Summary of Parallel Session 3A : Hadronic Validation

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Topics

- **Validation Status Report and Work Plan**
- **Validation for LHE experiments**
- **Related discussions**
- **Physics Performance and Benchmarking of INCL++**

Validation Tests Status & Work Plan (I)

- **Goal**
  - Run hadronic validation tests every release and store ALL results in the validation repository

- **Tests in the G4 Validation Repository**
  - capture, low and intermediate energy, spallation, low energy proton or ion on thick target, simplified calo

- **Tests to be developed/added**
  - Neutron transport, radioactive decays, abrasion/ablation, ion-ion, INCL++, but also high energy domain

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Validation Tests Status & Work Plan (II)

- **Core models are well covered from zero energy and through intermediate energy range:**
  - Capture, Precompound, Binary, Bertini, FTF, CHIPS
- **Higher energy end (~100-400GeV) needs work**
- **"Limited" or no coverage**
  - Low energy neutrons, photo/lepto-nuclear processes (CHIPS, Bertini), radioactive decays, abrasion/ablation, ions (Binary, QMD), elastic scattering, INCL++, Livermore fission
- **Validation of Cross Section**
  - Work started, system tests -> validation, need to expand

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Validation Tests Status & Work Plan (III): Discussion

- Work plan on missing or incomplete tests/models
- From developers: some test applications are ready but need to be committed/incorporated and executed regularly
- Storage/availability of results
- Availability of (some of the) tests to users ?
- Storage/availability of reference exp.data
- Status of unit tests, needs of their catalogue

Validation for LHC Experiments (I):

- **Full Scale Validation – Physics List**
  - Multiple processes for different particles
  - Interplay of different models
- **Extensive Suite of Calorimetric Applications**
  - ATLAS-, CMS-, LHCb-, and ZEUS-like
- **Focus on**
  - Shower shapes
  - Conservation of important quantities
- **Expanding concept – new request from LHCb**
  - Observables important for tracker – mult, xsec

Validation for LHC Experiments (II):

- **Contribution of models and processes**
  - neutron interactions, transport
  - pi0 production (especially in FTF)
  - role of Precompound/de-excitation

- **Test bench for new/prototype physics lists**
  - experiment with cascade (instead of PreCo) at the backend to string model
  - Potential list n:HP/p,n:BIC + BERP + FTF+BIC/BERP

Physics Performance and Benchmarking of INCL++:

- **Model overview and validity (~100MeV-2GeV)**
  - Particles/nuclei on nuclei
  - Cascade + various de-exciters, incl. G4Deexcitation
- **Results from benchmarking vs various exp.data**
  - Intercomparison vs different cascades+deexciters vs IAEA
  - Various projectile+target combo's, reaction cross sections, production of various secondaries
  - Many thick target experimental data used
- **Proposed future extension (~12GeV), preliminary benchmarking results**

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IAEA Intercomparison Vienna 2009

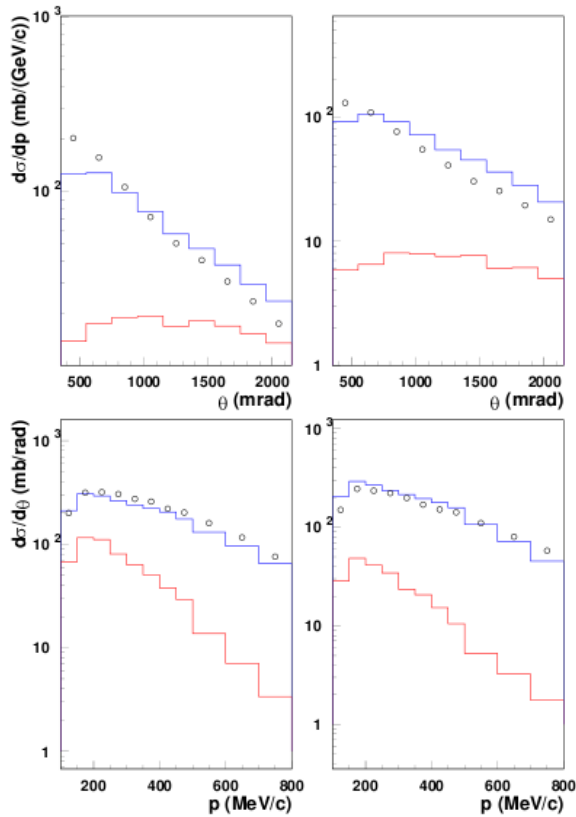Neutron production — Mean per region

Residus
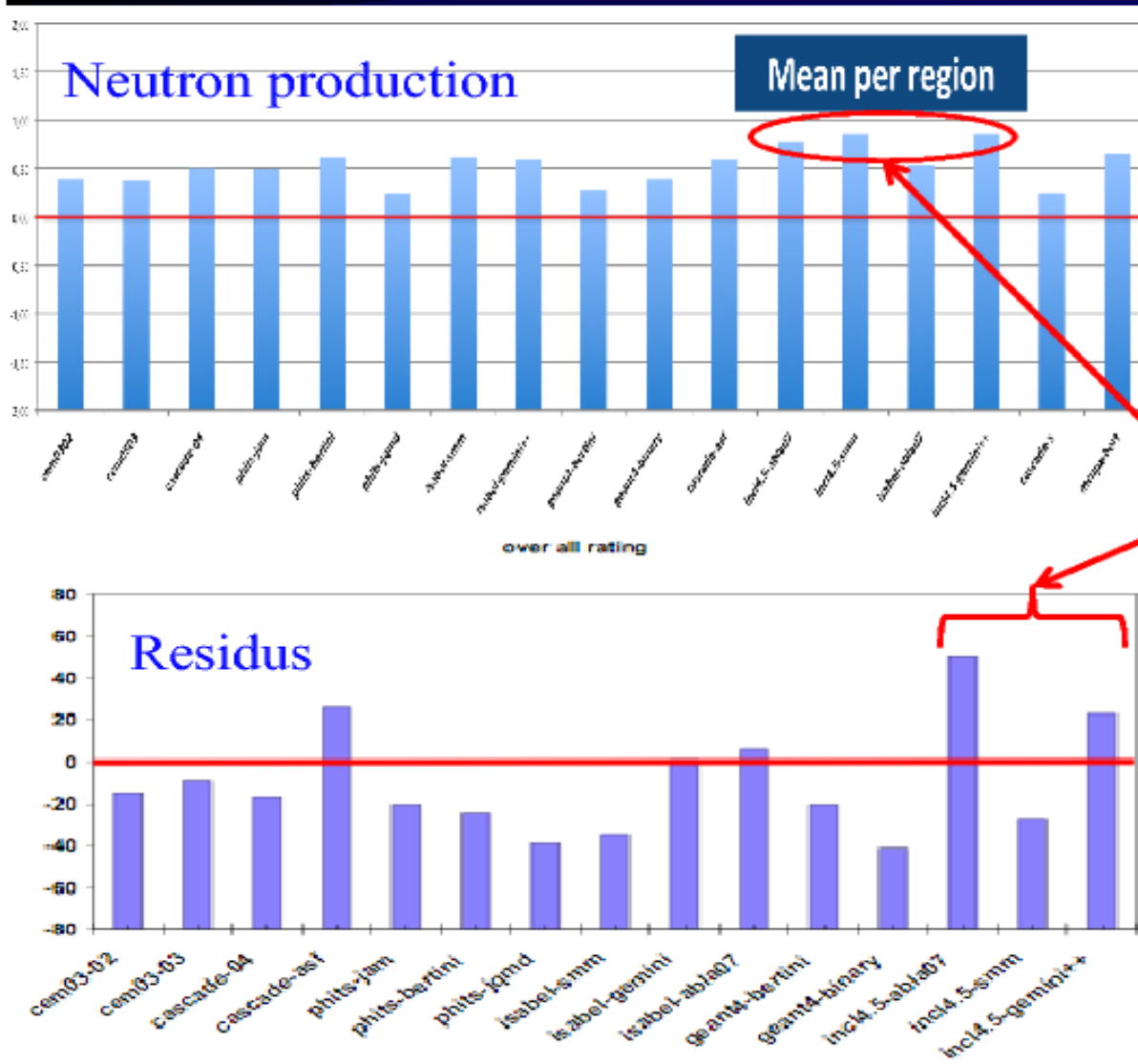
p(~40Mev-2.6GeV)
Targets: Fe and Pb

~12 cascades
~7 deexcitations

INCL4.5

(from J.C. David presentation)

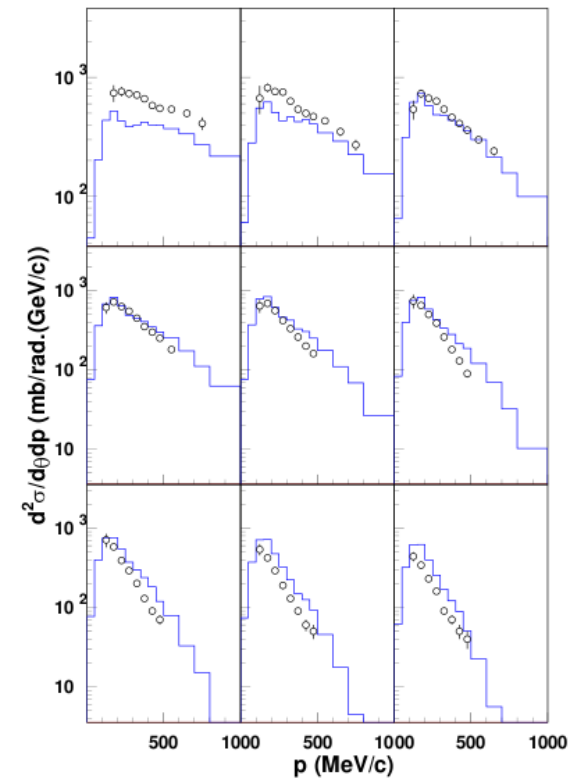**From Alain Boudard's talk**

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Future High Energy Extention to INCL++:
Addition of multi-pion channels (blue line)
HARP data used for benchmarking

(d) p (12 GeV/c) + C

(c) p (8 GeV/c) + Pb → π⁺

(b) π⁺ (5 GeV/c) + Cu → π⁻

From Alain Boudard's talk

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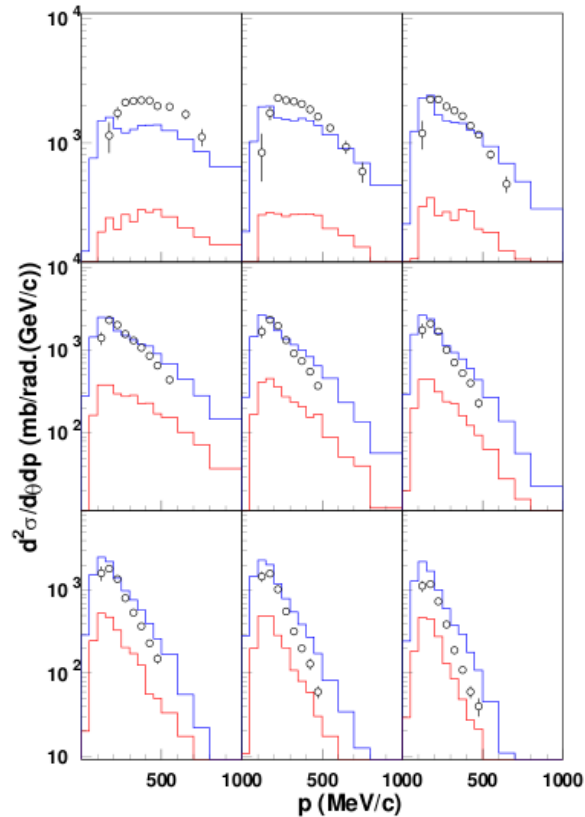
Summary

- **Geant4 Validation is a very important domain**
- **It benefits the users community**
- **It drives the improvements in Geant4**
- **Many efforts on a regular basis and documented**
  - Model level
  - Full scale applications
  - New developments
- **Certain areas still await more attention**
- **Help is most welcome in many ways !**