AHCAL Paper: Pion Response at Medium and Low Energies

Nils Feege

University of Hamburg

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FNAL / CERN Differences

	CERN 2007	FNAL 2008/09
Energy range	8 - 100 GeV	2 - 30 GeV
Setup	ECAL installed	No ECAL
Event selection	+ only track in ECAL	-
Cell equalization	CERN μ runs	FNAL μ runs
Particle gun	Upstream Cerenkov	Upstream AHCAL
e⁻ contamination	Negligible	Subtracted

➡ Everything else common (processors, scripts, …)!

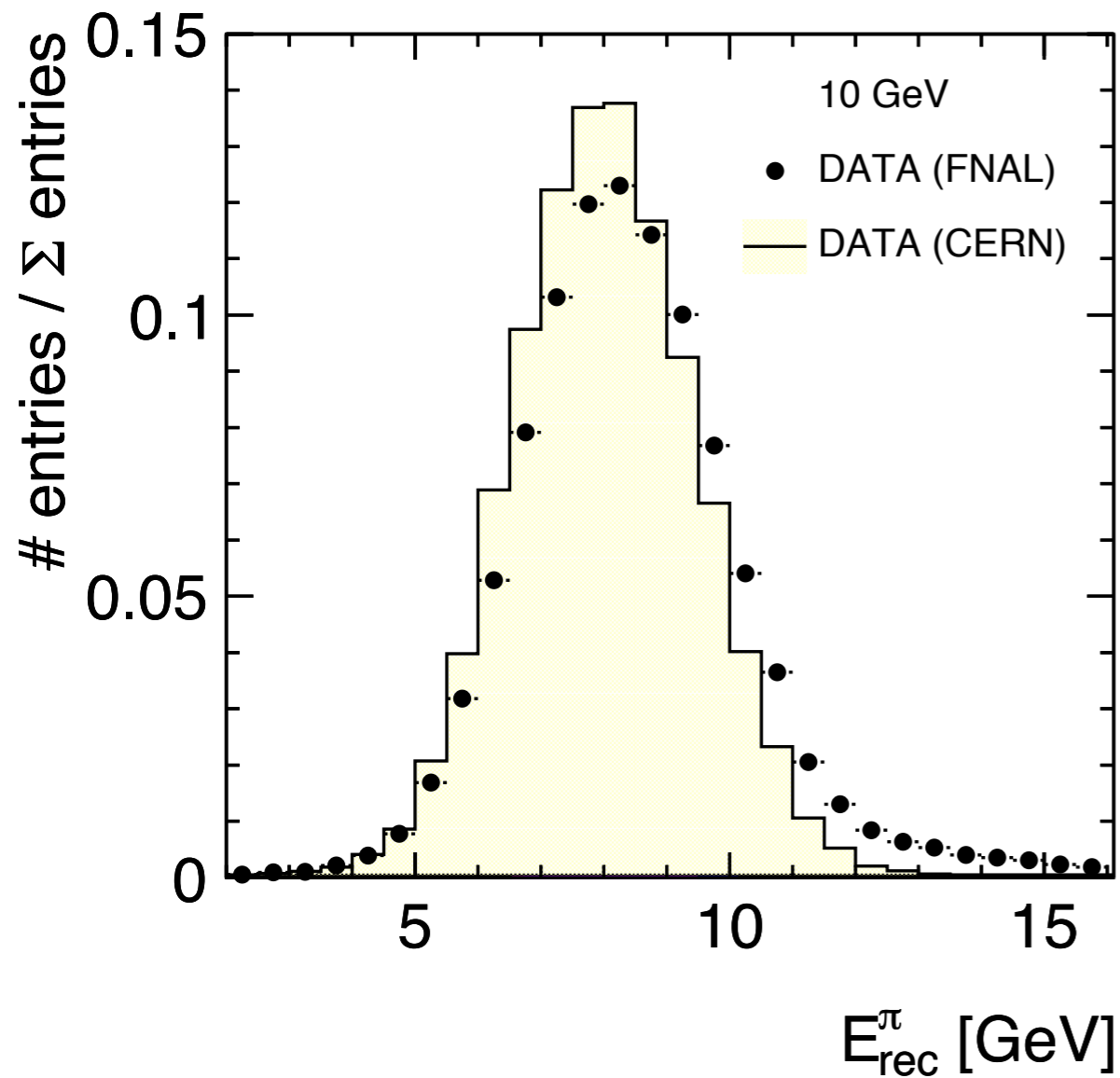# Electron contamination of FNAL π data

E_38

E_5

e

π

...

2 GeV

entries / Σ entries

- e MC
- π MC
- data
- e + π MC

E_5 / E_{38}
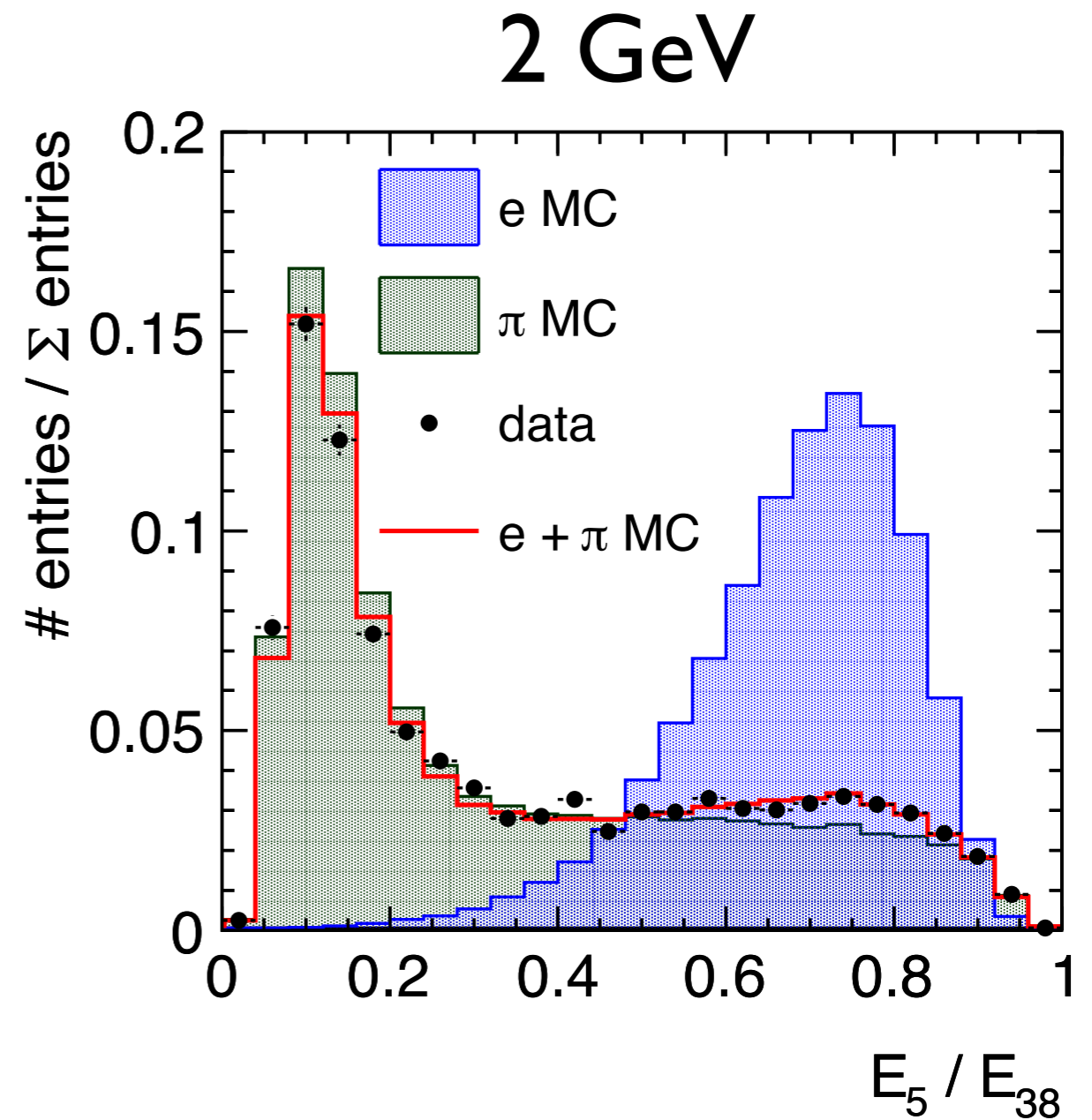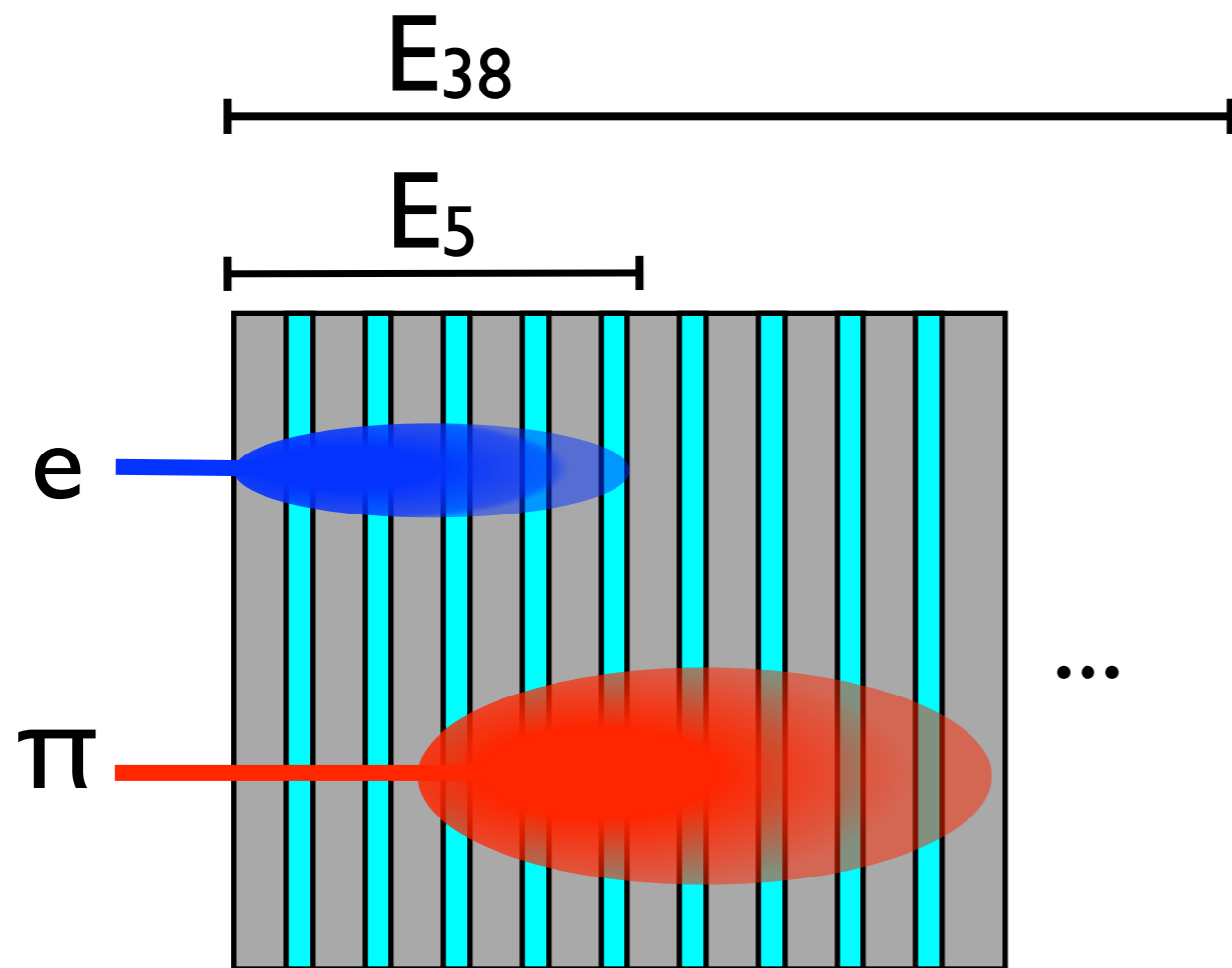
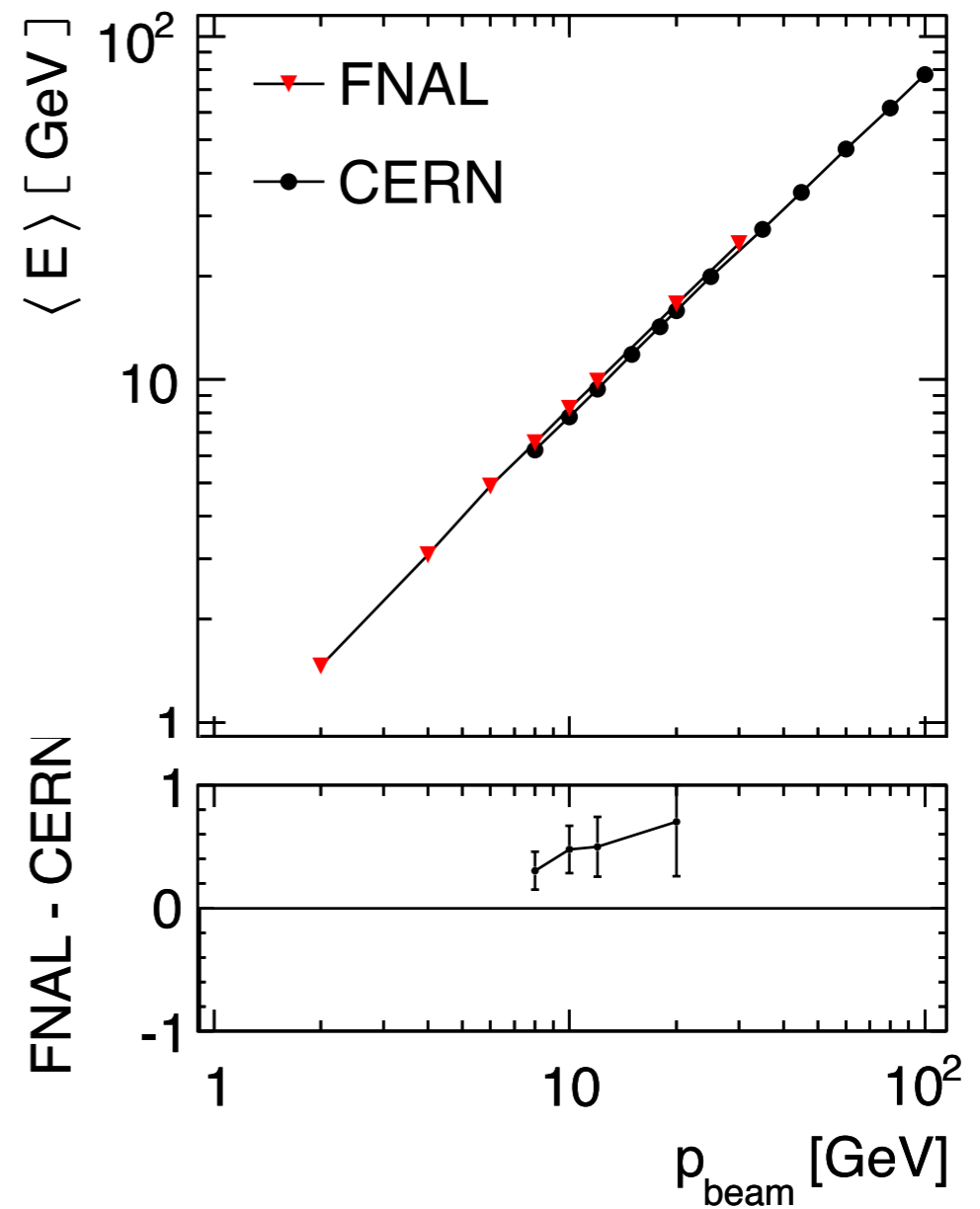| p_{beam} [GeV]	2	4	6
f_e [%]	8 ± 3	5 ± 3	2 ± 2

→ statistical subtraction

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Mean π response: CERN / FNAL Xcheck

DATA - 10 GeV

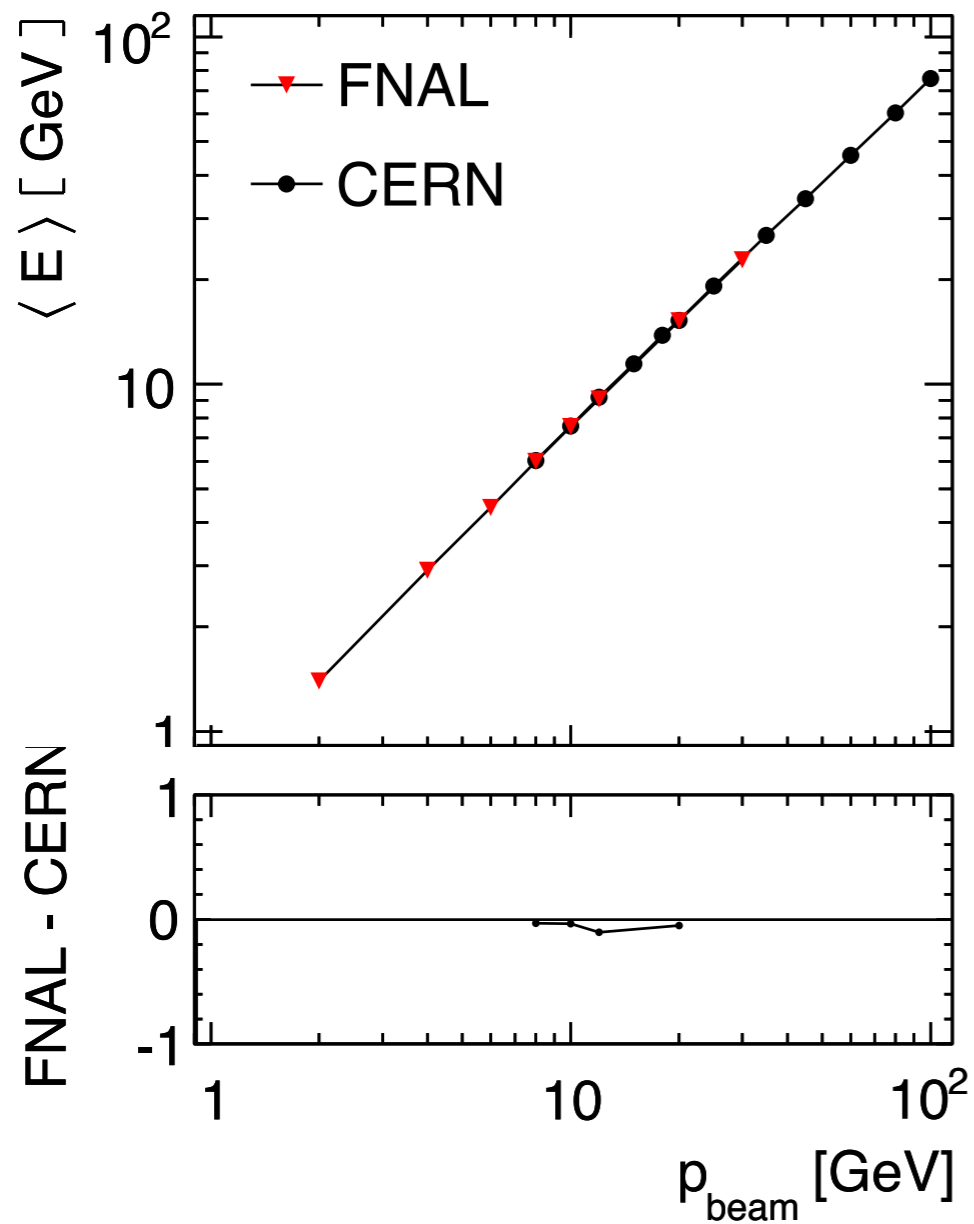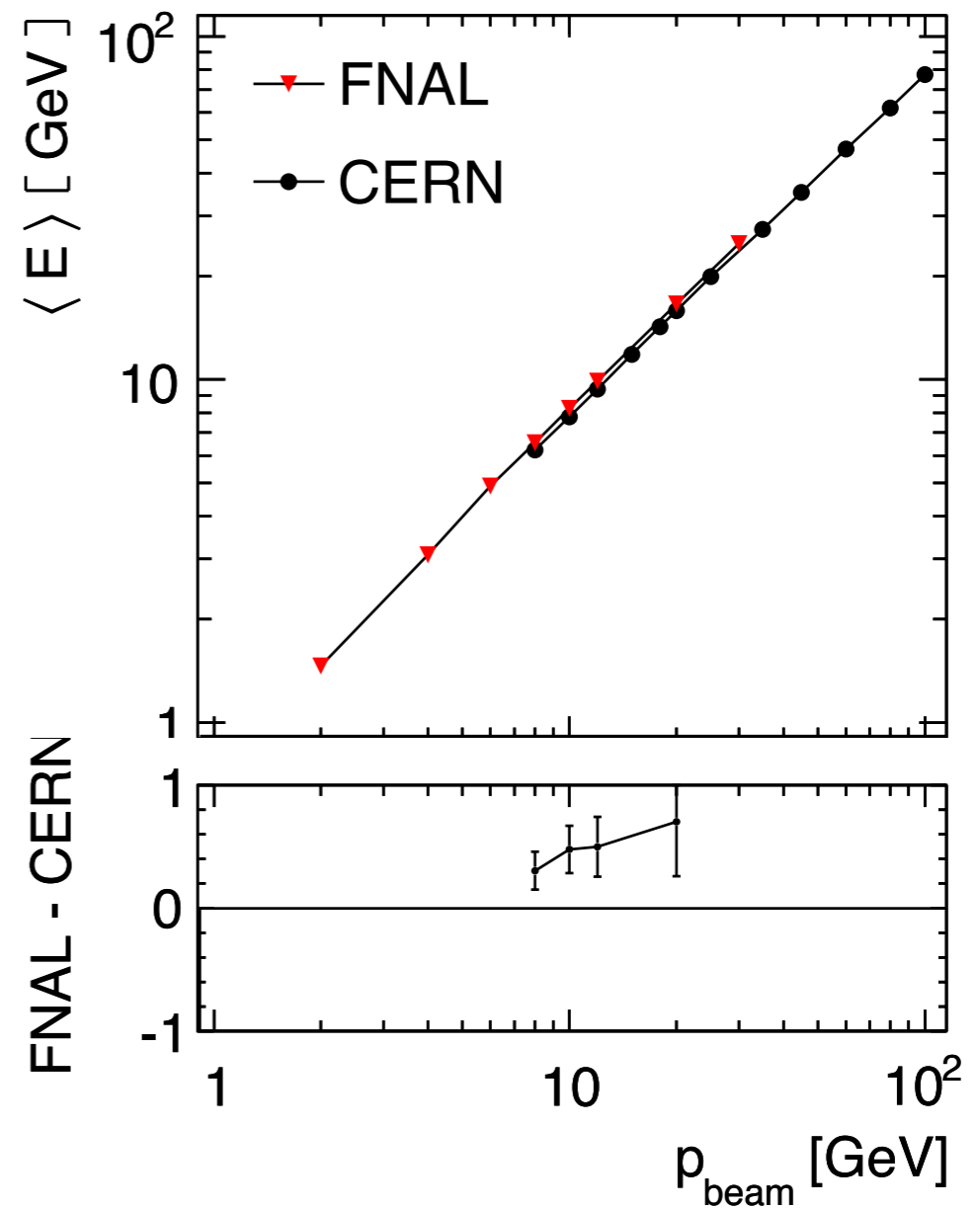## DATA

FNAL-CERN: 300-800 MeV shift (5% different scale)
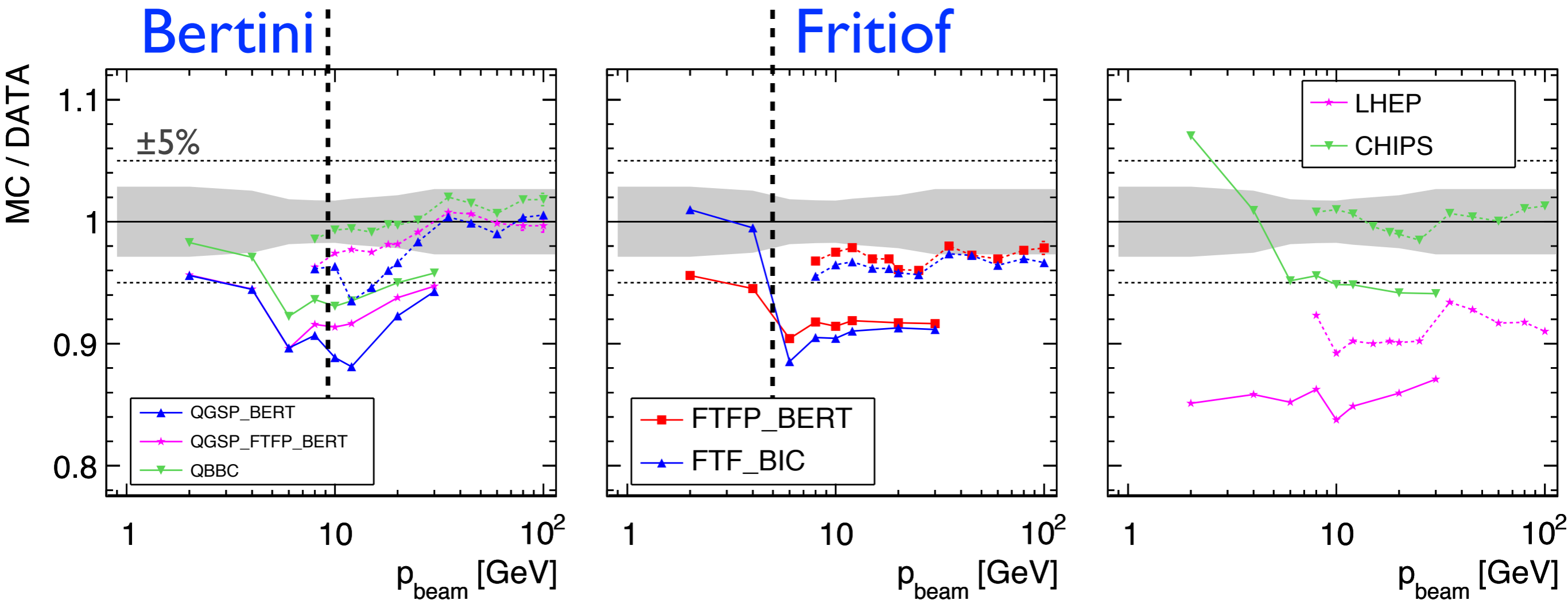
Mean π response: CERN / FNAL Xcheck
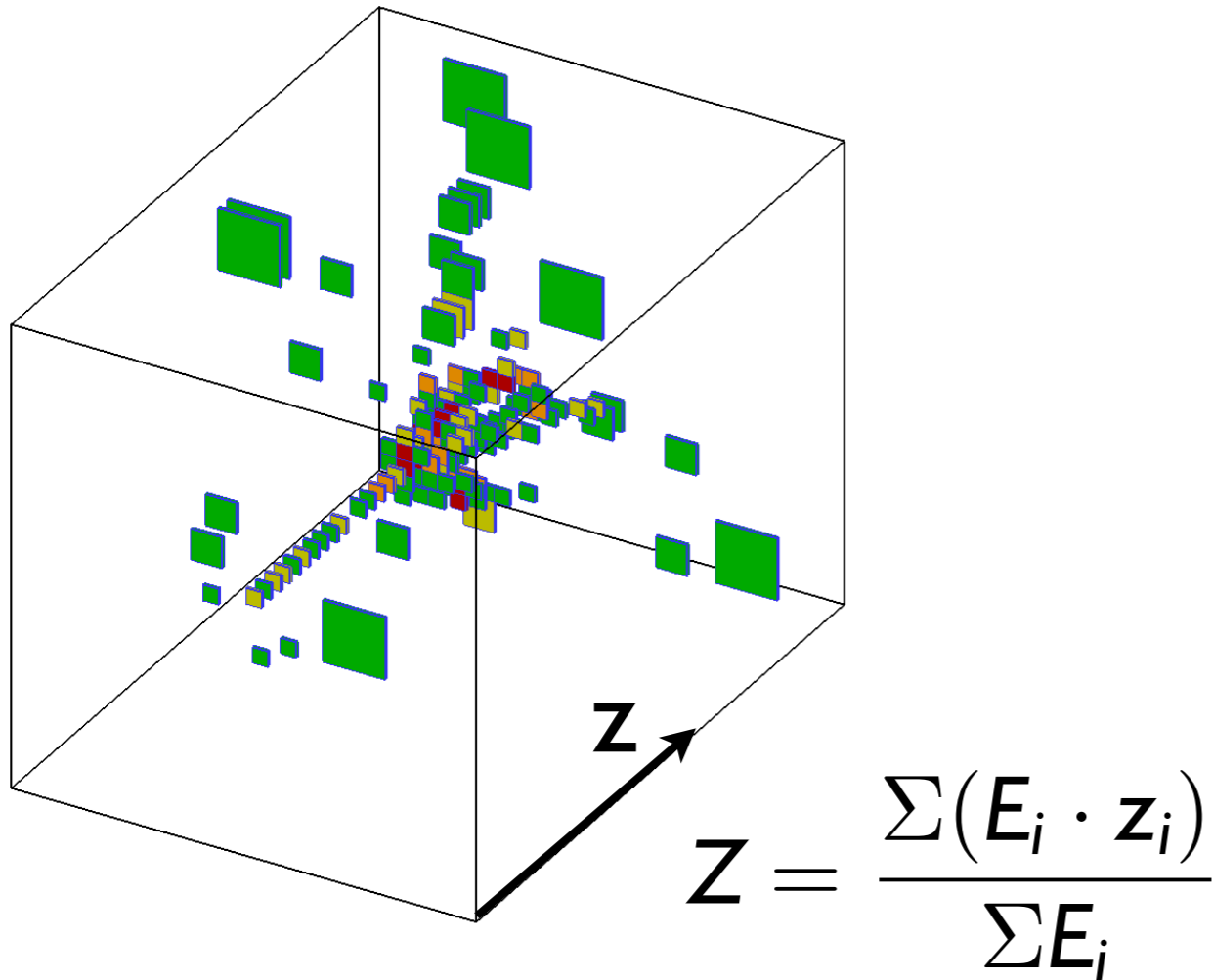

Shift (FNAL-CERN) only in data, MC consistent

Mean π response: Combined results

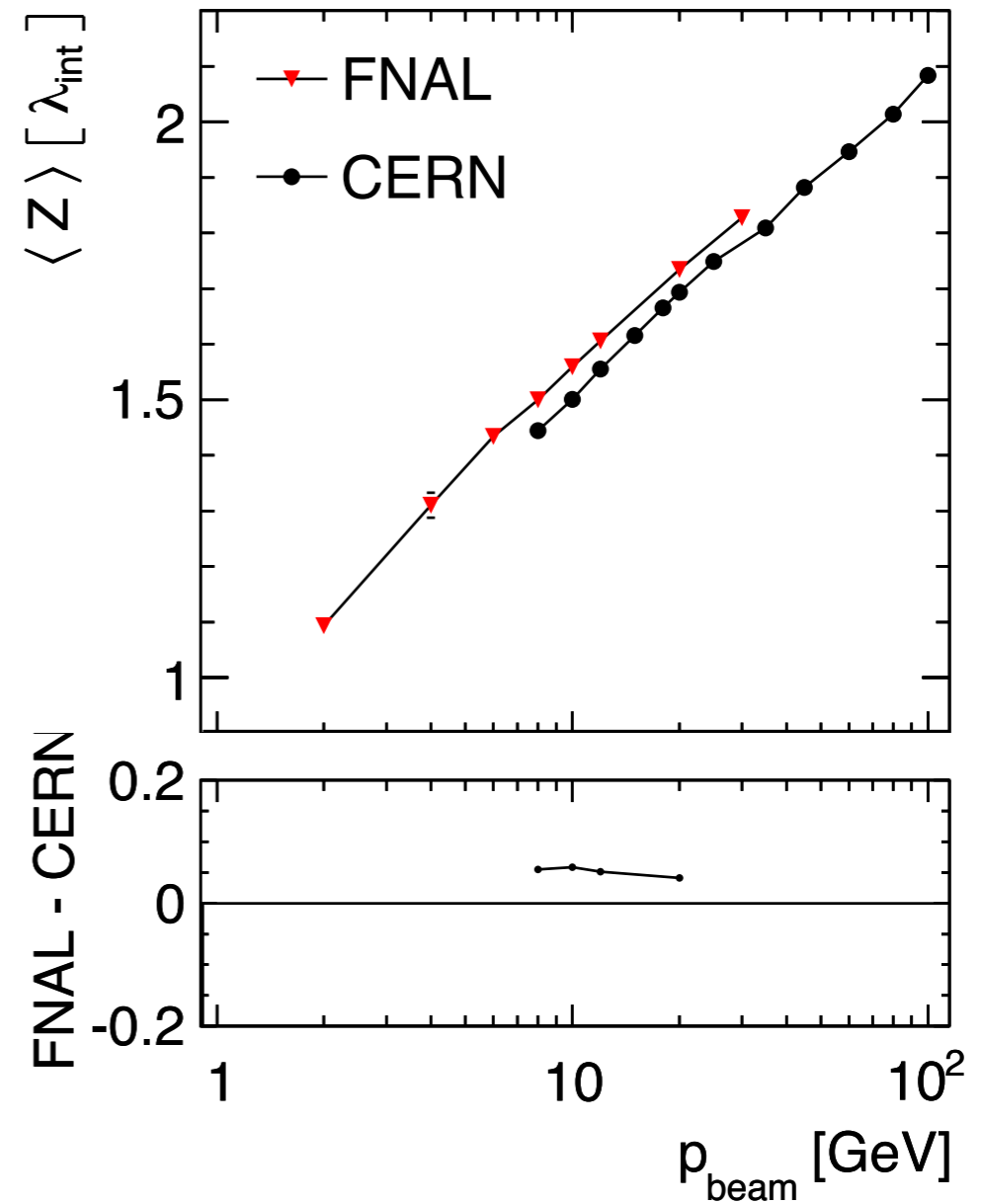e^- ➔ 120 MeV (9% @ 2 GeV) difference MC - DATA
Messages change at low energies (different models)

DATA

$$Z = \frac{\Sigma(E_i \cdot z_i)}{\Sigma E_i}$$

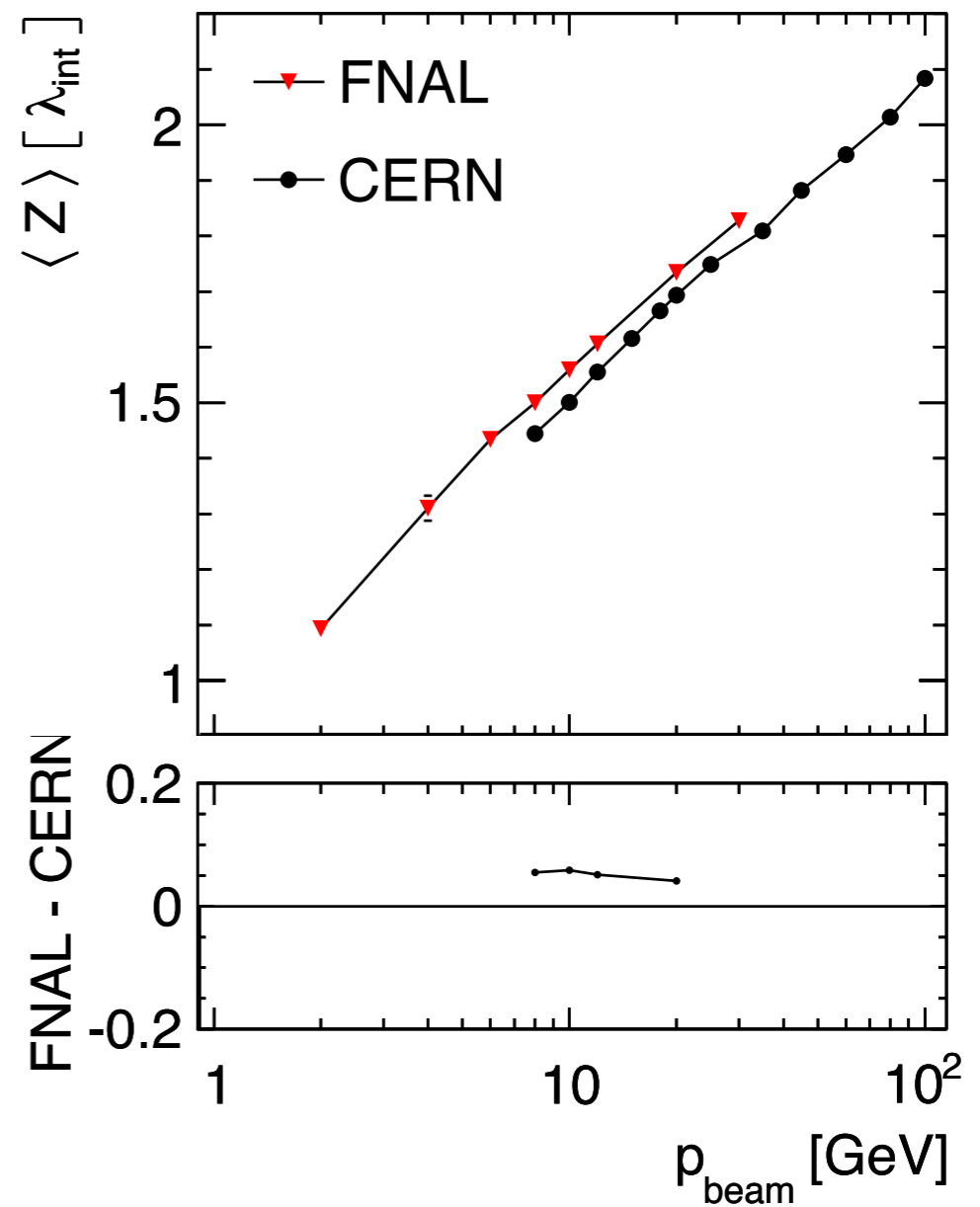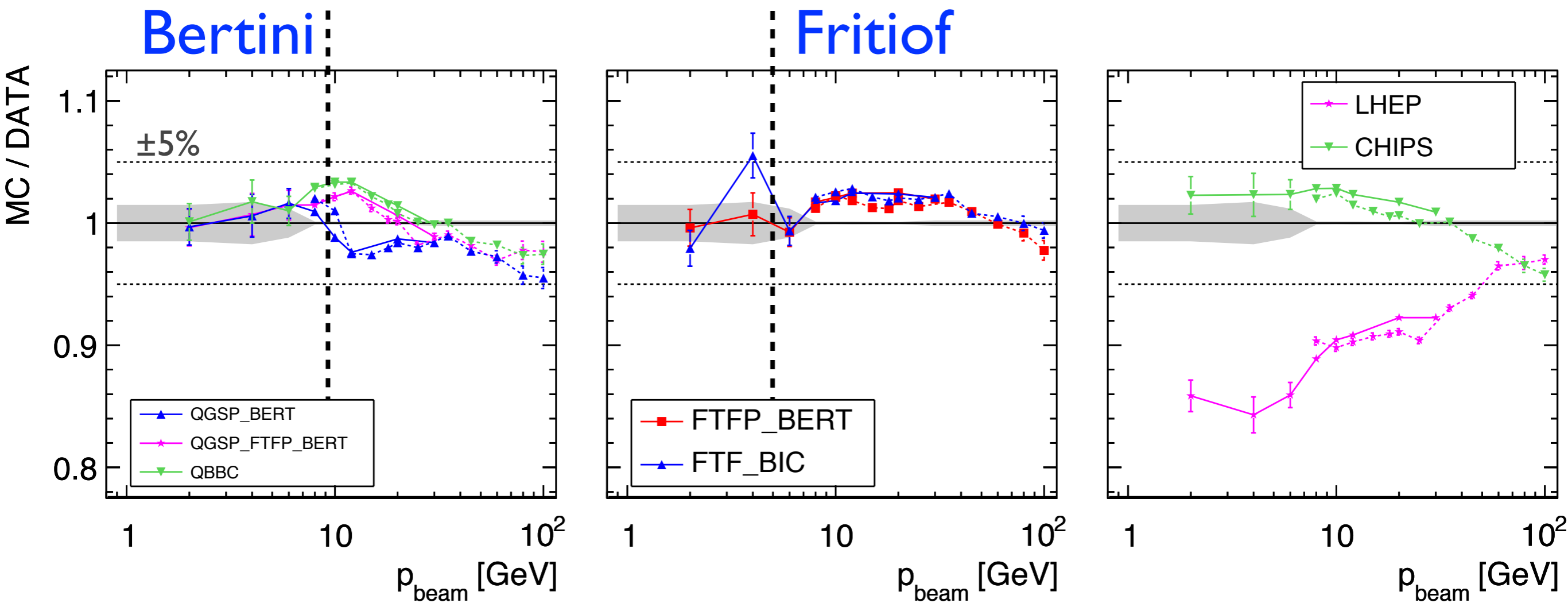$$0.1\ \lambda_{int} = 1\ \text{layer}$$

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Mean depth: CERN / FNAL Xcheck
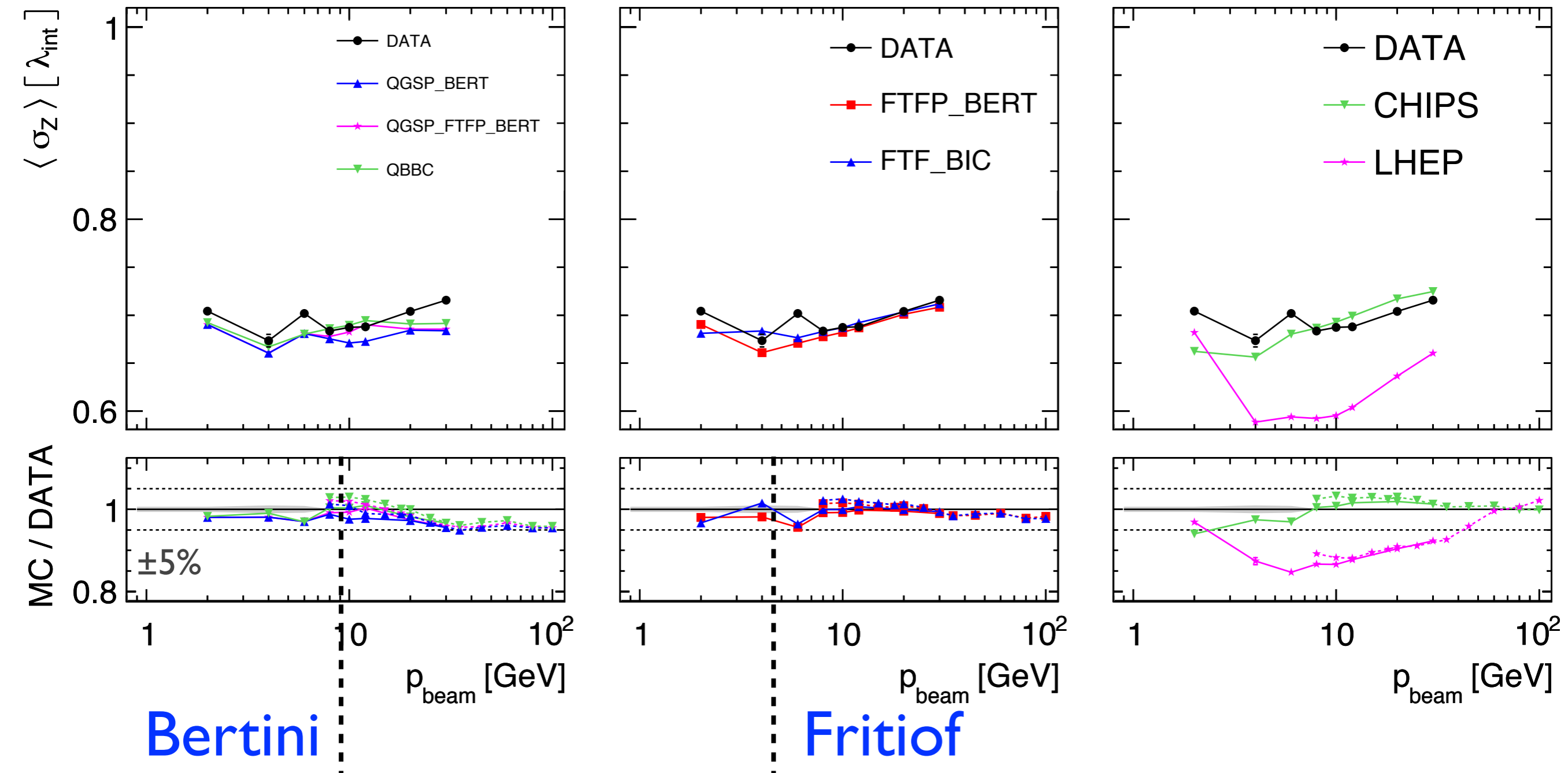

shift FNAL - CERN reproduced by MC

Mean shower depth <Z>: Combined results

Mean shower length: Combined results
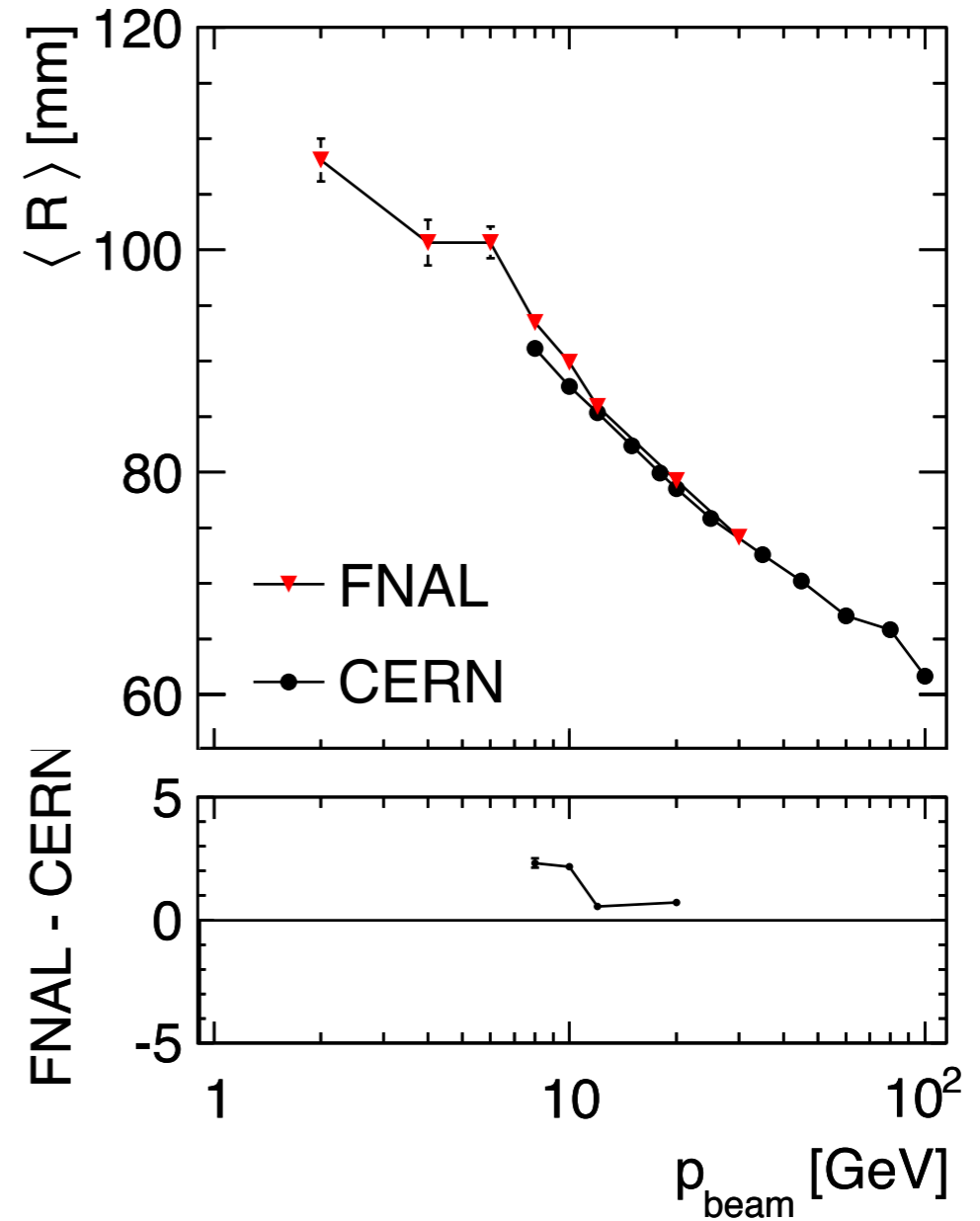

Bertini

Fritiof

Mean radius: CERN / FNAL Xcheck
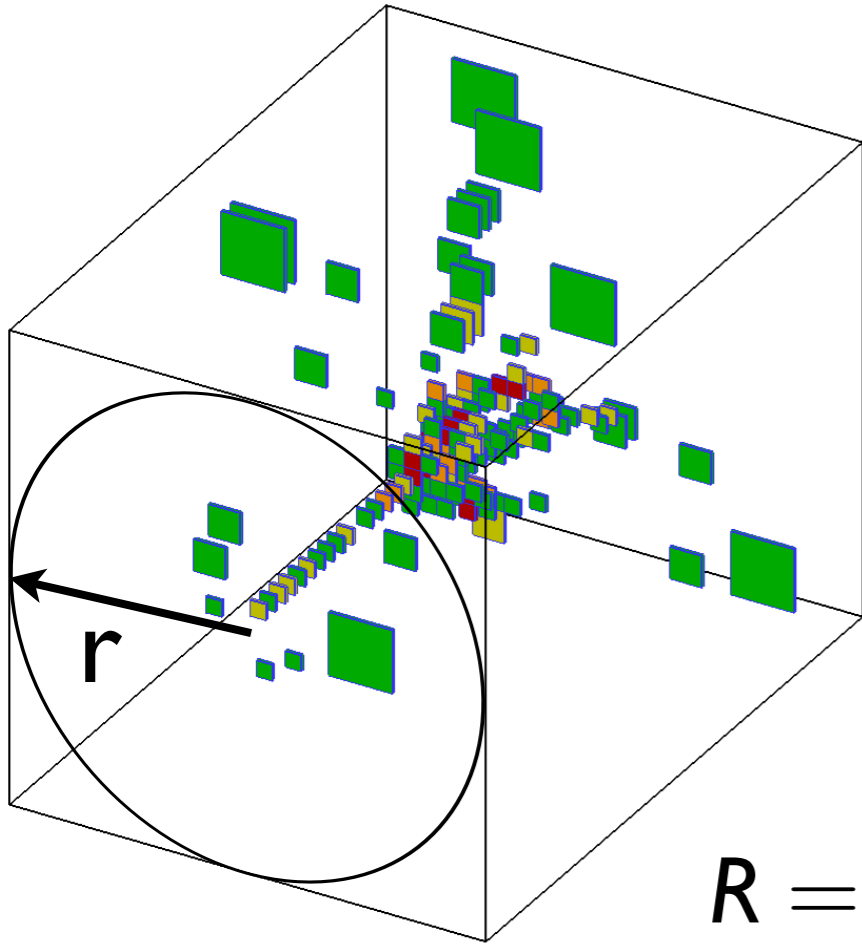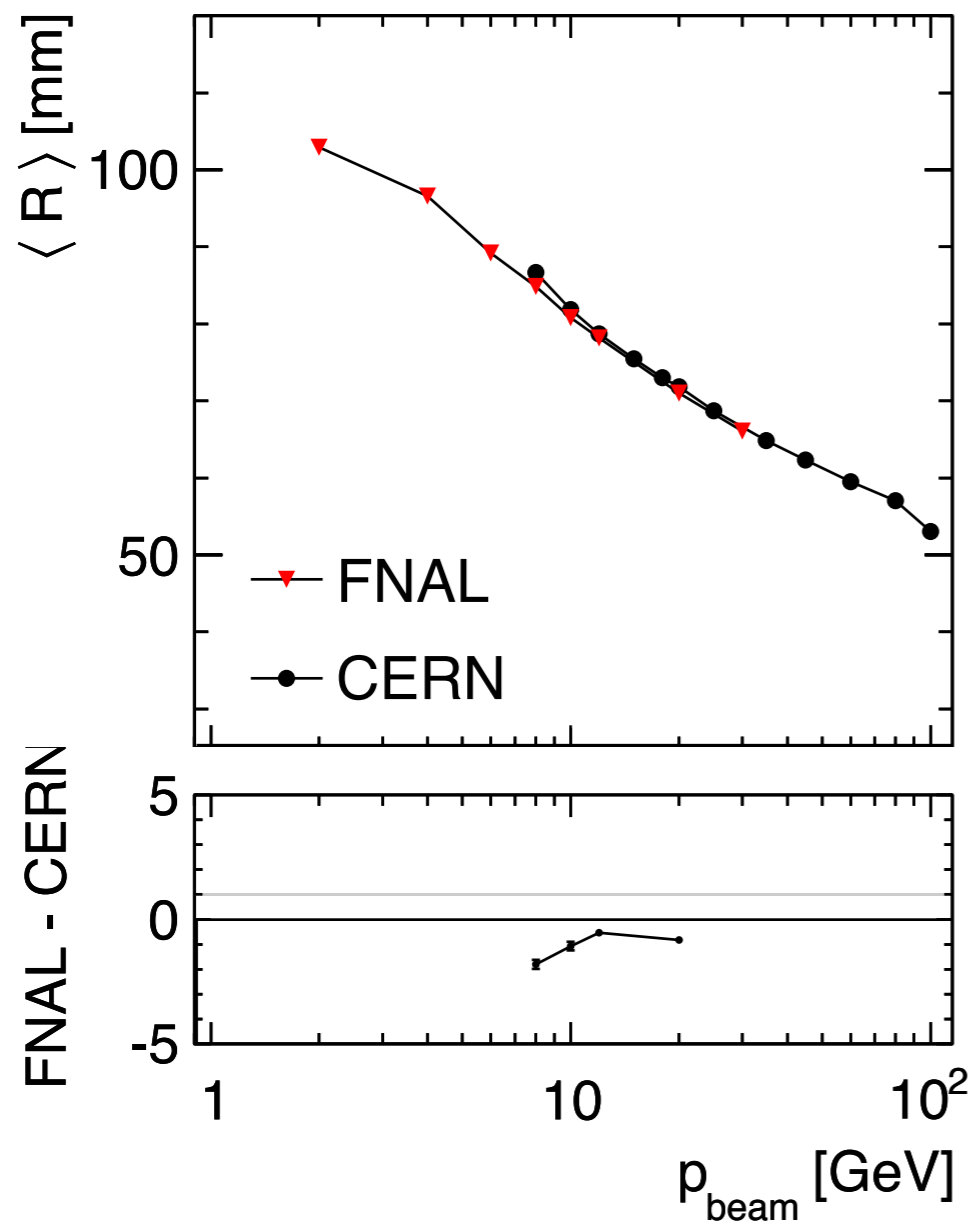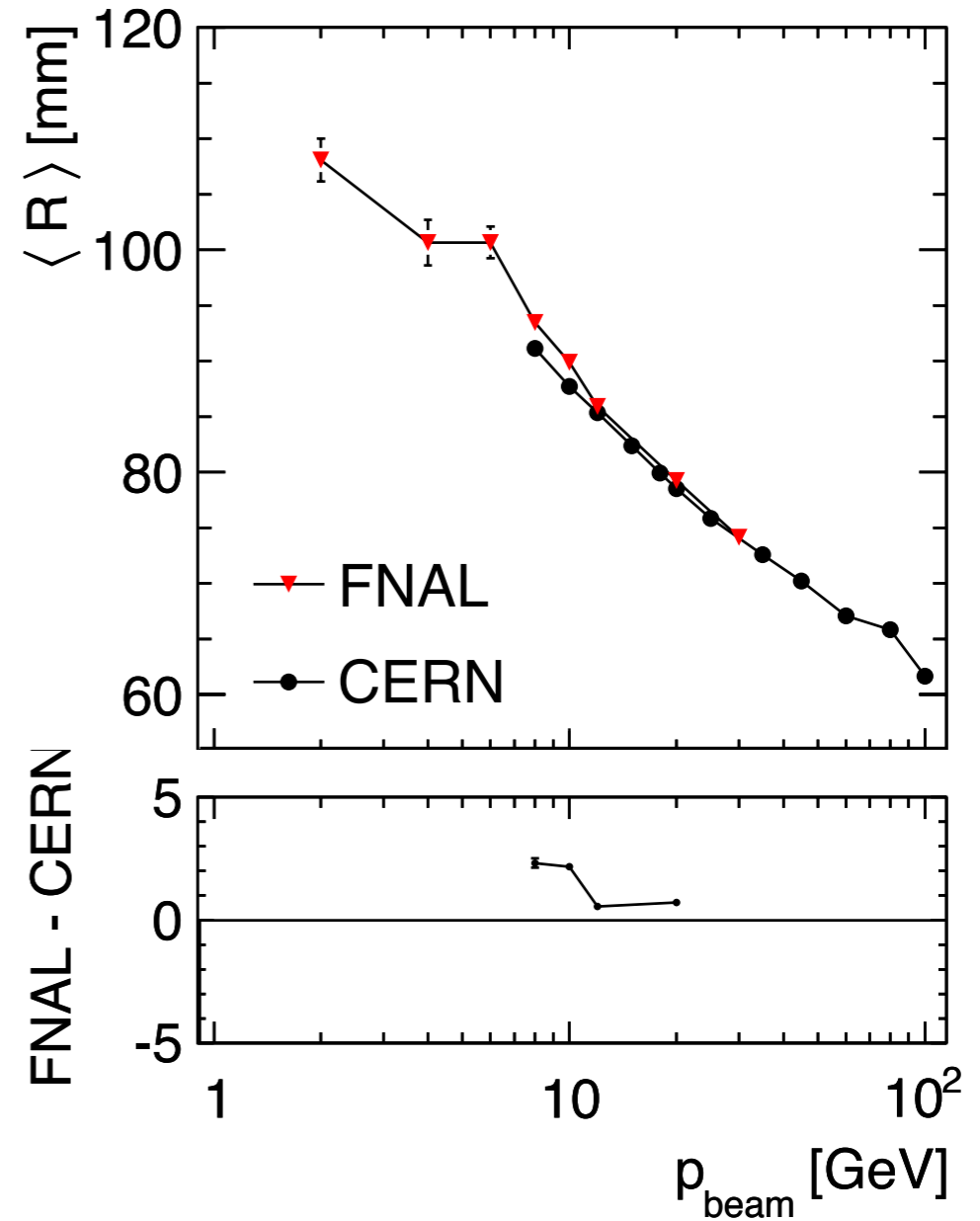

DATA

$$R = \frac{\Sigma(E_i \cdot r_i)}{\Sigma E_i}$$

cell size = 30 mm
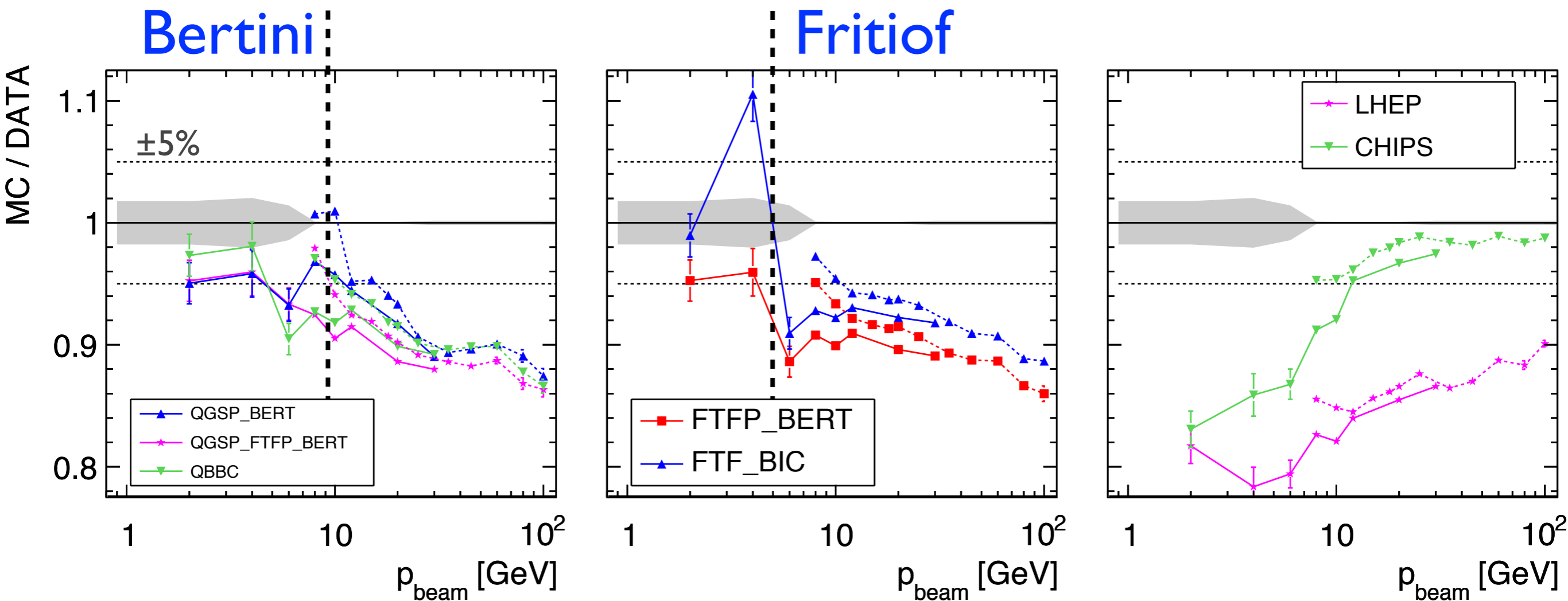
Mean radius: CERN / FNAL Xcheck

FTFP_BERT

DATA

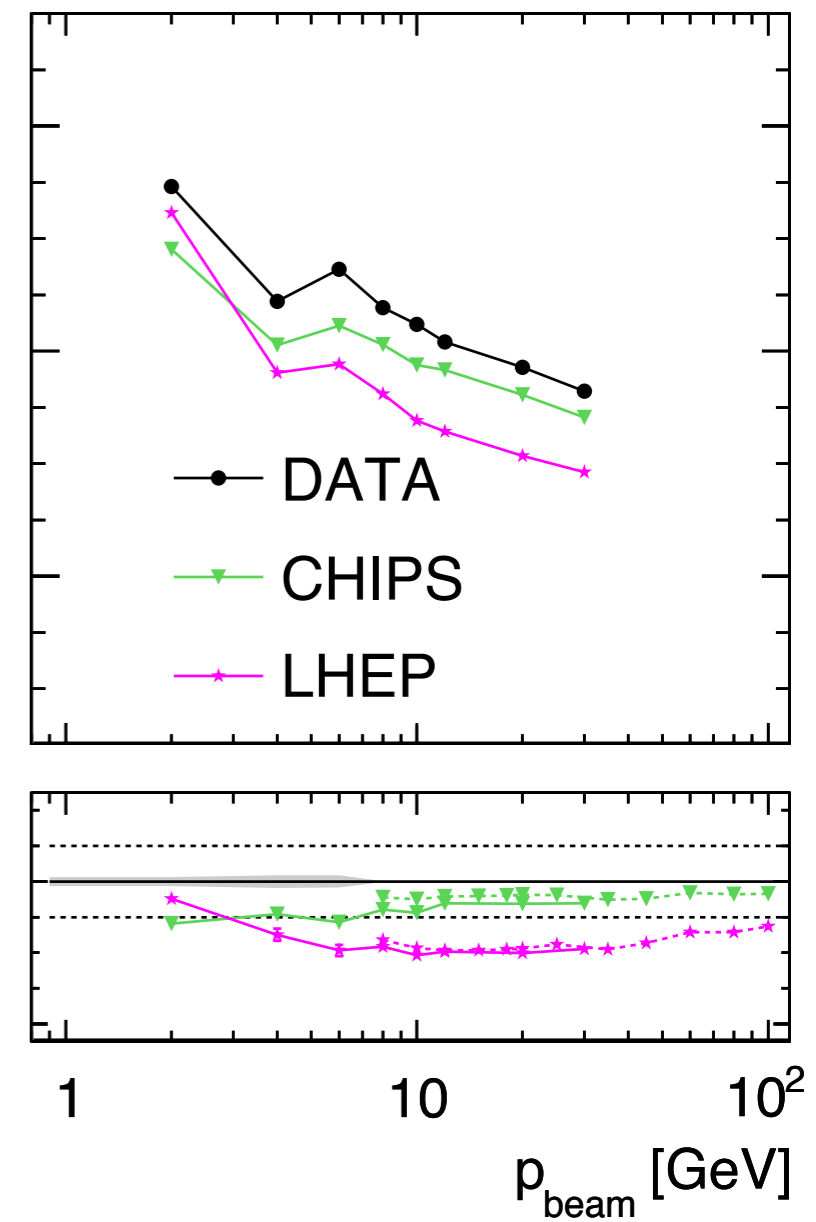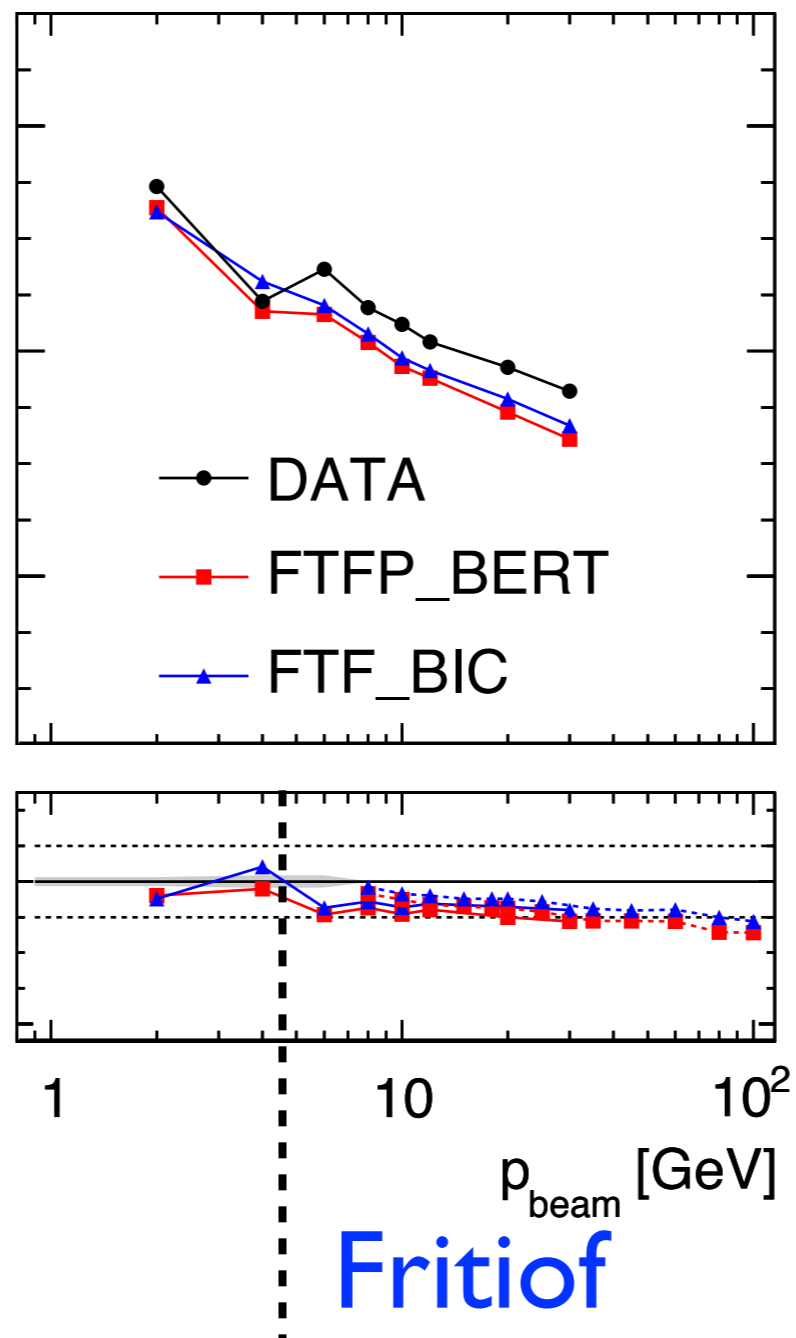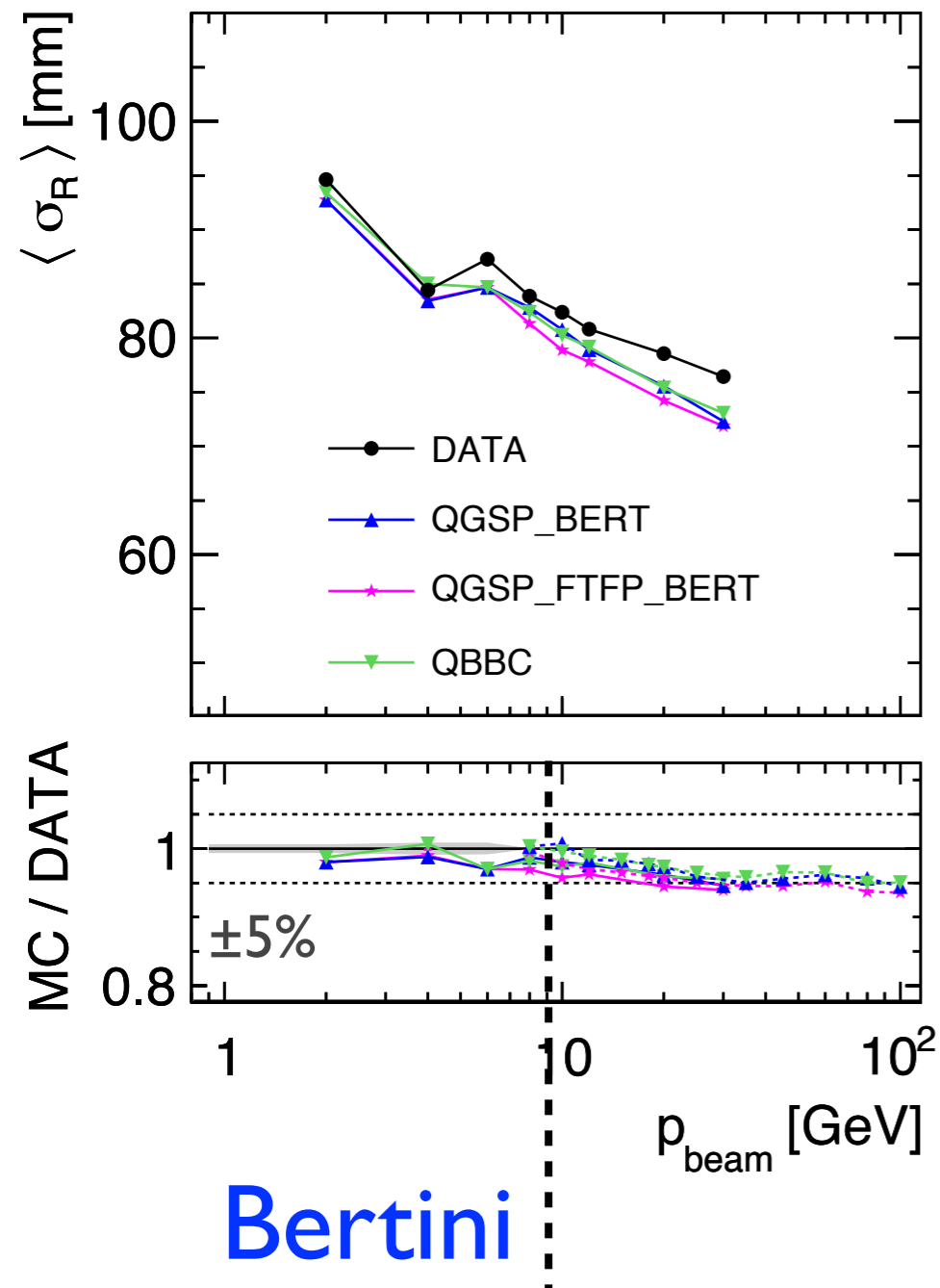
Excellent agreement CERN - FNAL (data and MC)

Mean shower radius <R>: Combined results

$e^- \rightarrow$ Only deviations > 9% significant

Mean radial extension: Combined results

Next steps

- Understand 5% shift / scale difference in π response in CERN and FNAL data

- Add longitudinal and radial shower profiles with decomposition of energy contributions from EM component and different hadrons

- Check standard deviation for Z, σ_Z, R, and σ_R in data and MC to compare event-to-event fluctuations

Summary

- CERN and FNAL analysis repeated using the same code and parameters to a large extent

- Data/MC agreement (Z, R) for CERN and FNAL data consistent at overlap energies
  ➨ Successful extension of the energy range

- Impressive performance of several Geant4 physics lists over the entire range from 2 to 100 GeV
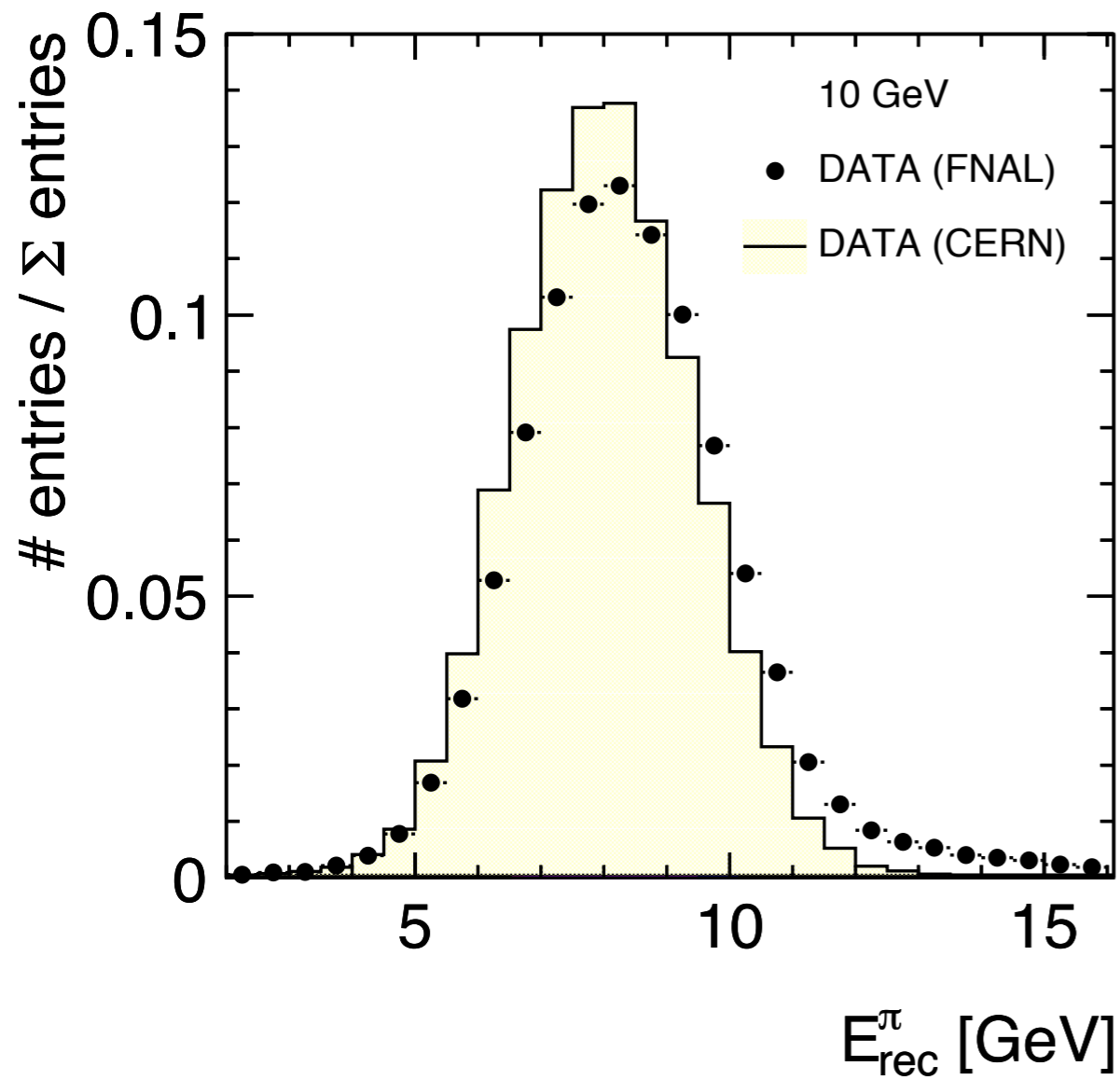
First paper draft soon ready for review

ADDITIONAL SLIDES

Temperature Correction

DATA - 10 GeV

DATA - 10 GeV