

ttH with boosted tops

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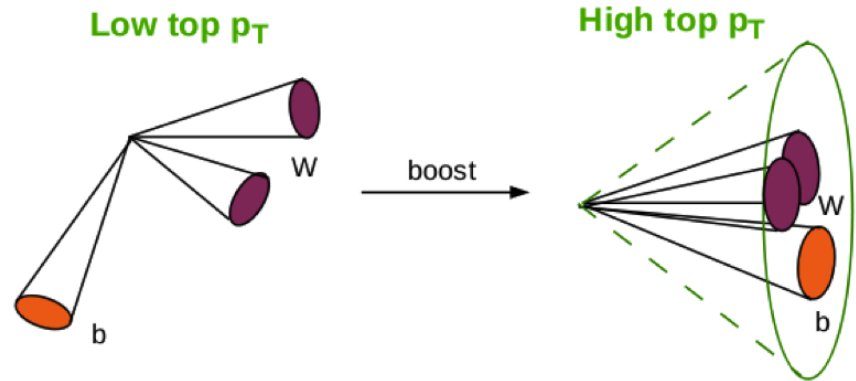
Also interested: James Ferrando (Glasgow), David Miller (chicago)

Boosted tops?

- At LHC 8TeV boosted objects are becoming heavily used
- Will be a standard tool at 13TeV, what about 100TeV?
Entering super boosted regime $p_T(\text{top}) > 5\text{TeV}$

- Cone size $R \sim 1 / \text{boost}$

- $p_T = 200\text{GeV} \rightarrow R \sim 2$
- $p_T = 1\text{TeV} \rightarrow R \sim 0.4$
- $p_T = 10\text{TeV} \rightarrow R \sim 0.05$



- Minimal distance to resolve two partons: $\Delta R \sim 2m/p_T$

Boosted tops?

- Applications

- Resonance $Z' \rightarrow t\bar{t}$, $W' \rightarrow t\bar{b}$
- Vector-like quarks $T \rightarrow Wb$, Zt , Ht $B \rightarrow Wt$, Zb , Hb
- Top anomalous couplings $W^* \rightarrow t\bar{b}$
- Top dipole moments (high $m_{t\bar{t}}$ spectrum)
- Susy searches
- **Select a clean sample of $t\bar{t}H$ (less combinatorics for $H \rightarrow b\bar{b}$)**

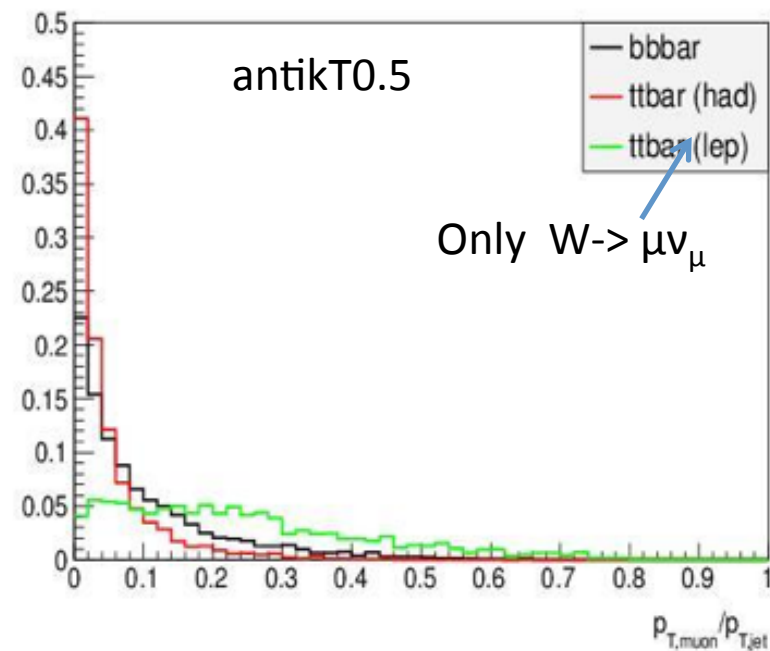
- Impact on the detector design

- Calorimeter depth, granularity
- Is sub-structure off the table?

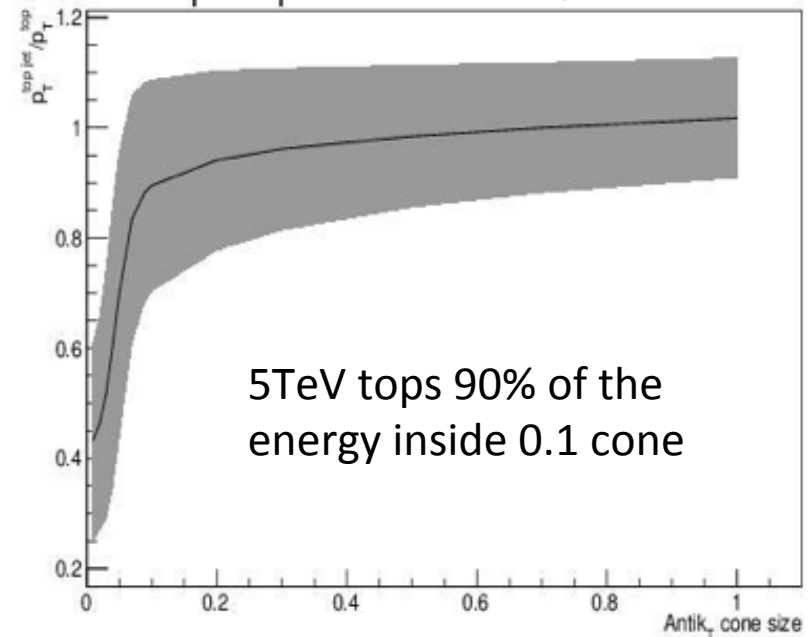
Preliminary studies

Madgraph + Pythia8,
 $p_T(\text{top}, b) > 5\text{TeV}$

Muon To Jet PT Ratio



$p_T^{\text{top jet}}/p_T^{\text{top}}$ ratio versus Antik_T cone size



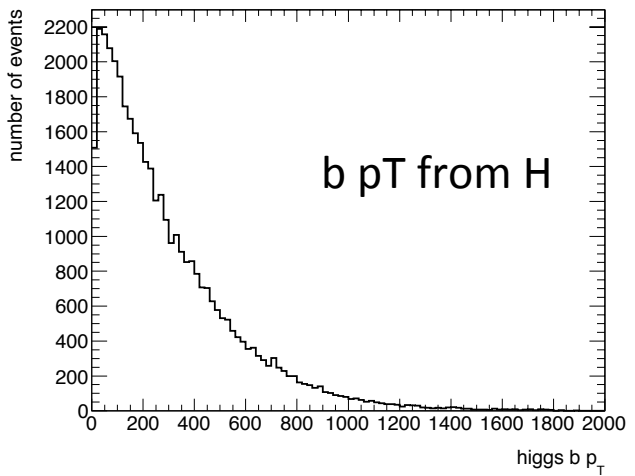
- Need also to consider collinear W emission in jets as a BG (next talk)

Very preliminary Setup

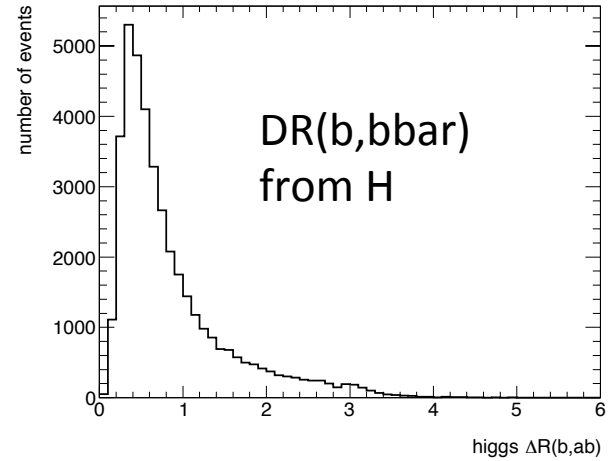
- Madgraph5 and Pythia6
- 4 Flavors scheme
- Use ptheavy to select high pT tops
- 90keV for ttH and ttbb
- Cross sections:
 - ttH(H bb) cross section (ptheavy > 750GeV): 0.48 ± 0.002 pb
 - Ttbb cross section (ptheavy > 750GeV): 8.1 ± 0.03 pb
- Use Delphes to dump STDHEP to root files and build truth jets

Plots truth level

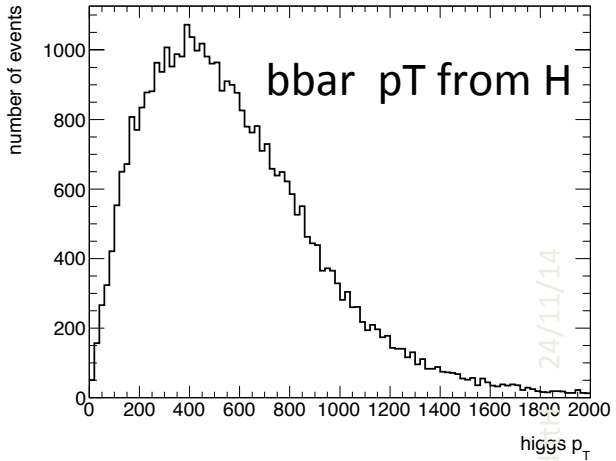
higgsb_pT



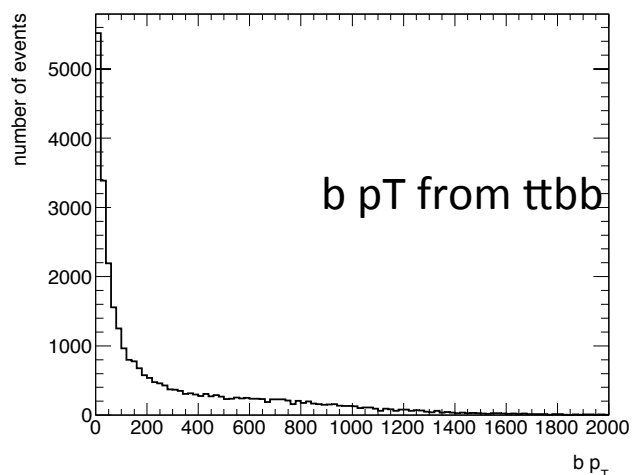
higgsbs_dr



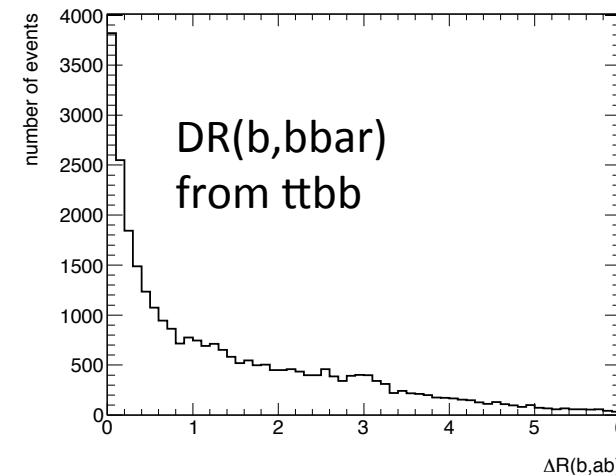
higgs_pT



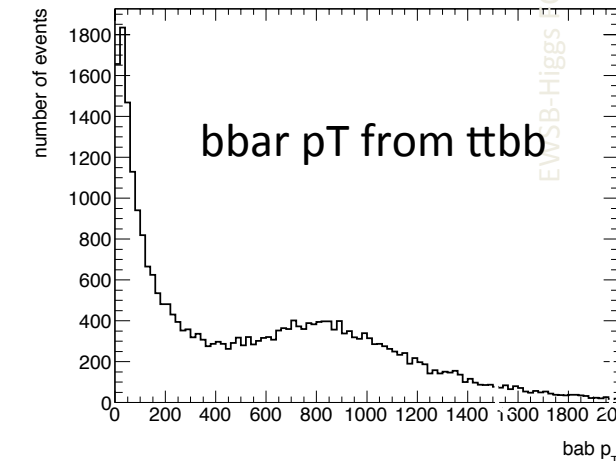
hb_pT



bs_dr



hbab_pT



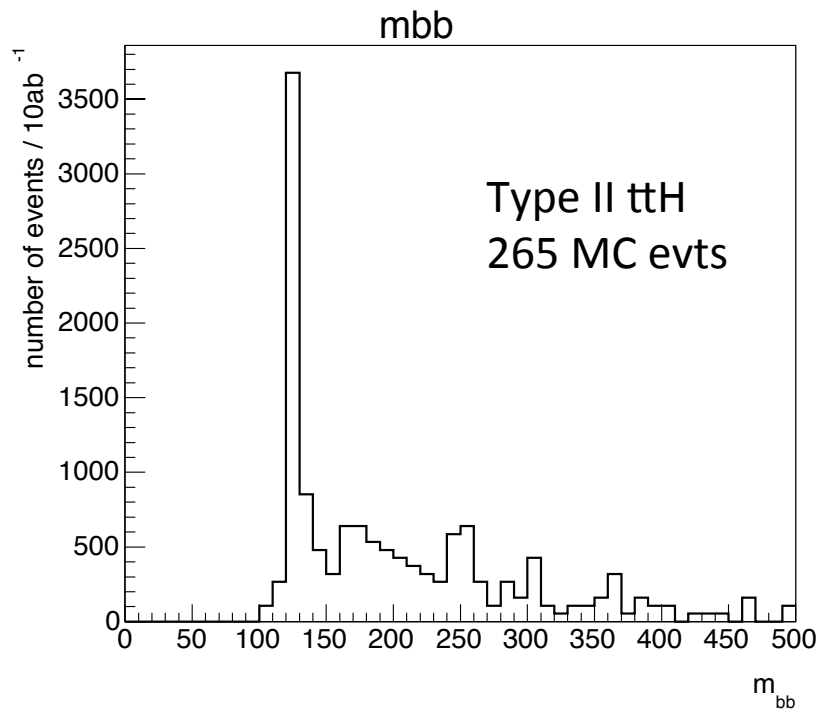
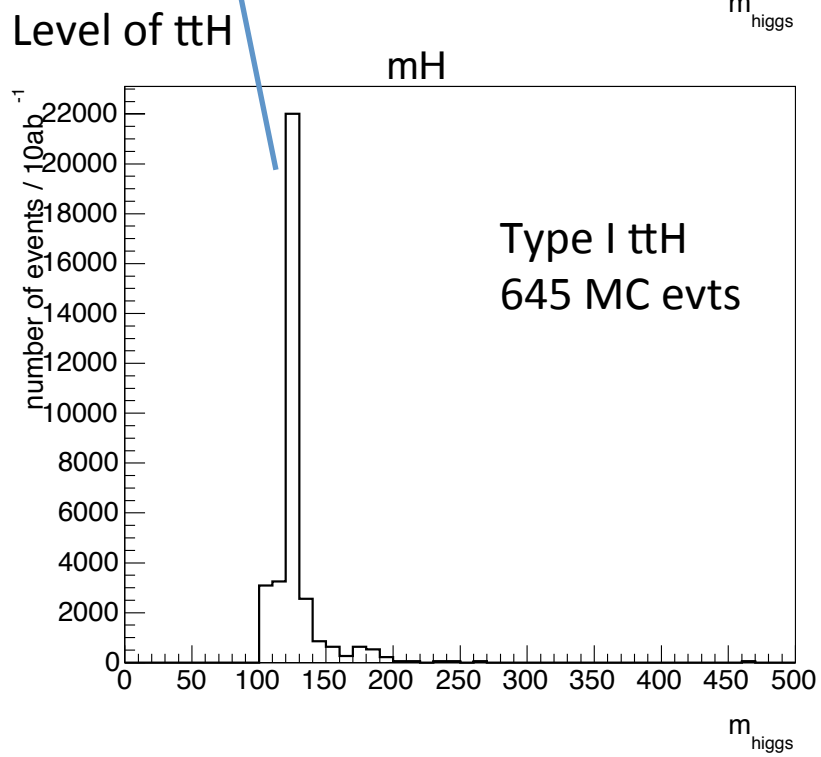
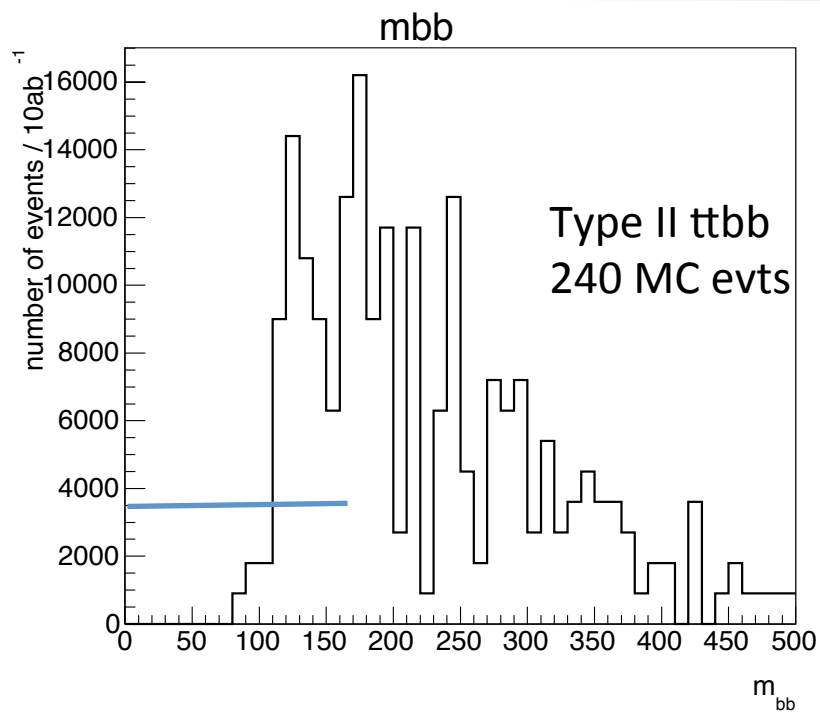
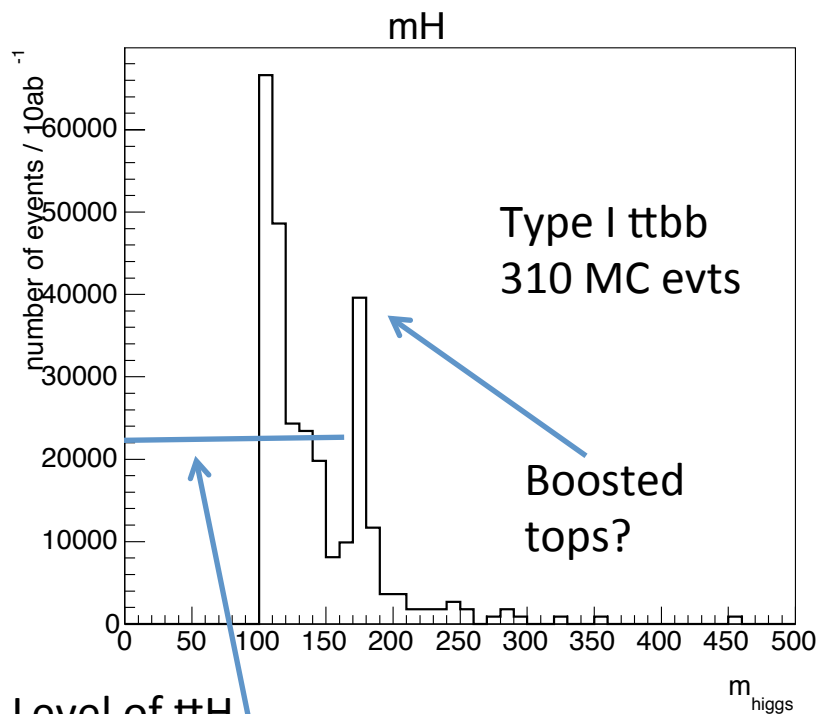
Very preliminary truth level analysis

- For the moment not using high p_T muons inside jets to tag boosted tops
- Use antikT0.4 jets, jets $|\eta| < 2.5$
- Select 2 jets with $p_T > 800 \text{ GeV}$, $m > 150 \text{ GeV}$ and $\text{DR}(j_1, j_2) > 2$

- For the Higgs:
 - typeI: jet $p_T > 500 \text{ GeV}$ and jet mass $> 100 \text{ GeV}$
 - typeII: dijet system with $p_T(j_i) > 175 \text{ GeV}$, $\text{DR}(j_1, j_2) < 1$, $p_T(j_1 j_2) > 400 \text{ GeV}$, choose the solution with the smallest DR

- ttH selection efficiency: 1% (910 events left...)
- Ttbb selection efficiency: 0.6% (550 events left...)

- Considering a luminosity of 10 ab^{-1}



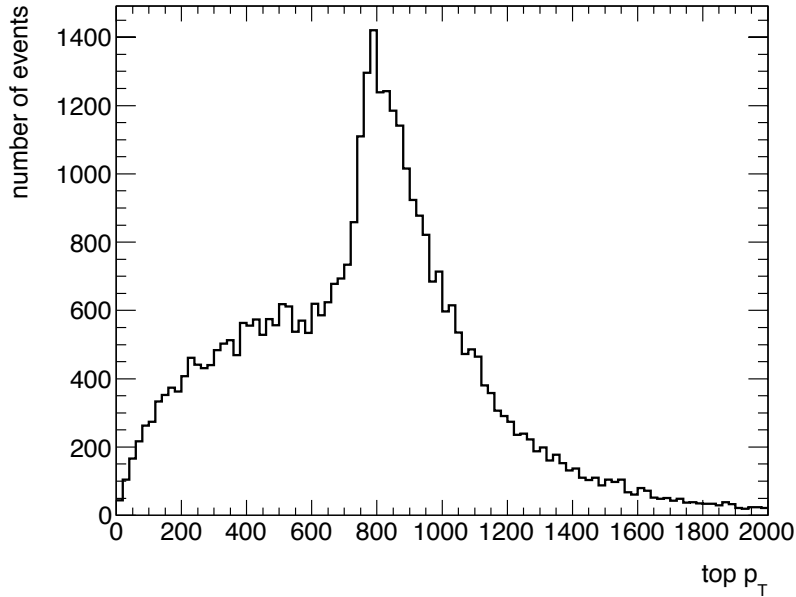
Next steps

- Use jet-substructure
- Use B-tagging
- Optimize signal selection
- Continue to work on a top tagger
- Need much more statistics...
- Need $t\bar{t}$ +jets in 5FS to have $b\bar{b}$ from parton shower

Backup

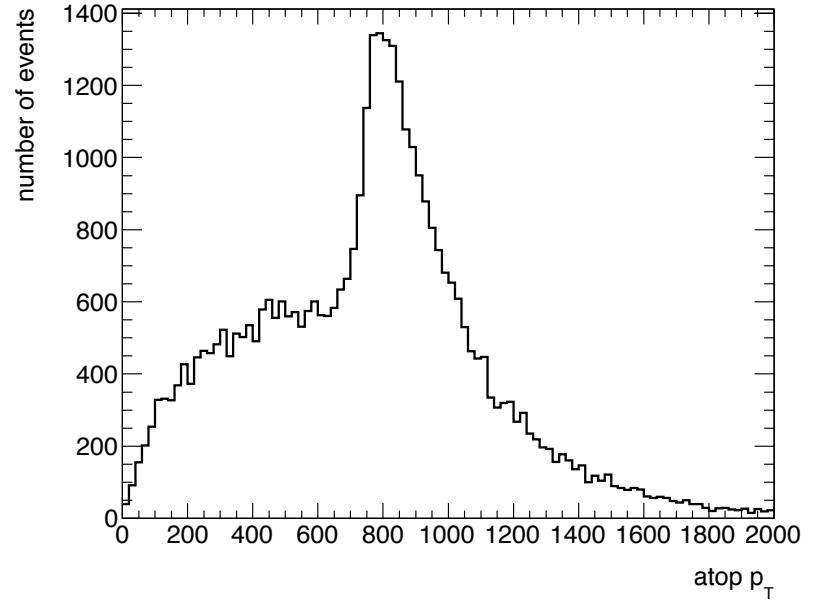
Top/atop pT

top_pT

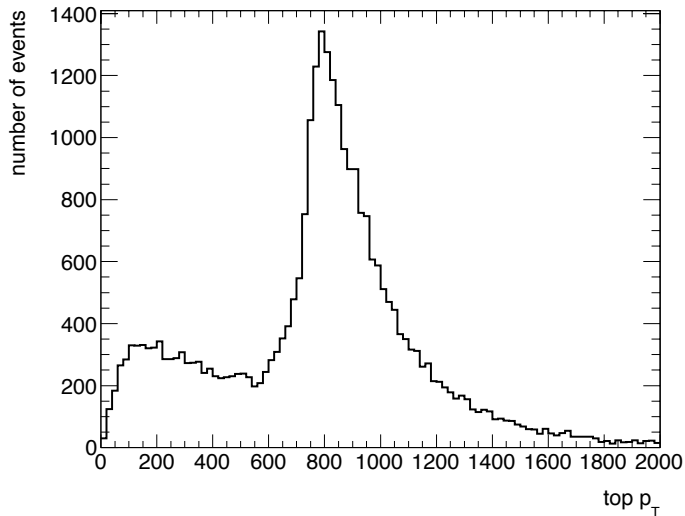


ttH

atop_pT

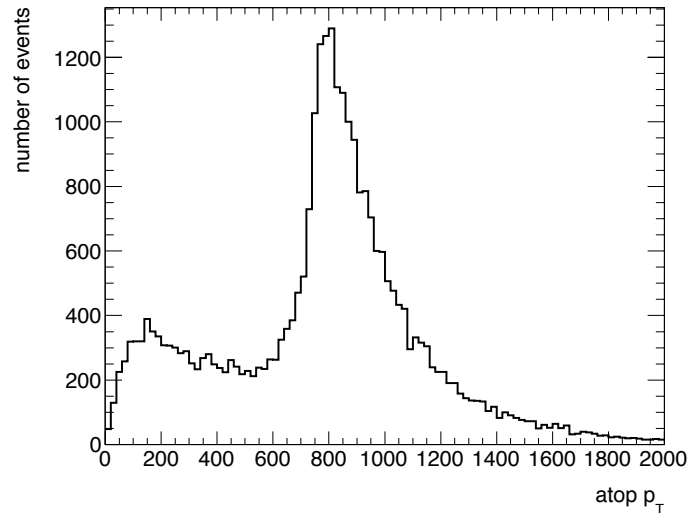


top_pT



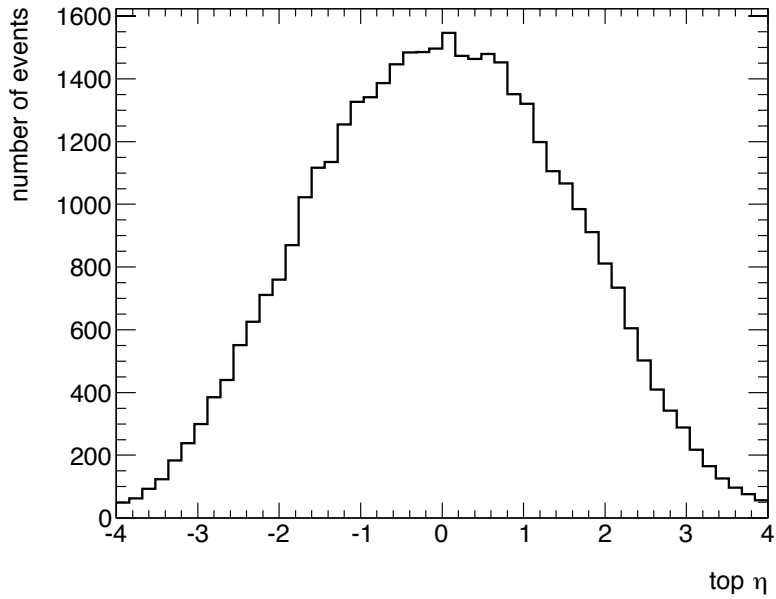
ttbb

atop_pT

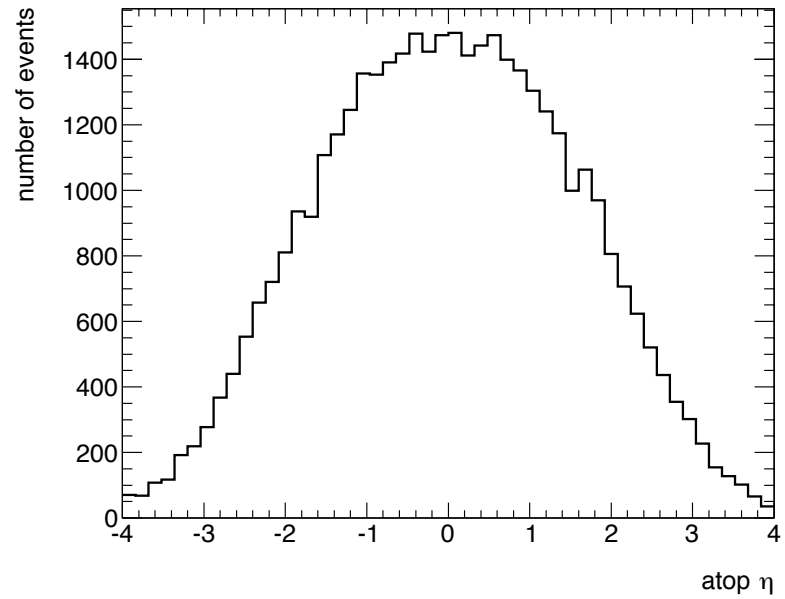


Top/atop eta

top_eta

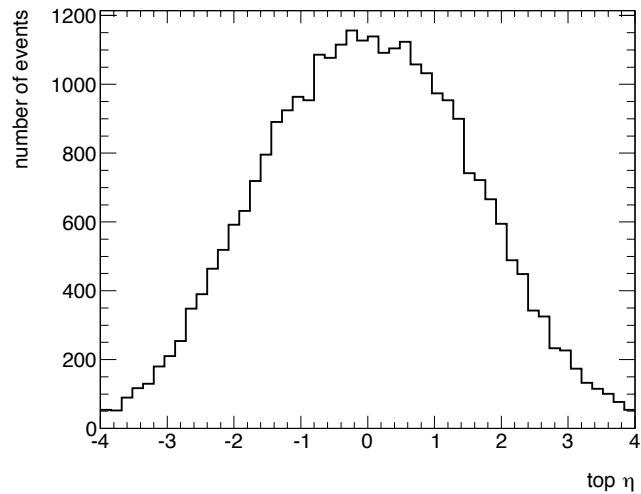


atop_eta

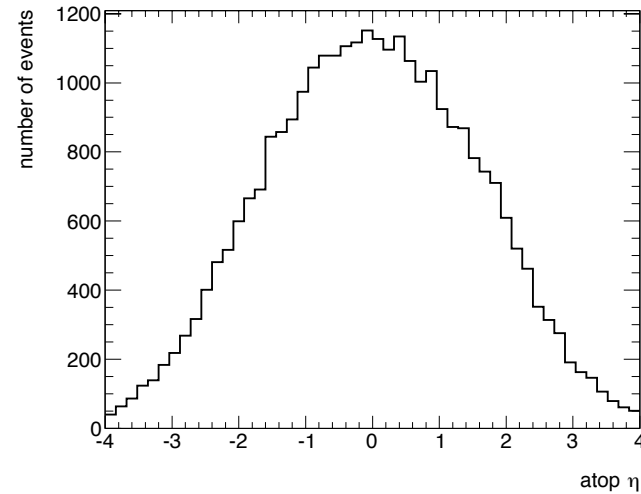


ttH

top_eta

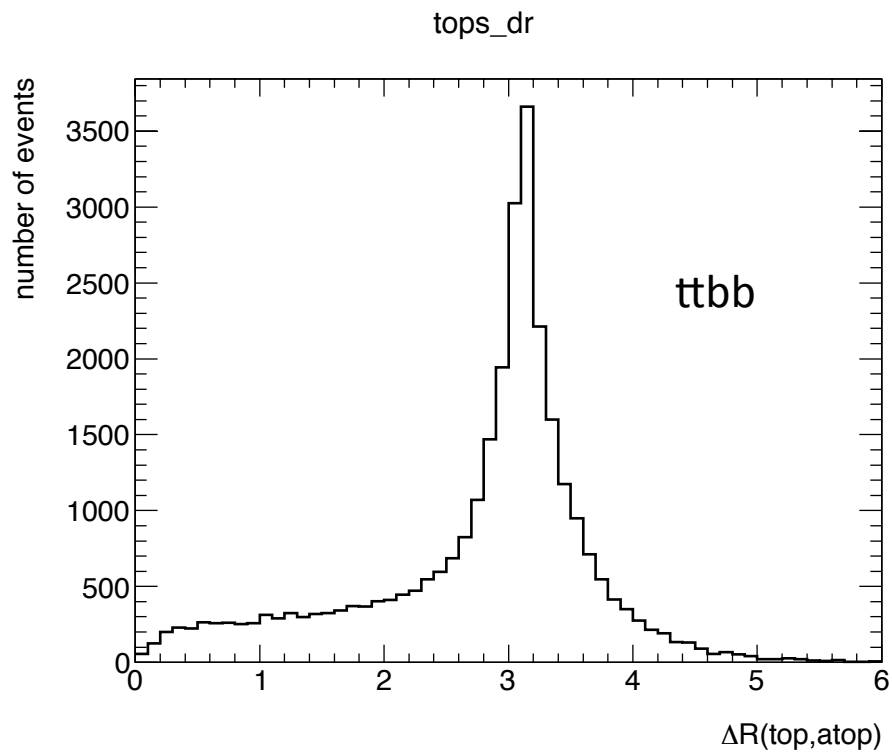
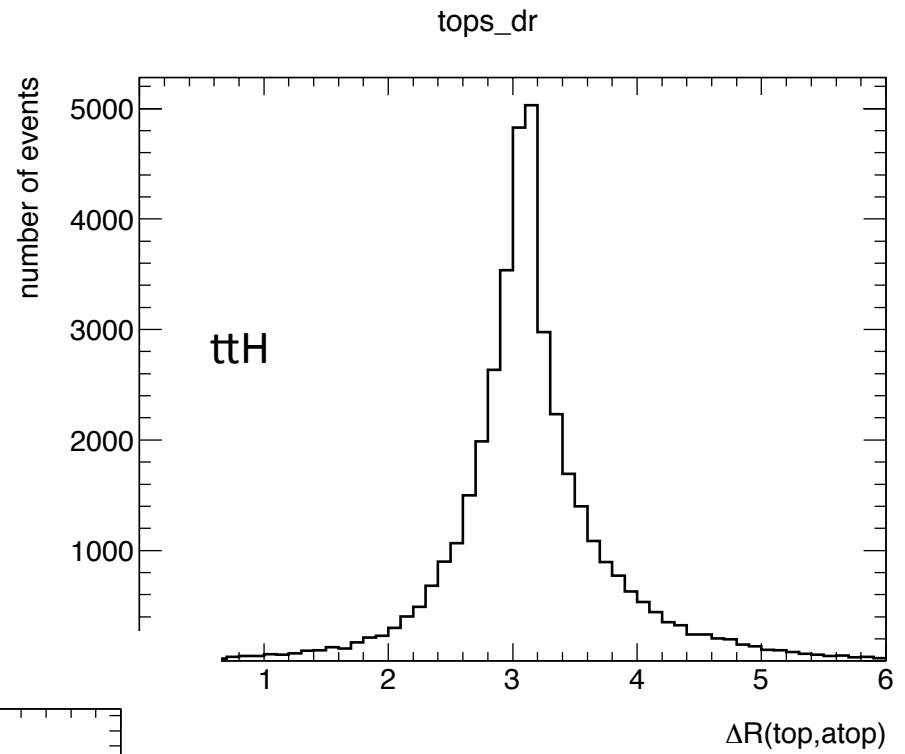


atop_eta

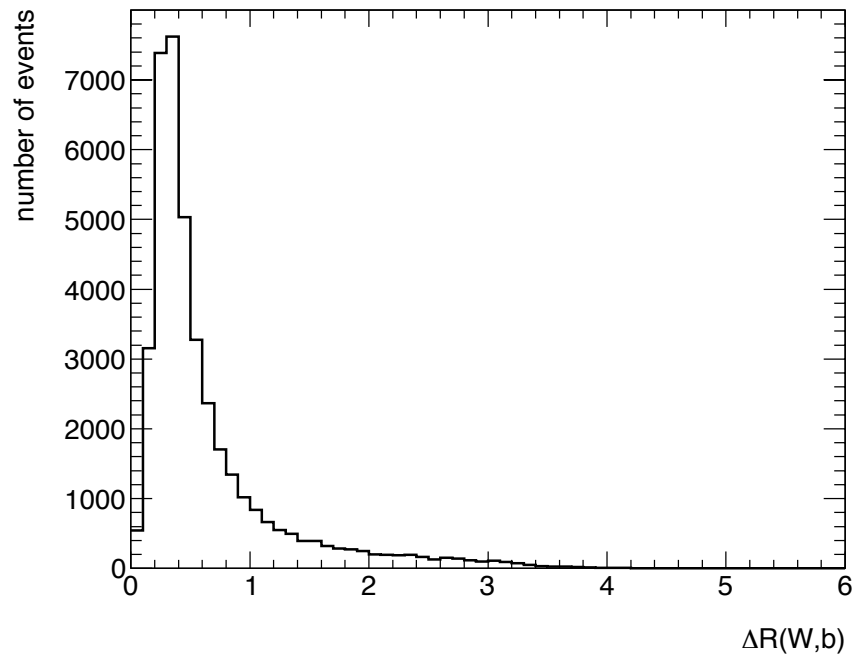


ttbb

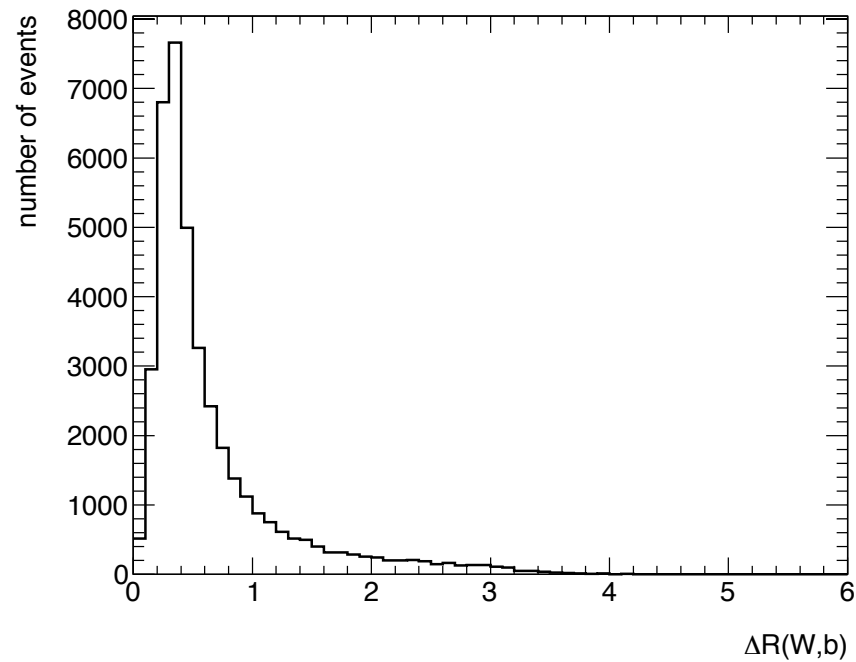
Top dr



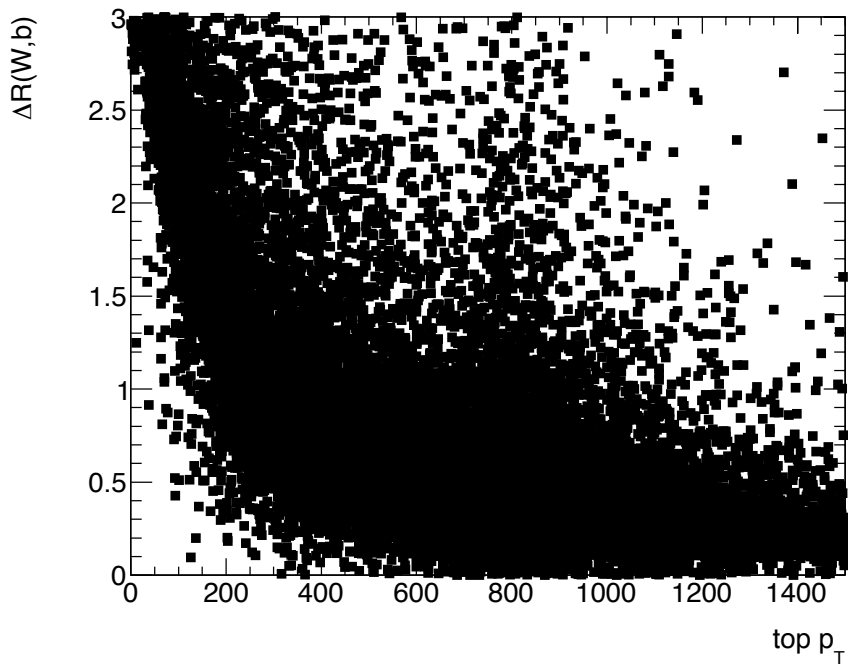
topdr_wb



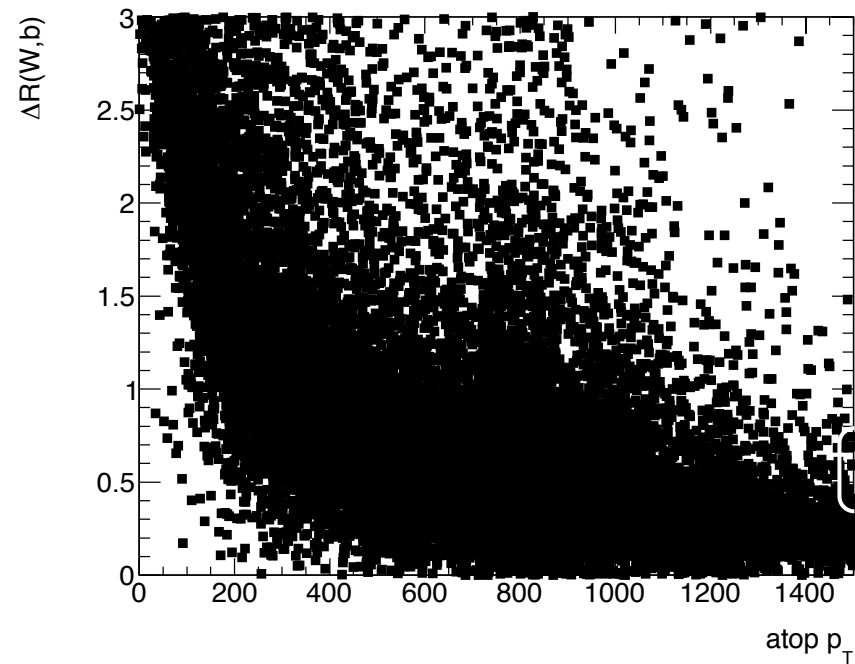
atopdr_wb



topdr_wb_pT

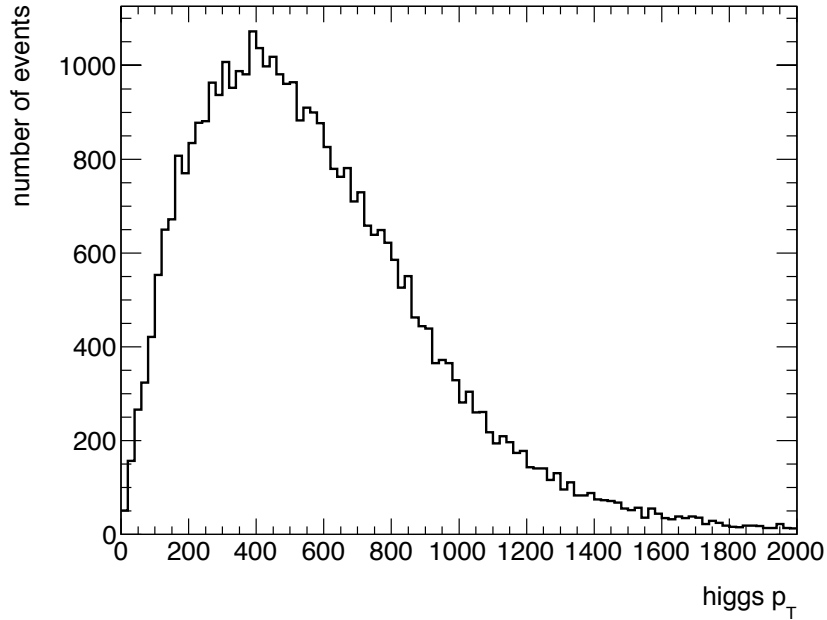


atopdr_wb_pT

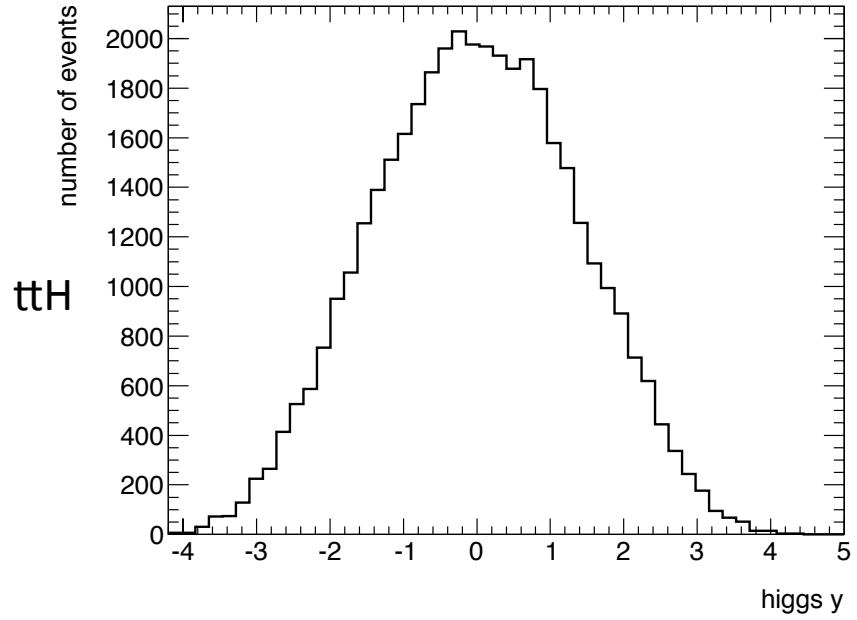


Higgs/bbpair

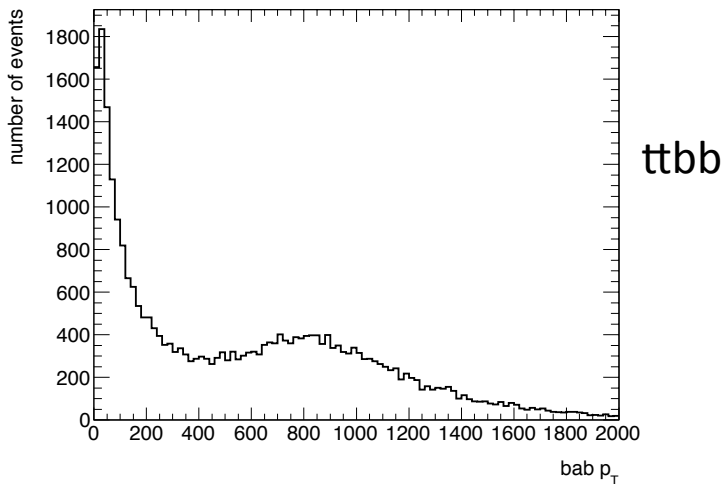
higgs_pT



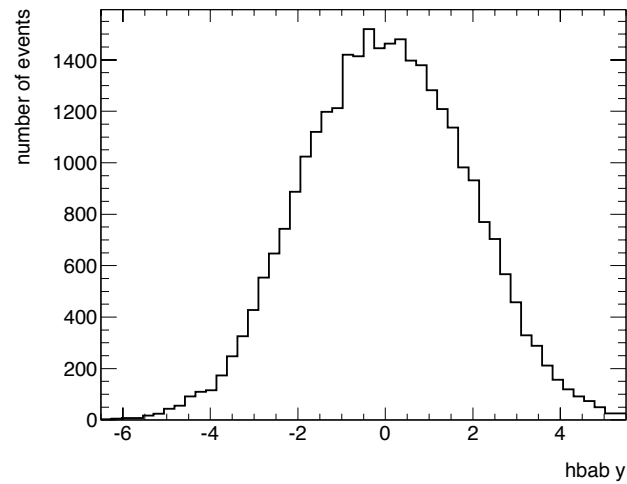
higgs_rapidity



hbab_pT

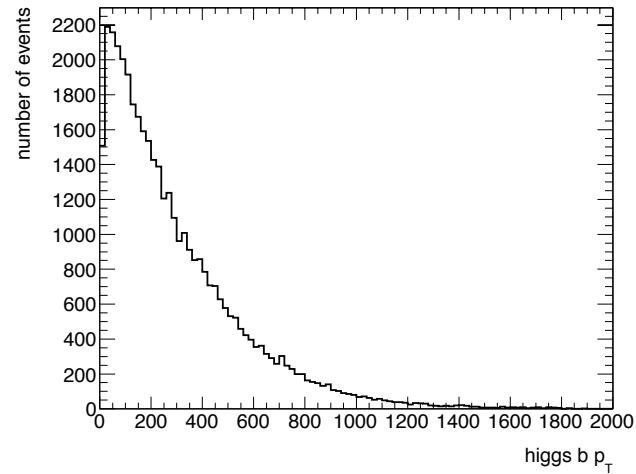


hbab_rapidity

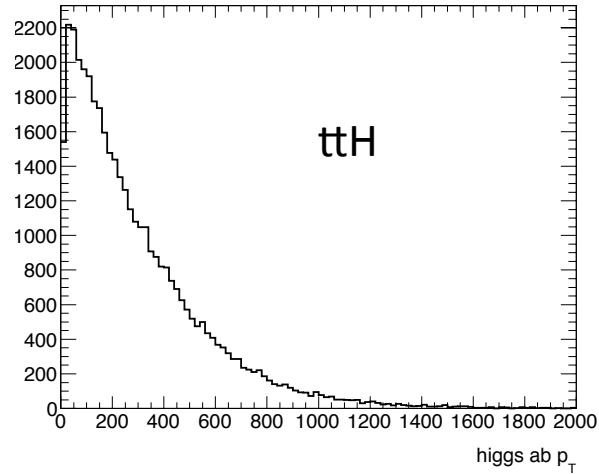


B from higgs/bbbar

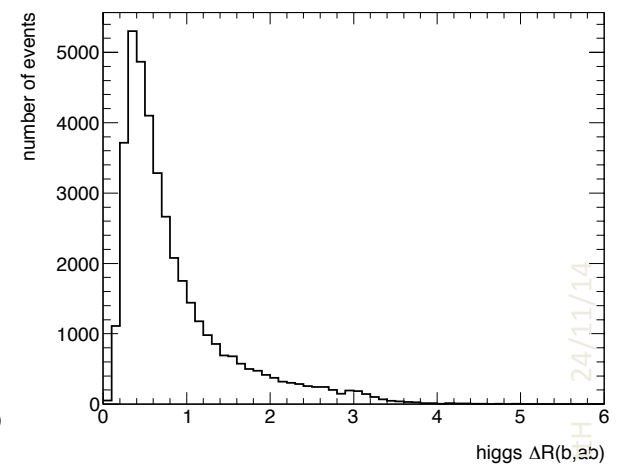
higgsb_pT



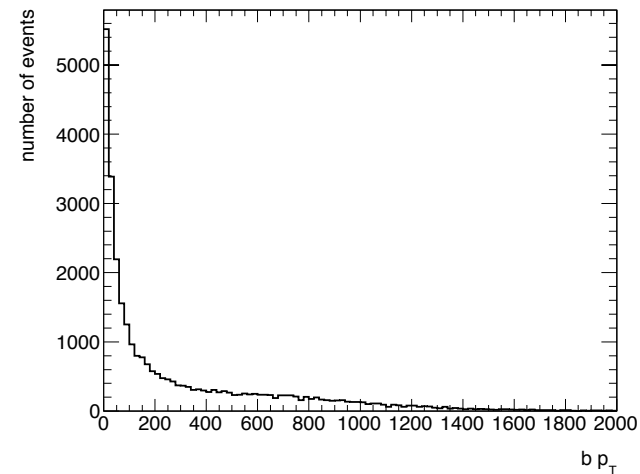
higgsab_pT



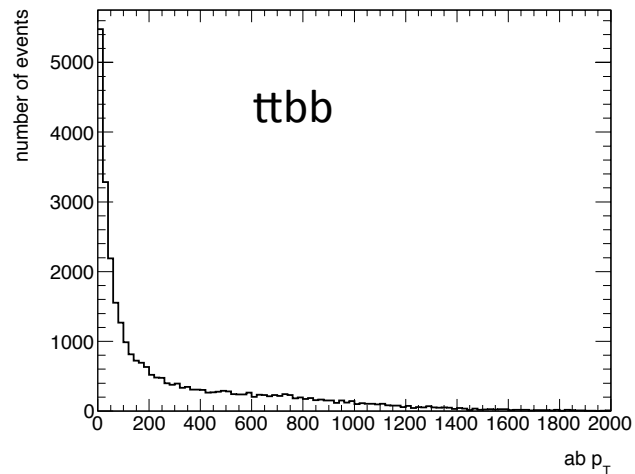
higgsbs_dr



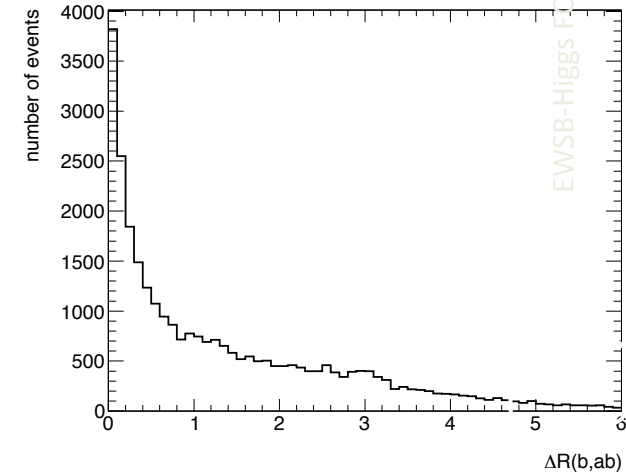
hb_pT



ab_pT



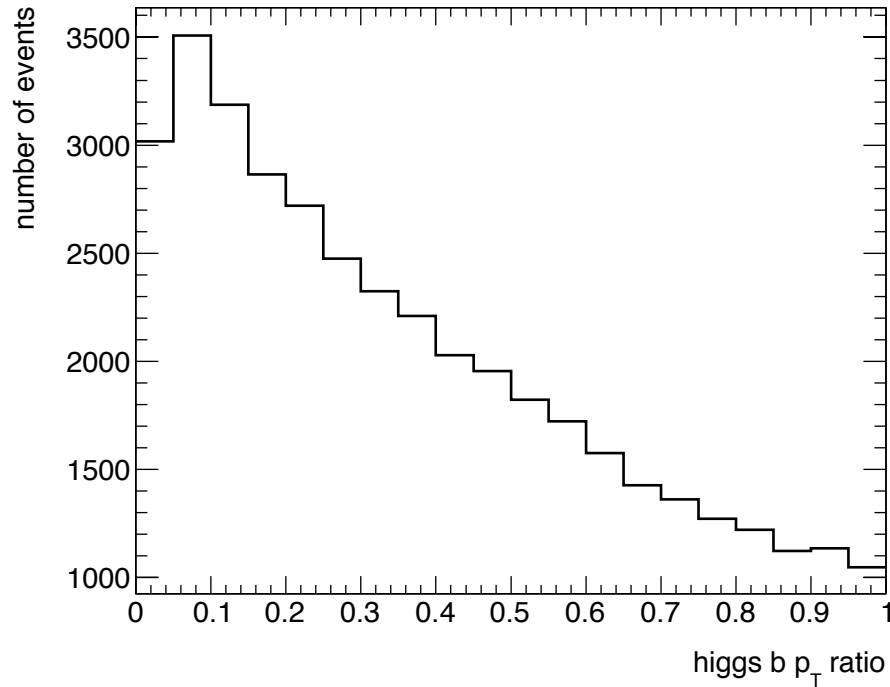
bs_dr



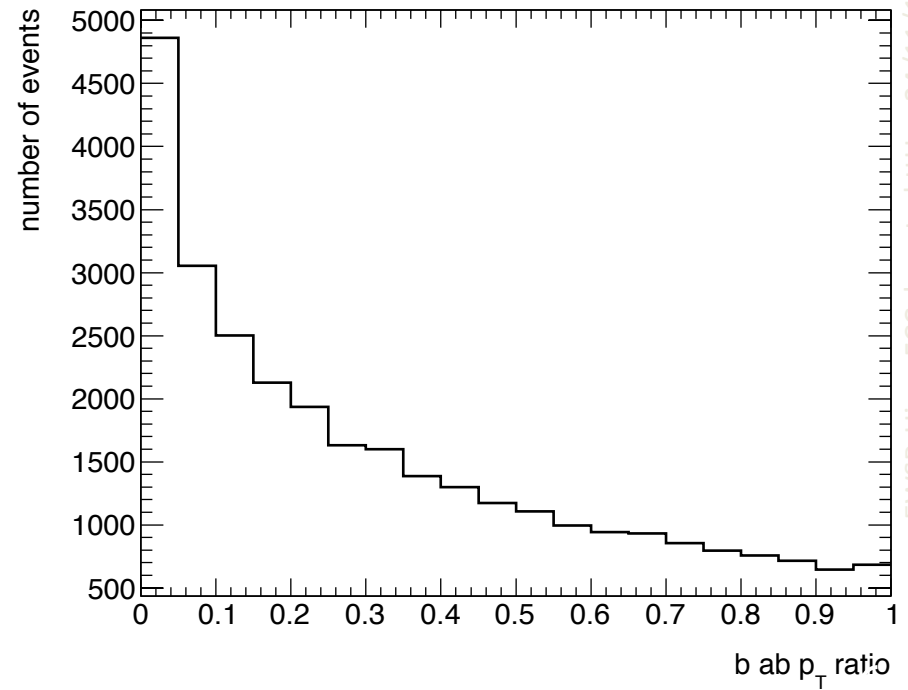
24/11/14
EWSB-Higgs FCC, boosted H

Pt ratio b1/b2

higgsbspRatio

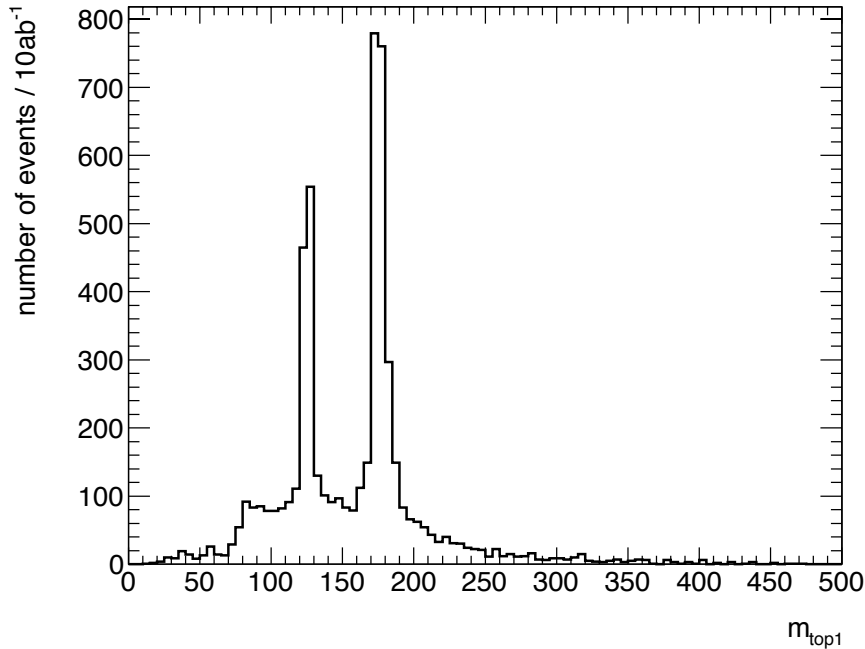


bsptRatio

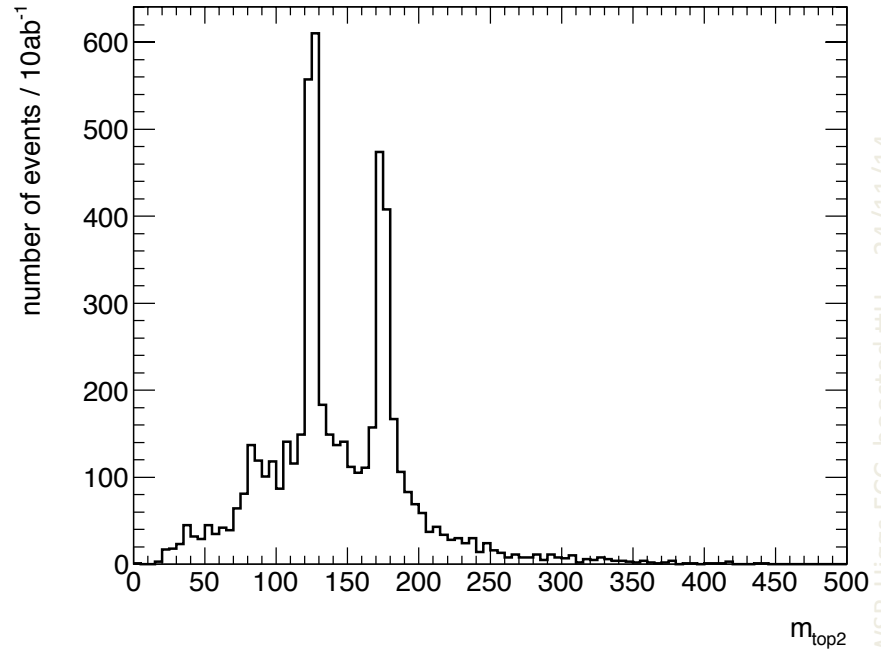


Selection, 2 leading jet pt mass

top1m



top2m



- Add a jet mass cut $>150 \text{ GeV}$ to select tops