Open beauty production at NICA

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Open beauty production at LO

1. Collinear parton model
2. Generalized parton model

Parton subprocesses

$$g+g \to b+\bar{b} \qquad q+\bar{q} \to b+\bar{b}, q=u, d, s$$

$$m_b = 4.5\,\text{GeV} \qquad \mu = \xi\sqrt{m_b^2+p_T^2}, \xi = \frac{1}{2}, 1, 2$$

B-meson production

Peterson fragmentation function ε=0.006 $\qquad z=(E_B+p_B)/(E_b+p_b)$

LHAPDF 6.3 LO PDF sets used

- CT10
- cteq6l1
- cteq66
- MSTW2008lo90cl
- MMHT2014lo68cl
- MSHT20lo_as130
- NNPDF40_lo_as_01180

b-quark production at $\sqrt{s} = 39\,\text{GeV}$

Experiment: D.M. Jansen et al., Fermilab 1994, «Measurement of the Bottom-Quark Production Cross Section in 800 GeV/c Proton-Gold Collisions»

$$\sigma\left(pN \to b\bar{b} + X\right) = 5.7 \pm 2.8\,\text{nb/nucleon}$$

σ(nb)/PDF	CT10	cteq6l1	MSTW2008lo90cl	cteq66	MMHT2014lo68cl	MSHT20lo_as130	NNPDF40_lo_as_01180
CPM, ξ=1	12.008	8.807	14.625	12.199	15.010	15.238	8.485
GPM, ξ=1	11.530	8.536	14.038	11.700	1.248	14.555	8.238

b-quark production at $\sqrt{s}=200\,\mathrm{GeV}$

Experiment: C. Aidala et. al., PHENIX 2017,
«B-meson production at forward and backward rapidity
in p+p and Cu+Au collisions at $\sqrt{s}=200\,\mathrm{GeV}$»

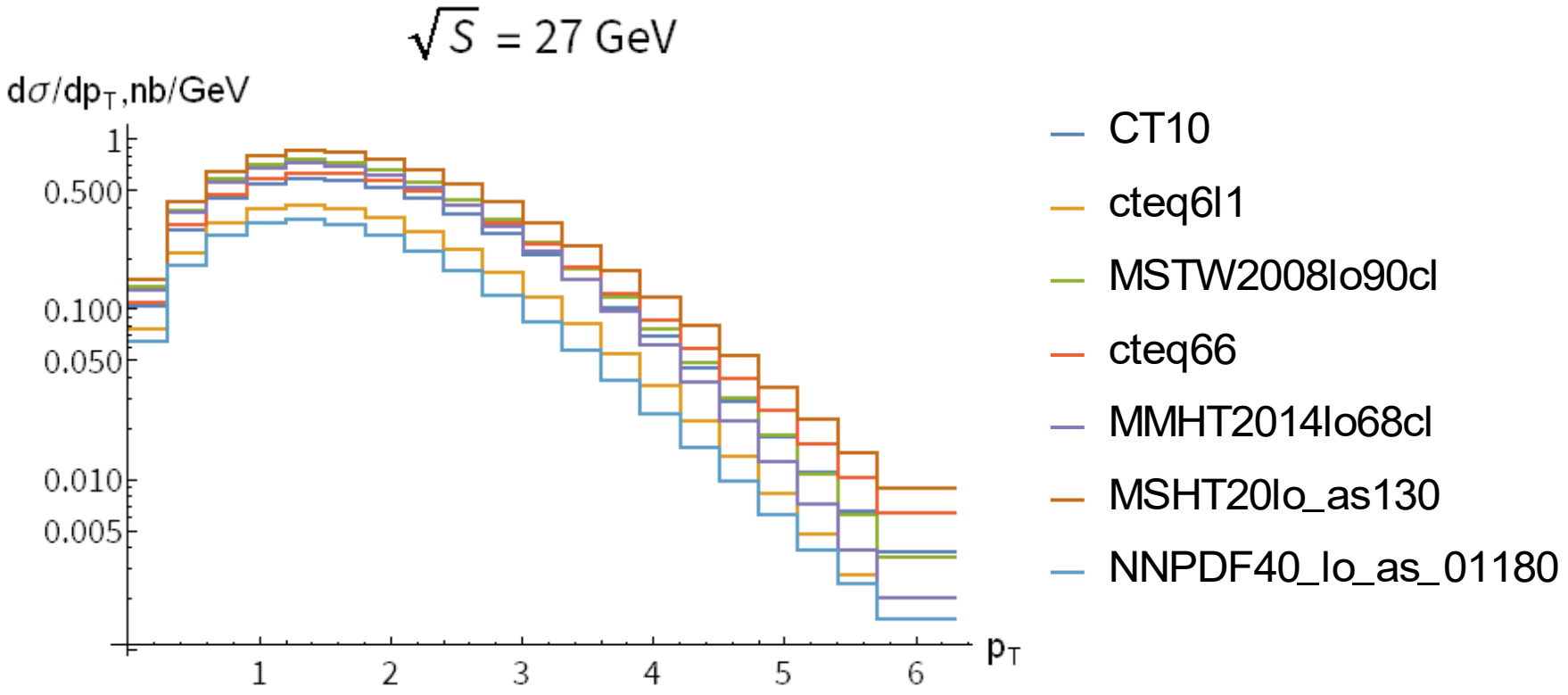
$$\frac{d\sigma}{dy}\left(pN\to b\bar{b}+X\right)=0.51\pm0.33\,\mu b,\ |y|=1.6$$

$\frac{d\sigma}{dy}(\mu b)$/PDF	CT10	cteq6l1	MSTW2008lo90cl	cteq66	MMHT2014lo68cl	MSHT20lo_as130	NNPDF40_lo_as_01180
CPM, ξ=1	0.271	0.254	0.276	0.265	0.298	0.307	0.229
GPM, ξ=1	0.265	0.247	0.271	0.258	0.291	0.299	0.226

Total b-quark cross sections at $\sqrt{s} = 27\,\mathrm{GeV}$

σ(nb)/PDF	CT10	cteq6l1	MSTW2008lo90cl	cteq66	MMHT2014lo68cl	MSHT20lo_as130	NNPDF40_lo_as_01180
CPM, ξ=1/2	4.751	2.801	6.808	5.190	6.486	7.033	2.081
CPM, ξ=1	1.448	0.954	1.811	1.598	1.689	2.165	0.756
CPM, ξ=2	0.582	0.422	0.676	0.645	0.618	0.908	0.349
GPM, ξ=1/2	4.629	2.747	6.618	5.062	6.290	6.861	2.033
GPM, ξ=1	1.414	0.938	1.772	1.561	1.646	2.121	0.746
GPM, ξ=2	0.570	0.416	0.662	0.631	0.604	0.893	0.344

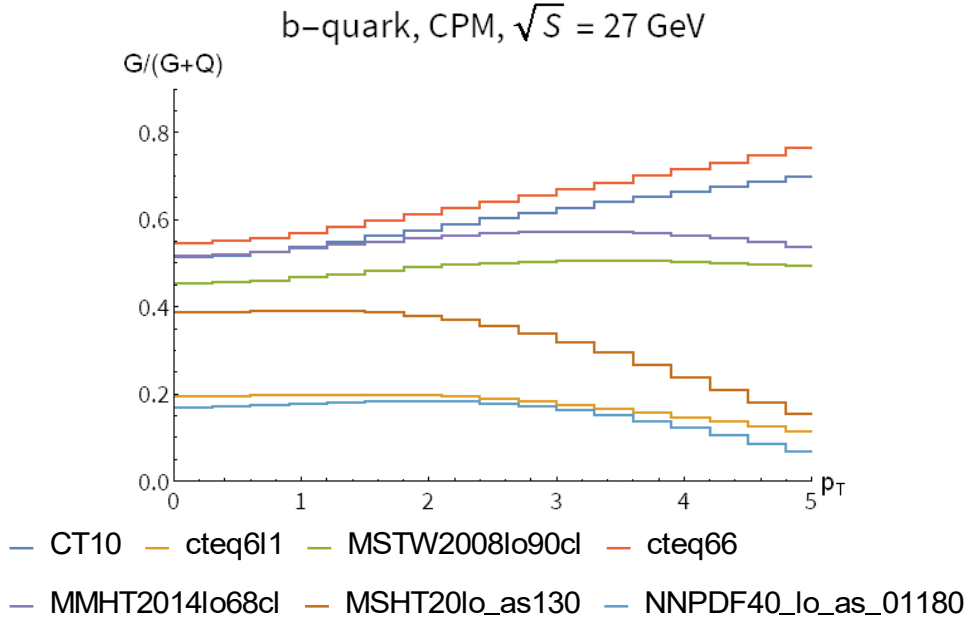
b-quark XS over transverse momenta

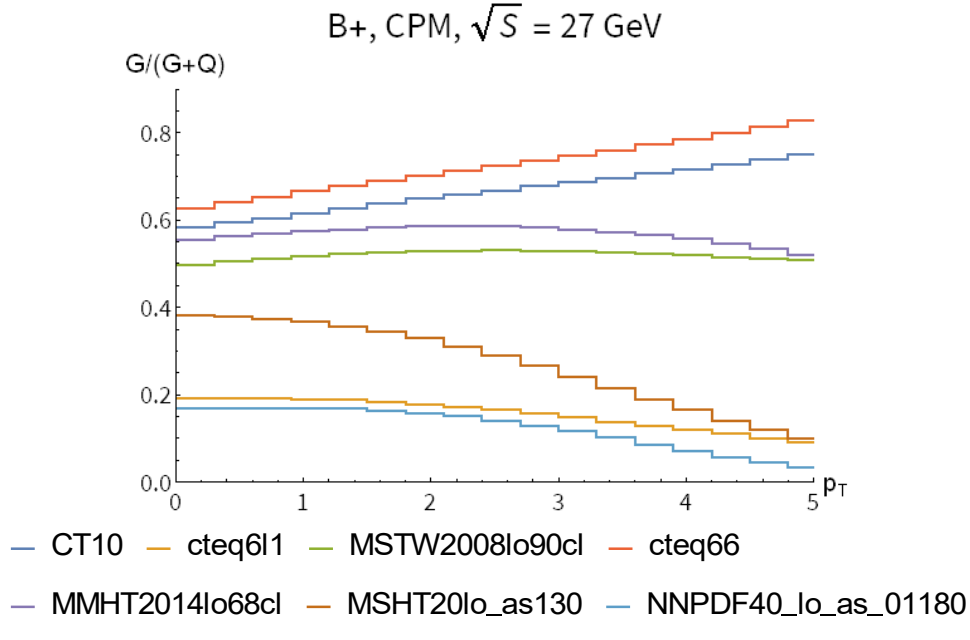


Total B+ meson cross sections at $\sqrt{s} = 27\,\text{GeV}$

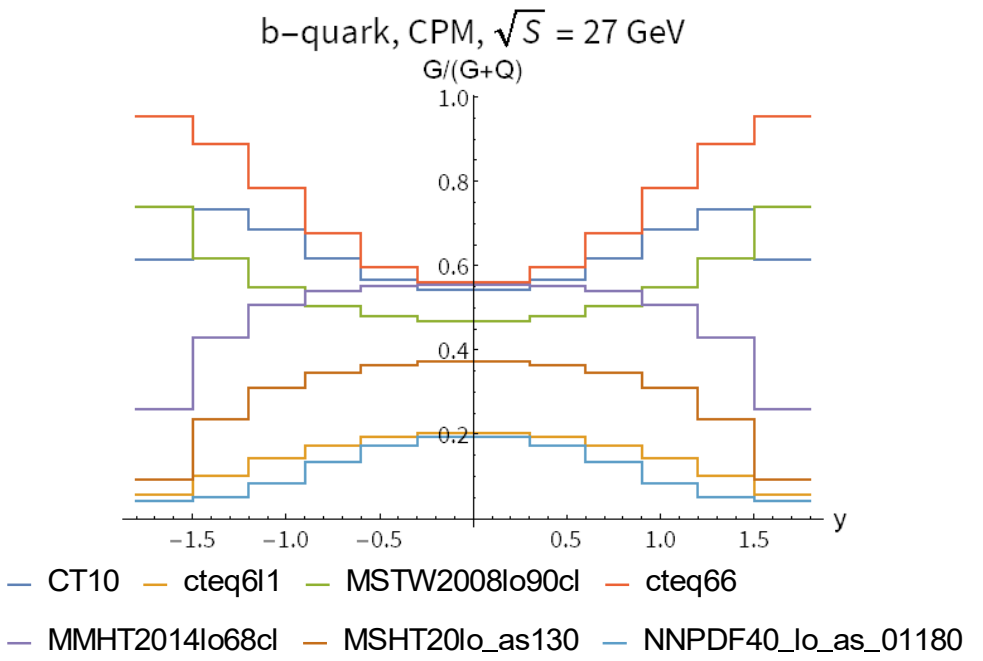
σ(nb)/PDF	CT10	cteq6l1	MSTW2008lo90cl	cteq66	MMHT2014lo68cl	MSHT20lo_as130	NNPDF40_lo_as_01180
CPM, ξ=1/2	1.743	0.966	2.507	1.934	2.361	2.554	0.698
CPM, ξ=1	0.508	0.319	0.632	0.569	0.583	0.756	0.248
CPM, ξ=2	0.198	0.139	0.228	0.223	0.206	0.309	0.113
GPM, ξ=1/2	1.724	0.964	2.472	1.914	2.342	2.541	0.698
GPM, ξ=1	0.504	0.319	0.628	0.566	0.582	0.754	0.248
GPM, ξ=2	0.197	0.138	0.227	0.222	0.206	0.309	0.113

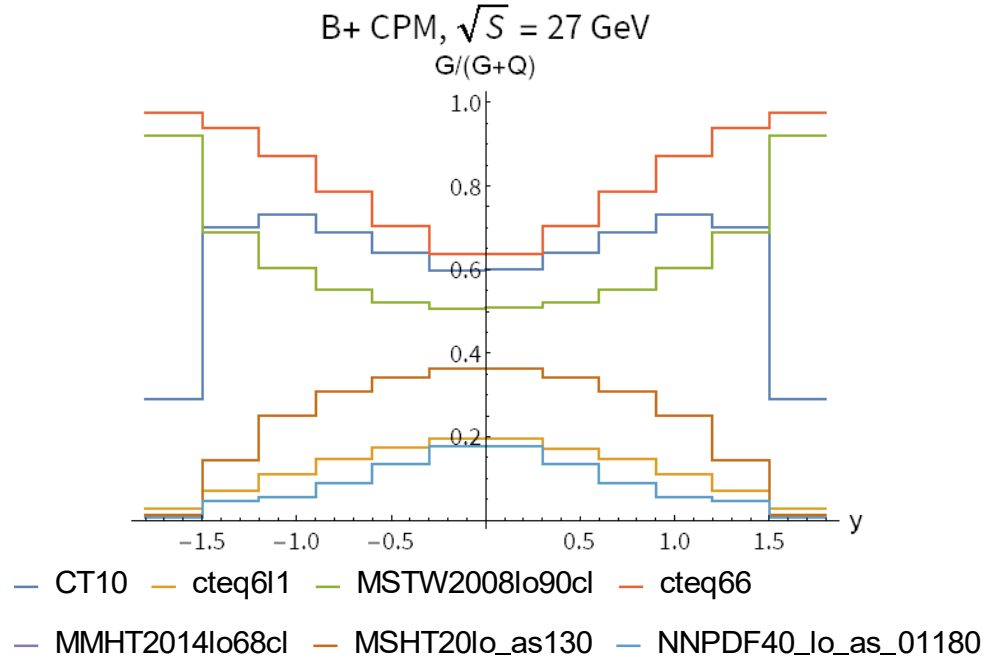
gluon initiated relative contribution



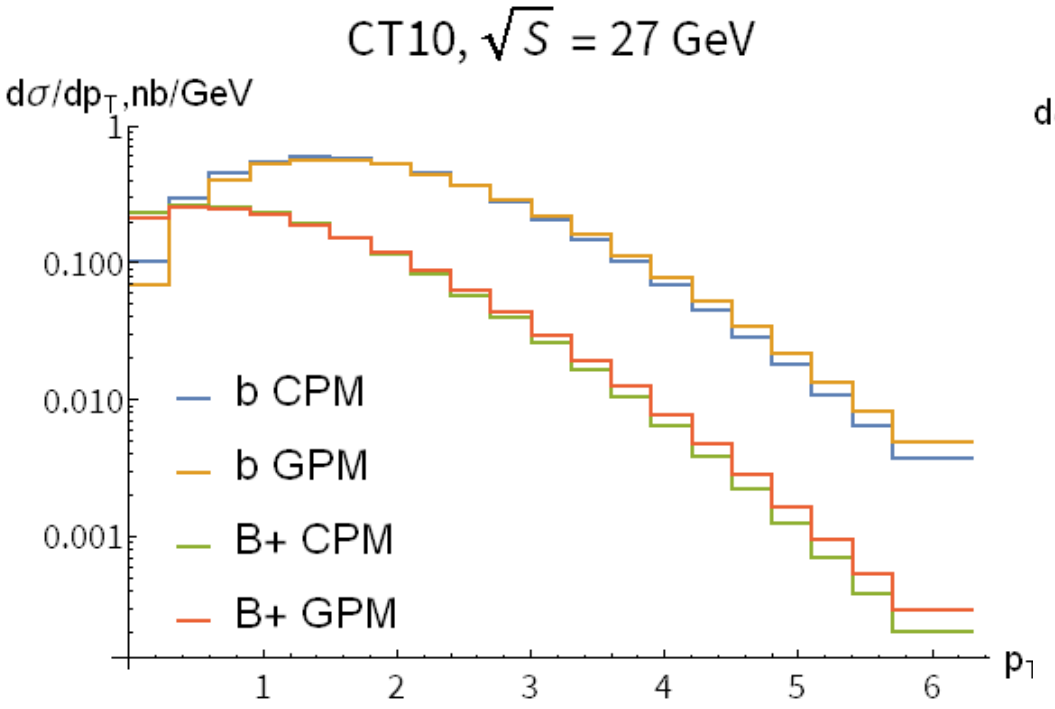


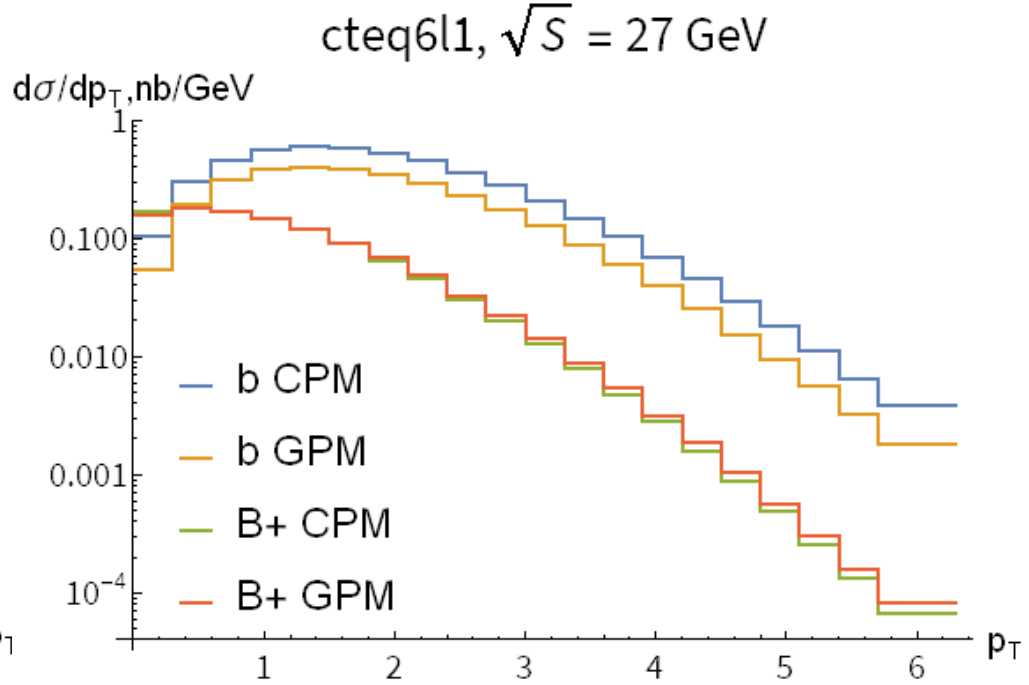
gluon initiated relative contribution



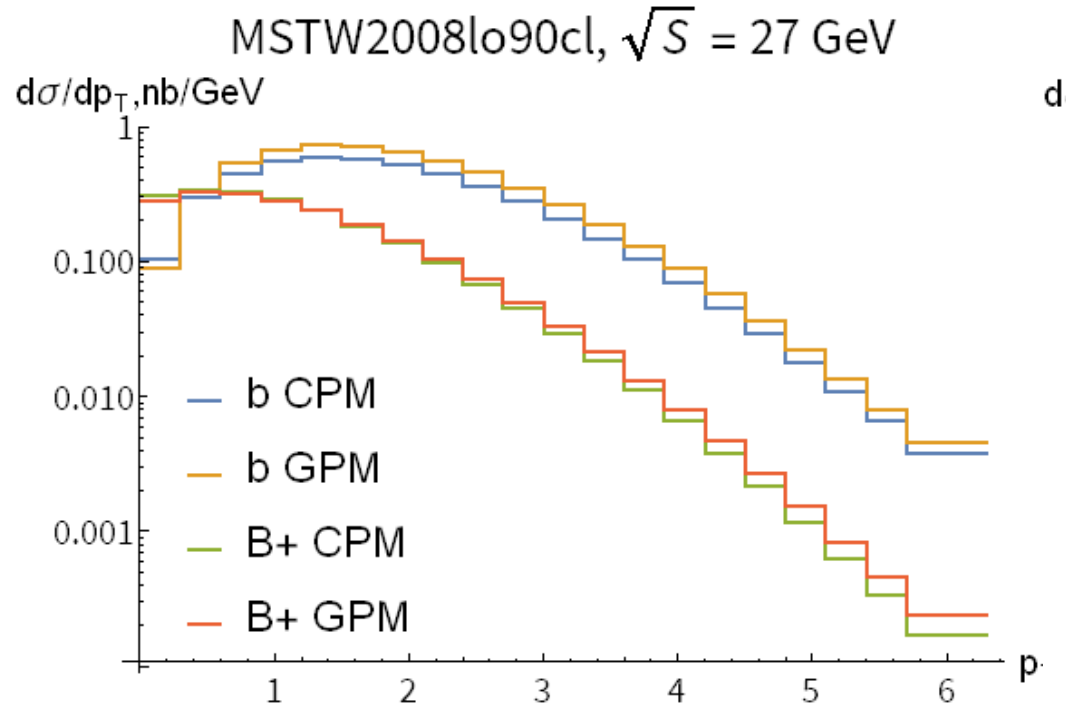


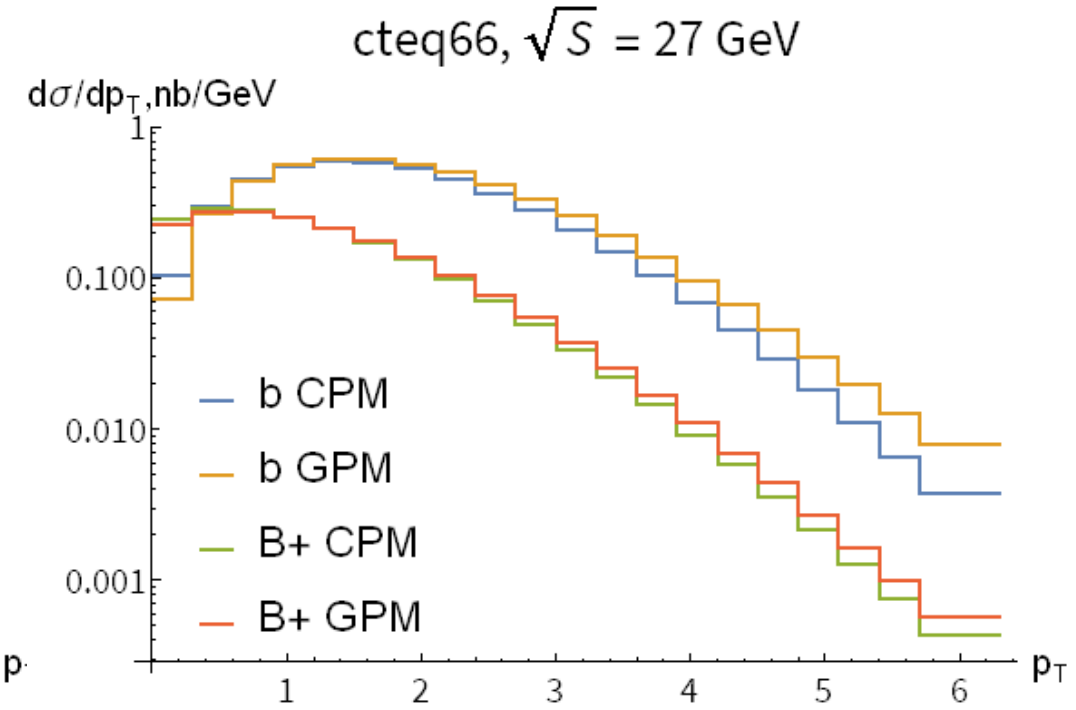
B+ production



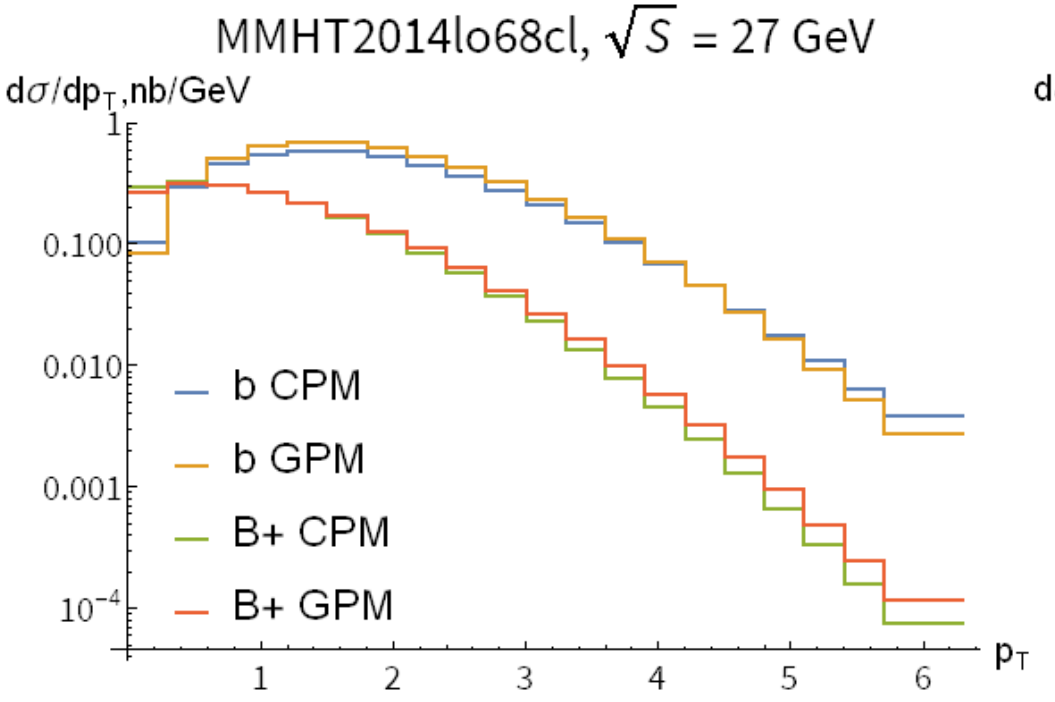


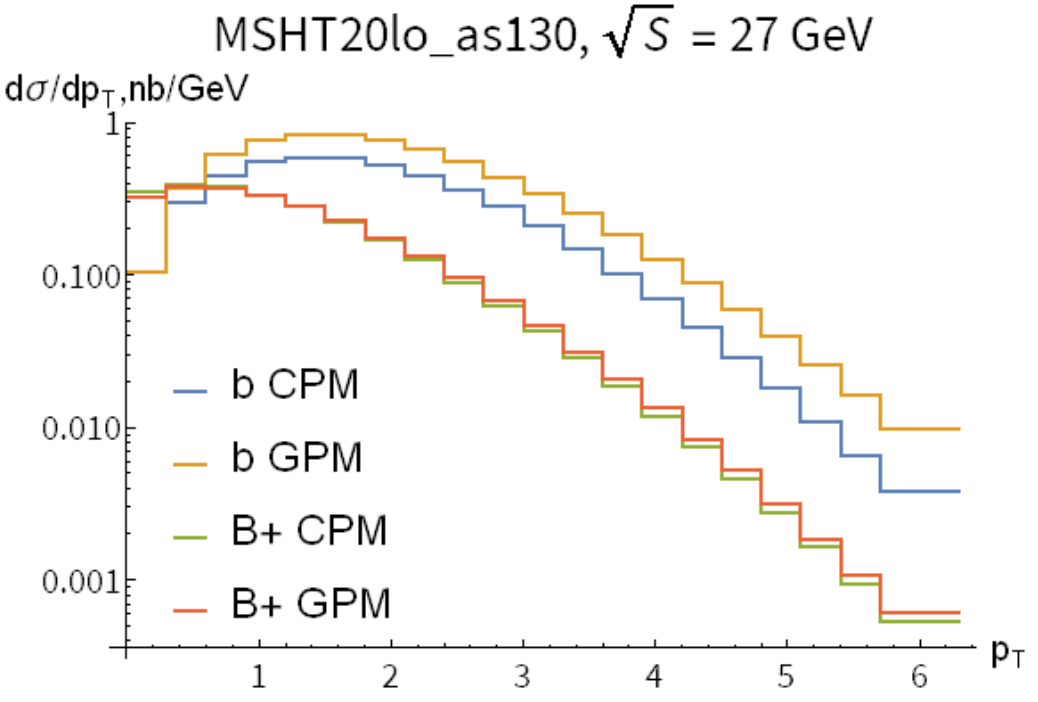
B+ production at $\sqrt{s} = 27\,\text{GeV}$



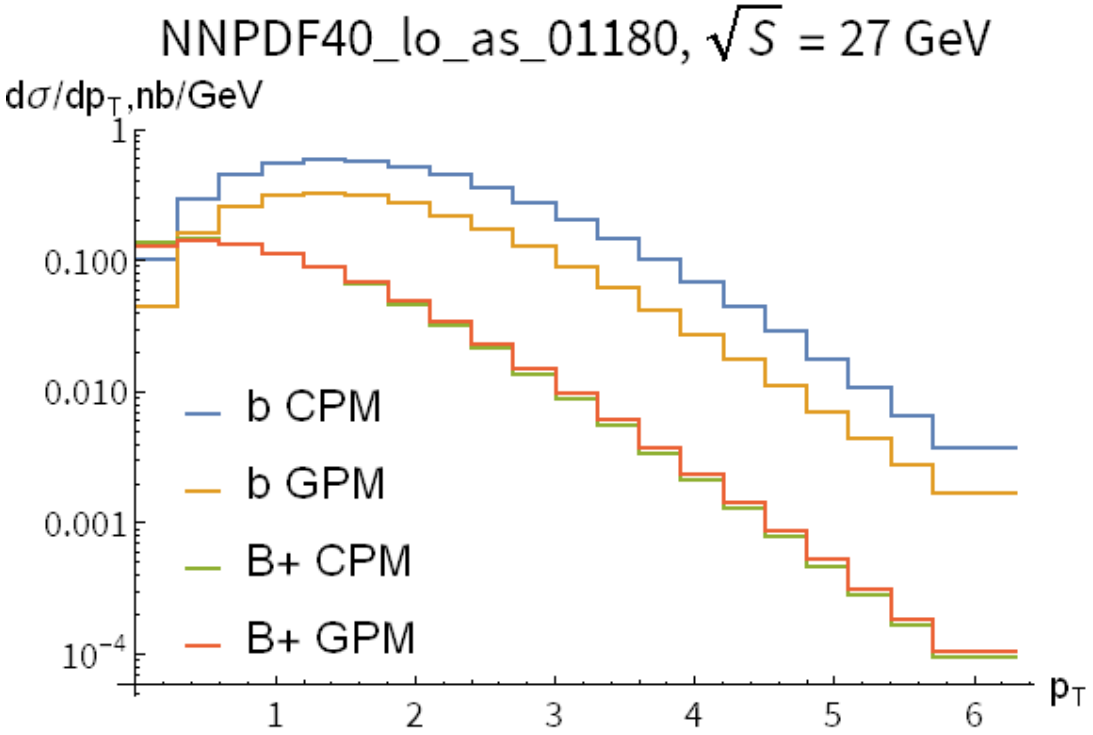


B+ production at $\sqrt{s} = 27\,\text{GeV}$

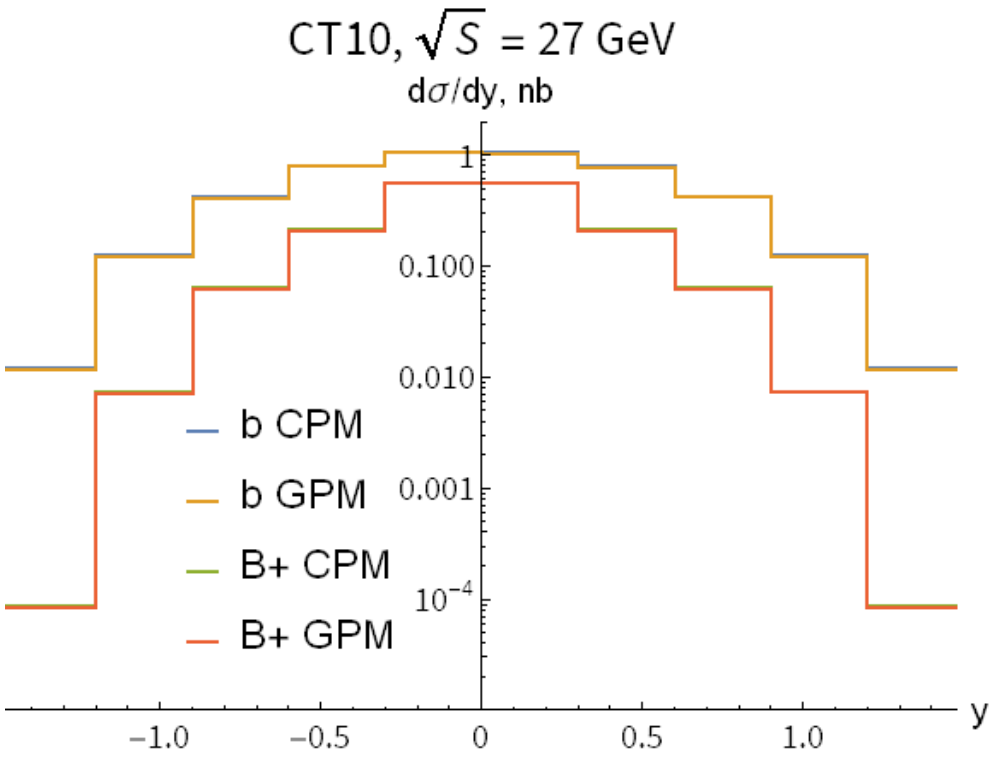


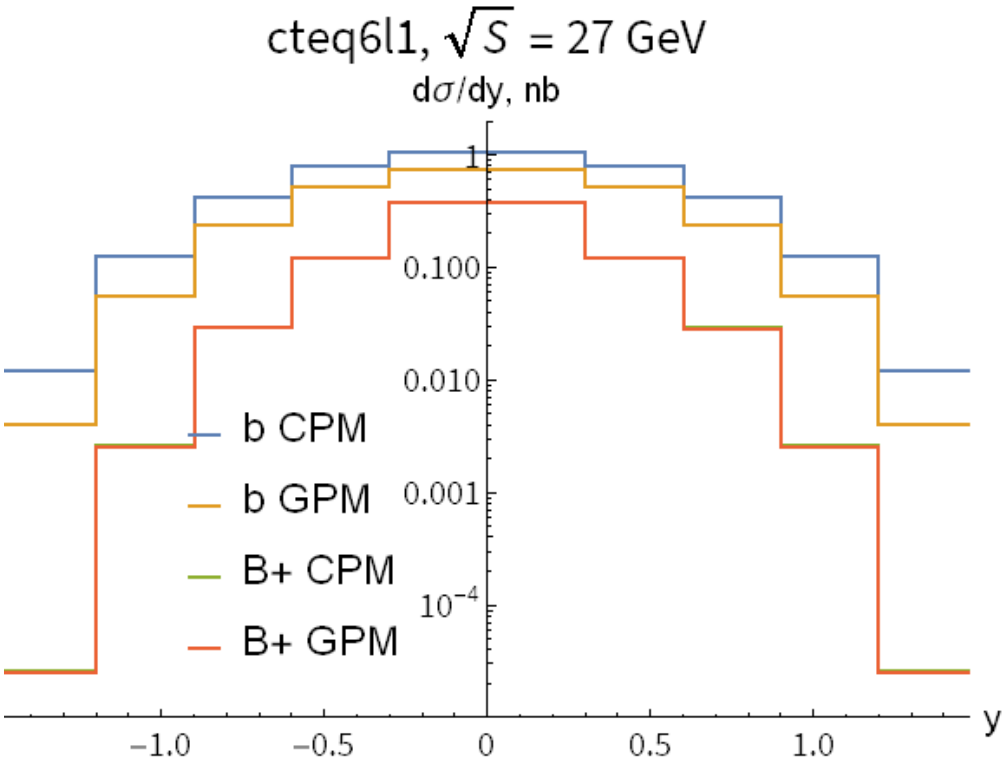


B+ production at $\sqrt{s} = 27\,\text{GeV}$

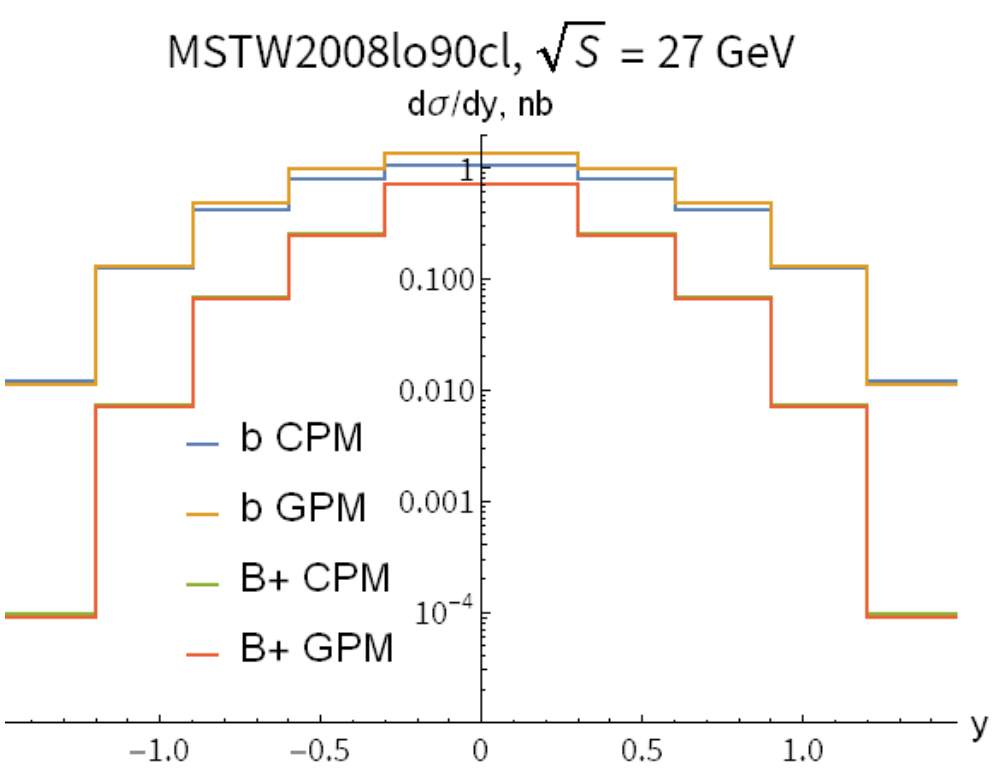


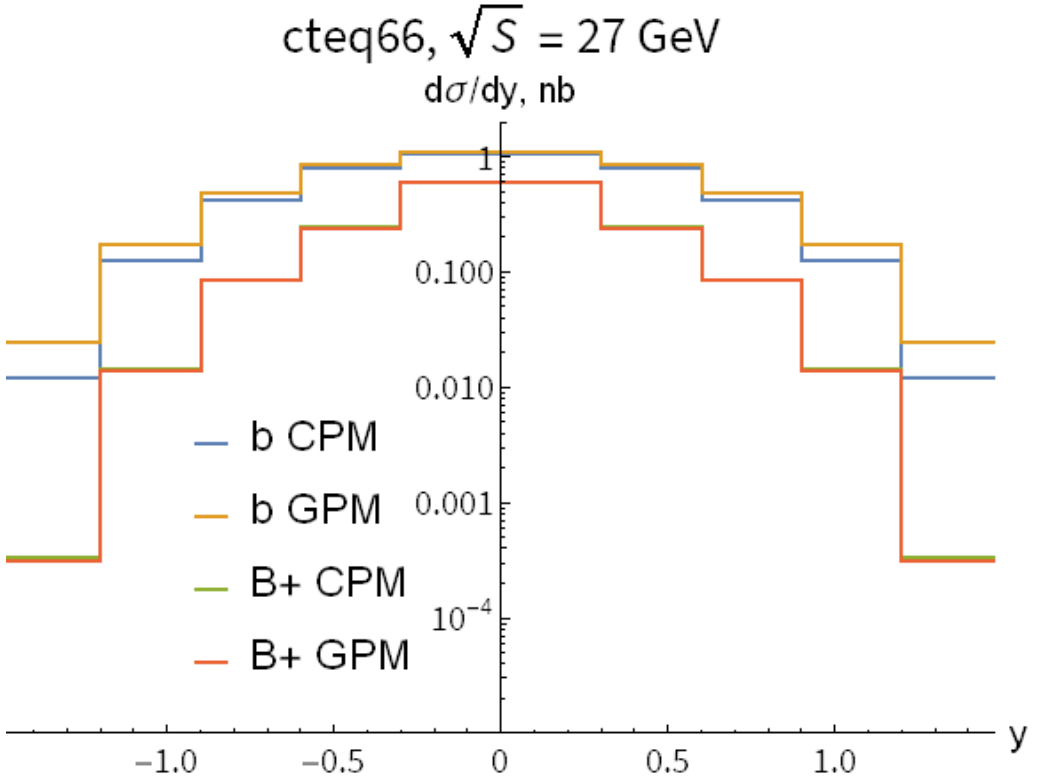
B+ production at $\sqrt{s} = 27\,\text{GeV}$



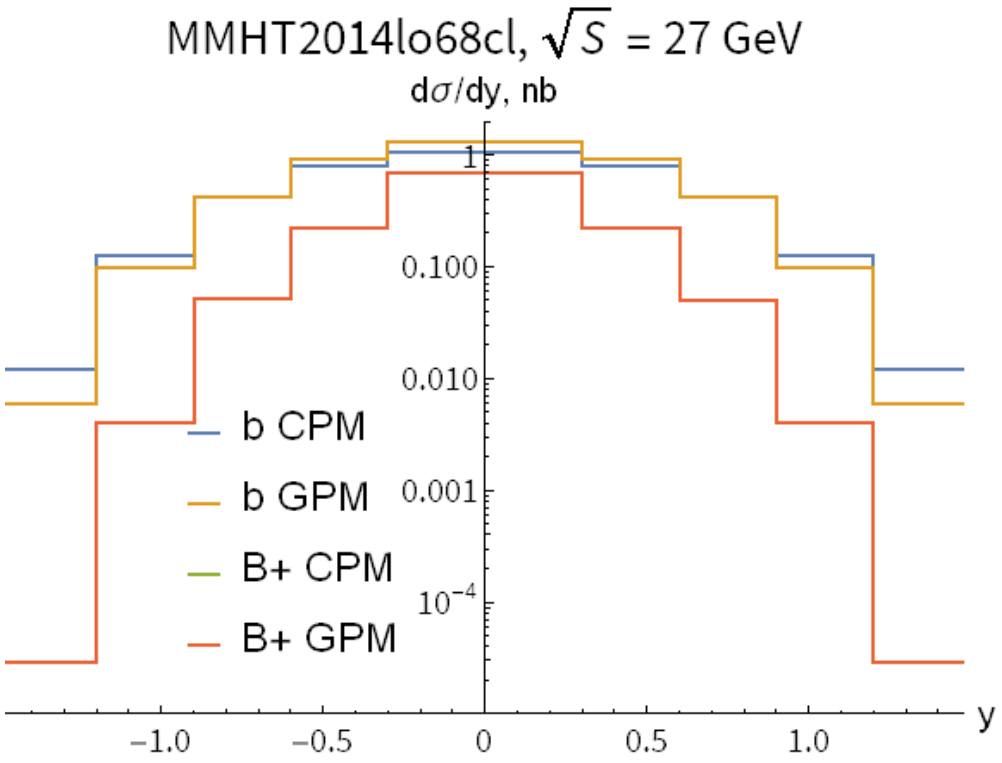


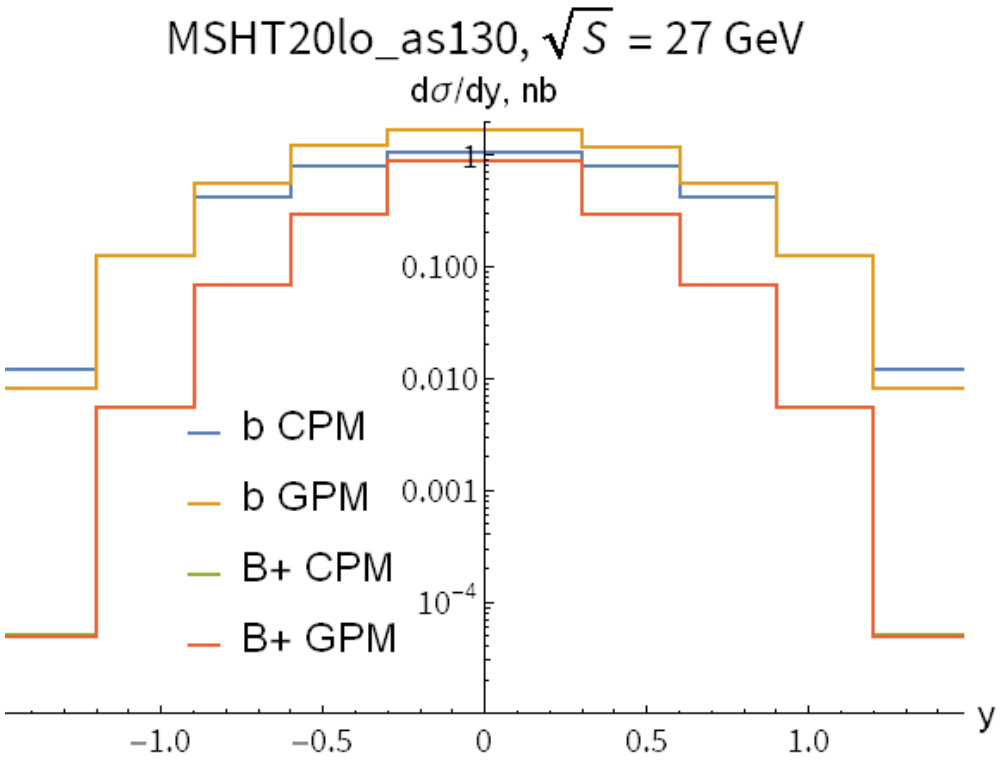
B+ production at $\sqrt{s} = 27\,\text{GeV}$



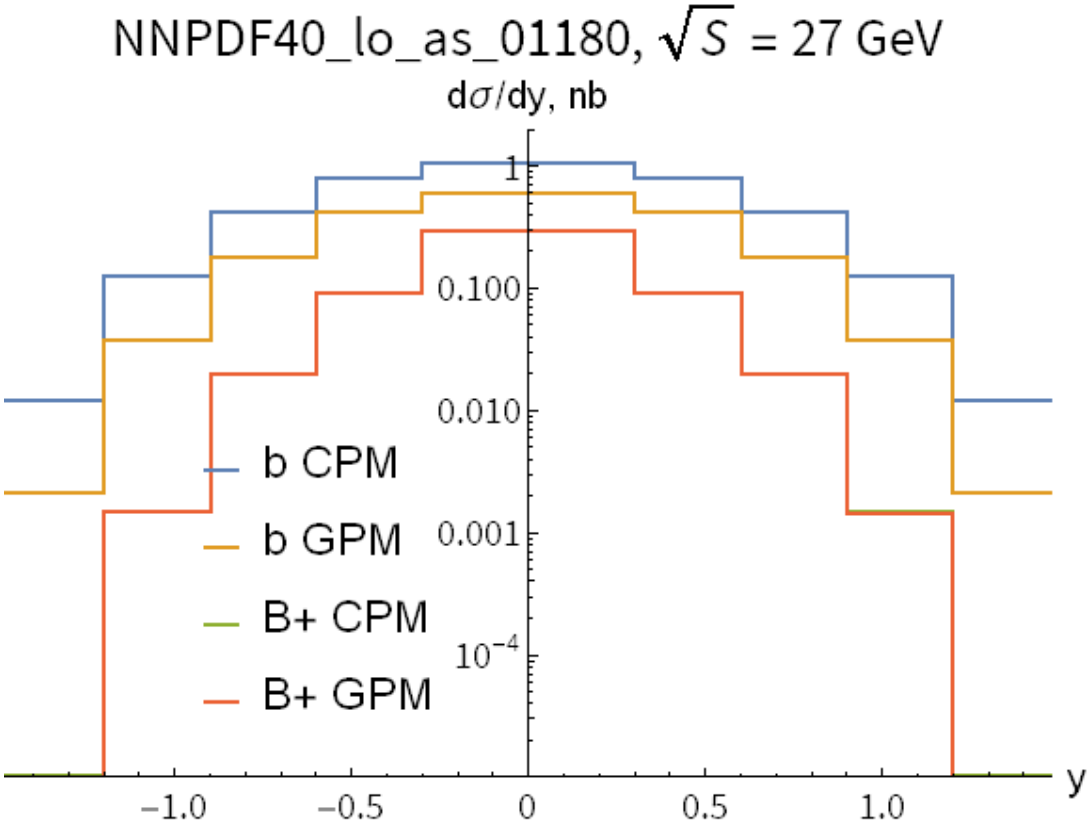


B+ production at $\sqrt{s} = 27\,\text{GeV}$

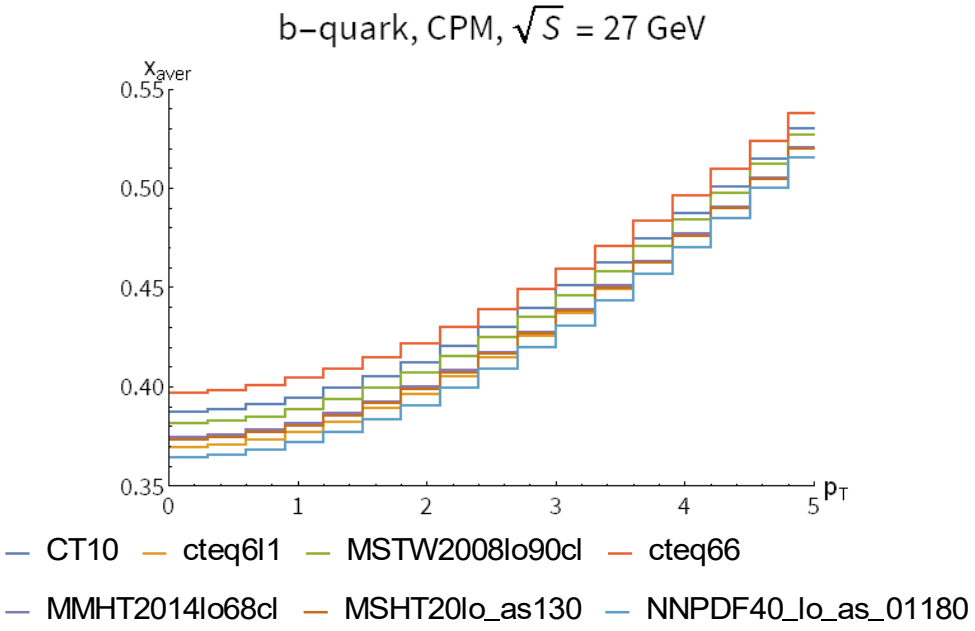


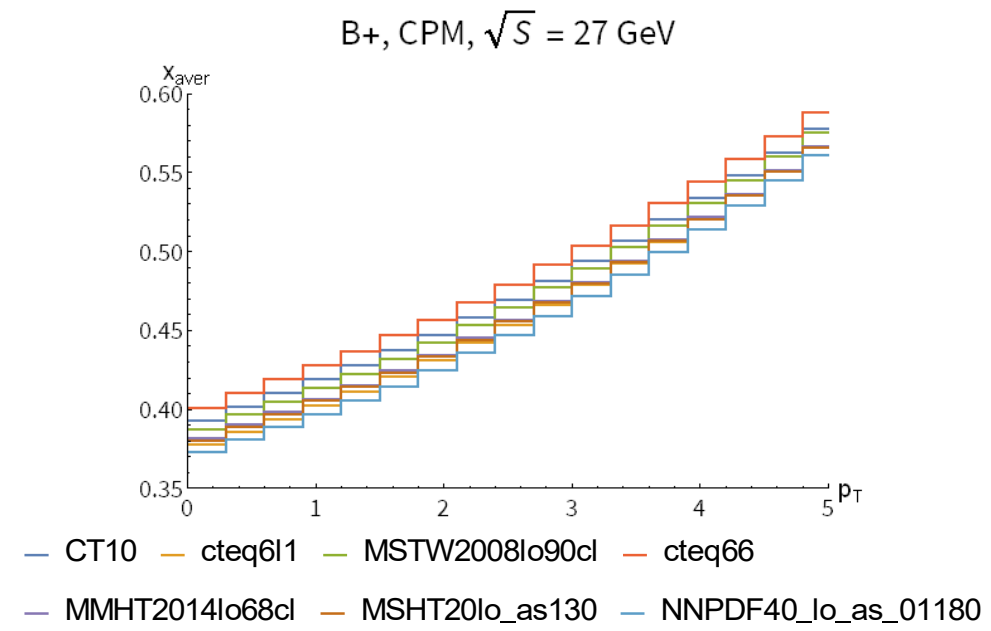


B+ production at $\sqrt{s} = 27\,\text{GeV}$



Average $x_{1,2}$


b–quark, CPM, $\sqrt{S}$ = 27 GeV
x_{aver}
0.55
0.50
0.45
0.40
0.35
0
1
2
3
4
5
p_T
CT10
cteq6l1
MSTW2008lo90cl
cteq66
MMHT2014lo68cl
MSHT20lo_as130
NNPDF40_lo_as_01180


B+, CPM, $\sqrt{S}$ = 27 GeV
x_{aver}
0.60
0.55
0.50
0.45
0.40
0.35
0
1
2
3
4
5
p_T
CT10
cteq6l1
MSTW2008lo90cl
cteq66
MMHT2014lo68cl
MSHT20lo_as130
NNPDF40_lo_as_01180

Thank you for your attention

Generalized parton model

$$\frac{d\sigma_{dir}^{\text{ОПМ}}}{dp_{\gamma T}dy_{\gamma}} = \frac{1}{8\pi}\sum_{a,b}\int dx_1 d^2\vec{q}_{1T}\Phi_a(x_1,\vec{q}_{1T},\mu^2)\int dx_2 d^2\vec{q}_{2T}\Phi_b(x_2,\vec{q}_{2T},\mu^2)\times$$
$$\times \frac{p_{\gamma T}}{x_1 x_2 S}\overline{|\mathscr{M}(a(q_1)b(q_2)\to\gamma(p_\gamma)c)|^2}\,\delta(\hat{s}+\hat{t}+\hat{u}),$$

$$\Phi_a(x,\vec{q}_T,\mu^2) = f_a(x,\mu^2)\frac{1}{\pi\langle q_T^2\rangle^{1/2}}e^{-q_T^2/\langle q_T^2\rangle}$$

$$q_1^{\mu} = x_1\frac{\sqrt{S}}{2}\left(1+\frac{q_{1T}^2}{x_1^2 S},\vec{q}_{1T},1-\frac{q_{1T}^2}{x_1^2 S}\right),$$
$$q_2^{\mu} = x_2\frac{\sqrt{S}}{2}\left(1+\frac{q_{2T}^2}{x_2^2 S},\vec{q}_{2T},-1+\frac{q_{2T}^2}{x_2^2 S}\right)$$