Milagro Collaboration Meeting

10/22-24/2000
Madison, WI

Decisions Made:

a.) Buy a new laser – Bussy look into
b.) Repair 2 broken AC units – Gus
c.) Research water chiller option – Michael
d.) Official Data
    i. Crab nhit>20 only (keep it simple)
        1. Andy's plots w/wo gamma hadron separation
        2. Andy's expectations for nhit>20
        3. Standard Caveats
            a. Preliminary
            b. Outriggers will improve things
            c. Gamma hadron separation is preliminary
    ii. GRB
        1. We will show what we have published
        2. We can show new work on scalers which showed that showed the energy limit on GRB970417a labeled PRELIMINARY
        3. Discuss new trigger to enhance GRBs
    iii. Moon in Milagro
e.) Abe will circulate draft of Nov 6 event paper
f.) Julie and Isabel and David will produce a draft of a longer GRB paper
g.) Joe will produce a paper on untriggered bursts
h.) Cy and Kelin will produce a DC source paper
i.) Cy and Morgan will produce a moon/pbar paper
j.) NIM Calibration paper (NYU work on)

Next meeting Feb. 25-27, 2001 meeting at UCI
Uber next meeting June ~18-21 at LANL

Write hadron tapes for Gaurang's analysis
Improve calibration at 20 PE
Change role of backup shift person – send them more pages
Tar code on REC tape
Update outrigger budget & schedule for outer outriggers

Andy's talk will appear >5 days before HEAD

Meeting Notes

1.) Cy for Morgan
   a.) Moon Shadow
   b.) Delta theta/theta correction works if NFIT>30
   c.) DTheta split into x and y components
   d.) Fits tilt (dx vs. x, etc) from Monte Carlo as a function of NFIT.
   e.) NFIT<30 not used in analysis

   Color slide of Moon Shadow before and after correction.
      a.) Before correction Moon at -0.5 degrees in dec
      b.) After at 0 in dec.
      c.) Deficit: 18,763+=641 evts Exp. 27,316+-1793
      d.) Resolution = 1.4+-0.1 degrees

   Likelihood analysis
      a.) deficit=20,000+-2250 evts
      b.) ra: -0.33 +- .23
      c.) dec: +.16+-.21
      d.) Matches well with MC prediction
      e.) With errors on RA pos. gives about 50-60% energy resolution.

   Ryan - Mo should calculate Likelihood at predicted moon pos.

2.) Cy for Kelin: All Sky Survey
   2.2-degree bins.
   Oversamples by moving 1/2 bin in each and both directions (4 maps)
   Distributions look Gaussian (over entire Grito dataset)
   Will derive limits
   Broke data into months - For each month they look normal
   Look at hot spot from each month (>3.7 sigma)
   ra 122.67 dec 19.44 (2 months 4.0 sigma & 3.7 sigma)

   2.8 sigma for Mrk501

3.) Gaurang for Scott: AGN
   Mrk501 1.5 degree bin full width (4.1 sigma)

" radial plot Dr=0.25 degrees - looks good (too good)
Stecker DeJager Salamon source list (likely TeV sources)
1ES 1652+398 = Mrk501 (4.11 sigma)
20 sources total
Working on upper limits
Searched 4-days, 12 days, & 36-day timescales.
Searched for successive days with LiMa>2 and >3. Sees nothing interesting.

4.) Gaurang for Isabel: GRB 970417a
lower limits to event energy
distance scale
limits on isotropic energy release from this GRB

NHIT distribution during burst compared to typical NHIT distribution
evts with NHIT>182. Typical is 4/17 (0 of 17 for this GRB)
Derives 3sigma upper limits on energy as a function of NHIT.
at NHIT=80 Emin = 200. at NHIT=160 Emin=600 GeV
340 GeV for 97 PMTs (min of GRB)
to 920 GeV for 182 PMTs (max of GRB)

Gus - this is incorrect - does not account for spectral index.
GBY – Isabel will redo to investigate sensitivity to spectral index, simply repeat same analysis but throw gammas on a spectrum vs. flat.

Fluence limit = Emin/Aeff.
Used Emin to get distance (Stecker IR field)

upper limit on Energy release (Ei=Emin,i)
for lower limit tau(Ei,z) = 1.

log Energy (ergs) as a function of redshift.
Straight line if z plotted on log scale
~100 times greater than in BATSE energy band.

5.) Joe: Burst Search Update
Untriggered. All timescale from 3 seconds to 6 hours
(x3 between timescales)
Nexp and Nobs distributions have bumps
Now understands bumps.

Bumps do not appear in 2-degree bin
optimal binsize vs. nexp, get overlap. Causes bumps.
look at perlman 1999 x-ray selected bl lacs and blazars to
compare to database of all intervals > 10^-4?

New bursts from Stern et al.
Offline analysis of BATSE data found 1000 new bursts
25 GRBs within zenith angle < 45 degrees during Milagrito running
NFIT>30
90% CL (search area)
optimal binsize
T90 time scale

BATSE pointing errors are large for these bursts.
But reported errors are not what we want (is largest deviation
for the elliptical error area).

Sees nothing.
Look at Stern numbers for 970417a
different ra, dec, t90 and bigger error box
gives only a start time.
see 16 exp 2.99 (1.2x10^-7) (did have 8.55x10^-9)
if you search entire new box with new start time get:
18 exp 2.98 P=3.2x10^-09.

6.) Miguel: BATSE + scalars.
Looking at BATSE data set.
Data mining BATSE for GRBs with z information to find a correlation
Luminosity vs. Lag (between energy channels 1 and 3)
Straight line on log-log plot (low energy shows up later for the weaker bursts)
But after all trials is not significant.
But need to do redshift correction (time dilation, and spectral shifts)
Miguel is redshift correcting luminosity and lag.
Problem is low stats and high energy events cascade down and
look like low energy events.

7.) Lazar: WIMPS
WIMP annihilation near Sun.
Existence of dark matter (radial velocity curves)

xxbar->gg (Eg=Mx) line source, doppler shifted by radial velocity and temperature.
trapped by Sun. Look for excess from Sun
Program to calculate radial dist. function of signal, almost complete

8.) Jim: Solar Proposal
Submitted to NSF - Atmospheric Sciences
3 very good
2 good
criticisms:
misunderstanding observation period
Criticism of analysis of Nov 6, 1997 event
insufficient knowledge of instrument
Asked for too much money (needed 5 excellents for this much money)
NSF wants and expects resubmission for <<$$ ($70k/yr will fly)
Hardware needs to come from elsewhere (MRI?)
Proposal to analyze data with existing hardware
JAG - possibly add $20-30k for small hardware upgrade (ala trigger card)

9.) Jordan: Money
Good News - NSF groups got funded at workable level for next 3 years
NSF has approved proposal (outriggers, operations, online computers)
Other News - NSF is reviewing LANL Support proposal. NSF wants UMd to start paying LANL subcontract from the outrigger/operations proposal ($250k/yr) until the LANL proposal get approved (panel meets in Feb. Should get funding in Feb.)

10.) Gus: Running Status and Repairs.
Running stably
Yearly (2000) uptime 93.3% (not including May – database has bad entries for May)
Leading causes of downtime:
Fire cost 15 days
Repairs cost 9 days
Calibrations 6 days - working on concurrent mode
Computer Hardware
Archiver getting more disk space

Low Voltage power supplies

DLT usage:

SAVE Tapes:	51/month
Sun/Moon:	23/month
Crab:	15/month
GRB:	3/month
Total:	100/month

PMT Repairs

9/15 Experiment down - pond seeded
9/16,17 Up for weekend
9/18,19 Diving get tubes up
9/19-21 PMTs repaired
9/22 Sabbath
9/25 Divers replace PMTs
9/26 Experiment up

1 PMT not repaired (115)
1 repaired PMT died, stressed during dive (240)
2 PMTs died during repairs
1 died right after repair (540 9/26/00)
2 died since (436 10/10/00 and 618 10/20/00)

11.) Gus: Air Conditioners

2 of 3 of our AC units are dead
Cost to replace $20-26k
Look into beefed up water-cooling system
5-10 ton units 5-9k
Decision: Repair current AC units
Study new cooling systems (water chillers)

12.) Bussy: Calibration Status

Appeal to buy new laser.
10/9-15/00 23 laser balls of data taken.
10/16-22 Struggled to take remaining 7 balls
Laser company has vanished
Data analysis (of calibration data) begun

Future:

Use good data from current data set & combine with former calibrations to get new constants
BUY A NEW LASER
Take another round of laser data
Prepare for outriggers

Decision: Form committee to look into new laser selection

13.) Cy: Shifts

14.) Cy: Safety

Went to a 1/2 day class (ISM for Managers)
Taught by DuPont ex-employee

Safety is important:

If we screw up we can get shutdown
Don't want anyone to get hurt
Safer == more efficient

LANL+DOE are in midst of safety & security frenzy

They have many aspects wrong
Emphasis on mandatory training is bad
Far too much paperwork

We should strive to do work safely and comply with LANL requirements

Example: Gus with diving
a.) Complete required training
b.) Let Cy or Mary Hockaday know about useless training in writing, make suggestions
c.) Truly think about safety - and act on it.

15.) Miguel: Compression

New version of compression coming up.

WACT will break the compression. For now to run WACT turn off compression

TALK TO MIGUEL IF YOU WANT CHANGES TO THE DATA STREAM.

16.) Julie: The DataBase

MySQL Sever on titus.physics.wis.edu
MySQL clients in LANL, UMD, Wisc, and UCSC

Fast remote access to data
Very efficient algorithm selection
Interfaces: C, perl, gui/sql, odbc

Layout:
- Tapes*->run, subrun, tapenum
- Status->Online errors, start/stop time, etc
- Ems2000-> Ems info
- Monitor->Output from monitor program
- Supp->Extra info from later analysis

Showed some interesting plots of correlations
between rate and temp, fracfit and day, deleo etc.

Use the database!

17.) Julie: Archiver
- Not much change
- Now buffering ~8 hours of raw data
  - Can save SAX bursts not IPN
- Problems:
  - Bad data write followed by failure to advance to end of data.
    - Media errors? Severe during summer, currently a major problem.
  - SCSI bus resets cause load/unload error
    - May damage tapes
  - Very slow data writes causing many tapes to appear short.
    - Disks fill

18.) Erik: Milagro trigger system upgrade
- Replace discriminator with VME module that adds functionality
  - Trigger types, event counter, PMT analog sum that generated trigger, smart trigger
- Up to 8 different types of trigger based on PMT analog sum
- Inputs for 3 external trigger types (Need more)
- Each trigger has a unique id
- Each event can have multiple trigger type.

Smart triggers

3 16 bit interfaces allow for smart trigger
A-D conversion of peak height and risetime
16-bit scaler for event counter
16-bit trigger word

Design in works.
Schedule:
Engineering begun
Dec. design and construction
Feb testing at site
Next year - smart trigger cards

19.) David Noyes: Lower trigger threshold
See more distant GRBs
For gammas increase in eff area is most pronounced at lower energies (as a result of lowering the trigger threshold)

Monte Carlo rate vs. Threshold
Survival prob. vs redshift
Convolve with Crab spectrum
Integrate from 10 GeV to 100 TeV
for z=.5 Nhit>10 get 2x10^-4 Hz Nhit>50 get 1x10^-5 Hz (for Crab strength)
No 1/r^2 in this calculation

20.) Liz: Intelligent Triggering
Events don't fit
Rate is high
Get many more events at very high zenith angle (>50 degrees)
High angle muons
Simple solution
Events that don't fit have different characteristic time
Risetime == time difference between 10% and 90% of PMTs to be hit
Fit showers and gammas have faster risetime than not fits.
Rise time cut:
at 44kHz 100ns risetime retain 10% of not fits and 40% of fit
and 75% of gamma events (but noise was not added to gamma MC)

21.) Abe: Nov. 6 Solar Event and Paper

Effective area to protons

Improved threshold estimates (7.6 Pes)

Corrected OR'd patch error

Throw range increased to 7000m (increases eff. Area by x100)

✍ major impact on solar event spectrum calculations

✍ new area predicts cosmic ray background to a factor of 3

At 10 GeV we have 10^3 m^2 sr eff. Area

Validity of 100 PMT signal

2x rms increase (peak/bkg w/2.5min bins)

starts at 11:40 UT (+- 15 min) (12:07 UT begins Climax)

isotropic in theta and phi

notfit / fit increases as event progresses

"Signal" goes away for NFIT>40

chi-sq does not change significantly through event

If you assume it comes from protons (isotropic) get p^-2.5 spectrum. HT scalars see p^-6.6. Neutron monitors see p^-5.2

There are other mechanisms to explain 100 PMT "signal"

Flashers

High rate flashers - not happening at onset

High PE low NFIT – none seem to be present

High PE High NFIT – are present during event, but no change during event.

High theta muons

Nfit/fit increases as event progresses – support for presence of >83 degree muons

But there are some excess events that fit

Excess not present for nfit>40

High Z ions

Spectral flux decreases with Z

Multiple muons

Included in Coriska

Coriska problems

Does have low energy problems

But this would affect HT scalars (which seem to be okay)

Suggestions – we need to understand true significance of 100 PMT increase.

Present state of analysis and paper

Require continuity with neutron monitor (at 4 GeV)

Using new eff. area get spectral index –6.6 +- 1.4

Our signal starts at 2 Rsun (low corona)

22.) Julie & David: Burst and Fluence paper

Need to provide GRB community with enough info to interpret our burst

Writing a follow-up paper

1.) Describe scaler hardware

2.) Scaler analysis and upper limits

3.) Sensitivity of Milagro detector

a. Describe simulations for scaler and air-shower data
b. Effective area vs. energy for scalers and shower data

4.) Discussion – implications

Scalers say spectral index harder than –3 and Ecutoff>700 GeV

23.) Cy: Other Milagrito Papers

1.) Solar paper – Abe (draft Nov)

2.) GRB 970411a – Julie (draft Nov) + AGN Search (Scott) – various timescales

3.) All-sky – (Kelin, Cy)

4.) Untriggered search (Joe)

5.) Moon Shadow (Morgan) pbars and energy scale

6.) Calibration NIM paper (NYU)

Editorial Boards – what is their role? Do we need them?

Try an overarching publications committee (3-4 people on a permanent basis)

24.) Jordan – Next Meeting

3/16 ICRC abstract due (6/1 for papers) – 8/7-15 meeting Hamburg.

Reserve February 25, 26, & 27 (Irvine).

June (18-21) for uber next meeting. Los Alamos

25.) Andy – Analysis of Crab data

a. Re-reconstructed.
b. 180 tapes to date (+-10 degrees in DEC)

Entire data set – 30.3Gevents – 228 effective days
Crab data 1.8 Gevents (75.8 days – average .27days/day)

Made zenith angle cut < 45 degrees
Standard V44 reconstruction with 2 changes
Greg's core fitter, curvature increased to 0.07ns/m
V44 includes:
1.) Laser timing calibrations with extrapolation for low LO and high HI TOT
2.) Laser based TOT-to-PE calibrations
3.) Chi-sq angle fitter from V44
4.) Events were logged with Nbottom>2 Pes
Prediction for Crab Signal
MC gammas from 100 GeV to 100 TeV
Crab spectrum 3.3x10^-7E-2.5 gammas/s/TeV/m^2
Included dead PMTs
Trigger threshold set to 65 PMTs (300 mV)
Expect 24.87 evts/day from the Crab

Sensitivity bottom line:
NFIT>20 Bin 2.1 sq 3.1 sigma (24.9 evts/day)
NFIT>80 Bin 1.7 sq 3.9 sigma (12.1 evts/day)
NFIT>150 Bin 1.1 3.4 Sigma (3.7 evts/day)

HEGRA Spectrum (2.8 E^-2.6) predicts 30% less significance
TIBET (8.2E^-2.6) predicts 70% more significance

We have 275 Crab days of exposure
200 days if you account for low rate days
Guess real exposure of 240 days (2/3 yr).

No gamma/hadron cut ~2 sigma for NFIT>20&80 nothing for 150.

After gamma/hadron (Gus version)
>20 4.0 sigma
>80 4.1 sigma
>150 2.6 sigma

26.) Gus: Gamma Hadron Separation

Extension of direct integration method to include additional parameters (beyond RA and DEC).
Used to make ON and OFF source X2 distributions (Nbottom>2PE /MAXPE(Bottom).
Likelihood analysis of ON and OFF distributions using Monte Carlo to generate expected distribution for gammas.

L = L(Nsignal=0,Nbackground=Nobs)/max(Nsignal)L(Nsignal,Nobs-Nsignal)

Maximizes at Nsignal = 600 2.4 sigma (NHIT>20)
Is constrained by Monte Carlo prediction of gamma events at large X2 (>5). But Monte Carlo has similar problem with protons.
Set gamma distribution to 0 beyond some value of X2.
Yields 3.0-3.5 sigma with ~3800 evts signal
Based ONLY on shape of ON and OFF. No information about excess used.
Need to get Monte Carlo and data to agree.
Also have problems with calibrations in region of interest (see talk below).

27.) Wystan: Crab and 26 AGN.
   a. What do we expect?
   b. Optimal analysis?
   c. Background rejection?
   d. What do we see? Is it consistent?
   e. Energy Spectrum, flux?

How AGN Selected
   Z<0.1 minimize IR absorption
   0<DEC<70
   X-ray selected Blazars
Useful papers:
   Perlman (astroph/9910321)

18 X-ray selected, 3 radio selected, 5 FSRQ = 26 total
Add 3 AGNs detected by Whipple (Mrk501, Mrk421, 1ES2344+514)
All EGRET AGN that meet criteria (W Comae, BL Lac)
3C371

Analysis –

Standard binned NFIT analysis
LiMa Sigma
Round Bins
Background Estimation by Time Sloshing
(2 hr pool, 30 events for each real event)
Incorporates Background Rejection if desired
Future: Use direct integration, and use max like

Optimal BinSize

0.7 degrees, nfit>20 (from deleo)
too small! Ignores core errors
✍ Used Andy's bin sizes (2.1 degree square bin -> 1.2 degree radius; nfit>20)

Data set on Crab:

A. Standard V44 w/wo rejection
B. Re-reconstructed V44a
No rejection: See 2.21 sigma
Muon finder: See 0.45 sigma
GBY X>5: See ~2.2 sigma
Gus X2>2.5 See ~3.5 sigma

26 AGN:

See nothing between July and Sept (tube repair)
With and without rejection.

28.) Roman: Combining Significances

Combining
independent samples
independent tests on the same sample

Fischer method:
if y uniform on [0,1] -> -2lny ~ chi-sq with 2 degrees of freedom
Ex. N=2, significance = P1P2[1-ln(P1P2)]

Just compare ON and OFF from Gus. Get:

Gamma/p shape alone 2.4 sigma
DC excess alone 2.2 sigma
Combined ala Fischer 3.3 sigma

29.) Jordan: Discussion of what we can show at the HEAD meeting.

Decisions:

Standard to show is data up until the repair.
Show Monte Carlo Xg (X2) for gammas and protons
Show Crab with and without gamma/hadron
Caveat about outriggers improving sensitivity
Caveat about preliminary analysis
Caveat about gamma/hadron work is preliminary
Show what we expect from Crab

30.) David Williams: Muon Finder

muonCand.c

Being run online in version 44 (number of muons found saved in REC data)

Local Max > Average of 8 Neighbors < 20

Fancy finder:

Sum of local Max + 2nd hottest, Average of 7 neighbors

Caviar "4/12" muon Cand. (Running online)

Largest 2x2 sum containing local maximum vs. Average of 12 neighbors

All look for isolated hot tube (gamma cores have large extent with hot tubes)

Looked at igloo triggers (known muons) in data. All 3 methods show nice muon peaks.

For normal data "caviar" had best separation.

But was using spectrum based PE calibrations

When use new laser calibrations separation disappears and we apparently do not see muons in normal data (can still see them in igloo data).

Data and Monte Carlo do not match.

Revised muonCand: 95% have >=1 muon found (igloo triggers)
69% have >=1 in data.

31.) Gus: Calibration Issues

?? HiTOT begins too late (15-30 PE depending upon PMT)
- Physical threshold at ~7 PE
- Lo TOT has poor resolution and large tail above 7-10 PE

?? PEMAX distribution is sensitive to calibrations
  - Spectrum based calibrations show no first peak
  - Laser calibrations show no first peak until MAX LOTOT imposed.
  - Position and amplitude of 2-peaks is sensitive to calibrations
  - Monte Carlo predictions are qualitatively correct but NOT quantitatively correct
  - Need to extend Hi TOT down to physical threshold
  - Roman and Lazar – may be possible using light from all laser balls to make TOT-to-PE calibrations.

?? Frequency distribution of PEMAX depends upon relative calibration of PMTs
  - Central PMTs are highly non-uniform in data
  - Adjust all Pes by: PES = Q(i)*PES. Where Q(i) is PMT dependent correction.
  - Derive Q's by aligning means of PMT PE distributions (only use 0-100 Pes to avoid problems with extrapolations).
  - Improve frequency distribution uniformity by factor of >3.
  - Remove 17 outlier PMTs (>4 sigma) and uniformity matches that predicted by Monte Carlo.

32.) GBY: Single Hadrons

a. t vs. r top layer
b. t vs. r bottom layer
c. log10(pesumbottom)
d. examples of single events

After 3 years of data we should have events up to 300 TeV.

Decision: Will strip these events to separate tape 0.6% of all data.

33.) GBY: Characteristics of proton triggers 0.1-10 TeV

~1 pmt / particle of >=5 Mev

~14 MeV/pe in air shower layer (no muons)

Energy distribution of electrons (50 MeV average) & gammas (35 MeV average)

Down to 5 MeV no turn over in number.

Core distance vs primary energy

Even at low energies get triggers out to 300 meters

34.) Frank: Computing at site
   a. Adding new computers at site to perform
      i. untriggered burst search.
      ii. Moon analysis
   b. At LANL adding new server and fast networking to whopper
   c. Perform speedy re-reconstruction

35.) Brenda: RXTE proposal
   Submitted a ToO proposal to RXTE
   Need to alert RXTE within 1 hour.

36.) David W.: Offline V50
   a. Structural changes to Code
      i. Use pointers to functions instead of switches
      ii. Initialize calibration data arrays outside of calibration routines
      iii. Read gzipped files
   b. Functional Changes to Code
      i. Add Greg's core finder
      ii. Add hit cleaning
      iii. Add more muon, gamma/hadron separation
      iv. Abandon MCASCII & MCASCII2
      v. Default curvature is 0.07 ns/m
      vi. Single Hadron selection

37.) Joe M: DelCA
   a. Deleo/2 is not our angular resolution
   b. Want to derive a function that parameterizes our resolution function from data
   c. DelCA:
      i. Is sensitive to curvature
      ii. Possible core fitter
   d. Used V22 of Monte Carlo
   e. Split tubes along line from core to pmt weighted average of shower.
   f. Trial function delangle = sqrt((deleo/2)**2 + (delca/2)**2)
   g. Is pretty well correlated with delangle

DelCA is sensitive to curvature

1. attempt to get curvature from data
2. perhaps find core

Future:

Use Greg's core locator to get angle to core
Then use delCA to find distance to core.

38.) David W.: The future of offline V50

a. Move to MPI system for offline and online
b. Get online and offline structures to agree

39.) Julie: Simulations

a. Old - V22, old water
b. New – V23, 24, & 25
    i. Small bug fixes
    ii. Use Michael's attenuation length measurements (no scattering)
    iii. Extra header information
c. For Milagrito use V22, 24, or 25
d. For Milagro use V23, 24, 25
e. 24 and 25 have a switch to go between Milagro and Grito
f. 25 allows you to use batch
g. Standard set at Wisconsin now
    i. 1000 x 1000 throw area
    ii. E^-2.4 for gammas
    iii. E^-2.7 for protons
    iv. 0.1-100 TeV for gammas
    v. 0.01-100 TeV protons
    vi. Assumes layer of air
h. Other stuff
    i. Large throw area (10,000 x 10,000)
    ii. No air layer between water and cover
    iii. Low energy
i. The crowd calls for more triggers!!
    i. Wgt showers (throw on E^-2.0 spectrum)
    ii. Start at 50-100 GeV
j. Proton Simulations - Includes layer of air between cover and water
    i. 1.3x10^8 throws between 10 GeV and 100 TeV
    ii. 500 triggers above 65 tubes
    iii. Starts at 10^1.5 GeV (2 triggers)

iv. Peaks at 1 TeV (60 triggers)

k. Proton simulations – no air between water and cover

i. 1.5 x 10^7 throws between 50 GeV and 100 TeV

ii. ~500 triggers above 65 tubes

iii. Start at 10^1.6 GeV (2 triggers)

iv. Peak at 10^3.2 GeV (70 triggers)

l. Trigger rate

i. Predict 934 Hz for 65 PMT trigger (with air between water and cover)

ii. 934/1.76 Hz for 65 PMT trigger (no air between water and cover)

iii. Deleo: simulated showers with no air seem to fit too well

m. Gamma-Ray Simulations

i. 2x10^7 throws from 100 GeV to 100 TeV

ii. 7000 triggers > 65 PMTs

iii. Starts at 100 GeV

iv. Peaks at 10^3.8 GeV

v. Mean 10^3.77 GeV (0-45 degrees)

vi. At zenith peaks at 1 TeV (mean 10^3.3 GeV)

n. Effective Areas

i. Vs zenith angle (800 m^2 at zenith, 80 m^2 at 43 degrees)

ii. Vs. Energy (1 m^2 at 100 GeV and 10^4 at 100 TeV)

iii. Under estimated at high energies (100 TeV) due to insufficient throw area

iv. Sensitivity vs. Declination

1. Events / day from source
2. Bkgd from data
3. Median energy vs dec, (6 TeV for sources that go near zenith)
4. Flux sensitivity vs. declination for 1 year (3x10^-10 gammas/m^2/sec (above 6 TeV) for dec of 40.)

v. Sensitivity

1. 3 sigma limits
2. 0-15 degrees:
    a. 1s 6.2x10^-7 ergs/cm^2/s
    b. 10s 6.6 x 10^-7 ergs/cm^2/s
    c. 100s 3.6 x 10^-6 ergs/cm^2/s

Simulations: What to do

1.) Cover/air, time profile

2.) Muon signals

3.) Tchi, NHIT, PE distributions
4.) Helium/CNO

40.) Frank: Moon over Milagro
   a. NFIT>20
   b. –9 sigma from online reconstruction all data up to mid summer
   c. Centered at 0.0 dec and –0.2 in RA (RA – RA_Moon = -0.2)
41.) Rob: WACT Status
   a. What we did
      i. Cabling
      ii. Buildings
      iii. Trenching
      iv. Rails and wheels
      v. Mirrors and frames
      vi. Aligned 2 mirrors
   b. Need to do
      i. Align remaining mirrors
      ii. Electronics
      iii. Camera
      iv. Bases
      v. Survey
42.) Tony: Outriggers
   a. Current design
      i. Overall layout
         1. 178 outriggers
         2. 66 inner outriggers 8-15meter spacing
         3. 112 outside of inner fence
         4. lightning protection for outer array only
            a. Currently uncertain: see Don C's email
      ii. Detector design
         1. 8' dia water tank
         2. 2.5' of water
         3. 8" PMT at center top
         4. Feed through for RG-59 uses 2 PVC fitting
            a. Need to check light-tightness of Michael feed through
         5. Feed through for fiber using ST connector
            a. Can be unplugged for calibrating with a standard fiber

        b. Need to check light tightness of this feed through
      6. Kits built at Irvine to install in tank
        a. Curtain of Tyvek with sand-filled pipe at bottom
        b. Air filled PVC at top
        c. 4 support pieces of PVC
      7. Scott put one together in ~10 minutes
    iii. Interface to DAQ and calibration system
      1. calibrated using laser light
b. Summary of work done to date
  i. At site
    1. Trenching for inner array
    2. Cabling for inner array
    3. For outer array complete to inner fence
    4. Trenching for fibers done
    5. 70 tanks ordered and received
    6. Electronics re-arranged
      a. Crate and power supplies installed for FE boards
      b. HV pod in place
      c. Installed CAMAC crate for scalers
  ii. Elsewhere
    1. UMD
      a. RG-59 cable ordered and received for inner array
      b. Optical fiber ordered and received at site
      c. Fiber feed throughs, connectors ordered. Soon to be received
    2. UCI
      a. Tyvek-PVC structure
        i. Design done
        ii. Materials ordered and received
        iii. 85% complete
      b. Design of PMT support and feed through
c. Summary of work to be done
  i. Inner array
    1. UCI
      a. Complete Tyvek structures
      b. Drive all parts to site

c. Install tanks

2. Site
    a. Fibers installed
    b. Deploy tanks
        i. Position
        ii. Level
        iii. Install Tyvek
        iv. Assemble PMT, pmt support & feed throughs
        v. Fill with pond water
        vi. Make light-tight and install tarp
        vii. Connectorize RG-59 cable in counting house
        viii. Connect fibers in laser shack
3. **Schedule**
    a. Complete by 4/18/2001
4. **Action items to make tanks useful**
    a. Survey
    b. Install electronics
    c. Calibrate
    d. Update calibration software
    e. Update reconstruction software
    f. Update monitoring program
    g. Trigger?

ii. Outer array

1. UCI
    a. TYVEK PVC structure
    b. Pmt supports
    c. Drive parts to site
2. UCSC
    a. Lightning protection: design/deploy
    b. Front-end electronics
3. UMD
    a. Thermal insulation of outer array cables design
4. Site
    a. Site prep
    b. Install lightning protection
    c. Cable layout
    d. Deploy tanks
        i. Prepare each site (level)

ii. Position each tank
iii. Install TYVEK
iv. Assemble pmt, pmt support & feed through
v. Install pmt support & connect RG-59 and fiber
vi. Fill with pond water
vii. Make light-tight install tarps

e. Connectorize RG-59 cables
f. Laser shack upgrade
    i. Design
    ii. Order
    iii. Build
g. Connectorize outer array fibers
h. Acquire calibration data

43.) Abe: Solar Events in Milagro

a. Response to solar events
    i. Receive alerts from neutron monitors, GOES, etc
b. July 14, 2000 event
    i. Seen in neutron monitors (GLE)
        1. Mt. Washington
        2. Durham, NH
    ii. See Forbush decreases with this event and previous event
    iii. Milagro HT scalers for muon and upper layers
        1. See nothing
        2. Rates are steadily rising
        3. Pressure is steadily decreasing
        4. We do seem to see the Forbush decreases (3-4% decrease)

44.) Julie: GRBs in Milagro

a. BATSE bursts
    i. 1.2 degree bin
    ii. No fit cut
    iii. Search area Briggs et al.
    iv. Duration from Huntsville comments (typically much longer than T90)
    v. Bursts with raw data re-reconstructed with V44
b. 17 GRBs in our field of view
    i. We have REC data for 12 of them (70%)
    ii. We have GRB data for 9 of them

iii. 2 that we missed because there was no GCN notice
iv. Distribution of probabilities – see nothing (10^-4.5 most unlikely)
v. /data01/grb/batse_triggered (at Wisconsin) contains REC & GRB data

45.) Matt W: IPN Bursts
a. IPN bursts with zenith angle < 45 degrees
b. ~10 bursts
c. 2 had BATSE ID numbers
d. We had complete data for ~7 bursts
e. Analysis has been done on 4 of them
f. Search 1 degree area with 1.2 degree radius bin
g. We see nothing (most improbable is 6%)

46.) Andy: All Sky Analysis
a. DC analysis – 30 Gevents
i. Mean = -.1797E-04
ii. RMS = 0.9986
iii. 10<=dec<=60
b. Blind GRB Search
i. Technique similar to PBH search
ii. Only look at bins with events
iii. Much faster for small timescales
iv. At smaller timescales < 0.3 sec use hit counting technique
v. Takes about 0.5-1 CPU to keep up with the data to search from .25ms to 39.8 seconds with 27 timescales
vi. End search for time gaps >0.1 seconds
vii. Temporal oversampling of 10%
viii. Total number of trials 1.5x10^18 (not independent)
ix. Most unlikely event at 0.631 second timescale
1. Probability 10^-14.5 (about factor of 100 beyond main distribution)
2. RA 199.9 dec 52.6
3. time 16700.548 day 1692
4. obs 10 events exp: 0.163 evts
5. Background rate was wrong
a. Total event rate dropped during end part of time used to estimate the total rate (averaged over 30 seconds)
b. If .16 -> .25 events probability goes to 2x10^13