Study of heavy quarks production in DIS at HERA using BGK dipole model

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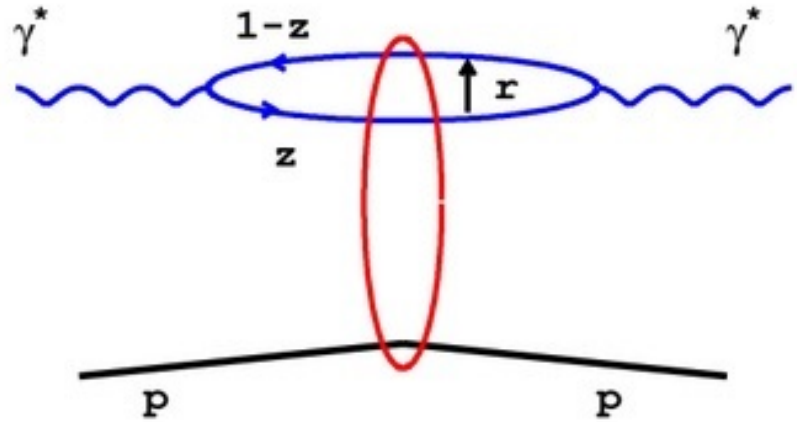
Agenda

Dipole model of DIS

- Dipole picture of DIS at small x in the proton rest frame



where r is the dipole size and z is the longitudinal momentum fraction of the quark/antiquark

- Factorization: dipole formation + dipole interaction

$$\sigma^{\gamma^* p} = \frac{4\pi^2 \alpha_{em}}{Q^2} F_2 = \sum_f \int d^2 r \int_0^1 dz |\Psi^\gamma(r, z, Q^2, m_f)|^2 \hat{\sigma}(r, x)$$

Dipole cross-section - BGK

- BGK (Bartels-Golec-Kowalski) parametrization

$$\hat{\sigma}(r,x) = \sigma_0\left(1 - exp\left[\frac{-\pi^2 r^2 \alpha_s(\mu^2) x g(x,\mu^2)}{3\sigma_0}\right]\right)$$

- $\mu^2 = \frac{C}{r^2} + \mu_0^2$ is the scale of the gluon density
- μ_0^2 is a starting scale of the QCD evolution $\mu_0^2 = Q_0^2$
- gluon density is evolved according to the LO DGLAP equations from the initial condition

$$xg(x,\mu_0^2) = A_g x^{\lambda_g}(1-x)^{C_g}$$

Heavy-flavor production in DIS

- The cross-section for the production of a heavy flavor of type Q, with Q being either charm c or beauty b, may be written in terms of the heavy-flavor contributions to the structure functions F_2 and F_L

$$\frac{d^2\sigma^{Q\overline{Q}}}{dx_{Bj}dQ^2} = \frac{2\pi\alpha^2(Q^2)}{x_{Bj}Q^4}\Big([1+(1-y)^2]F_2^{Q\overline{Q}}(x_{Bj},Q^2) - y^2F_L^{Q\overline{Q}}(x_{Bj},Q^2)\Big)$$

- The results are presented in terms of reduced cross-section, defined as follows

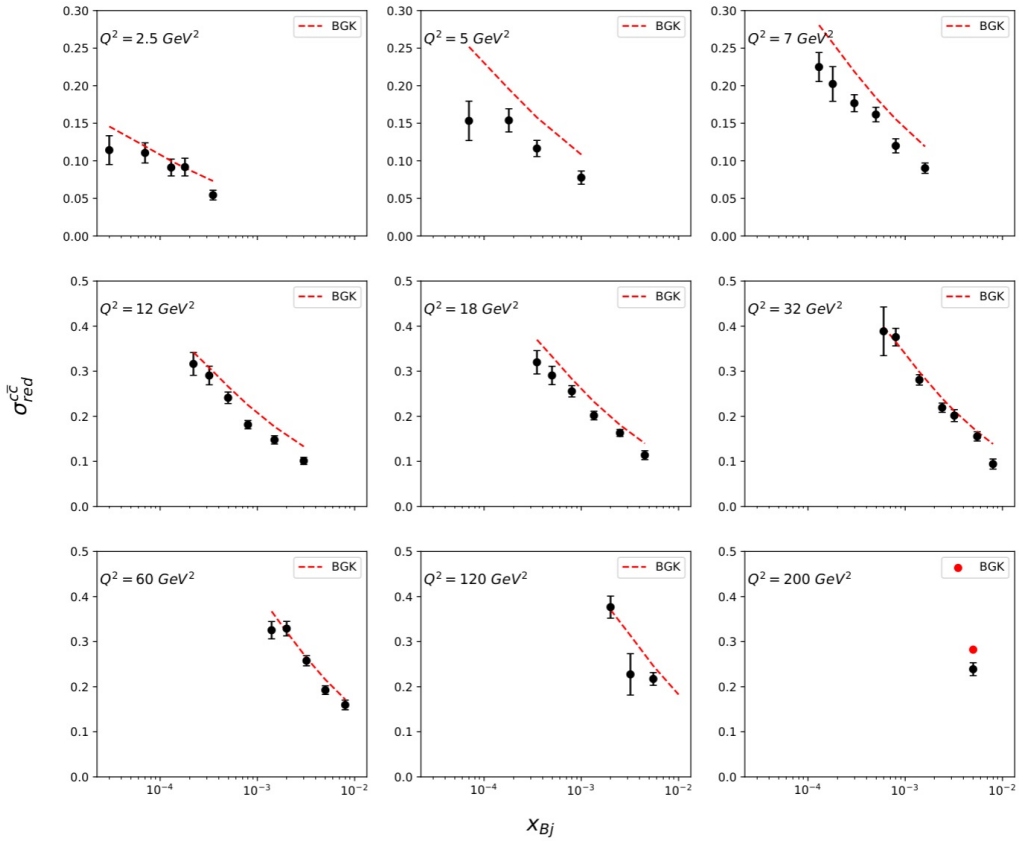
$$\sigma_{red}^{Q\overline{Q}} = \frac{d^2\sigma^{Q\overline{Q}}}{dx_{Bj}dQ^2}\cdot\frac{x_{Bj}Q^4}{2\pi\alpha^2(Q^2)[1+(1-y)^2]} = F_2^{Q\overline{Q}} - \frac{y^2}{1+(1-y)^2}F_L^{Q\overline{Q}}$$

Results of the fits

- Parameters from the BGK model fit with $m_c = 1.3$ GeV, $m_b = 4.05$ GeV to charm and beauty HERA data

Q_0^2 $[GeV^2]$	σ_0 $[GeV^2]$	A_g	λ_g	C_g	C $[GeV^2]$	Ndf	χ^2	χ^2/Ndf
1.9	152.35	1.2660	-0.1756	1.0670	4.0	64	112.81	1.763

- Comparison with HERA data for charm production



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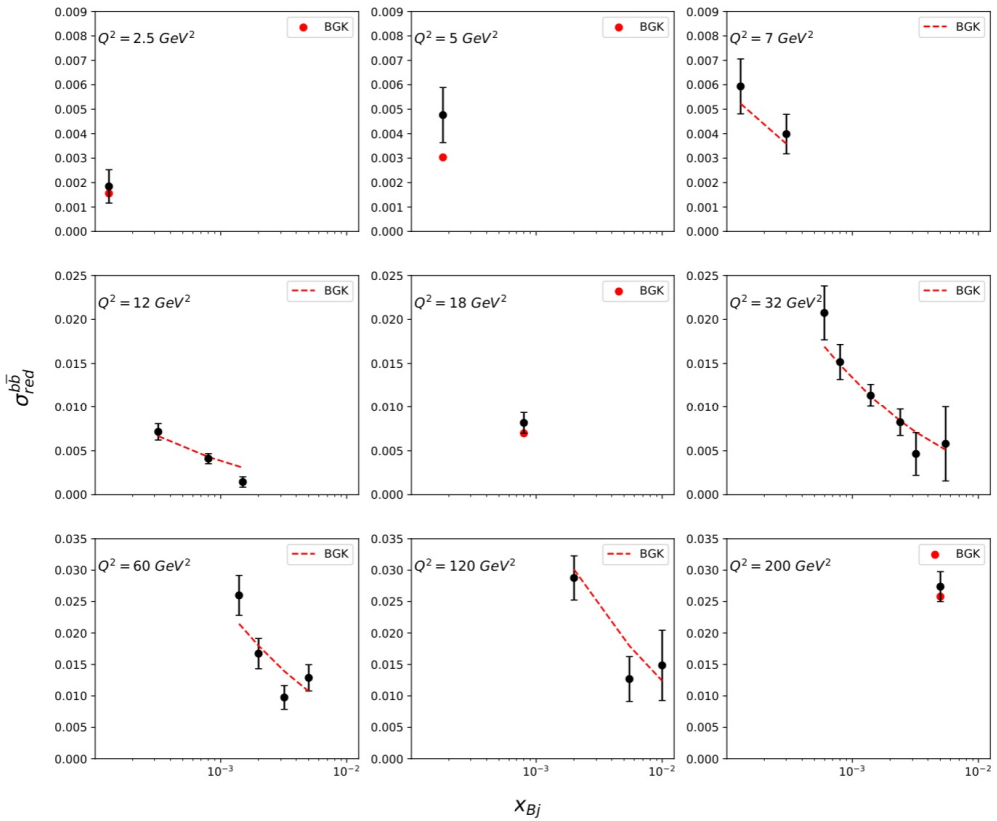
- Comparison with HERA data for beauty production

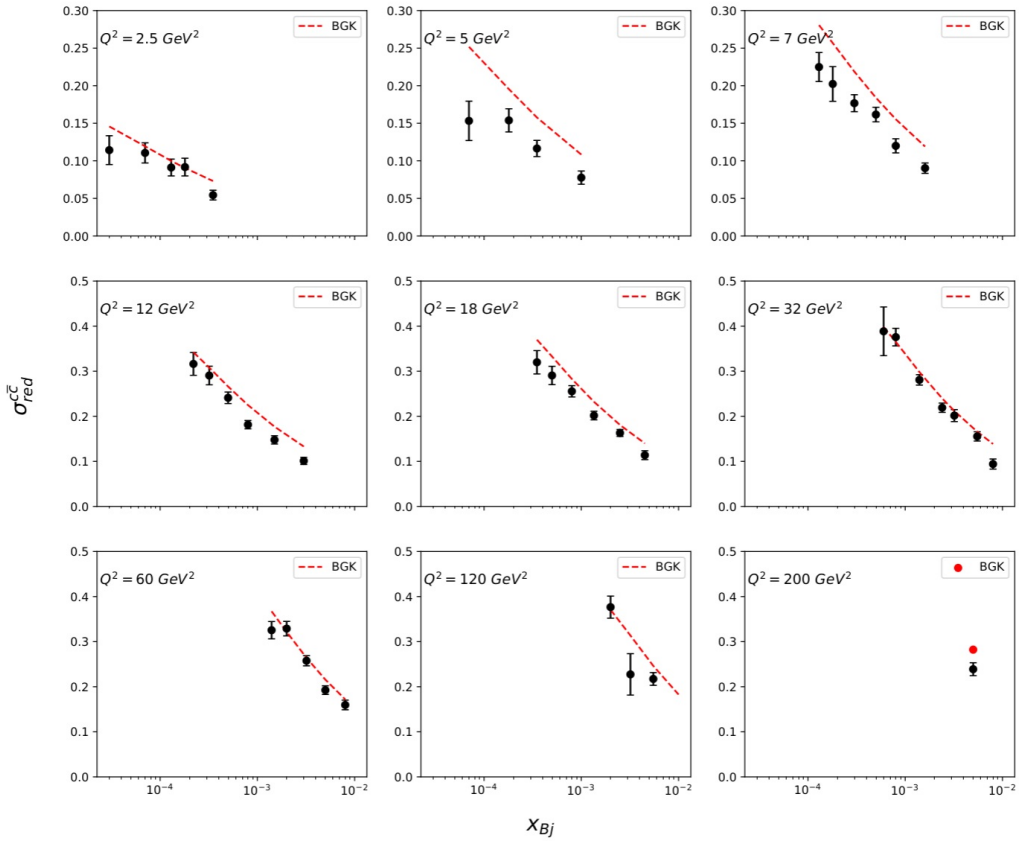


Results of the fits

- Parameters from the BGK model fit with $m_c = 1.4$ GeV, $m_b = 4.05$ GeV to charm and beauty HERA data

Q_0^2 $[GeV^2]$	σ_0 $[GeV^2]$	A_g	λ_g	C_g	C $[GeV^2]$	Ndf	χ^2	χ^2/Ndf
1.9	152.35	1.2659	-0.1756	1.0667	4.0	64	112.81	1.763

- Comparison with HERA data for charm production



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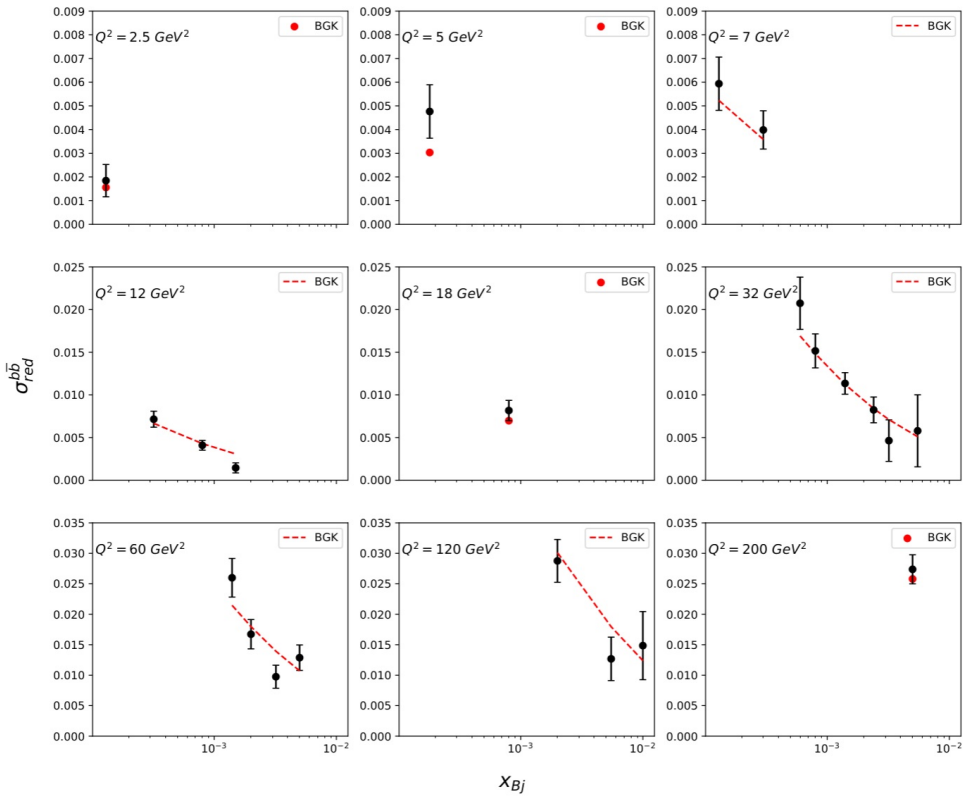
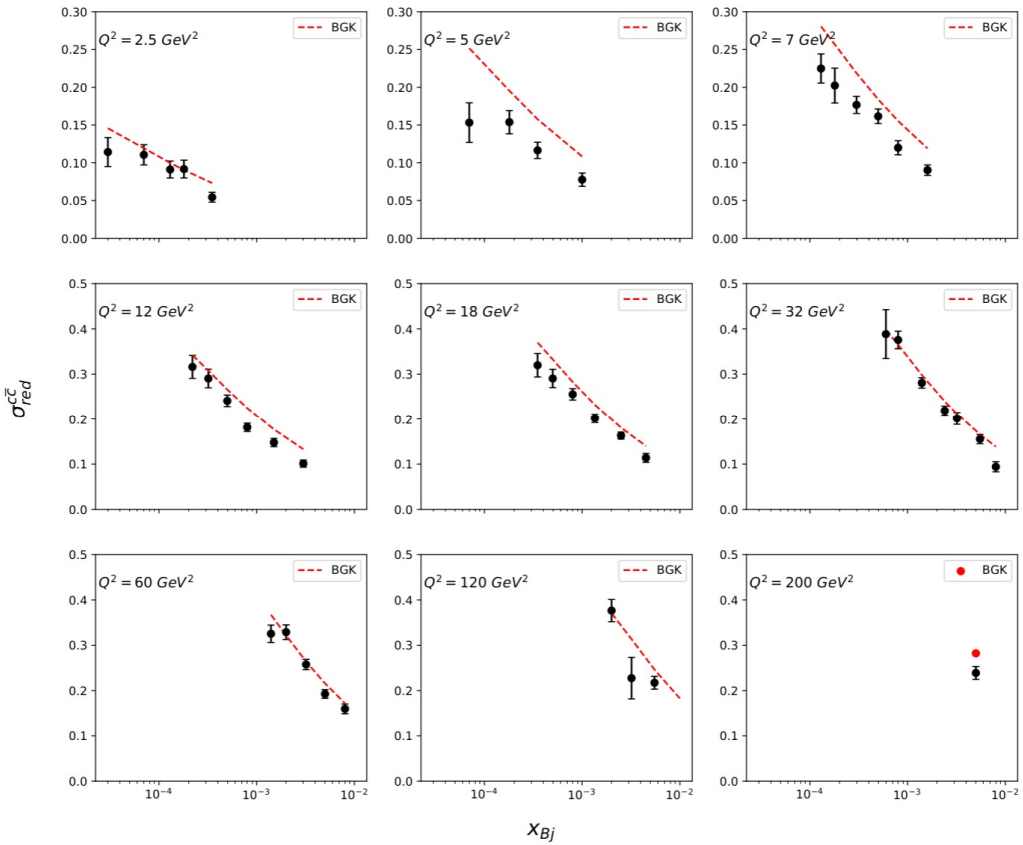


Results of the fits

- Parameters from the BGK model fit with $m_c = 1.5$ GeV, $m_b = 4.05$ GeV to charm and beauty HERA data

Q_0^2 $[GeV^2]$	σ_0 $[GeV^2]$	A_g	λ_g	C_g	C $[GeV^2]$	Ndf	χ^2	χ^2/Ndf
1.9	152.35	1.2669	-0.1755	1.0685	4.0	64	112.81	1.763

- Comparison with HERA data for charm production



Results of the fits

- Parameters from the BGK model fit with $m_c = 1.5$ GeV, $m_b = 4.05$ GeV to charm and beauty HERA data

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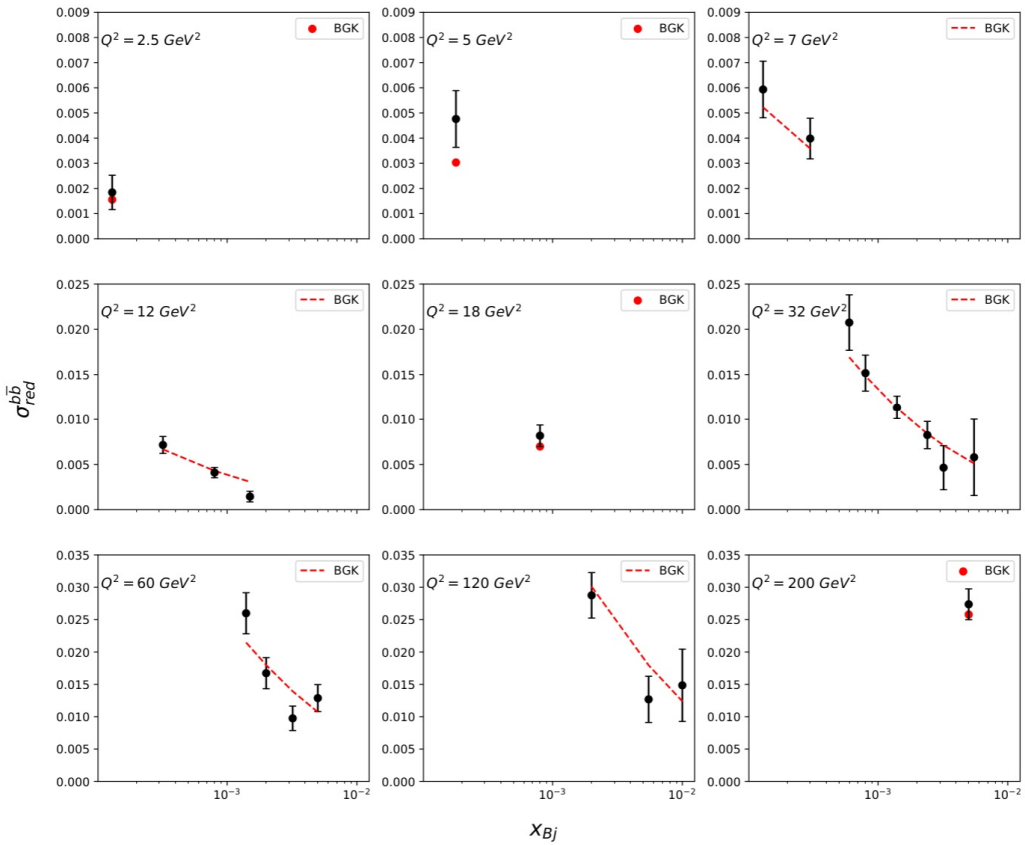
- Comparison with HERA data for beauty production



Summary

- We analyzed the charm and beauty production cross-section measurements in deep inelastic **ep** scattering at HERA using the BGK dipole model
- We added the contribution from beauty quark to the BGK dipole model in xFitter framework
- The obtained results from BGK dipole model fits are reasonable and similar to other global PDF fits

Data sources

H. Abramowicz et al.
Combination and QCD analysis of charm and beauty production cross-section measurements in deep inelastic ep scattering at HERA
DESY 18-037 (2018)

H. Abramowicz et al.
Combination of Measurements of Inclusive Deep Inelastic ep Scattering Cross Sections and QCD Analysis of HERA Data
The European Physical Journal C 75, 580 (2015)

Thank you for your attention!