Numerical values for ggF QCD scale uncertainties Comparing “WG1 scheme” with “STXS scheme”

Scheme from the Tackmanns

Bin	$\theta_{0/1}$ $\Delta_{0/1}$	$\theta_{1/2}$ $\Delta_{1/2}$	θ_{y} (θ_{φ}) Δ_{y}	θ_{60} Δ_{60}	$\theta_{1/2}^{60}$ $\Delta_{1/2}^{60}$	θ_{120} Δ_{120}	$\theta_{1/2}^{120}$ $\Delta_{1/2}^{120}$	θ_{200} Δ_{200}	$\theta_{1/2}^{200}$ $\Delta_{1/2}^{200}$
incl	0	0	$y_{\geq 0}$	0	0	0	0	1	0
$=$ 0j	-1	0	y_0	0	0	0	0	0	0
$=$ 1j	X_1	-1	y_1	$z_2 - z_1$	-1	$z_3 - z_2$	-1	z_4	-1
$\geq$ 2j	$1 - X_1$	$+1$	$y_{\geq 2}$	$z_1 - z_2$	$+1$	$z_2 - z_3$	$+1$	$1 - z_4$	$+1$
$\geq$ 1j [0,60]	x_1	0	$y_{\geq 1} x_1$	-1	0	$*$	0		
$=$ 1j [0,60]	$x_1 z_1$	$-x_1$	$y_1 x_1$	$-z_1$	0	$*$	0		
$\geq$ 2j [0,60]	$x_1 (1 - z_1)$	$+x_1$	$y_{\geq 2} x_1$	$-(1 - z_1)$	0	$*$	0		
$\geq$ 1j [60,120]	x_2	0	$y_{\geq 1} x_2$	$+1$	0	-1	0		
$=$ 1j [60,120]	$x_2 z_2$	$-x_2$	$y_1 x_2$	z_2	-1	$-z_2$	0		
$\geq$ 2j [60,120]	$x_2 (1 - z_2)$	$+x_2$	$y_{\geq 2} x_2$	$1 - z_2$	$+1$	$-(1 - z_2)$	0		
$\geq$ 1j [120,200]	x_3	0	$y_{\geq 1} x_3$	$*$	0	$+1$	0		
$=$ 1j [120,200]	$x_3 z_3$	$-x_3$	$y_1 x_3$	$*$	0	z_3	-1		
$\geq$ 2j [120,200]	$x_3 (1 - z_3)$	x_3	$y_{\geq 2} x_3$	$*$	0	$1 - z_3$	$+1$		
$\geq$ 1j [200,∞)	x_4	0	$y_{\geq 1} x_4$	$*$	0	$*$	0	1	0
$=$ 1j [200,∞)	$x_4 z_4$	$-x_4$	$y_1 x_4$	$*$	0	$*$	0	z_4	-1
$\geq$ 2j [200,∞)	$x_4 (1 - z_4)$	x_4	$y_{\geq 2} x_4$	$*$	0	$*$	0	$1 - z_4$	$+1$

Deriving the uncertainties

NEW: Now high stat (1.8 M events)

Bin	$\theta_{0/1}$	$\theta_{1/2}$	θ_y (θ_φ)	θ_{60}	$\theta^{60}_{1/2}$	θ_{120}	$\theta^{120}_{1/2}$	θ_{200}	$\theta^{200}_{1/2}$
	$\Delta_{0/1}$	$\Delta_{1/2}$	Δ_y	Δ_{60}	$\Delta^{60}_{1/2}$	Δ_{120}	$\Delta^{120}_{1/2}$	Δ_{200}	$\Delta^{200}_{1/2}$

First four uncertainty sources already in YR4 yield (aka μ), ressummation (aka ϕ) and the 0→1 and 1→2 migrations

From Powheg NNLOPS

```
Sig pTH (60,200) GeV: 9.526 pb
Sig pTH (60,200) GeV, Nj>=1: 9.095 pb

NNLOPS QCD variation (envelope):
  Dsig60_200up: 1.369
  Dsig60_200dn: 1.445

  sig(60,200) = 9.095 +/- 1.445 pb, 15.9%

Sig pTH in (120,200) GeV: 1.962 pb
Sig pTH (120,200) GeV, Nj>=1: 1.961 pb

  sig(120,200) = 1.961 +/- 0.401 pb, 20.4%

Sig pTH>200 GeV: 0.582 pb
Sig pTH>200 GeV, Nj>=1: 0.582 pb

  sig200 = 0.582 +/- 0.121 pb, 20.8%
```

```
Cross sections and fractional uncertainties
      STXS    sig      stat       mu      res     mig01    mig12
 >=1J 60-200   9.09 +/- 0.01    +6.3%    +5.8%    +6.5%    +1.8%
>=1J 120-200   1.96 +/- 0.01    +6.9%    +6.6%    +5.6%    +7.0%
   >=1J >200   0.58 +/- 0.00    +7.2%    +7.0%    +5.0%   +10.1%
    >=1J >60   9.68 +/- 0.01    +6.3%    +5.9%    +6.4%    +2.3%
   >=1J >120   2.54 +/- 0.01    +6.9%    +6.7%    +5.4%    +7.7%
         >=1  18.40 +/- 0.02    +6.1%    +5.6%    +6.8%    -0.1%
```

sig(60<pT<200 GeV, N_{jets}≥1) = 9.095 pb
BLPTW uncertainty: 10.9% (see above)
Total Powheg uncertainty: 15.9%

$\delta_{60} = 0.159 \ominus 0.109 = 11.6\%$
$\Delta_{60} = \delta_{60}\,\sigma_{60} = 1.055\,\text{pb}$

sig(120<pT<200 GeV, N_{jets}≥1) = 1.962 pb
BLPTW uncertainty: 13.1% (see above)
Total Powheg uncertainty: 20.4%

$\delta_{120} = 0.204 \ominus 0.131 \ominus \delta_{60} = 10.5\%$
$\Delta_{120} = 0.206\,\text{pb}$

sig(pT>200 GeV, N_{jets}≥1) = 0.582 pb
BLPTW uncertainty: 15.1% (see above)
Total Powheg uncertainty: 20.8% -> **14.3%**

```
Sig tot: 48.520 pb
Sig pTH<60 GeV: 38.412 pb
Sig pTH<60 GeV, Nj>=1: 8.719 pb
```

Cross section from +1 sigma shift of each source

Cross sections in pb

STXS	sig	stat	mu	res	mig01	mig12	D60	D120	D200
Incl	48.52	+/- 0.00	50.77	49.57	48.54	48.51	48.52	48.52	48.60
FWDH	4.27	+/- 0.01	4.46	4.35	4.25	4.25	4.25	4.26	4.27
VBF1	0.27	+/- 0.00	0.29	0.29	0.28	0.31	0.27	0.27	0.27
VBF2	0.36	+/- 0.00	0.39	0.39	0.37	0.42	0.37	0.37	0.36
0J	27.25	+/- 0.03	28.28	27.27	26.13	27.25	27.25	27.25	27.25
1J_0-60	6.49	+/- 0.01	6.84	6.79	7.02	6.04	5.71	6.41	6.49
1J_60	4.50	+/- 0.01	4.74	4.71	4.86	4.19	5.02	4.44	4.50
1J_120	0.74	+/- 0.00	0.78	0.77	0.80	0.69	0.83	0.82	0.74
1J_200	0.15	+/- 0.00	0.16	0.16	0.16	0.14	0.15	0.15	0.17
2J_0-60	1.22	+/- 0.01	1.32	1.32	1.27	1.42	1.07	1.21	1.22
2J_60	1.86	+/- 0.01	2.01	2.01	1.94	2.16	2.08	1.84	1.86
2J_120	0.99	+/- 0.00	1.06	1.06	1.02	1.15	1.10	1.09	0.99
2J_200	0.42	+/- 0.00	0.45	0.45	0.44	0.49	0.42	0.42	0.48
=0J	30.12	+/- 0.03	31.26	30.15	28.89	30.12	30.12	30.12	30.12
=1J	12.92	+/- 0.02	13.61	13.52	13.97	12.03	12.72	12.85	12.95
>=2J	5.47	+/- 0.01	5.90	5.90	5.69	6.35	5.68	5.55	5.53
>=1J 60-200	9.09	+/- 0.01	9.67	9.63	9.69	9.26	10.15	9.21	9.09
>=1J 120-200	1.96	+/- 0.01	2.10	2.09	2.07	2.10	2.19	2.17	1.96
>=1J >200	0.58	+/- 0.00	0.62	0.62	0.61	0.64	0.58	0.58	0.67
>=1J >60	9.68	+/- 0.01	10.29	10.25	10.30	9.90	10.73	9.79	9.76
>=1J >120	2.54	+/- 0.01	2.72	2.71	2.68	2.74	2.77	2.75	2.63
>=1	18.40	+/- 0.02	19.51	19.42	19.65	18.38	18.40	18.40	18.48

11 ggF STXS cats

Jet bins (includes fwd H)

Cross sections and absolute uncertainties

Cross sections and absolute uncertainties in pb

STXS	sig	stat	mu	res	mig01	mig12	D60	D120	D200	Tot
Incl	48.52	+/- 0.00	2.25	1.06	0.02	-0.01	-0.00	0.00	0.08	2.49
FWDH	4.27	+/- 0.01	0.19	0.08	-0.02	-0.02	-0.02	-0.01	0.00	0.21
VBF1	0.27	+/- 0.00	0.02	0.02	0.01	0.04	0.00	0.00	0.00	0.05
VBF2	0.36	+/- 0.00	0.03	0.03	0.01	0.06	0.01	0.01	0.00	0.07
0J	27.25	+/- 0.03	1.03	0.03	-1.12	0.00	0.00	0.00	0.00	1.52
1J_0-60	6.49	+/- 0.01	0.35	0.30	0.52	-0.45	-0.79	-0.08	0.00	1.14
1J_60	4.50	+/- 0.01	0.24	0.21	0.36	-0.31	0.52	-0.06	0.00	0.78
1J_120	0.74	+/- 0.00	0.04	0.03	0.06	-0.05	0.09	0.08	0.00	0.15
1J_200	0.15	+/- 0.00	0.01	0.01	0.01	-0.01	0.00	0.00	0.02	0.03
2J_0-60	1.22	+/- 0.01	0.10	0.10	0.05	0.20	-0.15	-0.02	0.00	0.29
2J_60	1.86	+/- 0.01	0.15	0.15	0.07	0.30	0.22	-0.02	0.00	0.43
2J_120	0.99	+/- 0.00	0.08	0.08	0.04	0.16	0.11	0.10	0.00	0.25
2J_200	0.42	+/- 0.00	0.03	0.03	0.02	0.07	0.00	0.00	0.06	0.10
=0J	30.12	+/- 0.03	1.14	0.03	-1.24	0.00	0.00	0.00	0.00	1.68
=1J	12.92	+/- 0.02	0.69	0.59	1.04	-0.90	-0.21	-0.07	0.02	1.66
>=2J	5.47	+/- 0.01	0.43	0.43	0.22	0.88	0.21	0.07	0.06	1.12
>=1J 60-200	9.09	+/- 0.01	0.57	0.53	0.59	0.17	1.05	0.11	0.00	1.45
>=1J 120-200	1.96	+/- 0.01	0.13	0.13	0.11	0.14	0.23	0.21	0.00	0.40
>=1J >200	0.58	+/- 0.00	0.04	0.04	0.03	0.06	0.00	0.00	0.08	0.12
>=1J >60	9.68	+/- 0.01	0.61	0.57	0.62	0.22	1.05	0.11	0.08	1.51
>=1J >120	2.54	+/- 0.01	0.18	0.17	0.14	0.20	0.23	0.21	0.08	0.47
>=1	18.40	+/- 0.02	1.12	1.02	1.26	-0.01	-0.00	0.00	0.08	1.97

11 ggF STXS cats

Jet bins (includes fwd H)

Filling in the "*x*"

Fractional impact of each uncertainty source

STXS	sig	stat	mu	res	mig01	mig12	D60	D120	D200
Total abs uncertainty			2.25	1.04	1.25	0.88	1.05	0.21	0.08
Incl	48.52	+/- 0.00	1.00	1.01	0.02	-0.01	-0.00	0.00	1.00
FWDH	4.27	+/- 0.01	0.08	0.07	-0.02	-0.02	-0.02	-0.04	0.02
VBF1	0.27	+/- 0.00	0.01	0.02	0.01	0.05	0.00	0.01	0.00
VBF2	0.36	+/- 0.00	0.01	0.03	0.01	0.07	0.01	0.03	0.00
0J	27.25	+/- 0.03	0.46	0.03	-0.90	0.00	0.00	0.00	0.00
1J_0-60	6.49	+/- 0.01	0.15	0.29	0.42	-0.51	-0.74	-0.41	0.00
1J_60	4.50	+/- 0.01	0.11	0.20	0.29	-0.35	0.49	-0.28	0.00
1J_120	0.74	+/- 0.00	0.02	0.03	0.05	-0.06	0.08	0.38	0.00
1J_200	0.15	+/- 0.00	0.00	0.01	0.01	-0.01	0.00	0.00	0.26
2J_0-60	1.22	+/- 0.01	0.04	0.09	0.04	0.22	-0.14	-0.08	0.00
2J_60	1.86	+/- 0.01	0.07	0.14	0.06	0.34	0.20	-0.12	0.00
2J_120	0.99	+/- 0.00	0.03	0.07	0.03	0.18	0.11	0.50	0.00
2J_200	0.42	+/- 0.00	0.01	0.03	0.01	0.08	0.00	0.00	0.72
=0J	30.12	+/- 0.03	0.50	0.03	-0.99	0.00	0.00	0.00	0.00
=1J	12.92	+/- 0.02	0.31	0.57	0.83	-1.02	-0.20	-0.36	0.26
>=2J	5.47	+/- 0.01	0.19	0.41	0.17	1.00	0.20	0.36	0.74
>=1J 60-200	9.09	+/- 0.01	0.25	0.51	0.47	0.19	1.00	0.55	0.00
>=1J 120-200	1.96	+/- 0.01	0.06	0.12	0.09	0.16	0.22	1.00	0.00
>=1J >200	0.58	+/- 0.00	0.02	0.04	0.02	0.07	0.00	0.00	1.00
>=1J >60	9.68	+/- 0.01	0.27	0.55	0.50	0.26	1.00	0.55	1.00
>=1J >120	2.54	+/- 0.01	0.08	0.16	0.11	0.22	0.22	1.00	1.00
>=1	18.40	+/- 0.02	0.50	0.98	1.01	-0.01	-0.00	0.00	1.00

Cross sections and relative uncertainties

Cross sections and fractional uncertainties

STXS	sig	stat	mu	res	mig01	mig12	D60	D120	D200	Tot
Incl	48.52	+/- 0.00	+4.6%	+2.2%	+0.0%	-0.0%	-0.0%	+0.0%	+0.2%	+5.1%
FWDH	4.27	+/- 0.01	+4.4%	+1.8%	-0.5%	-0.4%	-0.5%	-0.2%	+0.0%	+4.9%
VBF1	0.27	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	+1.5%	+0.8%	+0.0%	+20.1%
VBF2	0.36	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	+3.6%	+1.9%	+0.0%	+20.4%
0J	27.25	+/- 0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	+0.0%	+0.0%	+5.6%
1J_0-60	6.49	+/- 0.01	+5.3%	+4.6%	+8.1%	-6.9%	-12.1%	-1.3%	+0.0%	+17.6%
1J_60	4.50	+/- 0.01	+5.3%	+4.6%	+8.1%	-6.9%	+11.6%	-1.3%	+0.0%	+17.3%
1J_120	0.74	+/- 0.00	+5.3%	+4.6%	+8.1%	-6.9%	+11.6%	+10.5%	+0.0%	+20.2%
1J_200	0.15	+/- 0.00	+5.3%	+4.6%	+8.1%	-6.9%	+0.0%	+0.0%	+14.3%	+19.1%
2J_0-60	1.22	+/- 0.01	+7.9%	+7.9%	+3.9%	+16.2%	-12.1%	-1.3%	+0.0%	+23.4%
2J_60	1.86	+/- 0.01	+7.9%	+7.9%	+3.9%	+16.2%	+11.6%	-1.3%	+0.0%	+23.2%
2J_120	0.99	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	+11.6%	+10.5%	+0.0%	+25.4%
2J_200	0.42	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	+0.0%	+0.0%	+14.3%	+24.6%
=0J	30.12	+/- 0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	+0.0%	+0.0%	+5.6%
=1J	12.92	+/- 0.02	+5.3%	+4.6%	+8.1%	-6.9%	-1.6%	-0.6%	+0.2%	+12.9%
>=2J	5.47	+/- 0.01	+7.9%	+7.9%	+3.9%	+16.1%	+3.8%	+1.4%	+1.1%	+20.4%
>=1J 60-200	9.09	+/- 0.01	+6.3%	+5.8%	+6.5%	+1.8%	+11.6%	+1.2%	+0.0%	+16.0%
>=1J 120-200	1.96	+/- 0.01	+6.9%	+6.6%	+5.6%	+7.0%	+11.6%	+10.5%	+0.0%	+20.4%
>=1J >200	0.58	+/- 0.00	+7.2%	+7.0%	+5.0%	+10.1%	+0.0%	+0.0%	+14.3%	+20.8%
>=1J >60	9.68	+/- 0.01	+6.3%	+5.9%	+6.4%	+2.3%	+10.9%	+1.2%	+0.9%	+15.6%
>=1J >120	2.54	+/- 0.01	+6.9%	+6.7%	+5.4%	+7.7%	+8.9%	+8.1%	+3.3%	+18.4%
>=1	18.40	+/- 0.02	+6.1%	+5.6%	+6.8%	-0.1%	-0.0%	+0.0%	+0.5%	+10.7%

2M events

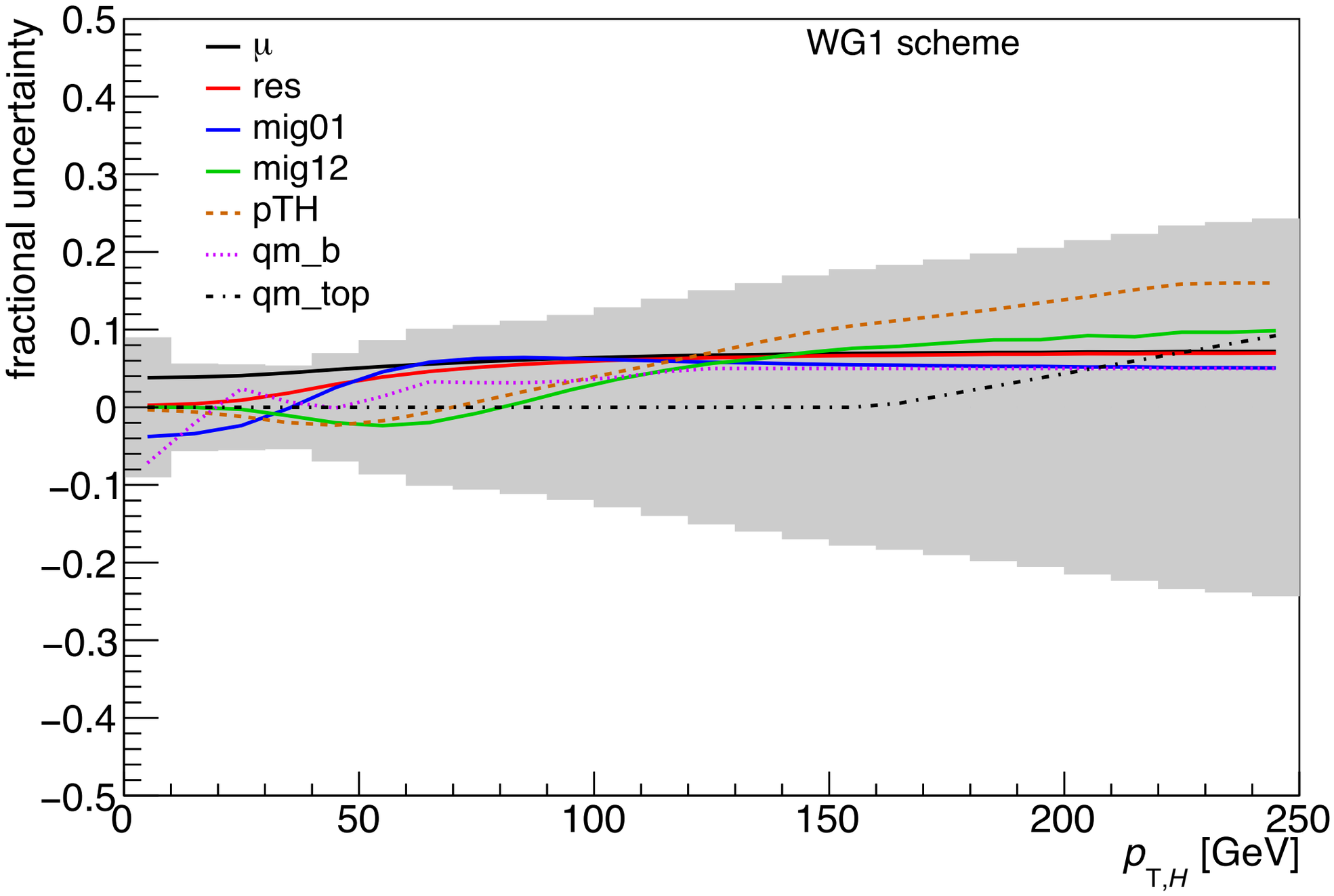
Cross section and rel. uncertainties: WG1 scheme

Cross sections and fractional uncertainties

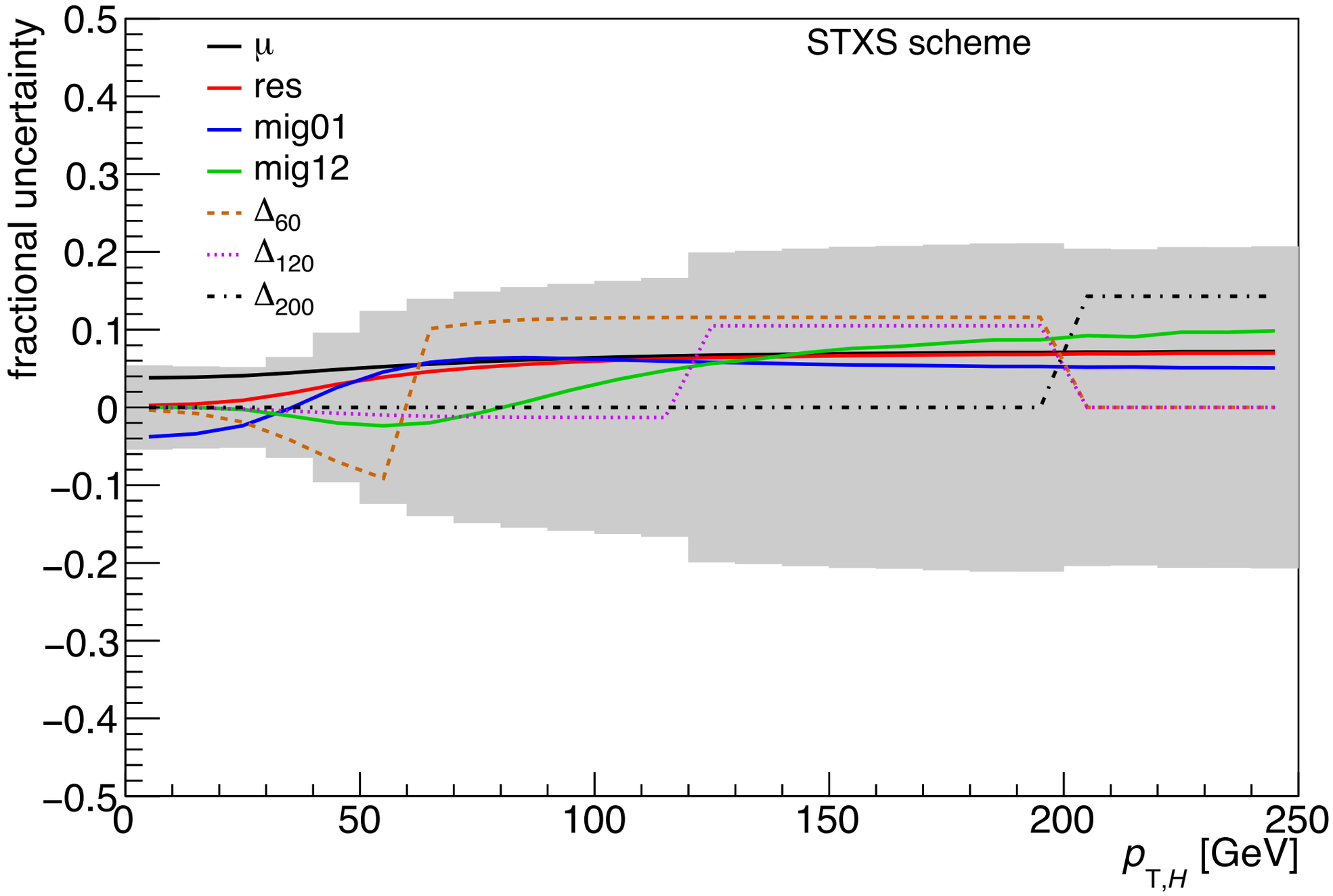
STXS	sig	stat	mu	res	mig01	mig12	pTH	qm_b	qm_top	Tot	Tot
Incl	48.52	+/- 0.00	+4.6%	+2.2%	+0.0%	-0.0%	-0.1%	-0.2%	+0.0%	+5.1%	+5.1%
FWDH	4.27	+/- 0.01	+4.4%	+1.8%	-0.5%	-0.4%	-0.5%	-0.6%	-1.5%	+5.1%	+4.9%
VBF1	0.27	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	-2.5%	-2.4%	+0.1%	+20.3%	+20.1%
VBF2	0.36	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	-0.9%	-1.1%	+0.2%	+20.1%	+20.4%
0J	27.25	+/- 0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	-0.2%	+0.0%	+5.6%	+5.6%
1J_0-60	6.49	+/- 0.01	+5.3%	+4.6%	+8.1%	-6.9%	-4.5%	-4.0%	+0.0%	+14.1%	+17.6%
1J_60	4.50	+/- 0.01	+5.3%	+4.6%	+8.1%	-6.9%	+3.0%	+4.9%	+0.0%	+14.0%	+17.3%
1J_120	0.74	+/- 0.00	+5.3%	+4.6%	+8.1%	-6.9%	+14.0%	+5.0%	+0.5%	+19.6%	+20.2%
1J_200	0.15	+/- 0.00	+5.3%	+4.6%	+8.1%	-6.9%	+16.0%	+5.0%	+10.5%	+23.5%	+19.1%
2J_0-60	1.22	+/- 0.01	+7.9%	+7.9%	+3.9%	+16.2%	-7.4%	-7.2%	+0.0%	+22.5%	+23.4%
2J_60	1.86	+/- 0.01	+7.9%	+7.9%	+3.9%	+16.2%	-1.0%	-0.1%	+0.0%	+20.0%	+23.2%
2J_120	0.99	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	+6.8%	+5.0%	+0.6%	+21.7%	+25.4%
2J_200	0.42	+/- 0.00	+7.9%	+7.9%	+3.9%	+16.2%	+15.5%	+5.0%	+11.8%	+28.3%	+24.6%
=0J	30.12	+/- 0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	-0.2%	-0.2%	+5.6%	+5.6%
=1J	12.92	+/- 0.02	+5.3%	+4.6%	+8.1%	-6.9%	-0.3%	+0.0%	+0.2%	+12.7%	+12.9%
>=2J	5.47	+/- 0.01	+7.9%	+7.9%	+3.9%	+16.1%	+0.1%	-0.7%	+1.1%	+20.0%	+20.4%
>=1J 60-200	9.09	+/- 0.01	+6.3%	+5.8%	+6.5%	+1.8%	+3.4%	+3.7%	+0.2%	+12.0%	+16.0%
>=1J 120-200	1.96	+/- 0.01	+6.9%	+6.6%	+5.6%	+7.0%	+9.6%	+5.0%	+0.6%	+17.0%	+20.4%
>=1J >200	0.58	+/- 0.00	+7.2%	+7.0%	+5.0%	+10.1%	+15.6%	+5.0%	+11.4%	+25.0%	+20.8%
>=1J >60	9.68	+/- 0.01	+6.3%	+5.9%	+6.4%	+2.3%	+4.2%	+3.8%	+0.8%	+12.4%	+15.6%
>=1J >120	2.54	+/- 0.01	+6.9%	+6.7%	+5.4%	+7.7%	+11.0%	+5.0%	+3.1%	+18.4%	+18.4%
>=1	18.40	+/- 0.02	+6.1%	+5.6%	+6.8%	-0.1%	-0.2%	-0.2%	+0.5%	+10.7%	+10.7%

"WG1 scheme" compared to total uncertainties of STXS scheme (right)

Higgs p_T spectrum



Higgs p_T spectrum



Higgs p_T spectrum