

Trilepton Analysis: NeuroBayes Results

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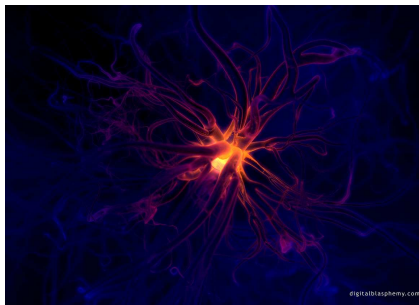
Collider Detector at Fermilab

24 October 2009

Summary

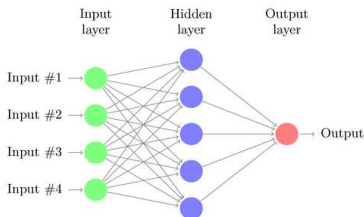
- 1 Intro. to NeuroBayes
- 2 NeuroBayes for $H \rightarrow WW$ Trileptons
 - No Z Peak Region
 - In Z Peak Region
- 3 Backup
 - Preselection
 - No Z Peak Variable Distributions
 - In Z Peak Variable Distributions

Intro. to NeuroBayes



- A neural net is a computational tool based on the structure of human neurons.
- NeuroBayes consists of both a kernel and interface. The kernel contains all functions for training and analysis, while the interface contains the functions needed by the user to run NeuroBayes from a C++ module.

Work Flow



- Begin with N input variables with likely discriminating potential.
- 1) create a set of inputs containing only MC backgrounds and signals.
- 2) create another set of inputs containing MC backgrounds, signals, and data.
- 3) Train NeuroBayes on 1). Creates and N -dim space assigning each point a value from a loss-function (returns 0 for correct choice, up to ∞ for wrong choice), which is to be minimized.
- 4) Find minima of the N -dim space. This identifies the signal region.
- 5) NeuroBayes "Expert" compares trained NN to data events from 2), which maps the N -dim space to a 1-dim space for the output.

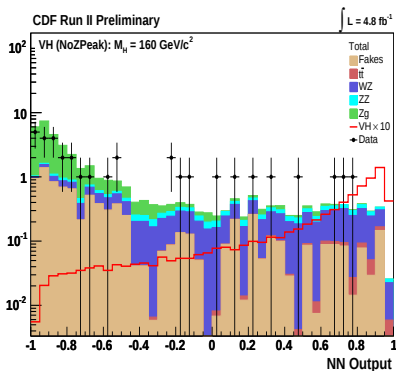
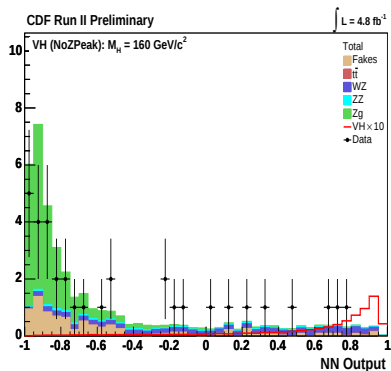
No Z Peak Analysis: Variables Used

- NJet
- 2nd lepton p_T
- $\cancel{E}_T$
- Dilepton Inv. Mass of Opp. Sign Close (by ϕ) Leptons
- ΔR Opp. Sign Close
- ΔR Opp. Sign Far
- $\Delta\phi$ b/w 2nd lepton and $\cancel{E}_T$
- Inv. Mass of 3rd lepton, $\cancel{E}_T$, Jets
- H_T : 3 leptons, $\cancel{E}_T$, Jets
- M_T : 3 leptons
- M_T : 3rd lepton, $\cancel{E}_T$
- M_T : 3 leptons, $\cancel{E}_T$, Jets

No Z Peak Analysis: Count

Process	Count
WZ	6.83
ZZ	1.99
$Z\gamma$	22.7
Fakes (WW , W +Jets, Z +Jets)	8.63
$t\bar{t}$	0.34
WH 160 Signal	0.57
ZH 160 Signal	0.18
Background Stack	40.1
Total Background + MC signal	40.28
data(4.8 fb^{-1})	34

No Z Peak Analysis: Result



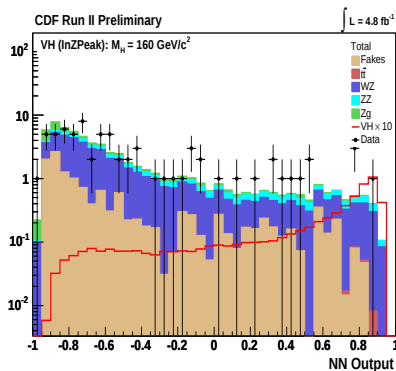
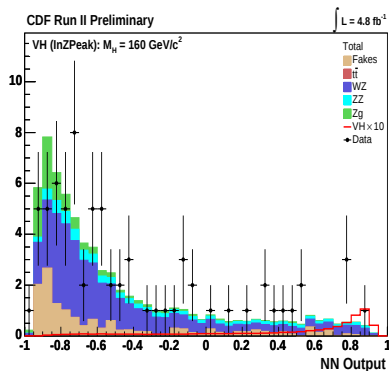
In Z Peak Analysis: Variables Used

- E_T
- NJet
- 2nd lepton p_T
- Dilepton Inv. Mass of Opp. Sign Close (by R) Leptons
- ΔR Opp. Sign Far
- $\Delta\phi$ b/w 2nd lepton and E_T
- $\Delta\phi$ b/w Sum of the 3 leptons and E_T
- $\Delta\phi$ Opp. Sign Close
- $\Delta\phi$ b/w Sum of Opp. Sign leptons on Z-peak and 3rd lepton
- Inv. Mass of 3 leptons
- Inv. Mass of 3rd lepton, E_T , Jets
- H_T : 3 leptons, E_T , Jets
- M_T : 3 leptons, E_T , Jets

In Z Peak Analysis: Count

Process	Count
WZ	36.4
ZZ	7.23
$Z\gamma$	9.12
Fakes (WW , W +Jets, Z +Jets)	13.8
$t\bar{t}$	0.06
$WH160$ Signal	0.07
$ZH160$ Signal	0.58
Background Stack	66.5
Total Background + MC signal	67.2
data(4.8 fb^{-1})	72

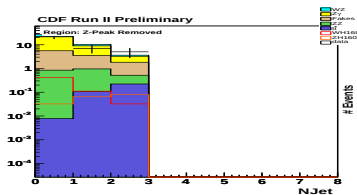
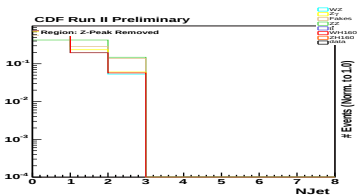
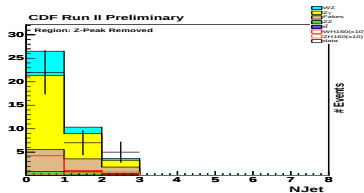
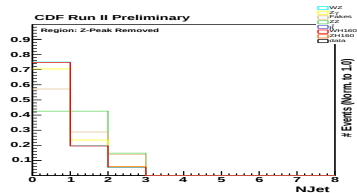
In Z Peak Analysis: Result



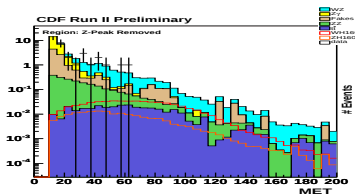
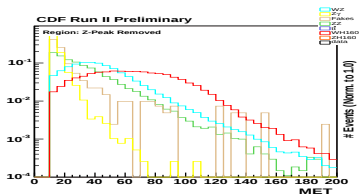
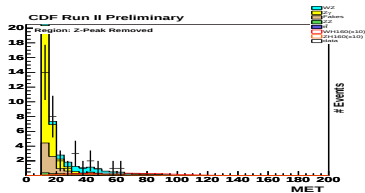
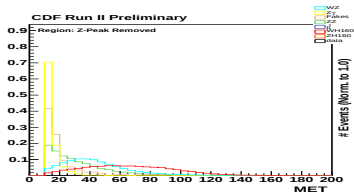
Preselection

- $E_T < 20.0$ GeV
- Basic Lepton ID (for two or three leptons)
- Good Run (accesses a list of good runs)
- Triggered Lepton (trigger bits passed for data)
- Max Δz_0 within limits
- Trilepton identified for event, but not same-sign analysis trileptons.

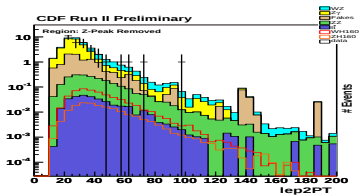
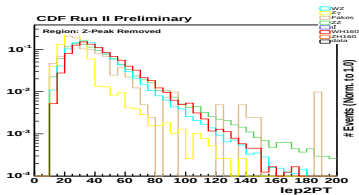
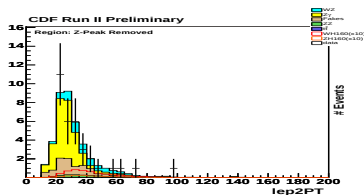
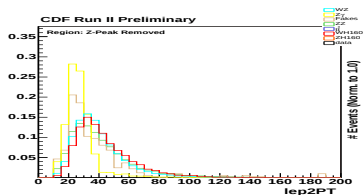
No Z Peak: NJet



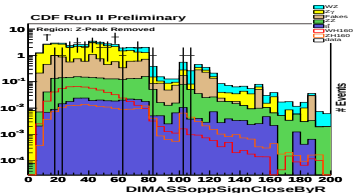
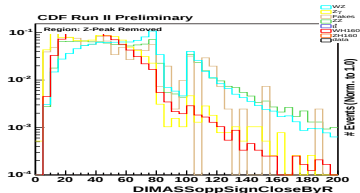
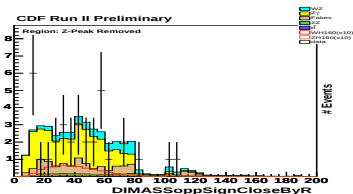
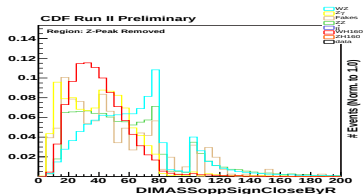
No Z Peak: $\cancel{E}_T$



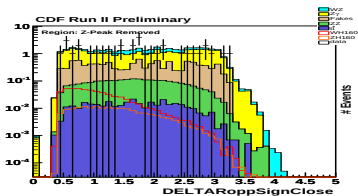
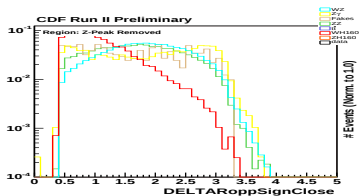
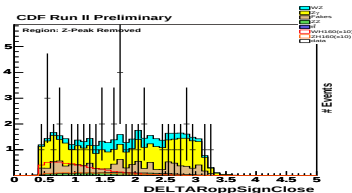
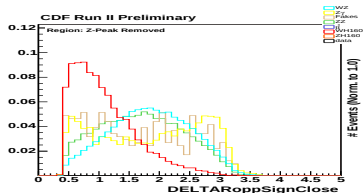
No Z Peak: 2nd Lepton p_T



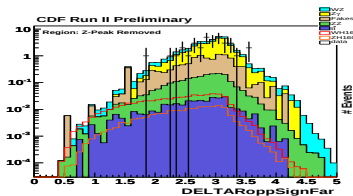
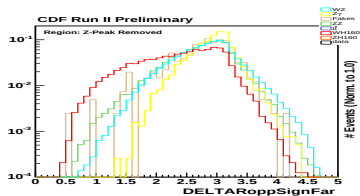
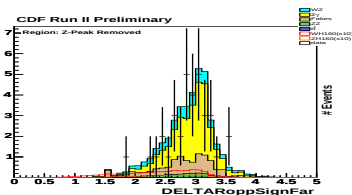
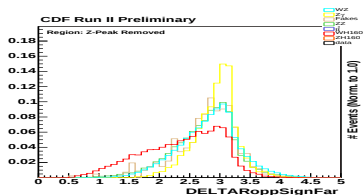
No Z Peak: Dilepton Inv. Mass of Opp. Sign Close (by R) Leptons



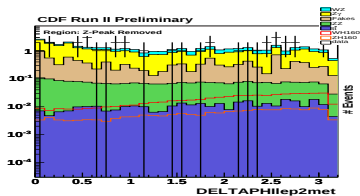
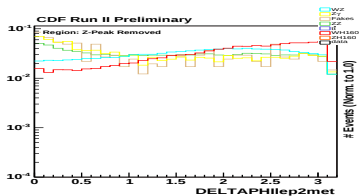
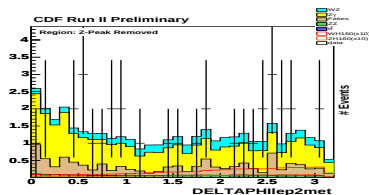
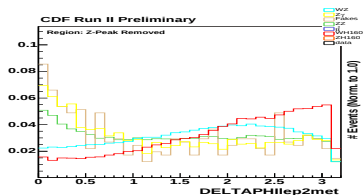
No Z Peak: ΔR Opp. Sign Close



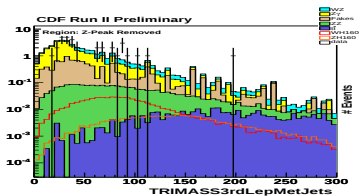
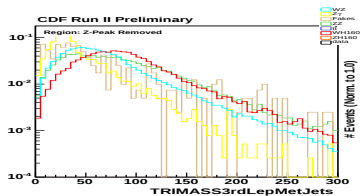
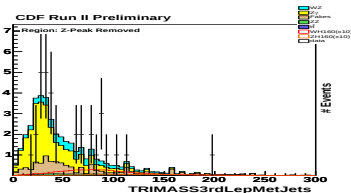
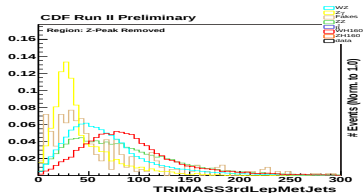
No Z Peak: ΔR Opp. Sign Far



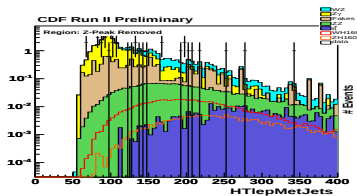
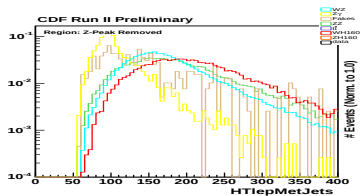
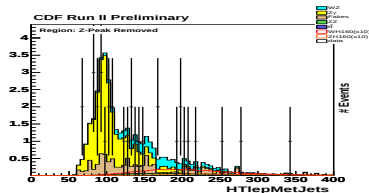
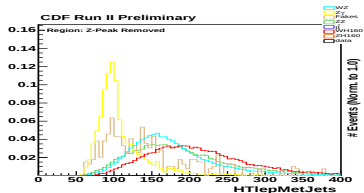
No Z Peak: $\Delta\phi$ b/w 2nd lepton and $\cancel{E}_T$



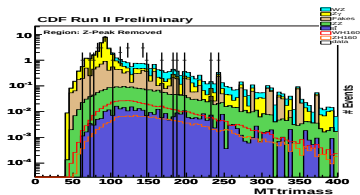
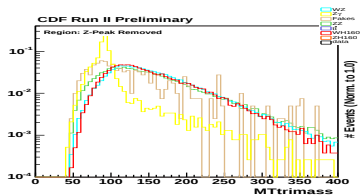
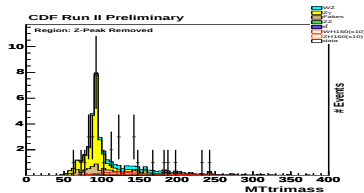
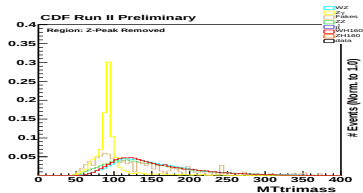
No Z Peak: Inv. Mass of 3rd lepton, $\cancel{E}_T$, Jets



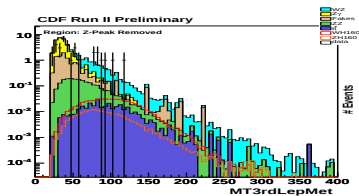
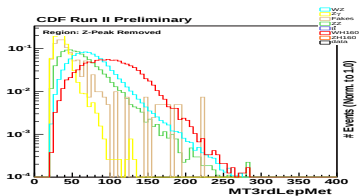
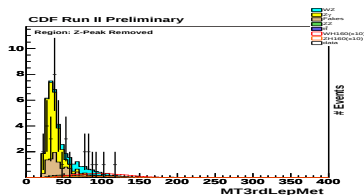
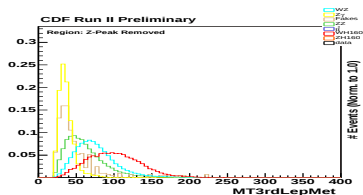
No Z Peak: H_T : 3 leptons, $\cancel{E}_T$, Jets



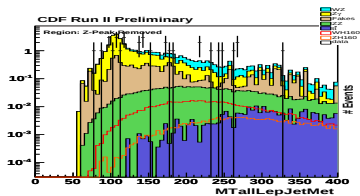
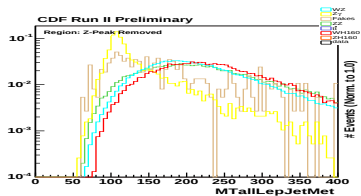
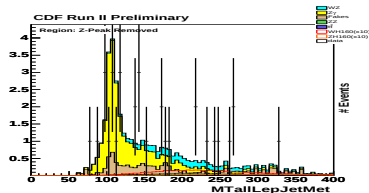
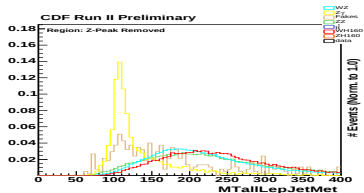
No Z Peak: M_T : 3 leptons



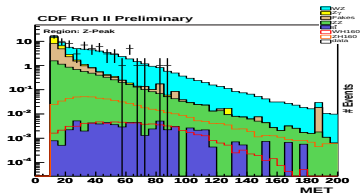
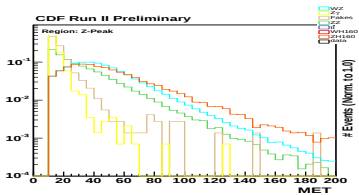
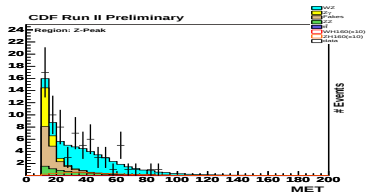
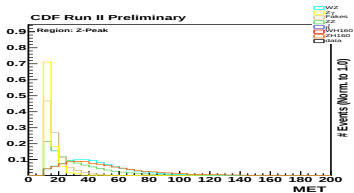
No Z Peak: M_T : 3rd lepton, $\cancel{E}_T$



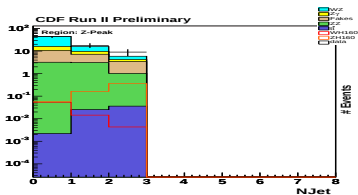
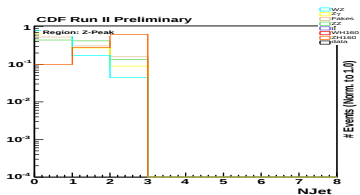
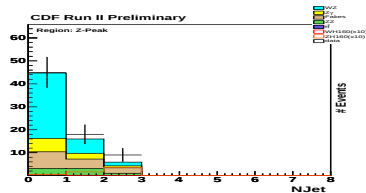
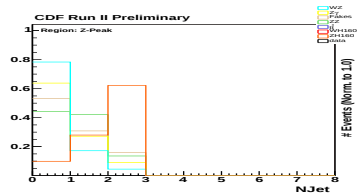
No Z Peak: M_T : 3 leptons, $\cancel{E}_T$, Jets



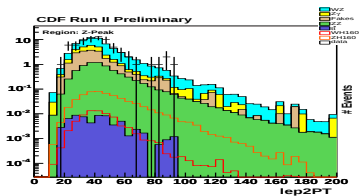
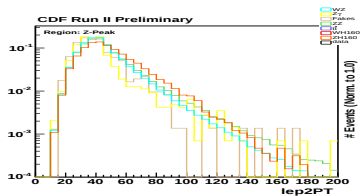
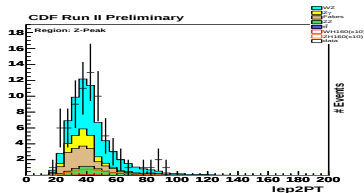
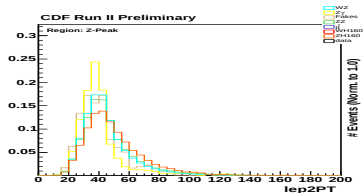
In Z Peak: E_T



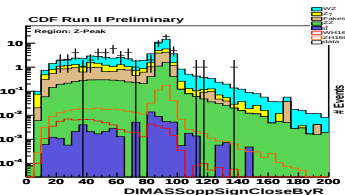
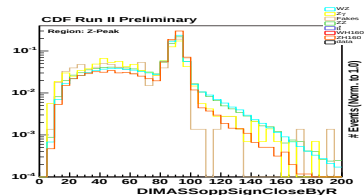
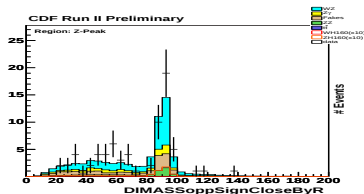
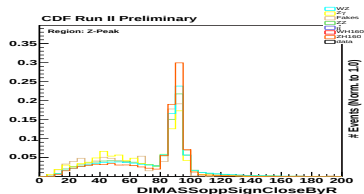
In Z Peak: NJet



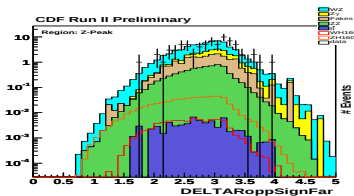
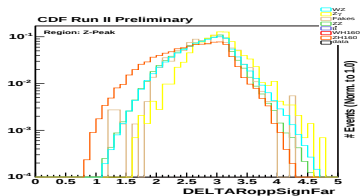
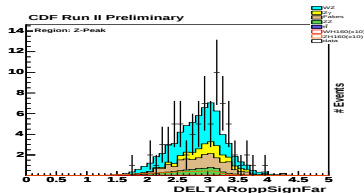
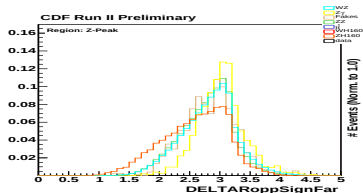
In Z Peak: 2nd Lepton p_T



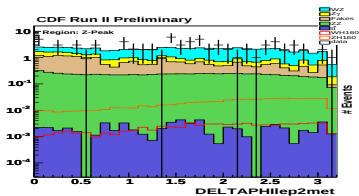
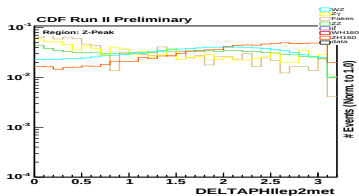
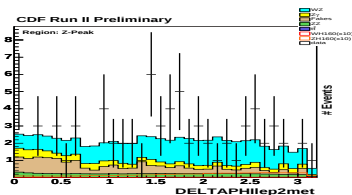
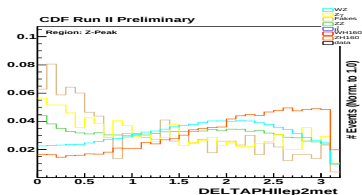
In Z Peak: Dilepton Inv. Mass of Opp. Sign Close (by R) Leptons



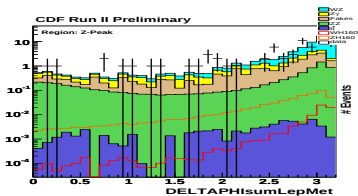
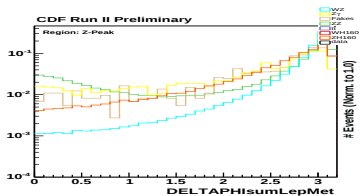
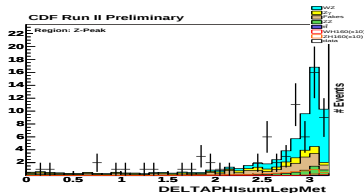
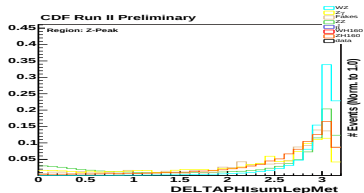
In Z Peak: ΔR Opp. Sign Far



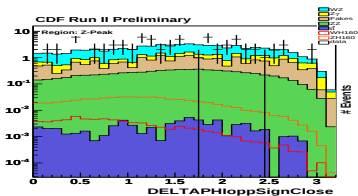
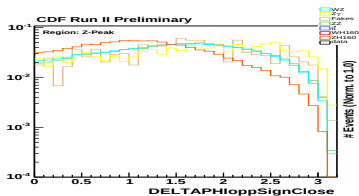
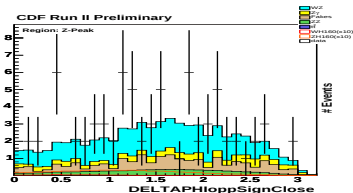
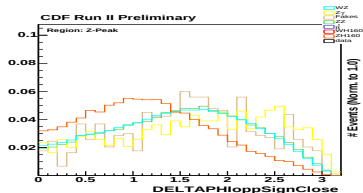
In Z Peak: $\Delta\phi$ b/w 2nd lepton and $\cancel{E}_T$



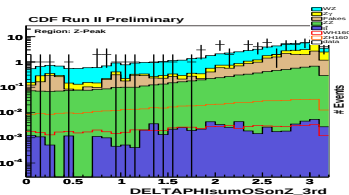
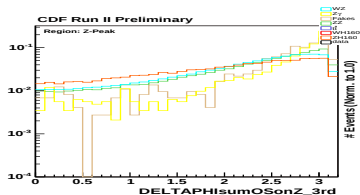
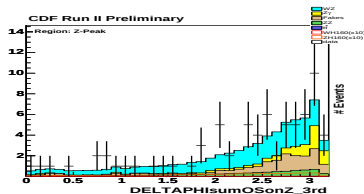
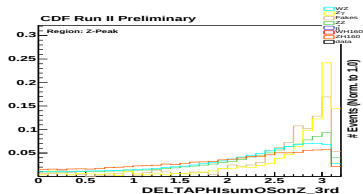
In Z Peak: $\Delta\phi$ b/w Sum of the 3 leptons and $\cancel{E}_T$



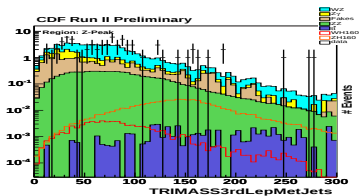
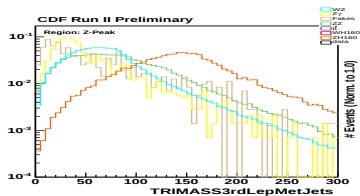
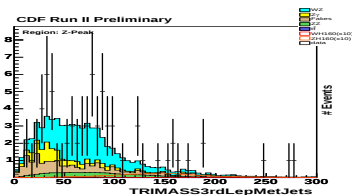
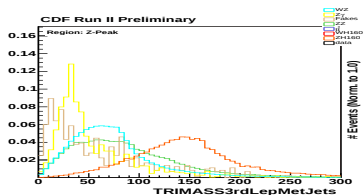
In Z Peak: $\Delta\phi$ Opp. Sign Close



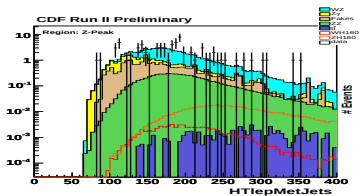
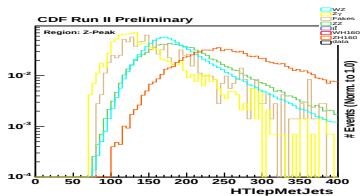
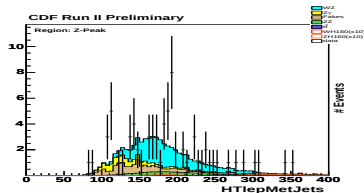
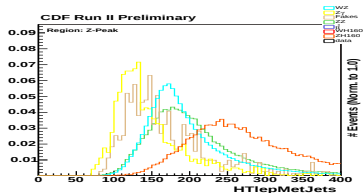
$\Delta\phi$ b/w Sum of Opp. Sign leptons on Z-peak and 3rd lepton



In Z Peak: Inv. Mass of 3rd lepton, $\cancel{E}_T$, Jets



In Z Peak: H_T : 3 leptons, $\cancel{E}_T$, Jets



In Z Peak: M_T : 3 leptons, $\cancel{E}_T$, Jets

