

# Status of Hadronic Validation

Dennis Wright  
6 October 2010

# Outline

- Survey of model validation
- Cross section validation
- Physics list and shower shape validation
- Status of quality of agreement metrics

# Model Validations in Good Shape

- **Precompound and de-excitation**
  - extensively tested using test30 and IAEA validation suites
  - not linked to current general hadronic validation pages, but will be linked to new validation pages
- **Cascades (Bertini, Binary, INCLA/ABLA) and CHIPS**
  - extensively tested in test30, test35, IAEA, and FNAL medium energy suites
  - linked to current general hadronic validation pages

# Model Validations in Reasonable Shape

## (1)

- **String models**
  - for medium energies ( $< 20$  GeV) , QGS and FTF are regularly validated and posted as part of test35, FNAL medium energy suite, etc.
    - will be linked to new hadronic validation pages
  - for higher energies (test43), results are not regularly updated
    - some results currently posted to general hadronic validation pages, but:
      - variety of targets and tested variables is not large
      - results are not indexed by release number
  - literature search required for more high energy data, or perhaps some will be available from LHC
    - current validations for hadron-nucleus all below 500 GeV

# Model Validations in Reasonable Shape

## (2)

- **Ion-ion**
  - Binary light ion validations done as part of IAEA tests, not yet linked to general validation page
  - QMD validations done for SATIF and other special cases, but no regular validation is done
- **Low energy neutrons**
  - several system tests are run regularly, but no regular validations and no comparison plots posted
  - lack of validation is somewhat mitigated by fact that HP neutron cross sections are many and usually unchanged from release to release

# Model Validations Which Need Work (1)

- **Elastic scattering**
  - some validation for CHIPS elastic, but no posting to validation pages
  - little or no validation done for LHEP, Coherent Elastic, LEpp, LEnp, and no posting to validation pages
  - for higher energies (test43), results are not regularly updated
- **Stopping models**
  - test48 under development, but regular validation not yet under way
  - some old CHIPS validation plots posted to general hadronic validation pages, otherwise none
- **Radioactive Decay**
  - regular validation not done, no plots posted on validation pages

# Model Validations Which Need Work (2)

- EM dissociation
  - no validation, no plots
- Abrasion/ablation
  - no validation, no plots
- Gamma- and electro-nuclear
  - some validation for CHIPS models, no plots posted to validation pages
  - no validation for LHEP models

# Cross Section Validations Which Need Work

- Prototype available for low energy neutron cross sections
  - compares to HP cross sections, not data
- All other cross section validations are almost non-existent
  - several comparison plots presented at LCG validation meeting, but only one plot (p-p elastic) posted to validation pages
    - CHIPS, LHEP, Glauber-Gribov
  - even for cross sections which have not changed recently, no regularly posted plots indexed by release number
    - LHEP, Barashenkov, ion-ion
- Challenge: collecting hadron-nucleus data to validate against
  - lots of p-p data, though



# Physics List and Shower Shape Validations

- In good shape and being done as part of LCG work
  - more transition validations to be added
  - link LCG plots to new hadronic validation web pages (or to combined EM and hadronic validation web pages)
- In general we have planned for more “thick target” and “full setup” validations
  - not much work done in extending this area
  - could be some overlap with examples which we could use as validation suites

# Quality of Agreement Metrics

- A major request from the Geant4 External Review
- First steps have been made in some validation suites to provide plots in MC/Data format
  - such an option needs to be extended to all validation plots
- One or two more generally applied measures should be adopted
  - $\mathcal{M}^{\text{MC}}$  works in some cases, but not all
  - sum of MC/data for complete plot

# Summary

- Precompound and cascade validation is fine
- String, ion-ion, low energy neutron model validations are reasonable, but could use some improvement
- Elastic scattering, stopping, radioactive decay, EM dissociation, Abrasion/Ablation, Gamma- and Electro-nuclear model validations all need a lot of work
- Regular cross section validation is almost non-existent
- Development of quality of agreement metrics is in its infancy