

Geant 4

*IEEE Nuclear Science Symposium and Medical Imaging Conference
Short Course*

Simulation Techniques Using Geant4

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<http://www.ge.infn.it/geant4/events/nss2008/geant4course.html>

This course exploits training material developed by several Geant4
Collaboration members: thanks to all of them!

Fast Simulation

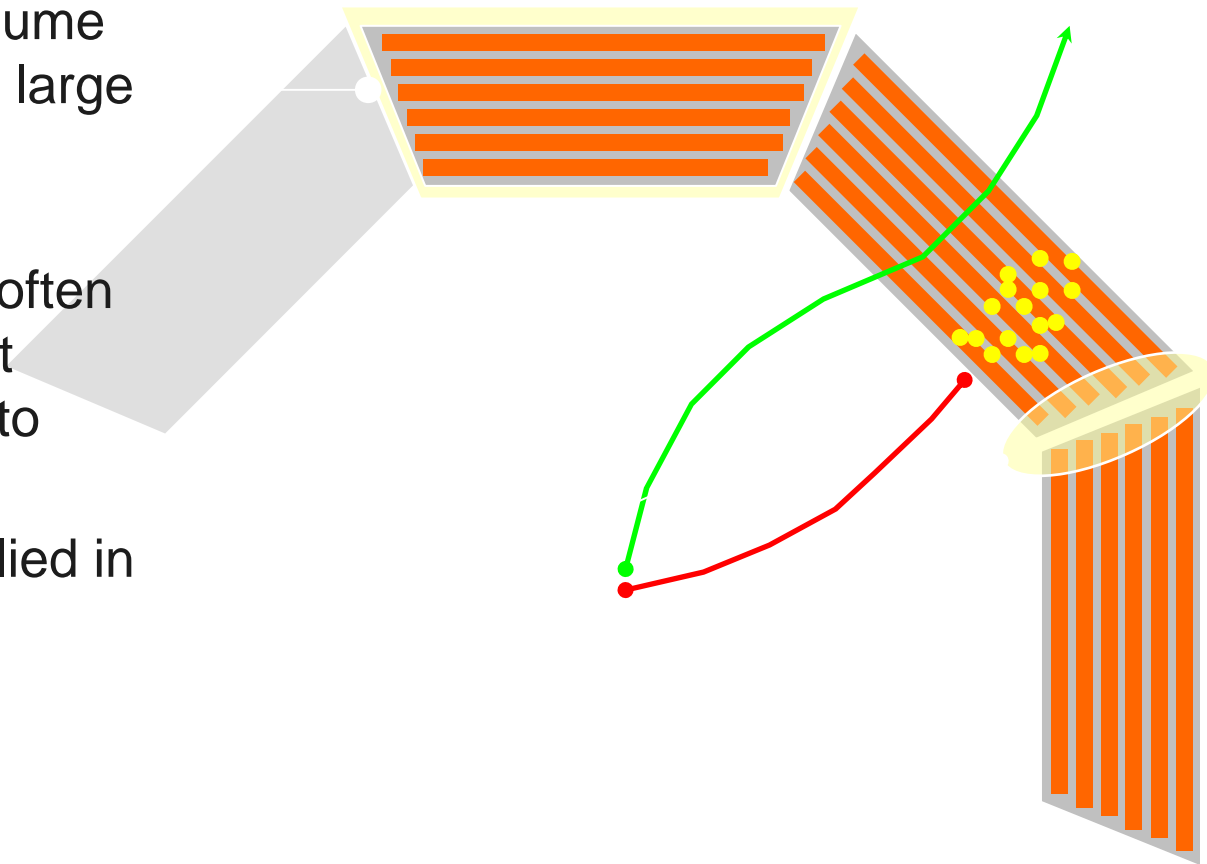
Basic concepts of simulation with Geant4 a s
a general purpose Monte Carlo toolkit

Generalities

- Fast Simulation, also called parameterisation, is a shortcut to the tracking
- Fast Simulation allows you to take over the tracking to implement your own fast physics and detector response
- The classical use case of fast simulation is the shower parameterisation
 - the typical several thousand steps per GeV computed by the tracking are replaced by a few ten of deposits per GeV
- Parameterisations are generally experiment dependent

Parameterisation features

- Parameterisations take place in an envelope. This is typically the mother volume of a sub-system or of a large module of such a sub-system
- Parameterisations are often particle type dependent and/or may apply only to some.
- They are often not applied in complicated regions.



G4VFastSimulationModel

- This is the base class allowing to implement concrete parameterisation models
- It has three pure virtual methods to be overridden :
 - `G4bool IsApplicable(const G4ParticleDefinition *)`
 - Which specify for which particles the model is valid
 - `G4bool ModelTrigger(const G4FastTrack &)`
 - Which allow to decide or not to trigger the model at the current point, in order to avoid to trigger in a « complicated region ».
 - `void DoIt(const G4FastTrack &, G4FastStep &)`
 - Which is the parameterisation properly said, invoked when the model has triggered.
- G4FastTrack provides input informations to the model (G4Track, envelope informations, ...)

Binding concrete models to an envelope

- Concrete models are bound to the envelope through a G4FastSimulationManager object
- This allows several models to be bound to a same envelope
- The « envelope » is simply a G4LogicalVolume which has received a G4FastSimulationManager
- All its [grand[...]]daughters will be sensitive to the parameterisations



G4FastSimulationManager

ModelForElectrons

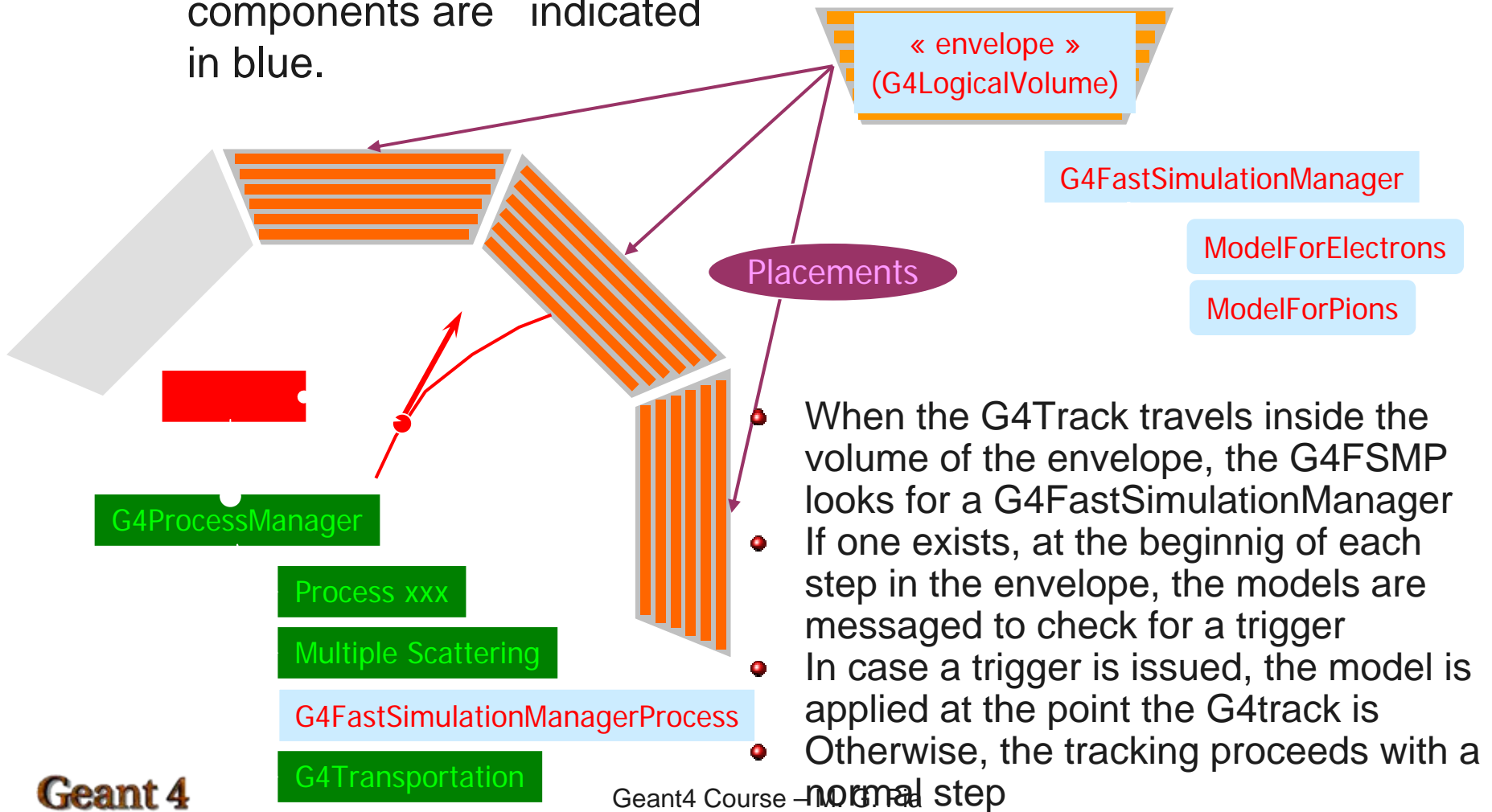
ModelForPions

G4FastSimulationManagerProcess

- The G4FastSimulationManagerProcess is a process providing the interface between the tracking and the fast simulation
- It has to be set to the particles to be parameterised:
 - The process ordering is the following:
 - [n-3] ...
 - [n-2] Multiple Scattering
 - [n-1] G4FastSimulationManagerProcess
 - [n] G4Transportation
- It can be set as a discrete process or it must be set as a continuous & discrete process if using ghost volumes

Summary Picture of Fast Simulation Mechanism

- The Fast Simulation components are indicated in blue.



Ghost Volumes

- Ghost volumes allow to define envelopes independently of the volumes of the tracking geometry
- This allows to group together the electromagnetic and hadronic calorimeters for pion parameterisation for example or to define envelopes for geometries coming out of a CAD system which don't have a hierarchical structure
- In addition Ghost volumes are sensitive to particle flavor, allowing to define in a completely independent way envelopes for electrons, envelopes for pion etc...