Scoring - 2

I. Hrivnacova, IPN Orsay

Credits M. Asai (SLAC), G. Folger (CERN) and others

Geant4 ED PHENIICS Tutorial,
13 - 17 May 2019, Orsay

Accessing information from Geant4 objects

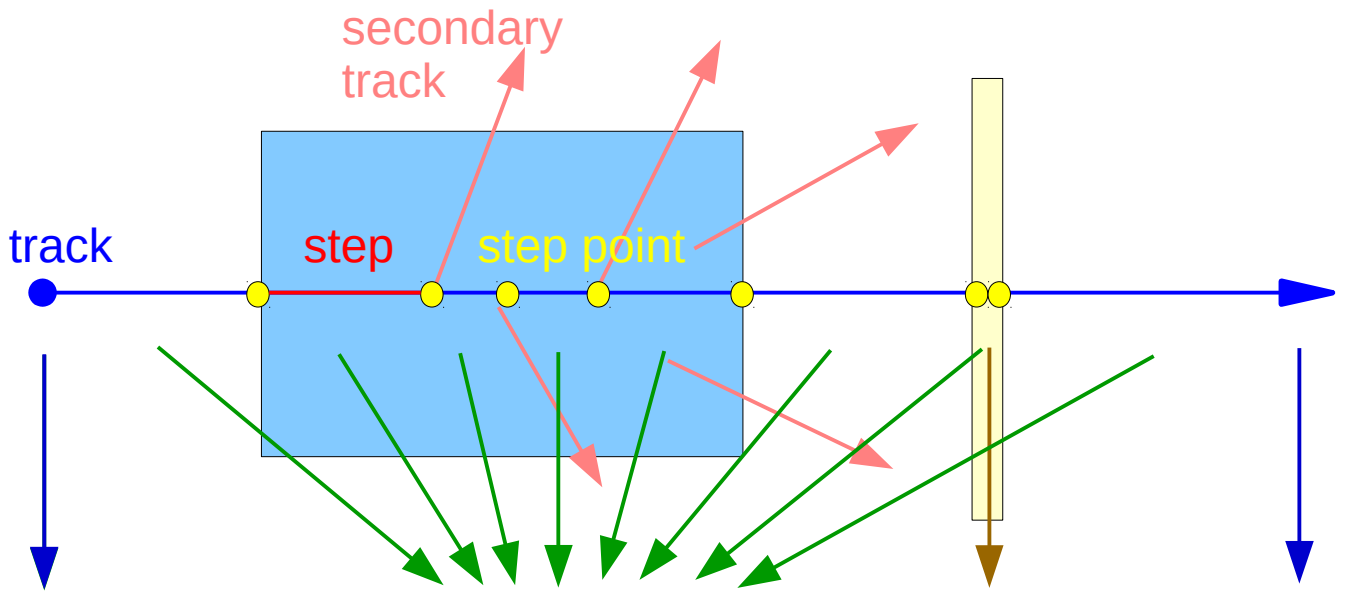
Getting Information from Geant4 Objects

- At each phase of run processing user can access the corresponding Geant4 objects:
  - G4Run, G4Event, G4Track, G4Step
  - Note that the objects are provided via constant pointer and so they cannot be modified in the user functions
- An overview of available "Get" functions is provided on the following slides
- The up-to-date information (for each Geant4 version) can be accessed via Geant4 LXR code browser:
  - http://www-geant4.kek.jp/LXR/index.html

Geant4 and User Application

Event Processing

A special user class, sensitive detector, can be attached to (a) selected volume(s) and then called during event processing



User Application	PreTracking Action	Stepping Action	Sensitive Detector	PostTracking Action
Geant4	**G4Track**	**G4Step**	**G4Step**	**G4Track**

Create a Hit

- A hit can be created when a step takes place in a sensitive logical volume, in a user sensitive detector function ProcessHits(..)
- In this function we have access to G4Step

MySD.cc

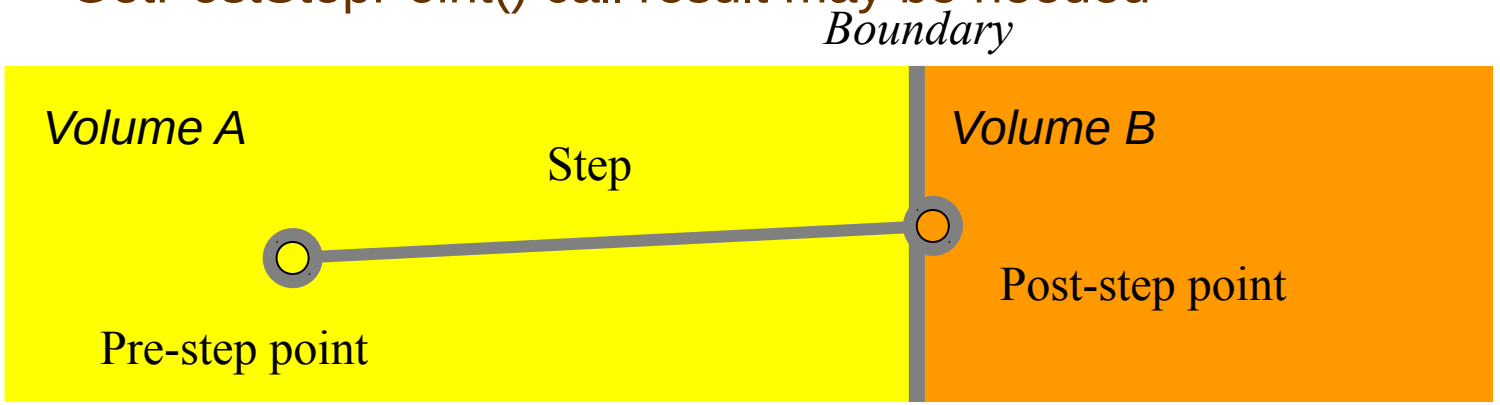
```
G4bool MySD::ProcessHits(G4Step* step,
                         G4TouchableHistory* /*history*/)
{
  MyHit* newHit = new MyHit();
  // Get some properties from G4Step and set them to the hit
  // newHit->SetXYZ();
  G4double edep = step->GetTotalEnergyDeposit();
  newHit->SetEdep(edep);
  // ...
}
```

Track, Step & Step Point

- The G4Track and G4Step objects give access to all properties of the tracked particles
- The track properties which can be different at start and end of step have to be accessed by G4StepPoint class

```
G4ThreeVector position
  = step->GetPreStepPoint()->GetPosition();
```

- The post step point may be 0 if track is leaving world (a test of the GetPostStepPoint() call result may be needed



G4Track

- The G4Track object can be accessed via G4Step:

```
G4Track* track = step->GetTrack();
```

- Some track properties can be accessed via the objects associated to a track
  - G4ParticleDefinition: static particle properties

```
G4double pdgCode
  = track->GetParticleDefinition()→GetPDGEncoding();
```

  - G4DynamicParticle: dynamic particle properties

```
G4double ...
  = track->GetDynamicParticle()→Get...();
```

Track Status

- At the end of each step, according to the processes involved, the state of a track may be changed.
  - It can be accessed via:

```
G4TrackStatus status = track->GetTrackStatus();
```

- The G4TrackStatus is enum which can take the following values
  - fAlive – track continues the tracking.
  - fStopButAlive - he track has come to zero kinetic energy, but still AtRest process to occur.
  - fStopAndKill - the track no longer exists - it has decayed, interacted or gone out of the world boundary. Secondaries will be pushed to the stack.
- The user can also change the status in UserSteppingAction with the following values
  - fKillTrackAndSecondaries, fSuspend, fPostponeToNextEvent

Step Status

- Step status is attached to G4StepPoint to indicate why that particular step was determined.
  - Use "PostStepPoint" to get the status of this step, "PreStepPoint" has the status of the previous step.

```
G4StepStatus status
  = step->GetPostStepPoint()->GetStepStatus();
```

- The G4StepStatus is `enum` which can take the following values
  - `fWorldBoundary` - step reached the world boundary
  - `fGeomBoundary` - step is limited by a volume boundary except the world
  - `fAtRestDoItProc, fAlongStepDoItProc, fPostStepDoItProc` - step is limited by a physical process
  - `fUserDefinedLimit, fExclusivelyForcedProc, fUndefined`
- To identify *a track entering [exiting] a volume*, pick `fGeomBoundary` status in PreStep [PostStep]

Overview of Geant4 Classes used in Scoring

G4Run, G4Event

G4Run useful functions:

G4int GetRunID() const;

G4int GetNumberOfEvent() const;

G4Event useful functions:

G4int GetEventID() const;

G4HCofThisEvent* GetHCofThisEvent() const;

- This function gives an access to all registered hits collections

G4DCofThisEvent* GetDCofThisEvent() const;

- This function gives an access to a digits collection (not presented in this course)

G4TrajectoryContainer* GetTrajectoryContainer() const

G4Track

Useful functions:

G4int Get[Track,Parent]ID() const;

const G4DynamicParticle* GetDynamicParticle() const;

const G4ParticleDefinition* GetParticleDefinition() const;

const G4VProcess* GetCreatorProcess() const;

const G4ThreeVector& Get[Vertex]Position() const;

G4double Get[Global,Local,Proper]Time() const;

G4double Get[Vertex][Kinetic,Total]Energy() const;

const G4ThreeVector[&] Get[Vertex]Momentum[Direction]() const;

G4double GetVelocity() const;

const G4ThreeVector& GetPolarization() const;

G4double GetWeight() const;

G4Track (2)

Useful functions:

G4double Get[TrackLength]() const;

[const G4Step*, G4int, G4double] Get[[Current]Step[Length,Number]]() const;

G4VPhysicalVolume* Get[[Next]Volume]() const;

G4Material* Get[[Next]Material]() const;

const G4MaterialCutsCouple* Get[[Next]MaterialCutsCouple]() const;

const [G4VTouchable*,G4TouchableHandle&] Get[[Next,Origin]Touchable[Handle]]() const;

G4TrackStatus Get[TrackStatus]() const;

G4Step

Useful functions:

G4Track* GetTrack() const;

G4StepPoint* GetPreStepPoint() const;

G4StepPoint* GetPostStepPoint() const;

G4double GetStepLength() const;

G4double Get[Total,NonIonizing]EnergyDeposit() const;

G4ThreeVector GetDeltaPosition() const;

G4double GetDeltaTime() const;

G4StepPoint

Useful functions:

const G4VProcess* GetProcessDefinedStep() const;

* const G4ThreeVector& GetPosition() const;

* G4double Get[Global,Local,Proper]Time() const;

* G4double Get[Kinetic,Total]Energy() const;

* const G4ThreeVector[&] GetMomentum[Direction]() const;

* G4double GetVelocity() const;

G4double Get[Beta,Gamma]() const;

* const G4ThreeVector& GetPolarization() const;

G4double GetMass() const;

G4double GetCharge() const;

G4double GetMagneticMoment() const;

* G4double GetWeight() const;

*The functions preceded with * exist also for G4Track*

G4StepPoint (2)

Useful functions:

G4VSensitiveDetector* GetSensitiveDetector() const;

* G4VPhysicalVolume* GetPhysicalVolume() const;

* G4Material* GetMaterial() const;

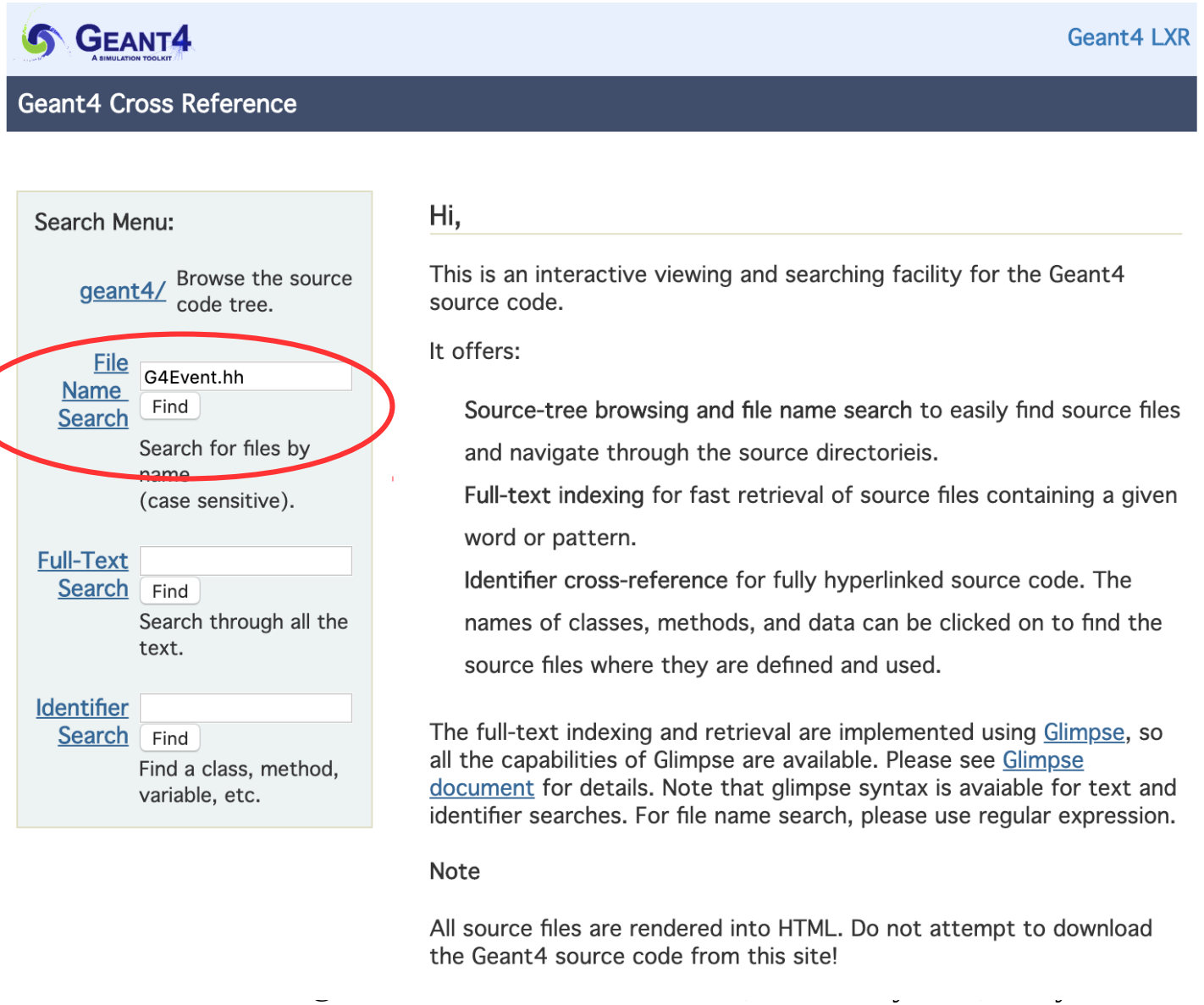
* const G4MaterialCutsCouple* Get[Next]MaterialCutsCouple() const;

* const [G4VTouchable*,G4TouchableHandle&] GetTouchable[Handle]() const;

G4StepStatus GetStepStatus() const;

Searching in Geant4 Source Code Documentation

LXR Browser (1)



GEANT4 A SIMULATION TOOLKIT

Geant4 LXR

Geant4 Cross Reference

Cross-Referencing Geant4

Version: [ReleaseNotes] [1.0] [1.1] [2.0] [3.0] [3.1] [3.2] [4.0] [4.0.p1] [4.0.p2]
[4.1] [4.1.p1] [5.0] [5.0.p1] [5.1] [5.1.p1] [5.2] [5.2.p1] [5.2.p2] [6.0] [6.0.p1]
[6.1] [6.2] [6.2.p1] [6.2.p2] [7.0] [7.0.p1] [7.1] [7.1.p1] [8.0] [8.0.p1] [8.1]
[8.1.p1] [8.1.p2] [8.2] [8.2.p1] [8.3] [8.3.p1] [8.3.p2] [9.0] [9.0.p1] [9.0.p2]
[9.1] [9.1.p1] [9.1.p2] [9.1.p3] [9.2] [9.2.p1] [9.2.p2] [9.2.p3] [9.2.p4] [9.3]
[9.3.p1] [9.3.p2] [9.4] [9.4.p1] [9.4.p2] [9.4.p3] [9.4.p4] [9.5] [9.5.p1] [9.5.p2]
[9.6] [9.6.p1] [9.6.p2] [9.6.p3] [9.6.p4] [10.0] [10.0.p1] [10.0.p2] [10.0.p3]
[10.0.p4] [10.1] [10.1.p1] [10.1.p2] [10.1.p3] [10.2] [10.2.p1] [10.2.p2] [10.2.p3]
[10.3] [10.3.p1] [10.3.p2] [10.3.p3] [10.4] [10.4.p1] [10.4.p2] [10.4.p3] [10.5]
[*10.5.p1*]

- [source navigation] - [identifier search] - [freetext search] - [*file search*] -

Search for files using regular expressions

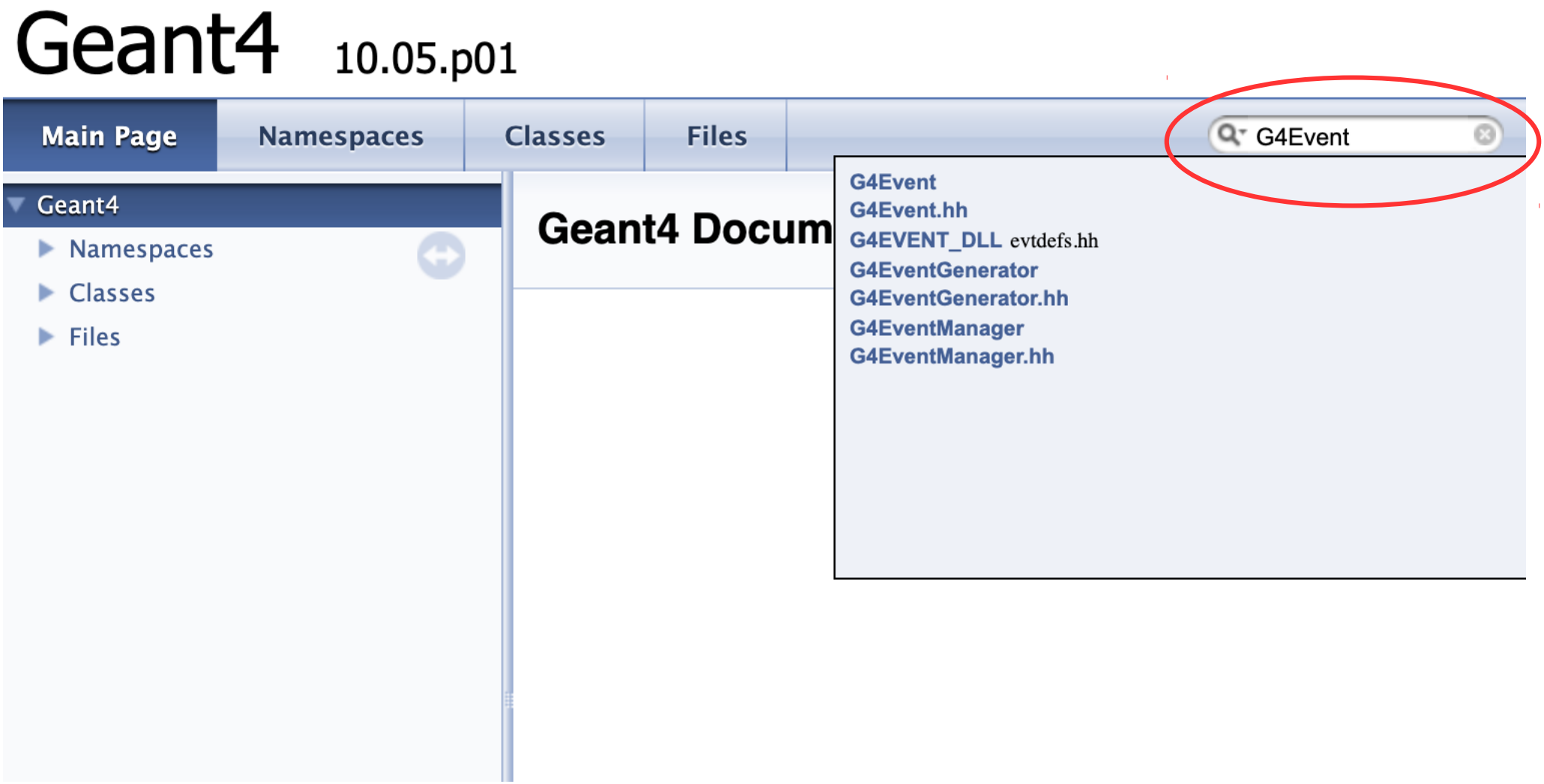
Find file: G4Event.hh search

/event/include/G4Event.hh

This page was automatically generated by the LXR engine.

```
139       { grips++; }
140       inline void PostProcessingFinished() const
141       { grips--;
142         if(grips<0)
143         { G4Exception("G4Event::Release()","EVENT91001",FatalException,
144                       "Number of grips became negative. This cannot be correct."); }
145       }
146       inline G4int GetNumberOfGrips() const
147       { return grips; }
148
149     public: // with description
150       inline G4int GetEventID() const
151       { return eventID; }
152       //  Returns the event ID
153       inline void AddPrimaryVertex(G4PrimaryVertex* aPrimaryVertex)
154       {
155         if( thePrimaryVertex == nullptr )
156         { thePrimaryVertex = aPrimaryVertex; }
157         else
158         { thePrimaryVertex->SetNext( aPrimaryVertex ); }
159         numberOfPrimaryVertex++;
160       }
161       //  This method sets a new primary vertex. This method must be invoked
162       // exclusively by G4VPrimaryGenerator concrete class.
163       inline G4int GetNumberOfPrimaryVertex() const
164       { return numberOfPrimaryVertex; }
165       //  Returns number of primary vertexes the G4Event object has.
166       inline G4PrimaryVertex* GetPrimaryVertex(G4int i=0)  const
167       {
168         if( i == 0 )
169         { return thePrimaryVertex; }
170         else if( i > 0 && i < numberOfPrimaryVertex )
171         {
172           G4PrimaryVertex* primaryVertex = thePrimaryVertex;
173           for( G4int j=0; j<i; j++ )
174           {
175             if( !primaryVertex ) return nullptr;
176             primaryVertex = primaryVertex->GetNext();
177           }
```

Doxygen


Geant4 10.05.p01
Main Page
Namespaces
Classes
Files
G4Event
Geant4
Namespaces
Classes
Files
Geant4 Docum
G4Event
G4Event.hh
G4EVENT_DLL evtdefs.hh
G4EventGenerator
G4EventGenerator.hh
G4EventManager
G4EventManager.hh

Geant4 10.05.p01

Main Page | Namespaces | Classes | Files | Search

Class List | Class Index | Class Hierarchy | Class Members

- G4Eta
- G4Etac
- G4EtaPr
- G4Evap
- G4Evap
- G4Evap
- G4Evap
- G4Evap
- G4Evap
- G4Evap
- G4Evap
- G4Event
  - G4Ev
  - G4Ev
  - ~G4E
  - G4Ev
  - opera
  - opera
  - opera
  - opera
  - Print
  - Draw

void	KeepForPostProcessing () const
void	PostProcessingFinished () const
G4int	GetNumberOfGrips () const
G4int	GetEventID () const
void	AddPrimaryVertex (G4PrimaryVertex *aPrimaryVertex)
G4int	GetNumberOfPrimaryVertex () const
G4PrimaryVertex *	GetPrimaryVertex (G4int i=0) const
G4HCofThisEvent *	GetHCofThisEvent () const
G4DCofThisEvent *	GetDCofThisEvent () const
G4TrajectoryContainer *	GetTrajectoryContainer () const
G4bool	IsAborted () const
void	SetUserInformation (G4VUserEventInformation *anInfo)
G4VUserEventInformation *	GetUserInformation () const
const G4String &	GetRandomNumberStatus () const
const G4String &	GetRandomNumberStatusForProcessing () const

Private Member Functions

	G4Event (const G4Event &)
G4Event &	operator= (const G4Event &)

Private Attributes

SetEve
SetHC
SetDC
SetTra
SetEve
SetRar
SetRar
KeepT
ToBeK
KeepF
PostPr
GetNu
GetEve
AddPr
GetNu
GetPri
GetHC
GetDC
GetTra

G4int GetEventID ( ) const

References **eventID**.

void AddPrimaryVertex (G4PrimaryVertex * aPrimaryVertex)

References **numberOfPrimaryVertex**, **G4PrimaryVertex::SetNext()**, and **thePrimaryVertex**.

G4int GetNumberOfPrimaryVertex ( ) const

References **numberOfPrimaryVertex**.

G4PrimaryVertex* GetPrimaryVertex (G4int i = 0) const

Summary

- The physical quantities of interest can be accessed via provided "Get" functions of Geant4 objects available during event processing:
  - G4Run, G4Event, G4Track, G4Step, G4StepPoint
- The complete, up-to date list of all available functions can be found in LXR browser:
  - http://www-geant4.kek.jp/LXR/index.html