

Geant4 Hadronic Group Work Plan for 2019

2nd version, 20 February 2019

String models (1/3)

- Study of **fast** particle production in hadronic interactions
 - Analysis of small-angle particle production in proton and pion nuclear interactions in FTF and QGS
 - HARP data (p/pi) at 3 - 15 GeV/c, Allaby data (19.2 GeV/c), data at 24 GeV/c, NA61/SHINE data on p+C interactions at 31 GeV/c, last Protvino data on p+C interactions at 31 GeV/c, Cronin data
 - V. Uzhinsky
- Study of **slow** particle production in hadronic interactions
 - Revision of the statistical multi-fragmentation model of Geant4, and analysis of nuclear multi-fragmentation data
 - V. Uzhinsky
- Extension of the string models (FTF and QGS) to **charmed & bottom hadrons**
 - V. Uzhinsky

String models (2/3)

- Re-thinking of the string fragmentation treatment for low-mass strings, and of antiproton annihilation in Geant4
 - V. Uzhinsky
- Development, fine-tuning and validation of FTF for antiproton – nucleus interactions from rest to hundred GeV
 - A. Galoyan
- Validation of FTF model for nucleus – nucleus interactions
 - A. Galoyan
- Collect experimental data on charm hadron production in hadron-nucleus interactions for future validation
 - A. Galoyan
- Introduce fusion of quark-gluon strings for FTF and QGS
 - A. Galoyan

String models (3/3)

- Investigation of physics effects of using Fortran EPOS with Geant4 for hadron interactions at very high energy
 - A. Ribon
- Hadronic shower effects of **FTF** and **QGS**
 - A. Ribon
- Code improvements of **FTF** and **QGS**
 - A. Ribon
- Further improvements of HIJING at RHIC & LHC energies
 - K. Abdel-Wagel

Intra-nuclear Cascade models

- **Bertini (BERT) model**
 - Improved multi-body phase generation and its validation against HARP data
 - Dennis Wright
 - Maintenance and user-support
 - M. Kelsey, Dennis Wright
- **Binary (BIC) model**
 - Development of a coalescence model
 - G. Folger
 - Code review and maintenance
 - G. Folger
- **INCL++ model**
 - Upgrades and maintenance
 - J-C. David, J. Hirtz, D. Mancusi, J.L. Rodriguez Sanchez

Precompound / De-Excitation models

- Include the gamma de-excitation chain into FermiBreakUp
 - V. Ivanchenko, J.M. Quesada
- Release of the new GEM model
 - V. Ivanchenko, J.M. Quesada

Radioactive Decay model

- Maintenance and update of RadioactiveDecay and PhotonEvaporation databases
 - L. Desorgher
- Add possibility for the user to add his own beta spectrum
 - L. Desorgher
- Build geant-val or similar validation test for G4Rad decay
 - L. Desorgher
- Beta-delayed particle emission
 - L. Sarmiento
- Superheavy elements
 - L. Sarmiento
- Connection of LLNL spontaneous fission model to RDM
 - Dennis Wright

ParticleHP model

- Validation & Maintenance of ParticleHP
 - Dennis Wright (SLAC)
 - P. Arce, E. Mendoza & D. Cano (CIEMAT)
 - A. Bhattacharyya, H. Kumawat (BARC)
- Verification and validation (when possible) of a Geant4 application for the simulation of (alpha, n) reactions
 - E. Mendoza & D. Cano
- Implementation in Geant4 of the SCINFUL-QMD physics for the detailed simulation of neutron detectors up to a few hundred MeV
 - E. Mendoza & D. Cano
- Improved gamma cascades
 - Dennis Wright

LEND model

(Low Energy Neutron Data , General Interaction Data interface)

- Complete, test, and release new version of LEND/GIDI : LLNL low energy nuclear data interface and data
 - Douglas Wright
- Maintenance and support of physics lists using LEND with LLNL fission model
 - Douglas Wright

NCrystal model

(Model for ~meV neutron scattering in both poly- and single-crystals)

- Publish paper describing the model
- Improved integration of the model in Geant4
 - X. Cai & T. Kittelmann

Elastic models

- Introduce a new model with delta-resonance elastic scattering for pions
 - V. Ivanchenko
- Improvement and validation of the diffuse elastic model
 - V. Grichine

Other models

- Muonic atoms
 - K. Genser, K. Lynch
- Neutrino- (electron-, gamma-) nucleus final-state models
 - V. Grichine
- Maintenance and validation of QMD
 - T. Koi
- Maintenance and hypernuclei production in ABLA++
 - J.L. Rodriguez Sanchez
- Interfacing BLOB (low-energy, entry-channel model) to G4
 - C. Mancini (GeNI/ALE project)

Cross Sections

- Improve hadronic cross sections (more accurate treatment of elastic, use of TOTEM data for pp)
 - V. Ivanchenko
- Extension of Glauber-Gribov nuclear cross sections for **heavy projectiles**: hyperons, charmed and bottom hadrons
 - V. Grichine

Validation & Testing

- Maintenance and periodic execution of Tests 19, 47, 48, 75, 23; maintenance of common hadronic test infrastructure
- Hadronic validation with BNL and MIPS data, and with the new high-granularity CMS test-beam
- Monitoring and documentation of physics lists with the focus on Intensity Frontier (IF) experiments
- Development and validation of the infrastructure for studying sensitivity of the MC predictions to the variations of the model parameters (with focus on Precompound, Bertini cascade, and FTF) and refining of the model parameters validity ranges if applicable
- Possible validation of interfaces of Geant4 hadronic models to be used by GENIE neutrino interaction code
- FNAL Team: S. Banerjee, K.Genser, R.Hatcher, H.Wenzel, J.Yarba¹³

Other Validation activities

- Validation of cascade models using the **n_TOF** evaluated neutron flux, obtained at EAR1 and EAR2
 - M. Cortes Giraldo
- Validation and maintenance of **TARC** (test15)
 - A. Howard, A. Bhattacharyya

Hadronic Framework

- Investigate possible simplifications of the hadronic framework
 - Starting with some design ideas considered in the context of GeantV physics...
 - A. Ribon *et al.*