

Geant 4

Introductory Course

Vladimir Grichine (Lebedev Inst., Moscow)

Maria Grazia Pia (*INFN Genova*)

Manju Sudhakar (*INFN Genova*)

PTB, Braunschweig, 22-26 June 2009

http://www.ge.infn.it/geant4/events/ptb_2009/geant4course.html

Plan of the course

- The course is articulated over 5 units
- Each unit:
 - Addresses a specific simulation domain
 - Morning lectures
 - Practical exercises in the afternoon on the topics learned in the morning
 - Exception: last afternoon devoted to a discussion session
- Hands-on sessions:
 - Brief summary of the topics learned in the morning lectures and goals of the exercises
 - Illustration of an example
 - Exercise: modifications and extensions of the code, starting from the example provided
 - Discussion of the solution

Unit 1 - The basics

- **Welcome - Introduction** - *Hosts, instructors and students*
- **Geant4 refresher seminar** - *M.G. Pia*
 - Overview of Geant4 capabilities
- **Introduction to Object Oriented Programming** - *M.G. Pia*
 - Basic concepts
 - Unified Modelling Language (UML)
 - Example: a class in C++, object instantiation
 - Design patterns: introduction, Singleton, Abstract Factory
- **Geant4 user application** - *M.G. Pia*
 - Basic concepts
 - Software design
 - User initialisations and actions
 - Elements of software development process

Unit 2 - How to describe an experimental set-up

- **Detector modelling 1**
 - Materials
 - Basic Geometry
- **Detector modelling 2**
 - Advanced Geometry
 - Read-out and detector response
- **Primary event generation**
 - Primary particle generation

Unit 3 - Physics in Geant4

- **Physics 1**

- Particles and physics processes, cuts
- Electromagnetic physics: standard processes, optical processes, muons (*A. Lechner*)

- **Physics 2**

- Electromagnetic physics: low-energy processes
- Hadronic physics

Unit 4 - Retrieving information from the simulation

- **Interactive capabilities**

- Visualisation
- User interface
- Data analysis

- **Encoding simulation results**

- Hits
- Digitisation

- **Interacting with Geant4 kernel**

- Review of user actions
- Retrieval of information from various objects: step, track, event etc.

Unit 5 - Beyond the basics

- **Overview of additional Geant4 capabilities**
 - Event biasing and scoring
 - Parameterisation (fast simulation)
 - Persistency
- **Review of Geant4 application in various domains**
 - High energy and nuclear physics experiments
 - Astroparticle physics, astrophysics and space science
 - Medical physics
 - Etc.
- **Geant4 in a distributed computing environment**
 - Basic concepts
 - Design of an application-independent system
 - Demo: running Geant4 simulations on the grid (if network to CERN is available)
- **How to learn more**
 - Documentation
 - User support

Geant4 Training and User Support

- This course is part of the training offered by the Geant4 Collaboration
 - an international collaboration of scientists, developing and maintaining the Geant4 Simulation Toolkit
- This course is a brief introduction to the functionality and use of the Geant4 Toolkit
 - it does not replace the study of Geant4 User Documentation
- Courses organized by the Geant4 Collaboration
 - information available from Geant4 web site <http://cern.ch/geant4>

Course material

- All course material can be downloaded from http://www.ge.infn.it/geant4/events/ptb_2009/geant4course.html
- Geant4 User Documentation and further training material can be found at Geant4 web site: <http://cern.ch/geant4>
- After this course, you may profit of Geant4 user support, provided by the Geant4 Collaboration
 - including a User Forum accessible through HyperNews
 - link from Geant4 home page

Questions and feedback

- Your feedback is important
 - Please let us know if the pace is appropriate, if you need further clarifications etc.
- Geant4 is huge!
 - We are Geant4 developers, but our own expertise is not infinite...
 - Thanks for your patience, if we don't have the answers to all your questions
 - But we'll put you in touch with other collaborators, should you need specific expertise
- Your feedback is important also after the course
 - We would like to hear from you!