Supplemental material

The $N_{\text{Tracks}}^{\text{PV}}$ distributions for three categories of events, namely minimum-bias events, D_s^+ signal events, and D^+ signal events, with the additional requirement of one reconstructed primary vertex for each category, are shown in Fig. 4. The distributions for D_s^+ and D^+ signal events are extracted from data; background is removed using the *sPlot* method [35].

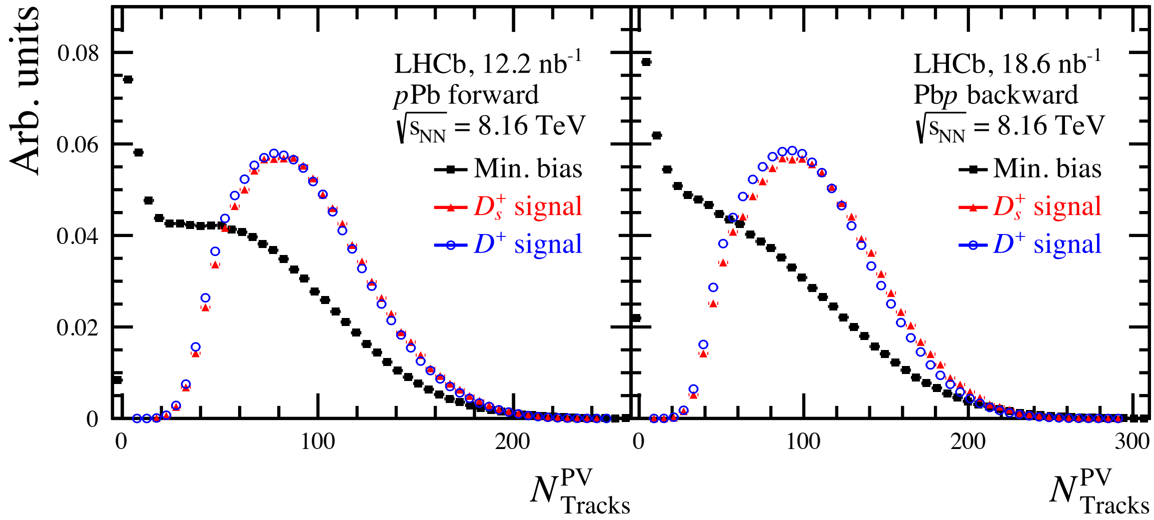

Figure 4: Distribution of the number of charged tracks used to reconstruct the PV for $D_{(s)}^+$ signal and minimum-bias events in (left) forward and (right) backward configurations, each with only one primary vertex. The vertical scale is arbitrary.

The results of the fits to the invariant-mass and $\log_{10}(\chi^2_{\text{IP}})$ distributions in the forward and backward rapidity intervals are shown in Fig. 5–8.

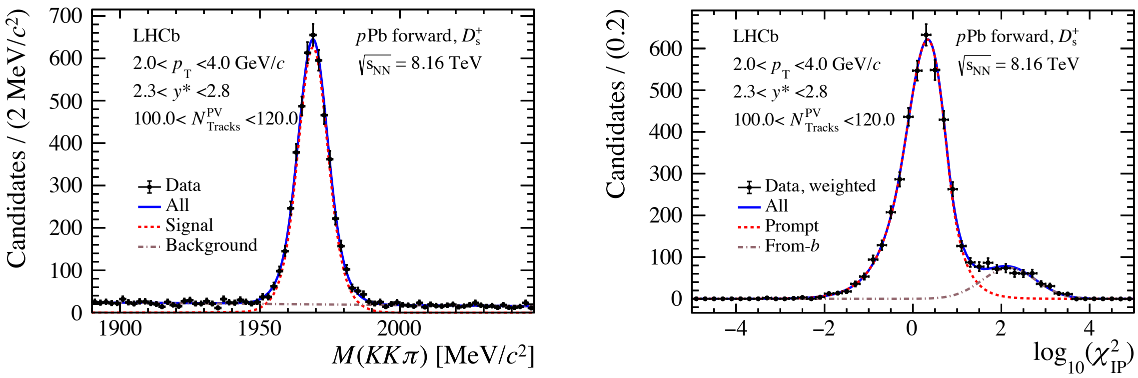

Figure 5: Distributions of (left) $M(KK\pi)$ and (right) $\log_{10}(\chi^2_{\text{IP}})$ for inclusive D_s^+ mesons in the forward data sample in the interval of $2.0 < p_{\text{T}} < 4.0\,\text{GeV}/c$, $2.3 < y^* < 2.8$ and $100 < N_{\text{Tracks}}^{\text{PV}} < 120$. The fit results are overlaid. For the $\log_{10}(\chi^2_{\text{IP}})$ fit, the data are weighted using the *sPlot* method to subtract the background component.

The differential cross-section for prompt D_s^+ and D^+ mesons in both forward and backward rapidities are shown in Fig. 9–12. The corresponding numerical values are listed

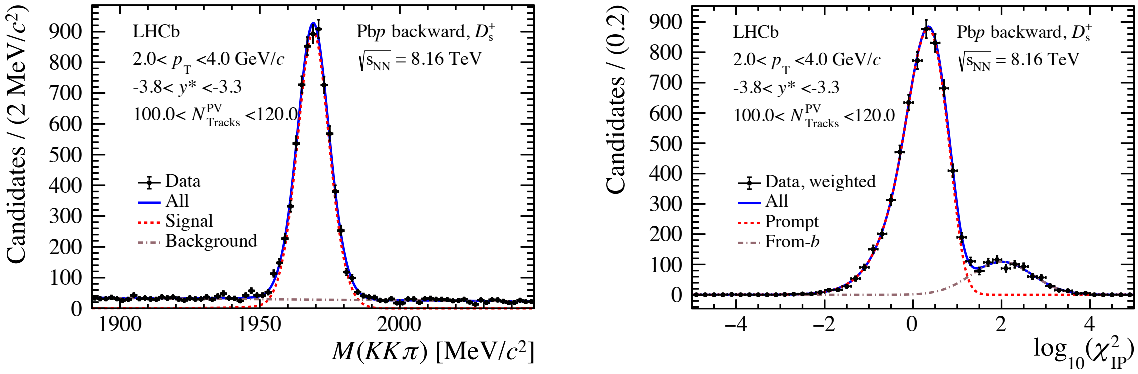

Figure 6: Distributions of (left) $M(KK\pi)$ and (right) $\log_{10}(\chi^2_{\text{IP}})$ for inclusive D_s^+ mesons in the backward data sample in the interval of $2.0 < p_{\text{T}} < 4.0\,\text{GeV}/c$, $-3.8 < y^* < -3.3$ and $100 < N^{\text{PV}}_{\text{Tracks}} < 120$. The fit results are overlaid. For the $\log_{10}(\chi^2_{\text{IP}})$ fit, the data are weighted using the *sPlot* method to subtract the background component.

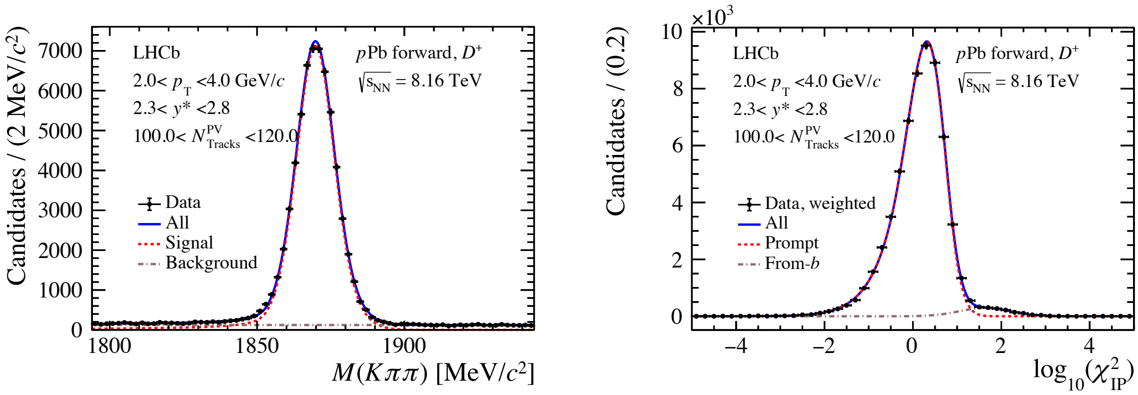

Figure 7: Distributions of (left) $M(K\pi\pi)$ and (right) $\log_{10}(\chi^2_{\text{IP}})$ for inclusive D^+ mesons in the forward data sample in the interval of $2.0 < p_{\text{T}} < 4.0\,\text{GeV}/c$, $2.3 < y^* < 2.8$ and $100 < N^{\text{PV}}_{\text{Tracks}} < 120$. The fit results are overlaid. For the $\log_{10}(\chi^2_{\text{IP}})$ fit, the data are weighted using the *sPlot* method to subtract the background component.

in Tables 2–7.

The nuclear modification factor $R_{p\text{Pb}}$ for prompt D_s^+ and D^+ mesons in both forward and backward rapidities are shown in Fig. 13–15. The corresponding numerical values are listed in Tables 8–13.

The numerical values for the forward and backward production ratio R_{FB} of prompt D_s^+ and D^+ mesons are given in Tables 14 and 15.

The production cross-section ratio of D_s^+ over D^+ mesons $\sigma_{D_s^+}/\sigma_{D^+}$ in both forward and backward rapidities are shown in Fig. 16–18. The corresponding numerical values are listed in Tables 16 and 17.

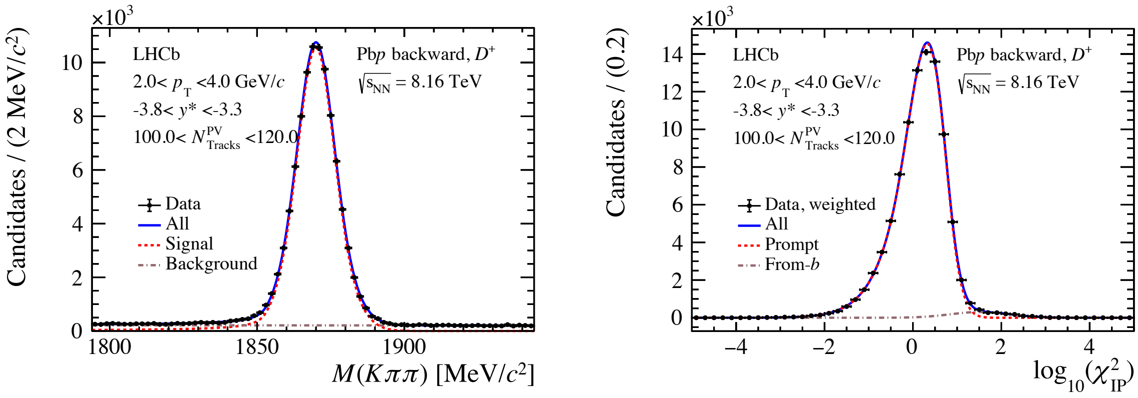

Figure 8: Distributions of (left) $M(K\pi\pi)$ and (right) $\log_{10}(\chi^2_{\text{IP}})$ for inclusive D^+ mesons in the backward data sample in the interval of $2.0 < p_{\text{T}} < 4.0\,\text{GeV}/c$, $-3.8 < y^* < -3.3$ and $100 < N_{\text{Tracks}}^{\text{PV}} < 120$. The fit results are overlaid. For the $\log_{10}(\chi^2_{\text{IP}})$ fit, the data are weighted using the *sPlot* method to subtract the background component.

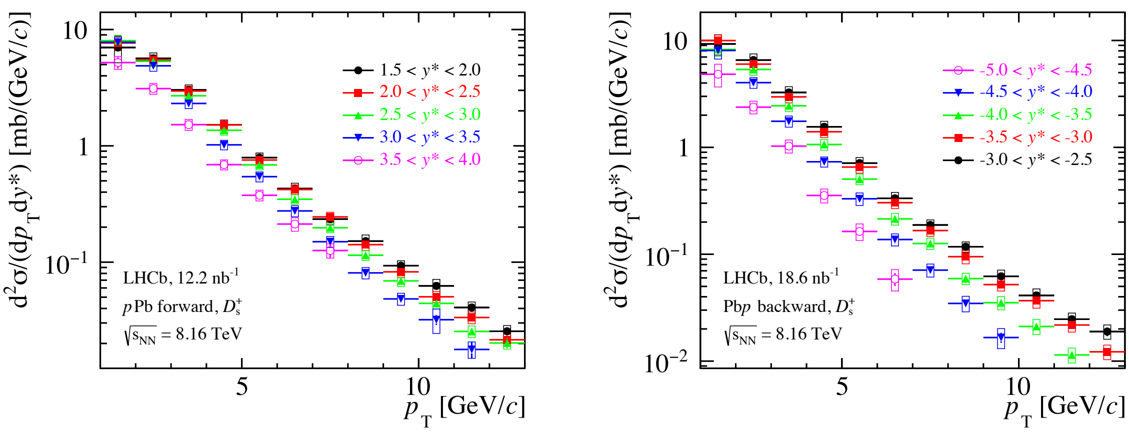

Figure 9: Double-differential cross-section of prompt D_s^+ production in pPb collisions at (left) forward and (right) backward rapidities. The vertical error bars show the statistical uncertainties and the boxes show the systematic uncertainties.

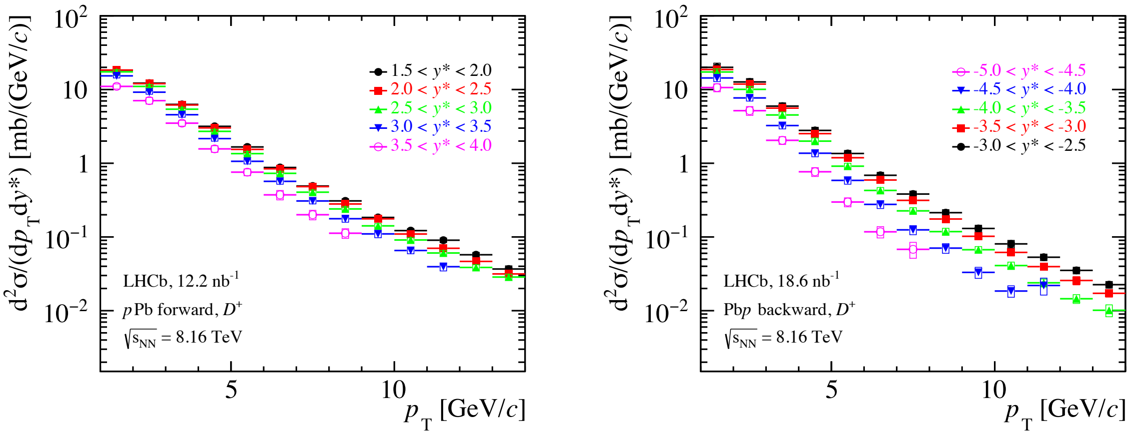

Figure 10: Double-differential cross-section of prompt D^{+} production in pPb collisions at (left) forward and (right) backward rapidities. The vertical error bars show the statistical uncertainties and the boxes show the systematic uncertainties.

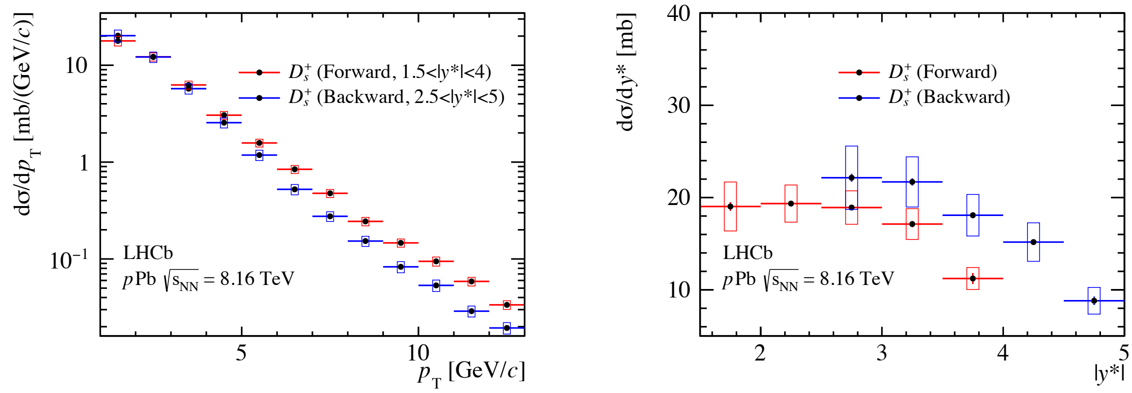

Figure 11: Differential cross-section of prompt D_s^{+} production in pPb collisions as a function of (left) p_{T} and (right) y^{*}. The vertical error bars show the statistical uncertainties and the boxes show the systematic uncertainties.

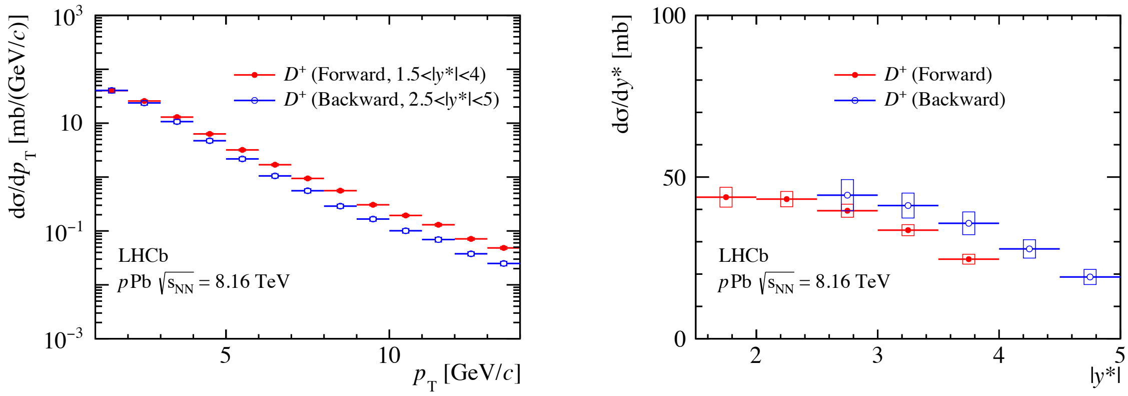

Figure 12: Differential cross-section of prompt D^+ production in pPb collisions as a function of (left) p_{T} and (right) y^*. The vertical error bars show the statistical uncertainties and the boxes show the systematic uncertainties.

Table 2: Double-differential cross-section for prompt D_s^+ production as a function of p_{T} and y^* in pPb collisions at forward and backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

	$\mathrm{d}^2\sigma/(\mathrm{d}p_{\mathrm{T}}\mathrm{d}y^*)$ [mb/(GeV/c)] (Forward)				
p_{T}[GeV/c]\ y^*	[1.5, 2]	[2, 2.5]	[2.5, 3]	[3, 3.5]	[3.5, 4]
[1, 2]	$7.006 \pm 0.422 \pm 1.613 \pm 0.861$	$7.658 \pm 0.220 \pm 0.745 \pm 0.775$	$8.021 \pm 0.270 \pm 0.441 \pm 0.763$	$7.770 \pm 0.334 \pm 0.389 \pm 0.733$	$5.197 \pm 0.583 \pm 0.378 \pm 0.536$
[2, 3]	$5.653 \pm 0.156 \pm 0.157 \pm 0.625$	$5.464 \pm 0.049 \pm 0.244 \pm 0.520$	$5.337 \pm 0.048 \pm 0.187 \pm 0.485$	$4.877 \pm 0.073 \pm 0.212 \pm 0.456$	$3.105 \pm 0.093 \pm 0.149 \pm 0.296$
[3, 4]	$3.027 \pm 0.120 \pm 0.051 \pm 0.310$	$2.961 \pm 0.042 \pm 0.094 \pm 0.273$	$2.694 \pm 0.026 \pm 0.034 \pm 0.245$	$2.314 \pm 0.032 \pm 0.064 \pm 0.215$	$1.521 \pm 0.055 \pm 0.074 \pm 0.146$
[4, 5]	$1.518 \pm 0.029 \pm 0.026 \pm 0.147$	$1.514 \pm 0.020 \pm 0.020 \pm 0.137$	$1.362 \pm 0.015 \pm 0.030 \pm 0.123$	$1.020 \pm 0.024 \pm 0.013 \pm 0.095$	$0.689 \pm 0.028 \pm 0.017 \pm 0.066$
[5, 6]	$0.792 \pm 0.022 \pm 0.017 \pm 0.075$	$0.755 \pm 0.014 \pm 0.012 \pm 0.068$	$0.686 \pm 0.010 \pm 0.014 \pm 0.062$	$0.543 \pm 0.011 \pm 0.016 \pm 0.051$	$0.376 \pm 0.016 \pm 0.014 \pm 0.037$
[6, 7]	$0.429 \pm 0.012 \pm 0.026 \pm 0.041$	$0.421 \pm 0.005 \pm 0.011 \pm 0.038$	$0.347 \pm 0.006 \pm 0.008 \pm 0.031$	$0.276 \pm 0.011 \pm 0.015 \pm 0.026$	$0.213 \pm 0.016 \pm 0.018 \pm 0.022$
[7, 8]	$0.235 \pm 0.008 \pm 0.012 \pm 0.022$	$0.245 \pm 0.005 \pm 0.007 \pm 0.022$	$0.197 \pm 0.005 \pm 0.004 \pm 0.018$	$0.150 \pm 0.007 \pm 0.008 \pm 0.014$	$0.126 \pm 0.017 \pm 0.011 \pm 0.014$
[8, 9]	$0.152 \pm 0.011 \pm 0.013 \pm 0.014$	$0.141 \pm 0.004 \pm 0.010 \pm 0.013$	$0.115 \pm 0.003 \pm 0.004 \pm 0.010$	$0.081 \pm 0.004 \pm 0.004 \pm 0.008$	–
[9, 10]	$0.093 \pm 0.008 \pm 0.004 \pm 0.009$	$0.083 \pm 0.002 \pm 0.005 \pm 0.008$	$0.069 \pm 0.002 \pm 0.003 \pm 0.006$	$0.048 \pm 0.003 \pm 0.003 \pm 0.005$	–
[10, 11]	$0.063 \pm 0.003 \pm 0.006 \pm 0.006$	$0.050 \pm 0.002 \pm 0.003 \pm 0.005$	$0.044 \pm 0.002 \pm 0.002 \pm 0.004$	$0.032 \pm 0.003 \pm 0.007 \pm 0.003$	–
[11, 12]	$0.041 \pm 0.002 \pm 0.002 \pm 0.004$	$0.033 \pm 0.001 \pm 0.002 \pm 0.003$	$0.025 \pm 0.001 \pm 0.002 \pm 0.002$	$0.018 \pm 0.003 \pm 0.002 \pm 0.002$	–
[12, 13]	$0.025 \pm 0.001 \pm 0.002 \pm 0.002$	$0.022 \pm 0.002 \pm 0.002 \pm 0.002$	$0.020 \pm 0.002 \pm 0.001 \pm 0.002$	–	–

	$\mathrm{d}^2\sigma/(\mathrm{d}p_{\mathrm{T}}\mathrm{d}y^*)$ [mb/(GeV/c)] (Backward)				
p_{T}[GeV/c]\ y^*	[−3, −2.5]	[−3.5, −3]	[−4, −3.5]	[−4.5, −4]	[−5, −4.5]
[1, 2]	$9.278 \pm 0.410 \pm 1.364 \pm 1.446$	$9.981 \pm 0.361 \pm 0.477 \pm 1.269$	$8.240 \pm 0.334 \pm 0.392 \pm 1.070$	$8.061 \pm 0.321 \pm 0.699 \pm 1.180$	$4.832 \pm 0.441 \pm 1.035 \pm 0.526$
[2, 3]	$6.553 \pm 0.128 \pm 0.205 \pm 0.913$	$6.009 \pm 0.135 \pm 0.244 \pm 0.726$	$5.355 \pm 0.054 \pm 0.125 \pm 0.626$	$4.031 \pm 0.065 \pm 0.137 \pm 0.446$	$2.379 \pm 0.120 \pm 0.136 \pm 0.293$
[3, 4]	$3.264 \pm 0.032 \pm 0.101 \pm 0.420$	$2.965 \pm 0.071 \pm 0.047 \pm 0.356$	$2.449 \pm 0.043 \pm 0.043 \pm 0.289$	$1.754 \pm 0.024 \pm 0.052 \pm 0.203$	$1.027 \pm 0.039 \pm 0.067 \pm 0.125$
[4, 5]	$1.556 \pm 0.037 \pm 0.034 \pm 0.194$	$1.399 \pm 0.015 \pm 0.026 \pm 0.165$	$1.063 \pm 0.022 \pm 0.022 \pm 0.122$	$0.733 \pm 0.009 \pm 0.021 \pm 0.077$	$0.355 \pm 0.016 \pm 0.027 \pm 0.046$
[5, 6]	$0.712 \pm 0.021 \pm 0.022 \pm 0.089$	$0.654 \pm 0.008 \pm 0.020 \pm 0.079$	$0.504 \pm 0.007 \pm 0.011 \pm 0.056$	$0.330 \pm 0.010 \pm 0.018 \pm 0.041$	$0.163 \pm 0.011 \pm 0.017 \pm 0.023$
[6, 7]	$0.334 \pm 0.014 \pm 0.018 \pm 0.041$	$0.304 \pm 0.004 \pm 0.008 \pm 0.036$	$0.214 \pm 0.005 \pm 0.007 \pm 0.026$	$0.137 \pm 0.004 \pm 0.007 \pm 0.016$	$0.059 \pm 0.008 \pm 0.011 \pm 0.008$
[7, 8]	$0.188 \pm 0.005 \pm 0.006 \pm 0.021$	$0.167 \pm 0.004 \pm 0.006 \pm 0.019$	$0.126 \pm 0.003 \pm 0.005 \pm 0.015$	$0.071 \pm 0.003 \pm 0.004 \pm 0.009$	–
[8, 9]	$0.117 \pm 0.004 \pm 0.005 \pm 0.012$	$0.095 \pm 0.002 \pm 0.005 \pm 0.013$	$0.059 \pm 0.005 \pm 0.003 \pm 0.007$	$0.035 \pm 0.002 \pm 0.004 \pm 0.005$	–
[9, 10]	$0.062 \pm 0.003 \pm 0.003 \pm 0.008$	$0.052 \pm 0.002 \pm 0.003 \pm 0.006$	$0.035 \pm 0.001 \pm 0.002 \pm 0.004$	$0.017 \pm 0.002 \pm 0.003 \pm 0.002$	–
[10, 11]	$0.041 \pm 0.002 \pm 0.003 \pm 0.005$	$0.037 \pm 0.001 \pm 0.003 \pm 0.004$	$0.021 \pm 0.001 \pm 0.002 \pm 0.003$	$0.008 \pm 0.002 \pm 0.002 \pm 0.001$	–
[11, 12]	$0.025 \pm 0.001 \pm 0.002 \pm 0.003$	$0.022 \pm 0.001 \pm 0.002 \pm 0.003$	$0.011 \pm 0.001 \pm 0.001 \pm 0.001$	–	–
[12, 13]	$0.019 \pm 0.002 \pm 0.002 \pm 0.002$	$0.012 \pm 0.001 \pm 0.001 \pm 0.002$	$0.008 \pm 0.001 \pm 0.001 \pm 0.001$	–	–

Table 3: Double-differential cross-section for prompt D^+ production as a function of p_T and y^* in pPb collisions at forward and backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

	$d^2\sigma/(dp_T dy^*)$ [mb/(GeV/c)] (Forward)				
p_T[GeV/c]\ y^*	[1.5, 2]	[2, 2.5]	[2.5, 3]	[3, 3.5]	[3.5, 4]
[1, 2]	18.276 ± 0.305 ± 0.884 ± 1.481	18.390 ± 0.095 ± 0.563 ± 1.209	17.369 ± 0.020 ± 0.607 ± 1.013	15.329 ± 0.080 ± 0.439 ± 0.885	11.032 ± 0.108 ± 0.632 ± 0.631
[2, 3]	12.215 ± 0.059 ± 0.364 ± 0.886	12.020 ± 0.024 ± 0.352 ± 0.701	11.018 ± 0.083 ± 0.372 ± 0.597	9.205 ± 0.026 ± 0.260 ± 0.506	7.066 ± 0.035 ± 0.608 ± 0.400
[3, 4]	6.286 ± 0.025 ± 0.171 ± 0.414	6.172 ± 0.014 ± 0.174 ± 0.343	5.410 ± 0.010 ± 0.141 ± 0.290	4.552 ± 0.010 ± 0.231 ± 0.249	3.498 ± 0.020 ± 0.245 ± 0.198
[4, 5]	3.168 ± 0.014 ± 0.086 ± 0.192	3.020 ± 0.005 ± 0.154 ± 0.161	2.708 ± 0.009 ± 0.103 ± 0.145	2.160 ± 0.008 ± 0.117 ± 0.118	1.566 ± 0.014 ± 0.133 ± 0.092
[5, 6]	1.664 ± 0.008 ± 0.047 ± 0.097	1.543 ± 0.005 ± 0.046 ± 0.082	1.350 ± 0.005 ± 0.062 ± 0.072	1.062 ± 0.005 ± 0.062 ± 0.059	0.757 ± 0.009 ± 0.065 ± 0.046
[6, 7]	0.876 ± 0.018 ± 0.024 ± 0.050	0.840 ± 0.004 ± 0.041 ± 0.045	0.730 ± 0.004 ± 0.031 ± 0.039	0.568 ± 0.004 ± 0.037 ± 0.032	0.373 ± 0.015 ± 0.049 ± 0.024
[7, 8]	0.491 ± 0.005 ± 0.014 ± 0.028	0.482 ± 0.003 ± 0.017 ± 0.026	0.405 ± 0.002 ± 0.019 ± 0.022	0.308 ± 0.003 ± 0.021 ± 0.018	0.200 ± 0.008 ± 0.026 ± 0.014
[8, 9]	0.308 ± 0.000 ± 0.013 ± 0.018	0.280 ± 0.002 ± 0.009 ± 0.015	0.240 ± 0.002 ± 0.011 ± 0.013	0.177 ± 0.003 ± 0.015 ± 0.011	0.112 ± 0.010 ± 0.014 ± 0.009
[9, 10]	0.184 ± 0.000 ± 0.007 ± 0.011	0.176 ± 0.001 ± 0.007 ± 0.010	0.141 ± 0.002 ± 0.007 ± 0.008	0.110 ± 0.002 ± 0.010 ± 0.007	–
[10, 11]	0.122 ± 0.002 ± 0.004 ± 0.007	0.110 ± 0.002 ± 0.004 ± 0.006	0.091 ± 0.001 ± 0.005 ± 0.005	0.066 ± 0.002 ± 0.005 ± 0.004	–
[11, 12]	0.090 ± 0.001 ± 0.004 ± 0.005	0.070 ± 0.001 ± 0.004 ± 0.004	0.061 ± 0.001 ± 0.004 ± 0.004	0.039 ± 0.002 ± 0.004 ± 0.003	–
[12, 13]	0.057 ± 0.001 ± 0.003 ± 0.003	0.047 ± 0.001 ± 0.002 ± 0.003	0.039 ± 0.001 ± 0.003 ± 0.002	–	–
[13, 14]	0.037 ± 0.001 ± 0.003 ± 0.002	0.032 ± 0.001 ± 0.002 ± 0.002	0.029 ± 0.001 ± 0.002 ± 0.002	–	–

	$d^2\sigma/(dp_T dy^*)$ [mb/(GeV/c)] (Backward)				
p_T[GeV/c]\ y^*	[−3, −2.5]	[−3.5, −3]	[−4, −3.5]	[−4.5, −4]	[−5, −4.5]
[1, 2]	20.016 ± 0.220 ± 0.866 ± 2.666	18.689 ± 0.079 ± 0.568 ± 2.120	17.293 ± 0.065 ± 0.508 ± 1.756	14.348 ± 0.206 ± 0.683 ± 1.395	10.639 ± 0.057 ± 0.815 ± 1.036
[2, 3]	12.676 ± 0.044 ± 0.377 ± 1.373	11.864 ± 0.022 ± 0.334 ± 1.214	10.054 ± 0.018 ± 0.233 ± 0.955	7.692 ± 0.020 ± 0.248 ± 0.678	5.165 ± 0.025 ± 0.526 ± 0.478
[3, 4]	5.957 ± 0.018 ± 0.154 ± 0.629	5.600 ± 0.010 ± 0.162 ± 0.530	4.519 ± 0.008 ± 0.138 ± 0.418	3.246 ± 0.010 ± 0.155 ± 0.284	2.046 ± 0.014 ± 0.150 ± 0.199
[4, 5]	2.788 ± 0.010 ± 0.091 ± 0.276	2.522 ± 0.006 ± 0.065 ± 0.230	1.996 ± 0.006 ± 0.104 ± 0.175	1.368 ± 0.005 ± 0.078 ± 0.121	0.766 ± 0.009 ± 0.077 ± 0.071
[5, 6]	1.356 ± 0.006 ± 0.042 ± 0.130	1.188 ± 0.002 ± 0.035 ± 0.105	0.912 ± 0.005 ± 0.039 ± 0.079	0.585 ± 0.003 ± 0.038 ± 0.054	0.298 ± 0.006 ± 0.029 ± 0.029
[6, 7]	0.687 ± 0.007 ± 0.016 ± 0.065	0.593 ± 0.001 ± 0.020 ± 0.053	0.428 ± 0.001 ± 0.018 ± 0.037	0.277 ± 0.002 ± 0.020 ± 0.027	0.117 ± 0.004 ± 0.015 ± 0.014
[7, 8]	0.382 ± 0.009 ± 0.012 ± 0.035	0.314 ± 0.002 ± 0.010 ± 0.029	0.226 ± 0.001 ± 0.012 ± 0.020	0.125 ± 0.002 ± 0.011 ± 0.014	0.068 ± 0.007 ± 0.014 ± 0.009
[8, 9]	0.214 ± 0.002 ± 0.007 ± 0.020	0.175 ± 0.001 ± 0.006 ± 0.016	0.118 ± 0.001 ± 0.005 ± 0.012	0.071 ± 0.002 ± 0.007 ± 0.008	–
[9, 10]	0.130 ± 0.001 ± 0.005 ± 0.013	0.102 ± 0.001 ± 0.004 ± 0.009	0.067 ± 0.001 ± 0.004 ± 0.006	0.033 ± 0.001 ± 0.005 ± 0.003	–
[10, 11]	0.081 ± 0.001 ± 0.004 ± 0.008	0.062 ± 0.001 ± 0.003 ± 0.006	0.041 ± 0.001 ± 0.003 ± 0.004	0.018 ± 0.001 ± 0.003 ± 0.002	–
[11, 12]	0.053 ± 0.001 ± 0.003 ± 0.005	0.040 ± 0.001 ± 0.002 ± 0.004	0.024 ± 0.001 ± 0.002 ± 0.002	0.022 ± 0.002 ± 0.005 ± 0.003	–
[12, 13]	0.035 ± 0.001 ± 0.002 ± 0.003	0.026 ± 0.000 ± 0.002 ± 0.002	0.015 ± 0.000 ± 0.001 ± 0.002	–	–
[13, 14]	0.023 ± 0.000 ± 0.001 ± 0.002	0.017 ± 0.000 ± 0.001 ± 0.002	0.010 ± 0.000 ± 0.001 ± 0.001	–	–

Table 4: Differential cross-section for prompt D_s^+ production as a function of p_{T} in pPb collisions at forward and backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

$p_{\mathrm{T}}[\,\mathrm{GeV}/c]$	$\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}$ $[\,\mathrm{mb}/(\,\mathrm{GeV}/c)]$ (Forward)
$[1, 2]$	$17.826 \pm 0.433 \pm 0.955 \pm 1.808$
$[2, 3]$	$12.218 \pm 0.104 \pm 0.216 \pm 1.177$
$[3, 4]$	$6.259 \pm 0.072 \pm 0.074 \pm 0.591$
$[4, 5]$	$3.051 \pm 0.027 \pm 0.025 \pm 0.283$
$[5, 6]$	$1.576 \pm 0.017 \pm 0.017 \pm 0.146$
$[6, 7]$	$0.843 \pm 0.012 \pm 0.019 \pm 0.079$
$[7, 8]$	$0.476 \pm 0.011 \pm 0.010 \pm 0.045$
$[8, 9]$	$0.244 \pm 0.006 \pm 0.009 \pm 0.023$
$[9, 10]$	$0.147 \pm 0.005 \pm 0.004 \pm 0.014$
$[10, 11]$	$0.095 \pm 0.003 \pm 0.005 \pm 0.009$
$[11, 12]$	$0.059 \pm 0.002 \pm 0.002 \pm 0.006$
$[12, 13]$	$0.034 \pm 0.002 \pm 0.001 \pm 0.003$

$p_{\mathrm{T}}[\,\mathrm{GeV}/c]$	$\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}$ $[\,\mathrm{mb}/(\,\mathrm{GeV}/c)]$ (Backward)
$[1, 2]$	$20.196 \pm 0.421 \pm 0.975 \pm 2.700$
$[2, 3]$	$12.163 \pm 0.119 \pm 0.196 \pm 1.490$
$[3, 4]$	$5.729 \pm 0.050 \pm 0.073 \pm 0.694$
$[4, 5]$	$2.553 \pm 0.025 \pm 0.029 \pm 0.300$
$[5, 6]$	$1.182 \pm 0.014 \pm 0.020 \pm 0.143$
$[6, 7]$	$0.524 \pm 0.009 \pm 0.012 \pm 0.063$
$[7, 8]$	$0.276 \pm 0.004 \pm 0.005 \pm 0.031$
$[8, 9]$	$0.153 \pm 0.004 \pm 0.004 \pm 0.018$
$[9, 10]$	$0.083 \pm 0.002 \pm 0.003 \pm 0.011$
$[10, 11]$	$0.053 \pm 0.002 \pm 0.003 \pm 0.007$
$[11, 12]$	$0.029 \pm 0.001 \pm 0.001 \pm 0.003$
$[12, 13]$	$0.019 \pm 0.001 \pm 0.001 \pm 0.002$

Table 5: Differential cross-section for prompt D^+ production as a function of p_{T} in pPb collisions at forward and backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

$p_{\mathrm{T}}[\mathrm{GeV}/c]$	$\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}$ [mb/(GeV/c)] (Forward)
$[1,2]$	$40.198 \pm 0.174 \pm 0.717 \pm 2.291$
$[2,3]$	$25.763 \pm 0.057 \pm 0.456 \pm 1.326$
$[3,4]$	$12.959 \pm 0.019 \pm 0.219 \pm 0.638$
$[4,5]$	$6.311 \pm 0.012 \pm 0.135 \pm 0.300$
$[5,6]$	$3.188 \pm 0.007 \pm 0.064 \pm 0.151$
$[6,7]$	$1.693 \pm 0.012 \pm 0.042 \pm 0.081$
$[7,8]$	$0.943 \pm 0.005 \pm 0.022 \pm 0.045$
$[8,9]$	$0.559 \pm 0.005 \pm 0.014 \pm 0.028$
$[9,10]$	$0.306 \pm 0.001 \pm 0.008 \pm 0.015$
$[10,11]$	$0.194 \pm 0.002 \pm 0.004 \pm 0.010$
$[11,12]$	$0.130 \pm 0.001 \pm 0.004 \pm 0.007$
$[12,13]$	$0.071 \pm 0.001 \pm 0.002 \pm 0.004$
$[13,14]$	$0.048 \pm 0.001 \pm 0.002 \pm 0.003$

$p_{\mathrm{T}}[\mathrm{GeV}/c]$	$\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}$ [mb/(GeV/c)] (Backward)
$[1,2]$	$40.492 \pm 0.161 \pm 0.785 \pm 4.317$
$[2,3]$	$23.726 \pm 0.031 \pm 0.402 \pm 2.241$
$[3,4]$	$10.684 \pm 0.014 \pm 0.170 \pm 0.981$
$[4,5]$	$4.720 \pm 0.008 \pm 0.094 \pm 0.414$
$[5,6]$	$2.170 \pm 0.005 \pm 0.041 \pm 0.188$
$[6,7]$	$1.050 \pm 0.004 \pm 0.020 \pm 0.093$
$[7,8]$	$0.557 \pm 0.006 \pm 0.013 \pm 0.051$
$[8,9]$	$0.289 \pm 0.002 \pm 0.007 \pm 0.026$
$[9,10]$	$0.166 \pm 0.001 \pm 0.004 \pm 0.015$
$[10,11]$	$0.101 \pm 0.001 \pm 0.003 \pm 0.010$
$[11,12]$	$0.069 \pm 0.001 \pm 0.003 \pm 0.007$
$[12,13]$	$0.038 \pm 0.000 \pm 0.002 \pm 0.003$
$[13,14]$	$0.025 \pm 0.000 \pm 0.001 \pm 0.002$

Table 6: Differential cross-section for prompt D_s^+ production as a function of y^* in pPb collisions at forward and backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

y^*	$\mathrm{d}\sigma/\mathrm{d}y^*$ [mb] (Forward)
$[1.5, 2.0]$	$19.032 \pm 0.467 \pm 1.622 \pm 2.098$
$[2.0, 2.5]$	$19.347 \pm 0.231 \pm 0.790 \pm 1.854$
$[2.5, 3.0]$	$18.918 \pm 0.276 \pm 0.482 \pm 1.749$
$[3.0, 3.5]$	$17.129 \pm 0.344 \pm 0.449 \pm 1.606$
$[3.5, 4.0]$	$11.227 \pm 0.594 \pm 0.414 \pm 1.113$

y^*	$\mathrm{d}\sigma/\mathrm{d}y^*$ [mb] (Backward)
$[-2.5, -3.0]$	$22.148 \pm 0.434 \pm 1.383 \pm 3.142$
$[-3.0, -3.5]$	$21.695 \pm 0.392 \pm 0.539 \pm 2.667$
$[-3.5, -4.0]$	$18.086 \pm 0.342 \pm 0.414 \pm 2.214$
$[-4.0, -4.5]$	$15.176 \pm 0.329 \pm 0.714 \pm 1.962$
$[-4.5, -5.0]$	$8.814 \pm 0.459 \pm 1.047 \pm 1.002$

Table 7: Differential cross-section for prompt D^+ production as a function of y^* in pPb collisions at forward and backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

y^*	$\mathrm{d}\sigma/\mathrm{d}y^*$ [mb] (Forward)
$[1.5, 2.0]$	$43.77 \pm 0.31 \pm 0.98 \pm 2.90$
$[2.0, 2.5]$	$43.18 \pm 0.10 \pm 0.71 \pm 2.26$
$[2.5, 3.0]$	$39.59 \pm 0.09 \pm 0.74 \pm 1.88$
$[3.0, 3.5]$	$33.58 \pm 0.09 \pm 0.58 \pm 1.62$
$[3.5, 4.0]$	$24.60 \pm 0.12 \pm 0.92 \pm 1.22$

y^*	$\mathrm{d}\sigma/\mathrm{d}y^*$ [mb] (Backward)
$[-3.0, -2.5]$	$44.40 \pm 0.23 \pm 0.96 \pm 4.73$
$[-3.5, -3.0]$	$41.19 \pm 0.08 \pm 0.68 \pm 3.80$
$[-4.0, -3.5]$	$35.70 \pm 0.07 \pm 0.59 \pm 3.47$
$[-4.5, -4.0]$	$27.78 \pm 0.21 \pm 0.75 \pm 2.74$
$[-5.0, -4.5]$	$19.10 \pm 0.06 \pm 0.99 \pm 2.13$

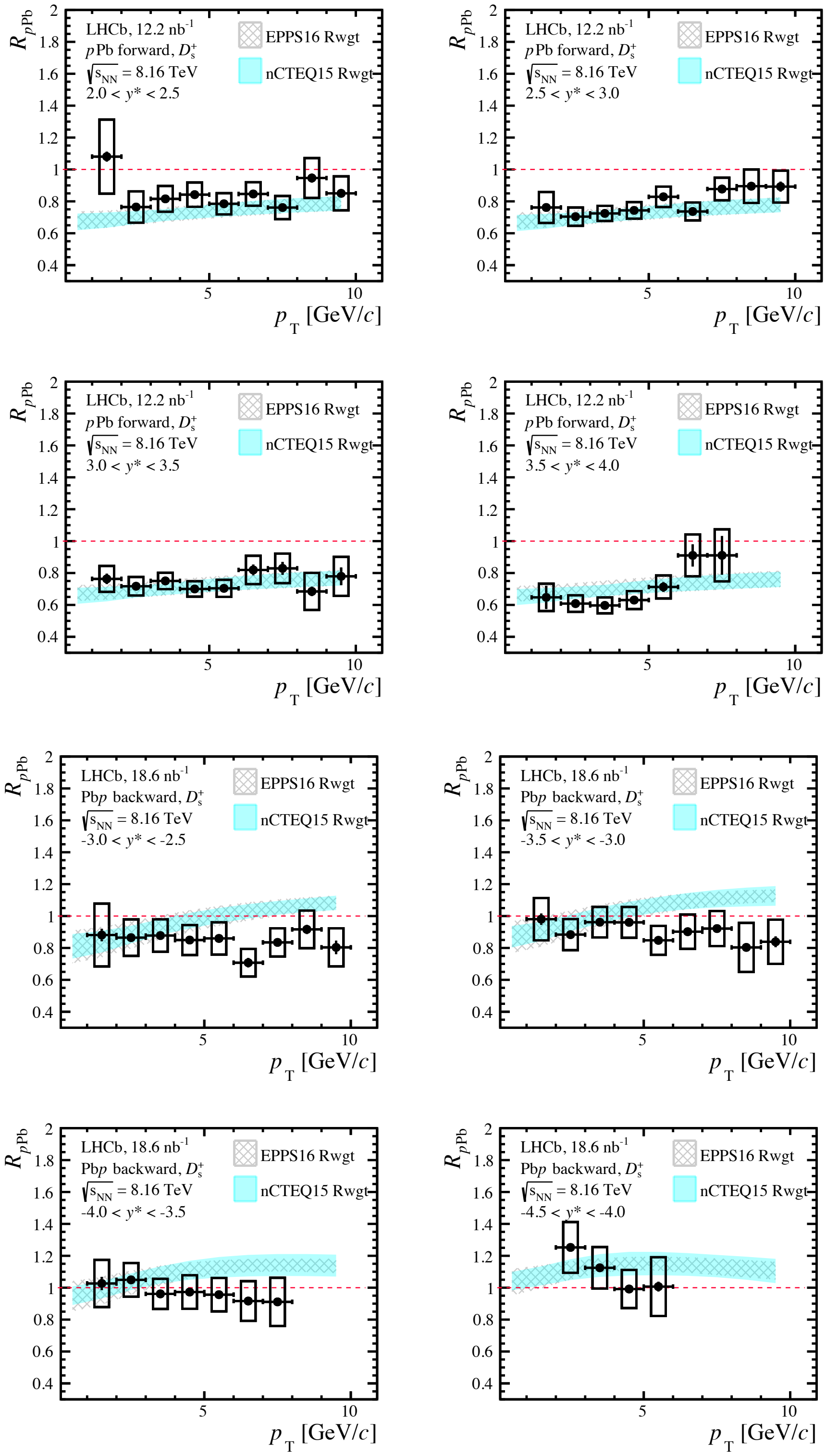

Figure 13: Nuclear modification factor $R_{p\text{Pb}}$ for prompt D_s^+ production as a function of p_T in different y^* intervals. The vertical error bars show the statistical uncertainties and the boxes show the systematic uncertainties. The coloured bands represent the theoretical calculations using the HELAC-Onia generator [47, 48], incorporating nPDFs EPPS16 (grey) [50] and nCTEQ15 (blue) [51].

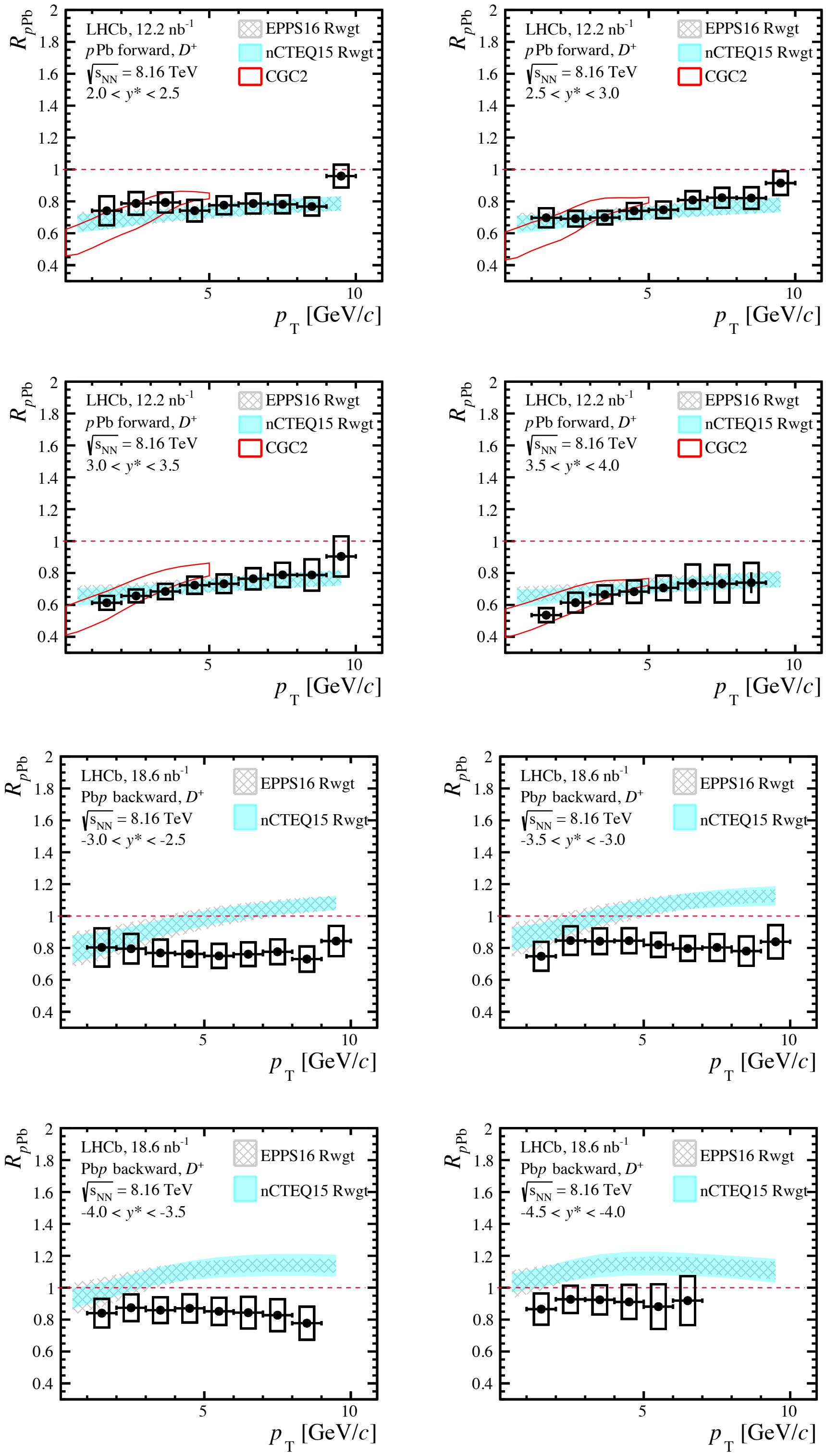

Figure 14: Nuclear modification factor $R_{p\text{Pb}}$ for prompt D^+ production as a function of p_{T} in different y^* intervals. The vertical error bars show the statistical uncertainties and the boxes show the systematic uncertainties. The coloured bands represent the theoretical calculations using the HELAC-Onia generator [47, 48], incorporating nPDFs EPPS16 (grey) [50] and nCTEQ15 (blue) [51]. The coloured line represent the CGC2 (red) calculations [59].

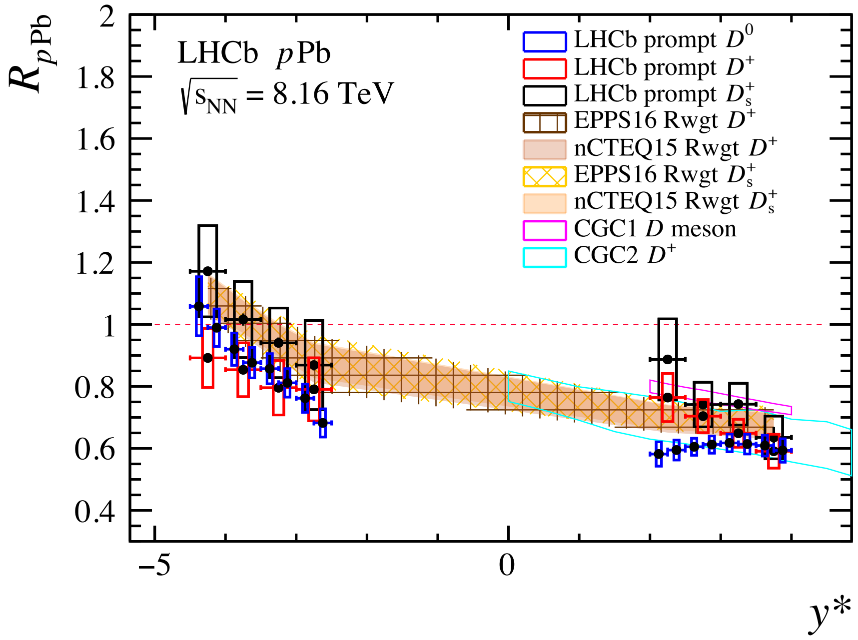

Figure 15: Nuclear modification factor as a function of y^* for prompt D^+ and D_s^+ mesons integrated over $1 < p_{\rm T} < 10\,{\rm GeV}/c$. The vertical error bars show the statistical uncertainties and the boxes show the systematic uncertainties. The LHCb D^0 results at $\sqrt{s_{\rm NN}}$ = 8.16 TeV [7] and theoretical calculations at $\sqrt{s_{\rm NN}}$ = 8.16 TeV are also shown [50, 51, 57–59].

Table 8: Nuclear modification factor $R_{p\mathrm{Pb}}$ for prompt D_s^+ production as a function of p_T at forward (integrated over the common rapidity region of $2.0 < y^* < 4.0$) and backward (integrated over the common rapidity region of $-4.5 < y^* < -2.5$) rapidity. The first uncertainty is statistical, the second systematic.

p_T [GeV/c]	$R_{p\mathrm{Pb}}$ (Forward)
$[1, 2]$	$0.800 \pm 0.021 \pm 0.112$
$[2, 3]$	$0.705 \pm 0.005 \pm 0.066$
$[3, 4]$	$0.731 \pm 0.006 \pm 0.057$
$[4, 5]$	$0.742 \pm 0.007 \pm 0.058$
$[5, 6]$	$0.764 \pm 0.008 \pm 0.063$
$[6, 7]$	$0.816 \pm 0.014 \pm 0.080$
$[7, 8]$	$0.829 \pm 0.022 \pm 0.090$
$[8, 9]$	$0.852 \pm 0.016 \pm 0.117$
$[9, 10]$	$0.845 \pm 0.019 \pm 0.109$
p_T [GeV/c]	$R_{p\mathrm{Pb}}$ (Backward)
$[1, 2]$	$0.957 \pm 0.022 \pm 0.160$
$[2, 3]$	$0.967 \pm 0.009 \pm 0.111$
$[3, 4]$	$0.956 \pm 0.008 \pm 0.101$
$[4, 5]$	$0.928 \pm 0.009 \pm 0.099$
$[5, 6]$	$0.896 \pm 0.010 \pm 0.107$
$[6, 7]$	$0.817 \pm 0.015 \pm 0.100$
$[7, 8]$	$0.883 \pm 0.013 \pm 0.110$
$[8, 9]$	$0.862 \pm 0.018 \pm 0.136$
$[9, 10]$	$0.819 \pm 0.028 \pm 0.127$

Table 9: Nuclear modification factor $R_{p\mathrm{Pb}}$ for prompt D_s^+ production as a function of y^*, integrated over $1 < p_\mathrm{T} < 10\,\mathrm{GeV}/c$. The first uncertainty is statistical, the second systematic.

y^*	$R_{p\mathrm{Pb}}$
$[-4.5, -4.0]$	$1.172 \pm 0.012 \pm 0.147$
$[-4.0, -3.5]$	$1.016 \pm 0.019 \pm 0.123$
$[-3.5, -3.0]$	$0.941 \pm 0.017 \pm 0.112$
$[-3.0, -2.5]$	$0.869 \pm 0.017 \pm 0.144$
$[2.0, 2.5]$	$0.887 \pm 0.011 \pm 0.131$
$[2.5, 3.0]$	$0.742 \pm 0.011 \pm 0.072$
$[3.0, 3.5]$	$0.743 \pm 0.015 \pm 0.067$
$[3.5, 4.0]$	$0.635 \pm 0.034 \pm 0.069$

Table 10: Nuclear modification factor $R_{p\mathrm{Pb}}$ for prompt D_s^+ production as a function of p_T and y^*. The first uncertainty is statistical, the second systematic.

	$R_{p\mathrm{Pb}}$ (Forward)			
$p_\mathrm{T}[\,\mathrm{GeV}/c]\backslash y^*$	$[2, 2.5]$	$[2.5, 3]$	$[3, 3.5]$	$[3.5, 4]$
$[1, 2]$	$1.080 \pm 0.031 \pm 0.232$	$0.762 \pm 0.026 \pm 0.097$	$0.763 \pm 0.033 \pm 0.081$	$0.647 \pm 0.073 \pm 0.086$
$[2, 3]$	$0.764 \pm 0.007 \pm 0.098$	$0.704 \pm 0.006 \pm 0.057$	$0.717 \pm 0.011 \pm 0.058$	$0.608 \pm 0.018 \pm 0.052$
$[3, 4]$	$0.816 \pm 0.012 \pm 0.081$	$0.724 \pm 0.007 \pm 0.047$	$0.750 \pm 0.010 \pm 0.051$	$0.597 \pm 0.022 \pm 0.050$
$[4, 5]$	$0.842 \pm 0.011 \pm 0.076$	$0.743 \pm 0.008 \pm 0.052$	$0.700 \pm 0.017 \pm 0.048$	$0.630 \pm 0.025 \pm 0.056$
$[5, 6]$	$0.785 \pm 0.015 \pm 0.067$	$0.828 \pm 0.012 \pm 0.064$	$0.704 \pm 0.014 \pm 0.053$	$0.713 \pm 0.031 \pm 0.072$
$[6, 7]$	$0.846 \pm 0.010 \pm 0.074$	$0.737 \pm 0.013 \pm 0.056$	$0.819 \pm 0.034 \pm 0.089$	$0.910 \pm 0.069 \pm 0.131$
$[7, 8]$	$0.761 \pm 0.014 \pm 0.073$	$0.877 \pm 0.021 \pm 0.071$	$0.829 \pm 0.040 \pm 0.093$	$0.911 \pm 0.121 \pm 0.163$
$[8, 9]$	$0.946 \pm 0.029 \pm 0.125$	$0.895 \pm 0.022 \pm 0.105$	$0.685 \pm 0.030 \pm 0.116$	–
$[9, 10]$	$0.850 \pm 0.019 \pm 0.107$	$0.893 \pm 0.031 \pm 0.100$	$0.779 \pm 0.055 \pm 0.122$	–

	$R_{p\mathrm{Pb}}$ (Backward)			
$p_\mathrm{T}[\,\mathrm{GeV}/c]\backslash y^*$	$[-3, -2.5]$	$[-3.5, -3]$	$[-4, -3.5]$	$[-4.5, -4]$
$[1, 2]$	$0.881 \pm 0.039 \pm 0.197$	$0.980 \pm 0.035 \pm 0.133$	$1.026 \pm 0.042 \pm 0.148$	–
$[2, 3]$	$0.865 \pm 0.017 \pm 0.114$	$0.883 \pm 0.020 \pm 0.097$	$1.049 \pm 0.011 \pm 0.105$	$1.252 \pm 0.020 \pm 0.159$
$[3, 4]$	$0.878 \pm 0.009 \pm 0.102$	$0.961 \pm 0.023 \pm 0.096$	$0.961 \pm 0.017 \pm 0.094$	$1.125 \pm 0.016 \pm 0.130$
$[4, 5]$	$0.849 \pm 0.020 \pm 0.094$	$0.960 \pm 0.011 \pm 0.097$	$0.973 \pm 0.021 \pm 0.105$	$0.992 \pm 0.012 \pm 0.120$
$[5, 6]$	$0.860 \pm 0.026 \pm 0.101$	$0.848 \pm 0.010 \pm 0.091$	$0.956 \pm 0.012 \pm 0.105$	$1.007 \pm 0.030 \pm 0.184$
$[6, 7]$	$0.707 \pm 0.030 \pm 0.087$	$0.902 \pm 0.012 \pm 0.107$	$0.916 \pm 0.020 \pm 0.124$	–
$[7, 8]$	$0.835 \pm 0.022 \pm 0.088$	$0.921 \pm 0.023 \pm 0.110$	$0.911 \pm 0.021 \pm 0.151$	–
$[8, 9]$	$0.916 \pm 0.029 \pm 0.118$	$0.803 \pm 0.020 \pm 0.154$	–	–
$[9, 10]$	$0.804 \pm 0.042 \pm 0.119$	$0.839 \pm 0.033 \pm 0.139$	–	–

Table 11: Nuclear modification factor $R_{p\mathrm{Pb}}$ for prompt D^+ production as a function of p_T at forward (integrated over the common rapidity region of $2.0 < y^* < 4.0$) and backward (integrated over the common rapidity region of $-4.5 < y^* < -2.5$) rapidity. The first uncertainty is statistical, the second systematic.

p_T [GeV/c]	$R_{p\mathrm{Pb}}$ (Forward)
$[1, 2]$	$0.652 \pm 0.002 \pm 0.058$
$[2, 3]$	$0.693 \pm 0.002 \pm 0.053$
$[3, 4]$	$0.715 \pm 0.001 \pm 0.051$
$[4, 5]$	$0.727 \pm 0.001 \pm 0.059$
$[5, 6]$	$0.746 \pm 0.002 \pm 0.058$
$[6, 7]$	$0.779 \pm 0.005 \pm 0.070$
$[7, 8]$	$0.787 \pm 0.005 \pm 0.071$
$[8, 9]$	$0.783 \pm 0.010 \pm 0.078$
$[9, 10]$	$0.929 \pm 0.006 \pm 0.087$
p_T [GeV/c]	$R_{p\mathrm{Pb}}$ (Backward)
$[1, 2]$	$0.808 \pm 0.004 \pm 0.100$
$[2, 3]$	$0.850 \pm 0.001 \pm 0.089$
$[3, 4]$	$0.834 \pm 0.001 \pm 0.083$
$[4, 5]$	$0.831 \pm 0.001 \pm 0.085$
$[5, 6]$	$0.809 \pm 0.002 \pm 0.085$
$[6, 7]$	$0.808 \pm 0.003 \pm 0.088$
$[7, 8]$	$0.797 \pm 0.008 \pm 0.085$
$[8, 9]$	$0.758 \pm 0.004 \pm 0.089$
$[9, 10]$	$0.841 \pm 0.005 \pm 0.098$

Table 12: Nuclear modification factor $R_{p\mathrm{Pb}}$ for prompt D^+ production as a function of y^*, integrated over $1 < p_\mathrm{T} < 10\,\mathrm{GeV}/c$. The first uncertainty is statistical, the second systematic.

y^*	$R_{p\mathrm{Pb}}$
$[-4.5, -4.0]$	$0.892 \pm 0.007 \pm 0.096$
$[-4.0, -3.5]$	$0.854 \pm 0.002 \pm 0.087$
$[-3.5, -3.0]$	$0.796 \pm 0.002 \pm 0.088$
$[-3.0, -2.5]$	$0.791 \pm 0.004 \pm 0.102$
$[2.0, 2.5]$	$0.764 \pm 0.002 \pm 0.078$
$[2.5, 3.0]$	$0.704 \pm 0.002 \pm 0.053$
$[3.0, 3.5]$	$0.649 \pm 0.002 \pm 0.045$
$[3.5, 4.0]$	$0.591 \pm 0.003 \pm 0.055$

Table 13: Nuclear modification factor $R_{p\mathrm{Pb}}$ for prompt D^+ production as a function of p_{T} and y^*. The first uncertainty is statistical, the second systematic.

	$R_{p\mathrm{Pb}}$ (Forward)			
$p_{\mathrm{T}}[\mathrm{GeV}/c]\backslash y^*$	$[2, 2.5]$	$[2.5, 3]$	$[3, 3.5]$	$[3.5, 4]$
$[1, 2]$	$0.741 \pm 0.004 \pm 0.091$	$0.697 \pm 0.001 \pm 0.060$	$0.613 \pm 0.003 \pm 0.044$	$0.536 \pm 0.005 \pm 0.044$
$[2, 3]$	$0.787 \pm 0.002 \pm 0.071$	$0.691 \pm 0.005 \pm 0.049$	$0.657 \pm 0.002 \pm 0.040$	$0.614 \pm 0.003 \pm 0.062$
$[3, 4]$	$0.793 \pm 0.002 \pm 0.063$	$0.698 \pm 0.001 \pm 0.042$	$0.684 \pm 0.002 \pm 0.048$	$0.665 \pm 0.004 \pm 0.057$
$[4, 5]$	$0.742 \pm 0.001 \pm 0.067$	$0.740 \pm 0.002 \pm 0.050$	$0.724 \pm 0.003 \pm 0.054$	$0.683 \pm 0.006 \pm 0.070$
$[5, 6]$	$0.776 \pm 0.002 \pm 0.057$	$0.747 \pm 0.003 \pm 0.052$	$0.733 \pm 0.003 \pm 0.058$	$0.707 \pm 0.008 \pm 0.077$
$[6, 7]$	$0.786 \pm 0.004 \pm 0.062$	$0.808 \pm 0.005 \pm 0.055$	$0.764 \pm 0.005 \pm 0.066$	$0.735 \pm 0.029 \pm 0.119$
$[7, 8]$	$0.781 \pm 0.005 \pm 0.056$	$0.822 \pm 0.005 \pm 0.063$	$0.788 \pm 0.008 \pm 0.076$	$0.733 \pm 0.030 \pm 0.118$
$[8, 9]$	$0.768 \pm 0.005 \pm 0.057$	$0.821 \pm 0.006 \pm 0.068$	$0.788 \pm 0.011 \pm 0.098$	$0.739 \pm 0.065 \pm 0.124$
$[9, 10]$	$0.958 \pm 0.008 \pm 0.072$	$0.915 \pm 0.010 \pm 0.075$	$0.904 \pm 0.015 \pm 0.126$	–

	$R_{p\mathrm{Pb}}$ (Backward)			
$p_{\mathrm{T}}[\mathrm{GeV}/c]\backslash y^*$	$[-3, -2.5]$	$[-3.5, -3]$	$[-4, -3.5]$	$[-4.5, -4]$
$[1, 2]$	$0.803 \pm 0.009 \pm 0.120$	$0.748 \pm 0.003 \pm 0.091$	$0.840 \pm 0.003 \pm 0.090$	$0.866 \pm 0.012 \pm 0.098$
$[2, 3]$	$0.795 \pm 0.003 \pm 0.093$	$0.846 \pm 0.002 \pm 0.090$	$0.874 \pm 0.002 \pm 0.084$	$0.927 \pm 0.002 \pm 0.086$
$[3, 4]$	$0.769 \pm 0.002 \pm 0.084$	$0.842 \pm 0.001 \pm 0.081$	$0.859 \pm 0.002 \pm 0.081$	$0.924 \pm 0.003 \pm 0.092$
$[4, 5]$	$0.762 \pm 0.003 \pm 0.080$	$0.845 \pm 0.002 \pm 0.078$	$0.870 \pm 0.003 \pm 0.089$	$0.911 \pm 0.003 \pm 0.107$
$[5, 6]$	$0.750 \pm 0.003 \pm 0.075$	$0.819 \pm 0.002 \pm 0.076$	$0.852 \pm 0.005 \pm 0.086$	$0.881 \pm 0.004 \pm 0.140$
$[6, 7]$	$0.761 \pm 0.008 \pm 0.074$	$0.797 \pm 0.002 \pm 0.077$	$0.843 \pm 0.002 \pm 0.099$	$0.919 \pm 0.008 \pm 0.153$
$[7, 8]$	$0.776 \pm 0.018 \pm 0.078$	$0.803 \pm 0.006 \pm 0.084$	$0.827 \pm 0.005 \pm 0.100$	–
$[8, 9]$	$0.730 \pm 0.008 \pm 0.079$	$0.780 \pm 0.004 \pm 0.092$	$0.777 \pm 0.009 \pm 0.104$	–
$[9, 10]$	$0.843 \pm 0.005 \pm 0.095$	$0.839 \pm 0.009 \pm 0.104$	–	–

Table 14: Forward and backward production ratio R_{FB} for prompt D_s^+ mesons as a function of p_{T} and y^*. The first uncertainty is statistical, the second systematic.

p_{T} [GeV/c]	R_{FB}
$[1, 2]$	$0.763 \pm 0.032 \pm 0.103$
$[2, 3]$	$0.743 \pm 0.011 \pm 0.079$
$[3, 4]$	$0.752 \pm 0.011 \pm 0.075$
$[4, 5]$	$0.764 \pm 0.013 \pm 0.073$
$[5, 6]$	$0.858 \pm 0.016 \pm 0.084$
$[6, 7]$	$0.982 \pm 0.030 \pm 0.102$
$[7, 8]$	$0.980 \pm 0.030 \pm 0.089$
$[8, 9]$	$0.921 \pm 0.028 \pm 0.092$
$[9, 10]$	$1.028 \pm 0.051 \pm 0.119$
$[10, 11]$	$0.978 \pm 0.057 \pm 0.148$
$[11, 12]$	$1.028 \pm 0.074 \pm 0.144$
$[12, 13]$	$1.068 \pm 0.144 \pm 0.161$
$\|y^*\|$	R_{FB}
$[2.5, 3.0]$	$0.854 \pm 0.021 \pm 0.119$
$[3.0, 3.5]$	$0.790 \pm 0.021 \pm 0.084$
$[3.5, 4.0]$	$0.623 \pm 0.035 \pm 0.071$

Table 15: Forward and backward production ratio R_{FB} for prompt D^+ mesons as a function of p_{T} and y^*. The first uncertainty is statistical, the second systematic.

p_{T} [GeV/c]	R_{FB}
$[1, 2]$	$0.775 \pm 0.004 \pm 0.092$
$[2, 3]$	$0.785 \pm 0.003 \pm 0.082$
$[3, 4]$	$0.832 \pm 0.002 \pm 0.083$
$[4, 5]$	$0.878 \pm 0.003 \pm 0.086$
$[5, 6]$	$0.913 \pm 0.004 \pm 0.088$
$[6, 7]$	$0.979 \pm 0.010 \pm 0.097$
$[7, 8]$	$0.993 \pm 0.014 \pm 0.101$
$[8, 9]$	$1.048 \pm 0.022 \pm 0.111$
$[9, 10]$	$1.081 \pm 0.013 \pm 0.118$
$[10, 11]$	$1.103 \pm 0.022 \pm 0.127$
$[11, 12]$	$1.097 \pm 0.028 \pm 0.126$
$[12, 13]$	$1.101 \pm 0.049 \pm 0.137$
$[13, 14]$	$1.272 \pm 0.044 \pm 0.163$
$\|y^*\|$	R_{FB}
$[2.5, 3.0]$	$0.881 \pm 0.005 \pm 0.104$
$[3.0, 3.5]$	$0.814 \pm 0.003 \pm 0.086$
$[3.5, 4.0]$	$0.690 \pm 0.004 \pm 0.072$

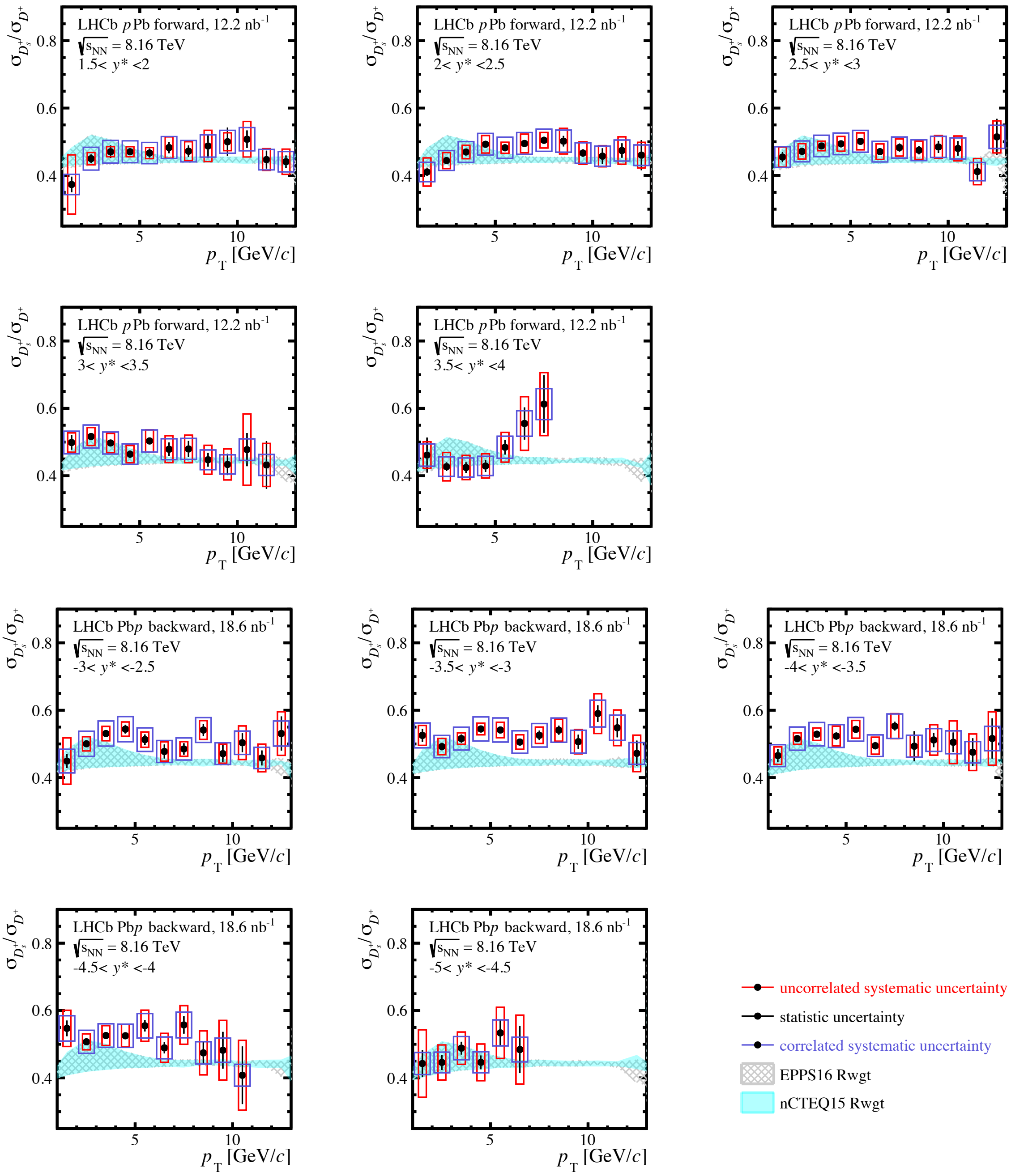

Figure 16: The production cross-section ratio $\sigma_{D_s^+}/\sigma_{D^+}$ as a function of p_{T} and y^* in pPb collisions. The error bars show the statistical uncertainty, the red boxes the uncorrelated systematic uncertainty and the blue boxes the correlated systematic uncertainty. The coloured bands correspond to the theoretical calculations, incorporating nPDFs EPPS16 (gray) [50] and nCTEQ15 (cyan) [51].

Table 16: The production cross-section ratio $\sigma_{D_s^+}/\sigma_{D^+}$ as a function of p_{T} and y^* in pPb collisions at (upper) forward and (lower) backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

	$\sigma_{D_s^+}/\sigma_{D^+}$ (Forward)				
$p_{\mathrm{T}}[\mathrm{GeV}/c]\backslash y^*$	[1.5, 2]	[2, 2.5]	[2.5, 3]	[3, 3.5]	[3.5, 4]
[1, 2]	$0.373 \pm 0.023 \pm 0.088 \pm 0.030$	$0.410 \pm 0.012 \pm 0.042 \pm 0.029$	$0.455 \pm 0.015 \pm 0.030 \pm 0.031$	$0.499 \pm 0.022 \pm 0.029 \pm 0.034$	$0.461 \pm 0.052 \pm 0.039 \pm 0.033$
[2, 3]	$0.450 \pm 0.013 \pm 0.018 \pm 0.034$	$0.444 \pm 0.004 \pm 0.024 \pm 0.030$	$0.472 \pm 0.006 \pm 0.023 \pm 0.031$	$0.516 \pm 0.008 \pm 0.027 \pm 0.034$	$0.427 \pm 0.013 \pm 0.042 \pm 0.029$
[3, 4]	$0.471 \pm 0.019 \pm 0.015 \pm 0.034$	$0.470 \pm 0.007 \pm 0.020 \pm 0.031$	$0.488 \pm 0.005 \pm 0.014 \pm 0.032$	$0.497 \pm 0.007 \pm 0.029 \pm 0.033$	$0.425 \pm 0.016 \pm 0.036 \pm 0.028$
[4, 5]	$0.470 \pm 0.009 \pm 0.015 \pm 0.032$	$0.493 \pm 0.007 \pm 0.026 \pm 0.032$	$0.494 \pm 0.006 \pm 0.022 \pm 0.032$	$0.464 \pm 0.011 \pm 0.026 \pm 0.030$	$0.429 \pm 0.018 \pm 0.036 \pm 0.029$
[5, 6]	$0.466 \pm 0.013 \pm 0.017 \pm 0.032$	$0.482 \pm 0.009 \pm 0.016 \pm 0.031$	$0.501 \pm 0.007 \pm 0.025 \pm 0.032$	$0.503 \pm 0.010 \pm 0.033 \pm 0.033$	$0.485 \pm 0.022 \pm 0.044 \pm 0.033$
[6, 7]	$0.483 \pm 0.017 \pm 0.032 \pm 0.033$	$0.495 \pm 0.006 \pm 0.028 \pm 0.032$	$0.471 \pm 0.009 \pm 0.023 \pm 0.030$	$0.479 \pm 0.020 \pm 0.040 \pm 0.031$	$0.555 \pm 0.048 \pm 0.080 \pm 0.038$
[7, 8]	$0.472 \pm 0.017 \pm 0.028 \pm 0.032$	$0.504 \pm 0.010 \pm 0.023 \pm 0.033$	$0.483 \pm 0.012 \pm 0.025 \pm 0.031$	$0.480 \pm 0.024 \pm 0.041 \pm 0.031$	$0.613 \pm 0.085 \pm 0.094 \pm 0.046$
[8, 9]	$0.487 \pm 0.036 \pm 0.047 \pm 0.033$	$0.502 \pm 0.016 \pm 0.038 \pm 0.033$	$0.475 \pm 0.012 \pm 0.027 \pm 0.031$	$0.447 \pm 0.020 \pm 0.043 \pm 0.029$	–
[9, 10]	$0.500 \pm 0.042 \pm 0.027 \pm 0.034$	$0.467 \pm 0.011 \pm 0.033 \pm 0.030$	$0.485 \pm 0.018 \pm 0.034 \pm 0.031$	$0.434 \pm 0.032 \pm 0.046 \pm 0.029$	–
[10, 11]	$0.508 \pm 0.026 \pm 0.053 \pm 0.035$	$0.457 \pm 0.023 \pm 0.031 \pm 0.030$	$0.480 \pm 0.022 \pm 0.037 \pm 0.031$	$0.478 \pm 0.049 \pm 0.106 \pm 0.032$	–
[11, 12]	$0.447 \pm 0.027 \pm 0.033 \pm 0.030$	$0.474 \pm 0.021 \pm 0.041 \pm 0.031$	$0.412 \pm 0.024 \pm 0.039 \pm 0.027$	$0.432 \pm 0.071 \pm 0.064 \pm 0.031$	–
[12, 13]	$0.441 \pm 0.019 \pm 0.037 \pm 0.030$	$0.460 \pm 0.045 \pm 0.038 \pm 0.030$	$0.514 \pm 0.053 \pm 0.048 \pm 0.034$	–	–

	$\sigma_{D_s^+}/\sigma_{D^+}$ (Backward)				
$p_{\mathrm{T}}[\mathrm{GeV}/c]\backslash y^*$	[−3, −2.5]	[−3.5, −3]	[−4, −3.5]	[−4.5, −4]	[−5, −4.5]
[1, 2]	$0.449 \pm 0.020 \pm 0.069 \pm 0.035$	$0.525 \pm 0.019 \pm 0.030 \pm 0.037$	$0.465 \pm 0.019 \pm 0.026 \pm 0.033$	$0.547 \pm 0.023 \pm 0.054 \pm 0.038$	$0.443 \pm 0.040 \pm 0.100 \pm 0.033$
[2, 3]	$0.500 \pm 0.010 \pm 0.021 \pm 0.037$	$0.492 \pm 0.011 \pm 0.024 \pm 0.033$	$0.516 \pm 0.005 \pm 0.017 \pm 0.034$	$0.507 \pm 0.008 \pm 0.024 \pm 0.034$	$0.446 \pm 0.023 \pm 0.052 \pm 0.031$
[3, 4]	$0.531 \pm 0.005 \pm 0.021 \pm 0.037$	$0.516 \pm 0.012 \pm 0.017 \pm 0.034$	$0.529 \pm 0.009 \pm 0.019 \pm 0.035$	$0.526 \pm 0.007 \pm 0.030 \pm 0.035$	$0.488 \pm 0.019 \pm 0.048 \pm 0.034$
[4, 5]	$0.544 \pm 0.013 \pm 0.021 \pm 0.037$	$0.544 \pm 0.006 \pm 0.017 \pm 0.036$	$0.523 \pm 0.011 \pm 0.029 \pm 0.034$	$0.525 \pm 0.006 \pm 0.034 \pm 0.034$	$0.446 \pm 0.020 \pm 0.054 \pm 0.031$
[5, 6]	$0.513 \pm 0.015 \pm 0.023 \pm 0.035$	$0.541 \pm 0.007 \pm 0.023 \pm 0.036$	$0.543 \pm 0.008 \pm 0.026 \pm 0.035$	$0.555 \pm 0.017 \pm 0.046 \pm 0.036$	$0.534 \pm 0.038 \pm 0.076 \pm 0.038$
[6, 7]	$0.478 \pm 0.021 \pm 0.029 \pm 0.033$	$0.506 \pm 0.007 \pm 0.022 \pm 0.033$	$0.495 \pm 0.011 \pm 0.025 \pm 0.032$	$0.489 \pm 0.017 \pm 0.043 \pm 0.032$	$0.484 \pm 0.070 \pm 0.102 \pm 0.037$
[7, 8]	$0.485 \pm 0.017 \pm 0.022 \pm 0.033$	$0.526 \pm 0.014 \pm 0.024 \pm 0.035$	$0.553 \pm 0.013 \pm 0.037 \pm 0.036$	$0.557 \pm 0.026 \pm 0.057 \pm 0.038$	–
[8, 9]	$0.541 \pm 0.018 \pm 0.028 \pm 0.037$	$0.541 \pm 0.013 \pm 0.033 \pm 0.036$	$0.493 \pm 0.044 \pm 0.032 \pm 0.032$	$0.474 \pm 0.032 \pm 0.065 \pm 0.033$	–
[9, 10]	$0.471 \pm 0.025 \pm 0.028 \pm 0.032$	$0.507 \pm 0.021 \pm 0.036 \pm 0.034$	$0.512 \pm 0.021 \pm 0.045 \pm 0.034$	$0.482 \pm 0.055 \pm 0.088 \pm 0.036$	–
[10, 11]	$0.504 \pm 0.028 \pm 0.050 \pm 0.035$	$0.590 \pm 0.025 \pm 0.059 \pm 0.040$	$0.505 \pm 0.029 \pm 0.063 \pm 0.034$	$0.408 \pm 0.085 \pm 0.104 \pm 0.032$	–
[11, 12]	$0.458 \pm 0.022 \pm 0.041 \pm 0.032$	$0.548 \pm 0.028 \pm 0.053 \pm 0.037$	$0.475 \pm 0.041 \pm 0.054 \pm 0.032$	–	–
[12, 13]	$0.531 \pm 0.051 \pm 0.065 \pm 0.037$	$0.472 \pm 0.038 \pm 0.054 \pm 0.032$	$0.516 \pm 0.060 \pm 0.079 \pm 0.036$	–	–

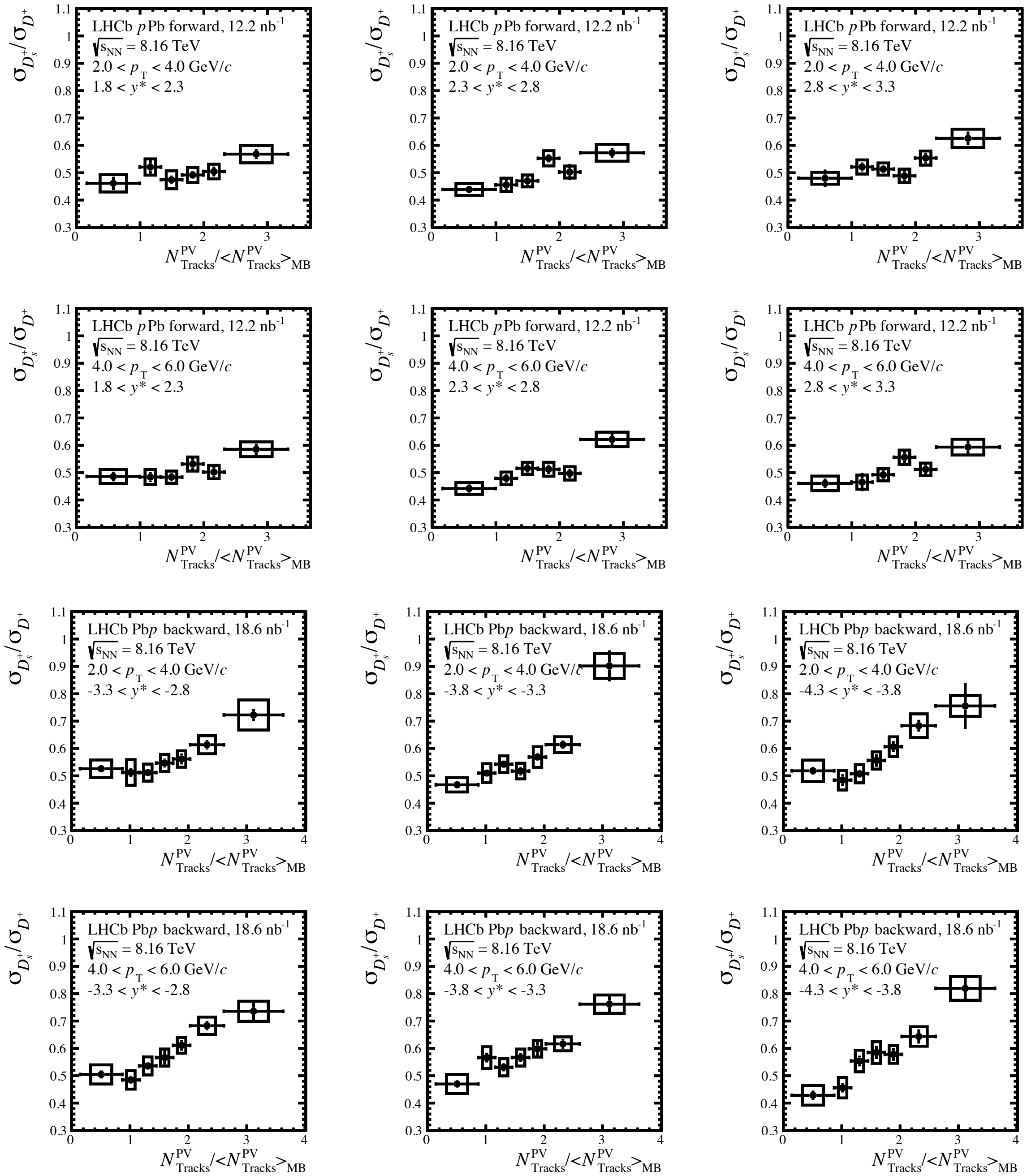

Figure 17: The production cross-section ratio, $\sigma_{D_s^+}/\sigma_{D^+}$, versus normalized event multiplicity in different D-meson p_{T} (2-6 GeV/c) and y^* ranges for the (six upper plots) forward and (six lower plots) backward rapidities. The vertical error bars show the statistical uncertainty, the boxes the systematic.

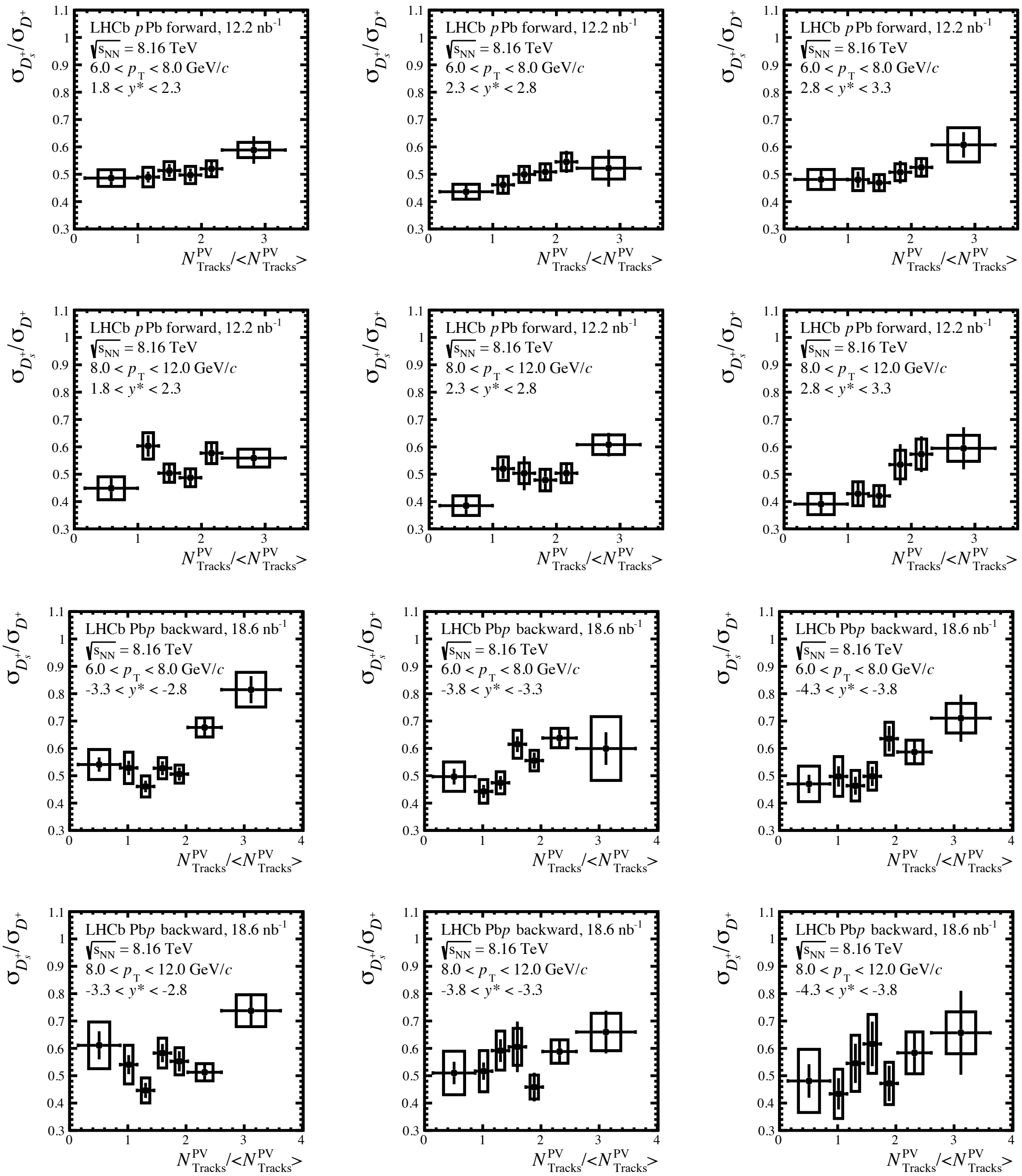

Figure 18: The production cross-section ratio, $\sigma_{D_s^+}/\sigma_{D^+}$, versus normalized event multiplicity in different D-meson p_{T} (6-12 GeV/c) and y^* ranges for the (six upper plots) forward and (six lower plots) backward rapidities. The vertical error bars show the statistical uncertainty, the boxes the systematic.

Table 17: The production cross-section ratio $\sigma_{D_s^+}/\sigma_{D^+}$ as a function of p_{T}, y^* and $N_{\mathrm{Tracks}}^{\mathrm{PV}}$ in pPb collisions at (upper) forward and (lower) backward rapidities. The first uncertainty is statistical, the second the component of the systematic uncertainty that is uncorrelated between bins and the third the correlated systematic component.

$\sigma_{D_s^+}/\sigma_{D^+}$ (Forward)						
$p_{\mathrm{T}}[\mathrm{GeV}/c], y^*\backslash N_{\mathrm{tracks}}^{\mathrm{PV}}$	$[10,60]$	$[60,80]$	$[80,100]$	$[100,120]$	$[120,140]$	$[140,200]$
$[2,4],[1.8,2.3]$	$0.46\pm0.02\pm0.02\pm0.02$	$0.52\pm0.03\pm0.02\pm0.02$	$0.47\pm0.02\pm0.03\pm0.02$	$0.49\pm0.02\pm0.02\pm0.02$	$0.50\pm0.02\pm0.02\pm0.02$	$0.57\pm0.02\pm0.02\pm0.03$
$[2,4],[2.3,2.8]$	$0.44\pm0.01\pm0.01\pm0.02$	$0.46\pm0.02\pm0.02\pm0.02$	$0.47\pm0.02\pm0.02\pm0.01$	$0.55\pm0.01\pm0.02\pm0.02$	$0.50\pm0.03\pm0.02\pm0.02$	$0.57\pm0.02\pm0.02\pm0.02$
$[2,4],[2.8,3.3]$	$0.48\pm0.03\pm0.02\pm0.02$	$0.52\pm0.02\pm0.02\pm0.02$	$0.51\pm0.02\pm0.02\pm0.02$	$0.49\pm0.02\pm0.02\pm0.02$	$0.55\pm0.02\pm0.02\pm0.02$	$0.63\pm0.02\pm0.02\pm0.02$
$[4,6],[1.8,2.3]$	$0.49\pm0.02\pm0.02\pm0.02$	$0.48\pm0.02\pm0.02\pm0.02$	$0.48\pm0.01\pm0.02\pm0.01$	$0.53\pm0.03\pm0.02\pm0.02$	$0.50\pm0.02\pm0.02\pm0.02$	$0.59\pm0.02\pm0.02\pm0.02$
$[4,6],[2.3,2.8]$	$0.44\pm0.01\pm0.01\pm0.02$	$0.48\pm0.02\pm0.02\pm0.01$	$0.52\pm0.02\pm0.02\pm0.01$	$0.51\pm0.02\pm0.02\pm0.02$	$0.50\pm0.02\pm0.02\pm0.01$	$0.62\pm0.02\pm0.02\pm0.02$
$[4,6],[2.8,3.3]$	$0.46\pm0.02\pm0.02\pm0.02$	$0.47\pm0.03\pm0.02\pm0.01$	$0.49\pm0.02\pm0.02\pm0.01$	$0.56\pm0.02\pm0.02\pm0.02$	$0.51\pm0.02\pm0.02\pm0.01$	$0.59\pm0.03\pm0.02\pm0.02$
$[6,8],[1.8,2.3]$	$0.49\pm0.03\pm0.03\pm0.02$	$0.49\pm0.02\pm0.03\pm0.02$	$0.51\pm0.02\pm0.03\pm0.01$	$0.50\pm0.02\pm0.03\pm0.02$	$0.52\pm0.03\pm0.02\pm0.02$	$0.59\pm0.05\pm0.02\pm0.02$
$[6,8],[2.3,2.8]$	$0.44\pm0.03\pm0.02\pm0.02$	$0.46\pm0.03\pm0.03\pm0.01$	$0.50\pm0.02\pm0.03\pm0.01$	$0.51\pm0.02\pm0.03\pm0.01$	$0.55\pm0.04\pm0.03\pm0.01$	$0.52\pm0.07\pm0.04\pm0.01$
$[6,8],[2.8,3.3]$	$0.48\pm0.03\pm0.03\pm0.02$	$0.48\pm0.03\pm0.04\pm0.01$	$0.47\pm0.03\pm0.03\pm0.01$	$0.51\pm0.04\pm0.03\pm0.01$	$0.53\pm0.04\pm0.03\pm0.01$	$0.61\pm0.05\pm0.06\pm0.02$
$[8,12],[1.8,2.3]$	$0.45\pm0.04\pm0.04\pm0.02$	$0.60\pm0.04\pm0.04\pm0.02$	$0.50\pm0.03\pm0.03\pm0.01$	$0.49\pm0.03\pm0.03\pm0.01$	$0.58\pm0.04\pm0.03\pm0.02$	$0.56\pm0.04\pm0.03\pm0.02$
$[8,12],[2.3,2.8]$	$0.39\pm0.03\pm0.03\pm0.01$	$0.52\pm0.04\pm0.04\pm0.02$	$0.50\pm0.06\pm0.04\pm0.01$	$0.48\pm0.04\pm0.04\pm0.01$	$0.50\pm0.04\pm0.03\pm0.01$	$0.61\pm0.04\pm0.03\pm0.02$
$[8,12],[2.8,3.3]$	$0.39\pm0.04\pm0.04\pm0.01$	$0.43\pm0.05\pm0.04\pm0.01$	$0.42\pm0.04\pm0.04\pm0.01$	$0.54\pm0.07\pm0.05\pm0.02$	$0.57\pm0.07\pm0.05\pm0.02$	$0.59\pm0.08\pm0.04\pm0.02$

$\sigma_{D_s^+}/\sigma_{D^+}$ (Backward)							
$p_{\mathrm{T}}[\mathrm{GeV}/c], y^*\backslash N_{\mathrm{tracks}}^{\mathrm{PV}}$	$[10,60]$	$[60,80]$	$[80,100]$	$[100,120]$	$[120,140]$	$[140,180]$	$[180,250]$
$[2,4],[-3.3,-2.8]$	$0.53\pm0.01\pm0.03\pm0.02$	$0.51\pm0.02\pm0.04\pm0.03$	$0.51\pm0.01\pm0.02\pm0.02$	$0.55\pm0.02\pm0.02\pm0.02$	$0.56\pm0.02\pm0.02\pm0.02$	$0.61\pm0.02\pm0.02\pm0.02$	$0.72\pm0.02\pm0.04\pm0.04$
$[2,4],[-3.8,-3.3]$	$0.47\pm0.01\pm0.02\pm0.01$	$0.51\pm0.01\pm0.03\pm0.02$	$0.54\pm0.01\pm0.03\pm0.02$	$0.52\pm0.02\pm0.02\pm0.02$	$0.57\pm0.01\pm0.03\pm0.02$	$0.61\pm0.02\pm0.02\pm0.02$	$0.90\pm0.06\pm0.03\pm0.04$
$[2,4],[-4.3,-3.8]$	$0.52\pm0.01\pm0.03\pm0.02$	$0.48\pm0.02\pm0.03\pm0.02$	$0.51\pm0.01\pm0.03\pm0.02$	$0.56\pm0.02\pm0.03\pm0.02$	$0.61\pm0.02\pm0.03\pm0.02$	$0.68\pm0.02\pm0.04\pm0.03$	$0.76\pm0.08\pm0.03\pm0.03$
$[4,6],[-3.3,-2.8]$	$0.50\pm0.01\pm0.03\pm0.02$	$0.48\pm0.02\pm0.03\pm0.02$	$0.54\pm0.01\pm0.03\pm0.02$	$0.57\pm0.03\pm0.02\pm0.02$	$0.61\pm0.02\pm0.02\pm0.02$	$0.68\pm0.02\pm0.02\pm0.02$	$0.74\pm0.03\pm0.02\pm0.03$
$[4,6],[-3.8,-3.3]$	$0.47\pm0.01\pm0.03\pm0.02$	$0.57\pm0.02\pm0.04\pm0.02$	$0.53\pm0.01\pm0.03\pm0.01$	$0.57\pm0.02\pm0.03\pm0.02$	$0.60\pm0.03\pm0.03\pm0.02$	$0.62\pm0.02\pm0.02\pm0.02$	$0.76\pm0.04\pm0.02\pm0.03$
$[4,6],[-4.3,-3.8]$	$0.43\pm0.02\pm0.03\pm0.02$	$0.46\pm0.02\pm0.03\pm0.02$	$0.55\pm0.02\pm0.04\pm0.02$	$0.58\pm0.02\pm0.04\pm0.02$	$0.58\pm0.02\pm0.03\pm0.02$	$0.64\pm0.03\pm0.03\pm0.02$	$0.82\pm0.05\pm0.03\pm0.03$
$[6,8],[-3.3,-2.8]$	$0.54\pm0.03\pm0.05\pm0.02$	$0.53\pm0.03\pm0.05\pm0.02$	$0.46\pm0.02\pm0.04\pm0.01$	$0.53\pm0.03\pm0.03\pm0.02$	$0.51\pm0.02\pm0.03\pm0.02$	$0.68\pm0.03\pm0.03\pm0.02$	$0.81\pm0.05\pm0.06\pm0.03$
$[6,8],[-3.8,-3.3]$	$0.50\pm0.03\pm0.05\pm0.02$	$0.44\pm0.02\pm0.04\pm0.01$	$0.47\pm0.02\pm0.04\pm0.01$	$0.62\pm0.03\pm0.05\pm0.02$	$0.56\pm0.03\pm0.03\pm0.02$	$0.64\pm0.03\pm0.03\pm0.02$	$0.60\pm0.06\pm0.11\pm0.02$
$[6,8],[-4.3,-3.8]$	$0.47\pm0.03\pm0.06\pm0.02$	$0.50\pm0.04\pm0.07\pm0.02$	$0.46\pm0.03\pm0.05\pm0.01$	$0.50\pm0.04\pm0.05\pm0.01$	$0.64\pm0.05\pm0.06\pm0.02$	$0.59\pm0.04\pm0.04\pm0.02$	$0.71\pm0.09\pm0.05\pm0.02$
$[8,12],[-3.3,-2.8]$	$0.61\pm0.05\pm0.08\pm0.02$	$0.54\pm0.03\pm0.07\pm0.02$	$0.45\pm0.03\pm0.04\pm0.02$	$0.58\pm0.03\pm0.05\pm0.02$	$0.55\pm0.04\pm0.05\pm0.02$	$0.51\pm0.03\pm0.03\pm0.02$	$0.74\pm0.06\pm0.05\pm0.02$
$[8,12],[-3.8,-3.3]$	$0.51\pm0.04\pm0.08\pm0.02$	$0.52\pm0.03\pm0.07\pm0.02$	$0.59\pm0.04\pm0.07\pm0.02$	$0.61\pm0.09\pm0.06\pm0.02$	$0.46\pm0.05\pm0.04\pm0.01$	$0.59\pm0.04\pm0.04\pm0.02$	$0.66\pm0.08\pm0.07\pm0.02$
$[8,12],[-4.3,-3.8]$	$0.48\pm0.06\pm0.11\pm0.02$	$0.43\pm0.06\pm0.09\pm0.02$	$0.55\pm0.07\pm0.10\pm0.02$	$0.62\pm0.08\pm0.11\pm0.02$	$0.47\pm0.06\pm0.08\pm0.02$	$0.58\pm0.08\pm0.07\pm0.02$	$0.66\pm0.15\pm0.07\pm0.02$