PROCEEDINGS OF SCIENCE

Higgs Search in $H \to WW^{(*)}$ Channel with the CMS Detector

Majid Hashemi*
University of Antwerp, Belgium
E-mail: majid.hashemi@cern.ch

In this report prospects of the search for the Standard Model Higgs boson in the decay channel $H \to WW^* \to \ell\nu\ell'\nu'$ (ℓ or ℓ' = e or μ) with the CMS experiment at the LHC is presented. The analysis relies on a full simulation of the detector response and the measurement of experimental and background systematics from data. The discovery reach is presented as a function of the Higgs boson mass at very low luminosities of O(1 fb^{-1}).

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1. Introduction

The standard model Higgs boson decay to a W boson pair is one of the main discovery channels of this particle in CMS. In this report results of the analysis of fully leptonic final state are presented.

2. Signal and Background Cross Sections

At LHC running at $\sqrt{s}$ =14 TeV, $\sigma\times$ BR($H \to WW^{(*)} \to \ell\nu\ell'\nu'$) = 2.34 *pb* for $m_{(H)} = 160$ GeV, i.e. 2340 events are expected to be collected at $1\,fb^{-1}$. Here $\ell = e$ or μ. Main background processes are WW leptonic decays ($12\,pb$), $t\bar{t}$ (836 *pb*) and W+jets (58 *nb*).

3. Selection of Events

Events are first selected online and saved into the tape. A preselection is then performed to reduce the data sample size. In the final event selection mass dependent cuts are applied on kinematic distributions. Examples of kinematic distributions are shown in Fig.1 .

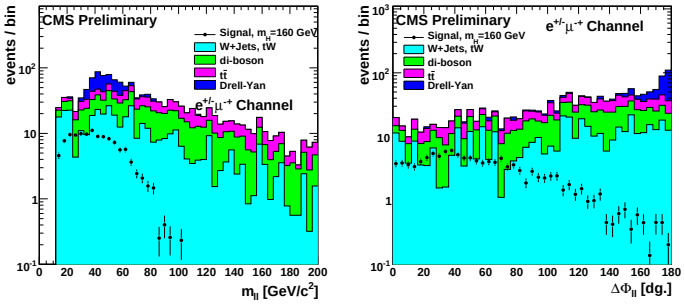

Figure 1: Invariant mass of the di-lepton system (a) and the azimuthal angle between them (b) for the eμ channel after basic selections for $m_{(H)} = 160\ GeV$. Distributions are normalized to $1\,fb^{-1}$.

More details on selection cuts are presented in Ref. [1]. Selection of events is performed either as a cut-based selection or multivariate analysis. Examples of distributions of multivariate analysis are shown in Fig. 2. A detailed study of background samples estimation from data and systematic uncertainties involved in the analysis has been performed and can be found in Ref. [1]. Figure 3 shows the signal statistical significance as a function of the Higgs boson mass in two scenarios of cut-based and multivariate analysis. Finally Fig. 4 shows the 95% C.L. exclusion limit as a function of the Higgs boson mass using multivariate analysis.

4. Conclusions

A Standard model Higgs boson could be rejected at 95% C.L. in CMS at $1\,fb^{-1}$ in the mass range 140$< m_{(H)} <$200 GeV while 5σ discovery is expected to be possible for $m_{(H)} \simeq 160$ GeV.

References

[1] CMS Physics analysis summary: CMS-PAS-HIG-08-006

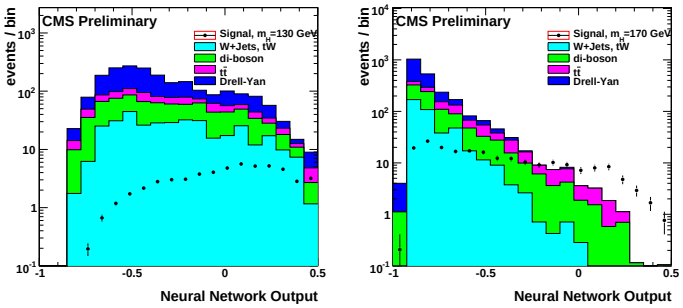

Figure 2: NN outputs for signal (black dots) and background (filled histograms) events for $m_{(H)}$=130 GeV (left) and $m_{(H)}$=170 GeV (right). The distributions are normalized to an integrated luminosity of 1 fb^{-1}.

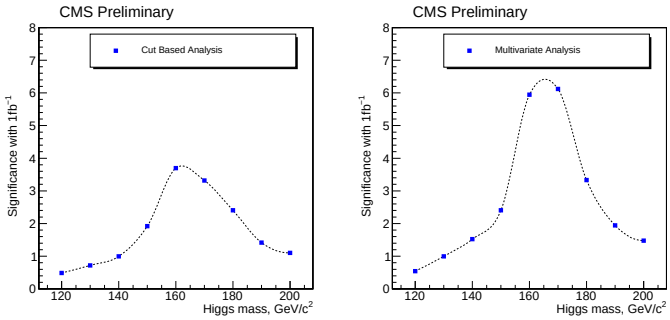

Figure 3: The expected significance of an event excess in assumption of a Higgs boson presence for the cut based (left) and multivariate analysis (right) for an integrated luminosity of 1 fb^{-1}.

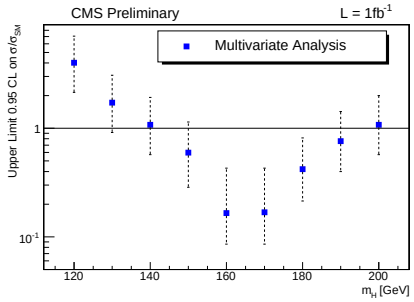

Figure 4: The 95% confidence level upper limits obtained for each of the Higgs mass considered. No signal is assumed to be present.