BDSIM
Beam Delivery Simulator
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BDSIM

- Simulation of particle transport in accelerator beam lines
- Use mad style syntax to define beam line
- Library of generic component geometries
- Use Geant4 for particle matter interactions
- Interface for ROOT analysis
- Visualisation
- Simulate beam losses
- Simulate propagation of secondaries etc.

The magnetic field in the material of the magnets is calculated as follows. The field at the pole-tips is
\[ B = \frac{1}{\mu_0} \frac{Q}{r} \]
where \( B \) is the magnetic field at the pole-tip, \( \mu_0 \) is the permeability of free space, \( Q \) is the
charge of the magnet, and \( r \) is the distance from the pole-tip.

Step length

The tracking performance was tested with a 20 k normal particle set through the long (6 km) CLET1.5 TeV-
per-beam. The results agree very well with the other tracking codes described in Ref. [2], with the possible
exceptions of tracking with synchrotron radiation (S) and collimation. The RMS spot size is very dependent on the
details of the treatment of SR and the RMS spot size is very dependent on the details of the tracking code.

Element Classes

- BDSQuadrupole
- BDSCollimator
- .......

Physics Processes

- eBremsstrahlung
- Transportation
- .......

"Steppers"

- Stepper
- .......
mybeamline.gmad

q1: quadrupole, l=0.1, k1=3.87;
dr1: drift, l=0.5;
dr2: drift, l=0.5;
all: line = (dr1, q1, dr2);

beam, particle=“e-”,
energy=1.3 * GeV,
distrType=“Gauss”,
sigmaX=0.002*mm,
sigmaY=0.002*mm,
sigmaXp=0.01*0.005,
sigmaYp=0.01*0.004;

use, period=all;
Example Workflow

- MADX TFS file
- python script
- GMAD (BDSIM) beam line
  - options
  - energy
  - aperture
  - physics lists
  - input beam
- input file .gmad
- (optional -> use generic components)
- Geometry DB
- Collimator settings / DB
- in future
Results Using BDSIM

• Tracking studies of CLIC collimation system\textsuperscript{[1]}
• Simulation of CLIC beam delivery system\textsuperscript{[2]}
• Halo estimates for linear colliders\textsuperscript{[3]}
• Simulation of the ILC\textsuperscript{[4]}
• Muon background reduction in CLIC\textsuperscript{[5]}
• Studies of ATF & ATF2 laserwire
• Laserwire for ILC / CLIC beam delivery system\textsuperscript{[6]}

\textsuperscript{[1]} I.Agapov, PRSTAB 12, 081001 (2009)
\textsuperscript{[2]} G.A.Blair, CERN-OPEN-2002-057
\textsuperscript{[3]} H.Burkhardt, PAC07 WEOCC03
\textsuperscript{[4]} J.Carter, Pramana 69, 6, 1133-1136 (2007)
\textsuperscript{[5]} L.Deacon, arXiv:1202.6628v1
\textsuperscript{[6]} L.Deacon, EPAC08 TUPC005
Previous Results

- CLIC beam delivery system

- Wakefields generated using an interface to PLACET

I. Agapov et.al PR-STAB 12, 081001 (2009).
Application to the LHC

- Track particles in ring for multi-turn distribution
- Generation and propagation of secondaries
- Fairly generic geometry
- Generate loss maps
- Generate background distributions for detectors

Similarly for Hi Lumi LHC

- Collimator studies
- Beam loss maps
- Beam background in detectors
LHC Lattice

- Successfully constructed using generic components
- ~100um mismatch between start and finish
Visualisations
Example Phase Space
Tracking in the LHC
Tracking in the LHC 2
Roadmap

- Aim to reproduce current studies for comparison
- Studies in parallel
- Two areas to compare:
  - tracking – SixTrack
  - energy deposition – FLUKA
Code Roadmap

• Optics – symplectic integration schemes
• Geometry
  — LHC specific – import FLUKA geometry?
  — aperture / beam pipe factory
• Collimators
  — interface to collimator db / settings
• Develop interfaces:
  — BDSIM tracking -> FLUKA
  — SixTrack tracking -> BDSIM
• Many internal updates required and underway
  — closed ring geometry vs linear
  — geometry imports
Thank you