Jet→Lepton
Fake Rate Measurements
(all eras)

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Overview

- Obtained Jet → Lepton Fake Rate measurements (with shape systematics) for all eras using latest post-processed Ntuples (as of Dec 13th 2019).

- Fits to the data converged in all bins except the numerator in the lowest cone$_{pt}$ bin in muon barrel case for 2018.

- Fake rate predictions from both data and QCD MC (QCDj) fairly in agreement with each other (except for the highest cone$_{pt}$ bins).

- Computed fake rates for TTbar MC (TTj) as well. These were found to be higher than QCD fakes across all eras for electrons.

- Data driven Fake Rate values also in the same ballpark as the measurements shown by CERN group.

**MEASUREMENT BINS**

Electron cone$_{pt}$ bins (GeV): [15.0, 25.0, 35.0, 45.0, 65.0, 100.0]
Electron Eta bins: [(< 1.479), (> 1.479)]

Muon cone$_{pt}$ bins (GeV): [10.0, 15.0, 20.0, 32.0, 45.0, 65.0, 100.0]
Muon Eta bins: [(< 1.2), (> 1.2)]

**DATACARD YIELD UNCERTAINTIES**

EWK Prefit Yield Unc. = 30%
Rares Prefit Yield Unc. = 10% & 100% (Uncorrel.)
TT Prefit Yield Unc. = 30%

**DATACARD SHAPE UNCERTAINTIES**

MET_Resp, MET_Resol,
CMS_ttHl_JES, CMS_ttHl_JER,
CMS_ttHl_UnClusteredEn
Effect of Shape Systematics

Tension in the fit

with Shape Systematics

w/o Shape Systematics

12/20/19

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FAKE RATE MEASUREMENTS
MUONS
(2016)
Fake rate vs. $p_T$ in different regions:

**Barrel**
- $|\eta| < 1.2$
- Data
- Fakes (QCD)
- Fakes (tt)

**Endcap**
- $1.2 < |\eta| < 2.4$
- Data
- Fakes (QCD)
- Fakes (tt)

Additional plots showing normalized fake rate vs. lepton $p_T$.
FAKE RATE MEASUREMENTS
ELECTRONS
(2016)
The graph shows the fake rate as a function of transverse momentum ($p_T$) for two different rapidity intervals: $|y| < 1.5$ and $1.5 < |y| < 2.5$.

- The data points are represented by black circles.
- The QCD fakes are represented by open squares.
- The fakes from the ttbar channel are represented by stars.

The figure is labeled "KBFI" and "CERN" with the date "12/20/19" and the name "R.K. Dewanjee, KBFI Group Meeting".
FAKE RATE MEASUREMENTS
MUONS
(2017)
FAKE RATE MEASUREMENTS
ELECTRONS
(2017)
Fake rate

$0 < | \eta | < 1.5$

$| \eta | < 2.5$

$0 \leq p_T [\text{GeV}] \leq 100$

KBFI

CERN

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FAKE RATE MEASUREMENTS
MUONS
(2018)
No data in Numerator For this bin
FAKE RATE MEASUREMENTS
ELECTRONS
(2018)
Conclusions

• Jet → Lepton Fake Rate measurements for all eras (2016, 2017 and 2018) were presented.

• This time shape as well as yield uncertainties (in slide 2) along with bin-by-bin uncertainties were used in the datacards for the fit.

• Applied shape uncertainties on MET response, MET resolution, JES, JER and Unclustered energy.

• Tensions towards the high end of mT_fix distribution were mitigated with the introduction of shape systematics.

• Estimated fakes from TTbar MC as well, found them to be higher than QCD MC driven fakes (especially for electrons).

• Need help from Giovanni (CERN group) in addressing this non-closure of TTbar and QCD fakes and the absence of data in one of the bins in muon barrel (for the numerator) in 2018 era.