



Improved kt -factorization calculations of prompt photon production at HERA

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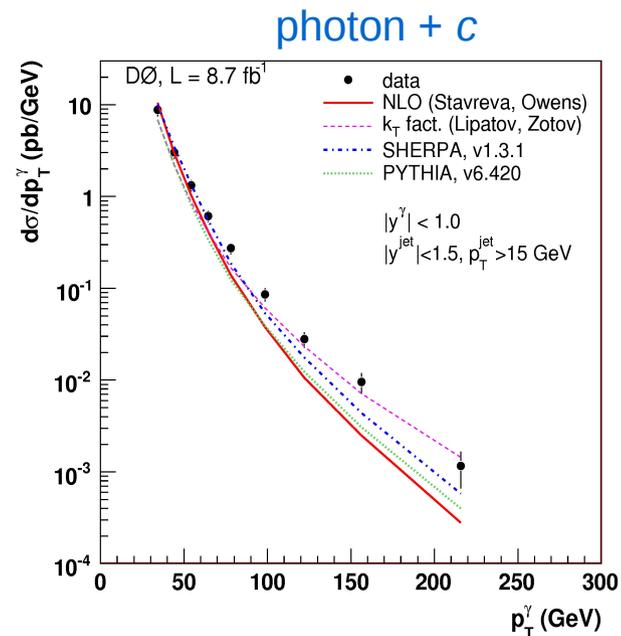
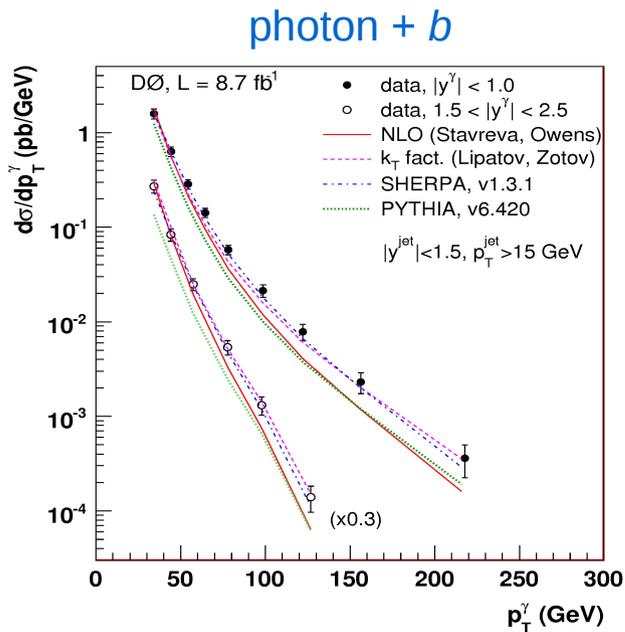
in collaboration with N.P. Zotov, M.A. Malyshev

What's new in our calculations

- Previously, our calculations of the prompt photon production at HERA was based on the $2 \rightarrow 2$ direct and resolved photon production mechanisms
A.V. Lipatov, N.P. Zotov, Phys. Rev. D 81, 094027 (2010); 72, 054002 (2005)
- Now we considered $O(\alpha^2\alpha_s)$ off-shell amplitudes for $\gamma g^* \rightarrow \gamma q q$ and $\gamma q \rightarrow \gamma q g$ subprocesses instead of $2 \rightarrow 2$ ones
- Main reason: more accurate treatment of jet kinematics in the associated photon + jet production case
- We included box contributions from $\gamma g \rightarrow \gamma g$ which are known to be sizeable in NLO pQCD calculations
M.Krawczuk, A. Zembruski, Phys. Rev. D 64, 114017 (2001)
- Numerical parameters remain unchanged

Feedback from Tevatron

Additional motivation for shift to 2 → 3 subprocesses: we successfully applied a similar approach to describe the D0 and CDF data on the photon + heavy quark jet production at Tevatron

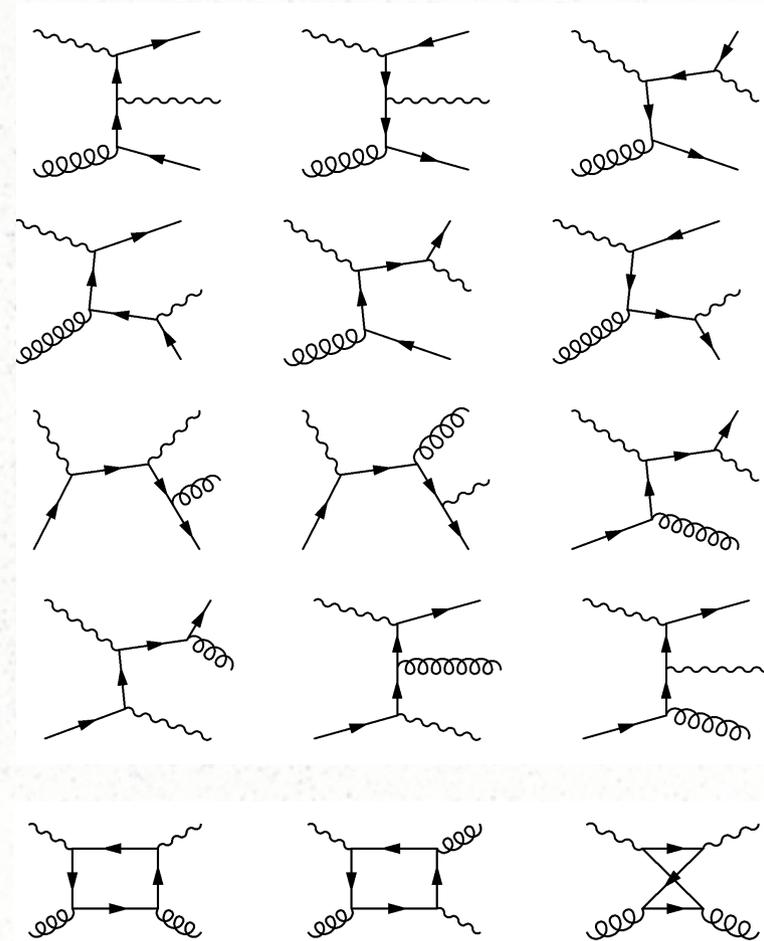


V.M. Abazov et al, D0 Collaboration, Phys. Lett. B 714, 32 (2012); 719, 354 (2013)
T. Aaltonen et al, CDF Collaboration, arXiv:1303.6136 [hep-ex]

Feynman diagrams for new subprocesses

- Considered $2 \rightarrow 3$ subprocesses in the kt-factorization approach cover LO direct and resolved photon contributions
- We does not need the TMD PDFs in a photon now
- Initial gluons are taken to be off-shell but quarks are on mass shell. We keep off-shell kinematics for all incoming particles
- Amplitude for box contribution was calculated a long time ago

E.L. Berger, E. Braaten, R.D. Field,
Nucl. Phys. B 239, 52 (1984)



Visible changes in the predictions

- Small enhancement of the predicted cross sections due to additional contribution from box diagrams
- Shape of calculated x_y distributions becomes closer to data due to more accurate jet kinematics
- Theoretical uncertainties band becomes wider. Reason of that can be connected with an extra α_s involved in the calculated $2 \rightarrow 3$ off-shell amplitudes:
 - both direct and resolved photon $2 \rightarrow 2$ contributions are order of $O(\alpha^2)$, so the hard scale involved in the PDFs only
 - calculated $2 \rightarrow 3$ diagrams are order of $O(\alpha^2 \alpha_s)$ that is important for theoretical uncertainties of kt-factorization predictions
- Feedback from ZEUS in photon + (light) jet production is very important for our investigation of photon + jet production at the LHC