Measurement of the mass of the W boson in e^+e^- collisions at LEP with $\sqrt{s} = 161 GeV$

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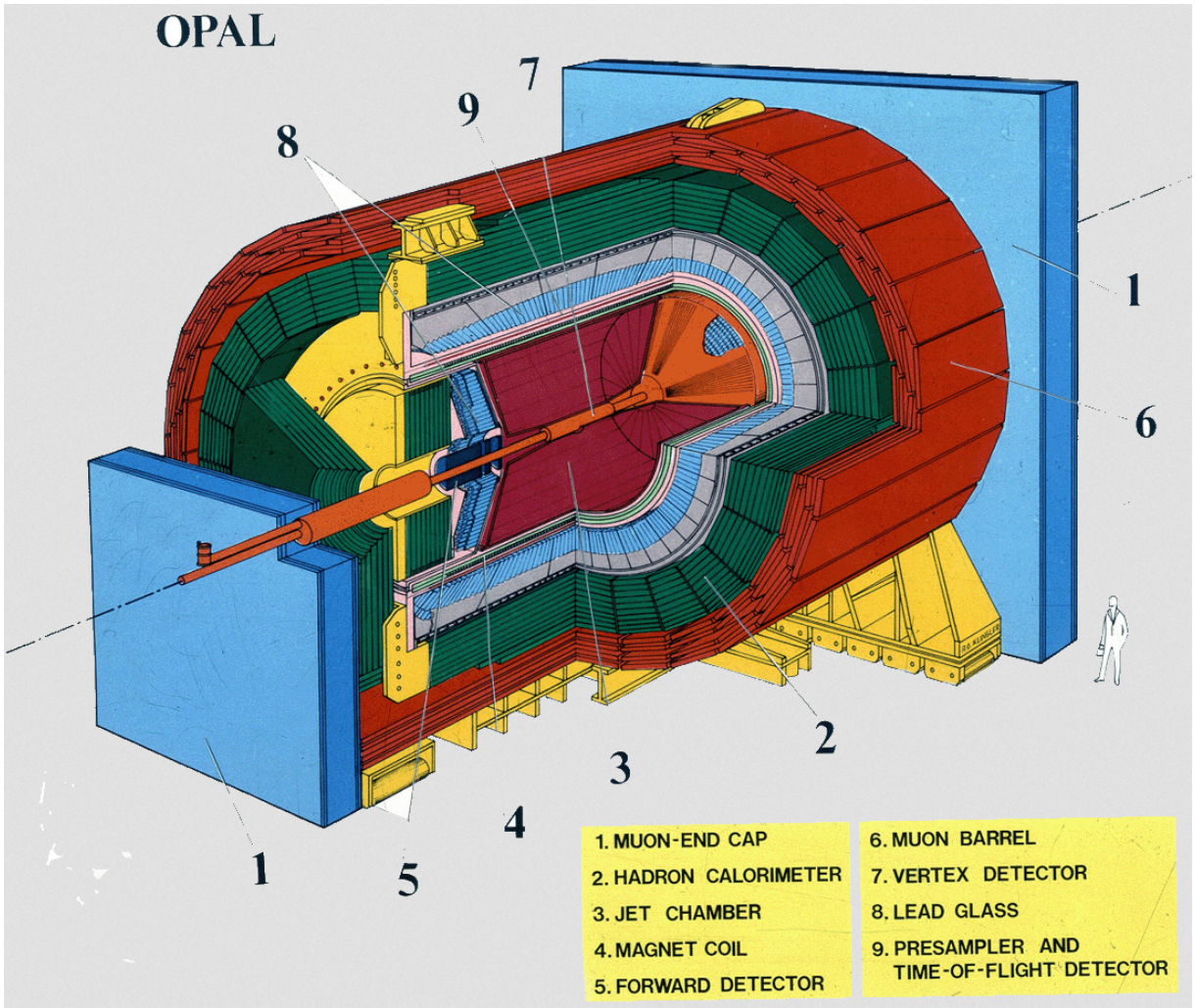
The experiment



W^+W^- production

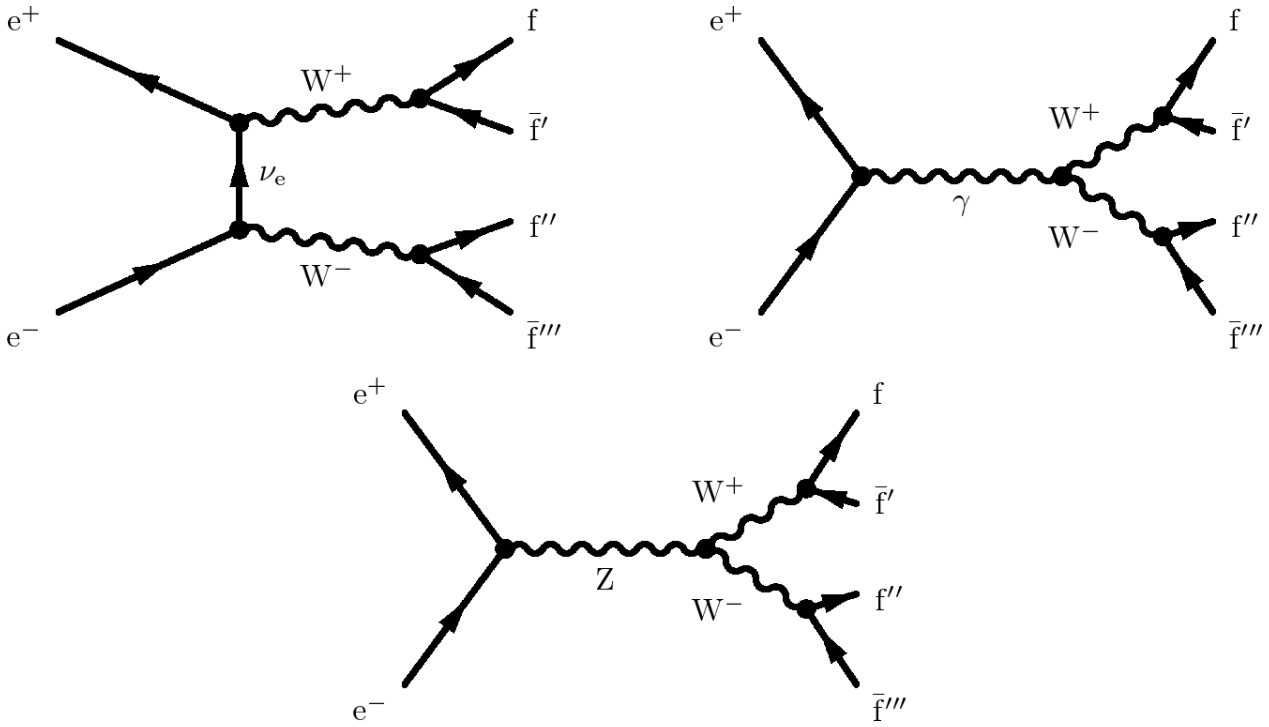


Figure: W^+W^- production and decay

$\rightarrow$ this leads to five different final states

Event Selection in the full hadronic channel

- approximately 46% of W^+W^- are expected to decay full hadronic
- largest background is $Z/\gamma \rightarrow q\bar{q}$ events with energetic initial state photons or hard gluon
- characteristic is four jets
- other cuts: $E_{meas} > 50 GeV$, kinematic fit with $m_{W,reco} > 72 GeV$, well seperated four-jet topology

$\rightarrow$ this removes 99% of the $Z/\gamma \rightarrow q\bar{q}$ background

W^+W^- production cross section

Observed number of candidate events in each W^+W^- decay channel with expected number of signal and background:

Selection	Expected signal	Expected background	Observed
$W^+W^- \to q\bar{q}q\bar{q}$	9.6 ± 1.0	3.44 ± 0.39	14
$W^+W^- \to q\bar{q}e\bar{\nu}_e$	3.89 ± 0.44	0.18 ± 0.27	3
$W^+W^- \to q\bar{q}\mu\bar{\nu}_\mu$	4.19 ± 0.46	0.27 ± 0.15	2
$W^+W^- \to q\bar{q}\tau\bar{\nu}_\tau$	2.32 ± 0.28	0.96 ± 0.34	7
$W^+W^- \to \ell^+\nu_\ell\ell'^-\bar{\nu}_{\ell'}$	2.58 ± 0.28	$0.19^{+0.12}_{-0.04}$	2
Combined	22.6 ± 2.4	5.0 ± 0.6	28

with $\mathcal{L} = 9.89 \pm 0.06 pb^{-1}$ at $\sqrt{s} = 161.3 \pm 0.2 GeV$ and

$M_W = 80.33 \pm 0.15 GeV$

W^+W^- production cross section

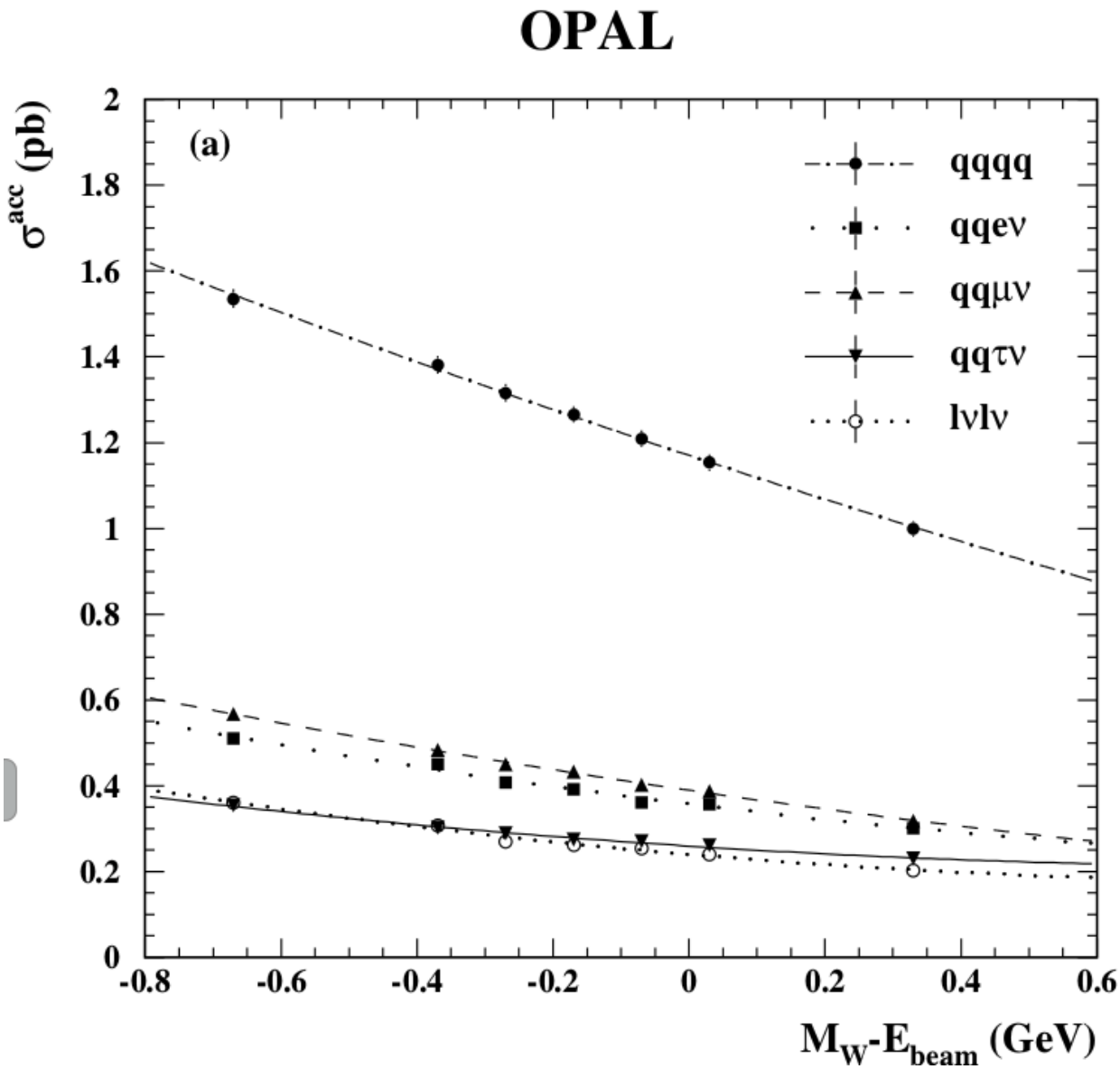
$$L = \prod_i P_i(N_i, \mu_i(\sigma_{WW})) = \prod_i \frac{\mu(\sigma_{WW})^{N_i} e^{-\mu_i(\sigma_{WW})}}{N_i!} \quad (1)$$

with L is likelihood, P_i Possion probabilities of observing N_i events and Monte Carlo prediction of $\mu(\sigma_{WW})$ events

maximum likelihood value yields to a crossection of:

$$\rightarrow \sigma_{WW} = 3.62^{+0.93}_{-0.82} \pm 0.16 pb$$

Determination of the W boson mass



Determination of the W boson mass

$$\mu_i(M_W - E_{beam}) = \mathcal{L} \cdot \sigma_i^{acc}(M_W - E_{beam}) \tag{2}$$

with i beeing different channels

- a maximum likelihood fit is performed to extract M_W
- assuming Standard Model branching ratios

$$\rightarrow M_W = 80.40^{+0.44+0.09}_{-0.41-0.10} \pm 0.10 Gev$$