Top Mass meeting, FNAL 02/15/2006

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l+j Top mass using the 3 best χ^2s

What we are doing

Framework: lepton+jet & template method

Standard in template method: choose the best reconstructed combination (*the lowest* χ^2) among the 24 (or 12, or 4) reconstructions

When the first is not the correct one, we enter the mass spectrum a (correlated) combinatoric BG

The target is to reduce the statistical error in the Top mass measurement recovering some information from the unselected combinations.

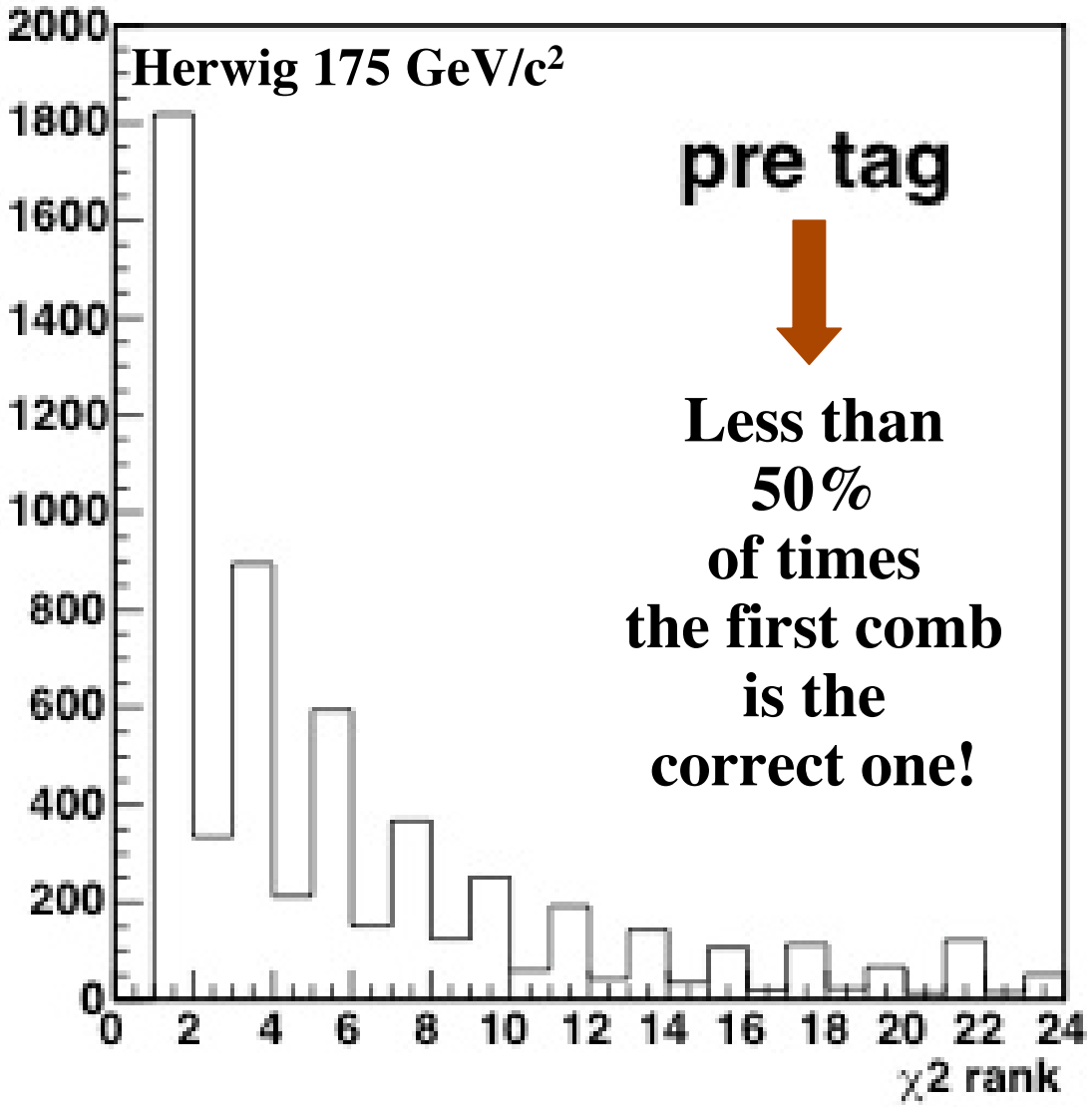
The Fitter Output

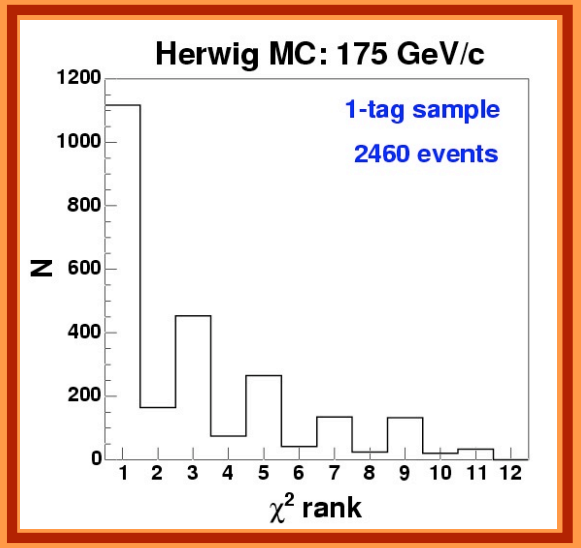
```
=====================================
   NRun:   162480 NEvent:      552 Lepton:        1
=====================================

#   1 Comb:  13 WlWj tagok chi2=   0.10 M= 141.18 eprb=  15.14 epl=  16.15 emn= -13.69
#   2 Comb:  14 WlWj tagok chi2=   0.10 M= 141.18 eprb=  15.14 epl=  16.15 emn= -13.69
#   3 Comb:  16 WljW tagok chi2=   0.26 M= 135.09 eprb=   7.80 epl=   7.74 emn=  -7.87
#   4 Comb:  24 jWlW       chi2=   0.37 M= 173.72 eprb=  14.31 epl=  13.95 emn= -14.77
#   5 Comb:  23 jWlW       chi2=   0.37 M= 173.73 eprb=  14.31 epl=  13.94 emn= -14.78
#   6 Comb:  18 WjlW tagok chi2=   0.39 M= 167.35 eprb=  11.04 epl=  11.04 emn= -11.08
#   7 Comb:   3 lWjW       chi2=   0.47 M= 18
#   8 Comb:   4 lWjW       chi2=   2.86 M= 16
#   9 Comb:  17 WjlW tagok chi2=   5.41 M= 14
#  10 Comb:  20 jlWW tagok chi2=   6.17 M= 15
#  11 Comb:   5 ljWW tagok chi2=   7.69 M= 20
#  12 Comb:   6 ljWW tagok chi2=  11.67 M= 18
#  13 Comb:   8 WWlj       chi2=  12.36 M= 13
#  14 Comb:   7 WWlj       chi2=  12.56 M= 12
#  15 Comb:  19 jlWW tagok chi2=  15.61 M= 16
#  16 Comb:  15 WljW tagok chi2=  15.64 M= 14
#  17 Comb:  12 WjWl tagok chi2=  17.17 M= 14
#  18 Comb:   9 WWjl       chi2=  18.11 M= 12
#  19 Comb:  10 WWjl       chi2=  18.11 M= 12
#  20 Comb:   1 lWWj       chi2=  20.92 M= 13
#  21 Comb:   2 lWWj       chi2=  20.92 M= 13
#  22 Comb:  11 WjWl tagok chi2=  22.60 M= 130.34 eprb=  18.03 epl=  21.23 emn= -17.30
#  23 Comb:  21 jWWl       chi2=  22.87 M= 136.06 eprb=  10.30 epl=  10.36 emn= -10.24
#  24 Comb:  22 jWWl       chi2=  22.87 M= 136.06 eprb=  10.30 epl=  10.36 emn= -10.24
```

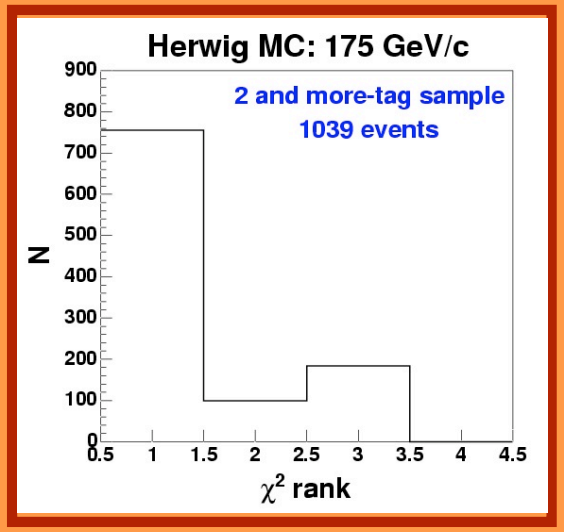
The neutrino p_z comes from a a second degree equation: in general there are two solution.

If the solution is one, but has multiplicity 2, then there are two reconstructions for one mass. We skip the second in this case.

Where is the right combination?

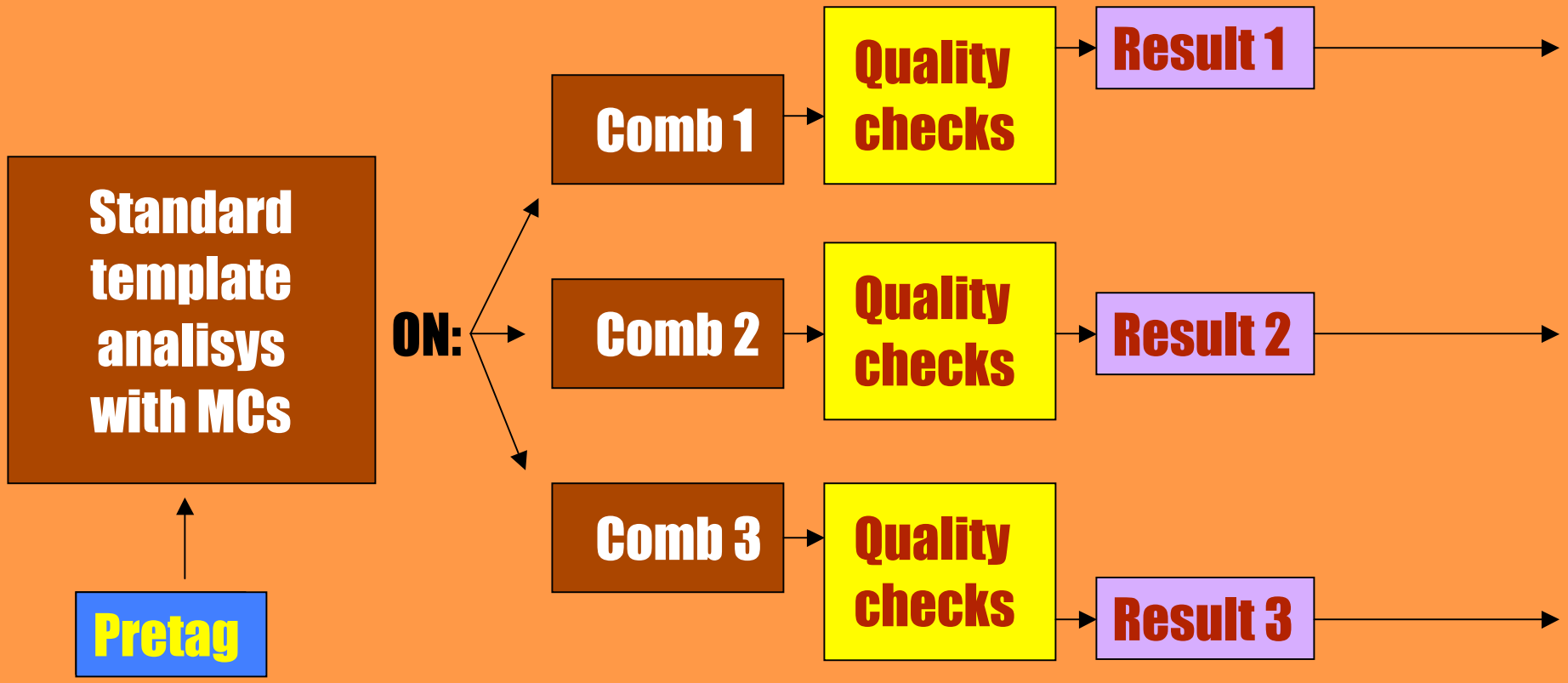






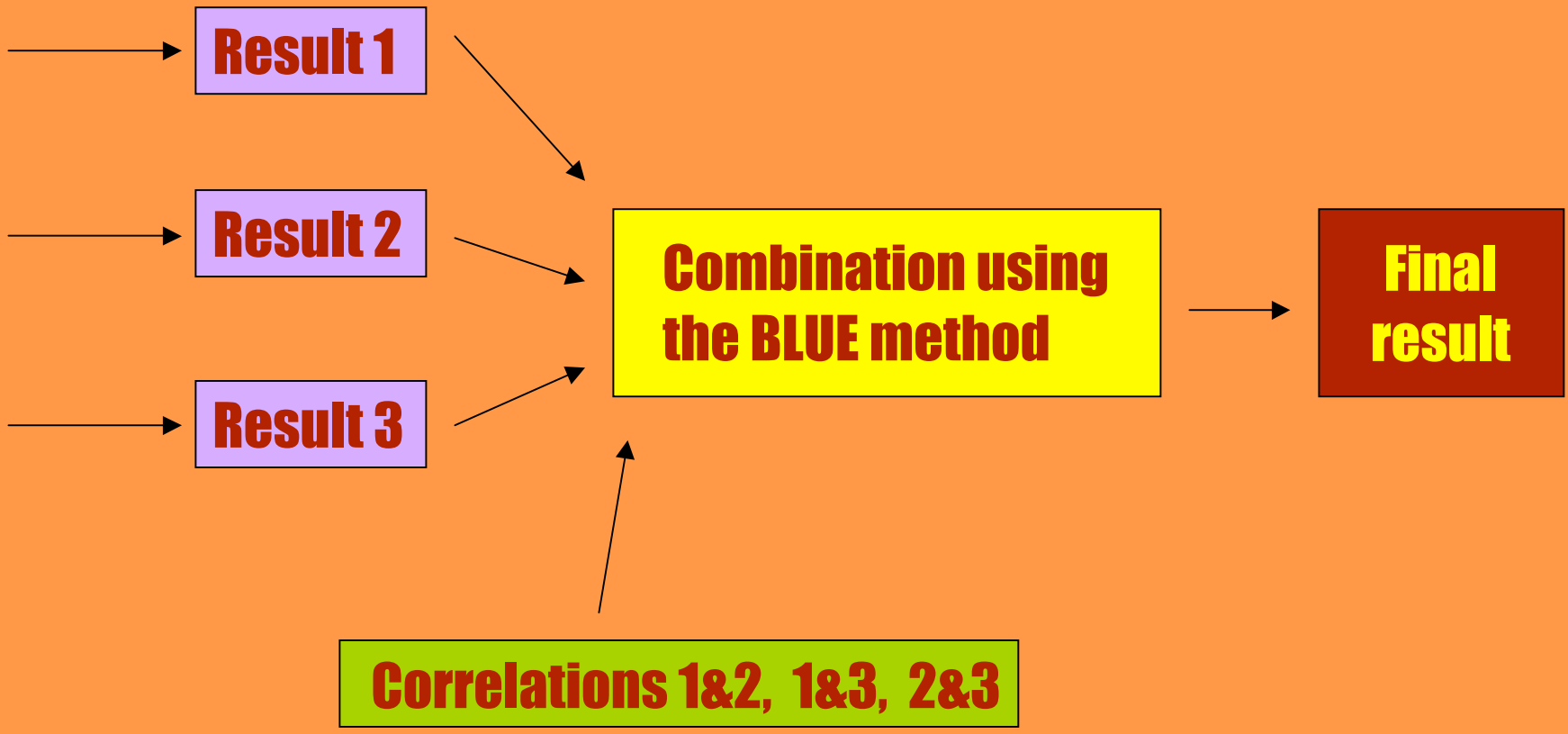
How we are going to do

We choose to consider the 3 best reconstrucions instead of 1.
All signal and BG templates are then crated for the 3 best choices.



What we are going to do

See also CDF note 6770



The BLUE

BLUE Method (Best Linear Unbiassed Estimate)

This method is to be applied to several measurements of the same quantity, wich are correlated, and guarantees a combined error ≤ of the smallest one given as input. ***(L.. Lyons, Gibaut; NIMA A270 1998 110-117)***

$$\hat{m} = \sum_i m_i \alpha_i$$

$$\sum_i \alpha_i = 1$$

$$\rho_{12} = \frac{\sigma_{12}}{\sigma_1 \sigma_2}$$

$$\sigma^2 = \begin{pmatrix} \alpha_1 & \alpha_2 & \alpha_3 \end{pmatrix} \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{12} & \sigma_2^2 & \sigma_{23} \\ \sigma_{13} & \sigma_{23} & \sigma_3^2 \end{pmatrix} \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{pmatrix}$$

- **From PEs (and) Data Likelihood Fit**
- **From PEs**

The work material for the templates

We use PEs to evaluate the likelihood fit quality. PEs are modeled on a *pretag* sample.

We are using Gen5 templates with JetCorr 04b

A $\chi^2 < 9$ cut is applied

We define our pretag as jetBin 4 ($\geq$4 jets) for the first 347 pb^{-1} of data, corresponding to the pre-2004 shutdown w/ and w/o silicon goodrun lists 7.0

Selection criteria

We used the standard selections for kinematical quantities and we based on the central detectors.

- **BG MC: Alpgen+Herwig**
- **Signal MC: Herwig for masses: 155, 160, 165, 170, 172.5, 175, 180, 185, 190 GeV.**

- **Leptons: CMUP, CMX, CEM with E_t>20 GeV, $|\eta|$<1**
- **Jets: $|\eta|$<2 , E_t>15 GeV, corrected up to level 4**
- **ME_t >20 GeV**

Signal# for template PEs

Signal estimation

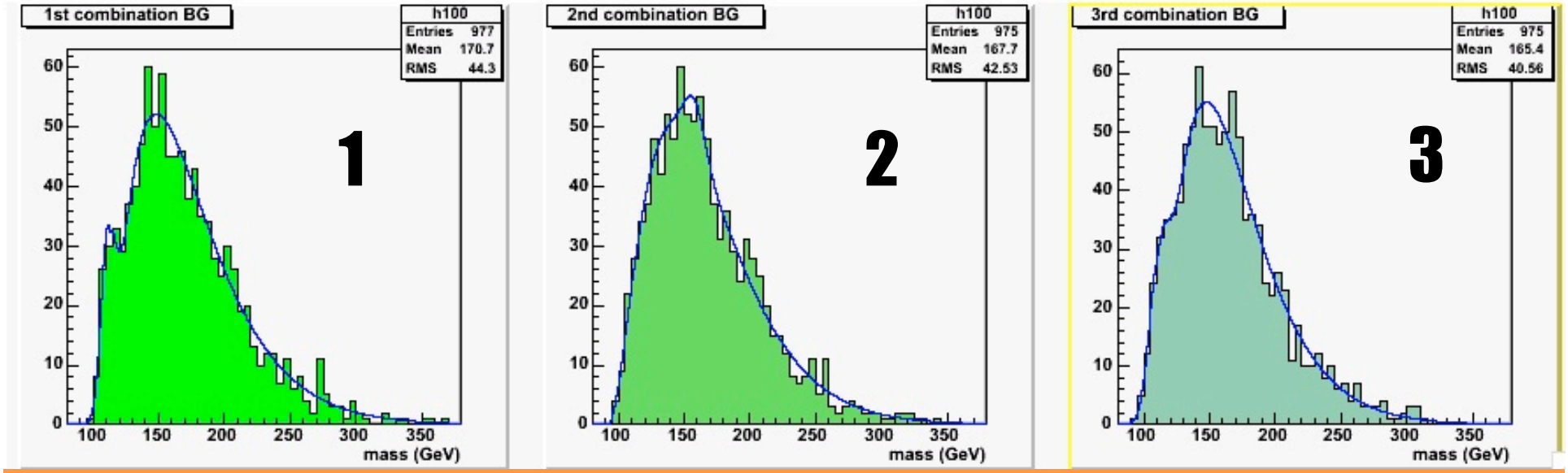
- Signal = $(data_{tagged} - BG_{tagged})/Eff_{tagevent}$
- 88 observed tagged events in 318.5 pb^{-1} (≥1 SECVTX tag).
- 17.6 ± 2.4 events are estimated to be BG with ≥1tag (note 7562)
- $Eff_{tagevent}$ = 0.60 ± 0.03 tag efficiency (note 7535)
- Signal (318.5 pb^{-1})= (88-17.6)/0.601 = 117 ± 10
- $\chi^2<9$ cut efficiency is estimated to be 0.938 based on `ttopel` dataset after jetBin=4 selection.
- $Signal_{pretag}$ (347 pb^{-1}, $\chi^2<9$)= 117 x 347 x 0.938/318.5 = 120 ± 10

Number of BG events for PEs

Number of BG events

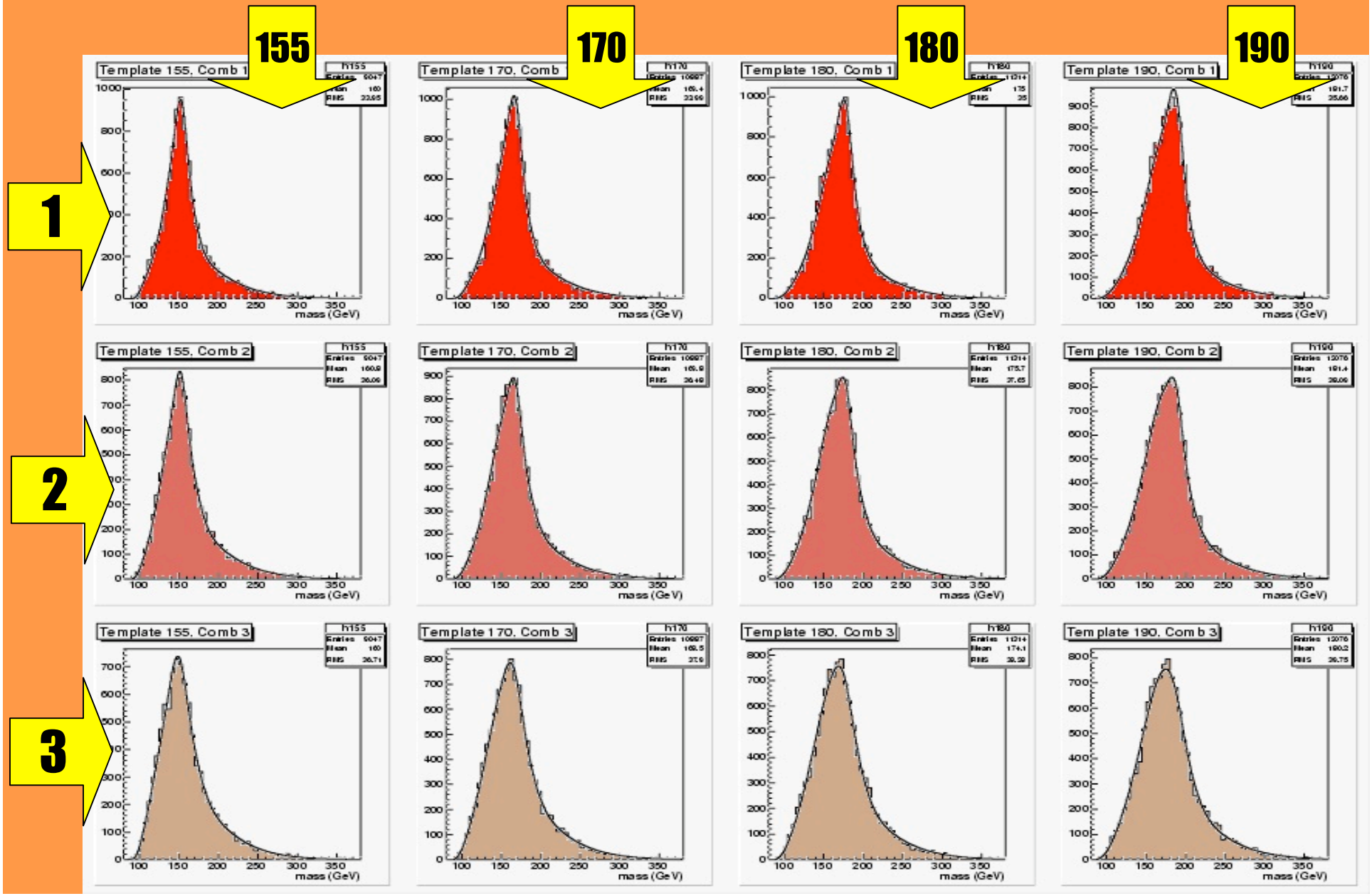
- **233** events were observed in the 347 pb^{-1} si/nosi good run lists.
- After χ^2 cut they are **218**
- $N_{BG}=N_{candidates} - N_{signal} = 98$
- **S/B = 1.22**

Background Fit

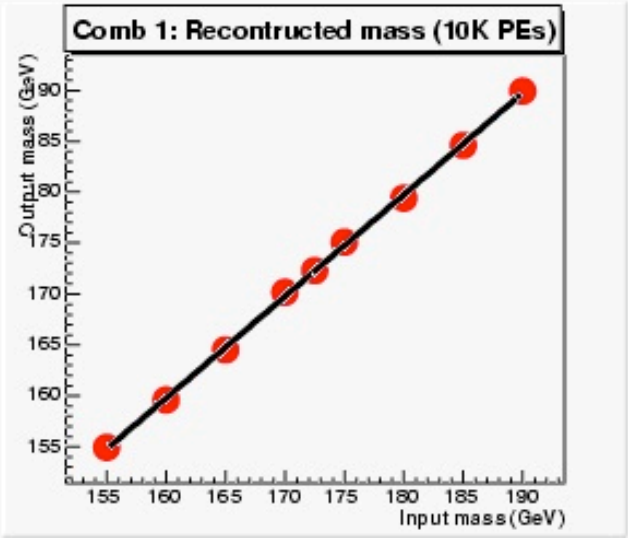


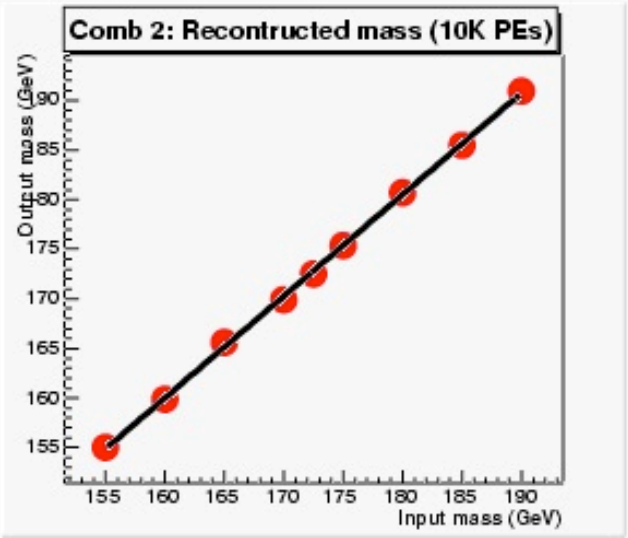
This BG is composed by 80% of W->4p and 20% by QCD

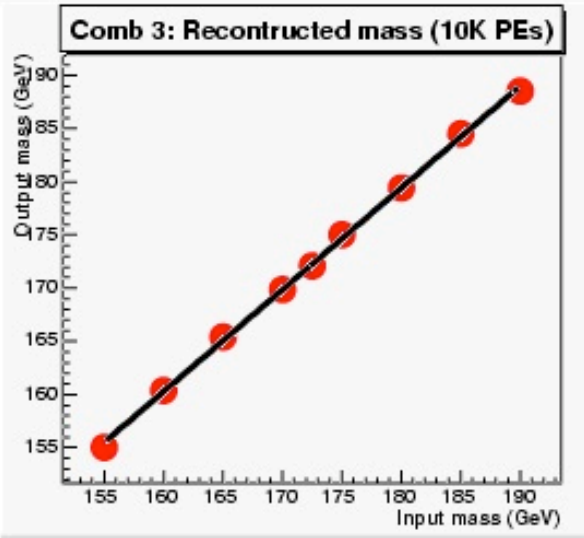
Signal Templates



Mass IN vs reconstructed





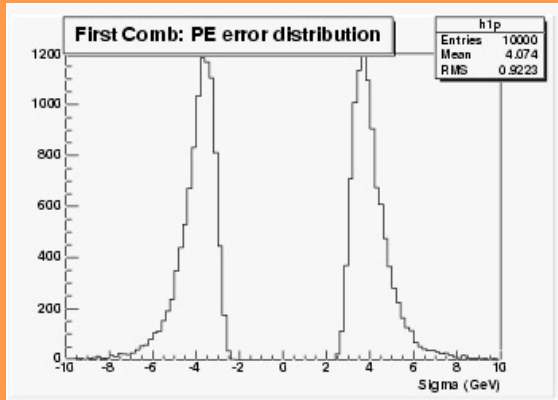


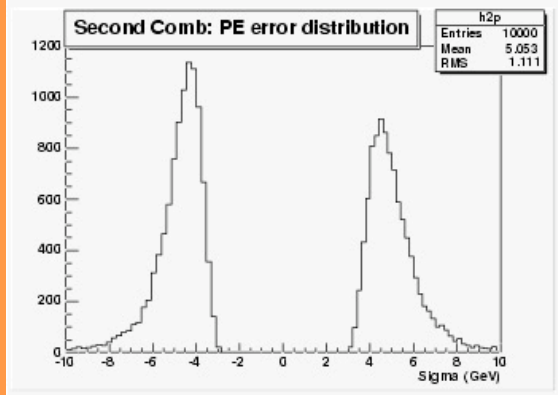
Comb 1
Fit slope:
0.999 ± 0.031

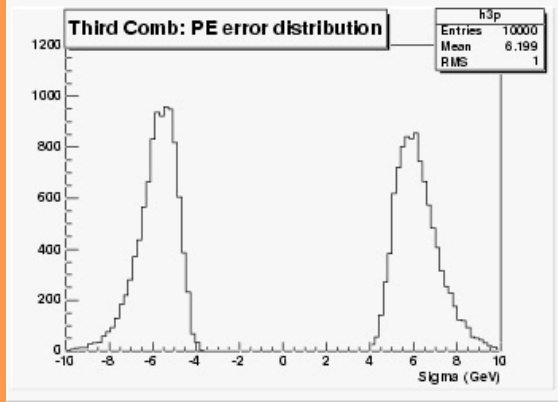
Comb 2
Fit slope:
1.024± 0.031

Comb 3
Fit slope:
0.957± 0.031

Error distributions for 172.5 GeV PEs





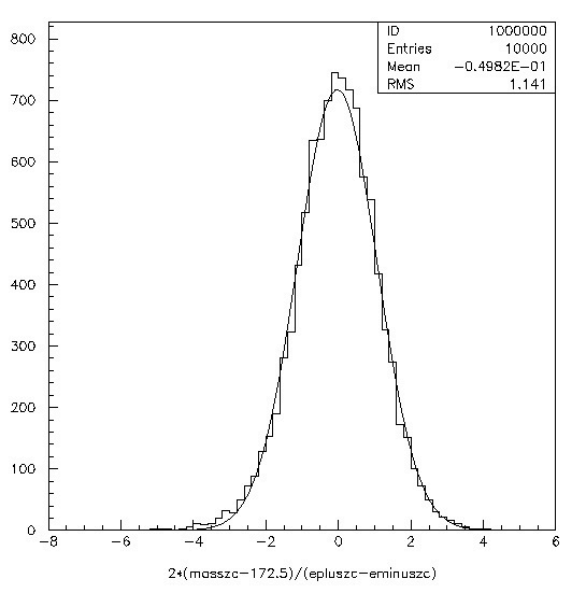


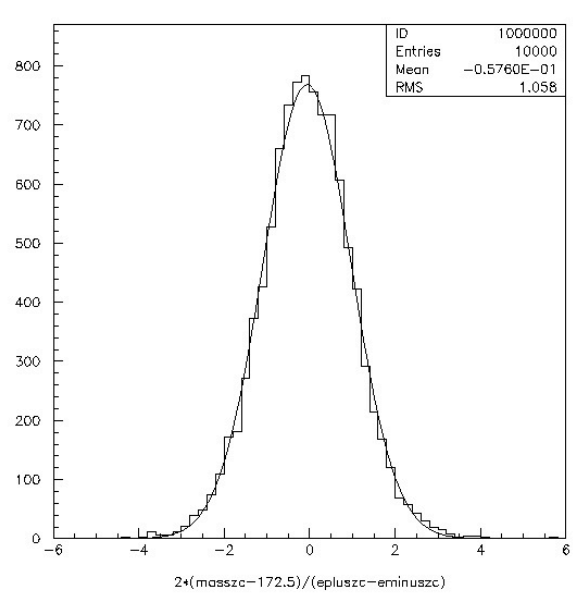
First Comb:
Peak+ : 3.7 GeV
Mean+: 4.1 GeV
Peak- : -3.6 GeV
Peak- : -4.0 GeV

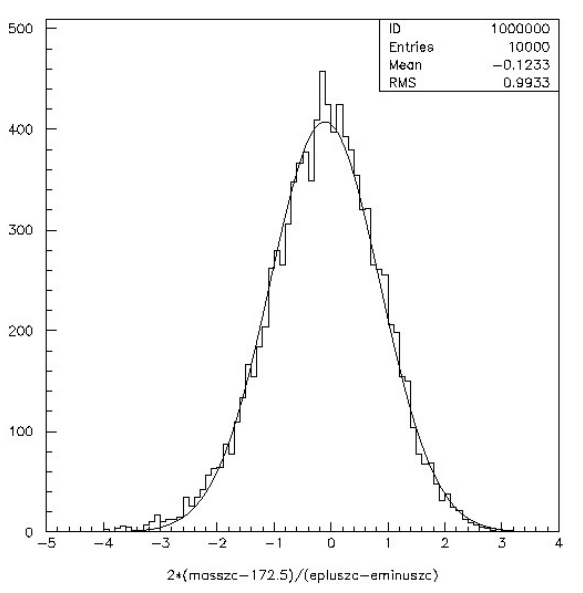
Second Comb:
Peak+ : 4.4 GeV
Mean+: 5.1 GeV
Peak- : -4.3 GeV
Peak- : -4.8 GeV

Third Comb:
Peak+ : 5.9 GeV
Mean+: 6.2 GeV
Peak- : -5.6 GeV
Peak- : -5.8 GeV

Pull Distributions for m=172.5







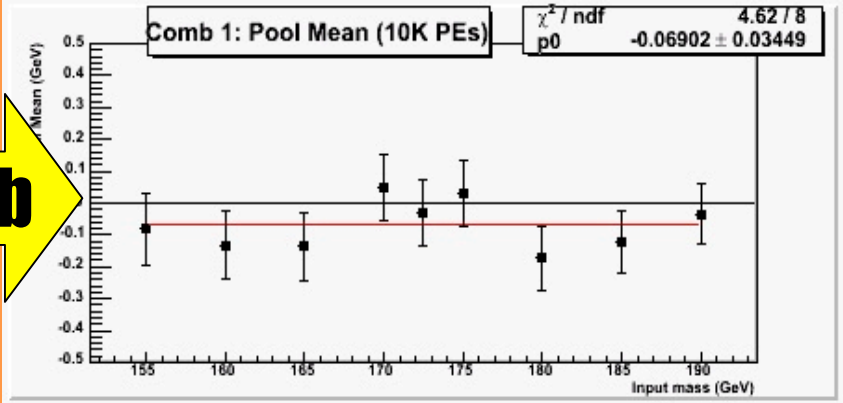
Comb 1

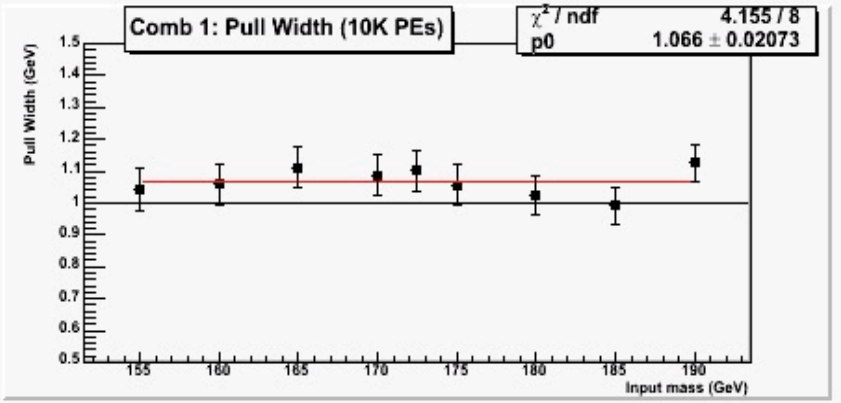
Comb 2

Comb 3

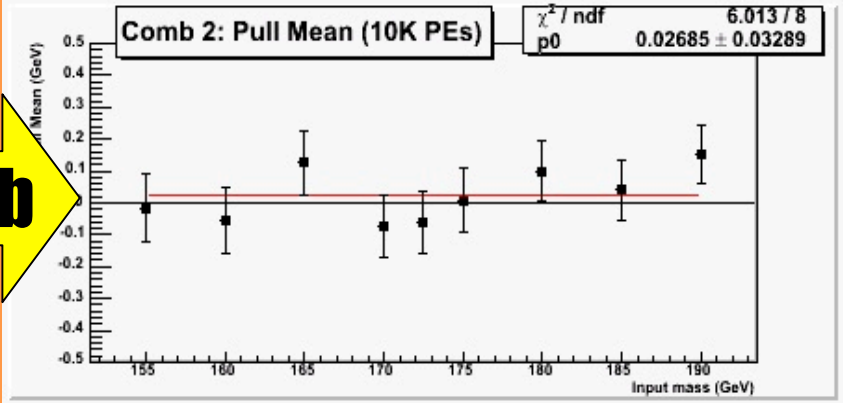
Pull Distributions centers and widths

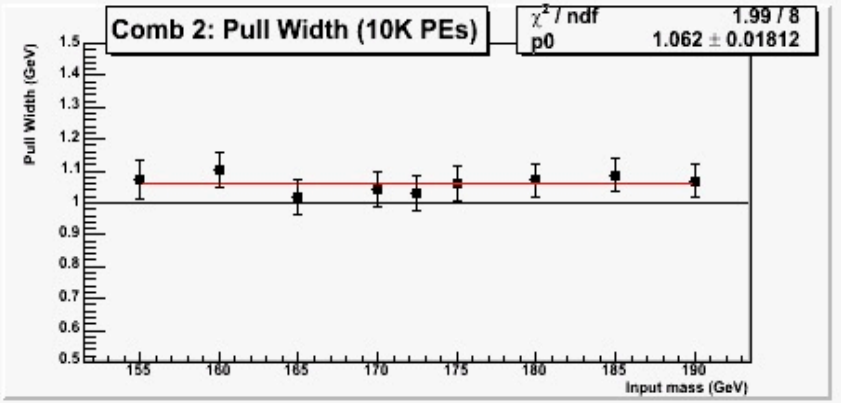
1 comb



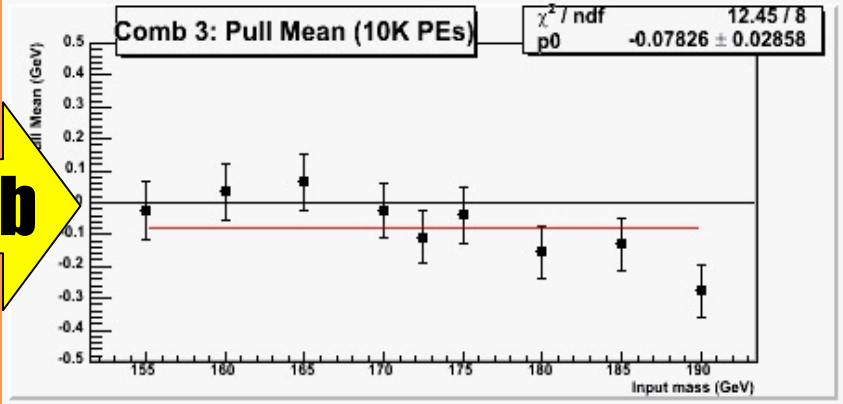


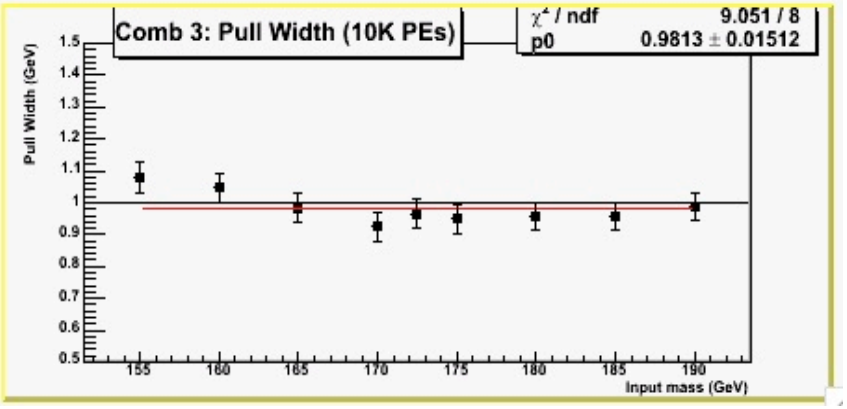
2 comb





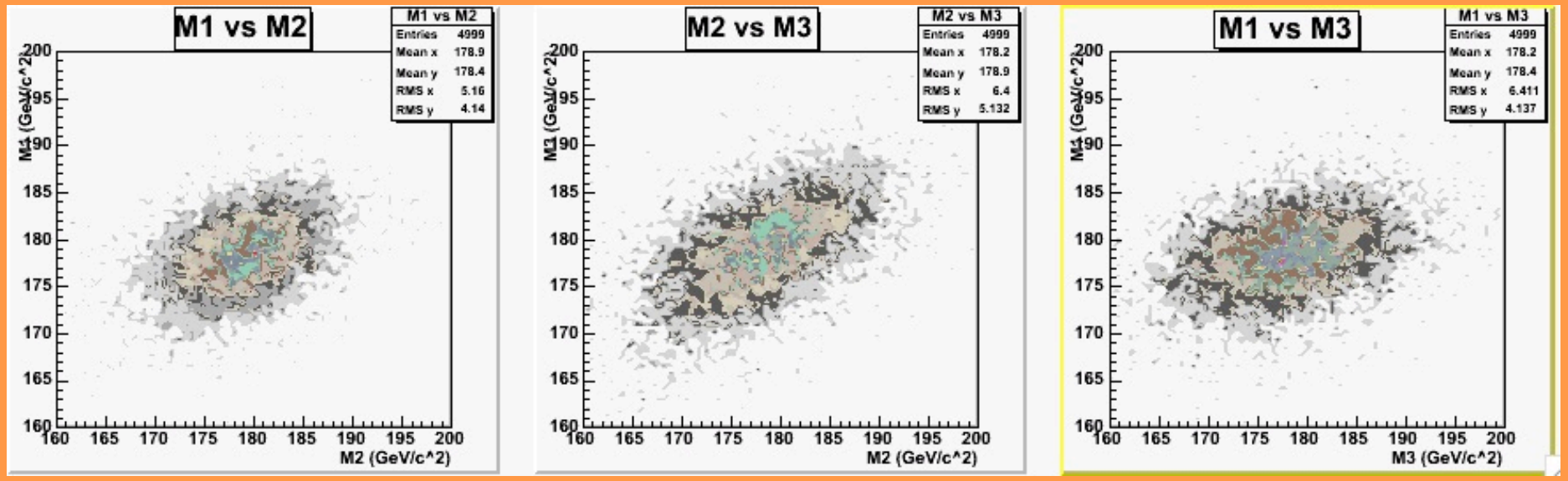
3 comb





Correlations

- We create pseudodata simultaneously from the three 172.5 GeV templates.
- 3 simultaneous fits give 3 reco masses and 3 reco errors, then loop over all PEs.
- Correlations are calculated among the sets of three ouputs from each PE.



BLUE results

$$\hat{m} = \sum_i m_i \alpha_i$$

$$\sigma^2 = \begin{pmatrix} \alpha_1 & \alpha_2 & \alpha_3 \end{pmatrix} \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{12} & \sigma_2^2 & \sigma_{23} \\ \sigma_{13} & \sigma_{23} & \sigma_3^2 \end{pmatrix} \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{pmatrix}$$

	165	**172.5**	180
MC sigma 1	4.54	**4.59**	4.20
MC sigma 2	4.96	**5.23**	5.24
MC sigma 3	5.90	**6.35**	6.54
corr(12)	0.38	**0.38**	0.38
corr(13)	0.37	**0.32**	0.33
corr(23)	0.57	**0.61**	0.56
alpha1	0.53	**0.58**	0.65
alpha2	0.35	**0.32**	0.28
alpha3	0.11	**0.11**	0.08
Sigma(Comb)	3.89	**4.01**	3.80
BLUE improv (%)	**-14**	**-13**	**-10**

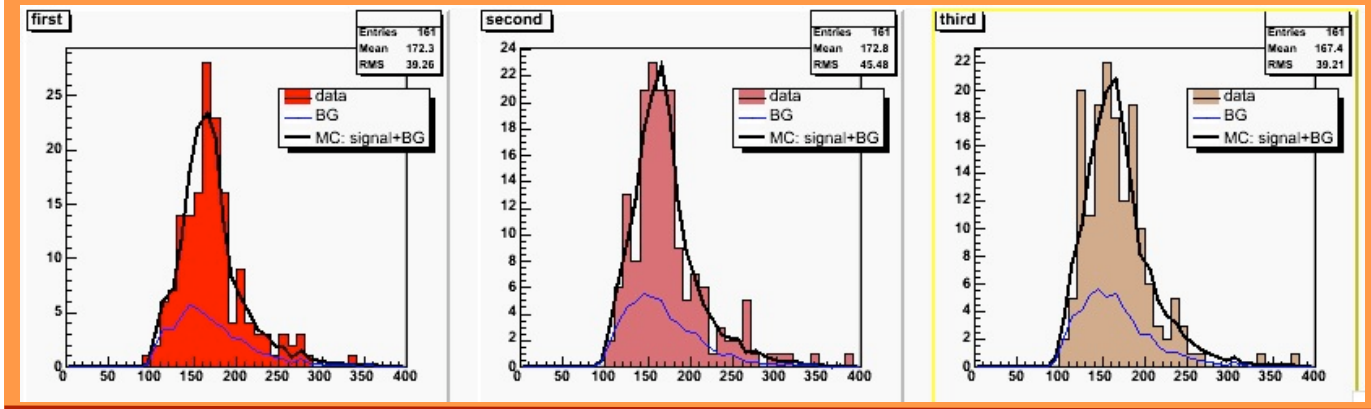
Plans

1. Move to Gen6
2. Apply to pretag data
3. Systematics
4. Study subsamples (notag, tag)

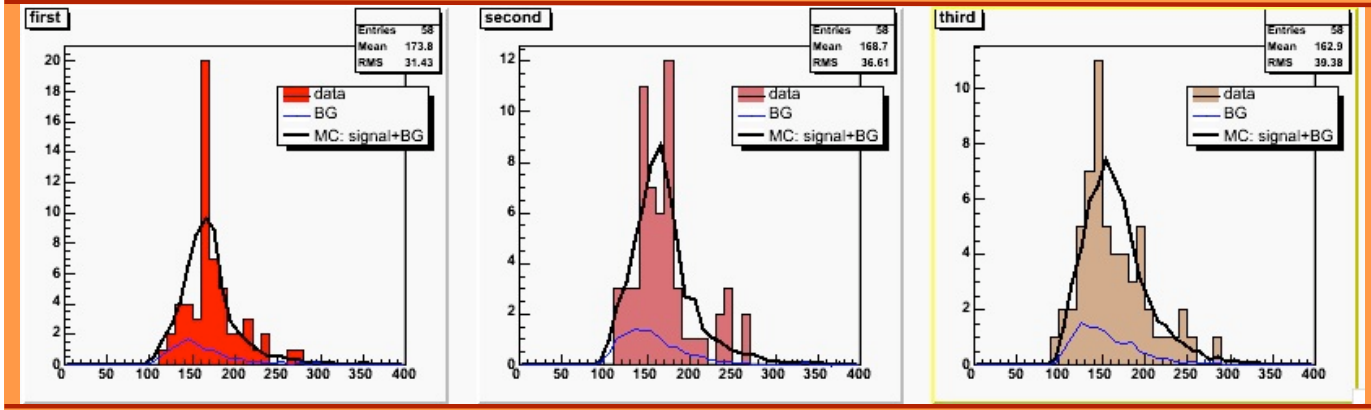

end

Backup slides

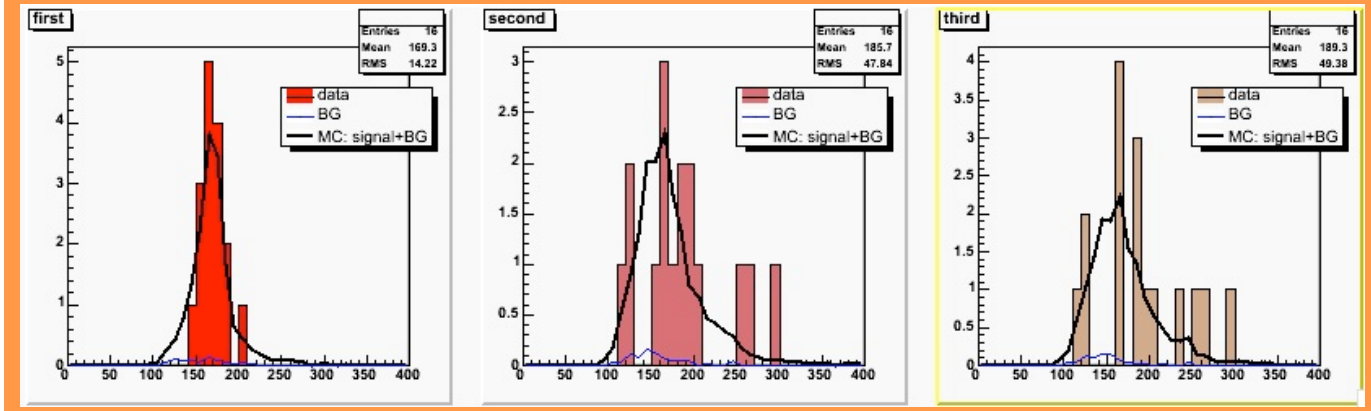
3 best χ^2 1



Pretag



1tagT



2tag