User Documents and Examples

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Geant4 ED PHENIICS Tutorial,

13 - 17 May 2019, Orsay

Outline

- ## User documents
  - Installation Guide, Application Developers' Guide, Physics Reference Manual, Toolkit Developers Guide

- ## Examples
  - Basic, extended and advanced examples

- ## User Aids
  - LXR source code browser
  - HyperNews User Forum
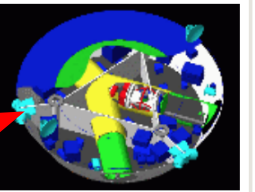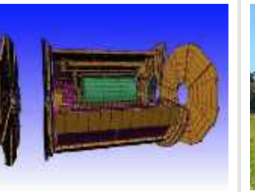 - Bug report system

Geant4 Web Pages
http://geant4.cern.ch

http://geant4.web.cern.ch/support

Geant4
A SIMULATION TOOLKIT

Download | **User Forum** ⊞
Contact Us | **Gallery**

User Support

Submitted by Anonymous (not verified) on Wed, 06/28/2017 - 11:23

1. Getting started
2. Training courses and materials
3. Source code
   a. Download page
   b. LXR code browser ⊞
   c. doxygen documentation ⊞
   d. GitHub ⊞
   e. GitLab @ CERN ⊞
4. Frequently Asked Questions (FAQ) ⊞
5. Bug reports and fixes ⊞
6. User requirements tracker ⊞
7. User Forum ⊞
8. Documentation
   a. Introduction to Geant4 [pdf]
   b. Installation Guide: [pdf]
   c. Application Developers ⊞ [pdf]

Related Links

- Object Oriented Analysis & Design
- Archive ⊞
- Mailing list subscription
- User requirements document (pdf)
- Technical Forum

Documentation

- New Geant4 User's Documents page since the last (10.4) release

- Links to User's Guides

  - Introduction to Geant4

  - Installation Guide

  - Application Developers Guide

  - Toolkit Developers Guide

  - Physics Reference Manual

  - Physics List Guide

- Changes in User's Documents since the last release (came only with the new documentation system)

Introduction to Geant4

- A basic introduction to Geant4 suitable for a novice user
- Contents:
  - Geant4 Scope of Application
  - History of Geant4
  - Overview of Geant4 Functionality
  - Geant4 User Support
  - Software Knowledge Required to Use the Geant4 Toolkit
  - Computing Environment Required by the Geant4 Toolkit
- Link

Installation Guide

- The installation guide instructs you in the setting up of the Geant4 toolkit on your computer.

  - How to install using CMake

  - How to build an application (executable program)

- List of supported platforms

  - Currently Linux, Mac OSX, Windows

- List of required software

  - C++ compiler, CMake, Geant4 toolkit

  - Choices for visualization software

- Link

Application Developers Guide

- Introduces new users to Geant4 toolkit
  - The first part of the document provides a step-by-step tutorial in the use of Geant4; this is for a novice user.

- Describes the most useful tools how to set up and run a simulation application
  - The second part describes the usage of the toolkit for practical applications, with a lot of example codes.
  - After reading this part, you will be able to start to write a detector simulation program for most applications/experiments.

- The third part is for those who want to make more advanced use of the toolkit.

- Link

Physics Reference Manual

- This is a detailed description of the physics interactions provided in the Geant4 toolkit

    - Presents the theoretical formulation, model or parameterization of the physics interactions included in Geant4

- Serves as a reference for toolkit users and developers who wish to consult the underlying physics of an interaction

- The manual contains some gaps in documentation - we're working on it. Improvements are expected by the next release.

- Link

Toolkit Developers Guide

- For developers and experienced users who want to contribute to the extension of the functionality to the Geant4 toolkit of Geant4

  - For example, to add a new physics process, to add a new particle, etc

  - A working knowledge of programming using C++ is assumed

- Includes

  - A description of the object oriented design of the Geant4 toolkit

  - A guidance for users who want to extend the functionality of of each class category of Geant4

- Link

Physics Lists Guide

- A brief guide to physics lists in particular the reference ones and the electromagnetic options.

- This is a new guide!

- This guide is a description of the physics lists class which is one of the mandatory user classes for a Geant4 application. It covers:

  - The "reference" physic lists included in the source distribution

  - The modularity and options.

  - Some use cases and areas of application are also described.

- Link

Examples

- Extensive set of examples distributed with the toolkit

- Varying complexity
  - **Basic**: complete applications demonstrating simple features of toolkit – good for tutorials

  - **Extended**: demonstrating specific features of Geant4 and more complex use cases – some require external (non-Geant4 libraries)

  - **Advanced**: complex, "real life" applications with complex geometries and physics focused on specific user communities

- Documentation provided in README files in each example, and web pages

Examples (2)

- The examples sources are distributed with Geant4 source in `geant4.10.05/examples` directory
- They are also included in Geant4 installation in `installation_path/share/Geant4-10.5/examples`
  - In this tutorial machines, installation_path = /usr/local
- The source code can be open with your editor and it can be also browsed with your web browser
  - http://geant4-userdoc.web.cern.ch/geant4-userdoc/Doxygen/examples_doc/html/ link
  - The hyperlinked examples source code can be accessed via "Modules" tab

Geant4 Examples

This module collects four sets of user examples aimed to demonstrate to the user how to make correct use of the GEANT4 toolkit by implementing in a correct way those user-classes which the user is supposed to customize in order to define his/her own simulation setup.

The **"basic"** set of examples is oriented to novice users and covering the most typical use-cases of a Geant4 application with keeping simplicity and ease of use.

An **"extended"** set of examples may require some additional libraries besides of Geant4. This set covers many specific use cases for actual detector simulation.

An **"advanced"** set of examples covers the use-cases typical of a "toolkit"-oriented kind of development, where real complete applications for different simulation studies are provided; may require additional third party products to be built.

Most of the examples can be run both in interactive and batch mode, and input macro files (*.in) and reference output files (*.out) are provided. Basic and most of the extended examples are considered part of the system testing suite for validation of the official releases of the GEANT4 toolkit. Basic and some of the extended and advanced examples are also used as "acceptance"-tests for the release process.

See more on each examples category pages:

- **Basic Examples**
- **Extended Examples**
- Advanced Examples

Example B1

- Simple geometry with a few solids

- Geometry with simple placements (G4PVPlacement)

- Scoring total dose in a selected volume via user action classes

- Geant4 physics list (QBBC)
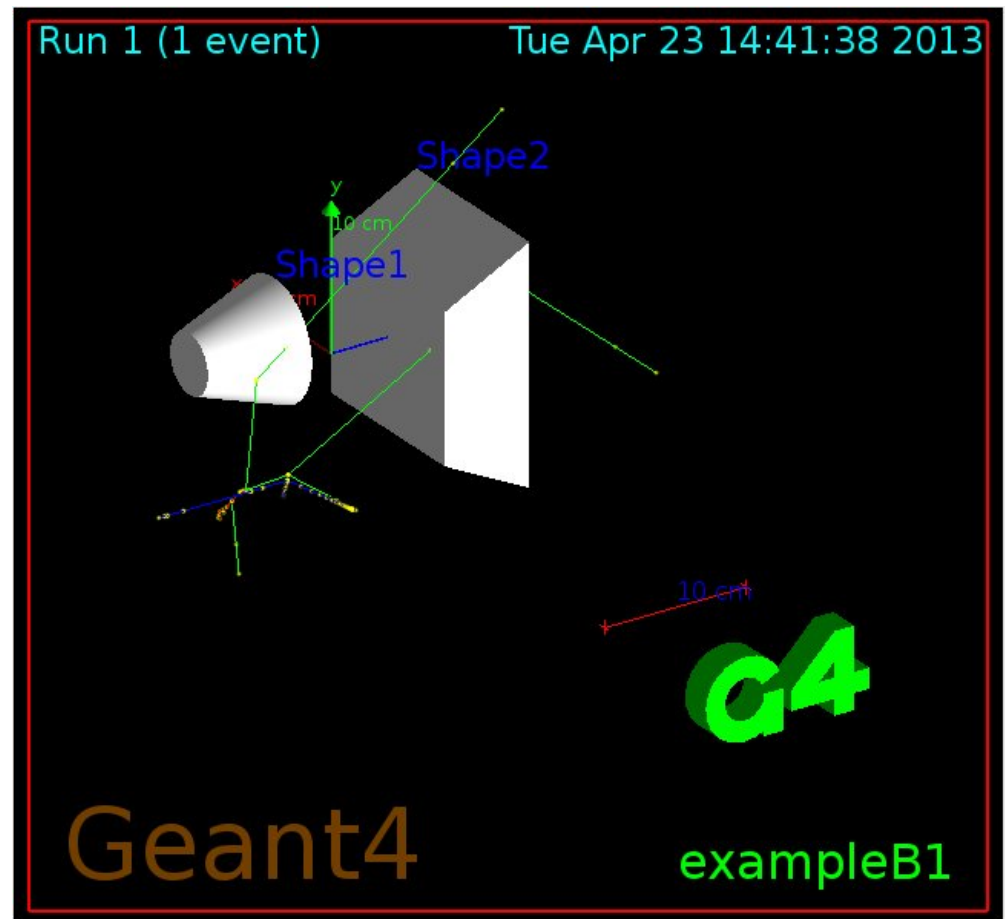
Example B2

- Simplified tracker geometry with global constant magnetic field

- Geometry with simple placements (G4PVPlacement) and parameterisation (G4PVParameterisation)

- Scoring within tracker via G4 sensitive detector and hits

- Geant4 physics list (FTFP_BERT) with step limiter
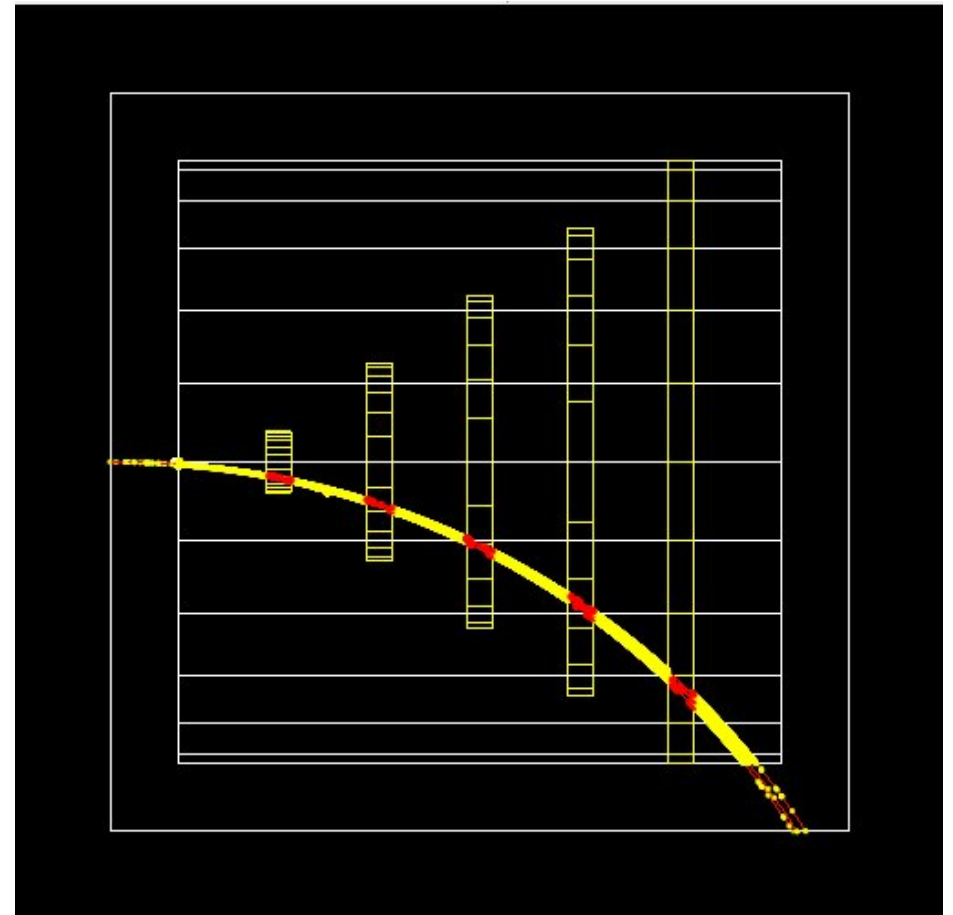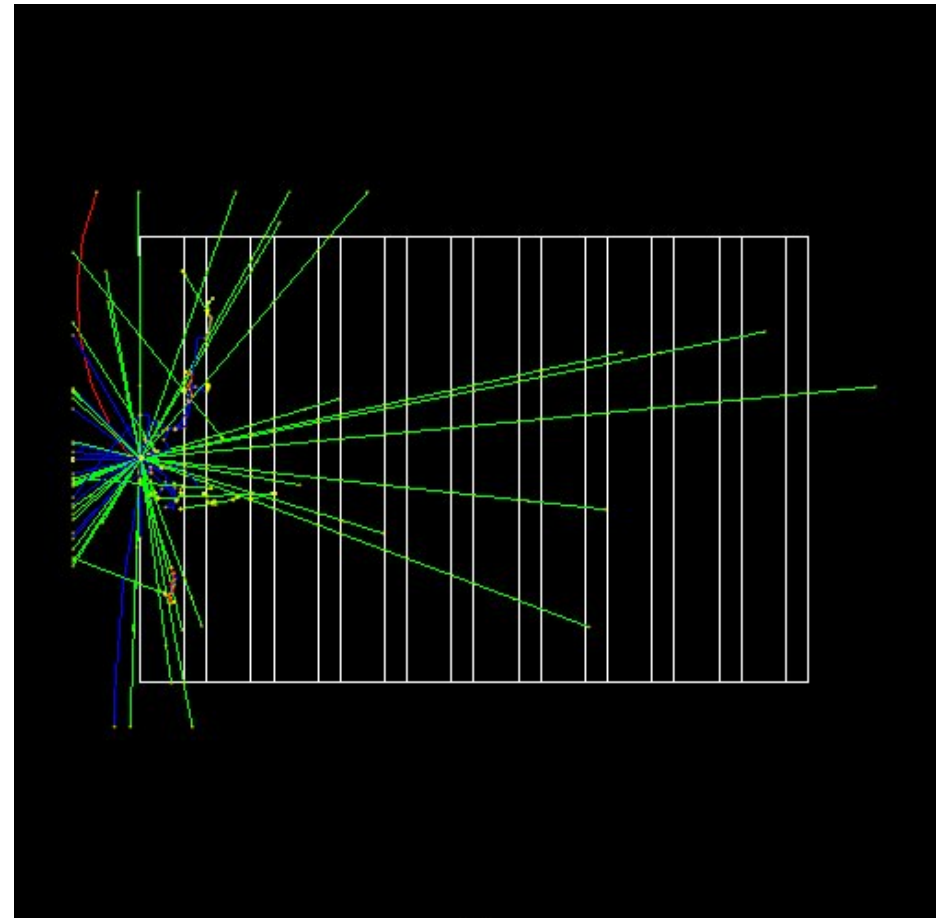
Example B3

- Schematic Positron Emitted Tomography system

- Geometry with simple placements with rotation (G4PVPlacement)

- Radioactive source

- Scoring within Crystals via G4 scorers

- Modular physics list built via builders provided in Geant4
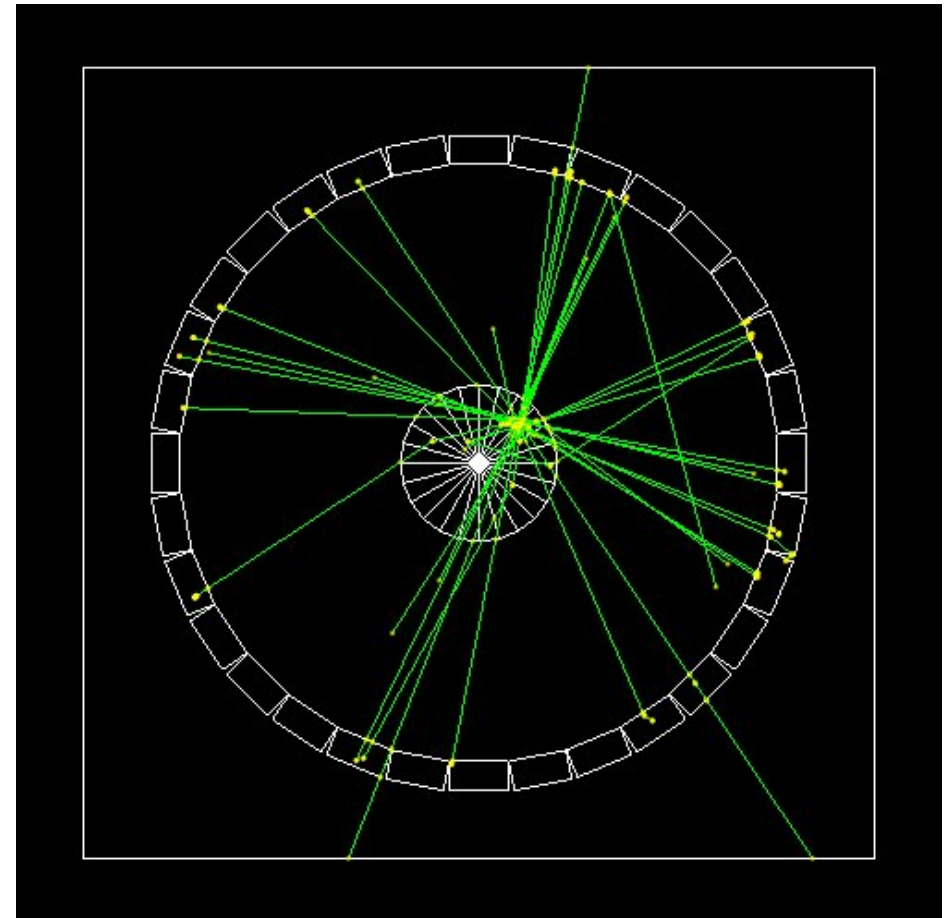
Example B4

- Simplified calorimeter with layers of two materials
- Geometry with replica (G4PVReplica)
- Scoring within layers in 4 ways:
  a) via user actions
  b) via user own object
  c) via G4 sensitive detector and hits
  d) and via scorers
- Geant4 physics list (FTFP_BERT)
- UI commands defined using G4GenericMessenger

Example B5

- A double-arm spectrometer with wire chambers, hodoscopes and calorimeters with a local constant magnetic field

- Geometry with placements with rotation, replicas and parameterisation

- Scoring within wire chambers, hodoscopes and calorimeters via G4 sensitive detector and hits

- Geant4 physics list (FTFP_BERT) with step limiter

- UI commands defined using G4GenericMessenger
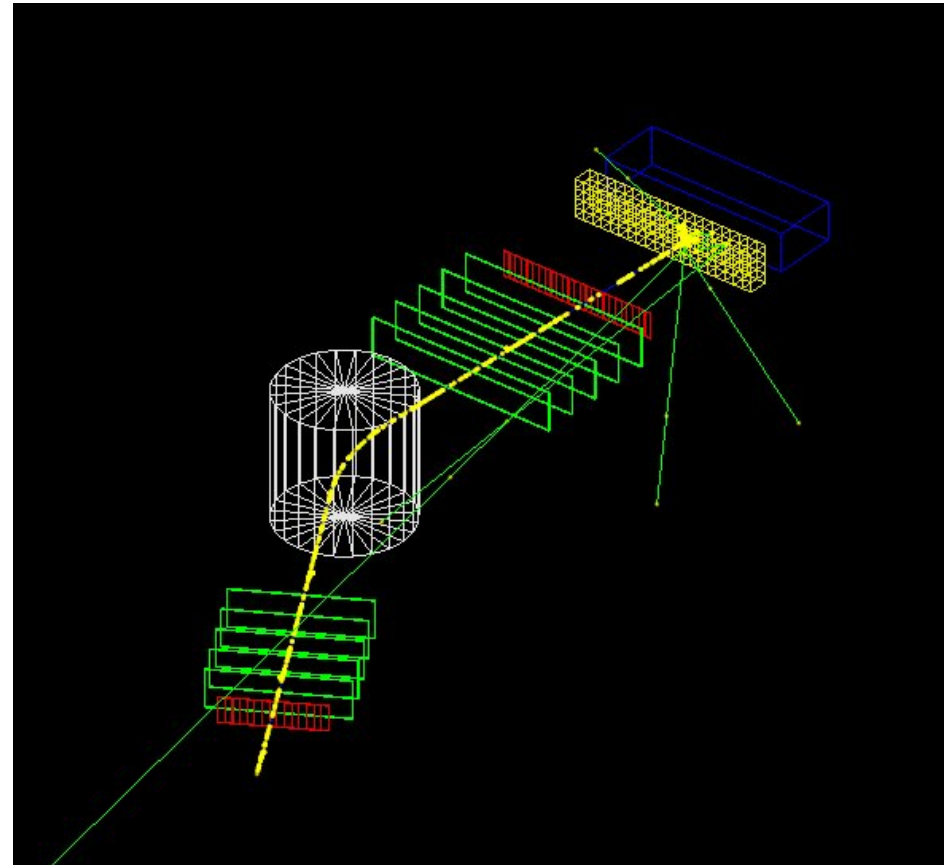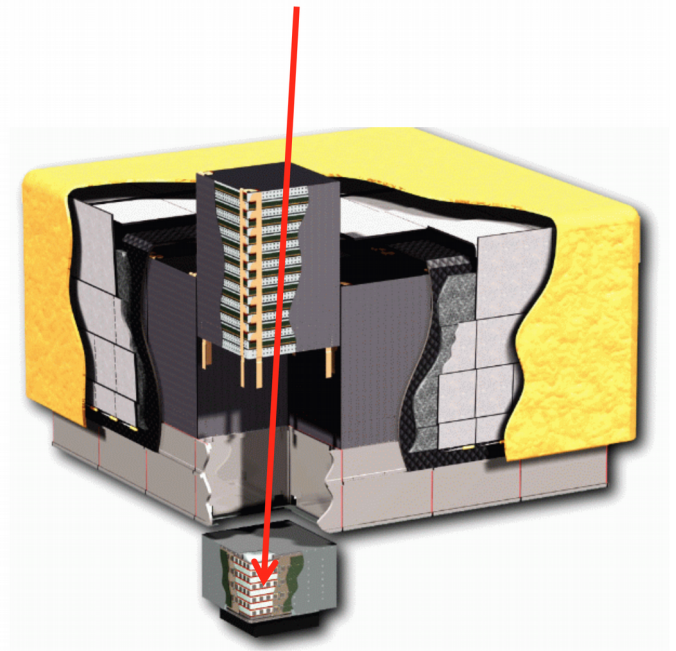
Extended Examples

- Section "Examples/Extended Examples" of Application Developers Guide
- Examples for testing and validation of processes and tracking:
  - electromagnetic (TestEm0 - TestEm18)
  - hadronic (Hadr00 - Hadr02)
  - EM field (field01 - field04)
- Examples to demonstrate Geant4 tools:
  - analysis, event generator, persistency, visualization
  - biasing, optical, medical, exotic physics, polarisation, radioactive decay
  - run and event
- Examples which extend the functionality of Geant4
  - parallel computing (MPI, TBB and TopC)

# 20 (+1) Extended Examples Categories

- analysis
- biasing
- common
- electromagnetic
- errorpropagation
- eventgenerator
- exoticphysics
- field
- g3tog4
- geometry

- hadronic
- medical
- optical
- parallel
- parameterisations
- persistency
- polarisation
- radioactivedecay
- runAndEvent
- visualization

- physicslists – new category in 10.4

Advanced Examples

Gamma Ray Space Telescope

- Section "Examples/Advanced Examples" of Application Developers Guide
- Examples of realistic applications of Geant4 in typical experimental environments
  - Gamma ray telescope, X-ray telescope, underground physics, hadron therapy, human phantom, ...
- Examples of advanced user interface facilities
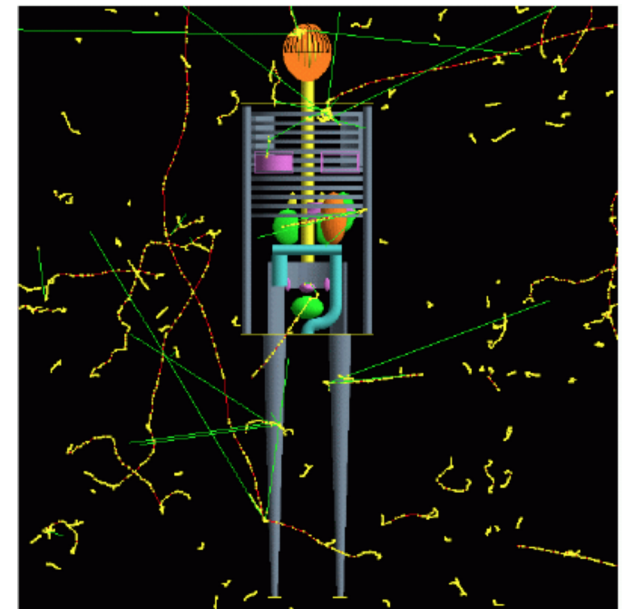
Human Phantom

22 Advanced Examples

- Air shower
- amsEcal
- Brachytherapy
- ChargeExchangeMC
- Composite calorimeter
- DoiPET
- eRosita
- Gamma-knife
- Gammaray telescope
- Hadrontherapy
- Human phantom

- Iort therapy
- LAr calorimeter
- Medical linac
- Microbeam
- Microelectronics
- Nanobeam
- Purging magnet
- Radioprotection
- Underground physics
- X-ray fluorescence
- X-ray telescope

Source Code Browsers

- Search entire Geant4 source tree by
  - A file name (e.g. G4Track.hh), or an identifier, or a text
- Result: a source file fully hyper-linked to classes and methods
  - Tells where classes and methods are defined
  - Also where they are referenced
- Several possibilities:
  - LXR code browser (link)
  - Doxygen documentation (link)
  - GitHub (link)
  - GitLab @ CERN (link)

HyperNews User Forum

- Discuss problems with other users, post questions for experts, etc.
- 23 forums roughly based on Geant4 categories
- 4 forums for specific application areas
- New forums may be requested by users

- To join: click on "New Member" at top of page and fill out form
- Link
    - Also on the top of Geant4 home page

Bug Reports and Fixes

- Problem tracking system files details of problems reported by users and developers.

- Each report is given a number and a status which changes from NEW to ASSIGNED and then CLOSED

  - When closing, the problem report is most classified as FIXED or INVALID, but more classifications are possible

- For participating you need to create a personal account and provide a legitimate email address

- Link

Summary

- User guides:
    - Installation and Application Developers Guides tell you how to get started building Geant4 and then building and running a simulation
    - Physics Reference Manual, Physics List Guide and Toolkit Developers Guide to learn about the physics of Geant4 and for a deeper knowledge of the structure and philosophy of Geant4

- Examples
    - Basic, Extended, Advanced

- A cross reference browser (LXR) is available for studying source code (also Doxygen, Github, Gitlab)
- A user forum is available for sharing ideas, asking questions
- A problem report system for tracking problems found by users