

Triggering Hadronic Inelastic Interactions

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- **Note: Presentation prepared by M. Paulini and given by Sunanda Banerjee on behalf of Soon Jun and M. Paulini**
- **To inform larger audience, we were asked to report about recent inquiry to Geant4 experts regarding technical issues with triggering hadronic inelastic interaction within G4FastSimulation model**



Introduction

Some History:

- **Gflash (EM shower parameterization) introduced to CMS by Joanna Weng**
- **Joanna contributed GFlash module in Geant4**
- **She was part of Geant4 collaboration representing CMS to allow for effective interaction among Geant4 developers and to guarantee proper integration and maintenance of module in Geant4 framework**
- **Joanna moved to new position and is available only as consultant in the future**
- **CMS will designate new contact for GFlash to Geant4 team for continued interaction and support**

The Issue

- Described in hypernews thread

<http://geant4-hn.slac.stanford.edu:5090/HyperNews/public/get/fastsim/26.html>

- **CMS wants to extend GFlash parameterization to hadronic model**
- **Within Geant4 we want to trigger hadronic model (GFlash) at point of first hadronic inelastic interaction inside envelope (ECAL+HCAL logical volume of CMS calorimeter)**
- **Want to still follow full G4 tracking with list of hadronic physics up to first inelastic interaction within envelope**
- **From this point on want to take over with parametrized physics, e.g. start GFlash parametrization**
- **Want to take all energy of particle exactly before interaction and want to use it for GFlash replacing result of relevant G4 interaction**

The Issue

- **Problem is that G4FastSimulationModel does not allow to trigger on parametrized physics based on any physics process associated with step**

- **Example of simplified code inside ModelTrigger (Geant 4.8.2)**

```
hG4bool trigger = false;
G4StepPoint* postStep = fastTrack.GetPrimaryTrack()->GetStep()->GetPostStepPoint();
G4String procName = postStep->GetProcessDefinedStep()->GetProcessName();
G4TrackVector* secondary = fastTrack.GetPrimaryTrack()->GetStep()->GetSecondary();
if( procName == "PionPlusInelastic" && (*secondary).size() > 0 ) {
    trigger = true;
    //should delete secondaries
    //fastTrack.GetPrimaryTrack()->GetStep()->DeleteSecondaryVector();
}
return trigger;
```

- **Kinetic energy of FastTrack in Dolt-method is the energy after hadronic interaction, i.e. after losing primary energy and creation of secondaries**

Possible Solution

- Received replies by M. Verderi, V. Ivantchenko & Gabriele Cosmo
- Interaction with John Apostolakis helped clarify use-case of G4, existing capabilities within Geant4 and pin-pointed central issue of original request
- John discussed potential solutions with developers of the fast simulation module
- Best solution today would be a wrapper process that would intercept and filter the output of an inelastic hadronic process and also serve to trigger a hadronic parameterization (during the next step) by communicating to the relevant parameterization
- Use of wrapper processes was pioneered a few years ago, for use in leading particle biasing. Possible to write a new (wrapper) process which takes the place of the physics process.
- It can check a particular condition and either act as the original process or undertake a different action

Possible Solution

- Sounds like viable solution to posed problem
- **When Soon is back from vacation plan to understand technical details on how to implement proposed wrapper process**
- **Looking forward to continued and fruitful interactions with Geant4 development team :-)**

