Report from Accelerator Applications

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Accelerator Applications

- Small (medical) accelerators
- High Energy accelerators
  - Collimation
  - Backgrounds
  - Beam diagnostics
  - Beam dumps

Requirements

- Long beamlines with few places requiring detailed modelling
- High intensity beams, only small portion of them interact with matter
- Fast tracking
- “On the fly” geometry construction
- Most of high energy physics processes, mainly EM showers, photon, e+/e-, muon and neutron transport
- Variance reduction
- Activation calculations

Example application - BDSIM

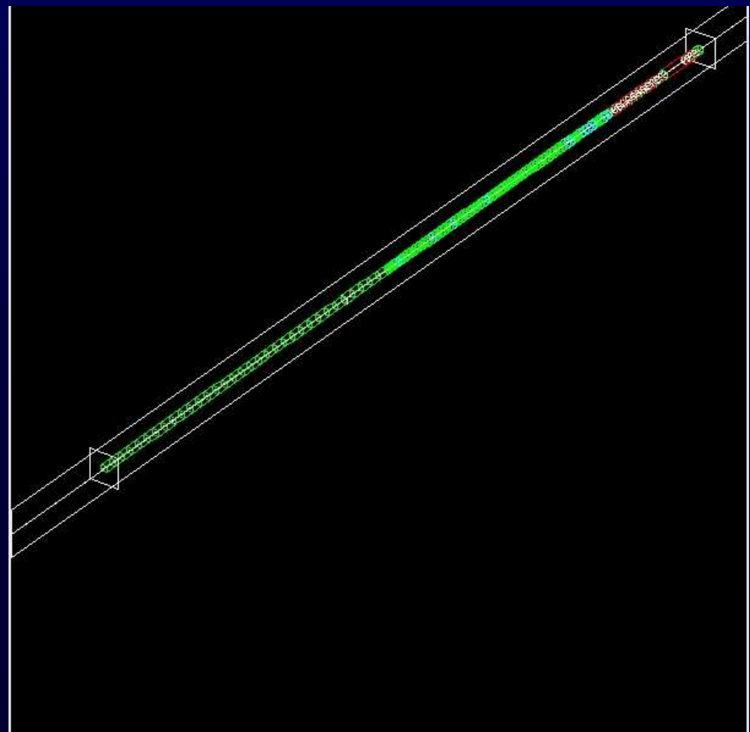
- I will try to illustrate how we address these issues with BDSIM
- BDSIM is a toolkit for beamline studies based on G4
- Set of predefined entities (magnets, collimators etc.)
- Some physics processes
- Tracking
- ASCII and ROOT output
- http://cvs.pp.rhul.ac.uk

Tasks

- Collimation in ILC
- Laserwire beam diagnostics in ATF, ILC,…
- Beam extraction and dumps for ILC
- Now I will cover issues that arise…

Geometry construction

- Set of predefined classes – quadrupoles, bends,etc.
- 3d beamlines
- up to 2-3 km long
- IR, diagnostics section - detailed
- Accelerator description language



GMAD

- MAD (CERN) is an industry standard for beamline optics studies
- MAD mostly defines transport properties (bending angles, multipole coefficients etc.)
- GMAD is a MAD extension allowing specification of element geometries, materials, beam parameters and physics lists.

GMAD example

```
qdk1=0.5;
qfk1=-0.4;

qd : quadrupole,l=0.5 * m, k1 = qdk1;
qf : quadrupole,l=0.5 *m, k1 = qfk1,tilt=pi/4;
d  : drift,l=2*m;

test:line=(qd,d,qf,d);

use,period=test;

beam,  particle=“e-”,energy=10.0 *GeV, nparticles=1e+3,distrType="gauss",sigmaX=0.1;

option, ngenerate=100, turnInteractions=1, useEMHadronic=0;
```

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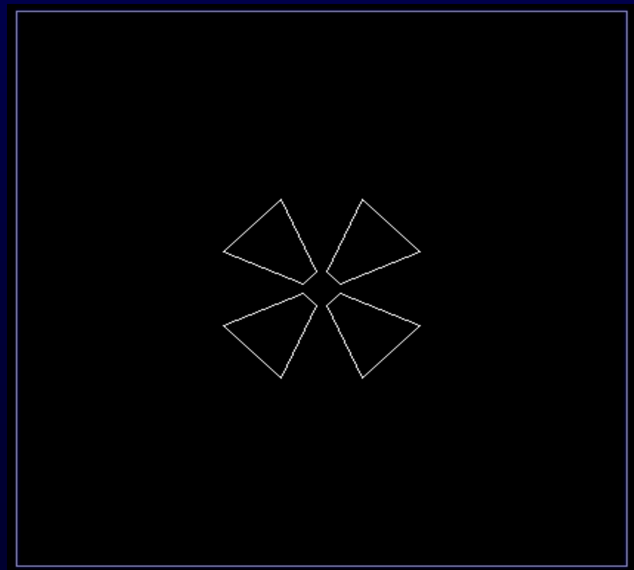
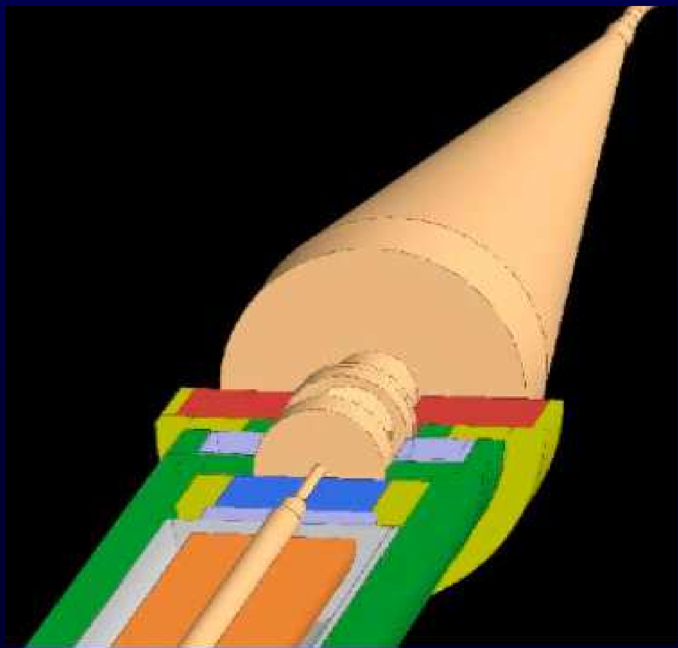
Drivers

- More complex objects can be constructed
- Geant-like Geometry description
  - Simple geometries
  - Field maps
- Mokka (ILC detector description standard), SQL-based
- Example – final focus magnet
- Hard to define geometry + field coherently
- Need some CAD tool

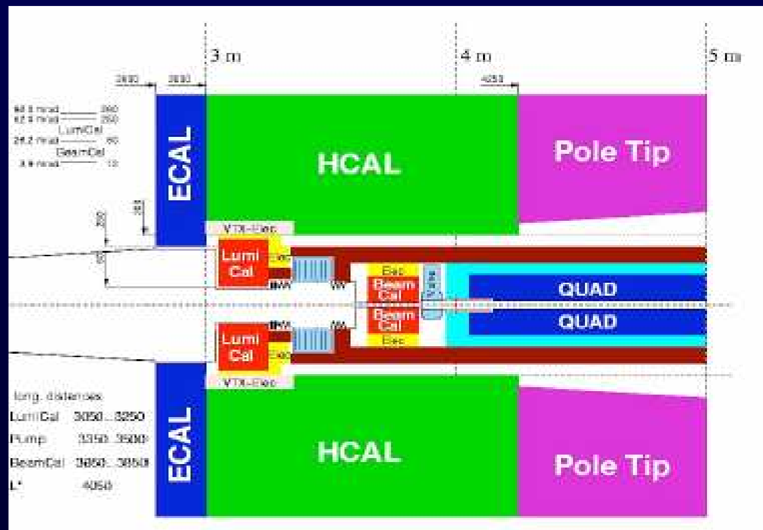


Standardization

- There has been some effort within ILC community
- XML – have not converged
- Mokka has been one of the few real options
- Still a big problem.
- Geant-CAD interface would be helpful



ILC
Interaction
Region



Stahl Design used to produce
the MySQL Geometry

Tracking

- Fast tracking (mappings) for multipole magnets
- RK in material, fields defined by maps
- Defaults G4 transportation in field-free regions
- Generally ok, but sometimes navigation problems with very long beamlines

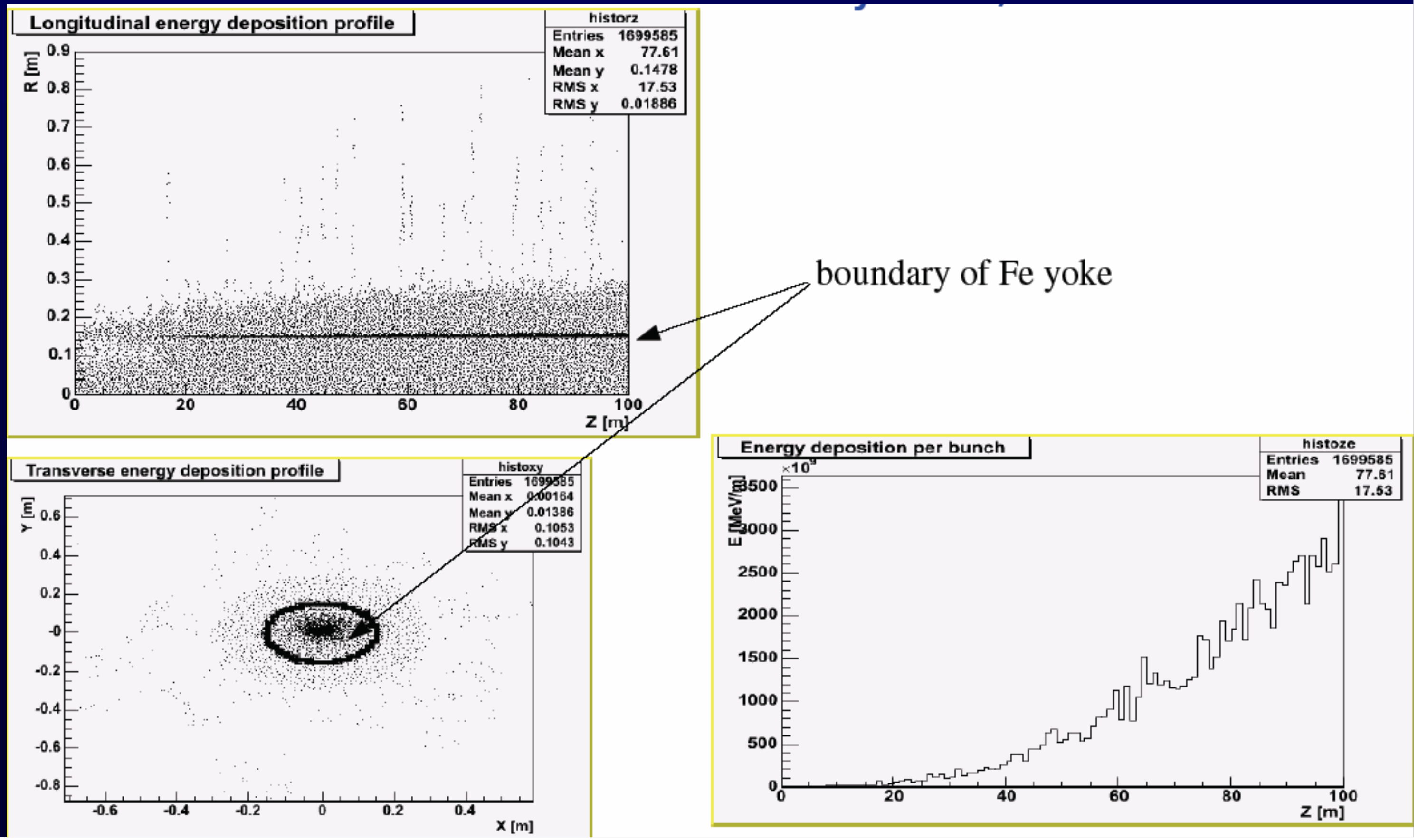
Physics processes

- Standard processes
- Synchrotron radiation, Compton scattering, muon pair production redefined for better statistics
- Fighting with neutrons

Variance reduction

- Usually track ~TeV beams, distances ~km

Beam dump calculations



Variance reduction

- We use techniques like cuts per region assignment
- Biasing for synchrotron radiation, Compton Scattering…
- EM showers still a problem (LPB?)
- working on Coulomb scattering for beam-gas
- Mixing biased and unbiased transport

Hadronic physics

- I have not made much testing myself, but there is a belief that G4 lags behind codes like MCNPX in neutron transport. We would like to have that changed!

Grid

- We are running a grid cluster, but use it basically just as a Beowulf cluster
- I see no major problems but maintenance

Conclusion

We are quite happy.