# Measuring the Fake Lepton Background in a Search for Supersymmetry

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# Overview

- Brief description of analysis and method
- Background prediction in SS mumu channel
- Background prediction in OS mumu channel
- Things to do for the future

# Analysis and Method

- Searching for same sign dileptons from pair produced stops

- Control region MT2 < 80

- Estimate background from one real and one fake lepton from data

- Define 'loose' electron, measure ratio of fake tight to fake loose leptons in QCD sample

- Look for loose-loose events in dilepton data, weight events to get predicted fake tight-tight background

# Event Weighting

TT
$$-\frac{\varepsilon_1\eta_1 + \varepsilon_2\eta_2}{(1 - \varepsilon_1\eta_1)(1 - \varepsilon_2\eta_2)}$$

LL
$$-\frac{2\varepsilon_1\varepsilon_2}{(1 - \varepsilon_1\eta_1)(1 - \varepsilon_2\eta_2)}$$

TL
$$\frac{(1 + \varepsilon_1\eta_1)\varepsilon_2}{(1 - \varepsilon_1\eta_1)(1 - \varepsilon_2\eta_2)}$$

LT
$$\frac{(1 + \varepsilon_2\eta_2)\varepsilon_1}{(1 - \varepsilon_1\eta_1)(1 - \varepsilon_2\eta_2)}$$

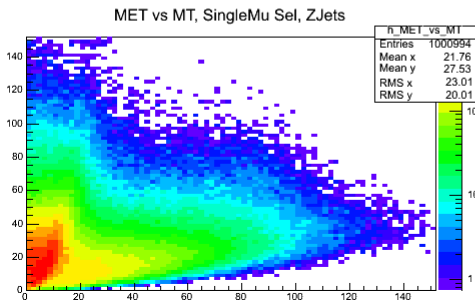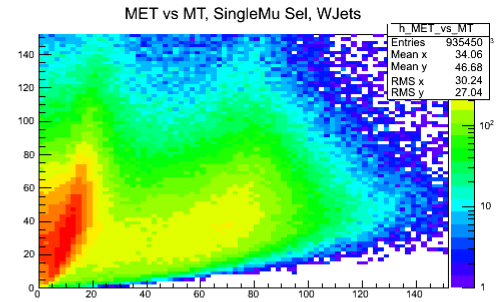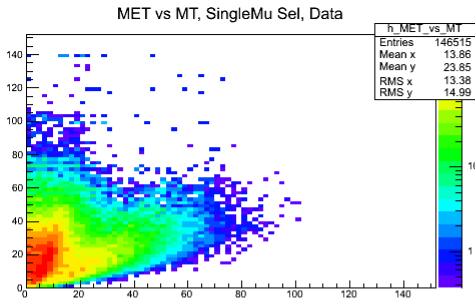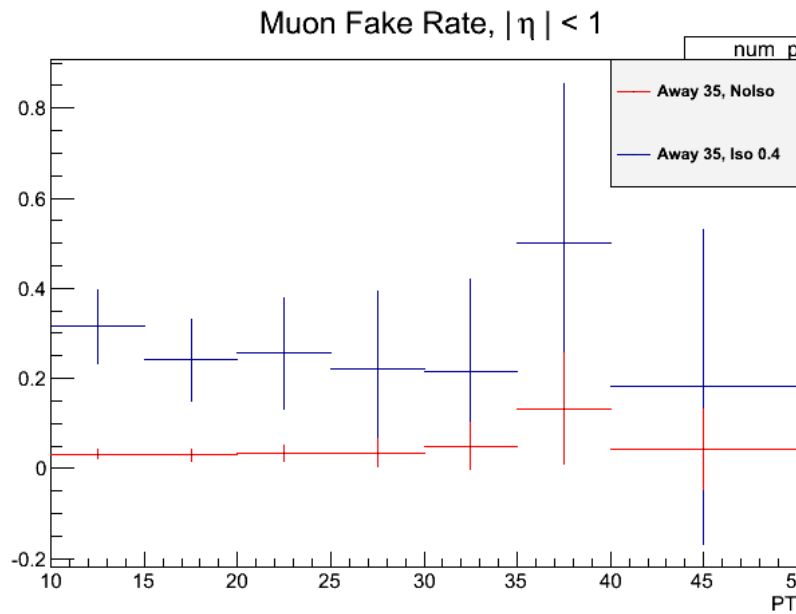| Tight-Loose | Tight-Tight |
|---|---|
| Loose-Loose | Loose-Tight |

$\varepsilon = \dfrac{f}{1-f}$   Tight/loose for fake leptons

$\eta = \dfrac{1-p}{p}$   loose/tight for real leptons

Error propagation implemented in code
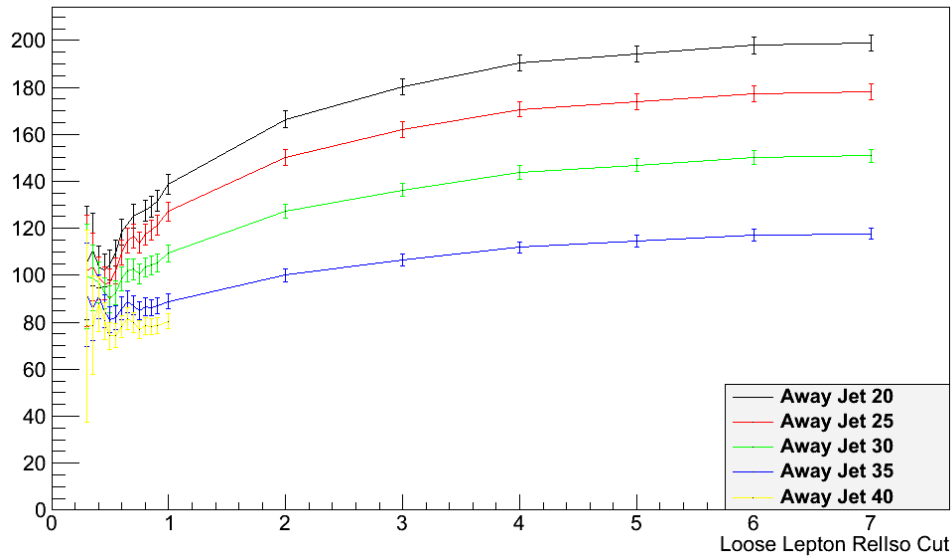p ≈ 1 (good approx for muons, not electrons)

# QCD sample

- Combining T_HLT_Mu8_v16 and T_HLT_Mu17_v3 triggers
- Weight muons by 1/(luminosity of trigger path) to combine the triggers
- Overlap of 51/154368 events
- Veto events with Z candidate or low mass resonance
- Require MET < 20 GeV and MT < 15 to reduce EWK contributions
- Require an away jet of DeltaR > 1 between the jet and all loose electrons/muons in event
- Fake rate error given from binomial formula
- err(FR) = sqrt(FR(1-FR)/Loose)

# QCD sample plots



Muon Fake Rate, |η| < 1

- Away 35, NoIso
- Away 35, Iso 0.4

MET vs MT, SingleMu Sel, Data
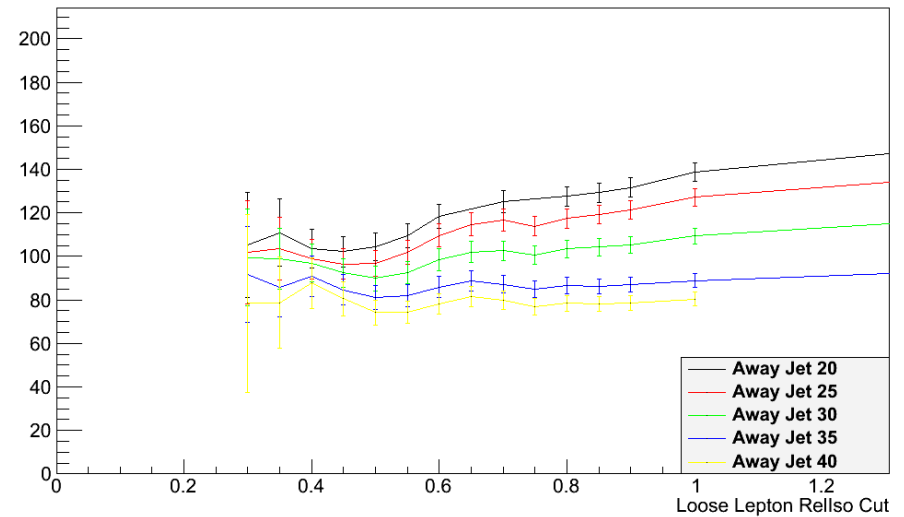
MET vs MT, SingleMu Sel, WJets
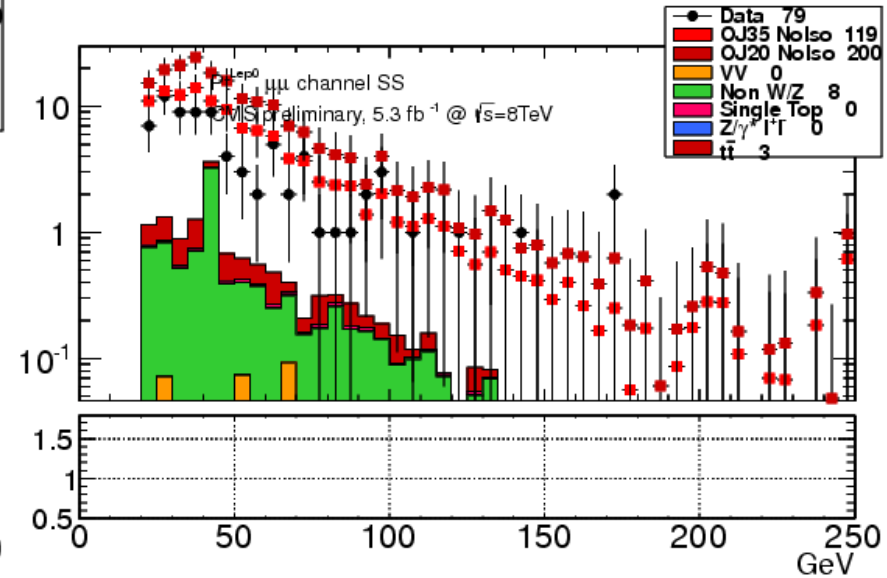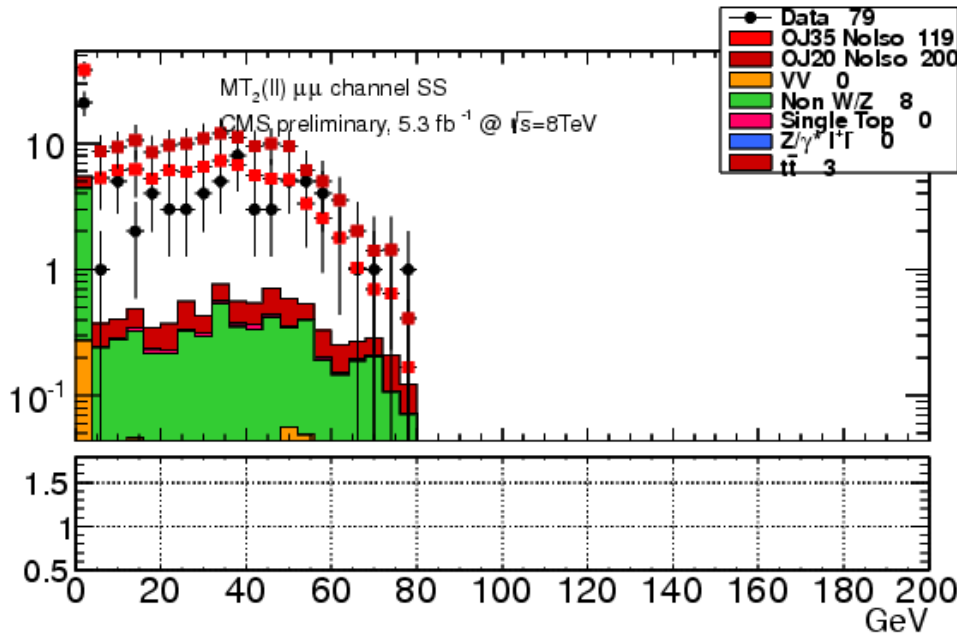
MET vs MT, SingleMu Sel, ZJets

# SS Plots- Bkg Yield



Fake Lepton Background Contribution to SS μμ channel

Fake Lepton Background Contribution to SS μμ channel

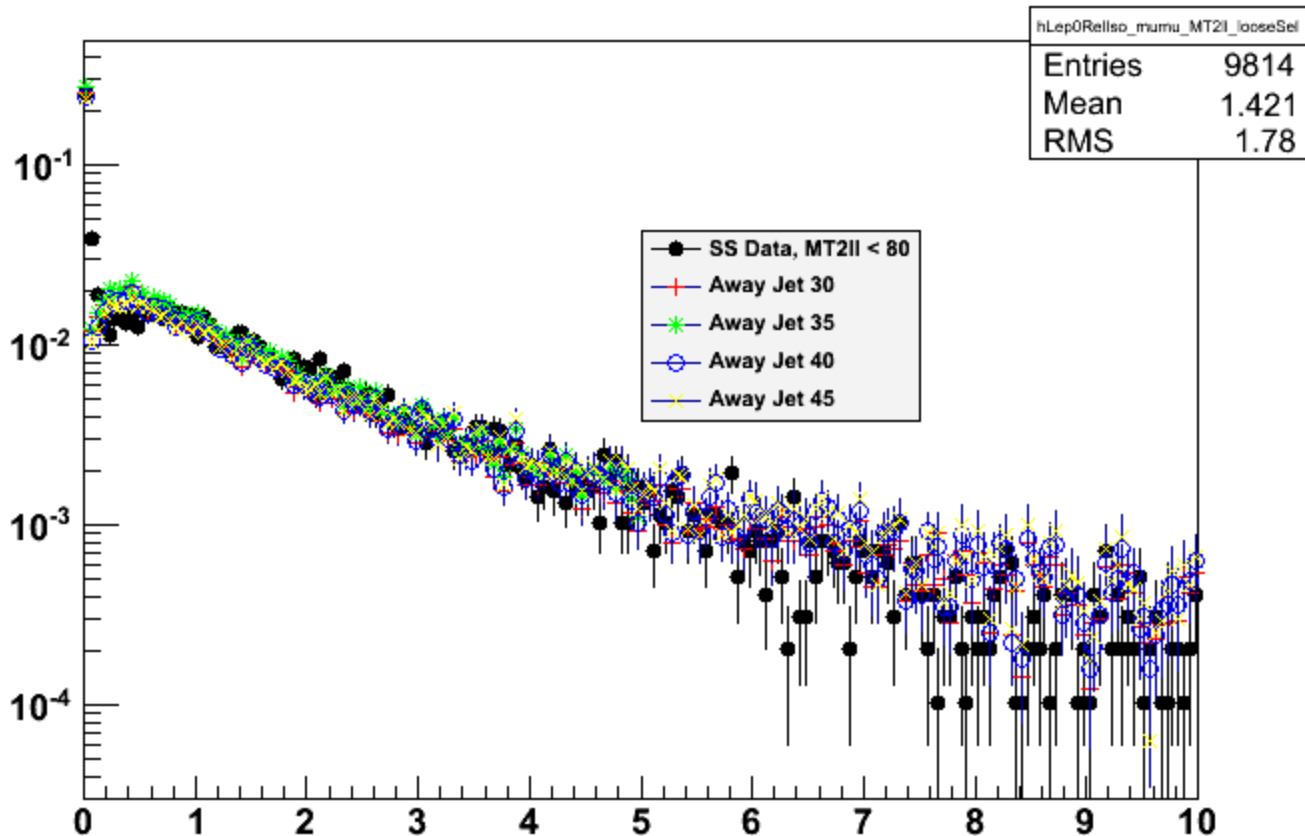# SS Plots- Distributions



Missing some MC processes....
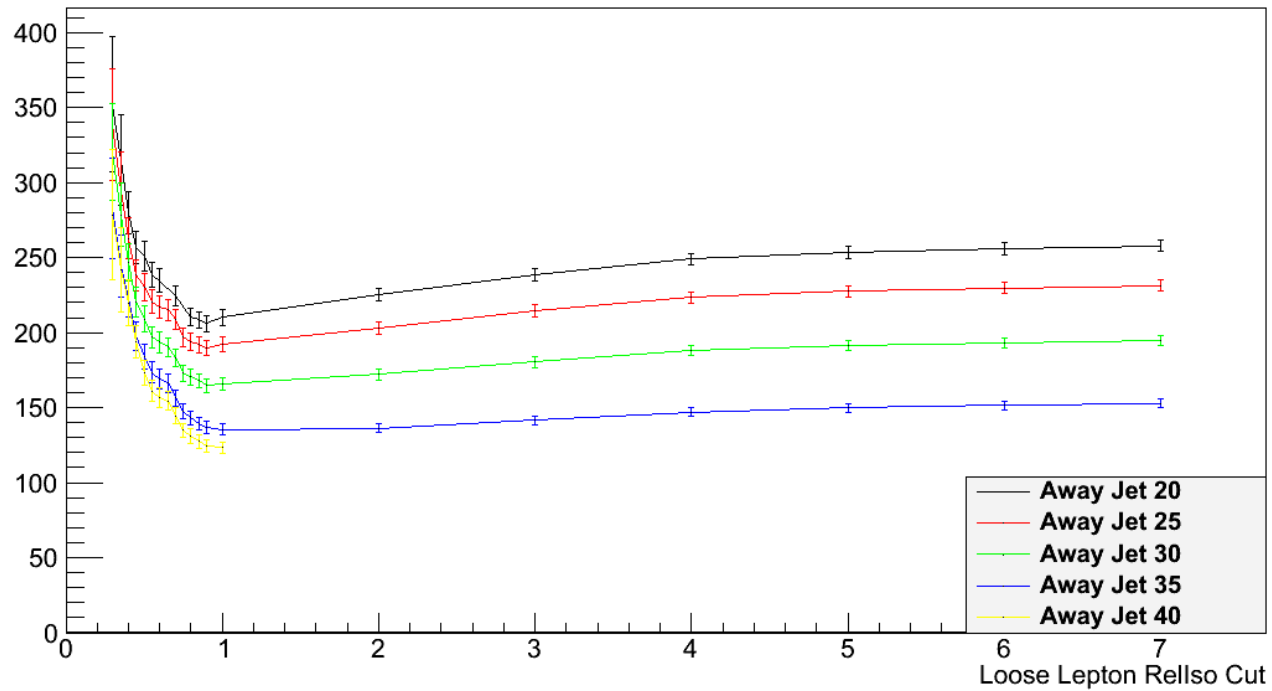SS region should be dominated by fake processes
Low statistics

# Compare Muon Isolation in QCD and SS Data



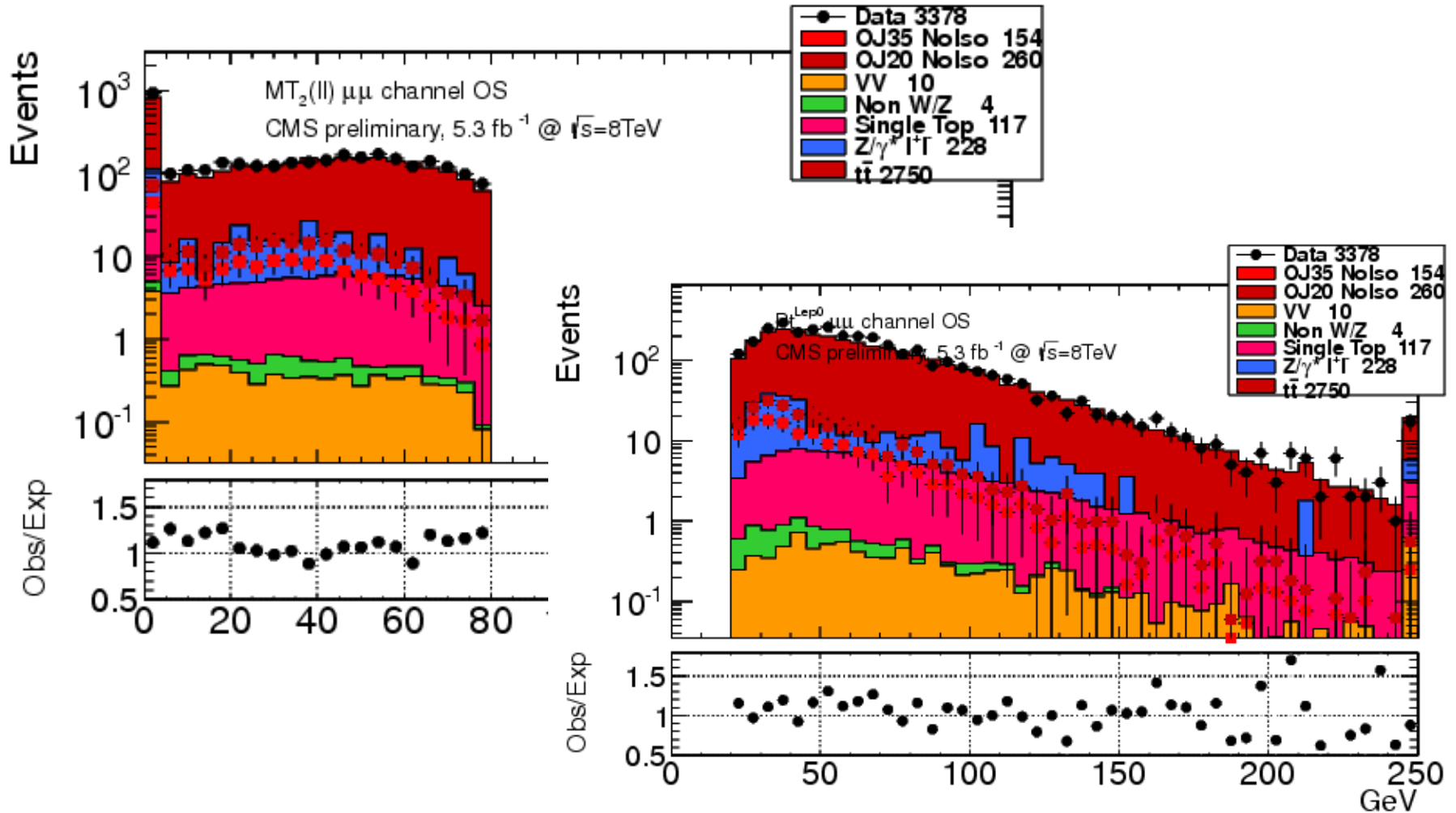RelIso distribution of Loose Muons

# OS Plots- Bkg Yield



Fake Lepton Background Contribution to OS μμ channel

# OS Plots- Distributions
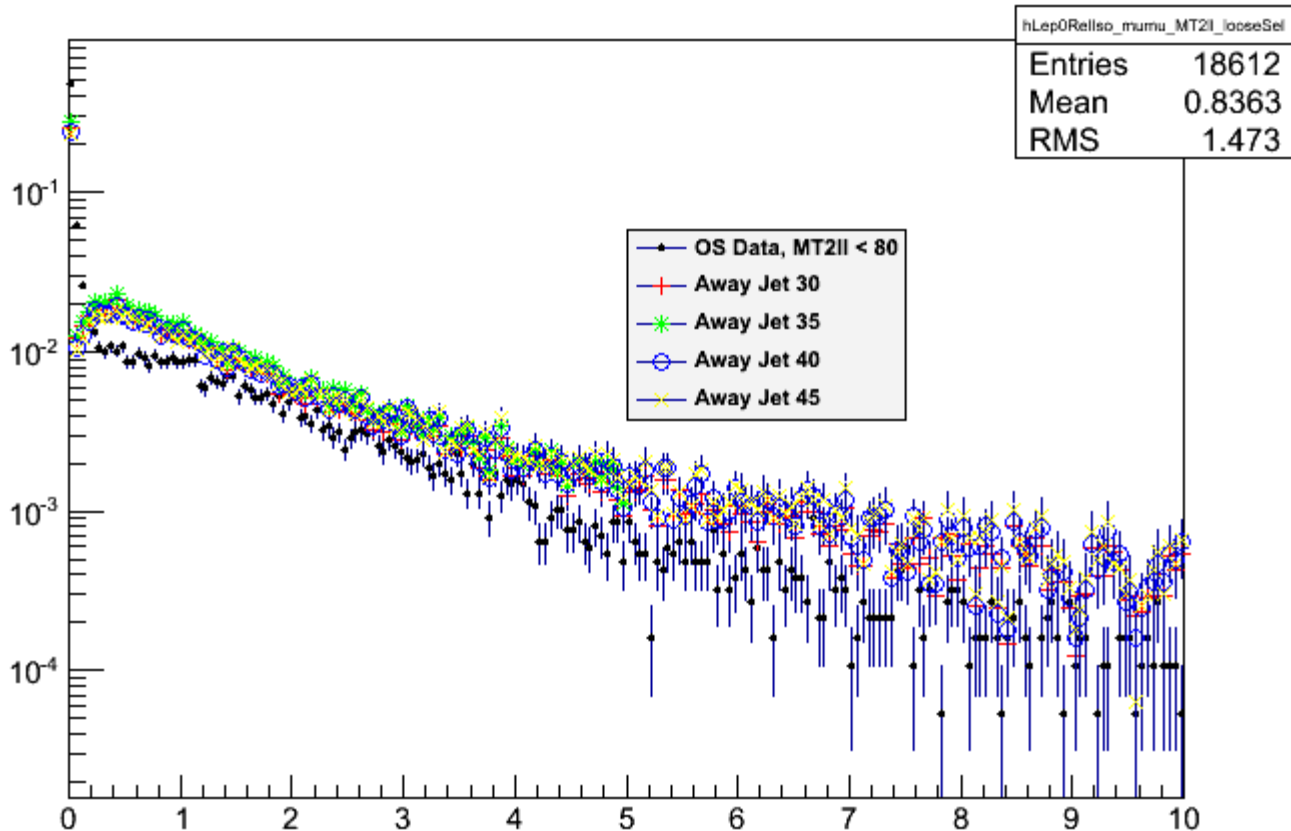


Prediction somewhat agrees with MC for the fake backgrounds…
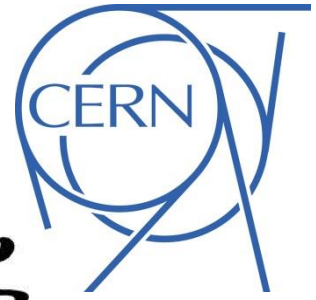
# Compare Isolation in QCD and OS Data sample



The distributions don't agree because we are comparing prompt and fake leptons to fake leptons only. Hence data will have more prompt leptons with tighter Iso
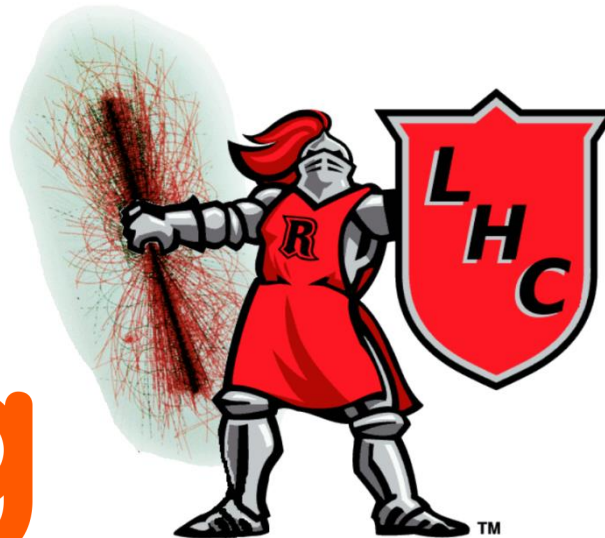
# Bias in QCD sample

- We only ask for single lepton triggers, but there was a dilepton requirement when trees were made

- Second lepton probably is looser, has greater isolation

# For the Future

- Do EWK removal
- Obtain an unbiased single lepton sample
- Find a control region with more statistics (verify with RelIso distribution)
- Do this for electrons!
- Do this with 20 ifb

Thank you!