

# Geant 4

## Introductory Course

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[http://www.ge.infn.it/geant4/events/ornl\\_2008/geant4course.html](http://www.ge.infn.it/geant4/events/ornl_2008/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 (*L. Pandola*)
- Basic Geometry (*A. Lechner*)

- **Detector modelling 2**

- Advanced Geometry (*L. Pandola*)
- Read-out and detector response (*A. Lechner*)

- **Primary event generation**

- Primary particle generation (*M.G. Pia*)

# Unit 3 - Physics in Geant4

- **Physics 1**

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

- **Physics 2**

- Electromagnetic physics: low-energy processes (*M.G. Pia*)
- Hadronic physics (*L. Pandola*)

# Unit 4 - Retrieving information from the simulation

- **Interactive capabilities**

- Visualisation
- User interface
- Data analysis (*A. Lechner*)

- **Encoding simulation results** (*A. Lechner*)

- Hits
- Digitisation

- **Interacting with Geant4 kernel** (*A. Lechner*)

- 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 (*L. Pandola*)
  - Parameterisation (fast simulation) (*M.G. Pia*)
  - Persistency (*M.G. Pia*)
- **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 (*A. Lechner*)**
  - 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 (*M.G. Pia*)**
  - 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/ornl\\_2008/geant4course.html](http://www.ge.infn.it/geant4/events/ornl_2008/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!