Simplified Calorimeter Validation

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16th Geant4 Collaboration Meeting

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Introduction

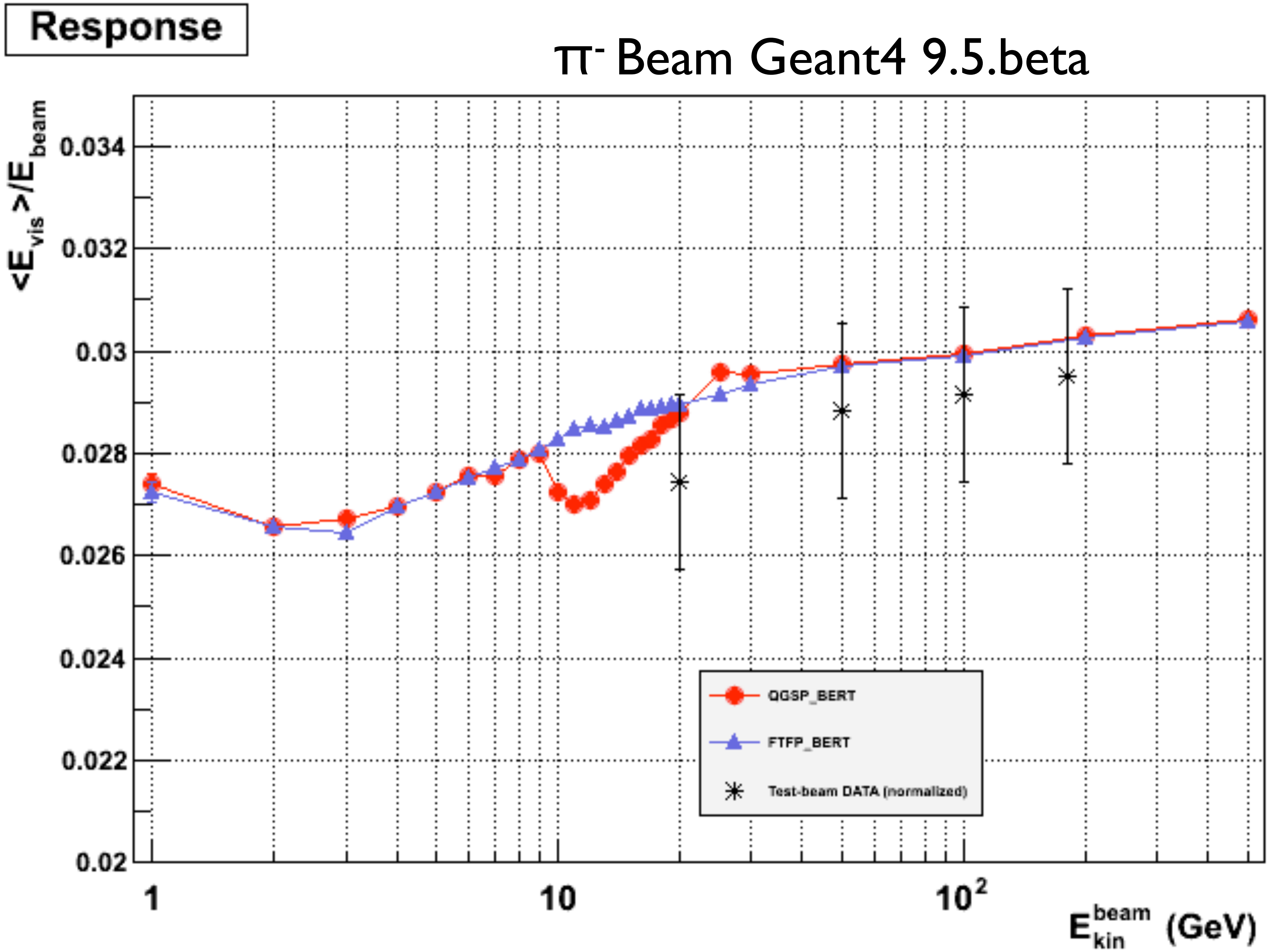
- For LHC era requirements were collected on expected performances of Geant4 (CERN-LCGAPP-2004-02)
  - **Calorimeters set the most stringent requirements**
  - Observables: **Response, Resolution, Shower Shapes**
  - Recently added: **Smoothness, anti-protons and K cross-sections**
- Readiness of G4 at LHC startup: CERN-LCGAPP-2010-02

Simplified Calorimeter

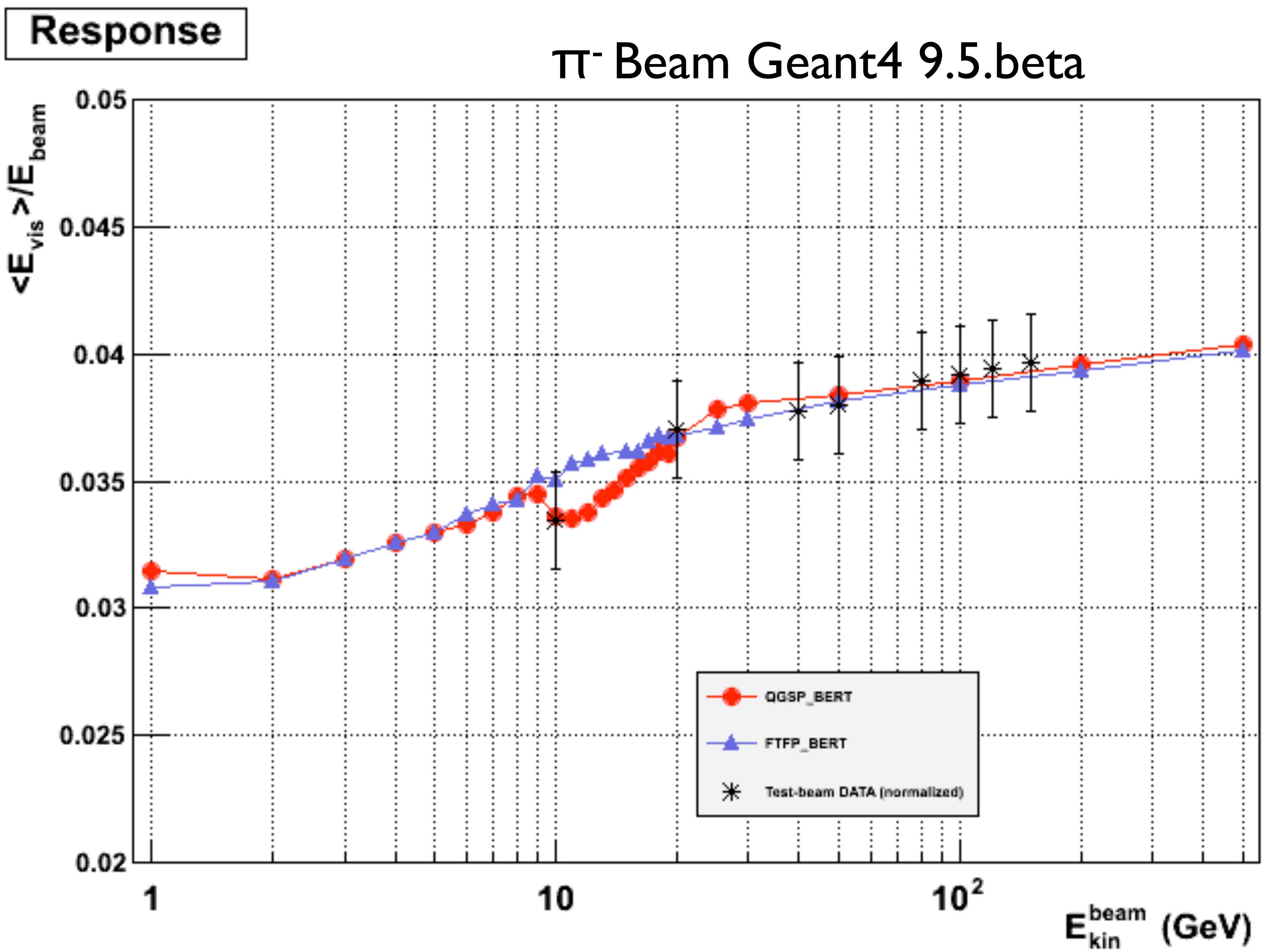
- **Geant4 Application with simplified geometry of different calorimete**r: all LHC ones, Zeus, one CALICE
  - "Sandwich" geometry, no read-out effects (only Birks')
- See last year workshop: Parallel 6-A

- No technical details here (see backup)
- Only showing plots with data, check last year presentations for additional material

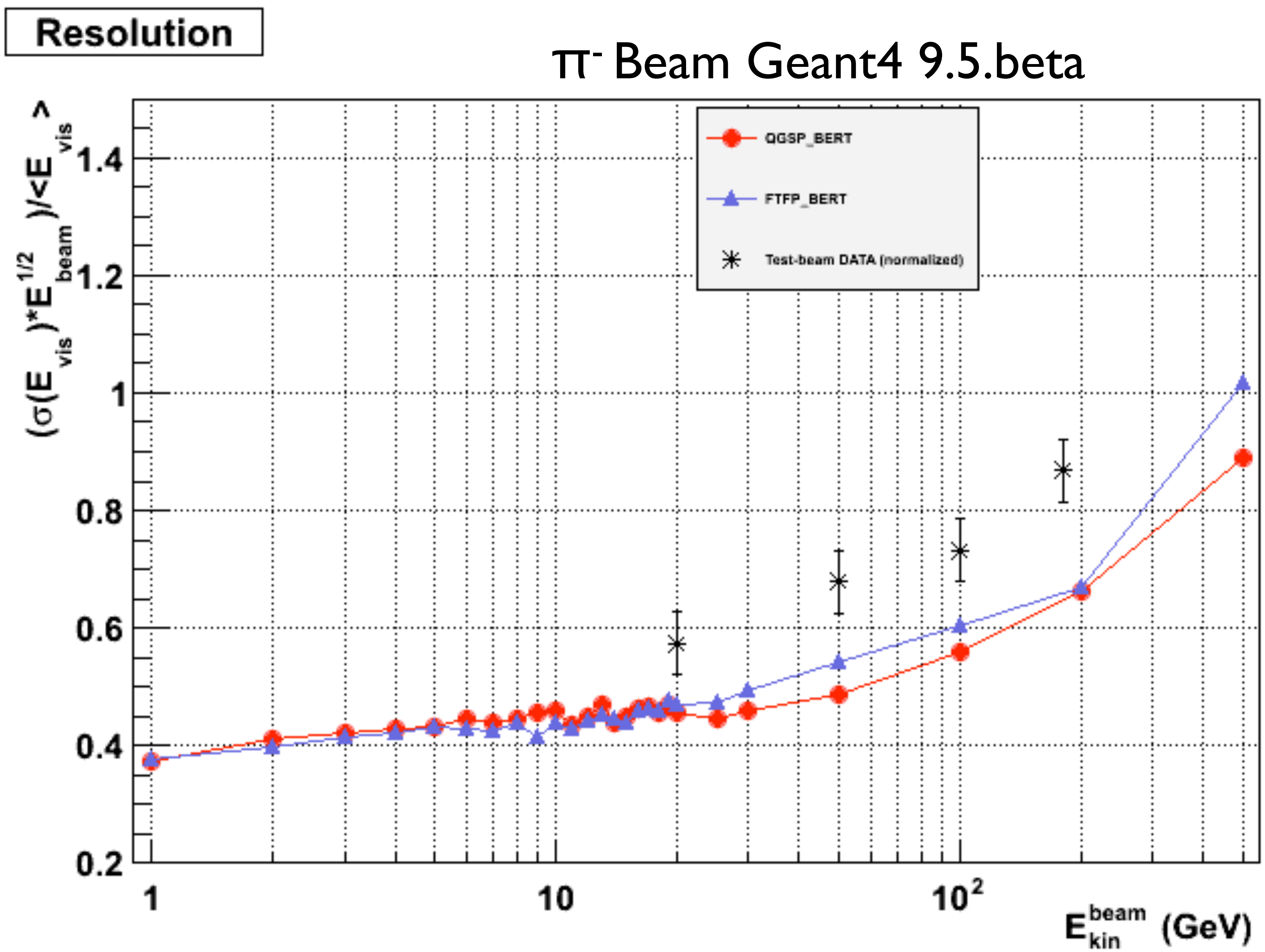
Response: Fe/Sci



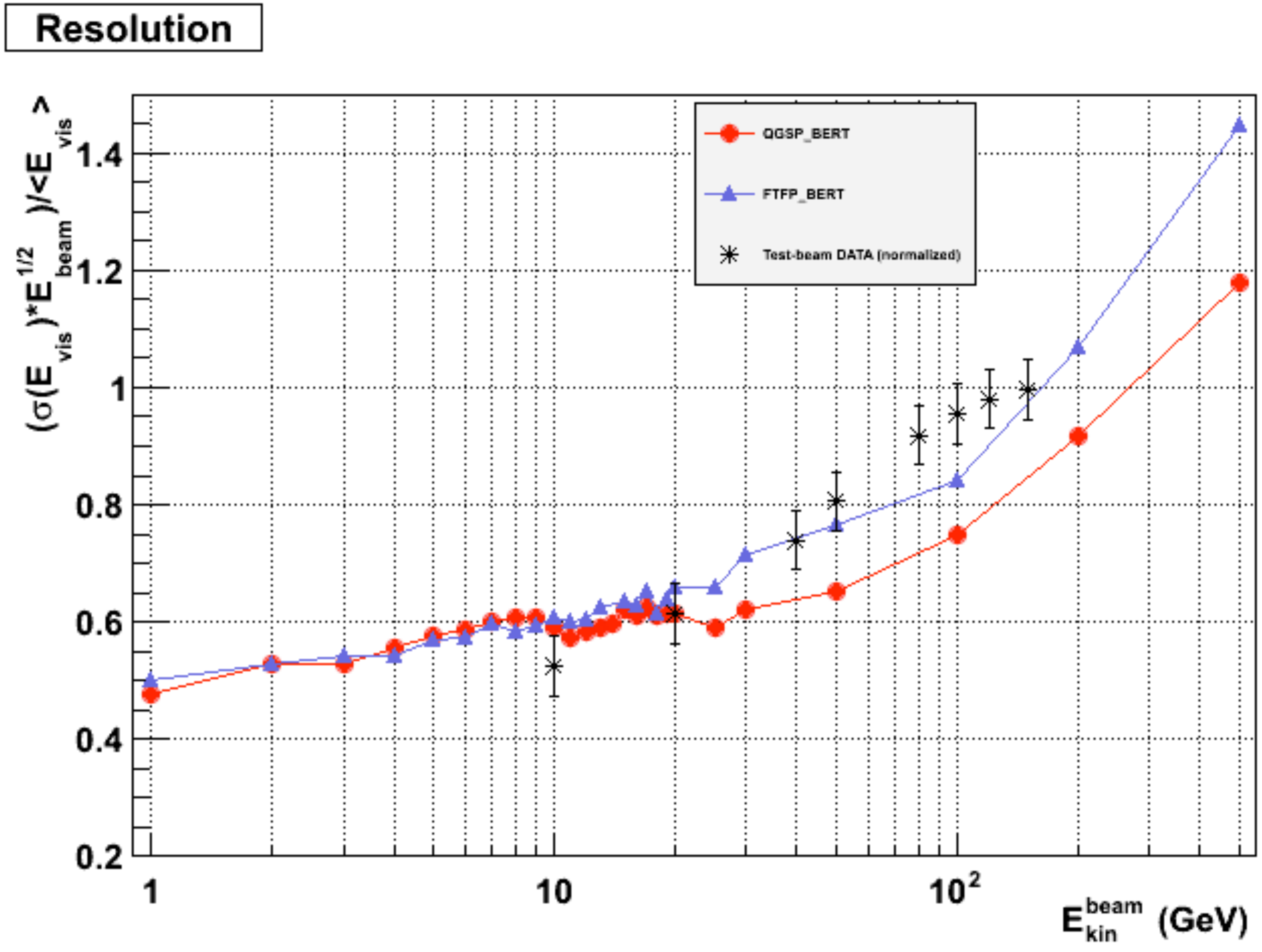
Response: Cu/LAr



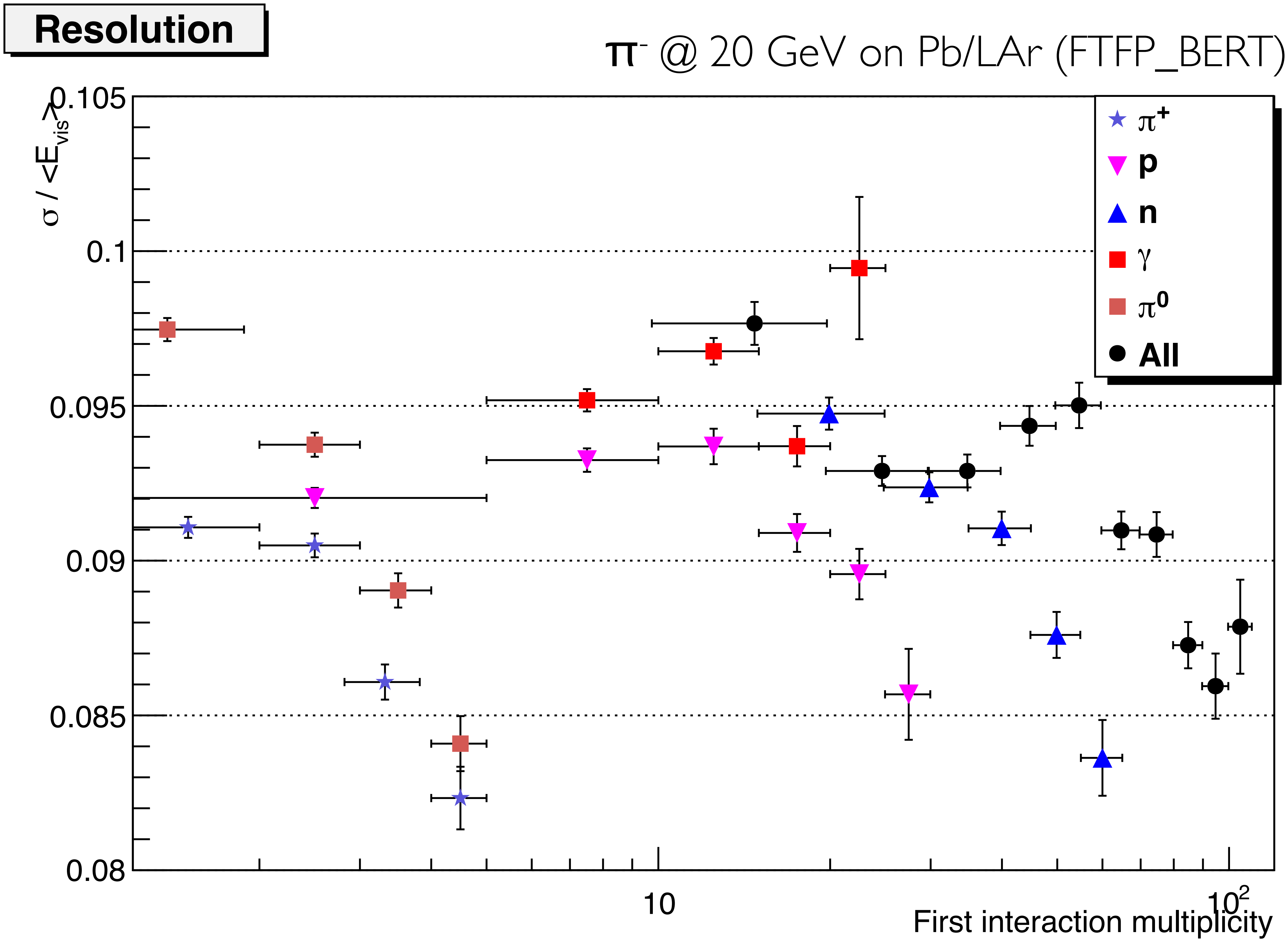
Resolution: Fe/Sci



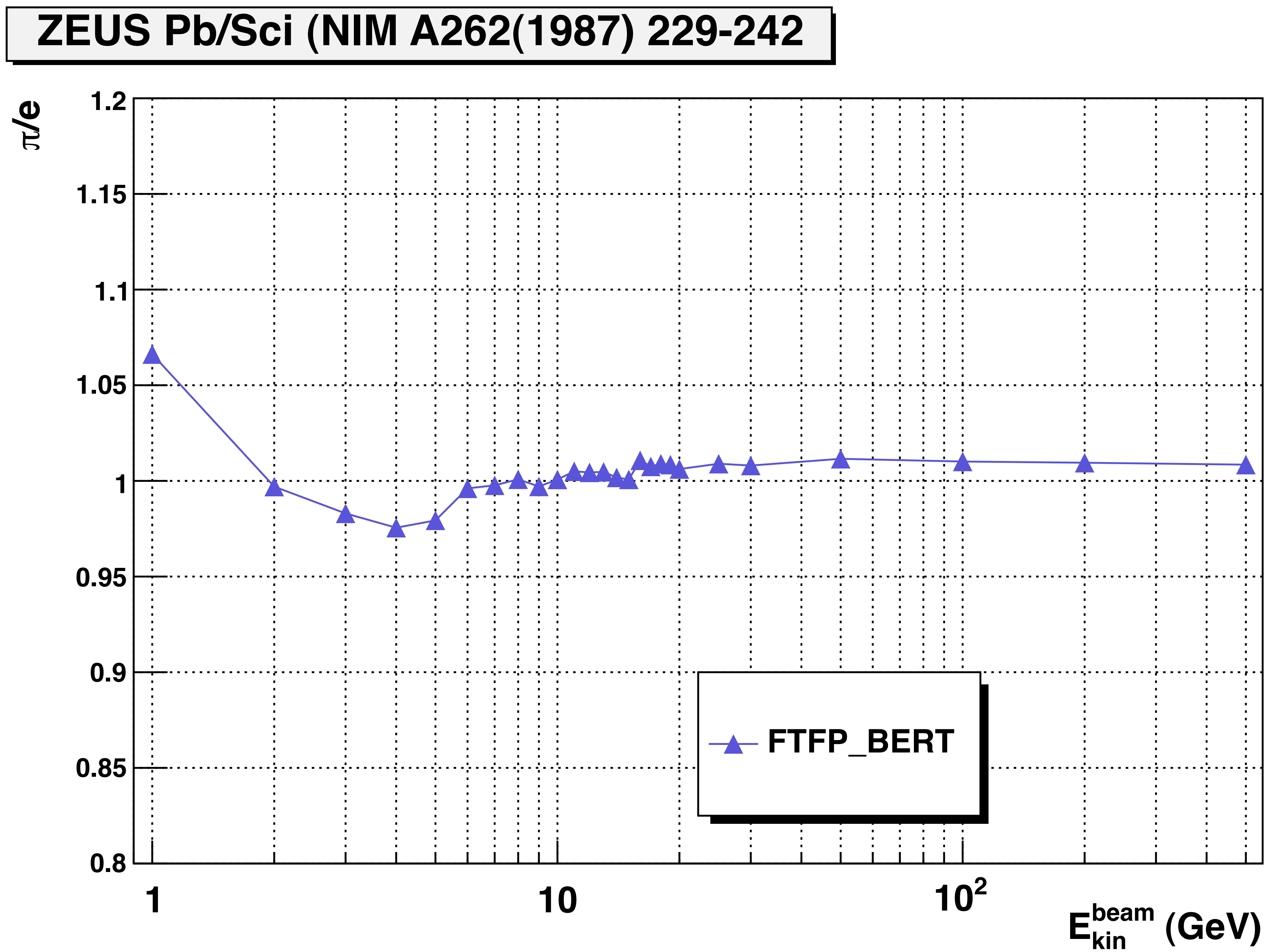
Resolution: Cu/LAr



Resolution as function of first interaction multiplicity

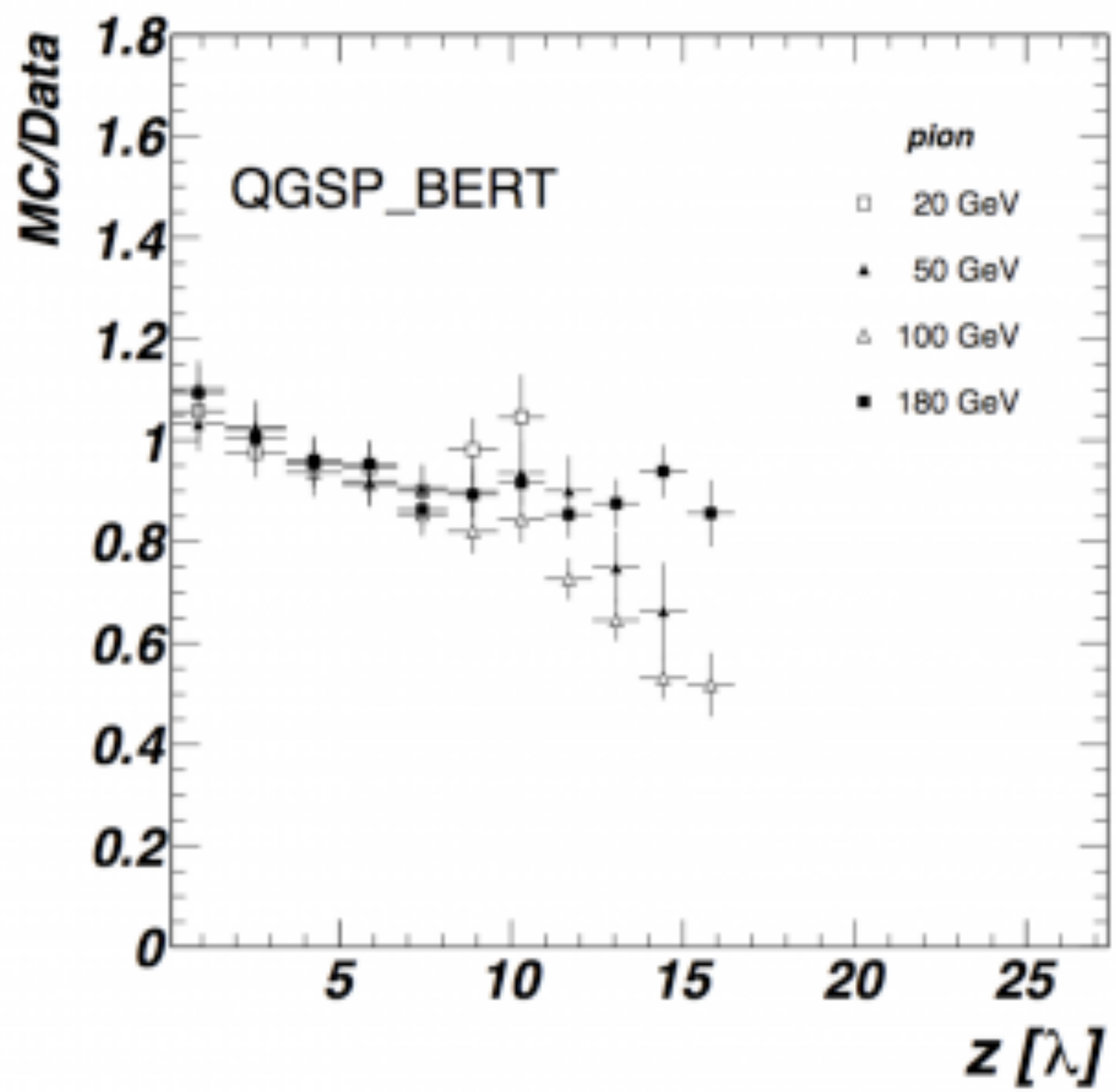


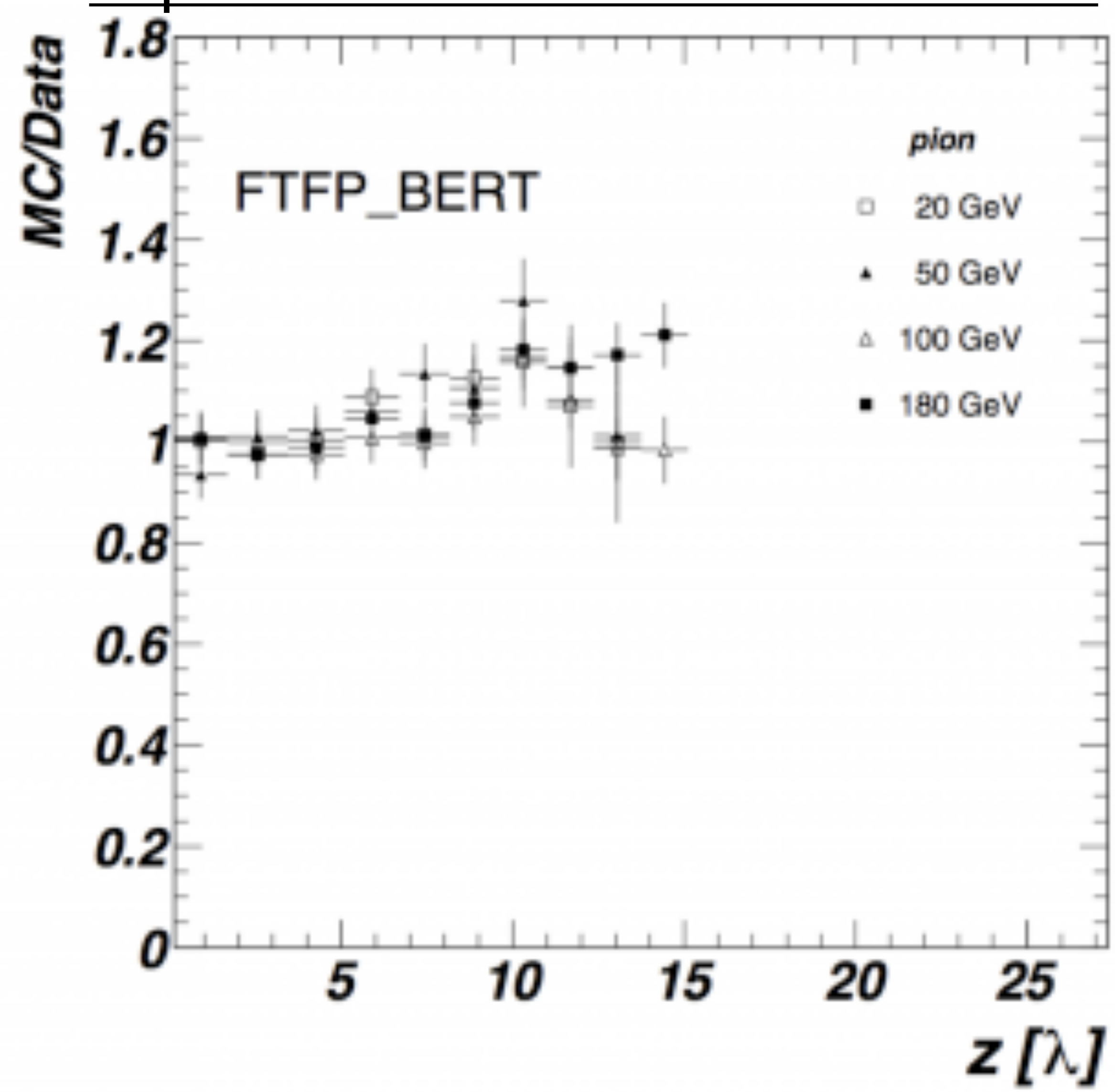
Compensating calorimeter



Longitudinal shape

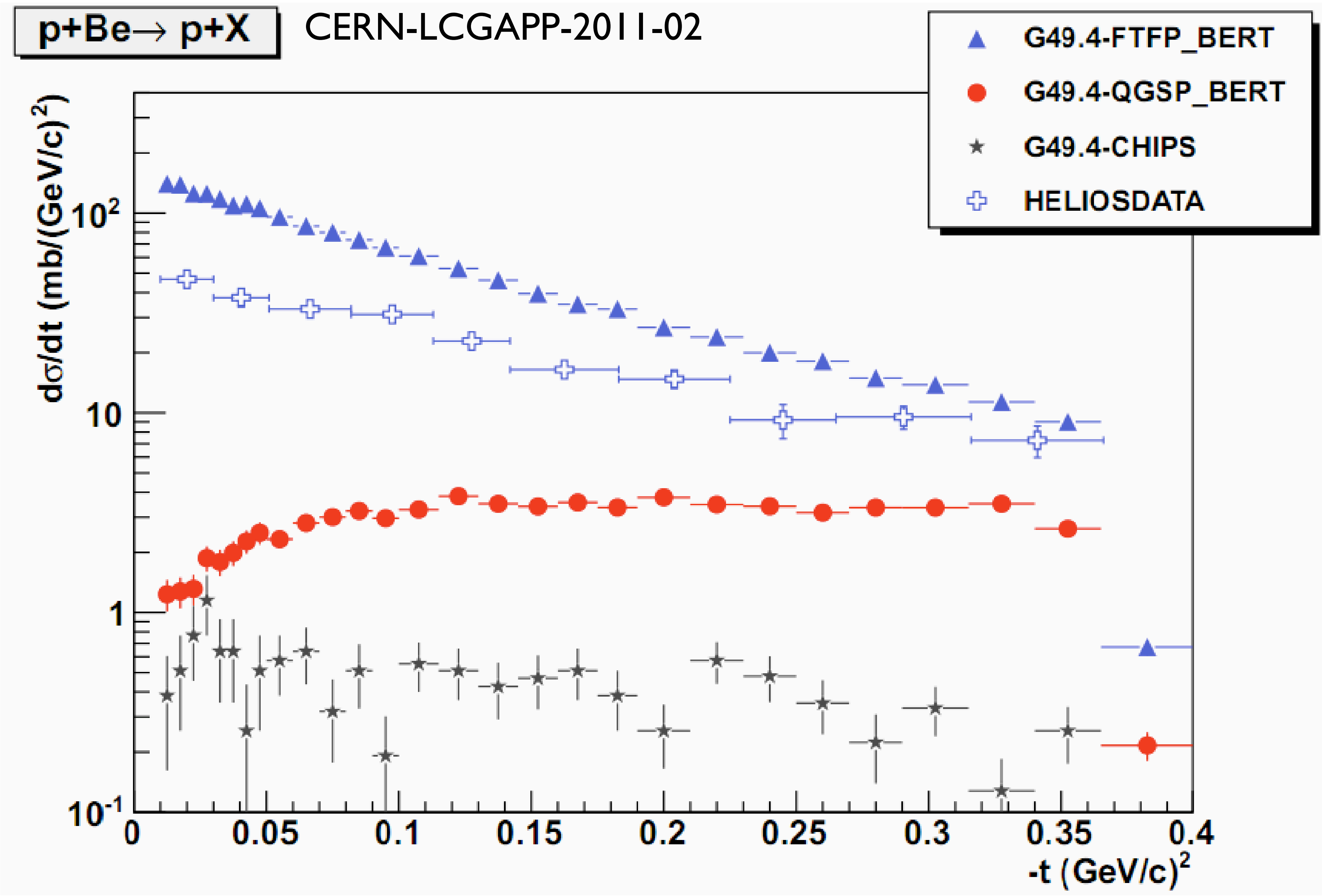
http://sftweb.cern.ch/validation/node/114





Full TileCal Test-beam simulation!
Need to find a way to compare with SimplifiedCalorimeter
QGS: shorter, FTF: longer

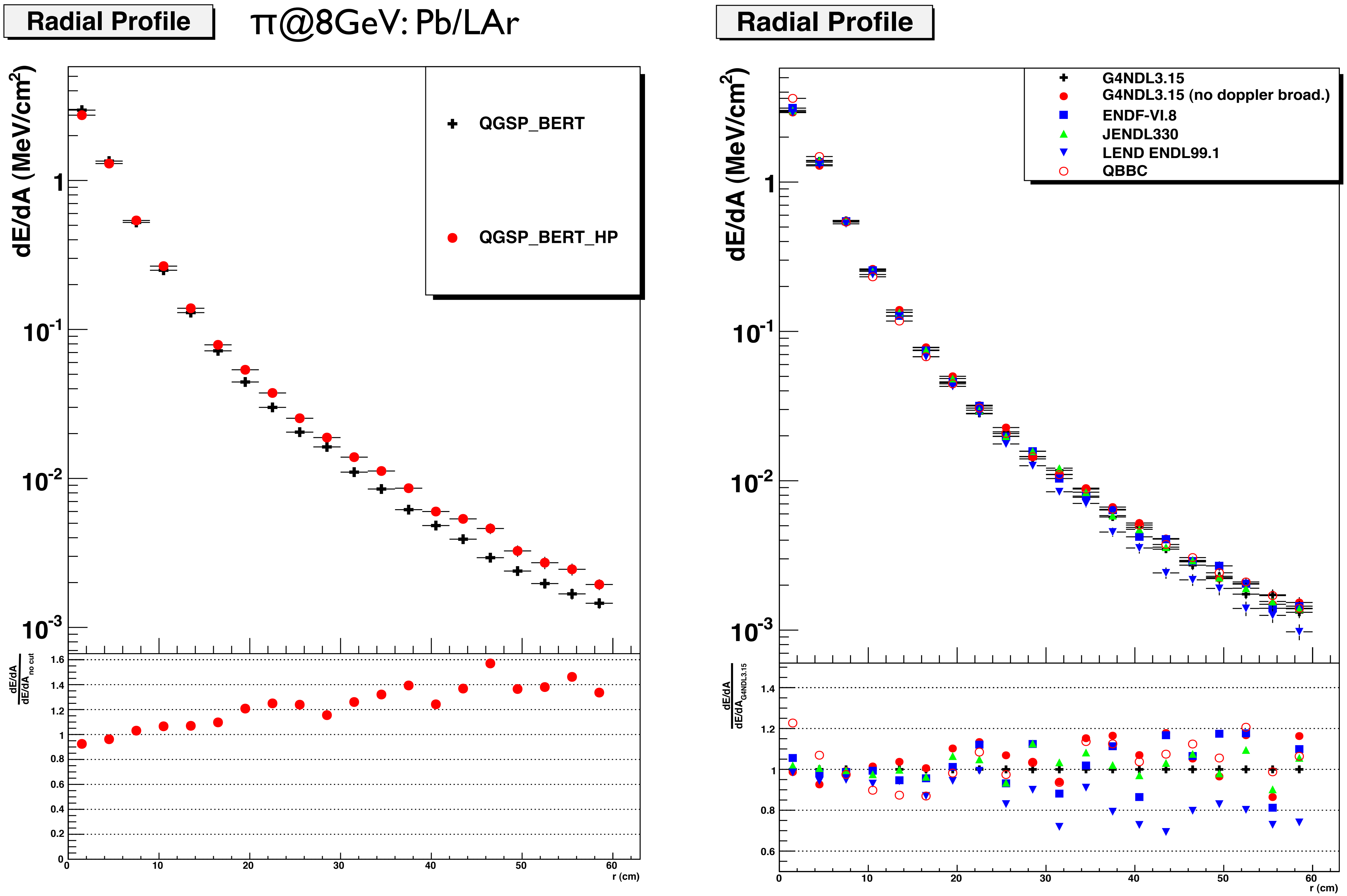
Diffraction and longitudinal shape



FTF predicts too much traget diffraction, while QGS too little
May play important role for longitudinal description
Investigating NA22 experiment
Quasi-elastic introduction improved QGS: re-evaluate

Radial profile

π@8GeV: Pb/LAr



Low-E neutrons play important role for lateral profile

Challenging to compare with data: need CALICE

Test-beam summary (G4 9.4.p01)

	Response	Resolution	Smoothness	Lateral Shape	Longitudinal Shape @10λ	Notes
QGSP_BERT	+(1-3)%	-(10-5)%	Bad	-(20-10)%	π: -10% p: -20%	anti-nucleons, hyperons via LHEP
FTFP_BERT	+(3-5)%	-(7-3)%	Good	π: -(20-10)% p: -(10-3)%	π: +10% p: +(10-20)%	anti-nucleons, hyperons via CHIPS(*)
CHIPS	+(10-5)%	-(20-10)%	Very Good	π: -(10-3)% p: -(20-10)%	π: -10% p: -20%	native anti-nucleons, hyperons
FTF_BIC(**)	+(3-5)%	-(6-2)%	Bad	-	π: +10%	Implements re-scattering at high E

(*): Native FTF model under development

(**): Much less tested at LHC

Conclusions

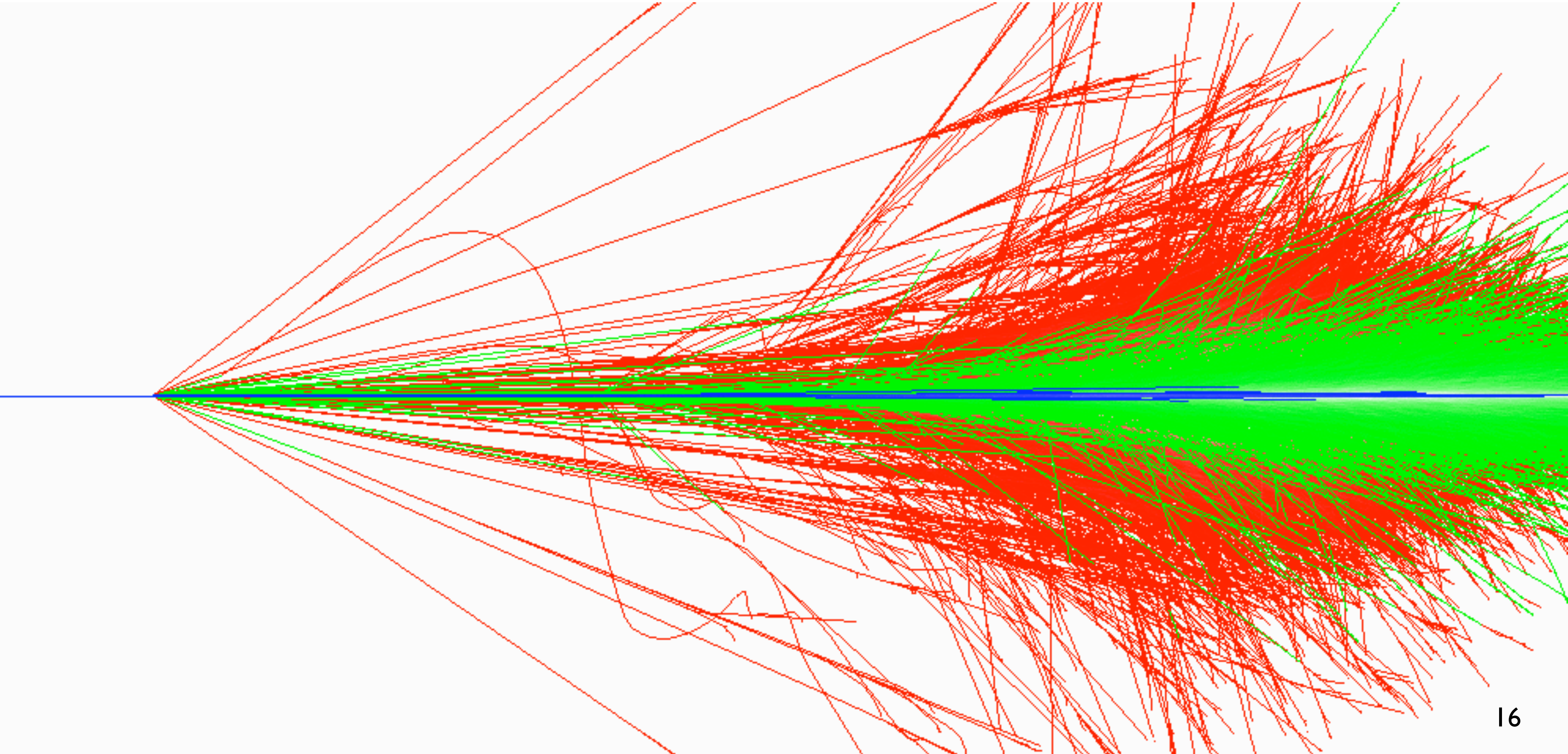
- **Smoothness** issue resolved with FTF based lists
- **Response** is higher of few %
  - FTFP_BERT is higher in 10-20 GeV region w.r.t. QGSP_BERT (good since no LEP is used there)
    - However this brings too much up jet-response in ATLAS: (high-E jets are composed of low-E particles!). Same behaviour observed for hadronic tau-decays (private communication)
  - Scintillator based calorimeters are challenging: need to further study role neutron elastic scattering
- **Resolution** is too good (should focus on π^0 production validation)
- Forward physics (q.e., diffraction) needs attention
- Low-E neutrons play an important role for lateral profile

Todos

- Test novel combination of models
  - Bertini as re-scattering for FTF
  - G4Precompound in Bertini
  - G4NeutronRadCapture

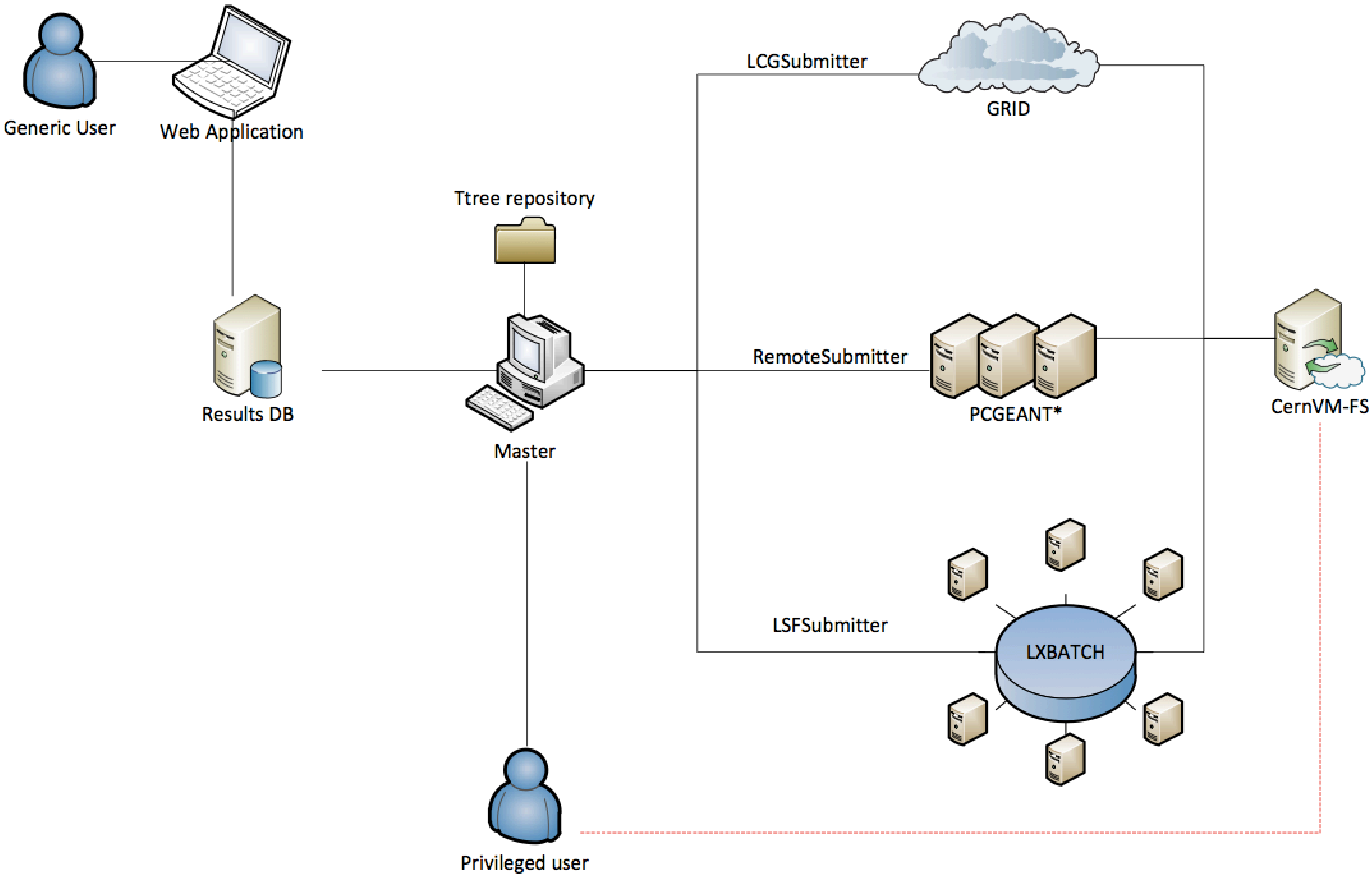
- Find data for longitudinal and lateral shower shape validation

Backup



Validation Components

- **Geant4 Application** performing simulation
  - Output ROOT trees and histograms
- **Python Application** performing analysis, writing results in DB and producing plots
- **DIANE application**
  - Jobs running on distributed resources (batch and GRID)
- **CernVM FileSystem** used for software distribution
- **DRUPAL web application** to show results


Generic User
Web Application
LCGSubmitter
GRID
Ttree repository
Results DB
Master
RemoteSubmitter
PCGEANT*
CernVM-FS
LSFSubmitter
LXBATCH
Privileged user

- Each reference tag is validated with SimplifiedCalorimeter
- A total of ~9 millions events is produced with E from 1 GeV to 500 GeV
- Resources usage:
  - 300 CPU produce results in ~1 week (need the GRID)
  - Data 200GB of ROOT files
  - Few MB in DataBase