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Revised Nov 2023 by M. Gr\"unewald (University Coll. Dublin) and
A. Gurtu (CERN; TIFR Mumbai).

Precision determination of the W mass is of great importance in testing the internal consistency of the Standard Model. From the time of its discovery in 1983, the W boson has been studied and its mass determined in p-barp and e+e- interactions; it is currently studied in pp interactions at the LHC. The mass and width definition used here corresponds to a Breit-Wigner with mass-dependent width.

Production of on-shell W bosons at hadron colliders is tagged by the charged lepton with high transverse momentum from its leptonic decay modes. Owing to the unknown parton-parton effective energy and missing energy in the longitudinal direction, the hadron collider experiments reconstruct the transverse mass of the W boson, and derive the W mass from comparing the transverse mass distribution with Monte Carlo predictions as a function of the mass mW. The transverse momentum of the charged lepton itself and the transverse missing energy (arising from the neutrino in W decay) are also sensitive to the W mass and used in its determination. These analyses use the electron and muon decay modes of the W boson.

At the e+e- collider LEP, a precise knowledge of the beam energy enables one to determine the e+e- --> W+W- cross section as a function of center of mass energy, as well as to reconstruct the W mass precisely from its decay products, even if one of them decays leptonically. Close to the W+W- production threshold (\sqrt{s} = 161~GeV), the dependence of the W-pair production cross section on mW is large, and this was used to determine mW. At higher centre-of-mass energies (172 to 209 GeV) this dependence is much weaker, thus W bosons were directly reconstructed and the mass determined as the invariant mass of the decay products, improving the resolution with a kinematic fit.

To compute the LEP average W mass, each experiment provided its measured W mass for the qqqq and qq lnu, l = e, mu, tau channels at each center-of-mass energy, along with a detailed break-up of uncertainty contributions: statistical, uncorrelated, partially correlated and fully correlated systematics~\cite{Schael:2013ita}. This yielded a combined LEP average W mass of mW = 80.376 +- 0.033 GeV. Errors on mW due to uncertainties in the LEP beam energy (9MeV), and possible effect of color reconnection (CR) and Bose-Einstein correlations (BEC) between quarks from different W bosons (8MeV) are included. Similarly the combined LEP average of the W boson total width is determined to be \Gamma_W = 2.195 0.083 GeV~\cite{Schael:2013ita}.

In the past a similar procedure was followed for the measurements at hadron colliders. The two Tevatron experiments CDF\cite{Aaltonen:2012bp} and D0\cite{Abazov:2012bv} identified common systematic errors: uncertainties due to the parton distribution functions (PDF), radiative corrections, and choice of mass (width) in the width (mass) measurements were treated as correlated and the resultant mass\cite{Aaltonen:2013iut} and width \cite{wmass:TEW:2010aj} of the W were determined. The W boson total width obtained is 2.046 +- 0.049 GeV. Similarly the mass results from the two LHC experiments, ATLAS~\cite{Aaboud:2017svj} and LHCb~\cite{LHCb:2021abm} were combined to obtain an LHC average mass of the W. An overall hadron collider average of the W mass was obtained as mW = 80.377 +- 0.013 GeV.

The results on mass and width are shown in Figures~\ref{MW} and ~\ref{GW}, respectively. Until 2022, all measurements were in good agreement with each other and with the world average. In April 2022 the CDF collaboration published a result mW = 80.4335 +- 0.0094 GeV~\cite{CDF:2022hxs}, based upon their full RUN II dataset of 8.8 fb-1. This result is of higher precision than the 2022 world average, but the two results disagree significantly.

The LHC-Tev Working MW Group, including W-mass experts from all hadron collider experiments, CDF, D0, ATLAS, CMS, LHCb, has been working to understand better the nature of this disagreement and suggest a way forward to obtain a world average value of W mass. Corrections, uncertainties and their correlations have been evaluated to a greater detail and used in the combination: the central values are corrected to a common theory description and PDF, and the uncertainties, especially due to PDFs, have been re-evaluated to account for correlations properly. The group reports [Amoroso 2023] that a combination of all W-mass measurements has a probability of compatibility of 0.5% only, and is therefore disfavoured. A 91% probability of compatibility is obtained when the CDF-II measurement is removed. The corresponding value of the W boson mass is 80369.2 ± 13.3 MeV, which we quote as the World Average. More details are given in [Amoroso 2023].