Tau Dilepton Analysis: $t\bar{t} \to \tau_h e j j$

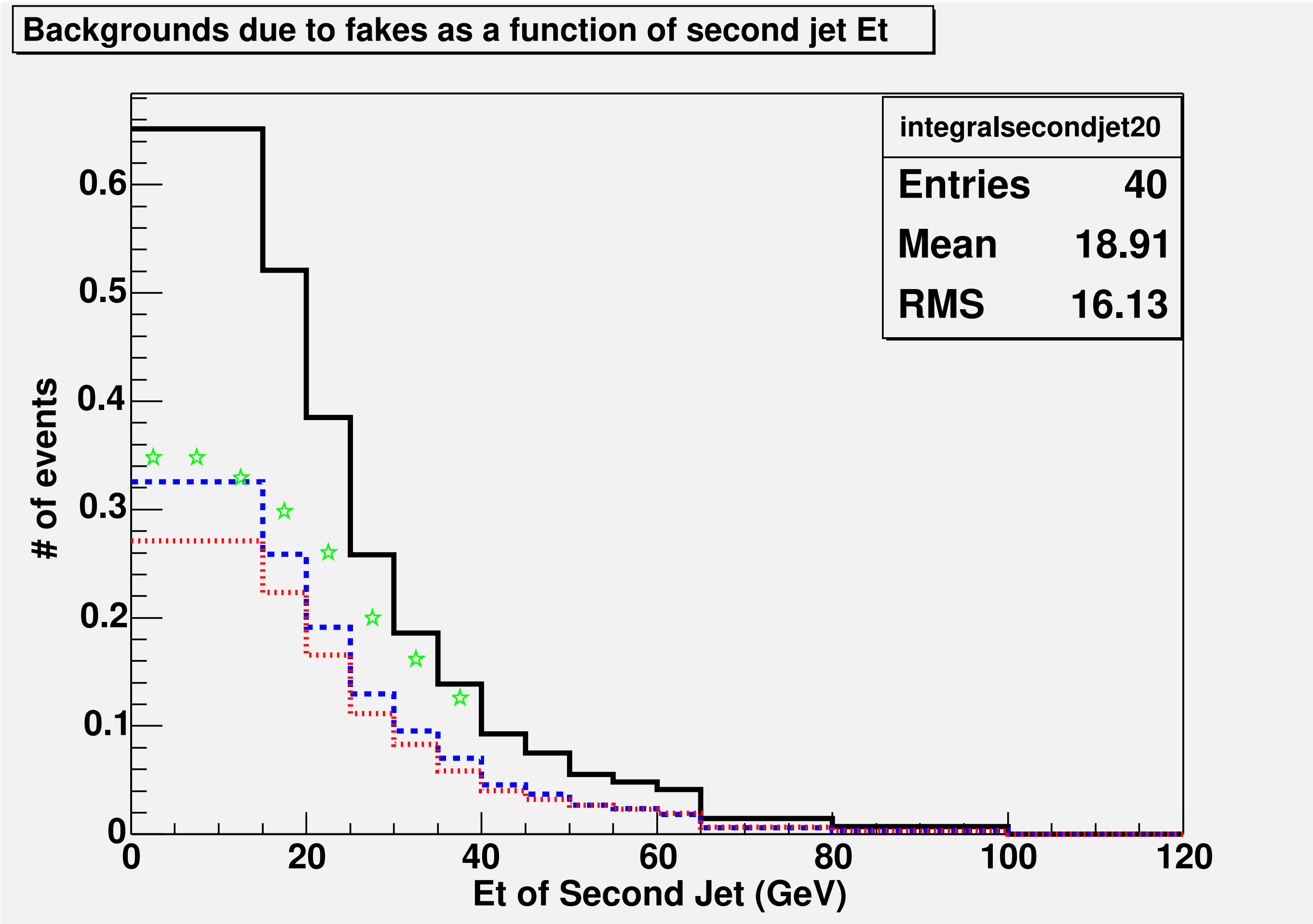
Dilepton Meeting, June 18, 2003

S. Demers, J. Insler, K. McFarland, T. Vaiciulis

- Tuning H_T and second Jet E_T
- WW Dibson Background
- Systematics

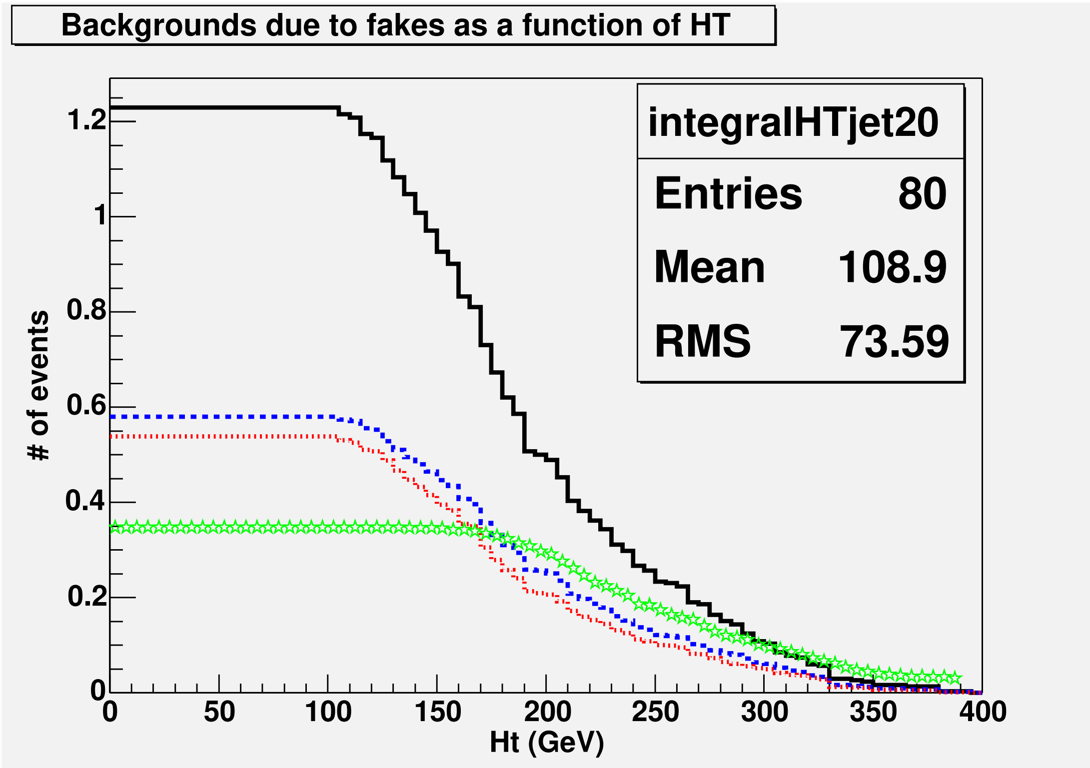
Optimize Cuts

- Improve upon previous method of choosing cuts (which was simply mirroring efficiency of the other Dilepton Analysis)
- Two variables with most promise: H_T and E_T of the second Jet



- Jet20, Jet50, Jet70, ttbar Signal from MC

Optimize Cuts

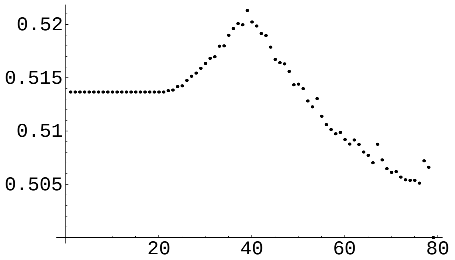


- Jet20, Jet50, Jet70, ttbar Signal from MC
- There is a large discrepency between the Jet20 fake rate and the Jet50, Jet70 fake rates
- CDFNote 6308 (Tau Reconstruction Efficiency and QCD Fake Rate for Run 2) lists possible causes:
  - different content of quark/gluon jets in the sample
  - different content of heavy flavor quarks
  - residual trigger bias
- We average the Jet20 and Jet50 rates and take half the difference as a systematic error

Optimize Cuts

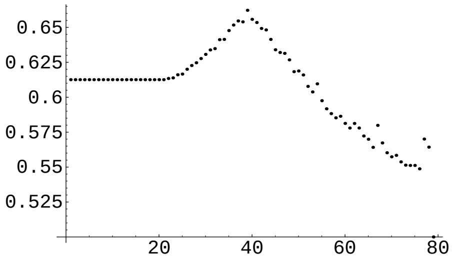
signal−to−background.nb 1

- With 72pb^{-1}:



Optimize Cuts

signal–to–background.nb 1



- With 10 times as much luminosity:

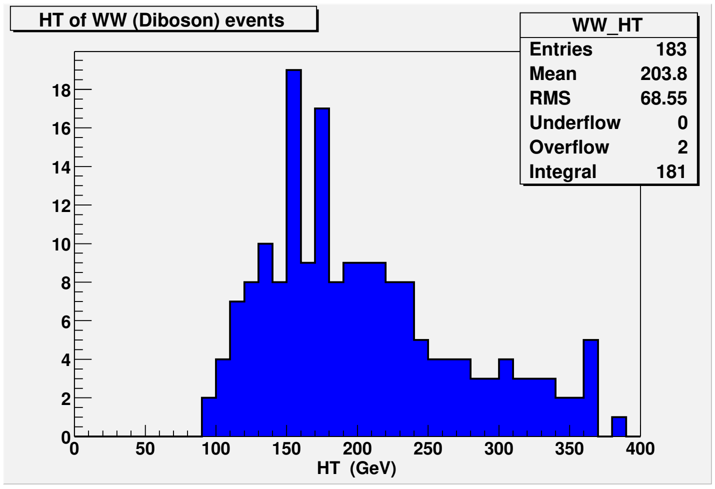
Optimize Cuts

- Use Poisson Statistics
  - Probability of getting N events given S signal events and B background events:
    - P(N | S + B) = $\frac{exp^{-S+B}(S+B)^N}{N!}$
  - If, however, there was no Signal, the probability of getting N events given simply B background events:
    - P(N | B) = $\frac{exp^{-B}(B)^N}{N!}$
- In order to maximize the amount of Signal averaged over the probability of seeing N events, we must maximize the ratio:

$$\frac{(P(N \,|\, S+B))^2}{P(N \,|\, B)}$$

WW Background

- Use Pythia WW sample representing $562 fb^{-1}$ (828,000 events with both W's being forced to decay leptonically)
  - 183 events before H_T cut and after all other cuts
  - 97 events after H_T cut (at 180GeV)
  - total background in 72pb^{-1} is 0.013 ($\pm$ 0.002) events (error is satistical only, value is as much as 30% too low because of 2-jet scale factor)
- Compare with e, μ Dilepton analysis with same luminosity
  - WW background of 0.066 ($\pm$ 0.003) events (error is statistical)
  - have to take into account $\tau \rightarrow hadron$ branching ratio, lower tau ID efficiency



Systematics

- Acceptance:
  - electron ID efficiency
  - tau ID efficiency (Note 6308, from MC: reconstruction estimated at 90%, ID at 50 - 55 %)
    - ∗ use results of embedded tau study P Murat, et al embedded tau study
  - jet energy scale
  - initial and final state radiation
- Jet Fakes
  - Trigger Bias: Use average value of Jet20 and Jet50 for fake rate and use half the distance between them as the systematic
  - jet energy scale
- Diboson Backgrounds
  - 2-jet rejection factor: CDFNote 6290 ("Background estimate from WW and WZ Production to the Top Dilepton signal") used a 30% systematic uncertainty to be conservative
  - jet energy scale
  - electron ID efficiency
  - tau ID efficiency

  - trigger efficiency
  - cross section uncertainty
- $Z \to \tau\tau + jets$
  - 2-jet rejection factor: currently using Herwig + Alpgen MC that includes 2 extra partons. a run over 1 parton sample would give a measure of this systematic
  - $\not\!\!E_{\mathrm{T}}$ energy scale
  - jet energy scale
- $Z \to ee + jets$
  - we measure from the data (don't have to worry about 2-jet rejection factor)
  - electron fake rate systematic from CDFNote 6408 data

Plan

- look at the data after finalizing backgrounds this week
- post CDF Note (in progress)
- Pre-Bless in June 26th Top Meeting