

Trilepton Analysis: The ZH Signals and Backgrounds

Discriminating Variable Candidates for the ZH Analysis

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Collider Detector at Fermilab

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Summary

1 Introduction

2 $\cancel{E}_T$

3 Dileptons Inv. Masses

4 ΔR Values

5 $\Delta\phi$ Values

6 Trimass, H_T , m_T

Basics

- With three leptons, there are three possible dilepton inv. masses

$$\left(\text{dimass} = \sqrt{\left(\sum_{i=1,2} E_i \right)^2 - \left(\sum_{i=1,2} p_{X,i} \right)^2 - \left(\sum_{i=1,2} p_{Y,i} \right)^2 - \left(\sum_{i=1,2} p_{Z,i} \right)^2} \right).$$

two categories:

- "NoZPeak": None of the three dimasses have $81.0 < \text{dimass} < 101.0$ GeV.
- "InZPeak": At least one of the three dimass have $81.0 < \text{dimass} < 101.0$ GeV.

Trimass, H_T , m_T

 E_T 

Table: E_T

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Trimass, H_T , m_T

Dimass Lower Opp. Sign

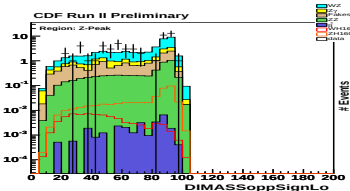
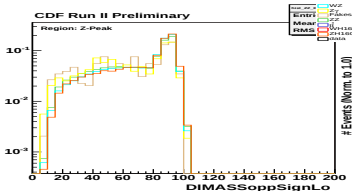
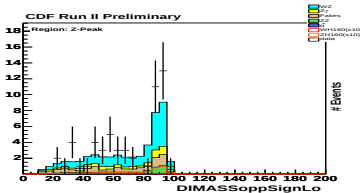
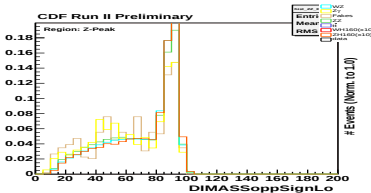


Table: Dimass Lower Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Dimass Higher Opp. Sign

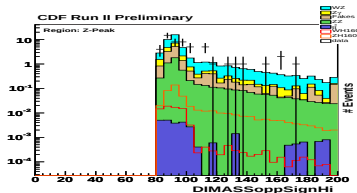
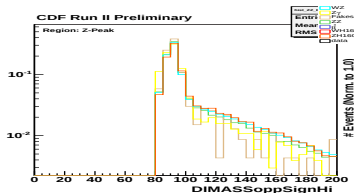
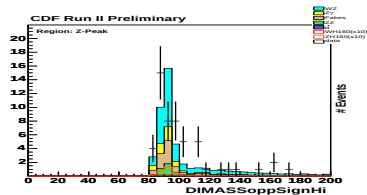
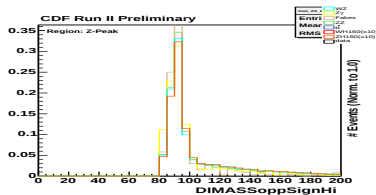


Table: Dimass Higher Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Dimass Close (by ΔR) Opp. Sign

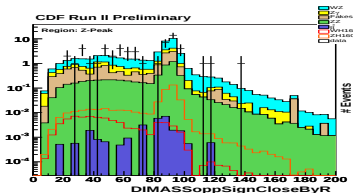
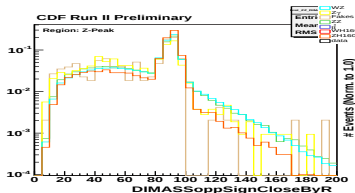
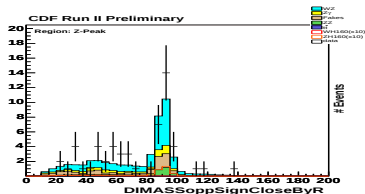
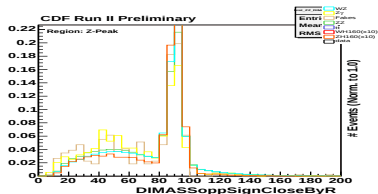


Table: Dimass Close (by ΔR) Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Trimass, H_T , m_T

Dimass Close (by ϕ) Opp. Sign

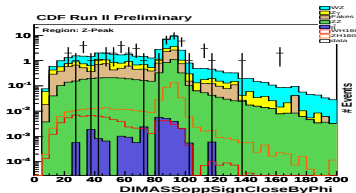
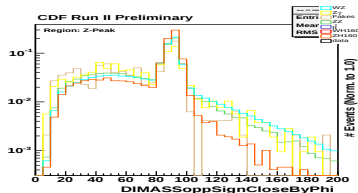
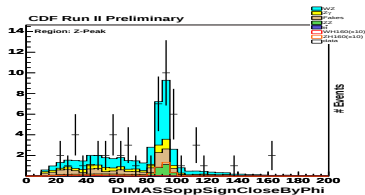
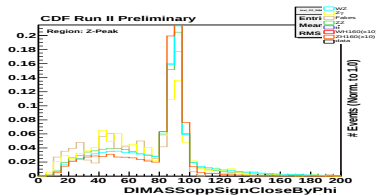


Table: Dimass Close (by ϕ) Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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ΔR Lower (by dimass) Opp. Sign

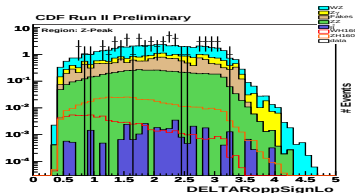
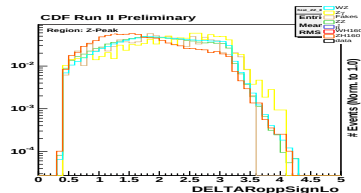
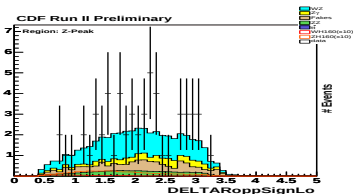
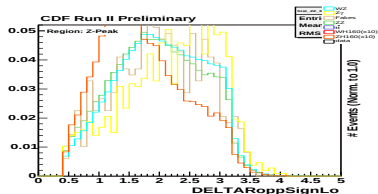


Table: ΔR Lower (by dimass) Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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ΔR Higher (by dimass) Opp. Sign

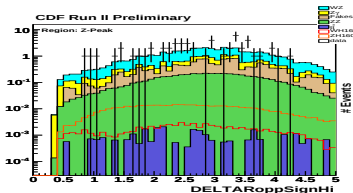
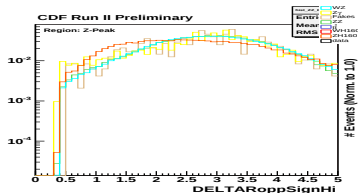
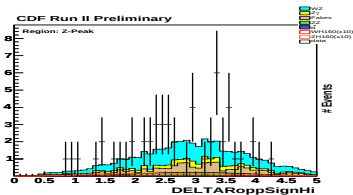
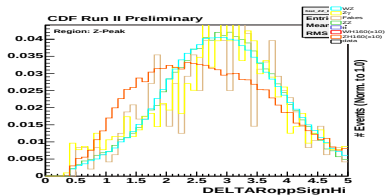


Table: ΔR Higher (by dimass) Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

ΔR Close Opp. Sign

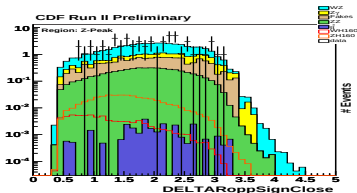
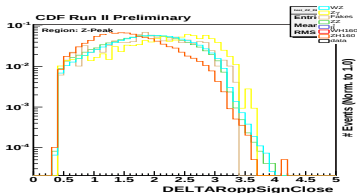
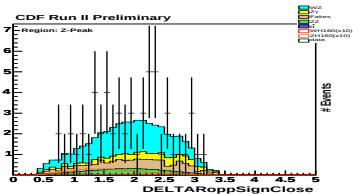
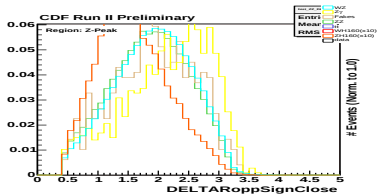


Table: ΔR Close Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
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σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

ΔR Far Opp. Sign

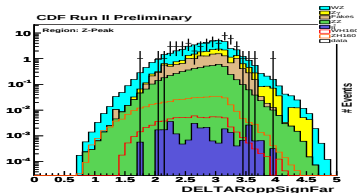
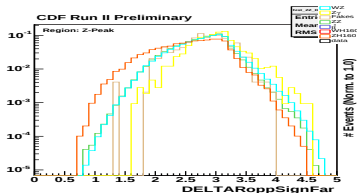
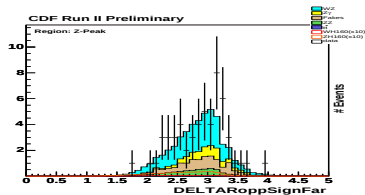
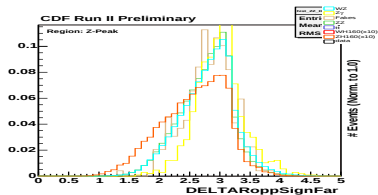


Table: ΔR Far Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
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Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

ΔR Same Sign

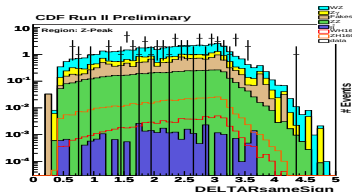
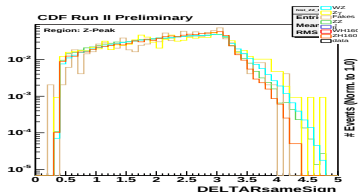
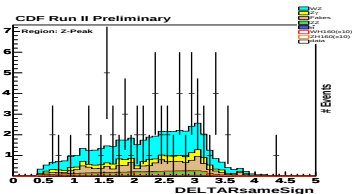
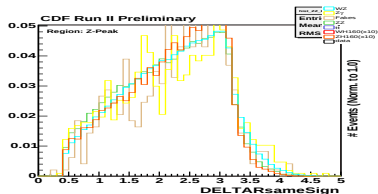


Table: ΔR Same Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Trimass, H_T , m_T

ΔR b/w Sum of Close OS Leptons and 3rd Lepton

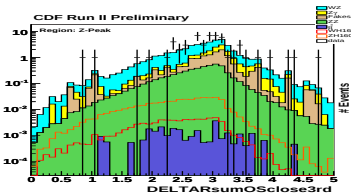
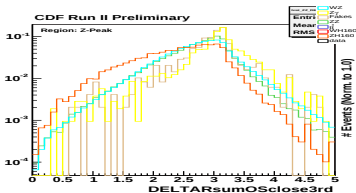
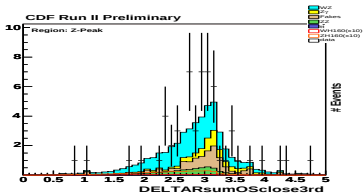
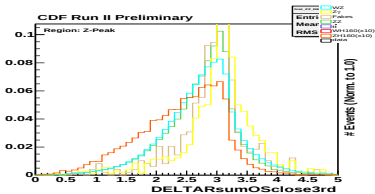


Table: ΔR b/w Sum of Close OS Leptons and 3rd Lepton

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Trimass, H_T , m_T

ΔR b/w Sum of OS Leptons on Z-Peak and 3rd Lepton

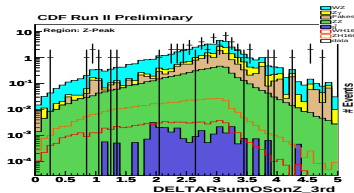
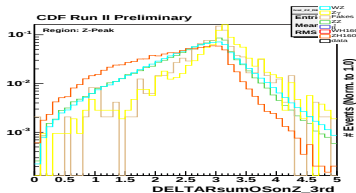
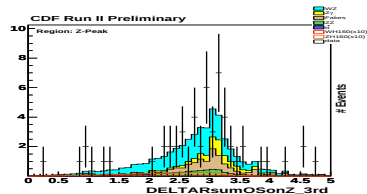
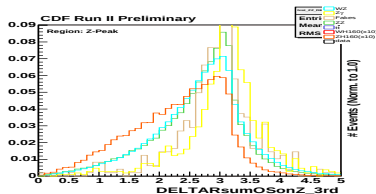


Table: ΔR b/w Sum of OS Leptons on Z-Peak and 3rd Lepton

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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$\Delta\phi$ b/w Vector Sum of Three Leptons and E_T

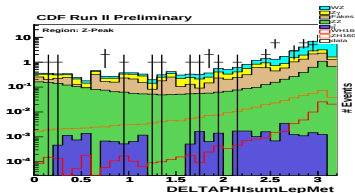
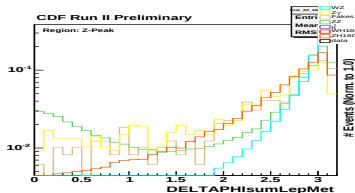
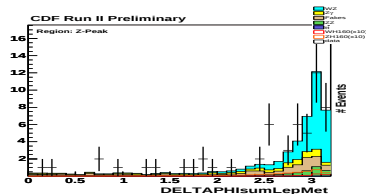
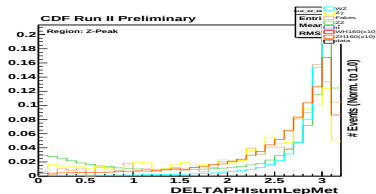


Table: $\Delta\phi$ b/w Vector Sum of Three Leptons and $\cancel{E}_T$

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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$\Delta\phi$ Close Opp. Sign Leptons

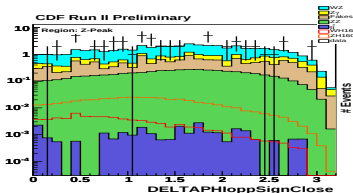
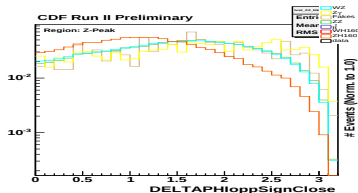
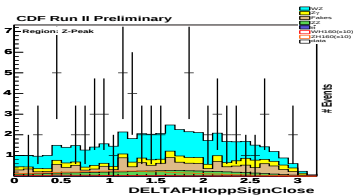
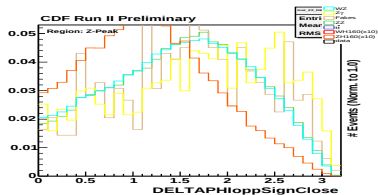


Table: $\Delta\phi$ Close Opp. Sign Leptons

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

$\Delta\phi$ Far Opp. Sign Leptons

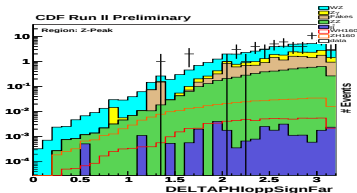
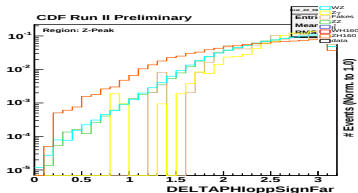
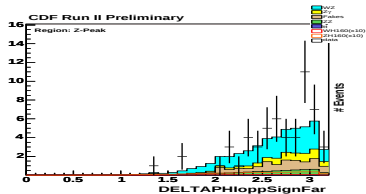
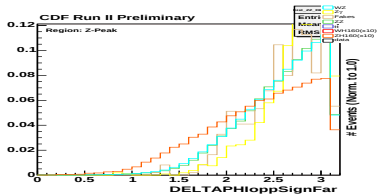


Table: $\Delta\phi$ Far Opp. Sign Leptons

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

$\Delta\phi$ Same Sign

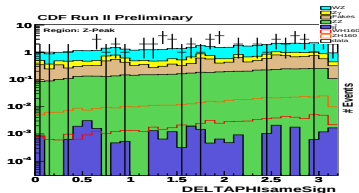
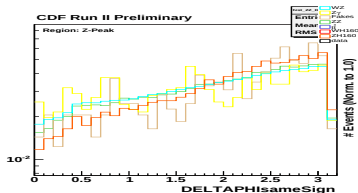
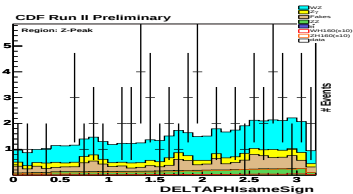
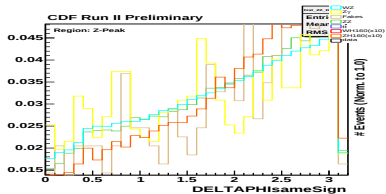


Table: $\Delta\phi$ Same Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Table: $\Delta\phi$ b/w Sum of Close Opp. Sign Leptons and the 3rd Lepton

Stack	tt	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	tt	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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$\Delta\phi$ b/w Sum of Close Opp. Sign Leptons and E_T

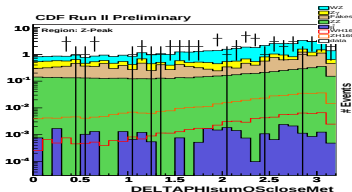
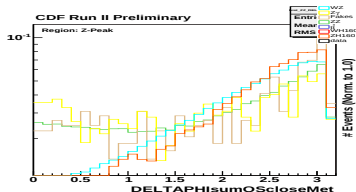
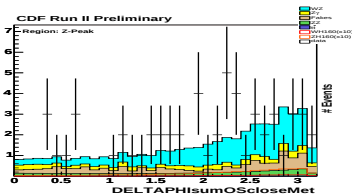
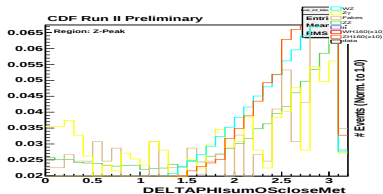


Table: $\Delta\phi$ b/w Sum of Close Opp. Sign Leptons and $\cancel{E}_T$

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

$\Delta\phi$ b/w Sum of Close Opp. Sign Leptons and $\not{E}_T$ +3rd Lepton

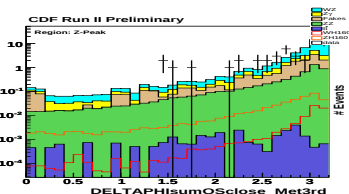
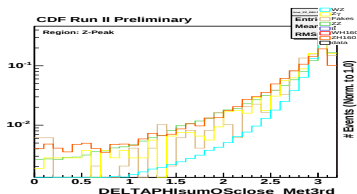
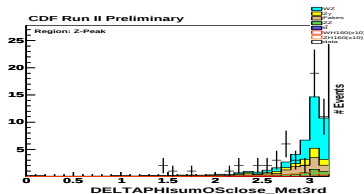
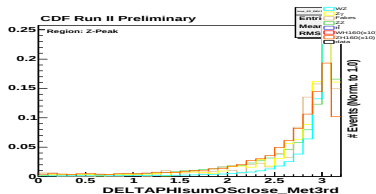


Table: $\Delta\phi$ b/w Sum of Close Opp. Sign Leptons and $\cancel{E}_T$ +3rd Lepton

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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Trilepton Inv. Mass

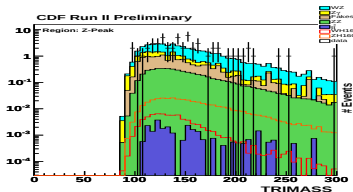
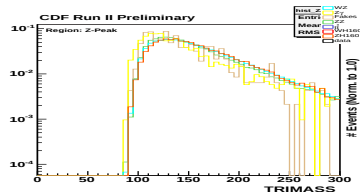
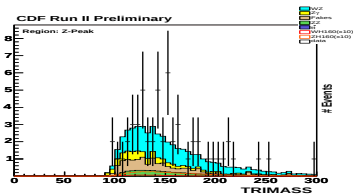
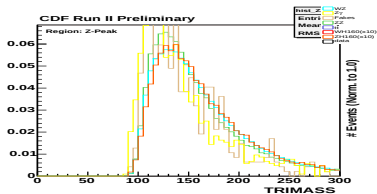


Table: Trilepton Inv. Mass

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Trimass, H_T , m_T

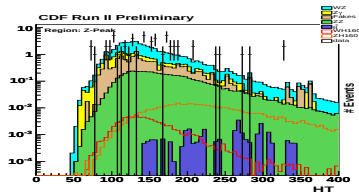
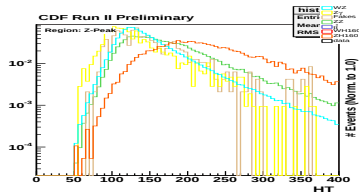
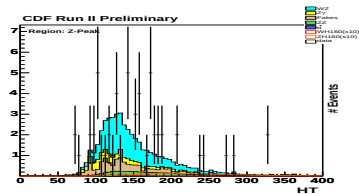
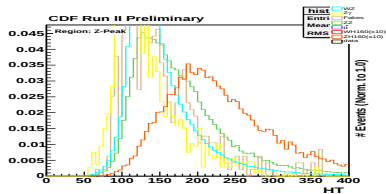
 H_T 

Table: H_T

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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$H_T + E_T$

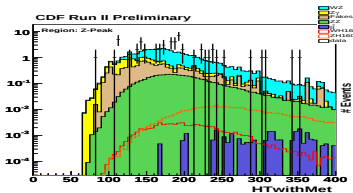
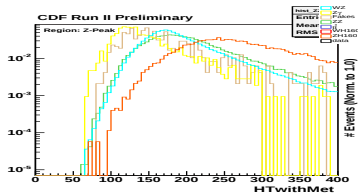
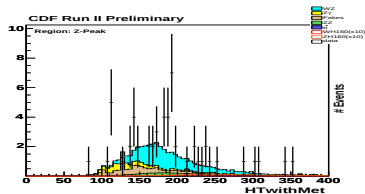
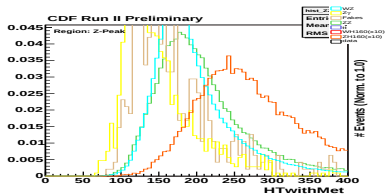


Table: $H_T + E_T$

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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m_T of the Three Leptons

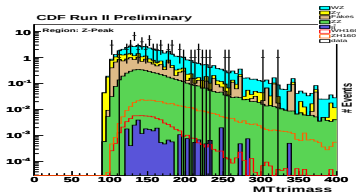
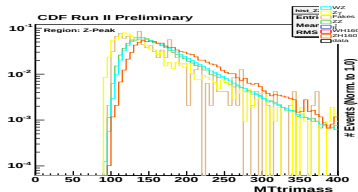
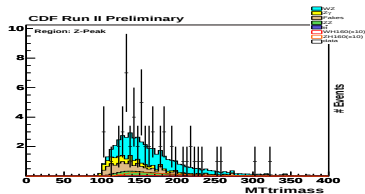
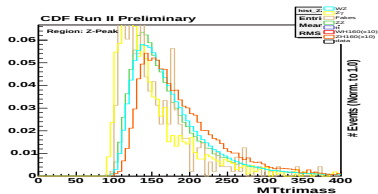


Table: m_T of the Three Leptons

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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m_T Low Opp. Sign

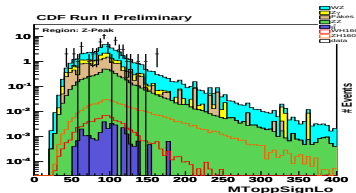
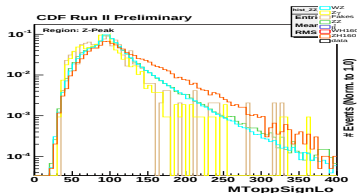
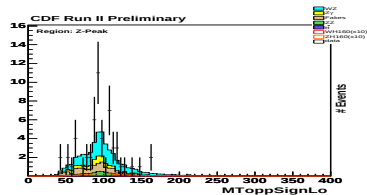
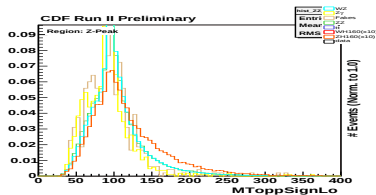


Table: m_T Low Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

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m_T High Opp. Sign

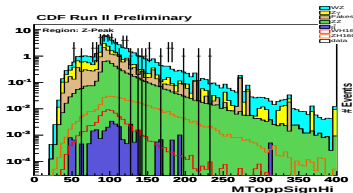
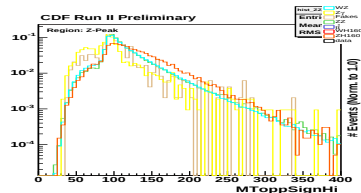
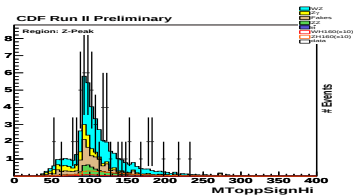
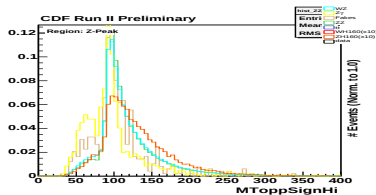


Table: m_T High Opp. Sign

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								

Norm	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
σ								