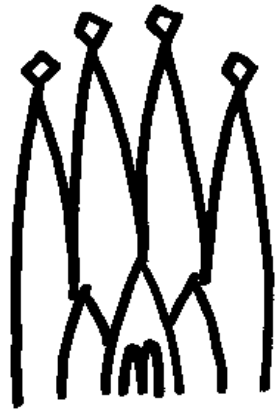
Detector Description in LHCb

Detector Description Workshop

13 June 2002

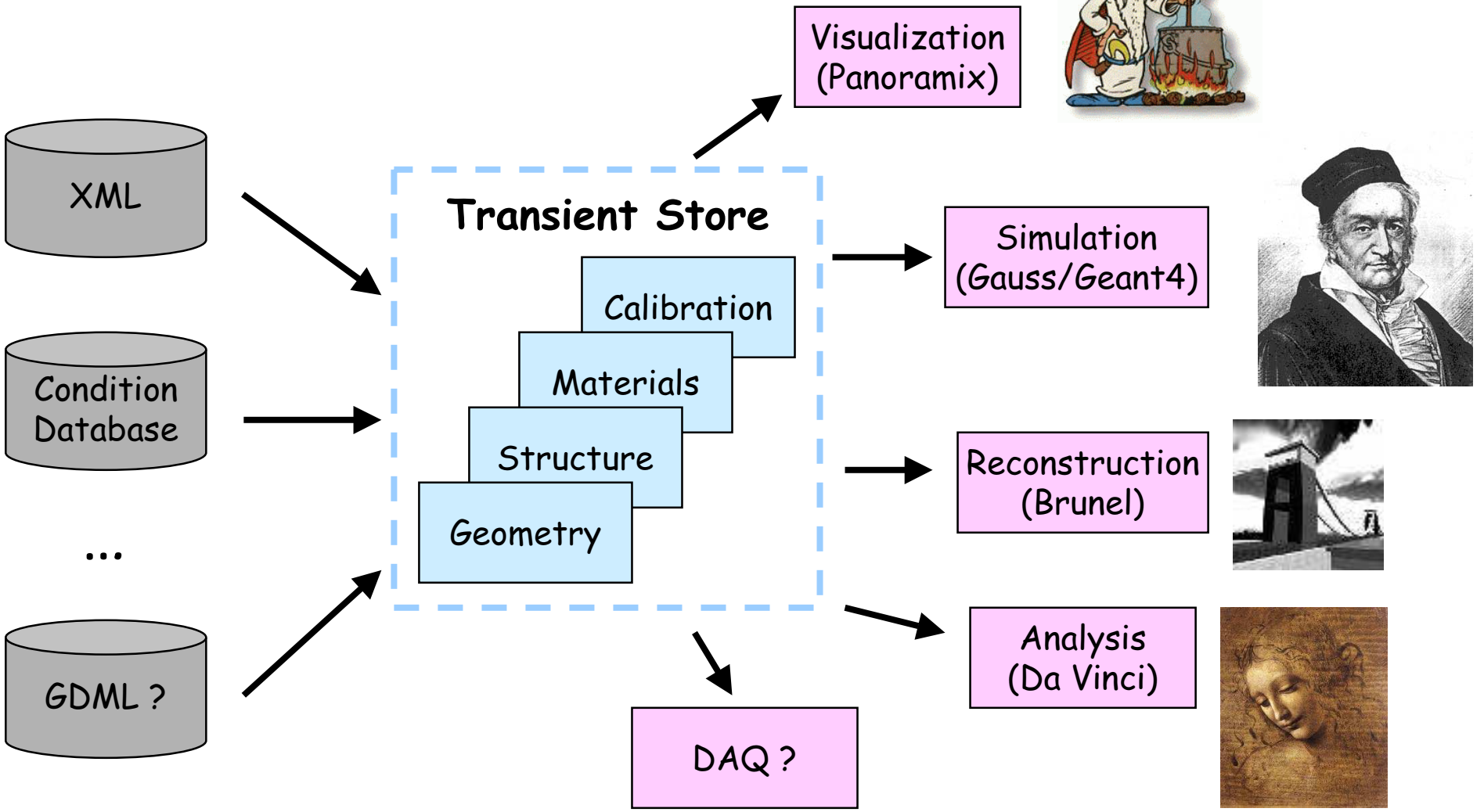
S. Ponce, P. Mato / CERN



Contents

- Architecture
- Transient layer
- Persistency layer : XML
- Condition Database
- Visualization
- Interfacing Geant4
- Status & examples

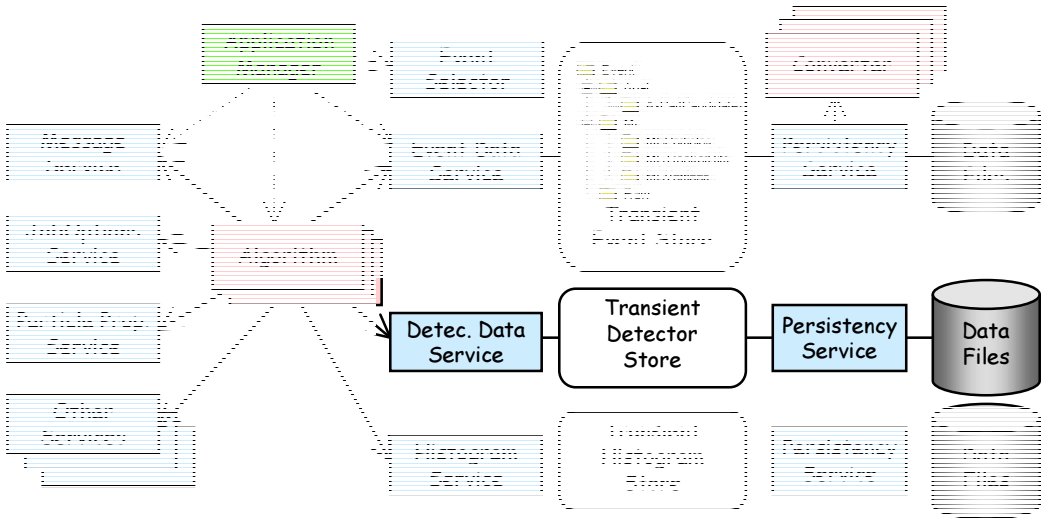
Architecture Overview



Architecture

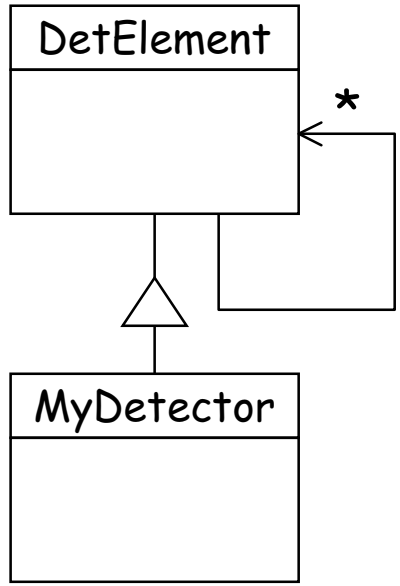
- Sub-Architecture of Gaudi
  - Same principles
  - Transient/Persistent representations
- Focus on the "Physics Algorithm"
- Coherent access to "all" detector data
  - Geometry, Calibration, Slow Control, etc.

Gaudi Architecture

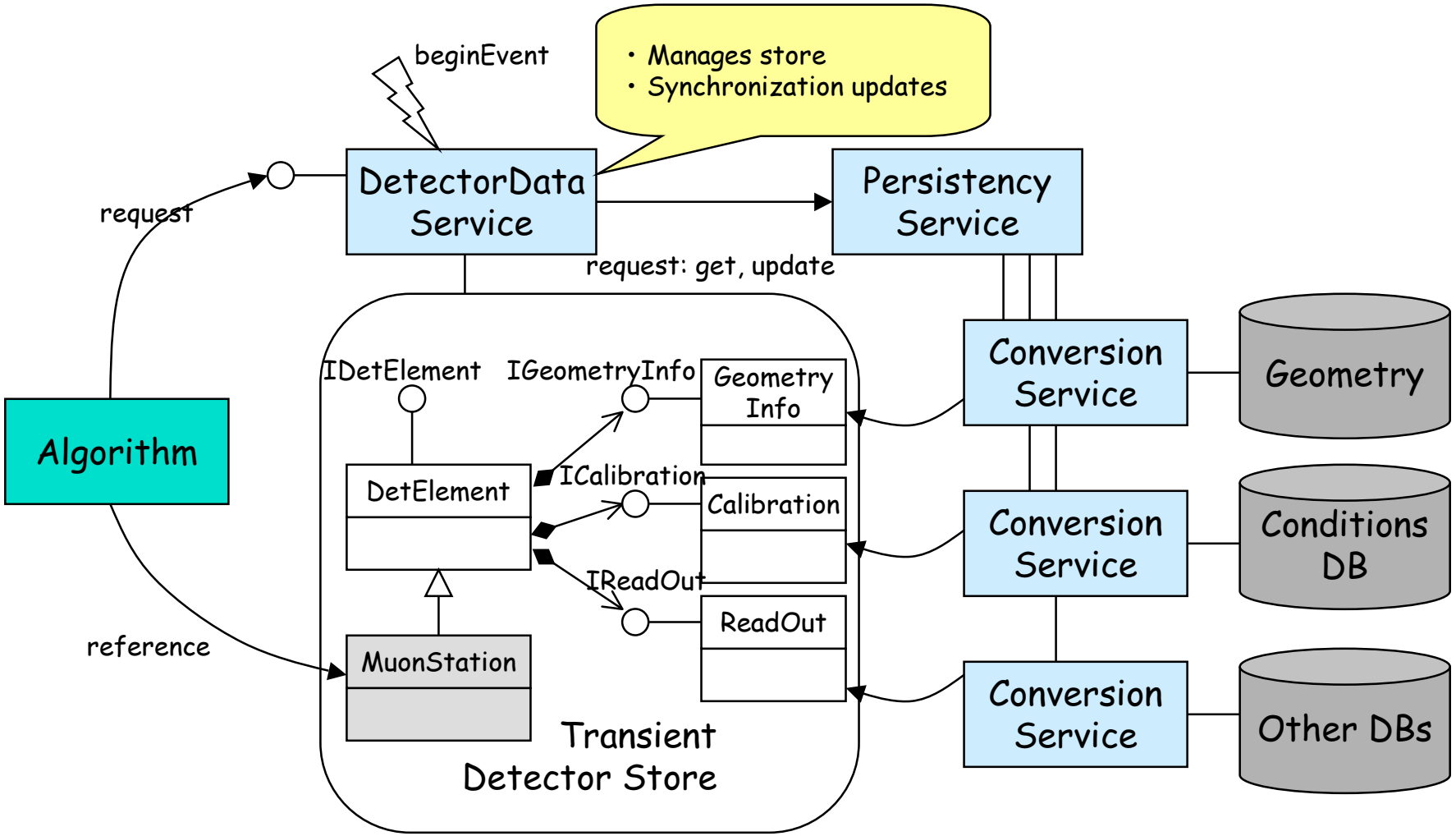


Logical Structure

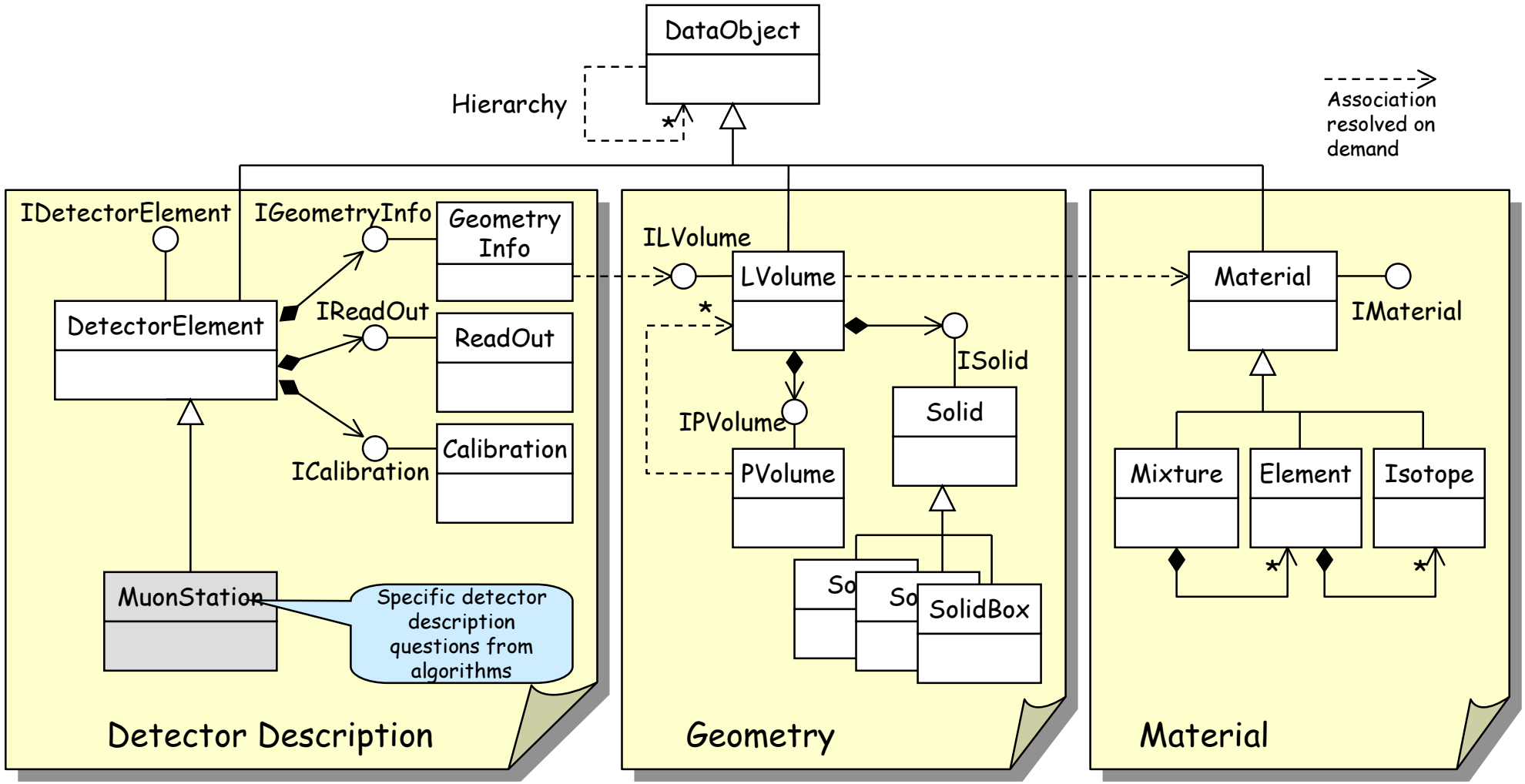
- The basic object is a Detector Element
  - Identification
  - Navigation (tree-like)
- DetElement as information center
  - Be able to answer any detector related question
    - » E.g. global position of strip#, temperature of detector, absolute channel gain, etc.
  - Placeholder for specific code
    - » The specific answers will be coded by "Physicists"



Algorithm Accessing Detector Data



Simplified Diagram



Persistency based on XML files

- XML is used as persistent representation of the Structure, Geometry and Materials (eventually also Conditions)
- Mapping each C++ class into an XML element
  - Inheritance emulation (Generic and Specific Detector Element)
  - Relationships using "Links" and symbolic names
- Allow math expressions with parameters and physical units
  - Using expression evaluator (available in CLHEP)

XML Files

- Separated XML files
  - By sub-detector and data type (structure, geometry, material)
  - Low coupling of developments
- Links between files through references
  - allows to see the whole description as a single XML tree
- Versioning done using CVS
- Possible migration to the "Conditions DB"

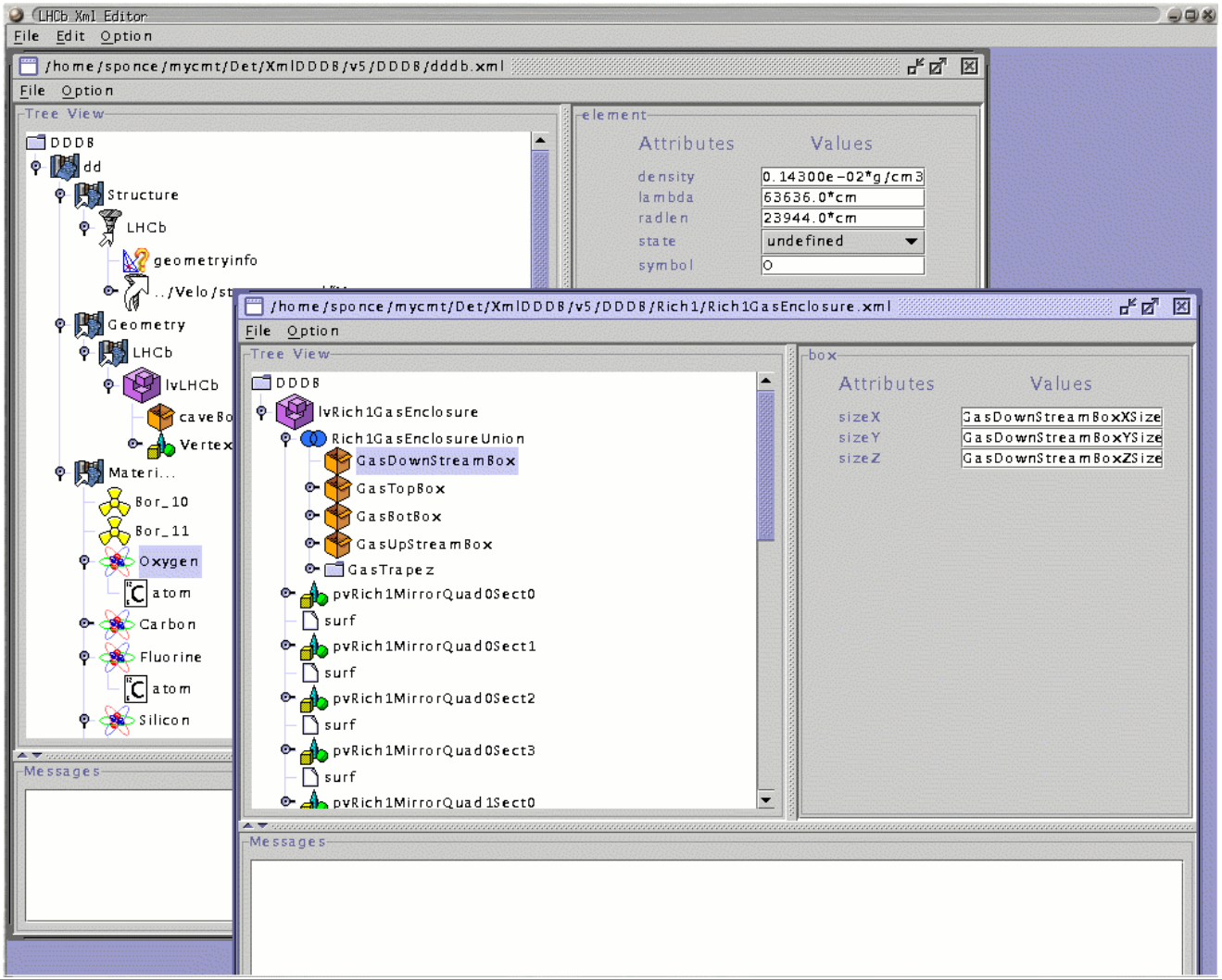
XML Converters

- Capable of converting (one way for the time being) XML into C++ objects
  - Using DOM interface (Xerces-C)
  - Specific converters for specific "DetElement" (to be provided by users)
- Available Converters
  - Structure: Catalog, DetElement
  - Geometry: LVolume, Surface, Solids (various shapes, boolean), PVolumes (parametric)
  - Materials: Isotope, Element, Mixture, TabulatedProperty

XML Detector Description Editor

- Developed a graphical editor to "hide" XML to the end-users (physicists)
  - It understands our model (DTD)
  - But it's generic (possible to use another DTD)
  - It understands "links" and allow us to edit a web of XML files as a single tree
  - It's implemented in Java (portable)

XMLEditor


LHCb Xml Editor
File Edit Option
/home/sponce/mycmt/Det/XmlDDDB/v5/DDDB/dddb.xml
File Option
Tree View
element
Attributes
Values
density
0.14300e-02*g/cm3
lambda
63636.0*cm
radlen
23944.0*cm
state
undefined
symbol
O
DDDB
dd
Structure
LHCb
geometryinfo
Geometry
lvLHCb
Vertex
Oxygen
atom
Carbon
Fluorine
Silicon
Messages
/home/sponce/mycmt/Det/XmlDDDB/v5/DDDB/Rich1/Rich1GasEnclosure.xml
box
sizeX
sizeY
sizeZ
GasDownStreamBoxXSize
GasDownStreamBoxYSize
GasDownStreamBoxZSize
lvRich1GasEnclosure
Rich1GasEnclosureUnion
GasDownStreamBox
GasTopBox
GasBotBox
GasUpStreamBox
GasTrapez
pvRich1MirrorQuad0Sect0
surf
pvRich1MirrorQuad0Sect1
pvRich1MirrorQuad0Sect2
pvRich1MirrorQuad0Sect3
pvRich1MirrorQuad1Sect0

Conditions DB

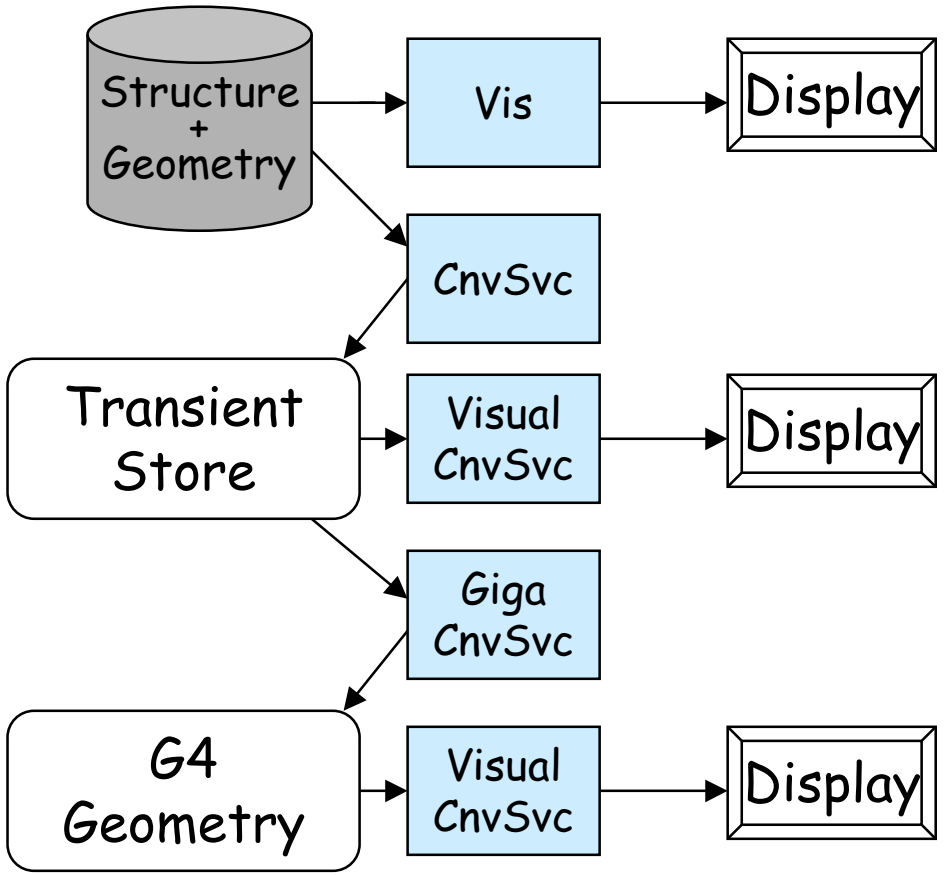
- Accessing detector conditions data (calibration, slow control, alignment, etc.) should be the same as geometry data
  - Time validity period and Versioning in addition
  - Conditions are integrated into the transient data model
  - Converters are responsible for converting from database rather than from XML
- Conditions are attached to Detector Elements as for geometry
  - each element has many conditions (calibration, alignment, slowcontrol, fastcontrol …)

Conditions DB Implementation

- Condition objects are stored in XML
- The XML fragments are stored using the Oracle condition DB developed by IT
- XML references are used to select between XML and condition DB :
  - <conditionref href="../Ecal/condition.xml#caEcal"/> → XML
  - <conditionref href="cond://dd/Calibration/Ecal/caEcal"/> → DataBase

Geometry Visualization

- Visualization is essential for developing the geometry
  - Applicable at the different data representations
- Generic geometry information conversion to 3D graphics data
- Panoramix (OnX)



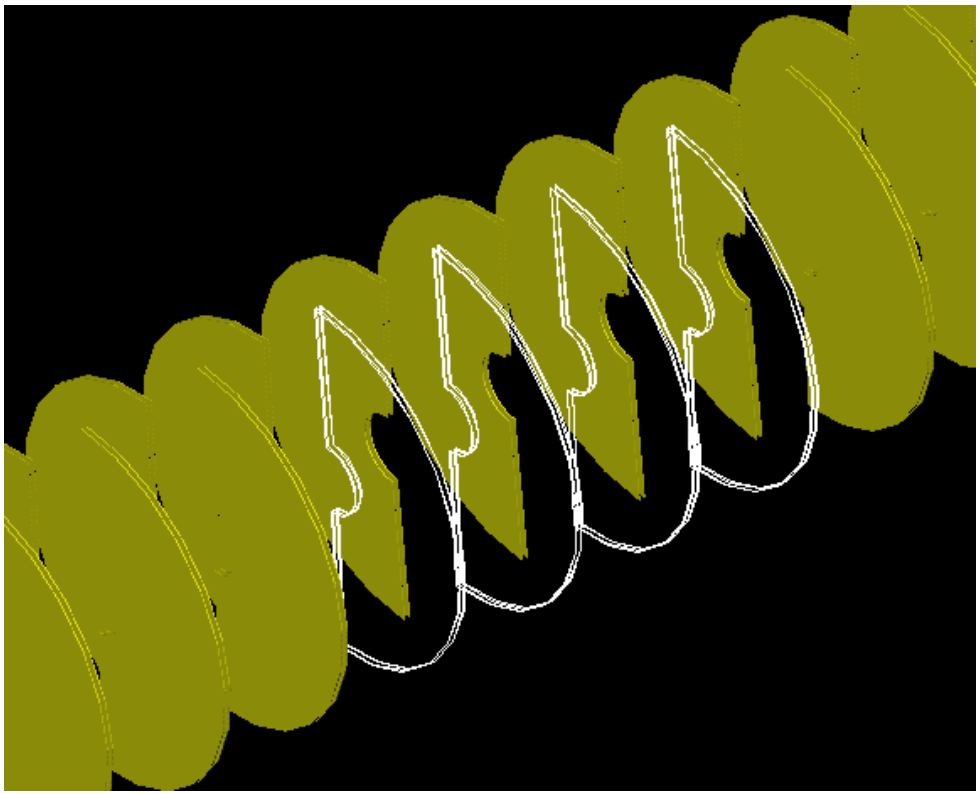
Interfacing With Geant4

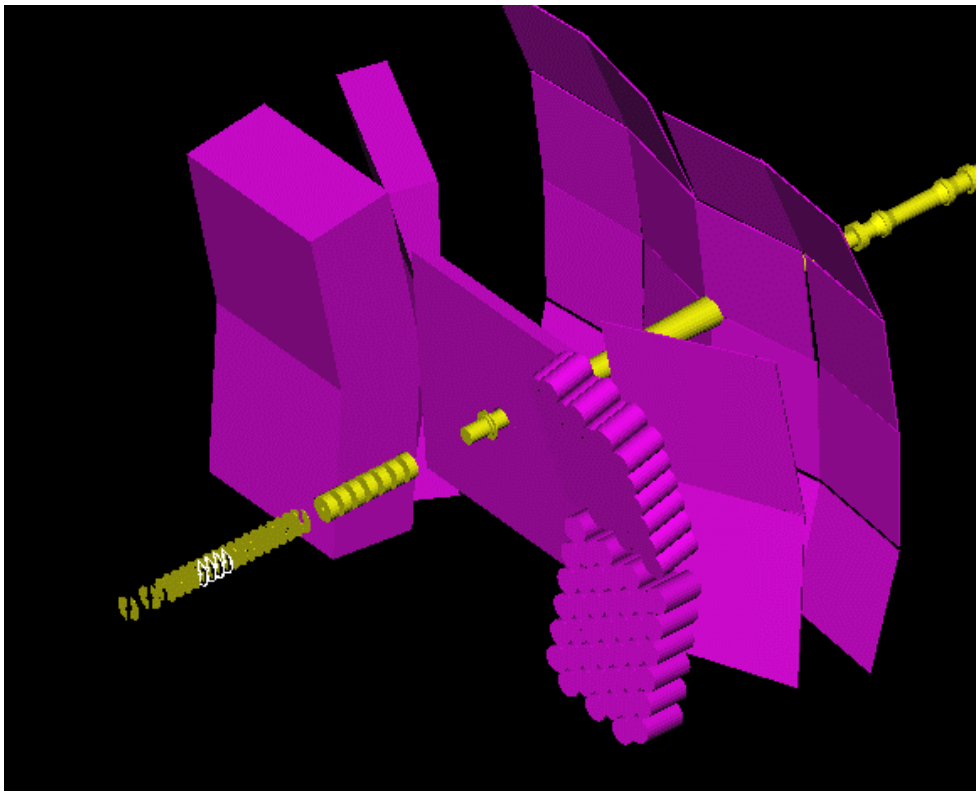
- We integrate Gaudi with Geant4 by providing a number of "Gaudi Services" (GiGa)
- The GiGaGeomCnvSvc is able to convert transient objects (DetElem, LVolume, Surfaces, etc.) into G4 geometry objects
  - The conversion does not require "user" code
  - Flexibility in mapping Gaudi model to Geant4 model
- Single source of Geometry information

Status of LHCb Detector Description

- The DetDesc framework is fully functional (transient classes, XML DTD, XML converters, editor, etc)
- All sub-detectors are already described (structure, geometry and materials) using the provided framework
- Visualization based on OnX : Panoramix. Allows to see geometry, events, histograms, …
- Conversion to Geant4 through GiGa is complete

Example 1 : Velo and Rich1





Example (2) : Zoom on Ecal