

BDSIM for Background Calculations

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LCWS05, Stanford

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- Overview
- Halo
- Muons
- IR region
- Future plans

Motivation and History

- Work dates back several years.
- Grew out of initial plans to include Geant processes in Merlin.
- Then “fast” tracking incorporated into Geant4.
- Now a stand-alone approach and an alternative tracking code.
- All Geant4 processes included automatically
 - Multiple scattering
 - Bremsstrahlung ...
- New processes modified (eg new SR, muons, laser-wire).
- MAD “optics” file input

So far, applied to:

CLIC BDS

ILC BDS

PETRA Laser-wire (benchmark SR)

1st public release under CVS. (I. Agapov) Jan 05.

Future GRID implementation

People

RHUL:

Ilya Agapov

GB

John Carter

Chafik Driouichi

- Optics design, beam diagnostics
- Collimation, muons, backgrounds
- SR, beam diagnostics, IR layout
- Laser-wire design

Orsay:

O. Dadoun

- IR layout, extraction line simulation

Daresbury:

R. Appleby

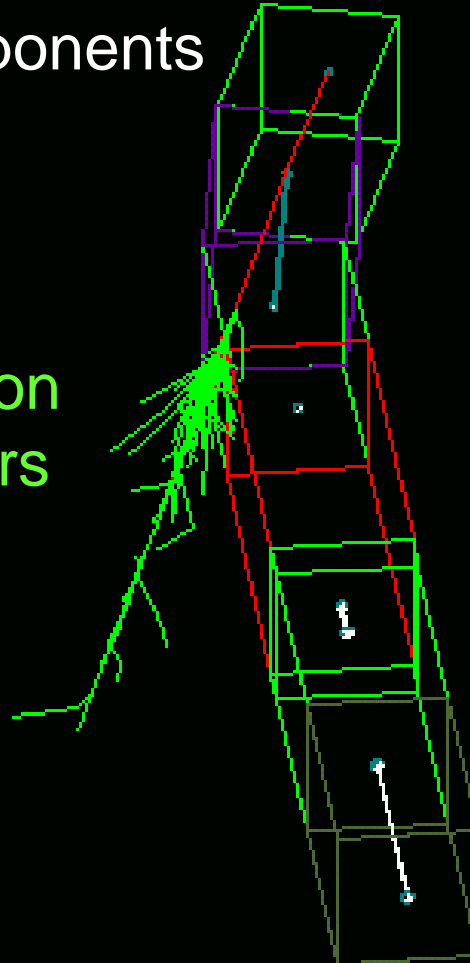
F. Jackson

- IR layout, extraction line simulation
- Collimation studies

Overview of Approach

Beam-lines are built up out of modular accelerator components

Full simulation of em showers

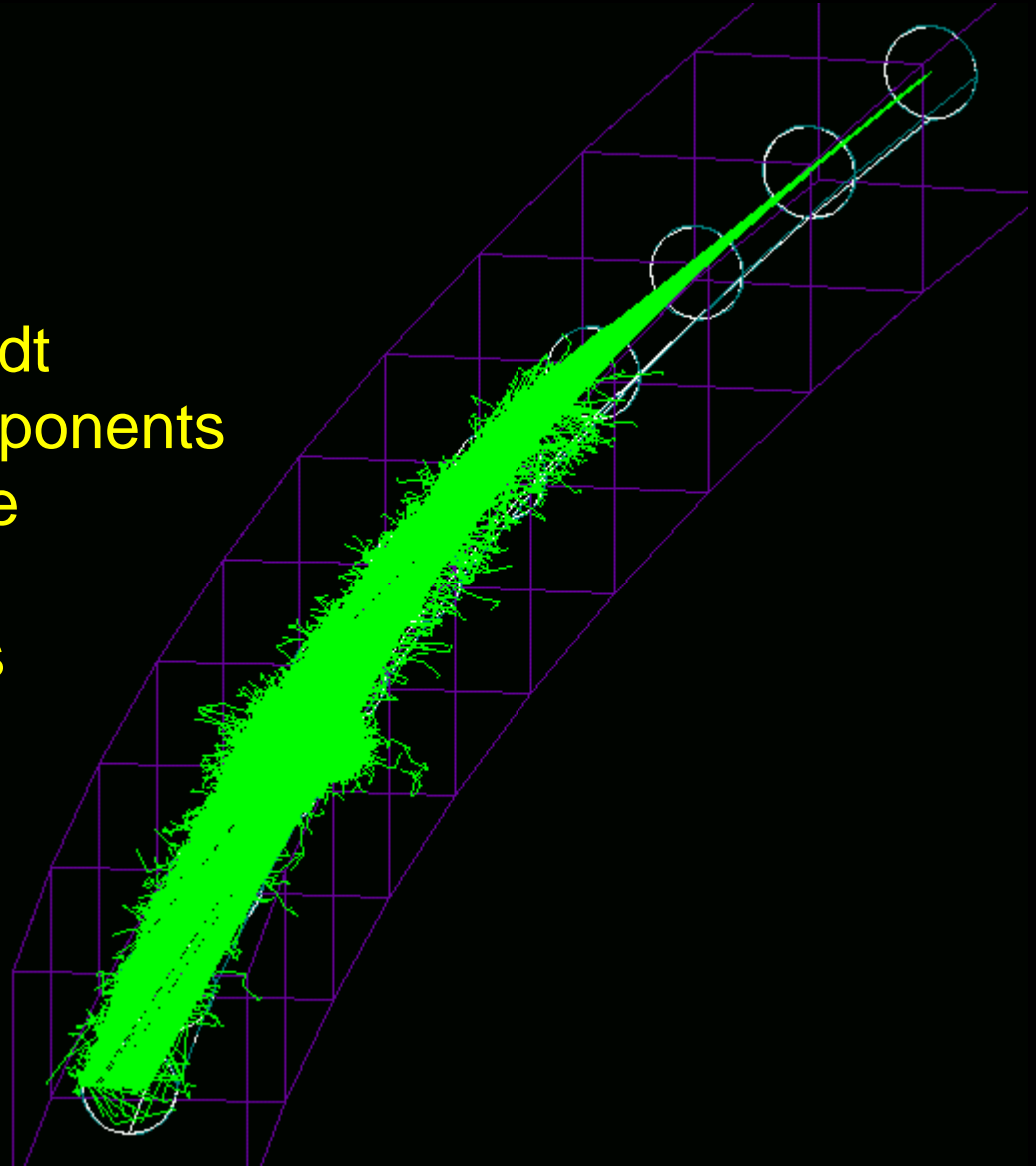


All secondaries tracked

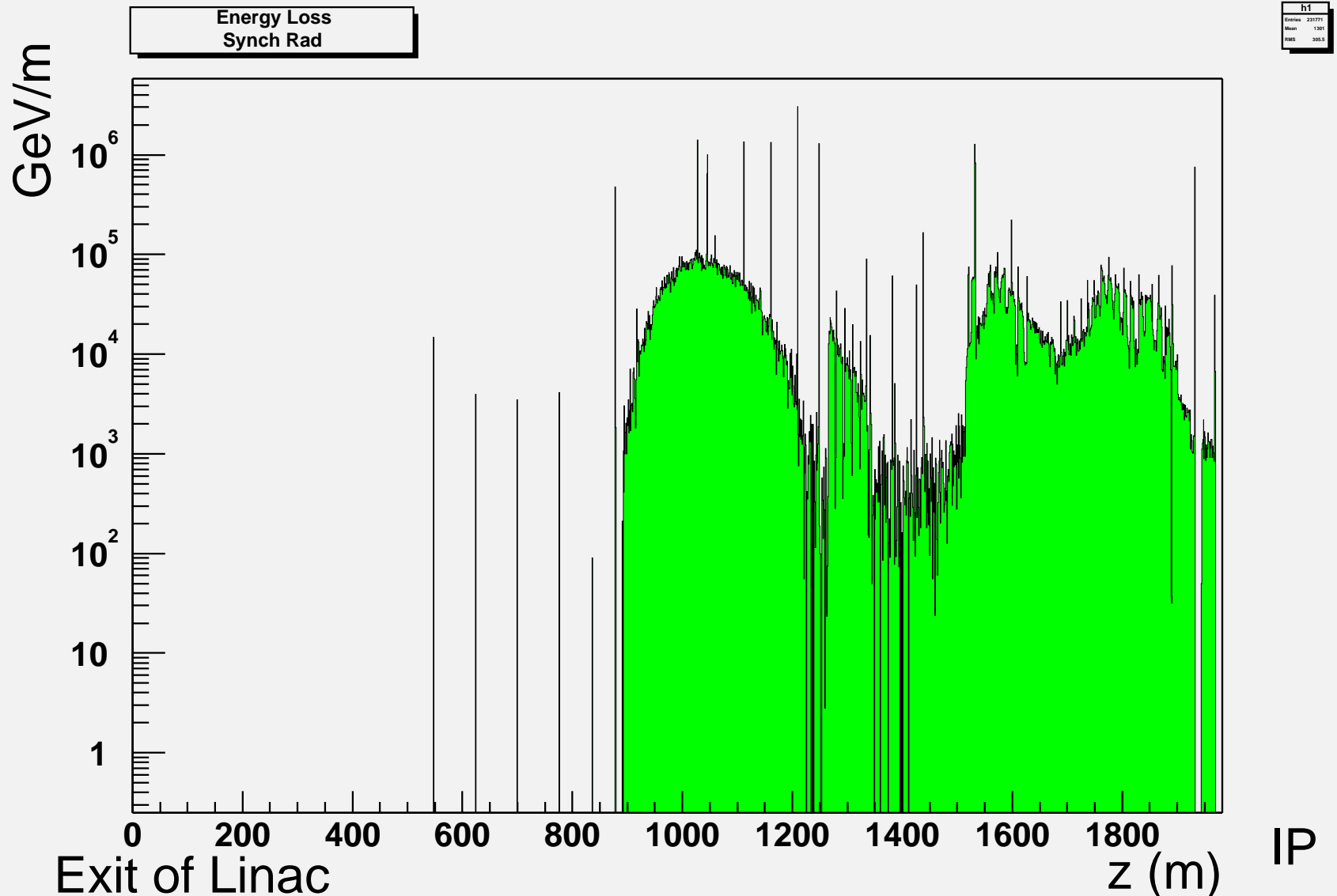
Synchrotron Radiation

Generator of H. Burkhardt
Implemented for all components
Based on local curvature
Individual photons from
individual parents

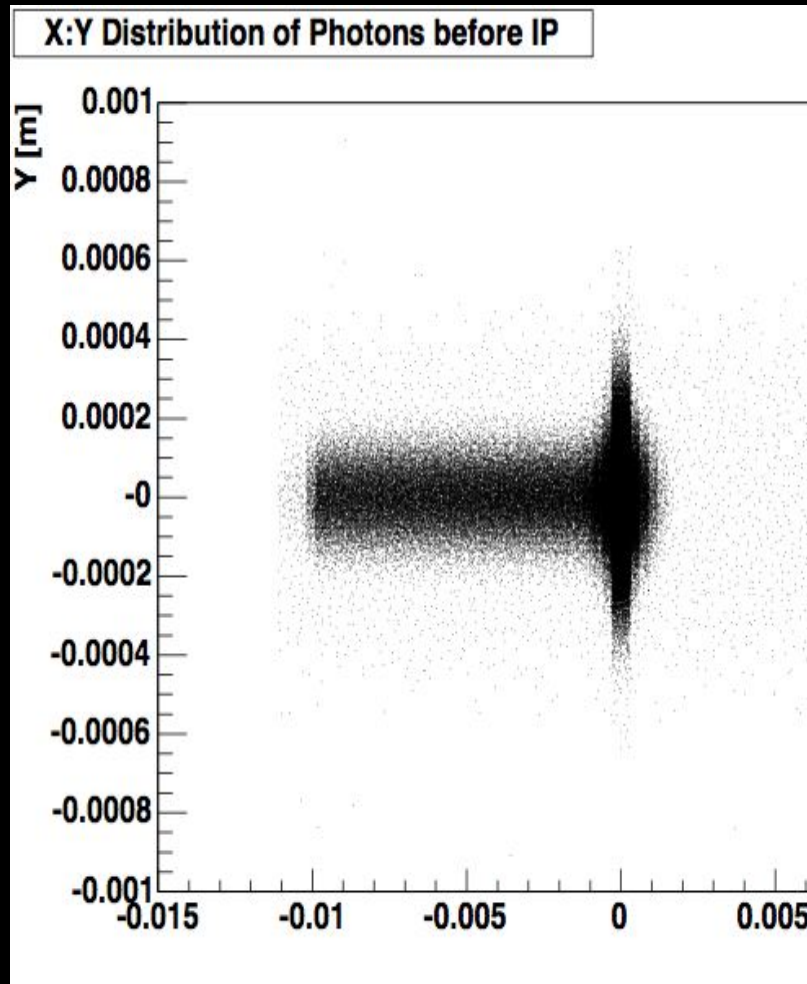
Primaries and secondaries
tracked



SR Absorption along ILC BDS

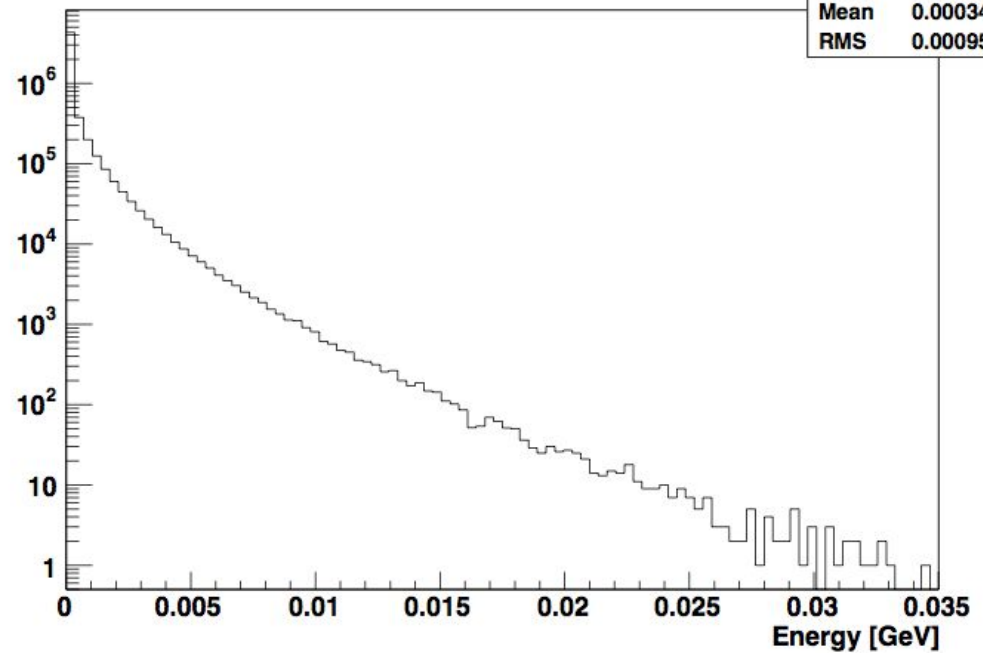


SR within beampipe



- J. Carter currently building IR model and simulation.
- Interface to Guinea-Pig format for SR of disrupted beam (track reflections back to IR)
- Implements low-energy G4 package

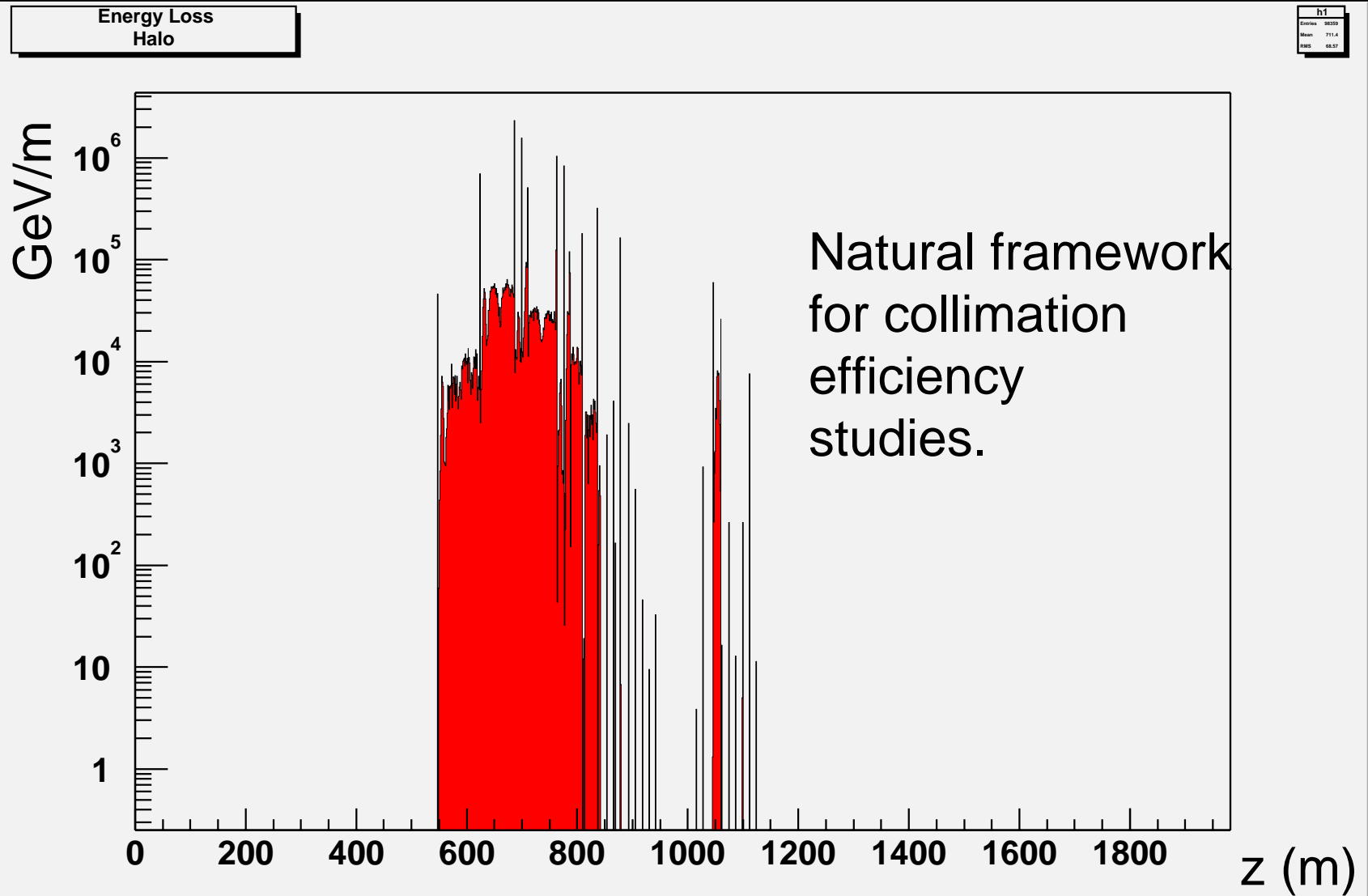
Energy of Photons before IP

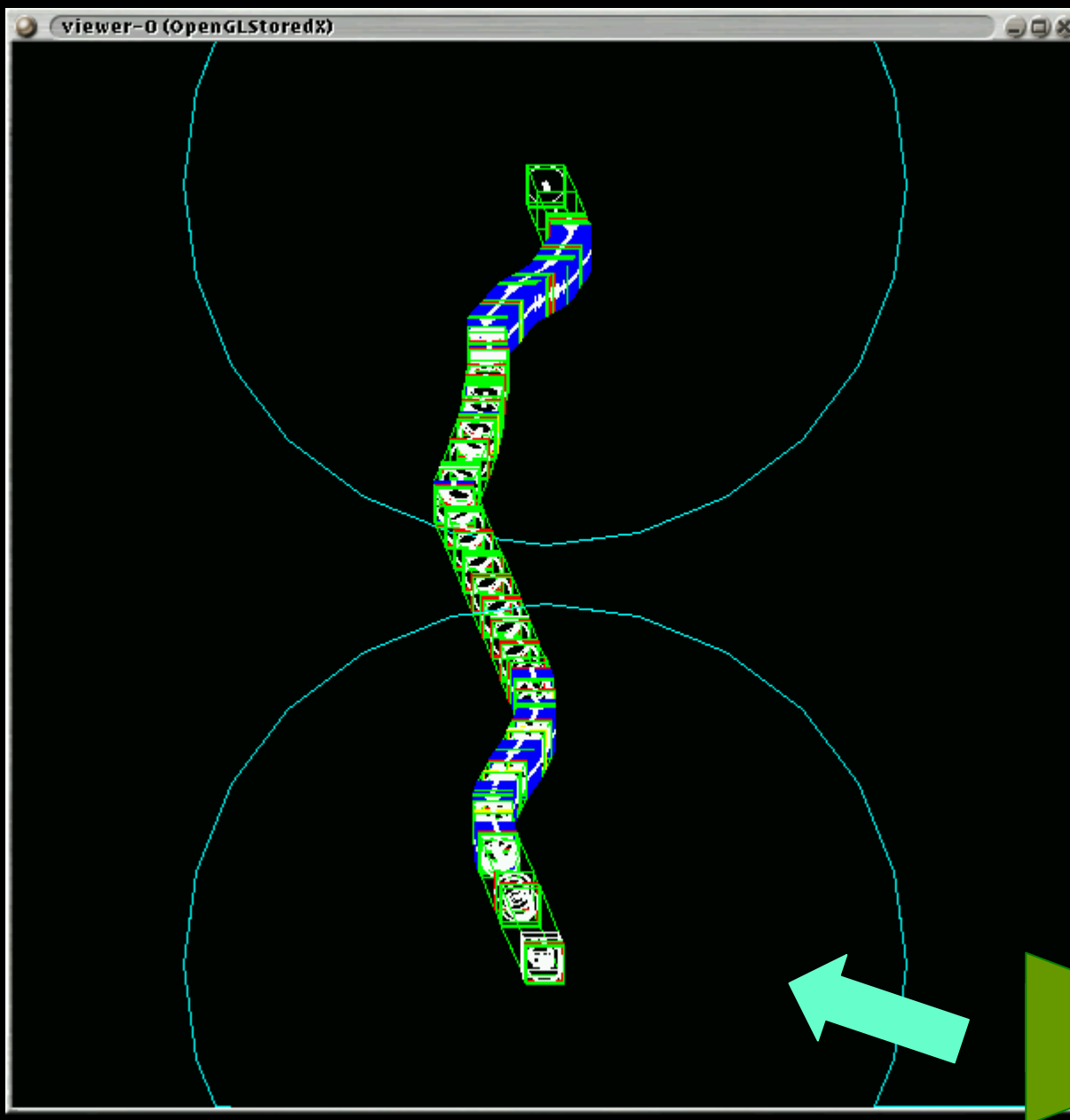


Axes scales are m

Core beam

ILC Beam Halo

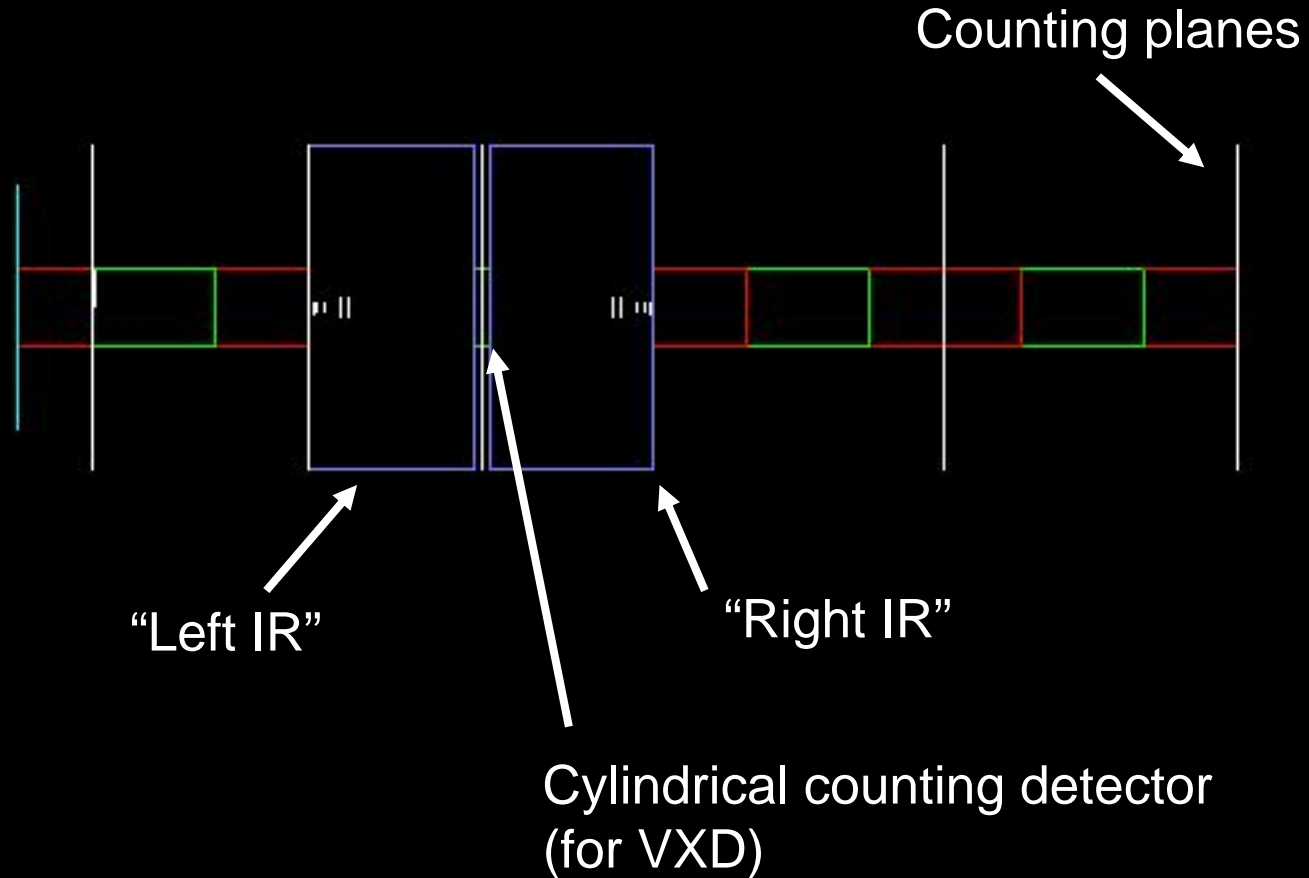




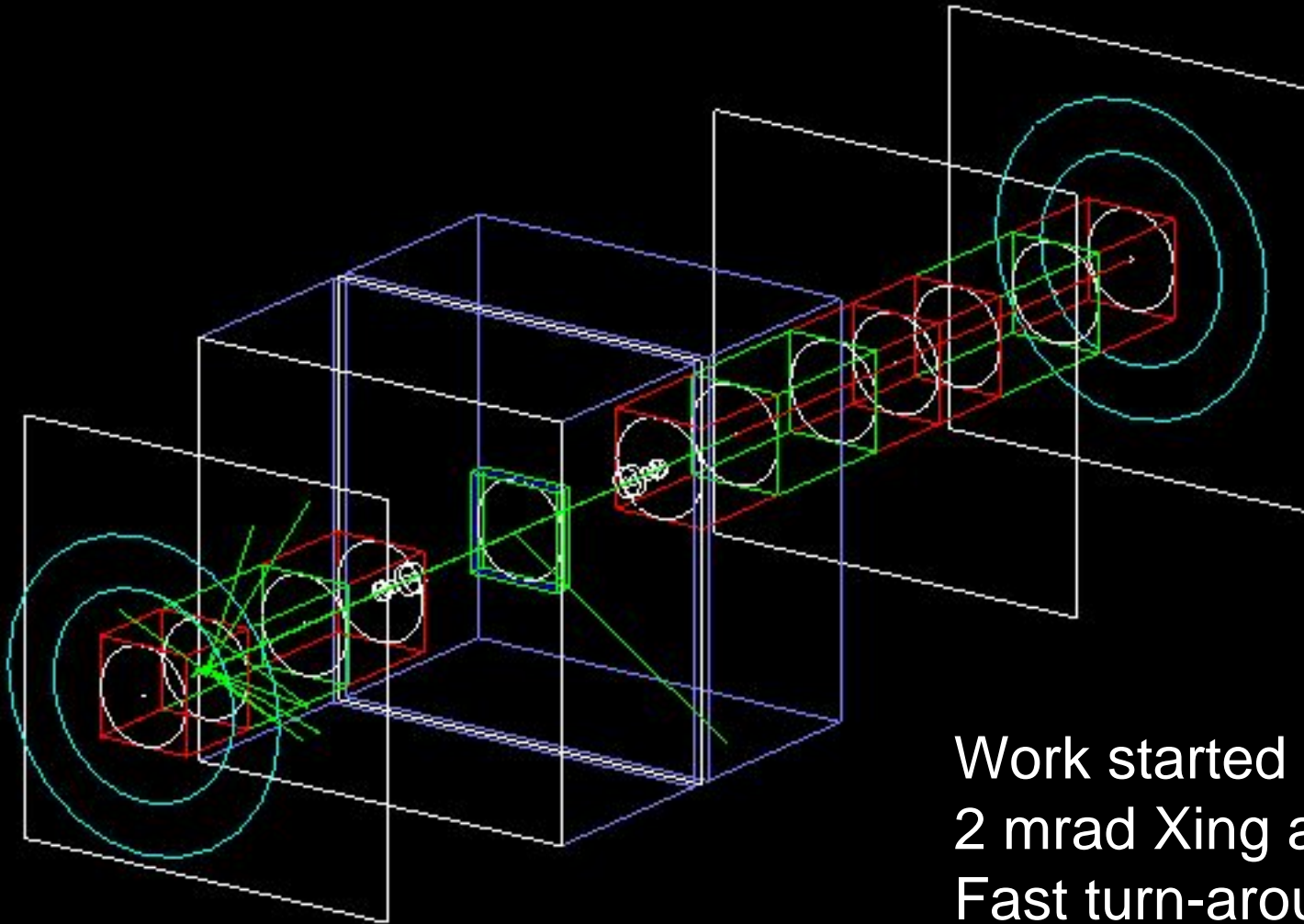
Add any detector IR
as a BDSIM object

Ideal for MDI studies
For various detectors

IR Region



Collimation Depth Studies

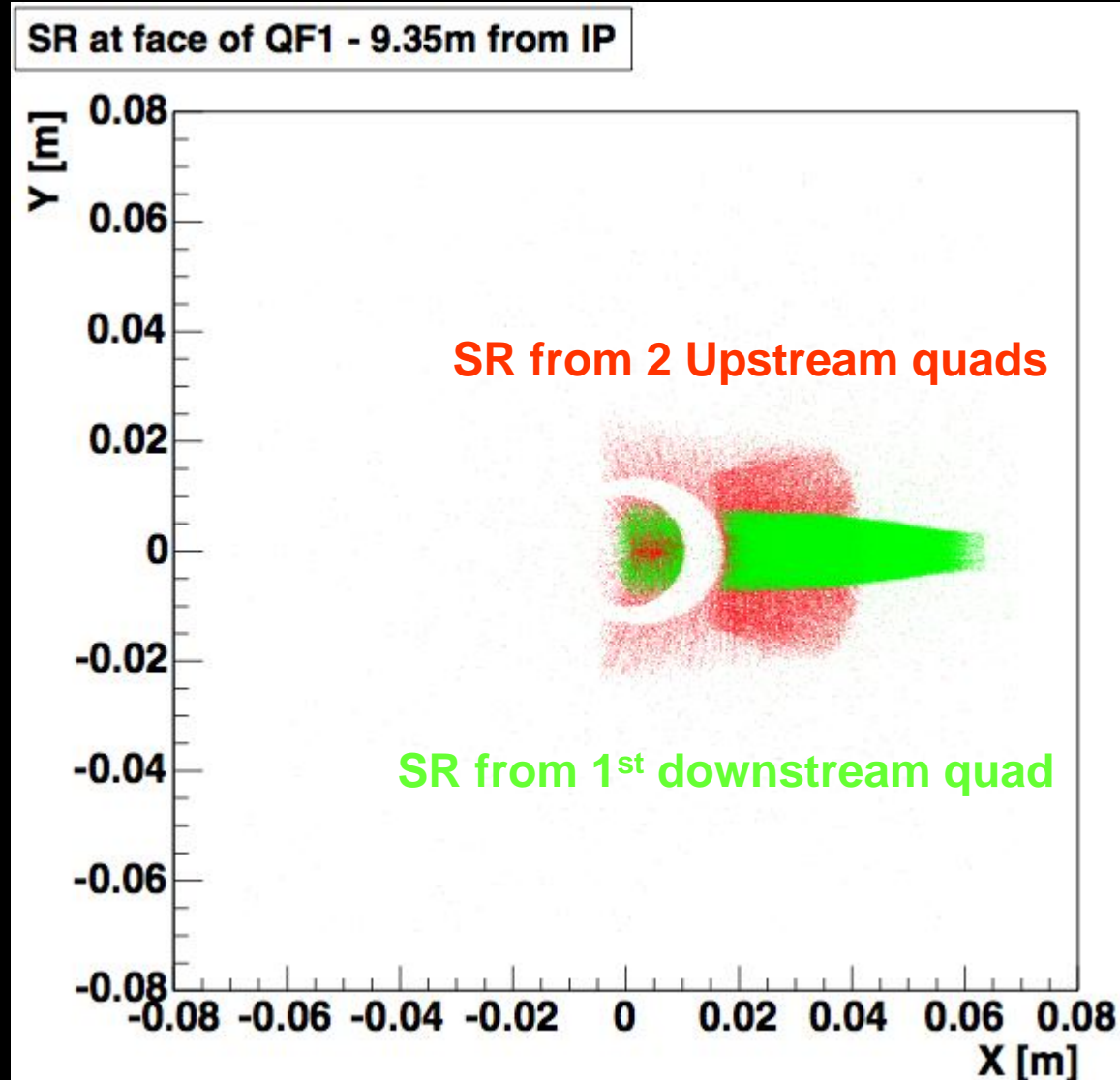
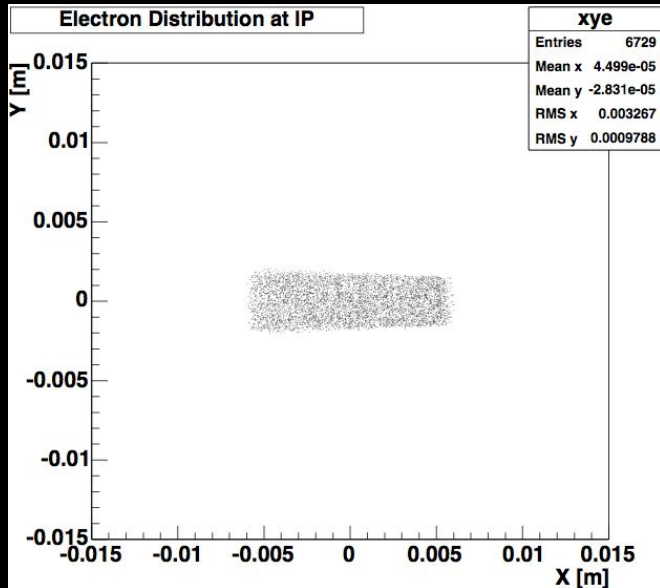


SR from halo

Work started on
2 mrad Xing angle;
Fast turn-around possible
for design upgrades

J. Carter

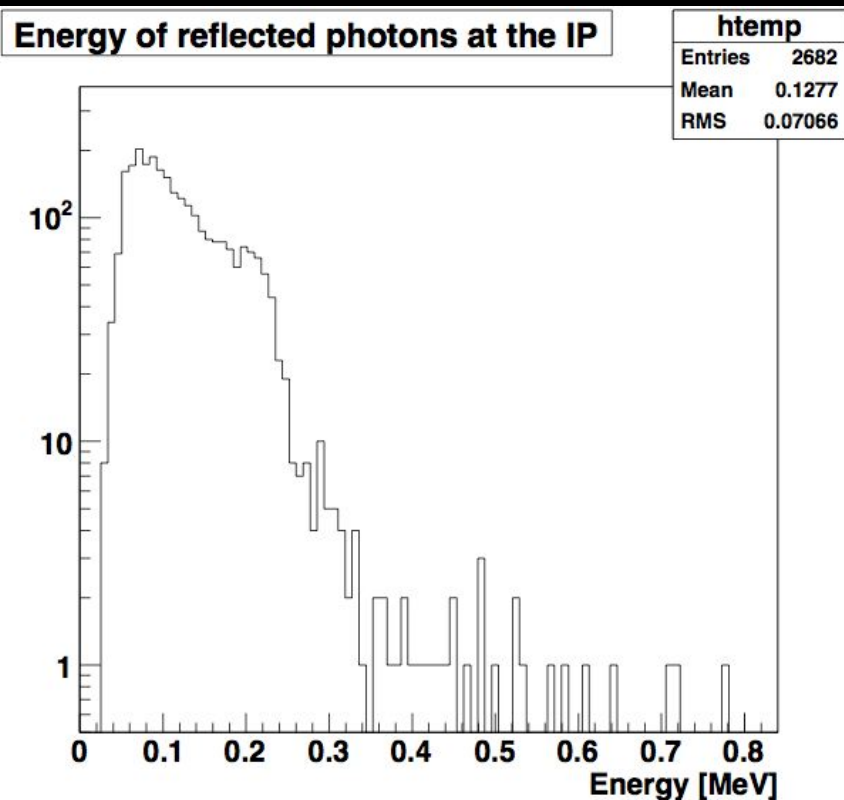
Halo SR – 2 mrad scheme



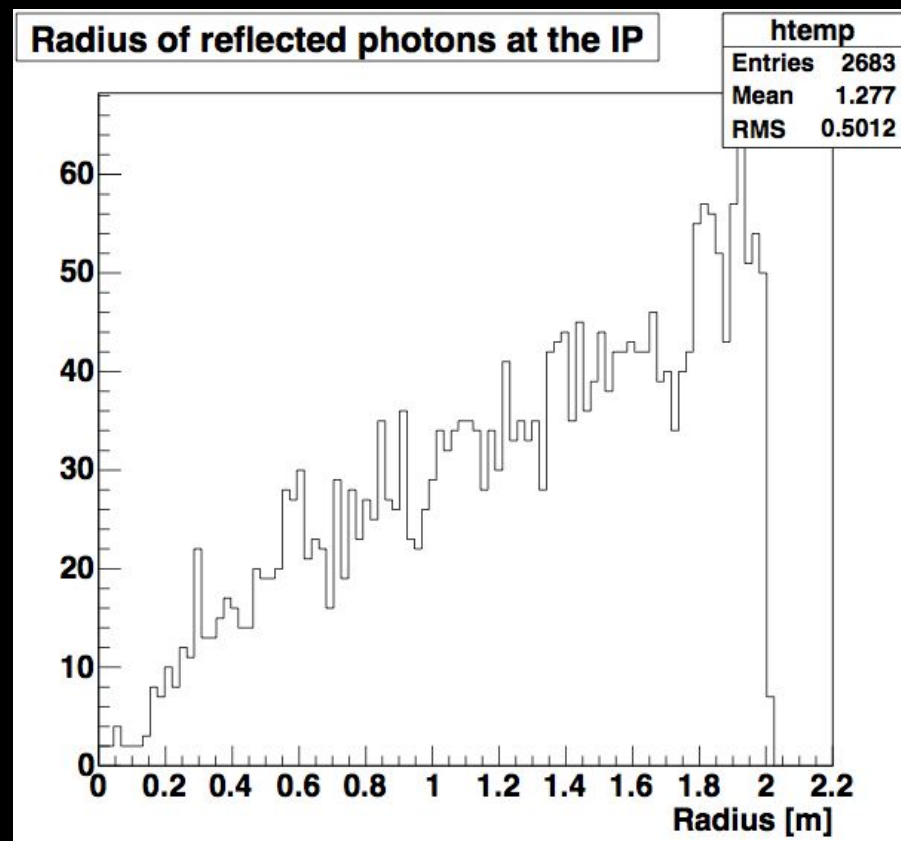
Flat halo event dist.
(from F. Jackson)

J. Carter (prelim)

Back-scatter at IP



SR : Originated after QD0 +
Original radius <40cm
(c.f. T. Murayama's analysis)



Total Reflection prob ~14%
Of these, hit rate at VXD
 $\sim 4 \cdot 10^{-4}$

J. Carter (prelim)

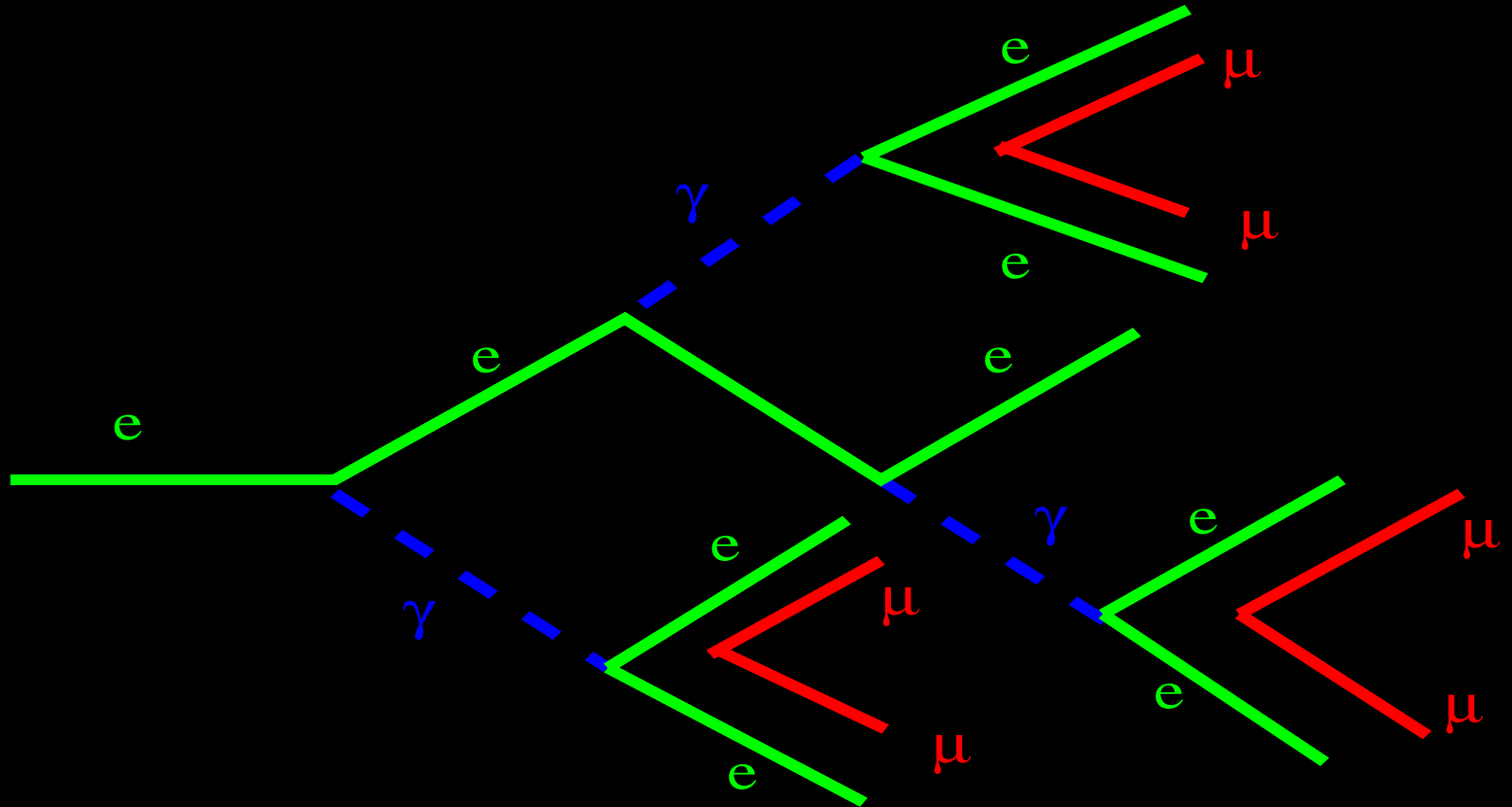
Muon Showers

Increase statistics for Bethe-Heitler by **forcing**

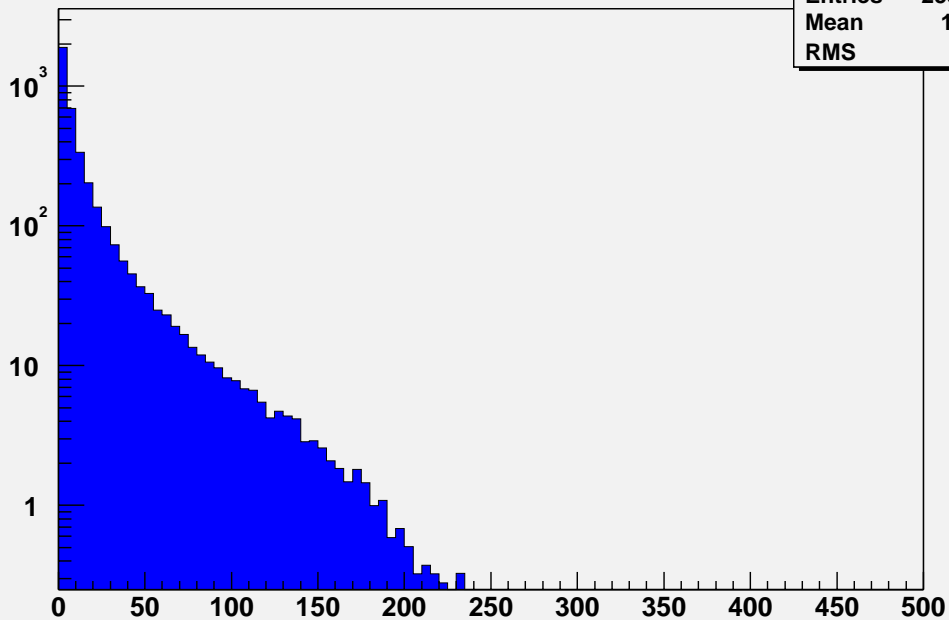
$$\gamma \rightarrow \mu^+ \mu^-$$

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

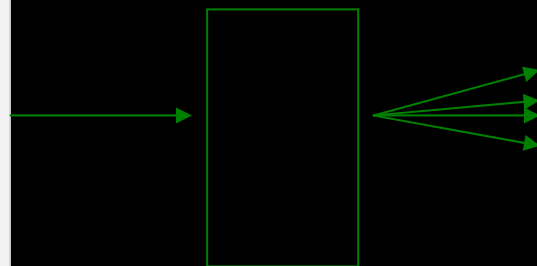
correct spectra via track weighting:



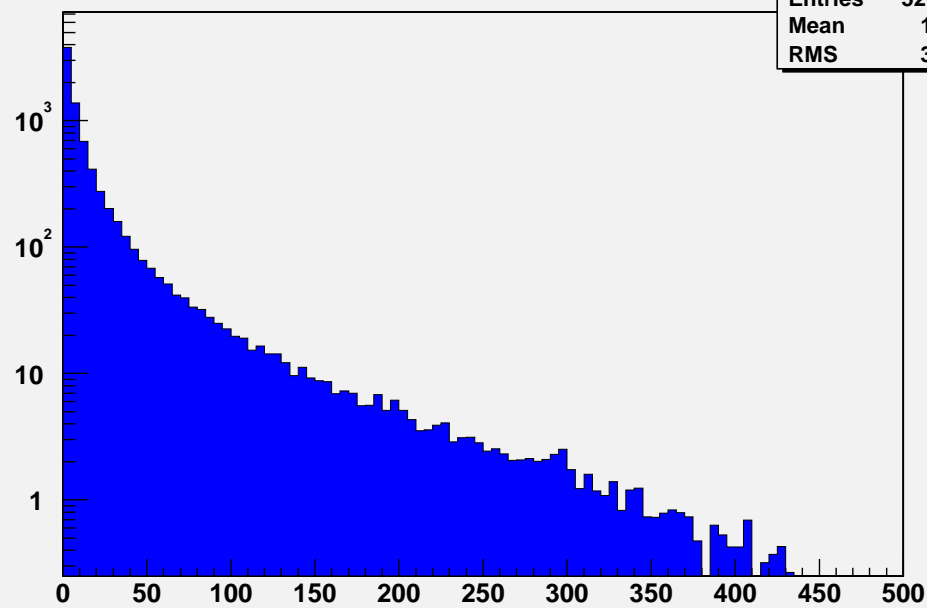
Energy of muons at collimator



250 GeV electron on 1m iron



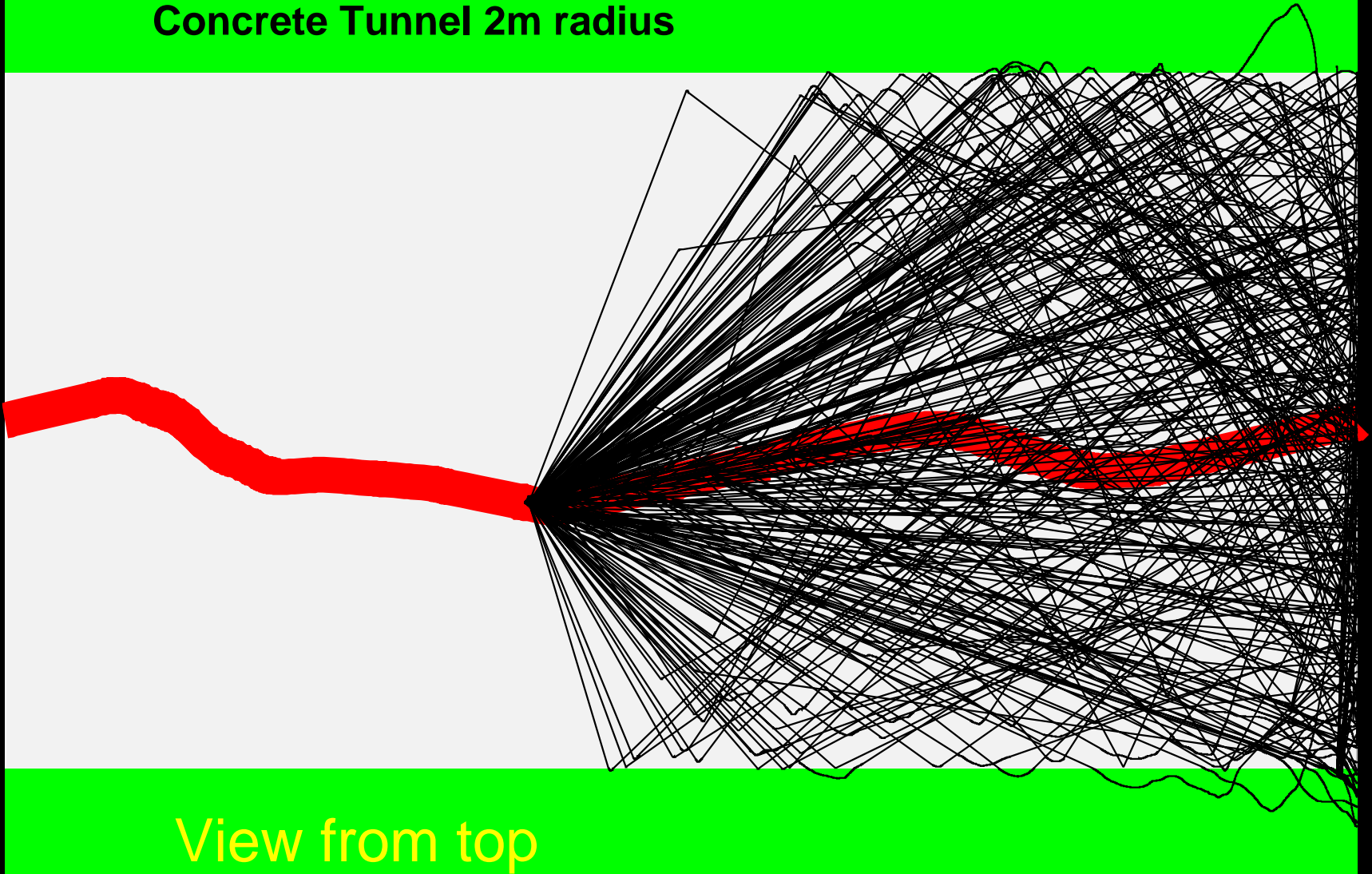
Energy of muons at collimator



500 GeV electron on 1m iron

TESLA: Muon Trajectories

Concrete Tunnel 2m radius



View from top

ILC: Muons at IP

Assume: 10^{-3} Halo bunch; ie $2 \cdot 10^7$ halo e's per bunch
 N_μ per e $\sim 1.4 \cdot 10^{-5}$, for 500 GeV e⁻ (Bethe-Heitler only)

Adding a cut on initial energy >100 GeV (reduces number of tracked muons by a factor of ~ 30 without affecting greatly the final results - preliminary)

Muon spoilers have now been implemented in BDSIM as iron cylinders. An optional toroidal magnetic field is also included

Including no spoilers and muon creation at $z=1532$,
Gives approximately 144 muons per bunch at IR.

(Assuming Concrete tunnel of 2m radius.)

Muon Rates at IP

Muon spoilers



Initial z (m)	Sp1 (Field/T)	Sp2 (Field/T)	Rel Flux
1532			1.0
1532		0	0.7
1532		1	0.7
624			0.5
624	0	0	0.2
624	1	1	0.2
624	1	-1	0.1

Neutrons

Neutron production via EM processes exists in BDSIM as an option.

Time consuming – new techniques required and lots of CPU (Grid).

I. Agapov and O. Dadoun will investigate these issues further.

Need to consider:

- Back-shine from beam dumps,
- Local losses from SR, halo in vicinity of IR.
- Interface to detector simulation

Summary

- First BDSIM beta-release was this year
- Community of users is growing - essential
- Benchmarking with data (eg laser-wire)
- Benchmarking with other codes
- Broad use – diagnostics, IR design, ...
- Implications of backgrounds for extraction line diagnostics
- Fast turn-around for ILC design changes
- Neutrons, SR implemented – also a new beam-gas implementation is planned
- Will get BDSIM running on the grid for high stats.