

# Geant4 Tutorial

Stanford University

3-6 March 2014

A four day hands-on course based on Geant4 version 10.0-patch01

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.

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://www-public.slac.stanford.edu/geant4/Tutorial2014.asp>

# Introductory Information

- Tutorial Structure
- Lecturers
- Catering
- Earthquakes
- Networking

# Monday

## 08:30 - 09:00 Registration

09:00 - 09:15 Welcome (Margot Gerritsen)

09:15 - 09:30 Tutorial Introduction (Joseph Perl)

- Network, logistics
- Tutorial structure
- Lecturer introduction

09:30 - 10:30 Kernel I (Makoto Asai)

- General introduction
- Global structure of Geant4
- Run, event, track, step, trajectory, etc.
- User classes

## 10:30 - 11:00 Break

11:00 - 11:40 User Documents and Examples (Mike Kelsey)

- Installation Guide
- Application developers manual
- Toolkit developers manual
- Physics reference manual
- Novice examples in Geant4 distribution
- Extended and advanced examples in Geant4 distribution
- LXR source code browser
- HyperNews

11:40 - 12:00 User Interface I (Makoto Asai)

- Syntax of UI command
- Interactive mode / batch mode
- G4UIExecutive class

12:00 - 12:30 Visualization I (Joseph Perl)

- Introduction to Visualization
- Quick Looks at Seven Visualization Drivers
- Basic Visualization Commands

## 12:30 - 14:00 Lunch Break

14:00 - 14:30 Analysis (Andrea Dotti)

- G4Tools : built-in analysis tool

14:30 - 15:00 Scoring I (Makoto Asai)

- Introduction to sensitivity
- Command-based scoring
- Add a new scorer/filter

15:00 - 15:30 Multithreading I (Andrea Dotti)

- Introduction to multithreading
- UI commands for multithreading

## 15:30 - 16:00 Break

16:00 - 17:30 [Hands-on I](#) (Andrea Dotti)

- Complete Geant4 installation if you have not already done so
  - [Installation guide](#)
- Execute a few novice examples to confirm the installation
- Troubleshooting: [Installation and Configuration Hypernews](#)

Instructors will stay late to assist anyone who has problems with installation or has trouble running the first examples

# Tuesday

## 09:00 - 09:30 Material Definition (Tatsumi Koi)

- Defining Materials
- NIST Material database

## 09:30 - 10:30 Geometry I (Makoto Asai)

- Introduction
- G4VUserDetectorConstruction class
- Solid
- Logical volume
- Region
- Physical volume
- Placement

## 10:30 - 11:00 Break

## 11:00 - 11:30 Physics I (Dennis Wright)

- Introduction
- G4VUserPhysicsList class
- Modular physics list
- Packaged physics lists
- Choosing appropriate Physics List

## 11:30 - 12:00 Physics II (Dennis Wright)

- Validation
- Processes
- Production thresholds
- Cuts per region

## 12:00 - 12:30 Physics III (Mike Kelsey)

- Decay
- Optical
- Phonon, electron/hole
- Channeling

## 12:30 - 14:00 Lunch Break

## 14:00 - 15:10 EM Physics (Tatsumi Koi)

- EM standard overview
- Multiple scattering
- Low-E EM overview

## 15:10 - 15:30 Primary Particle (Dennis Wright)

- G4VUserPrimaryGeneratorAction class
- Primary vertex and primary particle
- Built-in primary particle generators
- More on Particle Gun

## 15:30 - 16:00 Break

## 16:00 - 17:30 [Hands-on II](#) (Andrea Dotti)

- Material and a simple geometry
- Visualization of geometry
- Command-based scoring

19:30 Tour of Stanford Cancer Center.

Room for only up to 10.

See Joseph at today's 10:30 break  
if you want to sign up for this

# Wednesday

## 09:00 - 09:40 Geometry II (Makoto Asai)

- Parametrized volume
- Replicated volume
- Divided volume
- Nested-parametrization
- Assembly volume
- Reflected volume
- Touchable

## 09:40 - 10:00 Visualization II (Joseph Perl)

- Basic Visualization Commands

## 10:00 - 10:30 Scoring II (Makoto Asai)

- Define scorers in the tacking geometry
- Reduction of user data
- Sensitive detector
- Hits

## 10:30 - 11:00 Break

## 11:00 - 11:45 Hadronic Physics I (Mike Kelsey)

- Overview
- Precompound/de-excitation models
- Cascade models
- Parameterized models

## 11:45 - 12:30 Hadronic Physics II (Tatsumi Koi)

- Elastic process
- Neutron physics
- Ion physics

## 12:30 - 14:00 Lunch Break

## 14:00 - 14:45 Hadronic Physics III (Dennis Wright)

- String models
- Electro-nuclear models
- Capture / fission models
- Radioactive decay
- Process at rest

## 14:45 - 15:30 Geometry III (Makoto Asai)

- Magnetic field
- Field integration and other types of field
- GDML interface
- CAD interface
- Geometry checking tools
- Geometry optimization
- Parallel geometry
- Moving objects

## 15:30 - 16:00 Break

## 16:00 - 17:30 [Hands-on III](#) (Andrea Dotti)

- Complete geometry
- Define scorers
- User Actions I: printing information on the screen

# Thursday

09:00 - 10:30 [Hands-on IV](#) (Andrea Dotti)

- User Actions II: Accumulating information from a run
- Use g4tools to create histograms and output nutple files

10:30 - 11:00 Break

11:00 - 11:30 [Special lecture I](#) (Google)

11:30 - 12:00 Event Biasing (Mike Kelsey)

- Overview
- Geometrical biasing
- Physics biasing
- Bremsstrahlung splitting

12:00 - 12:30 User Interface II (Makoto Asai)

- Define user commands

12:30 - 14:00 Lunch Break

14:00 - 14:30 [Special lecture II](#) (Colfax)

14:30 - 15:00 Multithreading II (Andrea Dotti)

- Thread safety
- User thread initialization
- MPI
- Compiling Geant4 for Xeon Phi coprocessor

15:00 - 15:30 Kernel II (Makoto Asai)

- User limits
- User information classes
- Stack management

15:30 - 16:00 Break

16:00 - 16:30 [Special lecture III](#) (Nvidia)

16:30 - 17:00 How to Upgrade Your Geant4 Release (Joseph Perl)

- Major versus minor releases
- What to look for in the release notes

17:00 - 17:30 Q/A and Closing remarks (Makoto Asai)

17:30 Adjourn

# Lecturers

- All of the lecturers will be available throughout the week to help you with hands-on examples or individual questions.
- You are at Stanford, so no “Dr”, just first names!
- Makoto Asai - Run , Event (Multithreading), Detector Response, Geometry
- Andrea Dotti - Run, Event (Multithreading), Detector Response, Hadronic Physics
- Mike Kelsey - Hadronic Physics, Documentation
- Tatsumi Koi - Hadronic Physics (Neutron and Ion expert)
- Joseph Perl - Visualization, Installation, Medical Physics
- Dennis Wright - Hadronic Physics, Documentation

# Catering

- We spent the money you gave us on room fees and as much catering as we could afford.
- We didn't charge you enough to pay for lunches or dinners, but we hope you enjoy the basic breakfasts each day, coffee all day and a snack in the afternoon.
- For lunches, we suggest you explore this beautiful campus. There are too many options to list. Just look at campus maps or start wandering. A large concentration of food options are at the Student Union building, also called Tressider
- For a very convenient place for drinks or snacks after the day, Joseph recommends the Stanford Coffee House at Tressider



# Earthquakes

- Welcome to the San Andreas Fault Zone
- Some of us think earthquakes are cool
- If things start shaking, act like a Californian and remain calm
- You are safer staying put than running outside
  - Debris falling from the outsides of buildings is the greater hazard

# Networking

- You have access to the Stanford Visitor Network
- You are OUTSIDE the Stanford firewall
  - Stanford is not responsible for your safety
  - Treat this network as you would treat the network at a café, hotel or airport. You are not secure.
- Select the SSID Stanford Visitor from your device's list of available wireless networks.
  - Open a browser and load any URL; you will be redirected to an access page
  - Click Accept to acknowledge the terms of use. Your browser will be sent to a confirmation page and from there you can get online.