NOTE ON THE MASS OF THE W BOSON

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Till 1995 the production and study of the W boson was the exclusive domain of the $\overline{p}p$ colliders at CERN and FNAL. W production in these hadron colliders is tagged by a high p_T lepton from W decay. Owing to unknown parton–parton effective energy and missing energy in the longitudinal direction, the experiments reconstruct only the transverse mass of the W and derive the W mass from comparing the transverse mass distribution with Monte Carlo predictions as a function of M_W.

In 1996 the energy of LEP was increased in two steps to 161 GeV and 172 GeV, allowing the production of pairs of W bosons. A precise knowledge of the e^+e^- centre of mass energy enables one to reconstruct the W mass even if one of them decays leptonically. At LEP two methods have been used to obtain the W mass. In the first method the measured W–pair production cross sections, $\sigma(e^+e^- \rightarrow W^+W^-)$, have been used to determine the W mass using the Standard Model based dependence of this cross section on M_W (see Fig. 1). At 161 GeV, which is just above the W–pair production threshold, this dependence is a much more sensitive function of the W mass than at higher energies.

In the second method, which is used at the higher energies, the W mass has been determined by directly reconstructing the W from its decay products.

Each LEP experiment has combined their own mass values properly taking into account the common systematic errors. We have then combined their values into a LEP average leading to: $m_W = 80.49 \pm 0.14$ GeV. The error includes in the systematics a LEP energy uncertainty of $\pm$ 30 MeV and, in the case of the reconstruction method for the $q\overline{q}q\overline{q}$ channel, a possible effect of "color reconnection" and "Bose–Einstein correlations" between quarks from different W's. In our combination, the last two effects have been treated as 100% correlated between the experiments.

OUR AVERAGE is obtained by combining this LEP value with other measurements assuming no common systematics.

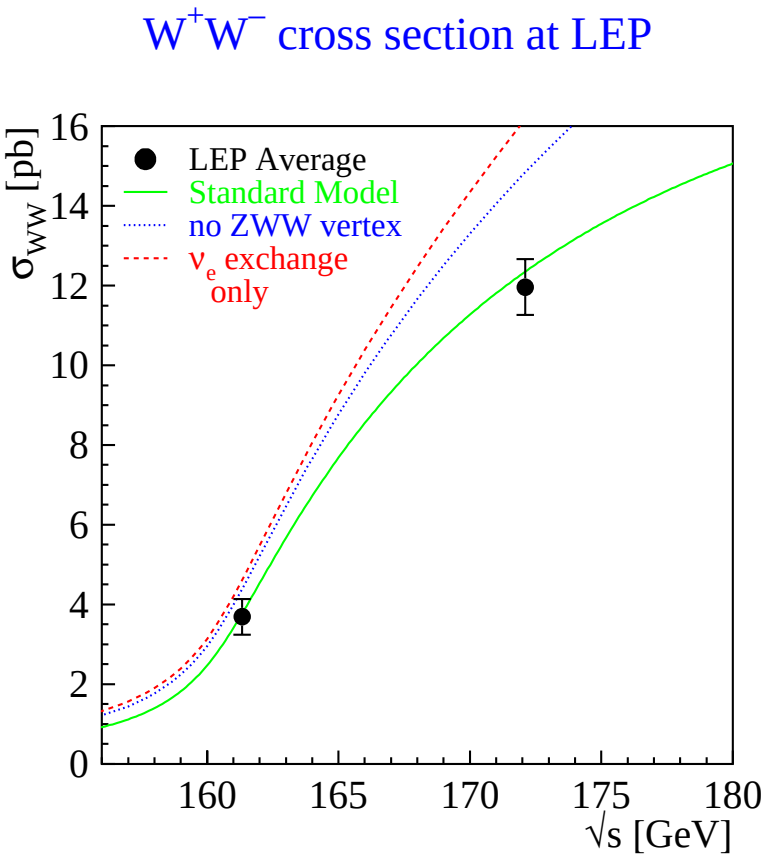

Figure 1: The W–pair cross section as a function of the center–of–mass energy. The data points are the LEP averages. The solid line is the Standard Model prediction. For comparison the figure contains also the cross section if the ZWW coupling did not exist (dotted line), or if only the t–channel ν_e exchange diagram existed (dashed line).

Combining published and unpublished preliminary Collider and LEP results (as of end of March 1998) yields an average W-boson mass of 80.375 ± 0.064 GeV (80.40 ± 0.09 GeV for p–p Colliders and 80.35 ± 0.09 GeV for LEP).

The Standard Model prediction from the electroweak fit, excluding the direct W mass measurements from LEP and Tevatron, gives a W–boson mass of 80.364 ± 0.035 GeV.