

# Geant4 Documentation

**Karim Laihem** / RWTH Aachen

## **Geant4 Training Event**

Calorimetry in HEP

DESY Zeuthen 10 – 13 May 2011



Reference talk: Gunter Folger / CERN

# Lets assume !!



# Lets assume !!

## Ambitious Physicist



# Lets assume !!

Ambitious Physicist

Starting a simulation study



# Lets assume !!

Ambitious Physicist

Starting a simulation study

Need to use Geant4 (proper toolkit)



# Lets assume !!



Ambitious Physicist

Starting a simulation study

Need to use Geant4 (proper toolkit)

First time looking into G4

# Lets assume !!



And you have to study this..



# Lets assume !!



**Don't  
give  
up !**



And you have to study this..

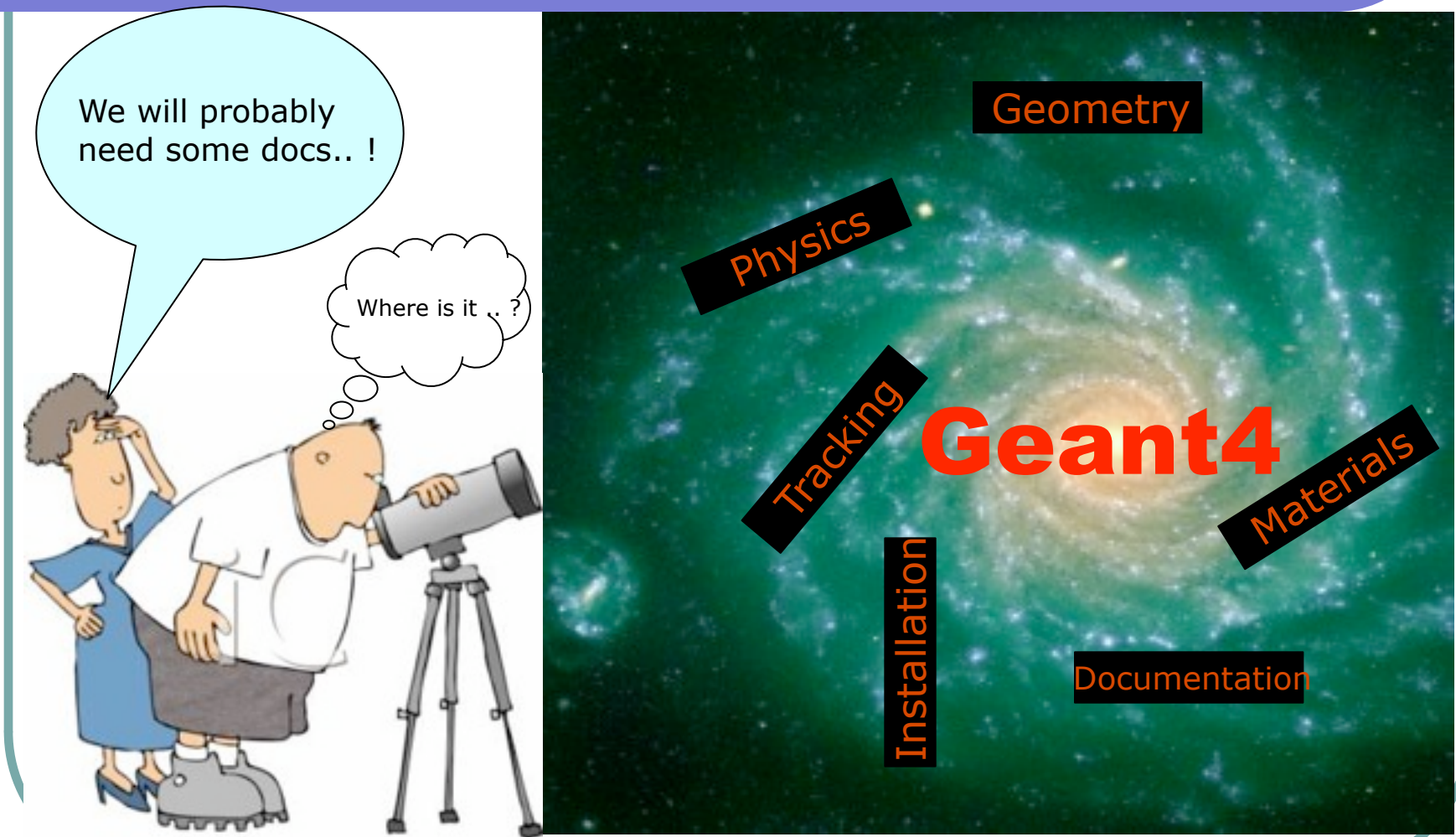


I will make it .. !!!

but where can I find ?



# I will make it .. !!!



# Overview

- User Documentation
- Getting help
  - FAQ
  - Geant4 HyperNews
  - Code documentation
  - Physics documentation
  - Working group and Geant4 related pages
  - Training courses material
- Examples
- Mailing List

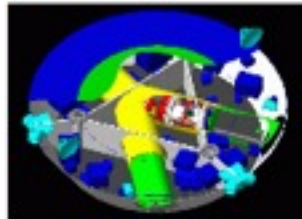
**Geant4** is a toolkit for the simulation of the passage of particles through matter. Its areas of application include high energy, nuclear and accelerator physics, as well as studies in medical and space science. The two main reference papers for Geant4 are published in *Nuclear Instruments and Methods in Physics Research A* [506 \(2003\) 250-303](#), and *IEEE Transactions on Nuclear Science* [53 No. 1 \(2006\) 270-278](#).

## Applications



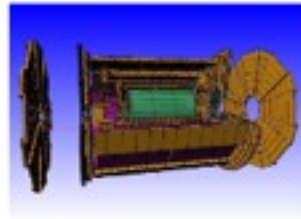
*A sampling of applications, technology transfer and other uses of Geant4*

## User Support



*Getting started, guides and information for users and developers*

## Results & Publications



*Validation of Geant4, results from experiments and publications*

## Collaboration



*Who we are: collaborating institutions, members, organization and legal information*

## News

- 1 March 2011 - [2011 planned developments](#)
- 25 February 2011 - **Patch-01** to release 9.4 is available from the [download](#) area.
- 24 September 2010 - **Patch-02** to release 9.3 is available from the [archive download](#) area.

## Events

- [Geant4 Training Event on Calorimetry in HEP](#), DESY, Zeuthen (Germany), 10-13 May 2011.
- [Geant4 Tutorial](#), University of Pennsylvania, Philadelphia (USA), 14-18 May 2011.
- [Geant4 Course at the 8<sup>th</sup> National School of Software for Nuclear, sub-nuclear and Applied Physics](#)
- 16<sup>th</sup> Geant4 Collaboration Meeting, SLAC, Stanford (USA), 19-23 September 2011
- [SASc-ISOLDE Autumn Workshop on Geant4](#), Čestá-Papiernička Centre, Bratislava

### [Past events](#)

**Geant4 home page**  
<http://cern.ch/geant4>  
-or-  
<http://geant4.org>



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## News

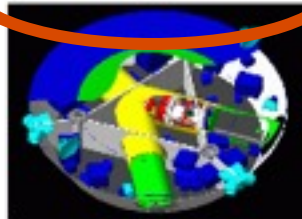
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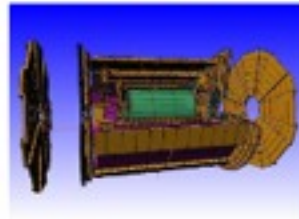
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## User Support

1. [Getting started](#)
2. [Training courses and materials](#)
3. [Source code](#)
  - a. [Download page](#)
  - b. [LXR code browser](#)
4. [Frequently Asked Questions \(FAQ\)](#)
5. [Bug reports and fixes](#)
6. [User requirements tracker](#)
7. [User Forum](#)
8. [Documentation](#)
  - a. [Introduction to Geant4](#)
  - b. [Installation Guide](#)
  - c. [Application Developers Guide](#)
  - d. [Toolkit Developers Guide](#)
  - e. [Physics Reference Manual](#)
  - f. [Software Reference Manual](#)
9. [Physics lists](#)
  - a. [Electromagnetic](#)
  - b. [Hadronic](#)
10. [User Aids](#)
  - a. [Process/model catalog](#)
  - b. [General particle source manual](#)
11. [Contact Coordinators & Contact Persons](#)



### Related Links

- [Object Oriented Analysis & Design](#)
- [Archive](#)
- [Mailing list subscription](#)
- [User requirements document \(pdf\)](#)
- [Technical Forum](#)

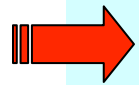


# User Documentation

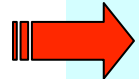
- Documentation (link to page with pdf version below)
  - Introduction to Geant4
  - Installation Guide
  - Application Developers Guide
  - Toolkit Developers Guide
  - Physics Reference Manual
  - Software Reference Manual

# User Documentation

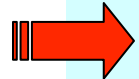
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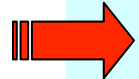
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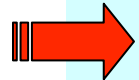
- Installation Guide



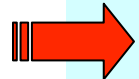
- Application Developers Guide



- Toolkit Developers Guide



- Physics Reference Manual



- Software Reference Manual

# Installation manual

URL: (html/pdf)

<http://cern.ch/geant4/UserDocumentation/UsersGuides/InstallationGuide/html/index.html>

<http://geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/InstallationGuide/fo/BookInstalGuide.pdf>

- Step by step instruction how to install Geant4 from source code
- Maybe other softwares are required
  - Compiler, CLHEP, etc.
- Installation choices
- Details on environment variables

# Installation manual

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- Guide for users developing an application based on Geant4 toolkit
  - Does not cover design or details of Geant4 classes
  - No description of physics models
- Introduces users to Geant4 toolkit
- How to set up and run simulation

- Contents
  - Getting started
  - Toolkit fundamentals
  - Detector Definition and Response
  - Tracking and Physics
  - User Actions
  - Communication and Control
  - Visualization
  - Examples

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- More details on Geant4 classes
  - Object oriented design
  - Explaining design choices
  - Algorithms
- How to extend Geant4 functionality

- Contents
  - Introduction
  - Design and Function of Geant4 Categories
    - ...
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# Physics Reference Manual

## URL (html/pdf)

<http://cern.ch/geant4/UserDocumentation/UsersGuides/PhysicsReferenceManual/fo/PhysicsReferenceManual.pdf>

- Detailed explanations of the physics implemented in the Geant4 toolkit
- Theoretical formulation, model, parameterization, or data underlying the physics interactions included in Geant4
- Probability of the occurrence of an interaction
  - and the sampling mechanisms required to simulate it
- Reference for toolkit users and developers who wish to

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# Getting help



- FAQ
- Geant4 HyperNews
- Code documentation
- Physics Lists
- Working group and Geant4 related pages
- Training courses material

# Getting Help - FAQ

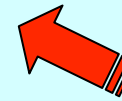
- Frequently asked questions (FAQ)  
<http://geant4.cern.ch/support/faq.shtml>
- First place to look for help
- Solutions to several problems or questions
  - Installation
  - Run time
  - Geometry
  - ...



# Getting Help - FAQ

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# Getting help - Hypernews

- Geant4 hypernews at

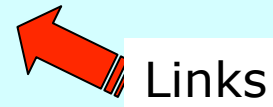
<http://hypernews.slac.stanford.edu/HyperNews/geant4/cindex>

- 24 forums grouped into 6 categories
- Open for all to **read** postings
- Only members may **create** postings
  - To join, click on “new Member” and fill form
- Members can also **subscribe** to forum(s)
  - receive posting in forum by e-mail

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GEANT4 at hypernews.slac.stanford.edu Forum List by Category

Not Logged In ([login](#))

# Geant 4

[Forums by Category](#)  
[Forums by Time Order](#)  
[Request a New Forum](#)

[Recent Postings](#)  
[Search in Forums](#)  
[Subscribe to Forums](#)

[Member Info](#)  
[Members List](#)  
[New Member](#)

[Overview](#)  
[Contact Admin](#)

[Page Help](#)

## Category: Applications

[Educational Applications](#)  
[Space Applications](#)

[Industrial instruments](#)

[Medical Applications](#)

## Category: Control of runs, events, tracks, particles

[Event and Track Management](#)

[Particles](#)

[Run Management](#)

## Category: Experimental Setup

[Fields: Magnetic and Otherwise](#)

[Geometry](#)

[Hits, Digitization and Pileup](#)

## Category: General matters

[Documentation and Examples](#)  
[Installation and Configuration](#)

[HyperNews System Announcements](#)  
[User Requirements](#)

[Hypernews Testing](#)

## Category: Interfaces

[\(Graphical\) User Interfaces](#)  
[Visualization](#)

[Analysis](#)

[Persistency](#)

## Category: Physics

[Electromagnetic Processes](#)  
[Physics List](#)

[Fast Simulation, Transportation & Others](#)  
[Processes Involving Optical Photons](#)

[Hadronic Processes](#)

# Getting help – Code Documentation

- LXR source code browser

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

- **Source-tree** browsing and filename search
- **Full-text** indexing
  - fast retrieval of source files containing a given word or pattern.
- **Identifier cross-reference**
  - fully hyperlinked source code
  - names of classes, methods, and data can be clicked on to find the source files where they are defined and used.
- implemented using [Glimpse](#), so all the capabilities of Glimpse are available, including regular expression searches.

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- Software reference manual

<http://geant4.cern.ch/bin/SRM/G4GenDoc.csh?flag=1>

- Details on the interface of important Geant4 classes
- All classes and methods needed by or available to the user
- Internal classes are not documented here

- Doxygen documentation (beta)

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# Getting help – Working group pages

## Geant4 related pages

- Working group web pages
  - Within Geant4 [collaboration page](#)
  - details on current work and plans
  - Additional information
  - Validation
  - Papers
- Geant4 related web pages [http://cern.ch/geant4/collaboration/other\\_g4\\_webs.shtml](http://cern.ch/geant4/collaboration/other_g4_webs.shtml)
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# Getting help – Training courses

- Training material used in courses

URL:

<http://cern.ch/geant4/support/training.shtml>

- Scope and depth on individual topics varies

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# Geant4 Examples

- **Novice examples**
  - Basic Geant4 features
  - seven examples
  - Each showing several aspects
- **Extended examples**
  - 20 groups of examples
  - demonstrate use of specific features
- **Advanced examples**
  - Complete applications
  - May depend on additional external software

# Geant4 'announce' mailing list

- Announcements of general interest to users
  - new releases or patches
  - Workshops
  - Tutorials
- To subscribe, follow link in user support page, right side panel, or

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# Summary

- Geant4 offers wide set of documentation
  - Book style manuals
  - Additional information in Geant4 web
    - Much linked from “user support”
    - Additional pages under “collaboration”
  - Examples show how to use Geant4 for wide range of applications
- Direct questions can be put to hypernews
  - Developers watch topics

# Exercise:

## Task 1.0

Go to the Geant4 homepage <http://cern.ch/geant4> .  
Locate the "User's Guide: For Application Developers".

## Task 2.0

Have a look to section "2.1. How to Define the main() Program" of the "User's Guide: For Application Developers".  
What are the three mandatory User Classes?

## Task 3.0

What are the predefined solids (geometry) in Geant4 ?  
Where would you look to have an idea on the predefined Materials in Geant4 ?

## Task 4.0

Where would you look for a description of Geant4 or [CLHEP](#) classes?  
What are the arguments to the constructor of [G4PVPlacement](#)?  
What method provides the absolute value of the G4ThreeVector?