

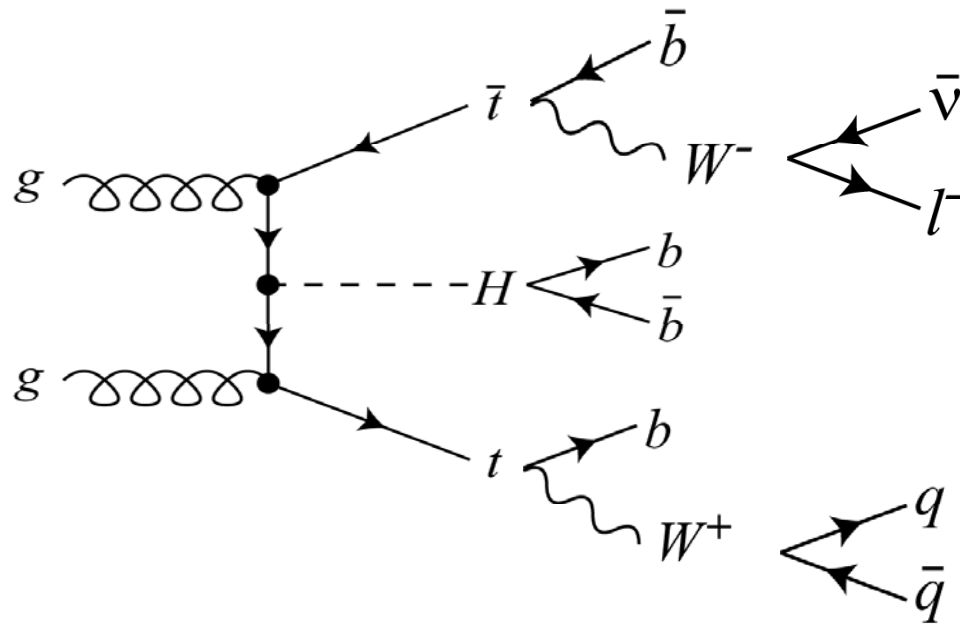


UK $t\bar{t}H(H \rightarrow b\bar{b})$ activities

Simon J.H. Dean, UCL

28/09/2007

Event Topology



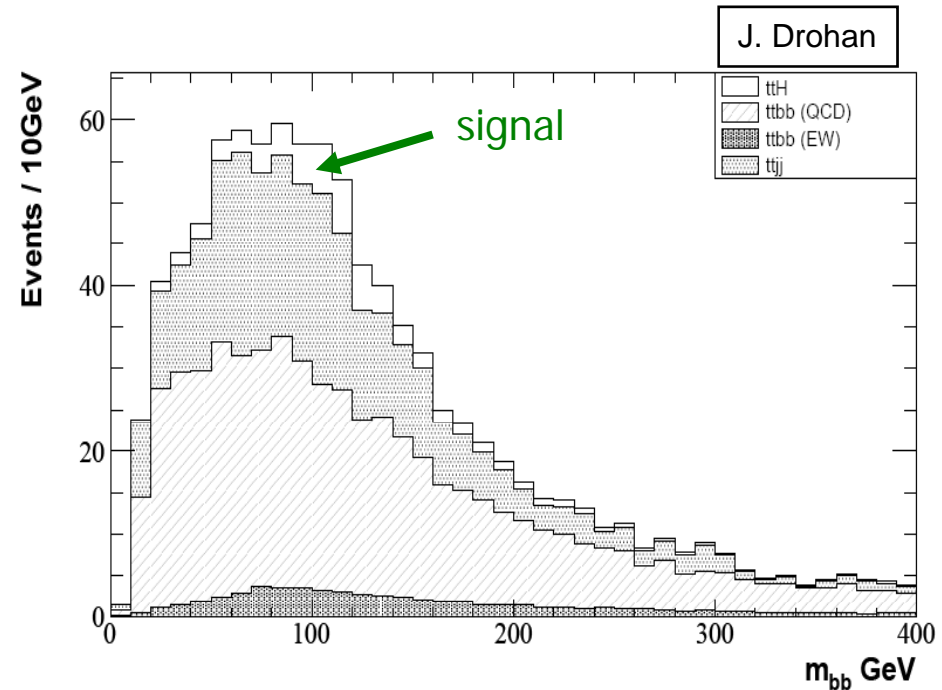
4 b-jets
2 light jets
1 isolated lepton
Missing momentum

Cut-Based Analysis

- **Preselection**
 - 1 isolated lepton, $p_T^e > 25\text{GeV}$, $p_T^\mu > 20\text{GeV}$, $|\eta| < 2.5$
 - At least 6 jets, $p_T > 15\text{GeV}$, $|\eta| < 5$
 - At least 4 tagged as b-jets
- **$W \rightarrow lv$**
 - constrain invariant mass of lv to W mass, solve for p_z^v
- **$W \rightarrow jj$**
 - Pairs of non b-jets with $m_{jj} = m_W \pm 25\text{GeV}$
- **Reconstruction of 2 top quarks**
 - Minimise χ^2 with top masses
 - Reconstructed top masses must be within $\pm 20\text{GeV}$ of m_t

Background Shape Study (C. Bernius)

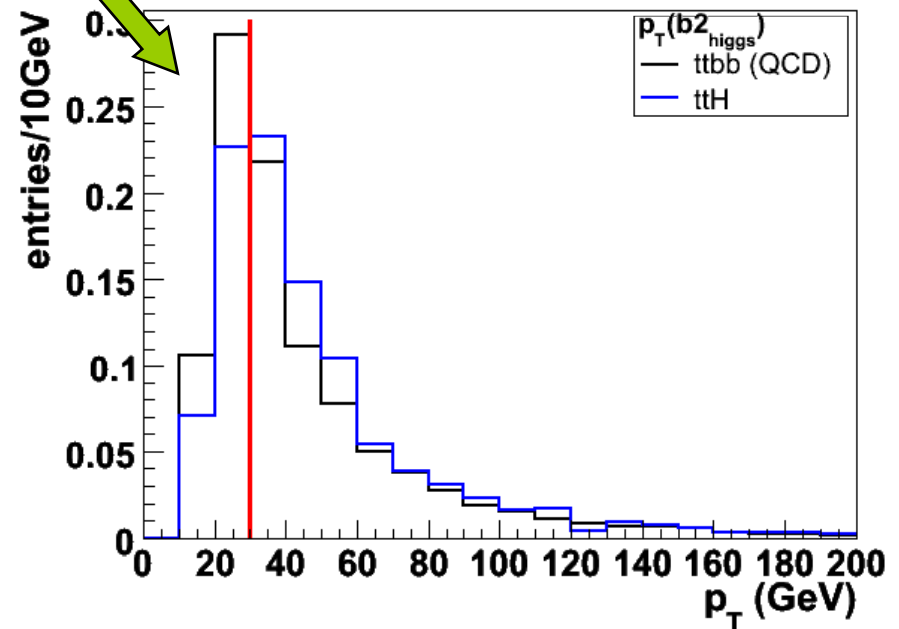
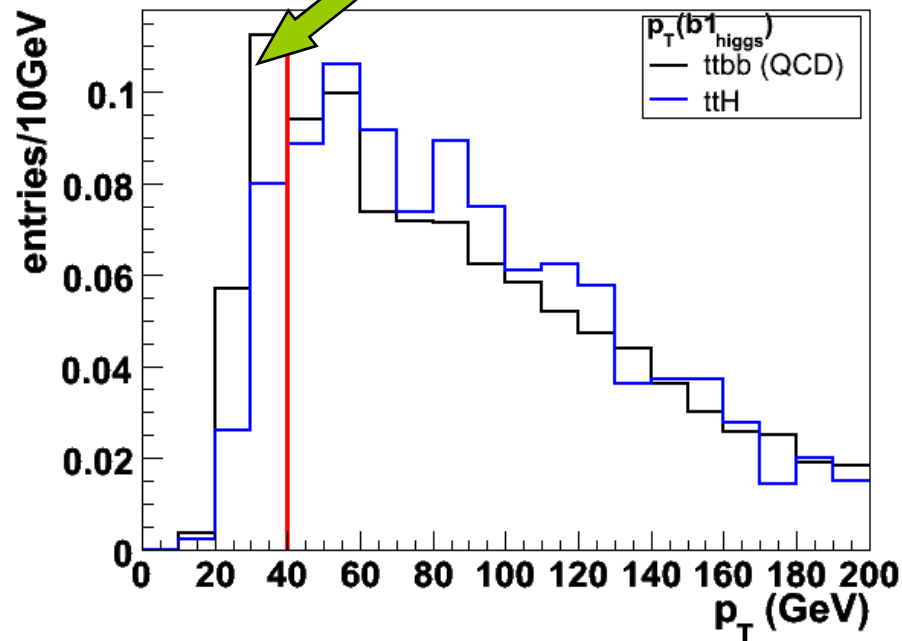
- Broad mass peak
- Background follows signal shape
- Would like better discrimination
- Started by considering $t\bar{t}H$ vs. $t\bar{t}b\bar{b}$ (QCD)



Background Shape Study

- Formulated "tight selection" on Higgs b-jets

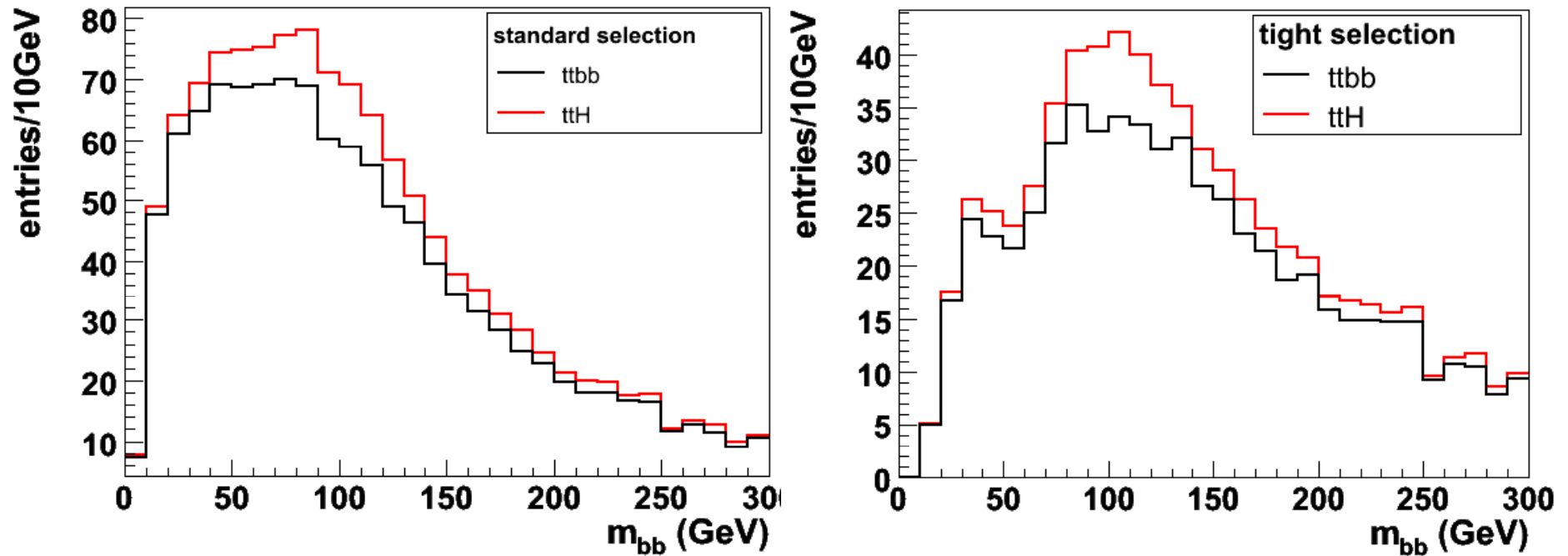
at low p_T more jets in $ttbb$ than ttH



Tight selection: $p_T(b^1_{\text{Higgs}}) > 40$ GeV, $p_T(b^2_{\text{Higgs}}) > 30$ GeV

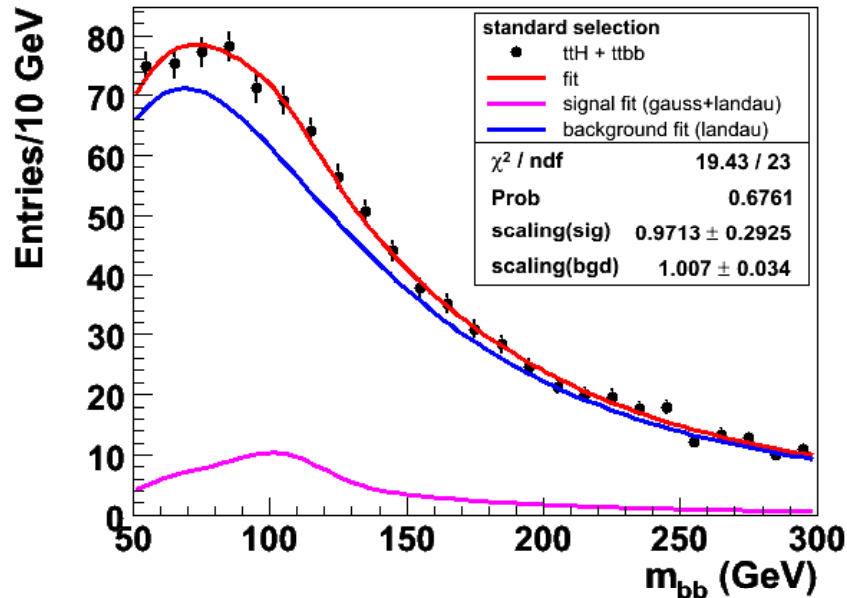
Shape Comparison

- Normalised to 30 fb^{-1} ("combined sample")



Combined Fit

Standard Selection

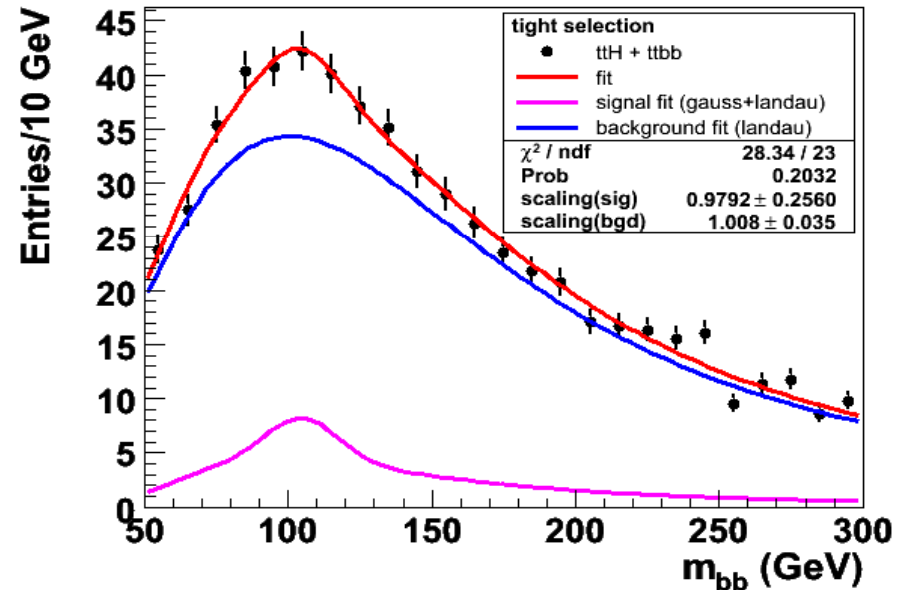


Region of interest: 90-150 GeV:

- signal (gauss+landau) = 437.9
- ttbb(QCD) (landau) = 3089.1
- -----
- signal/(signal+ttbb) = 0.12
- signal(gauss)/(all signal) = 0.28

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Tight Selection



Region of interest: 90-150 GeV:

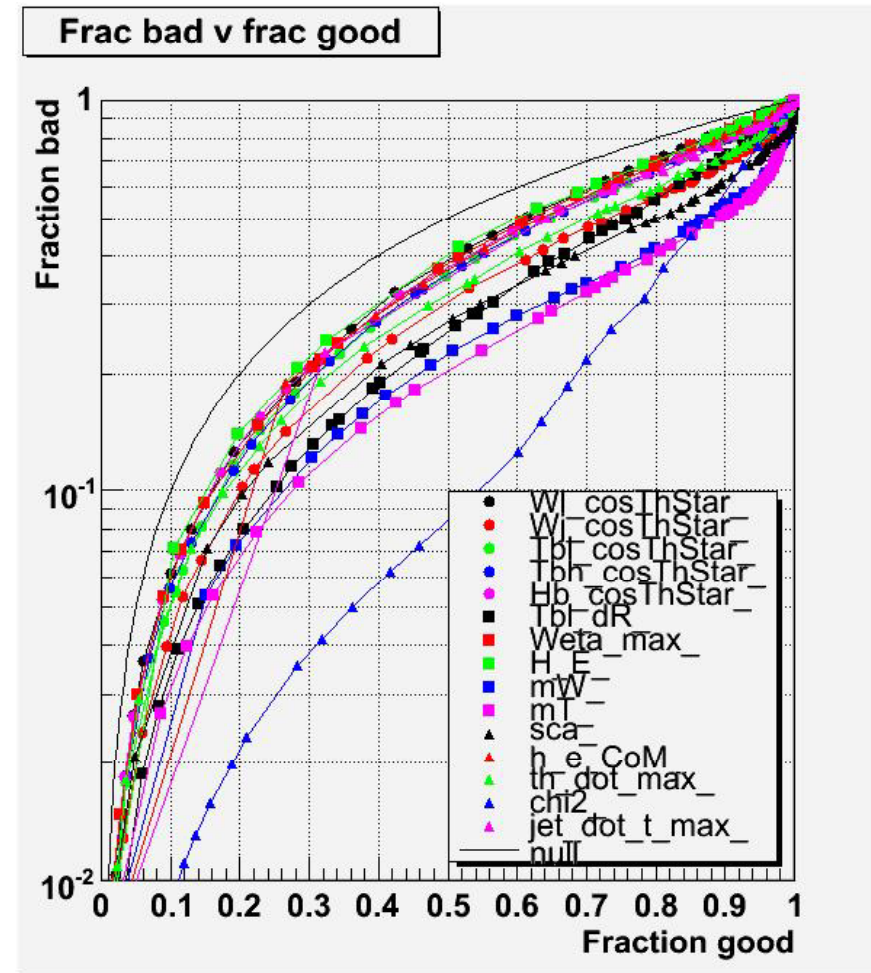
- signal (gauss+landau) = 377.9
- ttbb(QCD) (landau) = 1923.2
- -----
- --
- signal/(signal+ttbb) = 0.15
- signal(gauss)/(all signal) = 0.31

UK ttH(H→bb) activities

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Likelihood Analysis (W. Murray)

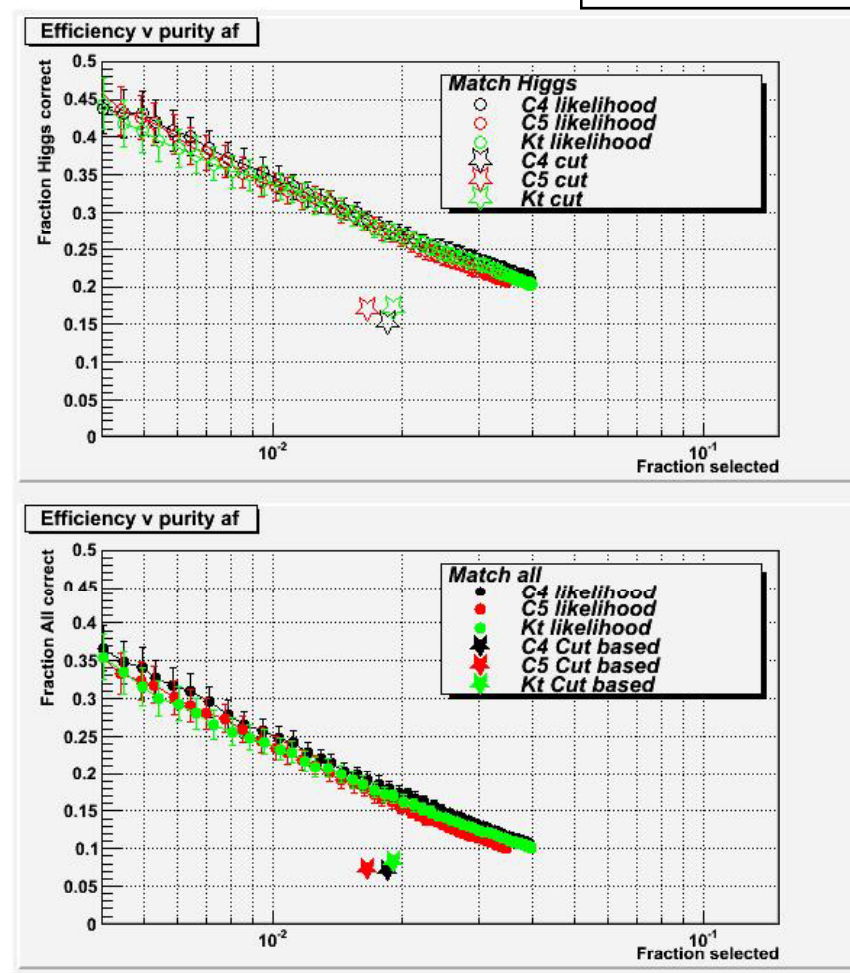
- Loop over all jet pairs with
 - both jets from Higgs b-tagged
 - combined b-tag of all 4 b-jets good
 - Hadronic W mass 30-150 GeV
 - Hadronic top mass 100-250 GeV
- Construct likelihoods
- Chi2 performs best



Cut-based vs. likelihood

W. Murray

- Comparison using cone 0.4, cone 0.5 and kT jets
- Better performance seen in likelihood approach
- Not run with all backgrounds yet



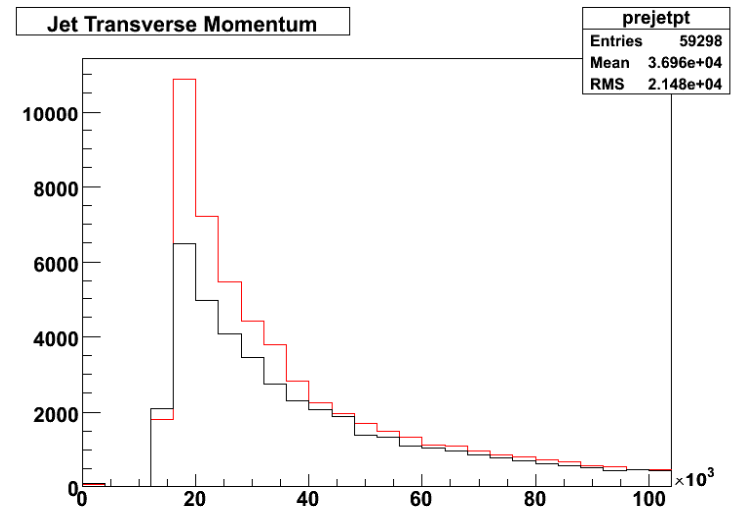
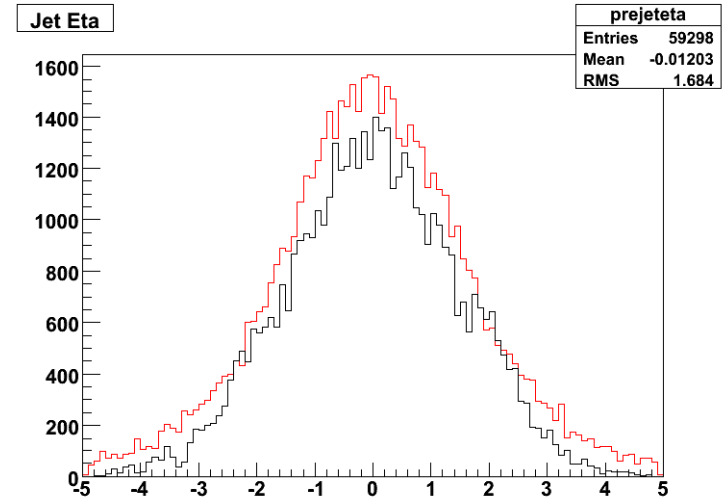
Fast Simulation Jets

- Fast simulation uses different cone jet finder than accessed by JetRec
- AtIfast currently only supplies the results of cone 0.4 jet finder in AOD output
- Can also run using kT algorithm
 - Done via KtEvent interface, same as JetRec
 - In principle, re-running AtIfast using kT and comparing with full-chain kT jets should give closer agreement

12.0.6 cone jets

- 7000 signal events considered for reasons given on previous slide
- Cone 0.4
- Included for both full and fast in 12.0.6 AOD files
- Noticeably higher number of jets from Atfast
- Overestimation of jet efficiency at low p_T , as seen in other analyses

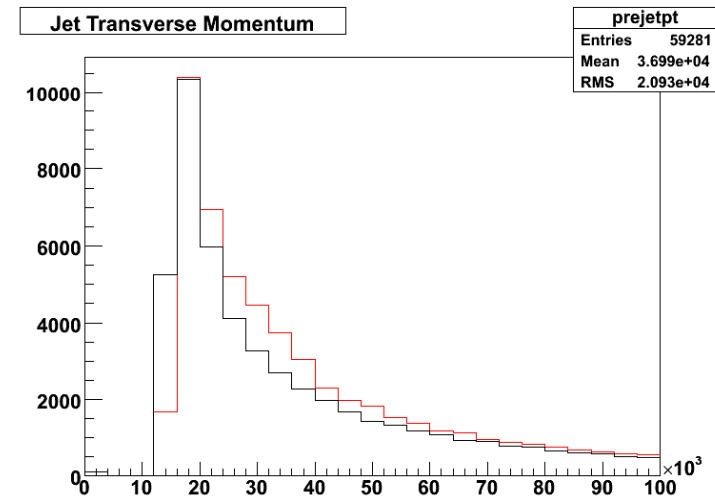
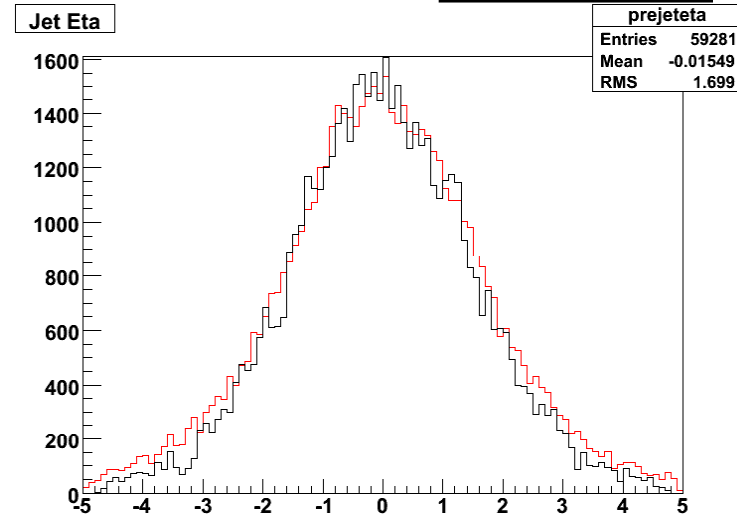
Full Fast



12.0.6 kT jets

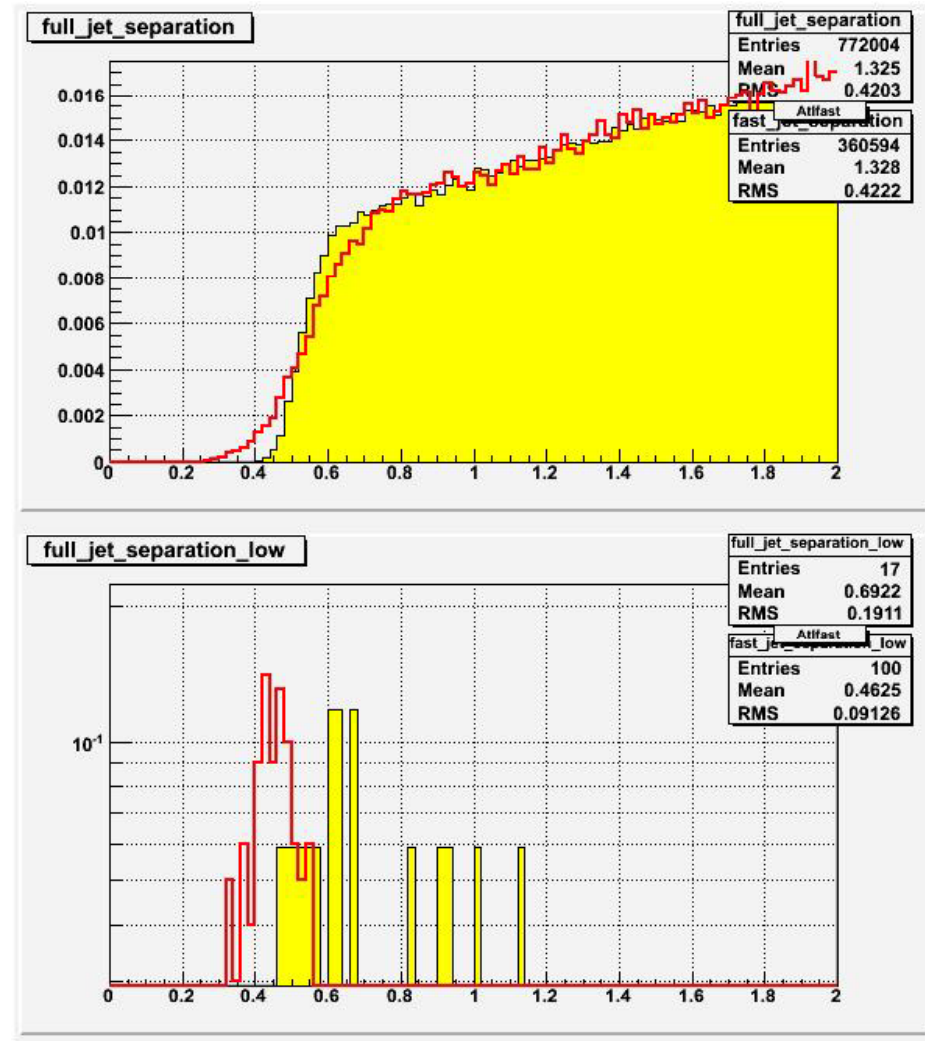
- Full chain jets included in 12.0.6 AODs, fast not
- AtI fast run directly from evgen files used in standard production
- R-parameter = 0.4
- Shift to higher pT in fast

Full Fast



Jet Separation (cone)

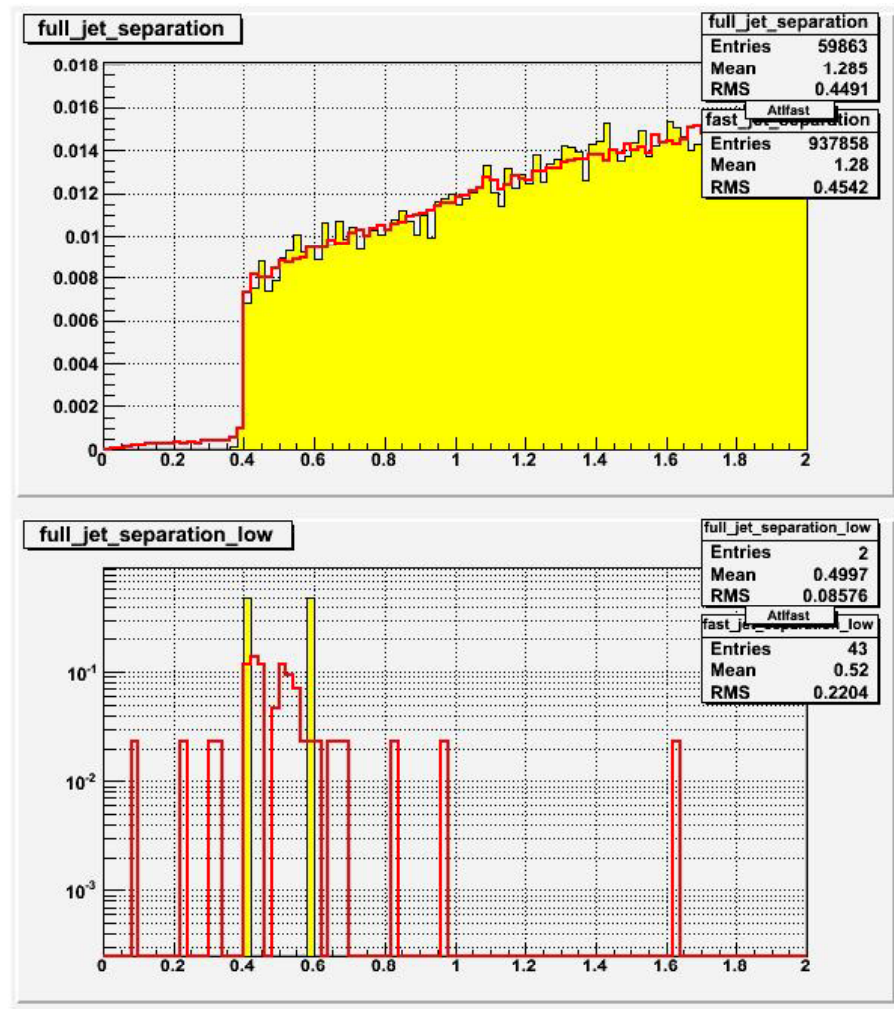
- dR between pairs of jets
- Behaviour at low separation in fast simulated jets



W. Murray

Jet Separation (kT)

- Closer agreement
- Behaviour at low separation still there, much less pronounced



W. Murray

Future Plans

- Pull efforts together for HG5 CSC note contribution
- Continue to explore improvements in event reconstruction