

A short follow-up of Higgs invisible decay and Higgs width study

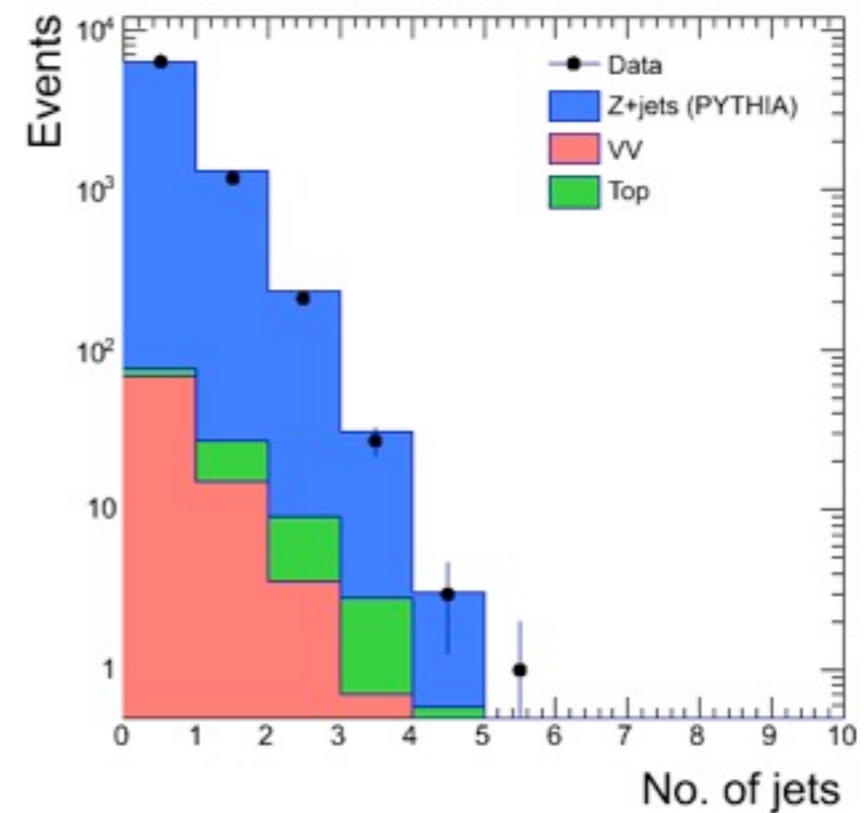
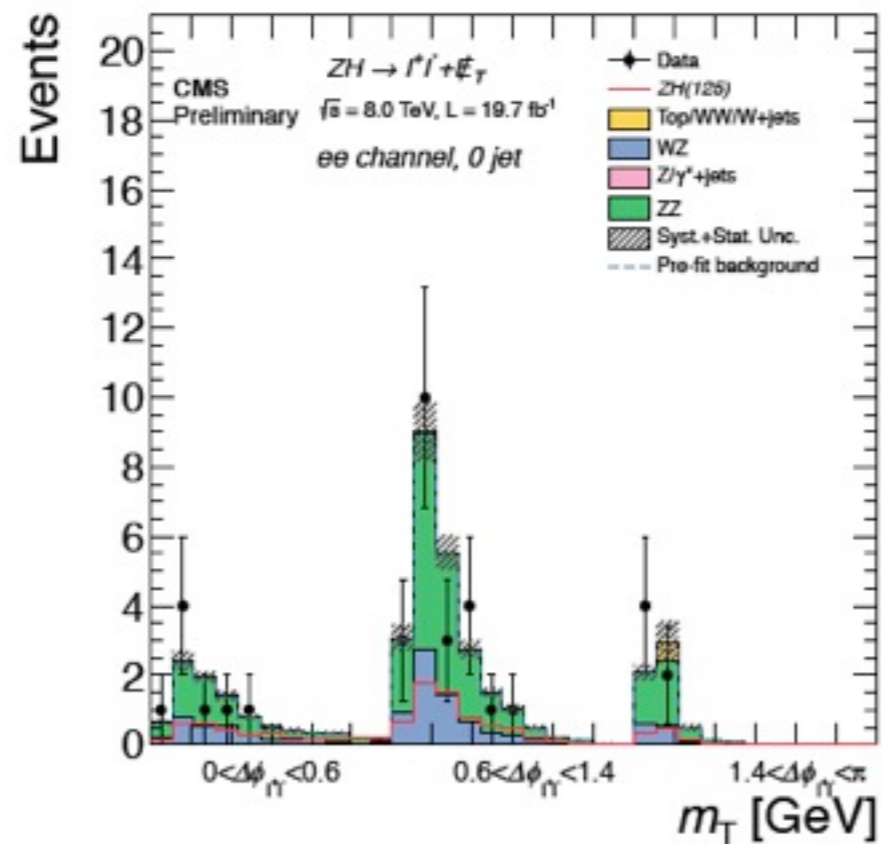
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ZH, H->invisible

Changes since PAS

- 2D shape analysis for 8 TeV - transverse mass vs. $\Delta\phi(\text{ll})$
- ZH+1j bin added

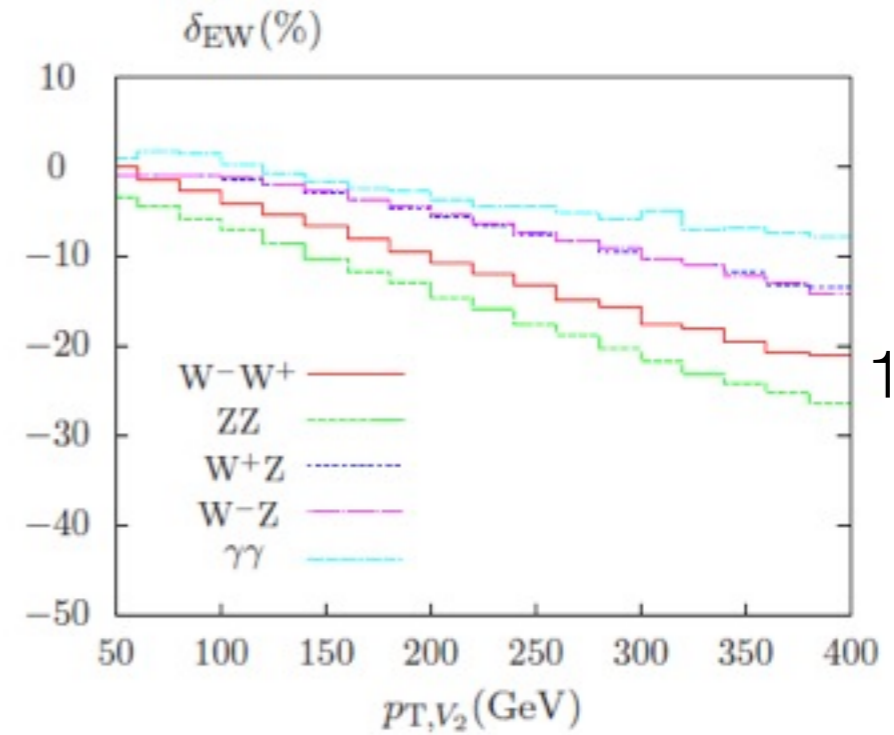


no. of jet in Pythia and data are compared after asking M_{ll} in [190,240] GeV

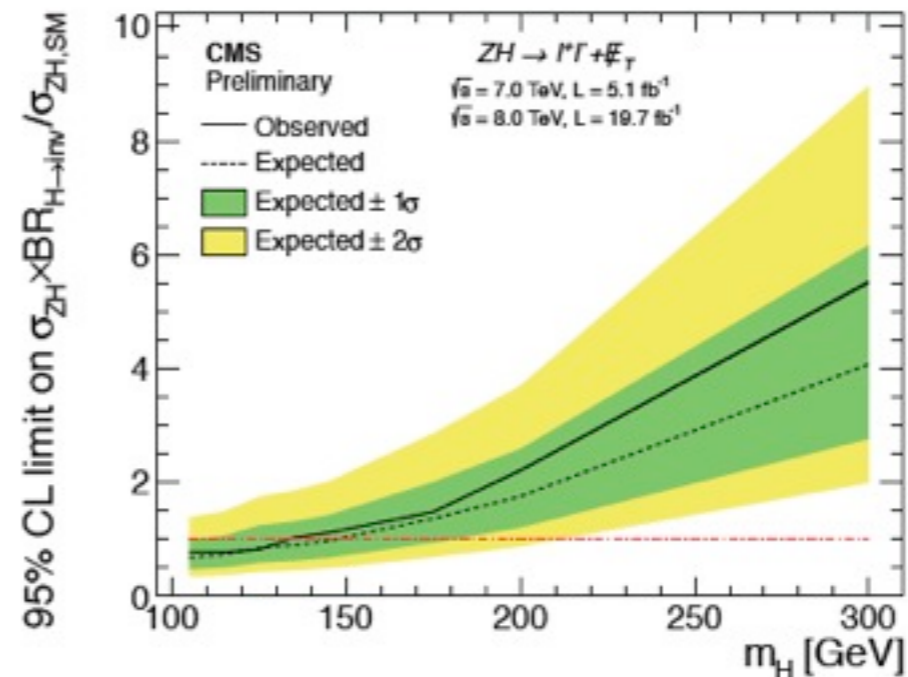
ZH, H->invisible Changes since PAS

- pT dependent NLO EW corrections to ZH and ZZ/WZ
- Searching mass range extended up to 300 GeV
- Synchronized and merged with another independent team

Observed(expected) upper limit on BR->invisible at 125GeV is 83(86)%; it was 75(91)%



1305.5402



CMS 5+20 /fb

Observed limit 83%(expected 86%)

Process	$\sqrt{s} = 7$ TeV		$\sqrt{s} = 8$ TeV	
	ee	$\mu\mu$	ee	$\mu\mu$
0 jet selection				
ZH(125)	2.3 ± 0.2	3.1 ± 0.3	10.3 ± 1.2	14.7 ± 1.5
$Z/\gamma^* \rightarrow \ell^+\ell^-$	0.1 ± 0.1	0.2 ± 0.2	0.2 ± 0.3	0.9 ± 1.4
$WZ \rightarrow 3\ell\nu$	1.7 ± 0.2	2.0 ± 0.3	10.4 ± 1.6	14.1 ± 1.7
$ZZ \rightarrow 2\ell 2\nu$	5.8 ± 0.7	7.8 ± 0.9	26.4 ± 3.0	35.9 ± 3.6
Top/WW/W + Jets	1.1 ± 6.4	1.0 ± 3.1	0.4 ± 1.5	0.7 ± 2.1
total bkg.	8.7 ± 6.5	11.0 ± 3.3	37.4 ± 3.7	51.6 ± 4.8
Data	9	10	36	46

ATLAS 5+13 /fb

ATLAS-CONF-2013-011

Observed limit 65%(expected 84%)

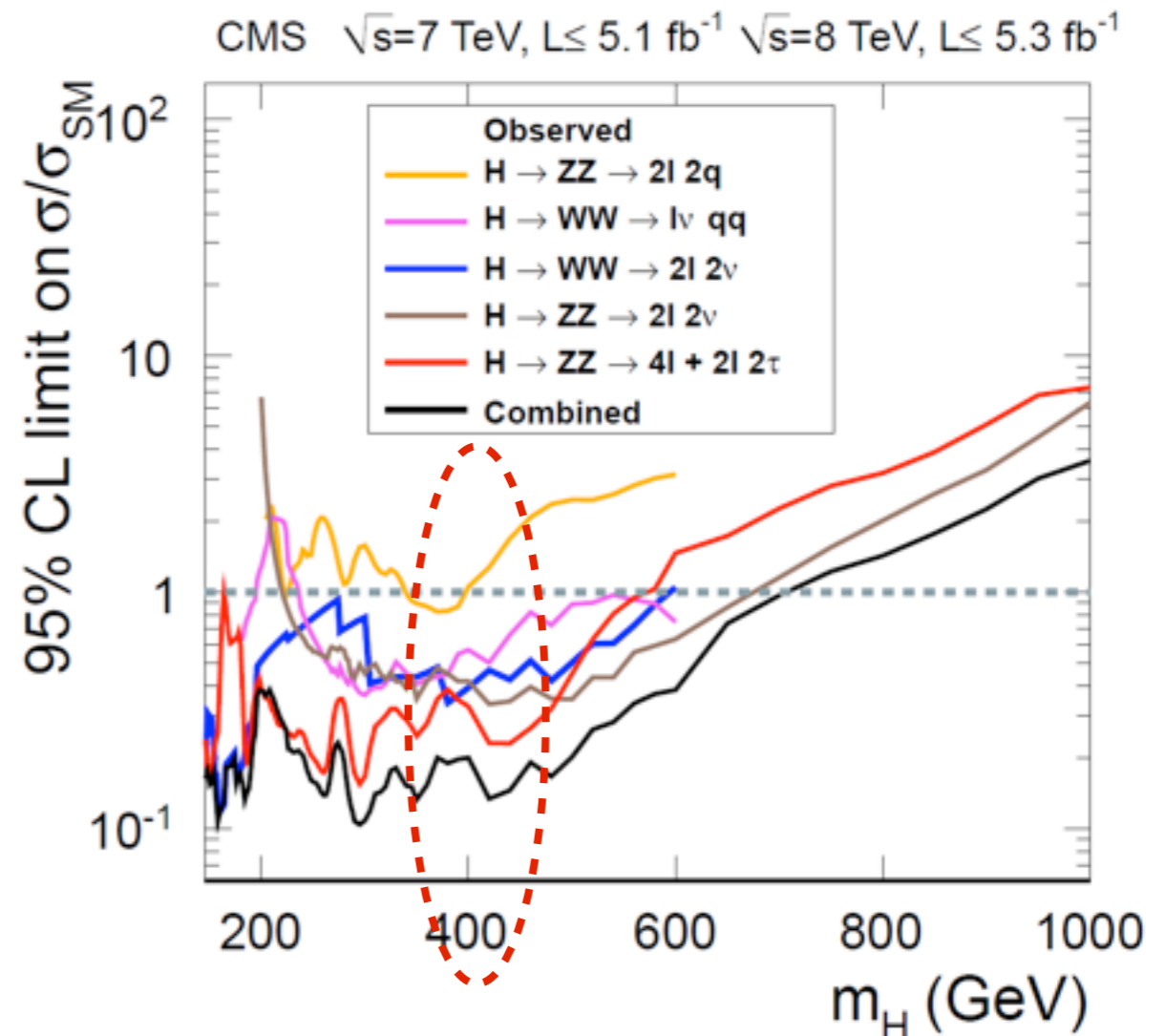
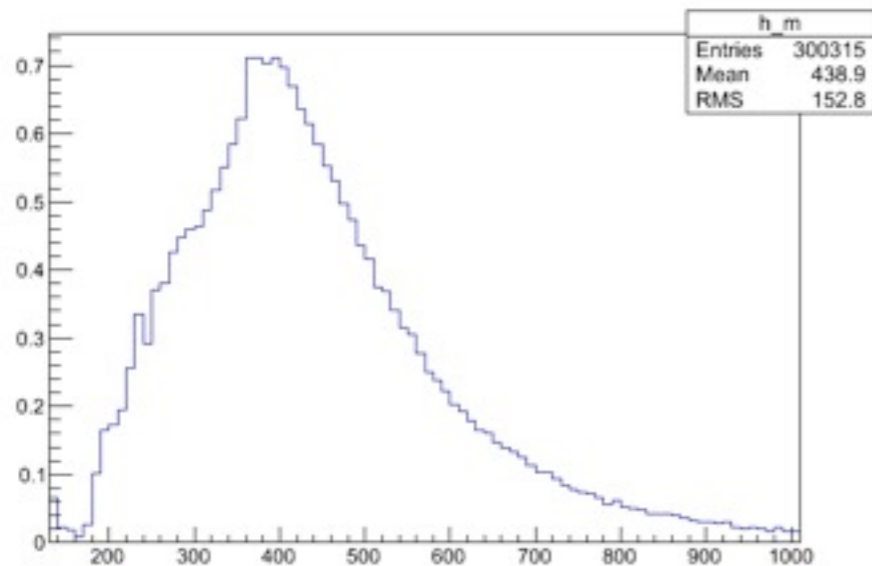
Data Period	2011 (7 TeV)	2012 (8 TeV)
ZZ	$23.5 \pm 0.8 \pm 2.5$	$56.5 \pm 1.2 \pm 5.7$
WZ	$6.2 \pm 0.4 \pm 0.7$	$13.9 \pm 1.2 \pm 2.1$
WW	$1.1 \pm 0.2 \pm 0.2$	used $e\mu$ data-driven
Top quark	$0.4 \pm 0.1 \pm 0.4$	used $e\mu$ data-driven
Top quark, WW and $Z \rightarrow \tau\tau$ ($e\mu$ data-driven)	used MC	$4.9 \pm 0.9 \pm 0.2$
Z	$0.16 \pm 0.13 \pm 0.09$	$1.4 \pm 0.4 \pm 0.7$
W + jets, multijet	$1.3 \pm 0.3 \pm 0.2$	$1.4 \pm 0.4 \pm 0.3$
Total BG	$32.7 \pm 1.0 \pm 2.6$	$78.0 \pm 2.0 \pm 6.5$
Observed	27	71

source	ZH	Z/γ^*	VVV	WZ	ZZ	$W^+W^-+top+Z/\gamma^* \rightarrow \tau^+\tau^-$	W + jets
luminosity	4.4	-	4.4	4.4	4.4	-	-
lepton efficiency	3.6	-	3.6	3.6	3.6	-	-
momentum resolution	0.2	-	0.7	0.1	0.3	-	-
E_T^{miss}	0.5	-	1.4	0.6	0.1	-	-
JES	1.8	-	9.4	3.7	2.1	-	-
Underlying event	3.0	-	-	-	-	-	-
PDF	5.5	-	-	4.8	5.7	-	-
QCD scales VH	7.0	-	-	-	-	-	-
QCD scales VV	-	-	-	10.7	6.5	-	-
QCD scales VVV	-	-	50.0	-	-	-	-
$Z/\gamma^* \rightarrow \ell^+\ell^-$ normalization	-	100.0	-	-	-	-	-
W^+W^-+top normalization	-	-	-	-	-	101.0	-
W + jets normalization	-	-	-	-	-	-	25.8
Monte Carlo statistics	2.5	-	12.5	2.3	1.1	-	55.4

Process	Estimation method	Uncertainty (%)	
		2011	2012
ZH Signal	MC	7	6
ZZ	MC	11	10
WZ	MC	12	14
WW	MC	14	not used
Top quark	MC	90	not used
Top quark, WW and $Z \rightarrow \tau\tau$	$e\mu$ CR	not used	4
Z	ABCD method	56	51
W + jets, multijet	Matrix method	15	22

Bounding Higgs width using off-shell production

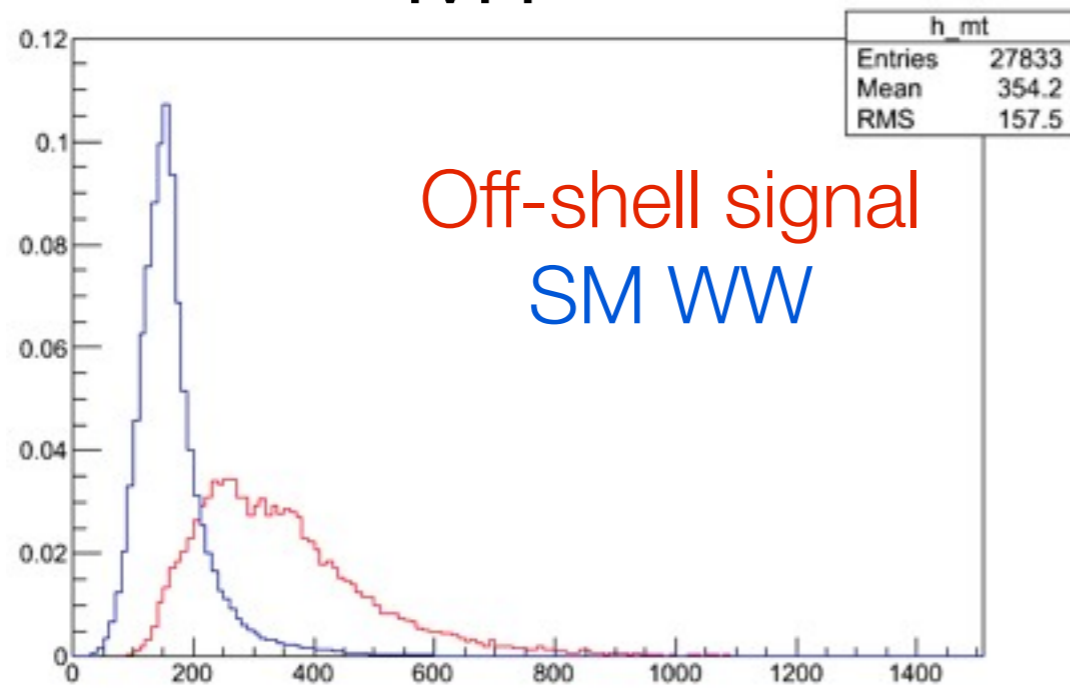
Shape of off-shell production of $H \rightarrow ZZ$ (Signal+Interference)



Rule of thumb: channels doing good job in 400 GeV heavy Higgs are sensitive to off-shell production

$H \rightarrow WW \rightarrow \nu\nu$

MT



M_II

