GLAST Engineering Tower Beamtest 99

GLAST Team Meeting
Gary Godfrey
Berrie Giebels
March 20, 2000

Setup – Gary (10 min)

1) Participants, chronology, goals.
2) Integration and installation pictures.
3) ESA beams (e+,γ,hadrons) and experimental layout.
4) Particle ID
5) Event Displays (Positron, Gamma, Proton)
6) DAQ and online diagnostics.
7) Data samples collected.
8) Neutrons from EM showers in CsI

Some results – Berrie (20 min)

9) Summary of data analysis effort.
10) Tracker (noise occuppancy, effic, PSF)
11) Calorimeter (ped widths, minI, position and energy resolution)
12) ACD

Beam Test Shift Takers (51)

R. Arnold	D. Engovatov	M. Hicks	P. Nolan	T. Schalk	G. Winker
H. Arrighi	T. Fieguth	M. Hirayama	A. Odian	E. Silva	
E. Bloom	D. Flath	N. Johnson	G. Paliaga	J. Silvis	
P. Bosted	M. Frigaard	R. Johnson	P. Parkinson	Z. Szalata	
B. Bumala	B. Giebels	W. Kroeger	B. Phlips	D. Thompson	
J. Clark	S. Gillespie	D. Lauben	S. Ritz	D. Tournear	
N. Cotton	G. Godfrey	Y. Lin	S. Rock	H. Traudl	
A. Crider	E. Grove	C. Milbury	D. Rupke	T. Waite	
I. Dobbs-Dixon	T. Handa	A. Moiseev	J. Russel	J. Wallace	
R. Dubois	J. Hernando	M. Nikolaou	H. Sadrozinski	R. Williamson	

Chronology

Nov 15, 1999	Tracker + its TEM arrive at SLAC.
Nov 29	ACD, Calorimeter, + TEMs arrive at SLAC
Dec 6-16	Positrons (1.6, 2, 5, 10, 20 GeV/c)(6×10^6 triggers).
Dec 17-22	Photons (Tagged .05-16 GeV/c) (13×10^6 triggers).
Jan 4-31	Hadrons (12.5, 13.5 GeV/c) (45×10^6 triggers).

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Goals

Ö Test integrated DAQ in data-taking environment

Ö Provide a testbed for flight software concepts

Ö Demonstrate Tracker and Calorimeter self triggering

* Measure the total-system dependent noise in each subsystem.

* Protons: Validate MC sim on which pattern cut rejection is based

* Tracker: PSF (tails, non-normal incidence, superglast)

* Calorim: X,Y, and E resolution (non-normal incidence), dyn range

* ACD: Measure veto due to backsplash from CsI energy

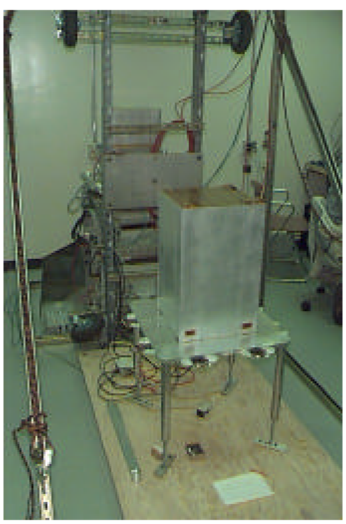
Ö Neutrons: Measure neutron hits in scint / CsI GeV

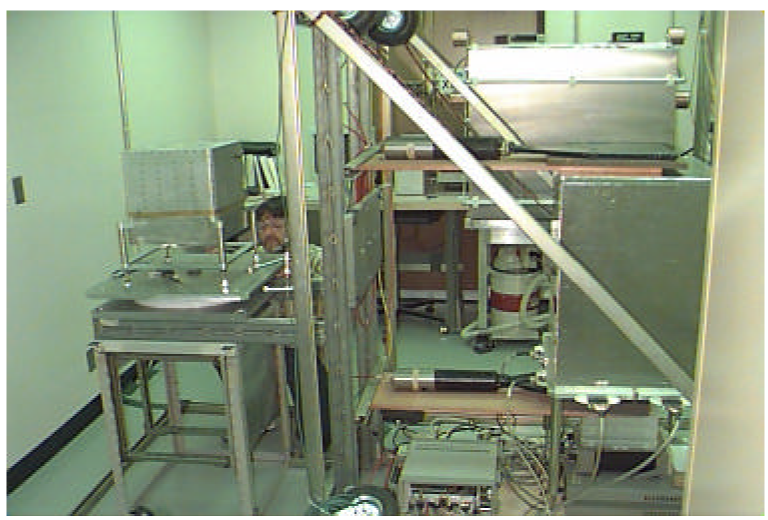
(Ö= Done * = Analysis in progress)

Integration and Installation Pictures

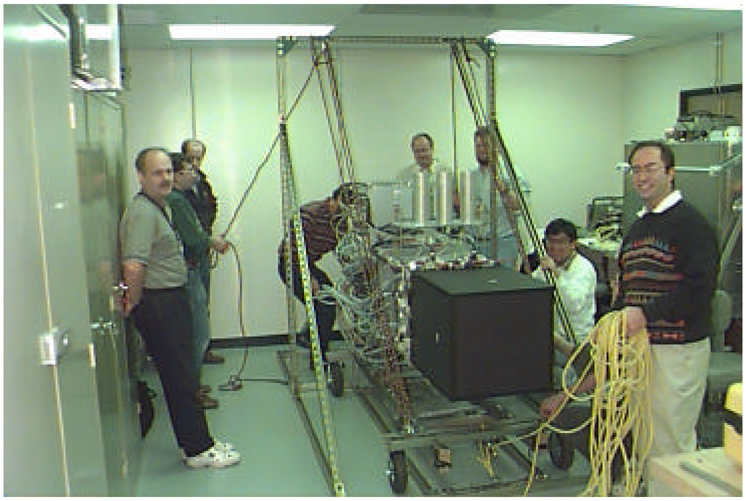
The Tracker, Calorimeter , and ACD arrive.

Integration begins.

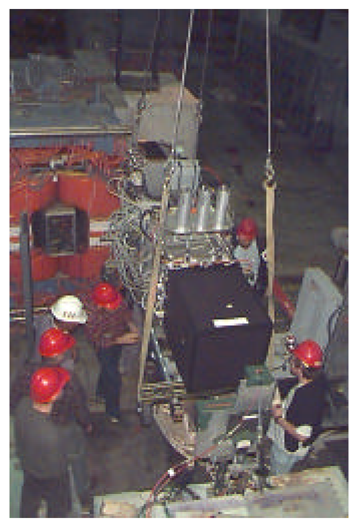




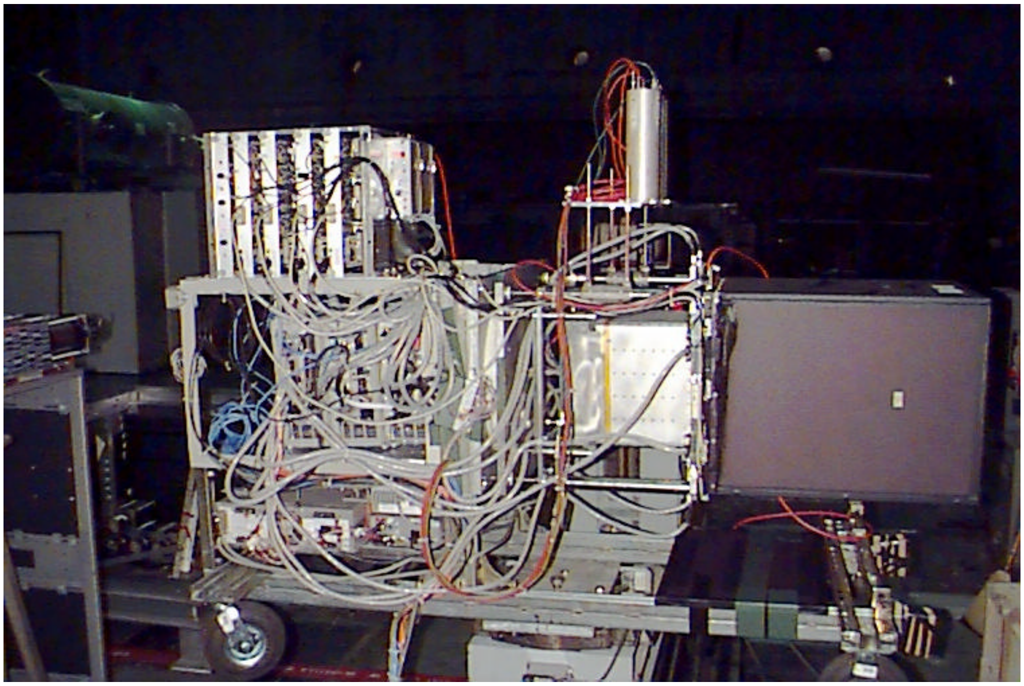
The Sleigh is lowered and leaves Central Lab



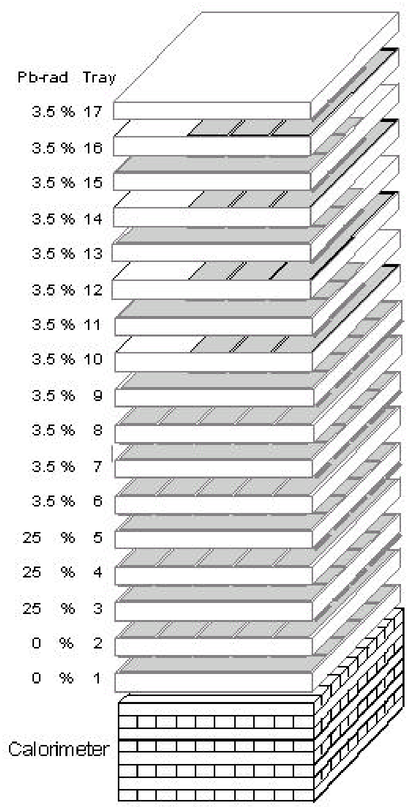
The Sleigh arrives at ESA and is mounted on Beamzilla.



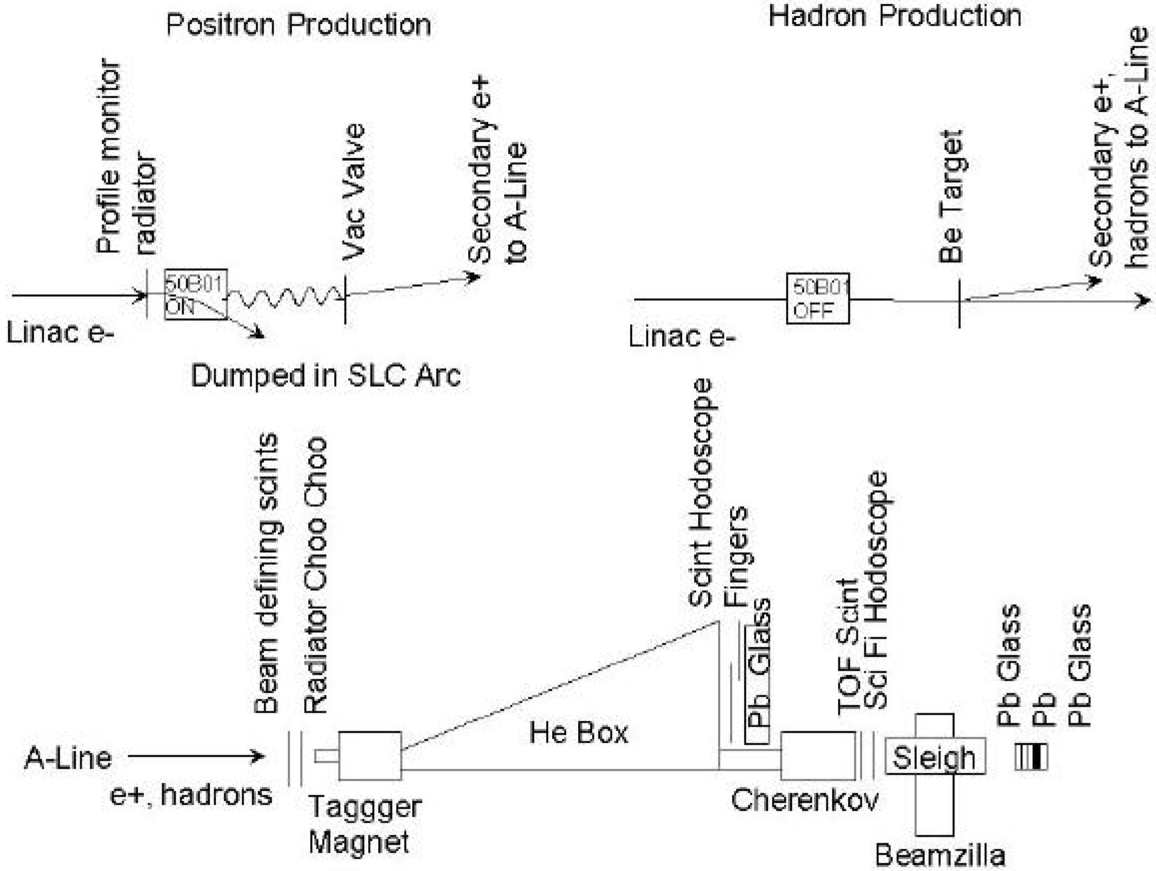
Ready for Beam

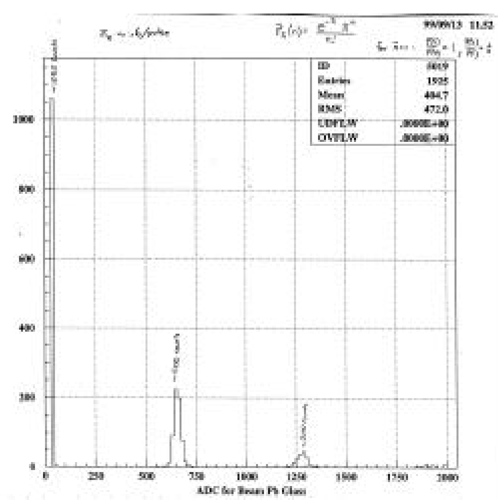


Beam Test Engineering Module Drawing



ESA Test Beams and GLAST Tower (Beamtest 99)

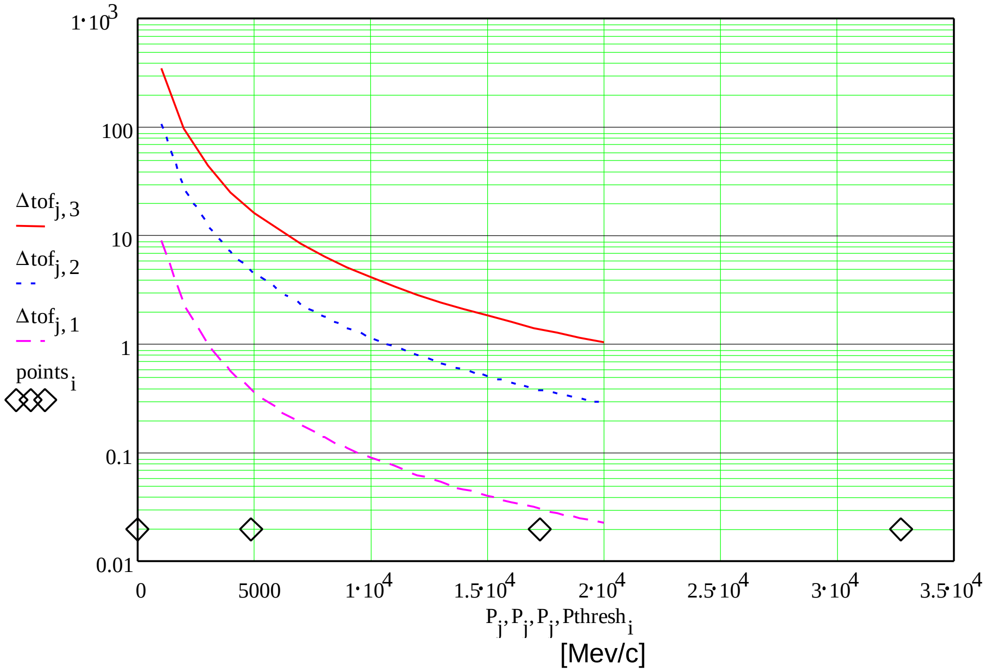




Beamline Pb glass block pulse height distribution for 10 GeV electrons. The Poisson statistics of 0,1,2,3 electrons per pulse peaks indicate the slits were set to an average of ~.6 electrons/pulse.

Particle ID

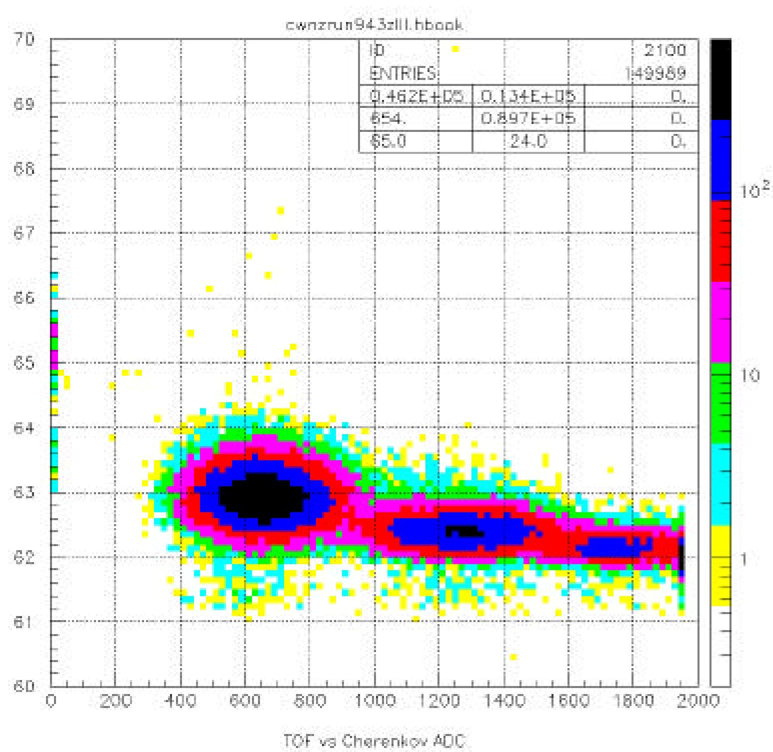
TOF [nsec] difference wrt electrons for protons (red), kaons(blue), pions(purple)



Diamonds: e thresh | pion threshold | kaon threshold | proton threshold

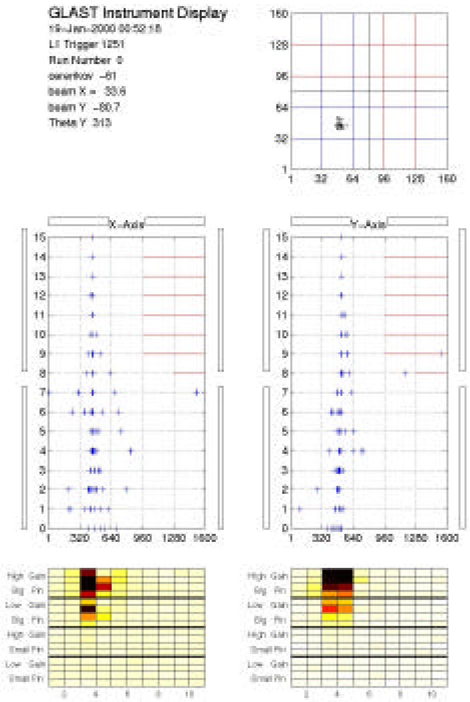
.02<P<5 Gev/c pi,k,p do not work Cherenkov. Tell pi,k,p apart by TOF.
5<P<17 Gev/c k,p do not work Cherenkov. Tell k,p apart by TOF.←13.5 GeV/c
17<P<33 GeV/c p do not work Cherenkov.

.0044 protons/pulse →

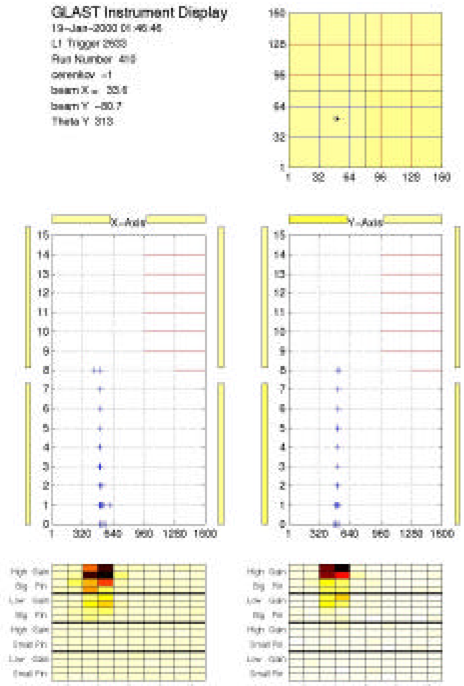


Event Displays

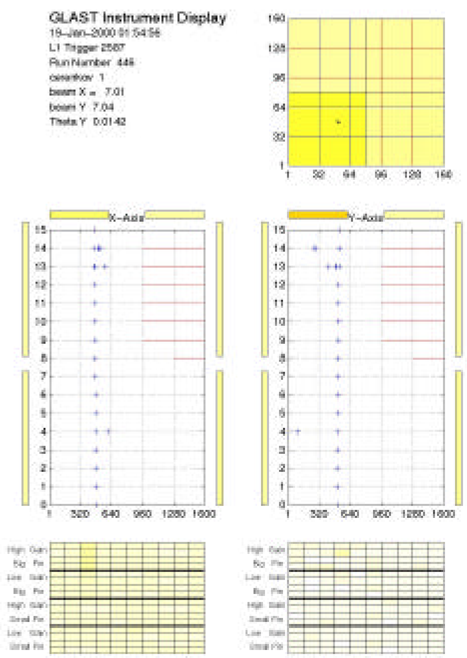
5 GeV/c Positron



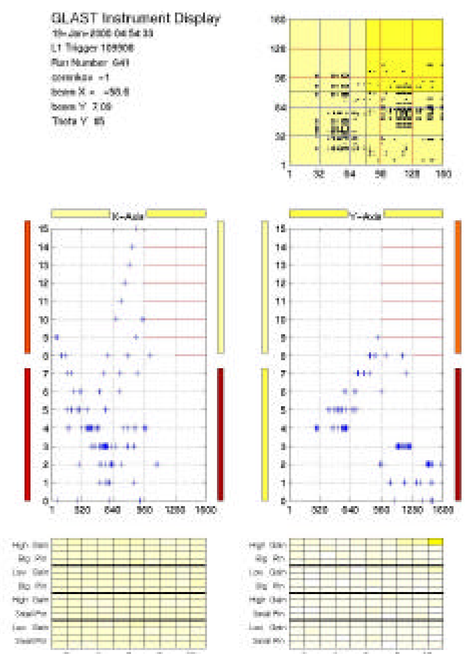
Gamma



12.5 GeV/c Proton



13.5 GeV/c Proton
(in side of superglast layer 4 to 3)



Run Time Diagnostics

ESA Paw plots (beam size, particles/pulse, tagger, particle ID)

PC IDL calorimeter event display

Sun Paw plots (tracker hits, strip occuppancies)

Matlab event display (tracker, cal, ACD) and strip occuppancy plots

Sun event display from GLASTSIM

What worked well on schedule

1) Three instruments developed in parallel at home institutions

2) Beam (Beamzilla, new target, safety approvals, beam scheduling)

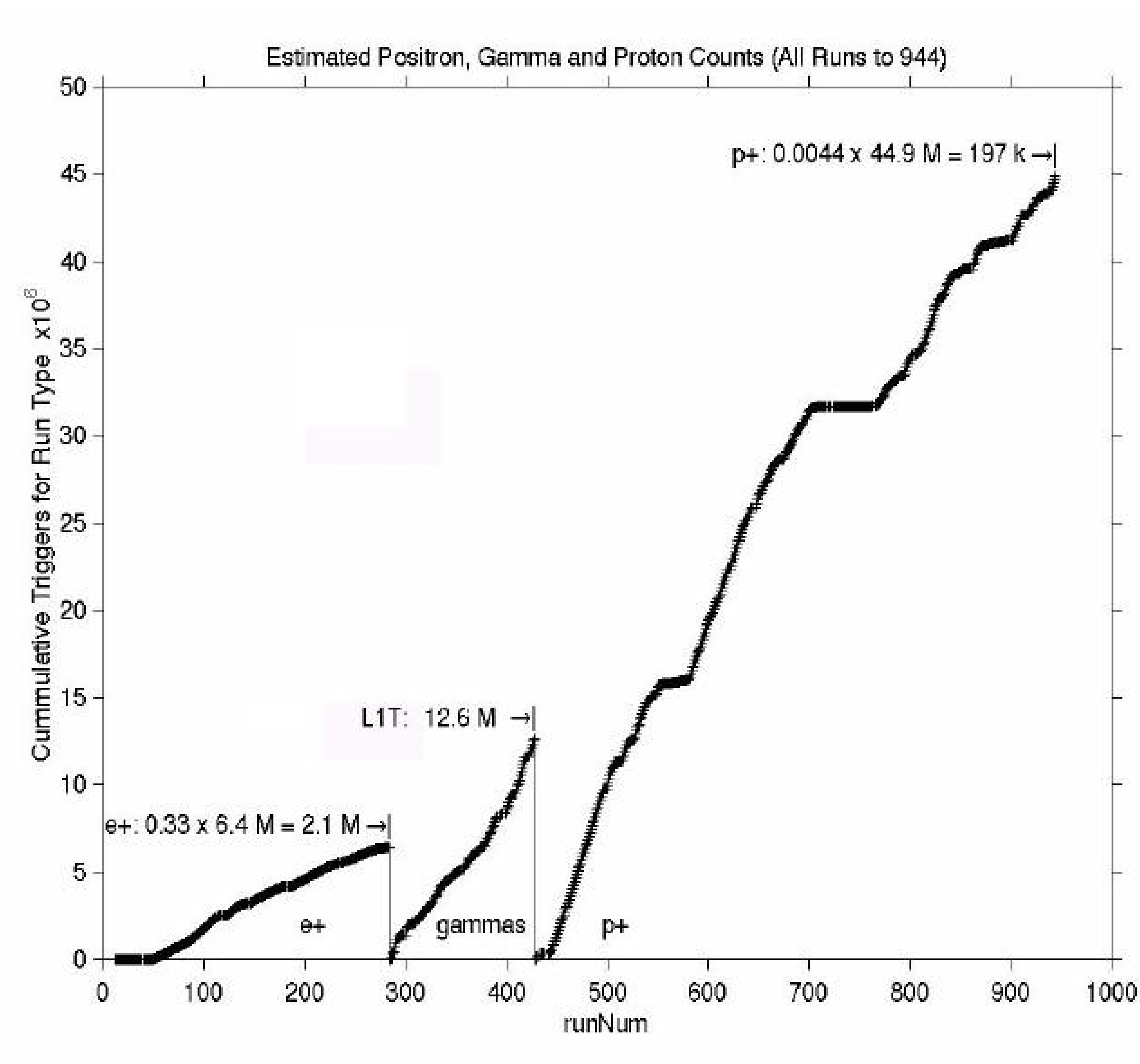
3) Mechanical Integration

What must be improved

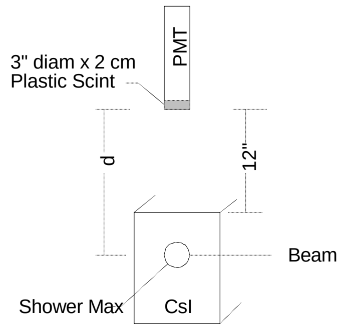
1) Software must be developed in parallel (not in series!) with the hardware.

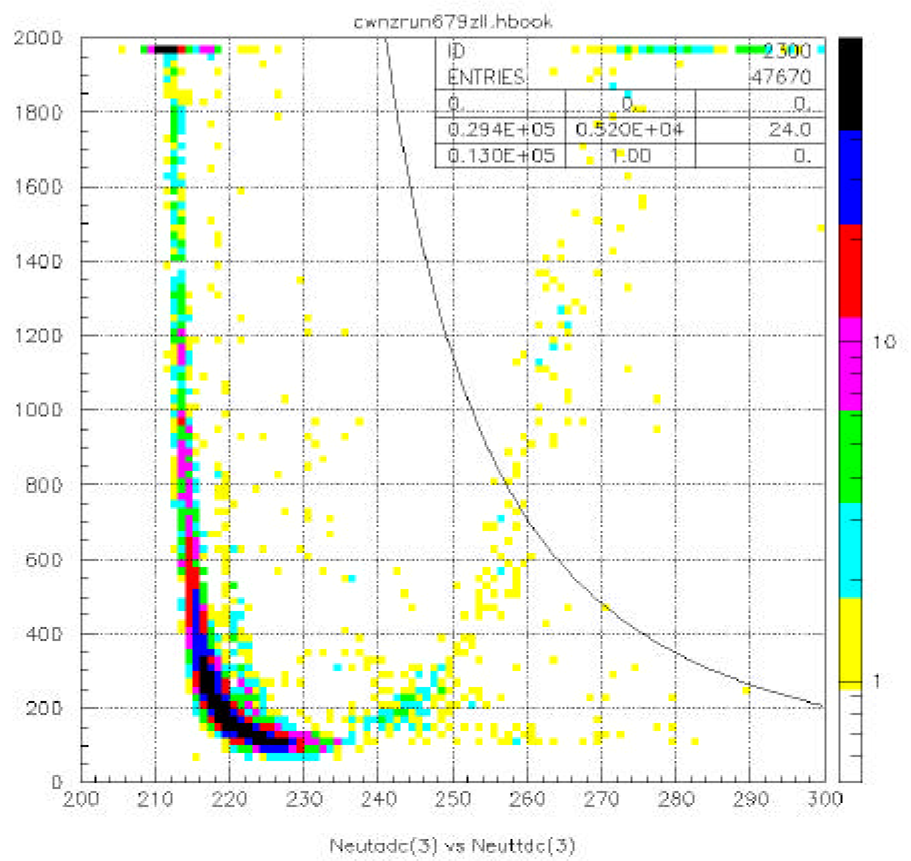
**Need detailed documentation of what software and hardware is to be built so both constructions can start together.

Data Samples Collected



Neutrons from EM Shower in CsI





Scintillator ADC versus TDC [nsec]. ADC chan 1800 is ~1 MeV. For this run 679 the scintillator is ~41 cm from shower max in the CsI, and the plot has been cut to have at least 13.5 GeV (the 1 e+ peak) in the CsI. 1)The curve is the kinetic energy of a neutron as a function of its time of flight. A hit proton in the scintillator will recoil with this energy or less. The scintillator will also saturate and record less than the true energy. 2) The prompt peak (gammas) is delayed for small pulses due to discriminator walk. A peculiar band rises up to the right and is thought to be due to the multihit tdc or due to gammas from elsewhere in the end station. 3) The remaining points beneath the curve are considered to be neutrons and are counted to see if they fall off as the square of the distances from shower max for various beam positions.

GLAST Beamtest 99 Neutron Detection

$i := 0..4$

$Run_i :=$ $ybzilla_i :=$

657	12.84
662	6.43
674	-.01
679	-6.41
684	-12.82

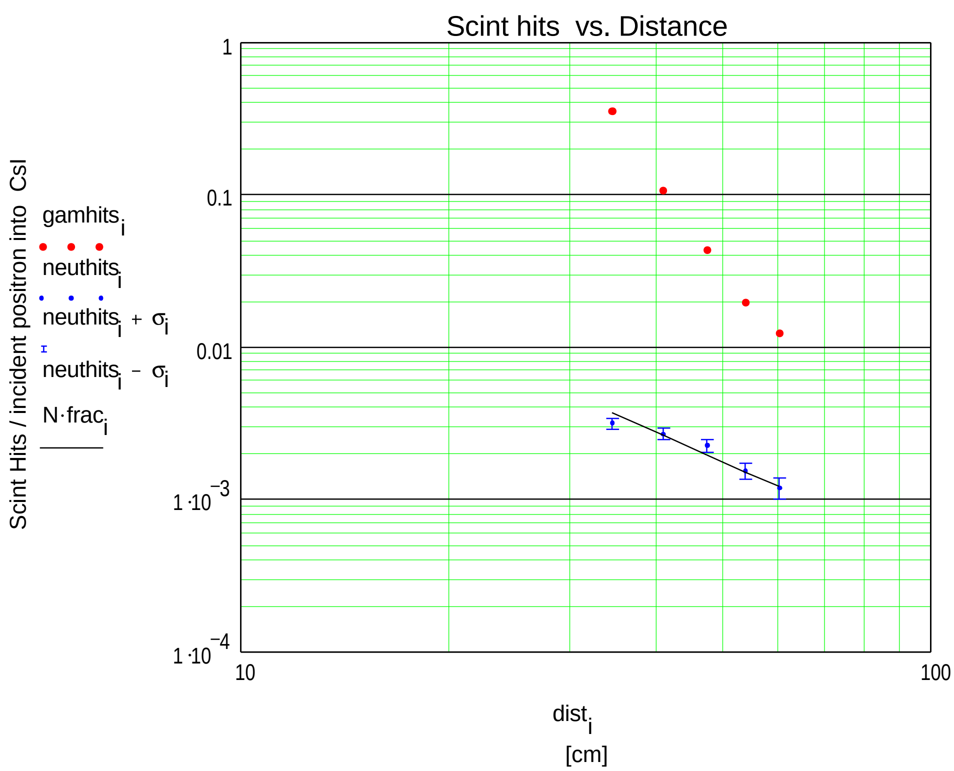
$$dist_i := 12.0 \cdot 2.54 + \frac{33.5}{2} + ybzilla_i \quad \text{[cm]}$$

$Run_i =$ $dist_i =$ $nelec_i :=$ $scinthits_i :=$ $neutrons_i :=$

Run_i	$dist_i$	$nelec_i$	$scinthits_i$	$neutrons_i$
657	60.07	33699	450	40
662	53.66	46401	974	71
674	47.22	46384	2120	104
679	40.82	47670	5200	128
684	34.41	43532	15600	137

$N := 1.2$

$$gamhits_i := \frac{scinthits_i - neutrons_i}{nelec_i} \qquad neuthits_i := \frac{neutrons_i}{nelec_i} \qquad \sigma_i := \frac{\sqrt{neutrons_i}}{nelec_i} \qquad frac_i := \frac{\pi \cdot \left(\frac{3 \cdot 2.54}{2}\right)^2}{4 \cdot \pi \cdot (dist_i)^2}$$



$$\frac{N}{13.5} = 0.089$$ [neutron hits in 4π x 2 cm thick plastic scint / GeV deposited in CsI]

Since ~.4 of 1 MeV neutrons interact in 2 cm of plastic, .089/.4=.22 neutrons/GeV were produced. This agrees with the pre-beamtest estimate of .2 neutrons/GeV.

Notice that the gamma hits fall faster than 1/dist^2 since the gammas are being attenuated by an increasing thickness of CsI as the distance is increased.