

# **Geant4 Advanced Course 2024 @ CERN**

## **Report of Contributions**

Contribution ID: 1

Type: **not specified**

## Overview

*Monday 14 October 2024 14:10 (15 minutes)*

- An overview of the topics covered in the course - and how they fit

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: 2

Type: **not specified**

## User Documents and Examples

- Installation Guide
- Application & Toolkit developers manuals
- Physics reference manual
- Basic examples in Geant4 distribution
- Extended and advanced examples in Geant4 distribution
- GitHub, LXR source code browser
- Reporting problems/requirements, HyperNews

**Presenter:** FOLGER, Gunter

Contribution ID: 3

Type: **not specified**

## User Interface - I

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

**Presenter:** NOVAK, Mihaly (CERN)

Contribution ID: 4

Type: **not specified**

## Visualization - I

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

**Presenter:** NOVAK, Mihaly (CERN)

Contribution ID: 5

Type: **not specified**

## User Actions, Hits and Digits

- Mandatory user actions
- Optional user actions
- Sensitive detectors
- Hit/digits collections

**Presenter:** POKORSKI, Witold (CERN)

Contribution ID: 6

Type: **not specified**

## Scoring

*Wednesday 16 October 2024 14:50 (40 minutes)*

- Introduction to Scoring
- Command-based scoring
- Sensitive detector vs. primitive scorer
- Basic structure of detector sensitivity
- Sensitive detectors and hits

**Presenter:** ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 7

Type: **not specified**

## Multithreading - I

- Introduction to multithreading
- UI commands for multithreading

**Presenter:** APOSTOLAKIS, John (CERN)



Contribution ID: 8

Type: **not specified**

## Discussion

*Monday 14 October 2024 17:40 (20 minutes)*

- EM physics
- Hadronic physics

**Presenters:** RIBON, Alberto (CERN); APOSTOLAKIS, John (CERN); IVANTCHENKO, Vladimir (CERN)

Contribution ID: 9

Type: **not specified**

## Material Definition

- Defining Materials
- NIST Material database

**Presenter:** NOVAK, Mihaly (CERN)

Contribution ID: **10**

Type: **not specified**

## Geometry - I

- G4UserDetectorConstruction class
- Geometrical shapes: solids
- Logical & Physical volumes
- Placements, Parametrised, Replicated volumes, basics
- Geometry checking tools
- GDML interface
- Magnetic field, basics

**Presenter:** COSMO, Gabriele (CERN)

Contribution ID: **11**

Type: **not specified**

## **Hands-on - II**

Exercise on physics processes & setup  
Electromagnetic examples

**Presenters:** NOVAK, Mihaly (CERN); IVANTCHENKO, Vladimir (CERN)

Contribution ID: **12**

Type: **not specified**

## Generators

- G4VUserPrimaryGeneratorAction class
- Primary vertex and primary particle
- Built-in primary particle generators
- Interfaces with external generators

**Presenter:** POKORSKI, Witold (CERN)

Contribution ID: **13**

Type: **not specified**

## Physics Lists

*Thursday 17 October 2024 16:30 (1h 10m)*

- Introduction to Physics Lists
- The Geant4 Physics List interface
- Using pre-packaged physics lists
- How to choose a physics list
- Examples

**Presenter:** FOLGER, Gunter

Contribution ID: 14

Type: **not specified**

## Particles and processes

- Particles
- Processes
- What happens at a step
- Cuts

**Presenter:** IVANTCHENKO, Vladimir (CERN)

Contribution ID: 15

Type: **not specified**

## Event biasing

- Overview
- Geometrical biasing
- Bremsstrahlung splitting

**Presenter:** ASAI, Makoto (SLAC National Accelerator Laboratory (US))



Contribution ID: 16

Type: **not specified**

## Additional User classes

*Wednesday 16 October 2024 16:00 (30 minutes)*

- User limits
- User information classes
- Stack management

**Presenter:** ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 17

Type: **not specified**

## Multithreading

*Wednesday 16 October 2024 14:00 (50 minutes)*

- Why use multi-threading in Geant4
- What data is shared between threads
- User commands to control threading and regular and error output
- User code / actions in multi-threaded (MT) mode

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: **18**

Type: **not specified**

## Hadronics physics II

*Friday 18 October 2024 16:20 (55 minutes)*

- Pre-compound and de-excitation models
- Intra-nuclear cascade models (Bertini, Binary, Liege (INCL))
- String models (Fritiof, Quark Gluon String)
- Capture/stopping models
- Fission models
- Elastic process
- Neutron physics
- Ion physics

**Presenter:** RIBON, Alberto (CERN)

Contribution ID: **19**

Type: **not specified**

## Questions & Answers

*Wednesday 16 October 2024 17:15 (45 minutes)*

General discussion on topics raised on Mattermost

Contribution ID: **20**

Type: **not specified**

## Geometry I

- G4UserDetectorConstruction class
- Geometrical shapes: solids
- Logical & Physical volumes
- Placements, Parametrised, Replicated volumes, basics
- Geometry checking tools
- GDML interface

**Presenter:** COSMO, Gabriele (CERN)

Contribution ID: 21

Type: **not specified**

## Magnetic Field

*Tuesday 15 October 2024 16:00 (1h 15m)*

- Magnetic field
- Field integration and other types of field
- Steppers & Interpolation

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: 22

Type: **not specified**

## Physics: particles and processes

*Monday 14 October 2024 14:25 (55 minutes)*

- Particles
- Ions
- Processes
- What happens at a step
- Order of initialisation and execution
- Cuts
- How to prepare custom particle and process

**Presenter:** IVANTCHENKO, Vladimir (CERN)

Contribution ID: 23

Type: **not specified**

## Electromagnetic physics

*Monday 14 October 2024 15:45 (1h 5m)*

- Energy loss
- Cuts per region
- Models per region
- Atomic de-excitation
- Multiple and single scattering
- Documentation for electromagnetic physics

**Presenter:** IVANTCHENKO, Vladimir (CERN)



Contribution ID: 24

Type: **not specified**

## Electromagnetic physics II - Optical Photons

*Thursday 17 October 2024 15:30 (1 hour)*

Optical photons - generation, propagation and their physics processes

**Presenter:** HOWARD, Alexander (Imperial College (GB))

Contribution ID: 25

Type: **not specified**

## Open Discussion

Any Geant4 topic - submit questions on Mattermost

**Presenters:** HOWARD, Alexander (Imperial College (GB)); APOSTOLAKIS, John (CERN); NOVAK, Mihaly (CERN); IVANTCHENKO, Vladimir (CERN)

Contribution ID: 26

Type: **not specified**

## Fast Simulation

- Fast parameterised simulation
- G4VFastSimulationModel
- G4FastSimulationManagerProcess
- Use of “Ghost” volumes
- Techniques of fast simulation
- Demo/Exercises

**Presenter:** ZABOROWSKA, Anna (CERN)

Contribution ID: 27

Type: **not specified**

## Physics Biasing

Physics biasing techniques

**Presenters:** RIBON, Alberto (CERN); ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 28

Type: **not specified**

## Definition of UI commands

*Wednesday 16 October 2024 16:30 (20 minutes)*

- G4UIExecutive
- Definition of custom UI commands

**Presenter:** ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 29

Type: **not specified**

## Event Biasing

*Friday 18 October 2024 14:00 (1 hour)*

- Introduction
- Early Provided Biasing Options
- Primary Particle Biasing
- Options In Hadronic
- Geometry-based importance biasing
- Weight Window Technique
- User defined biasing
- Reverse Monte-Carlo
- Generic Biasing Scheme

**Presenter:** VERDERI, Marc (Centre National de la Recherche Scientifique (FR))

Contribution ID: **30**

Type: **not specified**

## Fast Simulation

*Thursday 17 October 2024 14:00 (50 minutes)*

- Fast parameterised simulation
- G4VFastSimulationModel
- G4FastSimulationManagerProcess
- Use of “Ghost” volumes
- Techniques of fast simulation

**Primary author:** ZABOROWSKA, Anna (CERN)

**Presenters:** RIBON, Alberto (CERN); ZABOROWSKA, Anna (CERN)

Contribution ID: **31**

Type: **not specified**

## Afternoon Session 1



Contribution ID: 32

Type: **not specified**

## Afternoon Session 2

Contribution ID: 33

Type: **not specified**

## Physics Biasing

*Friday 18 October 2024 15:40 (40 minutes)*

Physics biasing techniques

**Presenter:** RIBON, Alberto (CERN)

Contribution ID: 34

Type: **not specified**

## Discussion

*Friday 18 October 2024 15:00 (20 minutes)*

- Event biasing
- Physics biasing

**Presenters:** RIBON, Alberto (CERN); VERDERI, Marc (Centre National de la Recherche Scientifique (FR))

Contribution ID: 35

Type: **not specified**

## Questions & Answers

*Friday 18 October 2024 17:15 (30 minutes)*

General discussion

Answers on topics raised on Mattermost

Contribution ID: **36**

Type: **not specified**

## Geometry

*Tuesday 15 October 2024 14:00 (1h 15m)*

- Placements, Replicated and Parameterised volumes, introduction
- Divided volumes
- Geometrical regions
- Touchables and Nested parameterisations
- Assembly volumes
- Reflected volumes
- Geometry optimization
- Parallel geometries
- Moving geometries
- CAD interface

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: 37

Type: **not specified**

## Discussion

*Thursday 17 October 2024 14:50 (15 minutes)*

Fast Simulation

Contribution ID: **38**

Type: **not specified**

## Discussion

*Thursday 17 October 2024 17:40 (20 minutes)*

- Physics lists
- Hadronic physics

**Presenters:** RIBON, Alberto (CERN); FOLGER, Gunter

Contribution ID: 39

Type: **not specified**

# Hadronic Physics - I

*Monday 14 October 2024 16:50 (50 minutes)*

Introduction (what is it, why we need it, what are the challenges)

Overview of the hadronic physics framework

Hadronic cross-sections

Hadronic final-state models

Hadronic data libraries

**Presenter:** RIBON, Alberto (CERN)



Contribution ID: 40

Type: **not specified**

## Discussion on UI, user actions and scoring

*Wednesday 16 October 2024 16:50 (25 minutes)*

- UI commands
- User actions
- Scoring

**Presenter:** ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 41

Type: **not specified**

## Scoring (repeat)

- Sensitive detectors & Hits
- Basic scoring commands
- Advanced scoring

**Presenters:** APOSTOLAKIS, John (CERN); ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 42

Type: **not specified**

## Definition of UI commands (repeat of morning)

- G4UIExecutive
- Definition of custom UI commands

**Presenters:** APOSTOLAKIS, John (CERN); ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 43

Type: **not specified**

## Additional User classes (repeat)

- User limits
- User information classes
- Stack management

**Presenters:** APOSTOLAKIS, John (CERN); ASAI, Makoto (SLAC National Accelerator Laboratory (US))

Contribution ID: 44

Type: **not specified**

## Discussion

- UI commands
- User actions
- Scoring

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: 45

Type: **not specified**

## Practicalities (repeat - adapted)

- Welcome to the (time-shifted) course
- Practical aspects - Zoom, Mattermost, Questions, ...

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: 46

Type: **not specified**

## Multithreading II

- thread safety
- split classes

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: 47

Type: **not specified**

## Discussion

*Tuesday 15 October 2024 17:15 (20 minutes)*

Magnetic Field

**Presenter:** APOSTOLAKIS, John (CERN)



Contribution ID: 48

Type: **not specified**

## Discussion

*Tuesday 15 October 2024 15:15 (20 minutes)*

Geometry

**Presenters:** Dr COSMO, Gabriele (CERN); APOSTOLAKIS, John (CERN)

Contribution ID: 49

Type: **not specified**

## Welcome and Practicalities

*Monday 14 October 2024 14:00 (10 minutes)*

- Welcome to the course
- Practical aspects - Zoom, Mattermost, Questions, ...

**Presenter:** APOSTOLAKIS, John (CERN)

Contribution ID: 50

Type: **not specified**

## Homework of Day 1

*Tuesday 15 October 2024 17:35 (20 minutes)*

Questions from exercises provided on Day 1