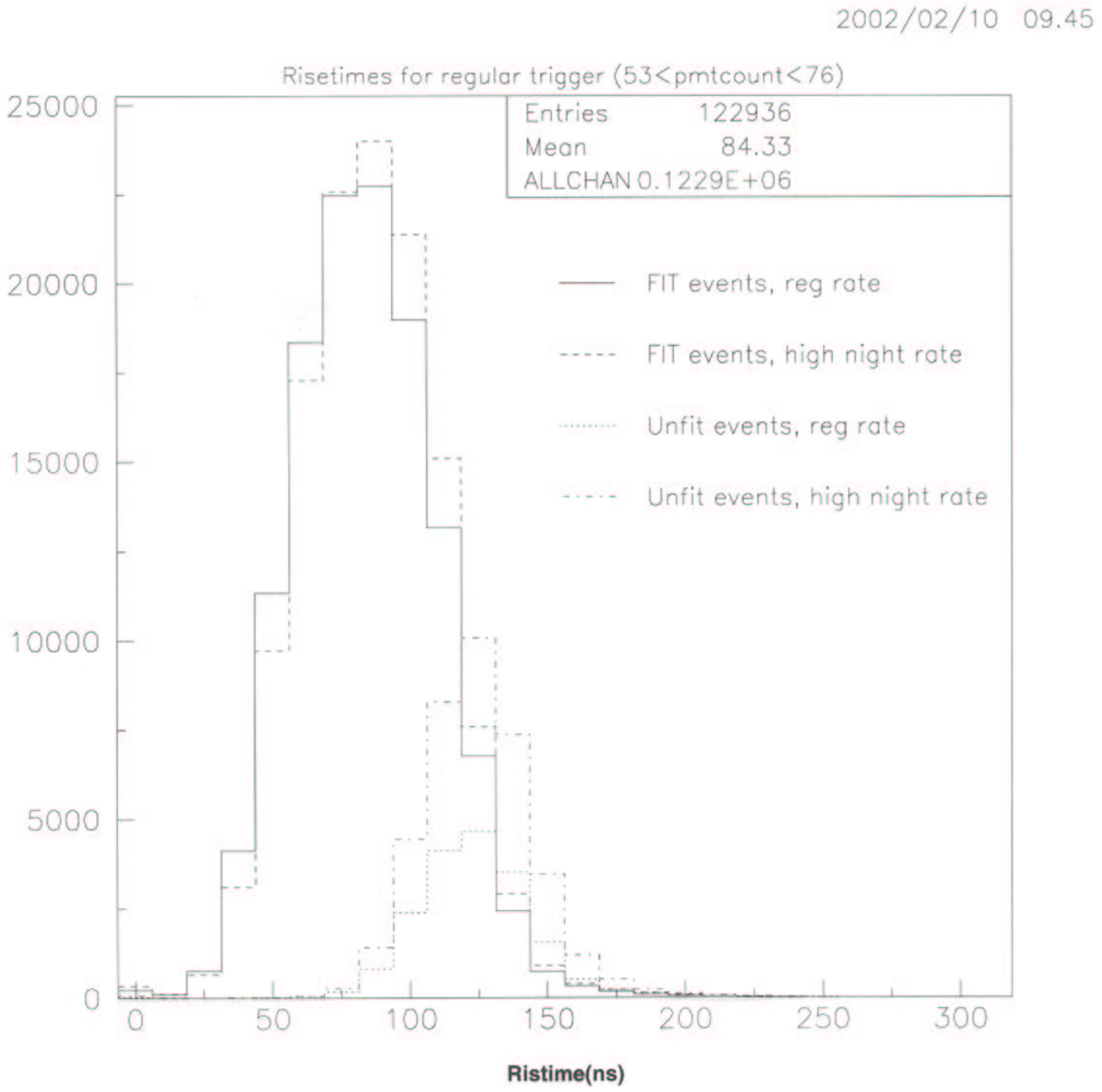
2002/02/08 16.13



Rate variations at night

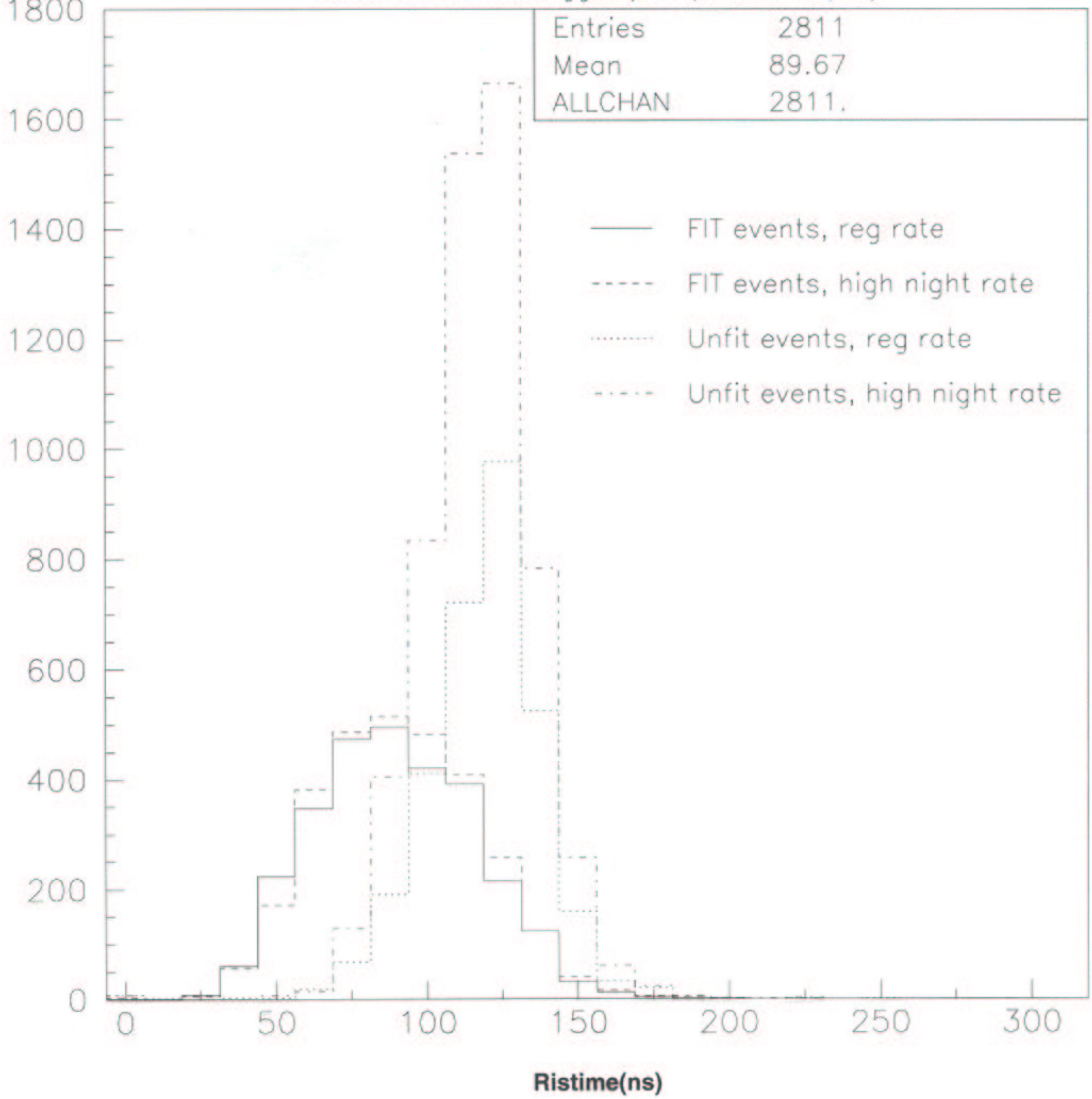


- There are often large increses in the trigger rate late at night/early morning.
  - Decrease in fit fraction.
- Can a risetime cut stabilize the rate?
  - If we cut in the 53–76 pmt range with risetimes <=100 ns, then this ~275 Hz increse drops to ~75 Hz.

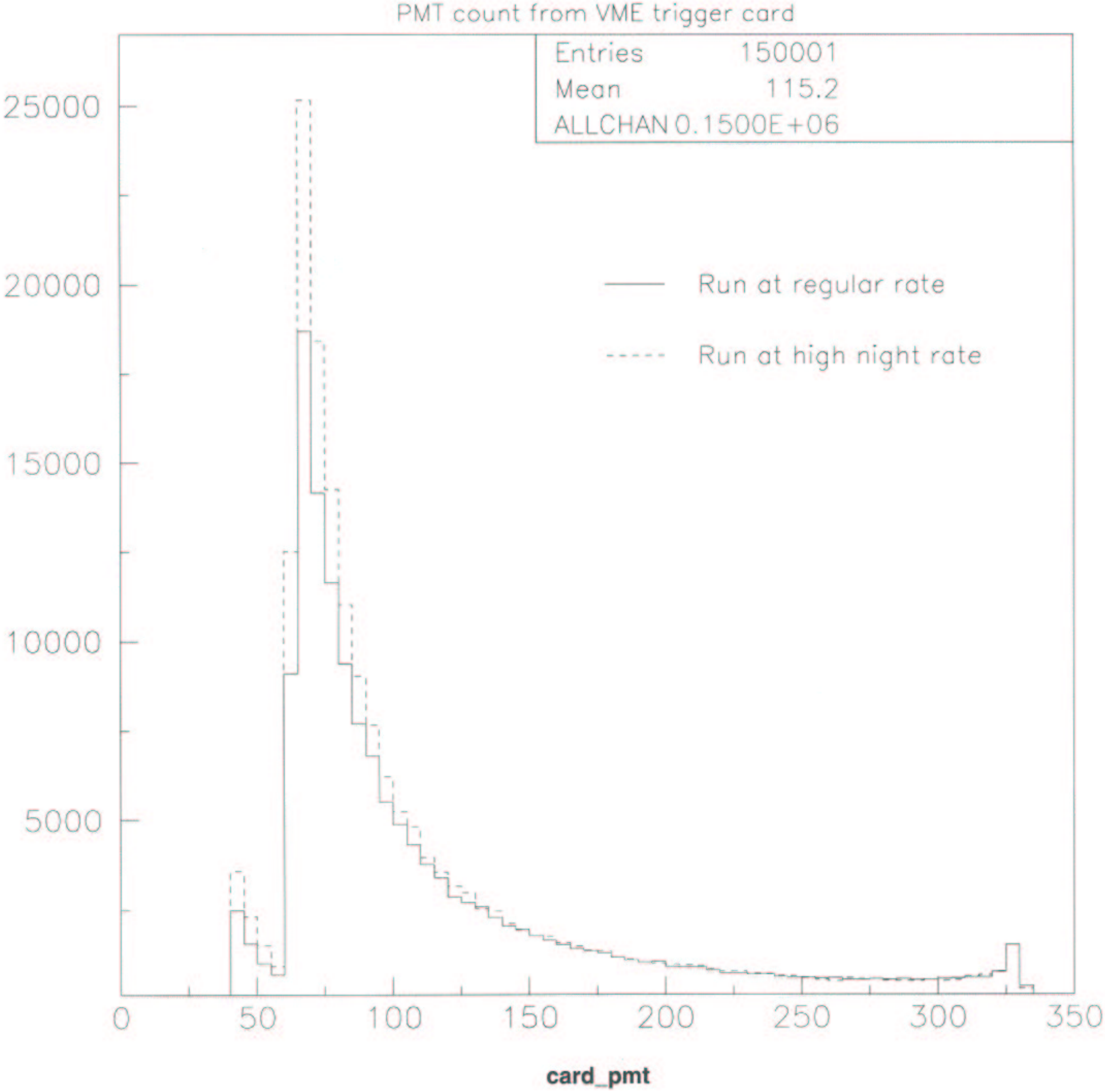

2002/02/10 09.45
Risetimes for regular trigger (53<pmtcount<76)
Entries 122936
Mean 84.33
ALLCHAN 0.1229E+06
FIT events, reg rate
FIT events, high night rate
Unfit events, reg rate
Unfit events, high night rate
25000
20000
15000
10000
5000
0
0
50
100
150
200
250
300
Ristime(ns)

2002/02/10 09.38

Risetimes for low trigger (~~53~~ 36<pmtcount<~~76~~ 93)

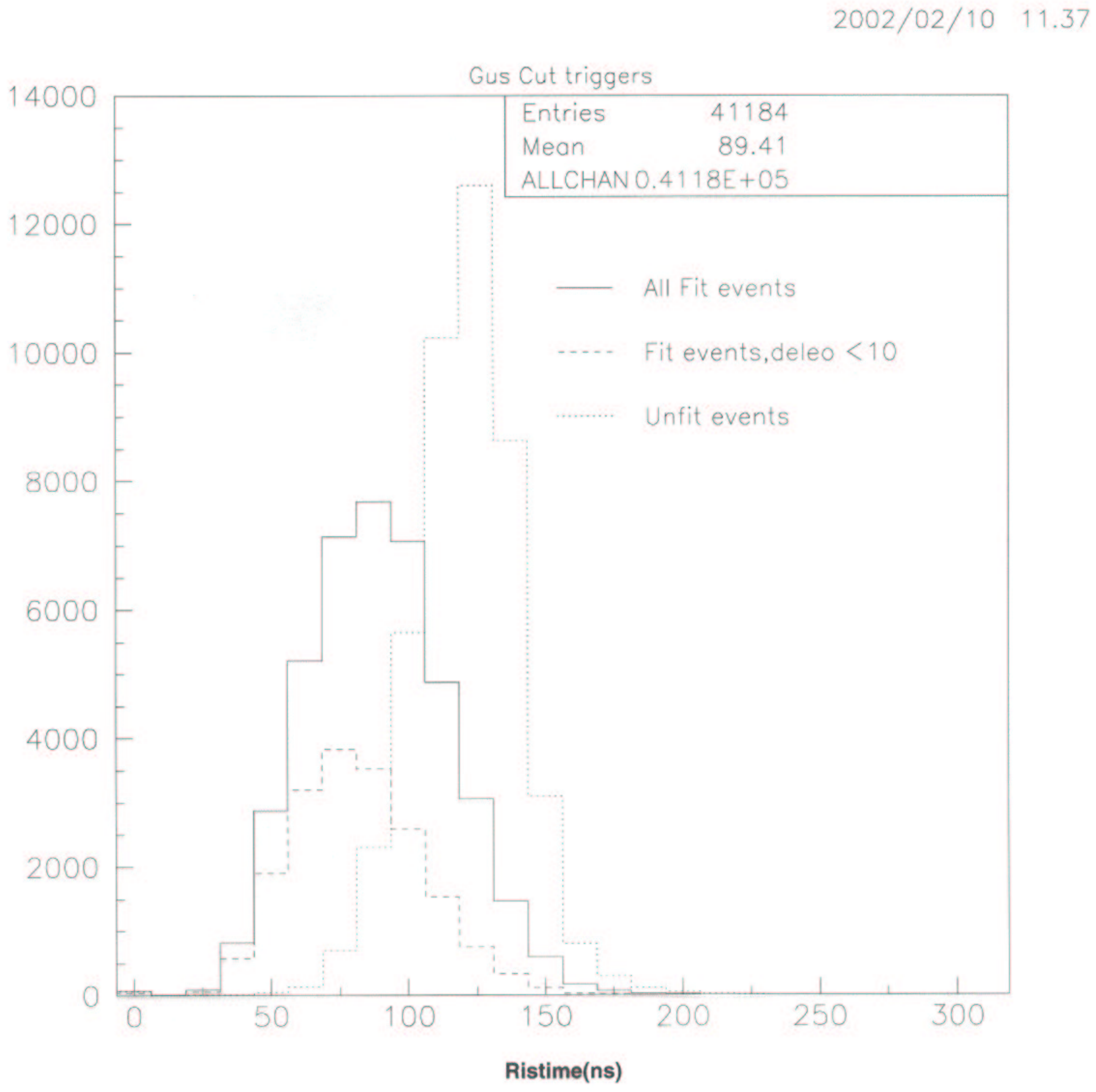


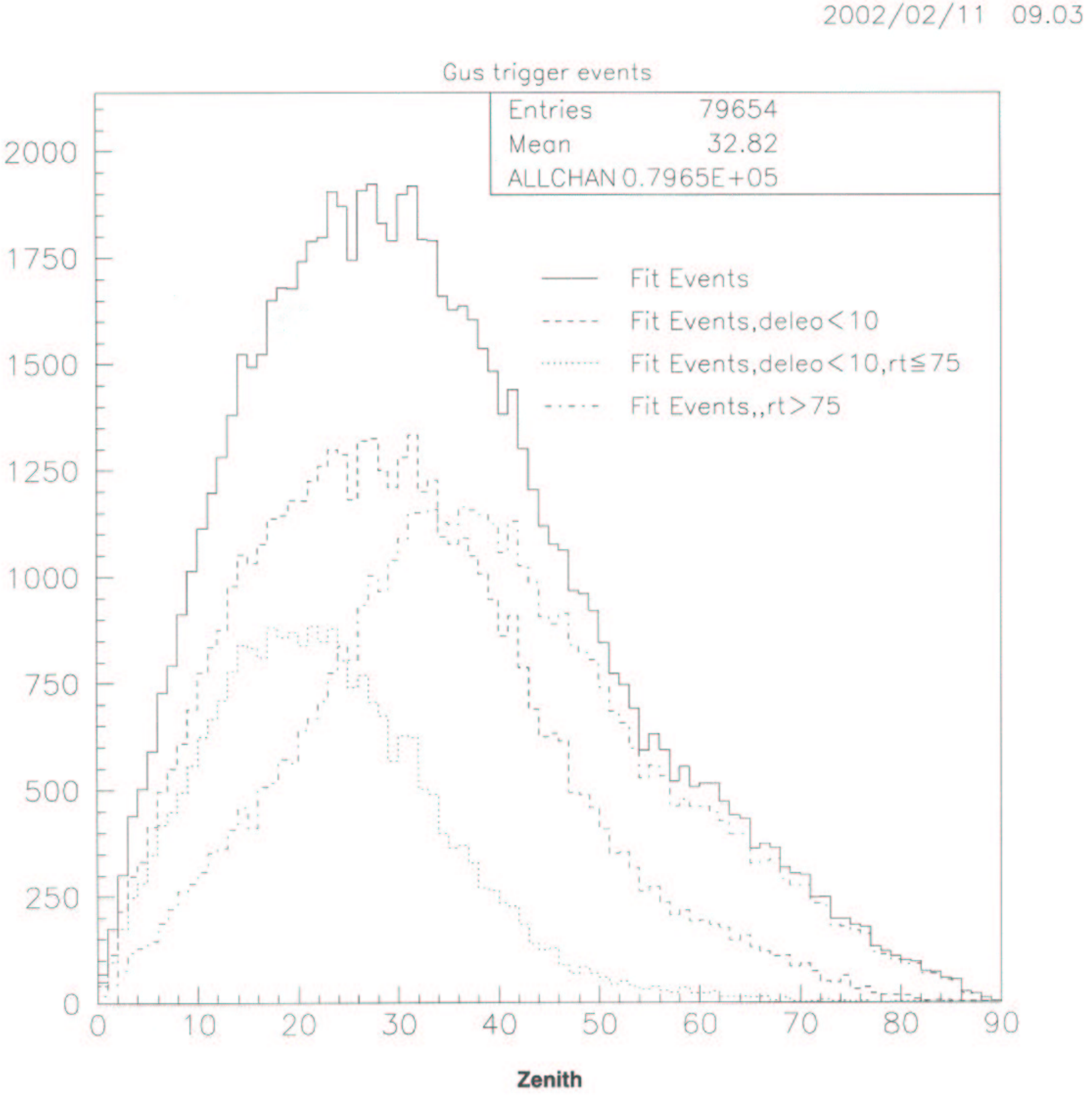
2002/02/10 09.25



Muon layer veto

- A first step toward trigger level Gamma/hadron separation
- Last week, Gus added a 3rd trigger type that uses the front panel veto to reject triggers.
  - #PMTs : 39–53 range
  - Events are vetoed if there are 2 or more HITOT hits in the muon layer.
- This cut seems to be independent of risetime.
  - Risetime distributions, zenith angle distributions
  - Seems additional reduction of this sample possible with a risetime cut


2002/02/10 11.37
Gus Cut triggers
Entries 41184
Mean 89.41
ALLCHAN 0.4118E+05
All Fit events
Fit events,deleo <10
Unfit events
14000
12000
10000
8000
6000
4000
2000
0
0
50
100
150
200
250
300
Ristime(ns)


2002/02/11 09.03
Gus trigger events
Entries 79654
Mean 32.82
ALLCHAN 0.7965E+05
Fit Events
Fit Events,deleo<10
Fit Events,deleo<10,rt≦75
Fit Events,,rt>75
2000
1750
1500
1250
1000
750
500
250
0
0
10
20
30
40
50
60
70
80
90
Zenith

A proposed trigger setup...

- More study is needed to settle details of setup, but overall we probably want something like:
- Trigger 1:
    - PMT >76 tubes, no risetime cut, no prescaling, no veto
    - About 700 Hz
- Trigger 2:
    - PMT> 53 tubes, risetime<= 100 ns, no prescale, no veto
        - Keeps 64% of raw events, 77 % of fit and 84% of good fits
    - About 450 Hz, and more stable in winter
- Trigger 3:
    - PMT> ~35 tubes, risetime<= 75 ns, no prescale, muon veto
        - Risetime cut keeps ~20% (~50% fits)of muon veto passing events.
        - Rejects ~95% of unfittable events
- Trigger 4: Unbiased prescale of 2,3 rejects.

Future work

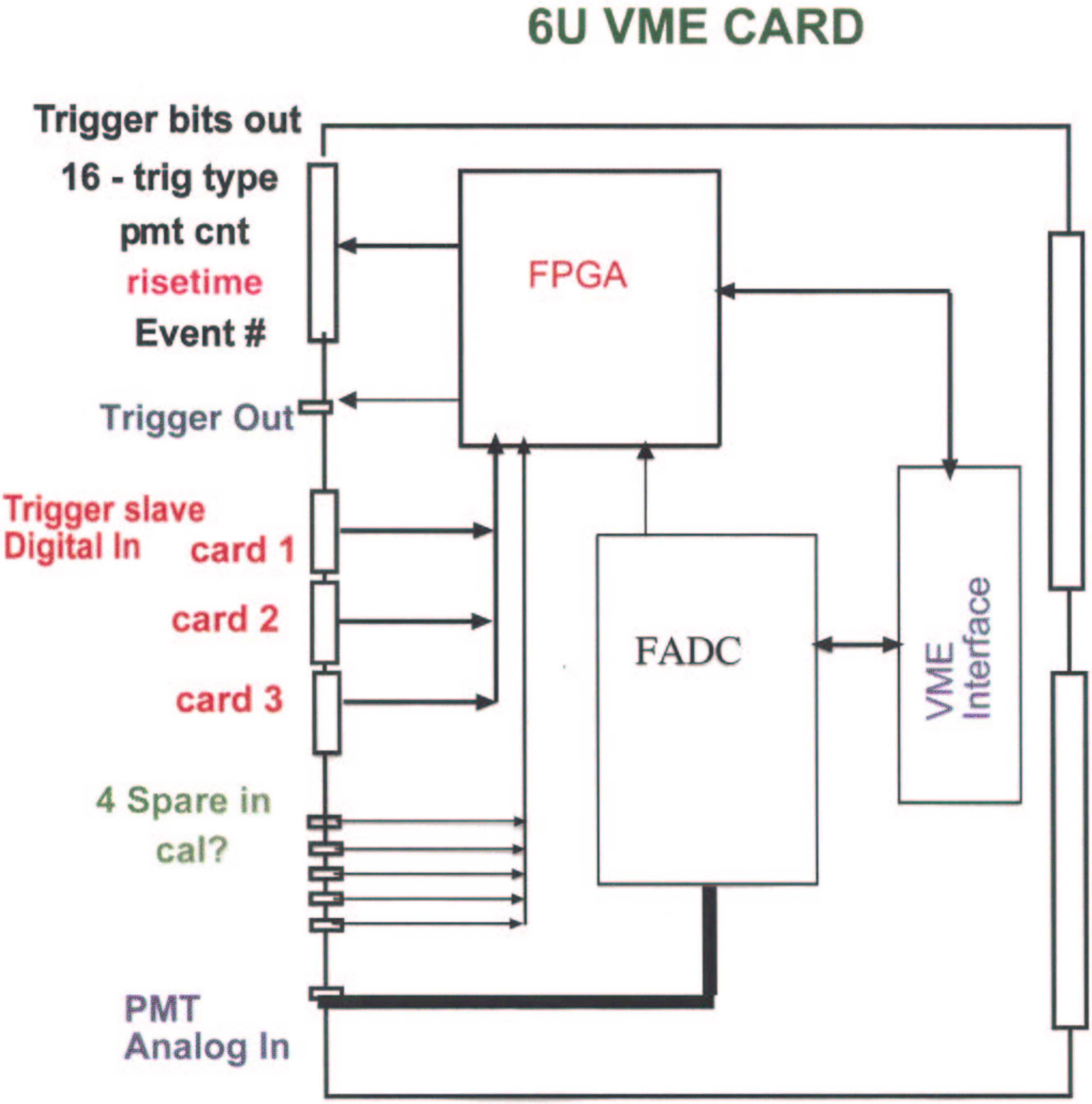
- More study to finalize trigger levels.
  - Take a look at some simulation data as well.
- The angle fitter was designed for high Nhit events and probably needs to be looked at again
  - Better angular resolution for low Nhit events
    ↳ ~~nhit~~ nfit dists.
- VME daughter cards for muon layer veto in progress
  - Settable discriminators for each channel
  - See Greg's talk.

11 Muon Trigger Cards - Greg Sullivan

Milagro Trigger Upgrades

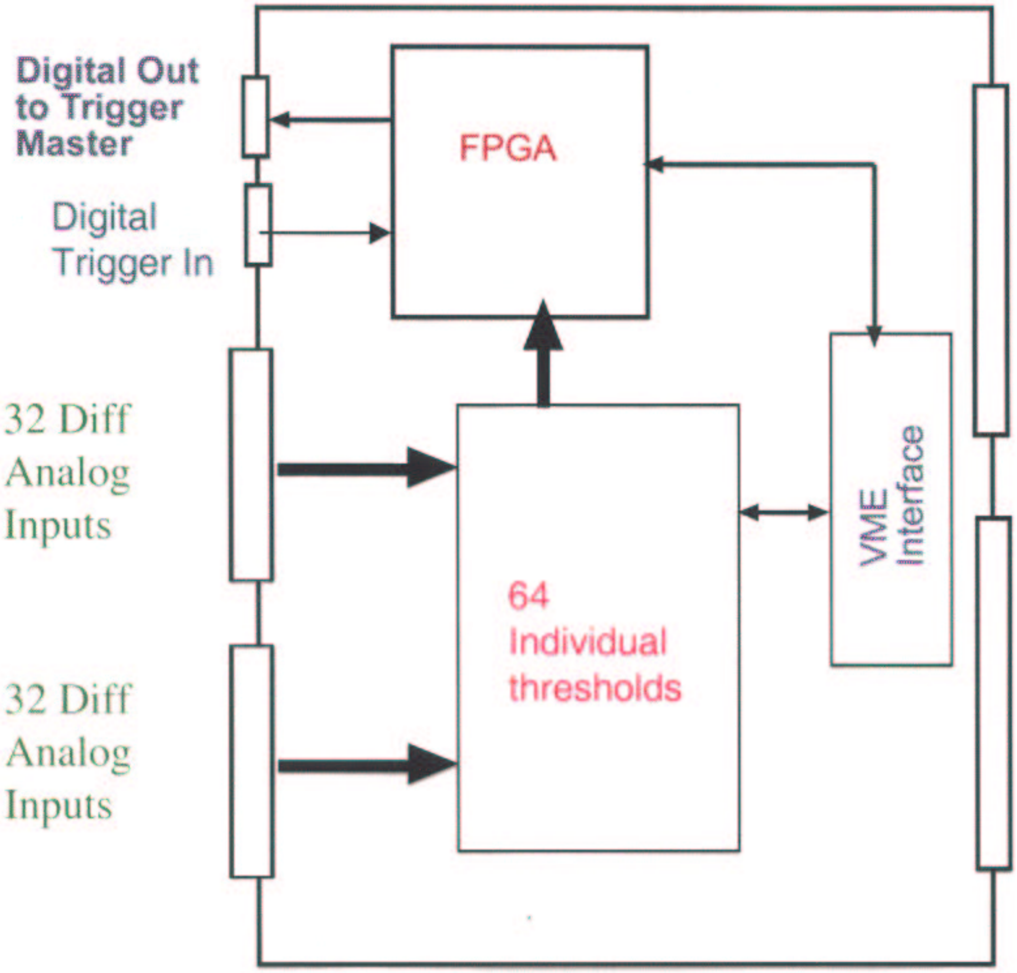
- Motivation for trigger upgrade
  - Operational reasons
    - Multiple trigger types
    - Pre-scaled samples
    - Trigger monitoring
    - Calibration triggers
    - Etc…
  - Physics Reasons
    - Reduce non-shower events at trigger
    - Decrease threshold
      - Improve GRB sensitivity
        - » Cosmological distances
        - » Need lowest possible energy

Functional Diagram of Trigger Master Card



Trigger Slave Card

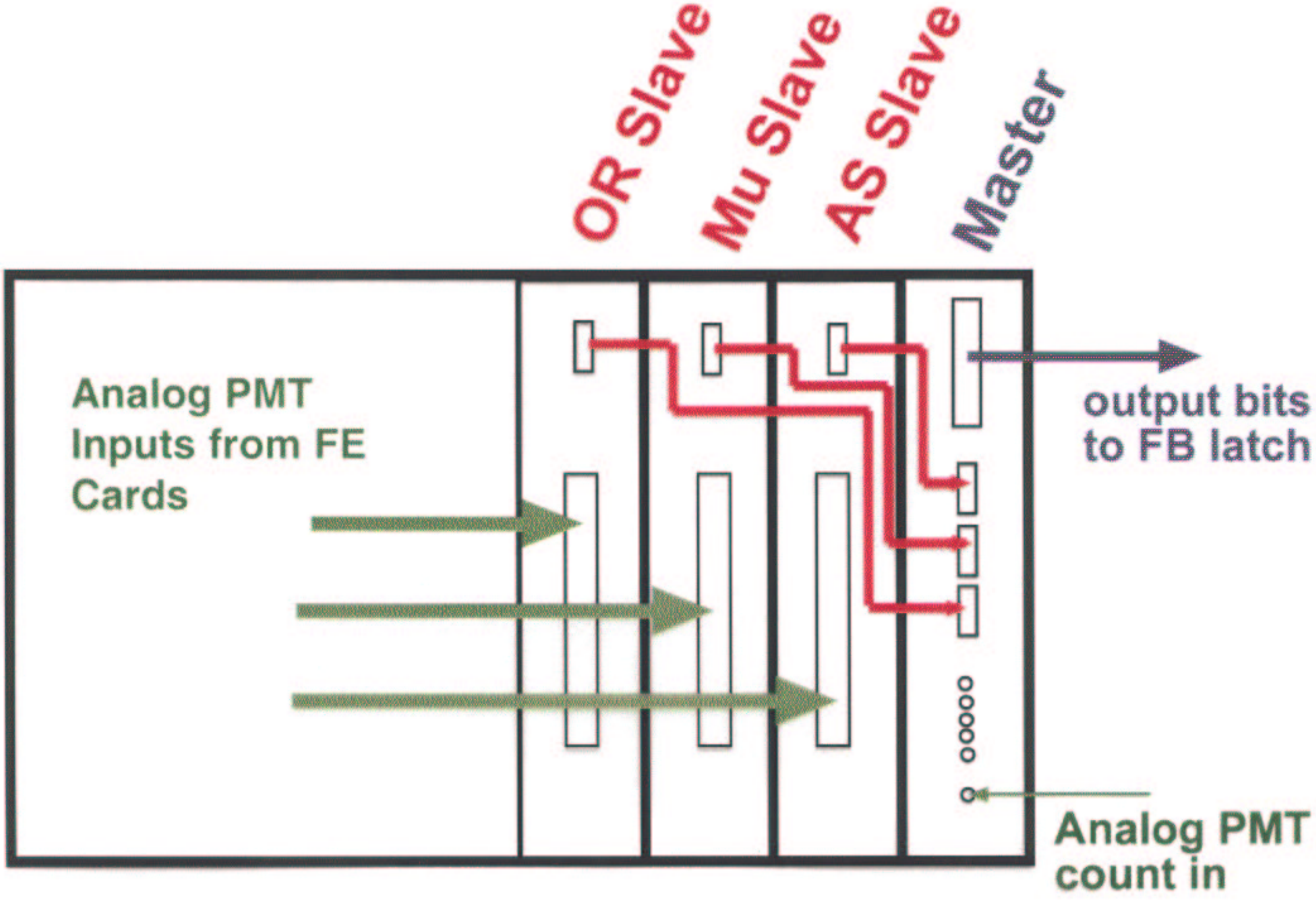
6U VME Card



- Use Front-End card Solar outputs to do logic for veto of background trigger events
  - Muons

Full Trigger System with Master & Slave Cards

VME Crate



OR Slave

Mu Slave

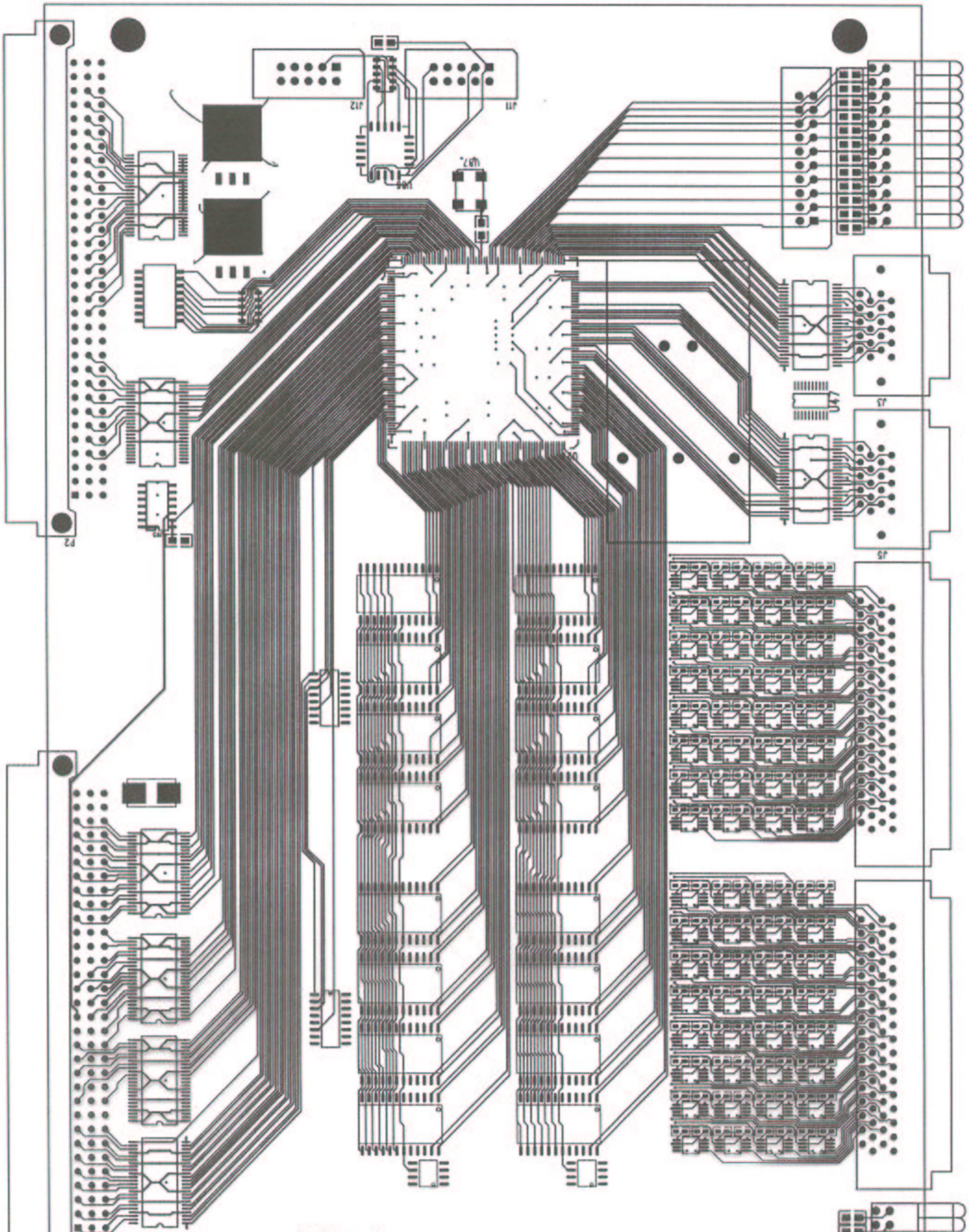
AS Slave

Master

Analog PMT Inputs from FE Cards

output bits to FB latch

Analog PMT count in


J12
J11
U47
J5
J5
P2
P1
University of Maryland
High Energy Physics

Summary

- Operational benefits to trigger card
  - Multiple Triggers
  - Flexible triggers
    - Risetime cut for free
    - "High threshold muon veto"
  - Trigger Slave Cards
    - Cards in production
      - Programmability
    - Muon, Outrigger, Air Shower
      - Best Algorithm?

12 New DAQ Sytem - Erik Blaufuss

The New DAQ System

Erik Blaufuss
University of Maryland

- Why?
- Where are we now?
  - New PCI–VME bridge
  - A rack mounted disk server at UMD
  - Software being developed, see Frank’s talk.
- What’s next...

Why?

- Our current DAQ system has some limits:
  - Our analysis at the current rate takes all of the CPU available in Kahuna.
  - A more complex core finder or angle fitter can not be done online.
  - Addition of outriggers/ VME trigger will probably require more complex fitting.
  - Recent disk problems with the current arrays
- Service contract on the SGI is expensive
  - $10,000 a year

Where are we now?

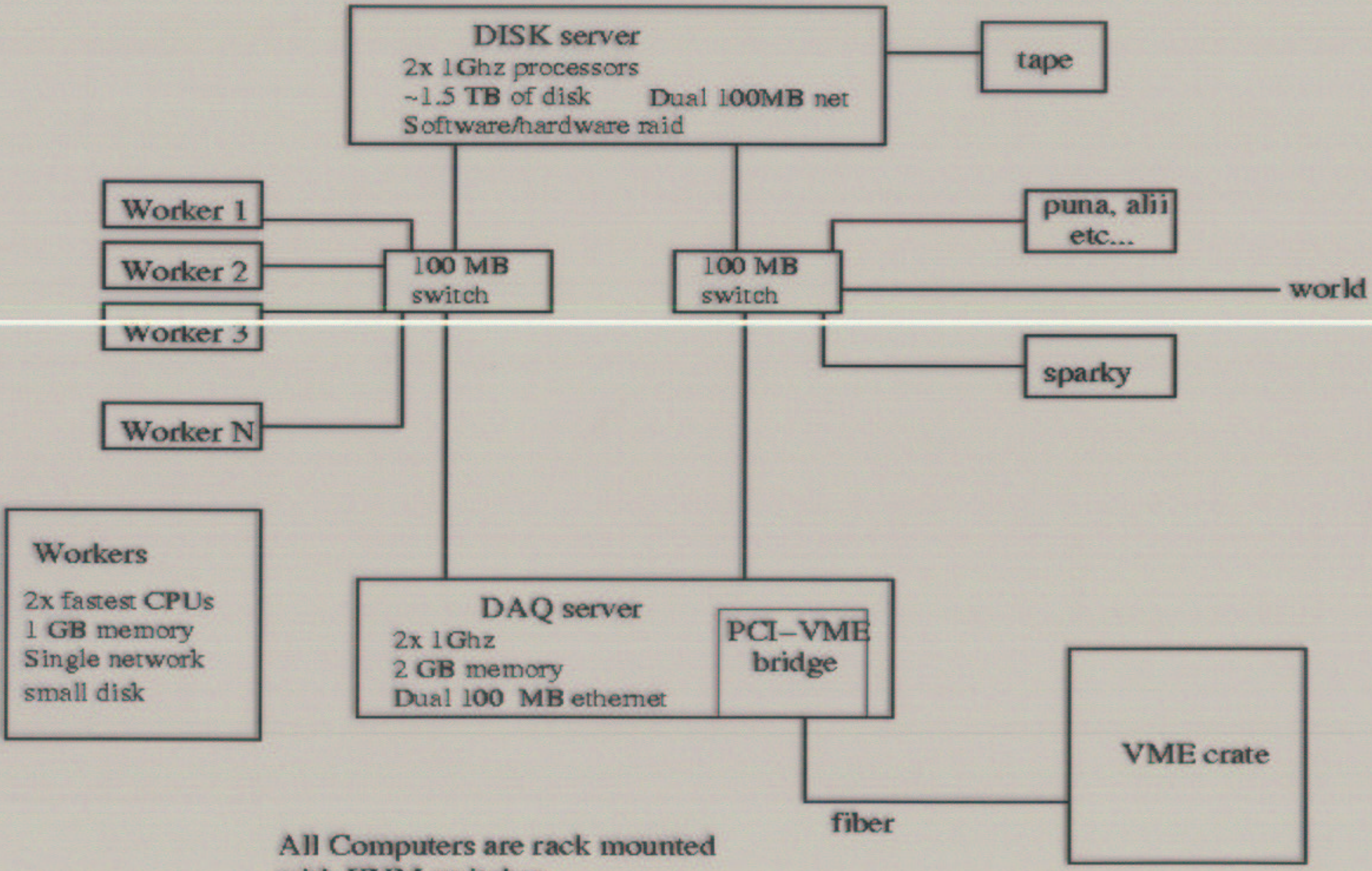
- Problems with 2.2 vs. 2.4 kernel are resolved
  - A new PCI–VME bridge from Struck has been released.
    - Sent me one for a free 8 week evaluation. Works well
    - We bought one.
    - Better transfer speeds:
      - ~35 MB/sec transfers (DMA)
      - 64 bit transfers possible
      - Memory maps supported.
    - Very responsive support from these guys.
    - A new bios exists for even faster performance.

- 3U rack server at UMD now.
  - 2x 1Ghz processors
  - 1 GB memory
  - 840 GB IDE disk array (pogolinux.com)
- Tested with PCI–VME bridge and high disk loads.
  - Performance of hardware raid was troubling.
    - Long system delays with hardware raid for VME reads
    - Software raid gives slightly slower performance but without "freezes"
  - Probably best to separate the disk array from the VME readout computer.

Things to come...

- DAQ code freeze is planned to aid move to new system
- Finish moving VME read out code to new PCI–VME bridge.
- Get things to the site (Goal: early April)
  - Start small, few workers, with similar analysis to current online
  - Add more workers as analysis becomes more complex.

A map of what things might look like



DISK server
2x 1Ghz processors
~1.5 TB of disk Dual 100MB net
Software/hardware raid

tape

Worker 1
Worker 2
Worker 3
Worker N

100 MB
switch

100 MB
switch

puna, alii
etc...

world

sparky

Workers
2x fastest CPUs
1 GB memory
Single network
small disk

DAQ server
2x 1Ghz
2 GB memory
Dual 100 MB ethernet

PCI–VME
bridge

fiber

VME crate

All Computers are rack mounted
with KVM switches

Things are still not completely set.

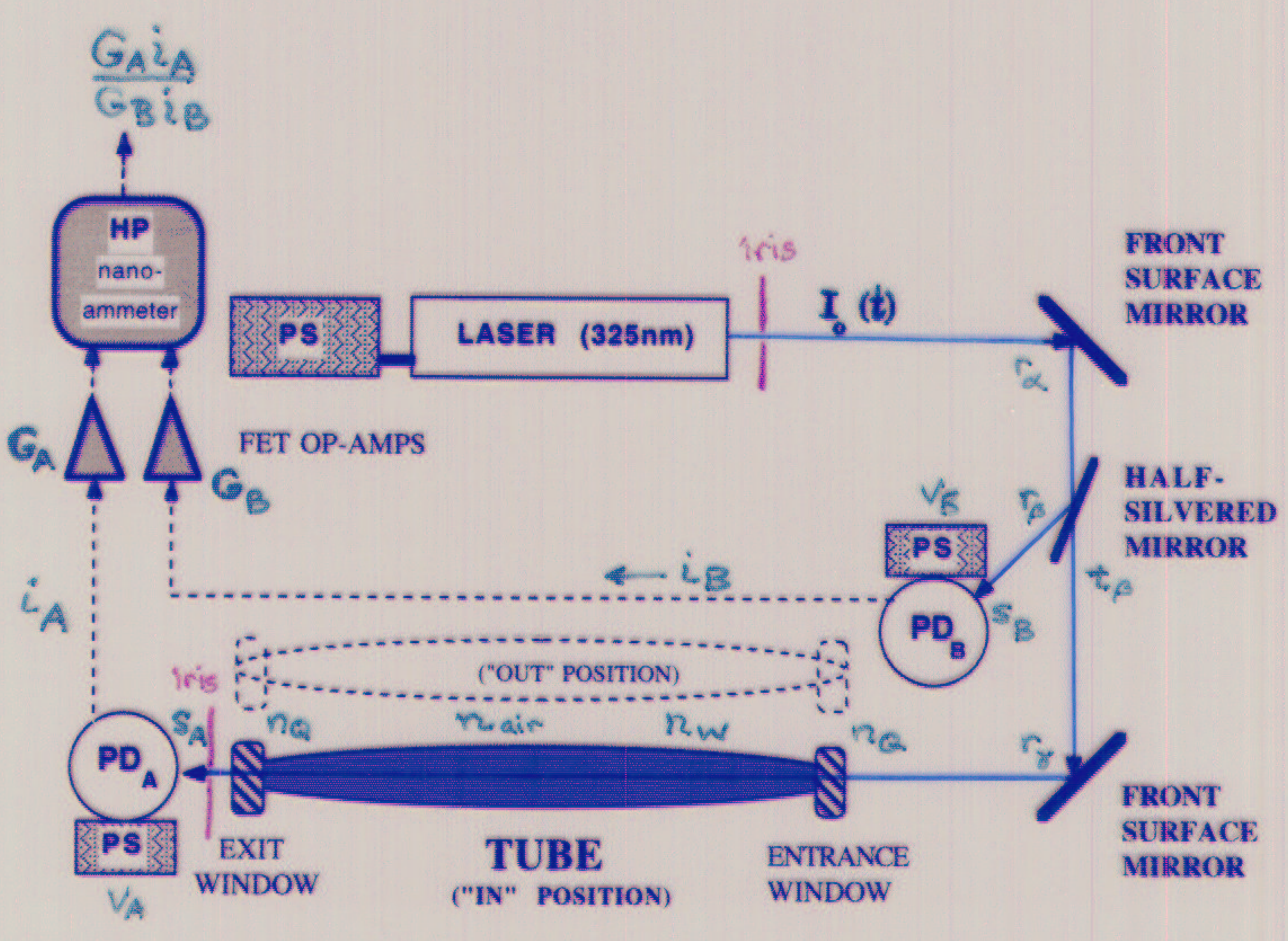
13 The Myths of Sysiphus: of Lasers, Glass, and Water - Don Coyne

Adventures with the TUBE

Finding systematic problems with the water attenuation-length measurements.

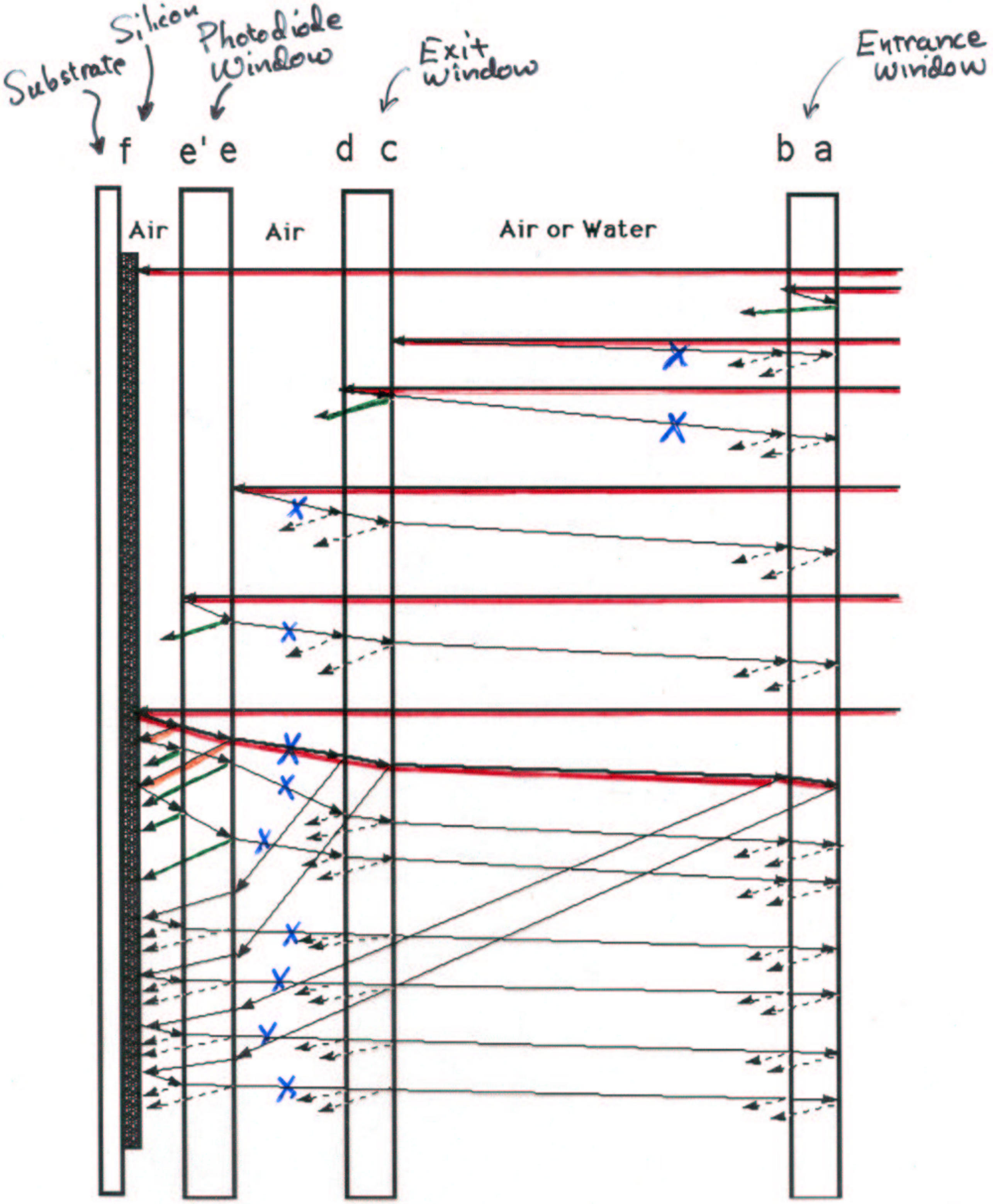
D. Coyne
Feb '02 Collab. Mtg.

LAYOUT OF THE APPARATUS



Already knew: Geometry Critical

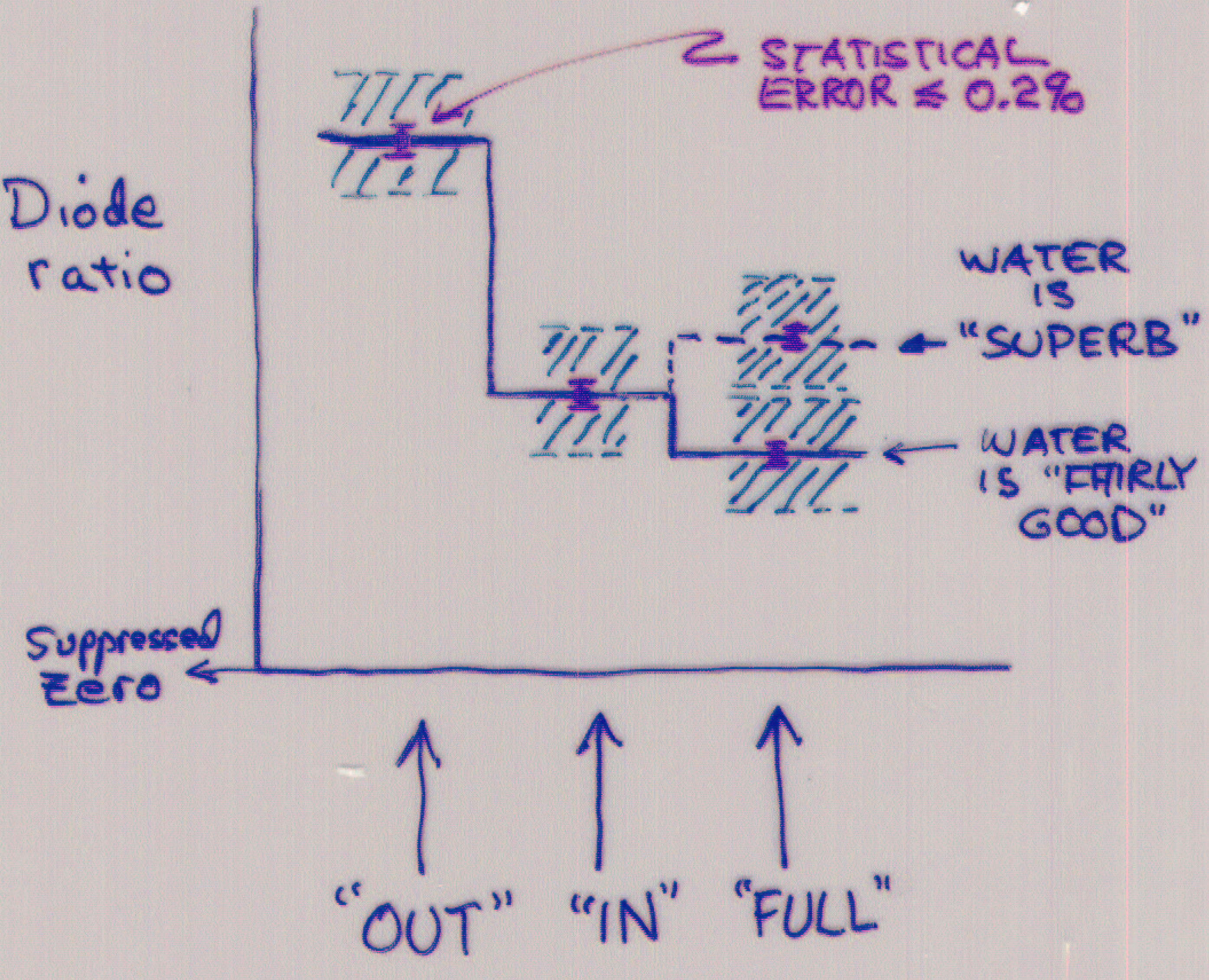
1. Can't return beam on itself (laser)
2. Must keep track of every reflection



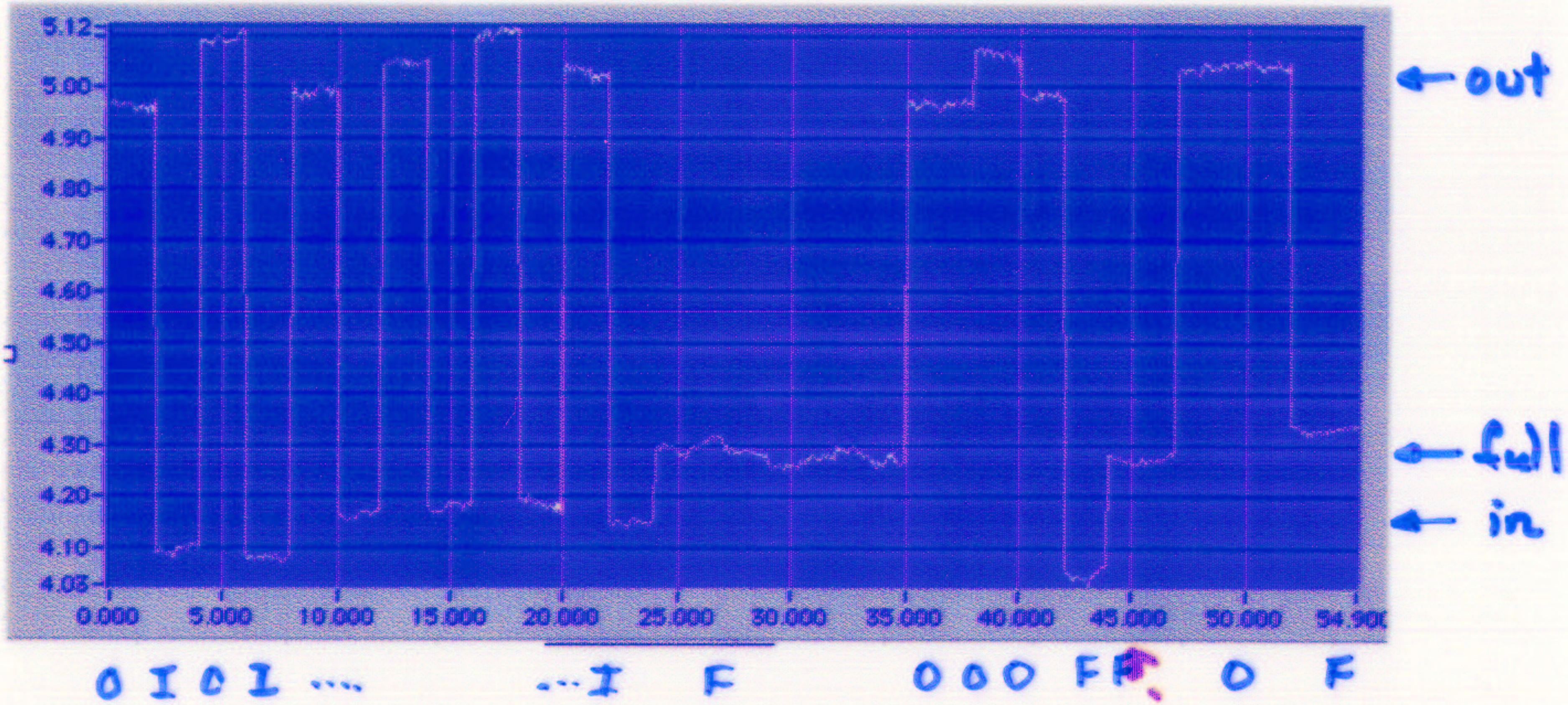
x eliminates: 4 first-order
44 second-order

keeps 1 zeroth-order
2 first-order
7 second-order

THE MEASUREMENT PROBLEM



OBSERVED SYSTEMATIC ERROR ≈ 2%

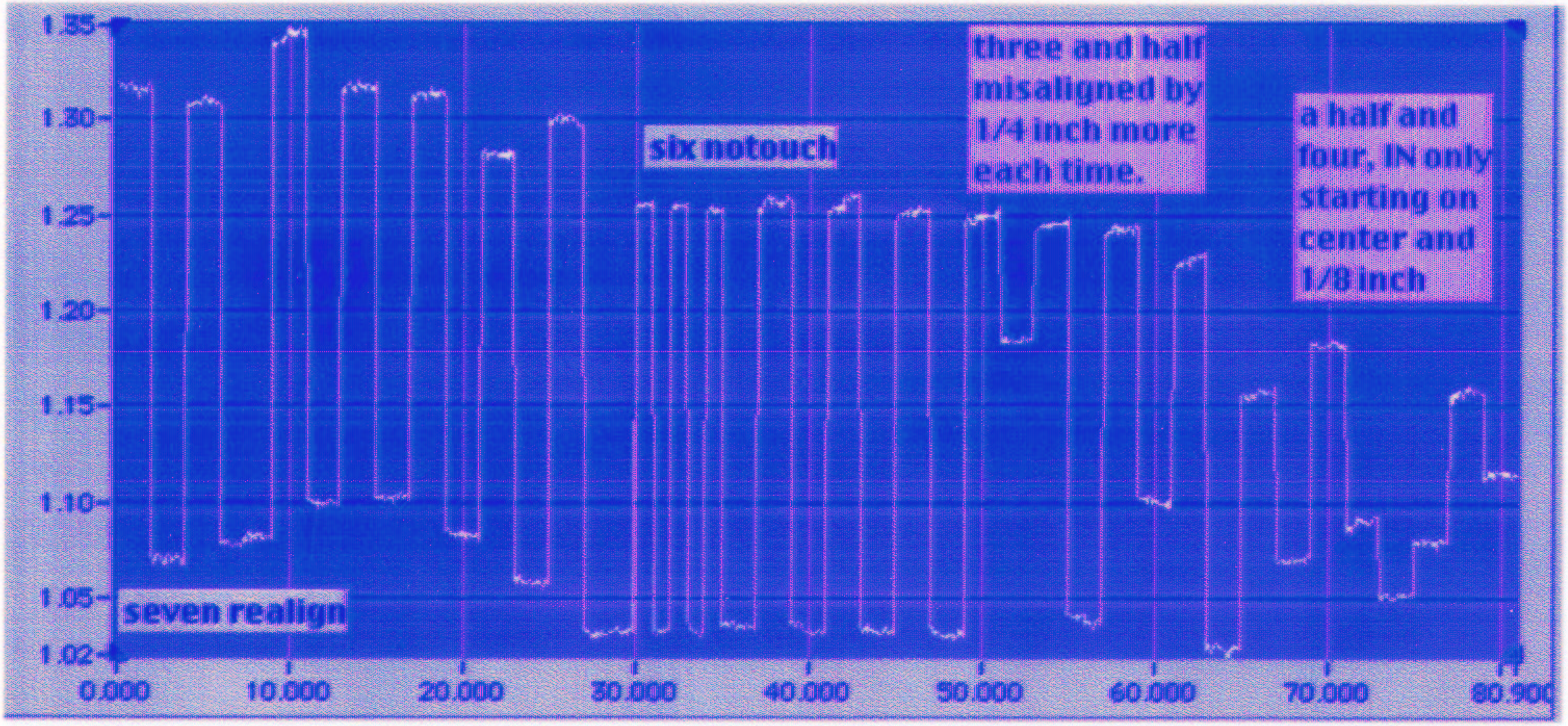


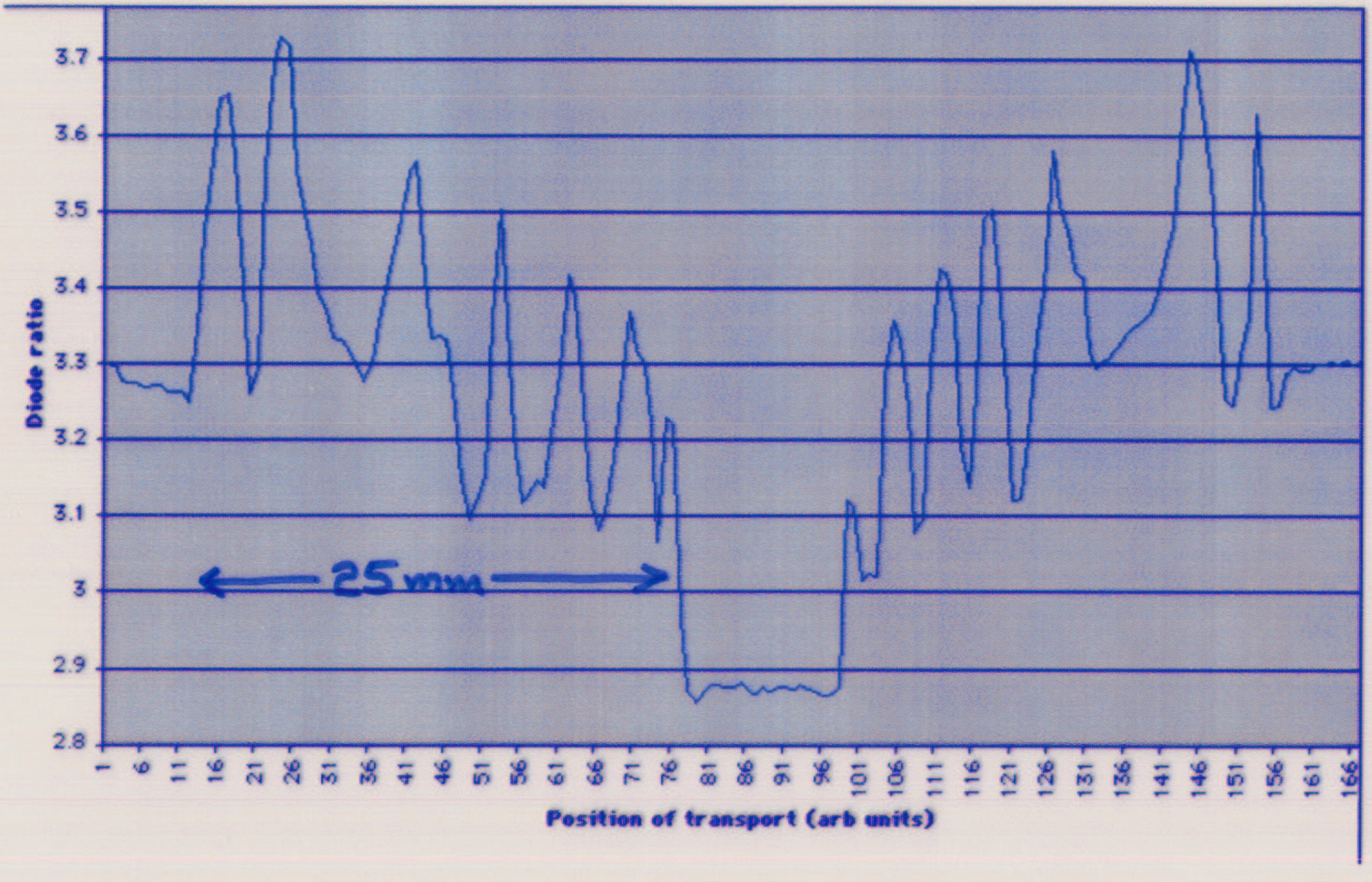
Recve. 12/13/01
λ = 28m ± 10?

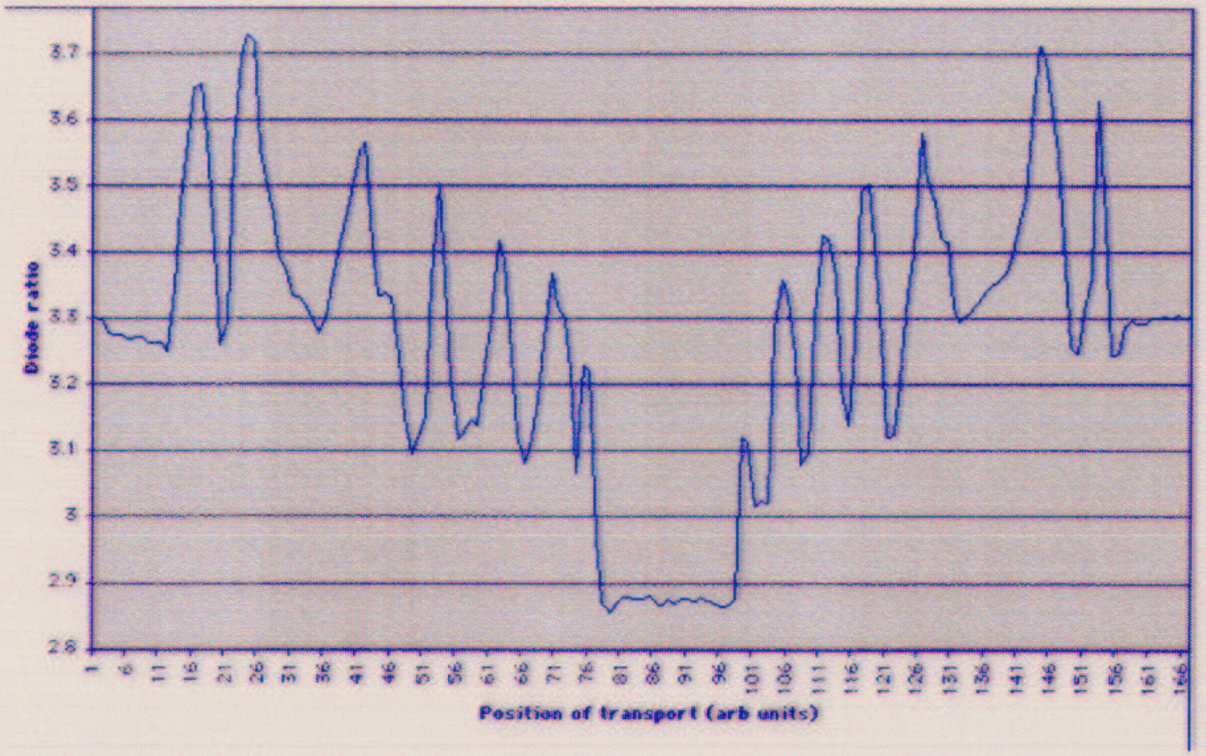
(λ=9m if use worst ALLCS)

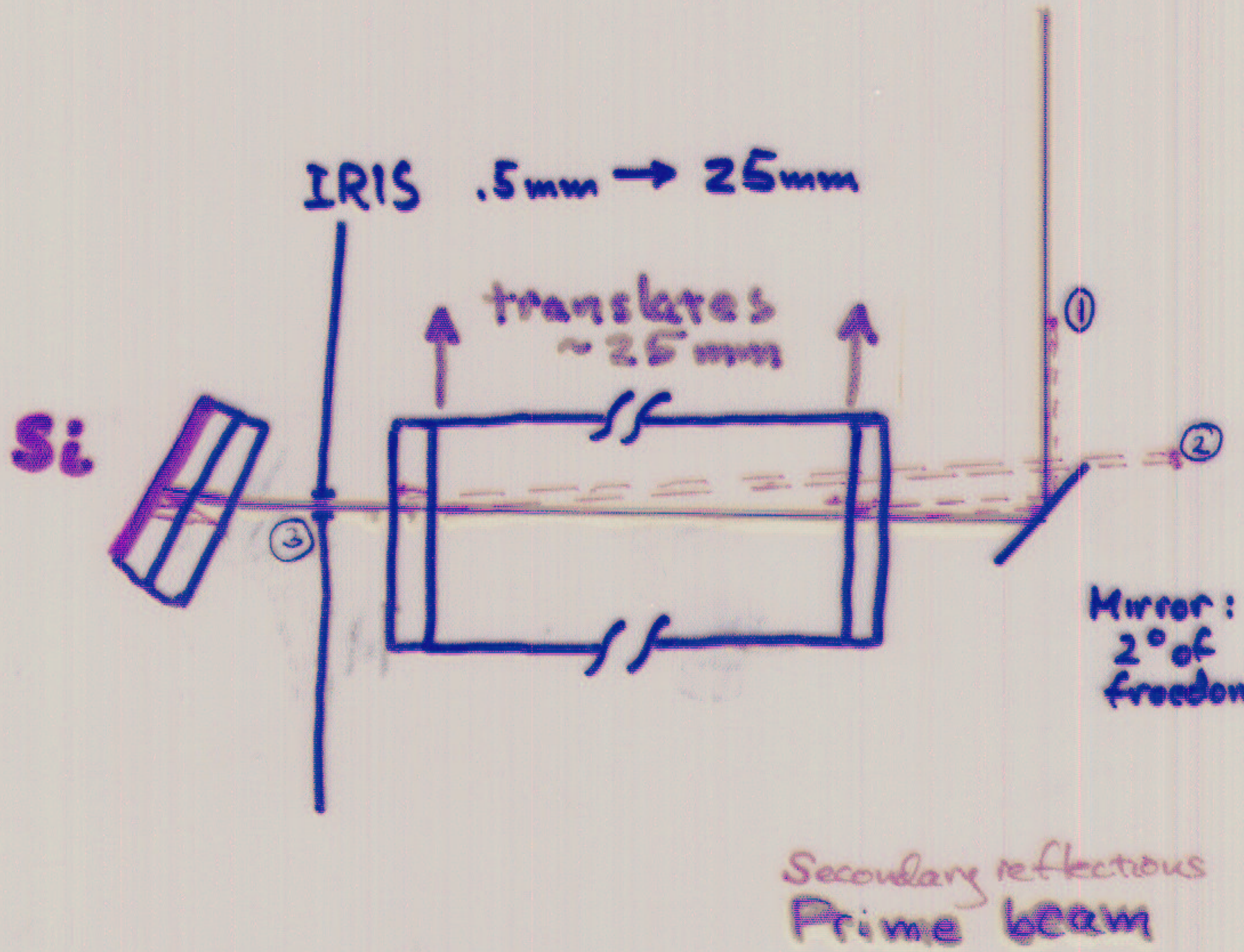
(Pond, similarly gave
λ = 42m ± 20)

I ±1% !


1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.02
0.000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.900
seven realign
six notouch
three and half misaligned by 1/4 inch more each time.
a half and four, IN only starting on center and 1/8 inch

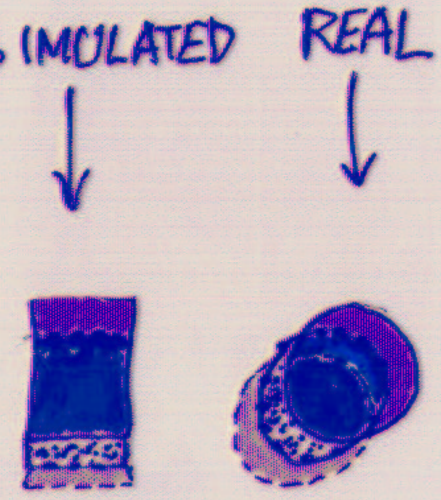

Diode ratio
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
25 mm
1
6
11
16
21
26
31
36
41
46
51
56
61
66
71
76
81
86
91
96
101
106
111
116
121
126
131
136
141
146
151
156
161
166
Position of transport (arb units)


Diode ratio
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
1
6
11
16
21
26
31
36
41
46
51
56
61
66
71
76
81
86
91
96
101
106
111
116
121
126
131
136
141
146
151
156
161
166
Position of transport (arb units)



Translation of 25mm
in carriage moves:

① < 0.2mm
② 1.5 mm ↳ 3mm looking from tube back towards mirror
③ < 0.1mm at iris



● $|\vec{I}|^2 \cdot area_1$

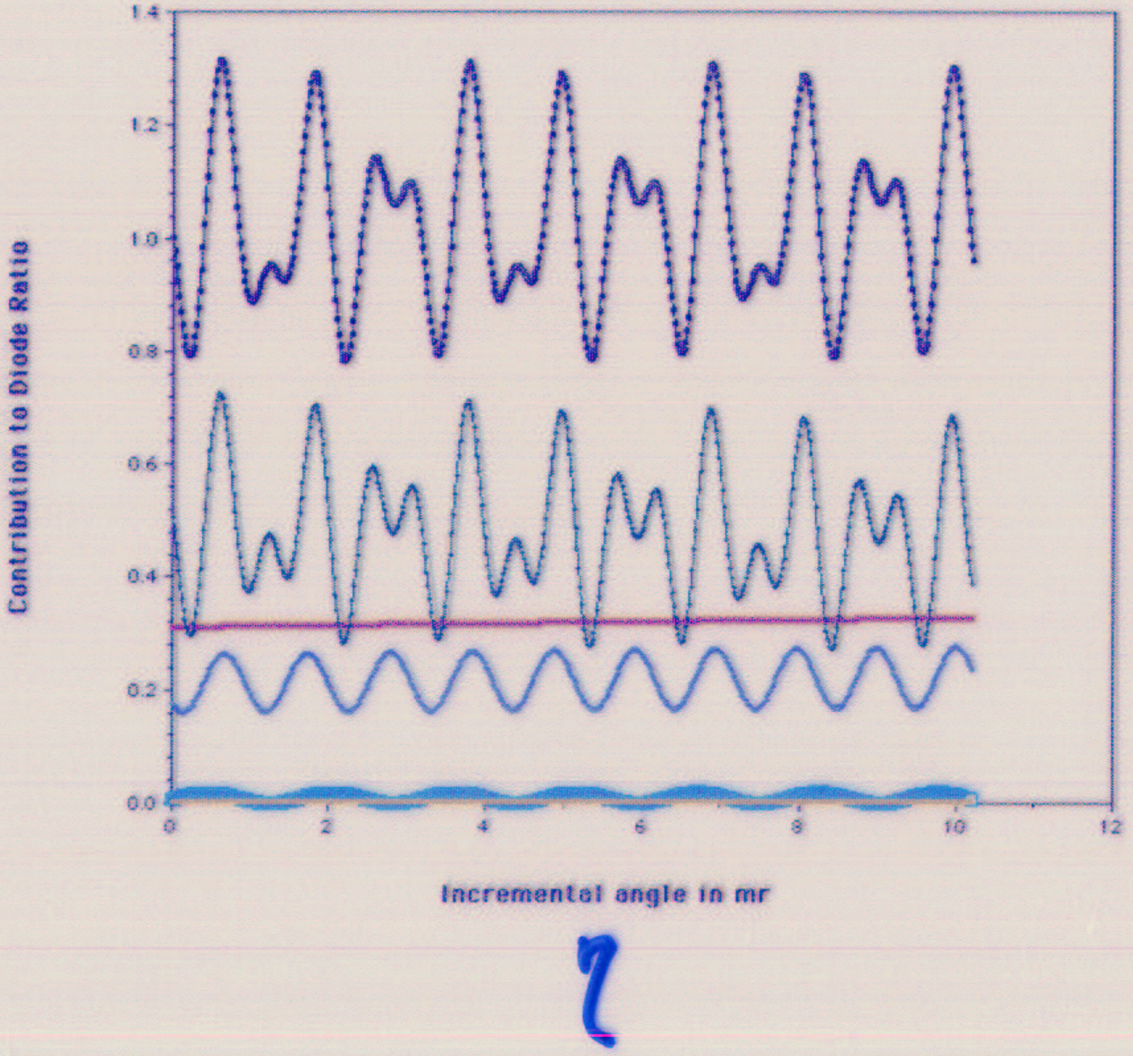
● $|\vec{I}+\vec{A}|^2 \cdot area_2$

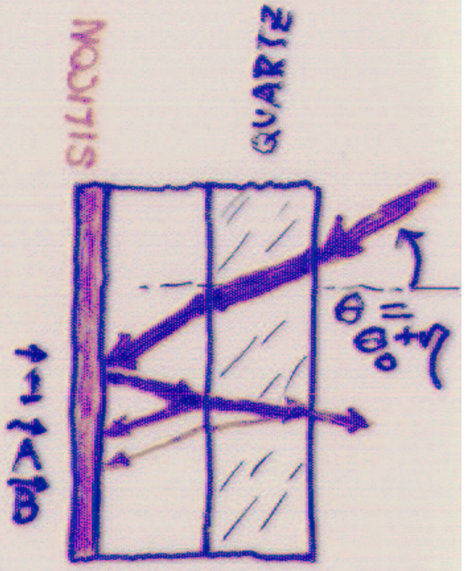
● $|\vec{I}+\vec{A}+\vec{B}|^2 \cdot area_3$

● $|\vec{A}+\vec{B}|^2 \cdot area_4$

● $|\vec{B}|^2 \cdot area_5$

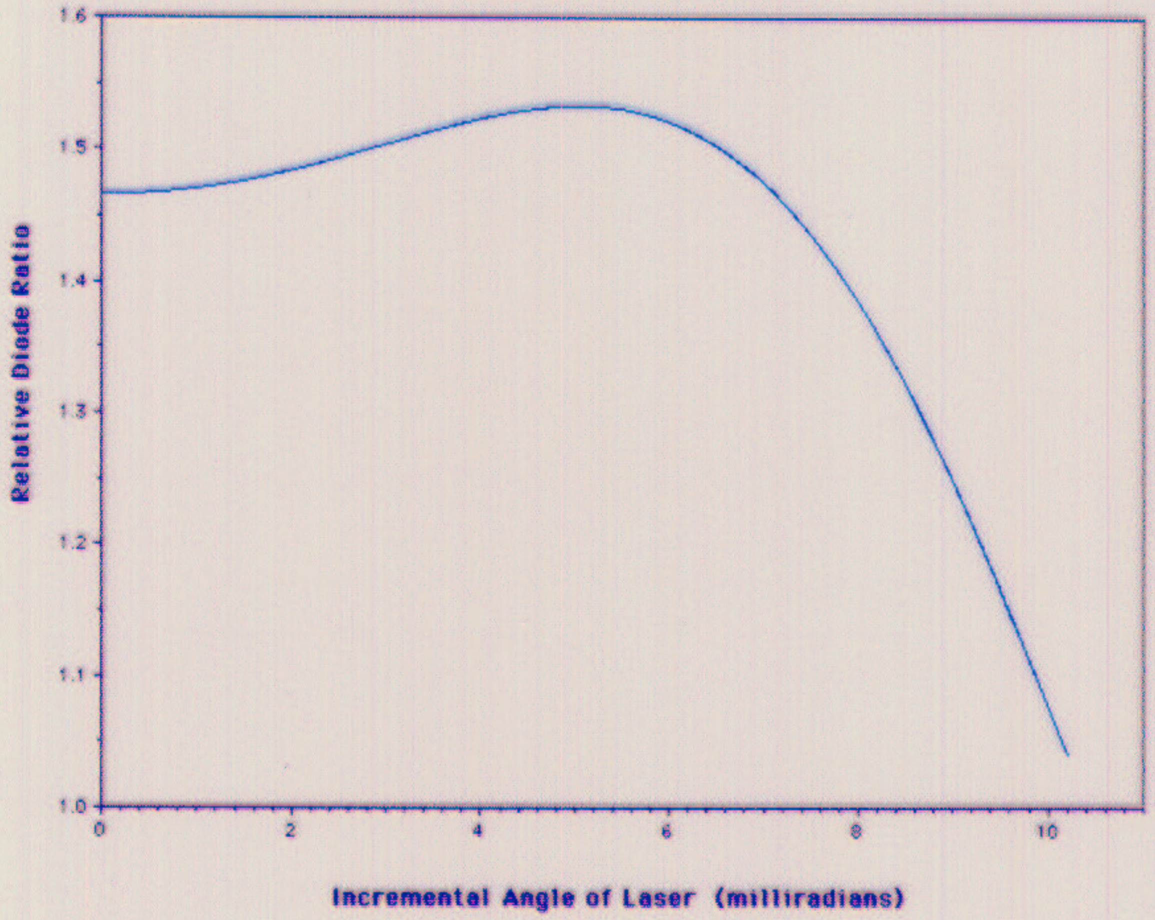
Components of the 11° Pattern





FINE INTERFERENCE PATTERN AT PHOTODIODE

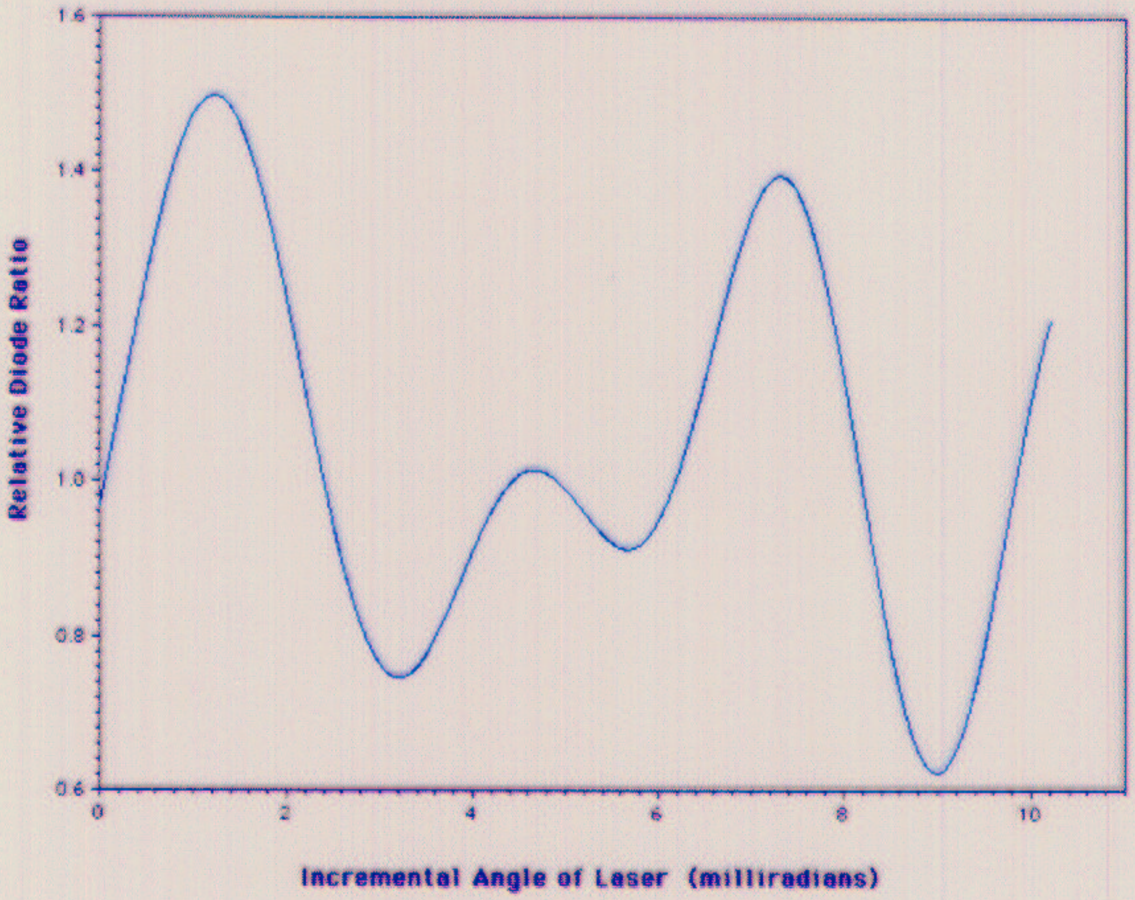
(Laser gross incident angle is exactly 0°)

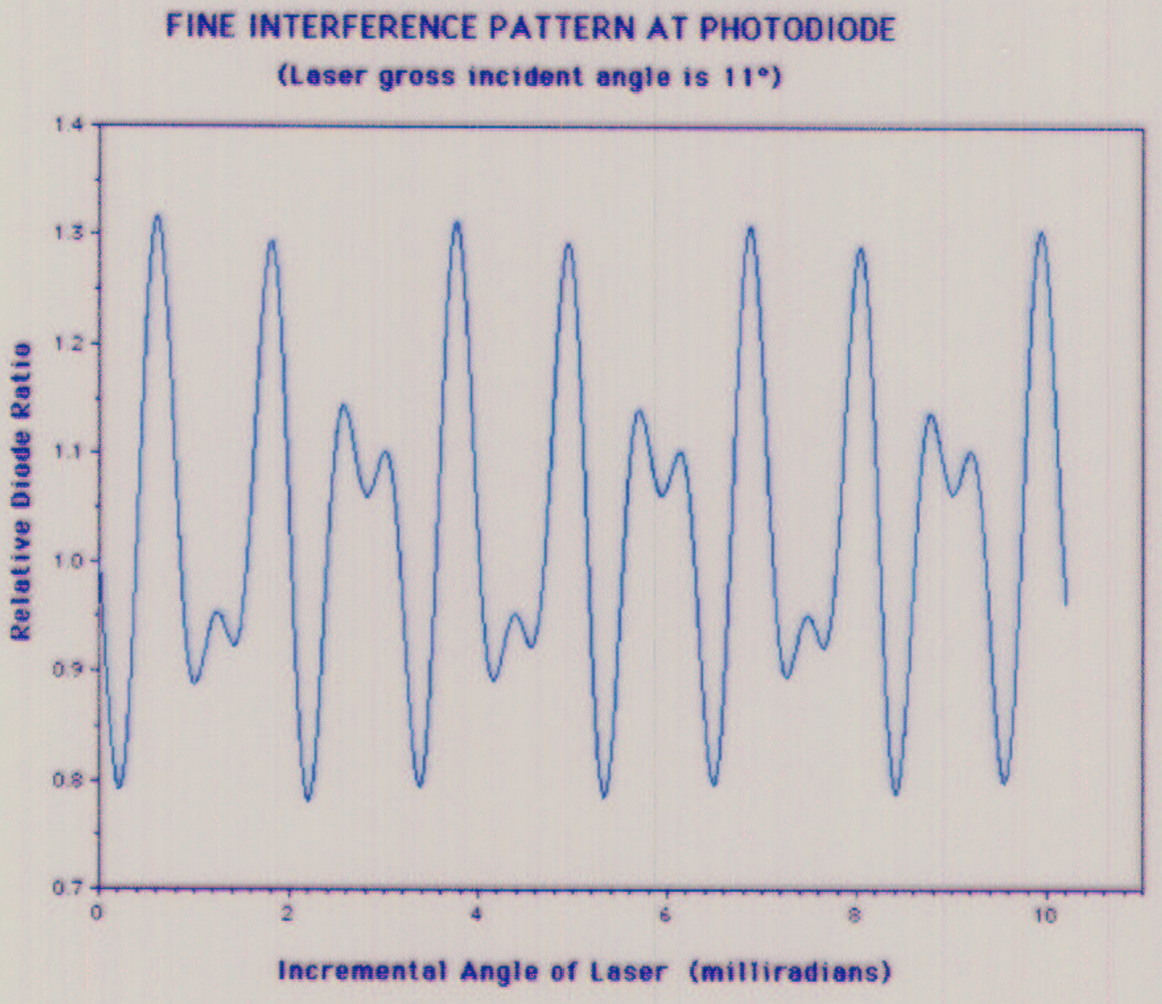


Relative to flux entering P.D.

FINE INTERFERENCE PATTERN AT PHOTODIODE

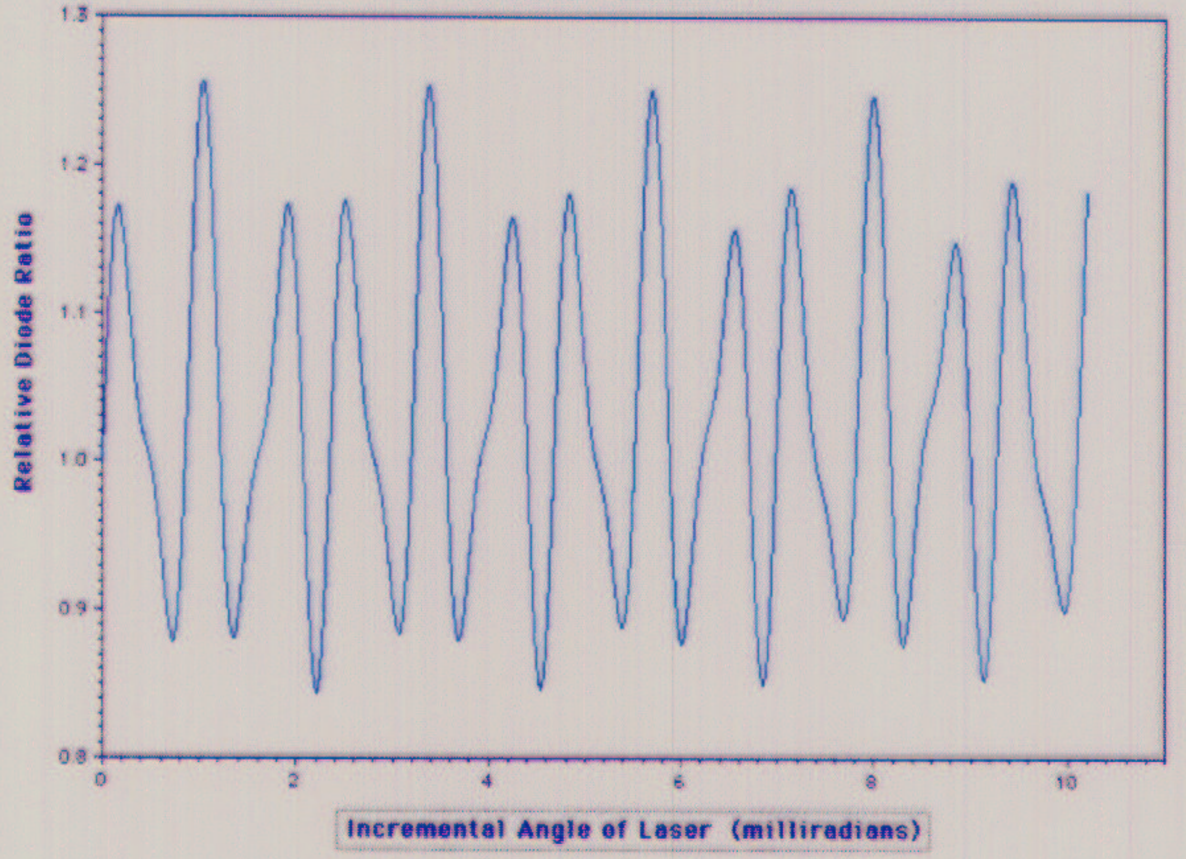
(Laser gross incident angle is 2°)



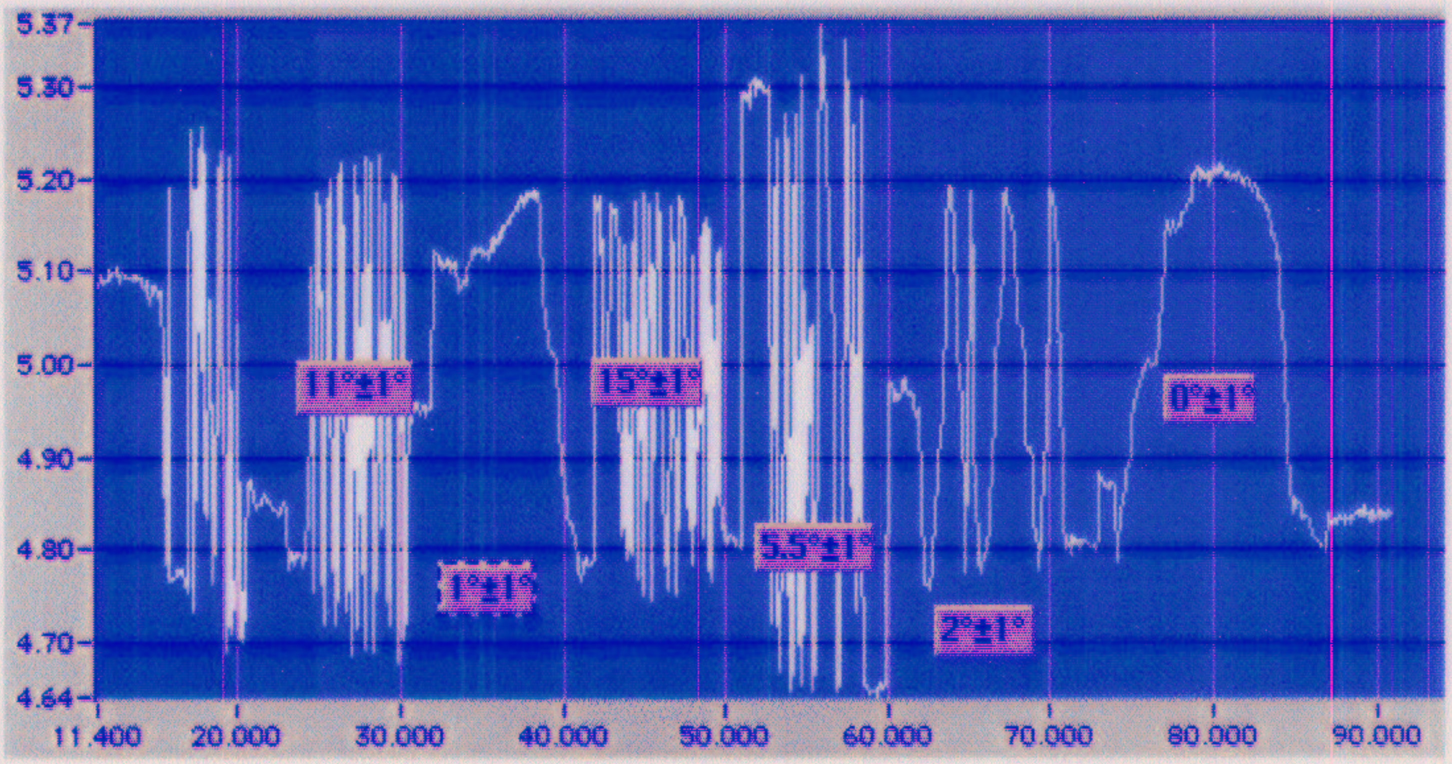


FINE INTERFERENCE PATTERN AT PHOTODIODE

(Laser gross incident angle is 11°)



FINE INTERFERENCE PATTERN AT PHOTODIODE
(Laser gross incident angle is 15°)


5.37
5.30
5.20
5.10
5.00
4.90
4.80
4.70
4.64
11.400
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
11°±1°
1°±1°
15°±1°
5.5°±1°
2°±1°
0°±1°

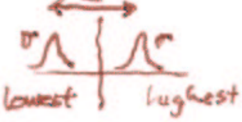
This week's results:

1. Confirmed interference in PD directly.

2. Discovered 2 other places beam should interfere
   - a) one does (entrance window)
   - b) the other doesn't (exit ")

3. Tried a hybrid technique:
   - Use 7° → a) kill PD interf. w/diffuser
   - b) tune interf. in entrance window to give "right" answer at PD.

This turned out to be incredibly stable -- better than .2% ! (in transmission)



4. Made water meas:

λ Recirc = 15.0 ± .9 m (limit of error)

λ Pond = 11.6 ± 1.4 m (")

Caveat: Stability does not imply that the answer is right.

14 Galactic Plane Update - Roman Fleysher

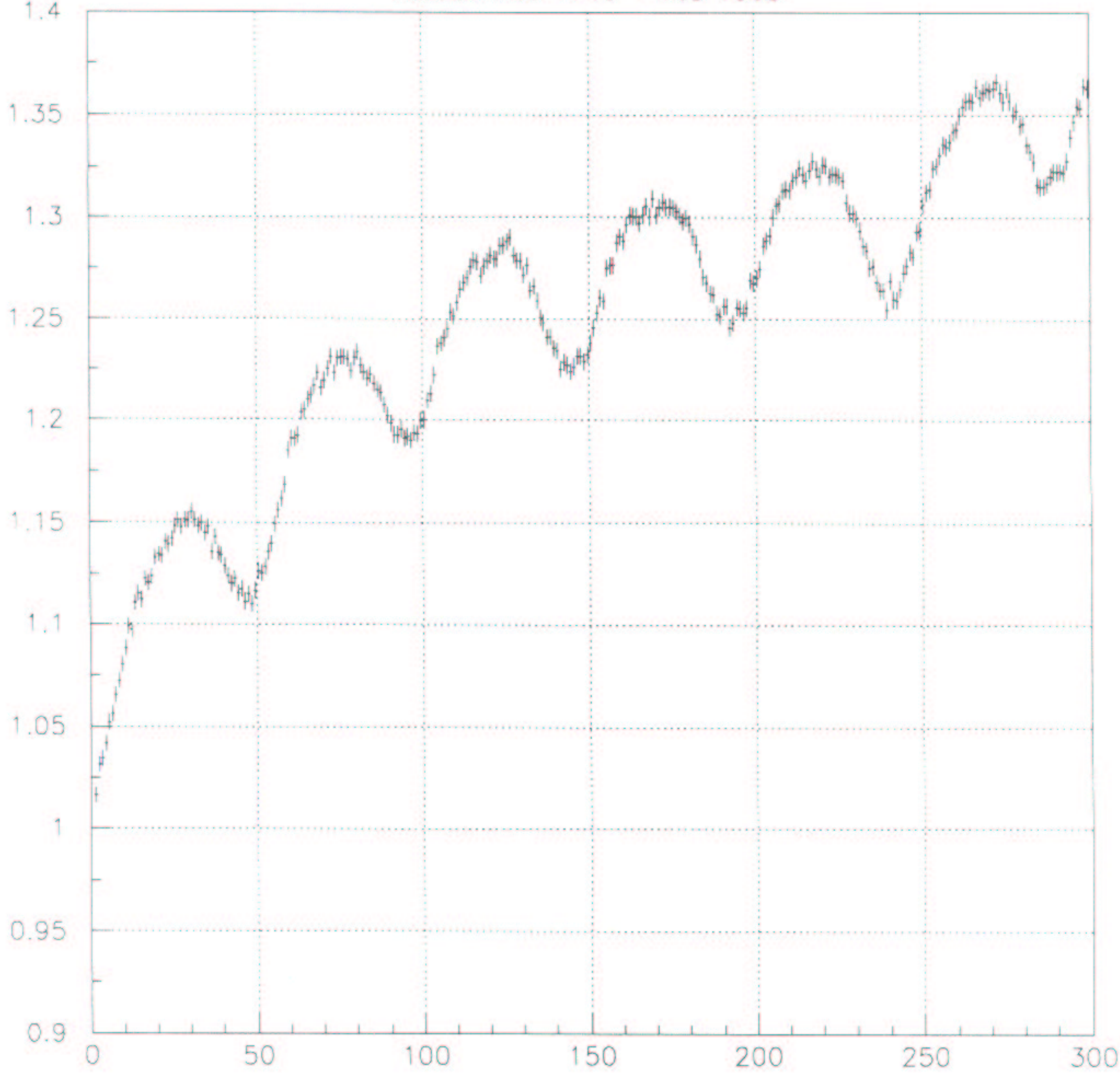
Galactic Plane Update

- Diurnal effects. on zenith distribution.
- Problems in background generation with time sloshing / direct integrations methods.

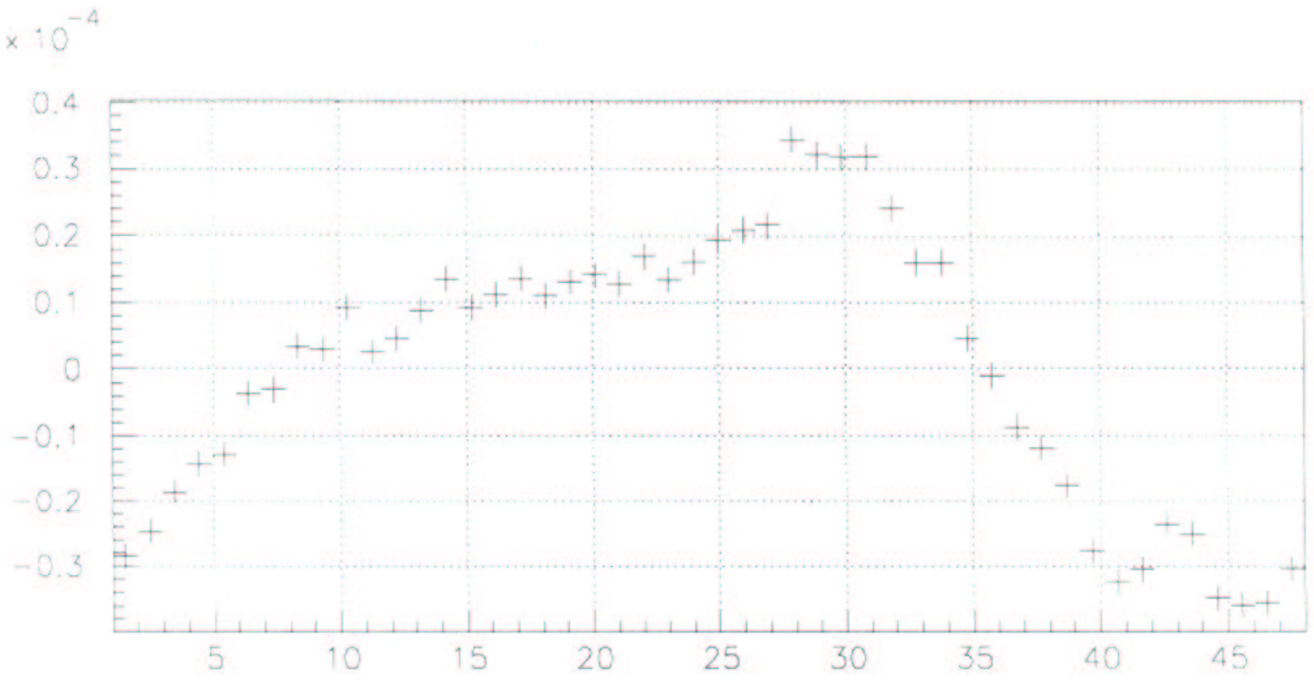
(and solution)

Zenith.

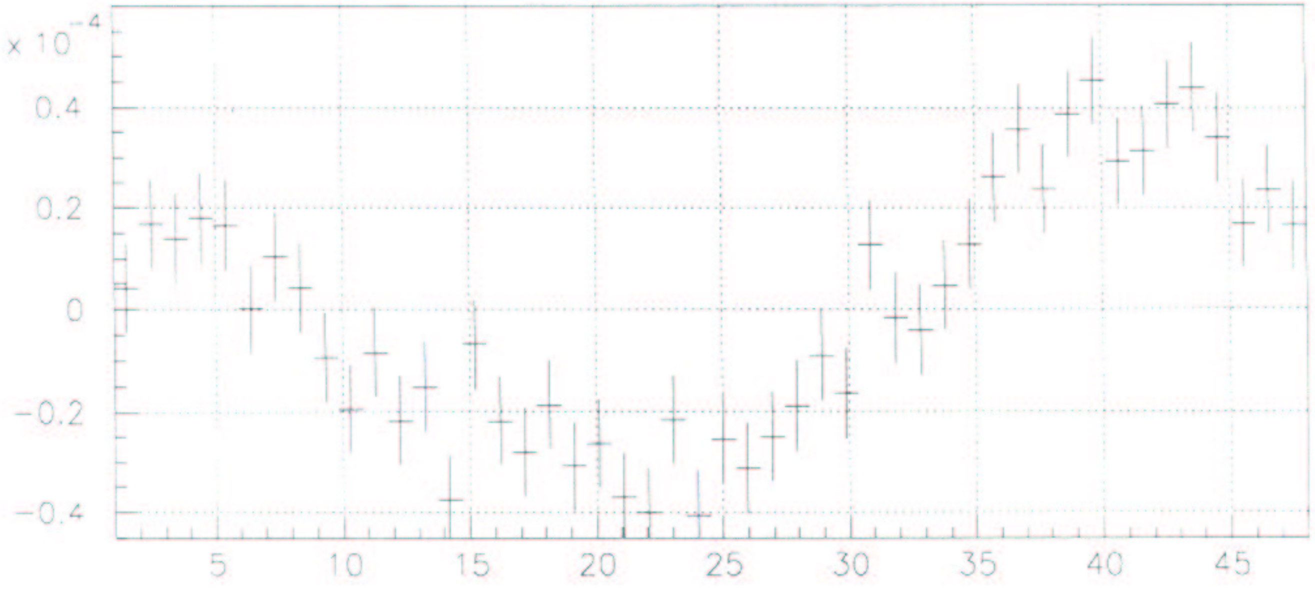
Hadron MJD 1745 – MJD 1805



Chi square vs time separation (half hours). ~~Gamma~~.

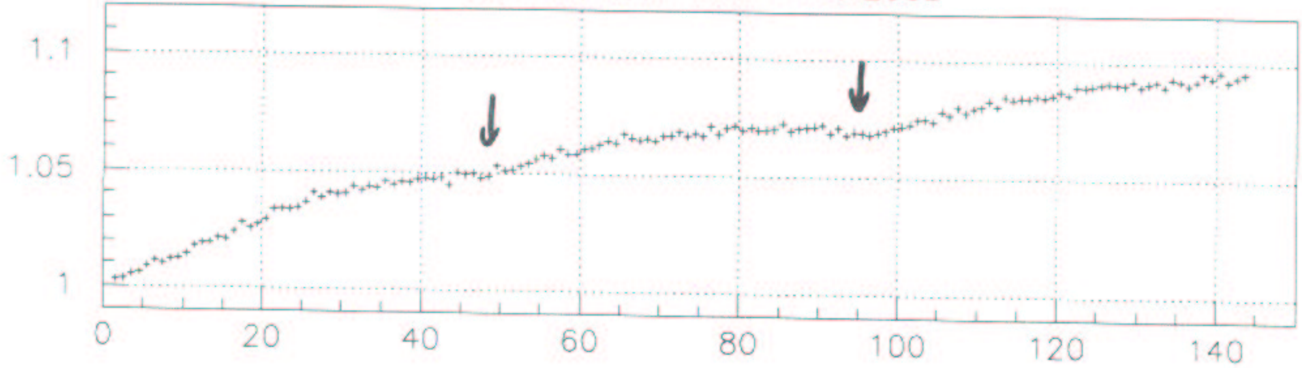


Zenith amplitude vs half hour. Hadron

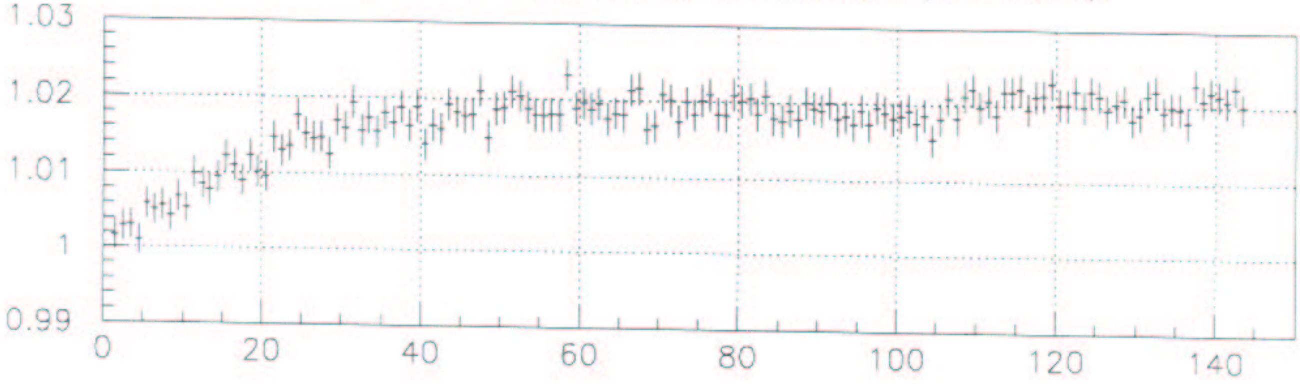


Zenith amplitude vs half hour. Gamma

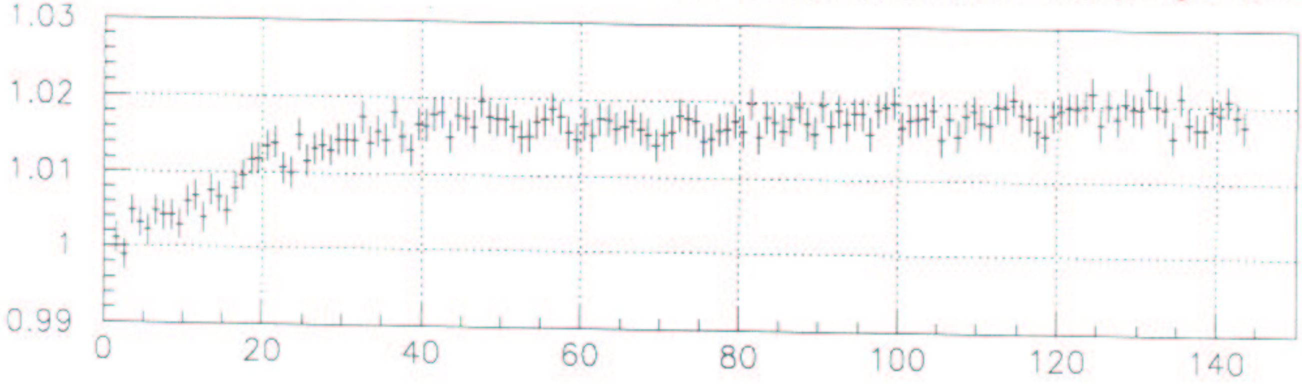
Gamma. MJD 1745 – MJD 2068



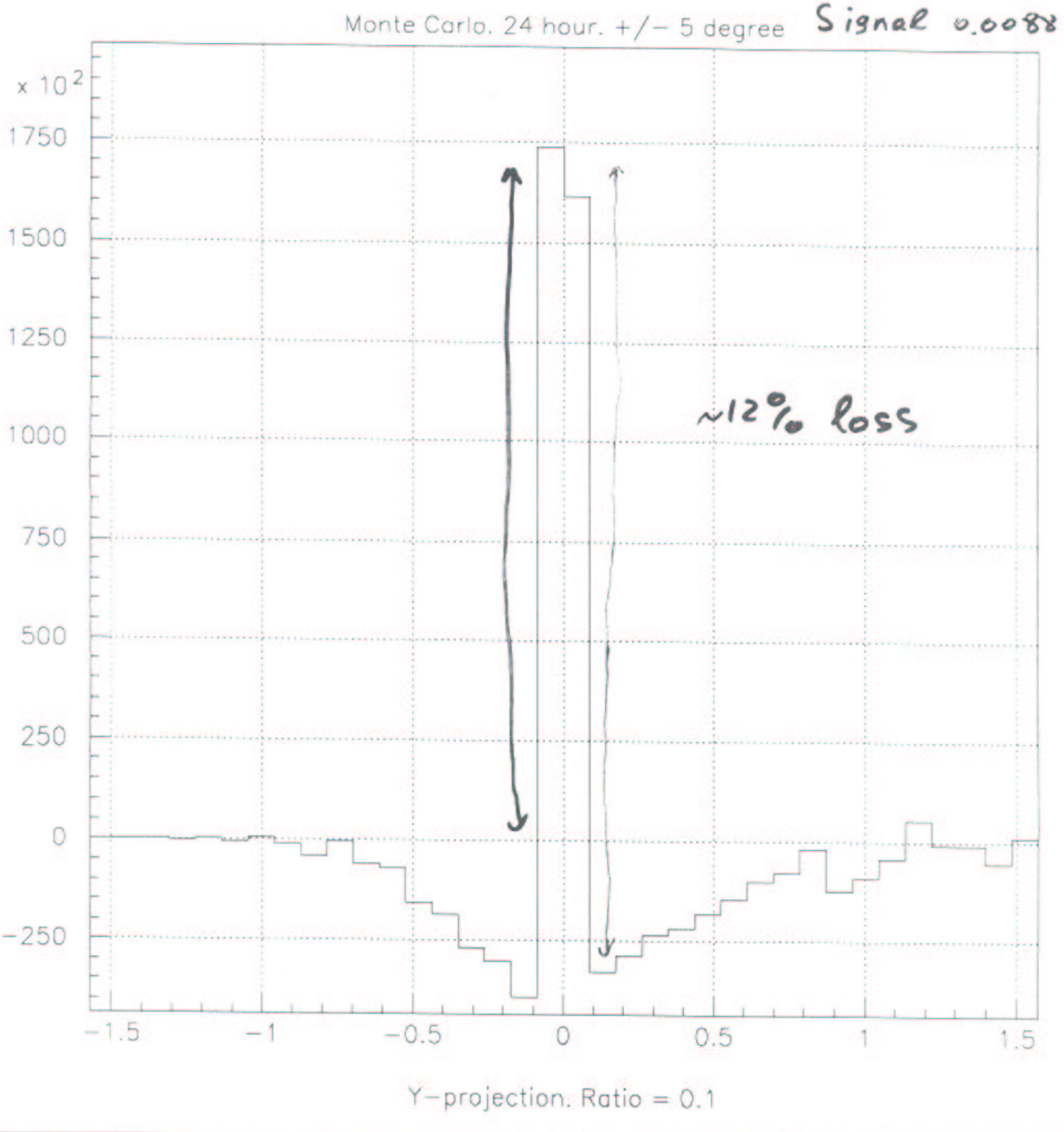
Chi square for ZENITH vs time separation (half hours).

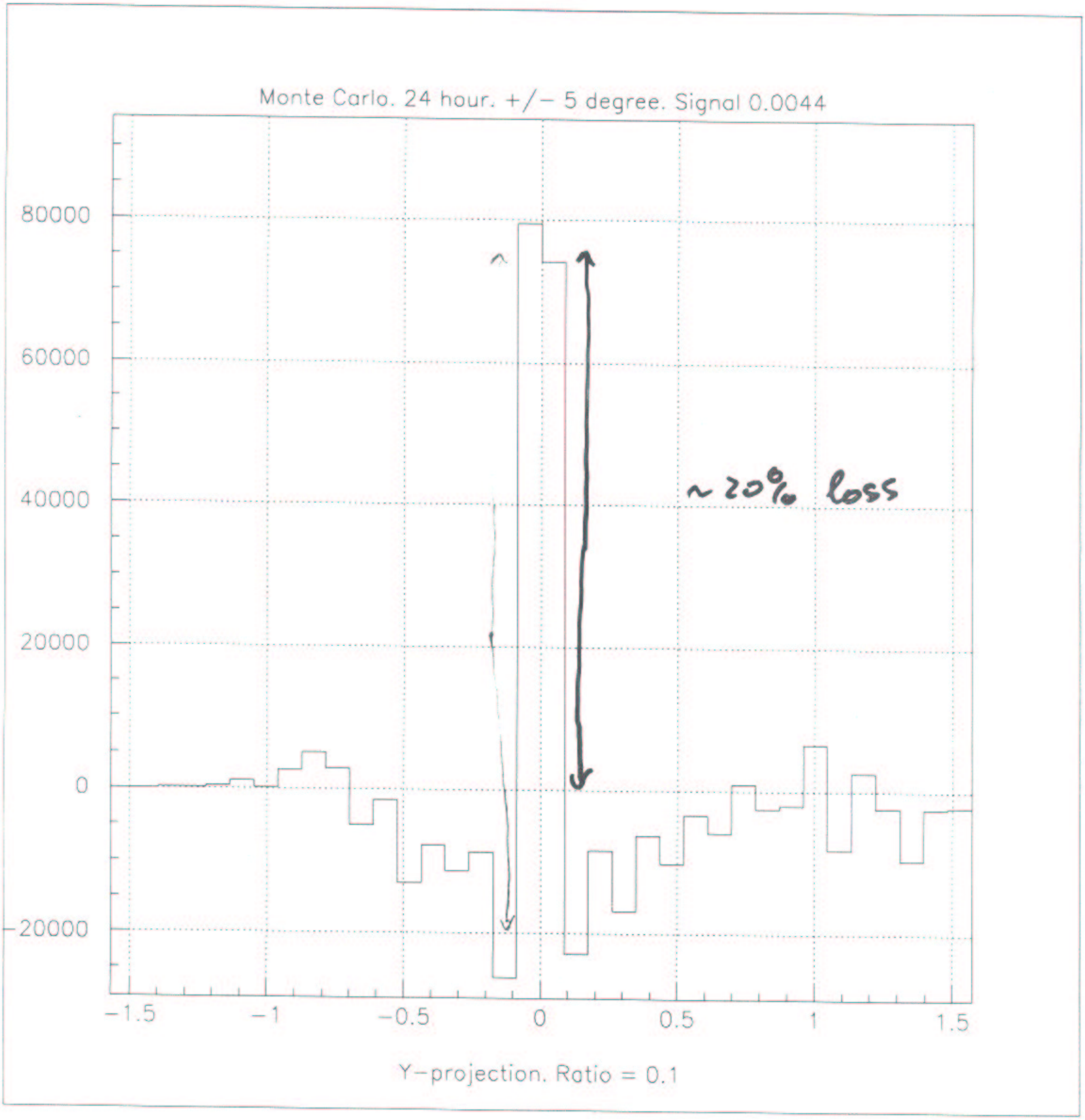


Chi square for AZIMUTH 1 vs time separation (half hours). $0 < z < 30°$



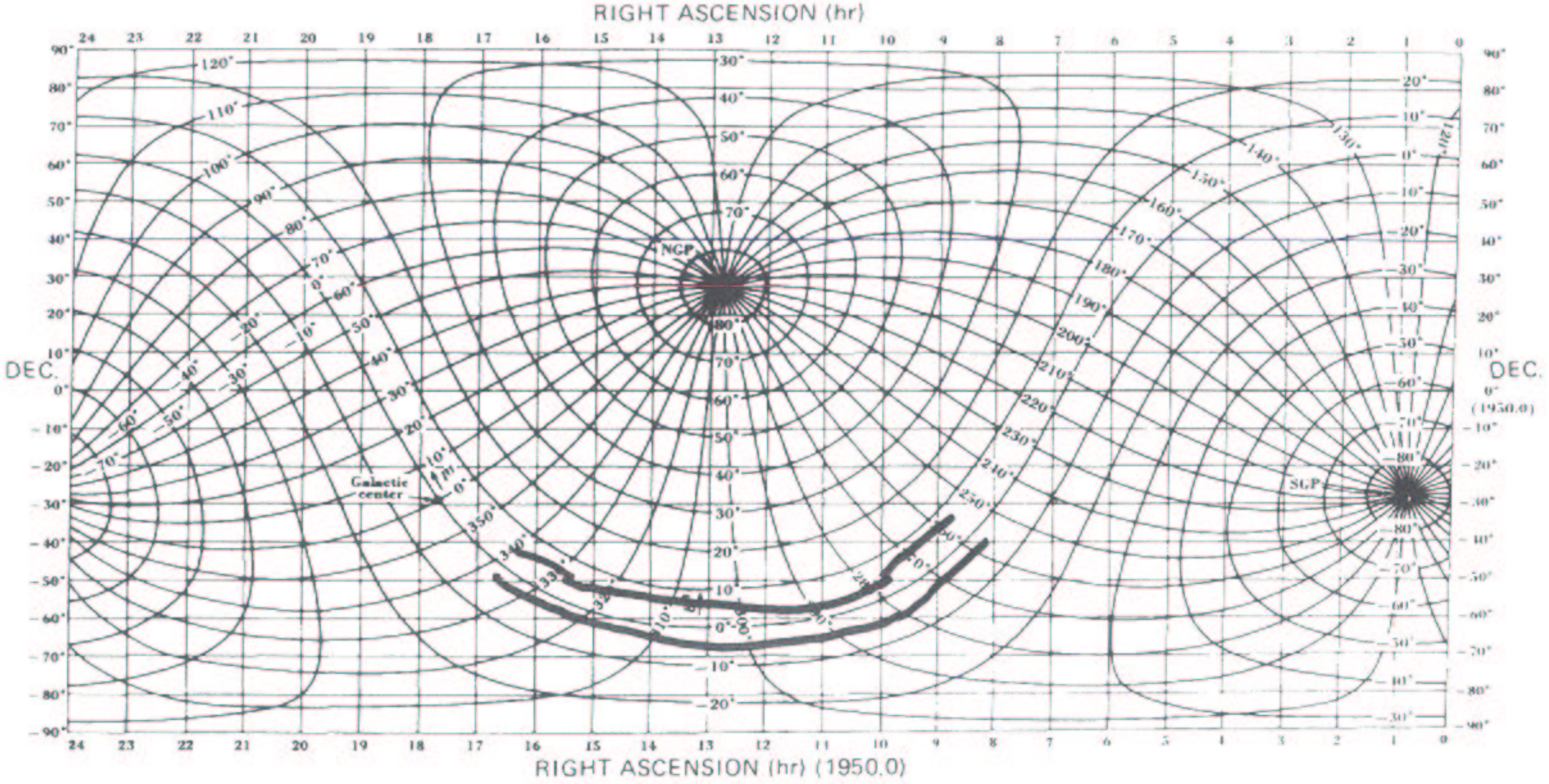
Chi square for AZIMUTH 2 vs time separation (half hours). $30° < z < 50°$

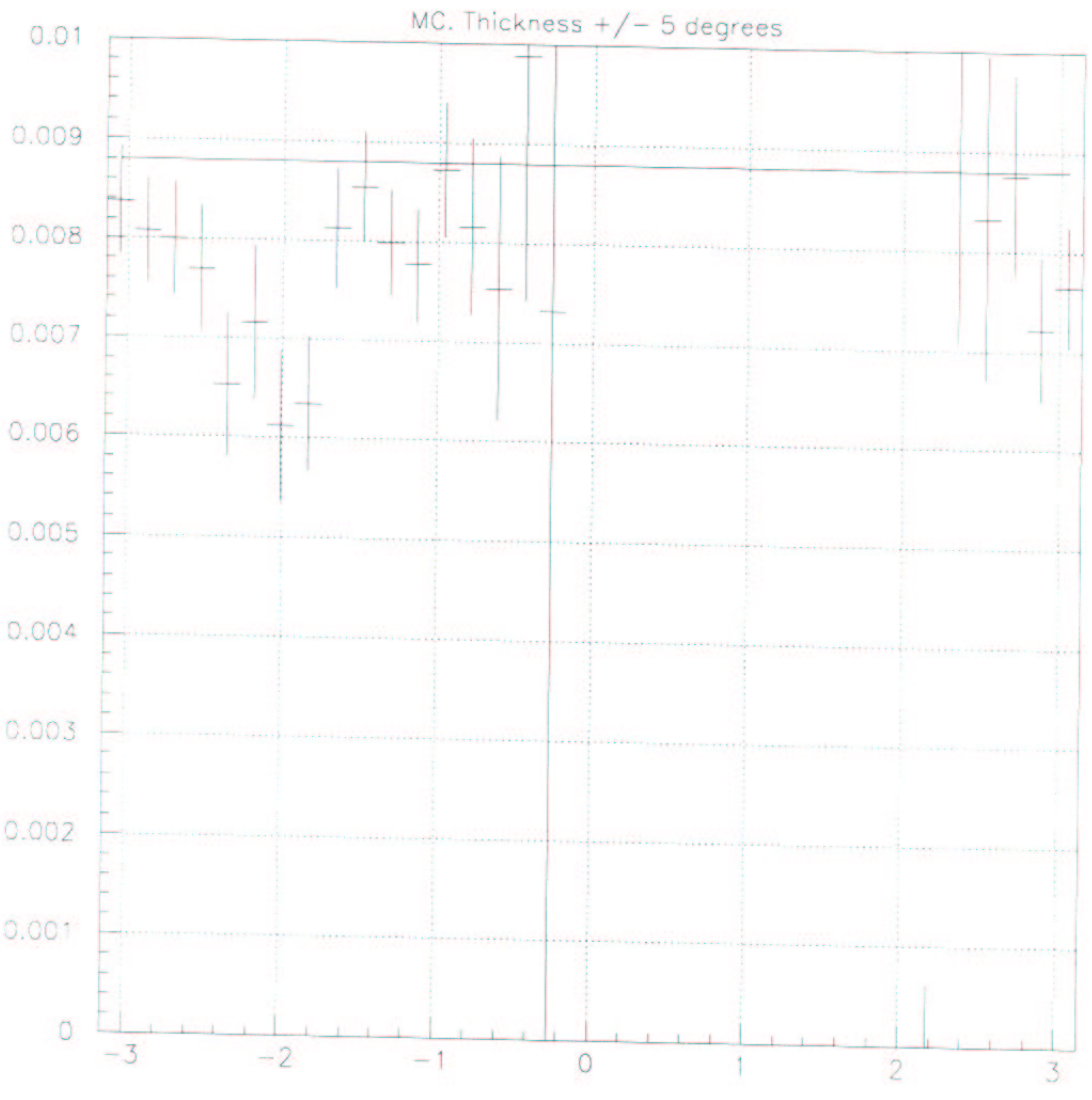

Monte Carlo. 24 hour. +/- 5 degree
Signal 0.0088
x 10^2
1750
1500
1250
1000
750
500
250
0
-250
-1.5
-1
-0.5
0
0.5
1
1.5
~12% loss
Y-projection. Ratio = 0.1


Monte Carlo. 24 hour. +/− 5 degree. Signal 0.0044
80000
60000
40000
20000
0
-20000
−1.5
−1
−0.5
0
0.5
1
1.5
Y−projection. Ratio = 0.1
~20% loss

Galactic–equatorial (celestial) systems (cont.)

Chart for conversion of equatorial (1950.0) coordinates into new galactic coordinates ($l^{II}b^{II}$) or vice versa. (Kraus, J. D., *Radio Astronomy*, 2nd edn., with permission.)




MC. Thickness +/− 5 degrees
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
−3
−2
−1
0
1
2
3
Flux Ratio. Total 0.00781 +/− 0.000160738. Expected 0.0088

Problem

Source events are included in background generation:

- Total number of events sloshed is too big (signal events should not be sloshed).

- List of available times is too big (signal event times should not be included).

$$N_B = \iint \left(1 - \varphi(\delta, h, t)\right) \varrho(\delta, h) \cdot R(t)\, dt\, dh\, d\delta$$

↖ ↗

should not contain signal events

$$\begin{aligned} \varphi(\delta, h, t) &= 0 \quad \text{"on-source"} \\ &= 1 \quad \text{"off-source"} \end{aligned}$$

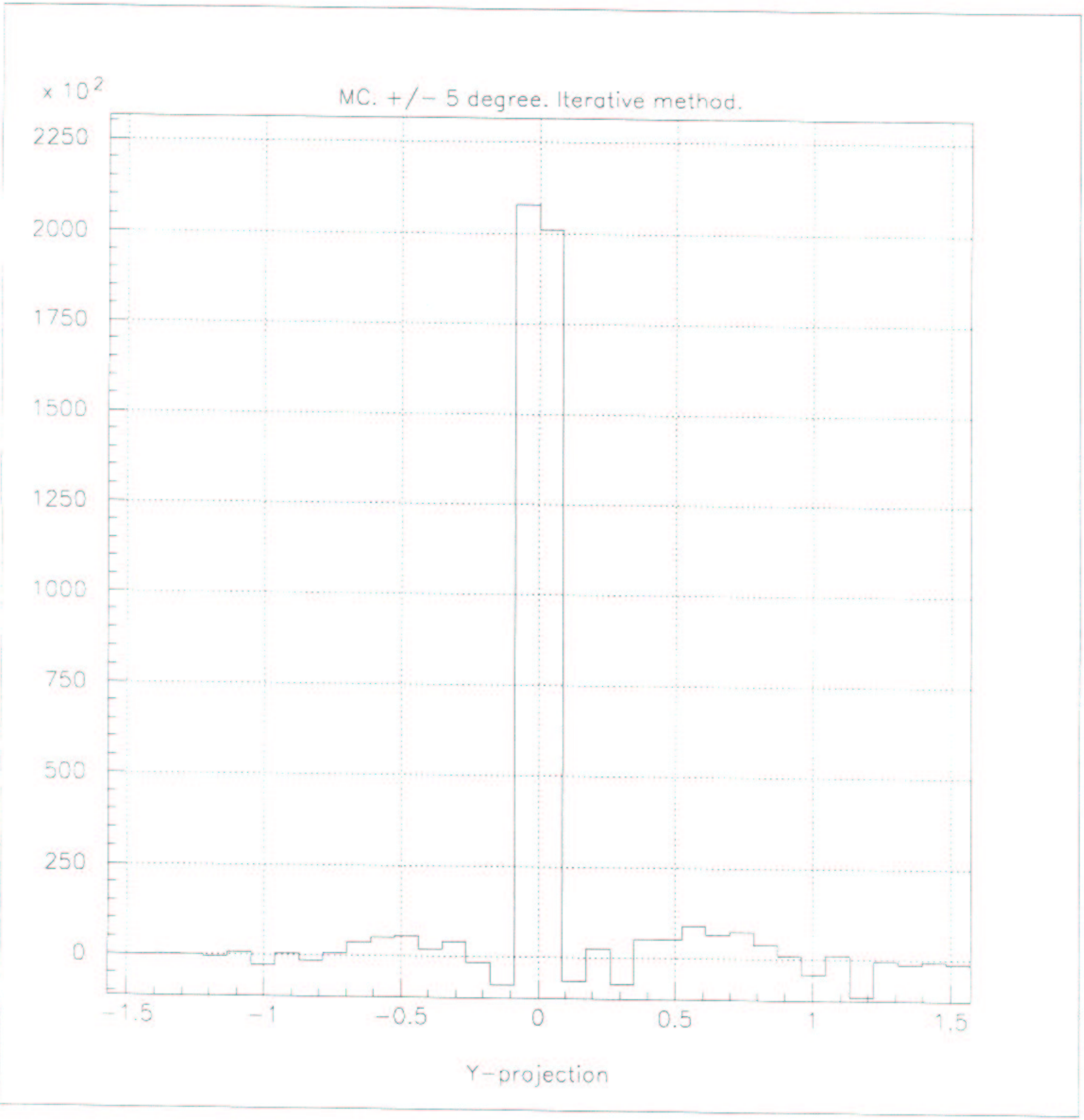
Background equations.

$$\mathcal{L} = \prod_{x,t} \frac{\left(\varphi(x,t)\cdot g(x)\cdot R(t)\right)^{N(x,t)}}{N(x,t)!} e^{-\varphi(x,t)\cdot g(x)\cdot R(t)}$$

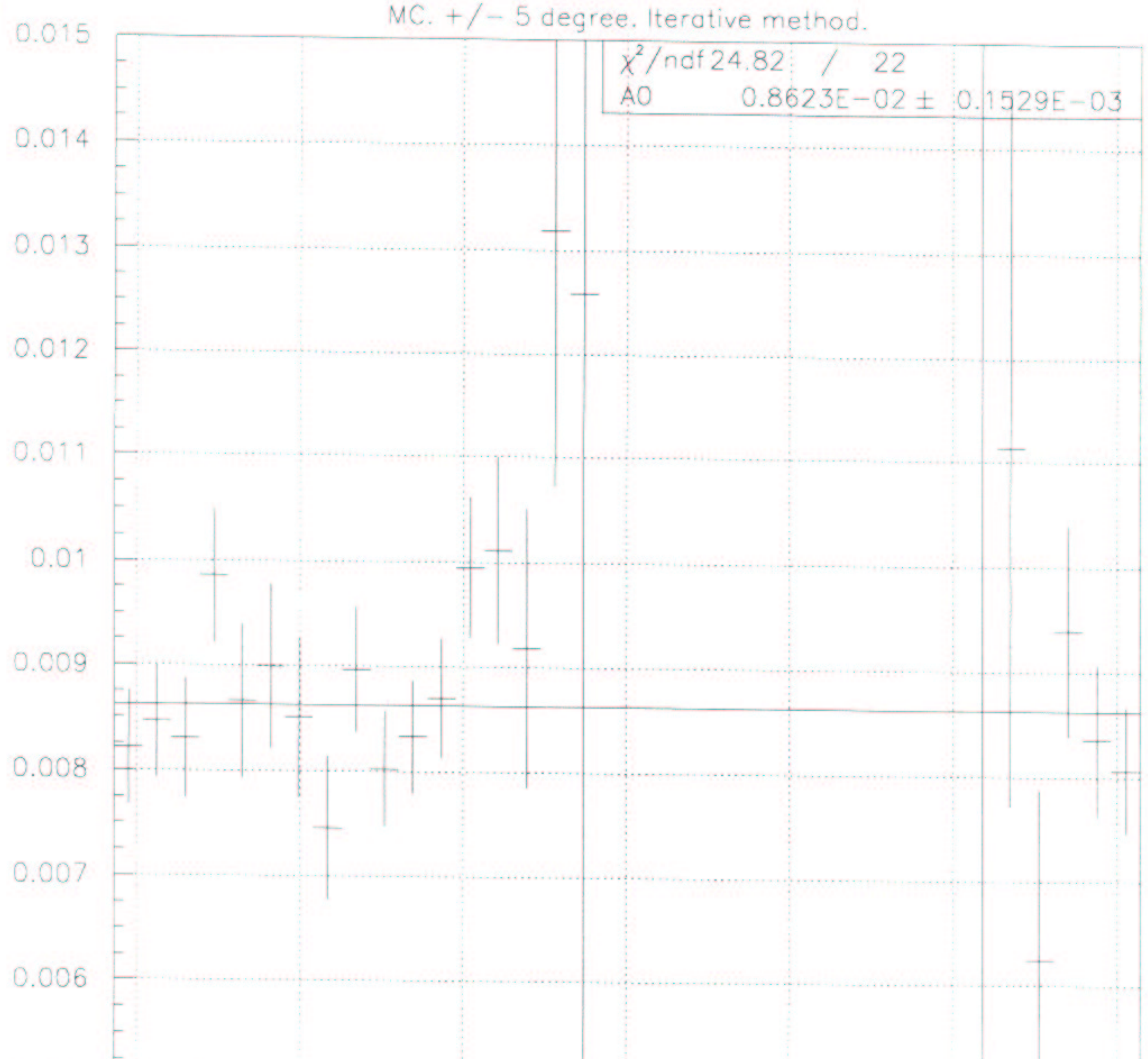
Maximize $\mathcal{L}$ to find $g(x)$, $R(t)$.

Obtain set of equations:

$$\frac{\delta \mathcal{L}}{\delta g(x)}: \quad \frac{\delta \mathcal{L}}{\delta R(t)}: \quad \left\{ \begin{array}{l} N_{out}(x) = \underline{g(x)} \cdot \int \varphi(x,t)\ \underline{R(t)}\, dt \\ \\ R_{out}(t) = \underline{R(t)} \cdot \int \varphi(x,t)\ \underline{g(x)}\, dx \end{array} \right.$$



x 10^2
MC. +/- 5 degree. Iterative method.
2250
2000
1750
1500
1250
1000
750
500
250
0
-1.5
-1
-0.5
0
0.5
1
1.5
Y-projection



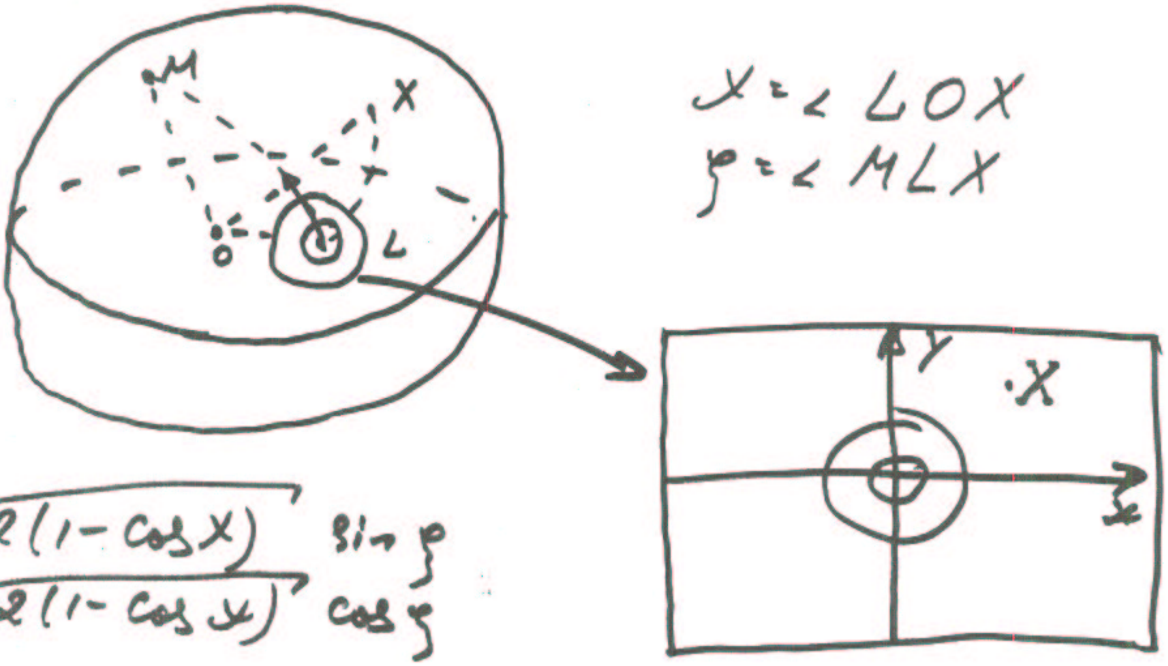
Flux Ratio vs Galactic Longitude. Expected 0.0088

15 Sun Shadow and Wimp Analysis - Lazar Fleysher

Sun / Wimps

Sky Mapping

- Area preserving
- Unique location of events
- Geomagnetic (at least for the Moon)



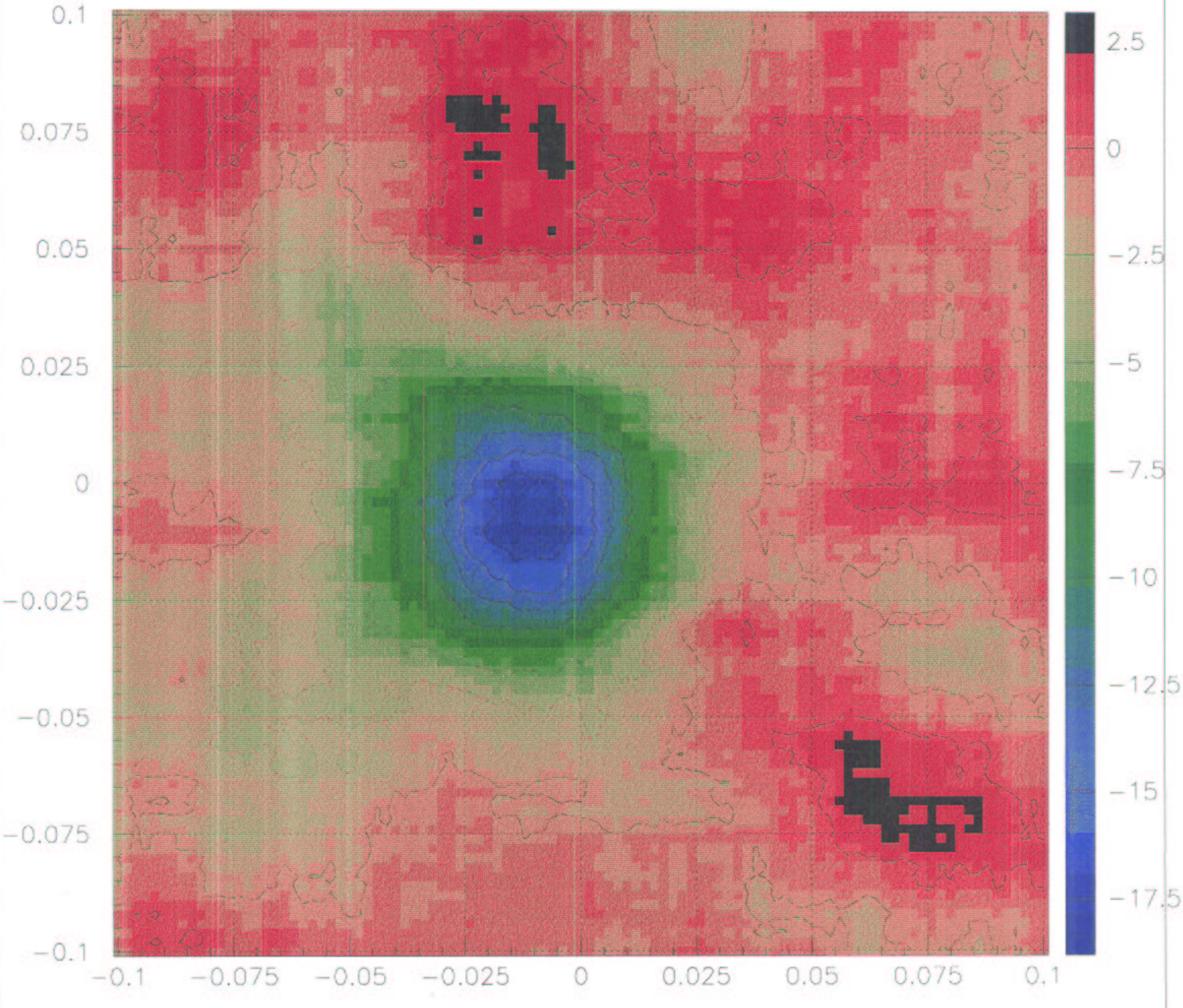
$\chi = \angle LOX$
$\varphi = \angle MLX$

$$\begin{cases} X = \sqrt{2(1-\cos\chi)}\ \sin\varphi \\ y = \sqrt{2(1-\cos\chi)}\ \cos\varphi \end{cases}$$

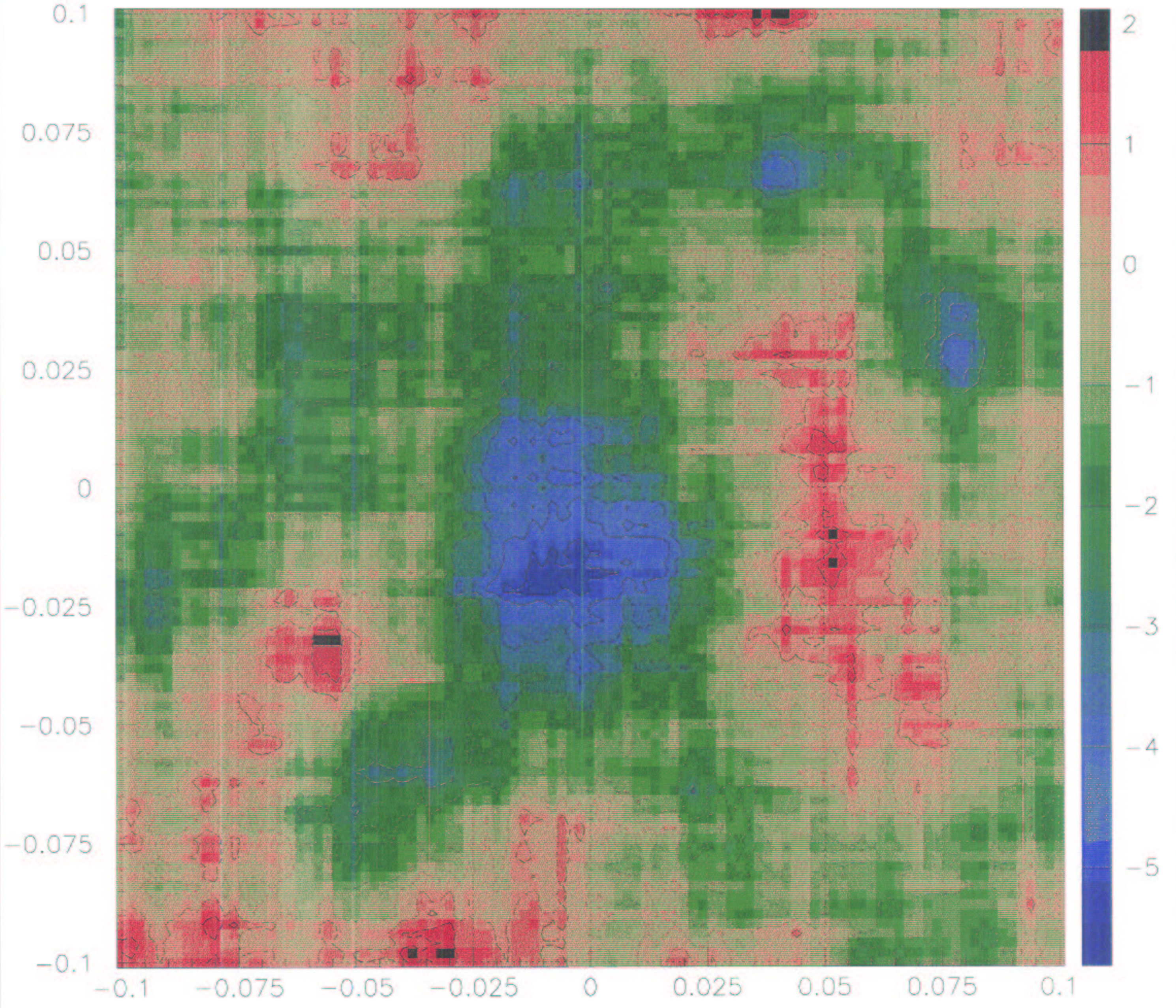
The mapping is all of the above!

Moon 03/00 – 01/01

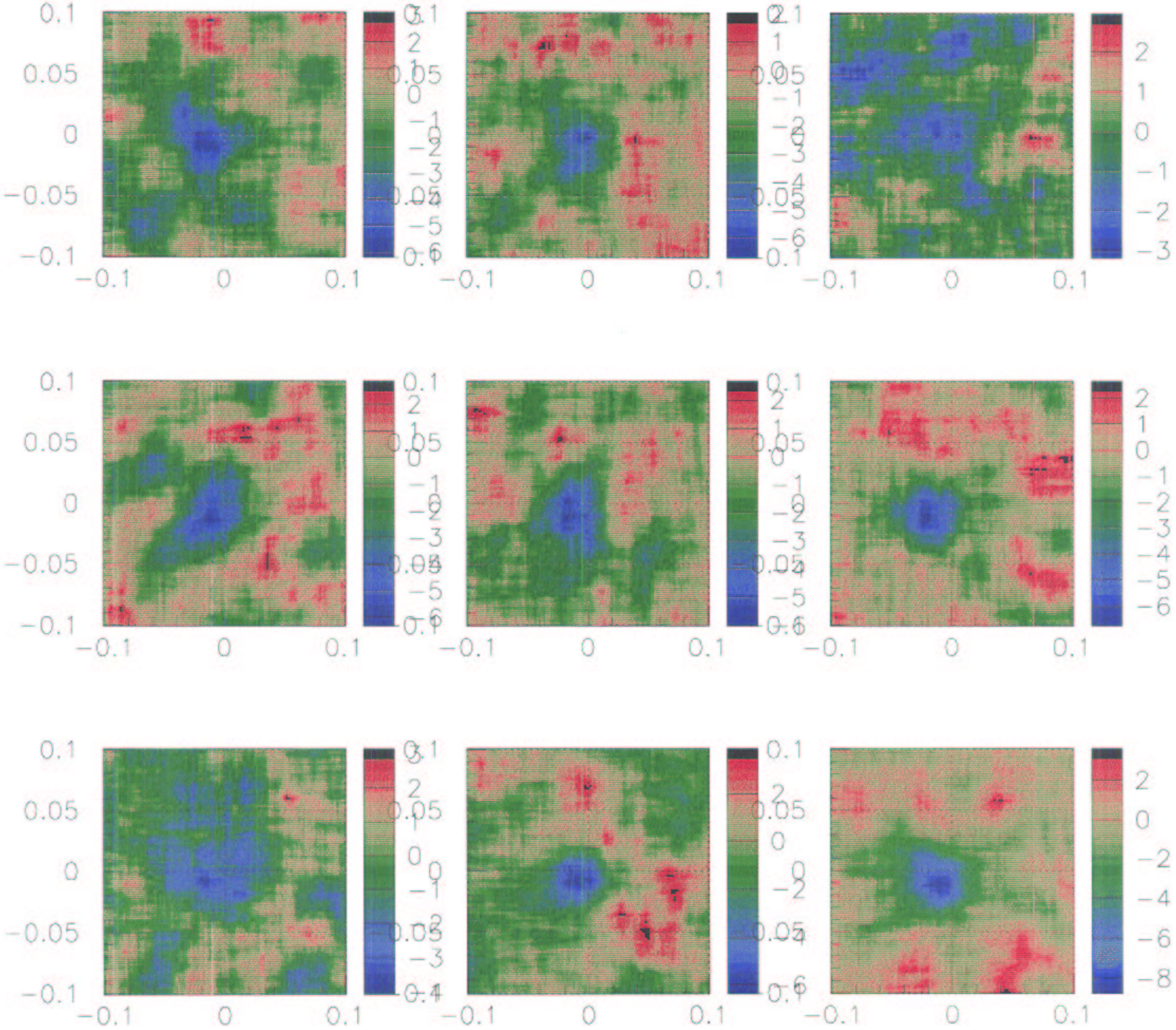
Min: (-0.80°, -0.57°) → -18.8σ



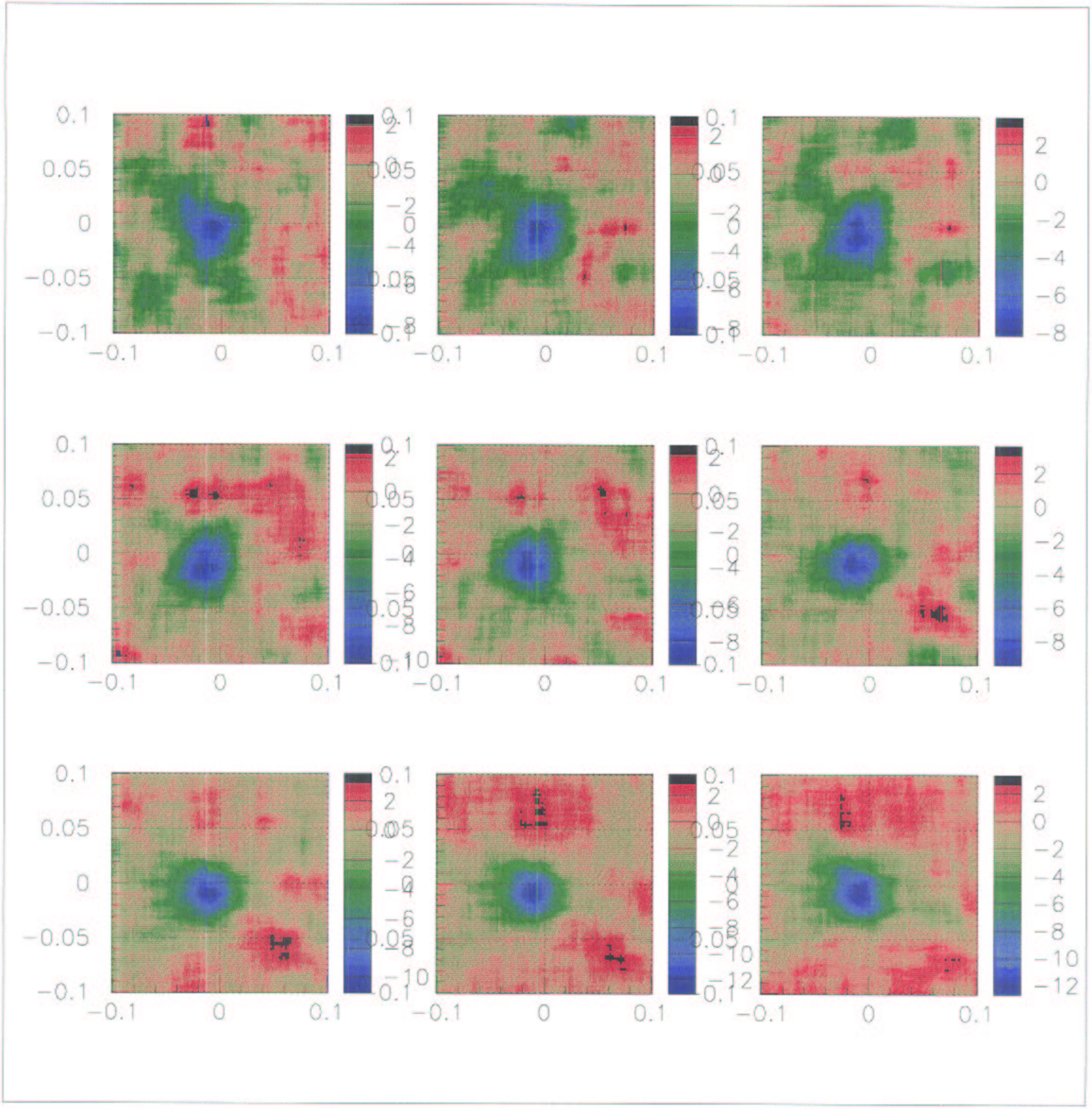
Sun 01/00 – 02/01



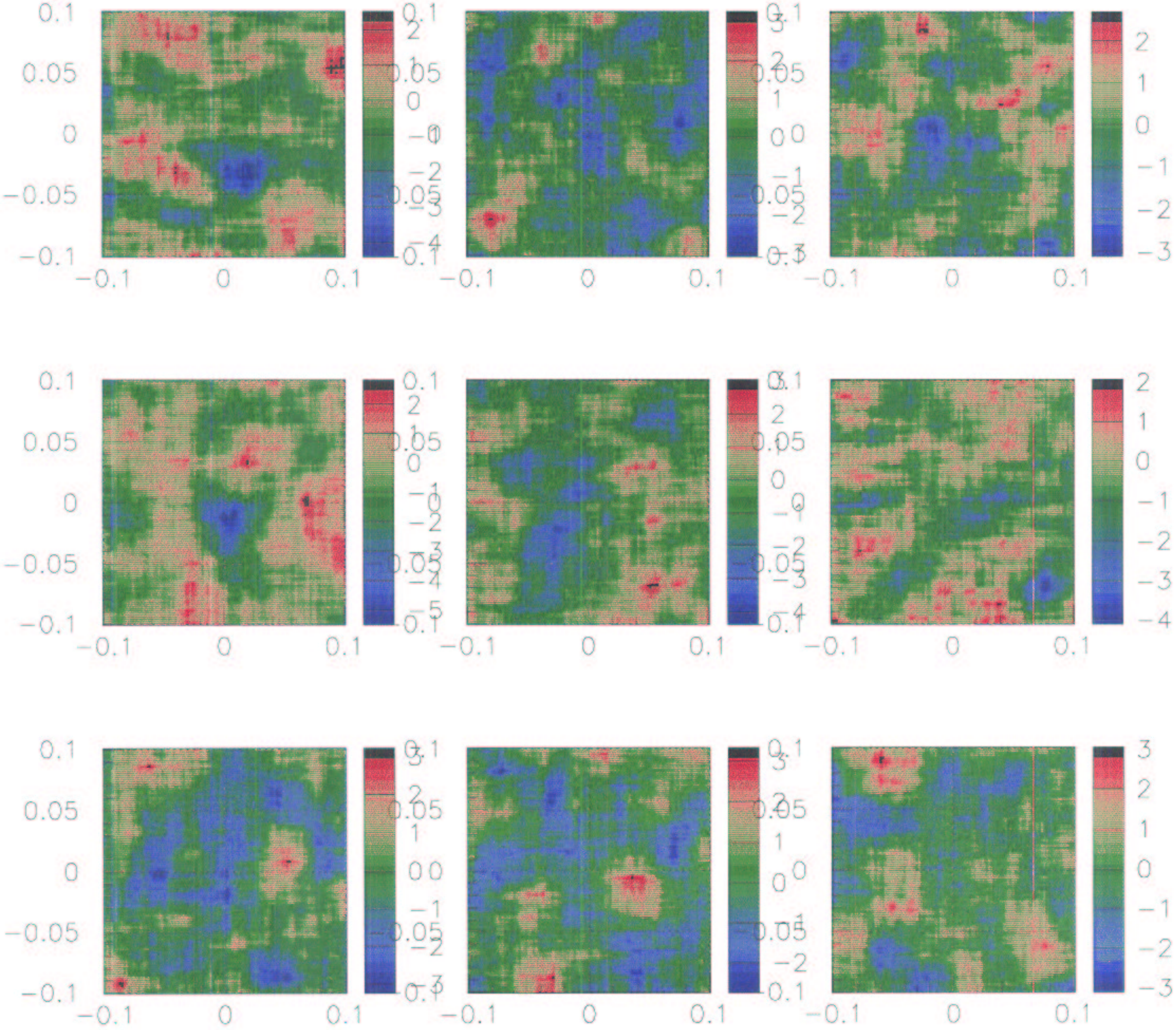
Monthly Moon (2000-2001)
(Mar - Nov)



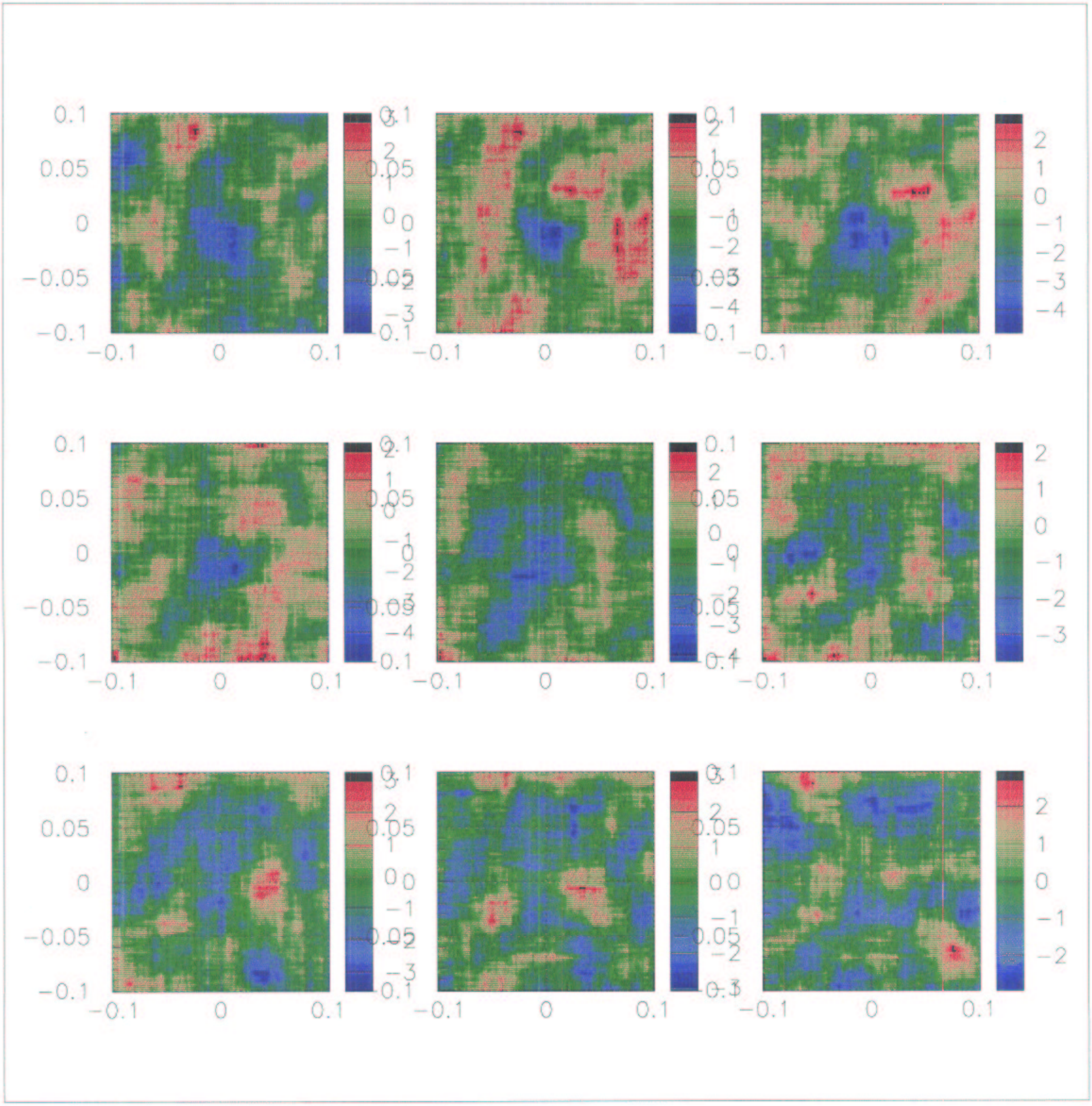
"Sliding" 3-monthly Moon

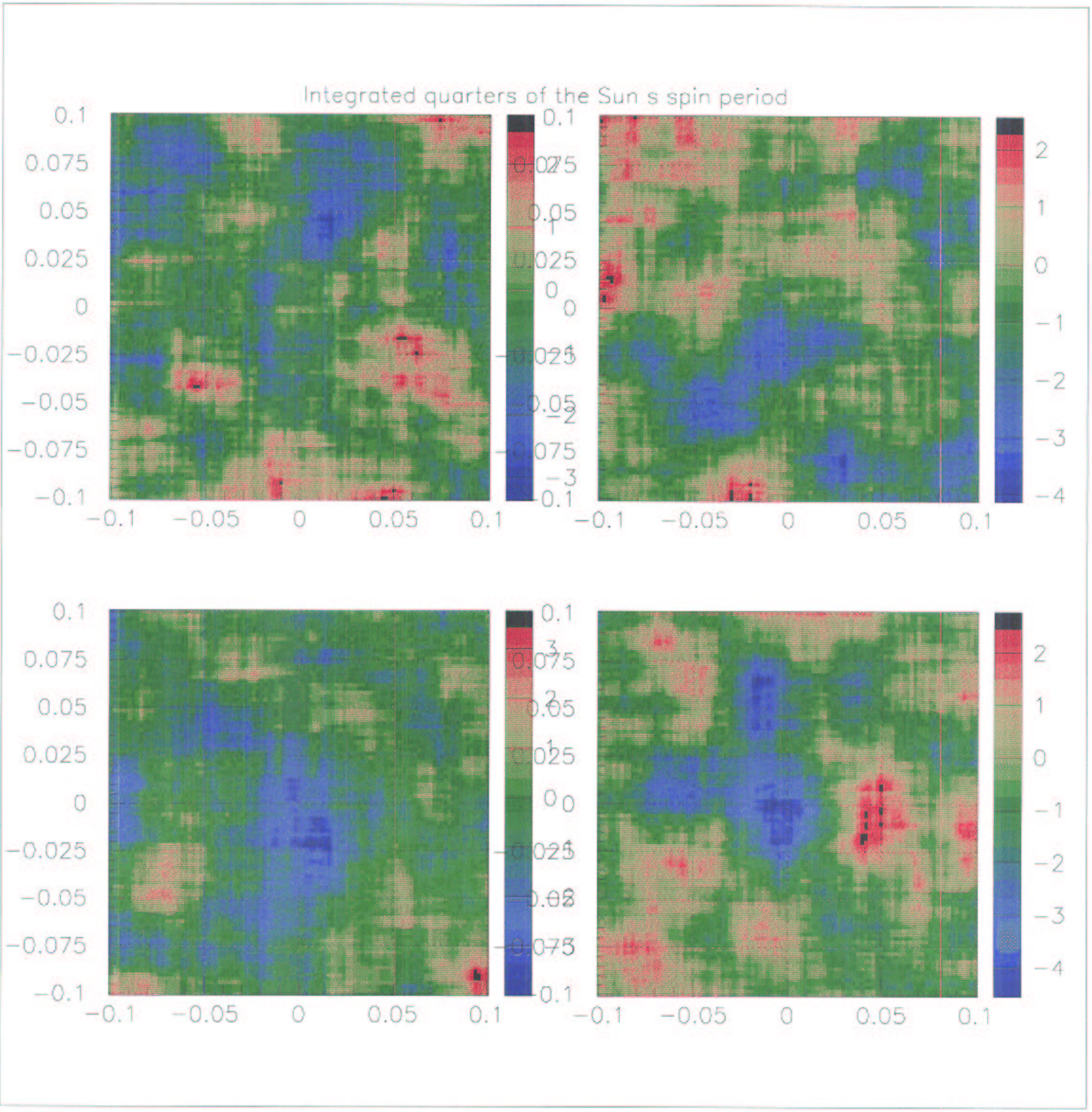


Monthly Sum 2000-2001
(Jan - Sep'00)



"Sliding" 3-monthly Sun




Integrated quarters of the Sun s spin period
0.1
0.075
0.05
0.025
0
−0.025
−0.05
−0.075
−0.1
−0.1
−0.05
0
0.05
0.1
2
1
0
−1
−2
−3
−4
3
2
1
0
−1
−2
−3

Background

- Efficiency and background rate from "off-source" region.
- Direct integration → expected background in "on-source" region.

Significance

S – # of signal events in "on-source"

B – # of background events in "on-source" from

$$\text{Significance} = \frac{N_{on} - \alpha N_{off}}{\sqrt{\alpha (N_{on} + N_{off})}} \quad \text{— Li Ma}$$

! $N_{on} = S$, $\alpha N_{off} = B$ and <u>independant</u>

! $\alpha = \frac{N_{on} t}{B}$ - exposure ratio (NOT time)

! Formula is correct for Poisson if:

$$\frac{(\text{significance})^6}{\sqrt{\alpha (N_{on} + N_{off})}} < 1$$

$N_{on} \sim \alpha N_{off} \sim 1.5 \cdot 10^6 \Rightarrow \text{significance} < 10$

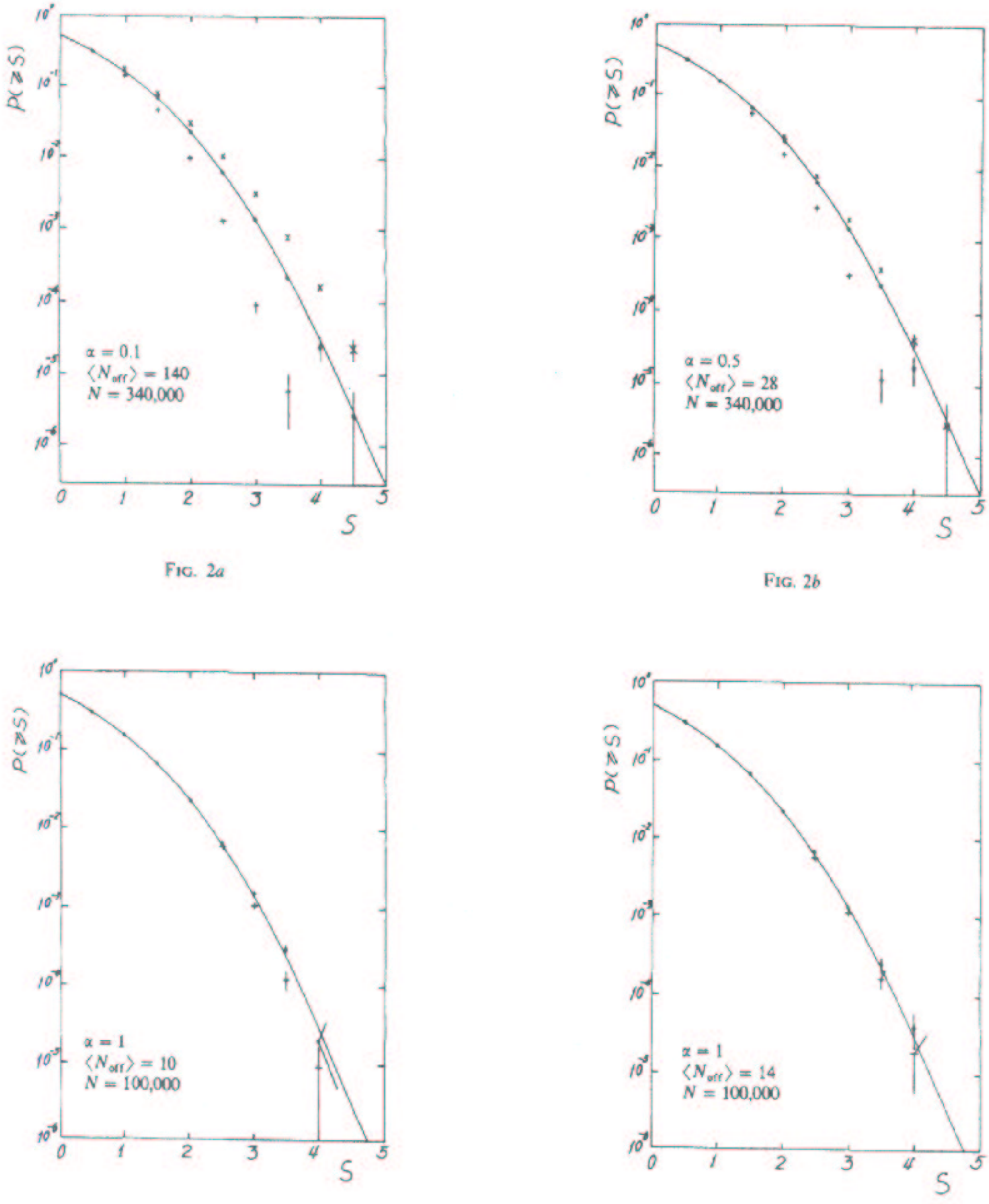


FIG. 2a

FIG. 2b

FIG. 2c

FIG. 2d

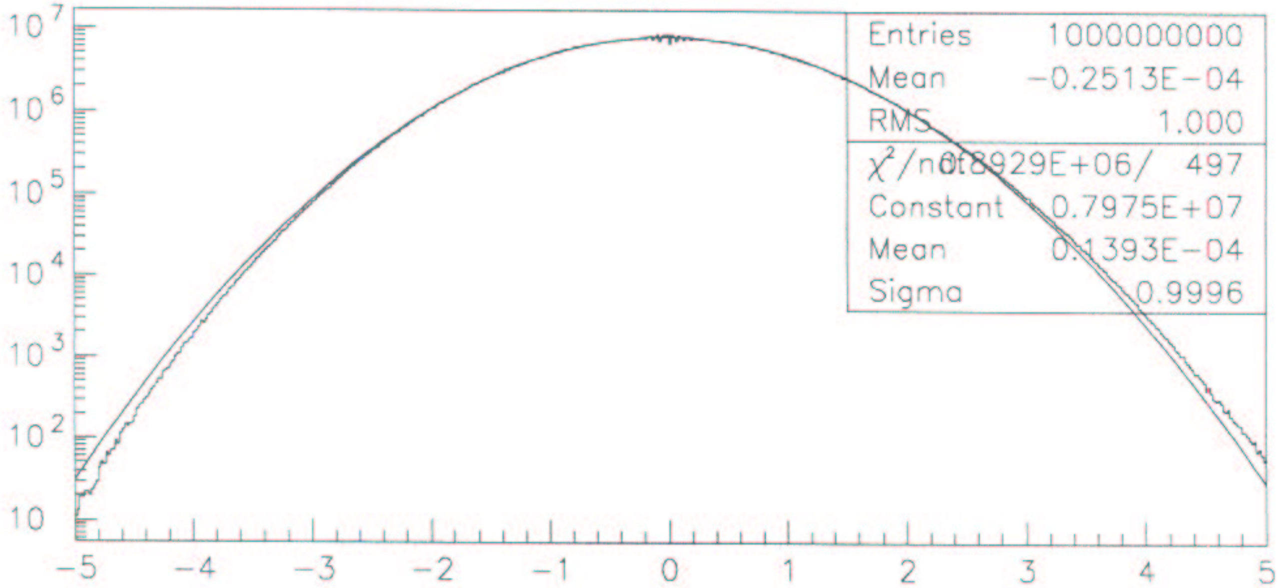
FIG. 2.—Integral frequency distributions of the significances of the Monte Carlo samples.

Pluses, from eq. (5): $S = \frac{N_{on} - \alpha N_{off}}{(N_{on} + \alpha^2 N_{off})^{1/2}}$.

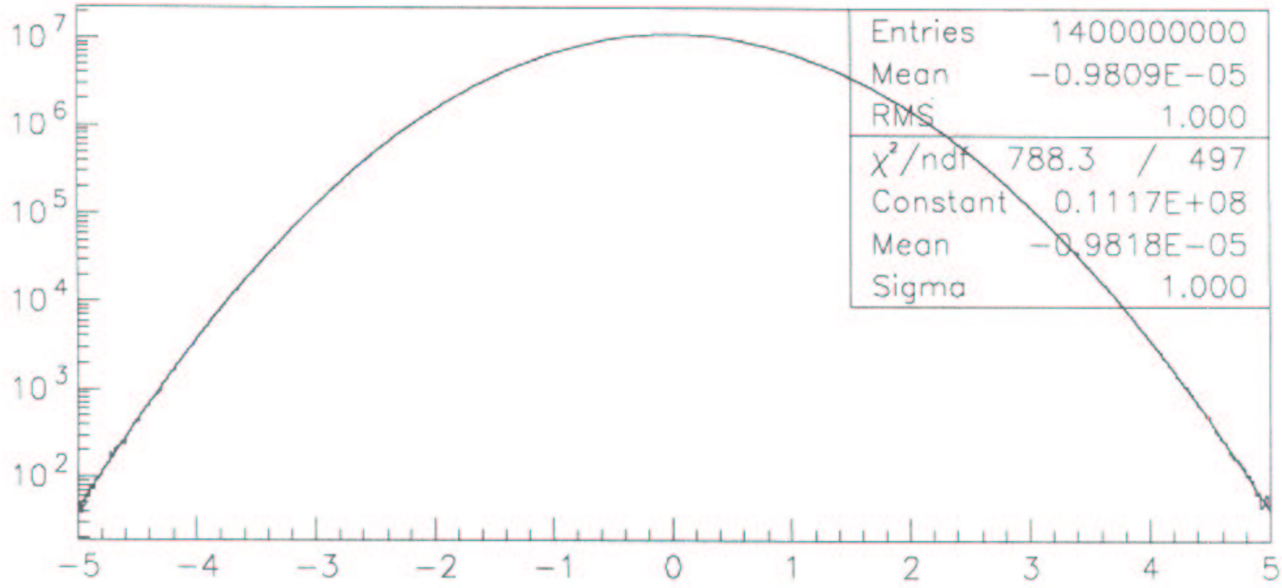
Crosses, from eq. (9): $S = \frac{N_{on} - \alpha N_{off}}{[\alpha(N_{on} + N_{off})]^{1/2}}$.

Filled Circles, from eq. (17): $S = 2^{1/2}\left\{N_{on} \ln \left[\frac{1 + \alpha}{\alpha}\left(\frac{N_{on}}{N_{on} + N_{off}}\right)\right] + N_{off} \ln \left[(1 + \alpha)\left(\frac{N_{off}}{N_{on} + N_{off}}\right)\right]\right\}^{1/2}$.

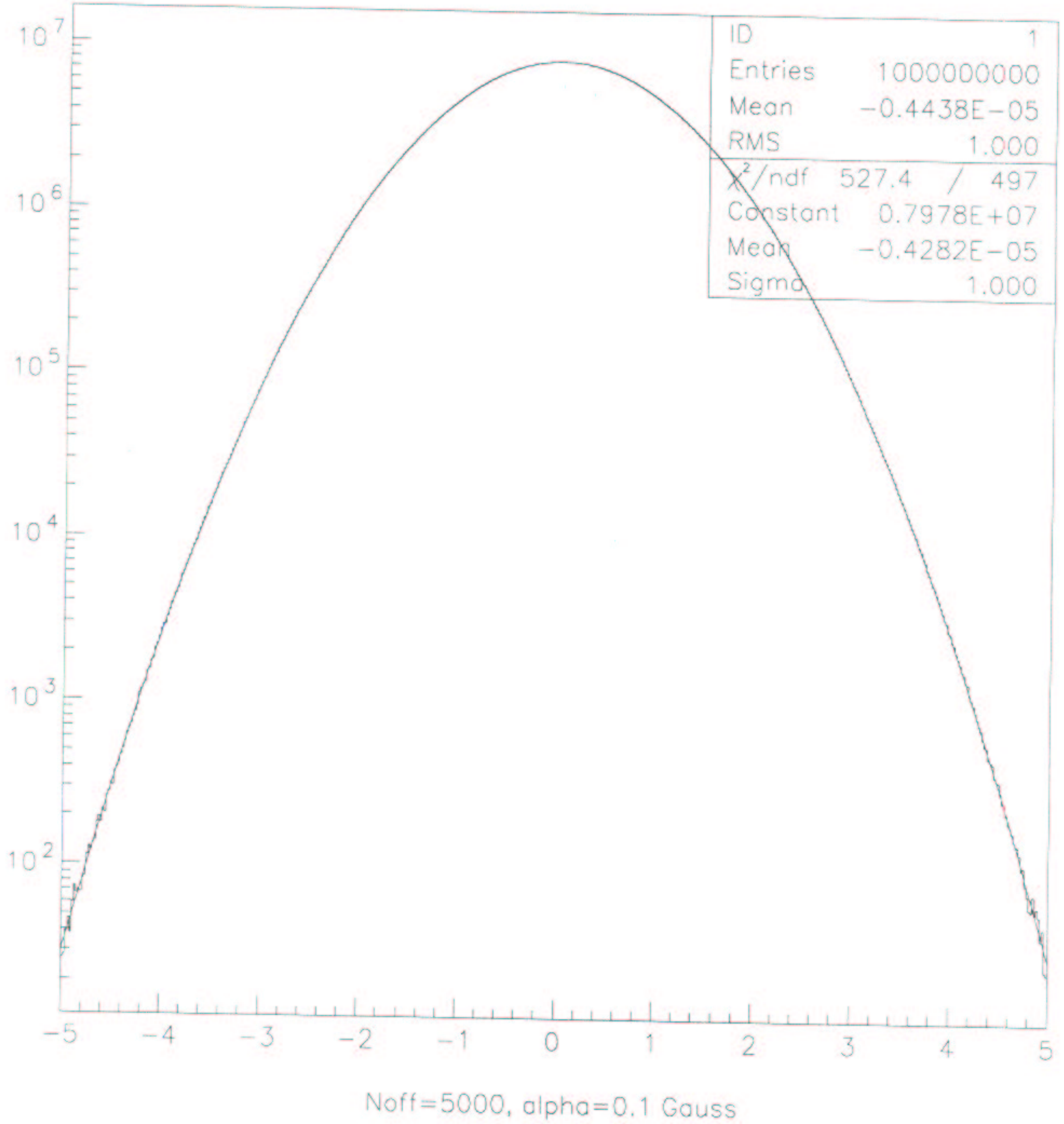
N is the number of samples for the Monte Carlo procedure. The curves indicate the standard normal distribution.



Noff = 5000, alpha = 0.1



Noff = 15000000, alpha = 0.1


ID 1
Entries 1000000000
Mean -0.4438E-05
RMS 1.000
χ^2/ndf 527.4 / 497
Constant 0.7978E+07
Mean -0.4282E-05
Sigma 1.000
10^7
10^6
10^5
10^4
10^3
10^2
−5
−4
−3
−2
−1
0
1
2
3
4
5
Noff=5000, alpha=0.1 Gauss

16 Search for Active Galaxies - Wystan Benbow

Thesis Analysis

Study: - Crab & 27 AGN for TeV Signal

- Overall & on time scales (1-150 day)
- Look for Correlation w/ RXTE

Purpose: Crab to understand sensitivity & stability of detector

AGN for "Science"

Analysis:

* Binned ON/OFF : $r = 1.2°$
* $nFit \geq 20$, $\theta \leq 60°$
* $X_2 \geq 2.5$ Hadron rejection
* Background Via Time Sloshing (15 x)
* Significance from Li & Ma
* Upper Limits from Helene's method

Data Set:

Runs: 2385 – 3535 (7/20/00 → 1/4/02)

Jul. Dates : 1745 → 2278

Total Length: 532.10 days

1st: Removed "troublesome" Runs/Subruns

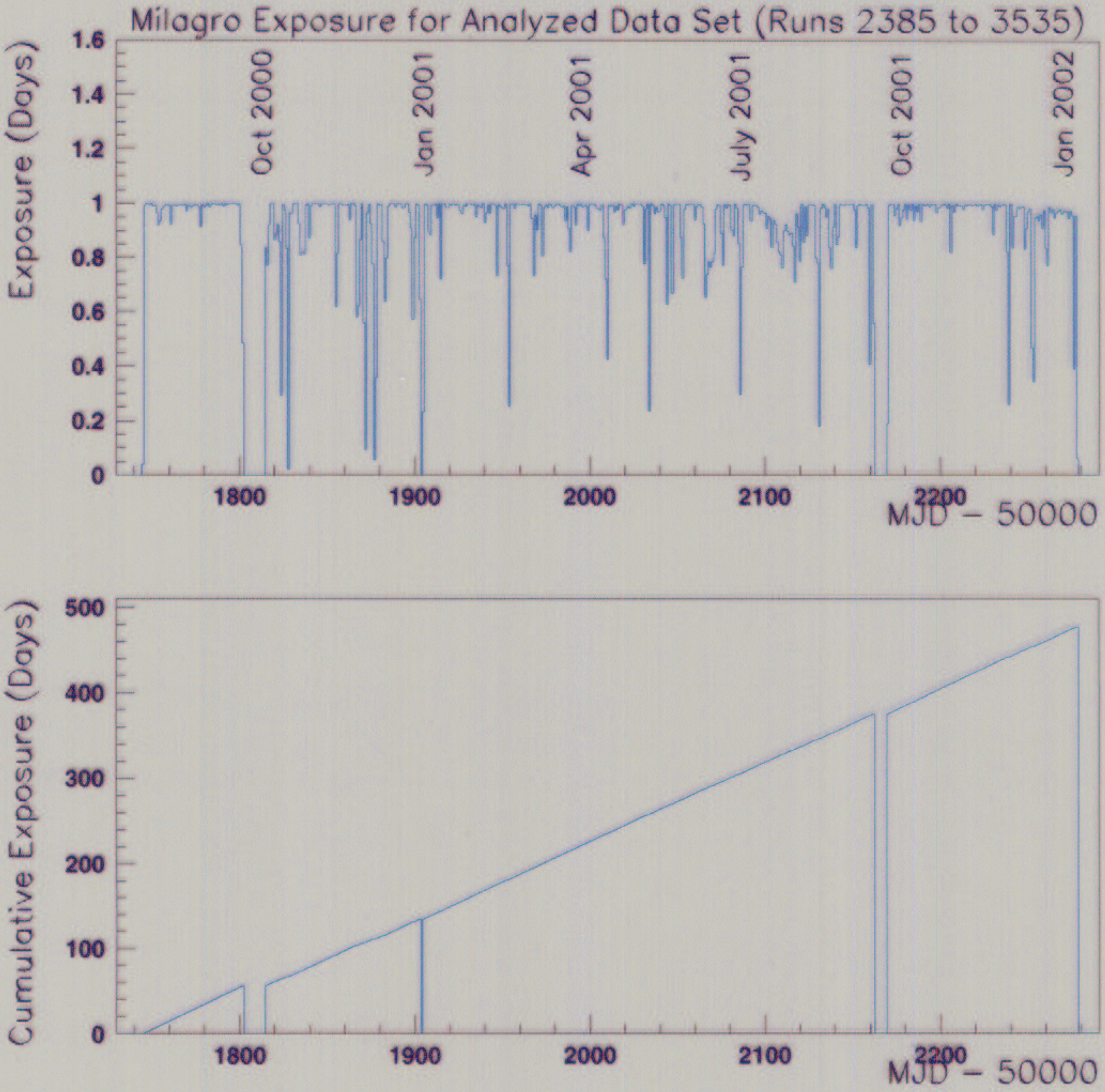
Ex: ADC runs, Bussy's Laser Runs,
Test runs, "junk" runs,
Runs w/ lots of time sequence errs

⇒ 585.6 Million Events tossed
30.9 mill. Events which would have "passed" cuts
6.32 Days of Exposure

⇒ Event Total: 59.8 Billion Events

Total "Live" Exposure: 476.7 Days

(90% Duty Cycle)


Milagro Exposure for Analyzed Data Set (Runs 2385 to 3535)
Exposure (Days)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Oct 2000
Jan 2001
Apr 2001
July 2001
Oct 2001
Jan 2002
1800
1900
2000
2100
2200
MJD − 50000
Cumulative Exposure (Days)
500
400
300
200
100
0
1800
1900
2000
2100
2200
MJD − 50000

Event / Rate Info

59.8 Billion Events Total

5.7 Billion are "failed" fits

Toss Events w/ "info" errors

⇒ 53.7 Billion "Usable" Events (90%)

Of these: 4.2 Billion Pass $X_2 > 2.5$ (7.9%)

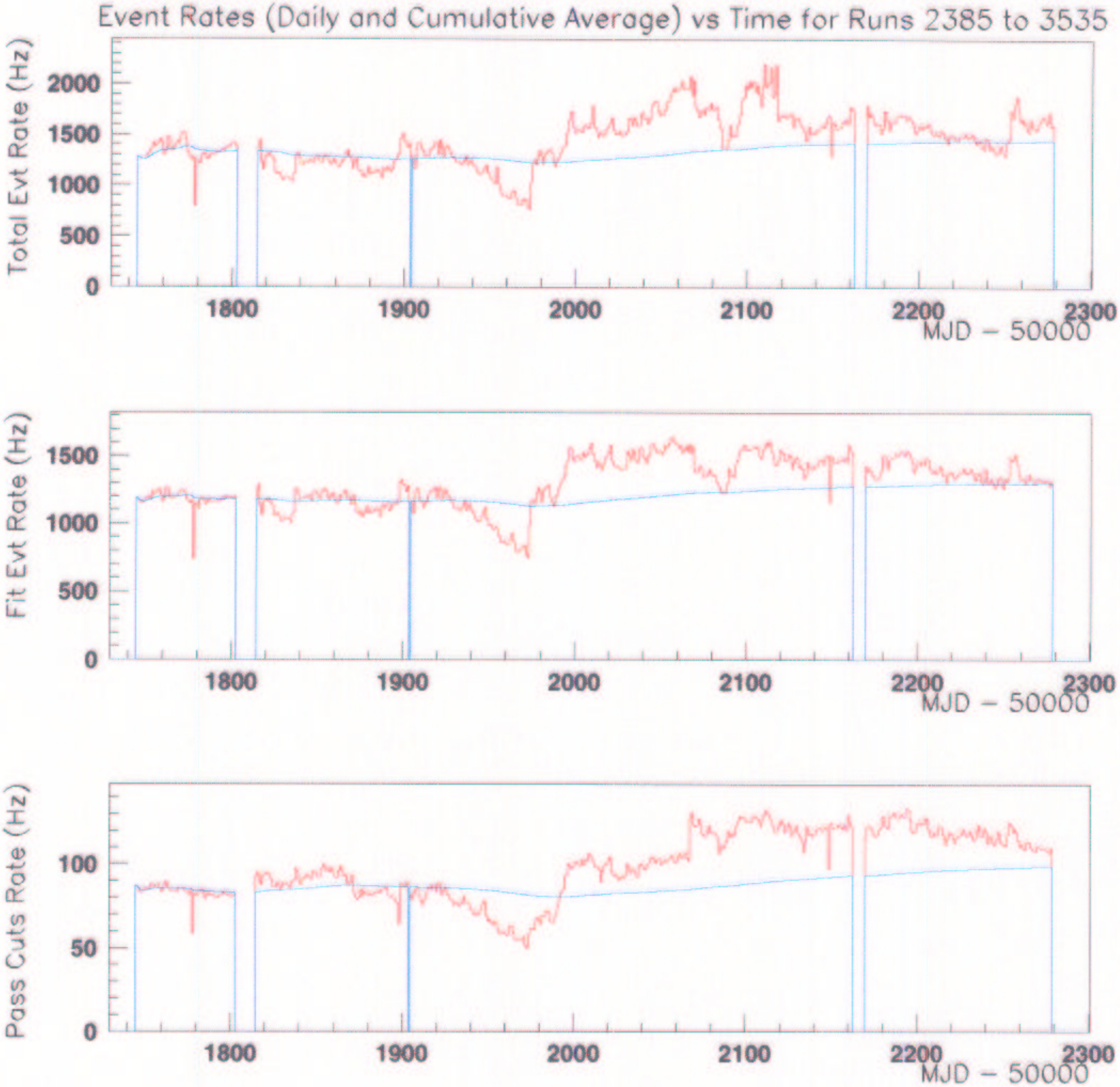
Additional Cuts: nFit ≥ 20, $\phi \leq 60^\circ$

⇒ **4.1 Billion Events in Analysis**
7.6% of Usable Events

Avg. Rates: 1452.4 Hz (Total Rate)

1303.6 Hz (Usable)

98.8 Hz (Pass Cuts)


Event Rates (Daily and Cumulative Average) vs Time for Runs 2385 to 3535
Total Evt Rate (Hz)
2000
1500
1000
500
0
1800
1900
2000
2100
2200
2300
MJD − 50000
Fit Evt Rate (Hz)
1500
1000
500
0
1800
1900
2000
2100
2200
2300
MJD − 50000
Pass Cuts Rate (Hz)
100
50
0
1800
1900
2000
2100
2200
2300
MJD − 50000

Event / Rate Info

59.8 Billion Events Total

5.7 Billion are "failed" fits

Toss Events w/ "info" errors

⇒ 53.7 Billion "Usable" Events (90%)

Of these: 4.2 Billion Pass $X_2 > 2.5$ (7.9%

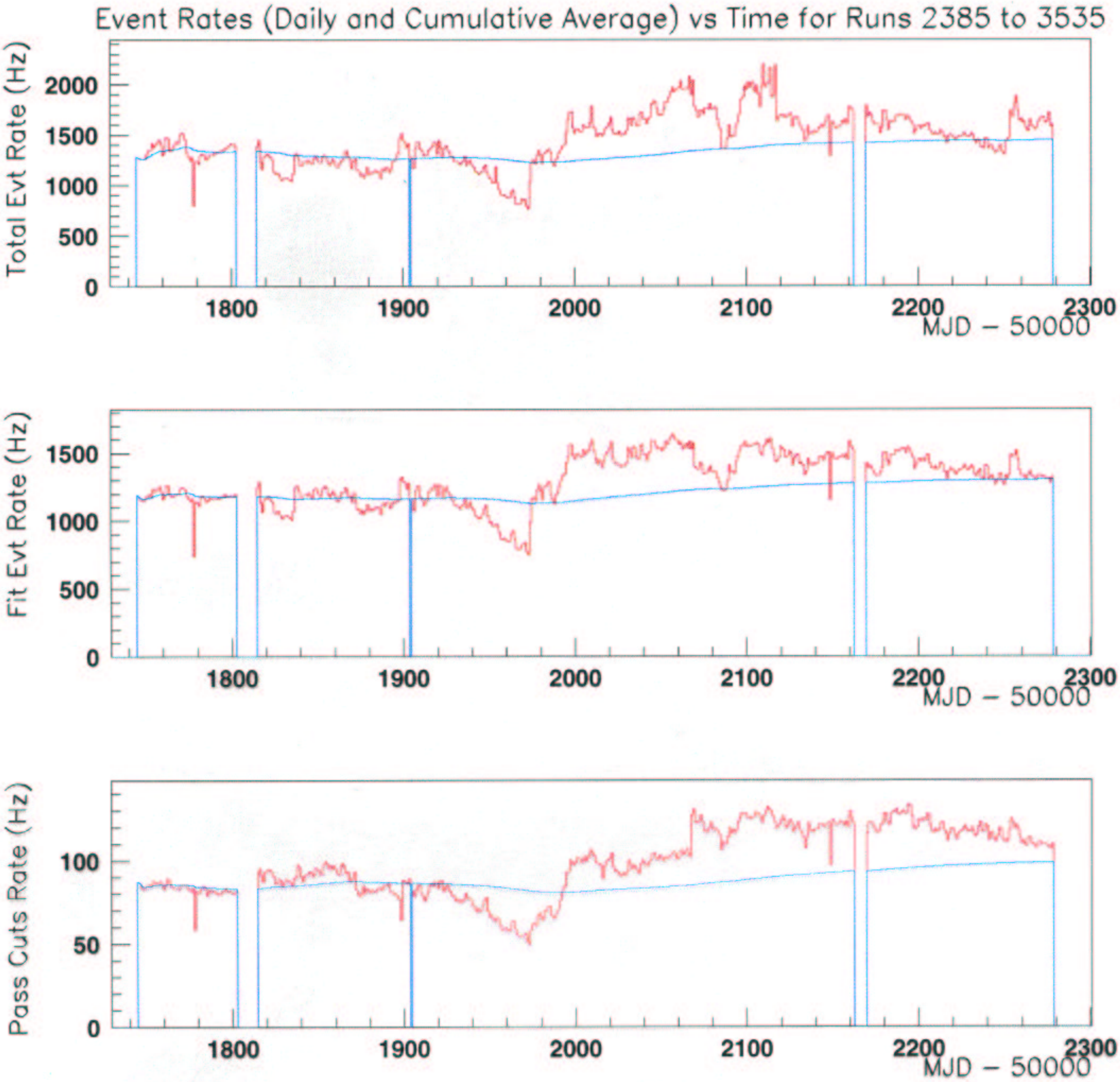
Additional Cuts: nFit ≥ 20, $\theta \leq 60^\circ$

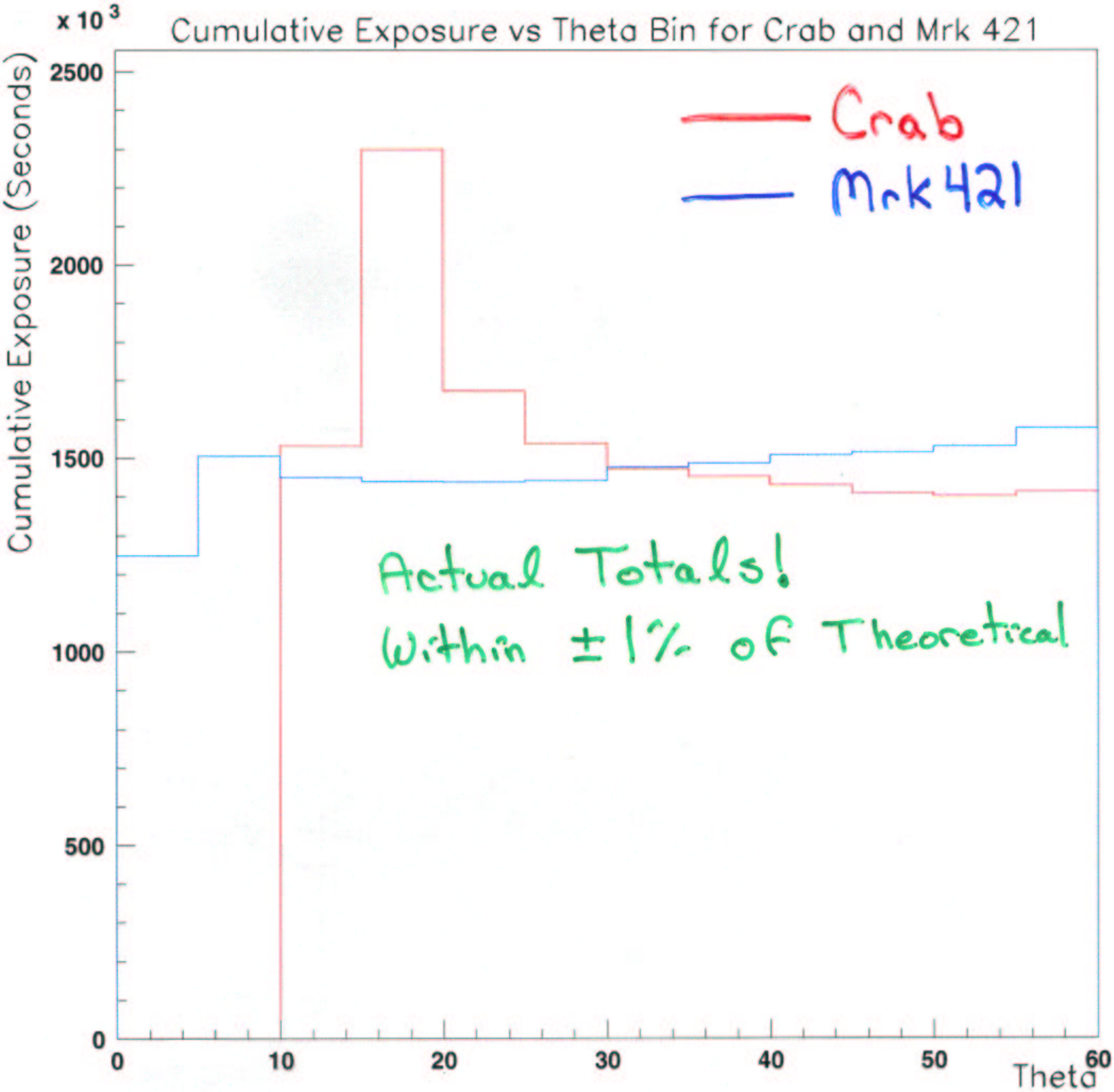
⇒ 4.1 Billion Events in Analysis
7.6% of Usable Events

Avg. Rates: 1452.4 Hz (Total Rate)

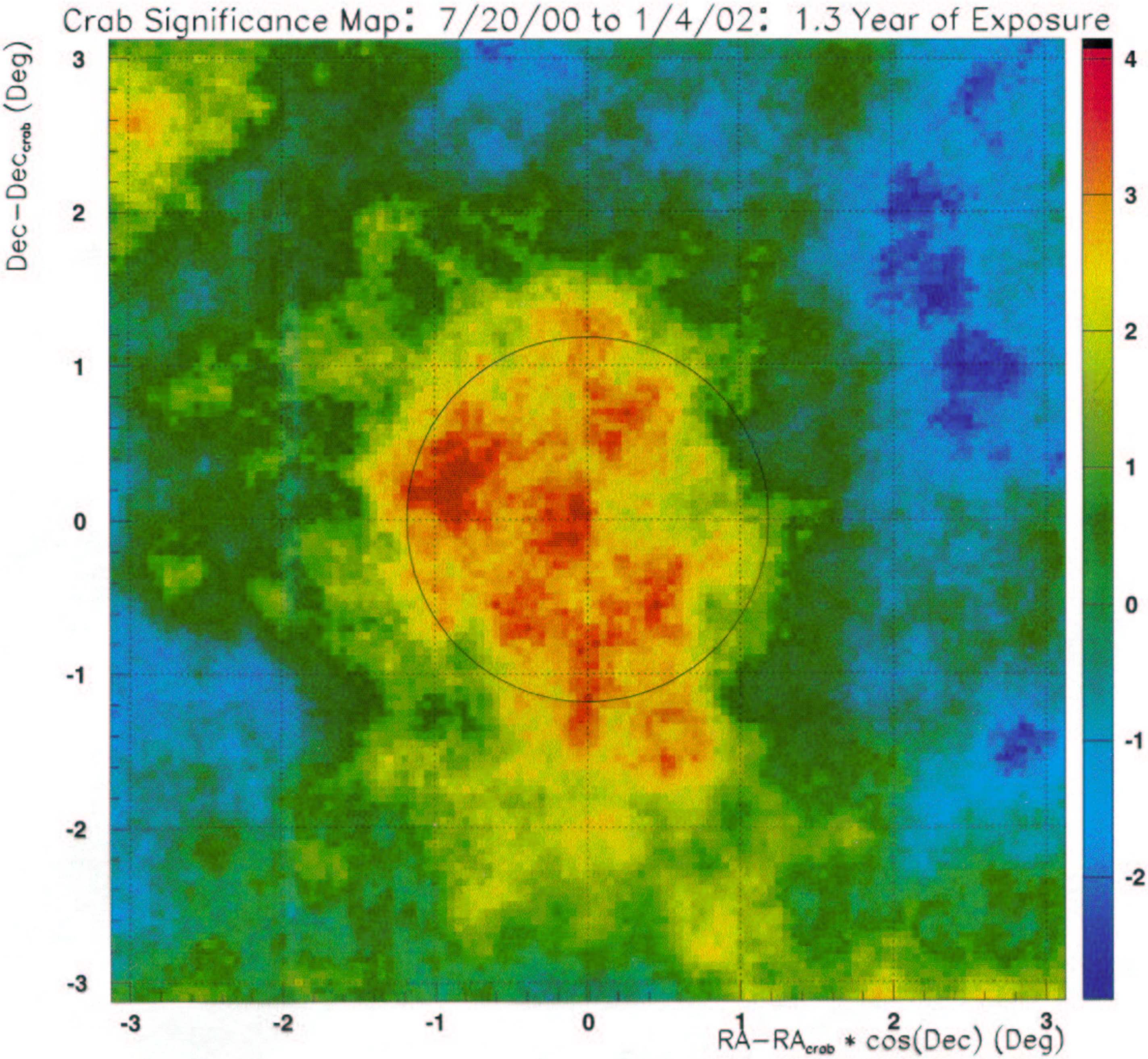
1303.6 Hz (Usable)

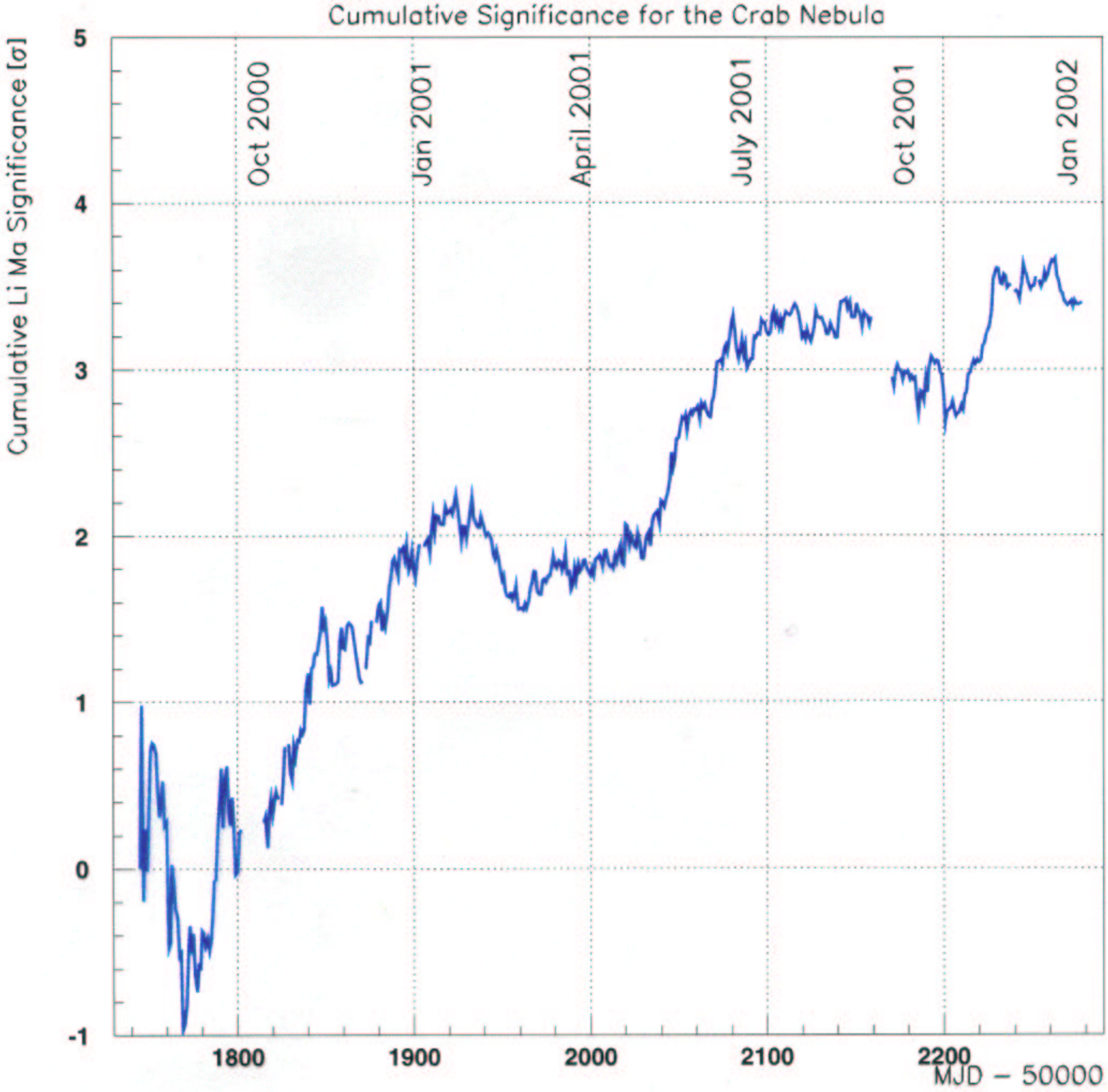
98.8 Hz (Pass Cuts)


Event Rates (Daily and Cumulative Average) vs Time for Runs 2385 to 3535
Total Evt Rate (Hz)
0
500
1000
1500
2000
1800
1900
2000
2100
2200
2300
MJD – 50000
Fit Evt Rate (Hz)
0
500
1000
1500
1800
1900
2000
2100
2200
2300
MJD – 50000
Pass Cuts Rate (Hz)
0
50
100
1800
1900
2000
2100
2200
2300
MJD – 50000



Actual Totals!
Within ± 1% of Theoretical


Crab Significance Map: 7/20/00 to 1/4/02: 1.3 Year of Exposure


Cumulative Significance for the Crab Nebula
Cumulative Li Ma Significance [σ]
5
4
3
2
1
0
-1
Oct 2000
Jan 2001
April 2001
July 2001
Oct 2001
Jan 2002
1800
1900
2000
2100
2200
MJD − 50000

What's Going On ???

Does v44 (pre-Greg's core) hurt:

v50 ⇒ End : 2610 ± 925

$t = .96\,\mathrm{yr}$ $\boxed{2.8\sigma}$

Is Analysis Broke? NO!!!

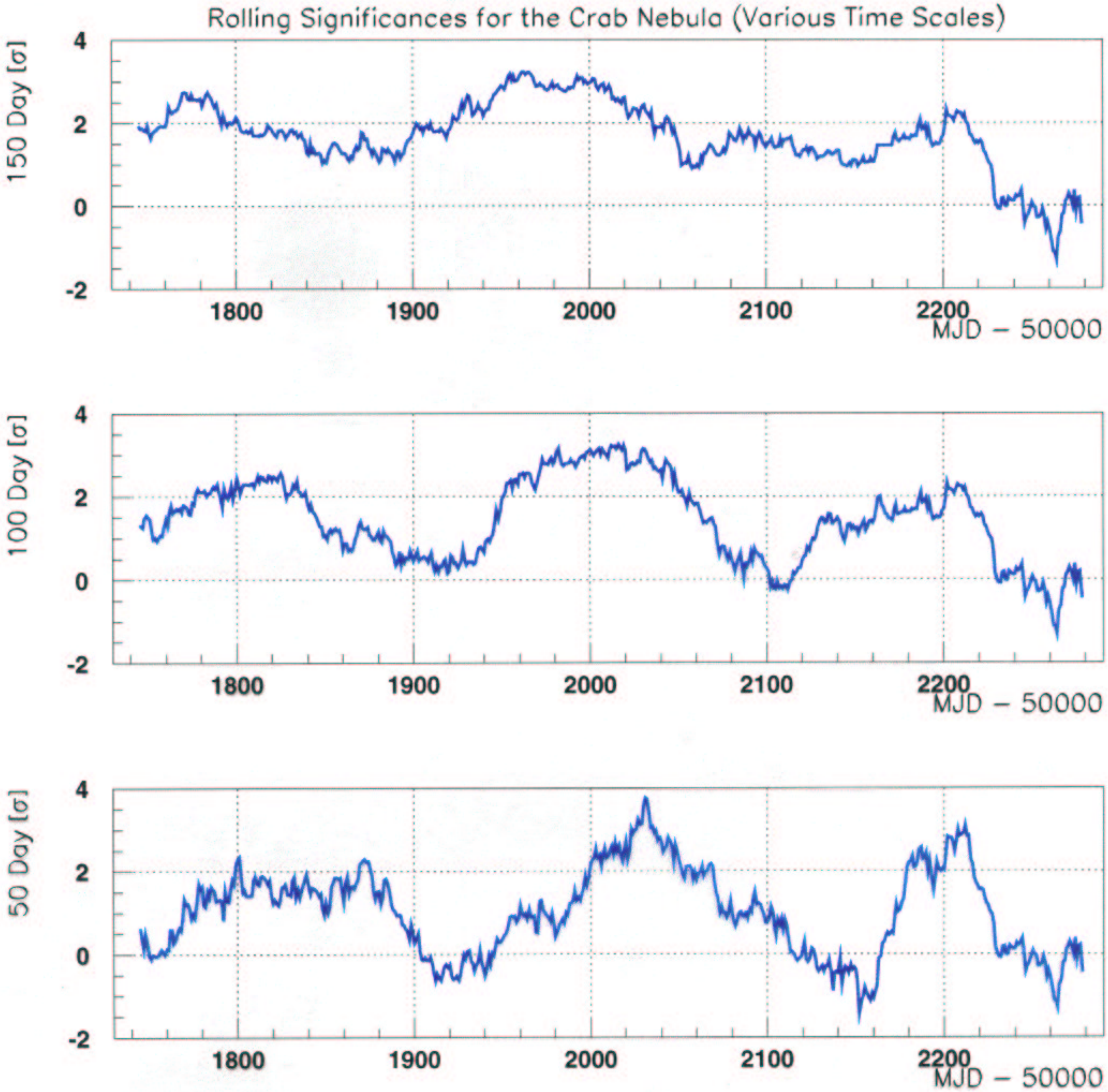
use v53 re-recon of Crab Data
+ online after v53 implemet

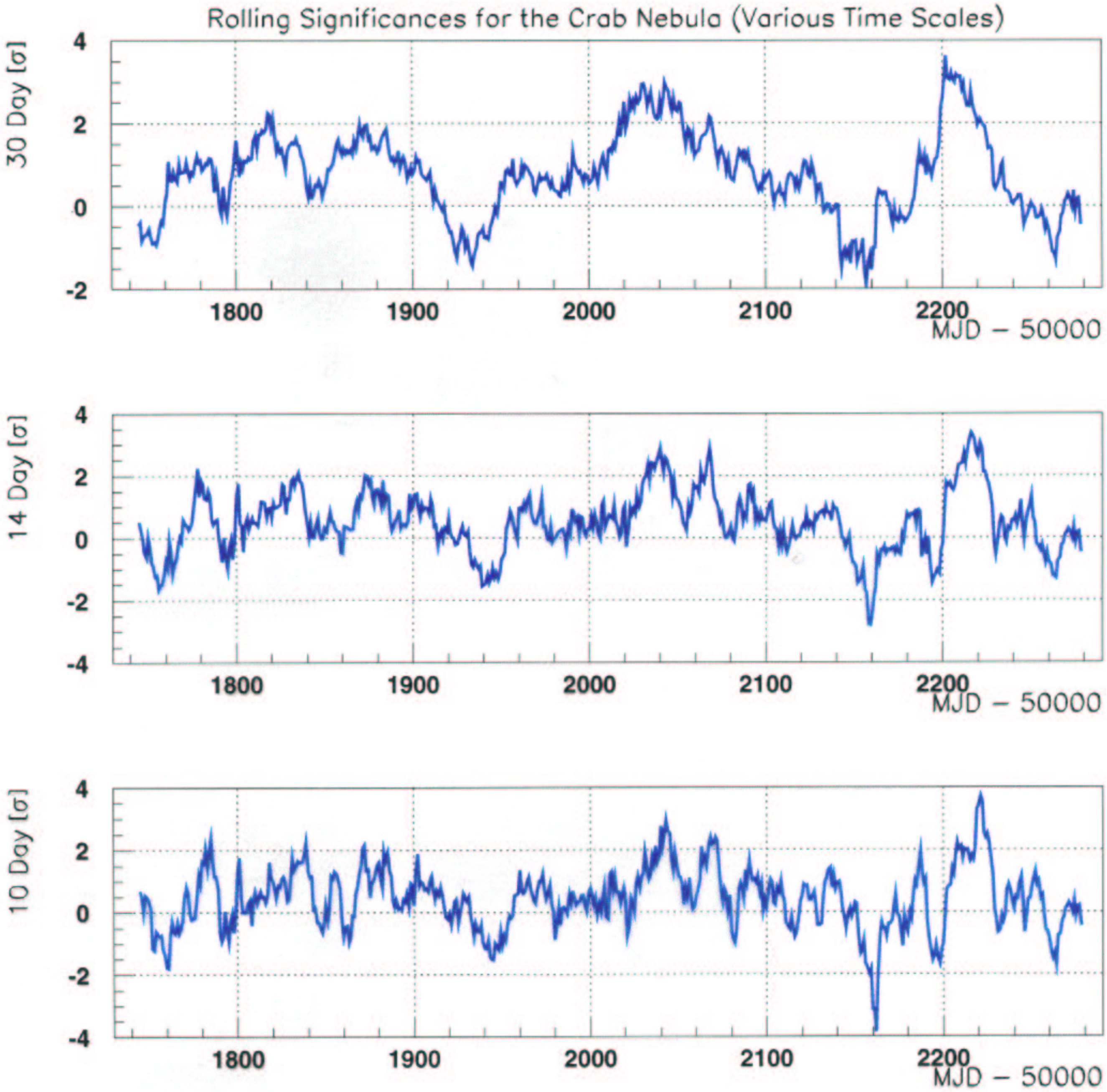
Run 1293 - 2995 re-recon, ⇒ 3535 total

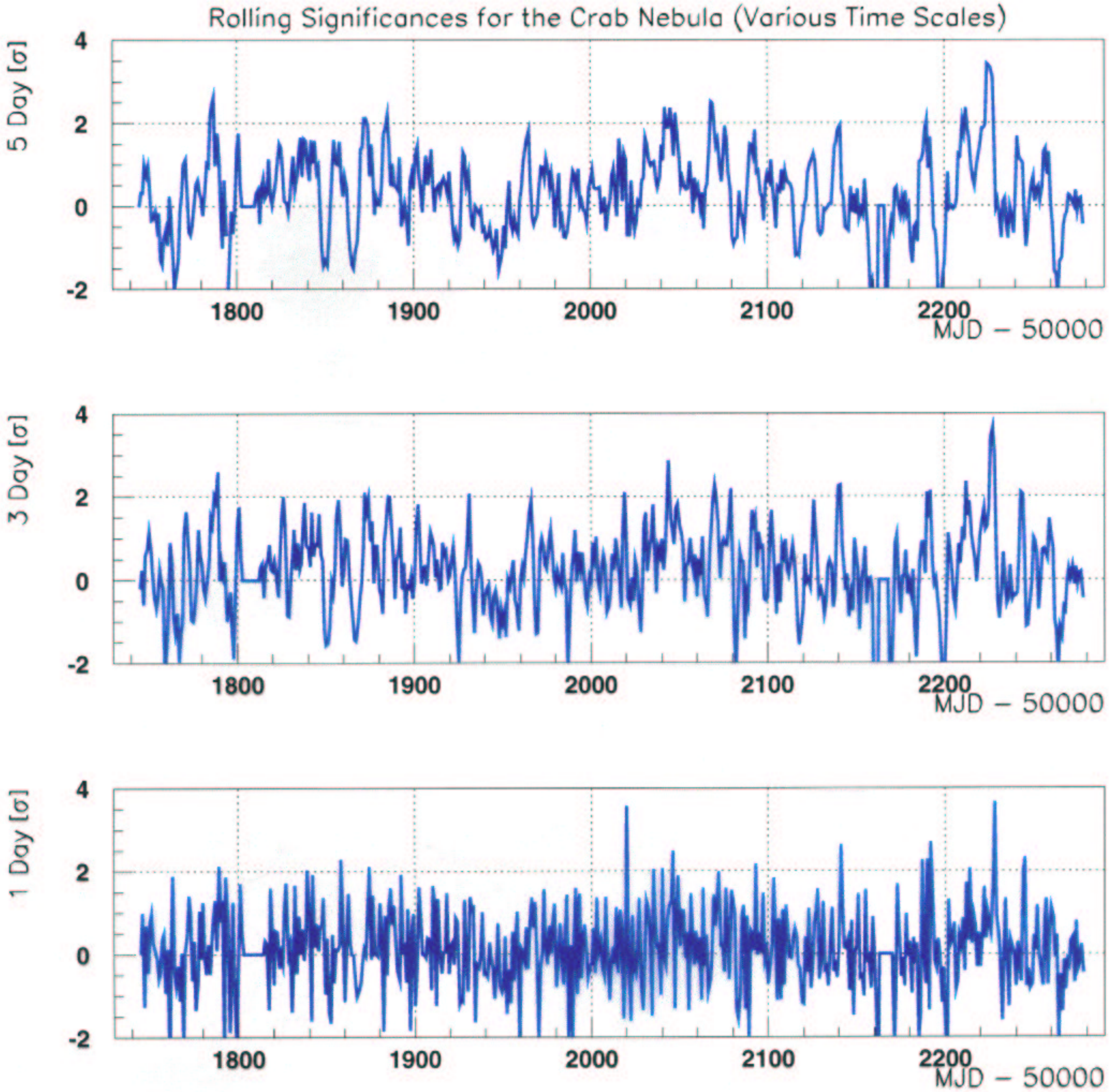
Result: 6535 ± 1372

$t = \sim 1.65\,\mathrm{yr}$ $\boxed{4.8\sigma}$

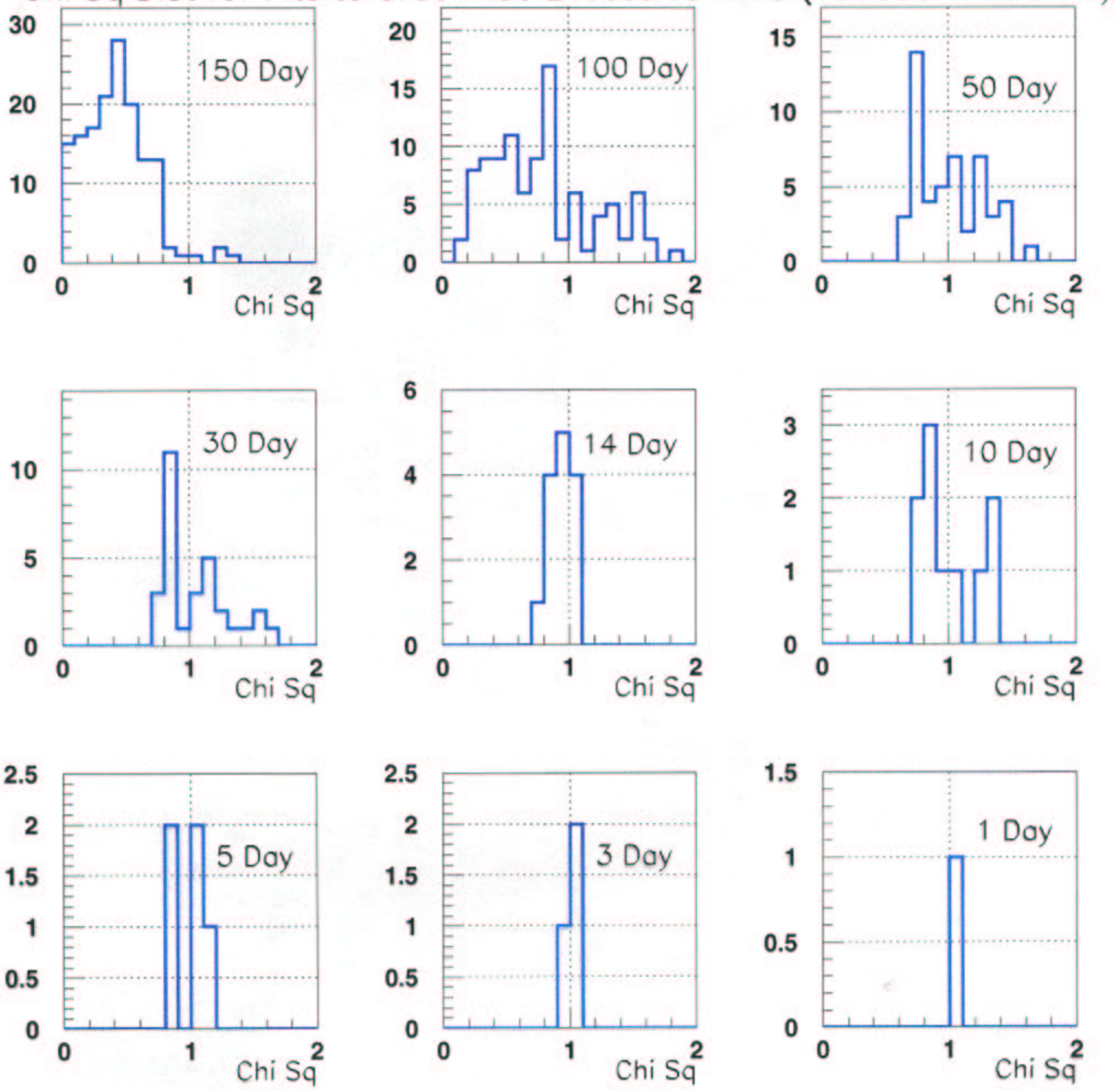
$\Rightarrow \sim 3.7\,\sigma/\mathrm{yr}$ ← Estimation:
"likely low"
as t is overestimated


Rolling Significances for the Crab Nebula (Various Time Scales)
150 Day [σ]
100 Day [σ]
50 Day [σ]
4
2
0
-2
1800
1900
2000
2100
2200
MJD − 50000


Rolling Significances for the Crab Nebula (Various Time Scales)
30 Day [σ]
4
2
0
-2
1800
1900
2000
2100
2200
MJD – 50000
14 Day [σ]
4
2
0
-2
-4
1800
1900
2000
2100
2200
MJD – 50000
10 Day [σ]
4
2
0
-2
-4
1800
1900
2000
2100
2200
MJD – 50000

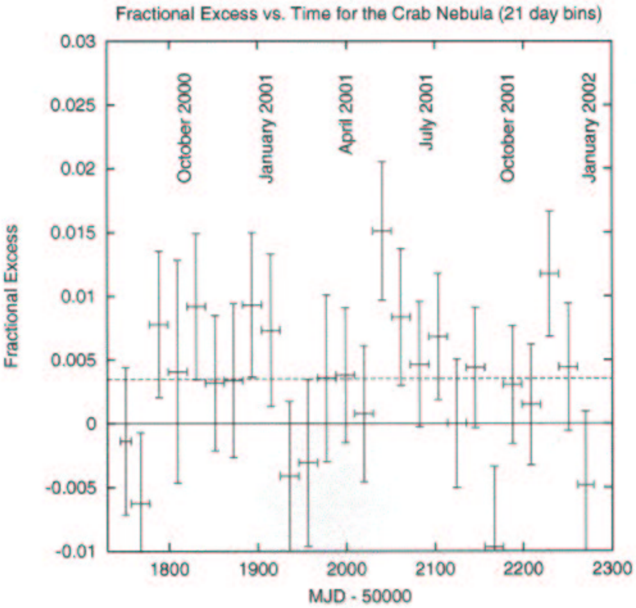

Rolling Significances for the Crab Nebula (Various Time Scales)
5 Day [σ]
3 Day [σ]
1 Day [σ]
4
2
0
-2
1800
1900
2000
2100
2200
MJD − 50000

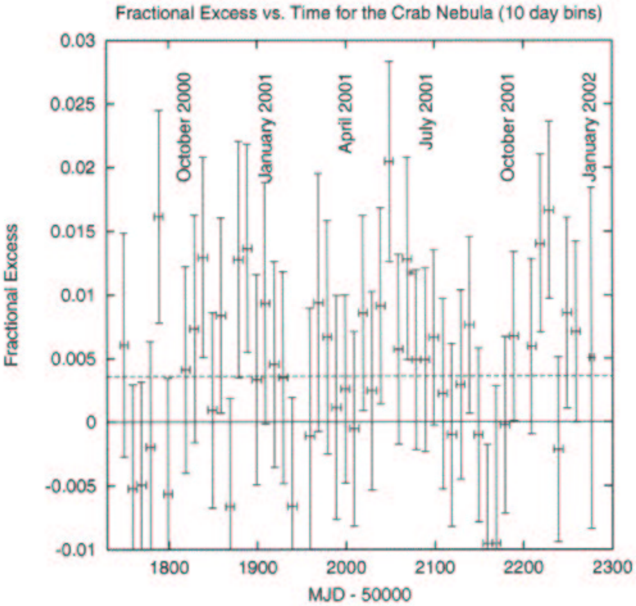
Chi Sq Dist for Fits to Crab Frac Excess vs Time (Various Time Bins)

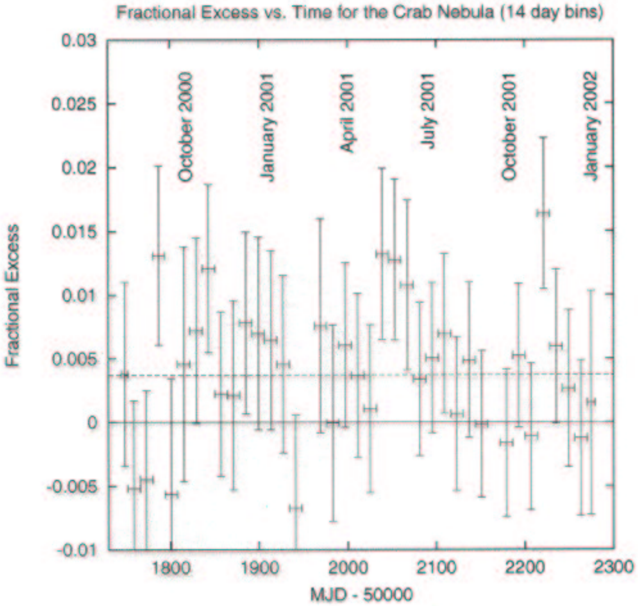


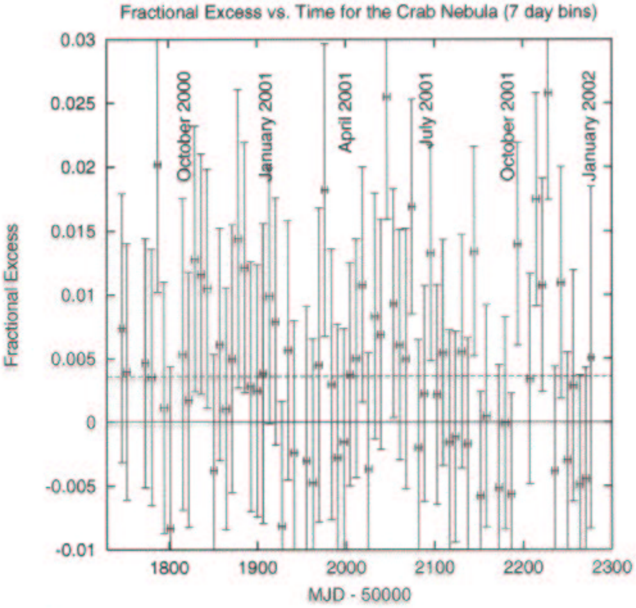
Results of Fits to Crab Frac. Excess

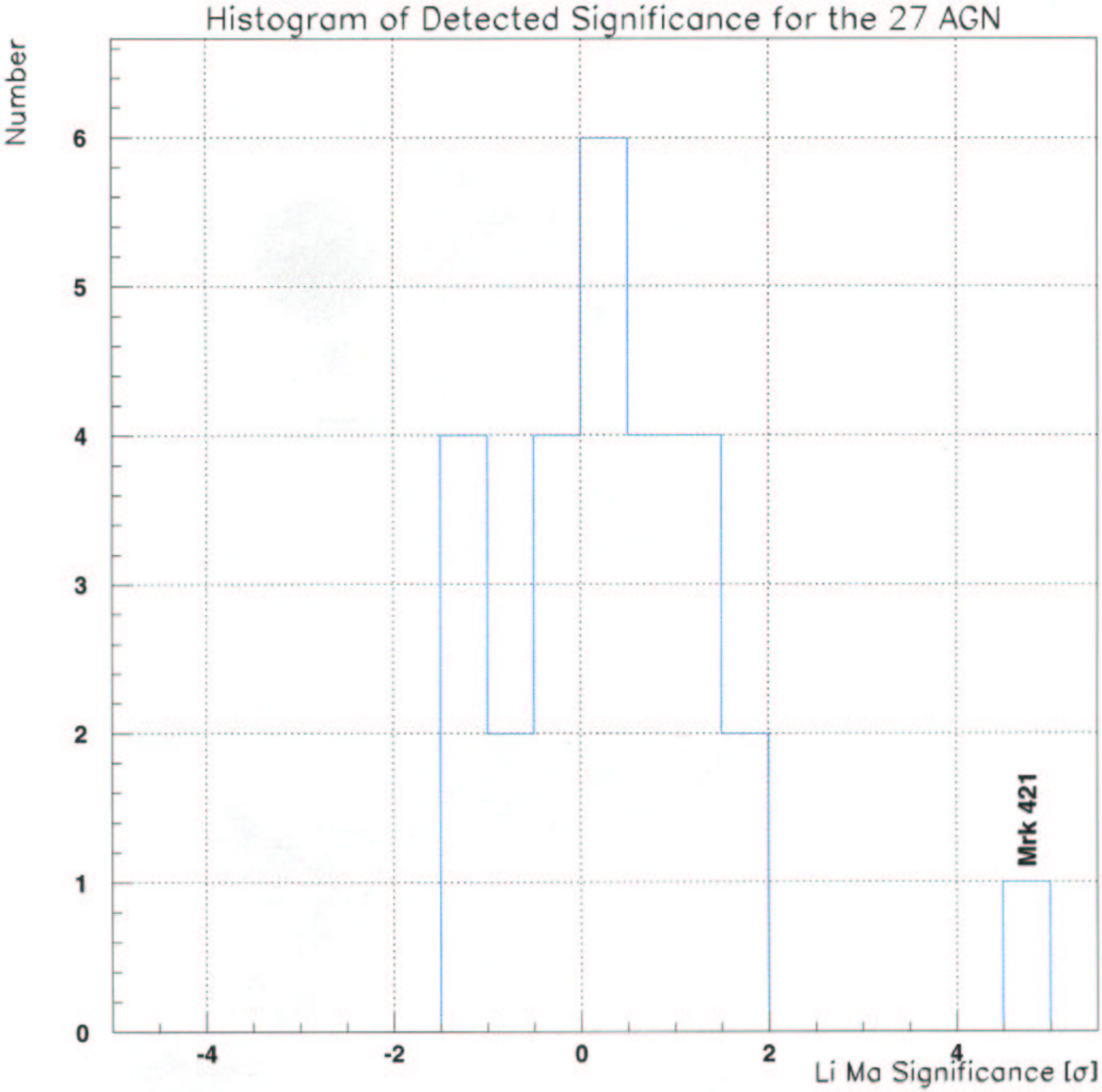
Timescale (Days)	Median χ^2	d.o.f	fit value (const)
150	0.41	4	0.0041 ± 0.0007
100	0.77	5	0.0040 ± 0.0010
50	0.99	10	0.0038 ± 0.0011
30	1.00	18	0.0035 ± 0.0011
21	1.03	25	0.0035 ± 0.0011
14	0.99	38	0.0037 ± 0.0011
10	0.93	52	0.0036 ± 0.0010
7	1.00	75	0.0036 ± 0.0011
5	1.01	105	0.0035 ± 0.0011
3	1.00	172	0.0034 ± 0.0011
1	1.04	502	0.0029 ± 0.0011


Fractional Excess vs. Time for the Crab Nebula (21 day bins)
Fractional Excess
MJD - 50000
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.01
1800
1900
2000
2100
2200
2300
October 2000
January 2001
April 2001
July 2001
October 2001
January 2002


Fractional Excess vs. Time for the Crab Nebula (10 day bins)
Fractional Excess
MJD - 50000
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.01
1800
1900
2000
2100
2200
2300
October 2000
January 2001
April 2001
July 2001
October 2001
January 2002


Fractional Excess vs. Time for the Crab Nebula (14 day bins)
Fractional Excess
MJD - 50000
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.01
1800
1900
2000
2100
2200
2300
October 2000
January 2001
April 2001
July 2001
October 2001
January 2002


Fractional Excess vs. Time for the Crab Nebula (7 day bins)
Fractional Excess
MJD - 50000
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.01
1800
1900
2000
2100
2200
2300
October 2000
January 2001
April 2001
July 2001
October 2001
January 2002


Histogram of Detected Significance for the 27 AGN
Number
0
1
2
3
4
5
6
-4
-2
0
2
4
Li Ma Significance [σ]
Mrk 421

Mrk 421 Results

Excess: 5989 ± 1244

t=1.3yr $\boxed{4.8\sigma}$

Averages to 4.2 σ/yr over Data Set

Flare Interval from RXTE:

JD 1860 → 2013

Excess: 2707 ± 615

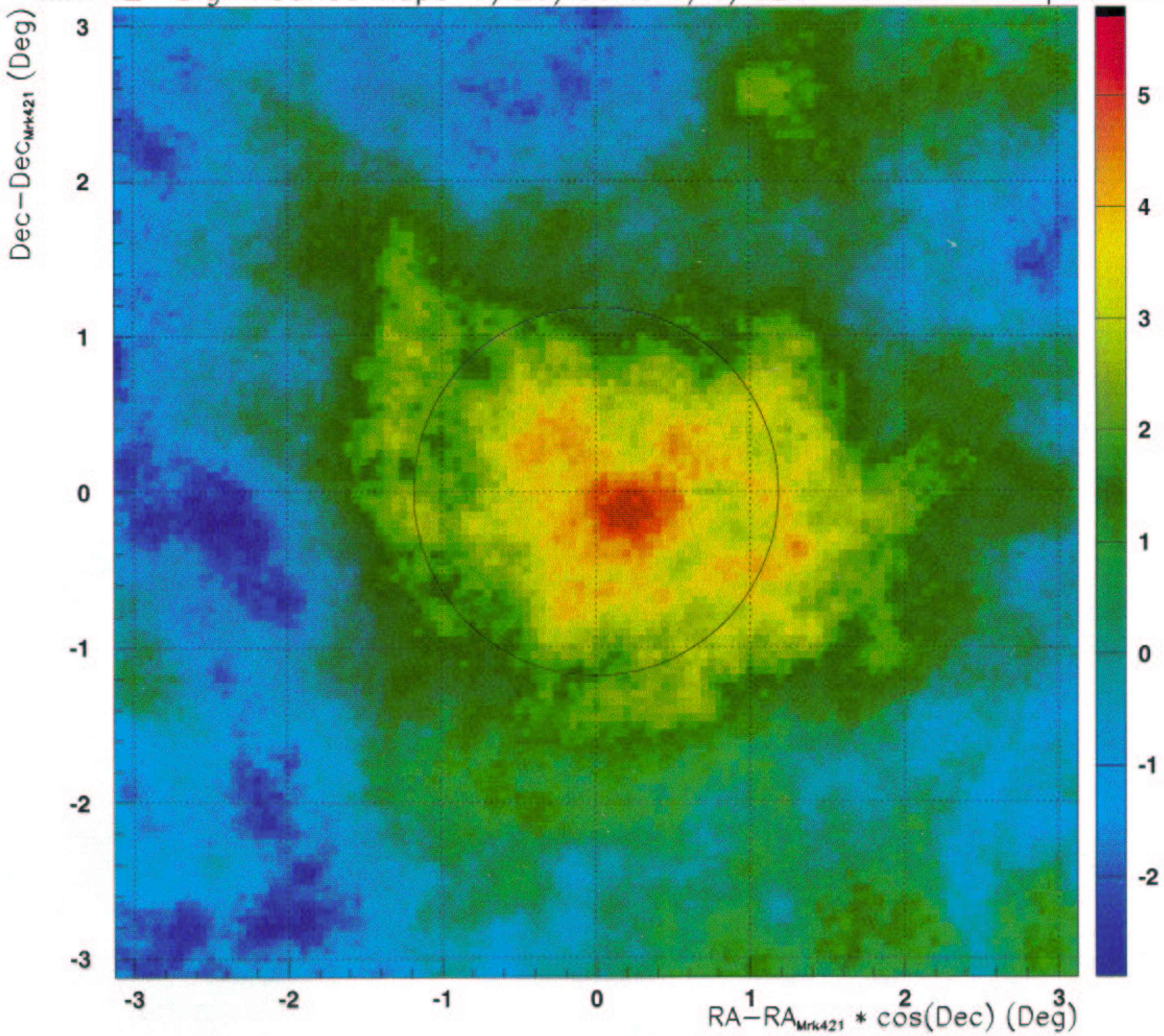
$\boxed{4.40\sigma}$

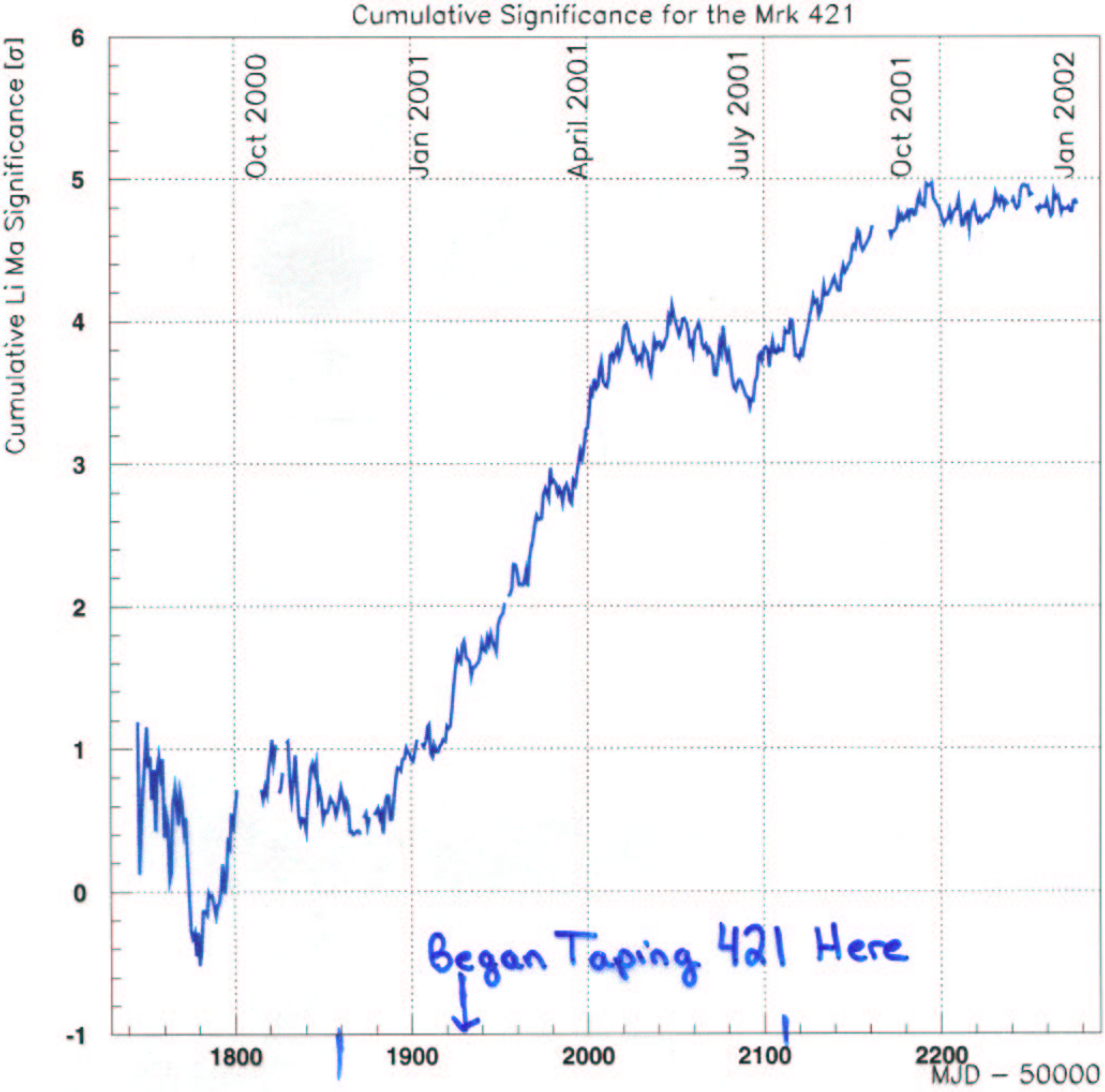
Since We Began Taping:

Excess: 4877 ± 1042

$\boxed{4.7\sigma}$

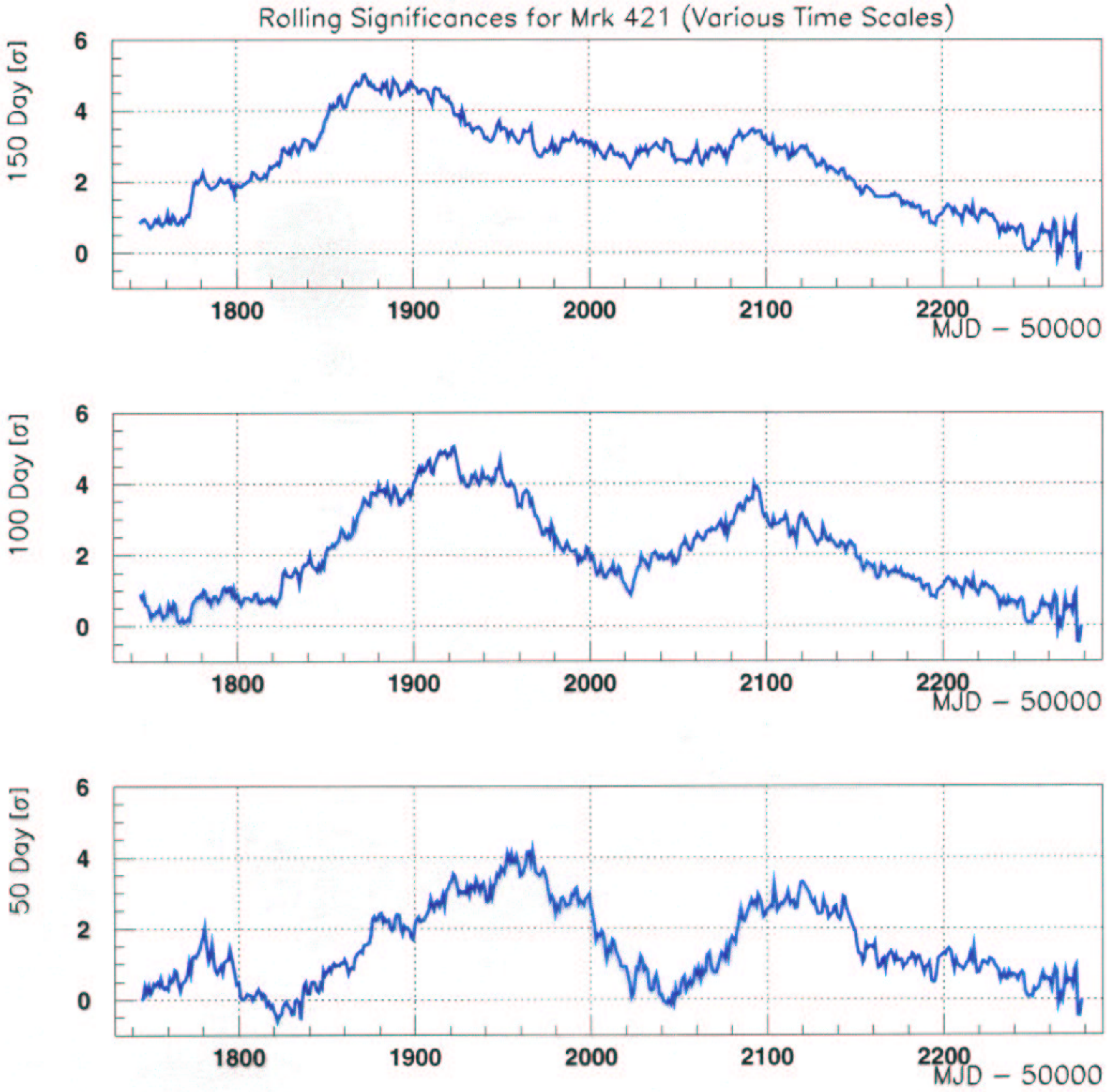
Mrk 421 Significance Map: 7/20/00 to 1/4/02: 1.3 Year of Exposure

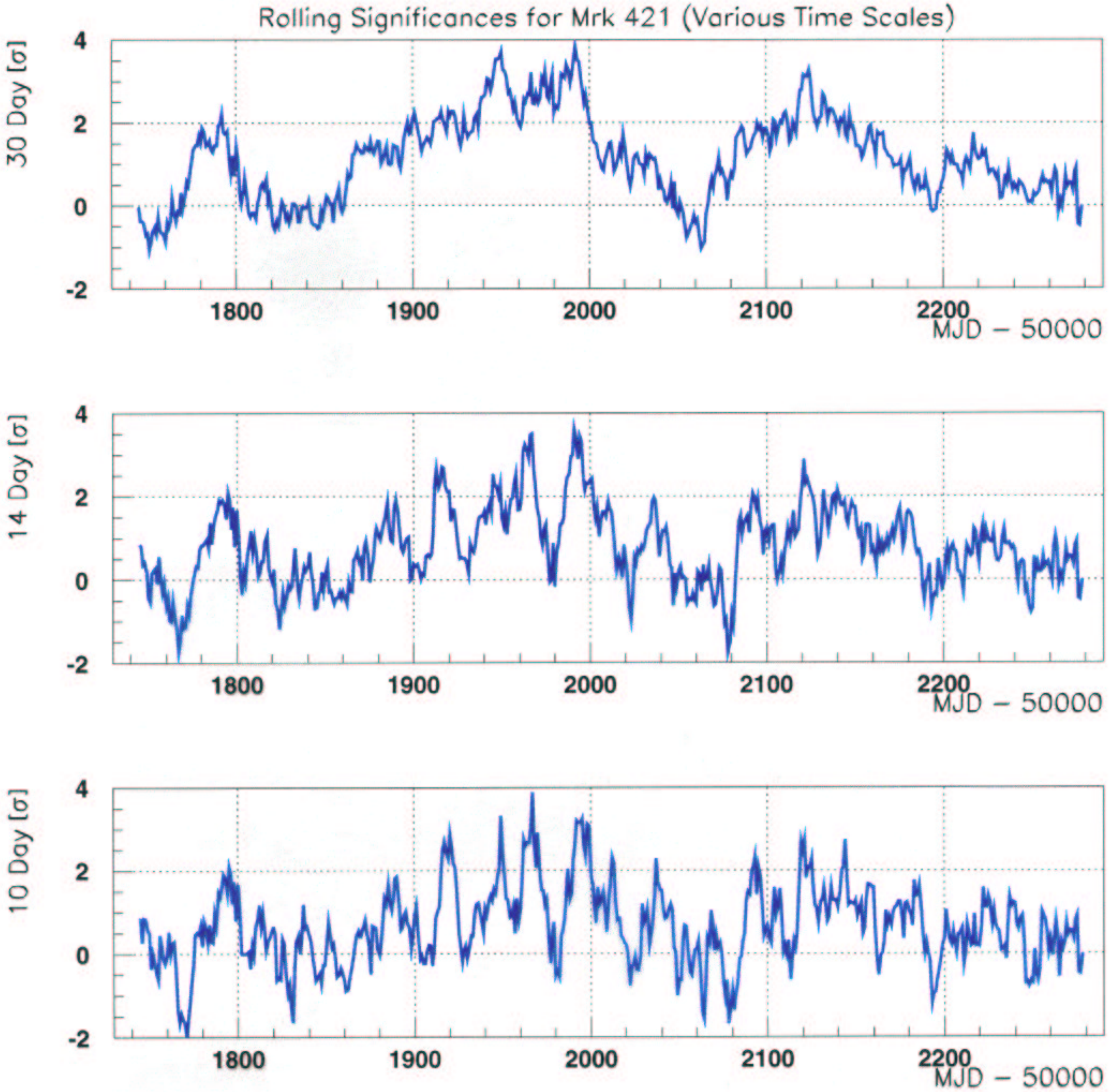


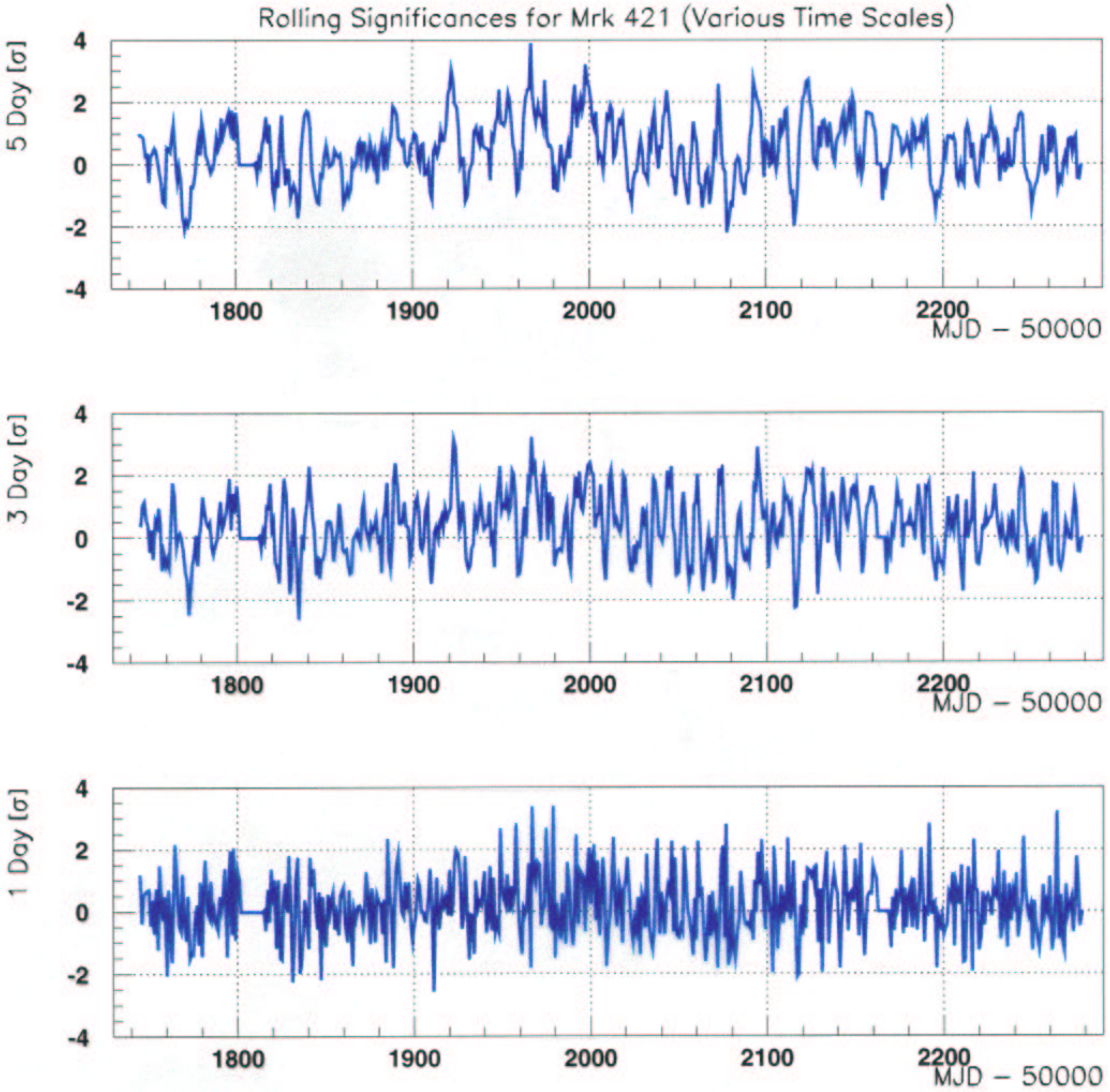


Began Taping 421 Here

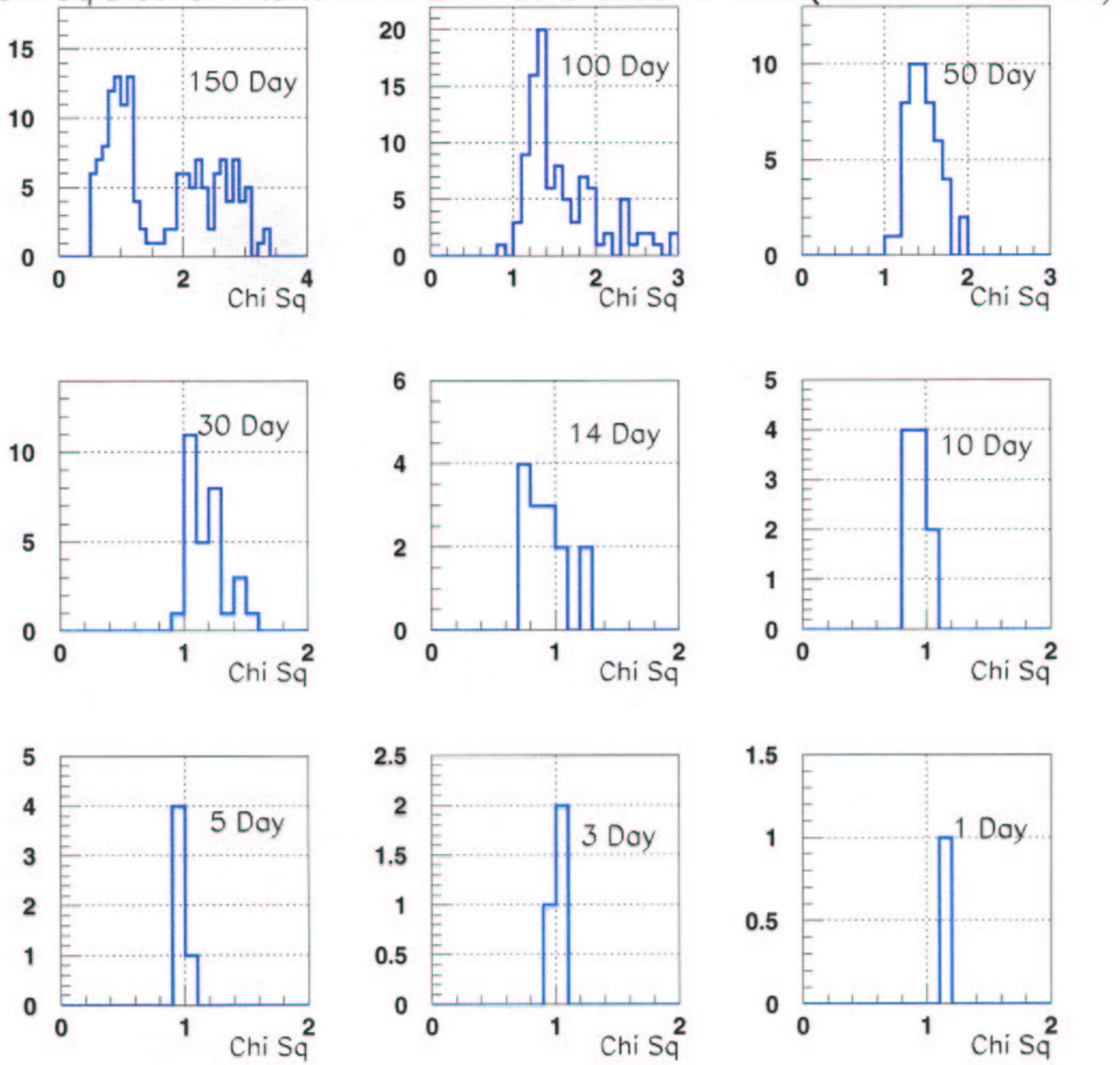
RXTE Flare


Rolling Significances for Mrk 421 (Various Time Scales)
150 Day [σ]
100 Day [σ]
50 Day [σ]
0
2
4
6
1800
1900
2000
2100
2200
MJD − 50000


Rolling Significances for Mrk 421 (Various Time Scales)
30 Day [σ]
14 Day [σ]
10 Day [σ]
4
2
0
-2
1800
1900
2000
2100
2200
MJD − 50000

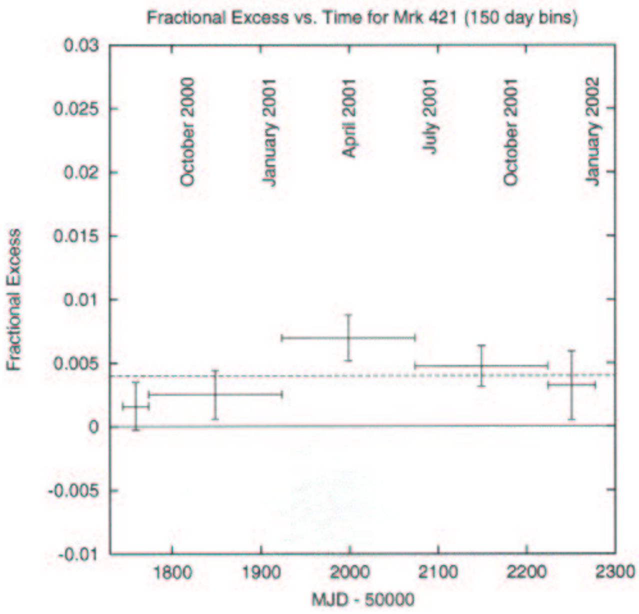

Rolling Significances for Mrk 421 (Various Time Scales)
5 Day [σ]
3 Day [σ]
1 Day [σ]
4
2
0
-2
-4
1800
1900
2000
2100
2200
MJD − 50000

Chi Sq Dist for Fits to Mrk 421 Frac Excess vs Time (Various Time Bins)

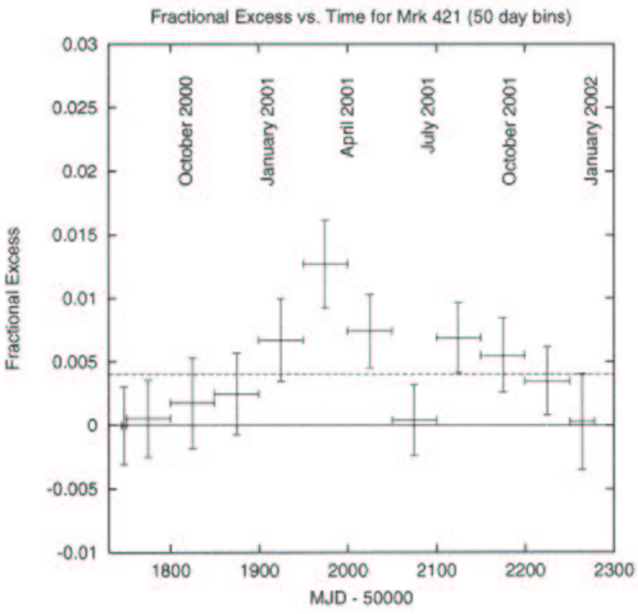


Results of Fits to Mrk421 Frac Excess

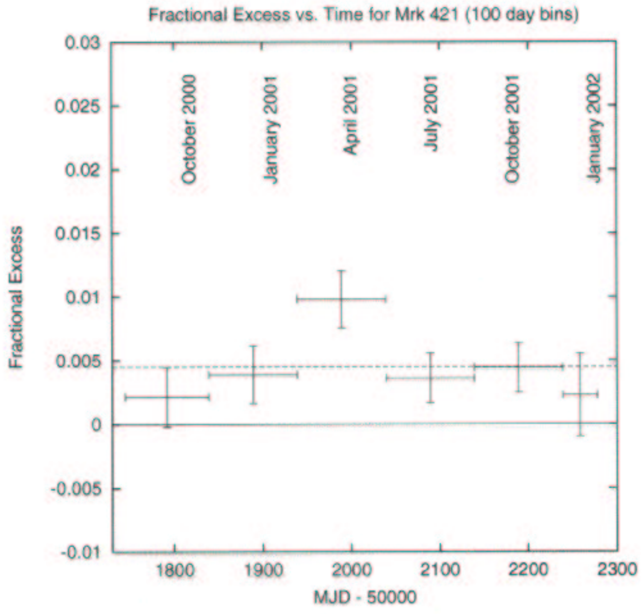
Time Scale (Days)	Median χ^2	d.o.f.	fit value (const)
150	1.31	4	0.0040 ± 0.0010
100	1.45	5	0.0045 ± 0.0011
50	1.46	11	0.0040 ± 0.0011
30	1.17	18	0.0042 ± 0.0010
21	1.00	25	0.0043 ± 0.0009
14	0.91	38	0.0044 ± 0.0009
10	0.96	52	0.0044 ± 0.0009
7	0.97	75	0.0044 ± 0.0009
5	0.94	103	0.0044 ± 0.0009
3	1.08	172	0.0043 ± 0.0010
1	1.11	506	0.0039 ± 0.0010



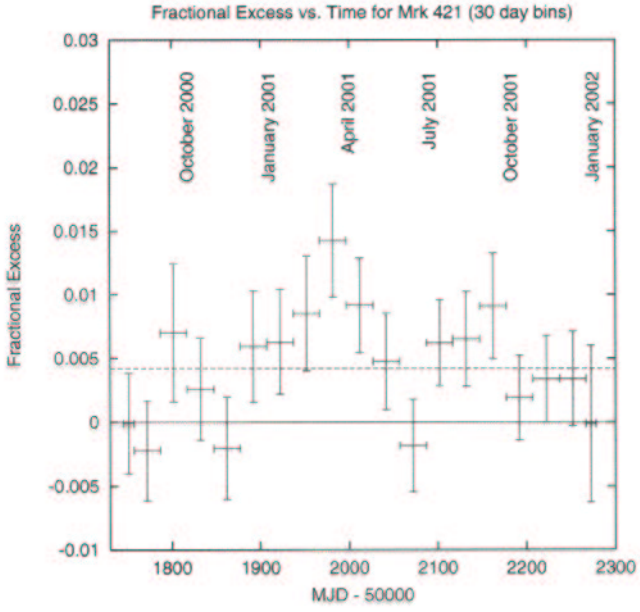
Fractional Excess vs. Time for Mrk 421 (150 day bins)



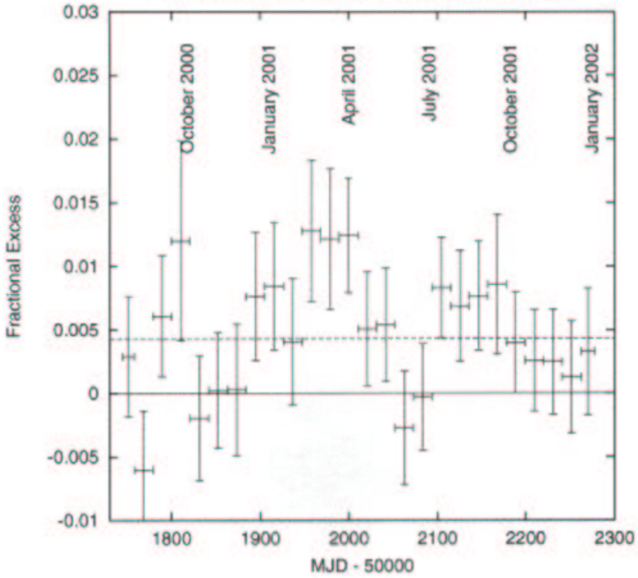
Fractional Excess vs. Time for Mrk 421 (50 day bins)



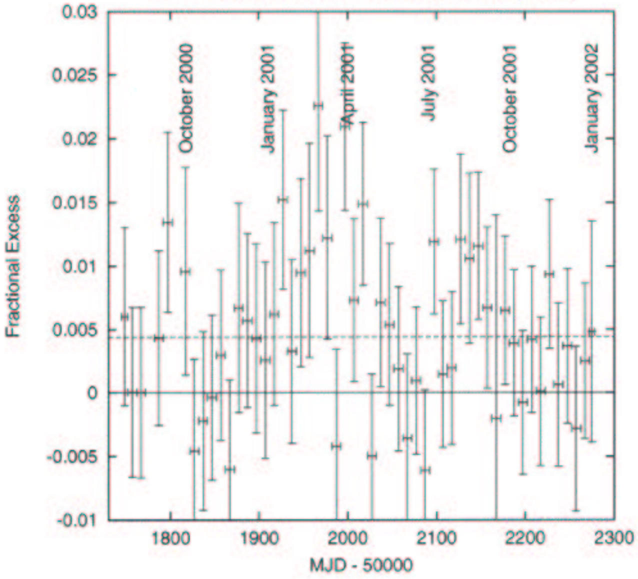
Fractional Excess vs. Time for Mrk 421 (100 day bins)



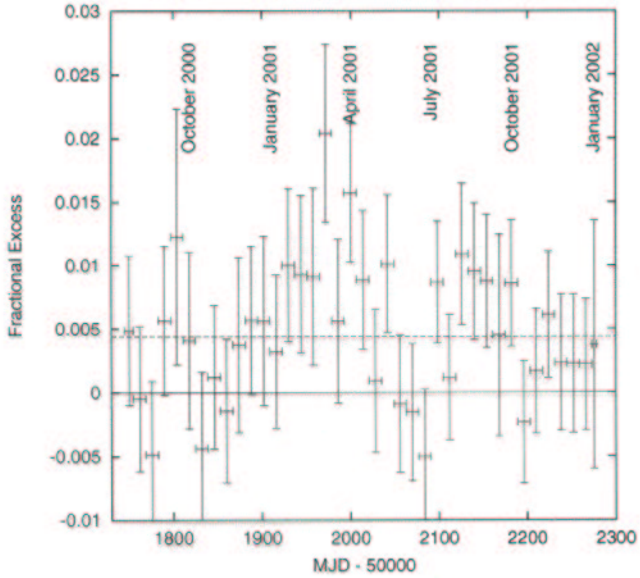
Fractional Excess vs. Time for Mrk 421 (30 day bins)



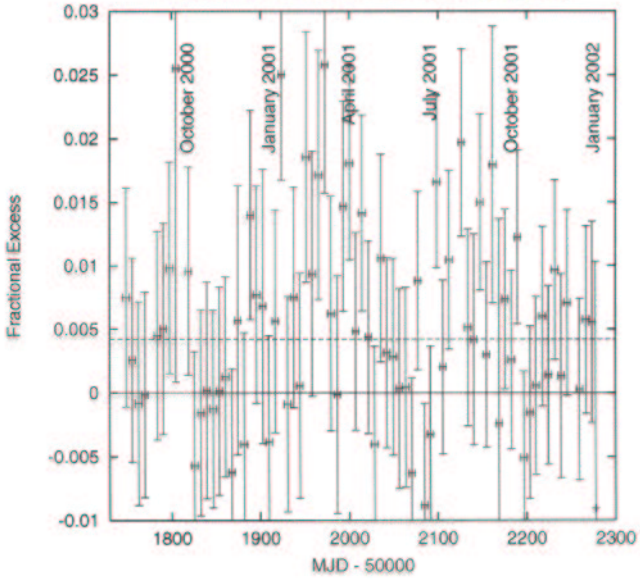
Fractional Excess vs. Time for Mrk 421 (21 day bins)



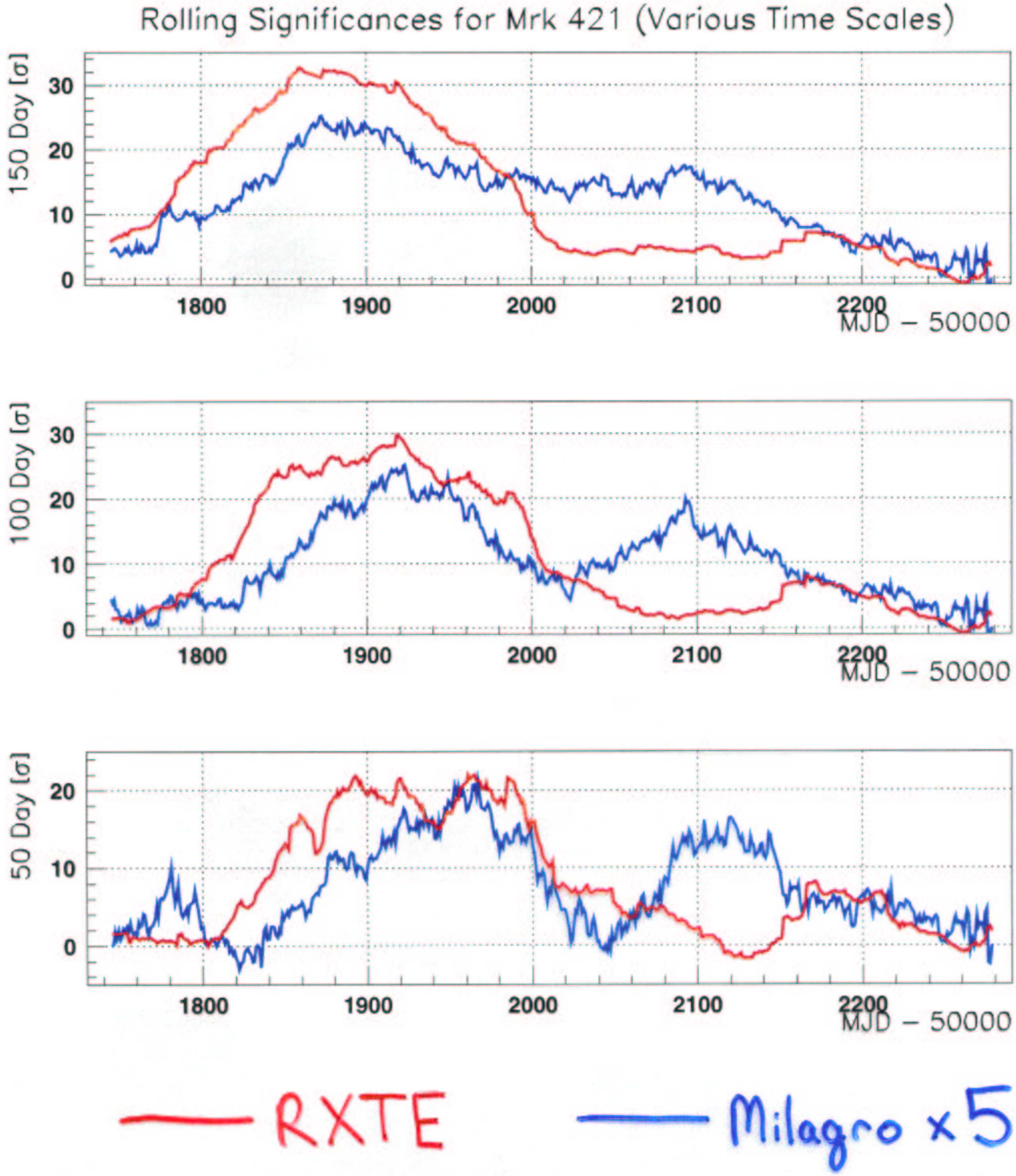
Fractional Excess vs. Time for Mrk 421 (10 day bins)

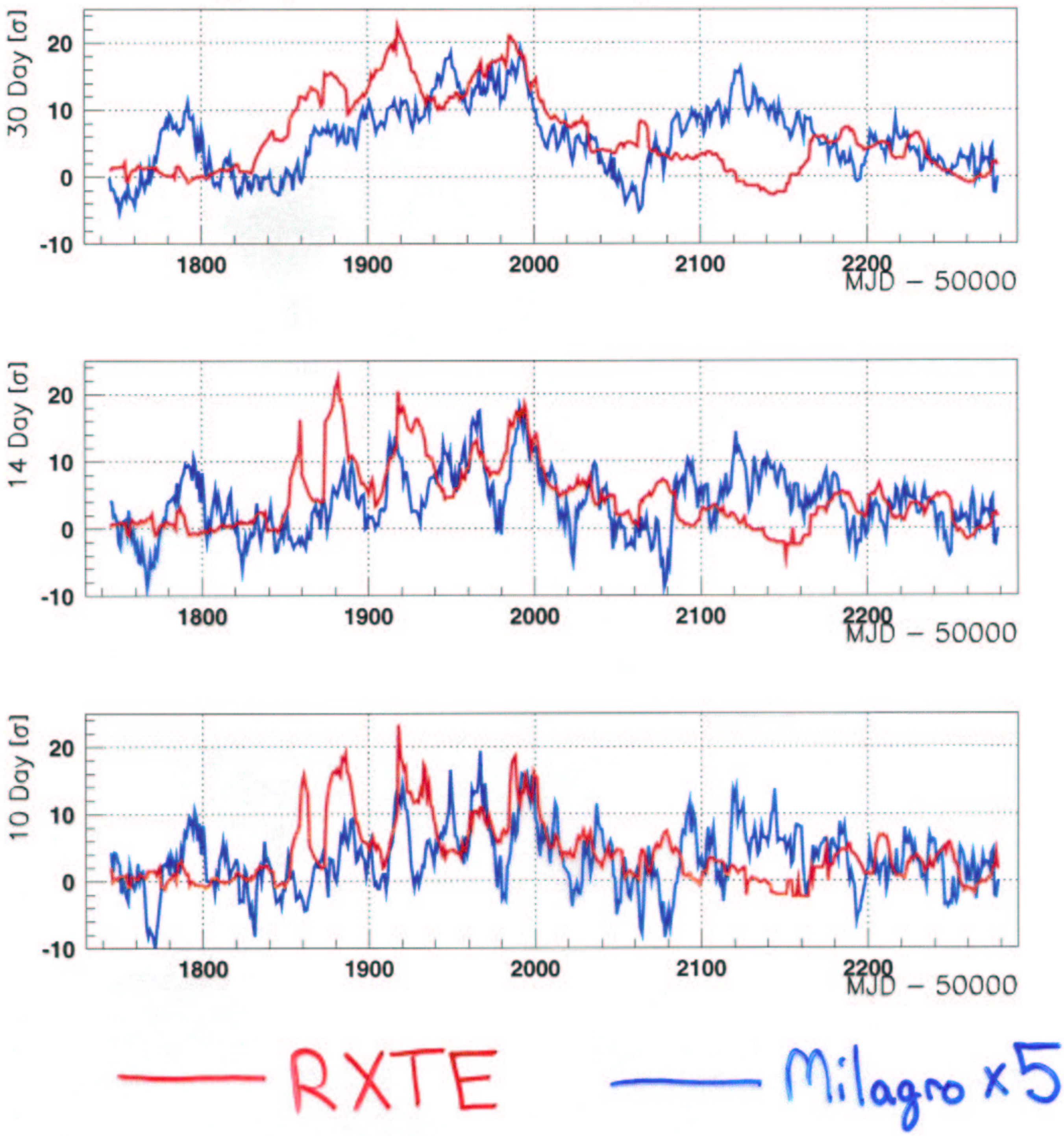


Fractional Excess vs. Time for Mrk 421 (14 day bins)

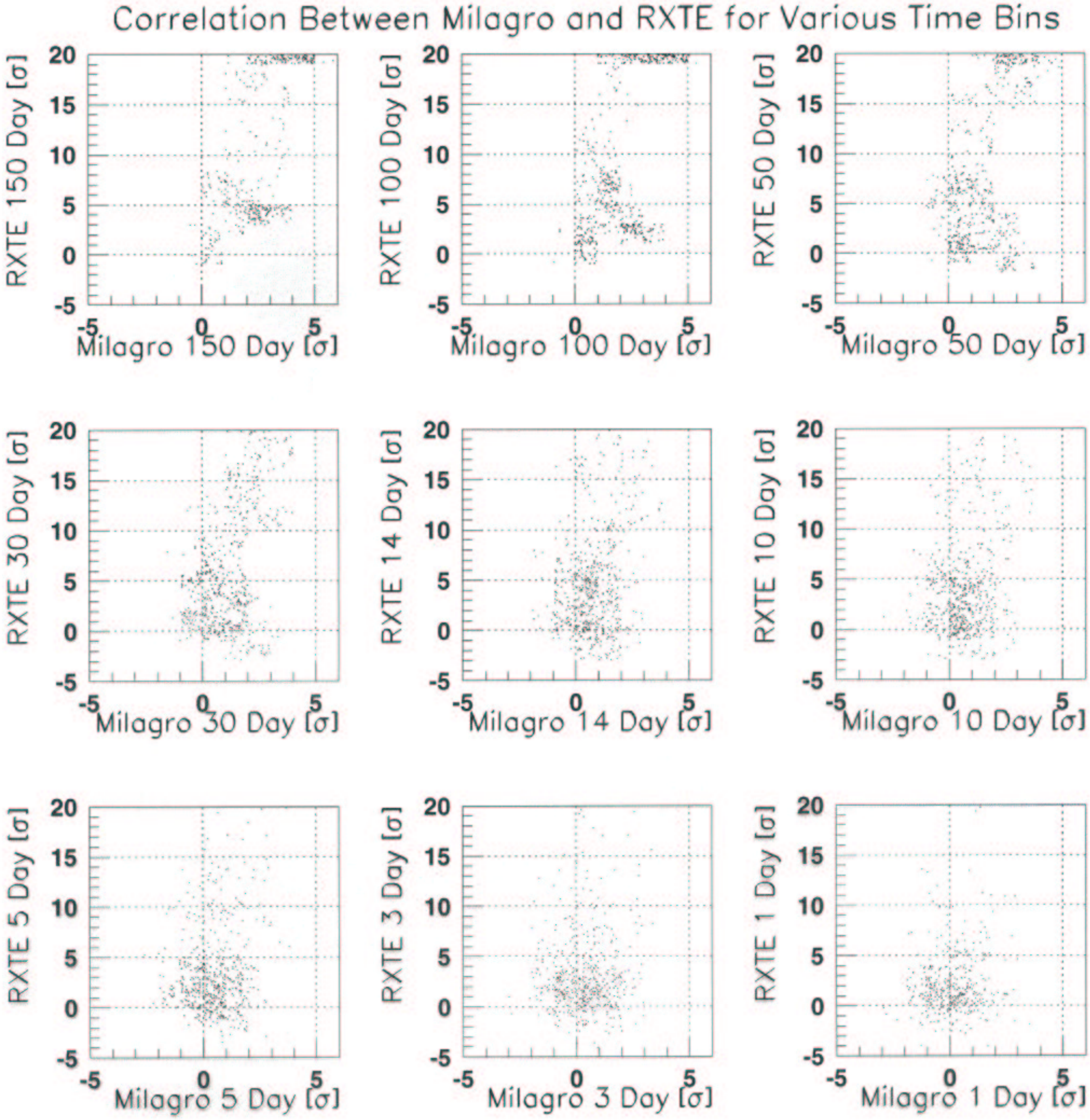


Fractional Excess vs. Time for Mrk 421 (7 day bins)

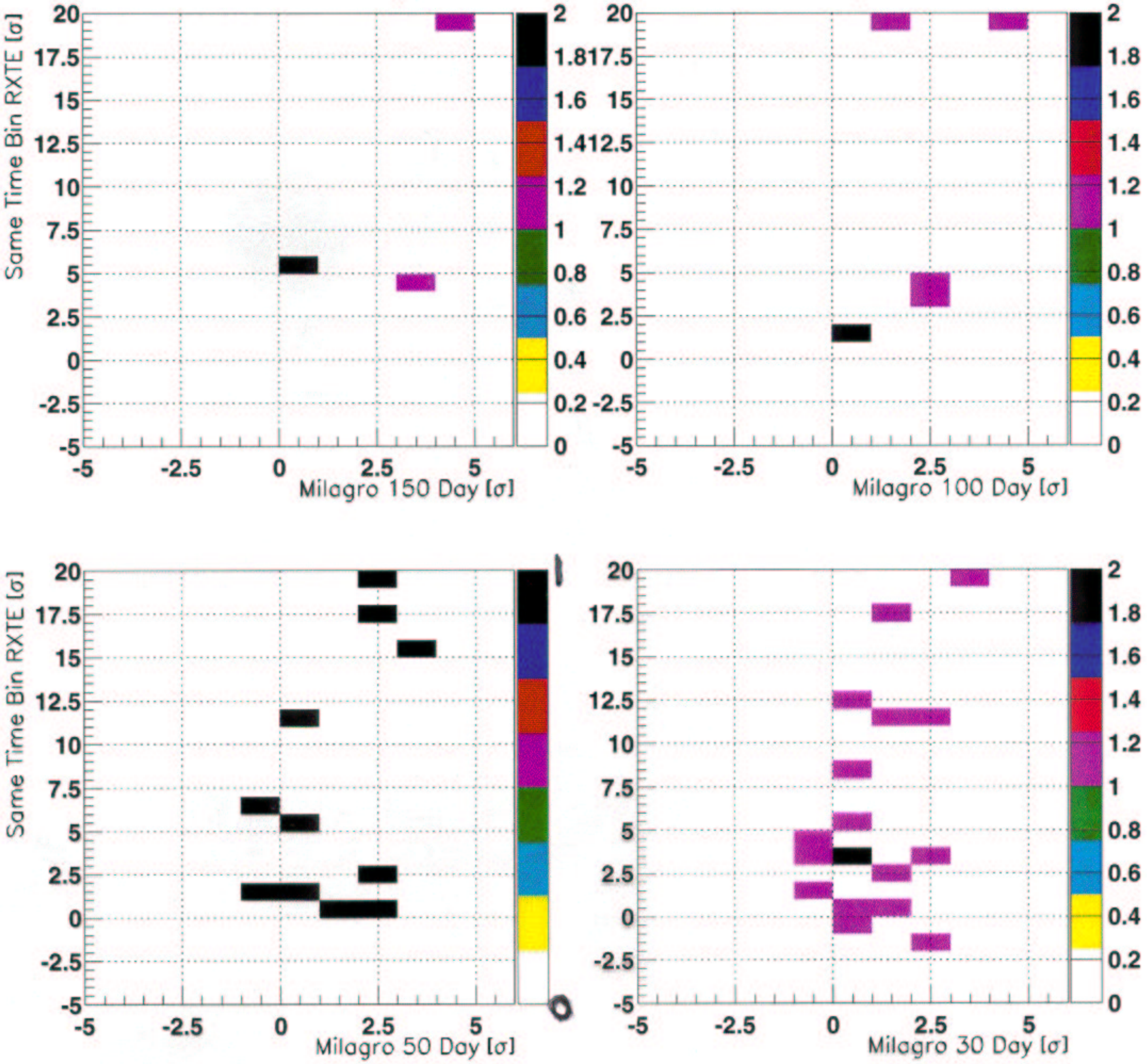

Rolling Significances for Mrk 421 (Various Time Scales)
150 Day [σ]
100 Day [σ]
50 Day [σ]
0
10
20
30
1800
1900
2000
2100
2200
MJD − 50000
RXTE
Milagro ×5

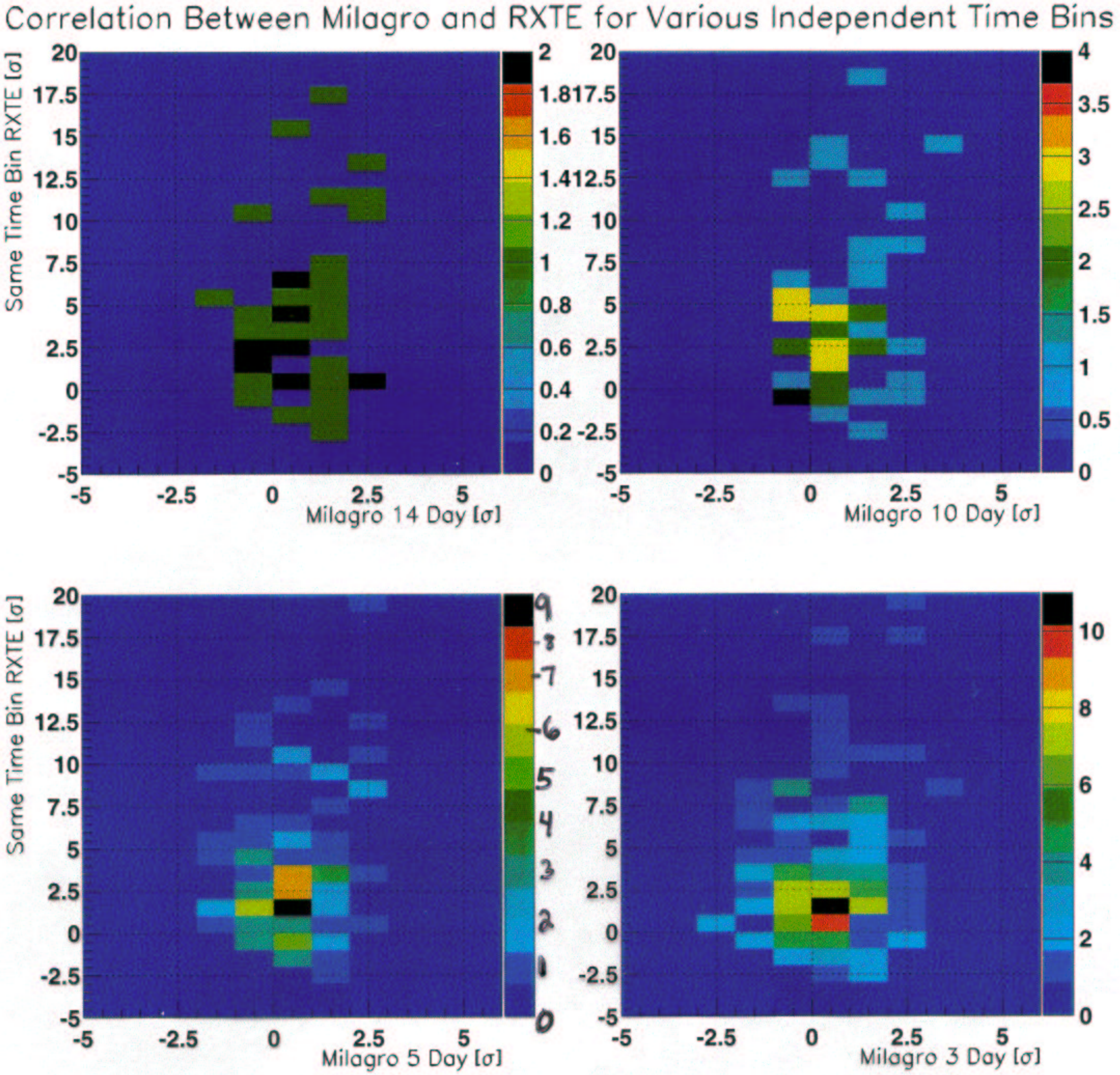


Rolling Significances for Mrk 421 (Various Time Scales)



Correlation Between Milagro and RXTE for Various Time Bins

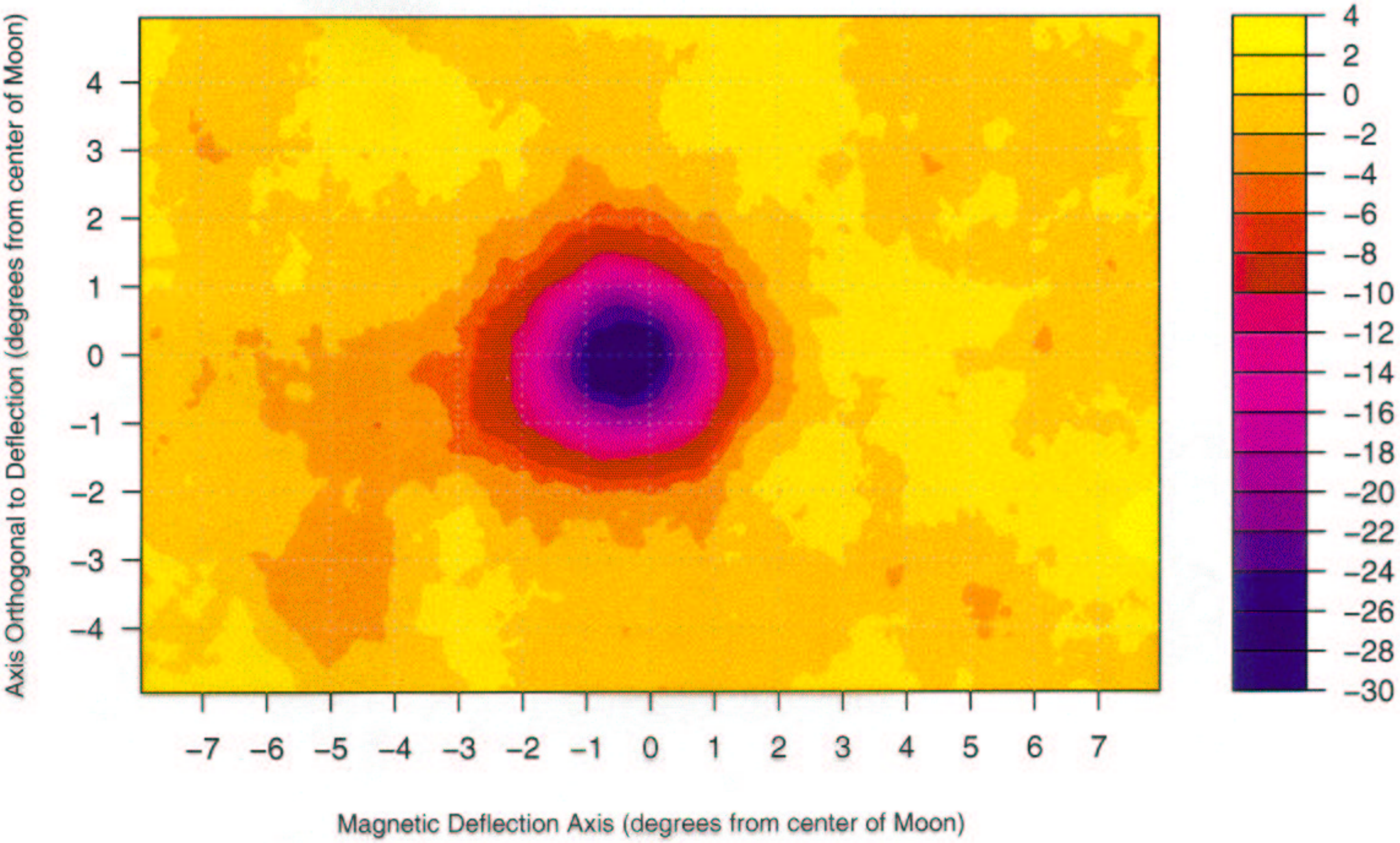

Correlation Between Milagro and RXTE for Various Independent Time Bins

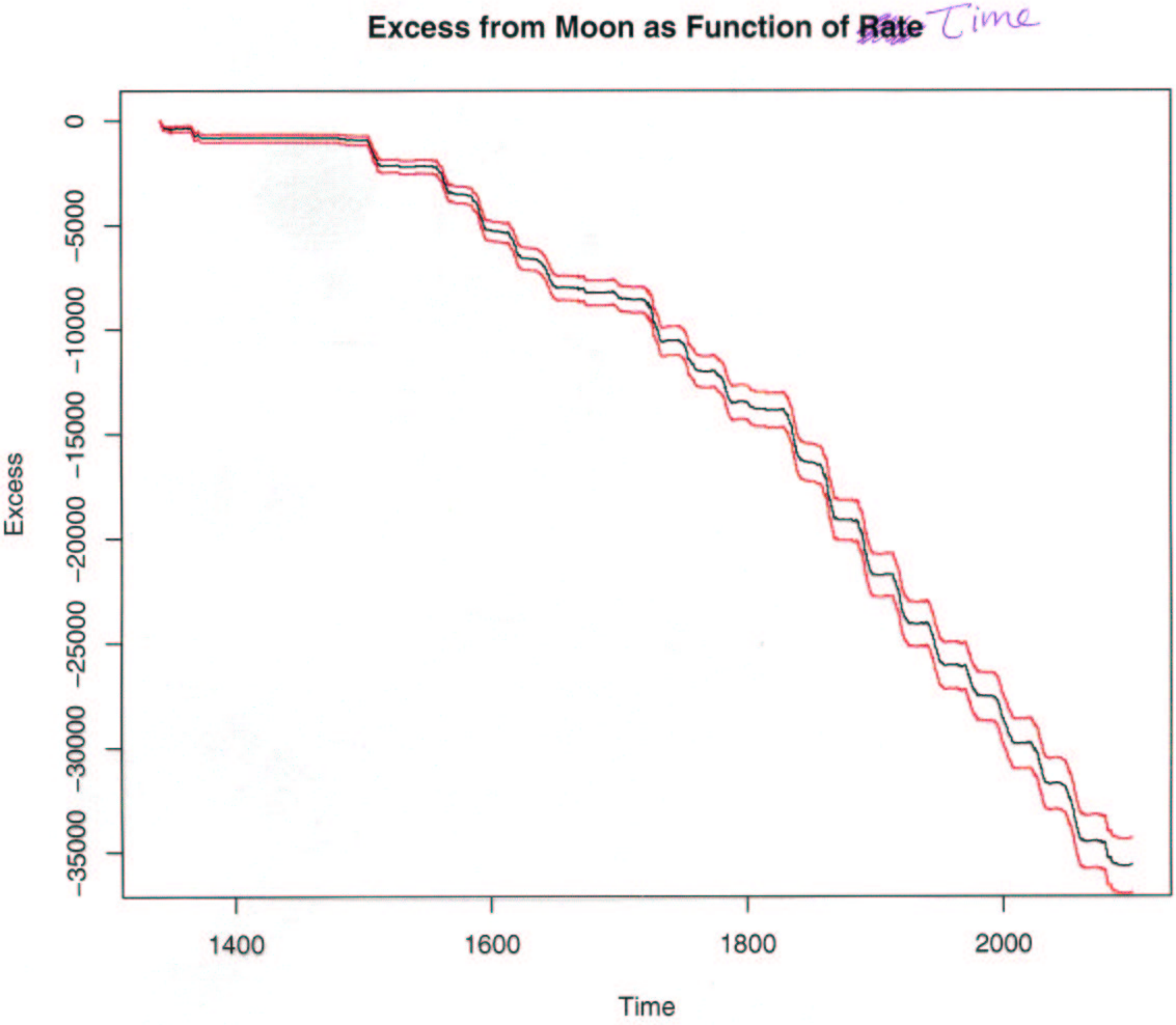


Correlation Between Milagro and RXTE for Various Independent Time Bins

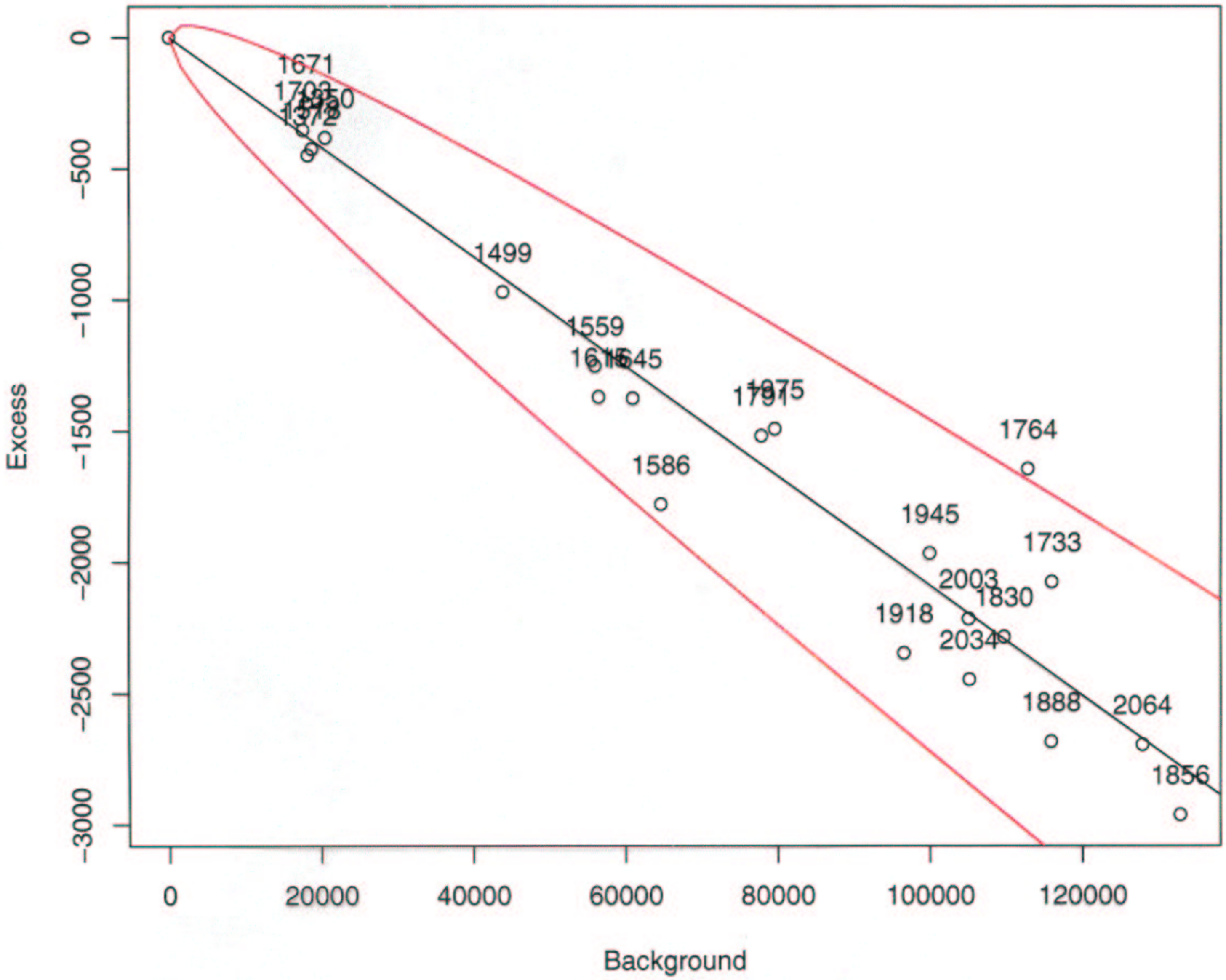
Nominal Coordinates	**Name**	**Class**	**z**	**Excess**	**Sig. σ**	**N90**
1101+384	Mrk 421	XBL	0.031	5989 ± 1244	4.8 σ	7583
1652+398	Mrk 501	XBL	0.034	1587 ± 1250	1.3 σ	3264
1426+428	1ES	XBL	0.129	-473 ± 1229	-0.4 σ	1754
2344+514	1ES	XBL	0.044	1589 ± 1115	1.4 σ	3068
0033+595	1ES	XBL	0.086	-775 ± 932	-0.8 σ	1134
0110+418	RGB	XBL	0.096	1115 ± 1244	0.9 σ	2851
0152+017	RGB	XBL	0.080	399 ± 518	0.8 σ	1134
0153+712	RGB	XBL	0.022	-468 ± 626	-0.7 σ	785
0214+517	RGB	XBL	0.049	141 ± 1111	0.1 σ	1915
0314+247	RGB	XBL	0.054	-501 ± 1112	-0.5 σ	1550
0656+426	RGB	XBL	0.059	-1388 ± 1234	-1.1 σ	1357
1133+704	Mrk 180	XBL	0.046	-139 ± 652	-0.2 σ	990
1532+302	RGB	XBL	0.064	-1240 ± 1198	-1.0 σ	1358
1610+671	RGB	XBL	0.067	1099 ± 737	1.5 σ	2074
1727+502	I Zw 187	XBL	0.055	-511 ± 1138	-0.4 σ	1586
1741+196	1ES	XBL	0.083	1956 ± 1001	2.0 σ	3254
1959+650	1ES	XBL	0.048	213 ± 793	0.3 σ	1443
2321+419	1ES	XBL	0.059	-1341 ± 1241	-1.1 σ	1386
2322+346	RGB	XBL	0.098	2404 ± 1246	1.9 σ	4020
0010+106	III Zw 2	FSRQ	0.090	718 ± 775	0.9 σ	1795
0138+398	B2	FSRQ	0.080	-1570 ± 1252	-1.3 σ	1320
0321+33	B2	FSRQ	0.062	54 ± 1239	0.04 σ	2071
1413+436	RGB	FSRQ	0.090	387 ± 1221	0.3 σ	2261
2209+184	PG	FSRQ	0.070	1271 ± 980	1.3 σ	2583
1219+285	W Comae	RBL	0.102	15 ± 1165	0.01 σ	1924
1807+698	3C371	RBL	0.051	112 ± 665	0.2 σ	1166
2200+420	BL Lac	RBL	0.069	987 ± 1240	0.8 σ	2740

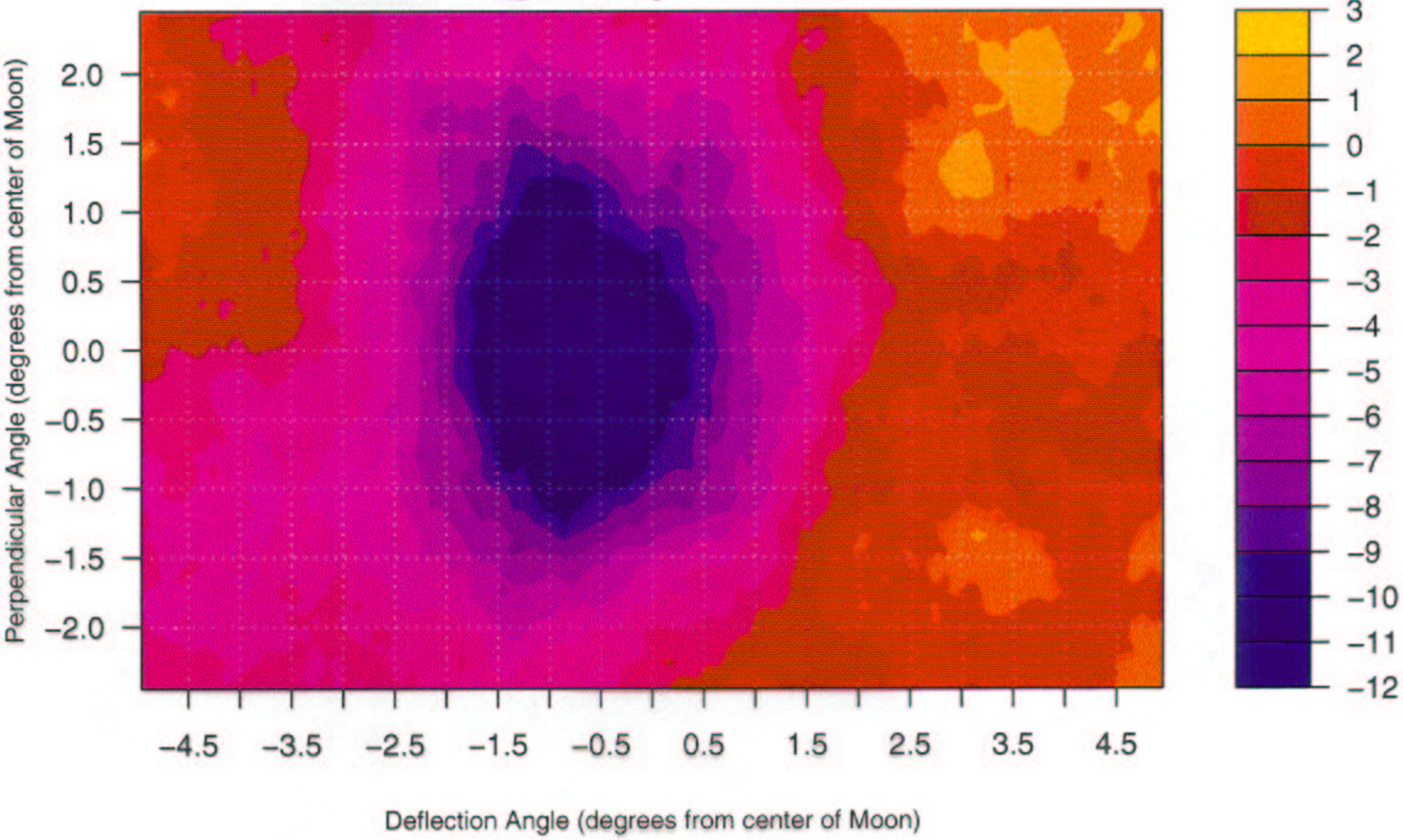
17 The Moon - Frank Samuelson


Axis Orthogonal to Deflection (degrees from center of Moon)
4
3
2
1
0
−1
−2
−3
−4
−7
−6
−5
−4
−3
−2
−1
0
1
2
3
4
5
6
7
Magnetic Deflection Axis (degrees from center of Moon)
4
2
0
−2
−4
−6
−8
−10
−12
−14
−16
−18
−20
−22
−24
−26
−28
−30



Excess from Moon as Function of ~~Rate~~ Time

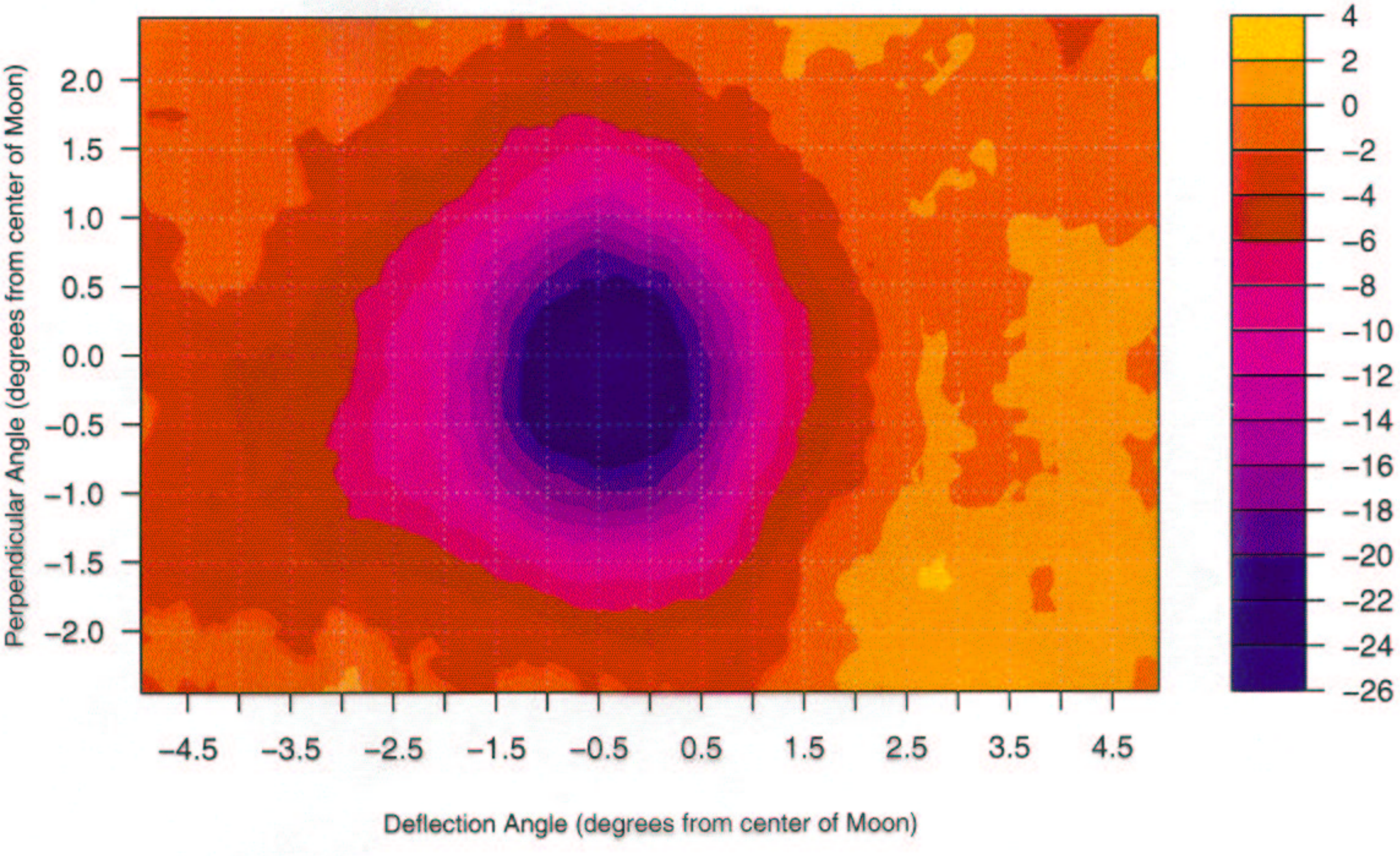

0
-500
-1000
-1500
-2000
-2500
-3000
Excess
0
20000
40000
60000
80000
100000
120000
Background
1671
1703
1850
1372
1499
1559
1615
1645
1975
1791
1764
1586
1945
1733
2003
1830
1918
2034
1888
2064
1856



Small Sizes

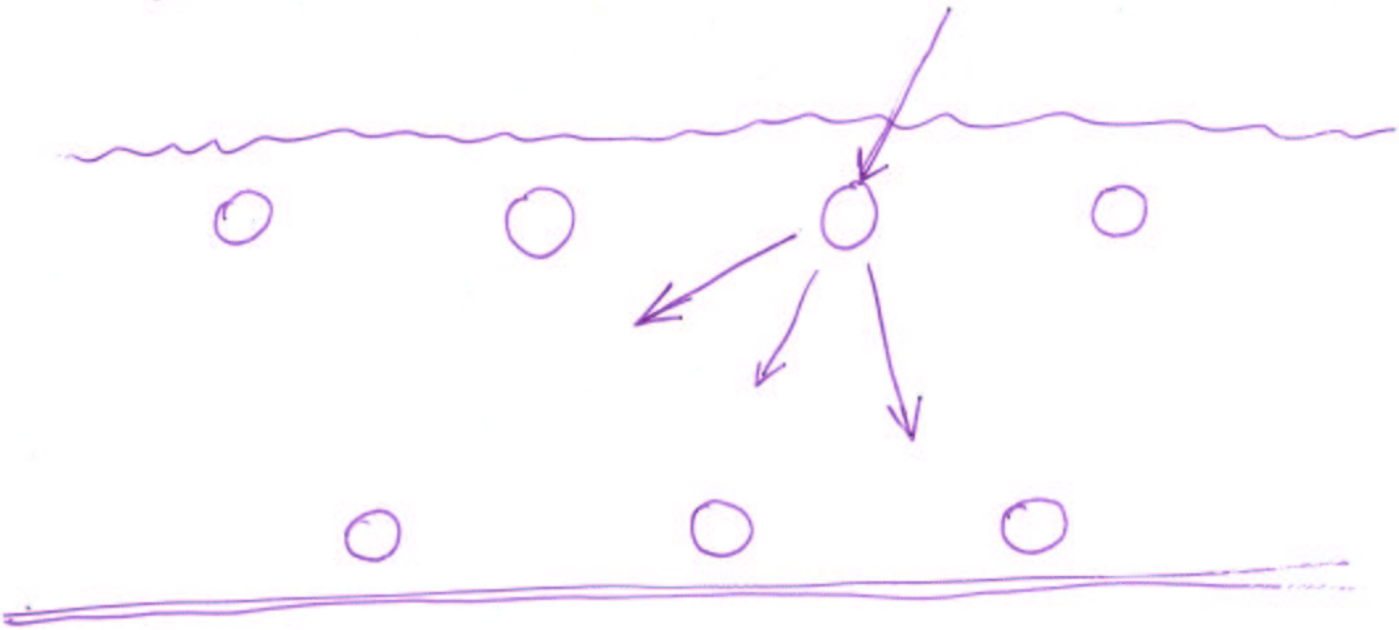
Perpendicular Angle (degrees from center of Moon)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−4.5
−3.5
−2.5
−1.5
−0.5
0.5
1.5
2.5
3.5
4.5
Deflection Angle (degrees from center of Moon)
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
−8
−9
−10
−11
−12

Large Sizes ($\sqrt{nhit \times npes}$)



18 Top Down Rejection - Frank Samuelson

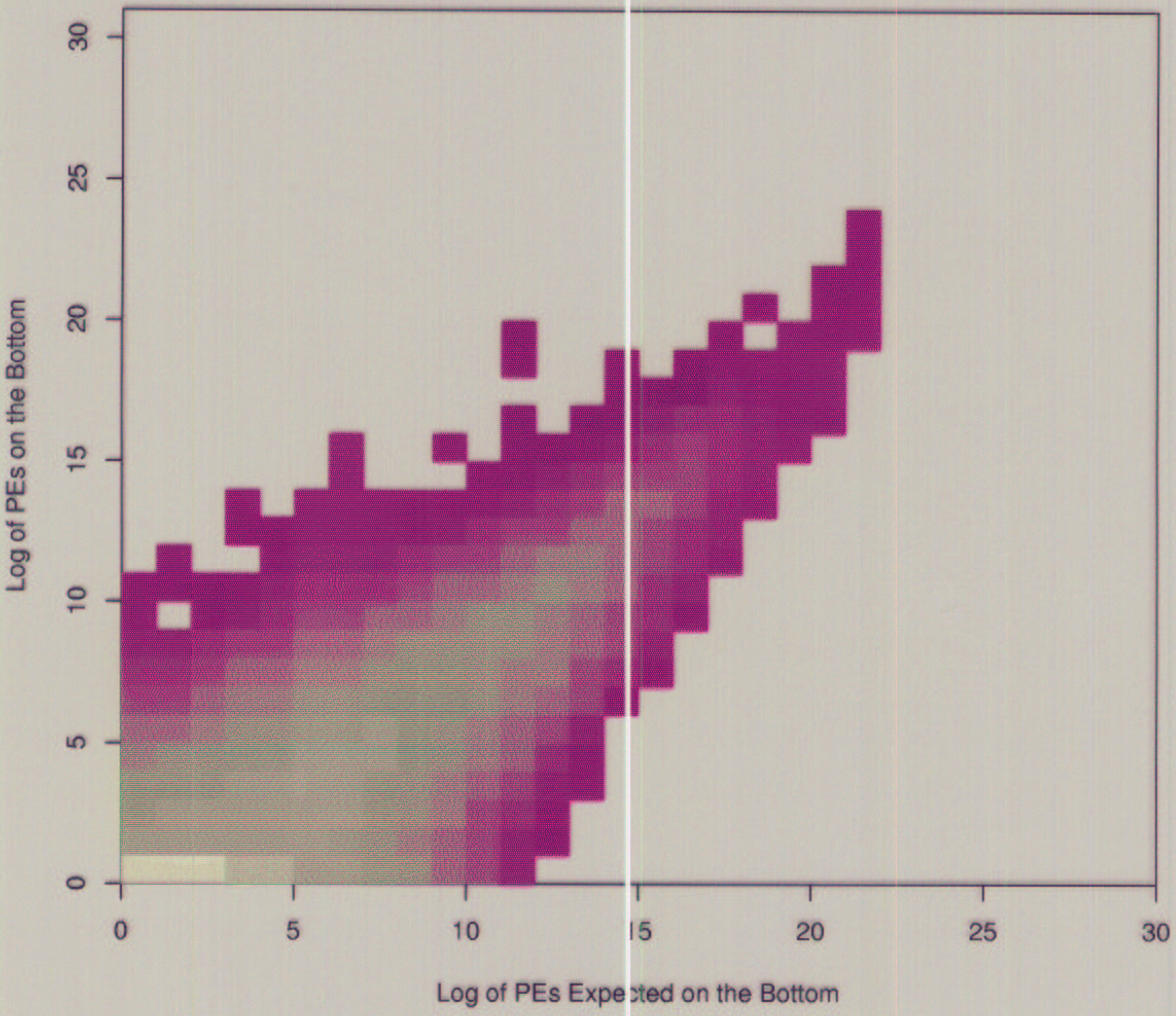
Top Bottom Comparison



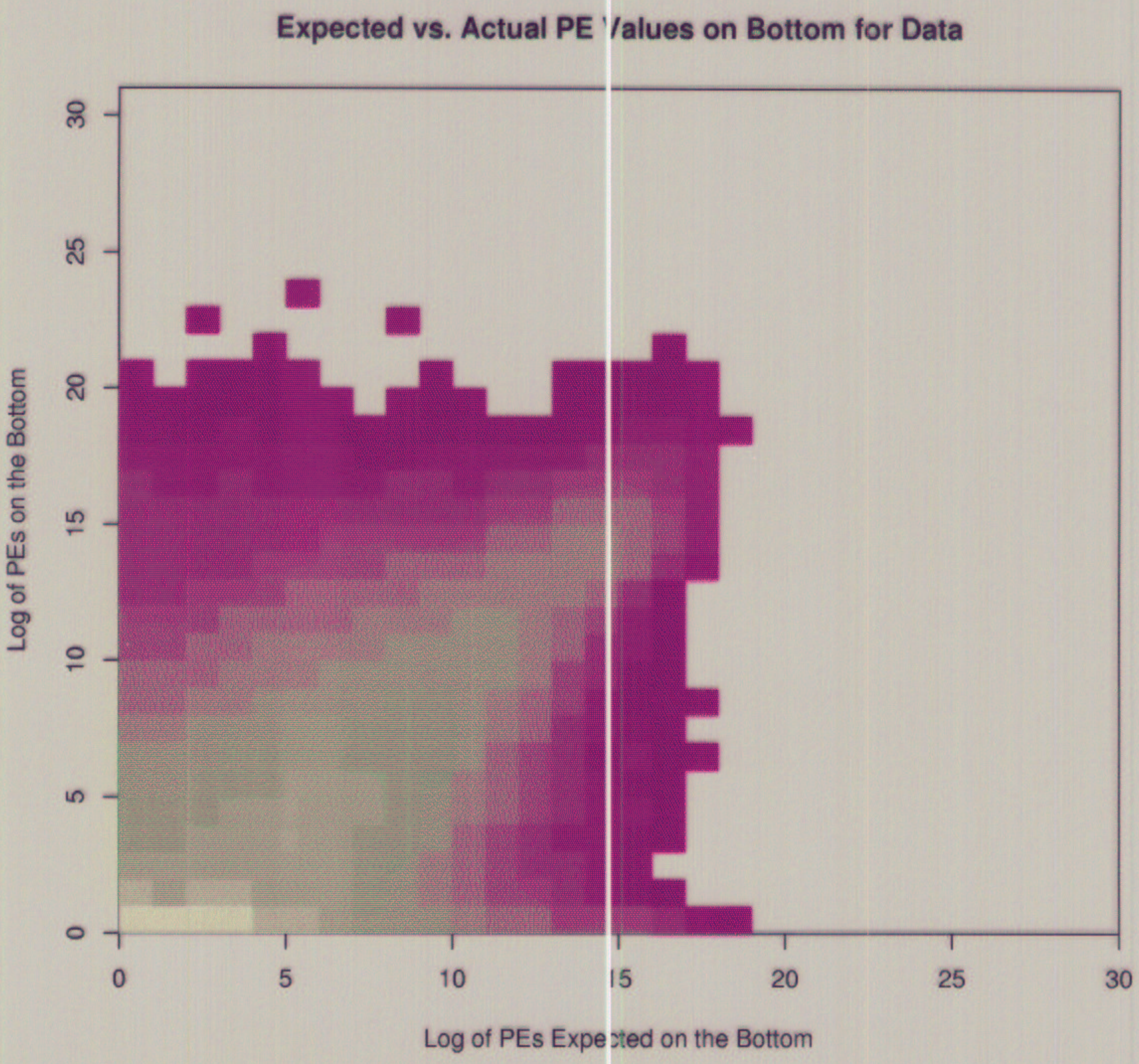
Estimate expected light on bottom by "propagating" light from top.

Convolve top by angle dependent point spread function to estimate bottom

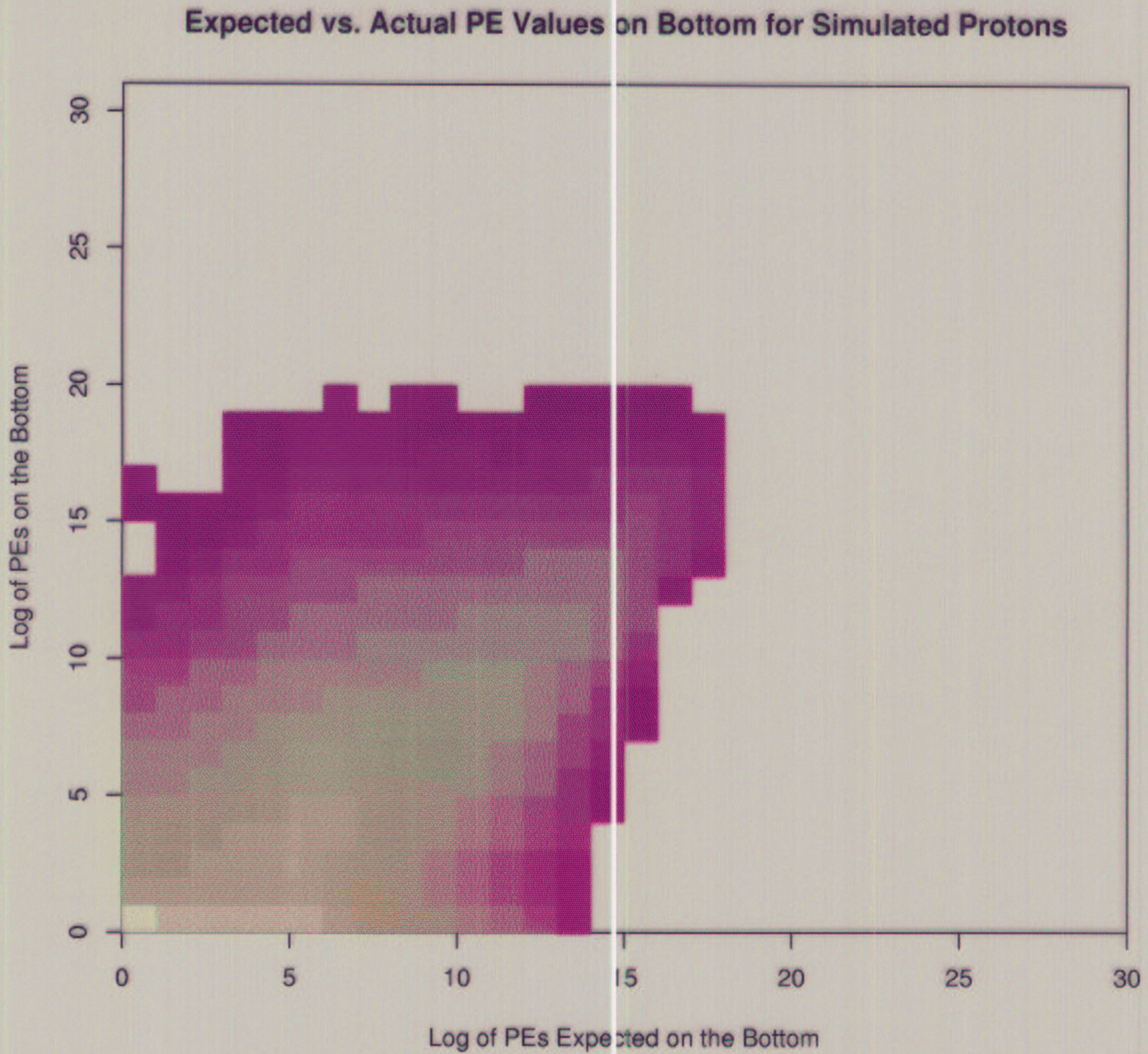
Compare estimated bottom with actual bottom.

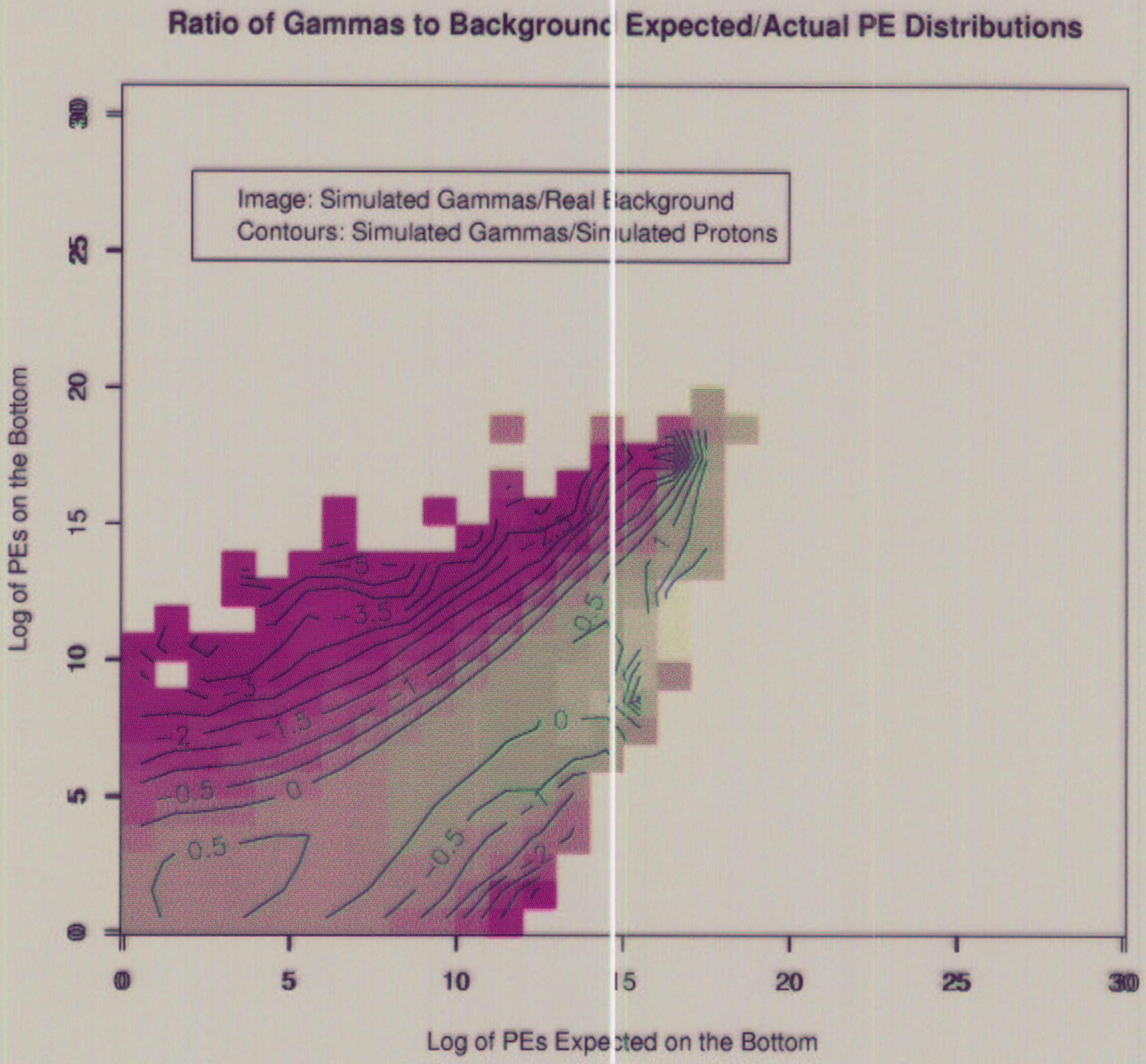


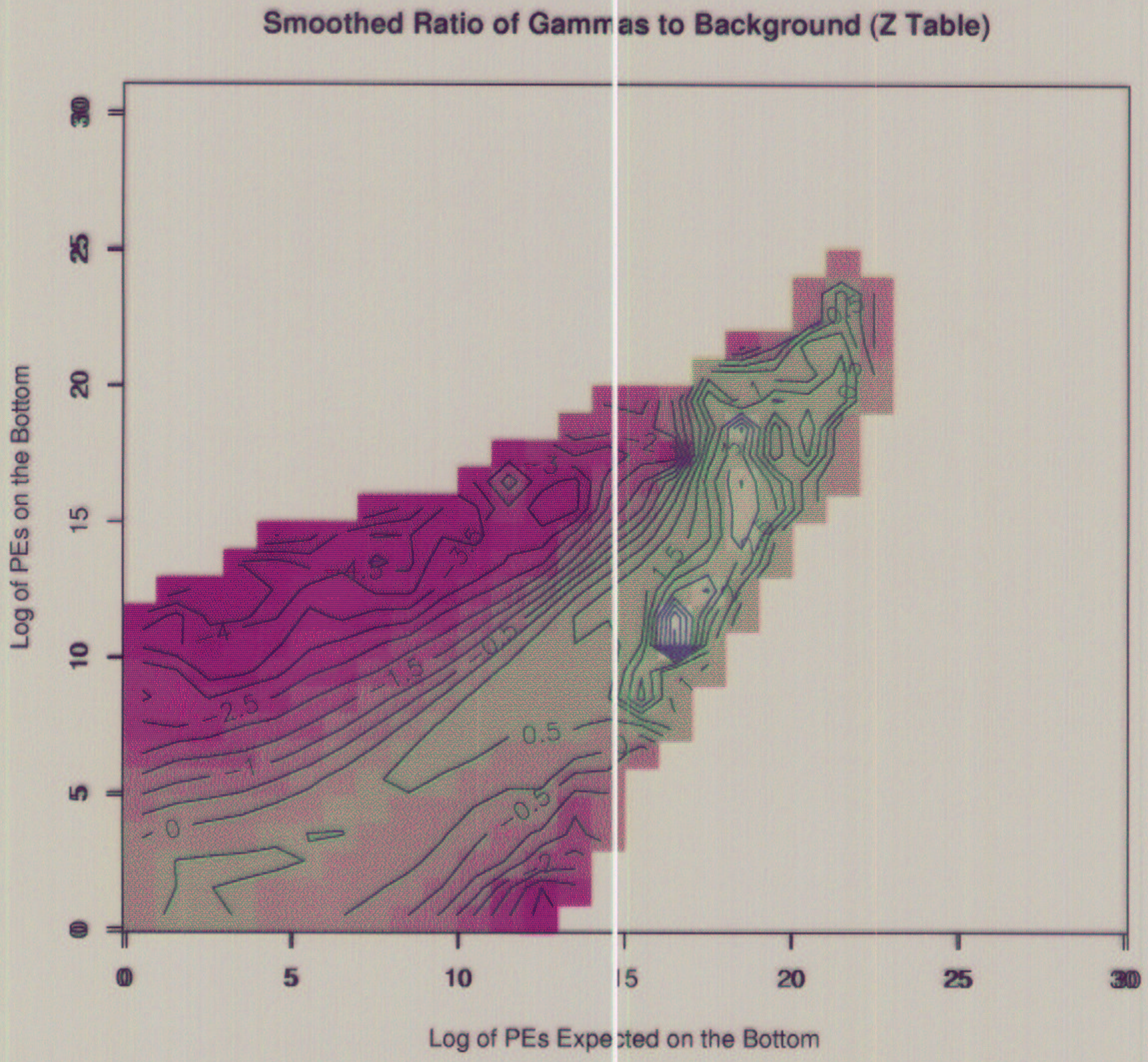
Expected vs. Actual PE Values on Bottom for Simulated Gammas

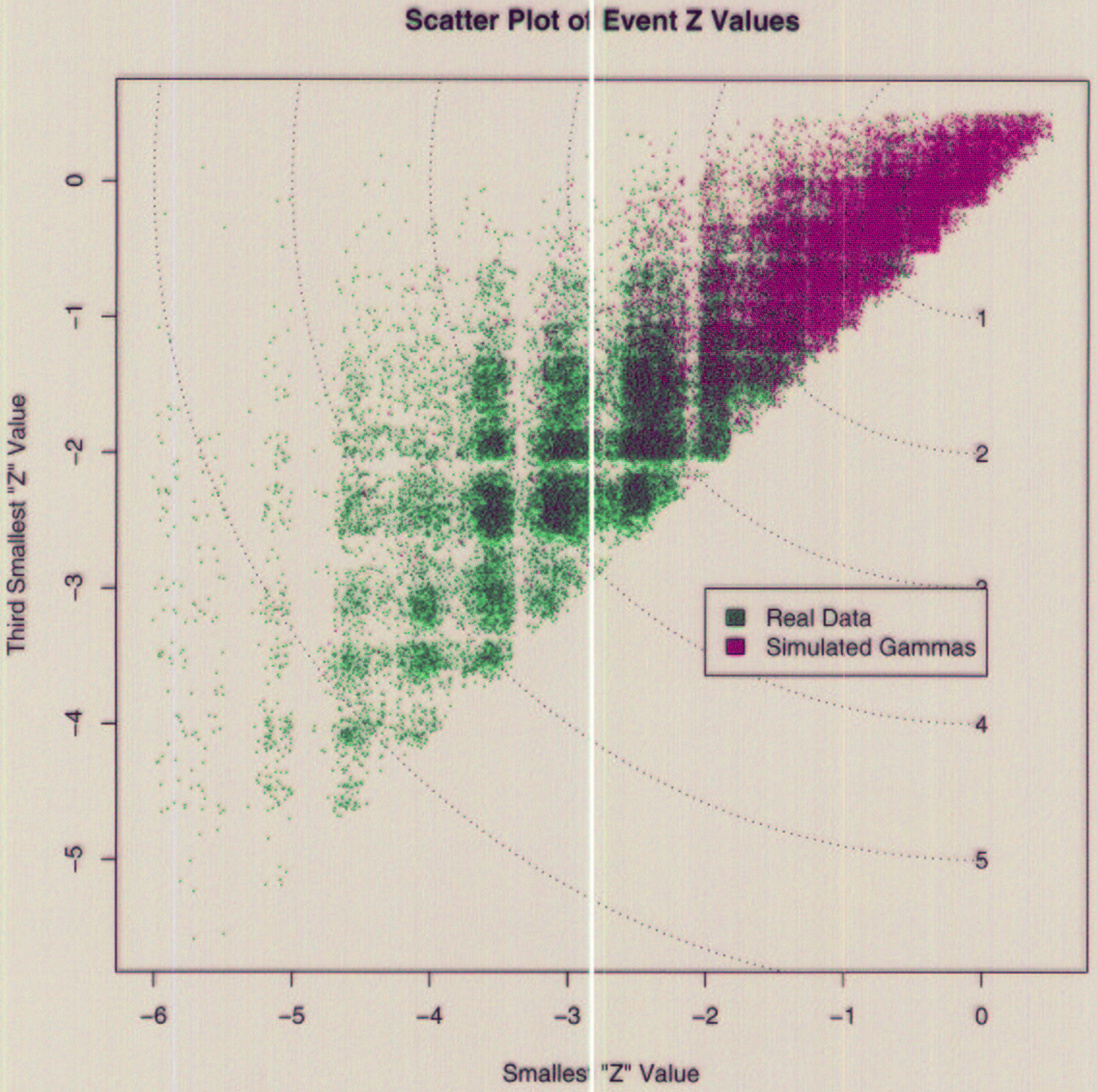


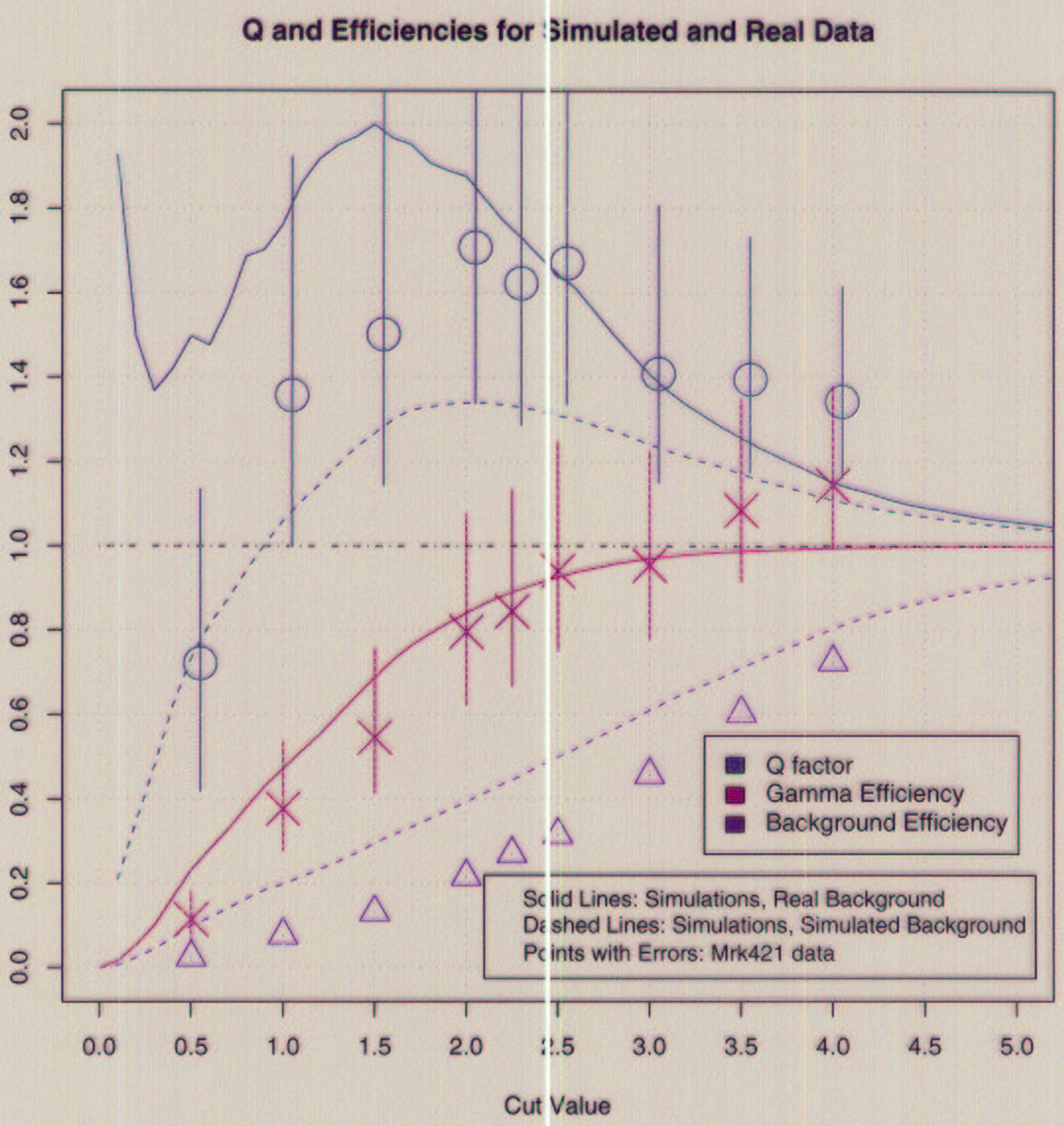
Expected vs. Actual PE Values on Bottom for Data
Log of PEs on the Bottom
Log of PEs Expected on the Bottom
0
5
10
15
20
25
30
0
5
10
15
20
25
30

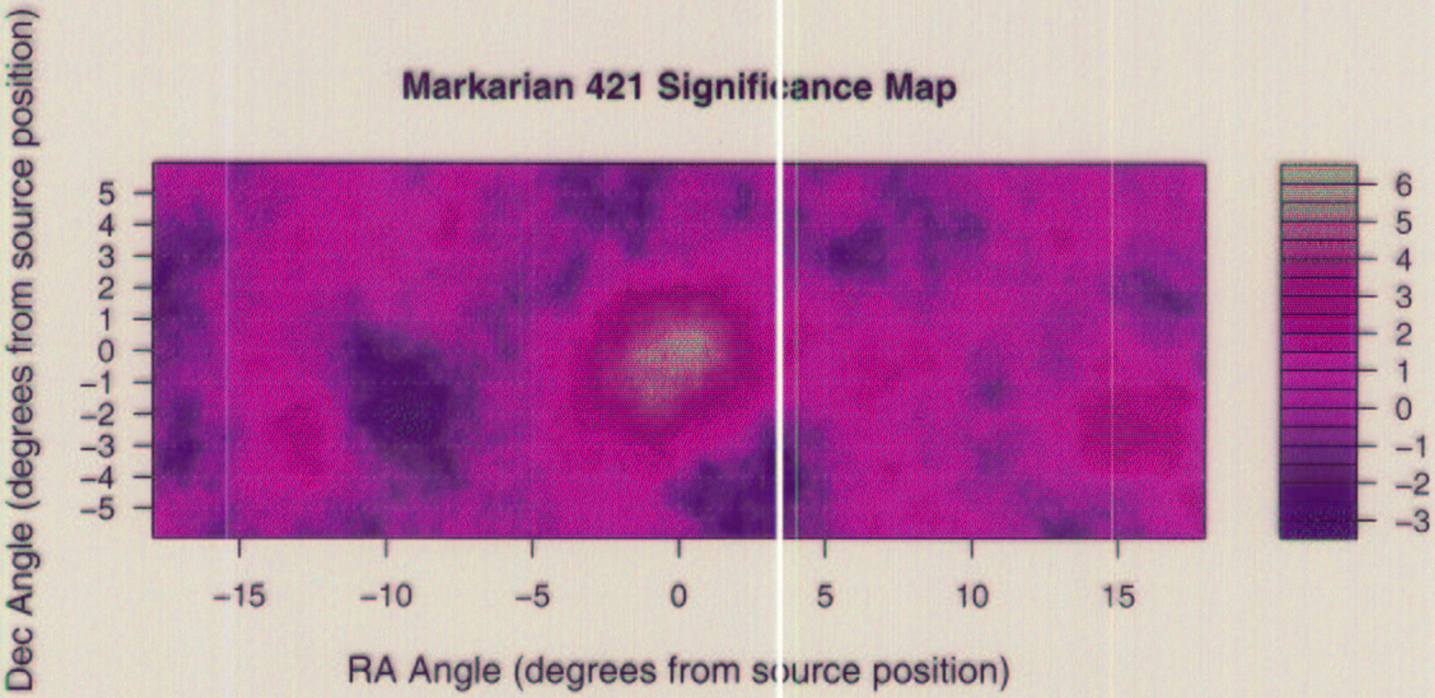

Expected vs. Actual PE Values on Bottom for Simulated Protons
Log of PEs on the Bottom
0
5
10
15
20
25
30
0
5
10
15
20
25
30
Log of PEs Expected on the Bottom

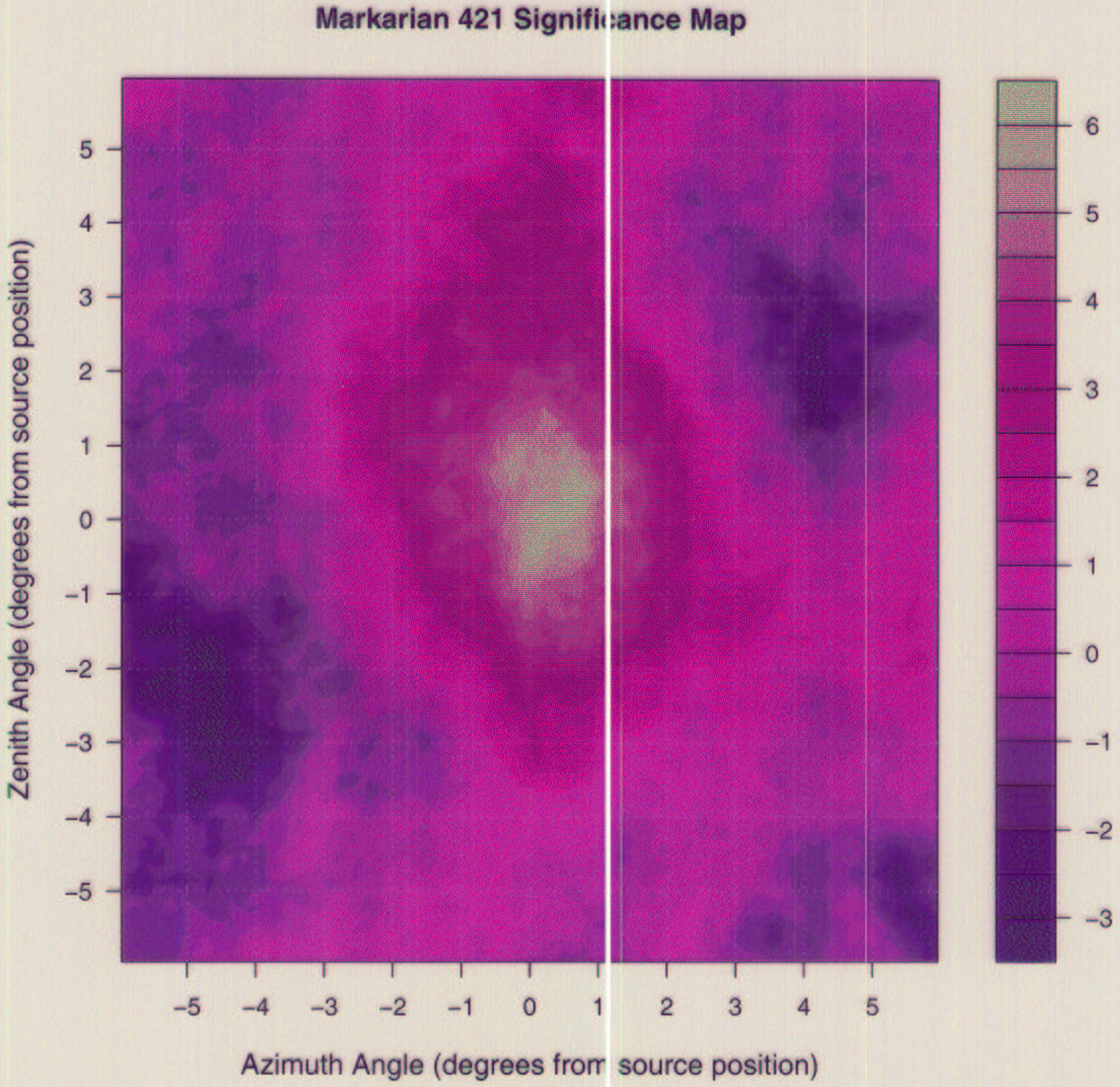
Ratio of Gammas to Background Expected/Actual PE Distributions
Image: Simulated Gammas/Real Background
Contours: Simulated Gammas/Simulated Protons
Log of PEs on the Bottom
Log of PEs Expected on the Bottom
0
5
10
15
20
25
30
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1


Smoothed Ratio of Gammas to Background (Z Table)
Log of PEs on the Bottom
Log of PEs Expected on the Bottom
0
5
10
15
20
25
30
-4.5
-4
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5


Scatter Plot of Event Z Values
Third Smallest "Z" Value
Smallest "Z" Value
0
−1
−2
−3
−4
−5
−6
−5
−4
−3
−2
−1
0
1
2
3
4
5
Real Data
Simulated Gammas


Q and Efficiencies for Simulated and Real Data
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Cut Value
Q factor
Gamma Efficiency
Background Efficiency
Solid Lines: Simulations, Real Background
Dashed Lines: Simulations, Simulated Background
Points with Errors: Mrk421 data


Markarian 421 Significance Map
Dec Angle (degrees from source position)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-15
-10
-5
0
5
10
15
RA Angle (degrees from source position)
6
5
4
3
2
1
0
-1
-2
-3


Markarian 421 Significance Map
Zenith Angle (degrees from source position)
5
4
3
2
1
0
−1
−2
−3
−4
−5
Azimuth Angle (degrees from source position)
−5
−4
−3
−2
−1
0
1
2
3
4
5
6
5
4
3
2
1
0
−1
−2
−3

19 Neural Networks - Xian-Wu Xu

Very primitive result of Crab Nebula analyzed by ANN

Xianwu Xu

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1. Equi-zenith angle method (EZA).
2. Deficit significance of moon by EZA.
3. Excess significance of Crab Nebula by EZA.
4. Simulation and ANN method.
5. Excess significance of Crab Nebula by EZA+ANN.

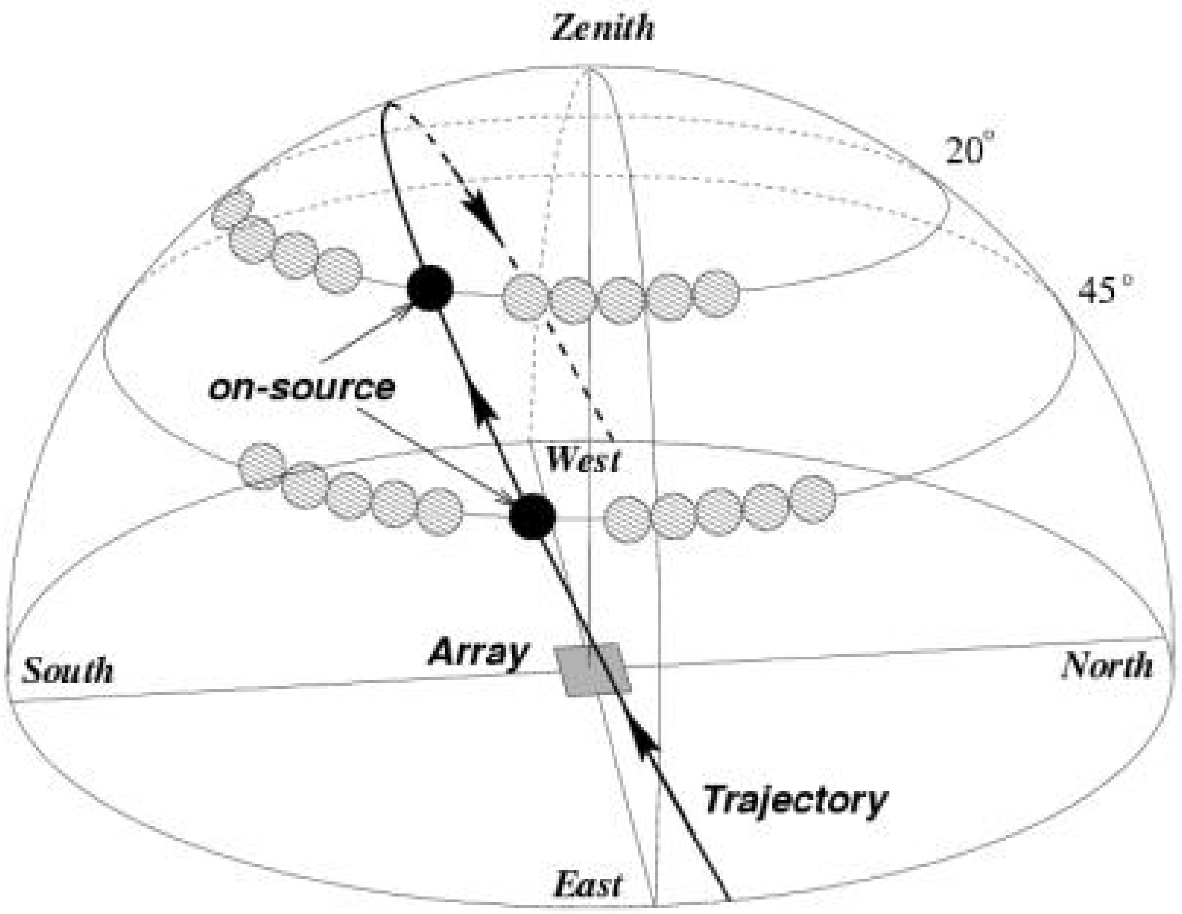
Very primitive result of Crab Nebula analyzed by ANN

Xianwu Xu

---

1. Equi-zenith angle method (EZA).
2. Deficit significance of moon by EZA.
3. Excess significance of Crab Nebula by EZA.
4. Simulation and ANN method.
5. Excess significance of Crab Nebula by EZA+ANN.

Equi-zenith angle method

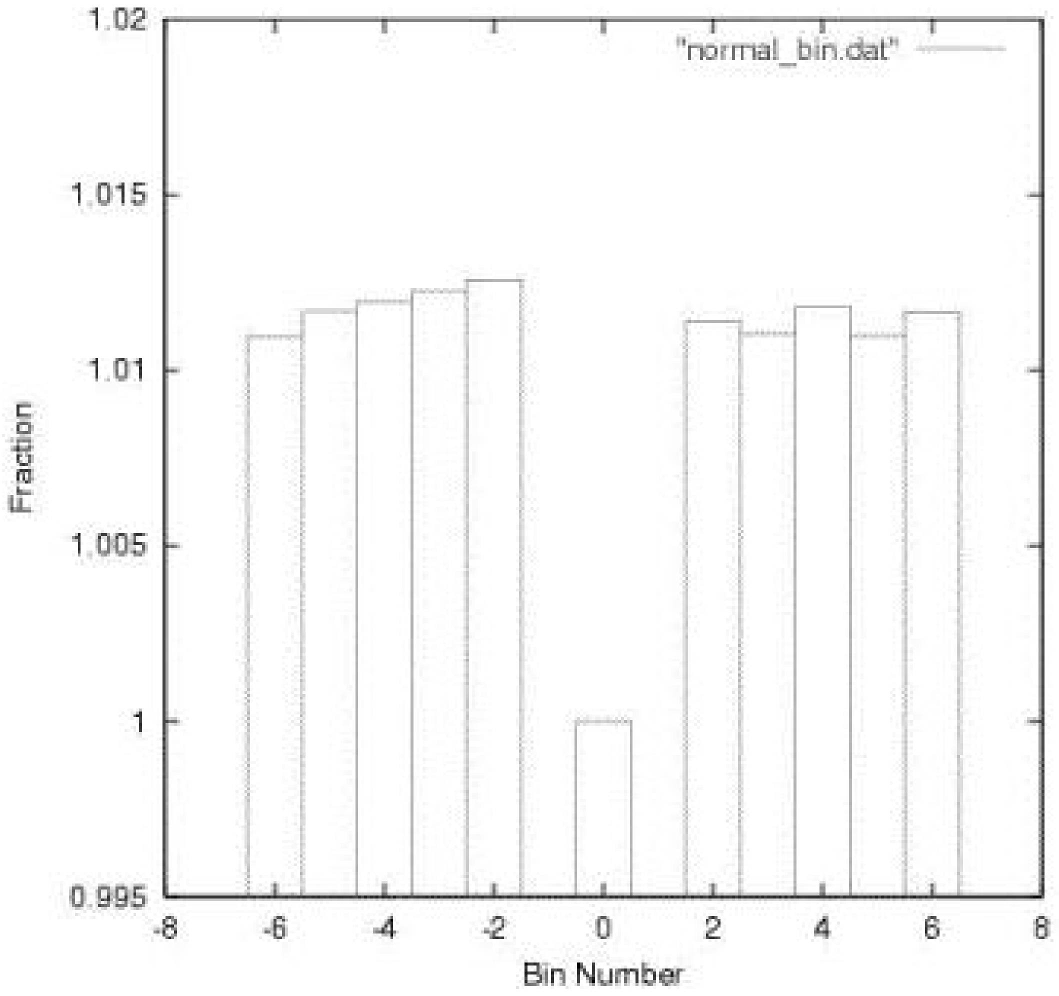


On-source and off-source

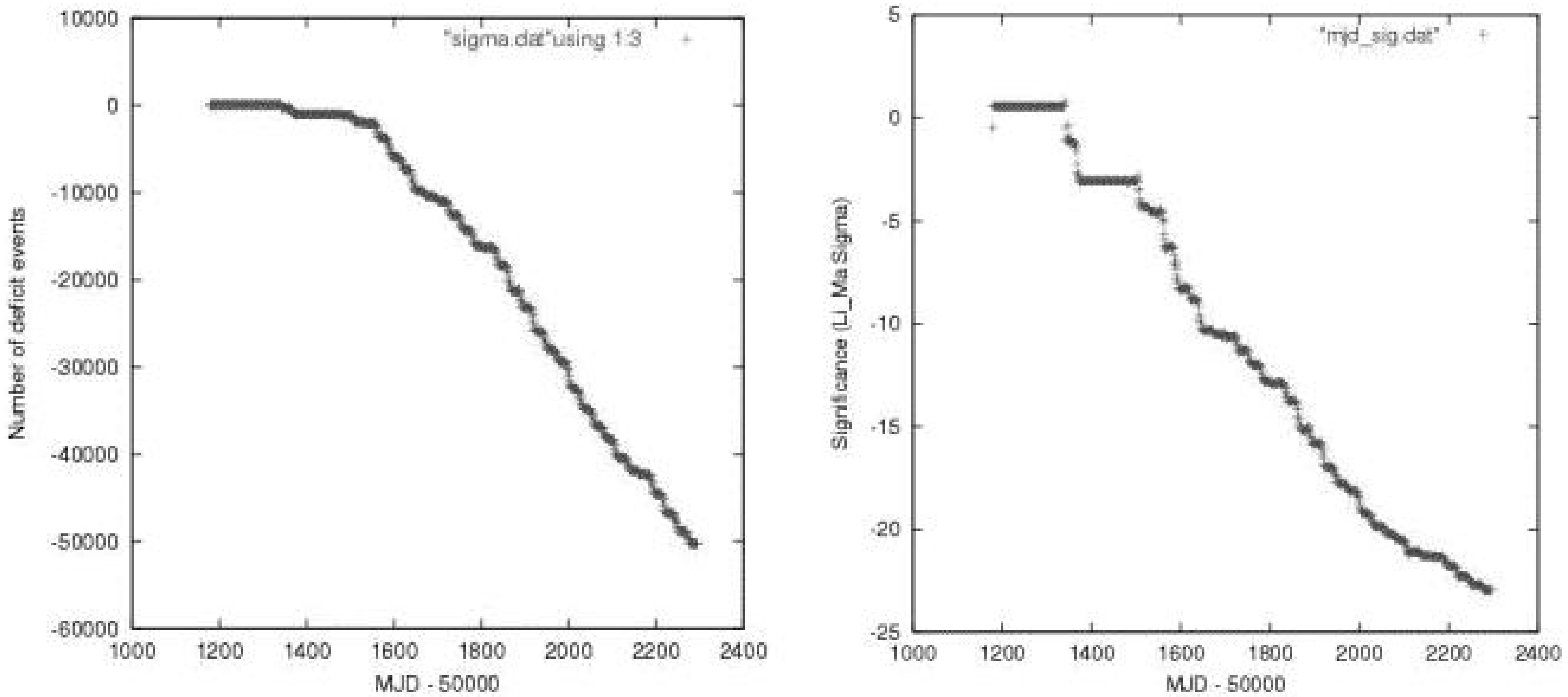
have
- same path length
- same exposure time
- same acceptance
- all events available

But
- azimuth correction
- minimum zenith

Horizontal coordinate system



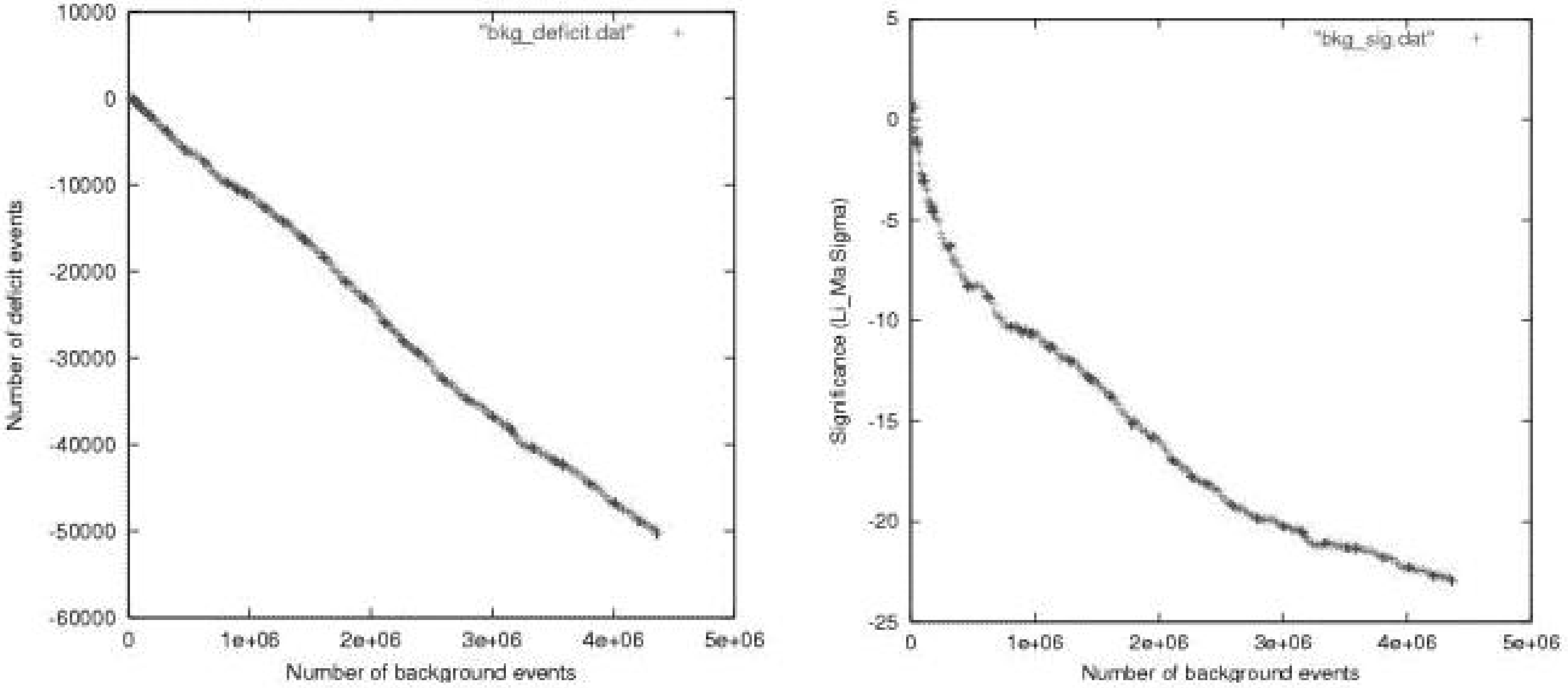
Number of events in each bin



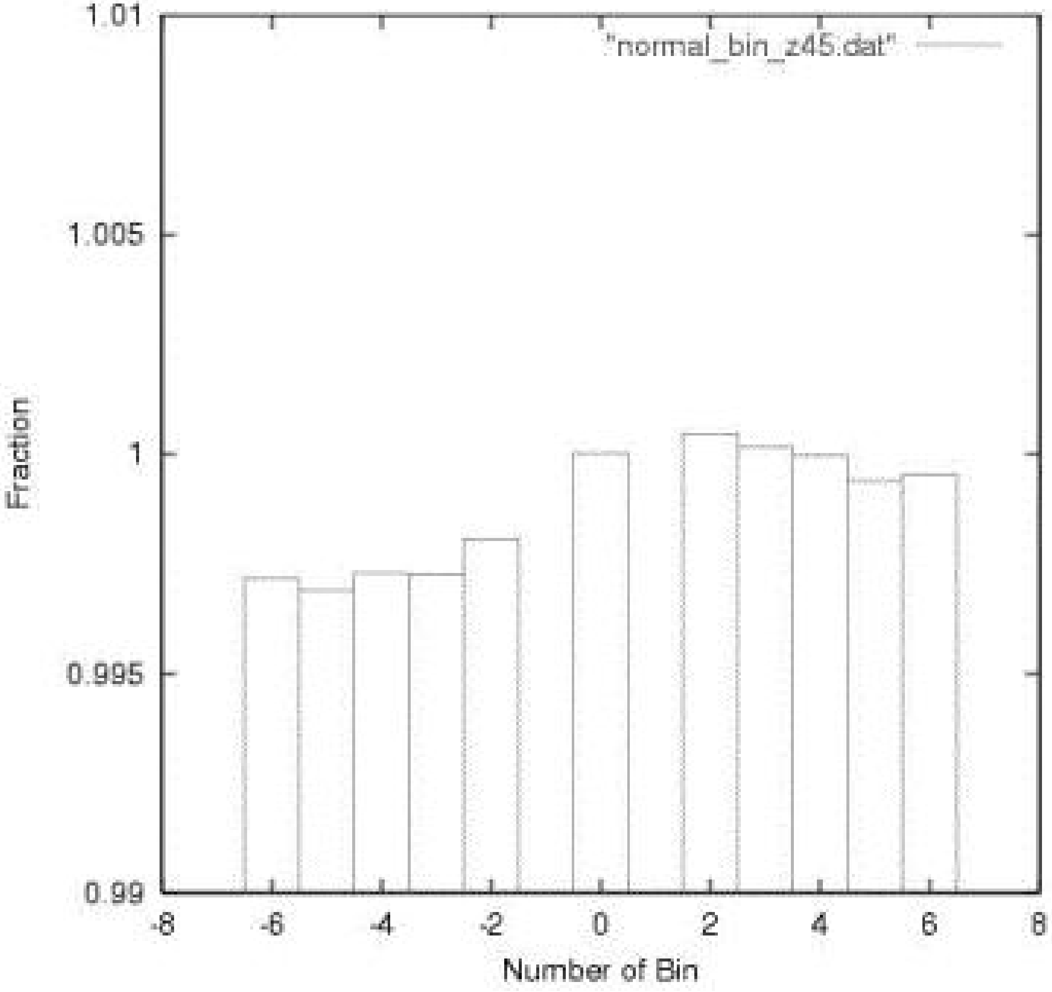
1200=>Jan. 22, 99

2000=>April 1, 2000

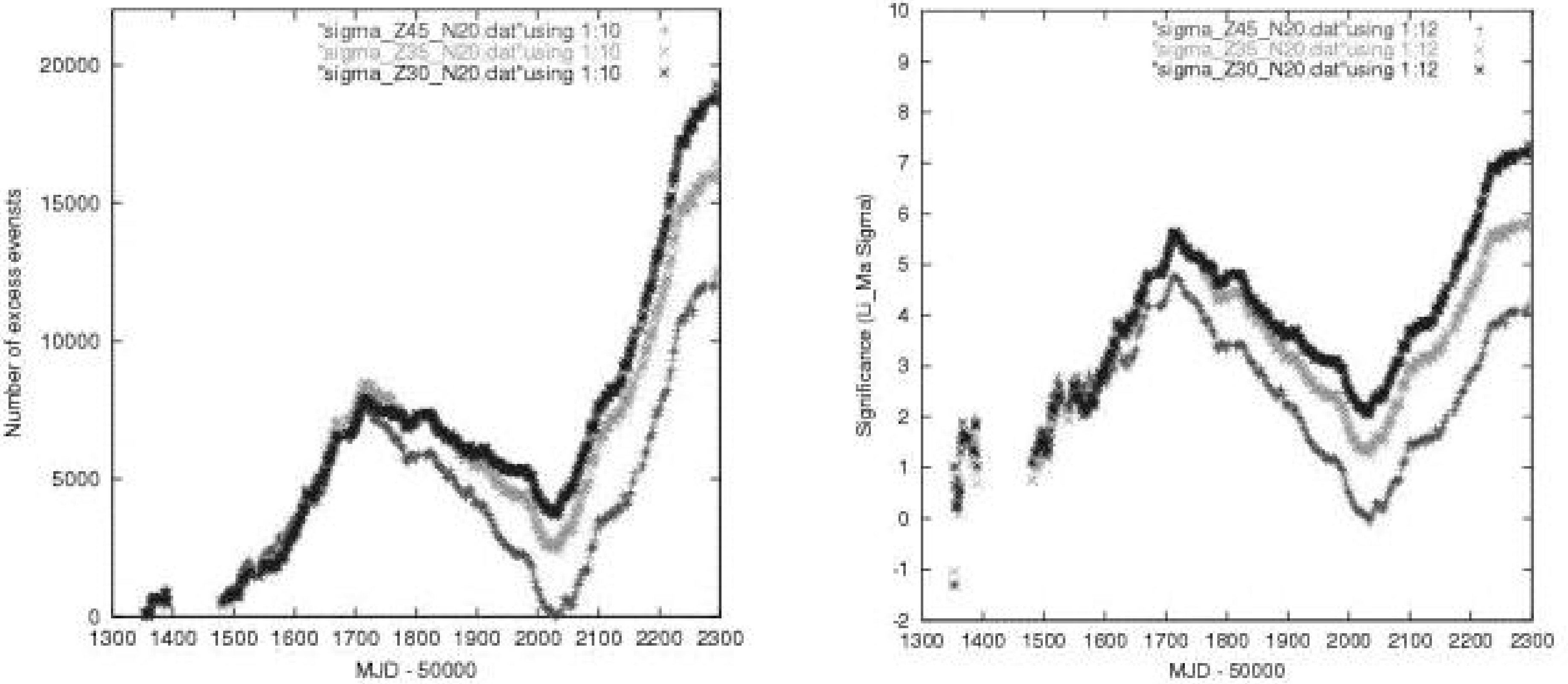
Accumulative number of events and significance vs. MJD



Accumulative number of events and significance vs. number of background events

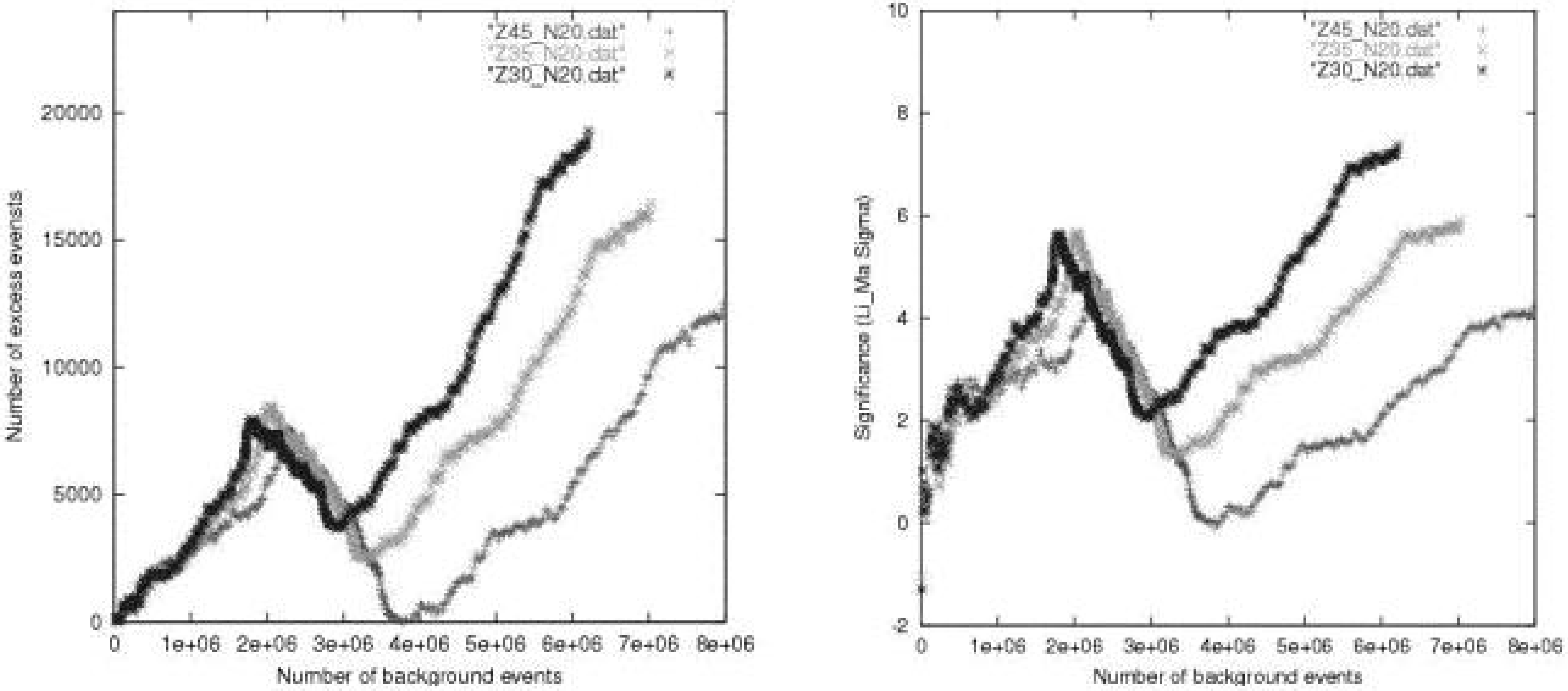


Number of events in each bin

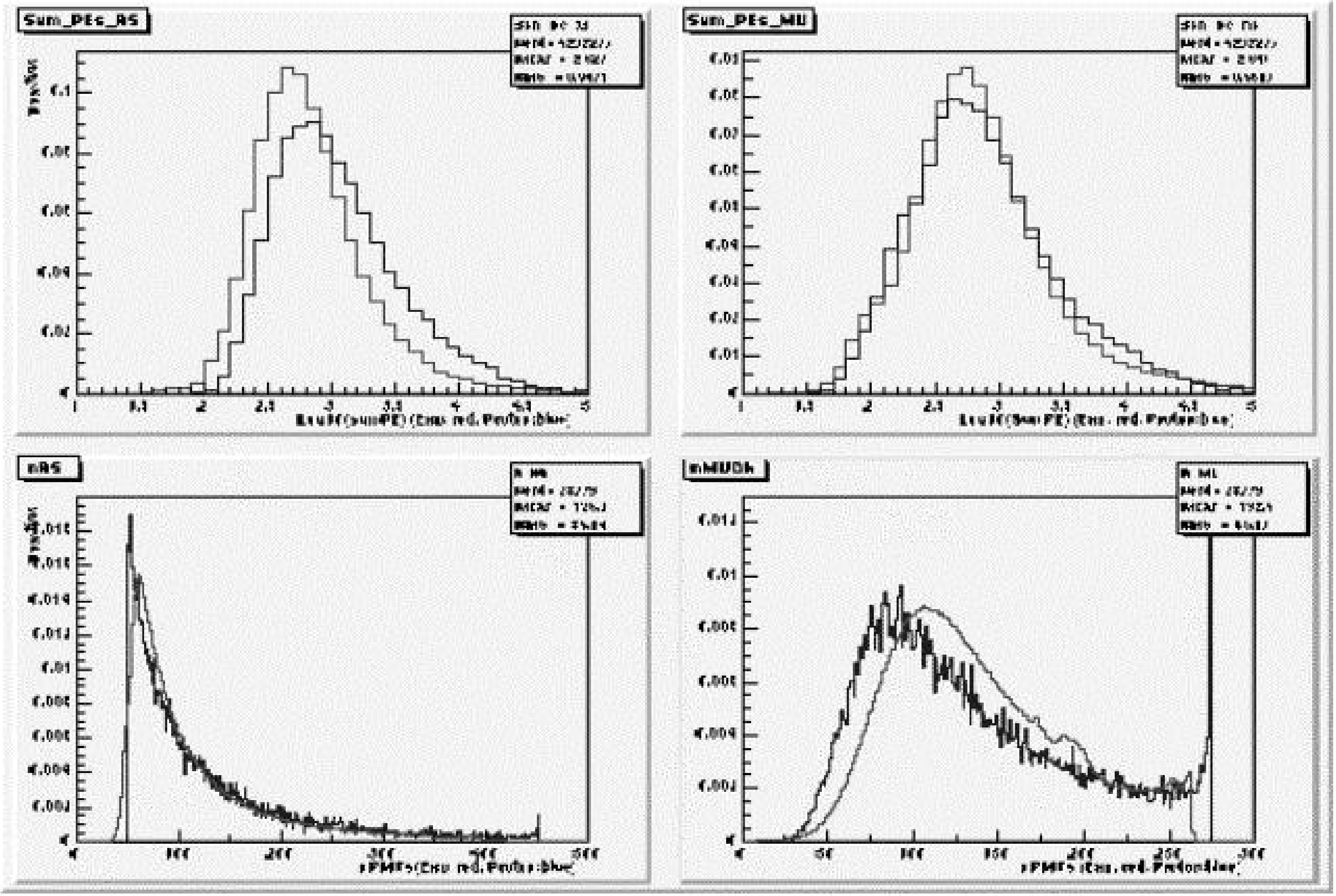


1700=>June 5, 2000
2000=>April 1, 2001

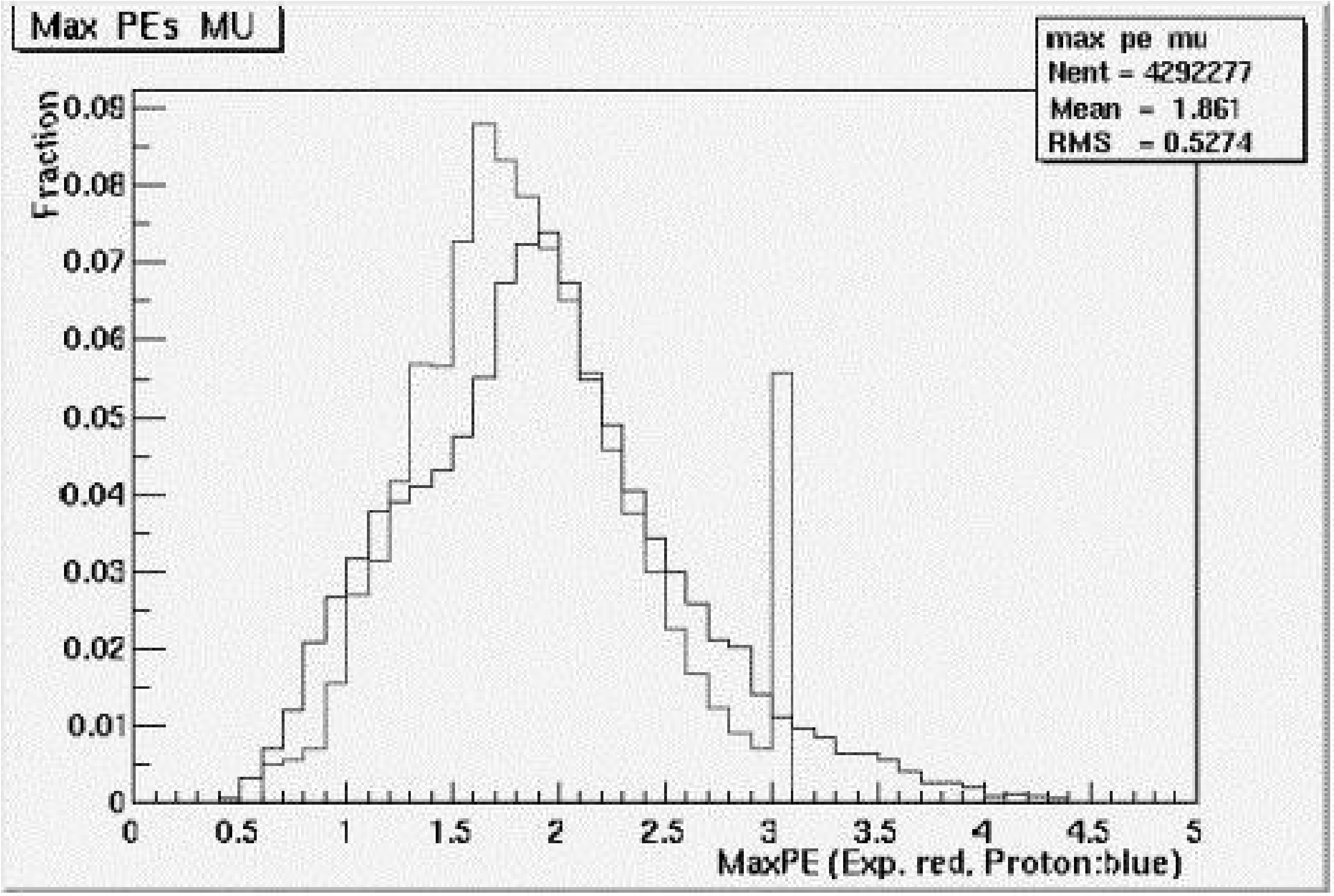
Accumulative number of events and significance vs. MJD



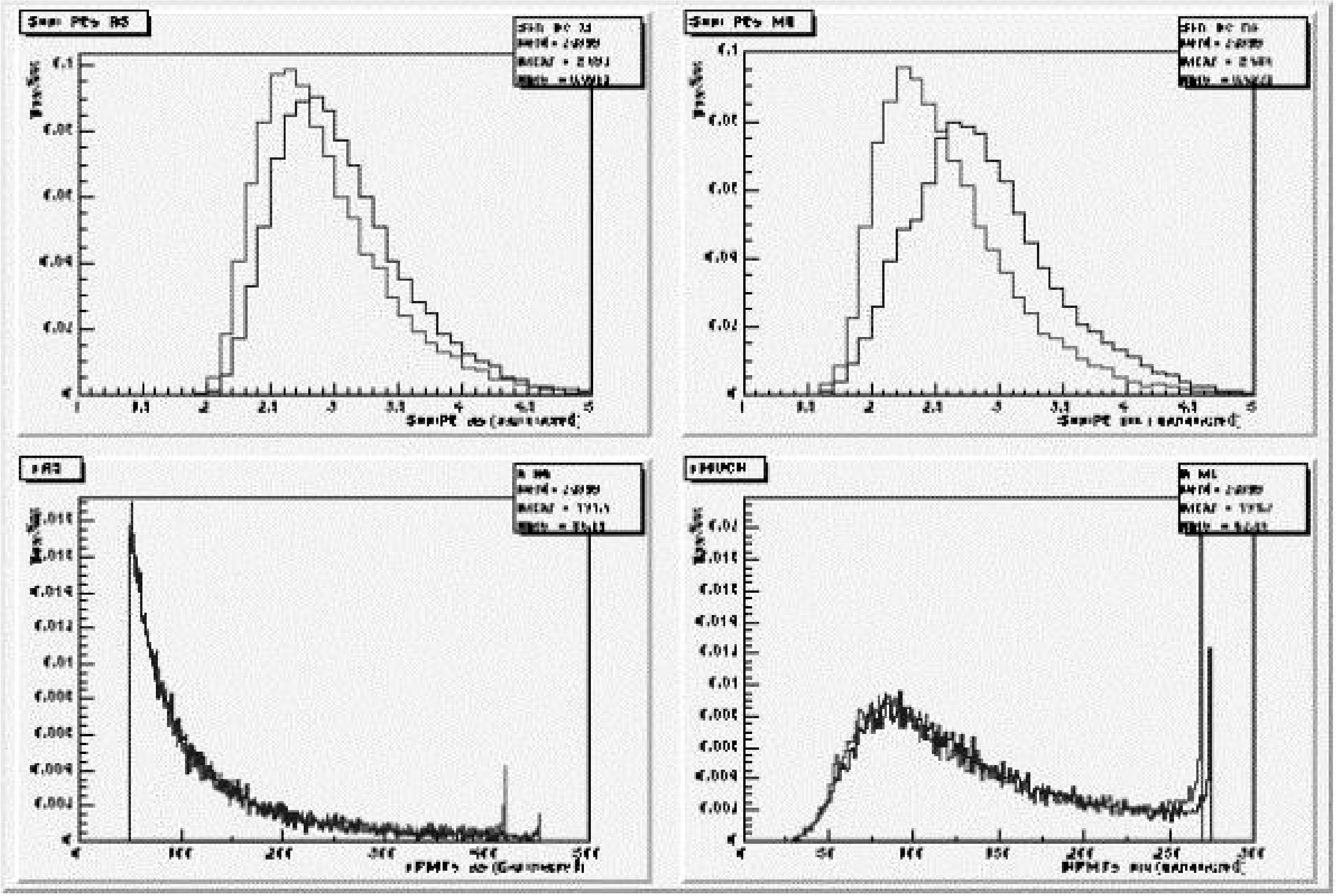
Accumulative number of events and significance vs. number of background events



Comparison between Milagro data and Simulation

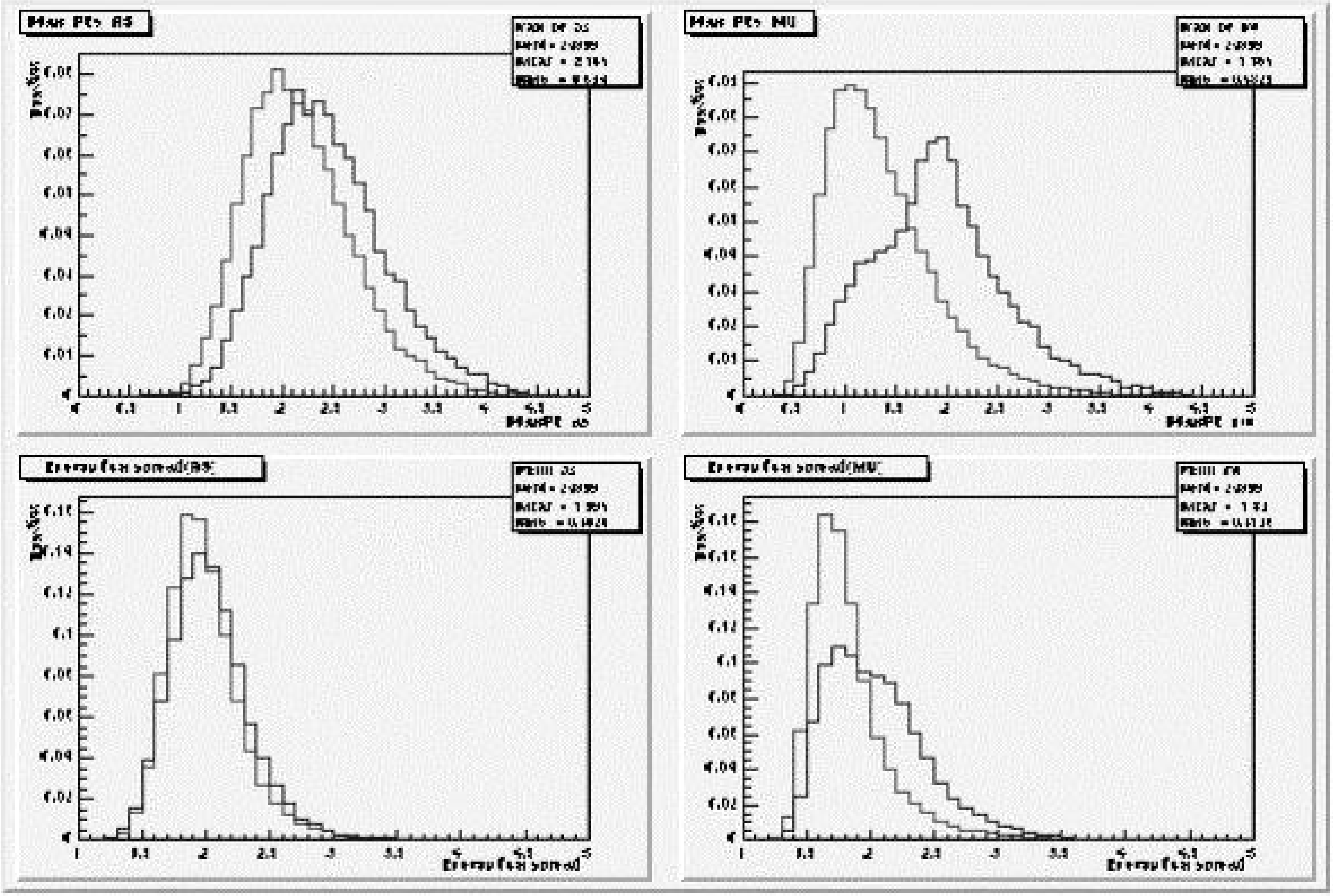


Comparison between Milagro data and Simulation



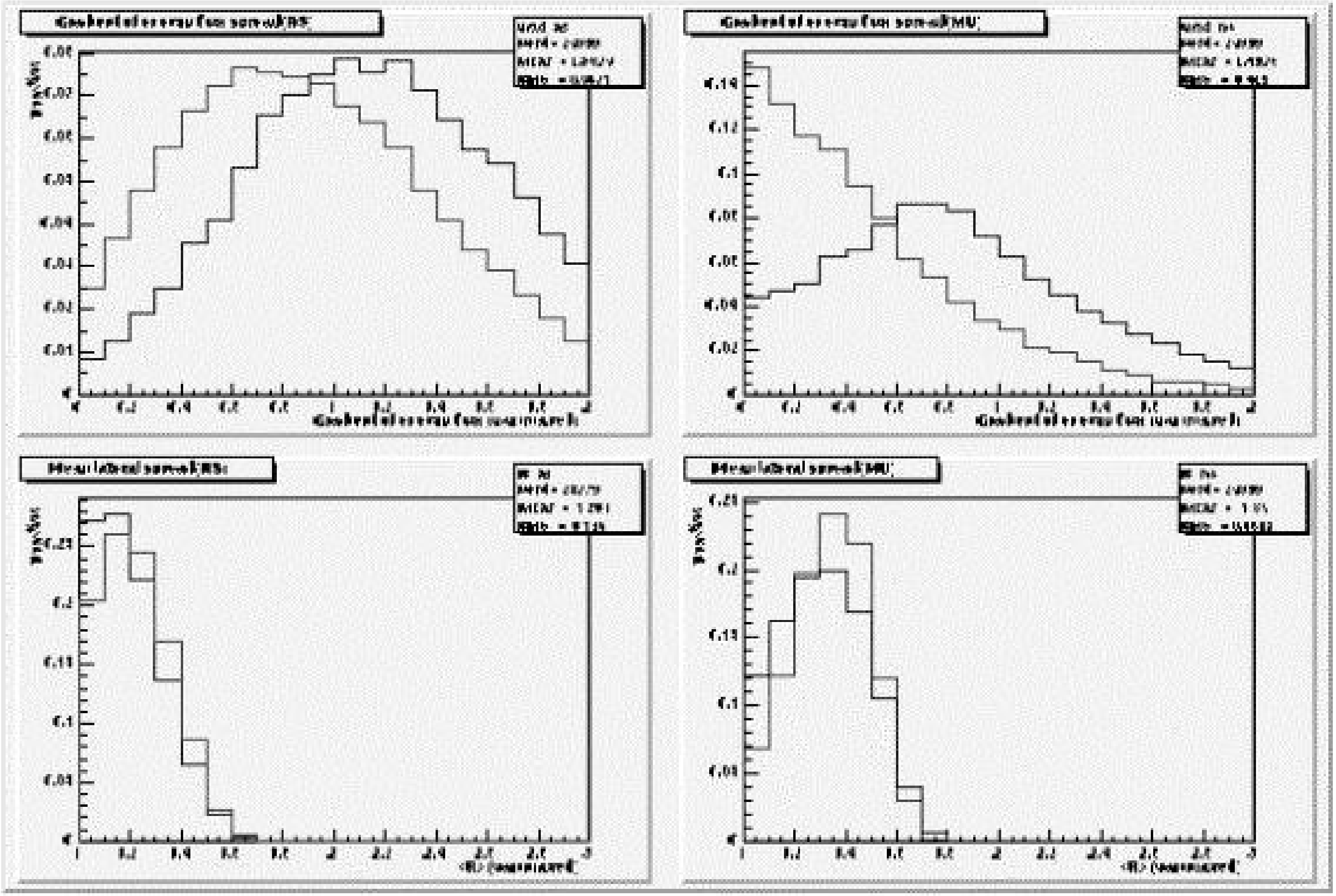
SumPEs(AS, MU), nPMTs(AS,MU)

Candidate Parameters



MaxPEs(AS,MU), <PExR>(AS,MU)

Candidate Parameters

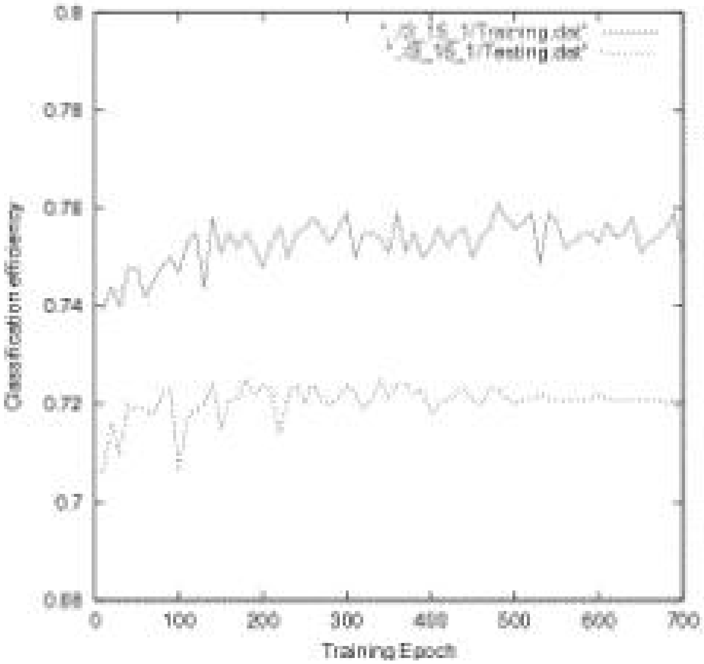


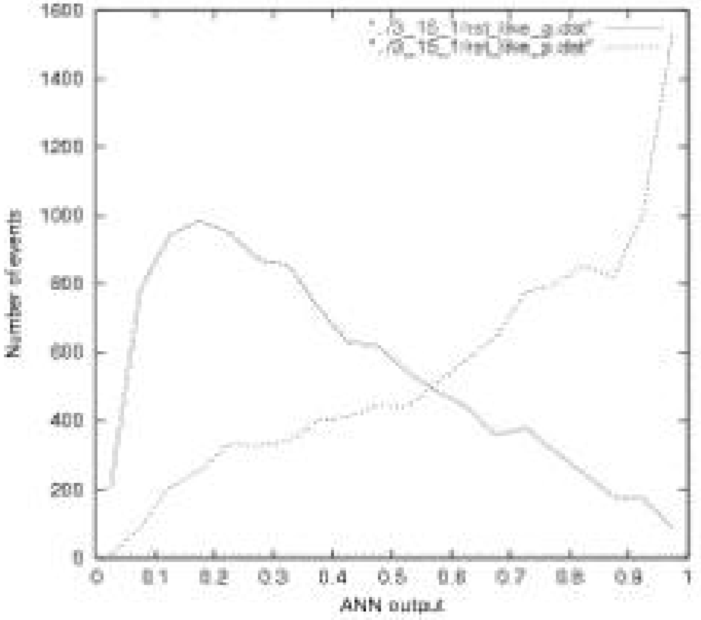
<Gradient of energy flux spread>(AS,MU), <R>(AS,MU)

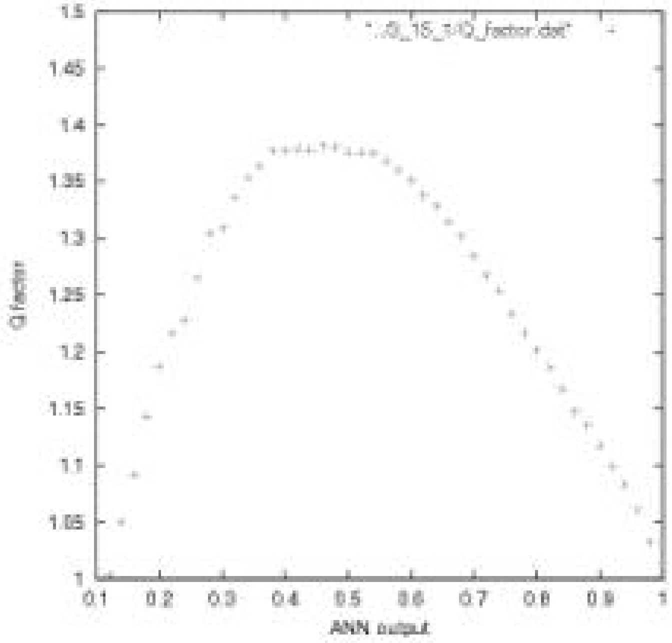
Candidate Parameters

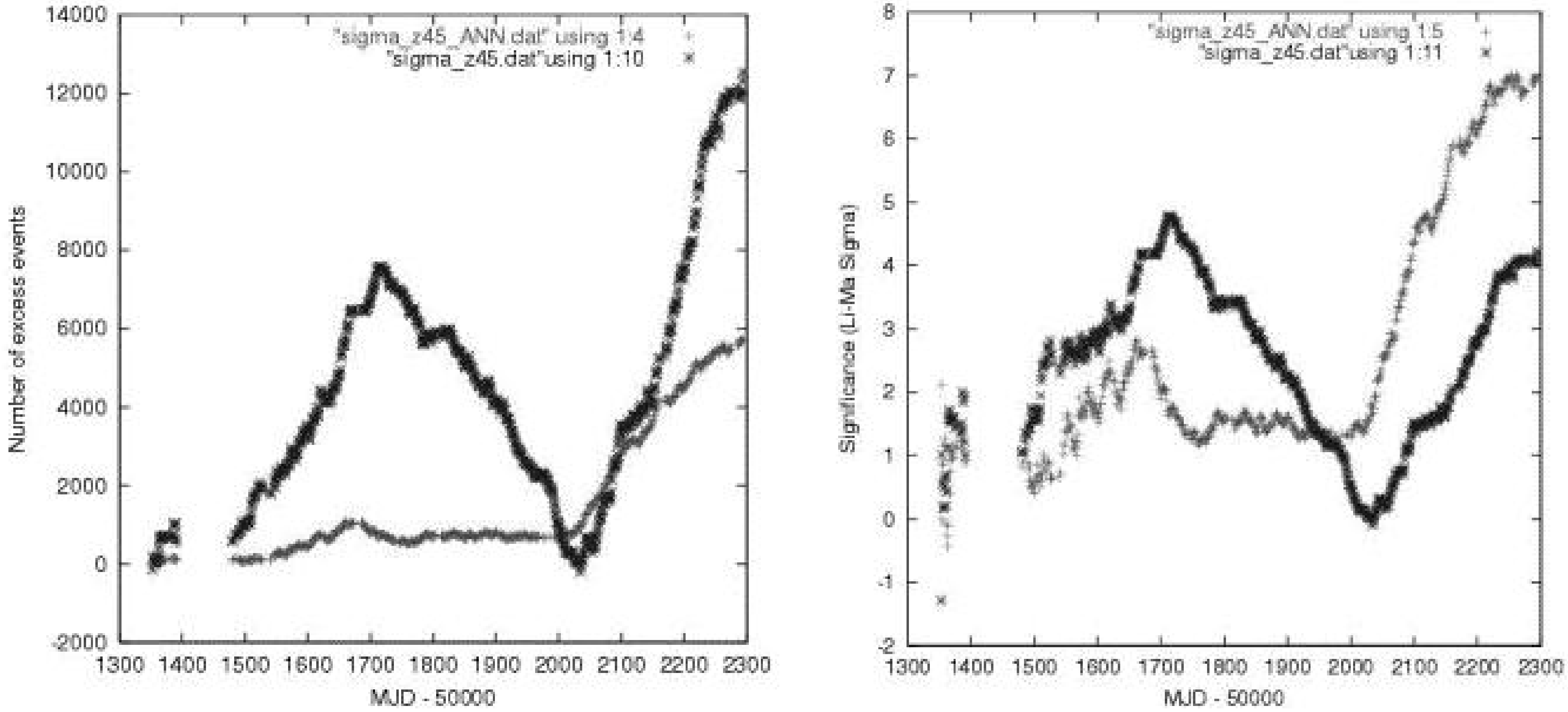
3-15-1 neural network:

Log10(SumPE_as)
Log10(SumPE_mu)
Log10(MaxPE_mu)

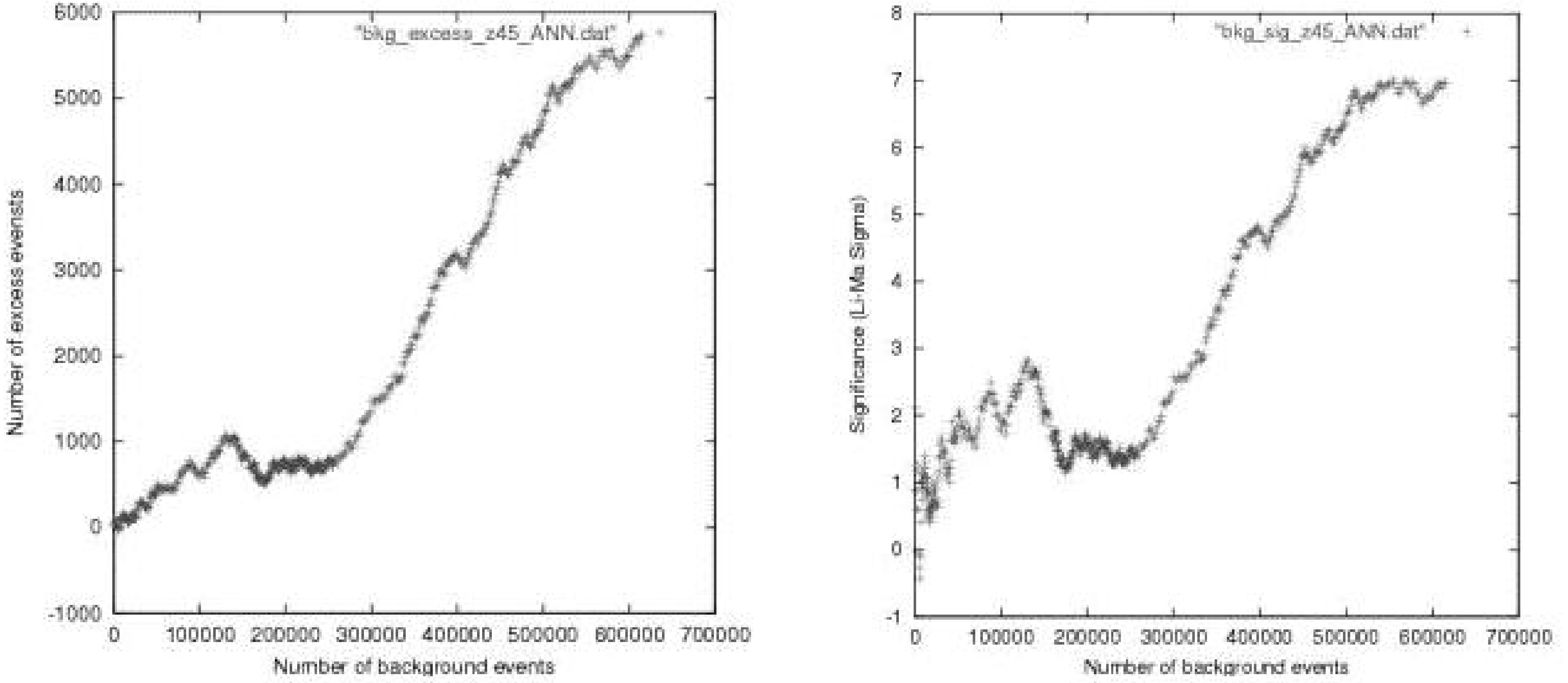




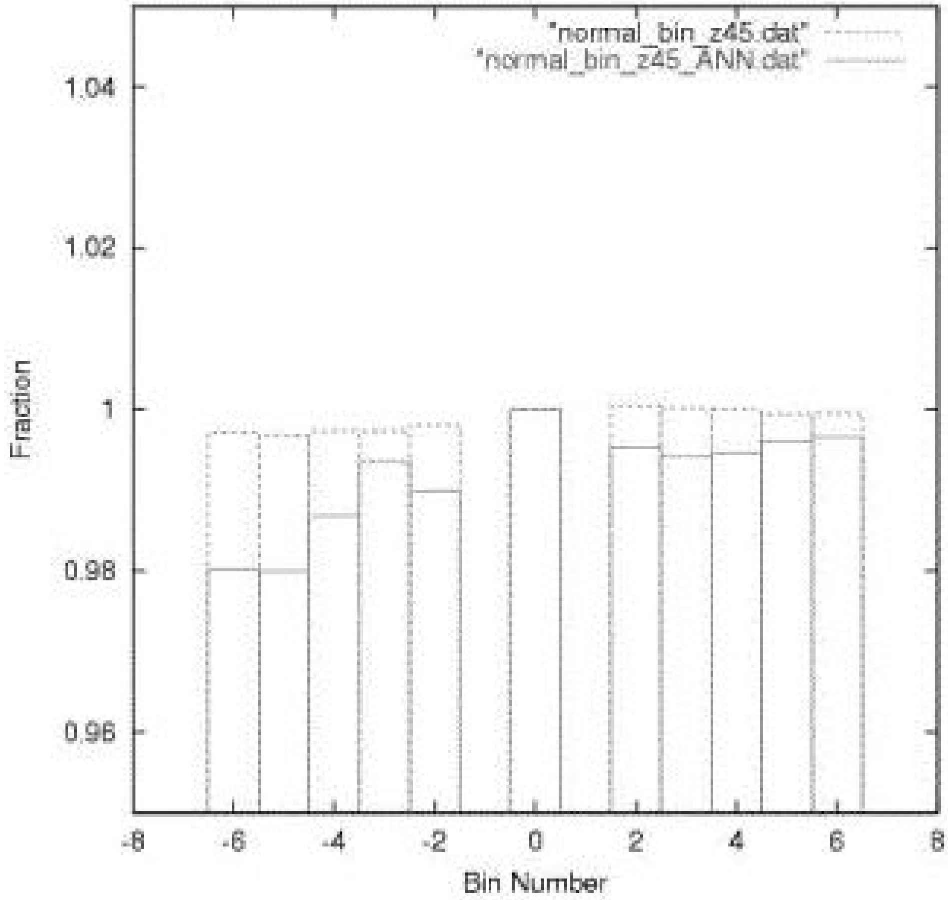




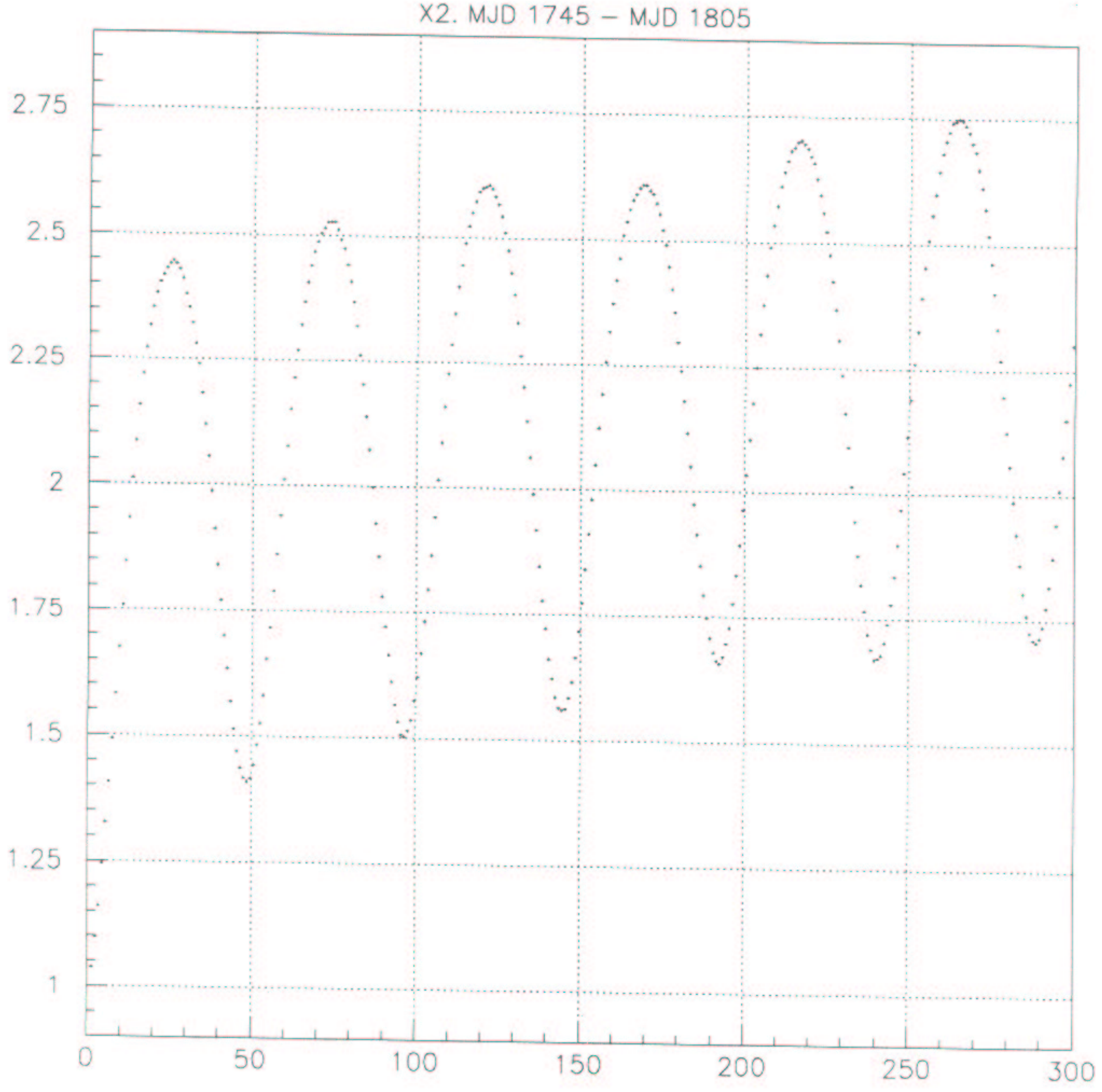
Accumulative number of events and significance vs. MJD

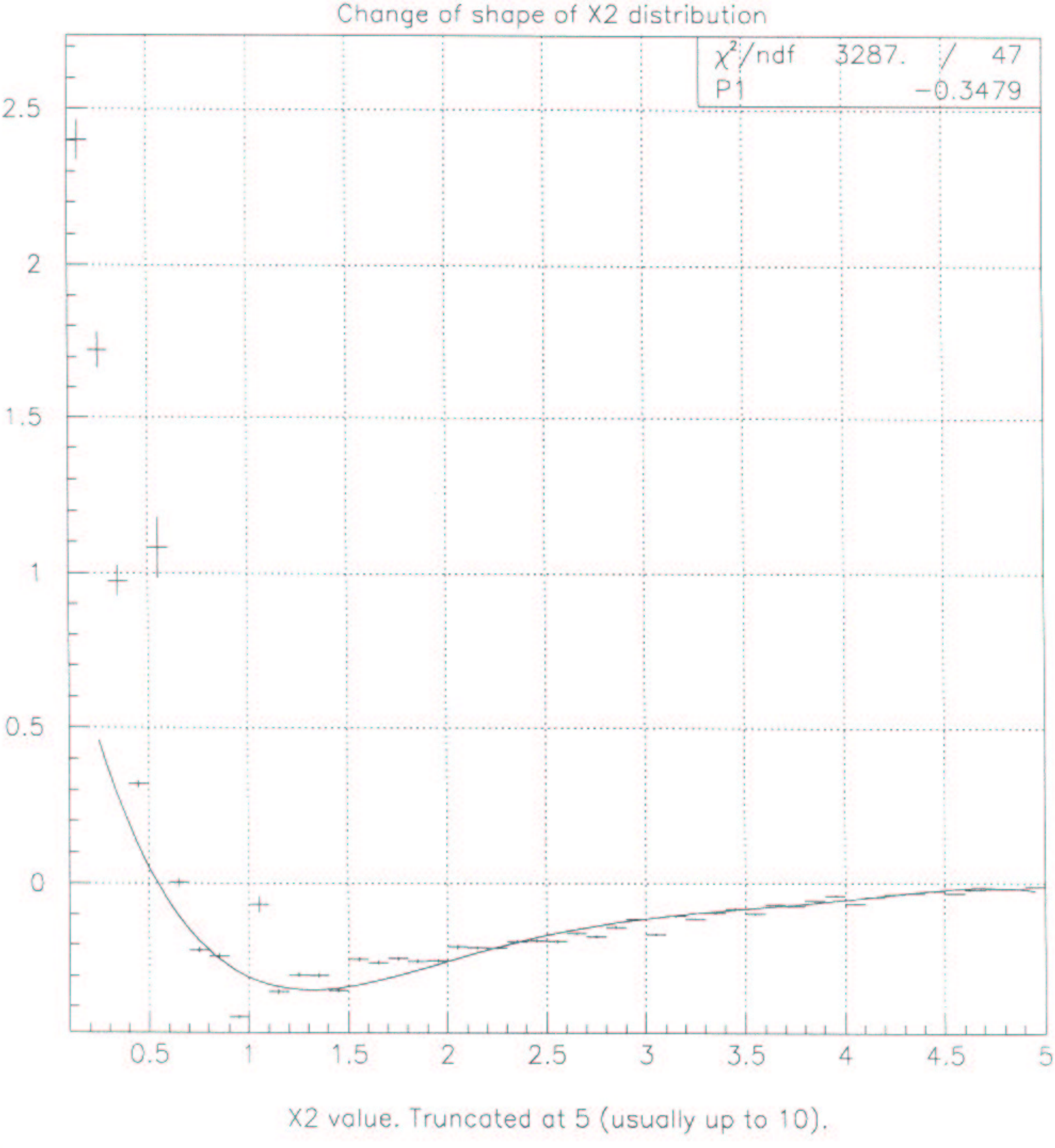


Accumulative number of events and significance vs. number of background events

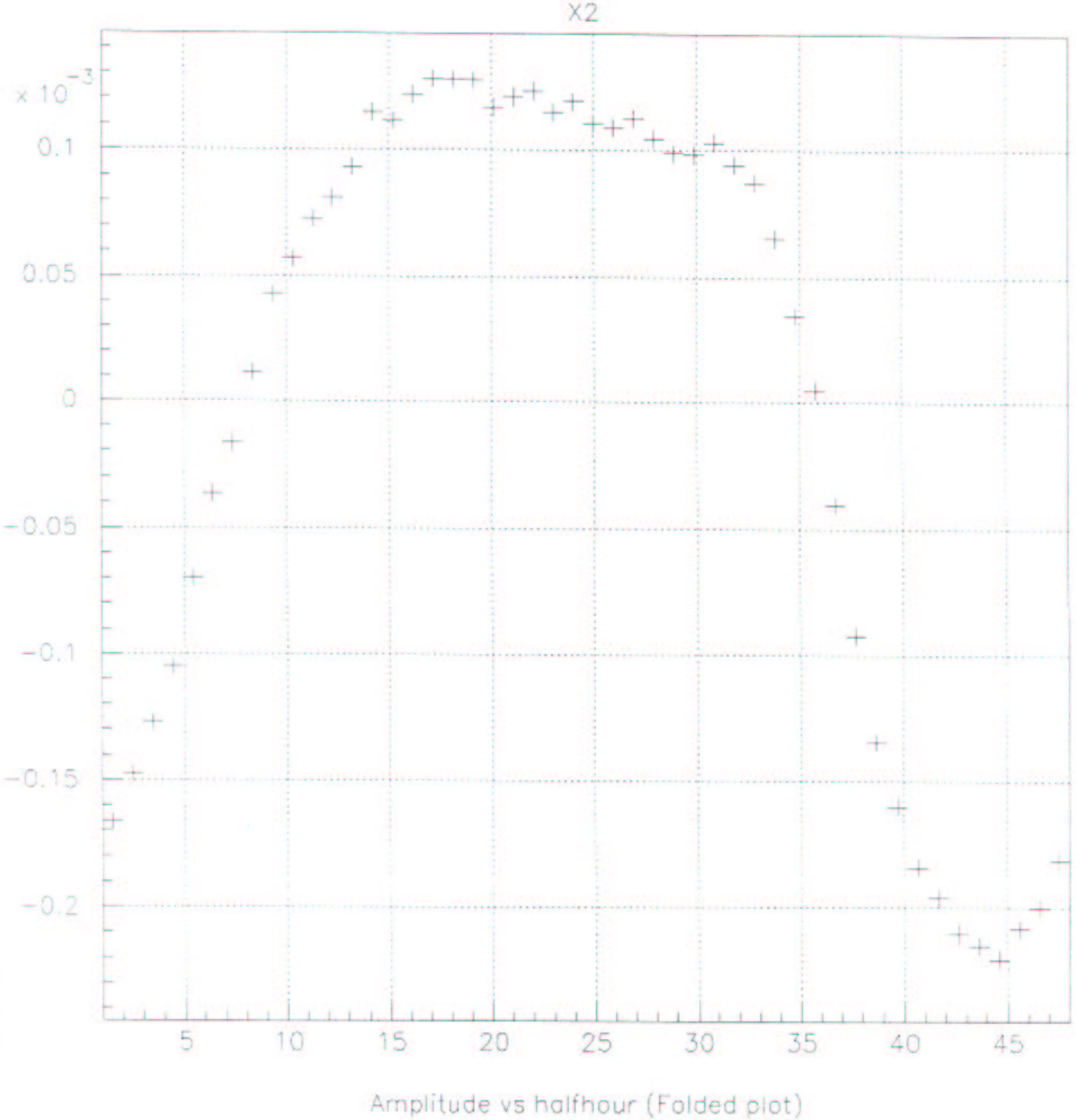


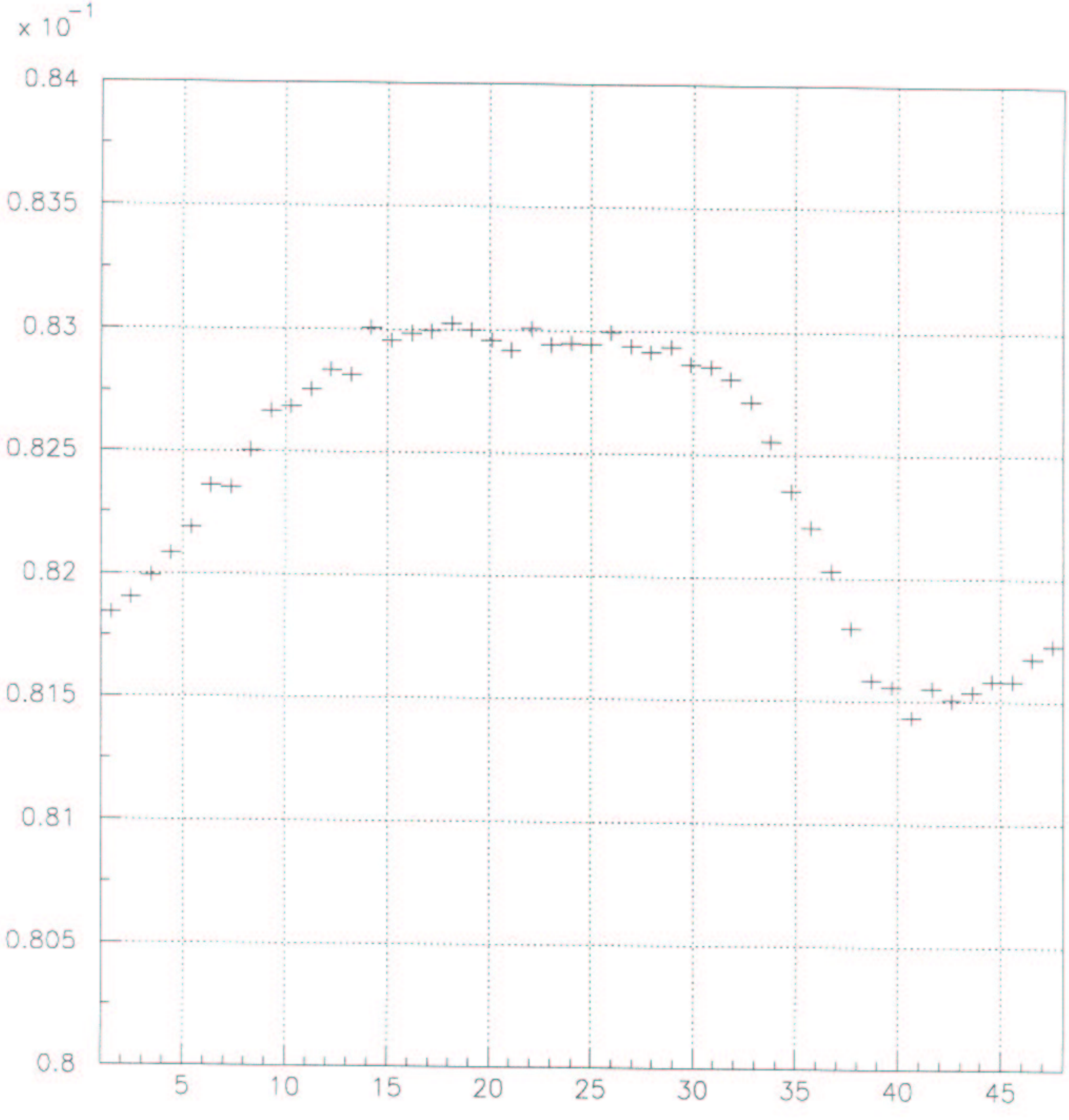
Number of events in each bin


X2. MJD 1745 – MJD 1805
2.75
2.5
2.25
2
1.75
1.5
1.25
1
0
50
100
150
200
250
300
Chi square vs time separation (half hours).



Change of shape of X2 distribution
χ^2/ndf 3287. / 47
P1 −0.3479
2.5
2
1.5
1
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
X2 value. Truncated at 5 (usually up to 10).


X2
× 10^-3
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
5
10
15
20
25
30
35
40
45
Amplitude vs halfhour (Folded plot)



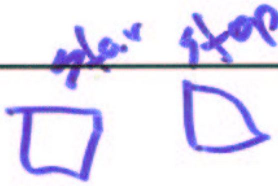
Fraction of gamma like (x2 .gt. 2.5) events vs UT half hour. (Folded plot)

21 Summary of Online Analysis Pre-Meeting - Magdalena Gonzalez

Milagro Online Burst Page

Update

Search Jobs Status



The Short Burst Search is Running

The Medium Burst Search is Running

The Long Burst Search is Running

Search Results

Short Search

Under Construction

Medium Search

Under Construction

Long Search

Under Construction

Search Histgroams

---

*Web page:

- info of running codes
- info of burst alerts:
  time, location, prob., etc.
- sky maps, prob. dist.
- easy way to run codes.

Summary of pre-meeting online analysis

- 3 codes for GRB searching
  - short burst (μs-40s) : Andy
  - medium burst (40s-3hr) : Miguel
  - long burst (2hr) : Liz
- Compare results
  sky maps, prob. dist.
- Save "possible burst" information in data base.
- Scripts:
  - check if jobs are running
  - send page to shift person if one job stops.
  - start jobs

22 Very Short Burst Search - Andy Smith

Status of Short GRB Search

- Code currently running online.
    - a) 27 time scales from 250us to 40s
    - b) 2.2 deg bin
    - c) X2>1 (weak cut)
    - d) ~40% of 1 CPU to keep up.
    - e) .2 deg bin spacing in RA,dec. 10% overlap in time, 26% overlap in duration

- Monitored by shift person.

- Liberal e−mail notification for candidates with estimated rate <50/yea

- Code running on completed subruns, so 1−7 minute delay between GRB and notification.

- Work is underway to bring notification times to down to ~4−6s with a socket connection to the data logger.

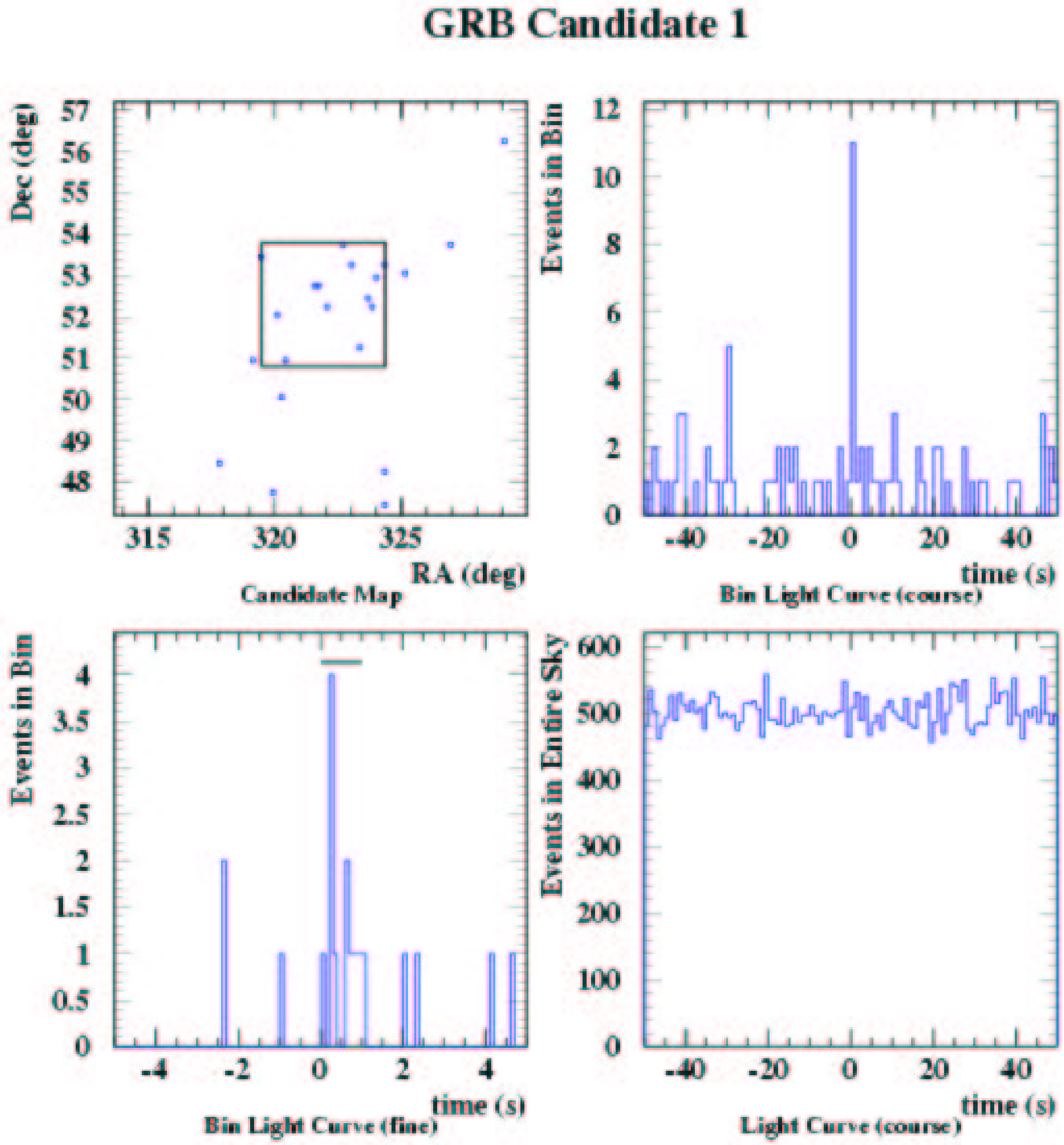
Sample E−mail Notification

```
−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
TITLE:                MILAGRO BURST POSITION NOTICE
GRB_DATE:             12258 TJD;    1105723392 DOY;    MM/DD/YY
GRB_TIME:             89040.649866 SOD; {24:44:0.649866} UT
GRB_DURATION:         39.81072 SEC
GRB_MIL_RA:           18.1 DEG {01h:12m:00s}
GRB_MIL_DEC:          72.6 DEG
GRB_SIGNAL:           18 EVENTS
GRB_BACKGROUND:        1.96619 EVENTS
GRB_SIGNIFICANCE:     4.70085e−12 (pre trials); EST ANNUAL RATE: 9.115688
GRB_MIL_ZEN:          39.5 DEG
COMMENTS:             Test Message
−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
```

GRB Candidate Plots

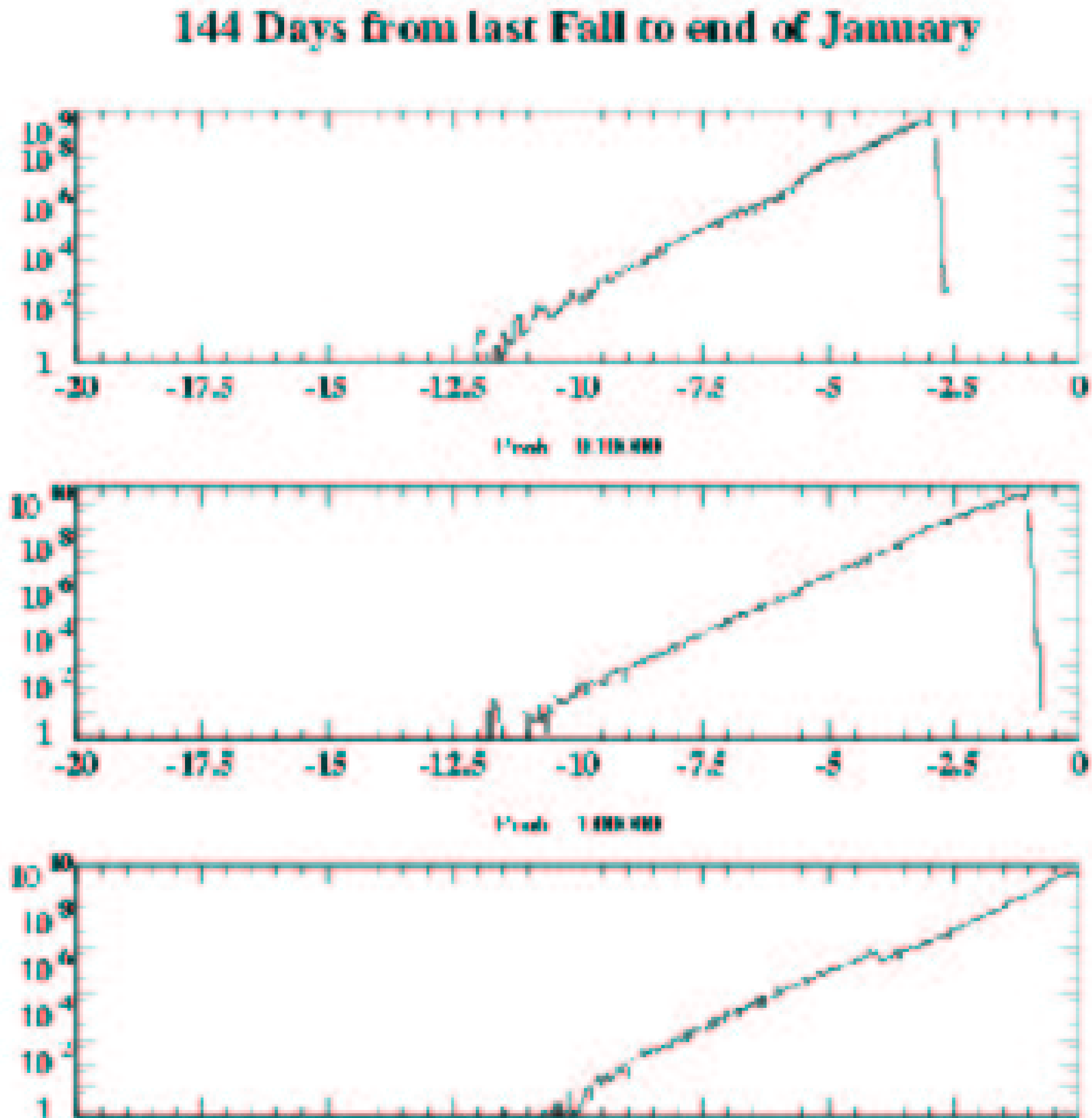
GRB Candidate:

JD = 52299
DT = 1.0s
RA = 321.8
Dec = 52.2
Nev = 11
Back = 0.892
Prob = 1.03E−11



Will make plots like this available in real time to the shift person and friends via the monitor web page.

3 of 27 probability distribution



144 Days from last Fall to end of January

23 Moon Paper - Cy Hoffman

The Moon Paper

I have failed in my effort to get Morgan to complete the updated (corrected) analysis.

I have changed my approach - aiming for a moon paper containing:

a) Milagrito results on systematic pointing error with confirmation from the offset moon shadow.

FIGURES: 1. Map of vicinity of moon showing offset in α, δ.

2. Expected systematic error from MC ($\Delta\theta$ vs θ)

3. Simulated shadow projected onto α, δ axes; uncorrected and corrected.

4. Map in vicinity of moon after correction.

b) Milagrito results on angular resolution derived from moon shadow.

c) Analysis of the moon shadow from Milagro data.

FIGURES: 5. Map of vicinity of moon .

6. Cumulative deficit vs distance from center.

7. Event map rotated according to magnetic deflection

Further results: Energy scale, antiproton shadow.

But getting Frank to complete the analysis is also taking a long time.

So there must be something fundamentally wrong in my approach.

I sought input from The Oxford English Dictionary:

moon, n.
c. Typifying a place impossible to reach or a thing impossible to get. Esp. in phrase to ask (cry, wish) for the moon: to ask or wish for the unattainable.

I can relate to that.

But it's driving me crazy -

lunatic, a.

1. Originally, affected with the kind of insanity that was supposed to have recurring periods dependent on the changes of the moon. In mod. use, synonymous with INSANE; current in popular and legal language, but not now employed technically by physicians.

I can relate to that, also.

02/08/02

STUDY OF THE SHADOWING OF TeV COSMIC RAYS BY THE MOON

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Abstract

The shadowing of TeV cosmic rays by the moon has been observed with data from the Milagrito and Milagro air-shower-particle detectors. The significance of the observed shadow from Milagro is **$>30\sigma$**. These data are used to study the systematic pointing accuracy and angular resolution of Milagro, and are compared to a similar analysis using the Milagrito detector, which had a significant systematic pointing error. The shadow of the moon is clearly displaced by the geomagnetic field, which provides a direct estimate of the energy response of Milagro, and allows a search for high-energy cosmic antiprotons. The 95% confidence level upper limit for the ratio of the TeV antiproton flux to proton flux in cosmic rays is ??%.

PACS: 95.55Vj; 96.40De; 96.40Pq; 96.50Bh

Keywords: Cosmic ray; cosmic ray composition; extensive air showers.

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24 Water on the Cover - Peter Nemethy

MILAGRO COLLAB. MTG. FEB. 11–12, 2002

P. Némethy

"WATER ON THE COVER"

FOR THE

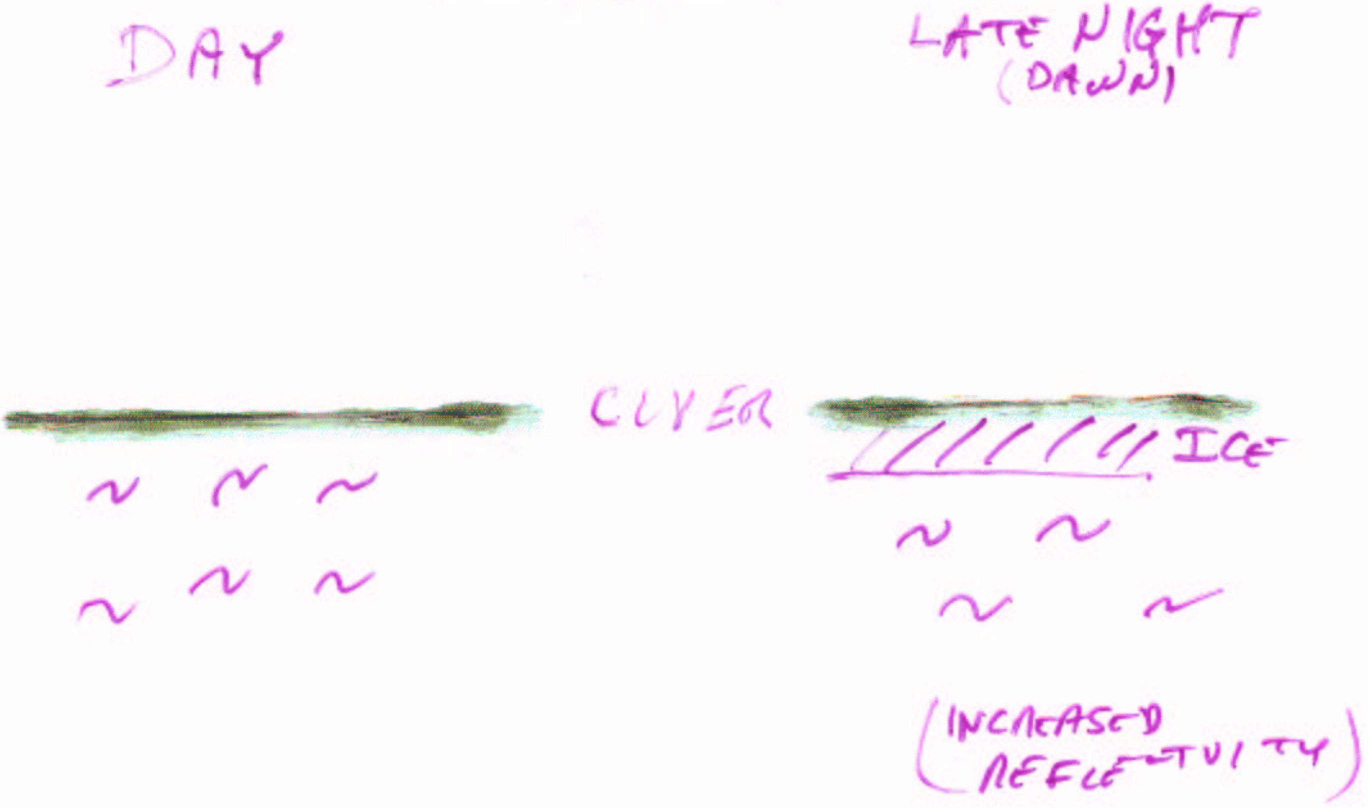
JOURNAL OF UNEXPECTED RESULTS

TOPIC: TRIGGER RATE RISE ON COLD WINTER NIGHTS (& AS SINGLES RATE RISE & DROP IN NFIT)

RISE & MAX (TYP. BEFORE DAWN)

NOT IN SUMMER/FALL/LATE SPR.
NOT ON CLOUDY NIGHTS in WINTER
NOT ON BALMY NIGHTS IN WINTER

?⇒ MODEL → ICE LAYER FORMING UNDER COVER; REMELTING DURING DAY ⇐?



PREDICT:

GUE
PN
⋮

"FIX?" ⇒ WATER ON COVER

⇒ ICE FORMATION IS **ABOVE COVER**

MID-JANUARY:

AN EXPERIMENT:

≃ 15 CM OF WATER ON COVER

DISCLAIMER

BUT: WARNING: DEPTH VERY UNEVEN!

ONCE COVER UNDER WATER ⇒ WE LOSE CONTROL OF COVER!

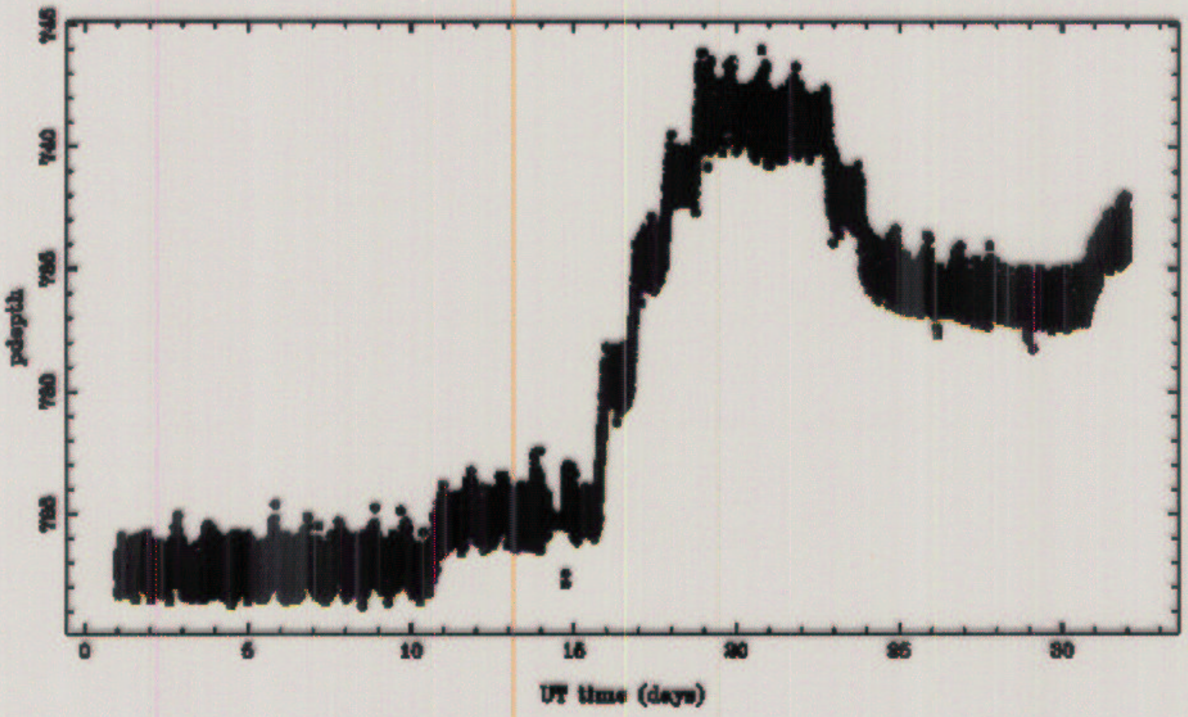
Milagro EMS data

Please, enter a date

year 2002 Month 1 Day Hour

Choose a parameter to plot Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	Set Axis Range (optional) You have to define all of these or none at all. xmin xmax ymin ymax
submit clear	

This graph was made with the parameters: month: 1, day: , year: 2002, hour:



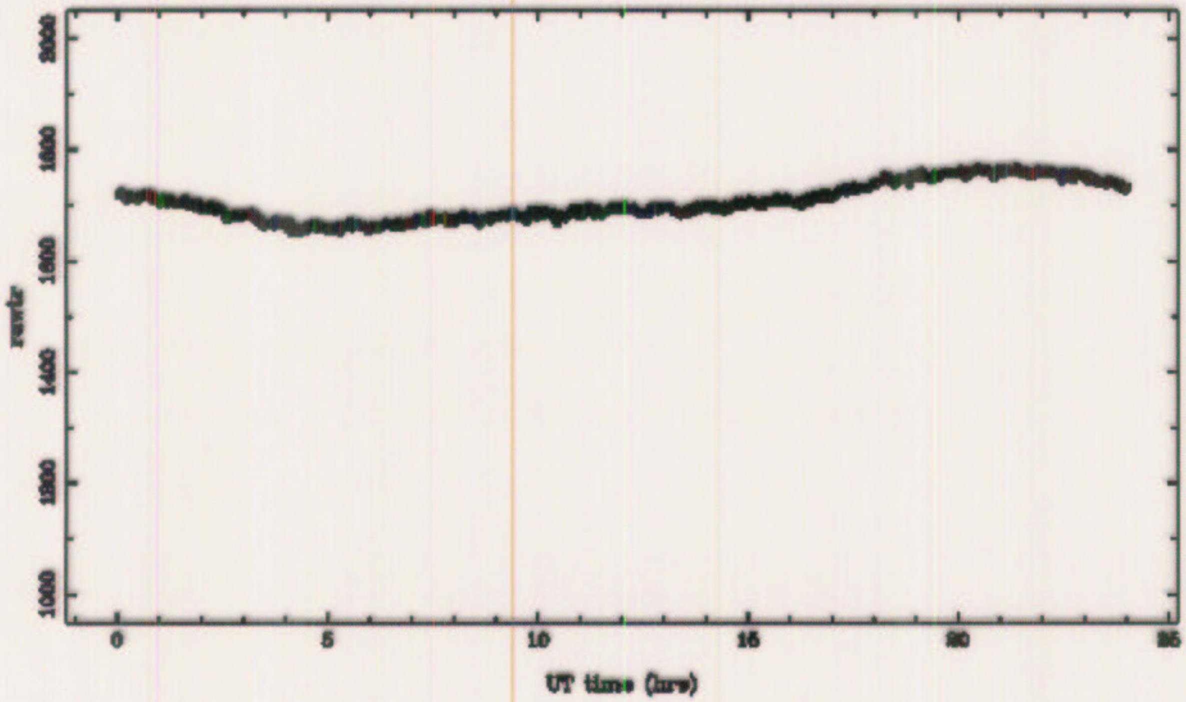
Milagro EMS data

Please, enter a date

year 2002 Month 1 Day 5 Hour

Choose a parameter to plot Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	Set Axis Range (optional) You have to define all of these or none at all. xmin `0.0` xmax `24.0` ymin `1000.0` ymax `2000.0`
submit clear	

This graph was made with the parameters: month: 1, day: 4, year: 2002, hour:



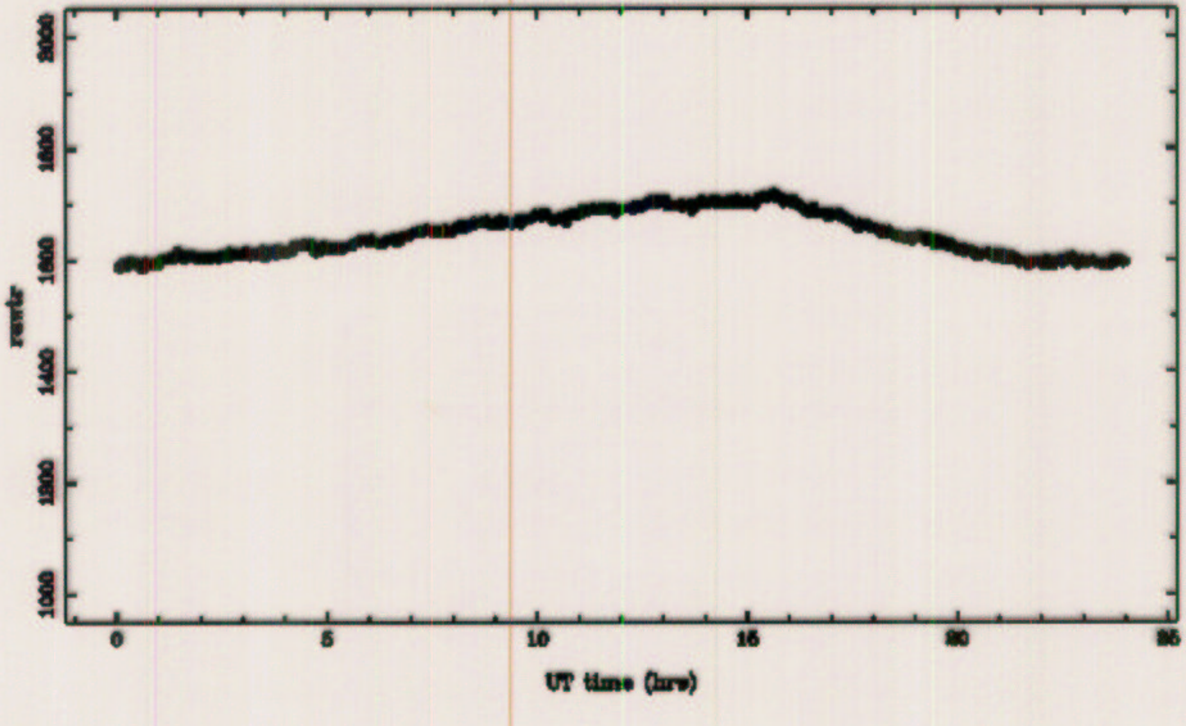
Milagro EMS data

Please, enter a date

year 2002 Month 1 Day 9 Hour

Choose a parameter to plot	Set Axis Range (optional)
Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	You have to define all of these or none at all. xmin `0.0` xmax `24.0` ymin `1000.0` ymax `2000.0`
submit clear	

This graph was made with the parameters: month: 1, day: 9, year: 2002, hour:



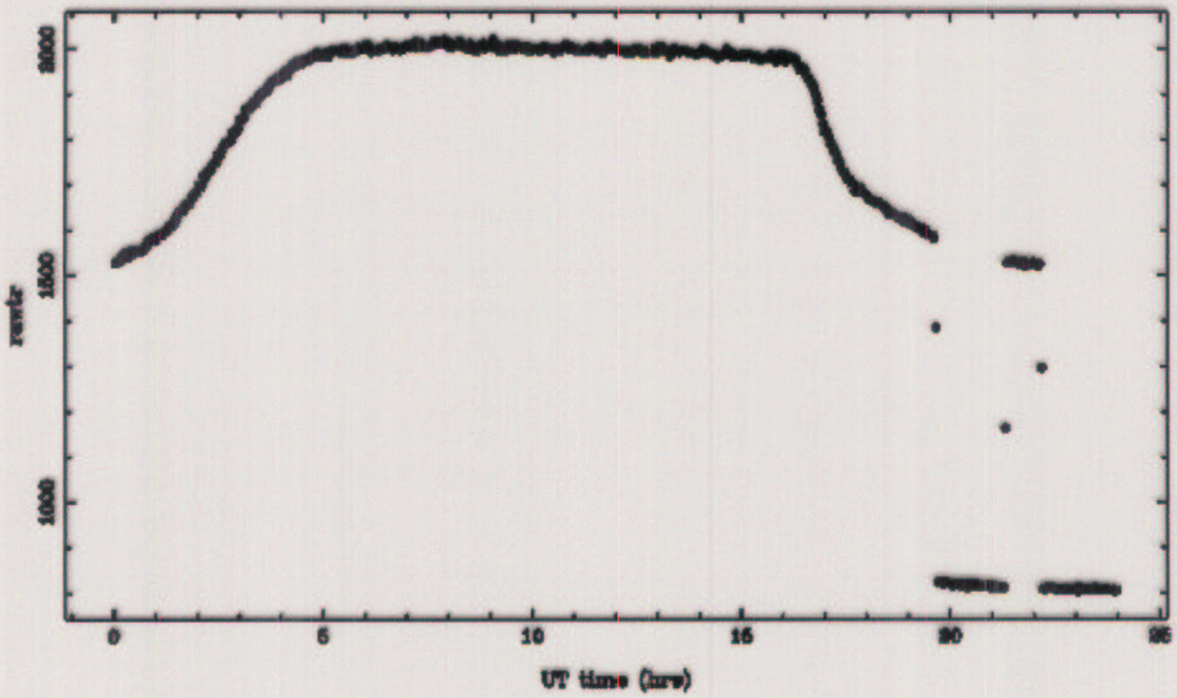
Milagro EMS data

Please, enter a date

year 2002 Month 1 Day 21 Hour

Choose a parameter to plot Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	Set Axis Range (optional) You have to define all of these or none at all. xmin xmax ymin ymax
submit clear	

This graph was made with the parameters: month: 1, day: 21, year: 2002, hour:



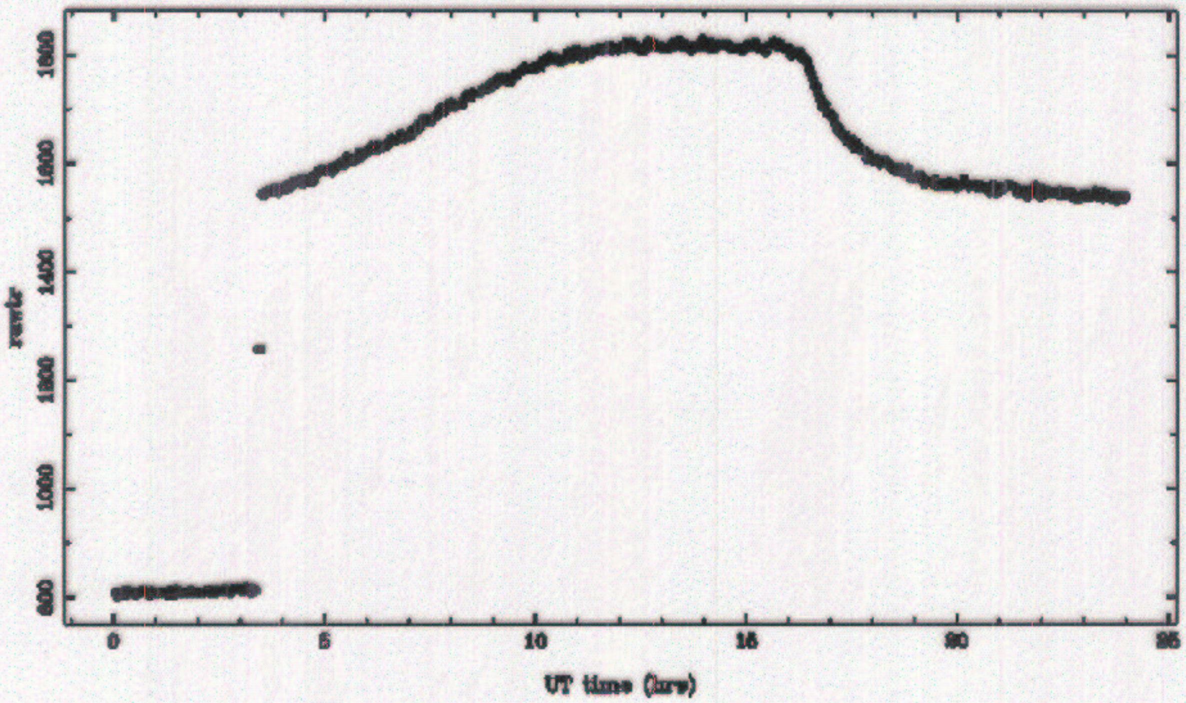
Milagro EMS data

Please, enter a date

year Month Day Hour
2002 1 22

Choose a parameter to plot	Set Axis Range (optional)
Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	You have to define all of these or none at all. xmin xmax ymin ymax
submit clear	

This graph was made with the parameters: month: 1, day: 22, year: 2002, hour:



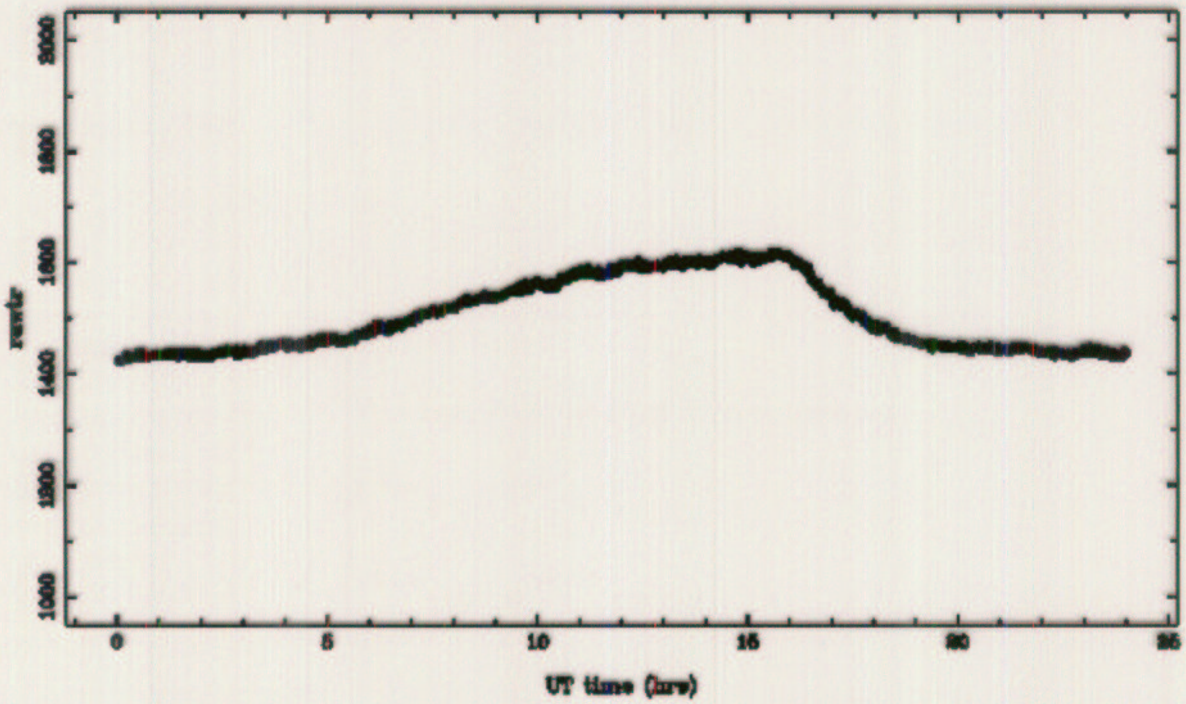
Milagro EMS data

Please, enter a date

year 2002 Month 1 Day 27 Hour

Choose a parameter to plot Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	Set Axis Range (optional) You have to define all of these or none at all. xmin `0.0` xmax `24.0` ymin `1000.0` ymax `2000.0`
submit clear	

This graph was made with the parameters: month: 1, day: 27, year: 2002, hour:



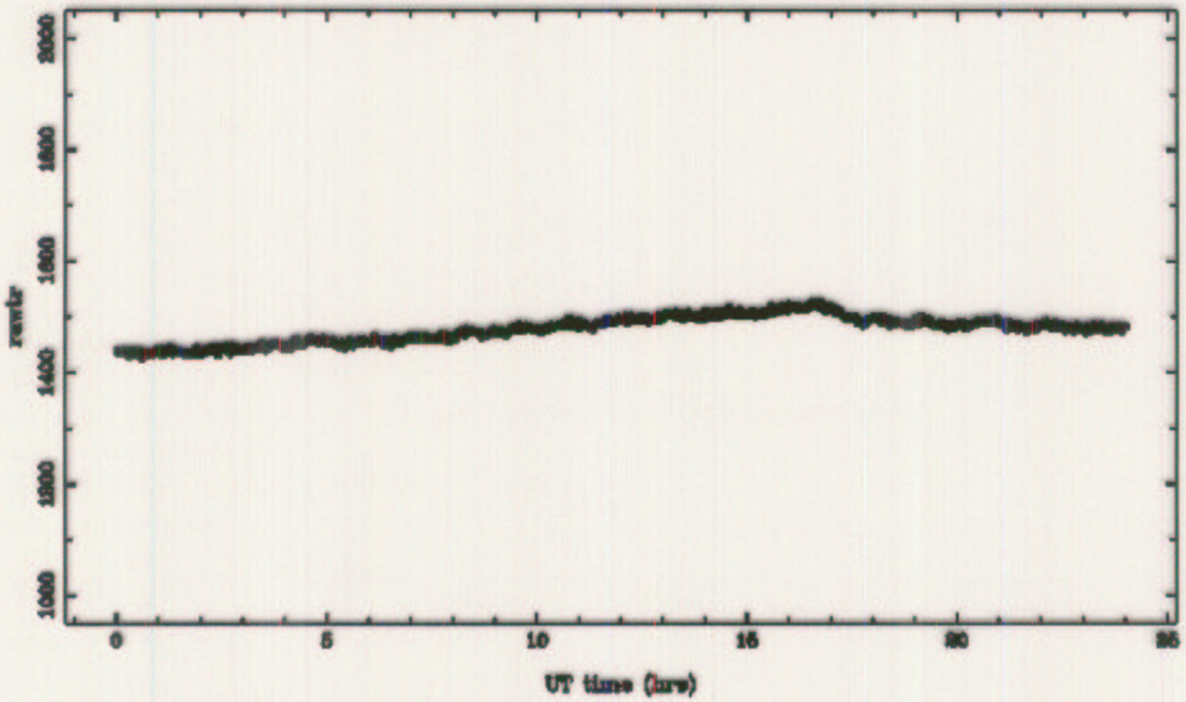
Milagro EMS data

Please, enter a date

year 2002 Month 1 Day 28 Hour

Choose a parameter to plot Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	Set Axis Range (optional) You have to define all of these or none at all. xmin `0.0` xmax `24.0` ymin `1000.0` ymax `2000.0`
submit clear	

This graph was made with the parameters: month: 1, day: 28, year: 2002, hour:



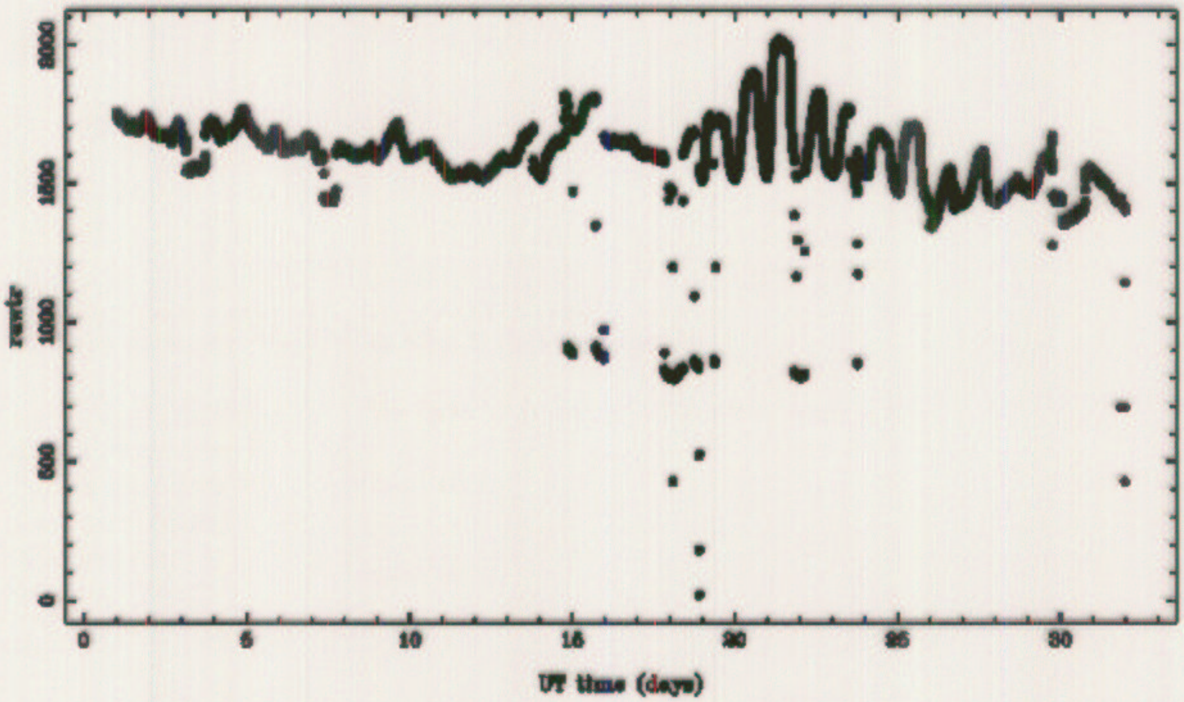
Milagro EMS data

Please, enter a date

year 2002 Month 1 Day Hour

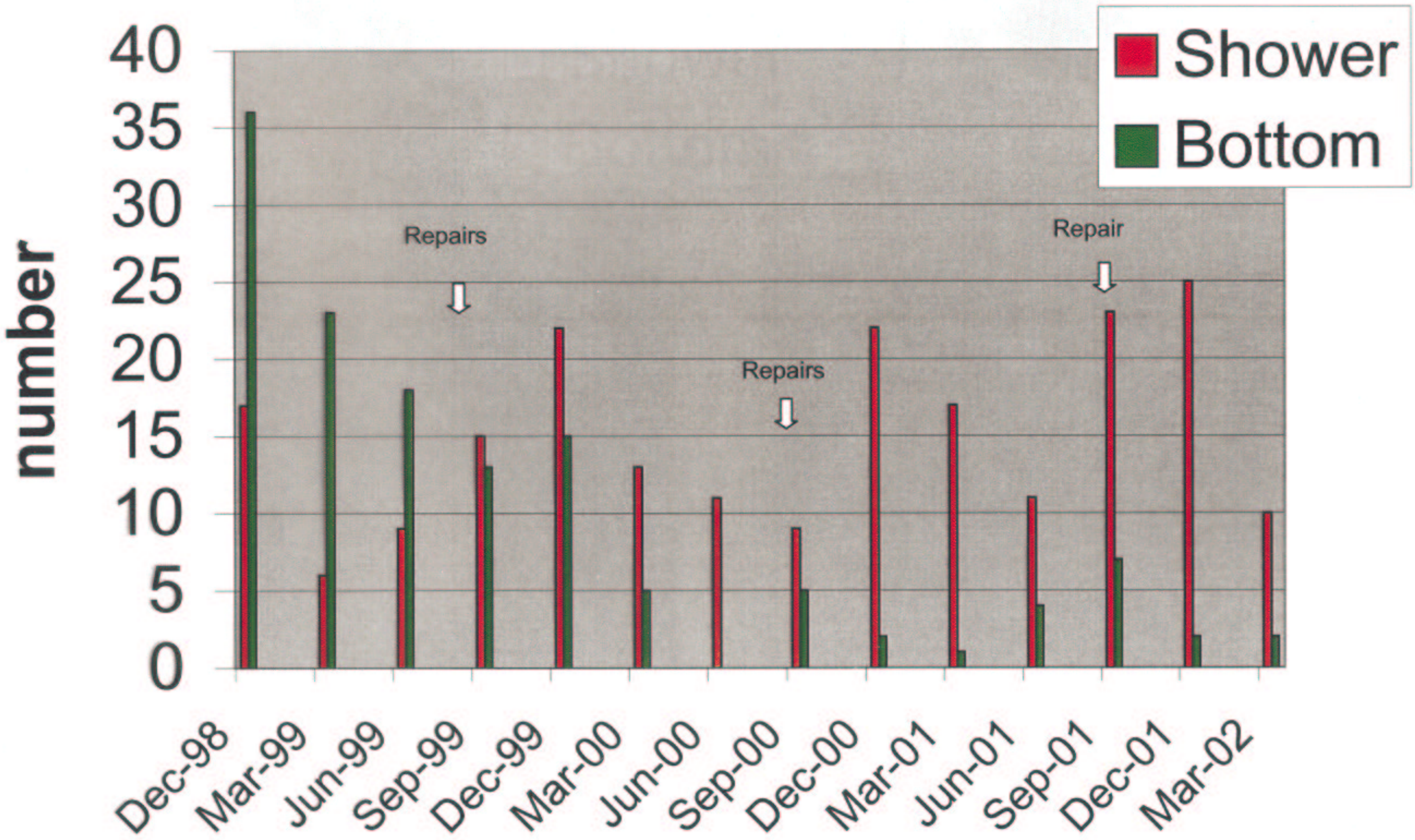
Choose a parameter to plot Gated trigger rate(Hz) Interior temp. (deg F) Outside temp (deg F) wind speed (mph) Rain (inches) Humidity (pcnt)	Set Axis Range (optional) You have to define all of these or none at all. xmin xmax ymin ymax
submit clear	

This graph was made with the parameters: month: 1, day: , year: 2002, hour:



25 PMT Deaths/Repair Plans - Cy Hoffman

PMT Deaths by Quarter



Some PMT Repair Numbers

PMT Repairs Made

	Top Layer Fischer Repair	Top Layer "Tube" Repair	Muon Layer Fischer Repair	Muon Layer "Tube Repair
1999	43	0	273	0
2000	25	20	4	15
2001	0	70	0	16

Present Status Of PMTs

	Never Repaired	Repaired w/Fischer	Repaired w/Tube	Presently dead
Top Layer	292	68	90	42
Bottom Layer	0	242	31	6

Experience with Repaired PMTs

	Fischer-years	Failures	Tube-years	Failures
Top Layer	145	5	60	1*
Bottom Layer	650	41	30	1*

*** PMTs presently dead. Previous tube failures were all leaks in PVC.**

PMT mean-time to failure

	Bare Fischer	Repaired - Fischer	Repaired - Tube
Top Layer	~7.5 years	30 years	>60 years
Bottom Layer	3 years	16 years	>30 years

Possible Future Repair Scenarios

A. Continue as we have been - repair only dead PMTs each year.

B. Repair all dead PMTs plus all bare Fischer connectors in top layer.

C. Repair all dead PMTs plus 1/2 of bare Fischer connectors in top layer.

Consequences

Scenario	# PMTs to repair	Downtime	Comments
A	~75 shower layer ~10 bottom layer	5-8 days	Finish process in 2006. Continue with PMTs dying
B	~300 shower layer ~10 bottom layer	20-30 days	Very few future PMT deaths
C	~150 shower layer ~10 bottom layer	10-15 days	Finish process in 2003.

Must take into account manpower needed for repairs:

Diving

Work in boats

Drilling PVC, installation of tube, soldering, etc.

OTHER ISSUES:

NEW BAffles

LOWER WAter level for REPAIR?

THE END