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# New QCD predictions for ep deep inelastic scattering and comparison with measurements

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## H1\_2005\_I676166 (HZH0502010): Measurement of beauty production at HERA using events with muons and jets (H1)

### Description: [1]

Measurement of beauty production at HERA using events requiring muons and jets in the final state. The beams were set to 920 GeV for protons and 27.5 GeV for positrons. Differential cross sections are measured in two distinct production regimes, namely photoproduction ( $Q^2 < 1 \text{ GeV}^2$ ), and deep inelastic scattering (DIS) ( $2 \text{ GeV}^2 < Q^2 < 100 \text{ GeV}^2$ ). For photoproduction and DIS, the cross section for following processes are respectively measured  $ep \rightarrow e\bar{b}bX \rightarrow ejj\mu X'$ , and  $ep \rightarrow e\bar{b}bX \rightarrow ej\mu X'$ . Jets (with  $p_T > 6 \text{ GeV}$  and  $|\eta| < 2.5$ ) are reconstructed using the  $k_T$  algorithm with a distance parameter of 1.0 and jet algorithms were applied in the laboratory and Breit frames for photoproduction and DIS, respectively. Muons (with  $p_T > 2.5 \text{ GeV}$ ) are inputs to the jet algorithm, and are required to be associated with a jet. Events were vetoed if the  $\eta - \phi$  distance between the jet axis and the muon was greater than 1.0. Finally, inelasticity cuts were applied for photoproduction ( $0.2 < y < 0.8$ ) and DIS ( $0.1 < y < 0.7$ ).

The original paper, [1], reported that the shape of the simulated events matched data well, however overall normalisation was too low. In the reconstructed **Rivet** routine, whereby the plots were scaled by normalising the number of events in simulation to number of events in data, the shape for some distributions did not match data well and the overall normalisation was not too low. Overall, momentum distributions for both muons and jets in the photoproduction and DIS regimes fit the shape of data well (two examples can be seen in Figure 1). Additionally, when comparing different parton distribution functions (as can be seen on the left of Figure 1), it can be seen that imploring NLO simulations results in a slightly better fit to data. Muon pseudorapidity and DIS kinematic variables (such as photon virtuality and Bjorken- $x$ ), however, did fit the data as well (as can be seen in Figure 2). Using Resolved processes were expected to contribute significantly to the photoproduction region. As can be seen in the Leading Jet Transverse Momentum plot in Figure 2, resolved photon processes contribute to a better fit to the data. In the events simulated for validating the **Rivet** routine, DIS events appeared in smaller proportions than reported in [1]. This, and the poor distribution shapes of DIS kinematic variables, may be due to the fact that in [1], it appears that DIS and photoproduction events were generated in separate samples - whilst when validating the **Rivet** routine, they were generated in the same sample. Furthermore, the constraint on muons appearing within the jet radius may be too stringent.

## References

- [1] Measurement of beauty production at hera using events with muons and jets. *The European Physical Journal C*, 41(4):453–467, Jun 2005.

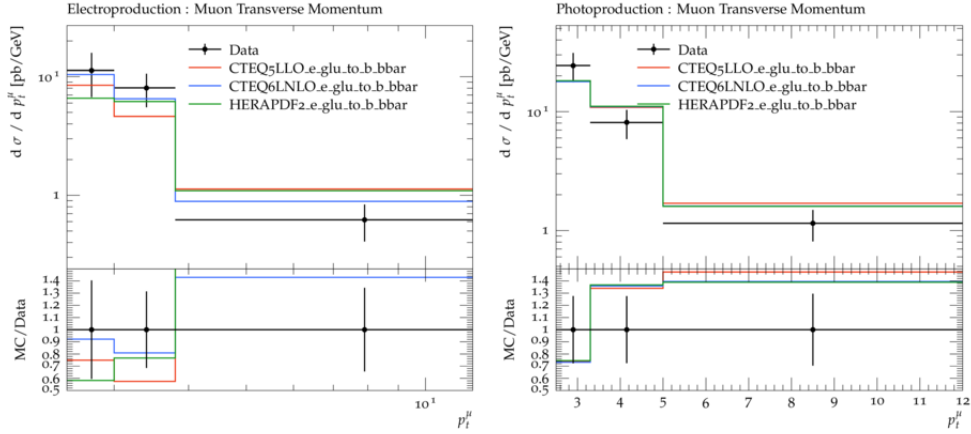


Figure 1: Comparison of results obtained using `Rivet` and events generated using three different parton distribution functions in `RAPGAP` for the direct production process,  $eg \rightarrow b\bar{b}$  in massive mode (IPRO=14)

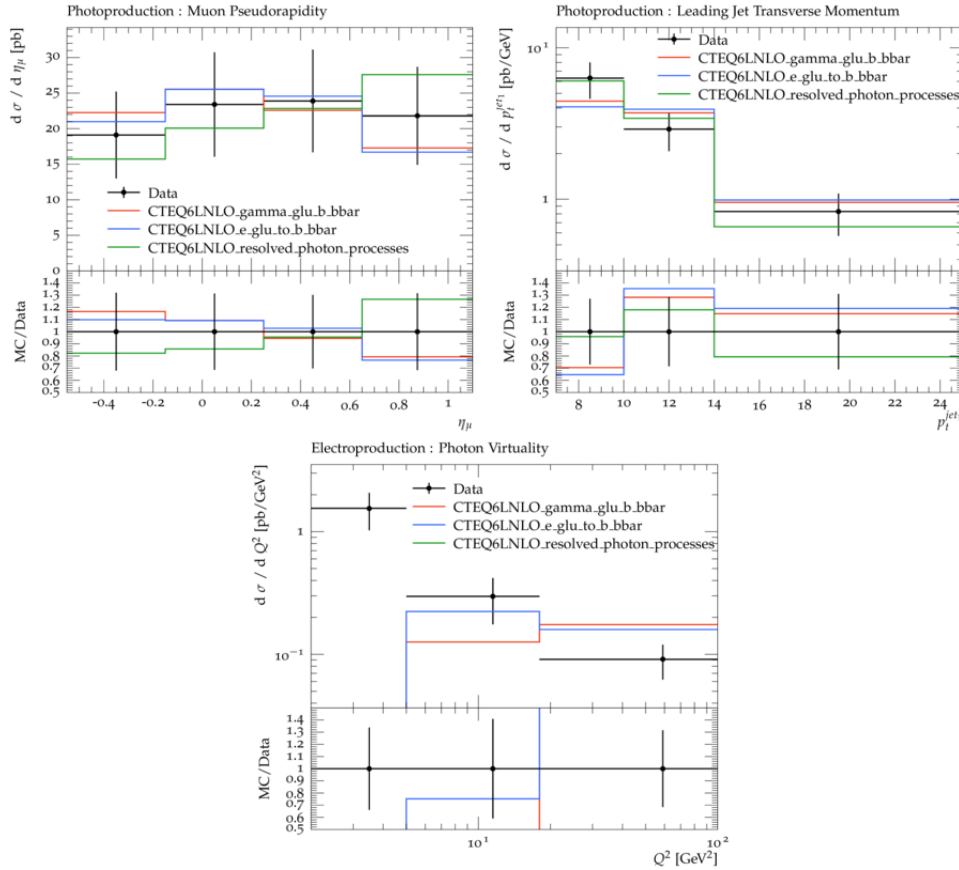


Figure 2: Comparison of results obtained using `Rivet` and events generated using three different production processes in `RAPGAP`:  $\gamma g \rightarrow b\bar{b}$  (IPRO=11),  $eg \rightarrow b\bar{b}$  (IPRO=14), and resolved photon processes (IPRO=18)