Presentation at the ALCPG-SLAC Meeting

Progress Report of Work at Colorado

October 23, 2003

THE GROUP

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2 new freshmen + 2 high school students

ACTIVITIES

- ***Simulation of Supersymmetry. New method to overcome the negative effects of beamstrahlung and bremmstrahlung.***
- ***Develop a new geometrical structure in calorimetry that is cost effective and will have the energy and time resolution required in a Linear Collider environment.***

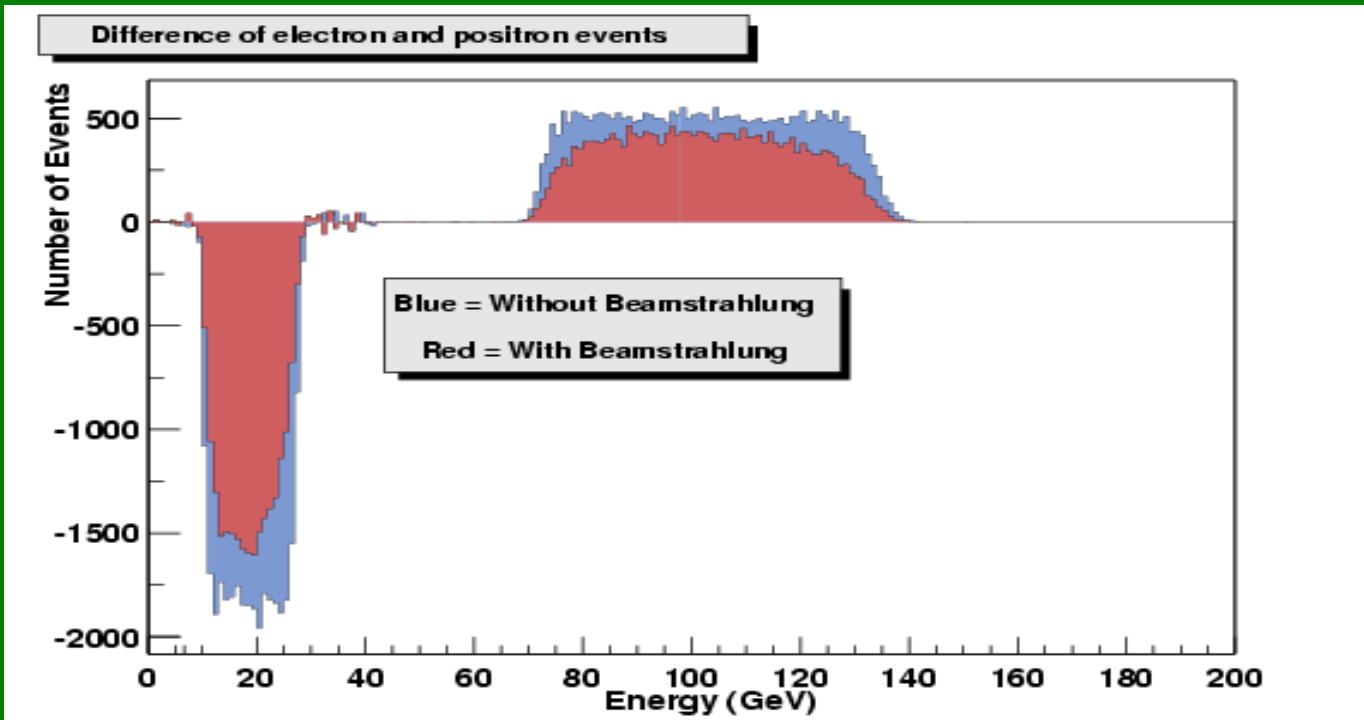
Simulation of Selectron Production

Case Study

- *Consider Case SPS3 , $M_{1/2}$ = 400 GeV.*
- *Mass of e_R = 178.3 GeV, Mass of e_L = 287.1 GeV, Mass of χ^0_1 = 160.6 GeV.*
- *Compare Fits with Beam and Bremmstrahlung and without.*
- *We use the e^+ - e^- Energy Spectra Substraction Technique to remove Standard Model Background.*

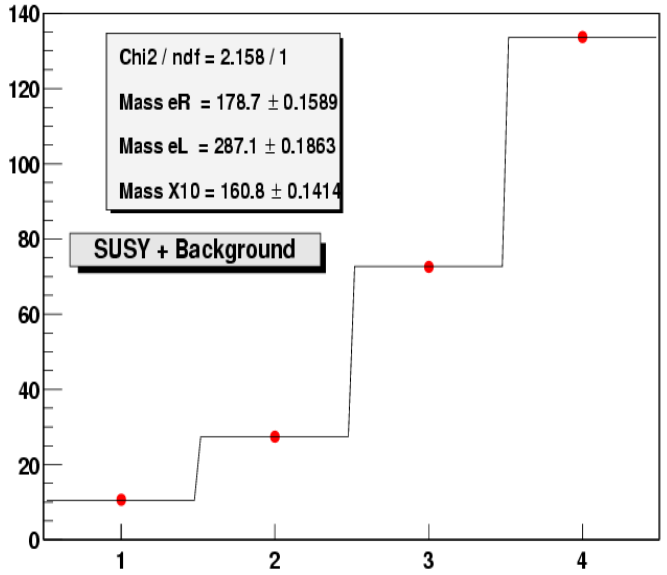
Selectron Production

$e^+ - e^-$ Energy Spectra

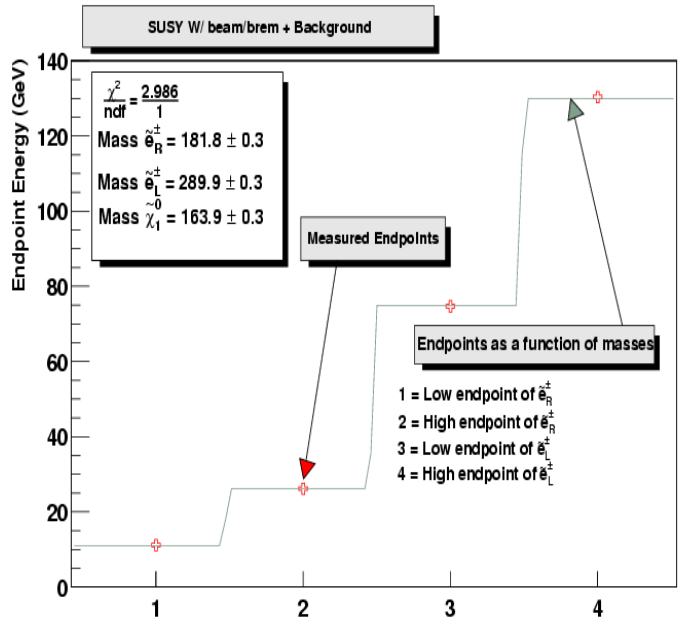


Resultant Fits to Energy Edges

No Bremm

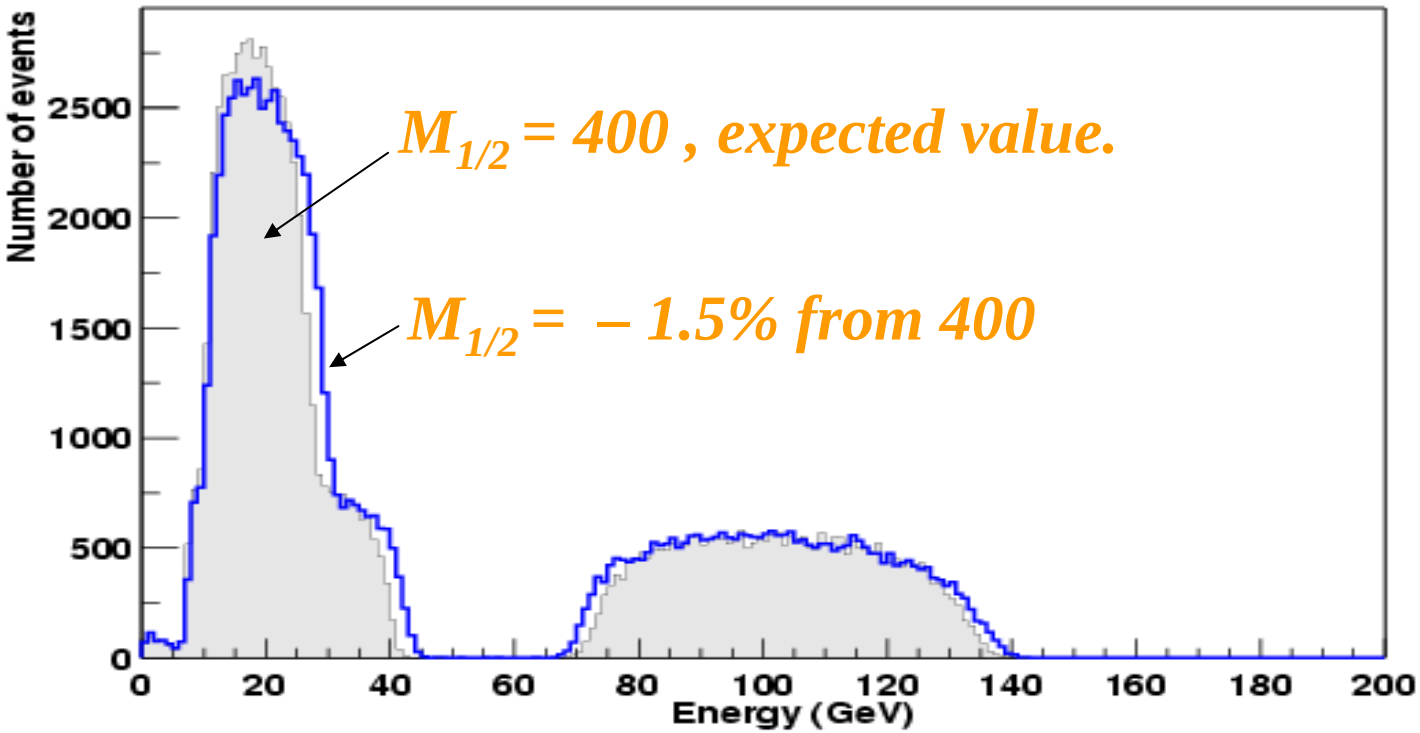


Bremm

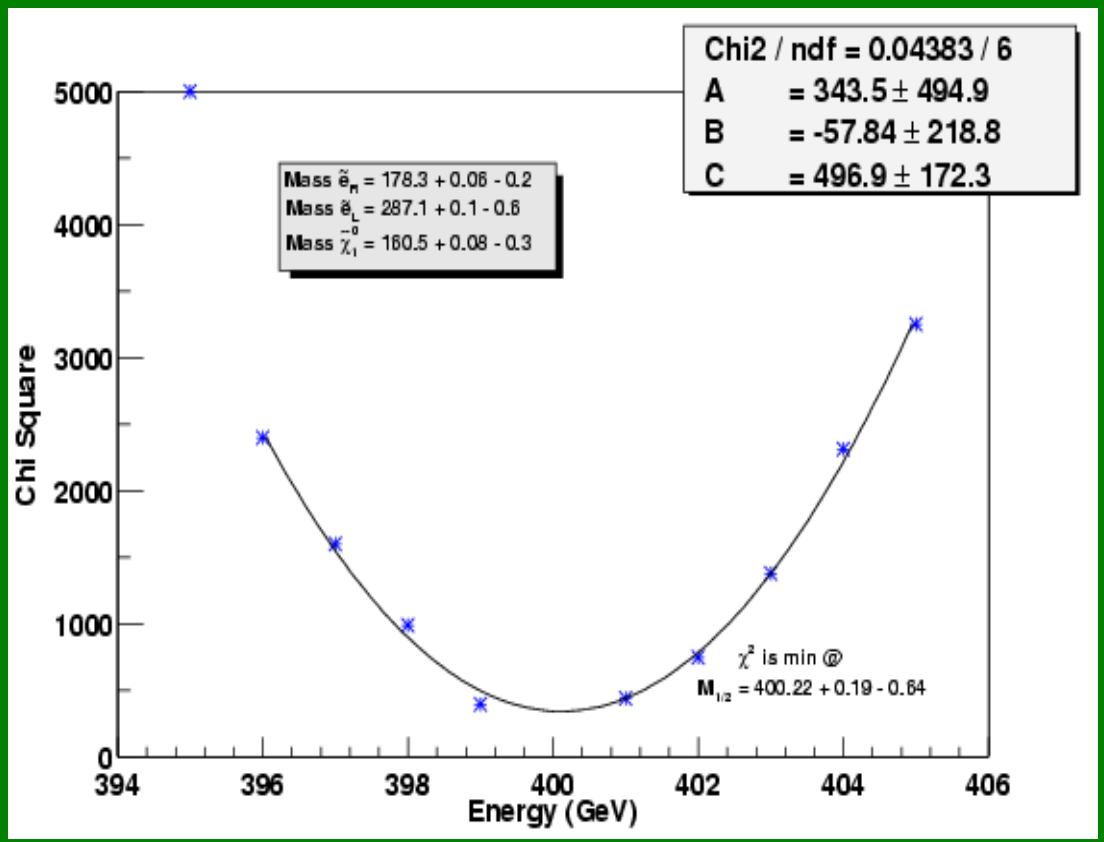


New Method to Determine Masses

- *Compare Energy Spectrum to those Generated with different parameters encompasing the correct one.*
- *Do a Chi Square Fit to the Spectra Comparison.*
- *Choose the minimum and determine the masses.*


Number of events
2500
2000
1500
1000
500
0
0
20
40
60
80
100
120
140
160
180
200
Energy (GeV)
$M_{1/2}$ = 400 , expected value.
$M_{1/2}$ = – 1.5% from 400

Chi Square Fit Distribution



$M_{1/2}(expec.) = 400\ GeV$

$M_{1/2}(fit) = 400.22^{+0.19}_{-0.54}\ GeV$

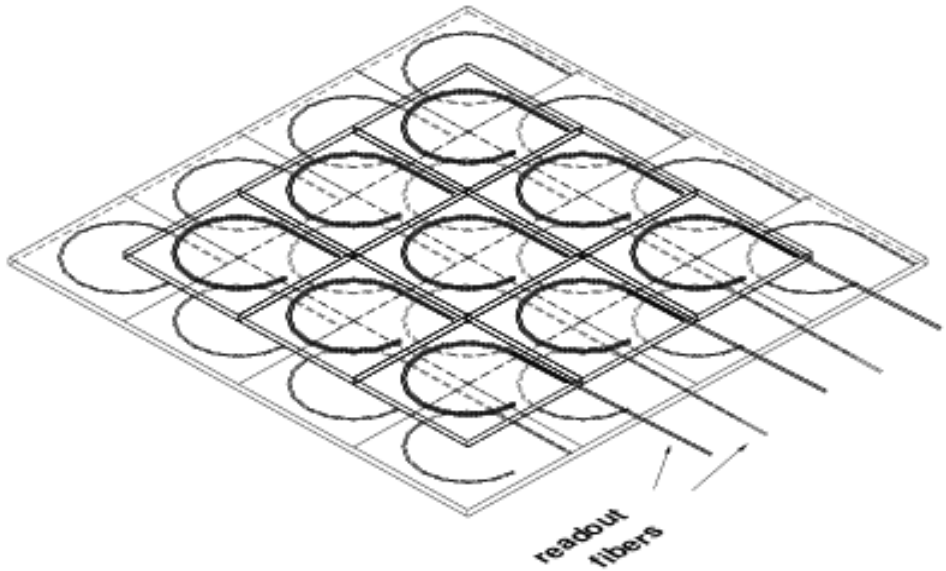
Activities for Coming Year

- *Apply method to Smuons to look for the left handed smuon with and without positron polarization.*
- *Apply method to Neutralinos. SUSY background can now be included in the fit since this background also varies with the parameters.*
- *This is a multi-year effort.*

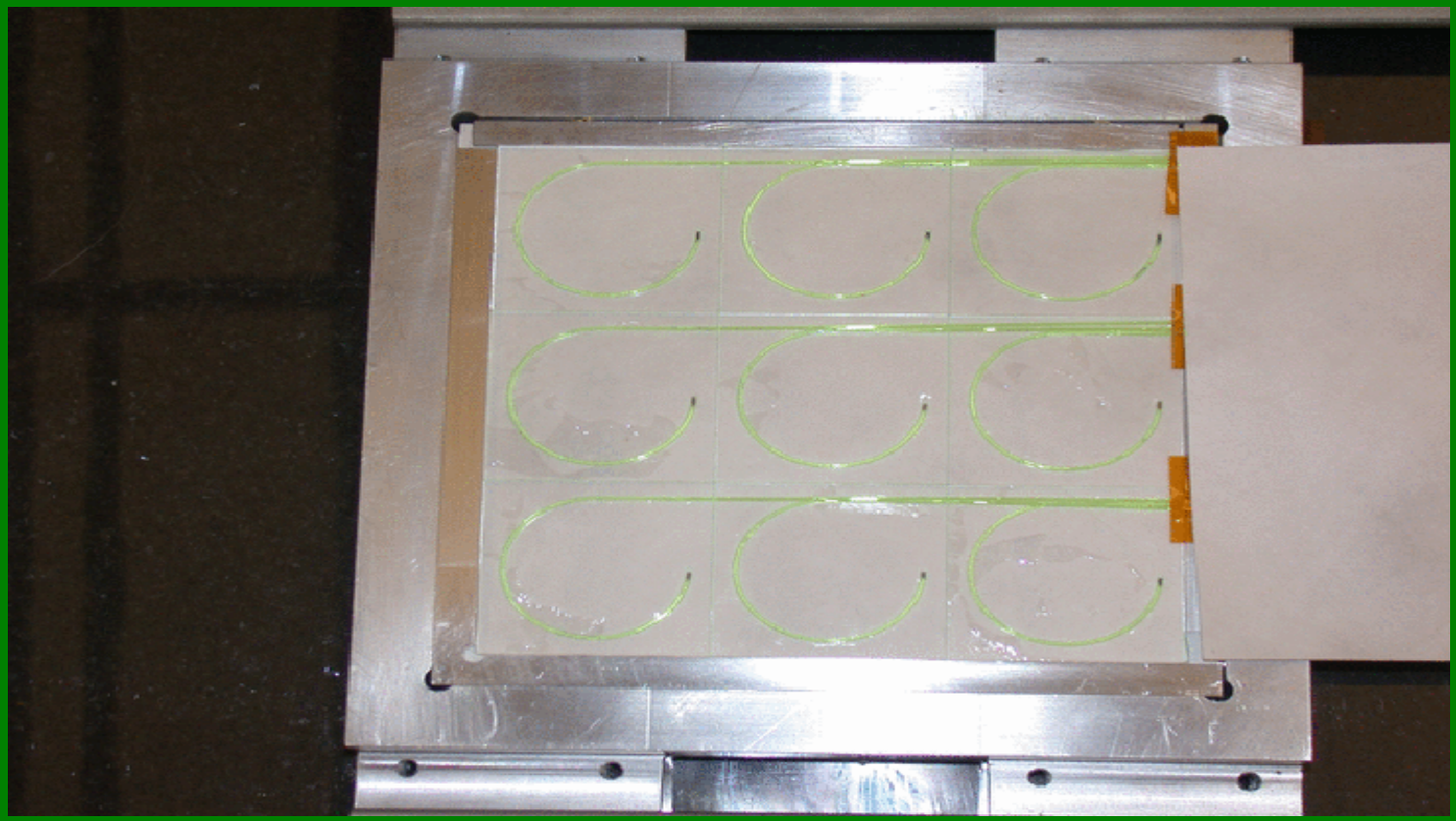
The Calorimeter

- Scintillator tile layers 5 x 5 cm^2, 2mm thick.
- Alternate layers are offset. See next slide.
- Effective 2.5 x 2.5 cm^2 spatial resolution.
- Reduces by 25 the number of channels when compared to 1 cm^2 tile structures.

The Basic Geometrical Structure

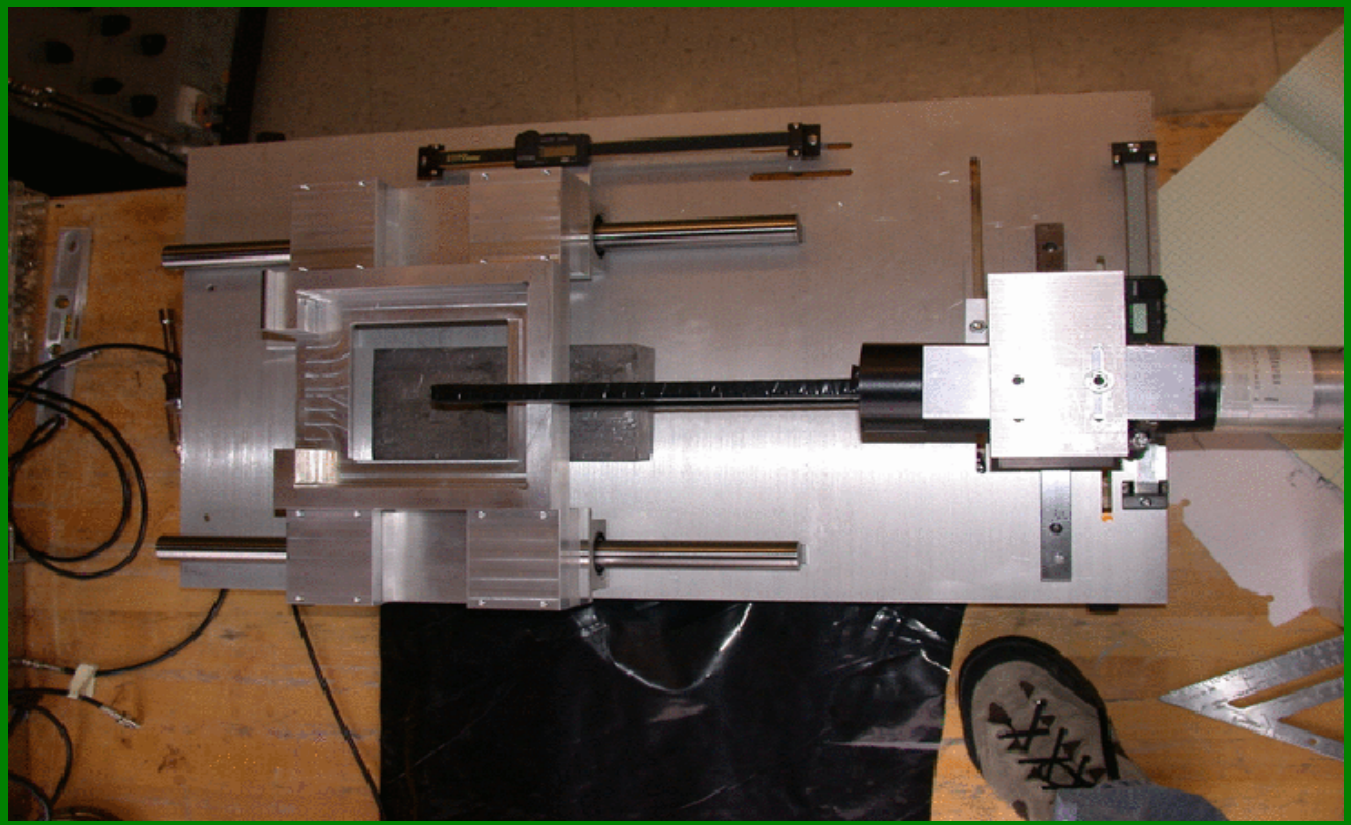


The Tile Arrangement

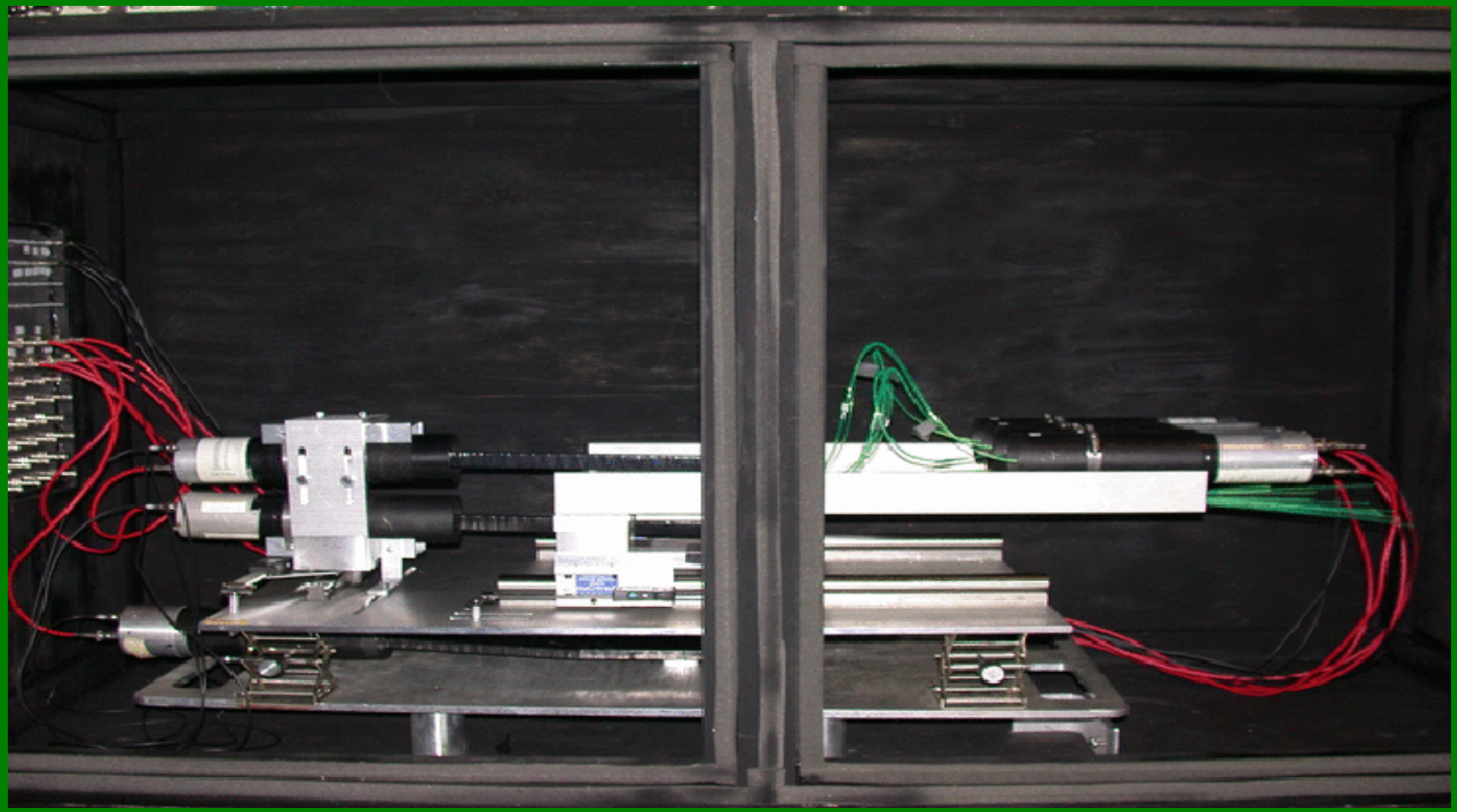


The Calorimeter test unit we have built

Cosmic Ray Trigger



The Calorimeter in the Black Box



New Readout Equipment

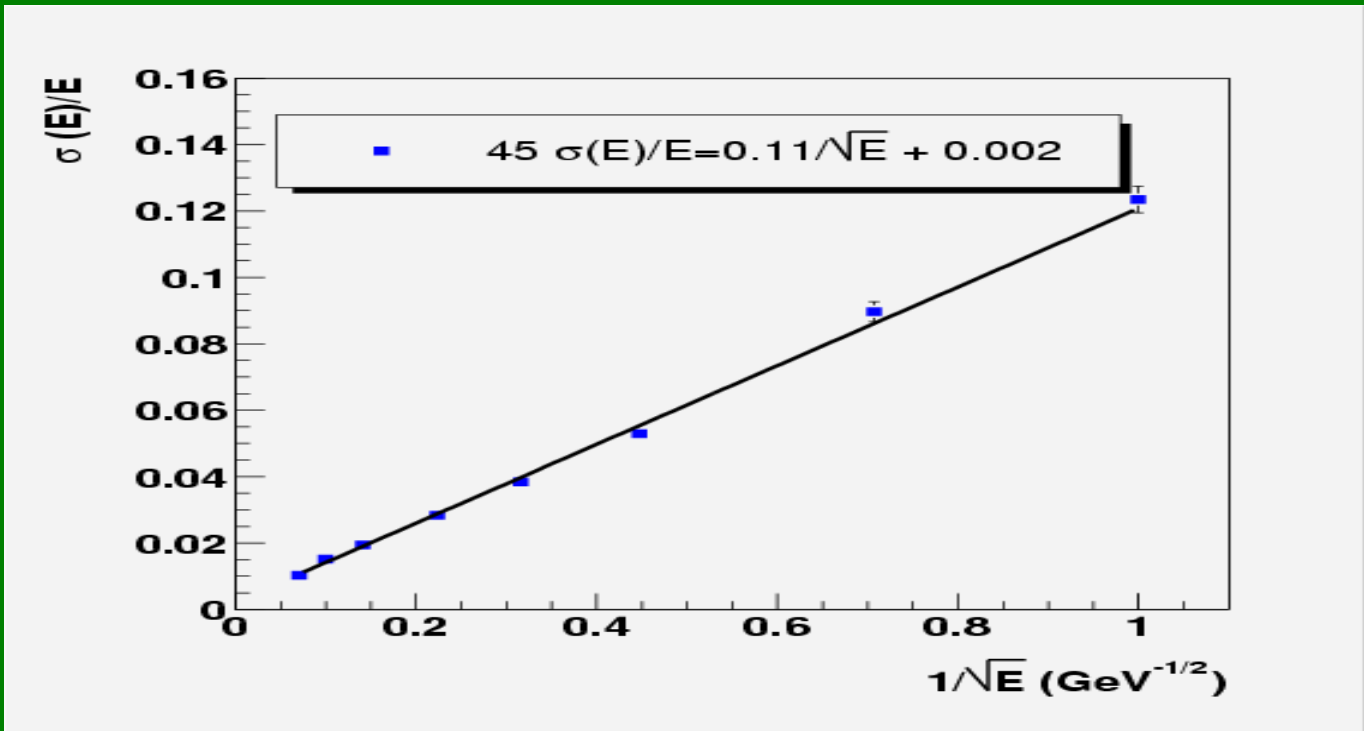
- ✓ *We have LabView Installed.*
- ✓ *University money.*
- ✓ *We are purchasing Readout from National Instruments or Acqiris. Probably it will be National Instruments. Bids.*
- ✓ *Had a demonstration yesterday, very impressive what one can do.*
- ✓ *We already know we have problems with calorimeter; low pulse height from cosmic muons. It is time to have fun investigating.*
- ✓ *A lot of work in the near future.*

Simulation of Energy Resolution

We have simulated 2 mm, 1 mm scintillator thicknesses and 35, 40 ,45 layers.

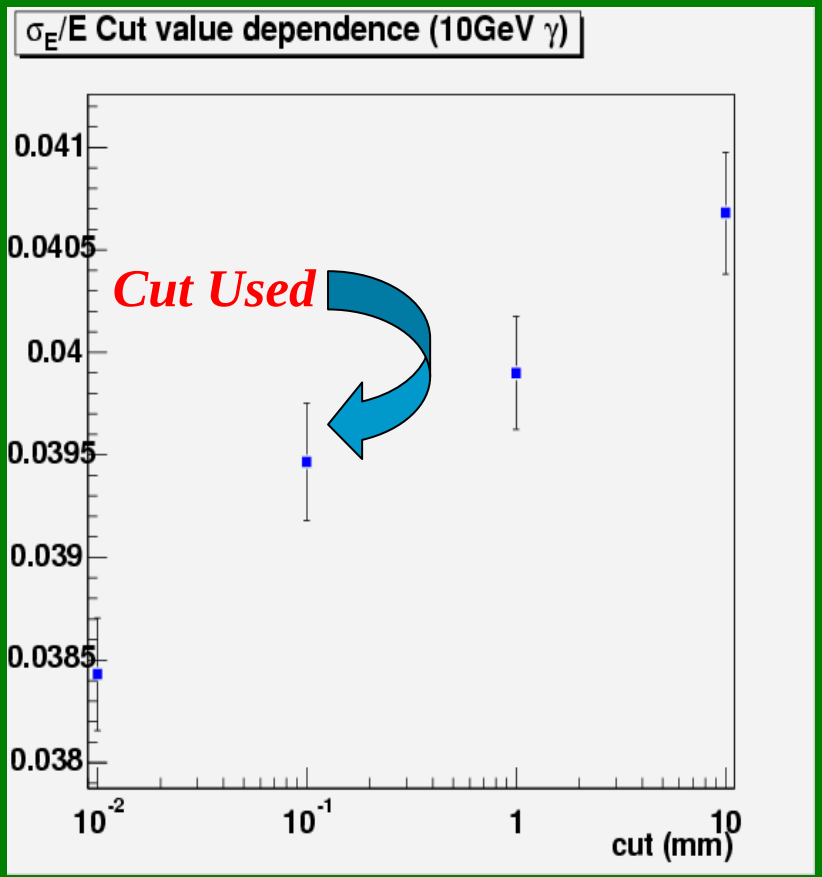
Simulated Energy Resolution

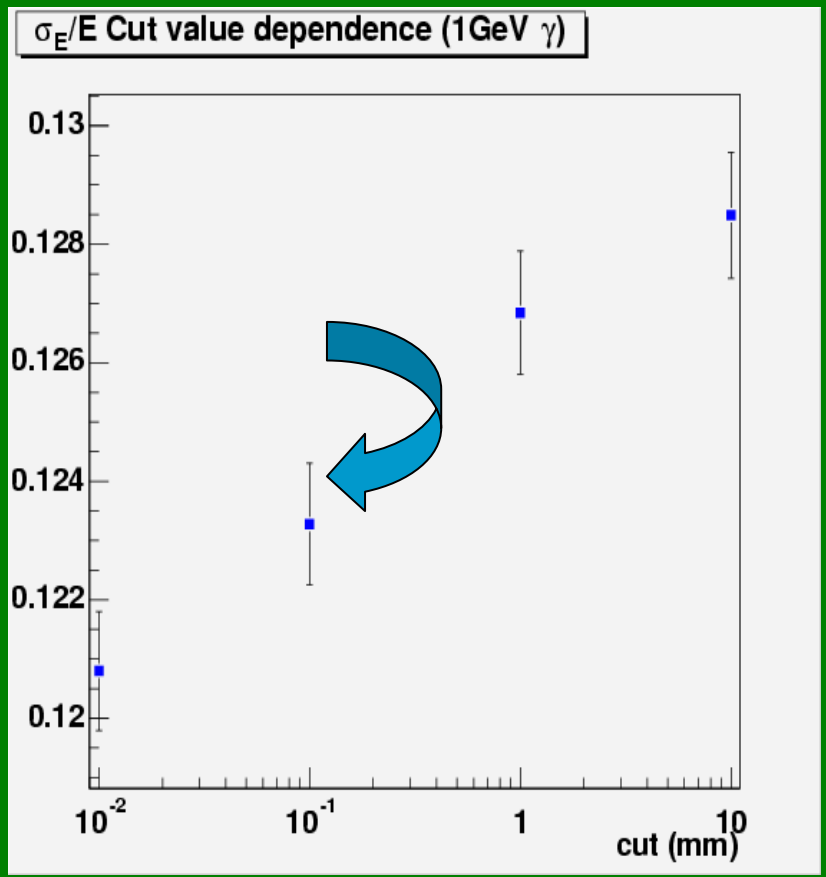
45 layers, 2mm scintillator, 1/2X_0 Tungsten



Caveat

Dependence of Simulated Resolution on GEANT Propagation Cut-Off





Conclusions on Energy Resolution

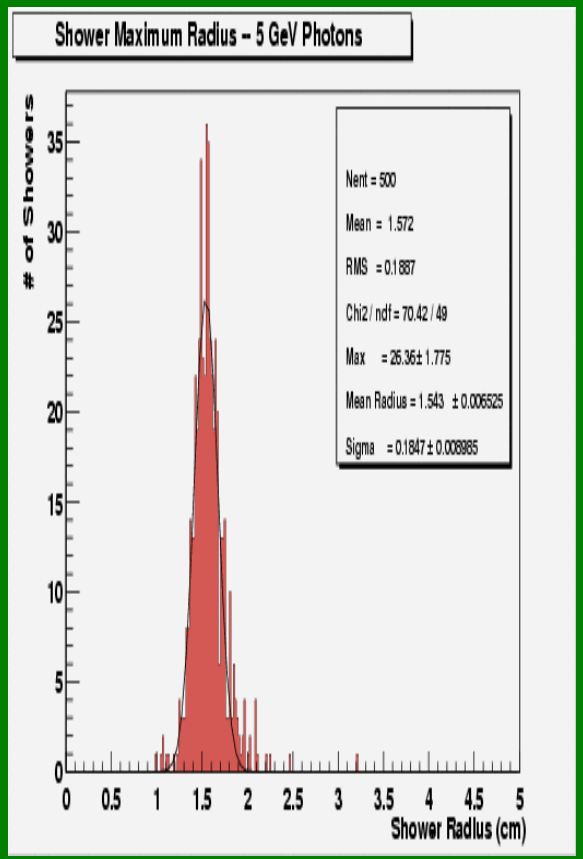
- *Energy Resolution of 11%/$E^{1/2}$ achievable.*
- *This resolution has been confirmed by Italian group working in Frascati.(Checcia).*
- *Need 2 mm thick scintillator and 45 layers.*
- *Need to study further whether increasing the thickness of Tungsten of the last ~5 layers will allow us to reduce the number of layers while maintaining the resolution.*

Issues on Spatial Resolution

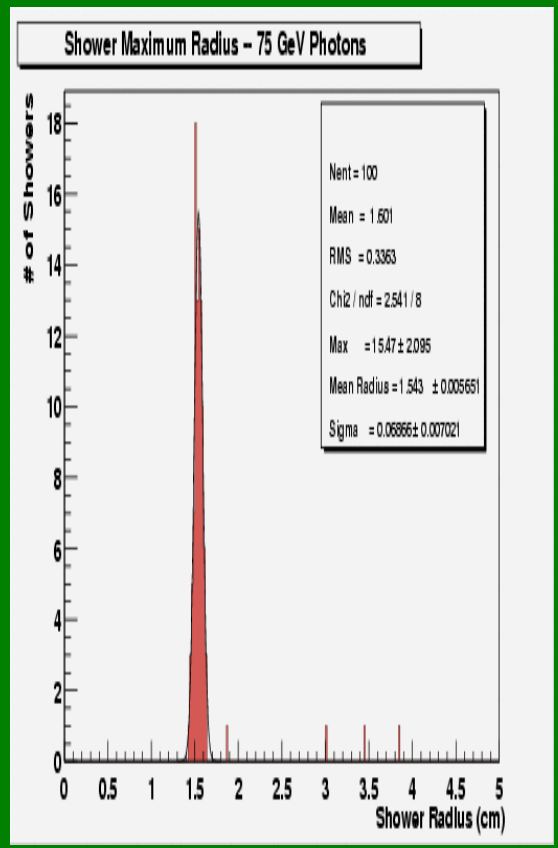
- ✓ *Moliere Radius*
- ✓ *Comparison of Photons Spatial Resolution with no offset case*
- ✓ *Resultant Spatial Resolution Comparison*
- ✓ *Net Mass and Jet Directional Resolution*
- ✓ *Can we Separate Hadrons from the Shower*
- ✓ *Energy Flow Resolution of 2.5 x 2.5 cm^2 versus 1 cm^2 tile structures.*

Moliere Radius of the Shower

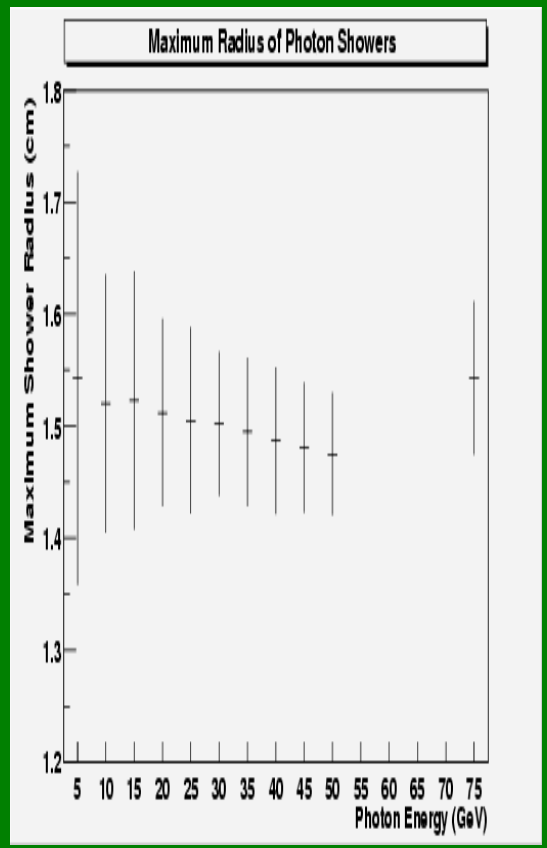
5 Gev Photon



75 GeV Photon

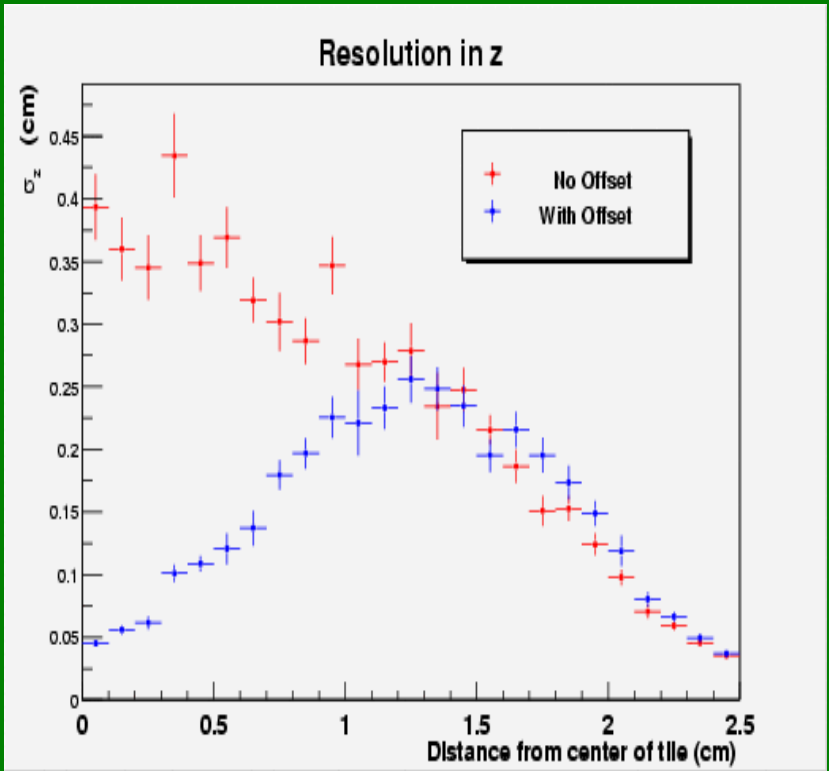


Moliere Radius vs P

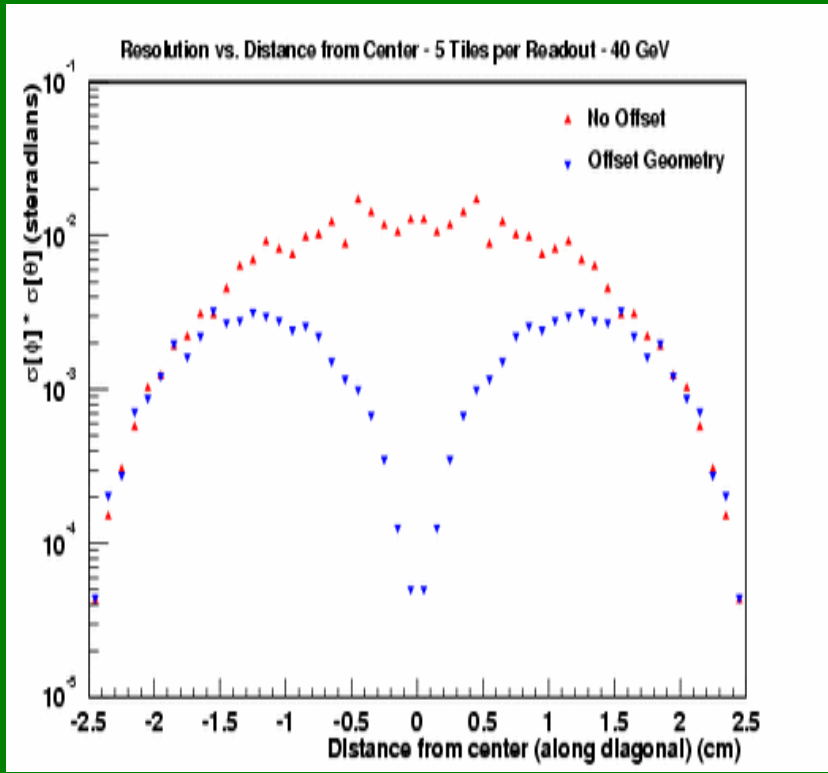


Spatial Resolution

1 dimension(z)

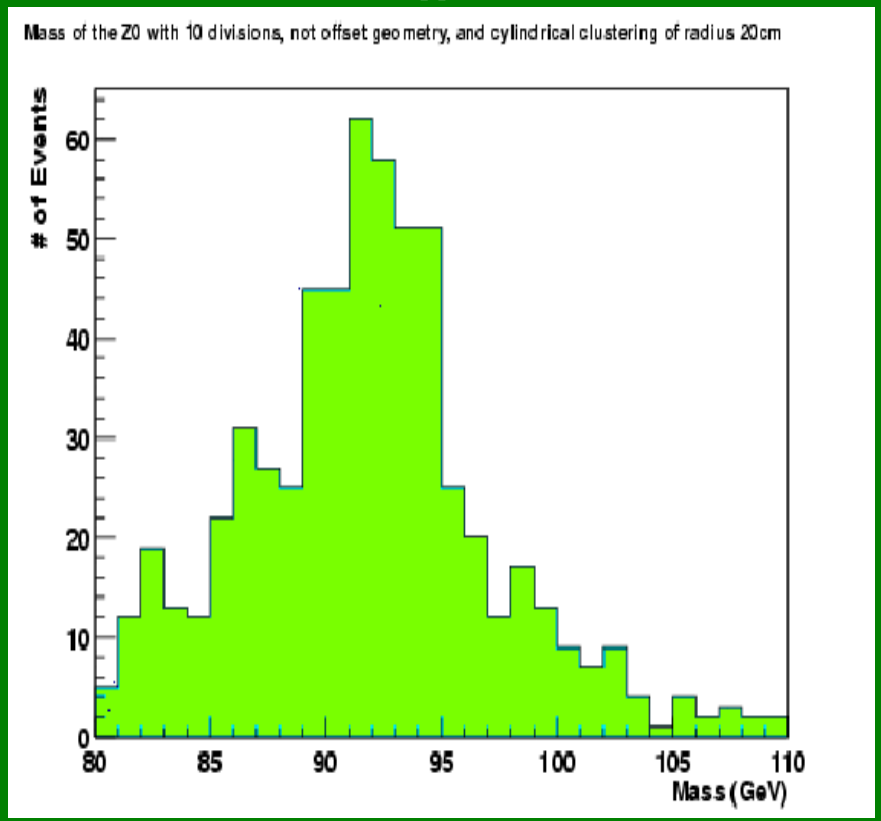


$\delta(\theta)\delta(\varphi)$

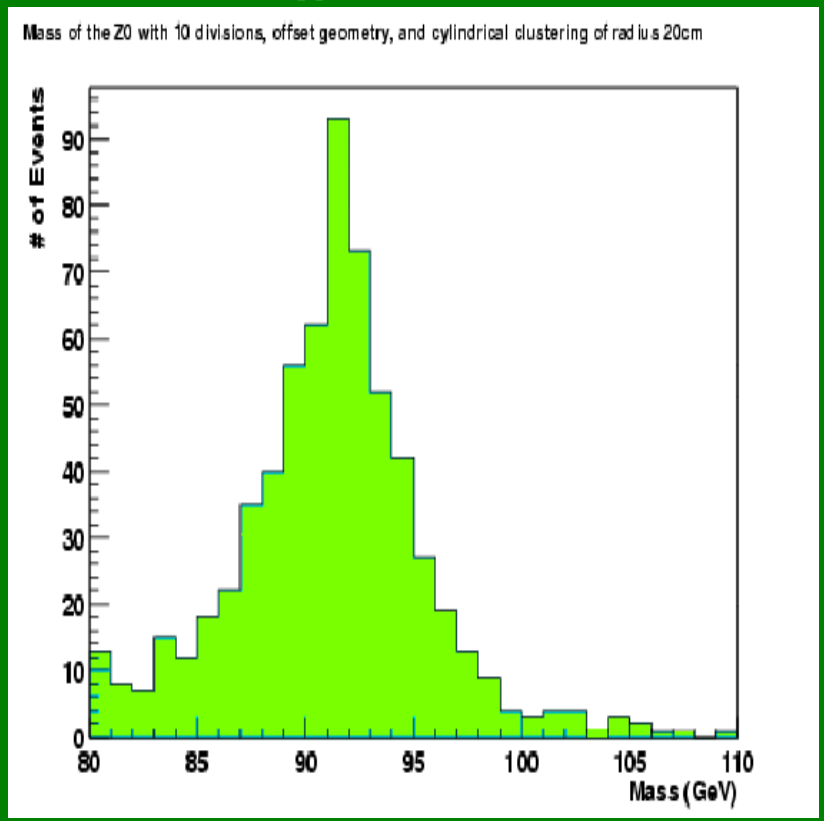


Mass of the $Z^0 \rightarrow e\ e$

No Offset

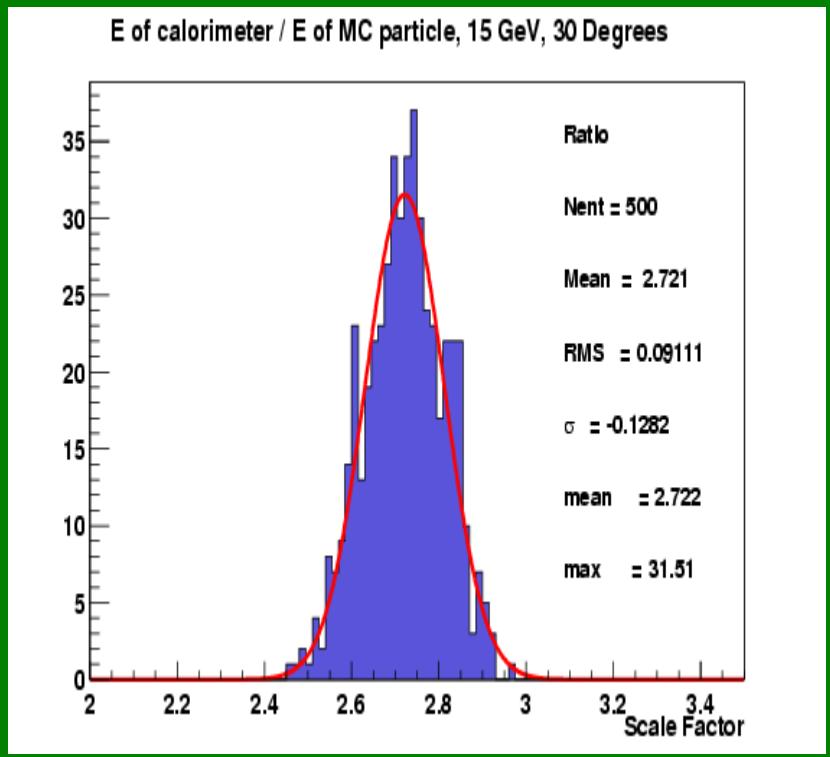


Offset

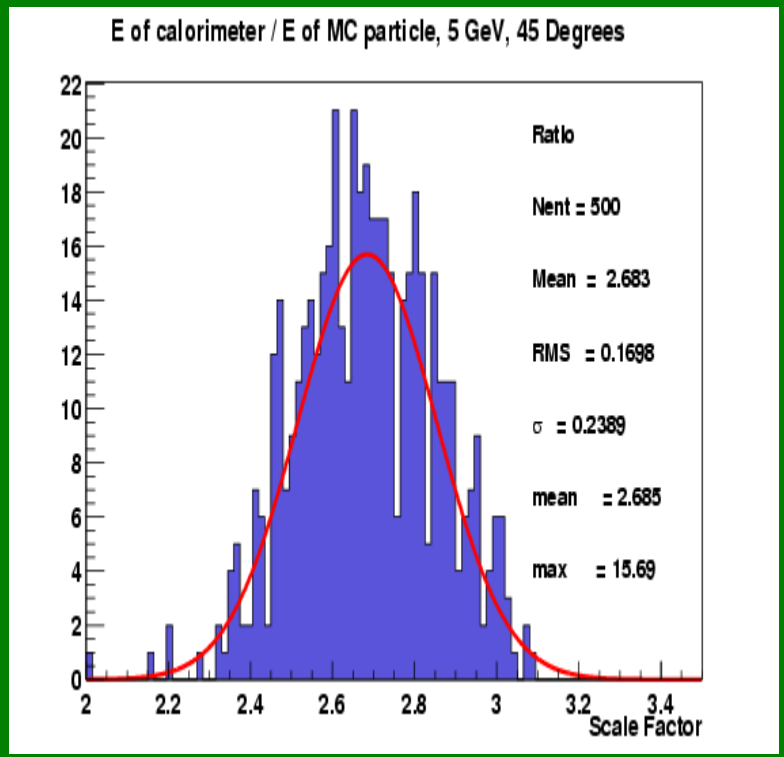


Energy Scale Constant

15 GeV, 30 deg.

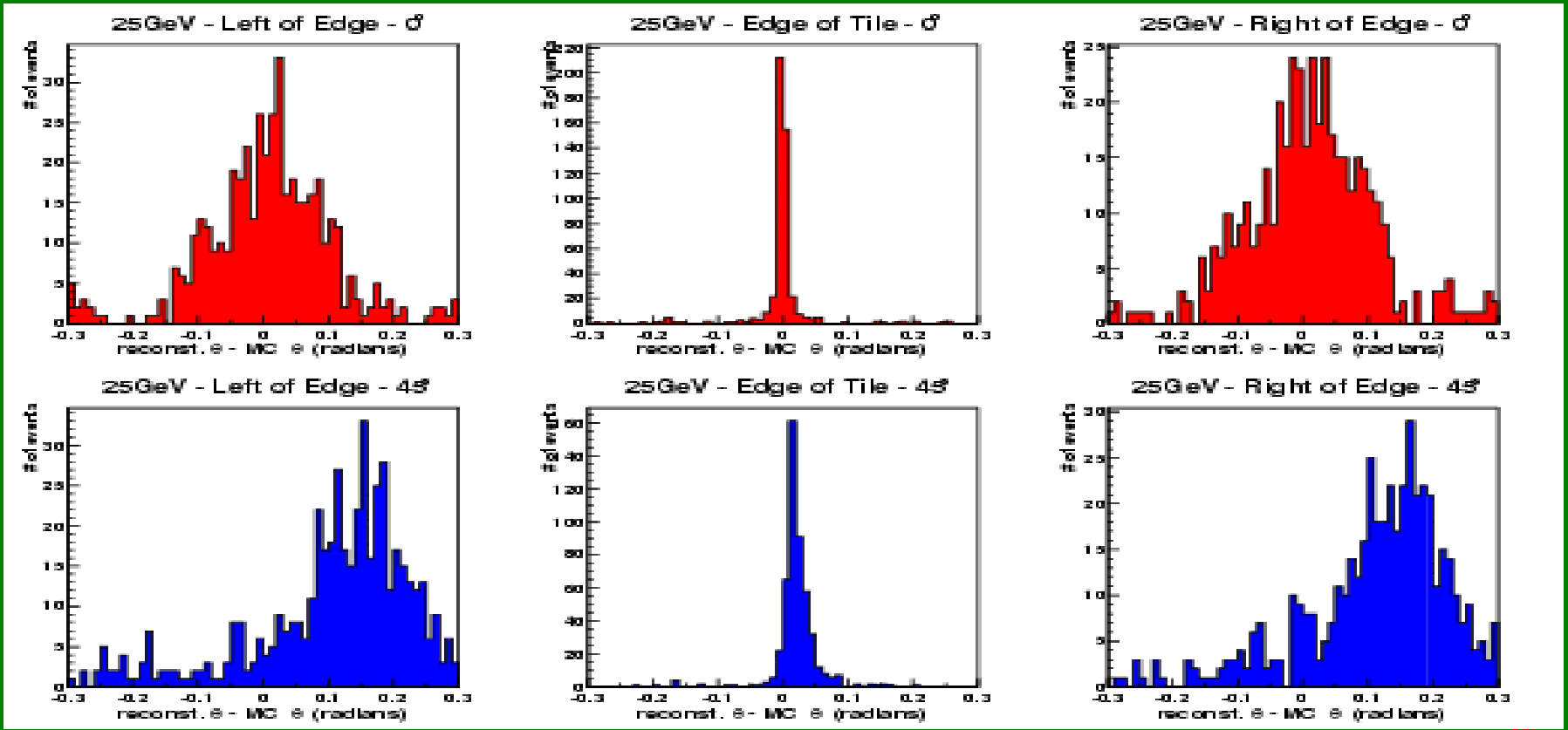


5GeV, 45 deg.

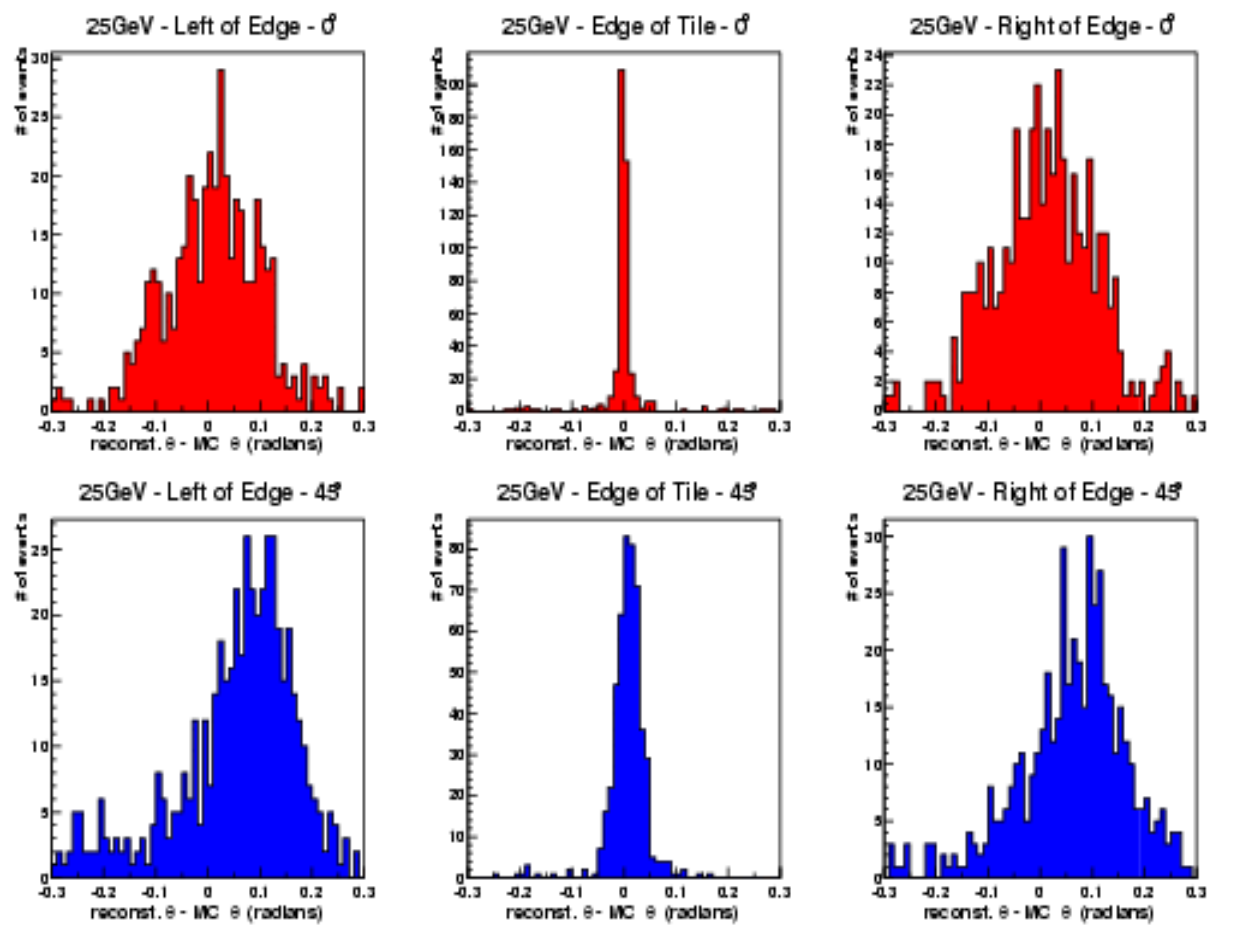


Directional Biases in the Shower Fit

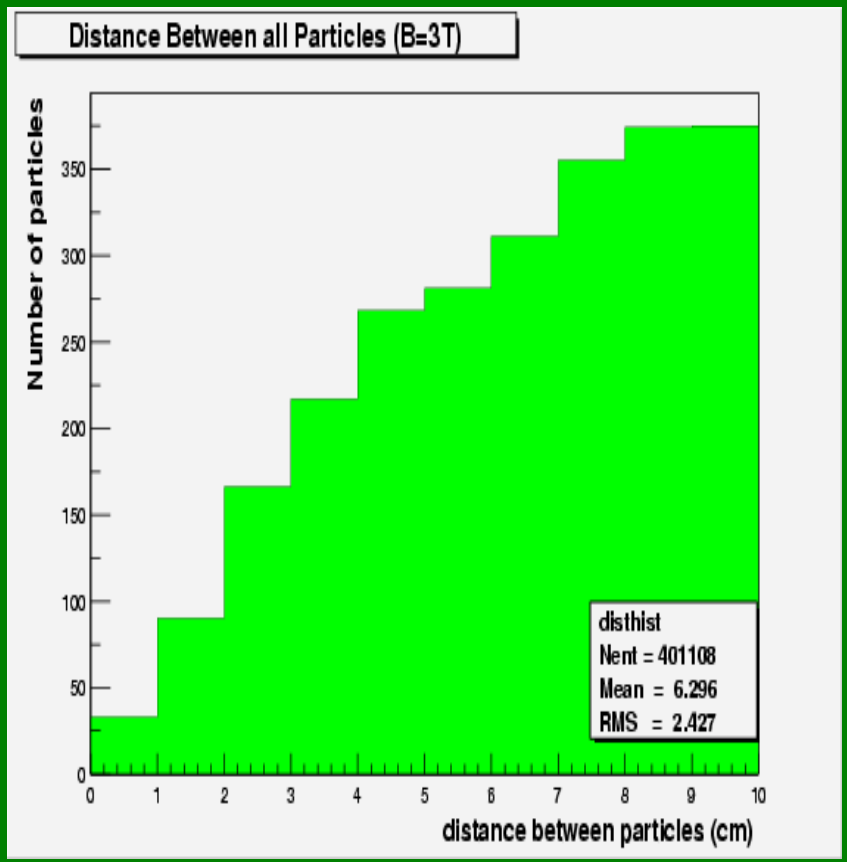
red = 0 dip angle ***blue = 45⁰ dip angle***

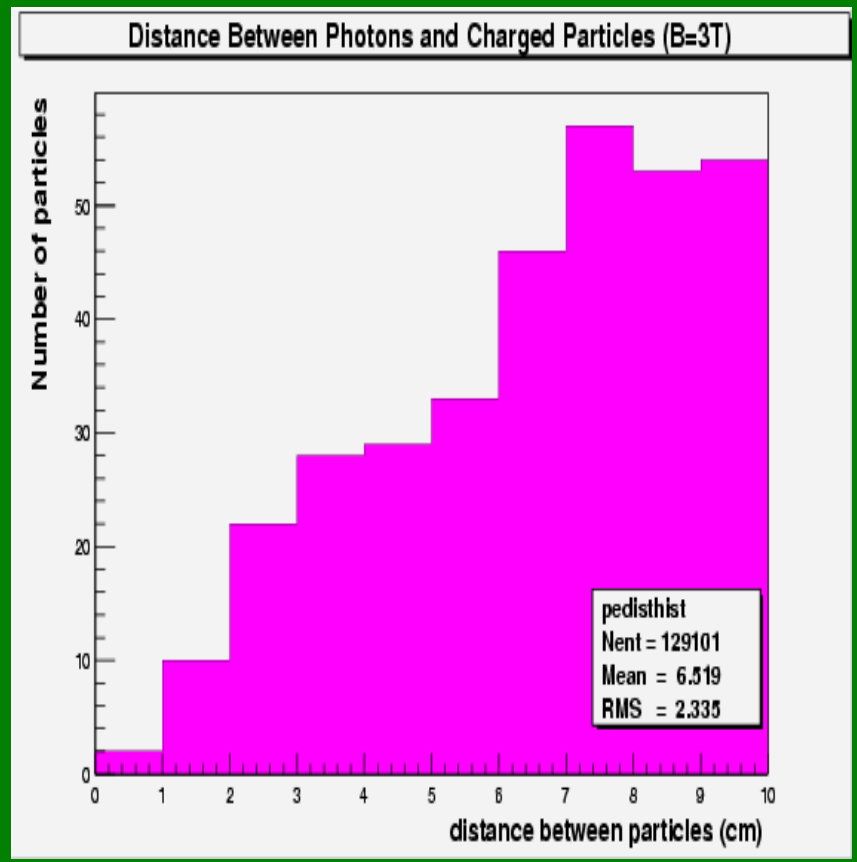


After 1st order Corrections



Distance Between Particles at Calorimeter





What Needs to be Studied

- We need to study the resolution effectiveness via simulation. Need to understand our present resolution.
- We need to study the light collection efficiency, uniformity. This will be done with cosmic rays. Tyvek versus Radiant Mirror paper.
- We need to study how to construct these in a simple manner to maintain cost effectiveness while maintaining accuracy.

Continue, What Needs to be Studied

- *We need to develop Extruded Scintillator techniques with the Fermilab folks to determine whether we can maintain thickness dimensions to within a fraction of a mm.*
- *Can we inscribe grooves 5 cm apart in Extruded Scintillator and can we maintain lateral dimensions to a mm.*
- *We need to develop Pattern Recognition and Energy Flow algorithms that use our different geometrical arrangement.*

Continue, What Needs to be Studied

- *We need to compare our algorithms with those of the silicon based study to determine cost benefit alternatives.*
- *Study electronics readout; APDs, VLPCs. We have started a collaboration with Fermilab's electronic group.*
- *This requires cryogenic techniques we do not have. Are investigating collaborative arrangements with Fermilab to provide cryogenics help.*