Charge misidentification study

Rozmin Daya

SMU

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High pT eγ meeting

Intro

- The efficiencies of identifying electrons and positrons (and the related misidentification rates) are expected to be worse for high pT objects
  - Important to understand at what pT threshold we start to see effect
  - Any extra observations may be helpful for reducing charge misID in the future
- Have measured the charge efficiency on data in $|\eta|$ bins
  - For the data study, used a Breit Wigner convoluted with Crystal Ball to describe the signal and an exponential for the background. Fit the data with combined signal + bg pdf and return fraction signal from the fit.
- And on MC in pT bins
  - Measurement on data work in progress (fits more complicated than in $|\eta|$ case)

Equations: T = tag, P = probe

- Shown are the equations used for charge efficiency and misidentification:

$$\varepsilon_{+} = \frac{T_{-}P_{+}}{T_{-}P_{+} + T_{-}P_{-}}$$

Efficiency for a true positron to be id'ed as positron

$$\varepsilon_{-} = \frac{T_{+}P_{-}}{T_{+}P_{-} + T_{+}P_{+}}$$

Efficiency for a true electron to be id'ed as electron

$$\rho_{-} = 1 - \varepsilon_{+} = \frac{T_{-}P_{-}}{T_{-}P_{+} + T_{-}P_{-}}$$

Negative misID: rate at which true positron is incorrectly id'ed as electron

$$\rho_{+} = 1 - \varepsilon_{-} = \frac{T_{+}P_{+}}{T_{+}P_{-} + T_{+}P_{+}}$$

Positive misID: rate at which true electron is incorrectly id'ed as positron

Selection criteria for data measurement

- Using periods B-D, EF_2e12_medium trigger, eγ standard GRL (corresponds to 177.59 pb-1)
- Require >=1 primary vertex with >=3 tracks, larError<1
- Tag electron:
  - pT>15 GeV, |η|<2.47 (crack excluded), eγ author (1 || 3)
  - el_OQ passed
  - el_tight passed
  - Highest pT electron passing taken as tag
- Probes (opposite charge and same charge probes):
  - Same as for tag, except pass el_medium
  - Opposite charge probe has charge opposite tag, same charge probe has charge same as tag
  - Highest pT probe candidates selected

Result in |η| bins

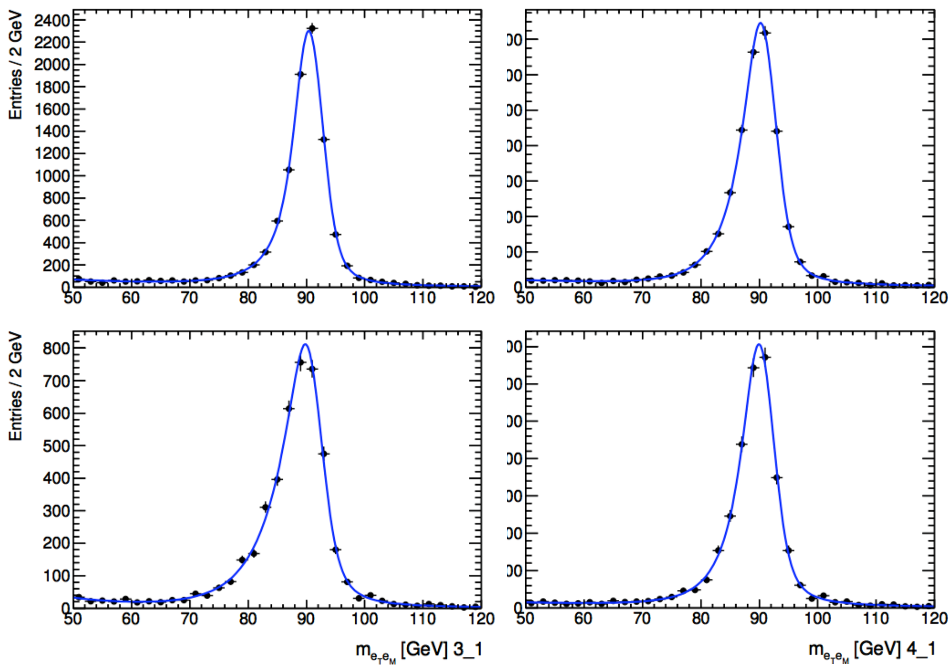
- Use 4 bins, 2 each in barrel and endcaps
- |η| bins={0.0, 0.8, 1.37, 1.52, 2.0, 2.47} crack bin excluded
- Errors shown are statistical (systematics not done yet)

	N_{pp}	N_{mm}	N_{pm}	N_{mp}
$0.00 \leq \lvert\eta\rvert < 0.80$	141 ± 17	51 ± 69	9084 ± 70	8993 ± 57
$0.80 \leq \lvert\eta\rvert < 1.37$	64 ± 8	148 ± 7	6557 ± 75	6370 ± 69
$1.52 < \lvert\eta\rvert < 2.00$	244 ± 33	146 ± 13	4323 ± 38	4112 ± 43
$2.00 \leq \lvert\eta\rvert < 2.47$	226 ± 12	208 ± 16	3022 ± 33	3028 ± 36

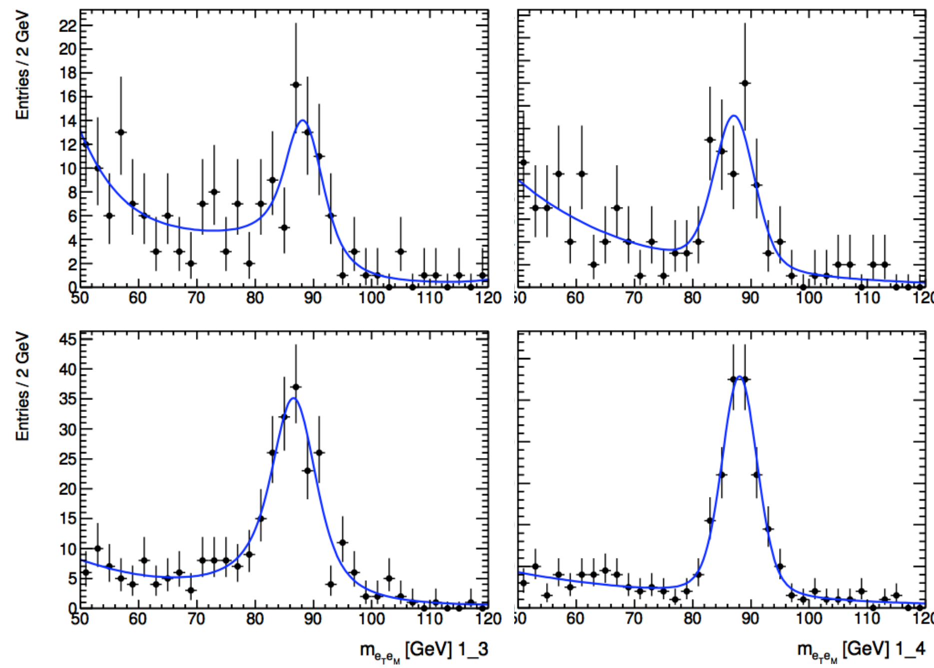
	ϵ_p (%)	ρ_m (%)	ϵ_m (%)	ρ_p (%)
$0.00 \leq \lvert\eta\rvert < 0.80$	99.4 ± 1.2	0.56 ± 0.01	98.5 ± 1.1	1.53 ± 0.02
$0.80 \leq \lvert\eta\rvert < 1.37$	97.7 ± 1.5	2.27 ± 0.03	99.0 ± 1.6	0.97 ± 0.02
$1.52 < \lvert\eta\rvert < 2.00$	96.6 ± 1.4	3.43 ± 0.05	94.7 ± 1.3	5.34 ± 0.07
$2.00 \leq \lvert\eta\rvert < 2.47$	93.6 ± 1.6	6.43 ± 0.11	93.0 ± 1.4	6.96 ± 0.11

Fits in $|\eta|$ bins

+- invariant masses



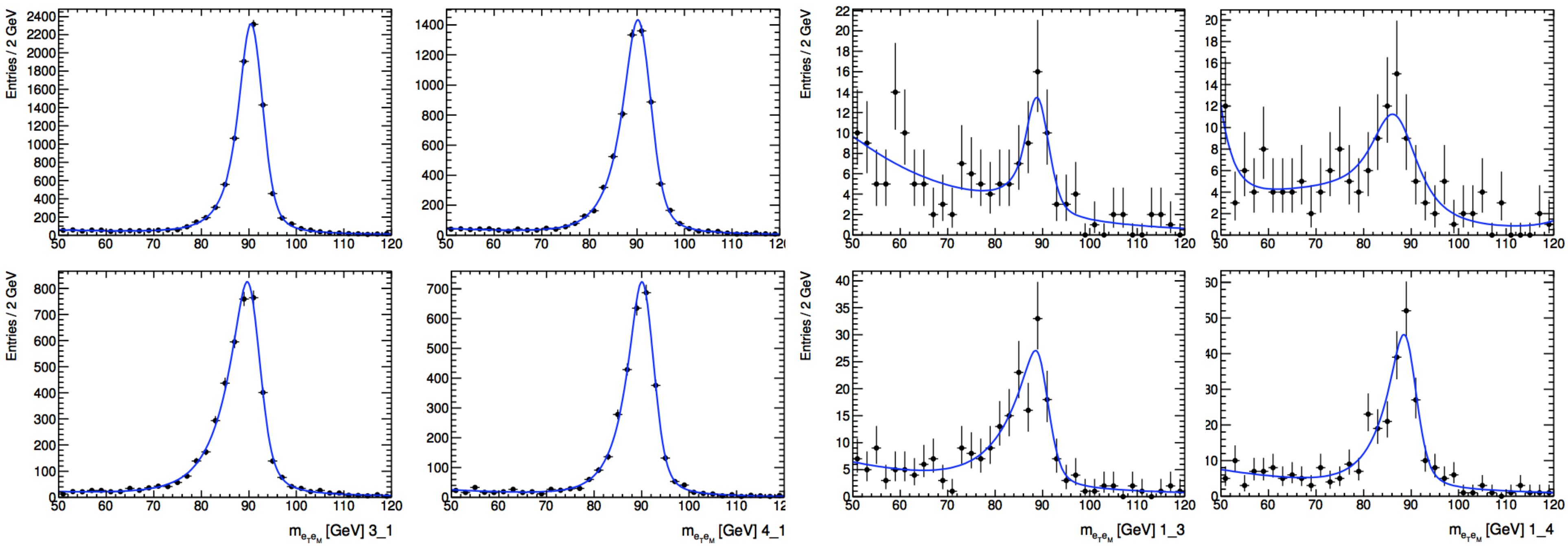
++ invariant masses



Fits in |η| bins

-+ invariant masses

- - invariant masses



MC measurement details

$$\varepsilon_+ = \frac{N_{\text{Reco+}}^{\text{Match True+}}}{N^{\text{True+}}} \qquad \varepsilon_- = \frac{N_{\text{Reco-}}^{\text{Match True-}}}{N^{\text{True-}}}$$

- Samples used:
  - (15-50 GeV): mc10_7TeV.105466.Pythia_DYee_75M120_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325925_00
  - (50-80 GeV): mc10_7TeV.105467.Pythia_DYee_120M250_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325926_00
  - (80-175 GeV): mc10_7TeV.105468.Pythia_DYee_250M400_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325927_00
  - (175-300 GeV): mc10_7TeV.105469.Pythia_DYee_400M600_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325928_00
  - (300-400 GeV): mc10_7TeV.105470.Pythia_DYee_600M800_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325929_00
  - (400-500 GeV): mc10_7TeV.105471.Pythia_DYee_800M1000_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325930_00
  - (500-600 GeV): mc10_7TeV.105472.Pythia_DYee_1000M1250_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325931_00
  - (600-700 GeV): mc10_7TeV.105473.Pythia_DYee_1250M1500_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325932_00
  - (700-800 GeV): mc10_7TeV.105474.Pythia_DYee_1500M1750_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325933_00
  - (800-1000 GeV): mc10_7TeV.105475.Pythia_DYee_1750M2000_unfiltered.*.e574_s933_s946_r2215_r2260_p545_tid325934_00

Result (%) in pT bins (MC)

	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-60	60-70
ε+	99.26	99.75	99.52	99.48	99.39	99.74	99.79	99.62	99.26
ε-	98.92	99.40	99.72	99.82	99.52	99.60	99.65	99.51	99.43

	70-80	80-90	90-100	100-125	125-150	150-175	175-200	200-250	250-300
ε+	99.71	99.80	99.42	99.36	99.34	99.43	99.29	99.46	99.49
ε-	99.39	98.76	99.24	98.78	99.30	98.96	98.66	98.96	98.63

	300-350	350-400	400-500	500-600	600-700	700-800	800-1000
ε+	99.49	99.12	99.12	98.58	98.26	97.89	97.09
ε-	98.90	98.55	98.63	97.59	97.02	96.41	96.25

Conclusions

- Clear dependence seen in $|\eta|$
  - Will check if there is asymmetry in η
  - And include rest of data
- pT dependence seems consistent up to around 500 GeV for positrons and 200 GeV for electrons
  - Further study required to understand why there is such a difference
- Working on completing pT binned measurement on data for 15-50 GeV region
  - Unlikely we will be able to do very high pT measurement from data soon, but if the charge misID is well described by MC, we can use the numbers shown.