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SM Higgs production cross sections at √s = 7 TeV (update in CERN Report4 2016)

- 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.

Mass range and step for SM-like Higgs boson:

Higgs Mass range	step size	# of points	addendum
[120,124] GeV	0.5 GeV	9 points	
[124,126] GeV	0.1 GeV	20 points	+ M_H=125.09 GeV
[126,130] GeV	0.5 GeV	8 points	

- Total 38 points for M_H=[120,130] GeV.

gluon-gluon Fusion Process

N3LO QCD cross sections supercede those of NNLO+NNLL QCD

- Cross sections are calculated by Zürich group at N3LO QCD and NLO EW accuracies [Anastasiou:2016cez].
- QCD scales: $\mu=\mu_F=\mu_R=M_H/2$ varied in the range of $[M_H/4,M_H]$.
- Theory uncertainty:
  - "±Theory" uncertainty is interpreted as a flat 100% confidence level.
  - "TH Gaussian" uncertainty is interpreted as a one-sigma range. It is estimated by max{+TH,-TH}/sqrt{3} as discussed in CERN Report 4 ggF section.
  - "TH Gaussian" uncertainty should be used for the construction of the workspace in the current LHC-HCG prescription.
- PDF set: PDF4LHC15_nnlo_100

- Cross sections are calculated with dFG program at NNLO+NNLL QCD and NLO EW accuracies.
- 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_nnlo_30

	N3LO								NNLO+N			
m_H (GeV)	Cross Section (pb)	+Theory %	-Theory %	TH Gaussian %	±(PDF+ $_s$) %	±PDF %	± $_s$ %		Cross Section (pb)	+QCD Scale %	-QCD Scale %	±
120.00	1.831E+01	+4.5	-7.1	±4.1	±3.3	±1.9	±2.7		1.661E+01	+7.4	-8.0	
120.50	1.816E+01	+4.5	-7.1	±4.1	±3.3	±1.9	±2.7		1.647E+01	+7.4	-8.0	
121.00	1.800E+01	+4.5	-7.1	±4.1	±3.3	±1.9	±2.7		1.634E+01	+7.4	-8.0	
121.50	1.785E+01	+4.5	-7.1	±4.1	±3.3	±1.9	±2.7		1.620E+01	+7.4	-8.0	

122.00	1.771E+01	+4.5	-7.1	±4.1	±3.3	±1.9	±2.7	1.607E+01	+7.3	-8.0	
122.50	1.756E+01	+4.5	-7.0	±4.1	±3.3	±1.9	±2.7	1.594E+01	+7.3	-8.0	
123.00	1.741E+01	+4.5	-7.0	±4.1	±3.3	±1.9	±2.7	1.581E+01	+7.3	-8.0	
123.50	1.727E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.568E+01	+7.3	-8.0	
124.00	1.713E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.556E+01	+7.3	-8.0	
124.10	1.710E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.553E+01	+7.3	-8.0	
124.20	1.707E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.551E+01	+7.3	-8.0	
124.30	1.704E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.548E+01	+7.3	-8.0	
124.40	1.702E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.546E+01	+7.3	-8.0	
124.50	1.699E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.543E+01	+7.3	-8.0	
124.60	1.696E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.541E+01	+7.3	-8.0	
124.70	1.693E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.538E+01	+7.3	-7.9	
124.80	1.690E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.536E+01	+7.3	-7.9	
124.90	1.688E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.533E+01	+7.3	-7.9	
125.00	1.685E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.531E+01	+7.3	-7.9	
125.09	1.682E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.529E+01	+7.3	-7.9	
125.10	1.682E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.528E+01	+7.3	-7.9	
125.20	1.679E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.526E+01	+7.3	-7.9	
125.30	1.677E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.523E+01	+7.3	-7.9	
125.40	1.674E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.521E+01	+7.3	-7.9	
125.50	1.671E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.519E+01	+7.3	-7.9	
125.60	1.668E+01	+4.4	-7.0	±4.0	±3.3	±1.9	±2.7	1.516E+01	+7.3	-7.9	
125.70	1.666E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.514E+01	+7.2	-7.9	
125.80	1.663E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.511E+01	+7.2	-7.9	
125.90	1.660E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.509E+01	+7.2	-7.9	
126.00	1.658E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.507E+01	+7.2	-7.9	
126.50	1.644E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.495E+01	+7.2	-7.9	
127.00	1.631E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.483E+01	+7.2	-7.9	
127.50	1.618E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.471E+01	+7.2	-7.9	
128.00	1.605E+01	+4.4	-6.9	±4.0	±3.3	±1.9	±2.7	1.460E+01	+7.2	-7.9	
128.50	1.592E+01	+4.3	-6.9	±4.0	±3.3	±1.9	±2.7	1.448E+01	+7.2	-7.9	
129.00	1.580E+01	+4.3	-6.8	±3.9	±3.3	±1.9	±2.7	1.437E+01	+7.2	-7.9	
129.50	1.567E+01	+4.3	-6.8	±3.9	±3.3	±1.9	±2.7	1.426E+01	+7.2	-7.9	
130.00	1.555E+01	+4.3	-6.8	±3.9	±3.3	±1.9	±2.7	1.415E+01	+7.1	-7.8	

VBF Process

- Cross sections are calculated at (approx.) NNLO QCD and NLO EW accuracies.
- Calculations are the same as CERN Report 3, except it is in NWA (CPS in CERN Report 3).
- Program: NNLO QCD (VBF@NNLO) and NLO EW (HAWK).
- QCD scales: $\mu=\mu_F=\mu_R=M_W$, uncertainty estimated in the range $1/2 < \mu/M_W < 2$ (keeping $\mu_F=\mu_R$).
  - ♦ No additional THU nor PU uncertainties assigned.
- PDF set: PDF4LHC15_nnlo_100 (QCD corrections) and NNPDF2.3QED (EW corrections + photon PDF)

m_H (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %
120.00	1.302E+00	+0.2	-0.2	±2.2	±2.1	±0.4
120.50	1.296E+00	+0.2	-0.2	±2.2	±2.1	±0.4
121.00	1.289E+00	+0.2	-0.2	±2.2	±2.1	±0.4
121.50	1.283E+00	+0.2	-0.2	±2.2	±2.1	±0.4
122.00	1.277E+00	+0.2	-0.2	±2.2	±2.1	±0.4

122.50	1.271E+00	+0.2	-0.2	±2.2	±2.1	±0.4
123.00	1.265E+00	+0.2	-0.2	±2.2	±2.1	±0.4
123.50	1.259E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.00	1.253E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.10	1.252E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.20	1.251E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.30	1.250E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.40	1.249E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.50	1.247E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.60	1.246E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.70	1.245E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.80	1.244E+00	+0.2	-0.2	±2.2	±2.1	±0.4
124.90	1.243E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.00	1.241E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.09	1.240E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.10	1.240E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.20	1.239E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.30	1.238E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.40	1.237E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.50	1.236E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.60	1.235E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.70	1.233E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.80	1.232E+00	+0.2	-0.2	±2.2	±2.1	±0.4
125.90	1.231E+00	+0.2	-0.2	±2.2	±2.1	±0.4
126.00	1.230E+00	+0.2	-0.2	±2.2	±2.1	±0.4
126.50	1.224E+00	+0.2	-0.2	±2.2	±2.1	±0.4
127.00	1.218E+00	+0.2	-0.2	±2.2	±2.1	±0.4
127.50	1.213E+00	+0.2	-0.2	±2.2	±2.1	±0.4
128.00	1.207E+00	+0.2	-0.2	±2.2	±2.1	±0.4
128.50	1.201E+00	+0.2	-0.2	±2.2	±2.1	±0.4
129.00	1.196E+00	+0.2	-0.2	±2.2	±2.1	±0.4
129.50	1.190E+00	+0.2	-0.2	±2.2	±2.1	±0.4
130.00	1.185E+00	+0.2	-0.2	±2.2	±2.1	±0.4

WH Process

- Cross sections are calculated at NNLO QCD and NLO EW accuracies.
  - ♦ Calculations are the same as CERN Report 3, except photon-induced contribution (see below).
  - ♦ Total cross section is calculated from WH 1 H cross section by subtracting photon-induced cross section, and then scaled via BR(W 1)=0.108535 in NLO EW accuracy.
- Program: NNLO QCD (VH@NNLO) and NLO EW (HAWK).
- QCD scales: $\mu=\mu_F=\mu_R=M_{VH}=(p_V+p_H)^2$ for QCD part and $\mu=\mu_F=\mu_R=M_{VH}+M_H$ for EW part. Uncertainty is estimated in the range $1/3 < \mu/M_{VH} < 3$ (μ_F and μ_R are varied independently).
  - ♦ No additional THU nor PU uncertainties assigned.
- PDF set: PDF4LHC15_nnlo_mc (QCD part) and NNPDF2.3QED (EW part).
- Photon-induced contribution of O(5%)
  - ♦ NOT included for total cross section (agrees with CERN Report 3 numbers within 1%).
  - ♦ Included in cross sections for dedicated WH 1 H (l=e,μ or) process (we strongly recommend to use these numbers for dedicated analyses).

pp WH Total Cross Section (with approximation)

m_H (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %	W^+H (pb)	W^-H (pb)
120.00	6.625E-01	+0.6	-0.9	±2.0	±1.9	±0.6	4.233E-01	2.392E-01
120.50	6.532E-01	+0.6	-0.9	±2.0	±1.9	±0.6	4.176E-01	2.357E-01
121.00	6.439E-01	+0.7	-0.9	±2.0	±2.0	±0.6	4.116E-01	2.324E-01
121.50	6.349E-01	+0.7	-0.9	±2.1	±2.0	±0.6	4.059E-01	2.291E-01
122.00	6.264E-01	+0.7	-0.9	±2.1	±2.0	±0.6	4.006E-01	2.258E-01
122.50	6.180E-01	+0.6	-0.9	±2.1	±2.0	±0.6	3.954E-01	2.226E-01
123.00	6.097E-01	+0.7	-0.9	±2.1	±2.0	±0.6	3.900E-01	2.197E-01
123.50	6.012E-01	+0.7	-0.9	±2.1	±2.0	±0.6	3.846E-01	2.166E-01
124.00	5.931E-01	+0.6	-0.8	±2.1	±2.0	±0.7	3.795E-01	2.136E-01
124.10	5.915E-01	+0.6	-0.8	±2.1	±2.0	±0.7	3.785E-01	2.130E-01
124.20	5.899E-01	+0.6	-0.8	±2.1	±2.0	±0.7	3.774E-01	2.125E-01
124.30	5.883E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.766E-01	2.117E-01
124.40	5.867E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.756E-01	2.111E-01
124.50	5.853E-01	+0.6	-0.9	±2.1	±2.0	±0.7	3.746E-01	2.107E-01
124.60	5.838E-01	+0.6	-1.0	±2.1	±2.0	±0.7	3.738E-01	2.100E-01
124.70	5.820E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.726E-01	2.094E-01
124.80	5.804E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.716E-01	2.088E-01
124.90	5.788E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.706E-01	2.082E-01
125.00	5.771E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.696E-01	2.076E-01
125.09	5.756E-01	+0.7	-0.8	±2.1	±2.0	±0.7	3.685E-01	2.070E-01
125.10	5.756E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.686E-01	2.069E-01
125.20	5.740E-01	+0.6	-0.9	±2.1	±2.0	±0.7	3.677E-01	2.063E-01
125.30	5.725E-01	+0.6	-0.9	±2.1	±2.0	±0.7	3.667E-01	2.058E-01
125.40	5.708E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.656E-01	2.052E-01
125.50	5.694E-01	+0.6	-0.9	±2.1	±2.0	±0.7	3.648E-01	2.046E-01
125.60	5.679E-01	+0.6	-0.9	±2.1	±2.0	±0.7	3.638E-01	2.041E-01
125.70	5.665E-01	+0.6	-0.9	±2.1	±2.0	±0.7	3.629E-01	2.035E-01
125.80	5.650E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.619E-01	2.031E-01
125.90	5.633E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.608E-01	2.025E-01
126.00	5.618E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.599E-01	2.019E-01
126.50	5.542E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.551E-01	1.991E-01
127.00	5.469E-01	+0.7	-0.9	±2.1	±2.0	±0.7	3.505E-01	1.964E-01
127.50	5.395E-01	+0.6	-0.9	±2.1	±2.0	±0.7	3.459E-01	1.937E-01
128.00	5.323E-01	+0.7	-0.9	±2.1	±2.0	±0.6	3.414E-01	1.909E-01
128.50	5.253E-01	+0.7	-0.9	±2.1	±2.0	±0.6	3.368E-01	1.884E-01
129.00	5.182E-01	+0.7	-0.9	±2.1	±2.0	±0.6	3.324E-01	1.857E-01
129.50	5.116E-01	+0.6	-1.0	±2.1	±2.0	±0.6	3.283E-01	1.834E-01
130.00	5.046E-01	+0.6	-0.9	±2.1	±2.0	±0.6	3.240E-01	1.807E-01

WH l H (l=e,μ or) Process

	W^+H l+ H							W^-H l-			
m_H (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %		Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ %
120.00	4.685E-02	+0.6	-0.9	±1.9	±1.8	±0.6	9.10E-04	2.648E-02	+0.6	-0.8	±2.3
120.50	4.622E-02	+0.6	-1.0	±1.9	±1.8	±0.6	9.00E-04	2.610E-02	+0.6	-0.8	±2.3
121.00	4.557E-02	+0.7	-0.9	±1.9	±1.9	±0.6	9.00E-04	2.574E-02	+0.6	-0.8	±2.3

121.50	4.495E-02	+0.7	-0.9	±2.0	±1.9	±0.6	9.00E-04	2.538E-02	+0.6	-0.9	±2.3
122.00	4.438E-02	+0.7	-0.9	±2.0	±1.9	±0.6	9.00E-04	2.503E-02	+0.7	-0.9	±2.3
122.50	4.380E-02	+0.6	-0.9	±2.0	±1.9	±0.6	8.90E-04	2.468E-02	+0.6	-0.8	±2.3
123.00	4.322E-02	+0.7	-0.9	±2.0	±1.9	±0.6	8.90E-04	2.435E-02	+0.6	-0.8	±2.3
123.50	4.263E-02	+0.7	-0.9	±2.0	±1.9	±0.6	8.90E-04	2.402E-02	+0.6	-0.9	±2.3
124.00	4.207E-02	+0.7	-0.8	±2.0	±1.9	±0.7	8.80E-04	2.369E-02	+0.5	-0.9	±2.3
124.10	4.196E-02	+0.7	-0.8	±2.0	±1.9	±0.7	8.80E-04	2.363E-02	+0.5	-0.9	±2.3
124.20	4.184E-02	+0.7	-0.8	±2.0	±1.9	±0.7	8.80E-04	2.357E-02	+0.5	-0.9	±2.3
124.30	4.175E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.349E-02	+0.6	-0.8	±2.3
124.40	4.165E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.342E-02	+0.6	-0.8	±2.3
124.50	4.154E-02	+0.6	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.338E-02	+0.5	-0.9	±2.3
124.60	4.145E-02	+0.6	-1.0	±2.0	±1.9	±0.7	8.80E-04	2.330E-02	+0.6	-0.9	±2.3
124.70	4.132E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.324E-02	+0.6	-0.9	±2.3
124.80	4.121E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.317E-02	+0.6	-0.9	±2.3
124.90	4.110E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.311E-02	+0.6	-0.9	±2.3
125.00	4.099E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.304E-02	+0.6	-0.8	±2.3
125.09	4.088E-02	+0.7	-0.8	±2.0	±1.9	±0.7	8.80E-04	2.298E-02	+0.6	-0.8	±2.3
125.10	4.089E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.297E-02	+0.6	-0.8	±2.3
125.20	4.079E-02	+0.6	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.290E-02	+0.7	-0.9	±2.3
125.30	4.068E-02	+0.6	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.285E-02	+0.6	-0.9	±2.3
125.40	4.056E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.278E-02	+0.6	-0.9	±2.3
125.50	4.047E-02	+0.6	-0.9	±2.0	±1.9	±0.7	8.80E-04	2.272E-02	+0.6	-0.9	±2.3
125.60	4.036E-02	+0.6	-0.9	±2.0	±1.9	±0.7	8.70E-04	2.266E-02	+0.6	-0.9	±2.3
125.70	4.026E-02	+0.6	-0.9	±2.0	±1.9	±0.7	8.70E-04	2.259E-02	+0.6	-0.8	±2.3
125.80	4.015E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.70E-04	2.254E-02	+0.6	-0.8	±2.3
125.90	4.003E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.70E-04	2.248E-02	+0.6	-0.9	±2.3
126.00	3.993E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.70E-04	2.241E-02	+0.7	-0.8	±2.3
126.50	3.941E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.70E-04	2.211E-02	+0.6	-0.9	±2.3
127.00	3.891E-02	+0.7	-0.9	±2.0	±1.9	±0.7	8.70E-04	2.182E-02	+0.6	-1.0	±2.3
127.50	3.840E-02	+0.6	-0.9	±2.0	±1.9	±0.7	8.60E-04	2.152E-02	+0.6	-0.9	±2.4
128.00	3.791E-02	+0.7	-0.9	±2.0	±1.9	±0.6	8.60E-04	2.122E-02	+0.7	-0.9	±2.4
128.50	3.742E-02	+0.7	-0.9	±2.0	±1.9	±0.6	8.60E-04	2.094E-02	+0.7	-0.9	±2.4
129.00	3.694E-02	+0.7	-0.9	±2.0	±1.9	±0.6	8.60E-04	2.065E-02	+0.6	-0.9	±2.4
129.50	3.648E-02	+0.6	-1.0	±2.0	±1.9	±0.6	8.50E-04	2.039E-02	+0.6	-0.9	±2.4
130.00	3.601E-02	+0.6	-0.9	±2.0	±1.9	±0.6	8.50E-04	2.010E-02	+0.7	-0.9	±2.4

ZH Process

- Cross sections are calculated at NNLO QCD and NLO EW accuracies.
  - ♦ Calculations are the same as CERN Report 3, except photon-induced contribution (see below).
  - ♦ Total cross section is calculated from ZH llH, H cross sections by subtracting photon-induced cross section, and then scaled via BR(Z ll)=0.0335962 and BR(Z)=0.201030 in NLO EW accuracy.
  - ♦ gg ZH (box-diagram) occurs as a part of NNLO QCD correction and included in the total cross section.
  - ♦ ZH cross section went up by +1~2%, due to +22~16% for √s = 7-14 TeV, due to increase in gg ZH for NLO+NLL QCD corrections (NLO in CERN Report 3).
- Program: NNLO QCD (VH@NNLO) and NLO EW (HAWK).
- QCD scales: $\mu=\mu_F=\mu_R=M_{VH}=(p_V+p_H)^2$ for QCD part and $\mu=\mu_F=\mu_R=M_{VH}+M_H$ for EW part. Uncertainty is estimated in the range $1/3 < \mu/M_{VH} < 3$ (μ_F and μ_R are varied independently).

- ♦ No additional THU nor PU uncertainties assigned.
- PDF set: PDF4LHC15_nnlo_mc (QCD part) and NNPDF2.3QED (EW part).
- Photon-induced contribution of O(1%) or below
  - ♦ NOT included for total cross section (agrees with CERN Report 3 numbers).
  - ♦ Included in cross sections for dedicated ZH llH, H (l=e,μ or) processes (we strongly recommend to use these numbers for dedicated analyses).

gg ZH Cross Section

- ZH production has two distinct sources of gg ZH:
  1. a genuine NNLO contribution to what called Drell-Yan-like , where ZH is accompanied by two-parton radiation, gg HZ+qqbar.
  2. top- and bottom-loop induced contribution without any additional partons in the final state.
- What is usually meant by gg HZ below is 2) above.
- The statement that all but gg HZ is the same as qq- and qg-initiated is correct only through NLO QCD.
- For separate cross sections and associated QCD scale uncertainties in qq/qg ZH(+gg HZ+qqbar) and gg ZH for NLO/LO MC normalization, use
  - ♦ (all but gg ZH) = (pp ZH)@(NNLO QCD + NLO EW, NLO+NLL QCD gg ZH) - (gg ZH)@(NLO+NLL QCD),
  - ♦ Separate QCD scale uncertainties are (all but gg ZH) or on (gg ZH) are calculated with VH@NNLO program.
- For M_H=125.0 GeV and at √s=7 TeV,

Process	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %
pp ZH	0.3392	+2.6%	-2.4%	±1.7%	±1.6%	±0.7%
qq/qg ZH, gg HZ+qqbar (all but gg ZH)	0.3113	+0.6%	-0.9%	±2.0%	±1.9%	±0.6%
gg ZH	0.02789	+25.6%	-19.1%	±3.6%	±3.0%	±2.1%

pp ZH Total Cross Section (with approximation)

m_H (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %	(gg ZH) (pb)
120.00	3.851E-01	+2.5	-2.2	±1.7	±1.6	±0.7	2.961E-02
120.50	3.803E-01	+2.4	-2.2	±1.7	±1.6	±0.7	2.938E-02
121.00	3.755E-01	+2.5	-2.2	±1.7	±1.6	±0.7	2.931E-02
121.50	3.705E-01	+2.5	-2.2	±1.7	±1.6	±0.7	2.909E-02
122.00	3.657E-01	+2.6	-2.1	±1.7	±1.6	±0.7	2.896E-02
122.50	3.612E-01	+2.6	-2.2	±1.7	±1.6	±0.7	2.876E-02
123.00	3.563E-01	+2.7	-2.1	±1.7	±1.6	±0.7	2.851E-02
123.50	3.518E-01	+2.6	-2.2	±1.7	±1.6	±0.7	2.841E-02
124.00	3.478E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.839E-02
124.10	3.470E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.822E-02
124.20	3.461E-01	+2.5	-2.3	±1.7	±1.6	±0.7	2.822E-02
124.30	3.452E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.817E-02
124.40	3.444E-01	+2.5	-2.3	±1.7	±1.6	±0.7	2.817E-02
124.50	3.434E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.814E-02
124.60	3.426E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.814E-02
124.70	3.417E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.809E-02
124.80	3.408E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.792E-02
124.90	3.401E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.792E-02
125.00	3.392E-01	+2.6	-2.4	±1.7	±1.6	±0.7	2.789E-02

125.09	3.384E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.792E-02
125.10	3.383E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.789E-02
125.20	3.375E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.789E-02
125.30	3.366E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.787E-02
125.40	3.357E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.784E-02
125.50	3.348E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.782E-02
125.60	3.339E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.782E-02
125.70	3.333E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.782E-02
125.80	3.325E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.779E-02
125.90	3.315E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.762E-02
126.00	3.307E-01	+2.6	-2.3	±1.7	±1.6	±0.7	2.760E-02
126.50	3.265E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.752E-02
127.00	3.225E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.730E-02
127.50	3.185E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.722E-02
128.00	3.146E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.697E-02
128.50	3.109E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.690E-02
129.00	3.071E-01	+2.7	-2.3	±1.7	±1.6	±0.7	2.665E-02
129.50	3.033E-01	+2.7	-2.4	±1.7	±1.6	±0.7	2.645E-02
130.00	2.996E-01	+2.7	-2.4	±1.7	±1.6	±0.7	2.635E-02

ZH llH, H (l=e,μ or) Process

	ZH l+l-H										
m_H (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %	gg ZH (pb)		Cross Section (pb)	+QCD Scale %	-QCD Scale %	&
120.00	1.297E-02	+2.5	-2.2	±1.7	±1.6	±0.7	1.00E-03	3.00E-05	7.740E-02	+2.5	-2.2	
120.50	1.281E-02	+2.4	-2.2	±1.7	±1.6	±0.7	9.90E-04	3.00E-05	7.643E-02	+2.4	-2.2	
121.00	1.265E-02	+2.5	-2.2	±1.7	±1.6	±0.7	9.90E-04	3.00E-05	7.546E-02	+2.5	-2.2	
121.50	1.248E-02	+2.5	-2.2	±1.7	±1.6	±0.7	9.80E-04	3.00E-05	7.448E-02	+2.5	-2.2	
122.00	1.232E-02	+2.6	-2.1	±1.7	±1.6	±0.7	9.80E-04	3.00E-05	7.351E-02	+2.6	-2.1	
122.50	1.217E-02	+2.6	-2.2	±1.7	±1.6	±0.7	9.70E-04	3.00E-05	7.259E-02	+2.6	-2.2	
123.00	1.200E-02	+2.7	-2.1	±1.7	±1.6	±0.7	9.60E-04	3.00E-05	7.162E-02	+2.7	-2.1	
123.50	1.185E-02	+2.6	-2.2	±1.7	±1.6	±0.7	9.60E-04	3.00E-05	7.073E-02	+2.6	-2.2	
124.00	1.172E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.60E-04	3.00E-05	6.990E-02	+2.6	-2.3	
124.10	1.169E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.50E-04	3.00E-05	6.973E-02	+2.6	-2.3	
124.20	1.166E-02	+2.5	-2.3	±1.7	±1.6	±0.7	9.50E-04	3.00E-05	6.958E-02	+2.5	-2.3	
124.30	1.163E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.50E-04	3.00E-05	6.937E-02	+2.6	-2.3	
124.40	1.160E-02	+2.5	-2.3	±1.7	±1.6	±0.7	9.50E-04	3.00E-05	6.923E-02	+2.5	-2.3	
124.50	1.157E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.50E-04	3.00E-05	6.901E-02	+2.7	-2.3	
124.60	1.154E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.50E-04	3.00E-05	6.888E-02	+2.6	-2.3	
124.70	1.151E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.50E-04	3.00E-05	6.869E-02	+2.6	-2.3	
124.80	1.148E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.850E-02	+2.6	-2.3	
124.90	1.146E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.835E-02	+2.6	-2.3	
125.00	1.143E-02	+2.6	-2.4	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.818E-02	+2.6	-2.4	
125.09	1.140E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.802E-02	+2.6	-2.3	
125.10	1.140E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.800E-02	+2.6	-2.3	
125.20	1.137E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.782E-02	+2.6	-2.3	
125.30	1.134E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.765E-02	+2.7	-2.3	
125.40	1.131E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.749E-02	+2.7	-2.3	
125.50	1.128E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.728E-02	+2.6	-2.3	

125.60	1.125E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.713E-02	+2.6	-2.3
125.70	1.123E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.697E-02	+2.6	-2.3
125.80	1.120E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.40E-04	3.00E-05	6.683E-02	+2.6	-2.3
125.90	1.117E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.30E-04	3.00E-05	6.662E-02	+2.6	-2.3
126.00	1.114E-02	+2.6	-2.3	±1.7	±1.6	±0.7	9.30E-04	3.00E-05	6.648E-02	+2.6	-2.3
126.50	1.100E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.30E-04	3.00E-05	6.562E-02	+2.7	-2.3
127.00	1.087E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.20E-04	3.00E-05	6.482E-02	+2.7	-2.3
127.50	1.073E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.20E-04	3.00E-05	6.403E-02	+2.7	-2.3
128.00	1.060E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.10E-04	3.00E-05	6.324E-02	+2.7	-2.3
128.50	1.048E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.10E-04	3.00E-05	6.248E-02	+2.7	-2.3
129.00	1.035E-02	+2.7	-2.3	±1.7	±1.6	±0.7	9.00E-04	3.00E-05	6.172E-02	+2.7	-2.3
129.50	1.022E-02	+2.7	-2.4	±1.7	±1.6	±0.7	8.90E-04	3.00E-05	6.097E-02	+2.7	-2.4
130.00	1.010E-02	+2.7	-2.4	±1.7	±1.6	±0.7	8.90E-04	3.00E-05	6.022E-02	+2.7	-2.4

ttH Process

- Cross sections are calculated at NLO QCD and NLO EW accuracies.
  - ♦ Calculations are the same as CERN Report 3, except NLO EW corrections are adopted now.
- Program: MadGraph5_aMC@NLO (Sherpa+OpenLoops as cross ceck)
- 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

m_H (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %
120.00	1.005E-01	+3.6	-9.3	±4.5	±3.9	±2.2
120.50	9.936E-02	+3.6	-9.3	±4.5	±3.9	±2.2
121.00	9.800E-02	+3.6	-9.3	±4.5	±3.9	±2.2
121.50	9.679E-02	+3.5	-9.2	±4.5	±3.9	±2.2
122.00	9.572E-02	+3.5	-9.2	±4.5	±3.9	±2.2
122.50	9.455E-02	+3.5	-9.2	±4.5	±3.9	±2.2
123.00	9.335E-02	+3.5	-9.2	±4.5	±3.9	±2.2
123.50	9.216E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.00	9.107E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.10	9.084E-02	+3.4	-9.2	±4.5	±3.9	±2.2
124.20	9.060E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.30	9.042E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.40	9.018E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.50	9.007E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.60	8.972E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.70	8.957E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.80	8.930E-02	+3.5	-9.2	±4.5	±3.9	±2.2
124.90	8.912E-02	+3.5	-9.2	±4.5	±3.9	±2.2
125.00	8.878E-02	+3.4	-9.2	±4.5	±3.9	±2.2
125.09	8.864E-02	+3.5	-9.2	±4.5	±3.9	±2.2
125.10	8.873E-02	+3.5	-9.2	±4.5	±3.9	±2.2
125.20	8.841E-02	+3.5	-9.2	±4.5	±3.9	±2.2
125.30	8.825E-02	+3.4	-9.2	±4.5	±3.9	±2.2
125.40	8.794E-02	+3.5	-9.2	±4.5	±3.9	±2.2
125.50	8.783E-02	+3.4	-9.2	±4.5	±3.9	±2.2
125.60	8.761E-02	+3.5	-9.2	±4.5	±3.9	±2.2

125.70	8.742E-02	+3.5	-9.2	±4.5	±3.9	±2.2
125.80	8.714E-02	+3.4	-9.2	±4.5	±3.9	±2.2
125.90	8.703E-02	+3.5	-9.2	±4.5	±3.9	±2.2
126.00	8.674E-02	+3.5	-9.2	±4.5	±3.9	±2.2
126.50	8.571E-02	+3.4	-9.2	±4.5	±3.9	±2.2
127.00	8.477E-02	+3.5	-9.2	±4.5	±3.9	±2.2
127.50	8.369E-02	+3.5	-9.2	±4.5	±3.9	±2.2
128.00	8.262E-02	+3.5	-9.2	±4.5	±3.9	±2.2
128.50	8.167E-02	+3.4	-9.2	±4.5	±3.9	±2.2
129.00	8.073E-02	+3.4	-9.2	±4.5	±3.9	±2.2
129.50	7.973E-02	+3.4	-9.2	±4.5	±3.9	±2.2
130.00	7.882E-02	+3.4	-9.2	±4.5	±3.9	±2.2

bbH Process

- The cross sections are the Santander matched numbers with 5FS (NNLO) and 4FS (NLO). No EW corrections.
- 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 + μ_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_nnlo_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+ $_s$) %	-(QCD Scale+PDF+ $_s$) %
120.00	1.782E-01	+21.0	-22.8
120.50	1.762E-01	+21.0	-22.8
121.00	1.735E-01	+20.9	-22.7
121.50	1.710E-01	+20.9	-22.7
122.00	1.688E-01	+20.9	-22.7
122.50	1.663E-01	+20.8	-22.6
123.00	1.634E-01	+20.7	-22.5
123.50	1.619E-01	+20.7	-22.5
124.00	1.597E-01	+20.8	-22.6
124.10	1.591E-01	+20.8	-22.6
124.20	1.586E-01	+20.8	-22.6
124.30	1.583E-01	+20.8	-22.7
124.40	1.579E-01	+20.9	-22.7
124.50	1.573E-01	+20.7	-22.5
124.60	1.572E-01	+20.8	-22.5
124.70	1.564E-01	+20.8	-22.5
124.80	1.557E-01	+20.8	-22.6
124.90	1.555E-01	+20.8	-22.6

125.00	1.552E-01	+20.7	-22.4
125.09	1.545E-01	+20.7	-22.5
125.10	1.547E-01	+20.8	-22.5
125.20	1.543E-01	+20.8	-22.5
125.30	1.538E-01	+20.8	-22.5
125.40	1.532E-01	+20.8	-22.6
125.50	1.527E-01	+20.7	-22.4
125.60	1.524E-01	+20.6	-22.4
125.70	1.521E-01	+20.7	-22.5
125.80	1.514E-01	+20.7	-22.5
125.90	1.510E-01	+20.8	-22.5
126.00	1.508E-01	+20.7	-22.3
126.50	1.486E-01	+20.6	-22.3
127.00	1.467E-01	+20.6	-22.3
127.50	1.446E-01	+20.5	-22.2
128.00	1.425E-01	+20.4	-22.2
128.50	1.406E-01	+20.4	-22.2
129.00	1.389E-01	+20.4	-22.1
129.50	1.370E-01	+20.4	-22.1
130.00	1.351E-01	+20.3	-22.1

tH Process

t-ch (qb tHq)

- Cross sections are calculated at NLO QCD accuracy (no NLO EW correction) 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) %	±(PDF+ $_s$) %	±PDF %	± $_s$ %	tH (pb)	tbarH (pb)
120.00	1.289E-02	+7.6	-16.6	±4.9	±4.7	±1.5	8.880E-03	4.000E-03
120.50	1.281E-02	+7.5	-16.5	±4.9	±4.7	±1.5	8.830E-03	3.970E-03
121.00	1.273E-02	+7.6	-16.5	±4.9	±4.7	±1.5	8.780E-03	3.950E-03
121.50	1.267E-02	+7.5	-16.6	±4.9	±4.7	±1.5	8.730E-03	3.930E-03
122.00	1.260E-02	+7.5	-16.6	±4.9	±4.7	±1.5	8.690E-03	3.920E-03
122.50	1.254E-02	+7.5	-16.8	±4.9	±4.7	±1.5	8.630E-03	3.890E-03
123.00	1.247E-02	+7.5	-16.7	±4.9	±4.7	±1.5	8.600E-03	3.880E-03
123.50	1.241E-02	+7.4	-16.8	±4.9	±4.7	±1.5	8.550E-03	3.860E-03
124.00	1.236E-02	+7.4	-17.0	±4.9	±4.7	±1.5	8.510E-03	3.840E-03
124.10	1.235E-02	+7.4	-16.9	±4.9	±4.7	±1.5	8.510E-03	3.840E-03
124.20	1.235E-02	+7.4	-17.0	±4.9	±4.7	±1.5	8.500E-03	3.830E-03
124.30	1.233E-02	+7.4	-17.0	±4.9	±4.7	±1.5	8.500E-03	3.830E-03
124.40	1.231E-02	+7.4	-17.0	±4.9	±4.7	±1.5	8.500E-03	3.830E-03

124.50	1.228E-02	+7.4	-16.9	±4.9	±4.7	±1.5	8.460E-03	3.820E-03
124.60	1.228E-02	+7.4	-16.8	±4.9	±4.7	±1.5	8.470E-03	3.820E-03
124.70	1.226E-02	+7.4	-16.8	±4.9	±4.7	±1.5	8.470E-03	3.810E-03
124.80	1.225E-02	+7.4	-16.8	±4.9	±4.7	±1.5	8.440E-03	3.810E-03
124.90	1.223E-02	+7.4	-16.8	±4.9	±4.7	±1.5	8.430E-03	3.800E-03
125.00	1.226E-02	+7.3	-17.2	±4.9	±4.7	±1.5	8.430E-03	3.800E-03
125.09	1.223E-02	+7.4	-17.0	±5.0	±4.7	±1.5	8.420E-03	3.800E-03
125.10	1.223E-02	+7.4	-17.0	±5.0	±4.7	±1.5	8.420E-03	3.800E-03
125.20	1.222E-02	+7.3	-16.9	±5.0	±4.7	±1.5	8.410E-03	3.800E-03
125.30	1.221E-02	+7.4	-16.9	±5.0	±4.7	±1.5	8.410E-03	3.790E-03
125.40	1.217E-02	+7.4	-16.8	±5.0	±4.7	±1.5	8.400E-03	3.790E-03
125.50	1.219E-02	+7.4	-17.0	±5.0	±4.7	±1.5	8.400E-03	3.790E-03
125.60	1.218E-02	+7.3	-17.1	±5.0	±4.7	±1.5	8.390E-03	3.780E-03
125.70	1.216E-02	+7.3	-17.0	±5.0	±4.7	±1.5	8.380E-03	3.780E-03
125.80	1.214E-02	+7.4	-16.8	±5.0	±4.7	±1.5	8.360E-03	3.780E-03
125.90	1.213E-02	+7.3	-17.0	±5.0	±4.7	±1.5	8.350E-03	3.770E-03
126.00	1.213E-02	+7.3	-17.0	±5.0	±4.7	±1.5	8.340E-03	3.770E-03
126.50	1.207E-02	+7.3	-17.1	±5.0	±4.7	±1.5	8.320E-03	3.750E-03
127.00	1.199E-02	+7.3	-17.1	±5.0	±4.7	±1.5	8.270E-03	3.740E-03
127.50	1.197E-02	+7.3	-17.1	±5.0	±4.7	±1.5	8.240E-03	3.720E-03
128.00	1.190E-02	+7.2	-17.2	±5.0	±4.7	±1.5	8.200E-03	3.700E-03
128.50	1.185E-02	+7.2	-17.5	±5.0	±4.8	±1.5	8.160E-03	3.690E-03
129.00	1.178E-02	+7.3	-17.2	±5.0	±4.8	±1.5	8.120E-03	3.670E-03
129.50	1.174E-02	+7.2	-17.4	±5.0	±4.8	±1.5	8.080E-03	3.660E-03
130.00	1.167E-02	+7.2	-17.4	±5.0	±4.8	±1.5	8.040E-03	3.650E-03

s-ch (qq tHb)

- Cross sections are calculated at NLO QCD accuracy (no NLO EW correction) 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 %	±(PDF+ $_s$) %	±PDF %	± $_s$ %	tH (pb)	tbarH (pb)
120.00	1.028E-03	+2.9	-2.5	±3.0	±3.0	±0.0	7.090E-04	3.190E-04
120.50	1.018E-03	+2.9	-2.5	±3.0	±3.0	±0.0	7.030E-04	3.150E-04
121.00	1.008E-03	+2.9	-2.5	±3.0	±3.0	±0.0	6.960E-04	3.110E-04
121.50	1.000E-03	+2.9	-2.6	±3.0	±3.0	±0.0	6.890E-04	3.090E-04
122.00	9.870E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.820E-04	3.050E-04
122.50	9.780E-04	+2.8	-2.5	±3.0	±3.0	±0.0	6.760E-04	3.020E-04
123.00	9.690E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.690E-04	2.990E-04
123.50	9.600E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.630E-04	2.960E-04
124.00	9.490E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.550E-04	2.930E-04
124.10	9.470E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.540E-04	2.920E-04
124.20	9.430E-04	+2.8	-2.5	±3.0	±3.0	±0.0	6.530E-04	2.910E-04
124.30	9.430E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.520E-04	2.910E-04
124.40	9.410E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.510E-04	2.900E-04
124.50	9.390E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.500E-04	2.900E-04

124.60	9.370E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.480E-04	2.890E-04
124.70	9.350E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.470E-04	2.880E-04
124.80	9.340E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.450E-04	2.880E-04
124.90	9.330E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.440E-04	2.870E-04
125.00	9.300E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.420E-04	2.870E-04
125.09	9.290E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.420E-04	2.860E-04
125.10	9.290E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.420E-04	2.860E-04
125.20	9.250E-04	+2.8	-2.5	±3.0	±3.0	±0.0	6.410E-04	2.850E-04
125.30	9.250E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.400E-04	2.850E-04
125.40	9.220E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.380E-04	2.840E-04
125.50	9.210E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.380E-04	2.840E-04
125.60	9.190E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.360E-04	2.830E-04
125.70	9.170E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.340E-04	2.830E-04
125.80	9.160E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.330E-04	2.820E-04
125.90	9.140E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.320E-04	2.810E-04
126.00	9.120E-04	+2.9	-2.5	±3.0	±3.0	±0.0	6.300E-04	2.800E-04
126.50	9.030E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.250E-04	2.780E-04
127.00	8.940E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.190E-04	2.750E-04
127.50	8.850E-04	+2.9	-2.6	±3.0	±3.0	±0.0	6.130E-04	2.720E-04
128.00	8.750E-04	+2.9	-2.5	±3.1	±3.1	±0.0	6.070E-04	2.700E-04
128.50	8.690E-04	+2.9	-2.6	±3.1	±3.1	±0.0	6.010E-04	2.670E-04
129.00	8.600E-04	+2.9	-2.6	±3.1	±3.1	±0.0	5.950E-04	2.640E-04
129.50	8.520E-04	+2.9	-2.6	±3.1	±3.1	±0.0	5.890E-04	2.620E-04
130.00	8.430E-04	+2.9	-2.6	±3.1	±3.1	±0.0	5.850E-04	2.590E-04

W-associated (gb tHW)

- Cross sections are calculated at NLO QCD accuracy (no NLO EW correction) in 5FS
  - With DR2 (Diagram Removal plus interference) described in [Demartin:2016axk]
  - (tHW$^-$) = (tbarHW$^+$) = ((tHW$^-$)+ (tbarHW$^+$))/2
- Program: MadGraph5_aMC@NLO
- QCD scales: $\mu=\mu_F=\mu_R=(M_{top}+M_H+M_W)/2$, uncertainty estimated in the range $1/2 < \mu/\{(M_{top}+M_H+M_W)/2\} < 2$ (with $1/2 < \mu_F/\mu_R < 2$ constraint).
- PDF set:
  - PDF4LHC15_nlo_30_pdfas (5FS)

m_H (GeV)	Cross Section (pb)	+QCD Scale %	-QCD Scale %	±(PDF+ $_s$) %	±PDF %	± $_s$ %
125.00	2.23E-03	+4.2	-5.5	±8.4	±8.2	±2.0

-- ReiTanaka - 2016-03-01

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