Convolution fit

in the $\mathrm{WW} \rightarrow \mathrm{qq}\ell\nu$ channel

at $\sqrt{s} = 189$ GeV

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A copy of the transparencies can be found at
/afs/cern.ch/user/d/dubbj/public/ww/ww_071299.ps

Method (1)

The Convolution method tries to use the full information of each WW-event in an Unbinned Maximum Likelihood Fit of an analytical distribution to the data.

- For each event i construct a χ^2**-function** of the **kinematic variables**, apply **momentum** and **energy conservation** and an **equal-mass constraint**.

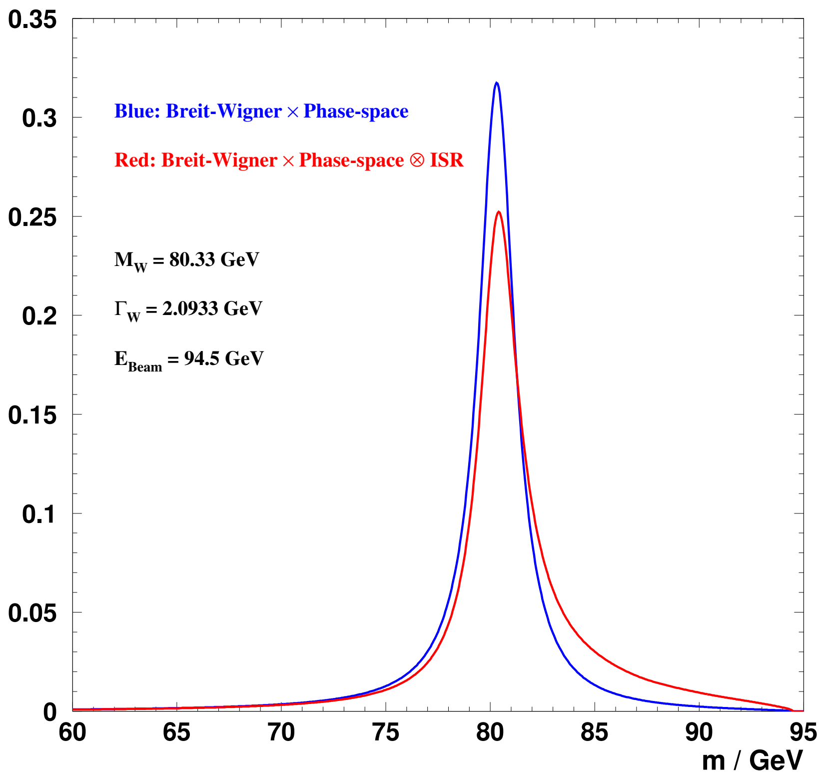
  Initial State Radiation (ISR) is **not taken into account** in the χ^2-function.

- Convert $\chi_i^2(m)$ into **probability density** $P_i(m)$, which corresponds to the (in general) **asymmetric error**.

- The **event-likelihood** $\mathscr{L}_i(\mathrm{M_W}, \Gamma_\mathrm{W})$ is given by the **convolution** of the **error-density** $P_i(m)$ with the **physics function** $f(m; \mathrm{M_W}, \Gamma_\mathrm{W})$.

Method (2)

- $f(m;\mathrm{M_W},\Gamma_\mathrm{W})$ is a **superposition** of relativistic **Breit-Wigner functions** (with phase-space factor) which are **shifted** by the difference of nominal and actual beam energy, $m \to m - (\sqrt{s} - \sqrt{s'})/2$, and **weighted** by the probability $Q(s')$ that the event occurred at a center-of-mass energy $\sqrt{s'}$. This takes the **effect of ISR** on the χ^2-function into account (in the statistic mean).



Comparison of a relativistic Breit-Wigner function (with phase space factor) and the physics function $f(m;\mathrm{M_W},\Gamma_\mathrm{W})$

Method (3)

- **Normalized background** functions for
  - $e^+e^- \to qq$
  - $e^+e^- \to We\nu$
  - $e^+e^- \to ZZ$

  are **included in the physics function**.

- The **total likelihood-function** is the product of the individual event-likelihoods,

$$\mathscr{L}(M_W) = \prod_{i=1}^{N_{Sample}} \mathscr{L}_i(M_W, \Gamma_W(M_W)).$$

  This function is **maximized to obtain** M_W (the W-width is constraint to its SM value).

Bias Correction (1)

- Fit data sized samples from MC runs with $\mathrm{M_{MC}}$ = 79.83, 80.08, 80.33, 80.58, 80.83 GeV.

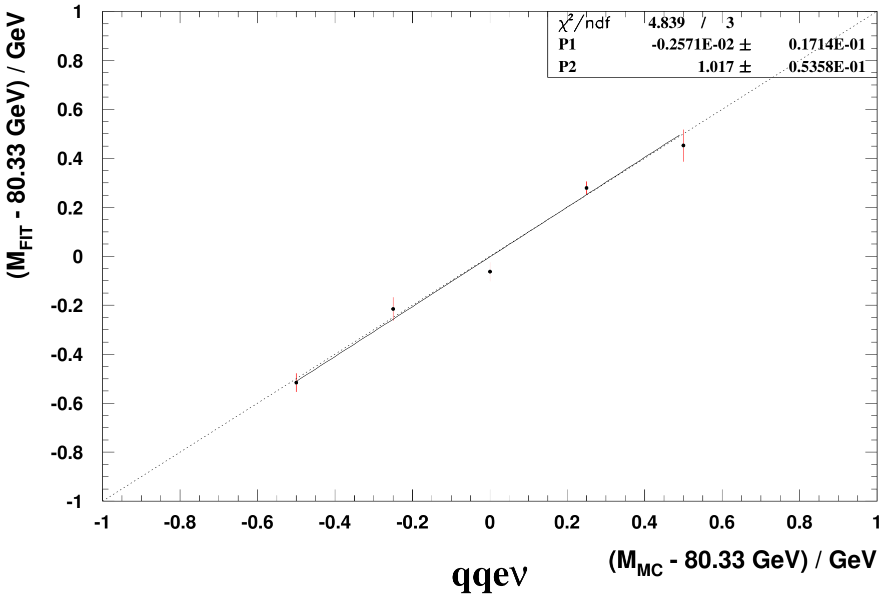
  Straight line fit to the mean values gives $\mathrm{M_{Fit}(M_{MC})}$.

- **Bias correction**: Use inverse of $\mathrm{M_{Fit}(M_{MC})}$.

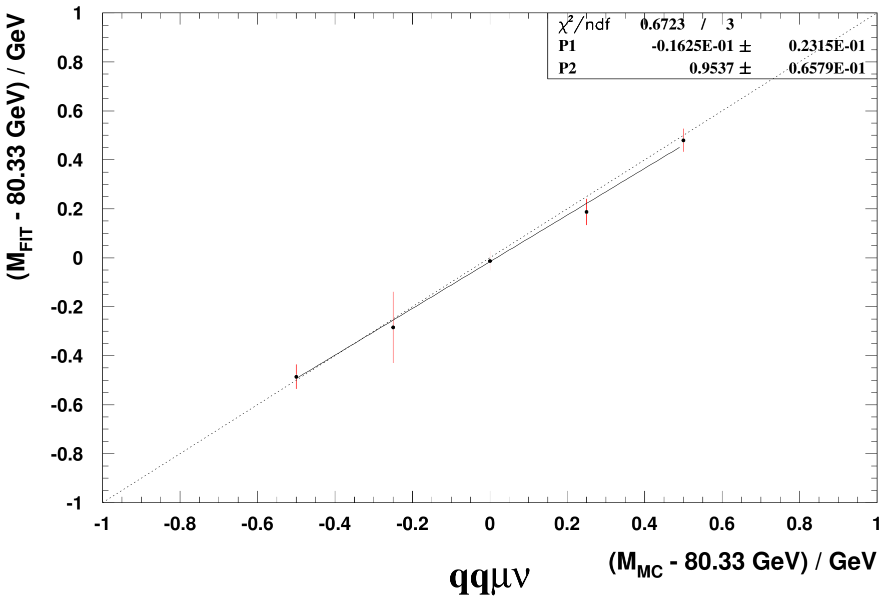
- **Scaling factor** for errors is given by the inverse slope of the fit.

Channel	Bias at $\mathrm{M_{MC}}$ = 80.33 GeV	Slope of $\mathrm{M_{FIT}(M_{MC})}$
$\mathrm{qq}e\nu$	-3 $\pm$ 17 MeV	1.01 $\pm$ 0.05
$\mathrm{qq}\mu\nu$	-16 $\pm$ 27 MeV	0.96 $\pm$ 0.07
$\mathrm{qq}\tau\nu$	-8 $\pm$ 22 MeV	0.85 $\pm$ 0.10

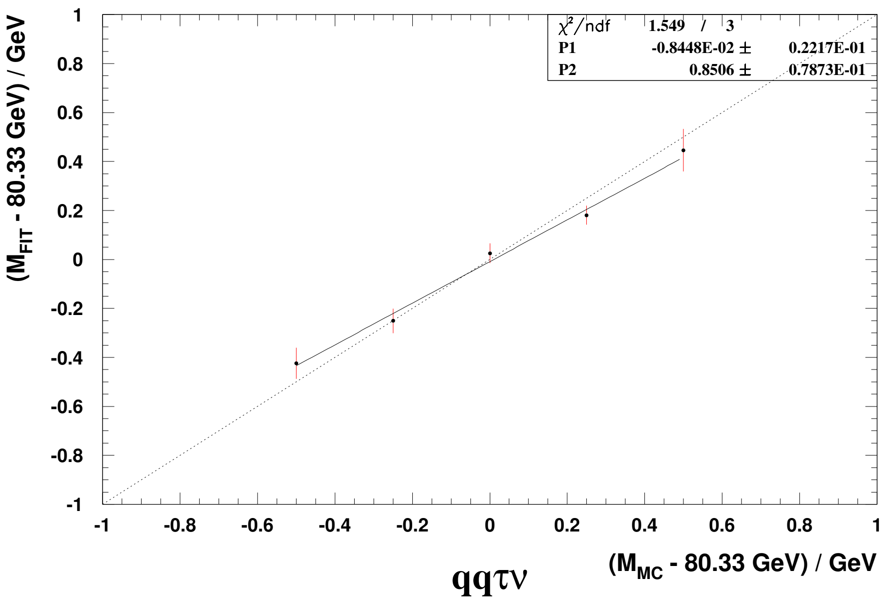
Bias Correction (2)



qqeν



qqμν



qqτν

Expected Errors

- **Ensemble test** with 2500 MC experiments
  - Same number of $\mathrm{qqe}\nu$, $\mathrm{qq}\mu\nu$ and $\mathrm{qq}\tau\nu$ events as selected data events
  - $\mathrm{e^+e^-} \to \mathrm{qq},\ \mathrm{We}\nu,\ \mathrm{ZZ}$ background included
  - Events are randomly selected from run 8058

- **RMS** and **Pull** of W-mass distributions

Channel	Exp. error $\mathrm{M_W}$ (MeV)	Pull width
$\mathrm{qqe}\nu$	160 ± 3	0.99 ± 0.01
$\mathrm{qq}\mu\nu$	172 ± 4	0.99 ± 0.01
$\mathrm{qq}\tau\nu$	264 ± 6	1.05 ± 0.01

Preliminary Results for OPAL data at $\sqrt{s} = 189$ GeV

Integrated luminosity: 183 pb^{-1}

Dadlist: ww_189.dad

Data events: 1215 $\mathrm{qq}\ell\nu$ (377 $\mathrm{qqe}\nu$, 402 $\mathrm{qq}\mu\nu$, 436 $\mathrm{qq}\tau\nu$)

Cuts: Standard WW112 sel. + fit probability $>$ 0.001
+ χ^2-curve smoothness and -limits

Remarks: Using MT package, Arianes Evil-τ package

Selected events: 1110 $\mathrm{qq}\ell\nu$ (345 $\mathrm{qqe}\nu$, 372 $\mathrm{qq}\mu\nu$, 393 $\mathrm{qq}\tau\nu$)

Channel	$\mathrm{M_W}\pm$ stat. $\pm$ sys. $\pm$ LEP error / GeV
$\mathrm{qqe}\nu$	$80.206 \pm 0.165 \pm 0.089 \pm 0.016$
$\mathrm{qq}\mu\nu$	$80.451 \pm 0.183 \pm 0.086 \pm 0.018$
$\mathrm{qq}\tau\nu$	$80.740 \pm 0.254 \pm 0.106 \pm 0.023$
$\mathrm{qq}\ell\nu$	$80.396 \pm 0.110 \pm 0.057 \pm 0.018$

* No systematic error for ISR

Summary

- Use trackless events
- Use events that failed probability cut