Additional comparisons with simulations using **QGSP_BERT** and **FTFP_BERT** physics lists from Geant4 version 9.6p01

The CALICE Collaboration [1]

Abstract

The addendum contains an additional comparison of the global observables described in the CAN-040 with simulations using QGSP_BERT and FTFP_BERT physics lists from GEANT4 version 9.6p01. There is a noteworthy improvement in the FTFP_BERT description of transverse shower profiles. The changes in predictions of the energy resolution are quite small for both physics lists.

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1 Introduction

The data points and simulations with GEANT4 version 9.4p03 shown in the plots below are the same as presented in CAN-040, the corresponding figures from CAN-040 are indicated in the captions.

The simulations with GEANT4 version 9.6p01 were done in the official Mokka environment (Mokka version 08_01) and were followed by official CALICE digitization chain from `calice_soft` version v04-05, which was used to digitize the samples generated with GEANT4 version 9.4p03 for CAN-040.

All procedures of event selection and extraction of observables are described in CAN-040.
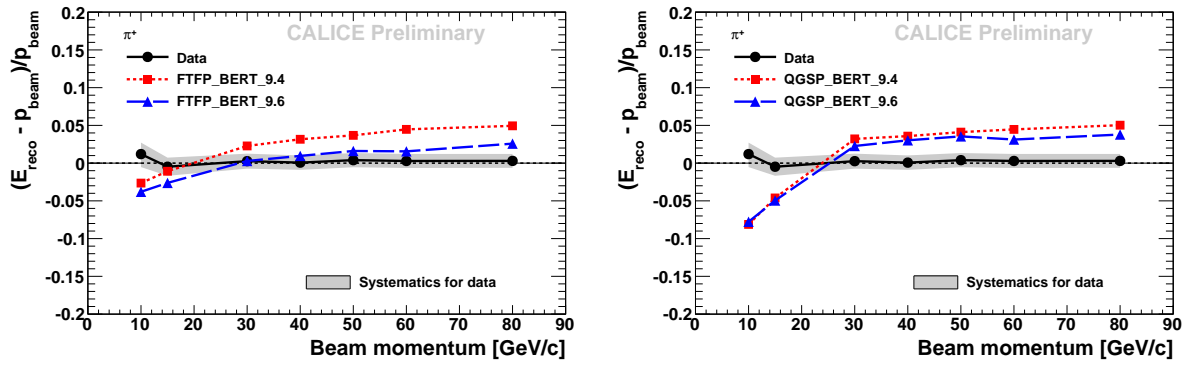
2 Comparisons for pions

Figure 1: Relative residuals of pion reconstructed energy E_{reco} to beam momentum for data (black circles) and simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue triangles) for FTFP_BERT physics list (left, see Fig. 22a from CAN-040) and QGSP_BERT physics list (right, see Fig. 3a from CAN-040). Systematic uncertainties for data are shown with grey band.
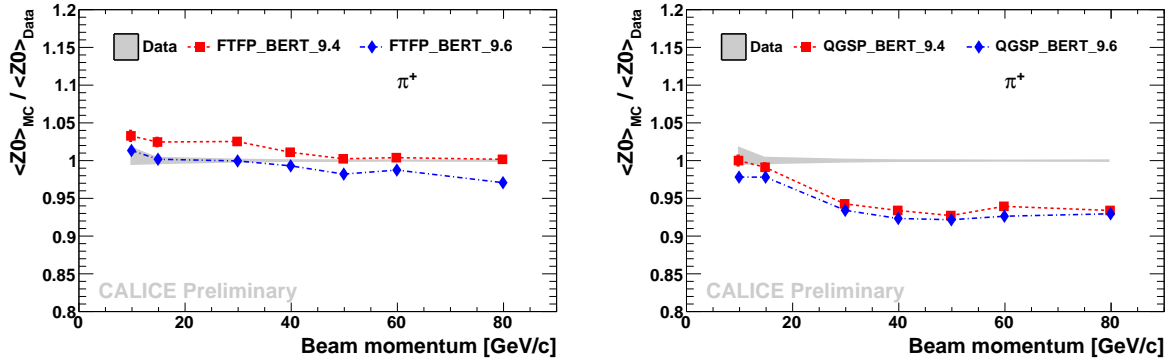
Figure 2: Ratio of mean longitudinal centre of gravity of pion shower extracted from simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue diamonds) for FTFP_BERT physics list (left) and QGSP_BERT physics list (right) to that extracted from data for different beam momenta. Systematic uncertainties for data are shown with grey band. See Fig. 10a from CAN-040.
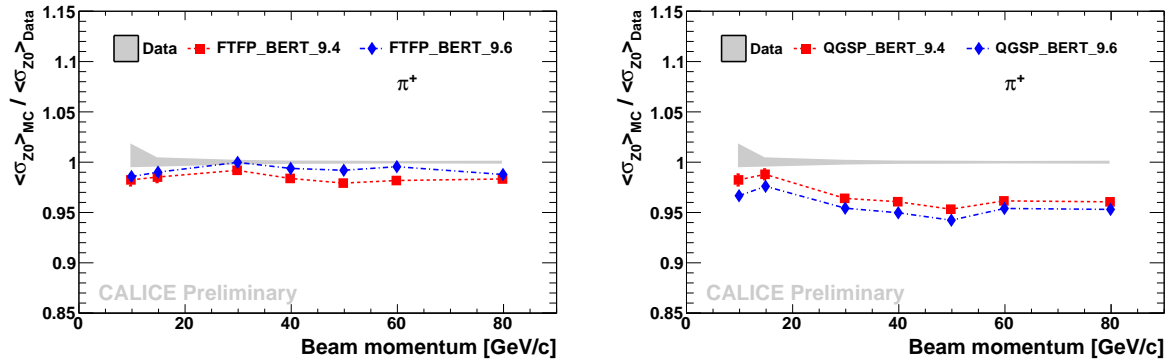

Figure 3: Ratio of mean standard deviation of longitudinal centre of gravity of pion shower extracted from simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue diamonds) for FTFP_BERT physics list (left) and QGSP_BERT physics list (right) to that extracted from data for different beam momenta. Systematic uncertainties for data are shown with grey band. See Fig. 12a from CAN-040.
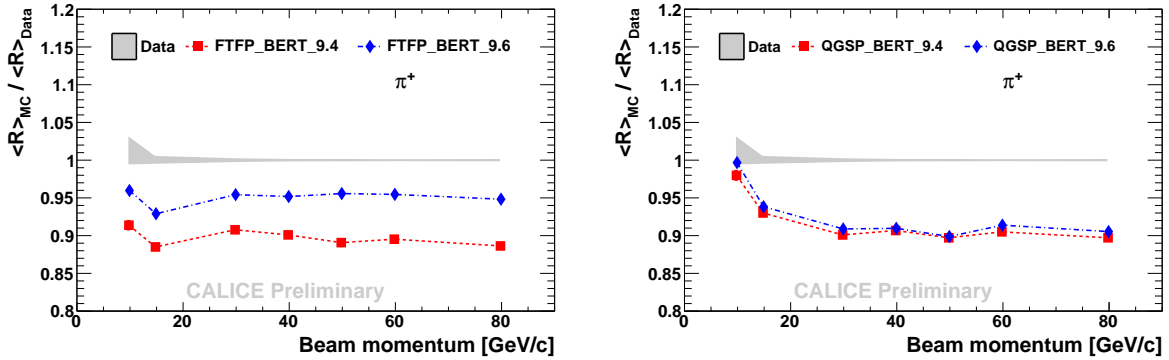
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Figure 4: Ratio of mean radial width of pion shower extracted from simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue diamonds) for FTFP_BERT physics list (left) and QGSP_BERT physics list (right) to that extracted from data for different beam momenta. Systematic uncertainties for data are shown with grey band. See Fig. 16a from CAN-040.
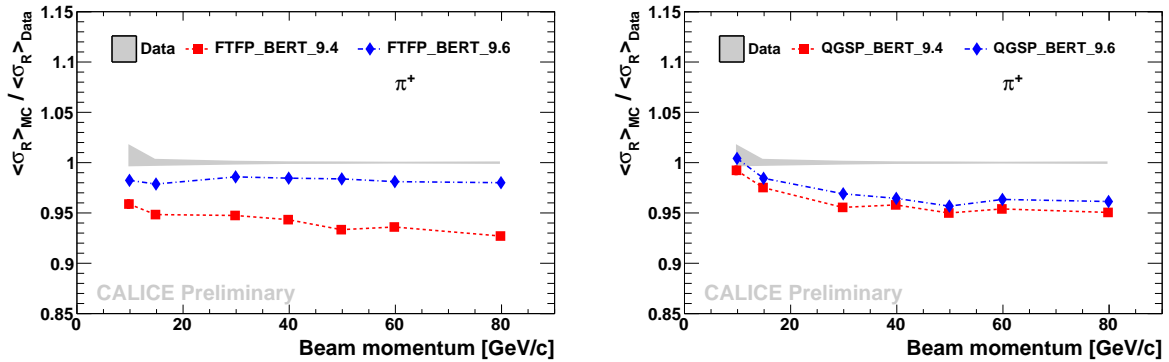

Figure 5: Ratio of mean standard deviation of radial width of pion shower extracted from simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue diamonds) for FTFP_BERT physics list (left) and QGSP_BERT physics list (right) to that extracted from data for different beam momenta. Systematic uncertainties for data are shown with grey band. See Fig. 18a from CAN-040.
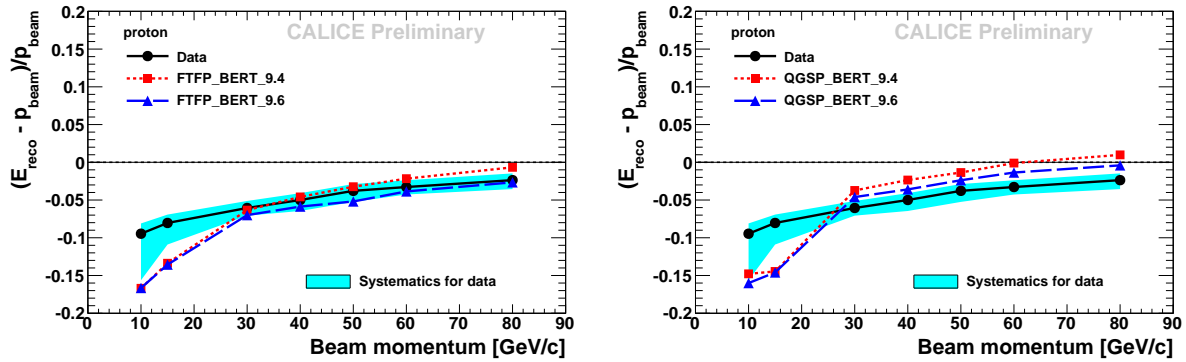
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3 Comparisons for protons

Figure 6: Relative residuals of proton reconstructed energy E_{reco} to beam momentum for data (black circles) and simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue triangles) for FTFP_BERT physics list (left, see Fig. 22a from CAN-040) and QGSP_BERT physics list (right, see Fig. 3a from CAN-040). Systematic uncertainties for data are shown with cyan band.
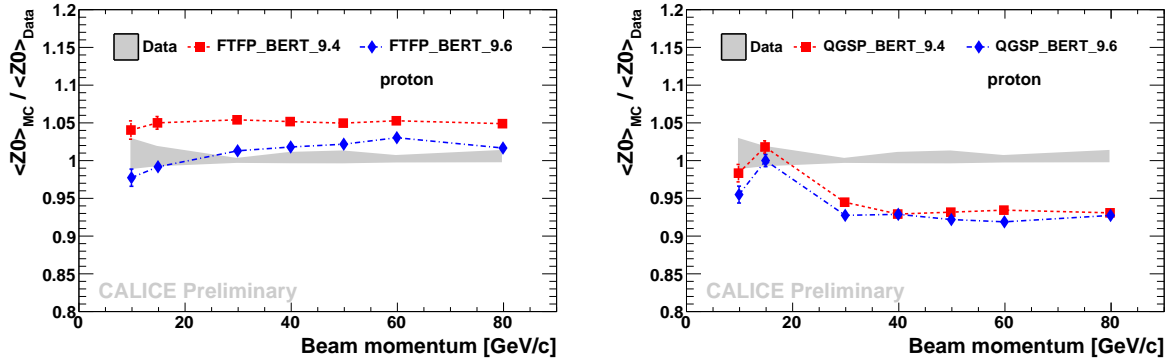
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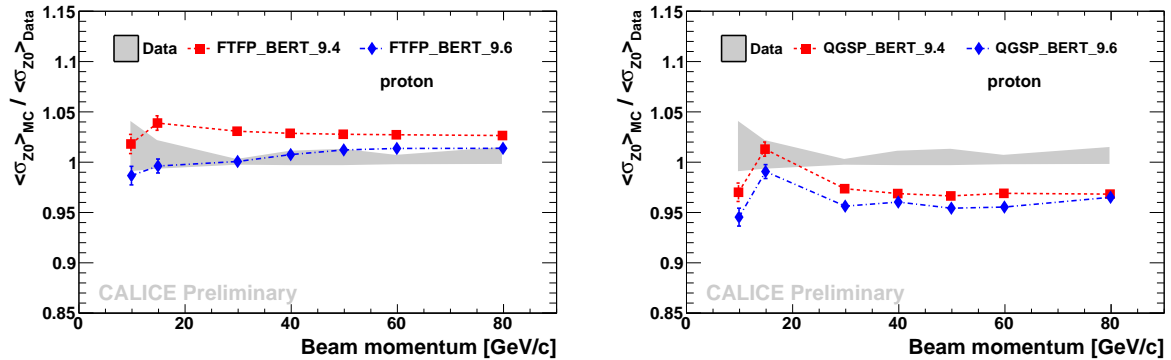

Figure 8: Ratio of mean standard deviation of longitudinal centre of gravity of proton shower extracted from simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue diamonds) for FTFP_BERT physics list (left) and QGSP_BERT physics list (right) to that extracted from data for different beam momenta. Systematic uncertainties for data are shown with grey band. See Fig. 12b from CAN-040.
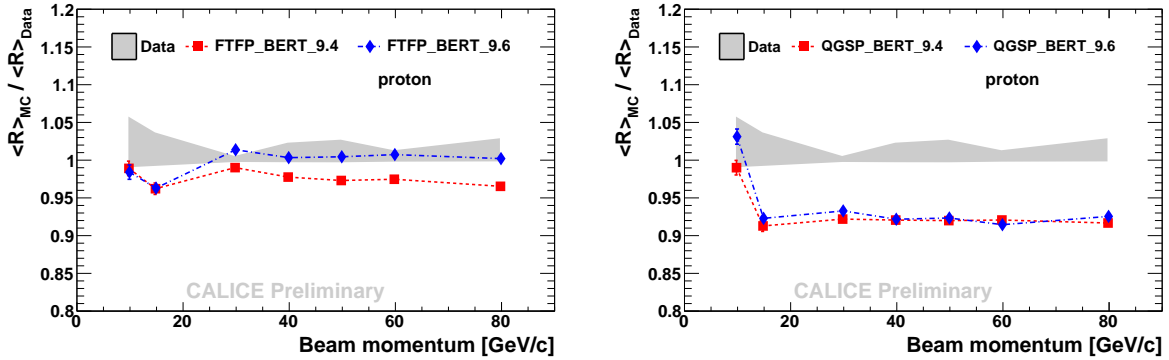
Figure 9: Ratio of mean radial width of proton showerextracted from simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue diamonds) for FTFP_BERT physics list (left) and QGSP_BERT physics list (right) to that extracted from data for different beam momenta. Systematic uncertainties for data are shown with grey band. See Fig. 16b from CAN-040.
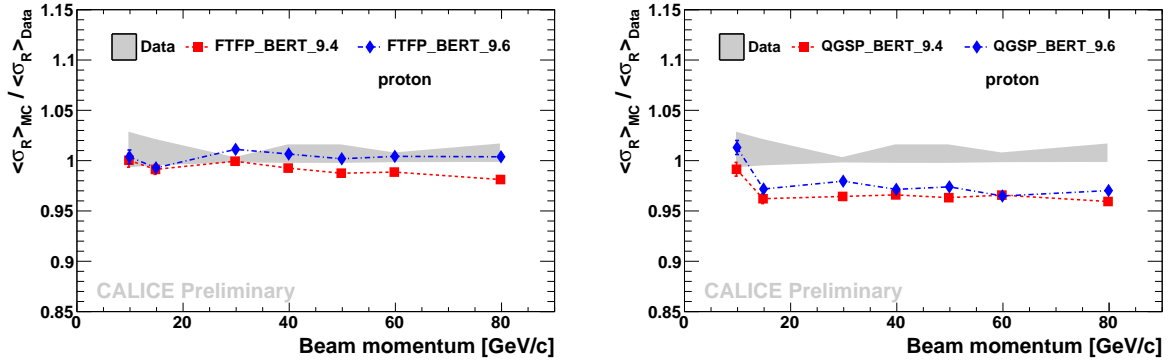

Figure 10: Ratio of mean standard deviation of radial width of proton shower extracted from simulations with GEANT4 version 9.4 (red squares) and version 9.6 (blue diamonds) for FTFP_BERT physics list (left) and QGSP_BERT physics list (right) to that extracted from data for different beam momenta. Systematic uncertainties for data are shown with grey band. See Fig. 18b from CAN-040.