Signal and Background Simulation for LW and BSM

Lawrence Deacon

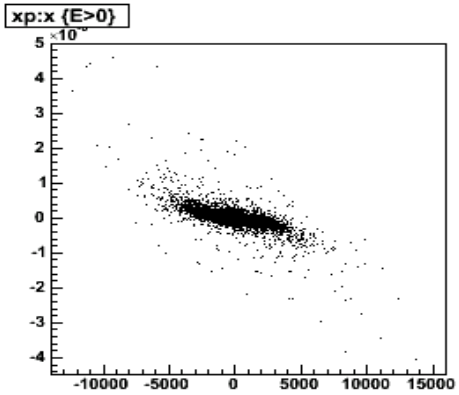
- Aims
- Halo
- Detectors
- Simulation
- Statistics
- Conclusion

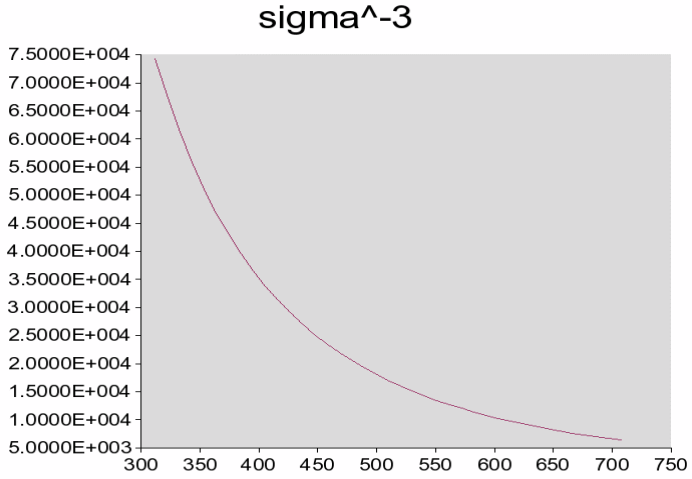
Aims

- I aim to predict the signal/ background levels for LW/ Shintake monitor at ATF2
- I am simulating background due to halo particles.
- Particles outside the core of the beam hit material along the extraction line and produce secondary particles which hit detectors.
- I am studying the effect of a halo distribution based on wire scanner measurements

Halo Distribution

- Made a halo distribution file by writing a ROOT macro-
- x, y
- x', y'
- z(=0), zp
- E, energy spread Distribution in x and x' was sigma^(1/r) starting at 3 or 4 sigma where r=3,4. This was based on wire scanner measurements at the extraction line
- x' and y' follow a similar distribution
- Defined by twiss parameters so that halo surrounds a central phase ellipse (core).

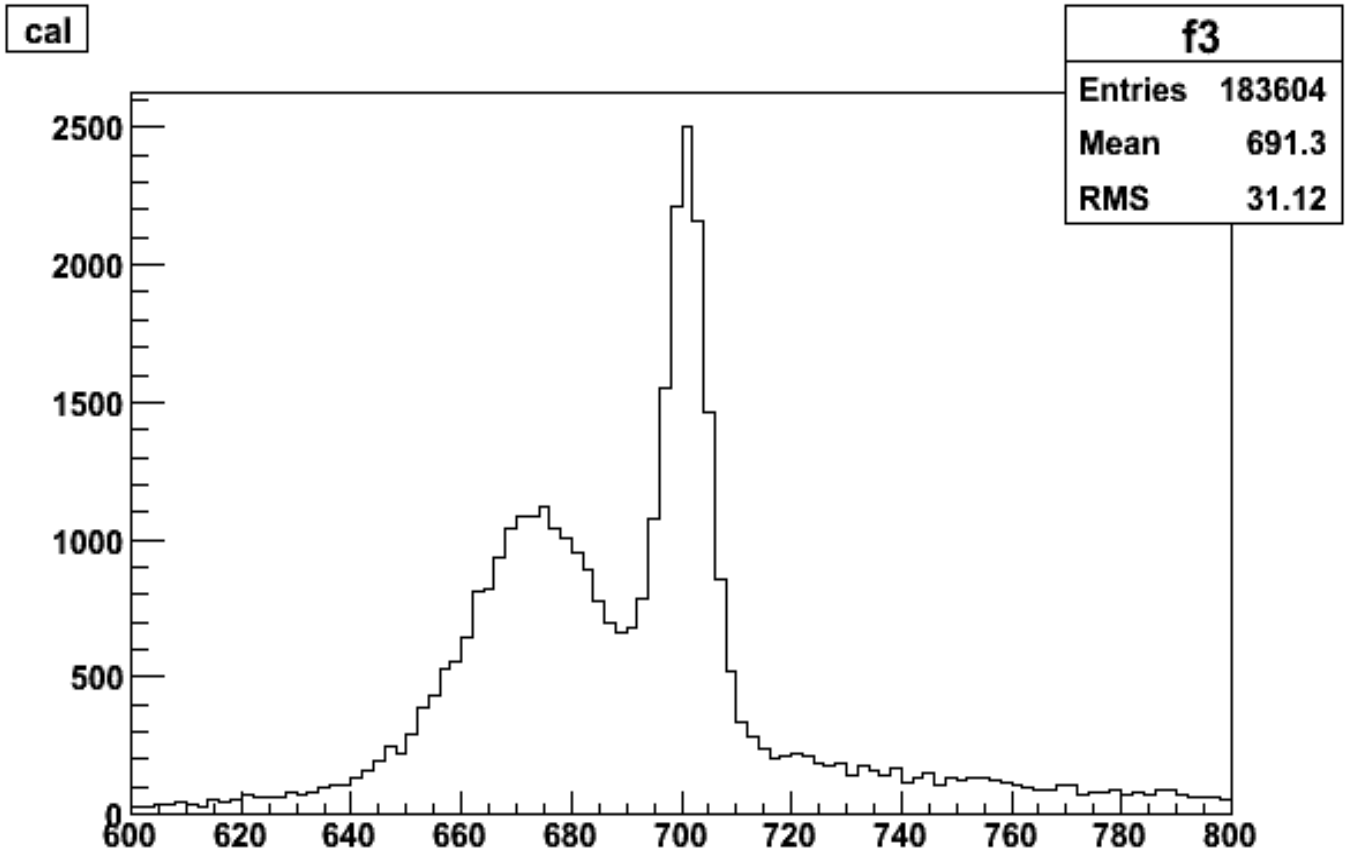




Detectors

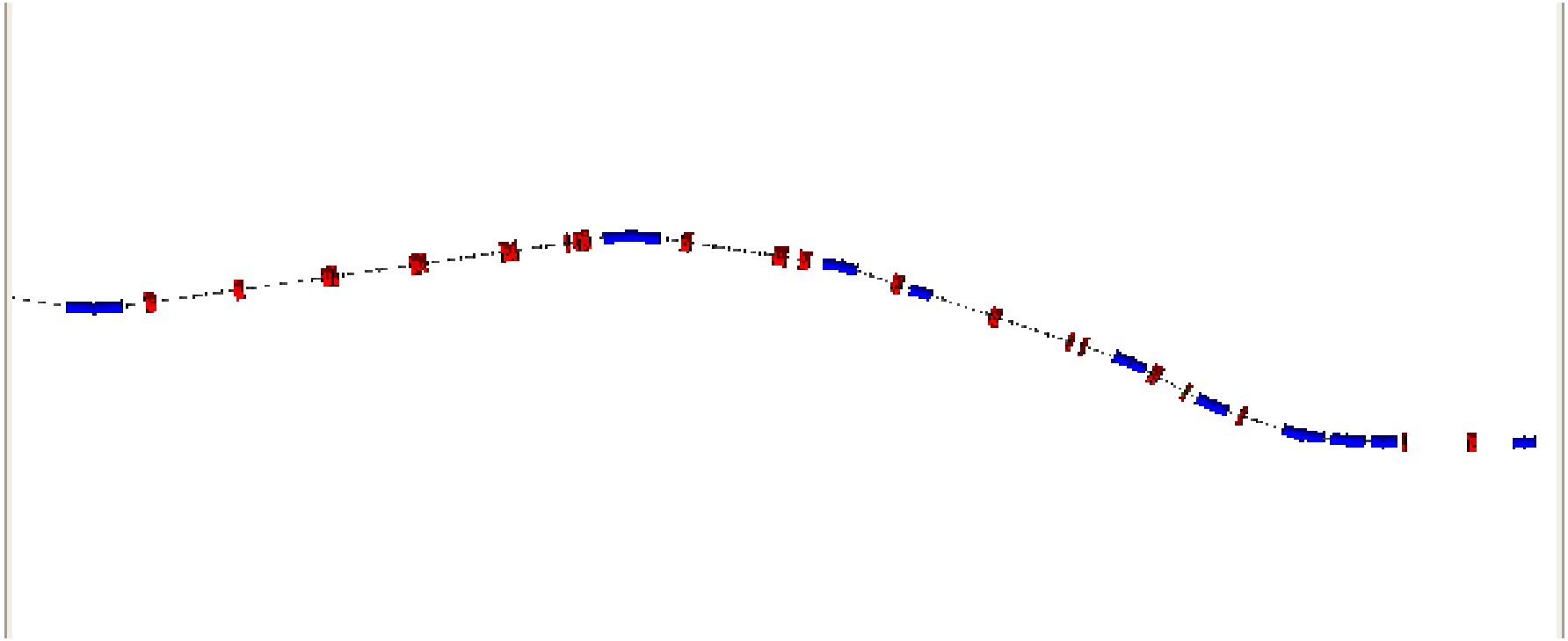
- Simulating the present ATF extraction line using BDSIM
- Have calibration data for calorimeter from cosmic muon source taken last week.
- Also have LW signal/ background data taken simultaneously in Cerenkov detector and Calorimeter taken on Wednesday
- I will use this data to verify the simulations
- If the simulations agree with the experimental data it should be straightforward to substitute the ATF gmad (bdsim file format) file for the ATF2 gmad file and carry out the same analysis in order to predict the background levels for various parts of the extraction line such as at the laser wire detector and Shintake monitor.

Calorimeter Calibration Using Cosmic Particles

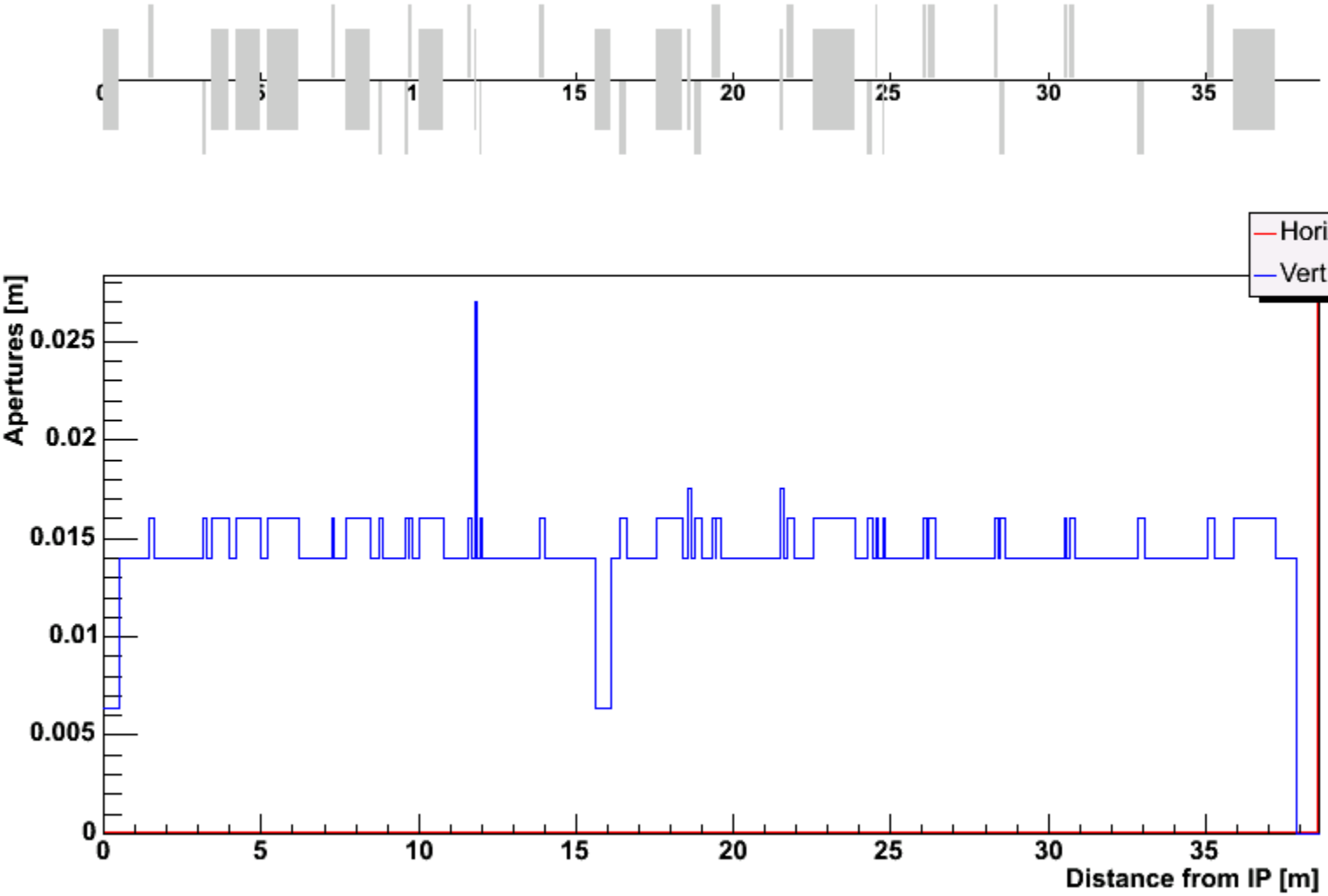


Simulation

- BDSIM gmad file based on ATF mad deck
- Used laser wire optics with small vertical electron spot size at laser wire
- Twiss parameters and emittances defined at start of simulation- these defined the distribution in phase space of the electrons



Apertures



Beam pipe radius is 14mm except in dipoles (where it is doubled)

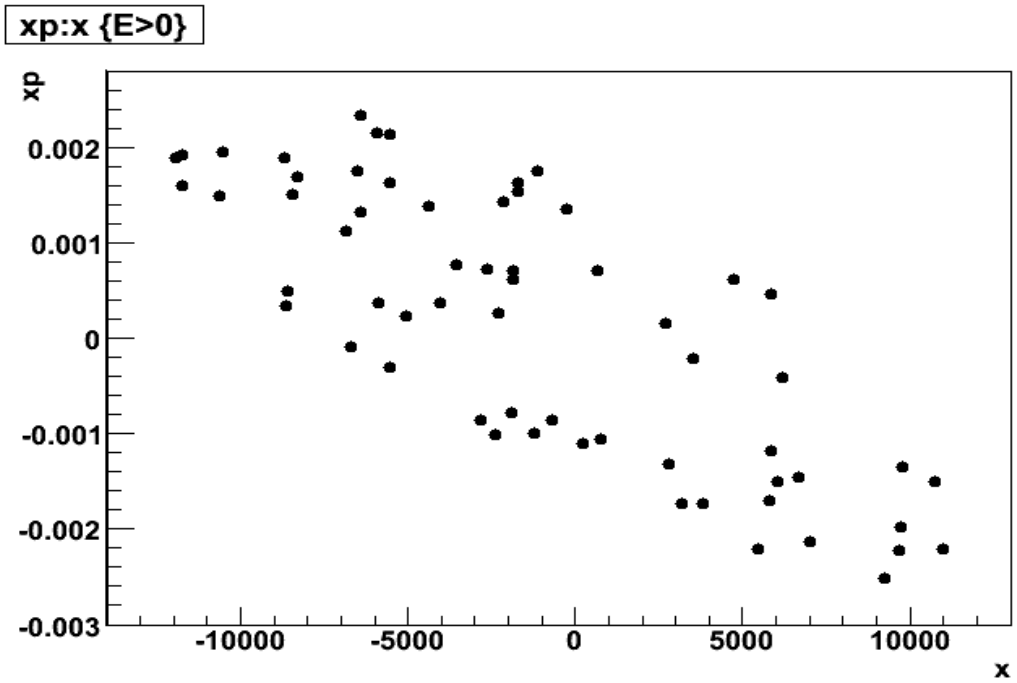
Statistics

- Most of the particles were getting though without hitting any material so were not causing any background
- Needed error in incident energy on detector was too large because of the small number of particles hitting the detector plane
- Simulating 1 million events took a long time and would need to and to extract the required information in this manner I would take need to run at least a hundred times this number of events
- I am solving this problem by putting greater weight on the regions of phase space that cause the most background in the initial bunch file and increasing the computing power by using the grid

Weighting

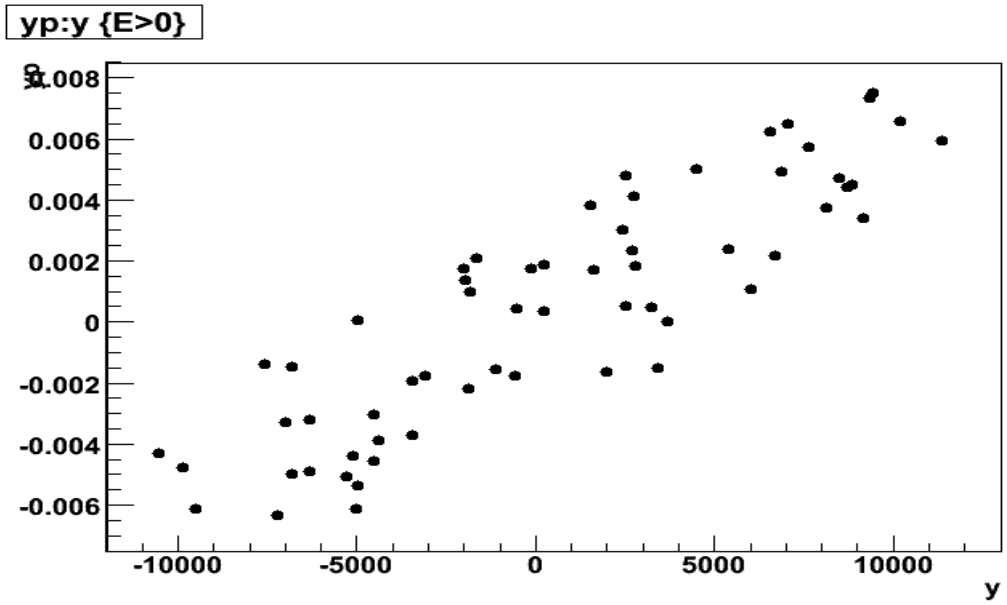
- I ran the simulation with a flatter distribution and the number of particles hitting the detector increased to about 50 particles per 59000 particles in input bunch.
- I wrote a macro to make spatial cuts, write an event list and plot the resulting x' : x distribution

Weighting

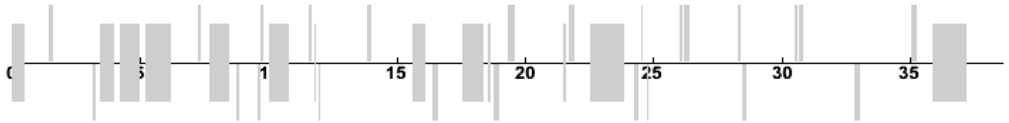


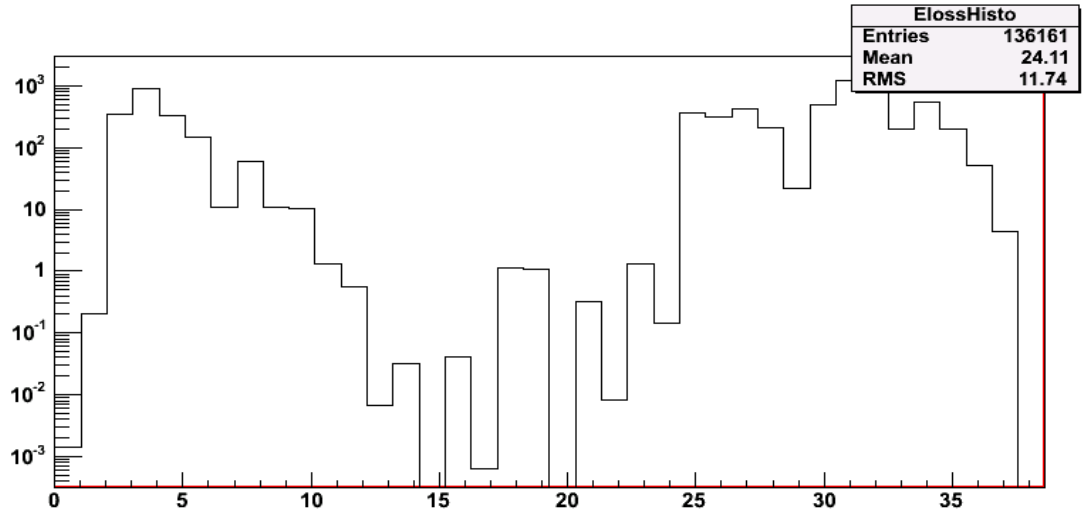
- Can reduce the amount of CPU time required by putting more weight outside the central region.
- Will run simulation again with this weighting and sigma^(1/r) distribution
- Will then need to normalize depending on the precise distribution.

Weighting Regions of Phase Space



- Little dependence on y/ yp





left: Energy loss vs Z. 1/r^3 halo distribution.

below: sigmaX and sigmaY vs Z (from ATF mad deck).

deacon, Wed Nov 1 09:34:12 GMT 2006 BDSIM input

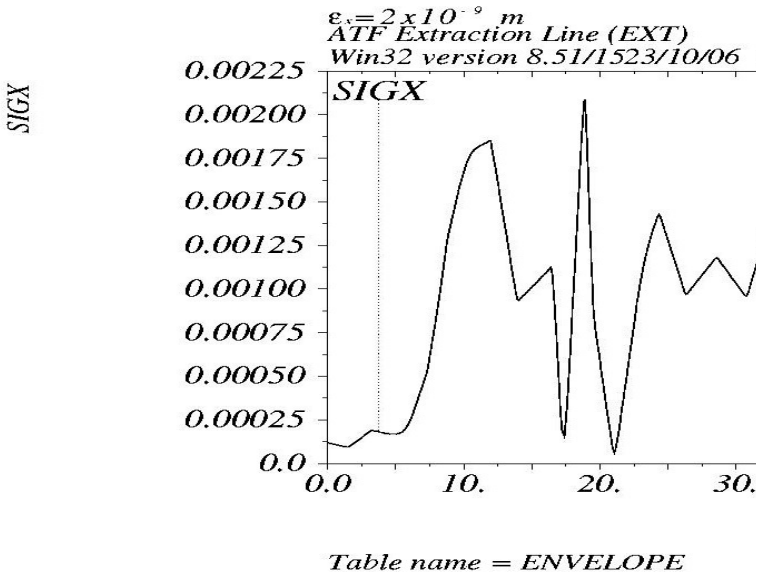


Table name = ENVELOPE

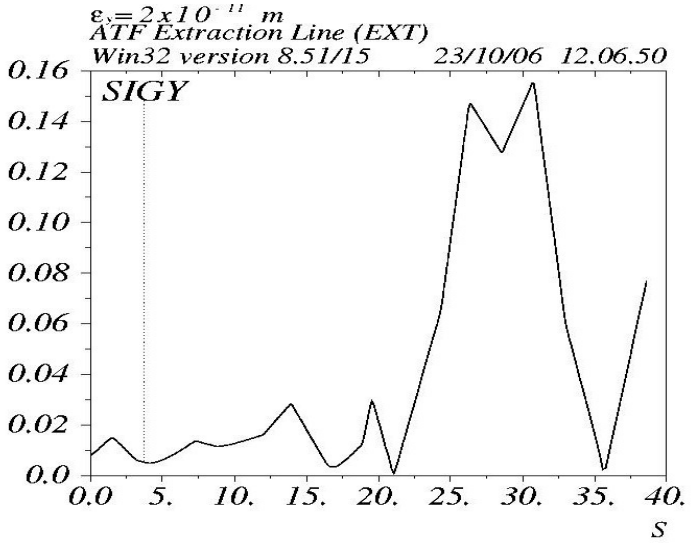
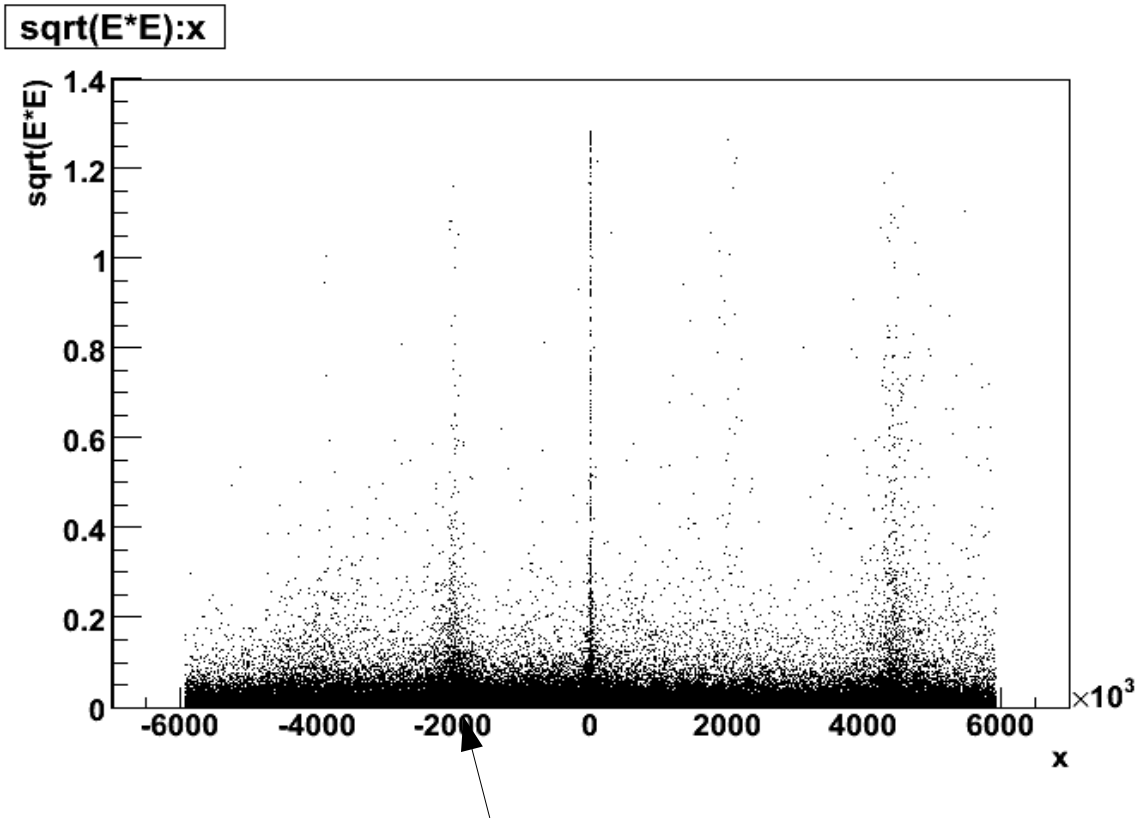


Table name = ENVELOPE

Energy Deposition in x at current (ATF) laser wire detector

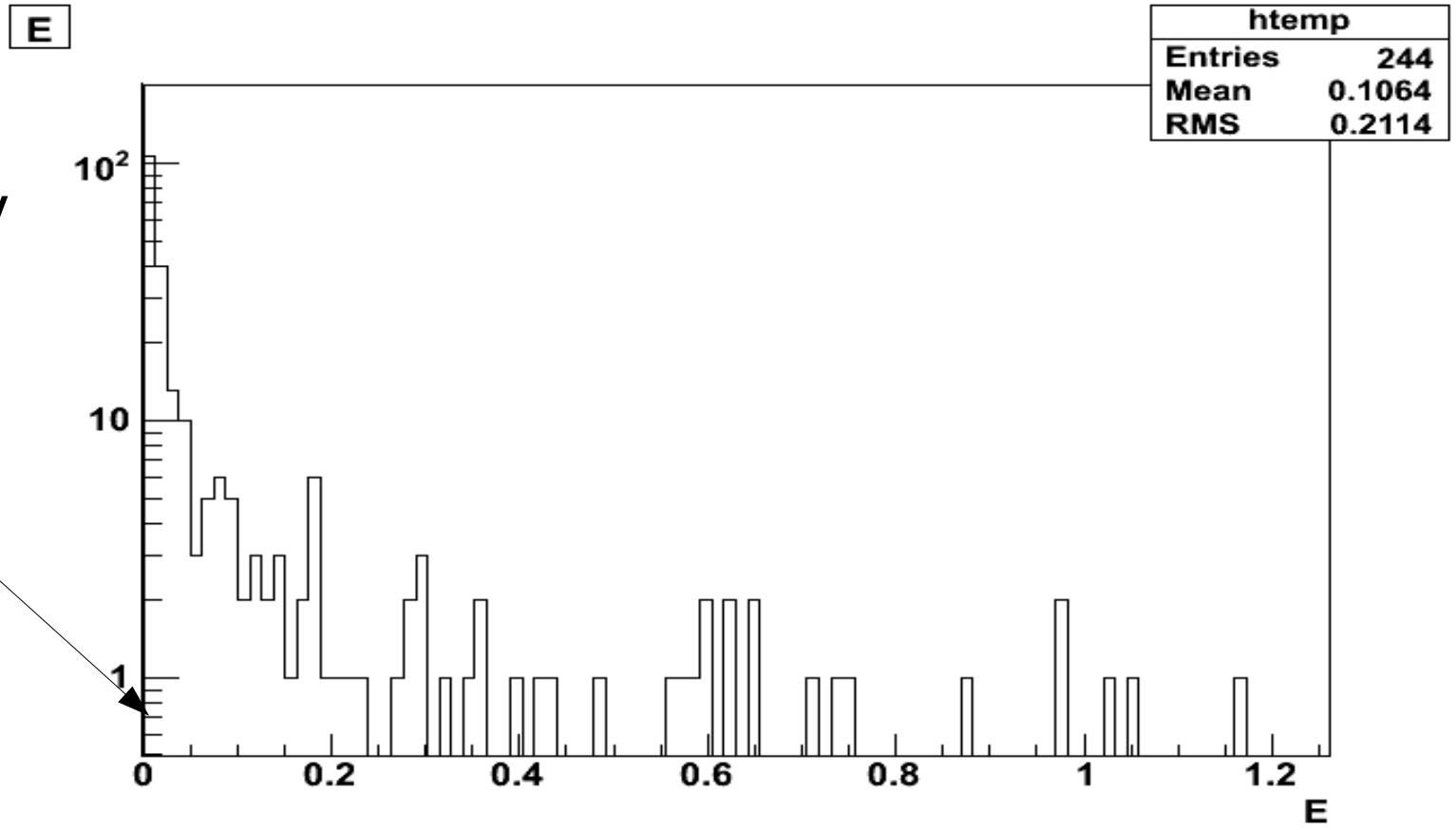


laser wire detector

- From flat distribution input bunch

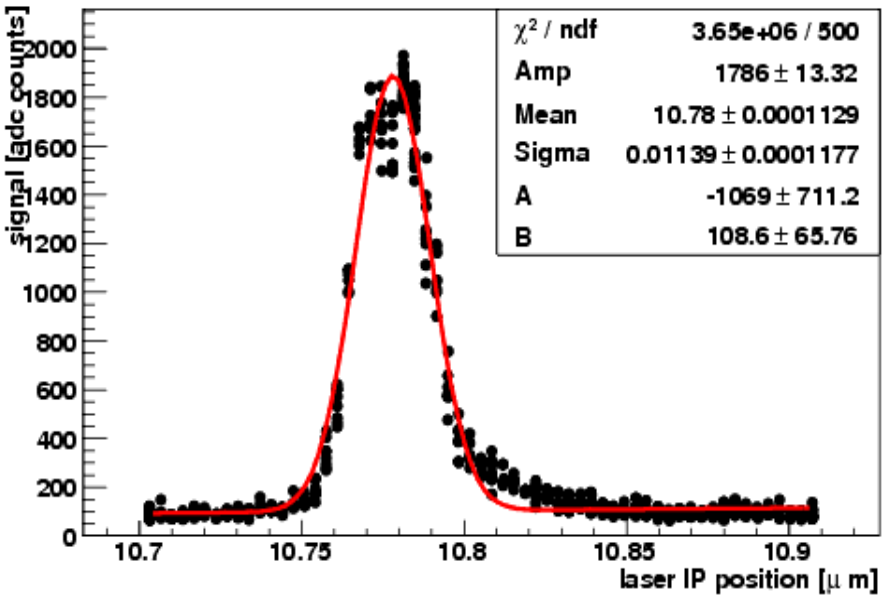
Energy Distribution in x at current (ATF) laser wire detecto

Threshold of Cerenkov detector 3 MeV. Higher signal to background ratio than calorimeter

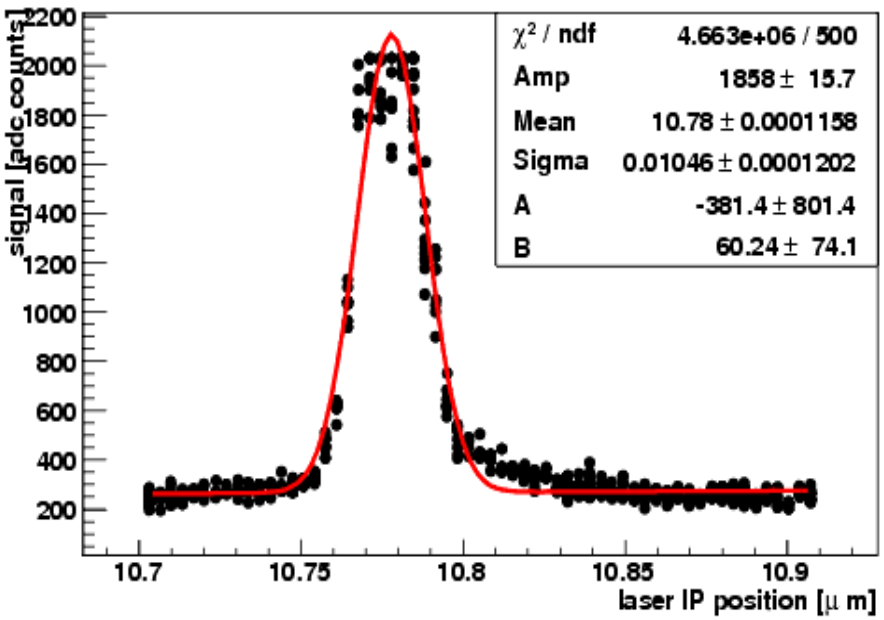


- Background energy spectrum (from flat distribution input bunch).

LW Scans 13th December 2006



Cerenkov detector



Calorimeter

Conclusion, Continuing Work

- Tracking code is running.
- Starting to make some real measurements- Calorimeter vs Cerenkov. Cerenkov measures all the energy whereas Cerenkov detector has a low energy cutoff.
- Do we want to map out background in other areas and compare to the simulation? Data from other detectors in the beam line would be useful for benchmarking.
- If the simulations match the data we can apply the same method to ATF2- the LW detector will be in a different place, probably closer to the beam pipe, and the background might be larger there- and also apply to Shintake monitor region.
- We could also apply these methods to the ILC.