

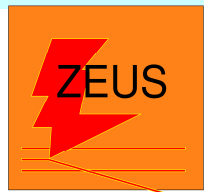
Status of paper

# Measurement of beauty production from dimuon events at HERA II



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- main physics goal: total beauty cross section at HERA

History: (long term project ☺)

- **HERA I analysis**, PhD thesis, I. Bloch, 2005 -> **reuse same analysis strategy**
- FMNRxPYTHIA **NLO calculations**, E. Nuncio-Quiroz, PhD thesis 2008, **still valid**
- paper on **total and differential b cross sections**, ZEUS, 2008 (HERA I)  
[http://www-zeus.desy.de/~ibloch/bbbar/bbbar\\_ibl\\_paper\\_master.html](http://www-zeus.desy.de/~ibloch/bbbar/bbbar_ibl_paper_master.html)
- basic **HERA II** analysis, PhD thesis, D. Bot, 2011 (with HERA I muon corrections)
- **muon efficiency calculations** for HERA II, K. Most, Master thesis 2011
- add **MVD secondary vertex analysis**, PhD thesis, N. Stefaniuk, 2017
- **preliminary for ICHEP18**
- write **HERA II paper**, A.G., I.B. 2018 -> **status today** (see also presentation 19.6.18)

## Developments since preliminary release

- **minor cosmetic issues** in preliminary plots kindly fixed by Iris
- resolution of question (Sasha et al.):  
**why does the data/NLO ratio look larger for differential cross sections than for total cross section?**  
-> explanation: Nazar picked up the NLO predictions with central QCD scale  $\mu = \mu_0$  for the figures  
(used for the HERA I preliminary)  
rather than those with  $\mu = \mu_0/2$  (used for the HERA I paper)

not wrong, but (unfortunately) different scale choice for total and differential predictions -> added statement to preliminary writeup

- > **will be made consistent for paper**  
(Ingo is investigating how to redo the plots)

## Investigation of reported ~15% internal inconsistencies

- had two successful investigation sessions with Ingo
- muon efficiency corrections: (confirmation)  
the HERA II corrections were applied (as it should be)  
but the (too large) uncertainties were propagated from the HERA I  
correction numbers obtained earlier by Danny (uncertainties will shrink)
- luminosity:  
the quoted luminosity ( $377 \text{ pb}^{-1}$ ) refers to the number WITHOUT  
MBTAKE. The number WITH MBTAKE is smaller.  
The muon efficiency corrections are probably those WITH MBTAKE  
(will increase cross section)
- Branching ratio corrections for  $b \rightarrow c \rightarrow \mu$  vs.  $b \rightarrow \mu$ :  
probably not (yet) applied (will reduce cross section)
- extrapolation from visible to total phase space:  
used the HERA I MC corrected number for total cross section  
used uncorrected HERA II MC for total (need to recheck MCs)

## Investigation of reported ~15% internal inconsistencies, part II

- further effects under investigation
  - > might need some additional iterations
- already investigated effects partially cancel and net effect is within known 15% discrepancy, and within total systematic errors quoted in preliminary
- all will be fixed for final paper

## Recent questions by Ewald:

- 1) The systematic uncertainty of the total beauty cross section in the draft paper from June 22 is not the same as the Nazar value in your presentation from June 19. What has been changed?

According to my records they are the same.

The originally suggested extra 15% uncertainty was not applied by ZEUS decision.

- 2) The calculation of the systematic uncertainties, as described in Section 8 does not consider explicitly that like and unlike charge muon pairs have some systematic errors where they differ. I guess that those are larger for unlike pairs. If this is correct, section 8 should be rewritten.

We use the difference between unlike and like sign muon pairs for the signal evaluation (as in the HERA I paper).

All quoted uncertainties refer to this difference.

## Recent questions by Ewald:

3) An estimate of the purity of the beauty sample is quoted to be about 50%, i.e. the background channels represent a large fraction of the event sample. Do you have more details? Should the purity be discussed in the paper?

As a function of kinematic variables?

The use of the unlike sign-like sign difference makes the light flavour background disappear (apart from small corrections, for which a systematic uncertainty is provided).

4) Since the beauty cross section is calculated from two data sets, unlike and like charge muon pairs, it would be an interesting cross check to calculate the cross section and uncertainties for both data sets separately.

This is unfortunately not possible, since we do not have a MC for the light flavour background.

## Conclusion

- the preliminary writeup is final
- there is progress in the understanding of some of the inconsistencies (within uncertainties) noticed already before the preliminary release, but some further investigations are needed before publication.
- all remaining issues appear to be solvable with some additional effort