Physics Lists from a pedestrian

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Plenary Session VI :
"*New physics model development and physics list*"
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Introduction [1/2]

- We, sometimes, are users of Geant4, facing everyday's users' life issues
  - We have to care about a "reasonably" balanced simulation
    - In which the various aspects are treated with a believed consistent level of accuracy
    - These aspects are geometry, physics list, detector response…
  - This "global" approach is in contrast with the sake of accuracy in a specialized field when acting as a Geant4 developer
  - And the user (me here ☺) has to deal with this so so…

Introduction [2/2]

- For the context :
  - I am using Geant4 to model the background in the environment of the ATF2/KEK prototype beam line
    - EM from beam line and neutrons from beam dump
  - I have to use biasing to get workable MC statistics
  - And since data do not compare well with MC at this point I have, of course, to check and study:
    - Detector effects, and they can be large, especially for neutrons
      - Eg : Birks saturation in plastic scintillators
    - And of course simulation effects, with in particular physics ones, and their translation in G4 language : physics list
- And so, I undertook a pedestrian approach to physics lists

layout

- The cold beauty of physics lists
- A bit of my experiences
- Few more cases
- Conclusion

The cold beauty of physics lists

- With no doubts : physics lists have been and are an immense progress in helping users' life. Period.
- Nevertheless, if ones does not find *exactly* what he/she needs among the various physics lists, the passed sentence is the same:

  "Write your own physics list !"
- And it is a severe sentence…
- A few "real life" (mine) examples…

A BIT OF MY EXPERIENCES

Physics list and biasing

- “Biasing is nothing”:
  - From a physics point of view
  - Biasing “just” exploits more efficiently the physics knowledge coded in a physics list
  - And aims at getting the very same (statistically speaking) physics output than if the normal / unbiased simulation was run for a very (often unaffordable) long time
- But to get biasing activated
  - I have to add the biasing process in the physics list !
  - And be back to G4ProcessManager questioning, remember about process ordering issues, etc.
  - Ie, I have to re-write/re-assemble a physics list, while I really don’t want to change the physics content !
- And shamely -but behaving as a “normal user”- I started to play/learn with biasing in the UserSteppingAction, and I continue so, because I am too lazy to restart a validation…

Radioactive decay [1/2]

- “Radioactive decay is (really) something”
- At some point I wanted to see if activation was playing a role in my signal
  - Activation caused by neutrons
- So I thought about radioactive decay and start with physics list in example exrdm
- But indeed:
  - I do not know if QGSP_BERT_HP + RadioactiveDecay does what I wish : handles activation
    - And could find conceivable the two responses : yes, no.
  - And could not find information about this
    - Even if I don’t say it does not exist

Radioactive decay [2/2]

- Should I make /stepping/verbose 1/2/10 to verify ?
  - EM showers → some neutrons → a very few in my detectors
  - Undoable, or have to write code for this, etc. ☹
- At the end my confidence in activating the activation is very low
  - But it would be much higher if using a reference and advertised physics list
  - or an option of some.

MORE CASES…

Physics list and scoring

- “Scoring is (really) nothing” !
  - From a physics point of view ;)
  - Scoring has nothing to do with physics, ie with interactions
  - It is “just” an interface between geometry and scorers to get information from the tracking collected
- But il want to activate scoring…
  - Just repeat the same story of rewriting a physics, for adding a process
  - Hoping that the physics will not change at all !

And fast simulation ?

- “Fast simulation process is nothing”
  - It interfaces the fast simulation models, attached to regions, to the tracking
  - But again : to activate fast simulation, the fast simulation interface process should be added to the physics list
    - And nasty example N05 does not tell anything about this !
- Fast simulation acts in some places, where you undertake the physics, but you really don’t want to risk to change the physics elsewhere
  - And so rewriting a physics list does not hold.

Conclusion

- Physics lists do help a lot
- But they are quite “monolithic”
  - And either you like it all or you change it
- In several cases, “technical processes” (biasing, scoring, fast simulation, other ?) ie that don’t change the physics content of the physics list, however require to change/adapt/rewrite a physics list
  - While they sound more as “options” for a physics list
- Some physics options look to be missing:
  - Radioactive decay may be added to many physics list
  - But would not make much sense for all of them : eg LEP ?
- Could we make physics list instances more flexible ?
  - Configurable with options ?
  - Still keeping their strength of providing a solid physics environment