

$p_T(H)$ limit for different luminosity: comparison between 2 studies

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Plan

Number of events : comparison between our 2 studies

Signal contribution

Background contribution

Significance

$p_T(H)$ limit for different luminosity

36 fb^{-1}

150 fb^{-1} (2018)

300 fb^{-1}

3000 fb^{-1}

Events with new bins

150 fb^{-1} (2018)

300 fb^{-1}

3000 fb^{-1}

References

Previous values : CMS AN-17-041

For new values:

Signal file :

output_GluGluHToGG_M - 125_13TeV_powheg_pythia8_0.root

Background file :

DiPhotonJetsBox_MGG - 80toInf_13TeV - Sherpa.root

For the new study with Monte Carlo generator, the following values were found with these parameters :

- ▶ $\text{RMS} = 2.797$
- ▶ $\text{Mean} = 124.3 \text{ GeV}$
- ▶ $\sigma_{opt} = 1.01$

So that we select the events in $[121.5 ; 127.1] \text{ GeV}$.

Background values are rounded.

New signal selection

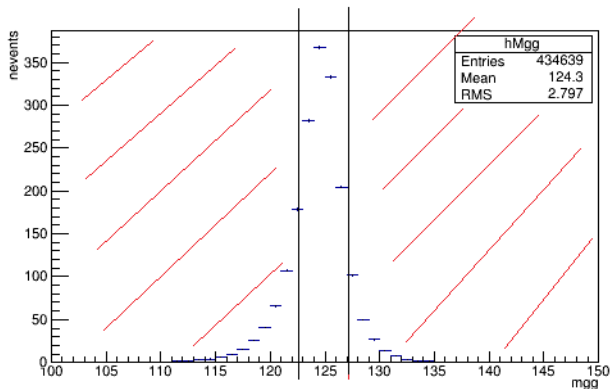


Figure 1: Histogram of the number of events as a function of the Higgs mass, new signal values come from the events between the black lines

Bin 1 : $p_T(H) \in [0; 15]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	540	2250	4500	45000
	Now	339	1696	3392	33920

Bin 2 : $p_T(H) \in [15; 30]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	756	3150	6300	63000
	Now	400	2000	4000	40000

Bin 3 : $p_T(H) \in [30; 45]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	432	1800	3600	36000
	Now	250	1250	2500	25000

Bin 4 : $p_T(H) \in [45; 85]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	576	2400	4800	48000
	Now	281	1406	2812	28120

Bin 5 : $p_T(H) \in [85; 125]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	216	900	1800	18000
	Now	88	437	874	8740

Bin 6 : $p_T(H) \in [125; 200]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	162	675	1350	13500
	Now	57	287	573	5730

Bin 7 : $p_T(H) \in [200; 350]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	81	338	675	6750
	Now	26	130	260	2600

Bin 8 : $p_T(H) \in [350; +\infty[$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	1.3	5	10.5	105
	Now	5.6	28	56	560

New background selection

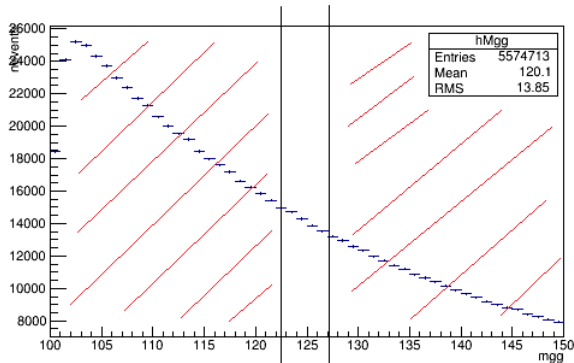


Figure 2: Histogram of the number of events as a function of the Higgs mass, new background values come from the events between the black lines

Bin 1 : $p_T(H) \in [0; 15]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	19200	80000	160000	1600000
	Now	12000	60000	120000	1200000

Bin 2 : $p_T(H) \in [15; 30]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	19000	80000	160000	1600000
	Now	16000	80000	160000	1600000

Bin 3 : $p_T(H) \in [30; 45]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	9000	37000	75000	750000
	Now	15000	75000	150000	1500000

Bin 4 : $p_T(H) \in [45; 85]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	10000	44000	87000	870000
	Now	25000	125000	250000	2500000

Bin 5 : $p_T(H) \in [85; 125]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	3000	12000	24000	240000
	Now	9000	45000	90000	900000

Bin 6 : $p_T(H) \in [125; 200]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	1000	5000	10000	100000
	Now	4000	20000	40000	400000

Bin 7 : $p_T(H) \in [200; 350]$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	300	1200	2400	24000
	Now	1000	5000	10000	100000

Bin 8 : $p_T(H) \in [350; +\infty[$ GeV

Luminosity (fb^{-1})		36	150	300	3000
Number of events	Previously	17.2	70	140	1400
	Now	100	500	1000	10000

Bin 1 : $p_T(H) \in [0; 15]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	339	1696	3392	33920
Background	12000	60000	120000	1200000
Significance	3.1	6.9	9.8	31

Bin 2 : $p_T(H) \in [15; 30]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	400	2000	4000	40000
Background	16000	80000	160000	1600000
Significance	3.2	7.1	10	32

Bin 3 : $p_T(H) \in [30; 45]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	250	1250	2500	25000
Background	15000	75000	150000	1500000
Significance	2.0	4.6	6.5	20

Bin 4 : $p_T(H) \in [45; 85]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	281	1406	2812	28120
Background	25000	125000	250000	2500000
Significance	1.8	4.0	5.6	17.8

Bin 5 : $p_T(H) \in [85; 125]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	88	437	874	8740
Background	9000	45000	90000	900000
Significance	0.9	2.1	2.9	9.2

Bin 6 : $p_T(H) \in [125; 200]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	57	287	573	5730
Background	4000	20000	40000	400000
Significance	0.9	2.0	2.9	9.1

Bin 7 : $p_T(H) \in [200; 350]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	26	130	260	2600
Background	1000	5000	10000	100000
Significance	0.8	1.8	2.6	8.2

Bin 8 : $p_T(H) \in [350; +\infty]$ GeV

Luminosity (fb^{-1})	36	150	300	3000
Signal	5.6	28	56	560
Background	100	500	1000	10000
Significance	0.6	1.3	1.8	5.6

Luminosity: 36 fb^{-1}

Limit imposed: at least 10 events for each bin

Maximum amplitude: 300 GeV

As we can see on slide 10: After 350 GeV there are only 6 events. We keep the maximum given by the document :

$$p_T(H)_{max} = 350 \text{ GeV} \quad (1)$$

Luminosity: 150 fb^{-1}

$p_T(H)(\text{GeV})$	≥ 457	≥ 458	[450;750]
Number of events	10.17	9.98	10.12

$$p_T(H)_{max} = 750 \text{ GeV} \quad (2)$$

We keep the following bins:

$p_T(H)(\text{GeV})$	[200;300]	[300;450]	[450;750]
Number of events	128.7	42.38	10.12

Luminosity: 300 fb^{-1}

$p_T(H)(\text{GeV})$	≥ 525	[525;800]	[500;800]
Number of events	10.19	9.33	12.46

$$p_T(H)_{max} = 800 \text{ GeV} \quad (3)$$

We keep the following bins:

$p_T(H)(\text{GeV})$	[350;500]	[500;800]
Number of events	47.97	12.46

Luminosity: 3000 fb^{-1}

$p_T(H)(\text{GeV})$	≥ 785	≥ 786	[785;1085]	[750;1050]
Number of events	10.28	9.85	9	11.13

$$p_T(H)_{max} = 1050 \text{ GeV} \quad (4)$$

We keep the following bins:

$p_T(H)(\text{GeV})$	[350;450]	[450;550]	[550;750]	[750;1050]
Number of events	398	133	68.96	11.13

For the following values, we used RMS and Mean of each bin to select the events in [mean−1.01 RMS ; mean+1.01 RMS], like in the first part of this presentation.

We also select the events such as :

$$\frac{\sigma_M}{M} \leq 0.03 \quad (5)$$

Luminosity: 150 fb^{-1}

$p_T(H)(\text{GeV})$	[200;300]	[300;450]	[450;750]
RMS	2.08	1.944	1.655
Mean	124.5	124.5	124.6
Signal	99	33.3	7.6
Background	3200	610	65
Significance	1.75	1.35	0.94

Luminosity: 300 fb^{-1}

$p_T(H)(\text{GeV})$	[200;350]	[350;500]	[500;800]
RMS	2.087	1.706	1.667
Mean	124.5	124.5	124.5
Signal	235	35.7	9.55
Background	7100	540	75
Significance	2.79	1.54	1.10

Luminosity: 3000 fb^{-1}

$p_T(H)(\text{GeV})$	[200;350]	[350;450]	[450;550]	[550;750]
RMS	2.087	1.717	1.781	1.382
Mean	124.5	124.5	124.5	124.6
Signal	2346	297	101	49.7
Background	71000	4800	1000	340
Significance	8.80	4.29	3.19	2.70

$p_T(H)(\text{GeV})$	[750;1050]
RMS	1.354
Mean	123.9
Signal	8.14
Background	67
Significance	0.99