Top Mass Measurement with DLM in lepton +jets channel

Contents

- Introduction
- DLM
- Pseudo Experiments
- Summary

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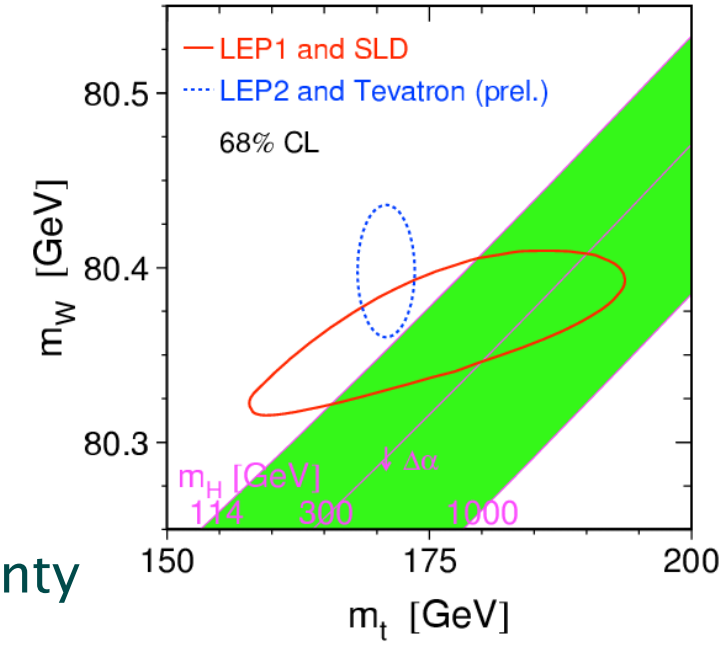
for CDF collaboration

Introduction

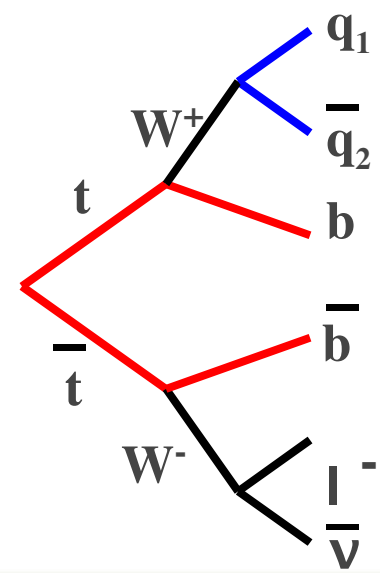
Top quark mass measurement

- Constraint on higgs mass with W boson and Top quark masses



Decay channel

- Dilepton 5%
  2 b-jets, 2 leptons, missing Et; 2ν's, low BR
- All hadronic 44 %
  6 jets(2b-jets); highest BR, but large uncertainty
- Lepton + Jets 30%
  4 jets(2b-jets), 1 lepton and missing Et;
  Good S/B, precise e,μ momenta and moderate BR



Dynamical Likelihood Method(DLM)

- Improve precision of measurements with a theoretical input (differential cross section): MC generation of parton level process consistent with measured quantities.

Dynamical Likelihood Method

Per Path Likelihood: Single reconstruction x from y(Bayes' formula)

$$L_{path}(x_i, M, JES; y_j) = N_j \frac{d\sigma}{d\Phi}(x_i; M)\, w(x_i, y_j; JES)$$

$$N_j^{-1} = \int dx \frac{d\sigma}{d\Phi}(x; M)\, w(x; y, JES)$$

x: parton level quantity
y: observed quantity
i: path number
j: event number
JES: jet energy scale

Per Event Likelihood

$$L_{ev}(M, JES; y_j) = \sum_i L_{path}(x_i, M; y_j, JES)$$

w: Transfer Function
p.d.f. for y when x is given

Joint Likelihood

$$L(M, JES) = \prod_j^{ev} L_{ev}(M, JES; y_j)$$

Mtop and JES are measured simultaneously in 2D likelihood

Transfer Function and JES

Define response variable to make Transfer Function (TF)

$$\xi(JES) = \frac{E_{parton} - E_{jet}(JES)}{E_{parton}}$$

JES can be measured by hadronic W mass

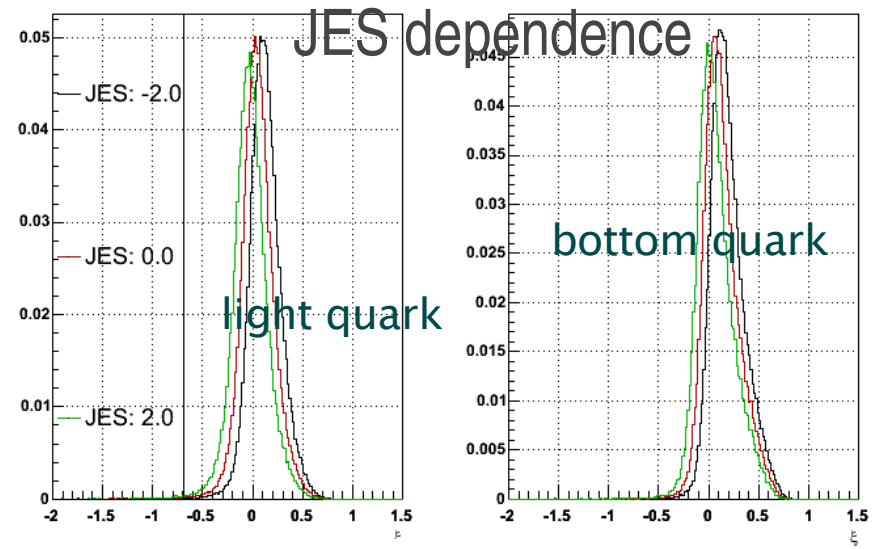
- Reconstruct Sw (Invariant mass of W) with TF depending on JES
- Decay Matrix constrains Sw

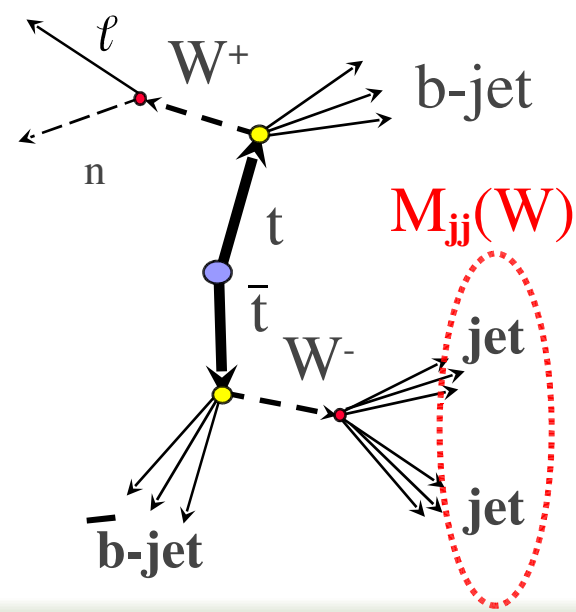
$$|D_{th}|^2 = \frac{g_w^4}{4}\frac{1}{2}\sum \frac{(t\cdot q_i)(b\cdot q_j)}{(\boxed{S_w} - M_W^2)^2 + M_W^2\Gamma_W^2}$$

Reconstructed

- Mtop and JES can be measured simultaneously by 2D Likelihood

$w(\xi, JES)$

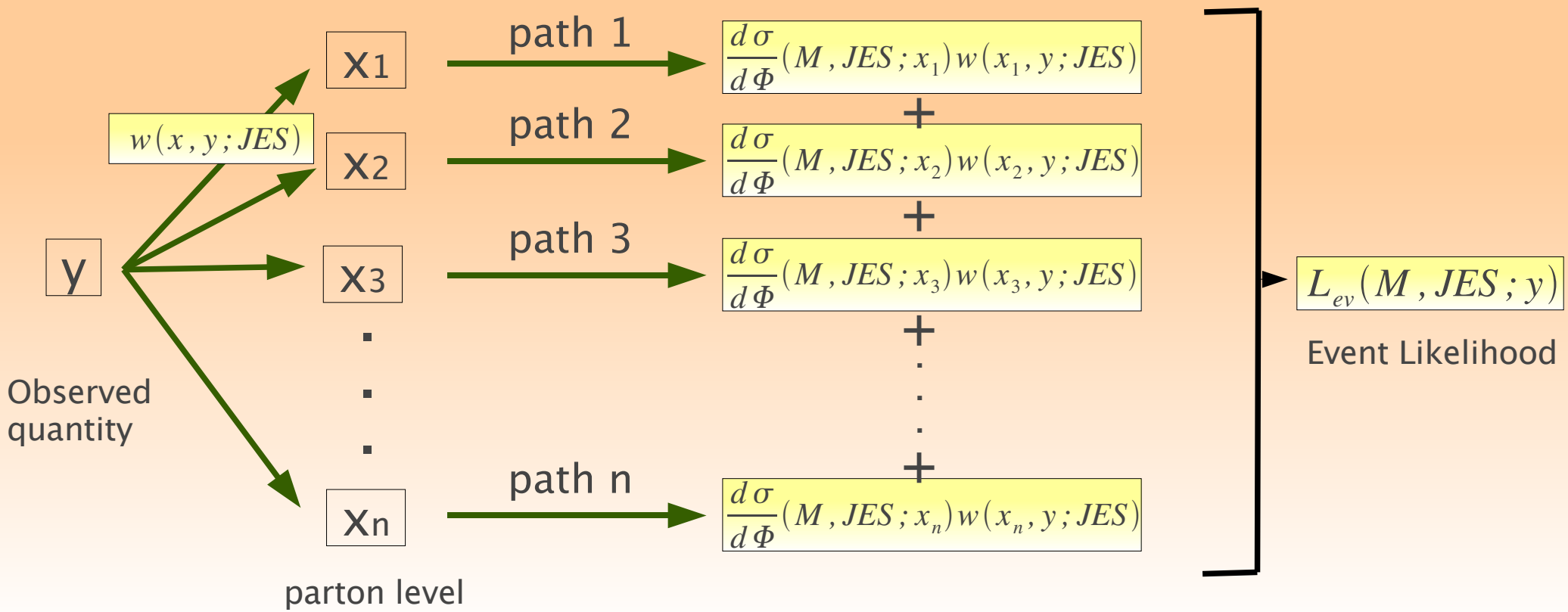




Path/Event Likelihood

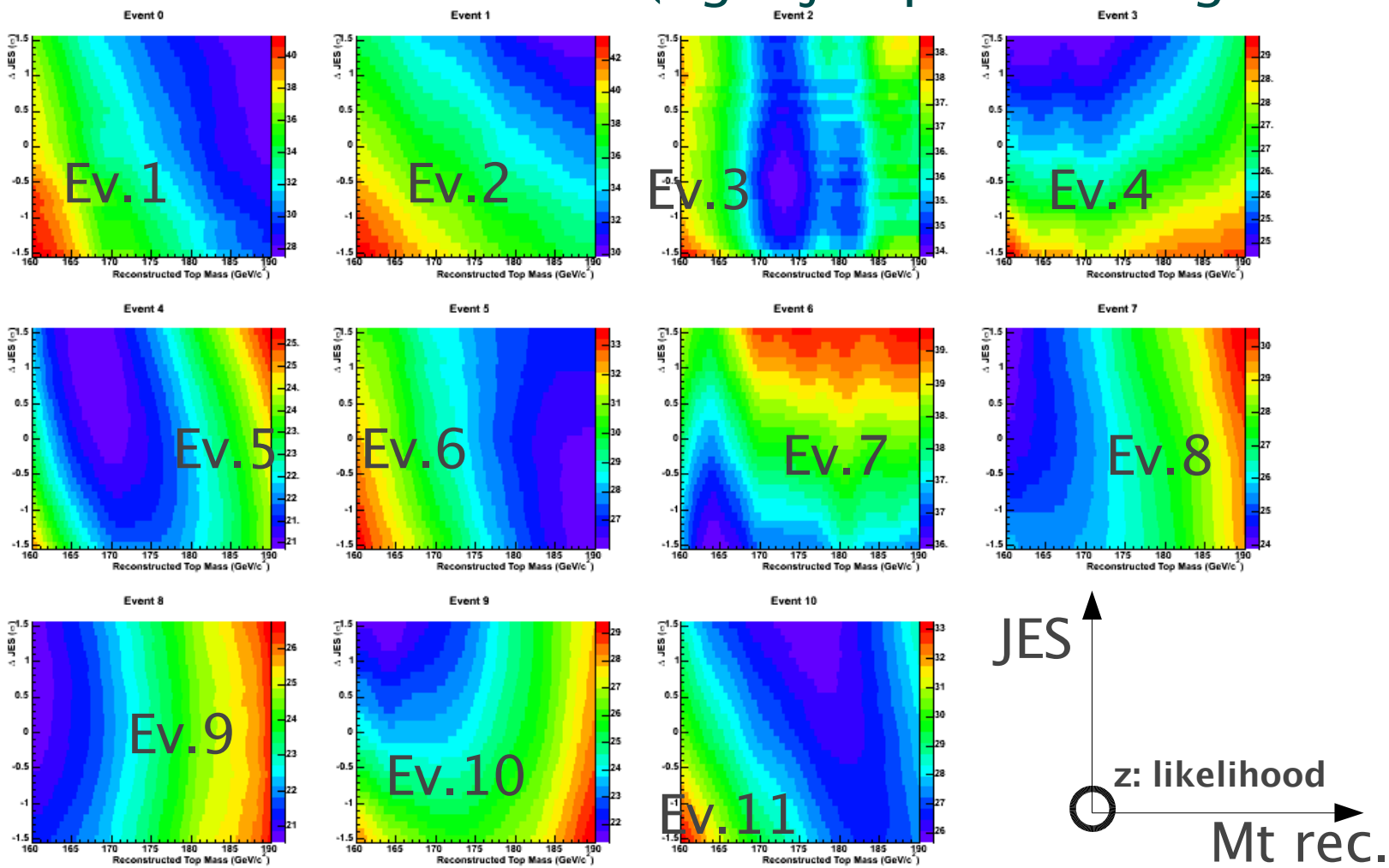
There are many sets of parton quantity x which result in observed quantity y . A path is one of the possible sets of x.

Illustration of reconstruction of an event :



Event Likelihood

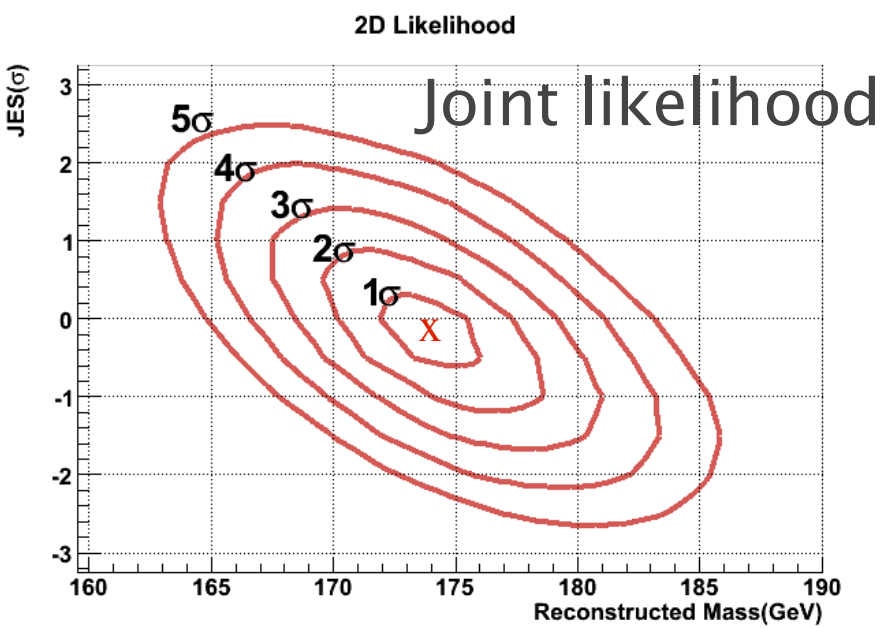
Examples of event likelihoods (right jet-parton assignment)



Joint Likelihood is obtained by multiplying event likelihoods.

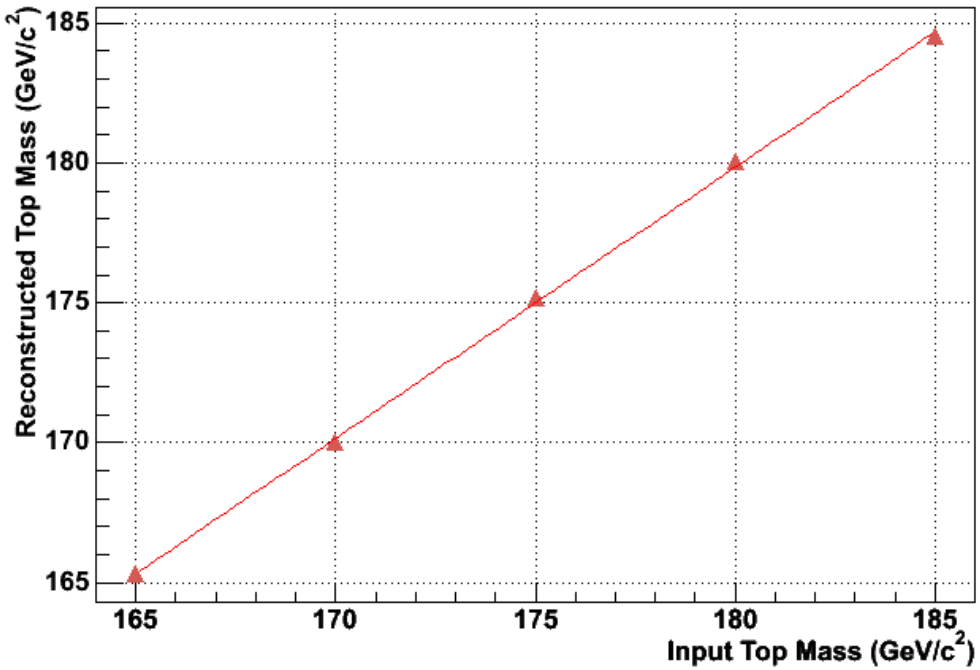
Signal Likelihood(Ideal case)

typical one pseudo experiment (PE)
with right jet-parton assignment



- input Mt = 175GeV
- input JES = 0.0
- Nev = 200 (assuming 1.2fb-1)
- 50k paths

Linearity check by ~500PE's



Mtop is reconstructed well

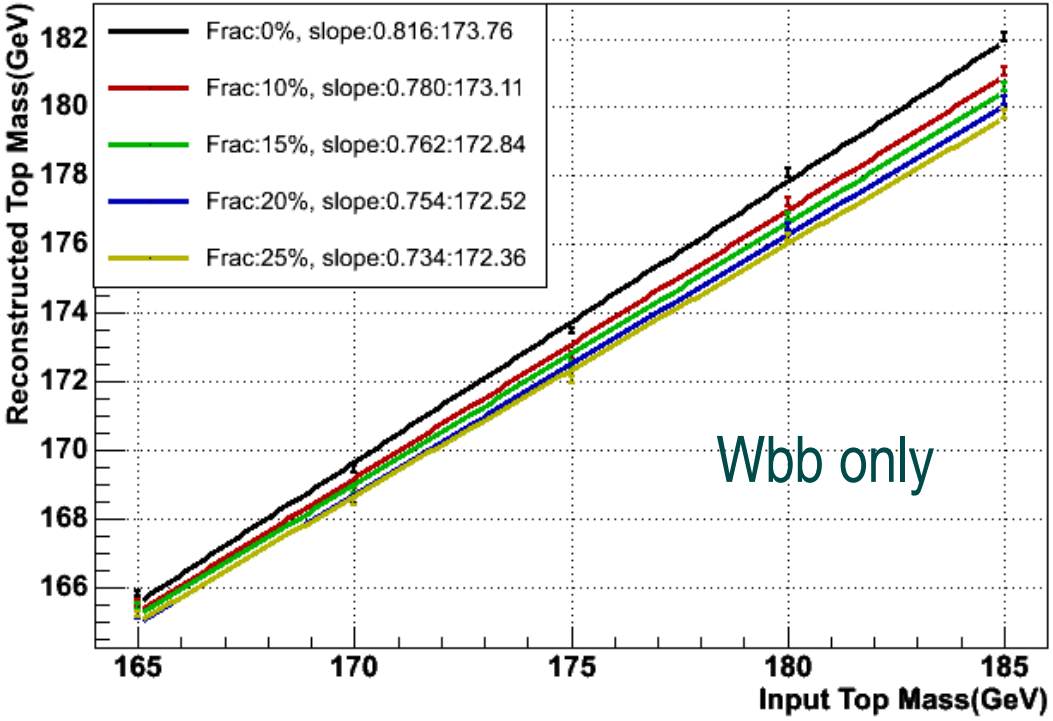
Realistic Consideration

Preliminary check on realistic case

- Jet-parton assignment unknown

- Background Effect

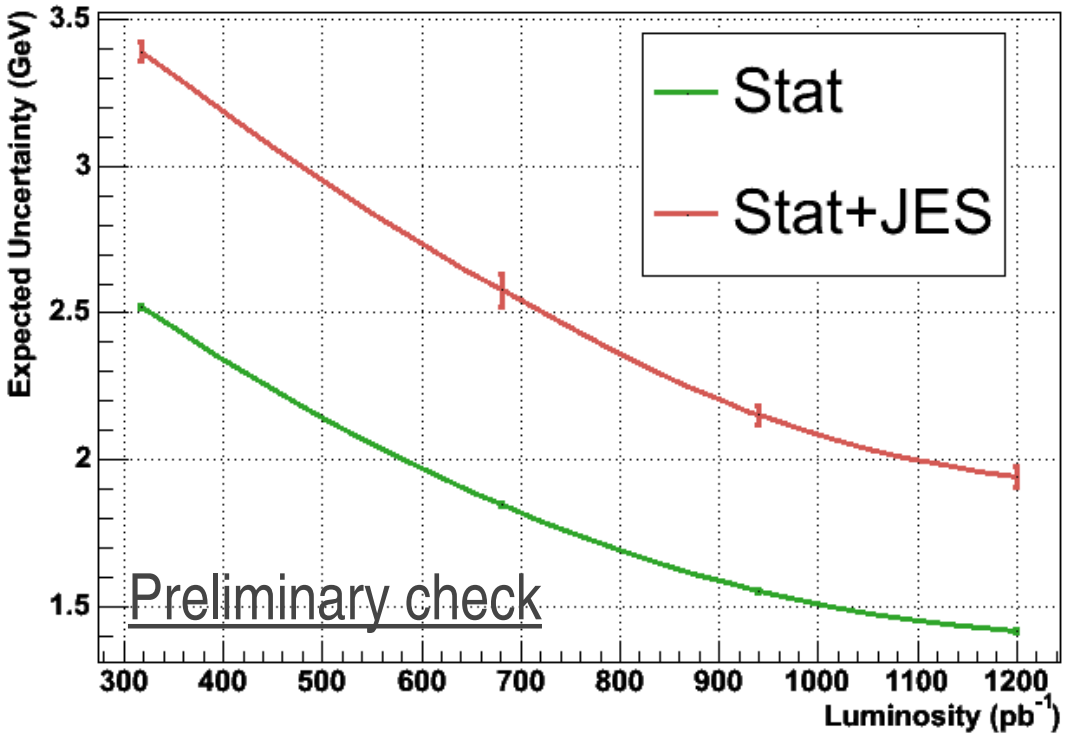
- Wbb is one of the dominant backgrounds
- Total background is estimated to be ~15%
- In this talk, the background is represented by 15% Wbb



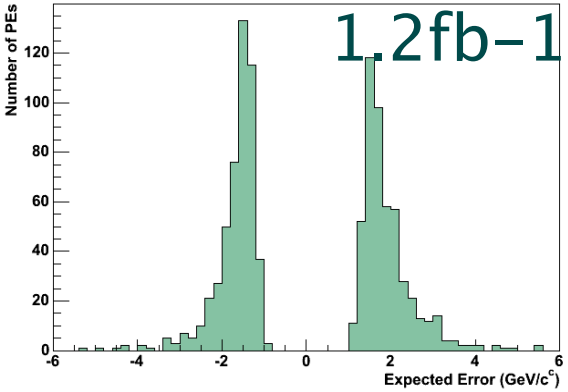
The slope goes down by increasing background fraction.
Measured Mtop need to be corrected by slope and constant.

Expected Statistical Uncertainty

Estimation of the expected uncertainty
(15% wbb background only)



Expected Uncertainty



~2.0 GeV(Stat+JES)@1.2fb-1

Summary

- DLM uses differential cross section per unit phase space element. The likelihood is defined by Bayes' formula.
- DLM integrated with JES gives 2D likelihood.
  - Transfer Function depends on JES.
  - Decay matrix elements in the likelihood can constrain invariant mass of hadronic W.
- Expected statistical uncertainty is ~2.0GeV at 1.2 fb-1.

Back up