

Physics Lists & validation tools developments

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Geant4 workshop 2019

Jefferson Lab

Content

- Physics lists
 - Technical changes
 - Changes to hadronics builders
 - Improvements in EM
- Validation tools
 - DoSSiER
 - [Geant-val](#)

Technical changes

Wish to remove templates from physics list classes since long
Vladimir suggested more changes in March wg meeting

Proposal by Vladimir
March 2019

Obsolete things in physics lists

Let us remove obsolete things

- Propose move *.icc to source *.cc remove templates and SetCuts methods
 - Templates in Physics List classes looks as an anachronism
 - SetCuts() method is not needed – base class method is fine
- Propose in the new *.cc files remove things, which we cannot support properly
 - G4DataQuestionnaire – cmake make necessary checks
 - Printout about version of Physics List (different from Geant4 version)

Implemented, with additions

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G4 geant4-dev Merge Requests > I414

Merged Opened 1 month ago by **Gunter Folger** Edit

phys-lists-V10-05-02, and phys-util-V10-05-00, phys-builders-V10-05-00, test23-V10-05-04, test38-V10-05-00, test46-V10-05-00, exhadr02-V10-05-02

Code clean-up in physics lists:

- remove template mechanism
 - except for G4GenericPhysicsList, G4PhysListStamper, and INCLXXPhysicsListHelper
- delete copy ctor and assignmnet operator
- for empty dtor, use =default
- move include/x.icc to src/x.cc for lists without template
- remove SetCuts() implementation where not specialised
- remove version number from lists
- remove G4DataQuestionnaire

Tag specifics:

- phys-lists-V10-05-02 - main cleanup
- phys-util-V10-05-00 - to remove G4DataQuestionnaire.hh

Remove use of G4DataQuestionnaire:

- phys-builders-V10-05-00
- test23-V10-05-04
- test38-V10-05-00
- test46-V10-05-00
- exhadr02-V10-05-02

Edited 1 month ago by Gunter Folger

To Do Mark as done

0 Assignees None - assign yourself

Milestone None

Time tracking No estimate or time spent

Labels None

Lock merge request Unlocked

4 participants

Notifications

Reference: geant4/geant4-dev!4...

Project
Repository
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CI / CD
Operations
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Collaps sidebar
https://gitlab.cern.ch/geant4/geant4-dev

Proposal by Vladimir
March 201

Hadronic cross sections

Default hadronic cross sections

- For long time the default hadronic cross section was GHEISHA
 - This was helping to reduce Physics List code
 - This was a source of several problems which we heroically resolved before the release involving time of several developers
 - Just recently Alberto fix the remaining bug (is it the last?)
- We do not need such defaults anymore
 - Now we have better cross sections practically for all particles
 - new defaults may be defined in process sub-library
 - Alternatively in hadronic physics in Physics List library
 - We should also remove cross section definition from all builders, which should build models

Done!

- Not really a physics lists issue
- Up to 10.5, default cross section dataset, based on Gheisha, were provided by default in
G4Hadron{Inelastic,Elastic,Fission,Capture,...)Process
- These defaults were removed
- Physics lists now MUST provide cross section for all particles over full energy range

Proposal by Vladimir
March 201

Hadronic Builders & String models

Pending

Hadronic builders and string models

- Builder objects by definition should serve in a thread to build models
 - They should not be kept in run time and be destructed end of run
 - They should be destructed after work is done
- QGS and FTF model instantiation looks exceptional
 - Instantiation of G4ExcitedStringDecay and template G4QGSParticipants make a problem to understand why this is needed
 - This construction may be well implemented within QGS and FTF model base classes
 - Extra interfaces may be left allowing to substitute the default sub-model

Changes to physics list content

Slides provided by Vladimir Ivantchenko and Alberto Ribon

EM Physics Lists updates for 10.6

- Opt4 (EMZ) physics is the main Physics List for accurate simulation
 - MscRangeFactor=0.08 instead of 0.2 (backported to 10.5p01) improving backscattering
 - 5D gamma conversion model is used
 - Propagated to Livermore and Penelope Physics Lists
 - Defined upper limit on the G4NuclearStopping process via new UI command
- In all standard EM physics G4GeneralGammaProcess may be enabled via UI command or G4EmParameters interface
- G4OpticalPhysics – improved UI commands
- DNA physics/chemistry:
 - Revised and updated all builders according DNA developments
 - Added G4EmDNAChemistry_option2

Note to hadronics physics lists updates

- Review and update of transition energy range for most physics lists
 - Was discussed in more detail in plenary session 3
- Modeling updates not discussed here, plenary 3

Status up to G4 10.5.ref07

- **[3, 12] GeV** transition region between FTFP and BERT in FTFP_BERT physics list
 - Since G4 10.3 (December 2016)
 - The main motivation was to use more BERT and less FTFP to have lower energy response and wider hadronic showers
 - But thin-target data (HARP) prefer FTFP to BERT above ~ 5 GeV
 - This transition region is for the main hadrons – pions, kaons, and nucleons – but for the other hadron types, different regions were used (mainly for historical reasons):
 - [2, 6] GeV for hyperons (Λ , Σ , Ξ , Ω)
 - [2, 4] GeV/nucleon for light ions (d, t, He3, α)
 - Transition region between BIC and FTFP was also different (again, mainly for historical reasons):
 - [9.5, 9.9] GeV for nucleons
 - For pions, either BERT, or BIC < 1.3 GeV, or BIC < 1.5 GeV was used depending on the physics list

Change in G4 10.5.ref08

- **[3, 6] GeV** new transition region between FTFP and BERT in FTFP_BERT physics list
 - Requested by CMS and supported by thin-target experimental data
 - Discussed and agreed at the Hadronic Group meeting on July 24th
 - Took the occasion to set consistently the same transition region for all hadrons (i.e. also for hyperons and light ions)
 - Reviewed also the transition for **BIC** (Binary Cascade model), for the physics list where it is used
 - **[3, 6] GeV** between FTFP and BIC for proton and neutron
 - For pions, **BIC < 1.5 GeV** , **1 GeV < BERT < 6 GeV** , **FTFP > 3 GeV**
 - Left unchanged the transition region QGSP – FTFP : **[12, 25] GeV**
 - Left unchanged the transition region in these 4 special P.L. : **FTFP_BERT_ATL** , **INCLXX**-based P.L. , **NuBeam** , **ShieldingM**
 - *See talk in plenary 3 by Alberto Ribon for details and results*

Status of validation tools

- Dossier
- [Geant-val](#)

DoSSiER Web Application and Web Service no longer actively developed

- Keep the Web Application and Web Service running as is and openly accessible for as long as we can
- Continue to maintain the underlying postgresql database and data.
- A JSON exchange format exists and an extract of the complete or part of the database can be done at any time. It allows to translate and export the data to a different database with a different schema.
- Looking into the submission process of hepdata/inspire to make the experimental validation data programmatically available via a web service. Already use inspire for references.

Geant-val

- Started as tool for simplified calorimeter regression testing for HEP
 - Expanded functionality for collecting plots to integrated system of running jobs, collecting result, and display results, offering also per test predefined default views
- Has expanded to include many tests (validation, regression testing) for hadronic, medical, and EM physics

List of tests currently included

Hadronic

- Hadr00
- Hadr00-elasticXS
- Hadr00-inelasticXS
- Hadr00-totalXS
- Simplified calo
- Test22-HARP p2p
- Test22-HARP p2pi+
- Test22-HARP p2pi-
- Test22-HARP pi+2p
- Test22-HARP pi+2pi+
- Test22-HARP pi+2pi-
- Test22-HARP pi-2p
- Test22-HARP pi-2pi+
- Test22-HARP pi-2pi-
- test22-NA61
- Test22-NA61 kaon0s
- Test22-NA61 kaons
- Test22-NA61 proton-pi

EM

- FluctTest
- MscHanson
- Simplified calo (ECAL)
- Test37
- TestEm3
- TestEm9
- Tileatlas

Medical

- Brachy-ir
- Bremsstrahlung
- C12Frag
- C12Frag-angular
- C12Frag-energy
- C12Frag-energy-Z1
- C12Frag-energy-Z2
- C12Frag-energy-Z3
- C12Frag-energy-Z4
- C12Frag-energy-Z5
- C12FragCC
- ElecBackScat
- ElecForwScat
- ElectronDEDX
- FanoCavity
- FragTest-yield
- LightIonBraggPeak
- LowEC12Frag
- LowEElecDPK
- LowEProtonBraggBeak
- Mammo
- Microyz
- NucNuclInelXS
- PhotonAttenuation
- ProtonC12BraggPeak
- ProtonC12NeutronYield

Demo

- Technical details were presented at Geant4 workshop in Lund, see [presentation](#) by Dmitri

Summary

- Physics lists cleanup removed obsolete constructs in the code
 - Lifetime of builders?
 - Instantiation of string models?
- Hadronics
 - Transition energies for BERT to FTFP made uniform, reduced overlap
 - Also improved transition energies for BIC -> BERT/FTFP
- EM
 - G4GeneralGammaProcess may be enabled via UI command or G4EmParameters interface
 - Improved EM opt4 (EMZ) / precise option
 - DNA physics/chemistry builders revised for DNA developments
- G4OpticalPhysics has improved UI
- Geant-val: provides many more tests or validation, continues to expand