Geant4 Hadronic Physics Group Work Plan for 2021

1st version, 20 January 2021

Hadronic String models

- Extend validation of charm production for **FTF** and **QGS**
  - A. Galoyan, V. Uzhinsky
- 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.*
  - A. Galoyan, V. Uzhinsky
- Validation of **FTF** nucleus-nucleus interactions
  - Using NA49 , NA61/SHINE , HADES experimental data
  - V. Uzhinsky
- Study of Pt-correlations of hadrons in p-p and pbar-p collisions in **FTF** and comparison with other models : UrQMD , QGSM , PYTHIA
  - A. Galoyan
- Code and hadronic shower improvements of **FTF** and **QGS** models
  - A. Ribon

Intra-nuclear Cascade models

- Bertini-like (**BERT**) model
  - Maintenance and user-support
    - M. Kelsey, Dennis Wright
  - Some model development for light nuclei
    - Dennis Wright
- Binary (**BIC**) model
  - Code review and maintenance
    - G. Folger
- Liege (**INCLXX**) model
  - Maintenance and user-support
    - J-C. David, D. Mancusi, J.L. Rodriguez Sanchez
  - Maintenance of ABLA++ model, including some improvements on hyper-nuclei
    - J.L. Rodriguez Sanchez
  - Start new development for antiproton
    - Ph.D. student under the supervision of J-C. David

Precompound / De-excitation models

- Maintenance and user support
  - V. Ivanchenko, J.M. Quesada
- Improvements of de-excitation models: FermiBreakUp, Evaporation, GEM; validation and tuning to data
  - V. Ivanchenko
- Extended validation and tuning of cross section and final-state for the gamma-nuclear model
  - V. Ivanchenko

Radioactive Decay model

- Maintenance and user support
  - Dennis Wright
- Maintenance of the database
  - L. Desorgher
- Superheavy elements
  - L. Sarmiento

ParticleHP model

- Validation & Maintenance
  - E. Mendoza, D. Cano, P. Arce
- 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
- Insert in Geant4 the NuDEX code (to generate EM de-excitation cascades)
- E. Mendoza, D. Cano
- Create a tool to automatically change the charged particle cross sections adding user experimental data
  - P. Arce

LEND model

- New reference physics list using LEND. Update GIDI/LEND interface.
  - Douglas Wright
- Implementation of a new version of MCGIDI, and incorporating it in LEND
  - B. Beck, J. Verbeke
- Bug-fixing in LEND
  - Dennis Wright

NCrystal model

- Add new physics (HighNESS project) + technical improvements
- Integration of the code in Geant4
- X. Cai, T. Kittelmann

Other Hadronic models

- Development and validation of neutrino / lepton – nuclear physics
  - V. Grichine
- Maintenance of the **QMD** model
  - T. Koi
- Muonic atom physics
  - K. Lynch
- Electromagnetic Dissociation (**ED**) model : clean-up and inclusion into Physics Lists as an option
  - V. Ivanchenko

Hadronic Cross Sections

- Improvement of light-ion nuclear cross sections
  - V. Grichine, V. Ivanchenko
- Revision of anti-baryon and light anti-ion nuclear cross sections
  - V. Uzhinsky
- 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
  - V. Grichine, V. Ivanchenko, V. Uzhinsky

Hadronic Framework

- Campaign for deleting obsolete classes and interfaces, and update of existing models for the major release, Geant4 11
  - V. Ivanchenko, A. Ribon
- Extension of the hadronic framework for light hyper-nuclei and anti-hyper-nuclei
  - ALICE request to transport light hyper-nuclei and anti-hyper-nuclei
  - V. Ivanchenko, A. Ribon
- Revise “CreatorModelID” for the major release, Geant4 11
  - A. Ribon

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)
- S. Banerjee, K. Genser, R. Hatcher, S.Y. Jun, H. Wenzel, J. Yarba

- Tests and user support via public Geant4 examples
  - M. Maire