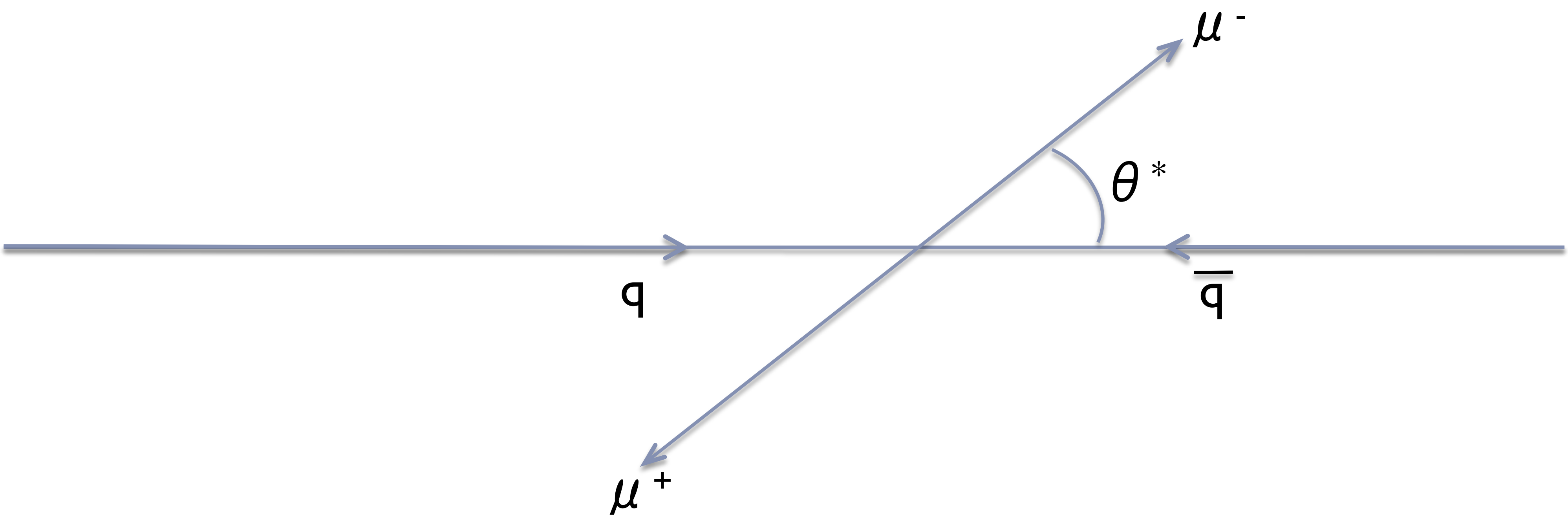
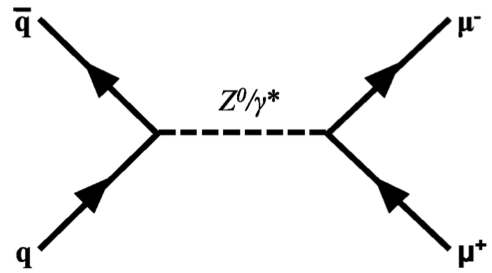


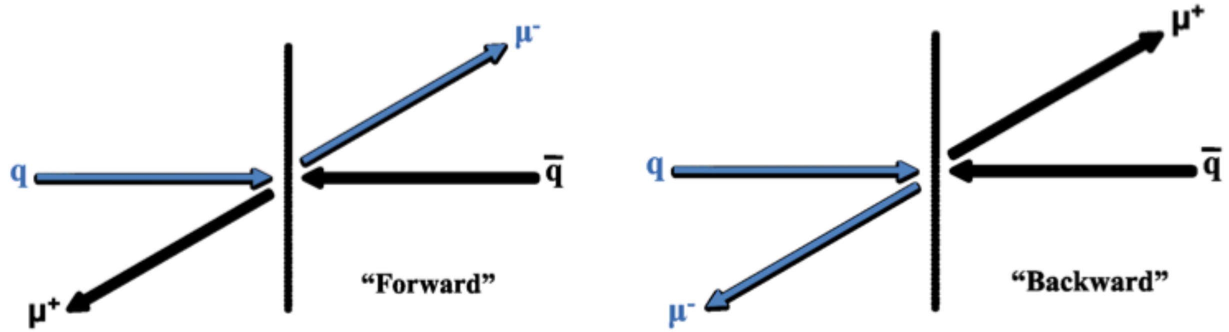
Update on A_{FB}

Myfanwy Liles

A_{FB} Reminder

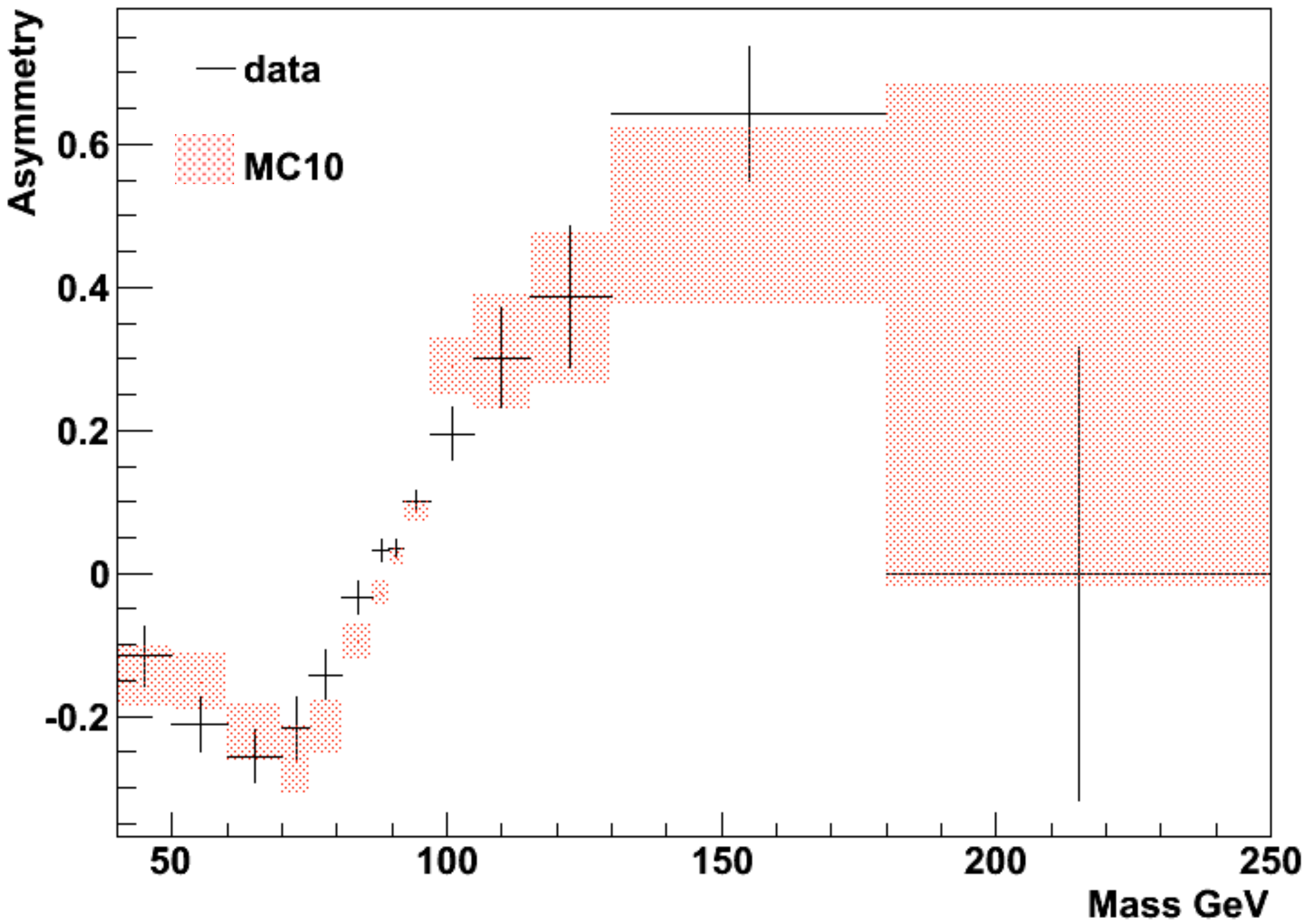


- Forward-Backward Asymmetry
- Due to parity violation of the weak interaction
- Interference between vector and axial couplings
- Why measure AFB?
  - Extract $\sin^2\theta_W$
  - Couplings of Z to quarks and to muons
  - Sensitive to New Physics



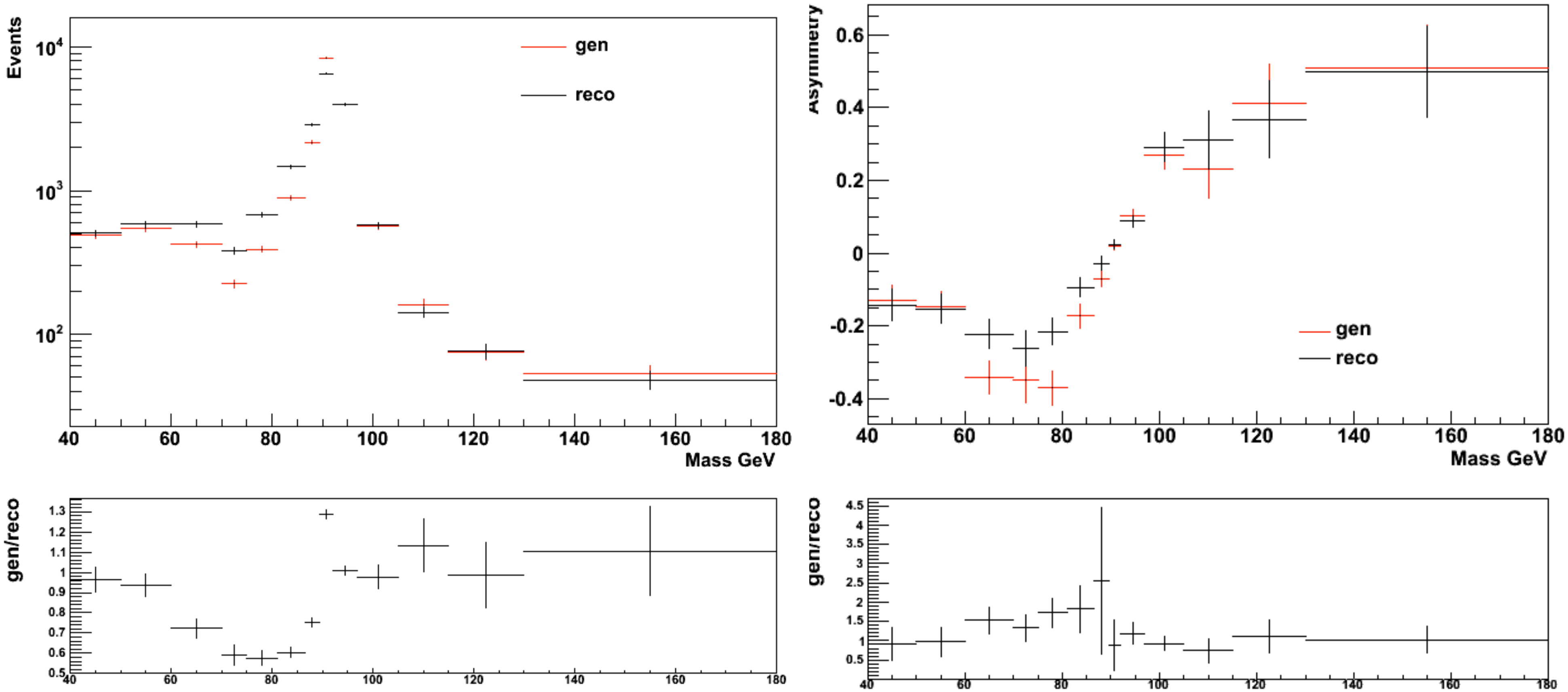
$$A_{FB} = \frac{N_F - N_B}{N_F + N_B}$$

2011 Data (Stripping 13b 341pb^{-1})



- More data to come shortly…

Detector effects MC10



- Events shifted to lower invariant mass
- Most noticeable effect on and below Z peak

Unfolding

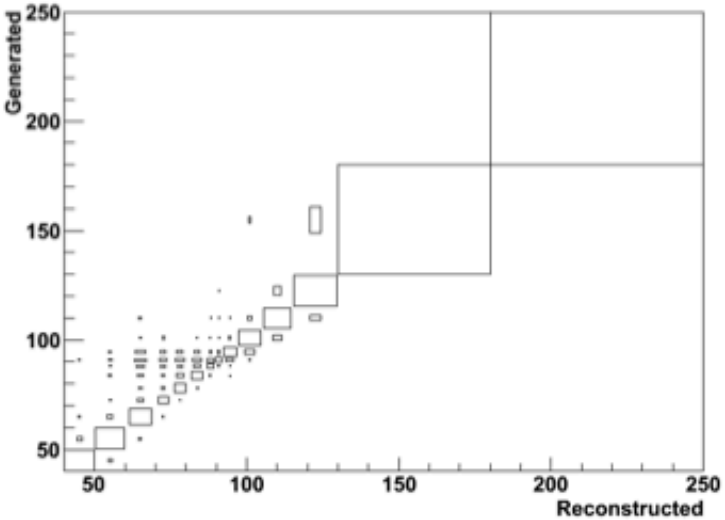
- Corrects for detector effects. Important to get raw A_{FB} distribution for comparison to theory and hence New Physics searches.

- Simple method: Produce correlation matrix. For each reconstructed mass bin, identify which generator bin the event came from. Separate for forward and backward events.

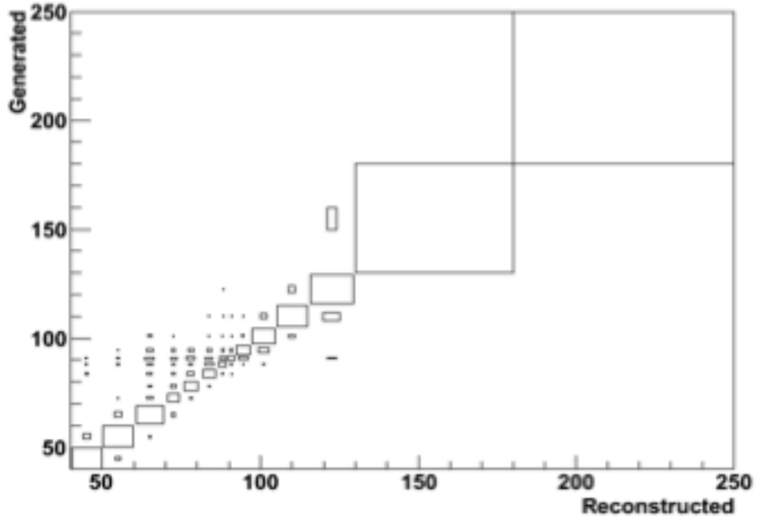
- Rij probability that an event reconstructed in bin i was generated in bin j

Unfolding response matrices

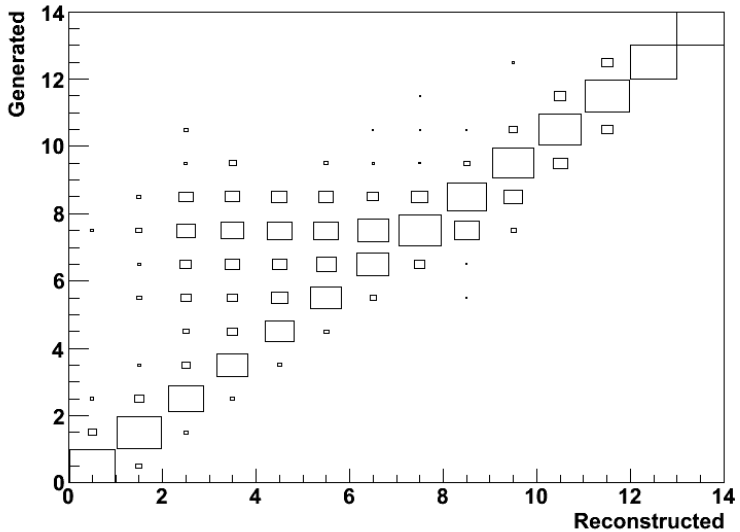
Forward events

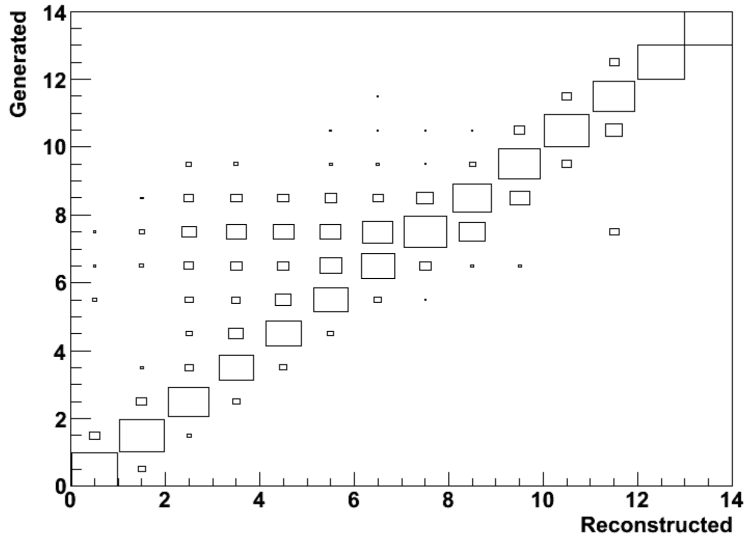


Backward events



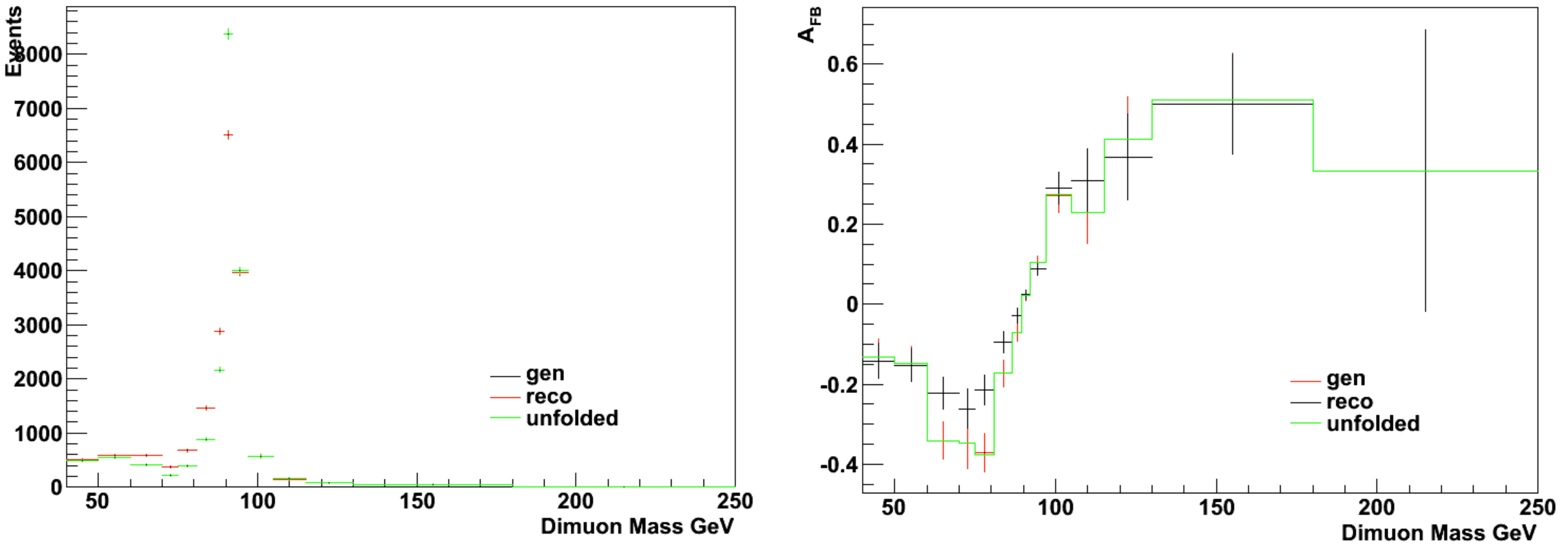
In mass bins





By bin number

Unfolding



- Method statistics limited within MC10
- Forward and backward matrices may turn out to be the same

Unfolding conclusion

- This method will correct for detector effects and unfold A_{FB} BUT dependant on the input distribution

- Currently extending to an iterative unfolding method to remove the dependence on the input distribution

- Trying to implement this with Roounfold
  - possibility to compare different unfolding techniques
  - better record of associated uncertainties

Method for extracting $\sin^2\theta_W$ following D0

1) Start with fully reconstructed MC

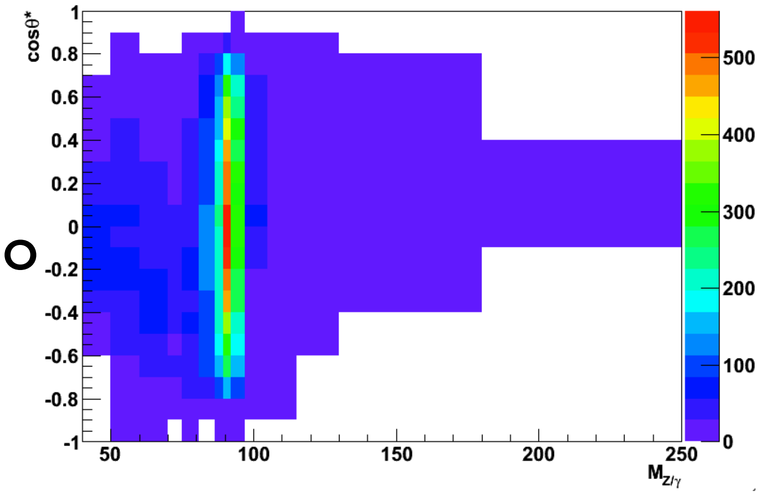
2) Use generator truth MC to create a weighting between reco and gen (for 2D distribution $\cos\theta^*$ vs $M_{\mu\mu}$)

3) Reweight many generator samples each with different $\sin^2\theta_W$ to create "reconstructed" samples.

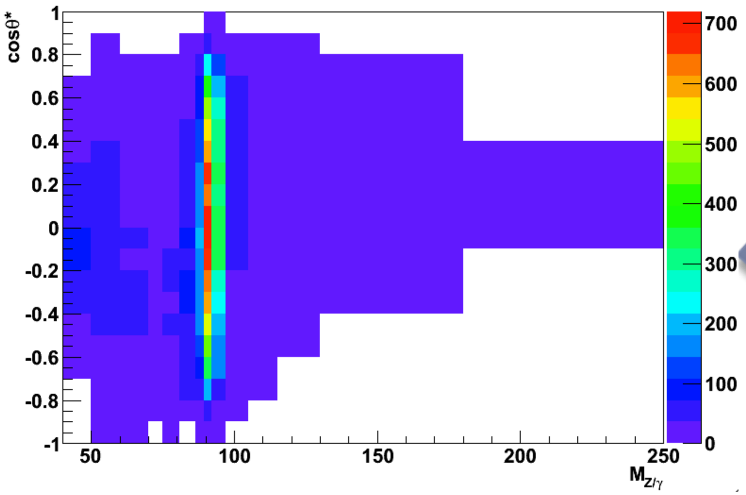
4) Extract $\sin^2\theta_W$ using χ^2 fit to 2D distributions

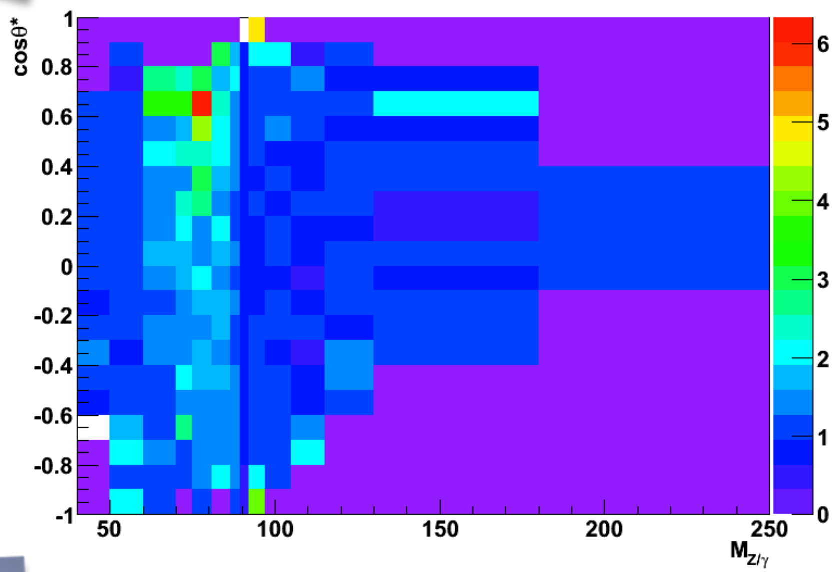
2D distributions

Reco



Gen





Reco/Gen reweighting histogram

Implementing this…

- Need to produce a lot of MC for this to work
  - Decent sample of Z/γ from MC11 1M events
  - > 40 generator MC samples ~5M events each
  - Generator level so relatively quick

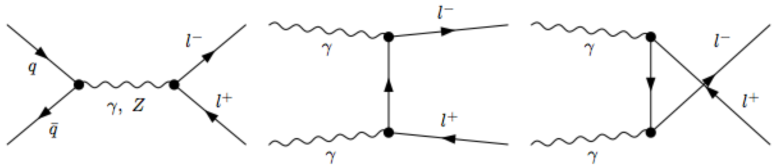
- For cross checks on reweighting procedure
  - Full MC11 sample with different input value of $\sin^2\theta_W$

- Better and more complex methods available
  - CMS uses MVA method (Multivariate Analysis)
  - More parameters – better fit
  - Will take time to develop

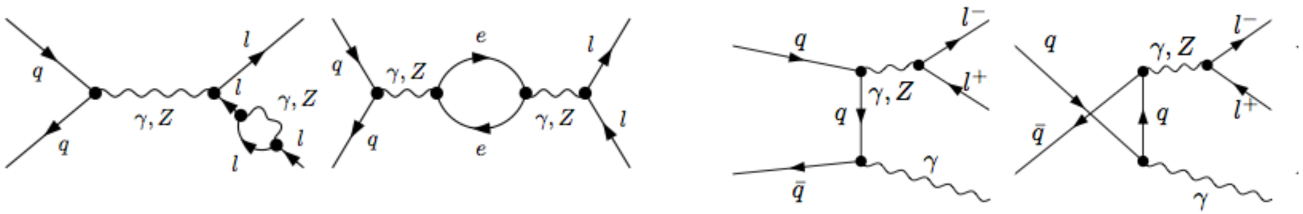
Electroweak Corrections

EWK corrections with HORACE

- Covers the following:
  1. Born

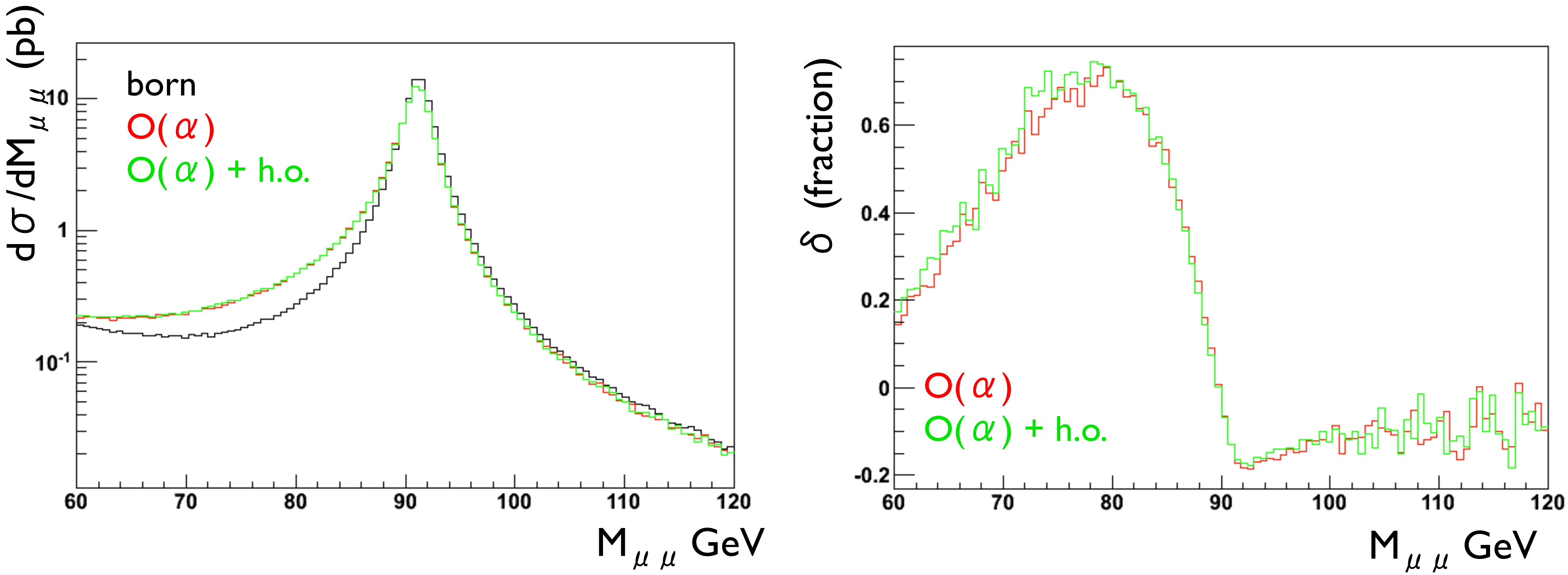


  2. O(alpha)

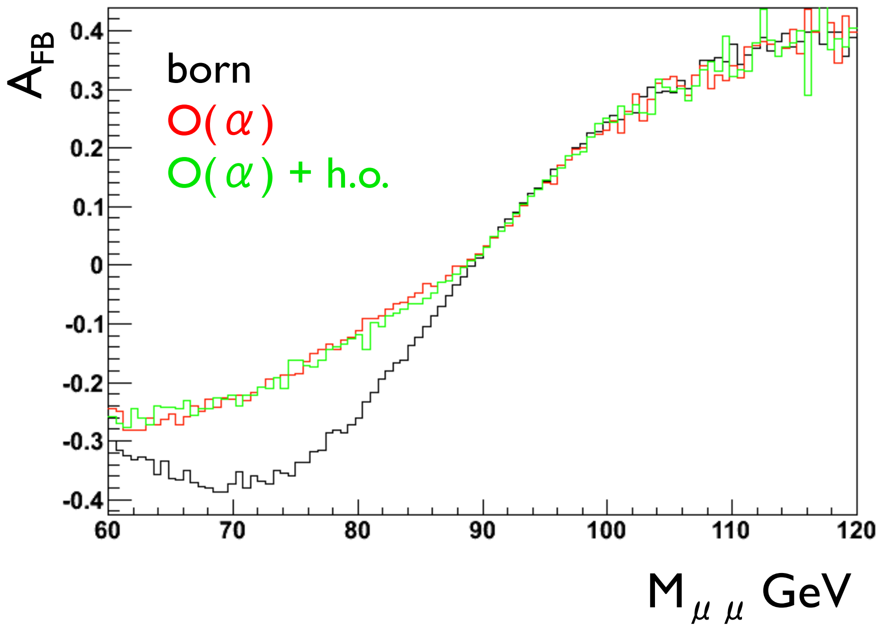


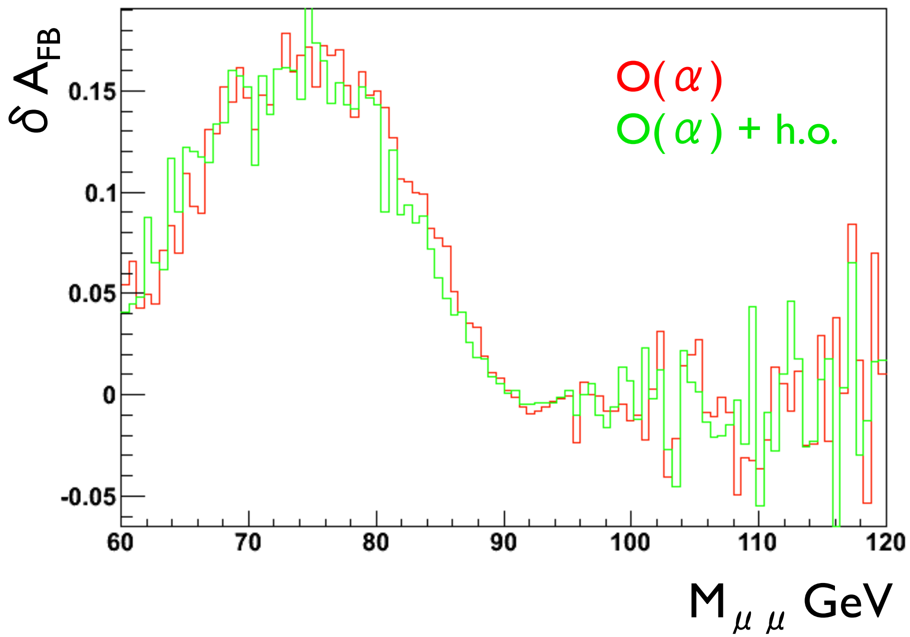
  3. O(alpha) matched to higher order corrections
     - "EW Sudakov logarithms"

Dimuon spectrum



EWK corrections to A_{FB}





- Large corrections to A_{FB} below Z peak
- Similar scale for O(α) and O(α) + h.o. corrections
- In agreement to paper by Horace authors
- Calculating corrections for the current binning scheme

Useful references

- Unfolding & $\sin^2\theta_W$:
  - D0 thesis *lss.fnal.gov/archive/**thesis**/fermilab-**thesis**-2010-18.pdf*
  - PHYSTAT 2011 conference http://indico.cern.ch/conferenceDisplay.py?confId=107747
  - RooUnfold http://hepunx.rl.ac.uk/~adye/software/unfold/RooUnfold.html
- HORACE and EWK corrections:
  - HORACE generator http://www2.pv.infn.it/~hepcomplex/horace.html
  - HORACE paper with Afb http://arxiv.org/abs/0710.1722
  - Electroweak corrections paper http://prd.aps.org/abstract/PRD/v65/i3/e033007