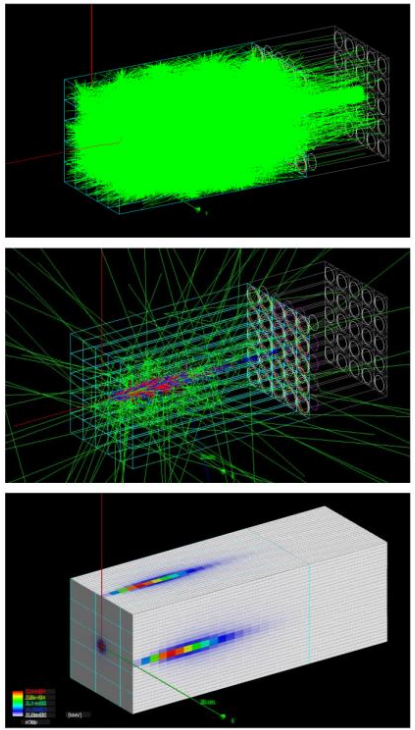
Summary of parallel 2B: Biasing and Fast Simulation Update

27th Geant4 Collaboration Meeting,
26th - 30th September 2022,
Rennes,
Marc Verderi (LLR)

Parallel 2B session


GEANT4
A SIMULATION TOOLKIT
Biasing and Scoring
Makoto Asai (JLab/SCT)
asai@jlab.org
Jefferson Lab
U.S. DEPARTMENT OF ENERGY
Office of Science
JSA

5 GeV e-



- Full simulation with optical photon transport to photo-multipliers
  - 18.41 sec/event

x 154

- Full simulation without optical photon transport
  - 0.119 sec/event

x 137

- Shower parameterization with GFlash
  - 0.00087 sec/event

Two issues

- GFlashEnergySpot, G4FastHit
  - Somewhat equivalent to G4Step but with single step-point
  - We can live with G4Step with one G4StepPoint object assigned to both Pre- and Post-step-point.
    - Problem in G4Step destructor is fixed at v11.0.p03.

- GFlashHitMaker, G4FastSimHitMaker
  - How to set (the name of) the parallel world(s) is the issue.

```
void myDetectorDescription::ConstructSD()
{
  auto gflashModel = new GFlashShowerModel("GFlashModel",localRegion);
  auto param = new GFlashHomoShowerParameterisation(fDetectorMater);
  gflashModel->SetParameterisation(*param);

  auto particleBounds = new GFlashParticleBounds();
  gflashModel->SetParticleBounds(*particleBounds);

  auto hitMaker = new GFlashHitMaker();
  hitMaker->SetNameOfWorldWithSD(componentName);
  gflashModel->SetHitMaker(*hitMaker);
}
```

GFlashHitMaker::make() – version 11.0.p03

```
46
47 GFlashHitMaker::GFlashHitMaker()
48 {
49   fTouchableHandle    = new G4TouchableHistory();
50   fpNavigator         = new G4Navigator();
51   fNaviSetup          = false;
52   fWorldWithSdName    = "";
53   fpSpotS = new G4Step();
54   fpSpotP = new G4StepPoint();
55   // N.B. Pre and Post step points are common.
56   fpSpotS->SetPreStepPoint(fpSpotP);
57   fpSpotS->SetPostStepPoint(fpSpotP);
58 }
59
60 GFlashHitMaker::~GFlashHitMaker()
61 {
62   delete fpNavigator;
63   delete fpSpotP;
64   fpSpotS->ResetPreStepPoint();
65   fpSpotS->ResetPostStepPoint();
66   delete fpSpotS;
67 }
```

GFlashHitMaker::make() : parallel world for scoring

```
68
69 void GFlashHitMaker::make(GFlashEnergySpot * aSpot, const G4FastTrack * aT)
70 {
71   // Locate the spot
72   if (!fNaviSetup)
73   {
74     // Choose the world volume that contains the sensitive detector based on its name (
75     G4VPhysicalVolume* worldWithSD = nullptr;
76     if(fWorldWithSdName.empty()) {
77       worldWithSD = G4TransportationManager::GetTransportationManager()->GetNavigatorFo
78       } else {
79       worldWithSD = G4TransportationManager::GetTransportationManager()->GetParallelWor
80     }
81     fpNavigator->SetWorldVolume(worldWithSD);
82     fpNavigator->
83       LocateGlobalPointAndUpdateTouchable(aSpot->GetPosition(),
84                                           fTouchableHandle(), false);
85     fNaviSetup = true;
86   }
87   else
88   {
89     fpNavigator->
90       LocateGlobalPointAndUpdateTouchable(aSpot->GetPosition(),
91                                           fTouchableHandle());
92   }
```

Status of GFlash example for sampling calorimeter

Igor Semeniouk
LLR, Ecole Polytechnique - CNRS/IN2P3

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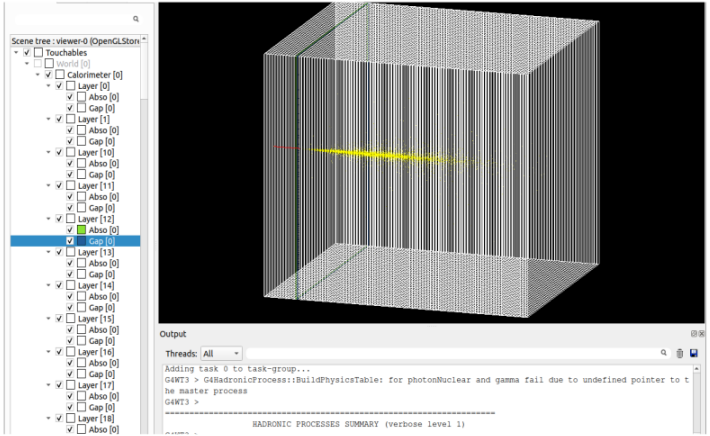
ExGflashb example

The application with allow compare and tune GFlash sampling shower parametrization versus full Geant4 shower development.

- All calorimeter is a single Gflash envelope
- Single “Gap” plate used as a SD volume
- Possibility to change materials and layer geometry
- Several geometry examples (macro files)
- The example produce following histograms:

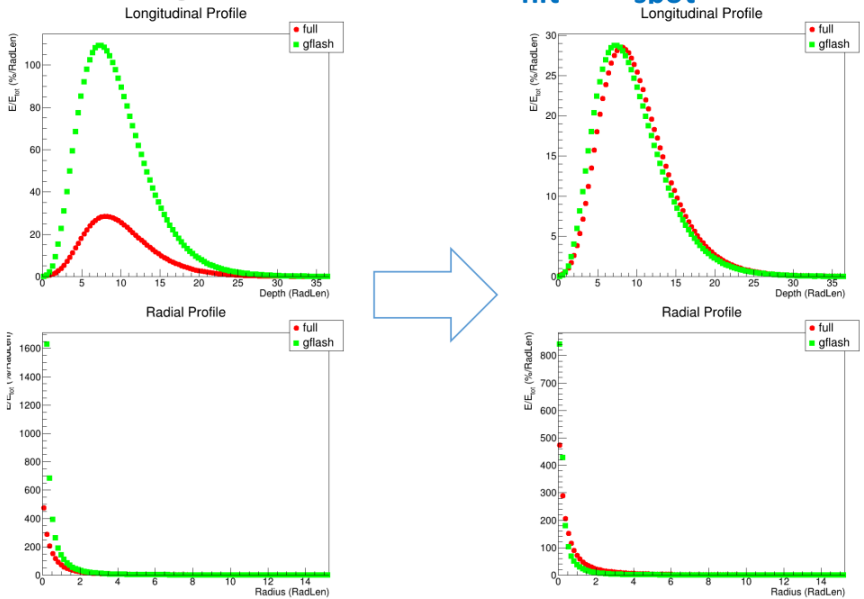
- h0 : energy deposit per event
- h1 : the number of hits per event
- h2 : the energy per hit (in MeV)
- p0 : longitudinal energy profile
- p1 : radial energy profile
- p2 : cumulated longitudinal energy profile
- p3 : cumulated radial energy profile



GFLASH Hits in Pb + Scintillator sampling calorimeter (aka LHCb), e^- , 50 GeV

2

ExGflashb
comparison of full Geant4 and GFLASH
Simple correction: $E_{hit} = E_{spot} \times C$



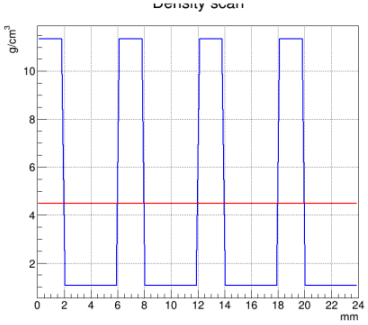
Budget of materials

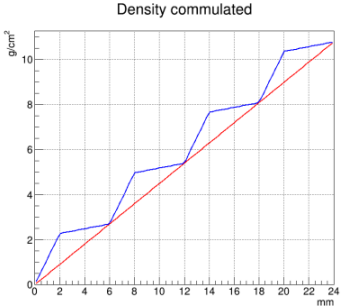
The GFLASH replace the absorber and decector materials with averaged muxture material.

This give highter enrgy deposition in detector (usually low dence material) and low energy depostion in absorber part(usually hight dence material) with respect of full simulation.

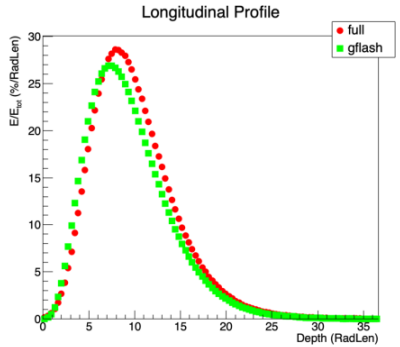
The total energy deposition remain correct.

Radiation length values also replaced by average Radiation length, this also changes the final energy depositions in absorbers and detectors layers.

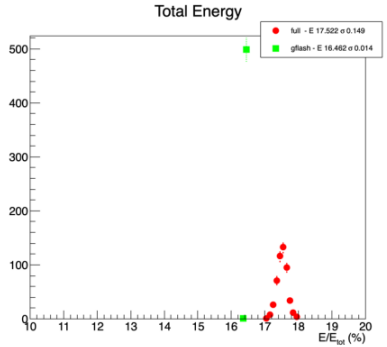




Automatic correction with density ratio



GFLASH vs Full simulation after density correction



GFLASH peak of E districution much nerrow then the peak from full simulation.