Additional comparisons with simulations using QGSP\_BERT and FTFP\_BERT physics lists from Geant4 version 9.6p01

The CALICE Collaboration

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.

This note contains preliminary CALICE results, and is for the use of members of the CALICE Collaboration and others to whom permission has been given.

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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 $E_{\text{reco}}$ 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.
Figure 4: Ratio of mean radial width of pion shower extracted from simulations with \textsc{Geant4} version 9.4 (red squares) and version 9.6 (blue diamonds) for \texttt{FTFP\_BERT} physics list (left) and \texttt{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 \textsc{Geant4} version 9.4 (red squares) and version 9.6 (blue diamonds) for \texttt{FTFP\_BERT} physics list (left) and \texttt{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.
3 Comparisons for protons

Figure 6: Relative residuals of proton reconstructed energy $E_{\text{reco}}$ 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.
Figure 7: Ratio of mean 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. 10b from CAN-040.

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 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. 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.