Recent Improvements of BDSIM

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- Motivation/Overview
- Examples
- GMAD Interface
- Detector Interface
- ILC crossing angle study
- Future plans/Summary

Overview of Approach

http://flc.pp.rhul.ac.uk/bdsim.html

Beamlines are built of modular accelerator components

Fast accelerator-style Tracking within beam-pipe

‘Normal’ G4 tracking outside

All secondaries tracked

Accelerator description format requirements

- Standard elements: drift, sbend, etc.
- Inherit MAD functionality
- Geometry specification
- Field specification
- Beam (and background) distribution spec.
- Run control

GMAD format

- Preserve the MAD (MAD-X) lattice description
- Take out some control commands
- Provide some additional geometry- and material-related functionality
- Provide drivers to geometry and field description formats
- flex/bison parser
- Implemented in BDSIM
- Can be easily transformed into XML

GMAD specification

Elements:

<name> : <type>,

attribute=<attr_val>,
attribute=<attr_val>,...;

Commands:

include <filename>;

use,period=<name>;

...

Beam parameters:

beam, attribute=<attr_val>,...;

Options:

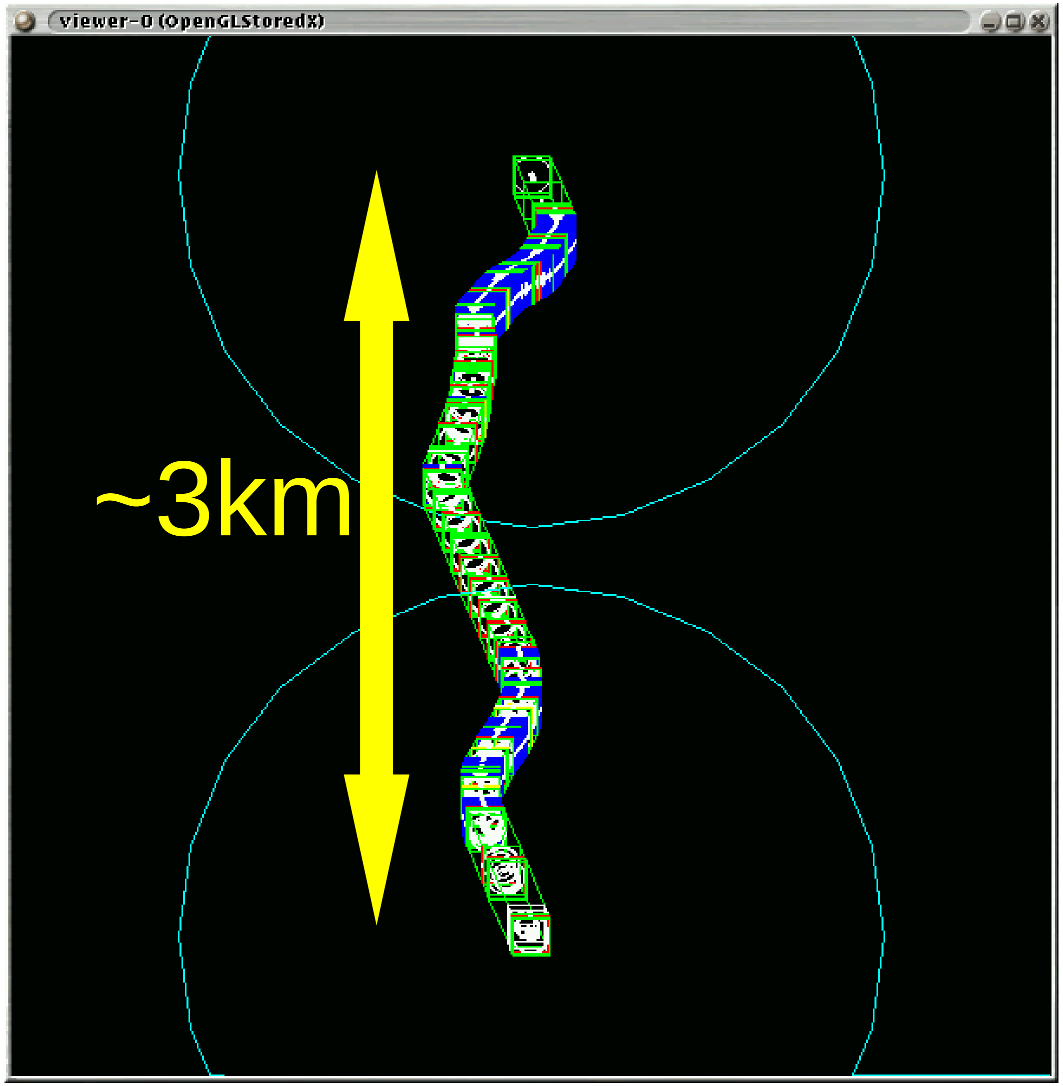
option, attribute=<attr_val>,...;

Element types:
marker,drift,
sbend,rbend,quadrupole,
sextupole,octupole,
solenoid,multipole,
coord_transform, rcol, ecol,
element

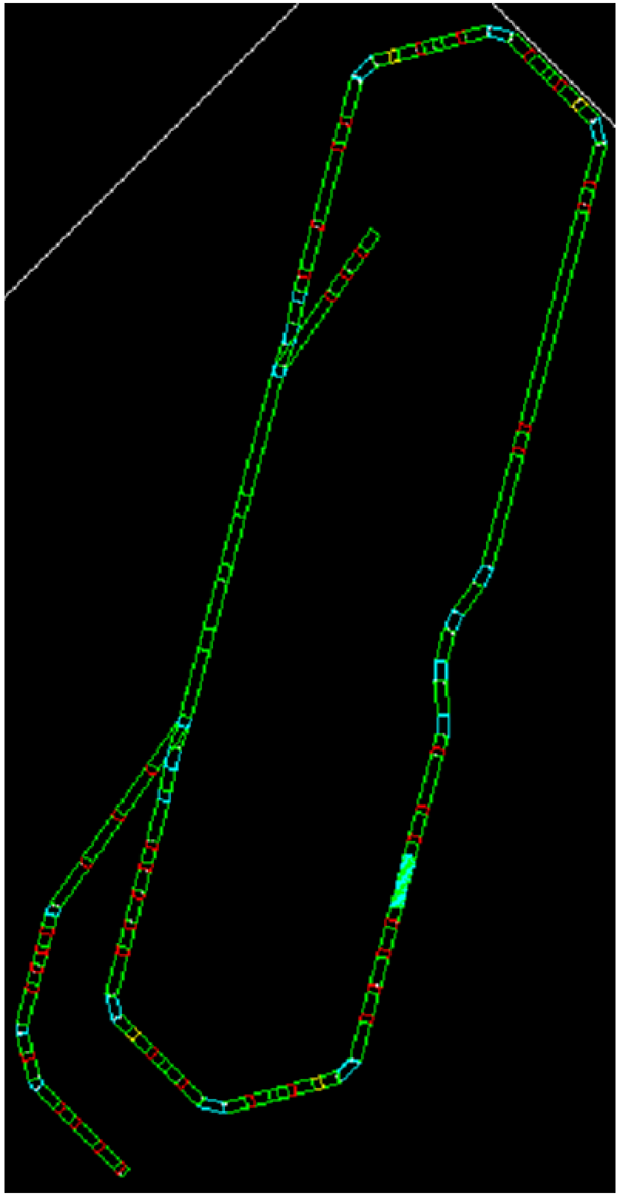
Commands:
use, gas, beam, sample

BDSIM Examples

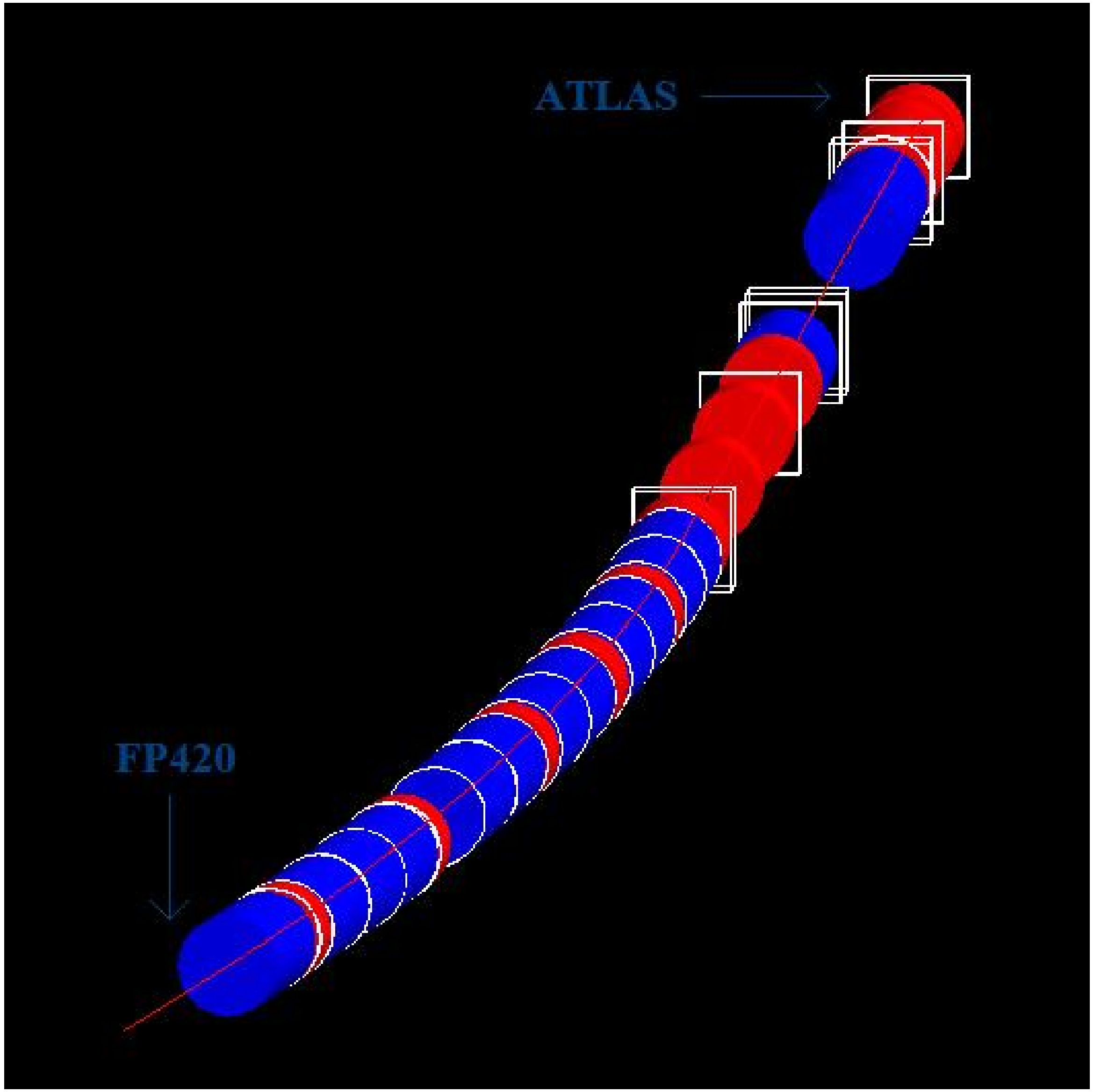
ILC Beam Delivery System



Energy Recovery Linac Prototype



Also being used at LHC

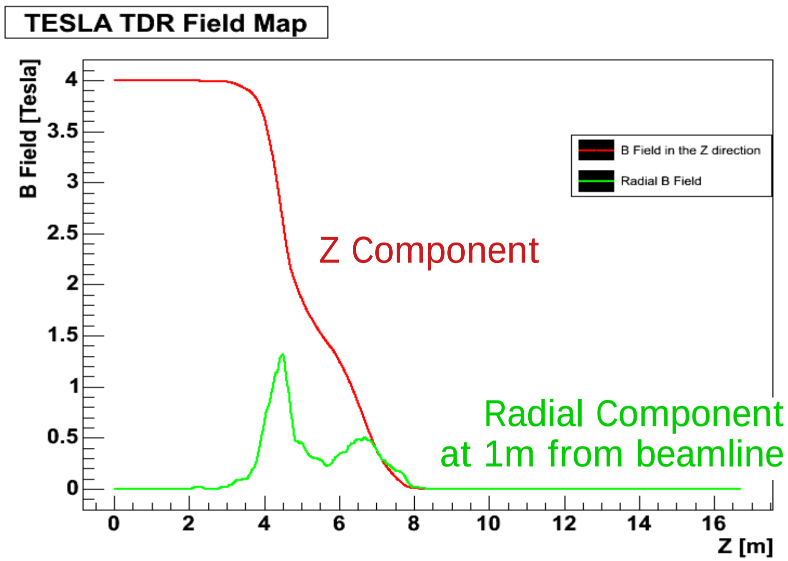


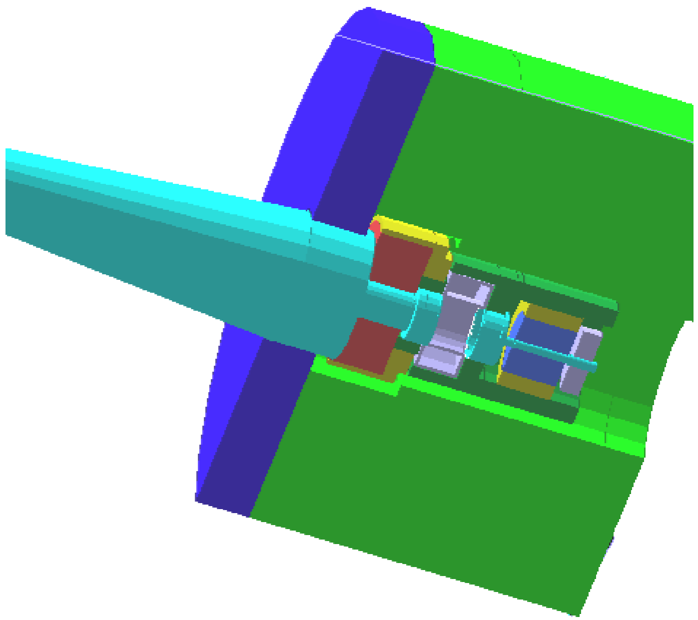
R. Appleby
G. Sellers

Interaction Region in BDSIM

- Full IR Geometry modelled in BDSIM
- Using MySQL geometry database
- Currently using the “Stahl” design for L* = 4.1m
- Includes a full Solenoid Field Map

  Choose from TESLA, GLD, or SiD fields





Screenshot of an IR Design in BDSIM

MySQL Format

- Typical Example of MySQL dumped output used by both BDSIM and Mokka
  - This could be parsed in ‘offline mode’
  - Accessed directly by Client/Server MySQL server structure
- Creating a complex structure by defining multiple solids
  - Specifying dimensions, positioning, materials - and can be extended to any properties needed, such as field strengths for magnets

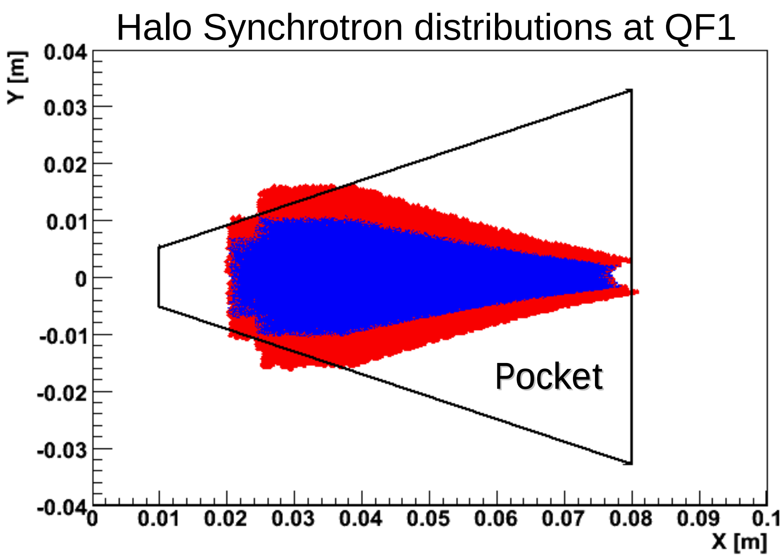
```
CREATE TABLE tungsten (
   zStart        DOUBLE(10,3),
   zEnd          DOUBLE(10,3),
   rInnerStart   DOUBLE(10,3),
   rInnerEnd     DOUBLE(10,3),
   rOuterStart   DOUBLE(10,3),
   rOuterEnd     DOUBLE(10,3),
   material      VARCHAR(32),
   name          VARCHAR(32)
);
# between LumCal and pump
INSERT INTO tungsten VALUES (3250.0, 3340.0, 110.0, 110.0, 160.0, 160.0, "Tungsten", "");
# shield around pump
INSERT INTO tungsten VALUES (3340.0, 3510.0, 210.0, 210.0, 250.0, 250.0, "Tungsten", "");
# shield behind pump
INSERT INTO tungsten VALUES (3510.0, 3580.0, 100.0, 100.0, 250.0, 250.0, "Tungsten", "");
# main support tube
INSERT INTO tungsten VALUES (3580.0, 3960, 180.0, 180.0, 250.0, 250.0, "Tungsten", "");
```

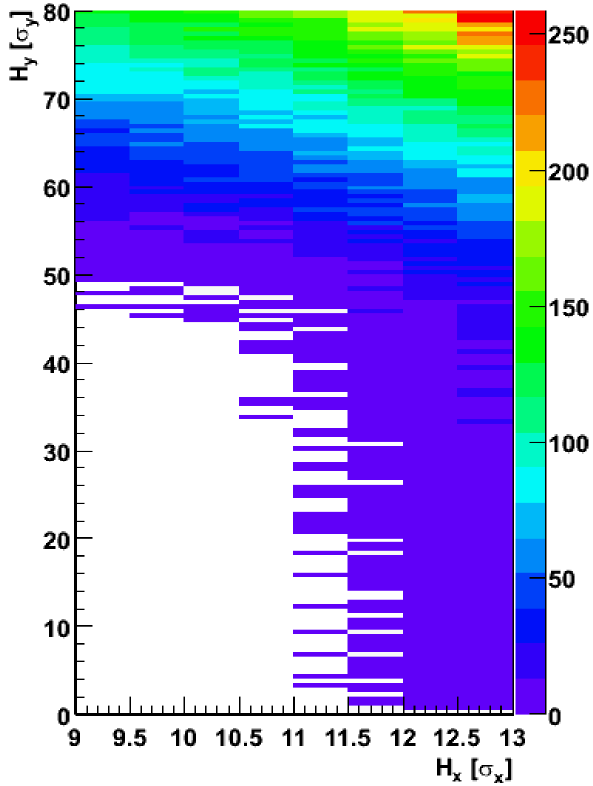
Halo Studies in the Interaction Region

- Track Halo electrons from the Final Doublet and Interaction Region
  - Also track associated Synchrotron Radiation
- Check Halo material passes all apertures

Nx = 9.0, Ny = 45

Nx = 9.0, Ny = 68





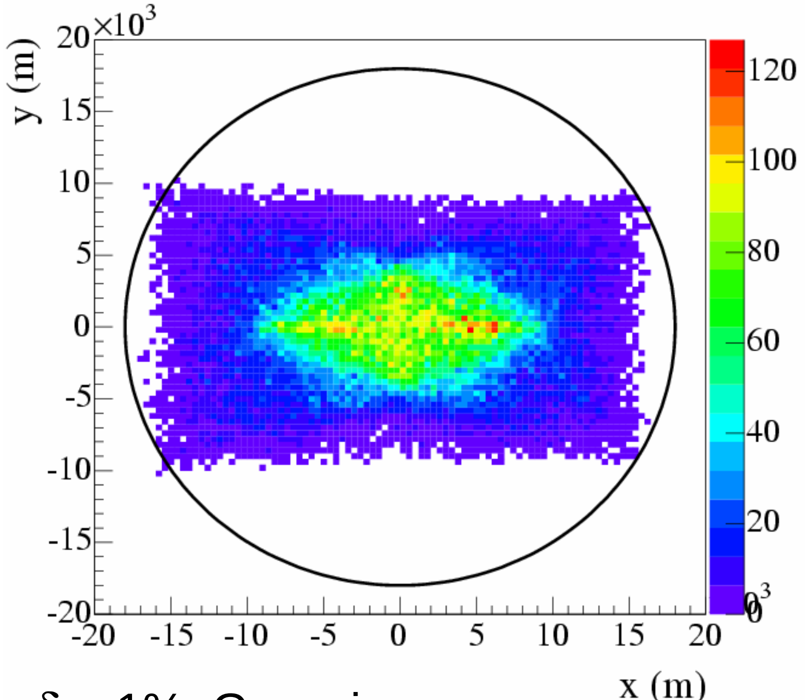
Units are numbers of sigma for collimation depth

J. Carter

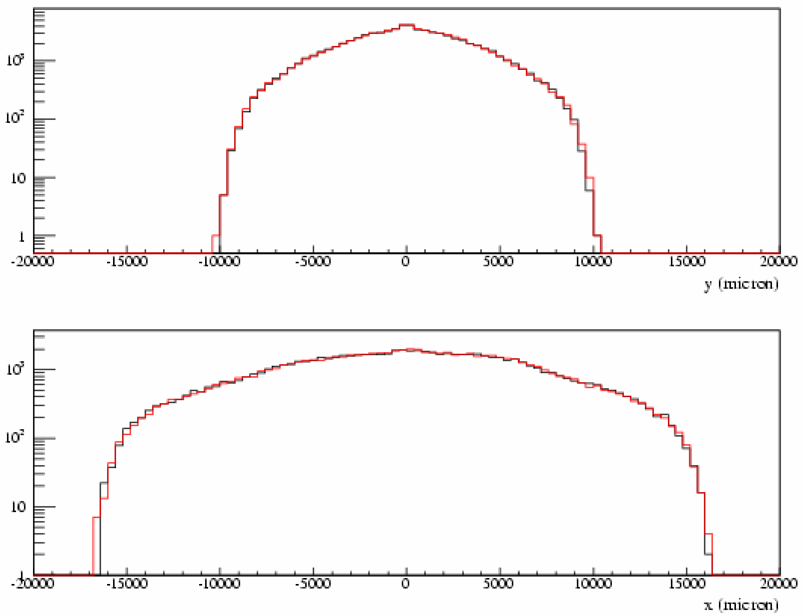
BDSIM cross check of collimation depths

- DBLT is linear on-energy envelope tracking
- BDSIM can track off-energy halo through FD

SR profile at 1st Extraction Quad (r=18mm)



δp=1%, Gaussian



On-energy, δp=1% Gaussian

F. Jackson, this meeting

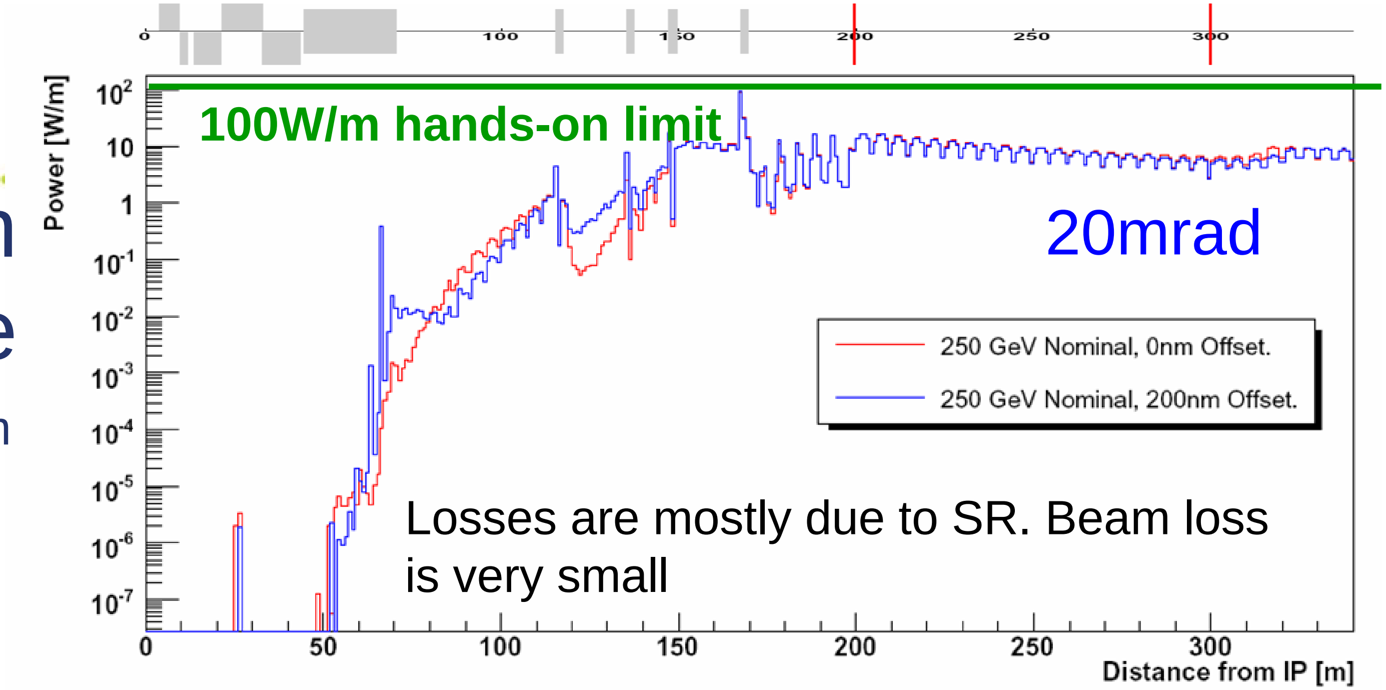
Losses in extraction line

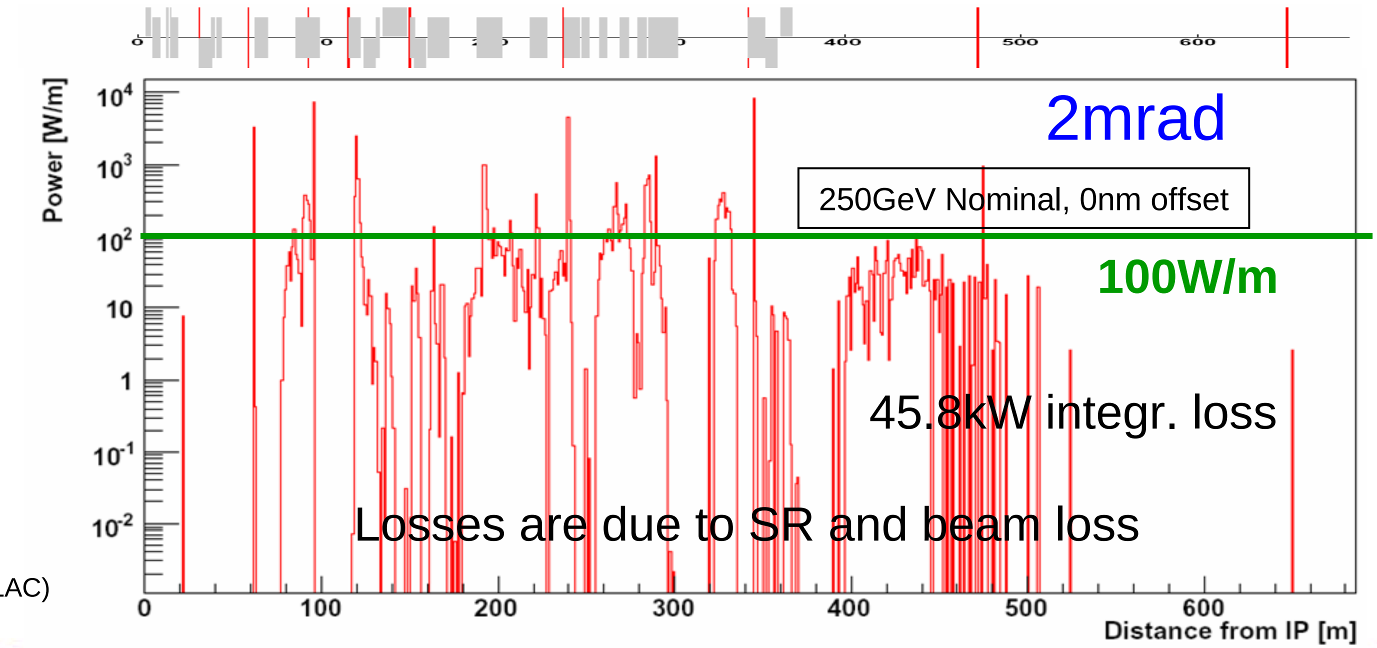
20mr: losses < 100W/m at 500GeV CM and 1TeV CM

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

Radiation conditions and shielding to be studied

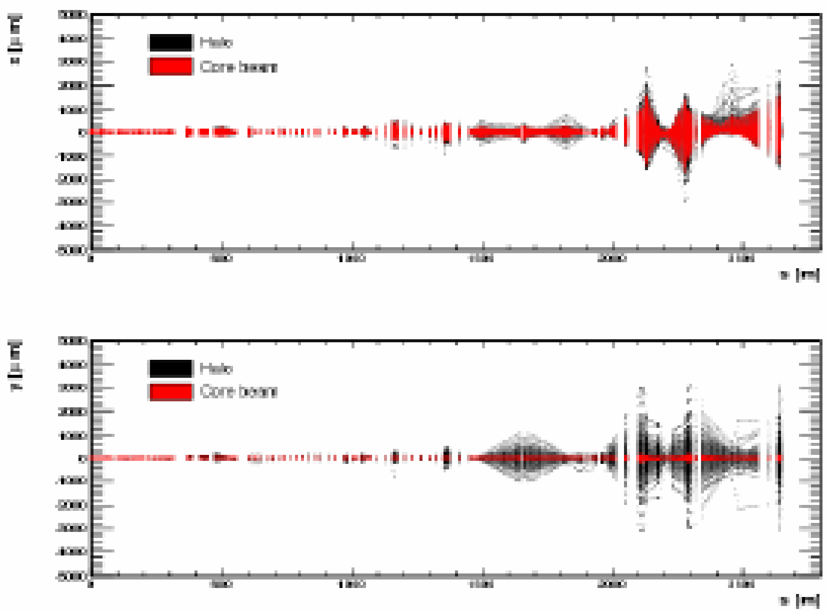
J. Carter, I. Agapov, G.A. Blair, L. Deacon (JAI/RHUL), A.I. Drozhdin, N.V. Mokhov (Fermilab), Y.M. Nosochkov, A.A. Seryi (SLAC)



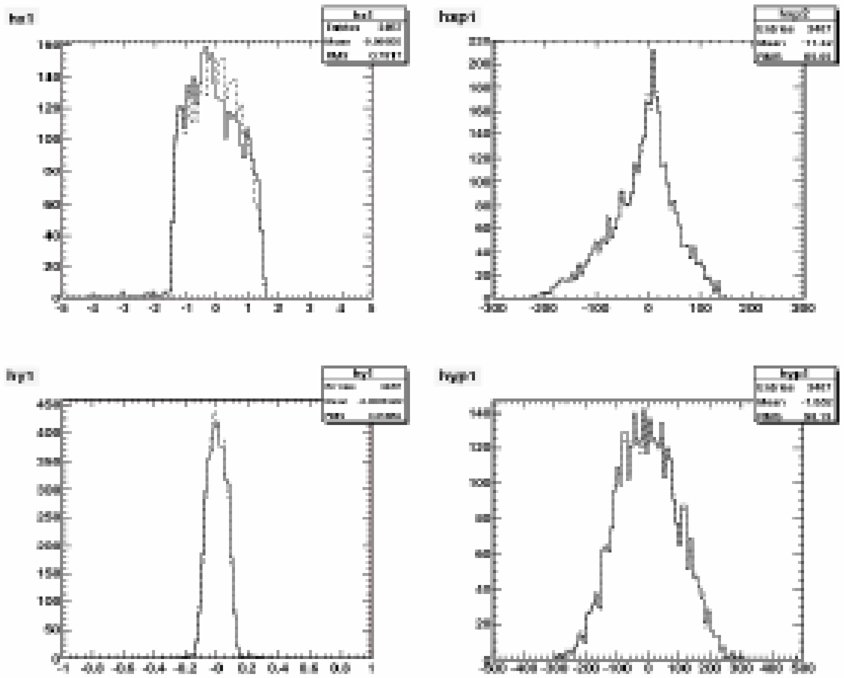


Particle process : Tools

- Standalone fast generators interfaced to Placet, Merlin
  - Beamgas
  - Tracking secondaries and losses



Beam-gas background tracking in ILC BDS



Flat halo distributions at IP after tracking placet vs BDSIM

BDSIM: Summary

- In 2006 the beta-testing of BDSIM was complete and the first release (v.0.1) followed in February. The BDSIM user's guide was published EUROTeV-Report-2006-014, "The BDSIM Toolkit".
- The extension to the xsif format, which allows more detailed accelerator component geometry descriptions, was developed and the corresponding module included in the distribution

  GMAD, EUROTeV-Memo-2006-003-1.
- BDSIM was used extensively for the ILC BDS simulations. Benchmarking tests were performed for particle tracking, electromagnetic and hadronic physics processes. The BDSIM distribution was deployed on the GRID to increase the performance. These developments were

  presented at EPAC 2006 "BDSIM – Beamline Simulation Toolkit Based on GEANT4", EUROTeV-Report-2006-035).

BDSIM: Summary/Future Plans

The results for the ILC collimation system and extraction lines were checked against MARS and STRUCT simulations and published

Simulation of the ILC Collimation System Using BDSIM, MARS15 and STRUCT EUROTeV-Report-2006-48.

At present BDSIM is used for various ILC BDS applications, LHC, Cornell ERL.

We expect that over the next year the development emphasis will be on the implementation of beam gas scattering (HTGen) and wakefields.