

# TRANSITION REGION: RECENT RESULTS AND PROGRESS

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Parallel 6-A: Transition region/shower shape

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# Response To Pions

- 🔊 It has been observed a non physical behaviour of the response to hadrons (first CMS then ATLAS, confirmed with simplified calorimeters)
  - Studied: energy carried by each secondary species in single interactions as a function of model and primary energy
    - Reduced response in the range  $10 < E_{\text{pri}} < 20$  GeV (QGSP\_BERT) due to the use of LEP models
- 🔊 Different strategies possible to solve this issue:
  - Test different transition regions \*\_TRV physics lists
  - New models that do not require L/HEP at all: CHIPS
  - Extend validity of existing models (BERT and FTFP) and couple directly

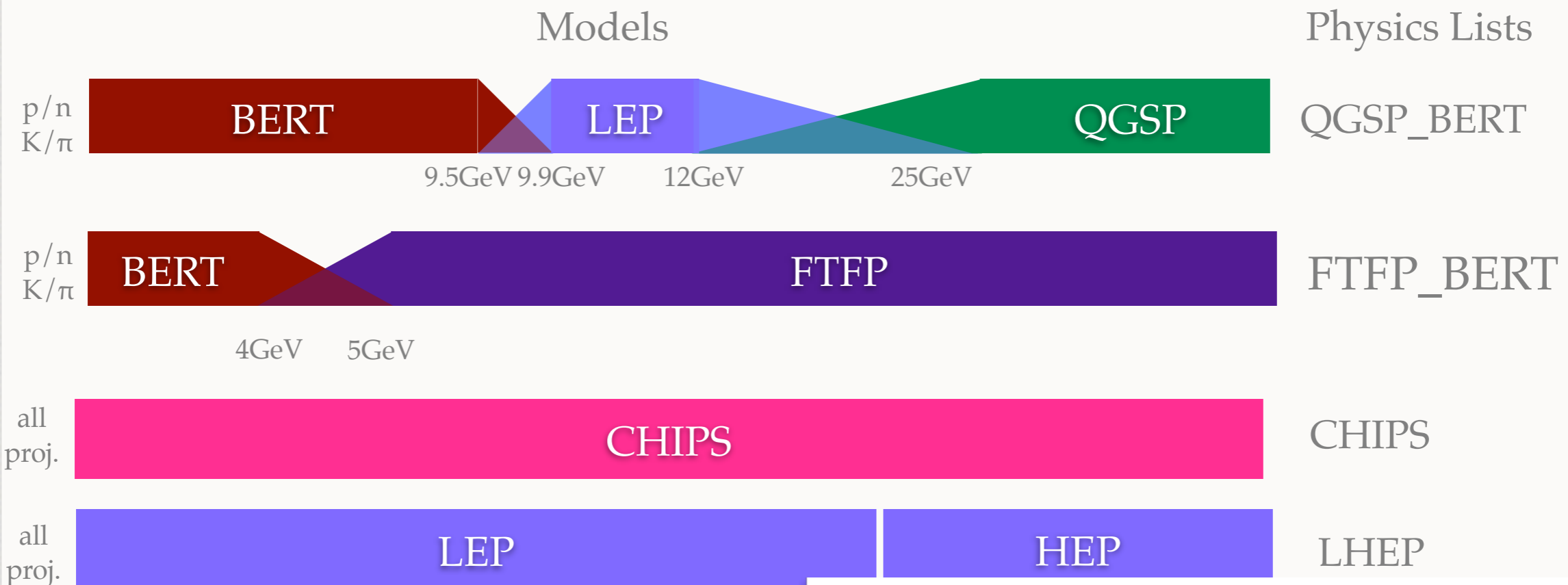
# Results In One Slide

- We have concentrated on the validation / tuning of FTFP\_BERT and CHIPS
- Very important: CHIPS released as “experimental” in 9.3 need further tuning (comparison with LHC test-beam data)
- From Simplified Calorimeter results and LHC data **the FTFP\_BERT physics list is the most promising alternative to QGSP\_BERT since gives similar results solving the transition issue**
- CHIPS is smooth, but its calorimetric observables (response, resolution, and shower shapes) are very different from other PLs and less compatible with data

# Physics Lists: Reminder

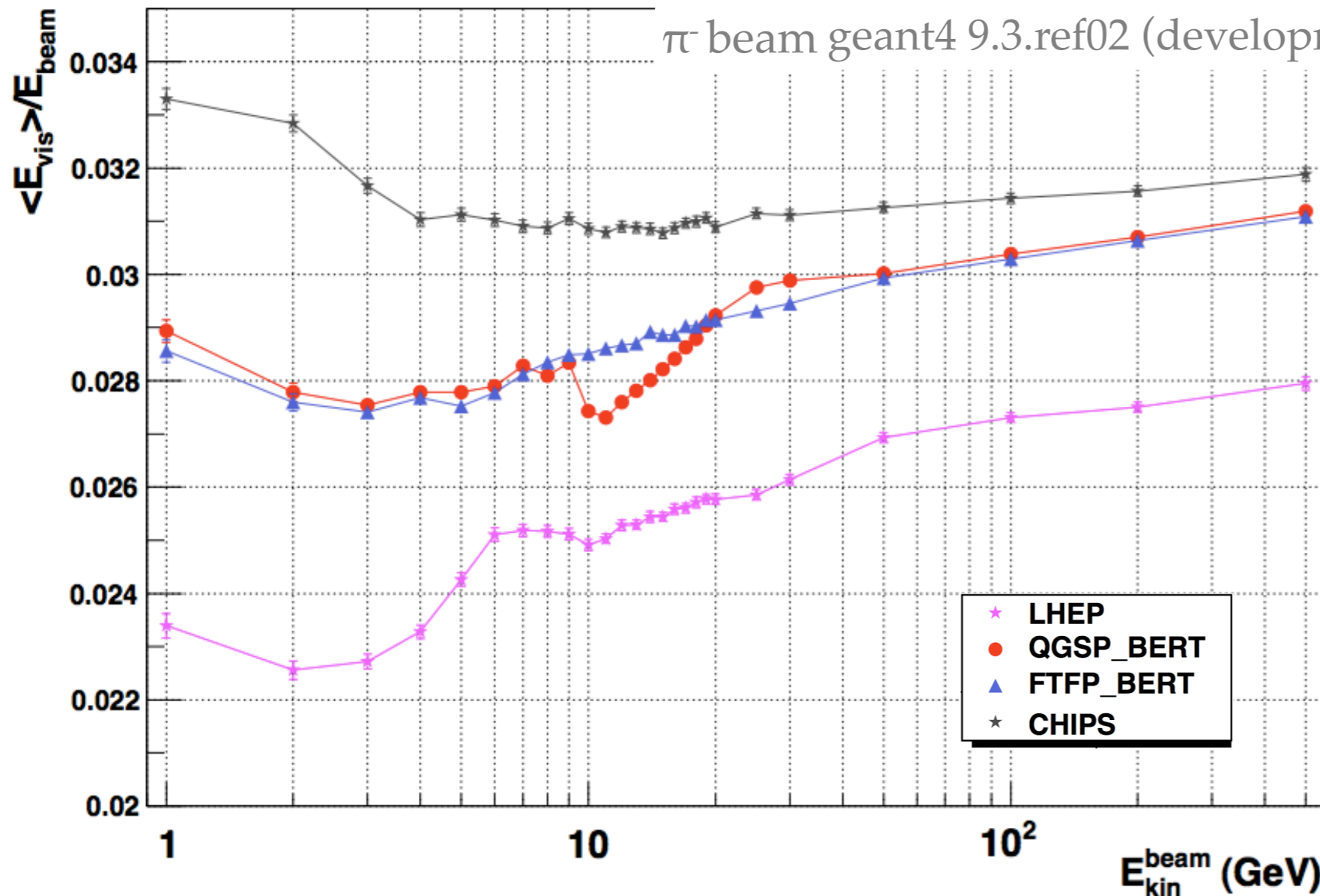
[http://geant4.cern.ch/support/proc\\_mod\\_catalog/physics\\_lists/physicsLists.shtml](http://geant4.cern.ch/support/proc_mod_catalog/physics_lists/physicsLists.shtml)

- A Physics List is a set of **consistent physics models for each particle in application**
- LHC tested several options: most challenging requirements on hadronic interactions come from ATLAS and CMS calorimeters
  - After detailed validation with test-beam: **QGSP\_BERT (2007)**
- For a given physics list when a hadronic interaction occurs a model, depending on primary type and energy, is sampled



CHIPS components used by other PL for capture of negative hadrons at rest and  $\gamma$ -Nuclear and Lepto-Nuclear interactions

# Simplified Fe/Sci Calorimeter

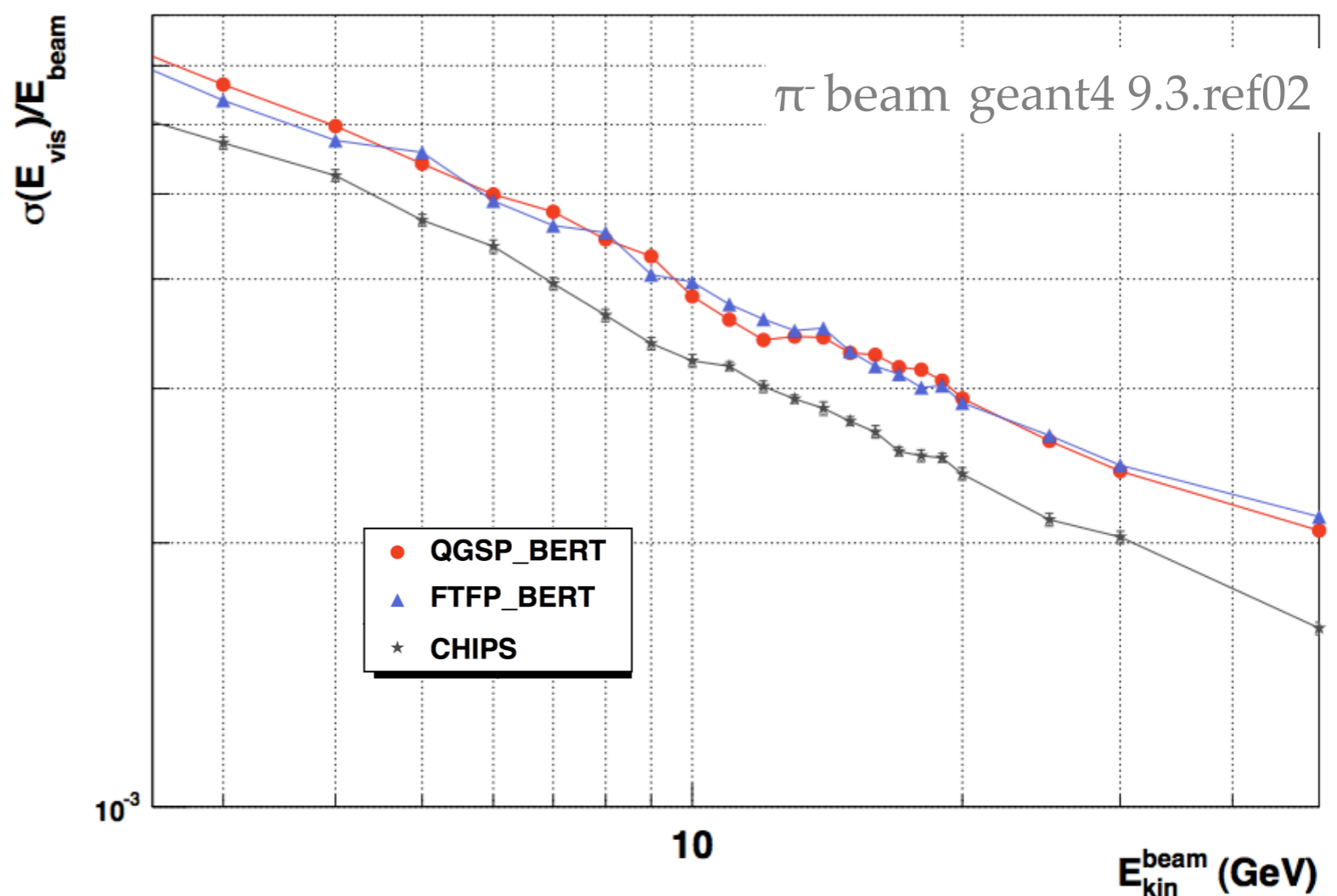
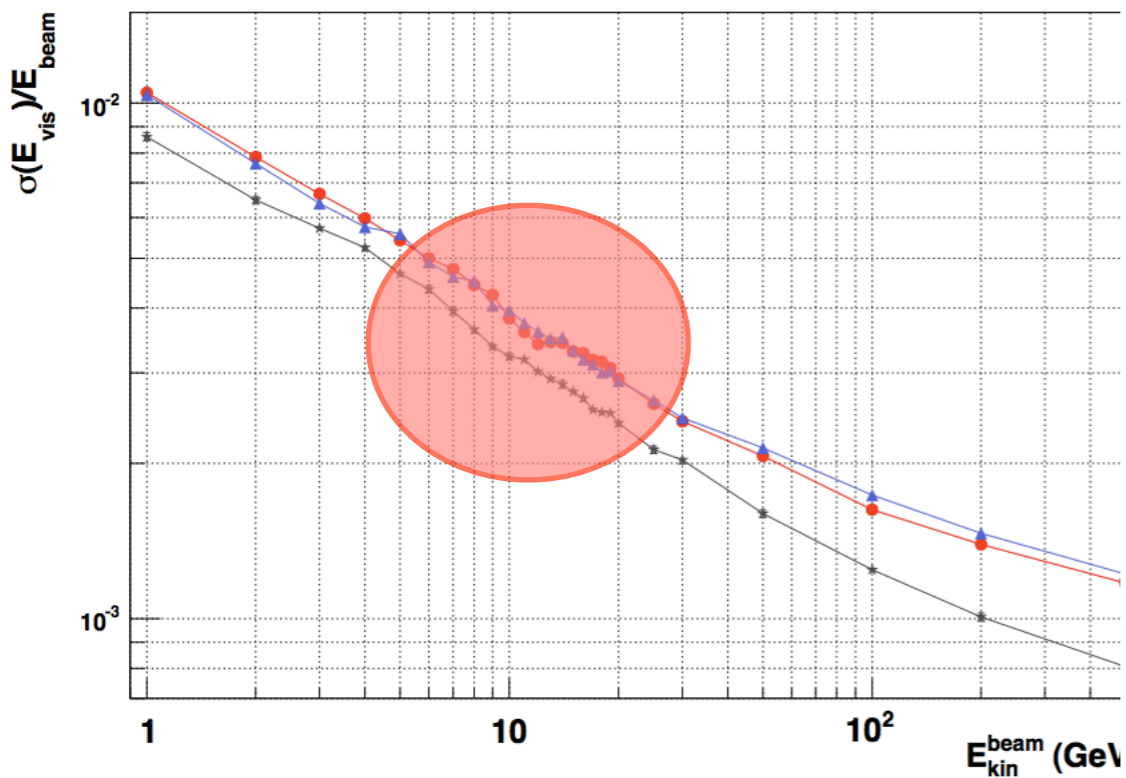


- 📍 QGSP\_BERT stable since G4 8.3 (May 2007)
- 📍 FTFP\_BERT smooth response (improved in G4 9.3)
- 📍 CHIPS (new in G4 9.3) higher response

FTFP\_BERT and CHIPS: **smooth response**.  
 FTFP\_BERT agrees with QGSP\_BERT, where  
 this one agrees with data

**Important:** starting from 9.4.beta FTFP\_BERT,  
 QGSP\_FTFP\_BERT and QGSP\_BERT\_CHIPS  
 use CHIPS models from "misc" particles and  
 CHIPS cross-sections for kaons

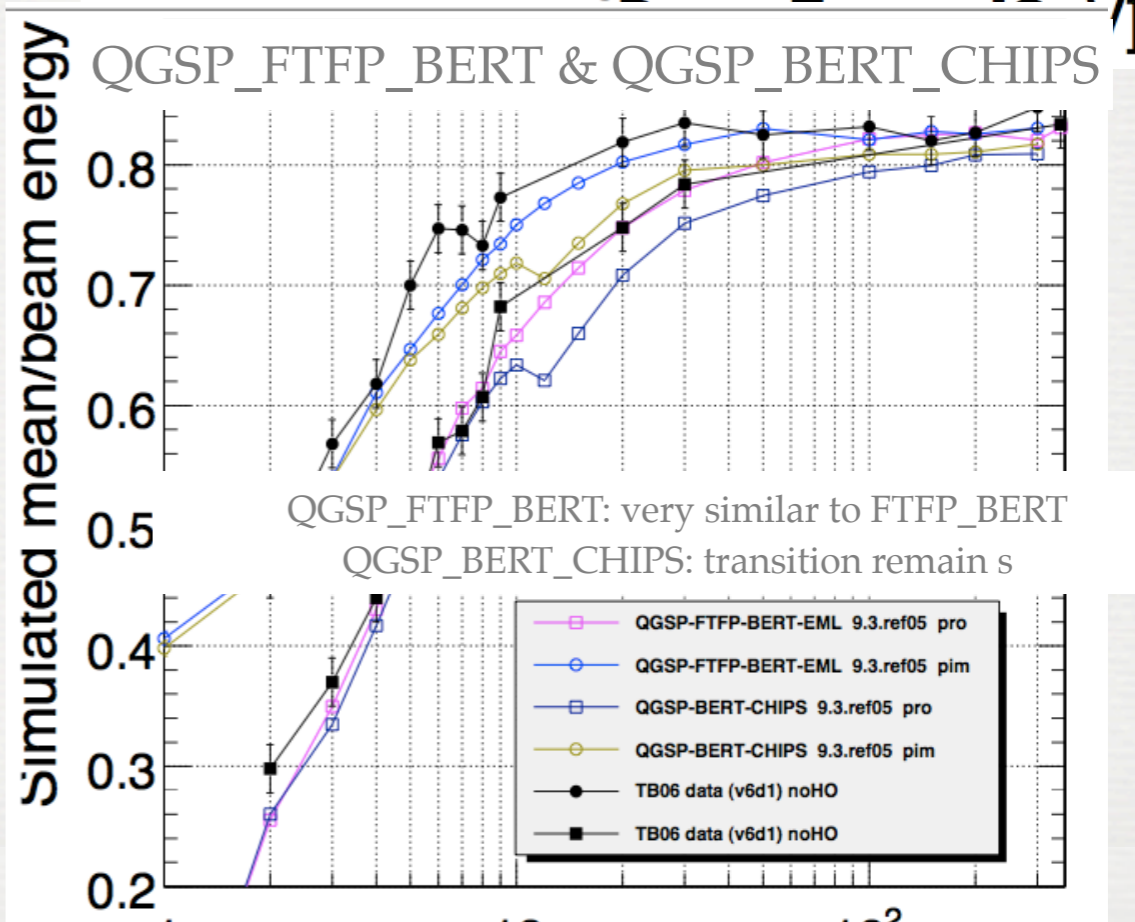
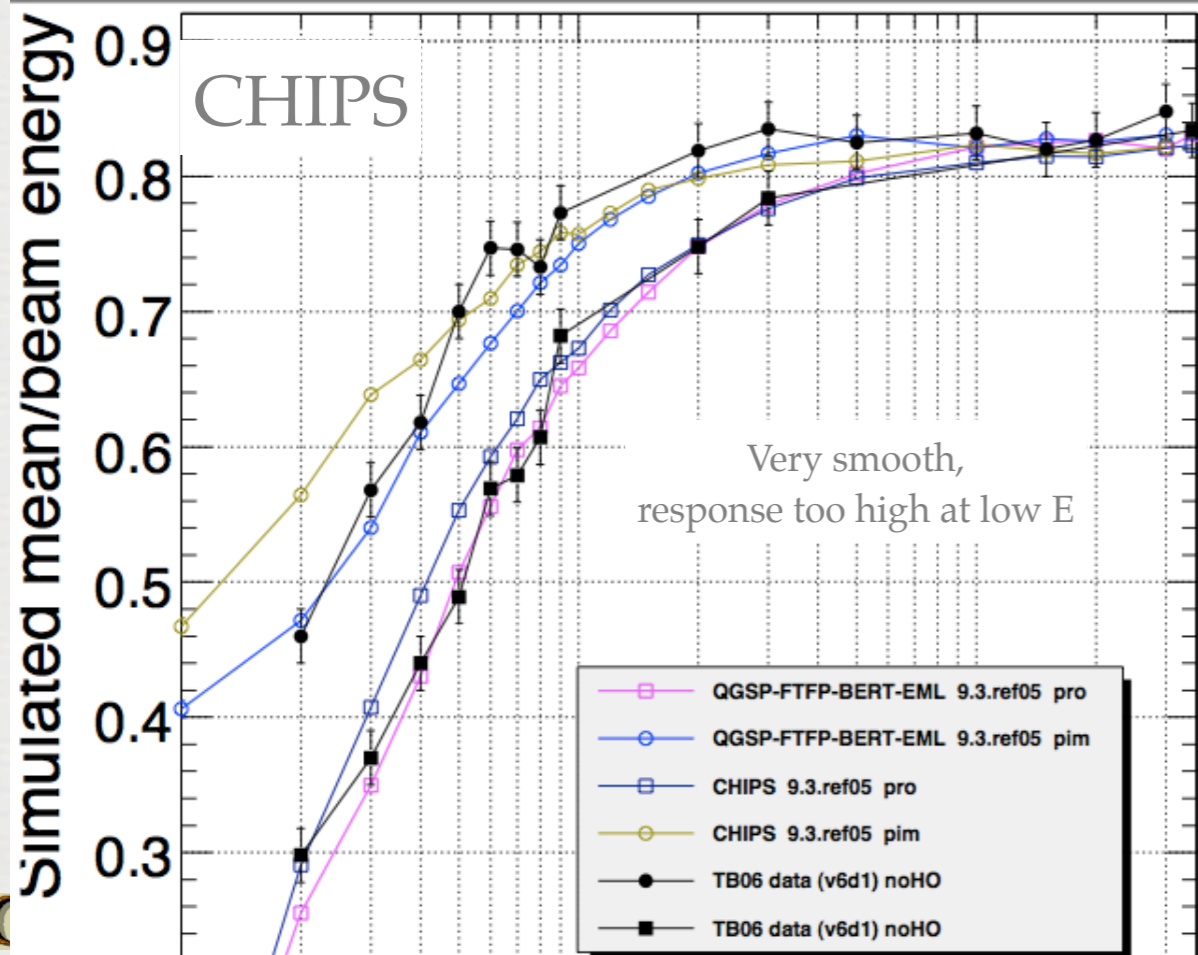
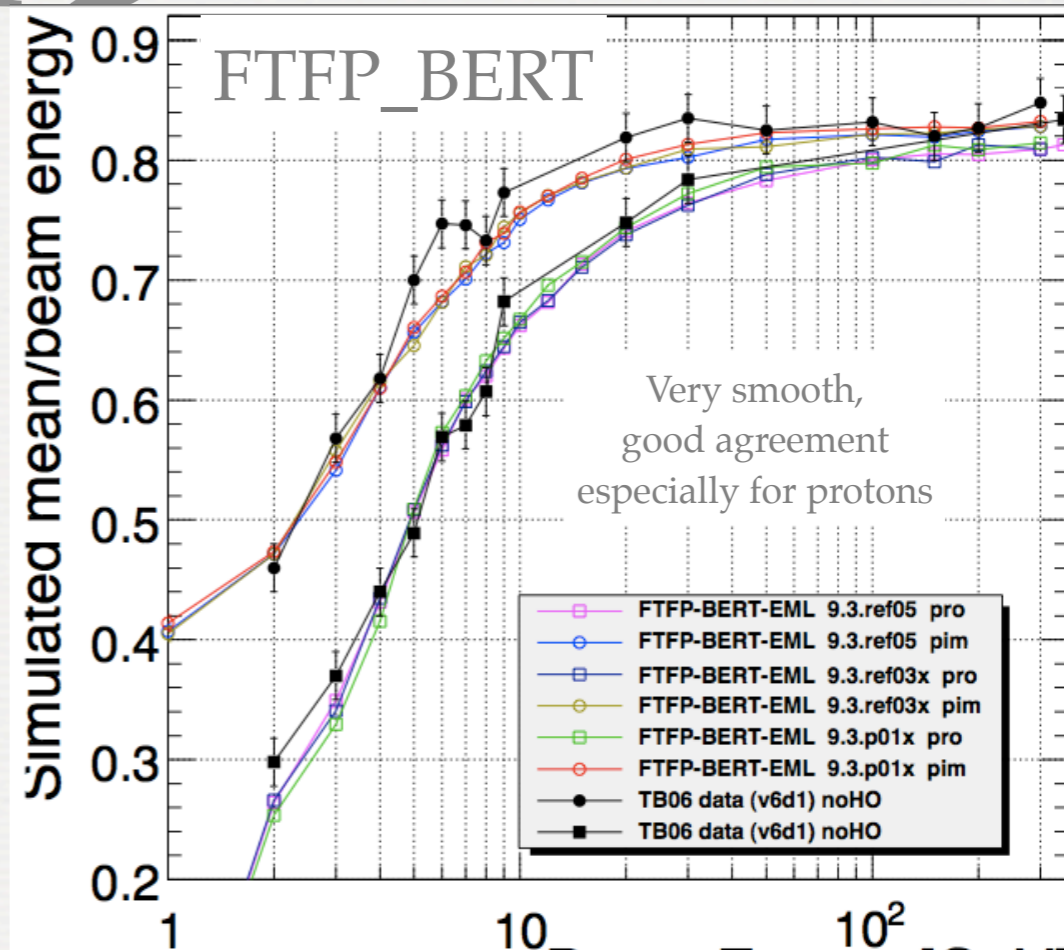
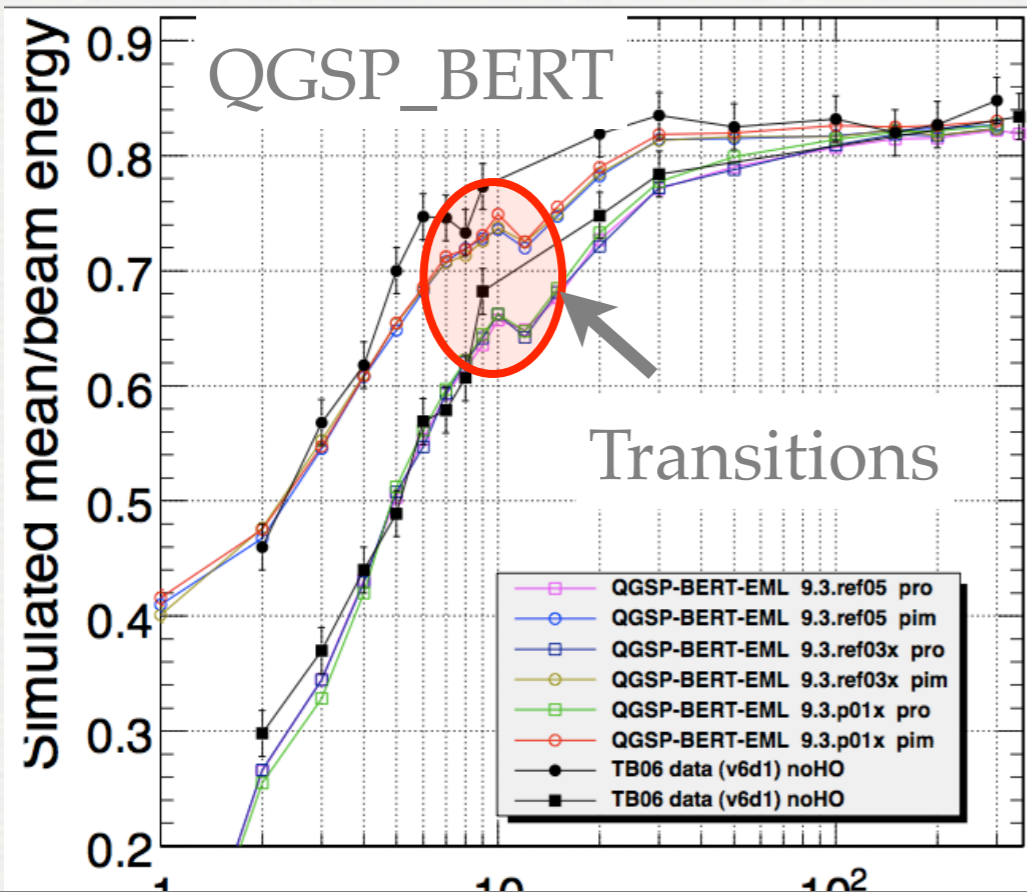
# Standard Deviation



- Resolution ( $\sigma(E_{vis}) / \langle E_{vis} \rangle$ ) is not a good observable:  $\langle E_{vis} \rangle$  has steps, prefer to show  $\sigma(E_{vis}) / E_{beam}$
- CHIPS smaller width
- QGSP\_BERT: step at 10 GeV

FTFP\_BERT and CHIPS: smooth.

# CMS TB



# Conclusions

- 📌 FTFP\_BERT physics lists is at the moment the most promising:
  - As good as QGSP\_BERT in describing LHC data
  - Does not show transition “effects” for response and resolution (see later for shower shapes)
  - QGSP\_FTFP\_BERT is a more conservative approach (experiments validated extensively QGS at HE) and is as good as FTFP\_BERT
- 📌 In the next talks we will talk about:
  - Recent improvements on FTF and BERT: in particular on the extension of the validity of these models
  - Shower shapes