Hadron production from NA61 - update

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University of Sussex
NOvA & DUNE PPFX meeting

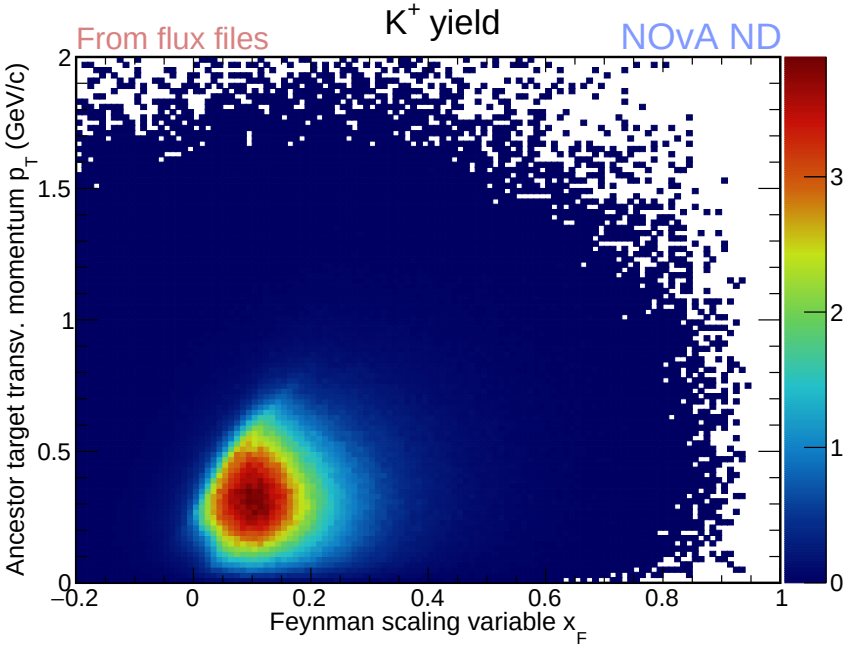
Introduction

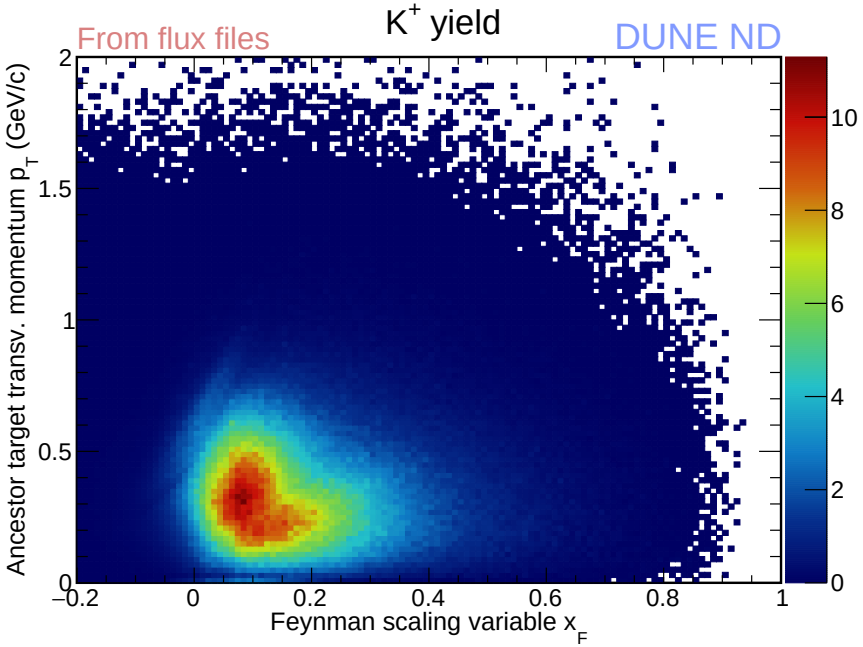
- I am working on adding new data from NA61 experiment mainly for the $p + C \to K^{\pm} + X$ production
- Also looking at $p + C \to \pi^{\pm} + X$ while I'm at it
  - We have plenty of data from NA49 in this channel so maybe we could use this to select the best interpolation/extrapolation method ???
- Now trying to catch up to the rest of the group (=Nilay and Antoni) and do
  - data-simulation comparisons in Invariant cross section in $p_T - x_F$ in different incident energies
  - including uncertainties (with what correlations?)
  - data interpolation (try both methods presented)

Previously on...

- The last time I presented here I showed:
  - Comparison of $K^{\pm}$ yields in $p_T - x_F$ in FHC for NOvA and DUNE
    $\Rightarrow K^{\pm}$ region of interest is $(-0.05 < x_F < 0.4, 0 < p_T < 0.8)$

From flux files





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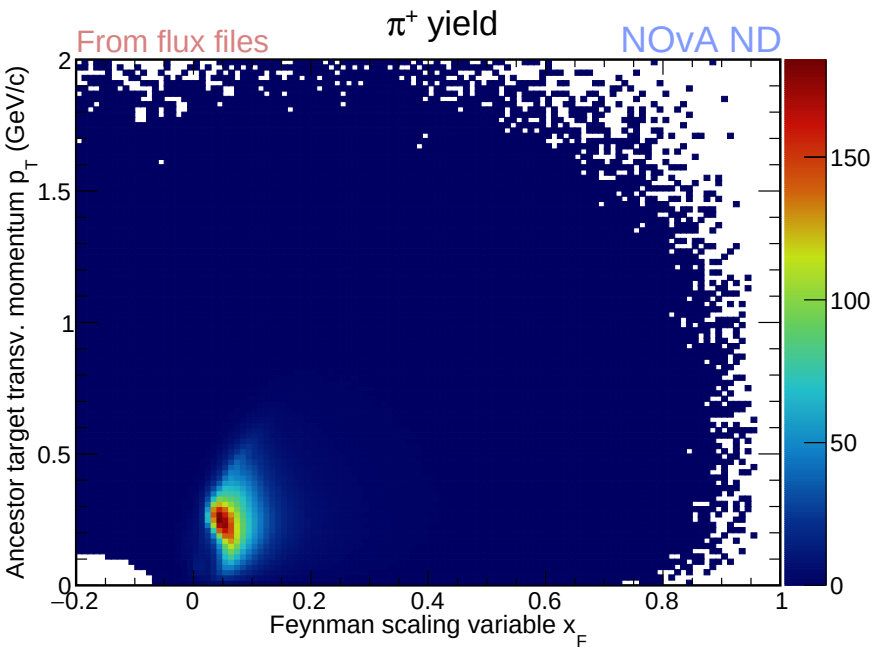

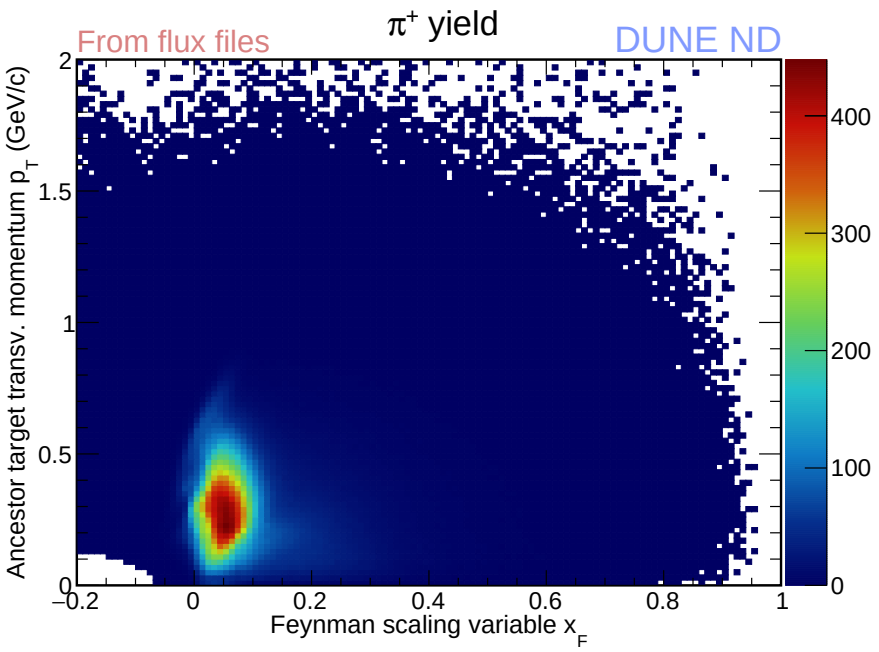

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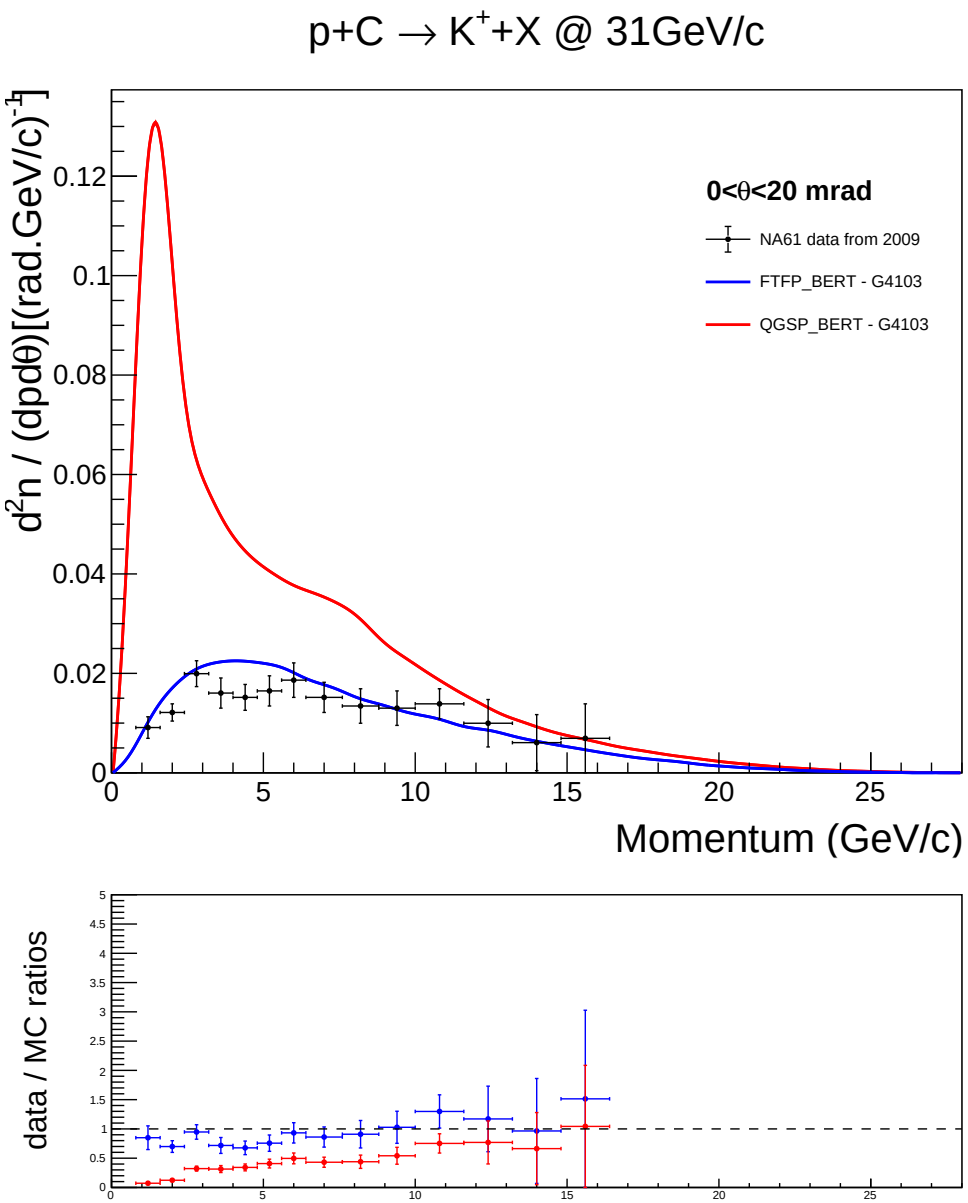
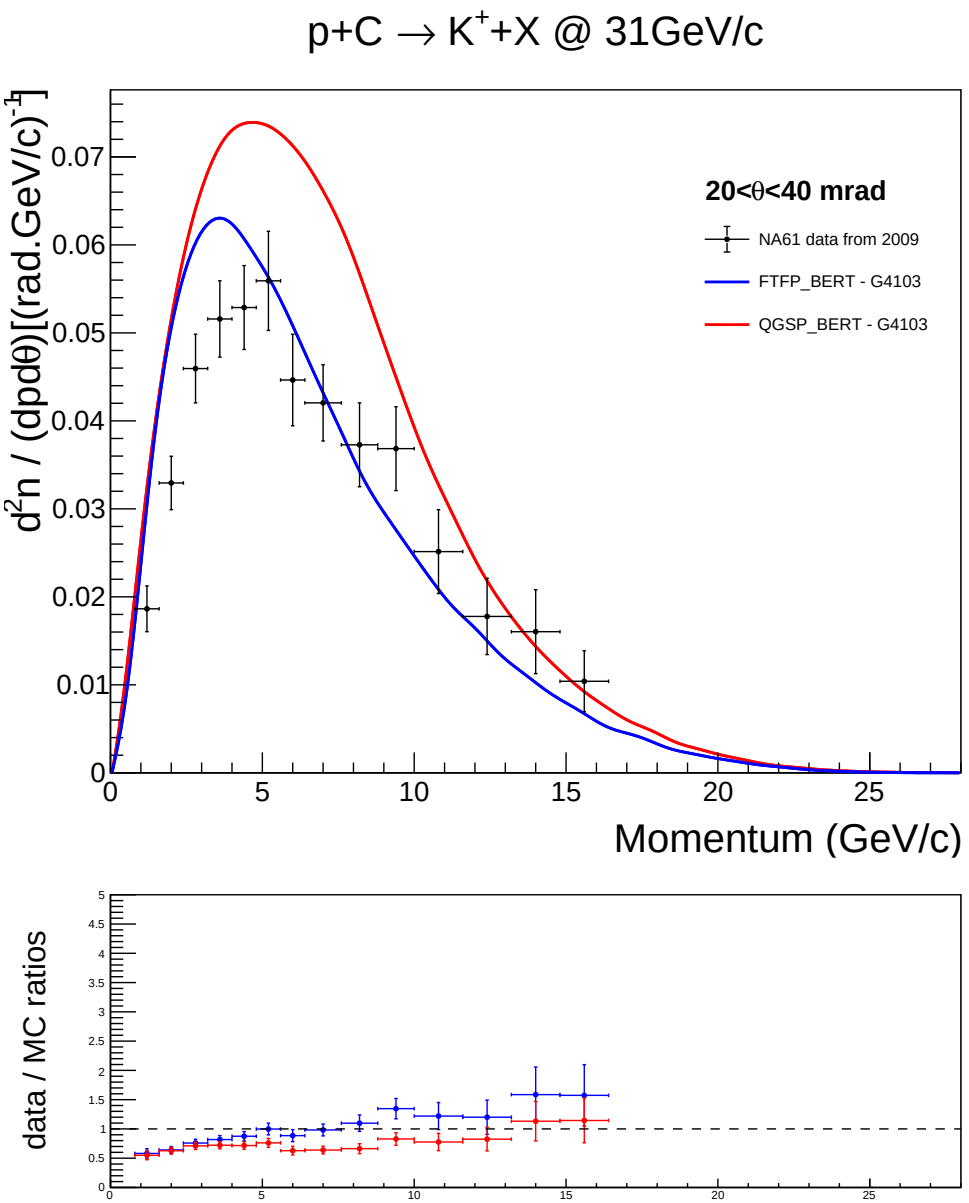
    $\Rightarrow \pi^{\pm}$ region of interest is $(-0.05 < x_F < 0.2, 0 < p_T < 0.8)$
- Comparison between NA61, NA49 and MIPP data coverage a binnings
- Comparison of data and MC in multiplicities for K^{+} production

Outline

- I haven't dealt with uncertainties and interpolations yet
- Presenting comparisons between different data and MC in multiplicities and invariant cross sections
  - both (`FTFP_BERT` and `QGSP_BERT`) have been generated in DUNE setup $\rightarrow$ use DUNE's version of Geant4 (`v04_10_3_p03b`, NOvA uses `v04_10_4_p02ba` to my knowledge)
- Comparison of NA61 data and MC multiplicities in the original bins $(p - \theta)$ in $31 GeV/c$ with ratios $\rightarrow$ Antoni's approach to interpolation
- Comparison of NA61($31 GeV/c$), NA49($158 GeV/c$) and MIPP($120 GeV/c$) data and MC invariant cross sections in $p_T - x_F$ in $31 GeV/c$, $120 GeV/c$ and $158 GeV/c$ $\rightarrow$ Nilay's (original) approach to interpolation
- NA49 and MIPP data and histograms for energy scaling in FLUKA are from ppfx/data
- The NA49 data haven't been scaled yet and the MIPP data are not yet included

Data-MC multiplicities comparison in $p - \theta$





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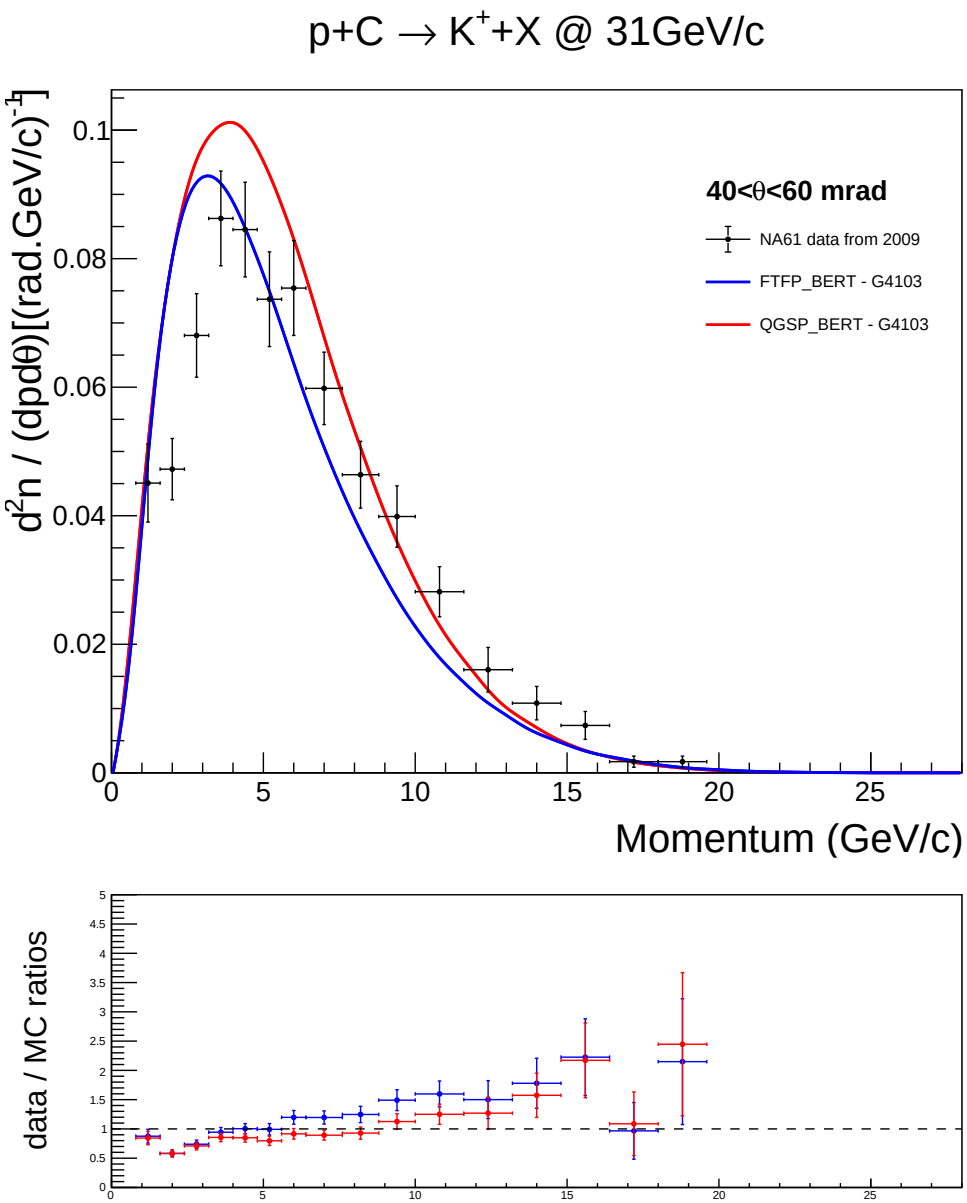

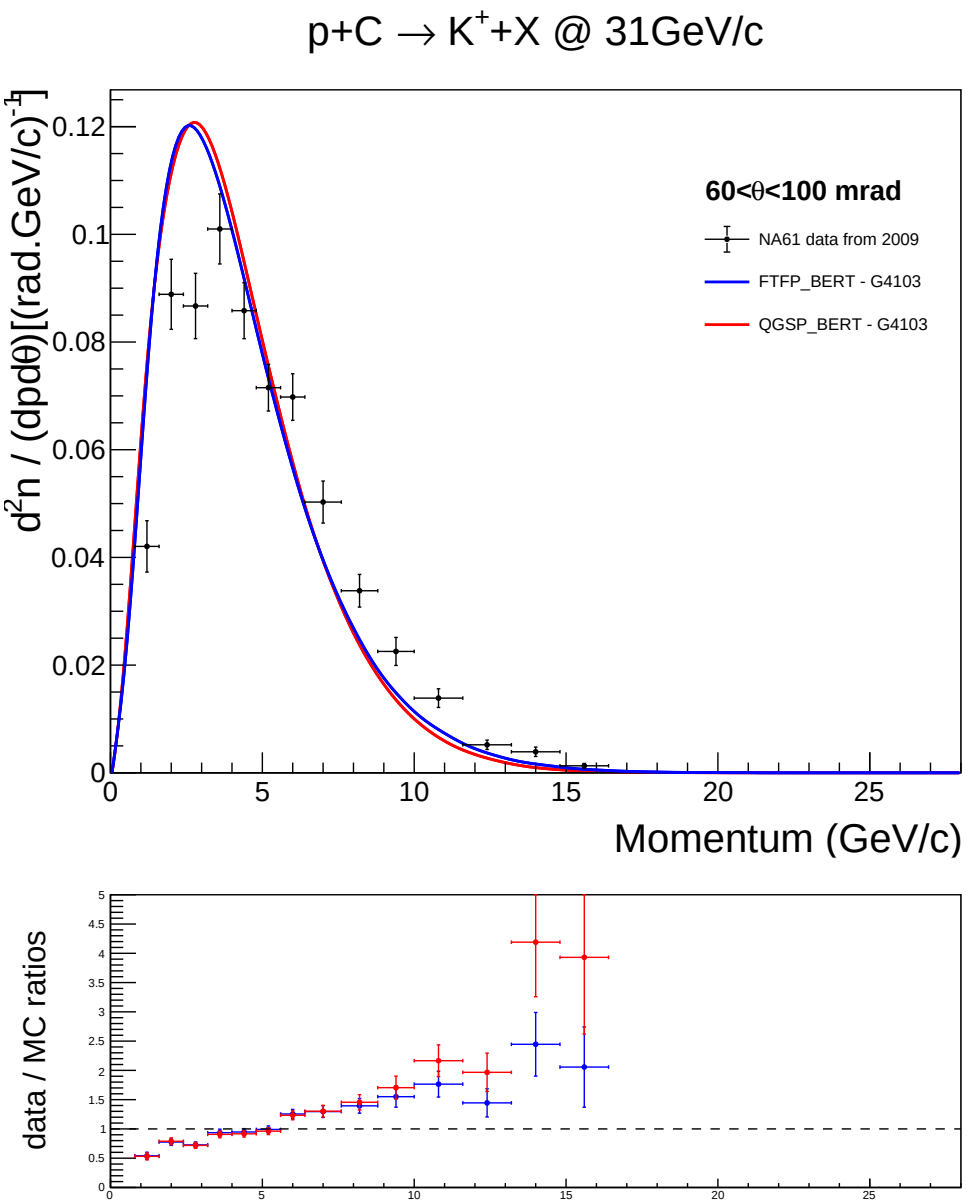

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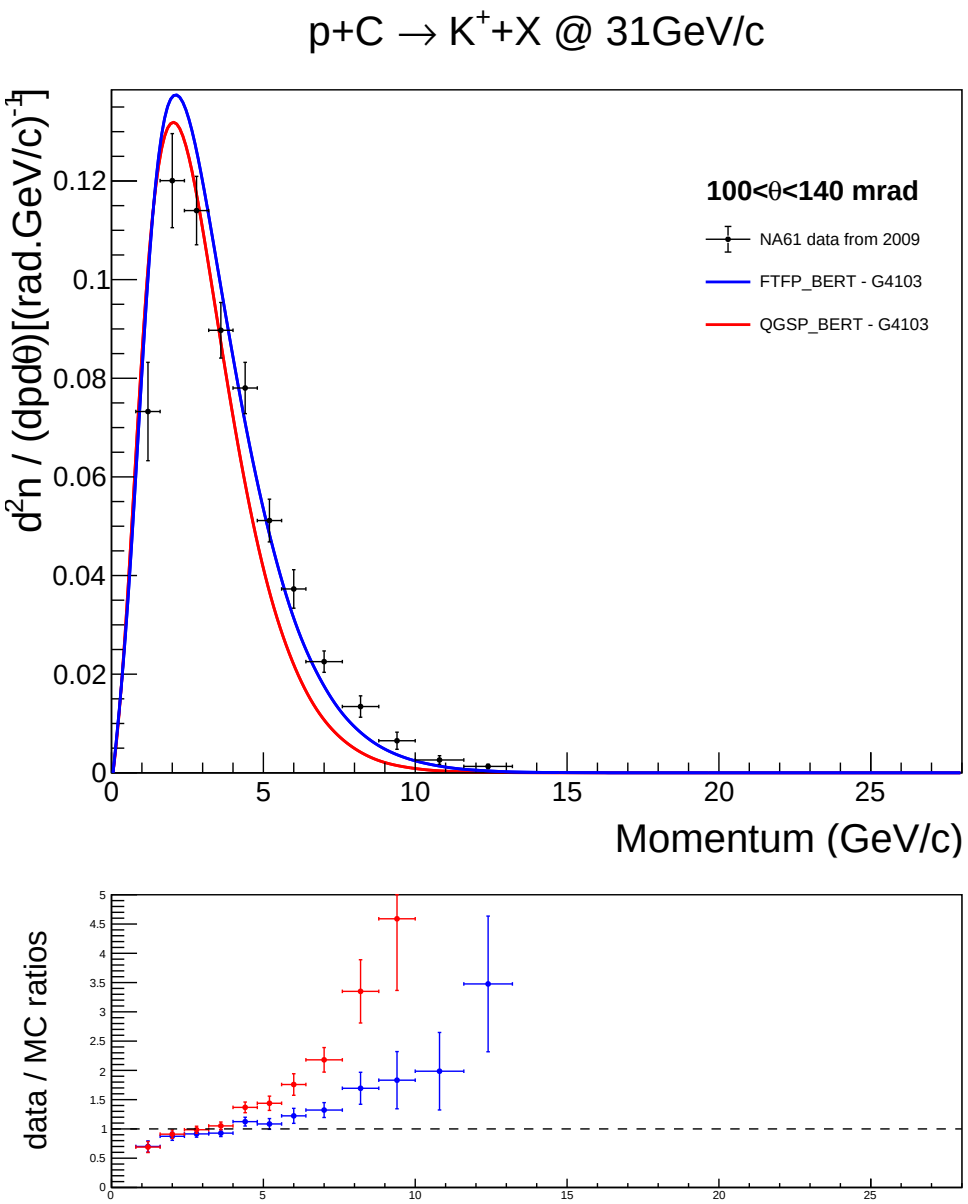

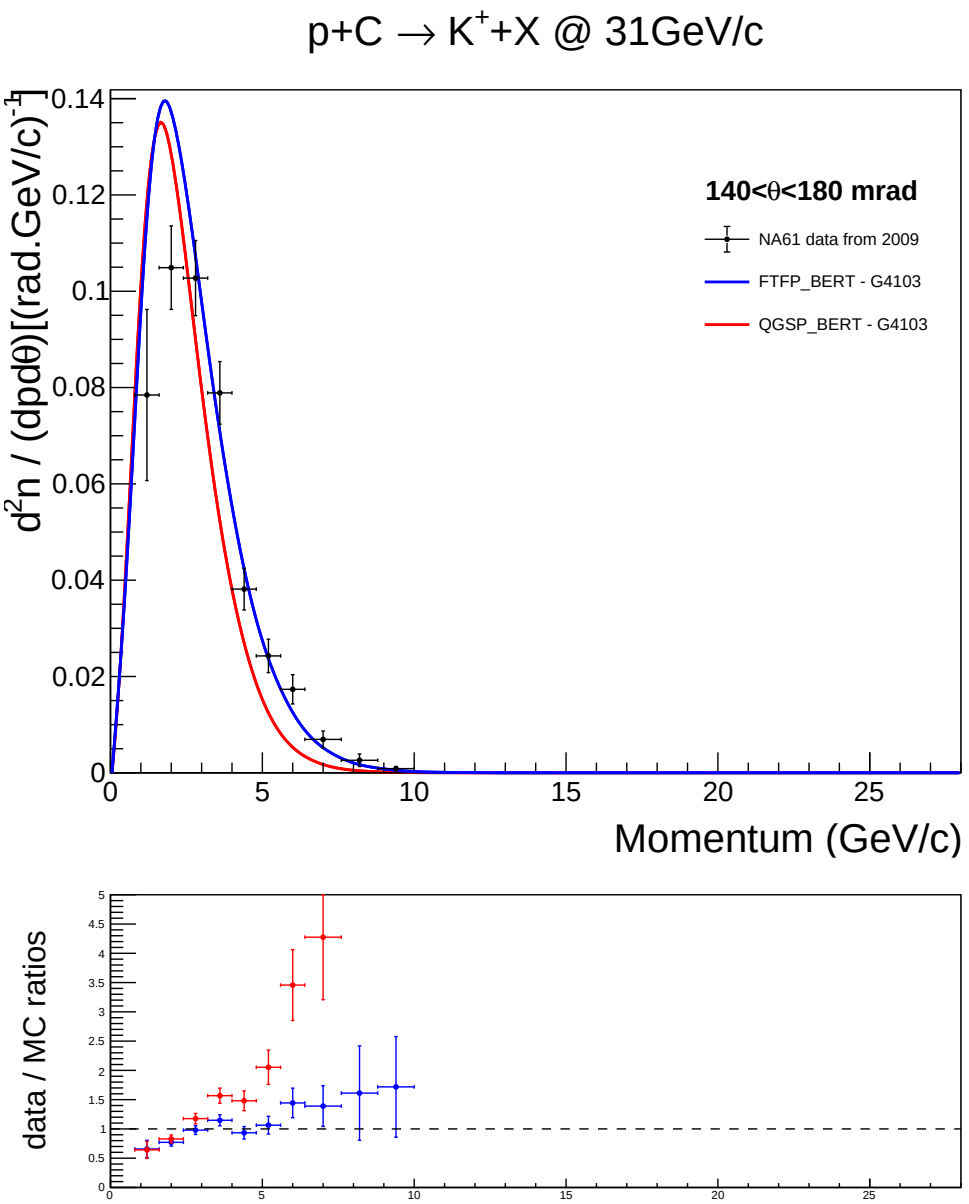

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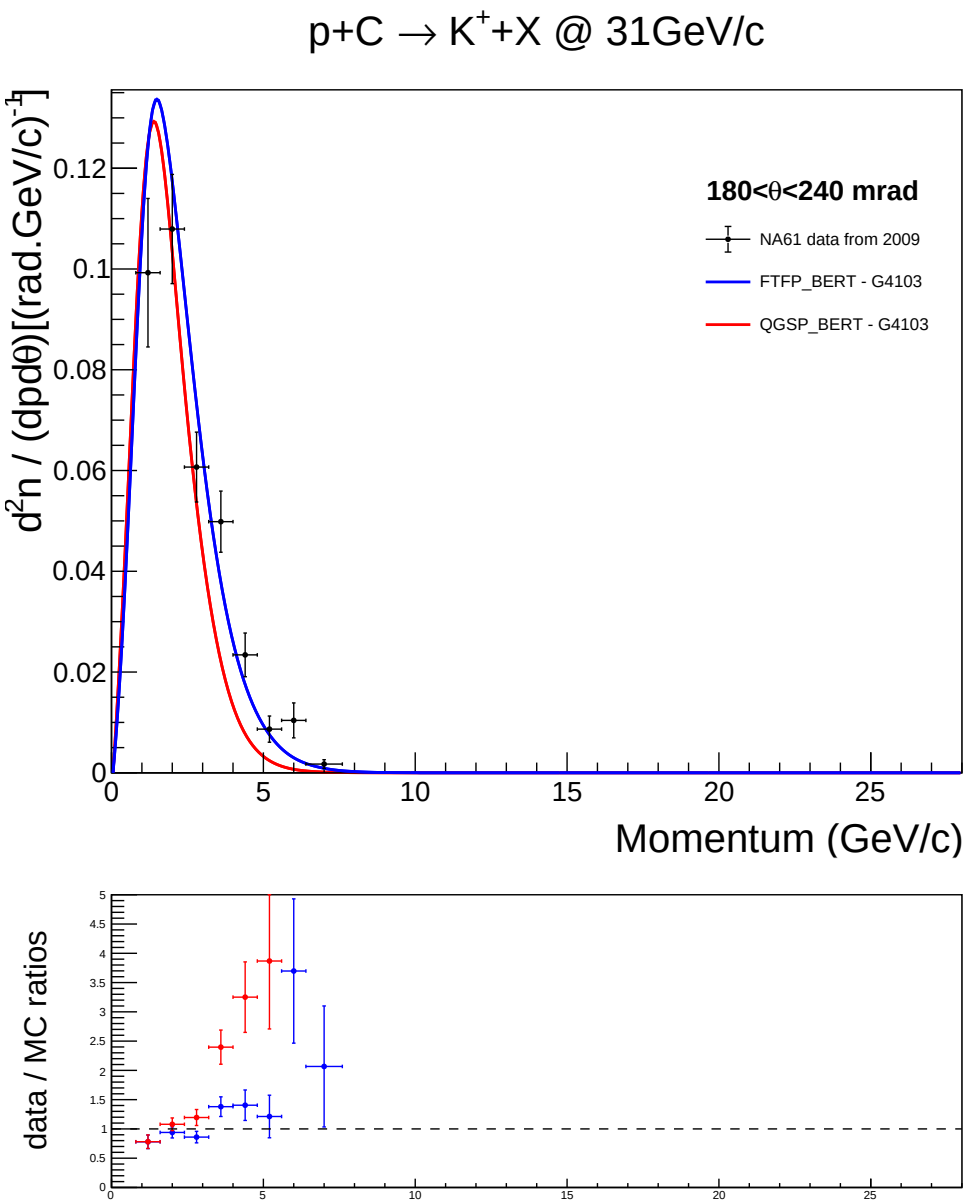

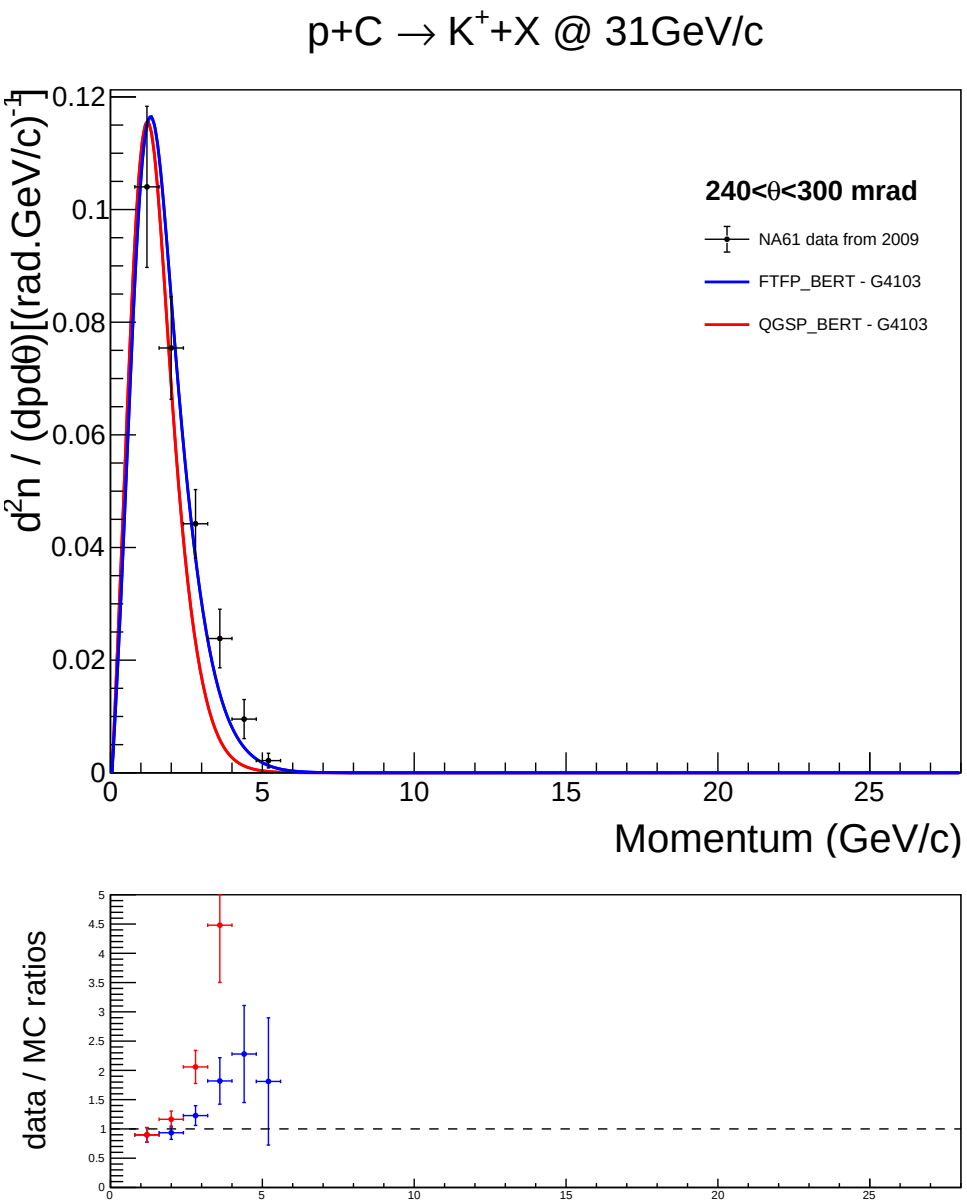

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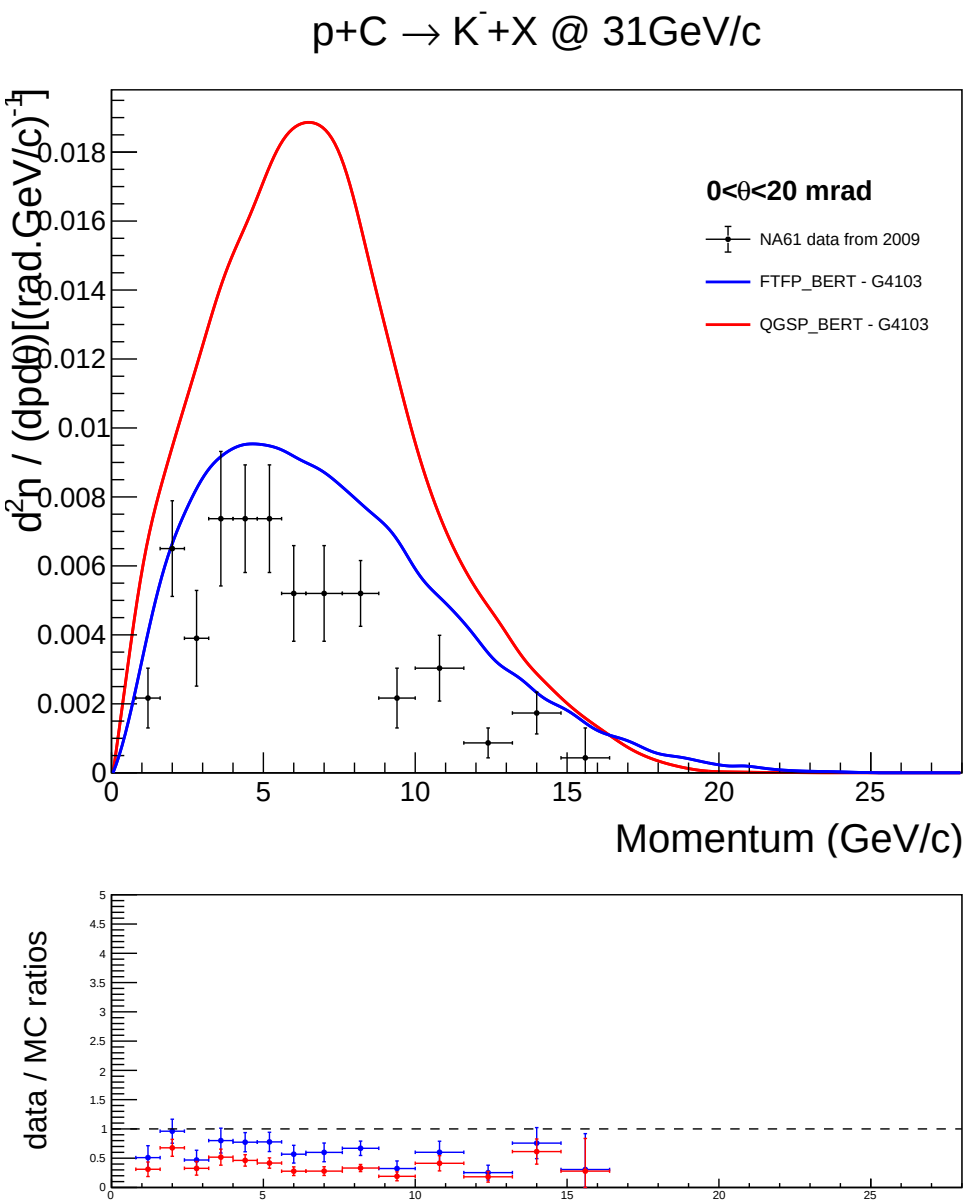

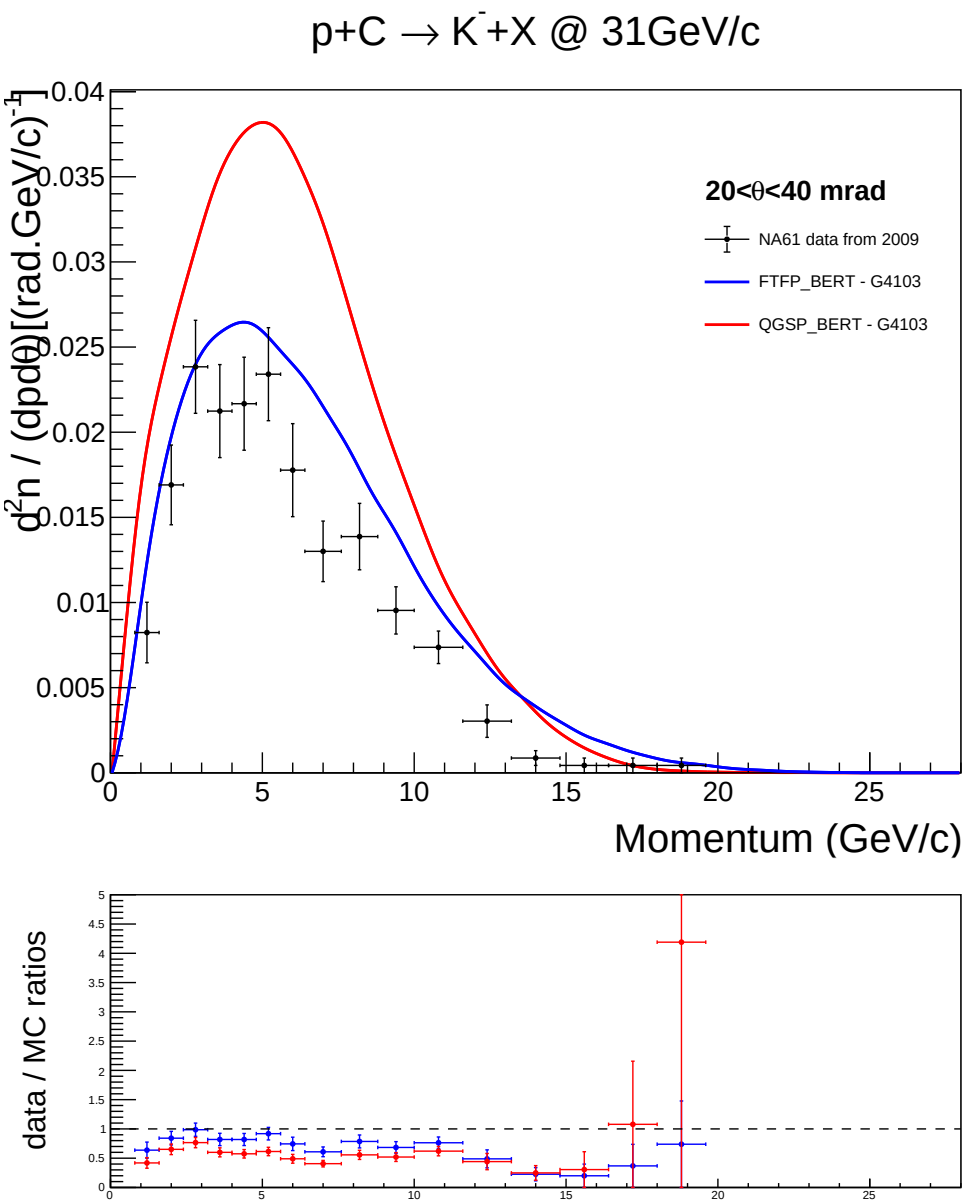

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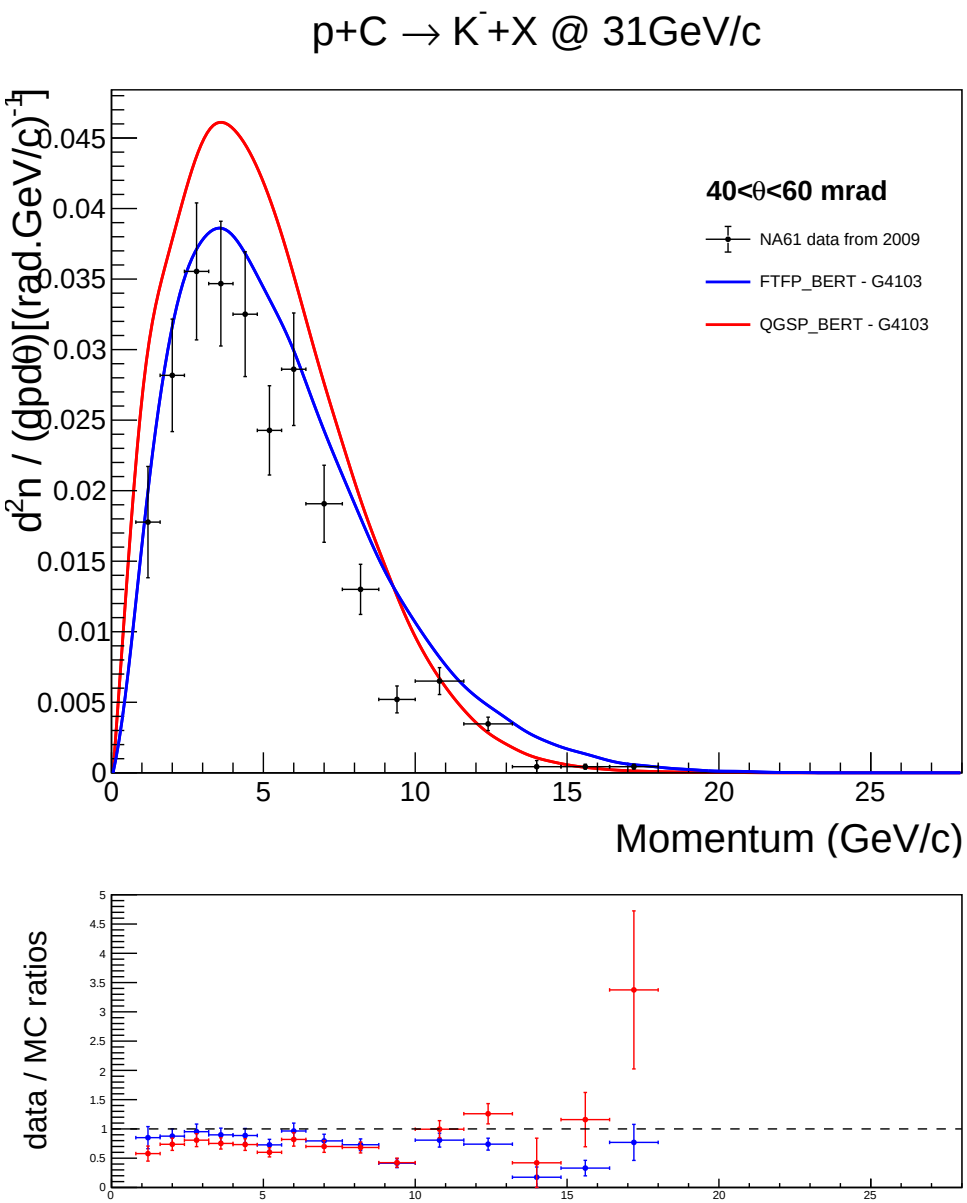

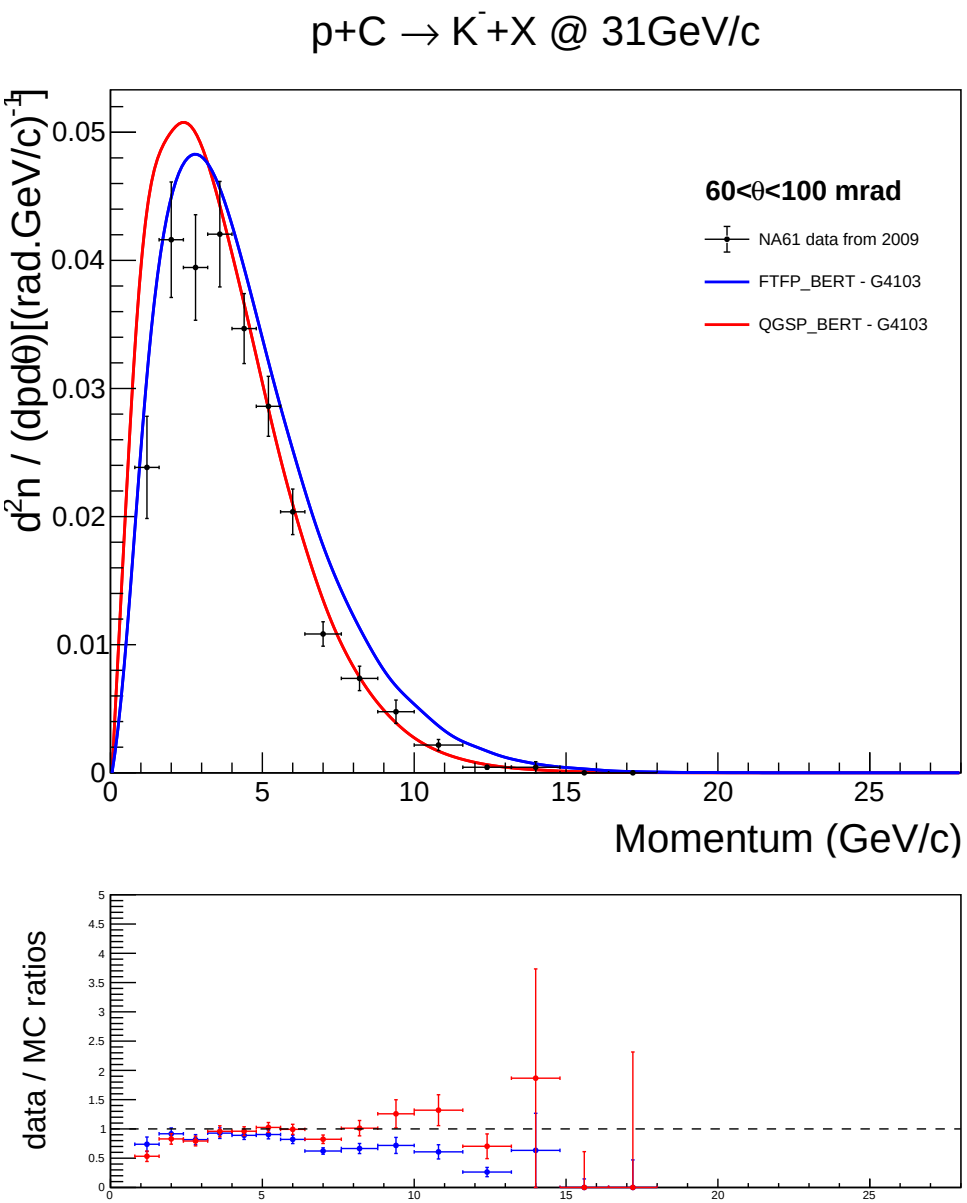

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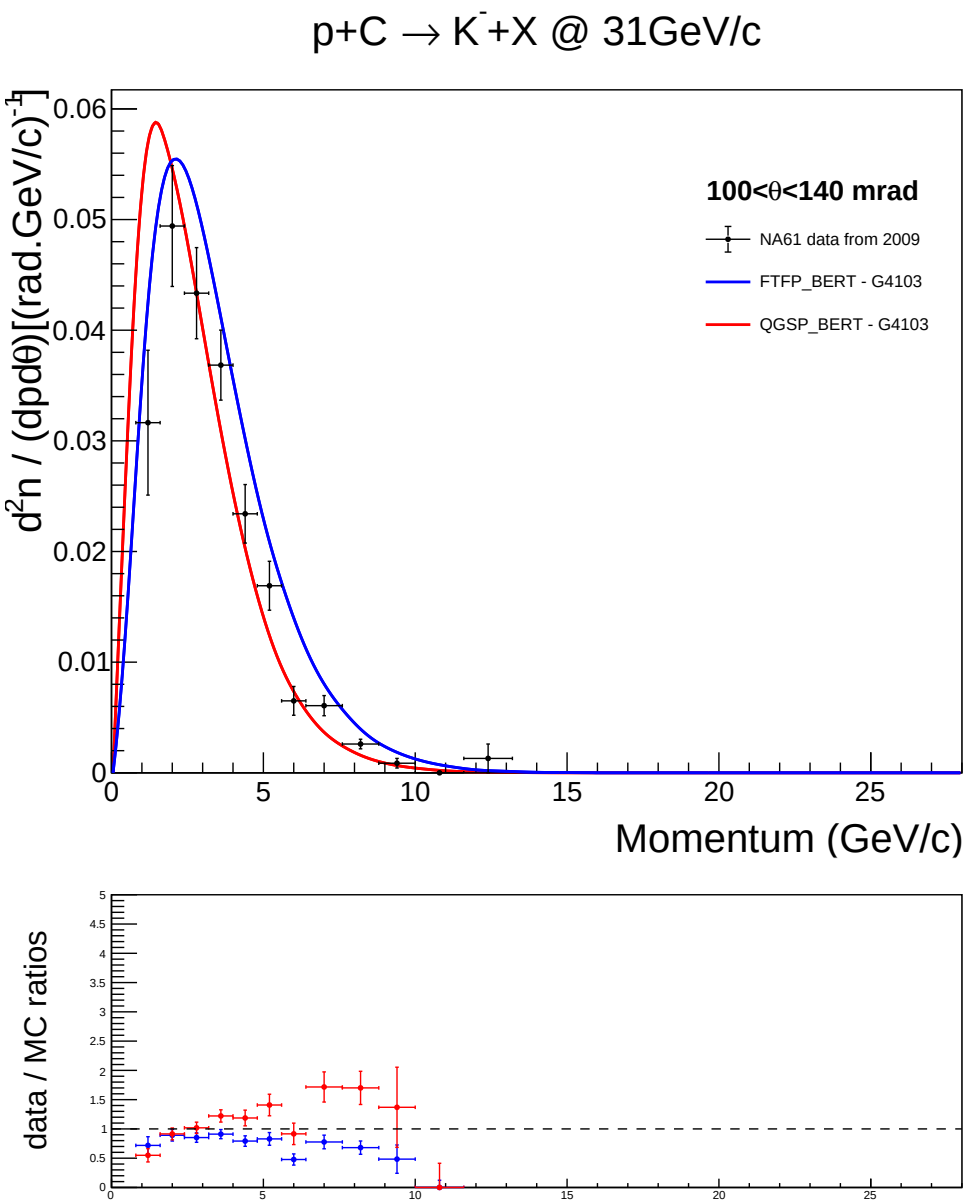

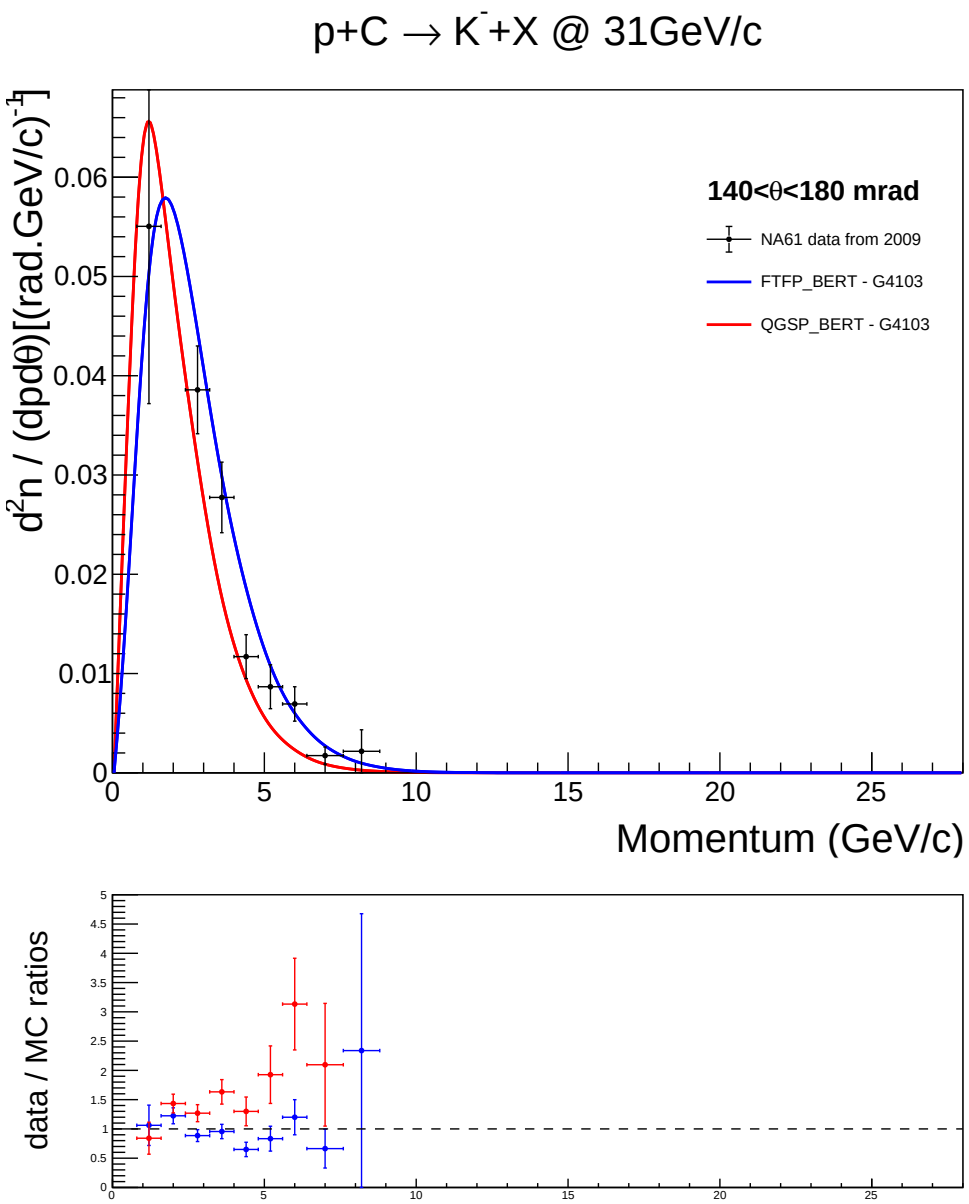

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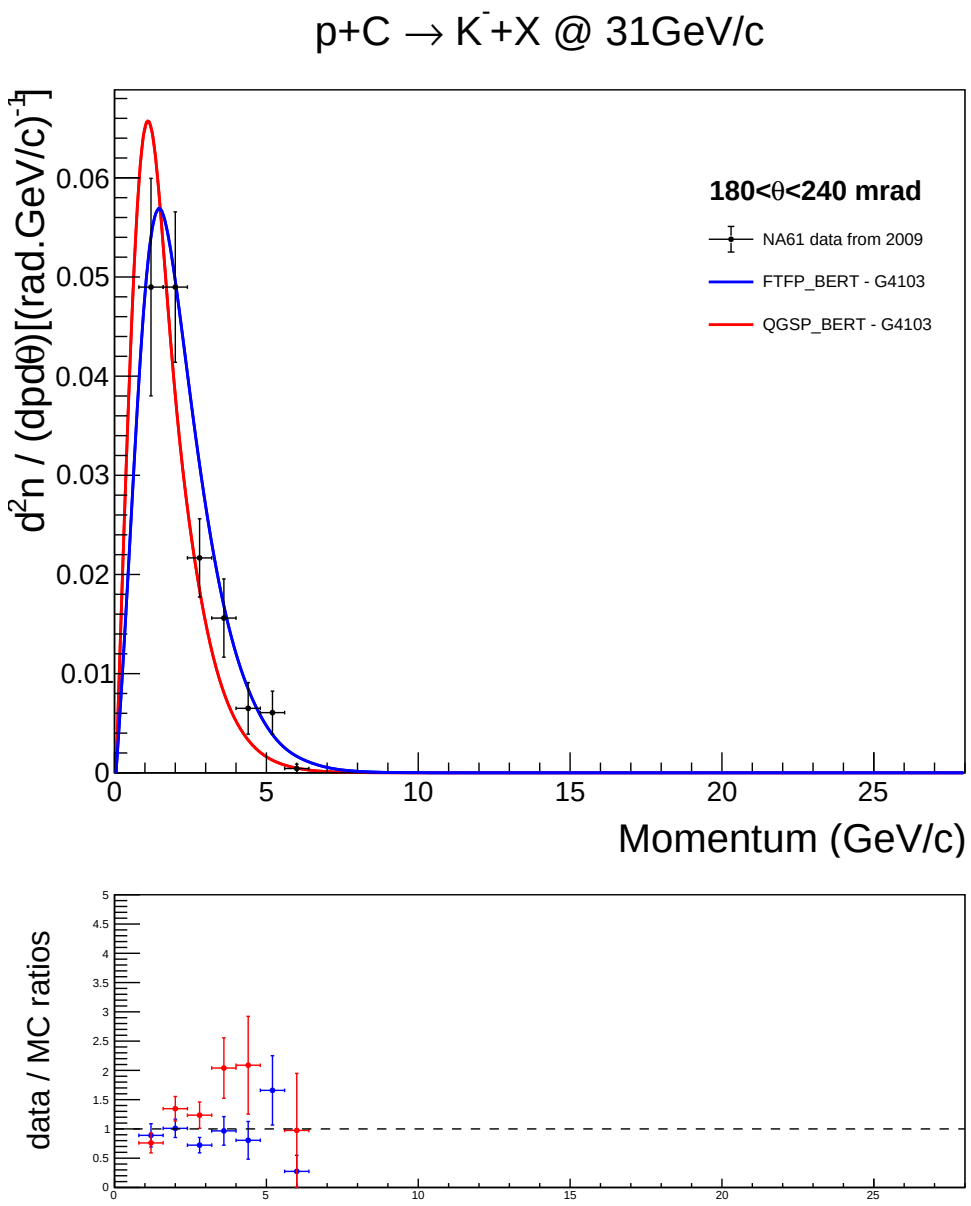

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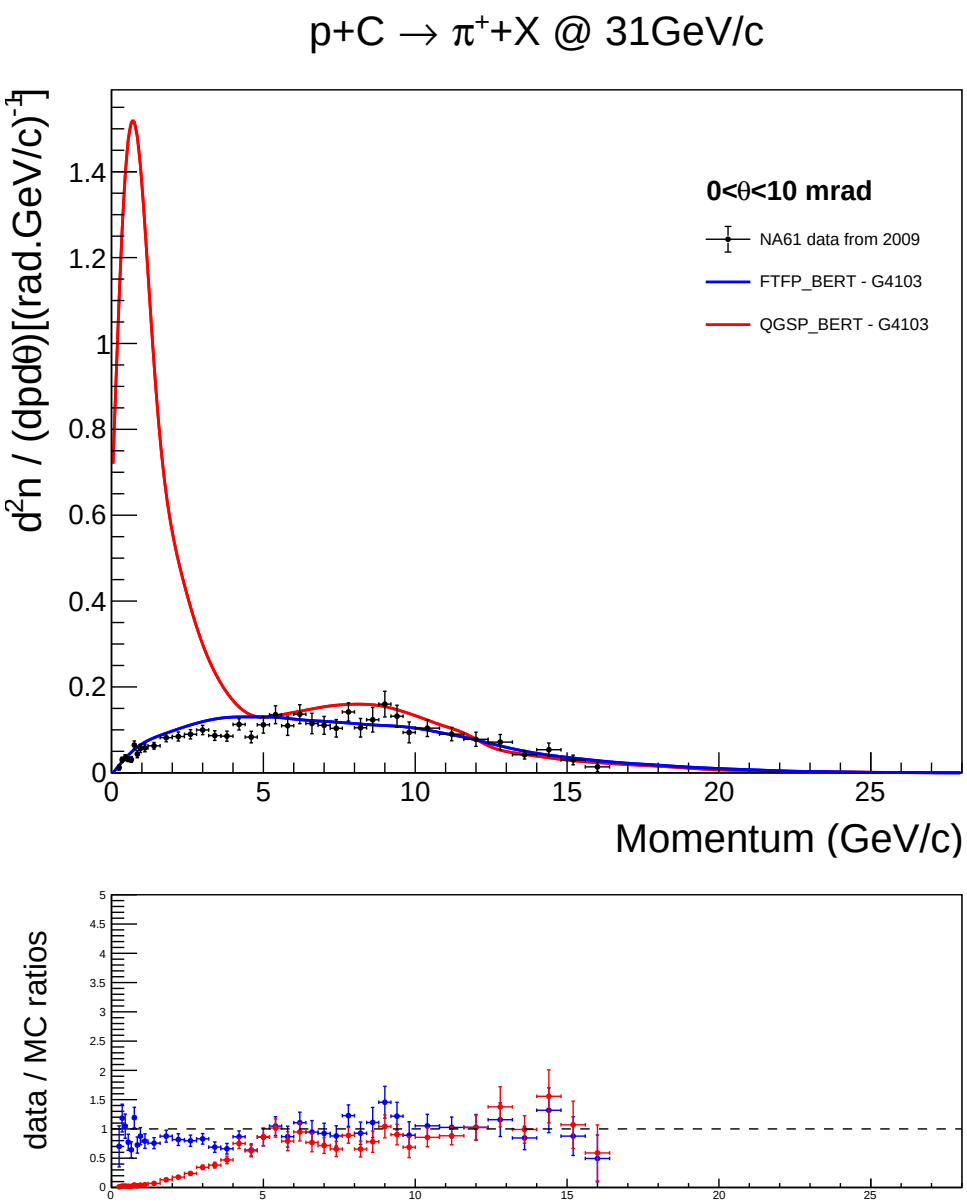

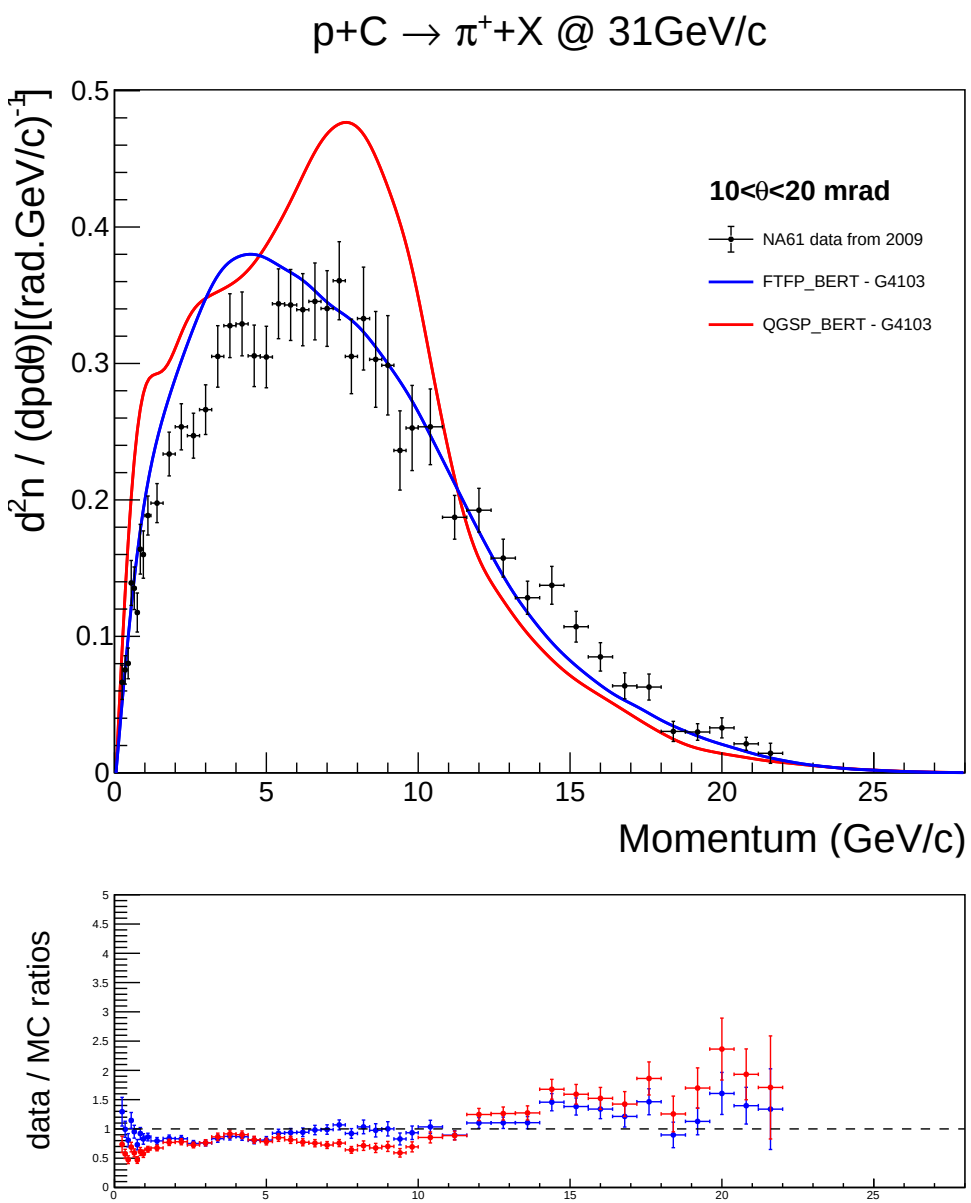

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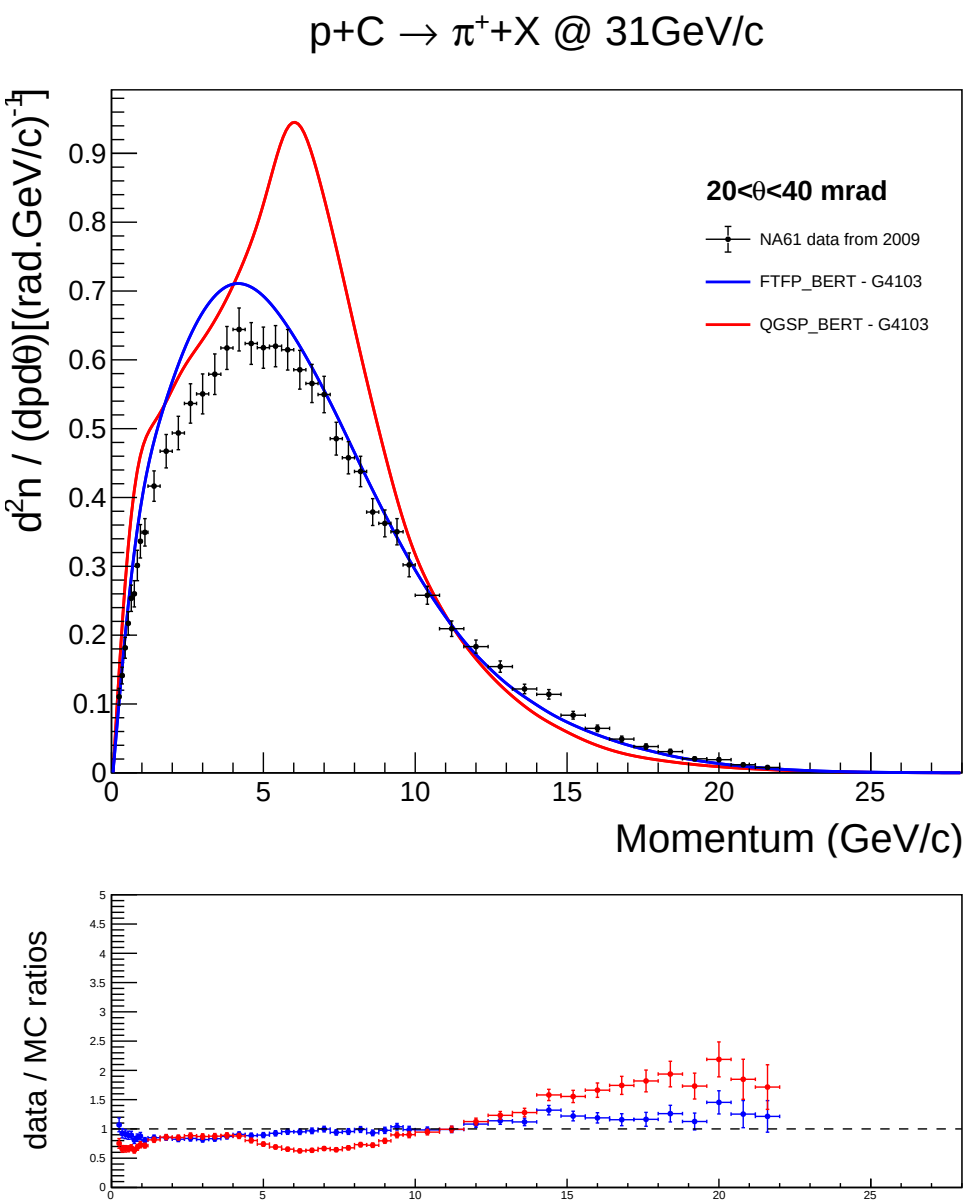

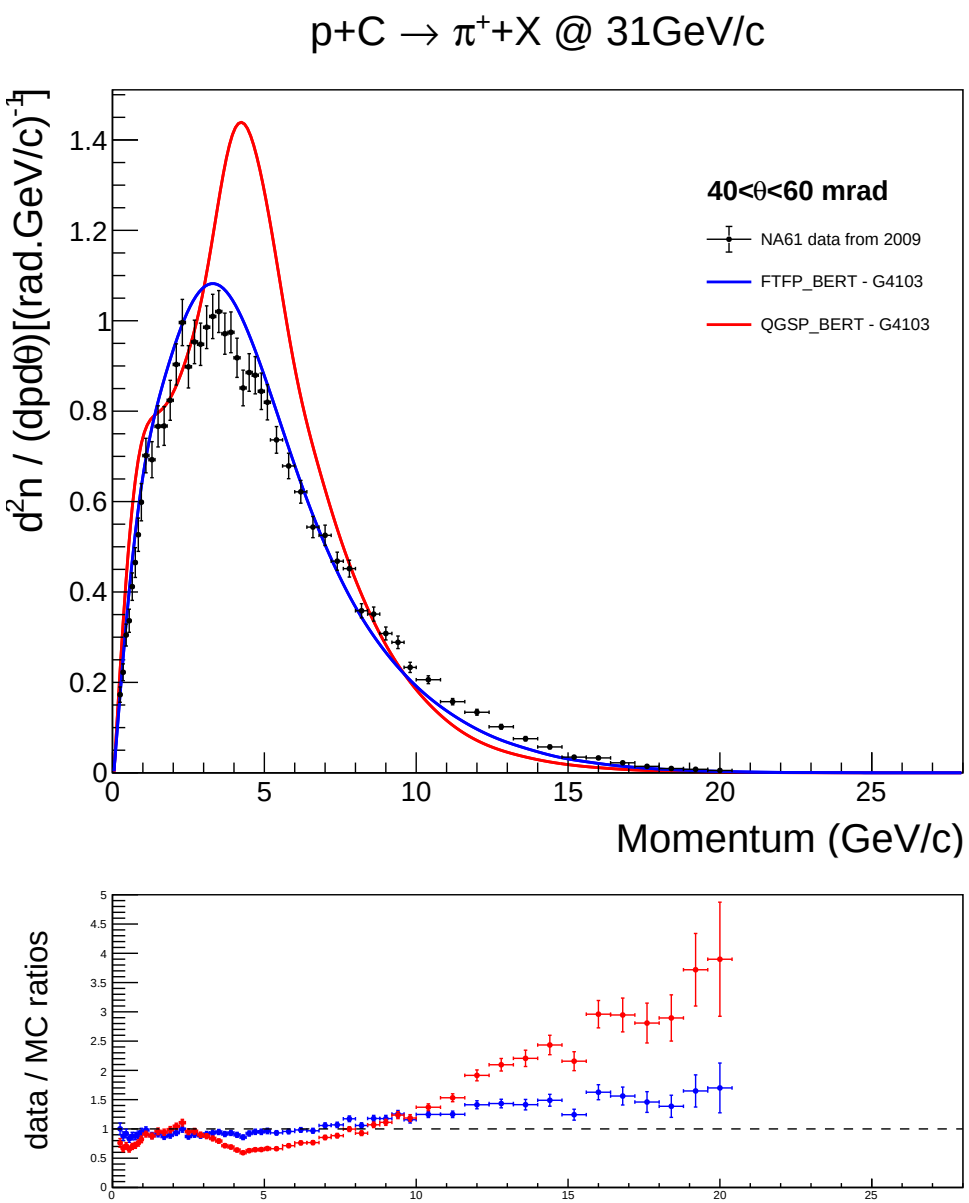

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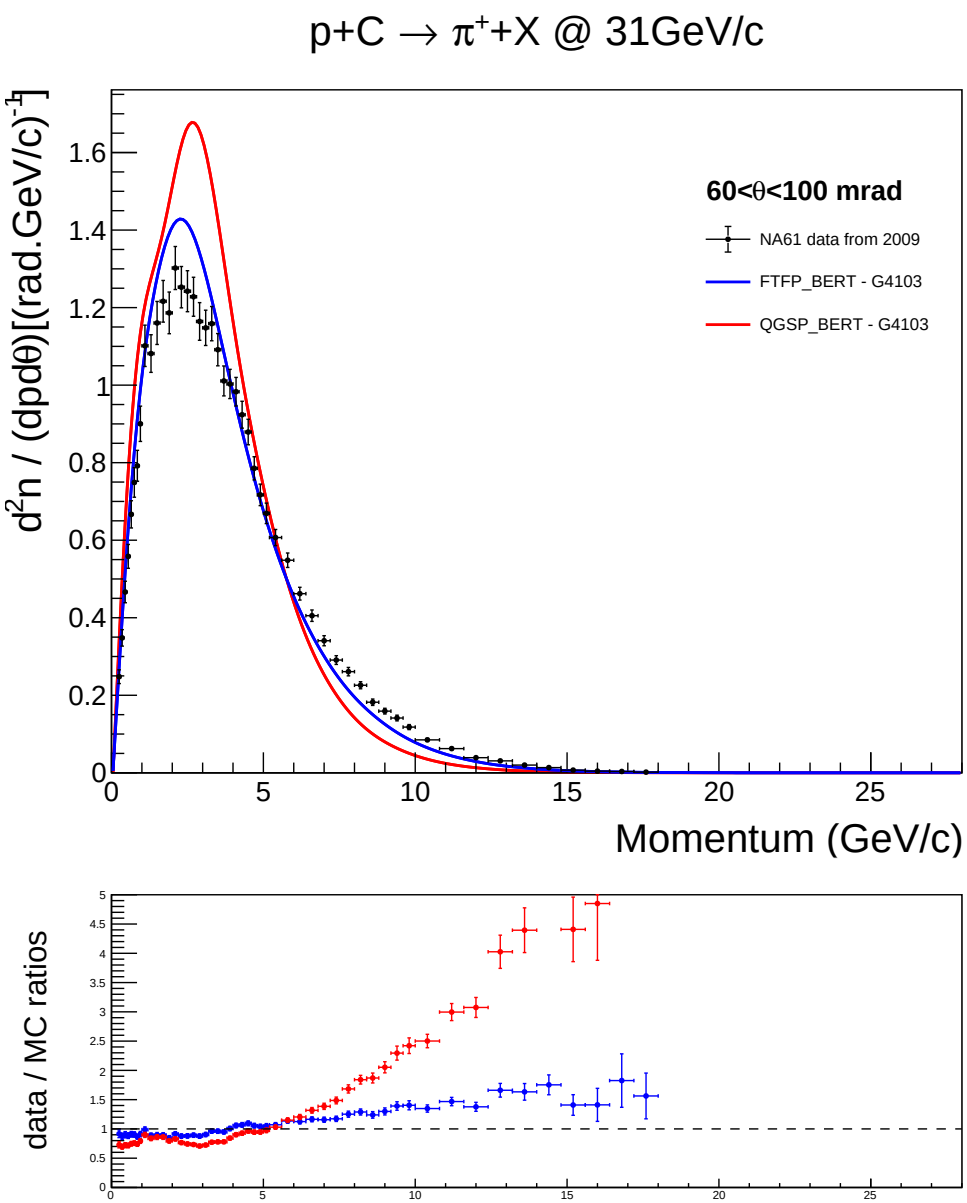

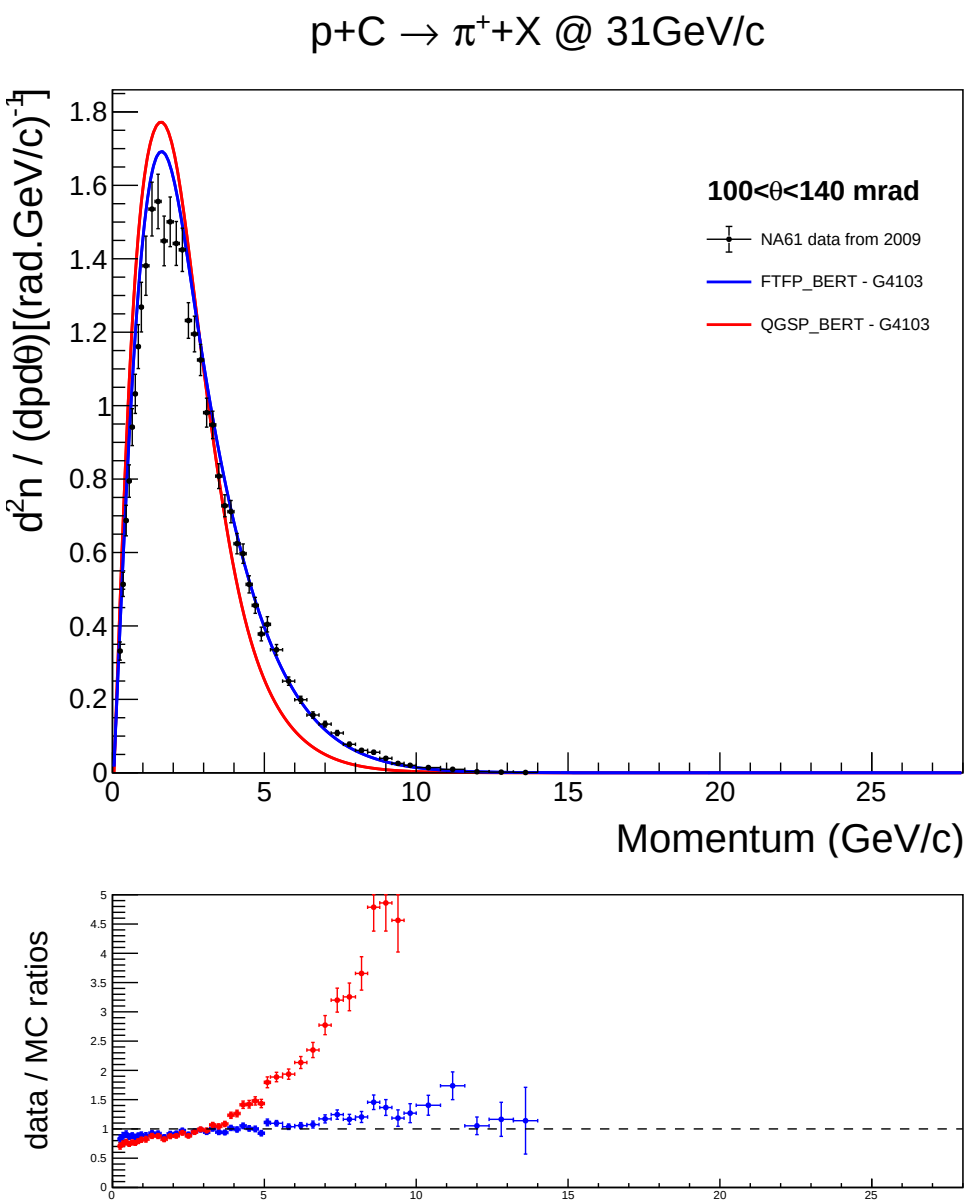

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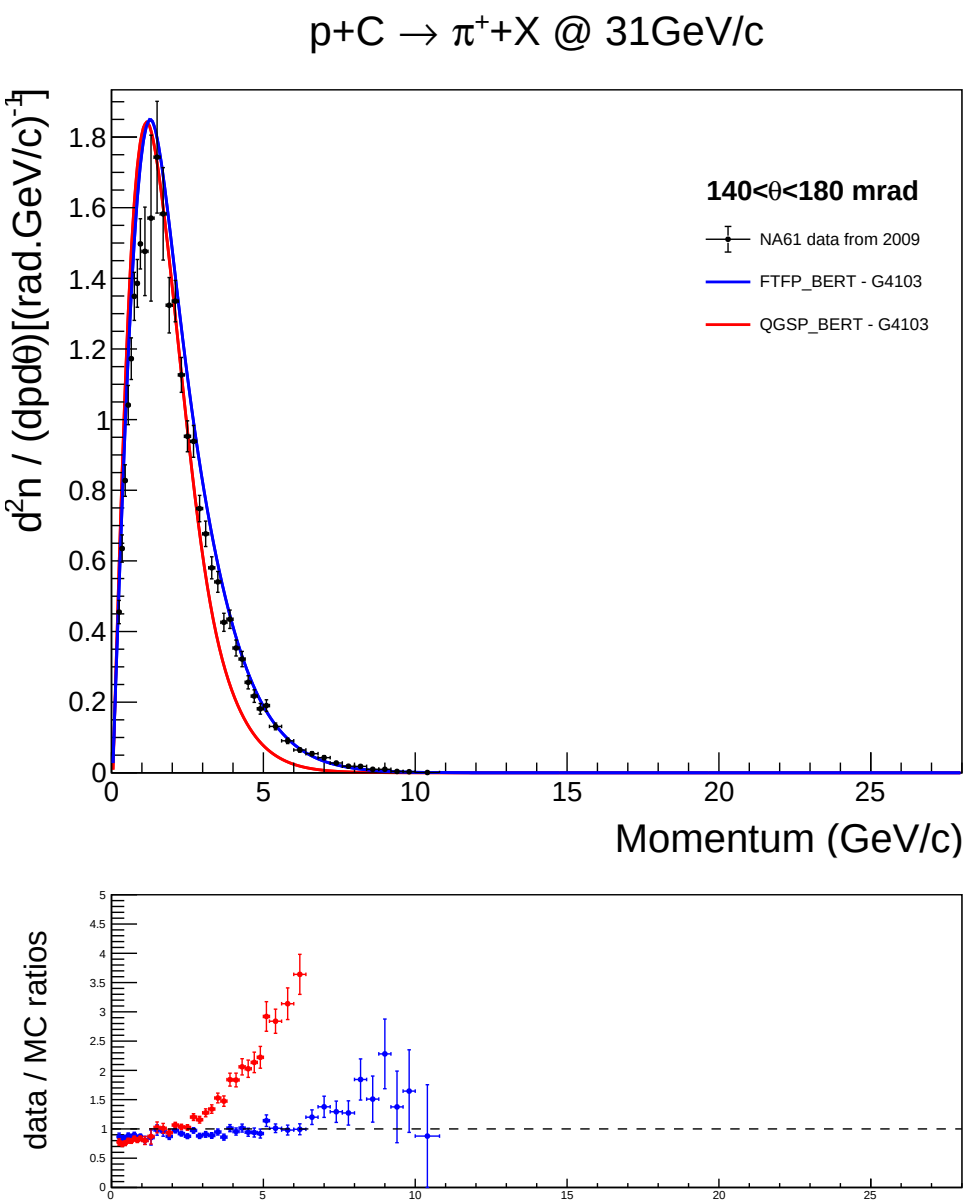

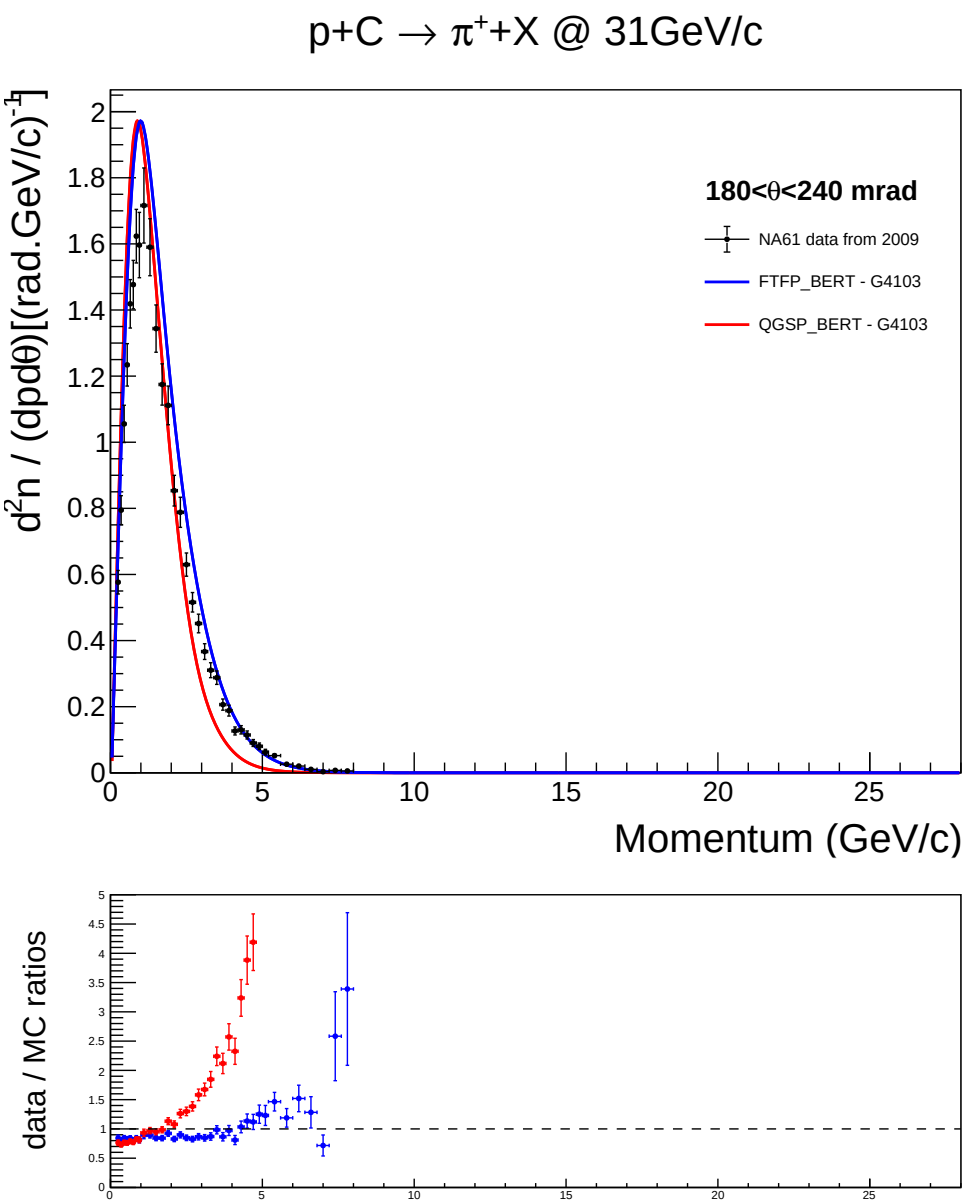

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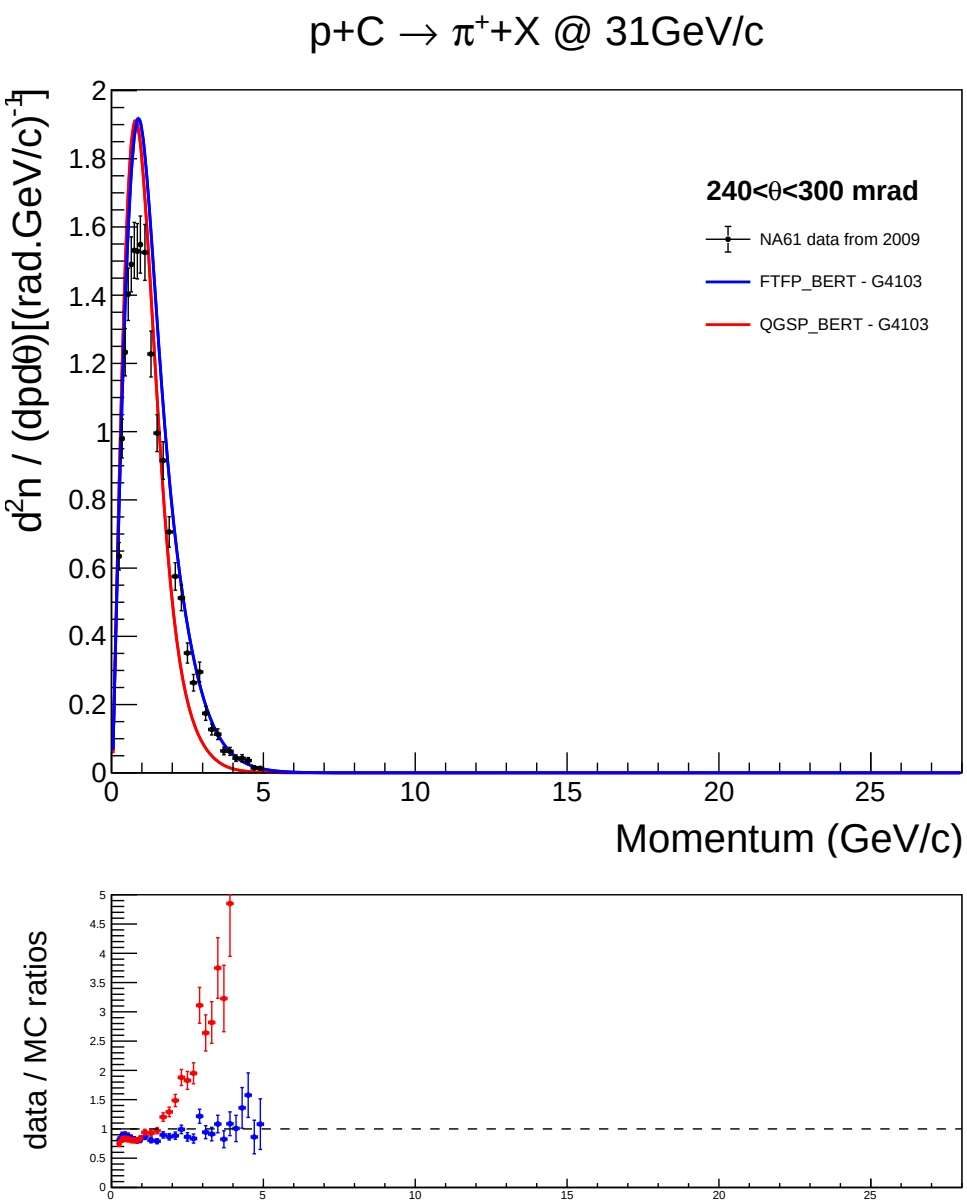

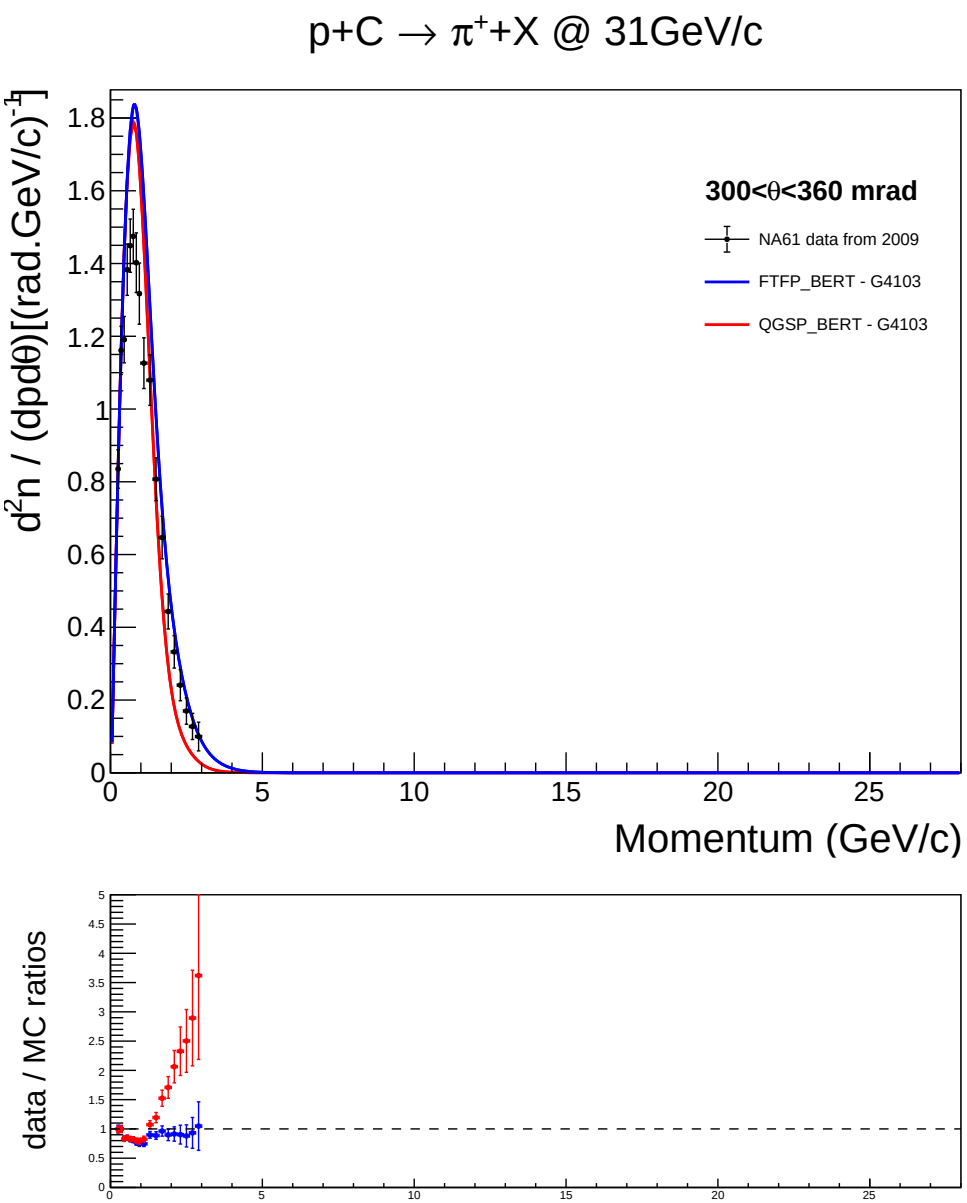

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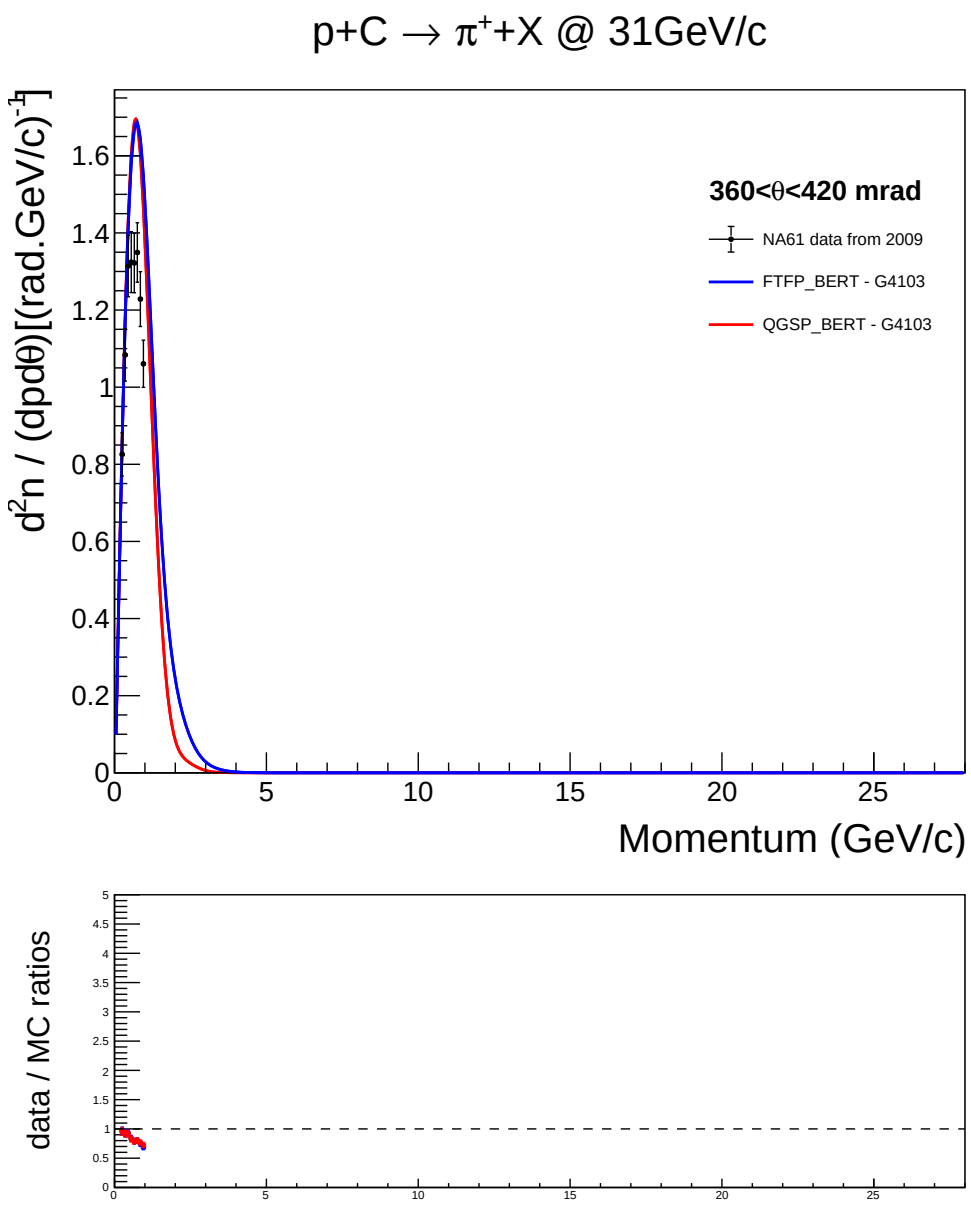

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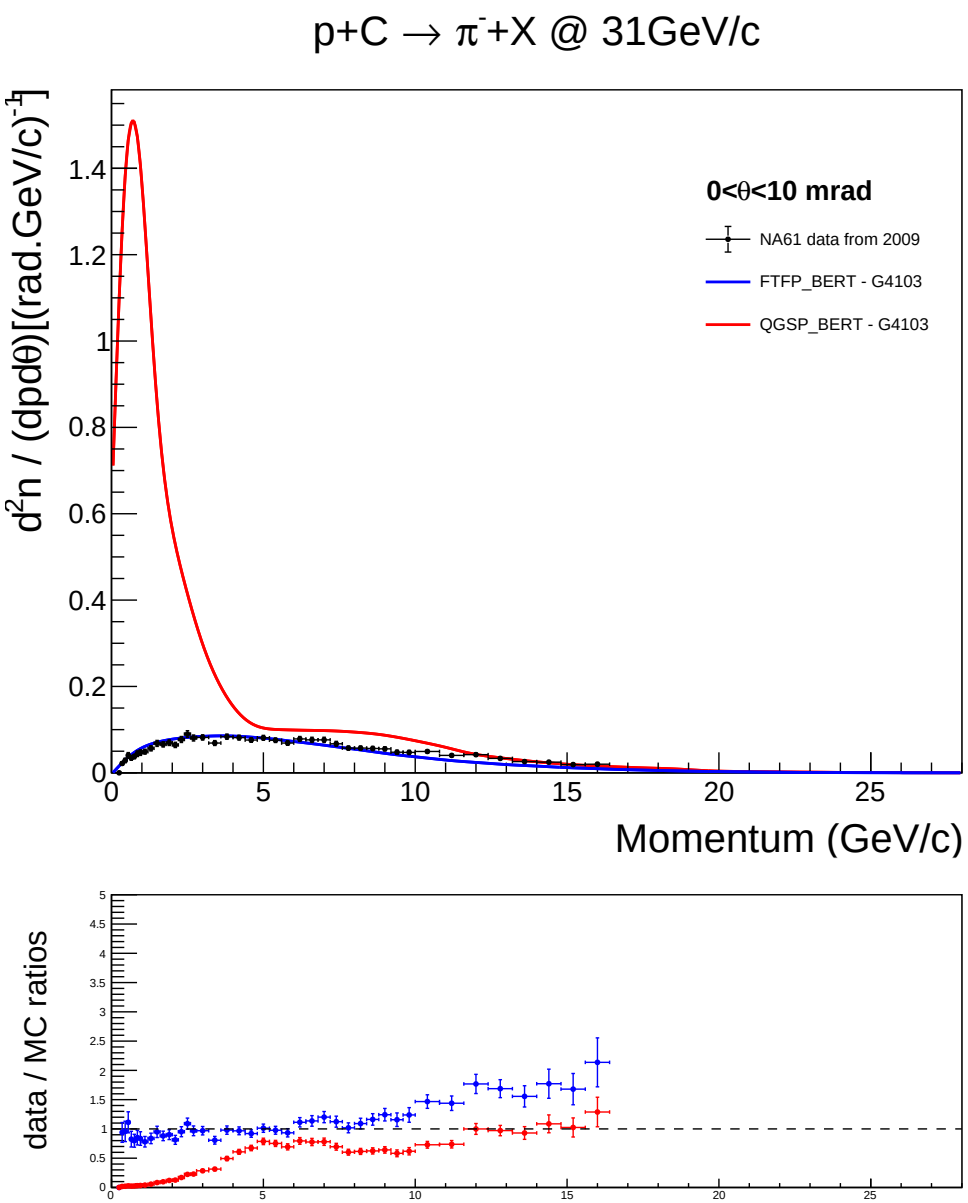

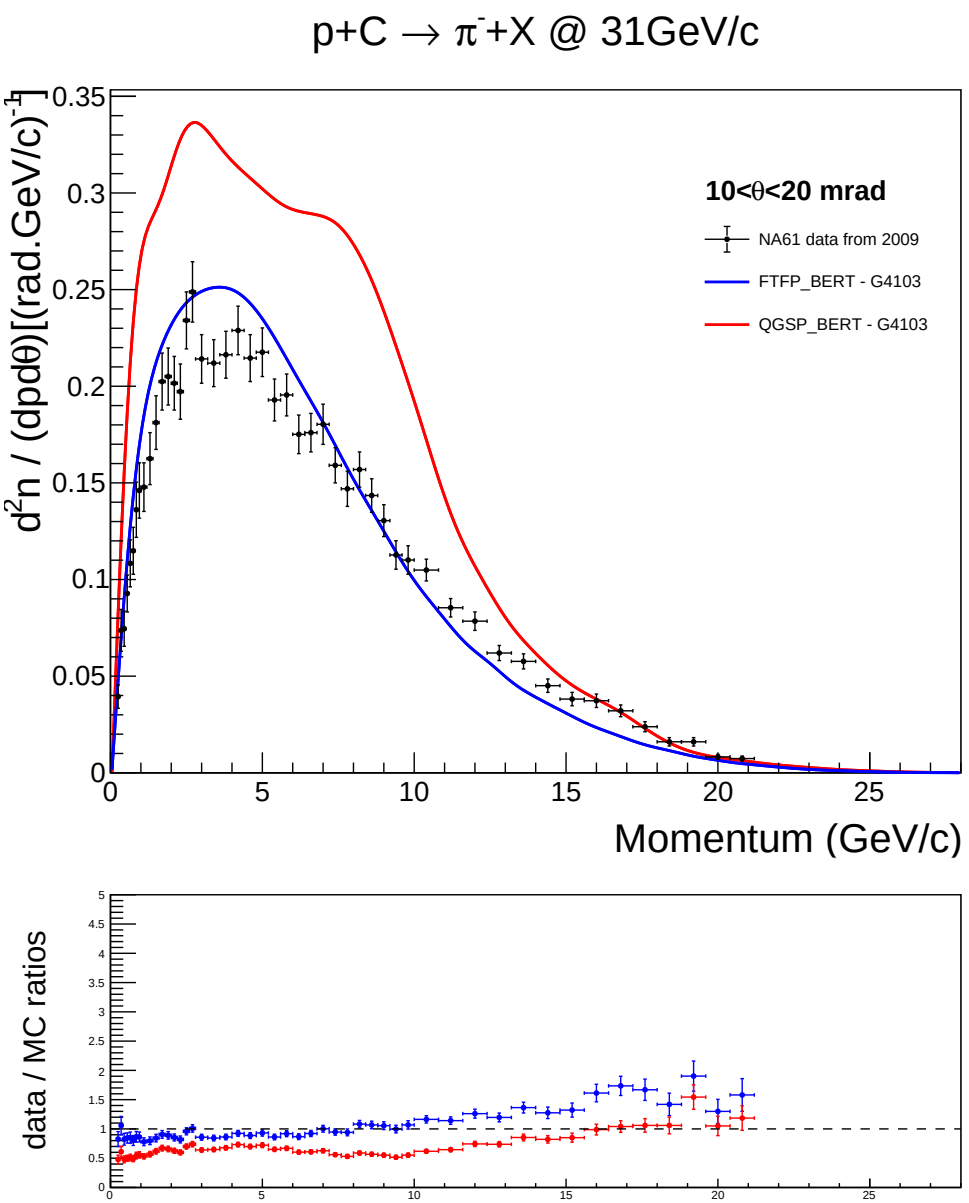

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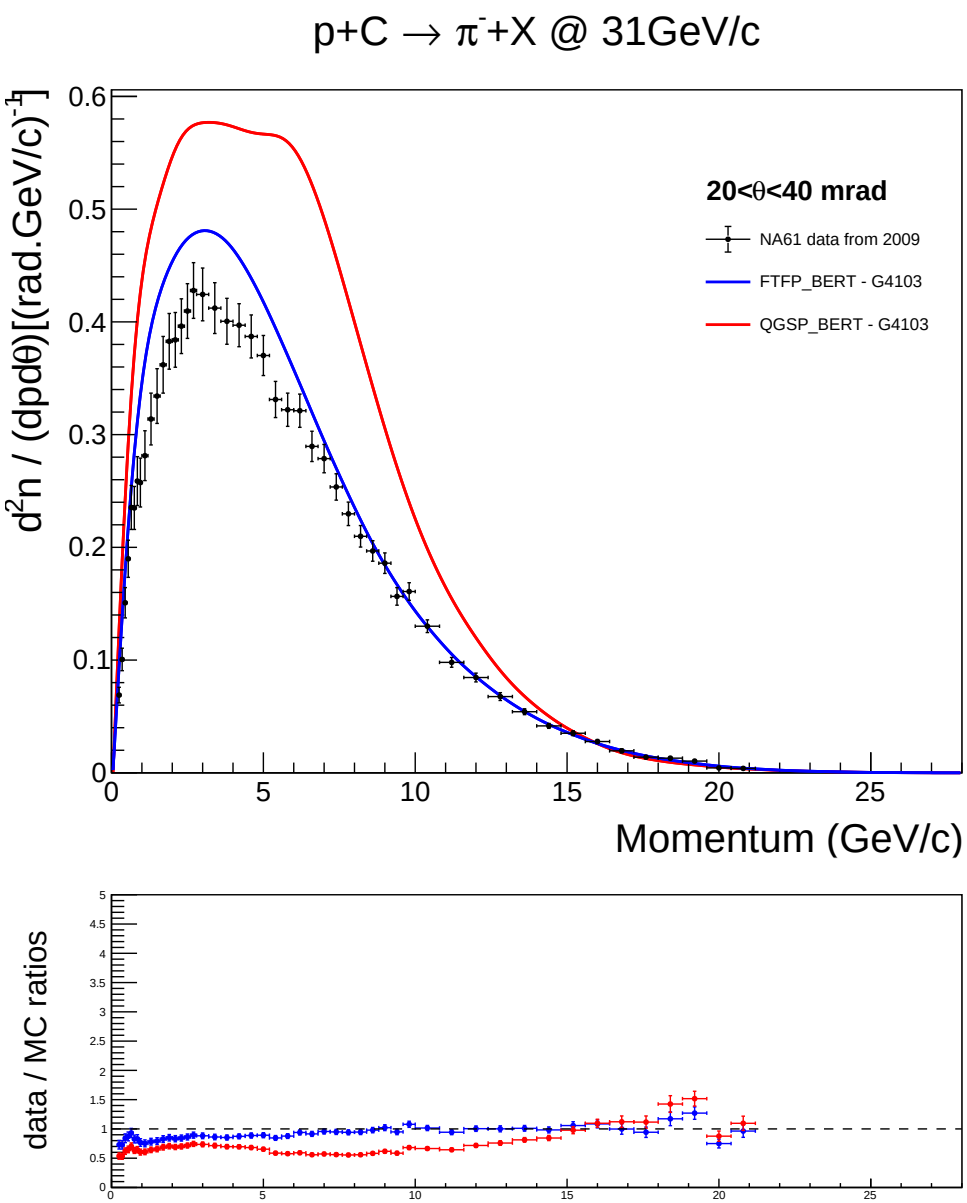

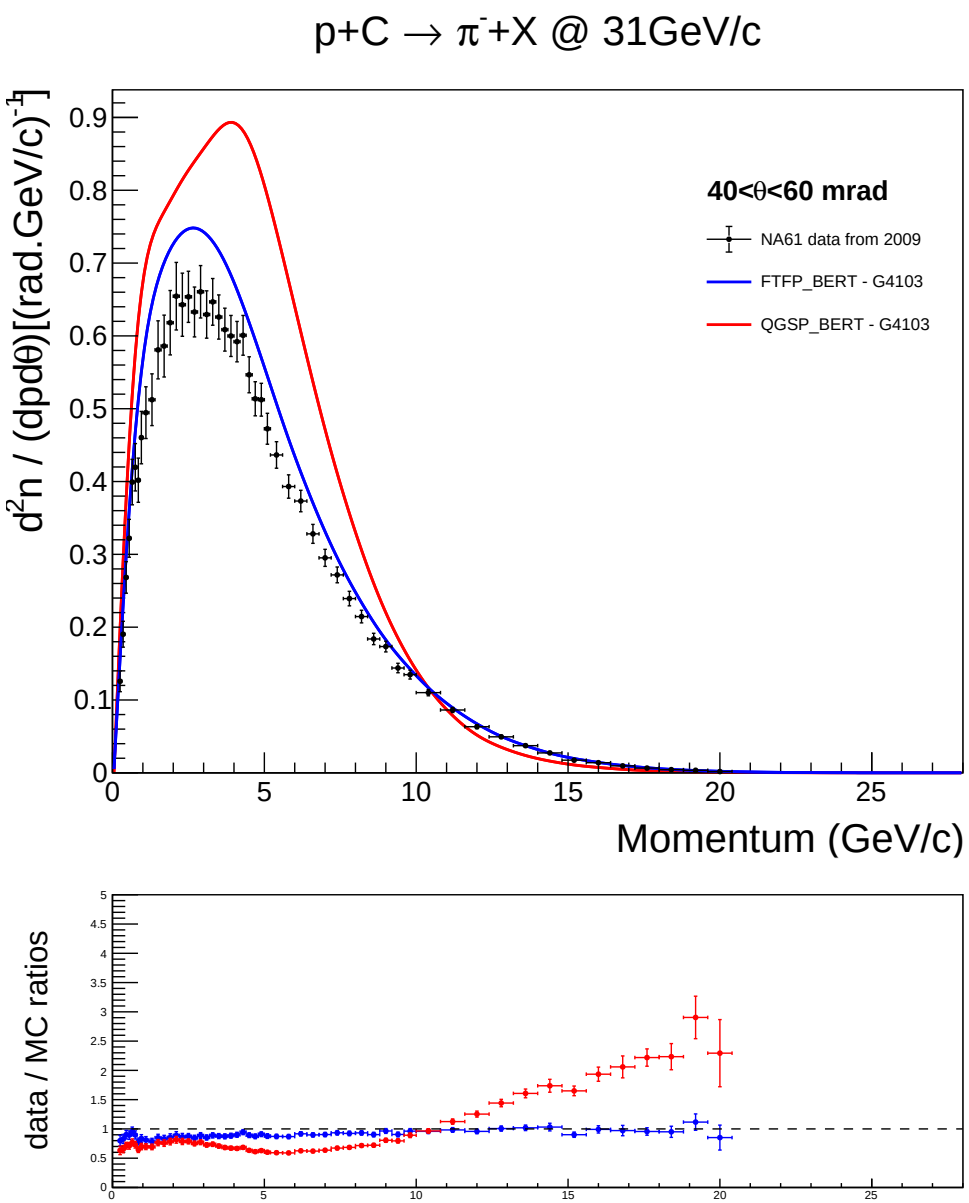

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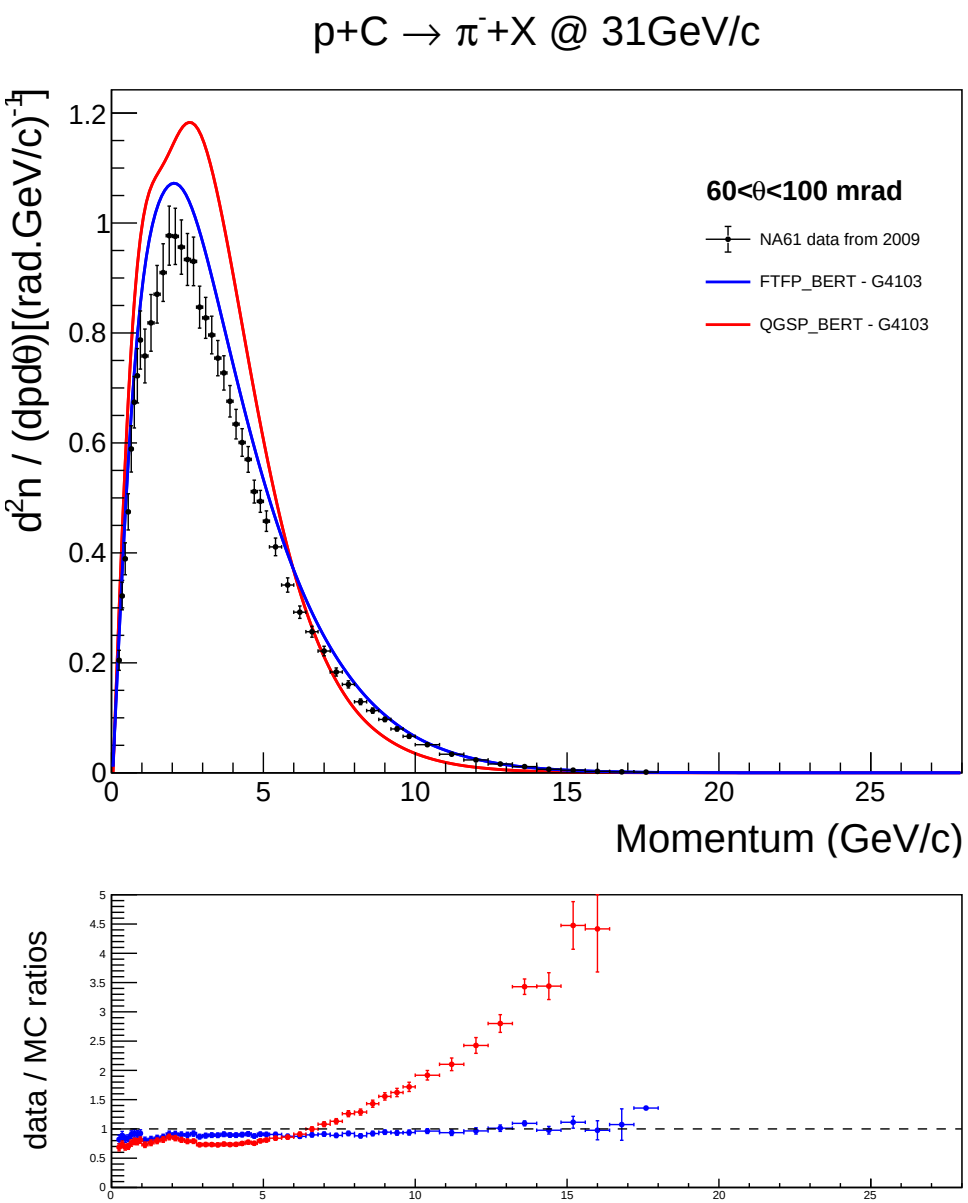

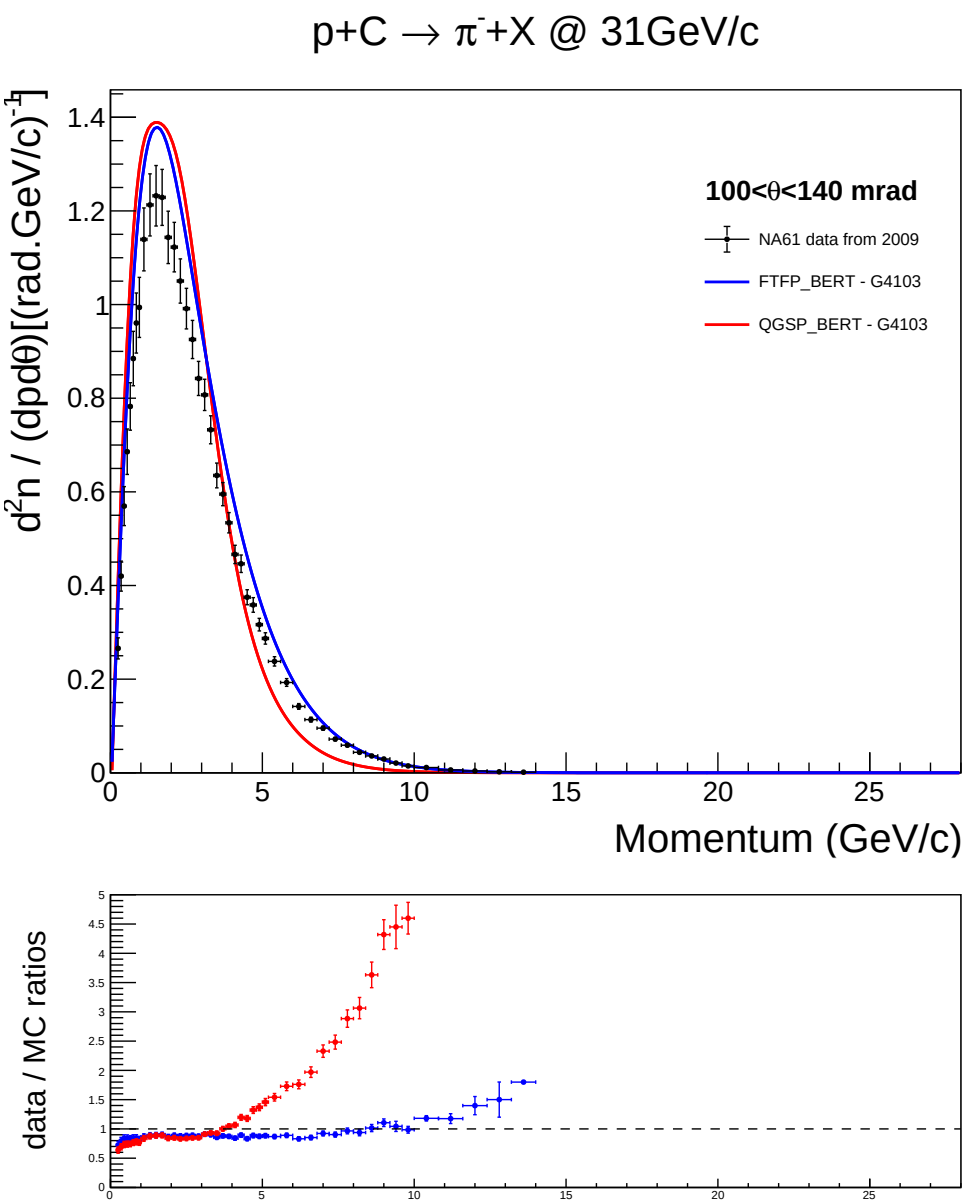

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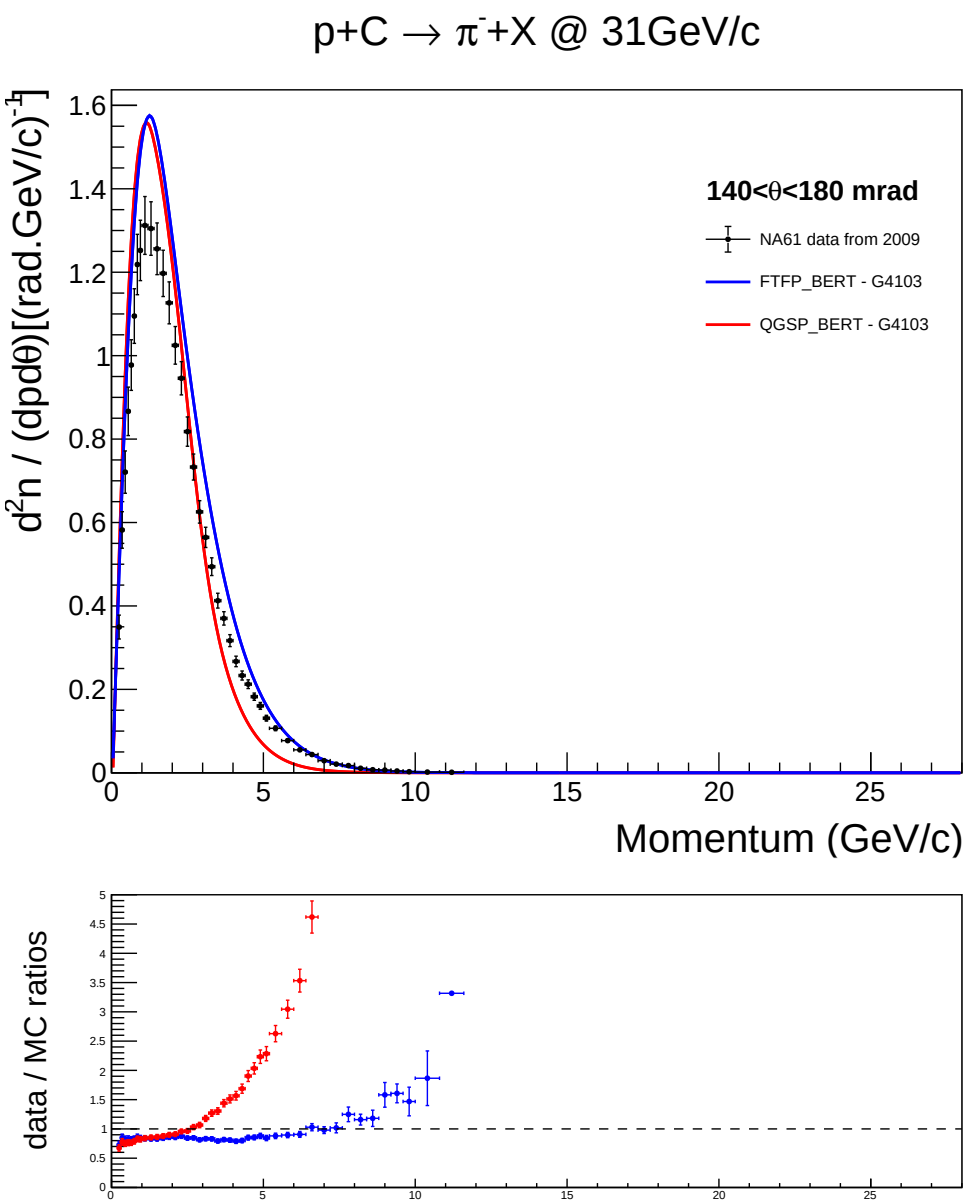

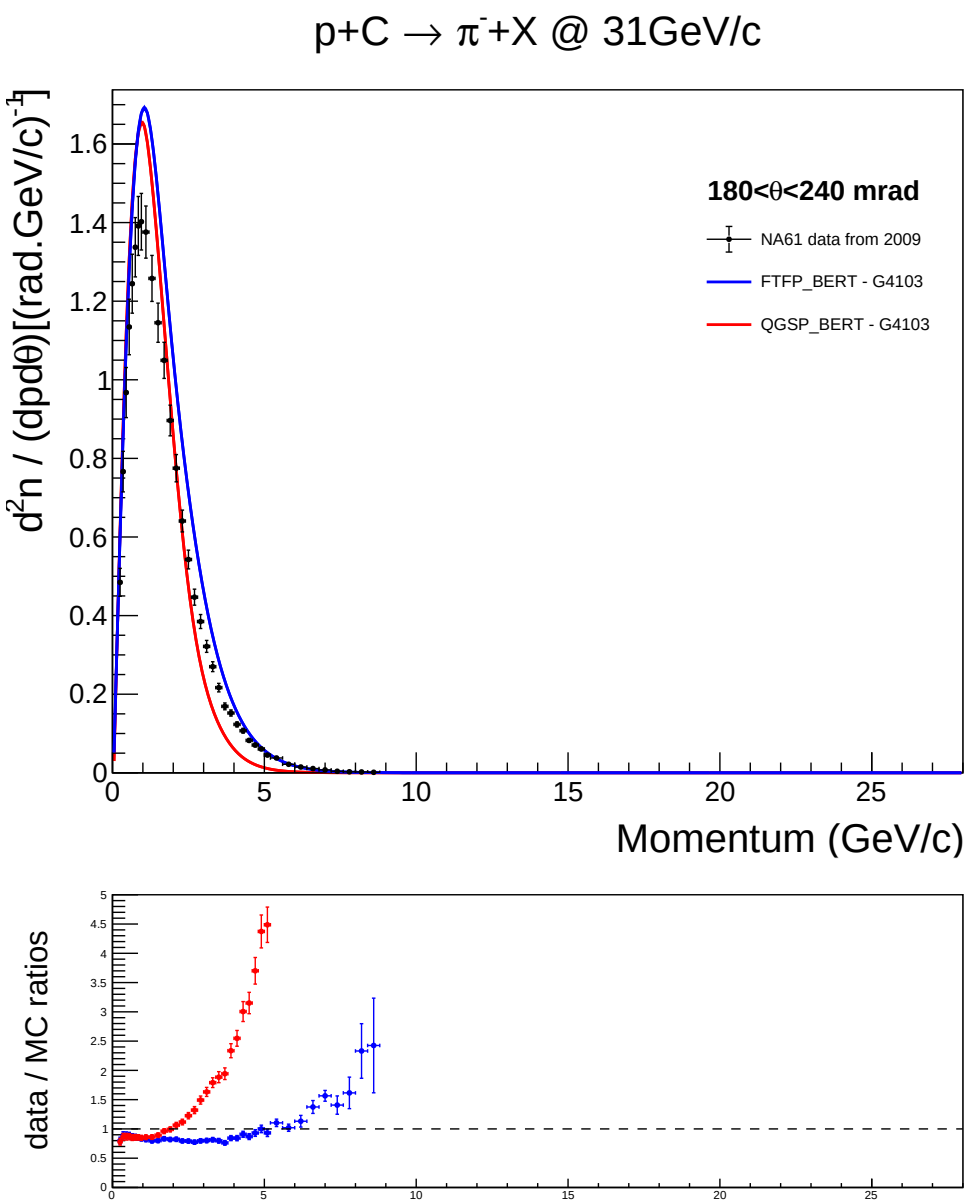

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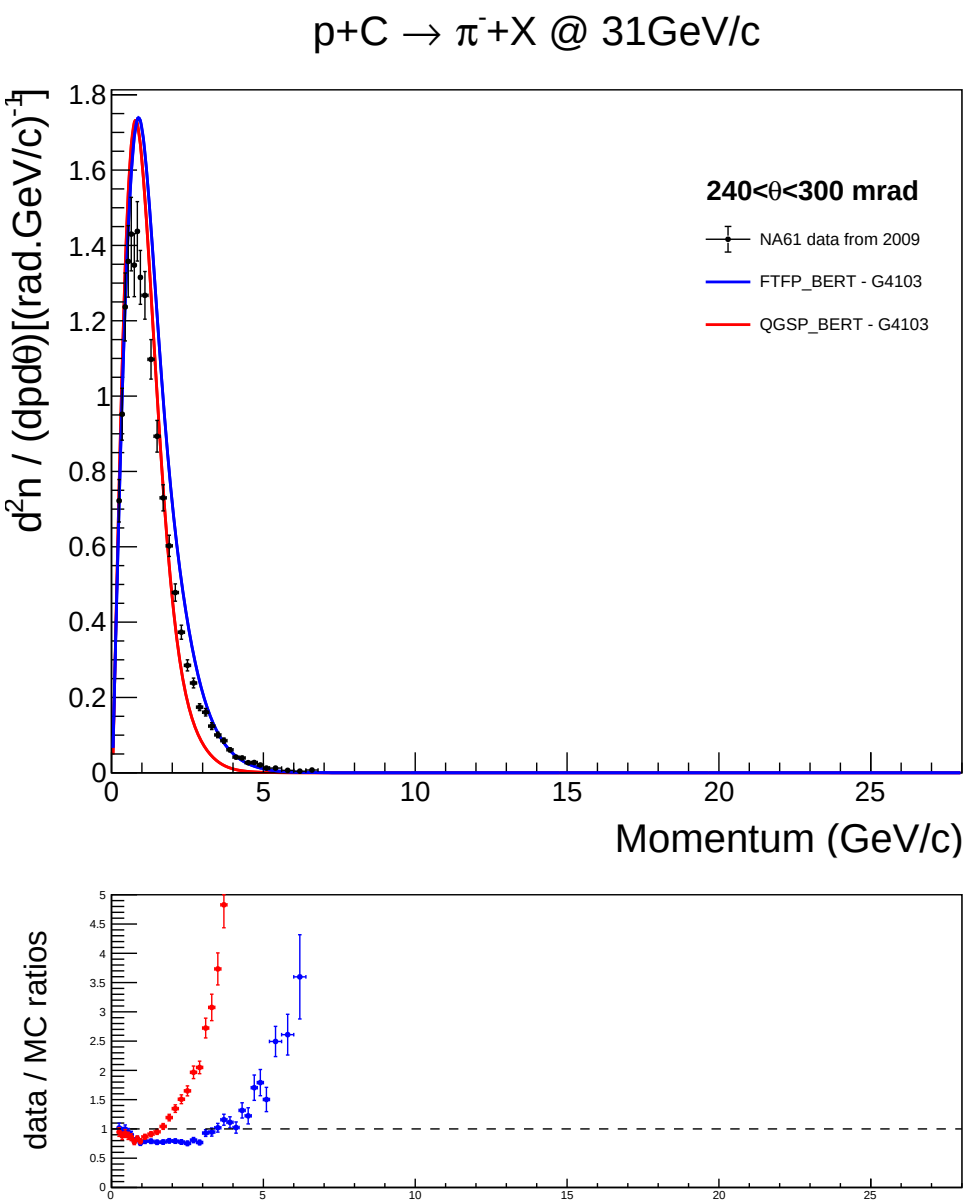

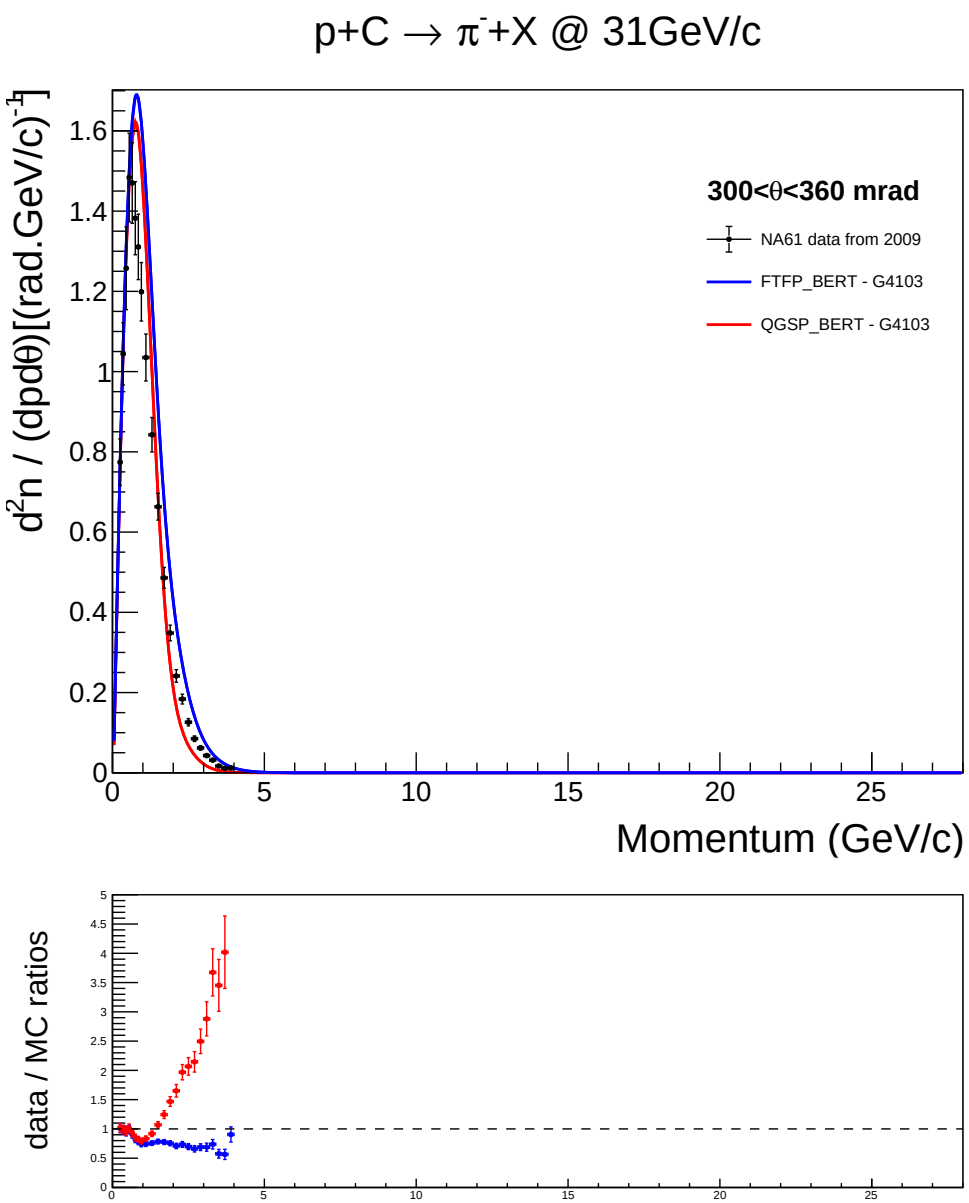

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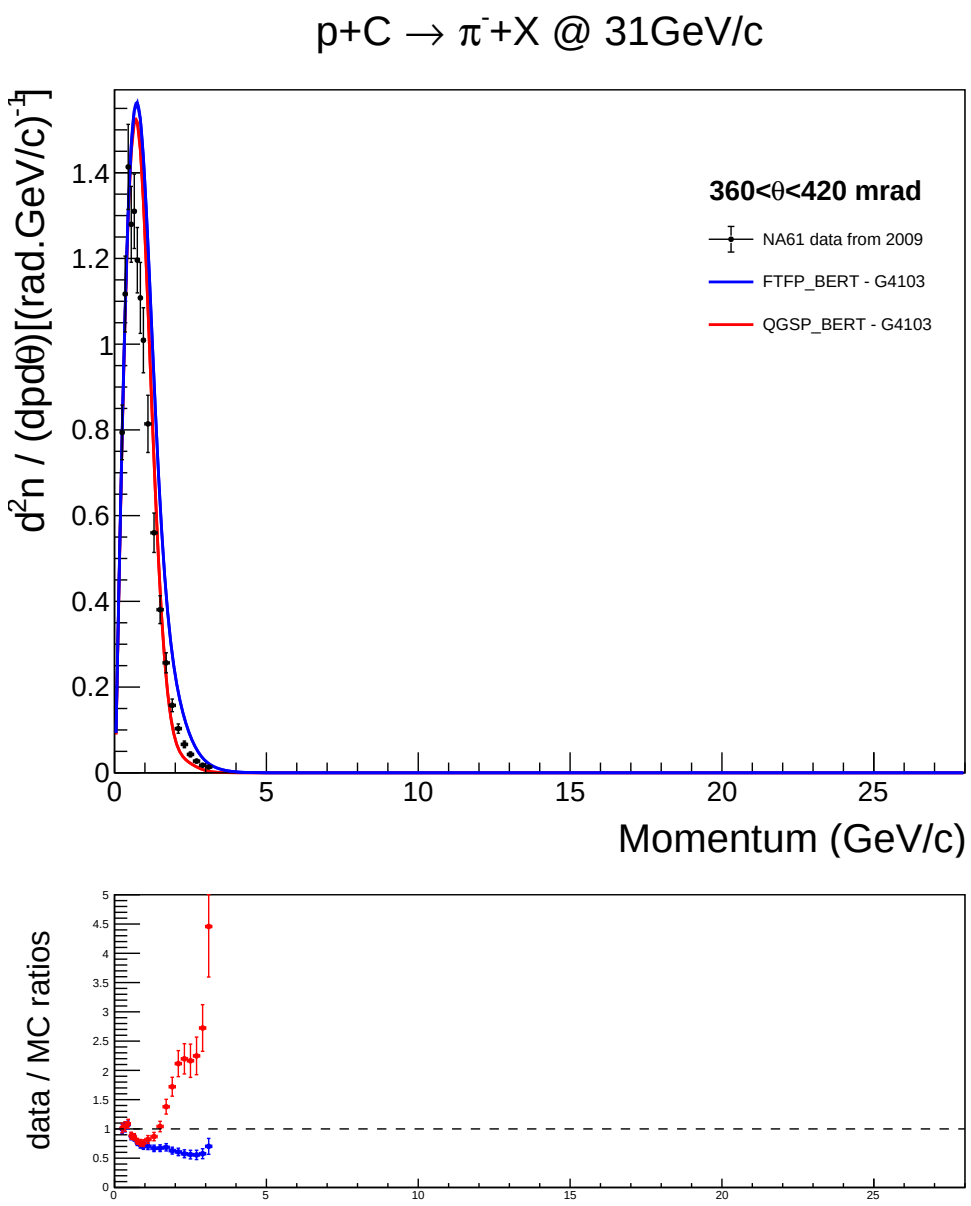
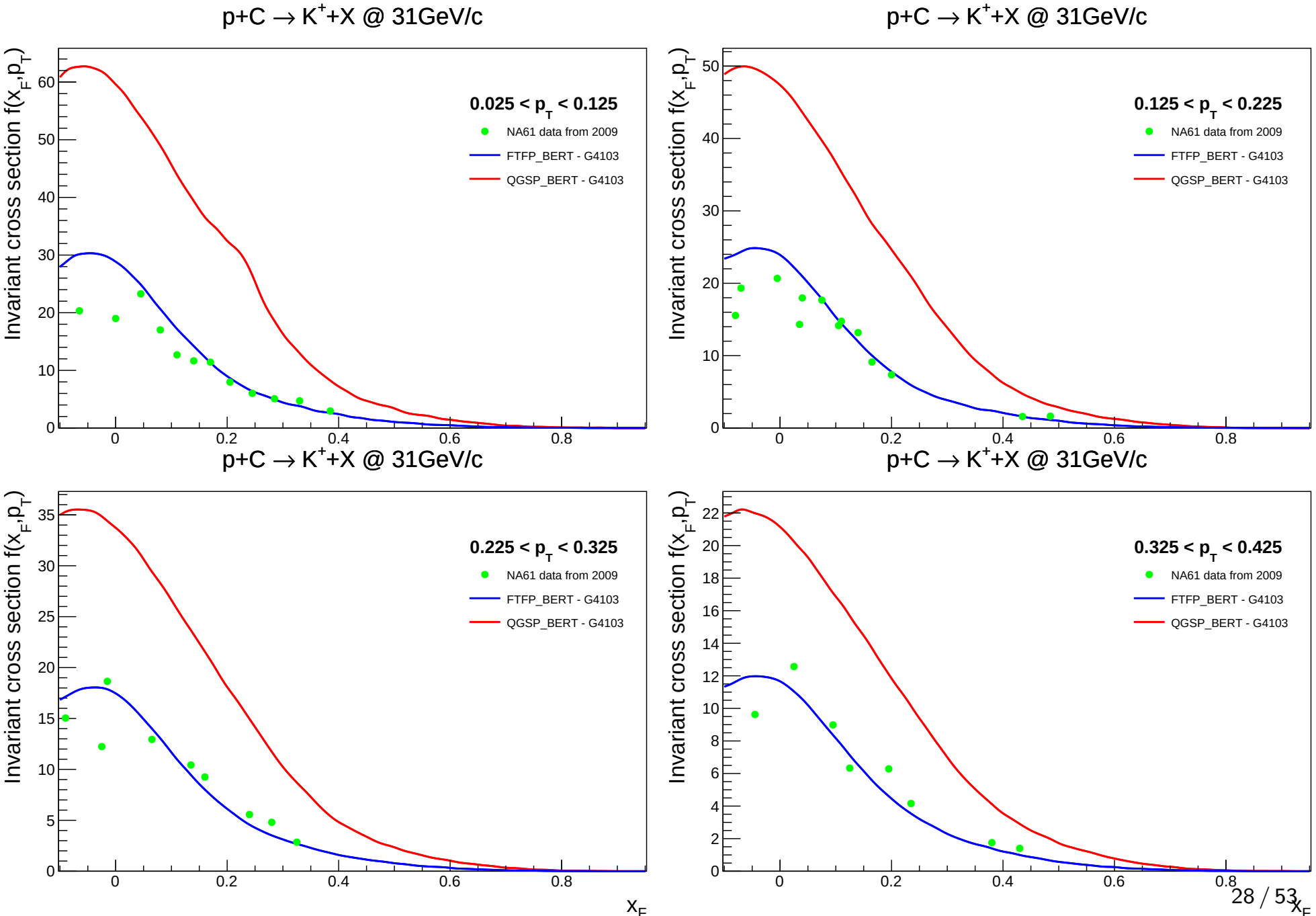


Data-MC inv. XS comparison in $x_F - p_T$

- I am taking centers of bins in $p - \theta$ and transforming them to $x_F - p_T$ (I know it's not exactly correct, it's the first attempt)
- I am filling the transformed values into a TH2F with binning based on the bins of the scaling histograms for easy scaling
  - 211 bins in x_F from -0.1025 to 0.9525
  - 40 bins in p_T from 0.025 to 2.025
- This is not ideal since several NA61 bins are outside this range
- I am plotting the TH2F as 1D histograms "slicing" through the p_T axis with $0.1 GeV/c$ steps (2 TH2 bins)
  - this introduces the non-continuous behaviour mostly visible in the π prod. plots

Data-MC inv. XS comparison in $x_F - p_T$ @31GeV/c



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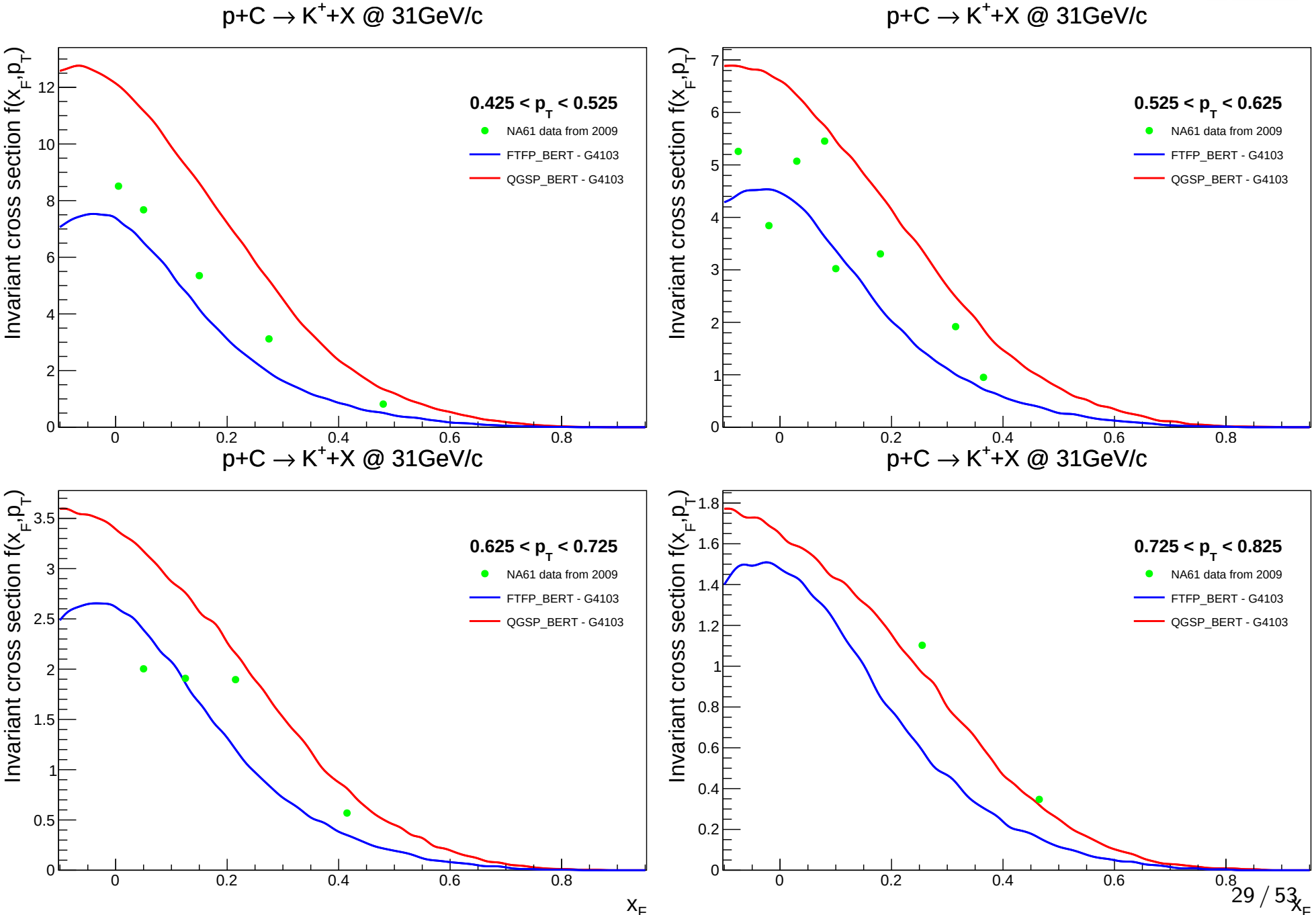

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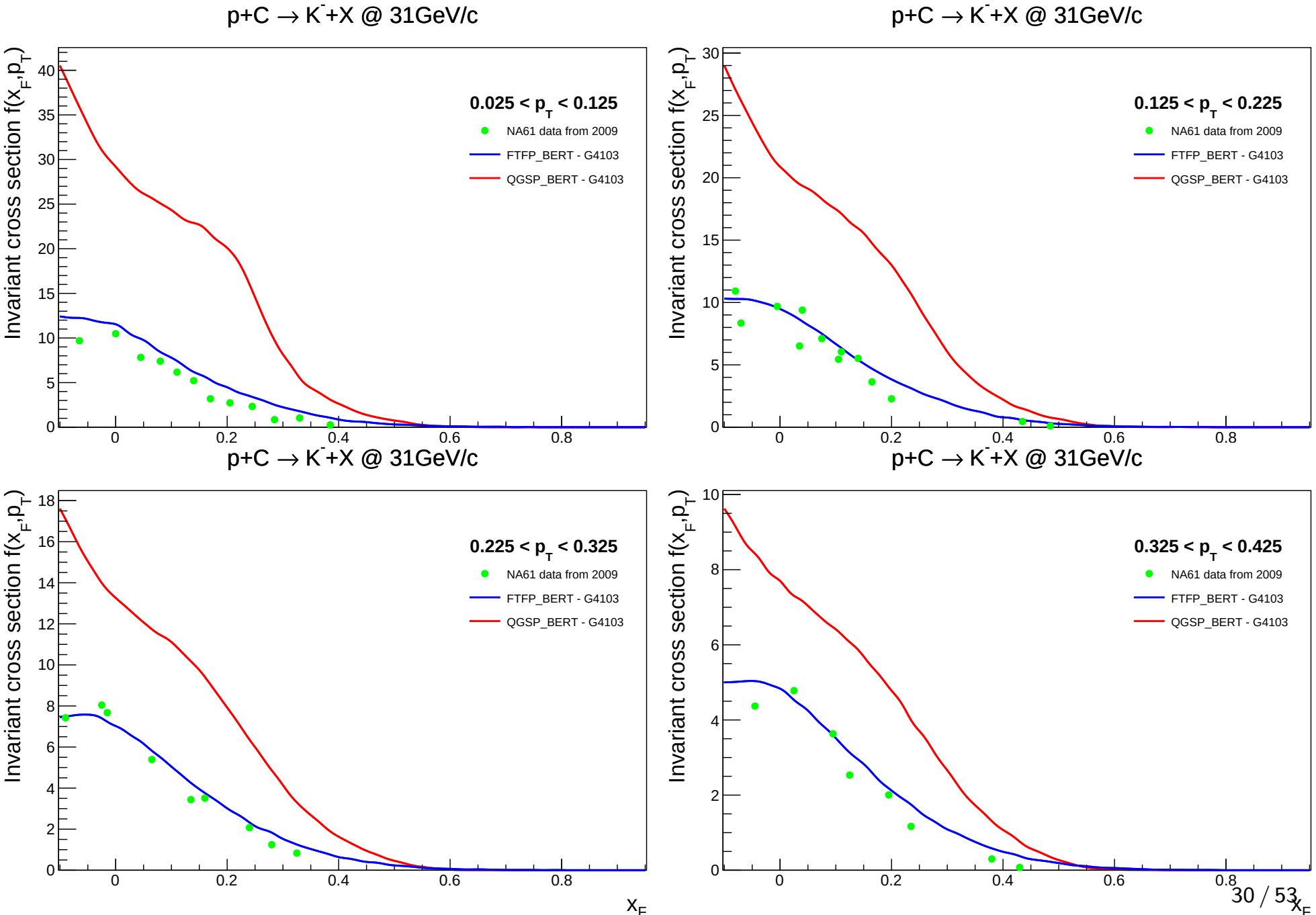

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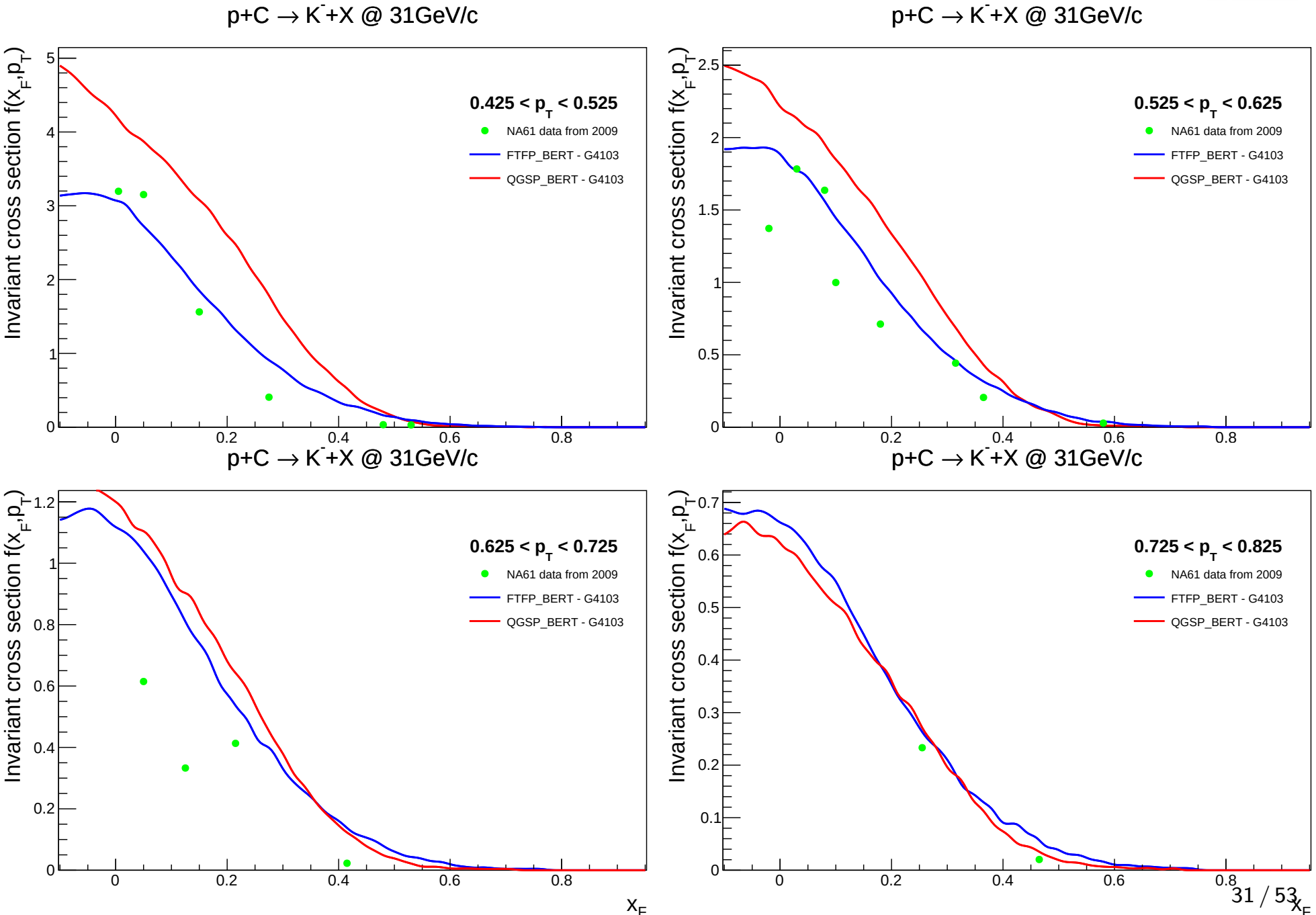

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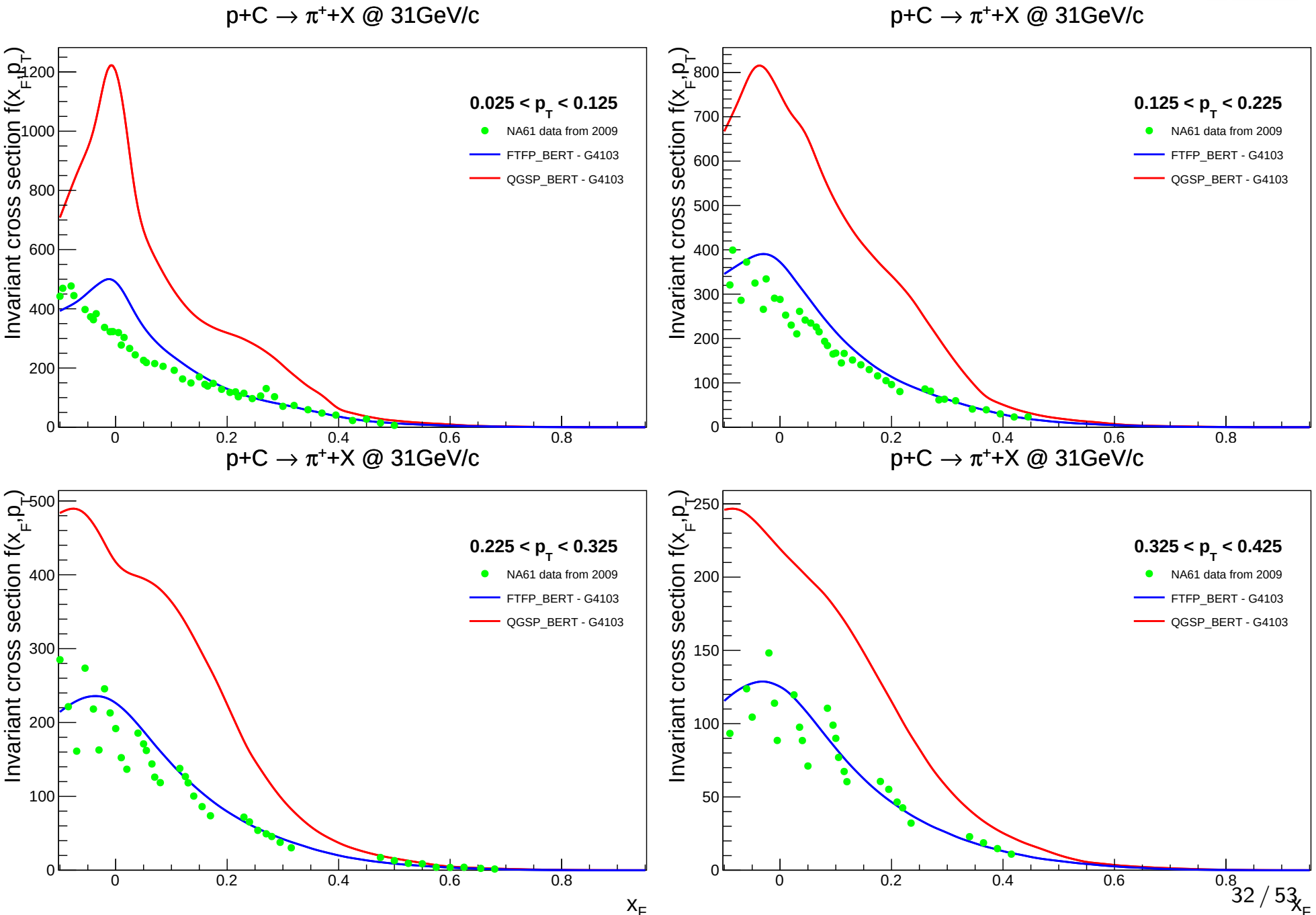

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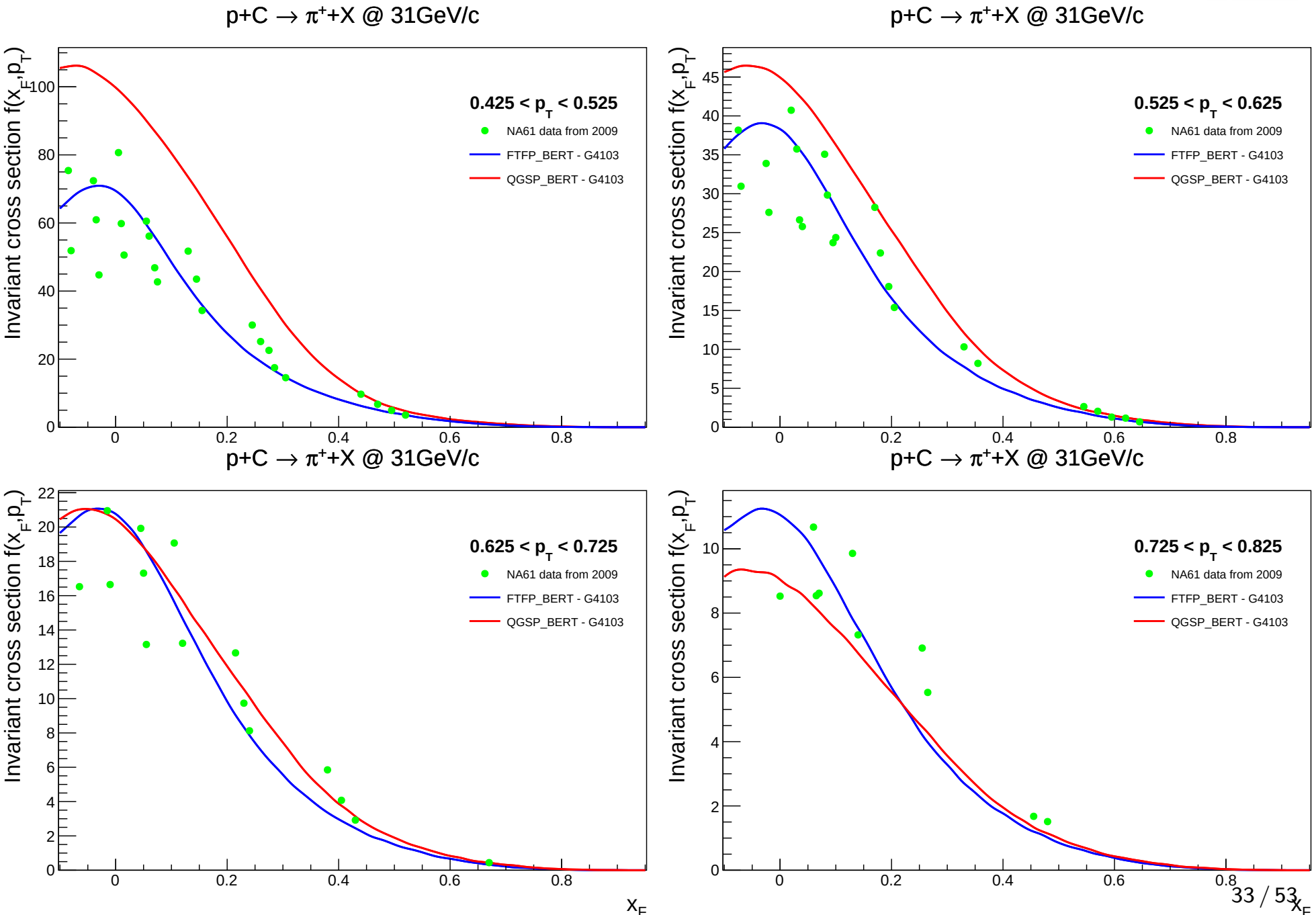

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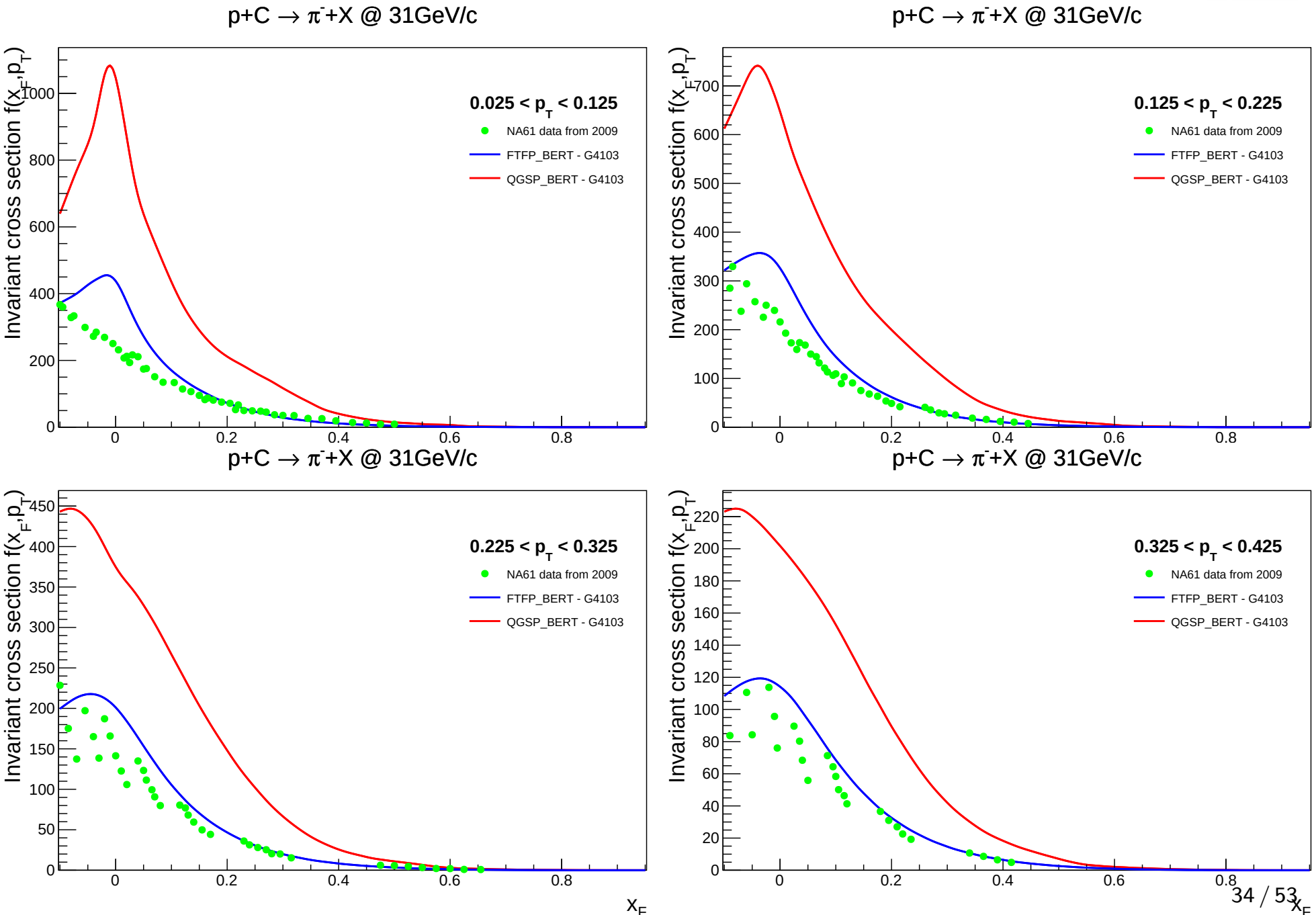

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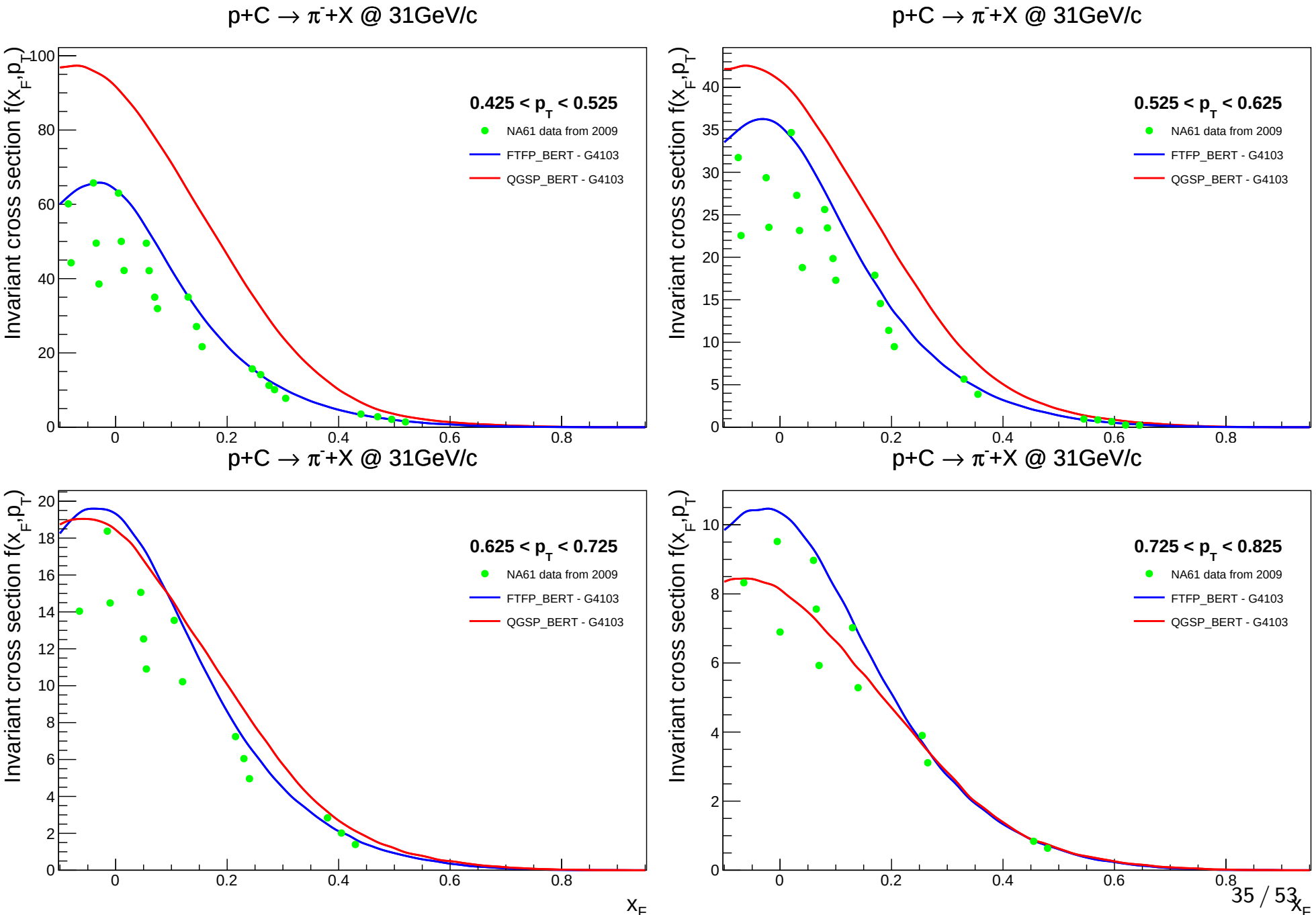
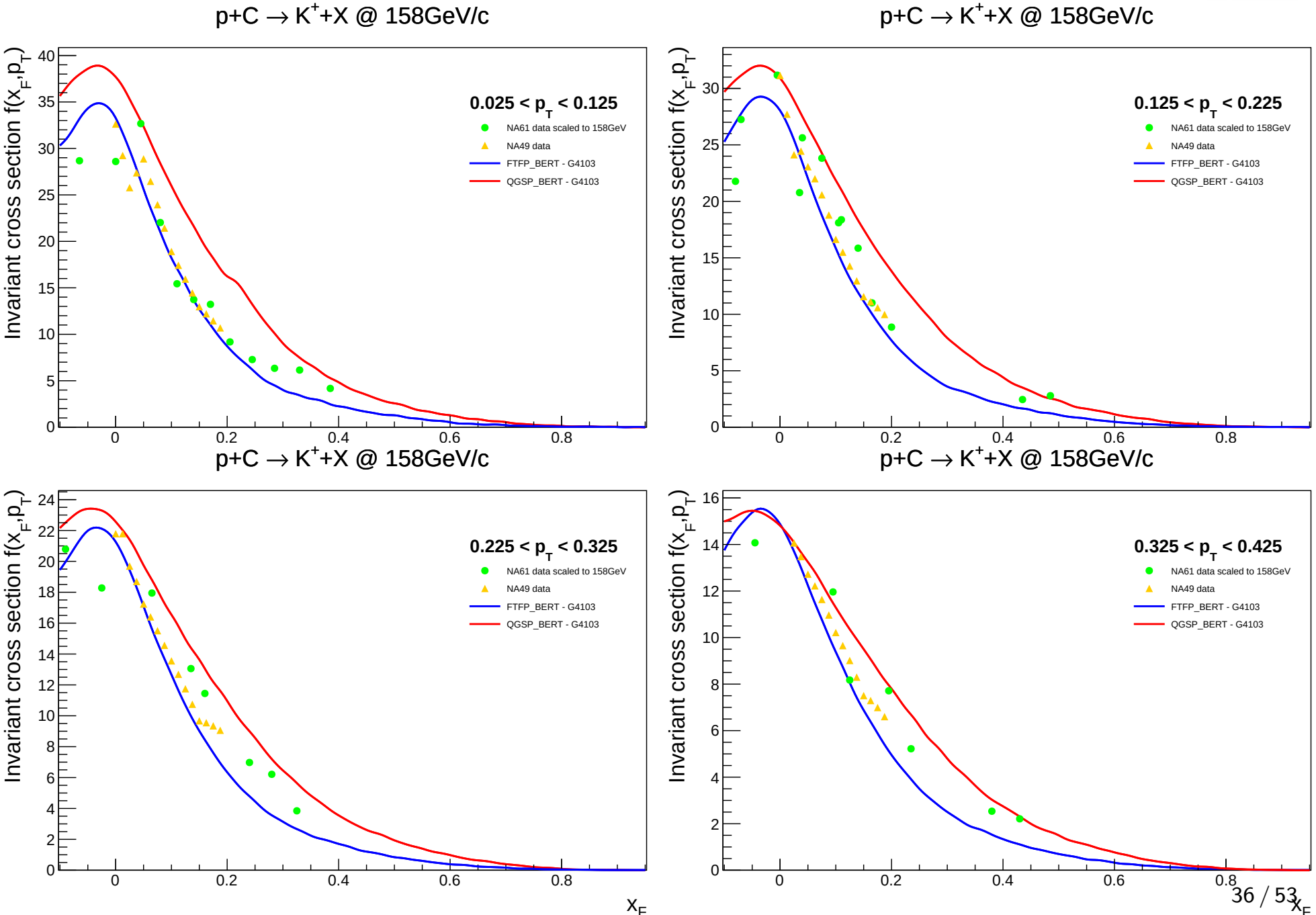
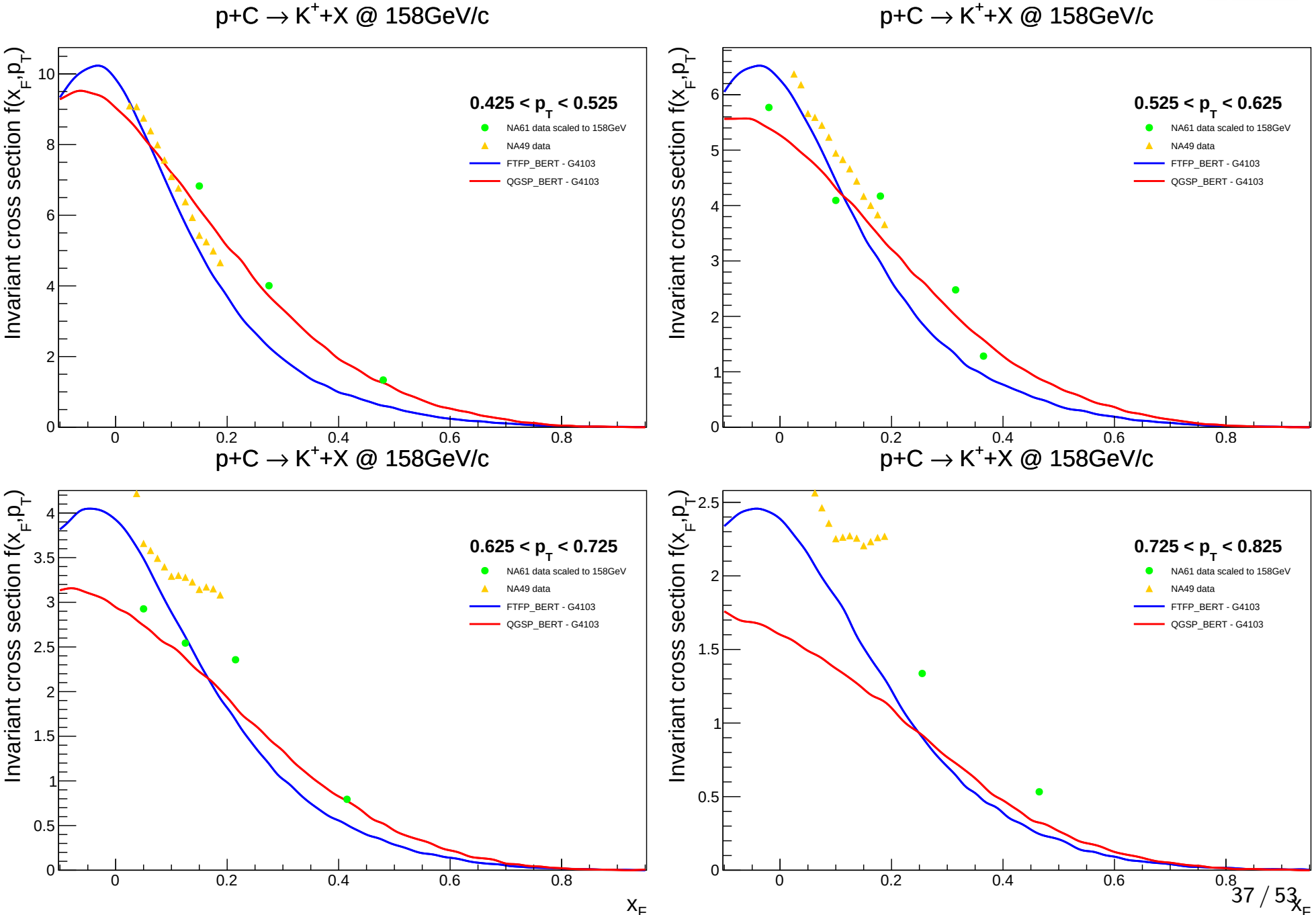


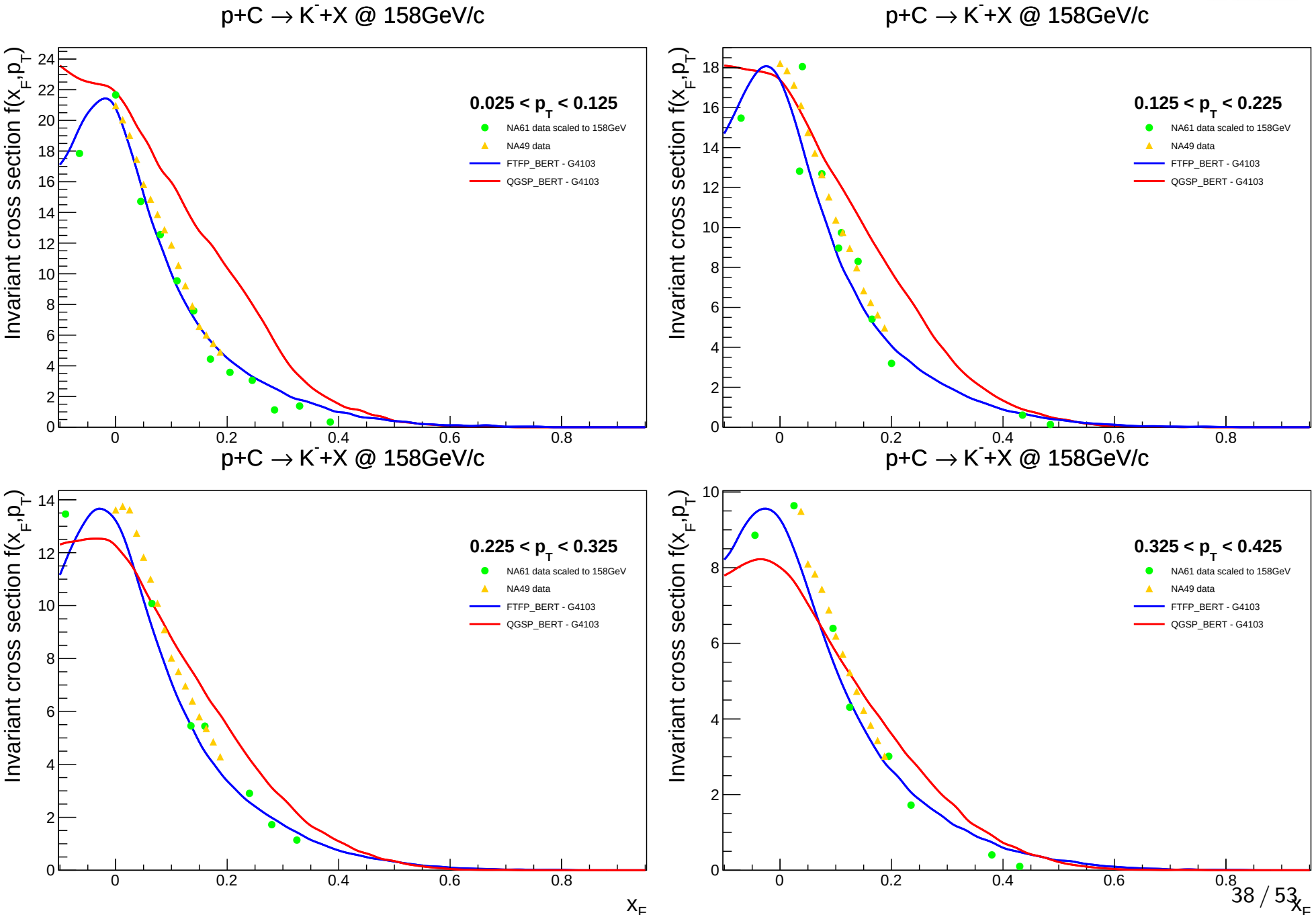
Data-MC inv. XS comparison in $x_F - p_T$ @158GeV/c



Data-MC inv. XS comparison in $x_F - p_T$ @158GeV/c



Data-MC inv. XS comparison in $x_F - p_T$ @158GeV/c



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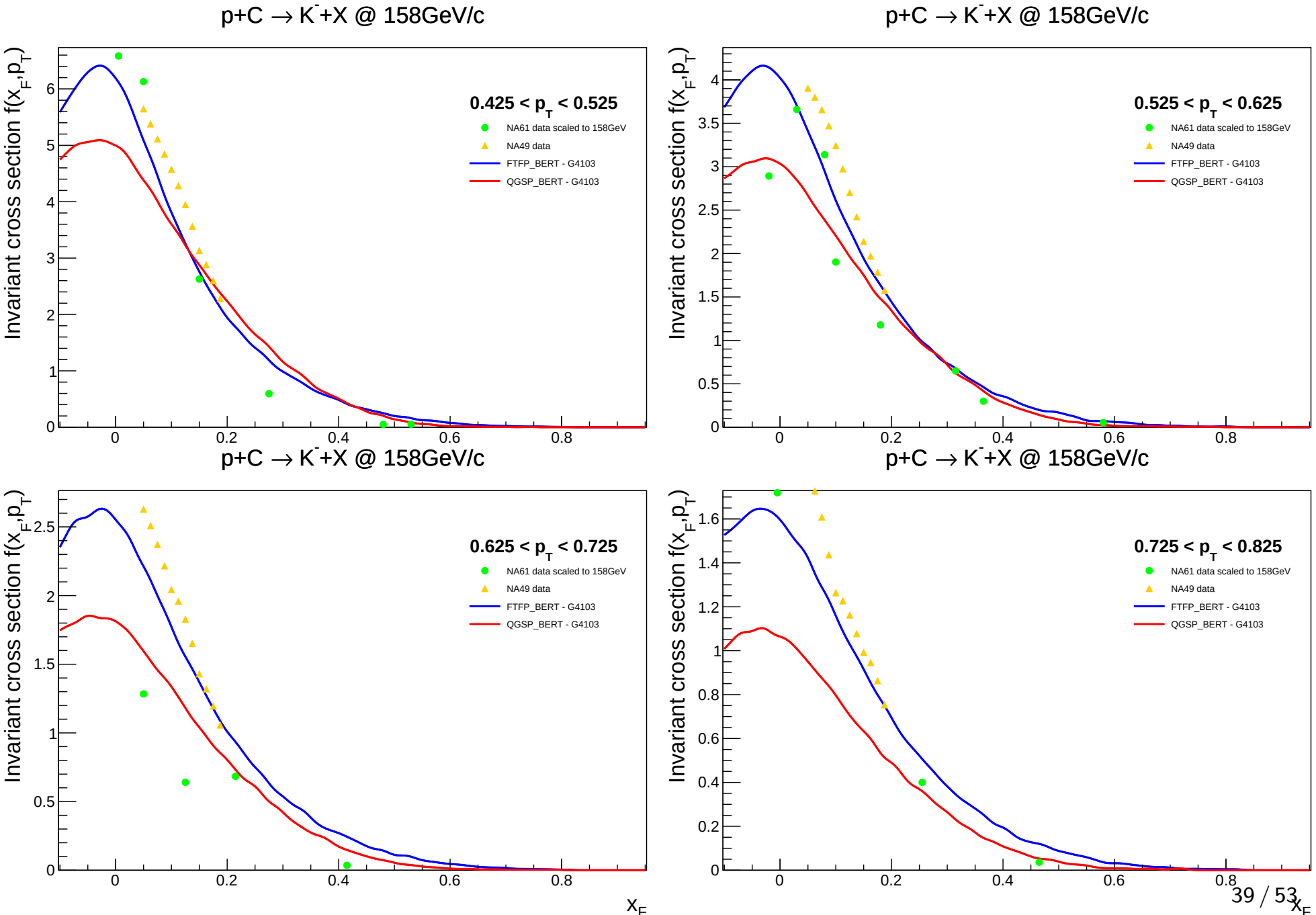
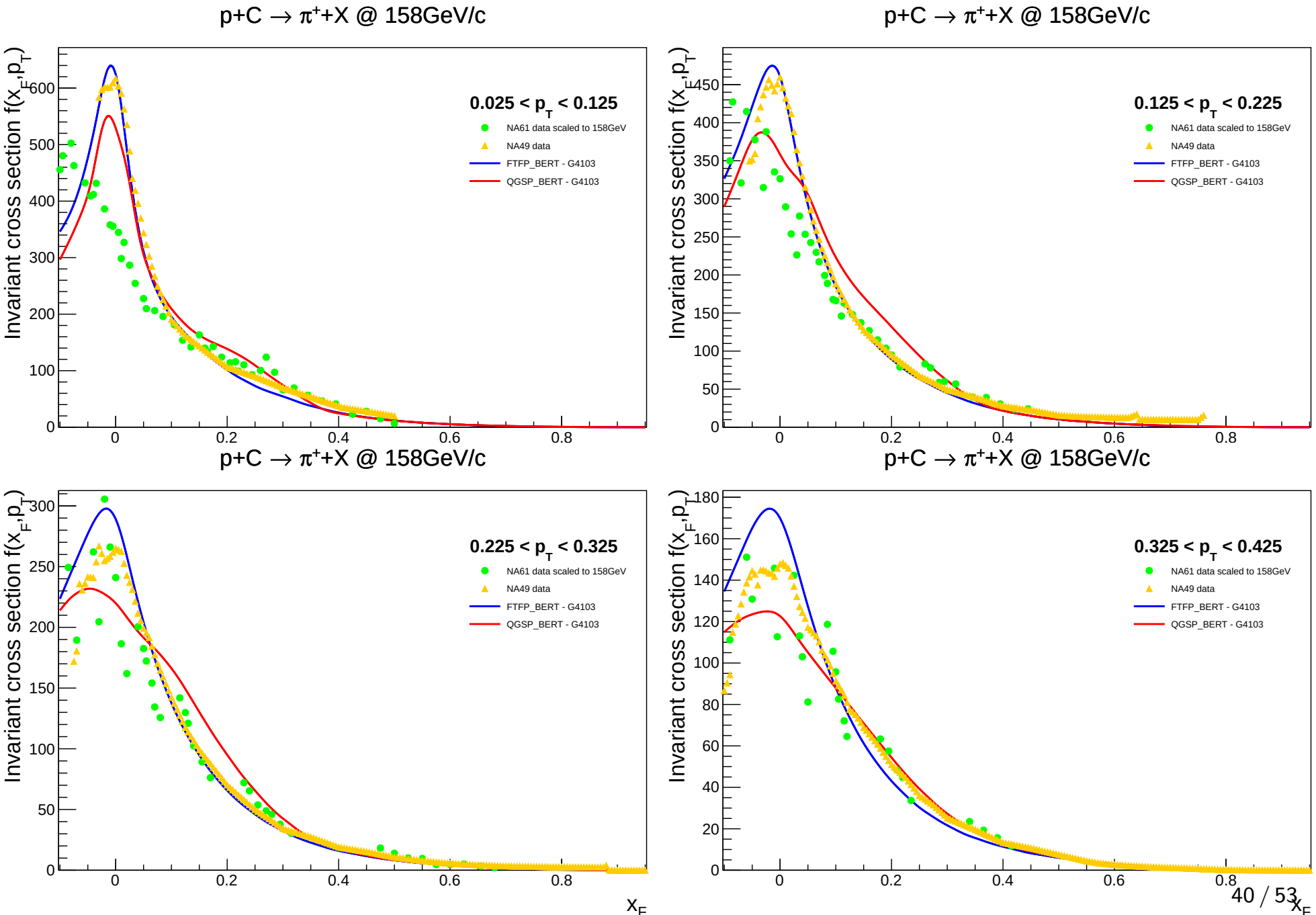
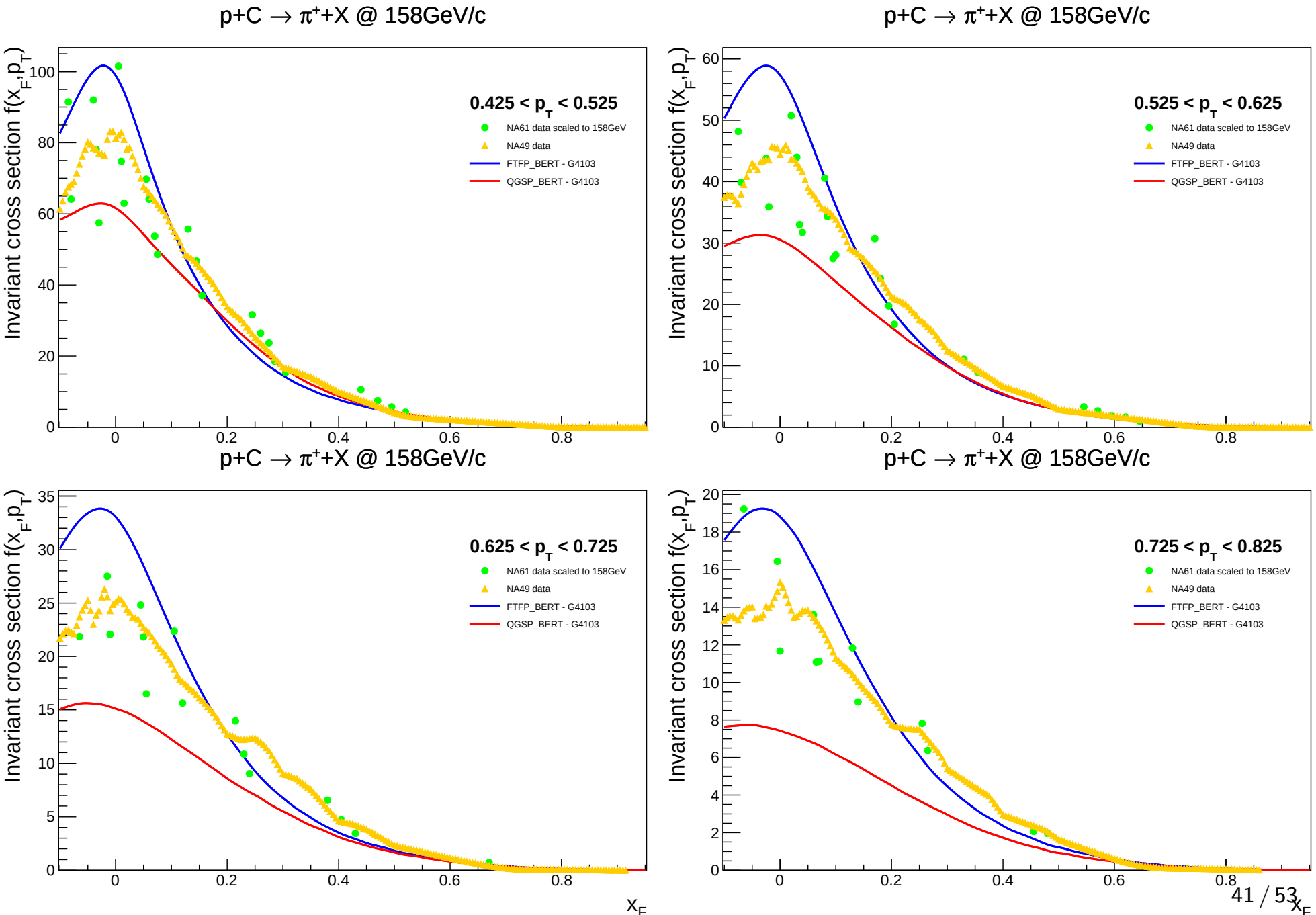


Data-MC inv. XS comparison in $x_F - p_T$ @158GeV/c



Data-MC inv. XS comparison in $x_F - p_T$ @158GeV/c



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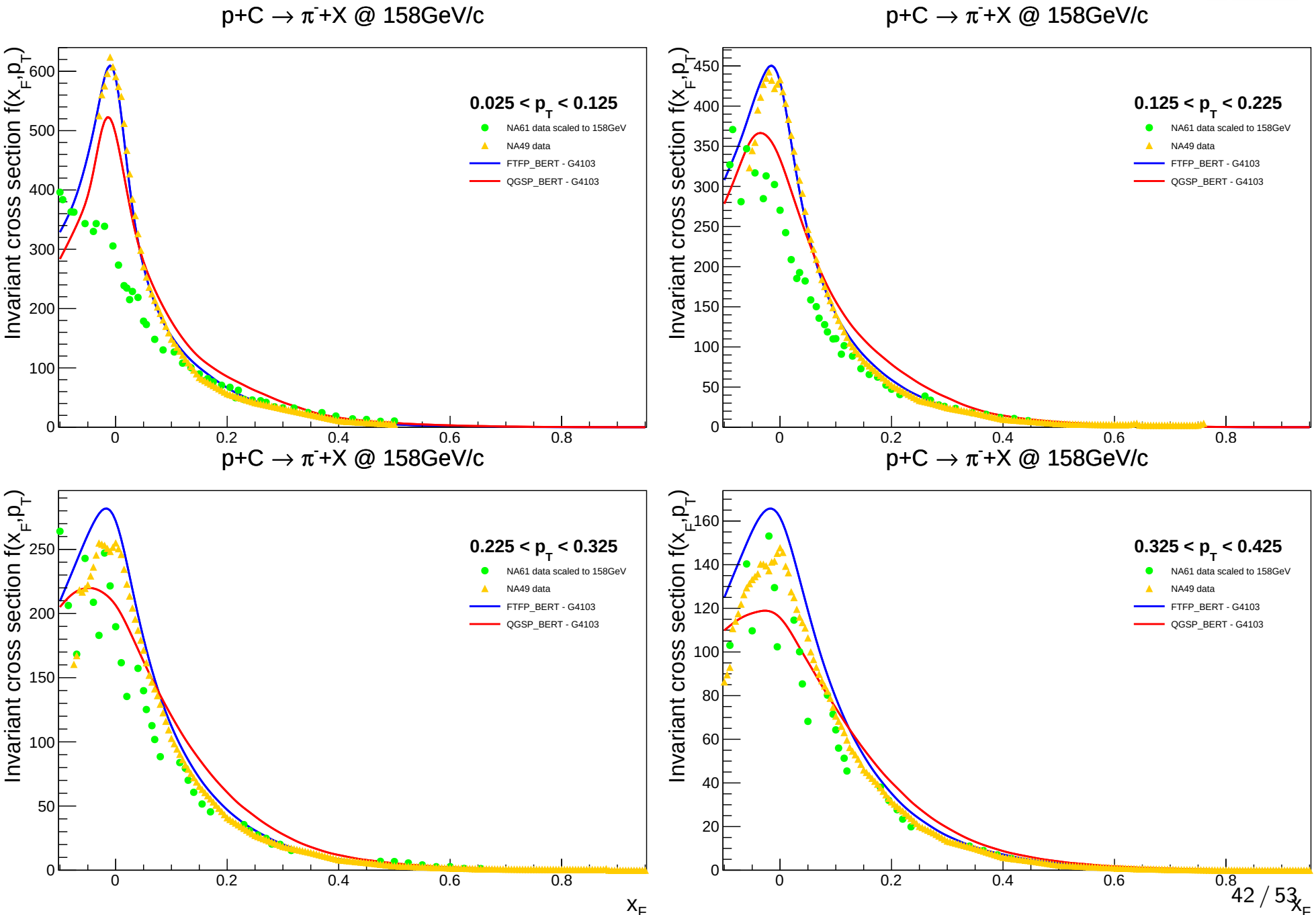
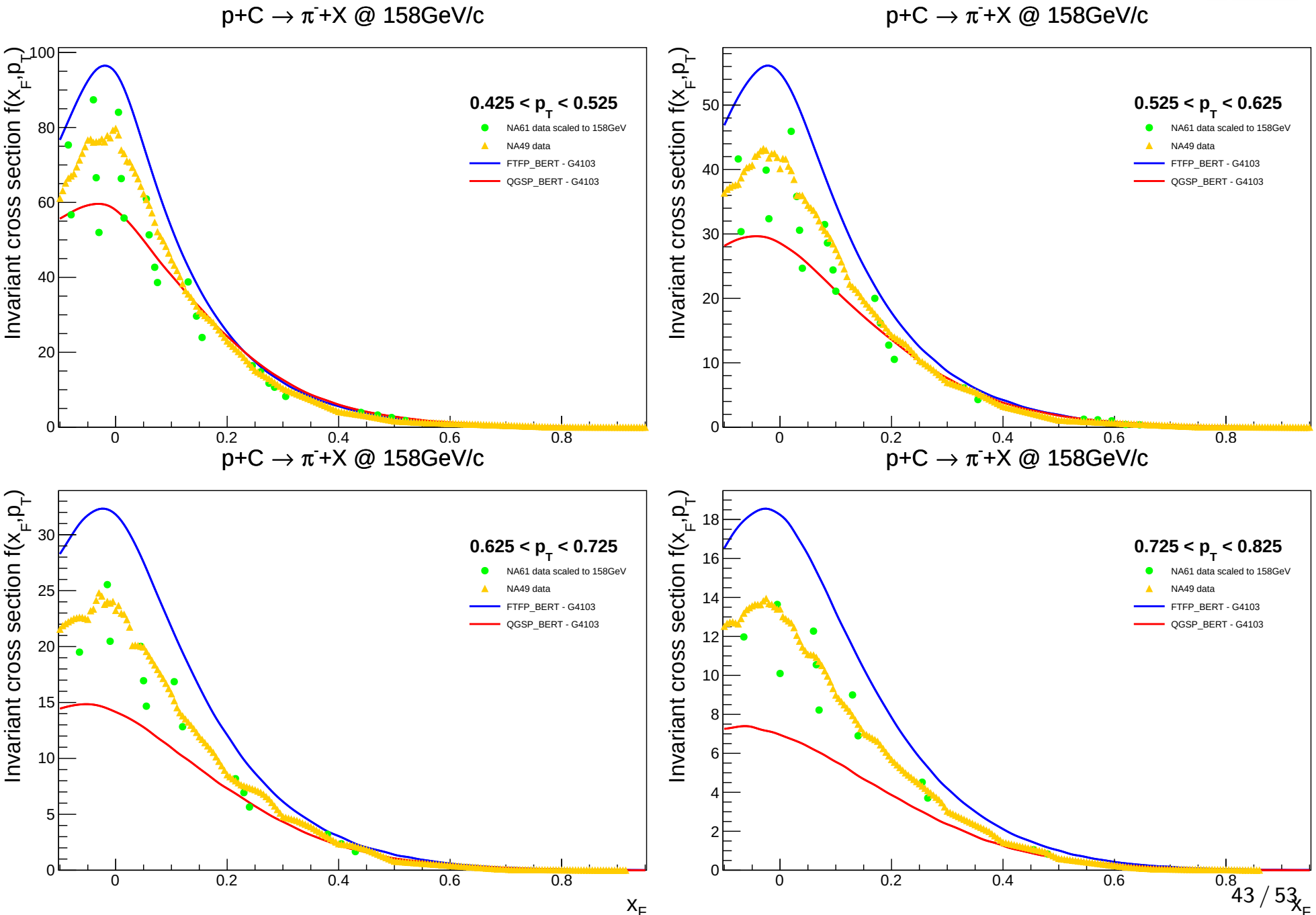
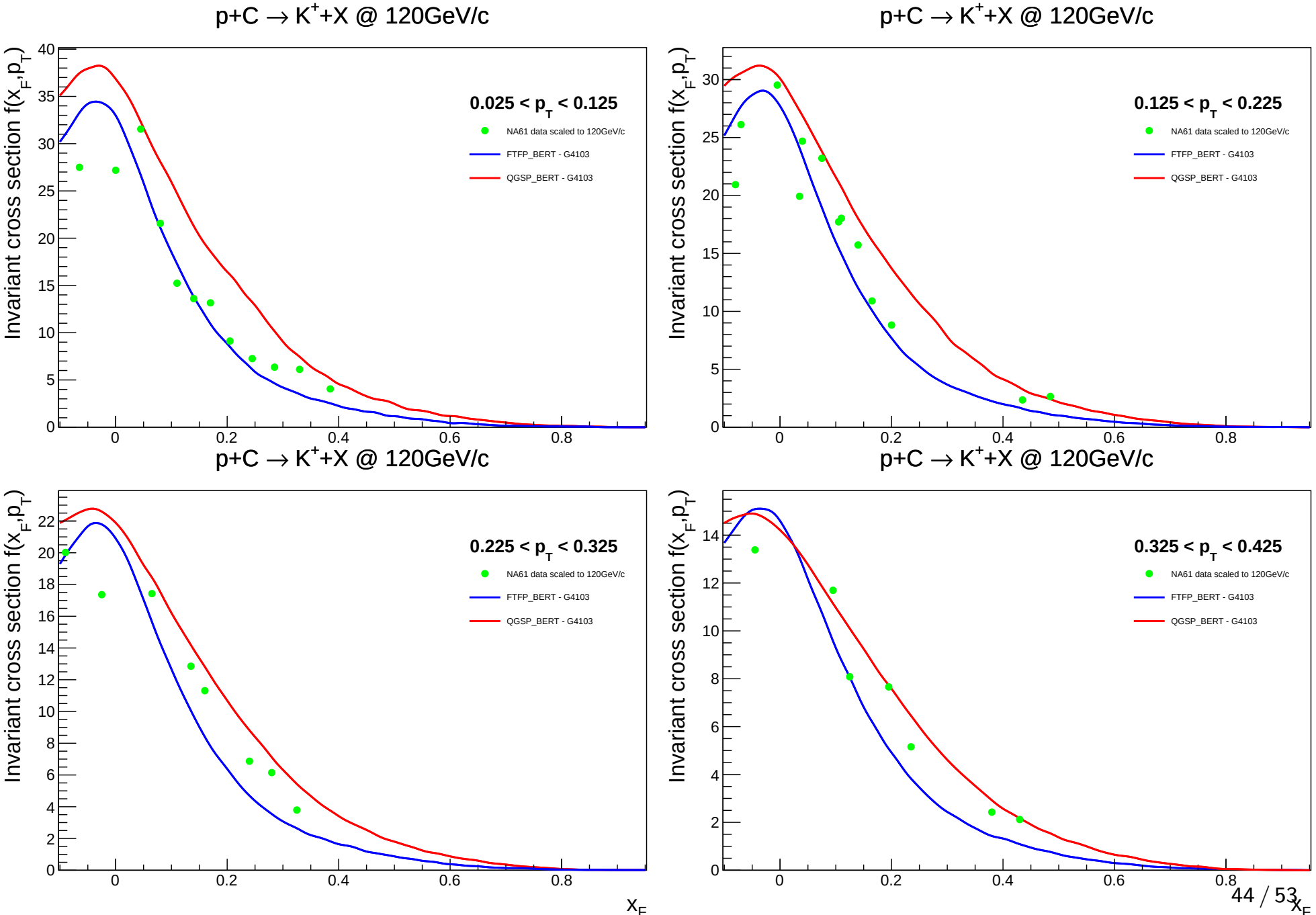


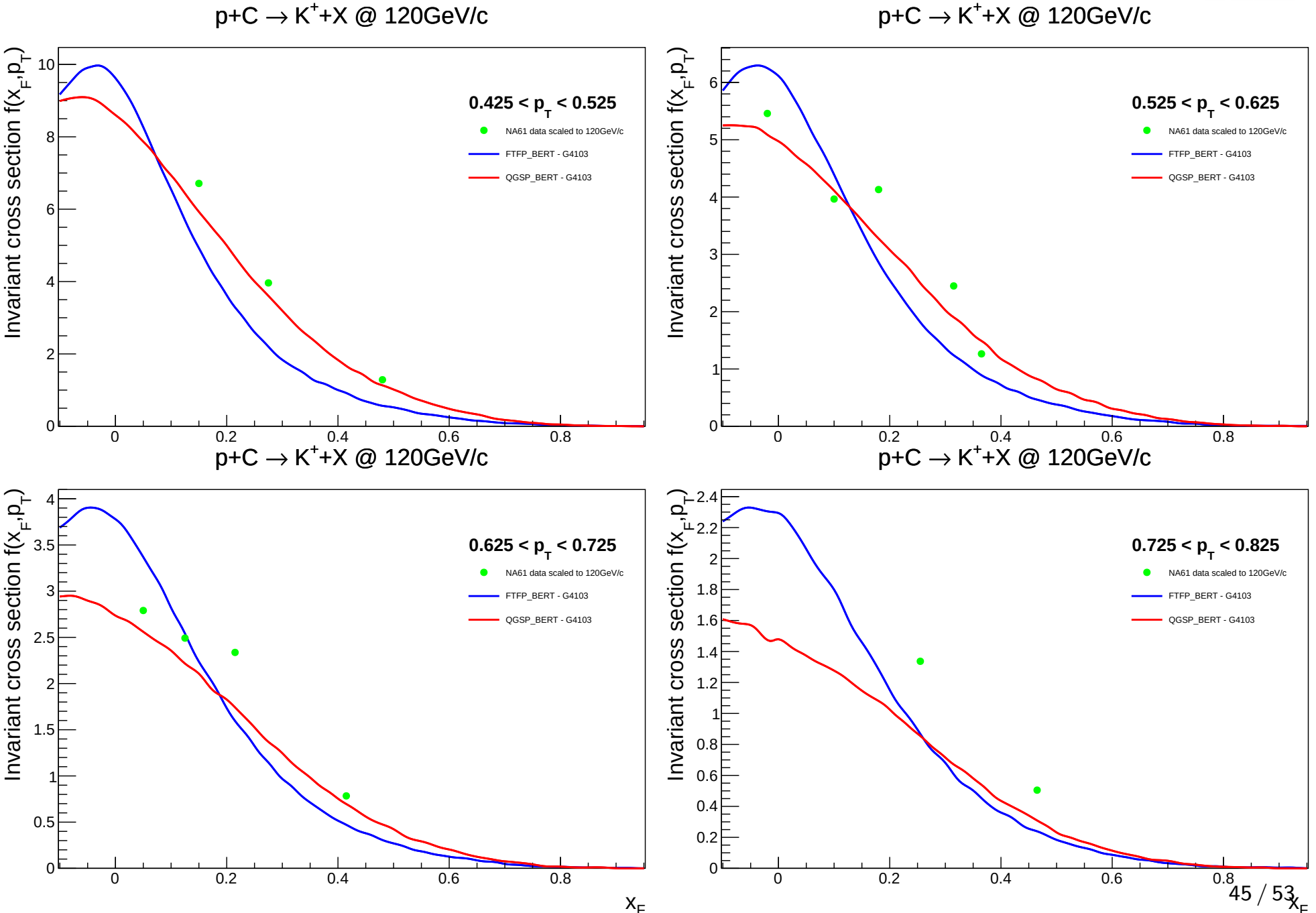
Data-MC inv. XS comparison in $x_F - p_T$ @158GeV/c



Data-MC inv. XS comparison in $x_F - p_T$ @120GeV/c



Data-MC inv. XS comparison in $x_F - p_T$ @120GeV/c



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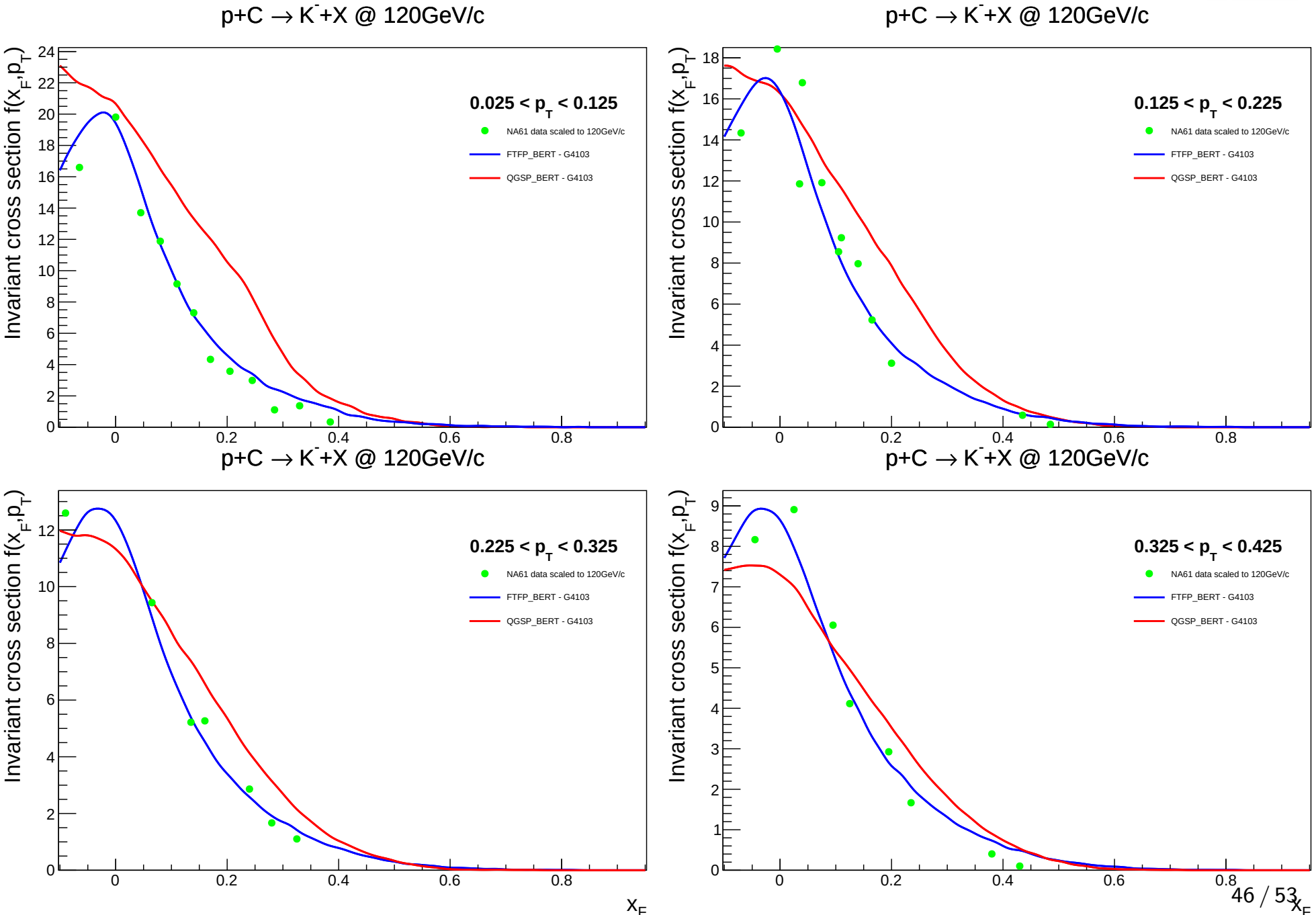
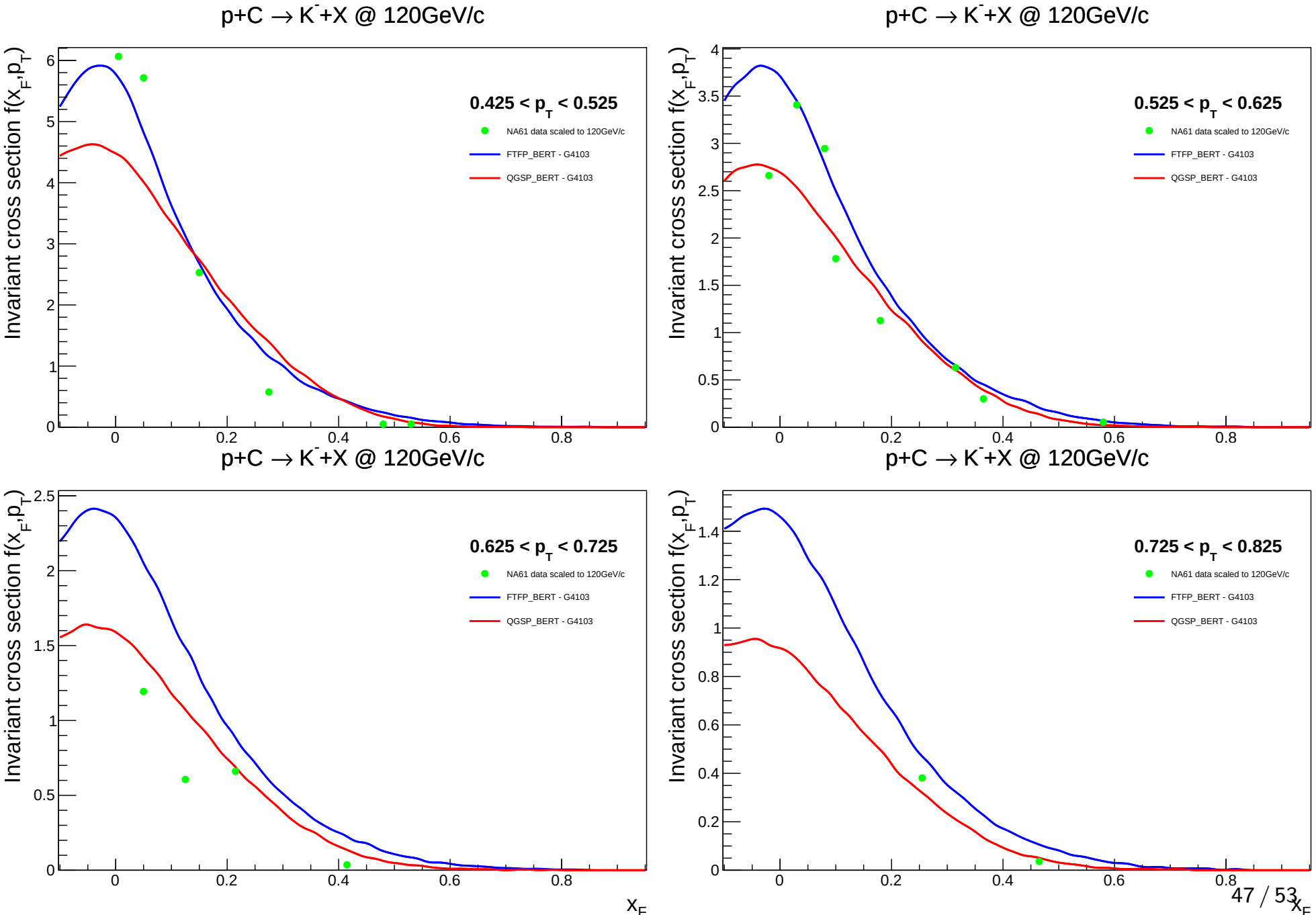


Data-MC inv. XS comparison in $x_F - p_T$ @120GeV/c



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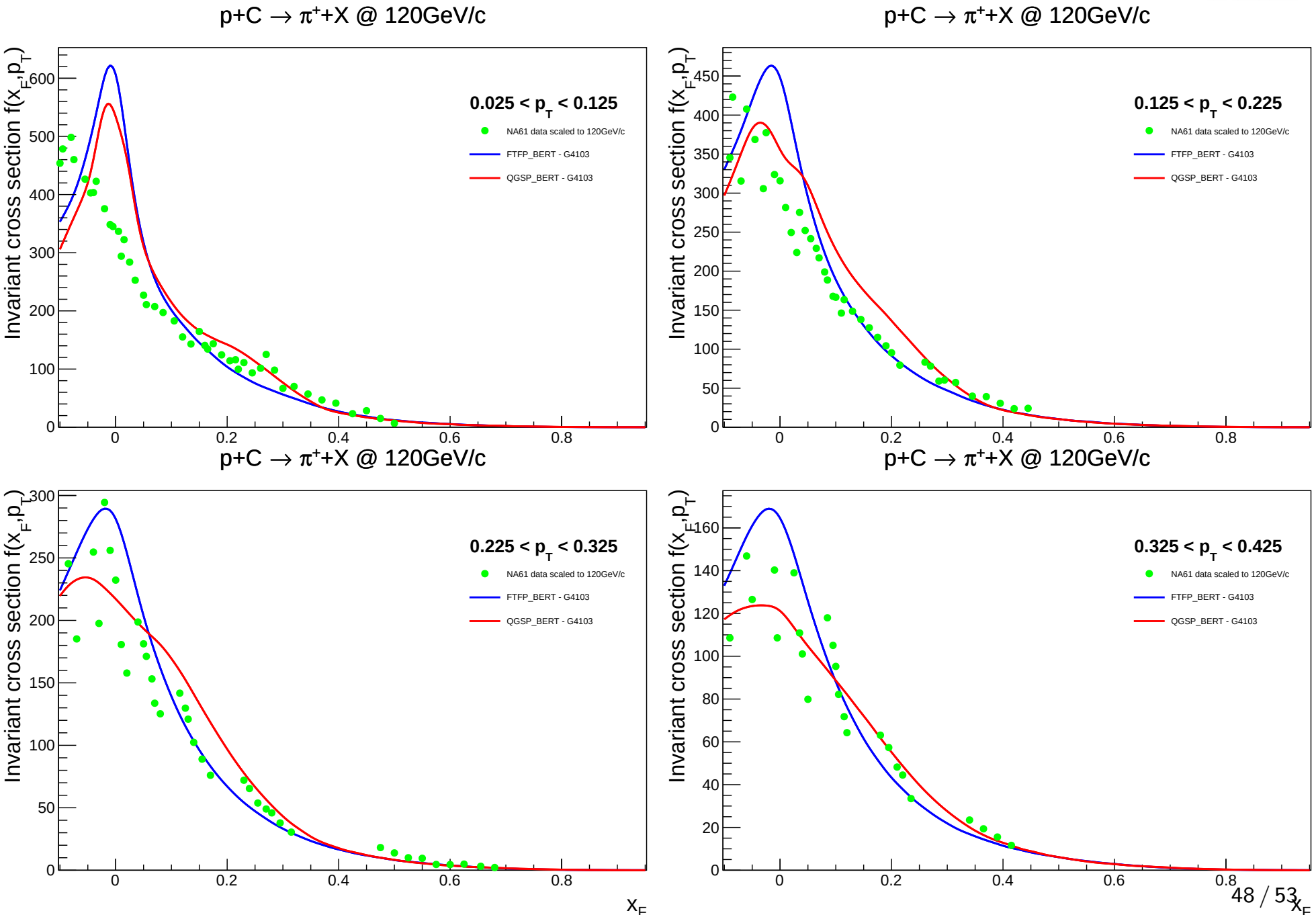

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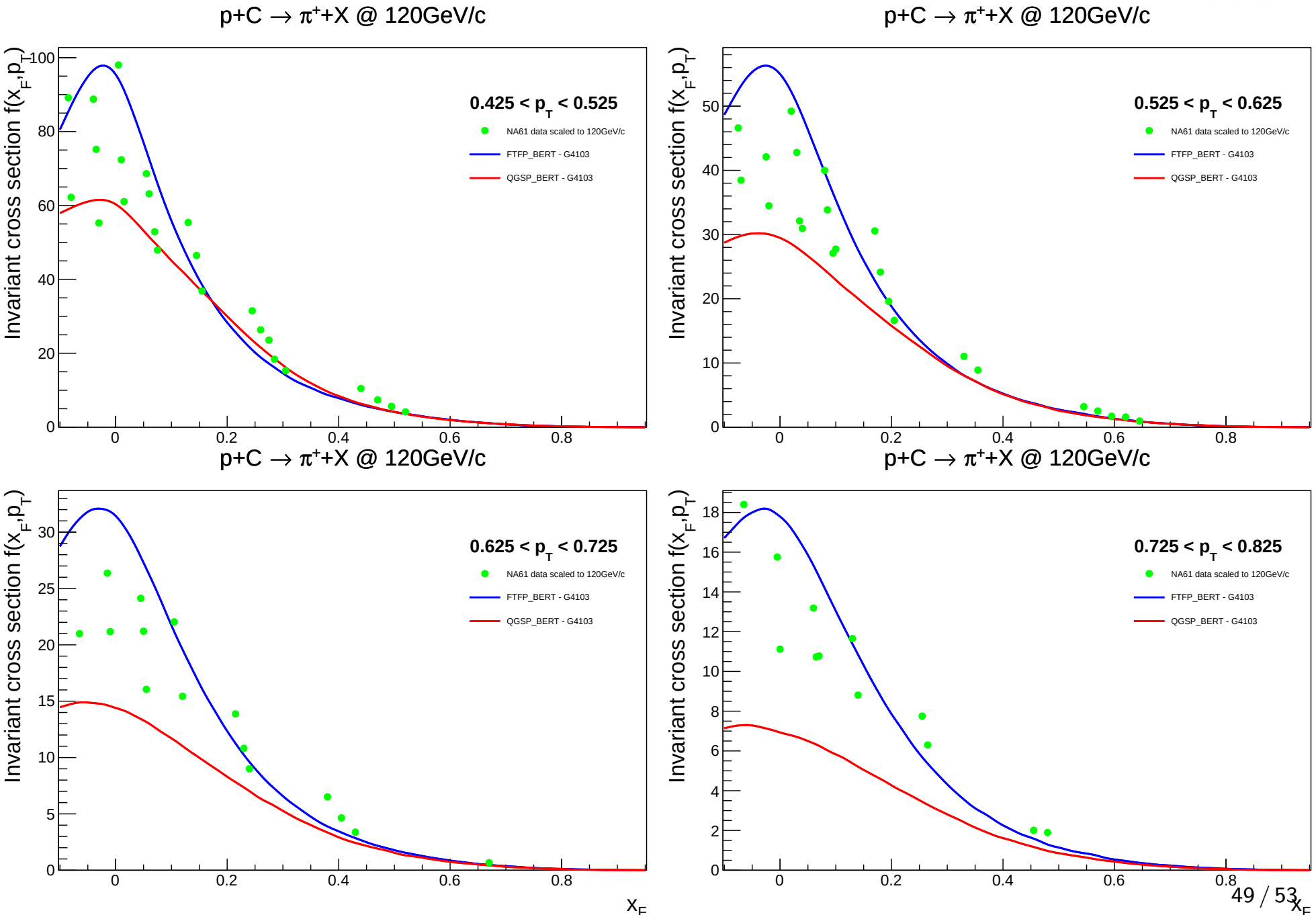

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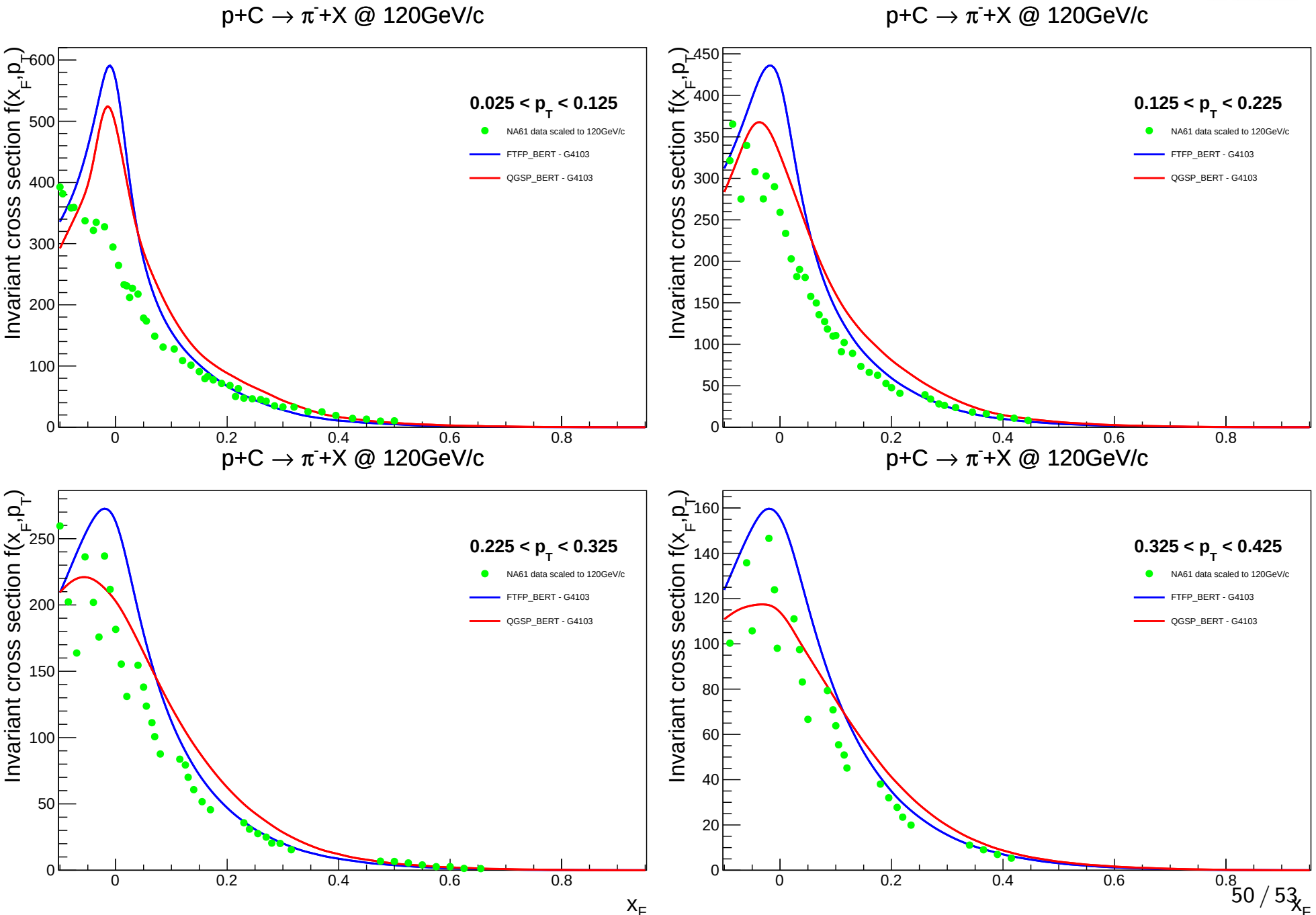

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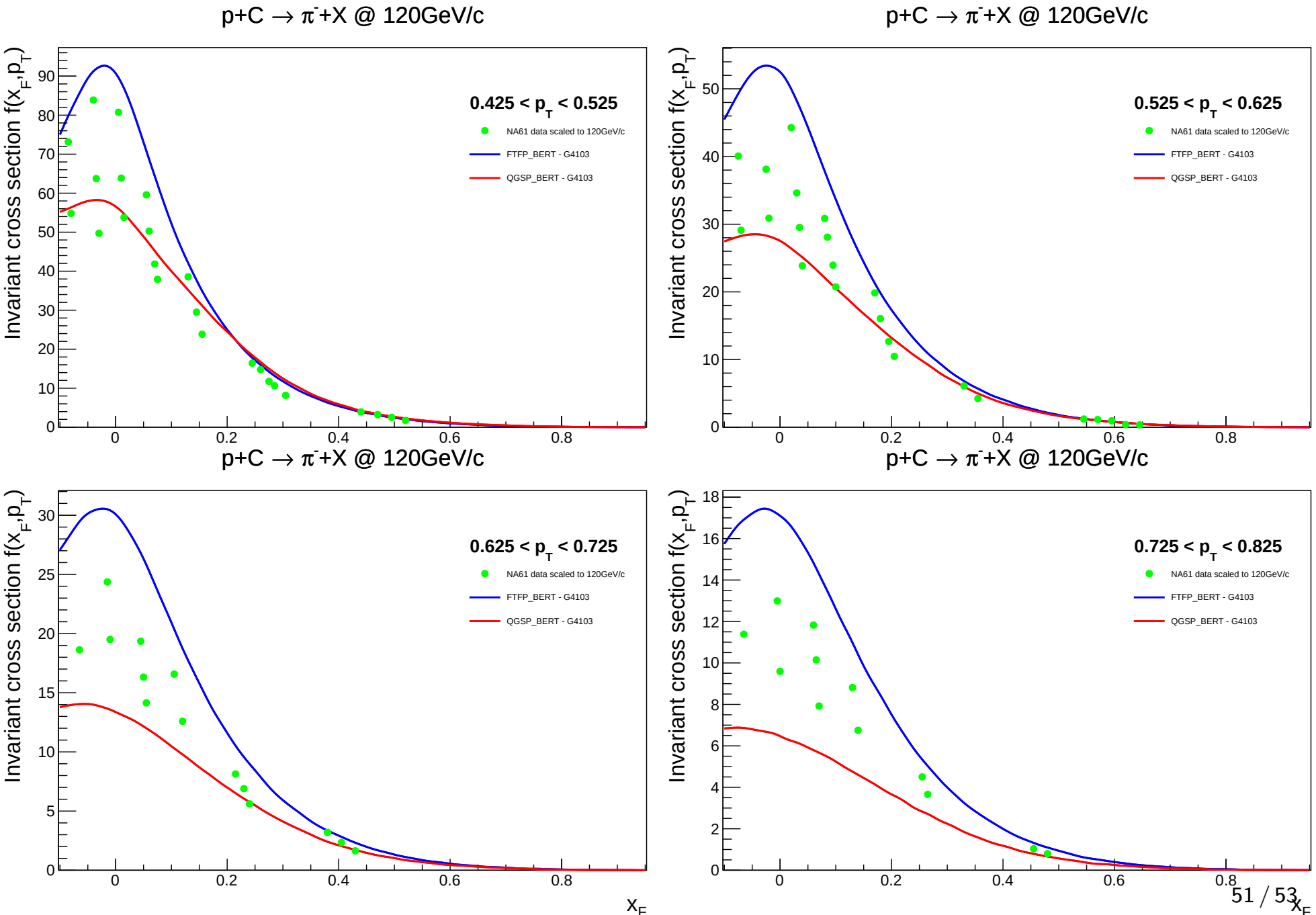

To do list

- Add scaled NA49 data and MIPP data
- Add uncertainties based on Nilay's approach
- Try different interpolations based on Nilay's and Antoni's approaches

Backup