Top quark mass reconstruction in the semi-leptonic channel using the Globalχ^2 algorithm (II)

- Preliminary results -

IFIC - Valencia

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Outline

Talk Outline

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Introduction

Goals

- Not to reinvent the wheel.
- **Repeat/Reproduce the top quark mass reconstruction done in the CSC T9 note (semileptonic channel).**
- Introduce the GlobalChi2 method which we have used for the ATLAS Silicon Tracker alignment for years.
  - Nowadays, GlobalChi2 is the baseline alignment algorithm for the ID alignment.
  - SiGlobalChi2Algs: http://atlas-sw.cern.ch/cgi-bin/viewcvs-atlas.cgi/offline/InnerDetector/InDetAlignAlgs/SiGlobalChi2Algs/
- Add a physics analysis to my thesis:
  - The main topic is the ATLAS Silicon Tracker alignment using the GlobalChi2 method
  - The GlobalChi2 would be the link between my frist part (ID alignment) and the second (top mass reco).

Channel: Semi-leptonic

- Top quark mass reconstruction in the semi-leptonic channel.
  - Production: $\sigma_{tt\ (LHC)}$ = (833±100) pb @ 14 TeV
  - Top decay (99.9%) through $t \longrightarrow W^+b$, where $t\bar{t} \longrightarrow W^+bW^-\bar{b}$
  - Final states depending on the W decay channel:
    - Fully-Hadronic (4/9): 6 jets (2x $W \longrightarrow jj$)
    - Fully-Leptonic (1/9): 2 leptons, 2 neutrinos and 2 jets (2x $W \longrightarrow l\nu$)
    - Semi-Leptonic (4/9): 1 lepton, 1 neutrino and 4 jets ($W \longrightarrow l\nu$ + $W \longrightarrow jj$)
  - Golden channel (lepton = e, μ): 2.5 10^6 events/year.

Introduction

Data Sample

- Based on the official TopView ntuples (generated with v12.14.0.3)
  - Simulation: ATLAS-CSC-01-02-00
    - New magnetic field description, misaligned geometry with material distortion.
  - Reconstruction: ATLAS-CSC-01-00-00
    - New magnetic field description, perfect geometry with calibration constants.
- Sample 5200 MC@NLO: 146 ntuples with 3750 events/ntuple: 547.5 kevents (1.117 fb^{-1})
  - user.top.TopViewCSC121403_StacoTauRec_30um.trig1_misal1_mc12.005200.T1_McAtNlo_Jimmyv12000604.001.AANT0._00XXX.root
- Cross section:
  - Fully-Hadronic channel: $\sigma_{tt\ (LHC)} \simeq 367$ pb
  - Fully-Leptonic channel: $\sigma_{tt\ (LHC)} \simeq 90$ pb
  - Semi-Leptonic channel (l = e,μ): $\sigma_{tt\ (LHC)} \simeq 250$ pb

Calibration and cuts (*see Maria's talk*)

- By default, we use the **H1 calibration method** for jets (dead material, muon substraction, etc...), etc... which are in the TopViewNtuples.
- Additionally, we use a **pre-calibration map** (energy and eta dependent) **for light jets and b-jets determined using MonteCarlo**
- Semi-Leptonic events → requirements: 2 or more light jets, 2 b-jets, 1 lepton (*e* or *μ*) and Etmiss > 20 GeV
- Basic cuts:
  - GoodJet: pT > 40 GeV and |eta| < 2.5
  - Good lepton: pT > 20 (25) GeV for *μ* (*e*) and |eta| < 2.5

Why GX2?

Globalχ^2

- There is a **parallelism** between the ID alignment and the top quark mass reconstruction:
  - In both, there are "global" variables and "local" variables".
  This translates in two nested fits:

Alignment case:

- Nested fits:
  1. Track fit (local variables)
     - The track parameters depends on the alignment constants as the tracks are reconstructed assuming a geometry
  2. Alignment parameters fit (global variables)

Top quark mass case:

- Nested fits:
  1. W fit (local variables)
     - The W boson parameters depends on the top parameters as the W is the daughter of the top quark decay and this depends on the boost: $t \rightarrow Wb$
  2. Top quark parameters fit (global variables)

Both situations are quite similar!

GlobalChi2 - Kinematic fit

- Several analysis perform with a Kinematic fit: CSC T9 note, ATL-COM-PHYS-2008-117,etc....
- Typical chi2 function:

$$\chi^2 = \sum_{\mathrm{jets}+\ell} \left(\frac{E_i^m - E_i^f}{\sigma_{E_i}} \right)^2 + \left(\frac{M_{jj} - M_W^{PDG}}{\Gamma_W^{PDG}} \right)^2 + \left(\frac{M_{l\nu} - M_W^{PDG}}{\Gamma_W^{PDG}} \right)^2 + \left(\frac{M_{jjb_H} - M_{top}^f}{\sigma_{topH}} \right)^2 + \left(\frac{M_{\ell\nu b_L} - M_{top}^f}{\sigma_{topL}} \right)$$

- Parameters: E_i^{fit}, M_{top}

- Kinematic fit: Explicit reconstruction of the event topology (assuming a particle decay model).
  - Traditional approach: All the parameters fitted altogether with kinematic constraints, for example $M_{jj} \rightarrow M_W(PDG)$.
  - GlobalChi2: nested fits. First, a chi2 minimization wrt W parameters and afterwards chi2 minimization wrt top parameters including the previous minimization.
- A *in-situ* calibration is done: $E_i^{fit} = \alpha_i E_i^{reco}$ (*i* represents the light jets, the b-jets or lepton)
  - This allows to study the Jet Energy Scale (JES), denoted as α_i, for light quarks and b quarks separately.

- In our current implementation, the GlobalChi2 is a Kinematic fit and moreover it is an analytical method, where every step can be controlled and monitored.
  - TopViewAna as interface to read the TopViewNtuples
  - Implemented as a standalone class (TLorentzVector as input)
  - Under development but already working as it will be shown.
  - Available in CVS: http://atlas-sw.cern.ch/cgi-bin/viewcvs-atlas.cgi/groups/IFIC-SCT/tops/VKiFi/

GlobalChi algorithm

GlobalChi2 basis

Starting point

This is a short version of the chi2 use in CSC T9 note (formula 5).

$$\chi^2 = \sum_{\text{jets}+\ell}\left(\frac{E_i^m - E_i^f}{\sigma_{E_i}}\right)^2 + \left(\frac{M_{jj} - M_W^{PDG}}{\Gamma_W^{PDG}}\right)^2 + \left(\frac{M_{l\nu} - M_W^{PDG}}{\Gamma_W^{PDG}}\right)^2 + \left(\frac{M_{jjb_H} - M_{top}^f}{\sigma_{top_H}}\right)^2 + \left(\frac{M_{\ell\nu b_L} - M_{top}^f}{\sigma_{top_L}}\right)^2$$

where $E_i^{fit} = \alpha_i E_i^{reco}$ as has been said before.

Change the notation to matrix representation: $\chi^2 = r^T V^{-1} r$

where **r** are called residual and represents (measurement - fit) and **V** is the covariance matrices of these measurements. In fact, the residuals **r=r(W,t)** where ***W*** represents the W boson parameters and ***t*** represents the top quark mass parameters.

$$\mathbf{r} = \begin{pmatrix} E^{mes}_{jet1} - E^{fit}_{jet1} \\ E^{mes}_{jet2} - E^{fit}_{jet2} \\ E^{mes}_{b_{had}} - E^{fit}_{b_{had}} \\ E^{mes}_{b_{lep}} - E^{fit}_{b_{lep}} \\ E^{mes}_{l} - E^{fit}_{l} \\ M_{jj} - M_W^{PDG} \\ M_{l\nu} - M_W^{PDG} \\ M_{jjb_{had}} - M_{top}^{PDG} \\ M_{l\nu b_{lep}} - M_{top}^{PDG} \end{pmatrix} \qquad V^{-1} = \begin{pmatrix} 1/\sigma^2_{E_{j1}} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1/\sigma^2_{E_{j2}} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1/\sigma^2_{E_{b_{had}}} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1/\sigma^2_{E_{b_{lep}}} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1/\sigma^2_{E_l} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1/\Gamma^2_{M_W} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1/\Gamma^2_{M_W} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1/\sigma^2_{M_{jjb_{had}}} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1/\sigma^2_{M_{l\nu b_{lep}}} \end{pmatrix}$$

constraints

where: $\mathbf{r} = \mathbf{r}(\mathbf{W}, \mathbf{t})$ →

- **W** represents the W fit parameters: **W** = {α_{jet1}, α_{jet2}}
- **t** represents the top fit parameters: **t** = {α_{bH}, α_{bL}, α_{lepton} and M_{top})

GlobalChi2 basis

Chi2 minimization

The goal is to minimize the Chi2 with respect t, so applying the minimum condition:

$$\chi^2 = r^T V^{-1} r$$ (1)

minimum condition... →

$$\frac{d\chi^2}{d\mathbf{t}} = 0$$ (2)

after some trivial algebra... $\chi^2 = r^T V^{-1} r$ →

$$\left(\frac{d\mathbf{r}}{d\mathbf{t}}\right)^T V^{-1}\mathbf{r} = 0$$ (3)

Then, as **r=r(W,t)**... one has to consider the residual derivatives...

$$d\mathbf{r} = \frac{\partial \mathbf{r}}{\partial \mathbf{W}} d\mathbf{W} + \frac{\partial \mathbf{r}}{\partial \mathbf{t}} d\mathbf{t}$$

And **dr/dt** can be calculated:

$$\frac{d\mathbf{r}}{d\mathbf{t}} = \frac{\partial \mathbf{r}}{\partial \mathbf{W}} \frac{d\mathbf{W}}{d\mathbf{t}} + \frac{\partial \mathbf{r}}{\partial \mathbf{t}}$$ (4)

Assumption:

- The W parameters depend on the top parameters (W's come from the top decays).
- The top parameters do not depend on the W parameters as the top mother particle and it is fixed (at simulation level the only particle with a fixed mass is the top).

Therefore, including this derivative into the previous expression: 3 + 4

$$\left(\frac{d\mathbf{r}}{d\mathbf{t}}\right)^T V^{-1}\mathbf{r} = \left(\frac{\partial \mathbf{r}}{\partial \mathbf{W}} \frac{d\mathbf{W}}{d\mathbf{t}} + \frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T V^{-1}\mathbf{r} = 0$$

Now, the question is how to calculate **dW/dt**, which correlates the W boson parameters and the top quark parameters....

... the answer is simple: a chi2 minimization wrt W have to be done!

GlobalChi2 basis

Chi2 minimization wrt W boson parameters

Now, the point is to calculate: $d\mathbf{W}/dt$
To do this, we need to perform a W boson fit:

$$\frac{\partial \chi^2}{\partial \mathbf{W}} = 0 \quad (6) \xrightarrow{\text{after some trivial algebra... } \chi^2 = r^T V^{-1} r} \left(\frac{\partial \mathbf{r}}{\partial \mathbf{W}}\right)^T V^{-1}\mathbf{r} = 0 \quad (7)$$

To solve this expression one has to consider that we are close to the solution:

$$\mathbf{r} = \mathbf{r}(\mathbf{W}_0, \mathbf{t}) + \left.\frac{\partial \mathbf{r}}{\partial \mathbf{W}}\right|_{W=W_0} \delta\mathbf{W} \quad (8)$$

where: $\mathbf{W} = \mathbf{W}_0 + \delta\mathbf{W}$

7 + 8 ⇢

$$\left(\frac{\partial \mathbf{r}}{\partial \mathbf{W}}\right)^T V^{-1}\mathbf{r} = \left(\frac{\partial \mathbf{r}(\mathbf{W}_0,\mathbf{t})}{\partial \mathbf{W}}\right)^T V^{-1}\mathbf{r}(\mathbf{W}_0,\mathbf{t}) + \left(\frac{\partial \mathbf{r}(\mathbf{W}_0,\mathbf{t})}{\partial \mathbf{W}}\right)^T V^{-1} \left.\frac{\partial \mathbf{r}}{\partial \mathbf{W}}\right|_{W_0} \delta\mathbf{W} = 0$$

Now, defining E and working out dW...

defining E...

$$E \equiv \left.\frac{\partial \mathbf{r}}{\partial \mathbf{W}}\right|_{W_0}$$

E will introduce the correlations!

$$\delta\mathbf{W} = -(E^T V^{-1} E)^{-1} E^T V^{-1} \mathbf{r}(\mathbf{W}_0, \mathbf{t}) \quad (9)$$

$$\frac{d\mathbf{W}}{d\mathbf{t}} = -(E^T V^{-1} E)^{-1} E^T V^{-1} \frac{\partial \mathbf{r}(\mathbf{W}_0, \mathbf{t})}{\partial \mathbf{t}} \quad (10)$$

Now, we have dW/dt and we can continue with expression 5.

GlobalChi2 basis

Chi2 minimization wrt top quark parameters

Once one has $d\mathbf{W}/d\mathbf{t}$, we can continue: (5) + (10)

$$\left(\frac{\partial \mathbf{r}}{\partial \mathbf{W}}\frac{d\mathbf{W}}{d\mathbf{t}}+\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T V^{-1}\mathbf{r}=\left(-E\left(E^TV^{-1}E\right)^{-1}E^TV^{-1}\frac{\partial \mathbf{r}}{\partial \mathbf{t}}+\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T V^{-1}\mathbf{r}=$$

$$=\left(\left(I-E\left(E^TV^{-1}E\right)^{-1}E^TV^{-1}\right)\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T V^{-1}\mathbf{r}=\left(\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T \mathcal{W}^{-1}\mathbf{r}=0 \quad (11)$$

↔

Defining $\mathcal{W}$...
(remider: correlations thanks to E)
if E=0, then $\mathcal{W}=V^{-1}$, therefore "standard" Chi2 case

$$\mathcal{W}\equiv\left(I-E(E^TV^{-1}E)^{-1}E^TV^{-1}\right)^T V^{-1} \quad (12)$$

To solve this expression, once more, we have to consider that we are close to the solution:

$$\mathbf{r}=\mathbf{r}(\mathbf{W}_0,\mathbf{t}_0)+\left.\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right|_{\mathbf{t}=\mathbf{t}_0}\delta\mathbf{t}$$

(11) + (12) ⟶

$$\left(\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T \mathcal{W}\mathbf{r}+\left(\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T \mathcal{W}\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\delta\mathbf{t}=0$$

Working out dt:

$$\delta\mathbf{t}=-\left[\left(\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T \mathcal{W}\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right]^{-1}\left(\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T \mathcal{W}\mathbf{r}=0 \quad (13)$$

$$\delta\mathbf{t}=-\mathcal{M}^{-1}\nu \quad (14)$$

These are the top parameter corrections!

$$\mathcal{M}=\left(\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T \mathcal{W}\frac{\partial \mathbf{r}}{\partial \mathbf{t}}$$

This is a Matrix (by the way, $\mathcal{M}^{-1}$ is the covariance matrix of the top fit parameters)

$$\nu=\left(\frac{\partial \mathbf{r}}{\partial \mathbf{t}}\right)^T \mathcal{W}\mathbf{r}$$

This is a Vector

Top quark mass analysis

Strategy

In the **CSC T9 note the strategy** is:

1. Event selection:
   - Semi-Leptonic events → requirements: 2 or more light jets, 2 b-jets, 1 lepton (*e* or μ) and Etmiss > 20 GeV
   - Cuts:
     - GoodJet: pT > 40 GeV and |eta| < 2.5
     - Good lepton: pT > 20 (25) GeV for μ (*e*) and |eta| < 2.5
2. Perform an hadronic W boson mass fit using a chi2 for the hadronic side.
   - In events with more than 2 light jets, the pair withe the smallest chi2 is kept as the pair candidate.
   - Once the light jet pair is selected, as a pre-selection, we reject W boson candidates outside the W mass peak (80 GeV/c^2) within a mass window of ±30 GeV/c^2
3. Hadronic b-jet association: choosing the closest b-jet (through ΔR) to the W boson candidate.
4. Perform the leptonic W boson mass fit determining the neutrino momentum (p_z^{ν}) using the Etmiss.
5. Leptonic b-jet association: choosing the other b-jet.
6. Kinematic Fit using the selected candidates → GlobalChi2 → M_{top}

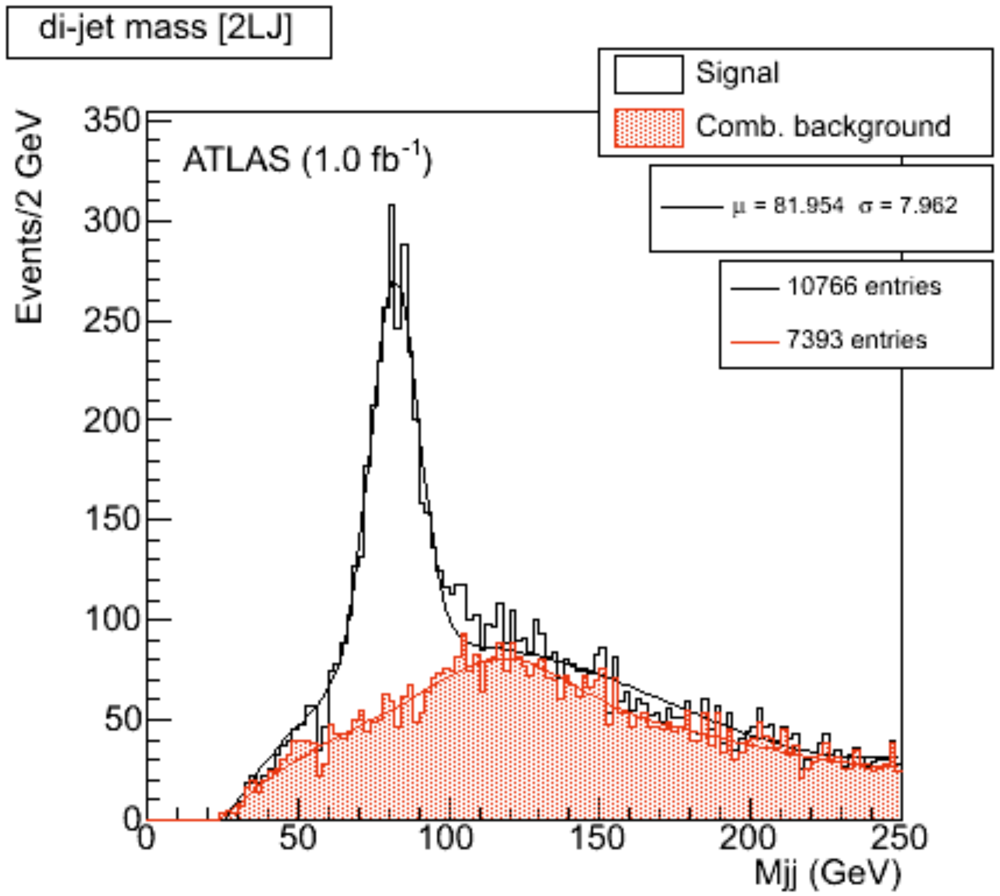
Hadronic W

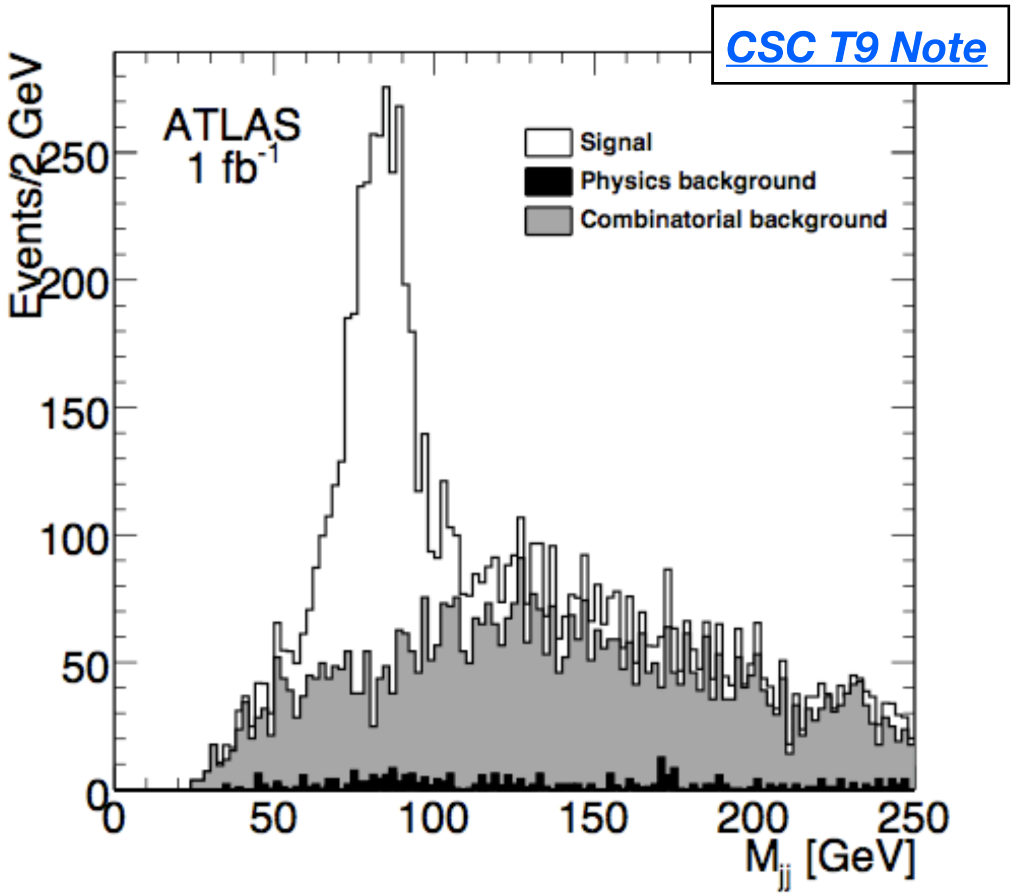
First an hadronic W boson mass reconstruction is perform through a chi2 minimization, where the chi2 is:

$$\chi^2 = \left(\frac{E^m_{j0} - E^f_{j0}}{\sigma_{E_j 0}}\right)^2 + \left(\frac{E^m_{j1} - E^f_{j1}}{\sigma_{E_j 1}}\right)^2 + \left(\frac{M_{jj} - M_W^{PDG}}{\Gamma_W^{PDG}}\right)^2$$

σ_E comes from the the calibration, where $\sigma_E = \sigma_E(E,Eta)$ (*see Maria's talk*).

Invariant mass of the light jet pair in events with only 2 light jets (label 2LJ)

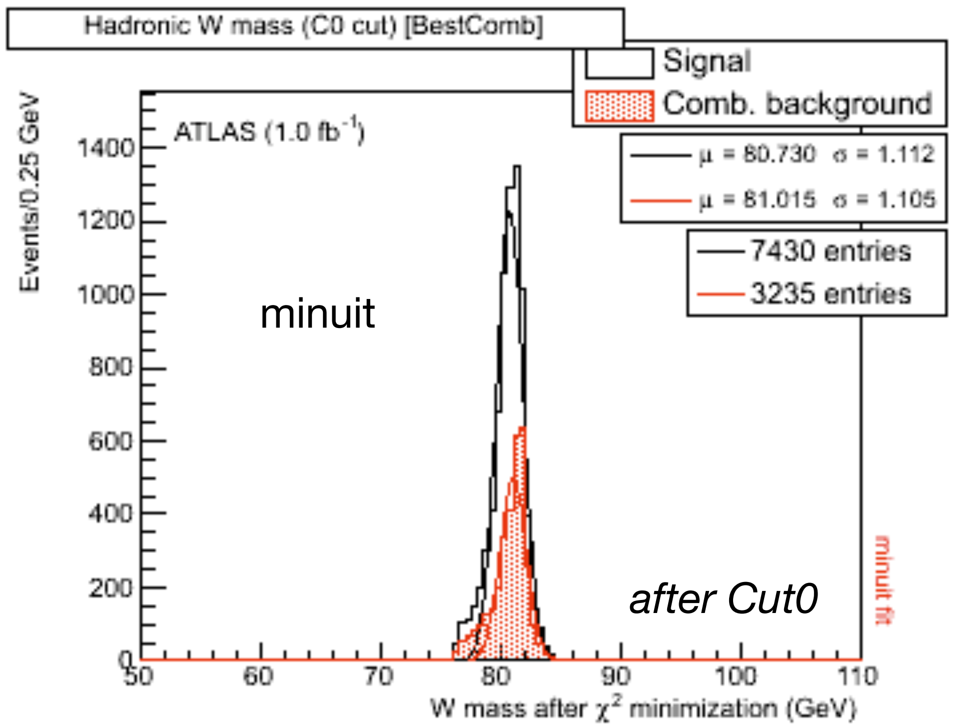


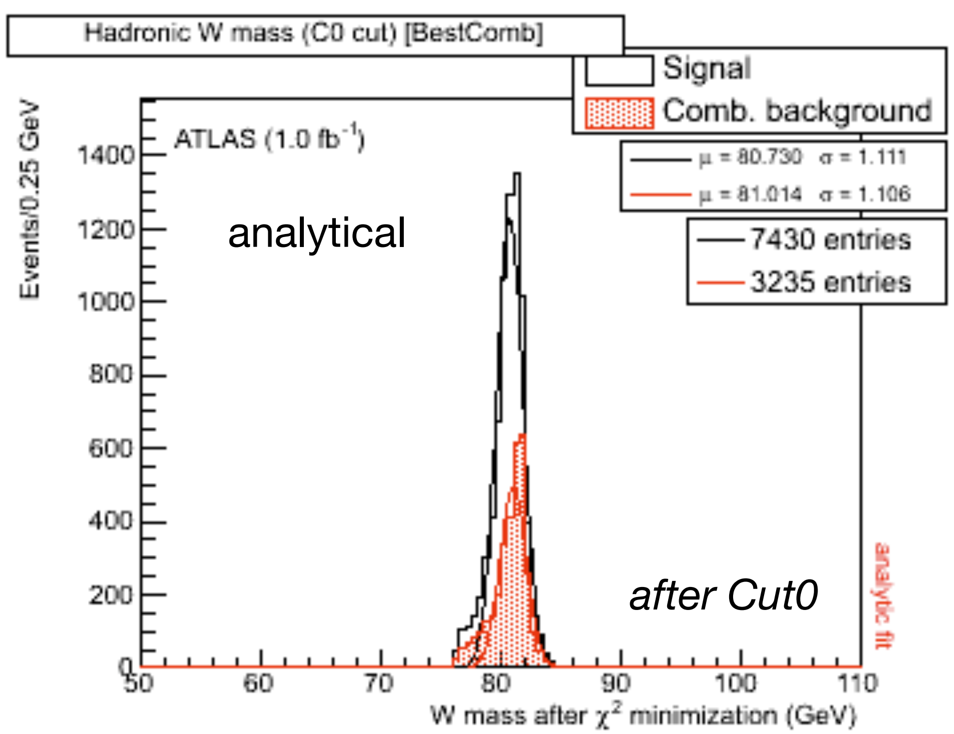


For events with more than 2 light jets, the pair with the smallest chi2 is kept as the hadronic W boson candidate (label BestComb)

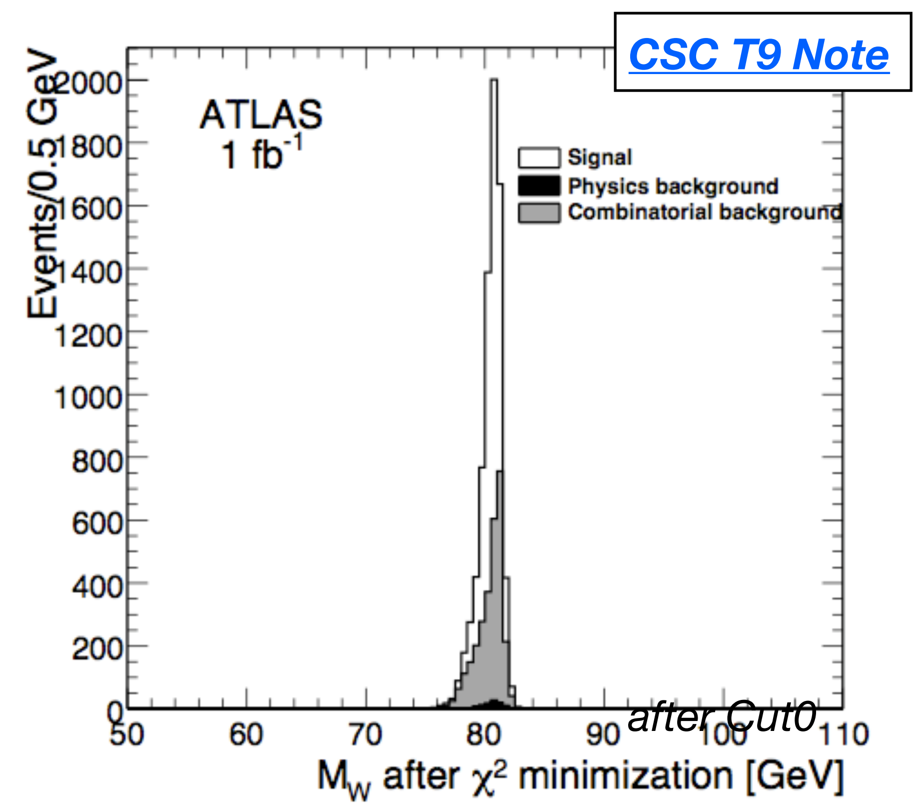
Hadronic W

We have implemented a “MINUIT version” (as in the CSC T9 note) and an “Analytic version” of the minimization.
This was done to compare both methods which naively should give the same results.
Then, the W boson mass after the chi2 minimization:



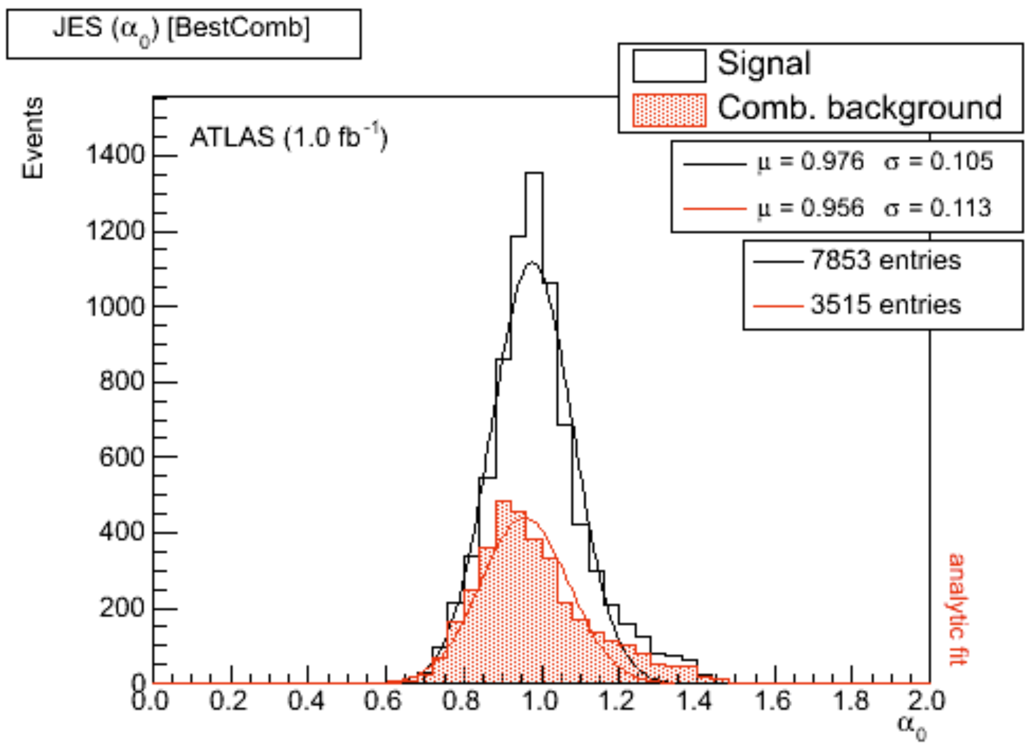


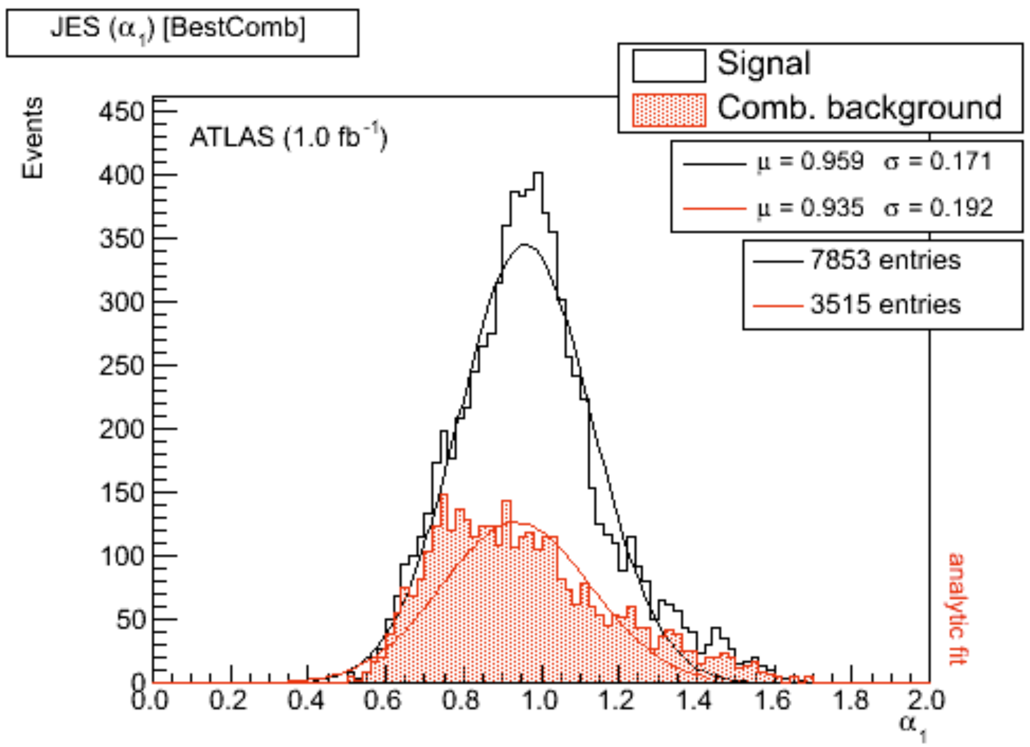
Both methods give the same results within their errors:
- Minuit: $\mu = (80.730 \pm 0.015)$ GeV/c^2 and $\sigma = (1.112 \pm 0.014)$ GeV/c^2
- Analytic: $\mu = (80.730 \pm 0.015)$ GeV/c^2 and $\sigma = (1.111 \pm 0.014)$ GeV/c^2



Hadronic W

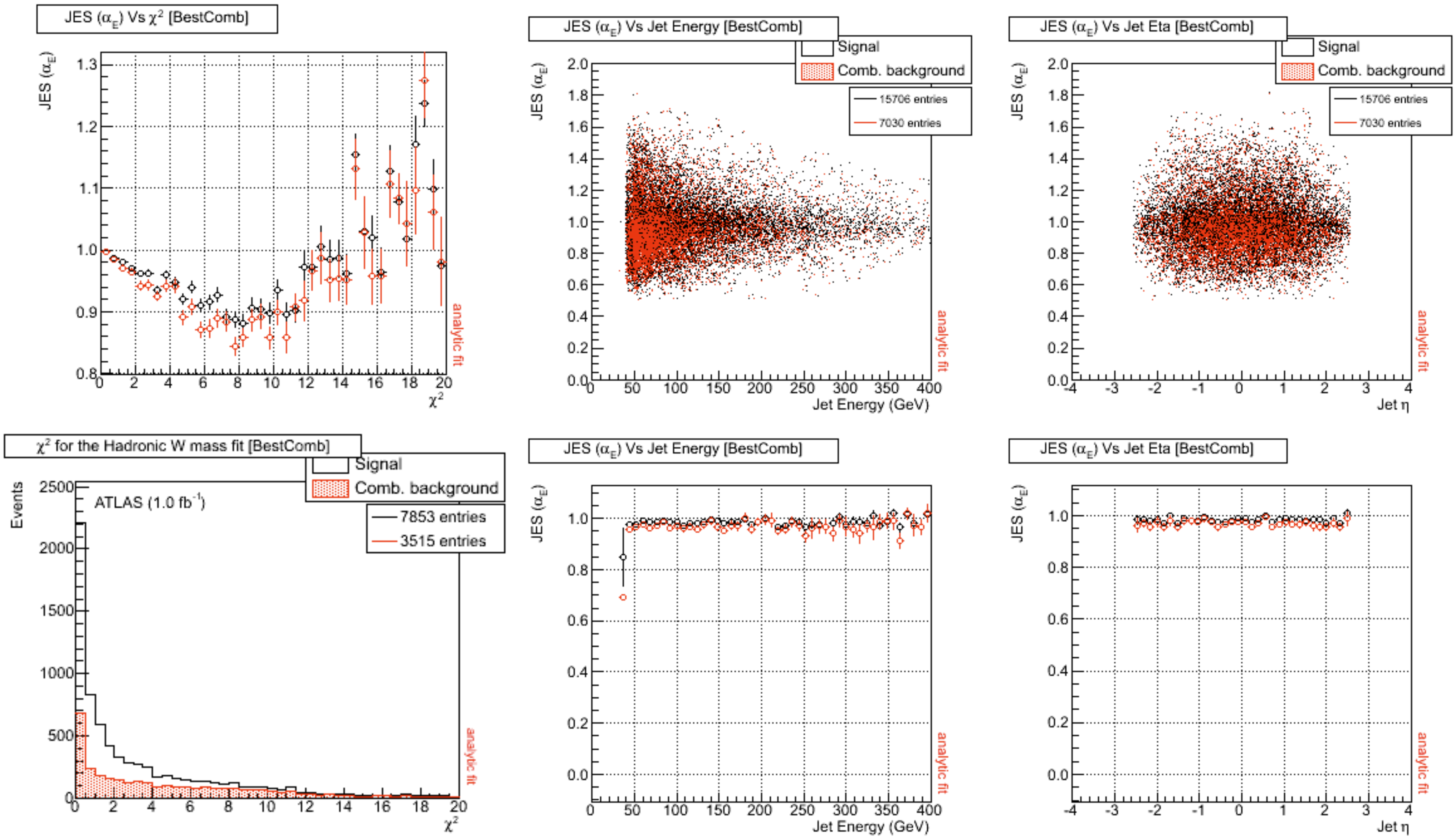
Many control plots: **fit results (JES)**, pulls, chi2 distributions, correlation plots, etc...





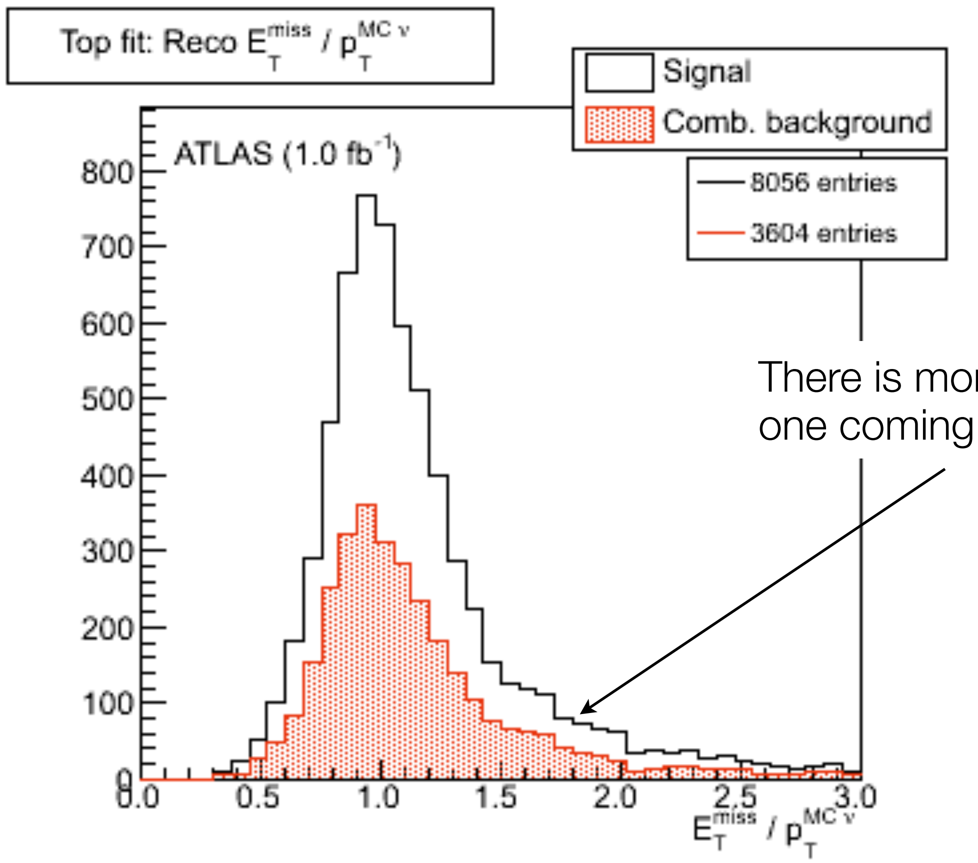
Hadronic W

Many control plots: fit results (JES), pulls, **chi2 distributions, correlation plots**, etc...



Leptonic W

To reconstruct the leptonic W, the main difficulty here comes from the kinematics of the neutrino.
The Etmiss is used as an estimator of the neutrino pT. This is just an approximation as is shown in the plot:



Four-momentum conservation for the $W \to \ell + \nu$ decay:

$$M_W^2 = m_\ell^2 + 2(E_\ell, \mathbf{p}^\ell)(E_\nu, \mathbf{p}^\nu)$$

$$M_W^2 = m_\ell^2 + 2E_\ell\sqrt{\not{E}_t^{\,2} + (p_z^\nu)^2} - 2\not{E}_t(p_x^\ell \cos\phi_{\not{E}_t} + p_y^\ell \sin\phi_{\not{E}_t}) - 2p_z^\ell p_z^\nu$$

This equation is quadratic in $p_z^{\,\nu}$ and it has no solution if the measured Etmiss fluctuates such that the neutrino-lepton invariant mass is above the W boson mass. In this case, in the CSC T9 note, $p_z^{\,\nu}$ is reduced (in steps) until a solution is found. We use the exact solution:

$$p_z^\nu = \frac{-p_z^\ell(M_W^2 - m_\ell^2 + 2p_x^\ell P_x^\nu + 2p_y^\ell p_y^\nu)}{2(E_\ell^2 - (p_z^\ell)^2)}\left(\pm\sqrt{E_\ell^2((M_W^2 - m_\ell^2 + 2P_x^\ell p_x^\nu + 2p_y^\ell p_y^\nu)^2 + 4\not{E}_t^2(-E_\ell^2 + (p_z^\ell)^2))}\right)$$

Leptonic W

$$p_z^\nu = \frac{-p_z^\ell(M_W^2 - m_\ell^2 + 2p_x^\ell P_x^\nu + 2p_y^\ell p_y^\nu)}{2(E_\ell^2 - (p_z^\ell)^2)} \left(\pm\sqrt{E_\ell^2((M_W^2 - m_\ell^2 + 2P_x^\ell p_x^\nu + 2p_y^\ell p_y^\nu)^2 + 4\,\not{E}_t^2(-E_\ell^2 + (p_z^\ell)^2))}\right)$$

Thus when this formula has no solution.... is because the term within the square root is negative. If that happens, one can find for which values of the Etmiss this term becomes positive (or at least 0). By doing so, one just scales Etmiss but preserves its direction. Therefore one has to solve a new quadratic equation, this time in terms of Etmiss' (the new missing transverse energy):

$$(M_W^2 - m_\ell^2 + 2P_x^\ell p_x^\nu + 2p_y^\ell p_y^\nu)^2 + 4\,\not{E}_t^2(-E_\ell^2 + (p_z^\ell)^2) = 0$$

and this equation has two solutions:

$$\not{E}_t' = \frac{-(M_W^2 - m_\ell^2)(p_x^\ell \cos\phi_{\not{E}_t} + p_y^\ell \sin\phi_{\not{E}_t}) \pm (M_W^2 - m_\ell^2)\sqrt{E_\ell^2 - (p_z^\ell)^2}}{2(E_\ell^2 - (p_z^\ell)^2 - (p_x^\ell \cos\phi_{\not{E}_t} + p_y^\ell \sin\phi_{\not{E}_t})^2)}$$

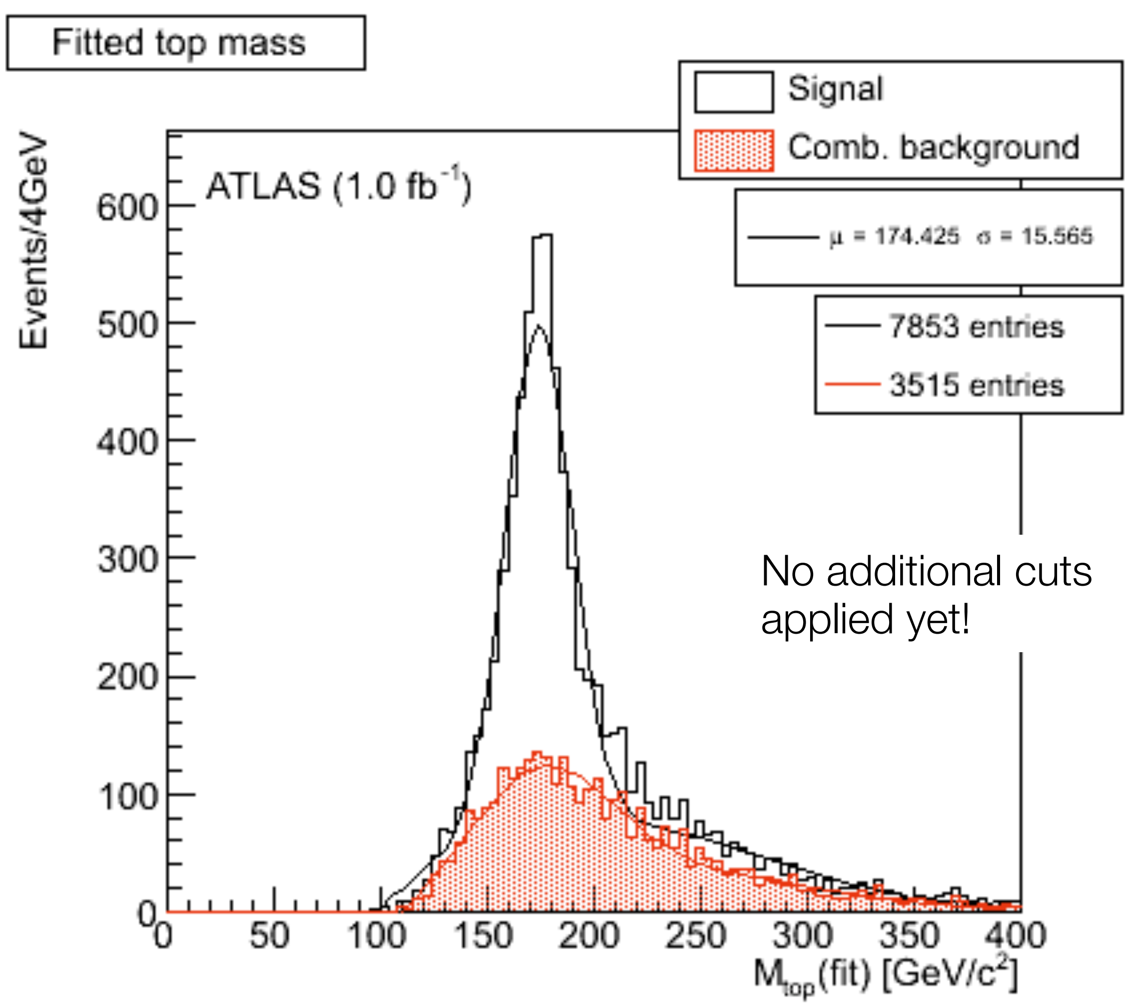
Thus, from the two solutions for $p_z{}^\nu$, we select the one which makes M_{jjbH} - $M_{\ell\nu bL}$ closer to zero. Afterwards, with this solution we can do the kinematic fit to extract the top quark mass....

Kinematic Fit

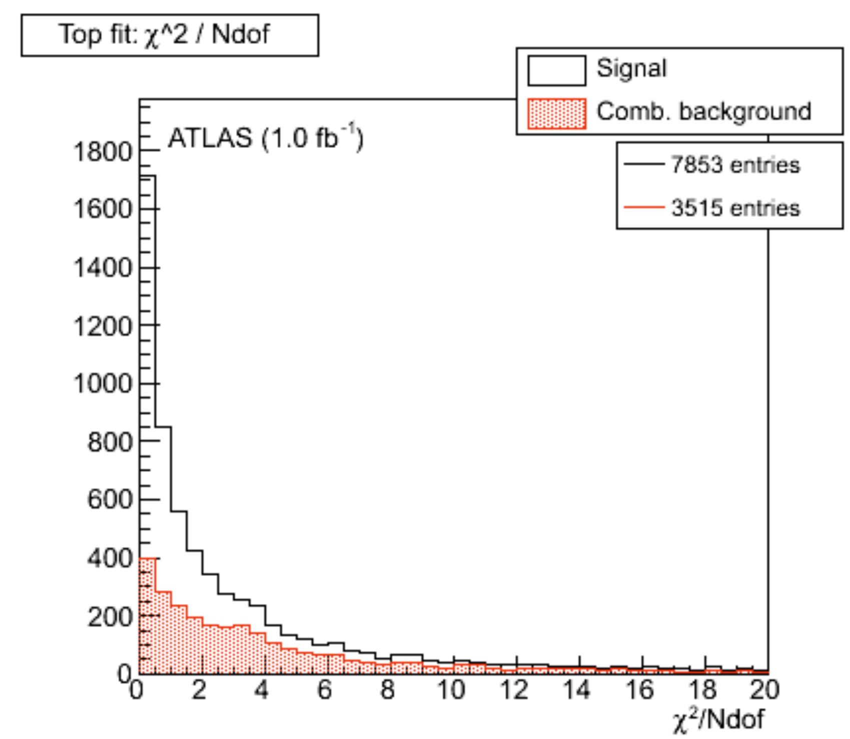
Now, we use the full chi2 (the initial one, from slide 5):

$$\chi^2 = \sum_{\mathrm{jets}+\ell} \left(\frac{E_i^m - E_i^f}{\sigma_{E_i}} \right)^2 + \left(\frac{M_{jj} - M_W^{PDG}}{\Gamma_W^{PDG}} \right)^2 + \left(\frac{M_{l\nu} - M_W^{PDG}}{\Gamma_W^{PDG}} \right)^2 + \left(\frac{M_{jjb_H} - M_{top}^f}{\sigma_{top_H}} \right)^2 + \left(\frac{M_{\ell\nu b_L} - M_{top}^f}{\sigma_{top_L}} \right)$$

The top quark mass can be extracted from the chi2 minimization wrt the top parameters where there is a nested chi2 minimization wrt the W boson parameters.



μ = (174.4 ± 0.3) GeV/c² and σ = (15.6 ± 0.04) GeV/c²

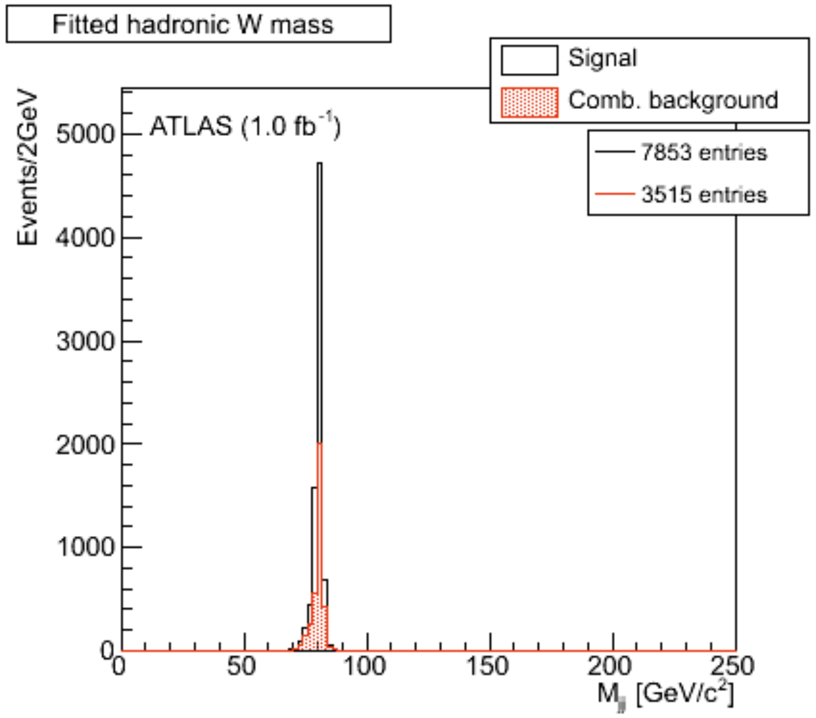


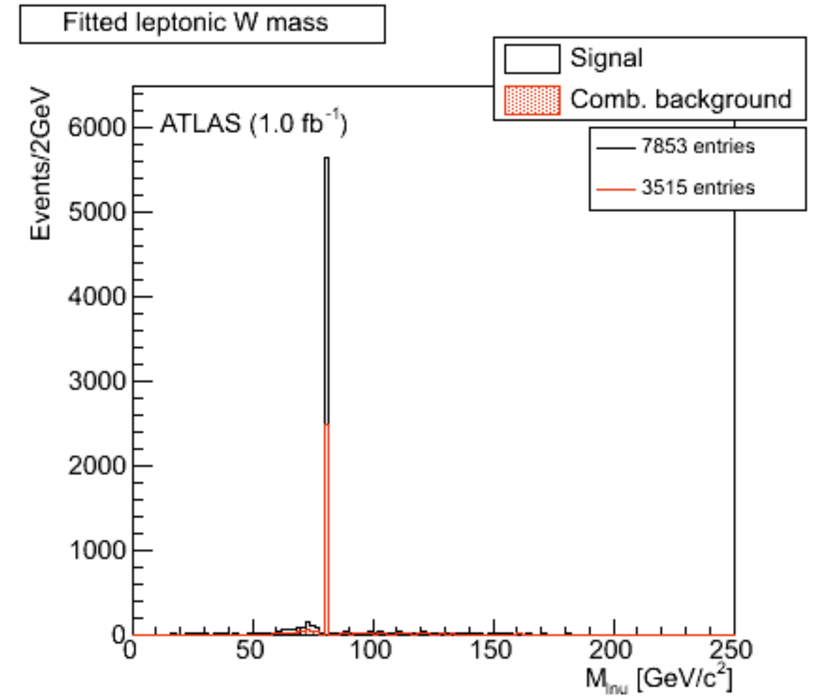
No distribution plot to compare in the CSC T9 note! :(

μ = (174.8 ± 0.4) GeV/c² after several cuts **CSC T9 Note**

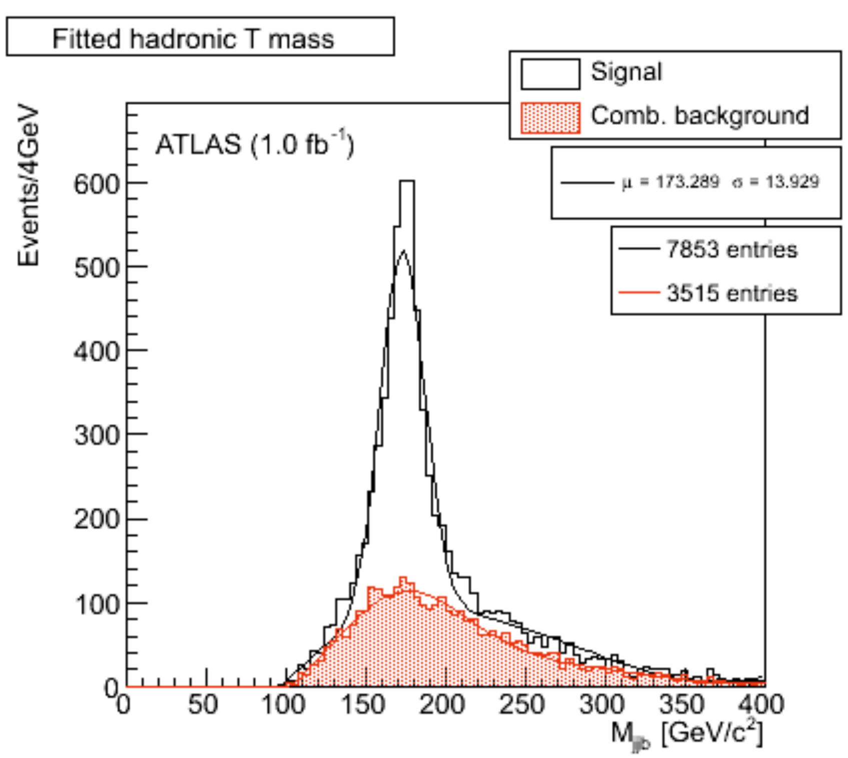
Kinematic Fit

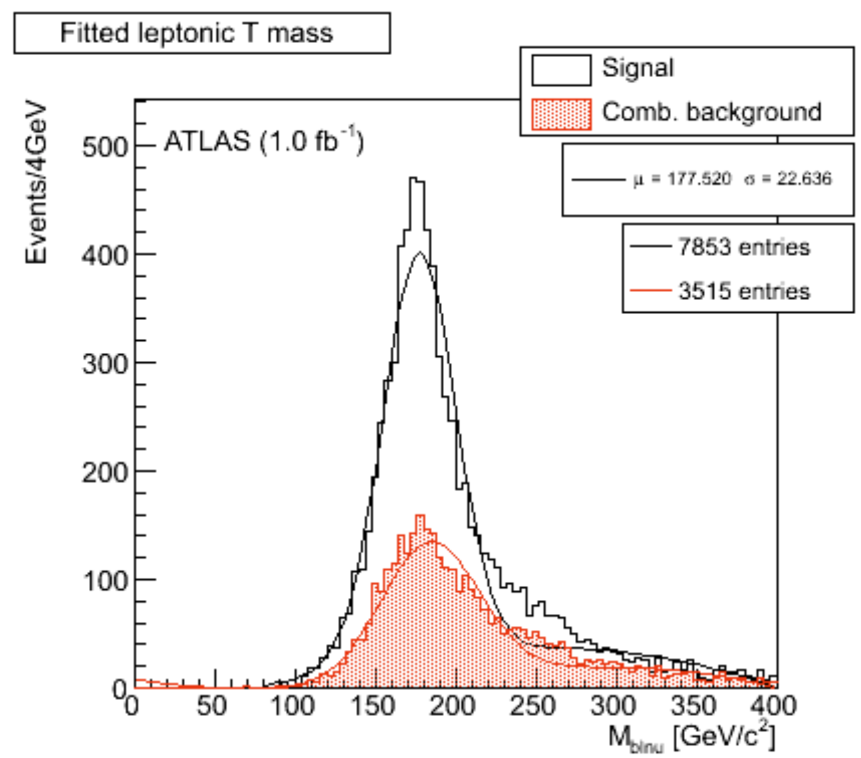
The hadronic W and the leptonic W can be reconstructed using the invariant mass of the jj and $\ell\nu$, respectively.





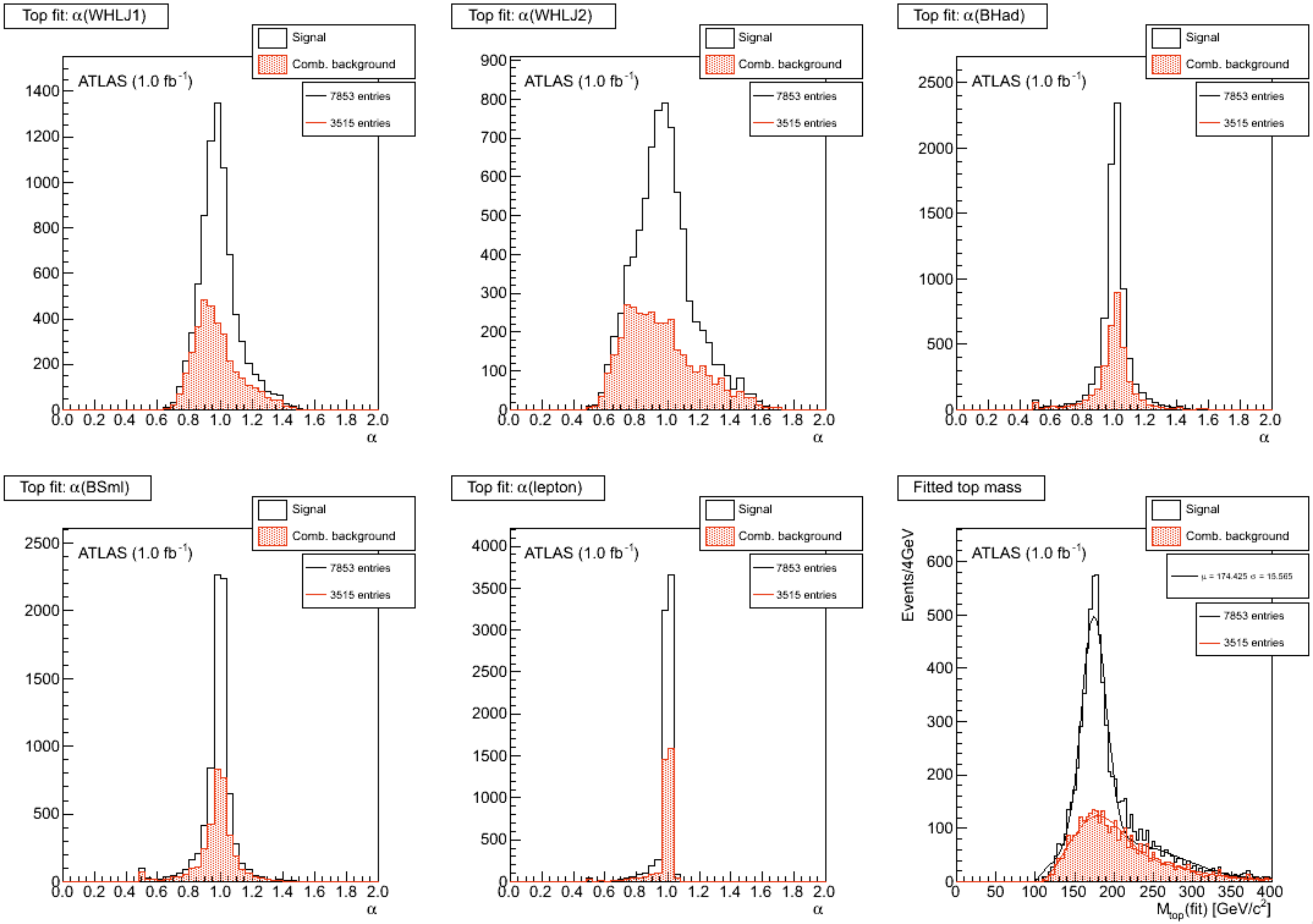
The hadronic top and the leptonic top can be reconstructed using the invariant mass of the jjb$_H$ and $\ell\nu$b$_L$, respectively.





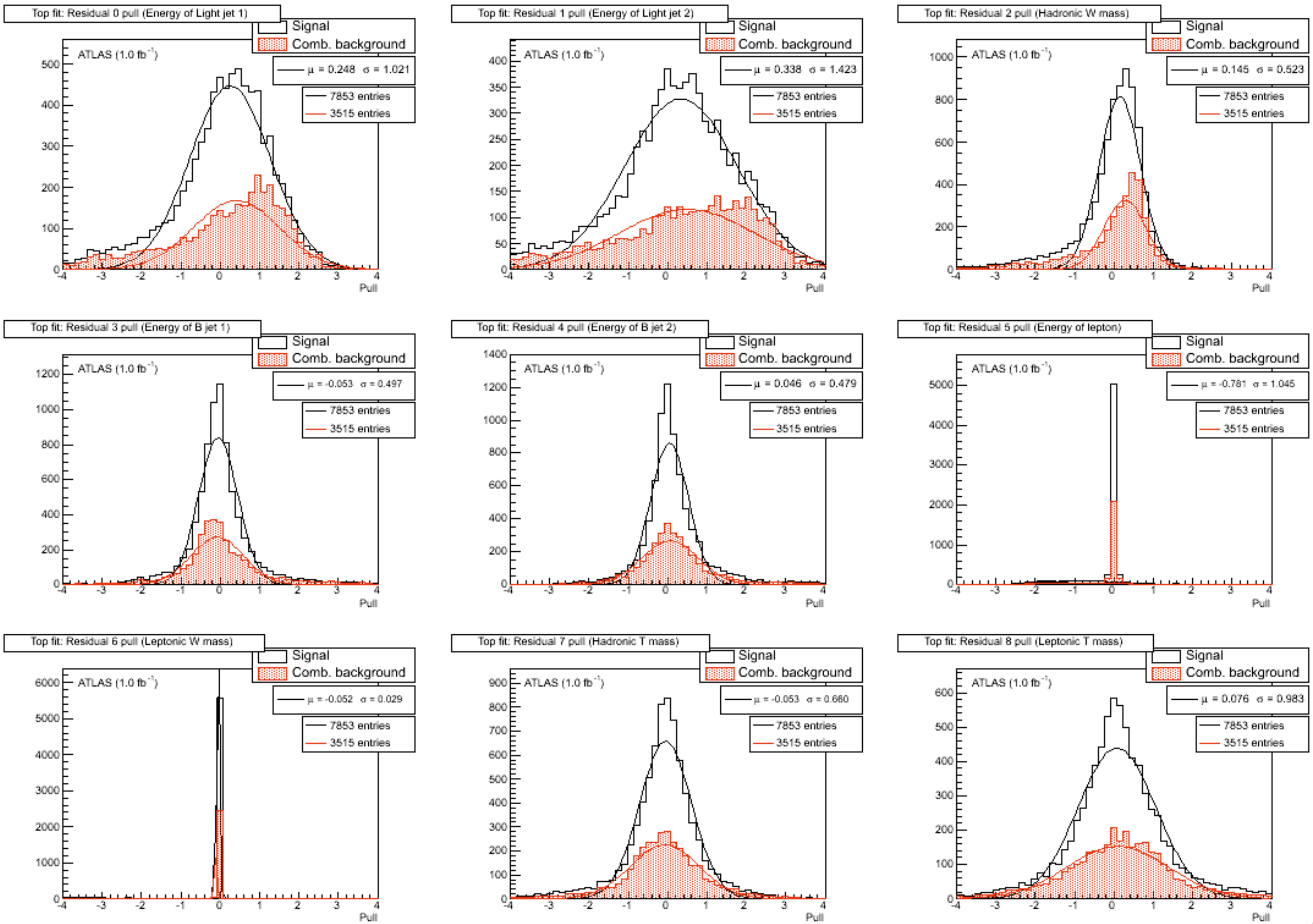
Kinematic Fit

Many control plots: **fit results (JES)**, pulls, chi2 distributions, correlation plots, etc...



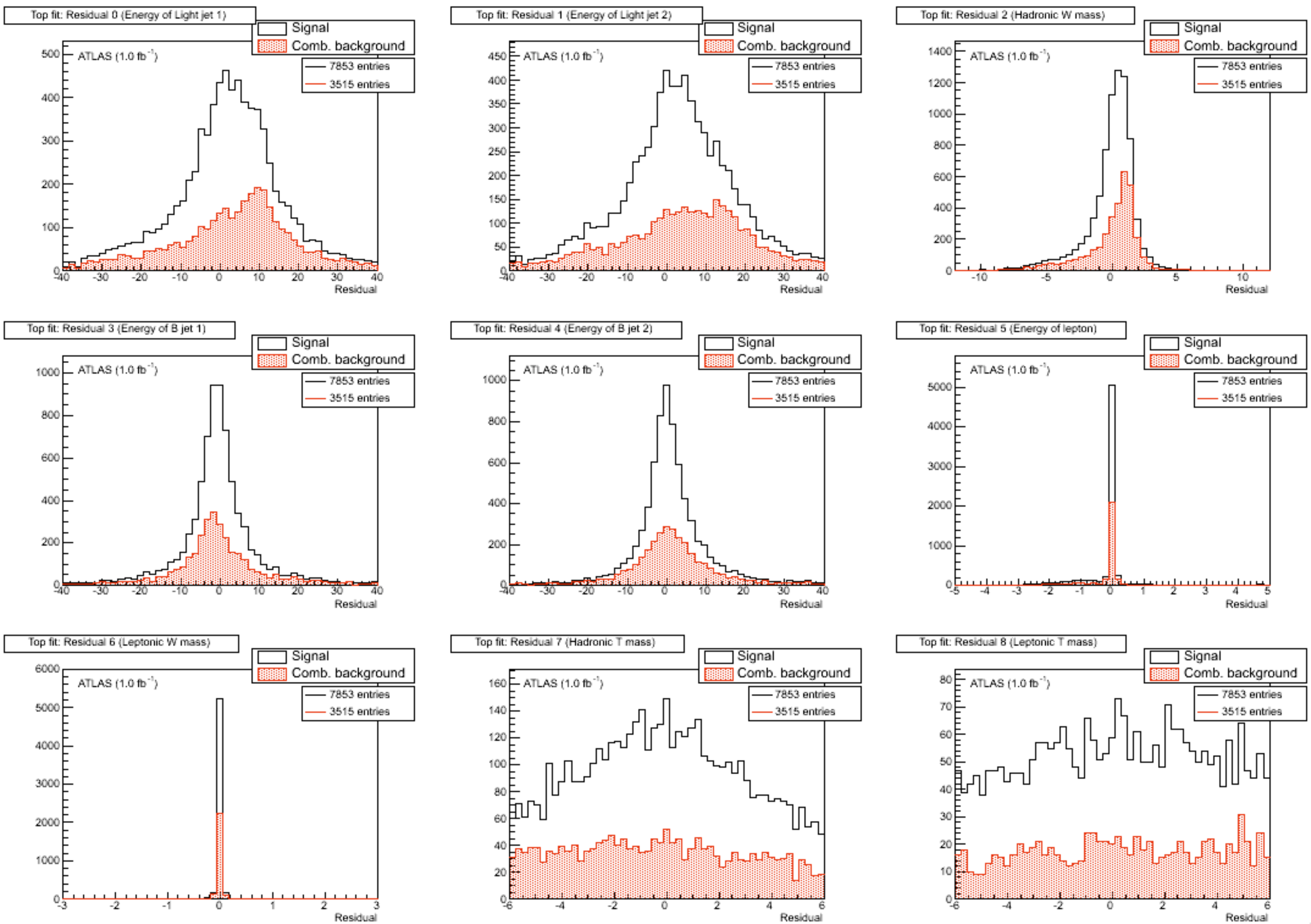
Kinematic Fit

Many control plots: fit results (JES), **pulls**, chi2 distributions, correlation plots, etc...



Kinematic Fit

Many control plots: fit results (JES), pulls, chi2 distributions, **residuals**, etc...



Summary

- A novel method is being developed based on the GlobalChi2 method.
- This algorithm contains two nested fits (first a W parameters fit and then a top parameters fit).
- It gives very good results!
- Code in CVS: http://atlas-sw.cern.ch/cgi-bin/viewcvs-atlas.cgi/groups/IFIC-SCT/tops/VKiFi/

Near Future

- Tune jet energy calibration and jet energy resolution.
- Tune the code.

- Stability: tests samples with different top quark mass at simulation level.
- Background Studies.
    - We have already run over the full hadronic sample which has a 0.02 % contribution (all events marked as Combinatorial Background)
- Systematic errors Studies.

- Constraints can be easily added to the original Chi2:
    - As we do in alignment: extra Chi2 terms.
    - As a Lagrange multipliers as in ATL-COM-PHYS-2008-117

Backup