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

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Outline

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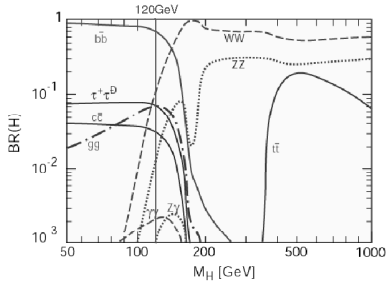
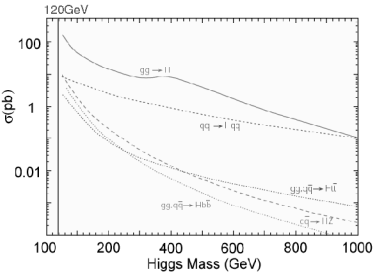
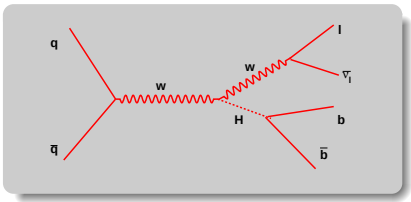
Introduction

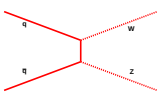


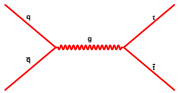


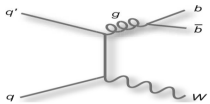
- $H \rightarrow b\bar{b}$ decay is dominant when Higgs mass is around 120 GeV
- $H \rightarrow b\bar{b}$ can be observed only in associated production with tt or W/Z boson (a lepton from tt, W/Z decay is needed for trigger)
- WH production model is very challenging due to large irreducible and reducible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

Produced Data samples









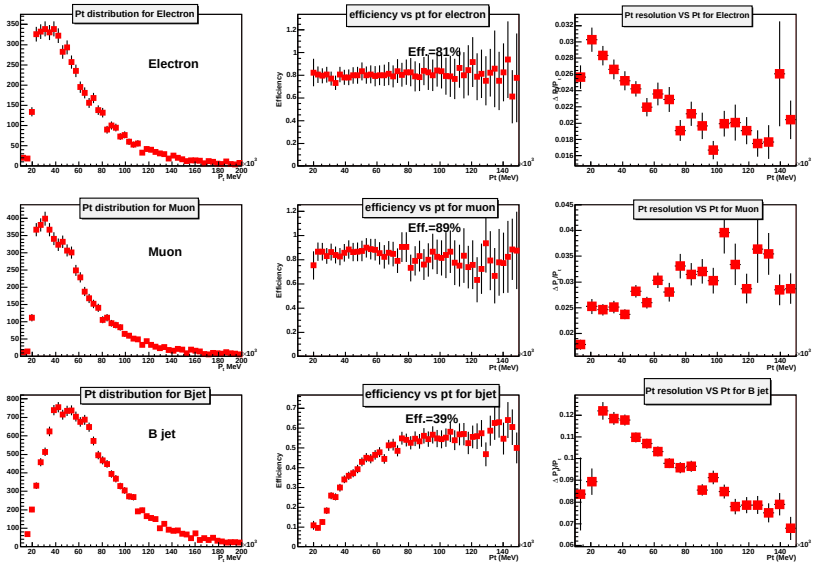
Produced MC samples for signal and some important backgrounds

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

Event selection

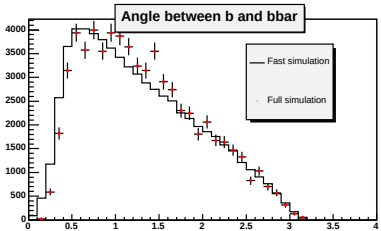
- 1 isolated lepton
  - P_t >20 GeV, $|\eta|$ <2.5
  - E_t <10GeV within the isolation cone of radius $\Delta R = \sqrt{(\Delta\eta)^2 + (\Delta\phi)^2}$=0.4
  - e_id: E-M cluster has a matched track in ID and cluster shape is consistent with e-hypotheses
  - μ_id: combined fit of muon track has good quality
- 2 good b jets
  - P_t >15 GeV, $|\eta|$ <2.5
  - b-tag: value of b-tagging parameter for jet >3
- 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, $|\eta| < 5$

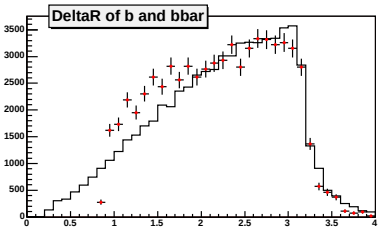
Reconstruction efficiency and resolution

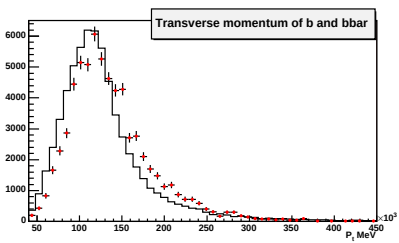


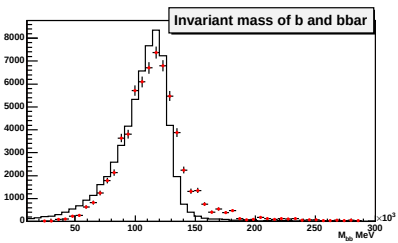
- the P_t resolutions are around 2.5% for electrons, 3.0% for muons

Comparison of Fast simulation and Full simulation for signal

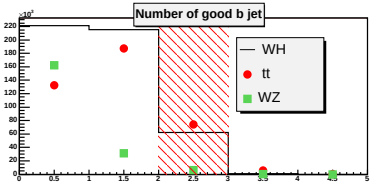


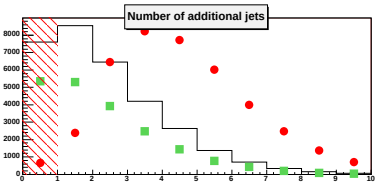


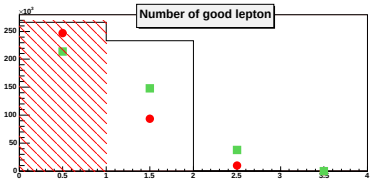


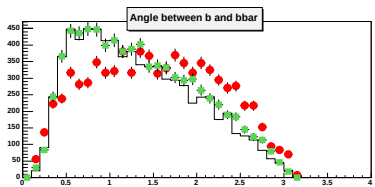


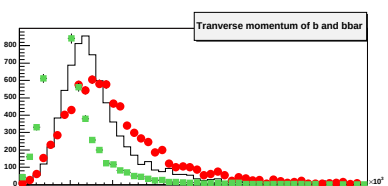
Signal and background distribution

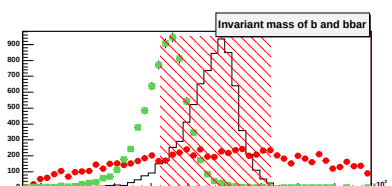




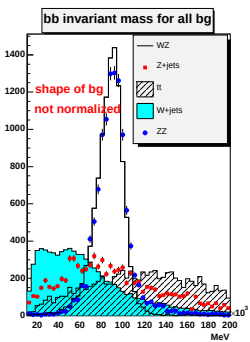


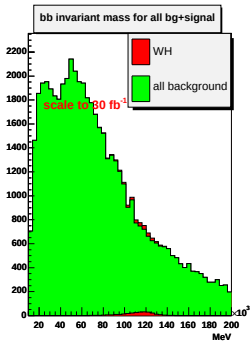






Rough signal significance estimate





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 $\pm 30 GeV/c^2$

Decay channel	Efficiencies(%)		$N_{final\ events}$		$N_{normalized\ to\ 30\ fb^{-1}}$		ATLAS TDR
	Fast	Full	Fast	Full	Fast	Full	
WH	1.422	2.70	7112	772	119	308	250
WZ	0.210	-	6307	-	231	-	220
tt	0.020	0.087	939	278	2868	3454	3700
W+jets	0.0002	-	98	-	7500	-	4160(Wjj+Wbj)
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

Conclusions and plans

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