

Geant4 Tutorial for Medical, Space and Particle Physics

SLAC - Redwood Room
7-10 March 2006

Four day hands-on course based on Geant4 version 8.0 with an emphasis on medical and space applications. Lectures will cover all aspects of Geant4 from basic installation through advanced topics and will be interspersed with examples that build a progressively more complex application extensible to real space or medical use.

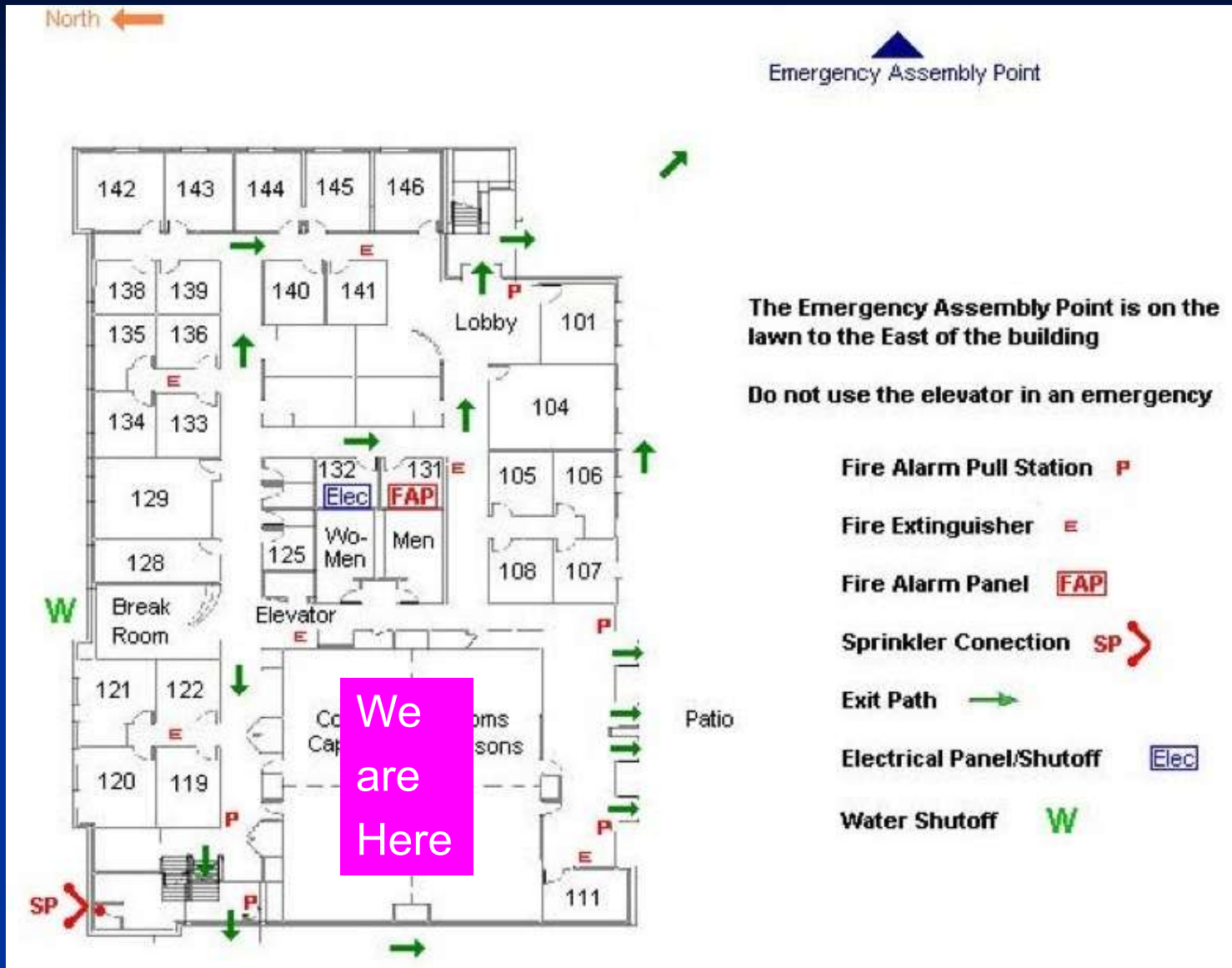
The course should be of interest both to complete novices and to those who already have some basic familiarity with Geant4. Participants are expected to have a reasonable knowledge of C++.

<http://geant4.slac.stanford.edu/SLACTutorial06/>

Introductory Information

- Emergency Information
- Networking
- Tutorial Structure

Exits and Emergency Assembly Point



Welcome to Earthquake Country

- Be aware of exits in your building
 - Speaker will indicate locations for this meeting
- Fire or other emergency evacuation
 - Follow building residents out of building to the assembly area
- Earthquake
 - Remain in building: Duck, cover, and hold position until shaking stops
 - Evacuate building to assembly area outside (follow others)
 - Stay away from windows, downed power lines
- In the event of an emergency
 - Dial 9-911 from a SLAC phone; or
 - Dial 911 from your cellular phone
 - Provide SLAC address (2575 Sand Hill Road, Menlo Park, CA; cross street Saga Lane) and your building/room number.

Networking

- Security
 - Anyone near the wireless access points could sniff the network and anyone with a laptop configured for wireless can connect to the visitor network.
 - To protect any information you send across the network (especially passwords) you should use appropriate encryption technology such as SSH, SSL, or one-time password authentication.
- Recommended Settings and Information
 - Wireless adapter card: 802.11b or 802.11g
 - Network configuration: DHCP
 - SSID: Set to visitor or to allow any value
 - Network Type: Set to infrastructure
 - Open access: No WEP, no data encryption, no registration or authentication
- Some Problem Areas To Avoid
 - Bridging must be turned off or disabled
 - for WXP see Network Connections, right click on the wireless adapter. Check for bridging.
 - Do not set the Network Type to Ad hoc
 - for WXP see Network Connections, right click on wireless adapter>Properties>Wireless Networks tab>Advanced. Select Access point (infrastructure) networks only
 - Mac laptops - Turn off AirPort setting
 - System Preferences>Network> Show: AirPort. Ensure that Allow this computer to create networks is not checked

Tuesday

Introductory Talks & Hands-On Installation of Geant4 and Related Vis Tools

08:30 - 09:00 Registration

09:00 - 09:10 Welcome (R. Mount)

09:10 - 09:30 Tutorial introduction (J. Perl)
Emergency Information
Networking
Tutorial structure

09:30 - 10:30 Kernel I (M. Asai)
General introduction
Global structure
Run, event, track, step, trajectory, etc.
User classes

10:30 - 11:00 Break

11:00 - 11:30 Geometry I (M. Asai)
Introduction
G4VUserDetectorConstruction class
Solid
Logical volume

11:30 - 12:00 Physics I (D. Wright) ([ppt](#), [pdf](#))
Introduction
G4VUserPhysicsList class
Modular physics list
Packaged physics lists

12:00 - 12:30 Visualization I (J. Perl)
Introduction to Visualization
Quick Looks at Seven Visualization Drivers

12:30 - 14:00 Break

14:00 - 14:30 User Interfaces I (M. Asai)
Syntax
Interactive mode / batch mode
G4UITerminal class

14:30 - 14:50 Visualization II (J. Tinslay)
Visualization UI commands

14:50 - 15:20 User documents and examples I (D. Wright)
([ppt](#), [pdf](#))
Installation Guide
Application developers manual
Novice examples in Geant4 distribution
LXR source code browser
HyperNews

15:20 - 15:50 Break

15:50 - 16:10 Installation of Geant4 (W. Kroeger)
Installation of CLHEP
Installation of Geant4
Installation of Data files
Installation of Visualization Tools, OpenGL, WIRED3 and DAWN

16:10 - 18:00 **Hands-on 1** (W. Kroeger)
Installation of Geant4

Lecturers will be on hand into the evening to help any users who have not yet been able to complete the Geant4 installation. Lecturers are also available for the people who had already installed Geant4 successfully to examine some examples.

Wednesday

Materials, Geometry, Visualization and First Part of Physics

09:00 - 09:40 **Hands-on 2** [instructions](#) (D. Wright)
Execute novice examples to confirm the Geant4 installation

09:40 - 10:10 Material definition (M. Maire)
Defining Materials
NIST Material database

10:10 - 10:30 Geometry II (M. Asai)
Placement volume
Parameterized volume

10:30 - 11:00 Break

11:00 - 11:30 Geometry III (M. Asai)
Replica, Division
Geometry checking tools
Touchable
Region

11:30 - 11:50 Visualization III (J. Tinslay)
Visualization of trajectory

11:50 - 12:10 Visualization IV (J. Perl)
Visualization attributes

12:10 - 12:30 Physics II (D. Wright) ([ppt](#), [pdf](#))
Overview
Processes

12:30 - 14:00 Break

14:00 - 14:30 Physics III (D. Wright) ([ppt](#), [pdf](#))
Production thresholds
Cuts per region
Decay
Optical

14:30 - 15:00 EM Physics I (M. Maire)
EM standard overview
Multiple scattering

15:00 - 15:30 EM Physics II (S. Incerti)
Low-E EM overview

15:30 - 16:00 Break

16:00 - 16:15 Introduction to hands-on example (T. Aso)

16:15 - 18:00 **Hands-on 3** (T. Aso)
Material and geometry implementation
Visualization

Thursday

Hadronic Physics, Scoring, Primary Particles and Sensitive Detectors

09:00 - 09:45 Hadronic Physics I (D. Wright) ([ppt](#), [pdf](#))

- Overview
- Cascade models
- Parameterized models

09:45 - 10:30 Hadronic Physics II (T. Koi)

- Neutron physics
- Ion physics
- Radioactive decay

10:30 - 11:00 Break

11:00 - 11:20 Scoring I (M. Asai)

- Introduction to sensitivity

11:20 - 12:00 Scoring II (T. Aso)

- G4VPrimitiveScorer* and related classes
- G4VSDFilter*
- G4Run* and *G4UserRunAction*

12:00 - 12:30 Analysis I (J. Perl)

- Analyze scored results

14:00 - 14:15 Introduction to hands-on example (T. Aso)

14:15 - 15:45 **Hands-on 4** (T. Aso)

- Define scorers
- Alternate physics lists
- Output results

15:45 - 16:15 Break

16:15 - 16:35 Primary particle (M. Asai)

- G4VUserPrimaryGeneratorAction* class
- G4ParticleGun*
- General particle source

16:35 - 17:00 Scoring III (M. Asai)

- Sensitive detector
- Hits

17:00 - 18:00 **Hands-on 5** (T. Aso)

- Storing hits

Friday

Advanced Topics and Brainstorming

09:00 - 09:30 User interface II (M. Asai)
Define user commands

09:30 - 10:10 Event biasing I (T. Aso)
Overview
Geometrical importance biasing

10:10 - 10:30 Event biasing II (J. Tinslay)
Bremsstrahlung splitting

10:30 - 11:00 Break

11:00 - 11:15 Introduction to hands-on example
(J. Tinslay)

11:15 - 12:30 **Hands-on 6** (J. Tinslay)
Event biasing by Bremsstrahlung splitting

12:30 - 14:00 Break

14:00 - 14:30 Geometry IV (M. Asai)
Magnetic field
Nested parameterization
Reflected volume, Assembly volume
Geometry optimization
Moving objects

14:30 - 15:10 Kernel II (M. Asai)
User limits
User information classes
Stack management
Shower parameterization
Persistency

15:10 - 15:40 User documents and examples II (D. Wright)
([ppt](#), [pdf](#))
Toolkit developers manual
Physics reference manual
Extended and advanced examples in Geant4 distribution

15:40 - 16:10 Break

16:10 - 17:20 **Brainstorming session**
Participants are encouraged to raise their issues of "how to create a simulation application".
Lecturers join to the brainstorming discussion.

17:20 - 17:30 Concluding remarks (M. Asai)

17:30 Adjourn

Coffee Breaks and Lunches

- Because we have charged no registration fee, we are unable to provide coffee or lunches, but breaks have been made long enough to allow you to take a short walk to get it yourself.
- SLAC Cafeteria across the main lawn
- Starbucks, Erik's Deli, Castillo's Mexican and other restaurants a 5 minute walk down Sand Hill Road to the Sharon Heights shopping center
- Coffee Breaks are 30 minutes
- Lunch Breaks are an hour and a half

Lecturers

- All of the lecturers will be available throughout the week to help you with hands-on examples or individual questions.
- Makoto Asai - Run , Event, Detector Response, Geometry
- Tsukasa Aso - Detector Response, Scoring, Biasing
- Sebastien Incerti - Low Energy EM
- Tatsumi Koi - Hadronics
- Wilko Kroeger - Installation
- Michel Maire - Standard EM
- Joseph Perl - Visualization
- Takashi Sasaki - Tracking
- Jane Tinslay - Visualization, Biasing
- Dennis Wright - Hadronics, Documentation