Update on electron efficiency from $Z \rightarrow e^+e^-$

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*on behalf of VBTF **Z analysis** team*

Egamma meeting
(Sept 28, 2010)

Concern on efficiency from last Egamma meeting

- Do we understand signal shapes in Tag+Fail sample ?
  - So far we lacked data constraints on signal shape for Tag+Fail sample
  - Worry was that the low side tail is uncontrolled & potentially large
  - We have now attempted to derive some powerful constraints on this shape from data

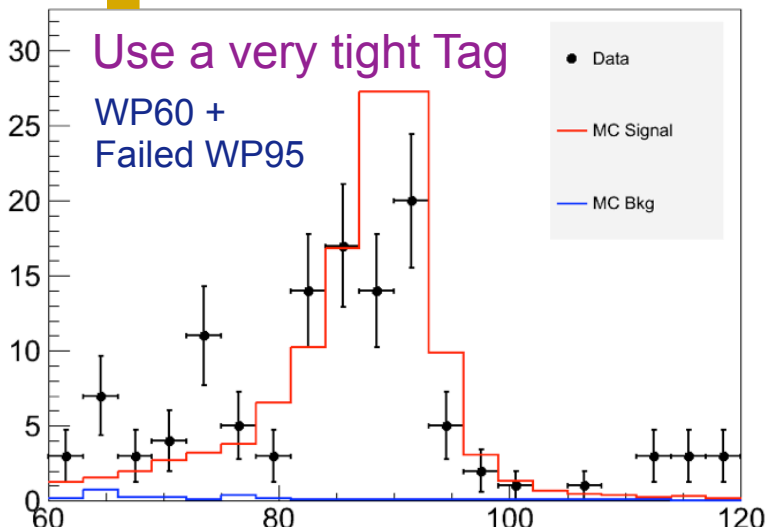
- Have we included the systematic uncertainty in efficiency due to the uncertainty in the Tag+Fail signal shape ?
  - Last week we didn't have this included.
  - Now we have done a detailed evaluation of the systematics from signal shape

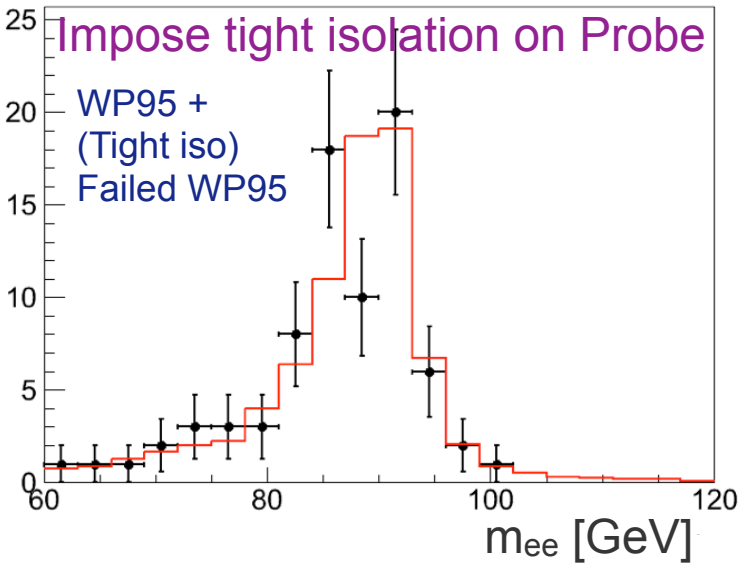
- Perform additional crosschecks to make sure
  - The efficiency numbers in MC are computed consistently.
  - Background estimation is understood: crosscheck with fake rate, SS/OS predictions etc.

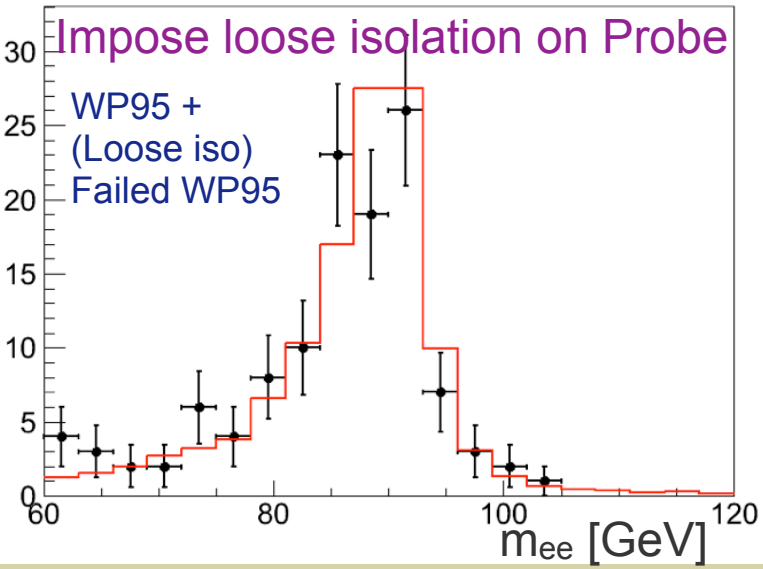
- In the following slides I will summarize these results. Si and Jeremy will show details of each methodology.

Constraints on signal shape in Tag+Fail sample from data

TF shape for WP95 in data, comparison with MC

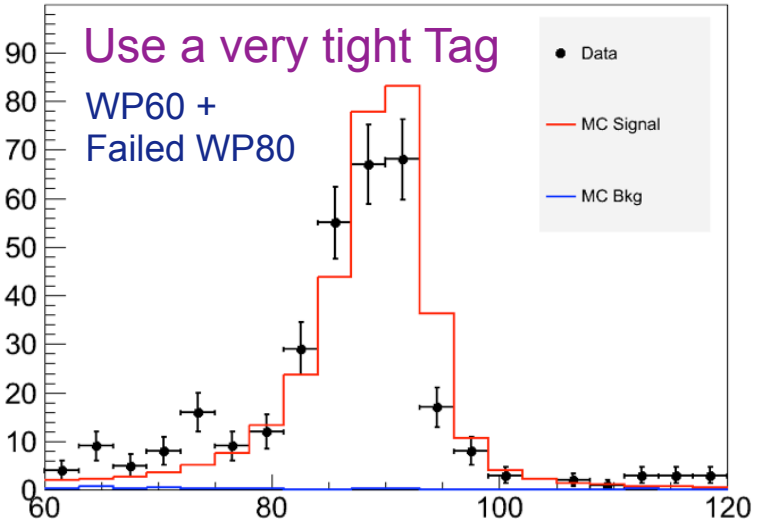


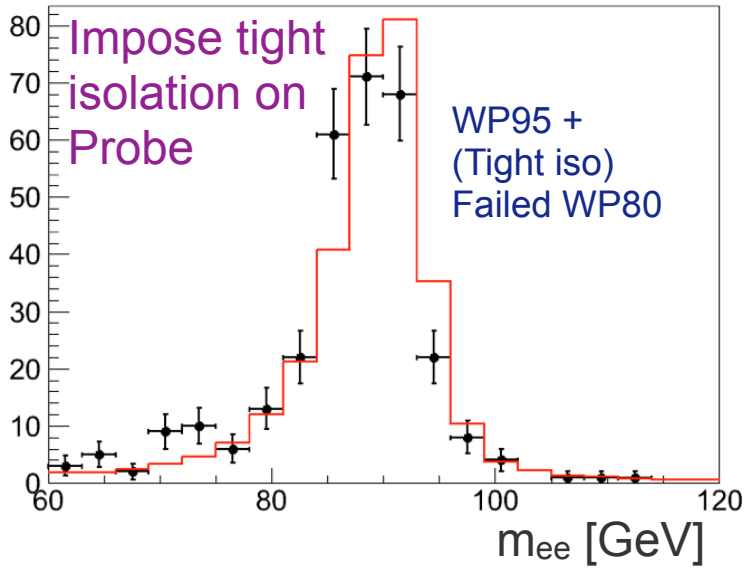


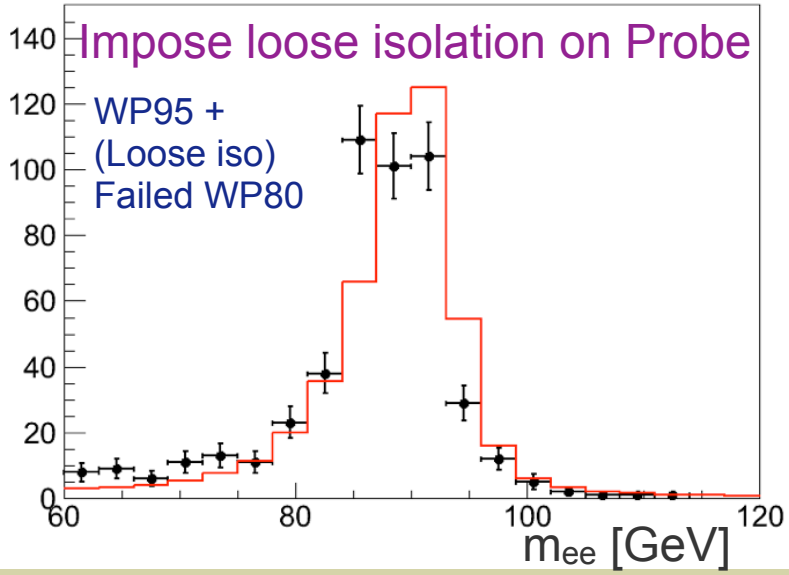


-Tag+Probe sample has very low background.
- MC signal is shown in Red. MC bkg in Blue.
-Tails are reasonably reproduced by simulation.
-The MC shape hasn't been corrected by resolution smearing in these plots.
-There is good overall agreement between data and MC for the signal shape.

TF shape for WP80 in data, comparison with MC







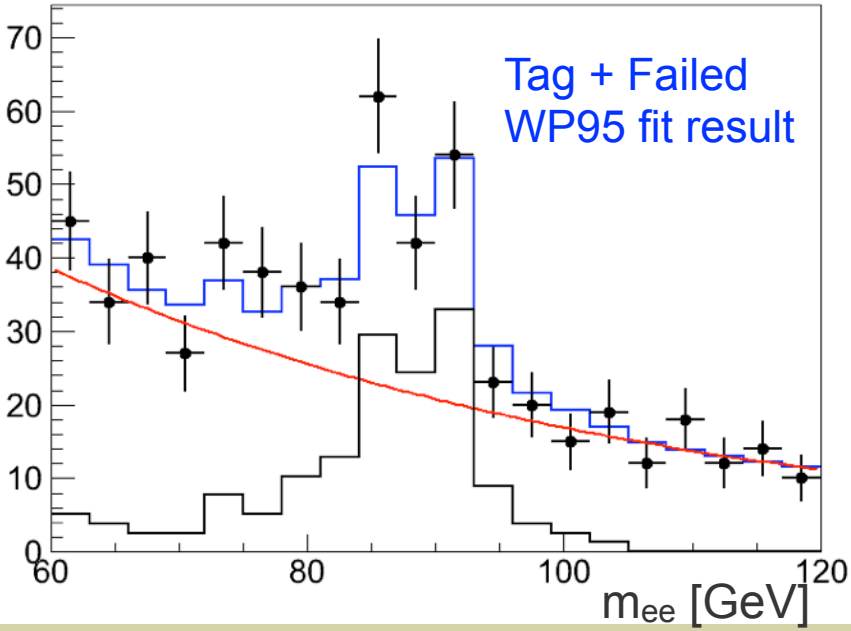
- MC signal is shown in Red. MC bkg in Blue.
-Tails are reasonably reproduced by simulation.
-Same conclusions as on the previous slide.
-There is good overall agreement between data and MC for the signal shape.

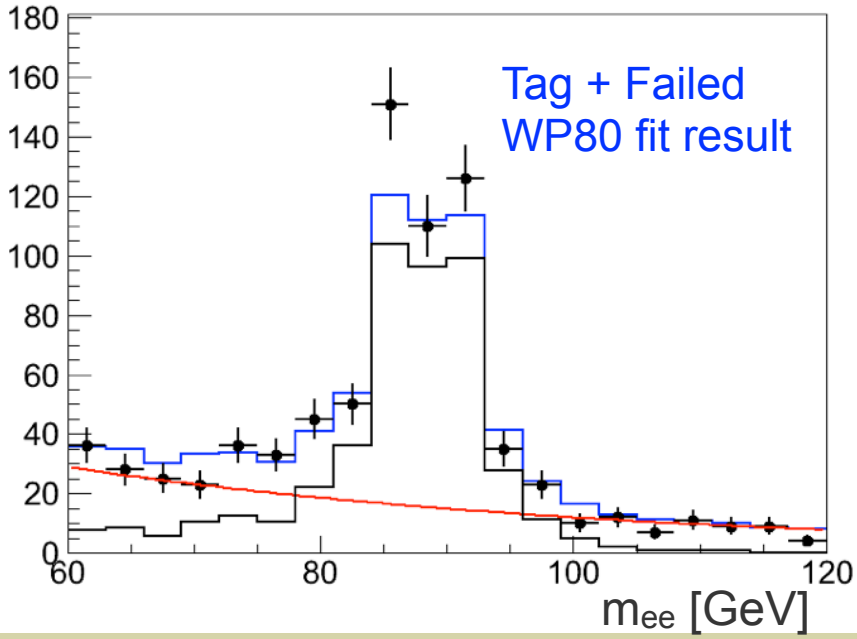
Syst. uncertainty in efficiency from TF shape

- Use the Tag + LooseIso Fail WP95(80) template as TF signal shape in the efficiency fit.
- Systematics = difference between this fit result vs standard fit result (i.e., MC template.

	Efficiency using data-based template	Standard Result
• WP95 Efficiency	92.9%	92.1%
• WP95 EE:	92.7%	92.3%
• WP95 EB:	93.0%	92.0%
• WP80 Efficiency	74.8%	75.8%

Signal shape syst. = 1%





Complete efficiency numbers
with systematic uncertainties

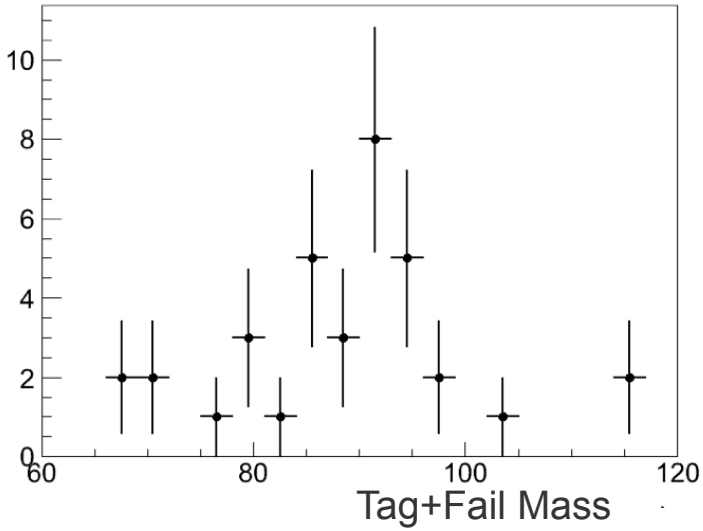
Super cluster→ecal-driven GsfElectron efficiency

(1) Select WP60 Tag + Photon (cleaned)

- Background is essentially 0. Do simple counting

Total:	0.976 + 0.004 - 0.005
EB:	0.981 + 0.004 - 0.005
EE:	0.967 + 0.009 - 0.011
Plus EB:	0.985 + 0.006 - 0.008
Plus EE:	0.955 + 0.014 - 0.018
Minus EB:	0.978 + 0.007 - 0.009
Minus EE:	0.975 + 0.011 - 0.016

MC: 0.981, R= data/MC = 0.994 ± 0.005

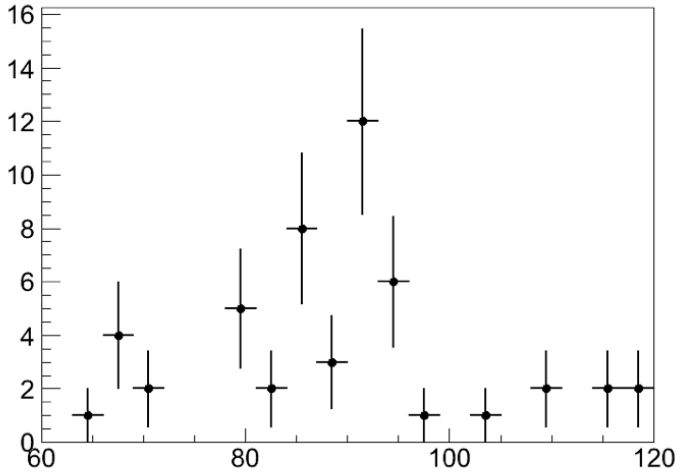


(2) Select WP80 Tag + Photon (cleaned) && Met < 25GeV

- No Background. Do simple counting

Total:	0.972 + 0.004 - 0.004
EB:	0.981 + 0.004 - 0.005
EE:	0.957 + 0.009 - 0.011
Plus EB:	0.981 + 0.006 - 0.007
Plus EE:	0.946 + 0.014 - 0.017
Minus EB:	0.987 + 0.004 - 0.006
Minus EE:	0.969 + 0.011 - 0.015

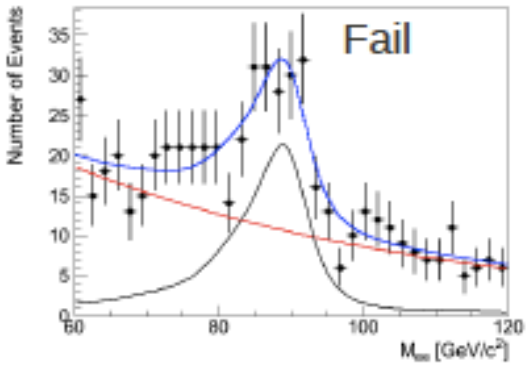
R=0.991±0.004. Propose to take R=1, syst =0.009.

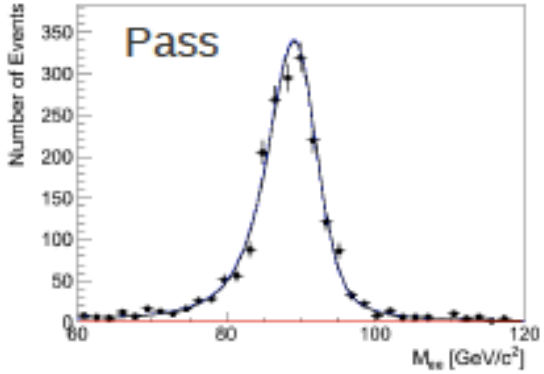


Ecal-driven GsfElectron → WP95 efficiency

- Tag (WP95) + EcalDriven GSF electron probe
- Perform extended likelihood fit as described previously

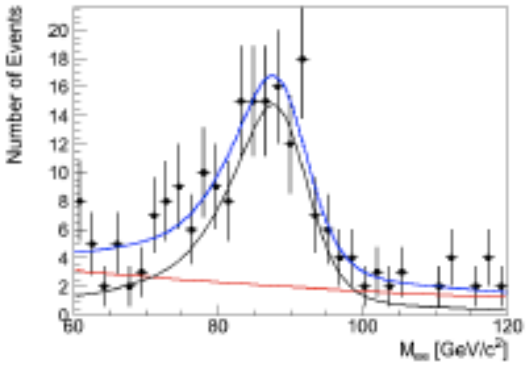
Total:	0.916 +/- 0.012
EB:	0.914 +/- 0.013
EE:	0.917 +/- 0.020
Plus EB:	0.931 +/- 0.029
Plus EE:	0.928 +/- 0.019
Minus EB:	0.900 +/- 0.028
Minus EE:	0.899 +/- 0.019

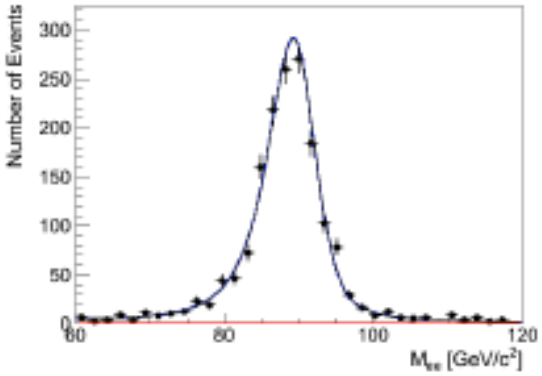




- Tag (WP80) + EcalDriven GSF electron probe

Total:	0.918 +/- 0.010
EB:	0.924 +/- 0.012
EE:	0.909 +/- 0.017
Plus EB:	0.930 +/- 0.016
Plus EE:	0.913 +/- 0.020
Minus EB:	0.915 +/- 0.017
Minus EE:	0.914 +/- 0.027





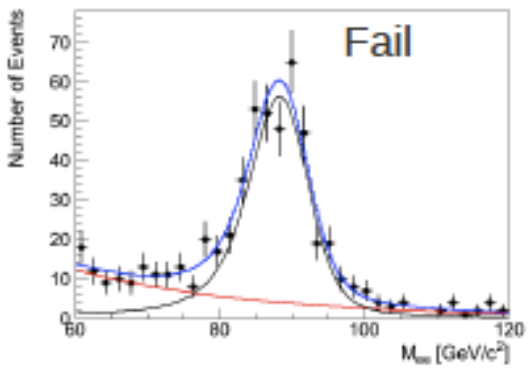
MC: 0.953, R= data/MC = 0.962 ±0.013

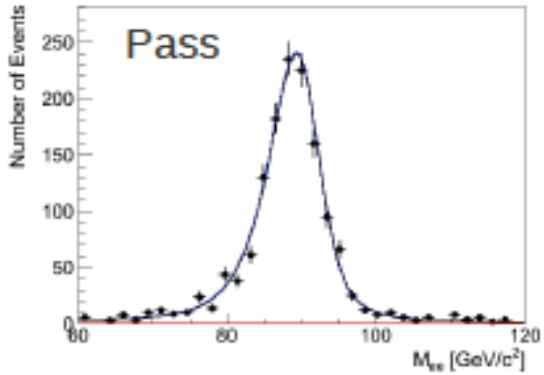
Ecal-driven GsfElectron → WP80 efficiency

Further cross checks still going on, will have final numbers by Thursday.

- Tag (WP80) + EcalDriven GSF electron probe
- Perform extended likelihood fit as described previously

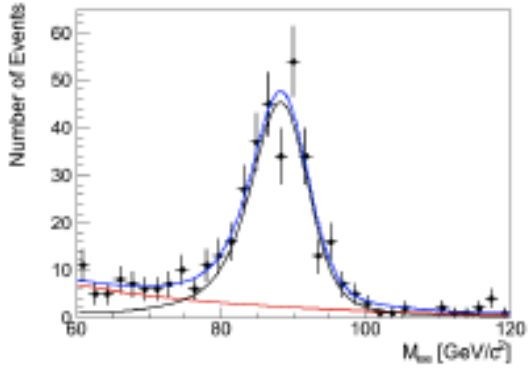
Total:	0.783 +/- 0.012
EB:	0.815 +/- 0.013
EE:	0.739 +/- 0.021
Plus EE :	0.745 +/- 0.027
Plus EB :	0.805 +/- 0.019
Minus EE :	0.739 +/- 0.033
Minus EB :	0.818 +/- 0.019

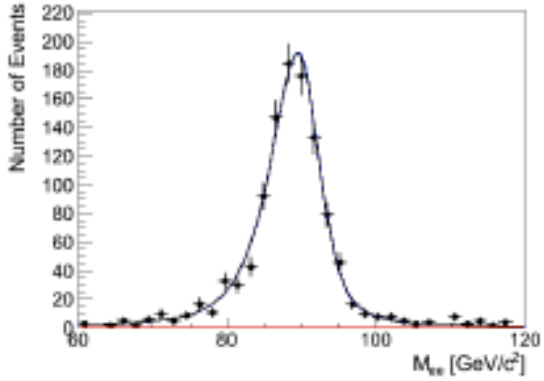




- Tag (WP60) + EcalDriven GSF electron probe

Total:	0.782 +/- 0.011
EB:	0.812 +/- 0.013
EE:	0.745 +/- 0.021
Plus EE :	0.776 +/- 0.030
Plus EB :	0.798 +/- 0.019
Minus EE :	0.690 +/- 0.034
Minus EB :	0.830 +/- 0.018





MC: 0.929, R= data/MC = 0.929 ±0.013

WP95→ HLT efficiency

- Tag (WP95) + WP95 electron probe
- No bkg, simple counting

Total:	0.988 + 0.002 - 0.003
EE :	0.990 + 0.004 - 0.006
EB :	0.987 + 0.003 - 0.004
Plus EB:	0.991 + 0.003 - 0.005
Plus EE:	0.987 + 0.006 - 0.010
Minus EB:	0.986 + 0.004 - 0.006
Minus EE:	0.990 + 0.004 - 0.009

Practically similar values for WP80.
See Si's talk for exact values.

MC: WP95 -> HLT_Ele15_LW_L1R (Note that it's a different trigger)

Total:	0.990 + 0.0001 - 0.0001
EE:	0.977 + 0.0003 - 0.0003
EB:	0.994 + 0.0001 – 0.0001

R= data/MC = 0.998 ± 0.013

Proposal: Since the SC→GsfElectron efficiency and WP[80,95]→HLT efficiency in data are consistent with MC, I propose that we should take data/MC scale factor 1 for these. We can assign full difference between data and MC as systematics. For GsfElectron→WP[80,95] efficiency, we should use the scale factor and uncertainty as measured from data.

Summary and changes w.r.t. last week

✦We realized that we had an inconsistency between data & MC:
- SC→GsfElectron efficiency in data was including tracker driven electron.
- This efficiency was 100%. With ECAL seed requirement it became 98%.
- This inconsistency gave a mistake of roughly 2% per electron.
- Now fixed by requiring that the input collection contains ECAL driven GsfElectron only.

✦Summary:
- Electron Reco, WP95, WP80, and HLT efficiencies are measured.
- Various cross checks performed with different selections. Get consistent results.
- An inconsistency in the GsfElectron definition is now fixed.
- Performed systematics estimate by measuring the reco efficiency using Tag + Loose Iso Fail data-based templates as signal shape input.
- Signal shape systematics estimated to be 1% using this procedure.

✦See talks by Jeremy and Si for more details on various crosschecks.

Backup