

Zero jet events

Status Report

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Objectives

- The zero-jet bin in Dilepton, MET is an important discovery sample, both for $H \rightarrow WW$ and other new physics signatures.
- A major background to this is $t\bar{t}$ production, where both W s got to lepton-neutrino, and the two b-quark jets are both missed.
- Therefore:
 - We need to examine the b-quarks to discover where they were lost
 - We need to examine the efficiency of our lepton cuts
 - To understand both of the above, we need to examine the generator-level kinematics of $t\bar{t}$ and WW .

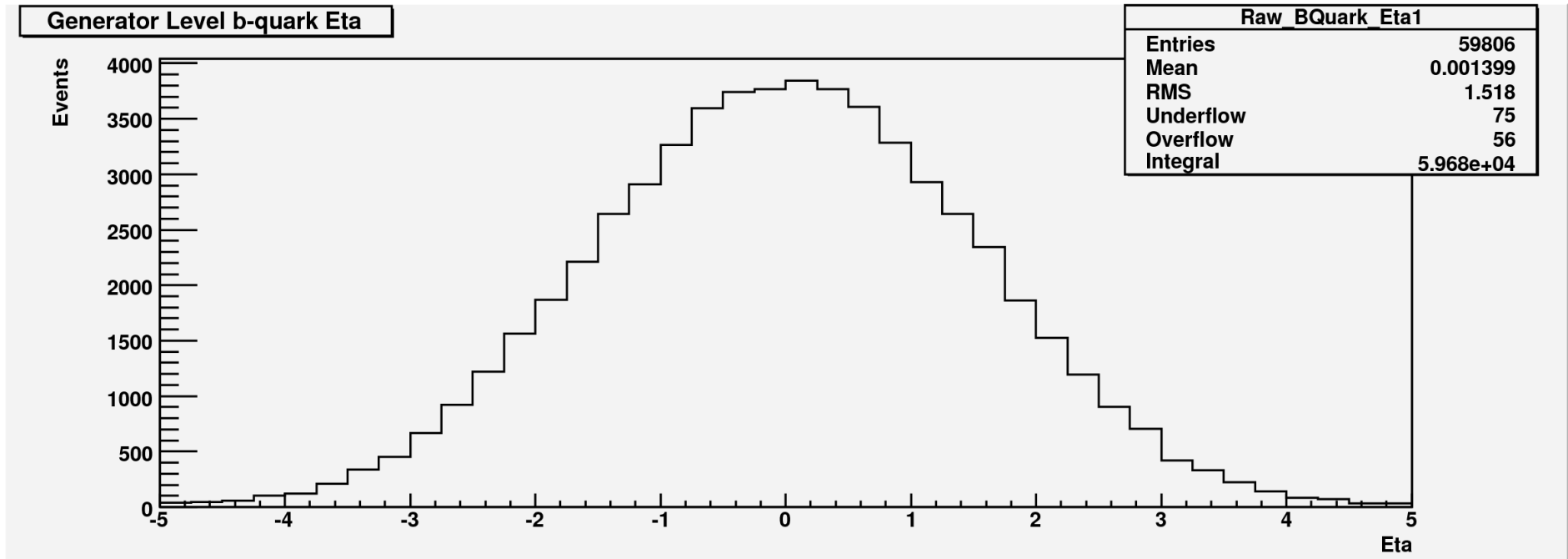
Surf & Turf Event Selection

Surf & Turf nominal Selection:

- Dilepton events (as displayed previously – see Matt L.'s earlier plots)
 - Require two, and only two leptons with various p_T requirements
 - Default lepton p_T is 20 GeV for hard, 19 for soft
- Jets (unless specified otherwise):
 - $|\eta| < 2.5$
 - $p_T > 20$ GeV

Used 30,000 generator level events from our $t\bar{t}b\bar{a}$ sample (luminosity*BR of 74pb) , and 9,900 WW events (luminosity*BR of 9.9pb).

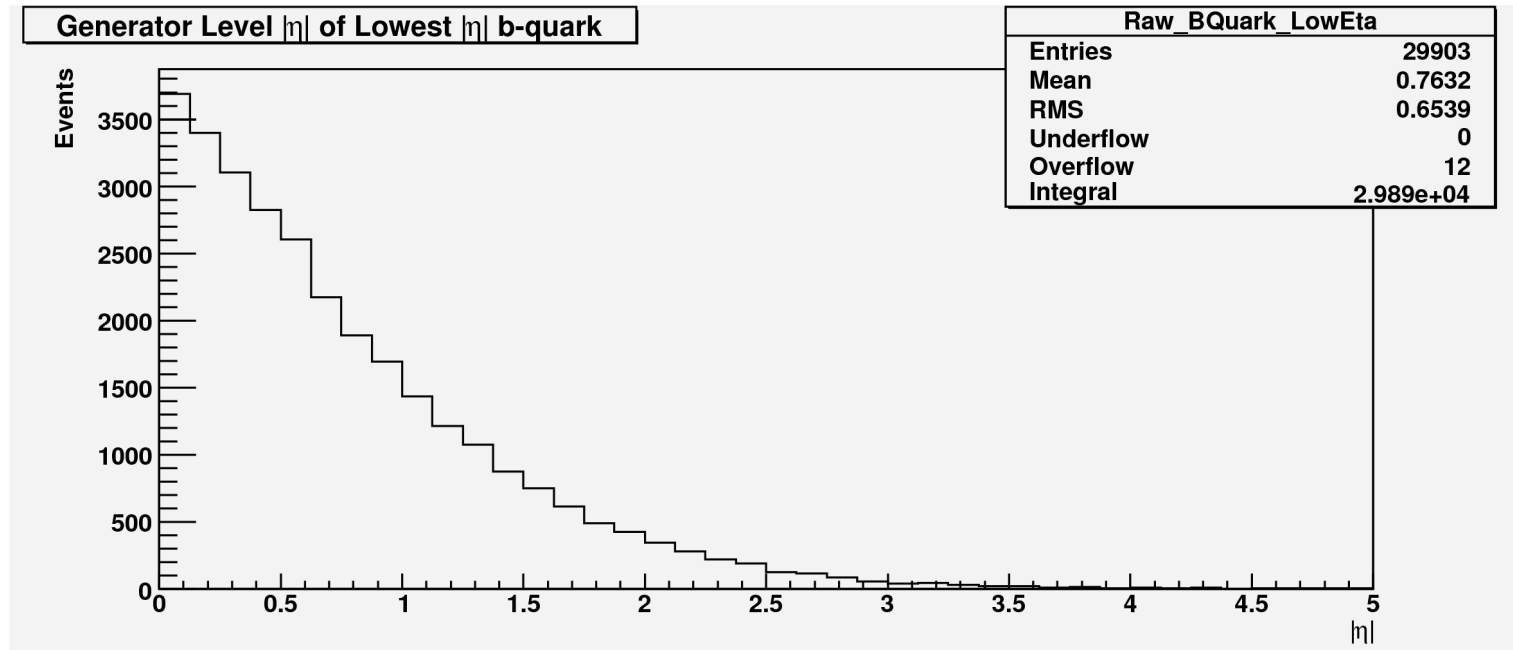
b-quark η at generator level



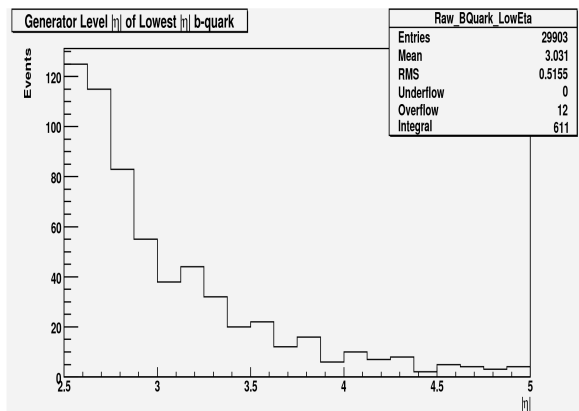
b-quark η at generator level for *all* b-quarks from all ttbar events

Only 89.9% of all b-quarks are within $|\eta| < 2.5$

b-quark η : Lowest η quark



$|\eta|$ of lowest $|\eta|$ b-quark in ttbar events at generator level



Zoom-in on $|\eta| > 2.5$ region.

Every event where the lowest eta jet has $|\eta| > 2.5$ loses both jets under the initial cuts.

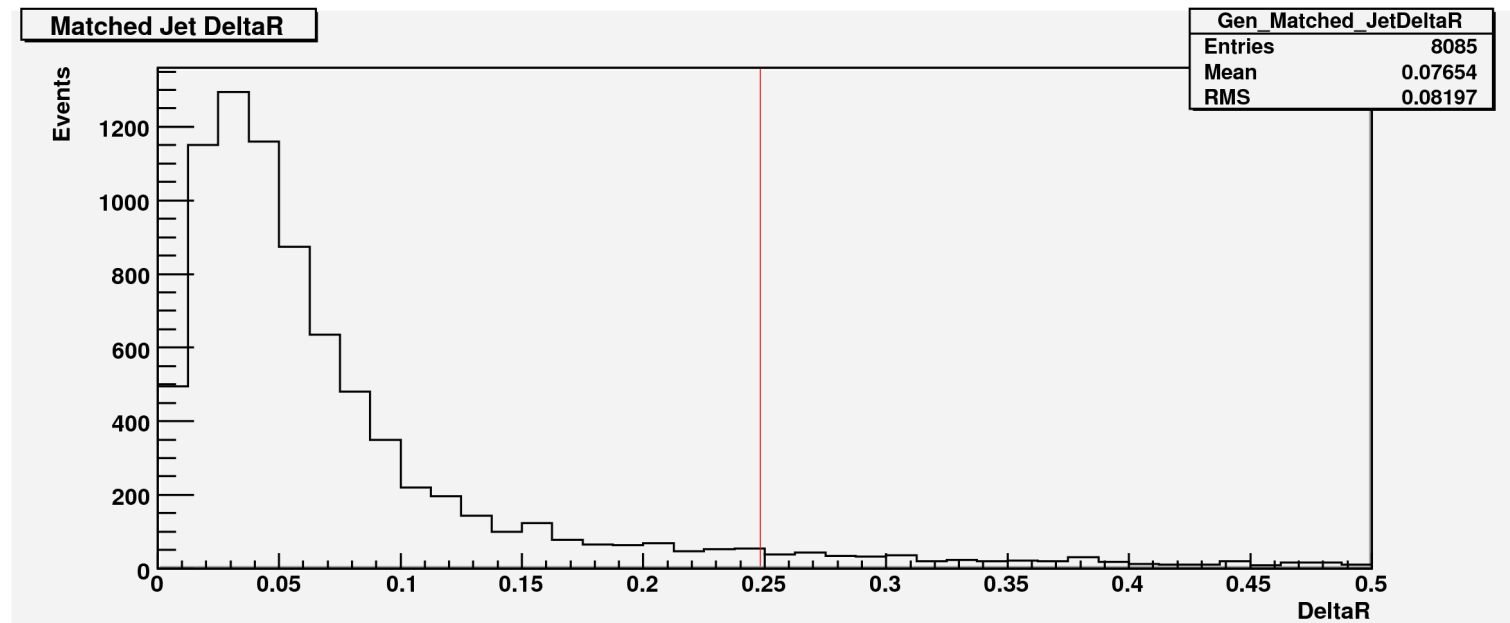
2% of all ttbar events go into the zero jet bin due to high η jets

Proposal on jet η

For our purposes, we recommend expanding the $|\eta|$ range for jets out to 5.0 for the purposes of examining the top, so as to gain more jet acceptance, and also for any process which has $t\bar{t}$ as a significant background, so as to remove the 2% of events that normally fall within the Zero Jet Bin.

Jet Matching

Matching jets to quarks is done by searching for a jet within a ΔR of 0.25 of a quark track. This ought to retain roughly 95% of the matches that are found for a larger cone of 0.5.



b-quark/Jet separation with simple cone of 0.5 matching, and with line showing 95% cut

Three Categories

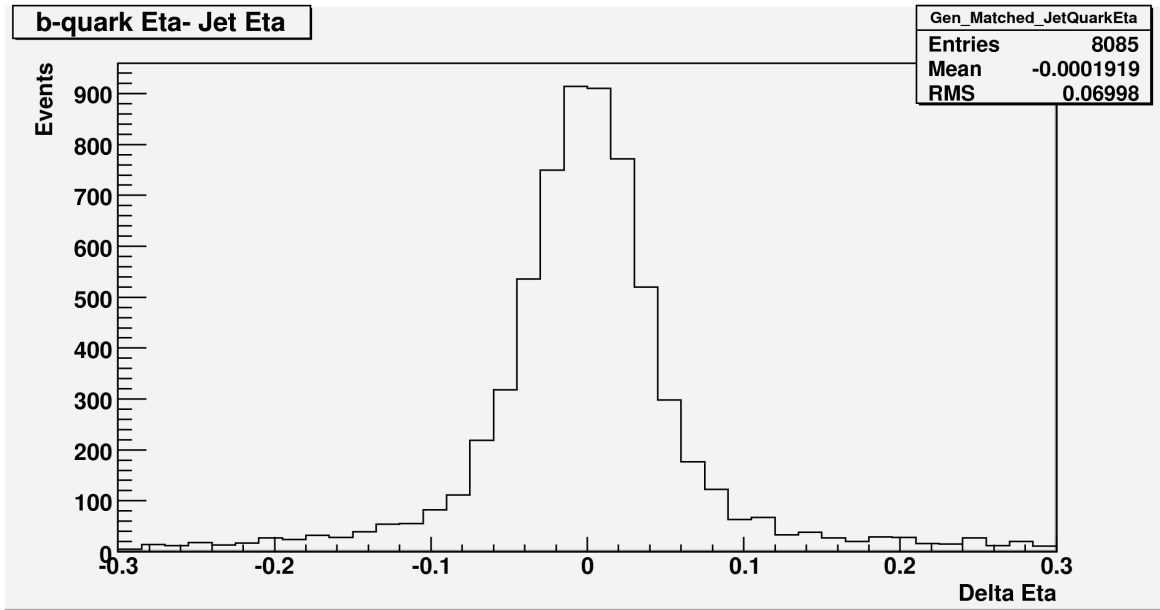
- Matched
 - b-quarks with a matching jet within $\Delta R < 0.25$
 - Does not fulfill duplicate requirements
- Unmatched
 - b-quarks without a matching jet within $\Delta R < 0.25$
- Duplicate
 - b-quarks with two or more matching jets within $\Delta R < 0.25$
 - This category currently unsorted, for later analysis

Total Amounts:

- Matched: 9066
- Unmatched: 5885
- Duplicate: 0

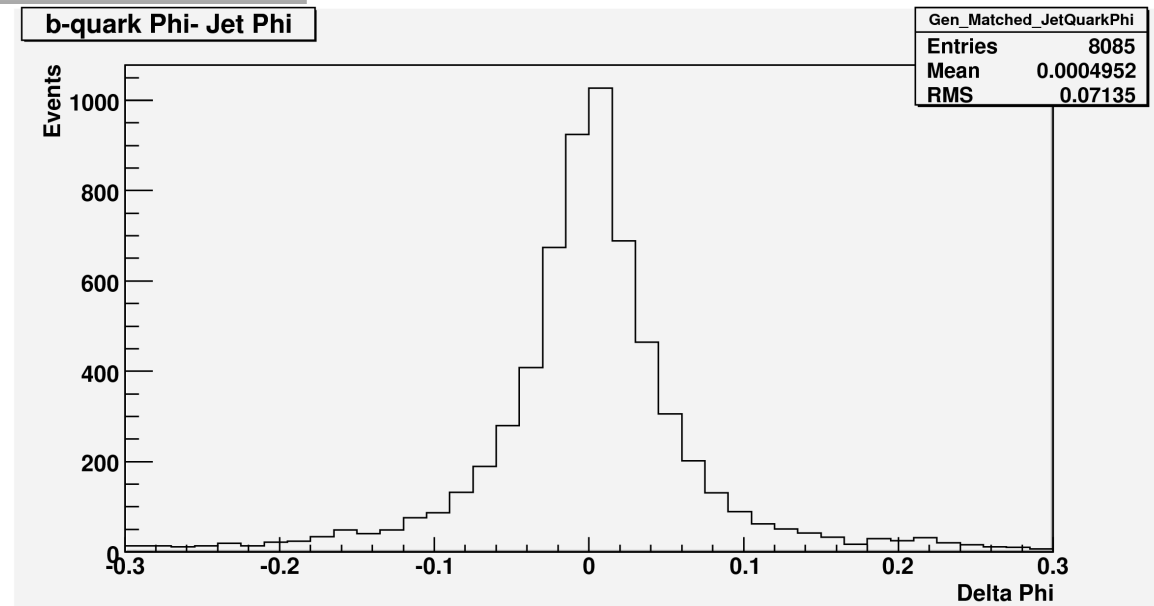
Deliberately stayed away from “closest” dR to have “unbiased residual” for now.

Jet Angular Resolution

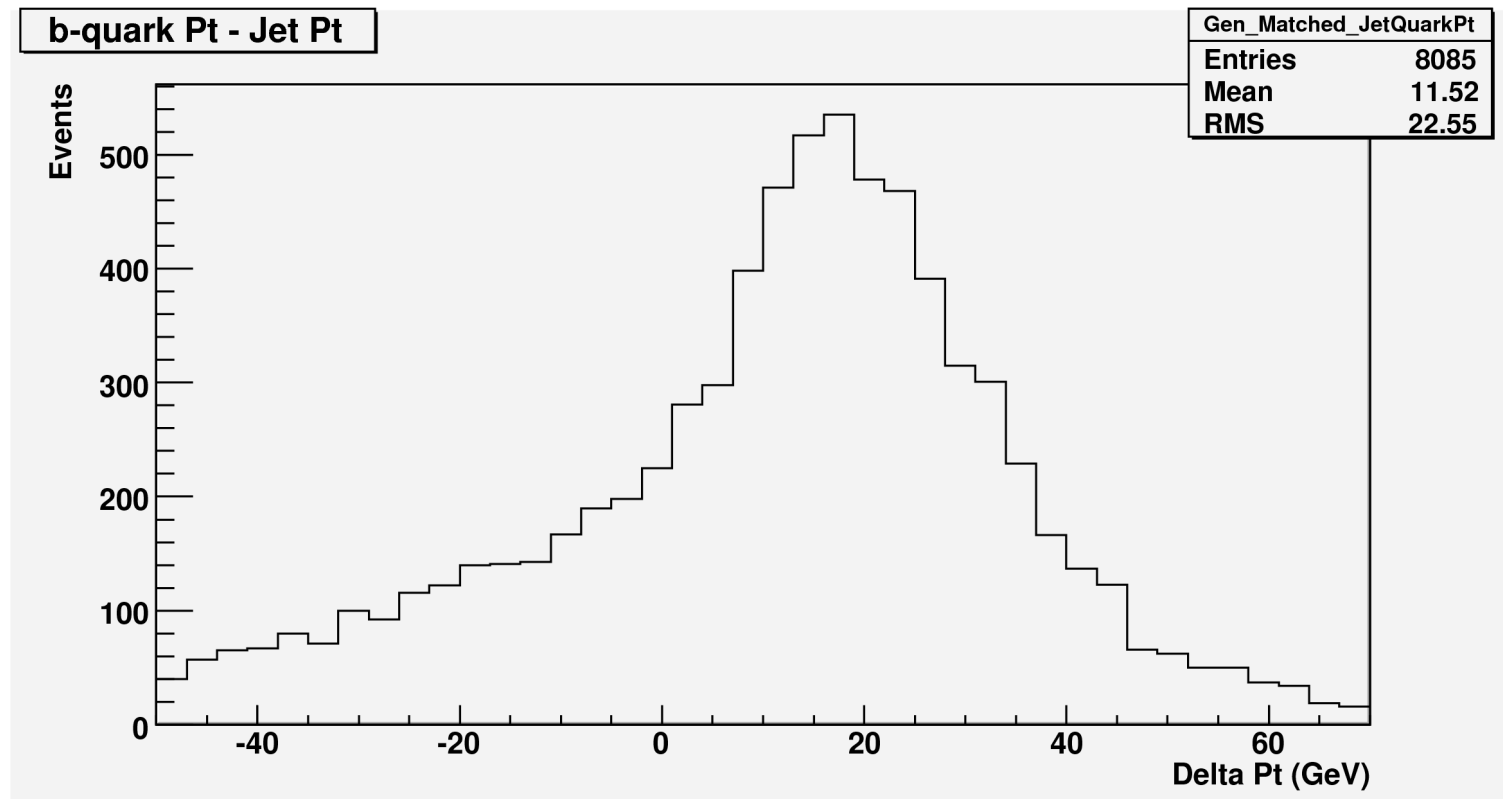


b-quark – reco jet η

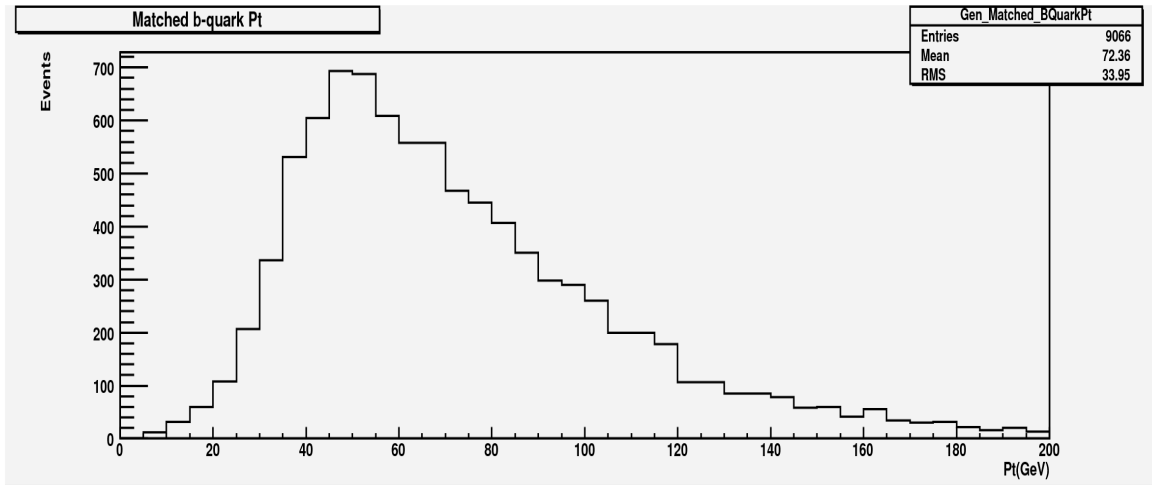
b-quark – reco jet ϕ



Jet p_T Resolution

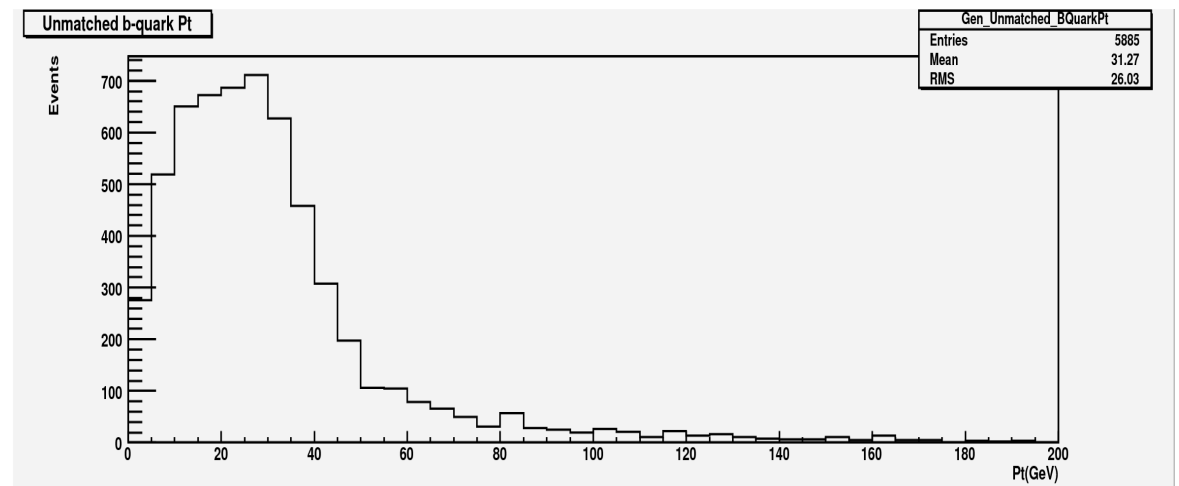


b-quark p_T for 2 categories

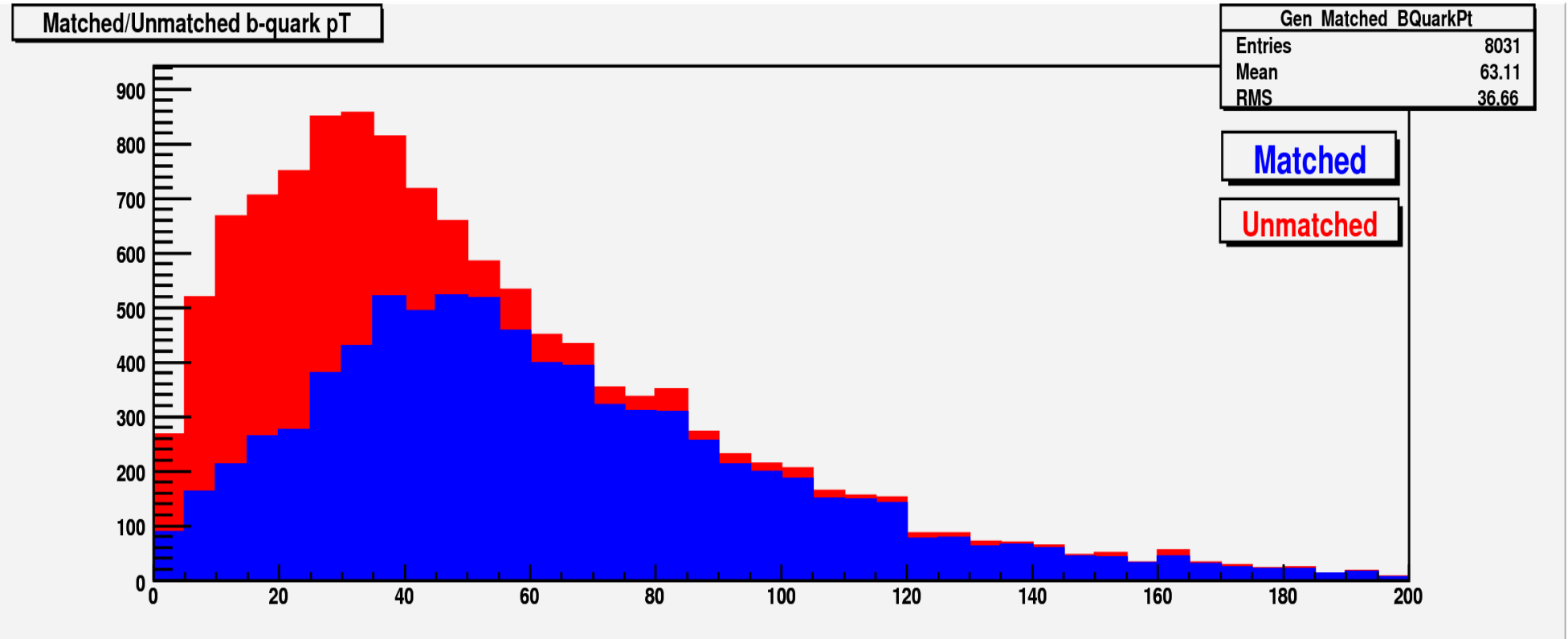


p_T for generator quarks in the Matched category

p_T for generator quarks in the Unmatched category

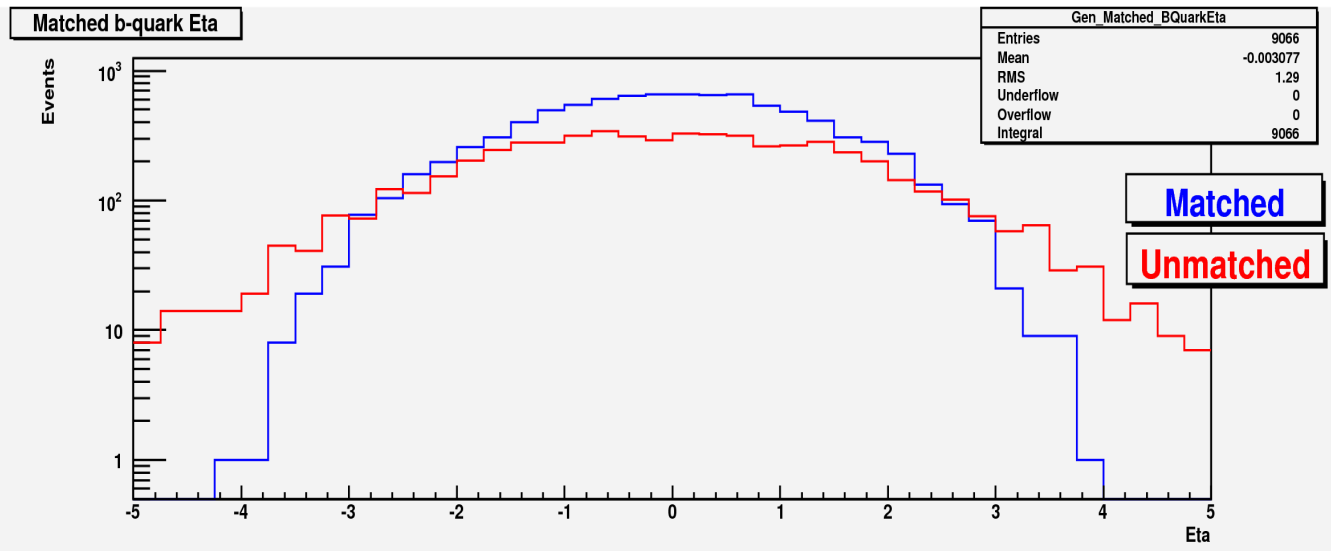
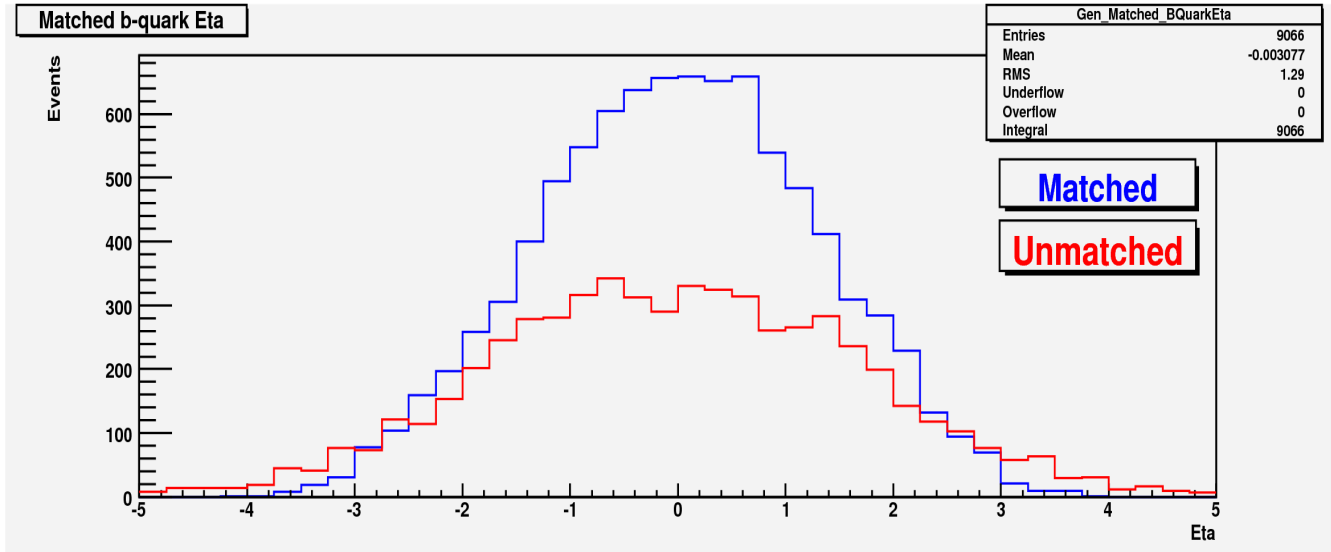


p_T Comparison



Stack plot of Unmatched/Matched b-quark p_T

η Comparison



Comparison between Matched and Unmatched jets in η , in standard and log format.

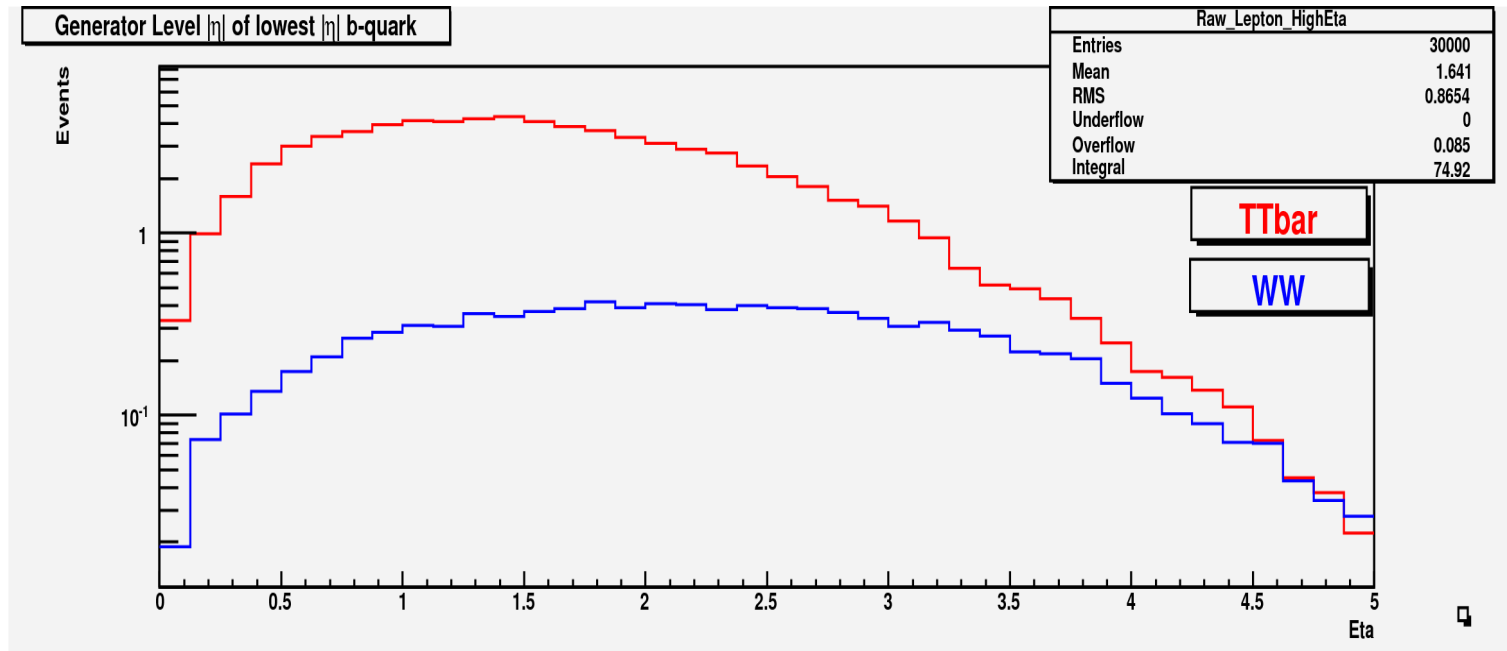
Analysis of Unmatched b-quarks

From the events that pass our dilepton selection, in the expanded jets (jet $|\eta| < 5.0$):

- 39% of b-quarks are unmatched (have no jets within $\Delta R < 0.25$ with $p_T > 20$)
- 14% of events have *both* b-quarks unmatched

Aside: Lepton η

A brief foray into leptons

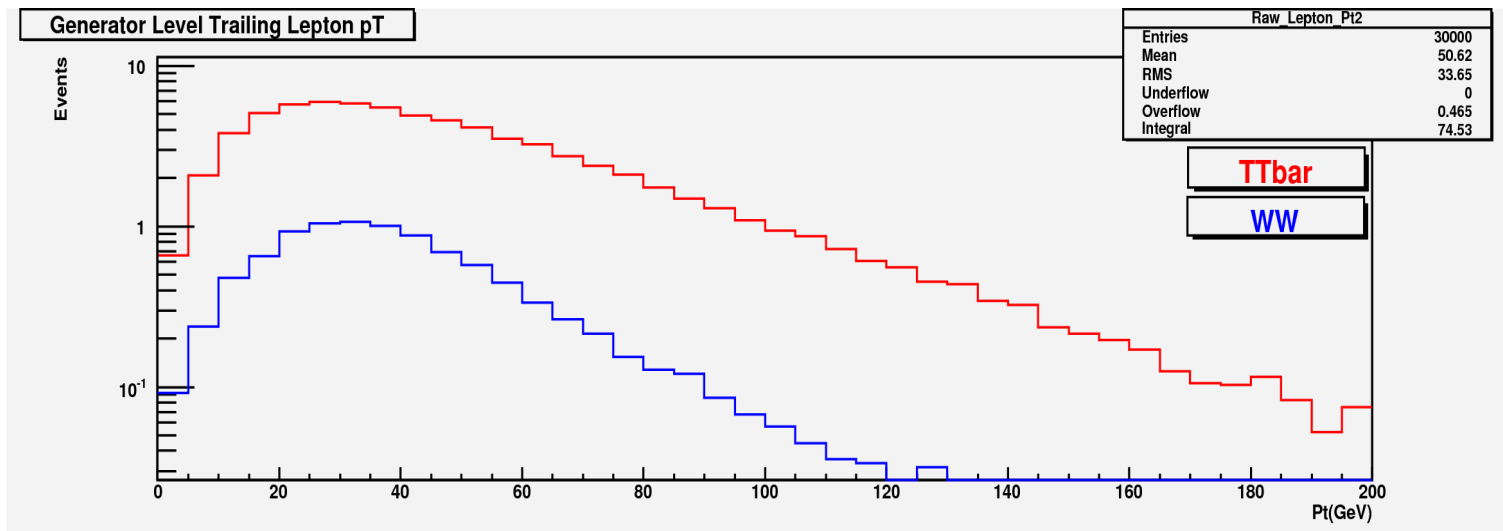


Generator Level $|\eta|$ of the highest $|\eta|$ lepton

Approximately 20% of all TTbar events have one lepton with $|\eta| > 2.4$ at generator level

Approximately 46% of all WW events have one lepton with $|\eta| > 2.4$ at generator level

Aside: Lepton p_T



Generator Level p_T of the lowest p_T lepton in all $t\bar{t}$ events

Approximately 16% of $T\bar{T}$ events have a lepton that falls below a p_T of 20 GeV at generator level.

Approximately 15% of WW events have a lepton that falls below a p_T of 20 GeV at generator level.

Conclusion thus far

- 10% of b-quarks from ttbar events have $|\eta| > 2.5$ at generator level.
- 2% of ttbar events have both b-quarks with $|\eta| > 2.5$ at generator level.
- 39% of b-quarks in reconstructed events have no 20 GeV jets within $\Delta R < 2.5$ and $|\eta| < 5.0$
- 14% of ttbar events have both b-quarks reconstructed with no jets within $\Delta R < 2.5$ and $|\eta| < 5.0$