Summary of Hadronic Validation Efforts

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Outline

- **Hadronic Validation Goals**
- **Detailed Status**
  - **Models validation**
  - **Cross sections validation**
  - **Physics lists and shower shape validation**
- **Archiving Results**
- **Hadronic tests for Geant4-MT (and other developments ?)**
- **Plans**
- **Summary**

Hadronic Validation Goals

- To cover and validate all aspects of the Geant4 hadronic physics domain as best as possible
  - "Moving target"
  - Still room for expansion of the suite
- To re-run validation suite on a regular basis
  - Ideally, re-run at each release
  - … or at least re-run relevant subset of tests when changes are introduced in a specific area
  - Absolutely needed for each public release
- Archive 100% of results; g4validation.fnal.gov:8080/G4ValidationWebApp

3

Model Validations (1)

- **Cascades (Bertini, Binary, INCL++) & CHIPS, LEP**
  - Low and intermediate energy, spallation
  - Extensively tested via test30, test35, test47
  - Some results are available/archived for 9.6.p02 (test47) and up to 9.6.ref07, and some are available up to ref02/ref03 but archived only up to ref00/ref00a
  - More tests of INCL++ in the plans
  - The 14.6GeV (BNL part of test47) is somewhat "orphan"
  - CHIPS, LEP are being decommissioned

Model Validations (2)

- **Precompound & de-excitation:**
  - Tested via test30(IAEA) tools (with other models)
  - Results up to 9.6.ref03 but no later than that
  - Archived only up to 9.6.ref00/ref00a
  - No results for latest public release 9.6.p02

Model Validations (3)

- **String models:**
  - For intermediate energy range (<20GeV), QSG and FTF are regularly tested via test35, test47
    - Large amount (but not all) of results archived in G4 Val Repo (same as with cascade models, see previous slide)
  - For higher energy test19 has been <u>introduced</u>
    - "Echo" older test43, datasets at 31GeV/c, 158GeV/c
    - Results available/archived for 9.6.p02 and up to 9.6.ref08
  - Plenty of HEP data – further expansion in the plans

Model Validations (4)

- **Capture and Annihilation Process:**
  - Tested "traditional", Bertini, FTF, CHIPS via test48
  - Results for pi-, K-, Sigma, Omega, pbar, mu- available/archived for 9.6.p02 and up to 9.6.ref07
  - CHIPS tested up to 9.6.p02 and is being decommissioned
- **Gamma-nuclear test has been <u>introduced</u> (test75):**
  - Bertini, CHIPS benchmarked vs exp.data
  - Results available/archived for 9.6.p02, up to 9.6.ref07
- **Ions:**
  - Binary light ion, INCL++, QMD via test30
  - also QMD validation for SATIF ? test61 ?
  - Results are **partially** available/archived (up to 9.6.ref00)

7

Model Validation – Need Work

- **Low energy neutrons (HP and LEND)**
  - Periodic presentations but no archived results at all
  - test11, test65 part of system testing
- **Elastic scattering, coherent elastic**
  - Several very good plots for LEpp, LEnp, CHIPS (F.Jones talk in 2010) but (still) needs consolidation
- **Radioactive Decay**
  - Occasional presentations but no plots
  - test18 part of system testing
- **Electro-N dissociation, Wilson abrasion, ablasion:**
  - No validation, no plots
  - test28 part of system testing

8

Cross Section Validation - Need (more) Work

- **Ongoing work**
  - **Anton I. has made a start some time ago (2012?)**
  - **Aida G. – FTF and xsec validation (test22, archived up to 9.6.ref04)**
- **Significant code restructuring, redesign**
  - **CHIPS xsec factorization**
  - **Barashenkov, Glauber-Gribov code redesign**
  - **Periodic presentations but no plots**
- **System tests available, can be made validation tests**
- **Dedicated slot in the G4 Val Repo is awaiting !**

Physics Lists

- **SimplifiedCalo – shower shapes: major phys.lists**
  - Run at each release
  - Results presented
  - Major portion of recent results archived
  - Although 9.6.p02 somehow missed !
  - Overlap with Performance monitoring task
- **Other approaches <u>in the work</u> – thick targets, for example in the intermediate and/or high energy range (test23):**
  - Look at specific interactions (similar to thin target)
  - Look at "bulk" secondaries
  - Other ideas possible

Archiving Results

g4validation.fnal.gov:8080/G4ValidationWebApp

- Detailed talk by Hans W. in 1B
- Highlights:
  - Collection of results significantly expanded; many results available up to 9.6.p02 (current and recommented)
  - New features added
    - Web-interfaced multiple-results upload
    - Categorization of results (public/internal)
    - Release Highlights incorporated
- MANY THANKS to all who contributed !!!
- BUT:
  - Most recent results are sometimes missing
  - Several more areas need to be covered/added
  - Some features (e.g. "overlay")are still in the works

11

From Dennis W. at Geant4-2012:

Work Plan (roughly in order of importance)

- Make FTF and QGS validation tests for the 100 – 400 GeV range, add them to the validation repository and run them for each release *NEW!*

- Nucleon-nucleus and pion-nucleus cross section validation suite *Ongoing*

- Make validation suite for INCL++ *In progress*

- Elastic scattering validation suite

- Low energy neutron validation suite

- Photo- and lepto-nuclear validation suite *NEW!*

- QMD validation suite *In progress*

- Radioactive decay validation suite

Hadronic tests for Geant4-MT (and other developments ?)

- **Interest prompted by recent questions**
- **Many validation tests are process-level tests and are single-threaded by definition (G4ProcessManager), but a reasonable subset can be used as a "sanity check"**
  - **Several tests have been initially tried on MT build**
  - **Future efforts need to be decided**
- **Physics list level tests (SimplifiedCalo) are used w/MT**
- **Testing physics list based applications w/MT is limited to the current development – only G4UI/BeamOn is operational**
  - **Waiting for feature of interest to FWK-based applications**
- **Other advanced developments should also be kept in mind, in terms of future validation needs/tools**

13

(Rough) Work Plans
– open for discussion/suggestions

- **Improve validation efforts in the following physics areas:**
  - **Low energy neutrons**
  - **Nucleon-N and pion-N cross-sections – continue and expand validation efforts**
  - **Radioactive decays**
  - **Elastic scattering**
  - **Electro-N dissociation, Wilson abrasion, ablasion**
- **Consider what efforts could be useful for Geant-MT validation**
- **Continue work on G4Validation Repository**
  - **Results**
  - **Tools**

14

Summary

- **G4 Validation involves a LOT of work**
- **Significant progress made over the past year**
  - Several item actions from last-year plan advanced
  - Impressive progress in archiving results
  - MANY THANKS FOR all who contributed !
- **Certain areas still need plenty of improvements**
  - Physics aspects
  - Collection of results
  - Tools and features for archiving and advertising
- **Further work plan outlined but is open for discussion and suggestions**