Cross Section and Branching Ratio Recommendations for Tevatron Higgs Searches

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for the CDF and D0 Collaborations

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We list in this document the predicted cross sections and decay branching fractions and their associated uncertainties. The WH, ZH, Vector-Boson Fusion (VBF), and $gg \to H$ production cross sections are listed at NNLO (NNLL) accuracy. The background cross sections are evaluated for WW, WZ, and ZZ, $t\bar{t}$, and single-top processes, updated to the latest available calculations and computed for $m_t = 173$ GeV. This note is prepared for use for the Summer 2011 conference results.

I. HIGGS BOSON CROSS SECTIONS AND BRANCHING FRACTIONS

Note: The citations at the end of this note list the sources from which these cross sections and branching fractions are obtained. They may not necesssarily cover a list long enough for every theorist's taste. For the LaTeX source of this note, which can be used to collect the numbers in a computer-readable format, contact Tom Junk, trj@fnal.gov.

Recent progress has been made in the production cross section calculations for WH, ZH, VBF and $gg \to H$ production. The WH and ZH production cross sections, previously from [1] are now updated to those in [2]. The net effect is a 4 to 6% drop in the WH and ZH production cross sections, depending on m_H. The authors explained to us that this change was due to including CKM matrix elements properly (as spotted by R. Harlander), and by increasing the number of integration samples when computing the NNLO cross sections integrating the output of sc v2hv [3]. The WH and ZH production cross sections, computed using the MSTW 2008 PDF set [4], are listed in Table I.

The VBF production cross sections are now available at NNLO in QCD [5] and are quite similar to our previous NLO calculations which were comptued using MCFM [6]. A newer calculation, called Hawk [7] introduces NLO electroweak corrections, but computes QCD corrections only at NLO. While the electroweak corrections are negative, they are very much smaller than the uncertainties we quote on the NNLO production cross section. Table II lists the VBF cross section at NNLO in QCD, along with the Hawk calculation, and the electroweak correction part. We recommend using the NNLO calculation which is computed with MSTW 2008 PDFs, but to cite also the Hawk calculation.

The $gg \to H$ production cross section is updated with respect to our previous calculation [8], by the same authors. The changes incorporated are to input $m_t = 173.1$ GeV (it had been 170.9 for the last iteration), and to include the full m_t dependence instead of using the partial large m_t approximation. We use, as before, the NNLO+NNLL calculation, which has a smaller scale dependence than the NNLO calculation. Massimiliano Grazzini recommends that the calculation be done with factorization and renormalization scales $\mu_f = \mu_r = m_H$. There is very little change in the NNLO+NNLL total cross section calculation with the scale. The updated $gg \to H$ production cross sections, computed with MSTW 2008 PDFs, and the associated uncertainties, are listed in Table III. The scale uncertainties are evalualted by varying $\mu_f = \mu_r$ up and down by a factor of 2.0, and evaluating the change in the NNLO cross section and applying the uncertainty to the NNLO+NNLL prediction. The PDF uncertainty is evaluated according to the full prescription of the PDF4LHC group [9], which is to take the envelope of the MSTW2008, central value, and the PDF+α_s uncertainties from MSTW2008, CTEQ6.6, and NNPDF2.0, using each group's prescription for combining the two types of uncertainties. Please also cite Ref. [11] in publications as well.

The Higgs boson decay branching fractions are obtained from the Handbook [12]. These branching fractions are computed by evaluating the partial decay widths of on-shell Higgs bosons to all possible final states allowed in the SM, and evaluating the fractions of the total decay width for each process. For all processes except $H \to W^+W^-$ and $H \to ZZ$, hdecay is used to compute the partial widths. hdecay includes rlevant higher-order QCD corrections to decays into quarks and gluons, and NLO electroweak corrections are included in the $H \to \gamma\gamma$ and $H \to gg$ processes. For $H \to W^+W^-$ and $H \to ZZ$, the Monte Carlo generator Prophecy4f [14] is used. It computes partial widths for

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TABLE I: The NNLO production cross section for WH, ZH, and the associated uncertainties

m_H (GeV/c^2)	σ_{WH} (fb)	σ_{ZH} (fb)	scale (%)	PDF+$\alpha_s^{\rm exp}$ (%)	$\alpha_s^{\rm th}$ (%)
100	291.90	169.8	$^{+0.7}_{-0.8}$	$^{+5.0}_{-5.0}$	$^{+0.5}_{-0.4}$
105	248.40	145.9	$^{+0.7}_{-0.8}$	$^{+5.4}_{-5.4}$	$^{+0.6}_{-0.4}$
110	212.00	125.7	$^{+0.7}_{-0.9}$	$^{+5.8}_{-5.8}$	$^{+0.6}_{-0.5}$
115	174.50	103.9	$^{+0.7}_{-0.9}$	$^{+6.1}_{-6.1}$	$^{+0.7}_{-0.5}$
120	150.10	90.2	$^{+0.7}_{-0.9}$	$^{+6.4}_{-6.3}$	$^{+0.8}_{-0.6}$
125	129.50	78.5	$^{+0.7}_{-1.0}$	$^{+6.6}_{-6.7}$	$^{+0.8}_{-0.6}$
130	112.00	68.5	$^{+0.7}_{-1.0}$	$^{+6.4}_{-6.7}$	$^{+1.0}_{-0.7}$
135	97.20	60.0	$^{+0.7}_{-1.0}$	$^{+6.9}_{-6.8}$	$^{+1.0}_{-0.7}$
140	84.60	52.7	$^{+0.7}_{-1.1}$	$^{+6.9}_{-6.7}$	$^{+1.1}_{-0.8}$
145	73.70	46.3	$^{+0.7}_{-1.1}$	$^{+7.3}_{-7.1}$	$^{+1.2}_{-0.9}$
150	64.40	40.8	$^{+0.8}_{-1.1}$	$^{+6.8}_{-6.7}$	$^{+1.2}_{-0.9}$
155	56.20	35.9	$^{+0.7}_{-1.1}$	$^{+7.5}_{-7.3}$	$^{+1.2}_{-1.1}$
160	48.50	31.4	$^{+0.8}_{-1.2}$	$^{+7.4}_{-6.8}$	$^{+1.4}_{-1.0}$
165	43.60	28.4	$^{+0.7}_{-1.1}$	$^{+7.8}_{-7.6}$	$^{+1.4}_{-1.1}$
170	38.50	25.3	$^{+0.8}_{-1.0}$	$^{+7.8}_{-7.0}$	$^{+1.6}_{-1.3}$
175	34.00	22.5	$^{+0.9}_{-1.2}$	$^{+7.9}_{-7.6}$	$^{+1.5}_{-1.2}$
180	30.10	20.0	$^{+0.7}_{-1.3}$	$^{+7.3}_{-7.3}$	$^{+1.7}_{-1.3}$
185	26.90	17.9	$^{+0.7}_{-1.1}$	$^{+7.8}_{-7.8}$	$^{+1.9}_{-1.5}$
190	24.00	16.1	$^{+0.8}_{-1.2}$	$^{+7.5}_{-7.5}$	$^{+1.7}_{-1.2}$
195	21.40	14.4	$^{+0.9}_{-1.4}$	$^{+8.4}_{-7.9}$	$^{+1.9}_{-1.4}$
200	19.10	13.0	$^{+1.0}_{-1.0}$	$^{+7.9}_{-7.3}$	$^{+2.1}_{-1.6}$
210	15.20	10.5	$^{+0.7}_{-0.7}$	$^{+7.2}_{-7.2}$	$^{+1.3}_{-1.3}$
220	12.30	8.5	$^{+0.3}_{-0.3}$	$^{+7.4}_{-7.4}$	$^{+1.1}_{-1.3}$
230	9.90	7.0	$^{+0.4}_{-0.4}$	$^{+7.6}_{-7.6}$	$^{+1.2}_{-1.4}$
240	8.03	5.7	$^{+0.2}_{-0.2}$	$^{+7.7}_{-7.7}$	$^{+1.4}_{-1.5}$
250	6.53	4.7	$^{+0.3}_{-0.3}$	$^{+7.8}_{-8.0}$	$^{+1.4}_{-1.5}$
260	5.33	3.9	$^{+0.2}_{-0.2}$	$^{+8.1}_{-8.1}$	$^{+1.5}_{-1.7}$
270	4.37	3.2	$^{+0.2}_{-0.2}$	$^{+8.0}_{-8.2}$	$^{+1.6}_{-1.6}$
280	3.59	2.7	$^{+0.3}_{-0.3}$	$^{+8.1}_{-8.4}$	$^{+1.7}_{-1.7}$
290	2.96	2.2	$^{+0.3}_{-0.3}$	$^{+8.4}_{-8.8}$	$^{+1.7}_{-1.7}$
300	2.45	1.9	$^{+0.0}_{0.0}$	$^{+8.6}_{-8.6}$	$^{+1.6}_{-2.0}$

Higgs boson decays at NLO, including NLO QCD and electroweak corrections and all interferences, for four-fermion final states of Higgs boson decay. More details are available in [12].

The decay branching ratios are listed in Table IV. Uncertainties on the Higgs boson decay branching fractions to W^+W^- and to $b\bar{b}$ due to m_b, m_c, and α_s are listed in Table 5 of [15]; The uncertainties in the W^+W^- and $b\bar{b}$ branching fractions are highly anti-correlated due to the sum of all branching fractions being unity. Table V lists the relative uncertainties in the $H \to b\bar{b}$ decay branching fraction due to uncertainties in α_s, m_b, and m_c as functions of m_H, with the appropriate signs; Table VI shows the same for the the $H \to c\bar{c}$ decay branching fraction, Table VII shows the same for the the $H \to \tau^+\tau^-$ decay branching fraction, Table VIII shows the same for the the $H \to W^+W^-$ decay branching fraction, and Table IX shows the same for the the $H \to ZZ$ decay branching fraction.

The references here indicate where our cross section numerical values come from, but do not represent a full citation of the appropriate literature.

TABLE II: The NNLO production cross section for Vector Boson Fusion and the associated uncertainties. The PDF+α_s uncertainties are 90% CL MSTW08 uncertainties.

m_H (GeV/c^2)	$\sigma_{\rm VBF}$ (NNLO) (fb)	scale (%)	PDF+α_s (%)	$\sigma_{\rm VBF}$ (HAWK) (fb)	EW Corr (fb)
100	100.1	$^{+0.7}_{-0.3}$	$\pm$ 4.8	98.6	-0.029
105	92.3	$^{+0.7}_{-0.3}$	$\pm$ 4.9	90.8	-0.028
110	85.1	$^{+0.8}_{-0.3}$	$\pm$ 4.9	83.8	-0.028
115	78.6	$^{+0.8}_{-0.3}$	$\pm$ 4.9	77.3	-0.028
120	72.7	$^{+0.6}_{-0.4}$	$\pm$ 4.9	71.4	-0.027
125	67.1	$^{+0.7}_{-0.3}$	$\pm$ 5.0	66.0	-0.028
130	62.1	$^{+0.7}_{-0.4}$	$\pm$ 5.0	61.0	-0.027
135	57.5	$^{+0.7}_{-0.4}$	$\pm$ 5.0	56.5	-0.027
140	53.2	$^{+0.7}_{-0.4}$	$\pm$ 5.0	52.3	-0.027
145	49.4	$^{+0.7}_{-0.4}$	$\pm$ 5.1	48.5	-0.027
150	45.8	$^{+0.7}_{-0.5}$	$\pm$ 5.1	44.9	-0.027
155	42.4	$^{+0.7}_{-0.5}$	$\pm$ 5.1	41.5	-0.028
160	39.4	$^{+0.7}_{-0.5}$	$\pm$ 5.1	38.5	-0.030
165	36.6	$^{+0.7}_{-0.5}$	$\pm$ 5.1	36.2	-0.017
170	34.0	$^{+0.7}_{-0.6}$	$\pm$ 5.2	33.6	-0.017
175	31.6	$^{+0.7}_{-0.6}$	$\pm$ 5.2	31.2	-0.018
180	29.4	$^{+0.7}_{-0.6}$	$\pm$ 5.2	28.9	-0.022
185	27.3	$^{+0.7}_{-0.6}$	$\pm$ 5.2	27.0	-0.016
190	25.4	$^{+0.7}_{-0.6}$	$\pm$ 5.2	25.1	-0.014
195	23.7	$^{+0.8}_{-0.7}$	$\pm$ 5.3	23.4	-0.015
200	22.0	$^{+0.8}_{-0.7}$	$\pm$ 5.3	21.7	-0.016
210	19.1	$^{+0.7}_{-0.7}$	$\pm$ 5.3	18.8	-0.018
220	16.6	$^{+0.7}_{-0.8}$	$\pm$ 5.3	16.3	-0.020
230	14.5	$^{+0.8}_{-0.8}$	$\pm$ 5.4	14.2	-0.022
240	12.6	$^{+0.8}_{-0.8}$	$\pm$ 5.4	12.3	-0.023
250	11.0	$^{+0.8}_{-0.9}$	$\pm$ 5.4	10.7	-0.024
260	9.6	$^{+0.8}_{-1.0}$	$\pm$ 5.5	9.4	-0.025
270	8.4	$^{+0.8}_{-1.0}$	$\pm$ 5.5	8.2	-0.026
280	7.4	$^{+0.8}_{-1.1}$	$\pm$ 5.5	7.1	-0.027
290	6.4	$^{+0.8}_{-1.1}$	$\pm$ 5.6	6.2	-0.026
300	5.6	$^{+0.8}_{-1.1}$	$\pm$ 5.6	5.4	-0.027

TABLE III: The SM NNLO+NNLL production cross section for $gg \to H$ and the associated uncertainties. The PDF+α_s uncertainties are the full PDF4LHC prescription.

m_H (GeV/c^2)	$\sigma_{gg\to H}$ (fb)	scale (up) (%)	scale (down) (%)	PDF+α_s (up) (%)	PDF+α_s (down) (%)
90	2442.3	7.39	-8.17	8.70	-11.82
95	2101.1	7.33	-8.02	8.94	-11.84
100	1821.8	7.31	-7.88	9.17	-11.85
105	1584.7	7.28	-7.75	9.41	-11.86
110	1385.0	7.24	-7.64	9.64	-11.87
115	1215.9	7.20	-7.53	9.80	-11.94
120	1072.3	7.19	-7.43	9.96	-12.01
125	949.3	7.13	-7.32	10.07	-12.17
130	842.9	7.18	-7.24	10.18	-12.34
135	750.8	7.18	-7.15	10.39	-12.41
140	670.6	7.17	-7.07	10.59	-12.49
145	600.6	7.16	-7.00	10.80	-12.59
150	539.1	7.16	-6.93	11.01	-12.69
155	484.0	7.15	-6.86	11.23	-12.75
160	432.3	7.16	-6.79	11.45	-12.80
165	383.7	7.18	-6.73	11.62	-12.85
170	344.0	7.21	-6.66	11.79	-12.90
175	309.7	7.23	-6.60	11.90	-12.94
180	279.2	7.23	-6.55	12.00	-12.98
185	252.1	7.24	-6.49	12.10	-13.03
190	228.0	7.25	-6.44	12.20	-13.07
195	207.2	7.28	-6.39	12.26	-13.08
200	189.1	7.30	-6.37	12.31	-13.10
210	158.9	7.37	-6.37	12.26	-12.94
220	134.5	7.43	-6.37	12.53	-13.17
230	114.7	7.48	-6.36	12.61	-13.21
240	98.4	7.55	-6.37	12.64	-13.23
250	85.0	7.65	-6.39	12.81	-13.38
260	73.8	7.76	-6.42	13.02	-13.58
270	64.5	7.83	-6.43	13.22	-13.78
280	56.7	7.93	-6.44	13.75	-14.33
290	50.1	8.06	-6.48	14.27	-14.86
300	44.7	8.23	-6.53	14.90	-15.51
320	36.4	8.44	-6.60	16.05	-16.67
340	31.1	8.74	-6.76	17.62	-18.32
360	29.5	9.05	-6.94	19.93	-20.71
380	25.0	9.35	-7.23	22.34	-23.23
400	19.8	9.66	-7.47	24.81	-25.85

TABLE IV: Higgs boson decay branching fractions from the LHC Cross Section Handbook [12]

m_H GeV/c^2	$B(H \to b\bar{b})$ (%)	$B(H \to c\bar{c})$ (%)	$B(H \to \tau^+\tau^-)$ (%)	$B(H \to W^+W^-)$ (%)	$B(H \to ZZ)$ (%)	$B(H \to \gamma\gamma)$ (%)
90	81.2	3.78	8.41	0.209	0.0421	0.123
95	80.4	3.73	8.41	0.472	0.0672	0.140
100	79.1	3.68	8.36	1.11	0.113	0.159
105	77.3	3.59	8.25	2.43	0.215	0.178
110	74.5	3.46	8.03	4.82	0.439	0.197
115	70.5	3.27	7.65	8.67	0.873	0.213
120	64.9	3.01	7.11	14.3	1.60	0.225
125	57.8	2.68	6.37	21.6	2.67	0.230
130	49.4	2.29	5.49	30.5	4.02	0.226
135	40.4	1.87	4.52	40.3	5.51	0.214
140	31.4	1.46	3.54	50.4	6.92	0.194
145	23.1	1.07	2.62	60.3	7.96	0.168
150	15.7	0.725	1.79	69.9	8.28	0.137
155	9.18	0.425	1.06	79.6	7.36	0.100
160	3.44	0.159	0.397	90.9	4.16	0.0533
165	1.19	0.0549	0.138	96.0	2.22	0.0230
170	0.787	0.0364	0.0920	96.5	2.36	0.0158
175	0.612	0.0283	0.0719	95.8	3.23	0.0123
180	0.497	0.0230	0.0587	93.2	6.02	0.0102
185	0.385	0.0178	0.0457	84.4	15.0	0.00809
190	0.315	0.0146	0.0376	78.6	20.9	0.00674
195	0.270	0.0125	0.0324	75.7	23.9	0.00589
200	0.238	0.0110	0.0287	74.1	25.6	0.00526
210	0.192	0.00889	0.0234	72.3	27.4	0.00434
220	0.160	0.00740	0.0196	71.4	28.4	0.00367
230	0.136	0.00627	0.0168	70.8	28.9	0.00314
240	0.117	0.00539	0.0145	70.4	29.4	0.00272
250	0.101	0.00468	0.0127	70.1	29.7	0.00237
260	0.0889	0.00411	0.0112	69.9	29.9	0.00208
270	0.0786	0.00363	0.0100	69.7	30.2	0.00184
280	0.0700	0.00323	0.00898	69.5	30.4	0.00163
290	0.0627	0.00290	0.00809	69.3	30.5	0.00145
300	0.0565	0.00261	0.00733	69.2	30.7	0.00130

TABLE V: Uncertainties in the decay branching fraction $Br(H \to b\bar{b})$ due to variations in α_s, m_b, and m_c. The superscripted uncertainties correspond to an upwards fluctuation in the uncertain parameter, and the subscripted uncertainties correspond to downwards fluctuations of the uncertain parameter.

m_H (GeV/c^2)	$\delta Br(H \to b\bar{b})$ (α_s) (%)	$\delta Br(H \to b\bar{b})$ (m_b) (%)	$\delta Br(H \to b\bar{b})(m_c)(\%)$ (m_c) (%)
100	$^{+0.34}_{-0.35}$	$^{+1.99}_{-0.70}$	$^{-0.74}_{+0.88}$
105	$^{+0.40}_{-0.40}$	$^{+2.20}_{-0.77}$	$^{-0.72}_{+0.85}$
110	$^{+0.47}_{-0.49}$	$^{+2.47}_{-0.88}$	$^{-0.71}_{+0.81}$
115	$^{+0.58}_{-0.61}$	$^{+2.90}_{-1.02}$	$^{-0.66}_{+0.78}$
120	$^{+0.72}_{-0.75}$	$^{+3.47}_{-1.21}$	$^{-0.61}_{+0.71}$
125	$^{+0.90}_{-0.94}$	$^{+4.23}_{-1.45}$	$^{-0.54}_{+0.64}$
130	$^{+1.12}_{-1.14}$	$^{+5.12}_{-1.75}$	$^{-0.47}_{+0.55}$
135	$^{+1.32}_{-1.37}$	$^{+6.05}_{-2.07}$	$^{-0.40}_{+0.42}$
140	$^{+1.54}_{-1.54}$	$^{+7.04}_{-2.35}$	$^{-0.29}_{+0.35}$
145	$^{+1.71}_{-1.75}$	$^{+7.94}_{-2.68}$	$^{-0.26}_{+0.26}$
150	$^{+1.88}_{-1.94}$	$^{+8.74}_{-2.91}$	$^{-0.19}_{+0.13}$
155	$^{+2.03}_{-2.06}$	$^{+9.51}_{-3.08}$	$^{-0.10}_{+0.11}$
160	$^{+2.17}_{-2.17}$	$^{+10.17}_{-3.26}$	$^{-0.03}_{+0.06}$
165	$^{+2.23}_{-2.23}$	$^{+10.45}_{-3.34}$	$^{+0.00}_{+0.09}$
170	$^{+2.24}_{-2.25}$	$^{+10.45}_{-3.36}$	$^{-0.03}_{+0.03}$
175	$^{+2.25}_{-2.25}$	$^{+10.48}_{-3.37}$	$^{-0.03}_{+0.02}$
180	$^{+2.25}_{-2.27}$	$^{+10.48}_{-3.37}$	$^{-0.02}_{+0.02}$
185	$^{+2.26}_{-2.26}$	$^{+10.50}_{-3.36}$	$^{-0.03}_{+0.03}$
190	$^{+2.28}_{-2.28}$	$^{+10.49}_{-3.39}$	$^{-0.03}_{+0.03}$
195	$^{+2.31}_{-2.28}$	$^{+10.50}_{-3.38}$	$^{+0.00}_{+0.04}$
200	$^{+2.28}_{-2.28}$	$^{+10.51}_{-3.36}$	$^{+0.00}_{0.00}$
210	$^{+2.30}_{-2.30}$	$^{+10.52}_{-3.37}$	$^{+0.00}_{0.00}$
220	$^{+2.32}_{-2.32}$	$^{+10.55}_{-3.34}$	$^{+0.00}_{0.00}$
230	$^{+2.28}_{-2.35}$	$^{+10.48}_{-3.42}$	$^{+0.00}_{0.00}$
240	$^{+2.30}_{-2.39}$	$^{+10.52}_{-3.36}$	$^{+0.00}_{0.00}$
250	$^{+2.36}_{-2.35}$	$^{+10.51}_{-3.38}$	$^{-0.02}_{+0.02}$
260	$^{+2.36}_{-2.37}$	$^{+10.53}_{-3.38}$	$^{-0.02}_{+0.02}$
270	$^{+2.38}_{-2.37}$	$^{+10.54}_{-3.38}$	$^{-0.01}_{+0.03}$
280	$^{+2.38}_{-2.38}$	$^{+10.54}_{-3.37}$	$^{-0.01}_{+0.03}$
290	$^{+2.39}_{-2.39}$	$^{+10.53}_{-3.38}$	$^{-0.02}_{+0.02}$
300	$^{+2.40}_{-2.40}$	$^{+10.53}_{-3.37}$	$^{-0.02}_{+0.02}$

TABLE VI: Uncertainties in the decay branching fraction $Br(H \to c\bar{c})$ due to variations in α_s, m_b, and m_c. The superscripted uncertainties correspond to an upwards fluctuation in the uncertain parameter, and the subscripted uncertainties correspond to downwards fluctuations of the uncertain parameter.

m_H (GeV/c^2)	$\delta Br(H \to c\bar{c})$ (α_s) (%)	$\delta Br(H \to c\bar{c})$ (m_b) (%)	$\delta Br(H \to c\bar{c})$ (m_c) (%)
100	$^{+5.05}_{-5.23}$	$^{-7.98}_{+2.86}$	$^{+18.67}_{-21.72}$
105	$^{+5.11}_{-5.27}$	$^{-7.81}_{+2.81}$	$^{+18.71}_{-21.73}$
110	$^{+5.16}_{-5.38}$	$^{-7.57}_{+2.66}$	$^{+18.72}_{-21.77}$
115	$^{+5.29}_{-5.46}$	$^{-7.20}_{+2.56}$	$^{+18.77}_{-21.79}$
120	$^{+5.43}_{-5.62}$	$^{-6.68}_{+2.33}$	$^{+18.82}_{-21.86}$
125	$^{+5.65}_{-5.76}$	$^{-5.98}_{+2.09}$	$^{+18.94}_{-21.89}$
130	$^{+5.87}_{-5.96}$	$^{-5.15}_{+1.82}$	$^{+19.05}_{-21.97}$
135	$^{+6.07}_{-6.17}$	$^{-4.30}_{+1.50}$	$^{+19.13}_{-22.03}$
140	$^{+6.28}_{-6.35}$	$^{-3.41}_{+1.20}$	$^{+19.25}_{-22.13}$
145	$^{+6.58}_{-6.48}$	$^{-2.56}_{+0.91}$	$^{+19.36}_{-22.16}$
150	$^{+6.66}_{-6.71}$	$^{-1.89}_{+0.62}$	$^{+19.39}_{-22.25}$
155	$^{+6.81}_{-6.83}$	$^{-1.22}_{+0.41}$	$^{+19.47}_{-22.30}$
160	$^{+6.97}_{-6.97}$	$^{-0.67}_{+0.18}$	$^{+19.51}_{-22.32}$
165	$^{+7.00}_{-7.02}$	$^{-0.43}_{+0.14}$	$^{+19.53}_{-22.36}$
170	$^{+7.03}_{-7.03}$	$^{-0.38}_{+0.13}$	$^{+19.55}_{-22.35}$
175	$^{+7.02}_{-7.05}$	$^{-0.35}_{+0.10}$	$^{+19.56}_{-22.37}$
180	$^{+7.06}_{-7.06}$	$^{-0.34}_{+0.13}$	$^{+19.54}_{-22.38}$
185	$^{+7.10}_{-7.05}$	$^{-0.33}_{+0.17}$	$^{+19.59}_{-22.36}$
190	$^{+7.06}_{-7.06}$	$^{-0.34}_{+0.14}$	$^{+19.55}_{-22.34}$
195	$^{+7.11}_{-7.03}$	$^{-0.32}_{+0.08}$	$^{+19.59}_{-22.37}$
200	$^{+7.09}_{-7.09}$	$^{-0.36}_{+0.09}$	$^{+19.55}_{-22.40}$
210	$^{+7.10}_{-7.09}$	$^{-0.32}_{+0.11}$	$^{+19.55}_{-22.37}$
220	$^{+7.12}_{-7.10}$	$^{-0.31}_{+0.11}$	$^{+19.55}_{-22.37}$
230	$^{+7.12}_{-7.11}$	$^{-0.32}_{+0.11}$	$^{+19.55}_{-22.38}$
240	$^{+7.13}_{-7.13}$	$^{-0.31}_{+0.09}$	$^{+19.54}_{-22.38}$
250	$^{+7.13}_{-7.13}$	$^{-0.32}_{+0.11}$	$^{+19.55}_{-22.38}$
260	$^{+7.15}_{-7.15}$	$^{-0.31}_{+0.10}$	$^{+19.55}_{-22.39}$
270	$^{+7.16}_{-7.16}$	$^{-0.30}_{+0.11}$	$^{+19.56}_{-22.38}$
280	$^{+7.18}_{-7.18}$	$^{-0.31}_{+0.09}$	$^{+19.54}_{-22.37}$
290	$^{+7.19}_{-7.16}$	$^{-0.31}_{+0.10}$	$^{+19.58}_{-22.37}$

TABLE VII: Uncertainties in the decay branching fraction $Br(H \to \tau^+\tau^-)$ due to variations in α_s, m_b, and m_c. The superscripted uncertainties correspond to an upwards fluctuation in the uncertain parameter, and the subscripted uncertainties correspond to downwards fluctuations of the uncertain parameter.

m_H (GeV/c^2)	$\delta Br(H \to \tau^+\tau^-)$ (α_s) (%)	$\delta Br(H \to \tau^+\tau^-)$ (m_b) (%)	$\delta Br(H \to \tau^+\tau^-)$ (m_c) (%)
100	$^{+1.66}_{-1.59}$	$^{+2.73}_{-7.63}$	$^{+0.85}_{-0.73}$
105	$^{+1.75}_{-1.68}$	$^{+2.68}_{-7.54}$	$^{+0.83}_{-0.72}$
110	$^{+1.67}_{-1.61}$	$^{+2.59}_{-7.29}$	$^{+0.80}_{-0.69}$
115	$^{+1.58}_{-1.52}$	$^{+2.44}_{-6.90}$	$^{+0.76}_{-0.64}$
120	$^{+1.45}_{-1.39}$	$^{+2.24}_{-6.38}$	$^{+0.70}_{-0.59}$
125	$^{+1.27}_{-1.23}$	$^{+1.98}_{-5.72}$	$^{+0.61}_{-0.53}$
130	$^{+1.06}_{-1.05}$	$^{+1.69}_{-4.91}$	$^{+0.51}_{-0.46}$
135	$^{+0.86}_{-0.84}$	$^{+1.36}_{-4.04}$	$^{+0.43}_{-0.37}$
140	$^{+0.66}_{-0.66}$	$^{+1.05}_{-3.18}$	$^{+0.33}_{-0.30}$
145	$^{+0.45}_{-0.49}$	$^{+0.75}_{-2.36}$	$^{+0.23}_{-0.23}$
150	$^{+0.33}_{-0.33}$	$^{+0.50}_{-1.60}$	$^{+0.17}_{-0.17}$
155	$^{+0.19}_{-0.19}$	$^{+0.28}_{-0.93}$	$^{+0.09}_{-0.09}$
160	$^{+0.05}_{-0.07}$	$^{+0.10}_{-0.37}$	$^{+0.02}_{-0.05}$
165	$^{0.00}_{+0.00}$	$^{+0.07}_{-0.14}$	$^{0.00}_{+0.00}$
170	$^{+0.01}_{-0.02}$	$^{+0.02}_{-0.09}$	$^{0.00}_{-0.01}$
175	$^{+0.01}_{-0.01}$	$^{+0.03}_{-0.06}$	$^{+0.01}_{+0.00}$
180	$^{+0.02}_{+0.00}$	$^{+0.02}_{-0.05}$	$^{+0.02}_{+0.00}$
185	$^{+0.02}_{+0.00}$	$^{+0.02}_{-0.02}$	$^{+0.02}_{+0.00}$
190	$^{0.00}_{+0.00}$	$^{+0.03}_{-0.03}$	$^{0.00}_{+0.00}$
195	$^{0.00}_{+0.00}$	$^{0.00}_{-0.03}$	$^{0.00}_{+0.00}$
200	$^{0.00}_{+0.00}$	$^{0.00}_{-0.03}$	$^{0.00}_{+0.00}$
210	$^{0.00}_{+0.00}$	$^{+0.04}_{+0.00}$	$^{0.00}_{+0.00}$
220	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
230	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
240	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
250	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
260	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
270	$^{+0.01}_{+0.00}$	$^{+0.01}_{+0.00}$	$^{+0.01}_{+0.00}$
280	$^{0.00}_{+0.00}$	$^{0.00}_{-0.01}$	$^{0.00}_{+0.00}$
290	$^{0.00}_{+0.00}$	$^{0.00}_{-0.01}$	$^{0.00}_{+0.00}$
300	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$

TABLE VIII: Uncertainties in the decay branching fraction $Br(H \to W^+W^-)$ due to variations in α_s, m_b, and m_c. The superscripted uncertainties correspond to an upwards fluctuation in the uncertain parameter, and the subscripted uncertainties correspond to downwards fluctuations of the uncertain parameter.

m_H (GeV/c^2)	$\delta Br(H \to W^+W^-)$ (α_s) (%)	$\delta Br(H \to W^+W^-)$ (m_b) (%)	$\delta Br(H \to W^+W^-)$ (m_c) (%)
100	$^{+1.67}_{-1.57}$	$^{+2.78}_{-7.61}$	$^{+0.93}_{-0.74}$
105	$^{+1.75}_{-1.67}$	$^{+2.66}_{-7.55}$	$^{+0.83}_{-0.72}$
110	$^{+1.68}_{-1.60}$	$^{+2.60}_{-7.29}$	$^{+0.80}_{-0.68}$
115	$^{+1.57}_{-1.52}$	$^{+2.44}_{-6.91}$	$^{+0.75}_{-0.65}$
120	$^{+1.43}_{-1.43}$	$^{+2.24}_{-6.38}$	$^{+0.68}_{-0.61}$
125	$^{+1.26}_{-1.26}$	$^{+1.98}_{-5.75}$	$^{+0.58}_{-0.54}$
130	$^{+1.09}_{-1.02}$	$^{+1.70}_{-4.89}$	$^{+0.51}_{-0.45}$
135	$^{+0.88}_{-0.83}$	$^{+1.39}_{-4.04}$	$^{+0.44}_{-0.36}$
140	$^{+0.66}_{-0.66}$	$^{+1.06}_{-3.17}$	$^{+0.33}_{-0.29}$
145	$^{+0.49}_{-0.46}$	$^{+0.79}_{-2.33}$	$^{+0.25}_{-0.20}$
150	$^{+0.31}_{-0.33}$	$^{+0.51}_{-1.59}$	$^{+0.16}_{-0.14}$
155	$^{+0.19}_{-0.18}$	$^{+0.31}_{-0.94}$	$^{+0.10}_{-0.08}$
160	$^{+0.07}_{-0.07}$	$^{+0.11}_{-0.35}$	$^{+0.03}_{-0.03}$
165	$^{+0.02}_{-0.02}$	$^{+0.04}_{-0.12}$	$^{+0.01}_{-0.01}$
170	$^{+0.01}_{-0.02}$	$^{+0.02}_{-0.08}$	$^{+0.01}_{-0.01}$
175	$^{+0.01}_{-0.01}$	$^{+0.02}_{-0.06}$	$^{+0.01}_{+0.00}$
180	$^{+0.01}_{-0.01}$	$^{+0.02}_{-0.04}$	$^{+0.01}_{+0.00}$
185	$^{+0.01}_{-0.01}$	$^{+0.01}_{-0.04}$	$^{0.00}_{+0.00}$
190	$^{+0.01}_{+0.00}$	$^{+0.01}_{-0.03}$	$^{0.00}_{+0.00}$
195	$^{+0.01}_{+0.00}$	$^{+0.01}_{-0.03}$	$^{0.00}_{+0.00}$
200	$^{+0.01}_{+0.00}$	$^{+0.01}_{-0.01}$	$^{0.00}_{+0.00}$
210	$^{0.00}_{+0.00}$	$^{+0.01}_{-0.01}$	$^{0.00}_{+0.00}$
220	$^{0.00}_{+0.00}$	$^{0.00}_{-0.01}$	$^{0.00}_{+0.00}$
230	$^{0.00}_{+0.00}$	$^{+0.01}_{-0.01}$	$^{0.00}_{+0.00}$
240	$^{0.00}_{-0.01}$	$^{0.00}_{-0.01}$	$^{0.00}_{+0.00}$
250	$^{0.00}_{+0.00}$	$^{+0.01}_{+0.00}$	$^{0.00}_{+0.00}$
260	$^{0.00}_{+0.00}$	$^{0.00}_{-0.01}$	$^{0.00}_{+0.00}$
270	$^{0.00}_{+0.00}$	$^{0.00}_{-0.01}$	$^{0.00}_{+0.00}$
280	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
290	$^{0.00}_{+0.00}$	$^{+0.01}_{+0.00}$	$^{0.00}_{+0.00}$
300	$^{0.00}_{+0.00}$	$^{0.00}_{-0.01}$	$^{0.00}_{+0.00}$

TABLE IX: Uncertainties in the decay branching fraction $Br(H \to ZZ)$ due to variations in α_s, m_b, and m_c. The superscripted uncertainties correspond to an upwards fluctuation in the uncertain parameter, and the subscripted uncertainties correspond to downwards fluctuations of the uncertain parameter.

m_H (GeV/c^2)	$\delta Br(H \to ZZ)$ (α_s) (%)	$\delta Br(H \to ZZ)$ (m_b) (%)	$\delta Br(H \to ZZ)$ (m_c) (%)
100	$^{+1.73}_{-1.55}$	$^{+2.73}_{-7.64}$	$^{+0.91}_{-0.73}$
105	$^{+1.71}_{-1.71}$	$^{+2.66}_{-7.57}$	$^{+0.81}_{-0.72}$
110	$^{+1.68}_{-1.61}$	$^{+2.58}_{-7.29}$	$^{+0.80}_{-0.68}$
115	$^{+1.57}_{-1.52}$	$^{+2.44}_{-6.92}$	$^{+0.74}_{-0.66}$
120	$^{+1.39}_{-1.39}$	$^{+2.24}_{-6.43}$	$^{+0.67}_{-0.61}$
125	$^{+1.28}_{-1.21}$	$^{+1.98}_{-5.71}$	$^{+0.62}_{-0.51}$
130	$^{+1.07}_{-1.05}$	$^{+1.68}_{-4.90}$	$^{+0.51}_{-0.46}$
135	$^{+0.86}_{-0.86}$	$^{+1.36}_{-4.04}$	$^{+0.41}_{-0.38}$
140	$^{+0.67}_{-0.64}$	$^{+1.06}_{-3.16}$	$^{+0.33}_{-0.29}$
145	$^{+0.49}_{-0.46}$	$^{+0.77}_{-2.32}$	$^{+0.25}_{-0.20}$
150	$^{+0.32}_{-0.31}$	$^{+0.52}_{-1.59}$	$^{+0.17}_{-0.14}$
155	$^{+0.18}_{-0.19}$	$^{+0.30}_{-0.95}$	$^{+0.09}_{-0.09}$
160	$^{+0.05}_{-0.07}$	$^{+0.10}_{-0.36}$	$^{+0.02}_{-0.05}$
165	$^{0.00}_{-0.05}$	$^{0.00}_{-0.14}$	$^{0.00}_{-0.05}$
170	$^{0.00}_{-0.04}$	$^{0.00}_{-0.08}$	$^{0.00}_{-0.04}$
175	$^{0.00}_{+0.00}$	$^{+0.03}_{-0.06}$	$^{0.00}_{+0.00}$
180	$^{+0.02}_{+0.00}$	$^{+0.02}_{-0.05}$	$^{0.00}_{+0.00}$
185	$^{0.00}_{+0.00}$	$^{0.00}_{-0.07}$	$^{0.00}_{+0.00}$
190	$^{0.00}_{+0.00}$	$^{0.00}_{-0.05}$	$^{0.00}_{+0.00}$
195	$^{0.00}_{+0.00}$	$^{0.00}_{-0.04}$	$^{0.00}_{+0.00}$
200	$^{0.00}_{+0.00}$	$^{+0.04}_{+0.00}$	$^{0.00}_{+0.00}$
210	$^{0.00}_{+0.00}$	$^{0.00}_{-0.04}$	$^{0.00}_{+0.00}$
220	$^{0.00}_{+0.00}$	$^{0.00}_{-0.04}$	$^{0.00}_{+0.00}$
230	$^{0.00}_{-0.03}$	$^{0.00}_{-0.03}$	$^{0.00}_{+0.00}$
240	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
250	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
260	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
270	$^{0.00}_{+0.00}$	$^{0.00}_{-0.03}$	$^{0.00}_{+0.00}$
280	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
290	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$
300	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$	$^{0.00}_{+0.00}$

II. MODELS WITH A FOURTH GENERATION OF FERMIONS

The calculations of the production cross sections and decay branching ratios of a Higgs boson in the minimal fourth-generation model used in our PRDRC [16], which are calculated in [17], and are listed in Table X. With respect to our previous table [16], the PDF+α_s fractional uncertainties have been updated with their SM values. The factorization and renormalization scale uncertainties are fractionally larger than their SM counterparts, and as there are additional diagrams which could add to the scale dependence, we do not update the scale uncertainties here.

There are two scenarios considered in [16]. In both scenarios, the mass of the fourth-generation down-type quark is set to 400 GeV, and the up-type quark to 450 GeV. The production cross sections and decay branching fractions of the Higgs boson depend very weakly on these masses. The two scenarios are distinguished by the choice of the lepton masses. In the low-mass scenario, We set the fourth-generation charged lepton's mass to 100 GeV, and the fourth-generation neutrino's mass to 80 GeV (both just beyond experimental limits), and in the high-mass scenario, both the charged lepton and the neutrino in the fourth generation have masses of 1 TeV. These choices have impacts on the decay branching fractions for Higgs bosons for which the leptonic decays are within kinematic reach. Decay branching fractions for these two scenarios are given detail in Tables XI and XII. The decay branching fractions are from a modified version of HDECAY [18].

TABLE X: The fourth-generation enhanced $\sigma(gg \to H)$ listed in fb for the low-mass scenario described in the text with $m_{d4} = 300$ GeV and $m_{d4} = 400$ GeV along with the $\mathcal{B}(H \to W^+W^-)$ for Higgs masses between 110 - 300 GeV. For these branching fractions, $m_{\nu_4} = 80$ GeV, $m_{\ell_4} = 100$ GeV. The uncertainty on the predicted cross section from variations in the PDF and factorization and renormalization scale are also listed in percentage where these have been determined from the MSTW 2008 90% C.L. uncertainty and by modification of the scale by factors of 1/2 and 2, respectively. Tables XI and XII provide more complete listings of branching fractions.

m_H (GeV)	$\sigma(gg \to H)$ $m_{d4} = 300$ GeV	$\sigma(gg \to H)$ $m_{d4} = 400$ GeV	uncert. PDF $+\alpha_s$ up(%)	uncert. PDF $+\alpha_s$ down(%)	uncert. μ up(%)	uncert. μ down(%)	$BR(H \to W^+W^-)$ $m_{d4} = 300$ GeV	$BR(H \to W^+W^-)$ $m_{d4} = 400$ GeV
110	12384	12308	7.24	-7.64	-8	12	0.028	0.028
115	10798	10725	7.20	-7.53	-8	12	0.050	0.051
120	9449.9	9384.3	7.19	-7.43	-8	12	0.083	0.083
125	8298.8	8240.0	7.13	-7.32	-8	12	0.13	0.13
130	7314.0	7258.7	7.18	-7.24	-8	12	0.19	0.19
135	6465.1	6414.2	7.18	-7.15	-8	12	0.26	0.26
140	5731.4	5684.1	7.17	-7.07	-8	12	0.35	0.35
145	5094.6	5050.4	7.16	-7.00	-8	12	0.44	0.44
150	4540.5	4498.5	7.16	-6.93	-8	12	0.55	0.55
155	4055.6	4017.6	7.15	-6.86	-8	12	0.68	0.68
160	3630.2	3595.1	7.16	-6.79	-8	12	0.85	0.85
165	3253.7	3220.7	7.18	-6.73	-8	12	0.91	0.91
170	2924.1	2893.2	7.21	-6.66	-8	12	0.89	0.88
175	2633.9	2604.4	7.23	-6.60	-8	12	0.86	0.86
180	2376.7	2348.9	7.23	-6.55	-8	12	0.83	0.83
185	2147.2	2121.5	7.24	-6.49	-8	12	0.74	0.74
190	1943.9	1919.7	7.25	-6.44	-8	12	0.69	0.69
195	1763.2	1740.2	7.28	-6.39	-8	12	0.66	0.66
200	1601.8	1580.0	7.30	-6.37	-8	12	0.65	0.65
210	1328.1	1308.4	7.37	-6.37	-8	12	0.62	0.62
220	1107.7	1089.6	7.43	-6.37	-8	12	0.60	0.60
230	928.61	912.21	7.48	-6.36	-8	12	0.59	0.59
240	782.52	767.44	7.55	-6.37	-8	12	0.58	0.58
250	662.60	648.81	7.65	-6.39	-8	12	0.58	0.58
260	563.53	550.90	7.76	-6.42	-8	12	0.57	0.58
270	481.49	469.93	7.83	-6.43	-8	12	0.57	0.57
280	413.24	402.68	7.93	-6.44	-8	12	0.58	0.58
290	356.39	346.53	8.06	-6.48	-8	12	0.58	0.58
300	308.70	299.71	8.23	-6.53	-8	12	0.58	0.58

TABLE XI: Decay branching fractions of the Higgs boson in a fourth-generation model with $m_{\nu_4} = 80$ GeV, $m_{\ell_4} = 100$ GeV, $m_{d_4} = 400$ GeV, and $m_{u_4} = 450$ GeV. From Ref. [18].

m_H (GeV)	$b\bar{b}$	$\tau^+\tau^-$	gg	$\gamma\gamma$	W^+W^-	ZZ	$\Gamma_{\rm tot}$ (GeV)	$\nu_4\bar{\nu}_4$	$\ell_4^+\ell_4^-$
110	0.4890	0.4917E-01	0.4084	0.2012E-03	0.2830E-01	0.2616E-02	0.4610E-02	0.000	0.000
115	0.4589	0.4653E-01	0.4176	0.2247E-03	0.5050E-01	0.5168E-02	0.5092E-02	0.000	0.000
120	0.4244	0.4338E-01	0.4194	0.2484E-03	0.8338E-01	0.9520E-02	0.5699E-02	0.000	0.000
125	0.3851	0.3967E-01	0.4119	0.2709E-03	0.1288	0.1612E-01	0.6492E-02	0.000	0.000
130	0.3412	0.3541E-01	0.3939	0.2907E-03	0.1877	0.2512E-01	0.7564E-02	0.000	0.000
135	0.2935	0.3067E-01	0.3647	0.3060E-03	0.2602	0.3618E-01	0.9068E-02	0.000	0.000
140	0.2432	0.2559E-01	0.3245	0.3147E-03	0.3457	0.4829E-01	0.1127E-01	0.000	0.000
145	0.1921	0.2034E-01	0.2745	0.3148E-03	0.4429	0.5966E-01	0.1469E-01	0.000	0.000
150	0.1411	0.1503E-01	0.2155	0.3025E-03	0.5529	0.6719E-01	0.2056E-01	0.000	0.000
155	0.9043E-01	0.9693E-02	0.1474	0.2695E-03	0.6813	0.6532E-01	0.3294E-01	0.000	0.000
160	0.3734E-01	0.4026E-02	0.6482E-01	0.1889E-03	0.8501	0.4086E-01	0.8187E-01	0.000	0.000
165	0.1180E-01	0.1279E-02	0.2177E-01	0.8412E-04	0.9055	0.1986E-01	0.2658	0.3873E-01	0.000
170	0.7700E-02	0.8391E-03	0.1508E-01	0.5813E-04	0.8877	0.2072E-01	0.4173	0.6724E-01	0.000
175	0.5907E-02	0.6470E-03	0.1226E-01	0.4700E-04	0.8634	0.2788E-01	0.5571	0.8933E-01	0.000
180	0.4751E-02	0.5231E-03	0.1043E-01	0.3969E-04	0.8283	0.5097E-01	0.7088	0.1045	0.000
185	0.3679E-02	0.4072E-03	0.8541E-02	0.3217E-04	0.7420	0.1380	0.9359	0.1070	0.000
190	0.2999E-02	0.3336E-03	0.7351E-02	0.2736E-04	0.6867	0.1935	1.173	0.1088	0.000
195	0.2575E-02	0.2879E-03	0.6657E-02	0.2445E-04	0.6614	0.2170	1.395	0.1118	0.000
200	0.2265E-02	0.2545E-03	0.6168E-02	0.2229E-04	0.6468	0.2300	1.619	0.1143	0.000
210	0.1791E-02	0.2030E-03	0.5393E-02	0.1804E-04	0.6197	0.2392	2.132	0.1147	0.1874E-01
220	0.1458E-02	0.1667E-03	0.4840E-02	0.1490E-04	0.6005	0.2415	2.719	0.1121	0.3927E-01
230	0.1218E-02	0.1404E-03	0.4440E-02	0.1262E-04	0.5882	0.2425	3.378	0.1083	0.5506E-01
240	0.1037E-02	0.1205E-03	0.4141E-02	0.1093E-04	0.5808	0.2436	4.108	0.1038	0.6627E-01
250	0.8967E-03	0.1050E-03	0.3913E-02	0.9642E-05	0.5768	0.2452	4.912	0.9912E-01	0.7385E-01
260	0.7853E-03	0.9257E-04	0.3736E-02	0.8638E-05	0.5750	0.2473	5.793	0.9440E-01	0.7866E-01
270	0.6949E-03	0.8247E-04	0.3598E-02	0.7844E-05	0.5747	0.2496	6.755	0.8977E-01	0.8144E-01
280	0.6202E-03	0.7409E-04	0.3490E-02	0.7209E-05	0.5755	0.2522	7.799	0.8531E-01	0.8272E-01
290	0.5577E-03	0.6704E-04	0.3407E-02	0.6697E-05	0.5770	0.2549	8.930	0.8105E-01	0.8292E-01
300	0.5047E-03	0.6103E-04	0.3344E-02	0.6284E-05	0.5790	0.2576	10.15	0.7700E-01	0.8231E-01

TABLE XII: Decay branching fractions of the Higgs boson in a fourth-generation model with $m_{\nu_4} = 1$ TeV, $m_{\ell_4} = 1$ TeV, $m_{d_4} = 300$ GeV, and $m_{u_4} = 350$ GeV. From Ref. [18].

m_H (GeV)	$b\bar{b}$	$\tau^+\tau^-$	gg	$\gamma\gamma$	W^+W^-	ZZ	$\Gamma_{\rm tot}$ (GeV)	$\nu_4\bar{\nu}_4$	$\ell_4^+\ell_4^-$
110	0.4890	0.4917E-01	0.4084	0.2187E-03	0.2830E-01	0.2616E-02	0.4610E-02	0.000	0.000
115	0.4589	0.4653E-01	0.4176	0.2456E-03	0.5050E-01	0.5168E-02	0.5092E-02	0.000	0.000
120	0.4244	0.4338E-01	0.4193	0.2729E-03	0.8338E-01	0.9520E-02	0.5699E-02	0.000	0.000
125	0.3851	0.3967E-01	0.4119	0.2991E-03	0.1288	0.1612E-01	0.6492E-02	0.000	0.000
130	0.3412	0.3541E-01	0.3939	0.3224E-03	0.1876	0.2512E-01	0.7564E-02	0.000	0.000
135	0.2935	0.3067E-01	0.3647	0.3405E-03	0.2602	0.3618E-01	0.9069E-02	0.000	0.000
140	0.2432	0.2559E-01	0.3245	0.3512E-03	0.3457	0.4829E-01	0.1127E-01	0.000	0.000
145	0.1920	0.2034E-01	0.2745	0.3518E-03	0.4428	0.5966E-01	0.1469E-01	0.000	0.000
150	0.1410	0.1503E-01	0.2155	0.3378E-03	0.5529	0.6719E-01	0.2056E-01	0.000	0.000
155	0.9043E-01	0.9693E-02	0.1474	0.2997E-03	0.6813	0.6532E-01	0.3294E-01	0.000	0.000
160	0.3734E-01	0.4026E-02	0.6482E-01	0.2073E-03	0.8501	0.4086E-01	0.8187E-01	0.000	0.000
165	0.1227E-01	0.1330E-02	0.2265E-01	0.9525E-04	0.9420	0.2066E-01	0.2555	0.000	0.000
170	0.8255E-02	0.8996E-03	0.1616E-01	0.6802E-04	0.9517	0.2221E-01	0.3893	0.000	0.000
175	0.6487E-02	0.7105E-03	0.1346E-01	0.5647E-04	0.9481	0.3061E-01	0.5074	0.000	0.000
180	0.5306E-02	0.5842E-03	0.1165E-01	0.4861E-04	0.9250	0.5692E-01	0.6347	0.000	0.000
185	0.4120E-02	0.4560E-03	0.9565E-02	0.3960E-04	0.8309	0.1545	0.8357	0.000	0.000
190	0.3365E-02	0.3743E-03	0.8248E-02	0.3383E-04	0.7705	0.2171	1.046	0.000	0.000
195	0.2899E-02	0.3241E-03	0.7494E-02	0.3041E-04	0.7446	0.2443	1.239	0.000	0.000
200	0.2558E-02	0.2873E-03	0.6964E-02	0.2793E-04	0.7302	0.2597	1.434	0.000	0.000
210	0.2066E-02	0.2342E-03	0.6224E-02	0.2434E-04	0.7152	0.2761	1.847	0.000	0.000
220	0.1718E-02	0.1965E-03	0.5704E-02	0.2171E-04	0.7076	0.2845	2.308	0.000	0.000
230	0.1455E-02	0.1678E-03	0.5307E-02	0.1965E-04	0.7031	0.2898	2.826	0.000	0.000
240	0.1249E-02	0.1451E-03	0.4990E-02	0.1797E-04	0.6999	0.2936	3.409	0.000	0.000
250	0.1084E-02	0.1269E-03	0.4732E-02	0.1658E-04	0.6974	0.2965	4.062	0.000	0.000
260	0.9496E-03	0.1119E-03	0.4518E-02	0.1542E-04	0.6953	0.2990	4.791	0.000	0.000
270	0.8384E-03	0.9950E-04	0.4341E-02	0.1443E-04	0.6934	0.3012	5.598	0.000	0.000
280	0.7455E-03	0.8905E-04	0.4195E-02	0.1360E-04	0.6917	0.3031	6.489	0.000	0.000
290	0.6671E-03	0.8018E-04	0.4075E-02	0.1289E-04	0.6902	0.3049	7.466	0.000	0.000
300	0.6004E-03	0.7259E-04	0.3978E-02	0.1229E-04	0.6887	0.3065	8.534	0.000	0.000

III. CROSS SECTIONS INVOLVING TOP QUARKS

For $t\bar{t}$, we use the calculation of Langenfeld, Moch, and Uwer [19], using $m_t = 173 \pm 1.2$ GeV, and the MSTW2008 PDF set:

$$\sigma_{t\bar{t}} = 7.04^{+0.24}_{-0.36}(\text{scale}) \pm 0.14(\text{PDF}) \pm 0.30(\text{mass})\text{pb}. \tag{1}$$

The PDF uncertainty quoted above is from the MSTW08 68% CL recommendation. It should be doubled in order to follow the PDF4LHC prescription, and to cover the difference between the value obtained when using MSTW08 PDFs and CTEQ 6.6 PDFs (a 4% difference). All told, this gives a 7% total relative uncertainty on $\sigma_{t\bar{t}}$.

For single top, we'll use the NLL t-channel calculation of Kidonakis [20], which has been updated using the MSTW2008 PDF set [4] via a private communication from Kidonakis. The abstract of that paper says it's NNNLO, but the private communication says NLL. The s-channel process we use Kidonakis [21], again using the MSTW2008 PDF set; the paper says the accuracy is NNLL. Both of these numbers below are the sum of the single t and single $\bar{t}$ cross sections, and both assume $m_t = 173 \pm 1.2$ GeV.

$$\sigma_{t-\text{chan}} = 2.10 \pm 0.027(\text{scale}) \pm 0.18(\text{PDF}) \pm 0.045(\text{mass})\text{pb}. \tag{2}$$

$$\sigma_{s-\text{chan}} = 1.046 \pm 0.006(\text{scale}) \pm 0.059\ (\text{PDF}) \pm 0.030\ (\text{mass})\ \text{pb}. \tag{3}$$

IV. DIBOSON CROSS SECTIONS

MCFM [6] has been used to compute the NLO cross sections for WW, WZ, and ZZ production [22].

Using a scale choice $\mu_0 = M_V^2 + p_T^2(V)$ and the MSTW2008 PDF set [4], the cross section for inclusive W^+W^- production is

$$\sigma_{W^+W^-} = 11.34^{+0.56}_{-0.49}\ (\text{scale})\ ^{+0.35}_{-0.28}(\text{PDF})\text{pb} \tag{4}$$

Lowering the factorization and renormalization scales by a factor of two increases the cross section, and raising the scales by a factor of two decreases the cross section. The PDF uncertainty has the same fractional impact on the predicted cross section independent of the scale choice.

Using a scale choice $\mu_0 = M_V^2 + p_T^2(V)$ and the MSTW2008 PDF set [4], the cross section for inclusive $W^\pm Z^0$ production is

$$\sigma_{W^\pm Z^0} = 3.22^{+0.20}_{-0.17}\ (\text{scale})\ ^{+0.11}_{-0.08}\ (\text{PDF})\ \text{pb} \tag{5}$$

For the Z^0, leptonic decays are used in the definition, with both γ and Z^0 exchange. The cross section is defined in the region $75 \leq m_{\ell^+\ell^-} \leq 105$ GeV for the leptons from the neutral current exchange. Lowering the factorization and renormalization scales by a factor of two increases the cross section, and raising the scales by a factor of two decreases the cross section.

$$\sigma_{Z^0Z^0} = 1.20^{+0.05}_{-0.04}\ (\text{scale})\ ^{+0.04}_{-0.03}\ (\text{PDF})\ \text{pb} \tag{6}$$

For the diboson cross section calculations, $|\eta_\ell| < 5$ for all calculations. Loosening this requirement to include all leptons makes a $\sim$+0.4% change in the predictions. Lowering the factorization and renormalization scales by a factor of two increases the cross section, and raising the scales by a factor of two decreases the cross section.

All PDF uncertainties are computed as the quadrature sum of the 20 68% CL eigenvectors provided with MSTW2008 (MSTW2008nlo68cl).

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