

$H \rightarrow b\bar{b}$ - Semi Leptonic: combination of background prediction

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Short description of background prediction

B-tag Matrix only (PAS)

- normalization: from BM with scale factor from data control region + extrapolation from control to signal region from MC
- bin central value: use that of BM.
- bin error: use that of the weighted average:

Proposed Weighted Average

- **normalization: get absolute prediction (as in the PAS) independently for BM and HB. Then absolute prediction is the weighted average of the two.**
- **bin central value: use the weighted average;**
- bin error: use that of the weighted average:

In **red** what changes between the two background determination methods.

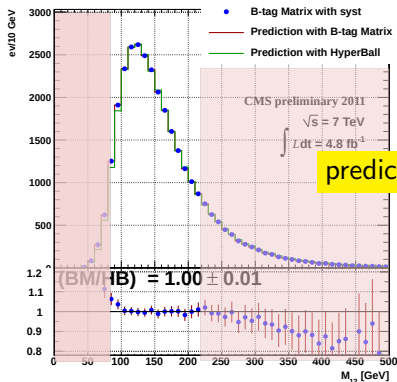


How big are the changes?

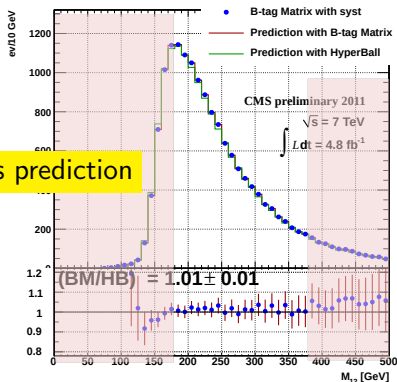
In signal region



Low Mass $M_H < 200$ GeV



High Mass $M_H > 200$ GeV



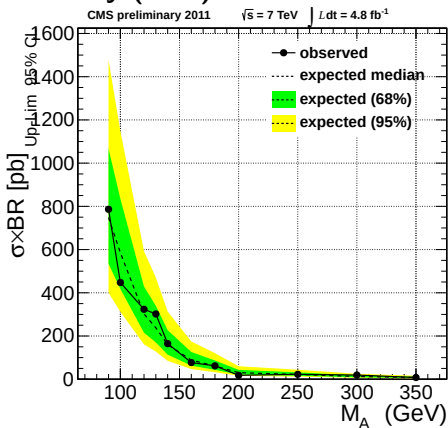
prediction vs prediction

- Absolute prediction, **NOT** normalized to each other;
- Both normalization and shape are very similar
- no significant changes moving from BM only (PAS) to weighted average.

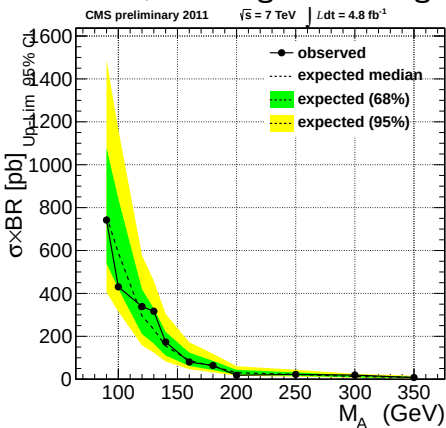


Limit on $\sigma \times BR$: B-tag Matrix vs Weighted Average

BM only (PAS)



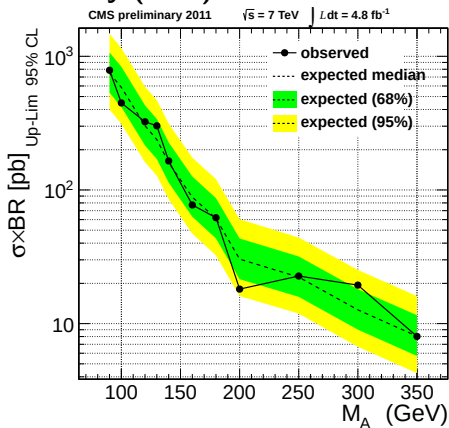
BM+HB weighted average



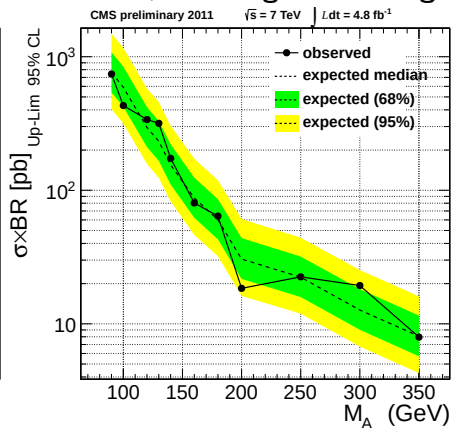


Limit on $\sigma \times BR$: B-tag Matrix vs Weighted Average

BM only (PAS)



BM+HB weighted average





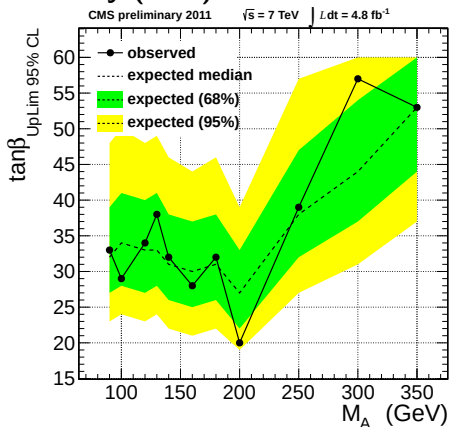
Limit on $\sigma \times BR$: B-tag Matrix vs Weighted Average

Mass (GeV)	Expected		Observed	
	BM	BM+HB	BM	BM+HB
90	786.49	741.845	747.989	760.403
100	447.715	430.762	585.5	589.952
120	323.684	338.621	302.39	295.219
130	302.019	317.128	238.053	232.539
140	164.874	173.437	160.102	154.917
160	77.223	80.3027	88.3517	87.5221
180	62.0003	64.0477	61.1897	60.1302
200	18.1158	18.4405	30.3794	30.5535
250	22.6946	22.4799	22.2784	22.3463
300	19.405	19.3451	12.6742	12.6742
350	8.01848	7.95511	8.05031	8.07628

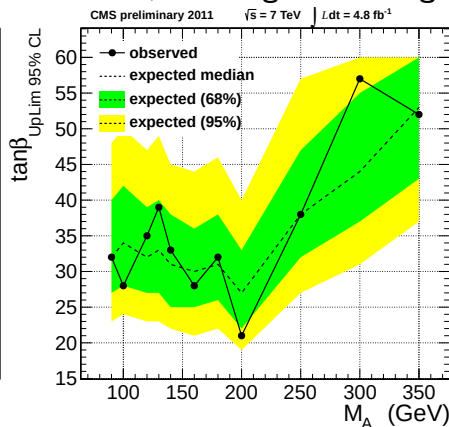


Limit on $\tan \beta$: B-tag Matrix vs Weighted Average

BM only (PAS)



BM+HB weighted average





Limit on $\tan \beta$: B-tag Matrix vs Weighted Average



Mass (GeV)	Expected		Observed	
	BM	BM+HB	BM	BM+HB
90	32	32	33	32
100	34	34	29	28
120	33	32	34	35
130	33	33	38	39
140	31	31	32	33
160	30	30	28	28
180	31	31	32	32
200	27	27	20	21
250	38	38	39	38
300	44	44	57	57
350	53	53	53	52



Conclusion



- In the PAS we used only B-tag matrix method to derive the background prediction, and the hyperball “only” for systematics
- we think that one of the key point of this analysis is to have two independent, data-driven background determination;
- this feature allows to test the robustness of the analysis, before opening the blind box, and to compute *a posteriori* systematics;
- We do want to use both methods by combining the prediction via a weighted average
- Since the two prediction (BM and HB) are very similar both for normalization and shape, the effect is quite small.



Limit on $\sigma \times BR$: Weighted Average

Mass	Obs	Exp	+1 σ	-1 σ	+2 σ	-2 σ
90	741.845	760.403	318.255	220.46	727.855	354.954
100	430.762	589.952	251.618	168.184	575.281	274.236
120	338.621	295.219	123.559	84.5147	282.582	137.807
130	317.128	232.539	97.3254	66.5706	225.532	108.548
140	173.437	154.917	66.073	44.3492	149.111	72.3147
160	80.3027	87.5221	36.631	25.2653	84.8851	41.1969
180	64.0477	60.1302	25.6459	17.2139	58.6349	28.0686
200	18.4405	30.5535	13.2748	8.87615	30.3379	14.3816
250	22.4799	22.3463	9.53084	6.47874	21.7906	10.4312
300	19.3451	12.6742	5.50665	3.65144	12.5847	5.91626
350	7.95511	8.07628	3.44459	2.36111	7.9773	3.80153



Limit on $\sigma \times BR$: B-tag Matrix (PAS)

Mass	Obs	Exp	+1 σ	-1 σ	+2 σ	-2 σ
90	786.49	747.989	319.022	213.237	729.388	347.698
100	447.715	585.5	249.719	167.616	563.555	273.309
120	323.684	302.39	126.561	87.119	289.447	141.155
130	302.019	238.053	101.531	67.5791	232.134	110.193
140	164.874	160.102	67.0083	46.4176	153.249	74.7353
160	77.223	88.3517	37.6826	25.2931	86.1546	41.2423
180	62.0003	61.1897	25.61	17.7764	59.3461	28.8022
200	18.1158	30.3794	12.957	8.88143	30.007	14.2997
250	22.6946	22.2784	9.50188	6.41843	21.7244	10.3995
300	19.405	12.6742	5.40561	3.65869	12.5188	5.96576
350	8.01848	8.05031	3.49769	2.32391	7.99352	3.78931



Limit on $\tan \beta$: Weighted Average

Mass	Obs	Exp	+1 σ	-1 σ	+2 σ	-2 σ
90	32	32	8	5	16	9
100	28	34	8	6	16	10
120	35	32	7	5	15	9
130	39	33	7	6	16	10
140	33	31	7	6	14	9
160	28	30	6	5	14	9
180	32	31	7	5	15	9
200	21	27	6	5	13	8
250	38	38	9	6	19	11
300	57	44	11	7	16	13
350	52	53	7	10	7	16



Limit on $\sigma \times BR$: B-tag Matrix (PAS)

Mass	Obs	Exp	+1 σ	-1 σ	+2 σ	-2 σ
90	33	32	7	5	16	9
100	29	34	7	6	16	10
120	34	33	7	6	15	10
130	38	33	8	5	16	9
140	32	31	7	5	15	9
160	28	30	7	5	14	9
180	32	31	7	5	15	9
200	20	27	6	5	12	8
250	39	38	9	6	19	11
300	57	44	10	7	16	13
350	53	53	7	9	7	16