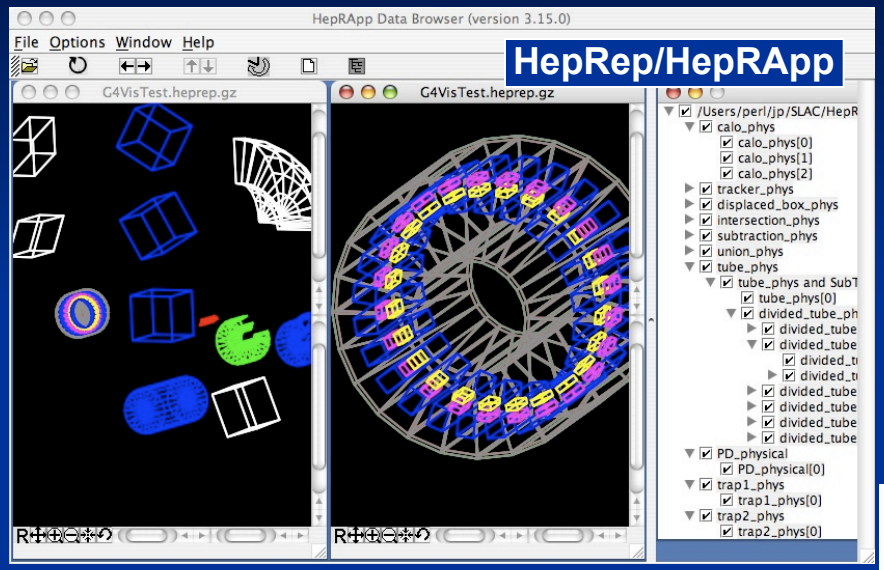
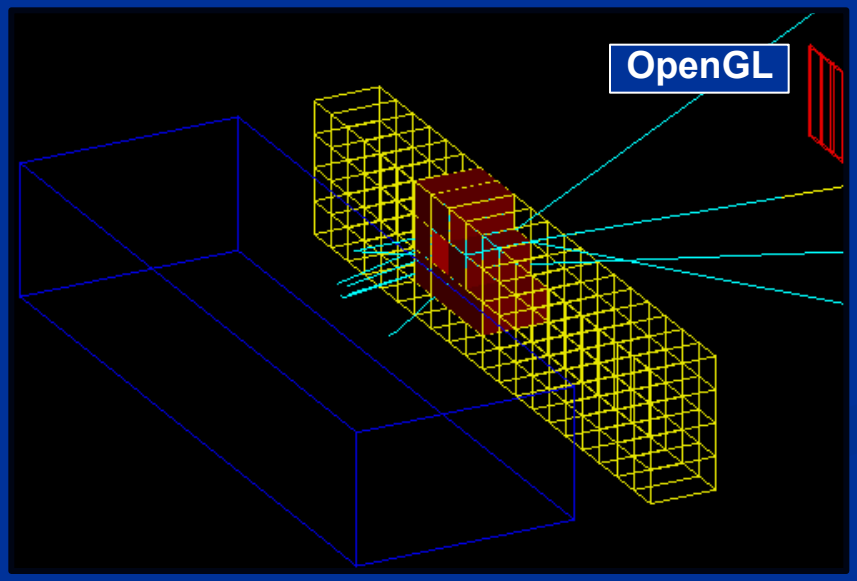
Introduction to Geant4 Visualization



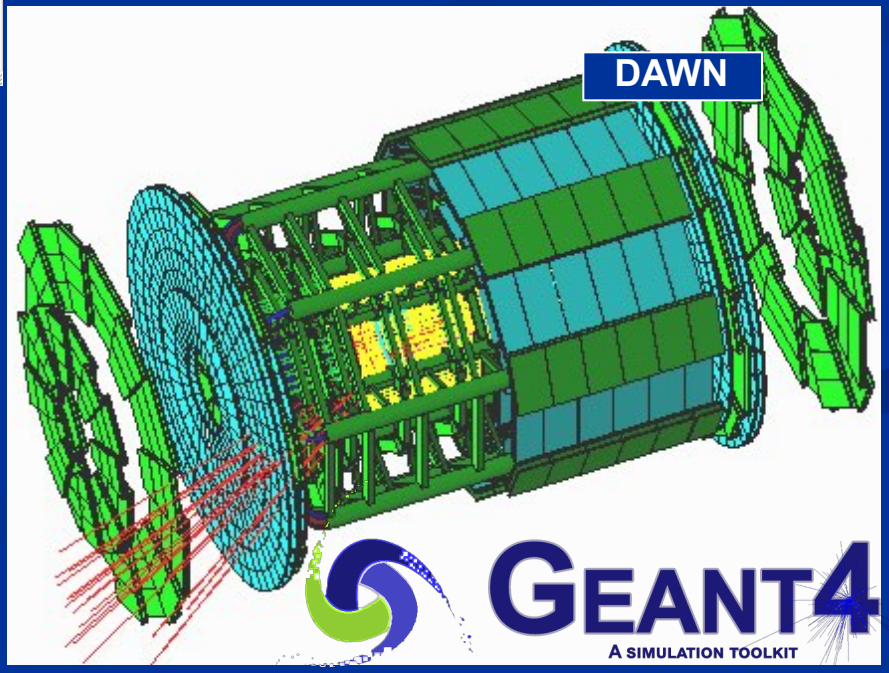


Laurent GARNIER,

IRISA / INS2I / CNRS

Based on Joseph Perl (SLAC) slides

Geant4 tutorial



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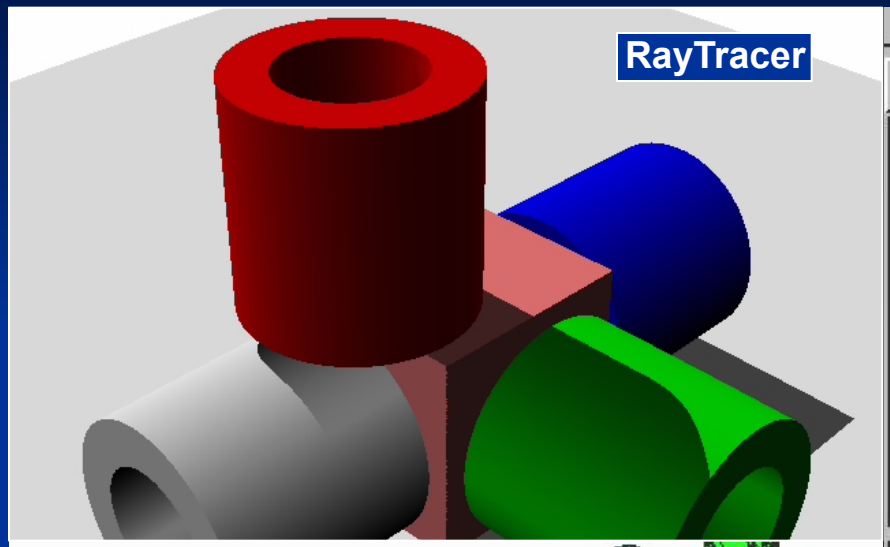
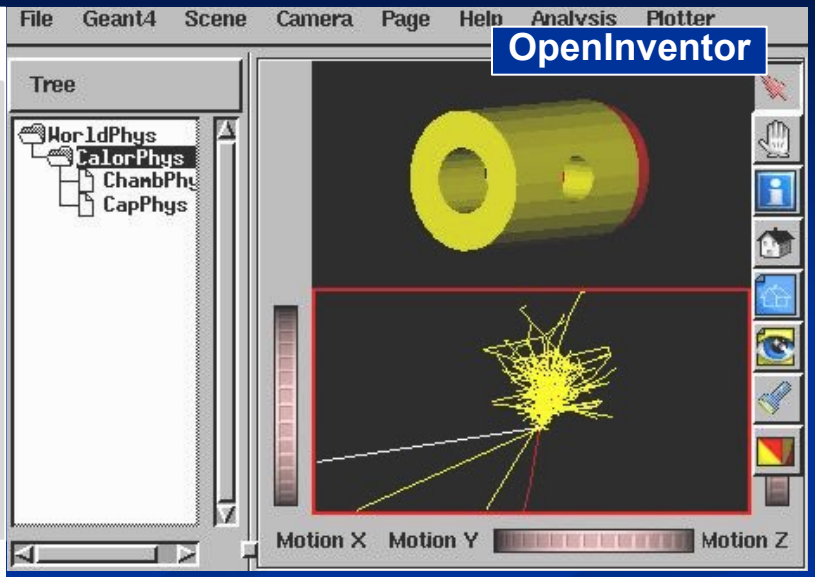
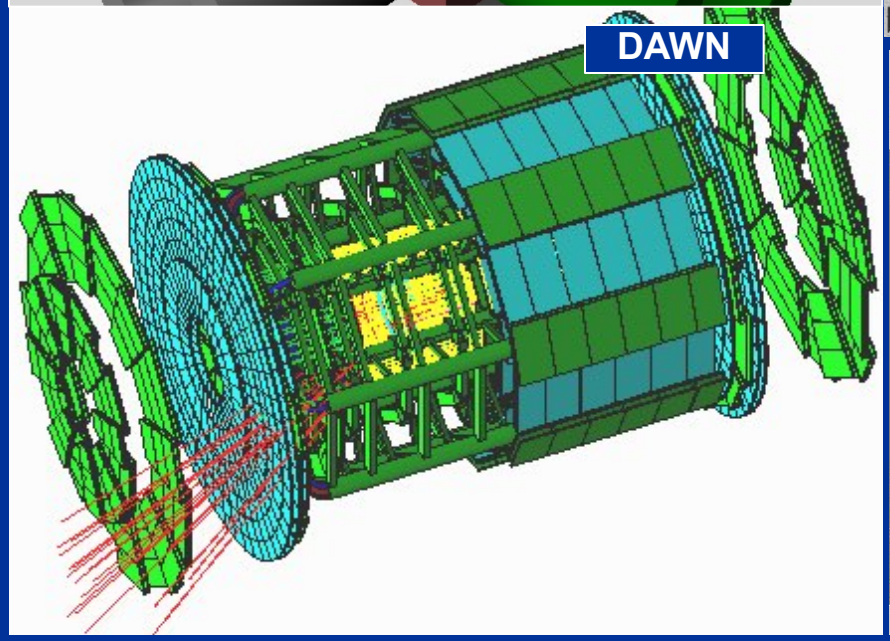
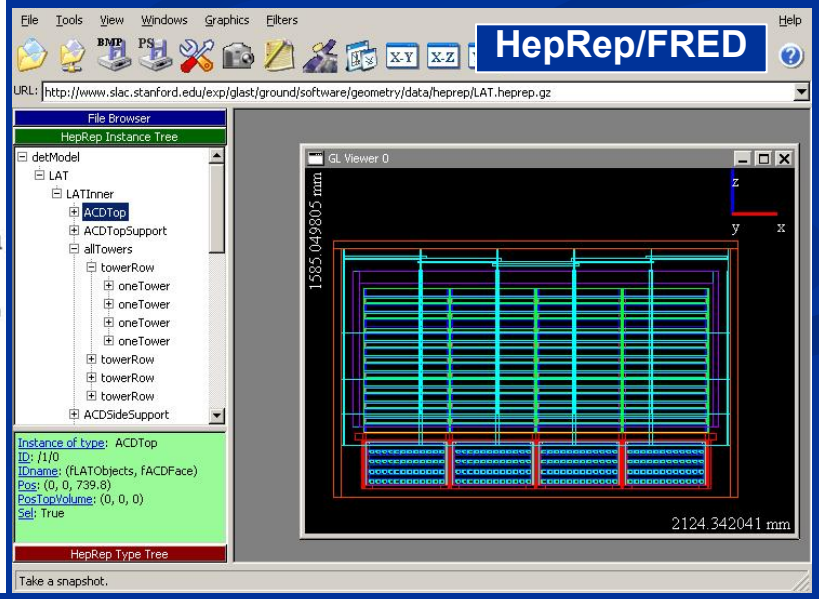
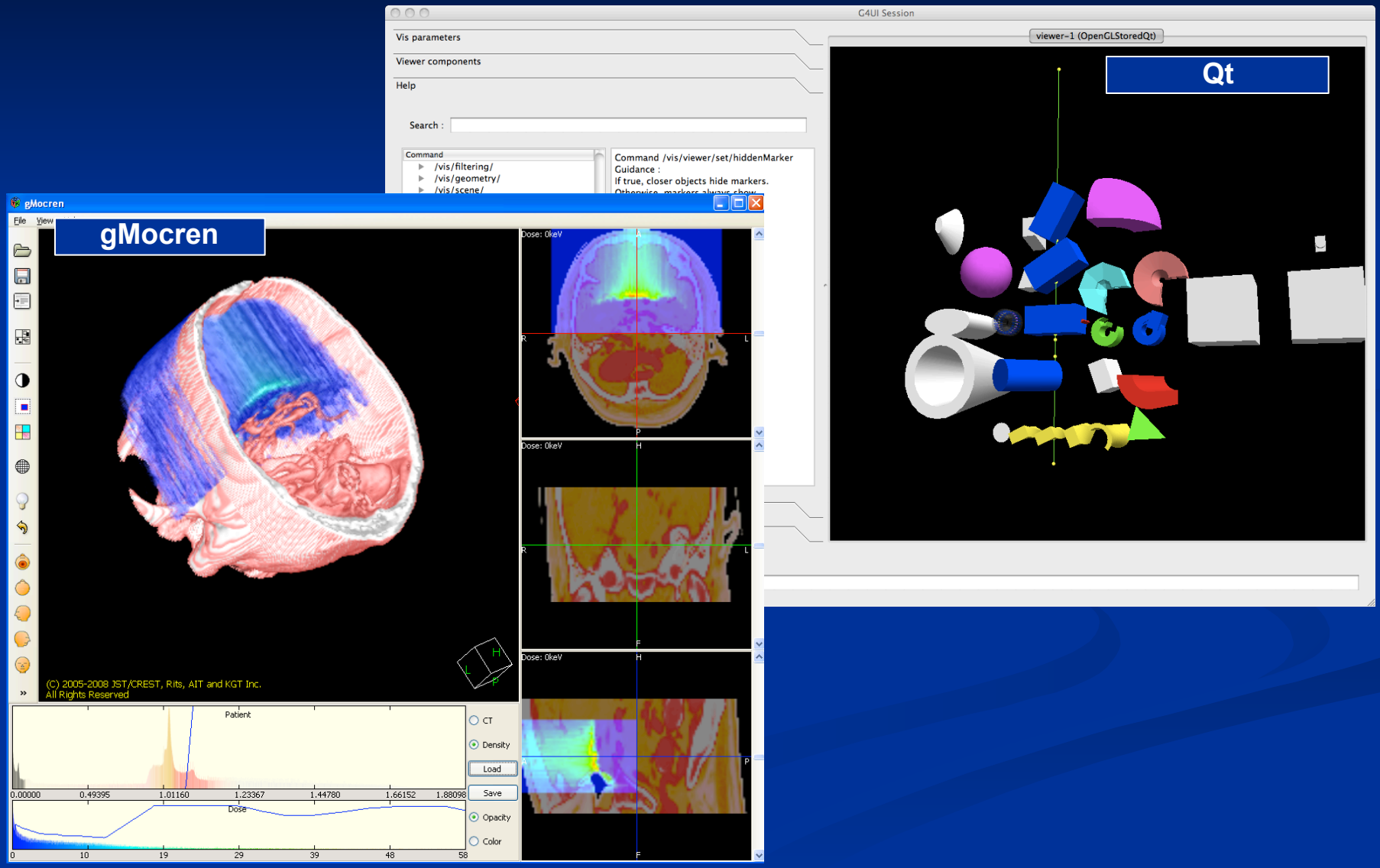








Introduction to Geant4 Visualization



Tutorials


Geant4 Vis Tutorial using the HepRApp HepRep Browser
File Options Window Help
Orientation Actions in the Po
To select from among some standa
right mouse button (Macintosh use
Orientation Actions
Orientation Toolbar
Projection
Mouse Function
Drawing Options
Geant4 Vis Tutorial using the DAWN Event Display - Netscape
File Edit View Go Bookmarks
And here is a good time to discu
graphics (not bitmapped graphics).
viewer's zoom feature, the image v
Now that you have some basic f
created during the previous tutoria
file called:
geant4\examples\extended\analysis
Or, if you skipped running Geant4
Run DAWN on this file:
dawn g4_01.prim
Go to the DAWN GUI's page 1
On the same page, change "Cam
you can type in a specific number t
new value).
You should end up with an imag
Document: Done (0.74
Geant4 Vis Tutorial using the OpenGL Event Display - Netscape
File Edit View Go Bookmarks Tools Window Help
The output appears as soor
included automatically at t
One last command for this
the detector was drawn as
command:
/vis/viewer/set/
/run/beamOn 1
The detector will then app
to still seee the tracks pass
viewer-0 (OpenG
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Geant4 @ IN2P3 – Geant4 Qt User Interface tutorial (based on 4.9.6 version)
http://geant4.in2p3.fr/spip.php?article84&lang=en
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Geant4 Qt User Interface tutorial (based on 4.9.6 version)
First tutorial : Download/Compilation/Installation/Launch B1
Step 1: Download Geant4
Step 2: Compilation and Installation (at 25")
Step 3: Example (B1) compilation (at 2'06)
Step 4: Run example (at 2'32)
exampleB1
Second tutorial : User Interface demo
Step 5: Qt interface
Step 6: Making movies (at 6'12)
Step 7: Export hight quality pictures (at 8'00)

What Can be Visualized

- Simulation data can be visualized:
  - Geometrical components
  - Particle trajectories and tracking steps
  - Hits of particles in the geometry
  - Scored energy, dose, etc.
- Other user defined objects can be visualized:
  - Polylines
    - such as coordinate axes
  - 3D Markers
    - such as eye guides
  - Text
    - descriptive character strings
    - comments or titles

Quick Overview of Visualization Driver Choices

- First I'll explain why there are so many visualization driver choices
- If you want more details about each visualization driver, see "references" at the end of this presentation

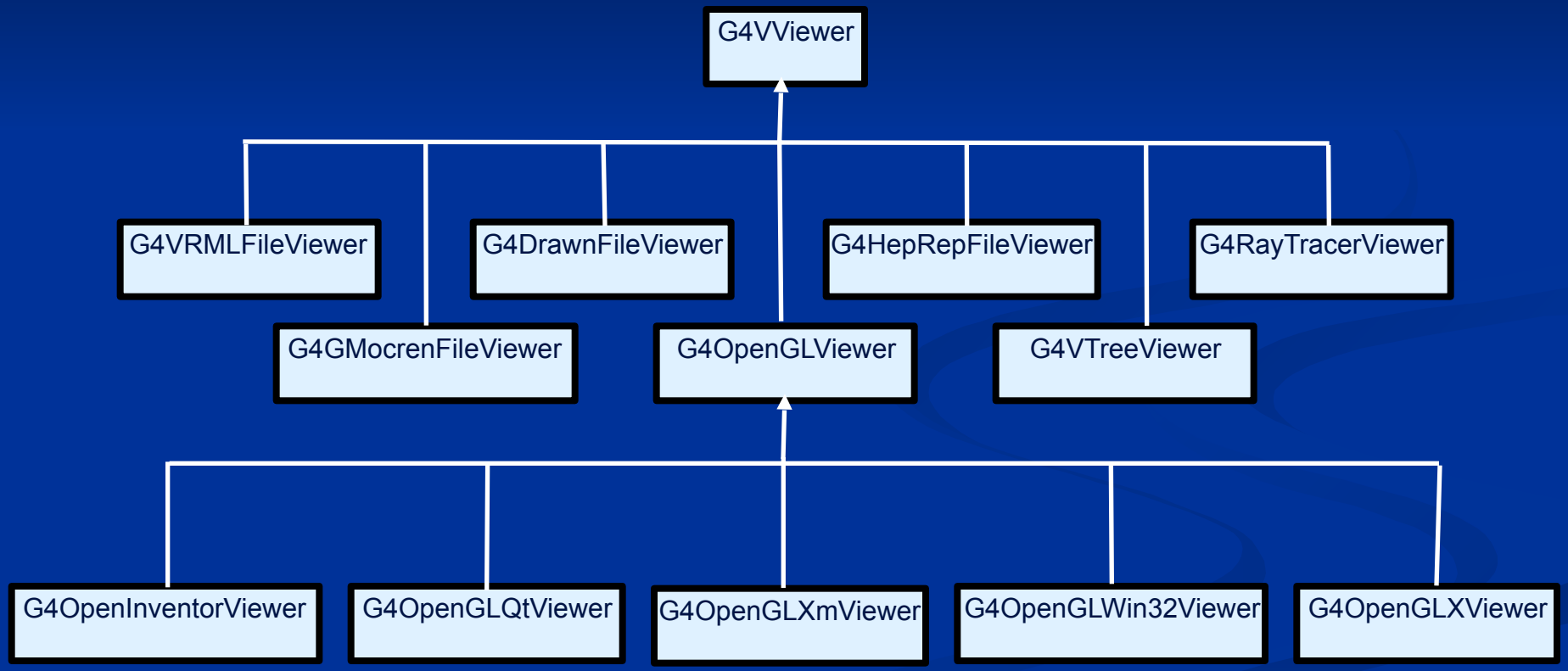
Driver	Variant	Hight quality print	Interactive	browse geometry hierarchies	Direct access to G4 kernel	Make movies	Web
OpenGL	X						
	Xm						
	Qt						
	Win32						
OpenInventor	Xt						
	Win32						
DAWN							
VRML							
HepRep							
gMocren							
RayTracer							
ACSII File							

Design by Interfaces

- You may ask why Geant4 has so many different visualization systems.
- This is a natural result of Geant4 being a toolkit and not a single application.

- To support user communities who incorporate Geant4 into their own pre-existing software frameworks, Geant4 visualization is built around a set of well defined interfaces.
  - These interfaces make it straightforward to connect Geant4's core visualization tools to any visualization system
    - able to drive advanced systems that can natively display complex solids such as Geant4's cut cylinders
    - able to drive more basic systems that do not understand such solids (system can ask Geant4 visualization to deconstruct complex solids into simpler polygons)
  - For those users who want a ready-made visualization solution from Geant4, these same interfaces have made it straightforward for us to provide a variety of solutions, each with particular areas of strength.

Class hierarchy diagram



Eight Visualization Drivers

- No Single Visualization Solution Can Meet all of Our Demands
- Quick response with flexible camera control
- High-quality Output for Publications
- Interactive Picking to Get More Information
- Complex Boolean Solids and Transparent or Reflective Surfaces
- 3D Format Suitable for Web Distribution
- Visualize Volume Data
- Understand Geometry Hierarchies

- By exploiting the same interface design that we need anyway to support visualization systems of existing frameworks
- We are able to take advantage of the best features of several different visualization drivers
- With a common set of user commands
- And minimal maintenance for many of the drivers

- We take advantage of the best features of many pre-existing visualization systems without having to reinvent those systems.

Controlling Visualization

- Your Geant4 code stays basically the same no matter which driver you use
- Visualization is performed either with commands or from C++ code
  - For the present tutorial, we confine ourselves to command-driven visualization.
- Some visualization drivers work directly from Geant4
  - OpenGL
  - OpenInventor
  - RayTracer
  - ASCIITree
- For other visualization drivers, you first have Geant4 produce a file, and then you have that file rendered by another application (which may have GUI control)
  - HepRepFile
  - DAWNFILE
  - VRML2FILE
  - gMocrenFile
- You can open more than one driver at a time.
  - For example, do a quick check in OpenGL, then save the same event for a beautiful DAWN plot

Controlling Which Drivers are Available

- Six of the visualization drivers are always included by default (since they require no external libraries):
  - HepRepFile
  - DAWNFILE
  - VRMLFILE
  - RayTracer
  - gMocrenFile
  - ASCIITree
- Other visualization drivers are included only if appropriate flags are set in CMake
- You can also add your own visualization driver.
  - Geant4's visualization system is modular. By creating just three new classes, you can direct Geant4 information to your own visualization system.

Simplest command Example

- Visualize your geometry in OpenGL:
- /vis/open OGL
- /vis/drawVolume

- Most examples come with a visualization macro more complete (including our exercise), which will be explained in more details later

To Open Visualization

- To Open a Driver
  - /vis/open <driver name>
- for example
  - /vis/open OGL
  - /vis/open DAWNFILE
  - /vis/open HepRepFile
  - /vis/open VRML2FILE
- The set of available drivers is listed when you first start Geant4, but you can also get this list with the command:
  - help /vis/open

OpenGL Additional Modes

- For all OpenGL drivers, 2 modes available :
  - Immediate mode
    - draws only to screen, no “memory”; detector can be redrawn after view changes but event data is lost.

    => Slow if you want to rotate/move the scene
  - Stored mode
    - Stored mode: creates graphical database (display lists); nothing is lost on simple operations like change of viewing angle

    ⇒ Slower at first draw, but faster after if you want to rotate/move the scene

exampleB2b run	Immediate mode	Stored mode
command	/vis/open OGLI	/vis/open OGLS
First draw time (sec)	1	15
Frame per sec	1	12

More about DrawVolume

- To draw the entire detector geometry:
  - /vis/drawVolume
- There are many additional options to let you draw only a selected subset of the detector geometry.
  - See separate presentation, Geant4 Advanced Visualization
- You can control the color, linewidth and other attributes of detailed geometry drawing using /vis/geometry commands such as:
  - /vis/geometry/set/colour volumeName depth colorName
  - For the full set of options, see the built-in command guidance.

References

- OpenScientist Home Page
  http://openscientist.lal.in2p3.fr
- HepRep: a generic interface definition for HEP event display representables
  http://www.slac.stanford.edu/~perl/heprep
- HepRApp HepRep Browser
  http://www.slac.stanford.edu/~perl/HepRApp
- Geant4 Qt Home Page
  http://geant4.in2p3.fr/spip.php?rubrique25&lang=en
- DAWN Home Page
  http://geant4.kek.jp/~tanaka/DAWN/About_DAWN.html
- DAWNCUT Home Page
  http://geant4.kek.jp/~tanaka/DAWN/About_DAWNCUT.html
- DAVID Home Page
  http://geant4.kek.jp/~tanaka/DAWN/About_DAVID.html
- Satoshi Tanaka's GEANT4 Ritsumeikan University Group Home Page (more information on DAWN, sample PRIM files, images, etc.)
  http://geant4.kek.jp/~tanaka/
- gMocren Home Page
  http://geant4.kek.jp/gMocren