

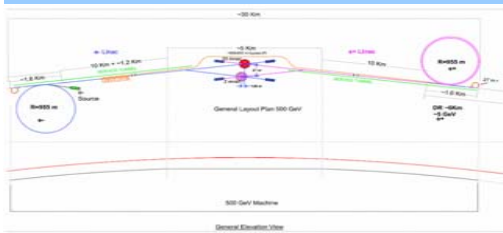
# *ILC07 Talk*



ILC – The International Linear Collider Project

## ***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*



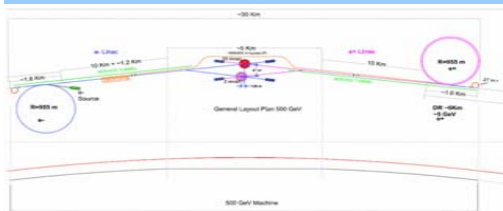
# *ILC07 Talk*



ILC – The International Linear Collider Project

## *The FCAL Collaboration*

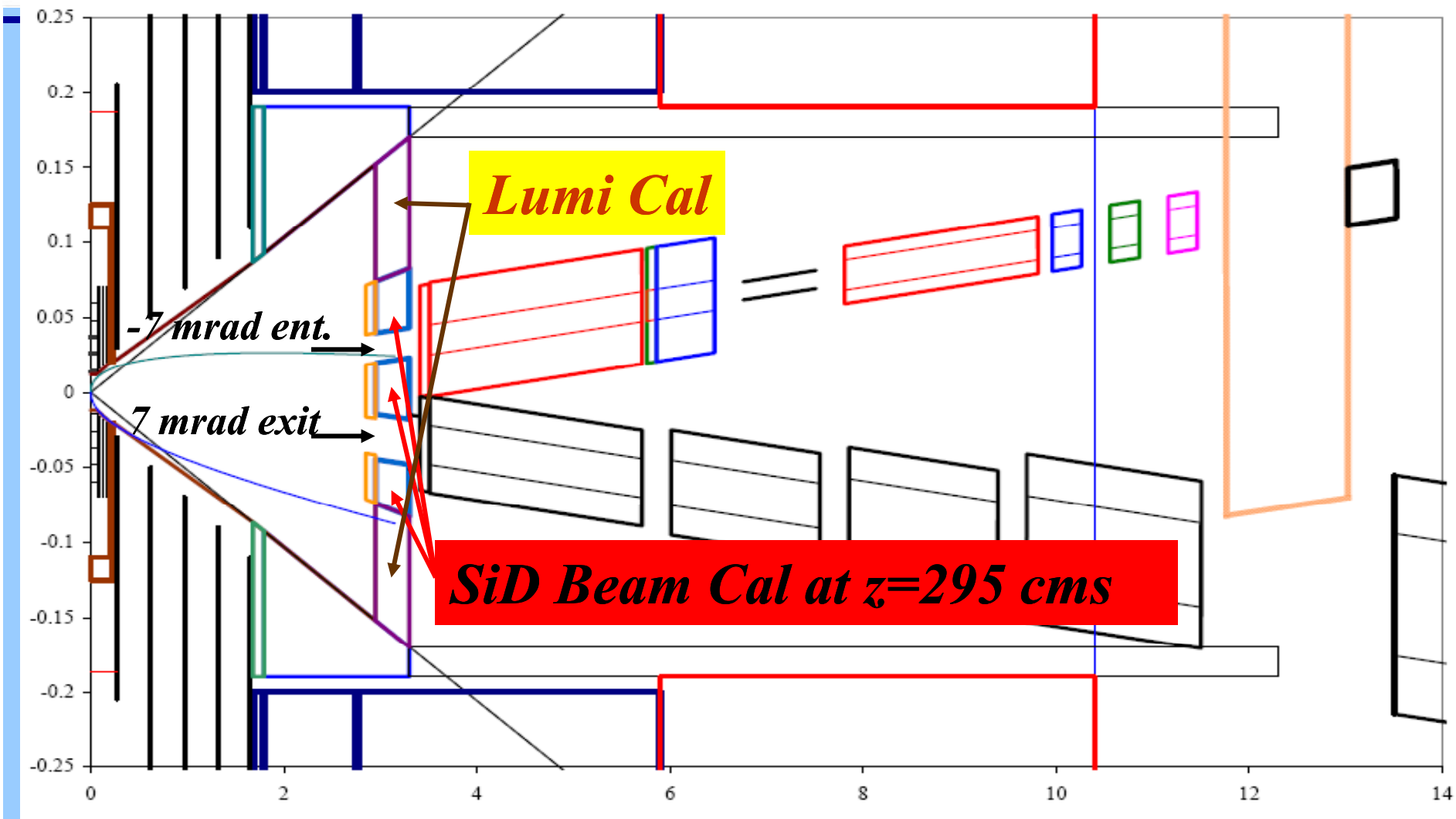




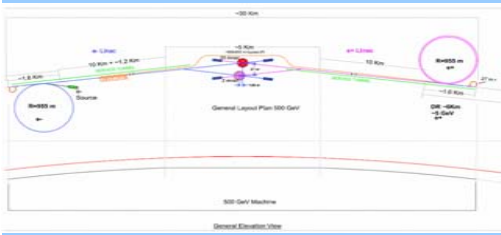
# ILC07 Talk



ILC - The International Linear Collider Project







# *ILC07 Talk*



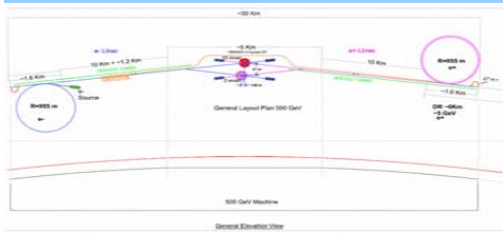
ILC – The International Linear Collider Project

## *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  $1 \times 1 \text{ cm}^2$  (Moliere radius of showers)*

*Third, we need to study the  $2 \gamma$  process to  
determine detection efficiency*



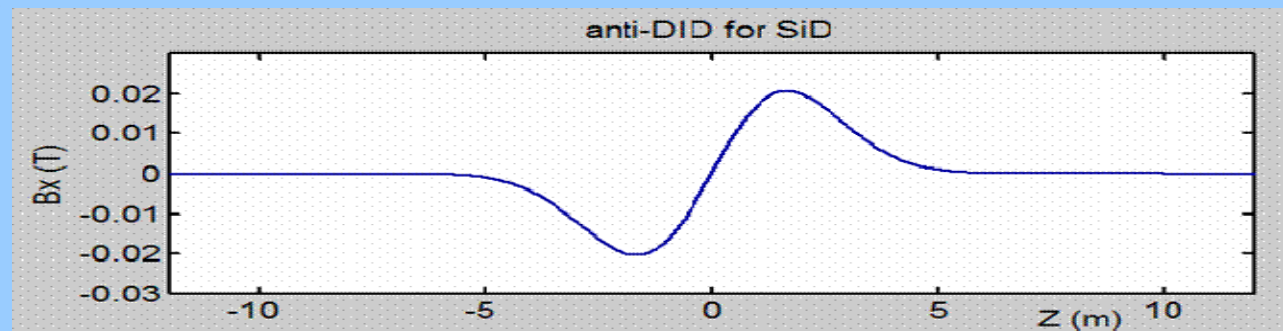
# ILC07 Talk

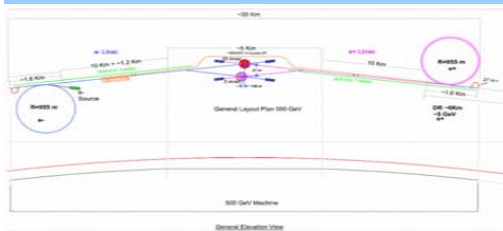


ILC – The International Linear Collider Project

*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.*





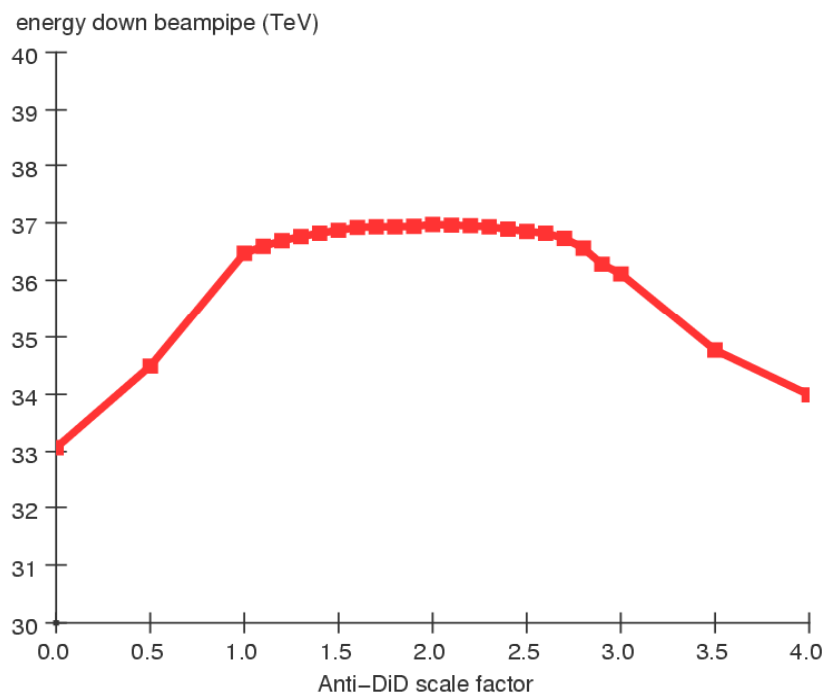
# ILC07 Talk



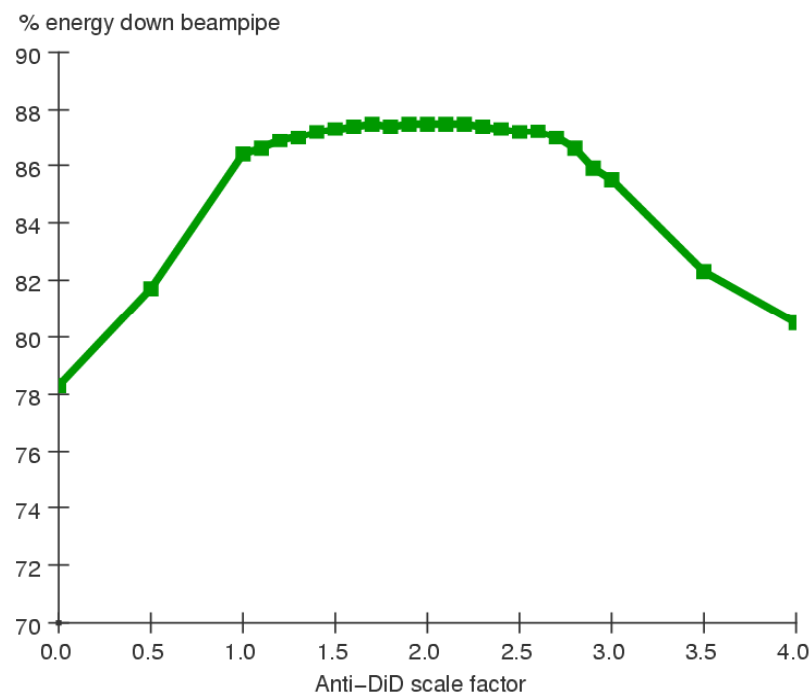
ILC – The International Linear Collider Project

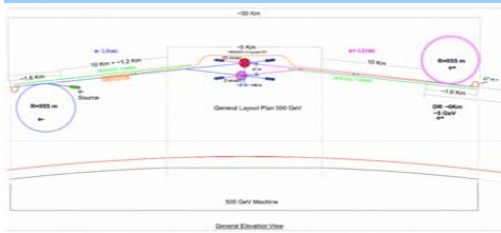
## *Anti-DiD Scale Factor to Maximize Energy into Beam Pipe*

**Anti-DiD optimization for detector @ z=295cm (TeV)**



**Anti-DiD optimization for detector @ z=295cm (%)**



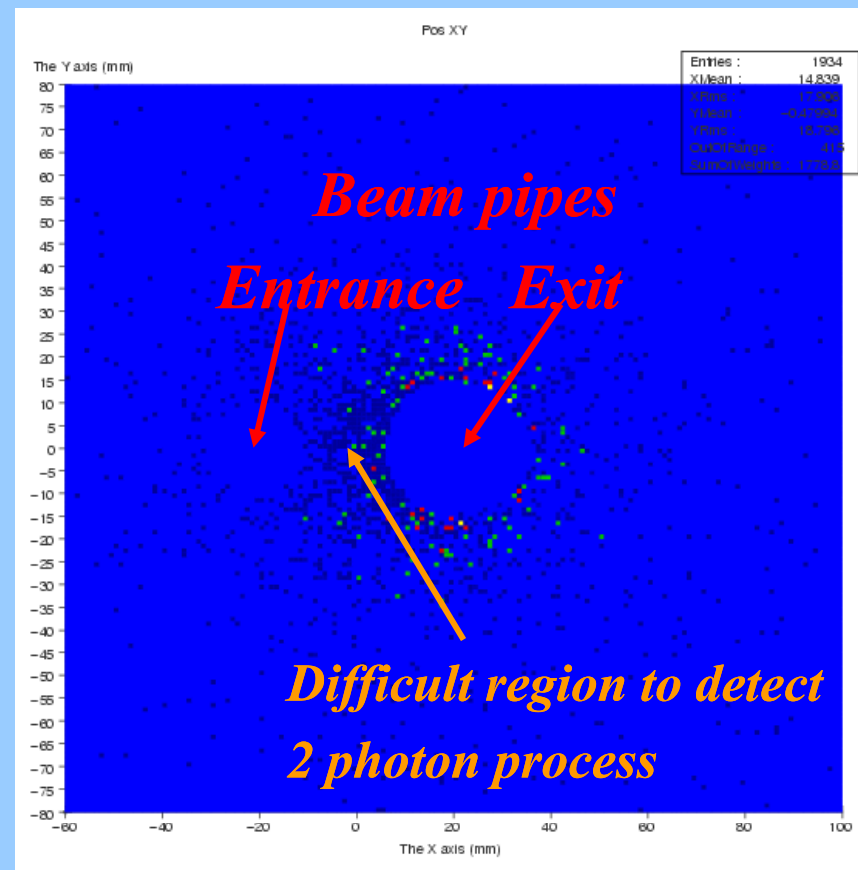
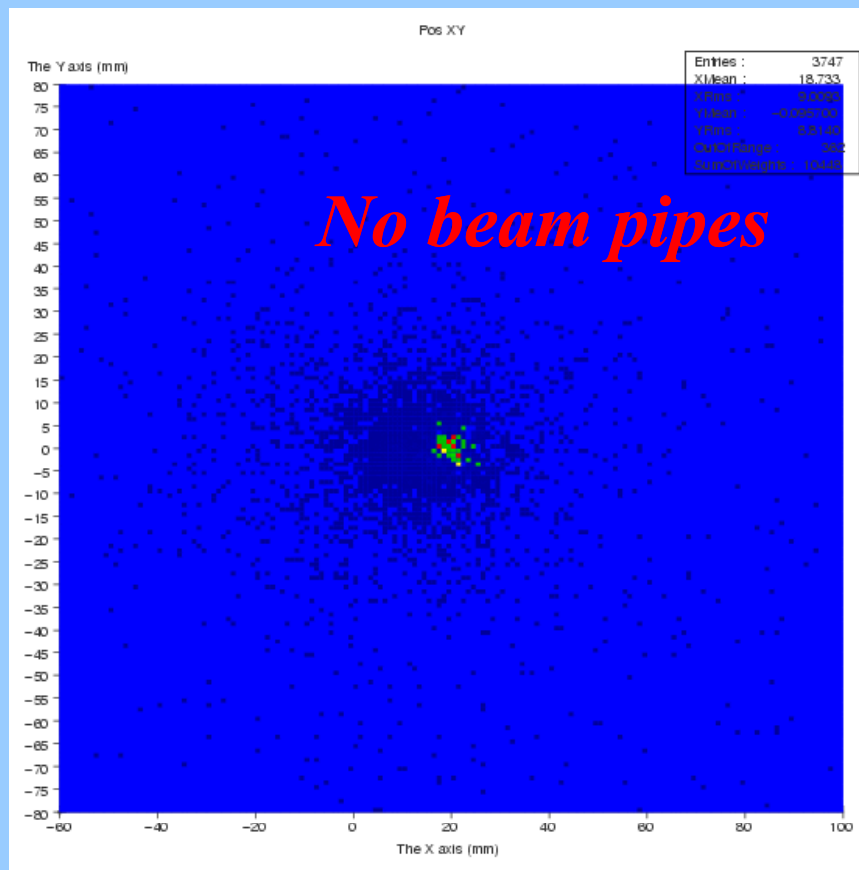


# ILC07 Talk

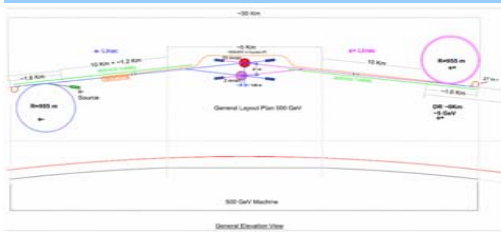


ILC – The International Linear Collider Project

## Beamstrahlung Distribution with Solenoid + Anti-DiD





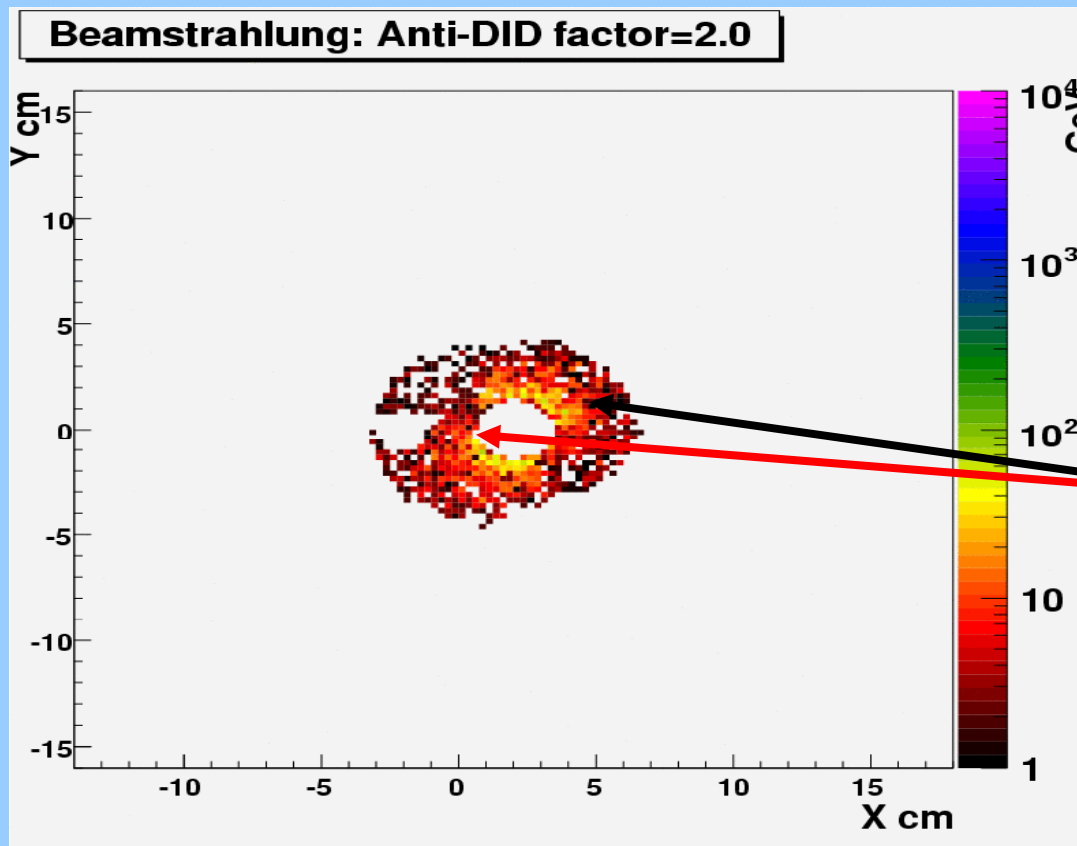


# ILC07 Talk



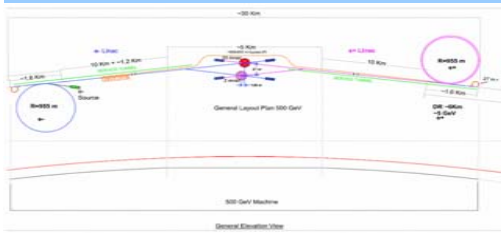
ILC – The International Linear Collider Project

## Beamstrahlung Energy Spectrum at the BeamCal



*In  $0.25 \times 0.25$   
 $cm^2$  areas*

*Not circularly  
uniform about exit  
beam hole*

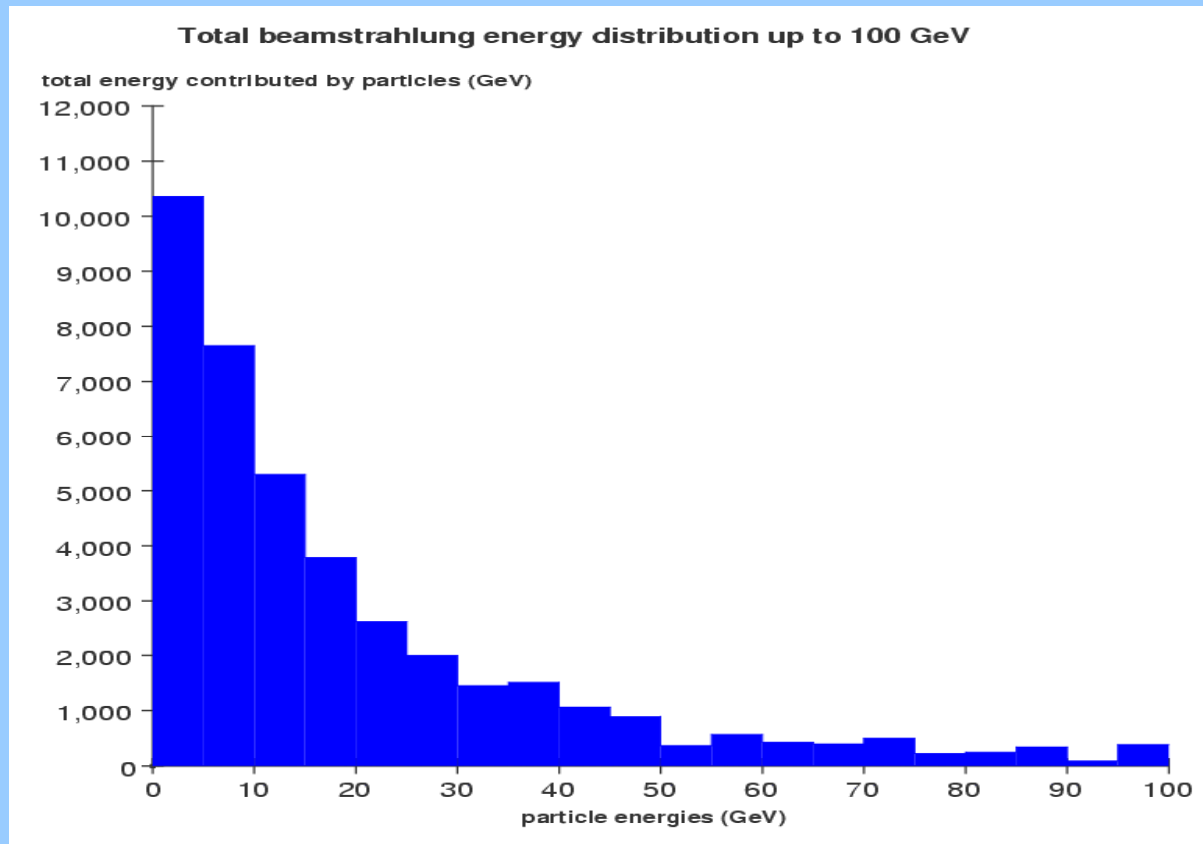


# ILC07 Talk

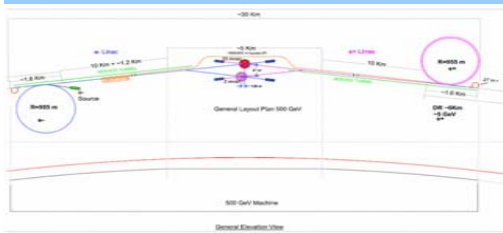


ILC – The International Linear Collider Project

## *Number of Beamstrahlung Electrons versus Energy*



*Most  
beamstrahlung  
electron/positrons  
are far lower  
energy than the  $2\gamma$   
electron/positrons*



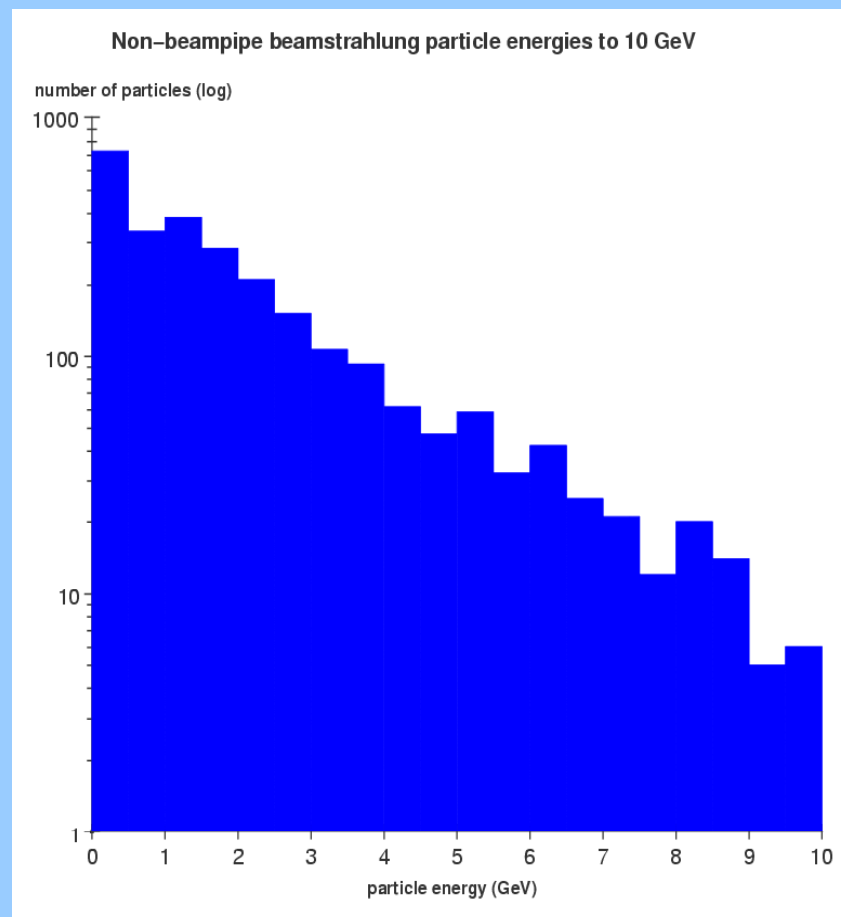
# ILC07 Talk



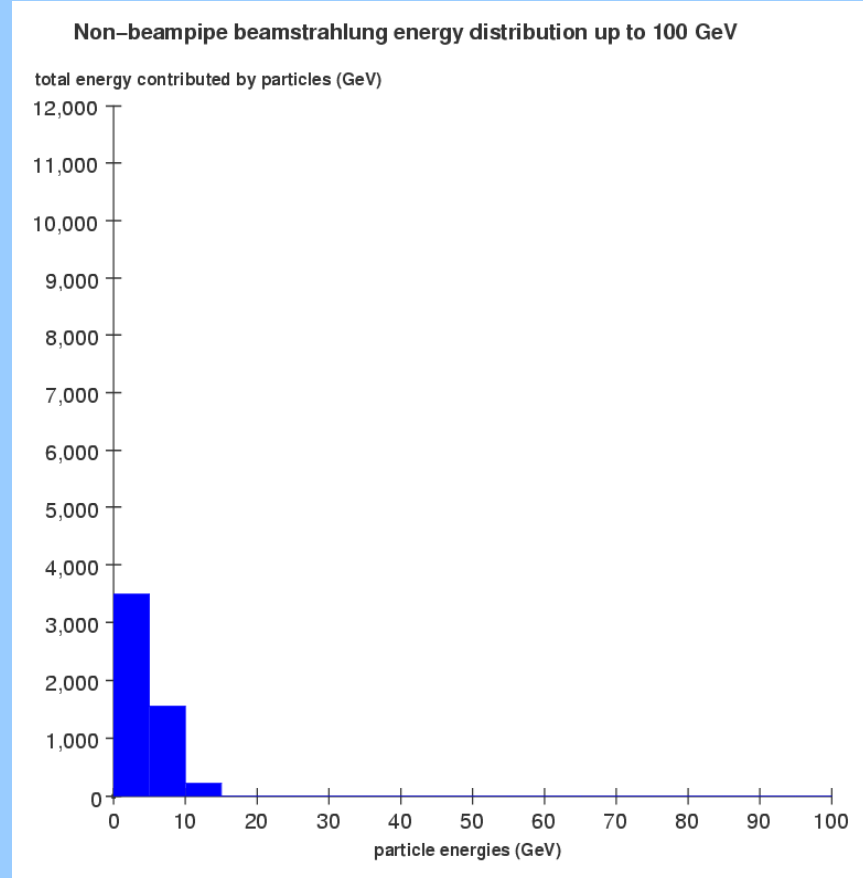
ILC – The International Linear Collider Project

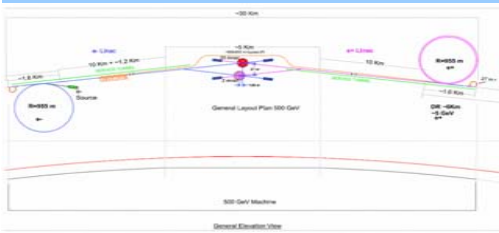
## Total Energy Deposited

Log scale



## Energy Deposited Outside Beampipes





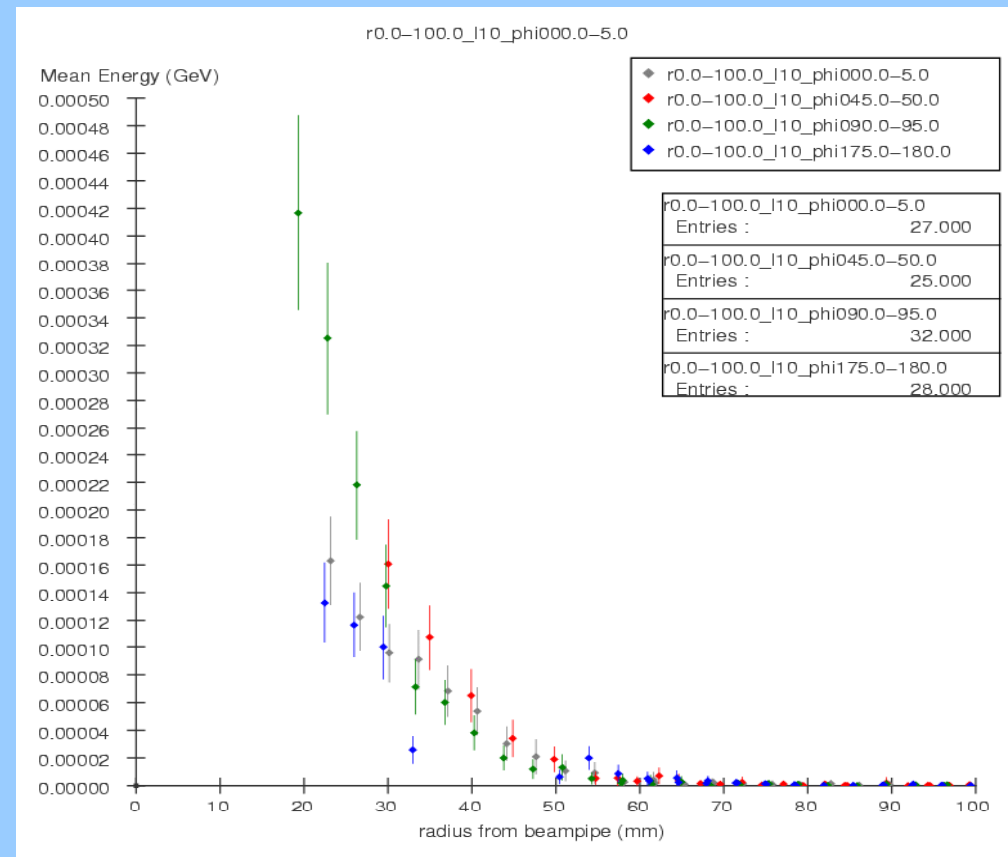
# ILC07 Talk

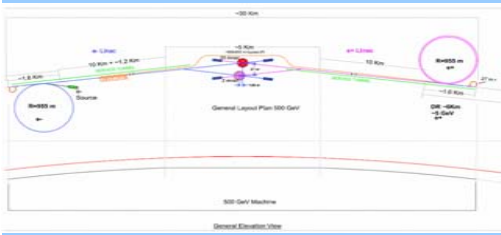


ILC – The International Linear Collider Project

## Beamstrahlung Energy Deposition

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



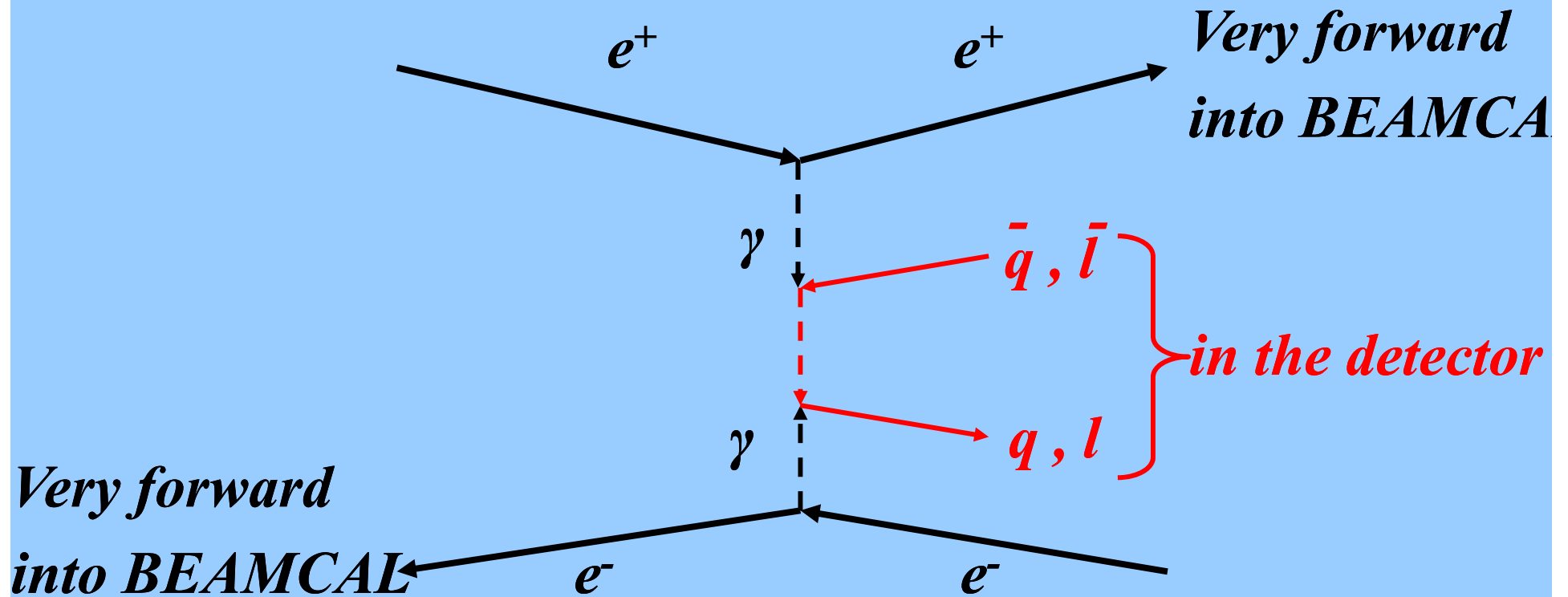


# ILC07 Talk

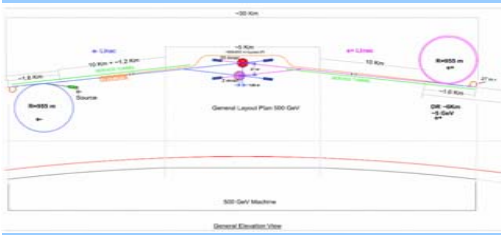


ILC – The International Linear Collider Project

## 2 Photon Process



*Discussion in Beam Cal section at end*



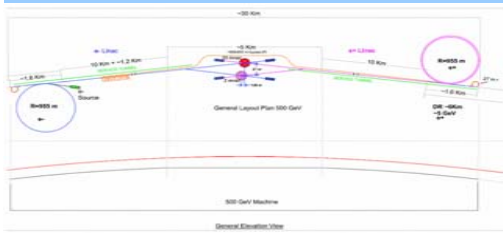
# *ILC07 Talk*



ILC – The International Linear Collider Project

*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.*





# ILC07 Talk

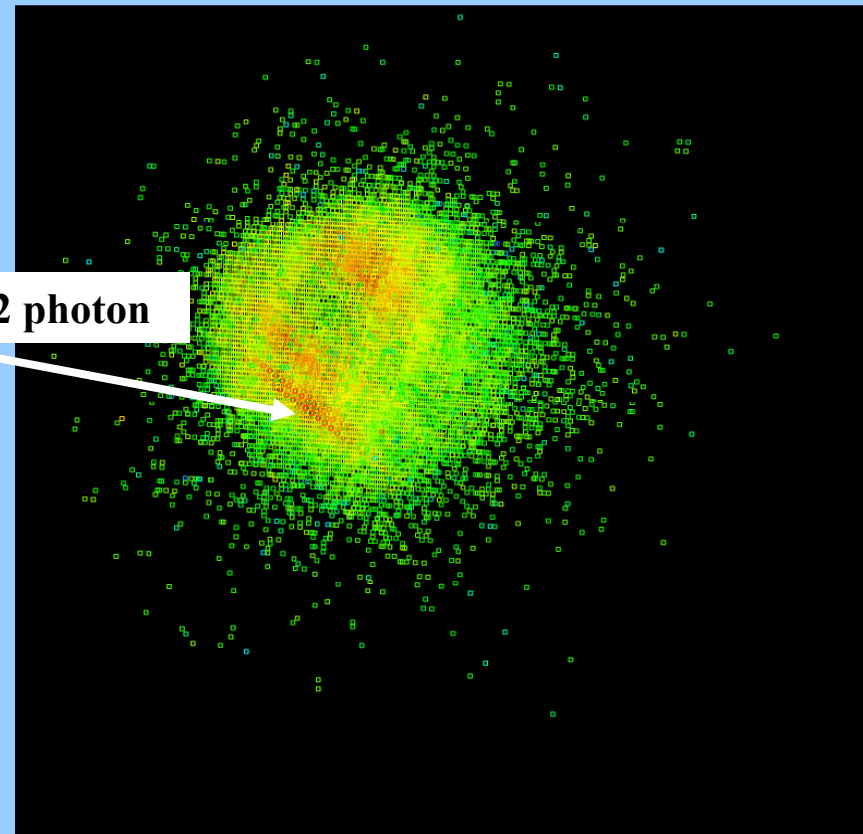
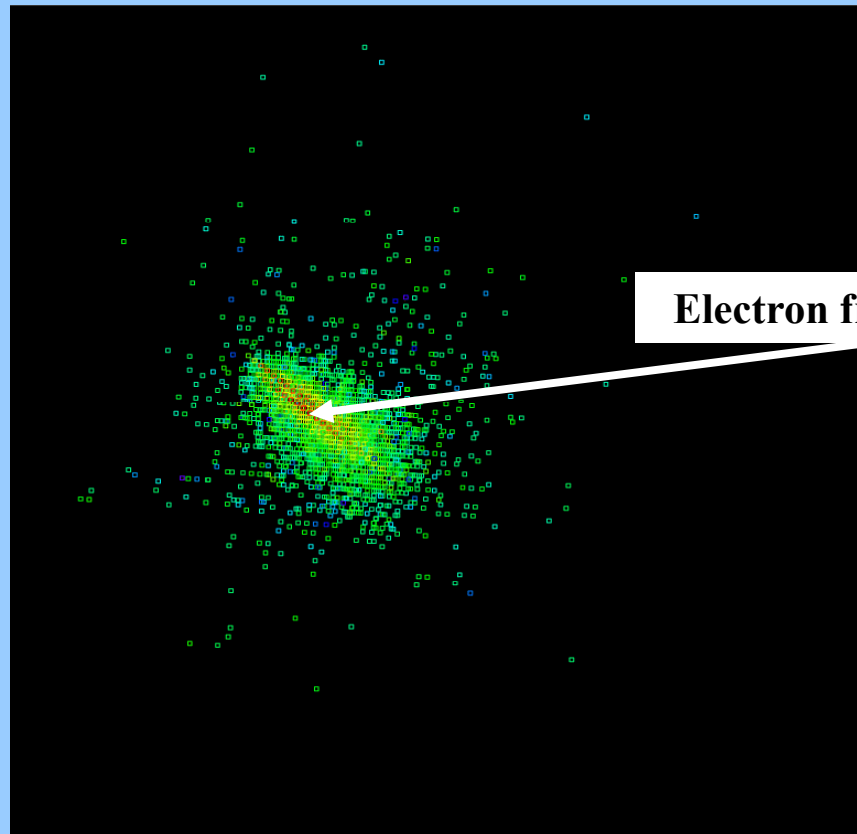


ILC – The International Linear Collider Project

## Side View

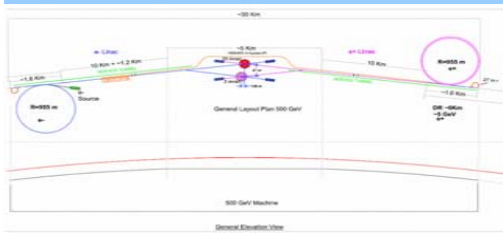
*electron from 2 photon*

*electron from 2 photon and  
beamstrahlung overlayed*



Electron from 2 photon



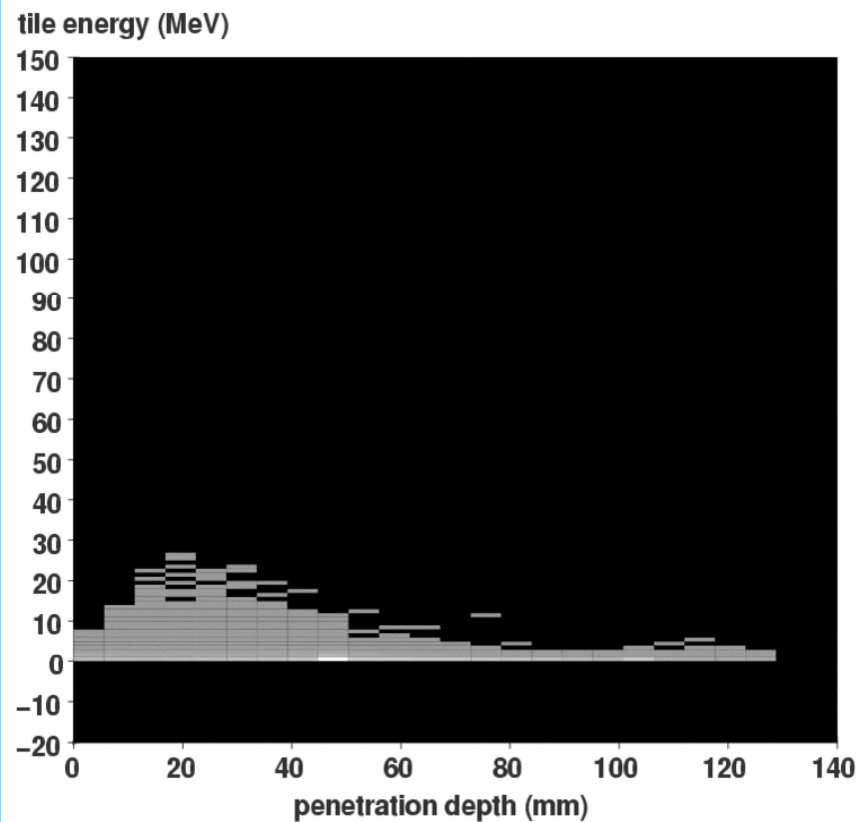


# ILC07 Talk

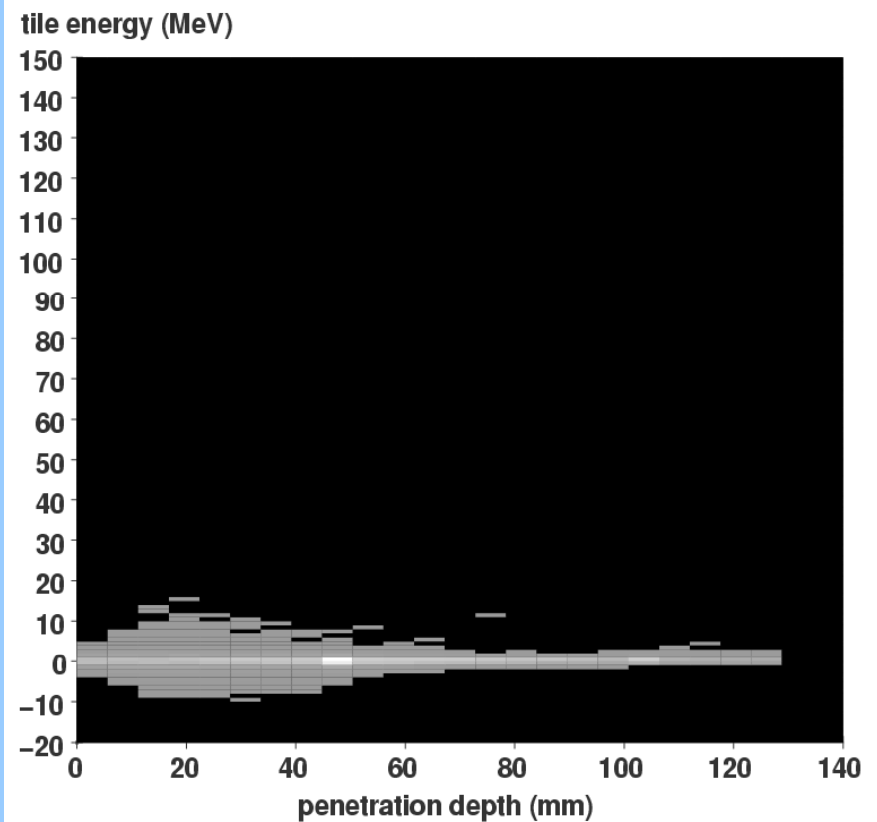


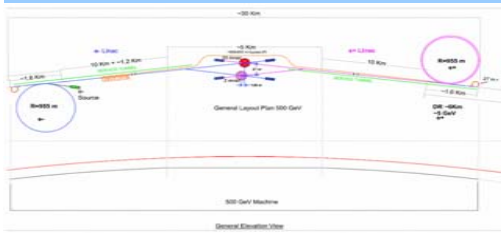
ILC – The International Linear Collider Project

Beamstrahlung Tile Energy



Subtracted Tile Energy (without 2-photon)



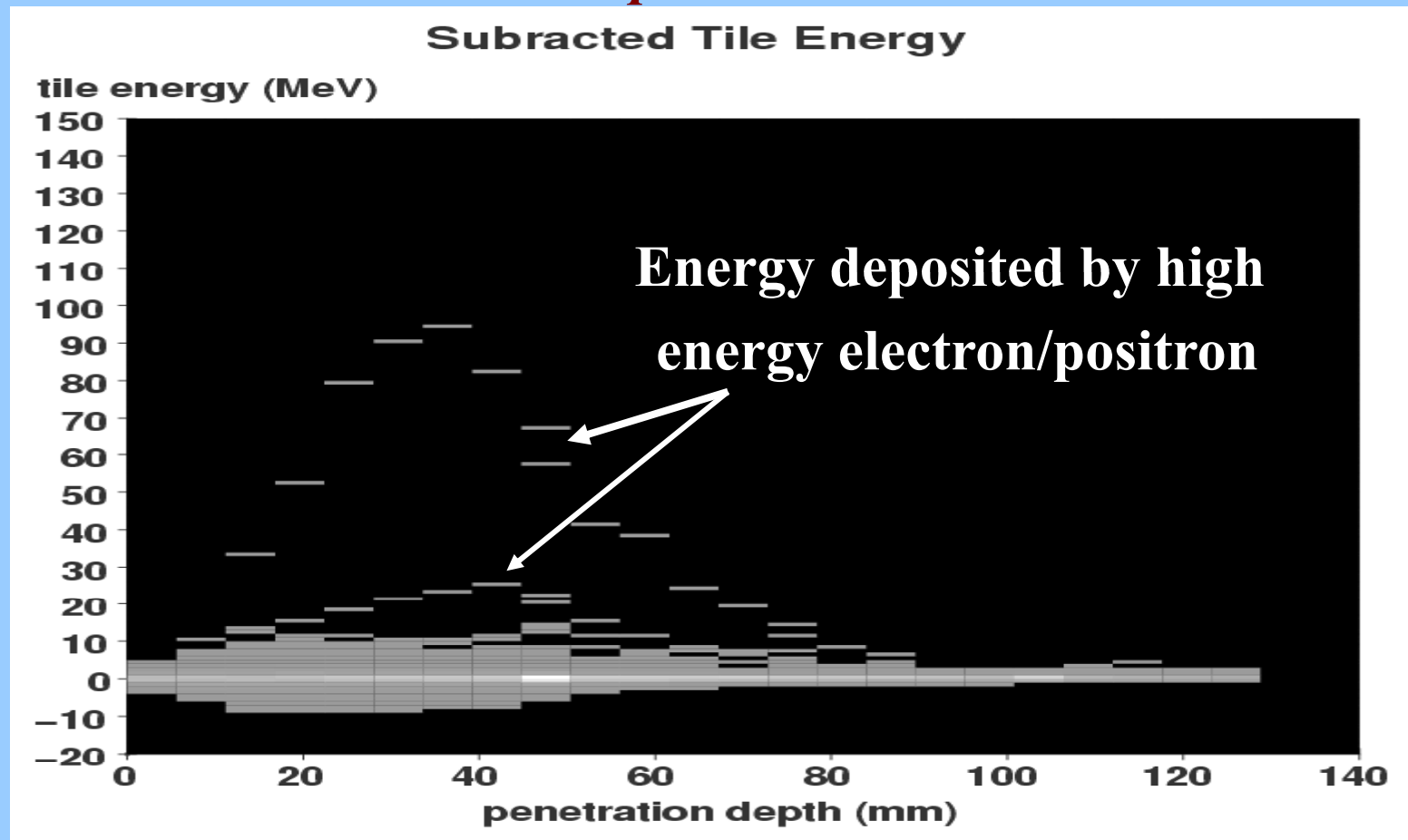


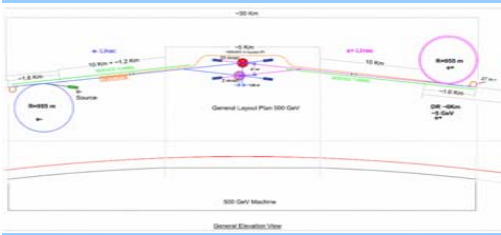
# ILC07 Talk



ILC – The International Linear Collider Project

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



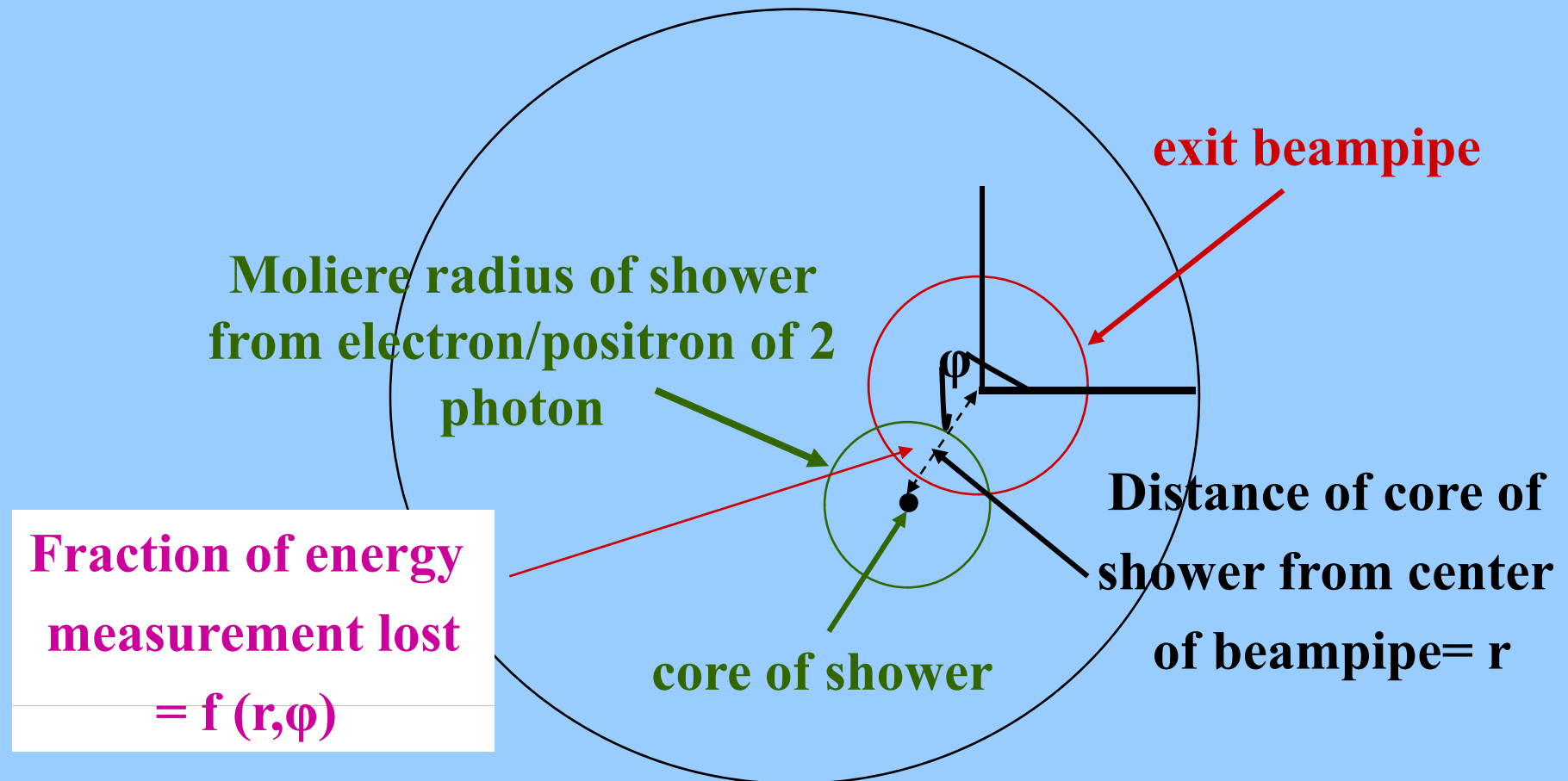


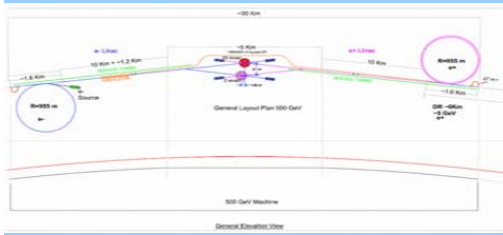
# ILC07 Talk



ILC – The International Linear Collider Project

## Energy Loss Correction due to Beampipe





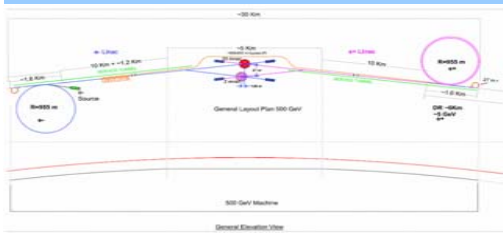
# *ILC07 Talk*



ILC – The International Linear Collider Project

## *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.*

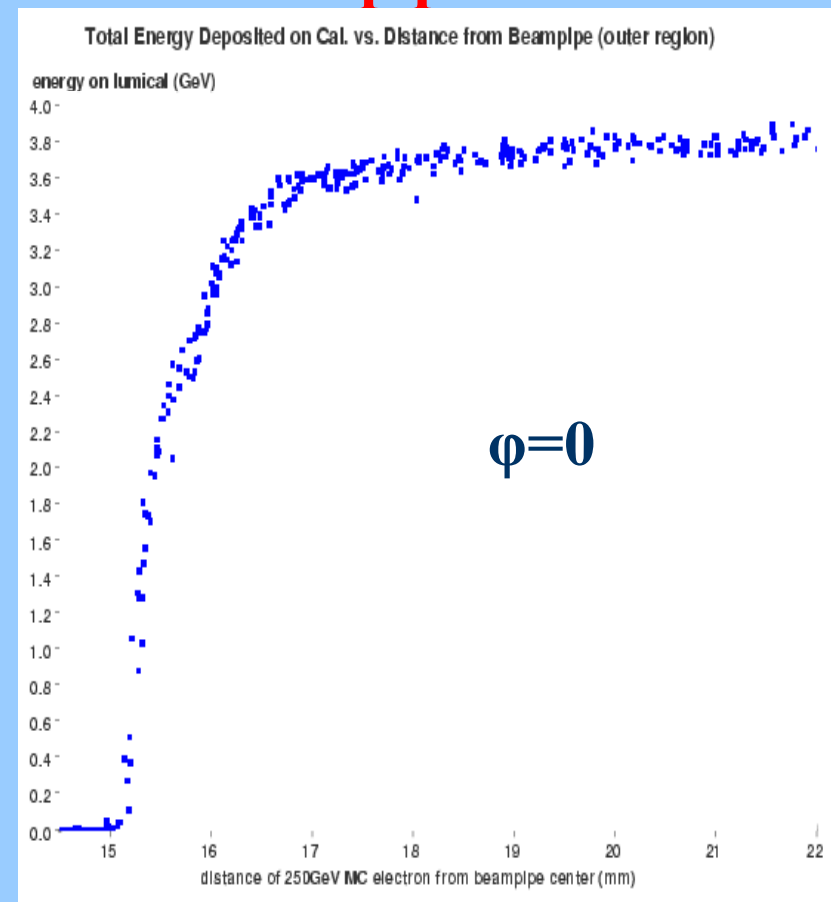
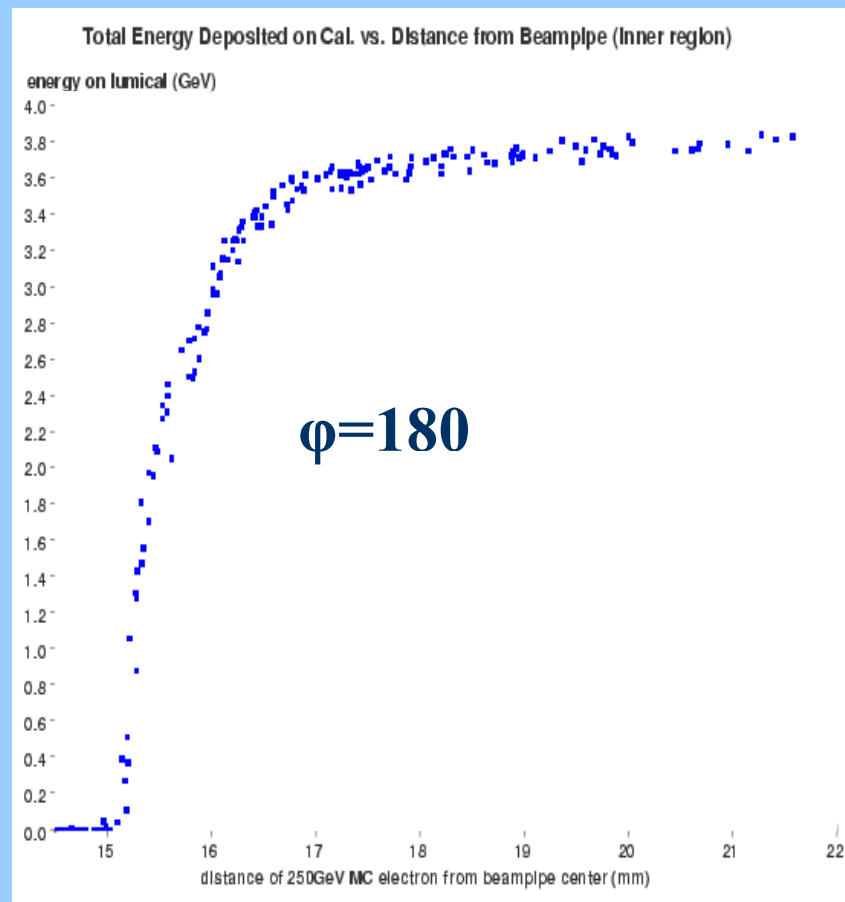


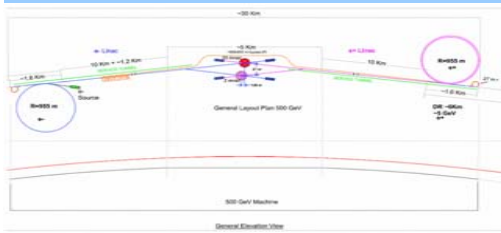
# ILC07 Talk



ILC – The International Linear Collider Project

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



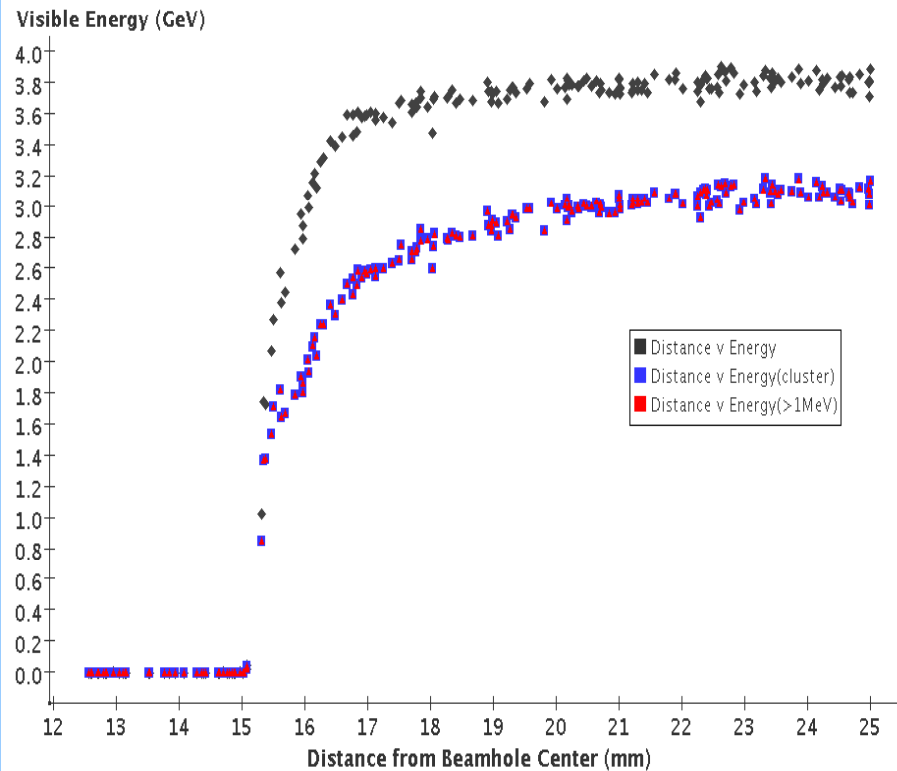


# ILC07 Talk

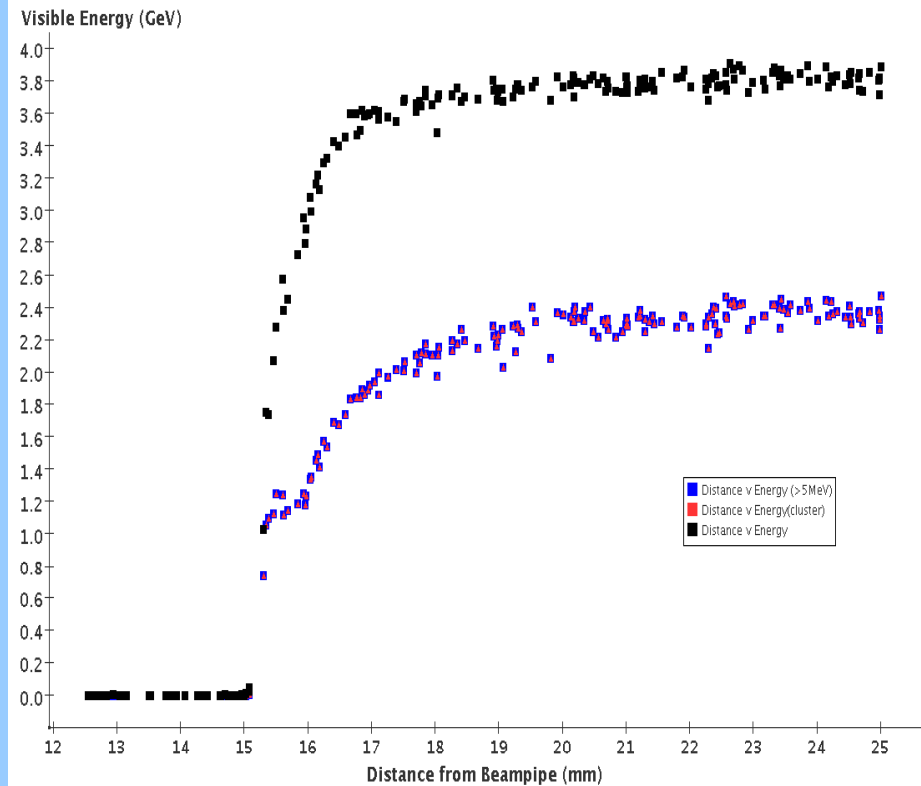


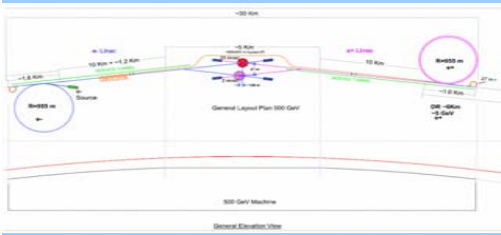
ILC – The International Linear Collider Project

Visible Shower Energy vs. Distance from Beampipe – 250GeV e-



Visible Energy vs. Distance from Beampipe – 250GeV e- (5MeV cut)





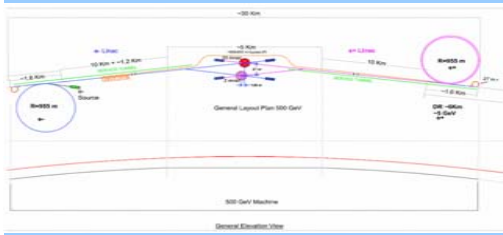
# *ILC07 Talk*



ILC – The International Linear Collider Project

## *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.*

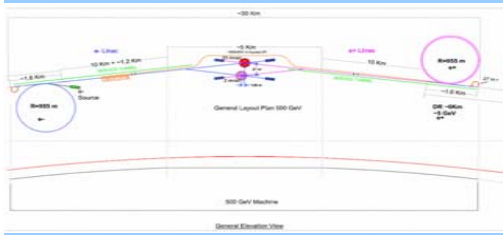


# *ILC07 Talk*



ILC – The International Linear Collider Project





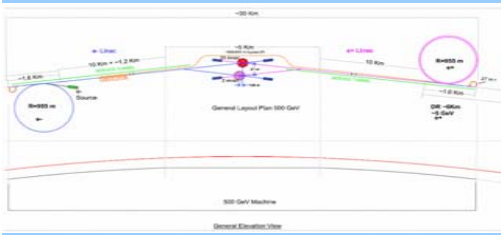
# *ILC07 Talk*



ILC – The International Linear Collider Project

## *The Simulation Aim*

*We want to determine how far down in  $P_t$  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.*



# *ILC07 Talk*



ILC – The International Linear Collider Project

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

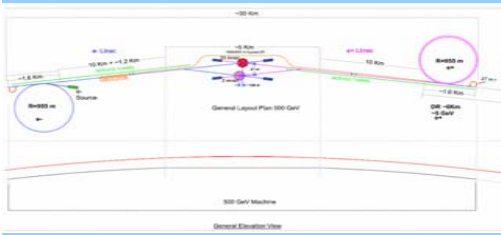
$$e^+ e^- \rightarrow \tilde{\tau}^+ \tilde{\tau}^- \rightarrow \tilde{\chi}_1^0 \tau^+ \tilde{\chi}_1^0 \tau^-$$

*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.*







# *ILC07 Talk*



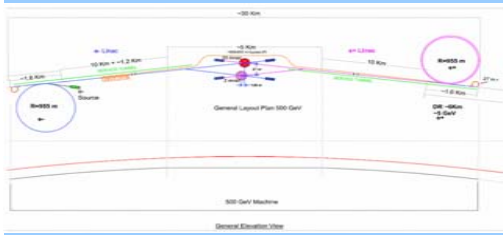
# ILC – The International Linear Collider Project

## 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.**



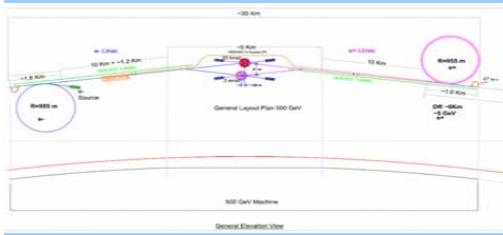
# *ILC07 Talk*



ILC – The International Linear Collider Project

## *NEXT STEPS*

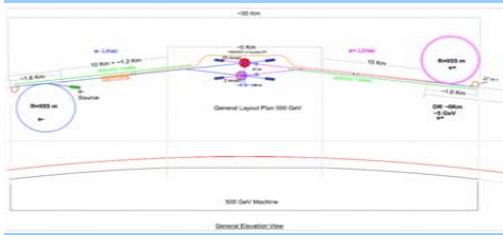
*Overlay 2 photon processes on the beamstrahlung data and extract the energy of the high momentum electrons by removing average energy depositions from beamstrahlung to determine how well we can determine the missing  $P_t$  in order to extract the correct background from extraneous events.*



# *ILC07 Talk*



ILC – The International Linear Collider Project



# *ILC07 Talk*



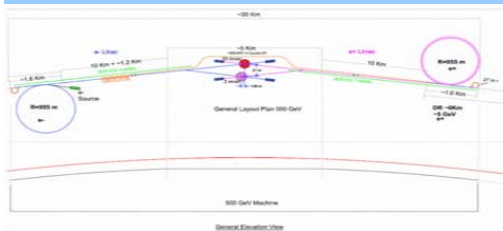
ILC – The International Linear Collider Project

*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  $P_t$ . Needed to measure the masses.*

*Work by Paul Steinbrecher and Gleb Oleinik*





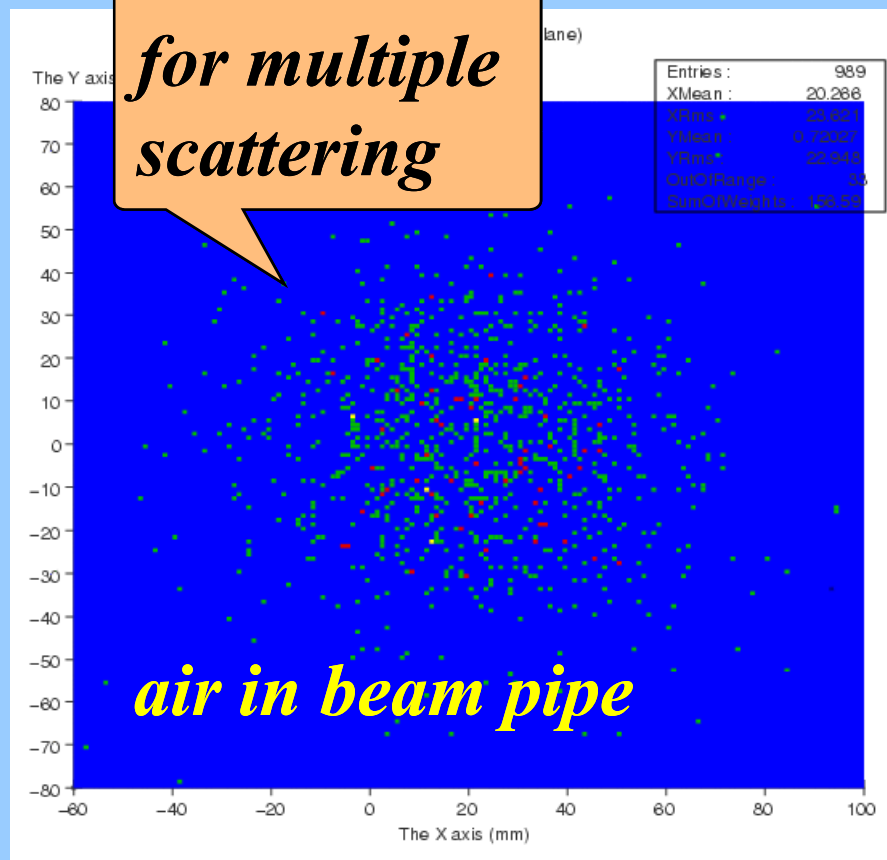
# ILC07 Talk



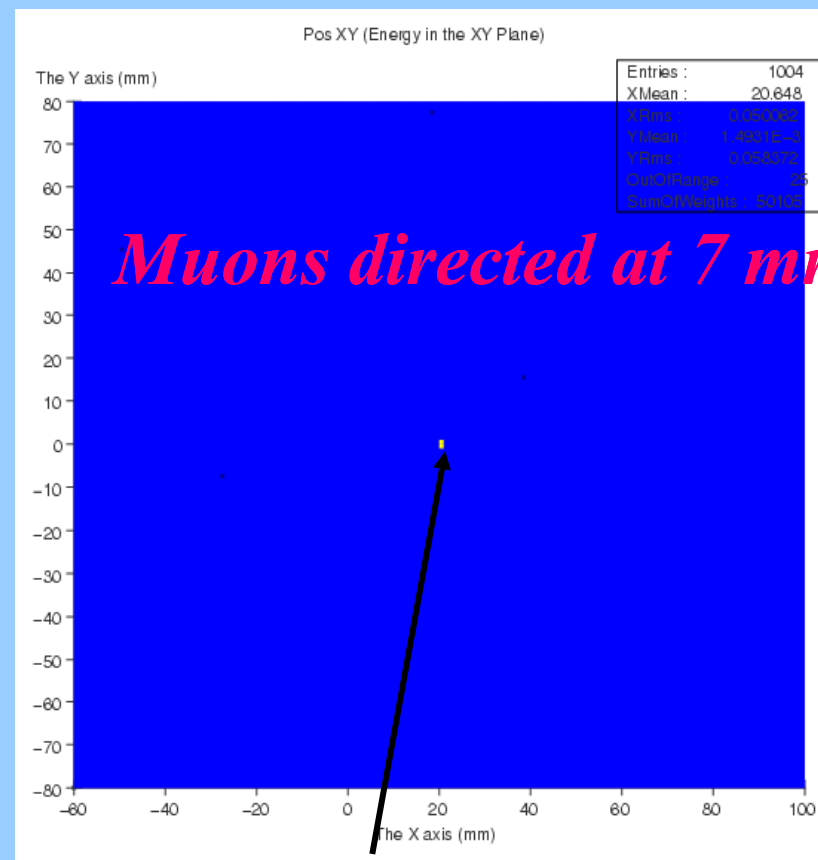
ILC – The International Linear Collider Project

## Testing GEANT 4.0

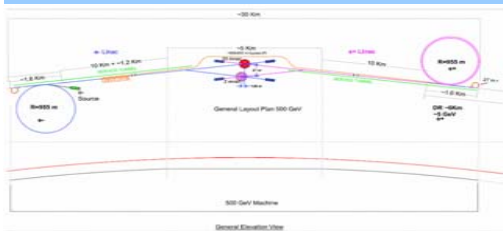
*Evidence  
for multiple  
scattering*



*No field, 50 MeV muons*



*No field, 50 GeV muons*



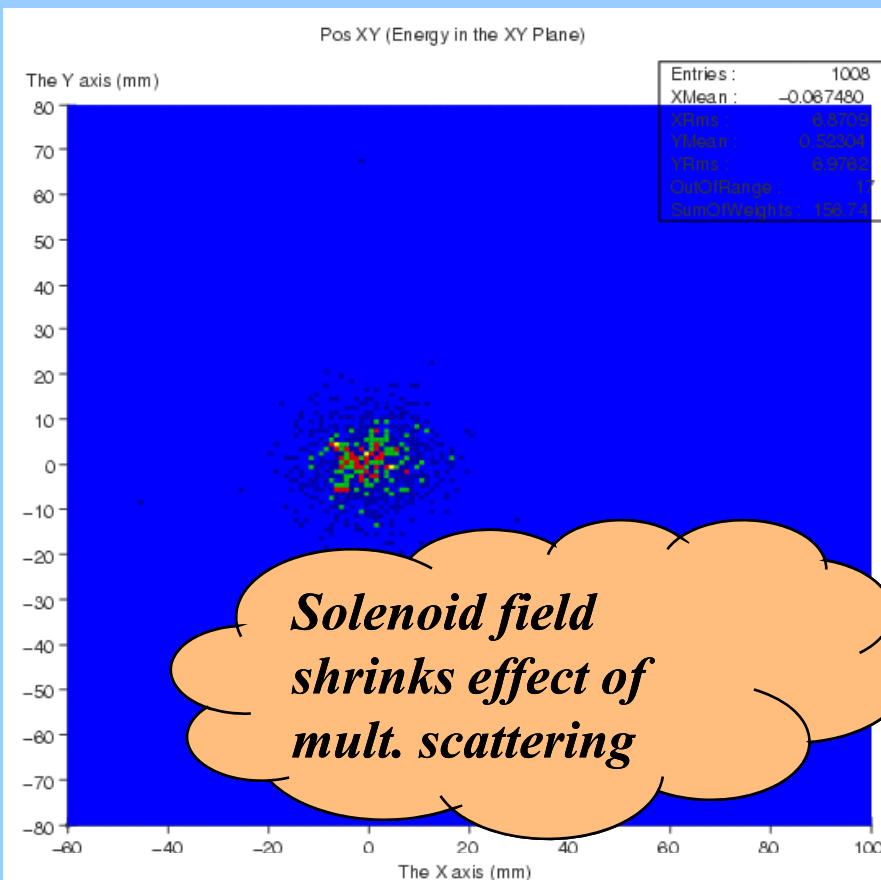
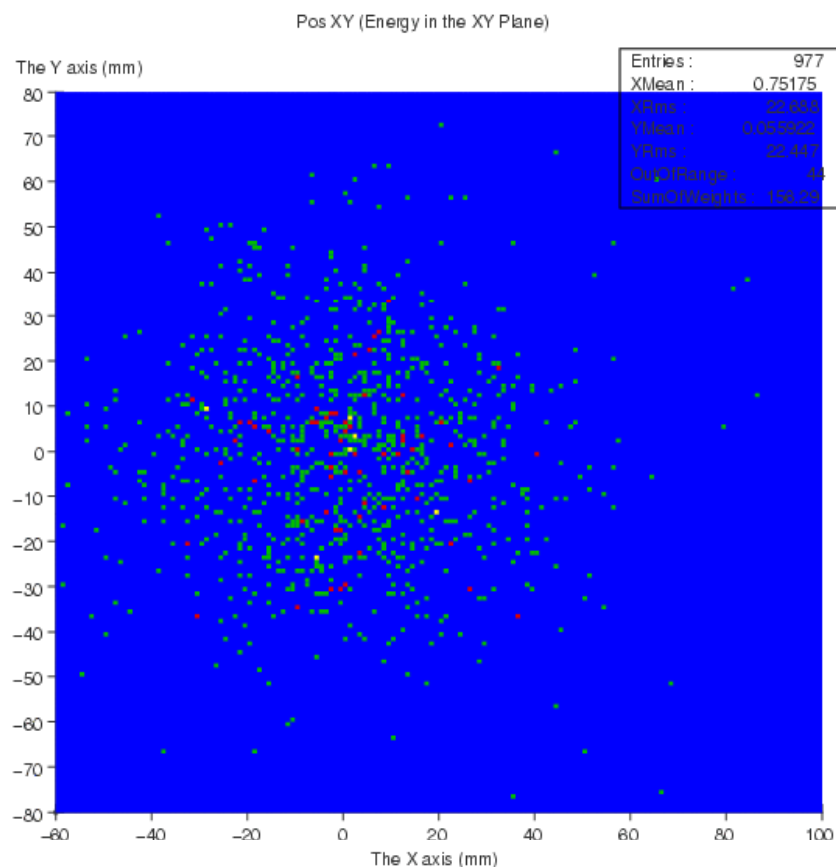
# ILC07 Talk

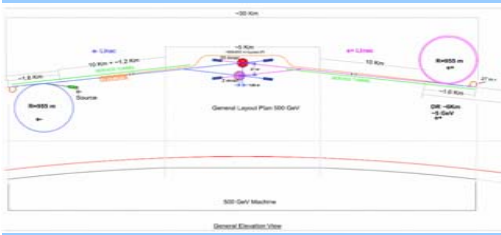


ILC – The International Linear Collider Project

*50 MeV, no field, forward*

*50 MeV, solenoid on, forward*





# *ILC07 Talk*

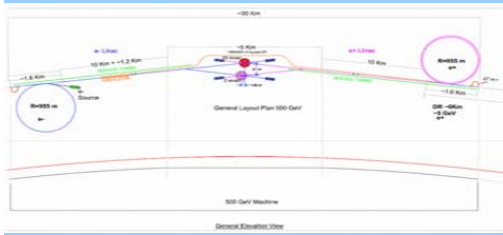


# ILC – The International Linear Collider Project

*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  $L^* \sim 350$  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.*

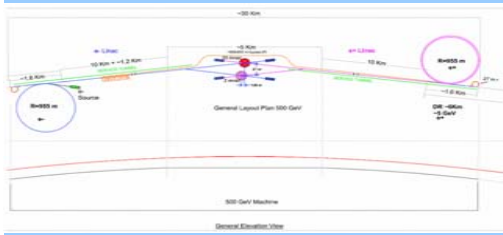
*All Simulation is work in progress.*



# *ILC07 Talk*



ILC – The International Linear Collider Project



# *ILC07 Talk*



ILC – The International Linear Collider Project