Geant 4

Summary of Parallel Session 3A
Hadronic Models: Developments and Validation (part I)

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20th Geant4 Collaboration Workshop

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Outline

- Geant4 String Models – A.Ribon
- Geant4 Cascade Models – M.Kelsey
- Status Report on the Varied Model Parameters Interface – J.Yarba
- Status of the Precompound Model – V.Ivanchenko

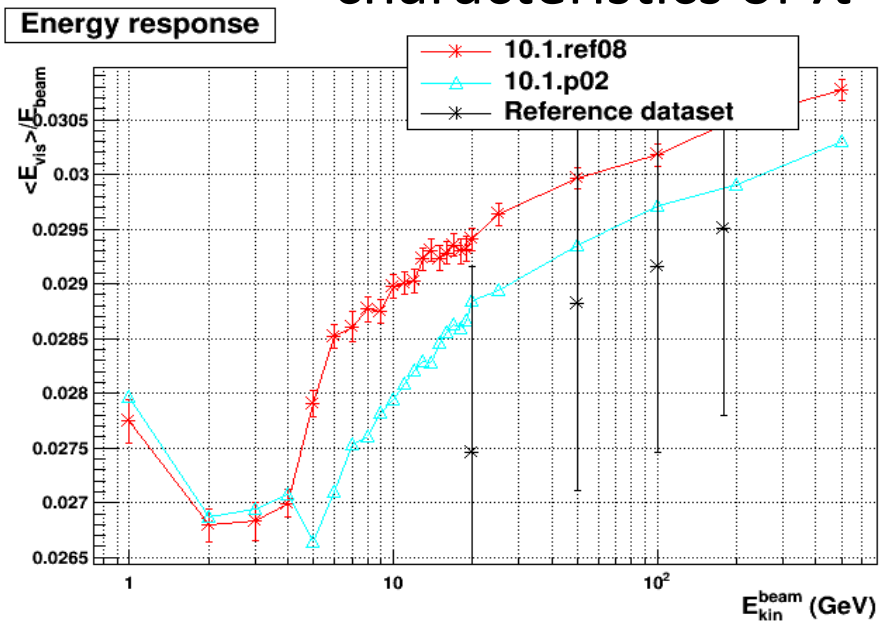
- Conveners: A.Ribon, J.Yarba

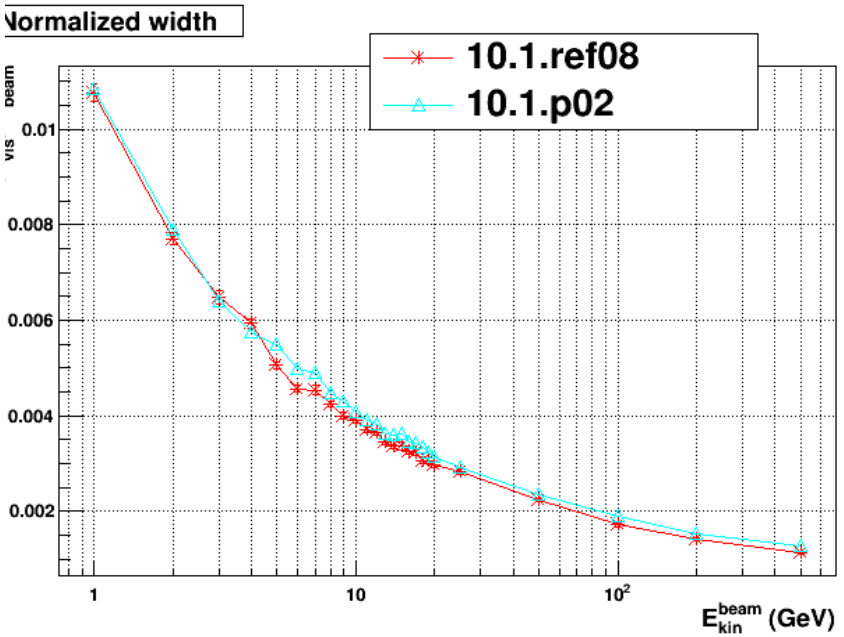
String Models (I)
A.Ribon

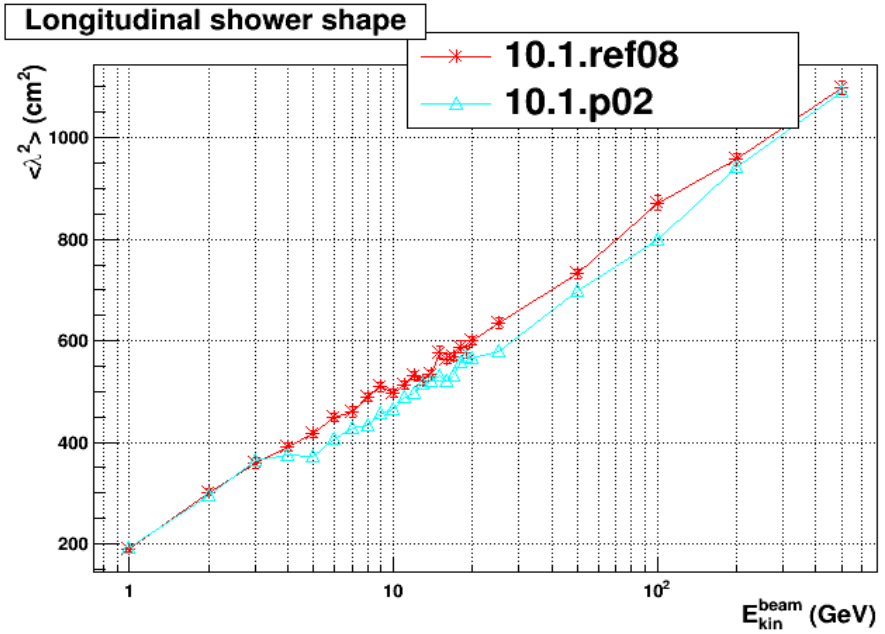
- **FTF**
  - Significantly improved in the range of tens of GeV and up (as of 10.1); will be used in Run 2 analysis by all LHC experiments
  - Tune of the FTF lowest energy sector related to the preparation of the excited nuclear remnants
    - Production of slow nucleons
      - Comparison vs thin target data look promising but…
      - … there's non-negligible impact (few %) on modeling of the hadronic shower shapes (goes the wrong way – see next slide)
  - Production of strange particles (K^0,Λ,Σ) in antiproton annihilation
    - Tuned the strangeness suppression and introduced anisotropic decay for diquark-strings (hyperon production)
  - Lower-energy limit of FTF applicability extended to 1GeV

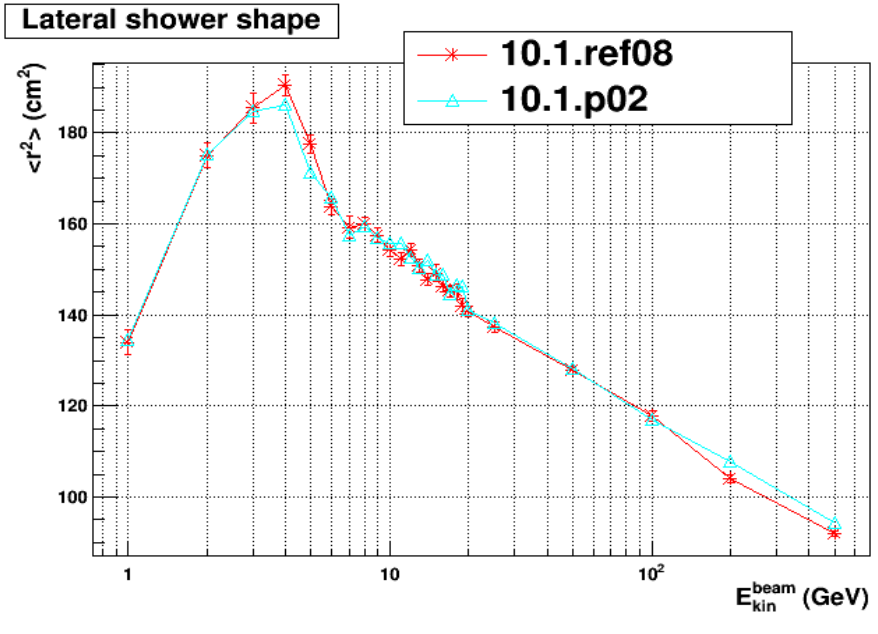
FTFP_BERT:

characteristics of π^--induced shower in Fe-Sci







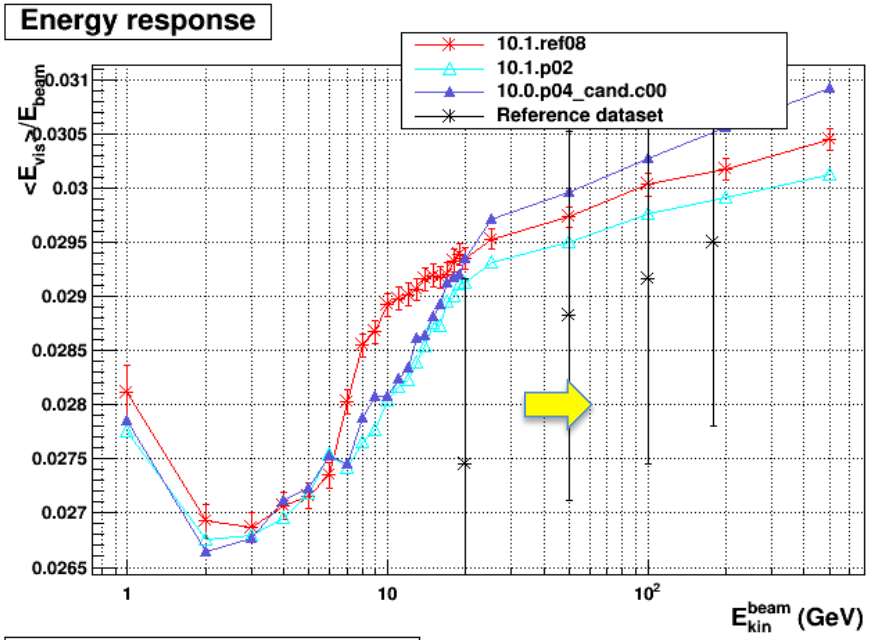


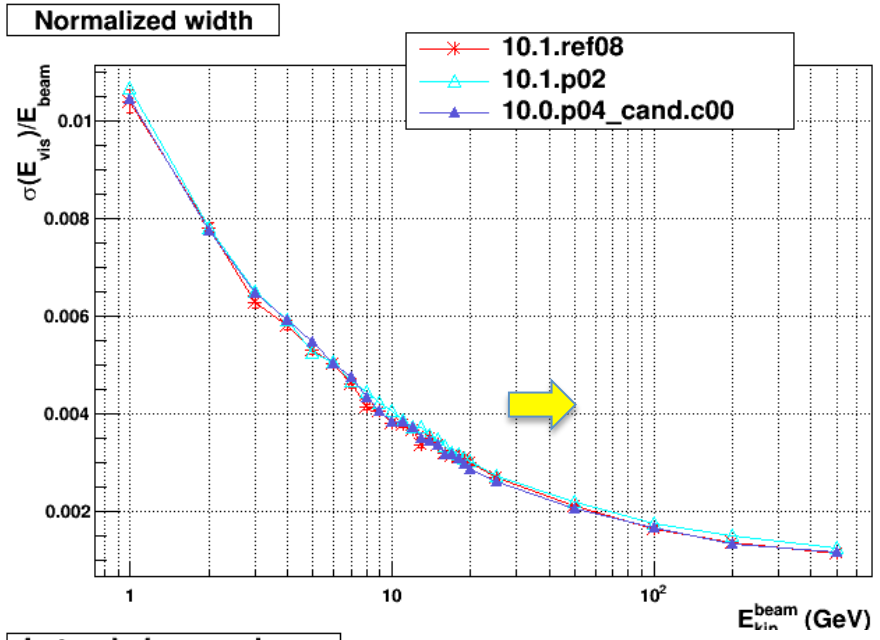
String Models (II)
A.Ribon

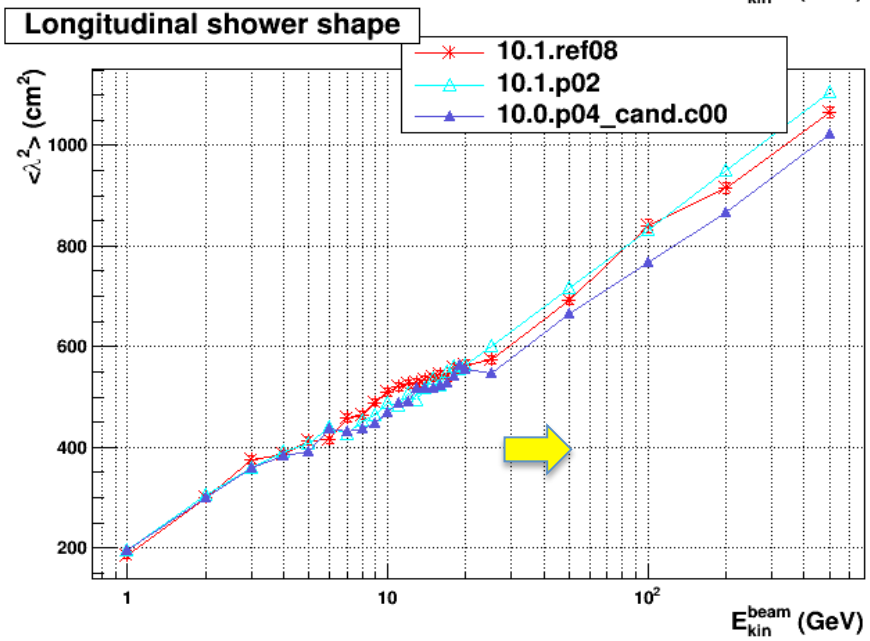
- **QGS**
  - Implementation is significantly different from the original Kaidalov's theory
  - Efforts to make model implementation consistent with the original ideas
    - Revised QGS string fragmentation - included in 10.1
    - Revised and improved formation of strings - ongoing
    - Parameters have NOT yet been re-tuned
    - Non-vacuum reggeon contribution needs to be included
- Comparison vs data:
  - Better in some areas, worse in some other areas at high energy (158GeV)
  - Worse towards the lower end of the model's applicability (31GeV)
  - Effect on shower shapes is being carefully monitored
- Discussion on how to release QGS in 10.2
  - Re-tuning is a complex process
  - QGS is widely used – controversial changes maybe confusing to users
  - Decision: release QGS in the same state in 10.1 cycle

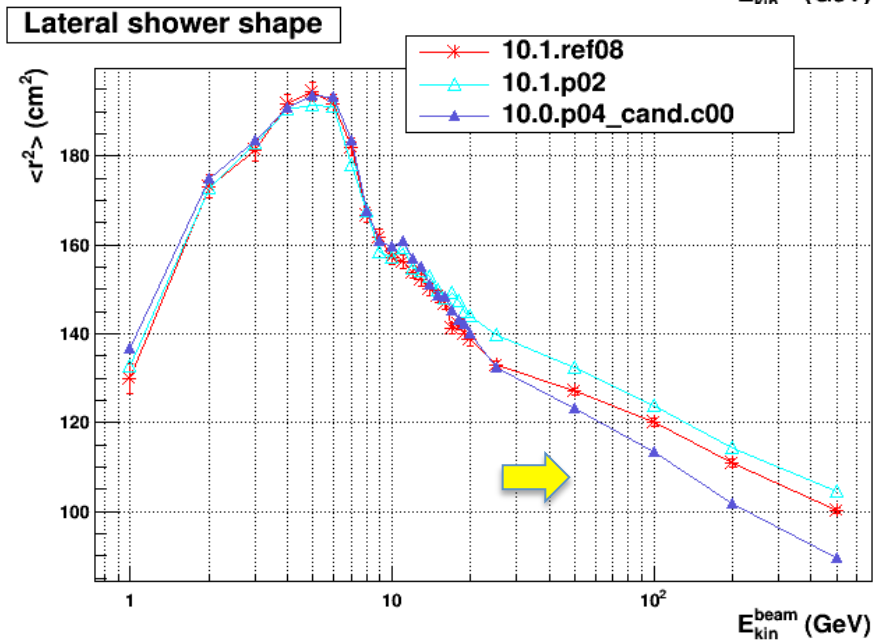
QGSP_FTFP_BERT:

characteristics of π^--induced shower in Fe-Sci









Intranuclear Cascade Models
M.Kelsey

- Common improvements
  - Migration to fast math
  - Proper (guaranteed) termination of loops
- **Bertini**
  - Extended K+n and K+p up to 32 GeV and 9-body "final" states
  - Introduced (optional) improved nucleon evaporation from giant dipole resonance excitation – in response to an earlier bug report
  - Exploring systematic variation of BERT parameters
- **INCLXX** – no development In this cycle
- **Binary** – improved four-momentum conservation for fragmented nuclei; otherwise no development in this cycle

Varied Model Parameters Interface (Bertini) J.Yarba

- The challenge
  - Standardize the machinery to compute systematic uncertainties due to model choice in the simulation
  - Help optimize model(s) parameters
- Software tools/features at the initial phase
  - Tools to vary intentionally exposed parameters in a controlled way, without recompiling the code
    - Convenient and uniform API
    - Documentation
  - Tools to comprehensively analyze the impact of perturbing model parameters around their current tuned values, to understand the induced uncertainties
- Joint efforts by Fermilab and SLAC teams
  - Bertini is the 1st use-case to exercise the idea and explore SW technologies

Precompound Model Status and Plans V.Ivanchenko

- Current Updates:
  - Technical aspects: memory/CPU usage, code duplication clean up
  - MT processing: thread safety, nuclear level management for MT
  - Revised computation of evaporation cross sections, unifying between Precompound and de-excitation
  - New nuclear level data structure
- Planned development:
  - New nuclear level data structure should be used by all de-exitation models (GEM, Evaporation, FermiBreakUp)
    - Need to ensure consistent use of the same nuclear level data by G4IonTable, Radioactive decays, de-excitation module
  - Multiple hardcoded parameters – encapsulate, make configurable
  - Migrate to C++11, further improve CPU performance
  - Validate, including introduction of dedicated photon evaporation test tools