Electroweak corrections and the W Asymmetry

- Effects of electroweak corrections (MC study)
- First look at W asymmetry
- Conclusion and Outlook

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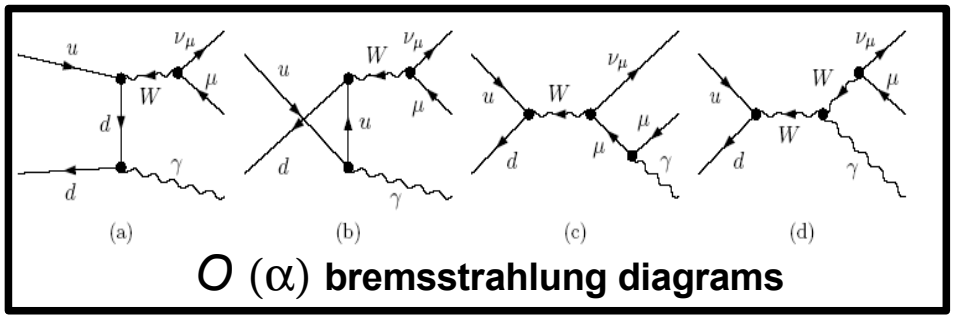
Electroweak corrections for $W \rightarrow e \nu_e$

- Precision measurement is crucial for the LHC:
  - **Luminosity measurement**
  - **PDF constraints**
  - **Test on the SM**

- NNLO corrections for Drell-Yan production of heavy gauge Bosons are stable

- EW corrections become more and more important in comparison



$O(\alpha)$ **bremsstrahlung diagrams**

Need to check impact on our measurements!!!

Method: Datasets and Generator used

Compare datasets **with** and **without** EW corrections

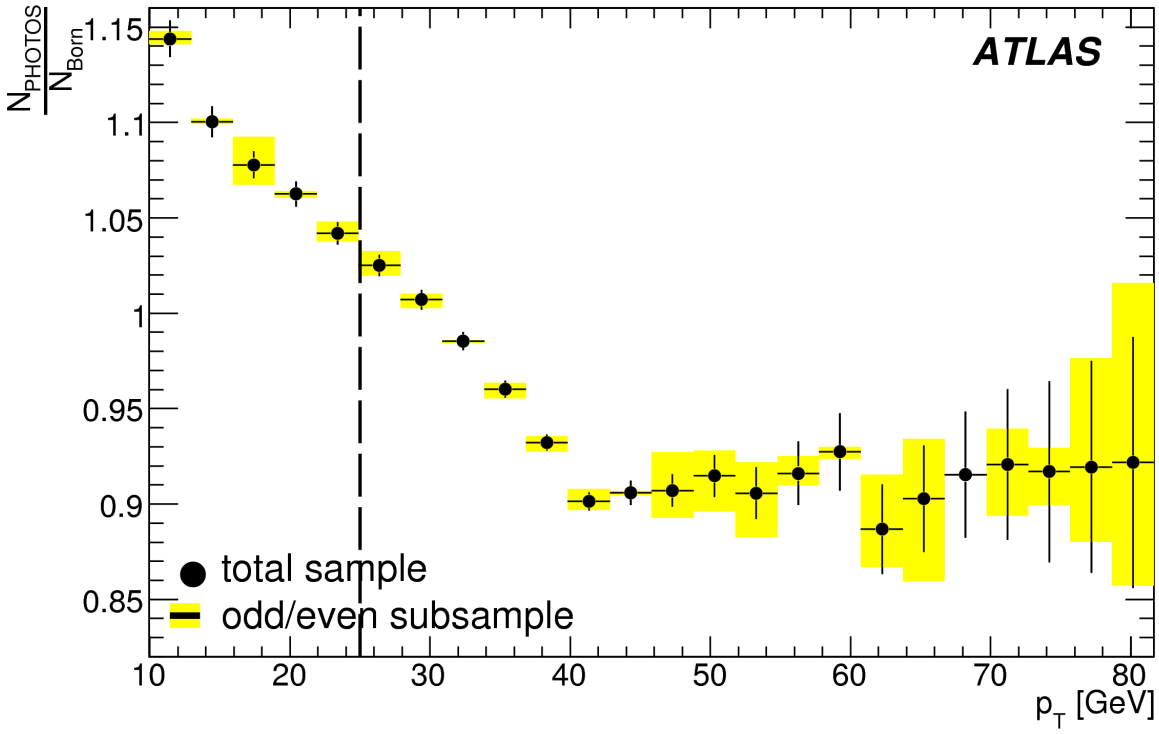
Check differences with regard to **shape** and **normalization**

- Herwig+Jimmy+Tauola:
  Standard MC generator
  uses LeptonFilter:
  $p_T^{electron} > 10$ GeV
  $|\eta|^{electron} < 2.7$
  ca. 800 000 events
  Luminosity: 48.1 pb^{-1}

- PHOTOS:
  Parton Shower (leading log)
  real EW corrections
  prompt photons
  No cross section information

Results: Effects on shapes

p_T of the decay lepton

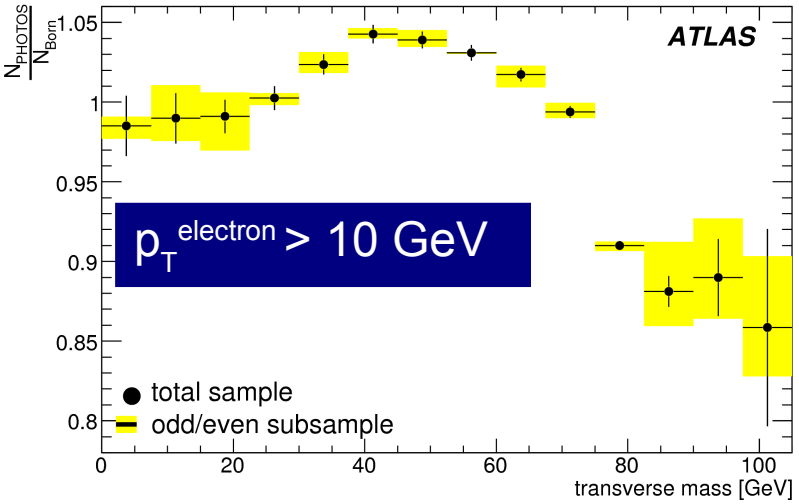


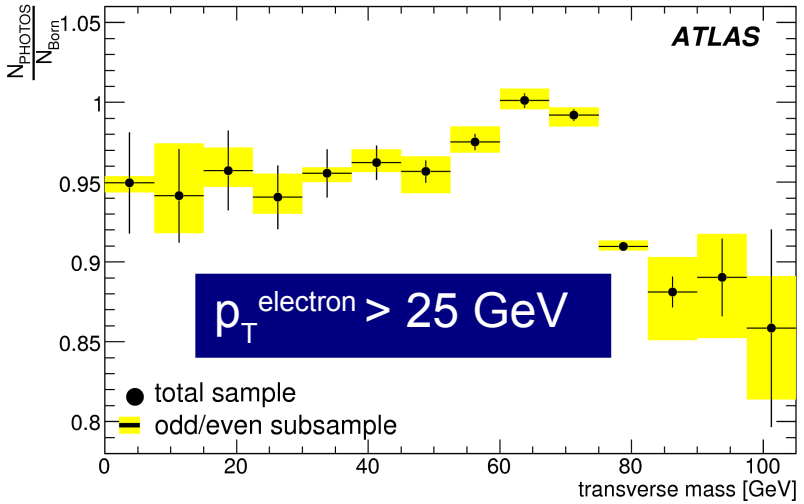
- **shift towards lower p_T of the decay lepton**
  - +15% for low $p_T^{electron}$
  - - 10% for high $p_T^{electron}$

Results: Effects on shapes

transverse mass of W-Boson

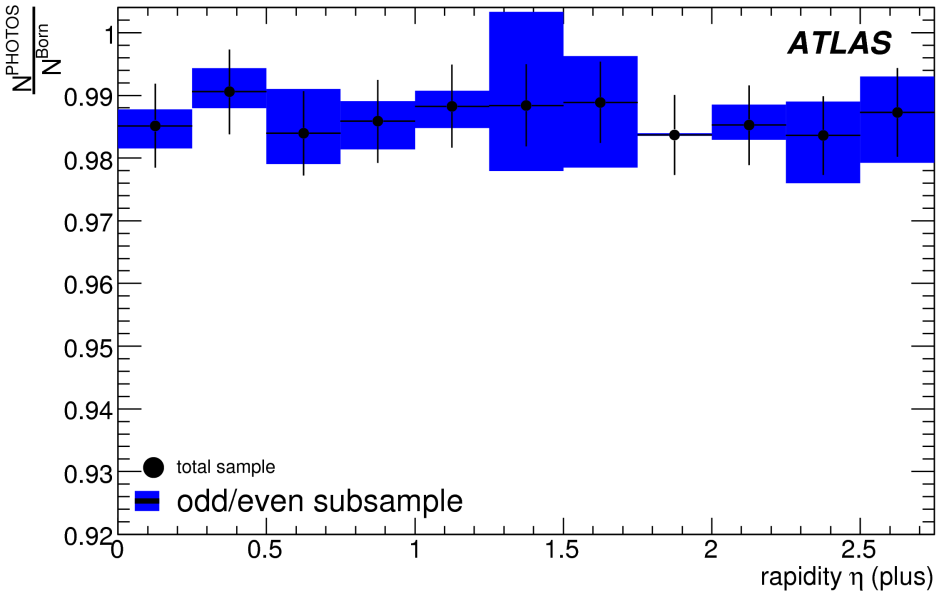
$$M_T(W) = \sqrt{2 \times p_T^e \times p_T^\nu \times (1 - \cos(\phi^e - \phi^\nu))}$$



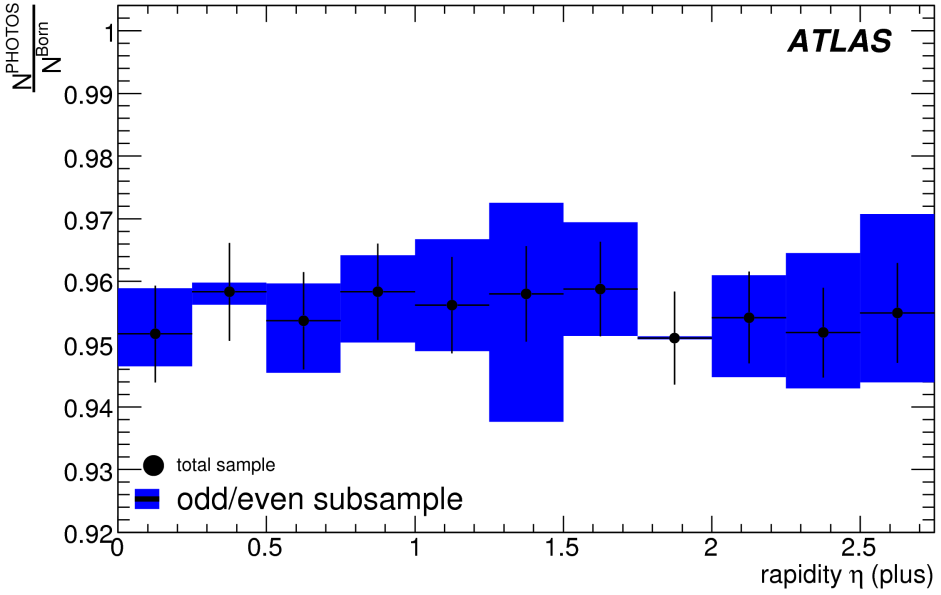


- **transverse mass shape distorted**
- **also normalization changes**

Results: Effects on the normalization



|η| (positive electrons)
p_T > 10 GeV



|η| (positive electrons)
p_T > 25 GeV

- **no distortion in shape**
- **significant shift in normalization**
  - 5% for p_T cut > 25 GeV
  - same order as differences between PDFs (~4-5%)

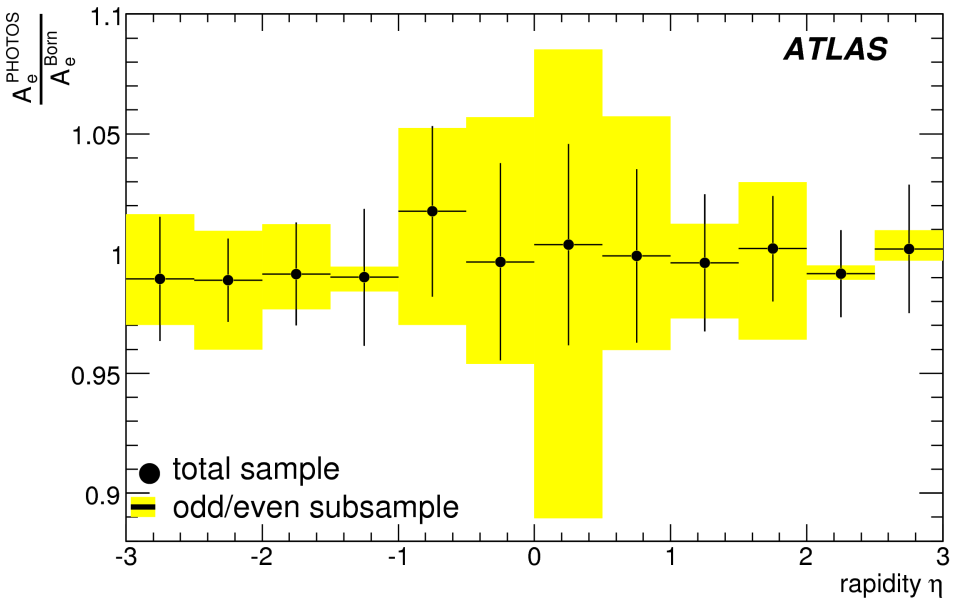
	relative difference (const. fit) $p_T^e > 10$ GeV	$p_T^e > 25$ GeV
N_{PHOTOS}/N_{Born} $\|\eta\|$ (positive electrons)	-1.4 ± 0.2%	-4.5±0.2%
N_{PHOTOS}/N_{Born} $\|\eta\|$ (negative electrons)	-1.2 ± 0.2%	-4.3±0.3%

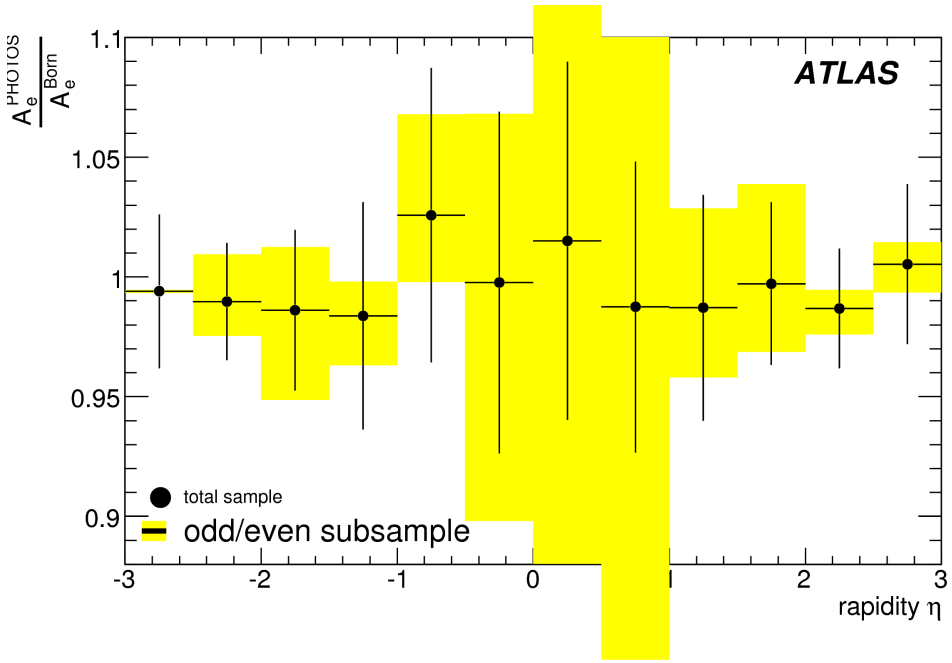
(cf. "Uncertainties on W and Z production at the LHC" - hep-ex/0509002)

Results: Effects on the normalization

electron asymmetry

$$A_l = \frac{d\sigma/d\eta(e^+) - d\sigma/d\eta(e^-)}{d\sigma/d\eta(e^+) + d\sigma/d\eta(e^-)}$$





- **no effect on Asymmetry**

	relative difference (constant fit)	
	$p_T^e > 10\,\mathrm{GeV}$	$p_T^e > 25\,\mathrm{GeV}$
$A_e^{\mathrm{PHOTOS}}/A_e^{\mathrm{Born}}$	-0.5 ± 0.7%	-0.7±1.1%

Asymmetry might be less sensitive to PDFs differences, but easier to measure with the precision needed

W Asymmetry: Cuts & Acceptances

TDR cuts:

P_T (electron) > 25 GeV

|η| (electron) < 2.4

E_t^{miss} > 25 GeV

Event Recoil < 20 GeV

NO jet > 30 GeV

Datasets

trig1_misal1_csc11.005100.JimmyWenu.recon.NTUP.v12000601
trig1_misal1_csc11.005140.JimmyZee.recon.NTUP.v12000601

scaled to 10 fb^{-1}

Reco cuts:

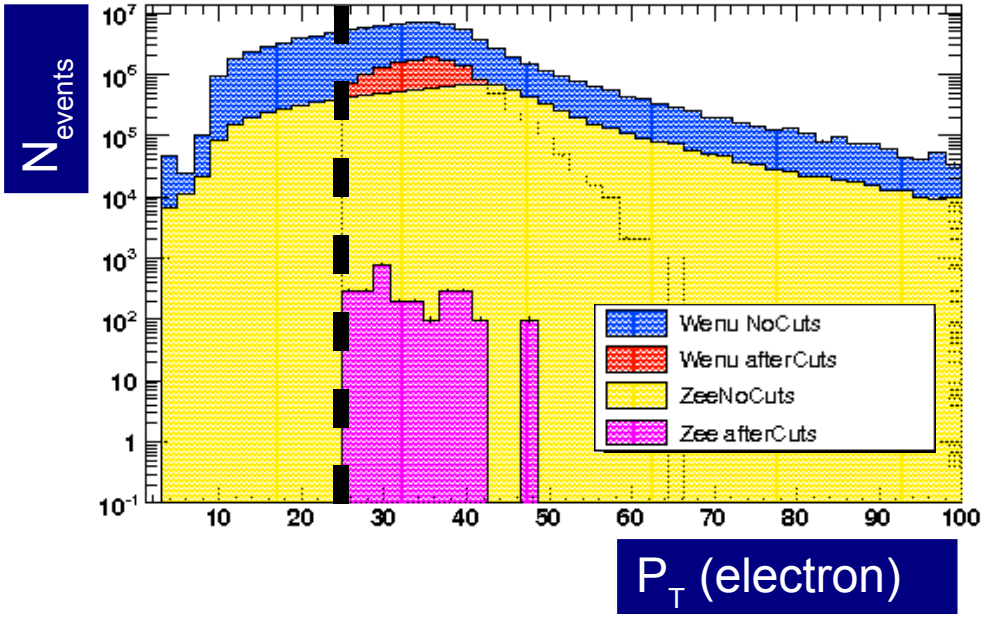
electron: isEM==1
hasTrack

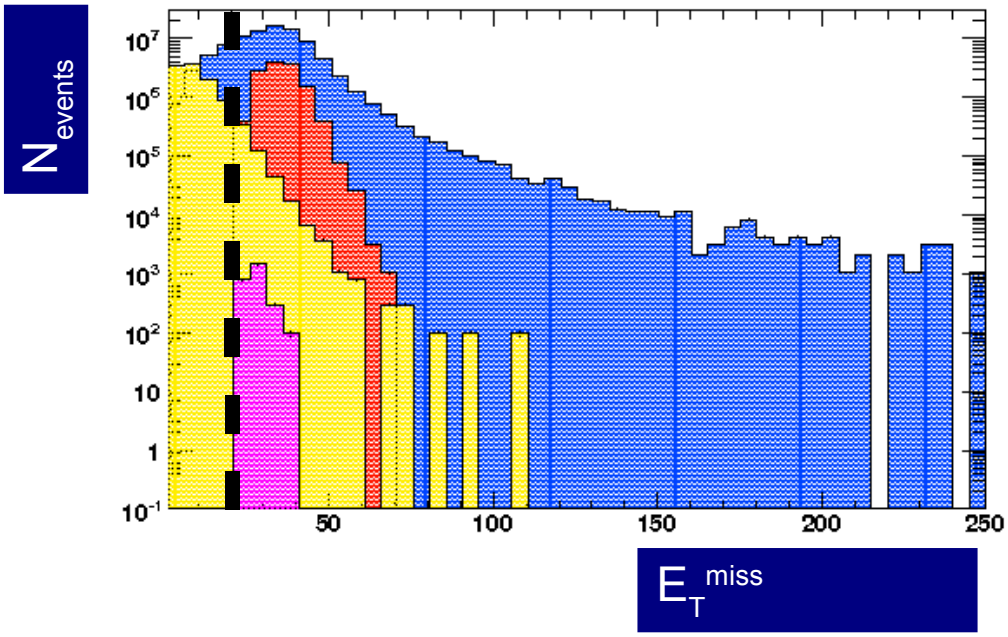
Datasample	cross section	number of events			ϵ_{reco}	ϵ_{cuts}
		before cuts	after Reco	after cuts		$\frac{N_{cuts}^{reco}}{N_{cuts}^{true}}$
$W \rightarrow e\nu$	17350 pb	163650	87124	12386	53.24%	21.73%
$Z \rightarrow ee$	1573 pb	159350	108236	27	67.92%	-

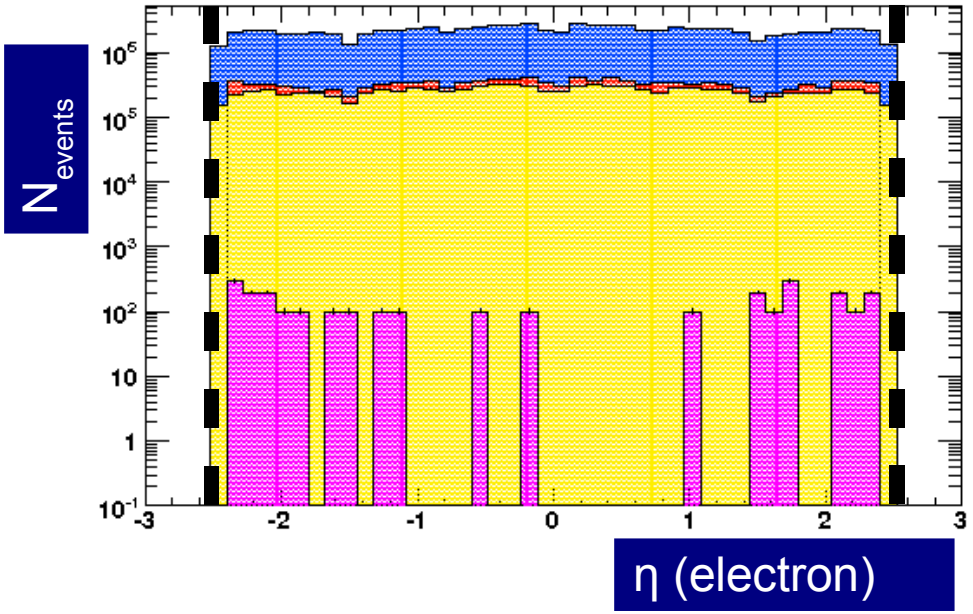
S/(S+B): 0.998

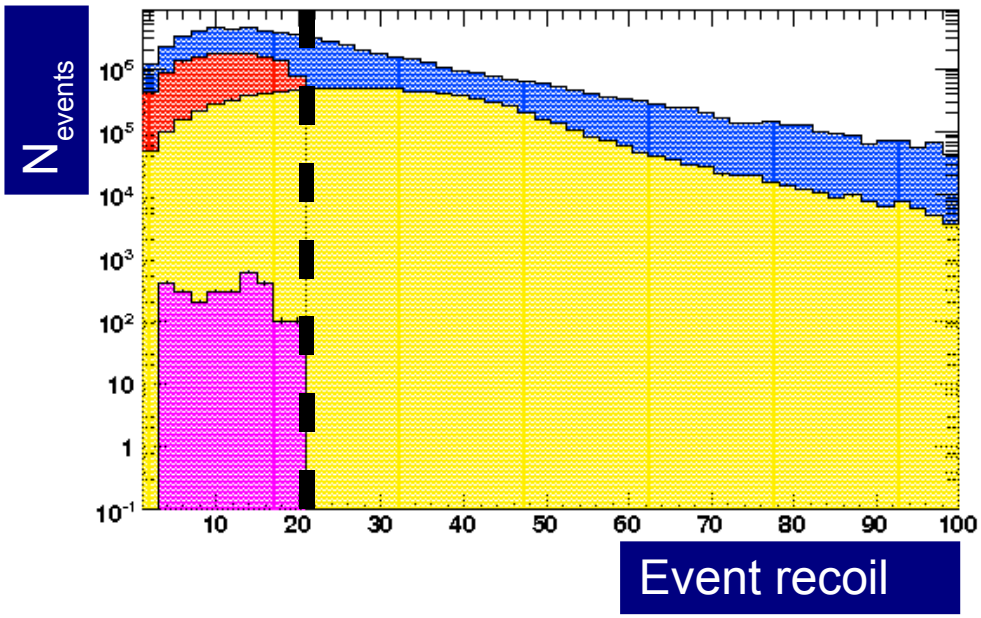
21.7 ± 2.4 %
(averaging over φ efficiency)

W Asymmetry: Cuts & Acceptances

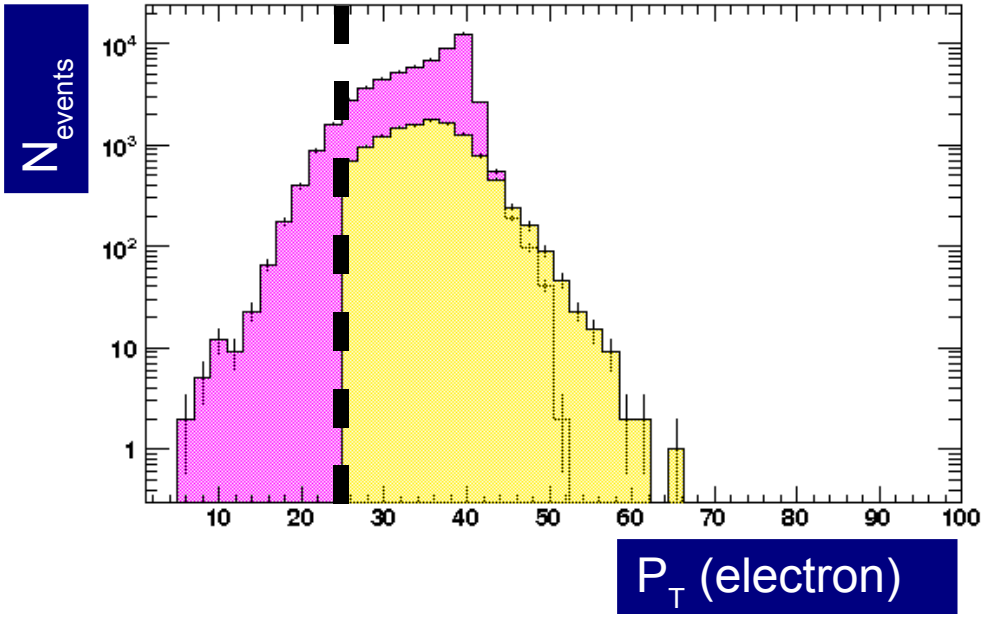


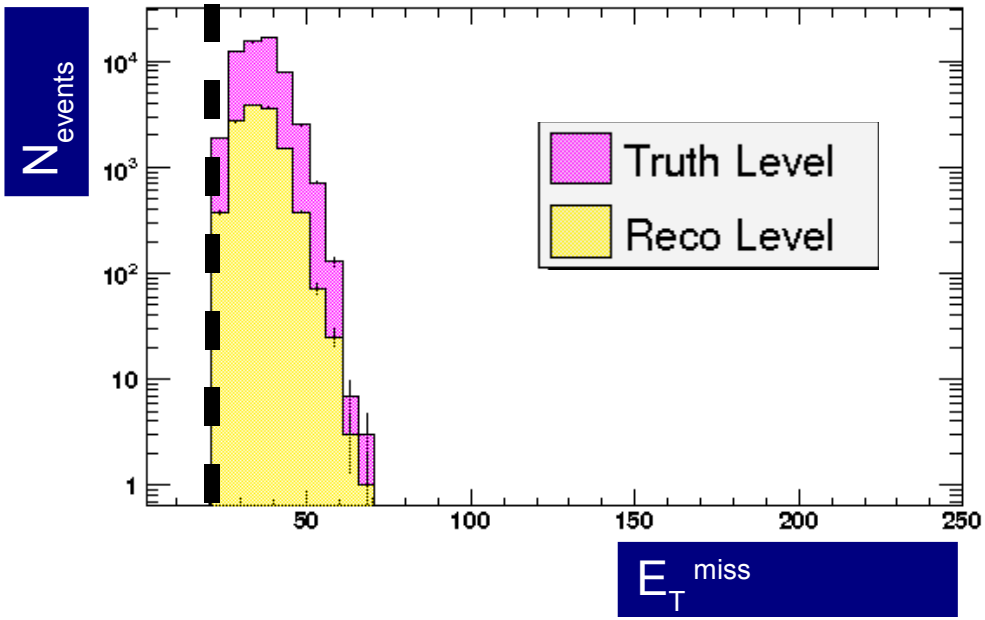


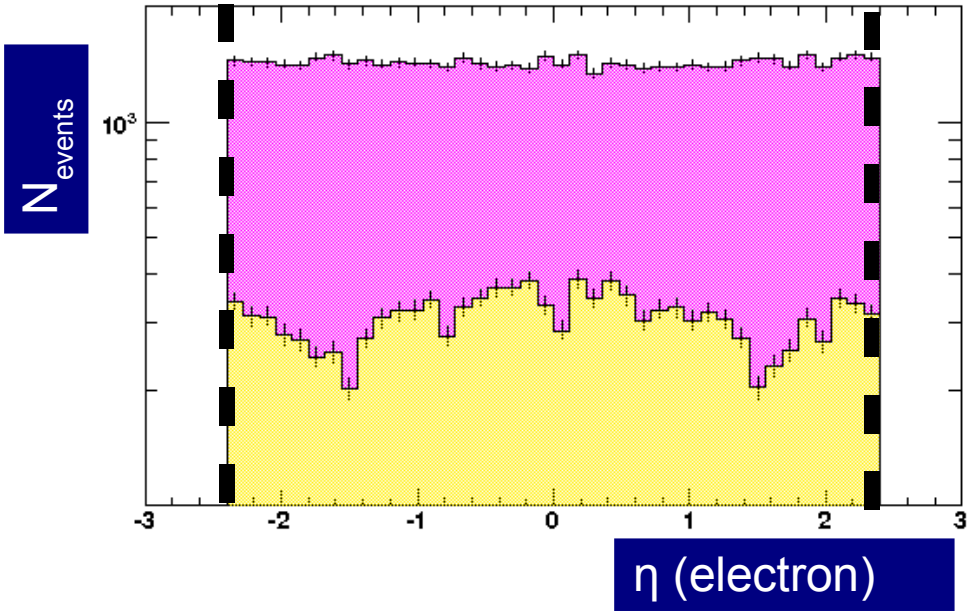


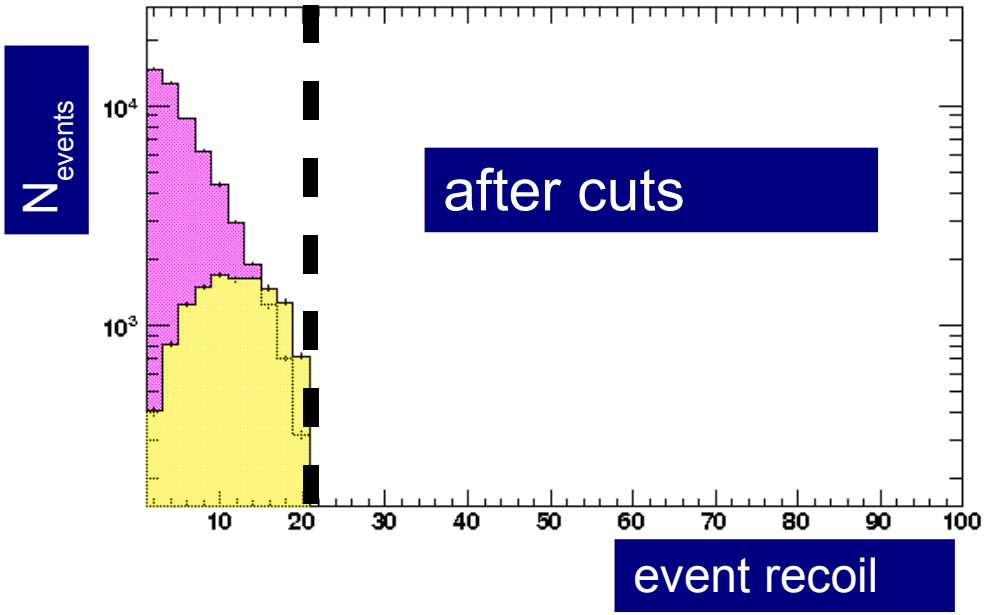


Comparison between Reco and Truth

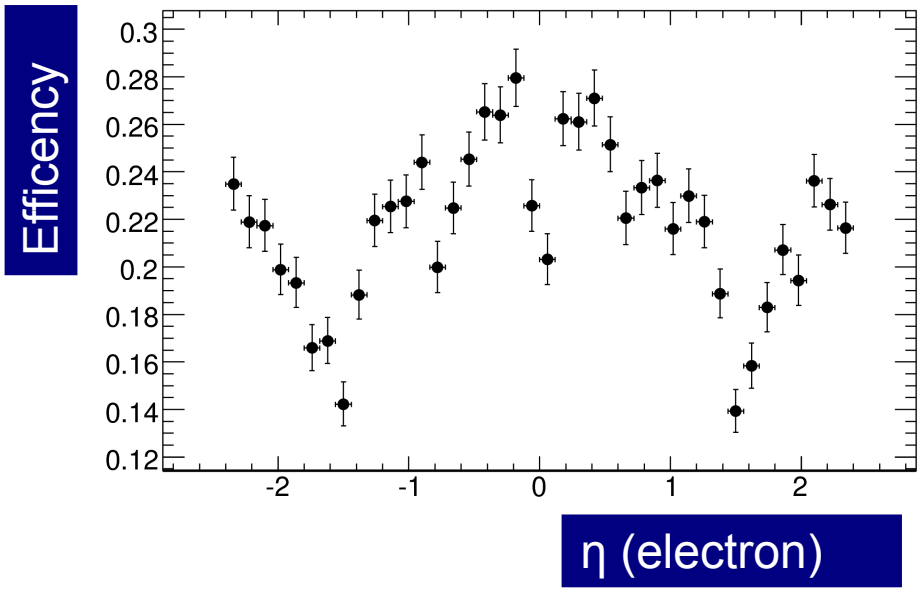




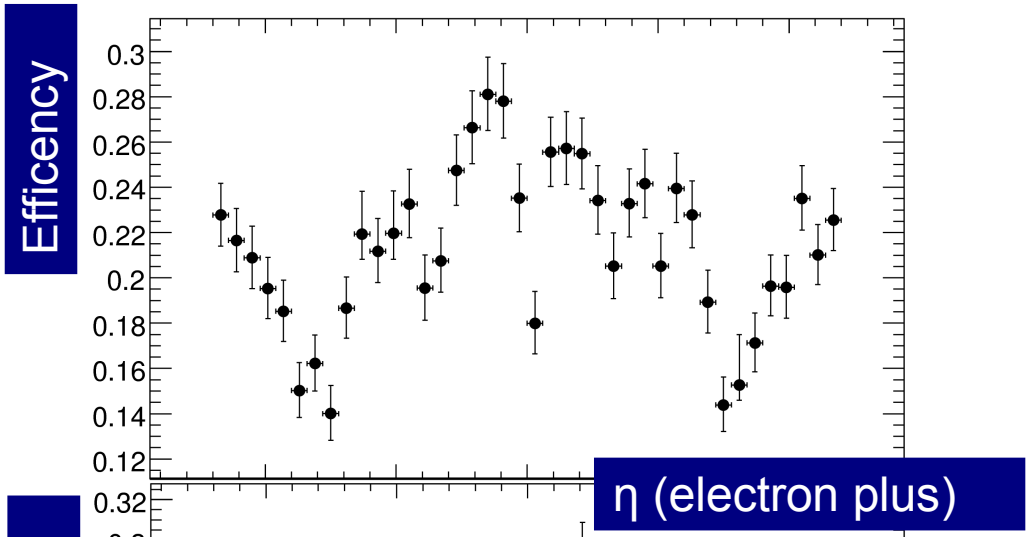


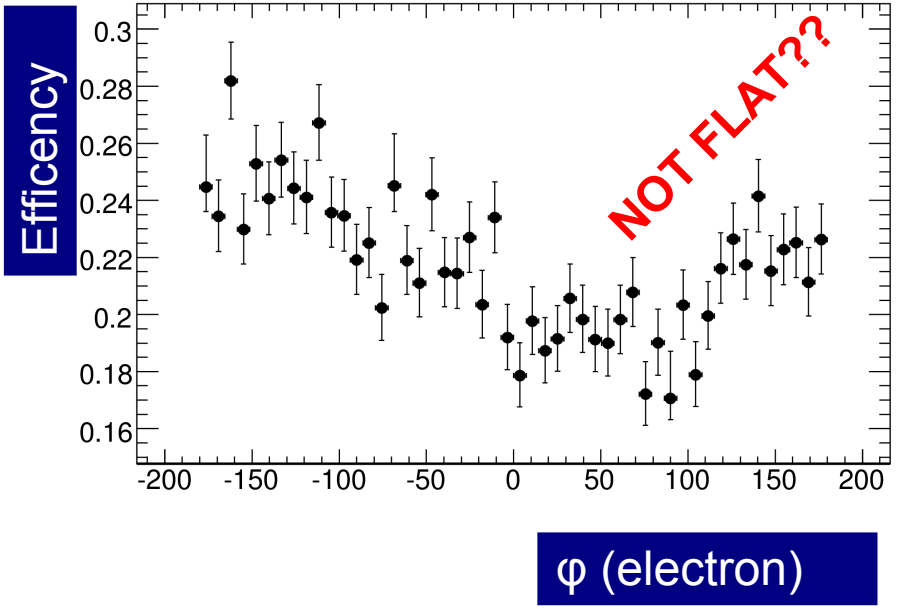


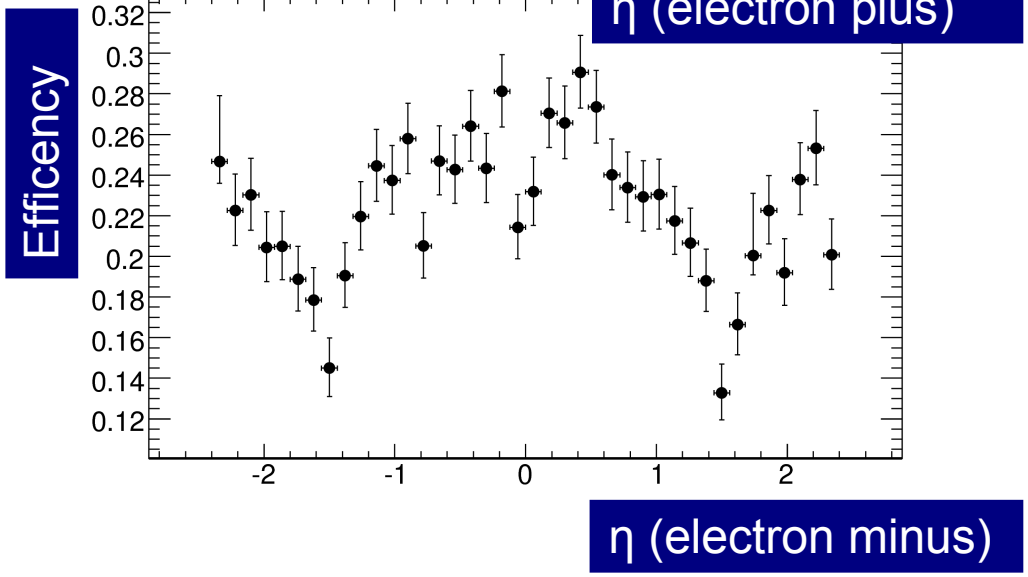
Acceptance efficiencies



minus: 22 ± 3 %
plus: 21 ± 3 %







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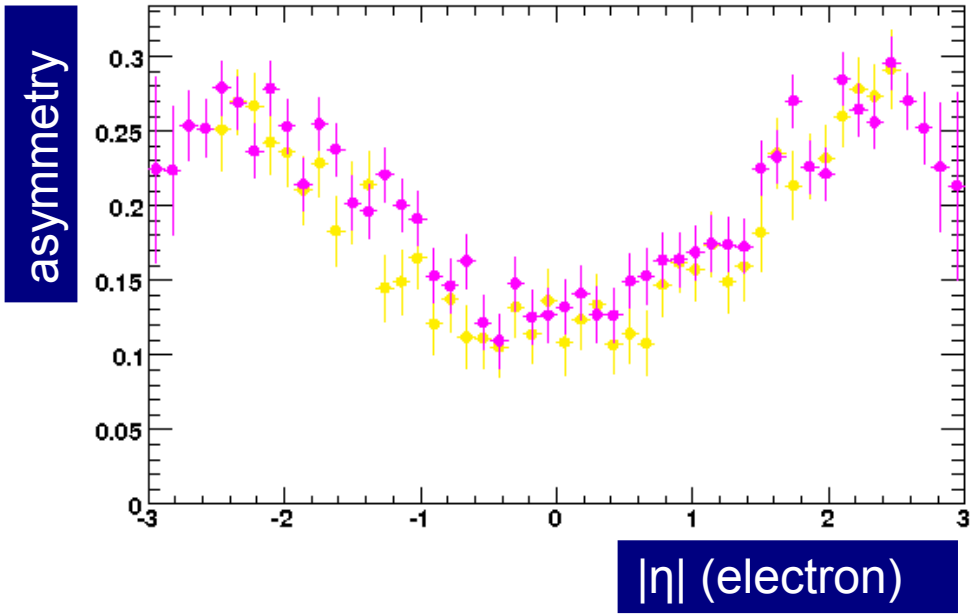
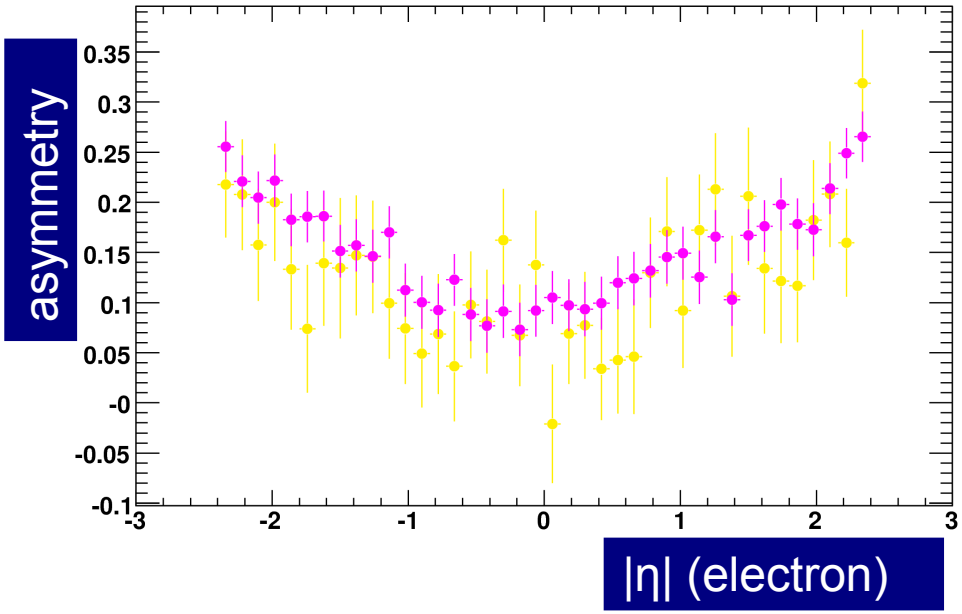


before cuts

Truth Level
Reco Level



after cuts

diluted asymmetry need to be corrected for

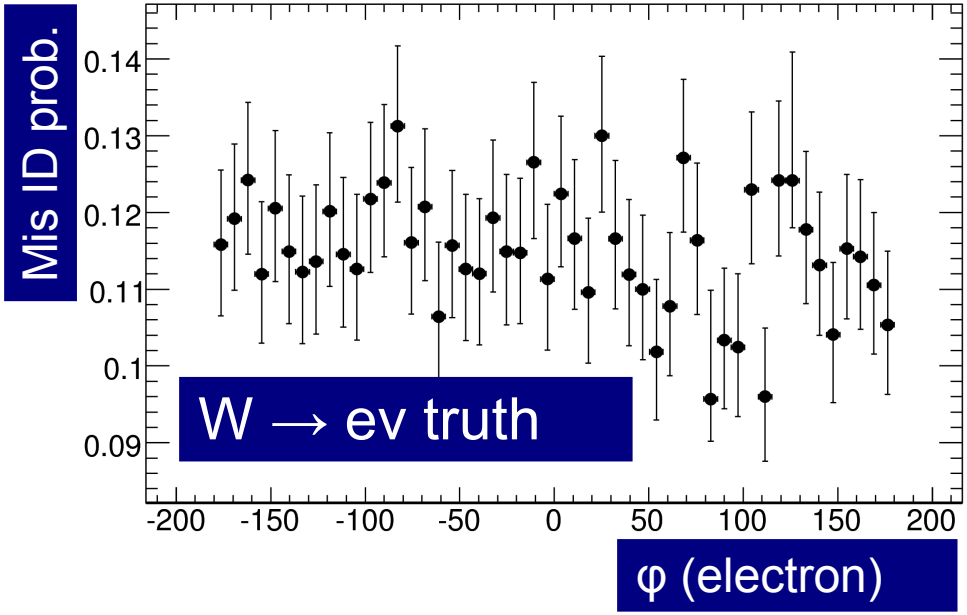
- charge MisID (~11%)
(before acceptance cuts)

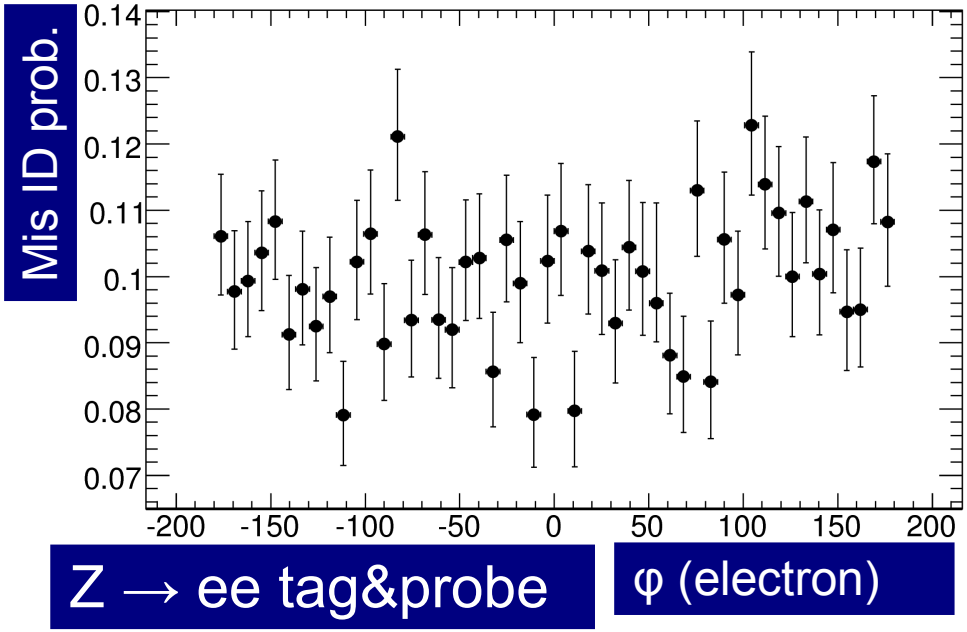
2 methods:
MC and tag&probe

Conclusions

- EW corrections have non-negligible effects on
  - **shape of p_T and W transverse mass distributions**
  - **normalisation of all distributions**
- Need to be included for
  - **precision measurements of W mass**
  - **for distinguishing between PDFs using rapidity distributions**
- Asymmetry is not affected
  - **good candidate for early measurements**
- First look at cuts and efficiencies for asymmetry measurement
  - **selection efficiency ~20%**
  - **good W/Z separation, high purity sample**
  - **Misidentification before event selection ~11%**

Needed: Correction for charge misID





- **same level of MisID probability for data (tag &probe) and MC method** (note: Cut on inv. mass Z_{ee})
- **However differential distributions look different**
- **Cut on inv. mass related???**