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Search of Standard Model Higgs in WH WWW 3l 3 at 7 and 8 TeV

Abstract

This note reports on a search for the associated Higgs (WH) Production with H W^+W^- in the 3 leptons final state in pp collisions at sqrt(s) = 7 TeV and 8 TeV. The analysis is performed using LHC data recorded with the CMS detector, corresponding to an integrated luminosity of 10 fb^{-1}. Candidates are selected in events with three leptons, electrons or muons, large missing energy and low hadronic activity. No significance excess of events above the standard model background expectation is observed. The observed (expected) upper limits at the 95% confidence level are about 4.8 (5.0) times larger than the standard model expectation from mH = 125 GeV/c^2.

Results

The observed number of data events and the expected number of signal and background events at different stages of the analysis are shown in Table below. The contribution from WH ( ) decays is about 20% of the total number of expected Higgs boson events for mH = 120 GeV, while it decreases to values below 10% for Higgs boson masses beyond 130 GeV. No significance excess of events is observed with respect to the background prediction, and 95% Confidence Level (CL) upper limits are calculated for the Higgs boson cross section with respect to the SM Higgs boson expectation, / $_{SM}$, using the modified frequentist construction CL_s. In total, four categories are considered: the two center of mass energies and the OSSF (opposite sign same flavor) and SSSF (same sign same flavor) final states. The number of events in each category is modeled as a Poisson random variable, whose mean value is the sum of the contributions from signal and background processes. All the sources of systematic uncertainties are considered.

* **Yields at different stages of the analysis**:

7 TeV SSSF channel						
stage	**WH( ) 125**	**WH(WW) 125**	**data**	**all bkg.**	**WZ**	**fakes**
3-lepton preselection	0.22 ± 0.02	0.44 ± 0.01	13	12.61 ± 1.14	2.08 ± 0.10	8.47 ± 1.13
min-MET > 30 GeV	0.15 ± 0.02	0.33 ± 0.01	9	9.04 ± 0.97	1.33 ± 0.08	6.19 ± 0.96
Z removal	0.15 ± 0.02	0.33 ± 0.01	9	9.04 ± 0.97	1.33 ± 0.08	6.19 ± 0.96
top veto	0.07 ± 0.01	0.26 ± 0.01	2	2.26 ± 0.42	0.77 ± 0.06	1.14 ± 0.42
Δ R(ll) and mll	0.04 ± 0.01	0.23 ± 0.01	2	1.07 ± 0.24	0.47 ± 0.05	0.43 ± 0.24
7 TeV OSSF channel						
stage	**WH( ) 125**	**WH(WW) 125**	**data**	**all bkg.**	**WZ**	**fakes**
3-lepton preselection	1.37 ± 0.06	1.38 ± 0.01	937	988.95 ± 12.01	502.76 ± 1.91	328.75 ± 9.41
min-MET > 40 GeV	0.62 ± 0.04	0.84 ± 0.01	237	248.92 ± 2.25	216.57 ± 1.11	16.42 ± 1.92
Z removal	0.18 ± 0.02	0.64 ± 0.01	28	28.58 ± 1.34	15.63 ± 0.47	9.56 ± 1.25
top veto	0.08 ± 0.01	0.50 ± 0.01	10	10.86 ± 0.67	8.70 ± 0.41	1.33 ± 0.52
Δ R(ll) and mll	0.05 ± 0.01	0.45 ± 0.01	5	6.76 ± 0.45	5.55 ± 0.16	0.74 ± 0.41
8 TeV SSSF channel						
stage	**WH( ) 125**	**WH(WW) 125**	**data**	**all bkg.**	**WZ**	**fakes**
3-lepton preselection	0.35 ± 0.04	1.03 ± 0.16	24	28.82 ± 2.09	2.01 ± 0.12	23.40 ± 2.06
min-MET > 30 GeV	0.23 ± 0.03	0.78 ± 0.14	17	21.88 ± 1.86	1.25 ± 0.09	17.85 ± 1.83
Z removal	0.23 ± 0.03	0.78 ± 0.14	17	21.88 ± 1.86	1.25 ± 0.09	17.85 ± 1.83
top veto	0.08 ± 0.02	0.43 ± 0.10	4	3.07 ± 0.66	0.69 ± 0.07	2.03 ± 0.65
Δ R(ll) and mll	0.06 ± 0.02	0.41 ± 0.10	1	2.20 ± 0.61	0.40 ± 0.05	1.54 ± 0.61
8 TeV OSSF channel						

stage	WH( ) 125	WH(WW) 125	data	all bkg.	WZ	fakes
3-lepton preselection	2.06 ± 0.11	6.01 ± 0.35	1361	1363.11 ± 16.06	547.61 ± 4.21	534.60 ± 13.27
min-MET > 40 GeV	1.02 ± 0.08	3.14 ± 0.25	304	324.65 ± 4.49	232.00 ± 2.83	38.03 ± 3.08
Z removal	0.41 ± 0.05	1.27 ± 0.15	62	60.65 ± 2.94	27.09 ± 1.92	24.09 ± 2.12
top veto	0.13 ± 0.03	0.68 ± 0.11	24	23.02 ± 2.00	18.60 ± 1.75	3.39 ± 0.96
Δ R(ll) and mll	0.11 ± 0.03	0.62 ± 0.11	10	9.35 ± 0.80	5.54 ± 0.20	3.10 ± 0.76

The expected and observed upper limits with 10 fb^{-1} of data are shown in Figure 1. Since the analysis is independent of Higgs mass, only small fluctuations are expected between different Higgs hypotheses. The observed (expected) upper limit at the 95% CL is 4.8 (5.0) times larger than the SM expectation for mH = 125 GeV. the bands represents the 1 and 2 probability intervals around the expected limit.

	png, pdf	**Figure 1:** Upper Limits at 95% C.L. in 10 fb^{-1} in the standard model Higgs scenario. The expected limits in the presence of the SM Higgs boson at mH = 125 GeV are also shown

Kinematic distributions

	png, pdf	**Min-Met distribution** after the trilepton selection for the SSSF category at 7 TeV

	png, pdf	**Min-Met distribution** after the trilepton selection for the OSSF category at 7 TeV

	png, pdf	**Min-Met distribution** after the trilepton selection for the SSSF category at 8 TeV
	png, pdf	**Min-Met distribution** after the trilepton selection for the OSSF category at 8 TeV
	png, pdf	**Dilepton mass difference with respect to mZ** after the min-MET requirement for the OSSF category at 7 TeV
	png, pdf	**Dilepton mass difference with respect to mZ** after the min-MET requirement for the OSSF category at 8 TeV

	png, pdf	**Dilepton for all categories together** after the min-MET and jet veto requirements
	png, pdf	**Leading jet p_t distribution** after the Z veto (3 lepton preselection + min-MET + Zremoval conditions) for the SSSF category at 7 TeV
	png, pdf	**Leading jet p_t distribution** after the Z veto (3 lepton preselection + min-MET + Zremoval conditions) for the OSSF category at 7 TeV
	png, pdf	**Leading jet p_t distribution** after the Z veto (3 lepton preselection + min-MET + Zremoval conditions) for the SSSF category at 8 TeV

	png, pdf	**Leading jet p_t distribution** after the Z veto (3 lepton preselection + min-MET + Zremoval conditions) for the OSSF category at 8 TeV

	png, pdf	**ΔR distribution between the opposite charged lepton pairs** after all other requirements for the SSSF category at 7 TeV

	png,pdf	**ΔR distribution between the opposite charged lepton pairs** after all other requirements for the OSSF category at 7 TeV

	png,pdf	**ΔR distribution between the opposite charged lepton pairs** after all other requirements for the SSSF category at 8 TeV

	png,pdf	**ΔR distribution between the opposite charged lepton pairs** after all other requirements for the OSSF category at 8 TeV

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