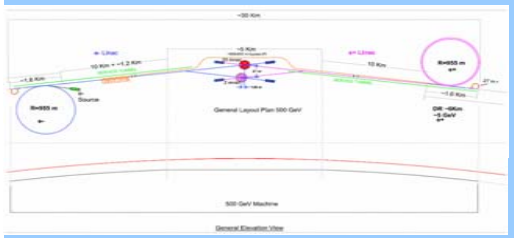

ILC07 Talk

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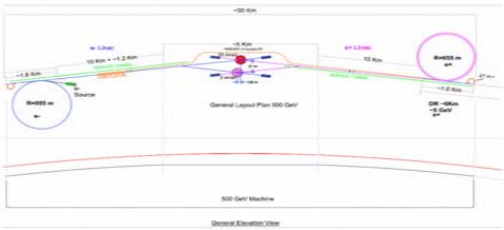
SIMULATION OF BEAMCAL WITH B FIELDS

Keith Drake, Tera Dunn, Jack Gill,
Maria Person Gulda , Uriel Nauenberg, Gleb Oleinik,
Joseph Proulx, Elliot Smith, Paul Steinbrecher
Jonathan Varkovitzky



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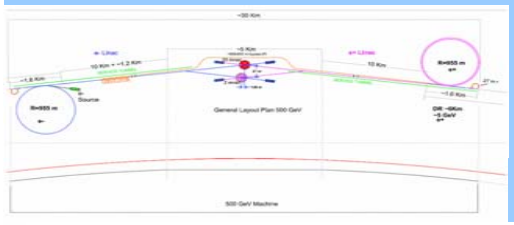
The FCAL Collaboration



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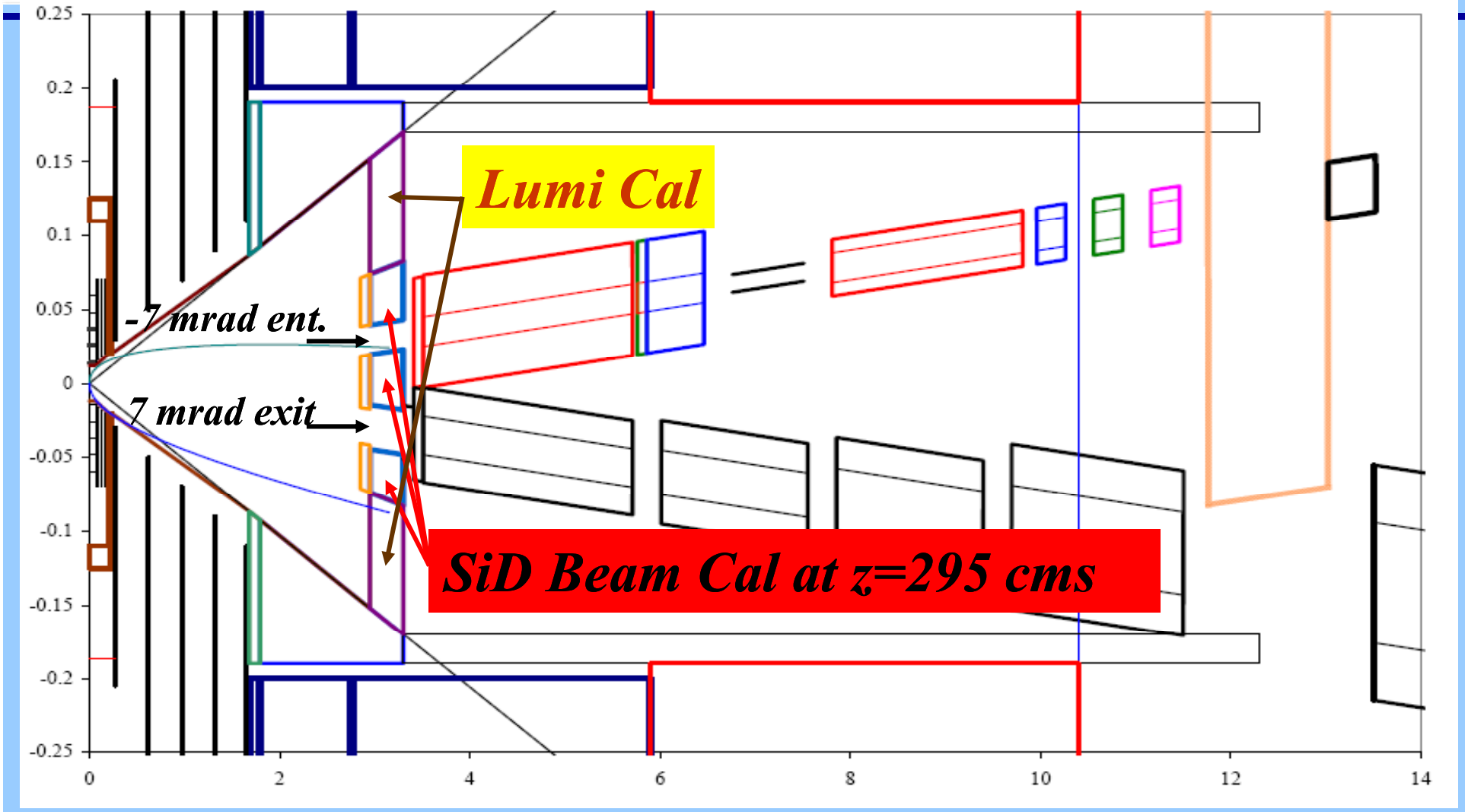

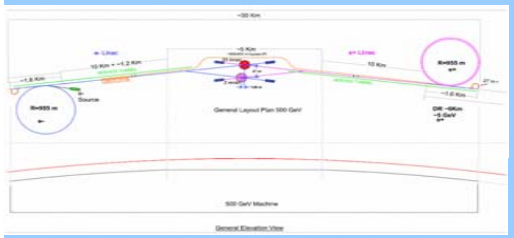

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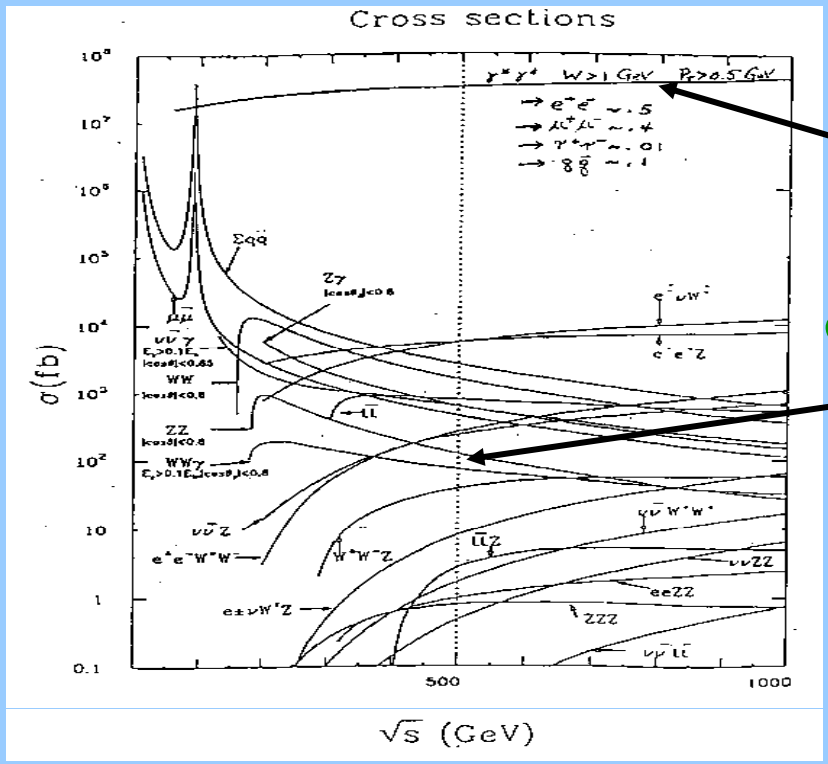
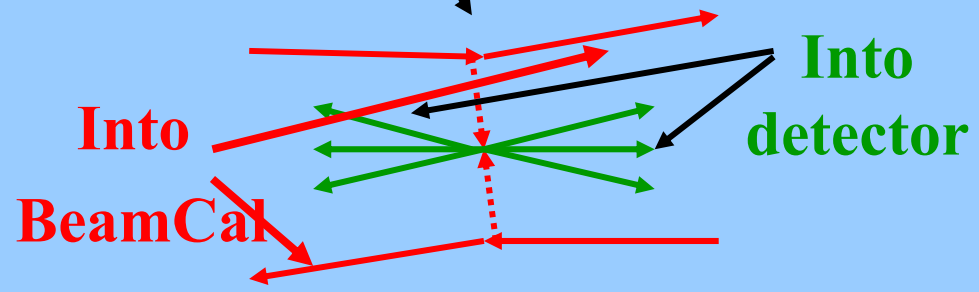
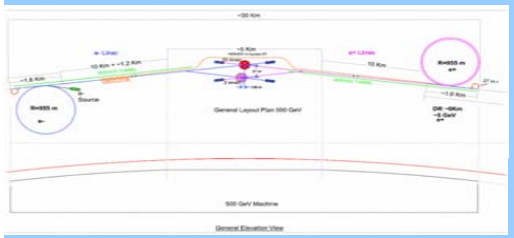
Why a Calorimeter in the Very Forward Direction



Two photon process

σ about 10^5 times SUSY processes





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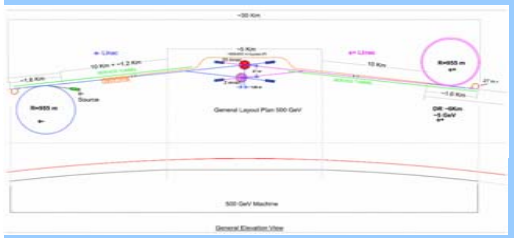
Study of the Beamstrahlung Spectrum at the BEAMCAL detector

First calibrated the Anti-DiD field proposed by Andrei Seryi

so that most of the energy goes into the beampipe

Second, look at the energy deposition by the beamstrahlung in 1 x 1 cm^2 (Moliere radius of showers)

Third, we need to study the 2 γ process to determine detection efficiency



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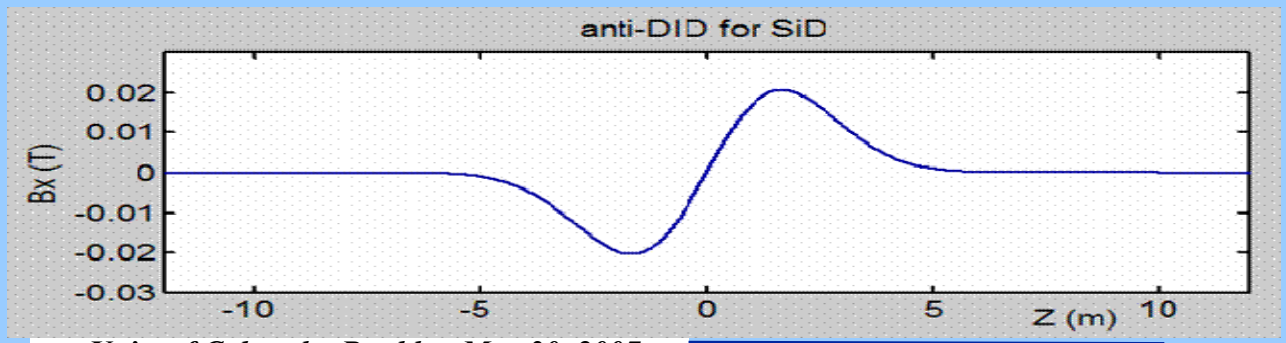
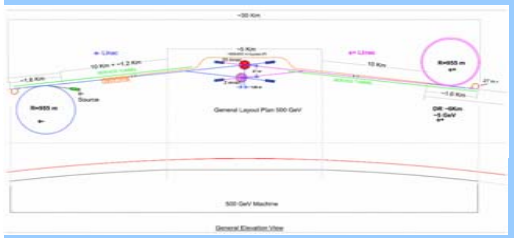
Solenoid field keeps the low energy charged particle in the forward direction. Beam hole is at 7 mrad.

Need to add an x field component to move low energy charged particles in the 7 mrad direction. Anti-DiD dipole field proposed by Andrei Seryi.





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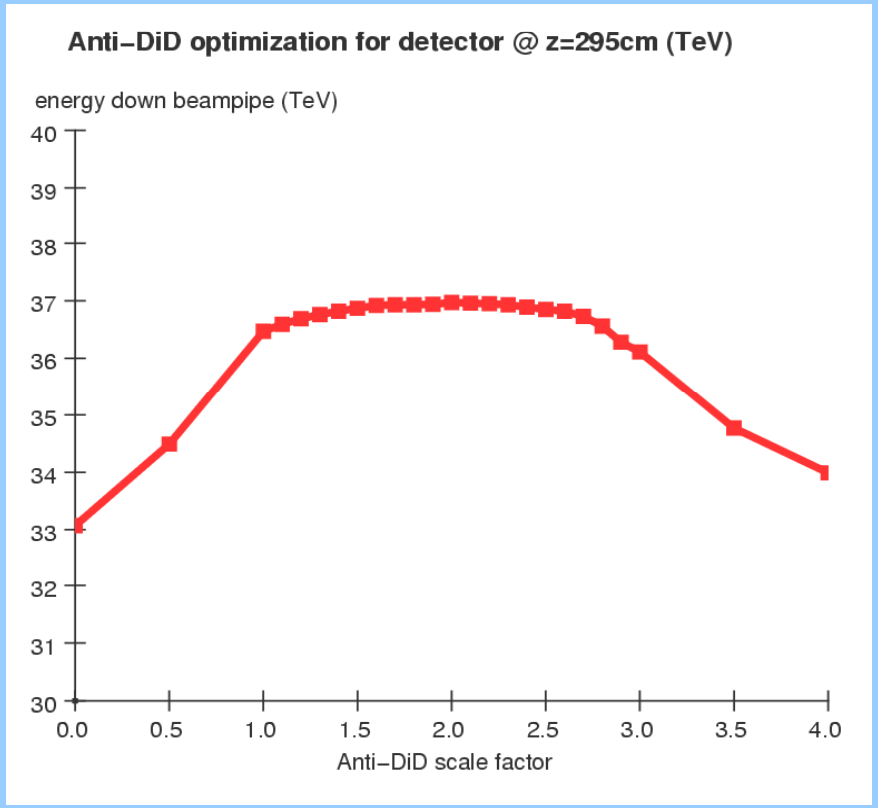
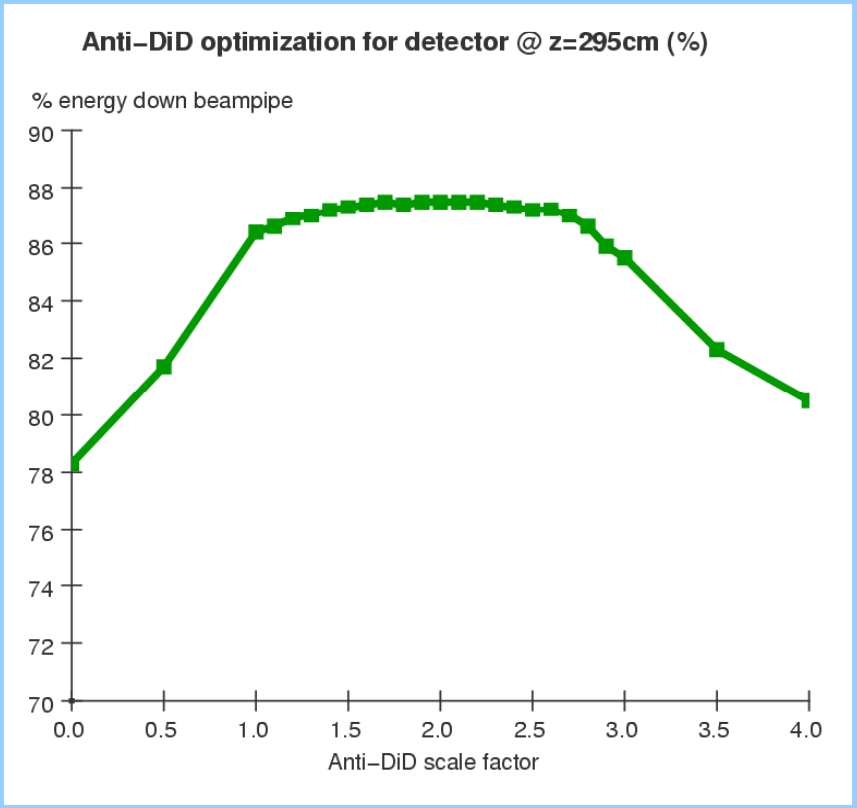
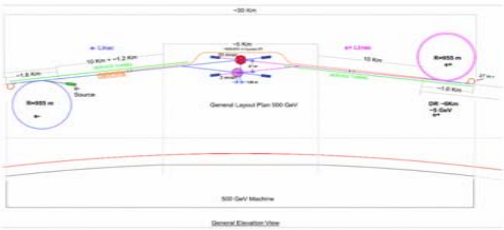
Anti-DiD Scale Factor to Maximize Energy into Beam Pipe







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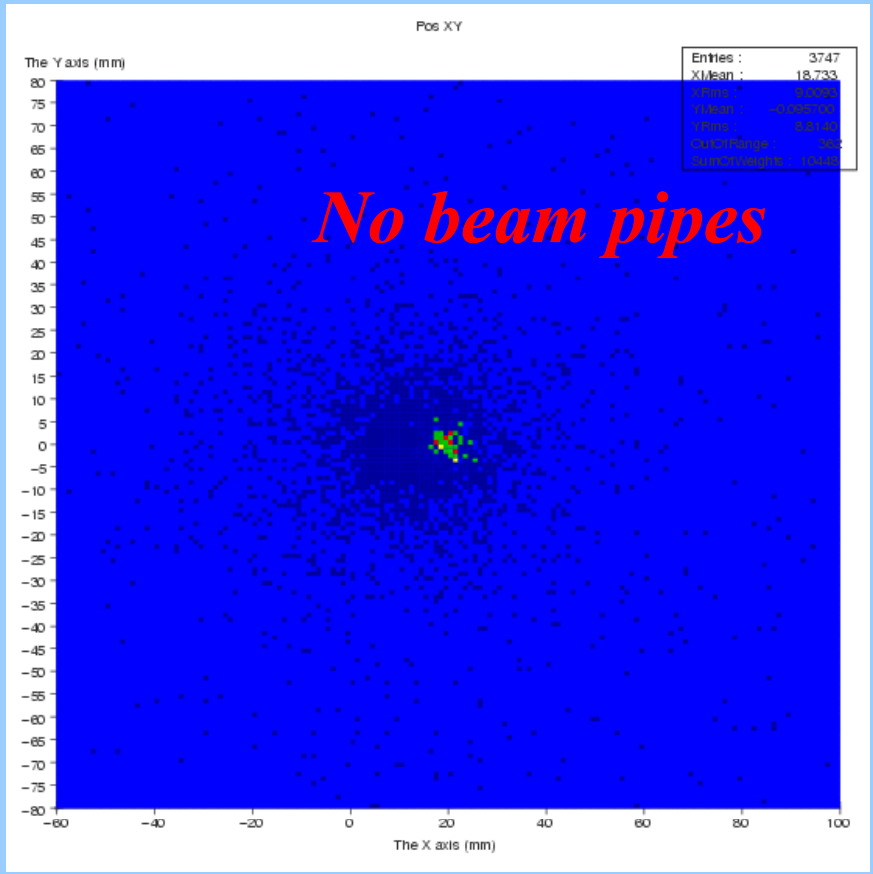
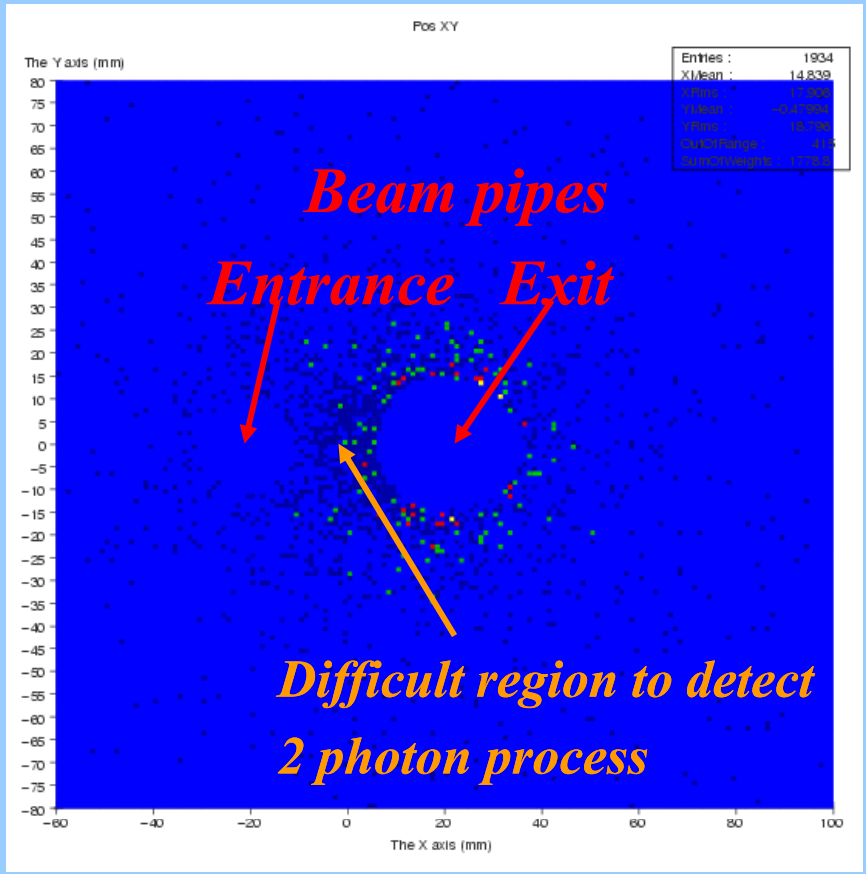
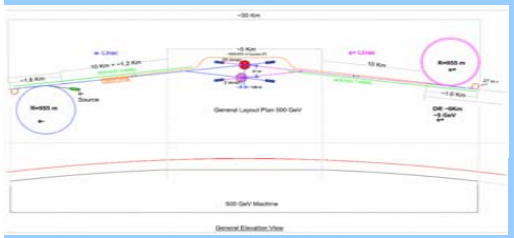
Beamstrahlung Distribution with Solenoid + Anti-DiD







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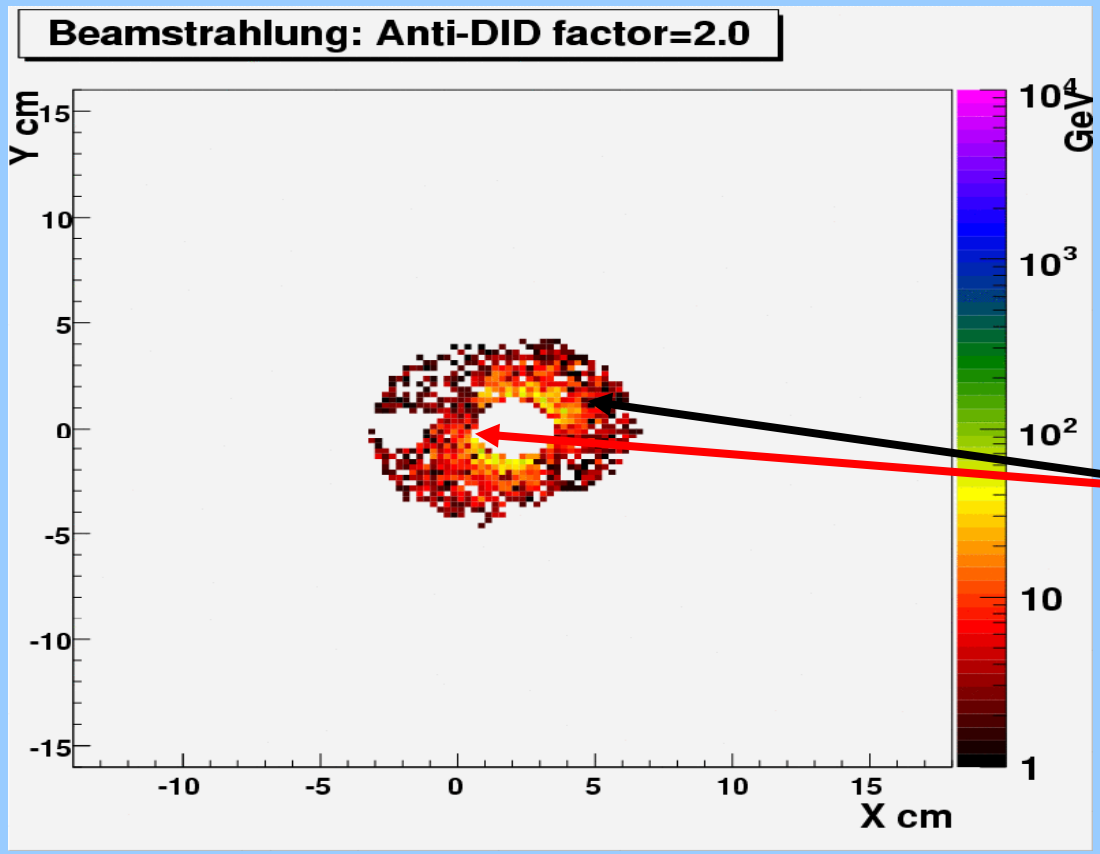
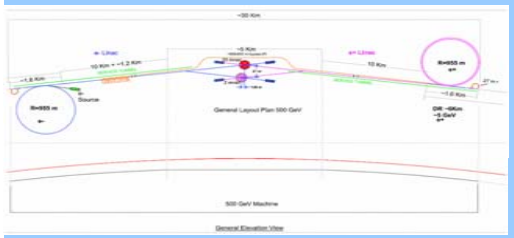
Beamstrahlung Energy Spectrum at the BeamCal



In 0.25 x 0.25 cm^2 areas

Not circularly uniform about exit beam hole



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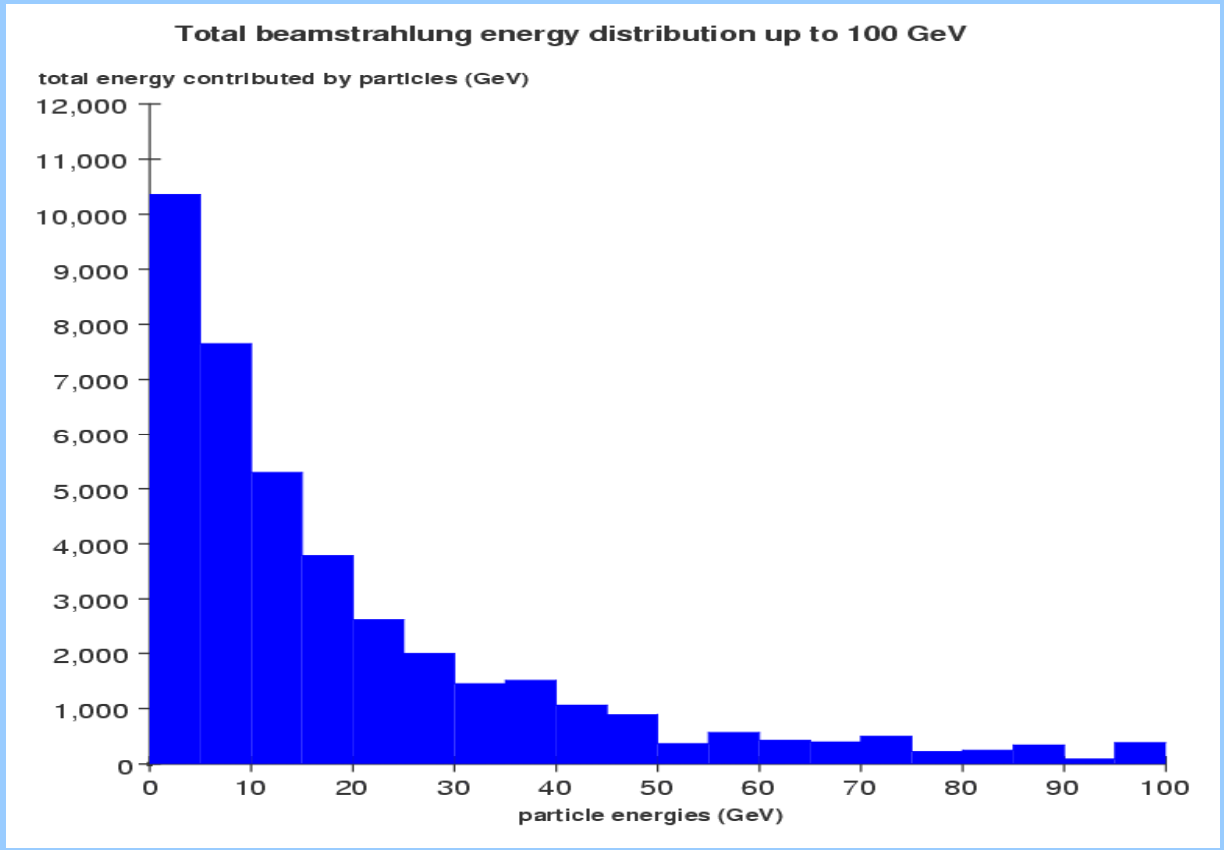
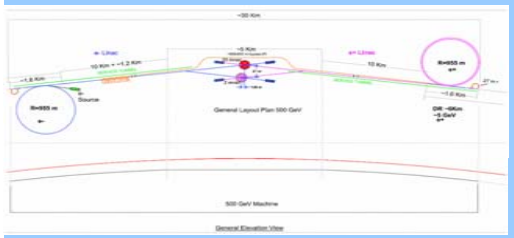
Number of Beamstrahlung Electrons versus Energy



Most beamstrahlung electron/positrons are far lower energy than the 2γ electron/positrons



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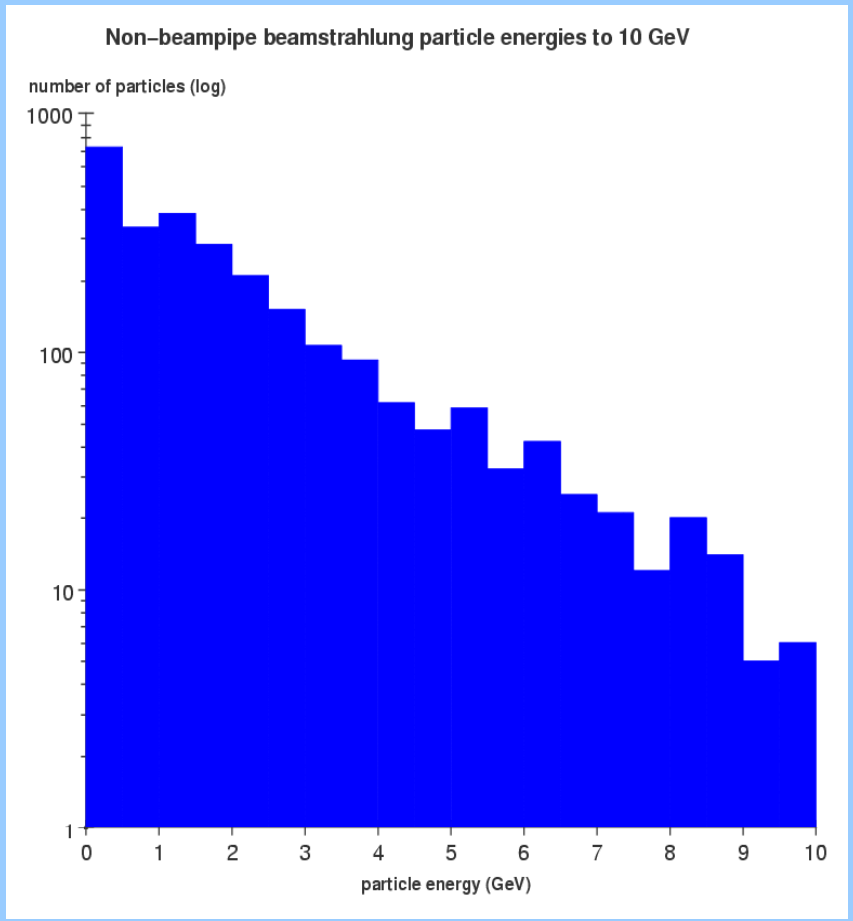
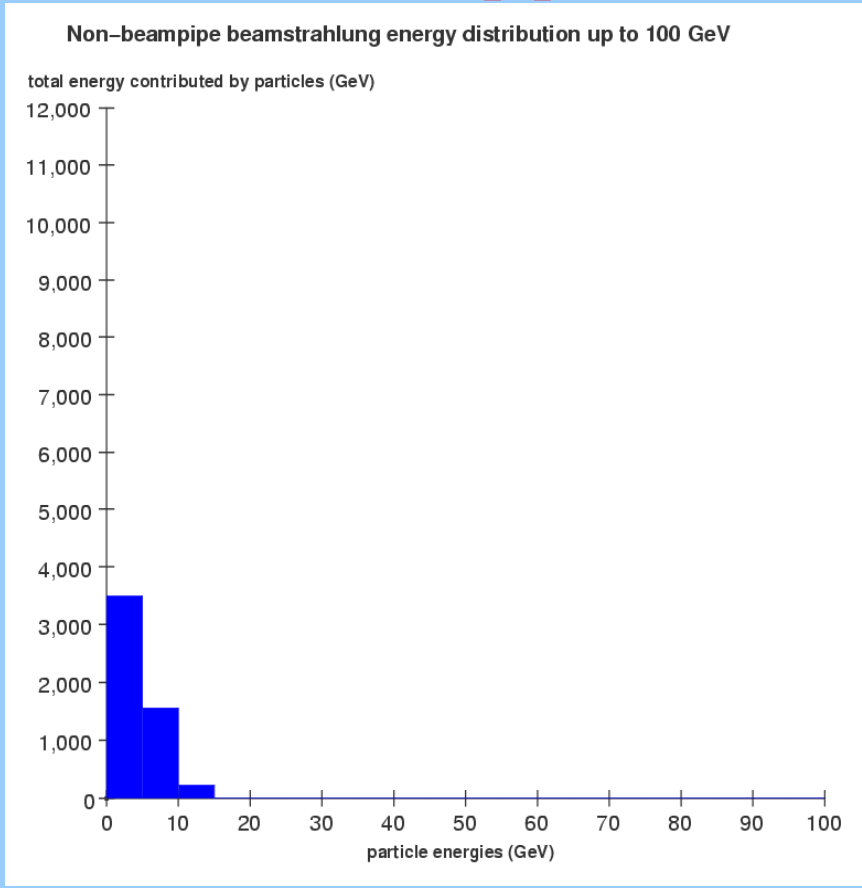
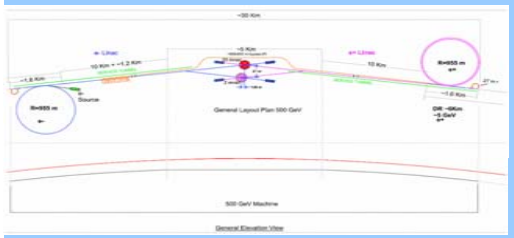
Total Energy Deposited

Log scale



Energy Deposited Outside Beampipes





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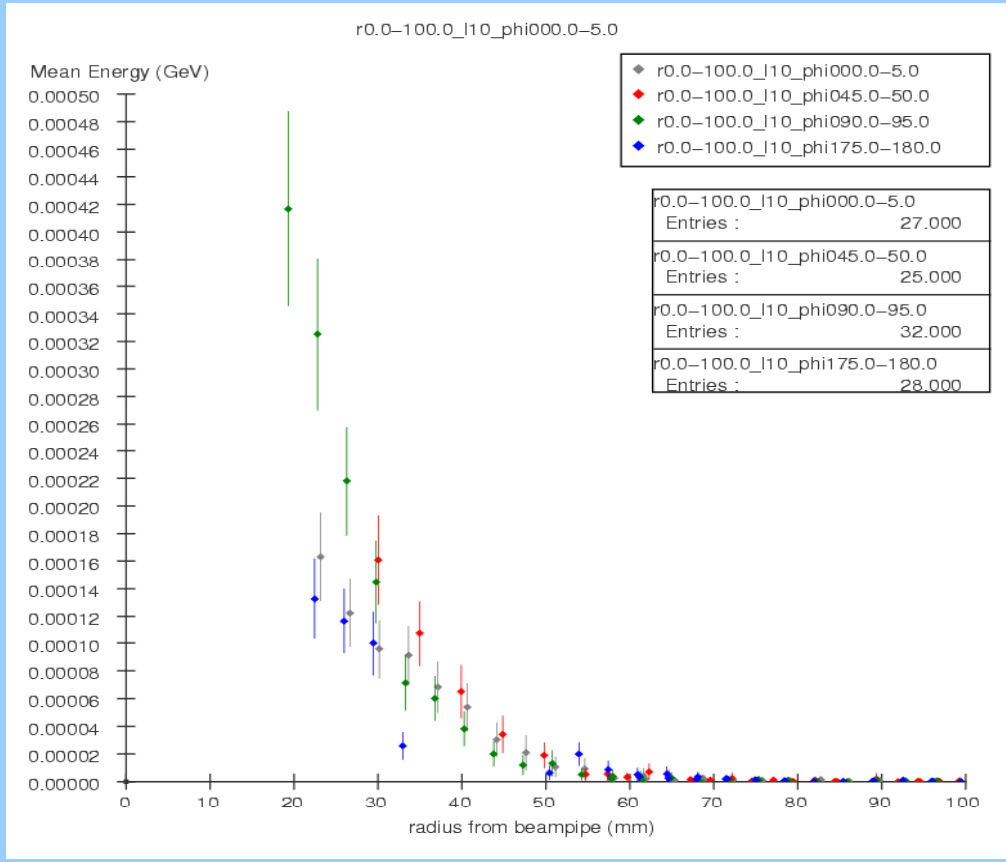
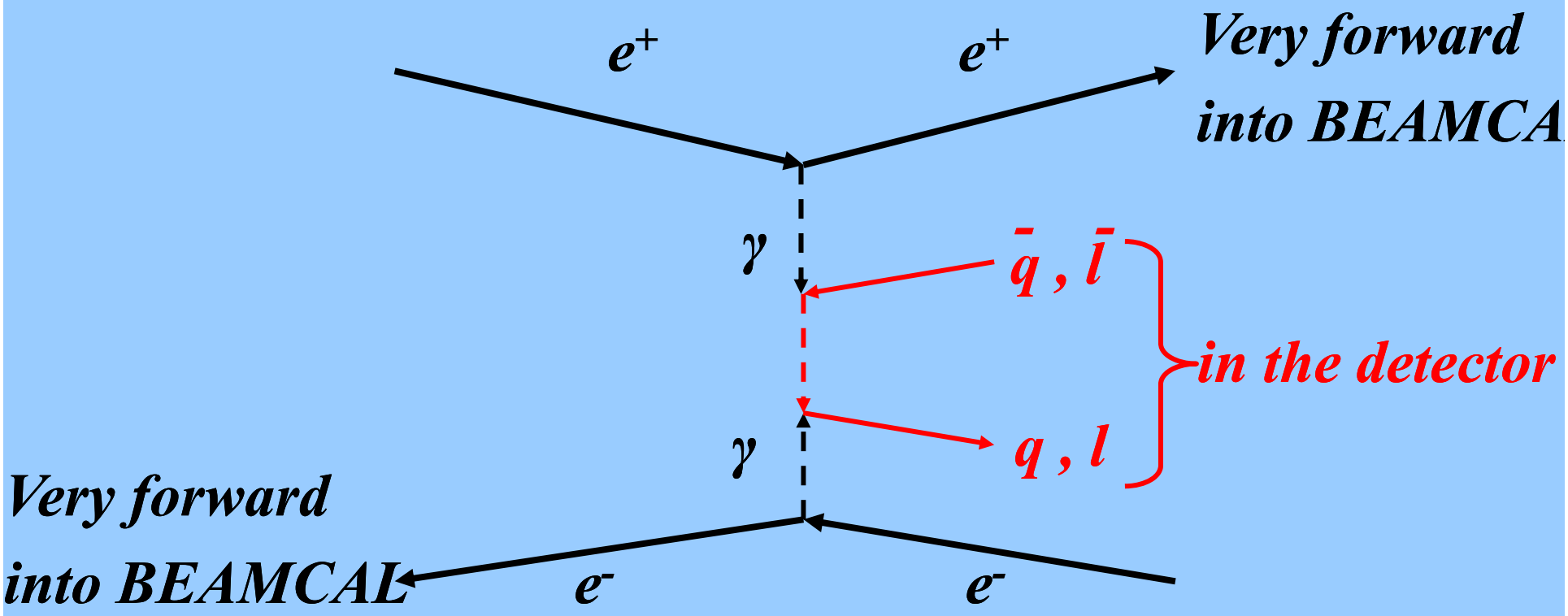
Beamstrahlung Energy Deposition

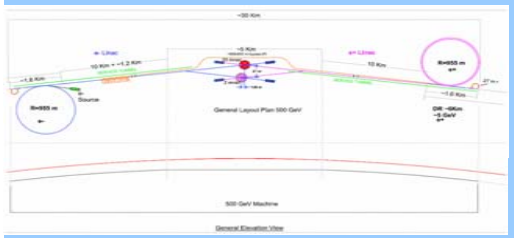
Means and Sigmas of energy deposited in layer 10 versus radius from beam pipe center at given azimuthal angles



2 Photon Process



Discussion in Beam Cal section at end



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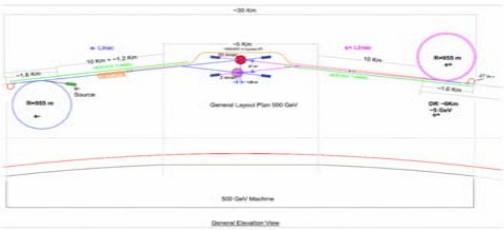
The 2 photon process needs to be observed in the midst of the beamstrahlung that is continuously present since this background occurs for every beam crossing. The question that needs answering is how well can we determine that we are observing a 2-photon process.



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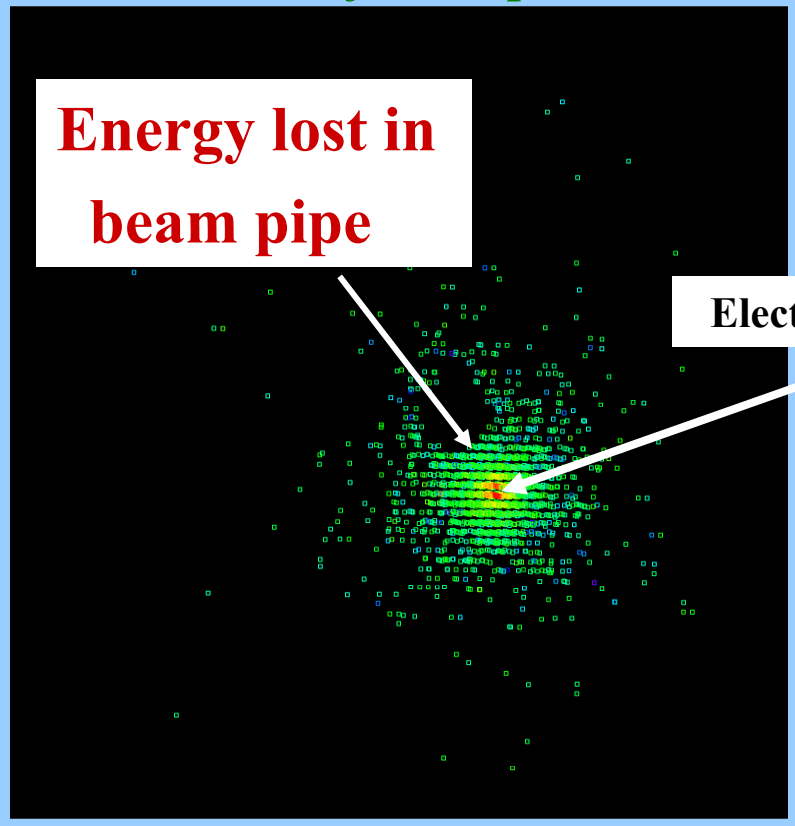
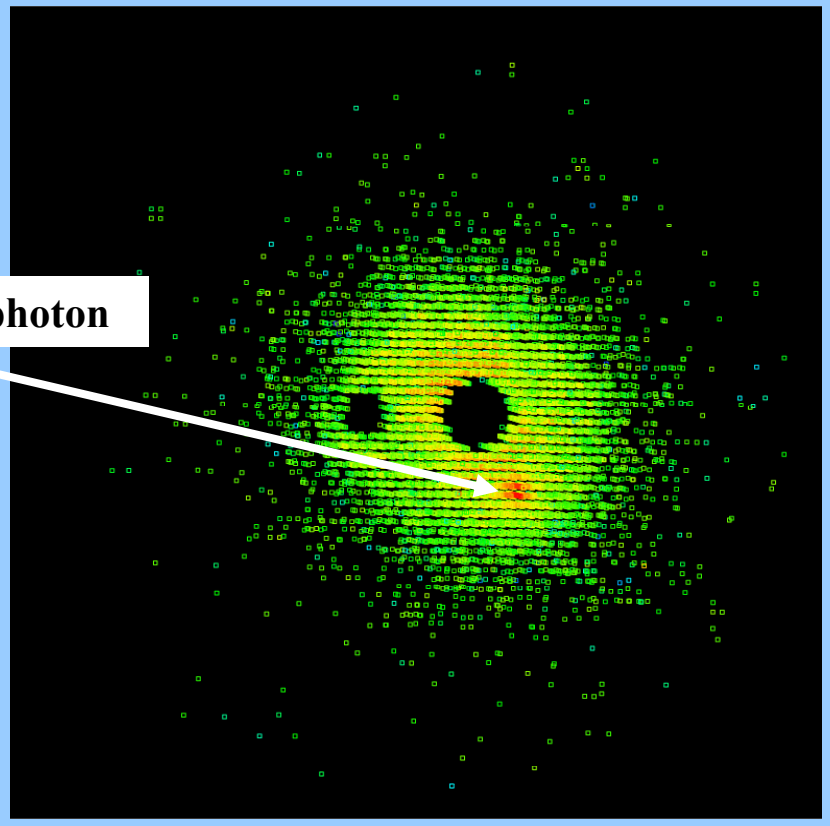
Head on Views

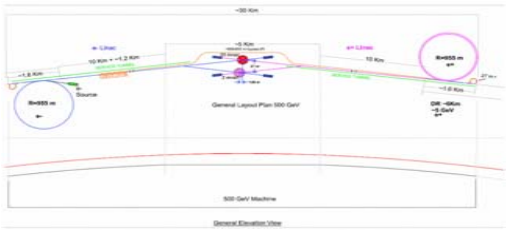
electron from 2 photon



electron from 2 photon and beamstrahlung overlayed



Electron from 2 photon



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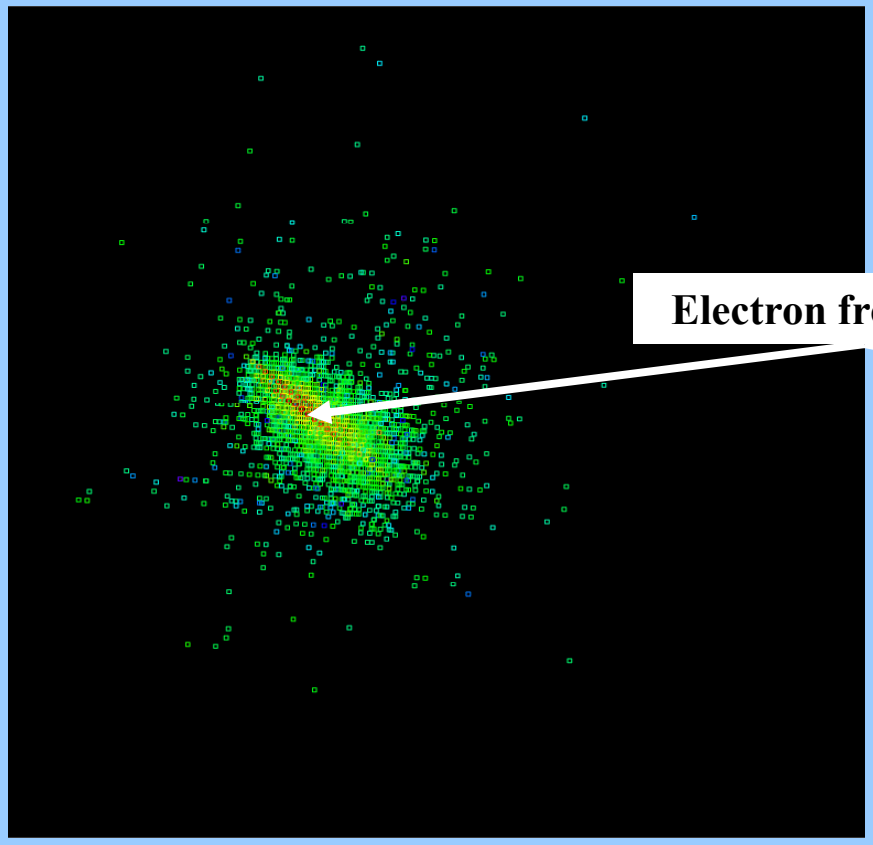
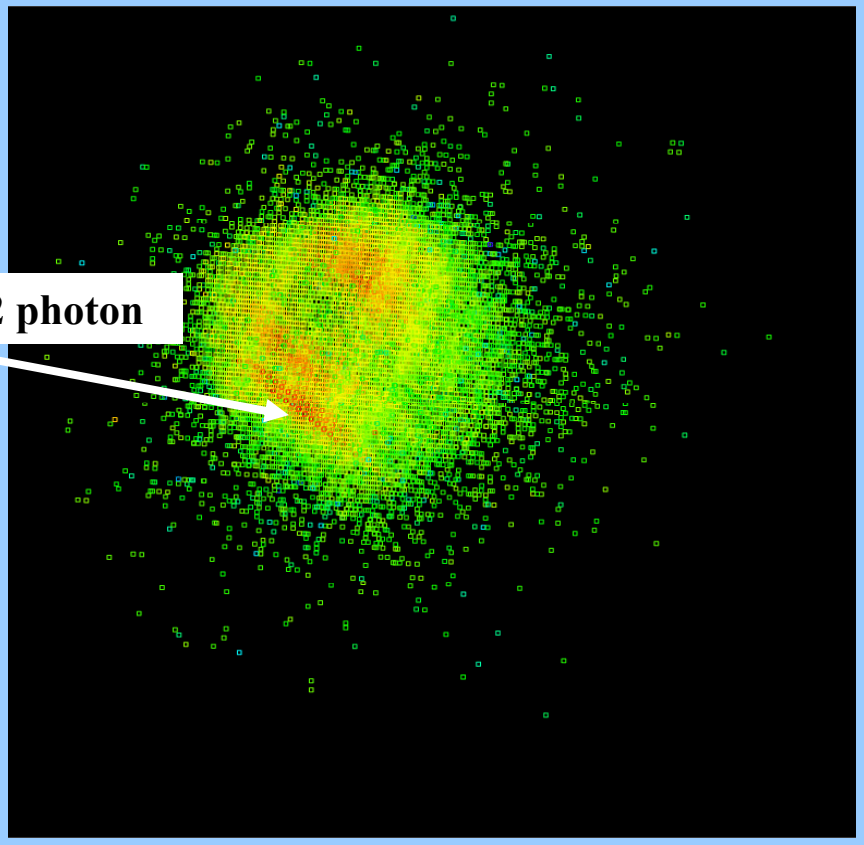
Side View

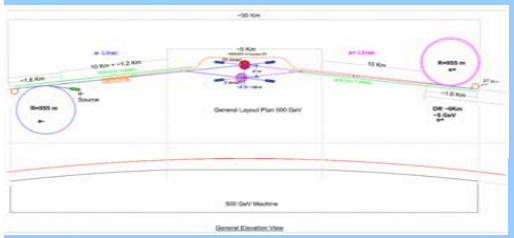
electron from 2 photon



electron from 2 photon and beamstrahlung overlayed



Electron from 2 photon



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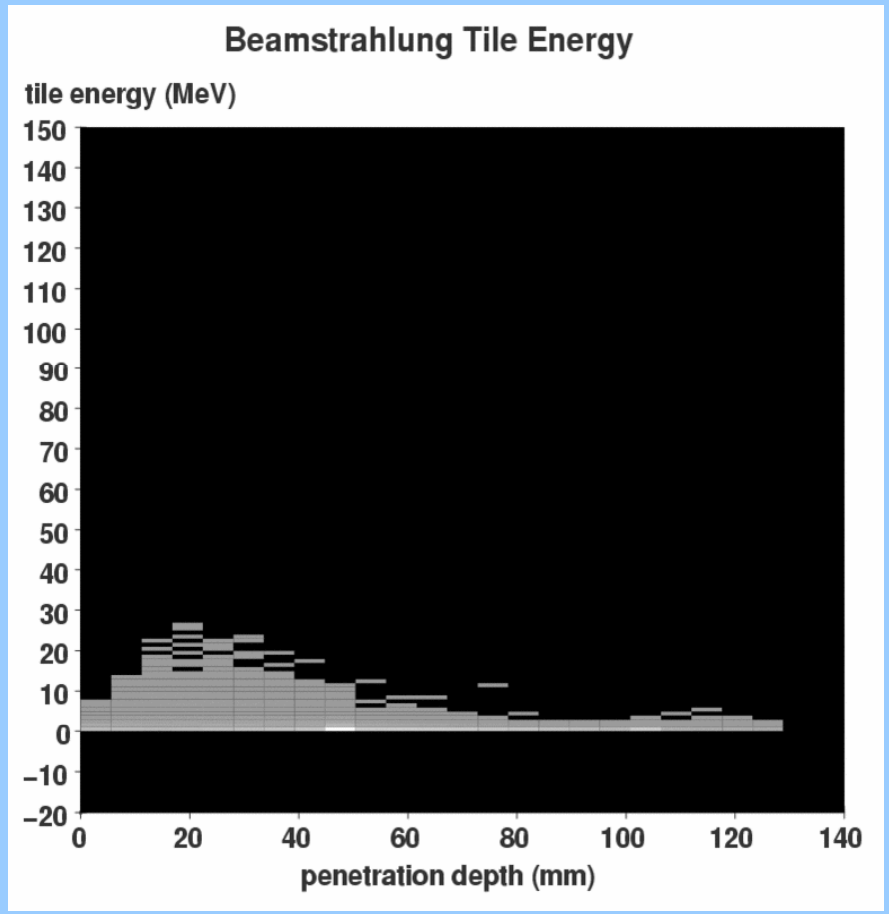

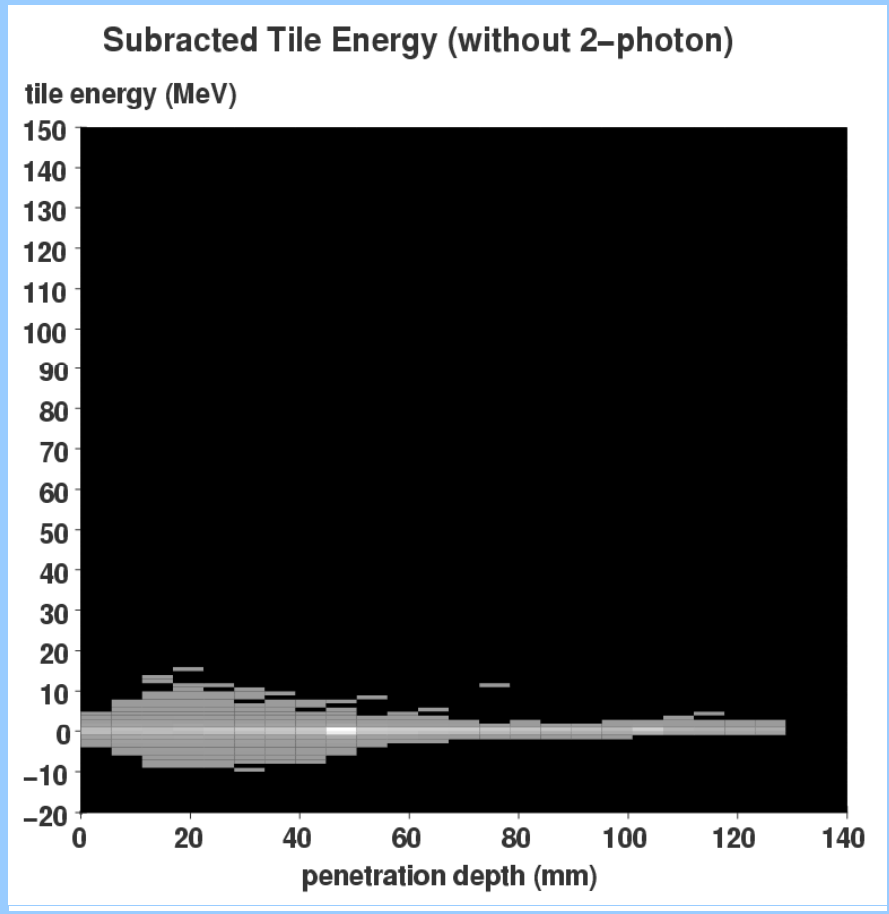

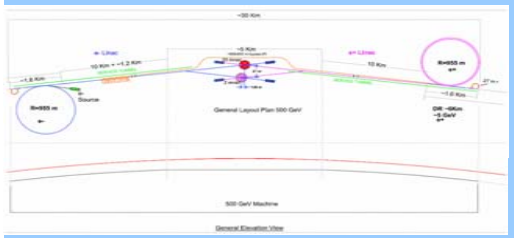

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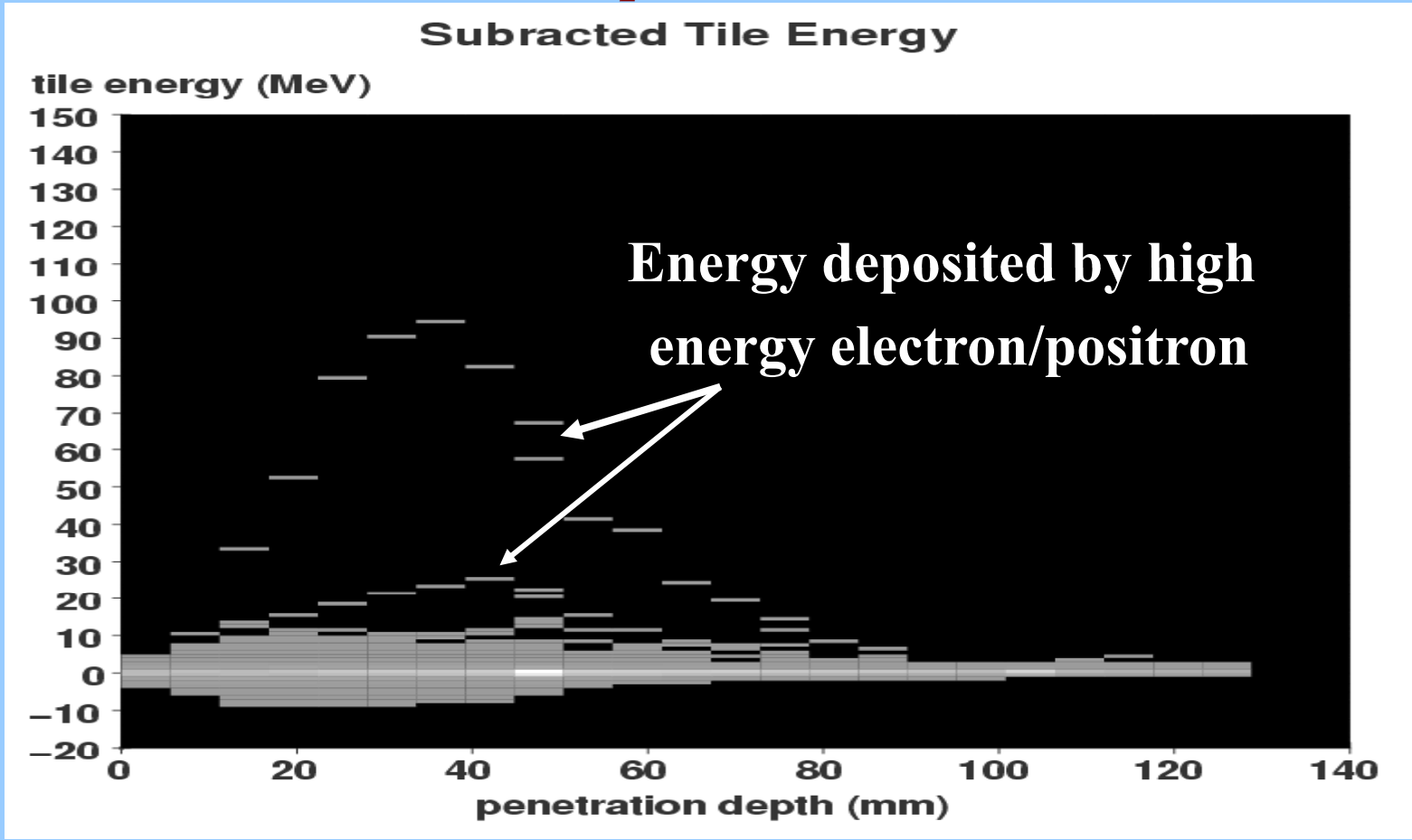
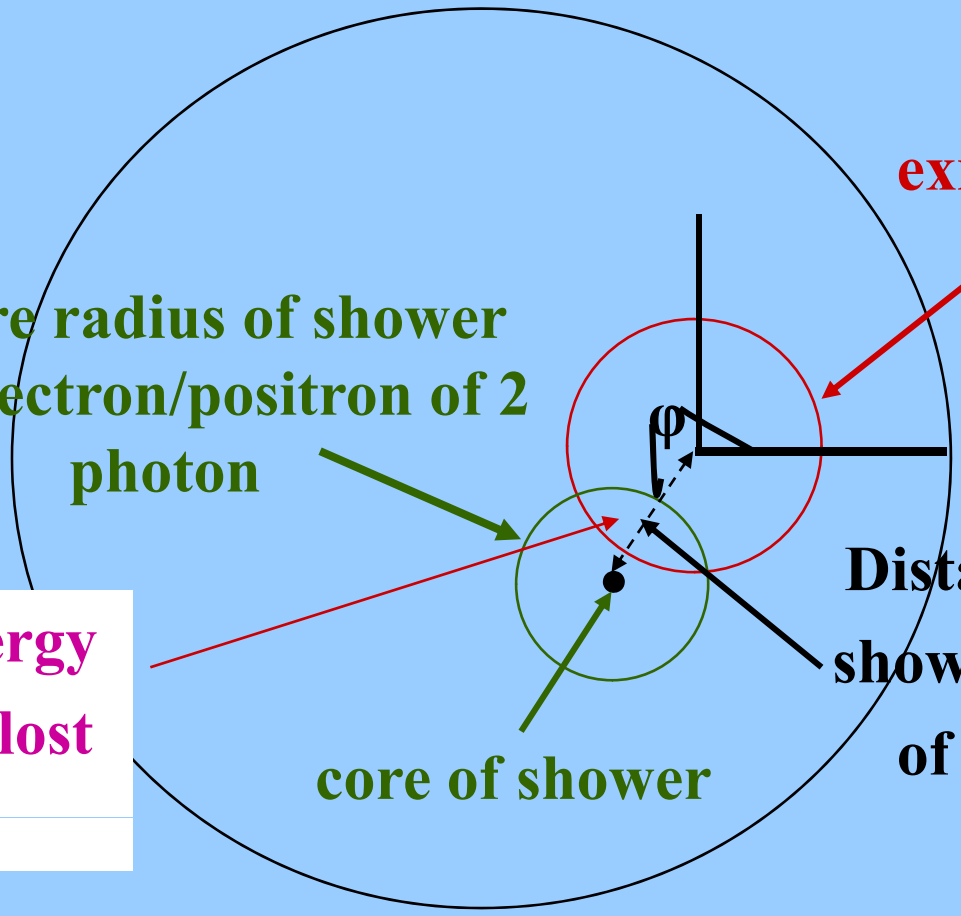
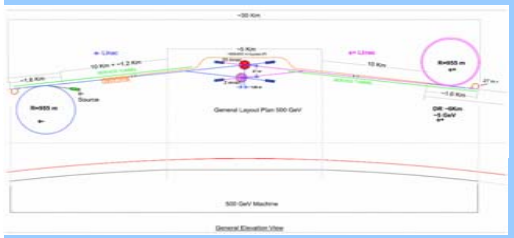
Observed signal of the electron/positron from 2 photon vs depth



Energy Loss Correction due to Beampipe

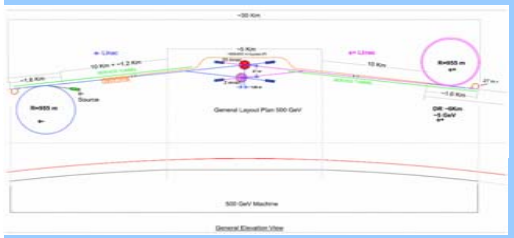


Fraction of energy measurement lost = f (r,φ)



Next Steps

- ***Determine the functional dependence of the energy measurement correction due to the geometrical effects from the exit and entrance beampipes. This is being carried out presently.***



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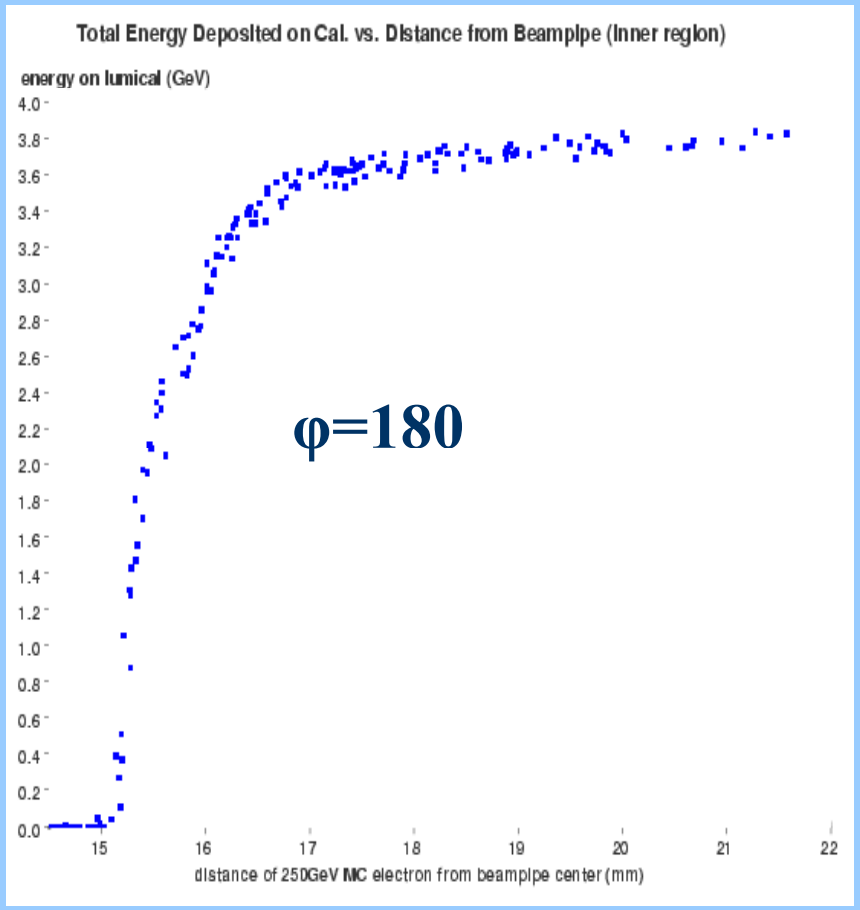
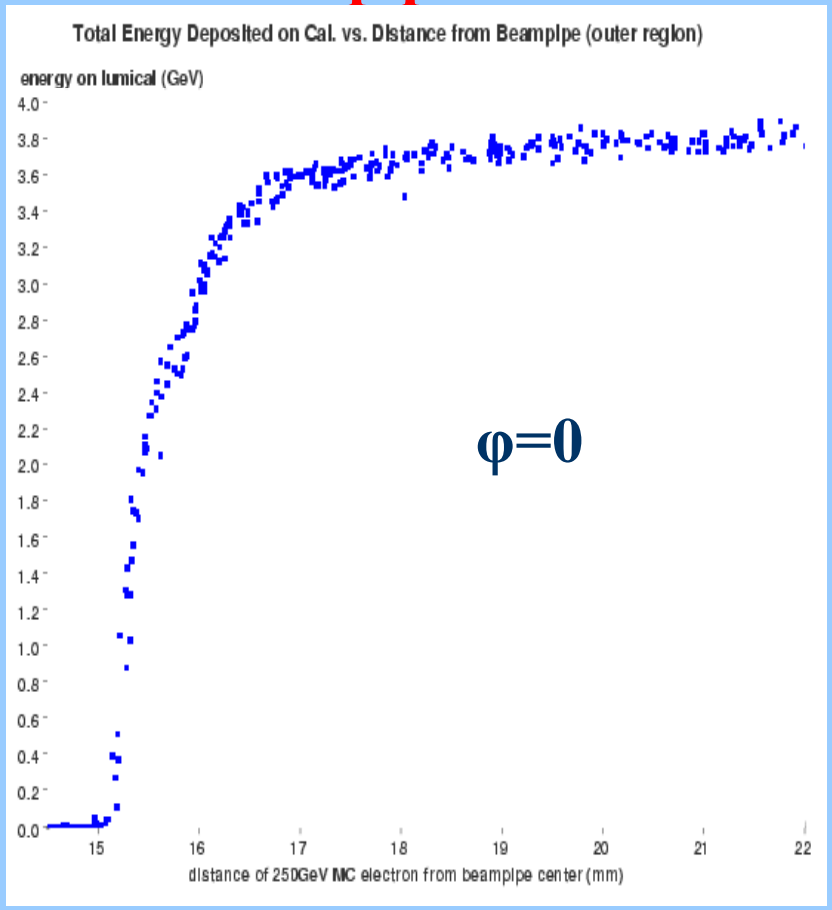
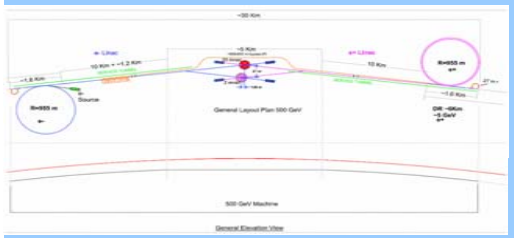
Energy Deposited by 250 GeV Electron in the BeamCal vs Distance from Center of Exit Beampipe







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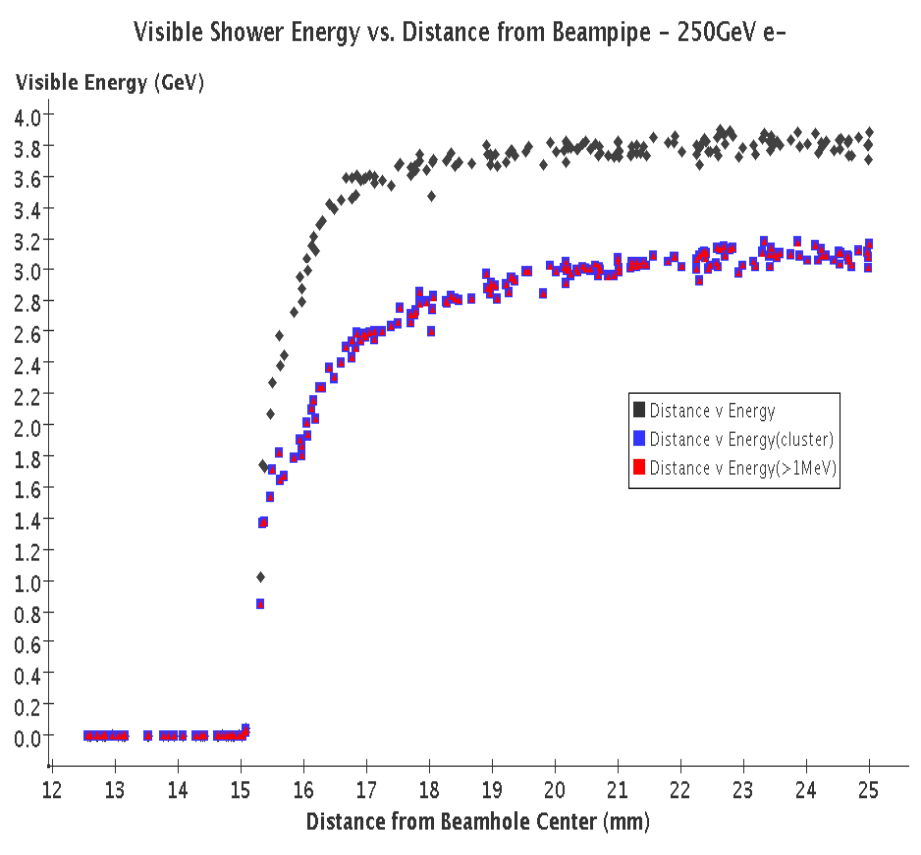
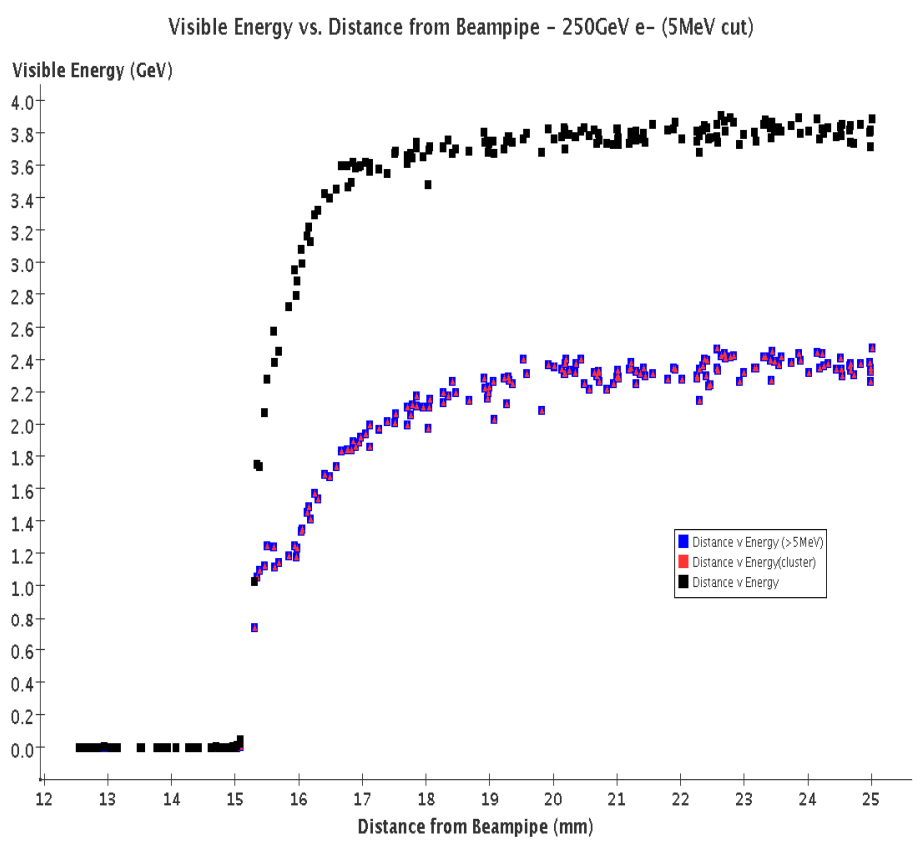
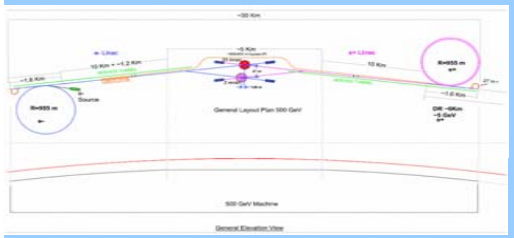
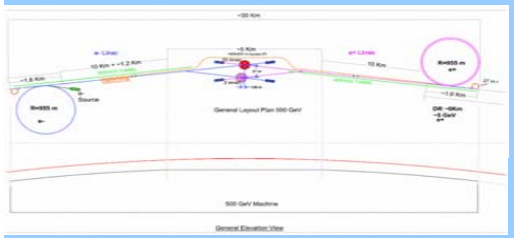






Next Steps

- *Correlate the observed energy above background with the incident energy and determine the functional dependence of the ratio and its resolution for various energy limit cuts.*
- *Apply this to the 2 photon process to determine how well we can satisfy energy and momentum conservation and be able to apply a transverse momentum or missing energy cut.*
- *Apply these to various SUSY processes to determine the limits of our analysis on their observation and measurement of masses from energy distributions of the SUSY decay particles.*
- *We hope to carry this out during the summer.*



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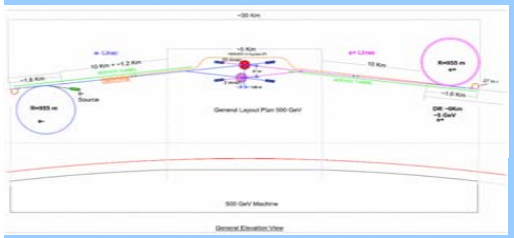
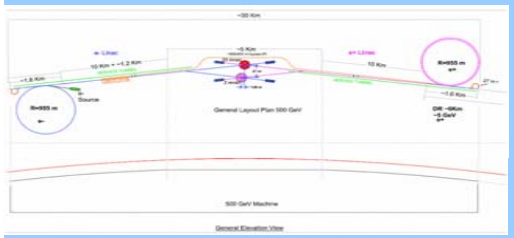


The Simulation Aim

We want to determine how far down in Pt we can observe the two photon background by requiring that we observe the forward electron and positron above the beamstrahlung. This will require that we distinguish shower shapes.



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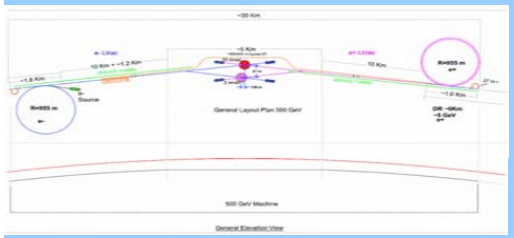
The ILC Parameters Committee is asking us to evaluate how well one can observe the process

$$e^+ e^- \rightarrow \tilde{\tau}^+ \tilde{\tau}^- \rightarrow \tilde{\chi}^0_1 \tau^+ \tilde{\chi}^0_1 \tau^-$$

where the stau-neutralino mass difference is 5 GeV. This is roughly point 3 in the Snowmass 2001 parameter set.

At the Valencia meeting this was discussed and our DESY colleagues pointed out that this signal can be observed.



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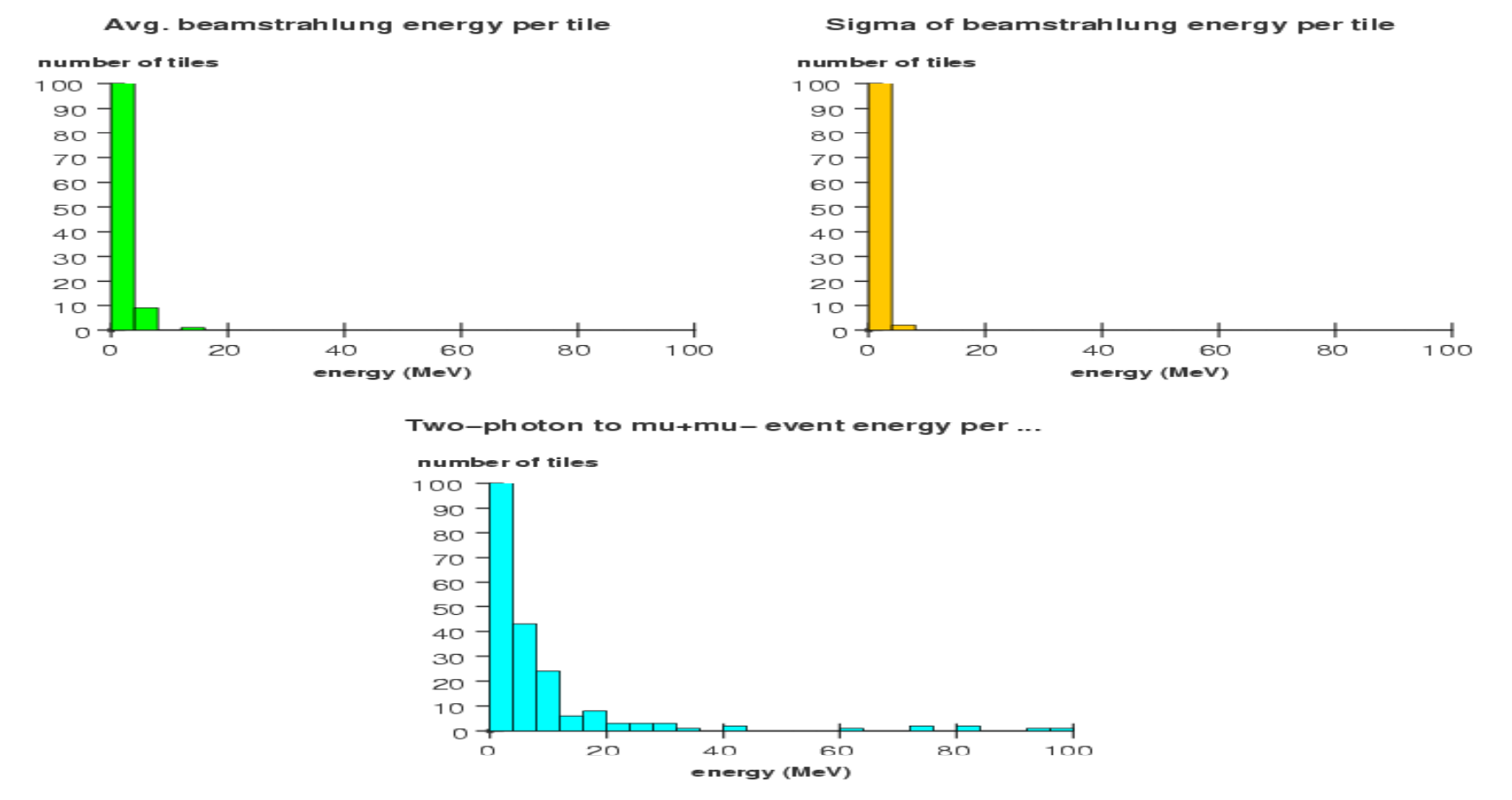
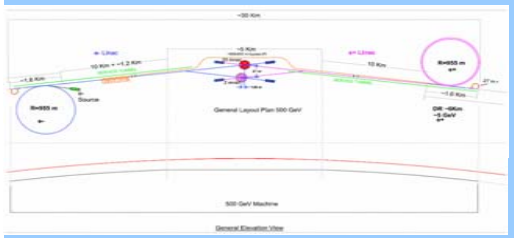
Energy Deposition of the Beamstrahlung and 2-Photon Process





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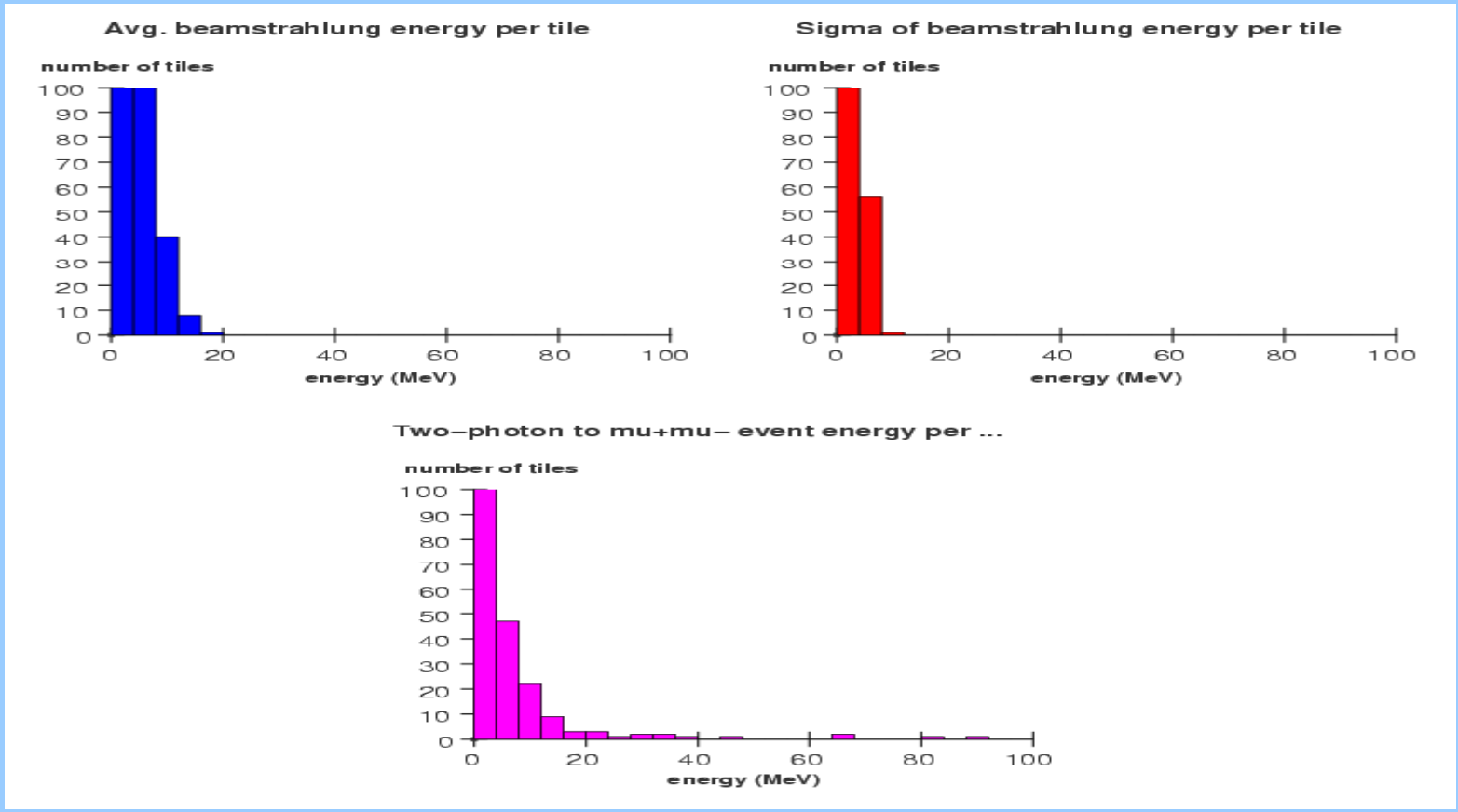
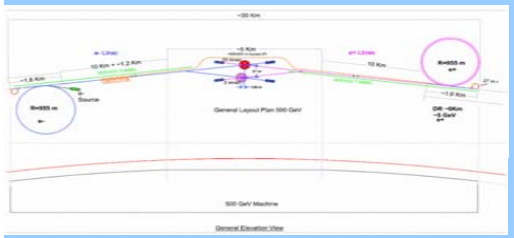
Energy Deposition of the Beamstrahlung and 2-Photon Process



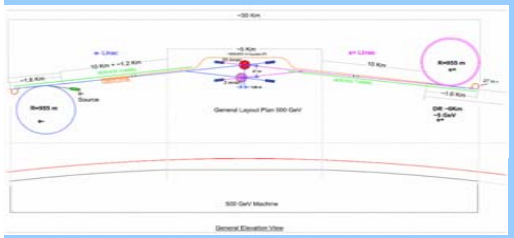


What Have we Accomplished

We have simulated with GEANT 4.0 the showers in the BeamCal due to the beamstrahlung and due to the 2-Photon process..

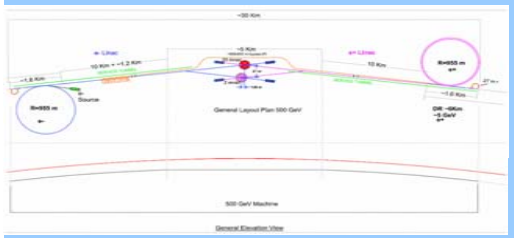
We have recorded the average energy deposition as a function of radius and angle from the center of the outgoing beampipe.

We have generated and recorded in a table the average energy deposited in each cell.



NEXT STEPS

Overlay 2 photon processes on the beamstrahlung data and extract the energy of the high momentum electrons by removing average energy depositions from beamstrahlung to determine how well we can determine the missing Pt in order to extract the correct background from extraneous events.



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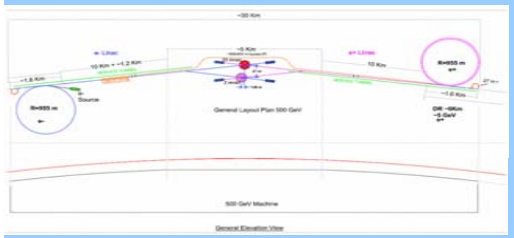

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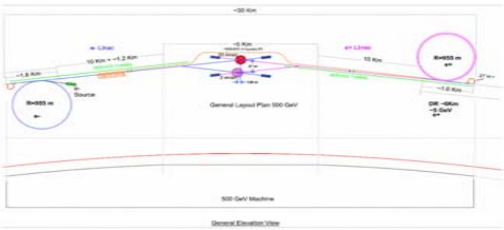
Study the efficiency to observe the electron and positron of the two photon process above the beamstrahlung background

Essential to remove this background in the study of Supersymmetry in the dynamical region of low Pt. Needed to measure the masses.

Work by Paul Steinbrecher and Gleb Oleinik



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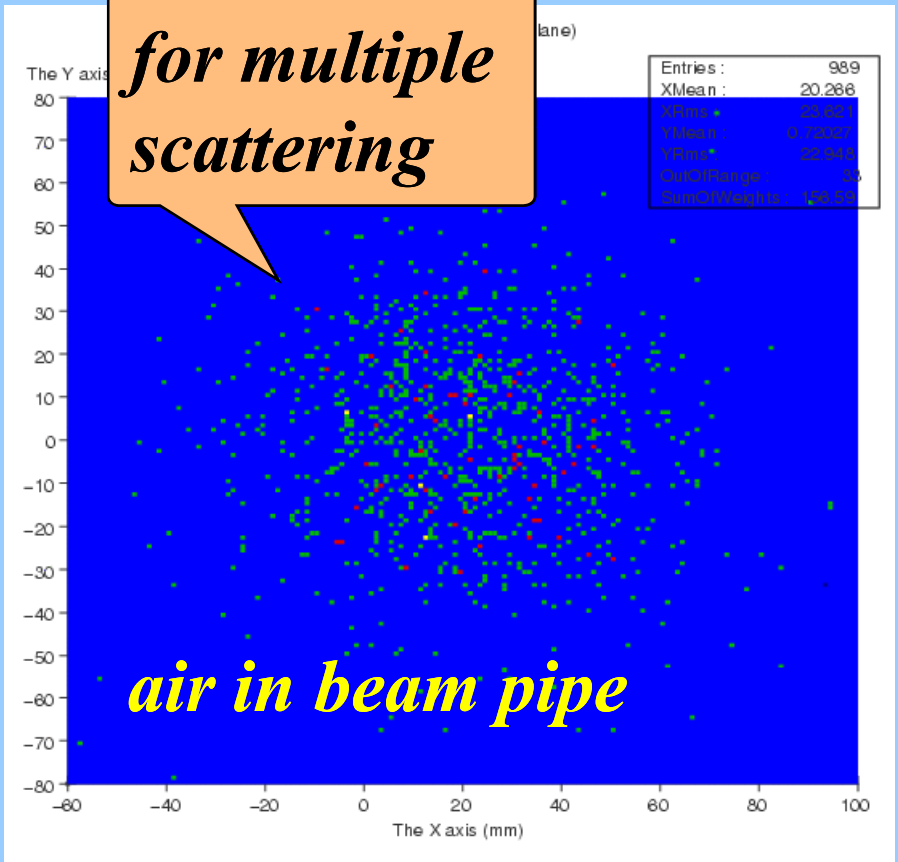
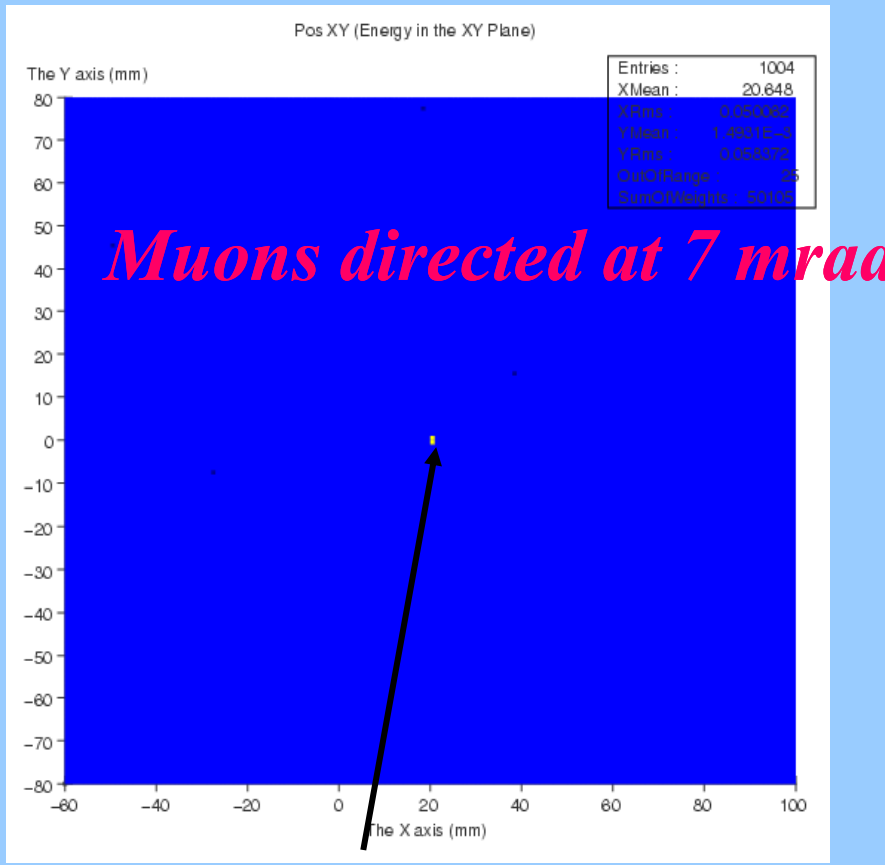
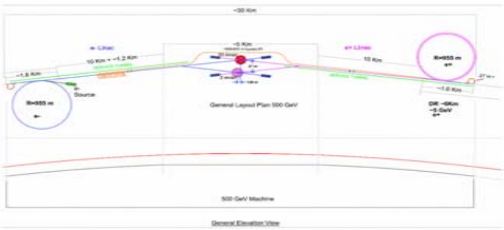
Testing GEANT 4.0





No field, 50 MeV muons **No field, 50 GeV muons**



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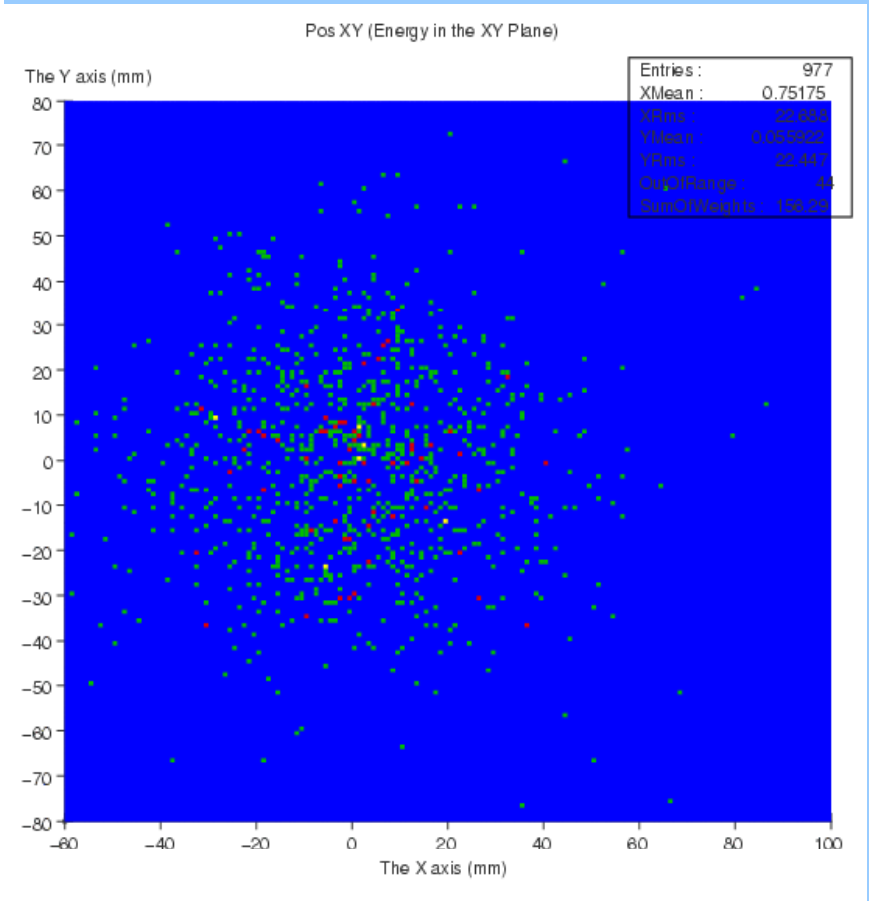
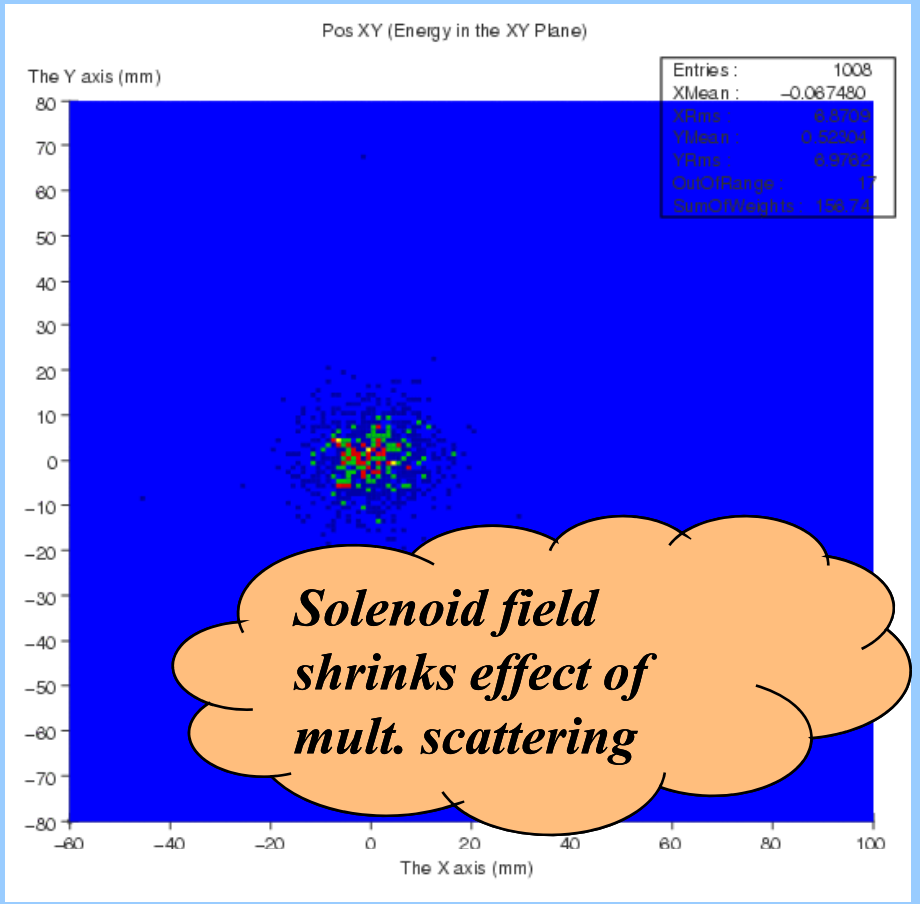
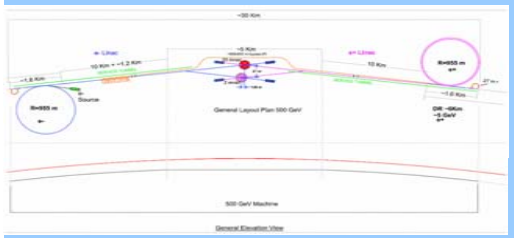
50 MeV, no field, forward



50 MeV, solenoid on, forward



Solenoid field shrinks effect of mult. scattering



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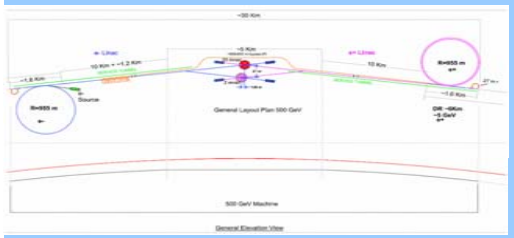
GEANT 4.0 seems to be working properly We have fixed various bugs in collaboration with SLAC team.

According to Seryi Anti-DiD was tuned assuming BEAM CAL is at L* ~ 350 cm. BEAM CAL for SiD is at 295 cm. Effect is clearly seen. Need to retune Anti-DiD to larger values. We are doing this.

All Simulation is work in progress.



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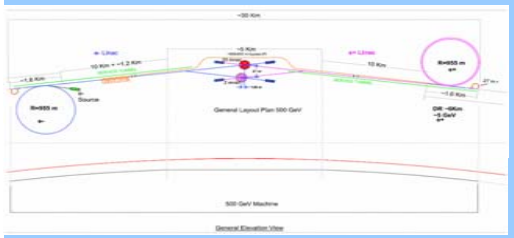

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