

Trilepton Analysis: The WH Signals and Backgrounds

Discriminating Variable Candidates for the WH 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.

Intro.
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 $\Delta\phi$
 Trimass, H_T , m_T

E_T

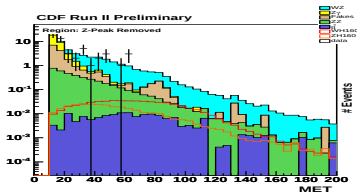
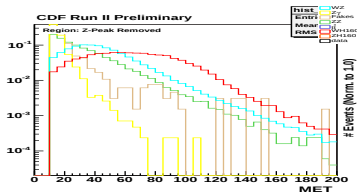
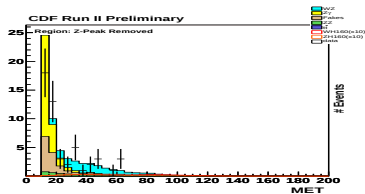
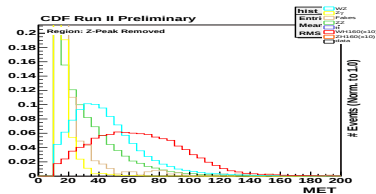


Table: E_T

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								

$\mathbb{E}_T$ ΔR $\Delta\phi$ Trimass, H_T , m_T

Dimass Lower Opp. Sign

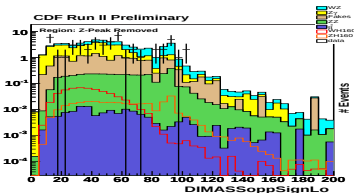
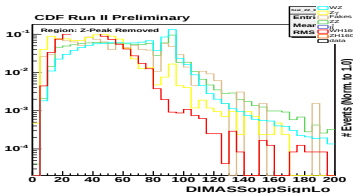
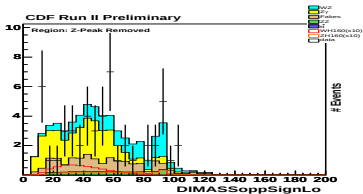
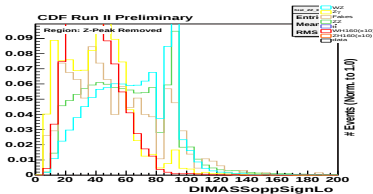


Table: Dimass Lower Opp. Sign

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								

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Dimass Higher Opp. Sign

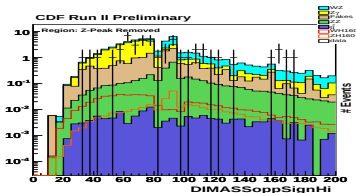
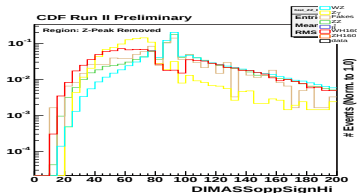
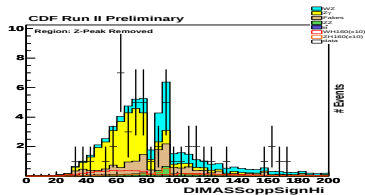
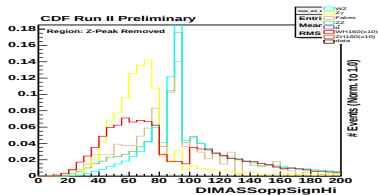


Table: Dimass Higher Opp. Sign

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								

E_T ΔR $\Delta\phi$ Trimass, H_T , m_T

Dimass Close (by ΔR) Opp. Sign

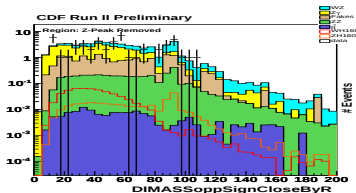
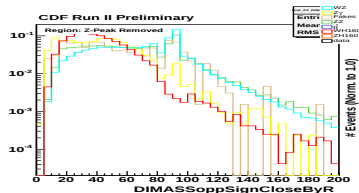
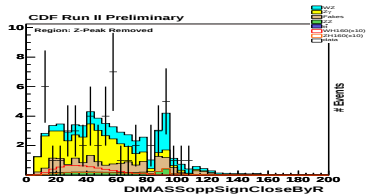
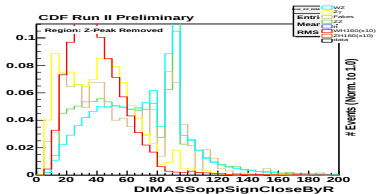


Table: Dimass Close (by ΔR) Opp. Sign

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

E_T

Dimasses

 ΔR $\Delta\phi$ Trimass, H_T , m_T

Dimass Close (by ϕ) Opp. Sign

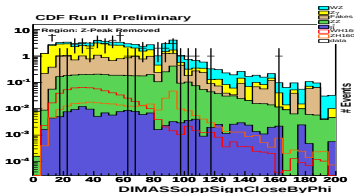
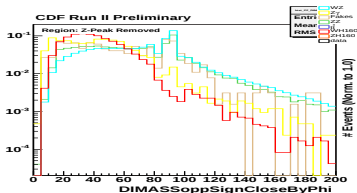
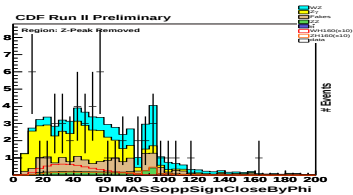
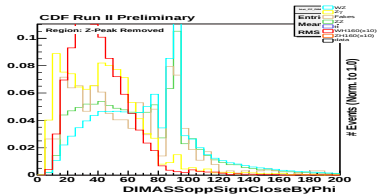


Table: Dimass Close (by ϕ) Opp. Sign

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								

Trimass, H_T , m_T

ΔR Lower (by dimass) Opp. Sign

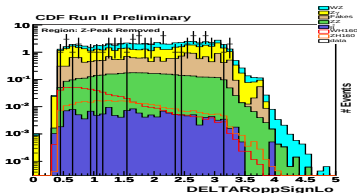
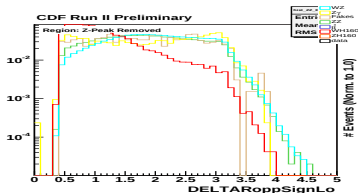
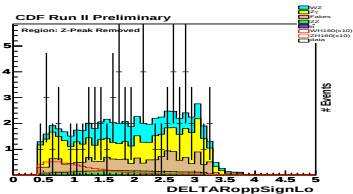
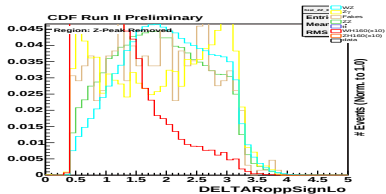


Table: ΔR Lower (by dimass) Opp. Sign

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
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ΔR Higher (by dimass) Opp. Sign

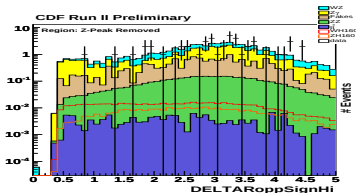
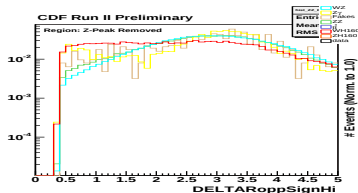
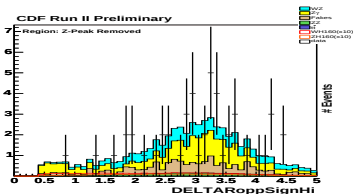
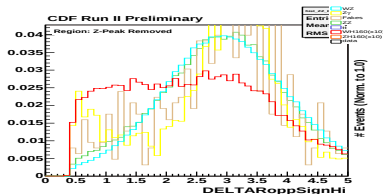


Table: ΔR Higher (by dimass) Opp. Sign

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

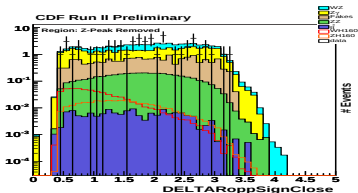
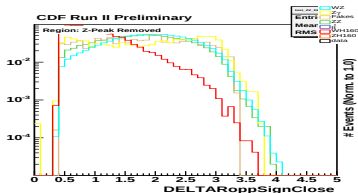
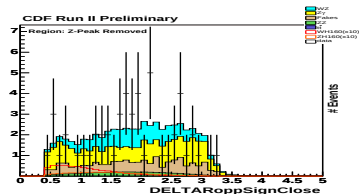
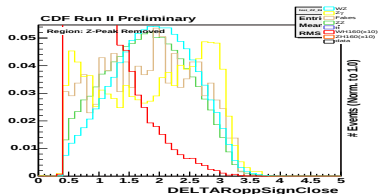


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ΔR Far Opp. Sign

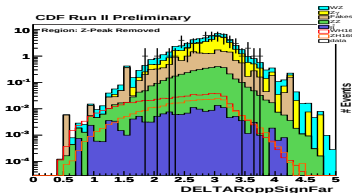
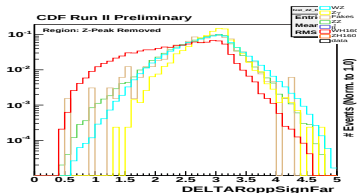
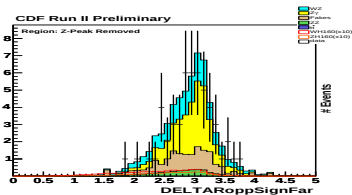
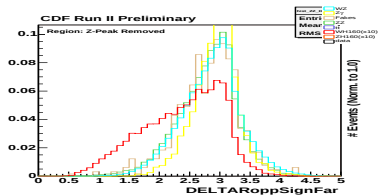


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ΔR Same Sign

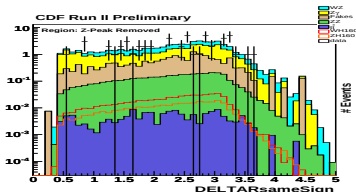
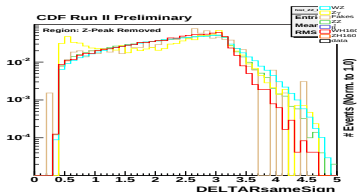
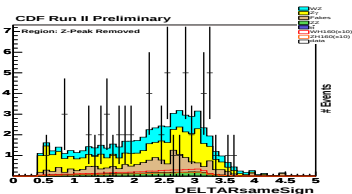
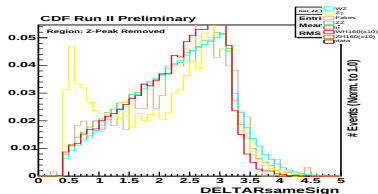


Table: ΔR Same Sign

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
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σ								

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

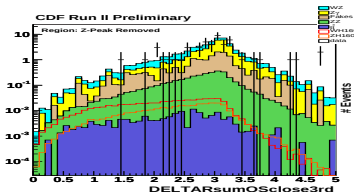
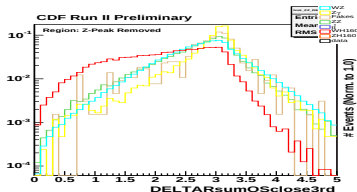
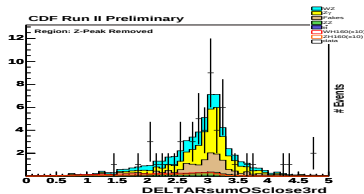
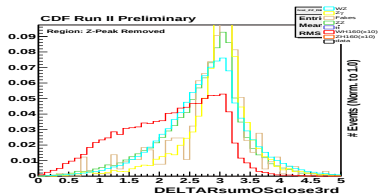


Table: ΔR b/w Sum of Close OS Leptons and 3rd Lepton

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								

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

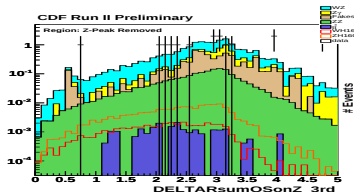
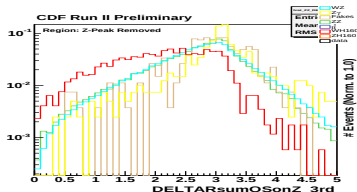
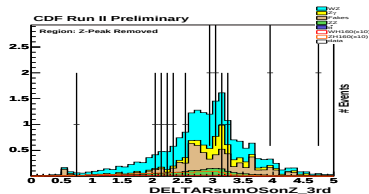
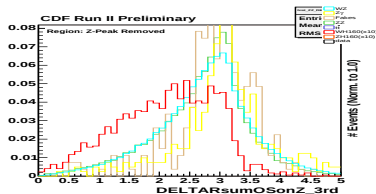


Table: ΔR b/w Sum of OS Leptons on Z-Peak and 3rd Lepton

Stack	$t\bar{t}$	ZZ	Fakes	$Z\gamma$	WZ	WH	ZH	data
Mean								
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Mean								
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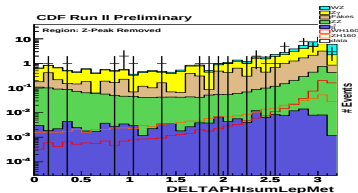
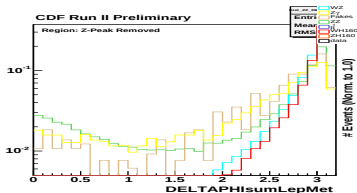
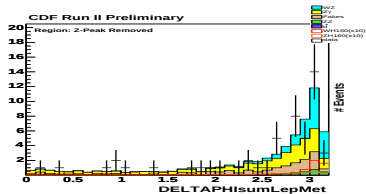
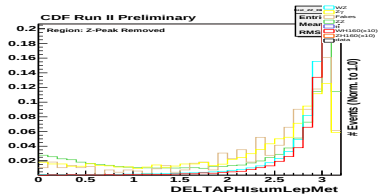
Trimass, H_T , m_T $\Delta\phi$ b/w Vector Sum of Three Leptons and $\cancel{E}_T$ 

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								
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$\Delta\phi$ Close Opp. Sign Leptons

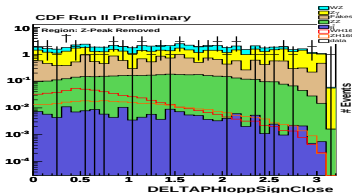
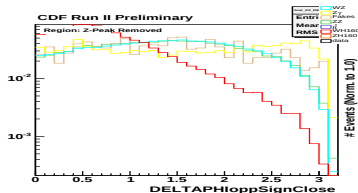
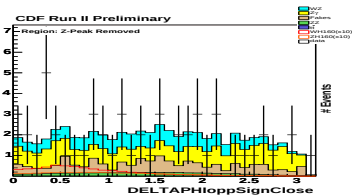
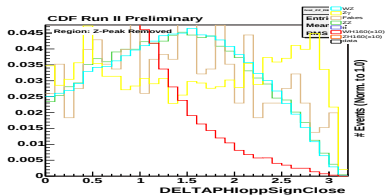


Table: $\Delta\phi$ Close Opp. Sign Leptons

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								

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$\Delta\phi$ Far Opp. Sign Leptons

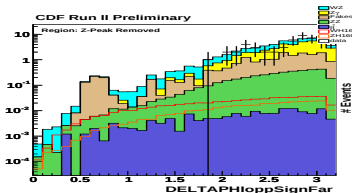
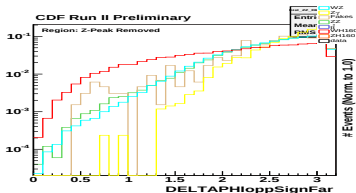
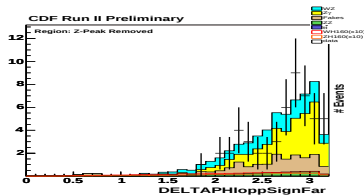
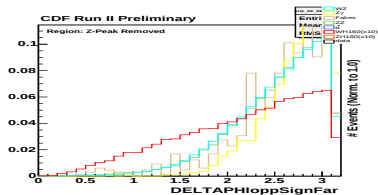


Table: $\Delta\phi$ Far Opp. Sign Leptons

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
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$\Delta\phi$ Same Sign

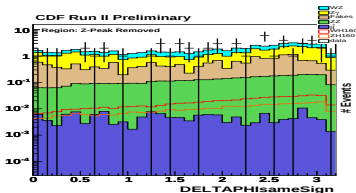
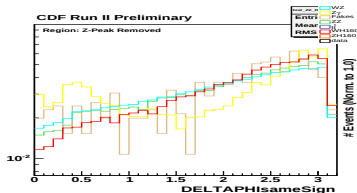
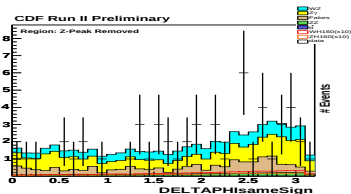
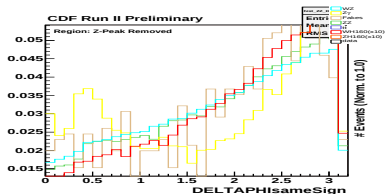


Table: $\Delta\phi$ Same Sign

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								

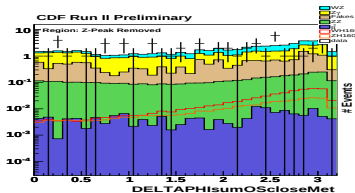
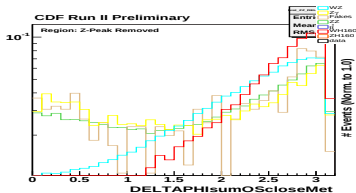
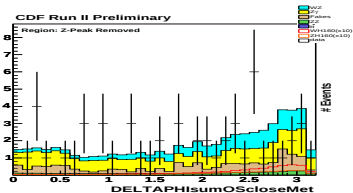
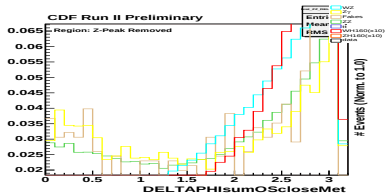
Trimass, H_T , m_T $\Delta\phi$ b/w Sum of Close Opp. Sign Leptons and E_T 

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								

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

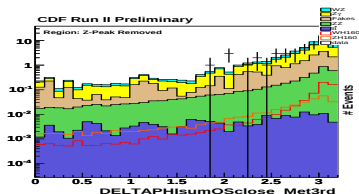
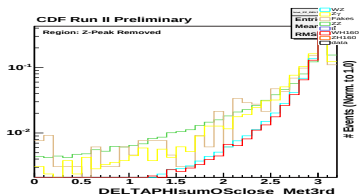
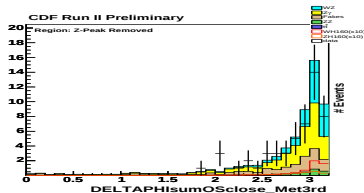
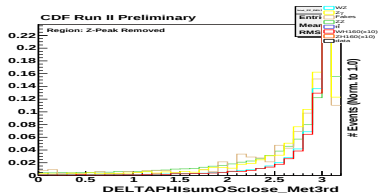


Table: $\Delta\phi$ b/w Sum of Close Opp. Sign Leptons and $\cancel{E}_T$ +3rd Lepton

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

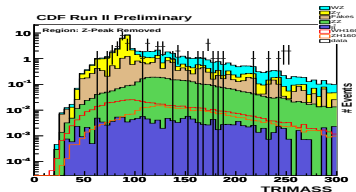
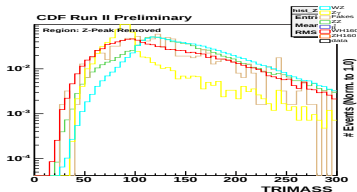
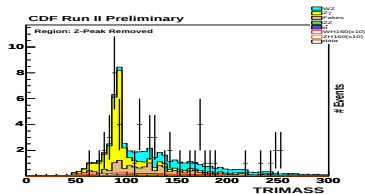
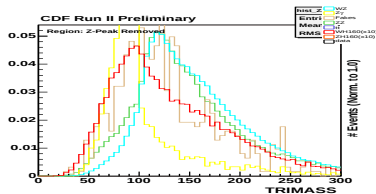


Table: Trilepton Inv. Mass

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								

Intro.
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H_T

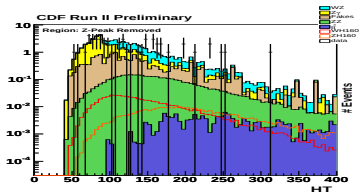
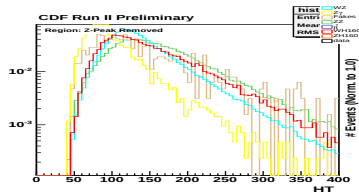
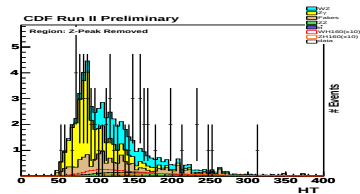
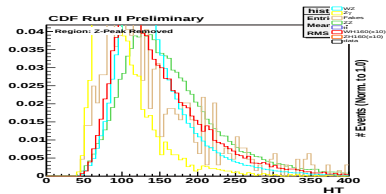


Table: H_T

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								

Trimass, H_T , m_T

$$H_T + E_T$$

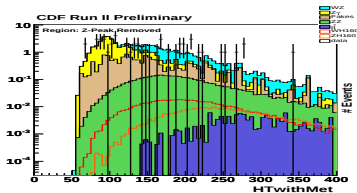
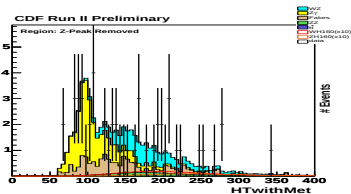


Table: $H_T + E_T$

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

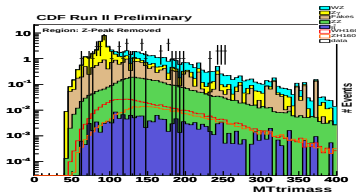
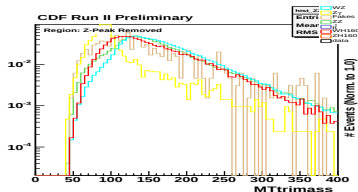
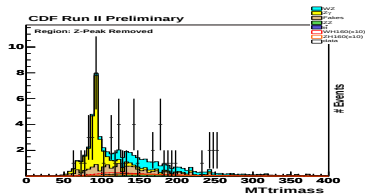
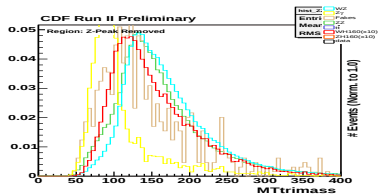


Table: m_T of the Three Leptons

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								

$\mathbb{E}_T$ ΔR $\Delta\phi$

Trimass, H_T , m_T

m_T Low Opp. Sign

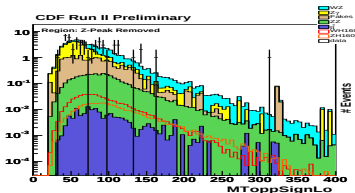
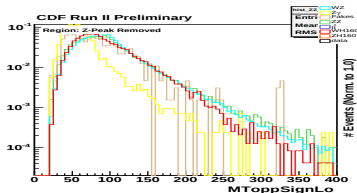
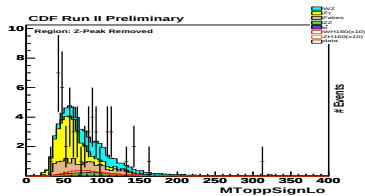
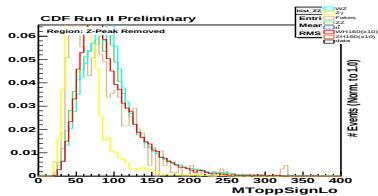


Table: m_T Low Opp. Sign

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								

Trimass, H_T , m_T

m_T High Opp. Sign

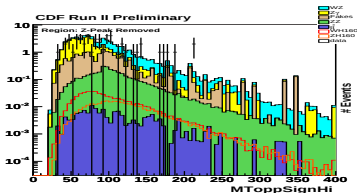
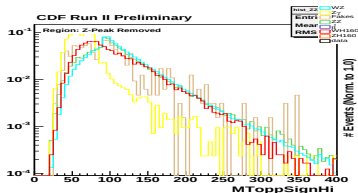
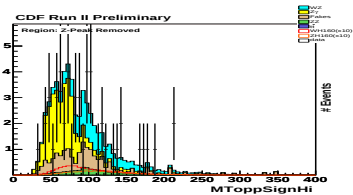
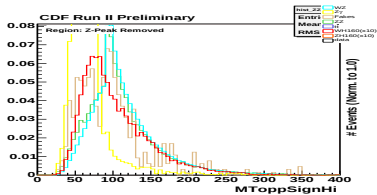


Table: m_T High Opp. Sign

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								