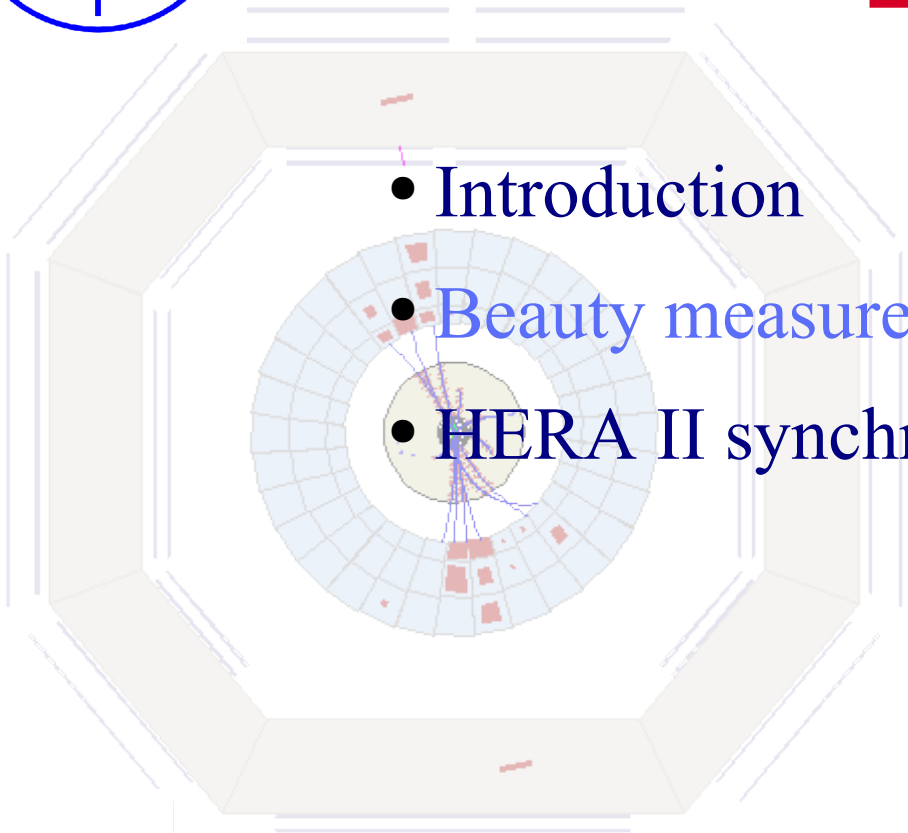
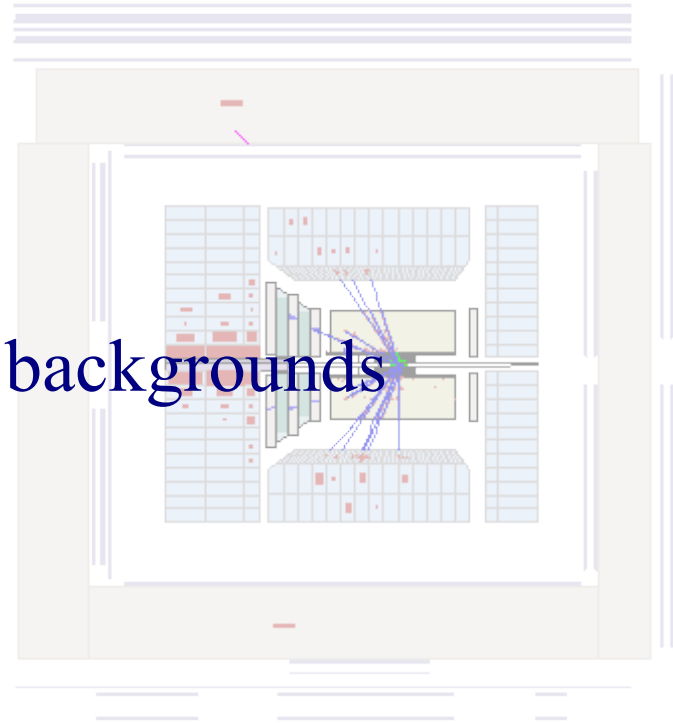
Verein der Freunde und Förderer des DESY · Prize Award

Measurement of beauty production from dimuon events at HERA/ZEUS

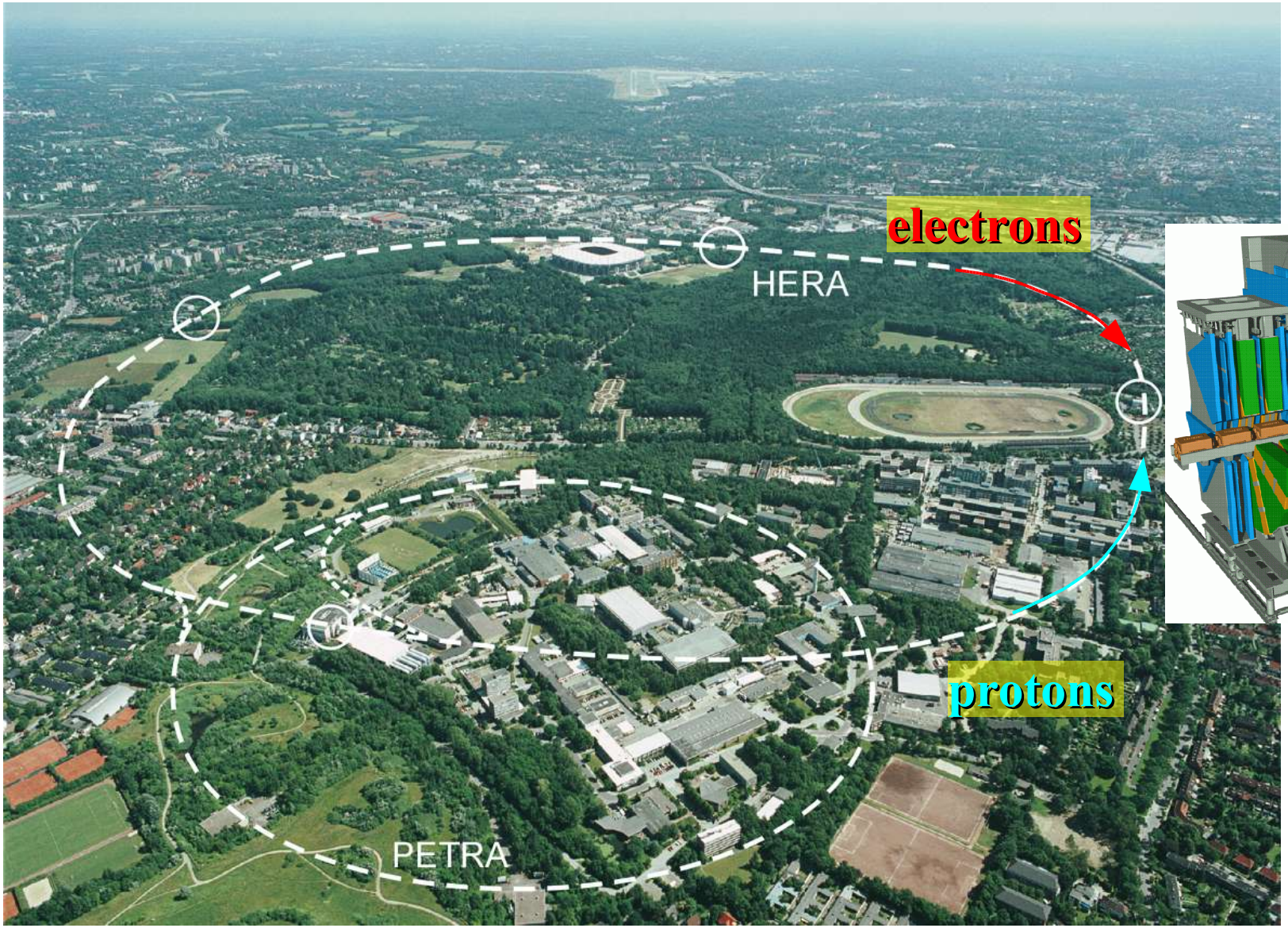
I. Bloch



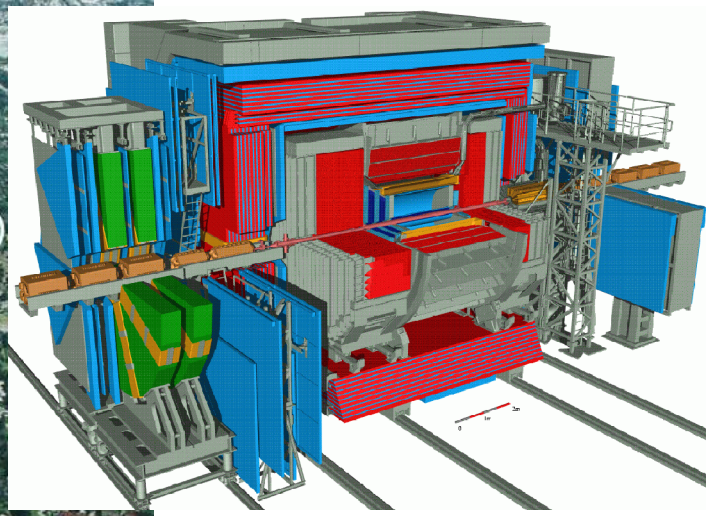


- Introduction
- Beauty measurements
- HERA II synchrotron rad. backgrounds

Electron proton collisions in the ZEUS detector at HERA

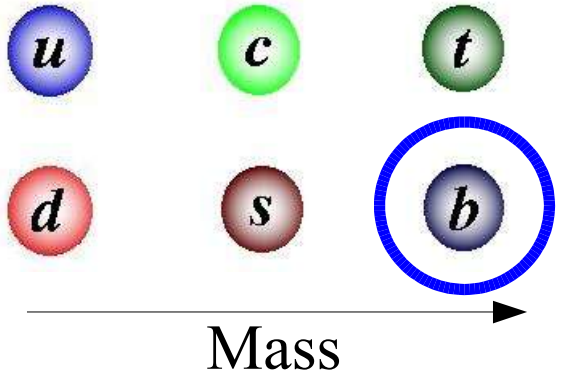


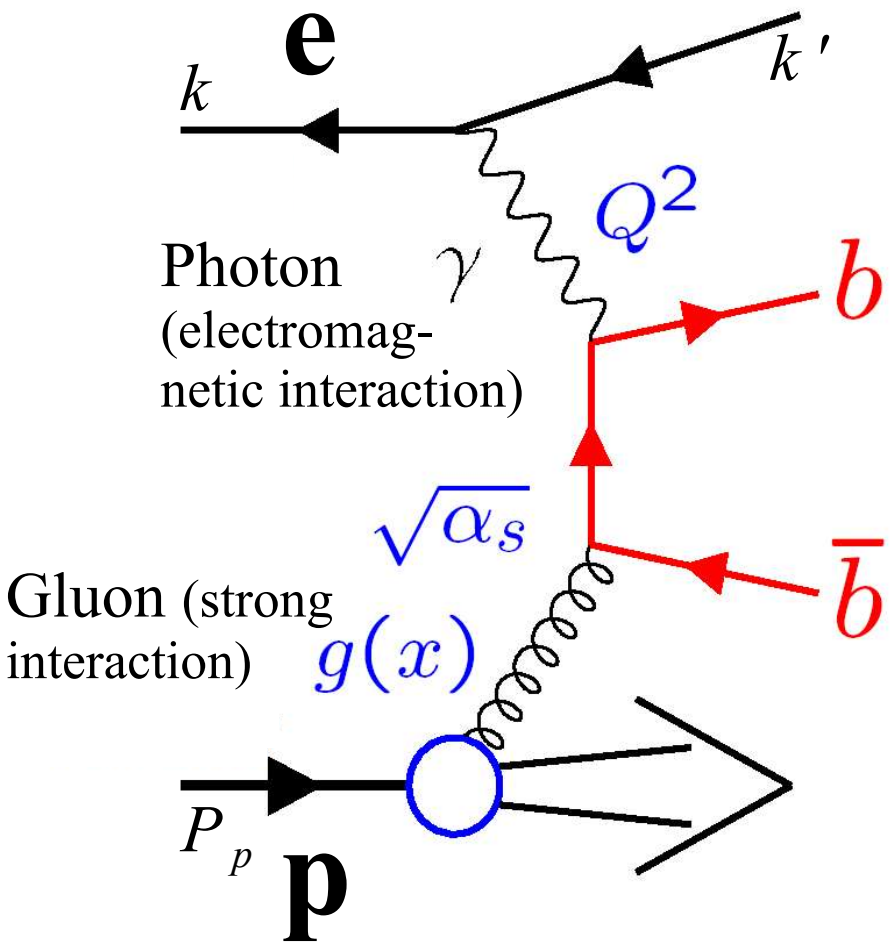
ZEUS detector:



Beauty Production - a testing ground for Quantum Chromo Dynamics

Study strong interaction using **b-quarks**.



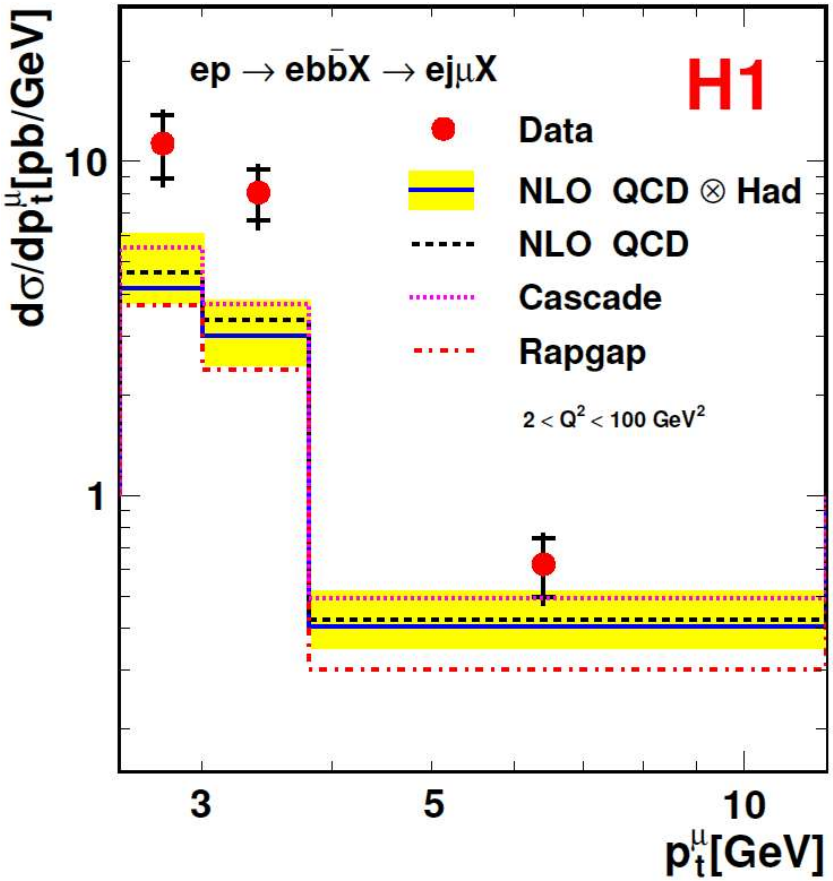


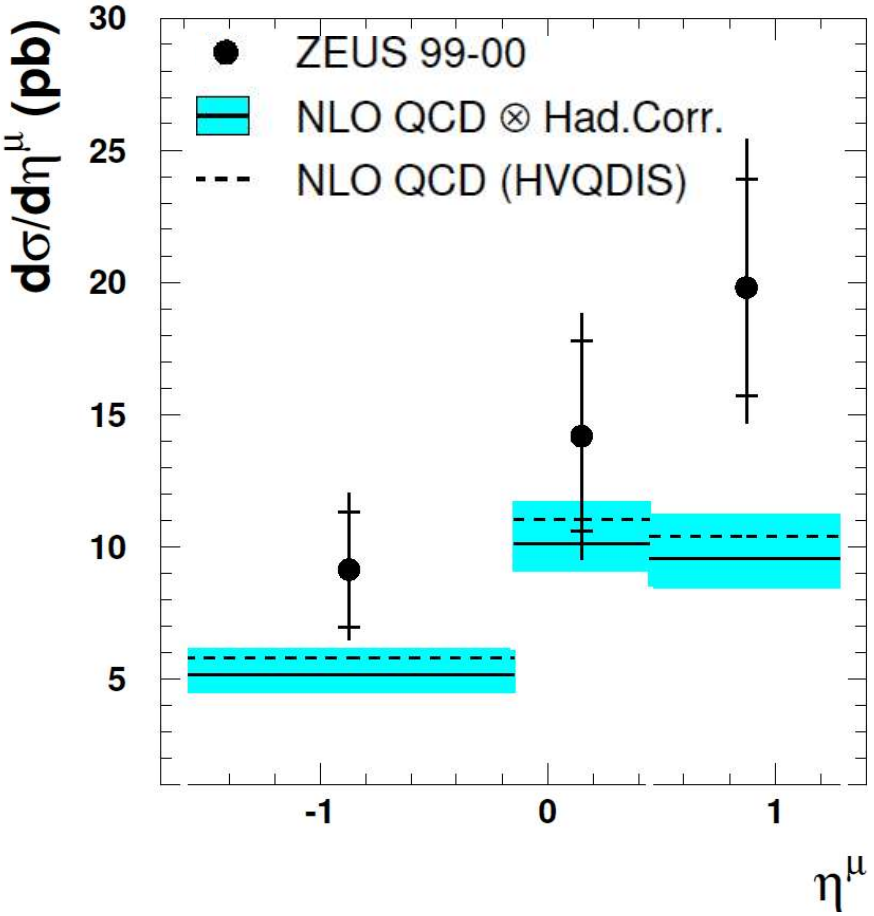
Dominant beauty-production process

Large b mass ($m_b \sim 5$ GeV) should ensure reliable perturbative QCD calculations.

Previous Beauty measurements with muons

Measuring **muons from beauty quark decays**:



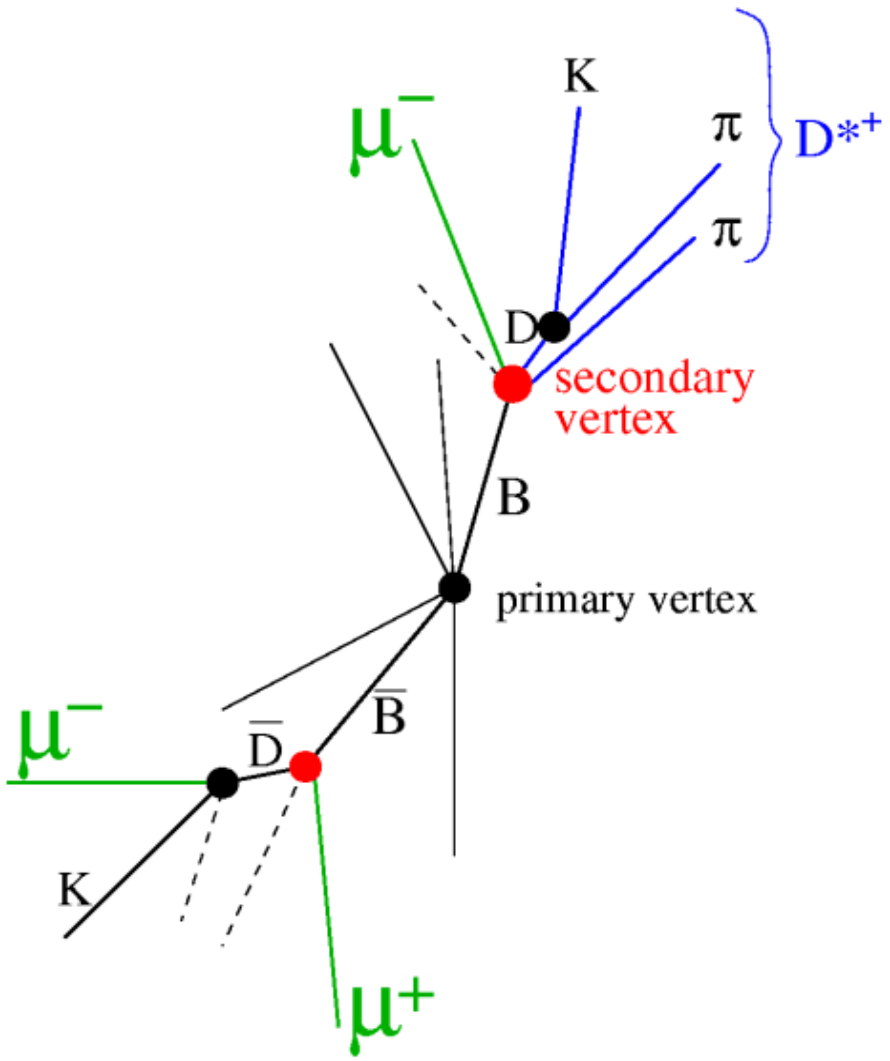


Data higher at low transverse momentum of the muon (p_T^{μ}).

Higher data **also in the forward direction (large η)**.

A trend? Extend η and p_T range:

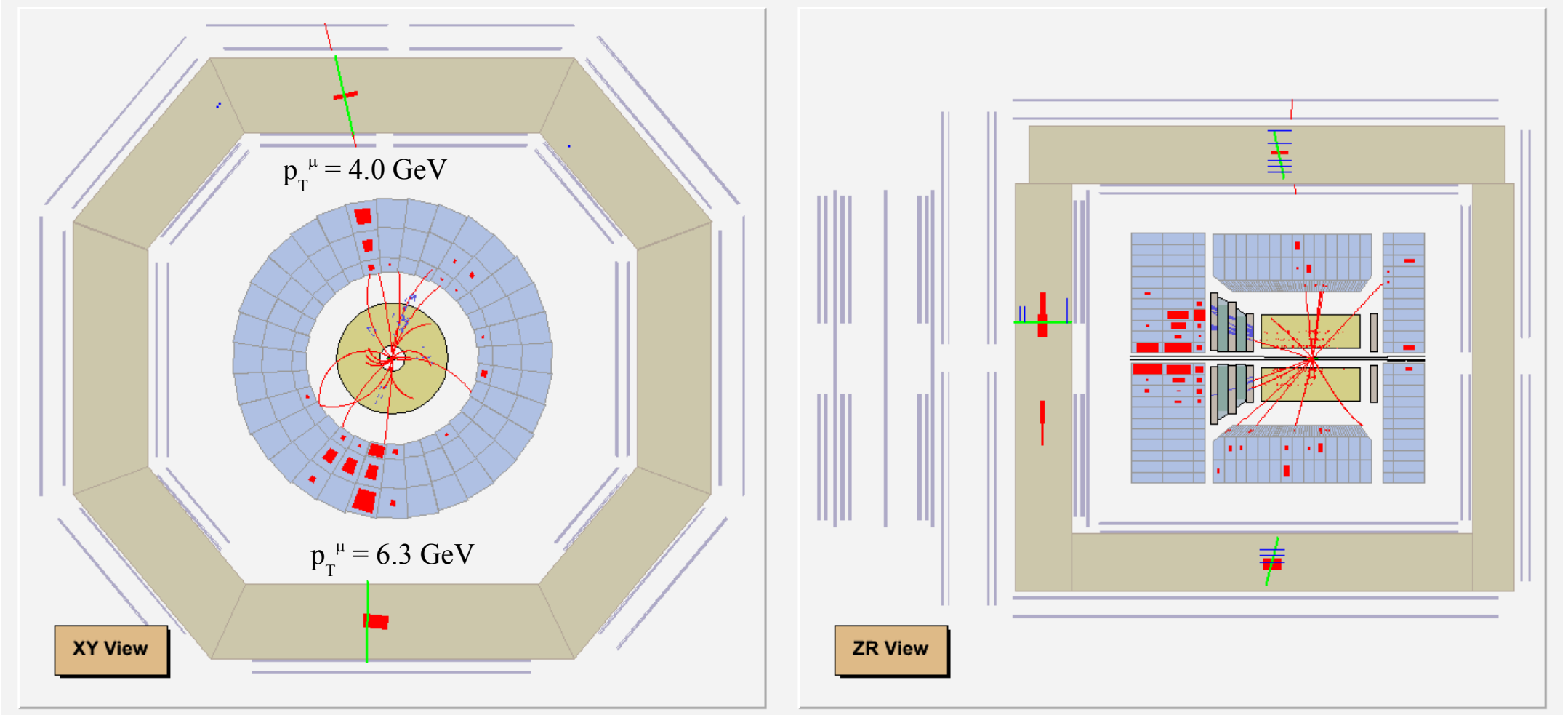
Goals of the $b\bar{b} \rightarrow \mu\mu$ analysis



- dimuon signature has low background
  - → lower muon p_T cuts
    - → sensitive even to B mesons at the kinematic threshold (low p_T)
- almost full angular coverage (muon detector system)
  - → **directly measure total $b\bar{b}$ cross section without any additional cuts**
- tag both b quarks
  - → **explicitly measure $b\bar{b}$ correlations**

A beauty(-ful) dimuon event

beauty candidate event:



Total beauty cross section

Using these events, we determined the **total cross section for beauty production**:

electron+proton → beauty+anti-beauty+anything

at HERA:

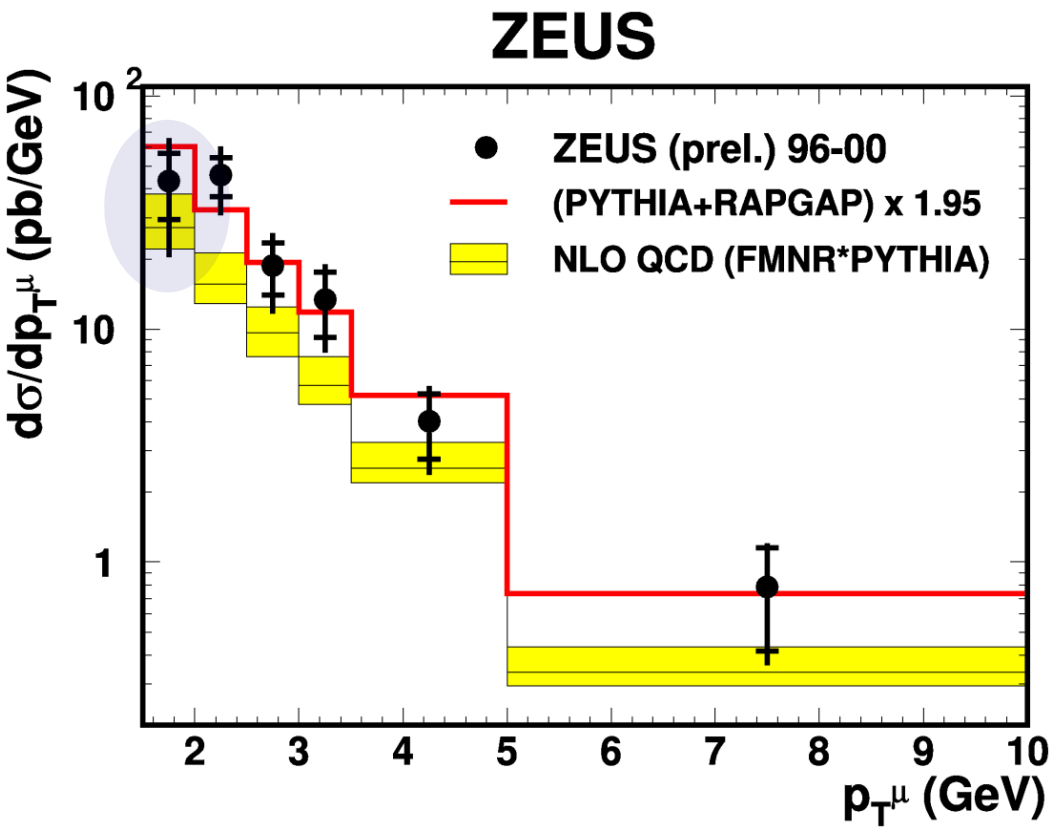
$$\sigma_{b\,tot}\ ep \to b\bar{b}X\ (318\ GeV) = 16.1 \pm 1.8\ (stat.)\ ^{+5.3}_{-4.8}\ (syst.)\ nb$$

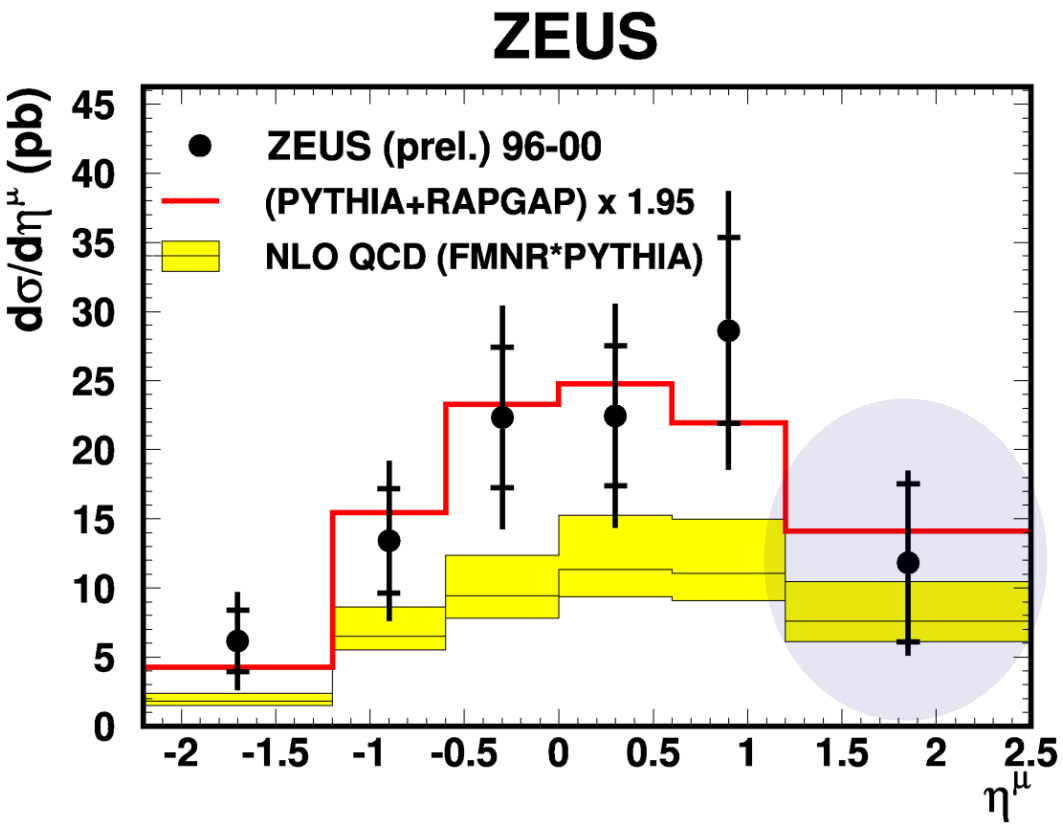
NLO QCD prediction: $6.8\ ^{+3.0}_{-1.7}$ **nb**

Offset of ~2σ - supports previous observations at low p_T.

Trend at forward η and low p_T?

Low p_T^b $b\bar{b}\rightarrow$dimuon cross sections:



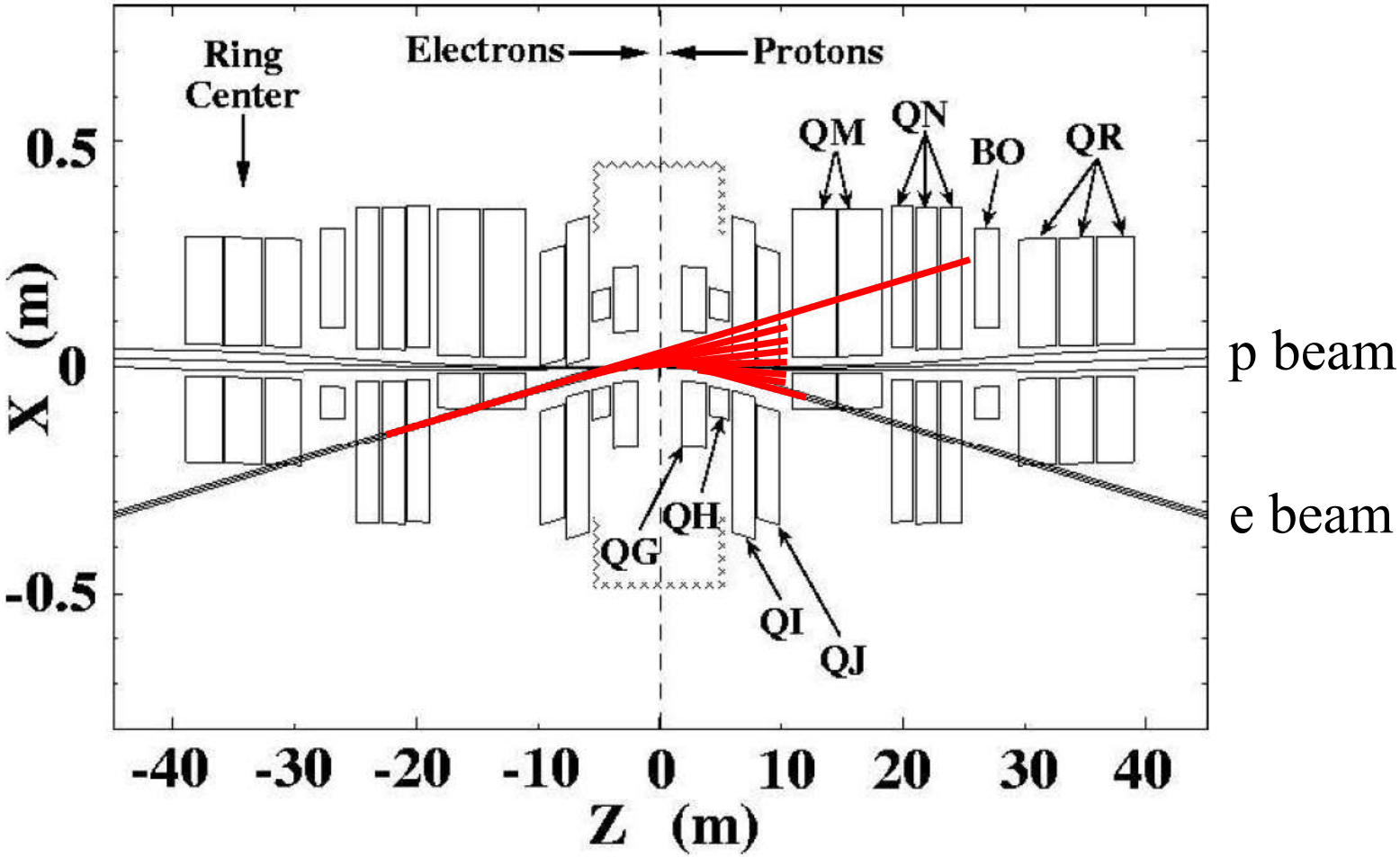


No evidence for trend at low p_T and forward η **to continue.**

Shape of data well described by theoretical calculations.

HERA II luminosity upgrade: Synchrotron Radiation backgrounds

Upgrade: New focusing scheme at ep collision points. **Higher luminosity**!



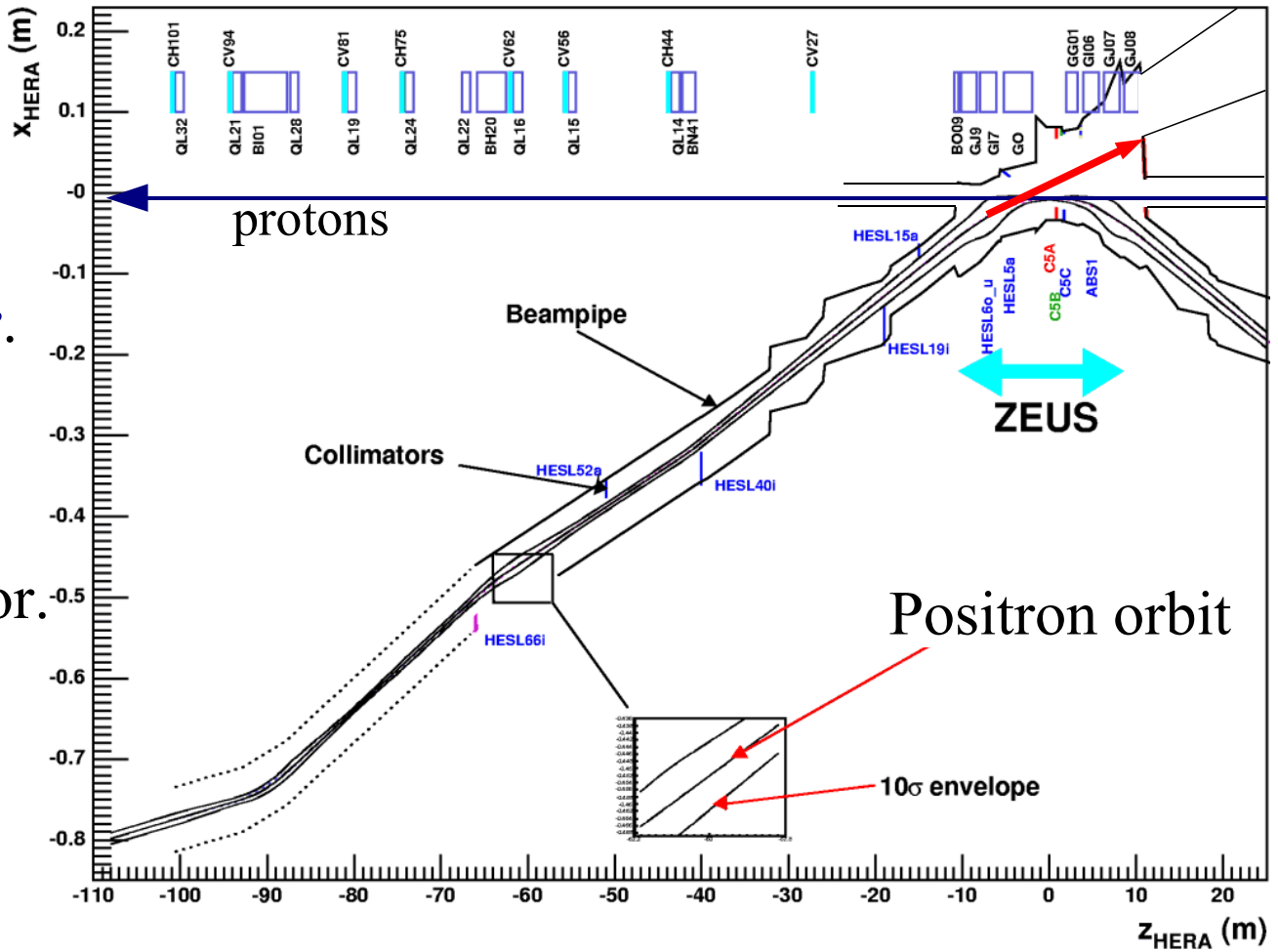
Drawback after startup: **large backgrounds** disabled data taking.

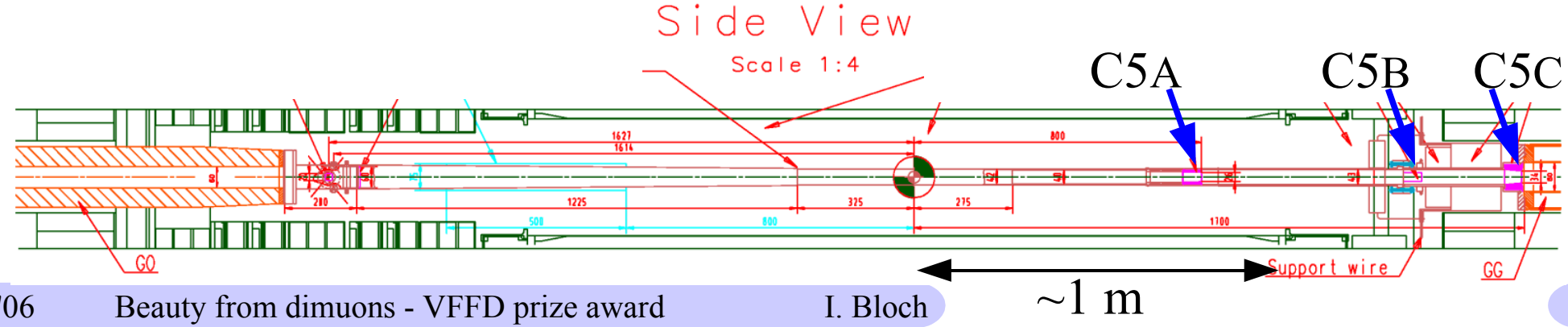
=> Needed to **reduce the backgrounds!**

Synchrotron radiation environment

SR is emitted from beam
and **travels towards detector**.

Backscattered mainly
from absorber at z =11 m.
Finally reaches central detector.





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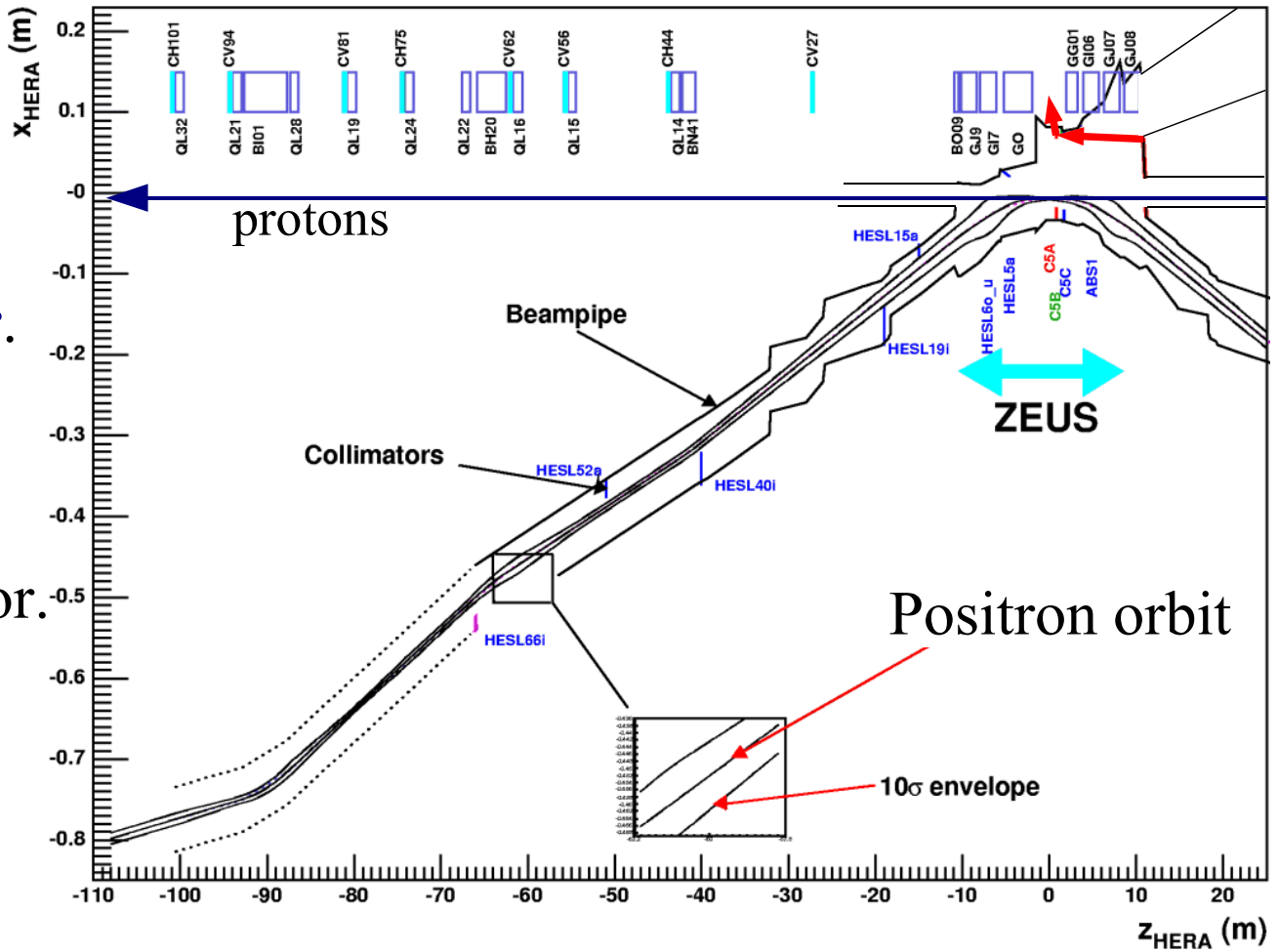
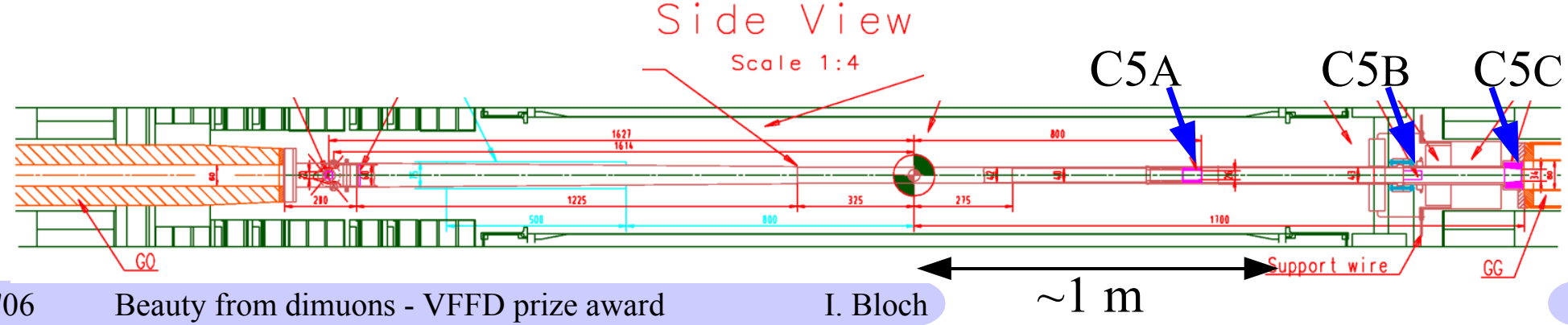
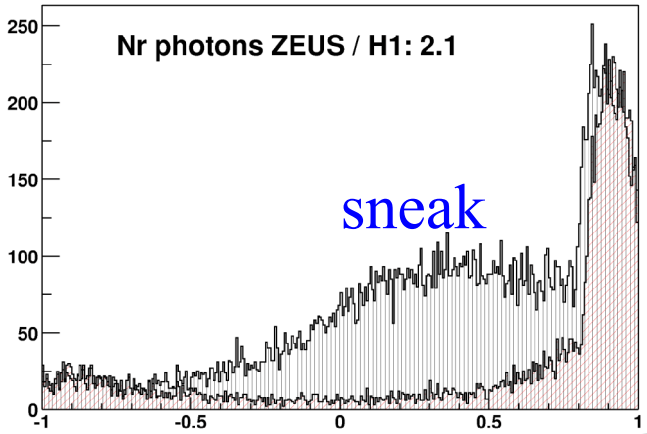
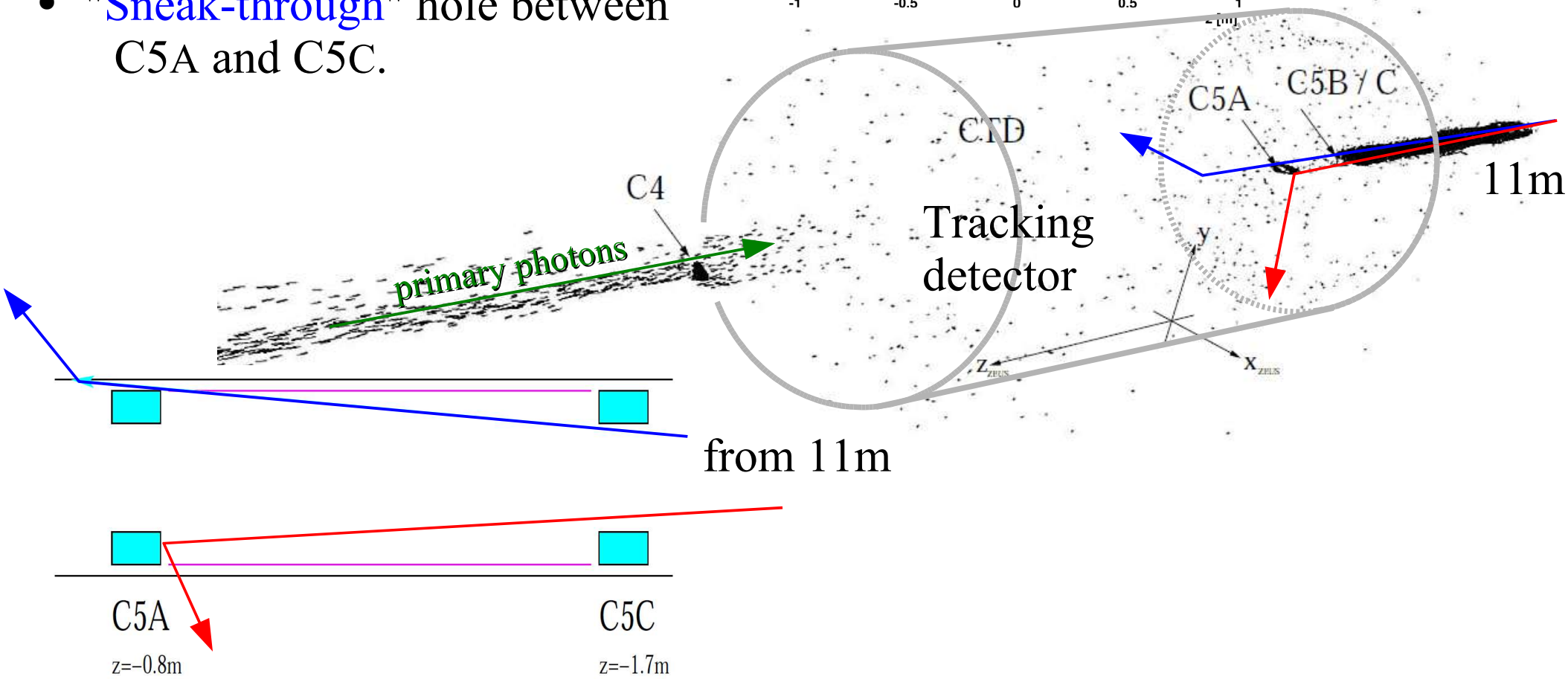




Simulation main conclusions

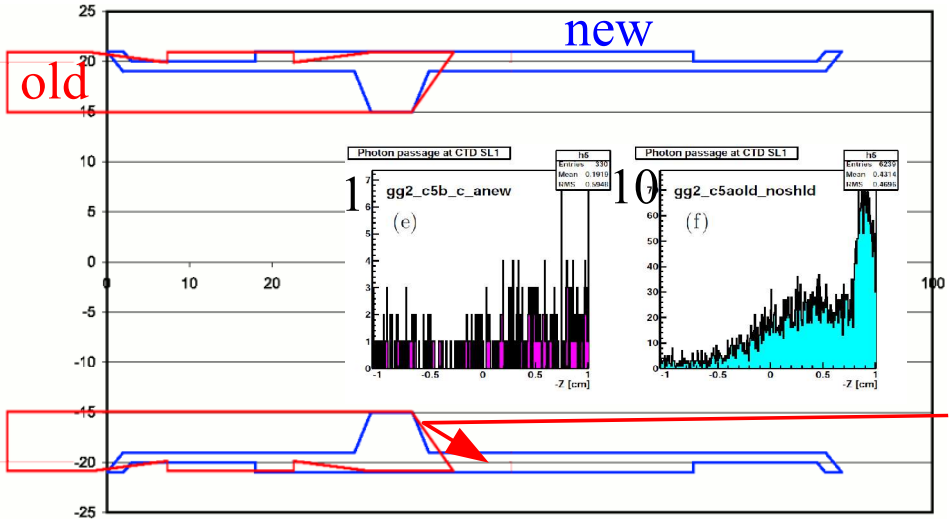
- **Main SR bg contribution**:
  Reflected SR from Abs4 at 11m:
  - Reflection from rear surface of C5A into CTD.
  - "Sneak-through" hole between C5A and C5C.

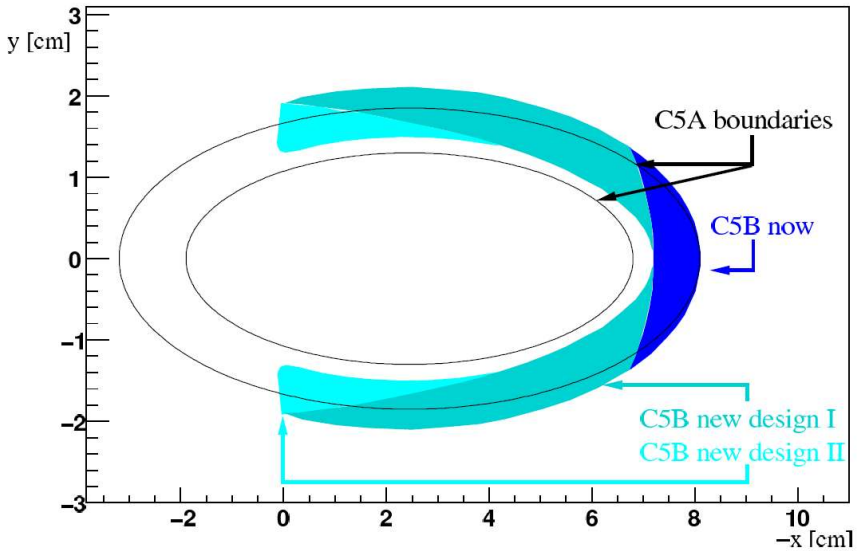




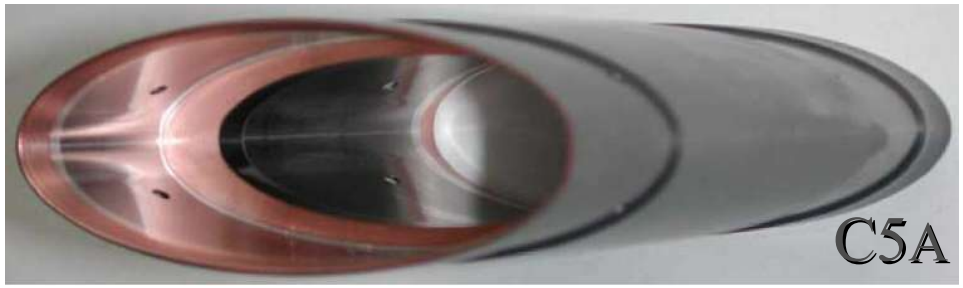
Synchrotron radiation collimator modifications

Final measures: Modify C5A, B and C:





Final collimators:



Synchrotron radiaton background reduced by more than a factor 10.

Conclusion

- **Enlarged muon p_T^{μ} and η^{μ} range**
- Determined **total $b\bar{b}$ cross section**
- **Comparison of cross sections with theory prediction**:
  general agreement of prediction with data, though not pertect at low p_T
  - no evidence to extend to smaller p_T or more forward η.
- **SR reduced by O(10)**