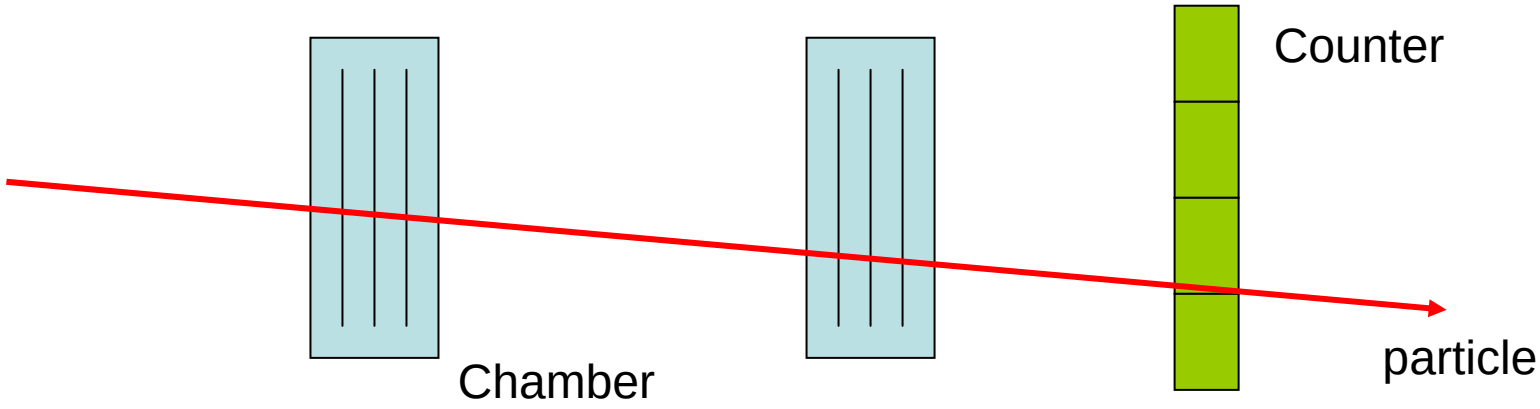
Geant zemi

2007/1/11

Sensitive detector



- In a simulation, we want to know
  - Position and time of the particle at the detector
  - Momentum and energy of the particle at the detector
  - Energy deposition of the particle in the detector
- We register the detector as a sensitive detector

Overview

Initialization

DetectorConstruction
Register some detectors as sensitive detector to SDManager

Hits
Define data style
Prepare a vector collection

Pair for each Sensitive detector

SensitiveDetector
Define detector's action when a particles pass the detector

EventAction
BeginOfEvent
Get ID of each sensitive detector from SDManager

One Event

Container

Counter

Step ΔE, time | **Step** ΔE, time | . . . | **Step** ΔE, time

Chamber

Step pos | **Step** pos | . . . | **Step** pos

EndOfEvent

Get this container for Each Sensitive detector
GetHC(detectorID)

Fill data to histogram

Registration of Sensitive Detector

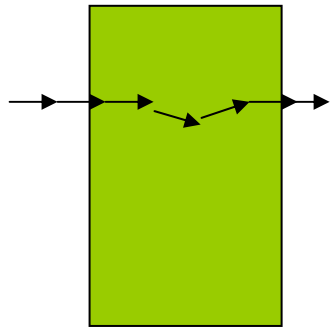
DetectorConstruction.cc

```
solidCalor = new G4Box("Calorimeter",        //its name
                    CalorThickness/2,CalorSizeYZ/2,CalorSizeYZ/2);

logicCalor = new G4LogicalVolume(solidCalor,  //its solid
                              Sci, //its material
                              "Calorimeter");      //its name

physiCalor = new G4PVPlacement(0,                    //no rotation
                            ……省略:)

//--------------Sensitive Detector
G4SDManager* SDman = G4SDManager::GetSDMpointer();
if(!counterSD)
  {
    counterSD = new ExN00CounterSD("counterSD",this);
    SDman->AddNewDetector( counterSD );
  }
logicCalor->SetSensitiveDetector(counterSD);
```

G4SDManager is the singleton manager class for sensitive detector.
We register a sensitive detector to G4SDManager.

Hit

- A hit is a snapshot of the physical interaction of a track in the sensitive region.
- The information of
  - Position and time of the step
  - Momentum and energy of track
  - Energy deposition of the step
  - Geometrical information

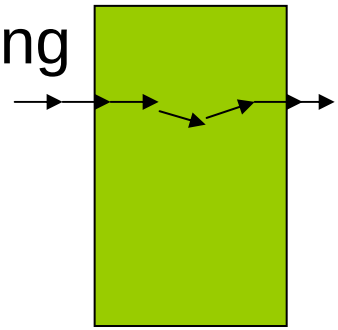


- G4VHit
  - G4VHit is an abstract base class which represent a hit
  - You have to inherit this base class and derive your own class
- G4THitsCollection
  - There are many hits in one event.
  - This is a vector collection which contain all hits in one event

```
class ExN00CounterHit : public G4VHit
{
 public:

   ExN00CounterHit();
  ~ExN00CounterHit();
      …省略…
 public:
   void AddAbs(G4double de, G4double dl) {EdepAbs += de; TrackLengthAbs += dl;};
   void SetTime(G4double time) {Time =time;};
   G4double GetEdepAbs()     { return EdepAbs; };
   G4double GetTrakAbs()     { return TrackLengthAbs; };
   G4double GetTime()     { return Time; };
 private:
   G4double EdepAbs, TrackLengthAbs;
   G4double Time;
};

//....oooOO0OOooo.....oooOO0OOooo.....oooOO0OOooo.....oooOO0OOooo.....

typedef G4THitsCollection<ExN00CounterHit> ExN00CounterHitsCollection;

extern G4Allocator<ExN00CounterHit> ExN00CounterHitAllocator;
```

Sensitive Detector

- G4VSensitiveDetector is an abstract base class which represents a detector.The principal mandate of a sensitive detector is the construction of hit objects using information from steps along a particle track.
- The ProcessHits() method performs this task using G4Step objects as input



- ProcessHits() method
  - This method Is invoked when there is a step in the sensitive detector.
  - In this method, you can get information of the particle which pass the detector and energy deposit.
  - These values are passed to ***Hit class .
  - Then this Hit information are stored in a vector container.

```
G4bool ExN00CounterSD::ProcessHits(G4Step* aStep,G4TouchableHistory* ROhist)
{
  //G4cout << "####ExN00CalorimeterSD::ProcessHits " << detectorname  << G4endl;
  G4double edep = aStep->GetTotalEnergyDeposit();
  G4double time = aStep->GetTrack()->GetGlobalTime();

  G4double stepl = 0.;
  G4String particleName;
  particleName = aStep->GetTrack()->GetDefinition()->GetParticleName();
  if (aStep->GetTrack()->GetDefinition()->GetPDGCharge() != 0.)
      stepl = aStep->GetStepLength();

  if ((edep==0.)&&(stepl==0.)) return false;

  G4TouchableHistory* theTouchable
    = (G4TouchableHistory*)(aStep->GetPreStepPoint()->GetTouchable());

  if (HitID==-1)
    {
      ExN00CounterHit* calHit = new ExN00CounterHit();
      calHit->AddAbs(edep, stepl);
      calHit->SetTime(time);
      HitID = CalCollection->insert(calHit) - 1;
    }
  else
    {
      (*CalCollection)[HitID]->AddAbs(edep,stepl);
    }

  return true;
}
```

EndOfEvent

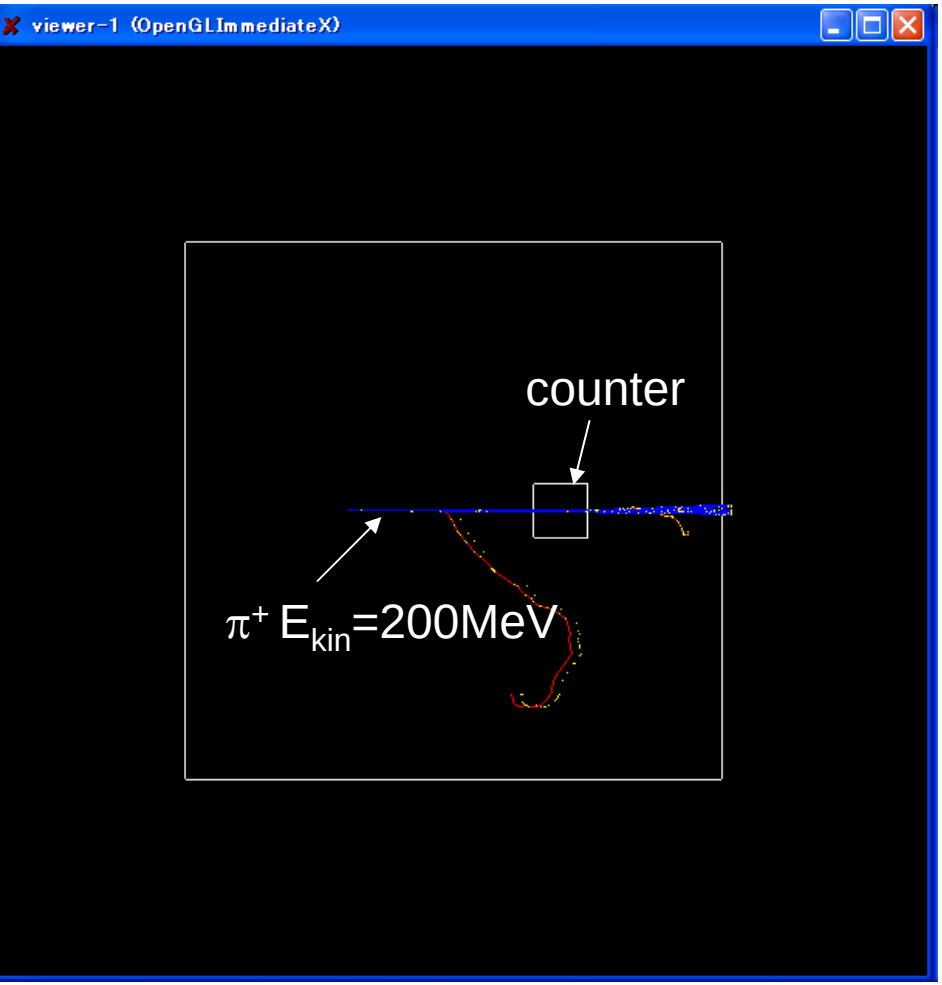
```
void ExN00EventAction::EndOfEventAction(const G4Event* evt)
{
  G4int evtNb = evt->GetEventID();

  G4HCofThisEvent* HCE = evt->GetHCofThisEvent();
  ExN00CounterHitsCollection* CounterHC = 0;

  if (HCE) CounterHC = (ExN00CounterHitsCollection*)(HCE-
>GetHC(counterCollID));
  if (CounterHC) {
    G4int n_hit = CounterHC->entries();
    for (G4int i=0;i<n_hit;i++){
      double time  = (*CounterHC)[i]->GetTime();
      double de    = (*CounterHC)[i]->GetEdepAbs();
      G4cout << "Time : " << time <<", dE : " << de << G4endl;
      AnaRoot->FillEnergyDeposit(de);
      AnaRoot->FillTime(time);
    }
  }
```

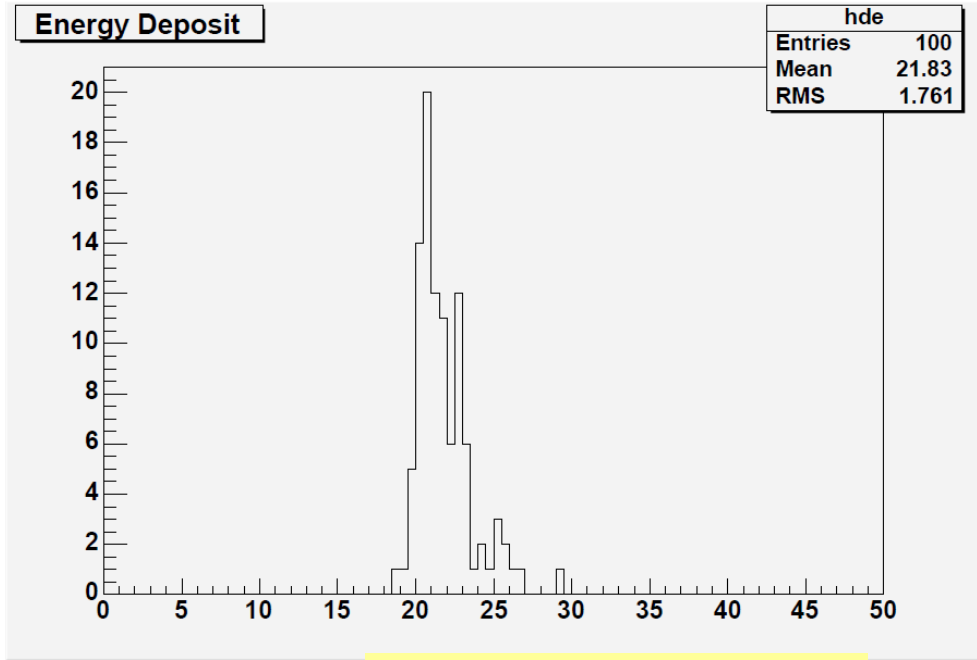
- You can get HitCollectoin of your sensitive detector for 1event at the EndOfEvent

Template example

- Farm:/home/miwa9/geant4/novice/N00p
- Expansion of N00
- New Added files
  - ExN00CounterHit.cc, .hh define Hit class and HitCollection
  - ExN00CounterSD.cc, .hh defile SensitiveDetector's behavior
  - ExN00RunAction.cc, .hh open root file at the BeginOfRun and close root file at the EndOfRun
  - ExN00AnaRoot.cc, .hh defile root files and histogram
- Modified files
  - ExN00DetectorConstruction.cc, .hh
  - ExN00EventAction.cc, .hh
  - exampleN00.cc
- Please copy this directory to your environment
  - cp –r /home/miwa9/geant4/novice/N00p .

Energy deposit at Counter (10cm thick plastic scintillator)





Energy deposit (MeV)

In this program, a root file is created for each run. (run(run#).root)

Root minimum

- > root
- root [] TFile f (“run0.root”); open root file
- root[] f.ls(); check the content of the file
  - TH1F hde;1 Energy Deposit
  - TH1F htime; 1 Time

This file have 2 TH1F histogram

- root [] hde->Draw() plot the histogram “hde”
- root [] htime->Draw() plot the histogram “htime”

Problem

- 今の条件(pi+, E_{kin}=200MeV, 10cm thick Scintillator)
  - Geantでenergy lossのヒストを作る。
  - Bethe-Blochで計算した値と比較する。
- カウンターの材質を鉛にする。このときに上の条件で行うとそれぞれどうなるか？Pi+は鉛の中で止まるかどうか？
- E_{kin}=200MeVのpi+をscintillatorで止めるには厚さはどれくらい必要か？Geantでシンチの厚さを変えながら調べてみる。
- シンチでpi+を止めたとき、止まった場所の分布はどうなっているか？このときは簡単のためdecay processはなしにしましょう。