Session 6 : Exercise

Code for download: session6_start.tar.gz

Exercise 6a (analysis):

- With use of `G4AnalysisManager`
  (see example B4/B4d):

  1. Create & fill histogram
     - Define a 1D histogram for the energy deposited per event for each calorimeter layer
     - Implement filling of histograms in the `EDEmCalorimeterSD::EndOfEvent()` function.
       Hint:
       To access the i-th calorimeter hit from fHitsCollection:
       `EDEmCalorimeterHit* hit = (EDEmCalorimeterHit*)(*fHitsCollection)[i];`
     - Activate plotting of histograms using the UI command(s)
  2. Create & fill ntuple
     - Define two ntuples representing the tracker chamber hit in each tracker chamber:
       - the chamber layer number
       - hit local position (x, y, z)
     - Implement filling of ntuple in `EDChamberSD::ProcessHits();`
  3. Inspect generated file in Root with Root browser
     - The command to call Root in our environment:
       `/usr/local/bin/root`

Exercise 6b (physics):

More collections for the calorimeter were added in the start code. Bounds for calorimeter histogram have been changed also. Prints for hit have been removed, in order to run statistics without being annoyed by long outputs.

1) Energy deposit depending on particle species

- Two calorimeter hits have been added in the hits collection to
  - collect deposit from charged particles in all layers
  - collect deposit from neutral particles
- Add histograms for these new quantities, and fill these historams.
  In the run action, you will have to add the creation of these
  histograms as, for example:

```
// histogram 10
analysisManager->CreateH1("AllCharged", "Charged Edep in all layers", 150, 0., 1500.);
// histogram 11
analysisManager->CreateH1("AllNeutral", "Neutral Edep in all layers" , 100, 0., 100.);
```

  Run 1000 protons in batch mode (much recommended !).

You will see that energy deposit from neutral particle
is quite marginal. Explain why neutral particles
deposit so few compared to charged ones.

2) Energy deposit depending on cut:

– Two other calorimeter hits have been added to
– collect deposit from the primary track
– collect deposit from other particles

– Add histograms for these new quantities, and fill these historams.
In the run action, you will have to add the creation of these
histograms as, for example:

```
// histogram 12
analysisManager->CreateH1("EdepPrimary", "Edep [MeV] by primary in calorimeter", 150, 0., 1500);
// histogram 13
analysisManager->CreateH1("EdepOthers", "Edep [MeV] by non-primary in calorimeter", 150, 0., 1500);
```

Make two productions, running in batch mode 1000 protons with cuts of
– 1 mm (everywhere),
– 1 km (everywhere),
Compare the histogram for the primary and for the other particles.
Explain what happens.

- *Hint: the calorimeter volume has its own cuts defined via the associated region. Find the appropriate command in the `/run` command directory.*

The effect can me made more spectacular shooting EM particles, as
most of the secondary production by EM particles is sensitive to
the production cuts.

Prepare a runPositron.mac file in order to run in *batch mode*
1000 positrons (/gun/particle e+) of 1.2 GeV (so that they hit the
calorimeter -verify interactively if needed-). Run several jobs
with cuts:
– 1 mm
– 1 cm
– 10 cm
– 1 m
– 1 km
Compare again the histograms of energy deposit.

Compare also the histogram per layer. Observe that these histograms are
not much different as long as the cut value is not large compared to the
layer dimensions.

Solution: session6_solution.tar.gz