Simulation of Secondaries for the Linear Collider

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Frascati 5th May 2004

- Overview of international effort
- BDSIM
- Beam Diagnostics
- Future plans
- Overview of effort

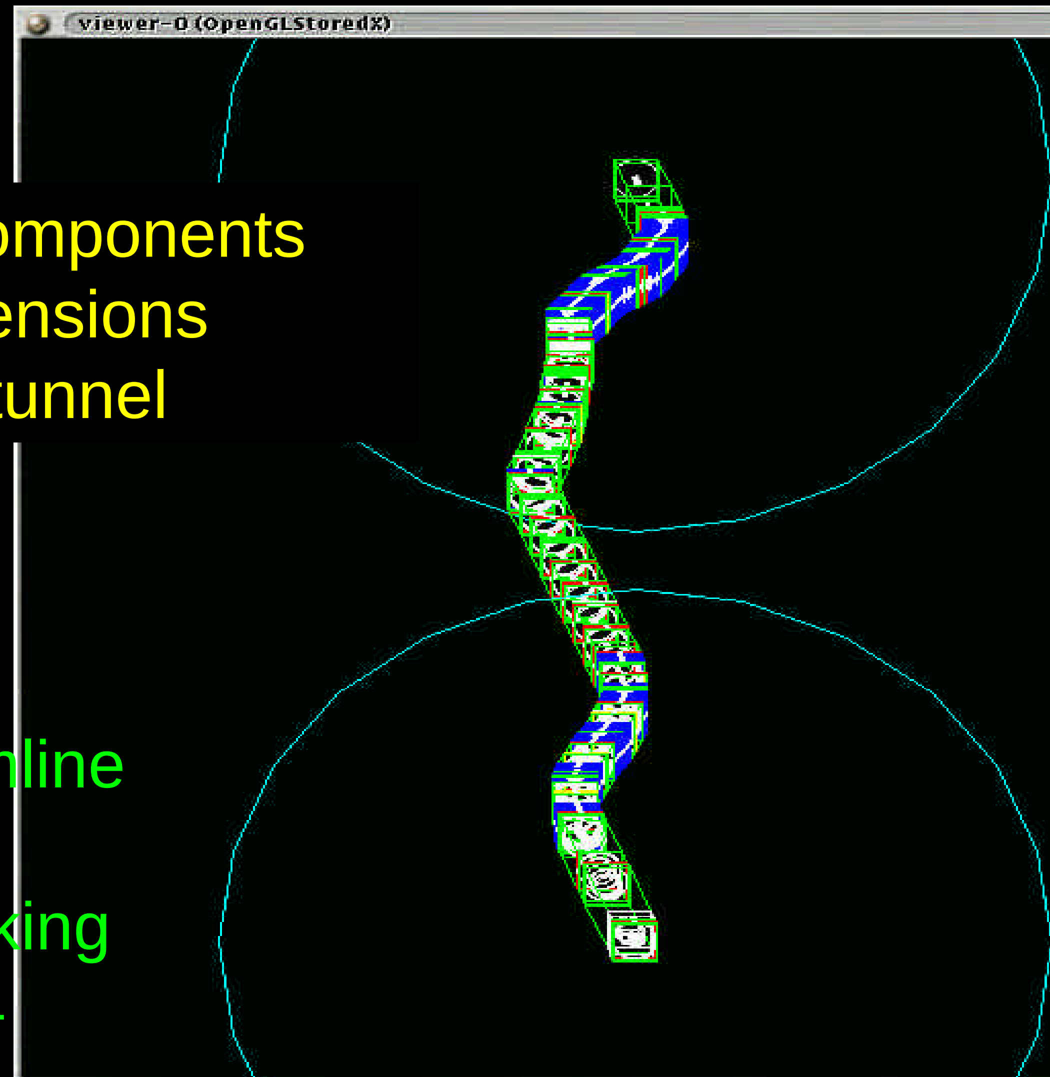
Codes for Secondaries

- N. Mokhov (Fermilab) – MARS
- L. Keller (SLAC) Turtle/MuCarlo
- T. Maruyama (SLAC) Geant3
- FLUKA
- BDS SIM (Tokyo Univ.) – Geant4
- BDSIM (GB) Geant4– see below.

BDSIM Functionality

Set by Cards file:

•Dimension of beamline components
•Concrete tunnel with dimensions
•Location of beamline wrt tunnel

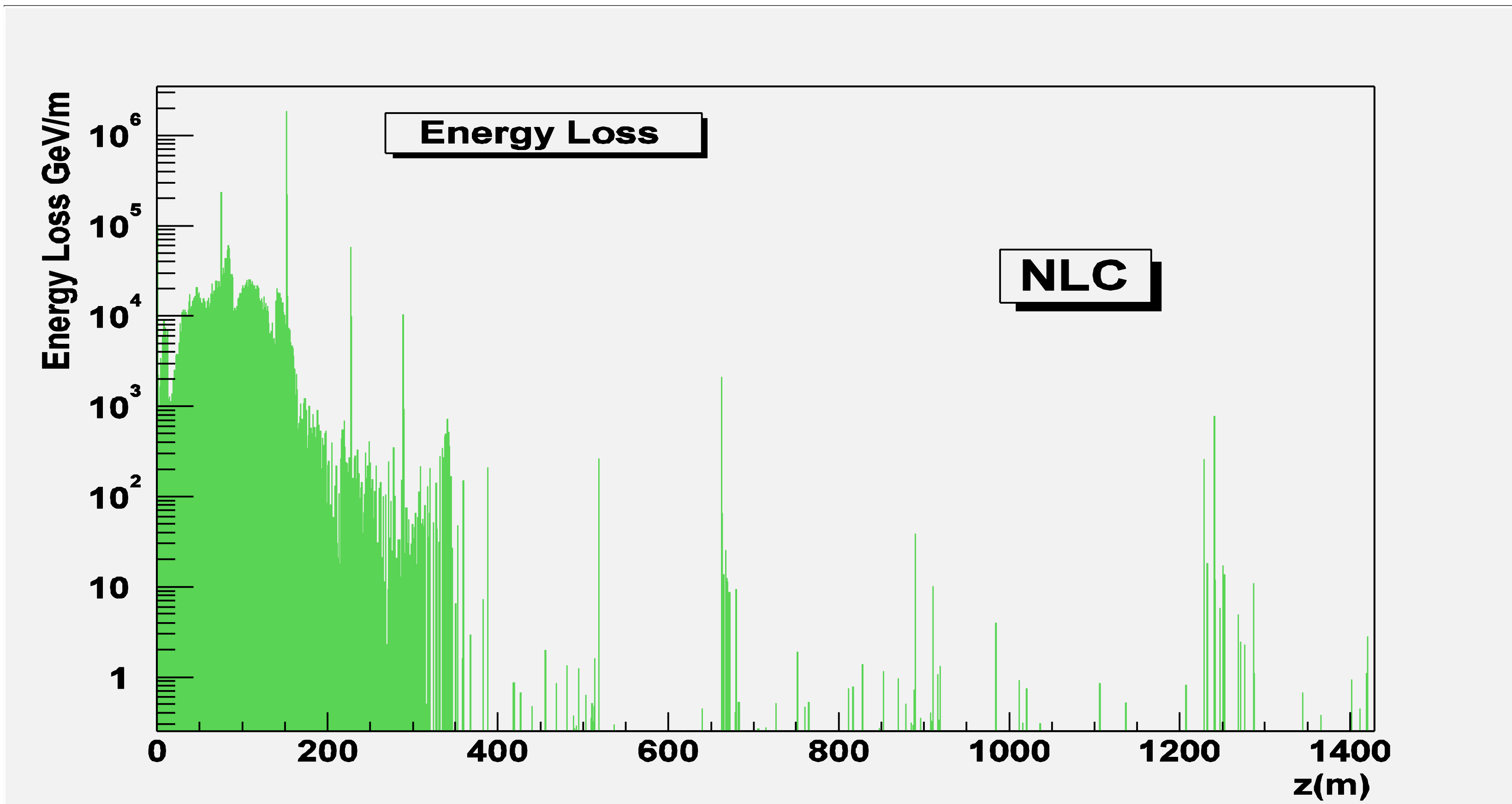


MAD Optics input for beamline

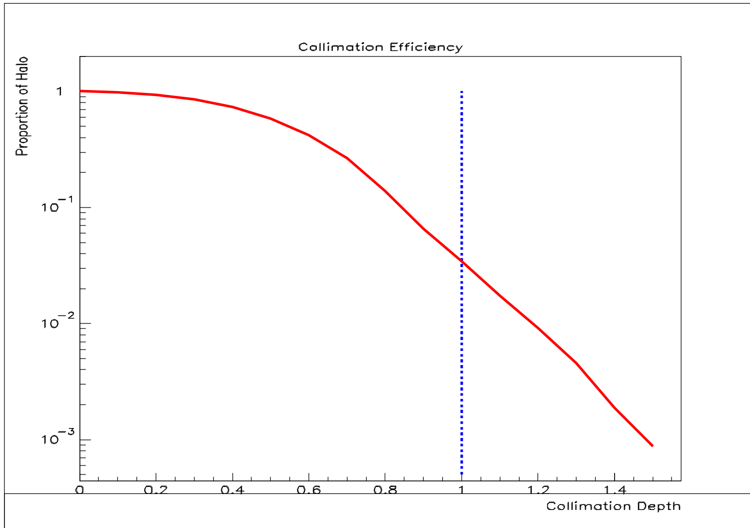
Fast accelerator-style tracking
Incorporated within geant4

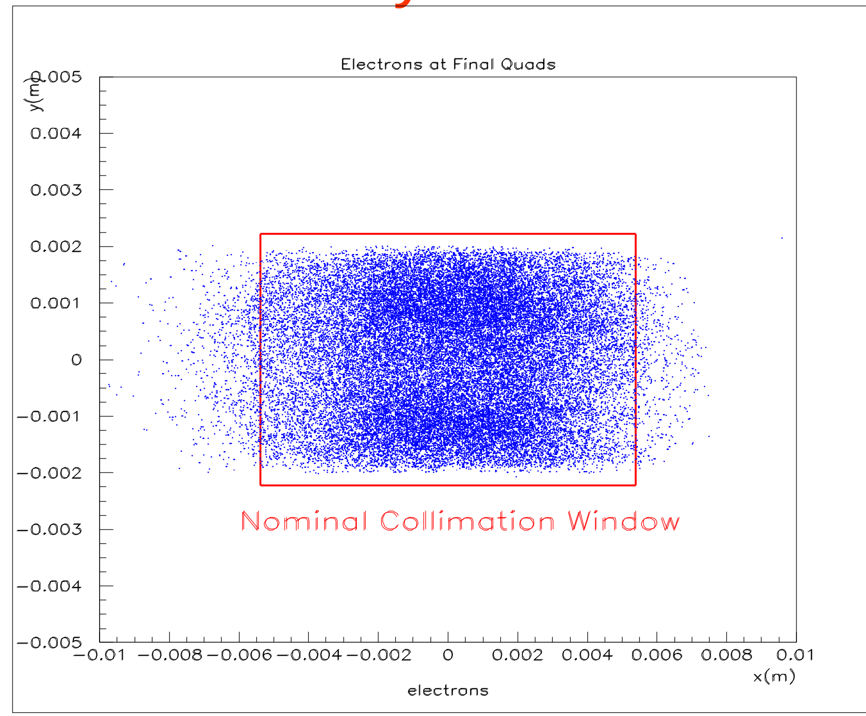
Halo studies

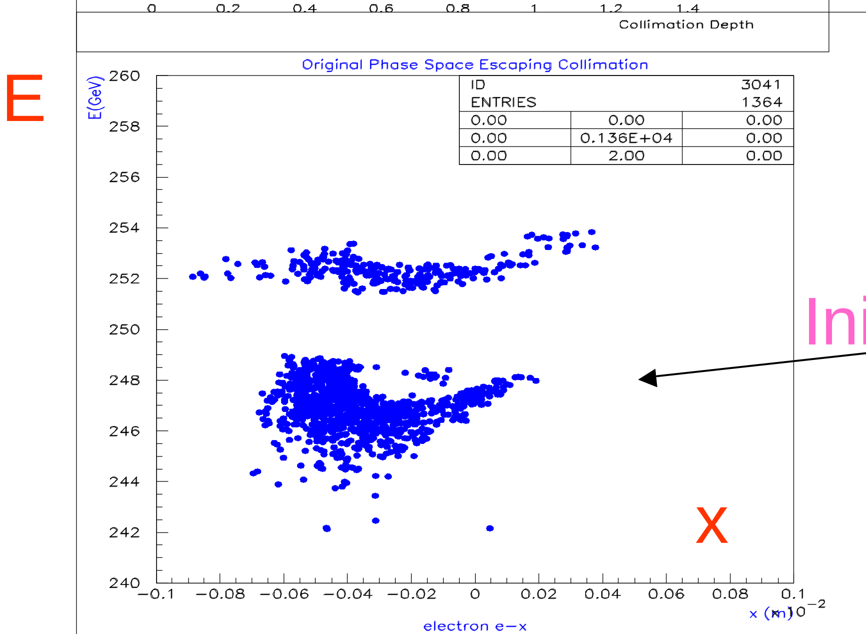
Beam Halo with 1/R distributions and apertures as given in A.Drozhdin et al.



TESLA collimation efficiency







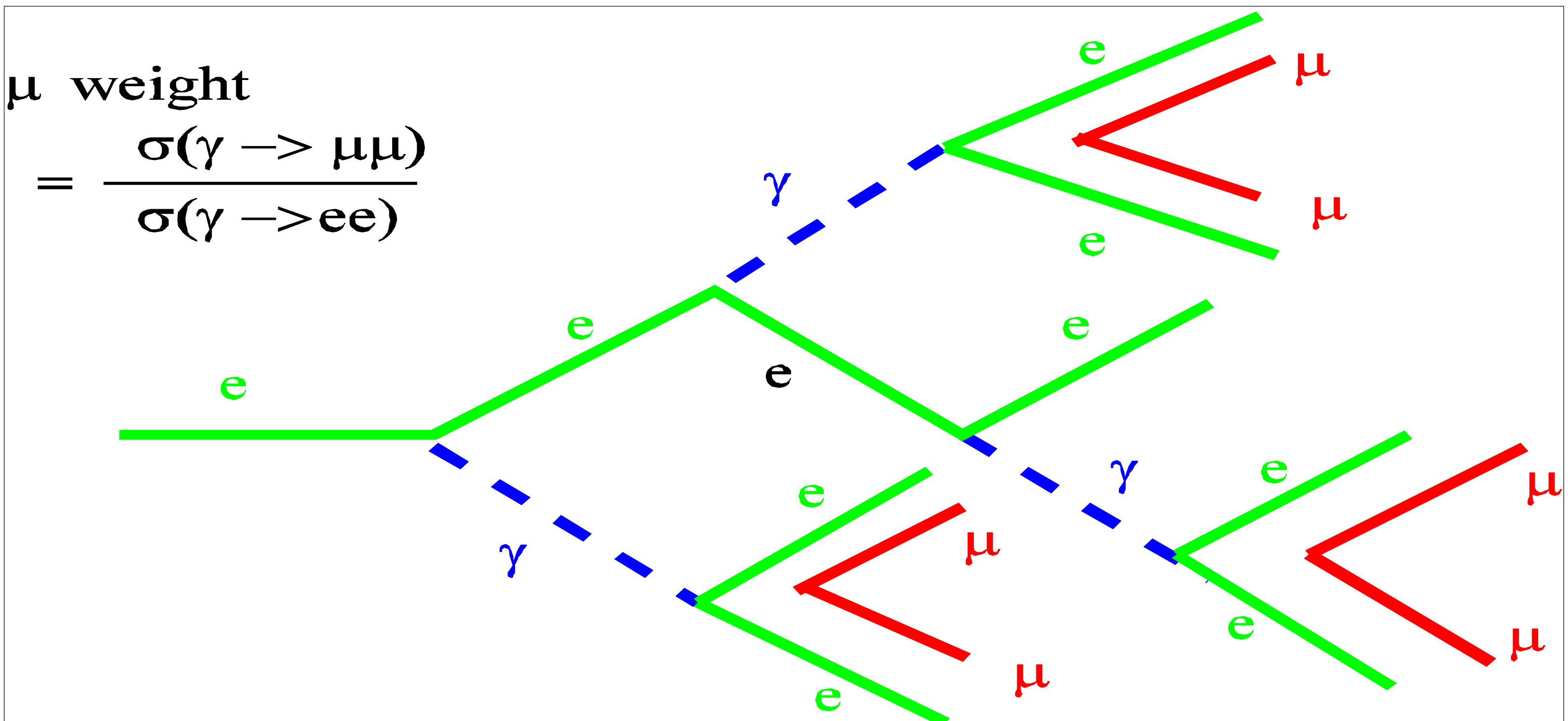
Initial phase space of escapers

Muon Showers

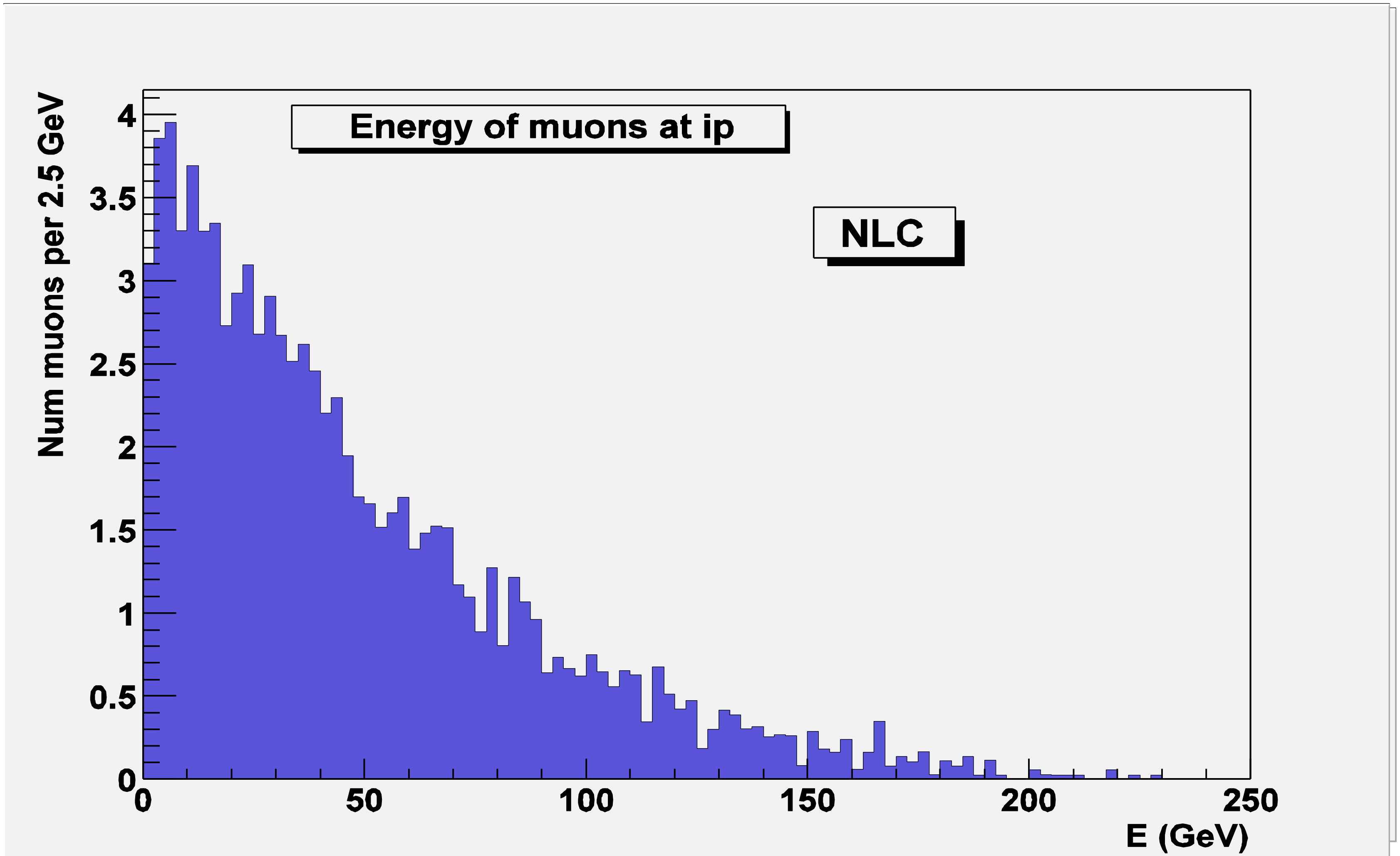
Increase statistics for Bethe-Heitler by **forcing** $g \rightarrow m^{+} m^{-}$

The muons are in addition to the electrons
(doesn't conserve energy)

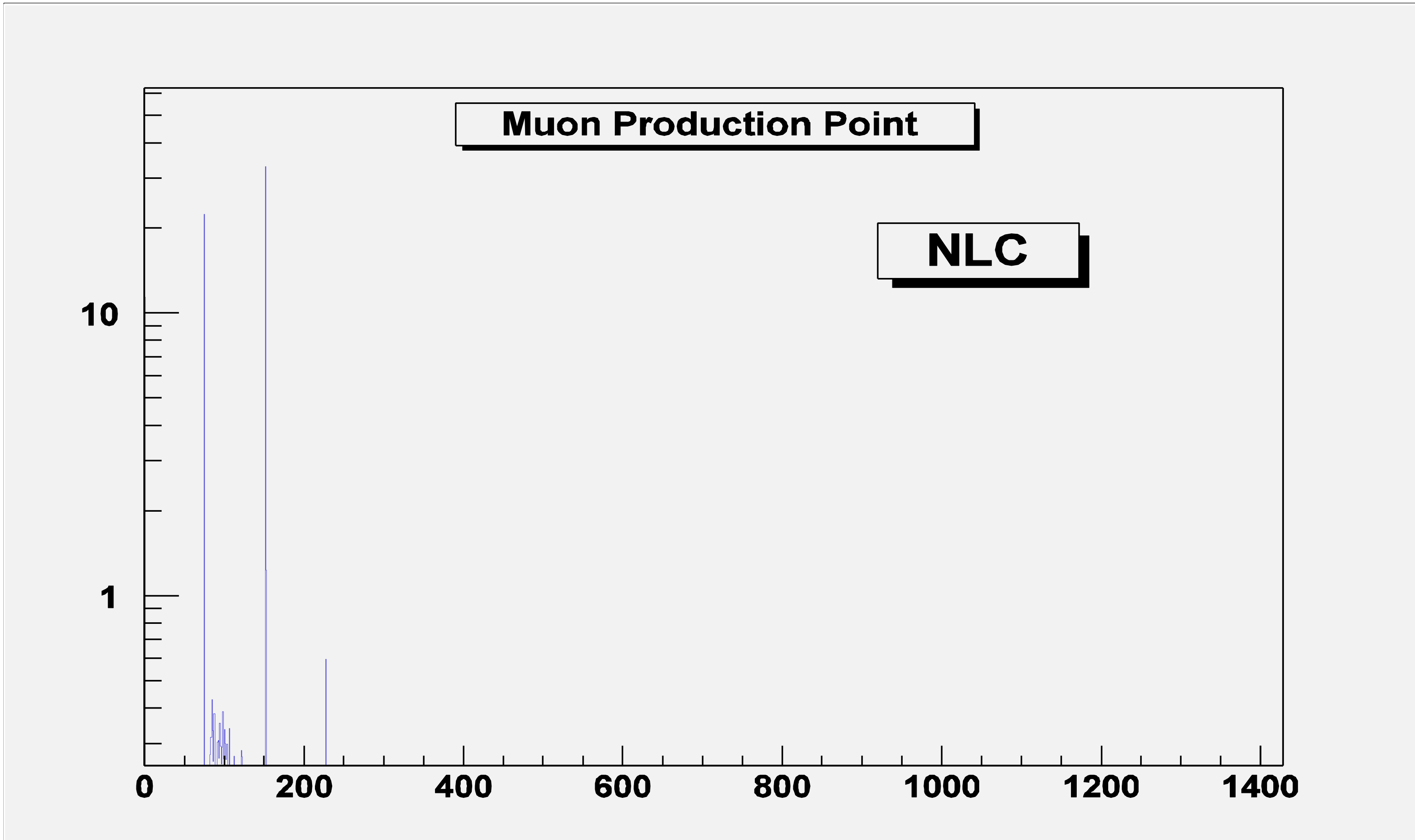
correct spectra via track weighting:



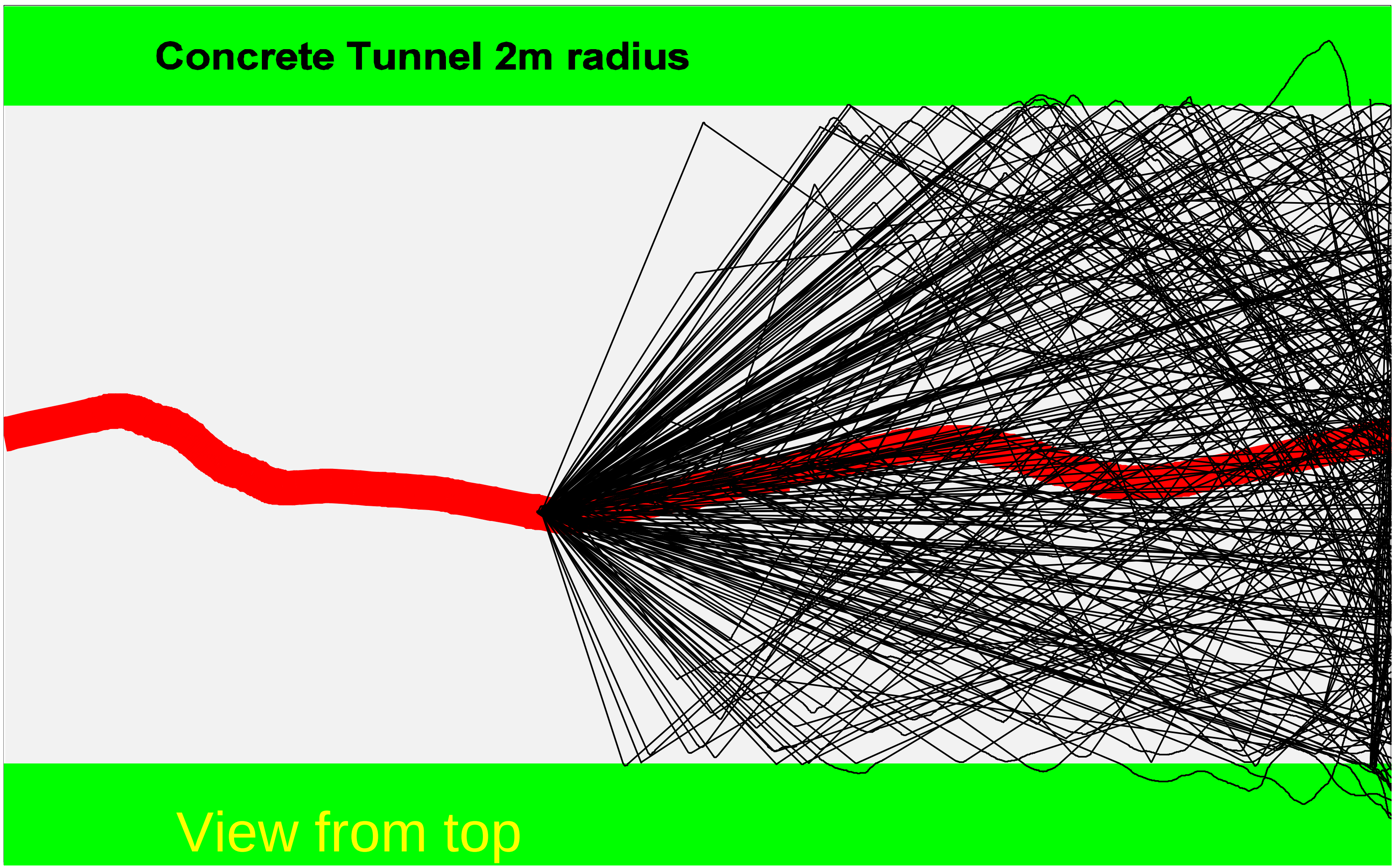
Muon Weighted Energy at IP



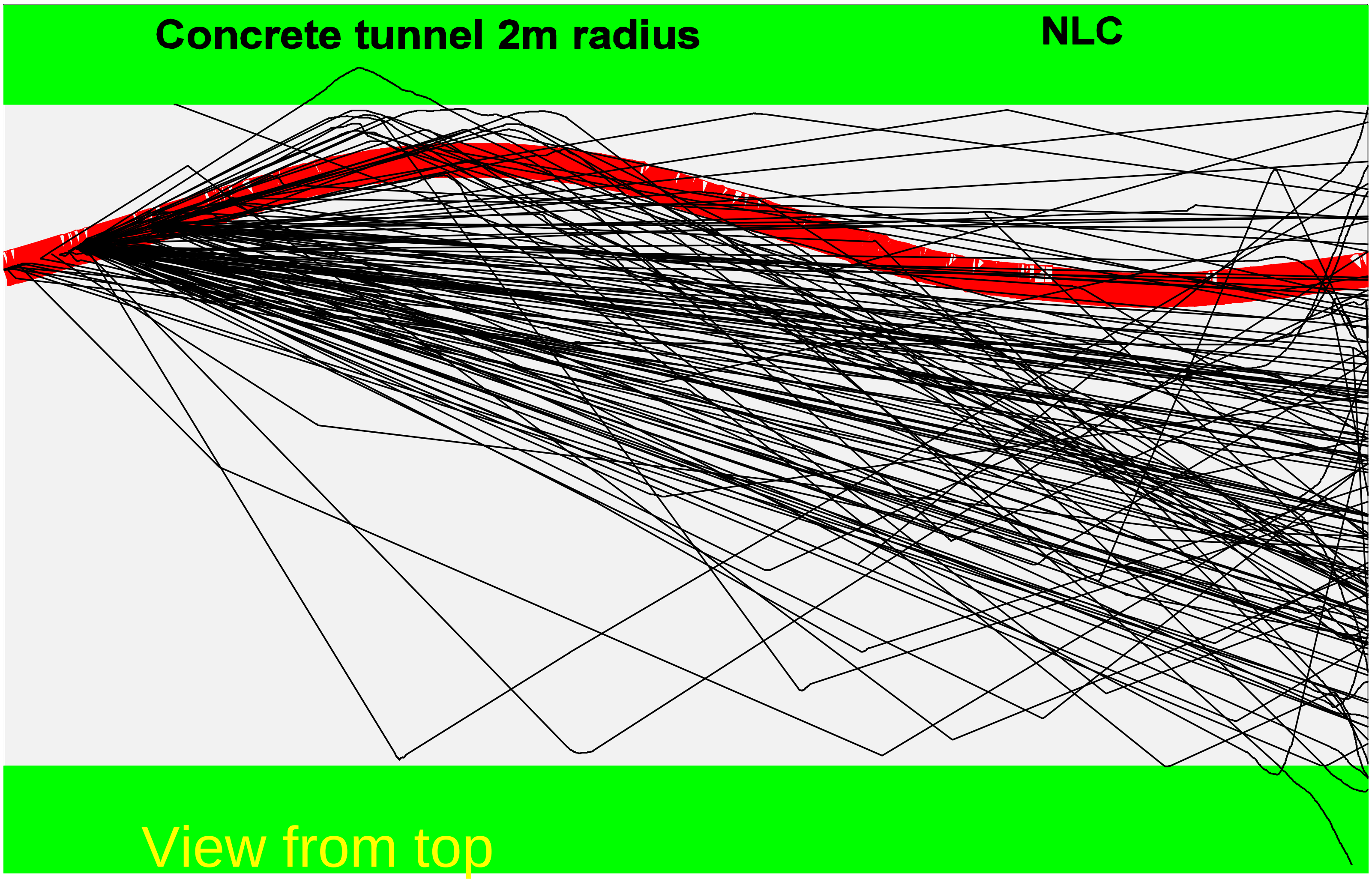
Muon Production Point



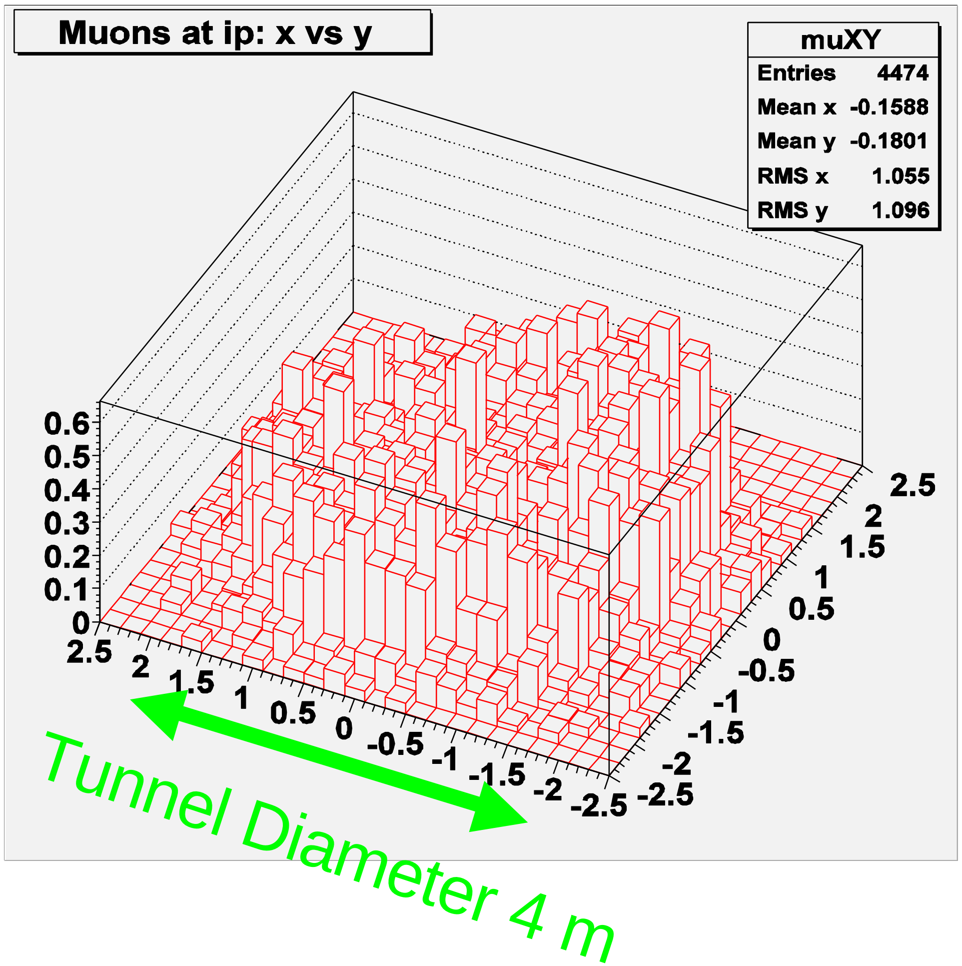
TESLA: Muon Trajectories



NLC: Muon Trajectories



TESLA: Muons at IP



10^{-3} Halo bunch

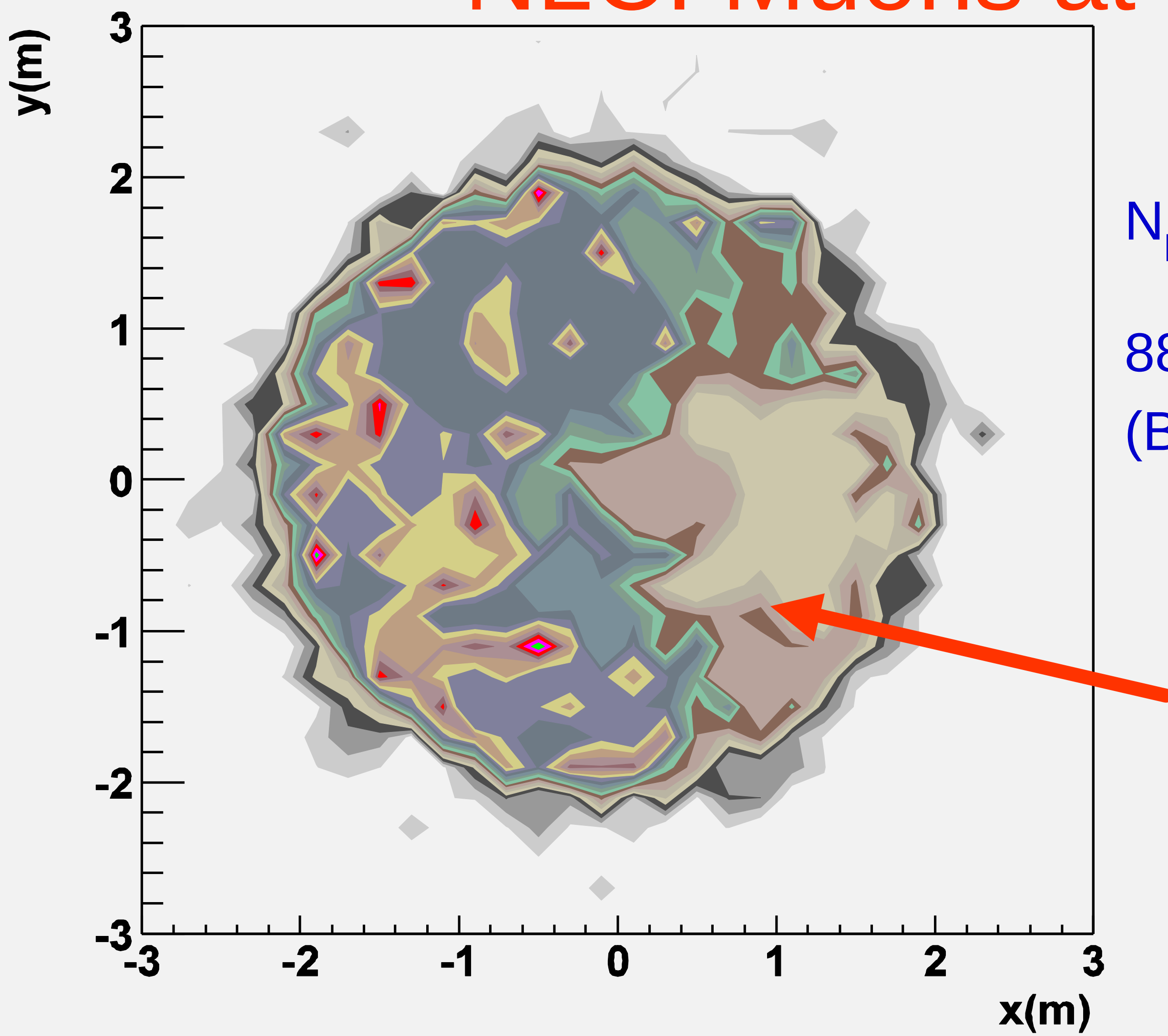
82% e's Lost in BDS

N_{μ} per lost e = 0.6 10^{-5}

(Bethe-Heitler only)

(TDR used 1.4 10^{-5} incl. other mechanisms)

NLC: Muons at IP

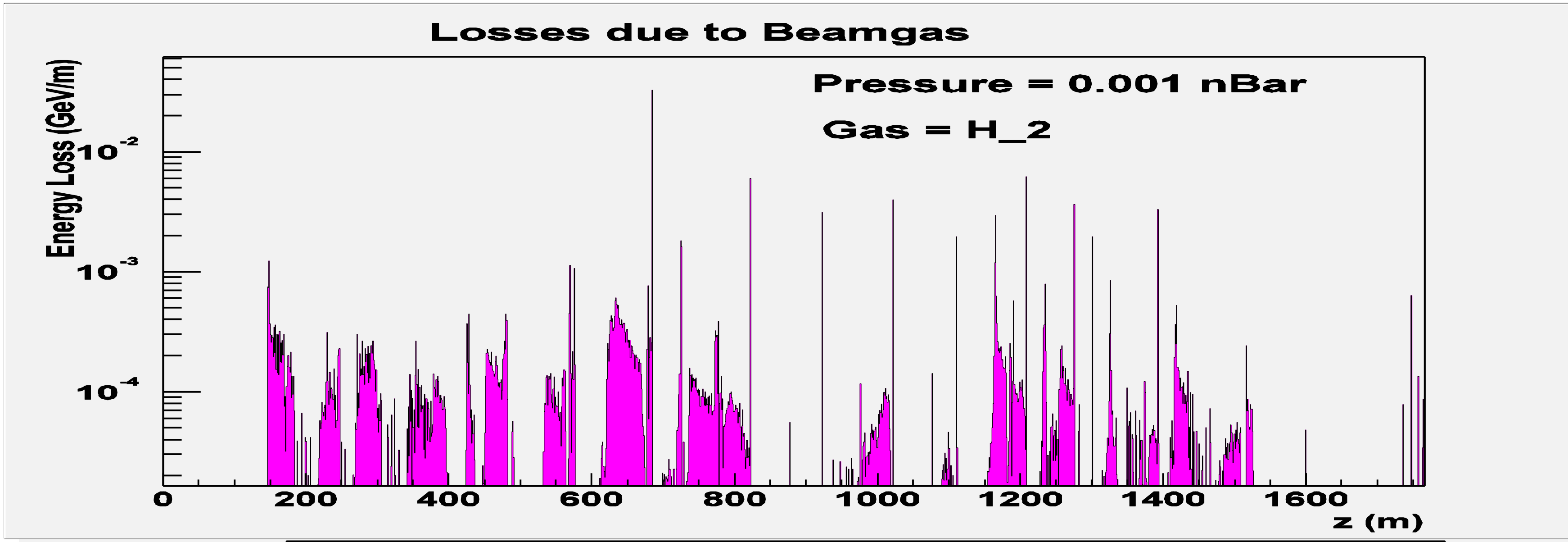


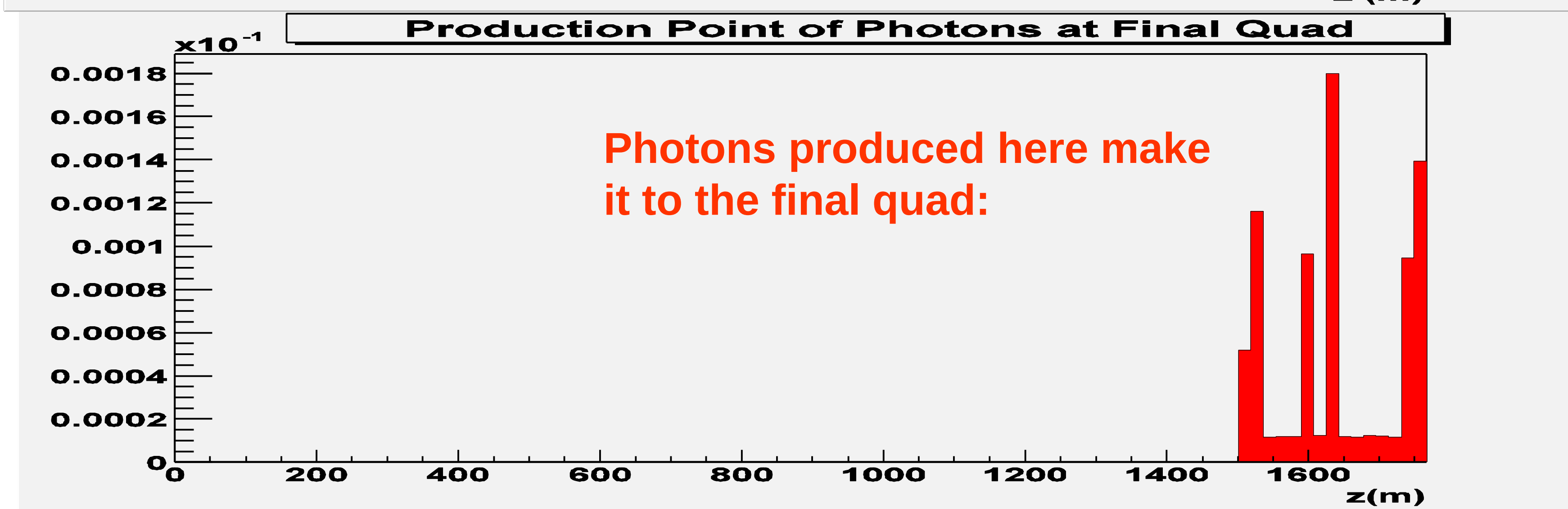
N_μ per lost e = 2.1 10^{-5}

88% e's Lost in BDS

(Bethe-Heitler only)

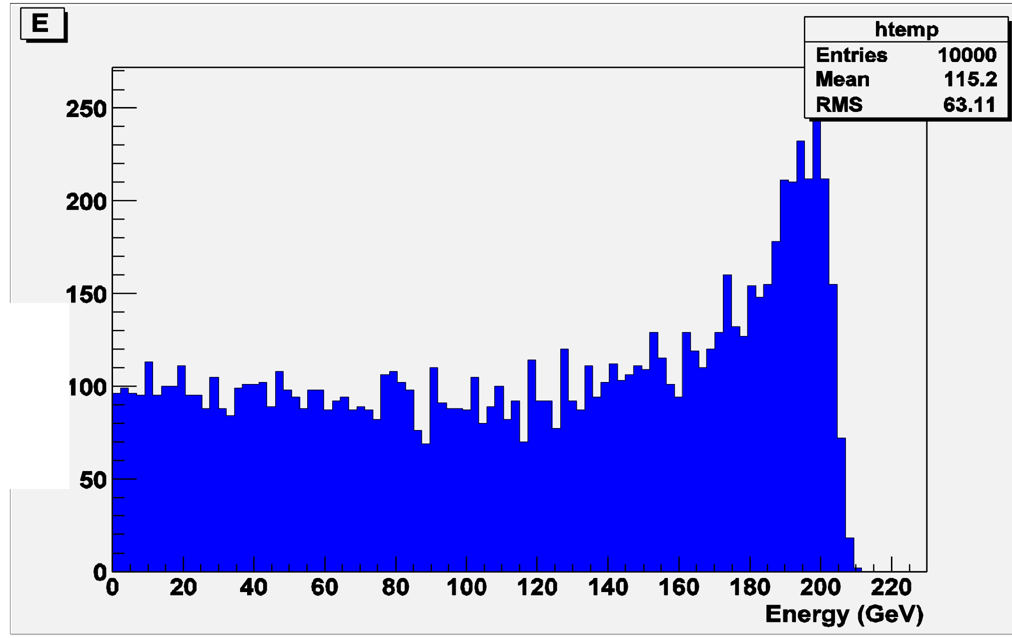
TESLA Beamgas:





Laser-wire simulation

$$N_C = N_b \frac{P_L \sigma_C \lambda}{c^2 h} \frac{1}{\sqrt{2\pi}\sigma_s} \exp\left(\frac{-y^2}{2\sigma_s^2}\right)$$



For: 10 MW laser pulse, s$_s$~10 µm, ?=532 nm

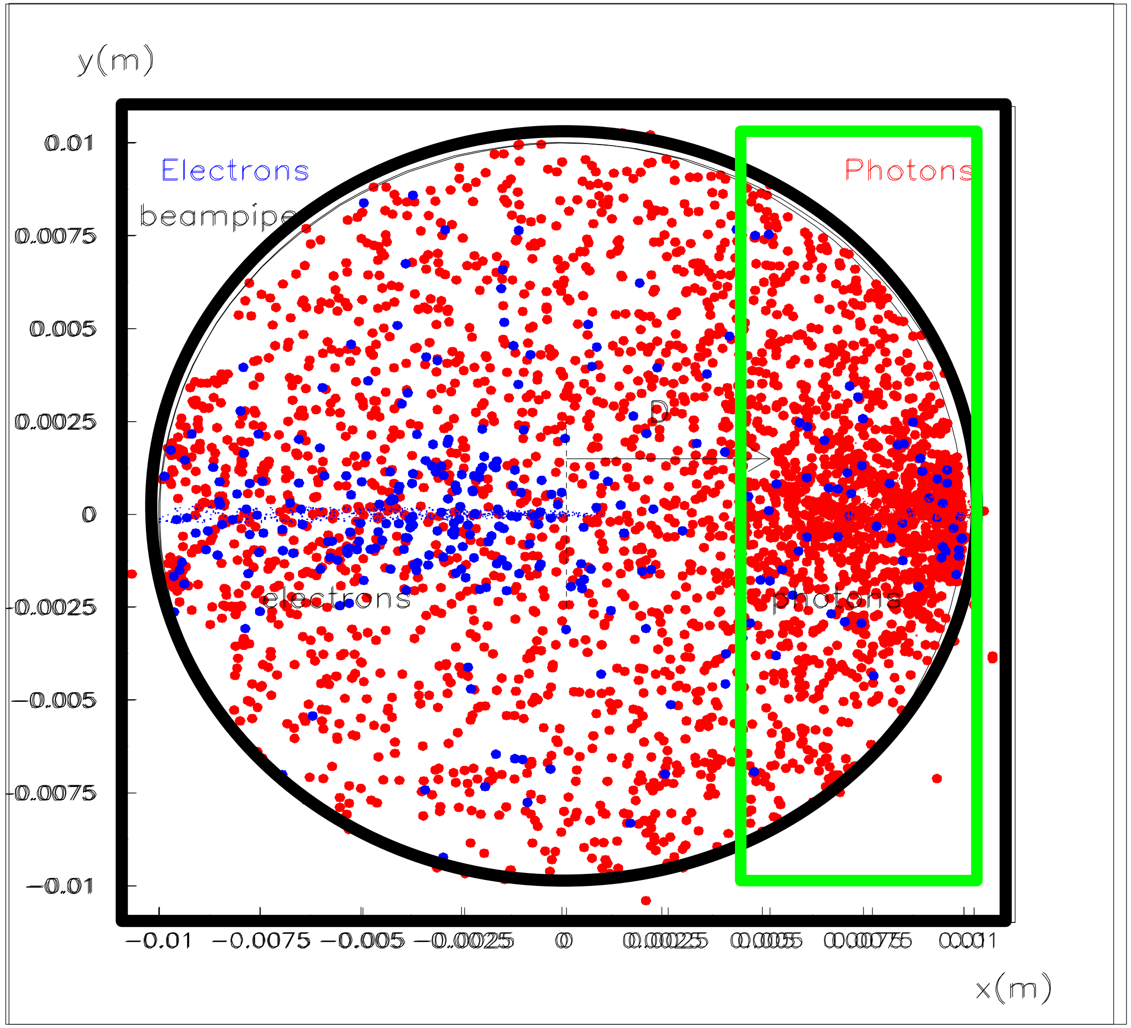
N_b= 2.10^{10} ; at peak N_C=4750

Max Compton energy per bunch = 5.4 10^5 GeV

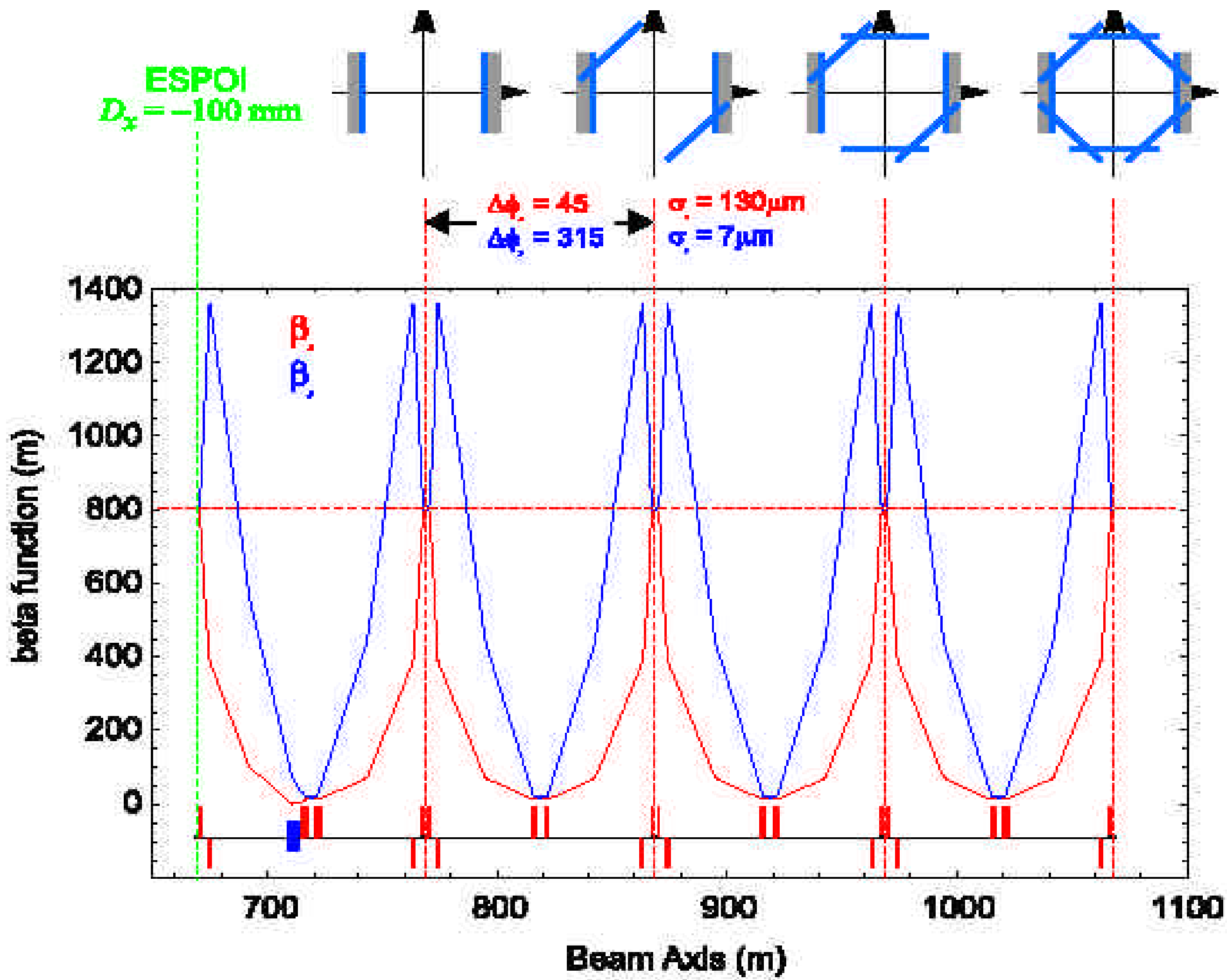
… but we need to measure the Gaussian tails too.

So 10^4 GeV is more realistic as a measure

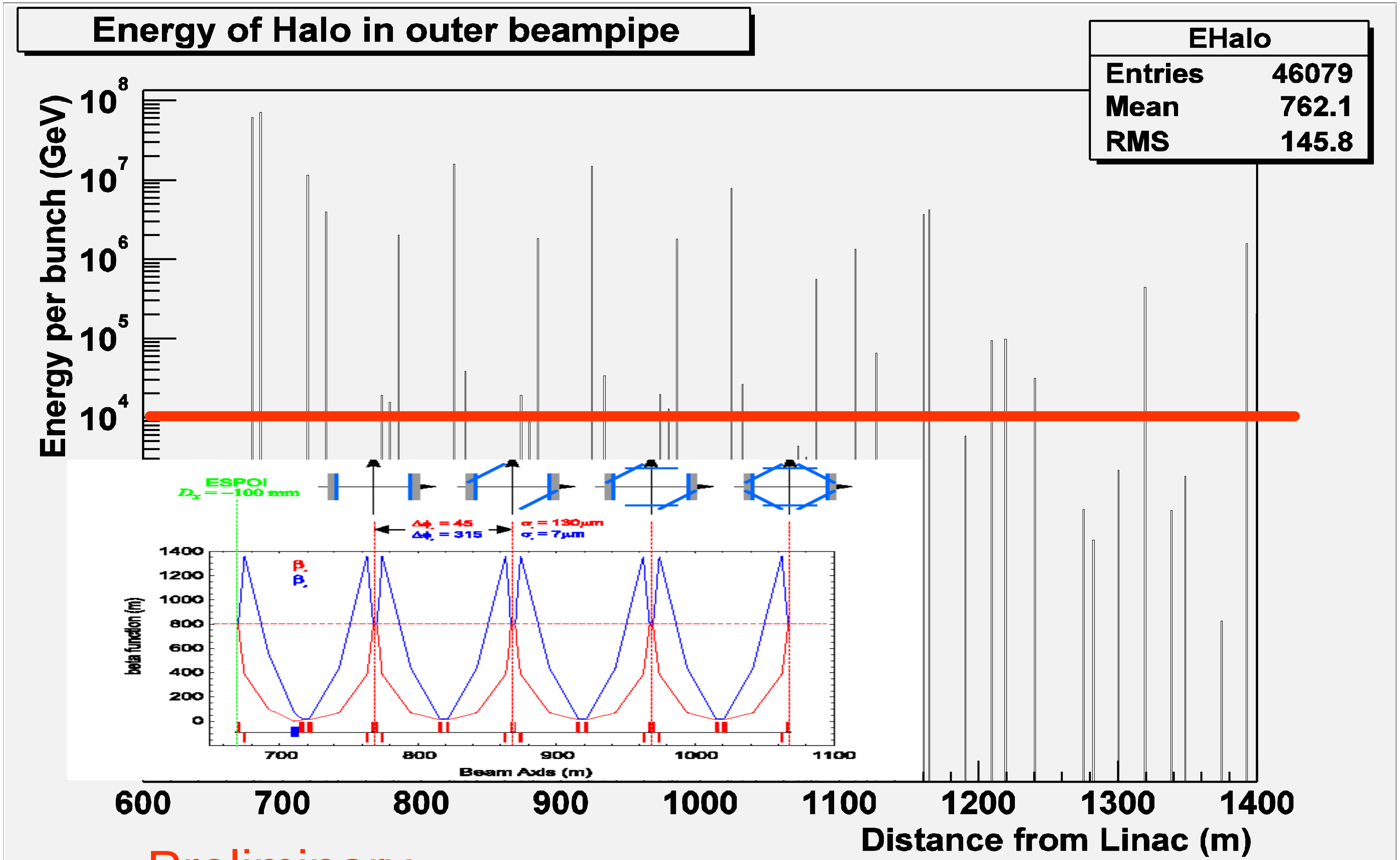
Inside Beampipe



Collimation Section



TESLA 10^{-3} Halo



Preliminary

Overview of Effort

- Code exists and runs – needs to be optimised and made user friendly.
- J. Carter (PhD) will look at beam diagnostics simulation and optimisation.
- New RA (RHUL) will work on optimisation of code, collimation system and SR in IR region.
- New RA (Manchester).
- Use of GRID to increase CPU.
- Include full simulations in the “design loop”.
- Understand Halo generation

Summary

- Several full-simulation packages are being used internationally
- BDSIM improved and producing new results for background studies.
- Fully OO and built within standard G4.
- Muons, beam-gas bremsstrahlung, Synchrotron Radiation under study.
- Used also for laser-wire simulation and optimisation of location etc.
- Tracking accuracy comparable to other standard machine trackers.
- Intend to include very detailed description of IR and extraction region.
- Need to increase statistics and optimise all LC designs taking secondaries into account.