BDSIM

Beam Delivery Simulator

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BDSIM

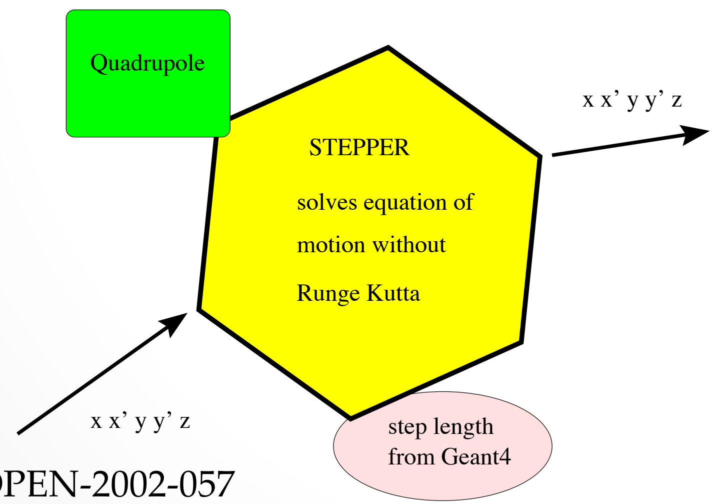
- Simulation of particle transport in accelerator beam lines
- Use mad style syntax to define beam line
- Library of generic component geometries
- Use Geant4 for particle matter interactions
- Interface for ROOT analysis
- Visualisation

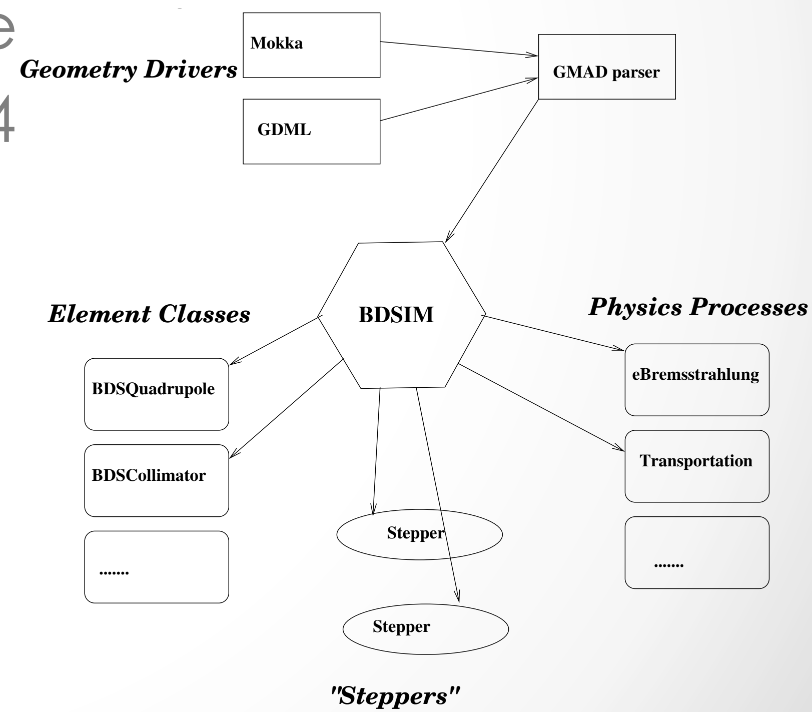
- Simulate beam losses
- Simulate propagation of secondaries etc.

I. Agapov, G. A. Blair, and J. Carter, The BDSIM Toolkit (2006), pp. 1–34. EUROTeV-Report-2006-014-1

Features

- Parser for easy construction of beam lines
- Classes for typical accelerator components
- Physics processes for fast tracking
- On-the-fly geometry construction
- GMDL & SQL detector database
- Physics updates through Geant4





G.A.Blair CERN-OPEN-2002-057

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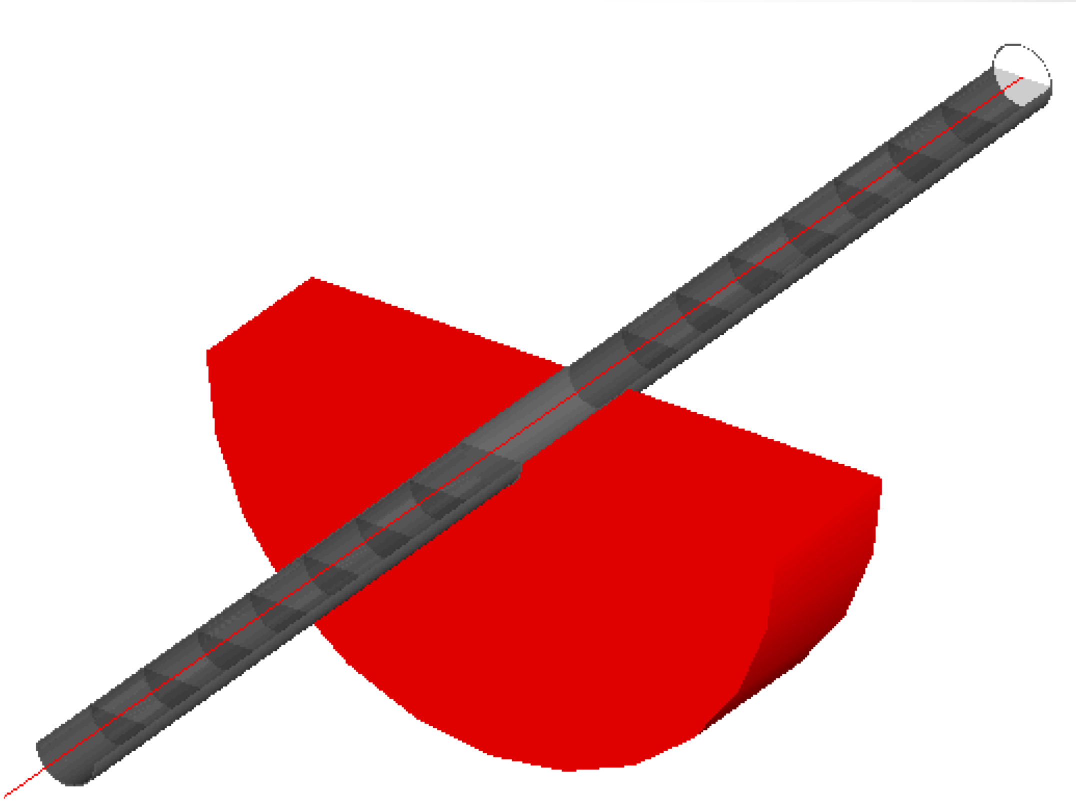
BDSIM – Basic Example

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;
```



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Example Workflow

MADX
TFS file

python script →

GMAD (BDSIM)
beam line

options
- energy
- aperture
- physics lists
- input beam

(optional -> use generic components)

Geometry DB

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in future

Collimator
settings / DB

input file
.gmad

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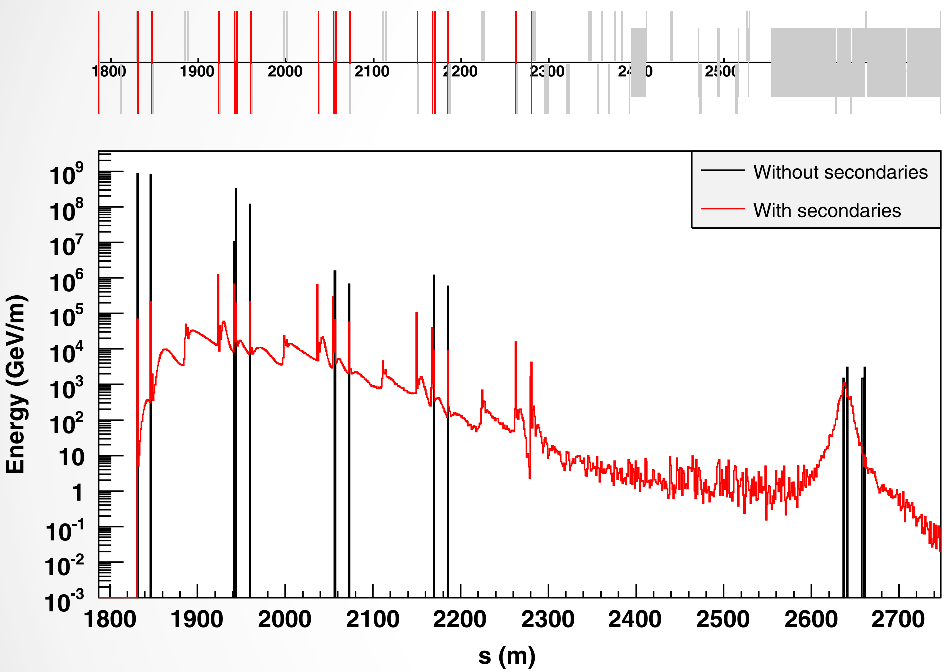
Results Using BDSIM

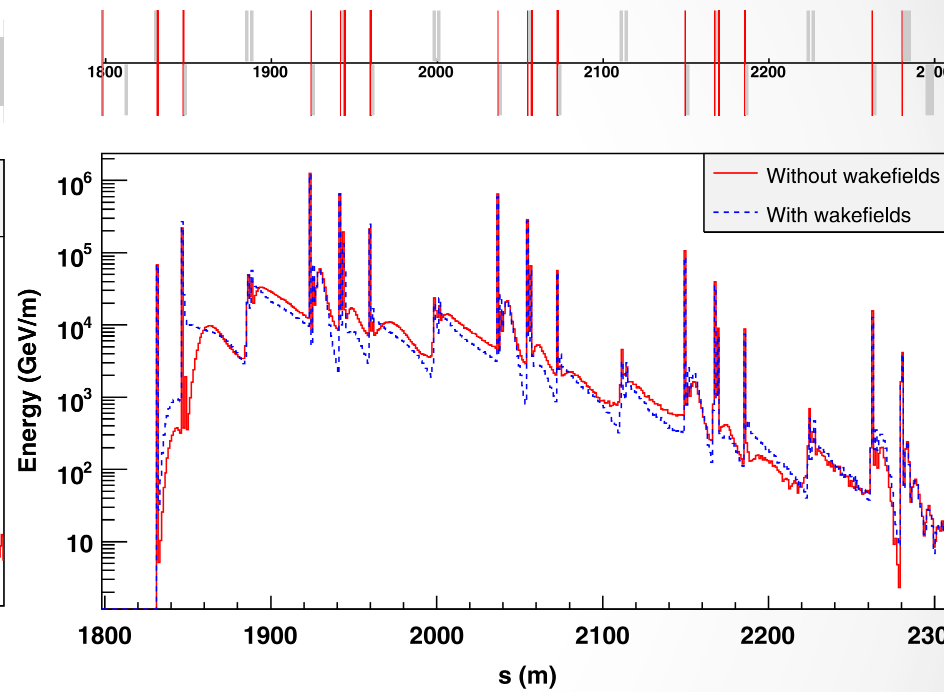
- Tracking studies of CLIC collimation system[1]
- Simulation of CLIC beam delivery system[2]
- Halo estimates for linear colliders[3]
- Simulation of the ILC[4]
- Muon background reduction in CLIC[5]
- Studies of ATF & ATF2 laserwire
- Laserwire for ILC / CLIC beam delivery system[6]

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

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Application to the LHC

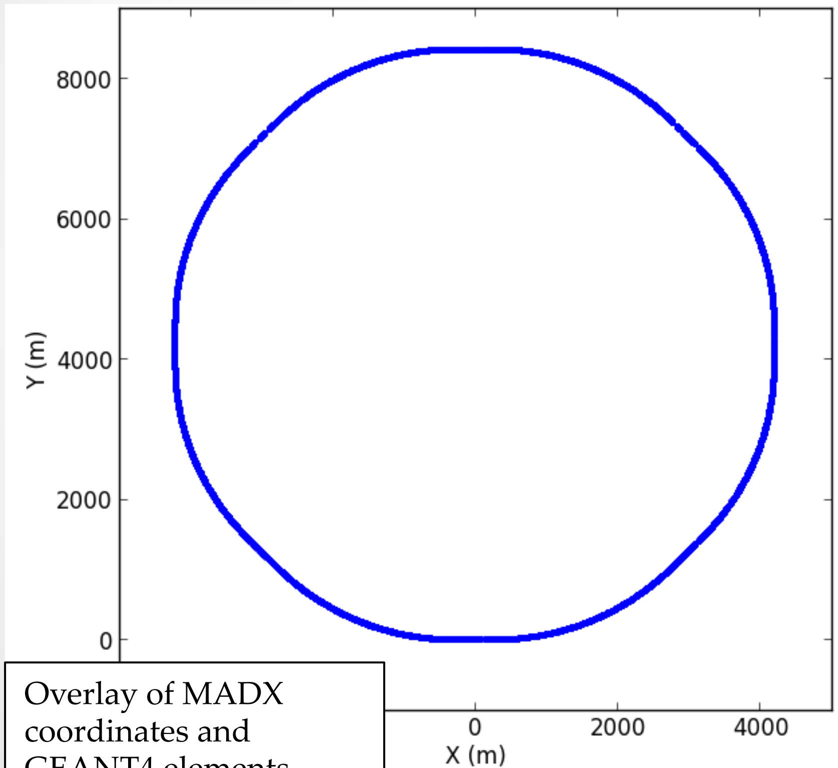
- Track particles in ring for multi-turn distribution
- Generation and propagation of secondaries
- Fairly generic geometry
- Generate loss maps
- Generate background distributions for detectors

Similarly for Hi Lumi LHC

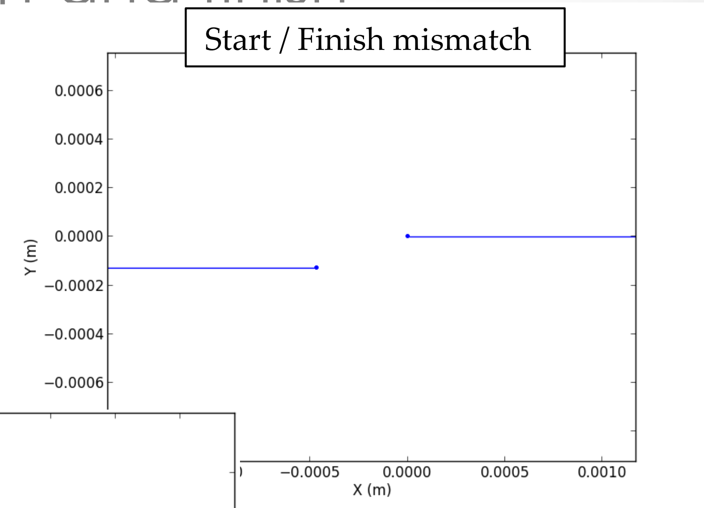
- Collimator studies
- Beam loss maps
- Beam background in detectors

LHC Lattice

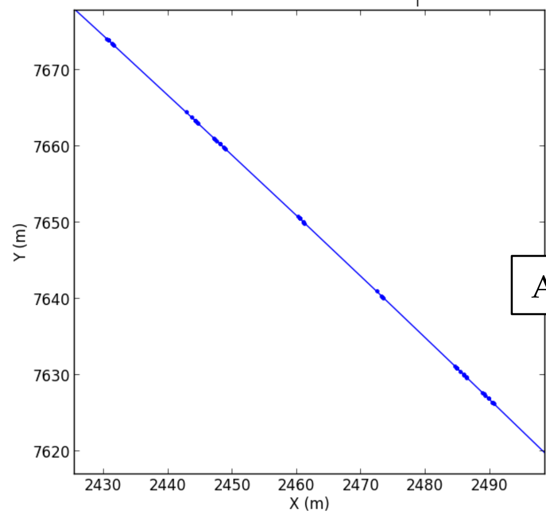
- Successfully constructed using generic components
- ~100um mismatch between start and finish



Overlay of MADX coordinates and GEANT4 elements



Start / Finish mismatch



Arc section

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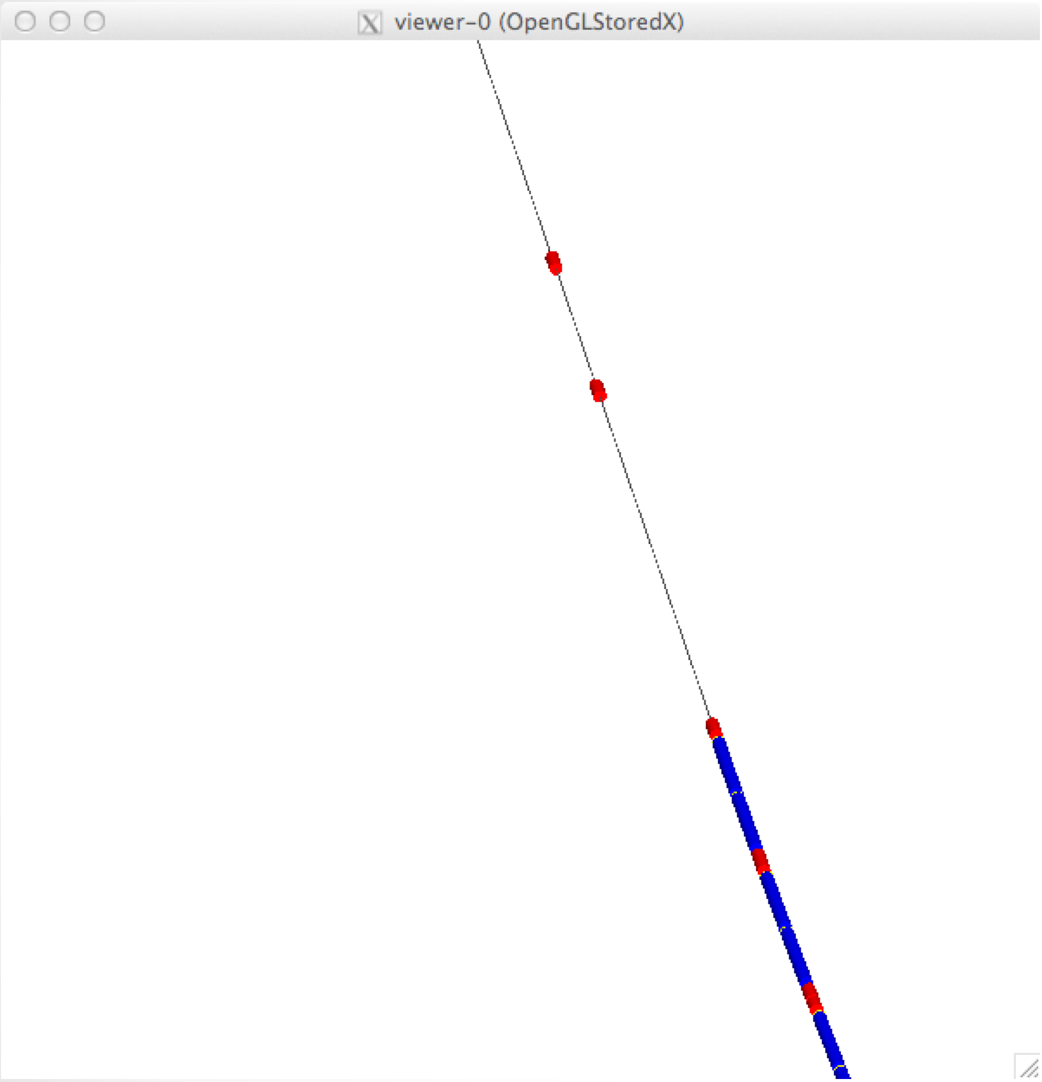
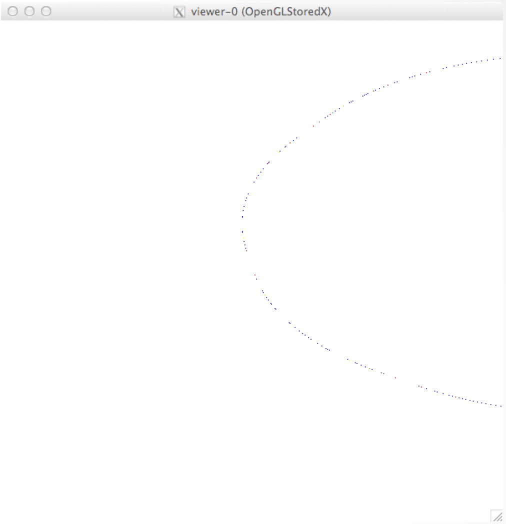
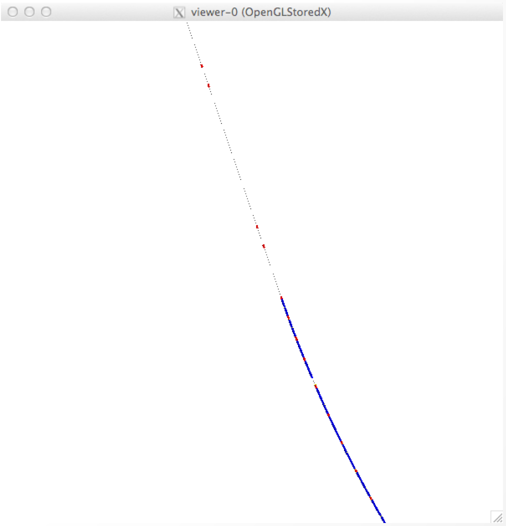
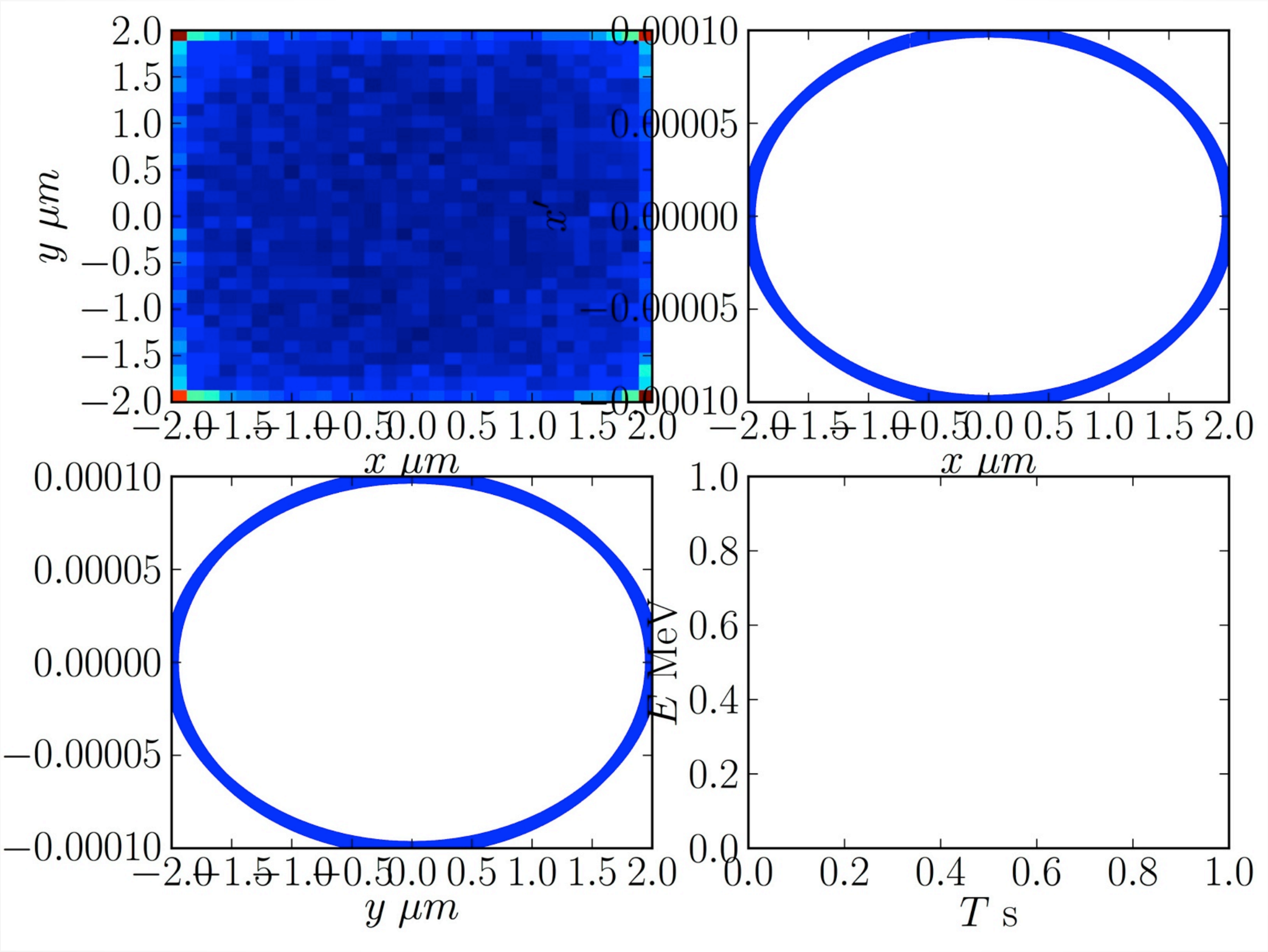
Visualisations



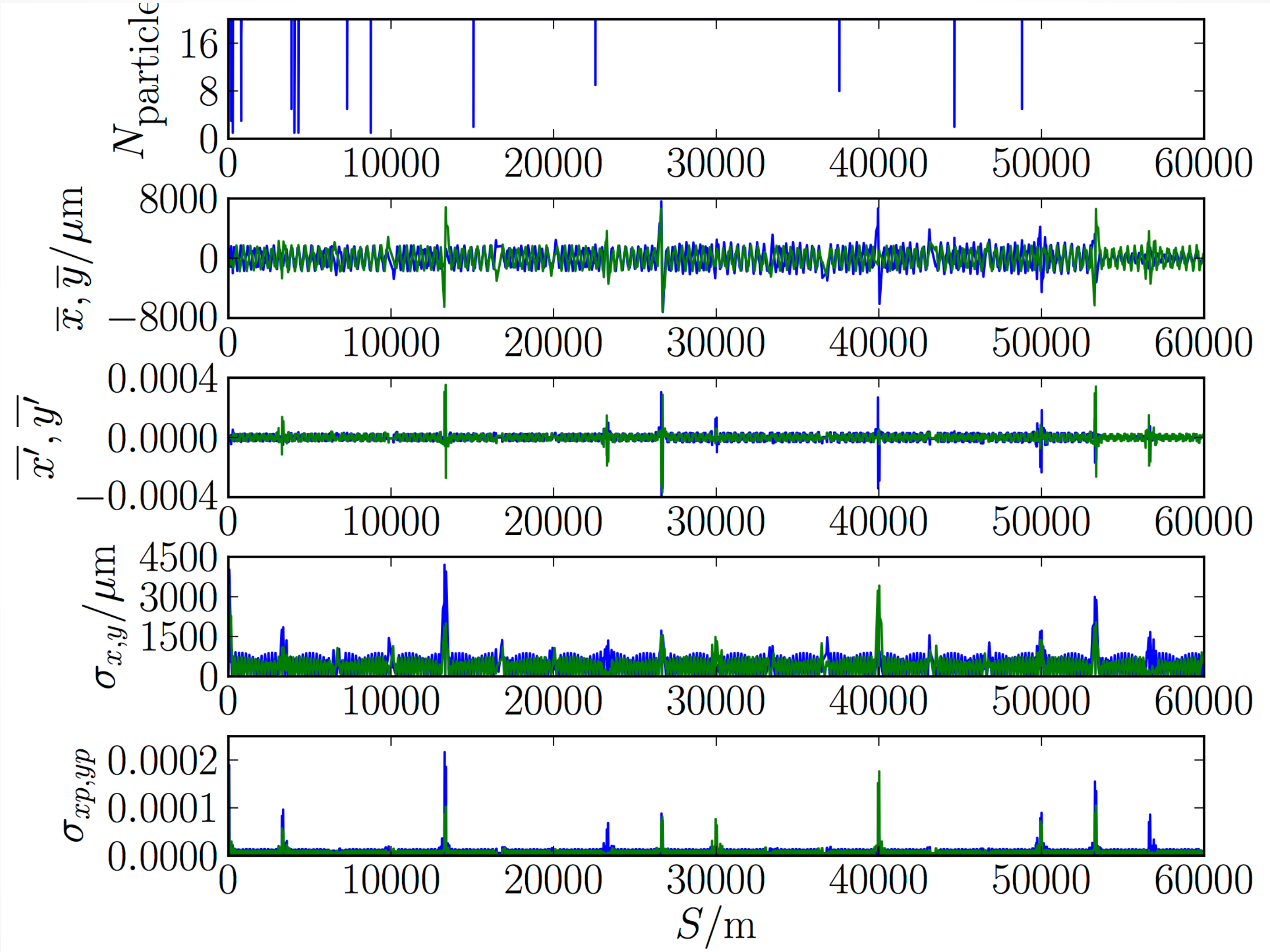




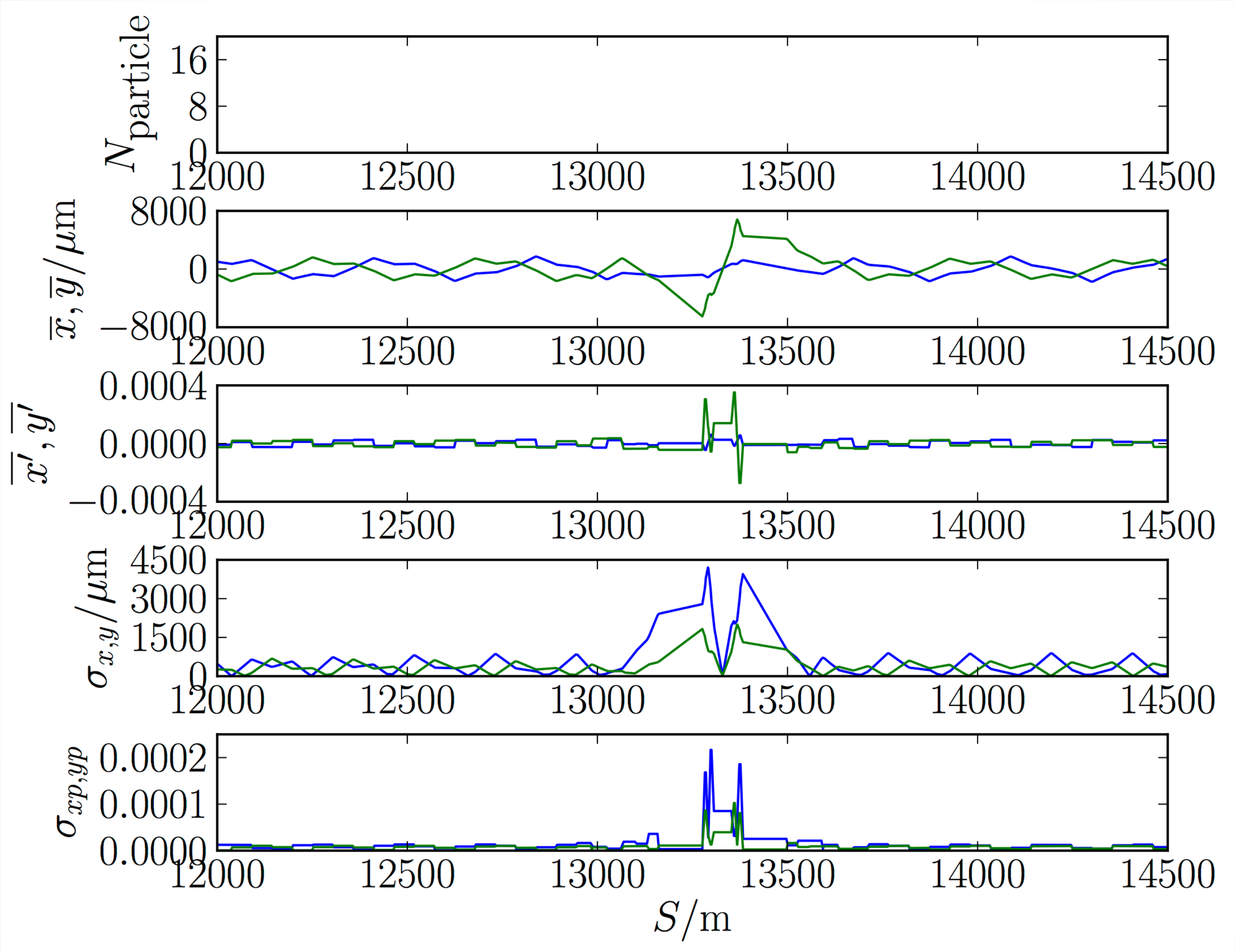
Example Phase Space



Tracking in the LHC



Tracking in the LHC 2



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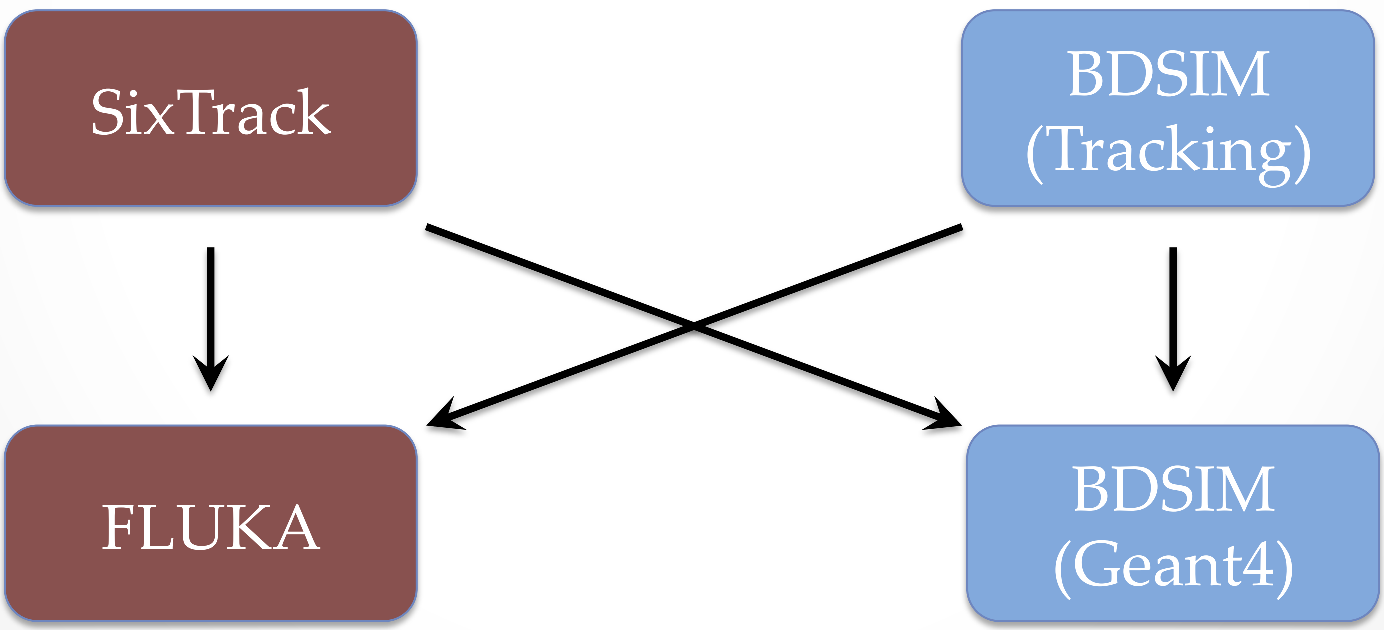
Roadmap

- 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