John Adams Institute for Accelerator Science

Royal Holloway University of London

BDS R&D

G A Blair

CLIC-UK Kickoff Meeting

CERN

12th April 2011

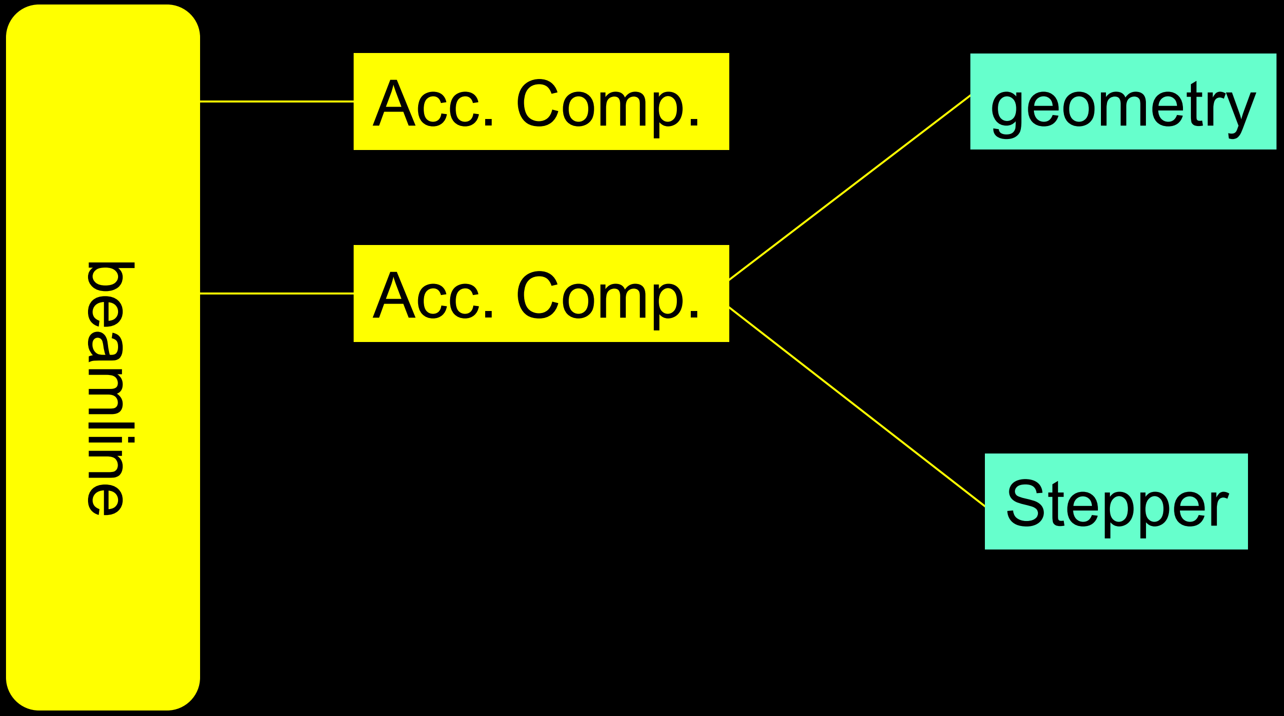
- Introduction
- BDSIM
- Instrumentation
- Summary

Science & Technology Facilities Council

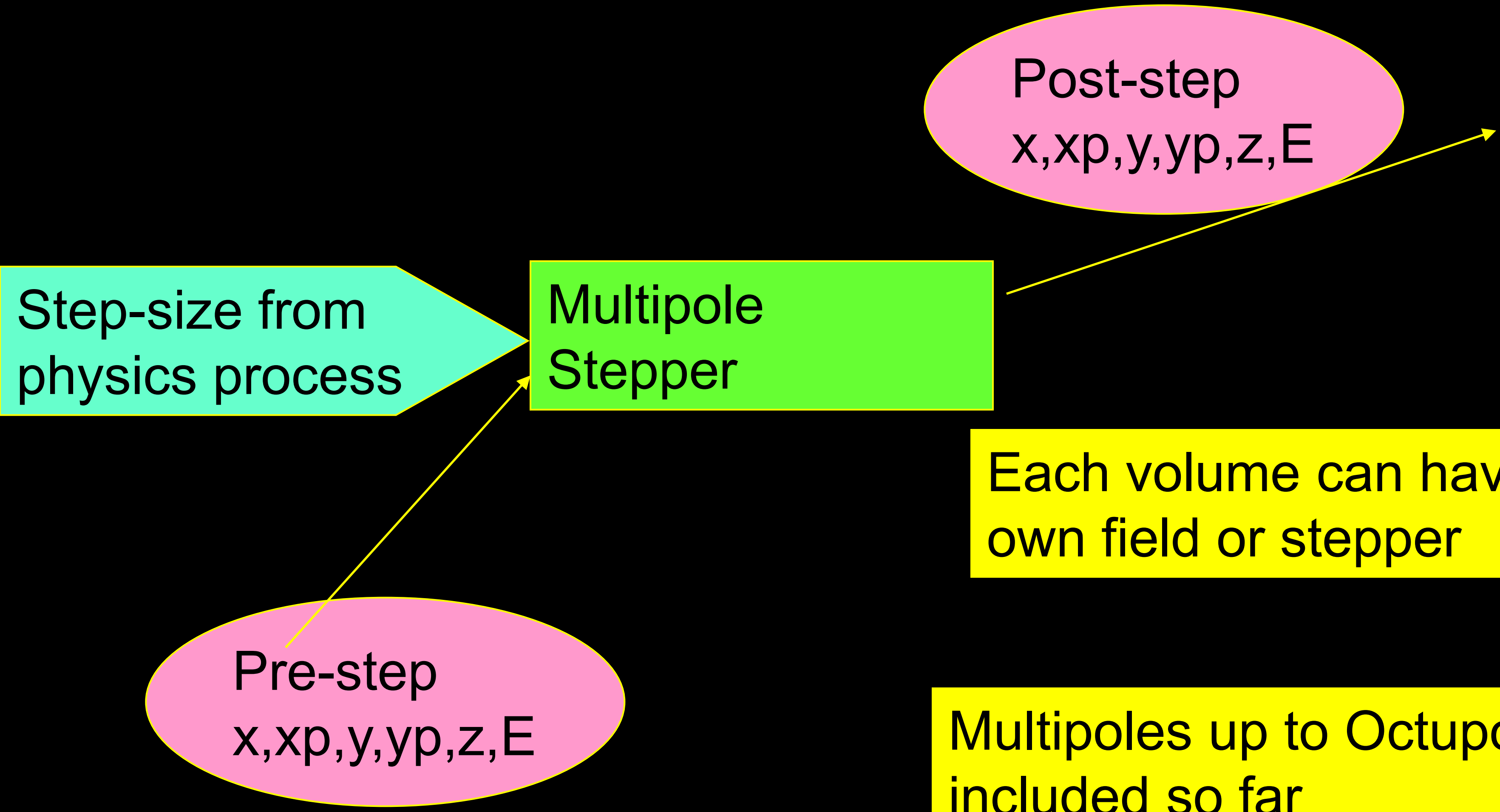
CERN

BDSIM: Basic Structure of Code

Object oriented approach natural for beamline structure



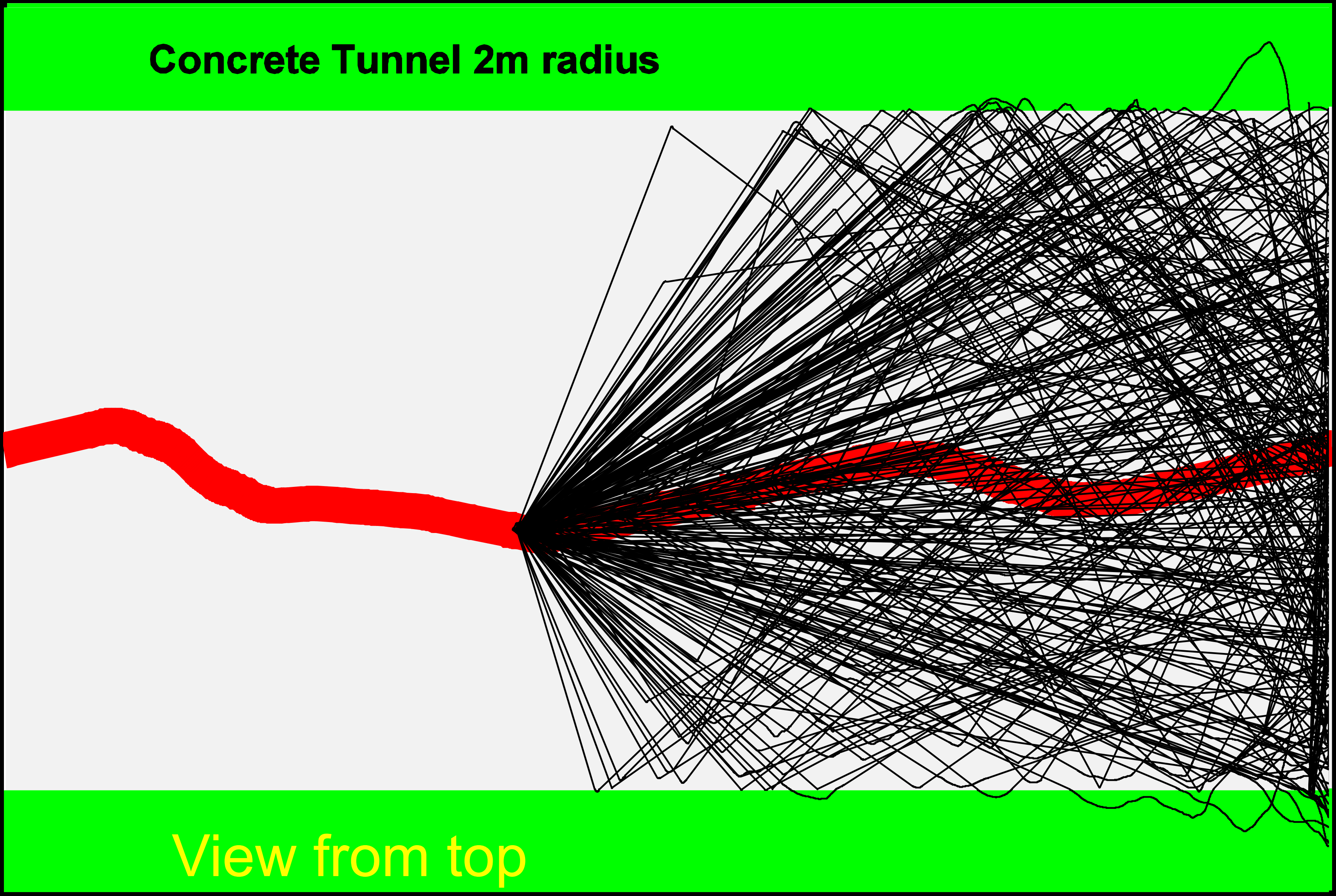
G4 Stepper



Each volume can have its own field or stepper

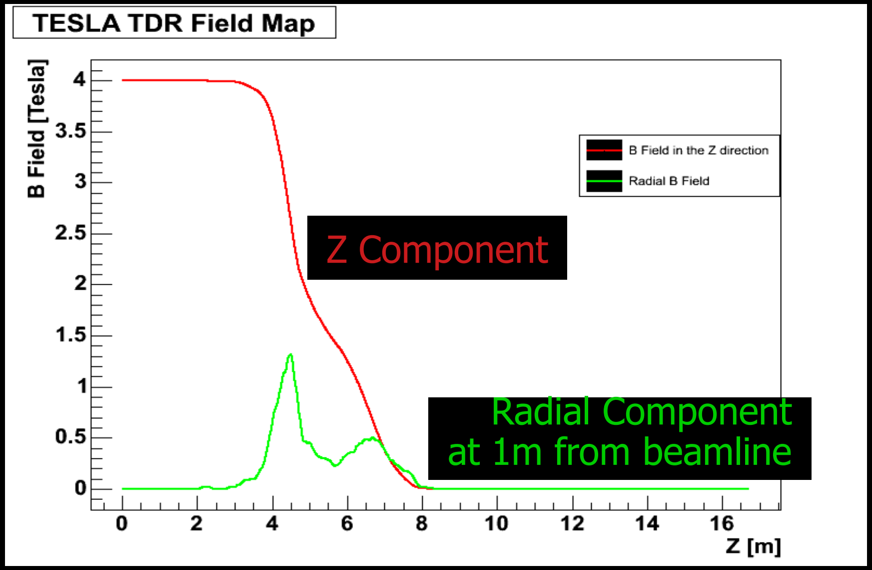
Multipoles up to Octupoles included so far

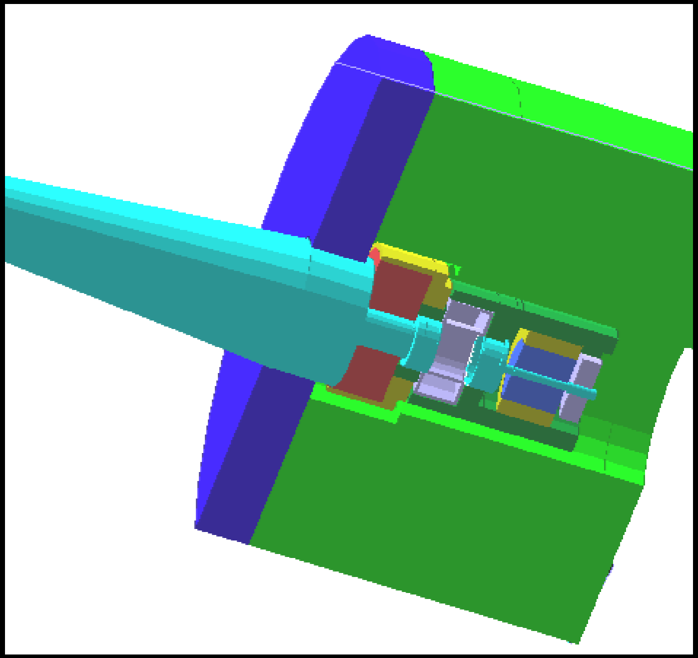
ILC/CLIC: Muon Trajectories



Interaction Region in BDSIM

- Full IR Geometry modelled in BDSIM
  - Using MySQL geometry database
    - Includes a full Solenoid Field Map





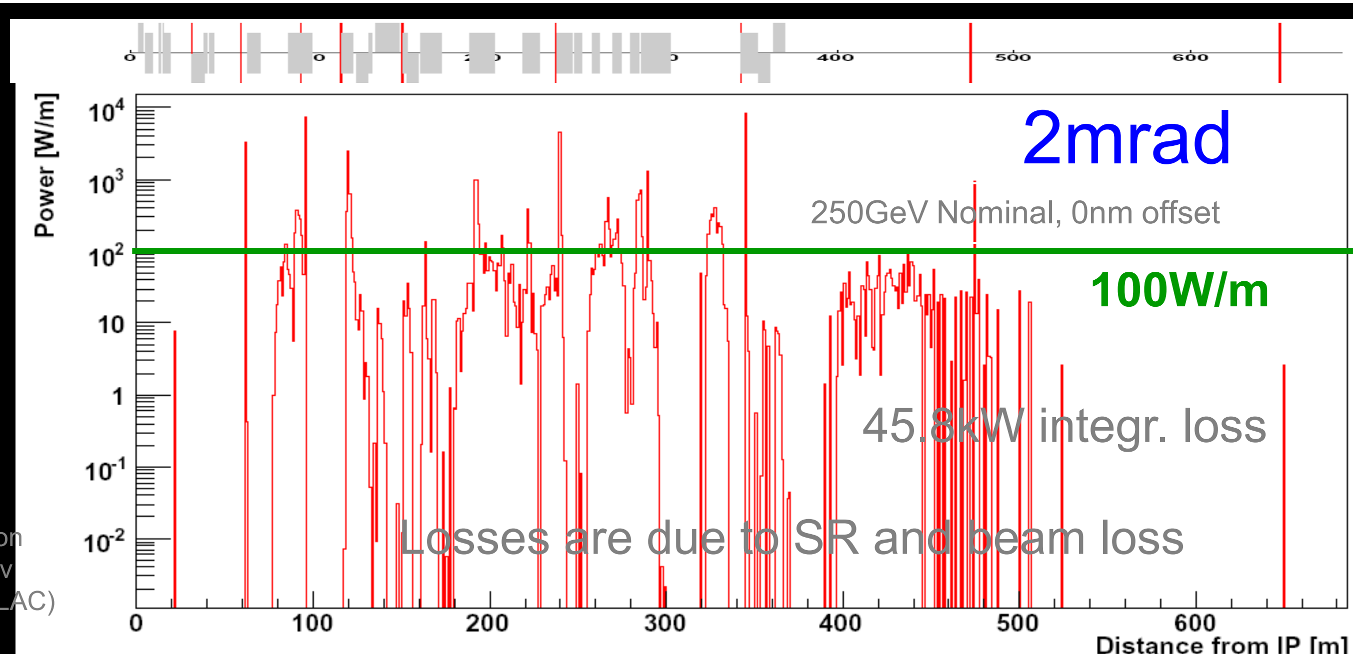
Screenshot of an IR Design in BDSIM

Losses in ILC extraction line

20mr: losses < 100W/m at 500GeV CM and 1TeV CM

2mr: losses are at 100W/m level for 500GeV CM and exceed this level at 1TeV

Radiation conditions and shielding to be studied



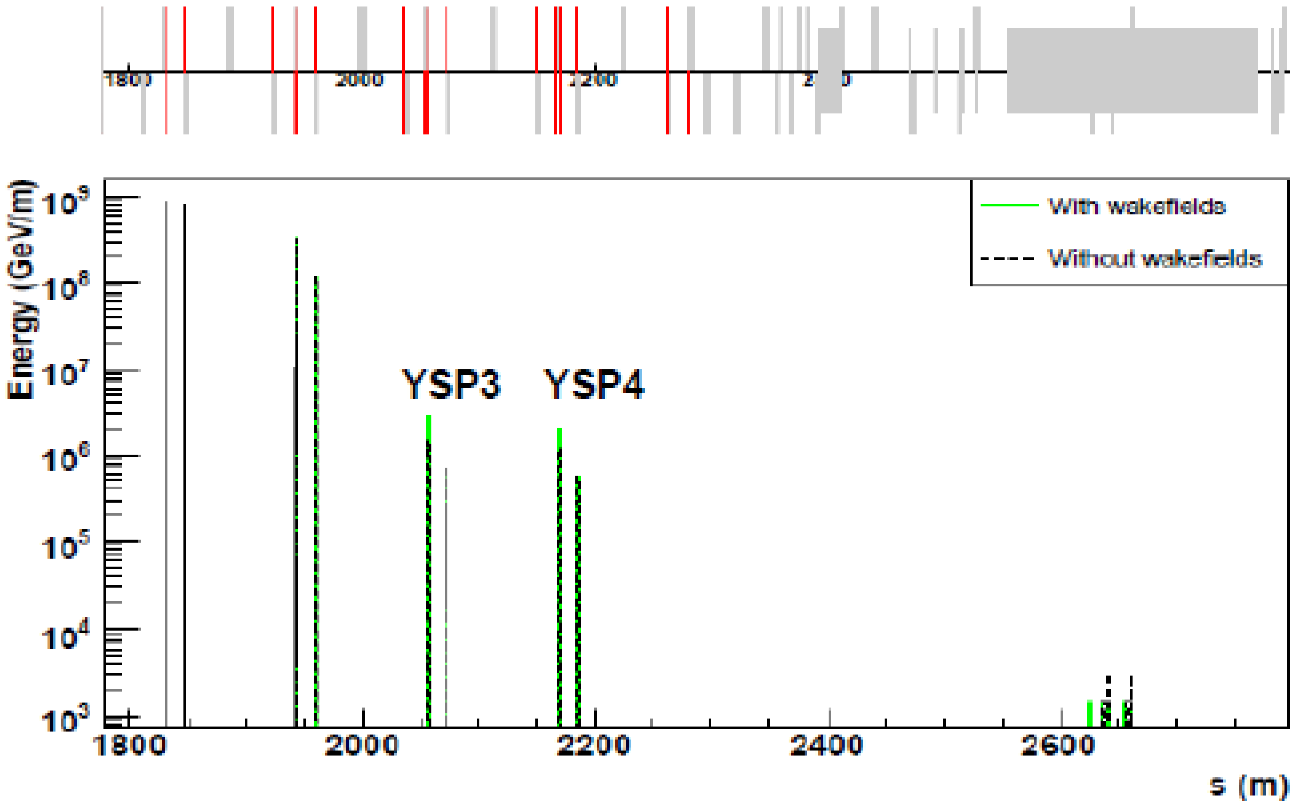
J. Carter, I. Agapov, G.A. Blair, L. Deacon (JAI/RHUL), A.I. Drozhdin, N.V. Mokhov (Fermilab), Y.M. Nosochkov, A.A. Seryi (SLAC)

J. Carter

Loss map along the BDS

with collimator wakefield effects (no secondary emission)

Hard-edge collimator assumption, and half-gaps: 10 σ_x and 44 σ_y

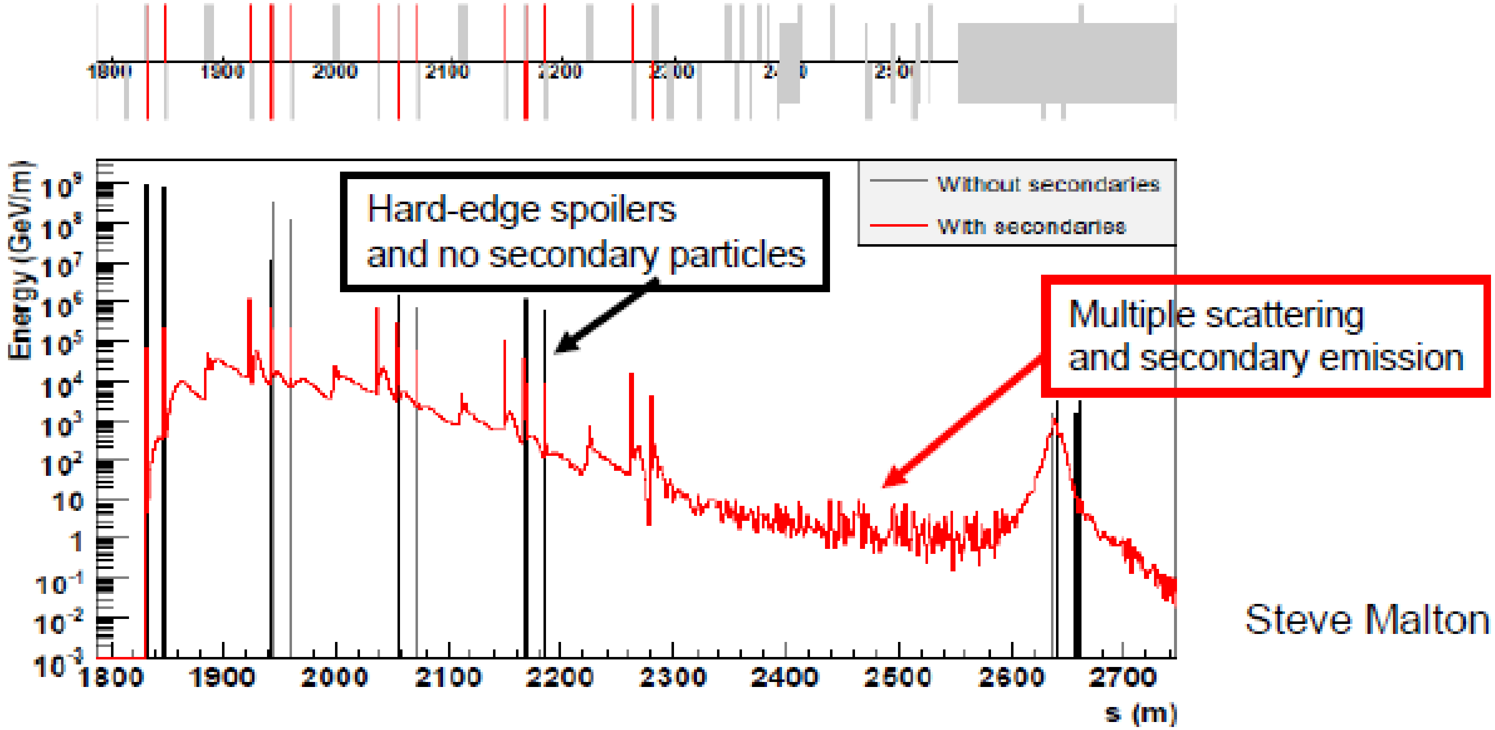


Steve Malton

- Considering that all particles hitting a collimator are absorbed totally at that point, the wakefields lead to approximately double the account of losses on the last two vertical spoilers (YSP3, YSP4)

Loss map along the BDS

with secondary particle production (no wakefields)



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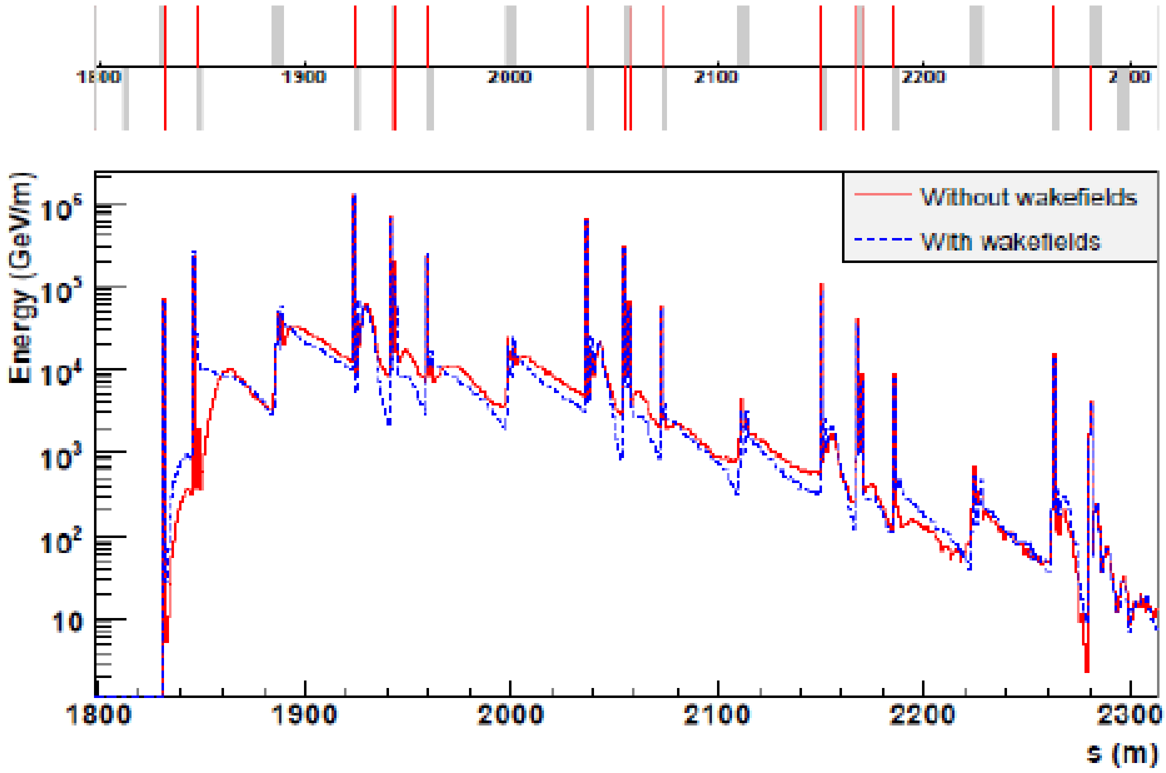
- Losses occur on the absorbers only when secondary particles are included
- With secondary particle emission the peak of particle loss is reduced approximately by 4 orders of magnitude at the four first spoilers
- There are a number of primary particles lost in the FFS

Loss map along the BDS

with secondary particle production + wakefields



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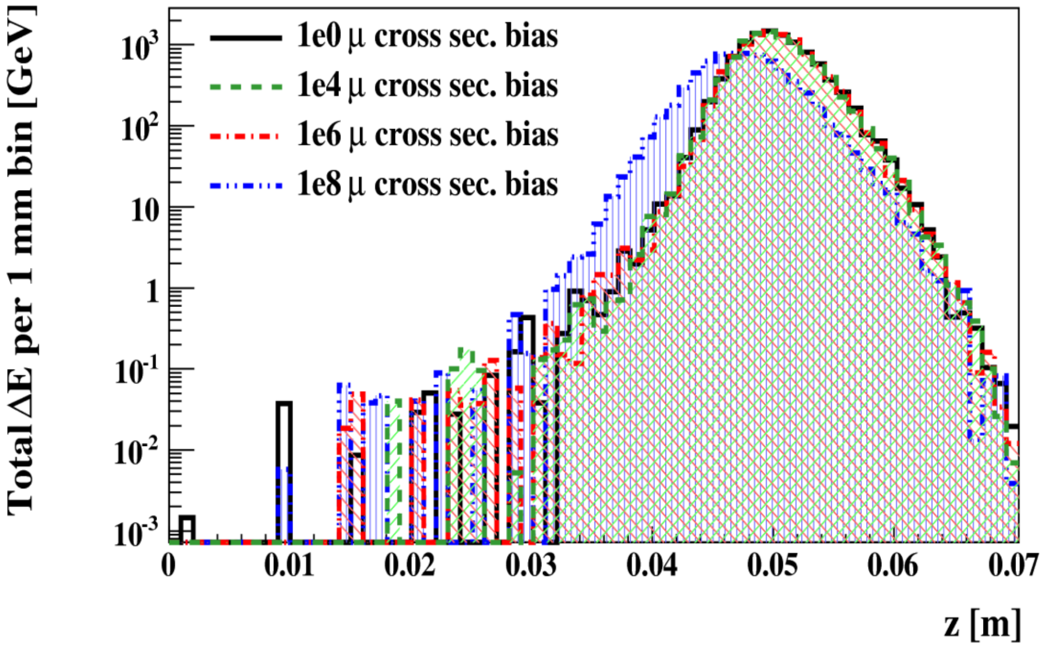
- Considering secondary particle production, losses on the collimators do not differ significantly between the cases with and without wakefields
- Losses closer to the spoiler when wakefields are included

New features – muon biasing

- To increase muon multiplicity, muon biasing was added. Using the following options:
- `option, gammaToMuFe=fact, annihiToMuFe=fact`
- enhances the gamma to muon pair and annihilation to muon pair cross sections by a factor `fact`.
- The muons and their secondaries are re-weighted accordingly.



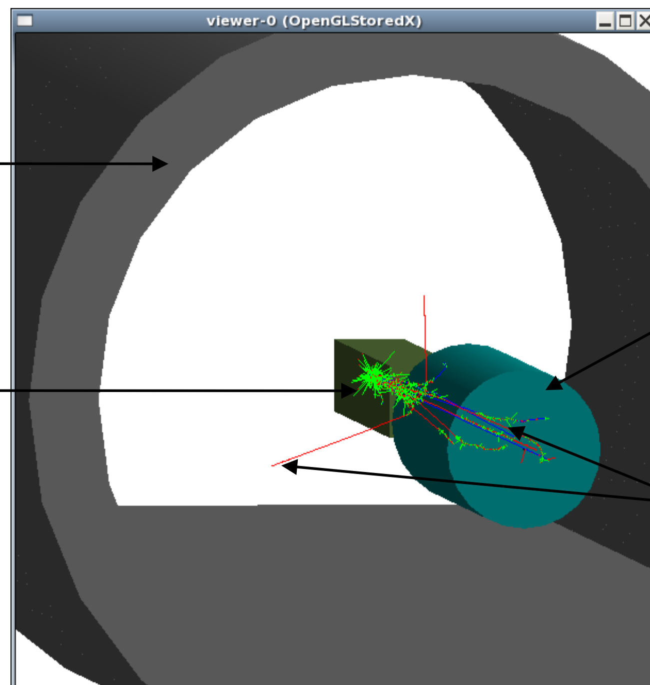
L. Deacon

New component – muspoiler

- A muspoiler is a magnetised iron cylinder used for muon sweeping. For example:

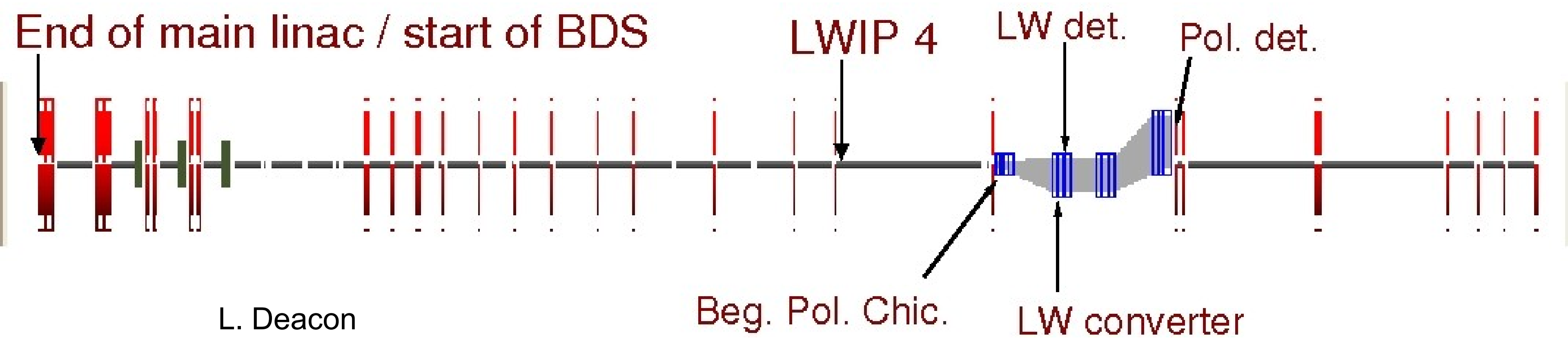
```
my_muspoiler: muspoiler, inR=1*cm, outR=55*cm,
   aper=8*mm, B=1.5, l=5*m;
```

defines a muspoiler called “my_muspoiler” with an inner radius of 1 cm, outer radius 55 cm, beam pipe radius of 8 mm, solenoidal magnetic field of 1 Tesla and length 5 m.



Laser-wire Signal extraction

- In the 2006 ILC baseline design the laser-wire signal detection in the beam delivery system was done in the same chicane as the polarimeter.
- This was simulated using BDSIM (screen shot below).
- It was shown that synchrotron radiation background could be removed by converting the laser-wire Compton photons to electron positron pairs and detecting them using a Cherenkov detector downstream of one of the dipoles. The low energy particles from the converted synchrotron radiation were deflected by the dipole.
- However, the laser wire was shown to create a significant signal in the polarimeter detector.
- A simple calculation predicted linac-related backgrounds of a few % per bunch for a vertical scan and 10% per bunch for a horizontal scan.
- Therefore preferable to locate laser wire after a bend downstream of the linac.
- Such a study also needs to be performed for CLIC.



L. Deacon

Summary

- BDSIM:
  - Upgraded code now available.
  - CERN collaboration also in CLIC post-IP region (L. Deacon).
  - CLIC Muons: production, collimation, MDI.
  - Some overlap with LHC simulation.
- Emittance measurement
  - Good overlap with laser-wire programme.
  - Collaboration established also with RTML.
- Instrumentation
  - Input realistic diagnostics performance into established simulation codes.
  - Comparison and benchmarking.
- Personnel
  - Lawrence Deacon is now a CERN fellow; we will need to recruit to replace him. Scope of the post can also be widened to match requirements.