

# Table of Contents

<b>BSM Higgs production cross sections at <math>\sqrt{s} = 8</math> TeV (update in CERN Report4 2016)</b> .....	<b>1</b>
BSM Higgs-boson production cross section calculation.....	1
Mass range and step for BSM Higgs boson:.....	1
gluon-gluon Fusion Process.....	1
VBF Process.....	4
WH Process.....	6
ZH Process.....	9
ttH Process.....	11
bbH Process.....	11
tH Process (t-ch).....	14
tH Process (s-ch).....	14

# BSM Higgs production cross sections at $\sqrt{s} = 8$ TeV (update in CERN Report4 2016)

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- Cross sections reported in CERN Report 4. See [here](#) and [here](#) here for previous numbers in CERN Report 3.
- Higgs cross sections and BRs in Spread sheet are available in xlsx format [NEW](#)
- You can find figures at our gallery [here](#).

## • BSM Higgs-boson production cross section calculation

- Please check Proposal on how to provide reference "Higgs" cross sections for BSM applications
- Full mass scan should be provided for major Higgs production processes:
  1. Major process: ggF, VBF, WH (also separate  $W^+H$  and  $W^-H$ ), ZH (also gg ZH)
  2. Associated Higgs with heavy quark: ttH, bbH
  3. Associated Higgs with single top-quark: tH (bq tHq', bg WtH, qq btH)
- Higgs width should be set to zero (NWA).
- Separate electroweak correction should be provided.
- For relevant processes, and if possible, the contributions proportional to different Higgs couplings should be given separately, together with the corresponding uncertainties.
- All other external parameters should be chosen as in the corresponding best SM predictions as well as the evaluation of the uncertainties.
- SM width: At each mass point, the corresponding Higgs widths calculated in the SM with the same characteristics above should be provided.
- Examples on how to use these predictions in specific cases are provided.

## Mass range and step for BSM Higgs boson:

Higgs Mass range	step size	# of points	addendum
[10,150] GeV	5 GeV	29 points	
[150,500] GeV	10 GeV	35 points	+ $M_H=125.09$ GeV
[500,3000] GeV	50 GeV	50 points	

- Total 115 points for  $M_H=[10,3000]$  GeV.
  - Lower mass limit might depend on stability of the code at low Bjorken-x. To be assessed.
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## gluon-gluon Fusion Process

- Cross sections are calculated with dFG program at NNLO+NNLL QCD (only) accuracy. Separate NLO EW correction factors  $1+_{EW}$  are also given for  $M_H=[100,2500]$ GeV.
  - ◆ This is an interim recommendation, will be updated when new N3LO QCD numbers became available.
- Calculations are the same as CERN Report 3 (i.e. top, bottom and charm quark effects are taken into account), except it is in NWA (CPS in CERN Report 3).
- Program: dFG
- QCD scales:  $\mu=\mu_F=\mu_R=M_H$ , uncertainty estimated in the range  $1/2 < \mu/M_H < 2$  with  $1/2 < \mu_F/\mu_R < 2$  constraint.
  - ◆ No additional THU nor PU uncertainties assigned.
- PDF set: PDF4LHC15\_nlo\_30

$m_H$ (GeV)				&pm;(PDF+ <sub>s</sub> ) %	&pm;PDF %	$1+_{EW}$
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	Cross Section (pb)	+QCD Scale %	-QCD Scale %			&pm; s %	
10.00	4.614E+03	+47.9	-37.3	±6.5	±5.9	±2.7	0.0000
15.00	2.701E+03	+33.6	-27.7	±5.1	±4.2	±2.8	0.0000
20.00	1.261E+03	+24.9	-21.2	±4.4	±3.2	±2.9	0.0000
25.00	6.676E+02	+20.3	-17.1	±4.1	±2.7	±3.0	0.0000
30.00	4.009E+02	+18.1	-14.8	±4.0	±2.5	±3.0	0.0000
35.00	2.664E+02	+15.9	-13.4	±3.8	±2.4	±3.0	0.0000
40.00	1.911E+02	+14.2	-12.6	±3.8	±2.2	±3.0	0.0000
45.00	1.450E+02	+13.0	-11.9	±3.7	±2.2	±3.0	0.0000
50.00	1.147E+02	+12.0	-11.3	±3.6	±2.1	±3.0	0.0000
55.00	9.365E+01	+11.2	-10.8	±3.6	±2.0	±2.9	0.0000
60.00	7.827E+01	+10.6	-10.4	±3.5	±2.0	±2.9	0.0000
65.00	6.661E+01	+10.1	-10.1	±3.5	±2.0	±2.8	0.0000
70.00	5.752E+01	+9.7	-9.8	±3.4	±2.0	±2.8	0.0000
75.00	5.025E+01	+9.3	-9.5	±3.4	±1.9	±2.8	0.0000
80.00	4.431E+01	+9.0	-9.3	±3.3	±1.9	±2.7	0.0000
85.00	3.940E+01	+8.7	-9.1	±3.3	±1.9	±2.7	0.0000
90.00	3.526E+01	+8.5	-8.9	±3.3	±1.9	±2.7	0.0000
95.00	3.175E+01	+8.3	-8.7	±3.3	±1.9	±2.7	0.0000
100.00	2.873E+01	+8.1	-8.6	±3.2	±1.9	±2.6	1.0418
105.00	2.611E+01	+7.9	-8.4	±3.2	±1.8	±2.6	1.0436
110.00	2.383E+01	+7.7	-8.3	±3.2	±1.8	±2.6	1.0455
115.00	2.184E+01	+7.6	-8.2	±3.2	±1.8	±2.6	1.0474
120.00	2.008E+01	+7.5	-8.1	±3.2	±1.8	±2.6	1.0494
125.00	1.851E+01	+7.3	-8.0	±3.1	±1.8	±2.6	1.0514
130.00	1.712E+01	+7.2	-7.9	±3.1	±1.8	±2.5	1.0534
135.00	1.587E+01	+7.1	-7.8	±3.1	±1.8	±2.5	1.0553
140.00	1.475E+01	+7.0	-7.7	±3.1	±1.8	±2.5	1.0571
145.00	1.375E+01	+6.9	-7.6	±3.1	±1.8	±2.5	1.0587
150.00	1.284E+01	+6.8	-7.5	±3.1	±1.8	±2.5	1.0598
160.00	1.127E+01	+6.6	-7.4	±3.1	±1.8	±2.5	1.0486
170.00	9.961E+00	+6.5	-7.3	±3.1	±1.8	±2.5	1.0206
180.00	8.866E+00	+6.4	-7.1	±3.1	±1.8	±2.5	1.0053
190.00	7.945E+00	+6.2	-7.0	±3.1	±1.8	±2.5	0.9872
200.00	7.163E+00	+6.1	-6.9	±3.1	±1.9	±2.5	0.9793
210.00	6.492E+00	+6.0	-6.8	±3.1	±1.9	±2.5	0.9761
220.00	5.919E+00	+6.0	-6.7	±3.1	±1.9	±2.5	0.9749
230.00	5.426E+00	+5.9	-6.6	±3.1	±1.9	±2.5	0.9749
240.00	5.000E+00	+5.9	-6.6	±3.2	±2.0	±2.5	0.9755
250.00	4.632E+00	+5.8	-6.5	±3.2	±2.0	±2.5	0.9762
260.00	4.314E+00	+5.8	-6.4	±3.2	±2.0	±2.5	0.9772
270.00	4.040E+00	+5.8	-6.3	±3.2	±2.0	±2.5	0.9783
280.00	3.807E+00	+5.8	-6.3	±3.2	±2.1	±2.5	0.9795
290.00	3.608E+00	+5.8	-6.2	±3.2	±2.1	±2.5	0.9805
300.00	3.444E+00	+5.8	-6.2	±3.3	±2.1	±2.5	0.9813
310.00	3.314E+00	+5.8	-6.1	±3.3	±2.2	±2.5	0.9819
320.00	3.222E+00	+5.8	-6.0	±3.3	±2.2	±2.5	0.9820
330.00	3.175E+00	+5.8	-5.9	±3.4	±2.3	±2.5	0.9813
340.00	3.200E+00	+5.9	-5.9	±3.4	±2.3	±2.5	0.9779

350.00	3.409E+00	+5.9	-5.8	±3.4	±2.3	±2.5	0.9595
360.00	3.503E+00	+5.9	-5.8	±3.5	±2.4	±2.5	0.9608
370.00	3.470E+00	+5.9	-5.7	±3.5	±2.4	±2.5	0.9642
380.00	3.357E+00	+5.9	-5.6	±3.6	±2.5	±2.5	0.9677
390.00	3.198E+00	+5.9	-5.6	±3.6	±2.5	±2.5	0.9713
400.00	3.011E+00	+5.9	-5.5	±3.6	±2.6	±2.6	0.9741
410.00	2.812E+00	+5.9	-5.5	±3.7	±2.6	±2.6	0.9771
420.00	2.609E+00	+5.9	-5.4	±3.7	±2.7	±2.6	0.9802
430.00	2.411E+00	+5.9	-5.4	±3.8	±2.8	±2.6	0.9830
440.00	2.220E+00	+5.9	-5.4	±3.8	±2.8	±2.6	0.9853
450.00	2.038E+00	+5.9	-5.3	±3.9	±2.9	±2.6	0.9878
460.00	1.868E+00	+5.9	-5.3	±3.9	±2.9	±2.6	0.9900
470.00	1.709E+00	+5.9	-5.3	±4.0	±3.0	±2.6	0.9921
480.00	1.562E+00	+5.9	-5.3	±4.0	±3.1	±2.6	0.9940
490.00	1.426E+00	+5.9	-5.2	±4.1	±3.1	±2.7	0.9961
500.00	1.301E+00	+5.9	-5.2	±4.2	±3.2	±2.7	0.9981
550.00	8.236E-01	+5.9	-5.1	±4.4	±3.5	±2.7	1.0069
600.00	5.241E-01	+6.0	-5.1	±4.8	±3.8	±2.8	1.0152
650.00	3.377E-01	+6.0	-5.1	±5.1	±4.2	±2.9	1.0226
700.00	2.207E-01	+6.1	-5.2	±5.4	±4.5	±3.0	1.0301
750.00	1.464E-01	+6.1	-5.2	±5.8	±4.9	±3.1	1.0377
800.00	9.849E-02	+6.2	-5.2	±6.1	±5.3	±3.1	1.0454
850.00	6.713E-02	+6.3	-5.3	±6.5	±5.6	±3.2	1.0532
900.00	4.634E-02	+6.3	-5.4	±6.9	±6.0	±3.3	1.0610
950.00	3.237E-02	+6.4	-5.4	±7.3	±6.4	±3.4	1.0695
1000.00	2.285E-02	+6.5	-5.5	±7.7	±6.8	±3.5	1.0783
1050.00	1.628E-02	+6.6	-5.6	±8.1	±7.2	±3.6	1.0890
1100.00	1.172E-02	+6.7	-5.6	±8.5	±7.6	±3.8	1.1004
1150.00	8.507E-03	+6.7	-5.7	±8.9	±8.0	±3.9	1.1122
1200.00	6.222E-03	+6.8	-5.8	±9.3	±8.4	±4.0	1.1242
1250.00	4.587E-03	+6.9	-5.8	±9.8	±8.9	±4.1	1.1364
1300.00	3.402E-03	+7.0	-5.9	±10.2	±9.3	±4.2	1.1475
1350.00	2.540E-03	+7.1	-6.0	±10.7	±9.7	±4.4	1.1586
1400.00	1.909E-03	+7.3	-6.1	±11.1	±10.2	±4.5	1.1700
1450.00	1.442E-03	+7.4	-6.2	±11.6	±10.7	±4.6	1.1816
1500.00	1.095E-03	+7.6	-6.2	±12.1	±11.1	±4.8	1.1937
1550.00	8.349E-04	+7.7	-6.3	±12.6	±11.6	±4.9	1.2069
1600.00	6.400E-04	+7.8	-6.4	±13.2	±12.1	±5.1	1.2206
1650.00	4.925E-04	+7.9	-6.5	±13.7	±12.7	±5.3	1.2347
1700.00	3.805E-04	+7.9	-6.6	±14.3	±13.2	±5.4	1.2493
1750.00	2.951E-04	+8.0	-3.6	±15.0	±8.3	±12.4	1.2644
1800.00	2.297E-04	+8.0	-4.3	±15.0	±9.9	±11.3	1.2798
1850.00	1.793E-04	+8.1	-4.9	±15.3	±11.4	±10.3	1.2955
1900.00	1.404E-04	+8.1	-5.4	±15.9	±12.8	±9.5	1.3117
1950.00	1.103E-04	+8.2	-5.9	±16.6	±14.0	±8.8	1.3283
2000.00	8.685E-05	+8.2	-6.3	±17.4	±15.2	±8.3	1.3453
2050.00	6.857E-05	+8.2	-6.7	±18.2	±16.4	±8.0	1.3627
2100.00	5.422E-05	+8.3	-7.1	±19.1	±17.5	±7.7	1.3806
2150.00	4.311E-05	+8.3	-7.4	±20.0	±18.5	±7.6	1.3989
2200.00	3.419E-05	+8.4	-7.6	±20.8	±19.4	±7.5	1.4176

2250.00	2.722E-05	+8.4	-7.9	±21.7	±20.4	±7.6	1.4367
2300.00	2.173E-05	+8.4	-8.1	±22.6	±21.2	±7.7	1.4563
2350.00	1.737E-05	+8.5	-8.2	±23.5	±22.1	±7.9	1.4763
2400.00	1.390E-05	+8.5	-8.4	±24.4	±23.0	±8.2	1.4968
2450.00	1.113E-05	+8.6	-8.5	±25.3	±23.8	±8.5	1.5177
2500.00	8.936E-06	+8.6	-8.6	±26.2	±24.6	±8.8	1.5390
2550.00	7.190E-06	+8.6	-8.6	±27.1	±25.5	±9.1	0.0000
2600.00	5.771E-06	+8.7	-8.7	±28.0	±26.3	±9.5	0.0000
2650.00	4.665E-06	+8.7	-8.7	±28.9	±27.2	±9.8	0.0000
2700.00	3.753E-06	+8.8	-8.8	±29.9	±28.1	±10.2	0.0000
2750.00	3.028E-06	+8.8	-8.8	±30.8	±29.0	±10.5	0.0000
2800.00	2.455E-06	+8.8	-8.8	±31.8	±30.0	±10.7	0.0000
2850.00	1.979E-06	+8.9	-8.9	±32.9	±31.0	±10.9	0.0000
2900.00	1.604E-06	+8.9	-8.9	±34.0	±32.1	±11.0	0.0000
2950.00	1.298E-06	+9.0	-9.0	±35.1	±33.3	±11.1	0.0000
3000.00	1.048E-06	+9.0	-9.0	±36.2	±34.5	±11.1	0.0000

## VBF Process

- Cross sections are calculated at (approx.) NNLO QCD accuracy.
- Calculations are the same as CERN Report 3, except it is in NWA (CPS in CERN Report 3).
- Program: NNLO QCD (VBF@NNLO)
- QCD scales:  $\mu = \mu_F = \mu_R = M_W$ , uncertainty estimated in the range  $1/2 < \mu/M_W < 2$  (scales have been varied independently by factor 2).
  - ◆ No additional THU nor PU uncertainties assigned.
- PDF set: PDF4LHC15\_nnlo\_30\_pdfas

$m_H$ (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ <sub>s</sub> ) %	±PDF %	± <sub>s</sub> %	1+ <sub>EW</sub>
10.00	5.474E+00	+0.9	-0.5	±2.0	±1.8	±0.8	
15.00	5.208E+00	+0.8	-0.5	±2.0	±1.8	±0.7	
20.00	4.934E+00	+0.8	-0.5	±2.0	±1.8	±0.7	
25.00	4.667E+00	+0.8	-0.4	±2.0	±1.8	±0.7	
30.00	4.413E+00	+0.7	-0.4	±1.9	±1.8	±0.7	
35.00	4.169E+00	+0.7	-0.4	±1.9	±1.8	±0.7	
40.00	3.938E+00	+0.6	-0.3	±1.9	±1.8	±0.6	
45.00	3.722E+00	+0.6	-0.3	±1.9	±1.8	±0.6	
50.00	3.519E+00	+0.6	-0.3	±1.9	±1.8	±0.6	
55.00	3.329E+00	+0.5	-0.3	±1.9	±1.8	±0.6	
60.00	3.152E+00	+0.5	-0.3	±1.9	±1.8	±0.6	
65.00	2.986E+00	+0.5	-0.3	±1.9	±1.8	±0.6	
70.00	2.831E+00	+0.5	-0.3	±1.9	±1.8	±0.6	
75.00	2.686E+00	+0.4	-0.2	±1.9	±1.8	±0.5	
80.00	2.550E+00	+0.4	-0.2	±1.9	±1.8	±0.5	
85.00	2.423E+00	+0.4	-0.2	±1.9	±1.8	±0.5	
90.00	2.304E+00	+0.4	-0.2	±1.9	±1.8	±0.5	
95.00	2.192E+00	+0.4	-0.2	±1.9	±1.8	±0.5	
100.00	2.087E+00	+0.3	-0.2	±1.9	±1.8	±0.5	
105.00	1.988E+00	+0.3	-0.2	±1.9	±1.8	±0.5	
110.00	1.896E+00	+0.3	-0.2	±1.9	±1.9	±0.5	
115.00	1.809E+00	+0.3	-0.2	±1.9	±1.9	±0.5	
120.00	1.727E+00	+0.3	-0.2	±1.9	±1.9	±0.5	

125.00	1.650E+00	+0.3	-0.2	±1.9	±1.9	±0.5	
130.00	1.577E+00	+0.2	-0.2	±1.9	±1.9	±0.4	
135.00	1.508E+00	+0.3	-0.2	±1.9	±1.9	±0.4	
140.00	1.443E+00	+0.3	-0.2	±1.9	±1.9	±0.4	
145.00	1.382E+00	+0.3	-0.2	±1.9	±1.9	±0.4	
150.00	1.323E+00	+0.2	-0.1	±1.9	±1.9	±0.4	
160.00	1.216E+00	+0.3	-0.1	±1.9	±1.9	±0.4	
170.00	1.120E+00	+0.3	-0.1	±1.9	±1.9	±0.4	
180.00	1.033E+00	+0.3	-0.1	±1.9	±1.9	±0.4	
190.00	9.549E-01	+0.2	-0.1	±2.0	±1.9	±0.4	
200.00	8.839E-01	+0.2	-0.1	±2.0	±1.9	±0.3	
210.00	8.195E-01	+0.2	-0.1	±2.0	±1.9	±0.3	
220.00	7.609E-01	+0.3	-0.1	±2.0	±1.9	±0.3	
230.00	7.074E-01	+0.3	-0.1	±2.0	±2.0	±0.3	
240.00	6.587E-01	+0.3	-0.1	±2.0	±2.0	±0.3	
250.00	6.140E-01	+0.3	-0.1	±2.0	±2.0	±0.3	
260.00	5.731E-01	+0.3	-0.1	±2.0	±2.0	±0.3	
270.00	5.356E-01	+0.3	-0.1	±2.0	±2.0	±0.3	
280.00	5.011E-01	+0.3	-0.1	±2.0	±2.0	±0.3	
290.00	4.692E-01	+0.3	-0.2	±2.0	±2.0	±0.2	
300.00	4.399E-01	+0.3	-0.2	±2.1	±2.0	±0.2	
310.00	4.128E-01	+0.3	-0.2	±2.1	±2.1	±0.2	
320.00	3.877E-01	+0.3	-0.2	±2.1	±2.1	±0.2	
330.00	3.644E-01	+0.3	-0.2	±2.1	±2.1	±0.2	
340.00	3.428E-01	+0.3	-0.2	±2.1	±2.1	±0.2	
350.00	3.228E-01	+0.3	-0.3	±2.1	±2.1	±0.2	
360.00	3.042E-01	+0.3	-0.3	±2.1	±2.1	±0.2	
370.00	2.868E-01	+0.3	-0.3	±2.1	±2.1	±0.2	
380.00	2.707E-01	+0.3	-0.3	±2.1	±2.1	±0.2	
390.00	2.556E-01	+0.3	-0.3	±2.2	±2.2	±0.2	
400.00	2.415E-01	+0.3	-0.4	±2.2	±2.2	±0.2	
410.00	2.284E-01	+0.3	-0.4	±2.2	±2.2	±0.1	
420.00	2.161E-01	+0.3	-0.4	±2.2	±2.2	±0.1	
430.00	2.046E-01	+0.3	-0.4	±2.2	±2.2	±0.1	
440.00	1.938E-01	+0.3	-0.4	±2.2	±2.2	±0.1	
450.00	1.837E-01	+0.3	-0.4	±2.2	±2.2	±0.1	
460.00	1.742E-01	+0.3	-0.5	±2.2	±2.2	±0.1	
470.00	1.652E-01	+0.3	-0.5	±2.3	±2.3	±0.1	
480.00	1.569E-01	+0.3	-0.5	±2.3	±2.3	±0.1	
490.00	1.490E-01	+0.3	-0.5	±2.3	±2.3	±0.1	
500.00	1.415E-01	+0.3	-0.5	±2.3	±2.3	±0.1	
550.00	1.103E-01	+0.3	-0.6	±2.4	±2.4	±0.0	
600.00	8.684E-02	+0.3	-0.7	±2.5	±2.5	±0.0	
650.00	6.892E-02	+0.3	-0.8	±2.5	±2.5	±0.0	
700.00	5.510E-02	+0.3	-0.8	±2.6	±2.6	±0.0	
750.00	4.433E-02	+0.3	-0.9	±2.7	±2.7	±0.1	
800.00	3.588E-02	+0.3	-1.0	±2.8	±2.8	±0.1	
850.00	2.918E-02	+0.4	-1.1	±2.9	±2.9	±0.1	
900.00	2.383E-02	+0.4	-1.1	±3.0	±3.0	±0.1	
950.00	1.954E-02	+0.4	-1.2	±3.1	±3.1	±0.1	

1000.00	1.608E-02	+0.5	-1.3	±3.2	±3.1	±0.1	
1050.00	1.328E-02	+0.5	-1.4	±3.3	±3.2	±0.2	
1100.00	1.099E-02	+0.6	-1.4	±3.4	±3.4	±0.2	
1150.00	9.126E-03	+0.6	-1.5	±3.5	±3.5	±0.2	
1200.00	7.593E-03	+0.6	-1.6	±3.6	±3.6	±0.2	
1250.00	6.331E-03	+0.7	-1.7	±3.7	±3.7	±0.2	
1300.00	5.289E-03	+0.7	-1.8	±3.8	±3.8	±0.2	
1350.00	4.425E-03	+0.8	-1.8	±4.0	±4.0	±0.2	
1400.00	3.709E-03	+0.8	-1.9	±4.1	±4.1	±0.2	
1450.00	3.113E-03	+0.8	-2.0	±4.2	±4.2	±0.2	
1500.00	2.616E-03	+0.9	-2.1	±4.4	±4.4	±0.2	
1550.00	2.200E-03	+0.9	-2.2	±4.6	±4.5	±0.2	
1600.00	1.853E-03	+1.0	-2.3	±4.7	±4.7	±0.2	
1650.00	1.562E-03	+1.0	-2.3	±4.9	±4.9	±0.2	
1700.00	1.318E-03	+1.1	-2.4	±5.1	±5.1	±0.2	
1750.00	1.112E-03	+1.1	-2.5	±5.3	±5.3	±0.2	
1800.00	9.395E-04	+1.2	-2.6	±5.5	±5.5	±0.2	
1850.00	7.941E-04	+1.2	-2.7	±5.7	±5.7	±0.2	
1900.00	6.714E-04	+1.3	-2.8	±5.9	±5.9	±0.1	
1950.00	5.680E-04	+1.3	-2.9	±6.2	±6.2	±0.1	
2000.00	4.807E-04	+1.4	-3.0	±6.4	±6.4	±0.1	
2050.00	4.068E-04	+1.4	-3.0	±6.7	±6.7	±0.1	
2100.00	3.444E-04	+1.5	-3.1	±7.0	±7.0	±0.1	
2150.00	2.917E-04	+1.5	-3.2	±7.2	±7.2	±0.1	
2200.00	2.470E-04	+1.6	-3.3	±7.5	±7.5	±0.0	
2250.00	2.092E-04	+1.6	-3.4	±7.8	±7.8	±0.0	
2300.00	1.772E-04	+1.7	-3.5	±8.2	±8.2	±0.0	
2350.00	1.501E-04	+1.8	-3.6	±8.5	±8.5	±0.0	
2400.00	1.271E-04	+1.8	-3.7	±8.9	±8.9	±0.1	
2450.00	1.076E-04	+1.9	-3.8	±9.2	±9.2	±0.1	
2500.00	9.112E-05	+1.9	-3.9	±9.6	±9.6	±0.1	
2550.00	7.713E-05	+2.0	-4.0	±10.0	±10.0	±0.2	
2600.00	6.527E-05	+2.1	-4.1	±10.4	±10.4	±0.2	
2650.00	5.522E-05	+2.1	-4.2	±10.8	±10.8	±0.2	
2700.00	4.670E-05	+2.2	-4.3	±11.3	±11.3	±0.3	
2750.00	3.948E-05	+2.3	-4.4	±11.8	±11.7	±0.3	
2800.00	3.337E-05	+2.4	-4.5	±12.2	±12.2	±0.3	
2850.00	2.819E-05	+2.4	-4.6	±12.7	±12.7	±0.4	
2900.00	2.380E-05	+2.5	-4.7	±13.2	±13.2	±0.4	
2950.00	2.009E-05	+2.6	-4.8	±13.8	±13.8	±0.5	
3000.00	1.695E-05	+2.6	-4.9	±14.3	±14.3	±0.5	

## WH Process

- Cross sections are calculated at NNLO QCD accuracy.
  - ◆ Calculations are the same as CERN Report 3.
- Program: NNLO QCD (VH@NNLO)
- QCD scales:  $\mu=\mu_F=\mu_R=M_{VH}=(p_V+p_H)^2$  for QCD part. Uncertainty is estimated in the range  $1/3 < \mu/M_{VH} < 3$  ( $\mu_F$  and  $\mu_R$  are varied independently).
  - ◆ No additional THU nor PU uncertainties assigned.

- PDF set: PDF4LHC15\_nnlo\_mc (QCD part)

- Photon-induced contribution of O(5%)

- ◆ NOT included for total cross section (agrees with CERN Report 3 numbers within 1%).

$m_H$ (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	$\pm$ ;(PDF+ %)	$\pm$ ;PDF %	$\pm$ ; %	1+ EW	W+H (pb)	W-H (pb)
10.00	1.392E+02	+0.9	-1.4	$\pm 2.0$				8.281E+01	5.643E+01
15.00	8.577E+01	+0.9	-1.3	$\pm 2.0$				5.128E+01	3.449E+01
20.00	5.708E+01	+0.6	-1.2	$\pm 2.0$				3.419E+01	2.289E+01
25.00	3.985E+01	+0.7	-1.0	$\pm 2.0$				2.396E+01	1.589E+01
30.00	2.888E+01	+0.4	-0.9	$\pm 2.0$				1.742E+01	1.146E+01
35.00	2.151E+01	+0.3	-1.1	$\pm 2.0$				1.303E+01	8.482E+00
40.00	1.635E+01	+0.4	-0.9	$\pm 2.0$				9.925E+00	6.423E+00
45.00	1.266E+01	+0.5	-0.8	$\pm 2.0$				7.710E+00	4.953E+00
50.00	9.959E+00	+0.4	-0.9	$\pm 1.9$				6.084E+00	3.875E+00
55.00	7.925E+00	+0.4	-0.6	$\pm 2.0$				4.853E+00	3.072E+00
60.00	6.388E+00	+0.4	-0.6	$\pm 2.0$				3.922E+00	2.466E+00
65.00	5.204E+00	+0.4	-0.6	$\pm 2.0$				3.206E+00	1.998E+00
70.00	4.277E+00	+0.4	-0.7	$\pm 2.0$				2.641E+00	1.636E+00
75.00	3.545E+00	+0.3	-0.7	$\pm 2.0$				2.196E+00	1.349E+00
80.00	2.961E+00	+0.3	-0.7	$\pm 2.0$				1.839E+00	1.122E+00
85.00	2.490E+00	+0.4	-0.8	$\pm 2.0$				1.549E+00	9.407E-01
90.00	2.106E+00	+0.5	-0.7	$\pm 2.0$				1.314E+00	7.920E-01
95.00	1.793E+00	+0.4	-0.8	$\pm 2.1$				1.121E+00	6.720E-01
100.00	1.534E+00	+0.5	-0.8	$\pm 2.1$				9.613E-01	5.724E-01
105.00	1.319E+00	+0.6	-0.8	$\pm 2.1$				8.289E-01	4.903E-01
110.00	1.139E+00	+0.5	-0.8	$\pm 2.0$				7.176E-01	4.216E-01
115.00	9.892E-01	+0.5	-0.9	$\pm 2.1$				6.243E-01	3.649E-01
120.00	8.623E-01	+0.6	-0.8	$\pm 2.1$				5.454E-01	3.169E-01
125.00	7.541E-01	+0.6	-0.9	$\pm 2.0$				4.784E-01	2.757E-01
130.00	6.623E-01	+0.6	-0.9	$\pm 2.1$				4.209E-01	2.414E-01
135.00	5.832E-01	+0.7	-0.9	$\pm 2.1$				3.713E-01	2.119E-01
140.00	5.152E-01	+0.7	-0.9	$\pm 2.1$				3.288E-01	1.864E-01
145.00	4.572E-01	+0.7	-0.9	$\pm 2.2$				2.923E-01	1.649E-01
150.00	4.066E-01	+0.7	-1.0	$\pm 2.2$				2.605E-01	1.461E-01
160.00	3.239E-01	+0.8	-0.9	$\pm 2.2$				2.084E-01	1.155E-01
170.00	2.608E-01	+0.8	-0.9	$\pm 2.3$				1.685E-01	9.231E-02
180.00	2.120E-01	+0.8	-0.9	$\pm 2.3$				1.375E-01	7.449E-02
190.00	1.736E-01	+0.9	-1.0	$\pm 2.4$				1.130E-01	6.062E-02
200.00	1.434E-01	+0.8	-1.0	$\pm 2.4$				9.370E-02	4.970E-02
210.00	1.193E-01	+0.9	-1.0	$\pm 2.4$				7.823E-02	4.104E-02
220.00	9.978E-02	+1.0	-1.0	$\pm 2.5$				6.567E-02	3.411E-02
230.00	8.402E-02	+0.9	-1.0	$\pm 2.5$				5.549E-02	2.853E-02
240.00	7.114E-02	+1.0	-1.0	$\pm 2.5$				4.714E-02	2.400E-02
250.00	6.053E-02	+1.0	-1.1	$\pm 2.6$				4.024E-02	2.029E-02
260.00	5.178E-02	+1.0	-1.2	$\pm 2.6$				3.453E-02	1.725E-02
270.00	4.448E-02	+1.0	-1.2	$\pm 2.6$				2.976E-02	1.472E-02
280.00	3.837E-02	+1.1	-1.2	$\pm 2.7$				2.576E-02	1.261E-02
290.00	3.324E-02	+1.1	-1.3	$\pm 2.7$				2.238E-02	1.086E-02
300.00	2.888E-02	+1.2	-1.3	$\pm 2.7$				1.950E-02	9.382E-03
310.00	2.520E-02	+1.2	-1.3	$\pm 2.8$				1.706E-02	8.137E-03



320.00	2.205E-02	+1.2	-1.4	±2.8				1.497E-02	7.079E-03
330.00	1.936E-02	+1.2	-1.4	±2.8				1.318E-02	6.179E-03
340.00	1.705E-02	+1.2	-1.5	±2.9				1.164E-02	5.408E-03
350.00	1.506E-02	+1.2	-1.5	±3.0				1.031E-02	4.748E-03
360.00	1.333E-02	+1.3	-1.5	±3.0				9.148E-03	4.181E-03
370.00	1.183E-02	+1.3	-1.5	±3.1				8.139E-03	3.690E-03
380.00	1.052E-02	+1.3	-1.6	±3.2				7.258E-03	3.264E-03
390.00	9.382E-03	+1.3	-1.6	±3.2				6.487E-03	2.895E-03
400.00	8.384E-03	+1.4	-1.6	±3.3				5.810E-03	2.574E-03
410.00	7.505E-03	+1.4	-1.6	±3.3				5.213E-03	2.292E-03
420.00	6.734E-03	+1.4	-1.7	±3.4				4.688E-03	2.046E-03
430.00	6.053E-03	+1.4	-1.7	±3.5				4.224E-03	1.829E-03
440.00	5.451E-03	+1.4	-1.8	±3.6				3.812E-03	1.639E-03
450.00	4.917E-03	+1.4	-1.8	±3.6				3.446E-03	1.471E-03
460.00	4.442E-03	+1.4	-1.8	±3.7				3.119E-03	1.323E-03
470.00	4.019E-03	+1.4	-1.8	±3.8				2.828E-03	1.191E-03
480.00	3.642E-03	+1.5	-1.9	±3.9				2.568E-03	1.074E-03
490.00	3.305E-03	+1.5	-1.9	±4.0				2.335E-03	9.703E-04
500.00	3.003E-03	+1.5	-1.9	±4.1				2.125E-03	8.780E-04
550.00	1.896E-03	+1.6	-2.0	±4.5				1.354E-03	5.423E-04
600.00	1.230E-03	+1.7	-2.1	±4.9				8.850E-04	3.449E-04
650.00	8.162E-04	+1.8	-2.3	±5.3				5.914E-04	2.248E-04
700.00	5.522E-04	+1.8	-2.4	±5.7				4.026E-04	1.496E-04
750.00	3.797E-04	+1.9	-2.5	±6.1				2.783E-04	1.014E-04
800.00	2.647E-04	+2.0	-2.6	±6.6				1.949E-04	6.978E-05
850.00	1.868E-04	+2.0	-2.7	±7.0				1.381E-04	4.869E-05
900.00	1.332E-04	+2.1	-2.8	±7.4				9.883E-05	3.439E-05
950.00	9.590E-05	+2.2	-2.9	±7.8				7.134E-05	2.456E-05
1000.00	6.961E-05	+2.2	-3.1	±8.2				5.190E-05	1.771E-05
1050.00	5.087E-05	+2.3	-3.2	±11.0				3.799E-05	1.288E-05
1100.00	3.742E-05	+2.3	-3.3	±13.9				2.798E-05	9.439E-06
1150.00	2.768E-05	+2.4	-3.4	±16.8				2.071E-05	6.967E-06
1200.00	2.058E-05	+2.5	-3.5	±19.7				1.540E-05	5.176E-06
1250.00	1.536E-05	+2.5	-3.5	±22.6				1.149E-05	3.868E-06
1300.00	1.151E-05	+2.6	-3.6	±25.5				8.607E-06	2.907E-06
1350.00	8.661E-06	+2.7	-3.7	±28.3				6.466E-06	2.195E-06
1400.00	6.537E-06	+2.8	-3.8	±31.1				4.872E-06	1.665E-06
1450.00	4.946E-06	+2.8	-3.9	±34.0				3.678E-06	1.268E-06
1500.00	3.751E-06	+2.9	-4.0	±36.8				2.781E-06	9.697E-07
1550.00	2.851E-06	+3.0	-4.1	±39.6				2.107E-06	7.441E-07
1600.00	2.171E-06	+3.0	-4.3	±42.4				1.598E-06	5.729E-07
1650.00	1.656E-06	+3.1	-4.4	±45.1				1.213E-06	4.425E-07
1700.00	1.264E-06	+3.2	-4.5	±47.7				9.215E-07	3.426E-07
1750.00	9.664E-07	+3.3	-4.6	±50.4				7.004E-07	2.660E-07
1800.00	7.394E-07	+3.4	-4.7	±53.0				5.323E-07	2.071E-07
1850.00	5.660E-07	+3.5	-4.8	±55.6				4.044E-07	1.616E-07
1900.00	4.336E-07	+3.6	-4.9	±58.1				3.072E-07	1.264E-07
1950.00	3.320E-07	+3.7	-5.1	±60.5				2.330E-07	9.900E-08
2000.00	2.543E-07	+3.8	-5.2	±62.9				1.766E-07	7.770E-08

## ZH Process

- Cross sections are calculated at NNLO QCD accuracy.
  - ◆ Calculations are the same as CERN Report 3.
  - ◆ gg ZH (box-diagram) occurs as a part of NNLO QCD correction and included in the total cross section.
- Program: NNLO QCD (VH@NNLO)
- QCD scales:  $\mu = \mu_F = \mu_R = M_{VH} = (p_V + p_H)^2$  for QCD part. Uncertainty is estimated in the range  $1/3 < \mu/M_{VH} < 3$  ( $\mu_F$  and  $\mu_R$  are varied independently).
  - ◆ No additional THU nor PU uncertainties assigned.
- PDF set: PDF4LHC15\_nlo\_mc (QCD part)
- Photon-induced contribution of O(1%) or below
  - ◆ NOT included for total cross section (agrees with CERN Report 3 numbers).

$m_H$ (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	$\pm$ (PDF+ %)	$\pm$ PDF %	$\pm$ %	1+ EW	(gg ZH) (pb)
10.00	6.051E+01	+0.8	-1.3	$\pm 2.1$				
15.00	3.824E+01	+0.6	-1.2	$\pm 2.1$				
20.00	2.602E+01	+0.4	-1.2	$\pm 2.1$				
25.00	1.847E+01	+0.7	-0.8	$\pm 2.1$				
30.00	1.364E+01	+0.3	-0.9	$\pm 2.1$				
35.00	1.030E+01	+0.5	-0.8	$\pm 2.1$				
40.00	7.936E+00	+0.6	-0.6	$\pm 2.1$				
45.00	6.237E+00	+0.6	-0.9	$\pm 2.1$				
50.00	4.963E+00	+0.7	-0.8	$\pm 2.1$				
55.00	4.002E+00	+0.8	-0.9	$\pm 2.0$				
60.00	3.259E+00	+1.0	-0.9	$\pm 2.0$				
65.00	2.685E+00	+1.1	-1.0	$\pm 2.0$				
70.00	2.232E+00	+1.2	-1.2	$\pm 1.9$				
75.00	1.869E+00	+1.2	-1.2	$\pm 1.9$				
80.00	1.577E+00	+1.3	-1.4	$\pm 1.8$				
85.00	1.338E+00	+1.5	-1.4	$\pm 1.8$				
90.00	1.142E+00	+1.8	-1.4	$\pm 1.8$				
95.00	9.816E-01	+1.8	-1.6	$\pm 1.8$				
100.00	8.479E-01	+2.0	-1.7	$\pm 1.8$				
105.00	7.359E-01	+2.2	-1.8	$\pm 1.8$				
110.00	6.416E-01	+2.3	-1.9	$\pm 1.7$				
115.00	5.611E-01	+2.5	-2.0	$\pm 1.7$				
120.00	4.935E-01	+2.7	-2.2	$\pm 1.7$				
125.00	4.353E-01	+2.9	-2.2	$\pm 1.7$				
130.00	3.854E-01	+3.0	-2.3	$\pm 1.7$				
135.00	3.422E-01	+3.1	-2.4	$\pm 1.7$				
140.00	3.046E-01	+3.3	-2.5	$\pm 1.7$				
145.00	2.719E-01	+3.5	-2.7	$\pm 1.7$				
150.00	2.435E-01	+3.6	-2.8	$\pm 1.7$				
160.00	1.965E-01	+3.8	-3.1	$\pm 1.7$				
170.00	1.599E-01	+4.0	-3.3	$\pm 1.8$				
180.00	1.309E-01	+4.1	-3.4	$\pm 1.8$				
190.00	1.078E-01	+4.3	-3.5	$\pm 1.8$				
200.00	8.927E-02	+4.3	-3.6	$\pm 1.8$				
210.00	7.419E-02	+4.3	-3.6	$\pm 1.8$				
220.00	6.194E-02	+4.1	-3.7	$\pm 1.9$				

230.00	5.184E-02	+4.1	-3.5	$\pm 1.9$				
240.00	4.355E-02	+4.0	-3.4	$\pm 2.0$				
250.00	3.674E-02	+3.8	-3.3	$\pm 2.0$				
260.00	3.114E-02	+3.6	-3.2	$\pm 2.1$				
270.00	2.651E-02	+3.3	-3.1	$\pm 2.1$				
280.00	2.266E-02	+3.2	-2.9	$\pm 2.2$				
290.00	1.945E-02	+3.0	-2.8	$\pm 2.2$				
300.00	1.677E-02	+2.8	-2.7	$\pm 2.2$				
310.00	1.452E-02	+2.7	-2.6	$\pm 2.3$				
320.00	1.262E-02	+2.6	-2.5	$\pm 2.3$				
330.00	1.101E-02	+2.5	-2.4	$\pm 2.4$				
340.00	9.647E-03	+2.4	-2.3	$\pm 2.4$				
350.00	8.490E-03	+2.4	-2.3	$\pm 2.5$				
360.00	7.503E-03	+2.4	-2.3	$\pm 2.5$				
370.00	6.653E-03	+2.4	-2.4	$\pm 2.6$				
380.00	5.917E-03	+2.4	-2.4	$\pm 2.6$				
390.00	5.274E-03	+2.5	-2.5	$\pm 2.7$				
400.00	4.715E-03	+2.6	-2.6	$\pm 2.7$				
410.00	4.225E-03	+2.7	-2.6	$\pm 2.8$				
420.00	3.794E-03	+2.8	-2.7	$\pm 2.8$				
430.00	3.415E-03	+2.8	-2.8	$\pm 2.8$				
440.00	3.079E-03	+3.0	-2.9	$\pm 2.8$				
450.00	2.782E-03	+3.1	-3.0	$\pm 2.8$				
460.00	2.519E-03	+3.1	-3.1	$\pm 2.8$				
470.00	2.284E-03	+3.3	-3.2	$\pm 2.9$				
480.00	2.074E-03	+3.4	-3.3	$\pm 2.9$				
490.00	1.887E-03	+3.5	-3.4	$\pm 2.9$				
500.00	1.719E-03	+3.7	-3.5	$\pm 2.9$				
550.00	1.102E-03	+4.4	-4.1	$\pm 3.1$				
600.00	7.277E-04	+5.2	-4.7	$\pm 3.4$				
650.00	4.925E-04	+6.0	-5.4	$\pm 3.6$				
700.00	3.404E-04	+6.7	-6.1	$\pm 3.8$				
750.00	2.395E-04	+7.5	-6.8	$\pm 4.0$				
800.00	1.710E-04	+8.3	-7.4	$\pm 4.2$				
850.00	1.236E-04	+9.0	-8.1	$\pm 4.4$				
900.00	9.037E-05	+9.9	-8.7	$\pm 4.7$				
950.00	6.673E-05	+10.7	-9.2	$\pm 4.9$				
1000.00	4.968E-05	+11.5	-9.8	$\pm 5.1$				
1050.00	3.734E-05	+12.2	-10.4	$\pm 5.5$				
1100.00	2.821E-05	+13.0	-11.0	$\pm 5.9$				
1150.00	2.147E-05	+13.6	-11.6	$\pm 6.3$				
1200.00	1.642E-05	+14.2	-12.2	$\pm 6.7$				
1250.00	1.261E-05	+15.1	-12.6	$\pm 7.1$				
1300.00	9.739E-06	+15.8	-13.1	$\pm 7.5$				
1350.00	7.553E-06	+16.4	-13.6	$\pm 7.9$				
1400.00	5.881E-06	+17.0	-14.2	$\pm 8.3$				
1450.00	4.591E-06	+17.9	-14.5	$\pm 8.7$				
1500.00	3.600E-06	+18.5	-15.1	$\pm 9.1$				
1550.00	2.829E-06	+19.1	-15.6	$\pm 9.5$				
1600.00	2.230E-06	+19.7	-16.1	$\pm 9.9$				

1650.00	1.761E-06	+20.4	-16.5	$\pm 10.2$				
1700.00	1.395E-06	+21.0	-16.9	$\pm 10.6$				
1750.00	1.107E-06	+21.6	-17.4	$\pm 11.0$				
1800.00	8.799E-07	+22.3	-17.8	$\pm 11.4$				
1850.00	7.005E-07	+22.9	-18.2	$\pm 11.8$				
1900.00	5.586E-07	+23.6	-18.5	$\pm 12.2$				
1950.00	4.460E-07	+24.1	-18.9	$\pm 12.6$				
2000.00	3.571E-07	+24.6	-19.3	$\pm 13.6$				

## ttH Process

- Cross sections are calculated at NLO QCD accuracy.
  - ◆ Calculations are the same as CERN Report 3.
- Program: MadGraph5\_aMC@NLO (Sherpa+OpenLoops as cross ceck)
- QCD scales:  $\mu=\mu_F=\mu_R=M_{\text{top}}+M_H/2$ , uncertainty estimated in the range  $1/2 < \mu/(M_{\text{top}}+M_H/2) < 2$  (with  $1/2 < \mu_F/\mu_R < 2$  constraint).
  - ◆ No additional THU nor PU uncertainties assigned.
- PDF set: PDF4LHC15\_nlo\_30\_pdfas

$m_H$ (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	$\pm$ (PDF+ $s$ ) %	$\pm$ PDF %	$\pm$ $s$ %	1+ $EW$
10.00	7.926E+00	+7.1	-10.6	$\pm 3.9$	$\pm 3.4$	$\pm 2.0$	0.984
30.00	2.562E+00	+6.4	-10.3	$\pm 4.0$	$\pm 3.5$	$\pm 2.0$	1.011
70.00	5.830E-01	+5.2	-9.8	$\pm 4.2$	$\pm 3.6$	$\pm 2.1$	1.025
100.00	2.441E-01	+4.5	-9.4	$\pm 4.2$	$\pm 3.7$	$\pm 2.1$	1.029
120.00	1.461E-01	+4.1	-9.2	$\pm 4.3$	$\pm 3.7$	$\pm 2.1$	1.027
125.00	1.296E-01	+4.1	-9.2	$\pm 4.3$	$\pm 3.7$	$\pm 2.1$	1.026
130.00	1.152E-01	+4.0	-9.2	$\pm 4.3$	$\pm 3.7$	$\pm 2.2$	1.025
150.00	7.364E-02	+3.7	-9.1	$\pm 4.4$	$\pm 3.8$	$\pm 2.2$	1.016
200.00	2.850E-02	+3.5	-9.1	$\pm 4.7$	$\pm 4.1$	$\pm 2.2$	1.006
250.00	1.361E-02	+4.1	-9.5	$\pm 5.2$	$\pm 4.6$	$\pm 2.3$	1.003
300.00	7.637E-03	+5.0	-10.3	$\pm 5.8$	$\pm 5.3$	$\pm 2.4$	1.018
400.00	3.244E-03	+6.9	-11.7	$\pm 7.4$	$\pm 6.9$	$\pm 2.7$	1.016
500.00	1.645E-03	+8.7	-13.0	$\pm 8.8$	$\pm 8.3$	$\pm 2.9$	1.034
750.00	3.840E-04	+11.4	-14.8	$\pm 11.9$	$\pm 11.3$	$\pm 3.6$	1.153
1000.00	1.000E-04	+12.9	-15.9	$\pm 15.0$	$\pm 14.3$	$\pm 4.4$	1.197
1500.00	8.181E-06	+15.0	-17.4	$\pm 21.8$	$\pm 20.8$	$\pm 6.5$	1.522
2000.00	7.601E-07	+17.1	-18.8	$\pm 29.3$	$\pm 27.8$	$\pm 9.1$	1.547
2500.00	7.201E-08	+18.8	-19.9	$\pm 37.6$	$\pm 35.4$	$\pm 12.8$	3.082
3000.00	6.456E-09	+20.5	-20.8	$\pm 47.6$	$\pm 43.9$	$\pm 18.2$	2.095

## bbH Process

- The cross sections are the Santander matched numbers with 5FS (NNLO) and 4FS (NLO).
- Program: SusHi for 5FS and dedicated version of MadGraph5\_aMC@NLO for 4FS.
- QCD scales:
  - ◆ 5FS:  $\mu_F=M_H/4$ ,  $\mu_R=M_H$ ,
  - ◆ 4FS:  $\mu_F=\mu_R=(M_H+2M_b)/4$ ,
  - ◆ scale with 7-point variation by a factor of 2 in both cases.
- Uncertainties
  - ◆ 5FS: Linearly added scale + (PDF  $s$ ) +  $M_b + \mu_b$  (PDF and  $s$  uncertainties are added in quadrature).

- ◆ 4FS: Only scale uncertainties (as they are the dominant ones) and no PDF uncertainties are included.
- PDF set
  - ◆ 5FS: Dedicated sets produced with APFEL are used which are generated from the PDF4LHC15\_nlo\_100 sets taken below the  $M_b$ -threshold and evolved upwards, while generating a b-PDF set at high scale.
  - ◆ 4FS: PDF4LHC15\_nlo\_nf4\_100

$m_H$ (GeV)	Cross Section (pb)	+(QCD Scale+PDF+ $\sigma$ ) %	-(QCD Scale+PDF+ $\sigma$ ) %	1+ $\sigma_{EW}$
10.00	6.366E+01	+84.0	-56.2	
15.00	3.458E+01	+60.6	-48.7	
20.00	2.171E+01	+48.8	-43.6	
25.00	1.450E+01	+45.0	-39.8	
30.00	9.894E+00	+38.2	-36.8	
35.00	7.077E+00	+35.2	-34.4	
40.00	5.161E+00	+33.8	-36.9	
45.00	3.900E+00	+32.5	-38.0	
50.00	2.991E+00	+31.0	-37.5	
55.00	2.351E+00	+29.5	-36.3	
60.00	1.871E+00	+28.1	-35.0	
65.00	1.510E+00	+27.2	-33.6	
70.00	1.228E+00	+26.2	-32.1	
75.00	1.012E+00	+25.7	-30.9	
80.00	8.349E-01	+24.8	-29.7	
85.00	6.966E-01	+24.2	-28.6	
90.00	5.842E-01	+23.6	-27.6	
95.00	4.955E-01	+23.1	-26.6	
100.00	4.215E-01	+22.5	-25.7	
105.00	3.595E-01	+22.2	-24.9	
110.00	3.094E-01	+21.8	-24.2	
115.00	2.665E-01	+21.0	-23.5	
120.00	2.315E-01	+20.8	-22.8	
125.00	2.021E-01	+20.7	-22.3	
130.00	1.763E-01	+20.3	-21.9	
135.00	1.550E-01	+20.1	-21.6	
140.00	1.364E-01	+19.7	-21.3	
145.00	1.203E-01	+19.3	-20.9	
150.00	1.066E-01	+19.1	-20.7	
160.00	8.430E-02	+18.7	-20.1	
170.00	6.734E-02	+18.2	-19.7	
180.00	5.441E-02	+18.0	-19.3	
190.00	4.434E-02	+17.8	-19.0	
200.00	3.636E-02	+17.5	-18.7	
210.00	3.004E-02	+17.3	-18.5	
220.00	2.494E-02	+16.9	-18.2	
230.00	2.088E-02	+16.9	-18.0	
240.00	1.755E-02	+16.8	-17.8	
250.00	1.484E-02	+16.9	-17.6	
260.00	1.262E-02	+16.9	-17.4	
270.00	1.076E-02	+16.7	-17.3	
280.00	9.229E-03	+16.6	-17.2	
290.00	7.945E-03	+16.8	-17.1	

300.00	6.846E-03	+16.7	-17.0	
310.00	5.935E-03	+16.6	-17.0	
320.00	5.156E-03	+16.4	-16.9	
330.00	4.494E-03	+16.4	-16.8	
340.00	3.937E-03	+16.6	-16.8	
350.00	3.451E-03	+16.7	-16.7	
360.00	3.033E-03	+16.7	-16.7	
370.00	2.674E-03	+16.9	-16.8	
380.00	2.361E-03	+16.9	-16.7	
390.00	2.095E-03	+17.1	-16.8	
400.00	1.860E-03	+17.2	-16.8	
410.00	1.653E-03	+17.3	-16.8	
420.00	1.474E-03	+17.5	-16.8	
430.00	1.317E-03	+17.5	-16.8	
440.00	1.177E-03	+17.6	-16.8	
450.00	1.055E-03	+17.8	-16.8	
460.00	9.463E-04	+17.9	-16.8	
470.00	8.517E-04	+18.0	-16.7	
480.00	7.668E-04	+18.2	-16.8	
490.00	6.913E-04	+18.2	-16.8	
500.00	6.256E-04	+18.4	-16.9	
550.00	3.832E-04	+19.1	-17.3	
600.00	2.418E-04	+19.9	-17.7	
650.00	1.567E-04	+20.2	-18.4	
700.00	1.037E-04	+20.5	-19.1	
750.00	6.987E-05	+20.8	-20.0	
800.00	4.789E-05	+21.2	-21.0	
850.00	3.326E-05	+21.8	-22.4	
900.00	2.346E-05	+22.5	-23.7	
950.00	1.672E-05	+23.4	-25.1	
1000.00	1.205E-05	+24.8	-26.0	
1050.00	8.756E-06	+26.2	-27.0	
1100.00	6.423E-06	+27.7	-28.0	
1150.00	4.747E-06	+28.9	-29.0	
1200.00	3.537E-06	+30.1	-30.1	
1250.00	2.653E-06	+31.3	-31.3	
1300.00	2.000E-06	+32.4	-32.4	
1350.00	1.517E-06	+33.5	-34.0	
1400.00	1.158E-06	+34.8	-35.8	
1450.00	8.871E-07	+36.5	-37.7	
1500.00	6.828E-07	+38.3	-39.5	
1550.00	5.273E-07	+39.9	-41.4	
1600.00	4.096E-07	+41.6	-43.3	
1650.00	3.188E-07	+43.4	-45.2	
1700.00	2.489E-07	+45.5	-46.8	
1750.00	1.949E-07	+47.7	-48.4	
1800.00	1.533E-07	+50.1	-49.9	
1850.00	1.200E-07	+52.5	-51.7	
1900.00	9.539E-08	+55.0	-53.2	
1950.00	7.518E-08	+57.7	-55.0	

2000.00	5.992E-08	+59.5	-56.3	
2050.00	4.764E-08	+60.1	-57.8	
2100.00	3.804E-08	+60.5	-59.1	
2150.00	3.028E-08	+60.9	-61.6	
2200.00	2.407E-08	+61.8	-64.0	
2250.00	1.937E-08	+64.6	-65.8	
2300.00	1.551E-08	+67.6	-68.0	
2350.00	1.245E-08	+70.7	-70.3	
2400.00	1.001E-08	+74.0	-72.6	
2450.00	8.063E-09	+77.3	-74.9	
2500.00	6.396E-09	+81.5	-78.0	
2550.00	5.217E-09	+84.6	-80.0	
2600.00	4.206E-09	+88.5	-82.7	
2650.00	3.421E-09	+92.0	-85.0	
2700.00	2.742E-09	+95.6	-88.2	
2750.00	2.215E-09	+97.5	-91.0	
2800.00	1.798E-09	+99.2	-93.7	
2850.00	1.448E-09	+103.0	-96.8	
2900.00	1.171E-09	+107.5	-99.9	
2950.00	9.427E-10	+112.1	-103.3	
3000.00	7.647E-10	+112.7	-105.4	

## tH Process (t-ch)

- Cross sections are calculated at NLO QCD accuracy in 5FS.
- Program: MadGraph5\_aMC@NLO
- QCD scales:  $\mu=\mu_F=\mu_R=(M_{top}+M_H)/4$ , uncertainty estimated in the range  $1/2 < \mu/\{(M_{top}+M_H)/4\} < 2$  (with  $1/2 < \mu_F/\mu_R < 2$  constraint).
  - ◆ Flavour scheme (FS) dependence (4FS - 5FS envelope) included in the scale uncertainty. No PU uncertainty assigned.
- PDF set:
  - ◆ PDF4LHC15\_nlo\_30\_pdfas (5FS)
  - ◆ PDF4LHC15\_nlo\_nf4\_100 (4FS central set), used to compute the combined scale+FS uncertainty in tH t-channel.

$m_H$ (GeV)	Cross Section (pb)	+(QCD Scale + FS) %	-(QCD Scale + FS) %	$\pm$ ;(PDF+ s) %	$\pm$ ;PDF % s	$\pm$ ; s	1+ EW	tH (pb)	tbarH (pb)
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## tH Process (s-ch)

- Cross sections are calculated at NLO QCD accuracy in 5FS.
- Program: MadGraph5\_aMC@NLO
- QCD scales:  $\mu=\mu_F=\mu_R=(M_{top}+M_H)/2$ , uncertainty estimated in the range  $1/2 < \mu/\{(M_{top}+M_H)/2\} < 2$  (with  $1/2 < \mu_F/\mu_R < 2$  constraint).
  - ◆ No additional THU nor PU uncertainties assigned.
- PDF set:
  - ◆ PDF4LHC15\_nlo\_30\_pdfas (5FS)

$m_H$ (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	$\pm$ ;(PDF+ s) %	$\pm$ ;PDF % s	$\pm$ ; s	1+ EW	tH (pb)	tbarH (pb)
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-- ReiTanaka - 2016-03-01

This topic: LHCPhysics > CERNYellowReportPageBSMA8TeV

Topic revision: r17 - 2016-12-08 - MarcoPieri



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