W mass direct measurement via Single-W process

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—> Current status of my study

Current status

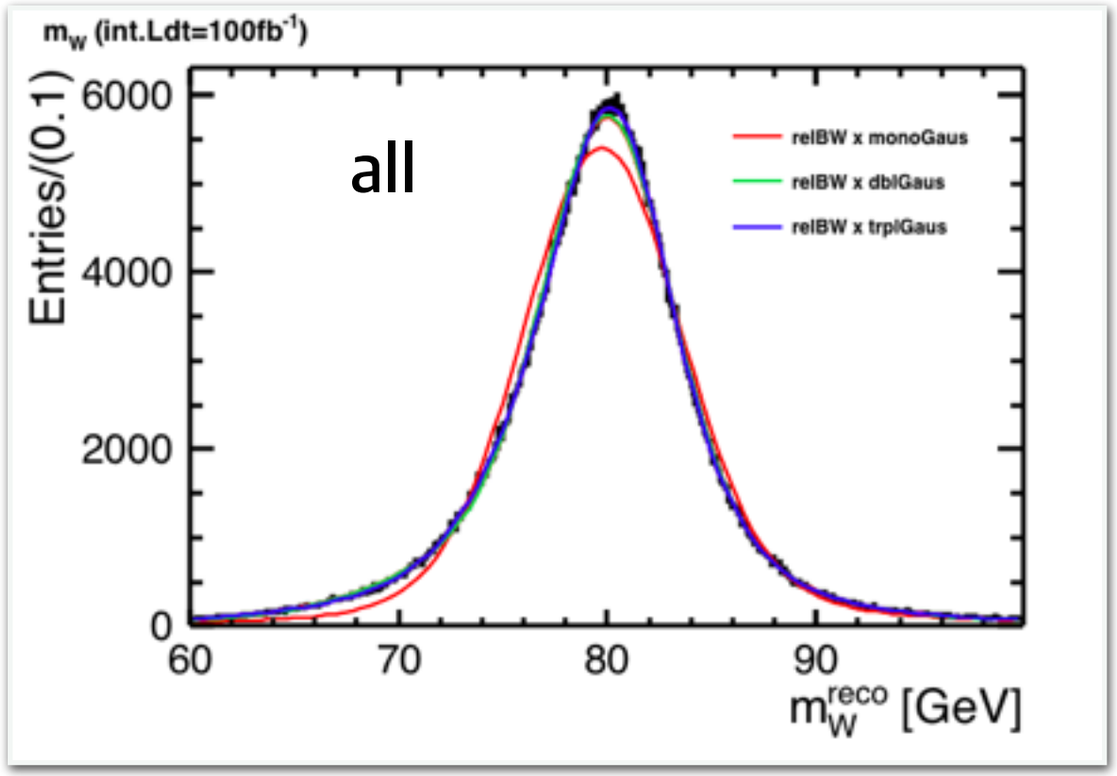
- Last week;
  - study of systematic error from JES uncertainty
  - introduced the analytic model (relBW×tripleGaus) to describe the m_W distribution
- This week;
  - try to understand the physical meaning of each Gaussian of triple-Gaussian resolution model
  - estimated m_W error and initial fitting parameter study

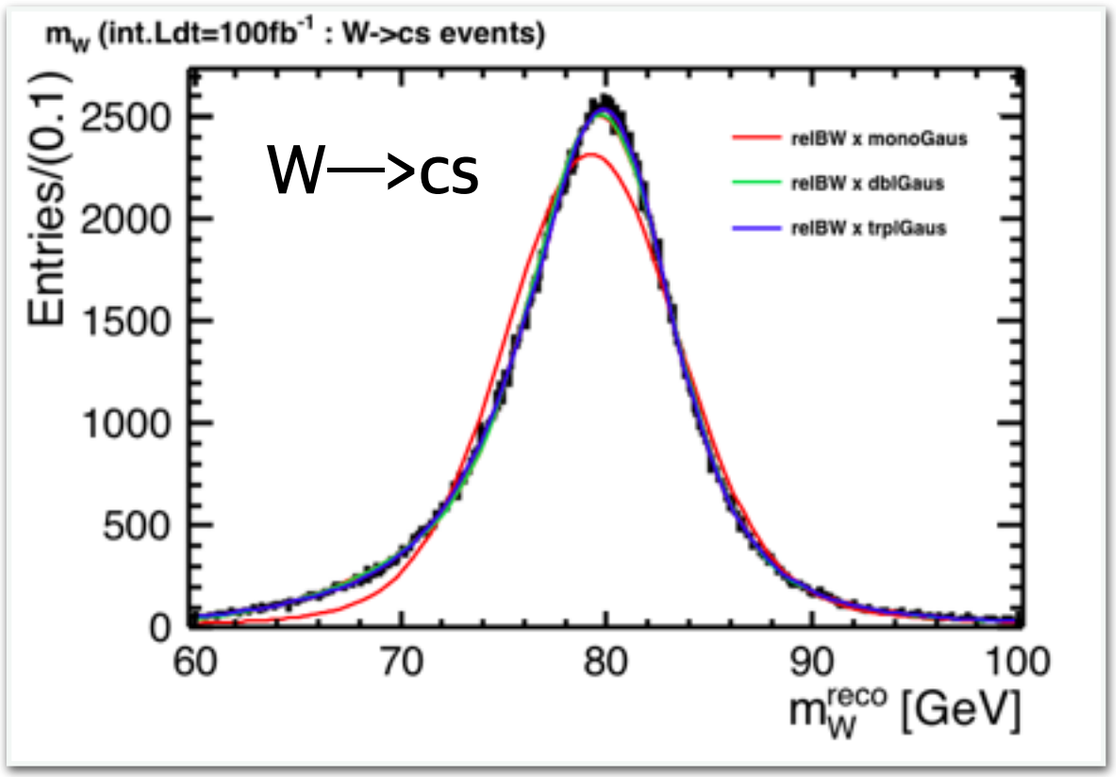
Fitting on m_W

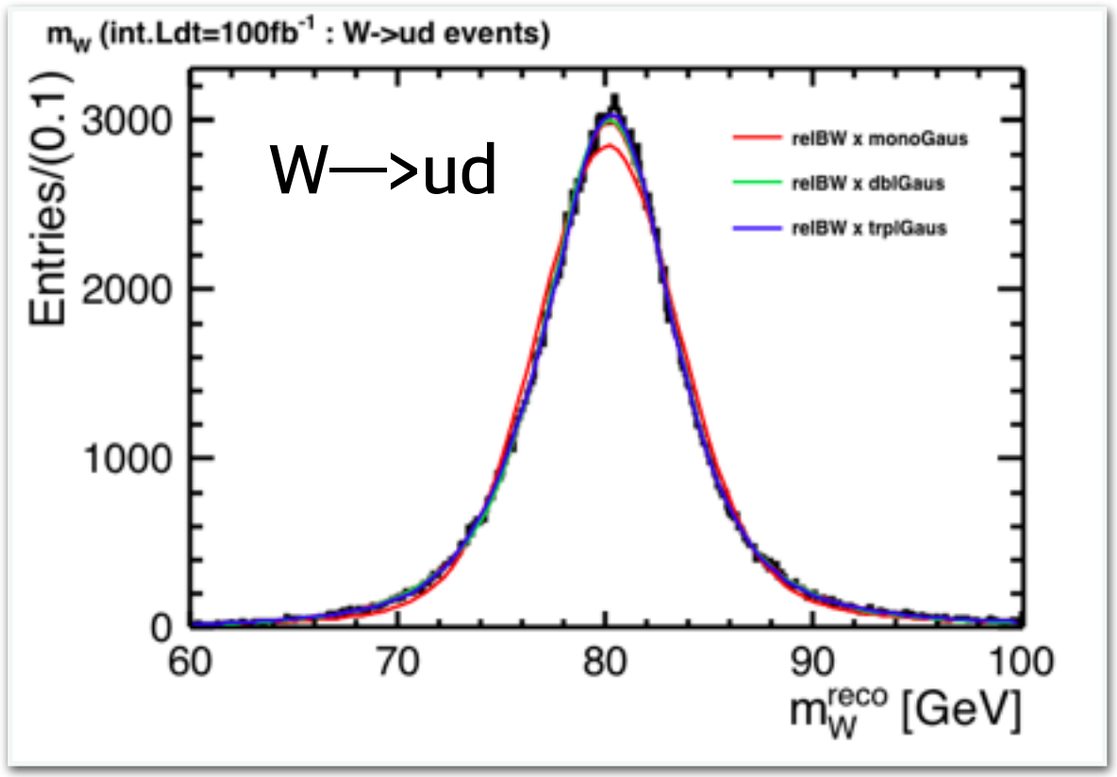
m_W^{reco} distributions

(reconstructed with perfect PFOs)

mono-Gaussian model (red line)
cannot describe the data well







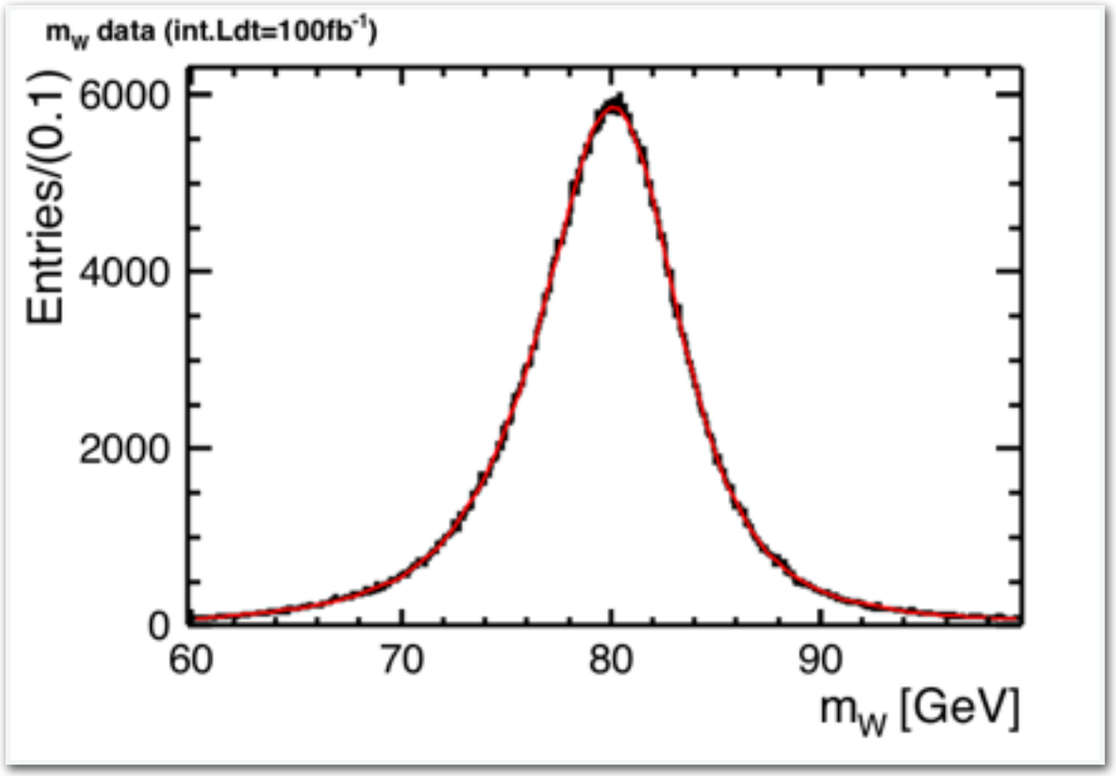
Necessity of each Gaussian

m_W fitting result table	m_W (all)	m_W (W—>ud)	m_W (W—>cs)
mono-Gaus	Failed	Converged but large err. & χ^2	Failed
dbl-Gaus	Failed	Success	Converged but no minimum around 80GeV
trpl-Gaus	Success	Converged but no minimum around 80GeV	Success

- W—>cs contains missing E_{jet} > 0 events, however W—>ud doesn't.
- double-Gaussian model works well only for the W—>ud data, and triple-Gaussian works well for the other data sets
    - this implies that one Gaussian of the three in triple-Gaussian model plays a role of missing E_{jet} contribution, and others for true detector effects

Estimated m_W error by fitting

- m_W stat. err. (int.Ldt=100fb^{-1}) :
  - ~ 6 MeV from template fitting
  - ~ 20 MeV from analytical fitting with relBW×trplGaus
    - this is much larger than that of template fitting
    - there may be more parameters to be fixed in this fitting



first, fit the m_W with convoluted model with 10 free parameters (Γ_W is fixed)

↓

fix the parameters of triple-Gaussian

↓

then re-fit m_W with only 3 free parameters, N, m_W and Γ_W, others are fixed

$m_W = 80.4192 \pm 0.0094$ GeV

Summary and next

- For the next,
  - estimate how well the ILD-JES can be calibrated
  - anyway, is there anyone who knows about any paper of ILD-JES calibration study ?

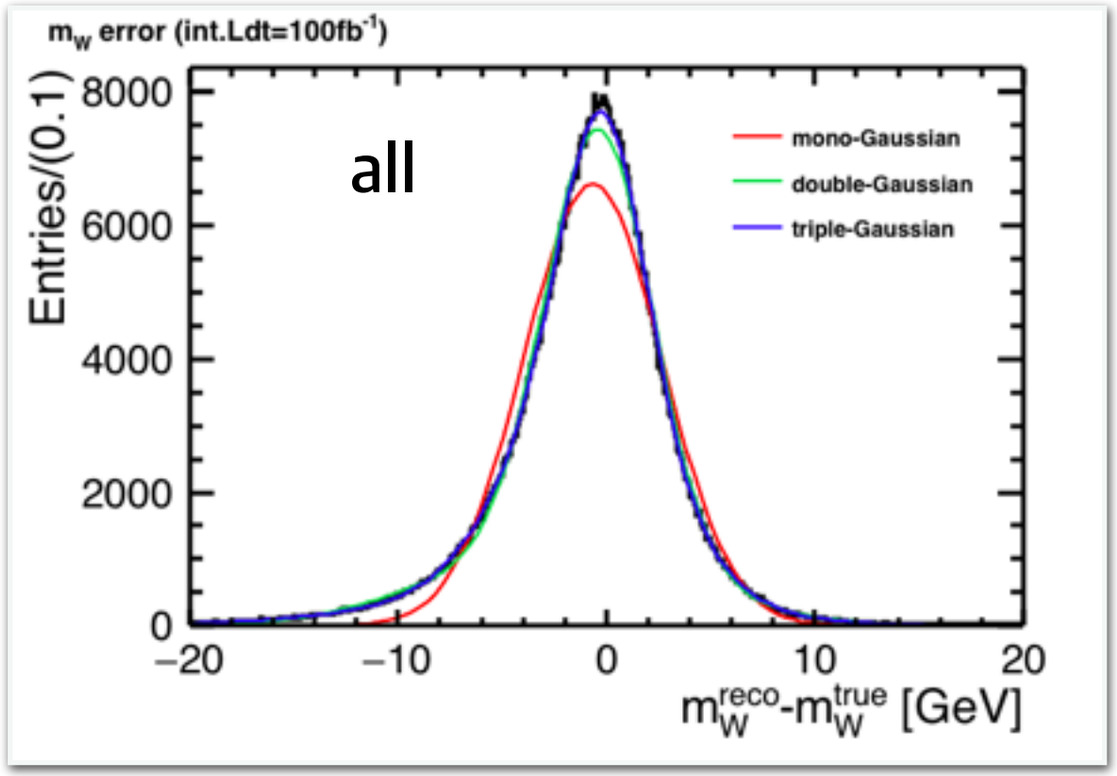
Back up

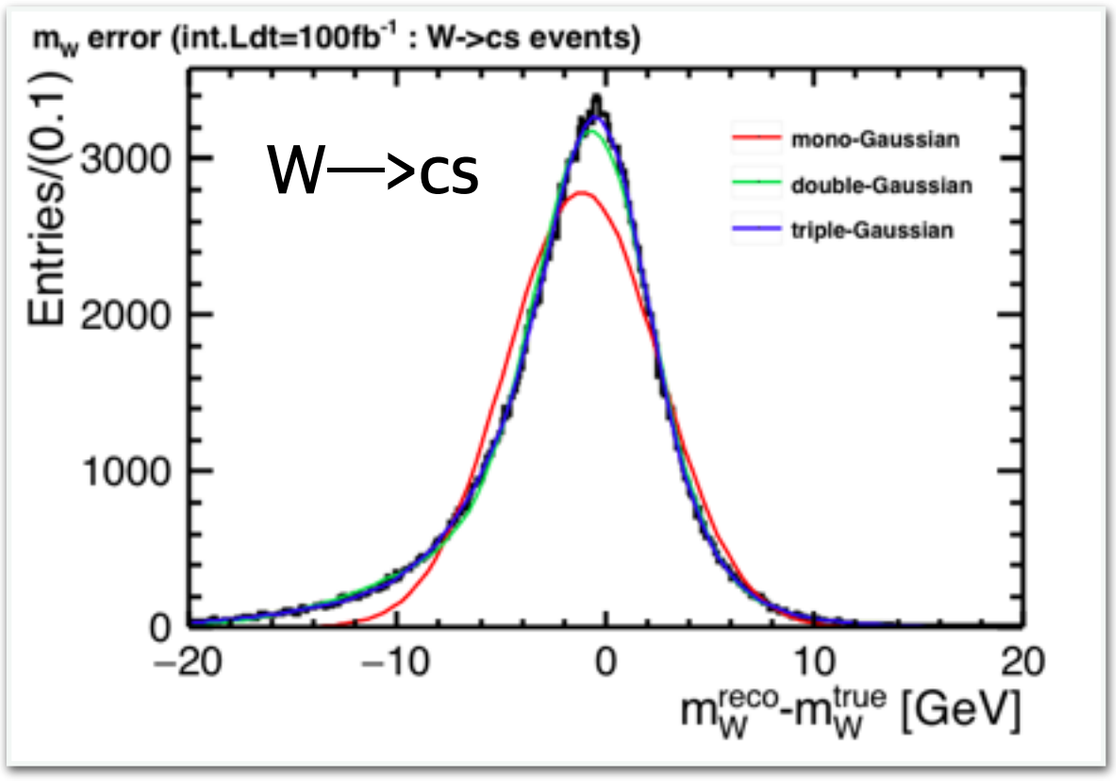
Fitting on m_W error

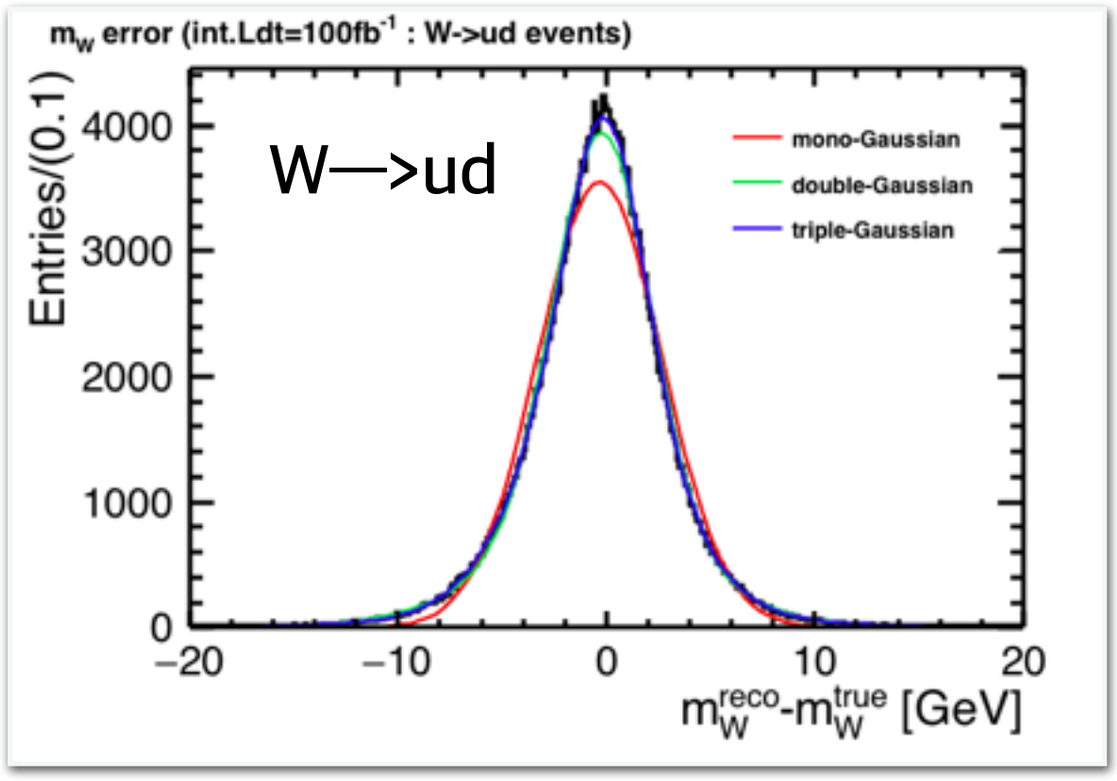
m_W^{reco} - m_W^{true} distributions

(reconstructed with perfect PFOs)

mono-Gaussian model cannot describe the data well







Template fitting result

systematic error here is defined as $m_W^{MC1,\,MC5} - m_W^{MC0}$

template —> data	fitted m_W [GeV]	systematic error [GeV]
MC0 —> D0 (true W mass)	80.413 ± 0.006	—
MC1 —> D0 (1% JES uncertainty)	80.333 ± 0.005	-0.080 (0.1%)
MC5 —> D0 (5% JES uncertainty)	80.061 ± 0.014	-0.352 (0.44%)

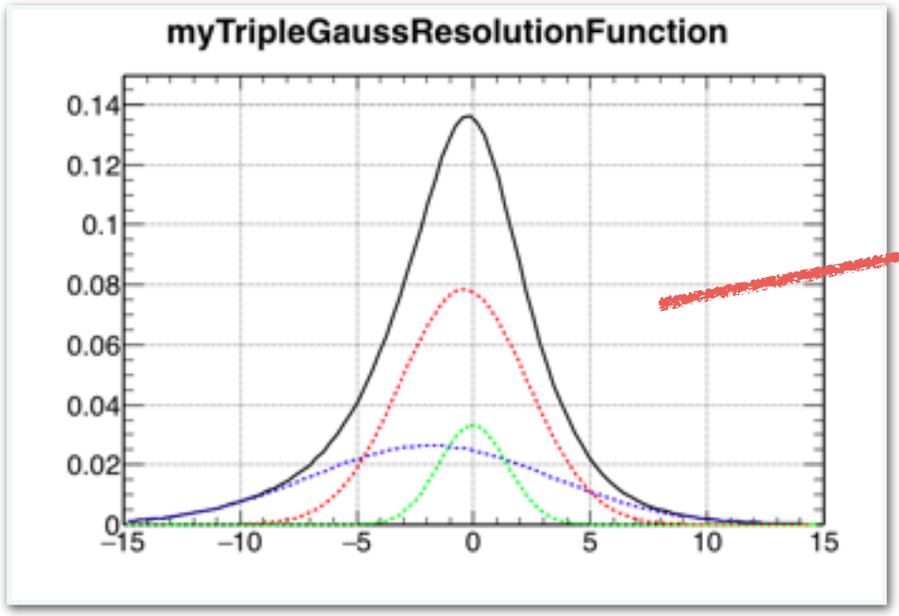
if the jet energy scale is known only to 1%, systematic error is 0.1%
as for 5% case, systematic error is 0.44%

Analytic m_W distribution model

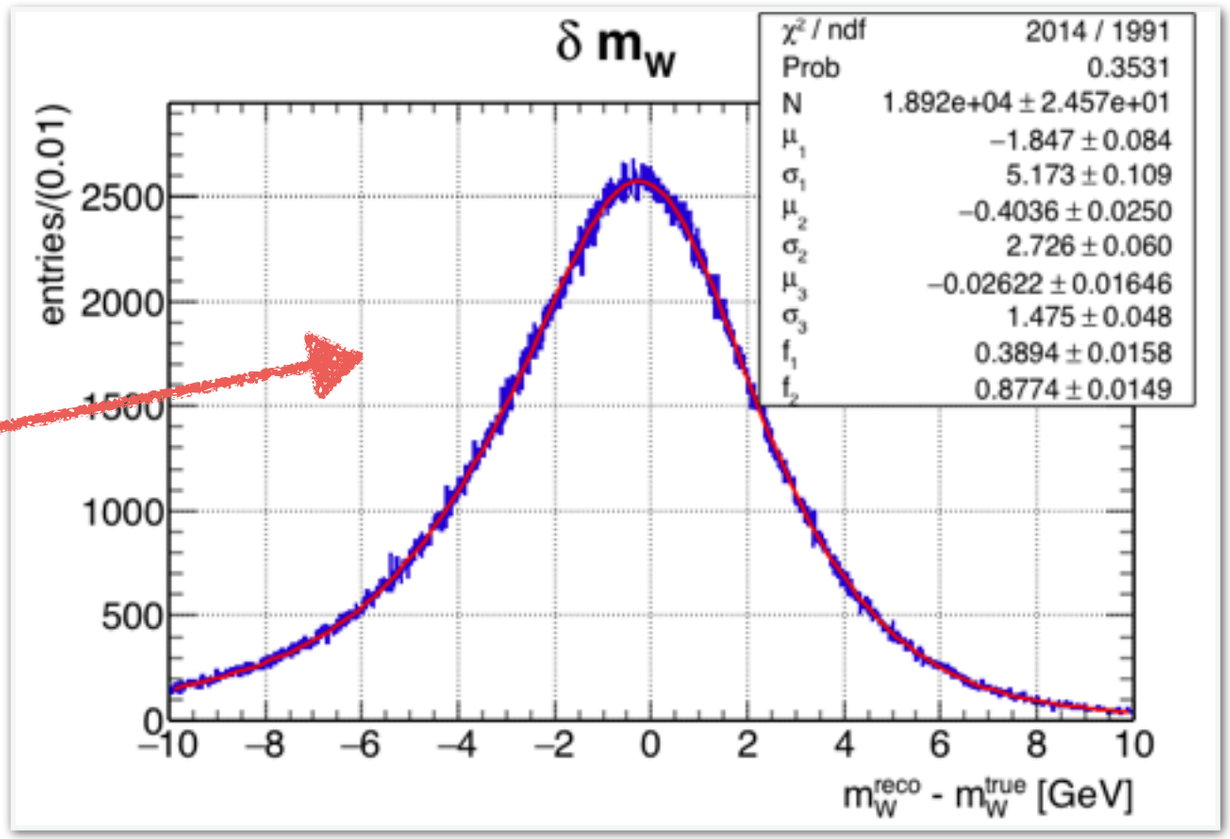
- Analytic model PDF is defined as ‘physics model’ convoluted with ‘detector model’
  - physics : relativistic Breit-Wigner —> describes generator level m_W line shape well
  - detector (before) : simple mono-Gaussian —> cannot describe detector effect well
  - detector (for now) : linear sum of triple-Gaussian —> ???

$$m_W^{reconstructed} - m_W^{true}$$

tri-Gaus model looks good to describe detector smearing effect

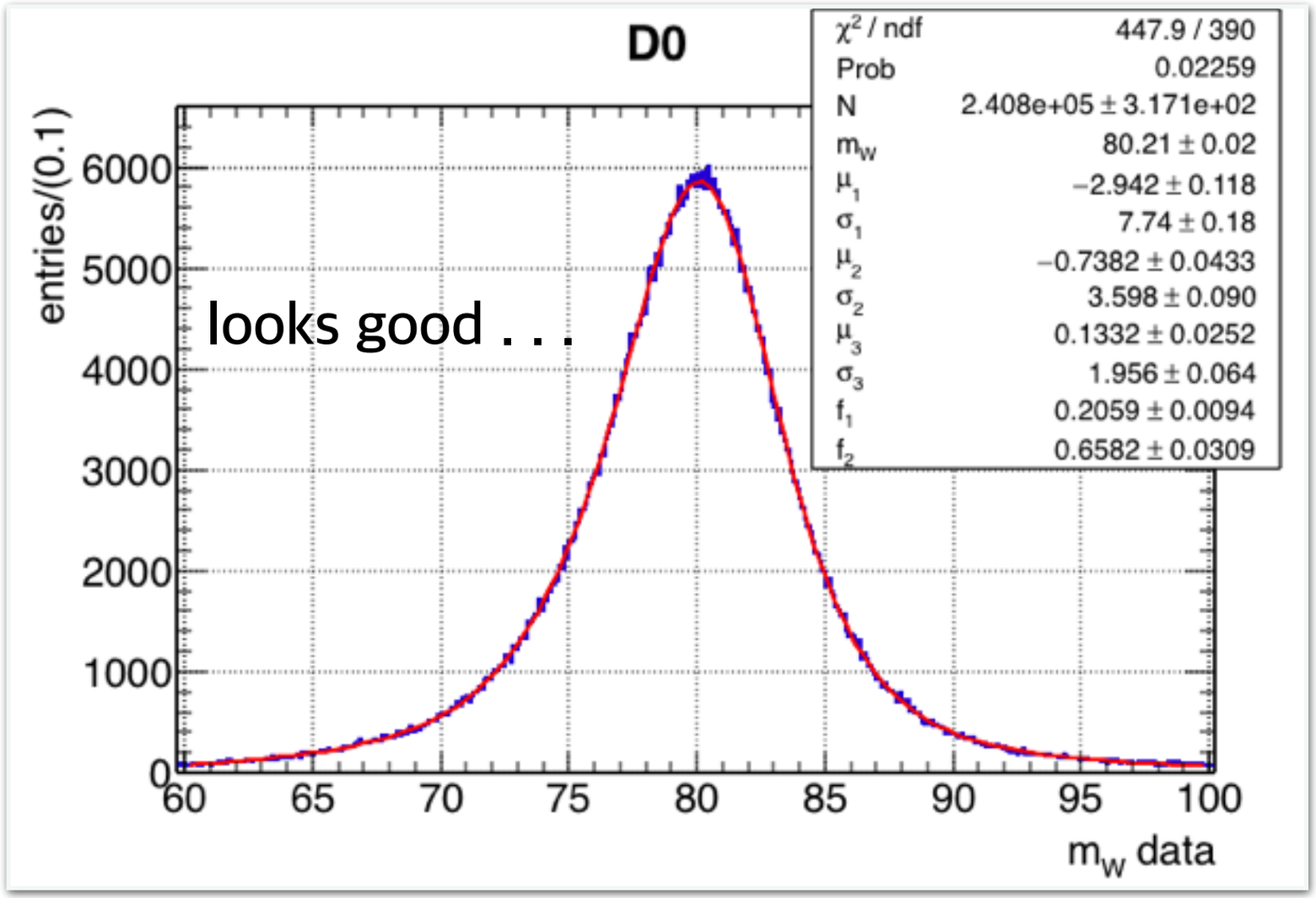


fit



Analytic m_W fitting

rel BW (physics) ⊗ triple Gaus (detector)



using Minuit minimization

D0 as same as above

11 pars;
10 free pars
1 fixed (Γ_W)

m_W = 80.21 ± 0.02 GeV
δm_W = 200 MeV
m_W error = 20 MeV

need to confirm the validity of this result

. . . another minimization package?