Update on the Status of BDSIM

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On behalf of:

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Anyone else I've forgotten…

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LCWS07

BDSIM

- What it is

- What it does

- What it looks like

- What we're making it do now

- What it should do in the future

BDSIM is …

- **An extension to the Geant4 toolkit**
  - Physics lists can be loaded from G4
  - Additional processes can also be added
- **A geometry builder**
  - gmad file parser
  - Mokka as external driver
  - Each element described as a C++ class
- **A fast particle tracker**
 - Each element has its own stepper process
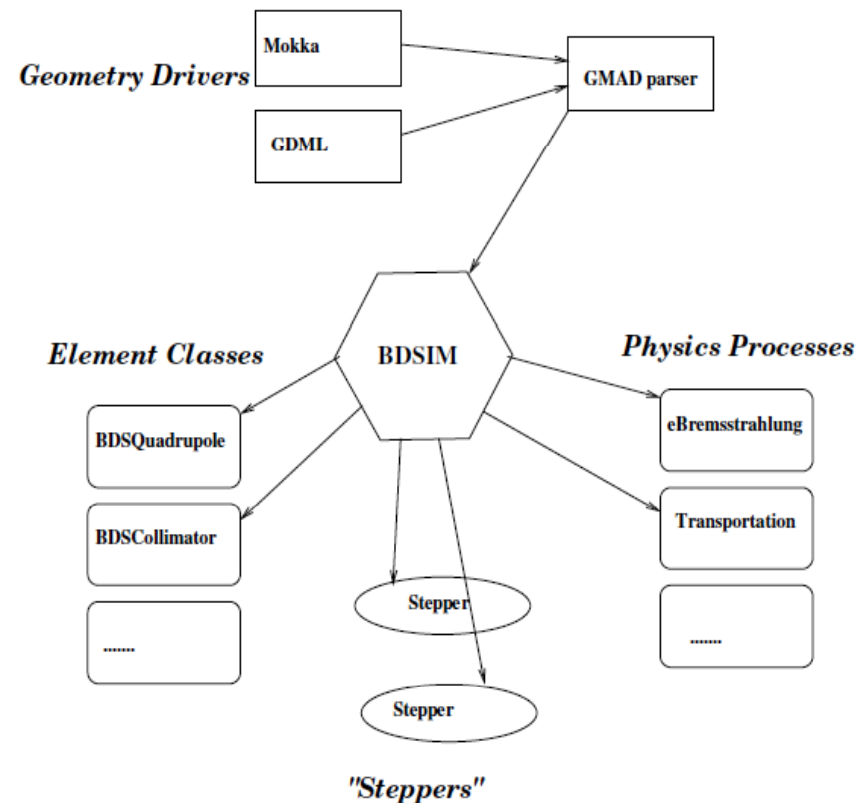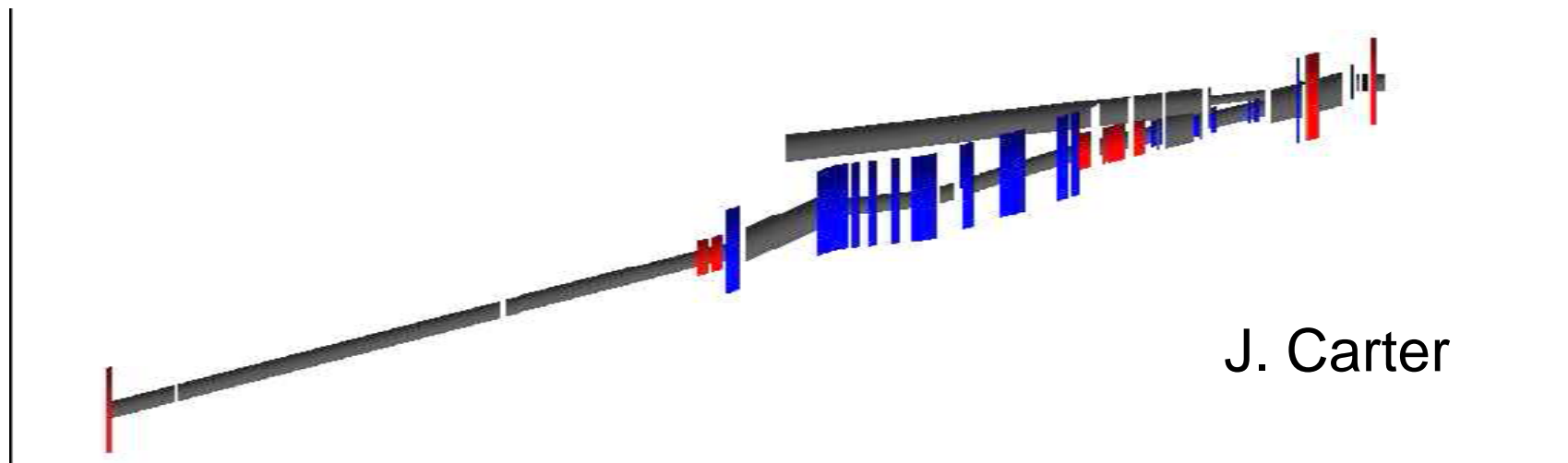
BDSIM does …

- **Transportation of primary particles**
  - Analytical solution to equation of motion used where one exists
  - Runge-Kutta elsewhere

- **Automatic generation and tracking of secondary particles**
  - Dependent on the loaded physics lists

- **Automatic switching between fast tracking in vacuum and Geant4 tracking in material**
  - Speeds up tracking inside beam pipe
  - Allows full generation of secondary particles elsewhere

- **Logging of energy deposition in beamline elements**
  - Beam losses, synchrotron radiation, spoilers, etc

- **Optional sampling of particle distribution at chosen beamline elements**
  - Good for benchmarking tracking against other codes

BDSIM looks like …

- v 0.1 - wireframe logical volumes

- v 0.3 - solid physical descriptions

- Batch mode also available (no visualisation)

Geometry Building
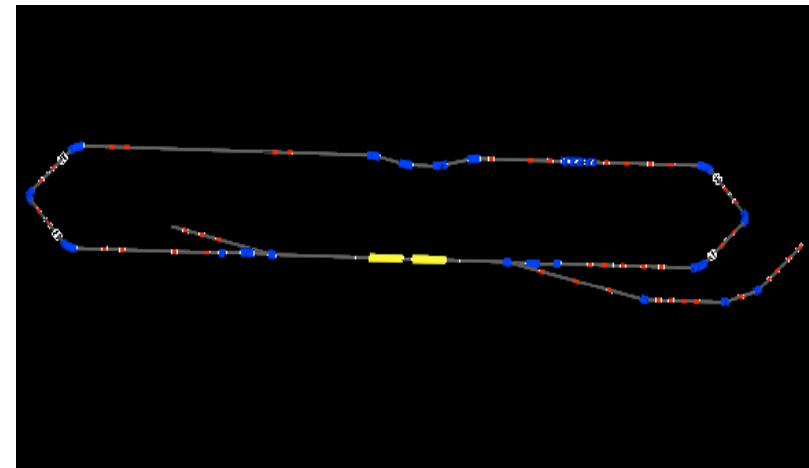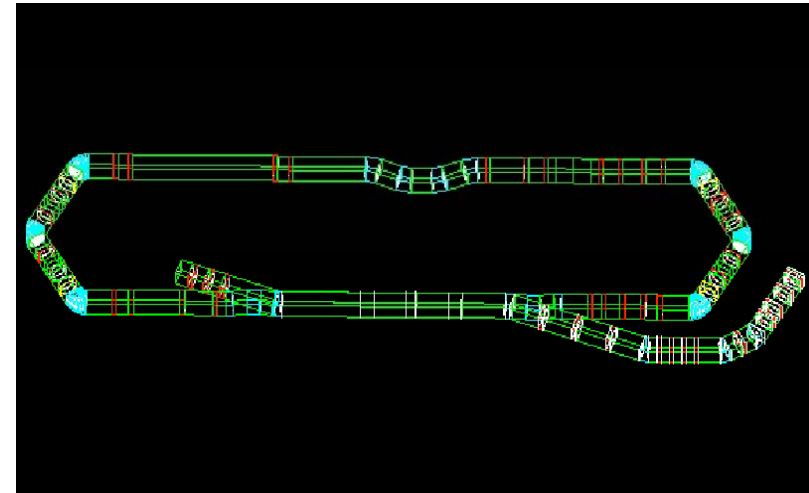
- SQL or GMAD description allows for insertion of arbitrary definition of 3D beamlines and elements
- Also overlay arbitrary magnetic field descriptions

J. Carter

GMAD example

- Script included in BDSIM distribution to convert MAD to GMAD
  - Deals with most unavailable elements
  - (Needs tweaking)

- Doesn't handle MADX pattern recognition

  eg: ECOLHCEL(B01, SX, SY, SPOILER): LINE=(…)

```
qd : quadrupole,l=0.5 * m, k1 = qdk1;
qf : quadrupole,l=0.5 *m, k1 = qfk1;
d  : drift,l=2*m;
dt : drift, l=3*m, tilt = pi/4;
sex: sextupole, l=1 * m, k2 = 10;
sbvu : sbend, l=2*m, angle=pi/7, tilt=pi/2;
sbvd : sbend, l=2*m, angle=pi/7, tilt=pi;
sbvr : sbend, l=2*m, angle=pi/7, tilt=0;
sb1 : sbend, l=2*m, angle=pi/7;
td: transform3d, z=0,phi=pi/4;
td1 : transform3d, theta=-pi/3;
td2 : transform3d, theta=pi/3;
vrot : transform3d, psi=pi/2;
ivrot : transform3d, psi=pi;
! method 1 - using coordinate transformations
test1:line=(d,vrot,sb1,d,ivrot,sb1,d,sb1,d,ivrot,sb1,d);
```
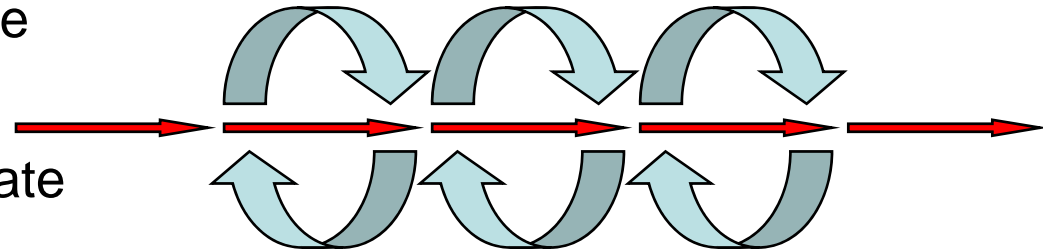
Wakefields

- **BDSIM tracks single particles**
  - Generates secondary particles
  - Cannot calculate wakefield kicks

- **Placet tracks bunch slices**
  - Calculates wakefield kicks
 - Cannot generate secondary particles

Combination:
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Daniel Schulte (CERN)
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The Idea

- Main beam tracking in BDSIM

- At collimators and spoilers bunch is held on stack

- Bunch is passed to Placet and tracked to calculate wakefield kicks

- Placet passes appropiate kicks to BDSIM

- BDSIM restarts at held position and applies kicks

- Repeat through wakefield region and then continue standard tracking

The Reality

- Main beam tracking in BDSIM

- At **DUMP** sensitive volume, particles are postponed until final event

- Bunch data is piped to Placet, which tracks through the element and calculates wakefield kicks

- Placet passes appropiate kicks and bunch data back to BDSIM

- BDSIM exits
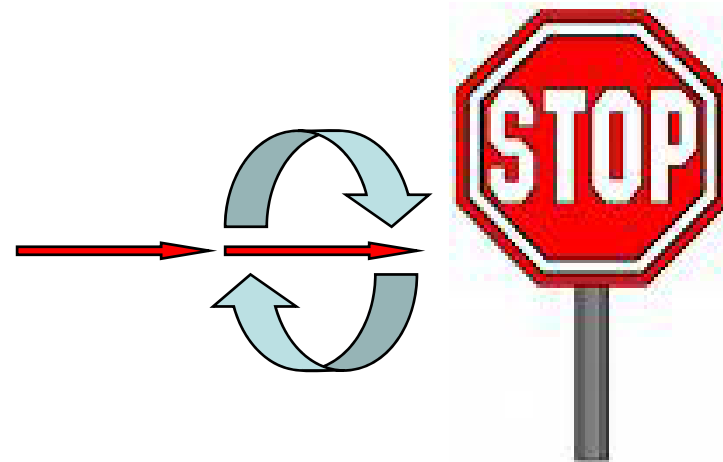
WORK ONGOING

Beam Gas

- BDSIM reverts to GEANT-based tracking when material is non-vacuum
  - Introducing beam gas is a problem

- Several methods under investigation
  - Thin, dense beam gas plug?
    - Need to randomise location at each step of tracking
  - Large interactions file?
    - Determine mean free path from gas density profile

- Need to avoid beam absorption losses
  - Replace interacting particle on stack with identical particle that has same initial parameters?

"To Do" List

- Interactive pan and zoom

- Realistic magnet geometries

- Material descriptions input from gmad file

- Mad2gmad script update

- XML geometry input

- Polarisation tracking

- Better output data
  - Energy deposition by element?
  - Activation and dosimetry?

- Update to gcc4.0, CLHEP2.0.x.x and G4.8.3?

- Anything else? Taking requests …

Further details

- http://ilc.pp.rhul.ac.uk/bdsim.html

- http://cvs.pp.rhul.ac.uk

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