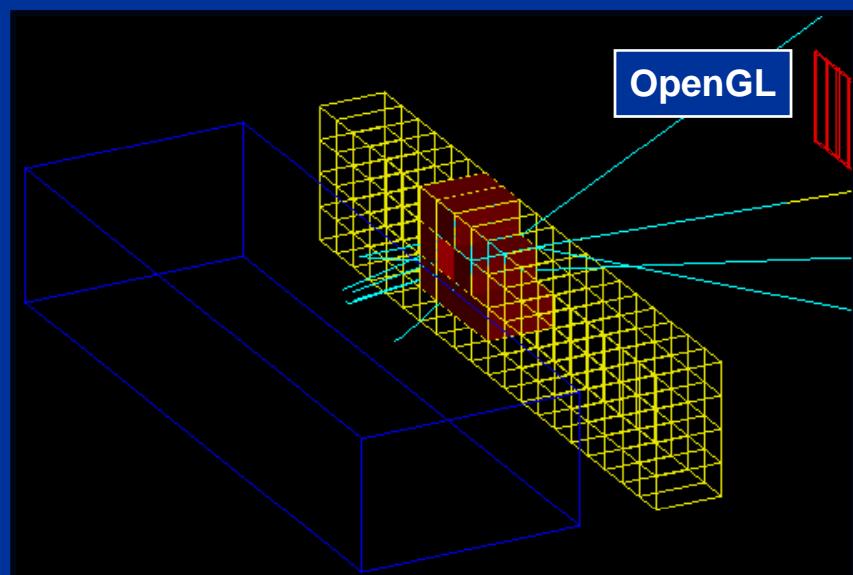
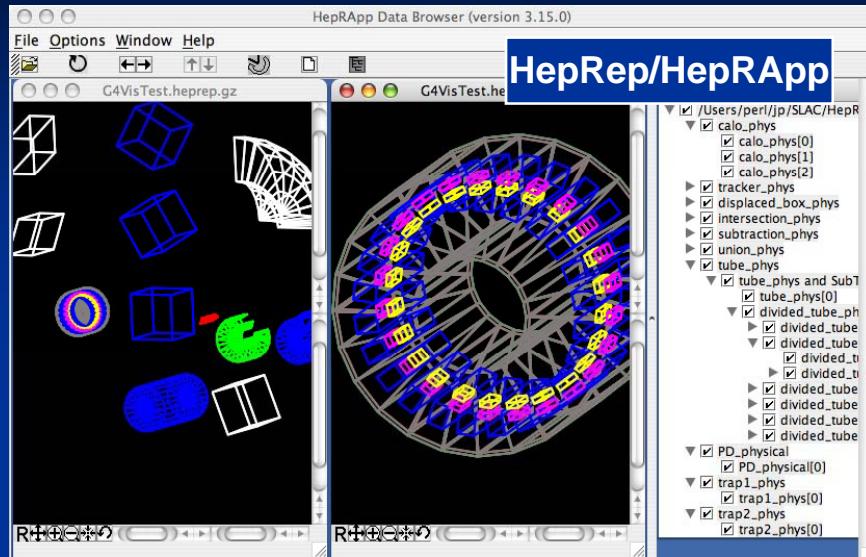
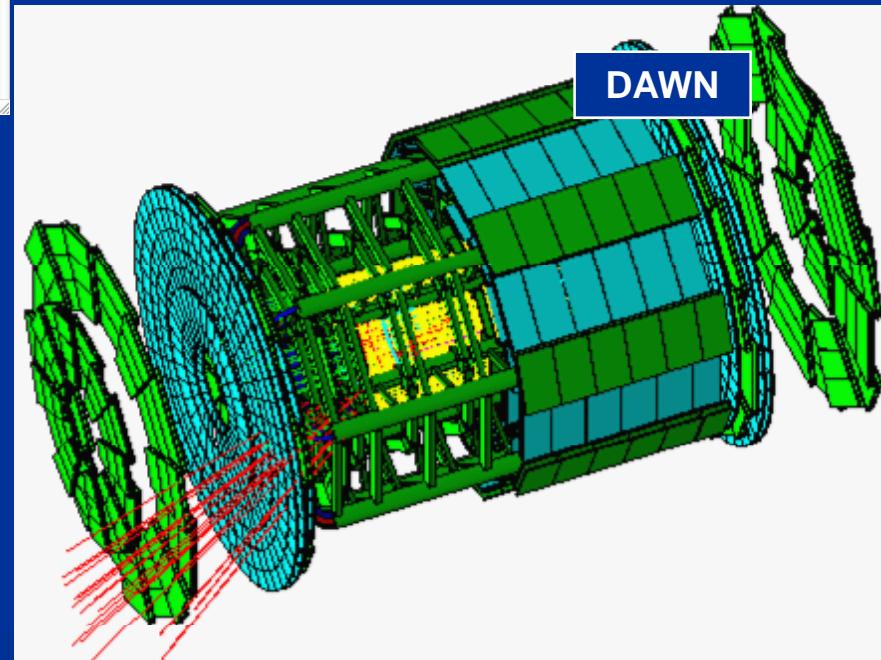


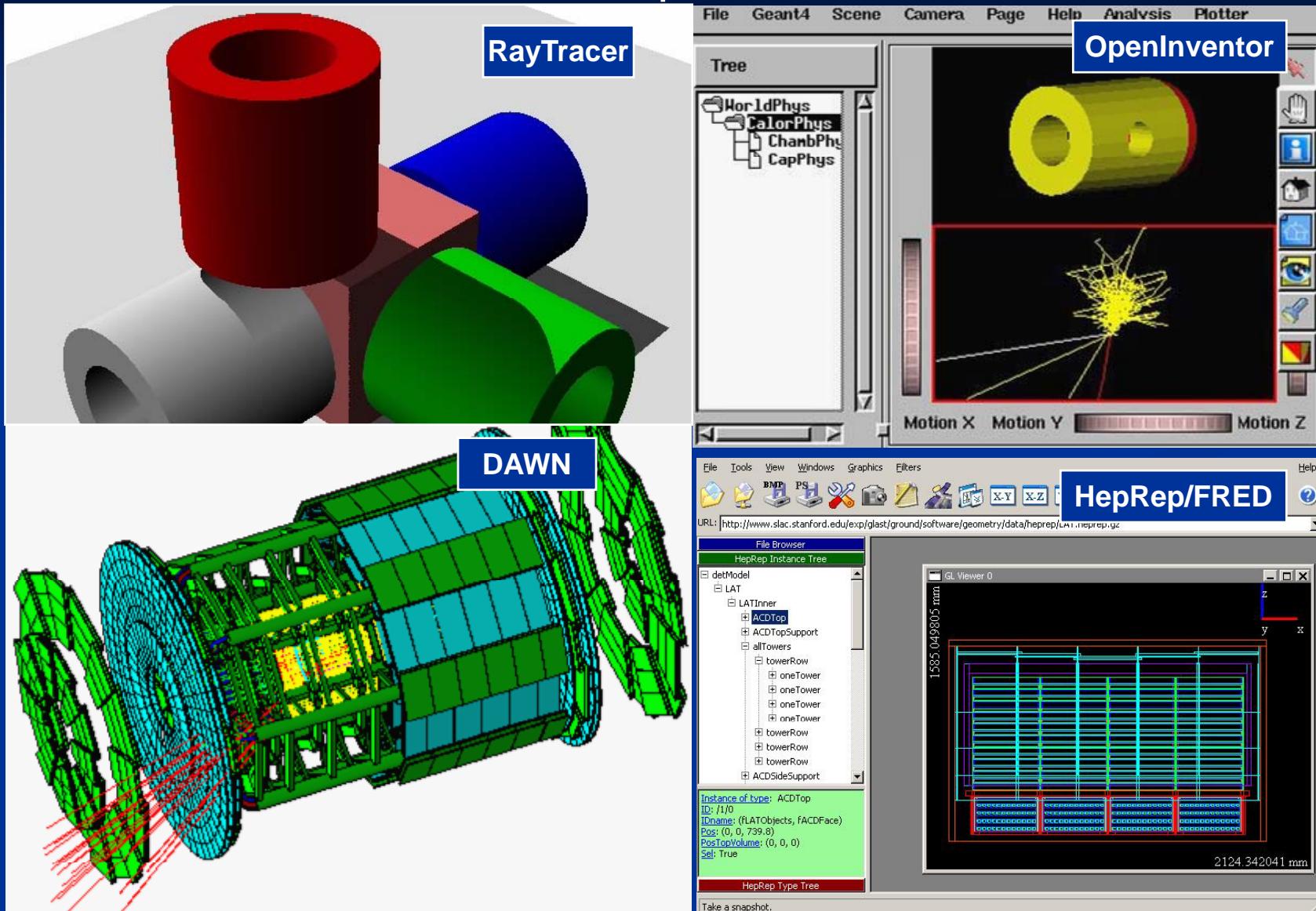
# Geant4 Visualization Review



Geant4 Collaboration  
Workshop  
Hebden Bridge  
18 September 2007  
Joseph Perl, SLAC



# Sorry, Vis Talks always need two pages of Cover Graphics



# Contents

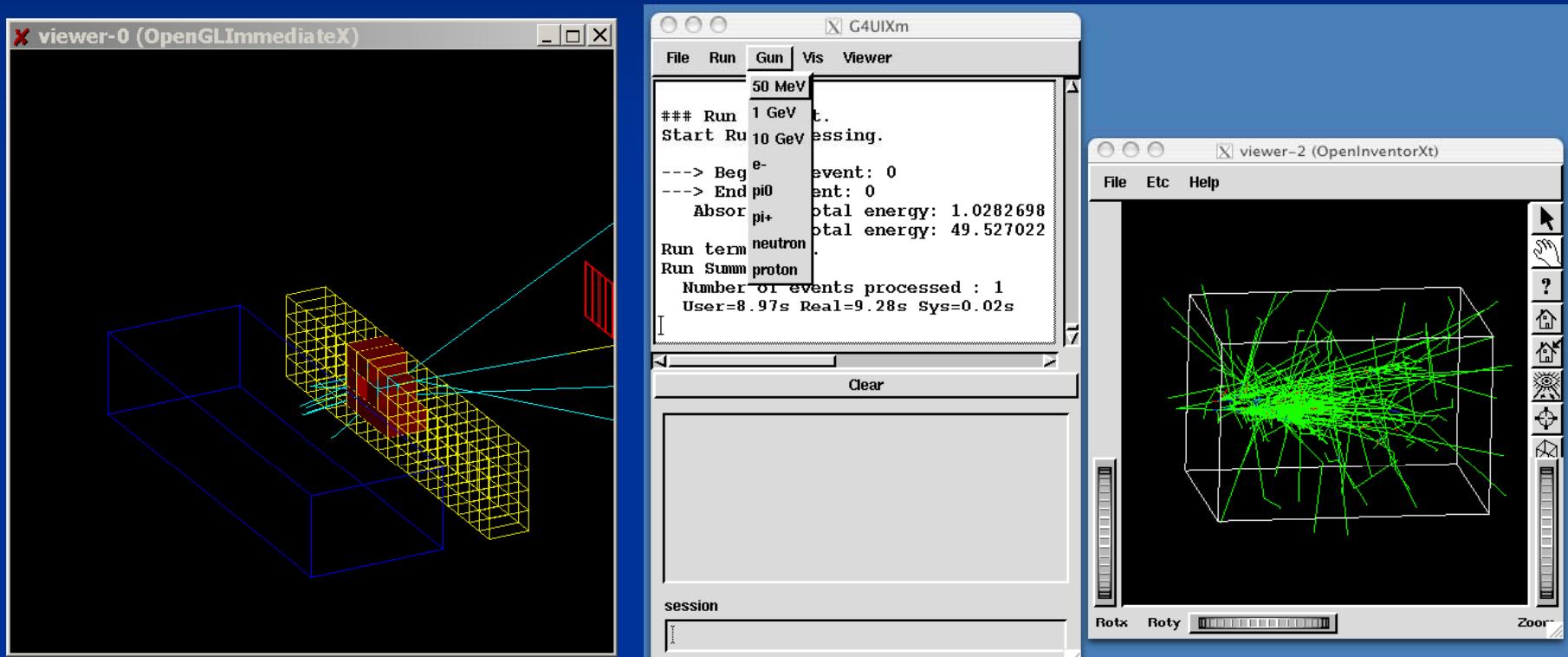
- Overview of Visualization Drivers
- Enhanced Trajectory Drawing
- Trajectory and Hit Filtering
- Smooth and Rich Trajectories
- Movies
- Volume Rendering
- Coming in Next Year: Visualization of Fields
- Subsequent talks in this session, cool new stuff:
  - Qt Interface - Laurent Garnier and Guy Barrand
  - Smooth Trajectories, Event Keeping, Picking in OGLX - John Allison
  - geant4Py Example and Web Application - Koichi Murakami

# Quick Overview of Visualization Driver Choices

- Geant4 comes with Seven families of visualization drivers:
  - OpenGL
  - OpenInventor
  - HepRep
  - DAWN
  - VRML
  - RayTracer
  - ASCIITree
- Just quick overview slides here.  
See references section for talks with more detail on individual drivers and commands.
- Different drivers are appropriate for different needs
- The set of commands the user sees are consistent regardless of the driver

# Quick response with flexible camera control to study geometries, trajectories and hits

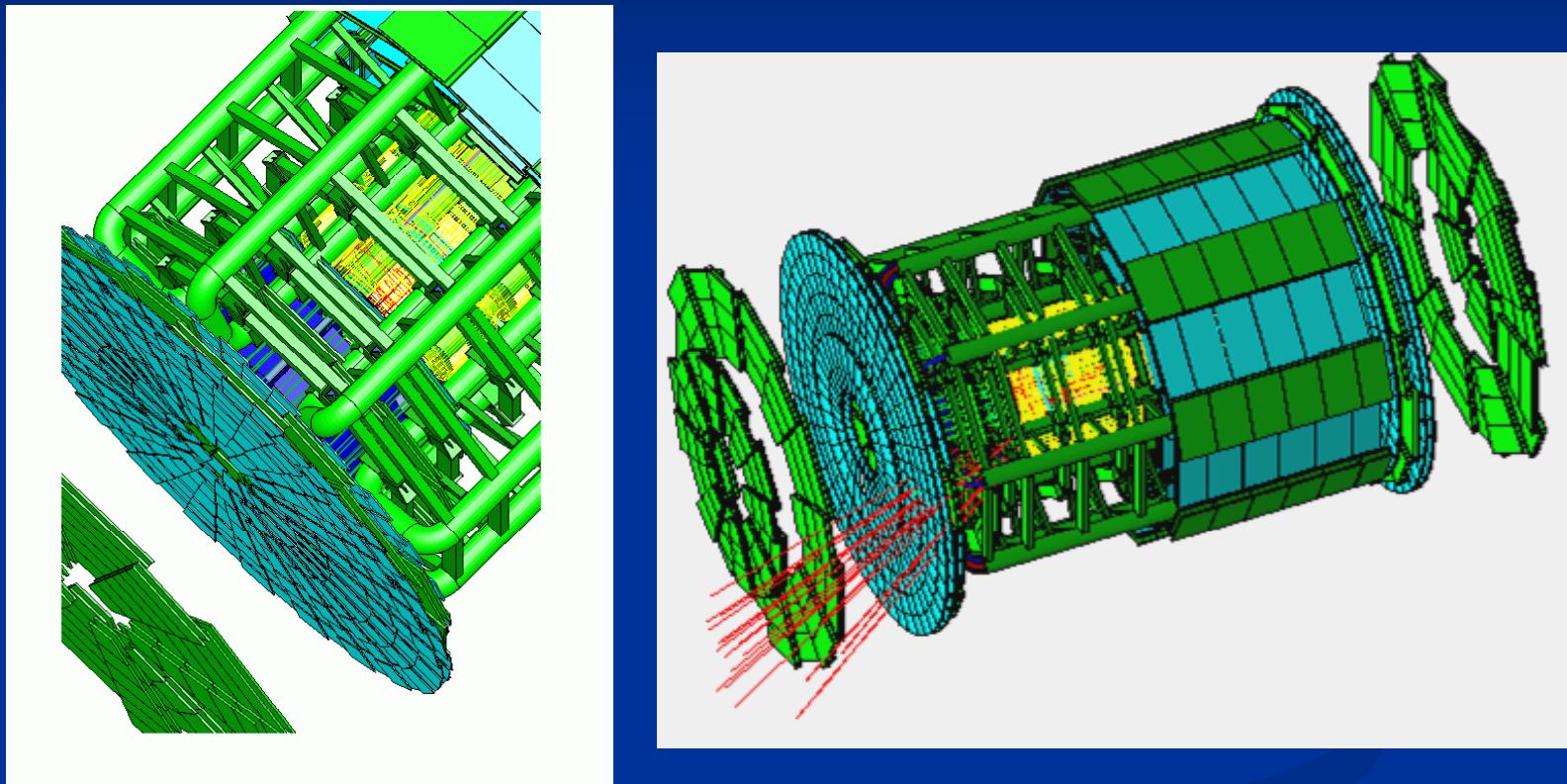
- OpenGL and OpenInventor



- Widely available world standards for fast, photo-realistic rendering.

# High-quality Output for Publications

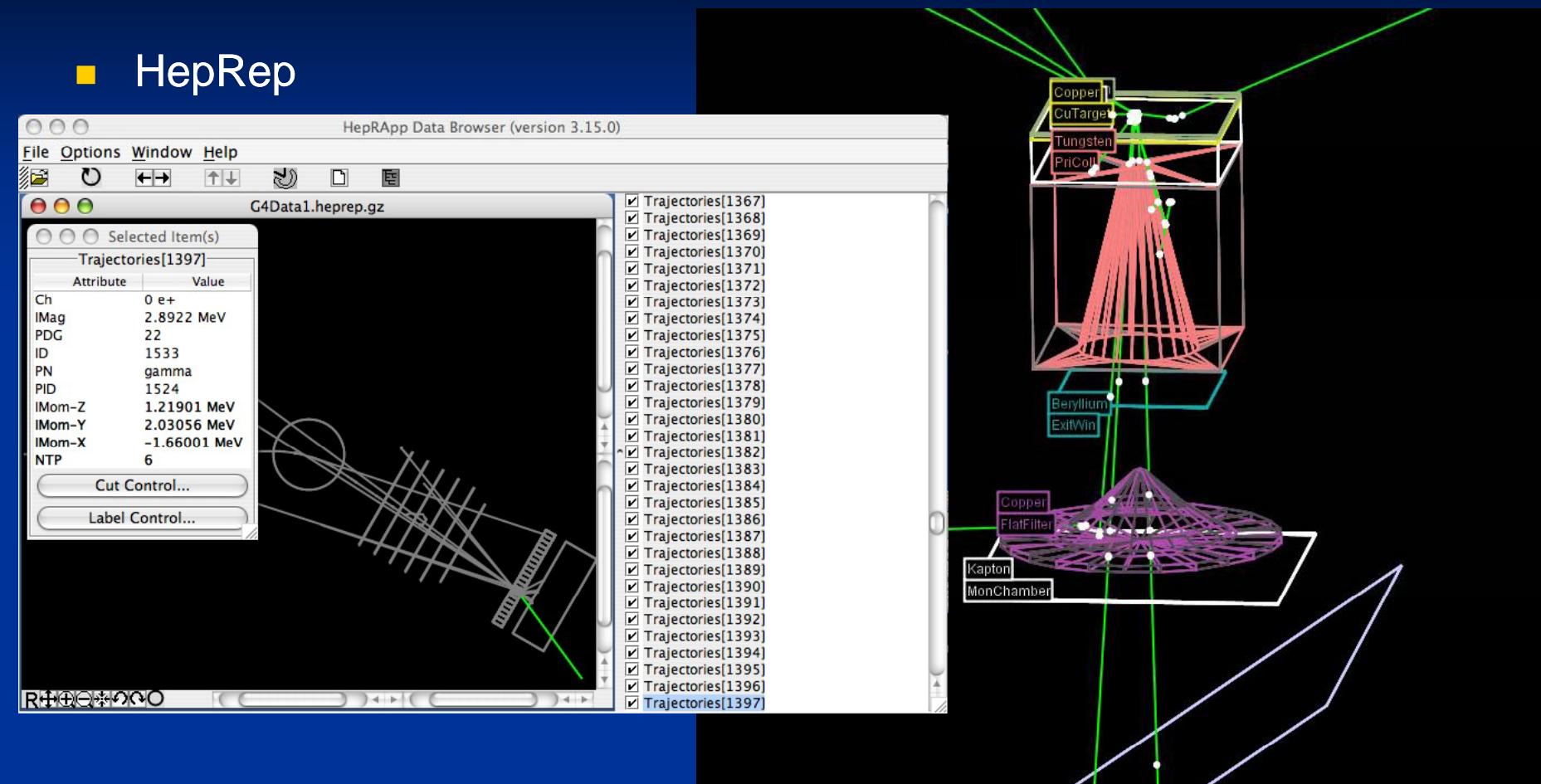
- DAWN



- Developed specifically for Geant4. Not fast, but the highest quality rendering available anywhere. Excellent for publications.

# Interactive Picking to Get More Information on Visualized Objects

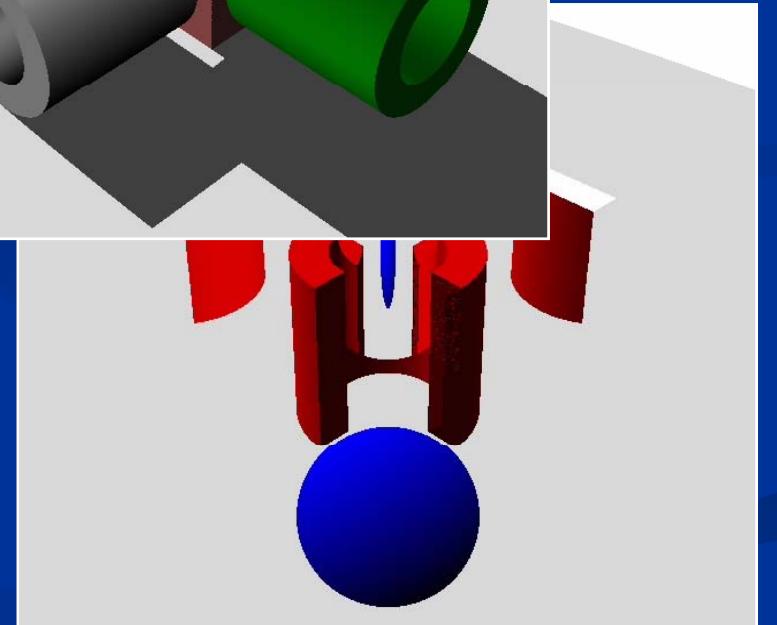
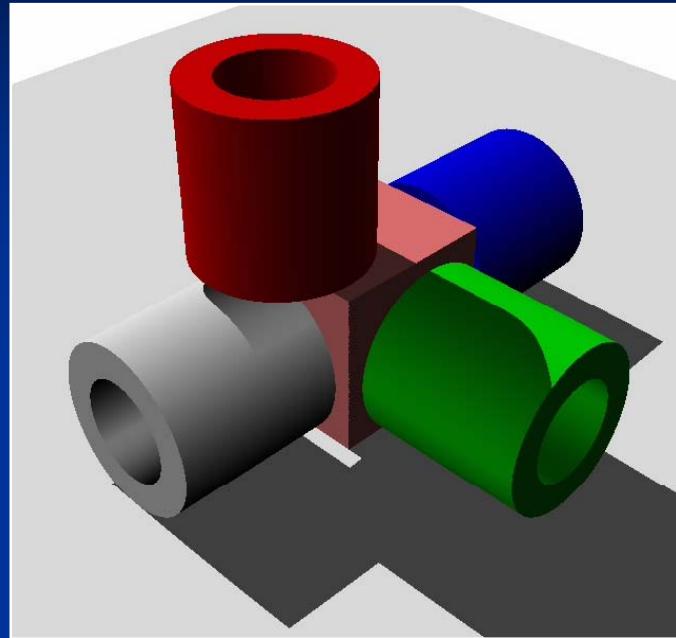
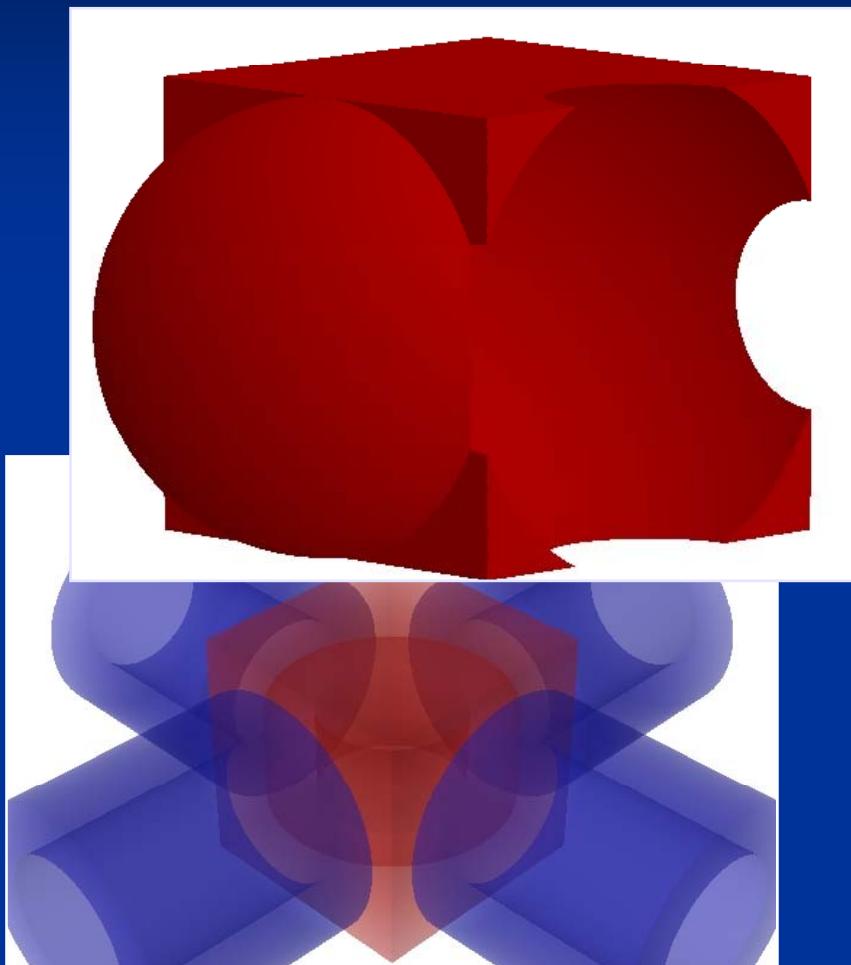
## ■ HepRep



- Reuses interactive HepRep browser applications already developed for other user communities (BaBar and GLAST). Explore hierarchies, pick to show attributes, apply cuts and labels.

# Understand Complex Boolean Solids and Transparent or Reflective Surfaces

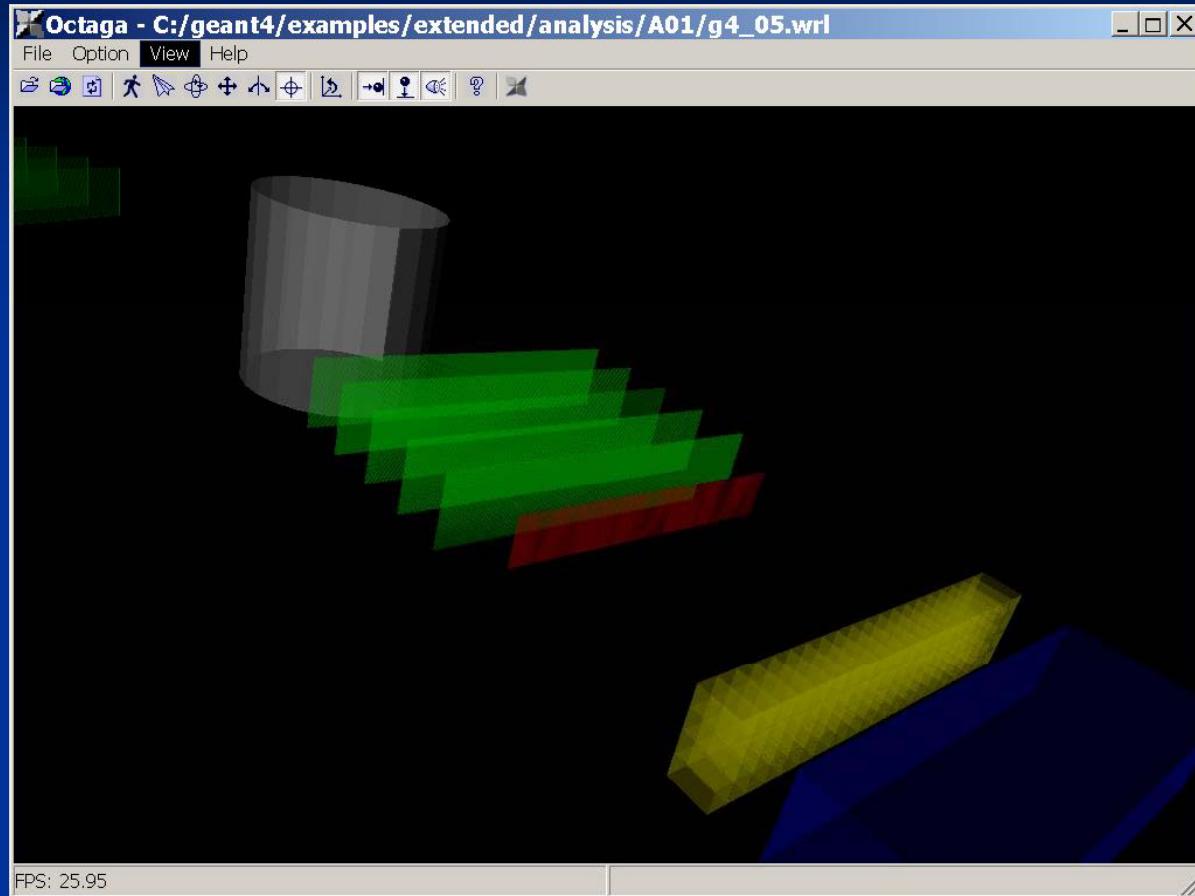
- RayTracer



- Reuses Geant4's own tracking to shoot photons through the geometry

# 3D Format Suitable for Web Distribution

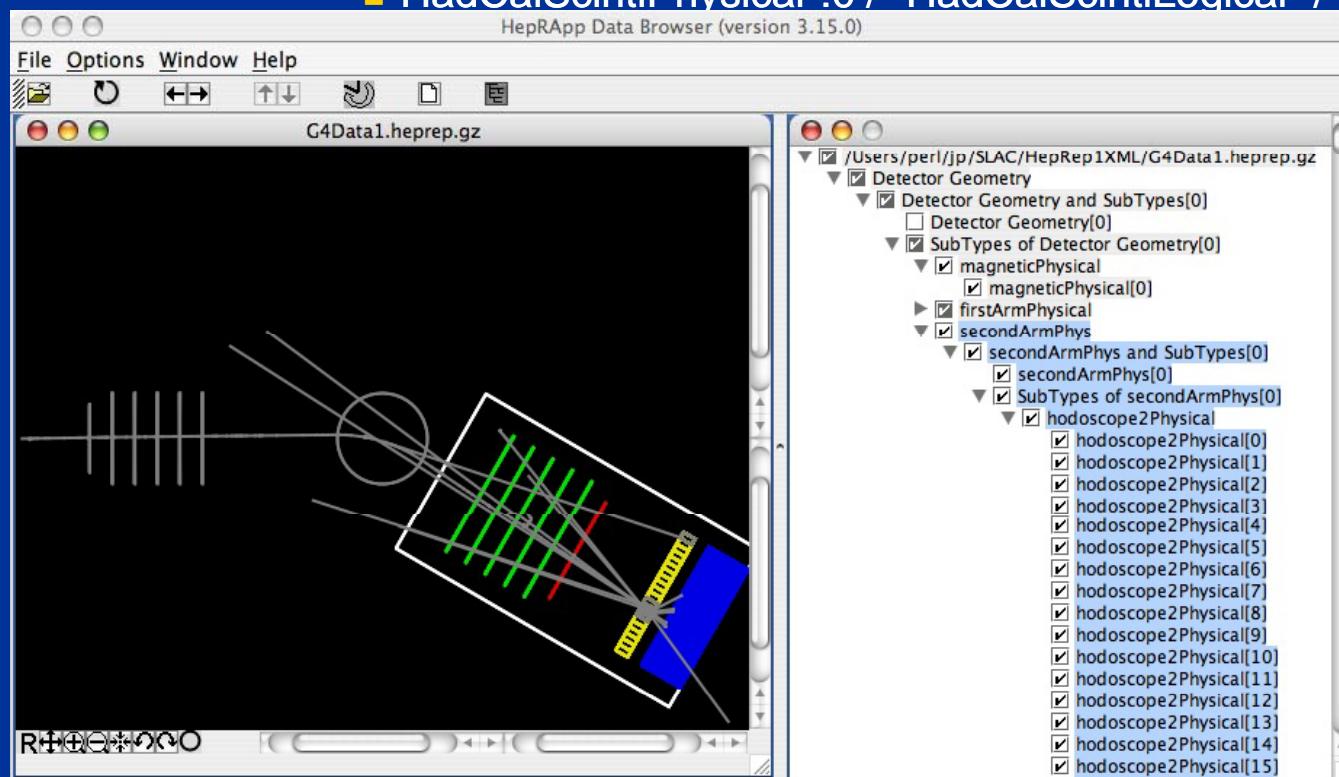
- VRML



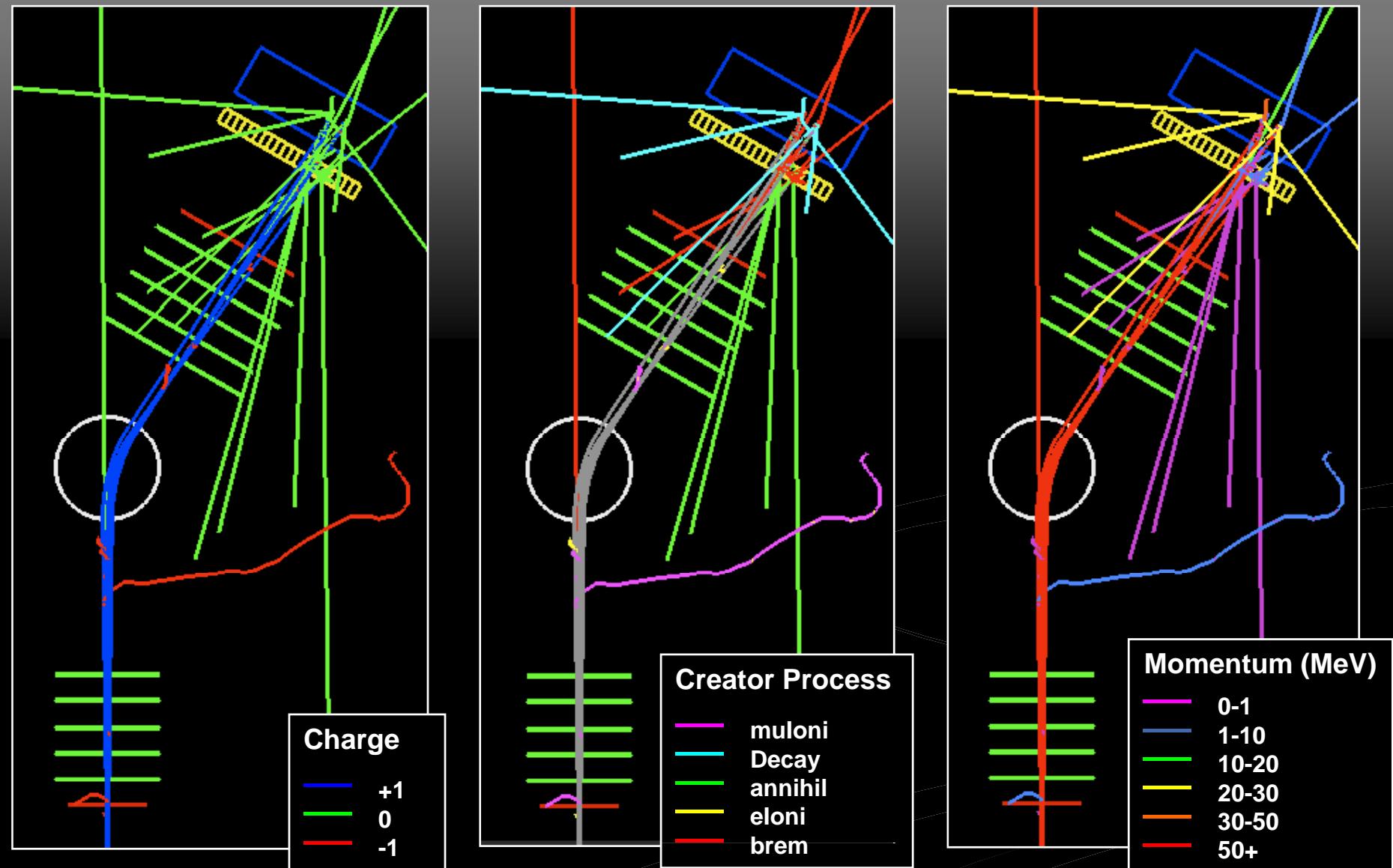
- Many VRML browsers available, some as web plug-ins

# Tools to Understand Geometry Hierarchies

- ASCIITree, HepRep
- /vis/ASCIITree/Verbose 4
- /vis/viewer/flush
- "HadCalorimeterPhysical":0 / "HadCalorimeterLogical" / "HadCalorimeterBox"(G4Box), 1.8 m<sup>3</sup>,
  - "HadCalColumnPhysical":-1 (10 replicas) / "HadCalColumnLogical" / "HadCalColumnBox"(G4Box),
    - "HadCalCellPhysical":-1 (2 replicas) / "HadCalCellLogical" / "HadCalCellBox"(G4Box),
      - "HadCalLayerPhysical":-1 (20 replicas) / "HadCalLayerLogical" / "HadCalLayerBox"(G4Box),
        - "HadCalScintiPhysical":0 / "HadCalScintiLogical" / "HadCalScintiBox"(G4Box)



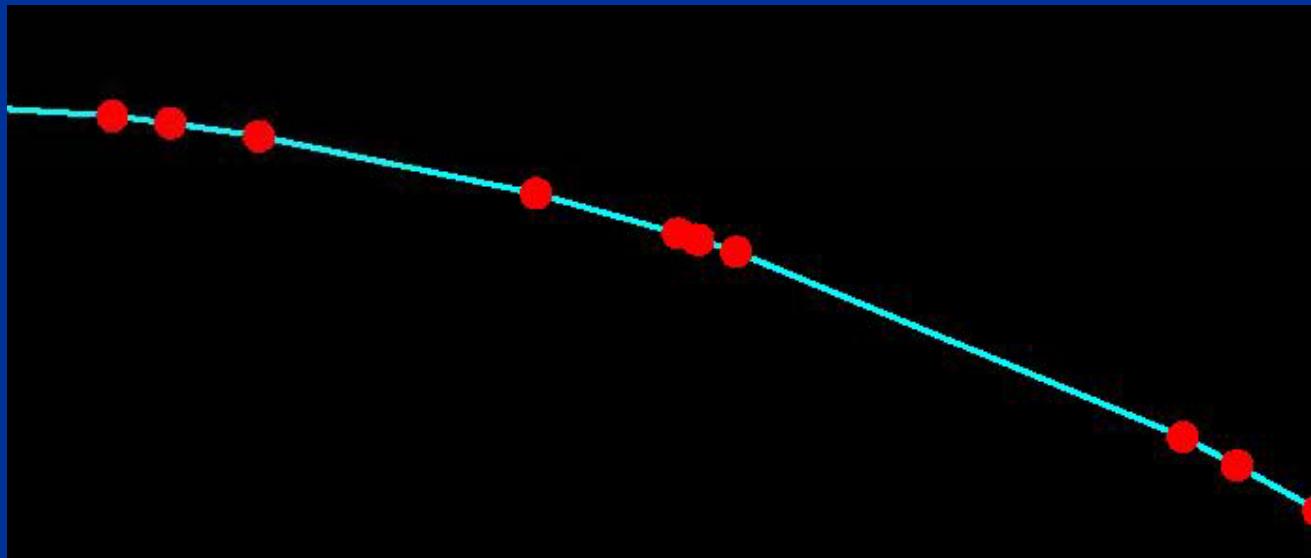
# Interactive Control of Trajectory Drawing Model



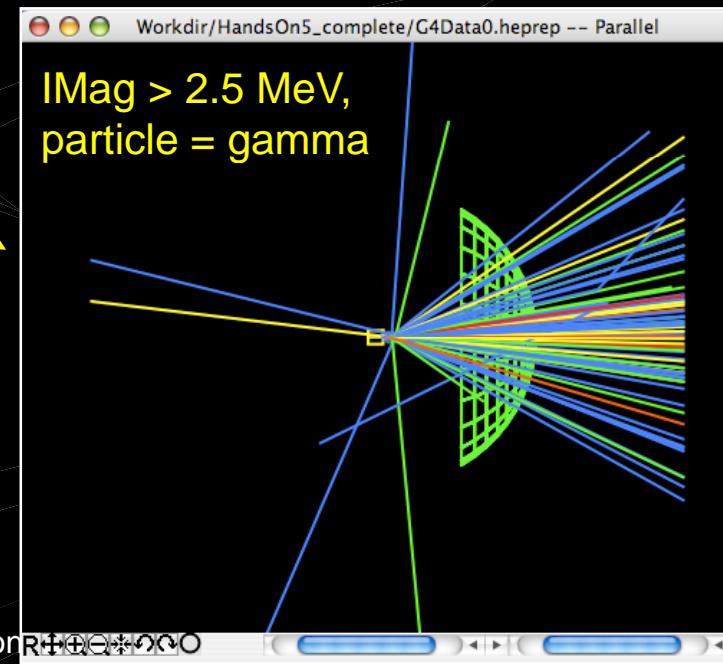
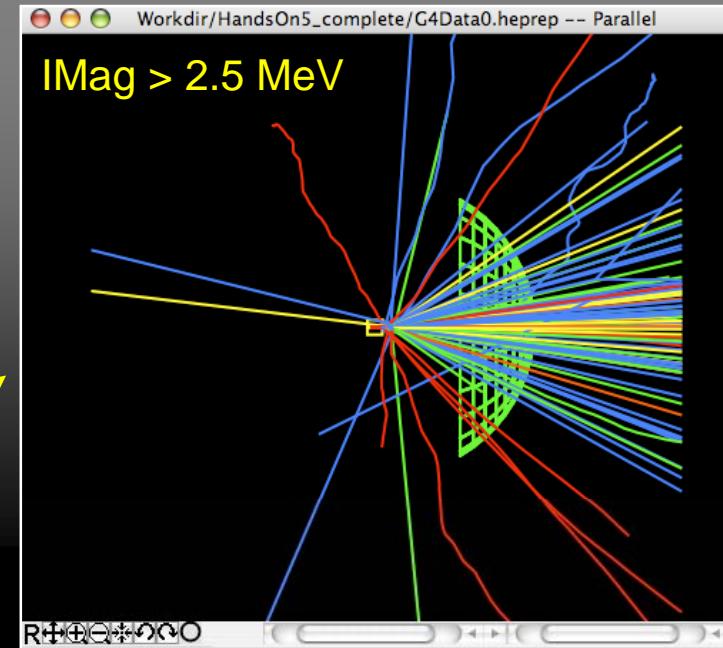
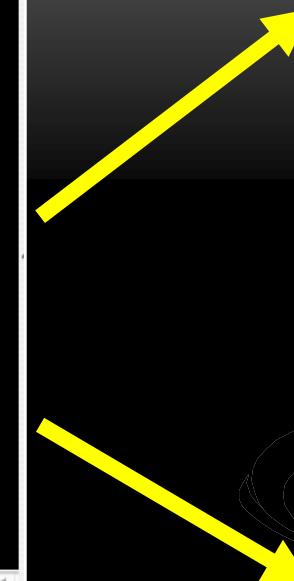
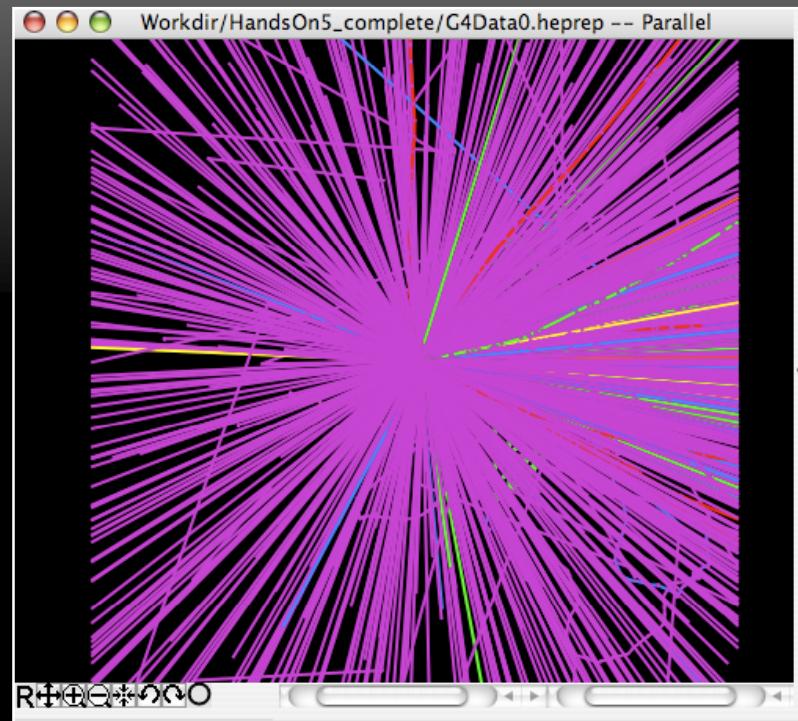
# Sample Commands: generic trajectory model

```
# Create a generic model (will get default name of generic-0)
# From here we can set overall defaults for things like line color,
# whether to show step points or just the trajectory line, etc.
/vi/modeling/trajectories/create/generic
```

```
# Configure the generic model to colour all trajectories cyan and to show step points
/vi/modeling/trajectories/generic-0/default/setDrawStepPts true
/vi/modeling/trajectories/generic-0/default/setStepPtsSize 16
/vi/modeling/trajectories/generic-0/default/setLineColour cyan
/vi/modeling/trajectories/generic-0/default/setStepPtsColour red
```



# Interactive Control of Trajectory and Hit Filtering



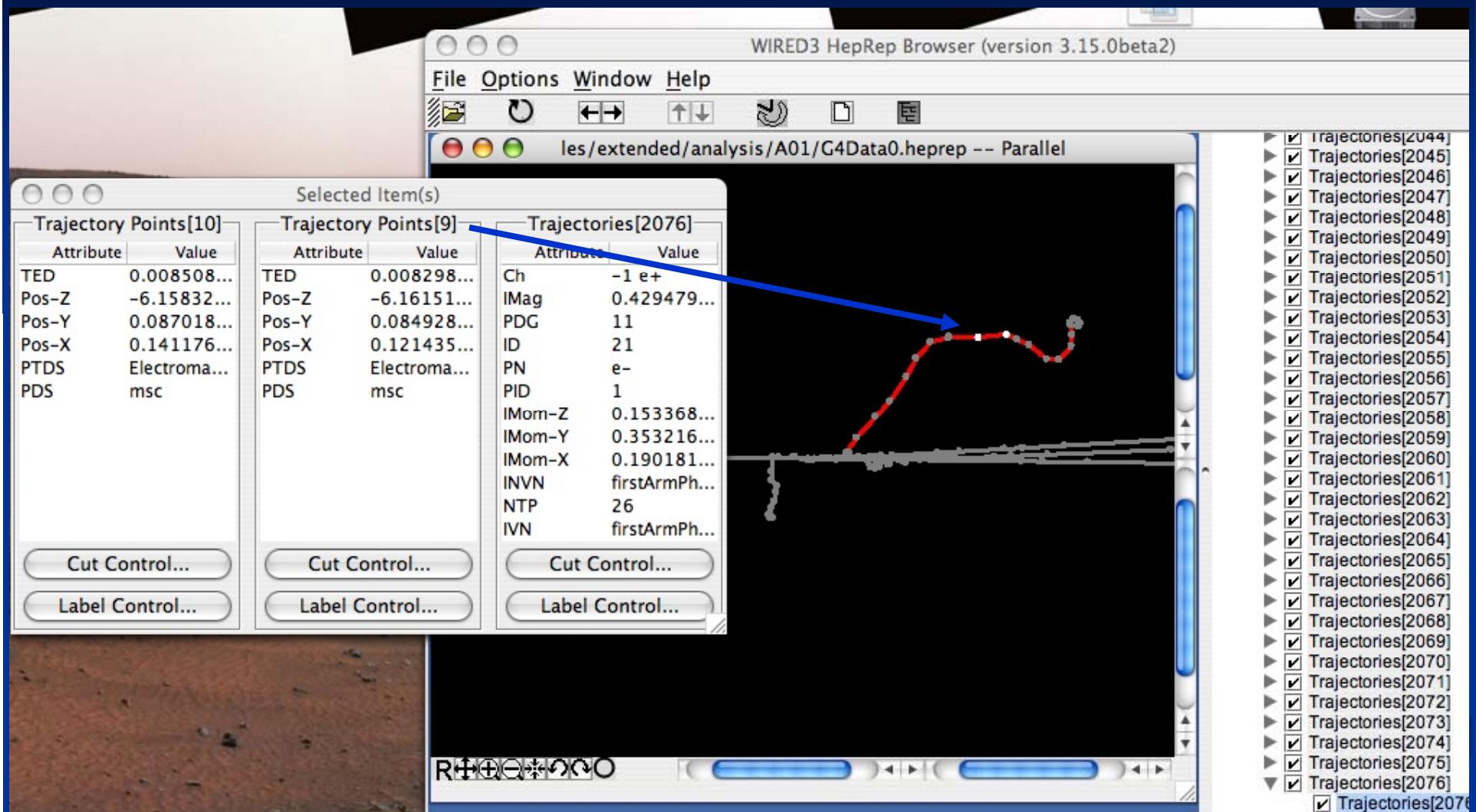
# Extra Information Available from the Trajectory

- Most users use the standard G4Trajectory
  - Smooth Trajectory adds auxiliary points to allow smoother line in visualization (not Geant4 Steps, no physics at auxiliary points)
    - Useful when trajectories are highly curved due to magnetic fields
  - Rich Trajectory encodes additional information at every step point
- Control via:
  - /vis/scene/add/trajectories
  - /vis/scene/add/trajectories smooth
  - /vis/scene/add/trajectories rich
  - /vis/scene/add/trajectories smooth rich
- If you actually want to display the trajectory points, you need to issue the appropriate trajectory modeling commands, such as:
  - /vis/modeling/trajectories/create/generic
  - /vis/modeling/trajectories/generic-0/default/setDrawStepPts true
  - /vis/modeling/trajectories/generic-0/default/setStepPtsSize 16
  - /vis/modeling/trajectories/generic-0/default/setStepPtsColour red

# Smooth Trajectory for Vis in Magnetic Fields

- See talk by John Allison later in this session

# Rich Trajectory



# Movies: Stitched Together from Multiple Stills

QuickTime™ and a  
YUV420 codec decompressor  
are needed to see this picture.

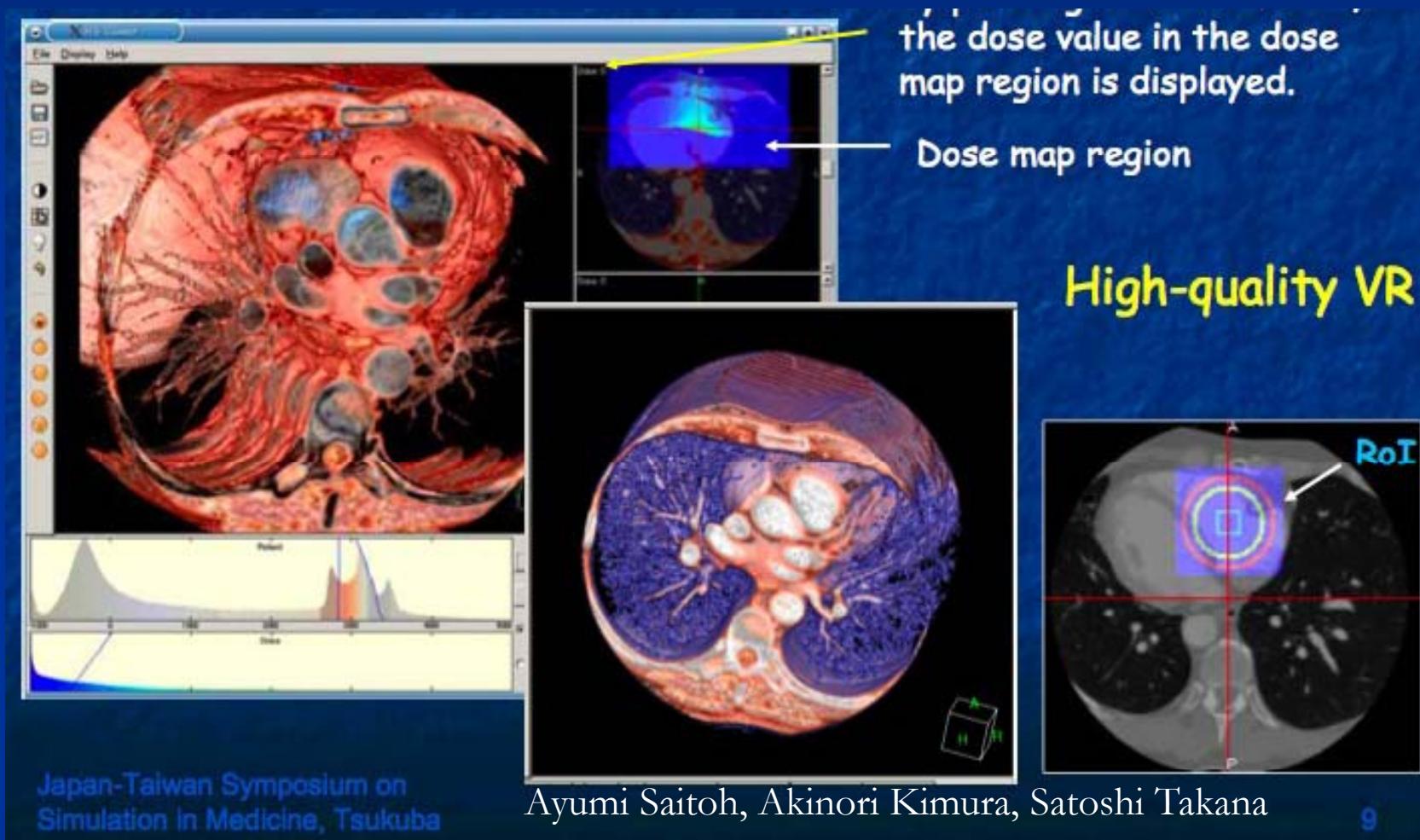
<http://www.hep.man.ac.uk/u/johna/pub/Geant4/Movies/g4RayTracer.mpg>

# Movies: Live from Geant4 OpenGL

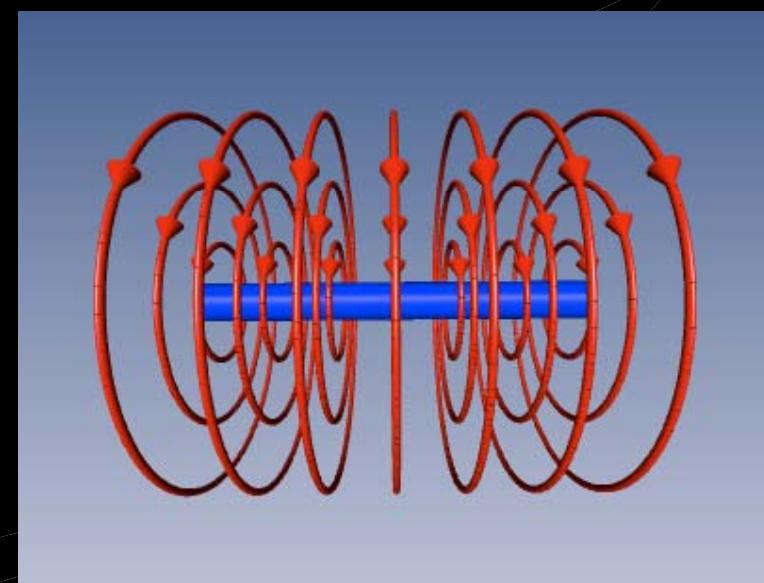
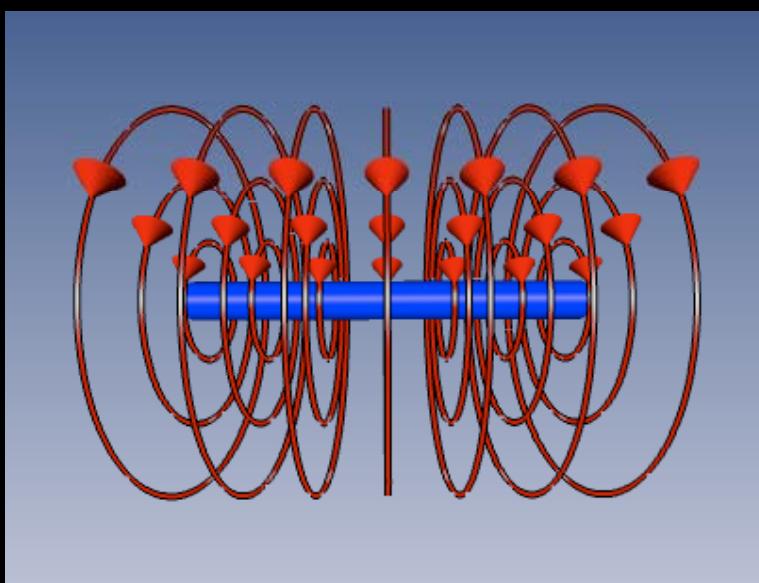
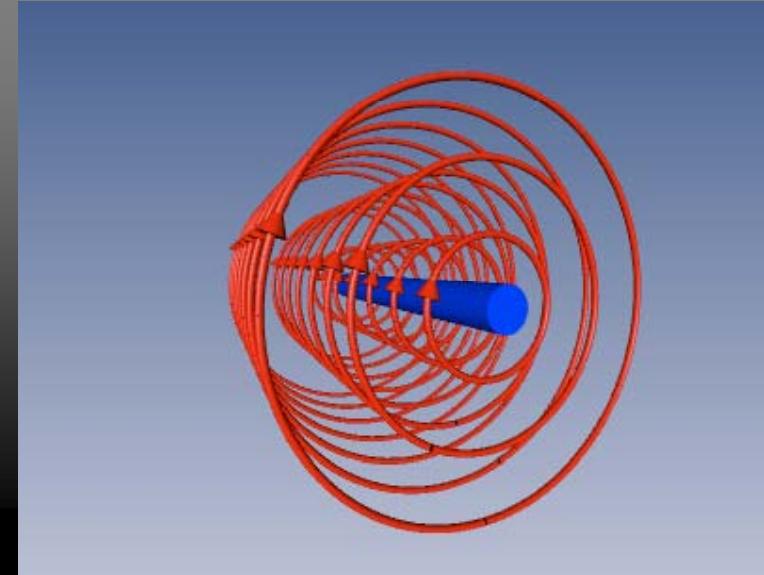
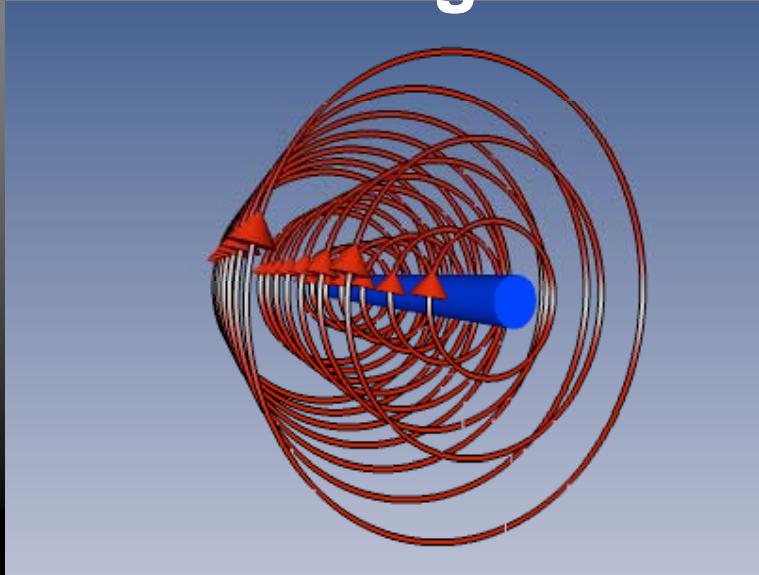
QuickTime™ and a  
decompressor  
are needed to see this picture.

# gMocren - to Visualization Volume Data

- Geant4 has been interfaced to a commercial tool for visualization of voxel data.
- Free to all Geant4 users.
- Does not actually function as integral part of the Geant4 visualization system.
  - Implemented as a G4 example, outputs data in form appropriate for gMocren



# Coming Soon: Visualization of Fields



Project Lead: Jane Tinslay

18 Sept 2007

J. Perl

Geant4 Visualization Review

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# References and Further Resources

# Geant4 Visualization Resources

## Geant4 Installation Guides

➤ <http://geant4.slac.stanford.edu/installation>

## Hands on HepRApp Tutorial

➤ <http://geant4.slac.stanford.edu/Presentations/vis/G4HepRAppTutorial/G4HepRAppTutorial.html>

## Hands on DAWN Tutorial

➤ <http://geant4.slac.stanford.edu/Presentations/vis/G4DAWNTutorial/G4DAWNTutorial.html>

## Hands on OpenGL Tutorial

➤ <http://geant4.slac.stanford.edu/Presentations/vis/G4OpenGLTutorial/G4OpenGLTutorial.html>

## Introduction to Geant4 Visualization

➤ <http://geant4.slac.stanford.edu/Presentations/vis/G4VisIntroduction.ppt> (and .pdf)

## Geant4 Visualization Commands

➤ <http://geant4.slac.stanford.edu/Presentations/vis/G4VisCommands.ppt> (and .pdf)

## Geant4 Advanced Visualization

➤ <http://geant4.slac.stanford.edu/Presentations/vis/G4VisAdvanced.ppt> (and .pdf)

## How to Make a Movie

➤ <http://geant4.slac.stanford.edu/Presentations/vis/HowToMakeAMovie.ppt> (and .pdf)

## Visualization Chapter of the Geant4 User's Guide for Application Developers

➤ <http://geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/ForApplicationDeveloper/html/>

## List of Visualization Commands:

➤ [http://geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/ForApplicationDeveloper/html/AllResources/Control/UIcommands/\\_vis\\_.html](http://geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/ForApplicationDeveloper/html/AllResources/Control/UIcommands/_vis_.html)

## For Questions or Comments: Geant4 Visualization Online Forum:

➤ <http://geant4-hn.slac.stanford.edu:5090/HyperNews/public/get/visualization.html>

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# 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>
- HepRAp HepRep Browser  
<http://www.slac.stanford.edu/~perl/HepRAp>
- Wired4 JAS Plug-In  
<http://wired.freehep.org>
- Fred: oh no, another event display (a HepRep client)  
<http://www.fisica.uniud.it/~glast/FRED>
- DAWN Home Page  
[http://geant4.kek.jp/~tanaka/DAWN/About\\_DAWN.html](http://geant4.kek.jp/~tanaka/DAWN/About_DAWN.html)
- DAWNCUT Home Page  
[http://geant4.kek.jp/~tanaka/DAWN/About\\_DAWNCUT.html](http://geant4.kek.jp/~tanaka/DAWN/About_DAWNCUT.html)
- DAVID Home Page  
[http://geant4.kek.jp/~tanaka/DAWN/About\\_DAVID.html](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/>