Table 1: Summary of different Standard Model signal models.

Signal process	$\mathcal{A}_{\text{fid}}$	ϵ	f_{nonfid}	$(1+f_{\text{nonfi}}$
Individual Higgs boson production modes				
gg→H (POWHEG+JHUGEN+PYTHIA8) 125	0.398 ± 0.001	0.592 ± 0.001	0.049 ± 0.001	0.621 ± 0.
VBF (POWHEG+JHUGEN+PYTHIA8) 125	0.445 ± 0.001	0.601 ± 0.002	0.038 ± 0.001	0.624 ± 0.
WH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.314 ± 0.001	0.577 ± 0.002	0.068 ± 0.001	0.616 ± 0.
ZH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.342 ± 0.002	0.592 ± 0.003	0.071 ± 0.002	0.634 ± 0.
ttH (POWHEG+JHUGEN+PYTHIA8) 125	0.311 ± 0.002	0.572 ± 0.003	0.136 ± 0.003	0.650 ± 0.
ggH(NNLOPS)	0.442 ± 0.001	0.595 ± 0.001	0.049 ± 0.001	0.624 ± 0.

Table 2: Summmary for different models used to check model dependence.

Signal process	$\mathcal{A}_{\text{fid}}$	ϵ	f_{nonfid}	$(1+f_{\text{nonfi}}$
Individual Higgs boson production modes				
gg→H (POWHEG+JHUGEN+PYTHIA8) 125	0.398 ± 0.001	0.592 ± 0.001	0.049 ± 0.001	0.621 ± 0.
VBF (POWHEG+JHUGEN+PYTHIA8) 125	0.445 ± 0.001	0.601 ± 0.002	0.038 ± 0.001	0.624 ± 0.
WH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.314 ± 0.001	0.577 ± 0.002	0.068 ± 0.001	0.616 ± 0.
ZH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.342 ± 0.002	0.592 ± 0.003	0.071 ± 0.002	0.634 ± 0.
ttH (POWHEG+JHUGEN+PYTHIA8) 125	0.311 ± 0.002	0.572 ± 0.003	0.136 ± 0.003	0.650 ± 0.
ggH(NNLOPS)	0.442 ± 0.001	0.595 ± 0.001	0.049 ± 0.001	0.624 ± 0.

Table 3: Standard Model signal Model Carlo Samples.

Sample	
GluGluHToZZTo4L_M125_13TeV_powheg2_JHUgenV6_pythia8_RunIISummer16MiniAODv2	gg-
VBF_HToZZTo4L_M125_13TeV_powheg2_JHUgenV6_pythia8_RunIISummer16MiniAODv2	VI
WH_HToZZTo4L_M125_13TeV_powheg2-minlo-HWJ_JHUgenV6_pythia8_RunIISummer16MiniAODv2	WH (
ZH_HToZZ_4LFilter_M125_13TeV_powheg2-minlo-HZJ_JHUgenV6_pythia8_RunIISummer16MiniAODv2	ZH (
ttH_HToZZ_4LFilter_M125_13TeV_powheg_JHUgen_pythia8_RunIISummer16MiniAODv2	tt
testGGH_nnlops_GENonly	

Table 4: Signal Model Carlo Samples used to test model dependence.

Sample	Description

Table 5: Fiducial volume acceptance per final state for different Standard Model signal models.

Sample	$4e$	4μ	$2e2\mu$	4ℓ
gg→H (POWHEG+JHUGEN+PYTHIA8) 125	0.389 ± 0.001	0.430 ± 0.001	0.397 ± 0.001	0.398 ± 0.
VBF (POWHEG+JHUGEN+PYTHIA8) 125	0.429 ± 0.002	0.473 ± 0.002	0.436 ± 0.002	0.445 ± 0.
WH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.323 ± 0.002	0.347 ± 0.002	0.324 ± 0.001	0.314 ± 0.
ZH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.324 ± 0.003	0.359 ± 0.003	0.336 ± 0.002	0.342 ± 0.
ttH (POWHEG+JHUGEN+PYTHIA8) 125	0.303 ± 0.003	0.339 ± 0.003	0.306 ± 0.002	0.311 ± 0.
ggH(NNLOPS)	0.426 ± 0.001	0.472 ± 0.001	0.434 ± 0.001	0.442 ± 0.

Table 6: Fiducial volume acceptance per final state for different signal models used to check model dependence.

Sample	$4e$	4μ	$2e2\mu$	4ℓ

Table 7: Reconstruction efficiency (ϵ) for fiducial events per final state for different Standard Model signal models.

Sample	$4e$	4μ	$2e2\mu$	4ℓ
gg→H (POWHEG+JHUGEN+PYTHIA8) 125	0.437 ± 0.002	0.793 ± 0.002	0.592 ± 0.002	0.592 ± 0.
VBF (POWHEG+JHUGEN+PYTHIA8) 125	0.464 ± 0.003	0.799 ± 0.002	0.605 ± 0.002	0.601 ± 0.
WH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.451 ± 0.004	0.775 ± 0.003	0.602 ± 0.003	0.577 ± 0.
ZH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.464 ± 0.006	0.775 ± 0.005	0.602 ± 0.004	0.592 ± 0.
ttH (POWHEG+JHUGEN+PYTHIA8) 125	0.459 ± 0.006	0.740 ± 0.005	0.591 ± 0.005	0.572 ± 0.
ggH(NNLOPS)	0.425 ± 0.002	0.776 ± 0.002	0.578 ± 0.001	0.595 ± 0.

Table 8: Reconstruction efficiency (ϵ) for fiducial events per final state for different models used to check model dependence.

Sample	$4e$	4μ	$2e2\mu$	4ℓ

Table 9: Ratio of reconstructed events which are from outside the fiducial volume and reconstructed events which are from within the fiducial volume (f_{out}) per final state for different Standard Model signal models.

Sample	$4e$	4μ	$2e2\mu$	4ℓ
gg→H (POWHEG+JHUGEN+PYTHIA8) 125	0.060 ± 0.002	0.046 ± 0.001	0.061 ± 0.001	0.049 ± 0.
VBF (POWHEG+JHUGEN+PYTHIA8) 125	0.051 ± 0.002	0.037 ± 0.001	0.046 ± 0.001	0.038 ± 0.
WH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.098 ± 0.004	0.057 ± 0.002	0.080 ± 0.002	0.068 ± 0.
ZH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.106 ± 0.006	0.071 ± 0.004	0.092 ± 0.004	0.071 ± 0.
ttH (POWHEG+JHUGEN+PYTHIA8) 125	0.275 ± 0.011	0.127 ± 0.005	0.193 ± 0.006	0.136 ± 0.
ggH(NNLOPS)	0.051 ± 0.001	0.046 ± 0.001	0.051 ± 0.001	0.049 ± 0.

Table 10: Ratio of reconstructed events which are from outside the fiducial volume and reconstructed events which are from within the fiducial volume (f_{out}) per final state for different models used to check model dependence.

Sample	$4e$	4μ	$2e2\mu$	4ℓ

Table 11: Fraction of signal events in the mass range 105.6–140.6 where at least one lepton selected is not from the Higgs boson decay

Sample	$4e$	4μ	$2e2\mu$	4ℓ
gg→H (POWHEG+JHUGEN+PYTHIA8) 125	0.002	0.002	0.002	0.003
VBF (POWHEG+JHUGEN+PYTHIA8) 125	0.002	0.003	0.003	0.003
WH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.037	0.031	0.042	0.039
ZH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	0.198	0.207	0.212	0.206
ttH (POWHEG+JHUGEN+PYTHIA8) 125	0.176	0.156	0.163	0.163
ggH(NNLOPS)	0.003	0.003	0.004	0.003

Table 12: Fraction of signal events in the mass range 105.6–140.6 where at least one lepton selected is not from the Higgs boson decay

Sample	$4e$	4μ	$2e2\mu$	4ℓ

Table 13: Percent change in events when increasing the jet energy scale by 1σ for various signal model (all final states combined).

Sample	N(jets)=0	N(jets)=1	N(jets)=2	N(jets)≥3
gg→H (POWHEG+JHUGEN+PYTHIA8) 125	-0.049	0.035	0.092	0.152
VBF (POWHEG+JHUGEN+PYTHIA8) 125	-0.153	-0.069	0.016	0.156
WH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	-0.062	-0.034	0.007	0.092
ZH (POWHEG+MINLO+JHUGEN+PYTHIA8) 125	-0.057	-0.034	0.010	0.085
ttH (POWHEG+JHUGEN+PYTHIA8) 125	0.000	-0.145	-0.107	0.008
ggH(NNLOPS)	-0.056	0.041	0.071	0.138

Table 14: Percent change in events when increasing the jet energy scale by 1σ for various signal model (all final states combined).

Sample	N(jets)=0	N(jets)=1	N(jets)=2	N(jets)≥3