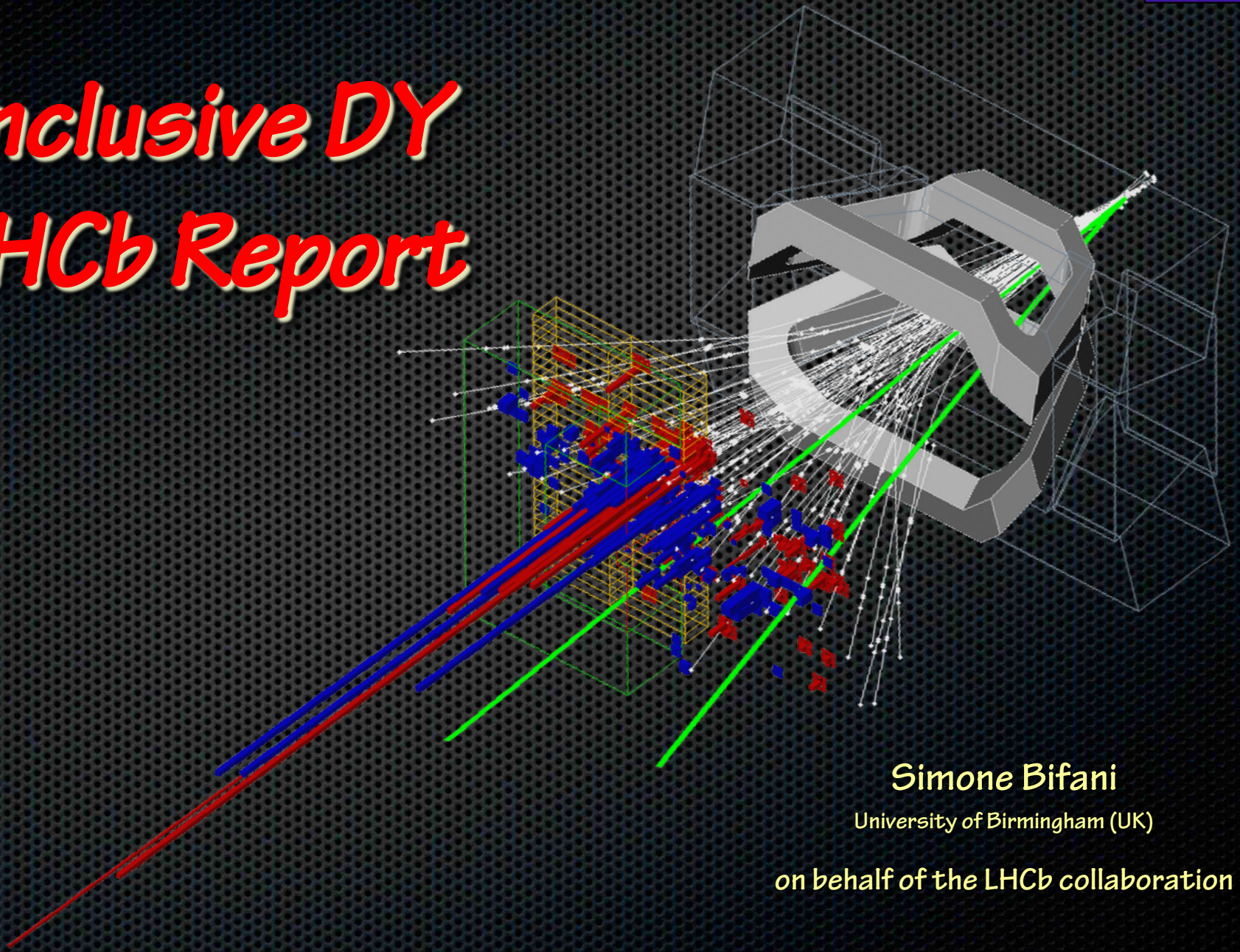
Inclusive DY LHCb Report



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on behalf of the LHCb collaboration

EW Precision Physics at the LHC, 30th June 2014

Outline

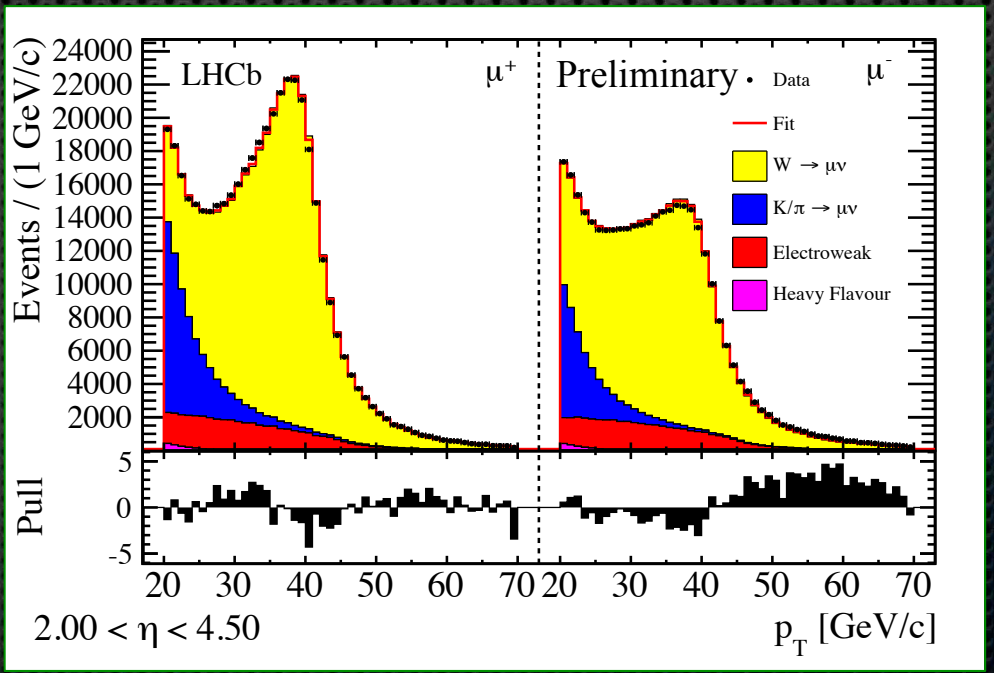
- Analysis Status
- Topics for Discussion

Analysis Status

- LHCb EW shopping list
  - » $W \to \mu\nu$ (2011): to be published in the next few weeks
  - » $W \to e\nu$ (2011): ongoing
  - » $W \to \tau\nu$ (2011): ongoing
  - » $Z \to \mu\mu$ (2011): LHCb-CONF-2013-007, working on publication
  - » $Z \to ee$ (2011): LHCb-PAPER-2012-036
  - » $Z \to \tau\tau$ (2011): LHCb-PAPER-2012-029
  - » Low mass Drell-Yan (2010): LHCb-CONF-2012-013, 2011 ongoing
  - » A_{FB} (2011): ongoing
- Update with the 2012 data ongoing for most of the analyses

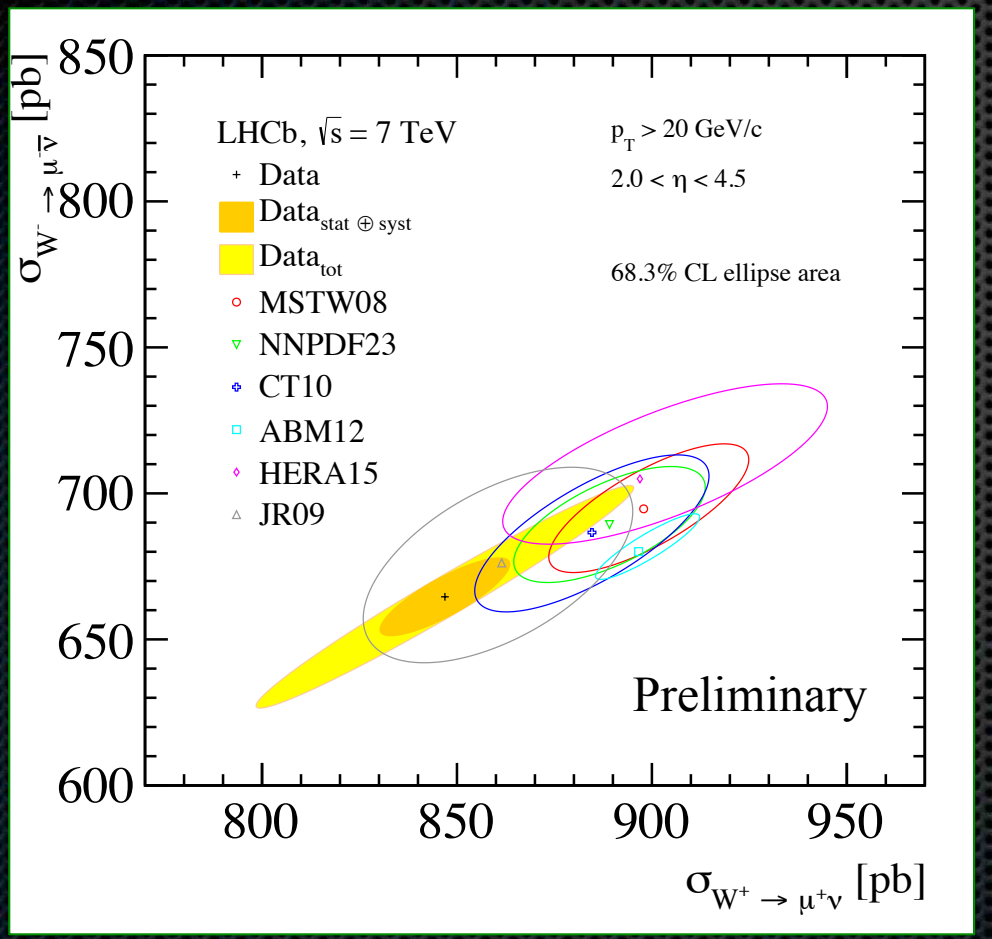
W -> μν

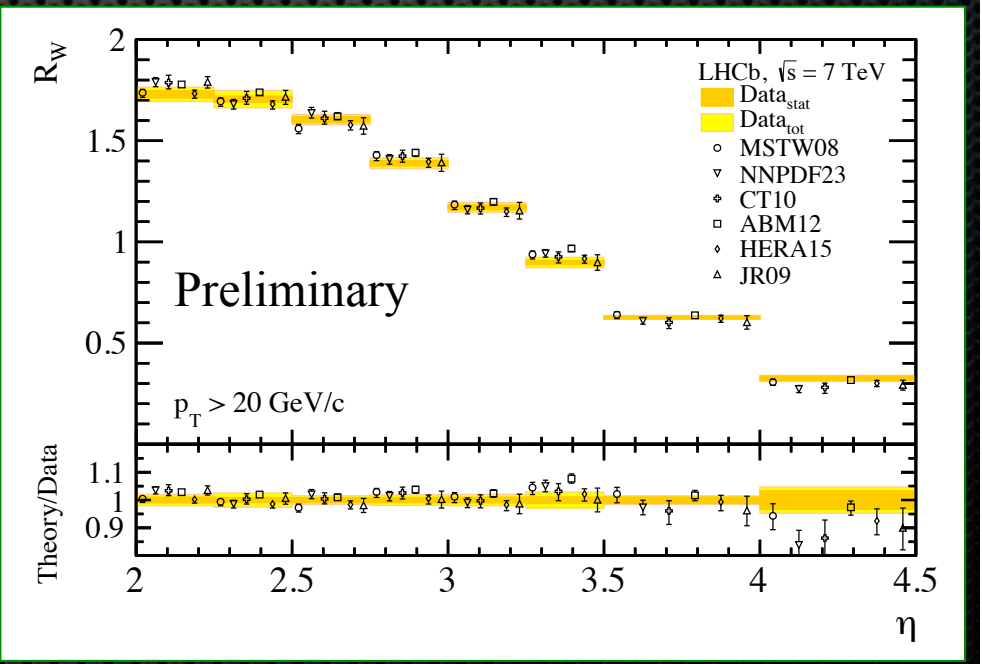
- Measurements performed in the forward region ($2.0 < \eta < 4.5$) for muons with $p_T > 20$ GeV/c
- Fit the positive and negative muon p_T spectra in data to expected shapes for signal (ResBos) and backgrounds (data, PYTHIA and ResBos) in 8 η bins
- All efficiencies determined from data and cross-checked with simulation
- FSR correction evaluated using PHOTOS interfaced to PYTHIA



W -> μν

- Results in general agreement with NNLO predictions (FEWZ)
  - PDF uncertainty at 68%
  - Scale uncertainties varied by factors of two around the boson mass





W -> μν

- Efficiency uncertainties limited by statistics
- Template shape uncertainty limited by the knowledge of the signal p_T spectrum

Source	$\Delta\sigma_{W^+\to\mu^+\nu}$ [%]	$\Delta\sigma_{W^-\to\mu^-\overline{\nu}}$ [%]	ΔR_W [%]
Template shape	0.24	0.40	0.60
Template normalisation	0.08	0.09	0.03
Reconstruction efficiency	1.21	1.20	0.12
Selection efficiency	0.33	0.32	0.18
Acceptance and FSR	0.17	0.12	0.21
Luminosity	3.50	3.50	—

- Tested different generators (PYTHIA POWHEG, ResBos)
- How to properly assess shape systematic?
- How big is the effect of EWK corrections on the muon p_T shape
- How to include them?

W -> μν

- The muon p_T is sensitive to the W mass
- W mass measurements generally use the lepton p_T and jet balancing to infer the missing energy and construct a pseudo-W-mass variable
- In principle we can fit the p_T templates from MC having different W masses to the data
- We need the muon p_T described theoretically as well as possible
- Once we know how much to vary the simulation by, we can work out what our precision would be on the W mass

Low Mass Drell-Yan

- **Fiducial volume**
  - Masses down to 10 GeV/c^2
  - Rapidity bins ($2.0 < y_{\mu\mu} < 4.5$)

- FEWZ tested at NNLO for masses down to 10 GeV/c^2
- The uncertainty in the lowest mass bin (10.5-11 GeV/c^2) is ~7%
  - Error up dominated by PDF (~6%)
  - Error down dominated by theory (~6%)

- **Questions**
  - Are EWK corrections implemented in FEWZ the best estimates?
  - What is an appropriate way to determine an uncertainty?

A_{FB}

- **Fiducial volume**
  - $p_{T,\mu} > 20$ GeV/c
  - $2.0 < \eta_{\mu} < 4.5$
  - $60 < m_{\mu\mu} < 120$ GeV/c^2
- Method
  - Correct A_{FB} for **detector resolution** within fiducial region
  - Fit to generator templates generated with different $\sin^2\theta_W$, which include QED, EWK and QCD higher order contributions, to extract a value for $\sin^2\theta_W$ in data.
- **Questions**
  - Are EWK corrections implemented in FEWZ and POWHEG-box the best estimates?
  - What is an appropriate way to determine an uncertainty?
  - Or should data be unfolded for EWK corrections using external code?