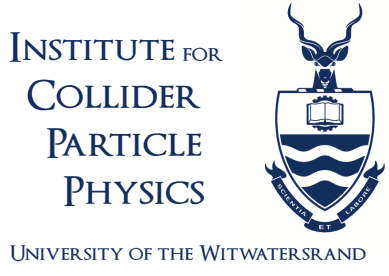
$4\ell + \text{MET}$ analysis update

Abdualazem Fadol

May 27, 2019



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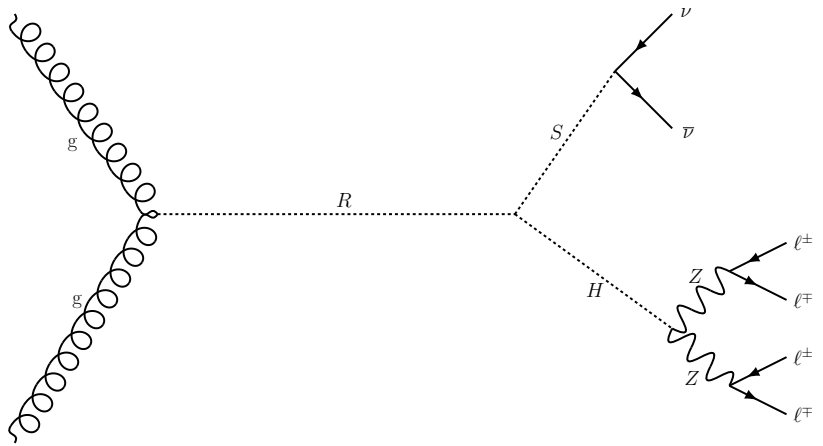

- Explores the presence of a heavy scalar boson, R;
- Produced in gluon-gluon fusion in association with Met;
- The resonance decays to lighter scalar H and S bosons;
- H decays into four leptons through ZZ bosons; and
- S decays to a pair of neutrinos.

$$gg \rightarrow R \rightarrow SH \rightarrow 4\ell + \text{Met} \Leftrightarrow \text{RSH-model}$$

The search looks at the region where the invariant mass of the four leptons greater than 200 GeV ($m_{4\ell} > 200$ GeV), and missing transverse energy. In the phase space of RSH model, we consider the mass of R to be between $(m_S + m_H) < m_R \leq 1500$ GeV.

Advantages for this channel

- The missing transverse energy background is very small; and
- It can be controlled by varying the masses of R, H, and S.

- RSH-model can be embedded into 2HDM+S or 2HDM+a

Eur. Phys. J. C manuscript No.
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Phenomenological signatures of additional scalar bosons at the LHC

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The N2HDM under Theoretical and Experimental Scrutiny

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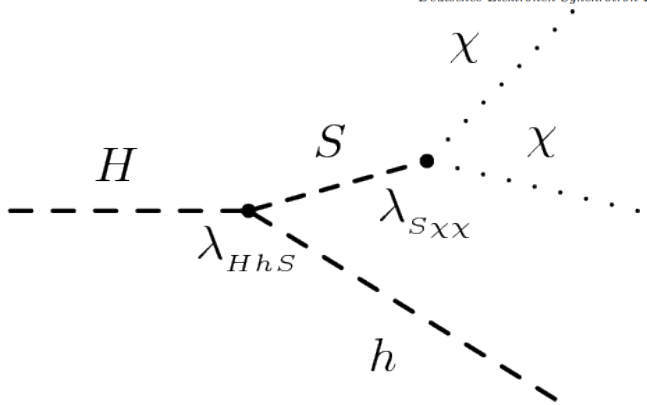


Figure: Changing $H \to R, h(125) \to H$; a theory study is going on.

Signal and background

Signal samples have already been produced, JIRA, as follows:

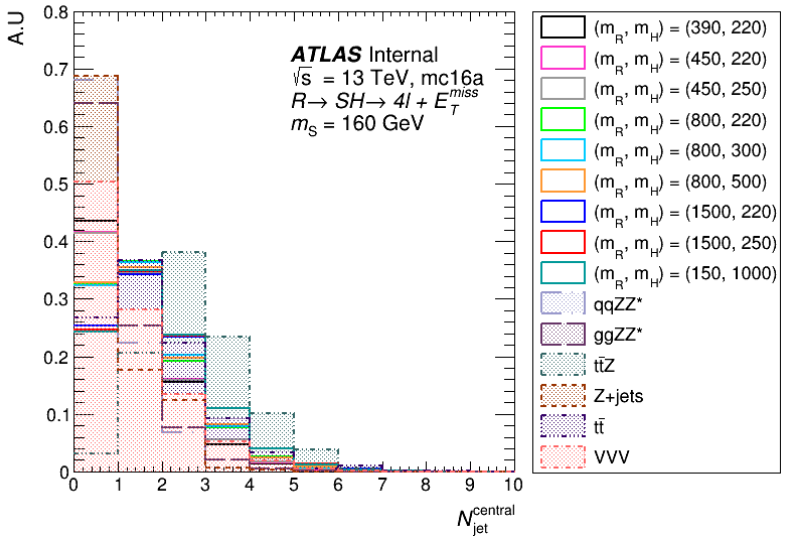
- The mass of S is fixed to 160 GeV;
- The masses of R are 390 GeV, 450 GeV, 800 GeV and 1500 GeV:
  - $m_R = 390$ GeV: $m_H = 220$ GeV
  - $m_R = 450$ GeV: $m_H = 220$ GeV and 250 GeV
  - $m_R = 800$ GeV: $m_H = 220$ GeV, 300 GeV and 500 GeV
  - $m_R = 1500$ GeV:$m_H = 220$ GeV, 250 GeV and 1000 GeV
- Requested HIGG2D1 derivation with cache: 21.2.55 and p-tag: p3782. It's done, you can see it here; and
- The mini-tree production is done using HZZAnalRun2Code.

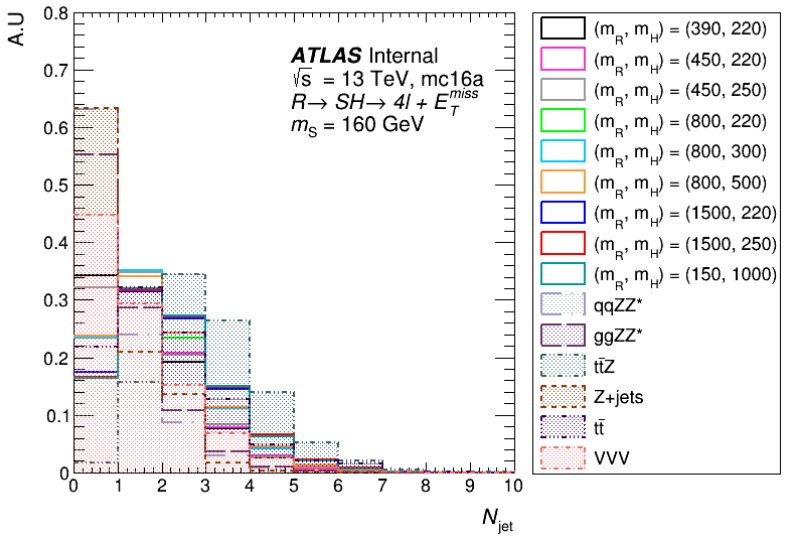
Background samples

- $qqZZ^*$, $ggZZ^*$, $t\bar{t}Z$, $Z + jets$, $t\bar{t}$ and VVV.

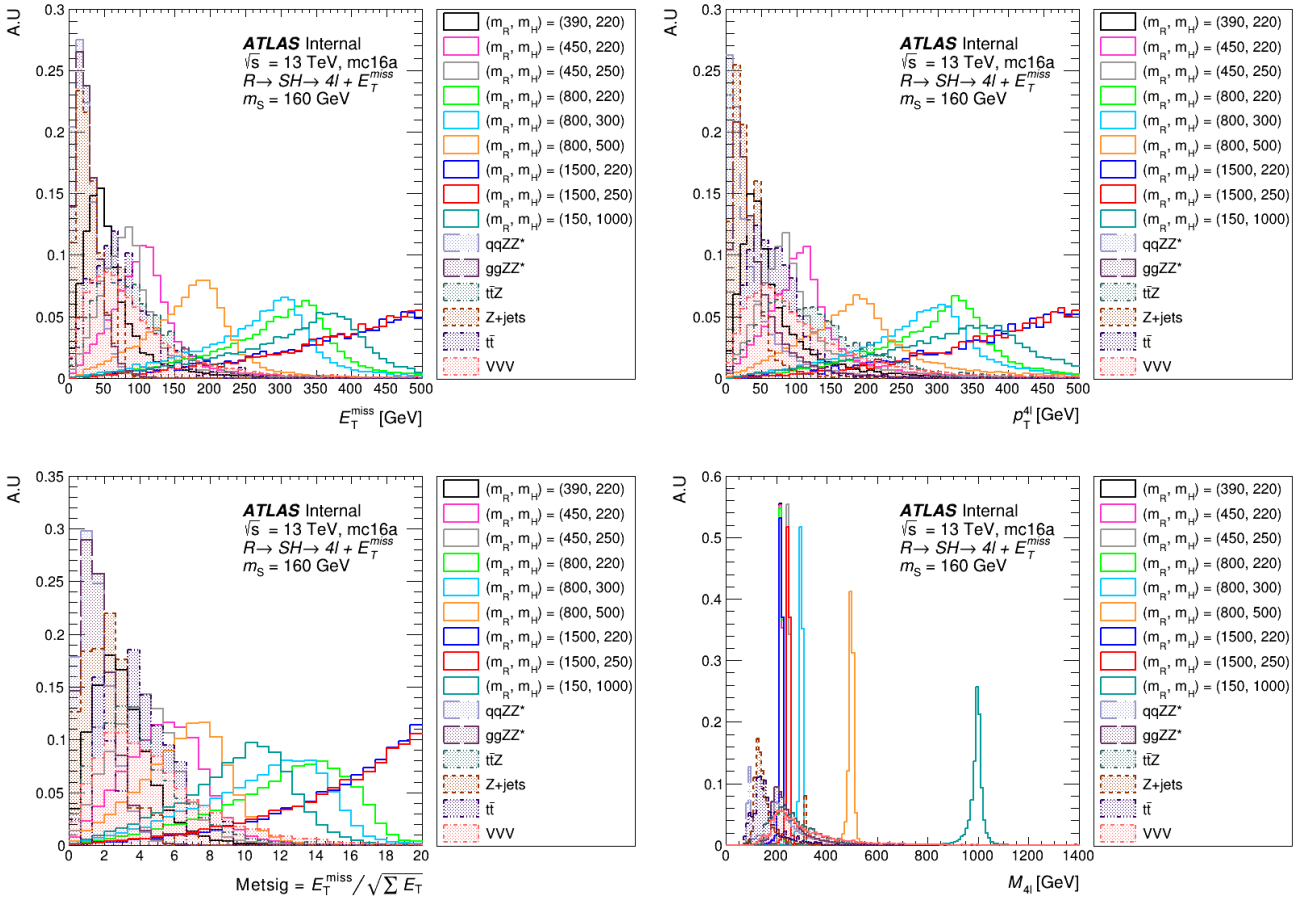
Event categorisation

- $4\mu, 4e, 2\mu2e, 2e2\mu$
- Objects selection
  - $E_T^e > 7$ GeV, $|\eta^e| < 2.47$
  - $p_T^\mu > 5$ GeV, $|\eta^\mu| < 2.7$
  - $p_T^{jet} > 30$ GeV, $|\eta^{jet}| < 4.5$
- With nominal selection of *HZZ*
- B-veto to reject $t\bar{t}Z$ background
- Events categorisation:
  - $N_{\text{jet}}^{\text{Central}} = 0$
  - $N_{\text{jet}}^{\text{Central}} \geq 1$
- Cut $p_T^{4\ell}$ and Metsig$= E_T^{\text{miss}}/\sqrt{\sum E_T}$





RSH-signal optimisation



2D scan of $p_{\mathrm{T}}^{4\ell}$ and Metsig, and select the cut that give maximum significance.

RSH-signal optimisation

- Signal and background are mc16a, mc16d and mc16d combined;
- The significance is calculated using $S/\sqrt{S+B}$ and $S/\sqrt{B}$;
- S, and B are the signal and background event, respectively;
- Background events are normalised to cross section for the $m_{4\ell} > 200$ GeV;
- Scaling background events by 20.3% uncertainty. It's calculated as follow:

The background scaled by a number extracted as follows: For instance, for $m_H = 220$, and $m_R = 390$: events in $m_{4\ell}(210 - 230)$ GeV over the full range of $m_{4\ell}(> 200)$ GeV.

RSH-signal optimisation

$p_T^{4\ell}$ and Metsig scan for zero central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{Cjet} = 0$	28.64±0.19	1582.11±6.15	208.34±0.81	0.99±0.10	1.82±0.20	0.65±0.23	7.22±0.10	1.44	1.50
$p_T^{4\ell} > 0.00$ GeV & METsig > 0.00	28.64±0.19	1582.11±6.15	208.34±0.81	0.99±0.10	1.82±0.20	0.65±0.23	7.22±0.10	1.44	1.50
$p_T^{4\ell} > 0.00$ GeV & METsig > 0.50	27.96±0.19	1406.51±5.82	190.43±0.77	0.98±0.09	1.74±0.20	0.65±0.23	7.13±0.10	1.49	1.55
$p_T^{4\ell} > 0.00$ GeV & METsig > 1.00	25.93±0.18	1069.25±5.08	150.33±0.69	0.95±0.09	1.56±0.19	0.57±0.22	6.88±0.10	1.56	1.64
$p_T^{4\ell} > 0.00$ GeV & METsig > 1.50	22.78±0.17	735.63±4.24	105.63±0.58	0.92±0.09	1.29±0.17	0.57±0.22	6.51±0.09	1.63	1.73
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.00	18.71±0.15	457.49±3.28	67.35±0.46	0.83±0.09	1.01±0.15	0.40±0.18	6.10±0.09	1.66	1.80
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.50	14.09±0.13	264.70±2.54	39.85±0.35	0.74±0.09	0.81±0.13	0.40±0.18	5.55±0.09	1.60	1.77
$p_T^{4\ell} > 0.00$ GeV & METsig > 3.00	9.59±0.11	139.30±1.79	21.23±0.26	0.64±0.08	0.39±0.09	0.40±0.18	5.02±0.08	1.45	1.65
$p_T^{4\ell} > 0.00$ GeV & METsig > 3.50	6.11±0.09	70.74±1.27	10.51±0.18	0.58±0.07	0.23±0.07	0.40±0.18	4.50±0.08	1.25	1.45
$p_T^{4\ell} > 0.00$ GeV & METsig > 4.00	3.55±0.07	32.14±0.88	4.90±0.12	0.39±0.06	0.18±0.06	0.09±0.09	3.96±0.07	1.02	1.22
$p_T^{4\ell} > 0.00$ GeV & METsig > 4.50	1.96±0.05	14.27±0.55	2.22±0.08	0.34±0.06	0.10±0.05	0.00±0.00	3.46±0.07	0.79	0.96
$p_T^{4\ell} > 0.00$ GeV & METsig > 5.00	1.04±0.04	5.75±0.36	1.02±0.06	0.27±0.05	0.05±0.03	0.00±0.00	3.01±0.06	0.59	0.73
$p_T^{4\ell} > 10.00$ & GeV METsig > 0.00	27.71±0.19	1047.97±5.52	177.23±0.75	0.99±0.10	1.55±0.19	0.57±0.22	7.10±0.10	1.66	1.75
$p_T^{4\ell} > 10.00$ & GeV METsig > 0.50	27.10±0.18	960.83±5.27	164.05±0.72	0.98±0.09	1.49±0.18	0.57±0.22	7.03±0.10	1.69	1.79
$p_T^{4\ell} > 10.00$ & GeV METsig > 1.00	25.24±0.18	738.86±4.60	130.68±0.64	0.95±0.09	1.33±0.17	0.57±0.22	6.80±0.10	1.77	1.89
$p_T^{4\ell} > 10.00$ & GeV METsig > 1.50	22.25±0.17	509.00±3.84	92.13±0.54	0.92±0.09	1.15±0.16	0.57±0.22	6.45±0.09	1.84	2.00
$p_T^{4\ell} > 10.00$ & GeV METsig > 2.00	18.33±0.15	323.31±2.97	59.35±0.43	0.83±0.09	0.87±0.14	0.40±0.18	6.05±0.09	1.85	2.06
$p_T^{4\ell} > 10.00$ & GeV METsig > 2.50	13.84±0.13	189.55±2.32	35.29±0.33	0.74±0.08	0.69±0.12	0.40±0.18	5.52±0.09	1.77	2.02
$p_T^{4\ell} > 10.00$ & GeV METsig > 3.00	9.42±0.11	100.41±1.62	18.92±0.24	0.63±0.08	0.34±0.09	0.40±0.18	4.99±0.08	1.59	1.87
$p_T^{4\ell} > 10.00$ & GeV METsig > 3.50	6.01±0.09	51.69±1.16	9.44±0.17	0.58±0.07	0.23±0.07	0.40±0.18	4.48±0.08	1.36	1.63
$p_T^{4\ell} > 10.00$ & GeV METsig > 4.00	3.50±0.07	23.93±0.81	4.44±0.12	0.39±0.06	0.18±0.06	0.09±0.09	3.95±0.07	1.10	1.35
$p_T^{4\ell} > 10.00$ & GeV METsig > 4.50	1.93±0.05	10.73±0.50	2.00±0.08	0.34±0.06	0.10±0.05	0.00±0.00	3.45±0.07	0.84	1.05
$p_T^{4\ell} > 10.00$ & GeV METsig > 5.00	1.04±0.04	4.22±0.33	0.92±0.05	0.27±0.05	0.05±0.03	0.00±0.00	3.00±0.06	0.62	0.79
$p_T^{4\ell} > 20.00$ & GeV METsig > 0.00	24.98±0.18	560.98±4.37	116.70±0.61	0.97±0.09	1.20±0.17	0.57±0.22	6.78±0.10	1.95	2.11
$p_T^{4\ell} > 20.00$ & GeV METsig > 0.50	24.47±0.17	518.74±4.22	109.03±0.59	0.96±0.09	1.14±0.16	0.57±0.22	6.73±0.10	1.97	2.15
$p_T^{4\ell} > 20.00$ & GeV METsig > 1.00	22.93±0.17	415.96±3.75	89.57±0.53	0.93±0.09	1.09±0.16	0.57±0.22	6.55±0.09	2.03	2.24
$p_T^{4\ell} > 20.00$ & GeV METsig > 1.50	20.45±0.16	295.80±3.18	64.71±0.45	0.90±0.09	1.01±0.15	0.57±0.22	6.29±0.09	2.09	2.36
$p_T^{4\ell} > 20.00$ & GeV METsig > 2.00	16.99±0.15	190.43±2.43	42.29±0.36	0.81±0.09	0.76±0.13	0.40±0.18	5.93±0.09	2.09	2.43
$p_T^{4\ell} > 20.00$ & GeV METsig > 2.50	12.89±0.13	114.16±1.91	25.80±0.28	0.72±0.08	0.58±0.11	0.40±0.18	5.45±0.09	1.97	2.36
$p_T^{4\ell} > 20.00$ & GeV METsig > 3.00	8.79±0.10	61.98±1.30	14.00±0.21	0.63±0.08	0.25±0.07	0.40±0.18	4.96±0.08	1.74	2.15
$p_T^{4\ell} > 20.00$ & GeV METsig > 3.50	5.59±0.08	32.57±0.95	7.12±0.15	0.57±0.07	0.16±0.06	0.40±0.18	4.47±0.08	1.45	1.84
$p_T^{4\ell} > 20.00$ & GeV METsig > 4.00	3.26±0.06	15.30±0.68	3.46±0.10	0.38±0.06	0.12±0.05	0.09±0.09	3.94±0.07	1.15	1.50
$p_T^{4\ell} > 20.00$ & GeV METsig > 4.50	1.79±0.05	6.95±0.41	1.56±0.07	0.33±0.06	0.05±0.03	0.00±0.00	3.45±0.07	0.86	1.13
$p_T^{4\ell} > 20.00$ & GeV METsig > 5.00	0.96±0.03	2.75±0.27	0.73±0.05	0.26±0.05	0.03±0.02	0.00±0.00	3.00±0.06	0.63	0.82
$p_T^{4\ell} > 30.00$ & GeV METsig > 0.00	20.20±0.16	306.80±2.95	69.12±0.47	0.93±0.09	0.87±0.14	0.49±0.20	6.30±0.09	2.04	2.29
$p_T^{4\ell} > 30.00$ & GeV METsig > 0.50	19.84±0.16	284.27±2.85	64.80±0.45	0.91±0.09	0.83±0.14	0.49±0.20	6.26±0.09	2.06	2.33
$p_T^{4\ell} > 30.00$ & GeV METsig > 1.00	18.71±0.15	229.56±2.58	54.08±0.41	0.90±0.09	0.81±0.13	0.49±0.20	6.15±0.09	2.12	2.43
$p_T^{4\ell} > 30.00$ & GeV METsig > 1.50	16.91±0.14	166.63±2.18	40.16±0.36	0.87±0.09	0.76±0.13	0.49±0.20	5.96±0.09	2.17	2.56
$p_T^{4\ell} > 30.00$ & GeV METsig > 2.00	14.31±0.13	110.37±1.58	26.88±0.29	0.79±0.09	0.59±0.12	0.40±0.18	5.68±0.09	2.17	2.64
$p_T^{4\ell} > 30.00$ & GeV METsig > 2.50	11.12±0.12	65.97±1.24	16.86±0.23	0.70±0.08	0.46±0.10	0.40±0.18	5.28±0.09	2.05	2.61
$p_T^{4\ell} > 30.00$ & GeV METsig > 3.00	7.60±0.10	36.71±0.91	9.38±0.17	0.61±0.08	0.23±0.07	0.40±0.18	4.85±0.08	1.78	2.34

RSH-signal optimisation

$p_{\mathrm{T}}^{4\ell}$ and Metsig scan for zero central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{\mathrm{Cjet}} = 0$	28.64±0.19	1582.11±6.15	208.34±0.81	0.99±0.10	1.82±0.20	0.65±0.23	7.22±0.10	1.44	1.50
$p_{\mathrm{T}}^{4\ell} > 30.00$ & GeV METsig > 3.50	4.85±0.08	19.70±0.66	4.88±0.12	0.55±0.07	0.14±0.05	0.40±0.18	4.40±0.08	1.47	1.96
$p_{\mathrm{T}}^{4\ell} > 30.00$ & GeV METsig > 4.00	2.84±0.06	9.78±0.45	2.41±0.09	0.38±0.06	0.12±0.05	0.09±0.09	3.91±0.07	1.14	1.54
$p_{\mathrm{T}}^{4\ell} > 30.00$ & GeV METsig > 4.50	1.58±0.04	4.74±0.31	1.11±0.06	0.33±0.06	0.05±0.03	0.00±0.00	3.43±0.07	0.84	1.13
$p_{\mathrm{T}}^{4\ell} > 30.00$ & GeV METsig > 5.00	0.84±0.03	1.86±0.20	0.54±0.04	0.26±0.05	0.03±0.02	0.00±0.00	2.99±0.06	0.60	0.79
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 0.00	13.66±0.13	164.79±1.84	39.99±0.36	0.89±0.09	0.47±0.10	0.39±0.18	5.69±0.09	1.81	2.08
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 0.50	13.43±0.13	152.96±1.76	37.50±0.34	0.87±0.09	0.47±0.10	0.39±0.18	5.67±0.09	1.84	2.12
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 1.00	12.69±0.13	123.01±1.56	31.39±0.31	0.86±0.09	0.47±0.10	0.39±0.18	5.61±0.09	1.88	2.21
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 1.50	11.48±0.12	90.92±1.34	23.45±0.27	0.82±0.09	0.43±0.10	0.39±0.18	5.49±0.09	1.91	2.31
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 2.00	9.87±0.11	60.96±1.05	15.91±0.22	0.75±0.08	0.38±0.09	0.30±0.16	5.31±0.09	1.90	2.40
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 2.50	7.97±0.10	37.26±0.83	10.27±0.18	0.67±0.08	0.31±0.08	0.30±0.16	5.02±0.08	1.83	2.41
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 3.00	5.60±0.08	21.28±0.63	5.87±0.14	0.58±0.08	0.15±0.06	0.30±0.16	4.68±0.08	1.60	2.17
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 3.50	3.68±0.07	11.69±0.46	3.09±0.10	0.53±0.07	0.09±0.04	0.30±0.16	4.29±0.08	1.32	1.82
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 4.00	2.21±0.05	6.08±0.32	1.57±0.07	0.37±0.06	0.07±0.04	0.09±0.09	3.84±0.07	1.02	1.41
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 4.50	1.26±0.04	3.27±0.23	0.74±0.05	0.32±0.06	0.03±0.02	0.00±0.00	3.40±0.07	0.75	1.00
$p_{\mathrm{T}}^{4\ell} > 40.00$ & GeV METsig > 5.00	0.65±0.03	1.47±0.16	0.37±0.03	0.25±0.05	0.03±0.02	0.00±0.00	2.97±0.06	0.50	0.64
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 0.00	7.39±0.10	92.53±1.23	23.15±0.27	0.82±0.09	0.34±0.09	0.30±0.16	5.14±0.08	1.30	1.48
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 0.50	7.24±0.09	86.11±1.19	21.60±0.26	0.80±0.09	0.34±0.09	0.30±0.16	5.13±0.08	1.31	1.50
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 1.00	6.79±0.09	69.57±1.02	18.00±0.24	0.78±0.08	0.34±0.09	0.30±0.16	5.10±0.08	1.34	1.55
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 1.50	6.06±0.09	50.86±0.85	13.34±0.21	0.74±0.08	0.32±0.08	0.30±0.16	5.03±0.08	1.34	1.60
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 2.00	5.21±0.08	33.75±0.70	9.00±0.17	0.68±0.08	0.27±0.08	0.30±0.16	4.90±0.08	1.34	1.65
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 2.50	4.27±0.07	21.09±0.56	5.85±0.14	0.62±0.08	0.23±0.07	0.30±0.16	4.69±0.08	1.29	1.65
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 3.00	3.12±0.06	12.57±0.43	3.34±0.10	0.54±0.07	0.11±0.05	0.30±0.16	4.45±0.08	1.14	1.50
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 3.50	2.15±0.05	7.22±0.32	1.84±0.08	0.51±0.07	0.09±0.04	0.30±0.16	4.14±0.08	0.96	1.27
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 4.00	1.31±0.04	3.79±0.22	0.97±0.06	0.37±0.06	0.07±0.04	0.09±0.09	3.74±0.07	0.74	0.97
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 4.50	0.76±0.03	2.04±0.16	0.43±0.04	0.32±0.06	0.03±0.02	0.00±0.00	3.34±0.07	0.54	0.68
$p_{\mathrm{T}}^{4\ell} > 50.00$ & GeV METsig > 5.00	0.41±0.02	1.02±0.11	0.21±0.03	0.24±0.05	0.03±0.02	0.00±0.00	2.95±0.06	0.36	0.43
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 0.00	3.93±0.07	56.19±0.90	13.71±0.21	0.73±0.08	0.20±0.07	0.27±0.15	4.55±0.08	0.90	1.00
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 0.50	3.84±0.07	51.94±0.86	12.80±0.20	0.72±0.08	0.20±0.07	0.27±0.15	4.54±0.08	0.90	1.02
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 1.00	3.56±0.07	41.19±0.74	10.58±0.18	0.71±0.08	0.20±0.07	0.27±0.15	4.53±0.08	0.91	1.04
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 1.50	3.14±0.06	29.82±0.60	7.79±0.16	0.68±0.08	0.18±0.06	0.27±0.15	4.48±0.08	0.91	1.06
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 2.00	2.64±0.06	20.07±0.48	5.22±0.13	0.63±0.08	0.18±0.06	0.27±0.15	4.40±0.08	0.89	1.06
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 2.50	2.17±0.05	12.53±0.38	3.34±0.10	0.58±0.08	0.15±0.06	0.27±0.15	4.25±0.08	0.86	1.05
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 3.00	1.61±0.05	7.30±0.29	1.89±0.08	0.53±0.07	0.09±0.04	0.27±0.15	4.08±0.07	0.76	0.95
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 3.50	1.13±0.04	4.24±0.22	1.05±0.06	0.49±0.07	0.07±0.04	0.27±0.15	3.87±0.07	0.64	0.79
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 4.00	0.71±0.03	2.34±0.16	0.62±0.04	0.35±0.06	0.05±0.03	0.09±0.09	3.54±0.07	0.49	0.60
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 4.50	0.44±0.02	1.29±0.12	0.28±0.03	0.30±0.06	0.03±0.02	0.00±0.00	3.22±0.07	0.36	0.43
$p_{\mathrm{T}}^{4\ell} > 60.00$ & GeV METsig > 5.00	0.24±0.02	0.74±0.08	0.16±0.02	0.23±0.05	0.03±0.02	0.00±0.00	2.87±0.06	0.23	0.26

RSH-signal optimisation

$p_T^{4\ell}$ and Metsig scan for one or more central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.00	2358.82±0.00	330.25±0.00	4.45±0.00	2.38±0.00	1.94±0.00	12.96±0.00	2.48	2.61
$N_{Cjet} \geq 1$	32.68±0.20	776.71±3.99	121.91±0.62	3.46±0.23	0.56±0.11	1.30±0.34	5.74±0.11	2.22	2.41
$p_T^{4\ell} > 0.00$ GeV & METsig > 0.00	32.68±0.20	776.71±3.99	121.91±0.62	3.46±0.23	0.56±0.11	1.30±0.34	5.74±0.11	2.22	2.41
$p_T^{4\ell} > 0.00$ GeV & METsig > 0.50	32.16±0.20	695.40±3.84	110.77±0.59	3.41±0.23	0.47±0.11	1.30±0.34	5.68±0.11	2.29	2.50
$p_T^{4\ell} > 0.00$ GeV & METsig > 1.00	30.47±0.19	517.99±3.02	85.54±0.52	3.33±0.23	0.38±0.09	1.30±0.34	5.48±0.10	2.45	2.73
$p_T^{4\ell} > 0.00$ GeV & METsig > 1.50	27.75±0.19	337.35±2.53	57.76±0.43	3.06±0.22	0.30±0.09	1.30±0.34	5.17±0.10	2.65	3.06
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.00	24.40±0.17	197.57±2.04	34.76±0.33	2.77±0.21	0.23±0.08	1.22±0.33	4.78±0.10	2.85	3.49
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.50	20.58±0.16	105.50±1.50	19.09±0.24	2.48±0.20	0.03±0.04	0.99±0.30	4.29±0.09	2.99	3.97
$p_T^{4\ell} > 0.00$ GeV & METsig > 3.00	16.83±0.14	52.18±1.22	9.90±0.18	2.19±0.19	0.01±0.03	0.99±0.30	3.78±0.08	3.03	4.49
$p_T^{4\ell} > 0.00$ GeV & METsig > 3.50	13.25±0.13	24.40±1.03	4.82±0.12	1.91±0.17	0.01±0.03	0.83±0.28	3.31±0.08	2.93	4.95
$p_T^{4\ell} > 0.00$ GeV & METsig > 4.00	10.08±0.11	10.46±0.92	2.24±0.08	1.66±0.16	0.01±0.03	0.74±0.27	2.92±0.07	2.72	5.27
$p_T^{4\ell} > 0.00$ GeV & METsig > 4.50	7.44±0.10	4.73±0.27	1.00±0.06	1.40±0.15	0.00±0.03	0.50±0.20	2.53±0.07	2.41	5.18
$p_T^{4\ell} > 0.00$ GeV & METsig > 5.00	5.39±0.08	2.03±0.18	0.42±0.04	1.26±0.13	0.00±0.03	0.50±0.20	2.15±0.06	2.09	4.75
$p_T^{4\ell} > 10.00$ GeV & METsig > 0.00	32.17±0.20	756.97±3.96	120.08±0.61	3.48±0.23	0.56±0.11	1.30±0.34	5.69±0.11	2.21	2.40
$p_T^{4\ell} > 10.00$ GeV & METsig > 0.50	31.64±0.20	677.17±3.82	109.06±0.58	3.43±0.23	0.47±0.11	1.30±0.34	5.63±0.10	2.28	2.49
$p_T^{4\ell} > 10.00$ GeV & METsig > 1.00	29.97±0.19	502.66±2.99	84.12±0.51	3.35±0.23	0.38±0.09	1.30±0.34	5.44±0.10	2.44	2.72
$p_T^{4\ell} > 10.00$ GeV & METsig > 1.50	27.29±0.18	325.78±2.50	56.67±0.42	3.08±0.22	0.30±0.09	1.30±0.34	5.13±0.10	2.64	3.06
$p_T^{4\ell} > 10.00$ GeV & METsig > 2.00	23.97±0.17	189.75±2.02	34.03±0.33	2.79±0.21	0.23±0.08	1.22±0.33	4.75±0.10	2.84	3.49
$p_T^{4\ell} > 10.00$ GeV & METsig > 2.50	20.24±0.16	100.90±1.48	18.64±0.24	2.49±0.20	0.03±0.04	0.99±0.30	4.26±0.09	2.98	3.98
$p_T^{4\ell} > 10.00$ GeV & METsig > 3.00	16.57±0.14	49.67±1.21	9.66±0.17	2.19±0.19	0.01±0.03	0.99±0.30	3.75±0.08	3.02	4.52
$p_T^{4\ell} > 10.00$ GeV & METsig > 3.50	13.06±0.13	23.14±1.03	4.72±0.12	1.92±0.17	0.01±0.03	0.83±0.28	3.29±0.08	2.92	4.98
$p_T^{4\ell} > 10.00$ GeV & METsig > 4.00	9.95±0.11	9.81±0.91	2.17±0.08	1.68±0.16	0.01±0.03	0.74±0.27	2.90±0.07	2.71	5.31
$p_T^{4\ell} > 10.00$ GeV & METsig > 4.50	7.36±0.10	4.51±0.27	0.97±0.05	1.41±0.15	0.00±0.03	0.50±0.20	2.52±0.07	2.40	5.19
$p_T^{4\ell} > 10.00$ GeV & METsig > 5.00	5.35±0.08	1.96±0.18	0.41±0.04	1.26±0.13	0.00±0.03	0.50±0.20	2.15±0.06	2.08	4.74
$p_T^{4\ell} > 20.00$ GeV & METsig > 0.00	30.64±0.19	717.49±3.87	113.74±0.60	3.44±0.23	0.56±0.11	1.30±0.34	5.56±0.10	2.16	2.34
$p_T^{4\ell} > 20.00$ GeV & METsig > 0.50	30.14±0.19	640.55±3.73	103.10±0.57	3.39±0.23	0.47±0.11	1.30±0.34	5.51±0.10	2.23	2.44
$p_T^{4\ell} > 20.00$ GeV & METsig > 1.00	28.53±0.19	473.15±2.90	79.20±0.50	3.32±0.23	0.38±0.09	1.30±0.34	5.32±0.10	2.39	2.67
$p_T^{4\ell} > 20.00$ GeV & METsig > 1.50	25.93±0.18	304.54±2.42	53.03±0.41	3.05±0.22	0.30±0.09	1.30±0.34	5.03±0.10	2.59	3.00
$p_T^{4\ell} > 20.00$ GeV & METsig > 2.00	22.79±0.17	175.33±1.95	31.65±0.31	2.77±0.21	0.23±0.08	1.22±0.33	4.66±0.09	2.79	3.44
$p_T^{4\ell} > 20.00$ GeV & METsig > 2.50	19.25±0.15	92.26±1.43	17.24±0.23	2.48±0.20	0.03±0.04	0.99±0.30	4.18±0.09	2.93	3.95
$p_T^{4\ell} > 20.00$ GeV & METsig > 3.00	15.81±0.14	44.72±1.17	8.90±0.17	2.20±0.19	0.01±0.03	0.99±0.30	3.69±0.08	2.98	4.51
$p_T^{4\ell} > 20.00$ GeV & METsig > 3.50	12.50±0.12	20.82±1.00	4.32±0.12	1.93±0.17	0.01±0.03	0.83±0.28	3.25±0.08	2.88	4.97
$p_T^{4\ell} > 20.00$ GeV & METsig > 4.00	9.55±0.11	8.63±0.90	1.95±0.08	1.69±0.16	0.01±0.03	0.74±0.27	2.87±0.07	2.67	5.32
$p_T^{4\ell} > 20.00$ GeV & METsig > 4.50	7.15±0.09	4.07±0.25	0.86±0.05	1.41±0.15	0.00±0.03	0.50±0.20	2.50±0.07	2.38	5.19
$p_T^{4\ell} > 20.00$ GeV & METsig > 5.00	5.21±0.08	1.84±0.17	0.36±0.03	1.25±0.13	0.00±0.03	0.50±0.20	2.13±0.06	2.05	4.69
$p_T^{4\ell} > 30.00$ GeV & METsig > 0.00	28.32±0.19	660.79±3.66	102.60±0.57	3.36±0.23	0.52±0.11	1.21±0.33	5.38±0.10	2.08	2.26
$p_T^{4\ell} > 30.00$ GeV & METsig > 0.50	27.84±0.19	588.60±3.53	92.82±0.54	3.31±0.23	0.45±0.10	1.21±0.33	5.33±0.10	2.15	2.35
$p_T^{4\ell} > 30.00$ GeV & METsig > 1.00	26.30±0.18	432.73±2.70	70.99±0.47	3.24±0.22	0.38±0.09	1.21±0.33	5.15±0.10	2.30	2.58
$p_T^{4\ell} > 30.00$ GeV & METsig > 1.50	23.87±0.17	275.68±2.26	47.18±0.38	2.98±0.22	0.30±0.09	1.21±0.33	4.87±0.10	2.50	2.91
$p_T^{4\ell} > 30.00$ GeV & METsig > 2.00	20.94±0.16	157.46±1.83	27.95±0.30	2.71±0.21	0.23±0.08	1.13±0.32	4.51±0.09	2.70	3.34
$p_T^{4\ell} > 30.00$ GeV & METsig > 2.50	17.66±0.15	81.79±1.33	15.08±0.22	2.42±0.20	0.03±0.04	0.99±0.30	4.06±0.09	2.83	3.84
$p_T^{4\ell} > 30.00$ GeV & METsig > 3.00	14.52±0.13	39.24±1.11	7.70±0.15	2.14±0.18	0.01±0.03	0.99±0.30	3.60±0.08	2.88	4.40

RSH-signal optimisation

$p_{\mathrm{T}}^{4\ell}$ and Metsig scan for one or more central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.00	2358.82±0.00	330.25±0.00	4.45±0.00	2.38±0.00	1.94±0.00	12.96±0.00	2.48	2.61
$N_{\mathrm{Cjet}} \geq 1$	32.68±0.20	776.71±3.99	121.91±0.62	3.46±0.23	0.56±0.11	1.30±0.34	5.74±0.11	2.22	2.41
$p_{\mathrm{T}}^{4\ell} > 30.00$ GeV & METsig > 3.50	11.53±0.12	17.88±0.96	3.71±0.11	1.89±0.17	0.01±0.03	0.83±0.28	3.17±0.08	2.79	4.88
$p_{\mathrm{T}}^{4\ell} > 30.00$ GeV & METsig > 4.00	8.91±0.10	7.27±0.88	1.64±0.07	1.66±0.16	0.01±0.03	0.74±0.27	2.81±0.07	2.60	5.26
$p_{\mathrm{T}}^{4\ell} > 30.00$ GeV & METsig > 4.50	6.75±0.09	3.38±0.21	0.73±0.05	1.38±0.14	0.00±0.03	0.50±0.20	2.45±0.07	2.32	5.15
$p_{\mathrm{T}}^{4\ell} > 30.00$ GeV & METsig > 5.00	4.98±0.08	1.52±0.15	0.30±0.03	1.24±0.13	0.00±0.03	0.50±0.20	2.09±0.06	2.01	4.66
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 0.00	25.48±0.18	582.02±2.83	88.65±0.53	3.26±0.23	0.45±0.10	1.21±0.33	5.10±0.10	1.99	2.17
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 0.50	25.04±0.18	517.60±2.69	80.06±0.50	3.21±0.22	0.38±0.09	1.21±0.33	5.06±0.10	2.06	2.25
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 1.00	23.64±0.17	380.53±2.34	61.15±0.44	3.15±0.22	0.33±0.08	1.21±0.33	4.89±0.10	2.20	2.47
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 1.50	21.46±0.16	240.71±1.94	40.20±0.35	2.90±0.21	0.25±0.07	1.21±0.33	4.62±0.09	2.39	2.80
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 2.00	18.83±0.15	136.43±1.55	23.61±0.27	2.63±0.20	0.23±0.07	1.13±0.32	4.30±0.09	2.59	3.22
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 2.50	15.95±0.14	69.88±1.23	12.62±0.20	2.36±0.19	0.06±0.03	0.99±0.30	3.87±0.09	2.73	3.74
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 3.00	13.15±0.13	33.00±1.05	6.42±0.14	2.09±0.18	0.03±0.03	0.99±0.30	3.45±0.08	2.77	4.31
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 3.50	10.52±0.11	15.05±0.93	3.07±0.10	1.84±0.17	0.03±0.03	0.83±0.28	3.05±0.07	2.68	4.78
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 4.00	8.26±0.10	5.99±0.86	1.36±0.06	1.63±0.15	0.03±0.03	0.74±0.27	2.72±0.07	2.51	5.19
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 4.50	6.34±0.09	2.83±0.19	0.63±0.04	1.37±0.14	0.03±0.03	0.50±0.20	2.39±0.07	2.25	5.06
$p_{\mathrm{T}}^{4\ell} > 40.00$ GeV & METsig > 5.00	4.77±0.08	1.27±0.13	0.26±0.03	1.23±0.13	0.03±0.03	0.50±0.20	2.04±0.06	1.97	4.59
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 0.00	22.44±0.17	497.49±2.46	73.83±0.48	3.11±0.22	0.37±0.09	1.13±0.32	4.85±0.10	1.89	2.07
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 0.50	22.03±0.17	442.01±2.33	66.64±0.46	3.07±0.22	0.30±0.08	1.13±0.32	4.80±0.10	1.95	2.15
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 1.00	20.82±0.16	323.20±2.05	50.75±0.40	3.02±0.22	0.25±0.07	1.13±0.32	4.65±0.09	2.10	2.36
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 1.50	18.91±0.15	202.82±1.69	33.16±0.32	2.80±0.21	0.19±0.06	1.13±0.32	4.40±0.09	2.28	2.68
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 2.00	16.64±0.14	114.10±1.38	19.31±0.25	2.53±0.20	0.18±0.06	1.05±0.31	4.12±0.09	2.47	3.11
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 2.50	14.17±0.13	58.12±1.14	10.31±0.18	2.27±0.19	0.03±0.03	0.91±0.29	3.71±0.08	2.61	3.62
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 3.00	11.78±0.12	27.07±0.99	5.15±0.13	2.01±0.18	0.03±0.03	0.91±0.29	3.31±0.08	2.66	4.21
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 3.50	9.51±0.11	12.34±0.90	2.45±0.09	1.76±0.16	0.03±0.03	0.75±0.27	2.94±0.07	2.58	4.69
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 4.00	7.56±0.10	4.69±0.85	1.09±0.06	1.55±0.15	0.03±0.03	0.66±0.25	2.63±0.07	2.43	5.14
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 4.50	5.90±0.09	2.34±0.16	0.52±0.04	1.28±0.14	0.03±0.03	0.41±0.18	2.32±0.06	2.18	4.99
$p_{\mathrm{T}}^{4\ell} > 50.00$ GeV & METsig > 5.00	4.51±0.07	1.11±0.12	0.21±0.03	1.16±0.13	0.03±0.03	0.41±0.18	2.00±0.06	1.92	4.51
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 0.00	19.33±0.15	422.91±2.03	60.23±0.44	2.93±0.21	0.31±0.08	1.04±0.31	4.59±0.09	1.77	1.93
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 0.50	18.98±0.15	375.26±1.92	54.41±0.41	2.89±0.21	0.28±0.08	1.04±0.31	4.55±0.09	1.83	2.01
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 1.00	17.97±0.15	273.87±1.65	41.37±0.36	2.85±0.21	0.23±0.07	1.04±0.31	4.41±0.09	1.96	2.22
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 1.50	16.42±0.14	171.17±1.29	26.93±0.29	2.64±0.20	0.17±0.06	1.04±0.31	4.19±0.09	2.15	2.54
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 2.00	14.55±0.13	95.75±0.97	15.56±0.22	2.38±0.19	0.16±0.06	0.96±0.30	3.93±0.09	2.34	2.96
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 2.50	12.47±0.12	48.79±0.69	8.20±0.16	2.10±0.19	0.03±0.03	0.82±0.28	3.55±0.08	2.48	3.47
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 3.00	10.48±0.11	22.96±0.49	4.06±0.11	1.85±0.17	0.03±0.03	0.82±0.28	3.17±0.08	2.53	4.05
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 3.50	8.57±0.10	10.76±0.33	1.94±0.08	1.62±0.16	0.03±0.03	0.65±0.25	2.82±0.07	2.45	4.50
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 4.00	6.95±0.09	4.49±0.21	0.86±0.05	1.43±0.15	0.03±0.03	0.57±0.24	2.54±0.07	2.32	4.90
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 4.50	5.52±0.08	1.87±0.14	0.40±0.04	1.18±0.14	0.03±0.03	0.41±0.18	2.24±0.06	2.12	4.95
$p_{\mathrm{T}}^{4\ell} > 60.00$ GeV & METsig > 5.00	4.30±0.07	0.93±0.10	0.17±0.02	1.10±0.13	0.03±0.03	0.41±0.18	1.93±0.06	1.88	4.46

RSH-signal optimisation

A narrow 2D scan for zero and one or more central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.590	2.733
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.480	2.614
$N_{\text{Cjet}} = 0$	28.64±0.19	1582.11±6.15	208.34±0.81	0.99±0.10	1.82±0.20	0.65±0.23	7.22±0.10	1.442	1.498
$p_T^{4\ell} > 20.00$ GeV & METsig > 1.50	20.45±0.16	295.80±3.18	64.71±0.45	0.90±0.09	1.01±0.15	0.57±0.22	6.29±0.09	2.094	2.362
$p_T^{4\ell} > 20.00$ GeV & METsig > 1.75	18.81±0.15	238.50±2.79	52.95±0.41	0.87±0.09	0.92±0.14	0.49±0.20	6.12±0.09	2.107	2.411
$p_T^{4\ell} > 20.00$ GeV & METsig > 2.00	16.99±0.15	190.43±2.43	42.29±0.36	0.81±0.09	0.76±0.13	0.40±0.18	5.93±0.09	2.094	2.431
$p_T^{4\ell} > 25.00$ GeV & METsig > 1.50	19.01±0.15	223.74±2.60	51.27±0.40	0.89±0.09	0.86±0.14	0.57±0.22	6.16±0.09	2.173	2.506
$p_T^{4\ell} > 25.00$ GeV & METsig > 1.75	17.56±0.15	181.96±2.21	42.37±0.37	0.86±0.09	0.79±0.13	0.49±0.20	6.00±0.09	2.183	2.557
$p_T^{4\ell} > 25.00$ GeV & METsig > 2.00	15.92±0.14	145.89±1.93	34.04±0.33	0.81±0.09	0.67±0.12	0.40±0.18	5.84±0.09	2.166	2.580
$p_T^{4\ell} > 30.00$ GeV & METsig > 1.50	16.91±0.14	166.63±2.18	40.16±0.36	0.87±0.09	0.76±0.13	0.49±0.20	5.96±0.09	2.173	2.560
$p_T^{4\ell} > 30.00$ GeV & METsig > 1.75	15.72±0.14	136.74±1.82	33.33±0.32	0.84±0.09	0.72±0.13	0.49±0.20	5.82±0.09	2.184	2.616
$p_T^{4\ell} > 30.00$ GeV & METsig > 2.00	14.31±0.13	110.37±1.58	26.88±0.29	0.79±0.09	0.59±0.12	0.40±0.18	5.68±0.09	2.165	2.640

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.590	2.733
B-veto	61.32±0.00	2358.82±0.00	330.25±0.00	4.45±0.00	2.38±0.00	1.94±0.00	12.96±0.00	2.480	2.614
$N_{\text{Cjet}} \geq 1$	32.68±0.20	776.71±3.99	121.91±0.62	3.46±0.23	0.56±0.11	1.30±0.34	5.74±0.11	2.217	2.405
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.00	24.40±0.17	197.57±2.04	34.76±0.33	2.77±0.21	0.23±0.08	1.22±0.33	4.78±0.10	2.848	3.486
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.25	22.54±0.17	145.84±1.83	26.18±0.29	2.65±0.21	0.14±0.06	1.13±0.32	4.55±0.09	2.930	3.723
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.50	20.58±0.16	105.50±1.50	19.09±0.24	2.48±0.20	0.03±0.04	0.99±0.30	4.29±0.09	2.987	3.970
$p_T^{4\ell} > 0.00$ GeV & METsig > 2.75	18.72±0.15	74.65±1.35	13.85±0.21	2.37±0.20	0.03±0.04	0.99±0.30	4.04±0.09	3.029	4.241
$p_T^{4\ell} > 0.00$ GeV & METsig > 3.00	16.83±0.14	52.18±1.22	9.90±0.18	2.19±0.19	0.01±0.03	0.99±0.30	3.78±0.08	3.030	4.494
$p_T^{4\ell} > 10.00$ GeV & METsig > 2.00	23.97±0.17	189.75±2.02	34.03±0.33	2.79±0.21	0.23±0.08	1.22±0.33	4.75±0.10	2.840	3.487
$p_T^{4\ell} > 10.00$ GeV & METsig > 2.25	22.15±0.17	139.69±1.80	25.60±0.28	2.66±0.21	0.14±0.06	1.13±0.32	4.52±0.09	2.923	3.729
$p_T^{4\ell} > 10.00$ GeV & METsig > 2.50	20.24±0.16	100.90±1.48	18.64±0.24	2.49±0.20	0.03±0.04	0.99±0.30	4.26±0.09	2.982	3.981
$p_T^{4\ell} > 10.00$ GeV & METsig > 2.75	18.41±0.15	71.23±1.33	13.50±0.20	2.38±0.19	0.03±0.04	0.99±0.30	4.02±0.09	3.022	4.257
$p_T^{4\ell} > 10.00$ GeV & METsig > 3.00	16.57±0.14	49.67±1.21	9.66±0.17	2.19±0.19	0.01±0.03	0.99±0.30	3.75±0.08	3.024	4.518
$p_T^{4\ell} > 5.00$ GeV & METsig > 2.00	24.30±0.17	195.02±2.03	34.62±0.33	2.78±0.21	0.23±0.08	1.22±0.33	4.77±0.10	2.849	3.491
$p_T^{4\ell} > 5.00$ GeV & METsig > 2.25	22.45±0.17	143.80±1.82	26.06±0.28	2.66±0.21	0.14±0.06	1.13±0.32	4.54±0.09	2.931	3.731
$p_T^{4\ell} > 5.00$ GeV & METsig > 2.50	20.50±0.16	104.06±1.50	18.99±0.24	2.49±0.20	0.03±0.04	0.99±0.30	4.28±0.09	2.989	3.978
$p_T^{4\ell} > 5.00$ GeV & METsig > 2.75	18.64±0.15	73.57±1.34	13.77±0.21	2.38±0.20	0.03±0.04	0.99±0.30	4.03±0.09	3.029	4.250
$p_T^{4\ell} > 5.00$ GeV & METsig > 3.00	16.76±0.14	51.41±1.22	9.83±0.17	2.19±0.19	0.01±0.03	0.99±0.30	3.77±0.08	3.029	4.504

- The total significance for both zero and one or mor central jet is 3.735 (quadrature sum)

Summary

Comparison between the jet/central jet and Metsig/$E_{\mathrm{T}}^{\mathrm{miss}}$ shows the central jet & Metsig is the best RSH-signal optimisation (See on the additional slides).

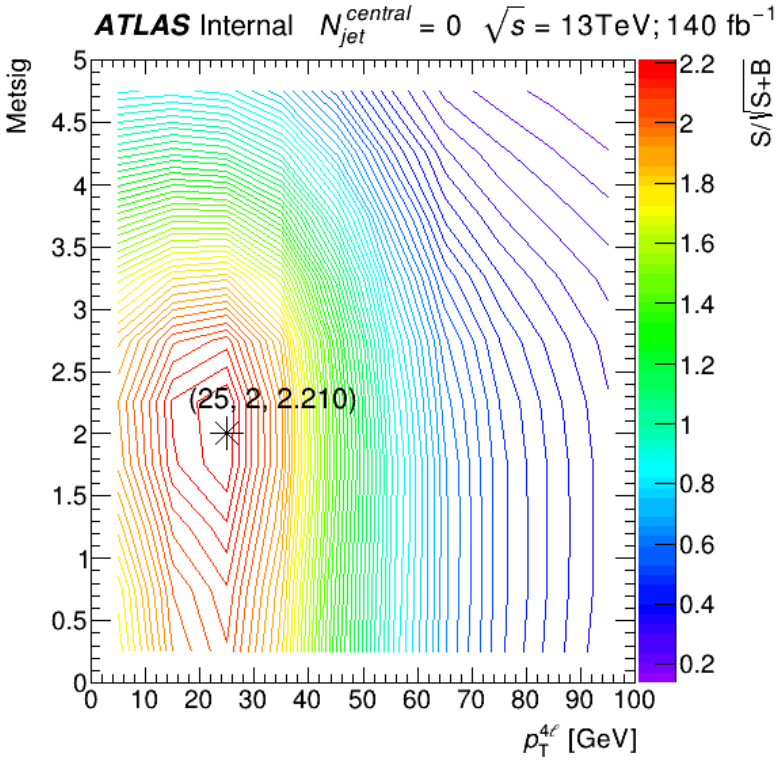
- For $= 0$ central jet: ($p_{\mathrm{T}}^{4\ell}$, Metsig, Sig) = (30 GeV, 1.75, 2.184);
- For ≥ 1 central jet: ($p_{\mathrm{T}}^{4\ell}$, Metsig, Sig) = (0 GeV, 3.0, 3.030);
- These are preliminary categories for low Met; and
- Further categories such as low, medium and high Met may be considered.

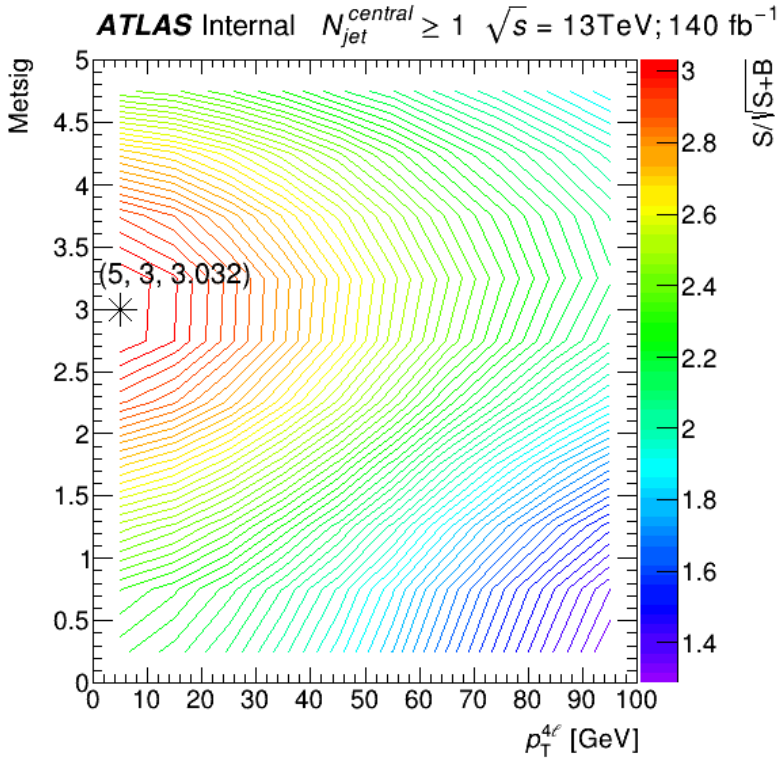
Work in progress

- Signal parametrisation
- MET re-weighting
- Background fit
- Simultaneous fit

Thank you!

Additional slides
2D mapping of $p_{\mathrm{T}}^{4\ell}$ and Metsig

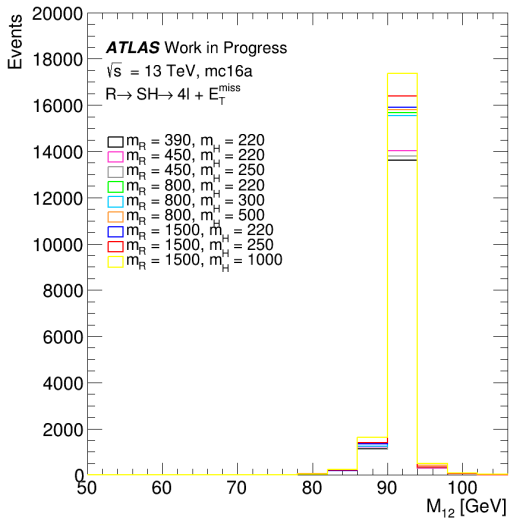


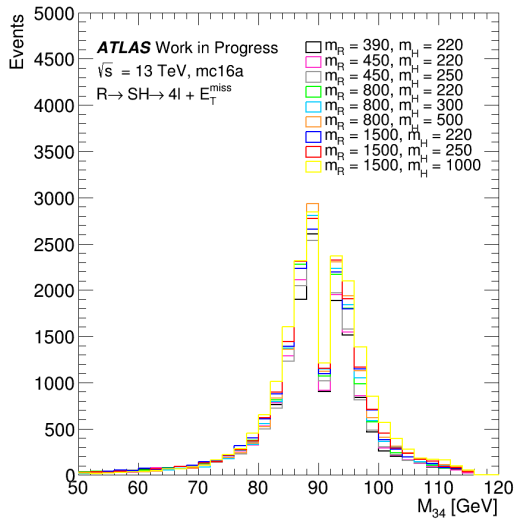


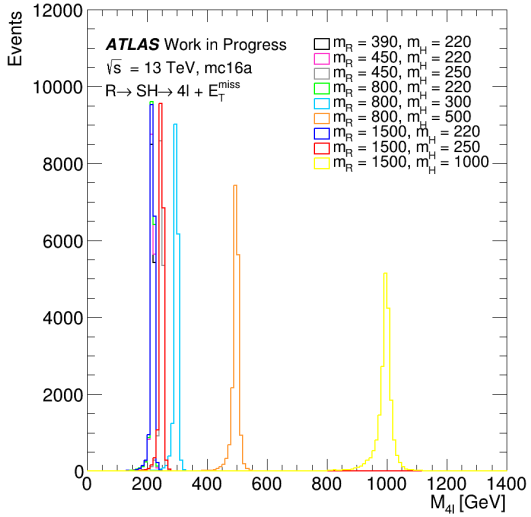
Additional slides

Event Selection	
Quadruplet Selection	- Require at least one quadruplet of leptons consisting of two pairs of same-flavour opposite-charge leptons fulfilling the following requirements: - p_T thresholds for three leading leptons in the quadruplet: 20, 15 and 10 GeV - At most 1 calo-tagged, stand-alone or silicon-associated muon per quadruplet - Leading di-lepton mass requirement: $50 < m_{12} < 106$ GeV - Sub-leading di-lepton mass requirement: $m_{\text{threshold}} < m_{34} < 115$ GeV - $\Delta R(\ell, \ell') > 0.10$ for all lepton pairs in the quadruplet - Remove quadruplet if alternative same-flavour opposite-charge di-lepton gives $m_{\ell\ell} < 5$ GeV - Keep all quadruplets passing the above selection
Isolation Needs updating	- Contribution from the other leptons of the quadruplet is subtracted - Muon track isolation ($\Delta R = 0.30$): $\Sigma p_T / p_T < 0.15$ - Muon calorimeter isolation ($\Delta R = 0.20$): $\Sigma E_T / p_T < 0.30$ - Electron track isolation ($\Delta R = 0.20$) : $\Sigma E_T / E_T < 0.15$ - Electron calorimeter isolation ($\Delta R = 0.20$) : $\Sigma E_T / E_T < 0.20$
Impact Parameter Significance	- Apply impact parameter significance cut to all leptons of the quadruplet - For electrons: $d_0/\sigma_{d_0} < 5$ - For muons: $d_0/\sigma_{d_0} < 3$
Best Quadruplet	- If more than one quadruplet has been selected, choose the quadruplet with highest Higgs decay ME according to channel: 4μ, $2e2\mu$, $2\mu2e$ and $4e$
Vertex Selection	- Require a common vertex for the leptons: - $\chi^2/\text{ndof} < 5$ for 4μ and < 9 for others decay channels

Additional slides
Kinematic distributions for the signal

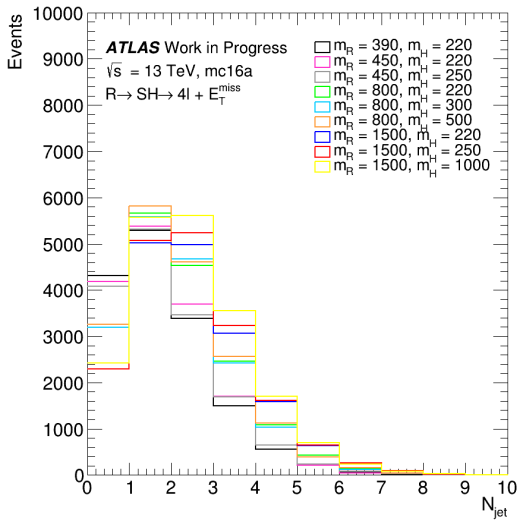


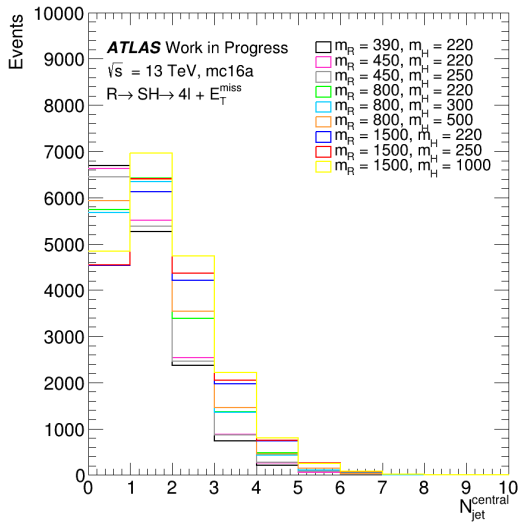


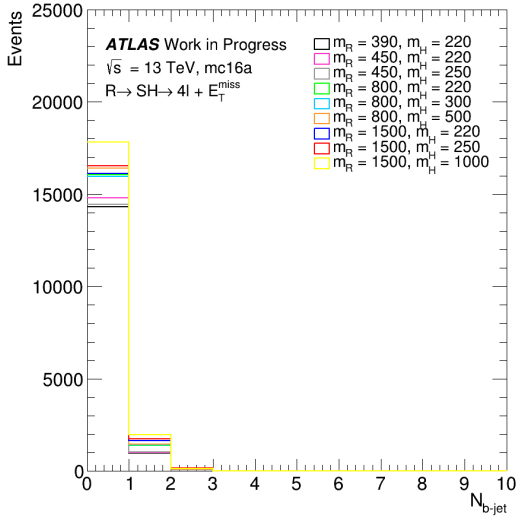


Additional slides

Kinematic distributions for the signal

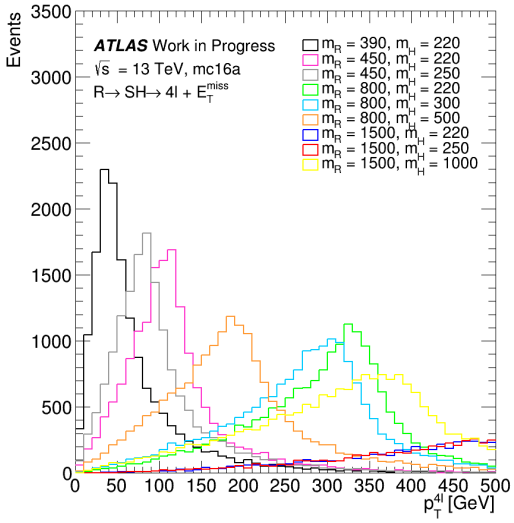


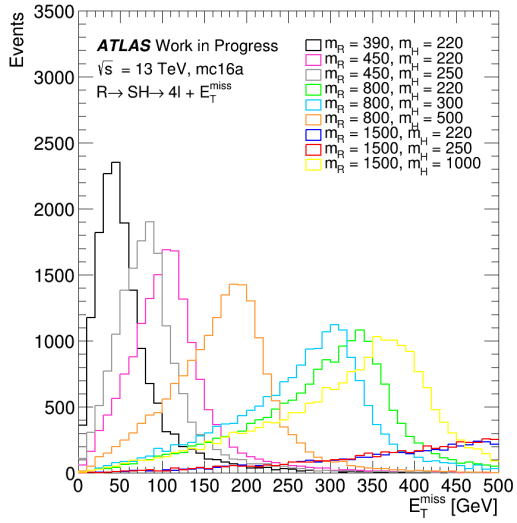


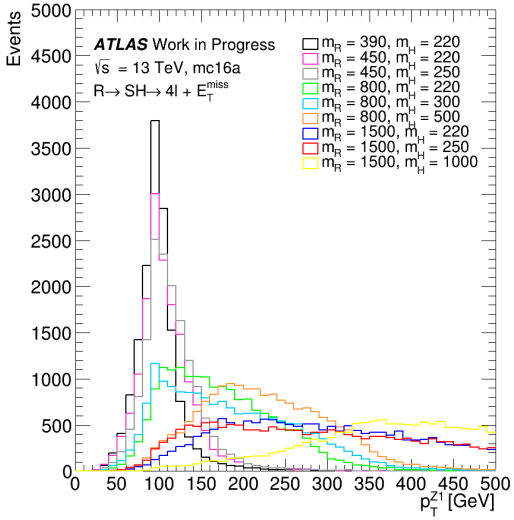


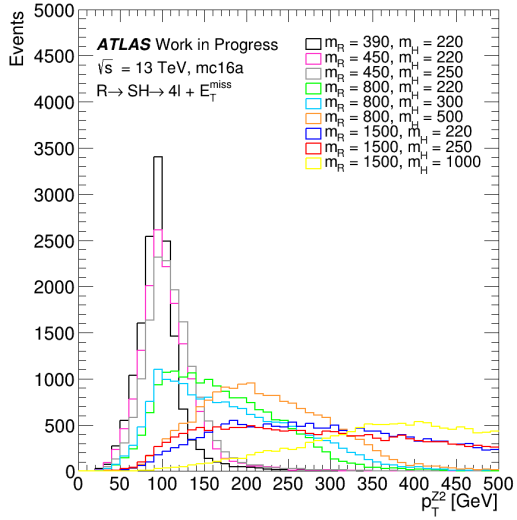
Additional slides

Kinematic distributions for the signal









Additional slides
Kinematic distributions for signal & background

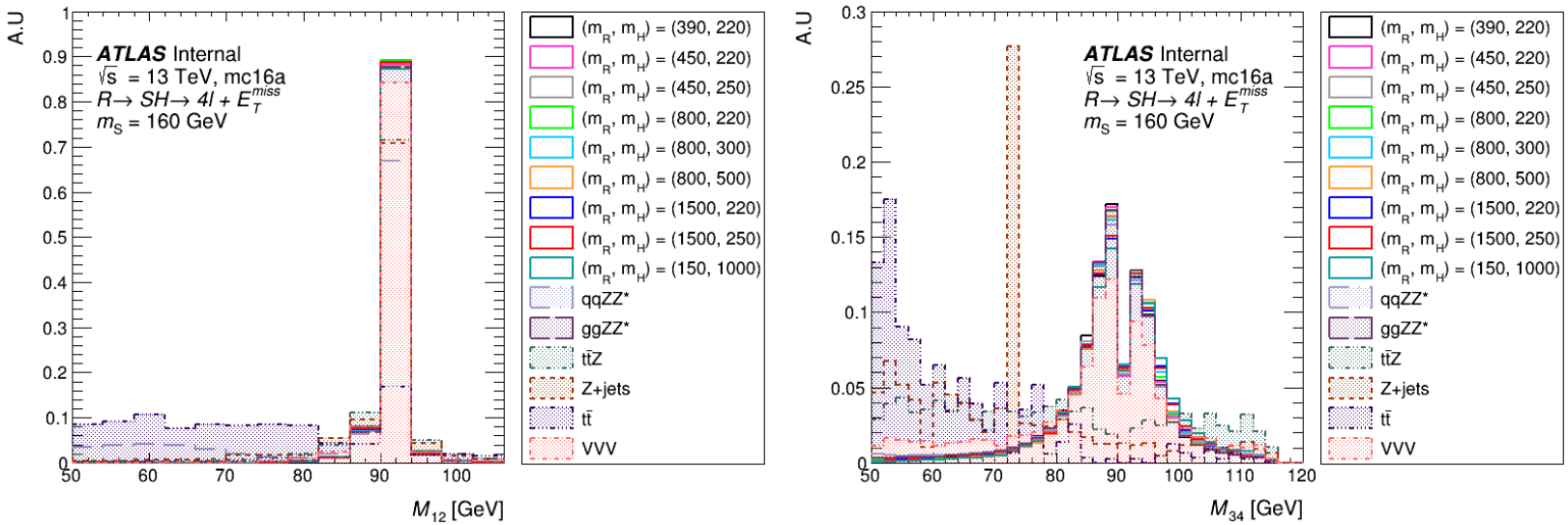


Figure: The invariant mass of the first (left) and the second (right) lepton pairs.

Additional slides
Kinematic distributions

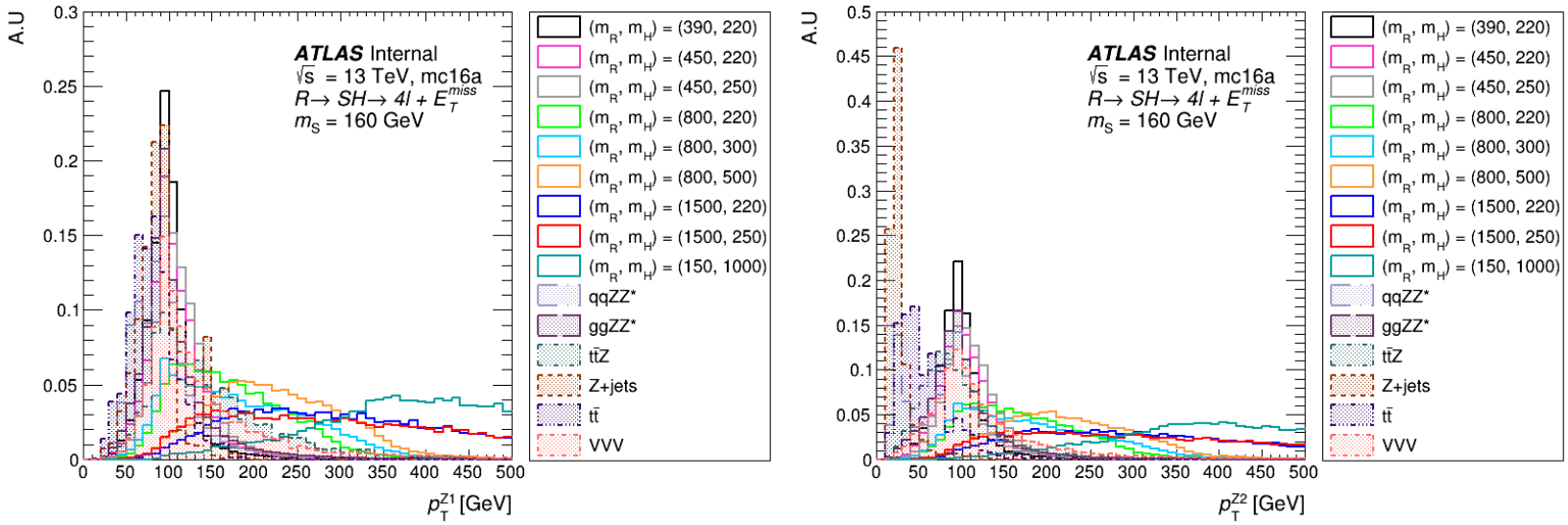
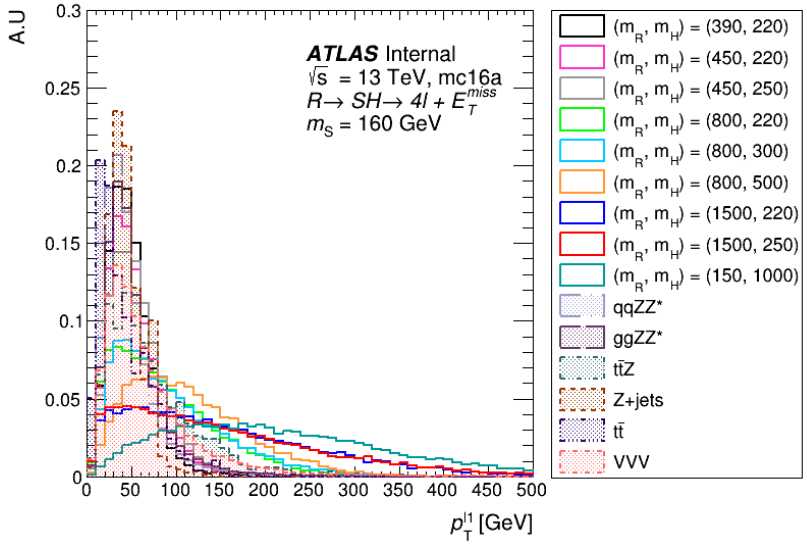
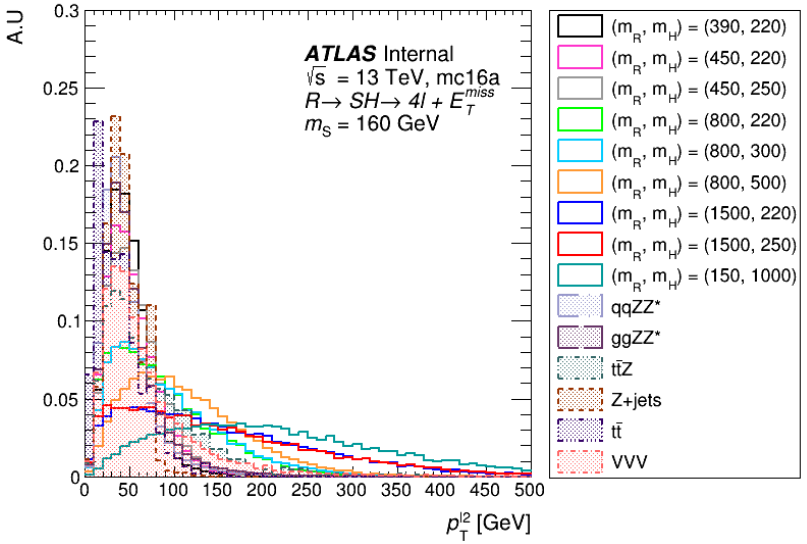
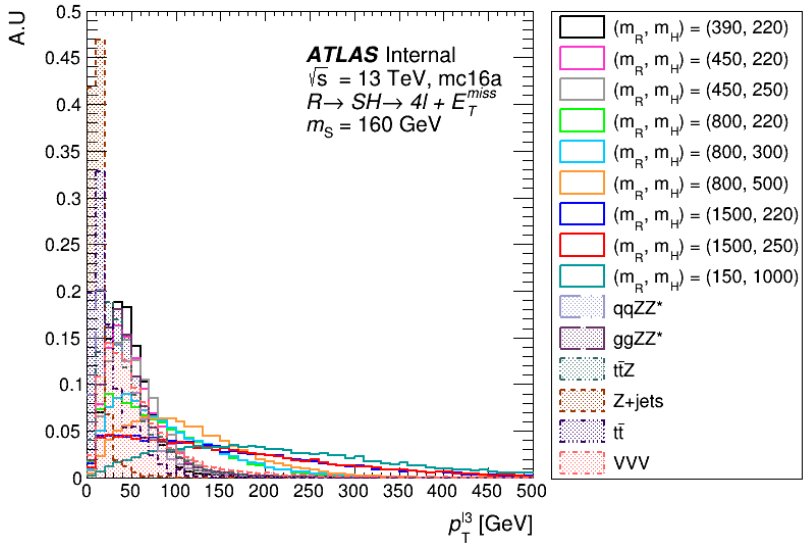


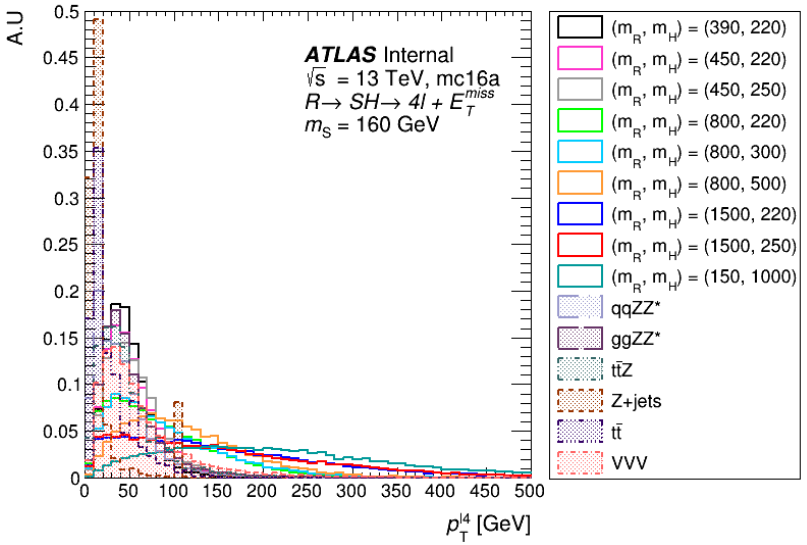
Figure: The invariant mass of the first (left) and the second (right) lepton pairs.

Additional slides
Kinematic distributions









Additional slides

$p_{\mathrm{T}}^{4\ell}$ and $E_{\mathrm{T}}^{\mathrm{miss}}$ scan for zero central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{\mathrm{Cjet}} = 0$	28.64±0.19	1582.11±6.15	208.34±0.81	0.99±0.10	1.82±0.20	0.65±0.23	7.22±0.10	1.44	1.50
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	28.64±0.19	1582.11±6.15	208.34±0.81	0.99±0.10	1.82±0.20	0.65±0.23	7.22±0.10	1.44	1.50
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	27.76±0.19	1340.84±5.70	184.65±0.76	0.98±0.09	1.67±0.19	0.65±0.23	7.11±0.10	1.51	1.57
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	24.99±0.18	958.03±4.79	137.07±0.66	0.96±0.09	1.35±0.17	0.57±0.22	6.80±0.10	1.58	1.67
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	20.74±0.16	603.46±3.81	89.74±0.53	0.94±0.09	1.01±0.15	0.48±0.20	6.38±0.09	1.62	1.74
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	15.31±0.14	349.69±2.81	53.37±0.41	0.83±0.09	0.64±0.12	0.40±0.18	5.86±0.09	1.54	1.68
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	10.20±0.11	188.73±1.98	29.02±0.30	0.72±0.08	0.37±0.09	0.40±0.18	5.29±0.09	1.37	1.51
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	6.30±0.09	98.23±1.43	14.80±0.21	0.66±0.08	0.21±0.07	0.40±0.18	4.69±0.08	1.14	1.28
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	3.76±0.07	47.62±0.97	7.24±0.15	0.53±0.07	0.16±0.06	0.21±0.13	4.10±0.08	0.94	1.08
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	2.12±0.05	22.15±0.64	3.49±0.10	0.44±0.07	0.10±0.05	0.09±0.09	3.58±0.07	0.74	0.86
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	1.20±0.04	10.53±0.43	1.64±0.07	0.40±0.06	0.10±0.05	0.09±0.09	3.11±0.07	0.57	0.67
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.65±0.03	4.90±0.29	0.76±0.05	0.32±0.05	0.02±0.02	0.09±0.09	2.66±0.06	0.42	0.49
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	27.71±0.19	1047.97±5.52	177.23±0.75	0.99±0.10	1.55±0.19	0.57±0.22	7.10±0.10	1.66	1.75
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	26.92±0.18	927.53±5.17	160.03±0.71	0.98±0.09	1.44±0.18	0.57±0.22	7.01±0.10	1.70	1.80
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	24.38±0.17	665.13±4.35	119.53±0.61	0.96±0.09	1.19±0.16	0.57±0.22	6.73±0.10	1.79	1.92
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	20.31±0.16	429.67±3.48	79.14±0.50	0.94±0.09	0.87±0.14	0.48±0.20	6.33±0.09	1.81	1.98
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	15.00±0.14	253.40±2.57	47.59±0.39	0.83±0.09	0.57±0.11	0.40±0.18	5.83±0.09	1.70	1.89
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	10.01±0.11	138.63±1.80	26.04±0.29	0.72±0.08	0.35±0.09	0.40±0.18	5.26±0.09	1.50	1.70
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	6.18±0.09	73.15±1.31	13.38±0.20	0.66±0.08	0.21±0.07	0.40±0.18	4.67±0.08	1.24	1.43
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	3.71±0.07	36.28±0.89	6.57±0.14	0.53±0.07	0.16±0.06	0.21±0.13	4.09±0.07	1.01	1.19
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	2.09±0.05	16.98±0.59	3.18±0.10	0.44±0.07	0.10±0.05	0.09±0.09	3.57±0.07	0.79	0.94
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	1.19±0.04	8.09±0.39	1.49±0.07	0.40±0.06	0.10±0.05	0.09±0.09	3.10±0.07	0.60	0.72
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.65±0.03	3.85±0.27	0.68±0.05	0.32±0.05	0.02±0.02	0.09±0.09	2.65±0.06	0.44	0.52
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	24.98±0.18	560.98±4.37	116.70±0.61	0.97±0.09	1.20±0.17	0.57±0.22	6.78±0.10	1.95	2.11
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	24.35±0.17	508.27±4.16	107.26±0.58	0.96±0.09	1.14±0.16	0.57±0.22	6.72±0.10	1.98	2.16
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	22.29±0.17	386.27±3.58	83.74±0.51	0.94±0.09	1.04±0.15	0.57±0.22	6.52±0.09	2.04	2.26
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	18.80±0.15	255.52±2.90	56.67±0.42	0.92±0.09	0.76±0.13	0.48±0.20	6.19±0.09	2.05	2.33
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	13.94±0.13	155.77±2.14	35.07±0.33	0.81±0.09	0.46±0.10	0.40±0.18	5.74±0.09	1.89	2.20
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	9.33±0.11	87.44±1.47	19.67±0.25	0.71±0.08	0.28±0.08	0.40±0.18	5.20±0.08	1.64	1.94
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	5.74±0.08	47.35±1.07	10.27±0.18	0.65±0.08	0.14±0.05	0.40±0.18	4.65±0.08	1.33	1.60
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	3.41±0.06	24.19±0.73	5.06±0.13	0.52±0.07	0.09±0.04	0.21±0.13	4.07±0.07	1.06	1.29
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	1.94±0.05	11.82±0.48	2.52±0.09	0.43±0.07	0.05±0.03	0.09±0.09	3.57±0.07	0.81	1.00
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	1.09±0.04	5.49±0.33	1.19±0.06	0.39±0.06	0.05±0.03	0.09±0.09	3.10±0.07	0.61	0.76
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.59±0.03	2.70±0.22	0.53±0.04	0.31±0.05	0.02±0.02	0.09±0.09	2.65±0.06	0.43	0.52
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	20.20±0.16	306.80±2.95	69.12±0.47	0.93±0.09	0.87±0.14	0.49±0.20	6.30±0.09	2.04	2.29
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	19.77±0.16	279.66±2.82	64.10±0.45	0.91±0.09	0.83±0.14	0.49±0.20	6.26±0.09	2.07	2.34
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	18.32±0.15	218.73±2.50	51.98±0.40	0.90±0.09	0.81±0.13	0.49±0.20	6.13±0.09	2.12	2.43
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	15.85±0.14	151.09±2.02	36.70±0.34	0.89±0.09	0.61±0.12	0.40±0.18	5.91±0.09	2.13	2.51
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	12.00±0.12	93.75±1.40	23.23±0.27	0.79±0.09	0.39±0.09	0.40±0.18	5.54±0.09	1.97	2.39
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	8.07±0.10	53.87±1.05	13.61±0.21	0.69±0.08	0.26±0.08	0.40±0.18	5.08±0.08	1.68	2.08

Additional slides

$p_T^{4\ell}$ and E_T^{miss} scan for zero central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{Cjet} = 0$	28.64±0.19	1582.11±6.15	208.34±0.81	0.99±0.10	1.82±0.20	0.65±0.23	7.22±0.10	1.44	1.50
$p_T^{4\ell} > 30.00$ & $E_T^{miss} > 60.00$ GeV	5.01±0.08	30.02±0.75	7.28±0.15	0.64±0.08	0.14±0.05	0.40±0.18	4.58±0.08	1.35	1.69
$p_T^{4\ell} > 30.00$ & $E_T^{miss} > 70.00$ GeV	2.99±0.06	15.89±0.53	3.64±0.11	0.51±0.07	0.09±0.04	0.21±0.13	4.04±0.07	1.06	1.34
$p_T^{4\ell} > 30.00$ & $E_T^{miss} > 80.00$ GeV	1.70±0.05	8.17±0.36	1.85±0.08	0.43±0.07	0.05±0.03	0.09±0.09	3.55±0.07	0.80	1.01
$p_T^{4\ell} > 30.00$ & $E_T^{miss} > 90.00$ GeV	0.97±0.03	4.02±0.24	0.91±0.05	0.39±0.06	0.05±0.03	0.09±0.09	3.08±0.07	0.59	0.74
$p_T^{4\ell} > 30.00$ & $E_T^{miss} > 100.00$ GeV	0.52±0.03	1.87±0.17	0.41±0.04	0.31±0.05	0.02±0.02	0.09±0.09	2.64±0.06	0.41	0.50
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 0.00$ GeV	13.66±0.13	164.79±1.84	39.99±0.36	0.89±0.09	0.47±0.10	0.39±0.18	5.69±0.09	1.81	2.08
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 10.00$ GeV	13.41±0.13	151.54±1.74	37.26±0.34	0.87±0.09	0.47±0.10	0.39±0.18	5.67±0.09	1.84	2.12
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 20.00$ GeV	12.47±0.12	120.21±1.52	30.67±0.31	0.86±0.09	0.47±0.10	0.39±0.18	5.61±0.09	1.87	2.20
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 30.00$ GeV	10.96±0.12	86.25±1.24	22.39±0.27	0.84±0.09	0.38±0.09	0.30±0.16	5.47±0.09	1.87	2.26
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 40.00$ GeV	8.73±0.10	55.08±0.96	14.63±0.21	0.75±0.08	0.29±0.08	0.30±0.16	5.25±0.09	1.77	2.22
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 50.00$ GeV	6.03±0.09	32.14±0.72	8.86±0.17	0.66±0.08	0.16±0.06	0.30±0.16	4.87±0.08	1.53	1.95
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 60.00$ GeV	3.80±0.07	18.76±0.54	4.84±0.12	0.61±0.08	0.09±0.04	0.30±0.16	4.45±0.08	1.22	1.56
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 70.00$ GeV	2.37±0.05	10.59±0.39	2.47±0.09	0.49±0.07	0.07±0.04	0.21±0.13	3.97±0.07	0.97	1.25
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 80.00$ GeV	1.36±0.04	5.59±0.28	1.23±0.06	0.42±0.07	0.03±0.02	0.09±0.09	3.51±0.07	0.72	0.92
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 90.00$ GeV	0.77±0.03	3.11±0.19	0.63±0.04	0.39±0.06	0.03±0.02	0.09±0.09	3.06±0.06	0.51	0.63
$p_T^{4\ell} > 40.00$ & $E_T^{miss} > 100.00$ GeV	0.42±0.02	1.55±0.13	0.31±0.03	0.31±0.05	0.00±0.00	0.09±0.09	2.63±0.06	0.36	0.43
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 0.00$ GeV	7.39±0.10	92.53±1.23	23.15±0.27	0.82±0.09	0.34±0.09	0.30±0.16	5.14±0.08	1.30	1.48
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 10.00$ GeV	7.22±0.09	85.85±1.18	21.58±0.26	0.80±0.09	0.34±0.09	0.30±0.16	5.13±0.08	1.31	1.50
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 20.00$ GeV	6.69±0.09	69.21±1.01	17.86±0.24	0.79±0.08	0.34±0.09	0.30±0.16	5.10±0.08	1.32	1.54
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 30.00$ GeV	5.88±0.09	50.27±0.82	13.11±0.20	0.76±0.08	0.27±0.08	0.30±0.16	5.02±0.08	1.31	1.56
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 40.00$ GeV	4.79±0.08	32.77±0.66	8.72±0.17	0.68±0.08	0.22±0.07	0.30±0.16	4.88±0.08	1.26	1.54
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 50.00$ GeV	3.58±0.07	20.41±0.51	5.46±0.13	0.61±0.08	0.14±0.05	0.30±0.16	4.62±0.08	1.13	1.42
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 60.00$ GeV	2.35±0.05	12.13±0.39	3.10±0.10	0.58±0.08	0.09±0.04	0.30±0.16	4.29±0.08	0.92	1.15
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 70.00$ GeV	1.51±0.04	7.12±0.29	1.64±0.07	0.47±0.07	0.07±0.04	0.21±0.13	3.88±0.07	0.73	0.91
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 80.00$ GeV	0.89±0.03	3.84±0.21	0.82±0.05	0.42±0.06	0.03±0.02	0.09±0.09	3.44±0.07	0.55	0.67
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 90.00$ GeV	0.53±0.03	2.24±0.14	0.42±0.04	0.38±0.06	0.03±0.02	0.09±0.09	3.03±0.06	0.39	0.47
$p_T^{4\ell} > 50.00$ & $E_T^{miss} > 100.00$ GeV	0.31±0.02	1.14±0.10	0.21±0.02	0.29±0.05	0.00±0.00	0.09±0.09	2.62±0.06	0.29	0.33
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 0.00$ GeV	3.93±0.07	56.19±0.90	13.71±0.21	0.73±0.08	0.20±0.07	0.27±0.15	4.55±0.08	0.90	1.00
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 10.00$ GeV	3.84±0.07	52.00±0.86	12.85±0.20	0.72±0.08	0.20±0.07	0.27±0.15	4.54±0.08	0.90	1.01
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 20.00$ GeV	3.53±0.07	41.55±0.74	10.65±0.18	0.71±0.08	0.20±0.07	0.27±0.15	4.53±0.08	0.90	1.03
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 30.00$ GeV	3.06±0.06	30.67±0.59	7.91±0.16	0.69±0.08	0.18±0.06	0.27±0.15	4.49±0.08	0.88	1.02
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 40.00$ GeV	2.51±0.06	20.57±0.48	5.29±0.13	0.63±0.08	0.15±0.06	0.27±0.15	4.40±0.08	0.84	0.99
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 50.00$ GeV	1.98±0.05	12.93±0.37	3.44±0.10	0.58±0.08	0.09±0.04	0.27±0.15	4.23±0.08	0.78	0.94
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 60.00$ GeV	1.37±0.04	7.80±0.29	1.99±0.08	0.57±0.08	0.07±0.04	0.27±0.15	4.02±0.07	0.66	0.79
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 70.00$ GeV	0.93±0.03	4.75±0.21	1.11±0.06	0.46±0.07	0.07±0.04	0.17±0.12	3.69±0.07	0.54	0.65
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 80.00$ GeV	0.58±0.03	2.66±0.15	0.59±0.04	0.40±0.06	0.03±0.02	0.09±0.09	3.33±0.07	0.41	0.49
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 90.00$ GeV	0.37±0.02	1.71±0.12	0.31±0.03	0.36±0.06	0.03±0.02	0.09±0.09	2.97±0.06	0.31	0.35
$p_T^{4\ell} > 60.00$ & $E_T^{miss} > 100.00$ GeV	0.25±0.02	0.96±0.08	0.17±0.02	0.28±0.05	0.00±0.00	0.09±0.09	2.59±0.06	0.24	0.27

Additional slides

$p_{\mathrm{T}}^{4\ell}$ and $E_{\mathrm{T}}^{\mathrm{miss}}$ scan for one or more central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{\mathrm{Cjet}} \geq 1$	32.68±0.19	776.71±6.15	121.91±0.81	3.46±0.10	0.56±0.20	1.30±0.23	5.74±0.10	2.22	2.41
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	32.68±0.19	776.71±6.15	121.91±0.81	3.46±0.10	0.56±0.20	1.30±0.23	5.74±0.10	2.22	2.41
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	32.11±0.19	699.06±5.70	111.29±0.76	3.42±0.09	0.47±0.19	1.30±0.23	5.69±0.10	2.28	2.49
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	30.40±0.18	534.26±4.79	87.26±0.66	3.32±0.09	0.38±0.17	1.30±0.22	5.52±0.10	2.41	2.68
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	27.59±0.16	364.50±3.81	60.72±0.53	3.11±0.09	0.30±0.15	1.30±0.20	5.27±0.09	2.56	2.94
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	24.23±0.14	225.64±2.81	38.50±0.41	2.97±0.09	0.16±0.12	1.22±0.18	4.94±0.09	2.71	3.25
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	20.57±0.11	130.91±1.98	22.70±0.30	2.70±0.08	0.05±0.09	0.99±0.18	4.54±0.09	2.81	3.59
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	17.11±0.09	73.40±1.43	12.71±0.21	2.49±0.08	0.01±0.07	0.99±0.18	4.09±0.08	2.85	3.92
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	14.05±0.07	38.36±0.97	6.89±0.15	2.18±0.07	0.01±0.06	0.82±0.13	3.62±0.08	2.83	4.33
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	11.32±0.05	20.64±0.64	3.59±0.10	1.94±0.07	0.01±0.05	0.65±0.09	3.27±0.07	2.71	4.58
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	9.08±0.04	10.47±0.43	1.80±0.07	1.73±0.06	0.03±0.05	0.57±0.09	2.93±0.07	2.56	4.82
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	7.40±0.03	5.45±0.29	0.92±0.05	1.46±0.05	0.03±0.02	0.48±0.09	2.62±0.06	2.39	4.96
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	32.17±0.19	756.97±5.52	120.08±0.75	3.48±0.10	0.56±0.19	1.30±0.22	5.69±0.10	2.21	2.40
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	31.60±0.18	680.91±5.17	109.59±0.71	3.43±0.09	0.47±0.18	1.30±0.22	5.65±0.10	2.27	2.48
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	29.91±0.17	519.30±4.35	85.85±0.61	3.33±0.09	0.38±0.16	1.30±0.22	5.48±0.10	2.40	2.68
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	27.14±0.16	353.42±3.48	59.68±0.50	3.13±0.09	0.30±0.14	1.30±0.20	5.23±0.09	2.55	2.93
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	23.83±0.14	218.62±2.57	37.84±0.39	2.98±0.09	0.16±0.11	1.22±0.18	4.91±0.09	2.70	3.24
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	20.28±0.11	126.73±1.80	22.31±0.29	2.71±0.08	0.05±0.09	0.99±0.18	4.51±0.09	2.81	3.59
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	16.89±0.09	70.99±1.31	12.50±0.20	2.49±0.08	0.01±0.07	0.99±0.18	4.07±0.08	2.84	3.93
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	13.89±0.07	37.21±0.89	6.78±0.14	2.19±0.07	0.01±0.06	0.82±0.13	3.61±0.07	2.83	4.33
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	11.23±0.05	20.06±0.59	3.53±0.10	1.96±0.07	0.01±0.05	0.65±0.09	3.26±0.07	2.71	4.59
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	9.04±0.04	10.21±0.39	1.77±0.07	1.74±0.06	0.03±0.05	0.57±0.09	2.92±0.07	2.55	4.83
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	7.36±0.03	5.33±0.27	0.91±0.05	1.47±0.05	0.03±0.02	0.48±0.09	2.62±0.06	2.38	4.96
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	30.64±0.18	717.49±4.37	113.74±0.61	3.44±0.09	0.56±0.17	1.30±0.22	5.56±0.10	2.16	2.34
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	30.11±0.17	644.57±4.16	103.66±0.58	3.39±0.09	0.47±0.16	1.30±0.22	5.52±0.10	2.22	2.43
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	28.46±0.17	490.94±3.58	81.12±0.51	3.30±0.09	0.38±0.15	1.30±0.22	5.36±0.09	2.35	2.62
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	25.83±0.15	333.22±2.90	56.28±0.42	3.10±0.09	0.30±0.13	1.30±0.20	5.12±0.09	2.50	2.87
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	22.70±0.13	205.37±2.14	35.67±0.33	2.95±0.09	0.16±0.10	1.22±0.18	4.82±0.09	2.65	3.18
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	19.38±0.11	118.81±1.47	21.06±0.25	2.70±0.08	0.05±0.08	0.99±0.18	4.44±0.08	2.76	3.54
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	16.22±0.08	66.49±1.07	11.79±0.18	2.48±0.08	0.01±0.05	0.99±0.18	4.02±0.08	2.80	3.89
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	13.41±0.06	35.08±0.73	6.41±0.13	2.20±0.07	0.01±0.04	0.82±0.13	3.57±0.07	2.79	4.29
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	10.93±0.05	18.87±0.48	3.33±0.09	1.97±0.07	0.01±0.03	0.65±0.09	3.22±0.07	2.68	4.58
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	8.85±0.04	9.70±0.33	1.64±0.06	1.76±0.06	0.03±0.03	0.57±0.09	2.89±0.07	2.53	4.82
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	7.25±0.03	5.21±0.22	0.85±0.04	1.48±0.05	0.03±0.02	0.48±0.09	2.60±0.06	2.36	4.93
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	28.32±0.16	660.79±2.95	102.60±0.47	3.36±0.09	0.52±0.14	1.21±0.20	5.38±0.09	2.08	2.26
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	27.81±0.16	593.58±2.82	93.47±0.45	3.31±0.09	0.45±0.14	1.21±0.20	5.34±0.09	2.14	2.34
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	26.26±0.15	451.85±2.50	73.18±0.40	3.22±0.09	0.38±0.13	1.21±0.20	5.19±0.09	2.26	2.52
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	23.81±0.14	306.11±2.02	50.74±0.34	3.02±0.09	0.30±0.12	1.21±0.18	4.96±0.09	2.40	2.76
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	20.91±0.12	188.86±1.40	32.19±0.27	2.88±0.09	0.16±0.09	1.13±0.18	4.68±0.09	2.54	3.06
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	17.93±0.10	109.05±1.05	19.10±0.21	2.63±0.08	0.05±0.08	0.99±0.18	4.32±0.08	2.66	3.41

Additional slides

$p_{\mathrm{T}}^{4\ell}$ and $E_{\mathrm{T}}^{\mathrm{miss}}$ scan for one or more central jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{\mathrm{Cjet}} \geq 1$	32.68±0.19	776.71±6.15	121.91±0.81	3.46±0.10	0.56±0.20	1.30±0.23	5.74±0.10	2.22	2.41
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	15.11±0.08	60.92±0.75	10.68±0.15	2.42±0.08	0.01±0.05	0.99±0.18	3.93±0.08	2.71	3.78
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	12.62±0.06	32.26±0.53	5.77±0.11	2.16±0.07	0.01±0.04	0.82±0.13	3.49±0.07	2.71	4.20
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	10.40±0.05	17.49±0.36	3.03±0.08	1.94±0.07	0.01±0.03	0.65±0.09	3.16±0.07	2.62	4.50
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	8.54±0.03	9.04±0.24	1.51±0.05	1.73±0.06	0.03±0.03	0.57±0.09	2.84±0.07	2.49	4.78
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	7.05±0.03	4.81±0.17	0.79±0.04	1.45±0.05	0.03±0.02	0.48±0.09	2.56±0.06	2.34	4.92
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	25.48±0.13	582.02±1.84	88.65±0.36	3.26±0.09	0.45±0.10	1.21±0.18	5.10±0.09	1.99	2.17
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	25.02±0.13	524.47±1.74	80.88±0.34	3.22±0.09	0.38±0.10	1.21±0.18	5.07±0.09	2.04	2.24
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	23.63±0.12	402.38±1.52	63.60±0.31	3.12±0.09	0.33±0.10	1.21±0.18	4.93±0.09	2.16	2.40
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	21.47±0.12	272.84±1.24	44.13±0.27	2.95±0.09	0.30±0.09	1.21±0.16	4.72±0.09	2.29	2.64
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	18.90±0.10	169.68±0.96	28.03±0.21	2.80±0.08	0.18±0.08	1.13±0.16	4.47±0.09	2.42	2.92
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	16.32±0.09	97.95±0.72	16.69±0.17	2.57±0.08	0.08±0.06	0.99±0.16	4.14±0.08	2.54	3.27
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	13.88±0.07	54.73±0.54	9.37±0.12	2.37±0.08	0.03±0.04	0.99±0.16	3.78±0.08	2.61	3.65
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	11.74±0.05	29.10±0.39	5.08±0.09	2.11±0.07	0.03±0.04	0.82±0.13	3.37±0.07	2.63	4.09
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	9.78±0.04	15.88±0.28	2.70±0.06	1.91±0.07	0.03±0.02	0.65±0.09	3.07±0.07	2.55	4.41
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	8.16±0.03	8.33±0.19	1.38±0.04	1.69±0.06	0.03±0.02	0.57±0.09	2.77±0.06	2.44	4.71
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	6.85±0.02	4.46±0.13	0.74±0.03	1.43±0.05	0.03±0.00	0.48±0.09	2.51±0.06	2.31	4.89
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	22.44±0.10	497.49±1.23	73.83±0.27	3.11±0.09	0.37±0.09	1.13±0.16	4.85±0.08	1.89	2.07
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	22.01±0.09	449.69±1.18	67.65±0.26	3.08±0.09	0.30±0.09	1.13±0.16	4.81±0.08	1.94	2.13
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	20.86±0.09	346.71±1.01	53.45±0.24	3.00±0.08	0.25±0.09	1.13±0.16	4.70±0.08	2.05	2.29
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	18.98±0.09	237.17±0.82	37.25±0.20	2.83±0.08	0.23±0.08	1.13±0.16	4.51±0.08	2.17	2.50
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	16.82±0.08	148.50±0.66	23.83±0.17	2.71±0.08	0.14±0.07	1.05±0.16	4.28±0.08	2.30	2.78
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	14.67±0.07	86.52±0.51	14.30±0.13	2.48±0.08	0.08±0.05	0.91±0.16	3.98±0.08	2.42	3.13
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	12.61±0.05	48.36±0.39	8.05±0.10	2.30±0.08	0.03±0.04	0.91±0.16	3.65±0.08	2.50	3.52
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	10.81±0.04	26.04±0.29	4.39±0.07	2.03±0.07	0.03±0.04	0.74±0.13	3.27±0.07	2.53	3.97
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	9.13±0.03	14.32±0.21	2.33±0.05	1.84±0.06	0.03±0.02	0.57±0.09	2.98±0.07	2.48	4.32
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	7.72±0.03	7.61±0.14	1.24±0.04	1.63±0.06	0.03±0.02	0.57±0.09	2.70±0.06	2.38	4.62
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	6.56±0.02	4.20±0.10	0.67±0.02	1.37±0.05	0.03±0.00	0.48±0.09	2.46±0.06	2.26	4.80
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	19.33±0.07	422.91±0.90	60.23±0.21	2.93±0.08	0.31±0.07	1.04±0.15	4.59±0.08	1.77	1.93
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	18.98±0.07	383.80±0.86	55.48±0.20	2.90±0.08	0.28±0.07	1.04±0.15	4.56±0.08	1.81	1.99
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	18.06±0.07	298.23±0.74	44.24±0.18	2.83±0.08	0.23±0.07	1.04±0.15	4.46±0.08	1.91	2.14
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	16.55±0.06	205.70±0.59	31.03±0.16	2.67±0.08	0.21±0.06	1.04±0.15	4.29±0.08	2.03	2.35
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	14.80±0.06	129.99±0.48	20.04±0.13	2.54±0.08	0.14±0.06	0.96±0.15	4.08±0.08	2.16	2.62
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	13.06±0.05	76.97±0.37	12.06±0.10	2.32±0.08	0.08±0.04	0.82±0.15	3.81±0.08	2.29	2.96
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	11.36±0.04	43.64±0.29	6.80±0.08	2.16±0.08	0.03±0.04	0.82±0.15	3.51±0.07	2.37	3.34
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	9.92±0.03	24.06±0.21	3.76±0.06	1.90±0.07	0.03±0.04	0.65±0.12	3.15±0.07	2.42	3.80
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	8.49±0.03	12.99±0.15	1.99±0.04	1.70±0.06	0.03±0.02	0.57±0.09	2.88±0.07	2.39	4.20
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	7.27±0.02	6.96±0.12	1.05±0.03	1.51±0.06	0.03±0.02	0.57±0.09	2.61±0.06	2.32	4.53
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	6.24±0.02	3.91±0.08	0.59±0.02	1.28±0.05	0.03±0.00	0.48±0.09	2.39±0.06	2.21	4.70

Additional slides

$p_{\mathrm{T}}^{4\ell}$ and $E_{\mathrm{T}}^{\mathrm{miss}}$ scan for zero jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{\mathrm{jet}} = 0$	22.44±0.17	1434.33±5.84	176.34±0.75	0.65±0.08	1.52±0.19	0.61±0.23	6.47±0.09	1.20	1.24
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	22.44±0.17	1434.33±5.84	176.34±0.75	0.65±0.08	1.52±0.19	0.61±0.23	6.47±0.09	1.20	1.24
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	21.73±0.16	1204.91±5.39	155.38±0.70	0.65±0.08	1.37±0.17	0.61±0.23	6.36±0.09	1.26	1.30
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	19.51±0.16	847.15±4.55	114.02±0.60	0.65±0.08	1.05±0.15	0.53±0.21	6.08±0.09	1.33	1.39
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	16.02±0.14	522.45±3.58	73.28±0.48	0.64±0.08	0.75±0.13	0.44±0.20	5.68±0.09	1.36	1.45
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	11.48±0.12	295.20±2.62	42.67±0.37	0.54±0.07	0.46±0.10	0.36±0.18	5.23±0.08	1.27	1.37
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	7.21±0.09	154.78±1.81	22.52±0.27	0.48±0.07	0.23±0.07	0.36±0.18	4.71±0.08	1.08	1.18
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	4.15±0.07	77.93±1.28	11.26±0.19	0.42±0.07	0.12±0.05	0.36±0.18	4.18±0.08	0.86	0.95
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	2.21±0.05	36.36±0.85	5.33±0.13	0.34±0.06	0.07±0.04	0.17±0.12	3.64±0.07	0.65	0.73
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	1.10±0.04	16.33±0.56	2.55±0.09	0.30±0.06	0.05±0.03	0.09±0.09	3.17±0.07	0.46	0.52
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	0.58±0.03	7.61±0.37	1.19±0.06	0.27±0.05	0.05±0.03	0.09±0.09	2.74±0.06	0.33	0.37
$p_{\mathrm{T}}^{4\ell} > 0.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.27±0.02	3.57±0.25	0.55±0.04	0.20±0.05	0.00±0.00	0.09±0.09	2.34±0.06	0.21	0.23
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	21.67±0.16	923.94±5.20	146.79±0.68	0.66±0.08	1.26±0.17	0.53±0.21	6.36±0.09	1.40	1.46
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	21.05±0.16	814.40±4.86	132.27±0.65	0.66±0.08	1.15±0.16	0.53±0.21	6.28±0.09	1.44	1.51
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	19.04±0.15	574.75±4.11	97.82±0.55	0.65±0.08	0.89±0.14	0.53±0.21	6.02±0.09	1.52	1.62
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	15.71±0.14	365.01±3.27	63.76±0.45	0.65±0.08	0.62±0.12	0.44±0.20	5.65±0.09	1.54	1.67
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	11.27±0.12	210.28±2.39	37.65±0.34	0.55±0.07	0.39±0.09	0.36±0.18	5.21±0.08	1.42	1.57
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	7.09±0.09	111.80±1.64	20.05±0.25	0.48±0.07	0.21±0.07	0.36±0.18	4.69±0.08	1.20	1.34
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	4.08±0.07	57.28±1.17	10.12±0.18	0.42±0.07	0.12±0.05	0.36±0.18	4.17±0.08	0.94	1.06
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	2.18±0.05	27.58±0.78	4.82±0.12	0.34±0.06	0.07±0.04	0.17±0.12	3.64±0.07	0.70	0.80
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	1.08±0.04	12.43±0.51	2.33±0.08	0.30±0.06	0.05±0.03	0.09±0.09	3.17±0.07	0.49	0.56
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	0.57±0.03	5.80±0.33	1.08±0.06	0.27±0.05	0.05±0.03	0.09±0.09	2.74±0.06	0.35	0.40
$p_{\mathrm{T}}^{4\ell} > 10.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.27±0.02	2.80±0.23	0.49±0.04	0.20±0.05	0.00±0.00	0.09±0.09	2.34±0.06	0.22	0.25
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	19.42±0.16	462.06±4.02	90.05±0.53	0.65±0.08	0.92±0.14	0.53±0.21	6.06±0.09	1.68	1.82
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	18.95±0.15	419.23±3.84	83.09±0.51	0.65±0.08	0.86±0.14	0.53±0.21	6.00±0.09	1.71	1.86
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	17.41±0.15	316.75±3.35	65.02±0.45	0.64±0.08	0.77±0.13	0.53±0.21	5.83±0.09	1.77	1.96
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	14.61±0.13	207.08±2.71	43.62±0.37	0.63±0.08	0.53±0.11	0.44±0.20	5.53±0.09	1.79	2.02
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	10.57±0.11	124.27±1.99	26.80±0.29	0.53±0.07	0.30±0.08	0.36±0.18	5.13±0.08	1.62	1.87
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	6.70±0.09	68.25±1.33	14.71±0.21	0.47±0.07	0.17±0.06	0.36±0.18	4.65±0.08	1.35	1.58
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	3.87±0.07	35.87±0.95	7.60±0.15	0.41±0.07	0.08±0.04	0.36±0.18	4.16±0.07	1.05	1.23
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	2.06±0.05	18.03±0.63	3.66±0.11	0.33±0.06	0.03±0.02	0.17±0.12	3.63±0.07	0.76	0.90
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	1.03±0.04	8.54±0.41	1.82±0.08	0.29±0.06	0.03±0.02	0.09±0.09	3.17±0.07	0.53	0.61
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	0.54±0.03	3.94±0.27	0.87±0.05	0.26±0.05	0.03±0.02	0.09±0.09	2.74±0.06	0.37	0.43
$p_{\mathrm{T}}^{4\ell} > 20.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.25±0.02	2.07±0.18	0.39±0.03	0.19±0.04	0.00±0.00	0.09±0.09	2.34±0.06	0.22	0.25
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	15.35±0.14	228.23±2.62	47.47±0.39	0.61±0.08	0.64±0.12	0.45±0.20	5.61±0.09	1.80	2.03
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	15.07±0.14	209.57±2.52	44.52±0.37	0.61±0.08	0.60±0.11	0.45±0.20	5.57±0.09	1.83	2.07
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	14.08±0.13	165.15±2.26	36.86±0.34	0.61±0.08	0.58±0.11	0.45±0.20	5.47±0.09	1.87	2.16
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	12.25±0.12	114.20±1.82	26.27±0.29	0.61±0.08	0.41±0.09	0.36±0.18	5.27±0.08	1.89	2.24
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	9.11±0.11	70.12±1.24	16.77±0.23	0.52±0.07	0.25±0.07	0.36±0.18	4.96±0.08	1.72	2.10

Additional slides

$p_{\mathrm{T}}^{4\ell}$ and $E_{\mathrm{T}}^{\mathrm{miss}}$ scan for zero jet

	$(m_R, m_H) = (390, 220)$	$qqZZ^*$	$ggZZ^*$	$t\bar{t}Z$	$Z + jets$	$t\bar{t}$	VVV	$s/\sqrt{s+b}$	$s/\sqrt{b}$
4ℓ	65.92±0.29	2474.93±7.43	345.02±1.04	26.89±0.61	2.59±0.24	3.28±0.56	13.74±0.15	2.59	2.73
B-veto	61.32±0.28	2358.82±7.33	330.25±1.02	4.45±0.25	2.38±0.23	1.94±0.41	12.96±0.15	2.48	2.61
$N_{\mathrm{jet}} = 0$	22.44±0.17	1434.33±5.84	176.34±0.75	0.65±0.08	1.52±0.19	0.61±0.23	6.47±0.09	1.20	1.24
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	5.82±0.08	39.86±0.92	9.73±0.17	0.45±0.07	0.17±0.06	0.36±0.18	4.54±0.08	1.41	1.74
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	3.40±0.06	21.64±0.65	5.19±0.13	0.41±0.07	0.07±0.04	0.36±0.18	4.09±0.07	1.08	1.34
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	1.83±0.05	11.32±0.45	2.55±0.09	0.33±0.06	0.03±0.02	0.17±0.12	3.60±0.07	0.78	0.96
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	0.93±0.03	5.63±0.29	1.32±0.06	0.29±0.06	0.03±0.02	0.09±0.09	3.15±0.07	0.53	0.64
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	0.48±0.02	2.72±0.19	0.66±0.05	0.26±0.05	0.03±0.02	0.09±0.09	2.73±0.06	0.36	0.42
$p_{\mathrm{T}}^{4\ell} > 30.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.22±0.02	1.34±0.13	0.29±0.03	0.19±0.04	0.00±0.00	0.09±0.09	2.34±0.06	0.21	0.24
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	9.53±0.11	103.93±1.43	23.19±0.27	0.59±0.08	0.36±0.09	0.35±0.17	5.05±0.08	1.57	1.83
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	9.41±0.11	97.12±1.39	22.01±0.26	0.59±0.07	0.36±0.09	0.35±0.17	5.03±0.08	1.59	1.86
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	8.89±0.11	78.73±1.25	18.78±0.24	0.59±0.07	0.36±0.09	0.35±0.17	4.98±0.08	1.62	1.94
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	7.94±0.10	57.66±1.03	14.22±0.21	0.58±0.07	0.29±0.08	0.27±0.15	4.86±0.08	1.63	2.00
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	6.33±0.09	36.93±0.79	9.63±0.17	0.50±0.07	0.20±0.07	0.27±0.15	4.70±0.08	1.54	1.94
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	4.15±0.07	21.51±0.59	5.86±0.14	0.44±0.07	0.12±0.05	0.27±0.15	4.36±0.08	1.27	1.61
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	2.47±0.06	12.41±0.44	3.24±0.10	0.39±0.07	0.05±0.03	0.27±0.15	3.99±0.07	0.96	1.21
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	1.40±0.04	6.98±0.31	1.63±0.07	0.32±0.06	0.03±0.02	0.17±0.12	3.54±0.07	0.70	0.87
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	0.71±0.03	3.72±0.21	0.83±0.05	0.28±0.06	0.03±0.02	0.09±0.09	3.12±0.06	0.46	0.55
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	0.36±0.02	2.16±0.15	0.44±0.04	0.25±0.05	0.03±0.02	0.09±0.09	2.72±0.06	0.29	0.33
$p_{\mathrm{T}}^{4\ell} > 40.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.16±0.01	1.15±0.11	0.22±0.03	0.18±0.04	0.00±0.00	0.09±0.09	2.33±0.06	0.16	0.17
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	4.18±0.07	48.07±0.82	10.81±0.18	0.52±0.07	0.25±0.08	0.27±0.15	4.56±0.08	1.01	1.16
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	4.12±0.07	45.54±0.79	10.33±0.18	0.51±0.07	0.25±0.08	0.27±0.15	4.55±0.08	1.01	1.17
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	3.92±0.07	38.48±0.72	9.05±0.17	0.51±0.07	0.25±0.08	0.27±0.15	4.53±0.08	1.02	1.19
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	3.54±0.07	29.31±0.62	7.05±0.15	0.49±0.07	0.20±0.07	0.27±0.15	4.46±0.08	1.02	1.22
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	2.93±0.06	19.59±0.50	5.06±0.13	0.42±0.07	0.16±0.06	0.27±0.15	4.36±0.08	0.98	1.19
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	2.11±0.05	12.52±0.39	3.23±0.10	0.38±0.06	0.09±0.05	0.27±0.15	4.14±0.07	0.84	1.03
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	1.29±0.04	7.42±0.29	1.92±0.08	0.35±0.06	0.05±0.03	0.27±0.15	3.85±0.07	0.64	0.77
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	0.73±0.03	4.49±0.21	1.02±0.06	0.30±0.06	0.03±0.02	0.17±0.12	3.47±0.07	0.45	0.53
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	0.38±0.02	2.49±0.14	0.52±0.04	0.27±0.05	0.03±0.02	0.09±0.09	3.07±0.06	0.29	0.33
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	0.20±0.02	1.57±0.11	0.28±0.03	0.24±0.05	0.03±0.02	0.09±0.09	2.70±0.06	0.18	0.20
$p_{\mathrm{T}}^{4\ell} > 50.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.09±0.01	0.87±0.08	0.14±0.02	0.17±0.04	0.00±0.00	0.09±0.09	2.32±0.06	0.10	0.10
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 0.00$ GeV	1.55±0.04	23.90±0.53	4.96±0.12	0.46±0.07	0.13±0.05	0.27±0.15	4.02±0.07	0.53	0.59
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 10.00$ GeV	1.52±0.04	22.61±0.51	4.81±0.12	0.46±0.07	0.13±0.05	0.27±0.15	4.01±0.07	0.54	0.59
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 20.00$ GeV	1.46±0.04	19.14±0.47	4.30±0.12	0.45±0.07	0.13±0.05	0.27±0.15	4.00±0.07	0.54	0.61
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 30.00$ GeV	1.33±0.04	15.06±0.40	3.47±0.10	0.45±0.07	0.13±0.05	0.27±0.15	3.97±0.07	0.54	0.61
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 40.00$ GeV	1.13±0.04	10.70±0.33	2.59±0.09	0.39±0.06	0.11±0.05	0.27±0.15	3.91±0.07	0.52	0.59
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 50.00$ GeV	0.86±0.03	7.02±0.26	1.76±0.07	0.36±0.06	0.05±0.03	0.27±0.15	3.78±0.07	0.46	0.53
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 60.00$ GeV	0.56±0.03	4.36±0.21	1.10±0.06	0.35±0.06	0.03±0.02	0.27±0.15	3.60±0.07	0.35	0.40
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 70.00$ GeV	0.33±0.02	2.84±0.15	0.66±0.05	0.29±0.06	0.03±0.02	0.17±0.12	3.30±0.07	0.24	0.27
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 80.00$ GeV	0.17±0.01	1.75±0.11	0.37±0.03	0.27±0.05	0.03±0.02	0.09±0.09	2.97±0.06	0.15	0.16
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 90.00$ GeV	0.09±0.01	1.18±0.09	0.21±0.03	0.23±0.05	0.03±0.02	0.09±0.09	2.64±0.06	0.09	0.09
$p_{\mathrm{T}}^{4\ell} > 60.00$ & $E_{\mathrm{T}}^{\mathrm{miss}} > 100.00$ GeV	0.05±0.01	0.73±0.07	0.11±0.02	0.17±0.04	0.00±0.00	0.09±0.09	2.30±0.06	0.06	0.06