Cut-based Higgs cross-section measurement in the tautau decay channel (36/fb)

Signal Region		Inclusive	$\tau_{\text{lep}}\tau_{\text{lep}}$	$\tau_{\text{lep}}\tau_{\text{had}}$	$\tau_{\text{had}}\tau_{\text{had}}$
VBF	High-$p_{\text{T}}^{\tau\tau}$	$p_{\text{T}}^{j2} > 30\,\text{GeV}$ $\lvert\Delta\eta_{jj}\rvert > 3$ $m_{jj} > 400\,\text{GeV}$ $\eta_{j_1} \cdot \eta_{j_2} < 0$ Central leptons	—		$p_{\text{T}}^{\tau\tau} > 140\,\text{GeV}$ $\Delta R_{\tau\tau} < 1.5$
	Tight		$m_{jj} > 800\,\text{GeV}$	$m_{jj} > 500\,\text{GeV}$ $p_{\text{T}}^{\tau\tau} > 100\,\text{GeV}$	Not VBF high-p_{T} $m_{jj} > (1550 - 250 \cdot \Delta\eta_{jj})\,\text{GeV}$
	Loose		Otherwise		
Boosted	High-$p_{\text{T}}^{\tau\tau}$	**Loose** Not VBF $p_{\text{T}}^{\tau\tau} > 100\,\text{GeV}$	**Tight**	$p_{\text{T}}^{\tau\tau} > 140\,\text{GeV}$ $\Delta R_{\tau\tau} < 1.5$	
	Low-$p_{\text{T}}^{\tau\tau}$		Otherwise		

Process	Particle-level selection	σ [pb]	σ^{SM} [pb]
ggF	$N_{\text{jets}} \geq 1$, $60 < p_{\text{T}}^{H} < 120\,\text{GeV}$, $\lvert y_H\rvert < 2.5$	$1.79 \pm 0.53\,\text{(stat.)} \pm 0.74\,\text{(syst.)}$	0.40 ± 0.05
ggF	$N_{\text{jets}} \geq 1$, $p_{\text{T}}^{H} > 120\,\text{GeV}$, $\lvert y_H\rvert < 2.5$	$0.12 \pm 0.05\,\text{(stat.)} \pm 0.05\,\text{(syst.)}$	0.14 ± 0.03
VBF	$\lvert y_H\rvert < 2.5$	$0.25 \pm 0.08\,\text{(stat.)} \pm 0.08\,\text{(syst.)}$	0.22 ± 0.01

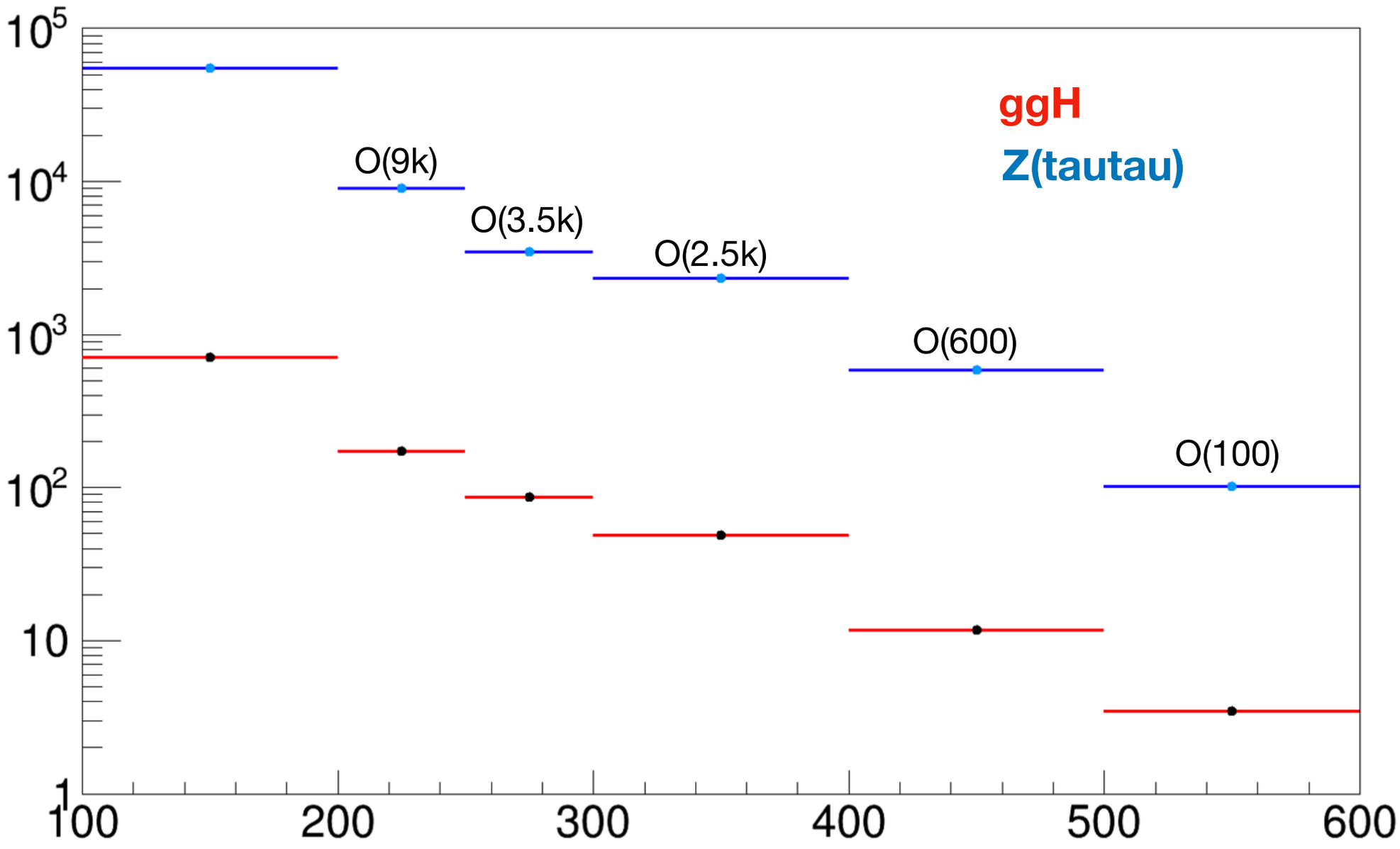
		Boost	
		loose	tight
ggH	fwdH	0	0
	VBFtopo jet3	2	2
	VBFtopo jet3veto	1	1
	J0	0	0
	1J ptH 0 60	0	0
	1J ptH 60 120	34	0
	1J ptH 120 200	40	28
	1J ptH gt200	0	26
	ge2J ptH 0 60	0	0
	ge2J ptH 60 120	21	0
	ge2J ptH 120 200	40	37
	ge2J ptH gt200	1	56

Already from these numbers some reach for pTH > 200GeV

(side-note:
120GeV boundary not ideal, larger contamination from fakes < ~140GeV)

Slightly more detailed look at pTH>200GeV

Consider events passing current "reco-level" selection, look only at truth-level quantities (L=140/fb)



Possible Options for main p_T^H bins

- Coarser: [200, 350, 500, (750), (1000)]
- Finer: [200, (250?), 300, (400), 500, (650), 800, (1000)]

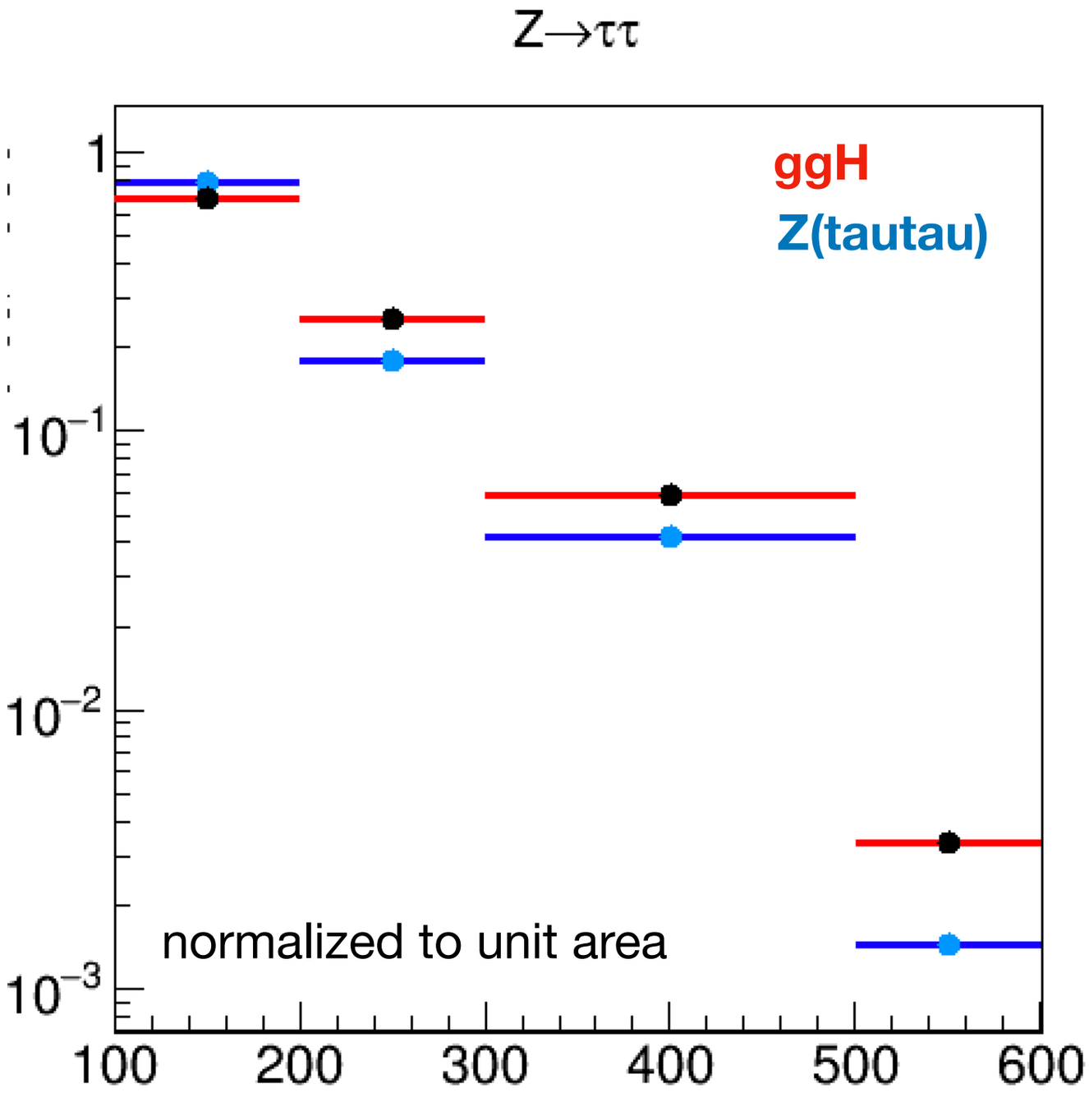
Selection **not** optimized for high-pTH
(hadhad) rapidly loosing power from dR(tautau) selection

Very simple S/sqrt(S+B) in each bin of pTH, gives an idea of the relative sensitivity of the pTH bins across the spectrum

(**not** a realistic estimate of the absolute sensitivity since no info on the m(tautau) discriminating variable is used)

Scaling the "boosted (pTH>100GeV)" 36/fb sensitivity to 140/fb, sigma~6
(many assumptions!)

pTH [GeV]	S/sqrt(S+B)	"sigma"
100-200	0.06	4.5
200-300	0.046	3.5
300-500	0.02	1.5
>500	0.01	0.8

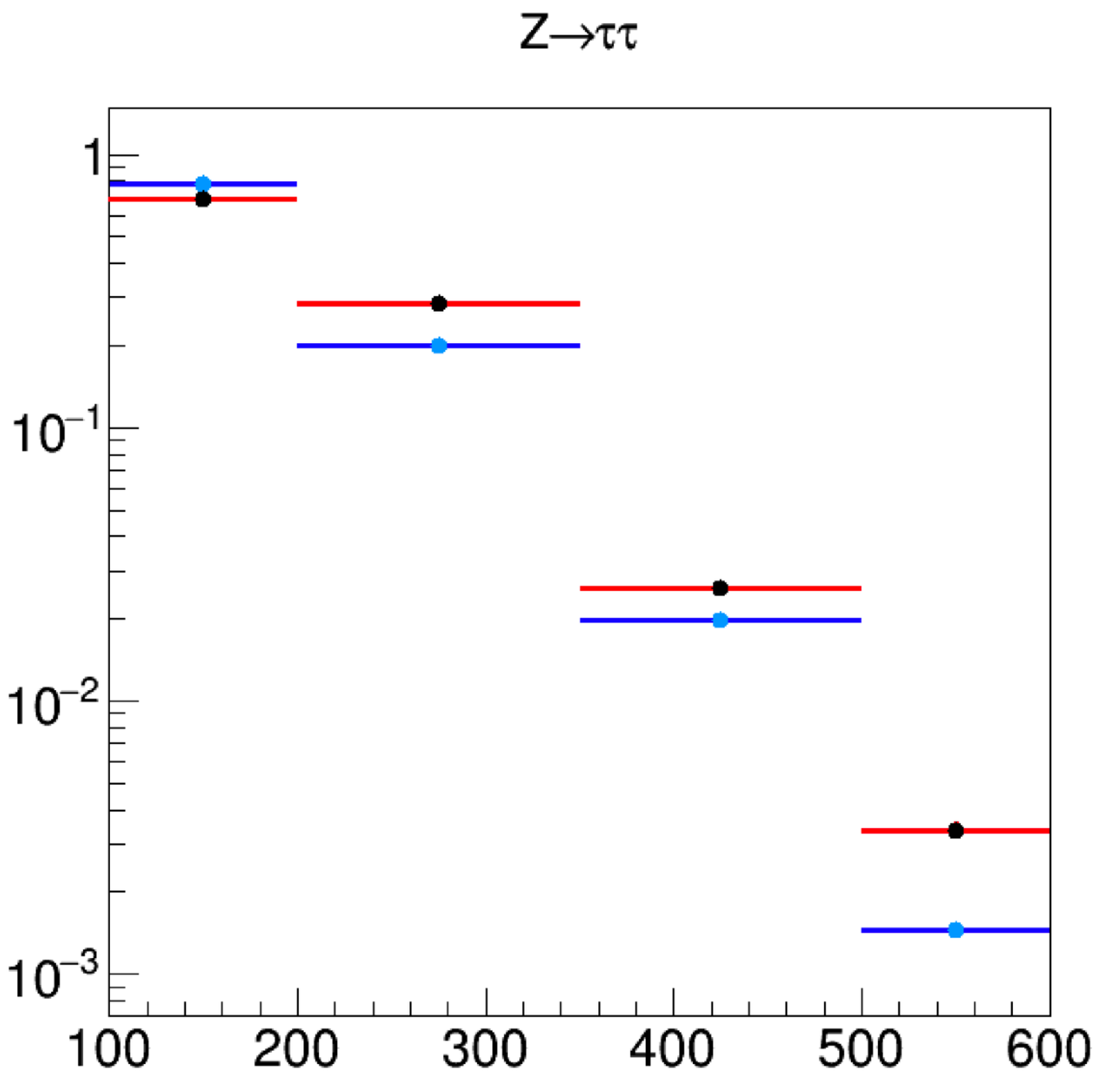


Very simple S/sqrt(S+B) in each bin of pTH, gives an idea of the relative sensitivity of the pTH bins across the spectrum

(**not** a realistic estimate of the absolute sensitivity since no info on the m(tautau) discriminating variable is used)

Scaling the "boosted (pTH>100GeV)" 36/fb sensitivity to 140/fb, sigma~6
(many assumptions!)

pTH [GeV]	S/sqrt(S+B)	"sigma"
100-200	0.06	4.5
200-350	0.049	3.7
350-500	0.014	1.1
>500	0.01	0.8



Very simple S/sqrt(S+B) in each bin of pTH, gives an idea of the relative sensitivity of the pTH bins across the spectrum

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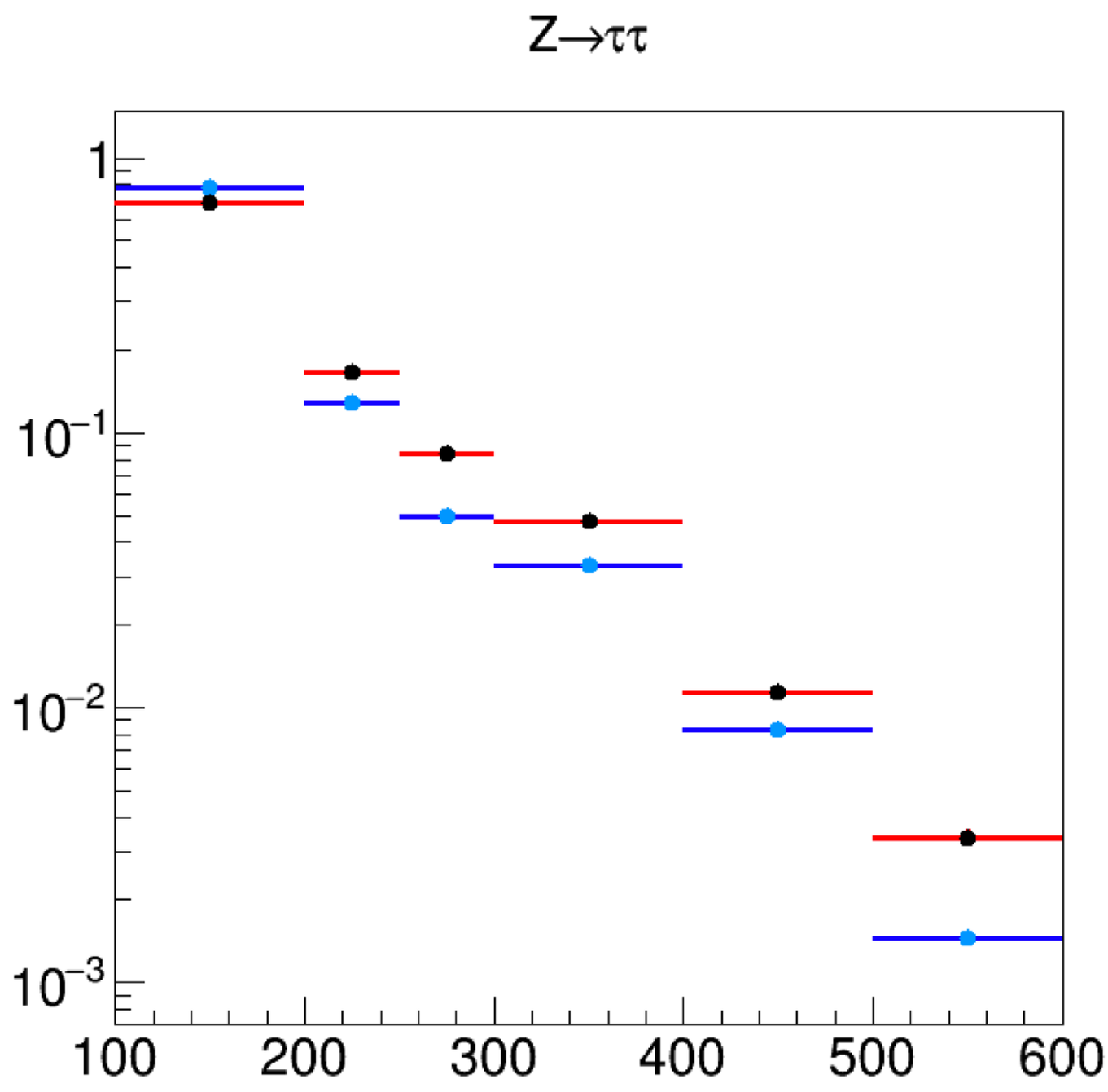
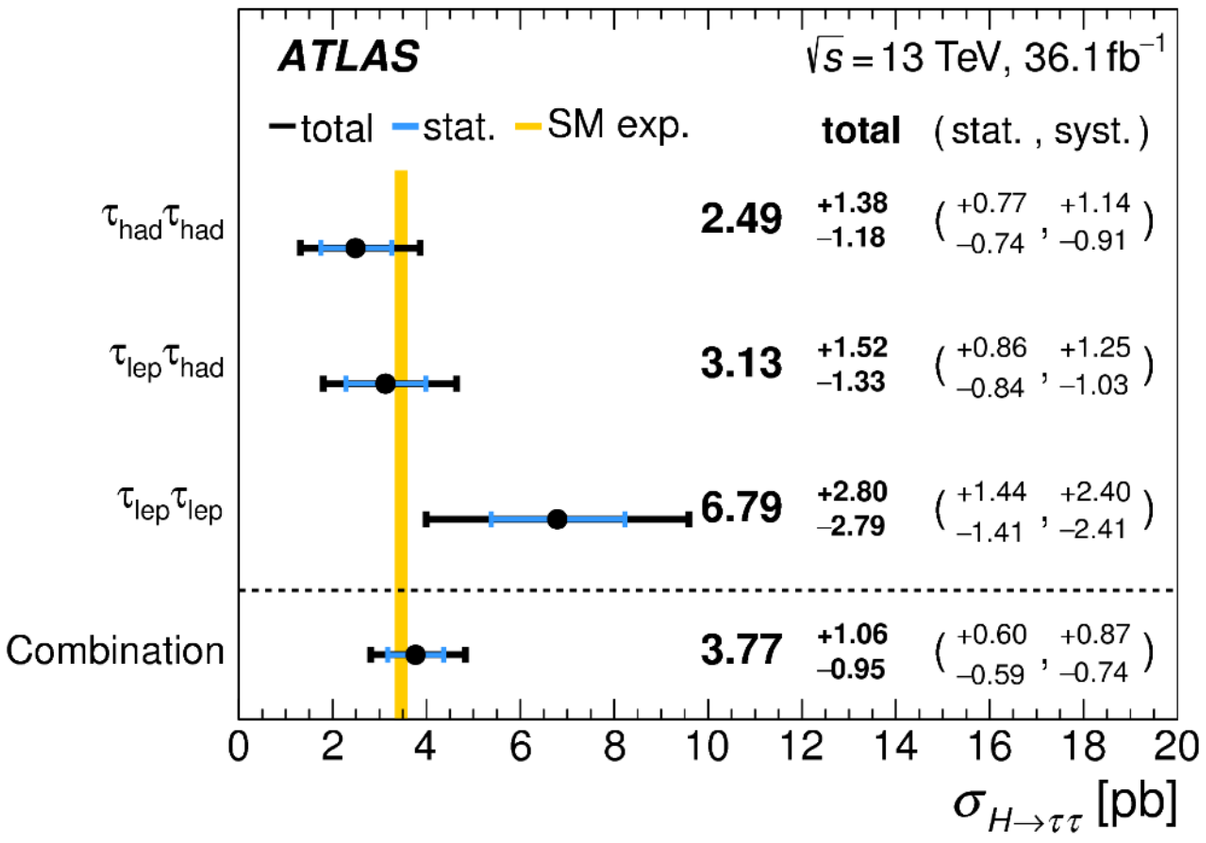
Scaling the "boosted (pTH>100GeV)" 36/fb sensitivity to 140/fb, sigma~6
(many assumptions!)

pTH [GeV]	S/sqrt(S+B)	"sigma"
100-200	0.06	4.5
200-250	0.036	2.7
250-300	0.03	2.2
300-400	0.02	1.5
400-500	0.01	0.8
>500	0.01	0.8



BACK-UP



	$\tau_{\text{had}}\tau_{\text{had}}$ VBF			$\tau_{\text{had}}\tau_{\text{had}}$ boosted	
	Loose	Tight	High-$p_{\text{T}}^{\tau\tau}$	Low-$p_{\text{T}}^{\tau\tau}$	High-$p_{\text{T}}^{\tau\tau}$
$Z \to \tau\tau$	67.3 ± 9.2	100 ± 12	141 ± 12	3250 ± 130	3582 ± 82
Misidentified τ	45.0 ± 5.4	96.4 ± 9.2	20.0 ± 2.9	1870 ± 140	364 ± 53
Other backgrounds	4.4 ± 1.4	11.6 ± 1.7	4.4 ± 0.7	281 ± 21	109.9 ± 9.2
ggF, $H \to \tau\tau$	1.1 ± 0.4	2.0 ± 0.7	3.5 ± 1.0	41 ± 11	48 ± 14
VBF, $H \to \tau\tau$	1.4 ± 0.5	6.4 ± 1.8	11.2 ± 3.0	9.0 ± 3.4	10.7 ± 2.9
WH, $H \to \tau\tau$	< 0.1	< 0.1	< 0.1	3.3 ± 0.9	4.4 ± 1.2
ZH, $H \to \tau\tau$	< 0.1	< 0.1	< 0.1	2.4 ± 0.7	2.9 ± 0.8
$t\bar{t}H$, $H \to \tau\tau$	< 0.1	< 0.1	< 0.1	1.6 ± 0.5	1.9 ± 0.5
Total background	116.7 ± 9.4	208 ± 12	165 ± 12	5401 ± 78	4057 ± 64
Total signal	2.6 ± 0.8	8.6 ± 2.4	14.9 ± 3.8	57 ± 15	68 ± 18
Data	121	220	179	5455	4103