

Predicting the dijet mass distribution of tagged b jets using the $ZH + E_T^{miss}$ Analysis

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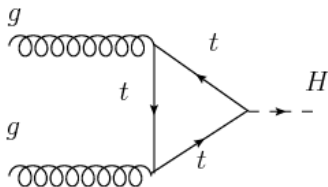
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Outline

- 1 Motivation
- 2 Samples
- 3 Selection
- 4 Cutoffs
- 5 Summary

Motivation

- Model developed requires H be produced primarily through ggF and decay to hh , VV and $h\chi\chi$



- Embedding H into a 2HDM beckons a new search channel:

$$pp \rightarrow A \rightarrow ZH$$

implying a search channel for large mass A , for hypothesized pseudo-scalar A .

- The large $H \rightarrow h\chi\chi$ and $h \rightarrow b\bar{b}$ branching ratios open up the $Vh + E_T^{miss}$ channels

Signal and Background

- Signal decays as $pp \rightarrow A \rightarrow l^\pm l^\mp b\bar{b} + E_T^{miss}$, for l^\pm either μ^\pm or e^\pm

$$pp \rightarrow A \rightarrow ZH$$

$$Z \rightarrow l^+l^-, H \rightarrow h\chi\chi$$

$$h \rightarrow b\bar{b}$$

- Background decays as given in samples ran over

Samples

The samples ran over were

- Single Top
- Diboson
- $W + \text{jets}$
- $Z + \text{jets}$
- $t\bar{t}$

Selection

The preselections are as follows:

- $ee/\mu\mu$ ($e\mu/\mu e$) final states + b-jets
- Exactly two oppositely charged leptons with $p_T > 25$ GeV
- $Z \rightarrow ll$ region for $70 < m_{ll} < 110$ GeV
- At least two central jets
- $E_T^{miss} > 100$ GeV
- $\Delta\phi(j1, E_T^{miss}) > 0.5$
- $\Delta\phi(j2, E_T^{miss}) > 0.5$
- B-tagging is done to all selected central jets
- In the 1 b-tag Category, we have *exactly* one b-jet
- In the 2 b-tag Category at least one of the b-jets must have $p_T > 45$ GeV
- MC comparison presented

Cutflows

Same Flavour Scheme

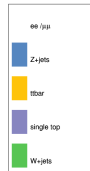
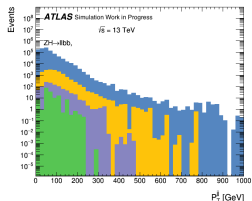
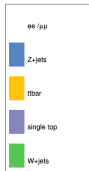
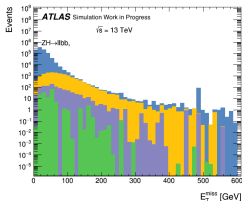
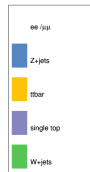
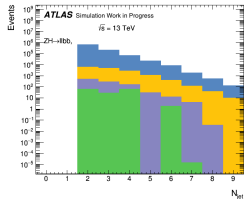
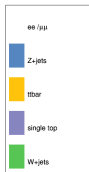
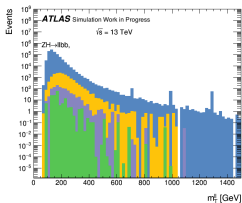
$ee/\mu\mu$	Single Top	Diboson	W+Jets	Z+Jets	t \bar{t} l
No Cuts	9790.13 \pm 16.85	6579.72 \pm 75.22	43970.93 \pm 660.50	1883642.25 \pm 4824.70	107052.43 \pm 99.49
Opposite Charge	8588.12 \pm 15.70	6366.03 \pm 74.13	24653.45 \pm 478.14	1861689.12 \pm 4804.25	99578.14 \pm 95.95
Same Flavour	4309.85 \pm 11.12	6166.61 \pm 72.80	11658.15 \pm 323.77	1843588.00 \pm 4791.81	49938.71 \pm 67.96
Lepton p_T	2413.90 \pm 8.27	4344.61 \pm 61.08	890.54 \pm 84.10	1347672.12 \pm 4340.26	29059.95 \pm 51.84
m_{ll}	639.91 \pm 4.26	4191.63 \pm 60.12	182.57 \pm 45.40	1281533.62 \pm 4287.27	8188.96 \pm 27.53
At least 2 jets	435.30 \pm 3.51	3422.53 \pm 54.76	130.24 \pm 32.40	500706.16 \pm 2484.59	7443.30 \pm 26.24
$E_T^{miss} > 100$ GeV	89.15 \pm 1.59	11.19 \pm 2.39	12.57 \pm 4.17	706.34 \pm 55.94	1571.01 \pm 12.04
$\Delta\phi(j1, E_T^{miss}) > 0.5$	87.76 \pm 1.58	9.28 \pm 1.76	12.45 \pm 4.16	570.42 \pm 52.97	1541.29 \pm 11.93
$\Delta\phi(j2, E_T^{miss}) > 0.5$	79.67 \pm 1.50	3.40 \pm 0.98	12.14 \pm 4.16	447.34 \pm 49.35	1368.99 \pm 11.24
Exactly 1b	42.97 \pm 1.10	1.06 \pm 0.62	0.46 \pm 0.27	24.93 \pm 4.20	649.61 \pm 7.75
Exactly 2b	16.11 \pm 0.68	0.00 \pm 0.00	0.04 \pm 0.02	2.37 \pm 1.18	490.09 \pm 6.72
b-jet $p_T > 45$ GeV	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00

Cutflows

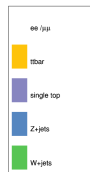
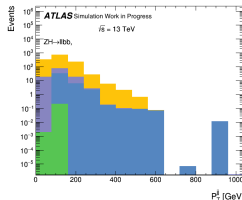
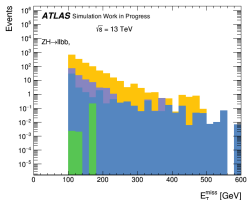
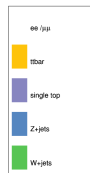
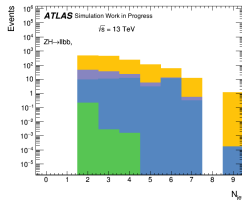
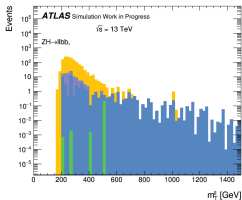
Different Flavour Scheme

$e\mu/\mu e$	Single Top	Diboson	W+Jets	Z+Jets	$t\bar{t}$
No Cuts	9790.13 \pm 16.85	6579.72 \pm 75.22	43970.93 \pm 660.50	1883642.25 \pm 4824.70	107052.43 \pm 99.49
Opposite Charge	8588.12 \pm 15.70	6366.03 \pm 74.13	24653.45 \pm 478.14	1861689.12 \pm 4804.25	99578.14 \pm 95.95
Different Flavour	4278.26 \pm 11.08	199.42 \pm 13.98	12995.30 \pm 351.84	18101.14 \pm 345.59	49639.43 \pm 67.74
Lepton $p_T > 25\text{GeV}$	2387.51 \pm 8.22	41.22 \pm 6.79	1086.84 \pm 107.67	7299.90 \pm 225.93	28852.22 \pm 51.65
m_{ll}	638.78 \pm 4.26	13.41 \pm 3.57	247.19 \pm 56.10	5688.96 \pm 206.32	8119.21 \pm 27.40
At Least 2 jets	438.17 \pm 3.53	8.56 \pm 3.10	189.05 \pm 46.39	2288.16 \pm 124.05	7368.57 \pm 26.10
E_T^{miss}	88.70 \pm 1.59	1.40 \pm 0.74	8.03 \pm 4.06	38.19 \pm 9.94	1569.08 \pm 12.04
$\Delta\phi(j1, E_T^{miss}) > 0.5$	87.11 \pm 1.57	0.77 \pm 0.47	7.99 \pm 4.06	16.28 \pm 8.26	1542.07 \pm 11.93
$\Delta\phi(j2, E_T^{miss}) > 0.5$	78.80 \pm 1.49	0.36 \pm 0.24	7.52 \pm 4.05	7.40 \pm 6.29	1364.80 \pm 11.22
Exactly 1 b jet	43.44 \pm 1.11	0.19 \pm 0.18	0.67 \pm 0.27	1.29 \pm 0.57	657.72 \pm 7.79
At least 2 b jets	16.23 \pm 0.68	0.00 \pm 0.00	0.02 \pm 0.02	0.06 \pm 0.11	480.07 \pm 6.65
b-jet $p_T > 45\text{GeV}$	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00

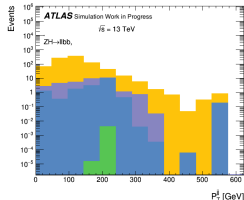
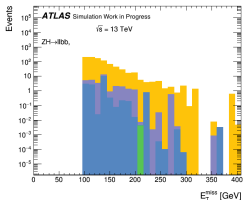
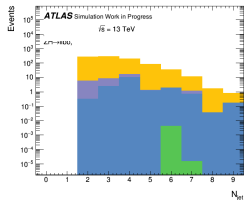
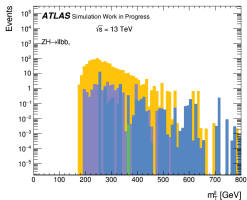
$ee/\mu\mu$: At least 2 b jets

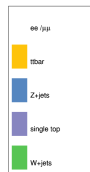
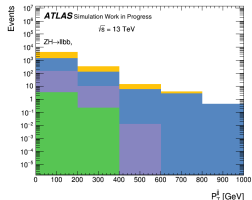
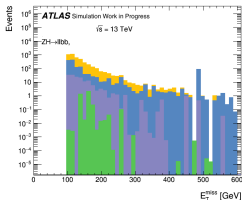
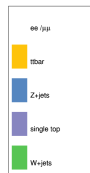
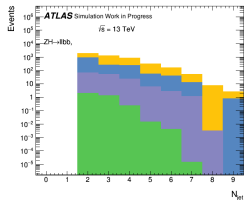
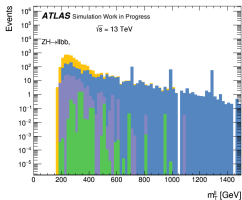


$ee/\mu\mu$: Exactly 1 b jet

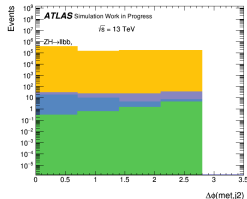
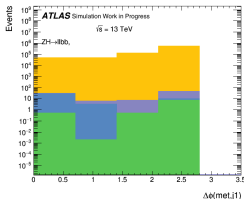
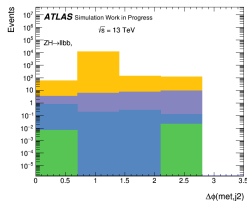
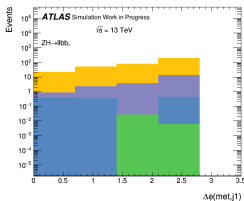


$ee/\mu\mu$: Exactly 2 b jets

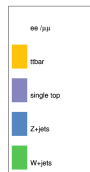
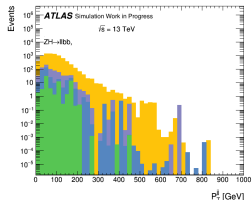
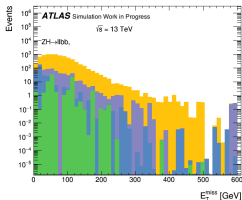
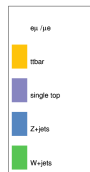
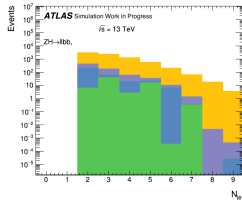
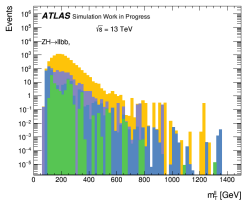


$$ee/\mu\mu: E_T^{miss} > 100 \text{ GeV}$$


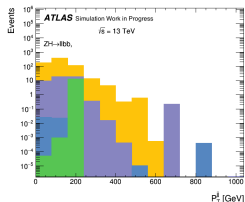
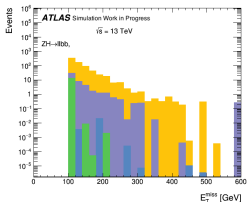
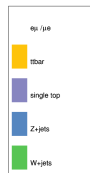
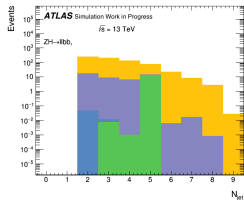
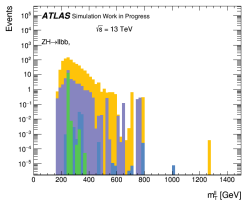
$ee/\mu\mu$: $\delta\phi$ for 2 b jets and $E_T^{miss} > 100\text{GeV}$



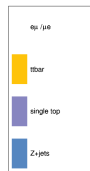
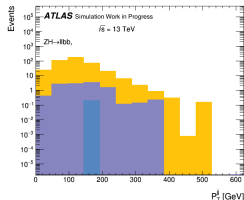
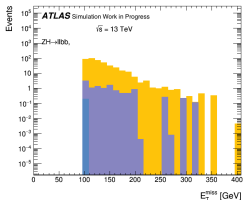
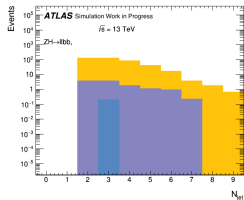
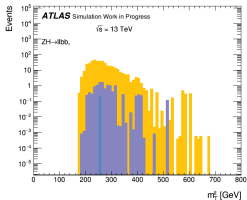
$e\mu/\mu e$: At least 2 jets

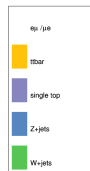
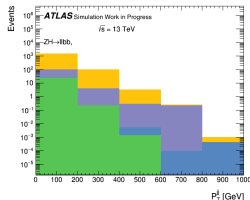
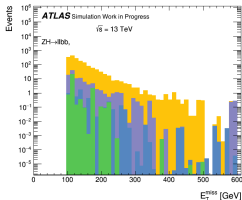
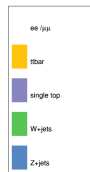
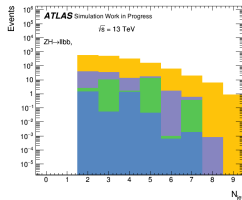
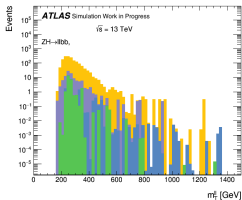


$e\mu/\mu e$: Exactly 1 b jet



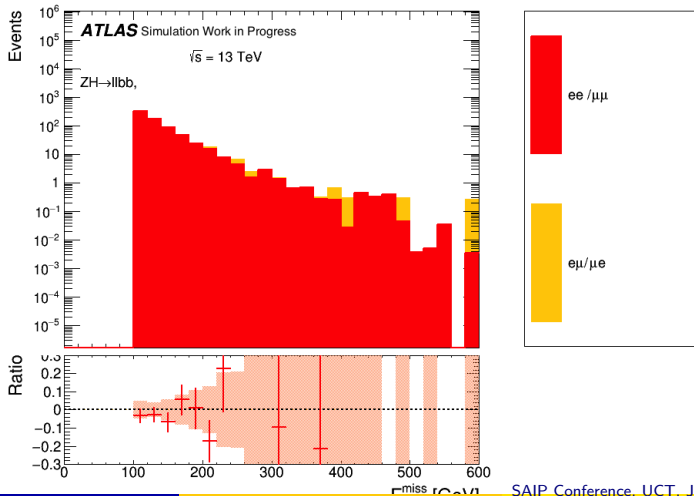
$e\mu/\mu e$: Exactly 2 b jets



$$e\mu/\mu e: E_T^{miss} > 100 \text{ GeV}$$


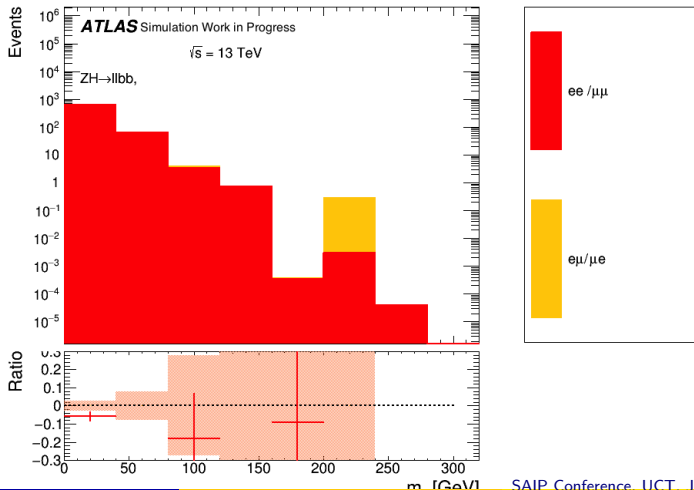
Comparison Distributions

$$E_T^{miss} > 100 \text{ GeV}$$



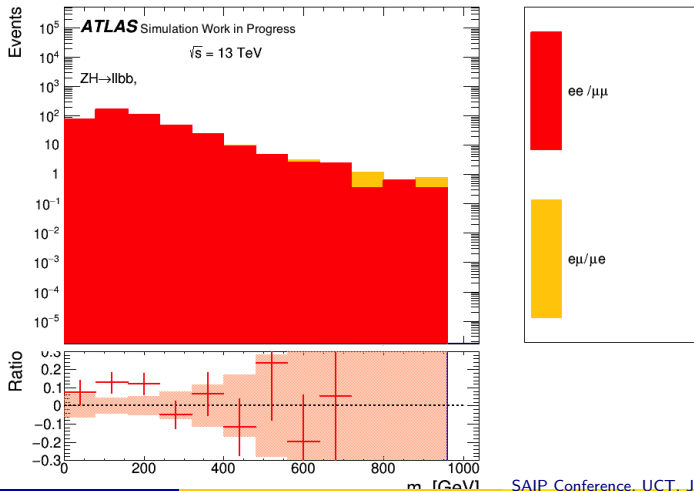
Comparison Distributions

Exactly 1 b jet



Comparison Distributions

Exactly 2 b jets



Summary

- Additional selections have suppressed the z +jets Bkg
- Very few statistics after 2 b cut
- Idea is to show that if the m_{jj} distributions for the $ee/\mu\mu$ and $e\mu/\mu e$ case are almost the same, then we can use a data driven method to predict the shape of m_{jj}
- This shows how to extract the top background