



Geant4 Hadronic Physics Group Work Plan for 2026

1st version, 18 February 2026

Hadronic String models (1/3)

- Analysis of Λ (Lambda hyperon) production in nucleus-nucleus interactions based on NA61/SHINE measurements
 - Vladimir Uzhinsky
- Analysis of Au+Au interactions with BES (RHIC) data at $\sqrt{s_{nn}} = 3.2 - 4.5$ GeV
 - Vladimir Uzhinsky
- Improve simulation of deuteron properties in the class *G4Fancy3DNucleus*
 - Vladimir Uzhinsky
- In QGS model, include finite energy corrections to the eikonal approximation
 - Vladimir Uzhinsky

Hadronic String models (2/3)

- Improve light anti-nucleus - nucleus cross sections at low energies using ALICE data – open requirement UR-59
 - Aida Galoyan
- Improve the probability of production of charmed particles for soft hadron-proton and proton-nucleus interactions using experimental data
 - Aida Galoyan
- Improve the kinematical properties of charmed particles produced in hadron-proton interactions in QGS and FTF models using experimental data
 - Aida Galoyan
- Creation of Geant4 tests for validating the production of charmed particles in hadron-proton and proton-nucleus interactions
 - Aida Galoyan

Hadronic String models (3/3)

- Continue the model parameter studies of BERT model
 - Julia Yarba and other FNAL collaborators (R. Hatcher, S.Y. Jun)
- Investigate recent issue on longitudinal pion showers in ATLAS FCAL
 - Pion showers in G4 10.1 (used in Run 2) are longer and in better agreement than in G4 10.6 (used in Run 3)
 - Alberto Ribon
- Maintenance and improvement of the hadronic framework; code improvements of **FTF** and **QGS** models
 - Alberto Ribon

Intra-nuclear Cascade models

- Bertini-like (**BERT**) model
 - Maintenance and user-support
 - M. Kelsey, Dennis Wright
- Binary (**BIC**) model
 - Code review and maintenance
 - Gunter Folger
- Liege (**INCLXX**) model
 - Maintenance and user-support
 - Jean-Christophe David
 - Extension for antideuteron
 - Jean-Christophe David
 - Optimisation of parameters and propagation of uncertainties
 - Jason Hirtz

Precompound / De-excitation models

- Maintenance, user support and improvement
 - Continue the effort of resolving bug reports related to de-excitation
 - Tuning of parameters based on experimental data
 - Development of a new multi-fragmentation model
 - Validate alternative FermiBreakUp and GEM models
 - N. Chalyi, V. Ivanchenko
- Maintenance and development of the ABLA++ model
 - Code optimization, cleanup, and documentation improvement
 - Adding more fission modes to improve the description of mass and charge distributions of fission fragments at low excitation energies
 - Optimisation of parameters
 - J. Hirtz, J. L. Rodriguez Sanchez

Radioactive Decay model

- Maintenance, user support and improvement
 - V. Ivanchenko, L. Sarmiento
- Maintenance of the database
 - L. Desorgher, V. Ivanchenko, L. Sarmiento, L. Thulliez, A. Tolosa Delgado
- Implementation of user-defined spectrum for beta and beta+ decays
 - L. Desorgher

Hadronic Datasets

- Maintenance of the latest hadronic datasets
G4ENSDFSTATE3.0, PhotonEvaporation6.1.2, RadioactiveDecay6.1.2
 - On-going effort to solve open bugs in hadronics thanks to these improved datasets
 - Make available the scripts and documentation on how to create these datasets
 - L. Desorgher, V. Ivanchenko, E. Mendoza, L. Sarmiento, L. Thulliez, A. Tolosa Delgado
- Update and optimisation of G4PARTICLEXS
 - Update based on room-temperature cross sections of NeutronHP - see next slide
 - Optimisation of accuracy, computational performance, and memory footprint
 - A. Bergardt, V. Ivanchenko

ParticleHP model

- Validation, maintenance and user support
 - P. Arce, D. Cano, E. Dumonteil, V. Ivanchenko, E. Mendoza, L. Thulliez, M. Zmeskal
- Implement the use of pre-Doppler broaden cross section database at a given temperature; implement the algorithm that allows to do that at the beginning of a Geant4 simulation (to be as versatile as possible)
 - E. Dumonteil, L. Thulliez, M. Zmeskal
- Translation of new nuclear data library releases from the ENDF-6 format to the G4NDL format, and verification
 - D. Cano, E. Mendoza
- Refinements of the integration of the NuDEX model into Geant4, and expand its usage (not only in neutron capture reactions)
 - D. Cano, E. Mendoza
- Continue the alternative software implementation of ParticleHP (in QGSP_BERT_HP)
 - Vladimir Ivanchenko

LEND model

- Maintenance and update of LEND and GIDI
 - B. Beck, C. Mattoon, Douglas Wright

Hadronic Elastic models

- Review of the pion elastic scattering model
 - Originated by an unphysical distribution reported recently by Sven Menke (ATLAS)
 - Vladimir Ivanchenko
- Improved elastic scattering of $p+d$, $d+d$, $d+A$, and other light nuclei at high energies using Glauber approximation
 - A. Galoyan, V. Uzhinsky

Other developments (1/2)

- Development and validation of gamma / lepton / neutrino – nuclear physics
 - Including code redesign
 - V. Grichine, V. Ivanchenko
- Maintenance of the interface to FLUKA.CERN for hadron-nucleus inelastic cross sections and final-state interactions
 - Gabrielle Hugo
- Use of Pythia8 as an external generator in Geant4
 - Application for LDMX experiment
 - E. Elen, L. Sarmiento
- Consolidation of charge exchange of pions and kaons
 - Required by NA64 experiment
 - V. Ivanchenko, M. Kirsanov

Other developments (2/2)

- Exploring the possibility of emulating BLOB or a portion of it with DL and of a differentiable pipeline to optimize QMD and LIQMD free parameters
 - L. Arsini, C. Mancini
- QMD model development:
investigating the nucleon-nucleus inelastic cross section;
preparing a new version of QMD based on a relativistic nuclear model.
 - Akihiro Haga
- Continue the development of the physics of muonic atoms
 - Kevin Lynch
- Implement the AMS (Adaptive Multilevel Splitting) variance reduction technique
 - Dumonteil, L. Thulliez

Hadronic Validation and Testing

- Extending the coverage of hadronic tests in *geant-val*
 - Calorimeter test-beams, L. Pezzotti, A. Tolosa-Delgado
 - Low-energy neutron tests, D. Konstantinov, L. Thulliez
- Hadronic validation using thin-target data and tests relevant to Fermilab experiments
 - Julia Yarba
- Study of the sensitivity of the MC predictions to the variations of various parameters and development of needed infrastructure
 - R. Hatcher, S.Y. Jun, J. Yarba
- Support of hadron-therapy applications
 - Serena Fattori