ggZH from ZH/WH ratio:

ggZH (loop-induced) might be sensitive to new physics through contribution to its loop structure

Measuring the ZH/WH ratio should allow to cancel part of the TH uncertainties on ZH and WH, making this quantity sensitive to deviations from the SM prediction (and in particular to NP effects in ggZH, which only contributes to the numerator)

$$R_{ZH/WH} = [\sigma(ggZH)+\sigma(qqZH)]/\sigma(WH)$$

Can we make some projections? Current results expressed as signal strengths mu:

$$mu_{VH} = \sigma(VH)/\sigma(VH)_{SM}$$

- what precision (on mu) could we reach (Run-2, HL-LHC)?
- what precision on THU could we expect?

JHEP08(2016)045
DOI: 10.1007/JHEP08(2016)045

CERN-EP-2016-100
16th September 2016

ATLAS+CMS, 7+8TeV, L~25/fb

Table 12: Measured signal strengths μ and their total uncertainties for different Higgs boson production processes. The results are shown for the combination of ATLAS and CMS, and separately for each experiment, for the combined $\sqrt{s}$ = 7 and 8 TeV data. The expected uncertainties in the measurements are displayed in parentheses. These results are obtained assuming that the Higgs boson branching fractions are the same as in the SM.

Production process	ATLAS+CMS	ATLAS	CMS
μ_{ggF}	$1.03^{+0.16}_{-0.14}$ $\left({}^{+0.16}_{-0.14}\right)$	$1.26^{+0.23}_{-0.20}$ $\left({}^{+0.21}_{-0.18}\right)$	$0.84^{+0.18}_{-0.16}$ $\left({}^{+0.20}_{-0.17}\right)$
μ_{VBF}	$1.18^{+0.25}_{-0.23}$ $\left({}^{+0.24}_{-0.23}\right)$	$1.21^{+0.33}_{-0.30}$ $\left({}^{+0.32}_{-0.29}\right)$	$1.14^{+0.37}_{-0.34}$ $\left({}^{+0.36}_{-0.34}\right)$
μ_{WH}	$0.89^{+0.40}_{-0.38}$ $\left({}^{+0.41}_{-0.39}\right)$	$1.25^{+0.56}_{-0.52}$ $\left({}^{+0.56}_{-0.53}\right)$	$0.46^{+0.57}_{-0.53}$ $\left({}^{+0.60}_{-0.57}\right)$
μ_{ZH}	$0.79^{+0.38}_{-0.36}$ $\left({}^{+0.39}_{-0.36}\right)$	$0.30^{+0.51}_{-0.45}$ $\left({}^{+0.55}_{-0.51}\right)$	$1.35^{+0.58}_{-0.54}$ $\left({}^{+0.55}_{-0.51}\right)$
μ_{ttH}	$2.3^{+0.7}_{-0.6}$ $\left({}^{+0.5}_{-0.5}\right)$	$1.9^{+0.8}_{-0.7}$ $\left({}^{+0.7}_{-0.7}\right)$	$2.9^{+1.0}_{-0.9}$ $\left({}^{+0.9}_{-0.8}\right)$

H(gamgam)+
H(WW)+
H(tautau)+
H(bb)

ATLAS+CMS, 7+8TeV, L~25/fb
mu_ZH = 0.79 (+0.38, -0.36)
mu_WH = 0.89 (+0.40, -0.38)

7+8TeV to 13TeV: scale by 1/sqrt(2) [assuming S&B x2]
25/fb to L1: scale by 1/sqrt(L1/25)

100/fb
e_ZH = 0.13 - e_WH = 0.14

300/fb
e_ZH = **0.08** - e_WH = **0.08**

1000/fb
e_ZH = 0.04 - e_WH = 0.04

3000/fb
e_ZH = **0.02** - e_WH = **0.03**

Lumi scaling:
- stat scaling
- syst scaling not trivial
- theory scaling?

sqrt(s) scaling not trivial:
(e.g. ttbar x4)

Could we make a more precise prediction?

- theory uncertainty rarely quoted separately
  ICHEP16 ATLAS VH(bb) analysis - 10% uncertainty on mu from VH TH
  (total XS + acceptance + shape from scales / PDFalphaS / UEPS)

- approximate scaling 8TeV-13TeV

- estimate of systematic uncertainties? different scenarios?

Table 8: Best fit values of $\sigma_i \cdot B^f$ for each specific channel $i \to H \to f$, as obtained from the generic parameterisation with 23 parameters for the combination of the ATLAS and CMS measurements, using the $\sqrt{s}$ = 7 and 8 TeV data. The cross sections are given for $\sqrt{s}$ = 8 TeV, assuming the SM values for $\sigma_i(7\ \text{TeV})/\sigma_i(8\ \text{TeV})$. The results are shown together with their total uncertainties and their breakdown into statistical and systematic components. The expected uncertainties in the measurements are displayed in parentheses. The SM predictions [32] and the ratios of the results to these SM predictions are also shown. The values labelled with a "–" are either not measured with a meaningful precision and therefore not quoted, in the case of the $H \to ZZ$ decay channel for the WH, ZH, and ttH production processes, or not measured at all and therefore fixed to their corresponding SM predictions, in the case of the $H \to bb$ decay mode for the ggF and VBF production processes.

Production process		Decay mode														
		$H \to \gamma\gamma$ [fb]			$H \to ZZ$ [fb]			$H \to WW$ [pb]			$H \to \tau\tau$ [fb]			$H \to bb$ [pb]		
		Best fit value	Uncertainty Stat	Syst	Best fit value	Uncertainty Stat	Syst	Best fit value	Uncertainty Stat	Syst	Best fit value	Uncertainty Stat	Syst	Best fit value	Uncertainty Stat	Syst
ggF	Measured	$48.0^{+10.0}_{-9.7}$	$^{+9.4}_{-9.4}$	$^{+3.2}_{-2.3}$	580^{+170}_{-160}	$^{+170}_{-160}$	$^{+40}_{-40}$	$3.5^{+0.7}_{-0.7}$	$^{+0.5}_{-0.5}$	$^{+0.5}_{-0.5}$	1300^{+700}_{-700}	$^{+400}_{-400}$	$^{+500}_{-500}$	–		
		$\left(^{+9.7}_{-9.5}\right)$	$\left(^{+9.4}_{-9.4}\right)$	$\left(^{+2.5}_{-1.6}\right)$	$\left(^{+150}_{-130}\right)$	$\left(^{+140}_{-130}\right)$	$\left(^{+30}_{-20}\right)$	$\left(^{+0.7}_{-0.7}\right)$	$\left(^{+0.5}_{-0.5}\right)$	$\left(^{+0.5}_{-0.5}\right)$	$\left(^{+700}_{-700}\right)$	$\left(^{+400}_{-400}\right)$	$\left(^{+500}_{-500}\right)$	–		
	Predicted	44 ±5			510 ±60			4.1 ±0.5			1210 ±140			11.0 ±1.2		
	Ratio	$1.10^{+0.23}_{-0.22}$	$^{+0.22}_{-0.21}$	$^{+0.07}_{-0.05}$	$1.13^{+0.34}_{-0.31}$	$^{+0.33}_{-0.30}$	$^{+0.09}_{-0.07}$	$0.84^{+0.17}_{-0.17}$	$^{+0.12}_{-0.12}$	$^{+0.12}_{-0.11}$	$1.0^{+0.6}_{-0.6}$	$^{+0.4}_{-0.4}$	$^{+0.4}_{-0.4}$	–		
VBF	Measured	$4.6^{+1.9}_{-1.8}$	$^{+1.8}_{-1.7}$	$^{+0.6}_{-0.5}$	3^{+46}_{-26}	$^{+46}_{-25}$	$^{+7}_{-7}$	$0.39^{+0.14}_{-0.13}$	$^{+0.13}_{-0.12}$	$^{+0.07}_{-0.05}$	125^{+39}_{-37}	$^{+34}_{-32}$	$^{+19}_{-18}$	–		
		$\left(^{+1.8}_{-1.6}\right)$	$\left(^{+1.7}_{-1.6}\right)$	$\left(^{+0.5}_{-0.4}\right)$	$\left(^{+60}_{-39}\right)$	$\left(^{+60}_{-39}\right)$	$\left(^{+8}_{-5}\right)$	$\left(^{+0.15}_{-0.13}\right)$	$\left(^{+0.13}_{-0.12}\right)$	$\left(^{+0.07}_{-0.06}\right)$	$\left(^{+39}_{-37}\right)$	$\left(^{+34}_{-32}\right)$	$\left(^{+19}_{-18}\right)$	–		
	Predicted	3.60 ±0.20			42.2 ±2.0			0.341 ±0.017			100 ±6			0.91 ±0.04		
	Ratio	$1.3^{+0.5}_{-0.5}$	$^{+0.5}_{-0.5}$	$^{+0.2}_{-0.1}$	$0.1^{+1.1}_{-0.6}$	$^{+1.1}_{-0.6}$	$^{+0.2}_{-0.2}$	$1.2^{+0.4}_{-0.4}$	$^{+0.4}_{-0.3}$	$^{+0.2}_{-0.2}$	$1.3^{+0.4}_{-0.4}$	$^{+0.3}_{-0.3}$	$^{+0.2}_{-0.2}$	–		
WH	Measured	$0.7^{+2.1}_{-1.9}$	$^{+2.1}_{-1.8}$	$^{+0.3}_{-0.3}$	–			$0.24^{+0.18}_{-0.16}$	$^{+0.15}_{-0.14}$	$^{+0.10}_{-0.08}$	-64^{+64}_{-61}	$^{+55}_{-50}$	$^{+32}_{-34}$	$0.42^{+0.21}_{-0.20}$	$^{+0.17}_{-0.16}$	$^{+0.12}_{-0.11}$
		$\left(^{+1.9}_{-1.8}\right)$	$\left(^{+1.9}_{-1.8}\right)$	$\left(^{+0.1}_{-0.1}\right)$	–			$\left(^{+0.16}_{-0.14}\right)$	$\left(^{+0.14}_{-0.13}\right)$	$\left(^{+0.08}_{-0.07}\right)$	$\left(^{+67}_{-64}\right)$	$\left(^{+60}_{-54}\right)$	$\left(^{+30}_{-32}\right)$	$\left(^{+0.22}_{-0.21}\right)$	$\left(^{+0.18}_{-0.17}\right)$	$\left(^{+0.12}_{-0.11}\right)$
	Predicted	1.60 ±0.09			18.8 ±0.9			0.152 ±0.007			44.3 ±2.8			0.404 ±0.017		
	Ratio	$0.5^{+1.3}_{-1.2}$	$^{+1.3}_{-1.1}$	$^{+0.2}_{-0.2}$	–			$1.6^{+1.2}_{-1.0}$	$^{+1.0}_{-0.9}$	$^{+0.6}_{-0.5}$	$-1.4^{+1.4}_{-1.4}$	$^{+1.2}_{-1.1}$	$^{+0.7}_{-0.8}$	$1.0^{+0.5}_{-0.5}$	$^{+0.4}_{-0.4}$	$^{+0.3}_{-0.3}$
ZH	Measured	$0.5^{+2.9}_{-2.4}$	$^{+2.8}_{-2.3}$	$^{+0.5}_{-0.2}$	–			$0.53^{+0.23}_{-0.20}$	$^{+0.21}_{-0.19}$	$^{+0.10}_{-0.07}$	58^{+56}_{-47}	$^{+52}_{-44}$	$^{+20}_{-16}$	$0.08^{+0.09}_{-0.09}$	$^{+0.08}_{-0.08}$	$^{+0.04}_{-0.04}$
		$\left(^{+2.3}_{-1.9}\right)$	$\left(^{+2.3}_{-1.9}\right)$	$\left(^{+0.1}_{-0.1}\right)$	–			$\left(^{+0.17}_{-0.14}\right)$	$\left(^{+0.16}_{-0.14}\right)$	$\left(^{+0.05}_{-0.04}\right)$	$\left(^{+49}_{-40}\right)$	$\left(^{+46}_{-38}\right)$	$\left(^{+16}_{-12}\right)$	$\left(^{+0.10}_{-0.09}\right)$	$\left(^{+0.09}_{-0.08}\right)$	$\left(^{+0.05}_{-0.04}\right)$
	Predicted	0.94 ±0.06			11.1 ±0.6			0.089 ±0.005			26.1 ±1.8			0.238 ±0.012		
	Ratio	$0.5^{+3.0}_{-2.5}$	$^{+3.0}_{-2.5}$	$^{+0.5}_{-0.2}$	–			$5.9^{+2.6}_{-2.2}$	$^{+2.3}_{-2.1}$	$^{+1.1}_{-0.8}$	$2.2^{+2.2}_{-1.8}$	$^{+2.0}_{-1.7}$	$^{+0.8}_{-0.6}$	$0.4^{+0.4}_{-0.4}$	$^{+0.3}_{-0.3}$	$^{+0.2}_{-0.2}$
ttH	Measured	$0.64^{+0.48}_{-0.38}$	$^{+0.48}_{-0.38}$	$^{+0.07}_{-0.04}$	–			$0.14^{+0.05}_{-0.05}$	$^{+0.04}_{-0.04}$	$^{+0.03}_{-0.03}$	-15^{+30}_{-26}	$^{+26}_{-22}$	$^{+15}_{-15}$	$0.08^{+0.07}_{-0.07}$	$^{+0.04}_{-0.04}$	$^{+0.06}_{-0.06}$
	Ratio	$2.2^{[illegible]}_{-1.3}$	$^{[illegible]}_{-1.3}$	$^{[illegible]}_{-0.1}$	–			$5.0^{[illegible]}_{-1.7}$	$^{[illegible]}_{-1.5}$	$^{[illegible]}_{-0.9}$	$-1.9^{[illegible]}_{-3.3}$	$^{[illegible]}_{-2.7}$	$^{[illegible]}_{-1.8}$	$1.1^{[illegible]}_{-1.0}$	$^{[illegible]}_{-0.5}$	$^{[illegible]}_{-0.8}$

No separate theory unc. from ATLAS+CMS combination paper

In addition…

- could we consider projection studies from ATLAS / CMS to get a more accurate estimate of uncertainties / combination of decay channels?

- how do we pass from the signal strength precision to the R ratio precision?

- how do we quote the impact of possible ggZH TH advancements? (if possible)

From signal strenghts to ratio:

$R_{ZH/WH}$ = [σ(ggZH)+σ(qqZH)]/σ(WH)
= (mu_{ZH}/mu_{WH}) / [(σ(ggZH)+σ(qqZH))$_{SM}$/σ(WH)$_{SM}$]

Part of theory uncertainties on [(σ(ggZ)+σ(qqZH))$_{SM}$/σ(WH)$_{SM}$] cancels out (from qqZH/qqWH)

Impact of theory uncertainty on ggZH from σ(ggZH)
(now and with (projected) improved TH calculation)

Not trivial to extrapolate the uncertainty on (mu_{ZH}/mu_{WH}) from the separate signal strength uncertainties:

simultaneous mu_{ZH} & mu_{WH} with correlated uncertainties

Combined fit ($mu_{ZH}+mu_{WH}$) reduces uncertainties by 30%(ZH)-60%(WH)
(this is the extreme case where the two are 100% correlated)

Total cross section TH prediction:

W+h

$\sqrt{s}$[GeV]	σ[fb]	Δ_{scale}[%]	$\Delta_{\text{PDF}/\alpha_s/\text{PDF}\oplus\alpha_s}$[%]	$\sigma^{\text{DY}}_{\text{NNLOQCD}}$[fb]	$\sigma_{t\text{-loop}}$[fb]	δ_{EW}[%]	σ_γ[fb]
7	40.99	$^{+0.7}_{-0.9}$	$\pm1.9/\pm0.7/\pm2.0$	42.78	0.42	-7.2	$0.88^{+1.10}_{-0.10}$
8	49.52	$^{+0.6}_{-0.9}$	$\pm1.8/\pm0.8/\pm2.0$	51.56	0.53	-7.3	$1.18^{+1.38}_{-0.14}$
13	94.26	$^{+0.5}_{-0.7}$	$\pm1.6/\pm0.9/\pm1.8$	97.18	1.20	-7.4	$3.09^{+3.33}_{-0.37}$
14	103.63	$^{+0.3}_{-0.8}$	$\pm1.5/\pm0.9/\pm1.8$	106.65	1.36	-7.4	$3.55^{+3.72}_{-0.43}$

W-h

$\sqrt{s}$[GeV]	σ[fb]	Δ_{scale}[%]	$\Delta_{\text{PDF}/\alpha_s/\text{PDF}\oplus\alpha_s}$[%]	$\sigma^{\text{DY}}_{\text{NNLOQCD}}$[fb]	$\sigma_{t\text{-loop}}$[fb]	δ_{EW}[%]	σ_γ[fb]
7	23.04	$^{+0.6}_{-0.8}$	$\pm2.2/\pm0.6/\pm2.3$	23.98	0.24	-7.0	$0.51^{+0.69}_{-0.05}$
8	28.62	$^{+0.6}_{-0.8}$	$\pm2.1/\pm0.6/\pm2.1$	29.71	0.31	-7.1	$0.70^{+0.94}_{-0.07}$
13	59.83	$^{+0.4}_{-0.7}$	$\pm1.8/\pm0.8/\pm2.0$	61.51	0.78	-7.3	$2.00^{+2.34}_{-0.22}$
14	66.49	$^{+0.5}_{-0.6}$	$\pm1.7/\pm0.9/\pm1.9$	68.24	0.89	-7.3	$2.32^{+2.65}_{-0.26}$

ZllH

$\sqrt{s}$[GeV]	σ[fb]	Δ_{scale}[%]	$\Delta_{\text{PDF}/\alpha_s/\text{PDF}\oplus\alpha_s}$[%]	$\sigma^{\text{DY}}_{\text{NNLOQCD}}$[fb]	$\sigma^{\text{ggZH}}_{\text{NLO+NLL}}$[fb]	$\sigma_{t\text{-loop}}$[fb]	δ_{EW}[%]	σ_γ[fb]
7	11.43	$^{+2.6}_{-2.4}$	$\pm1.6/\pm0.7/\pm1.7$	10.91	0.94	0.11	-5.2	$0.03^{+0.04}_{-0.00}$
8	14.18	$^{+2.9}_{-2.4}$	$\pm1.5/\pm0.8/\pm1.7$	13.36	1.33	0.14	-5.2	$0.04^{+0.05}_{-0.00}$
13	29.82	$^{+3.8}_{-3.1}$	$\pm1.3/\pm0.9/\pm1.6$	26.66	4.14	0.31	-5.3	$0.11^{+0.12}_{-0.01}$
14	33.27	$^{+3.8}_{-3.3}$	$\pm1.3/\pm1.0/\pm1.6$	29.47	4.87	0.36	-5.3	$0.12^{+0.13}_{-0.01}$

ZvvH

$\sqrt{s}$[GeV]	σ[fb]	Δ_{scale}[%]	$\Delta_{\text{PDF}/\alpha_s/\text{PDF}\oplus\alpha_s}$[%]	$\sigma^{\text{DY}}_{\text{NNLOQCD}}$[fb]	$\sigma^{\text{ggZH}}_{\text{NLO+NLL}}$[fb]	$\sigma_{t\text{-loop}}$[fb]	δ_{EW}[%]	σ_γ[fb]
7	68.18	$^{+2.6}_{-2.4}$	$\pm1.6/\pm0.7/\pm1.7$	64.70	5.59	0.64	-4.3	-0.00
8	84.56	$^{+2.9}_{-2.4}$	$\pm1.5/\pm0.8/\pm1.7$	79.25	7.89	0.81	-4.3	-0.00
13	177.62	$^{+3.8}_{-3.1}$	$\pm1.3/\pm0.9/\pm1.6$	158.10	24.57	1.85	-4.4	-0.00
14	198.12	$^{+3.8}_{-3.3}$	$\pm1.3/\pm1.0/\pm1.6$	174.77	28.88	2.11	-4.4	-0.00

Separate scale variations for ggZH and qqZH

(qq+gg)ZH(+3.8, -3.1) [%] ⟶ qqZH(+0.54, -0.63) [%]
ggZH(+25, -19) [%]

Fiducial cross section TH prediction:

YR4

W+h

$\sqrt{s}$[GeV]	σ[fb]	Δ_{scale}[%]	Δ_{PDF}[%]	$\sigma^{DY}_{NNLOQCD}$[fb]	δ_{EW}[%]	σ_γ[fb]
13	73.90	$^{+0.3}_{-0.3}$	±1.4	78.61	-8.3	$1.81^{+1.10}_{-0.23}$

W-h

$\sqrt{s}$[GeV]	σ[fb]	Δ_{scale}[%]	Δ_{PDF}[%]	$\sigma^{DY}_{NNLOQCD}$[fb]	δ_{EW}[%]	σ_γ[fb]
13	42.77	$^{+0.2}_{-0.3}$	±1.8	45.29	-8.0	$1.11^{+0.65}_{-0.12}$

ZllH

$\sqrt{s}$[GeV]	σ[fb]	Δ_{scale}[%]	Δ_{PDF}[%]	$\sigma^{DY}_{NNLOQCD}$[fb]	σ^{ggZH}[fb]	δ_{EW}[%]	σ_γ[fb]
13	16.08	$^{+2.2}_{-1.4}$	±1.2	16.21	1.36	-9.2	0.00

ATLAS, 7+8TeV, L~25/fb VH(bb)

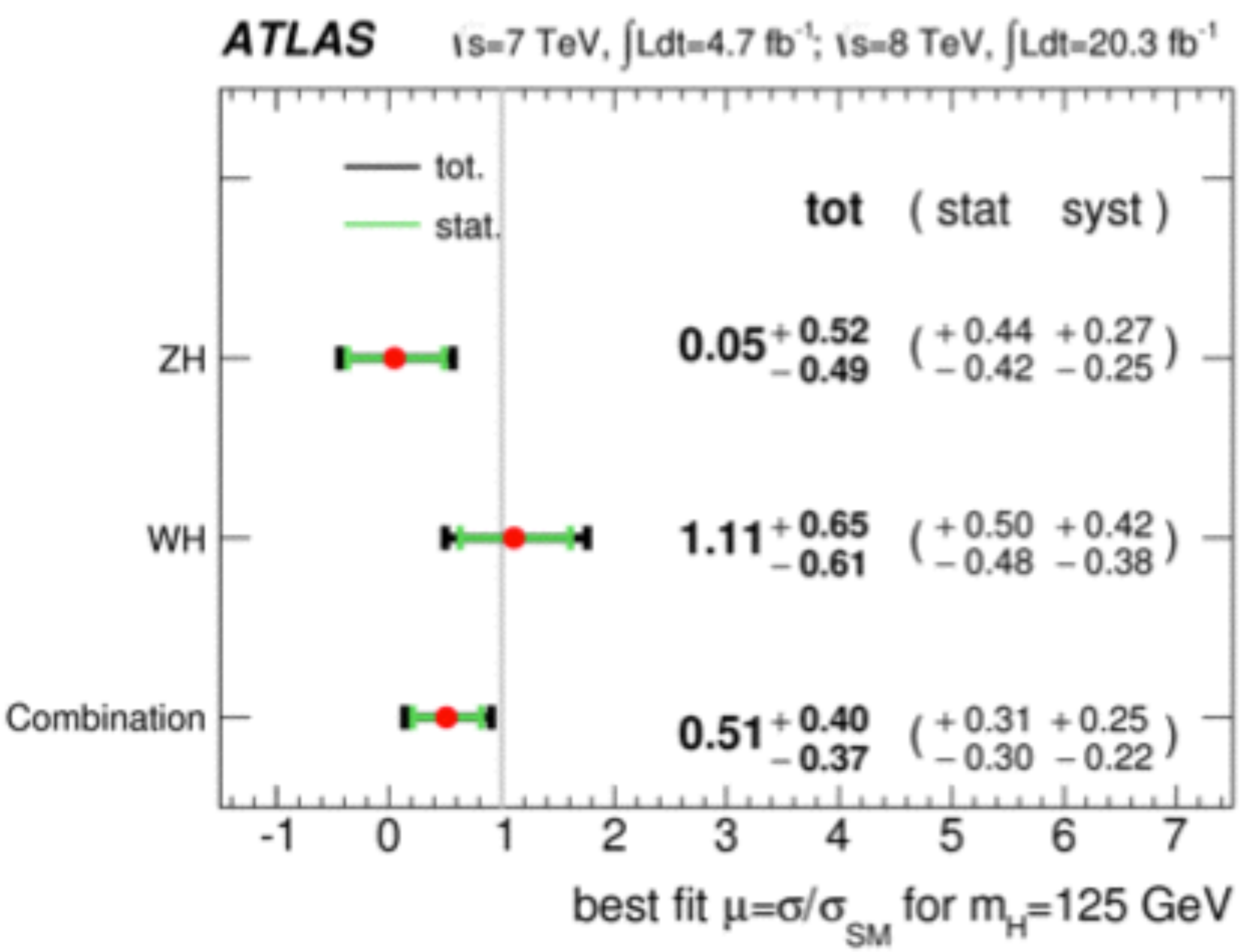
One word of caution…

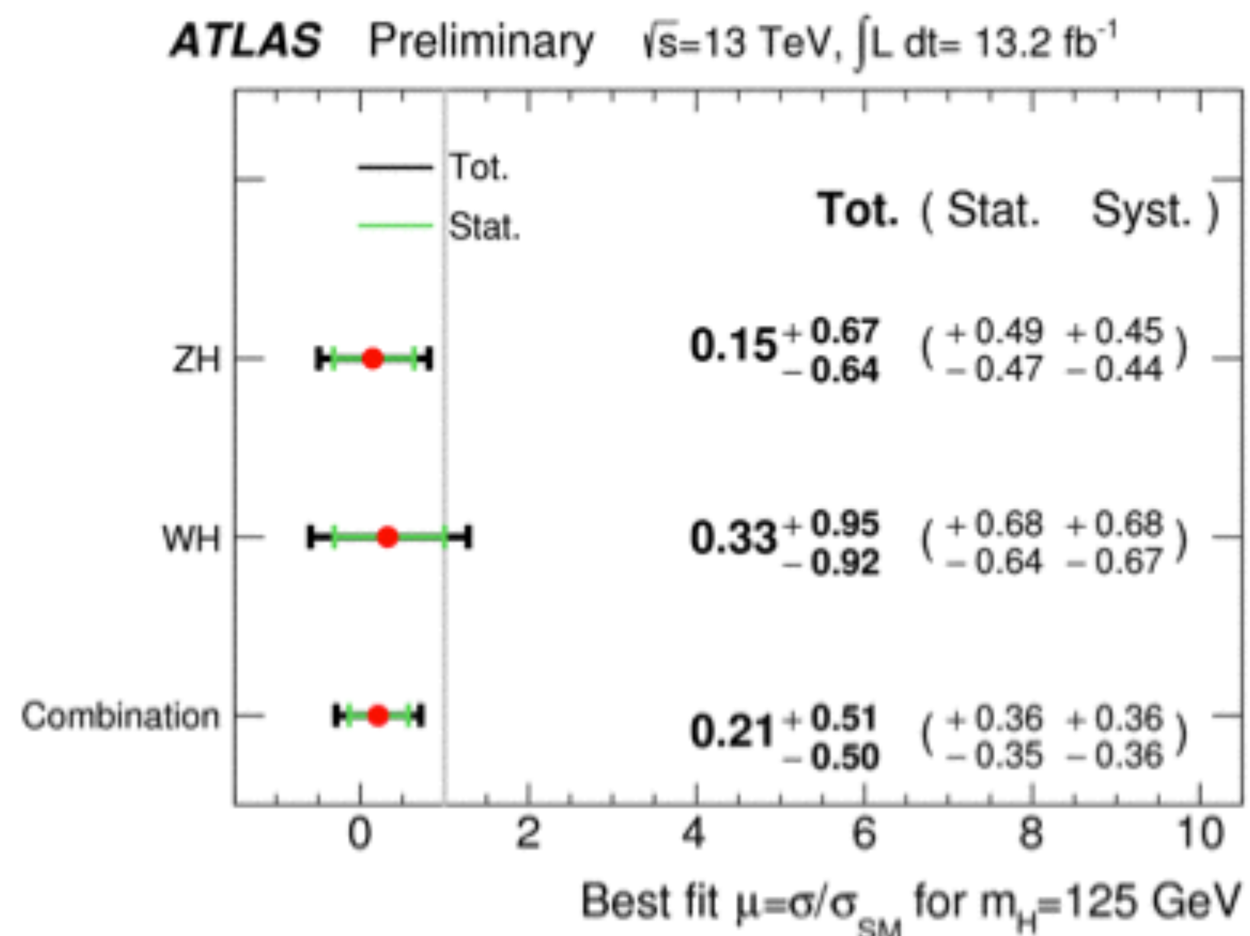
mu_ZH = 0.05 (+0.52, -0.49) - e_ZH = 0.50
mu_WH = 1.11 (+0.65, -0.61) - e_WH = 0.63

7+8TeV to 13TeV: scale by 1/sqrt(2) [assuming S&B x2]
25/fb to L1: scale by 1/sqrt(L1/25)

13.2/fb - scaled —> e_ZH = 0.49 - e_WH = 0.61

13.2/fb - ATLAS ICHEP16 results —> e_ZH = 0.65 - e_WH = 0.93





ATLAS-CONF-2016-091

BACK-UP

Table 9: Best fit values of $\sigma(gg \to H \to ZZ)$, σ_i/σ_{ggF}, and B^f/B^{ZZ}, as obtained from the generic parameterisation with nine parameters for the combined analysis of the $\sqrt{s} = 7$ and 8 TeV data. The values involving cross sections are given for $\sqrt{s} = 8$ TeV, assuming the SM values for $\sigma_i(7\text{ TeV})/\sigma_i(8\text{ TeV})$. The results are reported for the combination of ATLAS and CMS and also separately for each experiment, together with their total uncertainties and their breakdown into statistical and systematic components. The expected uncertainties in the measurements are displayed in parentheses. The SM predictions [32] are also shown with their total uncertainties.

Parameter	SM prediction	Best fit value	Uncertainty Stat	Uncertainty Syst	Best fit value	Uncertainty Stat	Uncertainty Syst	Best fit value	Uncertainty Stat	Uncertainty Syst
		ATLAS+CMS			ATLAS			CMS		
$\sigma(gg \to H \to ZZ)$ [pb]	0.51 ± 0.06	$0.59^{+0.11}_{-0.10}$ $\left(^{+0.11}_{-0.10}\right)$	$^{+0.11}_{-0.10}$ $\left(^{+0.11}_{-0.09}\right)$	$^{+0.02}_{-0.02}$ $\left(^{+0.03}_{-0.02}\right)$	$0.77^{+0.19}_{-0.17}$ $\left(^{+0.16}_{-0.14}\right)$	$^{+0.19}_{-0.16}$ $\left(^{+0.16}_{-0.13}\right)$	$^{+0.05}_{-0.03}$ $\left(^{+0.03}_{-0.02}\right)$	$0.44^{+0.14}_{-0.12}$ $\left(^{+0.15}_{-0.13}\right)$	$^{+0.13}_{-0.11}$ $\left(^{+0.15}_{-0.13}\right)$	$^{+0.05}_{-0.03}$ $\left(^{+0.04}_{-0.03}\right)$
$\sigma_{VBF}/\sigma_{ggF}$	0.082 ± 0.009	$0.109^{+0.034}_{-0.027}$ $\left(^{+0.029}_{-0.024}\right)$	$^{+0.029}_{-0.024}$ $\left(^{+0.024}_{-0.020}\right)$	$^{+0.018}_{-0.013}$ $\left(^{+0.016}_{-0.012}\right)$	$0.079^{+0.035}_{-0.026}$ $\left(^{+0.042}_{-0.031}\right)$	$^{+0.030}_{-0.023}$ $\left(^{+0.036}_{-0.028}\right)$	$^{+0.019}_{-0.012}$ $\left(^{+0.022}_{-0.014}\right)$	$0.138^{+0.073}_{-0.051}$ $\left(^{+0.043}_{-0.033}\right)$	$^{+0.061}_{-0.046}$ $\left(^{+0.037}_{-0.029}\right)$	$^{+0.039}_{-0.023}$ $\left(^{+0.023}_{-0.015}\right)$
σ_{WH}/σ_{ggF}	0.037 ± 0.004	$0.031^{+0.028}_{-0.026}$ $\left(^{+0.021}_{-0.017}\right)$	$^{+0.024}_{-0.022}$ $\left(^{+0.019}_{-0.015}\right)$	$^{+0.015}_{-0.014}$ $\left(^{+0.011}_{-0.007}\right)$	$0.054^{+0.036}_{-0.026}$ $\left(^{+0.033}_{-0.022}\right)$	$^{+0.031}_{-0.023}$ $\left(^{+0.029}_{-0.020}\right)$	$^{+0.020}_{-0.013}$ $\left(^{+0.015}_{-0.009}\right)$	$0.005^{+0.044}_{-0.037}$ $\left(^{+0.032}_{-0.022}\right)$	$^{+0.037}_{-0.028}$ $\left(^{+0.027}_{-0.020}\right)$	$^{+0.023}_{-0.024}$ $\left(^{+0.017}_{-0.010}\right)$
σ_{ZH}/σ_{ggF}	0.0216 ± 0.0024	$0.066^{+0.039}_{-0.031}$ $\left(^{+0.016}_{-0.011}\right)$	$^{+0.032}_{-0.025}$ $\left(^{+0.014}_{-0.010}\right)$	$^{+0.023}_{-0.018}$ $\left(^{+0.009}_{-0.004}\right)$	$0.013^{+0.028}_{-0.014}$ $\left(^{+0.027}_{-0.014}\right)$	$^{+0.021}_{-0.012}$ $\left(^{+0.023}_{-0.013}\right)$	$^{+0.018}_{-0.007}$ $\left(^{+0.014}_{-0.005}\right)$	$0.123^{+0.076}_{-0.053}$ $\left(^{+0.024}_{-0.013}\right)$	$^{+0.063}_{-0.046}$ $\left(^{+0.020}_{-0.012}\right)$	$^{+0.044}_{-0.026}$ $\left(^{+0.014}_{-0.006}\right)$