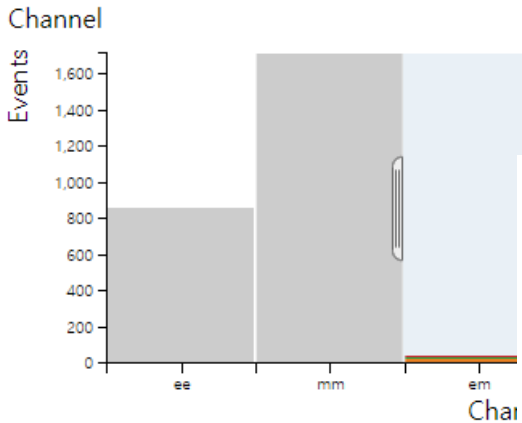
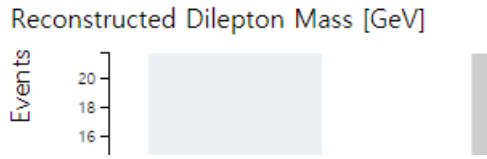
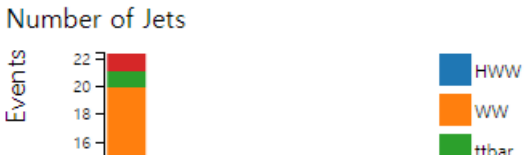
FINDING HIGGS BOSON

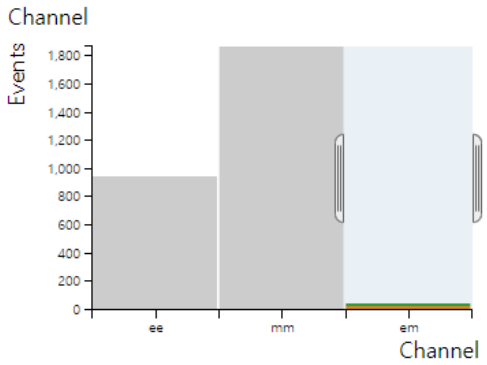
Open Cluster M46

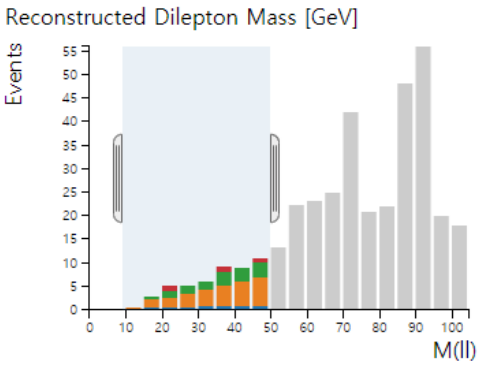
TRIAL

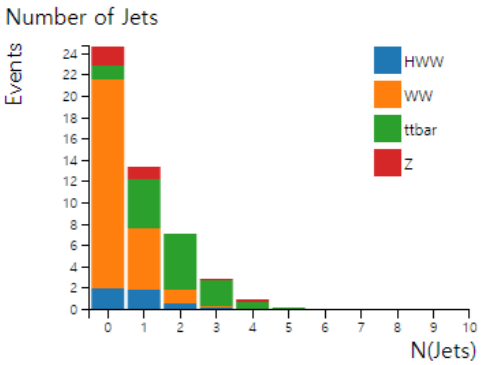

Channel
Events
ee
mm
em

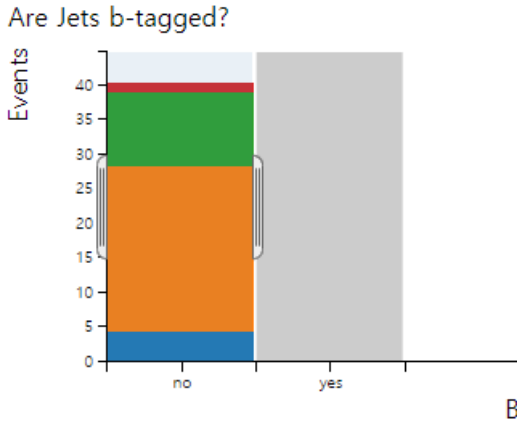

Reconstructed Dilepton Mass [GeV]
Events

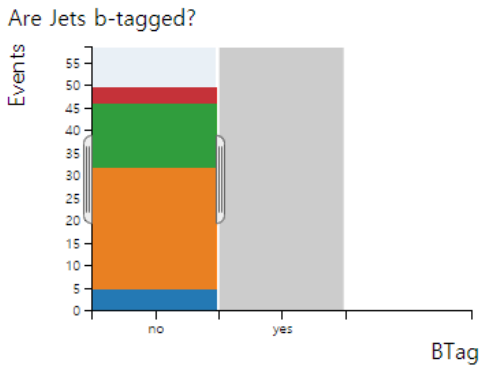

Number of Jets
Events
HWW
WW
ttbar

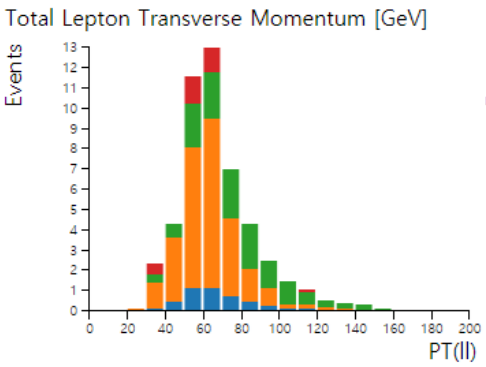

Channel
Events
ee
mm
em
Channel

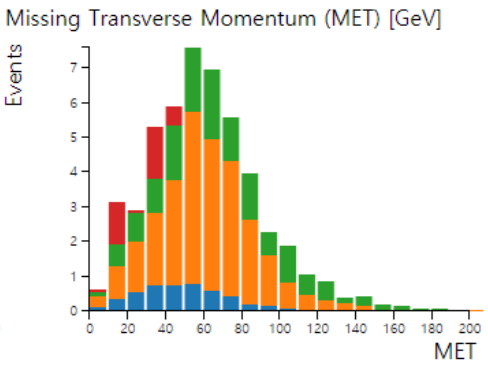

Reconstructed Dilepton Mass [GeV]
Events
M(ll)

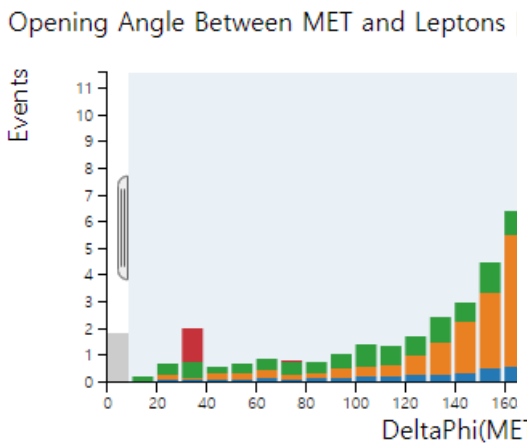

Number of Jets
Events
HWW
WW
ttbar
Z
N(Jets)

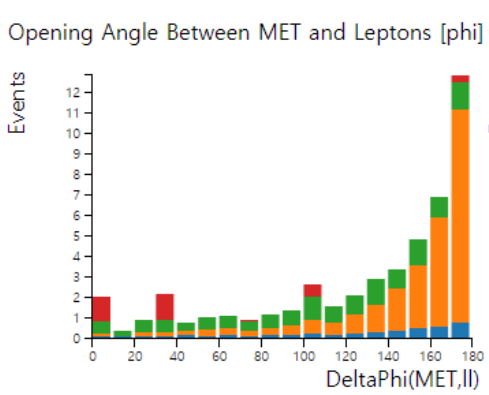

Are Jets b-tagged?
Events
no
yes

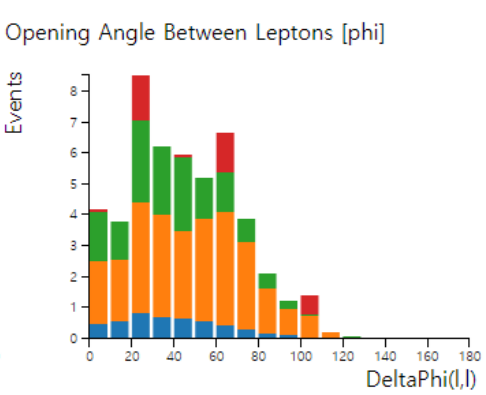

Are Jets b-tagged?
Events
no
yes
BTag

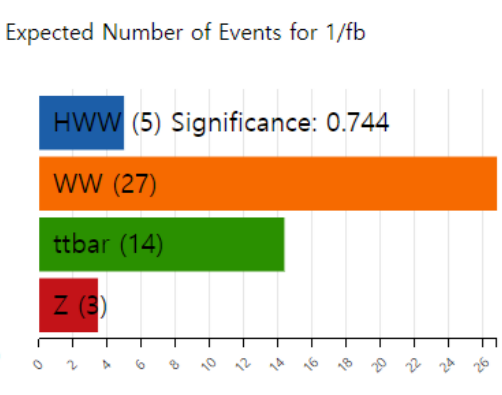

Total Lepton Transverse Momentum [GeV]
Events
PT(ll)


Missing Transverse Momentum (MET) [GeV]
Events
MET


Opening Angle Between MET and Leptons
Events
DeltaPhi(MET,ll)

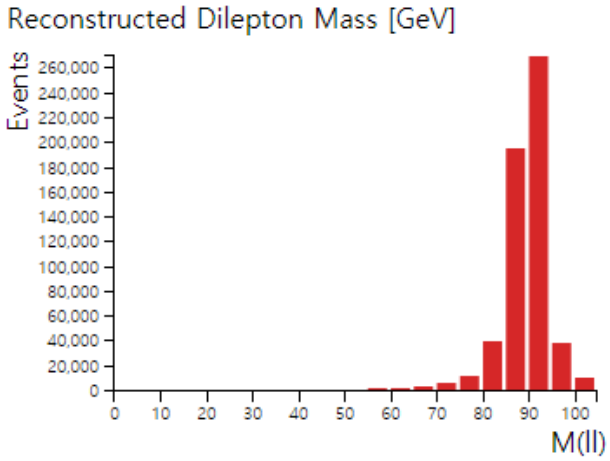

Opening Angle Between MET and Leptons [phi]
Events
DeltaPhi(MET,ll)

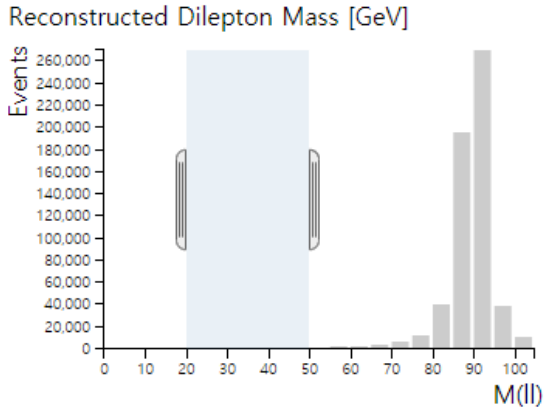

Opening Angle Between Leptons [phi]
Events
DeltaPhi(l,l)


Expected Number of Events for 1/fb
HWW (5) Significance: 0.744
WW (27)
ttbar (14)
Z (3)

SIMULATED AND SIMULATED+REAL (DILEPTON MASS)

Simulated



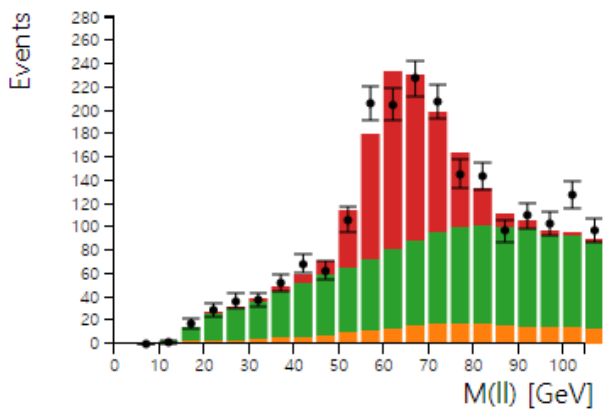


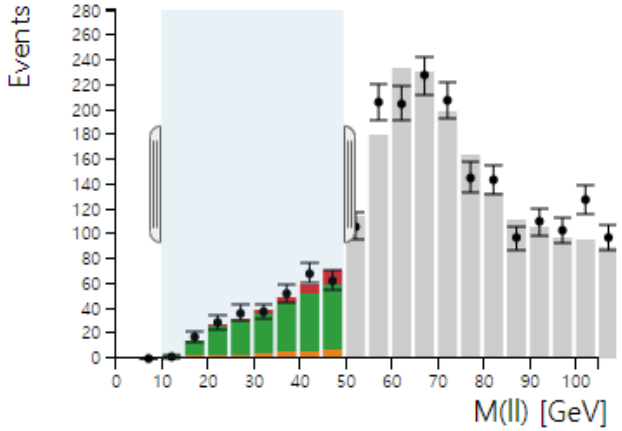
Significance HWW

0.021 ⇨ 0.198

Difference: 0.177

Simulated + Real





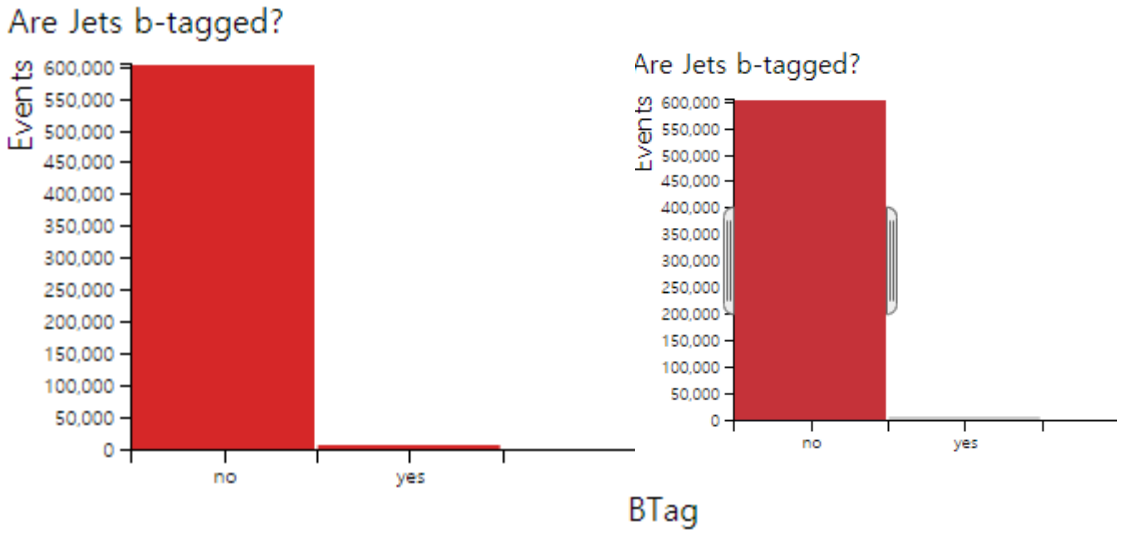
Significance HWW

0.098 ⇨ 0.207

Difference: 0.109

SIMULATED AND SIMULATED+REAL (B-TAGGED JETS)

Simulated

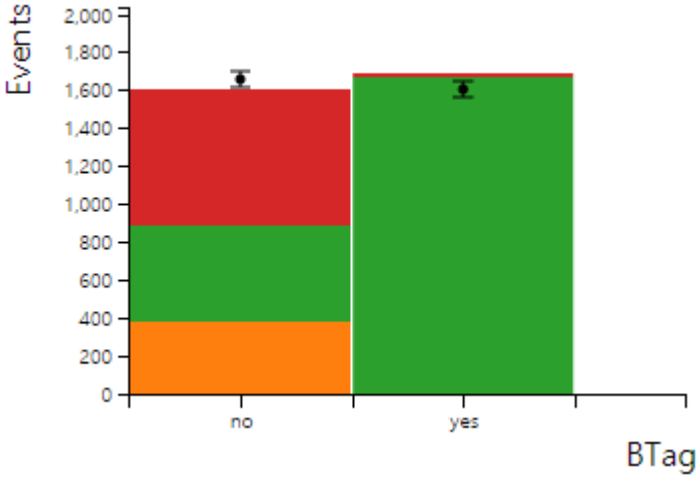


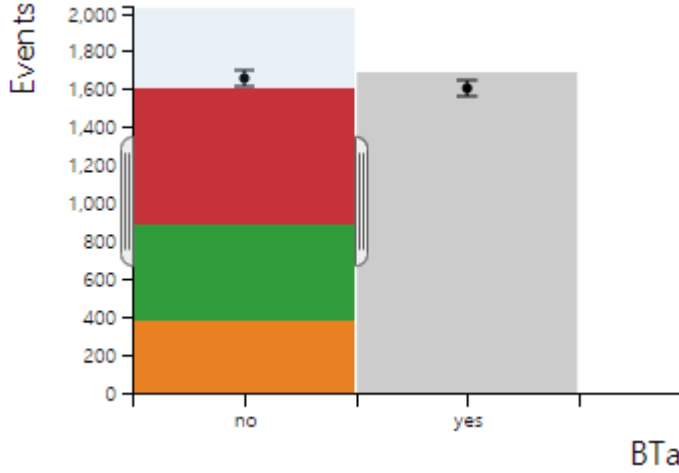
Significance HWW

0.021 ⇨ 0.021

Difference: 0

Simulated + Real





Significance HWW

0.098 ⇨ 0.136

Difference: 0.038

WHY REAL DATA AND SIMULATED DATA DON'T AGREE

conditions not being exactly the same e.g. energy,

not all background processes are included in the simulated data, or

- the physics has not been exactly modelled by the theory. Data and simulated data do not always agree: There is a small disagreement in normalisation of approximately 5% between simulated and real data. This may be attributed to the fact that the b-tagging scale factor is not applied despite two b-tags being required. A survey of the shapes of all presented histograms reveals no obvious discrepancies.

WHY ONLY LEPTONIC CHANNELS ARE AVAILABLE

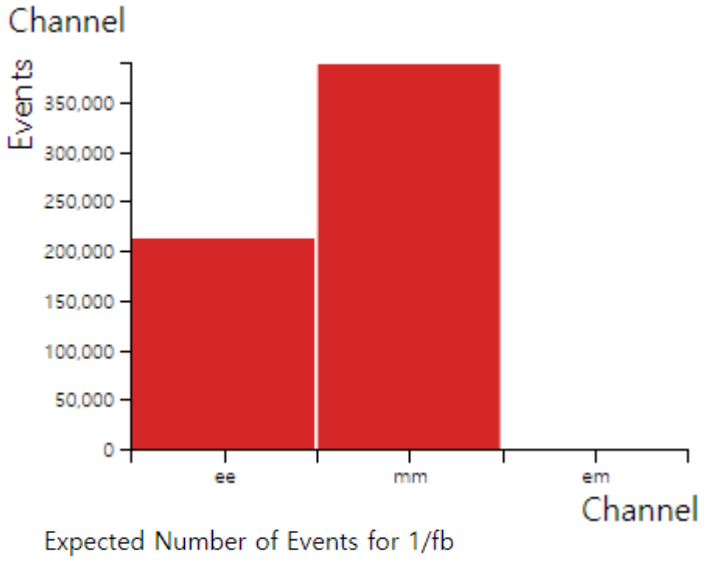
The decay mode with the highest branching ratio (BR) is the decay to hadrons, BR 70%, which is not easy to detect due to QCD background.

A large fraction of the leptonic decays are to a pair of neutrinos, BR 20%, which are difficult to detect since they hardly interact with matter.

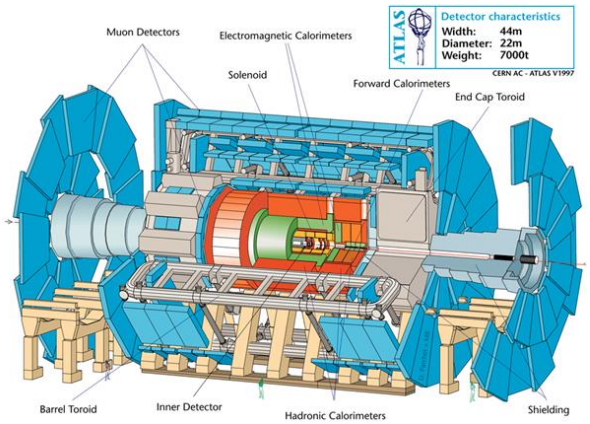
The decay to pairs of electrons, muons and taus have a BR of about 10% of the total.

In fact, the tau life time is very short, 3x10s, so it can be reconstructed only from its decay products. The efficiency of reconstructing taus is much lower than that of electrons and muons. So essentially, focusing on decays into electrons and muons, we are chasing just 6% of all the possible Higgs produced in the LHC.

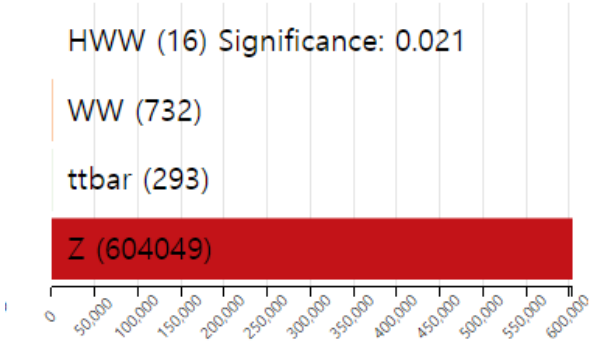
CHANNELS

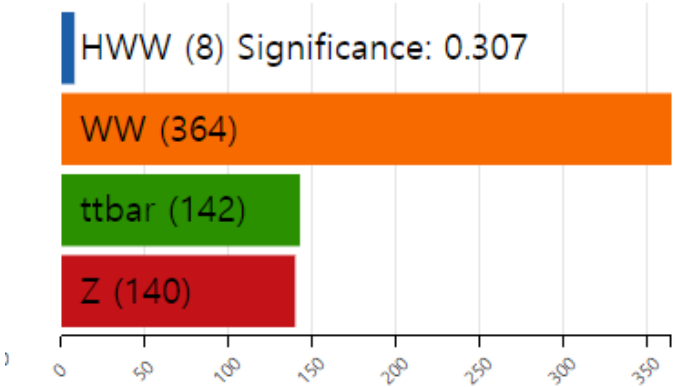


Expected Number of Events for 1/fb



Expected Number of Events for 1/fb



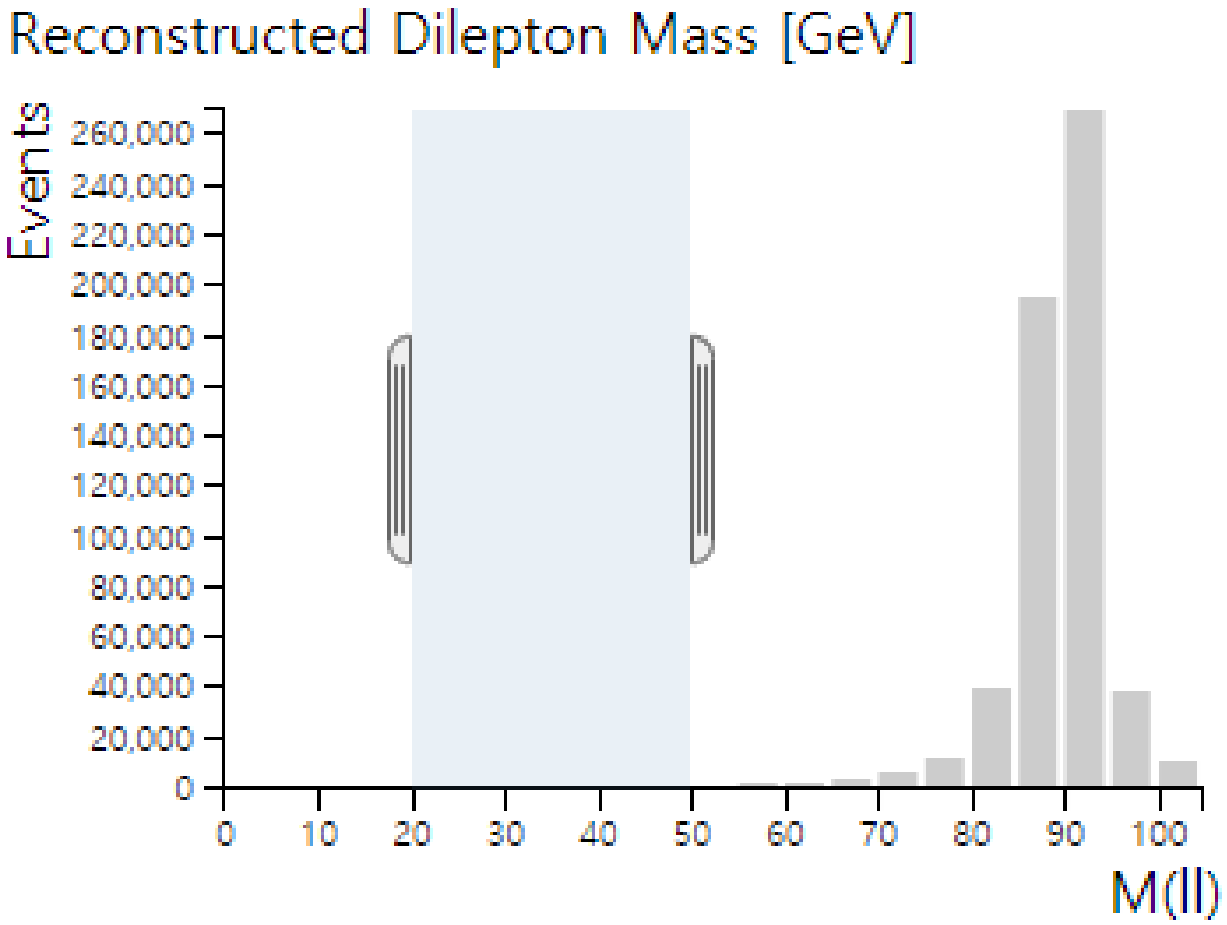


Higgs boson can decay into WW or ZZ. Each W boson can decay into a lepton and neutrino or to an up-type quark and a down-type quark. Decaying into a lepton and neutrino:

1. Electron&electron neutrino,
2. Muon&muon neutrino,
3. Tau&tau neutrino

For Z bosons, 1.(10%) charged lepton-antilepton pairs: electron-positron, muon-antimuon and tau-antitau pairs. 2. (20%) neutrino-antineutrino pair(3 possible decay modes). 3.(70%) a quark-antiquark pair is produced and appear as particle showers called jets(18 possible decay modes)

DILEPTON MASS



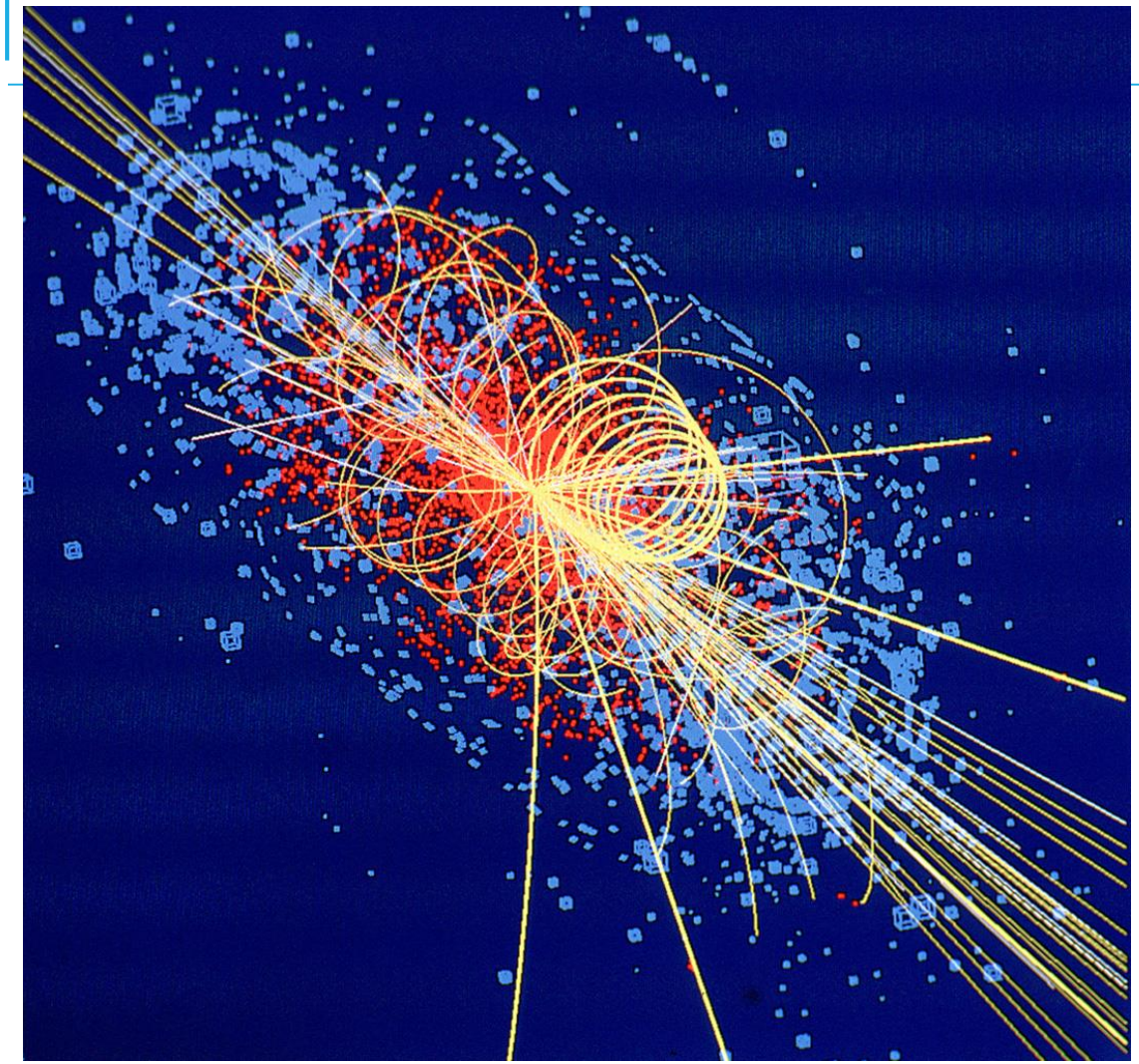
This graph depicts the alterations we have made to the reconstructed dilepton mass graph.

DI-LEPTON MASS

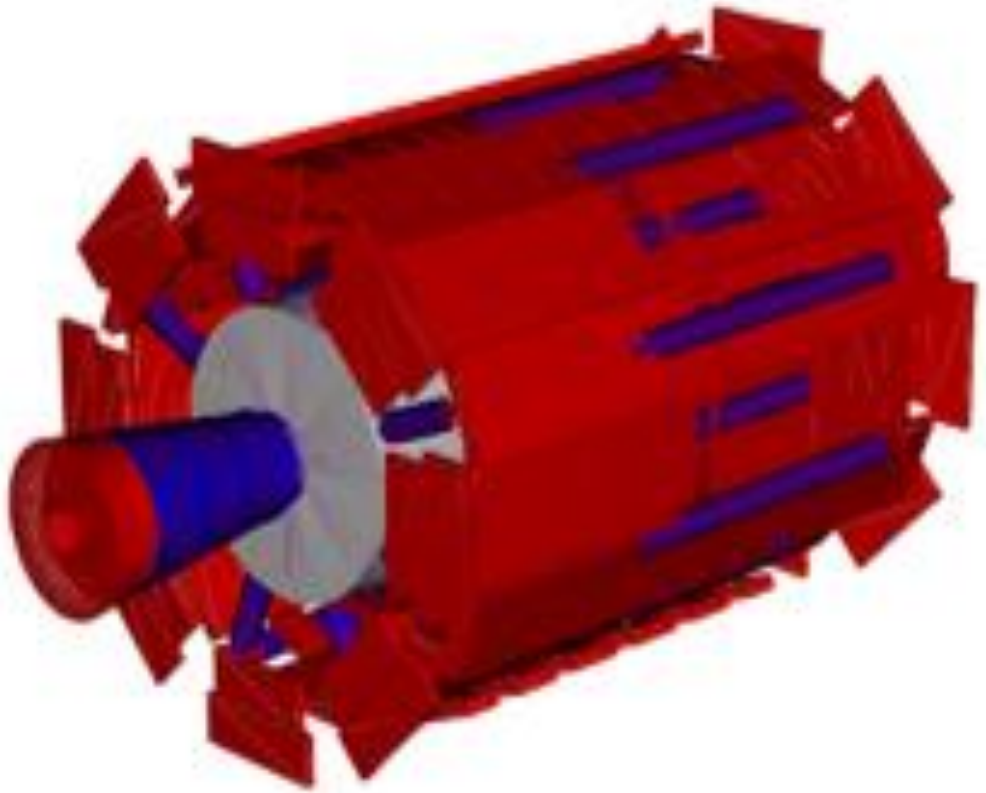
In March 2012, scientists at Fermilab in the US confirmed the most precise measurement of the W boson's mass to date, at 80.385 +/- 0.016 GeV/c^2, and the Z boson being 91.2 GeV/c^2,

we can remove a large number of boson events by selecting Reconstructed Dilepton Mass to be less than those values, whilst hardly touching our Higgs signal. It is thus a useful quantity to use to reduce the huge boson background.

B-TAGGED JETS



In order to increase the significance of finding the Higgs, we chose not to look at b-tagged jets, this is because they are not expected in leptonic decays. Thus, when B-tagged jets are generated, we must not account for them as they are background.



THANK YOU