Detector Description in LHCb

Detector Description Workshop

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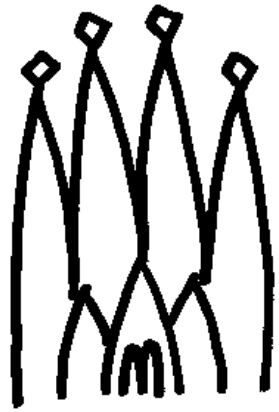


Contents

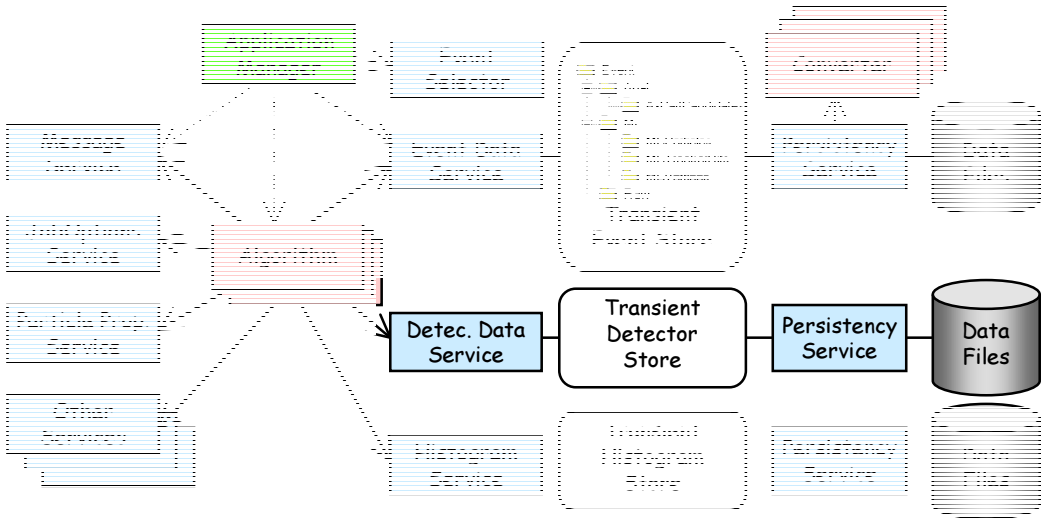
- Architecture
- Transient layer
- Persistency layer : XML
- Condition Database
- Visualization
- Interfacing Geant4
- Status & examples

Architecture Overview

Architecture

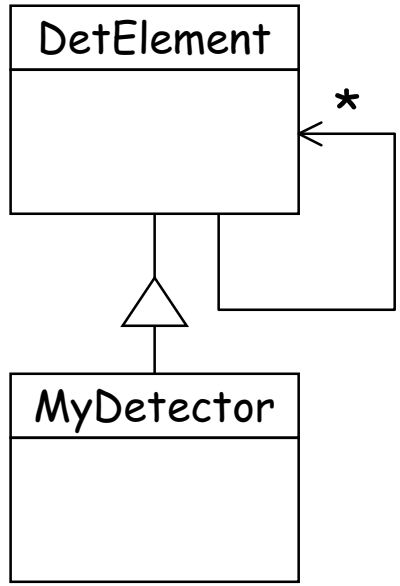
- Sub-Architecture of Gaudi
  - Same principles
  - Transient/Persistent representations
- Focus on the "Physics Algorithm"
- Coherent access to "all" detector data
  - Geometry, Calibration, Slow Control, etc.

Gaudi Architecture

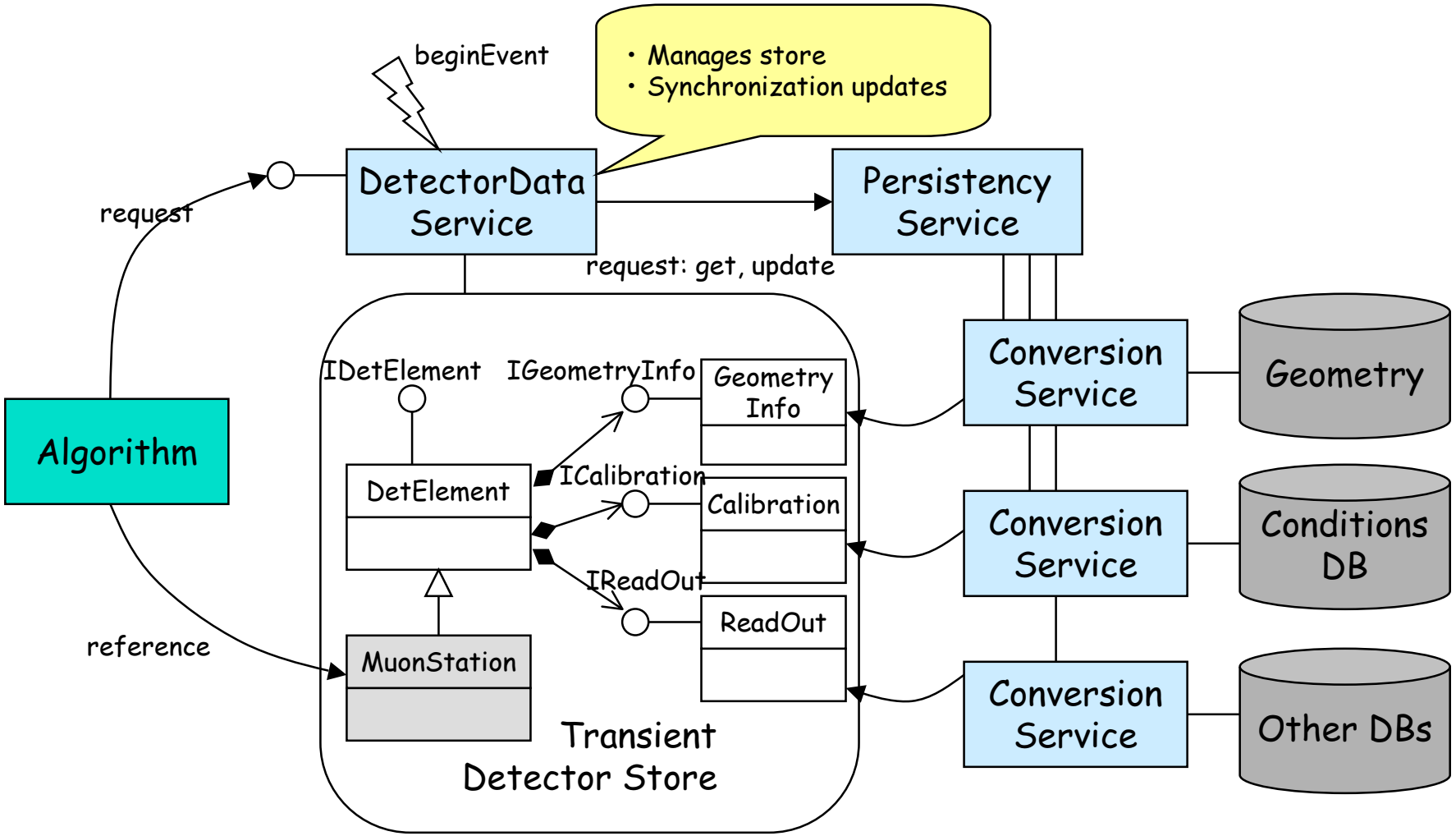


Logical Structure

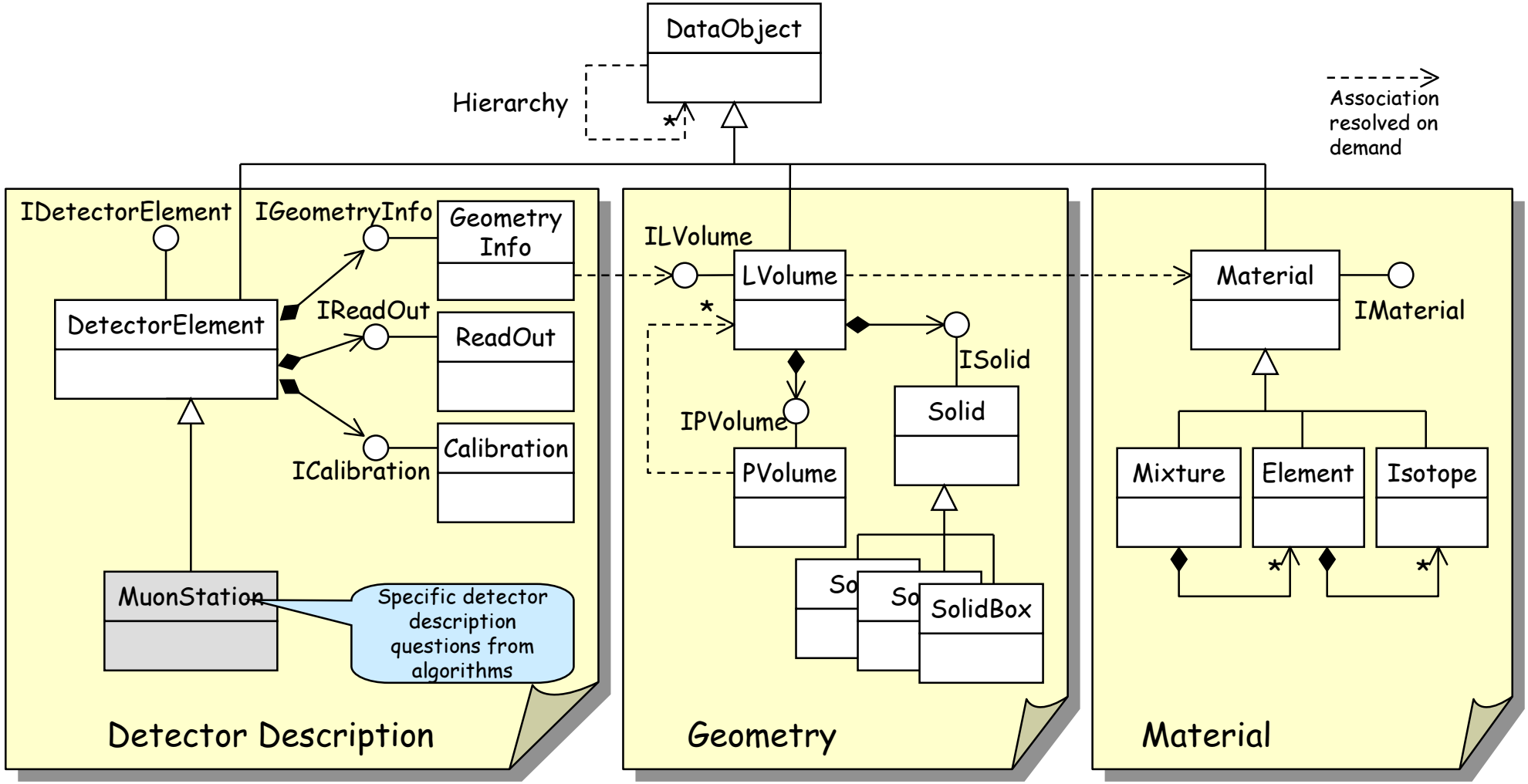
- The basic object is a Detector Element
  - Identification
  - Navigation (tree-like)
- DetElement as information center
  - Be able to answer any detector related question
    - » E.g. global position of strip#, temperature of detector, absolute channel gain, etc.
  - Placeholder for specific code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

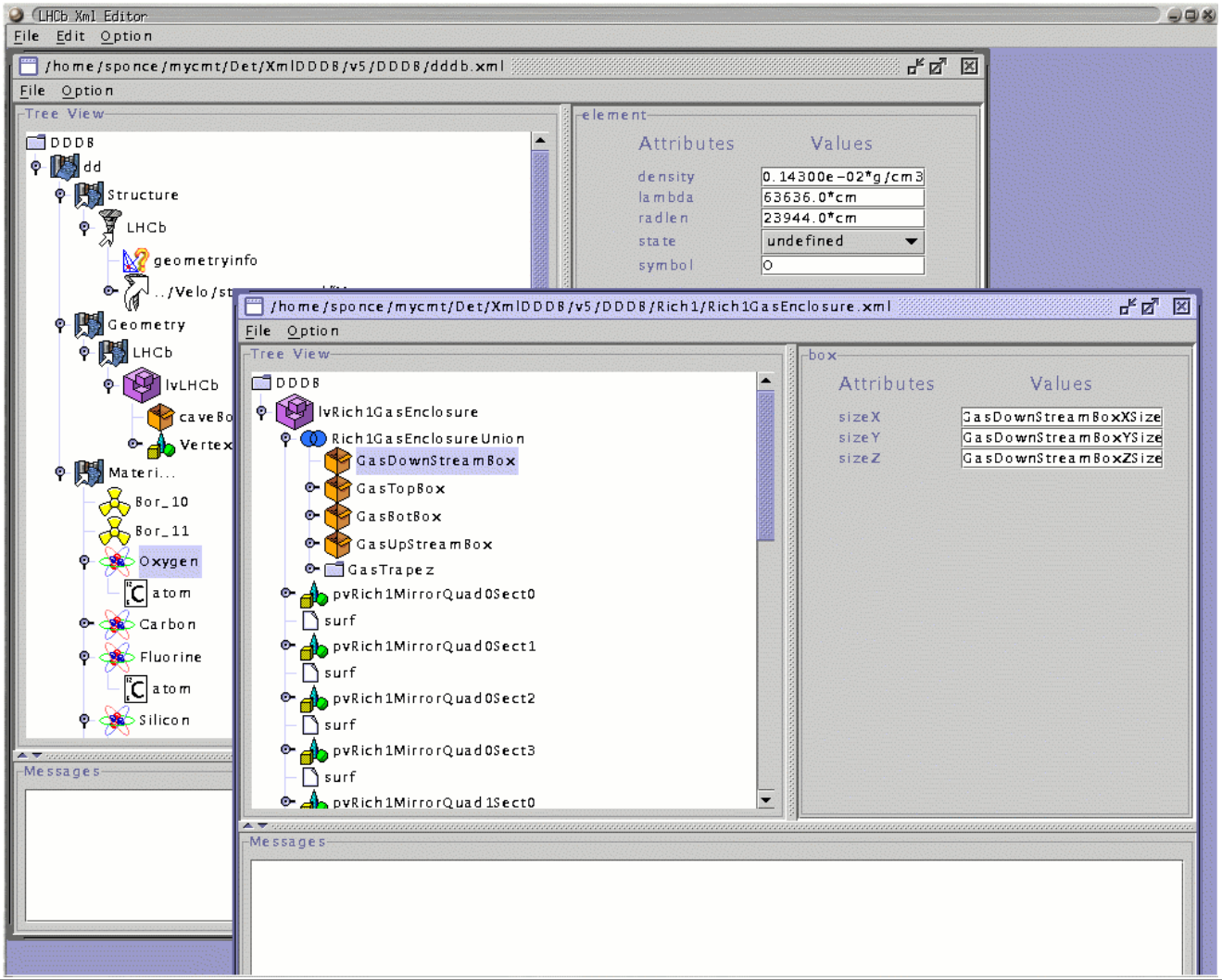
XML Converters

- 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
LHCb
lvLHCb
Oxygen
atom
Carbon
Fluorine
atom
Silicon
Messages
/home/sponce/mycmt/Det/XmlDDDB/v5/DDDB/Rich1/Rich1GasEnclosure.xml
File Option
Tree View
box
Attributes
Values
sizeX
GasDownStreamBoxXSize
sizeY
GasDownStreamBoxYSize
sizeZ
GasDownStreamBoxZSize
DDDB
lvRich1GasEnclosure
Rich1GasEnclosureUnion
GasDownStreamBox
GasTopBox
GasBotBox
GasUpStreamBox
GasTrapez
pvRich1MirrorQuad0Sect0
surf
pvRich1MirrorQuad0Sect1
surf
pvRich1MirrorQuad0Sect2
surf
pvRich1MirrorQuad0Sect3
surf
pvRich1MirrorQuad1Sect0
Messages

Conditions DB

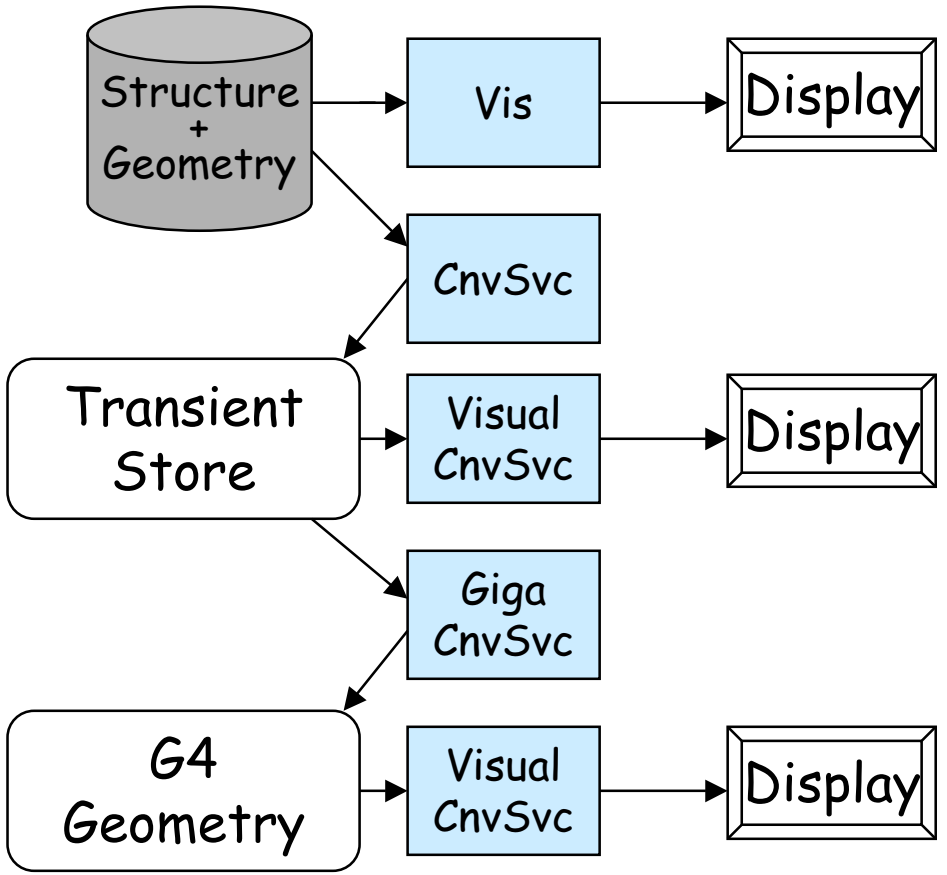
- Accessing detector conditions data (calibration, slow control, alignment, etc.) should be the same as geometry data
  - Time validity period and Versioning in addition
  - Conditions are integrated into the transient data model
  - Converters are responsible for converting from database rather than 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)



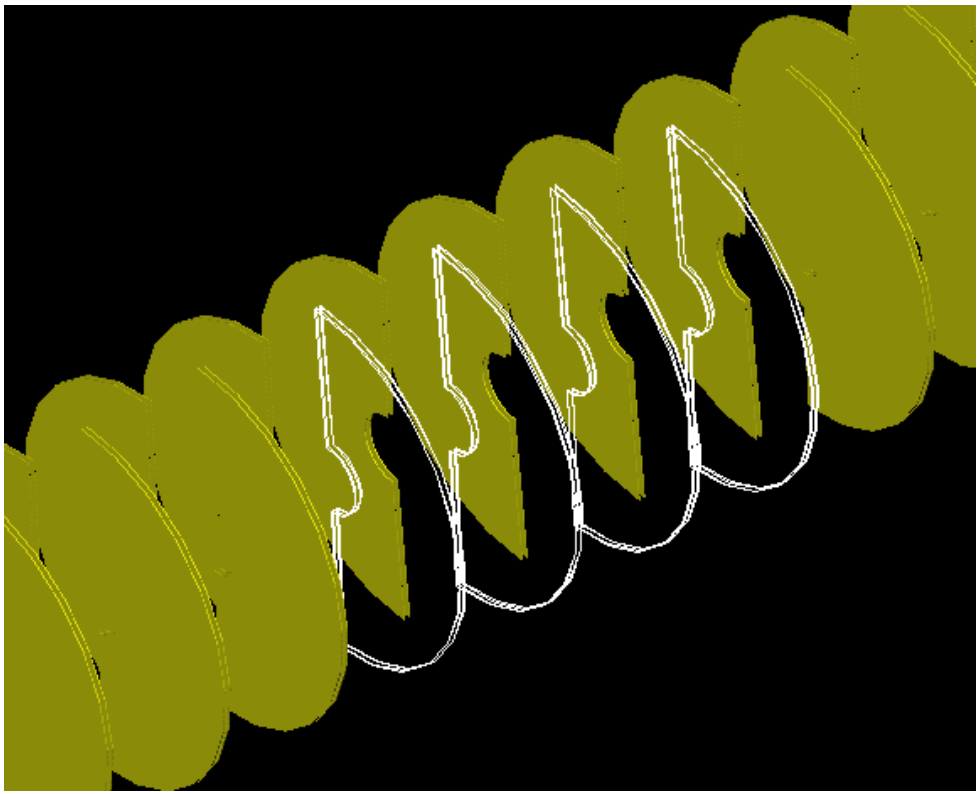
Interfacing With Geant4

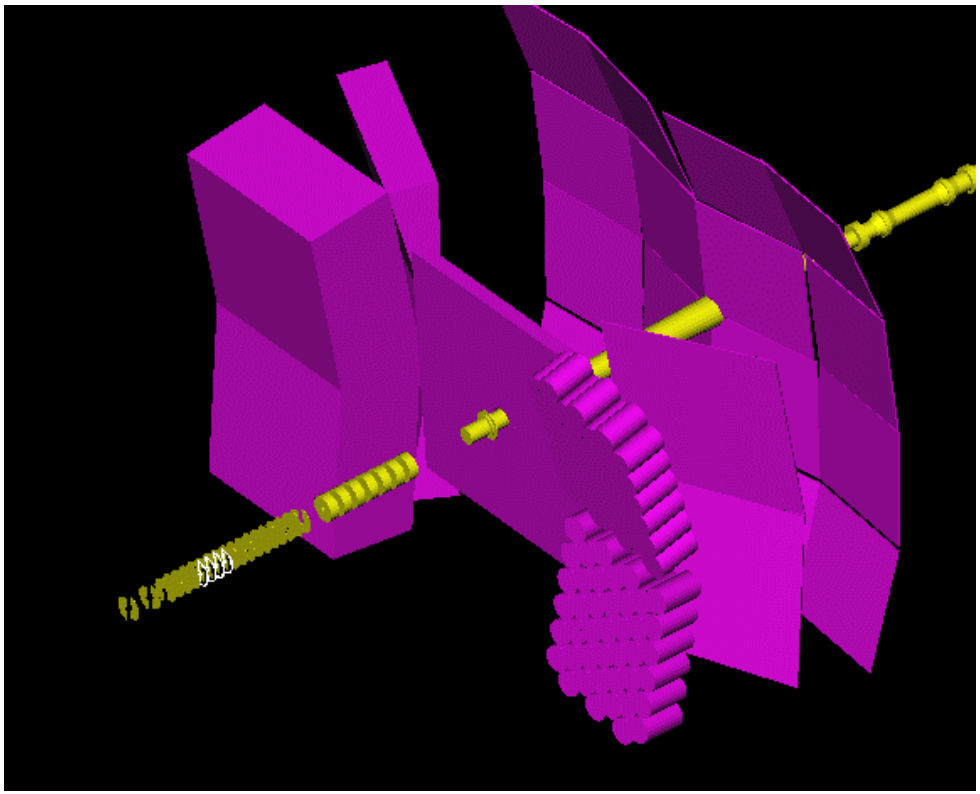
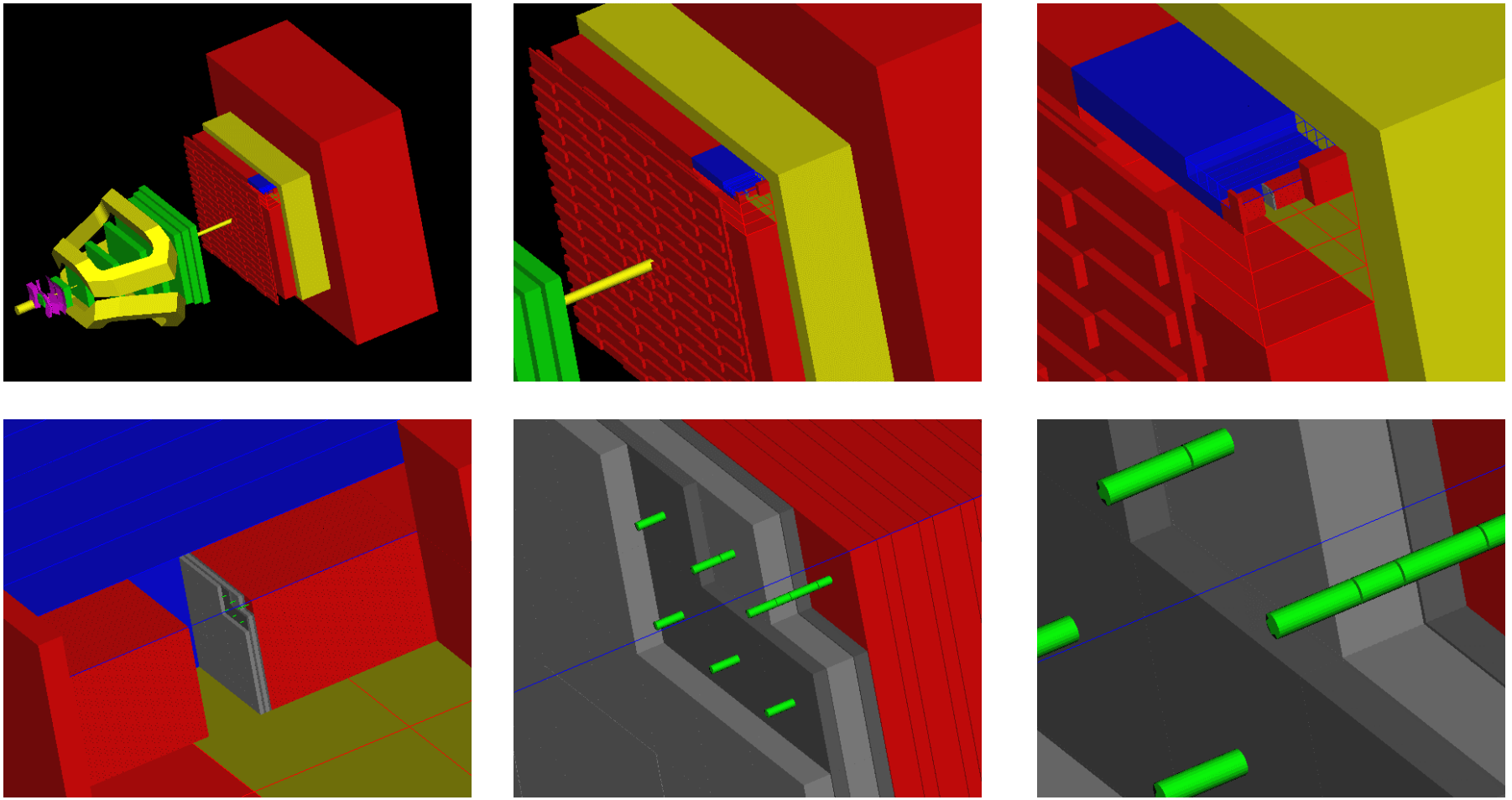
- We integrate Gaudi with Geant4 by providing a number of "Gaudi Services" (GiGa)
- The GiGaGeomCnvSvc is able to convert transient objects (DetElem, LVolume, Surfaces, etc.) into G4 geometry objects
  - The conversion does not require "user" code
  - Flexibility in mapping Gaudi model to Geant4 model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