

Material for $gg \rightarrow H$ Binning at High p_T

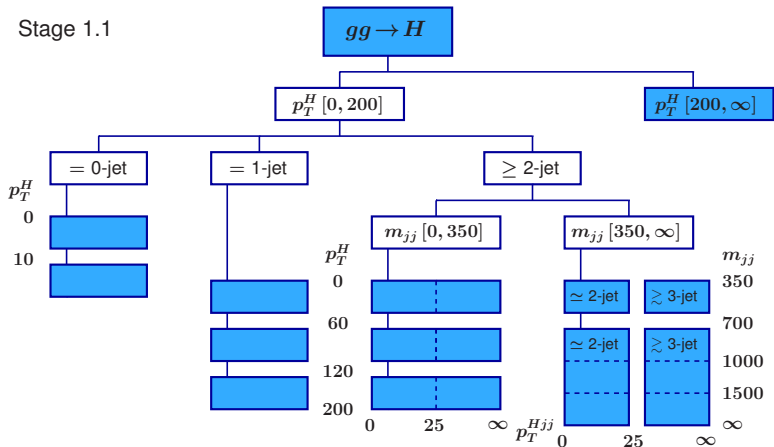
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Deutsches Elektronen-Synchrotron

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Current Stage 1.1.

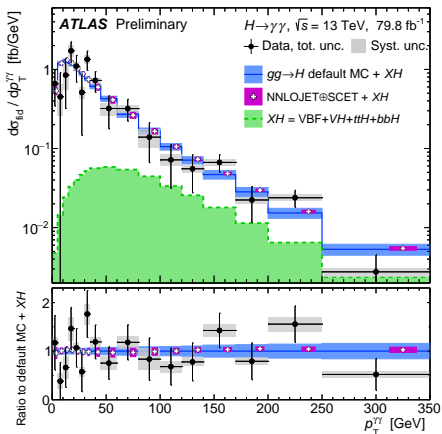
Stage 1.1



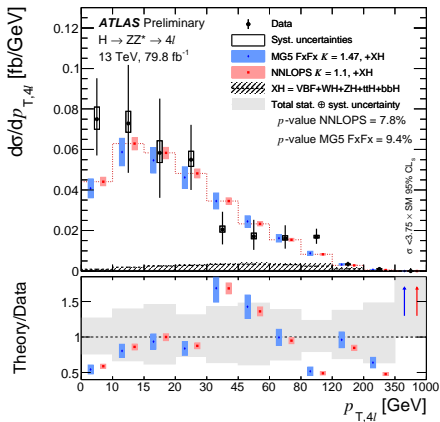
Goal: Define binning for $p_T^H [200, \infty]$ bin

$H \rightarrow \gamma\gamma, ZZ^*$

ATLAS $H \rightarrow \gamma\gamma$ (80/fb)



ATLAS $H \rightarrow ZZ^*$ (80/fb)

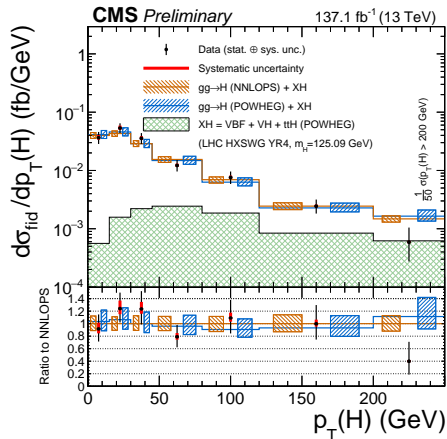


Current binning

- $H \rightarrow \gamma\gamma$: [..., 120, 140, 170, 200, 250, 350, 1000]
- $H \rightarrow ZZ^*$: [..., 120, 200, 350, 1000]

$$H \rightarrow \gamma\gamma, ZZ^*$$

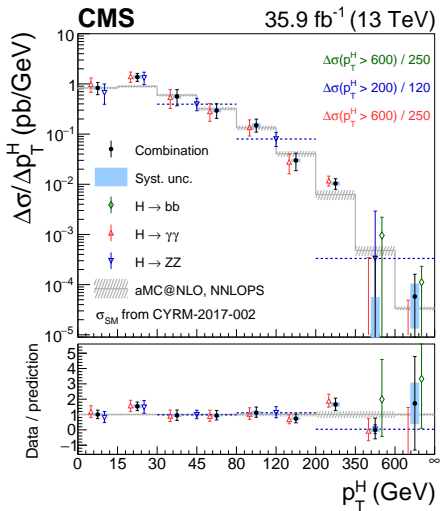
CMS $H \rightarrow ZZ^*$ (137/fb)



Current binning

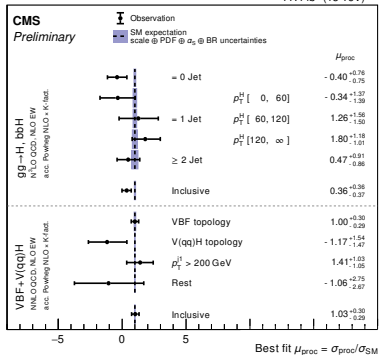
- Combined: [..., 120, 200, 350, 600, ∞]

CMS $H \rightarrow \gamma\gamma + ZZ^* + b\bar{b}$ (36/fb)



CMS $H \rightarrow \tau\tau$ (77/fb)

77.4 fb⁻¹ (13 TeV)



ATLAS $H \rightarrow \tau\tau$ (36/fb)

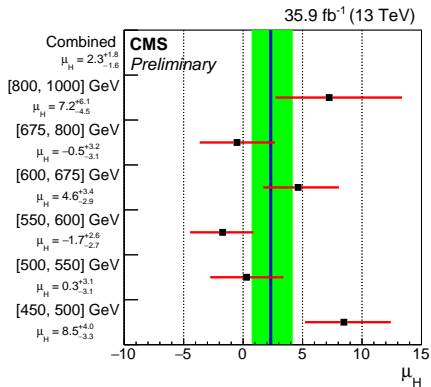
Process	Particle-level selection	σ [pb]	σ^{SM} [pb]
ggF	$N_{\text{jets}} \geq 1, 60 < p_T^H < 120 \text{ GeV}, y_H < 2.5$	1.79 ± 0.53 (stat.) ± 0.74 (syst.)	0.40 ± 0.05
ggF	$N_{\text{jets}} \geq 1, p_T^H > 120 \text{ GeV}, y_H < 2.5$	0.12 ± 0.05 (stat.) ± 0.05 (syst.)	0.14 ± 0.03
VBF	$ y_H < 2.5$	0.25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

50%

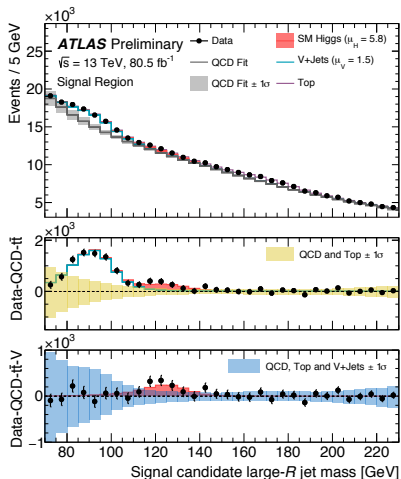
60%

$H \rightarrow b\bar{b}$

CMS $H \rightarrow b\bar{b}$ (36/fb)



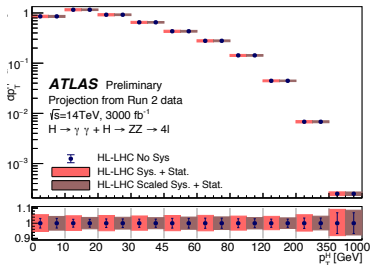
ATLAS $H \rightarrow b\bar{b}$ (80/fb)



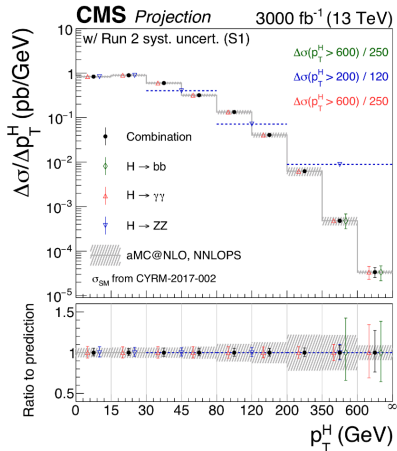
- ATLAS: reco Higgs-jet ($R = 1$) $p_T > 480 \text{ GeV}$
- CMS: $p_T > 450 \text{ GeV}$

HL-LHC Projections.

H->yy+H->ZZ* (3iab)



	200-350	>350
H->yy	6.3%	9.5%
H->ZZ	13.2%	24%
comb	5.4%	8.3%



p _T (H) (GeV)	0-15	15-30	30-45	45-80	80-120	120-200	200-350	350-600	600-∞
H → γγ	7.2%	6.8%	7.1%	6.9%	7.1%	6.7%	7.1%	9.9%	32.5%
H → ZZ	6.2%	5.7%	5.0%		5.5%		7.1%	9.6%	
H → bb	None							38.2%	37.1%
Combination	4.7%	4.4%	5.0%	4.7%	4.8%	4.7%	5.2%	8.5%	25.4%

Options And Questions.

Possible Options for main p_T^H bins

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

Questions

- Where do $H \rightarrow b\bar{b}$, $H \rightarrow \tau\tau$, $H \rightarrow \gamma\gamma/ZZ^*$ sensitivities stop? What can $H \rightarrow WW^*$ do?
- Is it useful to add jet(-like) bins?
 - ▶ What variable: p_T^{jet} , p_T^{jet}/p_T^H , $p_T(Hj)$, some $\Delta\phi$?
 - ▶ What cut value?