
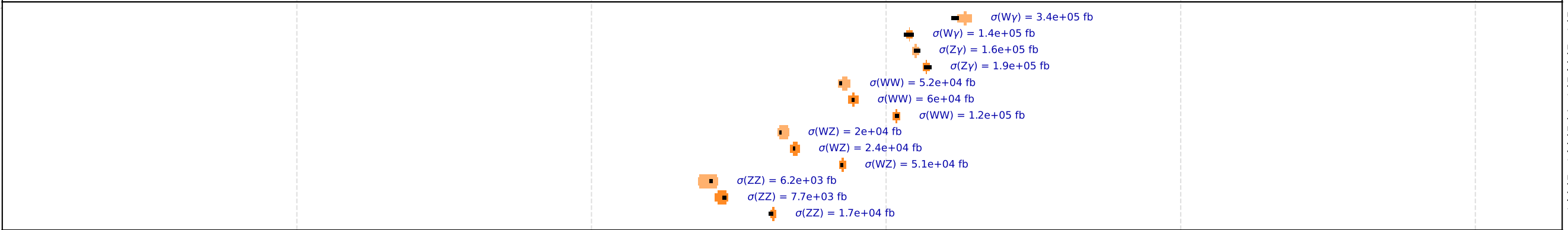
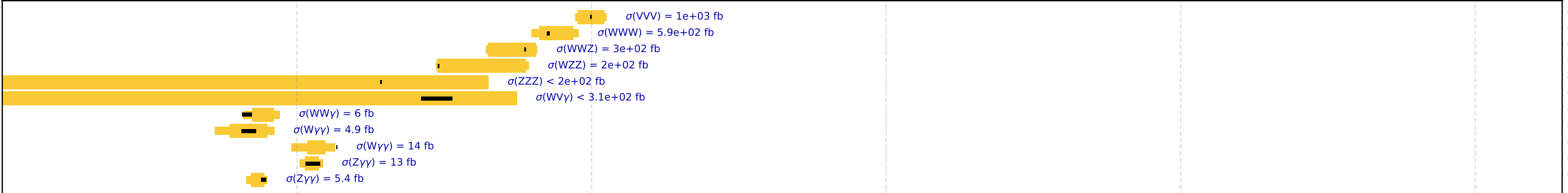
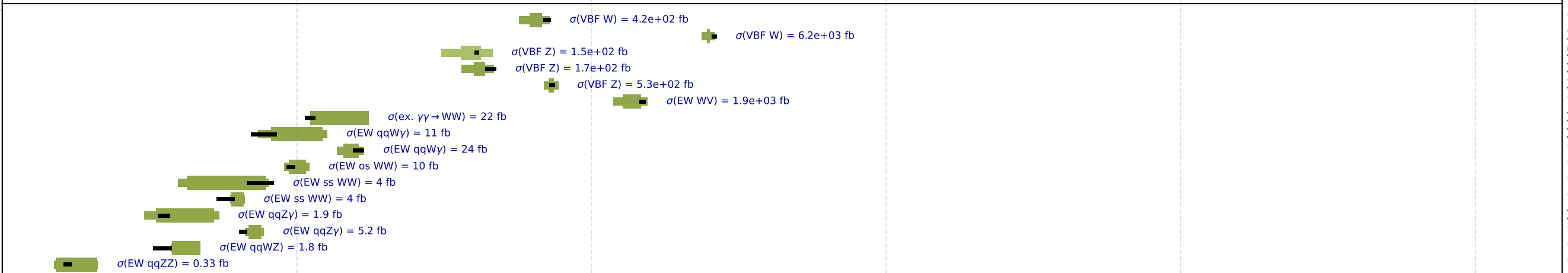
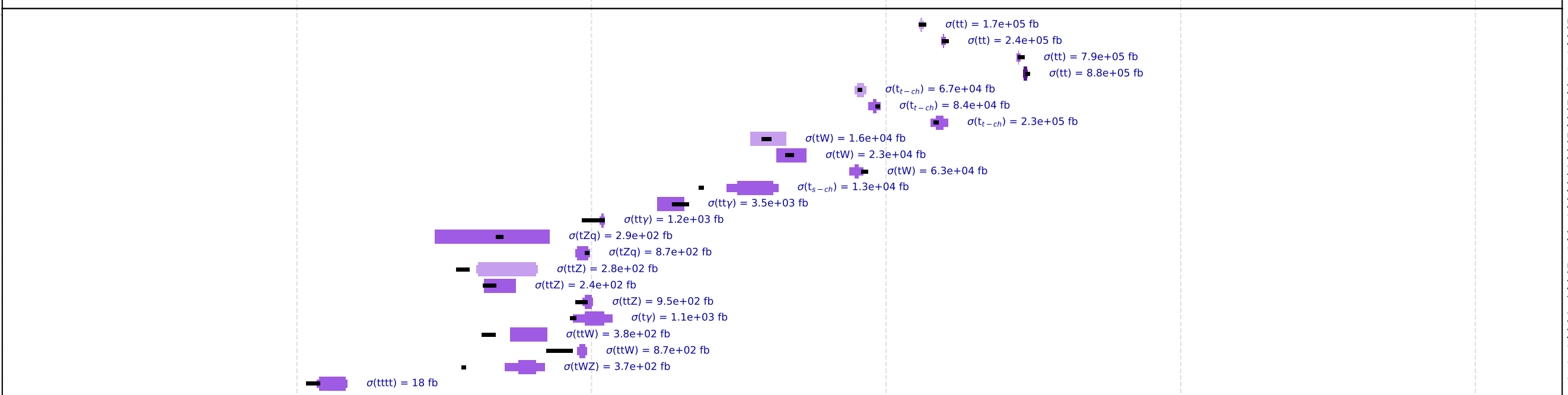
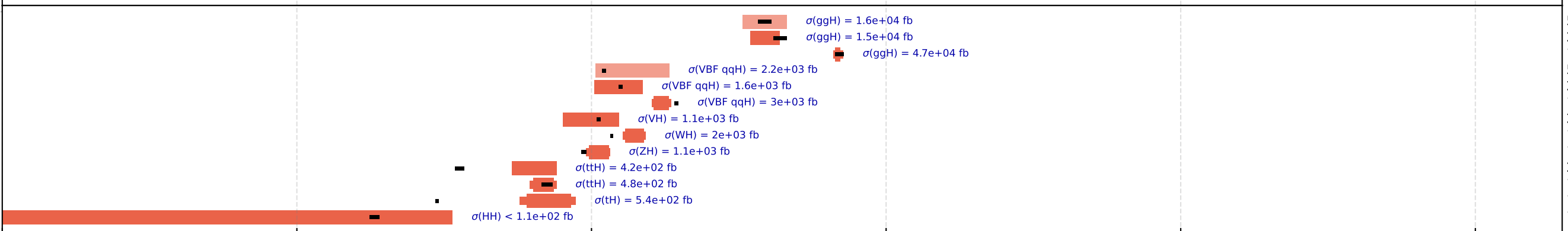


Overview of CMS cross section results

CMS preliminary

18 pb⁻¹ - 138 fb⁻¹ (7,8,13,13.6 TeV)

Electroweak	W	7 TeV	JHEP 10 (2011) 132		$\sigma(W) = 9.5e+07 \text{ fb}$ $\sigma(W) = 1.1e+08 \text{ fb}$ $\sigma(W) = 1.8e+08 \text{ fb}$ $\sigma(Z) = 2.9e+07 \text{ fb}$ $\sigma(Z) = 3.4e+07 \text{ fb}$ $\sigma(Z) = 5.6e+07 \text{ fb}$	36 pb^{-1} 18 pb^{-1} 43 pb^{-1} 36 pb^{-1} 18 pb^{-1} 2 fb^{-1}				
	W	8 TeV	PRL 112 (2014) 191802							
	W	13 TeV	SMP-15-004							
	Z	7 TeV	JHEP 10 (2011) 132							
	Z	8 TeV	PRL 112 (2014) 191802							
	Z	13 TeV	SMP-15-011							
di-Boson	W γ	7 TeV	PRD 89 (2014) 092005		$\sigma(W\gamma) = 3.4e+05 \text{ fb}$ $\sigma(W\gamma) = 1.4e+05 \text{ fb}$ $\sigma(Z\gamma) = 1.6e+05 \text{ fb}$ $\sigma(Z\gamma) = 1.9e+05 \text{ fb}$ $\sigma(WW) = 5.2e+04 \text{ fb}$ $\sigma(WW) = 6e+04 \text{ fb}$ $\sigma(WW) = 1.2e+05 \text{ fb}$ $\sigma(WZ) = 2e+04 \text{ fb}$ $\sigma(WZ) = 2.4e+04 \text{ fb}$ $\sigma(WZ) = 5.1e+04 \text{ fb}$ $\sigma(ZZ) = 6.2e+03 \text{ fb}$ $\sigma(ZZ) = 7.7e+03 \text{ fb}$ $\sigma(ZZ) = 1.7e+04 \text{ fb}$	5 fb^{-1} 137 fb^{-1} 5 fb^{-1} 20 fb^{-1} 5 fb^{-1} 19 fb^{-1} 36 fb^{-1} 5 fb^{-1} 20 fb^{-1} 137 fb^{-1} 5 fb^{-1} 20 fb^{-1} 137 fb^{-1}				
	W γ	13 TeV	PRL 126 252002 (2021)							
	Z γ	7 TeV	PRD 89 (2014) 092005							
	Z γ	8 TeV	JHEP 04 (2015) 164							
	WW	7 TeV	EPJC 73 (2013) 2610							
	WW	8 TeV	EPJC 76 (2016) 401							
	WW	13 TeV	PRD 102 092001 (2020)							
	WZ	7 TeV	EPJC 77 (2017) 236							
	WZ	8 TeV	EPJC 77 (2017) 236							
	WZ	13 TeV	JHEP 07 (2022) 032							
	ZZ	7 TeV	JHEP 01 (2013) 063							
	ZZ	8 TeV	PLB 740 (2015) 250							
	ZZ	13 TeV	EPJC 81 (2021) 200							
tri-Boson	VVV	13 TeV	PRL 125 151802 (2020)		$\sigma(VVV) = 1e+03 \text{ fb}$ $\sigma(WWW) = 5.9e+02 \text{ fb}$ $\sigma(WWZ) = 3e+02 \text{ fb}$ $\sigma(WZZ) = 2e+02 \text{ fb}$ $\sigma(ZZZ) < 2e+02 \text{ fb}$ $\sigma(WV\gamma) < 3.1e+02 \text{ fb}$ $\sigma(WW\gamma) = 6 \text{ fb}$ $\sigma(W\gamma\gamma) = 4.9 \text{ fb}$ $\sigma(W\gamma\gamma) = 14 \text{ fb}$ $\sigma(Z\gamma\gamma) = 13 \text{ fb}$ $\sigma(Z\gamma\gamma) = 5.4 \text{ fb}$	137 fb^{-1} 137 fb^{-1} 137 fb^{-1} 137 fb^{-1} 137 fb^{-1} 19 fb^{-1} 138 fb^{-1} 19 fb^{-1} 19 fb^{-1} 19 fb^{-1} 19 fb^{-1} 19 fb^{-1}				
	WWW	13 TeV	PRL 125 151802 (2020)							
	WWZ	13 TeV	PRL 125 151802 (2020)							
	WZZ	13 TeV	PRL 125 151802 (2020)							
	ZZZ	13 TeV	PRL 125 151802 (2020)							
	WV γ	8 TeV	PRD 90 032008 (2014)							
	WW γ	13 TeV	SMP-22-006							
	W $\gamma\gamma$	8 TeV	JHEP 10 (2017) 072							
	W $\gamma\gamma$	13 TeV	JHEP 10 (2021) 174							
	Z $\gamma\gamma$	8 TeV	JHEP 10 (2017) 072							
	Z $\gamma\gamma$	13 TeV	JHEP 10 (2021) 174							
	VBF and VBS	VBF W	8 TeV				JHEP 11 (2016) 147		$\sigma(\text{VBF W}) = 4.2e+02 \text{ fb}$ $\sigma(\text{VBF W}) = 6.2e+03 \text{ fb}$ $\sigma(\text{VBF Z}) = 1.5e+02 \text{ fb}$ $\sigma(\text{VBF Z}) = 1.7e+02 \text{ fb}$ $\sigma(\text{VBF Z}) = 5.3e+02 \text{ fb}$ $\sigma(\text{EW WV}) = 1.9e+03 \text{ fb}$ $\sigma(\text{ex. } \gamma\gamma \rightarrow WW) = 22 \text{ fb}$ $\sigma(\text{EW qqW}\gamma) = 11 \text{ fb}$ $\sigma(\text{EW qqW}\gamma) = 24 \text{ fb}$ $\sigma(\text{EW os WW}) = 10 \text{ fb}$ $\sigma(\text{EW ss WW}) = 4 \text{ fb}$ $\sigma(\text{EW ss WW}) = 4 \text{ fb}$ $\sigma(\text{EW qqZ}\gamma) = 1.9 \text{ fb}$ $\sigma(\text{EW qqZ}\gamma) = 5.2 \text{ fb}$ $\sigma(\text{EW qqWZ}) = 1.8 \text{ fb}$ $\sigma(\text{EW qqZZ}) = 0.33 \text{ fb}$	19 fb^{-1} 36 fb^{-1} 5 fb^{-1} 20 fb^{-1} 36 fb^{-1} 138 fb^{-1} 20 fb^{-1} 20 fb^{-1} 138 fb^{-1} 138 fb^{-1} 19 fb^{-1} 137 fb^{-1} 20 fb^{-1} 137 fb^{-1} 137 fb^{-1}
		VBF W	13 TeV				EPJC 80 (2020) 43			
VBF Z		7 TeV	JHEP 10 (2013) 101							
VBF Z		8 TeV	EPJC 75 (2015) 66							
VBF Z		13 TeV	EPJC 78 (2018) 589							
EW WV		13 TeV	PLB 834 (2022) 137438							
ex. $\gamma\gamma \rightarrow WW$		8 TeV	JHEP 08 (2016) 119							
EW qqW γ		8 TeV	JHEP 06 (2017) 106							
EW qqW γ		13 TeV	Accepted by PRD							
EW os WW		13 TeV	Submitted to PLB							
EW ss WW		8 TeV	PRL 114 051801 (2015)							
EW ss WW		13 TeV	PRL 120 081801 (2018)							
EW qqZ γ		8 TeV	PLB 770 (2017) 380							
EW qqZ γ		13 TeV	PRD 104 072001 (2021)							
EW qqWZ		13 TeV	PLB 809 (2020) 135710							
EW qqZZ		13 TeV	PLB 812 (2020) 135992							
Top		tt	7 TeV	JHEP 08 (2016) 029		$\sigma(tt) = 1.7e+05 \text{ fb}$ $\sigma(tt) = 2.4e+05 \text{ fb}$ $\sigma(tt) = 7.9e+05 \text{ fb}$ $\sigma(tt) = 8.8e+05 \text{ fb}$ $\sigma(t_t - ch) = 6.7e+04 \text{ fb}$ $\sigma(t_t - ch) = 8.4e+04 \text{ fb}$ $\sigma(t_t - ch) = 2.3e+05 \text{ fb}$ $\sigma(tW) = 1.6e+04 \text{ fb}$ $\sigma(tW) = 2.3e+04 \text{ fb}$ $\sigma(tW) = 6.3e+04 \text{ fb}$ $\sigma(t_{s - ch}) = 1.3e+04 \text{ fb}$ $\sigma(tty) = 3.5e+03 \text{ fb}$ $\sigma(tty) = 1.2e+03 \text{ fb}$ $\sigma(tZq) = 2.9e+02 \text{ fb}$ $\sigma(tZq) = 8.7e+02 \text{ fb}$ $\sigma(ttZ) = 2.8e+02 \text{ fb}$ $\sigma(ttZ) = 2.4e+02 \text{ fb}$ $\sigma(ttZ) = 9.5e+02 \text{ fb}$ $\sigma(tty) = 1.1e+03 \text{ fb}$ $\sigma(ttW) = 3.8e+02 \text{ fb}$ $\sigma(ttW) = 8.7e+02 \text{ fb}$ $\sigma(tWZ) = 3.7e+02 \text{ fb}$ $\sigma(tttt) = 18 \text{ fb}$	5 fb^{-1} 20 fb^{-1} 137 fb^{-1} 1 fb^{-1} 2 fb^{-1} 5 fb^{-1} 2 fb^{-1} 5 fb^{-1} 20 fb^{-1} 36 fb^{-1} 20 fb^{-1} 20 fb^{-1} 138 fb^{-1} 20 fb^{-1} 138 fb^{-1} 5 fb^{-1} 20 fb^{-1} 78 fb^{-1} 36 fb^{-1} 20 fb^{-1} 138 fb^{-1} 138 fb^{-1}			
	tt	8 TeV	JHEP 08 (2016) 029							
	tt	13 TeV	PRD 104 (2021) 092013							
	tt	13.6 TeV	Submitted to JHEP							
	$t_t - ch$	7 TeV	JHEP 12 (2012) 035							
	$t_t - ch$	8 TeV	JHEP 06 (2014) 090							
	$t_t - ch$	13 TeV	PLB 72 (2017) 752							
	tW	7 TeV	PRL 110 (2013) 022003							
	tW	8 TeV	PRL 112 (2014) 231802							
	tW	13 TeV	JHEP 10 (2018) 117							
	$t_{s - ch}$	8 TeV	JHEP 09 (2016) 027							
	tty	8 TeV	JHEP 10 (2017) 006							
	tty	13 TeV	JHEP 05 (2022) 091							
	tZq	8 TeV	JHEP 07 (2017) 003							
	tZq	13 TeV	JHEP 02 (2022) 107							
	ttZ	7 TeV	PRL 110 (2013) 172002							
	ttZ	8 TeV	JHEP 01 (2016) 096							
	ttZ	13 TeV	JHEP 03 (2020) 056							
	ty	13 TeV	PRL 121 221802 (2018)							
	ttW	8 TeV	JHEP 01 (2016) 096							
	ttW	13 TeV	Submitted to JHEP							
	tWZ	13 TeV	TOP-22-008							
	tttt	13 TeV	Submitted to PLB							
Higgs	ggH	7 TeV	EPJC 75 (2015) 212		$\sigma(ggH) = 1.6e+04 \text{ fb}$ $\sigma(ggH) = 1.5e+04 \text{ fb}$ $\sigma(ggH) = 4.7e+04 \text{ fb}$ $\sigma(\text{VBF qqH}) = 2.2e+03 \text{ fb}$ $\sigma(\text{VBF qqH}) = 1.6e+03 \text{ fb}$ $\sigma(\text{VBF qqH}) = 3e+03 \text{ fb}$ $\sigma(VH) = 1.1e+03 \text{ fb}$ $\sigma(WH) = 2e+03 \text{ fb}$ $\sigma(ZH) = 1.1e+03 \text{ fb}$ $\sigma(tH) = 4.2e+02 \text{ fb}$ $\sigma(tH) = 4.8e+02 \text{ fb}$ $\sigma(tH) = 5.4e+02 \text{ fb}$ $\sigma(HH) < 1.1e+02 \text{ fb}$	5 fb^{-1} 20 fb^{-1} 139 fb^{-1} 5 fb^{-1} 20 fb^{-1} 138 fb^{-1} 20 fb^{-1} 138 fb^{-1} 20 fb^{-1} 138 fb^{-1} 138 fb^{-1} 138 fb^{-1}				
	ggH	8 TeV	EPJC 75 (2015) 212							
	ggH	13 TeV	Nature 607 60-68 (2022)							
	VBF qqH	7 TeV	EPJC 75 (2015) 212							
	VBF qqH	8 TeV	EPJC 75 (2015) 212							
	VBF qqH	13 TeV	Nature 607 60-68 (2022)							
	VH	8 TeV	EPJC 75 (2015) 212							
	WH	13 TeV	Nature 607 60-68 (2022)							
	ZH	13 TeV	Nature 607 60-68 (2022)							
	ttH	8 TeV	EPJC 75 (2015) 212							
	ttH	13 TeV	Nature 607 60-68 (2022)							
	tH	13 TeV	Nature 607 60-68 (2022)							
	HH	13 TeV	Nature 607 60-68 (2022)							

Measured cross sections and exclusion limits at 95% C.L.

Inner colored bars statistical uncertainty, outer narrow bars statistical+systematic uncertainty

[See here for all cross section summary plots](#)

Light colored bars: 7 TeV, Medium: 8 TeV, Dark: 13 TeV, Darkest: 13.6 TeV, Black bars: theory prediction

 σ [fb]

September 2022