



Update on $Z \rightarrow e^+e^-$ cross section

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Fermilab

on behalf of Z Signal Extraction team:

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VBTF meeting
(Sept 3, 2010)

Z→ee cross section using $\int L = 1.34 \text{ pb}^{-1}$



$$N_{\text{Selected}} = 463 \pm 21.5$$

$$N_{\text{Background}} = 4.6 \pm 5.5$$

Electron offline efficiency:

$$\epsilon_{\text{Reco}} = 1.0000 \pm 0.0060 \text{ (stat)} \pm 0.0055 \text{ (syst)}$$

$$\epsilon_{\text{Reco} \rightarrow \text{WP95}} = 0.9524 \pm 0.0100 \text{ (stat)} \pm 0.0101 \text{ (syst)}$$

$$\epsilon_{\text{WP95} \rightarrow \text{HLT}} = 0.9797 \pm 0.0047 \text{ (stat)} \pm 0.0131 \text{ (syst)}$$

$$\text{Dilepton efficiency} = 0.9067 \pm 0.0219 \text{ (stat)} \pm 0.0217 \text{ (syst)}$$

$$\text{Acceptance} = 0.4357 \pm 1.1\% \text{ (theory)} \pm 1\% \text{ (Energy scale)}$$

from
MC

$$\sigma_{\gamma^*/Z} \times \text{BR}(Z \rightarrow ee) = 866.0 \pm 45.4 \text{ (stat)} \pm 33.8 \text{ (syst)} \pm 95.3 \text{ (lumi) pb}$$

$$\text{NLO prediction} = 970 \pm 20 \text{ pb}, \quad \text{NNLO prediction} = 972 \pm 39 \text{ pb}$$

Observed cross section is 10% lower than prediction !

The only MC ingredient now is acceptance. This will always remain so.

Simultaneous fit for cross section & efficiency



Simultaneous fit to three samples: TT, TF(EBEB), TF(EBEE+EEEE)

NO.	NAME	VALUE	ERROR	
1	bkgGammaFailTF_BB	-1.59986e-02	1.17222e-02	} Exponential bkg. shape for the two low purity samples
2	bkgGammaFailTF_End	-9.98742e-03	9.24291e-03	
3	eff_B	9.44921e-01	2.50674e-02	} Electron offline efficiency in the barrel and endcaps
4	eff_E	9.45688e-01	4.64287e-02	
5	massShiftTF_BB	-1.11956e+00	5.14202e-01	} Mass shifts due to electron energy scale
6	massShiftTF_End	-1.46626e+00	1.07183e+00	
7	massShiftTT	-5.44216e-01	2.15923e-01	
8	nBkgTF_BB	2.90186e+01	7.50783e+00	} # background events in low purity sample
9	nBkgTF_End	4.40033e+01	8.51631e+00	
10	resoTF_BB	6.69634e-02	1.31782e-01	} Gaussian resolution widths
11	resoTF_End	1.64161e-01	2.90844e+00	
12	resoTT	2.18652e+00	3.11306e-01	
13	xsec	8.89085e+02	4.94679e+01	} Z signal cross section (contains ~1% residual bkg.)

PARAMETER CORRELATION COEFFICIENTS

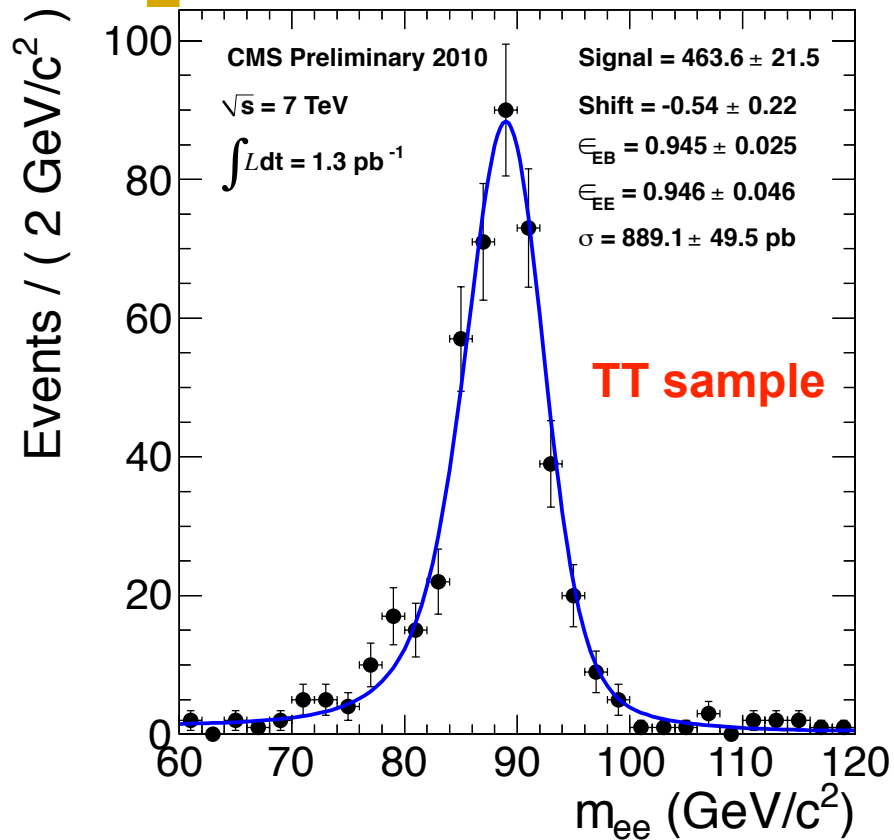
PARAMETER NO.	GLOBAL	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.04917	1.000	0.010	-0.043	-0.005	-0.008	-0.011	0.000	-0.034	-0.010	-0.001	-0.011	0.000	0.019
2	0.85772	0.010	1.000	-0.158	-0.751	0.001	-0.857	0.000	-0.073	-0.661	-0.000	-0.854	0.000	0.481
3	0.49232	-0.043	-0.158	1.000	0.028	-0.005	0.180	-0.000	0.318	0.155	0.000	0.179	-0.000	-0.293
4	0.88548	-0.005	-0.751	0.028	1.000	-0.001	0.856	-0.000	0.037	0.740	0.000	0.853	-0.000	-0.545
5	0.01047	-0.008	0.001	-0.005	-0.001	1.000	-0.001	0.000	-0.004	-0.001	-0.001	-0.001	0.000	0.002
6	0.99837	-0.011	-0.857	0.180	0.856	-0.001	1.000	-0.000	0.083	0.753	0.000	0.998	-0.000	-0.548
7	0.10532	0.000	0.000	-0.000	-0.000	0.000	-0.000	1.000	-0.000	-0.000	-0.000	-0.000	-0.105	0.000
8	0.32270	-0.034	-0.073	0.318	0.037	-0.004	0.083	-0.000	1.000	0.072	0.000	0.083	-0.000	-0.141
9	0.77851	-0.010	-0.661	0.155	0.740	-0.001	0.753	-0.000	0.072	1.000	0.000	0.750	-0.000	-0.474
10	0.00118	-0.001	-0.000	0.000	0.000	-0.001	0.000	-0.000	0.000	0.000	1.000	0.000	-0.000	-0.000
11	0.99830	-0.011	-0.854	0.179	0.853	-0.001	0.998	-0.000	0.083	0.750	0.000	1.000	-0.000	-0.547
12	0.10532	0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.105	-0.000	-0.000	-0.000	-0.000	1.000	0.000
13	0.61874	0.019	0.481	-0.293	-0.545	0.002	-0.548	0.000	-0.141	-0.474	-0.000	-0.547	0.000	1.000

cross section after bkg subtraction

$\sigma = 880.3 \pm 49.5$ (stat) ± 13.1 (syst) pb

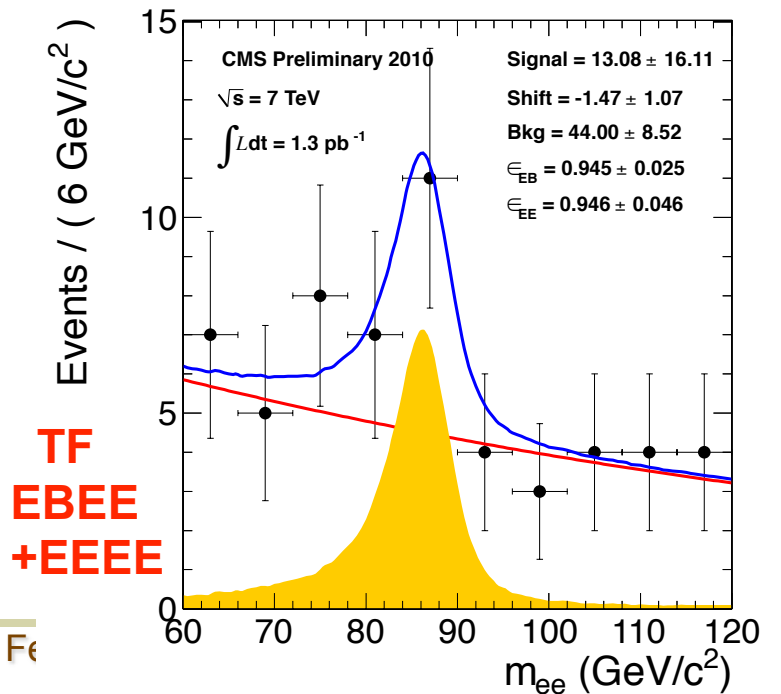
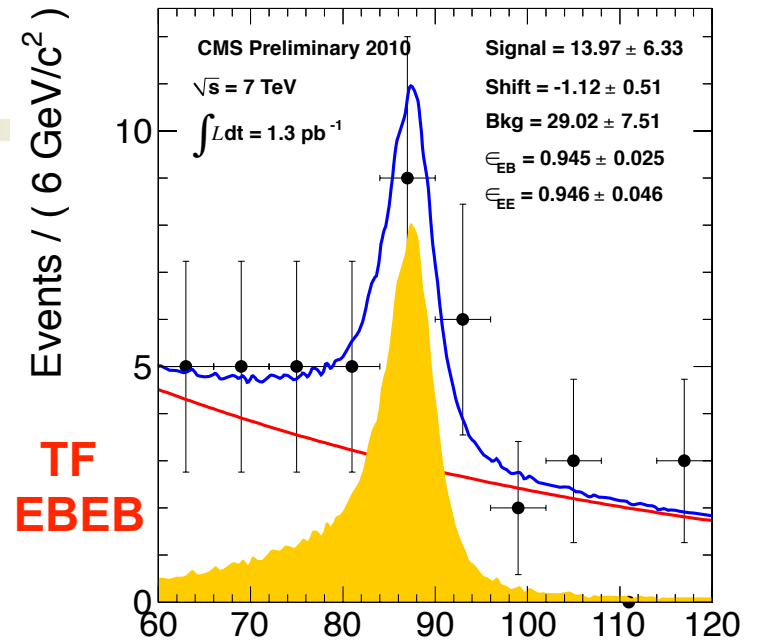
866.0 \pm 45.4 \pm 33.8 from simple counting

Simultaneous fit plots



- ◆ All three signal shapes taken from NLO (Powheg) MC + CMS simulation.
- ◆ Convolve using a Gaussian resolution.
- ◆ Let the energy scale float.

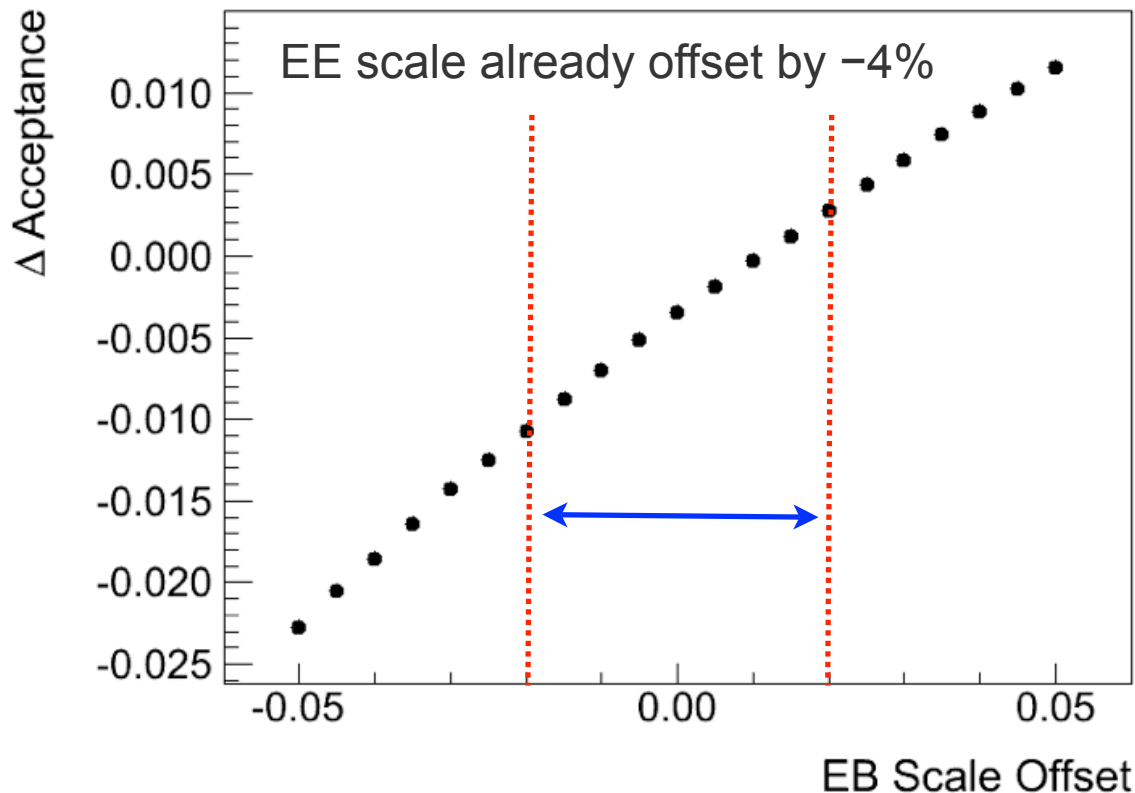
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Syst error in Z acceptance due to energy scale



- ◆ The impact of the energy scale on Z acceptance is small.
- ◆ The plot below shows the % change in acceptance vs the change in the EB energy scale when EE energy scale has already been shifted by -4%.
- ◆ We can safely assign a maximum syst. uncertainty of 1%.



If you look at the point where EB scale is shifted -2% and EE scale is shifted -4%, you see that the acceptance changes by about 1%. So this is the maximum systematic effect we could have.