GAUSS - GEANT4 based simulation for LHCb

GEANT4 Workshop
2 October 2002
W. Pokorski / CERN
Contents

- Introduction to LHCb software
- Overview of Gauss project
- GiGa - Gaudi interface to GEANT4
- Summary
GAUDI - LHCb software framework

- all of the LHCb event processing software is built within a framework - Gaudi framework
- separation between data and algorithms
- data store-centred architectural style
- separation between transient and persistent data
  - transient as a bridge between other representations
  - isolation of user codes/algorithms from underlying persistency technologies
- components interact through their abstract interfaces
  - algorithms manipulate data
  - conversion services change data representations
GAUDI - Applications

GAUDI - Applications

Gaudi Applications
- Gauss Simulation
- Brunel Reconstruction
- DaVinci Analysis
- Panoramix Visualization

Pluggable Components
- Event Generation
- GiGa Detector Simulation
- Digitization

Detector Simulation GiGa
- GiGa
- GiGa Conversion

Embedded Geant4
- Geant4 control and configuration, Actions

Conversion of transient objects to/from Geant4 representation

02/10/2002

Gauss Application
Gauss application

Generator  Detector Simulation  Digitization
GiGa overview

**GEANT4 Interface for Gaudi Applications or Gaudi Interface to GEANT4 Applications**
- GEANT4 callable and controllable from within GAUDI environment

- common detector geometry source used by other applications (reconstruction, visualisation)

- communication via Transient Stores (Event, Detector Data) as any other service or algorithm in Gaudi

- use of common services (ParticlePropertySvc, RandomNumberSvc, MagneticFieldSvc, etc.)
GiGa structure
GiGa features

- It’s a Gaudi service
- Provides access to internal G4 event loop via GiGaRunManager
- All interactions with Geant4 only through abstract interfaces of GiGa Service
- Minimizes the couplings to Geant4
- Allows loading external physics lists
- Instantiates (using Abstract Factory pattern) different “actions” (makes them to be pluggable components)
GiGa - Geometry Conversion

Xml description

Xml Cnv

Gaudi transient store

Geo Conversion Service

Materials

Volumes

Converter

Geant4 Materials

Geant4 Volumes
Geometry conversion ex. (RICH 1)

Xml → GiGa → G4 → OpenGL
GiGa - Kinematics Conversion

- HepMC Event
- LHCb Vertices
- LHCb Particles
- Kine Conversion Service
- Converter
- Geant4 Primary Vertices
- Geant4 Trajectories
GiGa - Hits Conversion

LHCb
Ecal Hits

LHCb
Muon Hits

LHCb
Velo Hits

Converter

Hits Conversion
Service

Geant4
Hits

Geant
Hits

Geant4
Hits
Detector Simulation - “physics lists”

- physics lists:
  - crucial part of the whole simulation program - will certainly require several tuning iterations
  - most of the stuff already implemented in Geant4
  - some specific processes needed implementation
    - for RICH: photoelectric process (creation of photoelectrons in HPDs), energy loss: in the silicon of HPDs
- new feature recently added to GiGa: modular physics lists
  - allows dynamic loading (via jobOptions) of particular physics “sublists”
  - expected to increase flexibility and to make validation easier
Sensitive Detectors & Hits

GiGaSensDetTracker

ProcessHit()

creates

G4TrackerHits

(Geant4)

GiGaTrackerHitsCnv

MCHits

(/Event/MC/OT/Hits)

<logvol name="lvU_ActiveLayer" ...
sensdet="GiGaSensDetTracker/myDet">
RICH1 with SingleParticleGun

RICH1 Event

Pion with 7 GeV/c. Cherenkov Photons In Aerogel and $\text{C}_4\text{F}_{10}$.

Rayleigh scattering Switched off for Illustration.

S. Easo
RICH1 Hits
Panoramix view of MCHits
Panoramix view of MCHits (2)
Summary

**Current Status:**

- we can run GEANT4 simulation with all the subdetectors included
- we are able to produce MCParticles, MCHits (from LHCb event model) and save them in a ROOT file
- we are testing/validating subdetector specific code and physics processes
- we have started adding digitization algorithms to Gauss
Planning:

- by end of the year: to have a complete GEANT4 based simulation application

- by the summer: to perform some “test productions”

- by ... : to definitely move from the old GEANT3 based simulation program to the new one, GEANT4 based