

Search for Higgs boson in $WH, H \rightarrow b\bar{b}$ decay channel with the ATLAS detector

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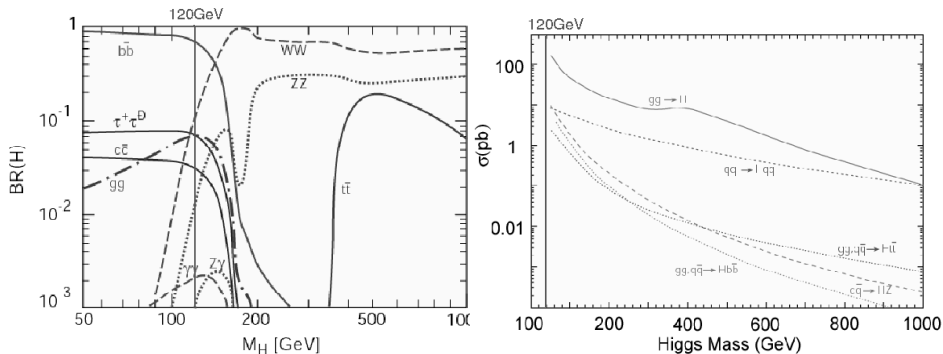
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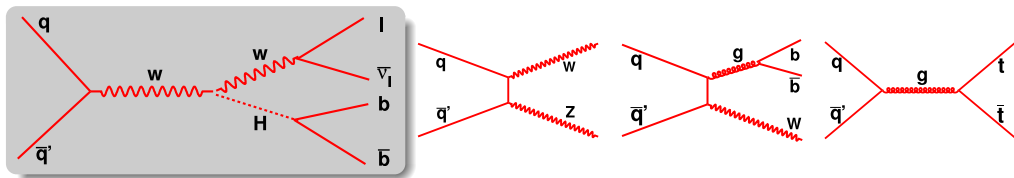
- Introduction
- MC samples
- Reconstruction efficiency and resolution
- Analysis result
- Summary and plans

Introduction



- $H \rightarrow b\bar{b}$ decay is dominant when Higgs mass is around 120 GeV
- $H \rightarrow b\bar{b}$ can be observed only in associated production with $t\bar{t}$ or W/Z boson (a lepton from $t\bar{t}$, W/Z decay is needed for trigger)
- WH production model is very challenging due to large irreducible and reducible backgrounds from WZ , $W+\text{jets}$, $Z+\text{jets}$, etc
- First study with full simulation

Produced Data samples

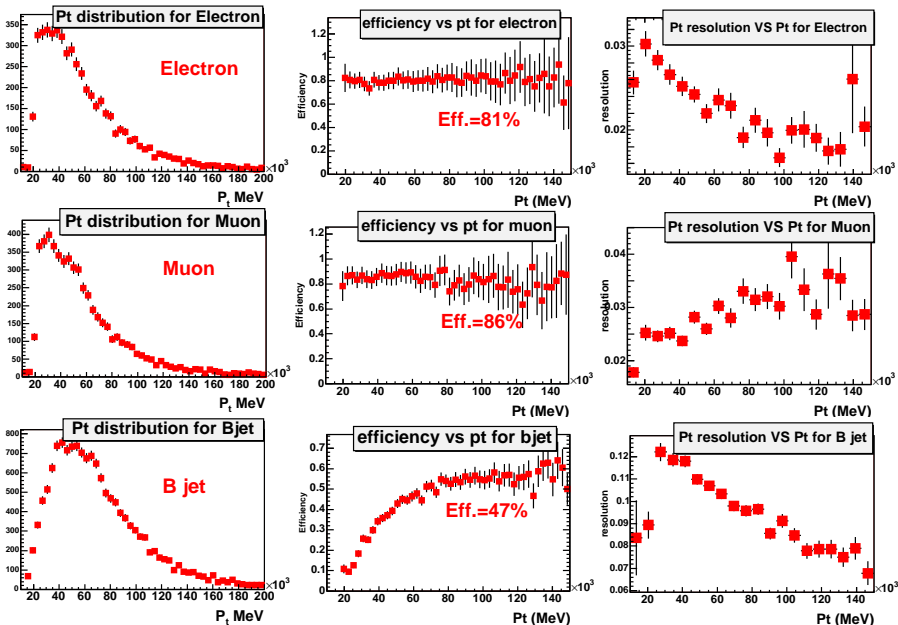


Produced MC samples for signal and some important backgrounds

Sample	$\sigma(\text{pb})$	MC generator		$N_{\text{generated}} (10^4)$		$N_{\text{expected for } \mathcal{L}=30 \text{ fb}^{-1}} (10^4)$
		Fast	Full	Fast	Full	
WH $W \rightarrow l\bar{\nu}_l$ $H \rightarrow b\bar{b}$	0.28	Pythia	Pythia	50	2.1	0.84
W+jets $W \rightarrow l\bar{\nu}_l$	114800	Pythia	-	4500	-	344400
WZ $W \rightarrow l\bar{\nu}_l$ $Z \rightarrow b\bar{b}$	1.3	Pythia	Pythia	100	1.1	3.9
WZ $W \rightarrow \text{Jets}$ $Z \rightarrow ll$	1.8	Pythia	-	100	-	5.4
WZ $W \rightarrow l\bar{\nu}_l$ $Z \rightarrow udsc$	4.8	Pythia	-	100	-	14.4
Z+jets $Z \rightarrow ll$	22822	Pythia	-	3630	-	68466
ZZ $Z \rightarrow ll$ $Z \rightarrow b\bar{b}$	0.38	Pythia	-	100	-	1.1
WW $W \rightarrow \text{Jets}$ $W \rightarrow udsc$	32.0	Pythia	-	200	-	96.0
$t\bar{t} \rightarrow WWb\bar{b}$ (W decay freely)	488.5	Pythia	MC@NLO	480	31.5	1465.5

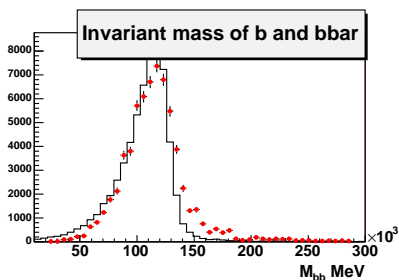
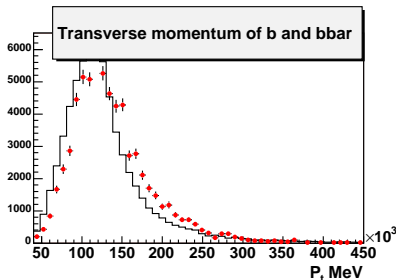
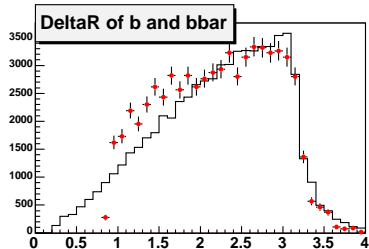
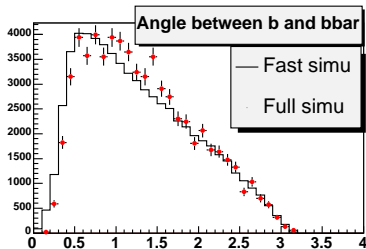
- **1 isolated lepton**
 - $P_t > 20$ GeV, $|\eta| < 2.5$
 - $E_t < 10$ GeV within the isolation cone of radius $\Delta R = \sqrt{(\Delta\eta)^2 + (\Delta\phi)^2} = 0.4$
 - e-id: E-M cluster has a matched track in ID and cluster shape is consistent with e-hypotheses
 - μ -id: combined fit of muon track has good quality
- **2 good b jets**
 - $P_t > 15$ GeV, $|\eta| < 2.5$
 - b-tag: standard ATLAS b-tagging
- To reject $t\bar{t}$ background: no additional leptons with $P_t > 6$ GeV, $|\eta| < 2.5$, no additional jets with $P_t > 15$ GeV, $|\eta| < 5$

Reconstruction efficiency and resolution



P_t resolutions are around 2.5% for electrons, 3.0% for muons, 12% for b jets

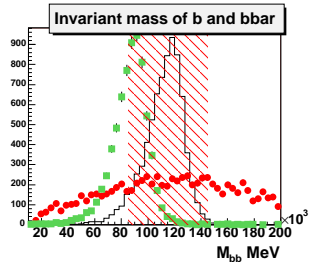
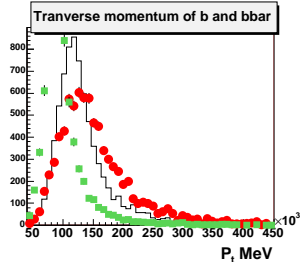
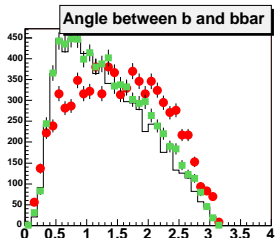
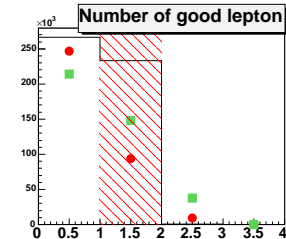
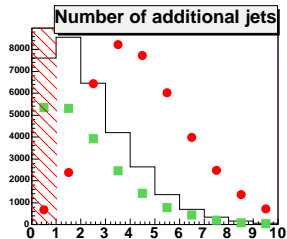
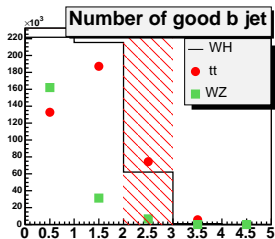
Comparison of Fast and Full simulation for signal



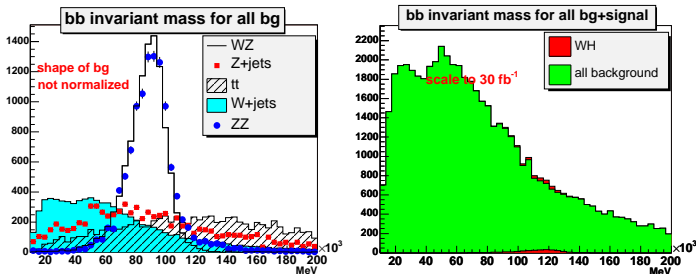
Different shape of DeltaR of b and \bar{b} :

If two jets are too close, they will be reconstructed as one jet by Full simulation. Fast simulation does not consider this situation

Signal and background distribution



Rough signal significance estimate



The expected WH , $W \rightarrow l\bar{\nu}_l$, $H \rightarrow b\bar{b}$ signal and background events in an m_{bb} mass window of $\pm 30\text{GeV}/c^2$

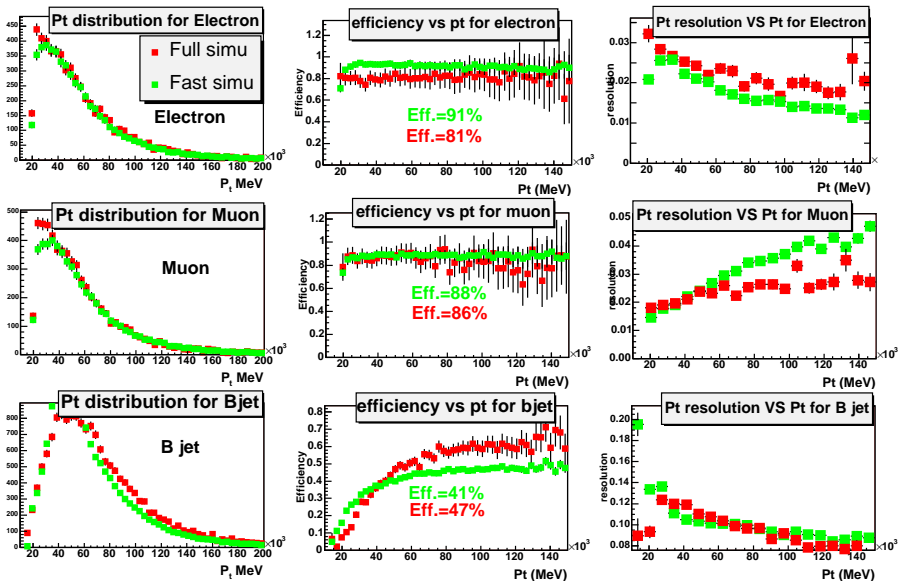
Decay channel	Efficiencies(%)		$N_{final\ events}$		$N_{normalized\ to\ 30\ fb^{-1}}$		ATLAS TDR
	Fast	Full	Fast	Full	Fast	Full	
WH	1.422	1.378	7112	289	119	116	250
WZ	0.210	0.482	6307	52	231	188	220
tt	0.020	0.044	939	139	2868	4372	3700
W+jets	0.0002	-	98	-	7500	-	4160(W _{jj} +W _{bj})
Z+jets	0.0003	-	103	-	2054	-	-
ZZ	0.301	-	3008	-	33	-	-
WW	0	-	0	-	0	-	-
Total Background					12686	-	10820
S/\sqrt{B}					1.1	-	2.4

Difference to TDR due to more detailed simulation of b-tagging efficiency

Conclusions and plans

- fast simulation with a more detailed parameterization of b-tagging has been performed, signal significance 2 times lower than ATLAS TDR
- $WH, H \rightarrow b\bar{b}$ decay channel is not a higgs discovery channel, unless very good predictions from MC background shape is provided
- to get more reliable signal significance estimate, larger samples $W+\text{jets}, Z+\text{jets}$ should be produced

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