A_{FB} at LHC

Myfanwy Liles (University of Liverpool)
Ronan McNulty (University College Dublin)
Tara Shears (University of Liverpool)

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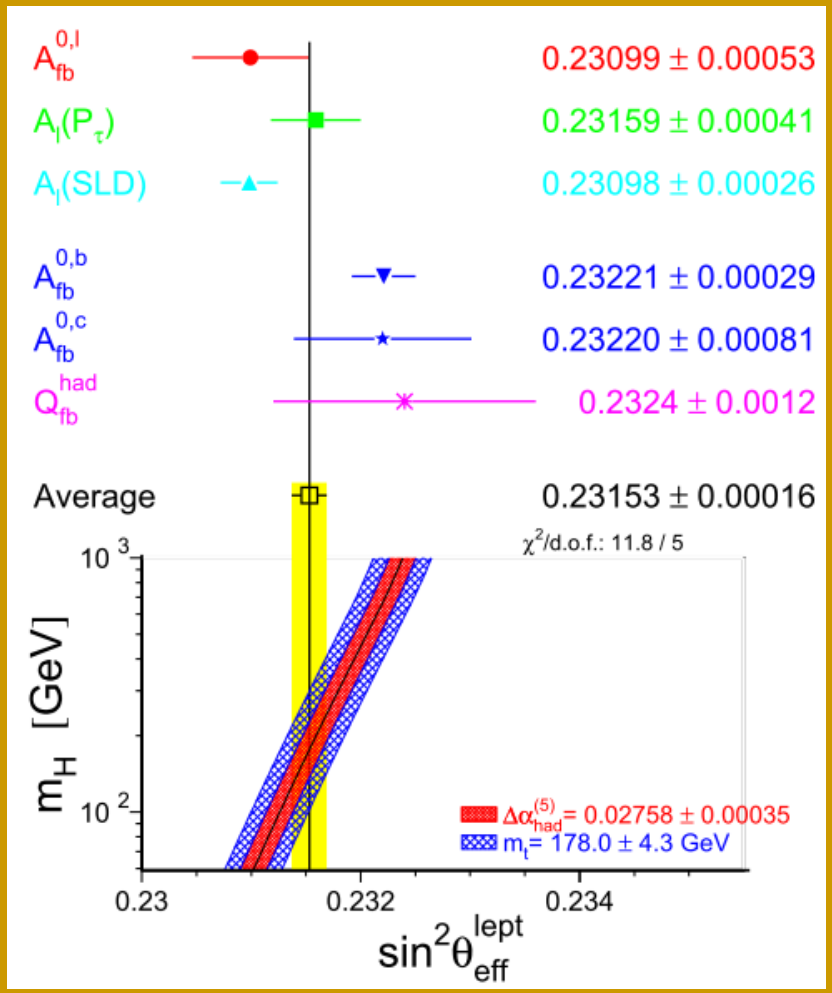
Outline

- Is it worth trying to measure A_{FB} at LHC?
- Rather simple and unsophisticated study
  - Horace
  - Pythia
- Motivate discussion and ideas

Current precision on $\sin^2\theta_W$

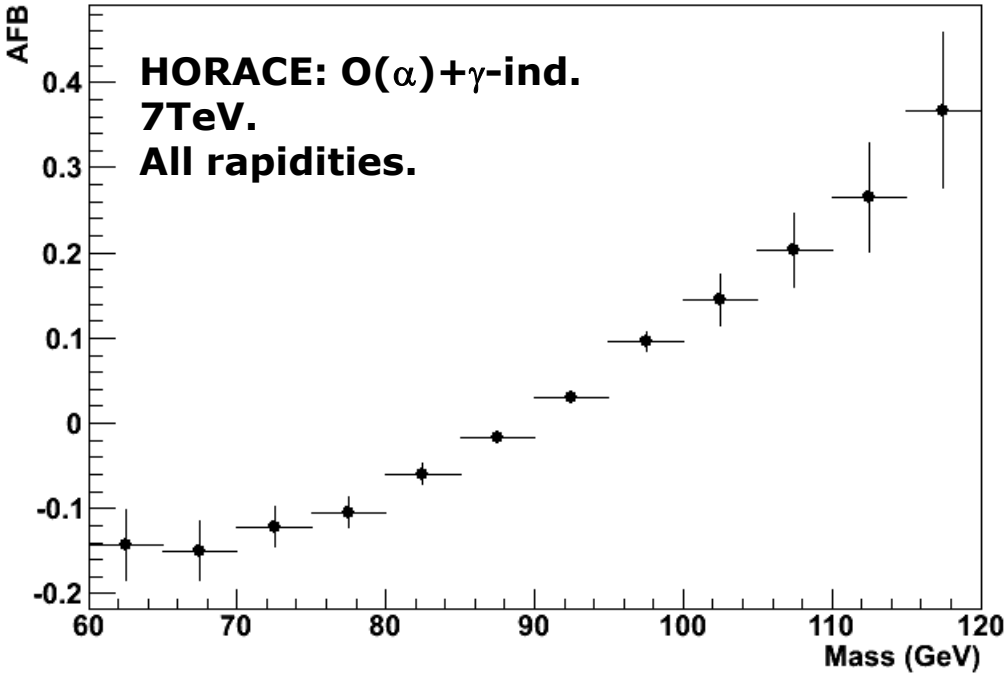


Unsatisfactory that two most precise measurements are >3σ apart, and that W.A. is marginally consistent with either.

Would like to make measurement with precision of ~0.0001.

A_{FB} away from Z pole

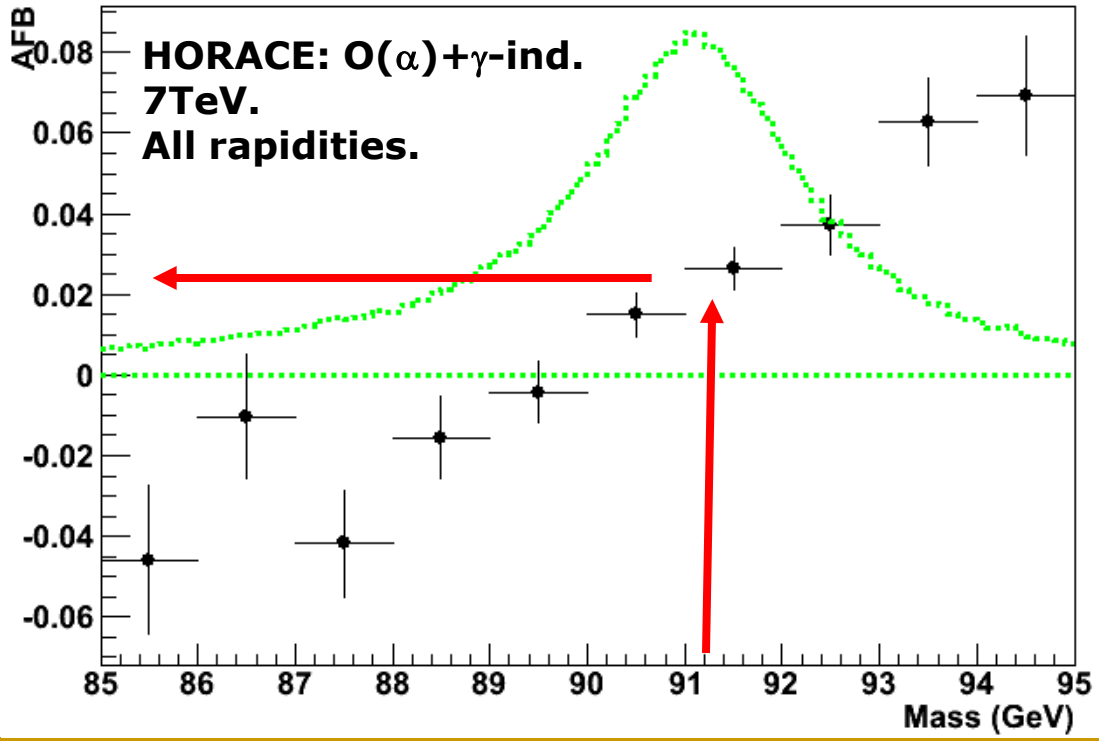
- Strong dependence with mass due to γ-Z interference. (To first order, zero on pole).



"Asymmetry greater further from pole"

A_{FB} away from Z pole

- On pole, due to different RH, LH Z coupling…
- Small positive value



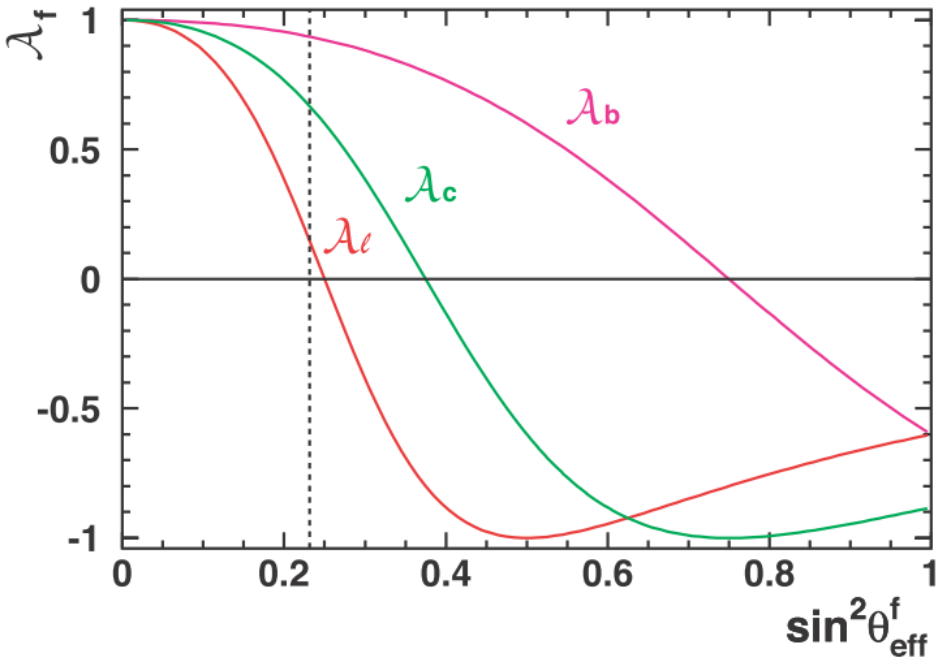
A_{FB} on Z pole

$$A_{FB}^{0,f} = \frac{3}{4} A_f \left(u A_u + d A_d + s A_s \right) \qquad A_f = \frac{2 g_{Vf} g_{Af}}{g_{Vf}^2 + g_{Af}^2}$$

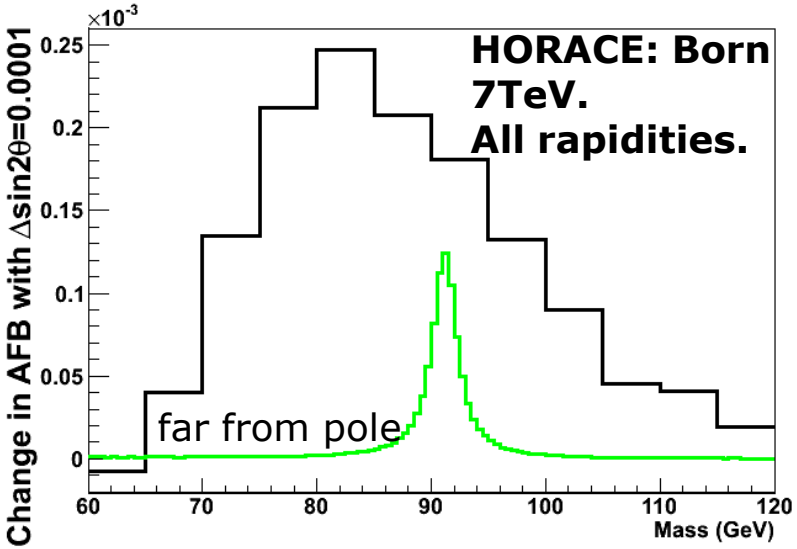
A_{FB} sensitive to $\sin^2\theta_W$

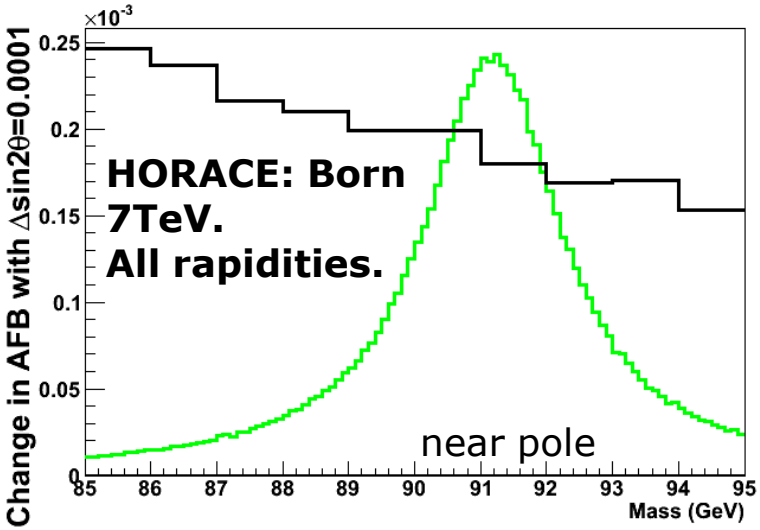
A_{FB} in muon channel at LHC is about 5 times larger than at LEP.

But sensitivity coming more from A_l rather than A_u or A_d



Where are we most sensitive?





Greatest sensitivity per event at 82 GeV

About 2/3 that sensitivity at 91 GeV

But much more stats.

So measurement on pole appears most sensitive to sin2θ

Problems for LHC

$$A_{FB}^{0,f} = \frac{3}{4} A_f \left(uA_u + dA_d + sA_s \right) \qquad A_f = \frac{2 g_{Vf} g_{Af}}{g_{Vf}^2 + g_{Af}^2}$$

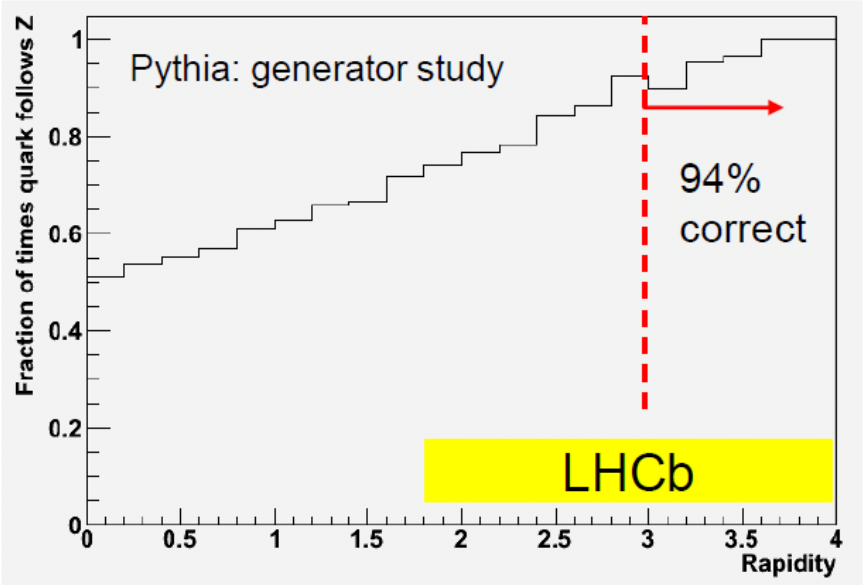
A_{FB} sensitive to $\sin^2\theta_W$

Uncertainties from :

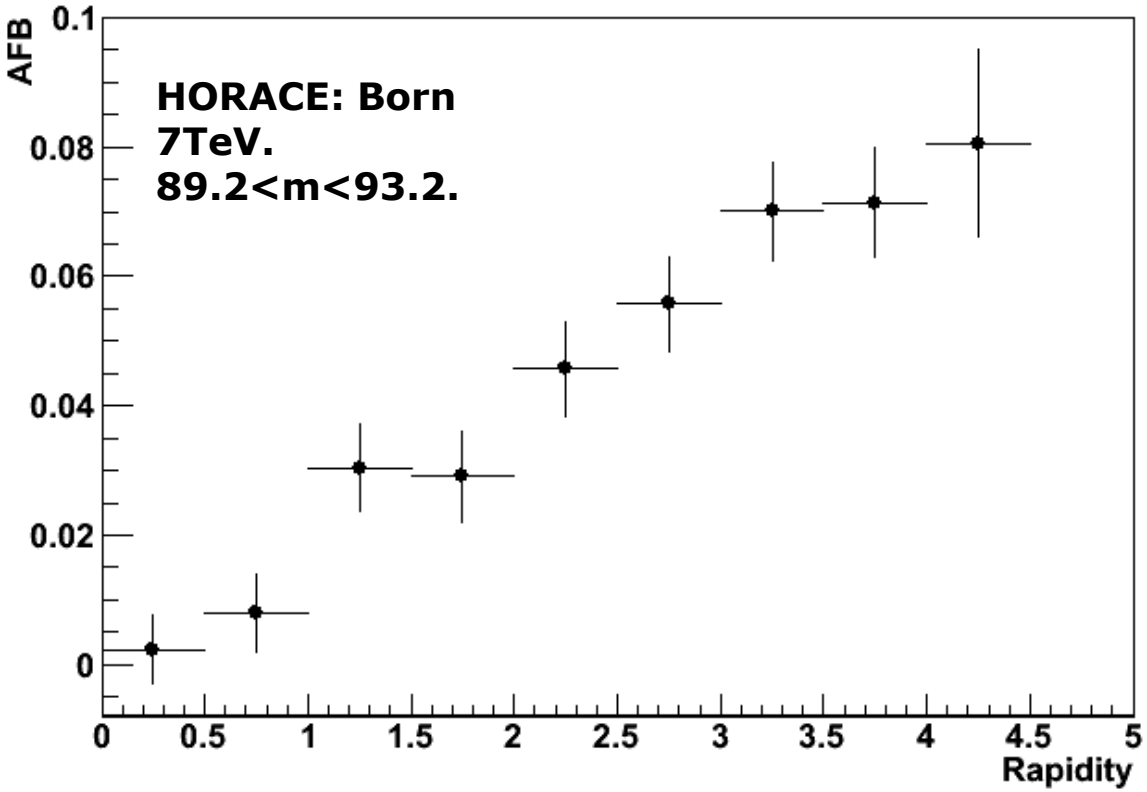
- Forward (quark) direction
- PDF knowledge of sea

LHCb:

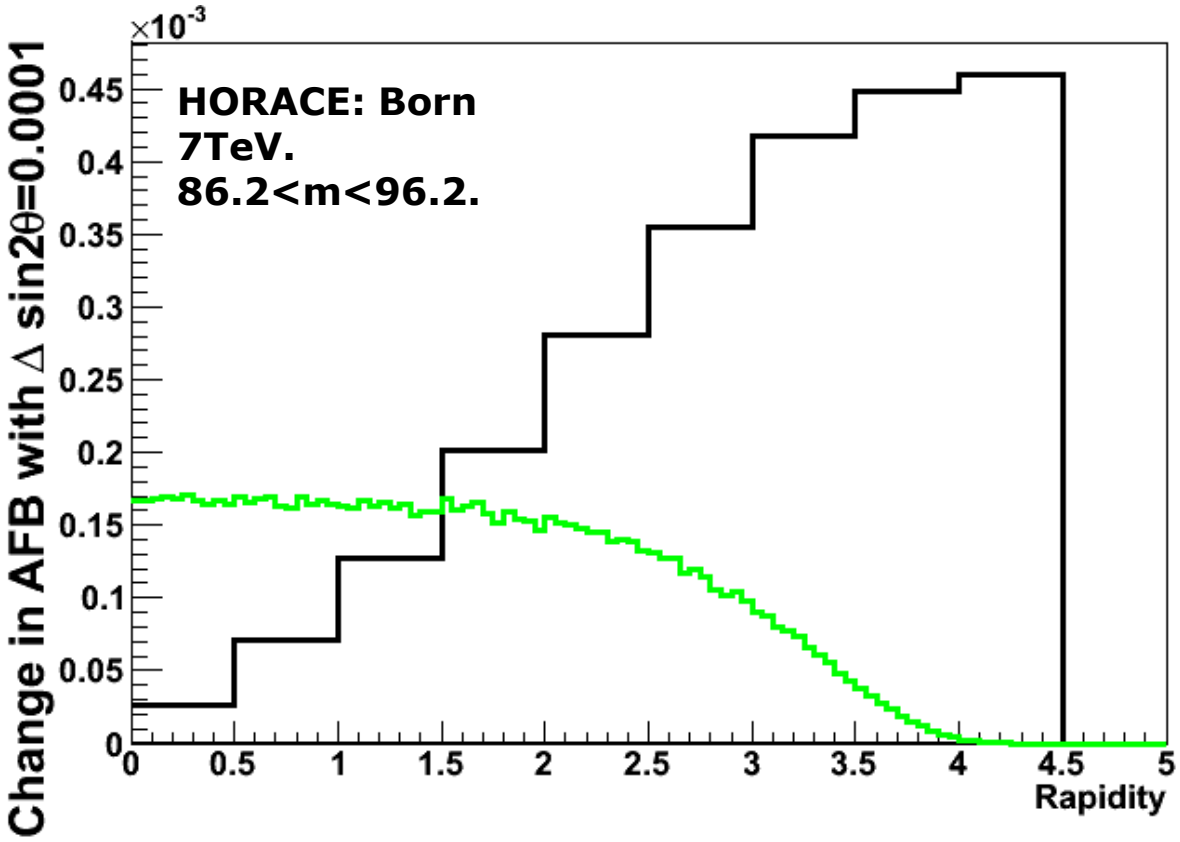
- predominately valence - sea collisions
- ss contribution reduced

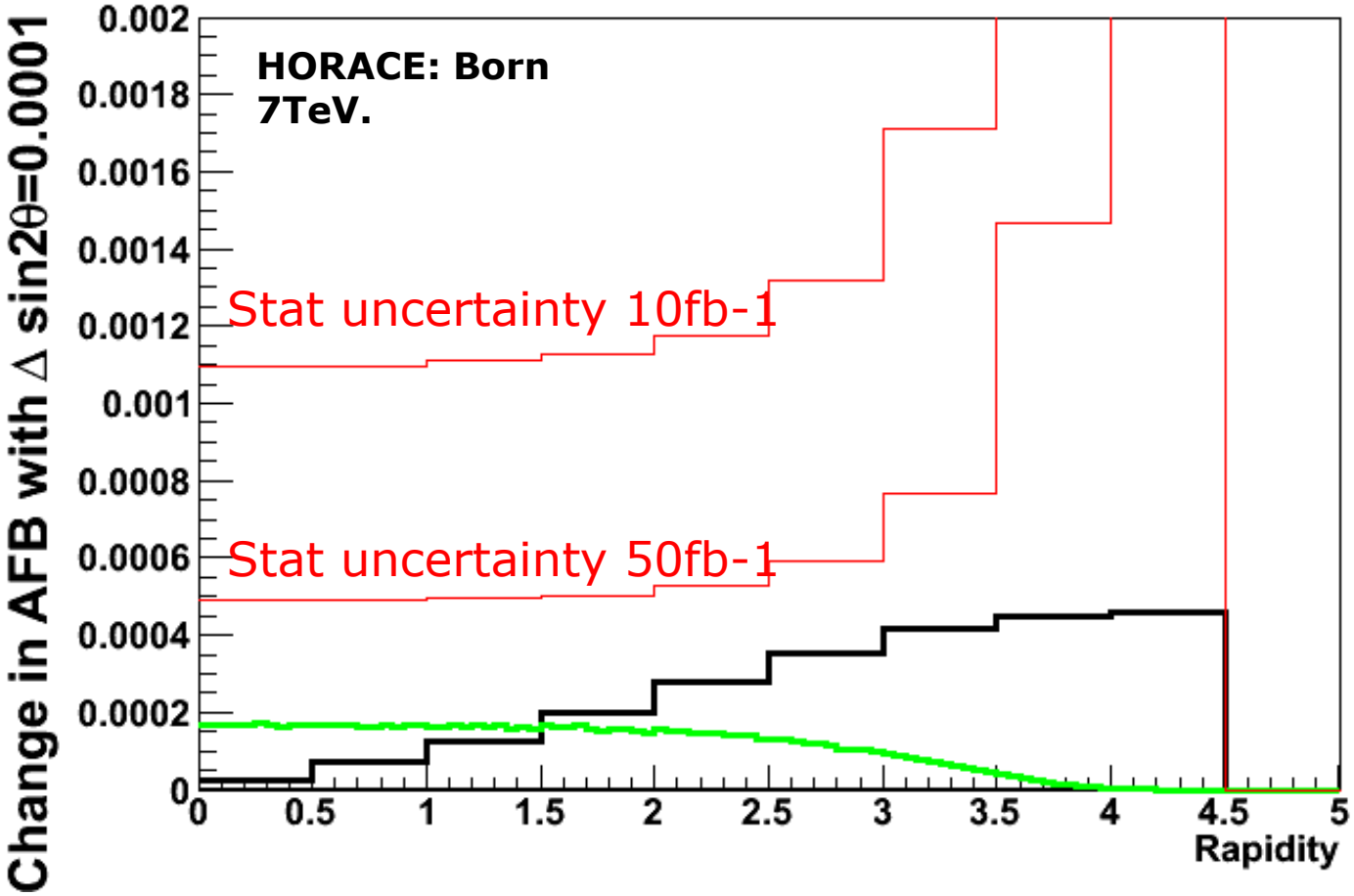


Going forward increases A_{FB}

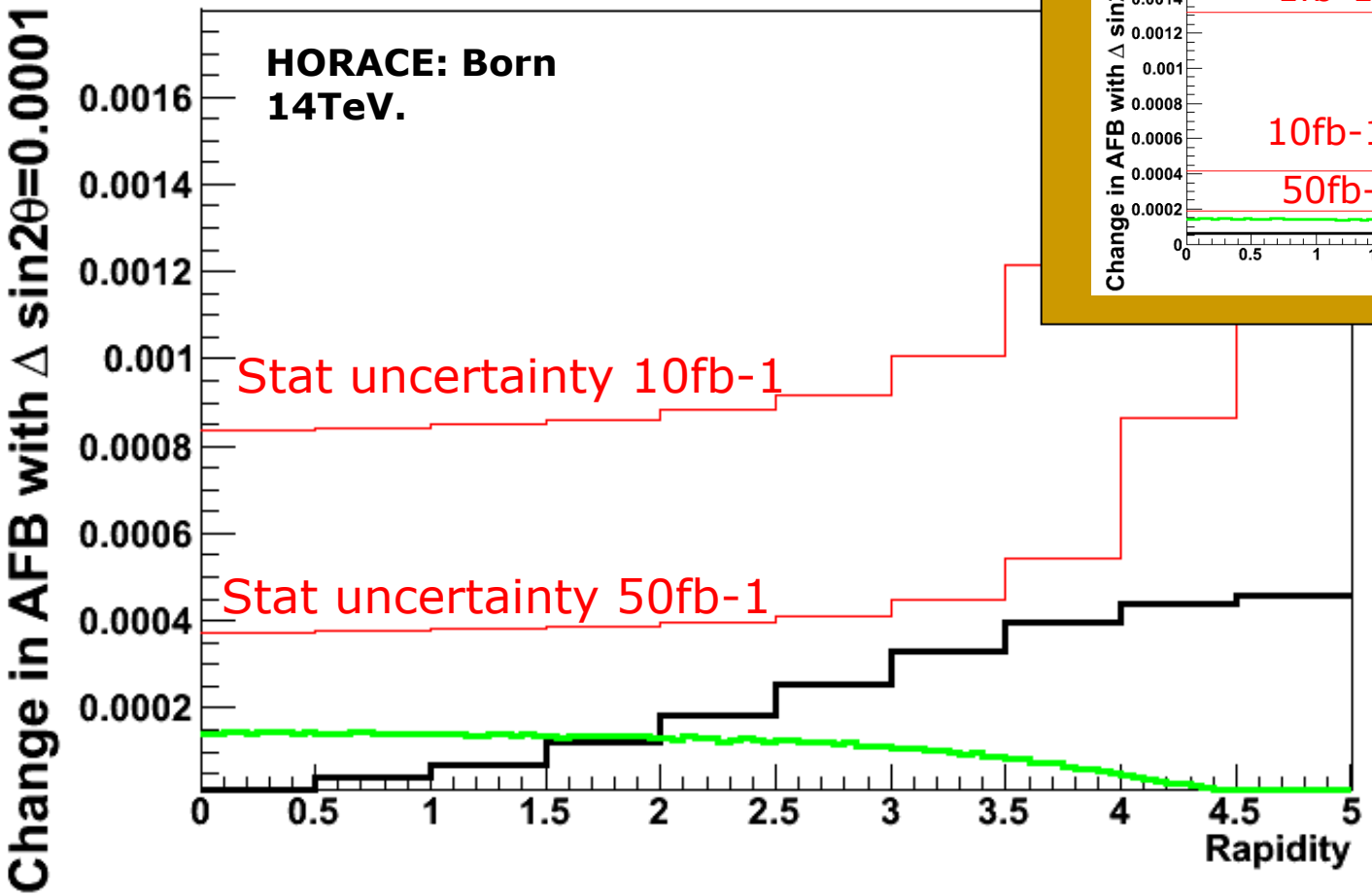


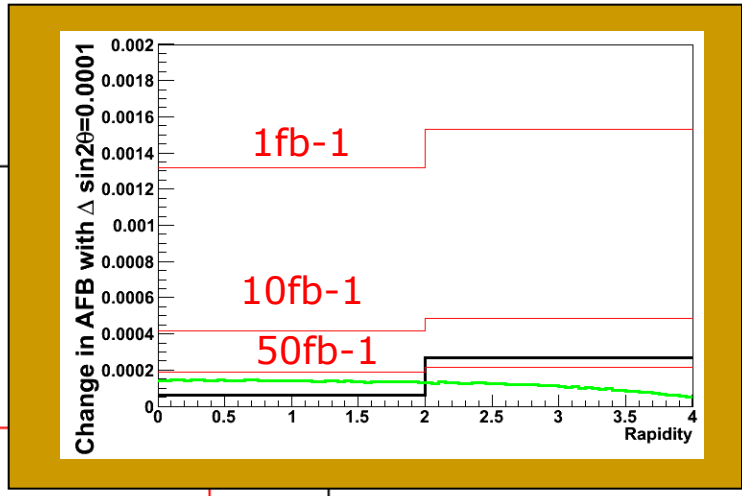
Going forward increases sensitivity…




HORACE: Born
7TeV.
Stat uncertainty 10fb-1
Stat uncertainty 50fb-1
Change in AFB with Δ sin2θ=0.0001
Rapidity
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

50fb-1 at 14 TeV measures $\sin^2\theta \sim 0.0001$





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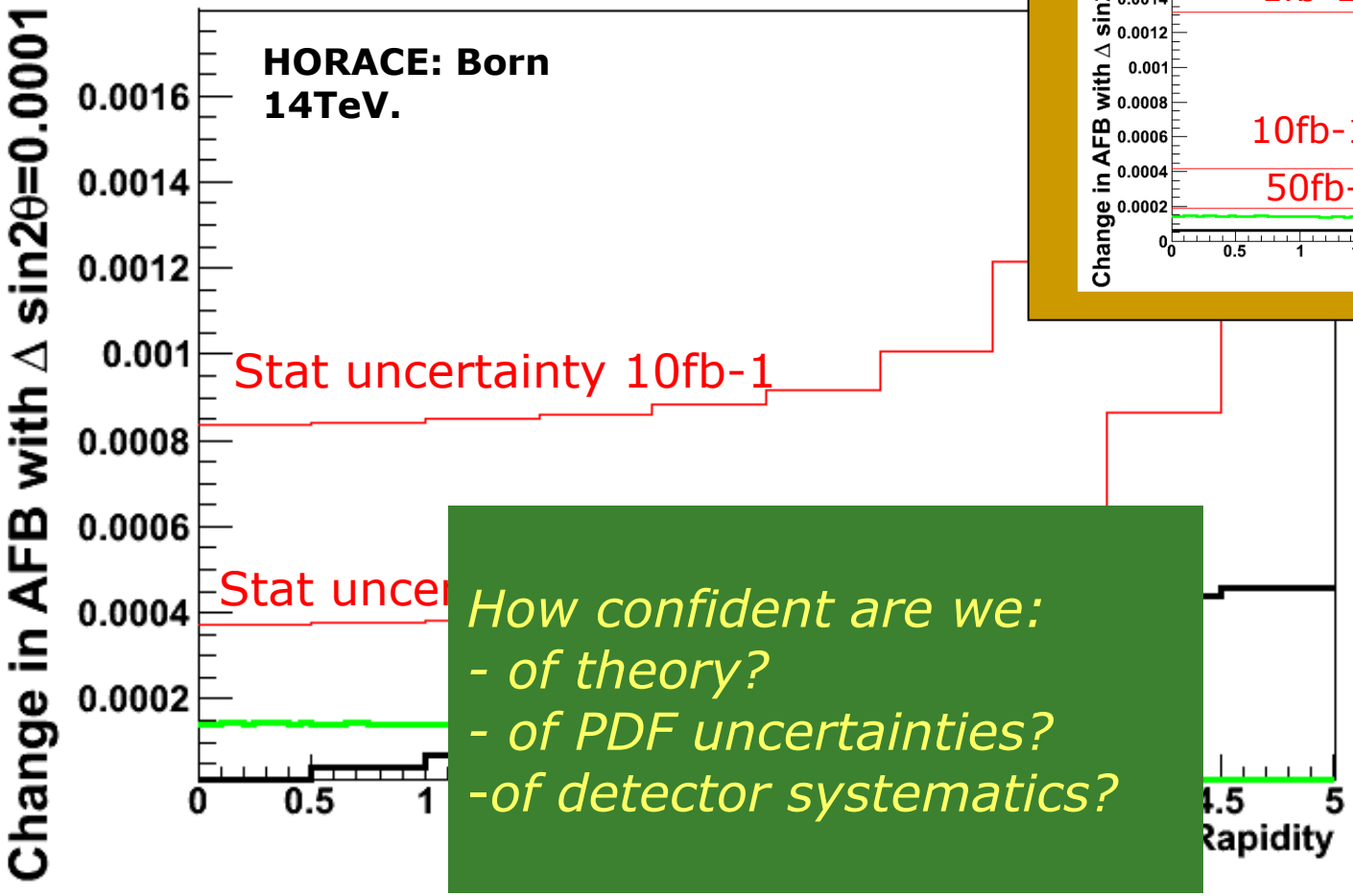
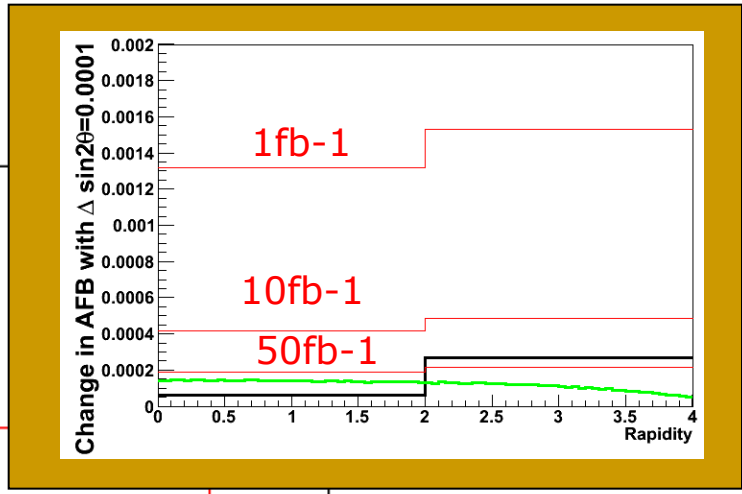


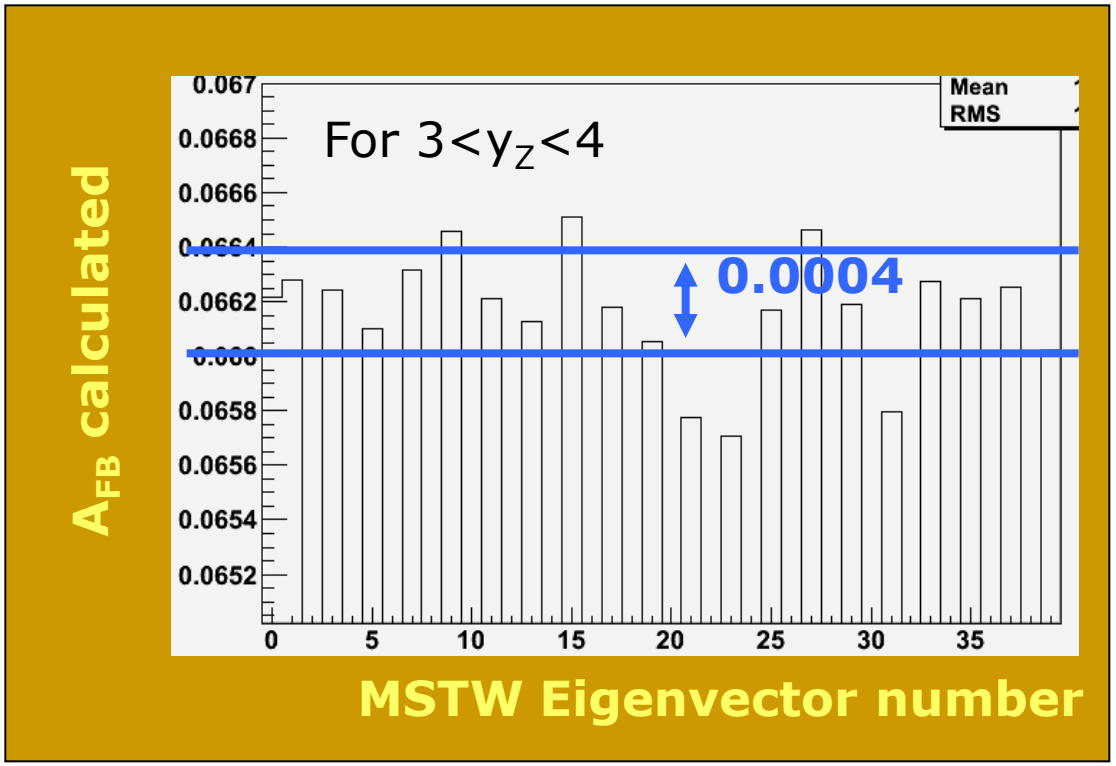


How confident are we:
- of theory?
- of PDF uncertainties?
-of detector systematics?

Uncertainty due to PDF

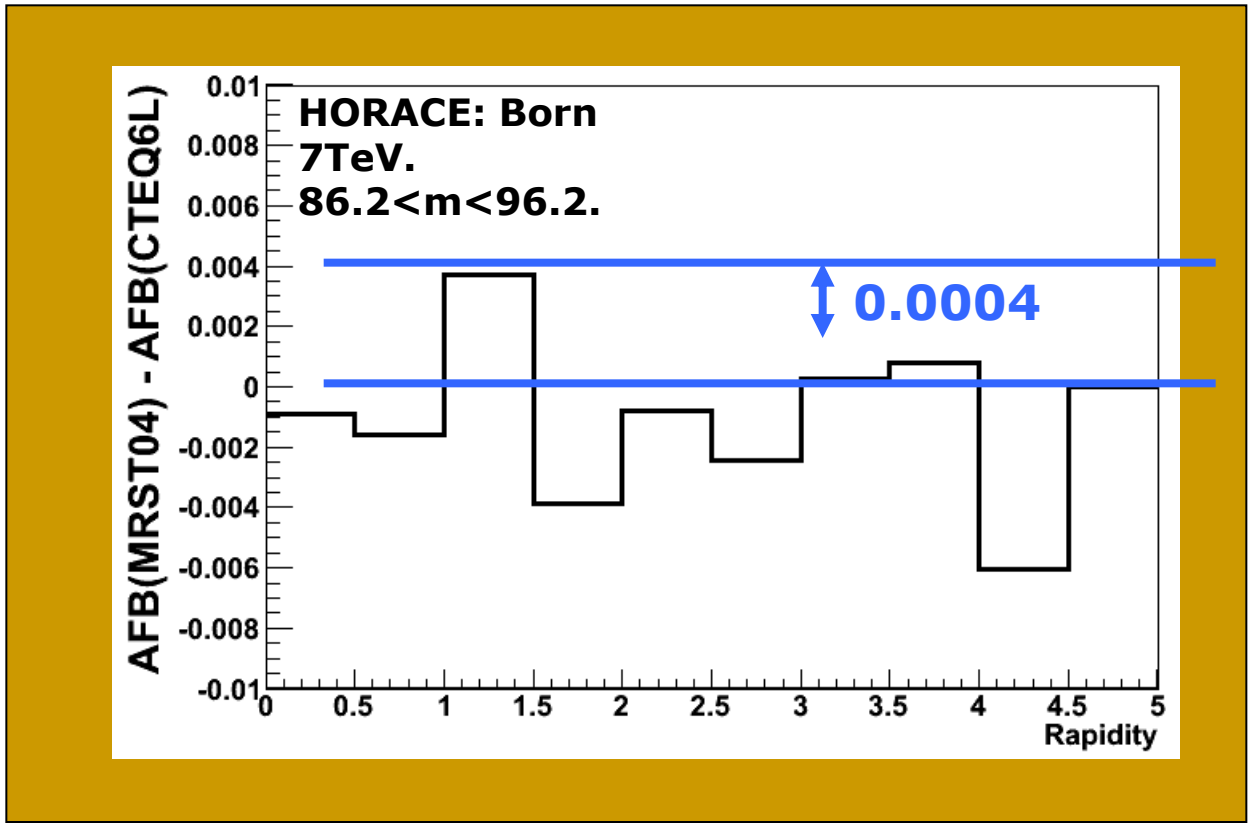
Uncertainty from PDF (from one PDF set) about the same as statistical uncertainty.

With time, this should improve (~ 50%?)



Uncertainty due to PDF

Difference between two (old) PDF sets about the same as statistical uncertainty.



Conclusions

- Is it worth trying to measure A_{FB} at LHC?
- …. Probably.