W mass direct measurement via Single-W process

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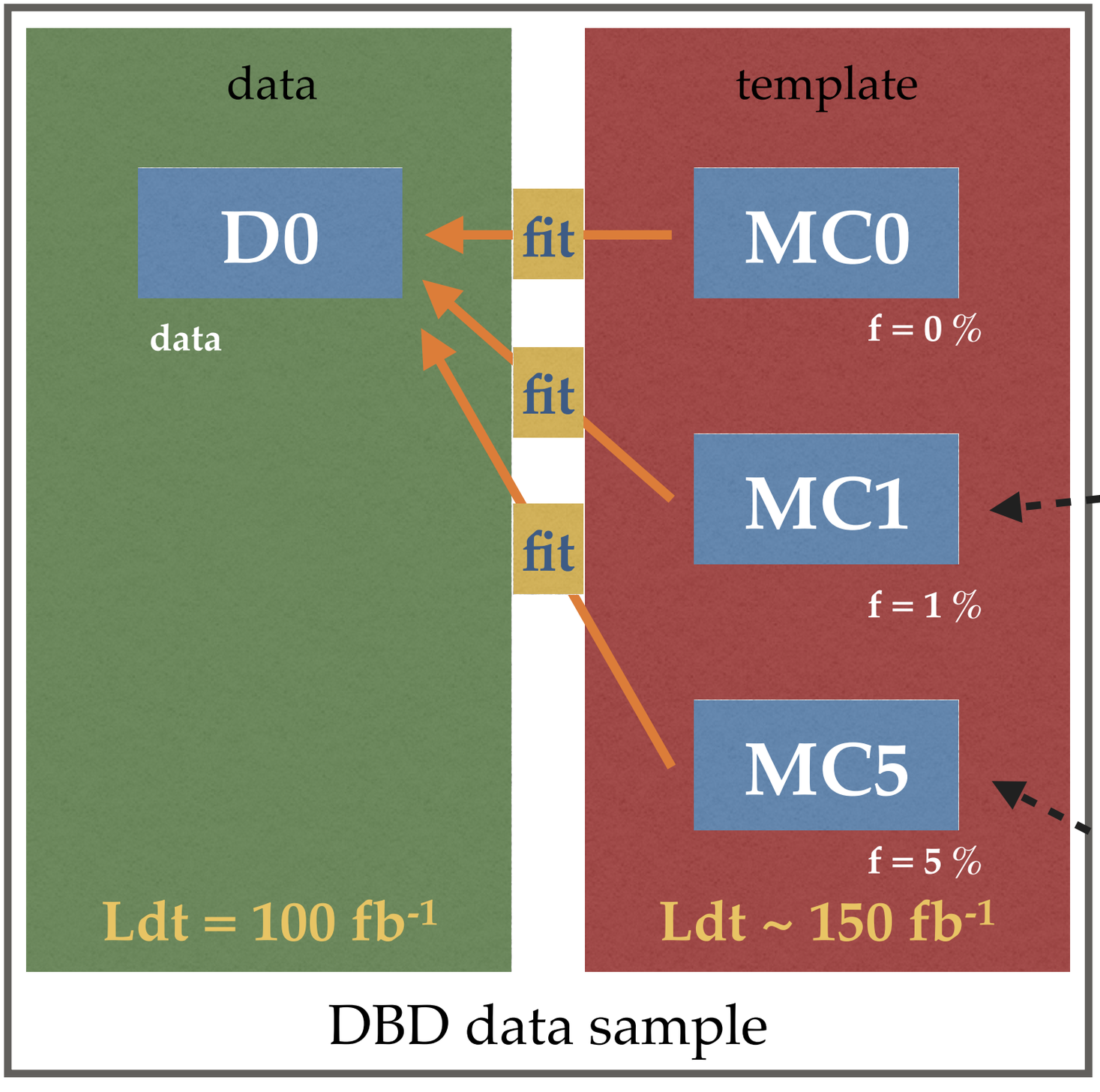
—> Current status of my study

Status

- What I have done (today's report);
  - study of the systematic error from JES uncertainty
  - building the PDF which describes analytic m_W line shape
- To do;
  - other systematics study
    - hadronization, pileup, PFA tunes, etc. . .
  - different E_{CM} (500GeV, 1TeV)
  - with more realistic situation (perfect PFO for now)

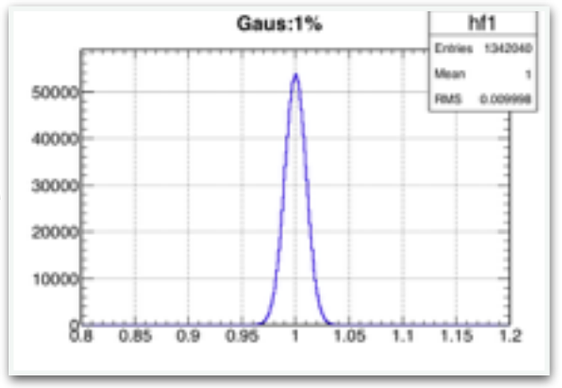
Estimate systematic error from JES



f = 1 for ILD jet energy scale

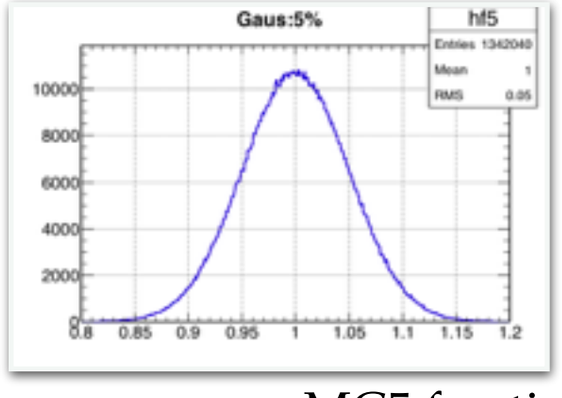
$$E_{jet}^{obtained} = f \times E_{jet}^{measured}$$

Gaussian with sigma of 1%



MC1 fraction

Gaussian with sigma of 5%



MC5 fraction

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%)

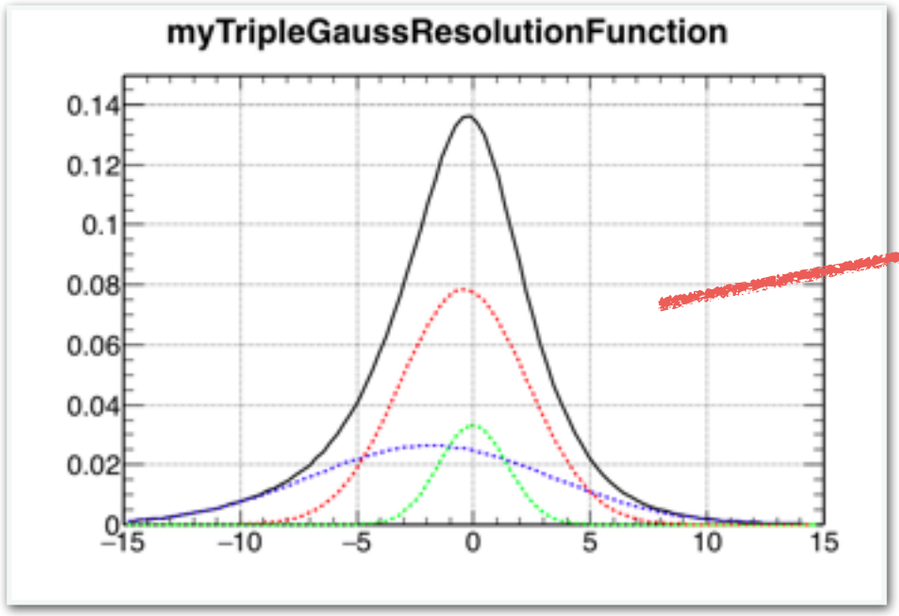
if the jet energy scale is known only to 1%, systematic error is 0.1%
as for 5% case, systematic error is 0.44%

Analytic m_W distribution model

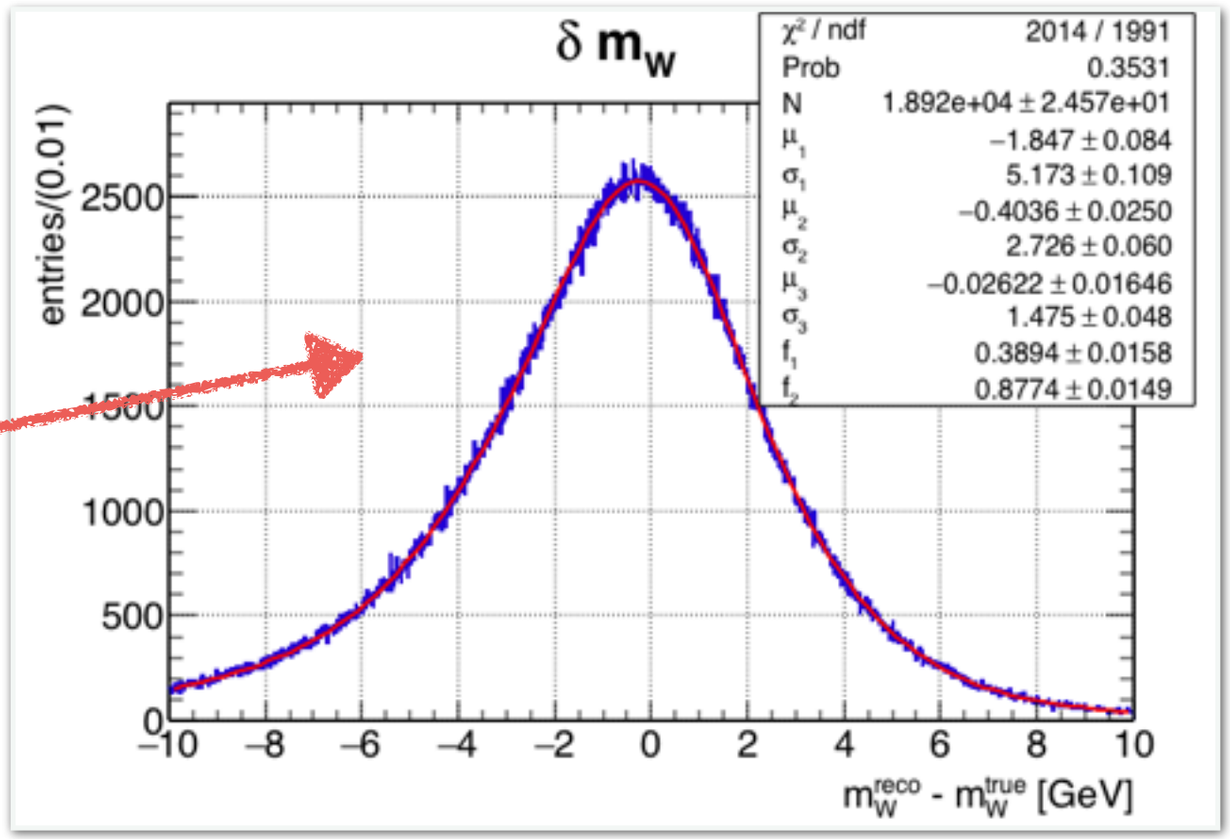
- Analytic model PDF is defined as ‘physics model’ convoluted with ‘detector model’
  - physics : relativistic Breit-Wigner —> describes generator level m_W line shape well
  - detector (before) : simple mono-Gaussian —> cannot describe detector effect well
  - detector (for now) : linear sum of triple-Gaussian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

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

tri-Gaus model looks good to describe detector smearing effect

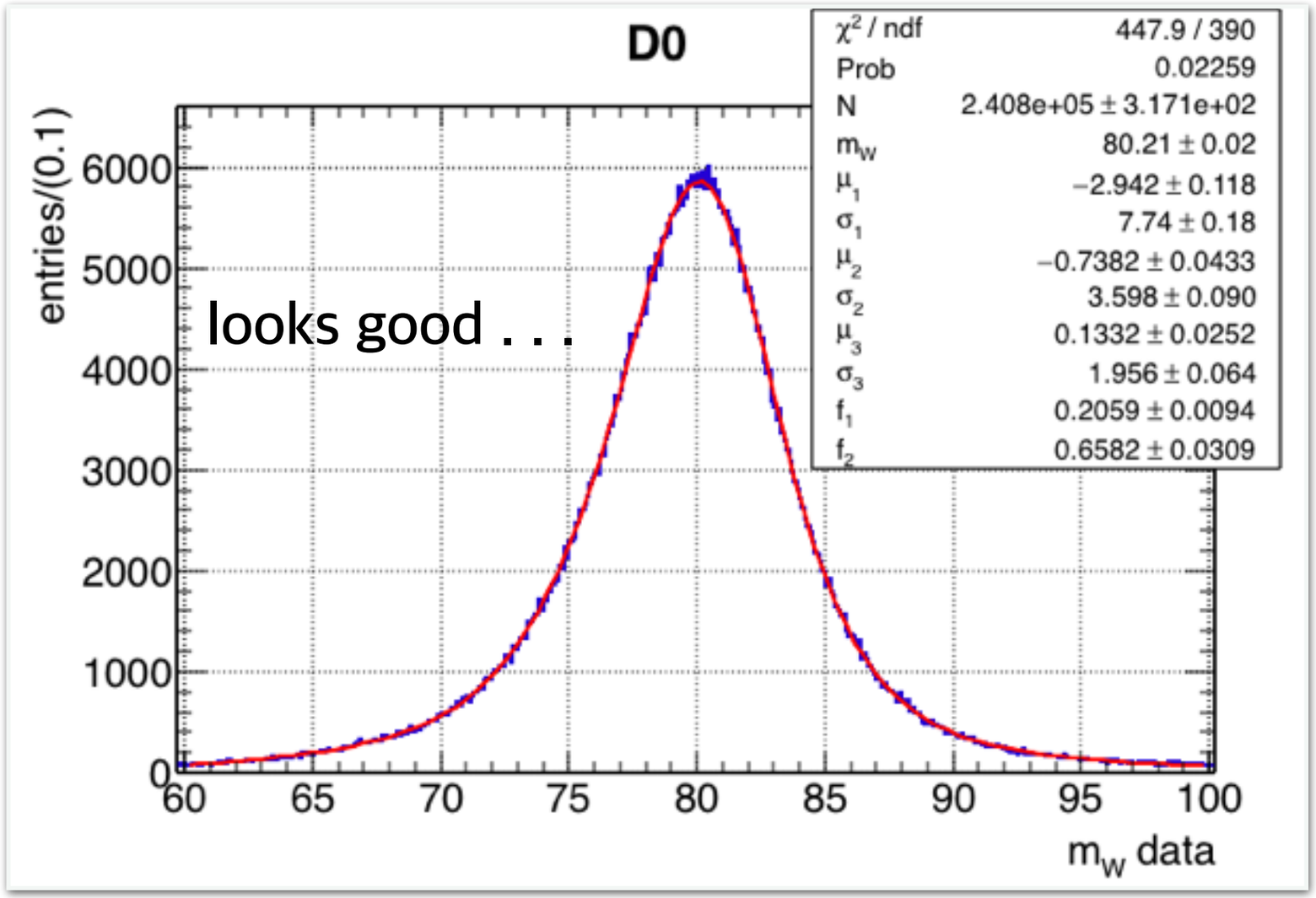


fit



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

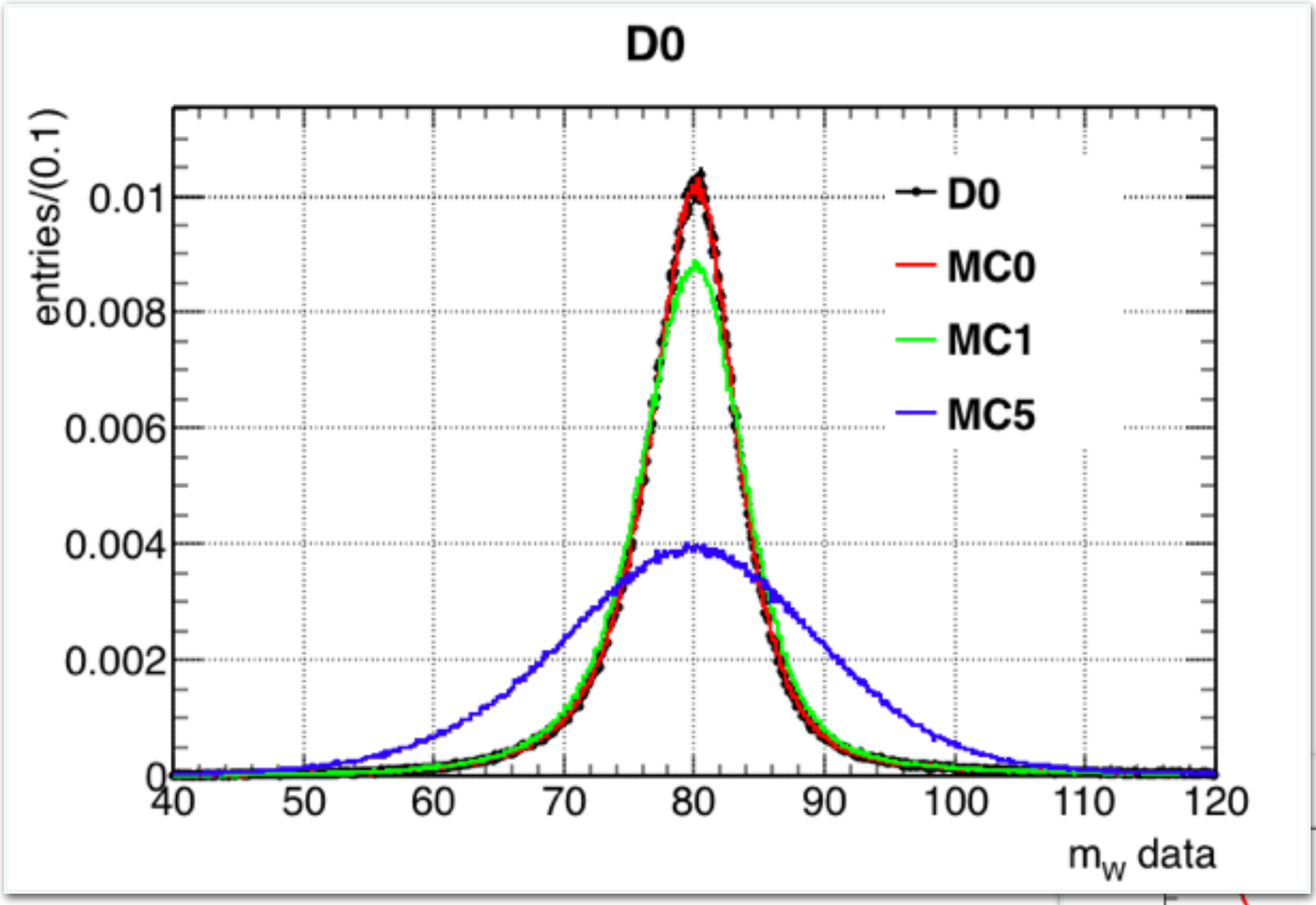
need to confirm the validity of this result

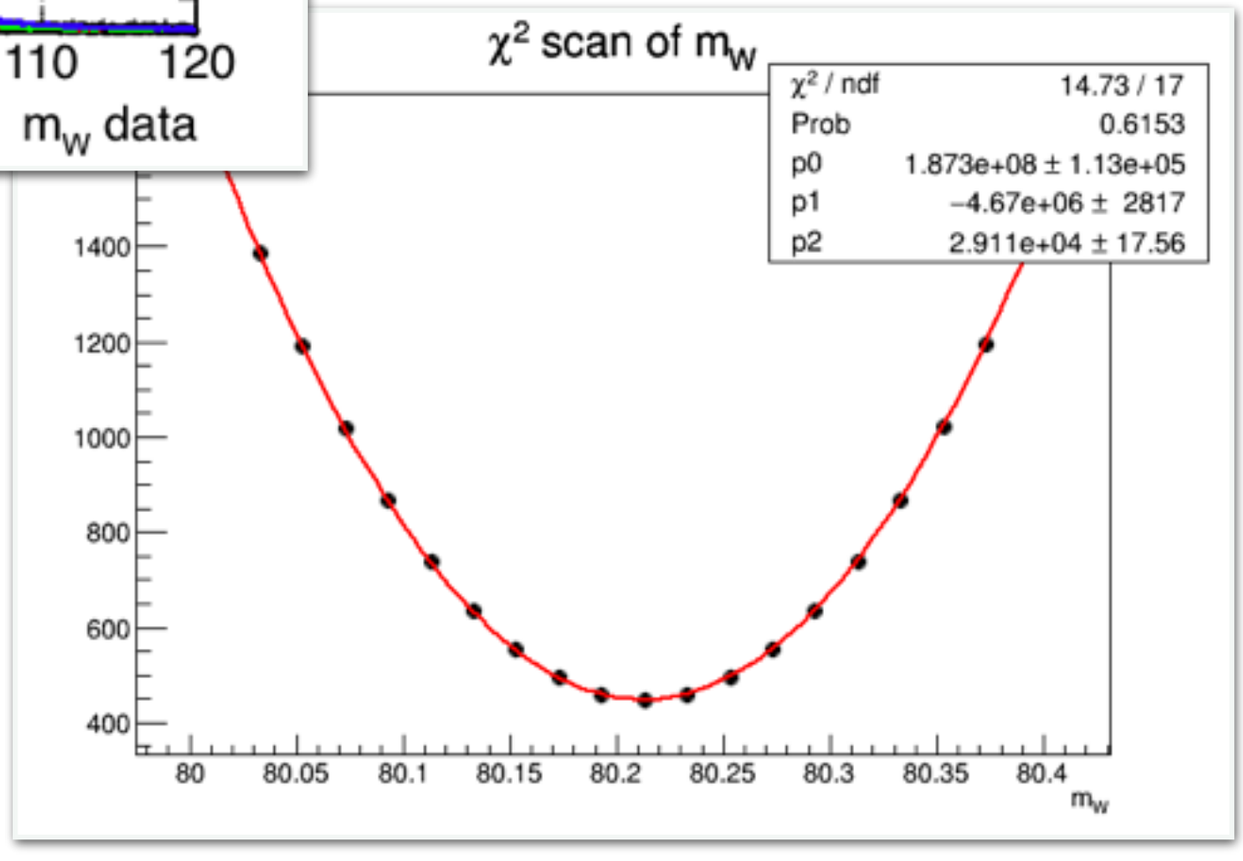
. . . another minimization package?

Summary and next

- W mass systematic error from JES uncertainty is
  - 80 MeV for 1% JES uncertainty (relative 0.1%)
  - 352 MeV for 5% JES uncertainty (relative 0.44%)
- The relBW convoluted with tri-Gaus resolution model looks good to describe the W mass distribution
  - we need to check the consistency of obtained result, estimated m_W error is 20 MeV
- For the next,
  - binning and fitting range scan with analytic PDF above

Back up


D0
entries/(0.1)
0.01
0.008
0.006
0.004
0.002
0
40
50
60
70
80
90
100
110
120
m_W data
D0
MC0
MC1
MC5


χ^2 scan of m_W
χ^2 / ndf 14.73 / 17
Prob 0.6153
p0 1.873e+08 ± 1.13e+05
p1 −4.67e+06 ± 2817
p2 2.911e+04 ± 17.56
1400
1200
1000
800
600
400
80
80.05
80.1
80.15
80.2
80.25
80.3
80.35
80.4
m_W