Beam Test Plan - SLAC End Station A Secondary Beams

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GLAST Collaboration Meeting

Available Beam

Max Primary Beam: 120 pps 48 GeV e-

Power cost + BaBar implies for most of our run a primary beam of:

30 pps 28 GeV e-

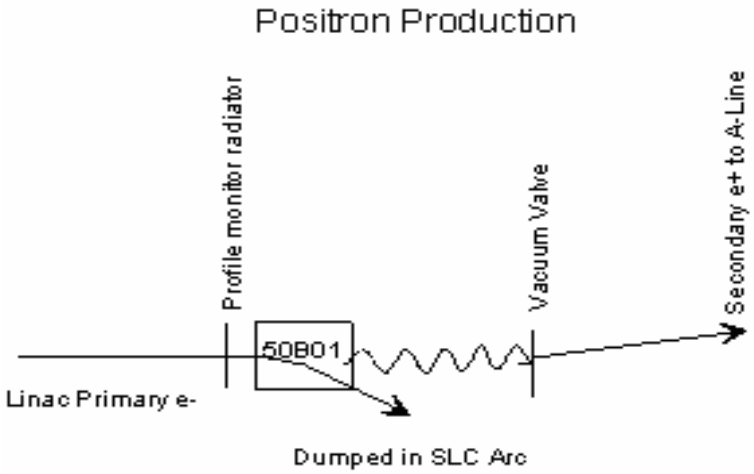
A-line momentum selects a secondary beam of:

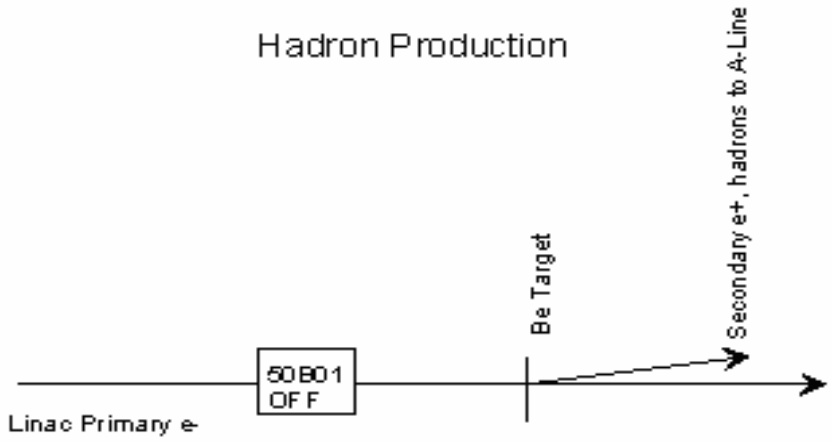
(target= profile mon + vac flange)
e+ (100%) (1 to ~20 Gev)

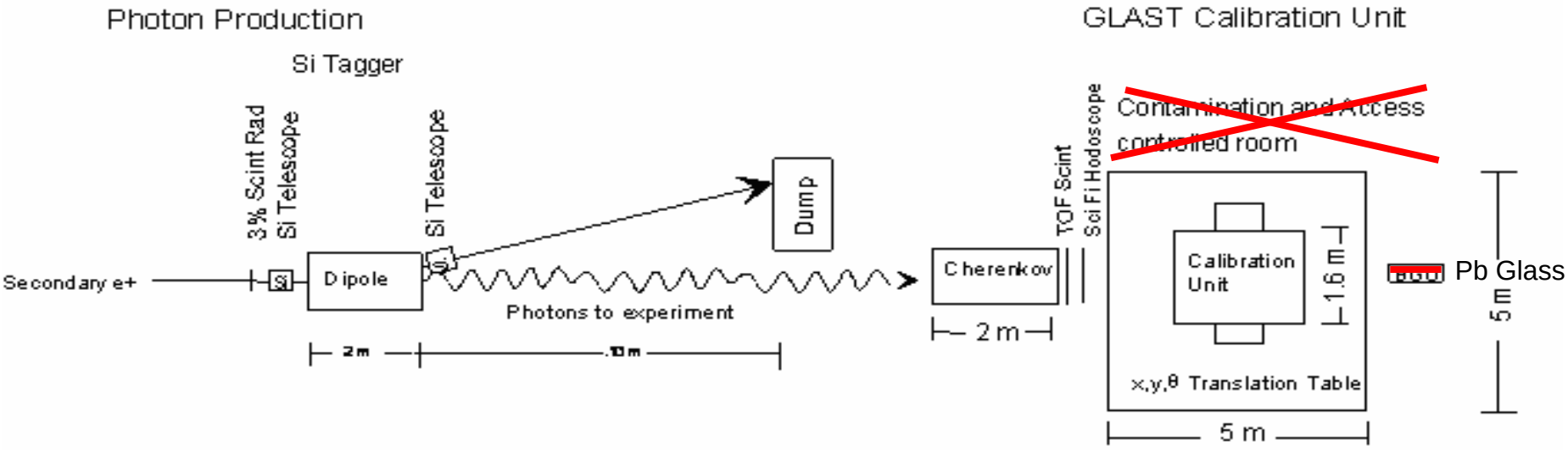
(target= Be)
e+(50%), π+(50%), p(.04%), K+(.01%) (1 to ~20 Gev)

$\Delta p/p \sim 1\%$ $\Delta\theta/\theta \sim 10^{-4}$ spot diam ~1 cm one pulse~10 ps

Layout


Positron Production
Profile monitor radiator
50B01
Vacuum Valve
Secondary e+ to A-Line
Linac Primary e-
Dumped in SLC Arc


Hadron Production
50B01
OFF
Be Target
Secondary e+, hadrons to A-Line
Linac Primary e-


Photon Production
Si Tagger
3% Scint Rad
Si Telescope
Si Telescope
Dump
Secondary e+
Si
Dipole
Si
Photons to experiment
2m
10m
GLAST Calibration Unit
TOF Scint
Sci Fi Hodoscope
Contamination and Access controlled room
Cherenkov
2 m
Calibration Unit
1.6 m
Pb Glass
5 m
x,y,θ Translation Table
5 m

The SLAC Test Plan

1 Month:

1) Calibrate the CsI energy response (various positions and angles)
   - Mono-energetic photons from the Van de Graaff (17.6 MeV)
   - Tagged photons (50 MeV to 1000 MeV) (from 1 and 4 GeV e+)
   - Single mono-energetic positrons (1 to 40 GeV),
   - Linac pulses containing multiple positrons (eg: 7 x 40 = 280 GeV).

2) Measure the Bremsstrahlung beam γ spectrum with the Calibration Unit.
   - Externally trigger CU on every beam pulse
   - 20 GeV positron beam with 3% radiator
   - CsI calorimeter (already calibrated) bins the γs in ±25% energy bins.
     (eg: 040, .060, .090, .135, .203, .304, .456, .683, 1.02, 1.54, 2.31, 3.46, 5.19, 7.78, 11.7, 17.5 GeV)
   - Variety of positions and angles
   - Compare to GLAST MC (energy spect and PSF) for e+ radiating in radiator.
   - Tagger magnet sweeps the <20 GeV positron beam into the dump
   - Simultaneously tags a limited range of photons (16-17 GeV).

3) Tag photons at a few different energies (just for backup)
   - 9 GeV e+ (Differential Brems subtraction) 5-6 GeV tagged γ
   - 11 GeV e+ (Tagged g at CU sweet spot) 7-8 GeV tagged γ
   - 18 GeV e+ (Differential Brems subtraction) 14-15 GeV tagged γ

1 Month:

4) 200 K protons (13 GeV) at a variety of positions and angles (~20 K per position)

Beam Test '99 - Beam Test Engineering Module

Results: Nuc Inst Meth A 474 (2001) 19-37.

~50 GLAST collaborators took shifts

SLAC End Station A
e+, γ = 1 month
hadrons= 1 month

194 um pitch SSDs (228 um now)
33 cm x 33 cm trays (38 x 38 now)

This is also the same tower flown in the balloon. BFEM=BTEM

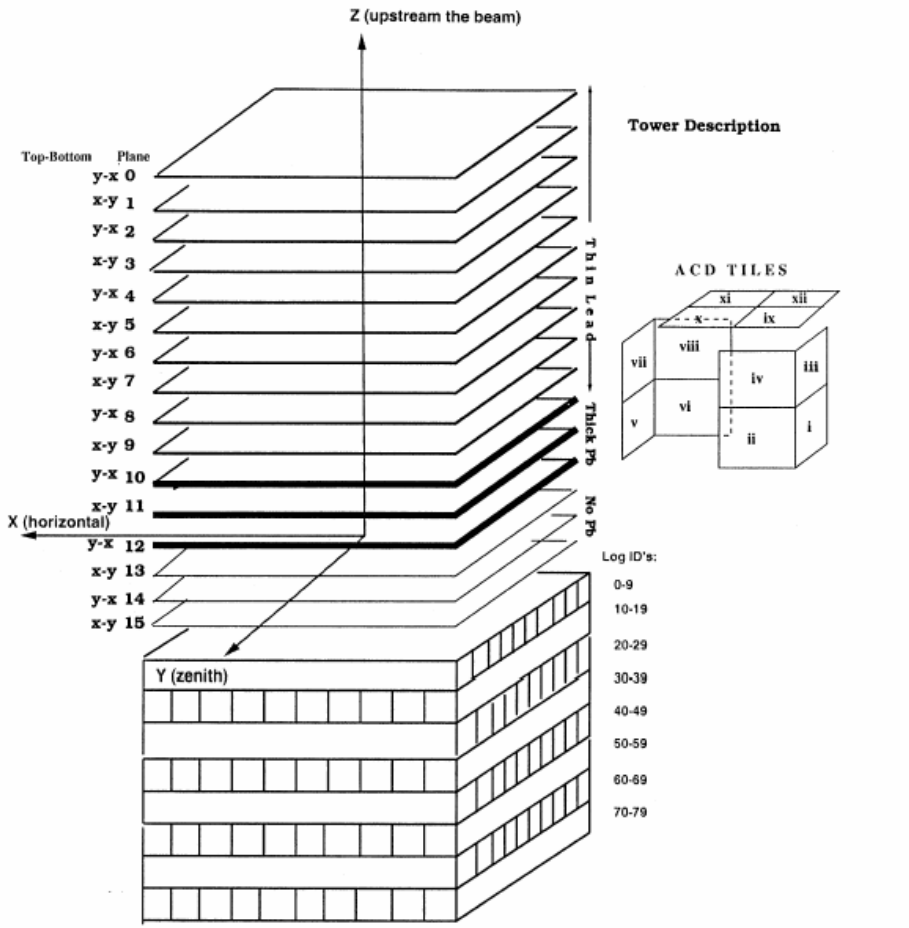
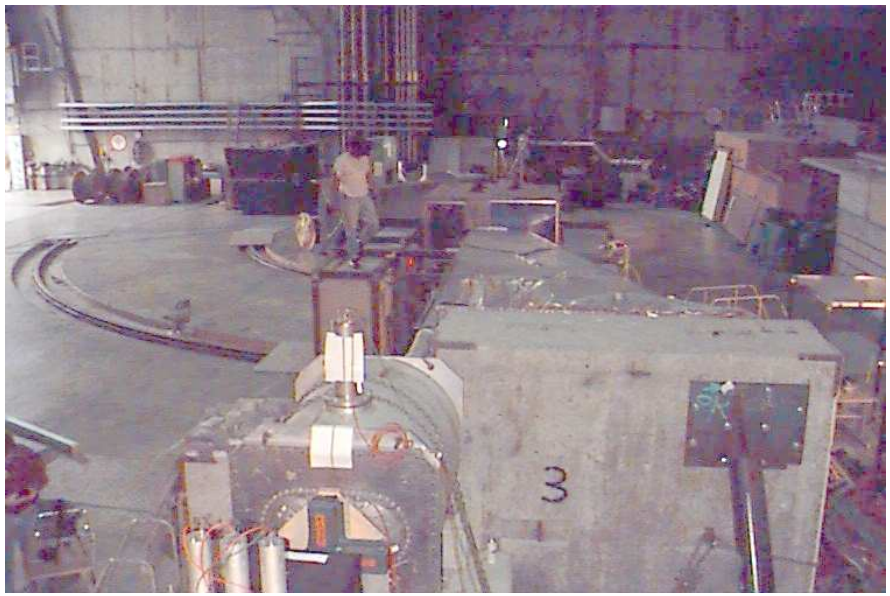
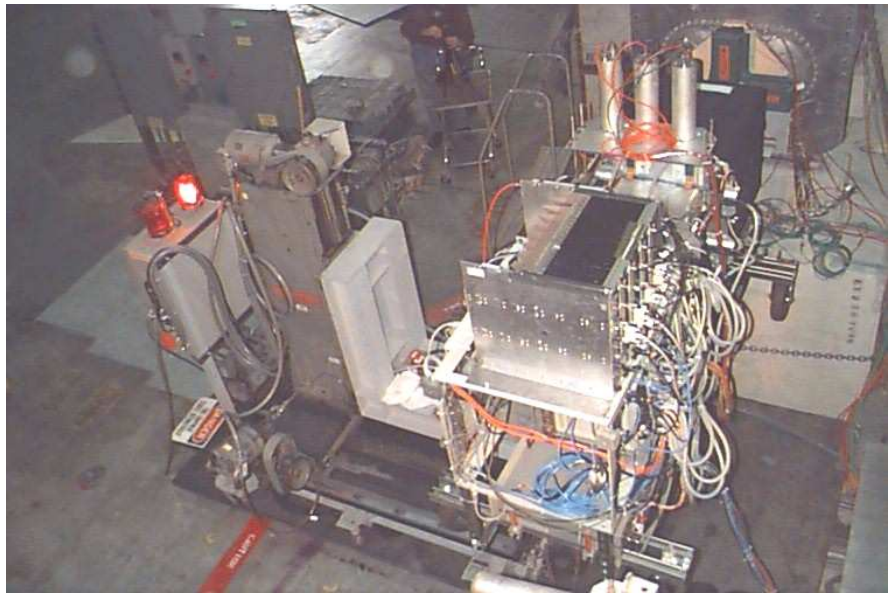


Fig. 1. A schematic drawing (not to scale) of the Engineering Model (BTEM). The ACD tiles are arranged in a "hat" configuration to enclose the silicon tracker.

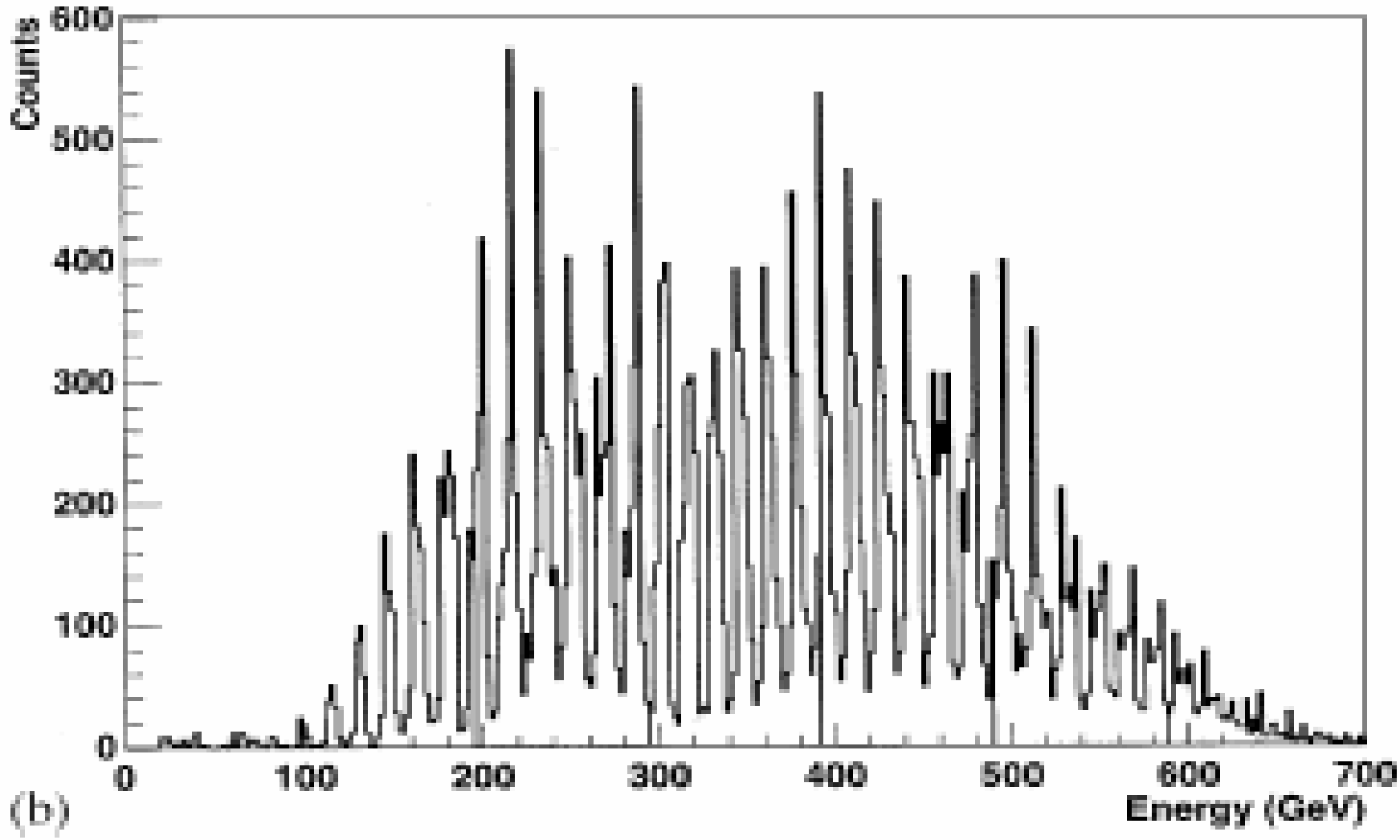
Beam Test '99 – Apparatus Pictures





Beamtest '99 - High Energy Cal Response

The A-line was set to 20 GeV. The mean e+/pulse was varied between 15 to 30.



Beamtest '99 – Measured Tkr PSF

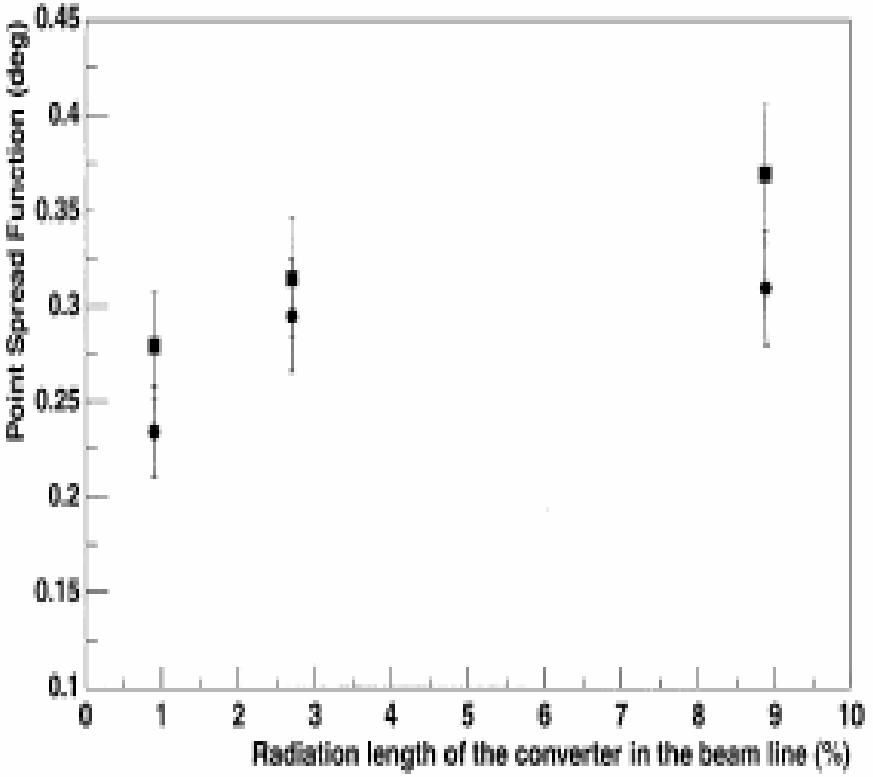


Fig. 17. PSF at 0° incident angle for 68% containment for three different radiators for 3.5 GeV (squares) and 5 GeV (circles) photons in the data.

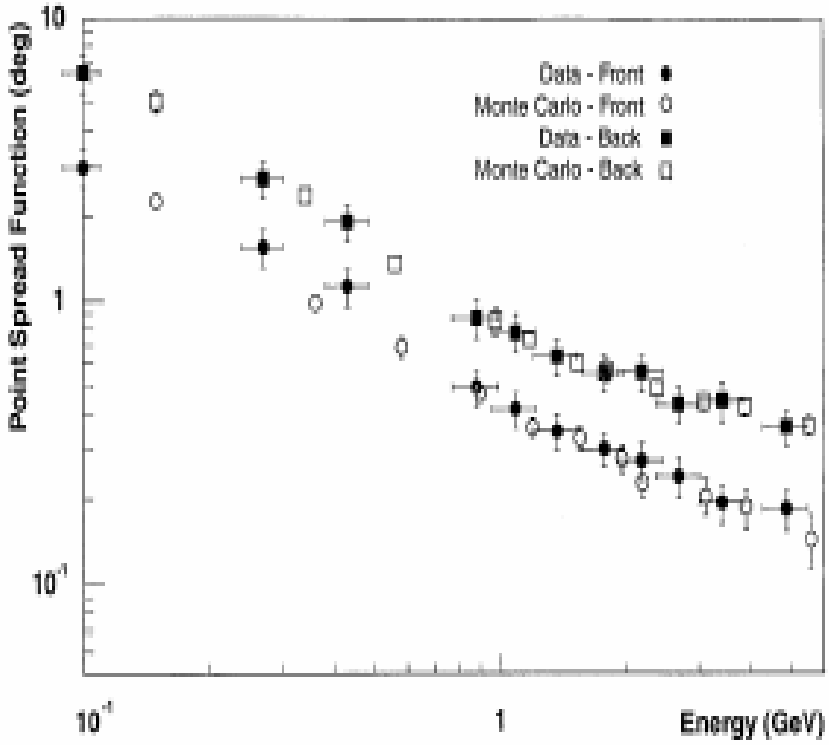
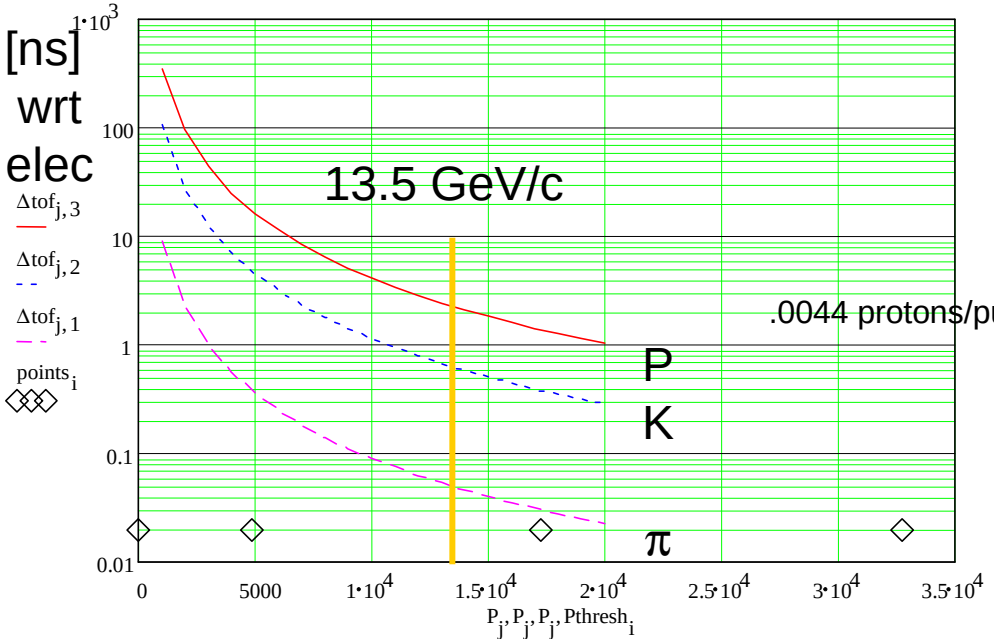


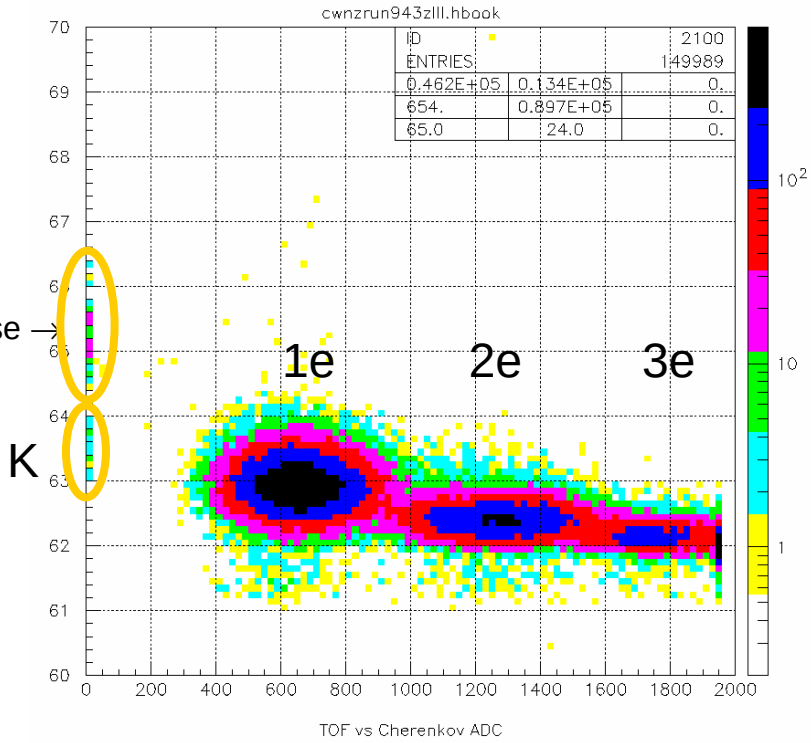
Fig. 18. PSF at 0° incident angle for 68% containment radius as a function of the reconstructed energy for both front and back sections of the tracker. Data points have been corrected for the thickness of the radiator in the beam line (see text).

Beamtest '99 - Particle Identification

.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.



e+ pion [Mev/c] kaon thresholds proton



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

Conclusions

1) A SLAC beam test will approximately be a repeat of the 1 Tower Beam Test '99 except with 2 ½ real flight like towers and electronics.

2) The highest single e+ into the Cal will be ~40 GeV. Energies up to 300 GeV will be multiple e+ per pulse and will have to be compared to a multiple e+ MC.

3) There will still only be 200 K protons (13 GeV/c) after 1 months data.

4) A SLAC run would be ~Oct-Nov, 2006 with setup during Spring+Summer.

Compare

	SLAC	PS (T9)	SPS (H4)
Energy Calib with e+	1-40 Gev (100% e+) -600 Gev (mult e+)	1 Gev (70% e) 5 Gev (10% e) 15 Gev (0% e)	8 – 300 Gev (>99%e) 200 Gev (99% e) 50 Gev (~95%e)
Brems γ	.01- 20 Gev	.01 - ~5 Gev	.01 – 300 Gev
Tagged γ	.05 – 20 Gev	.05 - ~20 Gev	No tagger installed?
Protons	200 K 30 x .0044= .01 Hz 13 Gev/c	~10^8 Can saturate trig →15 Gev/c	~10^8 Can saturate trig →300 Gev/c

SLAC: Few protons, no high random rate, multi e for high energy
PS+SPS: Beam purity(?), need two experiments to cover energy range