Geant4 10.7.p01
&
Hadronic Physics Group
Work Plan for 2021

Alberto Ribon

CERN EP/SFT

On behalf of the Geant4 Hadronic Physics Working Group

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1st part: G4 10.7.p01

Patch-01 of G4 10.7 (1/3)

- ## Data Sets
  - G4PARTICLEXS-3.1.1 : fixed data for He3 and He4 projectiles on a few light targets

- ## cross_sections/
  - G4ParticleInelasticXS , G4CrossSectionInelastic , G4CrossSectionElastic : extended maximum energy range for ion cross-sections
    - QBBC and other Physics Lists has the same high energy limits
  - Drop cache for per-element in G4CrossSectionDataStore::GetCrossSection, never used in practice
  - G4ParticleInelasticXS , G4NeutronCaptureXS , G4NeutronElasticXS , G4NeutronInelasticXS : make MAXZ variable static class member
  - G4GammaNuclearXS : fixed duplicated name of static variable
  - G4VCrossSectionRatio : use inheritance from G4VCrossSectionDataSet in order to guarantee deletion of the object at the end of run

Patch-01 of G4 10.7

- models/particle_hp/   (ParticleHP)
  - G4ParticleHPThermalScattering : added final state phi-rotation
    - Addressing problem reports #1856 and #2290

- stopping/
  - G4MuonicAtomDecay : fixed Coverity defects

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- physics_lists/
  - builders/ : replaced in G4HadronicBuilder 2-body decays of bottom mesons into charmed mesons and charged rho resonance, with 3-body decays into the same charmed mesons and charged pion and neutral pion
    - To get more precise numerical treatment of the decay kinematics in the rest frame
  - constructors/hadron_elastic/ : fixed type of builder in all hadron elastic constructors
    - Addressing problem report #2183
  - constructors/hadron_inelastic/ : fixed type of builder in all hadron inelastic constructors
    - Addressing problem report #2296

2nd part: Hadronic Work Plan

Hadronic String models

- Extend validation of charm production for **FTF** and **QGS**

- Improvement of antiproton and light anti-ion annihilations in **FTF**

  - From at rest to hundreds GeV

    - ALICE, CERN AD antiproton experiments, GAPS, Panda/GSI, *etc.*

- Validation of **FTF** nucleus-nucleus interactions

  - Using NA49 , NA61/SHINE , HADES experimental data

- Study of Pt-correlations of hadrons in p-p and pbar-p collisions in **FTF** and comparison with other models : UrQMD , QGSM , PYTHIA

- Code and hadronic shower improvements of **FTF** and **QGS** models

Intra-nuclear Cascade models

- Bertini-like (**BERT**) model

  - Maintenance and user-support

  - Some model development for light nuclei

- Binary (**BIC**) model

  - Code review and maintenance

- Liege (**INCLXX**) model

  - Maintenance and user-support

  - Maintenance of ABLA++ model, including some improvements on hyper-nuclei

  - Start new development for antiproton

Precompound / De-excitation models

- Maintenance and user support

- Improvements of de-excitation models: FermiBreakUp, Evaporation, GEM; validation and tuning to data

- Extended validation and tuning of cross section and final-state for the gamma-nuclear model

Radioactive Decay model

- Maintenance and user support

- Maintenance of the database

- Superheavy elements

ParticleHP model

- Validation & Maintenance

- Improvement of Geant4 for nuclear-fusion applications. Production of Lithium nuclear data libraries, verification and validation.

- Implement an option that forces ParticleHP to respect event-by-event conservations (energy-momentum, baryonic number, *etc.*)

- Extend ParticleHP model to higher energies

- Implement a very detailed physics for organic neutron detectors up to 100 - 200 MeV

  - Currently there is a specific model for n + 12C reactions up to 20 MeV

- Include in Geant4 the NuDEX code (to generate EM de-excitation cascades)

- Create a tool to automatically change the charged particle cross sections adding user experimental data

LEND model

- New reference physics list using LEND. Update GIDI/LEND interface.

- Implementation of a new version of MCGIDI, and incorporating it in LEND

- Bug-fixing in LEND

NCrystal model

- Add new physics (HighNESS project) + technical improvements

- Integration of the code in Geant4

Other Hadronic models

- Development and validation of neutrino / lepton – nuclear physics

- Maintenance of the **QMD** model

- Muonic atom physics

- Electromagnetic Dissociation (**ED**) model : clean-up and inclusion into Physics Lists as an option

Hadronic Cross Sections

- Improvement of light-ion – nuclear cross sections

- Revision of anti-baryon – nuclear cross sections, and of light anti-ion – nuclear cross sections

- Extension of nuclear cross sections for light hyper-nuclei and anti-hyper-nuclei projectiles

  - ALICE request to transport light hyper-nuclei and anti-hyper-nuclei

Hadronic Framework

- Campaign for deleting obsolete classes and interfaces, and update of existing models for the major release, Geant4 11

- Extension of the hadronic framework for light hyper-nuclei and anti-hyper-nuclei

  - ALICE request to transport light hyper-nuclei and anti-hyper-nuclei

- Revise "CreatorModelID" for the major release, Geant4 11

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Hadronic Validation and Testing

- Interfacing of tests 19, 23, 47, 48, 75 in geant-val , and their maintenance

- Hadronic validation with BNL and MIPS data, and with the new high-granularity CMS calorimeter test-beam

- Monitoring and documentation of physics lists with the focus on Intensity Frontier (IF) experiments

- Studying the sensitivity of the MC predictions to the variations of various parameters, with the focus on models such as FTF , BERT , Preco and development of needed infrastructure

- Investigating the adoption of external decayers (if time permits)

- Tests and user support via public Geant4 examples