User Documentation and Examples

Geant4 Tutorial: version 10.0.p01

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U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

Geant4 User Documentation

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Four manuals distributed at every Geant4 release

- Installation Guide
- Application Developer's Guide
- Toolkit Developer's Guide
- Physics Reference Manual

Many validated examples of varying complexity

- Basic Examples: core components of toolkit
- Extended Examples: extensions, configuration options
- Advanced Examples: complete "practical" applications

Online discussion forums for users and collaborators

Geant4 User Documentation

The four Users' Guides are generally updated and published at the same time as the toolkit is released.

http://geant4.cern.ch/support/userdocuments.shtml

All four Users' Guides are available as PDF documents (some of them quite long).

The *Installation*, *Application* and *Toolkit Guides* are also available in HTML form, broken into chapters.

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User Documentation

Version: Geant4 10.0 (Release: 6th December 2013)

Welcome to the Geant4 User's Documents page. This page gives you an overview of all available documents which are created and maintained by the Geant4 international collaboration.

GEANT4 is a toolkit for both full and fast Monte Carlo simulation of detectors in High Energy Physics. It is also designed to take into account the requirements of space and cosmic ray applications, nuclear, heavy ion and radiation computations, and medical applications.

The following document gives you a more complete introduction to Geant4.

- Introduction to Geant4 [pdf version]

For information of changes in User's Documents since the last release, please see the following note.

- Changes in User's Documents since the last release

You can search for the all Geant4 User's Documents containing the word you specified.

- Searching: Key in a string in the following field and hit the return key
  Tips

Geant4 Installation Guide

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You should have already encountered the *Installation Guide* in preparing for this tutorial.

- Supported and tested platforms
  - Linux flavors, MacOSX versions, Windows versions
- Use CMake to configure build environment
  - Source vs. build vs. installation directories
  - CMake options, advanced features
  - Installing database libraries
- Use GMake to compile and install
  - Shell scripts to set “minimal” user environment
- GMake still fully supported for user application builds

Application Developer's Guide

The *App Guide* covers all of the classes, and all of the software categories, you might need when writing your own user application.

- Geometry: shapes, materials, and structure
- Physics processes and physics lists
- Generating particles for events
- User actions: customizing the event loop
- Collecting data during events
- User interface: macros and commands
- Visualization

Toolkit Developer's Guide

The *Toolkit Guide* covers the design philosophy and organization of the toolkit, with information useful to both Geant4 collaboration members and users who want to add new features not available in the distribution.

- Defining special purpose solids for complex geometries
- Creating new physics processes or models
- Creating run or event managers with special features

The *Toolkit Guide* is currently being revised to provide more complete and up to date guidance.

Physics Reference Manual

The *PRM* provides a detailed summary of the physics implemented in each of the processes and models (EM, hadronic, and optical) with references to the source publications.

Geant4 Example Applications

As part of the toolkit distribution, Geant4 provides an extensive set of examples covering a wide range of complexity.

- ***Basic***: complete applications demonstrating simple features of toolkit, useful for tutorial purposes
- ***Extended***: demonstrate specific, more complex use cases; some require use of external (non-Geant4) libraries
- ***Advanced***: complex, "experiment-level" applications with complex geometries and physics focused on particular user communities

Documentation is in README files and Web pages

Basic Examples

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`http://geant4.web.cern.ch/geant4/UserDocumentation/Doxygen/examples_doc/html/README_basic.html`

Example B1

- Few simple solids, simple placements
- Scoring total dose in a selected volume user action classes

Example B2

- Magnetic field, parametrised placements
- Scoring within tracker via G4 sensitive detector and hits
- Geant4 physics list (FTFP_BERT) with step limiter

Example B3 (Schematic PET system)

- Simple placements with rotations
- Scoring within Crystals via G4 scorers
- Radioactive source, modular physics list using builders

Example B4 (Layered calorimeter)

- Geometry with replicas (G4PVReplica)
- Multiple scoring methods
- Histograms (1D) and ntuple saved in the output file

Example B5 (Double-arm spectrometer)

- Complex geometry with rotation, replicas and parametrisation
- Scoring within multiple volumes via G4 sensitive detector and hits
- Local UI commands defined using G4GenericMessenger
- Histograms (1D, 2D) and ntuple saved in the output file

Extended Examples

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http://geant4.web.cern.ch/geant4/UserDocumentation/Doxygen/examples_doc/html/README_extended.html

analysis	Histogramming through the AIDA interface
biasing	Examples of event biasing, scoring and reverse-MC
common	A set of common classes which can be reused in other examples demonstrating just a particular feature
electromagnetic	Specific EM physics simulation with histogramming
errorpropagation	Use of the error propagation utility (Geant4e)
eventgenerator	Applications demonstrating various ways of primary event generation: using Geant4 particle gun, Geant4 general particle source, using interface to HepMC, Pythia

Extended Examples (continued)

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exoticphysics	Exotic simulation applications (classical magnetic monopole, etc...)
field	Specific simulation setups in magnetic field
g3tog4	Examples of usage of the g3tog4 converter tool
geometry	Specific geometry examples and tools, OLAP tool for detection of overlapping geometries
hadronic	Specific hadronic physics simulation with histogramming
medical	Specific examples for medical physics applications
optical	Examples of generic optical processes simulation setups
parallel	Examples of event-level parallelism in Geant4 using the TOP-C distribution, and MPI technique
parameterisation	Examples for fast shower parameterisations according to specific models (gflash)

Extended Examples (continued)

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persistency	Persistency of geometry (GDML or ASCII) and simulation output
polarisation	Use of physics processes including polarization
radioactivedecay	Examples to simulate the decays of radioactive isotopes and induced radioactivity resulted from nuclear interactions
runAndEvent	Examples to demonstrate how to connect the information between primary particles and hits and utilize user-information classes
visualization	Specific visualization features and graphical customisations

Advanced Examples

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http://geant4advancedexampleswg.wikispaces.com/ExamplesDocumentation

amsEcal	Simulation of an Electromagnetic calorimeter allowing precise and three dimensional imaging of a lateral and longitudinal shower development
Brachytherapy	Dosimetry for endocavitary, interstitial and superficial brachytherapy
ChargeExchangeMC	Simulation of charge exchange real experiment performed at the Petesburg Nuclear Physics Institute (PNPI, Russia)
Composite calorimeter	A composite electromagnetic and hadronic calorimeter, similar to a *CMS* test beam set-up
Dnaphysics	Simulation of a track structure in liquid water using the Geant4 DNA very low energy processes

Advanced Examples (continued)

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Dnageometry	Simulation of a realistic cell nucleus, including DNA content
eRosita	PIXE simulation with Geant4
Gamma-knife	A device for Stereotactic Radiosurgery with Co60 sources for treatment of cerebral diseases
Gamma-ray telescope	A simplified typical gamma-ray telescope (such as GLAST), with advanced description of the detector response
Hadrontherapy	Simulation of a transport beam line for proton and ion therapy
Human_phantom	
iort_therapy	

Advanced Examples (continued)

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Medical Linac	**A typical LINAC accelerator for IMRT, simular to one used in the clinical practice**
Microbeam	**Simulation of a cellular irradiation microbeam line using a high resolution cellular phantom**
Microdosimetry	**Combination of Geant4 EM processes with Geant4-DNA processes**
Microelectronics	**Combination of Geant4 EM processes with G4MicroElec processes**
Nanobeam	**Simulation of a nanobeam line facility**
Purging magnet	**Electrons traveling through the magnetic field of a strong purging magnet in a radiotherapy treatment head**
Radioprotection	**Dose distributions in interplanetary space radiation enviroment, for the radioprotection of astronauts in space vehicles and planetary habitat.**

Advanced Examples (continued)

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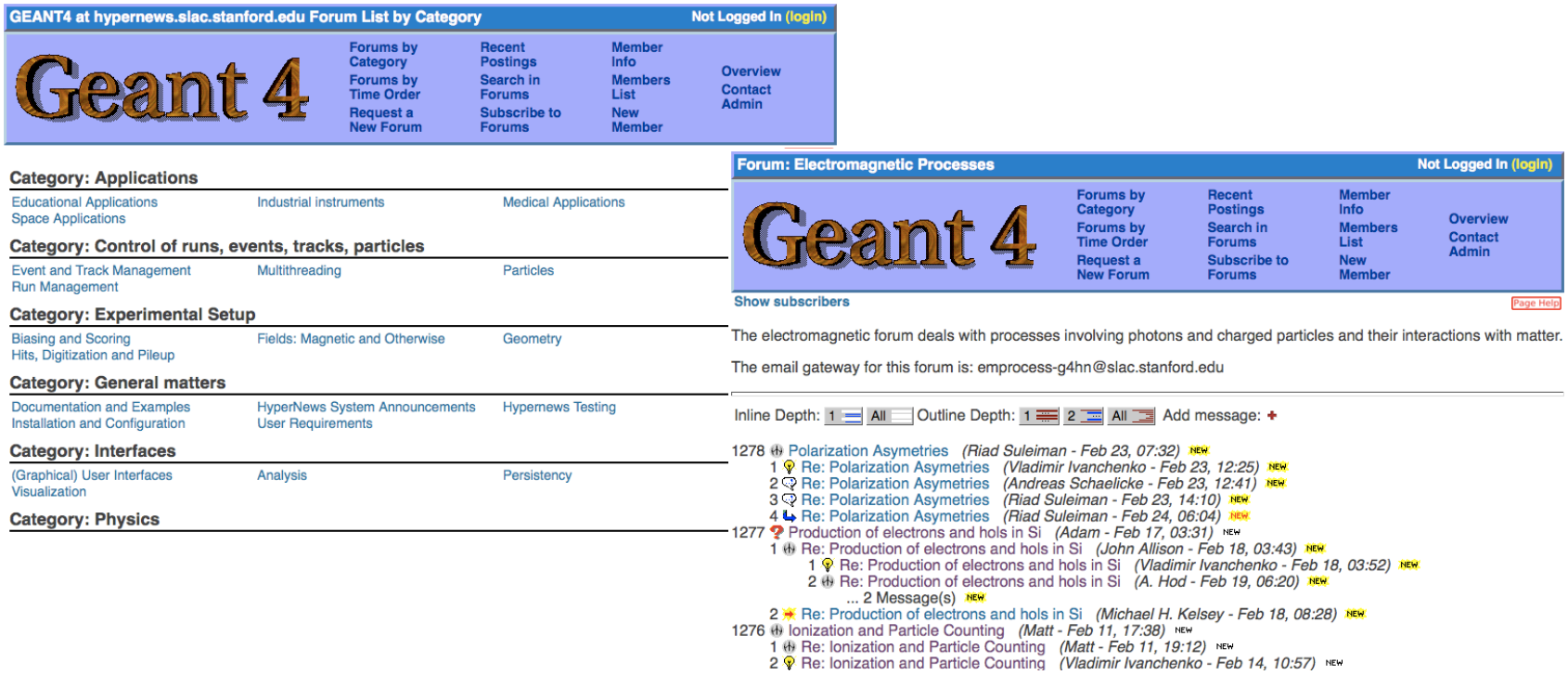
RICH	**A RICH detector in a set-up similar to the LHCb test beam**
Underground physics	**A simplified typical dark matter detector (such as the Boulby Mine experiment)**
X-ray fluorescence	**Elemental composition of material samples through X-ray fluorescence spectra**
X-ray telescope	**A simplified typical X-ray telescope (such as XMM-Newton or Chandra)**

Hypernews Discussion Forums

Multiple topical sections for discussion among users and between users and Geant4 developers

http://hypernews.slac.stanford.edu/HyperNews/geant4/cindex



LXR Source Code Browser

A Web interface to all of the Geant4 source code is available through KEK

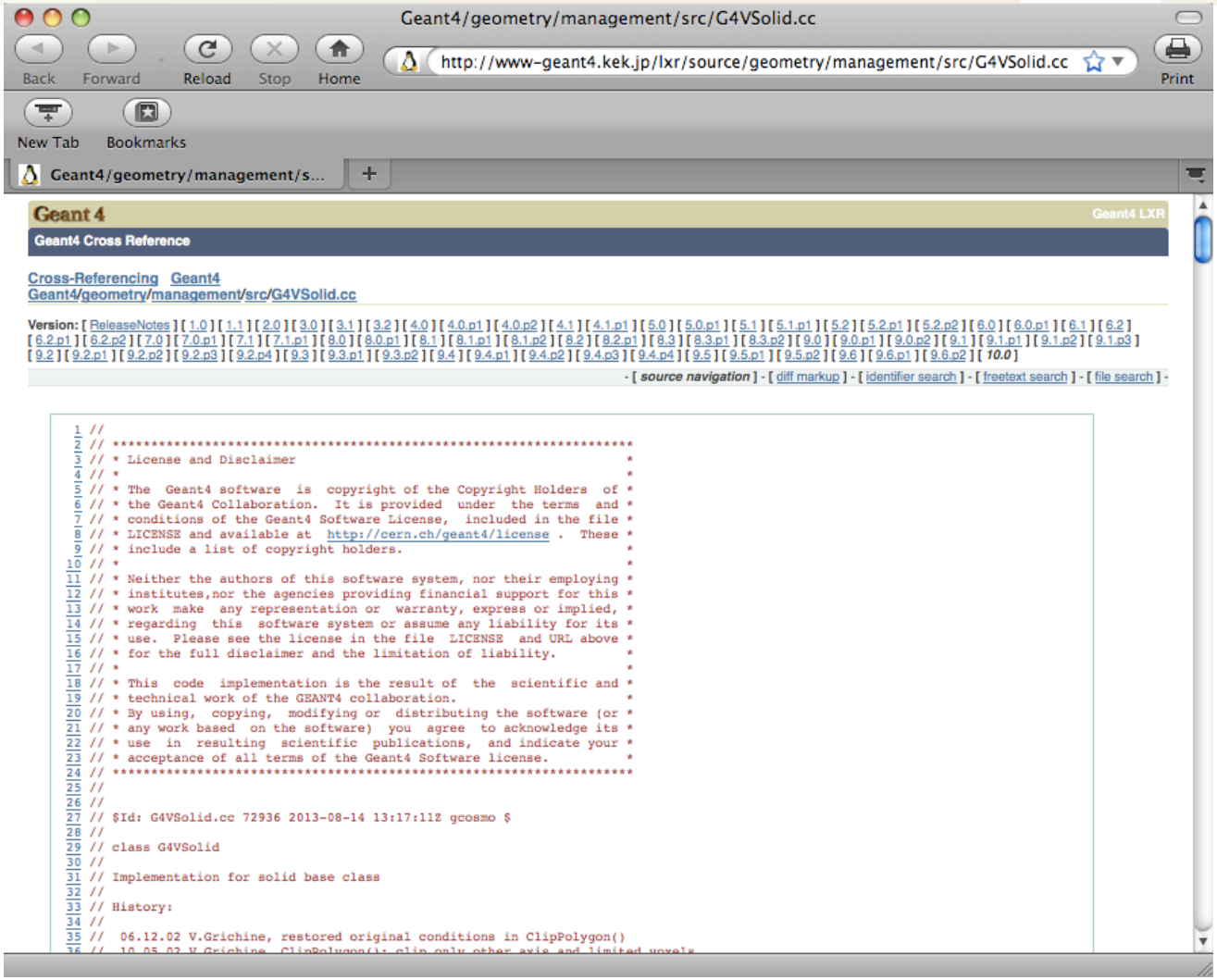
http://www-geant4.kek.jp/LXR/

- Code selectable by release number
- Annotated: headers, classes, functions hyperlinks

A Doxygen generated interface is also available, but not all code has necessary annotations

http://www-geant4.kek.jp/Reference/

LXR Source Code Browser



Doxygen Source Code Reference

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